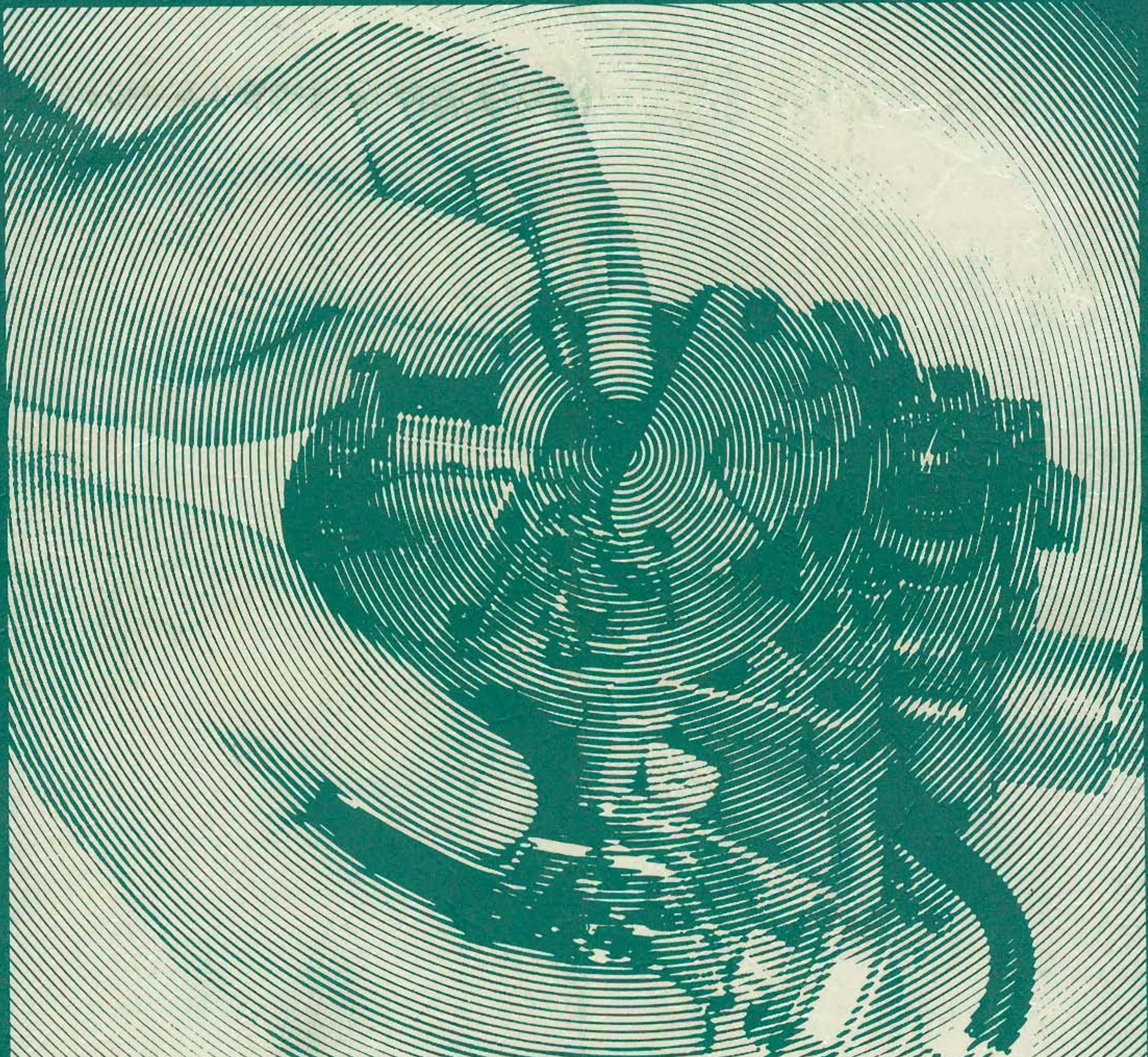
PONTIAC

GM

'77 Service Manual



IMPORTANT SAFETY NOTICE

Proper service and repair is important to the safe, reliable operation of all motor vehicles. The service procedures recommended by Pontiac and described in this service manual are effective methods of performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

It is important to note that this manual contains various Warnings, and Cautions which should be carefully read in order to minimize the risk of personal injury to service personnel or the possibility that improper service methods will be followed which may damage the vehicle or render it unsafe. It also is important to understand that these Warnings and Cautions are not exhaustive. Pontiac could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, Pontiac has not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Pontiac must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects.

CAUTION

1977 vehicles contain parts dimensioned in the metric system. Many fasteners are metric and some are very close in dimension to familiar customary measurements in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements as those removed, whether metric or customary. Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

Additional information concerning the identification of metric fasteners is contained in Section 0A of this Manual.

1977

PONTIAC SERVICE MANUAL

This manual applies to all 1977 Pontiac Series and Models. It contains service information on all components of the car except the body. Body information is contained in a separate Body Manual. Other information pertaining to the operation of the car is contained in the Owner's Manual which accompanies each vehicle.

All information, illustrations and specifications contained in this Manual are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

Any reference to brand names in this manual is intended merely as an example of the types of lubricants, tools, materials, etc. recommended for use in servicing the 1977 Pontiac Models. In all cases, an equivalent may be used.

PONTIAC MOTOR DIVISION

GENERAL MOTORS CORPORATION

PONTIAC, MICHIGAN 48053

S-7704F January, 1977 Litho in U.S.A.

TABLE OF CONTENTS

SECTION 0A

GENERAL INFORMATION

CONTENTS OF THIS SECTION

GENERAL INFORMATION

Only general specifications and information appear in this section. Detailed specifications on major units are given at the end of each respective section of this manual.

BODY IDENTIFICATION PLATE

Information as to body style, trim number, body number and paint code may be found stamped on the Body Identification Plate (Fig. 0A-1). This plate is attached to the upper horizontal surface of the dash panel (shroud) in the engine compartment. The plate is located on the right hand side on B Series and on the left hand side on all other models.

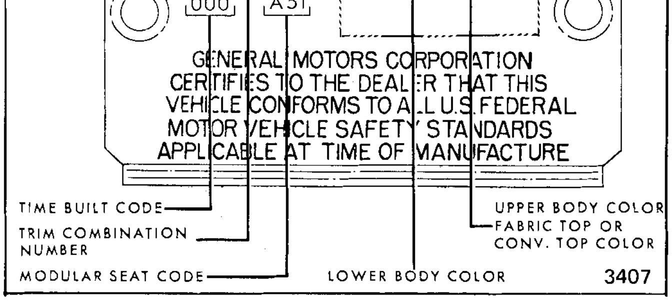


Fig. 0A-1 Vehicle Body Style Identification Plate

VEHICLE IDENTIFICATION PLATE

Serial number, assembly plant code, engine, carburetor, style, series and model year identification can be determined from the Manufacturer's Motor Vehicle Identification Number Plate. This plate is fastened to the upper left instrument panel area, visible through the windshield. The plate has embossed numerals as shown in Fig. 0A-2.

GOVERNMENT CERTIFICATION LABEL

All models have a label on the left door end panel stating that the car conforms to all government requirements.

NOTE: This label must not be removed.

CAR MODEL IDENTIFICATION

The various Pontiac models are identified both by names and by "series" letters. Fig. 0A-2 shows both methods of identification.

The third letter code in the vehicle identification number shows the plant where a given car was built (Fig. 0A-2).

ENGINE IDENTIFICATION

The engine letter code appears as the second letter in the vehicle identification number as shown in Fig. 0A-2.

For identification of specific engines refer to engine section in this manual.

IGNITION, DOOR AND TRUNK LOCKS

Two separate keys (Fig. 0A-3) are used; type "E" (square) for ignition switch only and type "H" (oval) for all doors, glove box, tailgate, hatchback and deck lid locks.

IGNITION LOCK

Removal

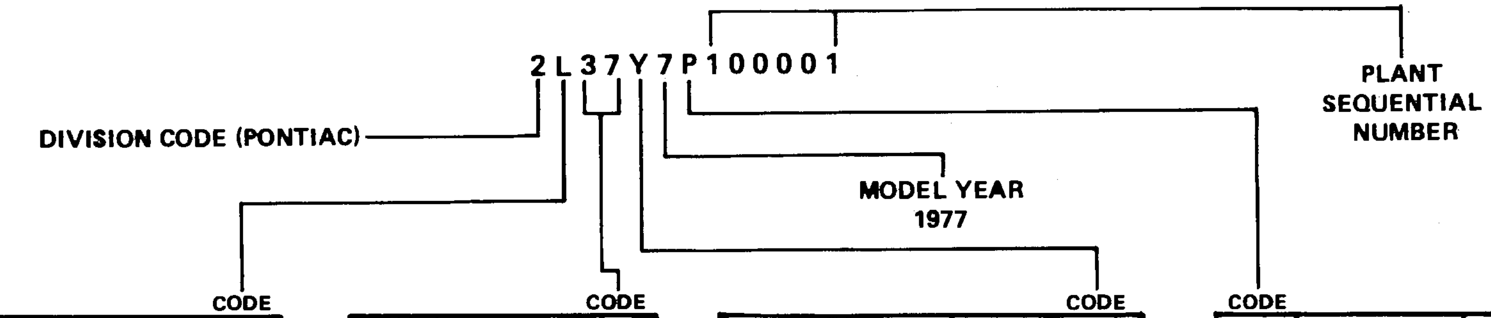
1. Remove lock assembly from steering column. See Section 3B4 in this manual.
2. Production lock is not serviceable and should be discarded.

NOTE: In the event that the old tumblers are to be re-used, the following procedure may be used to disassemble the lock cylinder.

a. Pry off gate adapter stop ring (Fig. 0A-4).

b. With key inserted in lock, turn counterclockwise to stop (accessory position).

c. Using suitable pick, depress brass pin in slot on side of cylinder as shown in Fig. 0A-5.



NAME	SERIES	SALES & VIN CODE
SUNBIRD	HM	M
ASTRE	HC	C
ASTRE SAFARI	HC	C
ASTRE	HC	C
FIREBIRD	FS	S
FIREBIRD ESPRIT	FT	T
FIREBIRD FORMULA	FU	U
FIREBIRD TRANS AM	FW	W
VENTURA	XY	Y
VENTURA	XY	Y
VENTURA	XY	Y
VENTURA SJ	XZ	Z
VENTURA SJ	XZ	Z
VENTURA SJ	XZ	Z
LE MANS	AD	D
LE MANS SAFARI	AD	D
LE MANS	AD	D
LE MANS	AF	F
GRAND LE MANS	AG	G
GRAND LE MANS	AG	G
GRAND LE MANS SAFARI	AG	G
GRAND PRIX	GJ	J
GRAND PRIX SJ	GH	H
GRAND PRIX LJ	GK	K
SAFARI	BL	L
CATALINA	BL	L
CATALINA	BL	L
GRAND SAFARI	BN	N
BONNEVILLE	BN	N
BONNEVILLE	BN	N
BONNEVILLE BROUGHAM	BQ	Q
BONNEVILLE BROUGHAM	BQ	Q

BODY TYPE	BODY VIN CODE
SPORT COUPE	27
HATCHBACK COUPE	07
COUPE	11
2 SEAT WAGON	15
HATCHBACK COUPE	77
2 DR. HARDTOP	87
2 DR. HARDTOP	87
2 DR. HARDTOP	87
2 DR. HARDTOP	87
HATCHBACK COUPE	17
2 DR. COUPE	27
4 DR. SEDAN	69
HATCHBACK COUPE	17
2 DR. COUPE	27
4 DR. SEDAN	69
4 DR. SEDAN	29
STATION WAGON	35
2 DR. COUPE	37
HARDTOP COUPE	37
4 DR. SEDAN	29
STATION WAGON	35
HARDTOP COUPE	37
HARDTOP COUPE	57
HARDTOP COUPE	57
HARDTOP COUPE	57
STATION WAGON	35
2 DR. COUPE	37
4 DR. SEDAN	69
STATION WAGON	35
2 DR. COUPE	37
4 DR. SEDAN	69
2 DR. COUPE	37
4 DR. SEDAN	69

ENGINE DESCRIPTION	ENGINE OPTION	ENGINE VIN CODE
140 C.I.D. 2-BBL.–L4	L11	B
151 C.I.D. 2-BBL.–L4	LX6	V
231 C.I.D. 2-BBL.–V6	LD7	C
140 C.I.D. 2-BBL.–L4	L11	B
151 C.I.D. 2-BBL.–L4	LX6	V
231 C.I.D. 2-BBL.–V6	LD7	C
301 C.I.D. 2-BBL.–V8	L27	Y
305 C.I.D. 2-BBL.–V8	LG3	U
350 C.I.D. 4-BBL.–V8	L76	P
350 C.I.D. 4-BBL.–V8	L34	R
400 C.I.D. 4-BBL.–V8	L78	Z
403 C.I.D. 4-BBL.–V8	L80	K
151 C.I.D. 2-BBL.–L4	LX6	V
231 C.I.D. 2-BBL.–V6	LD7	C
301 C.I.D. 2-BBL.–V8	L27	Y
305 C.I D. 2-BBL.–V8	LG3	U
350 C.I.D. 4-BBL.–V8	L34	R
350 C.I.D. 4-BBL.–V8	LM1	L
231 C.I.D. 2-BBL.–V6	LD7	C
301 C.I.D. 2-BBL.–V8	L27	Y
350 C.I.D. 4-BBL.–V8	L76	P
350 C.I.D. 4-BBL.–V8	L34	R
400 C.I.D. 4-BBL.–V8	L78	Z
403 C.I.D. 4-BBL.–V8	L80	K
301 C.I.D. 2-BBL.–V8	L27	Y
350 C.I.D. 4-BBL.–V8	L76	P
350 C.I.D. 4-BBL.–V8	L34	R
400 C.I.D. 4-BBL.–V8	L78	Z
403 C.I.D. 4-BBL.–V8	L80	K
231 C.I.D. 2-BBL.–V6	LD7	C
301 C.I.D. 2-BBL.–V8	L27	Y
350 C.I.D. 4-BBL.–V8	L76	P
350 C.I.D. 4-BBL.–V8	L34	R
400 C.I.D. 4-BBL.–V8	L78	Z
403 C.I.D. 4-BBL.–V8	L80	K

PLANT CODE	PLANT	STARTING VIN
2	STE THERESE	500001
U	LORDSTOWN	500001
U	LORDSTOWN	500001
N	NORWOOD	100001
T	TARRYTOWN	100001
L	VAN NUYS	100001
W	WILLOW RUN	100001
P	PONTIAC	100001
A	LAKEWOOD	100001
P	PONTIAC	100001
A	LAKEWOOD	100001
P	PONTIAC	100001
X	FAIRFAX	100001

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Fig. 0A-2 Vehicle Identification Plate Data

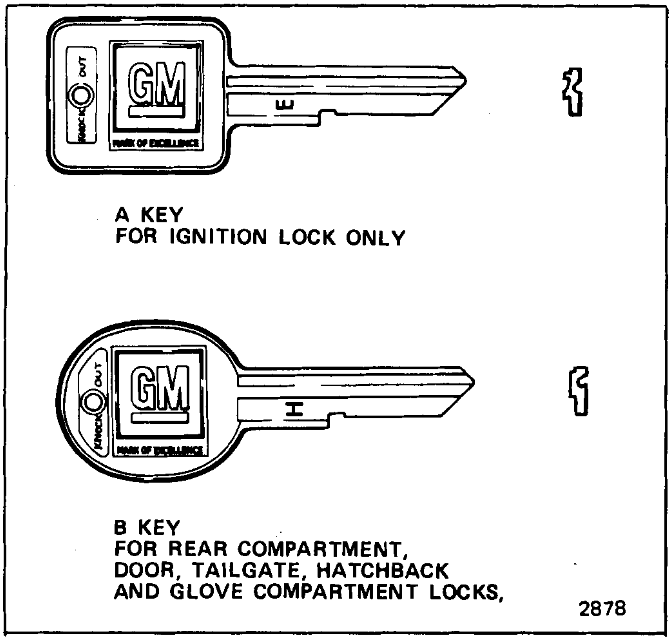

Fig. 0A-3 Key Blanks

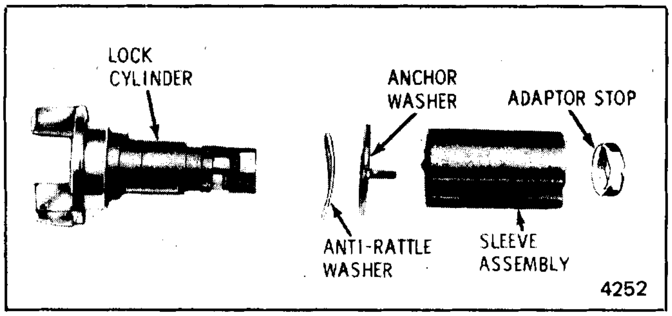

Fig. 0A-4 Exploded View of Lock Cylinder

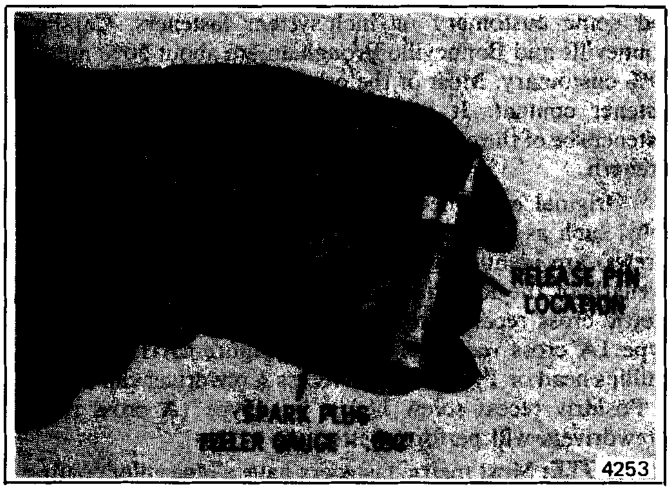

Fig. 0A-5 Depressing Lock Cylinder Retaining Pin

d. It will be necessary to fashion a pick and insert this behind the cylinder wall to depress the brass pin.

e. While holding pin depressed, turn key and lock slightly and pull lock assembly out of cylinder approximately 1/8".

f. Pull key out of lock assembly approximately two (2) teeth and, using suitable pick, slide or shake plastic retainer in end of lock toward pin side of cylinder.

g. Pull key and lock assembly out of cylinder.

h. Pry off tumbler retainer, unscrew springs and remove tumblers.

i. Retain tumblers and discard lock cylinder.

Coding Side Bar Lock

NOTE: The glove compartment lock uses a snap-in tumbler cylinder. With this design, the cylinder (less tumbler and springs) along with precoded tumblers and springs are serviced. The tumblers may be snapped out and in again, however, it is recommended that after two or three times the cylinder should be replaced with new tumblers since the retention is lessened each time. The OLD and NEW style cylinders are completely interchangeable.

Lock kits are available without tumblers, springs or retainers. Uncoded side bar locks may be coded to match the keys used on the car by ordering the above parts separately. Five types of tumblers are used to make the various combinations and each is coded according to a number, one (1) through five (5), stamped on its side. Before the lock cylinder may be coded, the correct code must be determined. If the numbered blank in the key head has not been removed, determine the code by consulting the lock manufacturer's code book. Should the blank be missing, proceed as follows:

1. Place the key on the silhouette in Fig. 0A-6, aligning the key with the outline as accurately as possible.

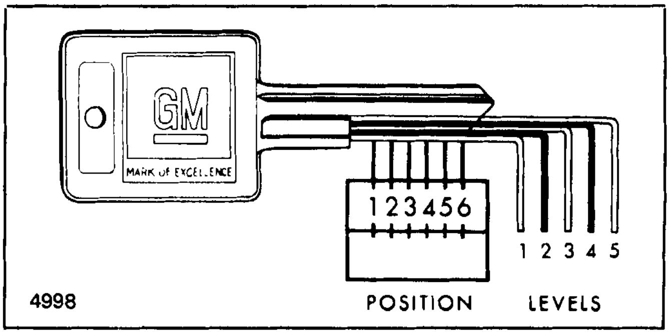

Fig. 0A-6 Key Coding Diagram

2. Starting at the base of the key blade, determine the lowest level visible in position No. 1.

3. Determine the lowest visible level for the remaining five positions. As each tumbler level is determined, write that number in the blank space above the position numbers.

After the key code has been determined, the correct tumblers should be installed as follows:

1. Beginning with slot next to head of cylinder (number one position) install tumblers in slots in sequence determined from key code.

2. Insert spring in each round cavity of each tumbler lock between slots (Figs. 0A-7 and 0A-8).

CAUTION: *Do not pull springs apart; unscrew them.*

3. Install spring retainer over springs, with ends inserted in slots, and hold in place.

4. Check by inserting cut key. Side bar will drop in place when key is inserted and correct tumblers have been installed.

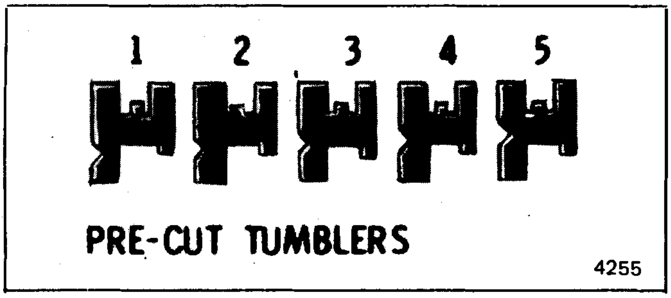

Fig. 0A-7 Pre-Cut Tumblers

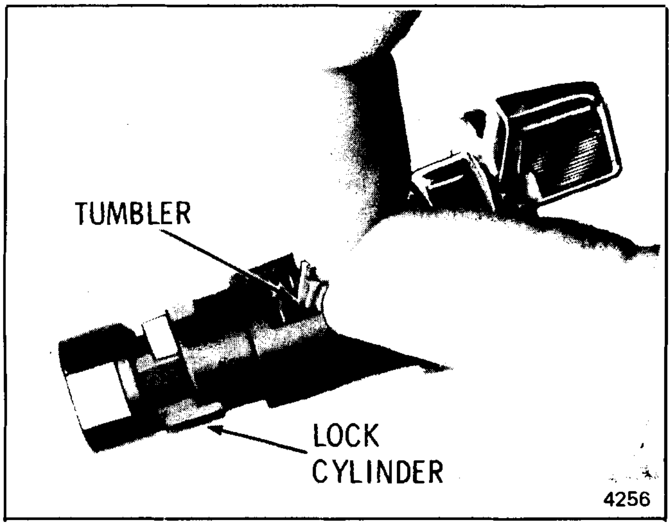

Fig. 0A-8 Installing Tumblers

5. Install spring retainer using vise. Stake as shown in Fig. 0A-9.

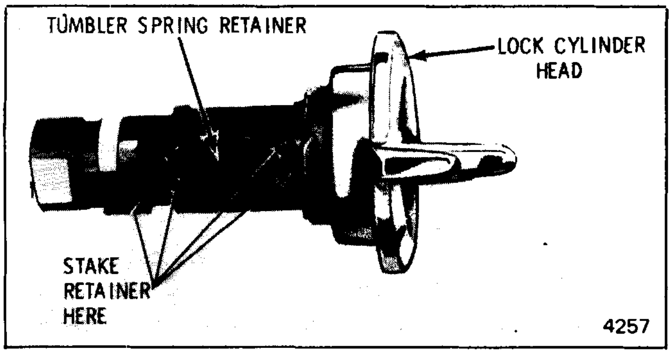

Fig. 0A-9 Staking Tumbler Spring Retainer

Installation

1. With key inserted in lock part way, assemble wave washer and special lock washer over lock as shown in Fig. 0A-4.

2. Align tang of washer over side bar of lock and insert assembly into cylinder so that tang on washer enters slot in cylinder.

3. Be sure plastic lock in cylinder does not interfere with assembly.

4. When lock is fully seated in cylinder, rotate lock cylinder to lock position and remove key.

5. Install stop adapter over tail of cylinder and rotate clockwise until adapter contacts stop pin located in sleeve. Stake as shown in Fig. 0A-10.

Fig.0A-10 Staking Adapter Stop

5. Assemble lock and cylinder assembly into steering column. See Section 3B4 of this manual.

METRIC FASTENERS

All 1977 Pontiacs have some metric threaded fasteners and some customary or inch-system fasteners. Catalina, Bonneville and Bonneville Brougham are about 50% metric, 50% customary. Most of the other cars have a small metric fastener content. It is most important that replacement fasteners be of the correct nominal diameter, thread pitch and strength.

Original equipment metric fasteners (except "beauty" bolts, such as exposed bumper bolts, and cross recess head screws) are identified by a number marking indicating the strength of the material in the fastener as outlined below. Metric cross recess screws are identified by a Posidriv or Type 1A cross recess as shown in Figure 0A-11. Either a Phillips head or Type 1A corss recess screwdriver can be used in Posidriv recess screw heads, but Type 1A cross recess screwdrivers will perform better.

NOTE: Most metric fasteners have a blue color coating. However, this should not be used as a positive way of identifying as some metric fasteners are not color coated.

General Motors Engineering Stardards, along with other North American Industries, have adopted a portion of the standard metric fastener sizes defined by ISO (International Stardards Organization). This was done to reduce the number of fastener sizes used and yet retain the optimum strength characteristics in each thread size. For example, the customary 1/4-20 and 1/4-28 screws are replaced by the metric M6.3 X 1 screw which has nearly the same diameter

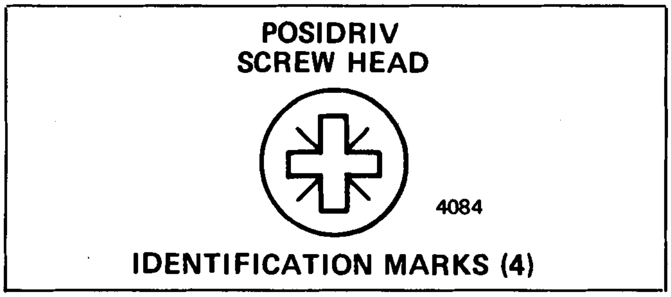

Fig. 0A-11 Cross Recess Screw

and 25.4 threads per inch. The thread pitch is in between the customary coarse and fine thread pitches.

Metric and customary thread notation differ slightly. The difference is illustrated in Fig. 0A-12.

FASTENER STRENGTH IDENTIFICATION

Most commonly used metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with radial line identification embossed on each bolt head. Markings correspond to two lines less than the actual grade (i.e., grade 7 bolt will exhibit 5 embossed radial lines on the bolt head). Some metric nuts will be marked with single digit strength identification numbers on the nut face. Fig. 0A-13 illustrates the different strength markings.

When replacing metric fasteners, be carful to use bolts and nuts of the same strength or greater than the original fasteners (the same number marking or higher). It is likewise important to select replacement fasteners of the correct size. Correct replacement bolts and nuts are available through General Motors Parts Division. Many metric fasteners available in the after-market parts channels were designed to metric standards of countries other than the United States, and may be of a lower strength, may not have the numbered head marking system, and may be of a different thread pitch. The metric fasteners used on these products are designed to new, international standards that may not yet be manufactured by some non-domestic bolt and nut suppliers. In general, except for special applications, the common sizes and pitches are:

M 6.3 X 1
M 8 X 1.25
M 10 X 1.5
M 12 X 1.75
M 14 X 2

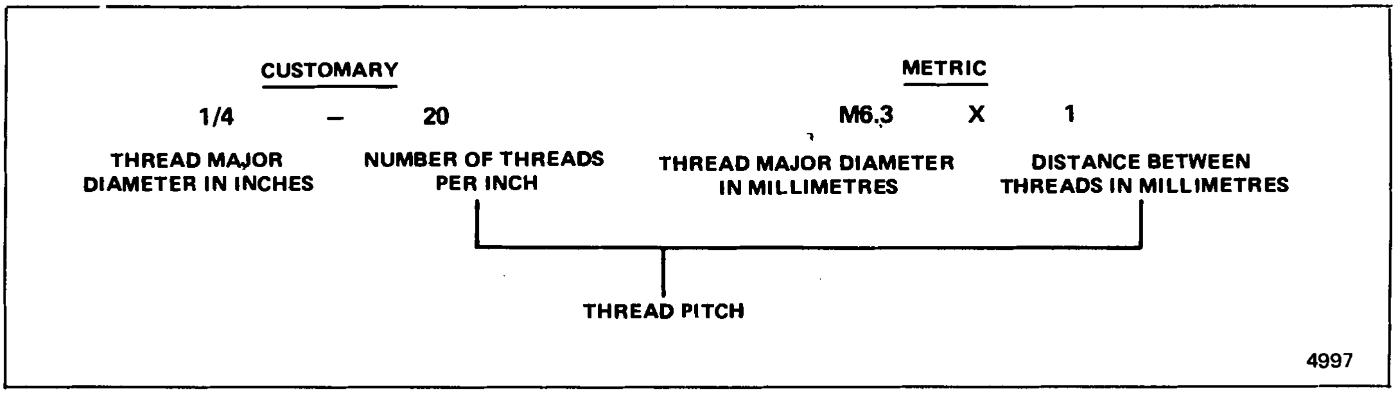

Fig. 0A-12 Thread Notation

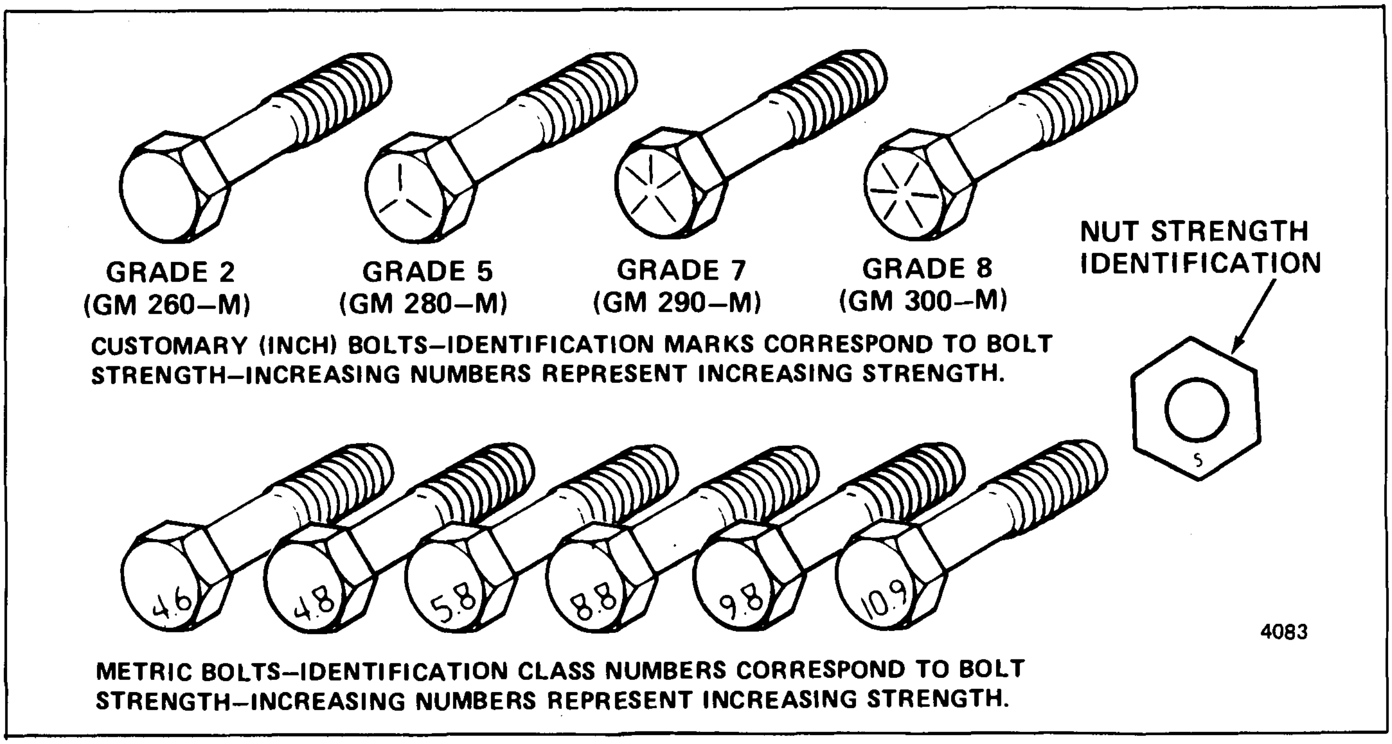

Fig. 0A-13 Bolt Strength Markings

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric MM.	Fractions	Decimal In.	Metric MM.
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

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Fig. 0A-14 Conversion Chart - Customary and Metric

U.S. and IMPERIAL CAPACITIES (Approximate)

Fuel —	A SERIES U.S. Gal.	A SERIES Imp. Gal.	B SERIES U.S. Gal.	B SERIES Imp. Gal.	F SERIES U.S. Gal.	F SERIES Imp. Gal.	G SERIES U.S. Gal.	G SERIES Imp. Gal.	H SERIES U.S. Gal.	H SERIES Imp. Gal.	X SERIES U.S. Gal.	X SERIES Imp. Gal.
Except HM Series	22.0	18.3	21.0	17.5	21.0	17.5	25.0	20.8	16.0	13.3	21.0	17.5
HM Series	--	--	--	--	--	--	--	--	18.5	15.4	--	--

Cooling —	Radiator	A U.S. Qt.	A Litres	A Imp. Qt.	B U.S. Qt.	B Litres	B Imp. Qt.	F U.S. Qt.	F Litres	F Imp. Qt.	G U.S. Qt.	G Litres	G Imp. Qt.	H U.S. Qt.	H Litres	H Imp. Qt.	X U.S. Qt.	X Litres	X Imp. Qt.
L4-140 Except HM Series	All	--	--	--	--	--	--	--	--	--	--	--	--	8.8	8.3	7.3	--	--	--
L4-140 HM Series	All	--	--	--	--	--	--	--	--	--	--	--	--	12.5	11.8	10.4	--	--	--
L4-151 Except HM Series	All	--	--	--	--	--	--	--	--	--	--	--	--	11.2	10.6	9.3	12.4	11.7	10.3
L4-151 HM Series	All	--	--	--	--	--	--	--	--	--	--	--	--	12.4	11.7	10.3	--	--	--
V6-231	All	14.5	13.7	12.1	12.9	12.2	10.8	13.1	12.4	10.9	--	--	--	13.1	12.4	10.9	13.8	13.1	11.5
V8-301 Except A/C	Std.	20.2	19.1	16.8	18.6	17.6	15.5	19.2	18.2	16.0	20.5	19.4	17.1	--	--	--	19.6	18.5	16.3
V8-301 with A/C	Std.	20.2	19.1	16.8	18.6	17.6	15.5	19.2	18.2	16.0	20.5	19.4	17.1	--	--	--	20.3	19.2	16.9
V8-301	H.D.	20.8	19.7	17.3	19.8	18.7	16.5	19.8	18.7	16.5	21.1	20.0	17.6	--	--	--	20.3	19.2	16.9
V8-305	All	--	--	--	--	--	--	17.3	16.4	14.4	--	--	--	--	--	--	17.3	16.4	14.4
V8-350(L)	All	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17.3	16.4	14.4
V8-350(P) Except A/C	Std.	21.4	20.3	17.8	19.8	18.7	16.5	20.4	19.3	17.0	21.6	20.4	18.0	--	--	--	--	--	--
V8-350(P) with A/C	Std.	22.0	20.8	18.3	19.8	18.7	16.5	21.2	20.1	17.7	22.1	20.9	18.4	--	--	--	--	--	--
V8-350(P)	H.D.	23.9	22.6	19.9	21.0	19.9	17.5	22.9	21.7	19.1	24.1	22.8	20.1	--	--	--	--	--	--
V8-350(R) Except A/C	Std.	16.7	15.8	13.9	15.0	14.2	12.5	15.6	14.8	13.0	17.0	16.1	14.2	--	--	--	16.6	15.7	13.8
V8-350(R) with A/C	Std.	16.7[1] 17.5[2]	15.8[1] 16.6[2]	13.9[1] 14.6[2]	15.0	14.2	12.5	16.4	15.5	13.7	17.0	16.1	14.2	--	--	--	16.6	15.7	13.8
V8-350(R)	H.D.	17.5	16.6	14.6	16.2	15.3	13.5	18.1	17.1	15.1	17.8	16.8	14.8	--	--	--	16.6	15.7	13.8
V8-400 Except A/C	Std.	21.4	20.3	17.8	19.8	18.7	16.5	20.4	19.3	17.0	21.6	20.4	18.0	--	--	--	--	--	--
V8-400 with A/C	Std.	22.0[1] 22.8[2]	20.8[1] 21.6[2]	18.3[1] 19.0[2]	21.0	19.9	17.5	22.9	21.7	19.1	22.1	20.9	18.4	--	--	--	--	--	--
V8-400	H.D.	23.9	22.6	19.9	21.0	19.9	17.5	22.9	21.7	19.1	24.1	22.8	20.1	--	--	--	--	--	--
V8-403 Except A/C	Std.	17.9[3] 18.7[4]	16.9[3] 17.7[4]	14.9[3] 15.6[4]	16.1	15.2	13.4	16.8	15.9	14.0	18.2[5] 19.0[6]	17.2[5] 18.0[6]	15.2[5] 15.8[6]	--	--	--	--	--	--
V8-403 with A/C	Std.	17.9[3] 18.7[4]	16.9[3] 17.7[4]	14.9[3] 15.6[4]	16.1[5] 17.3[6]	15.2[5] 16.4[6]	13.4[5] 14.4[6]	17.5	16.6	14.6	18.2[5] 19.0[6]	17.2[5] 18.0[6]	15.2[5] 15.8[6]	--	--	--	--	--	--
V8-403	H.D.	18.7	17.7	15.6	17.3	16.4	14.4	19.3	18.3	16.1	19.0	18.0	15.8	--	--	--	--	--	--

Engine Crankcase —	A U.S. Qt.	A Imp. Qt.	B U.S. Qt.	B Imp. Qt.	F U.S. Qt.	F Imp. Qt.	G U.S. Qt.	G Imp. Qt.	H U.S. Qt.	H Imp. Qt.	X U.S. Qt.	X Imp. Qt.
L4-140, L4-151 (with Filter Change)	--	--	--	--	--	--	--	--	4.0	3.3	4.0	3.3
L4-140, L4-151 (w/o Filter Change)	--	--	--	--	--	--	--	--	3.0	2.5	3.0	2.5
V6-231, V8-305, V8-350(L), V8-350(R), V8-403 (With Filter Change)	5.0	4.1	5.0	4.1	5.0	4.1	5.0	4.1	5.0	4.1	5.0	4.1
V6-231, V8-305, V8-350(L), V8-350(R), V8-403 (w/o Filter Change)	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3	4.0	3.3
V8-301, V8-350(P), V8-400 (with Filter Change)	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0	--	--	6.0	5.0
V8-301, V8-350(P), V8-400 (w/o Filter Change)	5.0	4.1	5.0	4.1	5.0	4.1	5.0	4.1	--	--	5.0	4.1

Transmission —	A U.S. Pt.	A Imp. Pt.	B U.S. Pt.	B Imp. Pt.	F U.S. Pt.	F Imp. Pt.	G U.S. Pt.	G Imp. Pt.	H U.S. Pt.	H Imp. Pt.	X U.S. Pt.	X Imp. Pt.
3 Spd. Manual	3.5	2.9	--	--	3.5	2.9	--	--	--	--	3.5	2.9
4 Spd. Manual	--	--	--	--	2.5	2.1	--	--	2.4	2.0	2.4	2.0
5 Spd. Manual	--	--	--	--	--	--	--	--	3.5	2.9	3.5	2.9
Automatic 200 Refill after Draining	--	--	6.0	5.0	--	--	--	--	6.0	5.0	6.0	5.0
Automatic 200 Refill after Disassembly	--	--	17.5[7] 13.5[8]	14.6[7] 11.3[8]	--	--	--	--	19.3	16.0	13.5[9] 17.5[10]	11.3[9] 14.6[10]
Automatic 250 Refill after Draining	--	--	--	--	--	--	--	--	5.0	4.2	--	--
Automatic 250 Refill after Disassembly	--	--	--	--	--	--	--	--	21.0	17.5	--	--
Automatic 350 Refill after Draining	8.0	6.7	8.0	6.7	8.0	6.7	8.0	6.7	5.0	4.2	--	--
Automatic 350 Refill after Disassembly	19.3	16.0	19.3	16.0	19.3	16.0	19.3	16.0	21.0	17.5	--	--
Automatic 400 Refill after Draining	7.5	6.3	7.5	6.3	--	--	7.5	6.3	--	--	--	--
Automatic 400 Refill after Disassembly	19.0	15.8	19.0	15.8	--	--	19.0	15.8	--	--	--	--

Differential —	A U.S. Pt.	A Imp. Pt.	B U.S. Pt.	B Imp. Pt.	F U.S. Pt.	F Imp. Pt.	G U.S. Pt.	G Imp. Pt.	H U.S. Pt.	H Imp. Pt.	X U.S. Pt.	X Imp. Pt.
	4.3	3.5	3.5[11] 4.3[12]	2.9[11] 3.5[12]	4.3	3.5	4.3	3.5	2.8[13] 3.5[14]	2.3[13] 2.9[14]	3.5	2.9

Brake Master Cylinder — Fill to ¼" from top using fluid meeting SAE J 1703A (Dot 3) Specs.

[1] Except Wagon
[2] Wagon
[3] Except Wagon & Except California
[4] Wagon or California
[5] Except California
[6] California
[7] Code PZ (2.8 Litres)
[8] Code PY (6.4 Litres)
[9] Except V8
[10] V8 Engine
[11] 7½" Axle
[12] Except 7½" Axle
[13] Except HM Series
[14] HM Series

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Fig. 0A-15 U.S. and Imperial Capacities (Approximate)

SECTION 0B

MAINTENANCE & LUBRICATION

CONTENTS OF THIS SECTION

DESCRIPTION

The maintenance schedules follow two basic formats, I and II. The major difference between the two schedules is in the Section "C" or Emission Control Maintenance. Sections "A" and "B" are the same in both schedules. The Schedule I (Fig. 0B-1) or Schedule II (Fig. 0B-2) is tied to the engine family number as shown on the emission control label on the radiator support or fan shroud. Some vehicles show the Schedule I or Schedule II designation on the label.

The maintenance schedule provided in the glove box materials with the vehicle will be the schedule specified for that vehicle. The engine family numbers (shown on the emissions control label), their displacement, carburetion designation, exhaust emissions certification and recommended maintenance schedule are shown in the following chart. You may note that engine families using Schedule II have a suffix "U".

COMPLETE VEHICLE MAINTENANCE SCHEDULE I – 1977 MODELS

WHEN TO PERFORM SERVICES (MONTHS OR MILES WHICHEVER OCCURS FIRST)	ITEM NO.	SERVICE	OWNER'S SERVICE LOG (MILES) INSERT MONTH, DAY, AND MILEAGE (i.e. MAY/5/8612) IN COLUMN CLOSEST TO MILEAGE WHEN SERVICE IS PERFORMED					
			7,500	15,000	22,500	30,000	37,500	45,000
SECTION A– LUBRICATION AND GENERAL MAINTENANCE								
Every 12 Months or 7,500 Miles	A-1	Chassis Lubrication	●	●	●	●	●	●
	A-2	●*Fluid Levels Check	●	●	●	●	●	●
	A-3	*Engine Oil Change	●	●	●	●	●	●
See Explanation	A-4	*Oil Filter Change	●		●		●	
	A-5	Tire Rotation (Steel Belted Radial)	●		●		●	
	A-6	Rear Axle Lube Change						
Every 12 Months	A-7	Air Conditioning Check		ANNUAL		ANNUAL		ANNUAL
Every 12 Months or 15,000 Miles	A-8	*Cooling System Check		●		●		●
Every 30,000 Miles	A-9	Wheel Bearing Repack				●		
	A-10	Manual Steering Gear Check				●		
	A-11	Clutch Cross Shaft Lubrication				●		
Every 60,000 Miles	A-12	*Auto. Trans. Fluid & Filter Change						
SECTION B–SAFETY MAINTENANCE								
Every 12 Months or 7,500 Miles	B-1	Owner Safety Checks	●	●	●	●	●	●
	B-2	Tire, Disc Brake, Wheel Check	●	●	●	●	●	●
	B-3	*Exhaust System Check	●	●	●	●	●	●
	B-4	Suspension and Steering Check	●	●	●	●	●	●
	B-5	Brake and Power Steering Check	●	●	●	●	●	●
Every 12 Months or 15,000 Miles	B-6	*Drive Belt Check		●		●		●
	B-7	Drum Brake and Parking Brake Check		●		●		●
	B-8	Throttle Linkage Check		●		●		●
	B-9	Underbody Flush & Check		●		●		●
	B-10	Bumper Check		●		●		●
SECTION C–EMISSION CONTROL MAINTENANCE								
At First 6 Months or 7,500 Miles - Then at 18 Month/ 22,500 Mile Intervals as Indicated in Log	C- 1	Thermo. Controlled Air Cleaner Check	●		●			●
	C- 2	Carburetor Choke Check	●		●			●
	C- 3	Engine Idle Speed Adjustment	●		●			●
	C- 4	EFE System Check	●		●			●
	C- 5	Carburetor Mounting Torque	●		●			●
	C- 6	Vacuum Advance System and Hoses Check	●		●			●
Every 12 Months or 15,000 Miles	C- 7	Fuel Filter Replacement		●		●		●
	C- 8	PCV System Check		●		●		●
		--PCV Valve and Filter Replacement				●		
Every 22,500 Miles	C- 9	Spark Plug Wires Check			●			●
	C-10	Idle Stop Solenoid, Idle Speed-Up Solenoid or Dashpot Check			●			●
	C-11	Spark Plug Replacement			(2)			●
	C-12	Engine Timing Adjustment and Distributor Check			●			●
	C-13	Carburetor Vacuum Break Adjustment			(3)			(3)
Every 24 Months or 30,000 Miles	C-14	ECS System Check and Filter Replacement				●		
	C-15	Fuel Cap, Tank and Lines Check				●		
Every 30,000 Miles	C-16	Air Cleaner Element Replacement				(1)		

● Also A Safety Service
* Also An Emission Control Service

(1) All Except L-4 Engines Which Do Not Receive This Service.

(2) All Except Engine Families 720K4EH, Which Do Not Receive This Service.

(3) Applies To 140 2-Bbl. And 301 V8.

Your 1977 Pontiac has been certified to meet emission standards at either high or low altitude as designated on the underhood Vehicle Emission Control Information Label. Vehicle operation will be optimum at the altitude designated on the Label but will be satisfactory at all altitudes.

The exhaust emission control systems used on 1977 model GM vehicles are not designed for conversion to allow the vehicles to meet emission standards when operated at other than the altitude designated on the Label. However, for some GM vehicles, conversion to meet emission standards at other than the designated altitude is possible and is permitted by government regulations. Information regarding conversion of your vehicle, if permitted, can be obtained from: Customer Services Department, Pontiac Motor Division, Central Office, One Pontiac Plaza, Pontiac, Michigan 48053, Telephone No. (313) 857-1316. Include your Vehicle Identification Number in your request.

Fig. 0B-1 Vehicle Maintenance Schedule I

COMPLETE VEHICLE MAINTENANCE SCHEDULE II – 1977 MODELS

WHEN TO PERFORM SERVICES (MONTHS OR MILES WHICHEVER OCCURS FIRST)	ITEM NO.	SERVICE	OWNER'S SERVICE LOG (MILES) INSERT MONTH, DAY, AND MILEAGE (i.e. MAY/5/8612) IN COLUMN CLOSEST TO MILEAGE WHEN SERVICE IS PERFORMED					
			7,500	15,000	22,500	30,000	37,500	45,000
		SECTION A – LUBRICATION AND GENERAL MAINTENANCE						
Every 12 Months or 7,500 Miles	A-1	Chassis Lubrication	●	●	●	●	●	●
	A-2	●•Fluid Levels Check	●	●	●	●	●	●
	A-3	•Engine Oil Change	●	●	●	●	●	●
See Explanation	A-4	•Oil Filter Change	●		●		●	
	A-5	Tire Rotation (Steel Belted Radial)	●		●		●	
	A-6	Rear Axle Lube Change						
Every 12 Months	A-7	Air Conditioning Check		ANNUAL		ANNUAL		ANNUAL
Every 12 Months or 15,000 Miles	A-8	•Cooling System Check		●		●		●
Every 30,000 Miles	A-9	Wheel Bearing Repack				●		
	A-10	Manual Steering Gear Check				●		
	A-11	Clutch Cross Shaft Lubrication				●		
Every 60,000 Miles	A-12	•Auto. Trans. Fluid & Filter Change						
		SECTION B – SAFETY MAINTENANCE						
Every 12 Months or 7,500 Miles	B-1	Owner Safety Checks	●	●	●	●	●	●
	B-2	Tire, Disc Brake, Wheel Check	●	●	●	●	●	●
	B-3	•Exhaust System Check	●	●	●	●	●	●
	B-4	Suspension and Steering Check	●	●	●	●	●	●
	B-5	Brake and Power Steering Check		●	●	●	●	●
Every 12 Months or 15,000 Miles	B-6	•Drive Belt Check	●	●		●		●
	B-7	Drum Brake and Parking Brake Check		●		●		●
	B-8	Throttle Linkage Check		●		●		●
	B-9	Underbody Flush & Check		●		●		●
	B-10	Bumper Check		●		●		●
		SECTION C – EMISSION CONTROL MAINTENANCE						
See Explanation At First 6 Months or 7,500 Miles - Then at 24 Month/ 30,000 Mile Intervals as Indicated in Log	C- 1	Carburetor Choke Check	●			●		●
	C- 2	Thermo. Controlled Air Cleaner Check	●			●		
	C- 3	Engine Idle Speed Adjustment	●			●		
	C- 4	EFE System Check	●			●		
	C- 5	Carburetor Mounting Torque	●			●		
	C- 6	Vacuum Advance System and Hoses Check		●		●		●
Every 12 Months or 15,000 Miles	C- 7	Fuel Filter Replacement		●		●		●
	C- 8	PCV System Check		●		●		●
		--PCV Valve and Filter Replacement				●		
Every 15,000 Miles	C- 9	Spark Plug Wires Check		●		●		●
	C-14	Differential Vacuum Delay & Separator Valve – if so equipped		●		●		●
Every 30,000 Miles	C-10	Idle Stop Solenoid, Idle Speed-Up Solenoid or Dashpot Check				●		
	C-11	Spark Plug Replacement				●		
	C-12	Engine Timing Adjustment and Distributor Check				●		
	C-13	Air Cleaner Element Replacement				(1)		
Every 24 Months or 30,000 Miles	C-15	ECS System Check and Filter Replacement				●		
	C-16	Fuel Cap, Tank and Lines Check				●		

- ● Also A Safety Service
- • Also An Emission Control Service

(1) All except L-4 engines, which do not receive this service.

Your 1977 Pontiac has been certified to meet emission standards at either high or low altitude as designated on the underhood Vehicle Emission Control Information Label. Vehicle operation will be optimum at the altitude designated on the Label but will be satisfactory at all altitudes.

The exhaust emission control systems used on 1977 model GM vehicles are not designed for conversion to allow the vehicles to meet emission standards when operated at other than the altitude designated on the Label. However, for some GM vehicles, conversion to meet emission standards at other than the designated altitude is possible and is permitted by government regulations. Information regarding conversion of your vehicle, if permitted, can be obtained from: Customer Services Department, Pontiac Motor Division, Central Office, One Pontiac Plaza, Pontiac, Michigan 48053, Telephone No. (313) 857-1316. Include your Vehicle Identification Number in your request.

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Fig. 0B-2 Vehicle Maintenance Schedule II

ENGINE FAMILIES

Engine Family No. (Emission Label)	Displacement Carburetor	Certification Standard*	Maintenance Schedule
710C2	140 - 2 bbl.	F, C & A	I
710Y2	305 - 2 bbl.	F	I
710J4S	350 - 4 bbl.	C & A	I
720X2U	151 - 2 bbl.	F	II
720X2E	151 - 2 bbl.	C	I
720S2E	302 - 2 bbl.	F	I
720K4EH	350/400 - 4 bbl.	F	I
730M4U	350/400 - 4 bbl.	F & A	II
730M4AU	350/403 - 4 bbl.	C	II
730P4UY	403 - 4 bbl.	F & A	II
740E2	231 - 2 bbl.	F	I
740E2LU	231 - 2 bbl.	C & A	II

*Certification Standard

F - Forty-nine states

C - California state

A - High altitude

EXPLANATION OF COMPLETE VEHICLE MAINTENANCE SCHEDULE

Presented below is a brief explanation of each of the services listed in the preceding Complete Vehicle Maintenance Schedules.

NORMAL VEHICLE USE - The owner's maintenance instructions contained in this maintenance schedule are based on the assumption that the car will be used as designed:

- to carry passengers and cargo within the limitations indicated on the vehicle tire placard affixed to either the edge of the driver's door or the inside of the glove box door,
- on reasonable road surfaces within legal operating limits,
- on a daily basis, as a general rule, for at least several miles, and
- on unleaded fuel.

Unusual operating conditions will require more frequent vehicle maintenance as specified in the respective sections included below.

After each of the following maintenance services is performed, it is recommended that you insert the month, day and mileage in the maintenance schedule under the appropriate "Owner Service Log" column.

SECTION A - LUBE & GENERAL MAINTENANCE

ITEM NO. & SERVICES

A-1–CHASSIS - Lubricate all grease fittings in front suspension and steering linkage. Lubricate transmission shift linkage, hood latch, hood and door hinges. Lubricate parking brake cable guides, underbody contact points and linkage.

Body Lubrication

Mechanical parts having contacting surfaces in relative motion with other body parts are lubricated during assembly. To maintain ease of operation, it is recommended that the following parts be lubricated at the basic service intervals shown in the vehicle Maintenance Schedule with lubricants as follows:

- All door and tailgate hinges are to be lubricated with engine oil (30 weight preferred). Apply lubricant to roller and hinge pin bushings but do not lubricate hold open link and roller contacting surfaces.
- External locks (door, tailgate, rear compartment lid), rear compartment lid hinges and torque rod to hinge surfaces and full-size station wagon tailgate torque rod assist link to body retainer are to be lubricated with Auto-Lube "A", part number 1050110, Spray-Lube "A", part number 1050520, 3M Lithium Spray Lube, number 8915, or equivalent.
- Lubricate lock cylinders with WD-40, 3M 4-way or equivalent spray lubricant.
- The lubrication requirements for seat mechanism, door hardware, tailgate hardware, sunroof and windshield wipers are covered in specific sections of the body service manual.

A-2–FLUID LEVELS - Check level of fluid in brake master cylinder●, power steering pump●, battery, engine*, axle, transmission* and windshield washer●. Engine coolant should be checked for proper level and freeze protection to at least -20°F. (-29°C.) or to the lowest temperature expected during the period of vehicle operation.* Proper engine coolant also provides corrosion protection.

Any significant fluid loss in any of these systems or units could mean that a malfunction is developing and corrective action should be taken immediately. A low fluid level in the brake master cylinder front reservoir could also be an indicator that the disc brake pads need replacing.

A-3–ENGINE OIL* - Change each 12 months or 7,500 miles, whichever occurs first under normal driving conditions, or each 3 months or 3,000 miles when the vehicle is operated under the following conditions: (a) driving in dusty conditions, (b) trailer pulling, (c) extensive idling or (d) short-trip operation at freezing temperatures (with engine not thoroughly warmed-up). See your Owner's Manual for additional details on engine oil.

A-4–ENGINE OIL FILTER* - Replace at the first oil change and every other oil change thereafter, if mileage (7,500 miles) is the determining factor. If time (12 months) is the determining factor, then change oil filter with every oil change.

A-5–TIRES - To equalize wear, rotate tires as described in Section on Wheels and Tires and adjust tire pressures as shown on tire placard on glove box door or edge of door. Steel belted radial tires should be rotated at first 7,500 miles and then at every 15,000 miles thereafter. Bias-belted tires should be rotated every 7,500 miles.

A-6–REAR AXLE - Change lubricant every 15,000 miles on all type rear axles or final drives when using vehicle to pull a trailer.

A-7–AIR CONDITIONING - Check condition of air conditioning system hoses and refrigerant charge at sight glass (if so equipped). Replace hoses and/or refrigerant if need is indicated.

A-8–COOLING SYSTEM* - At 12-month or 15,000-mile intervals, wash radiator cap and filler neck with clean water, pressure test system and radiator cap for proper pressure holding capacity (tighten hose clamps and inspect conditions of all cooling and heater hoses). Replace hoses if checked, swollen or otherwise deteriorated.

Also each 12 months or 15,000 miles, clean exterior of radiator core and air conditioning condenser. Every 24 months or 30,000 miles, drain, flush, and refill the cooling system with a new coolant solution as described in your Owner's Manual.

A-9–WHEEL BEARINGS - Clean and repack front wheel bearings with a lubricant meeting requirements of GM 6031-M.

A-10–MANUAL STEERING GEAR - Check for seal leakage around the pitman shaft and housing. If leakage is evident (solid grease oozing out - not just oily film), it should be corrected immediately.

A-11–CLUTCH CROSS SHAFT - Lubricate clutch cross shaft lever.

A-12–AUTOMATIC TRANSMISSION FLUID* - Under normal driving conditions, change the transmission fluid and service the sump filter every 60,000 miles. On 250 series transmissions, adjust the intermediate band at fluid change intervals.

Under unusual conditions, such as constant driving in heavy city traffic, trailer pulling, and commercial applications, services should be performed at 15,000-mile intervals.

*Also an Emission Control Service

●Also a Safety Service

SECTION B - SAFETY MAINTENANCE

NOTE: Items B-1 (a) thru (w) can be checked by the owner, while items B-2 thru B-10 should only be checked by a qualified mechanic. It is particularly important that any safety system which may have been adversely affected in an accident be checked and repaired as necessary before the vehicle is returned to use.

B-1–SAFETY CHECKS TO BE PERFORMED BY OWNER - The following checks should be made regularly during operation at no greater interval than 12 months or 7,500 miles, whichever occurs first, and more often when the need is indicated. Any deficiencies should be brought to the attention of your dealer or another service outlet, as soon as possible, so the advice of a qualified mechanic is available regarding the need for repairs or replacements.

a. STEERING COLUMN LOCK - Check for proper operation by attempting to turn key to LOCK position in the various transmission gear ranges when the car is stationary. Key should turn to LOCK position only when transmission control is in PARK on automatic transmission models or in reverse on manual transmission models. Key should be removable only in LOCK position.

STEERING COLUMN LOCK (ASTRE, SUNBIRD AND 5-SPEED VENTURA) - Check for proper operation by attempting to turn key to LOCK position without depressing key release lever with car stationary. Key should turn to LOCK position only with key release lever depressed. Key should be removable only in LOCK position.

b. PARKING BRAKE AND TRANSMISSION "PARK" MECHANISM - Check parking brake holding ability by parking on a fairly steep hill and restraining the vehicle with the parking brake only. On cars with automatic transmissions, check the holding ability of the "PARK" mechanism by releasing all brakes after the transmission selector lever has been placed in the "P" position.

CAUTION: *Before making checks (c) or (d) below, be sure to have a clear distance ahead and behind the car, set the parking brake and firmly* *apply the foot brake. Do not depress accelerator pedal. Be prepared to turn off ignition switch immediately if engine should start.*

c.STARTER SAFETY SWITCH (AUTOMATIC TRANSMISSION CARS) - Check starter safety switch by attempting to start the engine with the transmission in each of the driving gears. The starter should operate only in the Park ("P") or Neutral ("N") positions.

d. STARTER SAFETY SWITCH (MANUAL TRANSMISSION CARS) - To check, place the shift lever in neutral, depress the clutch halfway and attempt to start. The starter should operate only when clutch is fully depressed.

e. TRANSMISSION SHIFT INDICATOR - Check to be sure automatic transmission shift indicator accurately indicates the shift position selected.

f. STEERING - Be alert to any changes in steering action. The need for inspection or servicing may be indicated by increased effort to turn the steering wheel, excessive free play or unusual sounds when turning or parking.

g. WHEEL ALIGNMENT AND BALANCE - In addition to uneven or abnormal tire wear, the need for wheel alignment service may be indicated by a pull to the right or left when driving on a straight and level road. The need for wheel balancing is usually indicated by a vibration of the steering wheel or seat while driving at normal highway speeds.

h. BRAKES - Be alert to illumination of the brake warning light or changes in braking action, such as repeated pulling to one side, unusual sounds either when braking or between brake applications or increased brake pedal travel. Any of these could indicate the need for brake system inspection and/or service.

i. EXHAUST SYSTEM - Be alert to any change in the sound of the exhaust system or a smell of fumes which may indicate a leak or overheat condition requiring inspection and/or service. (See also Engine Exhaust Gas Caution and Catalytic Converter information in Owner's Manual and item B-3.)

j. WINDSHIELD WIPERS AND WASHERS - Check operation of wipers, as well as condition and alignment of wiper blades. Check amount and direction of fluid sprayed by washers during use.

k. DEFROSTERS - Check performance by moving controls to "DEF" and noting amount of air directed against the windshield.

l. REARVIEW MIRRORS AND SUN VISORS - Check that friction joints are properly adjusted so mirrors and sun visors stay in the selected position.

m. HORN - Blow the horn occasionally to be sure that it works. Check all button locations.

n. LAP AND SHOULDER BELTS - Check belts, buckles, latch plates, retractors, reminder systems, guide loops, keepers, clips and anchors for proper operation and for damage. Check to make certain that anchor mounting bolts are tight.

o. HEAD RESTRAINTS - Check that head restraints, if present, adjust properly in the up detent positions, and that no components are missing, damaged or loose.

p. SEAT ADJUSTERS - Check that seat adjusters securely engage by pushing forward and backward whenever a manual seat is adjusted.

q. SEAT BACK LATCHES - Check to see that seat back latches are holding by pulling forward on the top of each folding seat back (with doors closed if equipped with automatic seat back latches).

SEAT BACK LATCHES - Full-size Pontiacs with folding front seats have inertial seat back latches designed to prevent forward motion of the back rest only during a sudden slowing of the vehicle. Check that the seat back release lever on the bottom outboard side of each front seat back moves up and down freely. For proper operation, the lever must be in the down position.

r. LIGHTS AND BUZZERS - Check all instrument panel illuminating and warning lights, seat belt reminder light and buzzer, ignition key buzzer, interior lights, license plate lights, side marker lights, headlamps, parking lamps, tail lamps, brake lights, turn signals, backup lamps and bazard warning flashers. Have headlamp aim checked every 12 months or 15,000 miles, or more often if light beams seem to be aimed improperly.

s. GLASS - Check for broken, scratched, dirty or damaged glass on vehicle that could obscure vision or become an injury hazard.

t. DOOR LATCHES - Check for positive closing, latching and locking.

u. HOOD LATCHES - Check to make sure hood closes firmly by lifting on the hood after each closing. Check also for broken, damaged or missing parts which might prevent secure latching.

v. FLUID LEAKS - Check for fuel, water, oil or other fluid leaks by observing the ground beneath the vehicle after it has been parked for a while. (Water dripping from air conditioning system after use is normal.) If gasoline fumes or fluid are noticed at any time, the cause should be determined and corrected without delay because of the possibility of fire.

w. SPARE AND JACK - Check that spare tire assembly and jack equipment are securely stowed at all times.

B-2-TIRES, WHEELS AND DISC BRAKES - Check disc brake pads for wear and surface condition of rotors while wheels are removed during tire rotation (see item A-5). Check tires for excessive wear or damage. Make certain wheels are not bent or cracked and that wheel nuts have been tightened to the torque value specified in the owner's manual. Check tire inflation pressure (including the spare tire, unless it is a stowaway) when the tires are "cold" at least monthly, or more often if daily visual inspection indicates the need.

B-3-EXHAUST SYSTEM* - Check complete exhaust system, including catalytic converter, and nearby body areas and trunk lid, hatchback or tail gate, for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the trunk or passenger compartment or cause a heat build-up in the floor pan. Dust or water in the trunk may be an indication of a problem in one of these areas. Any necessary corrections should be made immediately. To help continue integrity, exhaust system pipes and resonators rearward of muffler must be replaced whenever a new muffler is installed (also see item B-1 (i)).

B-4–SUSPENSION AND STEERING - Check for damaged, loose or missing parts, or parts showing visible signs of excessive wear or lack of lubrication in front and rear suspension and steering system. Questionable parts noted should be replaced by a qualified mechanic without delay.

B-5–BRAKES AND POWER STEERING - Check lines and hoses for proper attachment, binding, leaks, cracks, chafing, deterioration, etc. Any questionable parts noted should be replaced or repaired immediately. When abrasion or wear is evident on lines or hoses, the cause must be corrected.

B-6–ENGINE DRIVE BELTS* - Check belts driving fan, AIR pump, generator, power steering pump and air conditioning compressor for cracks, fraying, wear and tension. Adjust or replace as necessary.

B-7–DRUM BRAKES AND PARKING BRAKE - (See item B-2 for disc brake check.) Check drum brake linings for wear or cracks and other internal brake components at each wheel (drums, wheel cylinders, etc.). Parking brake adjustment also should be checked whenever drum brake linings are checked.

NOTE: More frequent brake checks should be made if driving conditions and habits result in frequent brake application.

B-8–THROTTLE LINKAGE - Check for damaged or missing parts, interference or binding. Any deficiencies should be corrected without delay by a qualified mechanic.

B-9–UNDERBODY - Corrosive materials used for ice and snow removal and dust control can accumulate on the underbody. If allowed to remain, these materials can result in accelerated rusting and deterioration of underbody components, such as fuel lines, frame and floor pan, exhaust system, etc. At least once each year, preferably after a winter's exposure, these corrosive materials should be removed by flushing the underbody with plain water. Particular attention should be given to cleaning out those areas where mud and other foreign materials collect.

B-10–BUMPERS - Check the front and rear bumper systems at 12-month/15,000 mile intervals to be sure that impact protection and clearance originally designed into these systems remain in a state of full readiness. They also should be checked whenever there is obvious bumper misalignment, or whenever the vehicle has been involved in a significant collision in which the bumpers were struck, even when slight or no damage to the bumper systems can be seen.

SECTION C - EMISSIONS

SCH. I, C-1; SCH. II, C-2–THERMOSTATICALLY CONTROLLED AIR CLEANER - Inspect installation to make certain that all hoses and ducts are connected and correctly installed. Also check valve for proper operation. See Section 6E of this manual.

SCH. I, C-2; SCH. II, C-1–CARBURETOR CHOKE AND HOSES - Check choke mechanism and vacuum break for proper operation. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary. See Section 6C of this manual.

SCH. I & II, C-3–ENGINE IDLE SPEED - Adjust engine idle speed accurately (following the specifications shown on the label under the hood). Adjustments must be made with test equipment known to be accurate.

SCH. I & II, C-4–EARLY FUEL EVAPORATION (EFE) VALVE - Check valve for proper operation. A binding condition must be corrected. Check switch for proper operation. Check hoses for cracking, abrasion or deterioration. Replace parts as necessary. See Section 6E of this manual.

SCH. I & II, C-5–CARBURETOR MOUNTING - At designated intervals, torque carburetor attaching bolts and/or nuts to compensate for compression of the gasket.

SCH. I & II, C-6–VACUUM ADVANCE SYSTEM AND HOSES - Check system for proper operation and hoses for proper connection, cracking, abrasion or deterioration. Replace parts as necessary.

SCH. I & II, C-7–FUEL FILTER - Replace filter in carburetor at designated intervals or more frequently if clogged. See Section 6C of this manual.

SCH. I & II, C-8–POSITIVE CRANKCASE VENTILATION SYSTEM (PCV) - Check the PCV system for satisfactory operation at 15,000 mile intervals, and clean filter. Replace the PCV valve at 30,000 mile intervals and blow out PCV valve hose with compressed air. Replace deteriorated hoses.

The PCV filter (located in the air cleaner) should be replaced whenever the air cleaner element is replaced (all except L4 engine). See Section 6E of this manual.

SCH. I & II, C-9–SPARK PLUG WIRES - Clean exterior of wires; remove any evidence of corrosion on end terminals. Inspect spark plug wires for evidence of checking, burning, cracking of exterior insulation or other deterioration. Also check for a tight fit at distributor cap and spark plugs. If corrosion cannot be removed or other conditions above are noted, replace wire.

SCH. I & II, C-10–IDLE STOP SOLENOID, IDLE SPEED-UP SOLENOID AND DASHPOT - Check for proper operation. An inoperative solenoid or dashpot must be replaced. See Section 6C of this manual.

SCH. I & II, C-11-SPARK PLUGS - Replace plugs at designated intervals with type specified. See Section 6D of this manual.

SCH. I & II, C-12-TIMING AND DISTRIBUTOR CAP - Adjust ignition timing according to specifications. Also, carefully inspect the interior of the distributor cap and rotor for cracks, carbon tracking and terminal corrosion. Clean and replace as necessary.

SCH. I, C-13-CARBURETOR VACUUM BREAK ADJUSTMENT - Inspect vacuum break linkage for proper operation. A binding condition must be corrected. Check hoses for proper connection, cracking, abrasion or deterioration. Replace parts as necessary.

Adjust vacuum breaks at specified intervals following procedures and specifications as found in Section 6C of this manual.

SCH. I, C-14; SCH. II, C-15-EVAPORATION CONTROL SYSTEM (ECS) - Check all fuel and vapor lines and hoses for proper connections and correct routing as well as condition. Remove canister and check for cracks or damage. Replace damaged or deteriorated parts as necessary. Replace filter in lower section of canister.

SCH. I, C-15; SCH. II, C-16-FUEL CAP, FUEL LINES AND FUEL TANK -

1. Inspect the fuel tank, lines and cap for damage which could cause leaks.
2. Remove fuel cap and inspect gasket for an even imprint from the filler neck, and any indications of physical damage.
3. Replace any damaged or deteriorated parts.

SCH. I, C-16; SCH. II, C-13-AIR CLEANER ELEMENT - Replace the engine air cleaner element at designated intervals. (The PCV filter on all except L-4 engines should be replaced at the same intervals.)

Operation of vehicle in dusty areas will necessitate more frequent replacements. Your dealer can be of assistance in determining the proper replacement frequency for the conditions under which you operate your vehicle.

> **CAUTION:** *Do not operate the engine without the air cleaner unless temporary removal is necessary during repair or maintenance of the vehicle. When the air cleaner is removed, backfiring can cause fire in the engine compartment.*

SCH. II (ONLY), C-14-DIFFERENTIAL VACUUM DELAY AND SEPARATOR VALVE (DVDSV) -

Inspect hoses and lines for proper routing and secure connections. Check for cracks, abrasions and deterioration. Check system for proper operation. Replace parts as necessary. See Section 6E of this manual.

MAINTENANCE SERVICE SPECIFICATIONS

(Refer to Maintenance Schedule For Intervals)

Wheel Lug Nut Torque	
Except Cast Aluminum Wheel	
B Series (4 3/4" Bolt Circle)	80 ft. lb.
B Series (5" Bolt Circle)	100 ft. lb.
A, F and G Series	80 ft. lb.
H and X Series	80 ft. lb.
Cast Aluminum Wheel	
B Series (4 3/4" Bolt Circle)	90 ft. lb.
A, F and G Series	90 ft. lb.
H Series	90 ft. lb.
Carb. Mtg. Nut Torque (L-6)	15 ft. lb.
Carb. Mtg. Bolt/Nut (Exc. L-6)	10 ft. lb.
Spark Plug Torque (w/o Tapered Seat)	25 ft. lb.
Spark Plug Torque (w/Tapered Seat)	15 ft. lb.

FLUIDS AND LUBRICANTS

Power Steering System and Pump Reservoir	Power steering fluid 1050017 or equivalent
Differential-Standard	Lubricant 1050081 or equivalent
Final Drive	Lubricant 1050081 or equivalent
Differential-Anti-Spin	Lubricant 1050081 or equivalent
Manual Steering Gear	Lubricant 1051052 or equivalent
Manual Transmission (exc. 5-Speed)	SAE-80W or SAE-80W-90 GL-5 gear lubricant or equivalent
Brake System and Master Cylinder	5464231 or equivalent
Clutch Linkage (Man. Trans. Only)	
a. Pivot Points	Engine Oil
b. Push rod to clutch fork joint and cross shaft	Chassis grease meeting requirements of GM 6031-M
Manual Transmission Shift Linkage, Column Shift	Engine Oil
Shift Linkage, Floor Shift	Engine Oil
Hood Latch Assembly	
a. Pivots and spring anchor	Engine Oil
b. Release pawl	Chassis Grease
Hood Hinges	Engine Oil
Automatic Transmission Shift Linkage	Engine Oil
Chassis Lubrication	Chassis grease meeting requirements of GM 6031-M
Automatic Transmission (& 5-Speed Man. Trans.)	DEXRON®-II automatic transmission fluid or equivalent
Constant Velocity Universal Joint	Lubricant 1050679 or grease meeting requirements of GM 6040-M
Parking Brake Cables	Chassis Grease
Front Wheel Bearings	Chassis Grease
Body Door Hinge Pins, Station Wagon Tailgate Hinge and Linkage, Station Wagon Folding Seat, Fuel Door Hinge, Rear Compartment Lid Hinges	Engine Oil
Windshield Washer Solvent	1050001 or equivalent
Energizer (Battery)	Colorless, odorless, drinking water
Engine Coolant	1050027 or equivalent (50/50 mixture of water and a high quality Ethylene Glycol base) anti-freeze conforming to GM Spec. 1899-M
Engine Oil	"SE" Engine Oil conforming to GM Specs. GM 6136-M

ENGINE OIL AND FILTER

Recommendations

- Use only SE engine oil.
- Change oil each 6 months or 7500 miles, whichever occurs first, except under the following conditions:

--driving in dusty conditions

--trailer pulling

--extensive idling

--short-trip operation at freezing temperatures (engine not thoroughly warmed-up).

Under these conditions, change oil each 3 months or 3,000 miles, whichever occurs first.

- Operation in dust storms may require an immediate oil change.
- Replace the oil filter at the first oil change, and every second oil change thereafter. AC oil filters (or equivalent) provide excellent engine protection.

The above recommendations apply to the first changes as well as subsequent oil changes. The oil change interval is based on the use of SE oils and quality oil filters. Oil change intervals longer than those listed above will seriously reduce engine life and may affect the manufacturer's obligation under the provisions of the New Vehicle Warranty.

A high quality SE oil was installed in your engine at the factory. It is not necessary to change this factory-installed oil prior to the recommended normal change period. However, check the oil level more frequently during the break-in period since higher oil consumption is normal until the piston rings become seated.

The proper oil viscosity helps assure good cold and hot starting.

NOTE: Non-detergent and other low quality oils are specifically not recommended. Only the use of SE engine oils and proper oil and filter change intervals assure you of continued reliability and performance from your engine.

CHECKING OIL LEVEL

The engine oil should be maintained at proper level. The best time to check it is before operating the engine or as the last step in a fuel stop. This will allow the oil accumulation in the engine to drain back in the crankcase. To check the level, remove the oil gage rod (dipstick), wipe it clean and reinsert it firmly for an accurate reading. The oil gage rod is marked "full" and "ADD". The oil level should be maintained in the safety margin, neither going above the "FULL" line nor below the "ADD" line. Reseat the gage firmly after taking the reading.

RECOMMENDED VISCOSITY

SUPPLEMENTAL ENGINE OIL ADDITIVES

The regular use of supplemental additives is specifically not recommended and will increase operating costs. However, supplemental additives are available that can effectively and economically solve certain specific problems without causing other difficulties. For example, if higher detergency is required to reduce varnish and sludge deposits resulting from some unusual operational difficulty, a thoroughly tested and approved additive - "G.M. Super Engine Oil Supplement" (or equivalent) - is available at your dealer. In the event of an operational problem, consult your dealer for advice before using the supplemental additives.

To help assure good cold and hot starting, as well as maximum engine life, fuel economy and oil economy, select the proper viscosity for the temperature range anticipated from the chart in Fig. 0B-3.

NOTE: SAE 5W-30 oils are recommended for all seasons in vehicles normally operated in Canada. SAE 5W-20 oils are not recommended for sustained high-speed driving. SAE 30 oils may be used at temperatures above 40°F. (4°C.).

Types of Oil

The Letter Designation "SE" has been established to correspond with the requirements of GM 6136-M. "SE" engine oils will be better quality and perform better than "SA" through "SD" designations, and are recommended for all engines regardless of model year and previous engine oil quality recommendations.

The letter designations for passenger car service and their relationship to GM Specifications are described on the followong chart:

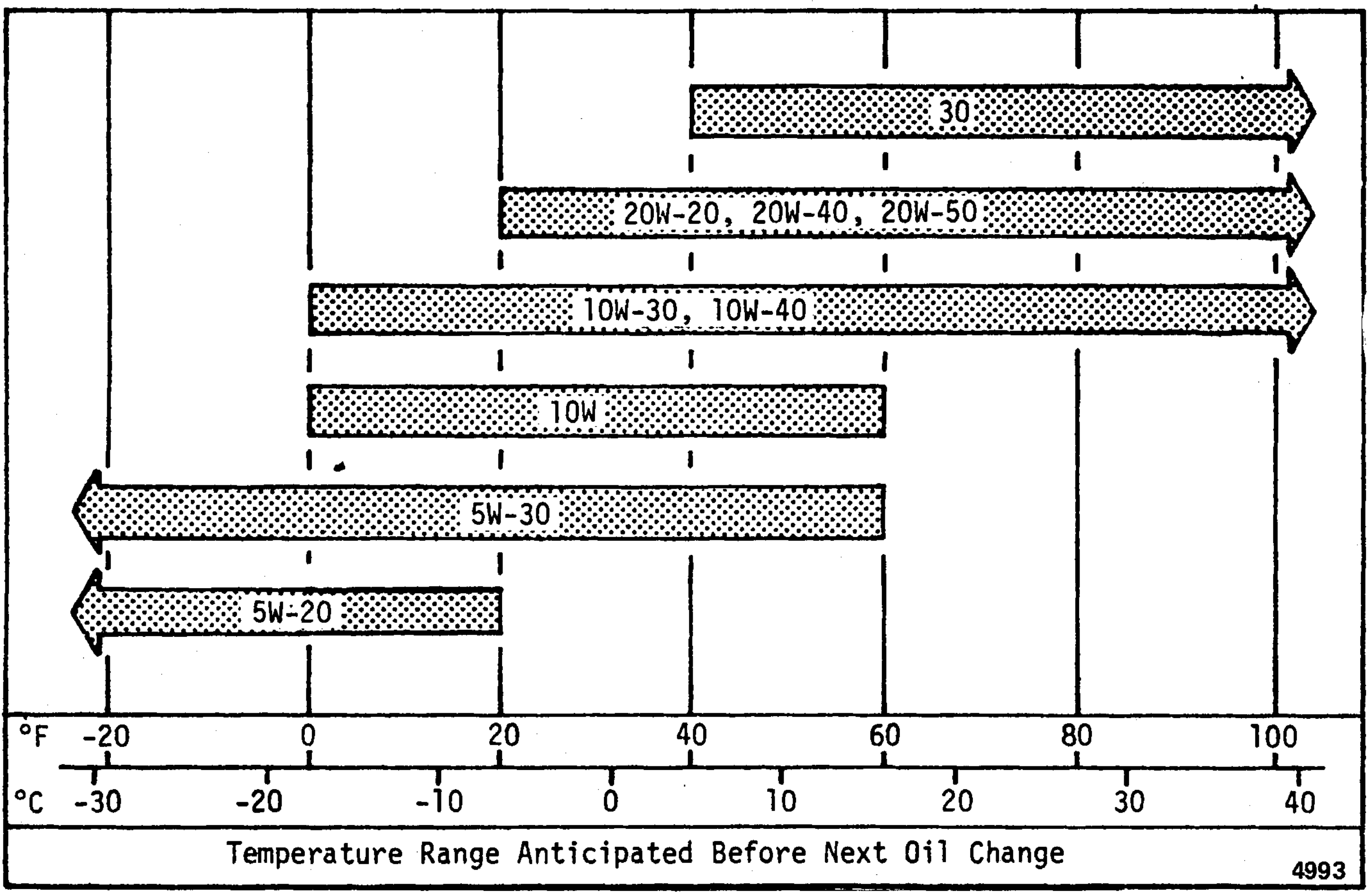
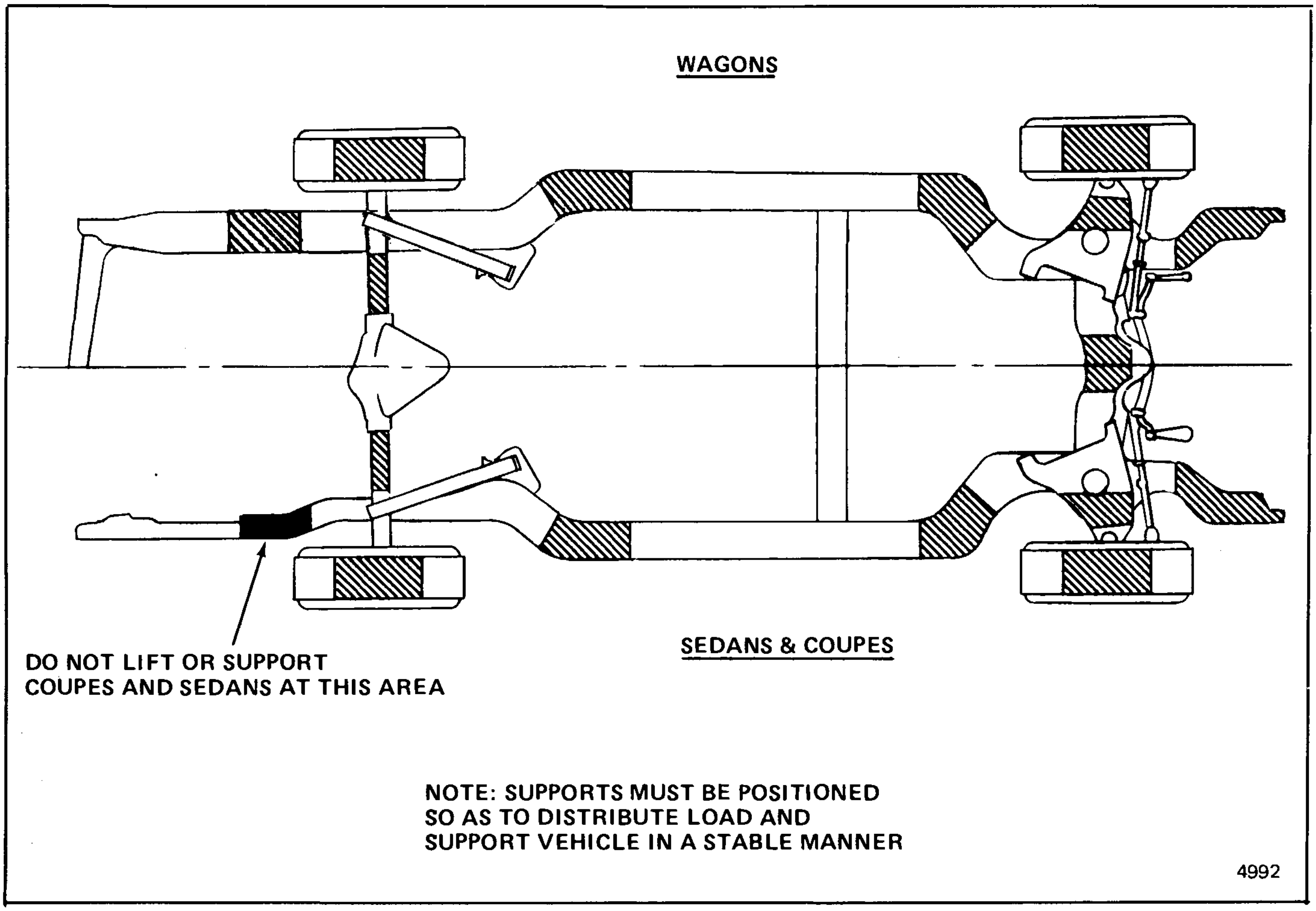


Fig. OB-3 Recommended SAE Viscosity Grades

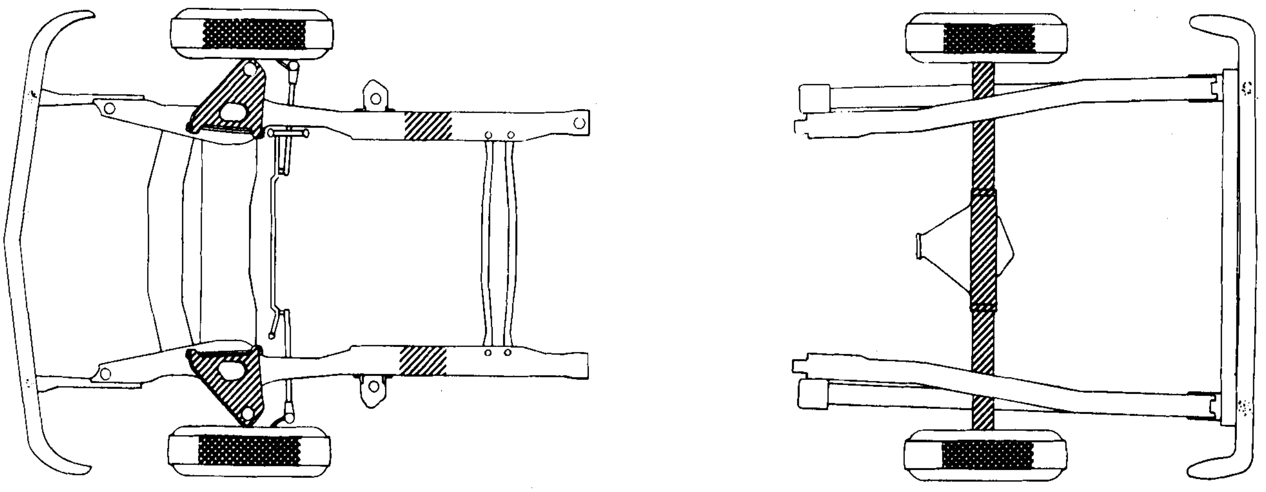
FILTERS	TYPE (OR EQUIVALENT)
Engine Oil	V6 PF40
	L4 PF25
	V8-Exc. 301, 305, 350(L) PF30
	V8-301 PF46
	V8-305,350(L) PF25
Carb. Air	L4-140 A595C
	L4-151 (Low Altitude) A742C
	L4-151 (California) A730C
	V6-231 A169CW
	V8-301,305 A329C
	V8-350(L) A348C
	V8-350(P), 400 A279C
	V8-350(R), 403 A212CW
Canister-Emission Control	7026014
PCV Filter (In Air Cleaner)	FB-59
PFV Filter (In Valve Cover)	FB-56
PCV Valve	L4-140 CV793
	L4-151 CV789C
	V6-231 CV770C
	V8-301 CV792C
	V8-305,350(L) CV774C
	V8-350(P), 350(R), 400, 403 CV679C
Carb. Fuel Inlet Filter	L4- V6, V8-305 GF 470
	V8-Exc. 305 GF 471
Transmission Oil Filter	THM 350 PF195
	THM 400 PF168



DO NOT LIFT OR SUPPORT
COUPES AND SEDANS AT THIS AREA

NOTE: SUPPORTS MUST BE POSITIONED
SO AS TO DISTRIBUTE LOAD AND
SUPPORT VEHICLE IN A STABLE MANNER

Fig. 0B-4 Lift Points - A, B and G Series



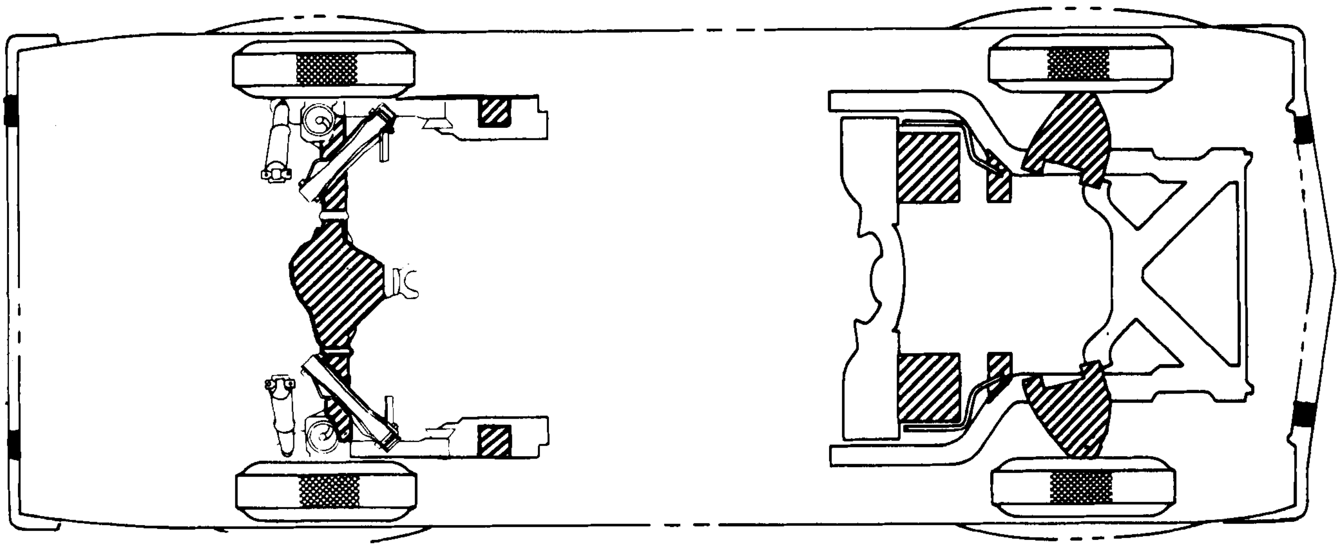
▩ DRIVE ON HOIST

░ BUMPER JACK AT FRAME ATTACHMENT ONLY

▨ FLOOR JACK OR HOIST LIFT

NOTE: SUPPORTS MUST BE POSITIONED SO AS TO DISTRIBUTE LOAD AND SUPPORT VEHICLE IN A STABLE MANNER.

Fig. 0B-5 Lift Points - F and X Series



▨ FLOOR JACK OR HOIST LIFT

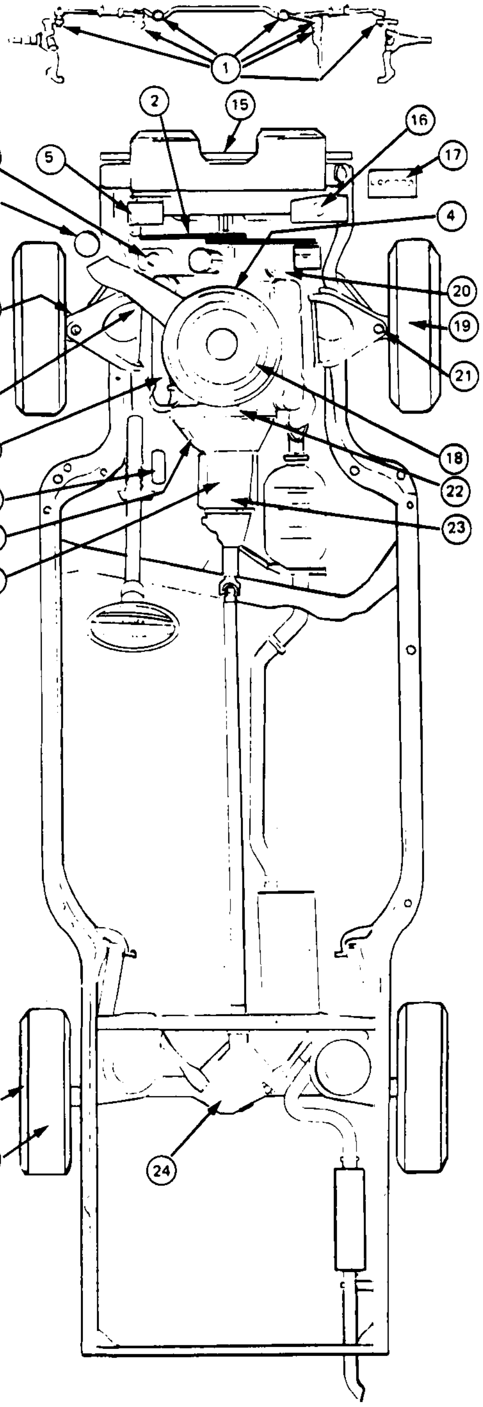
■ BUMPER JACK

▩ DRIVE ON HOIST

NOTE: SUPPORTS MUST BE POSITIONED SO AS TO DISTRIBUTE LOAD AND SUPPORT VEHICLE IN STABLE MANNER.

Fig. 0B-6 Lift Points - H Series

1. STEERING LINKAGE - LUBE (7) -CL- 7,500 Miles or 12 Months whichever occurs first.
2. ENGINE BELTS - Check condition and proper tension 15,000 Miles or 12 Months. Replace as necessary.
3. EVAPORATION CONTROL CANISTER FILTER - Replace filter on underside of canister every 24 Months or 30,000 Miles, whichever occurs first.
4. FUEL FILTER - Replace with recommended element 15,000 Miles or 12 Months whichever occurs first.
5. WINDSHIELD WASHER FLUID - Check level periodically.
6. LOWER BALL JOINTS (2) -CL- 7,500 Miles or 12 Months whichever occurs first.
7. ENGINE OIL - EO- Drain and refill every 7,500 Miles or 12 Months whichever occurs first.
8. STD. STEERING GEAR - SG- Lubed for life used for refill after repair only. Check every 30,000 miles.
9. POWER STEERING RESERVOIR - PSF- Check fluid level 12 Months or 7,500 Miles whichever occurs first.
10. BRAKE MASTER CYLINDER - HBF- Maintain level 1/4" ± 1/8" below top of reservoir 12 Months or 7,500 Miles whichever occurs first.
11. MANUAL TRANSMISSION — Maintain at filler opening - flushing & seasonal changes NOT recommended M.P.G. - S.A.E. - 80 W-90 GL-5 (SAE 80 W GL-5 in Canada). In 5 speed use - AT
12. CHECK CLUTCH LASH - (If equipped) Adjust if necessary every 7,500 Miles. Lubricate crosshaft every 30,000 Miles.
13. BRAKE MECHANISM - BL - Apply at Starwheel point of contact and lightly to 6 surfaces on which shoe rim rests 15,000 Miles, also apply to parking brake cable at guides and underbody contact points, if any.
14. TIRES - Maintain pressure periodically - refer to Group 3 for correct pressure and rotation.
15. AIR CONDITIONER - Functional check once a year.
16. RADIATOR - Check coolant level at each oil change. Replace every 30,000 Miles or 24 Months.
17. BATTERY - Check level periodically except Freedom Battery.
18. CRANKCASE VENTILATION ELEMENT AND AIR CLEANER ELEMENT - Inspect at each oil change - replace if necessary. Replace at least every 30,000 Miles - more often under adverse conditions.
19. FRONT WHEEL BEARINGS - (Disc Type Brakes) Inspect and lubricate with a premium high melting point wheel bearing grease when brakes are serviced. Part No. 1051344 or equivalent).
20. OIL FILTER ELEMENT - Replace with first oil change and then at alternate oil changes.
21. UPPER BALL JOINTS (2) -CL-7,500 Miles or 12 Months whichever occurs first.
22. PCV VALVE - Replace 30,000 Miles or 24 Months.
23. TURBO HYDRAMATIC - 200, 350, 400 FLUID AND FILTER - Replace at 60,000 Miles for normal driving or 15,000 Miles for heavy duty driving.
24. DIFFERENTIAL - ALL M.P.G. - Maintain level at filler opening to 3/8" below using part No. 1052271 or equivalent. Change lubricant in Positive Traction Axles at the first 15,000 Miles. Flushing and seasonal changes are NOT recommended. Where a vehicle is used for pulling a trailer, change lubricant every 15,000 Miles



LUBRICANTS

CL	Chassis Lubricant - Water Resistant Extreme Pressure EP No. 2 Multi-purpose Grease Which Meets B.M. Spec 6031M	MPG	Multi-Purpose Gear Lubricant Part No. 1052271 or equivalent Must meet A.P.I. - GL-5 gear oil service classification
AT	DEXRON® II Automatic Transmission Fluid G.M. Part No. 1050568-69-70 or Equivalent	SG	Calcium Soap # 2 Meeting G.M. Spec. 4673M. Do Not Use CL
EO	Engine Oil (Current Viscosity) SE*	PSF	Power Steering Gear Fluid or Equivalent Meeting G.M. Part No. 1050017 or equivalent
HBF	Hydraulic Brake Fluid - Delco Super No. 11* or equivalent		
BL	Brake Lube, Self-adjusting Per Spec. M.P. 6805		

*Equivalent Acceptable if it Meets Specifications

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Fig. 0B-7 Lubrication Chart

SECTION 1A

HEATING AND VENTILATION

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

HEATER CONTROL FUNCTIONAL TEST

(A, F, G SERIES)

Functional tests are to be made with engine running off fast idle speed cam with choke open and coolant warm.

1. Move Air Control (mode) lever to OFF, set fan switch to HI position and move temperature lever to full HOT.

- Blower operates with all air coming out purge opening at RH end of heater case.

2. Move Air Control (mode) lever to HEATER. Make sure lever is engaged in detent.

- Hot air comes chiefly from heater outlet, with some air from defroster nozzles.

3. Move Air Control (mode) lever to DEFROST.

- Hot air comes chiefly from defroster nozzles, with some air from heater outlet.

4. Move temperature lever to full COLD.

- Air from defroster is about the same temperature as the air outside the car.

5. Move the fan switch to LO, pausing at each detent.

- Blower speed and air flow decrease at each detent until low speed is obtained.

6. Move Air Control (mode) lever to OFF.

- Blower continues to run at low speed but all air comes out purge opening at R.H. end of heater case.

B SERIES

The engine should be idling off fast idle speed cam with choke open, coolant hot and the thermostat open (195°F. or 91°C.). The heater vent control mode lever and temperature lever efforts must be checked. These efforts should not be too low (below 2 lb. using pull-scale) or too high (above 6.5 lb.) or repair/ adjustment then be made.

1. Close all vent doors and set Air Control (mode) lever to VENT mode, full COLD temperature lever position and HI blower.

- Air comes mainly from heater outlet with some air also from defroster nozzle. The air temperature should be the same as air outside the vehicle.

2. Pull the LH vent control open.

- Some air comes from LH end of heater module (LH vent outlet) and some air comes from heater outlet.

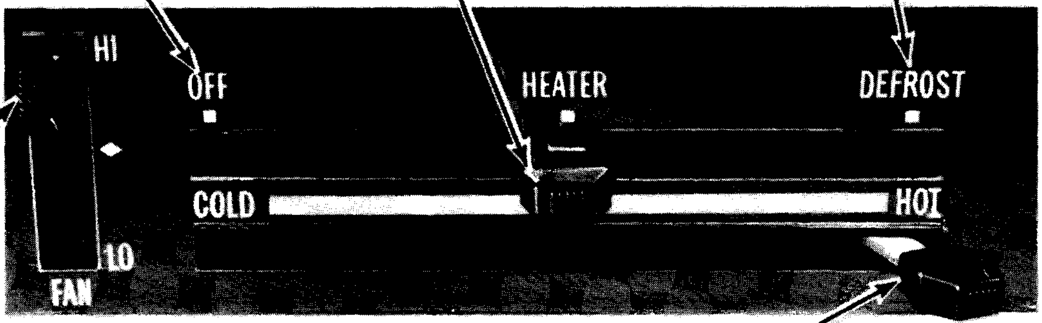
3. Push LH vent control closed and set temperature lever to full HOT position. Note effort requirements above.

- A reduced quantity of air (as compared to Step 2) comes mainly from heater outlet. The air temperature should now be hot (130°F. or 54°C.).

THIS POSITION ALLOWS OUTSIDE AIR ENTRY UNDER THE INSTRUMENT PANEL THRU A PURGE OPENING AT RIGHT SIDE OF HEATER CASE.

POSITION OF THIS SYSTEM SELECTOR LEVER DETERMINES AIR FLOW FROM PURGE OPENING, FLOOR OR WINDSHIELD OUTLETS—IN "HEATER," FLOW IS ABOUT 80% TO FLOOR & 20% TO WINDSHIELD.

THIS POSITION ALLOWS ABOUT 80% AIR FLOW TO WINDSHIELD & 20% TO FLOOR.



FAN SWITCH HAS NO "OFF" POSITION—WILL RUN ON "LO" SPEED WHEN SYSTEM SELECTOR LEVER IS MOVED TO "OFF" AS LONG AS IGNITION IS IN "RUN" POSITION.

TEMPERATURE LEVER POSITION WILL REGULATE OUTLET AIR TEMPERATURE BY BLENDING THE INCOMING OUTSIDE AIR THRU/AROUND THE HEATER CORE.

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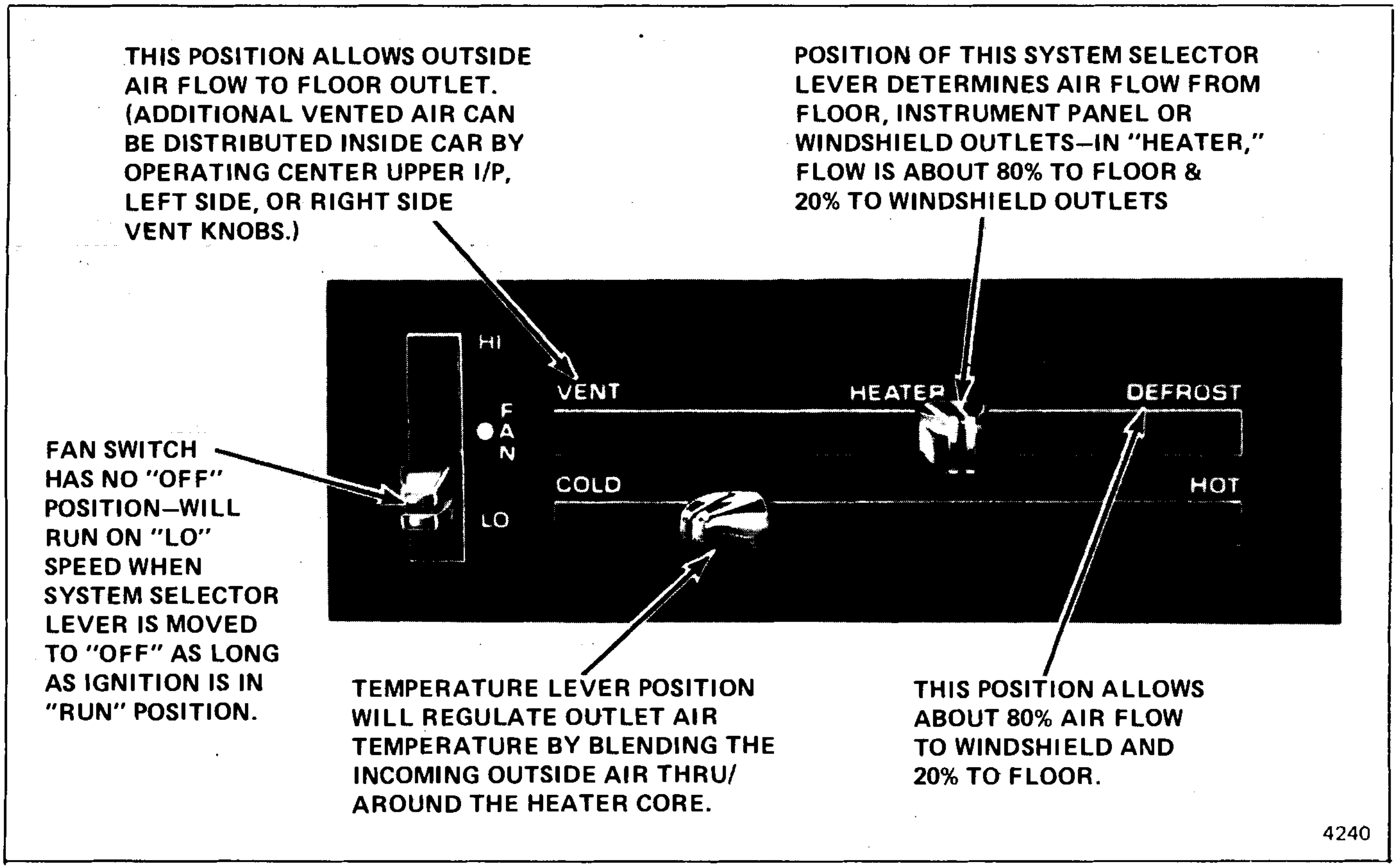
FIG. 1A-1 1977 A & G SERIES HEATER CONTROL



THIS POSITION ALLOWS OUTSIDE AIR FLOW TO FLOOR OUTLET. (ADDITIONAL VENTED AIR CAN BE DISTRIBUTED INSIDE CAR BY OPERATING CENTER UPPER I/P, LEFT SIDE, OR RIGHT SIDE VENT KNOBS.)

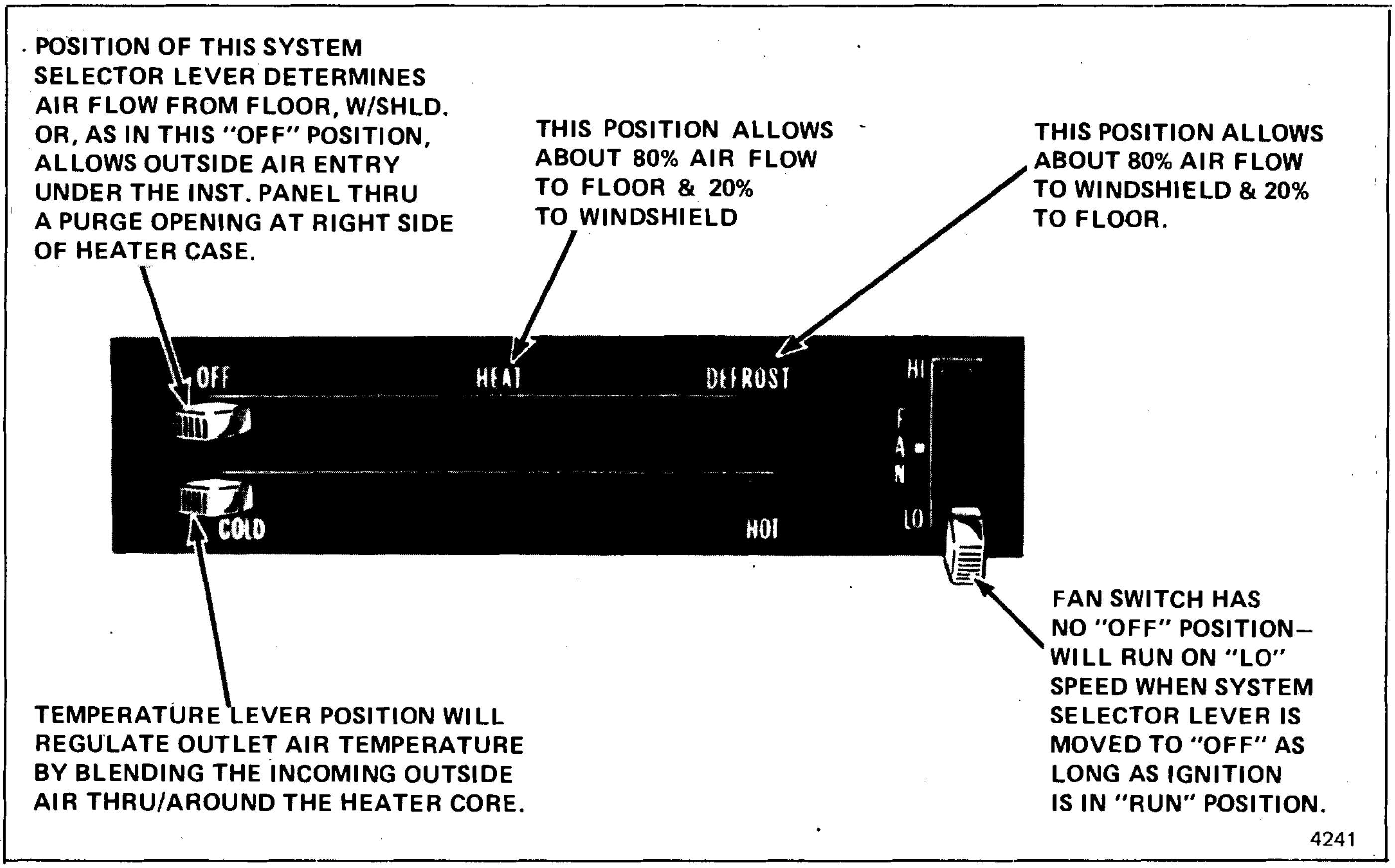
POSITION OF THIS SYSTEM SELECTOR LEVER DETERMINES AIR FLOW FROM FLOOR, INSTRUMENT PANEL OR WINDSHIELD OUTLETS—IN "HEATER," FLOW IS ABOUT 80% TO FLOOR & 20% TO WINDSHIELD OUTLETS

FAN SWITCH HAS NO "OFF" POSITION—WILL RUN ON "LO" SPEED WHEN SYSTEM SELECTOR LEVER IS MOVED TO "OFF" AS LONG AS IGNITION IS IN "RUN" POSITION.

TEMPERATURE LEVER POSITION WILL REGULATE OUTLET AIR TEMPERATURE BY BLENDING THE INCOMING OUTSIDE AIR THRU/ AROUND THE HEATER CORE.

THIS POSITION ALLOWS ABOUT 80% AIR FLOW TO WINDSHIELD AND 20% TO FLOOR.

FIG. 1A-2 1977 B SERIES HEATER CONTROL



POSITION OF THIS SYSTEM SELECTOR LEVER DETERMINES AIR FLOW FROM FLOOR, W/SHLD. OR, AS IN THIS "OFF" POSITION, ALLOWS OUTSIDE AIR ENTRY UNDER THE INST. PANEL THRU A PURGE OPENING AT RIGHT SIDE OF HEATER CASE.

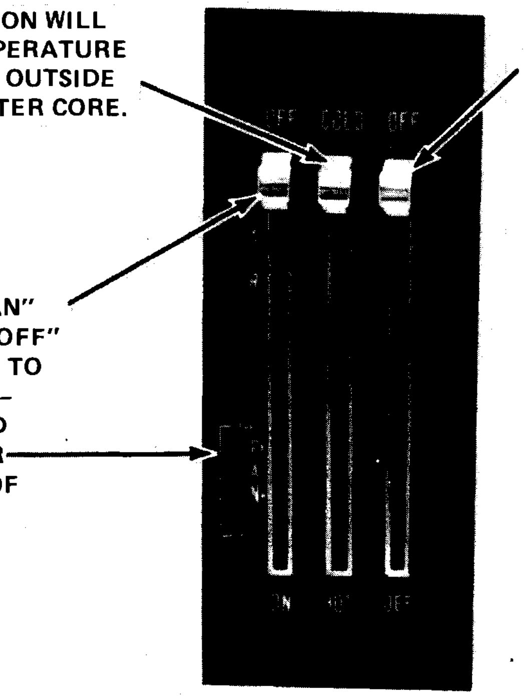
THIS POSITION ALLOWS ABOUT 80% AIR FLOW TO FLOOR & 20% TO WINDSHIELD

THIS POSITION ALLOWS ABOUT 80% AIR FLOW TO WINDSHIELD & 20% TO FLOOR.

TEMPERATURE LEVER POSITION WILL REGULATE OUTLET AIR TEMPERATURE BY BLENDING THE INCOMING OUTSIDE AIR THRU/AROUND THE HEATER CORE.

FAN SWITCH HAS NO "OFF" POSITION—WILL RUN ON "LO" SPEED WHEN SYSTEM SELECTOR LEVER IS MOVED TO "OFF" AS LONG AS IGNITION IS IN "RUN" POSITION.

FIG. 1A-3 1977 F SERIES HEATER CONTROL



TEMPERATURE LEVER POSITION WILL REGULATE OUTLET AIR TEMPERATURE BY BLENDING THE INCOMING OUTSIDE AIR THRU/AROUND THE HEATER CORE.

POSITION OF THIS "DEFROST" LEVER DETERMINES AIR FLOW FROM FLOOR OR WINDSHIELD OUTLETS—IN "OFF," FLOW IS ABOUT 80% TO FLOOR & 20% TO WINDSHIELD. IN "DEF," FLOW IS REVERSED. ANY POSITION BETWEEN "OFF-DEF" DIVIDES % ACCORDINGLY.

MOVING THIS "AIR-FAN" LEVER DOWN FROM "OFF" ALLOWS OUTSIDE AIR TO ENTER HEATER CASE—FURTHER DOWNWARD MOVEMENT OF LEVER ALLOWS SELECTION OF FAN SPEEDS.

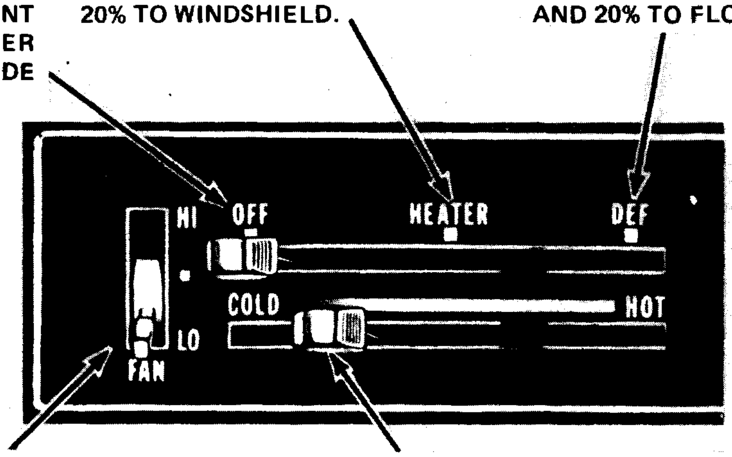
4242

FIG. 1A-4 1977 X SERIES HEATER CONTROL

POSITION OF THIS SYSTEM SELECTOR LEVER DETERMINES AIR FLOW FROM UNDER INSTRUMENT PANEL, FLOOR OR WINDSHIELD OUTLETS—THIS POSITION ALLOWS OUTSIDE AIR ENTRY UNDER THE INSTRUMENT PANEL THROUGH A HEATER BY-PASS OPENING AT RIGHT SIDE OF HEATER CASE.

THIS POSITION ALLOWS ABOUT 80% AIR FLOW TO FLOOR AND 20% TO WINDSHIELD.

THIS POSITION ALLOWS ABOUT 80% AIR FLOW TO WINDSHIELD AND 20% TO FLOOR.

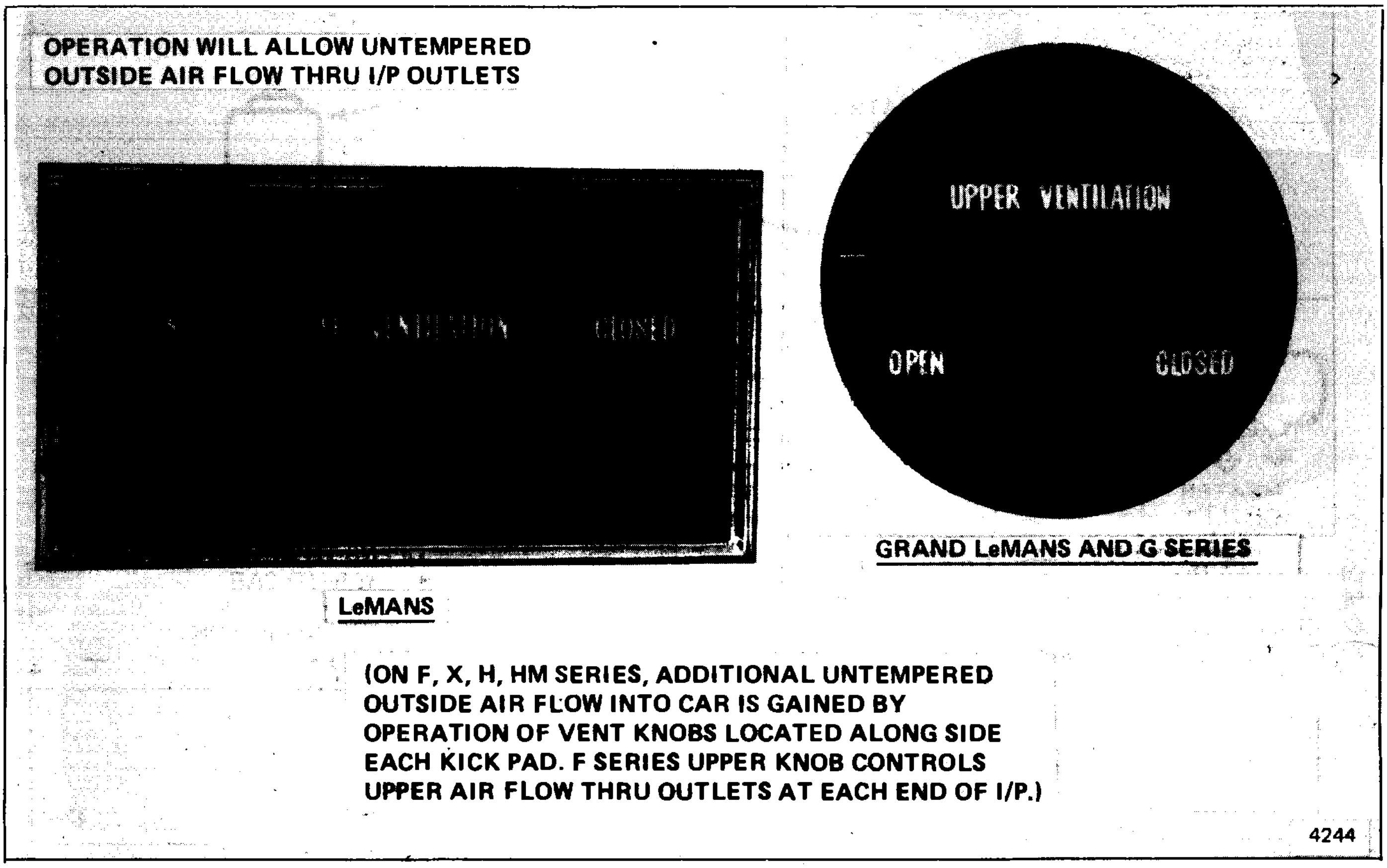


FAN SWITCH HAS NO "OFF" POSITION—WILL RUN ON "LO" SPEED WHEN SYSTEM SELECTOR LEVER IS MOVED TO "OFF" AS LONG AS IGNITION IS IN "ON" POSITION.

TEMPERATURE LEVER POSITION WILL REGULATE OUTLET AIR TEMPERATURE BY BLENDING THE INCOMING OUTSIDE AIR THROUGH/AROUND THE HEATER CORE.

4243

FIG. 1A-5 1977 ASTRE AND SUNBIRD HEATER CONTROL


OPERATION WILL ALLOW UNTEMPERED OUTSIDE AIR FLOW THRU I/P OUTLETS

(ON F, X, H, HM SERIES, ADDITIONAL UNTEMPERED OUTSIDE AIR FLOW INTO CAR IS GAINED BY OPERATION OF VENT KNOBS LOCATED ALONG SIDE EACH KICK PAD. F SERIES UPPER KNOB CONTROLS UPPER AIR FLOW THRU OUTLETS AT EACH END OF I/P.)

FIG. 1A-6 1977 VENTILATION CONTROLS

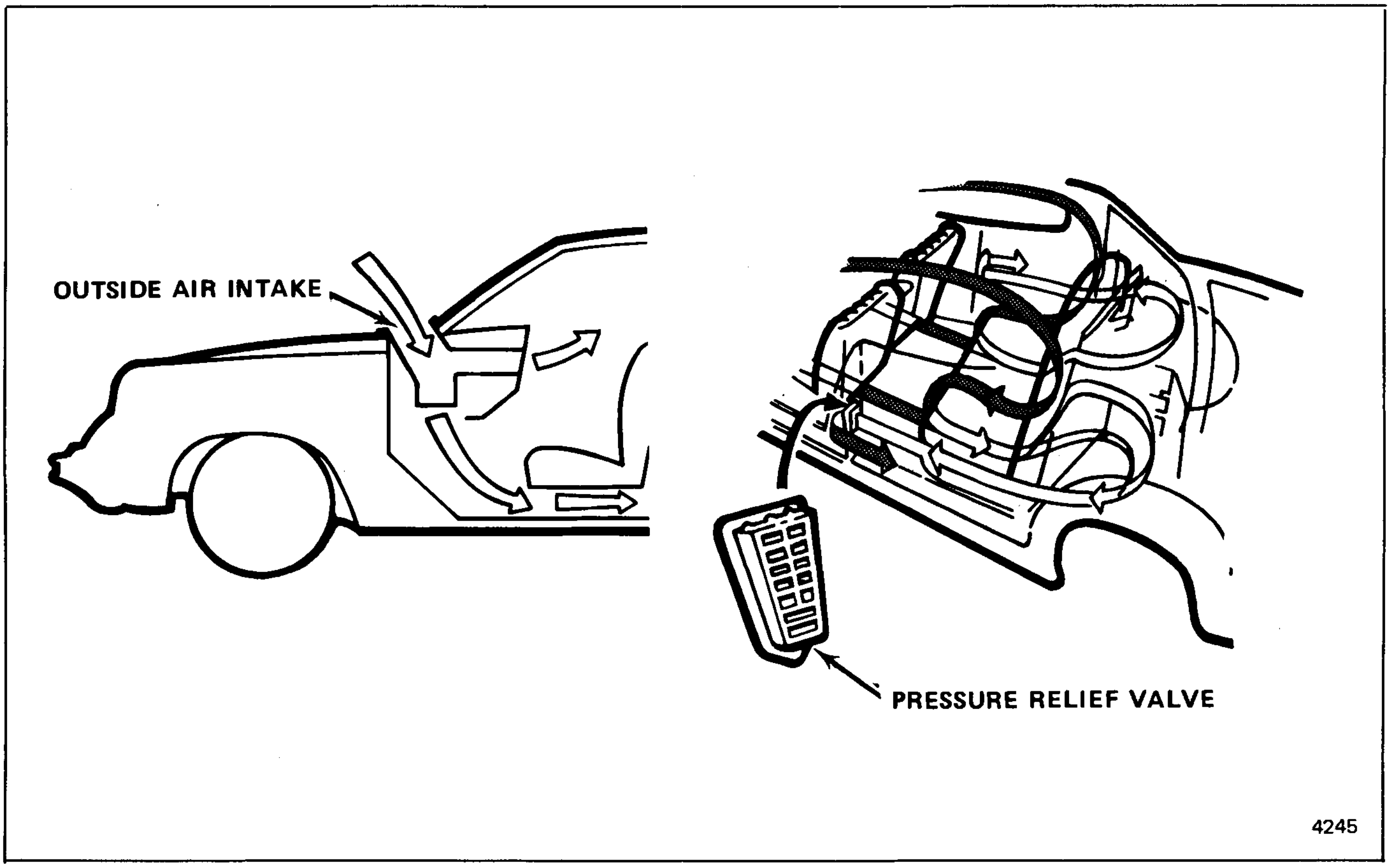


FIG. 1A-7 1977 TYPICAL INTERIOR BODY AIR FLOW & EXIT

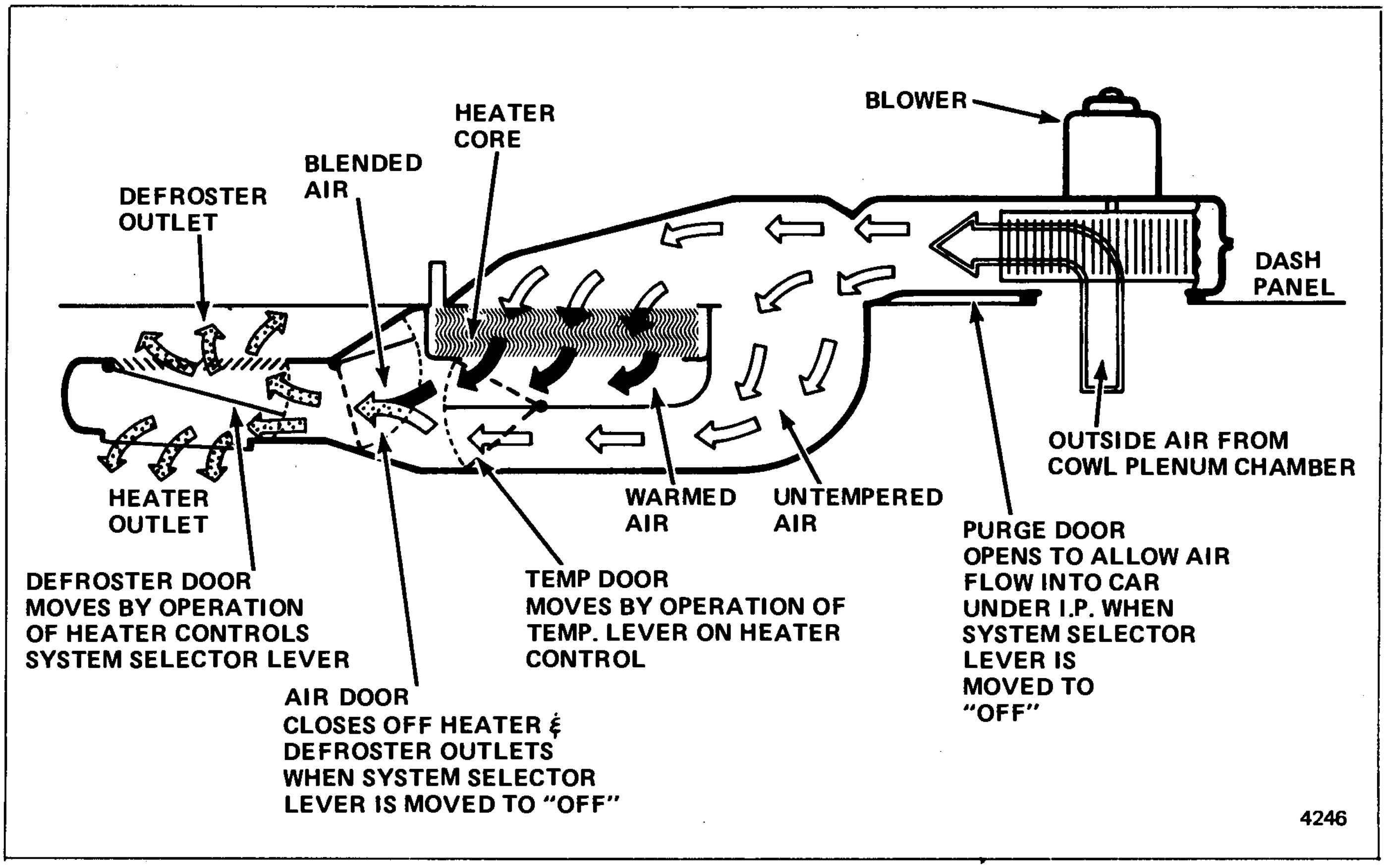


FIG. 1A-8 1977 TYPICAL HEATER AIR FLOW EXCEPT B & H SERIES

4. Slide the mode lever to the right to HEATER detent (note effort requirements above).

- A large quantity (as compared to Step 4) of hot air comes mainly from heater outlet with some air also from defroster nozzle.

5. Slide the mode lever to the extreme right to the DEFROST position (note effort requirements above).

- Hot air (130°F. or 54°C.) comes mainly from the defroster nozzle outlets with a small quantity of air from the heater outlet.

6. Move temperature lever to the maximum COLD position (extreme left end). Note effort requirements above.

- Air comes mainly from the defroster nozzle the same temperature as air outside the vehicle. Some air also comes from the heater outlet.

7. Move blower switch to "Med" detent and then LO.

- Blower speed and air flow decrease at each position.

8. Slide mode lever to the extreme left to the VENT position.

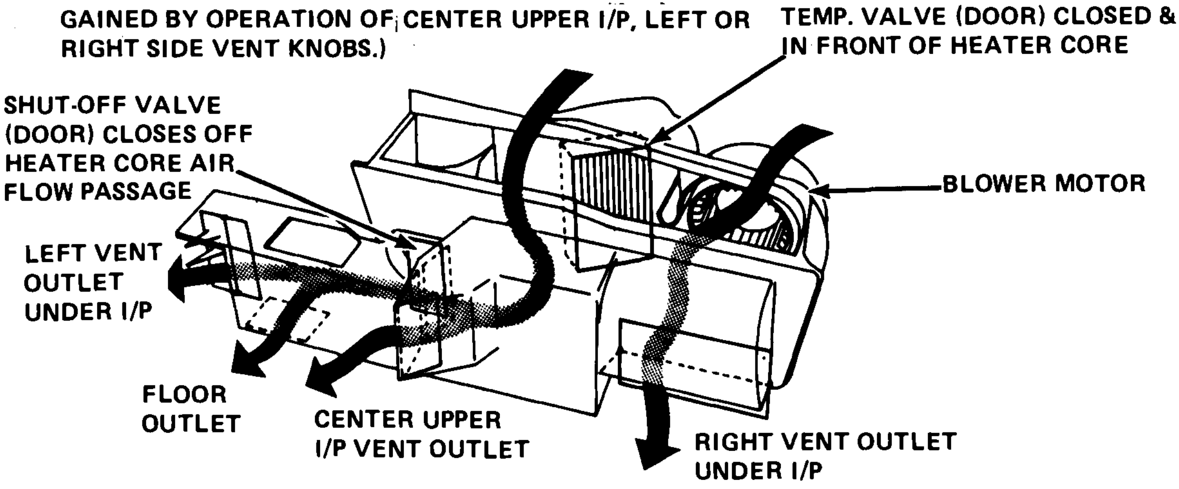
- Blower continues at LO speed with air coming mainly from heater outlet and some air from the defroster nozzle.

Should heater operate satisfactorily during above checks, it would appear that heater operation is normal. If during checks irregularities or complaints are noted, see DIAGNOSIS for cause and correction.

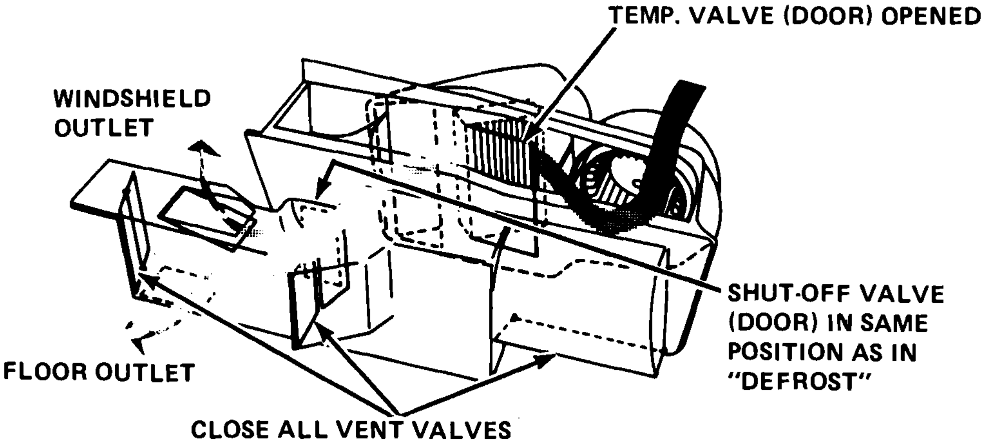
B SERIES

VENT MODE – UNTEMPERED AIR FLOW TO FLOOR OUTLET

(ADDITIONAL UNTEMPERED OUTSIDE AIR FLOW CAN BE GAINED BY OPERATION OF CENTER UPPER I/P, LEFT OR RIGHT SIDE VENT KNOBS.)



HEAT MODE – AIR FLOW TEMPERED BY HEATER CONTROL TEMP. LEVER



DEFROST MODE – AIR FLOW TEMPERED BY HEATER CONTROL TEMP. LEVER

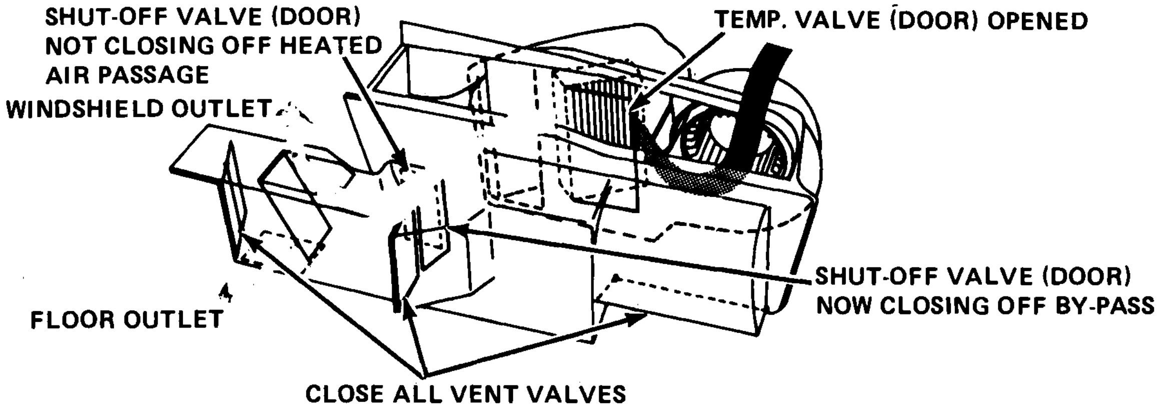
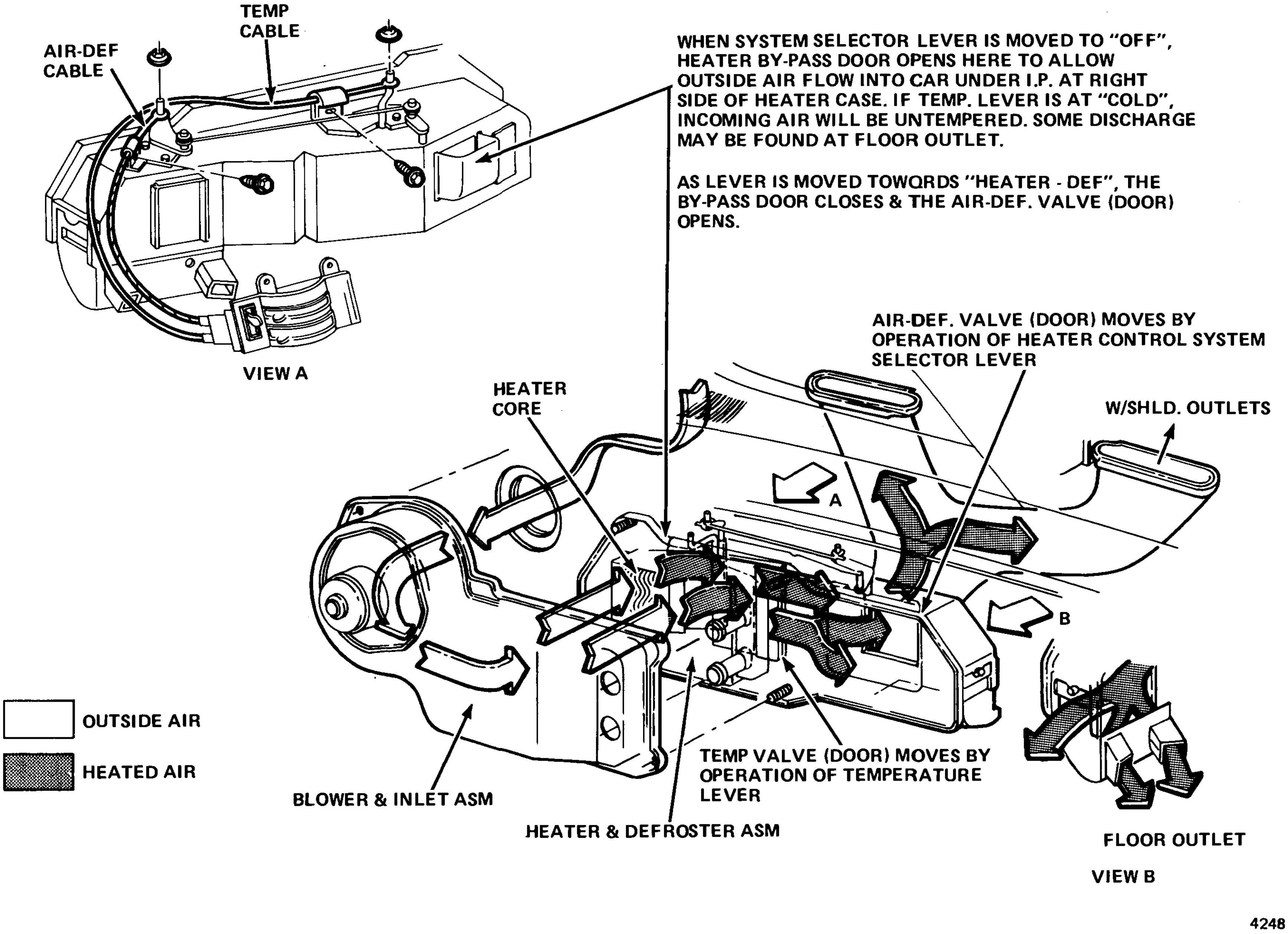


FIG. 1A-9 1977 B SERIES HEATER AIR FLOW



WHEN SYSTEM SELECTOR LEVER IS MOVED TO "OFF", HEATER BY-PASS DOOR OPENS HERE TO ALLOW OUTSIDE AIR FLOW INTO CAR UNDER I.P. AT RIGHT SIDE OF HEATER CASE. IF TEMP. LEVER IS AT "COLD", INCOMING AIR WILL BE UNTEMPERED. SOME DISCHARGE MAY BE FOUND AT FLOOR OUTLET.

AS LEVER IS MOVED TOWQRDS "HEATER - DEF", THE BY-PASS DOOR CLOSES & THE AIR-DEF. VALVE (DOOR) OPENS.

AIR-DEF. VALVE (DOOR) MOVES BY OPERATION OF HEATER CONTROL SYSTEM SELECTOR LEVER

TEMP VALVE (DOOR) MOVES BY OPERATION OF TEMPERATURE LEVER

FIG. 1A-10 1977 ASTRE AND SUNBIRD HEATER AIR FLOW

DIAGNOSIS

HEATER WIRING DIAGRAM

The heater wiring diagrams are part of Chassis Electrical Diagrams, located at rear of Section 8, and should be referred to for diagnosis of electrical problems in the heater system.

HEATER TROUBLE DIAGNOSIS

"INSUFFICIENT HEATING"

CAUSE	CORRECTION
Slow warming in car.	Incorrect operation of controls. Advise operator of proper operation of heater controls. Explain operation of vents and controls. Low coolant level. Check control cable and blower operation.
Objectionable engine or exhaust fumes in car.	Check for seal between engine compartment and plenum. Check for proper sealing between air inlet duct assembly and dash. Locate and seal any other air leaks.
Cold drafts on floor.	Check operation and adjustment of vent cables. Advise operator of proper operation of heater system Advise operator to use blower to force air to rear seat area. Check to be sure front floor mat is under floor mat retainer at dash.
Insufficient heat to rear seat.	Obstruction on floor, possibly wrinkled or torn insulator material between front seat and floor. Advise operator to use HI blower speed.
Low engine coolant level - drop in heater air temperature at all blower speeds.	Check radiator and cooling system for leaks, correct and fill to proper level. Run engine to clear any air lock.
Failure of engine cooling system to warm up.	Check engine thermostat; replace if required. Check coolant level.
Kinked heater hoses.	Remove kink or replace hose.
Foreign material obstructing water flow through heater core.	Remove foreign material if possible, otherwise replace core; can usually be heard as squishing noise at core.
Temperature door (valve) improperly adjusted. Air doors do not operate.	Adjust cable. Check installation and/or adjustment of air control or air-defrost cable.

"INADEQUATE REMOVAL OF FOG OR ICE"

CAUSE	CORRECTION
Air door does not open. Defroster door does not open fully.	Check cable operation.
Air door does not open.	Check installation and/or adjustment of air control or air-defrost cable.
Temperature door does not open.	Check and adjust temperature control cable if necessary.
Obstructions in defroster outlets at windshield.	Remove obstruction. Look for and fix loose instrument panel pad cover at defroster outlet.
Dinged defroster outlets.	Reshape outlet flange with fliers. The outlet should have a uniform opening.
Blower motor not connected.	Connect wire. Check ground.
Inoperative blower motor (A, B, F, G & H Series blower motor operates whenever ignition switch is ON or in RUN).	Check heater fuse and wiring. Replace motor is necessary.
Inoperative blower motor switch.	Check connectors, switch and wiring. Replace switch if necessary.

TOO WARM IN CAR

CAUSE	CORRECTION
Temperature door improperly adjusted.	Adjust temperature cable.
Incorrect operation of controls.	Advise operator of proper operation of heater system.

BLOWER INOPERATIVE

CAUSE	CORRECTION
Blown fuse.	Replace fuse.
Inoperative motor.	Replace motor.
Open circuit.	Repair circuit between ignition switch, blower switch and blower motor.
Inoperative blower motor switch.	Replace faulty siwtch.
Shorted or open blower resistor.	Check blower motor resistor.

MISCELLANEOUS

CAUSE	CORRECTION
Blown fuses caused by short in electrical system.	Locate and correct short.
Front floor mat wet under heater caused by improperly sealed windshield or leaking heater core.	Reseal windshield, or lead-in from radio antenna. Repair (if possible) or replace heater core. Check for proper seal to dash and for leak at hose connection on heater core. Hose leaking into the heater case is often misdiagnosed as leaking core.
Heater "gurgle" or whine.	Check engine coolant level in radiator. Check for obstruction in core and/or hoses.

ON-CAR SERVICE PROCEDURES

AVAILABLE HEATER CONTROL CABLE ADJUSTMENTS

A & G SERIES AIR CONTROL CABLE

1. Place air control lever in OFF position.

2. Hold air door crank on heater case in "closed" position.

2. Hold air door crank on heater case in "closed" position. (crank rotated full counter-clockwise when viewed from above.)

3. While holding air control door in closed position, adjust turnbuckle to move lever against end of slot in control panel. Then turn turnbuckle in opposite direction to move control lever 1/16" to 1/8" away from end of slot if eased out of detent.

4. Move lever to DEFROST position. Then back to OFF.

5. Lever must have slight spring-back. If not quite engaged in detent, must remain in detent when lever is moved full travel.

A & G SERIES TEMPERATURE CABLE

1. Place temp lever at full COLD position (full left).

2. Rotate temp door crank to full COLD position (crank rotated full clockwise as viewed from above).

3. Adjust turnbuckle until cable loop lines up with pin on crank.

4. Move lever to full HOT. If door is not heard hitting its seat, repeat the adjustment procedure.

B SERIES SHUT-OFF VALVE (PURGE DOOR) CABLE

- Rotate bell crank to pull valve (door) closed against module case.

- Adjust turnbuckle to enable ...

- Installation of cable end to bell crank post and snap-in flag.

F SERIES AIR CONTROL CABLE

1. Adjust mode cable by pulling to DEFROST position.

F SERIES TEMPERATURE CABLE

1. Adjust temperature cable by moving to MAX hot.

BOWDEN CABLE REPAIR

Repair cable or construct new cable of equal length using parts from bowden cable service repair kit. Use cable housing from original cable if possible. In most instances, only the wire portion of the cable will require replacement.

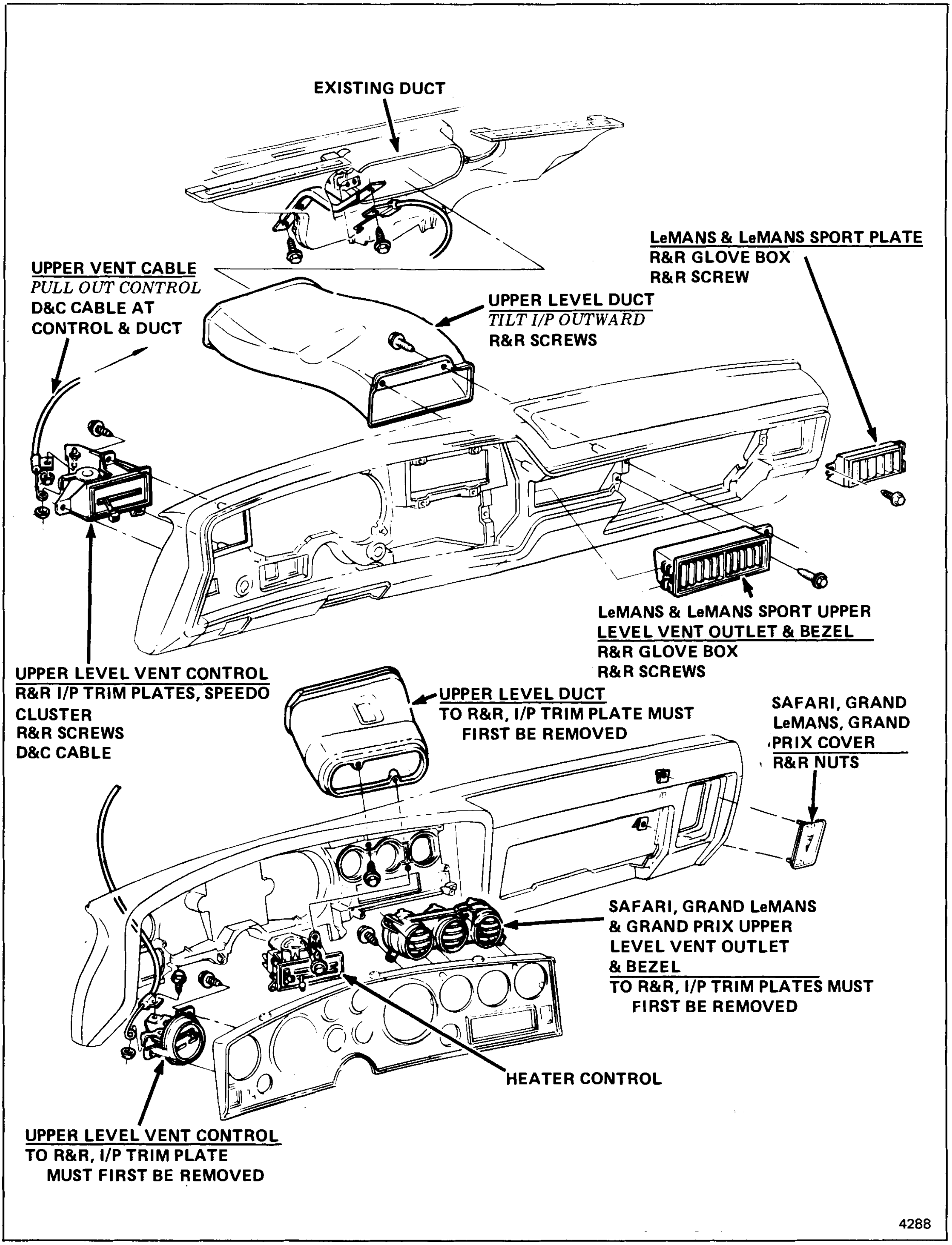
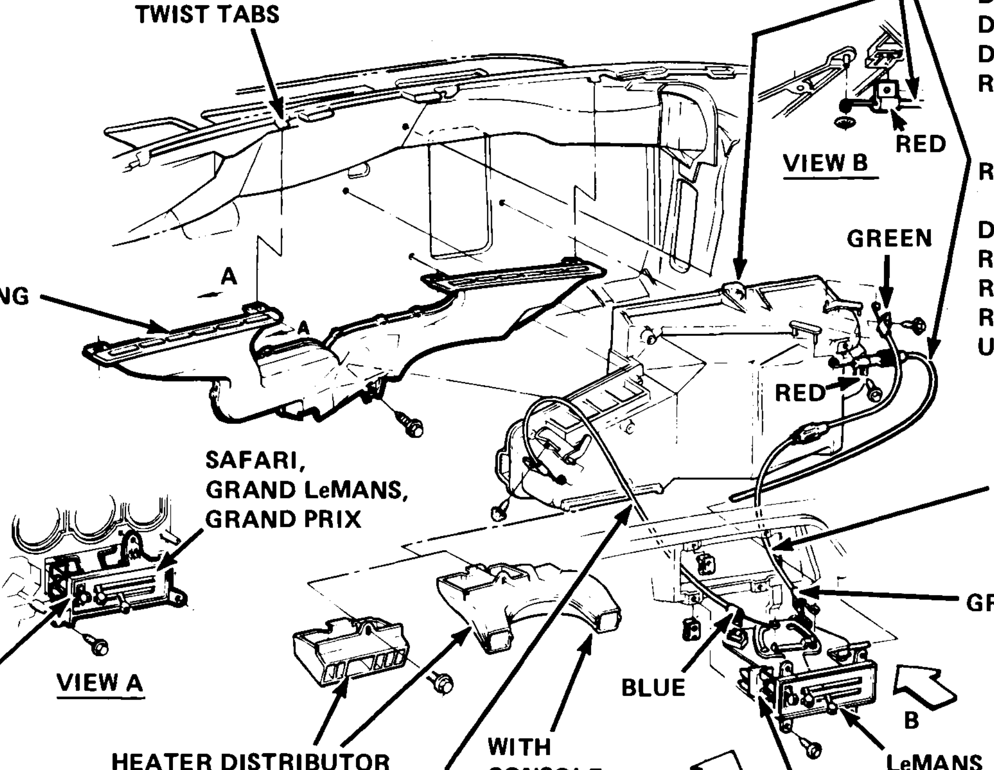


Fig. 1A-11 1977 A and G Series Heater Service Procedures (No. 1 of 4)



CABLE REMOVALS
PULL OUT HEATER CONTROL
D&C CABLES
NOTE: REPAIR CABLE OR CONSTRUCT NEW CABLE OF EQUAL LENGTH USING PARTS FROM BOWDEN CABLE REPAIR KIT. USE CABLE HOUSING FROM ORIGINAL CABLE IF POSSIBLE. IN MOST INSTANCES, ONLY THE WIRE PORTION OF THE CABLE WILL REQUIRE REPLACEMENT.

TEMP. CABLE
D&C BATTERY
R&R UPPER & LOWER I/P TRIM PLATES
R&R GLOVE BOX
D&C CABLE AT HEATER CASE
R&R HEATER CONTROL SCREWS & PULL CONTROL OUT
D&C ELECT. CONN. & CABLE REPAIR

HEATER CASE & CORE–DOORS
D&C BATTERY
DRAIN RADIATOR
D&C HEATER HOSES
R&R SCREWS & NUTS AT ENGINE SIDE & PASS. SIDE
R&R GLOVE BOX & DEFROSTER SCREW
D&C CABLES
R&R CASE & CORE SEALS
R&R CASE & CORE
R&R INTERNAL DOORS
USE NEW STRIP-CAULK SEALING MATERIAL

DEFROSTER DUCT
TILT I/P OUTWARD
STRAIGHTEN RETAINING TABS
R&R RET. SCREW

AIR CONTROL CABLE
SEE TEMP. CABLE R&R

HEATER CONTROL
D&C BATTERY
R&R ASH TRAY, I/P TRIM PLATES, RADIO KNOBS, GLOVE BOX
D&C CABLES AT HEATER CASE
R&R RETAINING SCREWS
D&C CABLES AND ELECT. CONN. AT CONTROL

HEATER DISTRIBUTOR
R&R SCREWS

DEFROST CABLE
SEE TEMP. CABLE R&R

BLOWER SWITCH
PULL CONTROL OUT
D&C ELECT. CONN.
R&R SCREWS

ITEMS TO BE ROUTED OVER UPPER LEVEL VENT DUCT ON AD, AF, EXC. SAFARI WAGON, MODELS ONLY

Fig. 1A-12 1977 A and G Series Heater Service Procedures (No. 2 of 4)

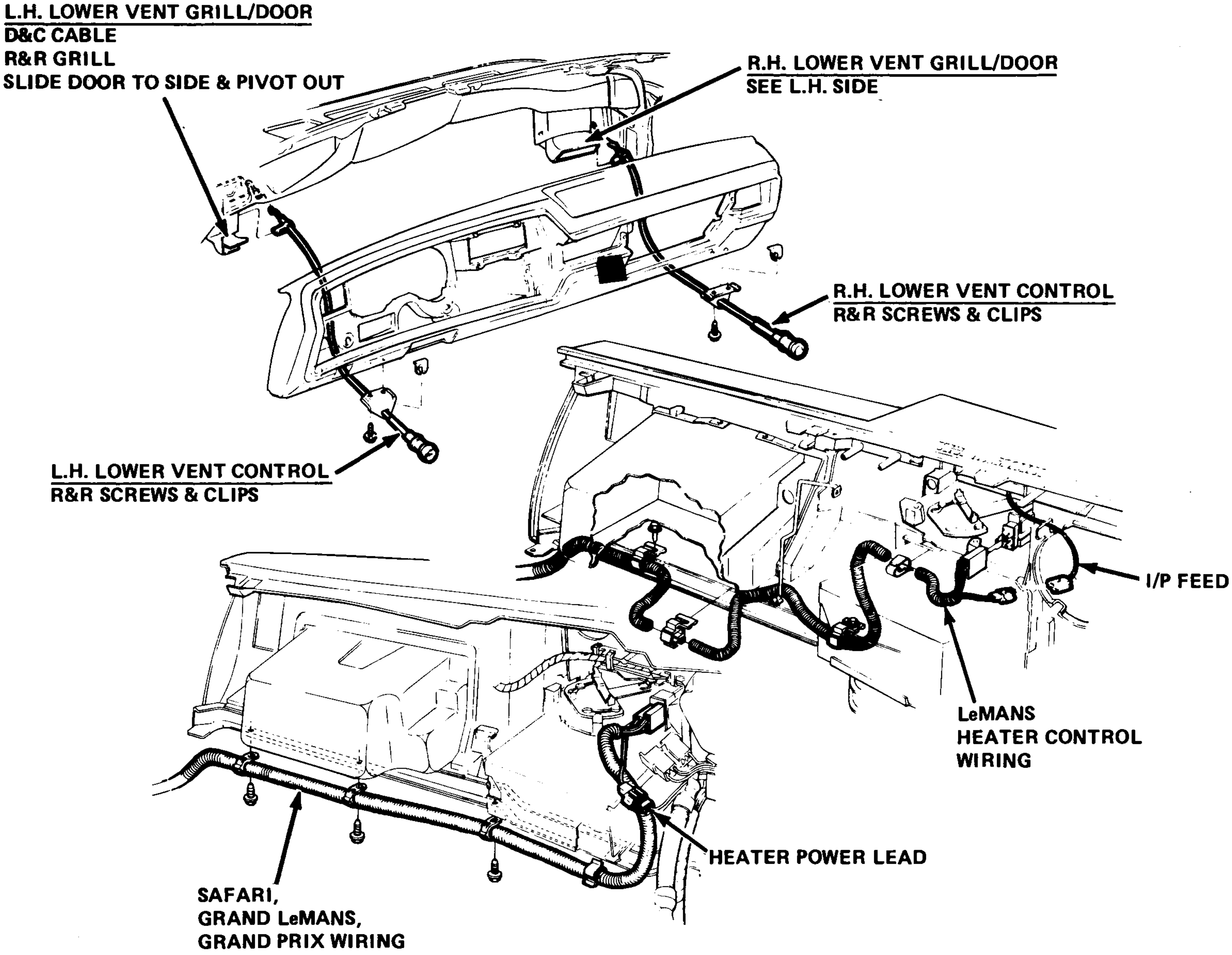
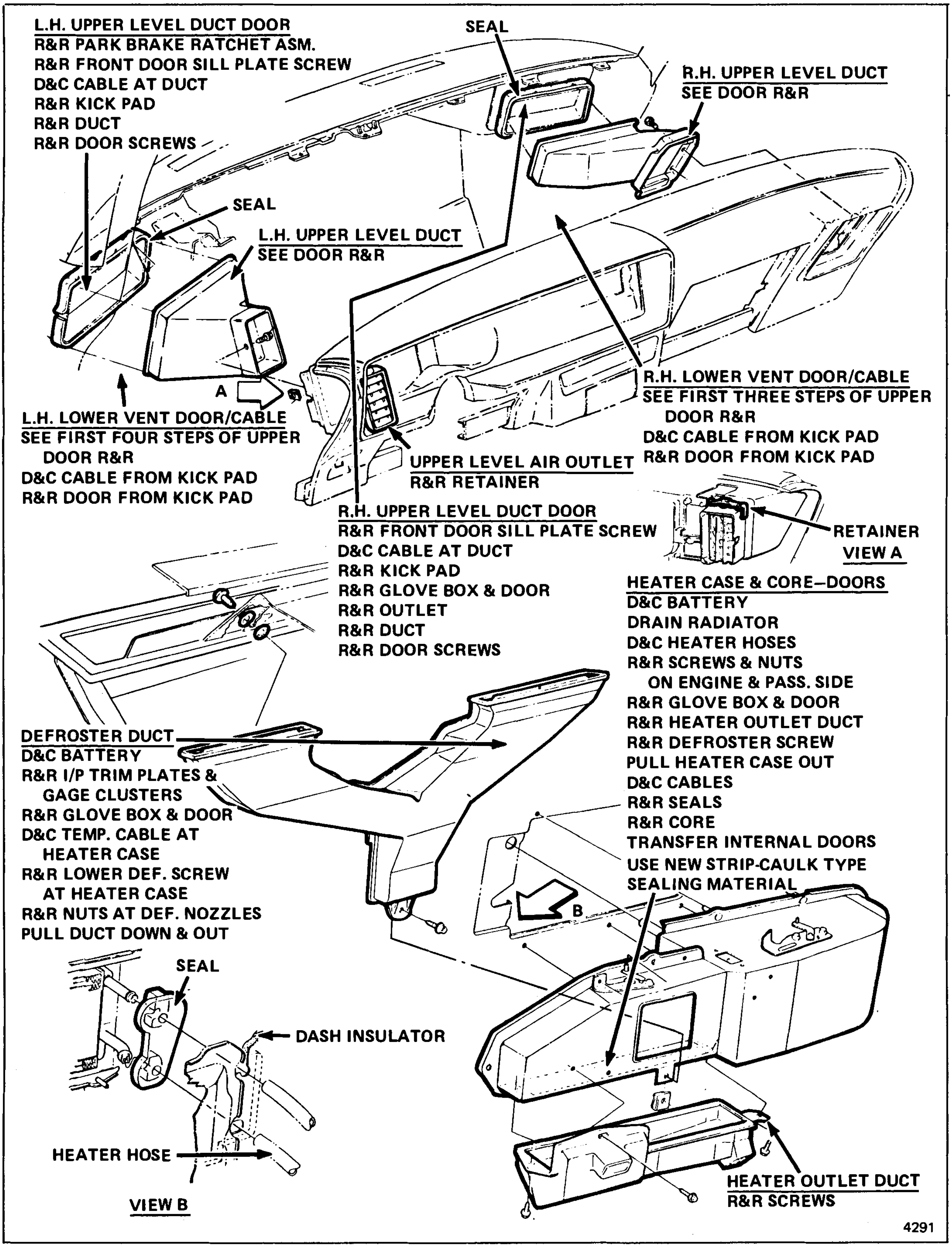


Fig. 1A-13 1977 A and G Series Heater Service Procedures (No. 3 of 4)



L.H. UPPER LEVEL DUCT DOOR
R&R PARK BRAKE RATCHET ASM.
R&R FRONT DOOR SILL PLATE SCREW
D&C CABLE AT DUCT
R&R KICK PAD
R&R DUCT
R&R DOOR SCREWS

R.H. UPPER LEVEL DUCT
SEE DOOR R&R

L.H. UPPER LEVEL DUCT
SEE DOOR R&R

L.H. LOWER VENT DOOR/CABLE
SEE FIRST FOUR STEPS OF UPPER DOOR R&R
D&C CABLE FROM KICK PAD
R&R DOOR FROM KICK PAD

R.H. LOWER VENT DOOR/CABLE
SEE FIRST THREE STEPS OF UPPER DOOR R&R
D&C CABLE FROM KICK PAD
R&R DOOR FROM KICK PAD

UPPER LEVEL AIR OUTLET
R&R RETAINER

R.H. UPPER LEVEL DUCT DOOR
R&R FRONT DOOR SILL PLATE SCREW
D&C CABLE AT DUCT
R&R KICK PAD
R&R GLOVE BOX & DOOR
R&R OUTLET
R&R DUCT
R&R DOOR SCREWS

VIEW A

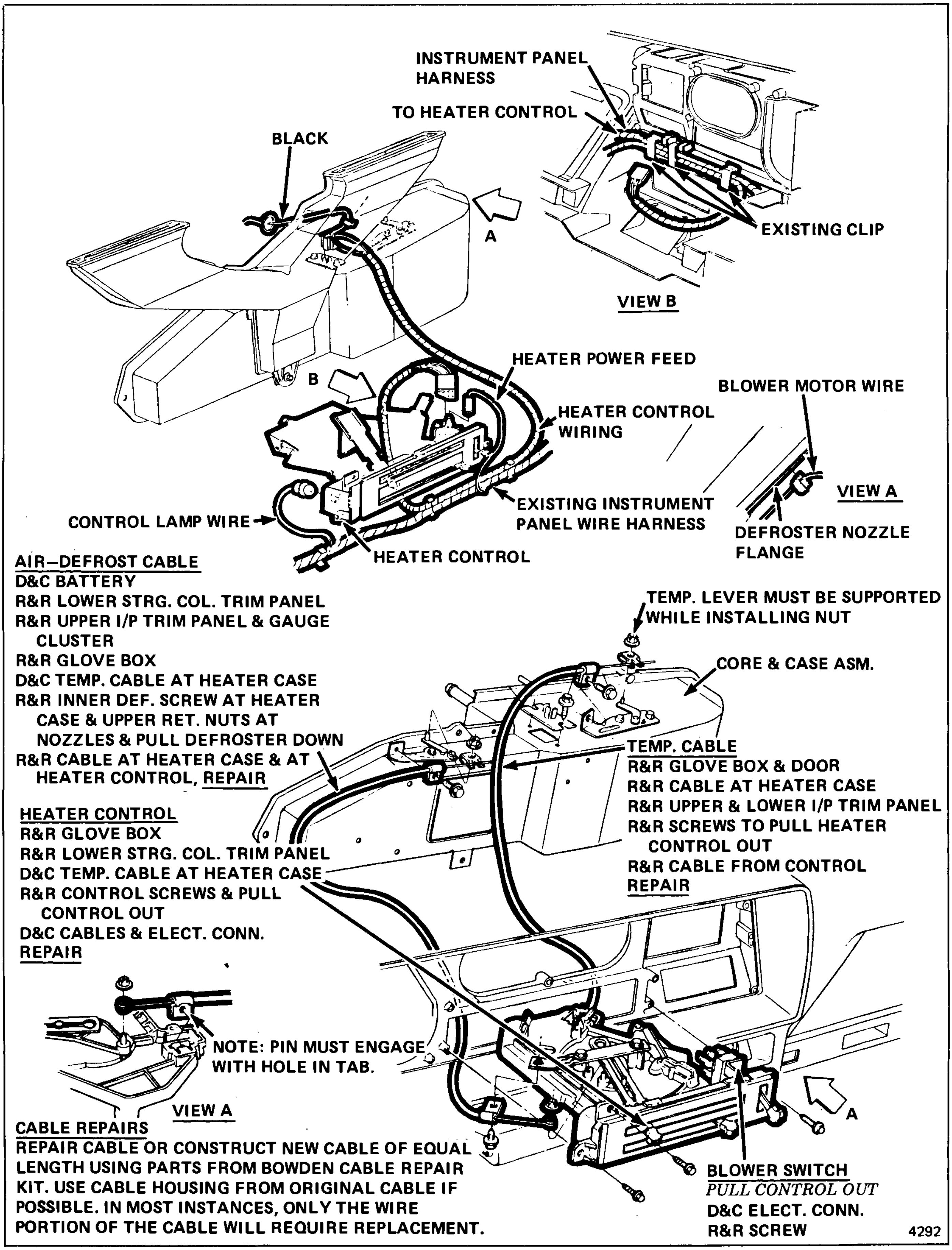
HEATER CASE & CORE–DOORS
D&C BATTERY
DRAIN RADIATOR
D&C HEATER HOSES
R&R SCREWS & NUTS ON ENGINE & PASS. SIDE
R&R GLOVE BOX & DOOR
R&R HEATER OUTLET DUCT
R&R DEFROSTER SCREW
PULL HEATER CASE OUT
D&C CABLES
R&R SEALS
R&R CORE
TRANSFER INTERNAL DOORS
USE NEW STRIP-CAULK TYPE SEALING MATERIAL

DEFROSTER DUCT
D&C BATTERY
R&R I/P TRIM PLATES & GAGE CLUSTERS
R&R GLOVE BOX & DOOR
D&C TEMP. CABLE AT HEATER CASE
R&R LOWER DEF. SCREW AT HEATER CASE
R&R NUTS AT DEF. NOZZLES
PULL DUCT DOWN & OUT

HEATER OUTLET DUCT
R&R SCREWS

VIEW B

Fig. 1A-15 1977 F Series Heater Service Procedures (No. 1 of 3)



AIR–DEFROST CABLE
D&C BATTERY
R&R LOWER STRG. COL. TRIM PANEL
R&R UPPER I/P TRIM PANEL & GAUGE CLUSTER
R&R GLOVE BOX
D&C TEMP. CABLE AT HEATER CASE
R&R INNER DEF. SCREW AT HEATER CASE & UPPER RET. NUTS AT NOZZLES & PULL DEFROSTER DOWN
R&R CABLE AT HEATER CASE & AT HEATER CONTROL, REPAIR

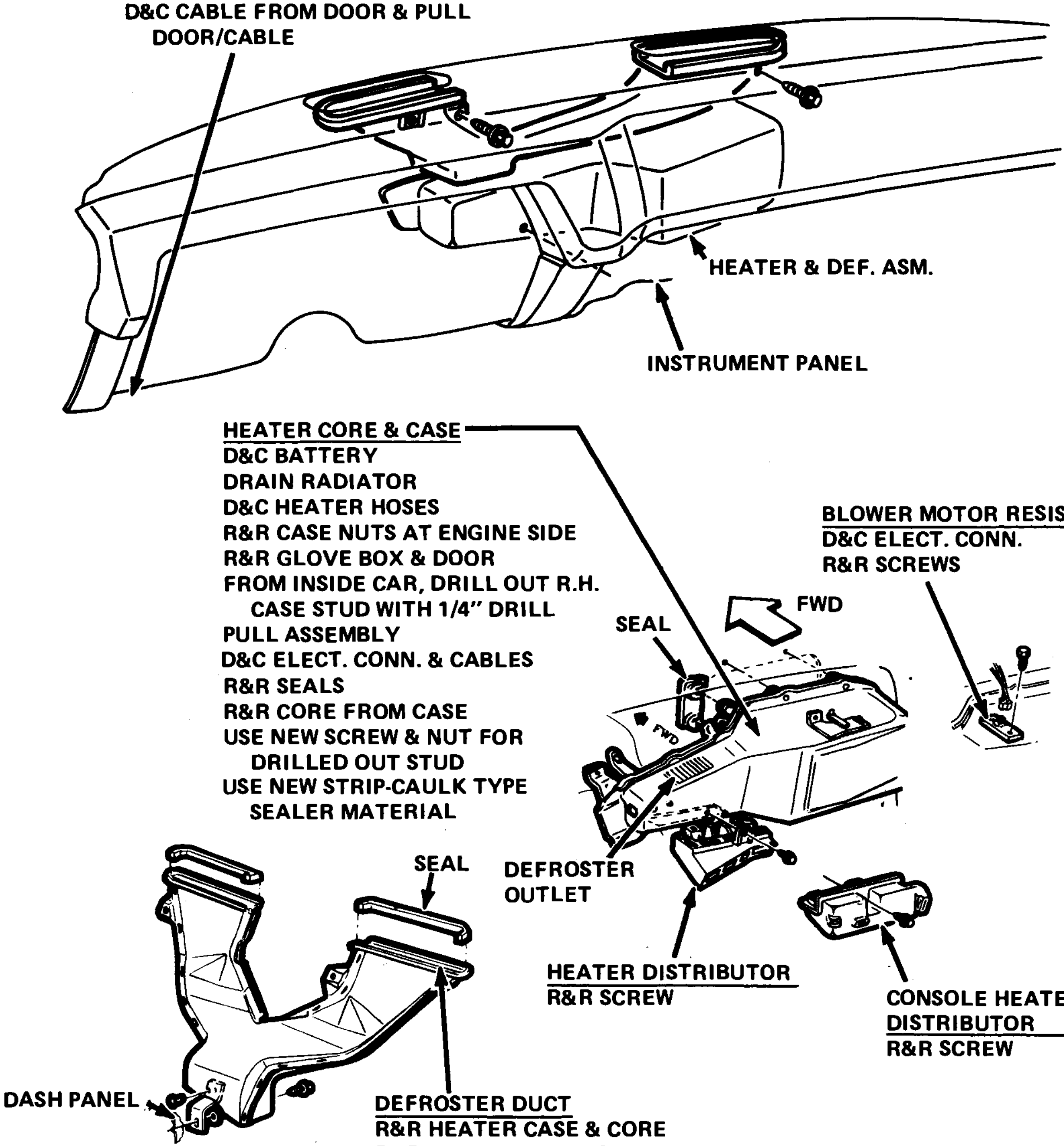
TEMP. CABLE
R&R GLOVE BOX & DOOR
R&R CABLE AT HEATER CASE
R&R UPPER & LOWER I/P TRIM PANEL
R&R SCREWS TO PULL HEATER CONTROL OUT
R&R CABLE FROM CONTROL
REPAIR

HEATER CONTROL
R&R GLOVE BOX
R&R LOWER STRG. COL. TRIM PANEL
D&C TEMP. CABLE AT HEATER CASE
R&R CONTROL SCREWS & PULL CONTROL OUT
D&C CABLES & ELECT. CONN.
REPAIR

CABLE REPAIRS
REPAIR CABLE OR CONSTRUCT NEW CABLE OF EQUAL LENGTH USING PARTS FROM BOWDEN CABLE REPAIR KIT. USE CABLE HOUSING FROM ORIGINAL CABLE IF POSSIBLE. IN MOST INSTANCES, ONLY THE WIRE PORTION OF THE CABLE WILL REQUIRE REPLACEMENT.

BLOWER SWITCH
PULL CONTROL OUT
D&C ELECT. CONN.
R&R SCREW

Fig. 1A-16 1977 F Series Heater Service Procedures (No. 2 of 3)



LOWER VENT DOOR/CABLE
AT L.H. SIDE, R&R PARK BRAKE
RATCHET
R&R FRONT SILL PLATE SCREW
R&R KICK PAD
D&C CABLE FROM DOOR & PULL
DOOR/CABLE

HEATER CORE & CASE
D&C BATTERY
DRAIN RADIATOR
D&C HEATER HOSES
R&R CASE NUTS AT ENGINE SIDE
R&R GLOVE BOX & DOOR
FROM INSIDE CAR, DRILL OUT R.H.
CASE STUD WITH 1/4" DRILL
PULL ASSEMBLY
D&C ELECT. CONN. & CABLES
R&R SEALS
R&R CORE FROM CASE
USE NEW SCREW & NUT FOR
DRILLED OUT STUD
USE NEW STRIP-CAULK TYPE
SEALER MATERIAL

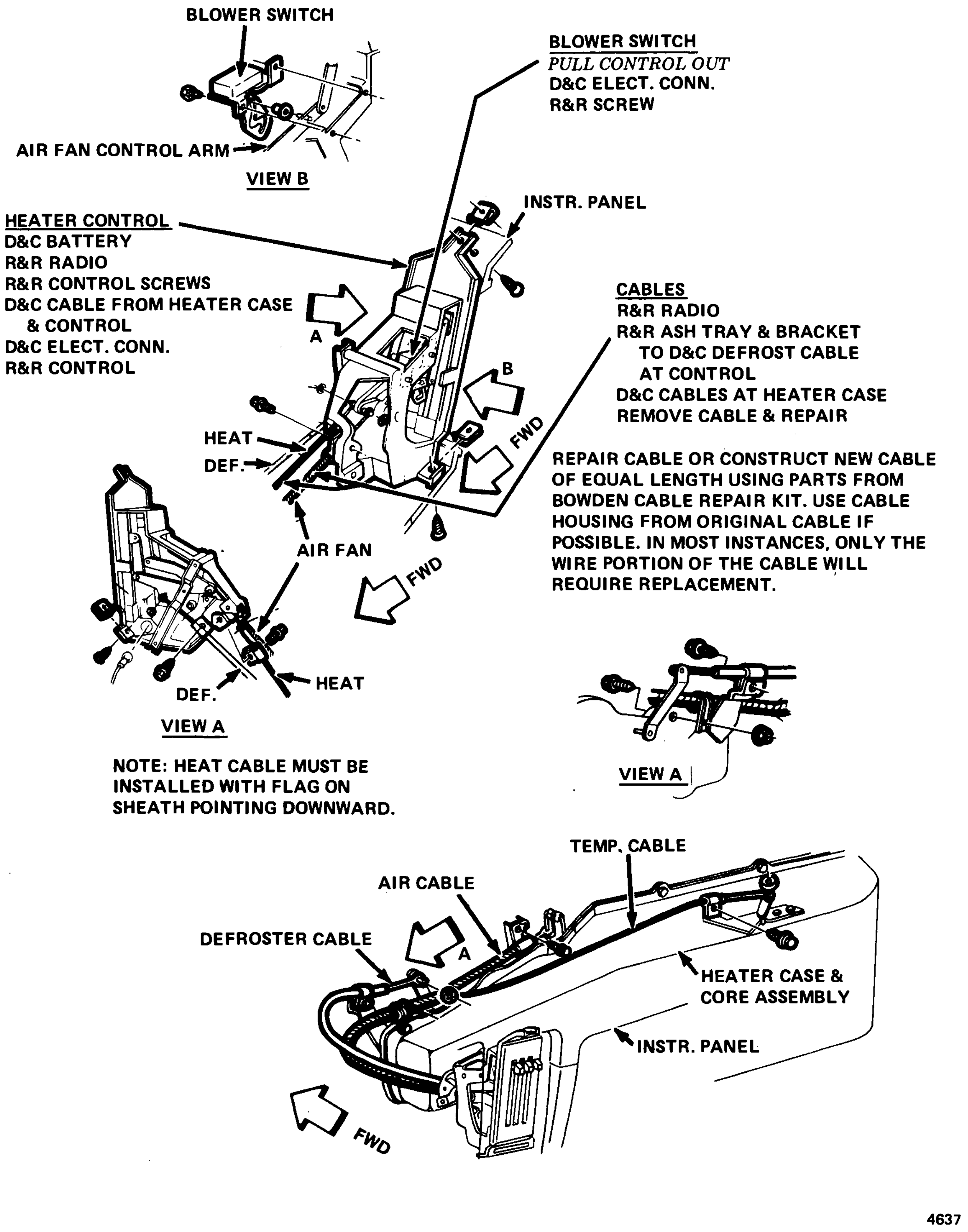
BLOWER MOTOR RESISTOR
D&C ELECT. CONN.
R&R SCREWS

HEATER DISTRIBUTOR
R&R SCREW

CONSOLE HEATER DISTRIBUTOR
R&R SCREW

DEFROSTER DUCT
R&R HEATER CASE & CORE
R&R UPPER NOZZLE SCREWS
& LOWER SCREW AT
DASH PANEL

Fig. 1A-18 1977 X Series Heater Service Procedures (No. 1 of 3)



BLOWER SWITCH
PULL CONTROL OUT
D&C ELECT. CONN.
R&R SCREW

HEATER CONTROL
D&C BATTERY
R&R RADIO
R&R CONTROL SCREWS
D&C CABLE FROM HEATER CASE & CONTROL
D&C ELECT. CONN.
R&R CONTROL

CABLES
R&R RADIO
R&R ASH TRAY & BRACKET TO D&C DEFROST CABLE AT CONTROL
D&C CABLES AT HEATER CASE
REMOVE CABLE & REPAIR

REPAIR CABLE OR CONSTRUCT NEW CABLE OF EQUAL LENGTH USING PARTS FROM BOWDEN CABLE REPAIR KIT. USE CABLE HOUSING FROM ORIGINAL CABLE IF POSSIBLE. IN MOST INSTANCES, ONLY THE WIRE PORTION OF THE CABLE WILL REQUIRE REPLACEMENT.

NOTE: HEAT CABLE MUST BE INSTALLED WITH FLAG ON SHEATH POINTING DOWNWARD.

Fig. 1A-19 1977 X Series Heater Service Procedures (No. 2 of 3)

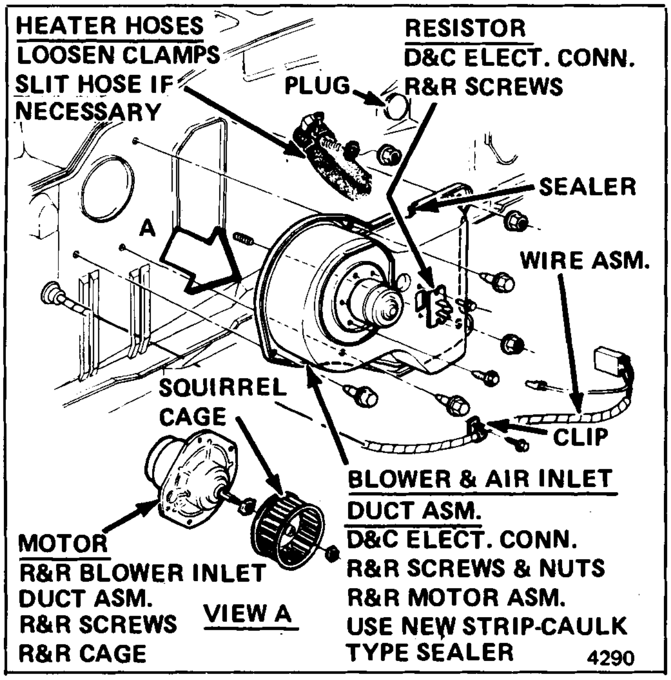


Fig. 1A-14 1977 A and G Series Heater Service Procedures (No. 4 of 4)

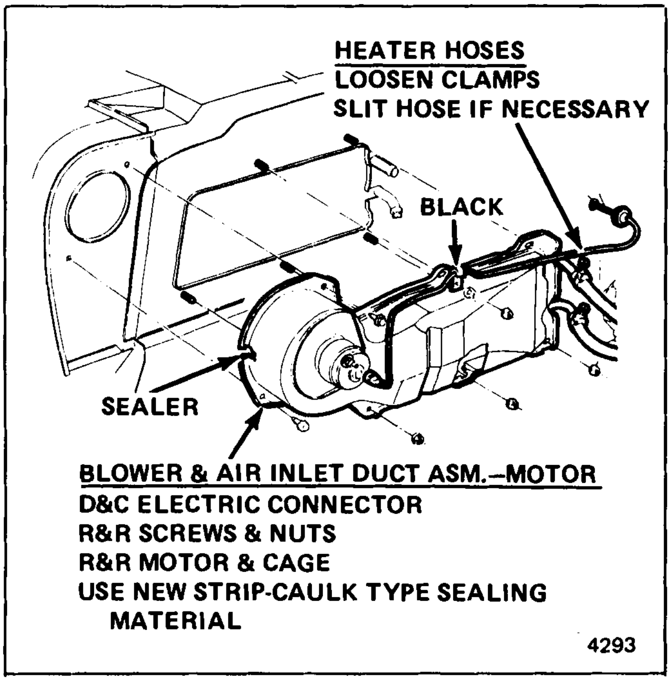


Fig. 1A-17 1977 F Series Heater Service Procedures (No. 3 of 3)

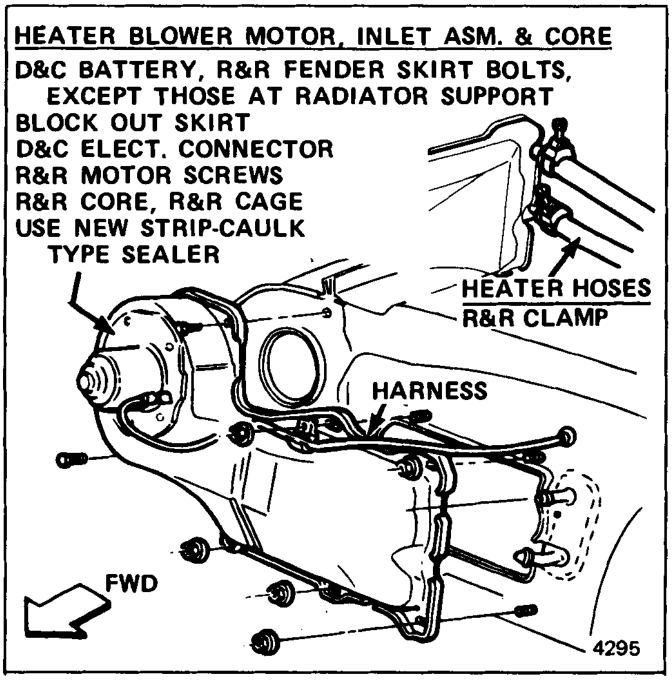
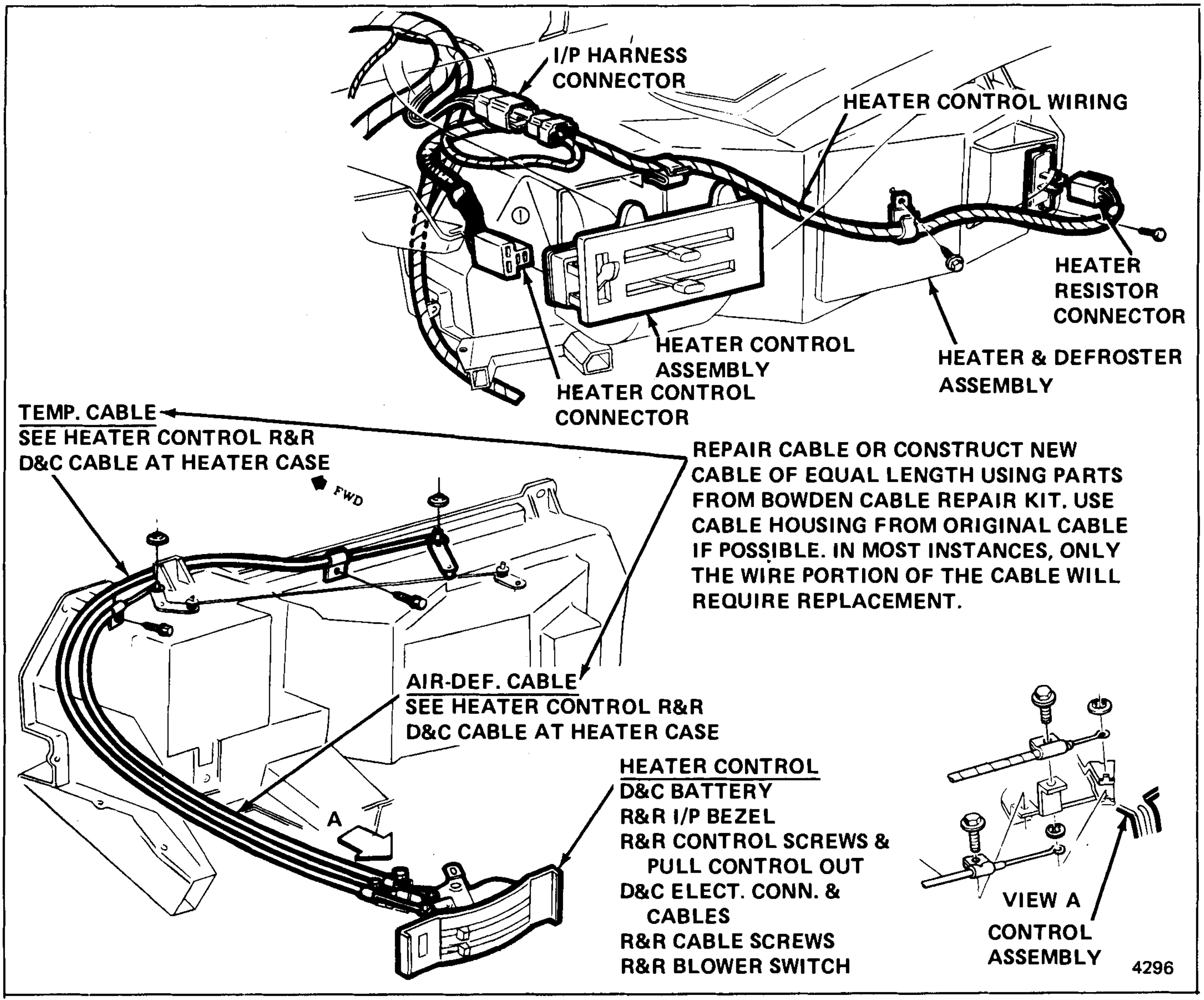


Fig. 1A-20 1977 X Series Heater Service Procedures (No. 3 of 3)



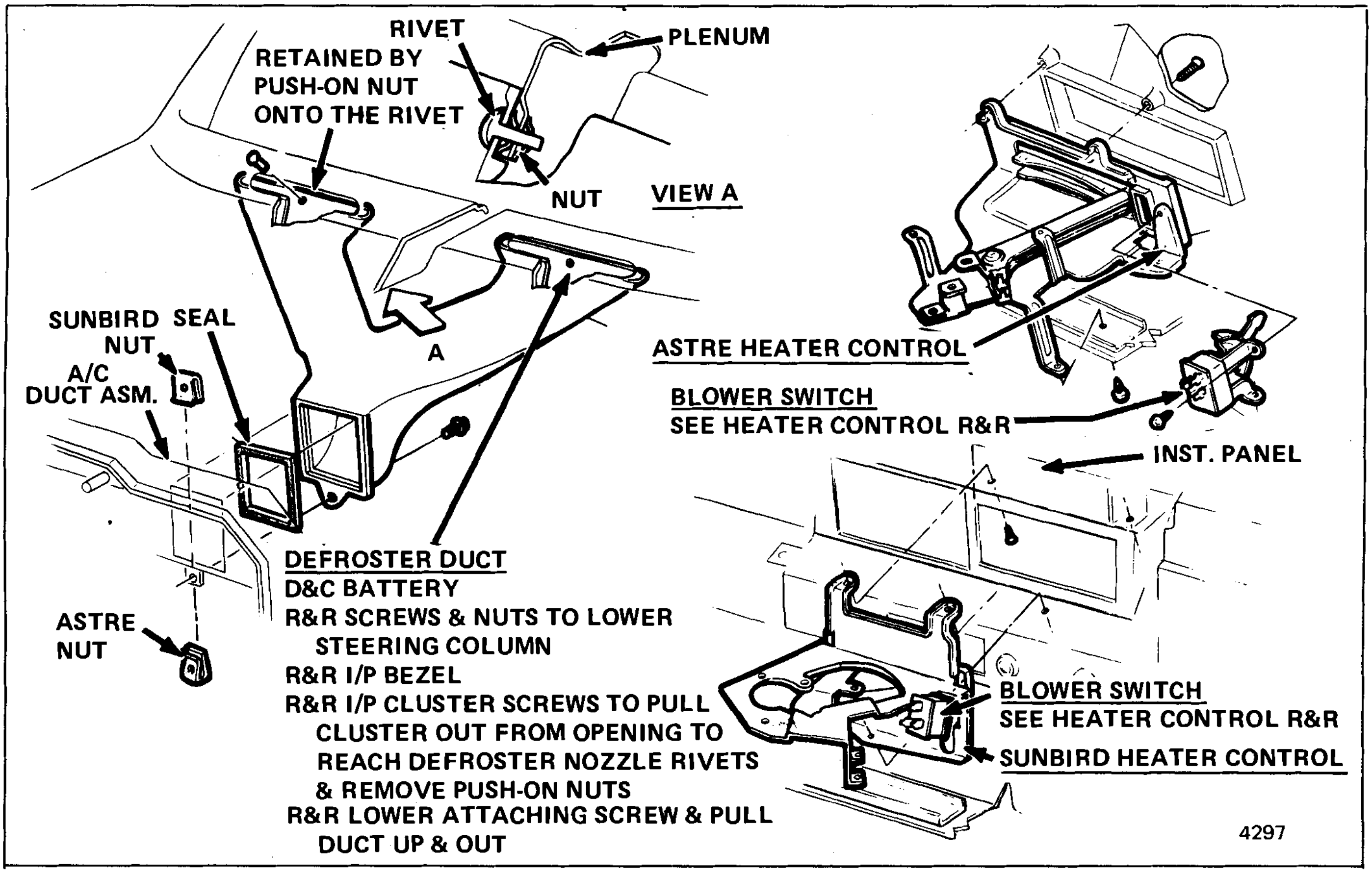
TEMP. CABLE
SEE HEATER CONTROL R&R
D&C CABLE AT HEATER CASE

REPAIR CABLE OR CONSTRUCT NEW CABLE OF EQUAL LENGTH USING PARTS FROM BOWDEN CABLE REPAIR KIT. USE CABLE HOUSING FROM ORIGINAL CABLE IF POSSIBLE. IN MOST INSTANCES, ONLY THE WIRE PORTION OF THE CABLE WILL REQUIRE REPLACEMENT.

AIR-DEF. CABLE
SEE HEATER CONTROL R&R
D&C CABLE AT HEATER CASE

HEATER CONTROL
D&C BATTERY
R&R I/P BEZEL
R&R CONTROL SCREWS & PULL CONTROL OUT
D&C ELECT. CONN. & CABLES
R&R CABLE SCREWS
R&R BLOWER SWITCH

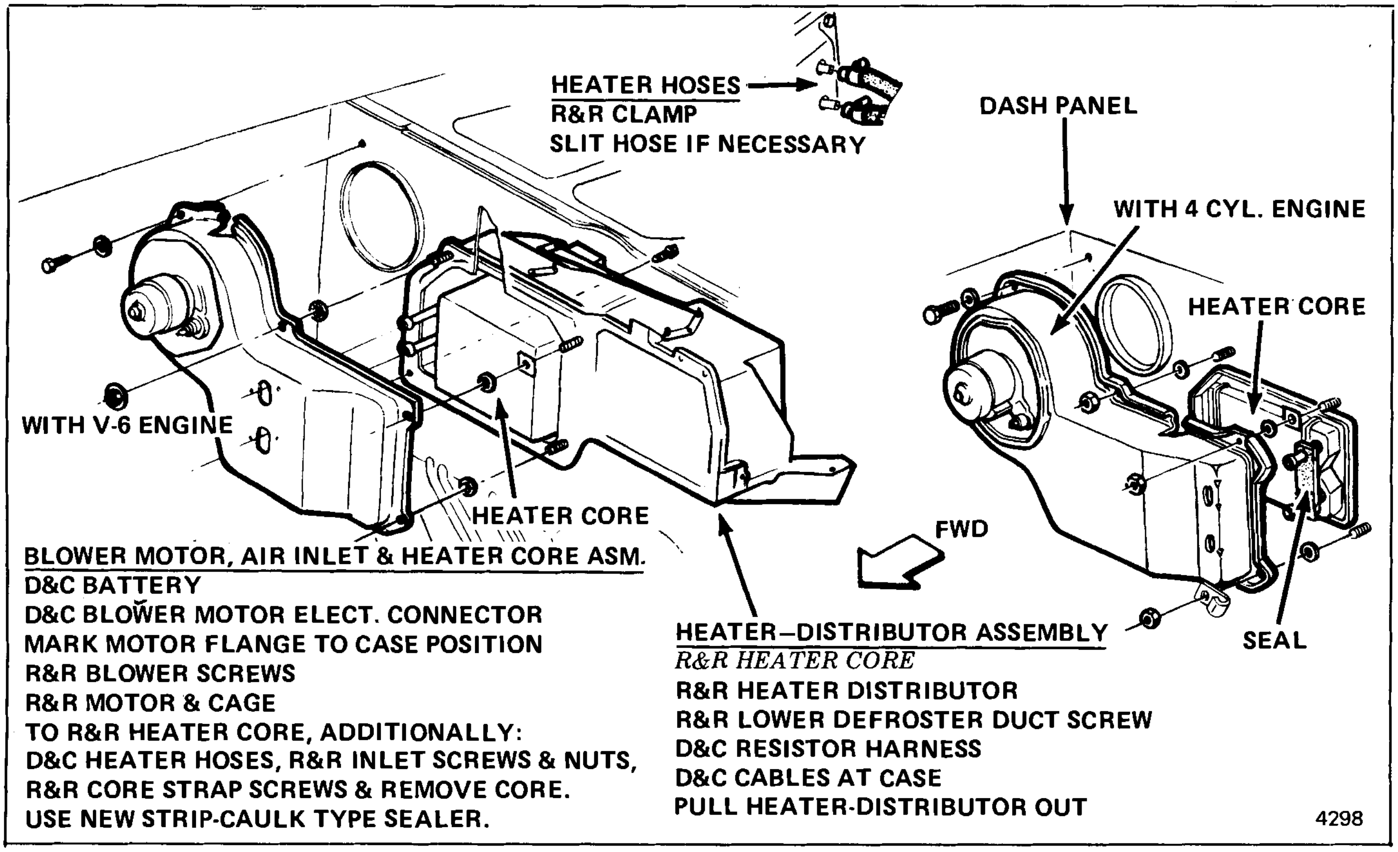
Fig. 1A-21 1977 Astre and Sunbird Heater Service Procedures (No. 1 of 3)



DEFROSTER DUCT

D&C BATTERY
R&R SCREWS & NUTS TO LOWER STEERING COLUMN
R&R I/P BEZEL
R&R I/P CLUSTER SCREWS TO PULL CLUSTER OUT FROM OPENING TO REACH DEFROSTER NOZZLE RIVETS & REMOVE PUSH-ON NUTS
R&R LOWER ATTACHING SCREW & PULL DUCT UP & OUT

Fig. 1A-22 1977 Astre and Sunbird Heater Service Procedures (No. 2 of 3)



HEATER HOSES

R&R CLAMP
SLIT HOSE IF NECESSARY

BLOWER MOTOR, AIR INLET & HEATER CORE ASM.

D&C BATTERY
D&C BLOWER MOTOR ELECT. CONNECTOR
MARK MOTOR FLANGE TO CASE POSITION
R&R BLOWER SCREWS
R&R MOTOR & CAGE
TO R&R HEATER CORE, ADDITIONALLY:
D&C HEATER HOSES, R&R INLET SCREWS & NUTS,
R&R CORE STRAP SCREWS & REMOVE CORE.
USE NEW STRIP-CAULK TYPE SEALER.

HEATER–DISTRIBUTOR ASSEMBLY

R&R HEATER CORE
R&R HEATER DISTRIBUTOR
R&R LOWER DEFROSTER DUCT SCREW
D&C RESISTOR HARNESS
D&C CABLES AT CASE
PULL HEATER-DISTRIBUTOR OUT

Fig. 1A-23 1977 Astre and Sunbird Heater Service Procedures (No. 3 of 3)

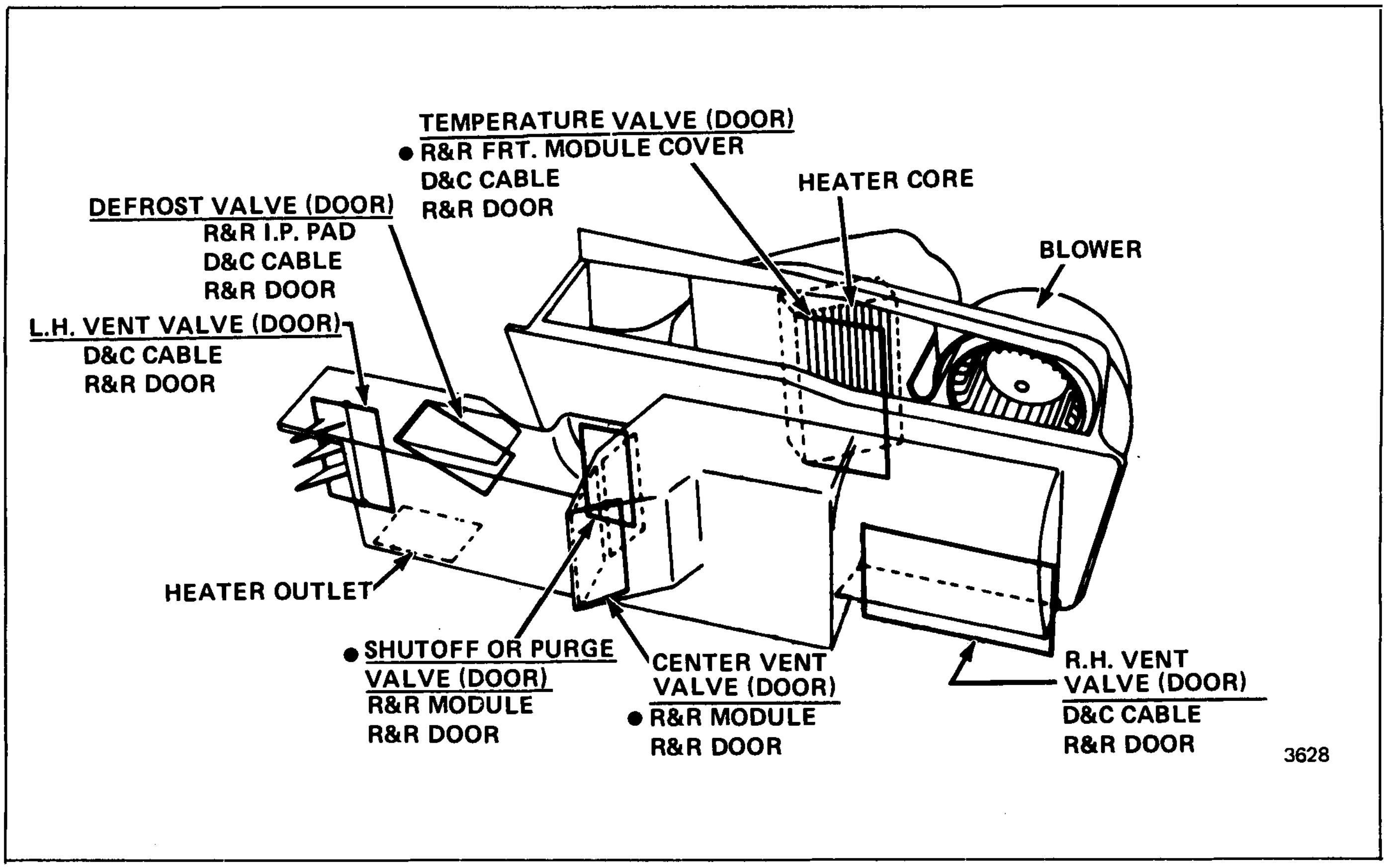
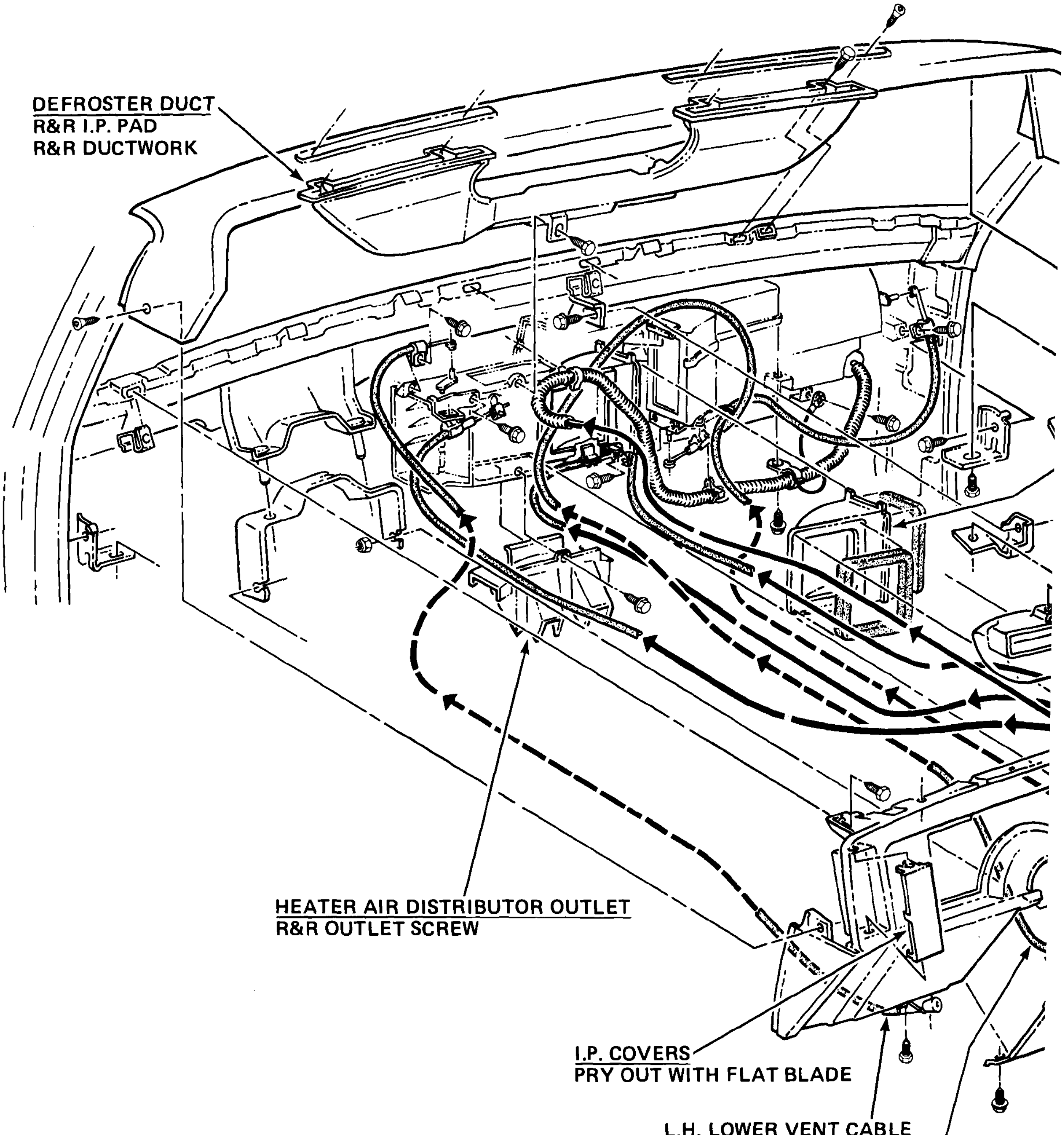


Fig. 1A-26 1977 B Series Heater Module



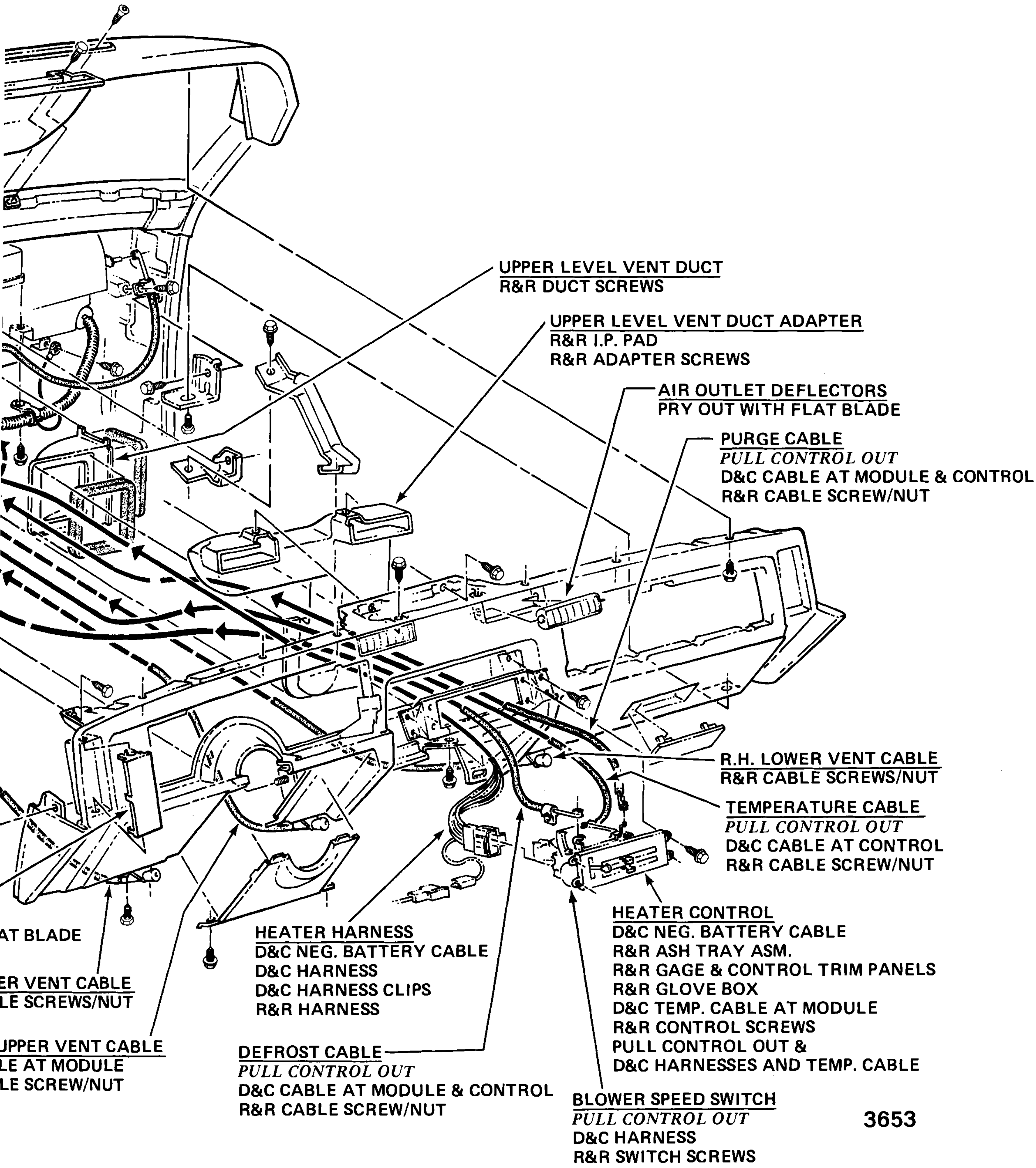
DEFROSTER DUCT
R&R I.P. PAD
R&R DUCTWORK

HEATER AIR DISTRIBUTOR OUTLET
R&R OUTLET SCREW

I.P. COVERS
PRY OUT WITH FLAT BLADE

L.H. LOWER VENT CABLE
R&R CABLE SCREWS/NUT

CENTER UPPER VENT CABLE
D&C CABLE AT MODULE
R&R CABLE SCREW/NUT



UPPER LEVEL VENT DUCT
R&R DUCT SCREWS

UPPER LEVEL VENT DUCT ADAPTER
R&R I.P. PAD
R&R ADAPTER SCREWS

AIR OUTLET DEFLECTORS
PRY OUT WITH FLAT BLADE

PURGE CABLE
PULL CONTROL OUT
D&C CABLE AT MODULE & CONTROL
R&R CABLE SCREW/NUT

R.H. LOWER VENT CABLE
R&R CABLE SCREWS/NUT

TEMPERATURE CABLE
PULL CONTROL OUT
D&C CABLE AT CONTROL
R&R CABLE SCREW/NUT

AT BLADE

HEATER HARNESS
D&C NEG. BATTERY CABLE
D&C HARNESS
D&C HARNESS CLIPS
R&R HARNESS

HEATER CONTROL
D&C NEG. BATTERY CABLE
R&R ASH TRAY ASM.
R&R GAGE & CONTROL TRIM PANELS
R&R GLOVE BOX
D&C TEMP. CABLE AT MODULE
R&R CONTROL SCREWS
PULL CONTROL OUT &
D&C HARNESSES AND TEMP. CABLE

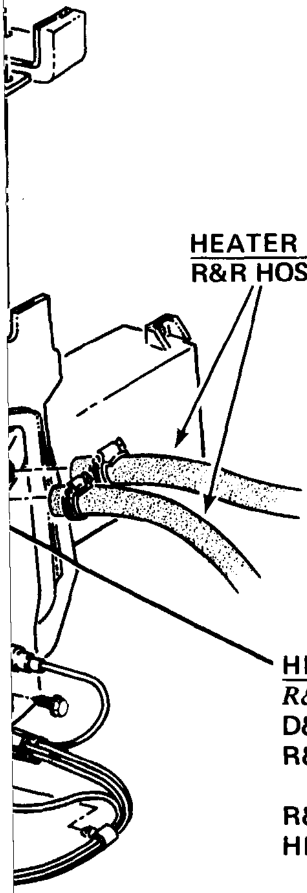
ER VENT CABLE
LE SCREWS/NUT

UPPER VENT CABLE
LE AT MODULE
LE SCREW/NUT

DEFROST CABLE
PULL CONTROL OUT
D&C CABLE AT MODULE & CONTROL
R&R CABLE SCREW/NUT

BLOWER SPEED SWITCH
PULL CONTROL OUT
D&C HARNESS
R&R SWITCH SCREWS

Fig. 1A-24 1977 B Series Heater Interior Service Procedures



HEATER HOSES
R&R HOSE CLAMPS

HEATER CORE
R&R HEATER HOSES
D&C ELECTRICAL CONNECTORS
R&R FRONT MODULE COVER
SCREWS
R&R CORE
HEATER

WS

3654

CTORS

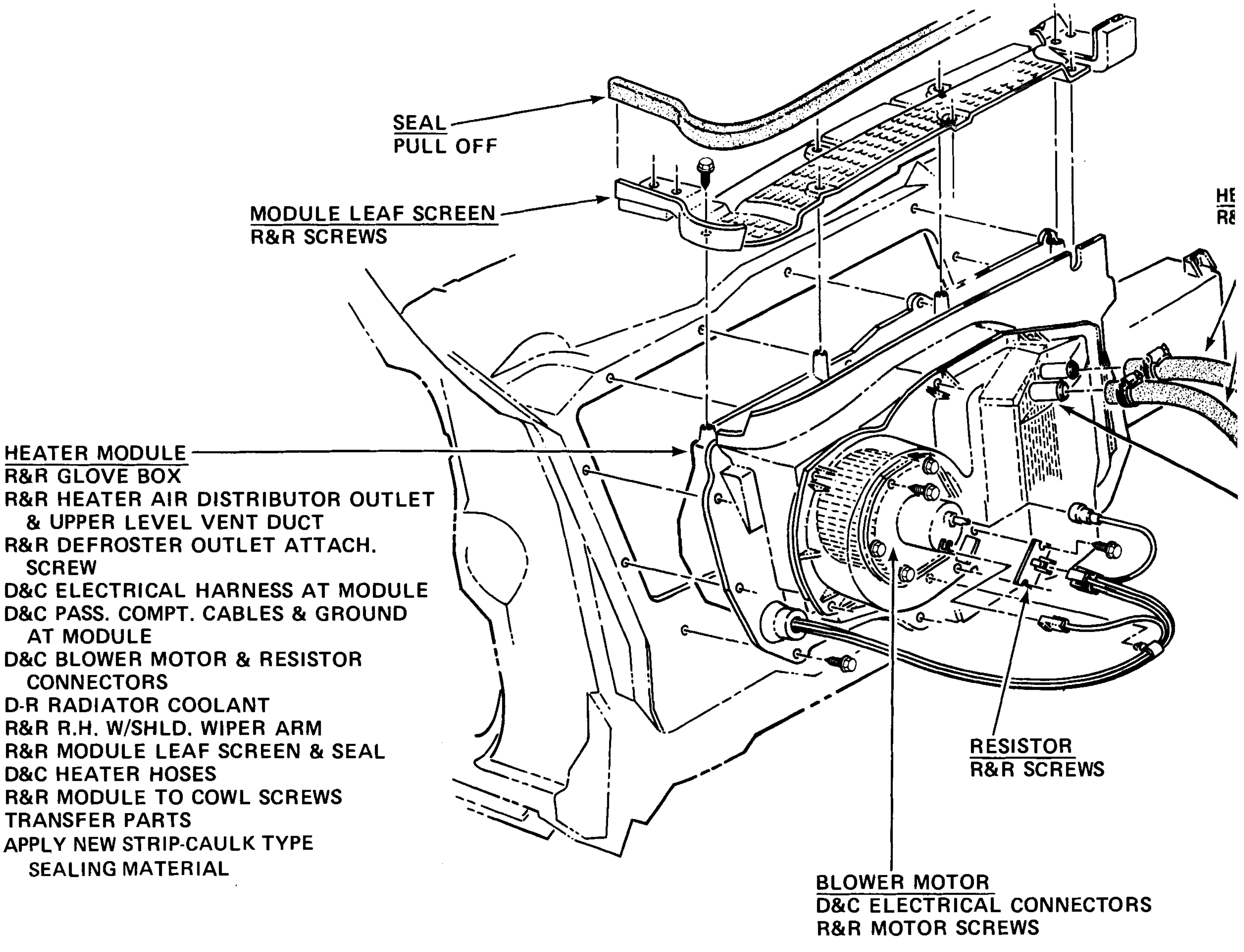


Fig. 1A-25 1977 B Series Heater Exterior Service Procedures

SECTION 1B

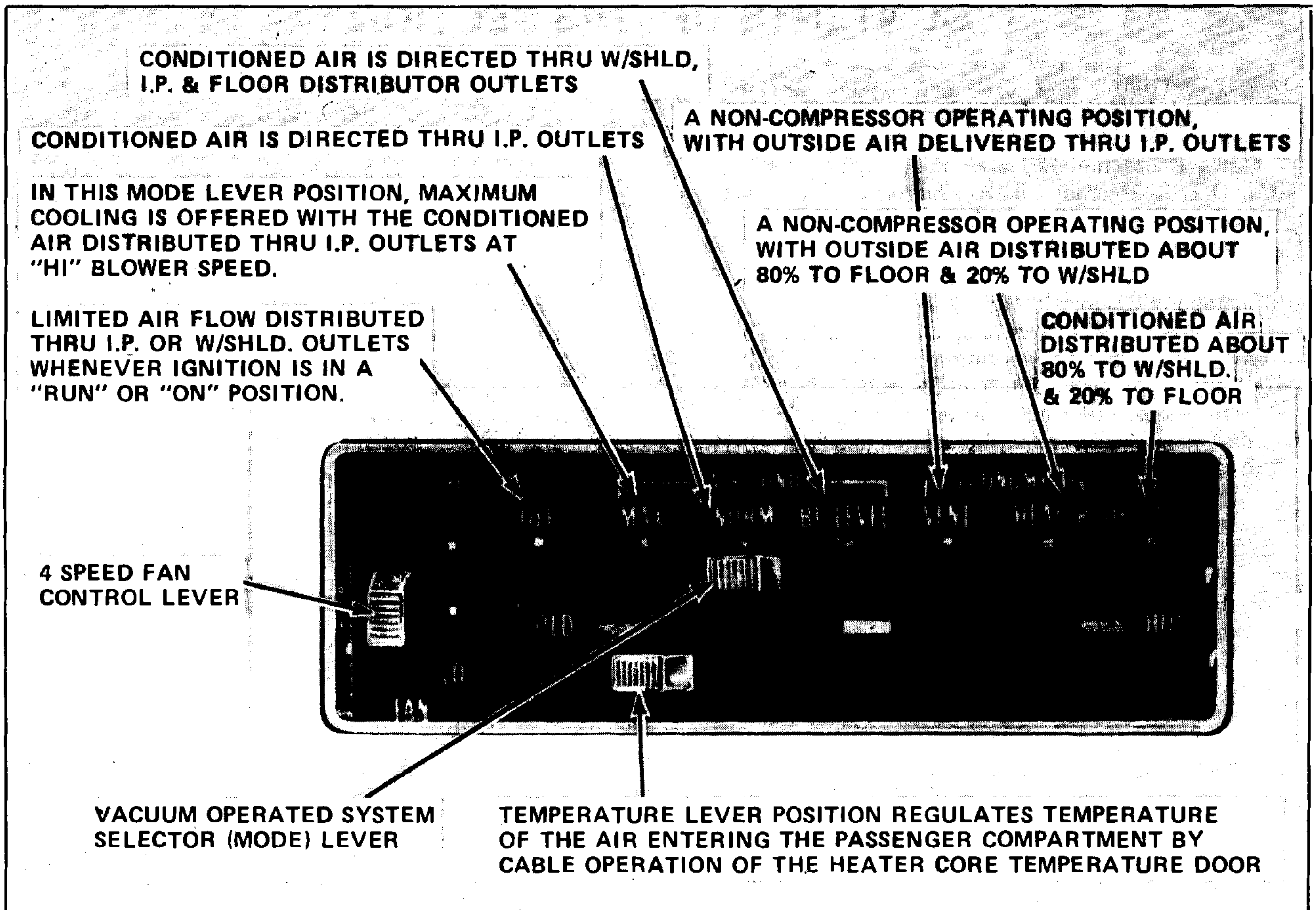
CUSTOM AIR CONDITIONING

CAUITON: *When performing air conditioning diagnosis on Pontiac vehicles equipped with a catalytic converter, it will be necessary to* **WARM** the engine to a **NORMAL** operating temperature **BEFORE** attempting to idle the engine for periods greater than five (5) minutes. Once the choke is open and fast idle speed reduced to a normal idle, diagnosis and adjustments can be made.

NOTE: References to C60 in this Section 1B of the Service Manual indicate Manually Operated Custom Air Conditioning. C65 indicates Automatic Temperature Control of the same cycling clutch (C.C.O.T.) refrigerant control system. See Section 1C for additional C65 information.

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION



THIS A&G SERIES A/C CONTROL REPRESENTS THE TYPICAL 1977 A/C CONTROL FACE. ALL 1977 CUSTOM A/C CONTROLS HAVE IDENTICAL MODE LEVER POSITIONS, A 4-SPEED BLOWER LO-TO-HI FAN & COLD-TO-HOT TEMPERATURE LEVER CONTROL. F SERIES CONTROLS HAVE THE BLOWER FAN SWITCH MOUNTED AT THE R.H. SIDE OF THE CONTROL. THE X SERIES CONTROL IS ARRANGED WITH VERTICAL LEVER TRAVELS. THE B SERIES CUSTOM A/C CONTROL TEMP. LEVER AT "FULL COLD" TRAVEL WILL OPERATE THE WATER VALVE TO SHUT OFF WATER FLOW TO THE HEATER CORE.

2304

FIG. 1B-1 1977 CUSTOM A/C CONTROL

C.C.O.T. REFRIGERANT OIL DISTRIBUTION

A-6 COMPRESSOR -- requires 10 fluid ounces of 525 viscosity oil

R-4 COMPRESSOR -- requires 6 fluid ounces of 525 viscosity oil

1. IF THERE ARE **NO** SIGNS OF EXCESSIVE OIL LEAKAGE, add the following amount of oil depending on component replaced:

For A-6 & R-4 Compressor Systems - Evaporator - (3 fluid ounces)

For A-6 & R-4 Compressor Systems - Condenser - (1 fluid ounce)

For R-4 Compressor System only - Accumulator (Drain oil, measure, replace same amount plus 1 oz.)

For A-6 Compressor System only - Accumulator (see Item 2 below)

2. HOWEVER, ON AN A-6 COMPRESSOR SYSTEM:

- IF **EITHER** THE ACCUMULATOR OR THE COMPRESSOR IS TO BE REPLACED...
- OR **IF THERE ARE SIGNS** OF ABUNDANT OIL LEAKAGE...

THEN **BOTH** ACCUMULATOR AND COMPRESSOR must be removed -- oil drained -- and measured to determine correct quantity of oil replacement for the system. If the amount of oil recovered is 4 oz. or more, replace with a like amount of new oil. If less than 4 oz. are recovered, add 6 oz. of new oil.

NOTE: A good A-6 system will have 6 ounces of oil found in the accumulator and/or compressor. Neither necessarily has 3 ounces - could be more or less. This is why **BOTH** have to be measured.

- IN ADDITION to these measured amounts, one (1) additional fluid ounce MUST be added to replace that amount captured in the oil desiccant of the replaced accumulator assembly.

NOTE: New service A-6 Compressors are shipped with 10 ounces of oil already inside. Therefore, when a new A-6 Compressor is installed, its oil must first be drained and measured to leave only that like amount drained and measured in the oil compressor.

3. ON AN R-4 COMPRESSOR SYSTEM WITH SIGNS OF ABUNDANT OIL LEAKAGE:

- **ONLY THE ACCUMULATOR** SHOULD BE REMOVED from the system, oil drained and then measured to determine correct quantity of oil replacement. If the amount drained is 2 oz. or more, replace with like amount. If less than 2 oz., replace with 2 oz. of new oil.
- IN ADDITION to this amount, add 1 oz. to replace the amount captured in the old desiccant of the replaced accumulator assembly.

NOTE: Because the R-4 Compressor has no oil sump, it is not necessary to remove this compressor to measure oil.

PRECAUTIONS IN HANDLING REFRIGERANT-12

1. Do not leave drum of Refrigerant-12 uncapped.
2. Do not carry any container of Refrigerant-12 in passenger compartment of car.
3. Do not subject any container of Refrigerant-12 to high temperature.
4. Do not weld or steam clean on or near system.
5. Do not fill drum of Refrigerant-12 completely.
6. Do not discharge vapor into area where flame is exposed.
7. Do not expose eyes to liquid.

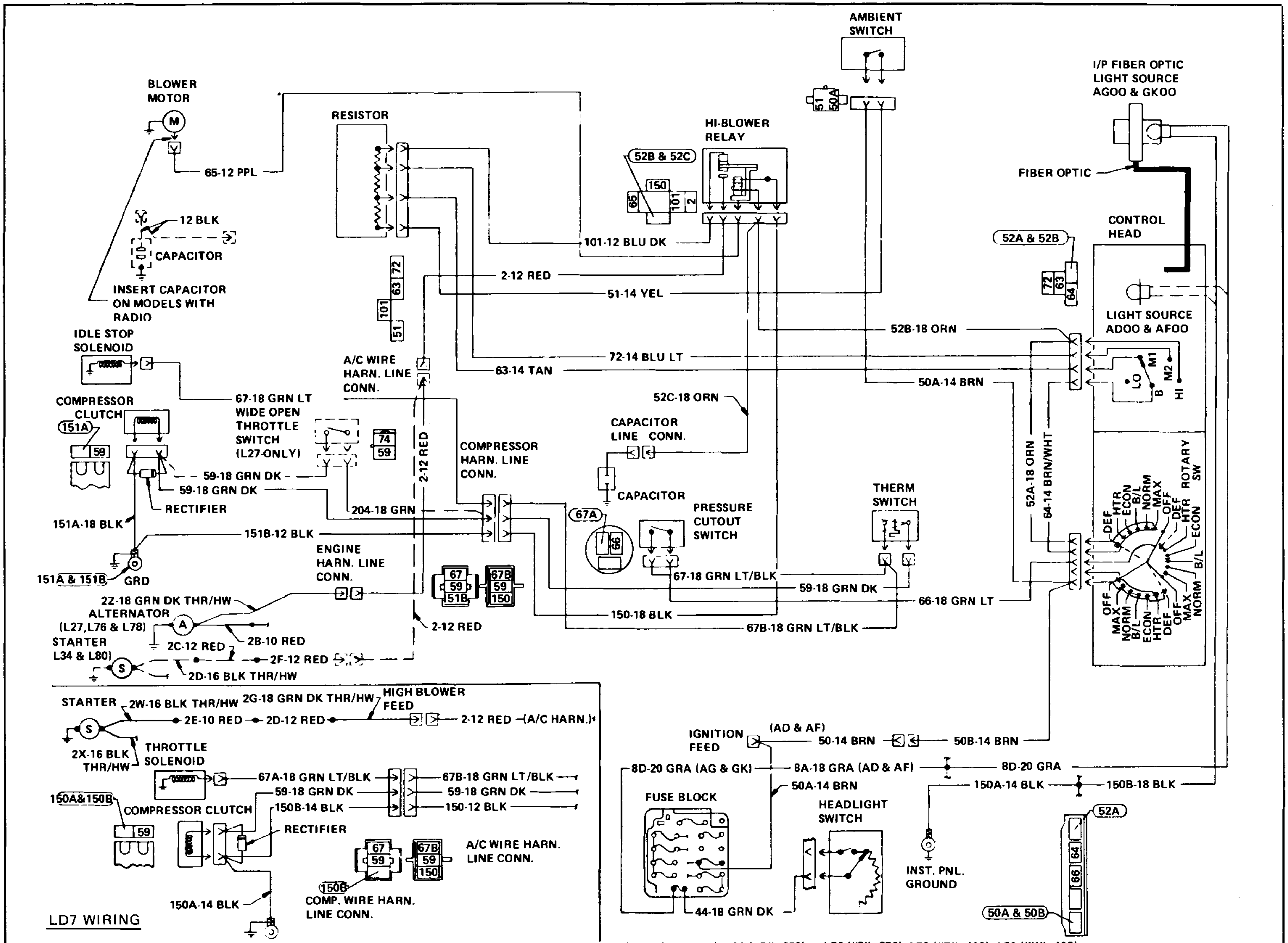
WARNING: IF REFRIGERANT-12 LIQUID SHOULD STRIKE THE EYE, CALL A DOCTOR IMMEDIATELY.

A. DO NOT RUB THE EYE. SPLASH THE AFFECTED AREA WITH QUANTITIES OF COLD WATER TO GRADUALLY GET THE TEMPERATURE ABOVE THE FREEZING POINT.

B. THE USE OF AN ANTISEPTIC OIL IS HELPFUL IN PROVIDING A PROTECTIVE FILM OVER THE EYEBALL TO REDUCE THE POSSIBILITY OF INFECTION.

C. OBTAIN TREATMENT AS SOON AS POSSIBLE, FROM A DOCTOR OR EYE SPECIALIST.

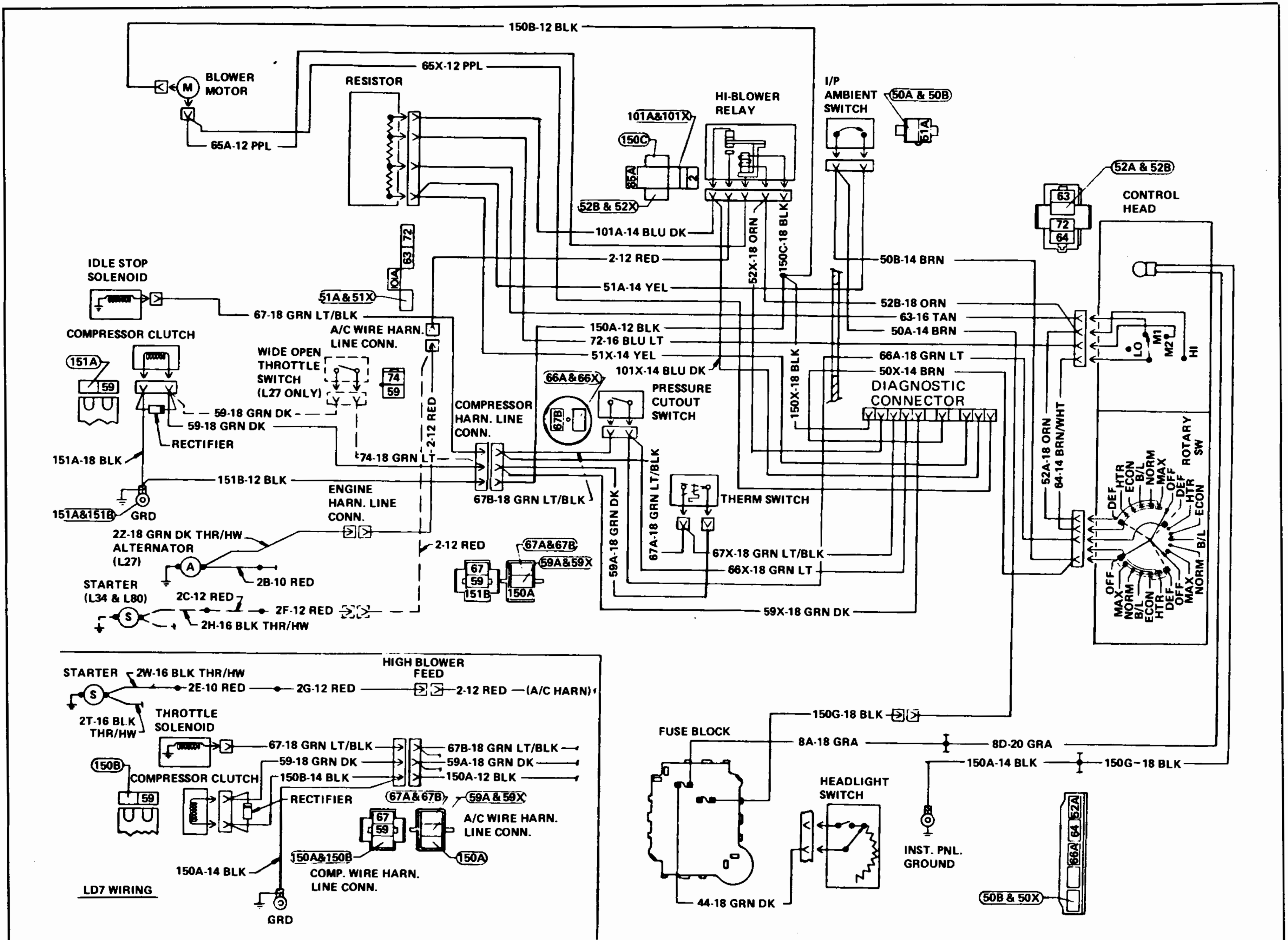
SHOULD LIQUID R-12 COME INTO CONTACT WITH THE SKIN, THE INJURY SHOULD BE TREATED THE SAME AS SKIN WHICH HAS BEEN FROSTBITTEN OR FROZEN.



1977 "A" & "G" SERIES AIR CONDITIONING WIRING FOR ENGINE CODES LD7 ("C"—231), L27 ("Y"—301), L34 ("R"—350), L76 ("P"—350), L78 ("Z"—400), L80 ("K"—403)

5006

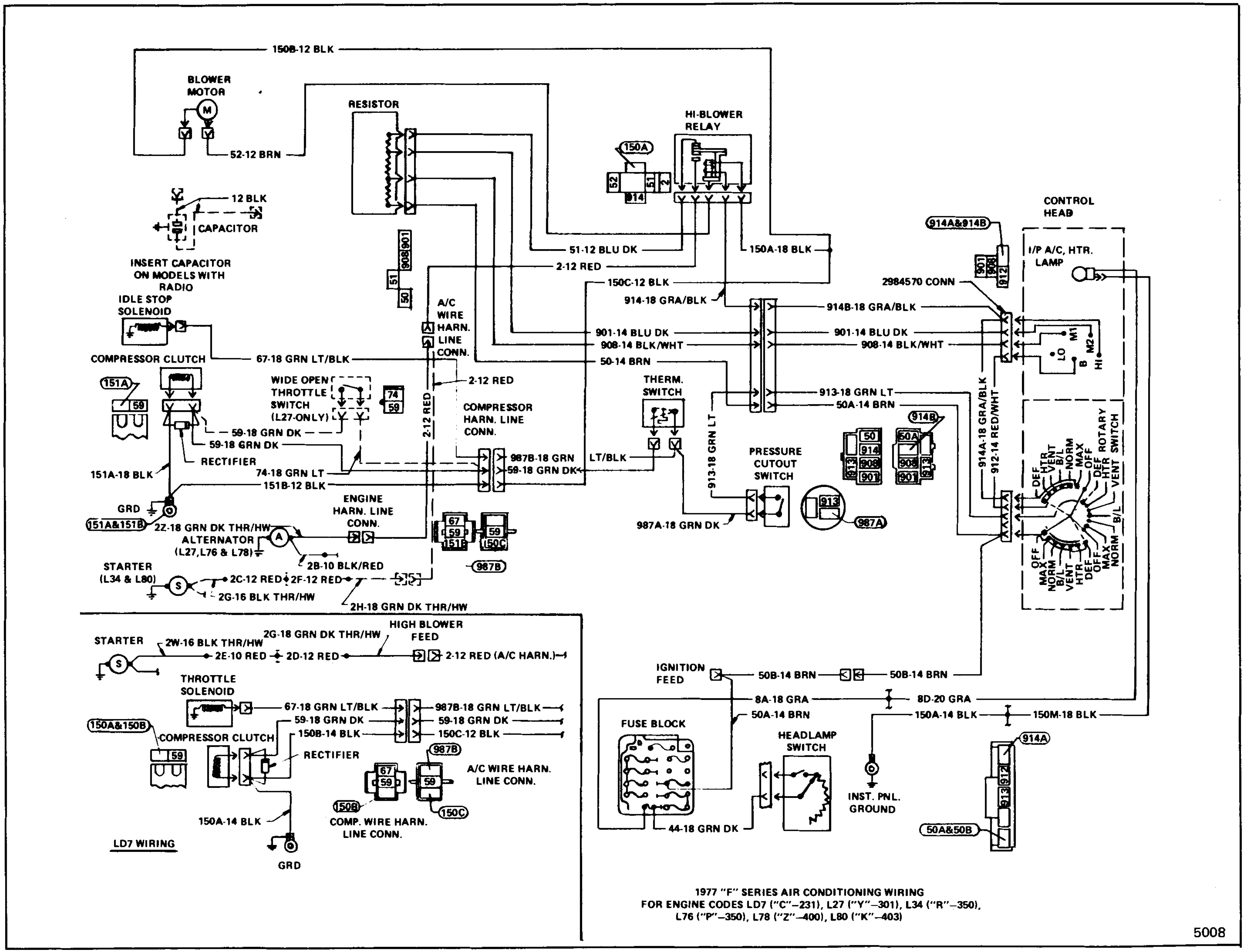
Fig. 1B-2 1977 A & G Series C60 & C65 A/C Wiring



1977 "B" SERIES AIR CONDITIONING WIRING FOR ENGINE CODES LD7 ("C"–231), L27 ("Y"–301), L34 ("R"–350), L76 ("P"–350), L78 ("Z"–400), L80 ("K"–403)

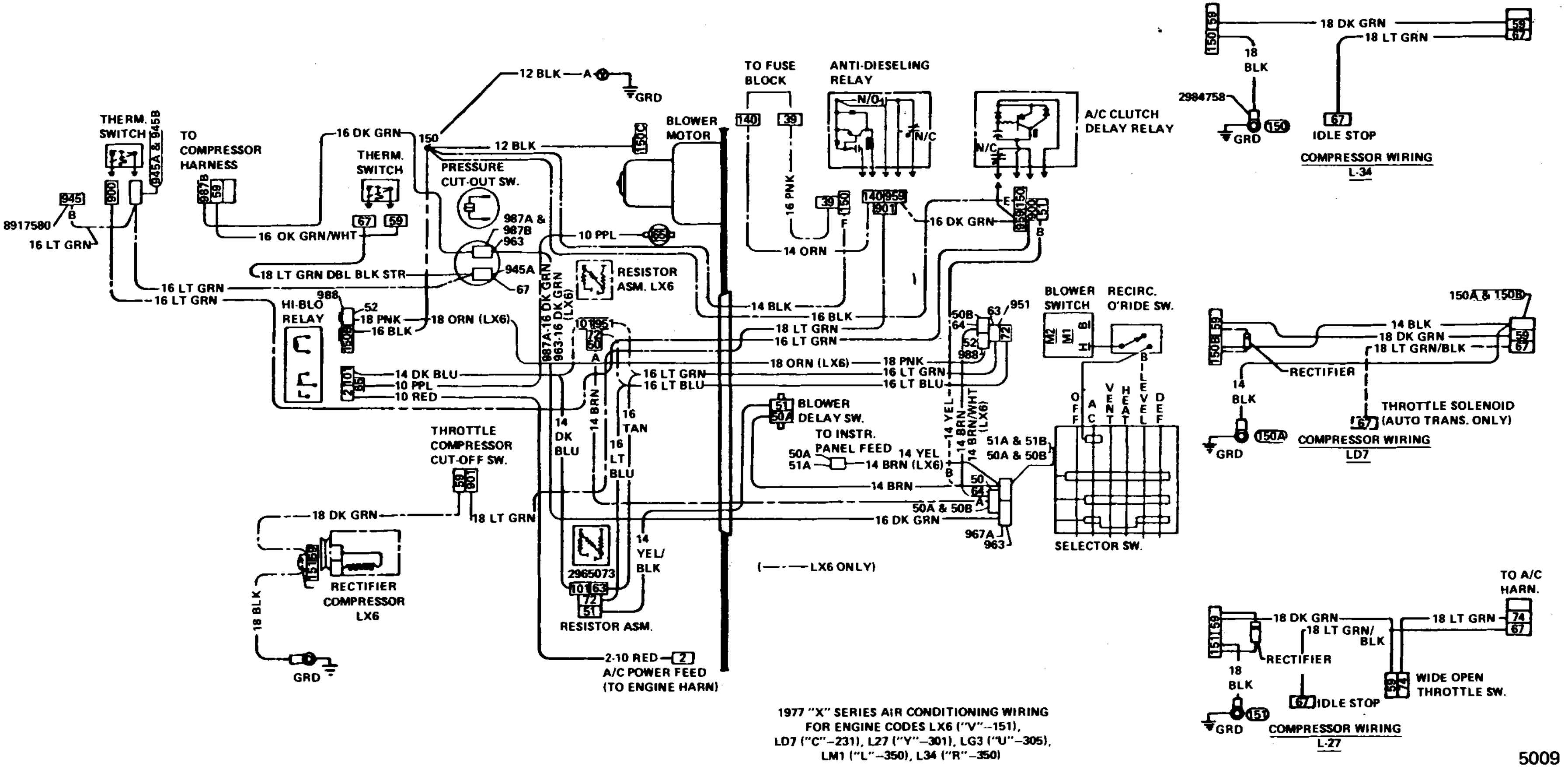
5007

Fig. 1B-3 1977 B Series C60 & C65 A/C Wiring



1977 "F" SERIES AIR CONDITIONING WIRING
FOR ENGINE CODES LD7 ("C"–231), L27 ("Y"–301), L34 ("R"–350),
L76 ("P"–350), L78 ("Z"–400), L80 ("K"–403)

Fig. 1B-4 1977 F Series C60 A/C Wiring



1977 "X" SERIES AIR CONDITIONING WIRING FOR ENGINE CODES LX6 ("V"–151), LD7 ("C"–231), L27 ("Y"–301), LG3 ("U"–305), LM1 ("L"–350), L34 ("R"–350)

Fig. 1B-5 1977 X Series C60 A/C Wiring

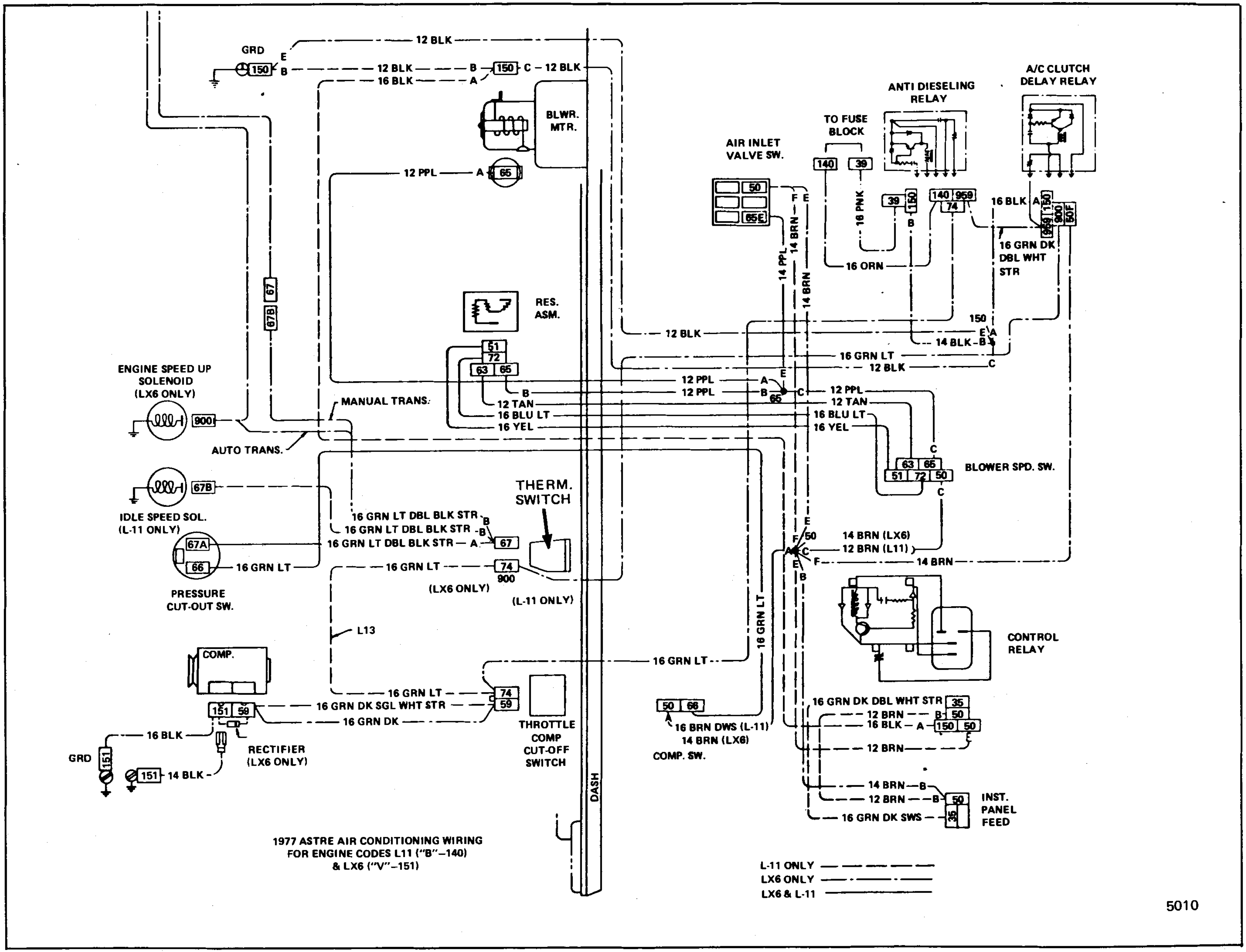
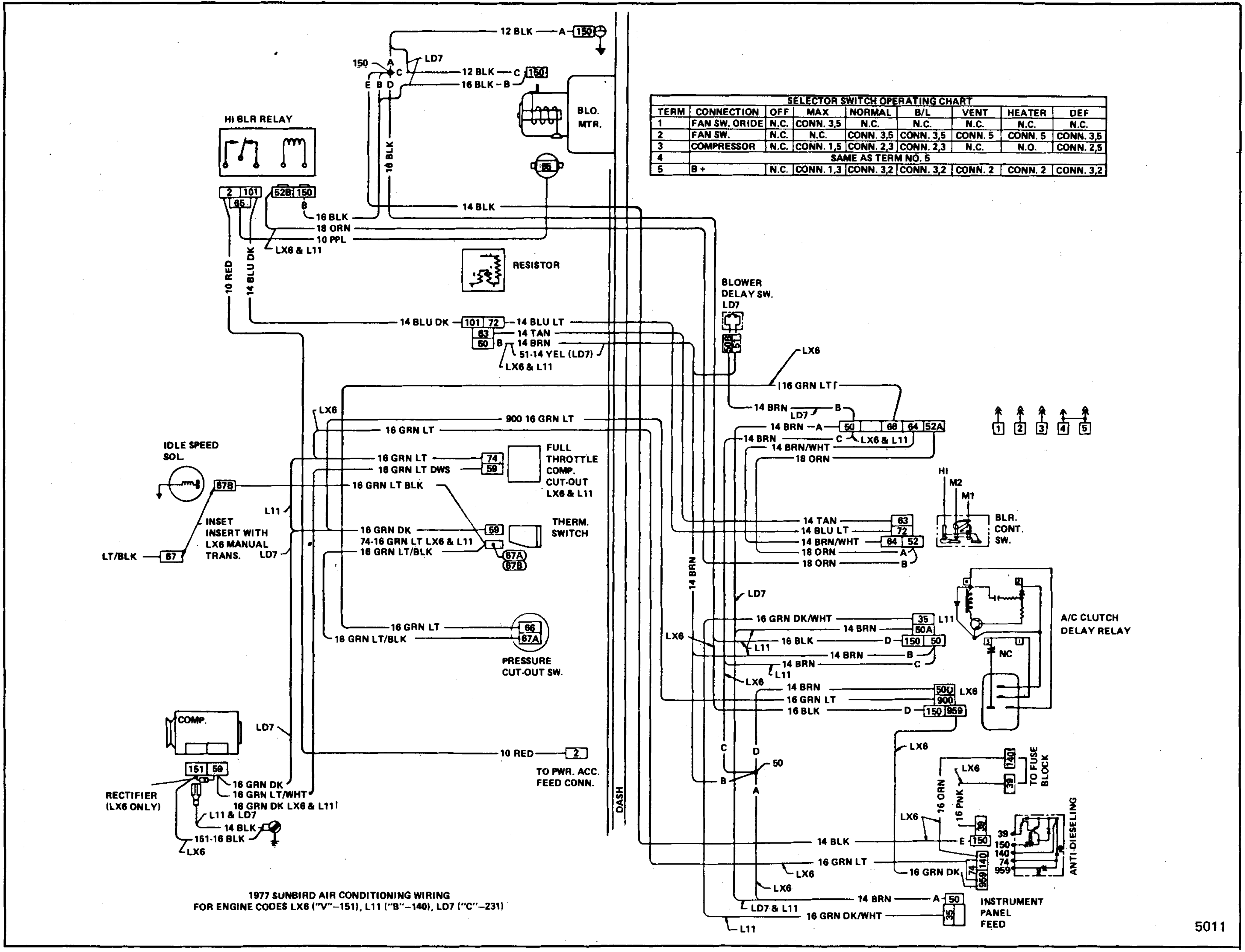


Fig. 1B-6 1977 Astre Series C60 A/C Wiring



SELECTOR SWITCH OPERATING CHART								
TERM	CONNECTION	OFF	MAX	NORMAL	B/L	VENT	HEATER	DEF
1	FAN SW. ORIDE	N.C.	CONN. 3,5	N.C.	N.C.	N.C.	N.C.	N.C.
2	FAN SW.	N.C.	N.C.	CONN. 3,5	CONN. 3,5	CONN. 5	CONN. 5	CONN. 3,5
3	COMPRESSOR	N.C.	CONN. 1,5	CONN. 2,3	CONN. 2,3	N.C.	N.O.	CONN. 2,5
4	SAME AS TERM NO. 5							
5	B +	N.C.	CONN. 1,3	CONN. 3,2	CONN. 3,2	CONN. 2	CONN. 2	CONN. 3,2

Fig. 1B-7 1977 Sunbird C60 A/C Wiring

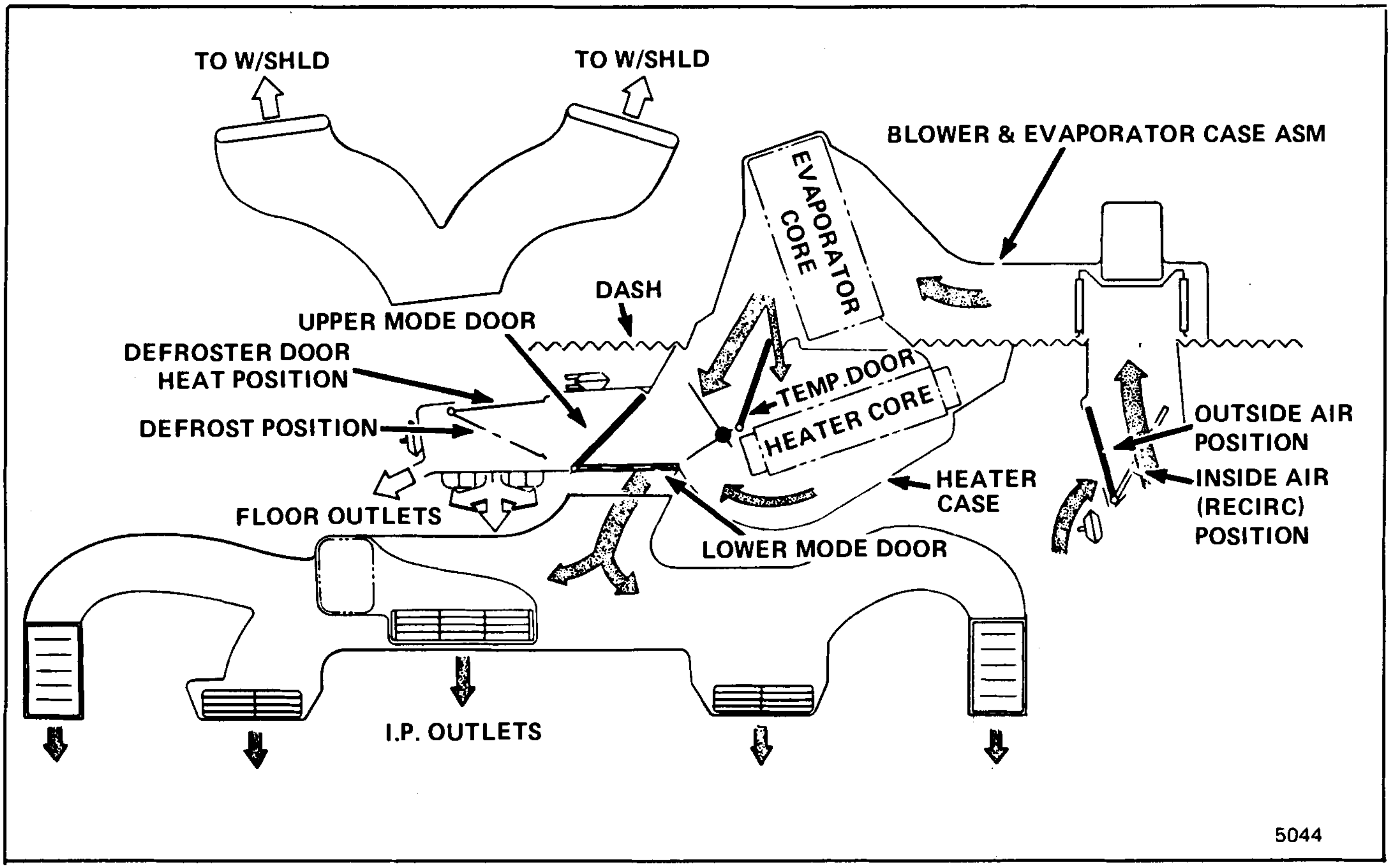
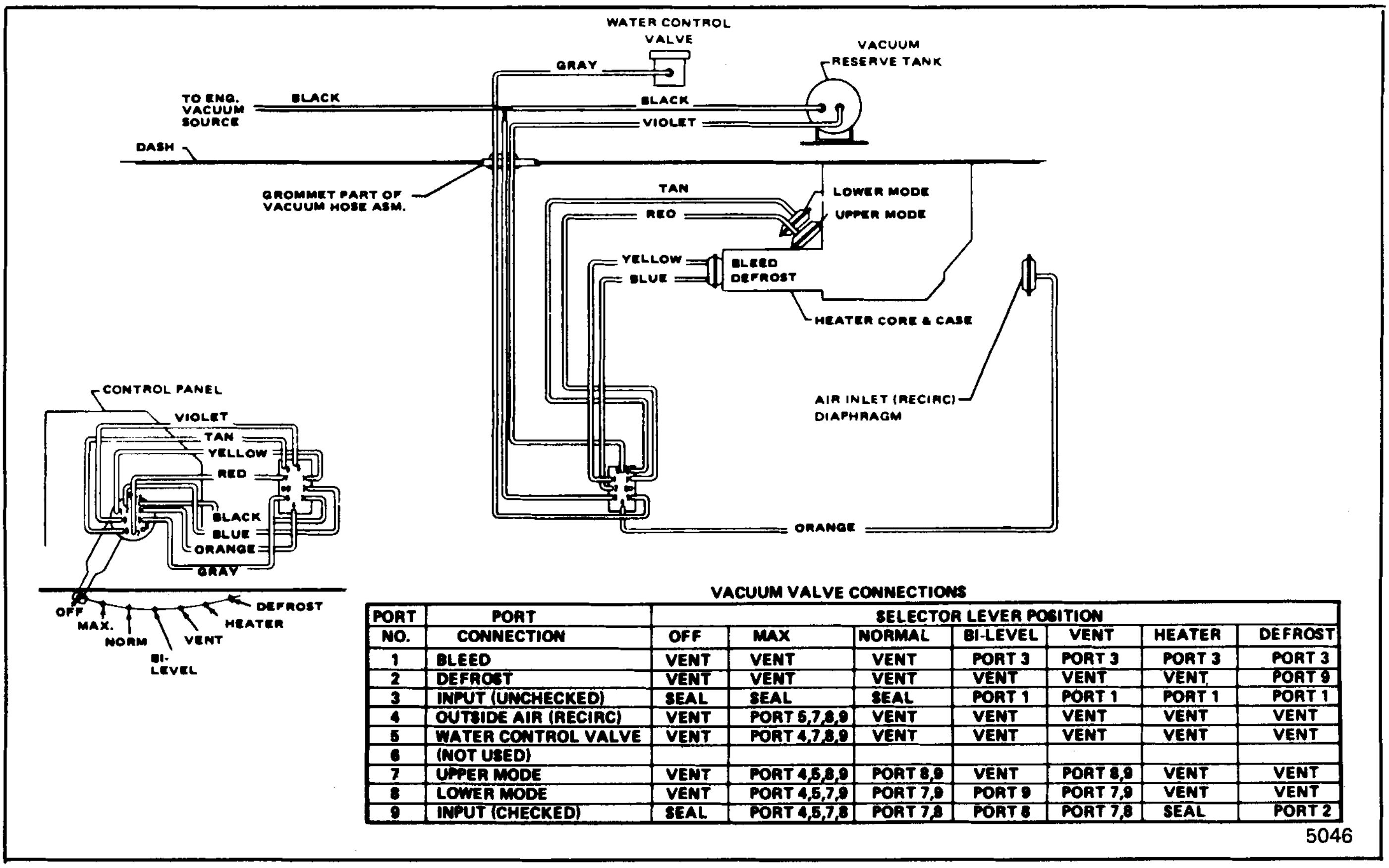


Fig. 1B-8 1977 Typical A/C Air Flows

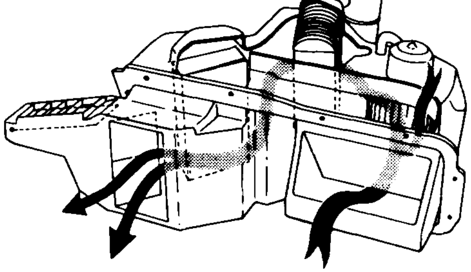


VACUUM VALVE CONNECTIONS

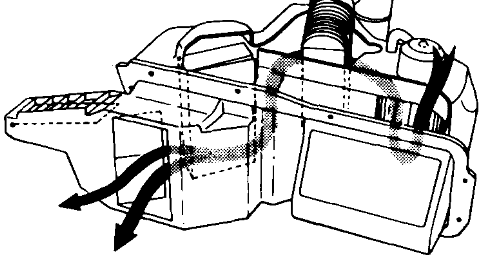
PORT NO.	PORT CONNECTION	SELECTOR LEVER POSITION						
		OFF	MAX	NORMAL	BI-LEVEL	VENT	HEATER	DEFROST
1	BLEED	VENT	VENT	VENT	PORT 3	PORT 3	PORT 3	PORT 3
2	DEFROST	VENT	VENT	VENT	VENT	VENT	VENT	PORT 9
3	INPUT (UNCHECKED)	SEAL	SEAL	SEAL	PORT 1	PORT 1	PORT 1	PORT 1
4	OUTSIDE AIR (RECIRC)	VENT	PORT 5,7,8,9	VENT	VENT	VENT	VENT	VENT
5	WATER CONTROL VALVE	VENT	PORT 4,7,8,9	VENT	VENT	VENT	VENT	VENT
6	(NOT USED)							
7	UPPER MODE	VENT	PORT 4,5,8,9	PORT 8,9	VENT	PORT 8,9	VENT	VENT
8	LOWER MODE	VENT	PORT 4,5,7,9	PORT 7,9	PORT 9	PORT 7,9	VENT	VENT
9	INPUT (CHECKED)	SEAL	PORT 4,5,7,8	PORT 7,8	PORT 8	PORT 7,8	SEAL	PORT 2

Fig. 1B-9 1977 A & G Series C60 A/C Vacuum Diagram

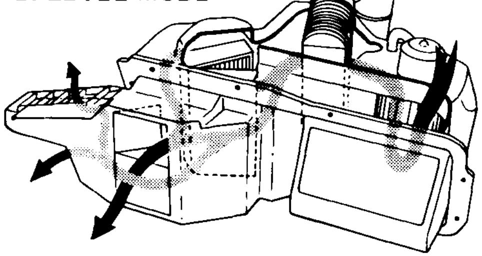
MAXIMUM AIR MODE



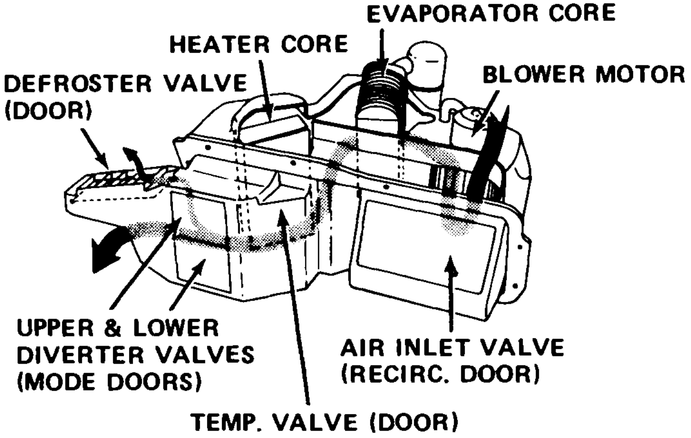
NORMAL MODE

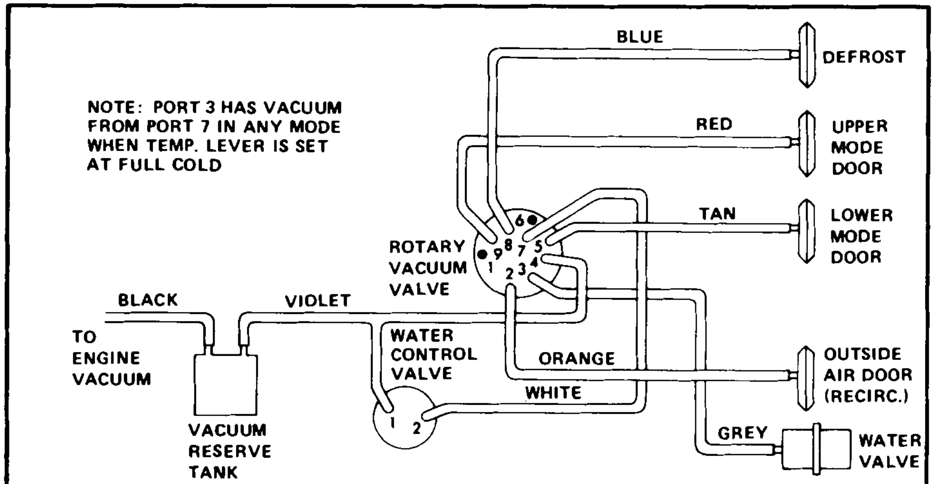


BI-LEVEL MODE



OFF MODE

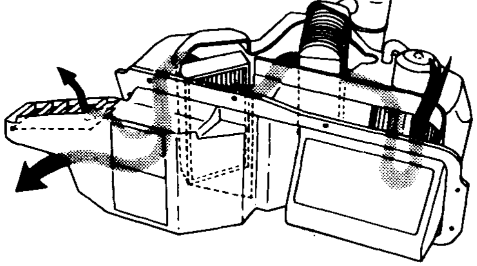




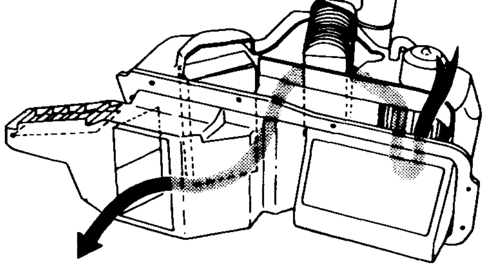
SELECTOR LEVER POSITION

PORT NO.	PORT	OFF	MAX	NORM	BI LEVEL	VENT	HEAT	DEFROST
1	NOT USED ············							
2	OUTSIDE AIR (RECIRC)··		▨					
3	WATER CONTROL-VALVE		▨					
4	INPUT-CHECKED ·······	▨	▨	▨	▨	▨	▨	▨
5	LOWER MODE DOOR ····		▨	▨		▨		
6	NOT USED ············							
7	INPUT WATER CONTROL·							
8	DEFROSTER ··········							▨
9	UPPER MODE DOOR ····		▨	▨	▨	▨		

HEAT MODE



VENT MODE



DEFROST MODE

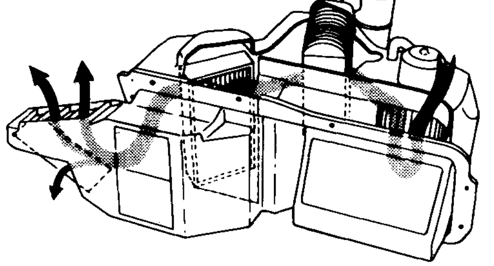


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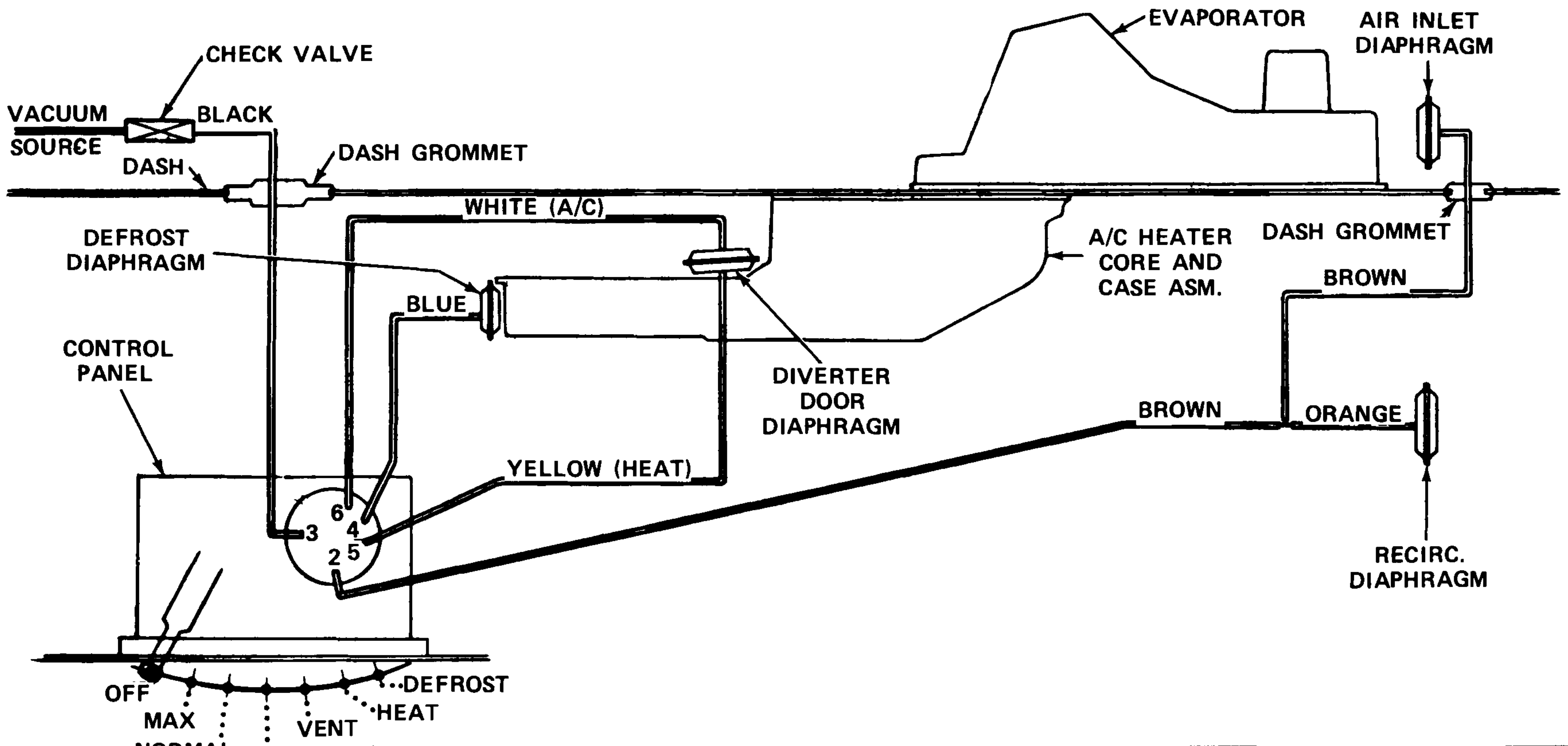
Fig. 1B-10 1977 B Series C60 A/C Vacuum Diagram



PORT NO.	CONNECTION	POSITION						
		OFF	MAX	NORM	B/L	VENT	HEAT	DEFROST
6	A/C	VENT	VACUUM	VACUUM	VENT	VACUUM	VENT	VENT
2	OUTSIDE AIR	VENT	VACUUM	VENT	VENT	VENT	VENT	VENT
3	INPUT	VACUUM	VACUUM	VACUUM	SEAL	VACUUM	VACUUM	VACUUM
4	DEFROST	VENT	VENT	VENT	VENT	VENT	VENT	VACUUM
5	HEATER	VACUUM	VENT	VENT	VENT	VENT	VACUUM	VACUUM

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Fig. 1B-11 1977 F Series C60 A/C Vacuum Diagram

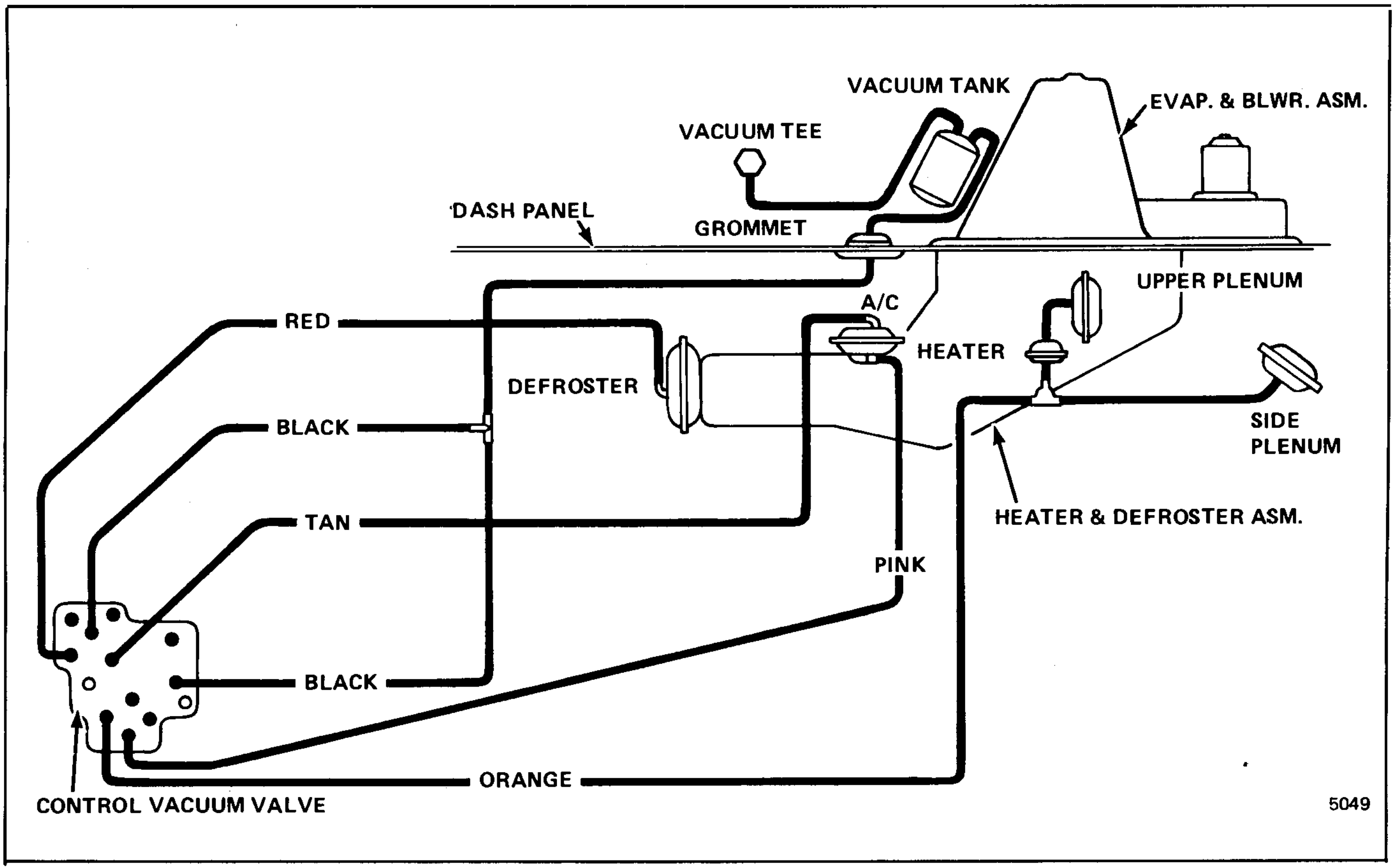

Fig. 1B-12 1977 X Series C60 A/C Vacuum Diagram

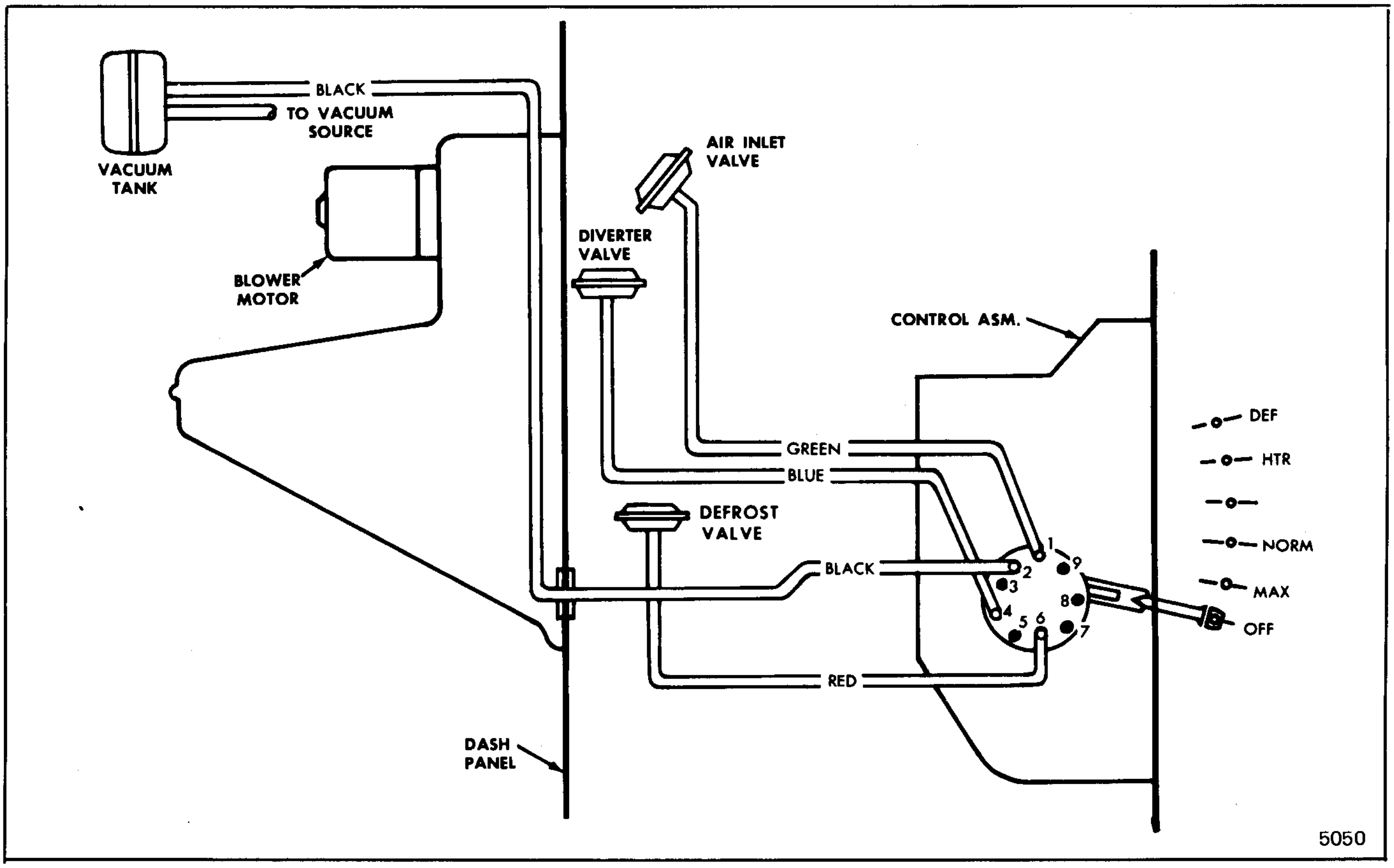

Fig. 1B-13 1977 Astre C60 A/C Vacuum Diagram

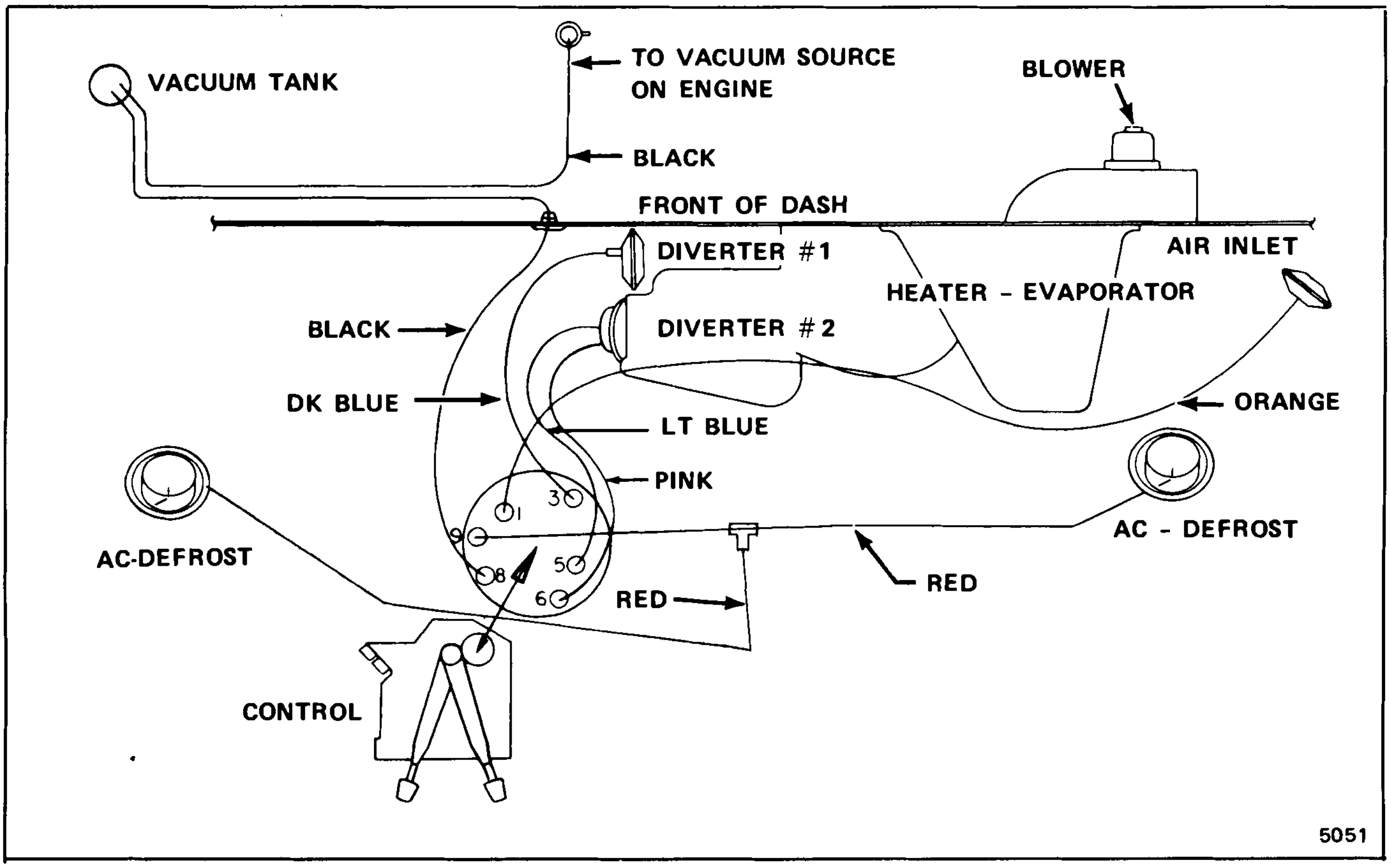

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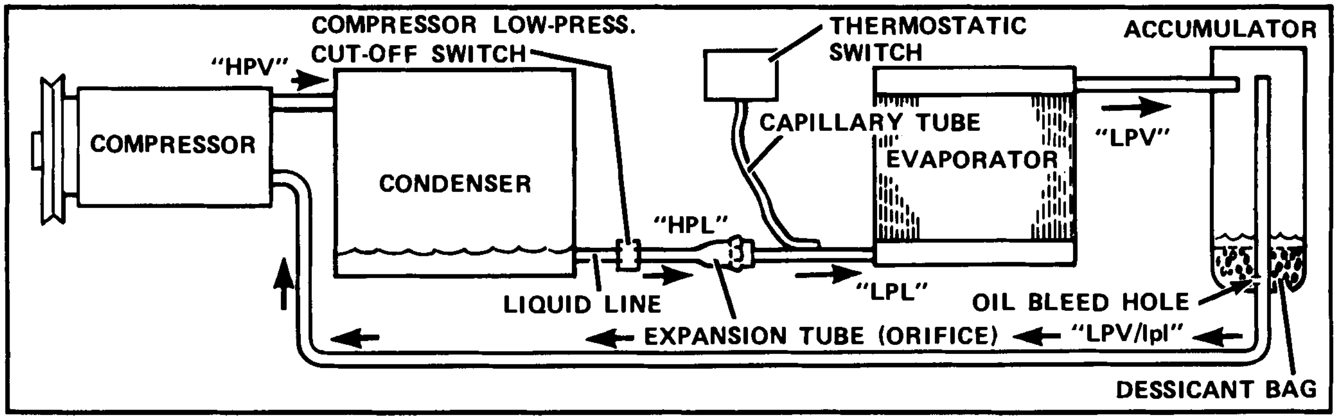
Fig. 1B-14 1977 Sunbird C60 A/C Vacuum Diagram



"HPV" – HIGH PRESSURE VAPOR LEAVING COMPRESSOR.

"HPL" – VAPOR IS COOLED DOWN BY CONDENSER AIR FLOW AND LEAVES AS HIGH PRESSURE LIQUID.

"LPL" – ORIFICE METERS THE LIQUID R-12, INTO EVAPORATOR, REDUCING ITS PRESSURE, AND WARM BLOWER AIR ACROSS EVAPORATOR CORE CAUSES BOILING OFF OF LIQUID INTO VAPOR.

"LPV" – LEAVES EVAPORATOR AS LOW PRESSURE VAPOR AND RETURNS WITH THE SMALL AMOUNT OF . . .

"lpl" – . . . LOW PRESSURE LIQUID THAT DIDN'T BOIL OFF COMPLETELY BACK TO THE COMPRESSOR TO BE COMPRESSED AGAIN.

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Fig. 1B-15 1977 C.C.O.T. Major System Components & Refrigerant Flow

REFRIGERANT — 12
PRESSURE — TEMPERATURE
RELATIONSHIP

The table below indicates the pressure of Refrigerant — 12 at various temperatures. For instance, a drum of Refrigerant at a temperature of 80°F (26.6°C) will have a pressure of 84.1 PSI (579.9 kPa). If it is heated to 125°F (51.6°C), the pressure will increase to 167.5 PSI (1154.9 kPa). It also can be used conversely to determine the temperature at which Refrigerant — 12 boils under various pressures. For example, at a pressure of 30.1 PSI (207.5 kPa), Refrigerant — 12 boils at 32°F (0°C).

(°F)(°C)		(PSIG)(kPa)		(°F)(°C)		(PSIG)(kPa)	
-21.7	-29.8C	0(ATMOSPHERIC PRESSURE)	0(kPa)	55	12.7C	52.0	358.5
				60	15.5C	57.7	397.8
-20	-28.8C	2.4	16.5	65	18.3C	63.7	439.2
-10	-23.3C	4.5	31.0	70	21.1C	70.1	482.7
-5	-20.5C	6.8	46.9	75	23.8C	76.9	530.2
0	-17.7C	9.2	63.4	80	26.6C	84.1	579.9
5	-15.0C	11.8	81.4	85	29.4C	91.7	632.3
10	-12.2C	14.7	101.4	90	32.2C	99.6	686.7
15	-9.4C	17.7	122.0	95	35.0C	108.1	745.3
20	-6.6C	21.1	145.5	100	37.7C	116.9	806.0
25	-3.8C	24.6	169.6	105	40.5C	126.2	870.2
30	-1.1C	28.5	196.5	110	43.3C	136.0	937.7
32	0C	30.1	207.5	115	46.1C	146.5	1010.1
35	1.6C	32.6	224.8	120	48.8C	157.1	1083.2
40	4.4C	37.0	255.1	125	51.6C	167.5	1154.9
45	7.2C	41.7	287.5	130	54.4C	179.0	1234.2
50	10.0C	46.7	322.0	140	60.0C	204.5	1410.0

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Fig. 1B-16 1977 Pressure-Temperature Relationship of R-12

1977 PONTIAC A/C SYSTEM
REFRIGERANT-12 CAPACITIES

REFRIGERANT-12 CHARGING CAPACITIES FOR 1977 PONTIAC A/C SYSTEMS ARE AS FOLLOWS:

	LBS. OF R-12
A SERIES	3.75
G SERIES	3.75
B SERIES	3.75
F SERIES	3.25
H SERIES	2.50
HM SERIES	3.25
X SERIES	3.50

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Fig. 1B-17 1977 R-12 Charging Capacities

All Refrigerant-12 drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum for the same reason.

If it is necessary to transport or carry any container of Refrigerant-12 in a car, keep it in the luggage compartment. If the drum is exposed to the radiant heat of the sun, the resultant increase in pressure may cause the safety plug to release or the drum to burst.

For the same reason, the Refrigerant-12 container should never be subjected to excessive temperature when charging a system. The R-12 container may be heated for charging purposes by placing in not over 125°F. (51°C.) water or being wrapped with warm, wet rags. NEVER HEAT ABOVE 125°F. (51°C.) OR USE BLOW TORCH, RADIATOR OR STOVE to heat the container.

Welding or steam cleaning near any of the refrigerant lines or components of the air conditioning system could build up dangerous and damaging pressures in the system.

If the occasion arises to fill a small Refrigerant-12 drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion. If the R-12 drum were completely full and the temperature was increased, tremendous hydraulic force could be developed.

WARNING: AVOID BREATHING SMOKE AND FUMES PRODUCED BY THE BURNING OF THE REFRIGERANT-12. SUCH FUMES MAY BE HAZARDOUS.

One of the most important cautions concerns the eyes. Any liquid Refrigerant-12 which may accidentally escape is approximately 21°F. (-6°C.) below zero. If liquid R-12 should touch the eyes, serious damage could result. Always wear goggles to protect the eyes when opening refrigerant connections.

PRECAUTIONS IN HANDLING REFRIGERANT LINES AND FITTINGS

CAUTION: *The following precautions should be observed when handling refrigerant lines and fittings.*

- All metal tubing lines should be free of kinks, because of the restriction that kinks will offer to the flow of Refrigerant-12. The refrigeration capacity of the entire system can be greatly reduced by a single kink.
- The flexible hose lines should never be bent to a radius of less than 4 times the diameter of the hose.
- The flexible hose lines shold never be allowed to come within a distance of 2-1/2" of the exhaust manifold.
- Flexible hose lines should be inspected at least once a year for leaks or brittleness. If found brittle or leaking they shuold be replaced with new lines.
- Use only new lines that have been sealed during storage.

WARNING: ALWAYS WEAR SAFETY GOGGLES WHEN OPENING REFRIGERANT LINES.

- WHEN DISCONNECTING ANY FITTING IN THE REFRIGERATION SYSTEM, THE SYSTEM MUST FIRST BE DISCHARGED OF ALL REFRIGERANT-12. HOWEVER, PROCEED VERY CAUTIOUSLY REGARDLESS OF GAGE READINGS. OPEN VERY SLOWLY, KEEPING FACE AND HANDS AWAY SO THAT NO INJURY CAN OCCUR IF THERE HAPPENS TO BE LIQUID REFRIGERANT-12 IN THE LINE. If pressure is noticed when fitting is loosened, allow it to bleed off as described under DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS.
- In the event any refrigerant line is opened to the atmosphere, it should be immediately capped or taped to prevent entrance of moisture and dirt, which can cause internal compressor wear or plugged lines, condenser and evaporator core, expansion tubes (orifice) or compressor inlet screens.
- The use of the proper wrenches when making connections on O-ring fittings is important. The use of improper wrenches may damage the connection. The opposing fitting should always be backed up with a wrench to prevent distortion of connecting lines or components. When connecting the flexible hose connections, it is important that the swaged fitting and the flare nut, as well as the coupling to which it is attached, be held at the same time using three different wrenches to prevent turning the fitting and damaging the ground seat.
- O-rings and seats must be in perfect condition. A burr or piece of dirt may cause a refrigerant leak.

Always replace the O-ring when a connection has been broken. When replacing the O-ring, first dip it in clean refrigeration oil.

CAUTION: *Where steel to aluminum connections are being made, use torque for aluminum tubing (see Fig. 1B-22).*

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The efficient operation of the air conditioning refrigeration system is dependent upon on the pressure-temperature relationship of pure Refrigerant-12. As long as the system contains pure R-12 (plus a certain amount of 525 viscosity compressor oil which mixes with the R-12, it is considered to be chemically stable.

When foreign materials, such as dirt, air or moisture are allowed to get into the system they will change the pressure-temperature relationship of the Refrigerant-12. Thus, the system will no longer operate at the proper pressures and temperatures and the efficiency will decrease.

The following general practices should be observed to insure chemical stability in the system:

1. Whenever it becomes necessary to disconnect a refrigerant connection, wipe away any dirt or oil at and near the connection to eliminate the possibility of dirt entering the system. Both sides of the connection should be capped, plugged or taped as soon as possible to prevent the entrance of dirt, foreign material and moisture. (It must be remembered that all air contains moisture. Air that enters any part of the refrigerant system will carry moisture with it and the exposed surfaces will collect the moisture quickly.)
2. Keep tools clean and dry. This includes the gage set and replacement parts.
3. When adding 525 viscosity refrigerant oil (see ADDING OIL in the "Discharging, Adding Oil, Evacuating and Charging Procedures for C.C.O.T. A/C Systems"), the container/transfer tube through which the oil will flow should be exceptionally clean and dry due to the fact that refrigeration oil is as moisture-free as it is possible to make it. Therefore, it will quickly absorb any moisture with which it comes in contact. For this reason, the oil container should not be opened until ready for use and then it should be capped immediately after use.
4. When it is necessary to "open" an A/C system, have everything needed ready and handy so that as little time as possible will be required to perform the operation. Do not leave the A/C system open any longer than is necessary.
5. Any time the A/C system has been "opened", it should be properly Evacuated before re-charging with Refrigerant-12 according to DISCHARGING, ADDING OIL, EVACUATING & CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS.

REFRIGERANT CHARGING PRECAUTIONS

Normally, air conditioning systems are charged making use of the J 23500-1 Charging Station which uses the 30 lb. container of Refrigerant-12. 14 oz. Refrigerant-12 disposable cans are also used. Discharging, Adding Oil, Evacuating and Charging Procedures for C.C.O.T. Systems are described on following pages in the Service Manual.

With 14 oz. Disposable Can Charging:

- Do not Charge while compressor system is hot.
- Empty container completely before disposing.
- When opening valves designed for use with container, follow manufacturer's directions carefully.
- Always use pressure gages before and during Charging.
- ALWAYS CHARGE THROUGH LOW-SIDE OF A/C SYSTEM (low-side fitting is found on Accumulator).
- NEVER connect on HIGH-SIDE of A/C system or to any system having a pressure higher than indicated on the R-12 container.
- See Disposable Can Charging procedures later in section.

With J 23500-01 Charging Station:

- Follow manufacturer's directions carefully with three exceptions:
- HI-PRESSURE VALVE OF GAGE SET SHOULD BE CLOSED AT ALL TIMES DURING CHARGING
- DO NOT CONNECT HIGH PRESSURE LINE TO A/C SYSTEM
- ALL EVACUATING AND CHARGING OF A/C SYSTEM MUST BE PERFORMED THROUGH LOW PRESSURE VALVE/LINE TO LOW-SIDE SERVICE FITTING ON ACCUMULATOR.

DIAGNOSIS

LEAK TESTING THE SYSTEM

Whenever a refrigerant leak is suspected in the system or a service operation performed which results in disturbing lines or connections, it is advisable to test for leaks. Common sense should be the governing factor in performing any refrigerant leak test, since the need and extent of any such test will, in general, depend upon the nature of the complaint and the type of service performed on the system.

LIQUID LEAK DETECTORS

There are a number of fittings and places throughout the air conditioning unit where a liquid leak detector solution may be used to pinpoint refrigerant leaks.

By merely applying solution to the area with the swab that is attached to the bottle cap, bubbles will form within seconds if there is a leak.

For confined areas, such as sections of the evaporator and condenser, the electronic leak detector is more practical for determining leaks.

ELECTRONIC LEAK DETECTOR - J 23400

The electronic refrigerant leak detector, J 23400 (Fig. 1B-18), is portable, powered by batteries and has only one control knob to adjust. The J 23400 is operated as follows:

1. Turn trigger knob ON and note piercing "squeal" generated by tester.
2. Continue to turn trigger knob in same direction until squeal stops.

At this point, the tester is ready for use. To check operation, remove cap from reference leak, remove sensor probe from brackets and hold electrode cage near the reference leak. The reference leak (1/2 oz. per year) will cause a tone to be generated from the tester. Replace reference leak cap and begin testing for leaks in refrigerant system.

Testing

If a malfunction in the refrigerant system is suspected due to abnormal system pressures, check the following:

1. Restrictions in evaporator or condenser core, hoses, tubes, etc.
2. Refrigerant leaks.
3. Compressor clutch slippage.
4. Improper drive belt tension.
5. Excessive moisture in refrigerant system.
6. Plugged accumulator, expansion tube (orifice) or compressor suction inlet screen.

Preliminary Checks

1. Check compressor belt for proper tension.
2. Check all refrigeration lines for leaks, kinks, or other restrictions.
3. Check all air ducts for leaks or restrictions. Air restriction may indicate a plugged (or partially plugged) evaporator core.

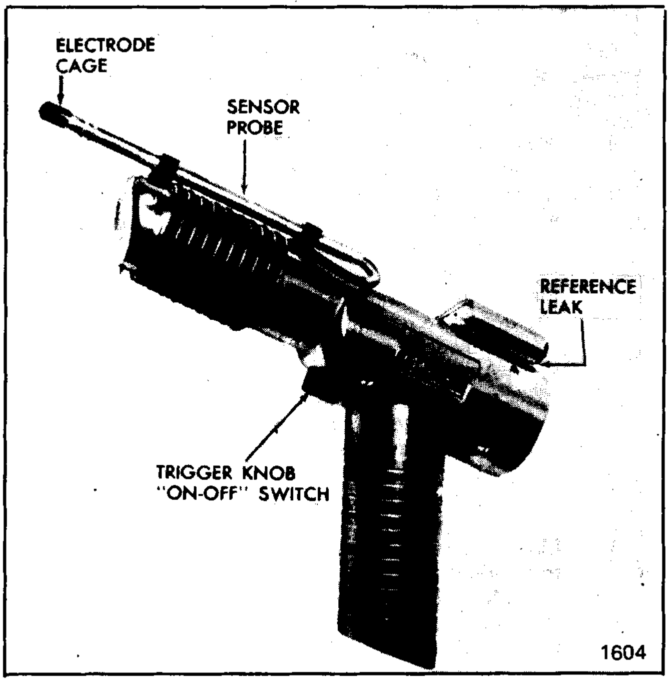

Fig. 1B-18 J 23400 Electronic Leak Detector

4. Check outer surfaces of radiator and condenser cores to be sure they are not plugged with dirt, leaves or other foreign material. Be sure to check between the condenser and radiator as well as the outer surfaces.
5. Start properly operating, tuned engine and set up A/C system according to appropriate Performance Conditions stated in A/C System Diagnostic Procedure.

C60 CUSTOM & C65 AUTO. TEMP. A/C FUNCTIONAL TEST–A, F, G SERIES

Custom engine operating, coolant warm and environment above 45°F. or 7°C. (C65 testing ambient should be 75°F. or 24°C.).

1. Move mode lever to OFF. Set blower switch to HI blower (full up) and move temperature lever to full COLD (all the way to the left).
    - The blower will run on LO speed with air flow out the heater outlet only.
    - The compressor is not running.
2. Move mode lever to DEFROST. (Note: Each lever position has a detent to lock the lever in place.)
    - Blower comes on HI speed.
    - Air comes chiefly from defroster nozzles with some air from heater outlet.
    - Compressor is running.
3. Move selector lever to HEATER.
    - Air comes chiefly from heater outlet with some air from defroster nozzles.
    - Compressor is not running.
4. Move temperature lever to maximum heat (all the way to the right).
    - Note increasing temperature of air from the heater outlet.
5. Move mode lever to VENT.
    - Air comes from A/C outlets.
    - The compressor is not running.
6. Move mode lever to BI-LEVEL.
    - Air comes from defroster nozzles, heater outlet and A/C outlets.
    - The compressor is running.
7. Move mode lever to NORMAL.
    - Air comes from the air conditioning outlets.
    - Compressor is running.
8. Move the blower switch to full down, pausing at each detent on way.
    - Blower speed and air flow decrease a step at each position.
9. Move mode lever to MAX.
    - Blower comes on HI speed.
    - Air noise is heard from right front corner of passenger compartment as system goes on "inside" air.
    - Compressor is running.

(Note that there is a restrictor in the line which will delay obtaining air from the defroster nozzle in heater and bi-level mode when coming from any position except defrost.)

C60 A/C FUNCTIONAL TEST–ALL H & X SERIES

A standard test of the function of the system is to be conducted in the following manner:

1. Doors or windows open.
2. Selector lever at NORM A/C with TEMP lever at cold.
3. Temperature indicators at condenser inlet and center outlet.
4. Start engine and run at 2000 R.P.M.
5. After one minute the minimum drop in temperature of the air from the center outlet should be as follows:

CONDENSER INLET TEMPERATURE	70°F. 21°C.	80°F. 27°C.	90°F. – 110°F. 32°C. – 43°C.
MINIMUM CTR. OUTLET TEMP. DROP	20°F. -7°C.	25°F. -4°C.	30°F. -1°C.

C60 CUSTOM A/C FUNCTIONAL TEST–B SERIES

Prior to test initiation, the engine should idle off fast idle speed cam, with the temperature lever set to maximum COLD, for about 20 minutes or until the engine thermostat is open (195°F. or 91°C.). Ambient temperature should be about 75°F. (24°C.) but not lower than 45°F. (7°C.) or above 90°F. (32°C.). Control lever efforts must also be checked. These efforts should not be too low (below 2 lb. using pull-scale) or too high (above 6.5 lb.) or repair/adjustment then be made.

1. Slide mode lever to OFF. Set blower switch to HI and leave the temperature lever in the maximum COLD position.
    - Blower air, the same temperature as air outside the vehicle, will be discharged from the heater outlet. The blower will run on LO speed only. The compressor is not running.
2. Slide the mode lever to NORM. Note the detent at each mode position and insure the lever efforts are within requirements above.
    - Blower air increases to HI speed and exits from the A/C outlets. The compressor comes "on" and may cycle off-and-on. Air temperature should be about 45°F. (7°C.) at the A/C outlets.
3. Slide the mode lever to BI LEVEL.
    - Air exits from the A/C outlets and the heater outlet. The air speed from the A/C outlets decreases some from Step 2, the compressor comes "on" and may cycle off-and-on. Air temperature should be about 45°F. (7°C.) from both the heater and A/C outlets.
4. Slide the mode lever to VENT.
    - Air exits from the A/C outlets only. The air speed should be HI (comparable to Step 2). The compressor is not running. Air temperature should be equivalent to air outside the vehicle.
5. Slide the mode lever to HEATER.
    - Air exits mainly from the heater outlet with some air from the defroster nozzle. The compressor is not running. Air temperature should be equivalent to air outside the vehicle. Blower speed should still be HI.
6. Slide the temperature lever from maximum COLD to maximum HOT (far left to far right). Note the lever effort requirements above.
    - The air temperature from the heater outlet should rise rapidly from outside ambient temperature to about 140°F. (60°C.) Blower speed should still be HI.
7. Slide the mode lever to DEFROST.
    - Air exits mainly from the defroster nozzle with some air from the heater outlet. The compressor comes "on" and may cycle off-and-on. Air temperature should be about 140°F. (60°C.). Blower speed should still be HI.
8. Move the blower switch to LO, pausing at each of the two intermediate positions.
    - Blower speed and air flow should decrease accordingly at each position.
9. Slide the temperature lever to maximum COLD (far left) and the mode selector to MAX.
    - Blower comes on HI speed. Air exits from the A/C outlets only. Air noise is heard from the right front corner of the passenger compartment as the system goes on "inside" air. The compressor comes "on" and may cycle off-and-on. Air temperature should be about 45°F. (7°C.) at the A/C outlets.

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Fig. 1B-19 1977 Functional A/C Tests

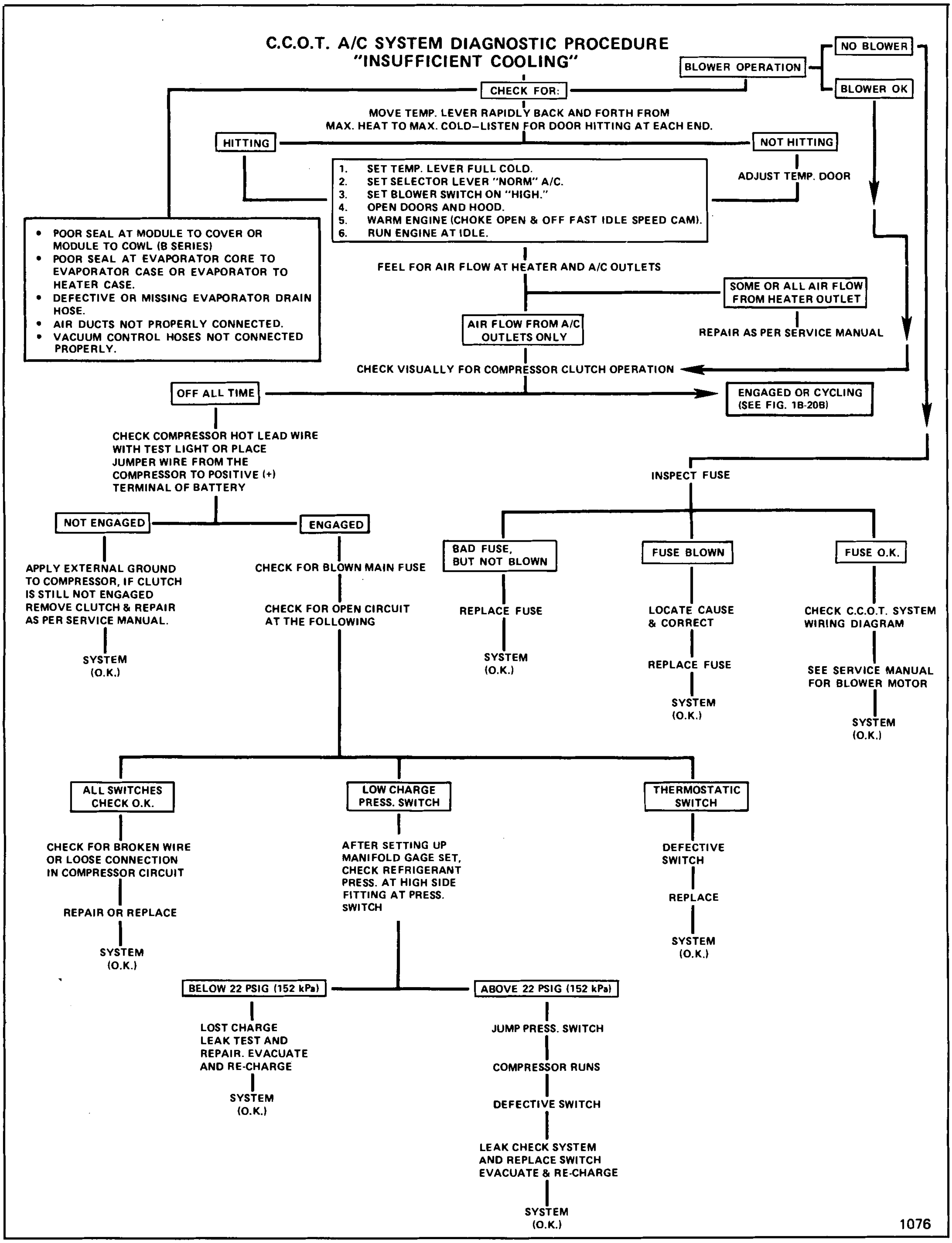
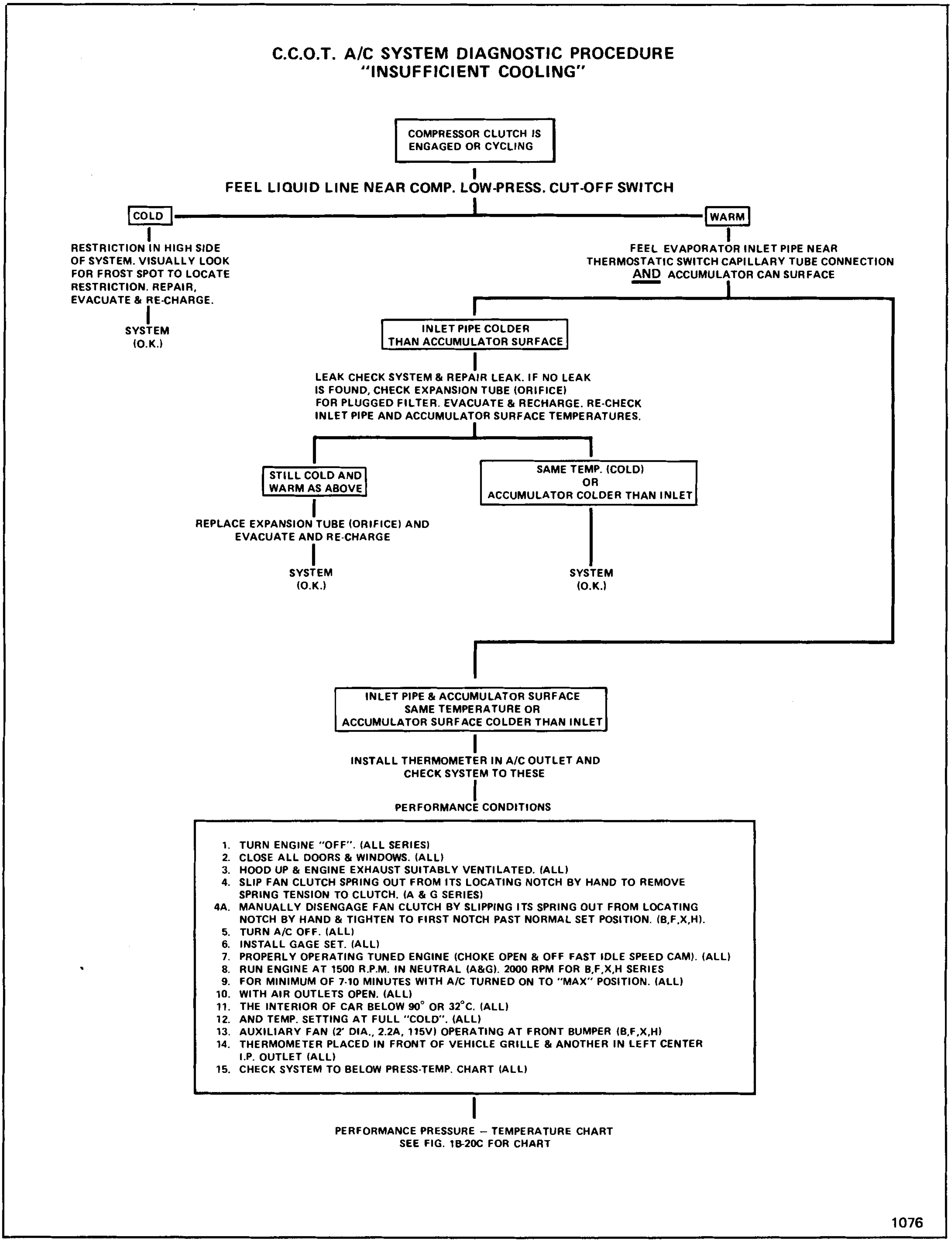


Fig. 1B-20A 1977 C.C.O.T. System Diagnostic Procedure



1. TURN ENGINE "OFF". (ALL SERIES)
2. CLOSE ALL DOORS & WINDOWS. (ALL)
3. HOOD UP & ENGINE EXHAUST SUITABLY VENTILATED. (ALL)
4. SLIP FAN CLUTCH SPRING OUT FROM ITS LOCATING NOTCH BY HAND TO REMOVE SPRING TENSION TO CLUTCH. (A & G SERIES)

4A. MANUALLY DISENGAGE FAN CLUTCH BY SLIPPING ITS SPRING OUT FROM LOCATING NOTCH BY HAND & TIGHTEN TO FIRST NOTCH PAST NORMAL SET POSITION. (B,F,X,H).

5. TURN A/C OFF. (ALL)
6. INSTALL GAGE SET. (ALL)
7. PROPERLY OPERATING TUNED ENGINE (CHOKE OPEN & OFF FAST IDLE SPEED CAM). (ALL)
8. RUN ENGINE AT 1500 R.P.M. IN NEUTRAL (A&G). 2000 RPM FOR B,F,X,H SERIES
9. FOR MINIMUM OF 7-10 MINUTES WITH A/C TURNED ON TO "MAX" POSITION. (ALL)
10. WITH AIR OUTLETS OPEN. (ALL)
11. THE INTERIOR OF CAR BELOW 90° OR 32°C. (ALL)
12. AND TEMP. SETTING AT FULL "COLD". (ALL)
13. AUXILIARY FAN (2' DIA., 2.2A, 115V) OPERATING AT FRONT BUMPER (B,F,X,H)
14. THERMOMETER PLACED IN FRONT OF VEHICLE GRILLE & ANOTHER IN LEFT CENTER I.P. OUTLET (ALL)
15. CHECK SYSTEM TO BELOW PRESS-TEMP. CHART (ALL)

Fig. 1B-20B 1977 C.C.O.T. System Diagnostic Procedure

C.C.O.T. A/C SYSTEM DIAGNOSTIC PROCEDURE "INSUFFICIENT COOLING"

PERFORMANCE PRESSURE—TEMPERATURE CHART

REFRIGERANT CHARGE (SEE FIG. 1B-17)

TEMPERATURE OF AIR ENTERING CONDENSER		70 F (21 C)	80 F (27 C)	90 F (32 C)	100 F (38 C)	110 F (43 C)
*COMPRESSOR OUT PRESSURE (BEFORE EXPANSION ORIFICE	A & G SERIES	125-175 psi 862-1207 kPa	145-195 psi 1000-1345 kPa	170-220 psi 1172-1517 kPa	195-245 psi 1345-1689 kPa	225-275 psi 1551-1896 kPa
	B SERIES	140-180 psi 965-1241 kPa	170-210 psi 1172-1448 kPa	200-240 psi 1379-1655 kPa	235-275 psi 1620-1896 kPa	265-305 psi 1827-2103 kPa
	F SERIES		195-235 psi 1345-1620 kPa		225-265 psi 1551-1827 kPa	
	X SERIES		160-200 psi 1103-1379 kPa		215-255 psi 1482-1758 kPa	
	ASTRE		160-200 psi 1103-1379 kPa		230-270 psi 1586-1862 kPa	
	SUNBIRD		160-200 psi 1103-1379 kPa		240-280 psi 1655-1931 kPa	
*EVAPORATOR PRESSURE (AT ACCUMULATOR)**	A & G SERIES	25-32 psi 172-221 kPa	25-32 psi 172-221 kPa	25-32 psi 172-221 kPa	25-32 psi 172-221 kPa	25-32 psi 172-221 kPa
	B SERIES	24-27 psi 165-186 kPa	24-27 psi 165-186 kPa	24-27 psi 165-186 kPa	24-27 psi 165-186 kPa	24-27 psi 165-186 kPa
	F SERIES		24-27 psi 165-186 kPa		24-27 psi 165-186 kPa	
	X SERIES		24-27 psi 165-186 kPa		24-27 psi 165-186 kPa	
	ASTRE		24-27 psi 165-186 kPa		24-27 psi 165-186 kPa	
	SUNBIRD		24-27 psi 165-186 kPa		24-27 psi 165-186 kPa	
*DISCHARGE AIR TEMPERATURE— LEFT CENTER OUTLET	A & G SERIES	39-44 F 283-303 C	40-45 F 276-310 C	41-46 F 283-317 C	43-48 F 296-331 C	45-50 F 310-345 C
	B SERIES	41-43 F 283-296 C	42-44 F 290-303 C	42-44 F 290-303 C	43-45 F 296-310 C	43-45 F 296-310 C
	F SERIES		38-45 F 262-310 C		38-45 F 262-310 C	
	X SERIES		38-45 F 262-310 C		38-45 F 262-310 C	
	ASTRE		38-45 F 262-310 C		38-45 F 262-310 C	
	SUNBIRD		38-45 F 262-310 C		38-45 F 262-310 C	

*Just before compressor disengages **At sea level

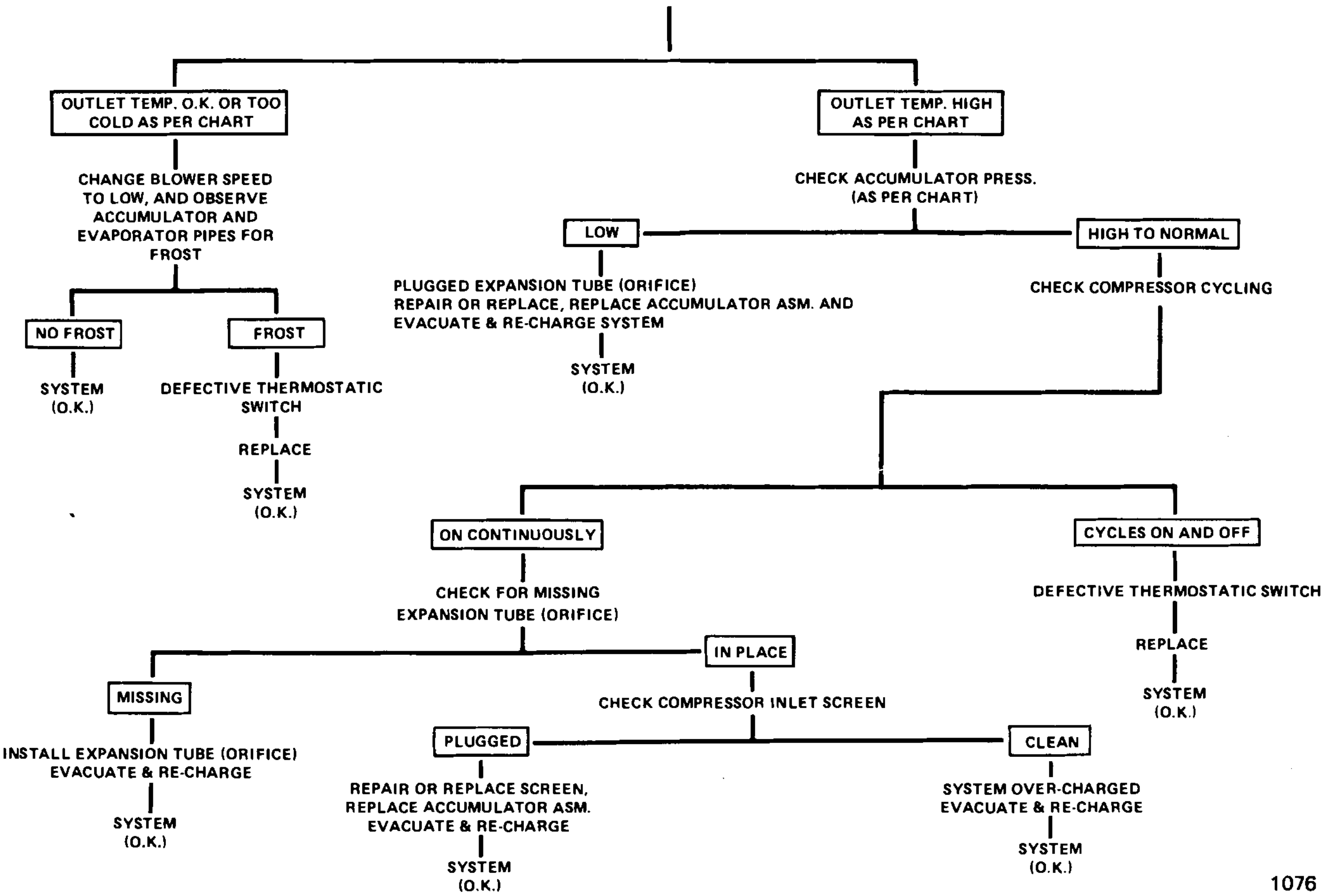


Fig. 1B-20C 1977 C.C.O.T. System Diagnostic Procedure

TROUBLE DIAGNOSIS

When diagnosing problems in the electrical and vacuum systems of the air conditioning system, consult Figs. 1B-1 thru 1B-7 for electrical wiring diagrams and Figs. 1B-9 thru 1B-14 for vacuum diagrams. (NOTE: Ports on rotary vacuum valves are illustrated in a manner to provide simplicity in following vacuum schematic lines but are numbered in consecutive order on the actual valve).

Operational Test

To aid in determining whether or not the air conditioning electrical, air, vacuum and refrigeration systems are operating properly and efficiently, a table of performance characteristics is shown in Fig. 1B-20.

1. Operation of the air conditioning blower at all four speeds and engagement of the compressor clutch would indicate that the electrical circuits are functioning properly.
2. The same hand-felt temperature of the evaporator inlet pipe **AND** the accumulator can surface of an operating system would indicate a properly charged Refrigeration-12 system.
3. Operation of the control panel selector (mode) lever to distribute air from designed outlets would indicate proper vacuum and diaphragm function.

INSUFFICIENT HEATING

CONDITION AND CAUSE	CORRECTION
Heater outlet Temperature too low.	Check duct work for proper installation. Check blower operation. Inspect TEMP lever and cable for proper operation. Check heater hoses for function. On A, B and G Series check water control valve as follows: 1. Start engine and allow to warm up. 2. Set control panel for MAX mode. 3. Feel hose from water valve to heater core. Hose should not be hot. This indicates that vacuum is applied to the water control valve and that the water supply to the heater core is shut off. In any other position of the control panel selector (mode) lever, water should flow to the heater core. If not, check water control valve and vacuum supply hose. 4. On B Series, C60 Custom A/C, vacuum should be applied and water flow should stop as temperature lever is moved to maximum COLD position in any A/C mode position.

A/C REFRIGERANT SYSTEM DIAGNOSIS

INSUFFICIENT COOLING "QUICK-CHECK" PROCEDURE

The following C.C.O.T. "Hand-Feel" procedure can be used to quickly determine whether or not the system has the proper charge of Refrigerant-12 (providing ambient temperature is above 70°F. or 21°C.). This check can be made in a matter of minutes, simplifying system diagnosis by pinpointing the problem to the amount of R-12 charge in the system or by eliminating this possibility from the over-all checkout.

1. Engine must be warm (CHOKE OPEN and OFF FAST IDLE SPEED CAM).

2. Hood and body doors open.

3. Selector lever set at NORM.

4. Temperature lever at COLD.
5. Blower on HI.
6. Normal engine idle.
7. "Hand-Feel" temperature of evaporator inlet pipe near thermostatic switch capillary tube connection AND accumulator can surface with compressor engaged.

a. BOTH SAME TEMPERATURE **AND** SOME DEGREE COOLER THAN AMBIENT--Proper condition: check for other problems (see A/C System Diagnostic Procedure).

b. INLET PIPE COOLER than accumulator surface-low refrigerant charge.

- Add slight amounts (1/4 lbs.) of refrigerant UNTIL BOTH feel the same temperature. Allow stabilization time between additions.
- Then ddd 14 oz. (1 can) additional refrigerant.

c. INLET PIPE HAS FROST ACCUMULATION--Accumulator surface warmer; proceed as in Step b above.

THERMOSTATIC SWITCH DIAGNOSIS

1. Install Gage Set and set up the vehicle as described under "Performance Conditions" in "C.C.O.T. System Diagnostic Procedure".
2. Set the control at NORM mode, LO blower.

- The thermostatic switch should cycle the compressor off in 5 minutes or less. If the compressor operates continuously AND the accumulator frosts, this is an abnormal condition and will lead to evaporator freeze-up. The problem is either loose clamps around the capillary tube to the evaporator inlet pipe or a defective switch.
- If the compressor does not operate, thermostatic switch is defective (provided that it has been established that battery voltage is available at one swtich terminal with the A/C "on"). This, of course, results in no cooling. Replace the switch.
- The thermostatic switch is pre-set and cannot be adjusted.

When trouble shooting the refrigerant system, refer to Fig. 1B-20, "C.C.O.T. A/C System Diagnostic Procedure".

B SERIES A/C DIAGNOSTIC CONNECTOR

Before using these diagnostic charts, check system operation as follows with ignition switch turned ON. M1 means low intermediate speed; M2 means high intermediate speed.

Blower Switch Positions	A/C Control Mode Position	Operation should be: Blower Speed	Compressor Clutch
Low, M1, M2, High	OFF	Low only	Off
Low, M1, M2, High	Vent, Heat	Low, M1, M2, High	Off
Low, M1, M2, High	Norm, Bi-Level & Defrost	Low, M1, M2, High	On
Low, M1, M2, High	Max	High only	On

Look up the sympton in the charts and make the checks indicated. The connector will allow you to quickly isolate the problem to a unit (switch, relay, clutch, blower, etc.) or the wire connecting that unit in the circuit. If the problem area is a given control (switch or relay) or wire, the defect can be found by jumpering across the control.

If the jumper makes the system work, the control is defective. If not, the problem is in the wire or connector. With the jumper in place, connect a voltmeter from the jumper to ground. If no voltage is present, fault is in the hot lead. If voltage is present, the fault is in the other wire.

B SERIES C60 & C65 AIR CONDITIONING ELECTRICAL DIAGNOSIS

Ignition switch in ON position, engine stopped and inside car temperature over 55°F. (13°C.).

Blower switch in LOW position and A/C control in VENT mode unless otherwise noted.

NOTE: Always check connections at a unit before replacing it.

1. No blower, any speed compressor clutch engages	a. 1 to G	3 volts or more	Faulty motor, ground or capacitor lead.
		Under 3 volts	Go to b.
	b. 2 to G	3 volts or more	Faulty relay, or purple wire, relay to motor.
		Under 3 volts	Stalled motor.
2. No blower and compressor clutch does not engage	If Heater-A/C fuse is blown, check for a ground in circuit, or excessive motor or clutch current. If not, check for an open lead from ignition switch to low blower delay (in-car ambient) switch or bad A/C harness ground.		
3. No low speed	3 to G	10 volts or more	Faulty resistor.
		Under 10 volts	Faulty low blower delay (in-car ambient) switch or wire to resistor.
4. No low or M1 Speed			Faulty resistor.
5. No blower except in high or max A/C	2 to G	3 volts or more	Faulty relay.
		Under 3 volts	Faulty resistor or wire from resistor to relay.
6. No high blower under any condition Place blower switch in HIGH	9 to G	10 volts or more	Faulty high blower relay, open red wire to relay, or bad relay ground.
		Under 10 volts	Faulty wire to relay coil from blower switch.
7. No high speed except in max A/C			Faulty blower switch.
8. No high speed in Max A/C			Faulty A/C control or wire from A/C control to blower switch.
9. No M1 speed			Faulty blower switch or wire to resistor.
10. No M2 speed			Faulty blower switch or wire to resistor.
11. No M1, M2 or high with switch (OK in max A/C). Place blower switch in HIGH	Voltage at A/C control terminal #2	10 volts or more	Faulty blower switch to wire to blower switch.
		Under 10 volts	Faulty A/C control.

12. Low bLower only (compressor clutch inoperative)	4 to G	10 volts or more	Faulty A/C control
		Under 10 volts	Faulty wire from low blower delay (in-car ambient) switch to A/C control.
13. Compressor clutch and blower motor inoperative	See symptom #2		
14. Comp. clutch operates in norm., max., bi-level or defrost, but not in all			Faulty A/C control.
15. Compressor clutch inoperative (blower OK) A/C control in norm.	a. 6 to G	10 volts or more	Faulty clutch or ground, or compressor clutch harness.
	b. 8 to G	Under 10 volts	Go to step b.
		10 volts or more	Faulty thermostatic switch or wire to clutch.
	c. 7 to G	Under 10 volts	Go to step c.
		10 volts or more	Faulty refrigerant pressure switch, wire from refrigerant pressure switch to thermostatic switch, or low refrigerant charge.
		Under 10 volts	Faulty A/C control or lead from control to refrigerant pressure switch.

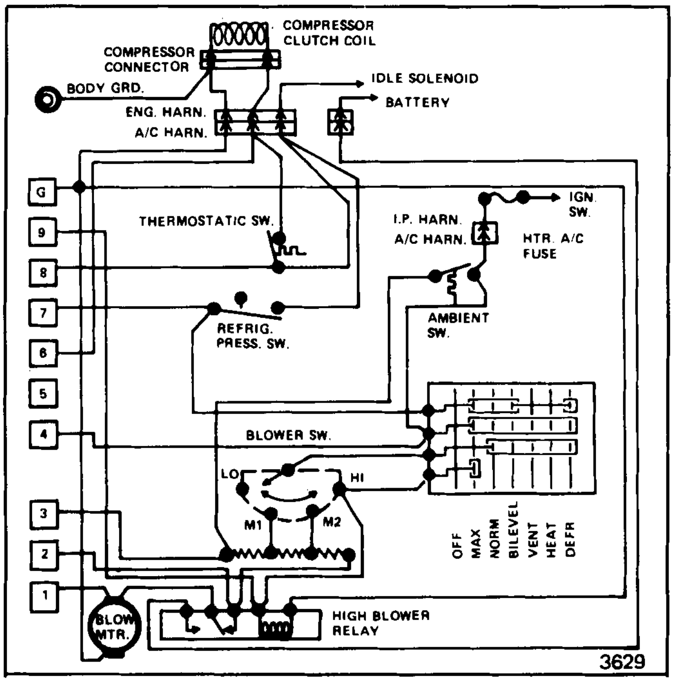


Fig. 1B-21 1977 B Series Diagnostic Connector Wiring Diagram

ON-CAR SERVICE PROCEDURES

PRECAUTIONARY SERVICE MEASURES

Before any service is attempted which requies opening of refrigerant lines or components, the person doing the work should be thoroughly familiar with the information under PRECAUTIONS IN HANDLING REFRIGERANT-12, PRECAUTIONS IN HANDLING REFRIGERANT LINES AND FITTINGS, MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM, AND REFRIGERANT CHARGING PRECAUTIONS and should follow very carefully the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS instructions given on the following pages for the unit being serviced.

The major reasons behind these measures are safety and the prevention of dirt and moisture in the system which can restrict A/C system refrigerant flow.

The presence of moisture can also cause the formation of hydochloric or hydrofluoric acids in the system.

All sub-assemblies are dehydrated and sealed prior to shipping. They are to remain sealed until just prior to making connections. All sub-assemblies should be at room temperature before uncapping (this prevents condensation of moisture from the air that enters the system). If, for any reason, caps are removed but the connections are not made, parts should be resealed as soon as possible.

All precautions should be taken to prevent damage to fittings or connections. Any fittings getting grease or dirt on them should be wiped clean with a cloth dampened with trichlorethylene (naphtha, stoddard solvent or kerosene may be used). Make sure fittings are dry prior to re-assembly. If dirt, grease or moisture get inside pipes and cannot be removed, the pipe should be replaced.

Sealing caps should be removed from sub-assemblies just prior to making connections for final assembly. Use a small amount of clean 525 viscosity refrigerant oil on all tube and hose joints. Always use new O-rings dipped in the clean refrigerant oil when assembling joints. The oil will aid in assembly and help provide a leak-proof joint. When tightening joints, use a second wrench to hold stationary part of connection so that a solid feel can be attained. This will indicate proper assembly.

METAL TUBE OUTSIDE DIAMETER	THREAD AND FITTING SIZE	STEEL TUBING TORQUE		ALUMINUM OR COPPER TUBING TORQUE		NOMINAL TORQUE WRENCH SPAN
		LB. FT.	N·m	LB. FT.	N·m	
1/4	7/16	10-15	14-20	5-7	7-9	5/8
3/8	5/8	30-35	41-48	11-13	15-18	3/4
1/2	3/4	30-35	41-48	15-20	20-27	7/8
5/8	7/8	30-35	41-48	21-27	29-37	1 1/16
3/4	1 1/16	30-35	41-48	28-33	38-45	1 1/4

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Fig. 1B-22 1977 Pipe & Hose Connection Torque Chart

CAUTION: *Tighten all tubing connections as shown in torque chart (Fig. 1B-22). Insufficient or excessive torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage.*

DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS

The refrigerant system may be Discharged, Evacuated and Charged using J 23500-01 air conditioning Service Charging Station or the J 5725-04 Manifold and Gage Set and 14 oz. disposable cans of Refrigerant-12.

Charging lines from the Charging Station or Manifold and Gage Set require the use of gage adapters to connect to system service fittings. A straight gage Adapter J 5420 and a 90-degree angle gage Adapter J 9459 are available.

WARNING: ALWAYS WEAR GOGGLES AND WRAP A CLEAN CLOTH AROUND FITTINGS AND CONNECTIONS WHEN DOING WORK THAT INVOLVES OPENING THE REFRIGERATION SYSTEM. IF LIQUID REFRIGERANT COMES INTO CONTACT WITH THE SKIN OR EYES, INJURY CAN RESULT.

DISCHARGING THE C.C.O.T. A/C SYSTEM

In replacing any of the air conditioning refrigeration components the system must be completely discharged of Refrigerant-12.

1. With ignition turned OFF, remove protective cap from LOW-SIDE service fitting and connect Charging Station J 23500-01 Gage Set as indicated below.

or 1. With ignition turned OFF and protective cap removed from LOW-SIDE service fitting, discharge system by SLOWLY connecting a gage hose to LOW-SIDE service fitting on Accumulator and discharging into oil bottle (Fig. 1B-24). As hose is SLOWLY tightened down onto Schrader valve, Refrigerant-12 will begin to discharge from the system into the container. If no discharge occurs, check for missing or defective Schrader depressor in hose fitting.

2. When the system is completely discharged (no vapor escaping with hose fully-tightened down), measure, record and discard any collected oil. If this quantity is 1/2 OZ. OR MORE, it must be added to system, plus any trapped in removed parts BEFORE Evacuation and Charging with Refrigerant-12 (see C.C.O.T. Refrigerant Oil Distribution for specific quantity instructions on oil found in removed parts).

3. With the LOW-SIDE of system **fully** discharged, check high-side system fitting (on liquid line or muffler) for remaining pressure by connecting a downward directed 36" section J 4318-35B Charging Line with attached J 24598 Straight or J 25499 901 angle Fitting Adapter SLOWLY tightened down to depress the fitting valve.

4. **If pressure is found on the high-side** of the system, attempt to discharge high-side using same procedure as used for low-side. (This condition indicates a restriction and high-side components should be removed and/or diagnosed to determine the area restricted.)

WARNING: AS ALWAYS, PERSONAL CARE MUST BE TAKEN WHENEVER A COMPONENT IS REMOVED WHERE ENTRAPMENT OF REFRIGERANT IS SUSPECTED.

EVACUATING, ADDING REFRIGERANT OIL AND CHARGING THE C.C.O.T. A/C SYSTEM

If the system has been opened for any repair, or the Refrigerant-12 charge lost, the system must be Evacuated prior to Charging to remove any trace of air or moisture that may have entered.

NOTE: Evacuation and Charging is a combined procedure, with all lines and gages, as well as the system, to be purged with R-12 and Evacuated just prior to Charging.

There are three standard Refrigerant-12 Evacuate and Charge procedures which include Oil Addition:

- J 23500-01 Charging Station Method
- Disposable Can Method
- Drum Method

CAUTION: *Under no circumstances should alcohol be used in the system in an attempt to remove moisture, regardless of the successful use of alcohol in other refrigerant systems.*

Prior to Evacuation, check the low pressure gage for proper calibration. With the gage disconnected from the refrigeration system, be sure that the pointer indicates to the center of "O". Lightly tap gage a few times to be sure pointer is not sticking. If necessary, calibrate as follows:

a. Remove cover from gage.

b. Holding gage pointer adjusting screw firmly with one hand, carefully force pointer in the proper direction in proper amount to position pointer through the center of "O" position. Tap gage a few times to be sure pointer is not sticking. Replace gage cover.

J 23500-01 CHARGING STATION METHOD

Follow Charging instructions provided with the J 23500-01 Charging Station in use **with the following exceptions:**

1. DO NOT CONNECT THE HIGH PRESSURE LINE TO THE AIR CONDITIONING SYSTEM.

2. KEEP THE HIGH PRESSURE VALVE ON THE CHARGING STATION CLOSED AT ALL TIME.

3. PERFORM THE ENTIRE EVACUATE AND CHARGE PROCEDURE THROUGH THE ACCUMULATOR LOW-SIDE PRESSURE SERVICE FITTING.

4. ADDING OIL TO THE C.C.O.T. A/C SYSTEM should take place **after** Discharge and **before** Evacuation procedures by removing the refrigeration suction hose at the Accumulator outlet pipe connection, pouring the correct quantity of refrigerant oil into the hose or pipe and then properly reconnecting hose to pipe (see Discharging Step No.

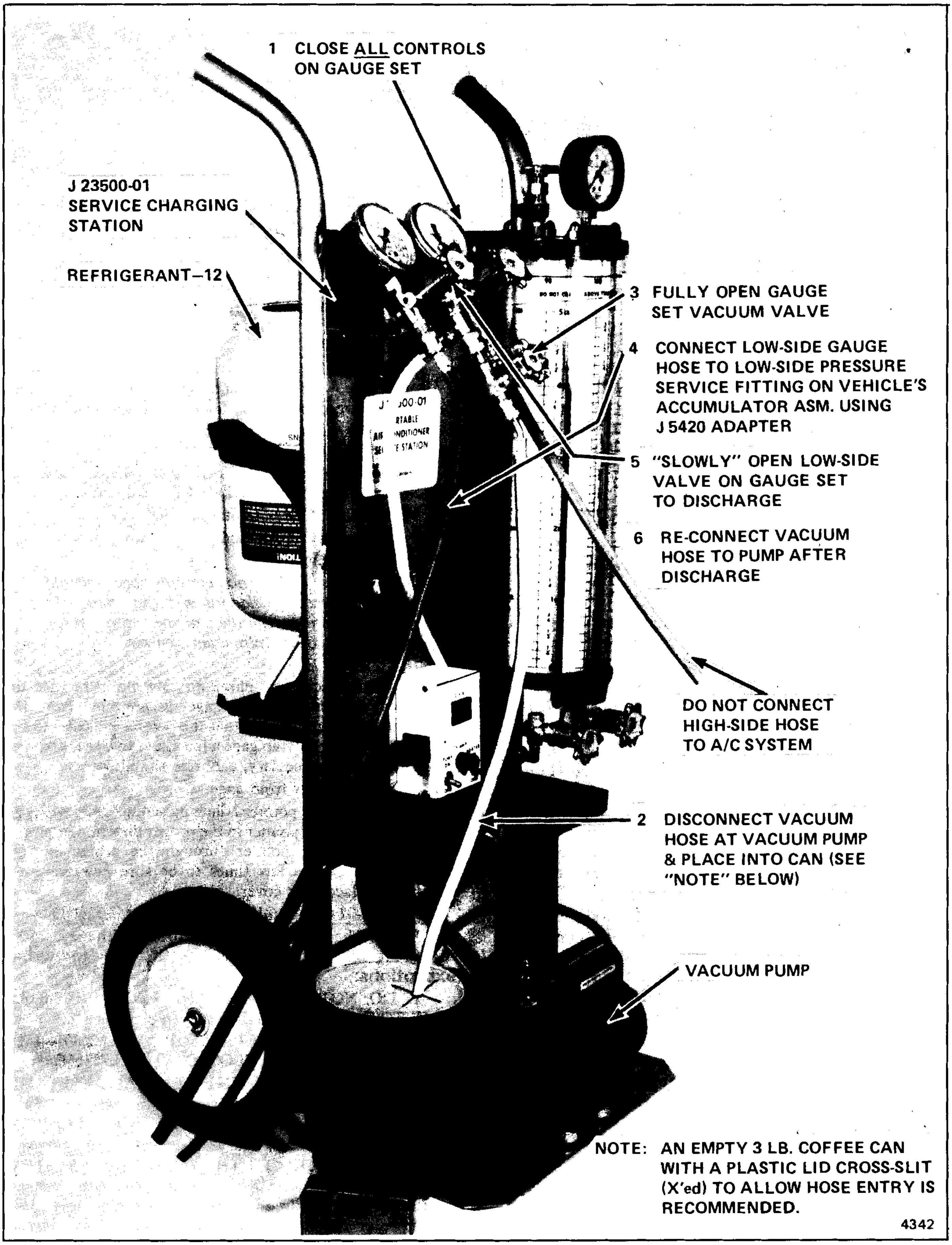


Fig. 1B-23 Discharging the 1977 C.C.O.T. A/C System with J 23500-01 Station

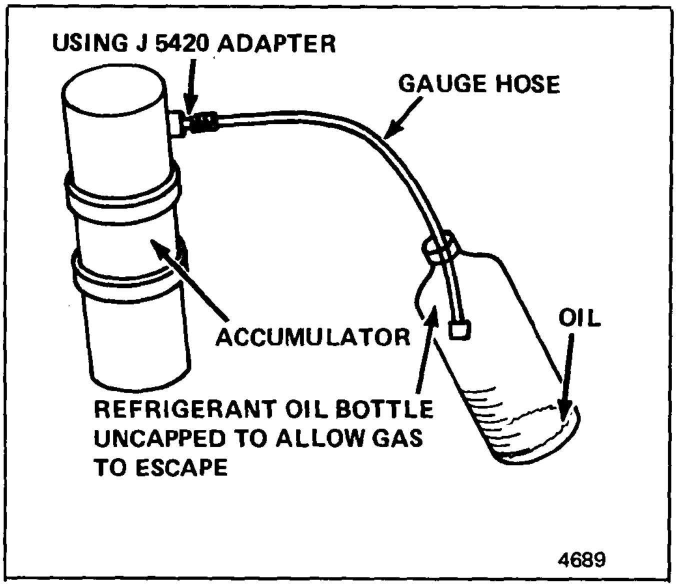


Fig. 1B-24 Discharging the 1977 C.C.O.T. A/C System Without J 23500-01 Station

2 and C.C.O.T. REFRIGERANT OIL DISTRIBUTION for specific quantity instructions).

5. Following these procedures will prevent accidental high-side vehicle system pressure being subjected to the Charging Station in the event an error is made in valve sequence during compressor operation to pull in the Refrigerant-12 charge.

6. See ADDITIONAL CHARGING INSTRUCTIONS on following page.

DISPOSABLE CAN OR REFRIGERANT DRUM METHOD

ADDING OIL TO THE C.C.O.T. A/C SYSTEM should take place **after** Discharge **and before** Evacuation procedures by removing the refrigeration suction hose at the Accumulator outlet pipe connection, pouring the correct quantity of refrigerant oil into the hose or pipe and then properly reconnecting hose to pipe (see Discharging Step No. 2 and C.C.O.T. REFRIGERANT OIL DISTRIBUTION for specific quantity instructions).

- If the Refrigerant-12 drum is used, place it on a scale and note the total weight before Charging. Watch the scale during Charging to determine the amount of R-12 used.
- If disposable R-12 cans are used close the tapping valve and then attach can(s) following instructions included with the tapping valve or tapping manifold adapter.

1. Connect Manifold Gage Set J 5725-04 as shown in Fig. 1B-25.

- LOW pressure gage set valve to Accumulator.
- Gage set center hose to Refrigerant-12 source
- High pressure gage set valve to vacuum pump.

2. **TO BEGIN EVACUATION OF THE C.C.O.T. A/C SYSTEM,** with Manifold Gage Set and Vacuum Pump as illustrated in Fig. 1B-25, SLOWLY open high and low-side gage valves and begin vacuum pump operation. Pump the system for 15 minutes **after low-side** gage reaches 28"-29" vacuum or more.

NOTE: In all Evacuation procedures, the specification of 28"-29" of Mercury vacuum is used. This specification can only be reached at or near sea level. **For each 1,**000 feet above sea level, specification should be lowered by one inch of mercury vacuum. At 5,000 feet elevation only 23"-24" of vacuum is required.

If prescribed vacuum can't be reached, close vacuum control valve, shut off pump and look for a leak at connections or pump.

3. When the system is fully Evacuated, close the high-side gage set valve and turn OFF the vacuum pump.

4. Water **low-side** gage to be sure vacuum holds for 5 (FIVE) minutes. Proceed to Charging if vacuum is held.

5. IF VACUUM DOES NOT HOLD FOR 5 MINUTES, charge system with 1/2 pound Refrigerant-12 and leak check. Discharge system again and repair leak as necessary. Repeat Evacuation procedure.

TO BEGIN CHARGING OF THE C.C.O.T. A/C SYSTEM

With the Refrigerant-12 drum or can(s) inverted, open R-12 source valve(s) and allow liquid R-12 to flow into system (see "Refrigerant Charging Capacities" for full-charge requirement). See following ADDITIONAL CHARGING INSTRUCTIONS.

Additional Charging Instructions

If sufficient R-12 has not flowed into the system, use the compressor as follows to draw in the remainder of the R-12 charge.

1. Shut off R-12 source valve.

2. Jumper wire the C.C.O.T. System thermostatic switch by removing connector from switch and installing jumper in connector to keep compressor clutch from cycling.

3. Start engine, run with choke open and fast idle speed reduced to normal idle, set A/C control on NORM and blower speed on HI.

4. SLOWLY re-open R-12 source valve and control to maintain 40 p.s.i. (276 kPa) or less LOW-SIDE gage reading to draw in balance of required full-charge amount of R-12.

NOTE: During this Charging, operation can be sped by placing a large volume fan to pass air over the condenser. If condenser temperature is maintained below charging cylinder temperature, Refrigerant-12 will enter system more rapidly.

5. Shut off R-12 source valve and run engine for 30 seconds to clear lines and gages.

6. With the engine running, remove the charging low-side hose **adapter from the Accumulator service fittings.** Unscrew rapidly to avoid excess R-12 escape from system.

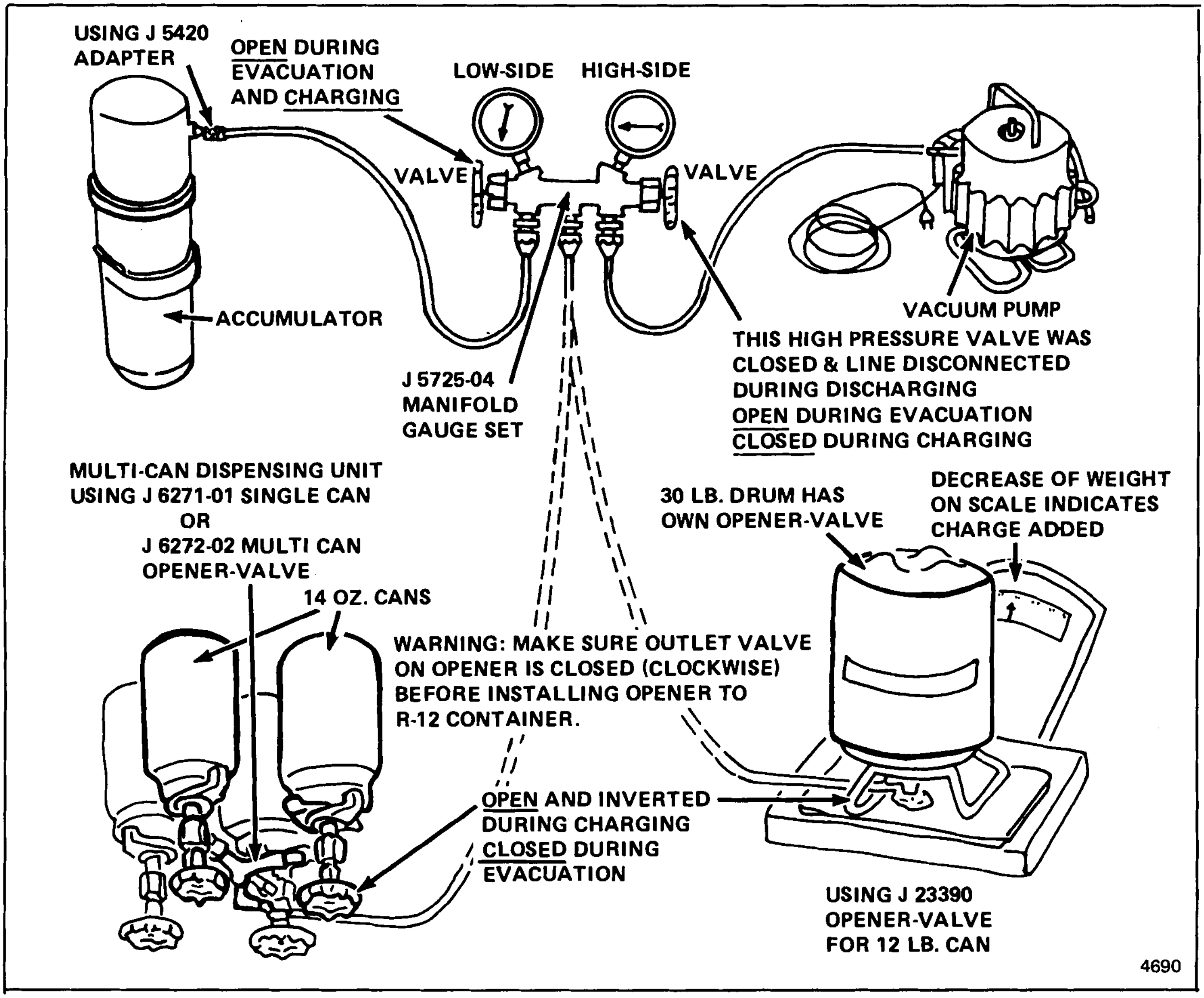


Fig. 1B-25 Charging the 1977 C.C.O.T. A/C System With Disposable Can or Refrigerant Drum

WARNING: NEVER REMOVE A GAGE LINE FROM ITS ADAPTER WHEN LINE IS CONNECTED TO A/C SYSTEM. ALWAYS REMOVE THE LINE ADAPTER FROM THE SERVICE FITTING TO DISCONNECT A LINE. DO NOT REMOVE CHARGING HOSE AT GAGE SET WHILE ATTACHED TO ACCUMULATOR. THIS WILL RESULT IN COMPLETE DISCHARGE OF SYSTEM DUE TO THE DEPRESSED SCHRADER VALVE IN SERVICE LOW-SIDE FITTING.

7. Replace protective cap on Accumulator fitting and remove jumper wire from thermostatic switch. Reconnect thermostatic switch.

8. Leak check system with J 23400 Electronic Leak Detector.

9. With system fully charged and leak-checked, continue to operate system and test for proper system pressures as outlined under PERFORMANCE DATE in C.C.O.T. A/C SYSTEM DIAGNOSTIC PROCEDURE.

ACCUMULATOR ASSEMBLY

The accumulator assembly for the C.C.O.T. system has a service replacement which includes two O-rings (for the inlet and outlet connections). The desiccant within the shell is NOT serviced separately - it is part of the sealed accumulator assembly.

The accumulator assembly should ONLY be replaced when:

1. A physical perforation to the accumulator is found, resulting in a leak.
2. The expansion tube (orifice) screen is plugged.
3. The compressor inlet screen is plugged.
4. An evaporator fails because of inside-out (internal) corrosion.

DO NOT REPLACE the accumulator assembly when:

1. Merely a dent is found in the outer shell of the accumulator.

2. A vehicle is involved in a collision and no physical perforation to the accumulator is found. An open refrigerant line should be capped or have a plastic bag tightly taped around it.

COMPRESSOR OVERHAUL

For Compressor REMOVAL AND INSTALLATION, see Figures 1B-172 thru 175 later in section.

For all practical purposes, all vehicles make use of the same air conditioning 4 and 6-cylinder compressors. Actual differences between compressors are found in their mounting brackets, pulleys, connector assemblies and compressor capacities, none of which will affect the following Overhaul Procedures.

When servicing the compressor, it is essential that steps be taken to prevent dirt or foreign material from getting on or into the compressor parts and system during disassembly or reassembly of the compressor. CLEAN TOOLS AND CLEAN WORK AREA ARE VERY IMPORTANT FOR PROPER SERVICE. The compressor connection areas and the exterior of the compressor should be cleaned off as much as possible prior to any "on are" repairs or removal of the compressor for workbench service. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with clean solvent (trichlorethylene, naphtha or stoddard solvent) and dried with dry air. When necessary to use a cloth on any part, it should be of a non-lint producing type.

Although certain service operations can be performed without completely removing the compressor from the car, the operations described herein are based on bench over-haul with the compressor removed from the car. They have been prepared in sequence in order of accessibility of the components.

Pad fender/skirt and secure compressor near top of fender skirt with wire, rope, etc.

CAUTION: *Do not kink or place excessive tension on lines or hoses.*

MINOR REPAIR PROCEDURES FOR THE A-6 COMPRESSOR

The following operations to the A-6 Compressor Clutch Plate and Hub, Pulley and Bearing, and Coil and Housing are covered as "Minor" because they may be performed WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR from the vehicle.

The Compressor Shaft Seal assembly and Pressure Relief Valve may also be serviced WITHOUT REMOVING THE COMPRESSOR from the vehicle but these operations are covered later in this section as "Major Repair Procedures" because the system MUST FIRST BE PURGED of Refrigerant-12.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to Fig. 1B-27 and Fig. 1B-28 for information relative to parts nomenclature and location.

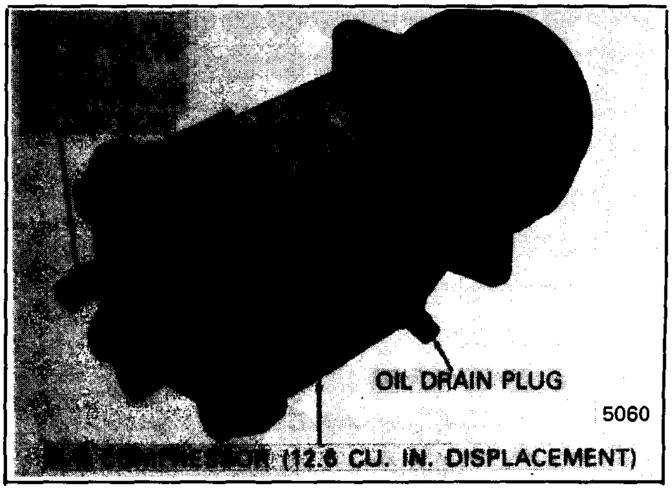


Fig. 1B-26 A-6 Compressor

Removal and illustration of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench.

The work area, tools, and parts must be kept clean at all times. Parts Tray J 9402 (see Fig. 1B-60) should be used for all parts being removed, as well as for replacement parts.

When an A-6 compressor is removed from the car for servicing, the amount of oil remaining in the compressor should be drained **and measured.** This oil should then be discarded and new 525 viscosity refrigerant oil added to the compressor (See Fig. 1B-26 and see "C.C.O.T. Refrigerant Oil Distribution").

The accumulator in the A-6 system must also be removed-oil drained-measured, etc. if the compressor is removed from the system. The opposite is also true. If the accumulator is removed, then the compressor must also be removed and oil quantities determined (see "C.C.O.T. Refrigerant Oil Distribution").

A-6 COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY

Remove

1. Place Holding Fixture J 9396 in a vise and clamp the compressor in the Holding Fixture.

2. Keep clutch hub from turning with Clutch Hub Holder J 25030 or J 9403, and remove locknut from end of shaft using Thin Wall Socket J 9399 (Fig. 1B-29).

CAUTION: *To avoid internal damage to the compressor, DO NOT DRIVE OR POUND on the Clutch Plate and Hub assembly OR on the end of the shaft. If proper tools to remove and replace clutch parts are not used, it is possible to disturb*

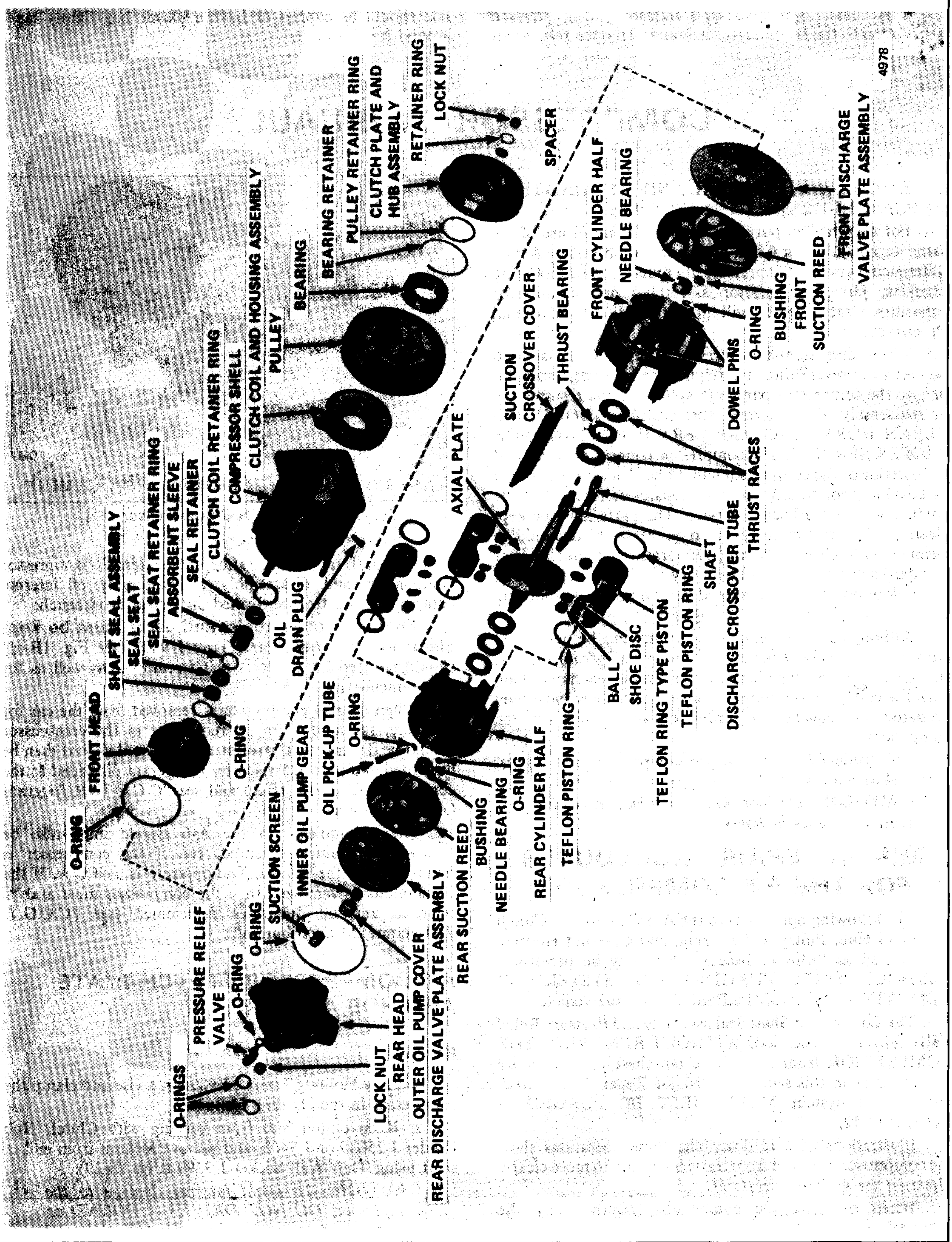


Fig. 1B-27 Exploded View of A-6 Compressor

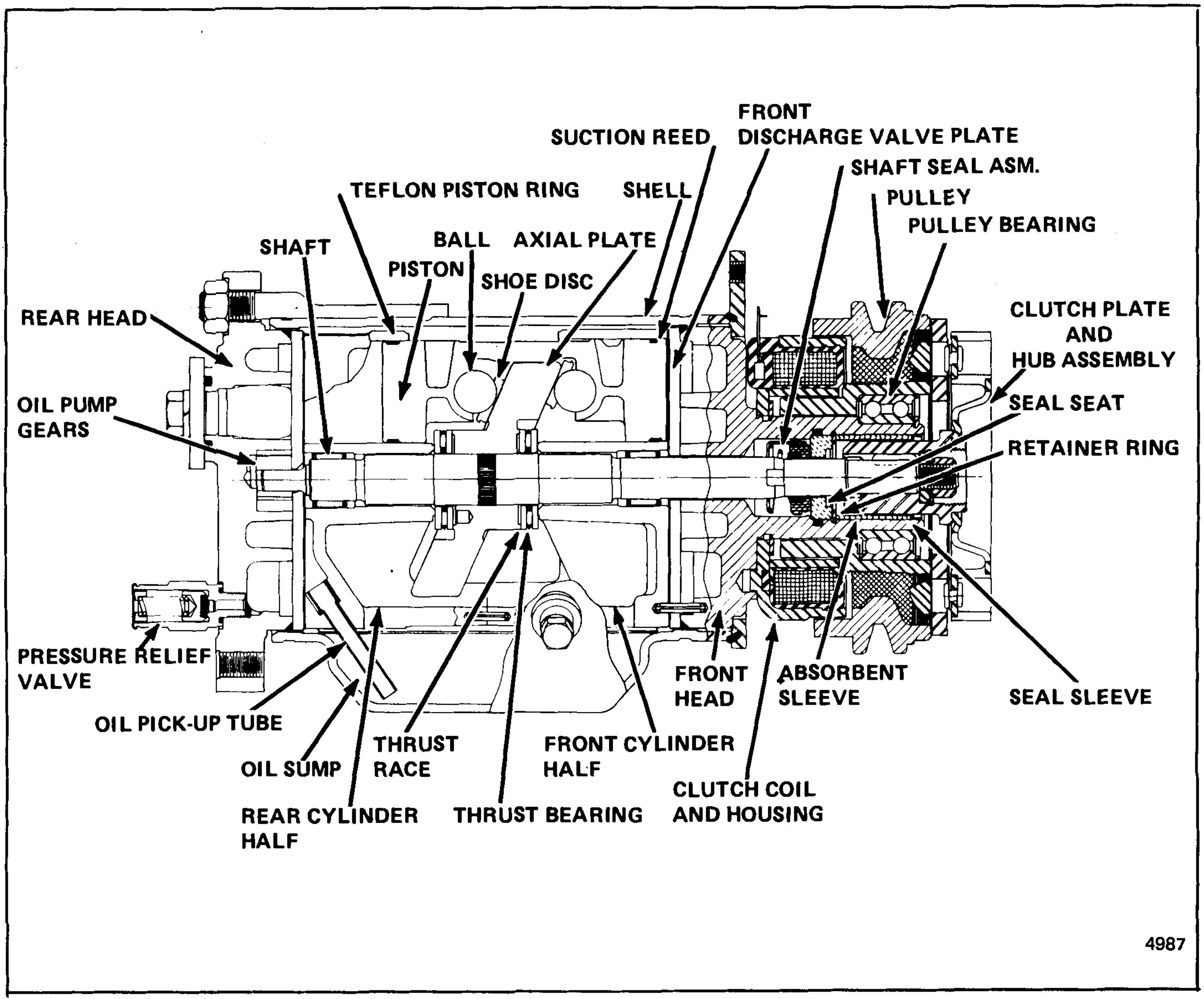


Fig. 1B-28 1977 A-6 Compressor Cross Section

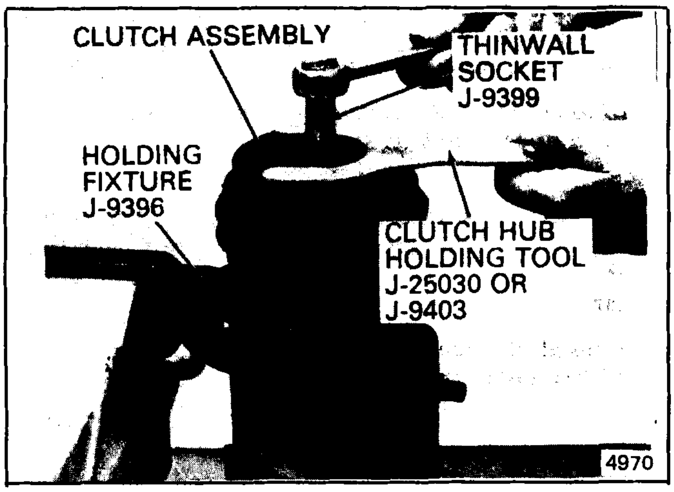


Fig. 1B-29 Removing 1977 A-6 Shaft Lock Nut

the position of the axial plate (keyed to the main shaft), resulting in compressor damage and seal leakage due to shifting of the crankshaft.

3. Thread Clutch Plate and Hub assembly Remover J 9401 into hub. Hold body of Remover with a wrench and tighten center screw to remove Clutch Plate and Hub assembly (Fig. 1B-30).

4. Remove square drive key from shaft or drive plate hub.

5. Remove hub spacer retainer ring using Snap-Ring Pliers J 5403 (#21), and then remove hub spacer (Fig. 1B-31).

6. Inspect driven plate for cracks or stresses in the drive surface. Do not replace driven plate for a scoring condition (Fig. 1B-32).

If the frictional surface shows signs of damage due to excessive heat, the clutch plate and hub and pulley and bearing should be replaced. Check further for the underlying cause of the damage (i.e. low coil-voltage - coil should draw 3.2 amps at 12 volts - or binding of the compressor internal

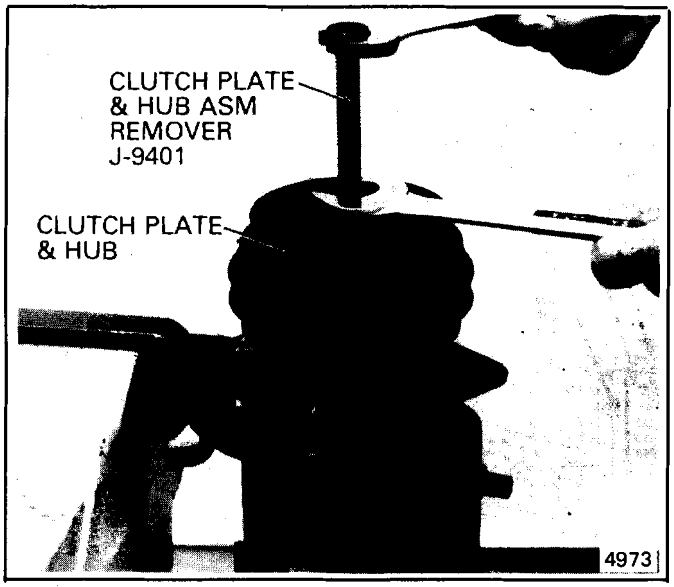


Fig. 1B-30 Removing 1977 A-6 Clutch Plate and Hub Asm.

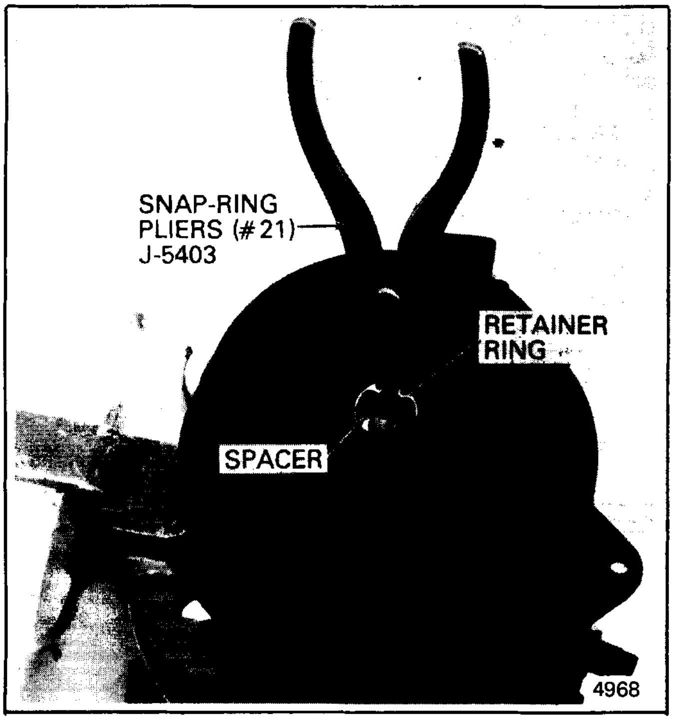


Fig. 1B-31 Removing or Installing Retainer Ring in 1977 A-6 Clutch Drive Plate

mechanism, clutch air gap too wide, broken drive plate to hub asm. springs, etc.

Replace

1. Insert the square drive key into the hub of driven plate; allow it to project approximately 3/16" out of the keyway.

2. Line up the key in the hub with keyway **in the shaft** (Fig. 1B-33).

3. Position the Drive Plate Installed J 9480-1 on the threaded end of the shaft. The Spacer J 9480-2 should be in place **under** the hex nut on the tool. This tool has a left hand thread on the body (Fig. 1B-34).

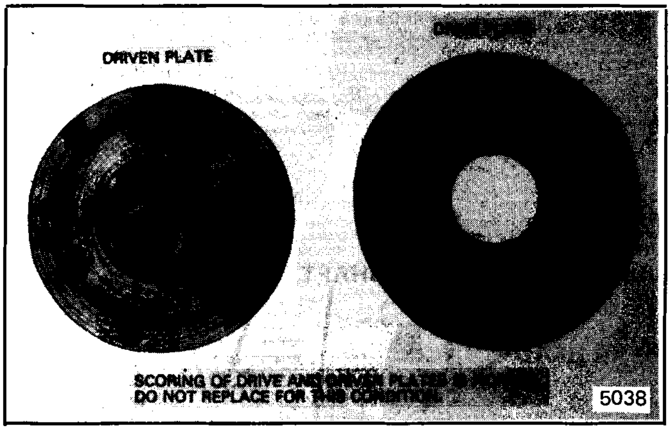


Fig. 1B-32 1977 A-6 Clutch Driven Plate and Drive Plate

Fig. 1B-33 Aligning 1977 A-6 Drive Plate Key

4. Press the driven plate onto the shaft until there is approximately 3/32" space between the frictional faces of the clutch drive plate and pulley.

CAUTION: *Make certain key remains in place when pressing hub on shaft.*

A ZERO thrust race is approximately 3/32" thick and may be used to roughly gage this operation. Use Clutch Hub Holder J 25030 or J 9403 to hold clutch plate and hub if necessary.

5. Install the hub spacer and, using Snap-Ring Pliers J 5403 (#21), install the retainer ring (see installed Retainer Ring in inset of Fig. 1B-28), with convex side of ring facing spacer.

6. Using Thin-Wall Socket J 9399 and Clutch Hub Holder J 25030 or J 9403 to install a new shaft locknut **with shoulder or circular projection on the locknut facing towards retainer ring.** Tighten the nut to 14-26 lb.ft. torque. Air gap between the frictional faces should now be .022" to .057" (Fig. 1B-35). If not, check for mispositioned key or shaft.

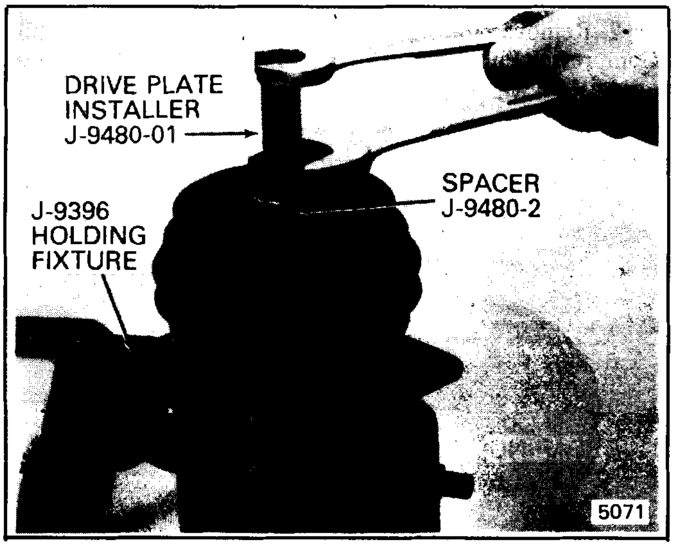


Fig. 1B-34 Installing 1977 A-6 Drive Plate

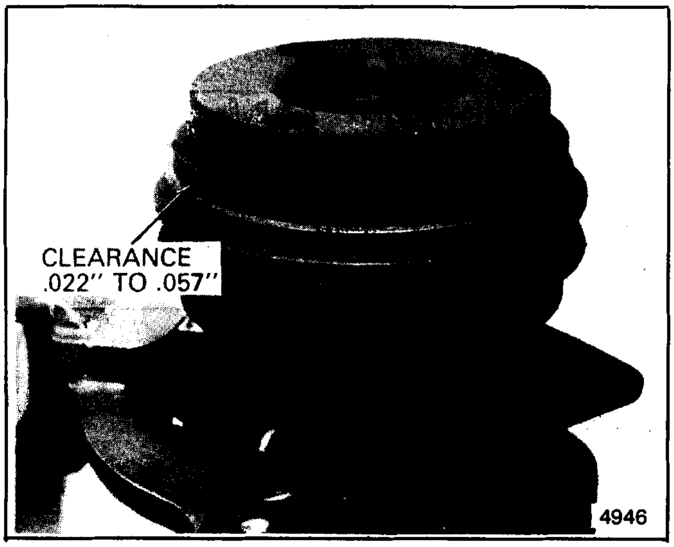


Fig. 1B-35 Checking 1977 A-6 Air Gap

7. The pulley should now rotate freely.

8. Operate the refrigeration system under MAXimum load conditions and engine speed at 2000 RPM. Rapidly cycle the clutch by turning the air conditioning system on-and-off at least 15 times at approximately one second intervals to burnish the mating parts of the clutch.

A-6 COMPRESSOR PULLEY AND BEARING ASSEMBLY

Remove

1. Remove clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Assembly" removal procedure.

2. Remove pulley retainer ring using Snap-Ring Pliers J 6435 (#26), Fig. 1B-36.

3. Pry out absorbent sleeve retainer, and remove absorbent sleeve from compressor neck.

4. Place Puller Pilot J 9395 over end of compressor shaft.

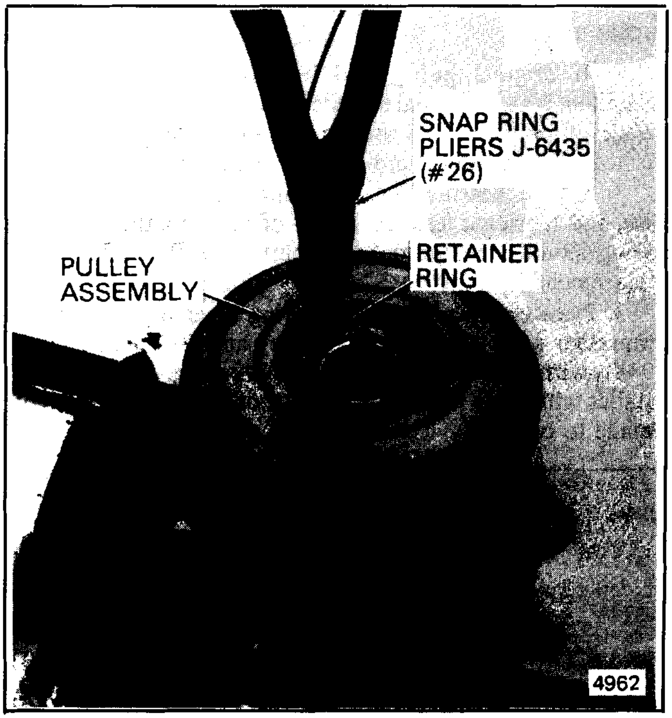


Fig. 1B-36 Removing 1977 A-6 Pulley Retainer Ring

CAUTION: *It is important that Puller Pilot J 9395 be used to prevent internal damage to compressor when removing pulley.* **Under no circumstances should Puller be used DIRECTLY against drilled end of shaft.**

5. Remove Pulley and Bearing Assembly using Pulley Puller J 8433 (Fig. 1B-37).

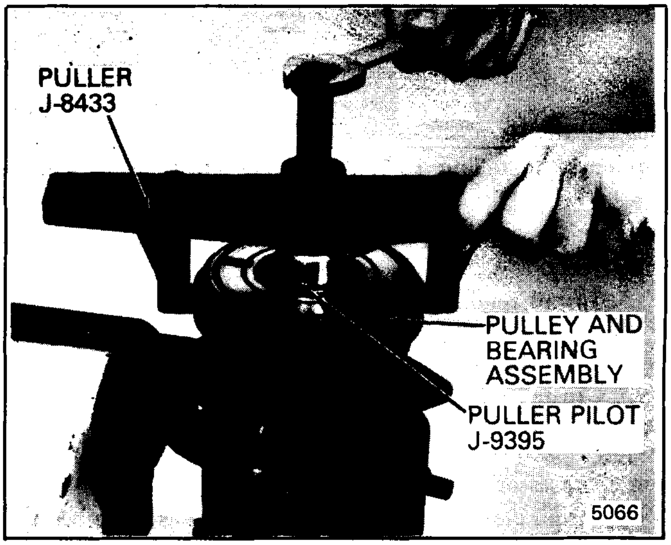


Fig. 1B-37 Removing 1977 A-6 Pulley and Bearing Asm.

Inspection

Check the appearance of the pulley and bearing assembly (see Fig. 1B-32). The frictional surfaces of the pulley and bearing assembly should be cleaned with a suitable solvent before reinstallation.

Replace

1. If original pulley and bearing assembly is to be reinstalled, wipe frictional surface of pulley clean. If frictional surface of pulley shows any indication of damage due to overheating, the pulley and bearing should be replaced.

2. Check bearing for brinelling, excessive looseness, noise, and lubricant leakage. If any of these conditions exist, bearing should be replaced. See "Compressor Pulley Bearing" Replacement Procedure.

3. Press or tap pulley and bearing assembly on neck of compressor until it seats, using Pulley and Bearing Installer J 9481 with Universal Handle J 8092 (Fig. 1B-38). The Installer will apply force to inner race of bearing and prevent damage to bearing.

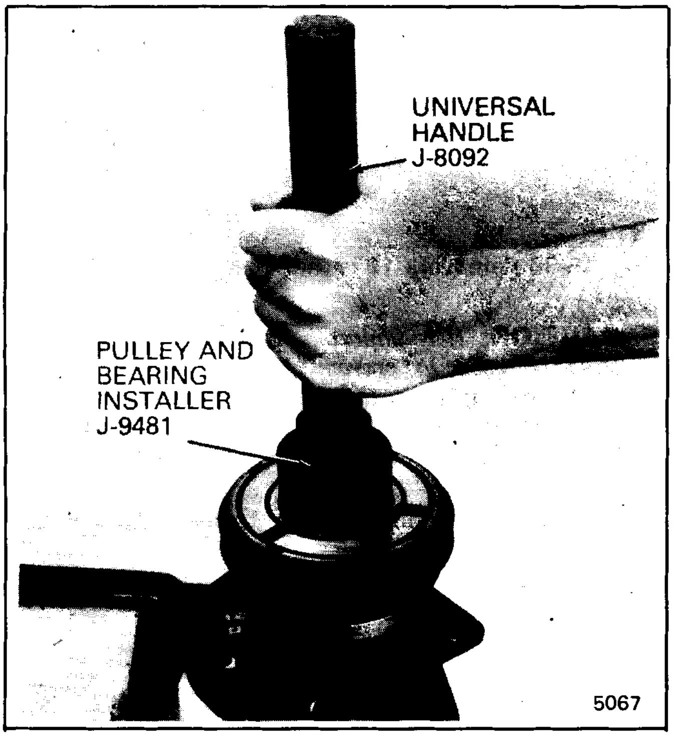


Fig. 1B-38 Installing 1977 A-6 Pulley and Bearing Asm.

4. Check pulley for binding or roughness. Pulley should rotate freely.

5. Install retainer ring, using Snap Ring Pliers J 6435 (#26).

6. Install absorbent sleeve in compressor neck.

7. Install absorbent sleeve retainer in neck of compressor. Using sleeve from Seal Seat Remover-Installer J 23128, install retainer so that outer edge is recessed 1/32" from compressor neck face.

8. Install clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Replacement Procedure.

A-6 COMPRESSOR PULLEY BEARING

Remove

1. Remove clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Removal procedure.

2. Remove pulley and bearing assembly as described in "Compressor Pulley and Bearing Asm." Removal procedure.

3. Remove pulley bearing retainer ring with a small screwdriver or pointed tool (Fig. 1B-39).

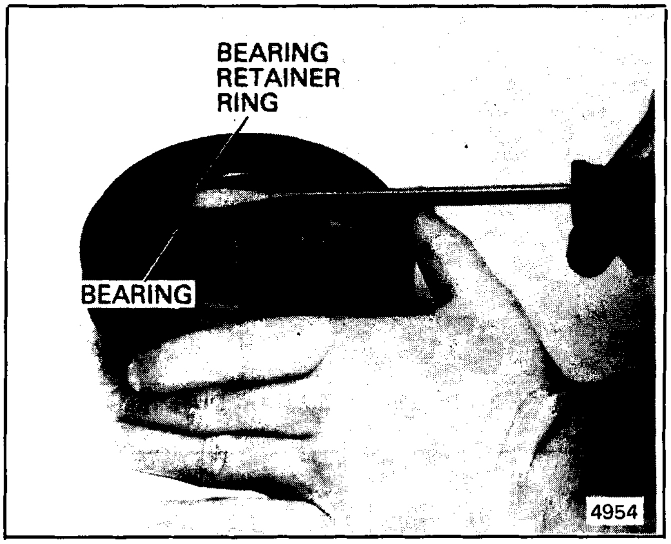


Fig. 1B-39 Removing 1977 A-6 Pulley and Bearing Retainer Ring

4. Place pulley and bearing assembly on inverted Support Block J 21352 and, using Pulley Bearing Remover J 9398 with Universal Handle J 8092, drive Bearing assembly out of pulley (Fig. 1B-40).

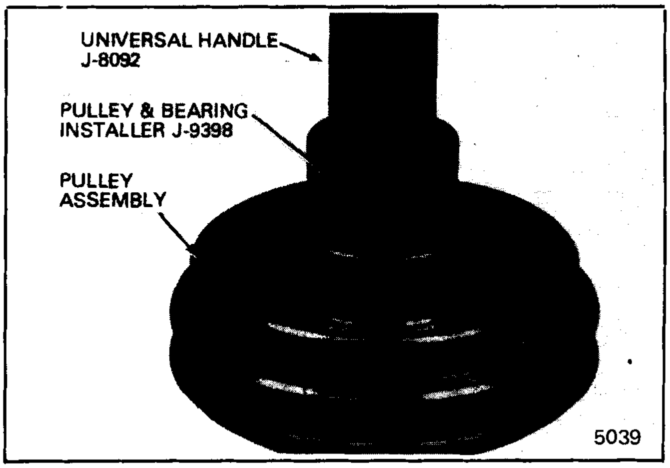


Fig. 1B-40 Removing Bearing From 1977 A-6 Pulley Asm.

Replace

1. Install new bearing in pulley using Pulley and Bearing Installer J 9481 with Universal Handle J 8092 (Fig. 1B-41). The Installer will apply the force to the outer race of the bearing.

> **CAUTION:** *DO NOT CLEAN NEW BEARING ASSEMBLY WITH ANY TYPE OF SOLVENT. Bearing is supplied with correct lubricant when assembled and requires no other lubricant at any time.*

2. Install bearing retainer ring, making certain that it is properly seated in ring groove.

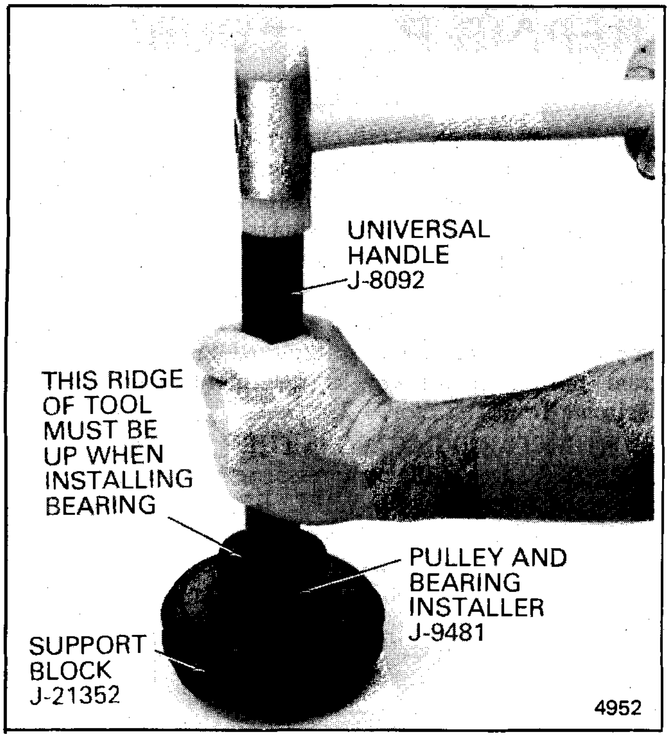


Fig. 1B-41 Installing Bearing on 1977 A-6 Pulley

3. Install pulley and bearing assembly as described in "Compressor Pulley and Bearing Asm." Replacement procedure.

4. Install clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Replacement procedure.

A-6 COMPRESSOR CLUTCH COIL AND HOUSING ASSEMBLY

Remove

1. Remove clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Removal procedure.

2. Remove pulley and bearing assembly as described in "Compressor Pulley and Bearing Asm." Removal procedure. **Note position of terminals on coil housing and scribe location on compressor front head casting.**

4. Remove coil housing retaining ring using Snap-Ring Pliers J 6435 (#26) (Fig. 1B-42).

5. Lift Coil and Housing assembly off compressor.

Replace

1. Position coil and housing assembly on compressor front head casting so that electrical terminals line up with marks previously scribed on compressor (Fig. 1B-43).

2. Align locating extrusions on coil housing with holes in front head casting.

3. Install coil housing retainer ring **with flat side of ring facing coil,** using Snap-Ring Pliers J 6435 (#26).

4. Install pulley and bearing assembly as described in "Compressor Pulley and Bearing Asm." Replacement procedure.

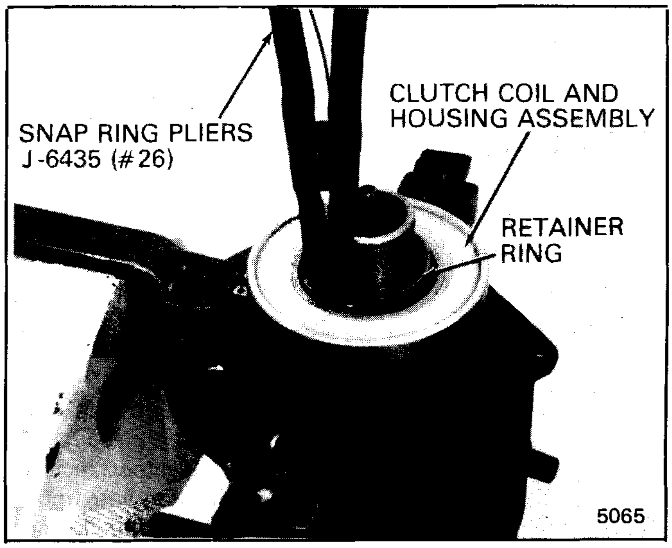


Fig. 1B-42 Removing 1977 A-6 Coil Housing Retainer Ring

5. Install clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Replacement procedure.

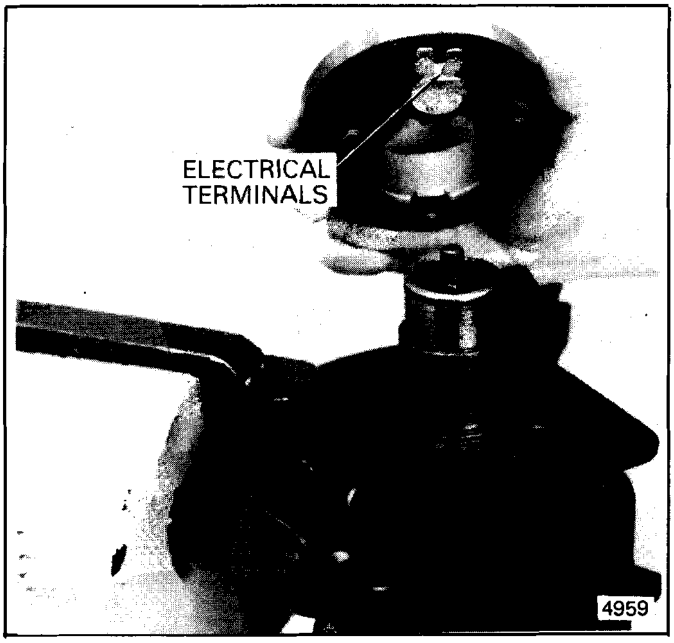


Fig. 1B-43 Installing 1977 A-6 Coil Housing

MAJOR A-6 COMPRESSOR REPAIR PROCEDURES

Service repair procedures to the Compressor Shaft Seal and Pressure Relief Valve or disassembly of the Internal Compressor Mechanism are considered "MAJOR" SINCE THE REFRIGERATION SYSTEM MUST BE COMPLETELY PURGED OF REFRIGERANT before proceeding and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of the proper, clean service tools. Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

These procedures are based on the use of the proper service tools and the condition that an adequate stock of service parts is available.

All parts required for servicing are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the mechanism assembly just as they are removed from the service package.

Piston shoe discs and shaft thrust races will be identified by "number" on the parts themselves for reference to determine their size and dimension (see Fig. 1B-68).

A-6 COMPRESSOR SHAFT SEAL

SEAL LEAK DETECTION

A SHAFT SEAL SHOULD NOT BE CHANGED BECAUSE OF AN OIL-LINE ON THE HOOD INSULATOR. The seal is designed to seep some oil for lubrication purposes. Only change a shaft seal when a leak is detected by the following procedure.

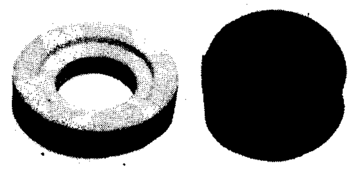
When refrigerant system components other than the compressor are replaced, the compressor must be removed and oil drained from the compressor if oil was sprayed in large amounts due to leaks or a broken shaft seal.

Compressor shaft seals, unless replaced during a compressor overhaul, are to be replaced only on the basis of actual refrigerant leakage as determined by test with Electronic Leak Detector, J 23400.

WHEN REPLACING THE SHAFT SEAL ASSEMBLY, even if the compressor remains on the vehicle during the operation, IT WILL BE NECESSARY TO PURGE THE SYSTEM OF REFRIGERANT as outlined earlier in the Service Manual. (See "Discharging, Adding Oil, Evacuating and Charging Procedures for C.C.O.T. A/C Systems".)

Remove

1. After first purging the system of refrigerant, remove the clutch plate and hub assembly and shaft key as described in "Compressor Clutch Plate and Hub Asm." Removal procedure.
2. Pry out the sleeve retainer and remove the absorbent sleeve. Remove the shaft seal seat retaining ring, using Snap-Ring Pliers J 5403 (#21). See Figure 1B-45.
3. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal seat and the shaft itself. **This is absolutely necessary to prevent any dirt or foreign material from getting into compressor.**
4. Place Seal Protector J 22974 over the end of the shaft to prevent chipping the ceramic seat. Fully engage the knurled tangs of Seal Seat Remover-Installer J 23128 into the recessed portion of the seal seat by turning the handle



SPECIFICATION PARTS	
SEAL	CARBON MATERIAL. LARGE CHAMFER ON INSIDE DIAMTER.
SEAT	CERAMIC MATERIAL WITH POLISHED FACE.
O-RINGS	NEOPRENE, THUS CAPABLE OF GIVING HEAT RESISTANCE AND LIFE EXPECTANCY.

Fig. 1B-44 Specification 1977 A-6 and R-4 Compressor Shaft Seal Kit

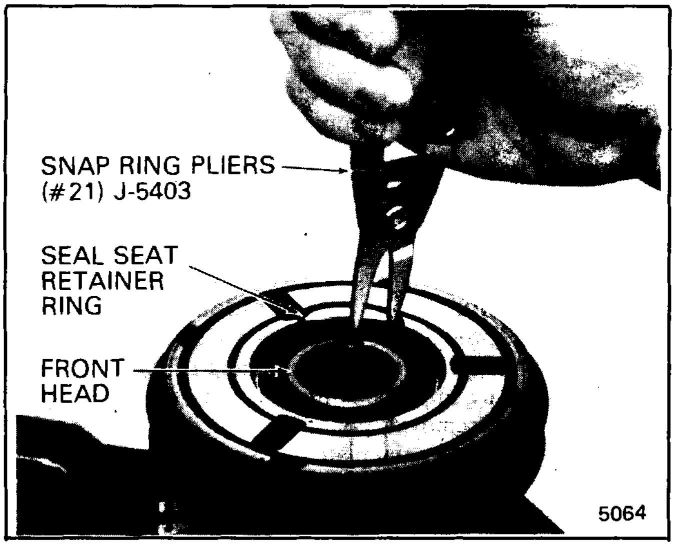


Fig. 1B-45 Removing or Installing 1977 A-6 Shaft Seal Seat Retaining Ring

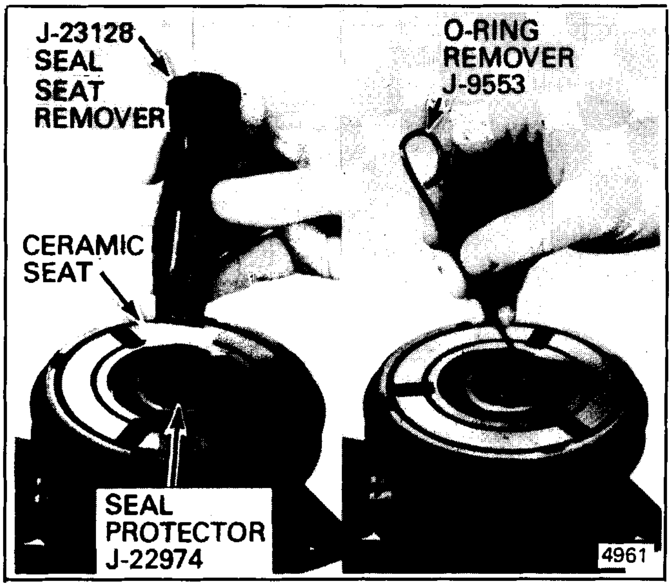


Fig. 1B-46 Removing 1977 A-6 Shaft Seal Seat and O-

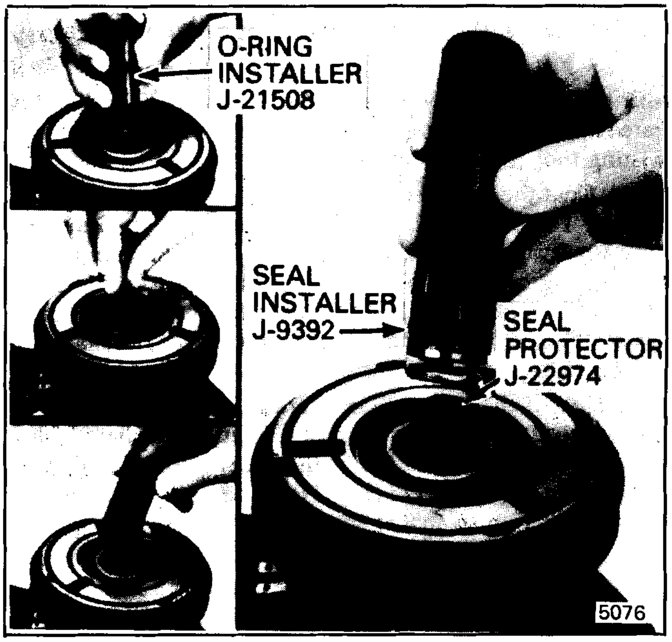


Fig. 1B-47 Replacing 1977 A-6 Seal and O-Ring

clockwise. Lift the seat from the compressor with a rotary motion (Fig. 1B-46).

CAUTION: *DO NOT tighten the handle with a wrench or pliers; however, the handle must be hand-tightened securely to remove the seat.*

5. With Seal Protector J 22974 still over the end of the shaft, engage the tabs on the seal assembly with the tangs on Seal Installer J 9392 by twisting the tool **clockwise, while pressing the tool down.** Then lift the seal assembly out (see Fig. 1B-47).

6. Remove the seal seat O-ring from the compressor neck using O-Ring Remover J 9533 (see Fig. 1B-46).

7. Recheck the shaft and inside of the compressor neck for dirt or neck foreign material and be sure these areas are perfectly clean before installing new parts.

Inspection

SEALS SHOULD NOT BE REUSED. ALWAYS USE A NEW SEAL KIT ON REBUILD (see Fig. 1B-44). Be extremely careful that the face of the seal to be installed is not scratched or damaged in any way. Make sure that the seal seat and seal are free of lint and dirt that could damage the seal surface or prevent sealing.

Replace

1. Coat new seal seat O-ring with clean 525 viscosity refrigerant oil and install in compressor neck, **making certain it is installed in bottom groove** (Fig. 1B-47 and Fig. 1B-48). Top groove is for retainer ring. Use O-Ring Installer J 21508.

2. Coat the O-ring and seal face of the new seal assembly with clean 525 viscosity refrigerant oil. Carefully mount the seal assembly to Seal Installer J 9392 by engaging the tabs of the seal with the tangs of the tool (Fig. 1B-47).

3. Place Seal Protector J 22974 (Fig. 1B-47) over end of shaft and **carefully slide the new seal assembly onto the shaft. Gently twist the tool CLOCK-WISE, while pushing the seal assembly down the shaft**

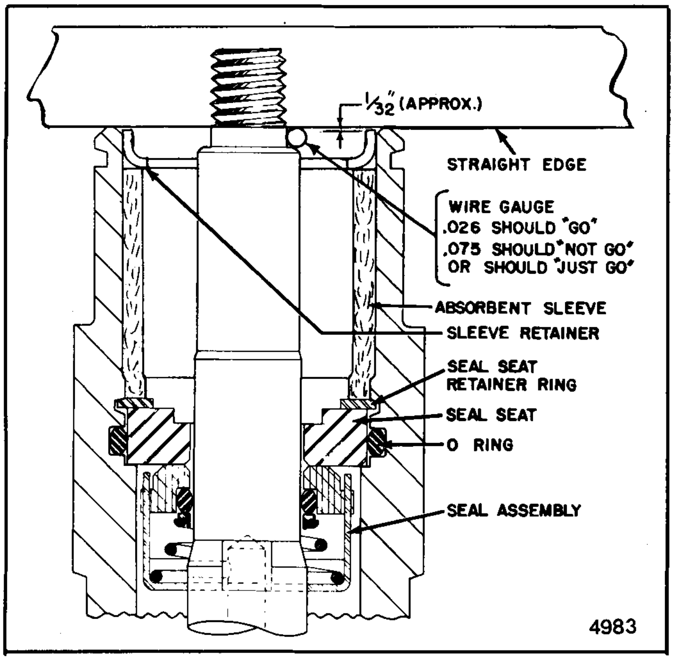


Fig. 1B-48 1977 A-6 Compressor Shaft and Seal

until the seal assembly engages the flats on the shaft and is seated in place. Disengage the tool by pressing downward and twisting tool counterclockwise.

4. Coat the seal face of the new seal seat with clean 525 viscosity refrigerant oil. Mount the seal seat on Seal Seat Remover-Installer J 23128 and install it in the compressor neck, taking care not to dislodge the seal seat O-ring nand being sure the seal seat makes a good seal with the O-ring. Remove Seal Protector J 22974 from the end of the shaft (see Fig. 1B-46).

5. Install the new seal seat retainer ring **with its flat side against the seal seat,** using Snap-Ring Pliers J 5403 (#21). See Fig. 1B-45. Use the sleeve from Seal Seat Remover-Installer J 23128 (Fig. 1B-46) to press in on the seal seat retainer ring so that it snaps into its groove.

6. Install Compressor Leak Test Fixture J 9625 on rear head of compressor and connect gage charging lines as shown for bench test in Fig. 1B-49 or pressurize SUCTION SIDE of compressor on car with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and oil sump down, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the seal with Electronic Leak Detector J 23400. Correct any leak found. Remove and discard the shaft nut.

7. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.

8. Install the new absorbent sleeve by rolling the material into a cylinder, overlapping the ends, and then slipping the sleeve into the compressor neck with the overlap towards the top of the compressor. With a small screwdriver or similar instrument, carefully spread the sleeve until the ends of the sleeve butt at the top vertical centerline.

9. Position the new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Pulley Puller Pilot J 9395 (see Fig. 1B-37) may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place (retainer should be recessed approximately 1/32" front the face of the compressor neck). (See Fig. 1B-48).

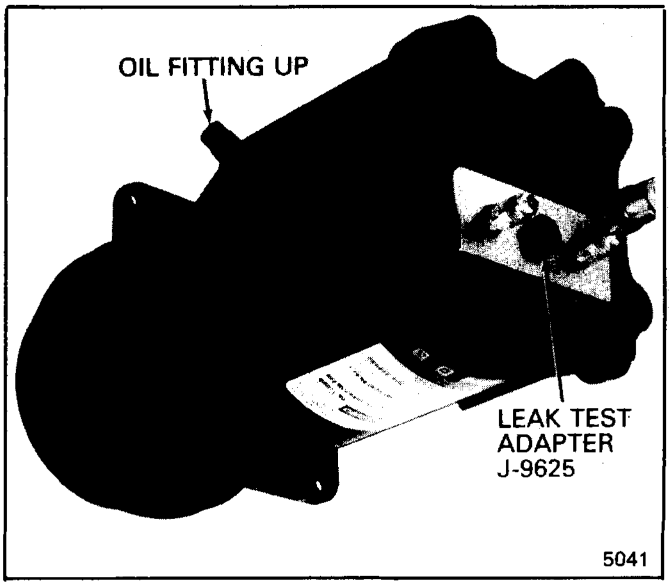


Fig. 1B-49 Leak Testing 1977 A-6 Compressor

10. Reinstall the clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm." Replacement procedure.

Some compressor shaft seal leaks may be the result of mispositioning of the axial plate on the compressor shaft. The mispositioning of the axial plate may be caused by improper procedures used during pulley and driven plate removal, pounding, collisions or dropping the compressor. If the axial plate is mispositioned, the carbon face of the shaft seal assembly may not contact the seal seat and the rear thrust races and bearing may be damaged.

If there appears to be too much or insufficient air gap between the drive and driven plates, dislocation of the shaft should be suspected. If the carbon seal is not seating against the seal seat, it will not be possible to completely "Evacuate the System" as outlined under DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS.

To check for proper positioning of the axial plate on the shaft, remove the clutch driven plate and measure the distance between the front head extension and the flat shoulder on the shaft as shown in Fig. 1B-48. To measure this distance, use a wire gage (**the clearance should be between .026" and .075"**). If the shaft has been pushed back in the axial plate (measurement greater than .075"), disassemble the compressor and replace the shaft and axial plate assembly rear thrust races and thrust bearing.

11. "Add Oil, Evacuate and Charte System" (see DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS).

A-6 COMPRESSOR PRESSURE RELIEF VALVE

When necessary to replace the pressure relief valve, located in the compressor rear head casting (Fig. 1B-50), the valve assembly should be removed after PURGING THE

SYSTEM OF REFRIGERANT and a new valve and gasket installed (see DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS).

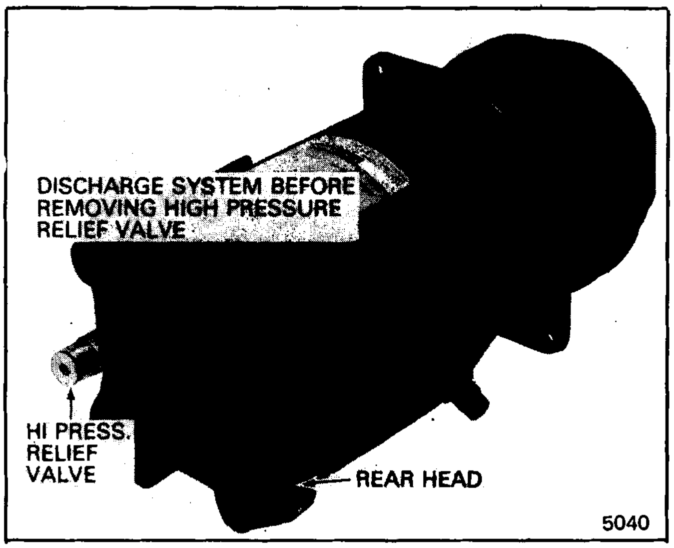


Fig. 1B-50 1977 A-6 High Pressure Relief Valve

A-6 COMPRESSOR INTERNAL MECHANISM

Service operations to the rear head or internal mechanism of the compressor "should be performed with the compressor removed from the vehicle to insure that the necessary degree of cleanliness may be maintained. Clean hands, clean tools and a clean bench, preferably covered with clean paper, are of extreme importance.

An inspection should be made of the internal mechanism assembly to determine if any service operations should be performed. A detailed inspection of parts should be made to determine if it is economically feasible to replace them.

Remove

1. Before proceeding with disassembly, wipe exterior surface of compressor clean.

2. All oil in compressor should be drained and measured. Assist draining by positioning compressor with oil drain plug down. **Record the amount of oil drained from the compressor**

3. Invert compressor and Holding Fixture J 9396 with front end of compressor shaft facing downward (Fig. 1B-51).

Additional oil may leak from the compressor at this time. All oil must be drained into a container so that TOTAL amount can be measured. A liquid measuring cup may be used for this purpose. Drained oil should then be discarded.

4. Remove four locknuts from threaded studs on compressor shell and remove rear head. Tap uniformly around rear head if head is binding (Fig. 1B-51).

5. Wipe excess oil from all sealing surfaces on rear head casting webs, and examine sealing surfaces (Fig. 1B-52). If any damage is observed, the head should be replaced.

6. Remove suction screen and examine for any damage or contamination. Clean or replace if necessary.

7. Paint an identifying mark on exposed face of inner and outer oil pump gears and then remove gears. Identifying marks are to assure that gears, if reused, will be installed on identical position.

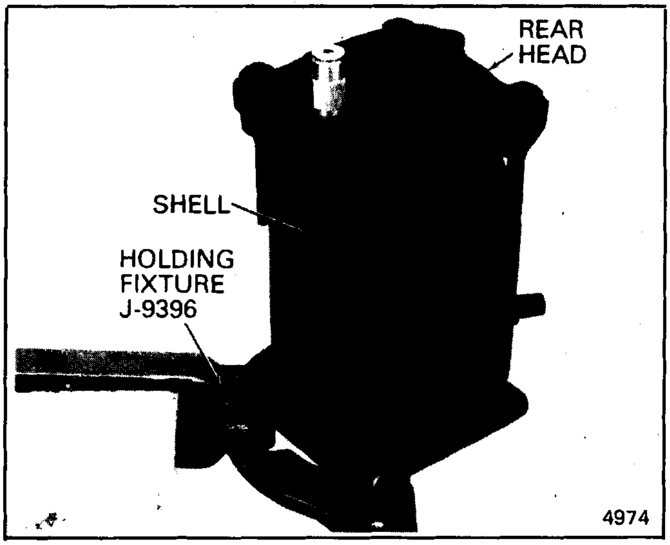


Fig. 1B-51 1977 A-6 Compressor Installed in Holding

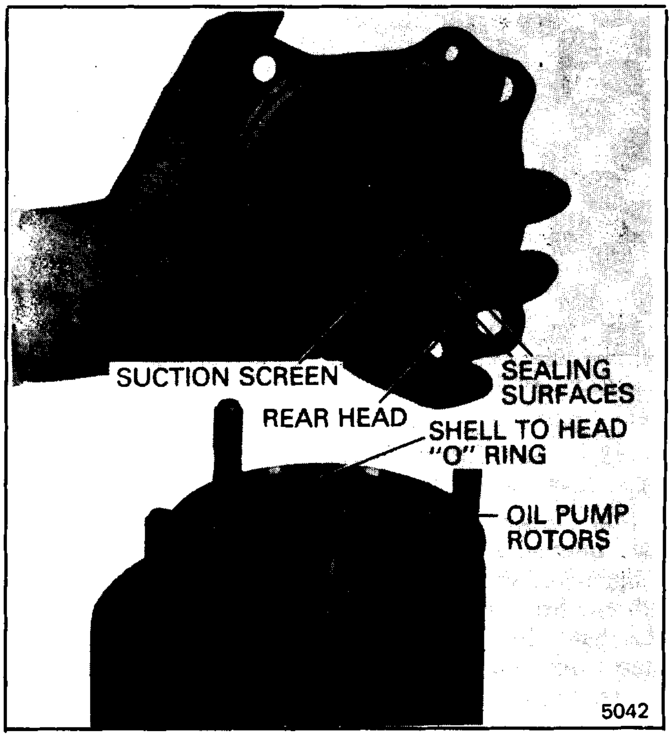


Fig. 1B-52 1977 A-6 Rear Head Removal

8. Remove and discard rear head to shell O-ring.

9. Carefully remove rear discharge valve plate assembly. Use two small screwdrivers under reed retainers to pry up on assembly (Fig. 1B-53). **Do not position screwdrivers between reeds and reed seats.**

10. Examine valve reeds and seats. Replace entire assembly if any reeds or seats are damaged.

11. Using two small screwdrivers, carefully remove rear suction reed (Fig. 1B-54). **Do not pry up on horeshoe-shaped reed valves.**

12. Examine reeds for damage, and replace if necessary.

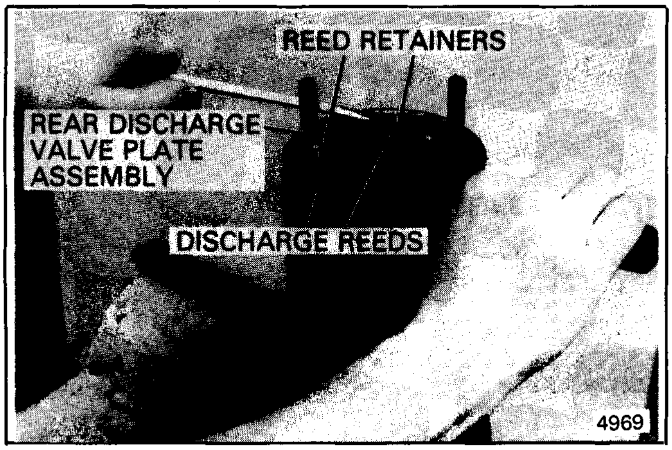


Fig. 1B-53 Removing 1977 A-6 Rear Discharge Valve Plate

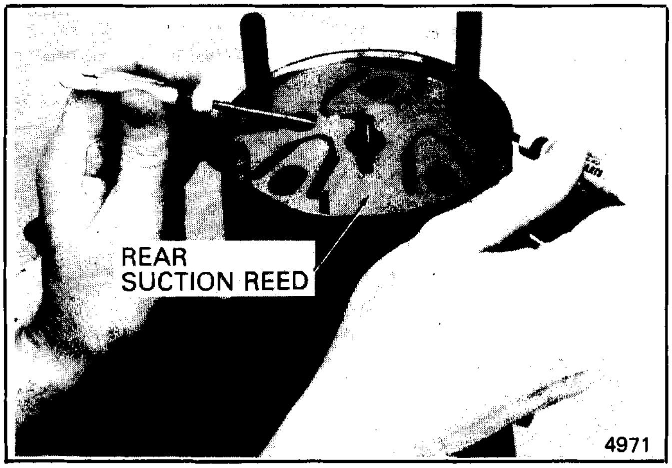


Fig. 1B-54 Removing 1977 A-6 Rear Suction Reed

13. Using Oil Pick-Up Tube Remover J 5139 (Fig. 1B-55), remove oil pick-up tube. Remove O-ring from oil inlet.

14. Loosen compressor from Holding Fixture J 9396, place Internal Assembly Support Block J 21352 over oil pump end of shaft and, holding Support Block in position with one hand, lift compressor from Holding Fixture with other hand. Invert compressor and position on bench with Internal Assembly Support Block resting on bench.

15. Lift front head and compressor shell assembly up, leaving internal mechanism resting on Internal Assembly Support Block.

CAUTION: *To prevent damage to shaft, DO NOT TAP ON END OF COMPRESSOR SHAFT to remove internal mechanism. If mechanism will not slide out of compressor shell, tap on front head with a plastic hammer.*

16. Rest compressor shell on its side and push front head assembly through compressor shell, **being careful not to damage sealing areas on inner side of front head.** Discard O-ring.

It may be necessary to tap on outside of front head, using a plastic hammer, to overcome friction of O-ring seal between front head and compressor shell.

17. Wipe excess oil from sealing surfaces on front head casting webs and examine sealing surface. If any surface damage is observed, the head should be replaced.

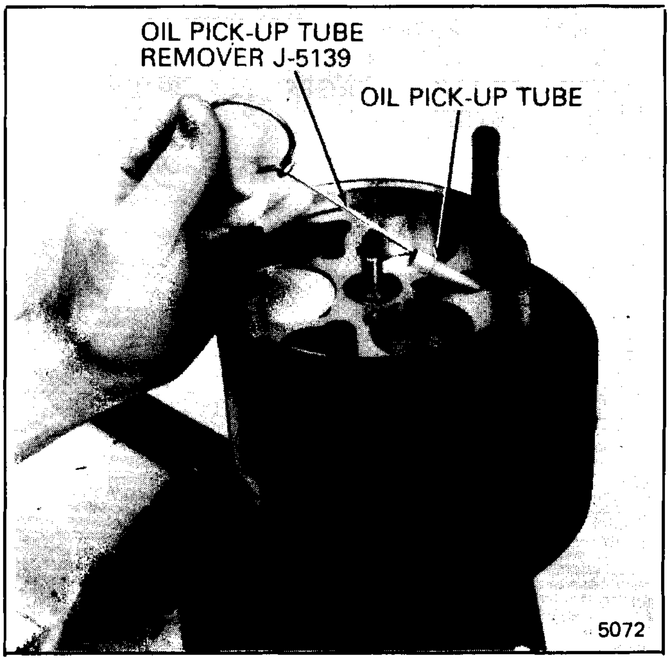


Fig. 1B-55 Removing 1977 A-6 Oil Pick-Up Tube

18. Remove front discharge valve plate assembly and front suction reed plate. Examine reeds and seats. Replace necessary parts.

19. Remove suction cross-over cover by prying with screwdriver between cylinder casting and cover (Fig. 1B-56).

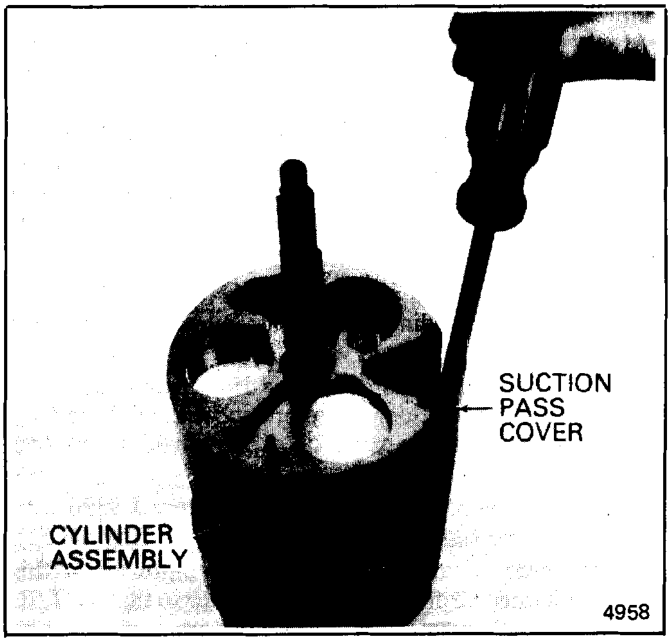


Fig. 1B-56 Removing 1977 A-6 Suction Cross-Over Cover

20. Examine internal mechanism for any obvious damage. If internal mechanism has sustained major damage, due to loss of refrigerant or oil, it may be necessary to use the Service internal mechanism Assembly rather than replace individual parts.

A-6 COMPRESSOR INTERNAL MECHANISM

Disassembly

Use Parts Tray J 9402 (Fig. 1B-60) to retain compressor parts during disassembly.

1. Remove internal mechanism from compressor as described in "Compressor Internal Mechanism" Removal procedure.

2. Identify by pencil mark, or some other suitable means, each piston numbering them as 1, 2 and 3 (Fig. 1B-57).

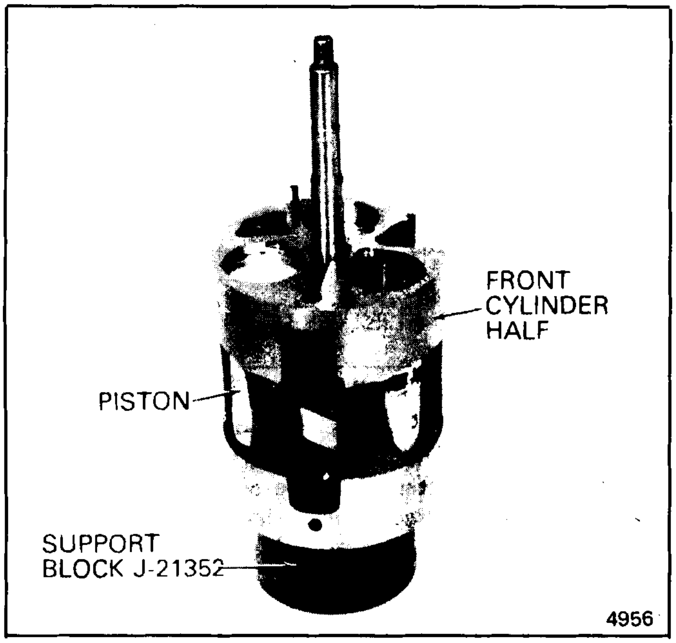


Fig. 1B-57 Numbering 1977 A-6 Piston and Cylinder Bores

Number the piston bores in the front cylinder half in like manner, so that pistons can be replaced in their original locations.

3. Separate cylinder halves, using a wood block and mallet (Fig. 1B-58). Make certain that discharge cross-over tube does not contact axial plate when separating cylinder halves (a new Service discharge cross-over tube will be installed later).

CAUTION: *UNDER NO CIRCUMSTANCES SHOULD SHAFT BE STRUCK AT EITHER END in an effort to separate upper and lower cylinder halves because the shaft and the axial plate could be damaged.*

4. Carefully remove the rear half of the cylinder from the pistons and set the front cylinder half, with the piston, shaft and axial plate in Compressing Fixture J 9397.

5. Pull up on compressor shaft and remove piston previously identified as No. 1, with balls and shoe discs, from axial plate.

a. **Inspect the Teflon piston rings** for nicks, cuts or metal particles imbedded in exposed ring surface and replace the piston rings as required if either condition exists. See "Teflon Piston Ring" Replacement procedure.

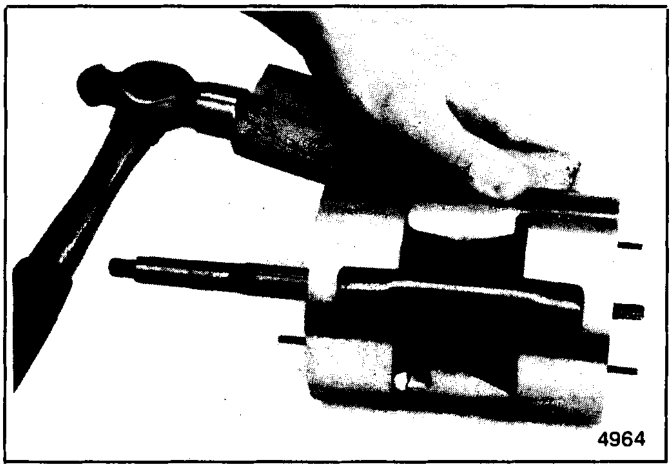


Fig. 1B-58 Separating 1977 A-6 Cylinder Halves

6. Remove and discard the piston shoe discs.

7. Remove and examine piston balls, and if satisfactory for re-use, place balls in No. 1 compartment of Parts Tray J 9402 (Fig. 1B-60).

8. Place piston in No. 1 compartment of Parts Tray J 9402, with notch in casting web at front end of piston (Fig. 1B-59) into the dimpled groove of Parts Tray compartment.

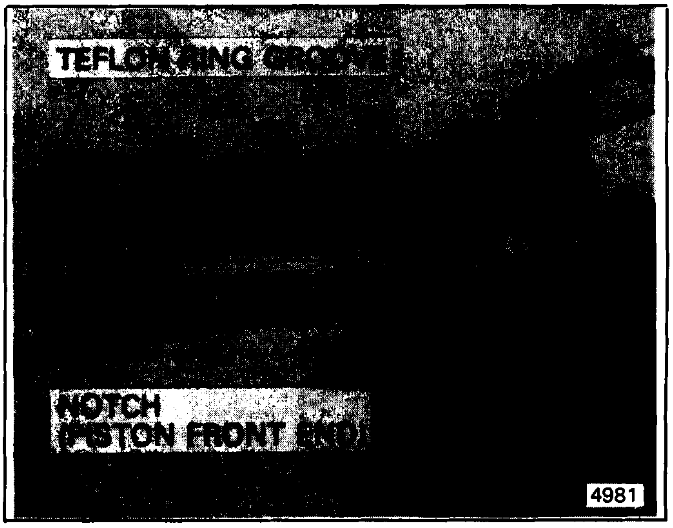


Fig. 1B-59 Notch Identifying Front End of 1977 A-6 Piston

9. Repeat Steps 5 through 9 for Pistons No. 2 and No. 3.

10. Remove rear combination of thrust races and thrust bearing from shaft. Discard races and bearing.

11. Remove shaft assembly from front cylinder half. If the discharge cross-over tube remained in the front cylinder half, it may be necessary to bend discharge cross-over tube slightly in order to remove shaft.

12. Remove front combination of thrust races and bearing from shaft. Discard races and bearing (Fig. 1B-61).

13. Examine surface of axial plate and shaft. Replace **as an assembly,** if necessary.

A certain amount of shoe disc wear on axial plate is normal, as well as some markings indicating load of needle bearings on shaft.

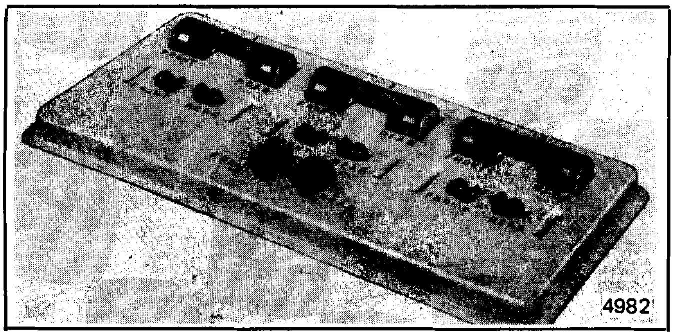


Fig. 1B-60 1977 A-6 Parts Tray

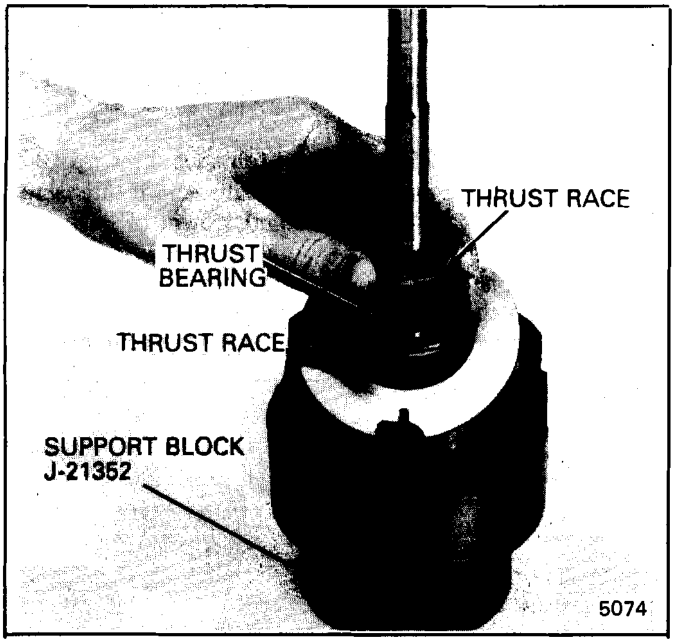


Fig. 1B-61 Removing 1977 A-6 Front Thrust Races and Bearings

14. Remove discharge cross-over tube from cylinder half, using self-clamping pliers.

This is necessary only on original factory equipment, as ends of the tube are swedged into cylinder halves. The discharge cross-over tube in internal mechanism assemblies that have been **previously** serviced have an O-ring and bushing at EACH END of the tube, and can be easily removed by hand (see Fig. 1B-80).

15. Examine piston bores and needle bearings in front and rear cylinder halves. Replace front and rear cylinder halves. Replace front and rear cylinders if any cylinder bore is deeply scored or damaged.

16. Needle bearings may be removed if necessary by driving them out with special Thin-Wall Socket J 9399. Insert socket in hub end (inner side) of cylinder head and drive bearing out. To install needle bearing, place cylinder half on Support Block J 21352, and insert bearing in end of cylinder head with bearing **identification marks UP.** Use Needle Bearing Installer J 9432 and drive bearing into cylinder head (Fig. 1B-62), until tool bottoms on the cylinder face.

Two different width needle bearings are used in Production compressors - a 1/2" size and a 5/8" size. **The bearings ARE interchangeable.** Service replacement bearings are all 1/2".

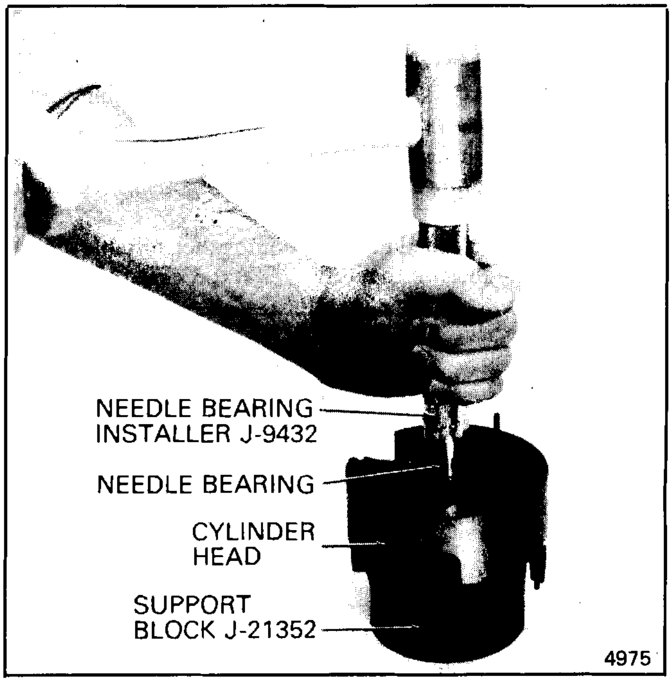


Fig. 1B-62 Installing 1977 A-6 Needle Bearing

17. Wash all parts to be re-used with trichlorethylene, naphtha, stoddard solvent, kerosene, or a similar solvent. Air-dry parts using a source of clean, dry air.

Compressor internal components may be identified by referred to Fig. 1B-27 and Fig. 1B-28.

A-6 COMRESSOR INTERNAL MECHANISM

GAGING OPERATION

1. Install Compressing Fixture J 9397 on Holding Fixture J 9396 in vise. Place front cylinder half in Compressing Fixture, flat side down. Front cylinder half has long slot extending out from shaft hole.

2. Secure from Service parts stock **four** ZERO thrust races and **three** ZERO shoe discs.

3. Intall a ZERO thrust race, thrust bearing, and a second ZERO thrust race on front end of compressor shaft. Lubricate races and bearing with petrolatum.

4. Insert threaded end of shaft through needle bearing in front cylinder half, and allow thrust race and bearing assembly to rest on hub of cylinder.

5. Now install a ZERO thrust race on rear end of compressor shaft (Fig. 1B-63), so that it rests on hub of axial plate. Then install thrust bearing and a second ZERO thrust race. Lubricate races and bearing with petrolatum.

6. Lubricate ball pockets of the No. 1 Piston with 525 viscosity refrigerant oil and place a ball in each socket. Use balls previously removed if they are to be re-used.

7. Lubricate cavity of a ZERO shoe disc with 525 viscosity refrigerant oil and place show disc over ball in **front end** of piston (Fig. 1B-64).

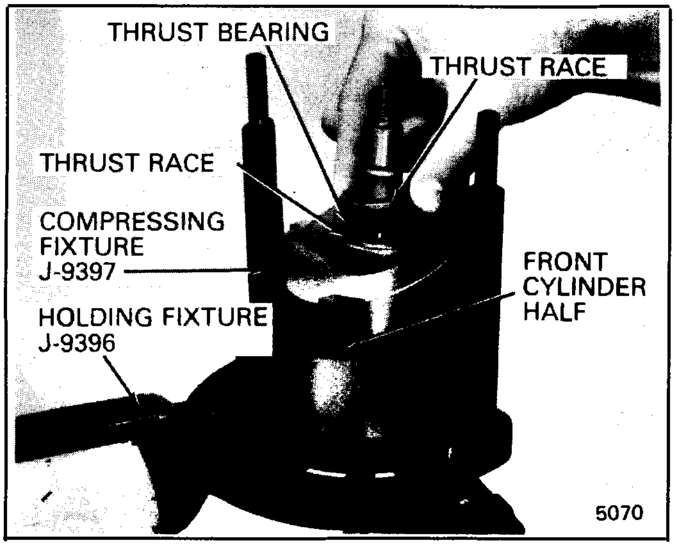


Fig. 1B-63 Installing 1977 A-6 Rear Thrust Races and Bearings

Front end of piston has an identifying notch in casting web (Fig. 1B-59).

CAUTION: *Exercise care in handling the Piston and Ring Assembly, particularly during assembly into and removal from the cylinder bores to prevent damage to the Teflon piston rings.*

Shoe discs should not be installed on rear of piston during following "Gaging" operation.

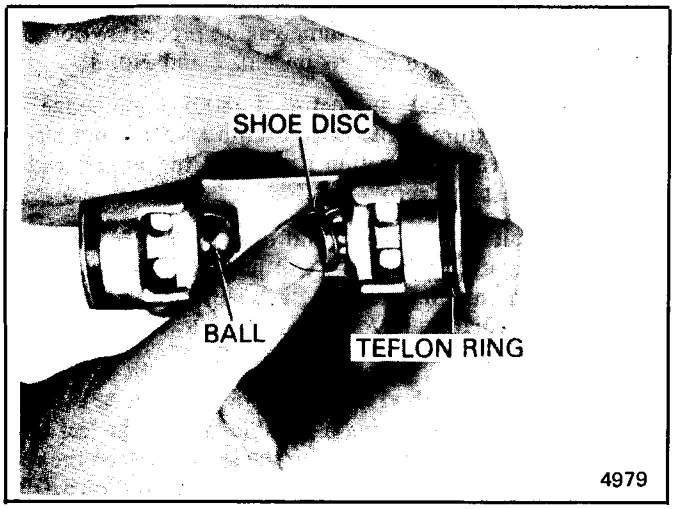


Fig. 1B-64 Installing 1977 A-6 Front Shoe Disc

8. Rotate shaft and axial plate until high point of axial plate is over the No. 1 Piston cylinder bore.

9. Lift shaft assembly up and hold front thrust race and bearing assembly against axial plate hub.

10. Position piston over No. 1 cylinder bore (notched end of piston being on bottom and piston straddling axial plate) and lower the shaft to allow piston to drop into its bore (Fig. 1B-65).

11. Repeat Steps 6 through 10 for Pistons No. 2 and No. 3.

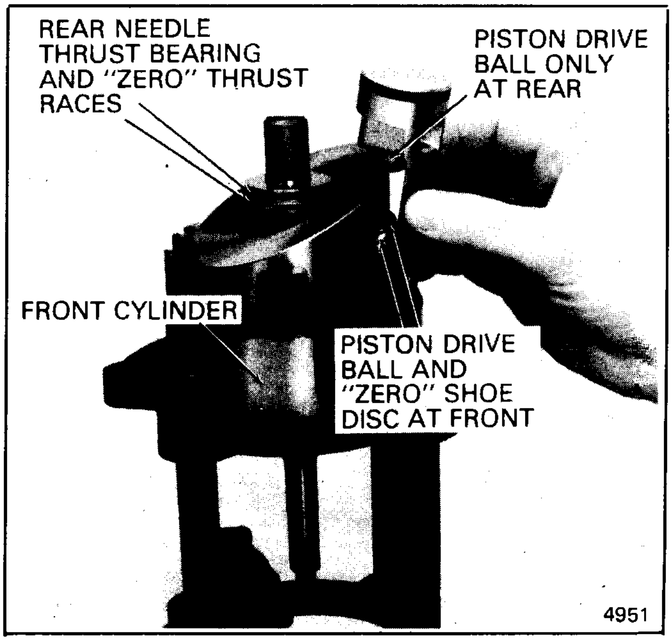


Fig. 1B-65 Installing 1977 A-6 Piston During Gaging Operation

12. Install rear cylinder half on pistons, aligning cylinder with discharge cross-over tube hole in front cylinder.

Tap into place using a plastic mallet or piece of clean wood and hammer (Fig. 1B-66).

13. Position discharge cross-over tube opening between a pair of Compressing Fixture bolts to permit access for feeler gage.

14. Install top plate on Compressing Fixture J 9397. Tighten nuts to 15 lb. ft. torque using a 0-25 lb. ft. torque wrench.

Gaging Procedure (Steps 15 thru 18)

The gaging operations which follow have been worked out on a simple basis to establish and provide necessary running tolerances. Two gaging procedures are necessary.

The first is made to choose the proper size shoe discs to provide, at each piston, a .0016" to .0024" total preload between the seats and the axial plate at the tightest place through the 360-degree rotation of the axial plate at the tightest plate. The bronze shoe discs are provided in .0005" variations, including a basic ZERO show.

The second, performed at the rear shaft thrust bearing and race pack, is designed to obtain .0025" to .0030" preload between the hub surfaces of the axial plate and the front and rear hubs of the cylinder. A total of 14 steel thrust races, including a basic ZERO race, are provided in increments of .0005" thickness to provide the required fit.

Feeler and Tension Gage Set J 9564-01 or J 9661-01 may be used for gaging proper shoe disc size. Feeler Gage Set J 9564-01 or Dial Indicator Set J 8001-3 may be used to determine proper thrust race size.

PROPER SELECTION OF THRUST RACES AND BALL SEATS IS OF EXTREME IMPORTANCE.

15. Measure clearance between rear ball of No. 1 Piston and axial plate, in following manner:

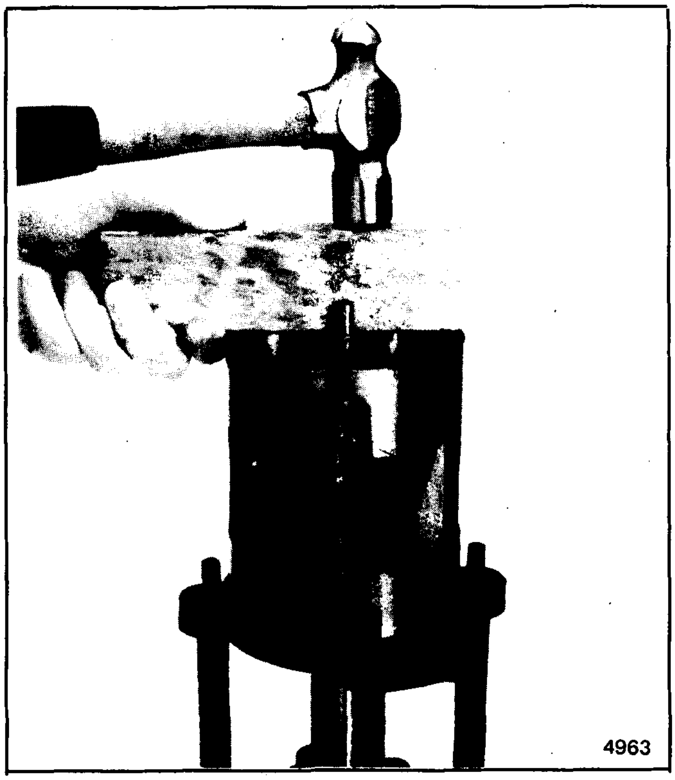


Fig. 1B-66 Assembling 1977 A-6 Cylinder Halves

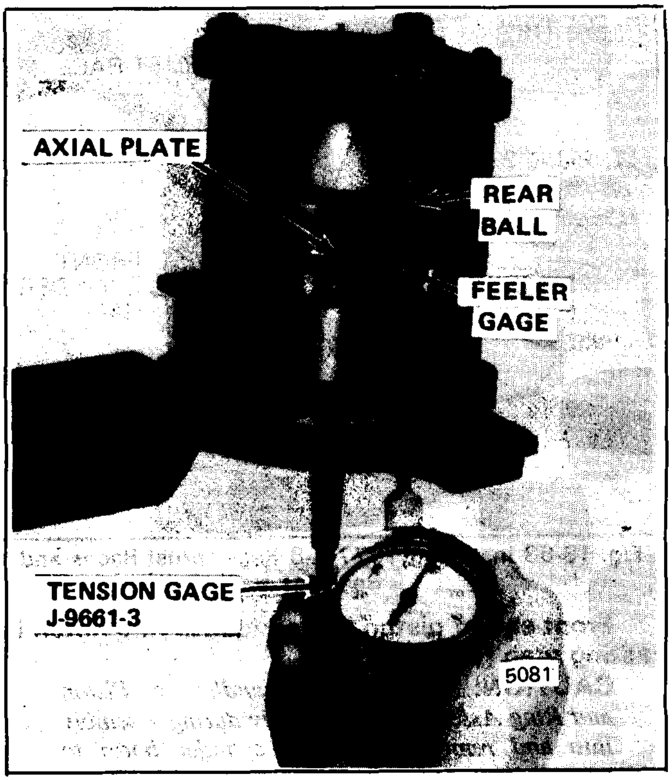


Fig. 1B-67 Gaging 1977 A-6 Rear Piston Ball

a. Select a suitable combination of well-oiled Feeler Gage leaves to fit snugly between ball and axial plate.

b. Attach Tension Gage J 9661-3 to the feeler gage. A distribution point checking scale or Spring Scale J 544 may be used.

c. Pull on Spring Scale to slide Feeler Gage stock out from between ball and axial plate, and note reading on Spring Scale as Feeler Gage is removed (Fig. 1B-67). **Reading should be between 4 and 8 ounces.**

d. If reading in Step c, above is under 4 OR over 8 ounces, reduce or increase thickness of Feeler Gage leaves and repeat Steps a. through c. above until a reading of 4 to 8 ounces is obtained. Record clearance between ball and axial plate that results in the 4 to 8 ounce pull on Spring Scale.

16. Now rotate shaft 120° and repeat Step 15 between same ball and axial plate. Record this measurement.

If shaft is hard to rotate, install shaft nut onto shaft and turn shaft with wrench.

17. Rotate shaft another 120° and again repeat Step 15 between these same parts and record measurements.

18. Select a "numbered" shoe disc corresponding to minimum feeler gage reading recorded in the three checks above. (See example in Fig. 1B-69). Place shoe discs in Parts Tray J 9402 compartment corresponding to Piston No. 1 and rear ball pocket position.

Shoe discs are provided in .0005" (one-half thousandths) variations. There are a total of 11 sizes available for field servicing. All show discs are marked with the shoe size, which corresponds to the last three digits of the piece part number. (See Shoe Disc Size Chart in Fig. 1B-68).

Once a proper selection of the shoe has been made, the MATCHED COMBINATION OF SHOE DISC TO REAR BALL AND SPHERICAL CAVITY IN PISTON MUST BE KEPT IN PROPER RELATIONSHIP during disassembly after gaging operation, and during final assembly of internal mechanism.

19. Repeat in detail the same gaging procedure outlined in Steps 15 through 18 for Piston No. 2 and No. 3.

20. Mount Dial Indicator J 8001-3 on edge of Compressing Fixture J 9397 with Clamp J 8001-1 and Sleeve J 8001-2 (Fig. 1B-70). Position Dial Indicator on rear end of shaft and adjust to "zero".

Apply full hand-force at end of mainshaft a few times before reading clearance. This will help squeeze the oil out from/between mating parts. Push upward and record measurement. Dial Indicator increments are .001"; therefore, reading must be estimated to nearest .0005".

An alternate method of selecting a proper race is to use Gage Set J 9661-01 selecting a suitable feeler gage leaf until the result is a 4 to 8 ounce pull on the scale between the rear thrust bearing and upper (or outer rear) thrust race (Fig. 1B-71). If the pull is just less than 4 ounces, add .0005" to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ounces, then subtract .0005" from the thickness of the feeler stock. **Select a race TWO (2) FULL SIZES LARGER than feeler gage thickness**

(If feeler gage is .007", select a No. 9 or 090 race).

21. **Select a thrust race with a "number" corresponding to TWO (2) FULL SIZES LARGER than Dial Indicator or feeler gage measurement of the amount of end play shown.** (If measurement is .007", select a No.9 or 090 race.) **Place thrust race in right-hand slot at bottom center of Parts Tray J 9402.**

SHOE DISC			THRUST BEARING RACE		
PART NO. ENDING IN	IDENTIFICATION STAMP	MIN. FEELER GAGE READING	PART NO. ENDING IN	IDENTIFICATION STAMP	DIAL INDICATOR READING
000	0	.0000	000	0	.0000
175	17-1/2	.0175	050	5	.0050
180	18	.0180	055	5-1/2	.0055
185	18-1/2	.0185	060	6	.0060
190	19	.0190	065	6-1/2	.0065
195	19-1/2	.0195	070	7	.0070
200	20	.0200	075	7-1/2	.0075
205	20-1/2	.0205	080	8	.0080
210	21	.0210	085	8-1/2	.0085
215	21-1/2	.0215	090	9	.0090
220	22	.0220	095	9-1/2	.0095
			100	10	.0100
			105	10-1/2	.0105
			110	11	.0110
			115	11-1/2	.0115
			120	12	.0120

0913

Fig. 1B-68 Available 1977 A-6 Service Shoes and Thrust Races

	POSITION 1	POSITION 2	POSITION 3	SELECT AND USE SHOE NO.
PISTON NO. 1	.019"	.0195"	.019"	19
PISTON NO. 2	.020"	.020"	.020"	20
PISTON NO. 3	.021"	.021"	.022"	21

0914

Fig. 1B-69 Selection of Proper 1977 A-6 Shoe Disc

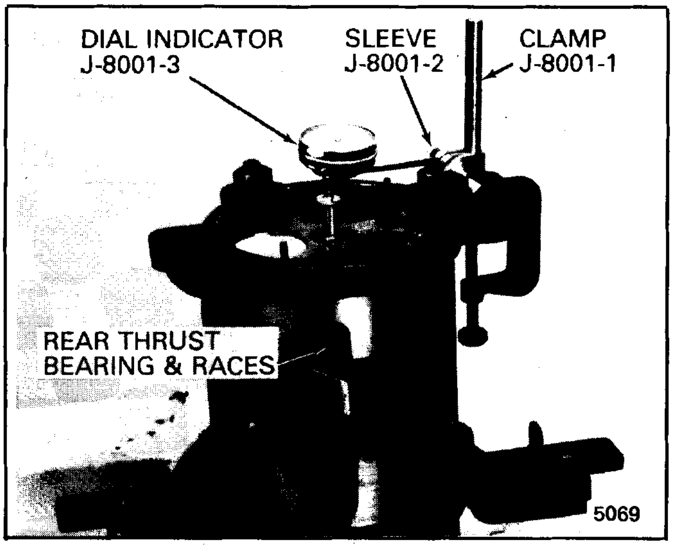


Fig. 1B-70 Gaging 1977 A-6 Rear Thrust Race

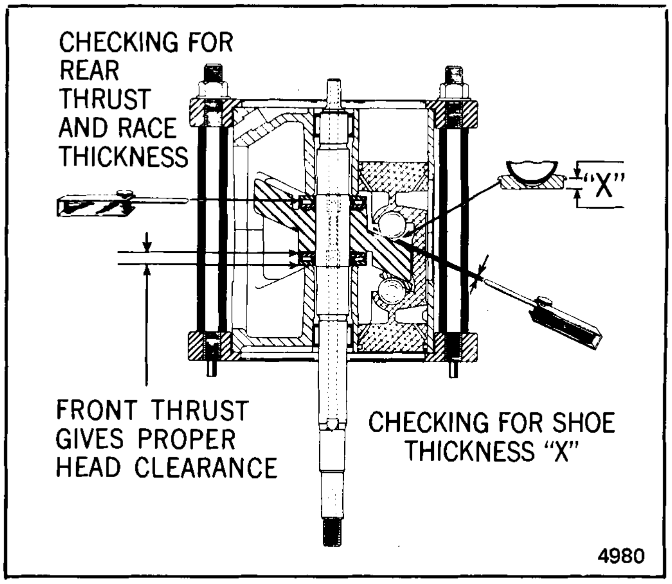


Fig. 1B-71 Checking 1977 A-6 Piston and Shaft End Play

Fifteen (15) thrust races are provided in increments of .0005" (one-half thousandths) thickness and one ZERO gage thickness, providing a total of 16 sizes available for field service.

This "number" also corresponds to the last three digits of the piece part number. See Thrust Race size Chart in Fig. 1B-68.

22. Remove nuts from top plate of Compressing Fixture J 9397, and remove top plate.

23. Separate cylinder halves while unit is in Fixture. It may be necessary to use a wood block and mallet.

24. **Remove rear cylinder half and carefully remove one piston at a time from axial plate and front cylinder half. DO NOT LOSE THE RELATIONSHIP of the front ball and shoe disc and rear ball. Transfer each piston, ball and shoe disc to its proper place in Parts Tray J 9402.**

25. Remove rear outer ZERO thrust race from shaft and install thrust race just selected.

The ZERO thrust race may be put aside for re-use in additional gaging or rebuilding operations.

A-6 TEFLON PISTON RING REPLACEMENT

The Teflon piston ring installing, sizing and gaging tools are shown in Fig. 1B-72.

1. Remove the old piston rings by CAREFULLY slicing through the ring with a knife or sharp instrument, holding the blade almost flat with the piston surface. Be careful not to damage the aluminum piston OR piston groove in cutting to remove the ring.

WARNING: EXERCISE PERSONAL CARE IN CUTTING THE PISTON RING FOR REMOVAL.

2. Clean the piston and piston ring grooves with a recommended cleaning solvent and blow the piston dry with dry air (Trichlorethylene, naphtha, stoddard solvent, kerosene, or equivalent).

3. Set the piston on end on a clean, flat surface and install the Ring Installer Guide J 24608-2 on the end of the piston (Fig. 1B-73).

4. Install a Teflon ring on the Ring Installer Guide J 24605-2 as shown in Fig. 1B-73, **with the dished or dull-side down and glossy-side up.**

5. Push the Ring Installer J 24608-5 down over the Installer Guide J 24608-2 to install the Teflon ring in the piston ring groove (Fig. 1B-74). If the Teflon ring is slightly off position in the ring groove, it can be positioned into place by fingernail or blunt-edged tool that will not damage the piston.

The Ring Installer J 24608-5 will retain the Installer Guide J 24608-2 internally when the Teflon ring is installed on the piston. Remove the Installer Guide from the Ring Installer and **DO NOT STORE THE INSTALLER GUIDE IN THE RING INSTALLER, as the Ring Installer Segment Retainer O-Ring J 24608-3 will be stretched and possibly weakened during storage.** This could result in the O-Ring J 24608-3 not holding the Ring Installer segments tight enough to the Installer Guide J 24608-2 to properly install the Teflon ring on the piston.

6. Lubricate the piston ring area with 525 viscosity refrigerant oil and rotate the Piston and Ring Assembly into the Ring Sizer J 24608-6 **at a slight angle** (Fig. 1B-76). Rotate the piston, while pushing inward, until the piston is inserted against the center stop of the Ring Sizer J 23608-6.

CAUTION: *DO NOT push the Piston and Ring Assembly into the Ring Sizer J 24608-6 without proper positioning and rotating as described above, as the ends of the needle bearings of the Ring Sizer may damage the end of the piston.*

7. Rotate the Piston and Ring Assembly in the Ring Sizer J 24608-6 several COMPLETE turns, until the Assembly rotates relatively free in the Ring Sizer (Fig. 1B-76).

8. Remove the Piston and Ring Assembly, wipe the end of the piston and ring area with a clean cloth and then push the Piston and Ring Assembly into the Ring Gage J 24608-1 (Fig. 1B-77). The piston should go through the Ring Gage with a 6-lb. force or less without lubrication. If not, repeat Steps 6 and 7.

9. Repeat the procedure for the opposite end of the piston.

CAUTION: *DO NOT lay the piston down on a dirty surface where dirt or metal chips might become imbedded in the Teflon ring surface.*

10. Lubricate BOTH ENDS of the piston with 525 viscosity refrigerant oil before inserting the piston into the cylinder bore.

CAUTION: *Reasonable care should be exercised in installing the piston into the cylinder bore to prevent damage to the Teflon ring.*

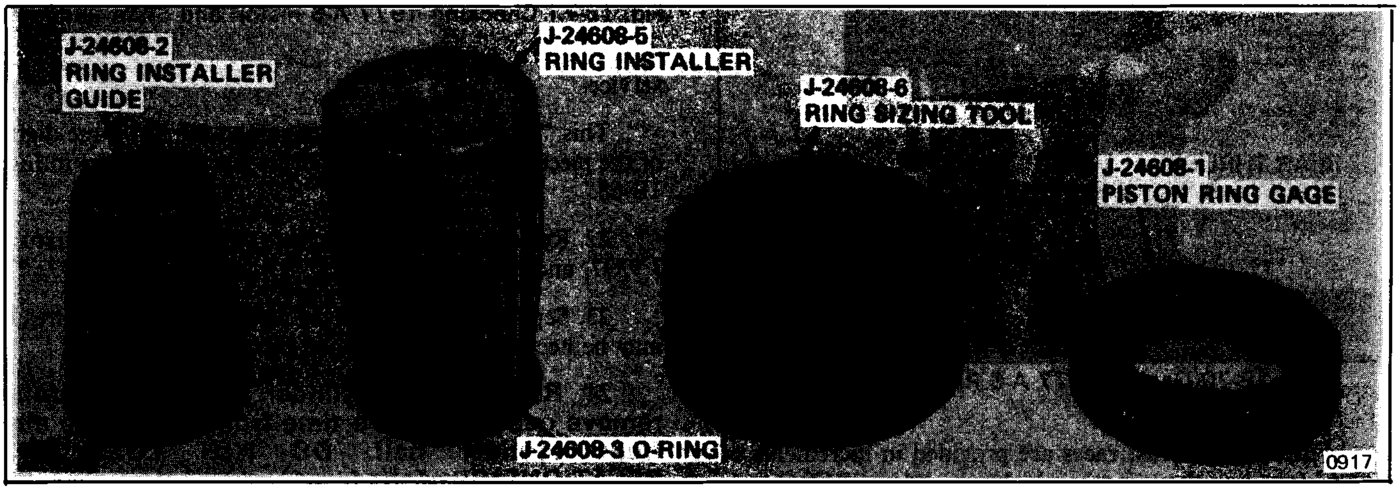


Fig. 1B-72 Teflon 1977 A-6 Teflon Piston Ring Installing, Sizing and Gaging Tools

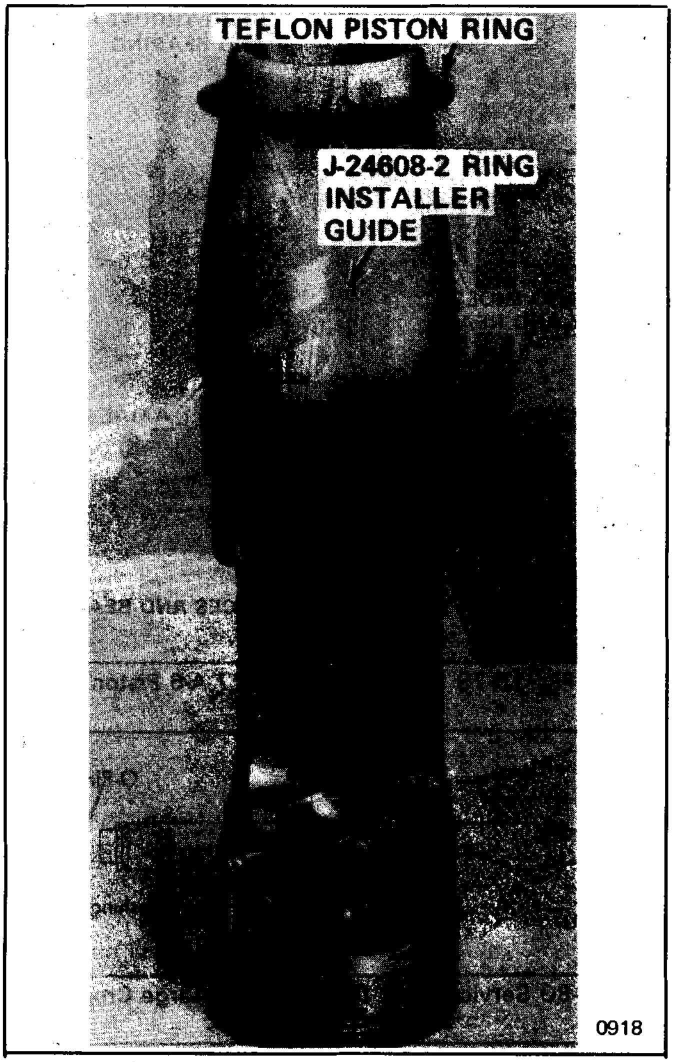


Fig. 1B-73 1977 A-6 Teflon Piston Ring Positioned on Ring Installer Guide

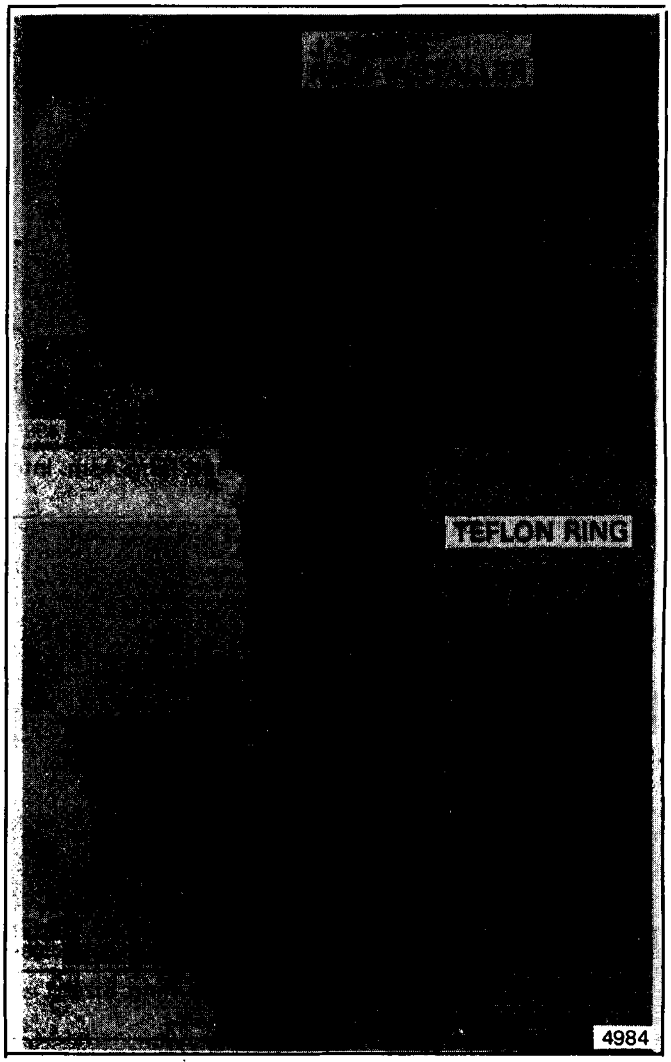


Fig. 1B-74 Installing 1977 A-6 Teflon Piston Ring

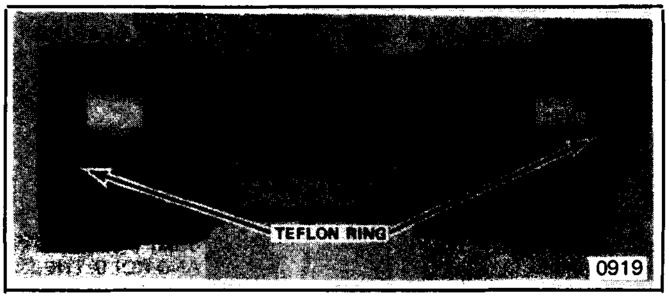


Fig. 1B-75 1977 A-6 Teflon Piston Ring Installed in Piston Groove

A-6 COMPRESSOR INTERNAL MECHANISM

Assembly

After properly performing the "Gaging Procedure", choosing the correct shoe discs and thrust races, and installing any needed Teflon Piston Rings, the cylinder assembly may now be reassembled. Be sure to install all NEW seals and O-rings. All are included in the compressor O-Ring Service Kit.

Assembly procedure is as follows:

1. Support the FRONT half of the cylinder assembly on Compressing Fixture J 9397. Install the shaft and axial plate, threaded end **down,** with its front bearing race pack (ZERO race, bearing NUMBERED race), if this was not already done at the end of the "Gaging Procedure".

2. Apply a light smear of petroleum jelly to the "numbered" shoe discs chosen in the Gaging Procedure and install all balls and shoe discs in their proper place in the piston assembly.

3. Rotate the axial plate so that the high point is above cylinder bore No. 1. Carefully assemble Piston No. 1, complete with ball and ZERO shoe disc on the **front** and ball and NUMBERED shoe dies on the **rear,** over the axial plate. Hold front thrust bearing pack tightly against axial plate hub while lifting hub. Insert the Piston Assembly into the front cylinder half (Fig. 1B-78).

4. Repeat this operation for Pistons No. 2 and No. 3 (Fig. 1B-79).

5. Without installing any O-rings or bushings, assemble one end of the new Service discharge cross-over tube into the hole in the front cylinder half (Fig. 1B-80 and 1B-81).

Be sure the flattened portion of this tube faces the **inside** of the compressor to allow for axial plate clearance (Fig. 1B-81).

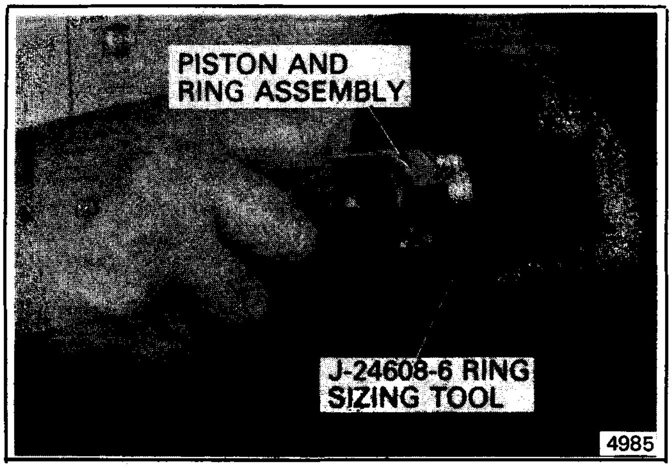


Fig. 1B-76 Turning 1977 A-6 Piston and Ring Asm. into Ring Sizing Tool

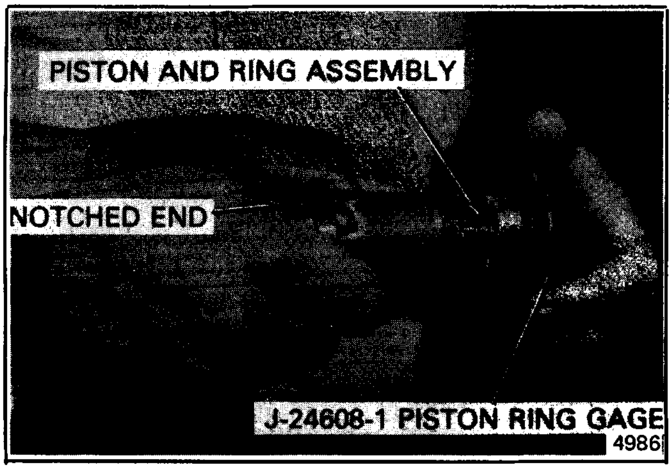


Fig. 1B-77 Gaging 1977 A-6 Piston Ring Size

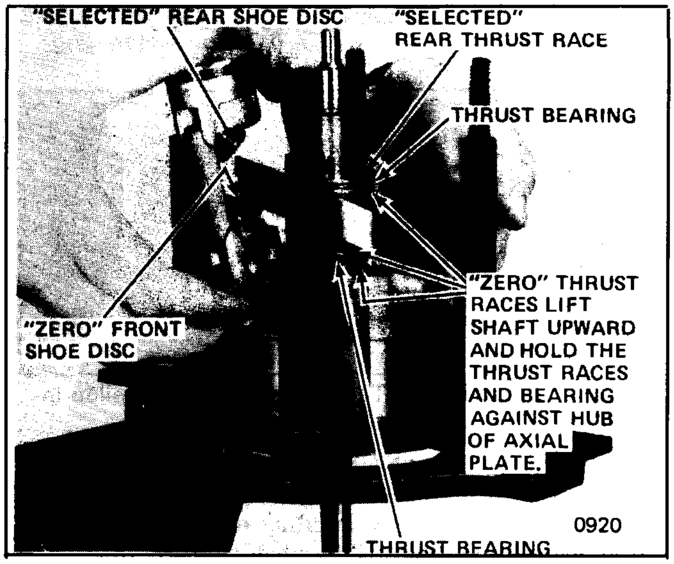


Fig. 1B-78 Installing 1st 1977 A-6 Piston Assembly Into Front Cylinder Half

6. Now rotate the shaft to position the pistons in a stair-step arrangement; then **carefully** place the rear cylinder half over the shaft and start the pistons into the cylinder bore (Fig. 1B-82).

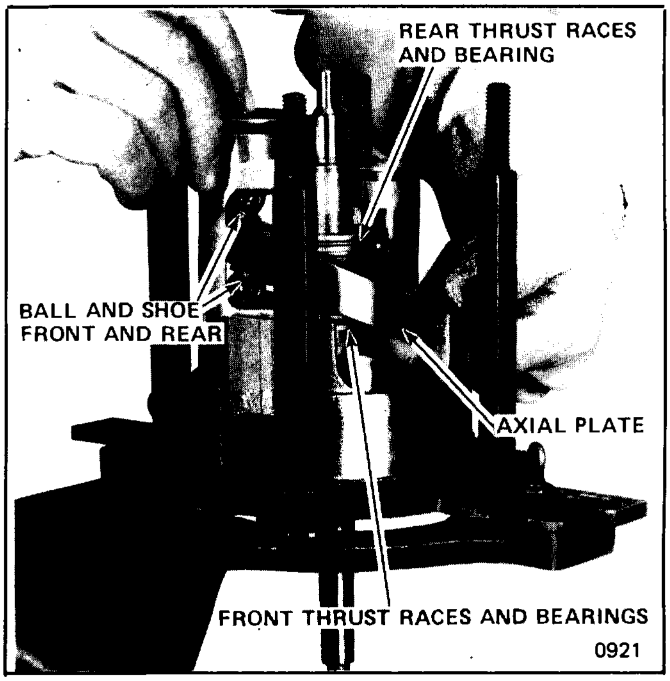


Fig. 1B-79 Installing 2nd 1977 A-6 Piston

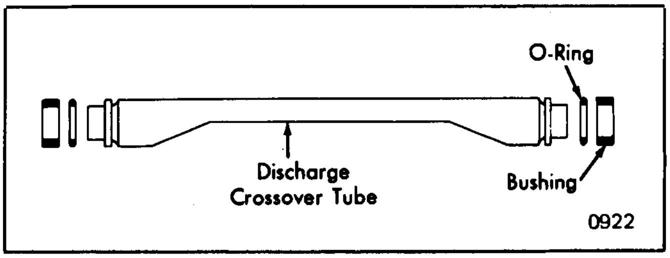


Fig. 1B-80 Service-Type 1977 A-6 Discharge Cross-Over Tube

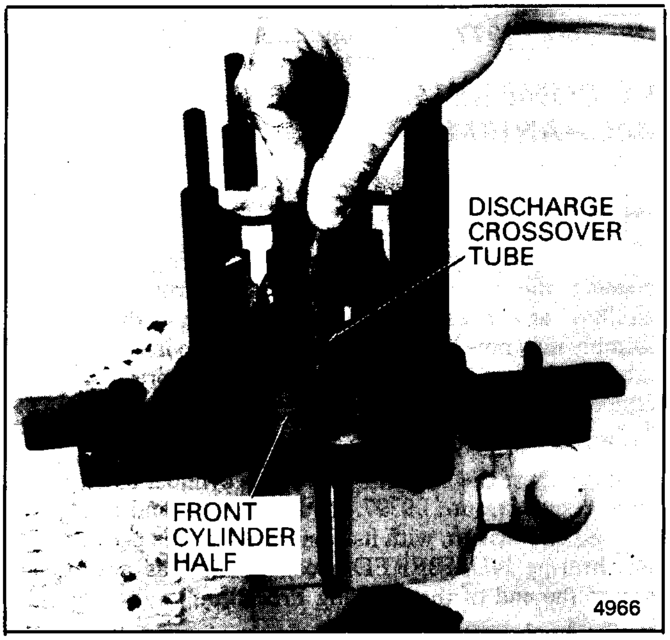


Fig. 1B-81 Installing 1977 A-6 Discharge Cross-over Tube

7. When all three Piston and Ring assemblies are in their respective cylinders, align the end of the discharge cross-over tube with the hole in the rear half of the cylinder.

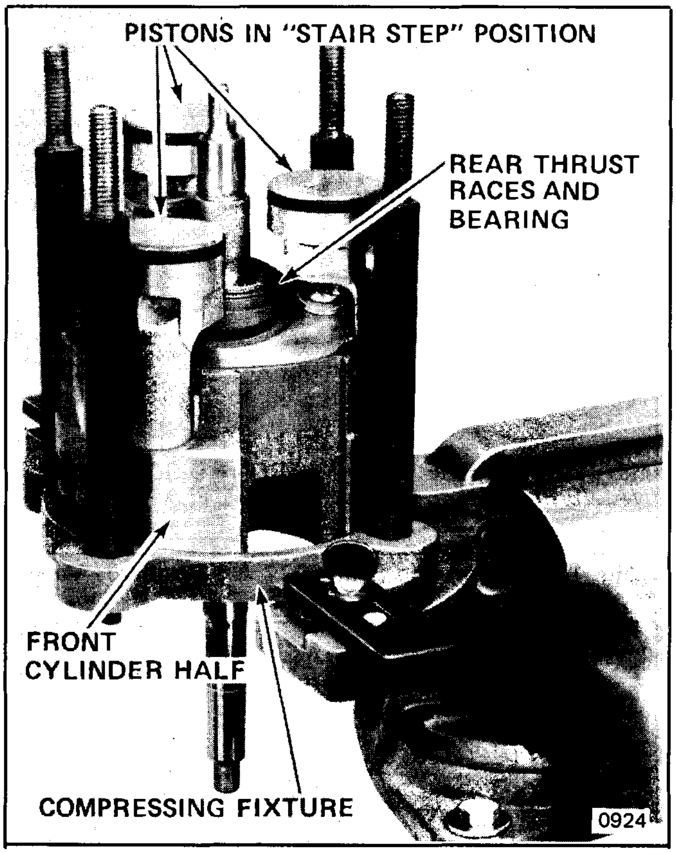


Fig. 1B-82 1977 A-6 Pistons Positioned in Stair-Step Arrangement

8. When all parts are in proper alignment, tap with a clean wood block and mallet to seat the rear half of the cylinder over the locating dowel pins. If necessary, clamp the cylinder in Compressing Fixture J 9397, to complete drawing the cylinder halves together.

9. Generously lubricate all moving parts with clean 525 viscosity refrigerant oil and check for free rotation of the parts.

10. Replace the suction cross-over cover (Fig. 1B-83). Compress the cover as shown to start it into the slot, and then press or carefully tap it in until flush on both ends.

A-6 COMPRESSOR INTERNAL MECHANISM

Re-Install

1. Place internal mechanism on Internal Assembly Support Block J 21352, with **rear-end** of shaft in block hole.

2. Now install new O-ring and busing in **front-end** of discharge cross-over tube (Fig. 1B-84). The O-ring and bushing are Service parts only for internal mechanism that have been disassembled in the field (Also see Fig. 1B-80).

3. Install new dowel pins in front cylinder half, if previously removed.

4. Install front suction reed plate on front cylinder half. Align with dowel pins, suction ports, oil return slot, and discharge cross-over tube (Fig. 1B-85).

5. Install front discharge valve plate assembly, aligning holes with dowel pins and proper openings in front suction reed plate (Fig. 1B-86).

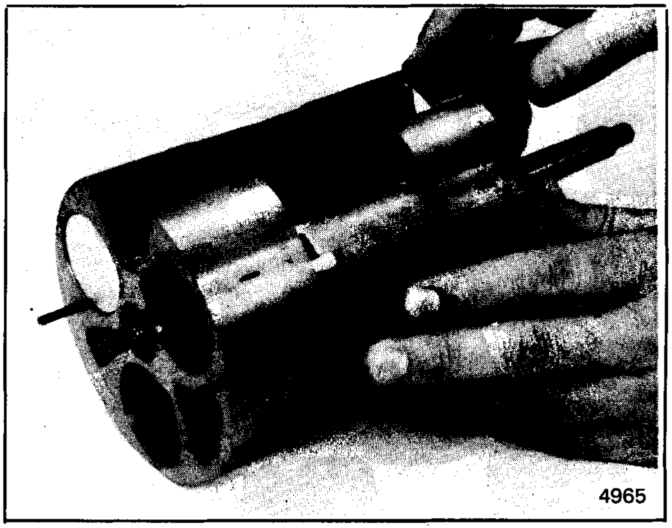


Fig. 1B-83 Installing 1977 A-6 Suction Cross-over Cover

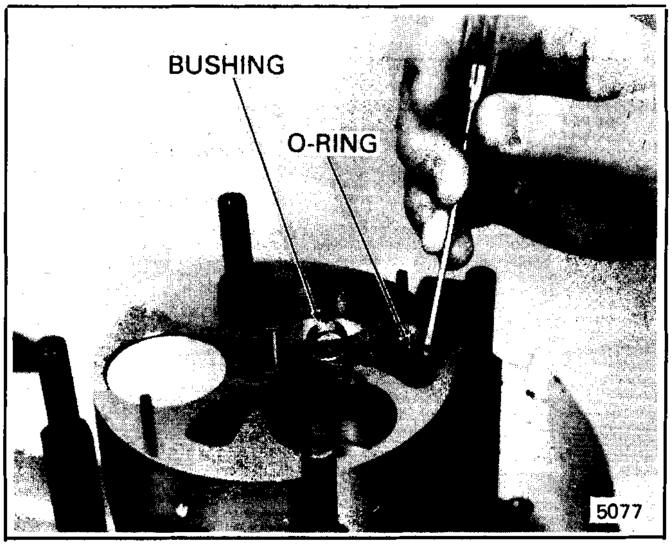


Fig. 1B-84 Installing O-Ring On 1977 A-6 Discharge Cross-Over Tube

Front discharge plate has a large diameter hole in the center (Fig. 1B-87).

6. Coat sealing surfaces on webs of compressor front head casting with clean 525 viscosity refrigerant oil.

7. Determine **exact** position of front head casting in relation to dowel pins on internal mechanism. Mark position of dowel pins on sides of front head assembly and on sides of internal mechanism with a grease pencil. Carefully lower front head casting into position (Fig. 1B-88), **making certain that sealing area around center bore of head assembly does not contact shaft** as head assembly is lowered. **Do not rotate head assembly** to line up with dowel pins, as the sealing areas would contact reed retainers.

8. Generously lubricate new O-ring and angled groove at lower edge of front head casting with 525 viscosity refrigerant oil and install new O-ring into groove (Fig. 1B-89).

9. Coat inside machined surfaces of compressor shell with 525 viscosity refrigerant oil and position shell on internal mechanism, resting on O-ring seal.

10. Using flat-side of a small screwdriver, gently position O-ring in around circumference of internal mechanism until

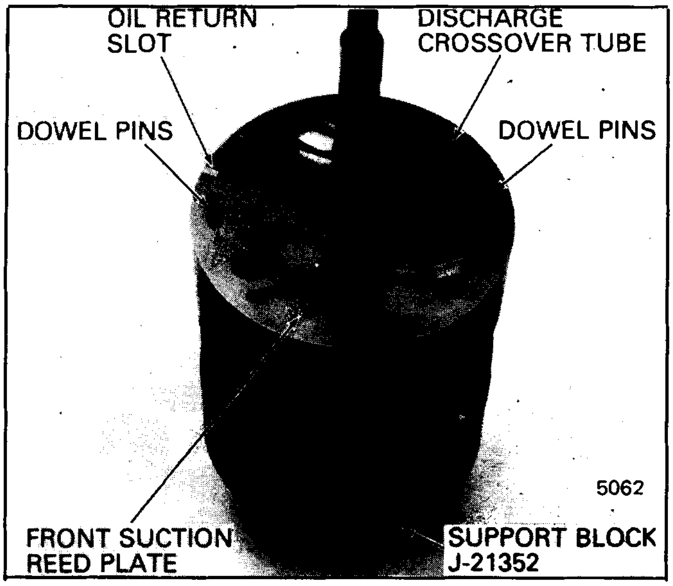


Fig. 1B-85 Installing 1977 A-6 Front Suction Reed

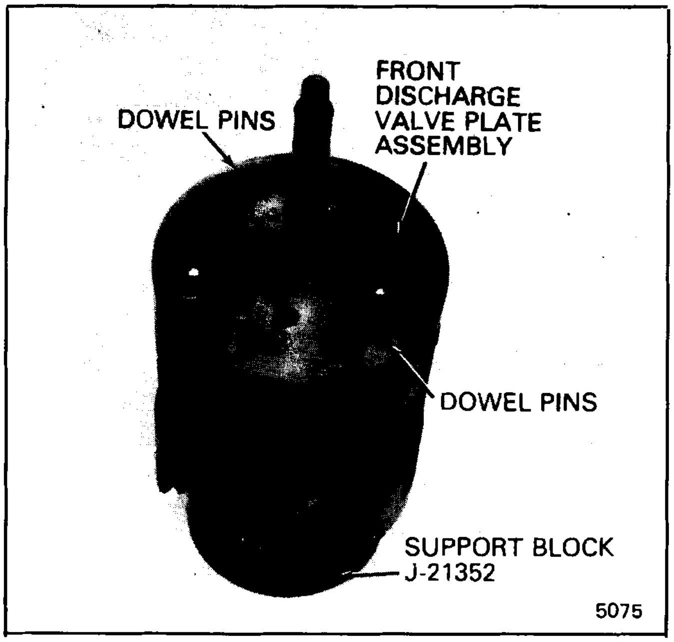


Fig. 1B-86 Installing 1977 A-6 Front Discharge Valve Plate

compressor shell slides down over internal mechanism. As shell slides down, line up oil sump with oil intake tube hole (Fig. 1B-90).

11. Holding Support Block, invert assembly and place back into Holding Fixture with front end of shaft down. Remove Support Block.

12. Install new dowel pins in rear cylinder half, if previously removed.

13. Install new O-ring in oil pick-up tube cavity.

14. Lubricate oil pick-up tube with 525 viscosity refrigerant oil and install into cavity, rotating compressor mechanism to align tube with hole in shell baffle (Fig. 1B-91).

15. Install new O-ring and bushing on **rear-end** of discharge cross-over tube (See Fig. 1B-80).

16. Install rear suction reed over dowel pins, **with slot TOWARDS sump.**

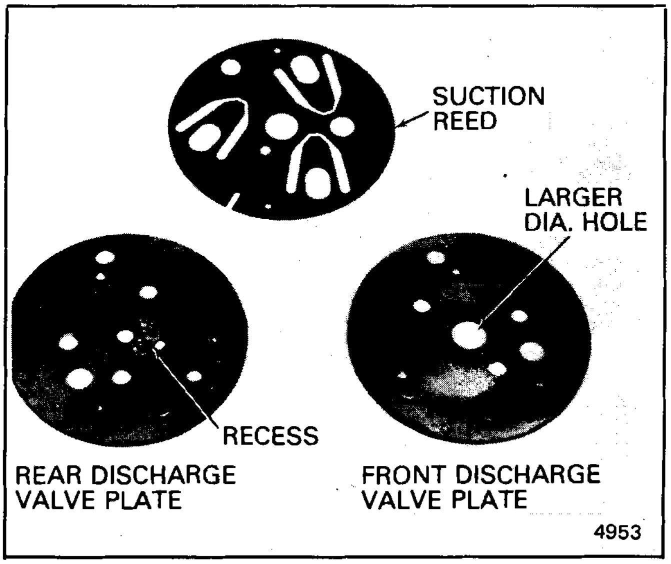


Fig. 1B-87 Front and Rear 1977 A-6 Discharge Valve Plates

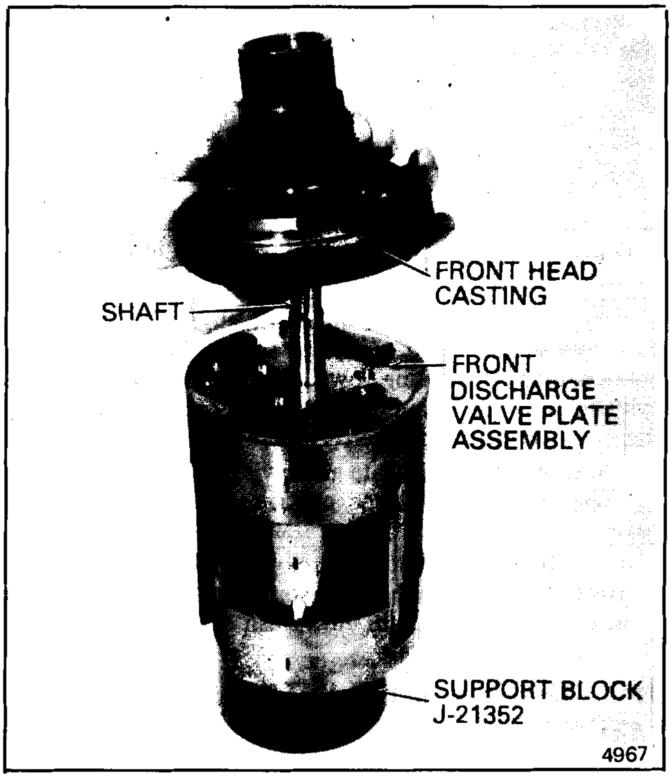


Fig. 1B-88 Installing 1977 A-6 Front Head Casting

17. Install rear discharge valve plate assembly over dowel pins, **with reed retainers UP.**

18. Position inner oil pump gear over shaft with previously applied identification **mark UP.**

19. Position outer oil pump gear over inner gear with previously applied identification **mark up** and, when standing facing oil sump, position outer gear so that it meshes with inner gear at the 9-o'clock position, and resulting cavity between gear teeth is then at 3-o'clock position (Fig. 1B-92).

20. Generously oil rear discharge valve plate assembly with 525 viscosity refrigerant oil around outer edge where large diameter O-ring will be placed. Oil the valve reeds, pump gears, and area where sealing surface will contact rear

Fig. 1B-89 1977 A-6 Front Head O-Ring Installed

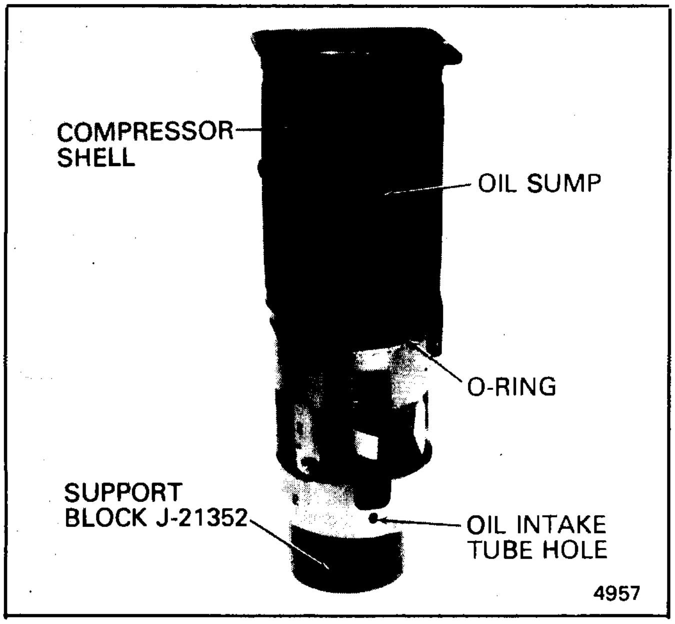


Fig. 1B-90 Installing 1977 A-6 Compressor Shell

discharge valve plate.

21. Using the 525 oil, lubricate new head to-shell O-ring and install on rear discharge valve plate, in contact with shell (Fig. 1B-93).

22. Install suction screen in rear head casting, using care not to damage screen.

23. Coat sealing surface on webs of compressor rear head casting with 525 viscosity refrigerant oil.

24. Install rear head assembly over studs on compressor shell.

The two lower threaded compressor mounting holes should be in alignment with the compressor sump.

Make certain that suction screen does not drop out of place when lowering rear head into position (Fig. 1B-94).

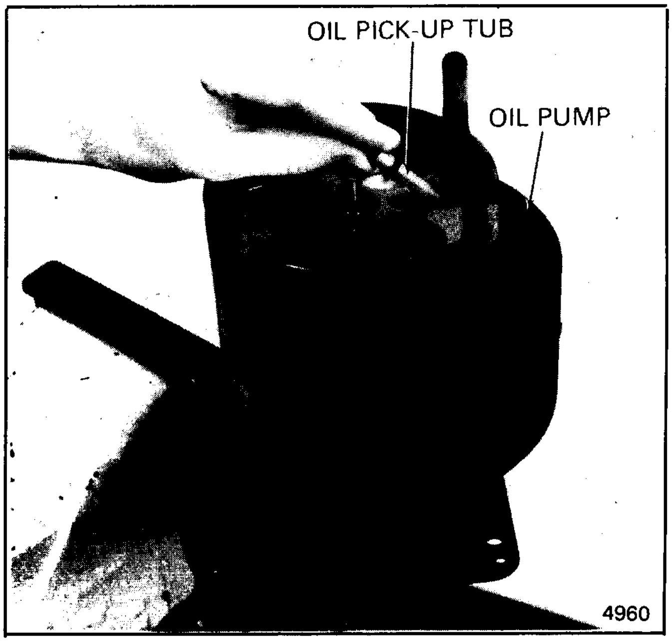


Fig. 1B-91 Installing 1977 A-6 Oil Pick-up Tube

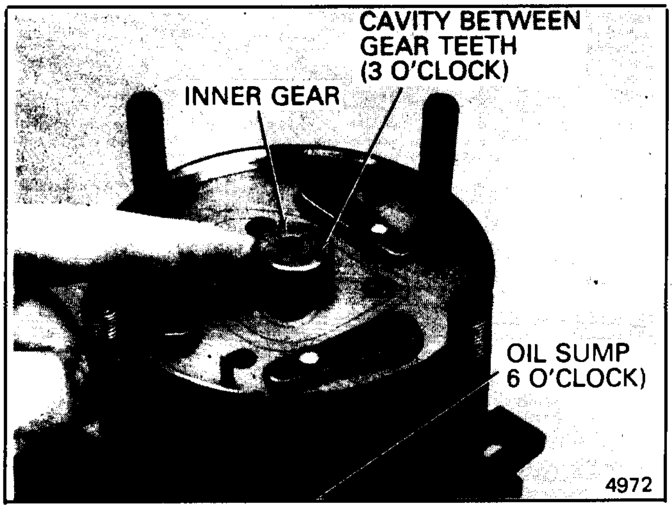


Fig. 1B-92 Positioning 1977 A-6 Oil Pump Gears

If rear head assembly will not slide down over dowels in internal mechanism, twist front head assembly back-and-forth very slightly by-hand until rear head drops over dowel pins.

25. Install nuts on threaded shell studs and tighten evenly to 25 lb. ft. torque using a 0-50 lb. ft. torque wrench.

26. Invert compressor in Holding Fixture and install compressor shaft seal as described in "Compressor Shaft Seal" Replacement procedure.

27. Install compressor clutch coil and housing assembly as described in "Compressor Clutch Coil and Housing Asm." Replacement procedure.

28. Install compressor pulley and bearing assembly as described in "Compressor Pulley and Bearing" Replacement procedure.

29. Install compressor clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Asm.' Replacement procedure.

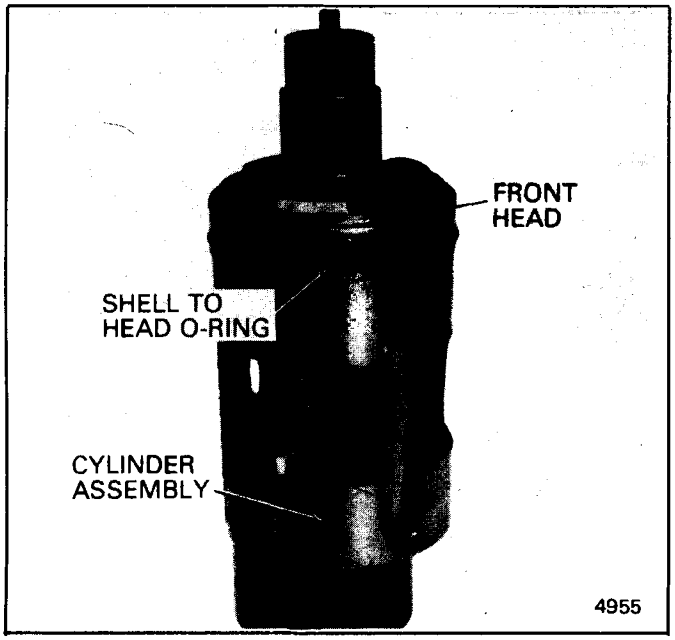


Fig. 1B-93 1977 A-6 Shell-To-Front Head O-Ring Installation

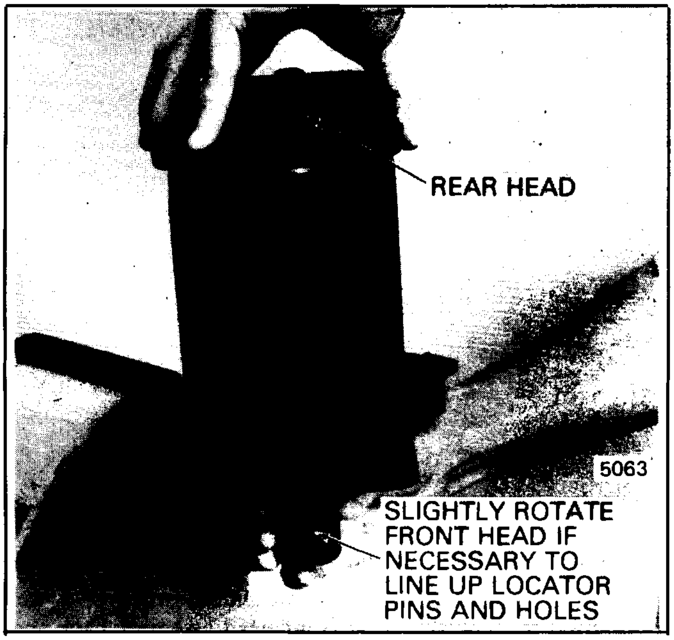


Fig. 1B-94 Installing 1977 A-6 Rear Head

30. Add required amount of 525 viscosity refrigerant oil (see "C.C.O.T. Refrigerant Oil Distribution").

31. Check for external and internal leaks as described in the following "Compressor Leak Testing" procedure.

MINOR REPAIR PROCEDURES FOR THE R-4 COMPRESSOR

The following operations to the R-4 Compressor Clutch Plate and Hub, Rotor and Bearing, and Coil & Pulley Rim are covered as "Minor" because they may be performed WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR from the vehicle.

The Compressor Shaft Seal assembly and Pressure Relief Valve may also be serviced WITHOUT REMOVING THE COMPRESSOR from the vehicle but these operations are covered later in this section as "Major Repair Procedures" because the system MUST FIRST BE PURGED of Refrigerant-12.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

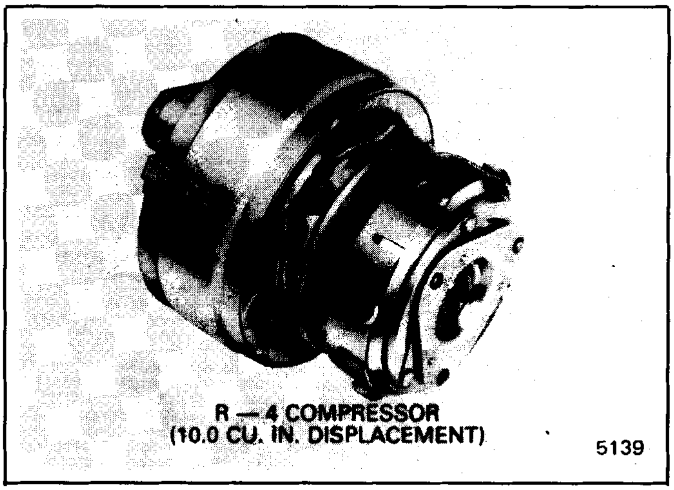


Fig. 1B-95 1977 R-4 Compressor

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to Fig. 1B-96 and Fig. 1B-97 for information relative to parts nomenclature and location.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. **The work area, tools and parts must be kept clean at all times.**

See "C.C.O.T. Refrigerant Oil Distribution" for specific conditions of oil addition to the A/C system.

R-4 COMPRESSOR CLUTCH PLATE AND HUB ASM.

Remove

1. If compressor is not removed from the car, loosen compressor mounting brackets, disconnect the compressor drive belt and reposition the compressor for access, if necessary.

If compressor has been removed from the car, attach the compressor to the holding fixture, J 25008-1, and clamp the holding fixture in a vise (Fig. 1B-98).

2. Keep the clutch hub from turning with the Clutch Hub Holding Tool, J 25030, and remove and discard the shaft nut using Thin Wall Socket, J 9399, Fig. 1B-99.

3. Thread the Clutch Plate and Hub Assembly Remover, J 9401, into the hub. Hold the body of the tool with a wrench and turn the center screw into the remover body to remove the clutch plate and hub assembly (Fig. 1B-100).

4. Remove the shaft key.

Replace

1. Install the shaft key into the hub key groove (Fig. 1B-101). Allow the key to project approximately 3/16" out of the keyway.

The shaft key is curved slightly to provide an interference fit in the shaft key groove to permit the key projection without falling out.

2. Be sure the frictional surface of the clutch plate and the clutch rotor are clean before installing the clutch plate and hub assembly.

3. Align the shaft key with the shaft keyway and assemble the clutch plate and hub assembly on the compressor shaft.

CAUTION: *To avoid internal damage to the compressor, do not drive or pound on the clutch hub or shaft.*

4. Place Spacer Bearing, J 9480-2, on hub, insert the end of Clutch Plate and Hub Assembly Installer, J 9480-1, through the spacer and thread the tool onto the end of the compressor shaft (Fig. 1B-102).

5. Hold the hex portion of the J 9480-1 body with a wrench and tighten the center screw to press the hub onto the shaft until there is a .020-.040 inch air gap between the frictional surfaces of the clutch plate and clutch rotor.

6. Install a new shaft nut with the small diameter boss of the nut against the crankshaft shoulder, using Thin Wall Socket, J 9399. Hold the clutch plate and hub assembly with Clutch Hub Holding Tool, J 25030, and tighten to 8-12 foot pounds torque, using a 0-25 pounds torque wrench.

7. If operation is performed with compressor on car, connect drive belt, tighten mounting brackets and adjust belt tension. If operation is performed on bench, install compressor. Evacuate and charge system according to procedure.

R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING

Remove

1. Remove the clutch plate and hub assembly as described in "R-4 Compressor Clutch Plate & Hub Asm." Removal procedure.

2. Remove rotor and bearing assembly retaining ring using Snap Ring Pliers, J 6083 (#24), Fig. 1B-103. Mark the location of the clutch coil terminals.

If the clutch rotor and/or rotor bearing only are to be replaced, bend the lockwashers away from the pulley rim mounting screws (see Fig. 1B-104), and remove the six mounting screws and special lock washers before proceeding with Step 3. Discard the lock washers.

3. Install Rotor and Bearing Puller, J 25031-2, down into the rotor until the Puller arms engage the recessed edge of the rotor hub. Hold the Puller and arms in place and tighten the Puller screw against the Puller Guide to remove the clutch rotor and bearing assembly (Fig. 1B-105), being careful not to drop the Puller guide.

If the pulley rim mounting screws and washers were removed in Step 2, only the clutch rotor and bearing assembly will be removed for replacement. The clutch coil and housing assembly is pressed onto the front head of the compressor with a press fit and will not be removed unless the pulley rim mounting screws are left securely in place and the pulley rim pulls the coil and housing assembly off with the total clutch rotor and pulley rim assembly.

5. Place the rotor and bearing assembly on blocks as shown in Fig. 1B-106. Drive the bearing out of the rotor hub with Rotor Bearing Remover, J 25029.

It is not necessary to remove the staking at the rear of the rotor hub to remove the bearing (see Fig. 1B-107).

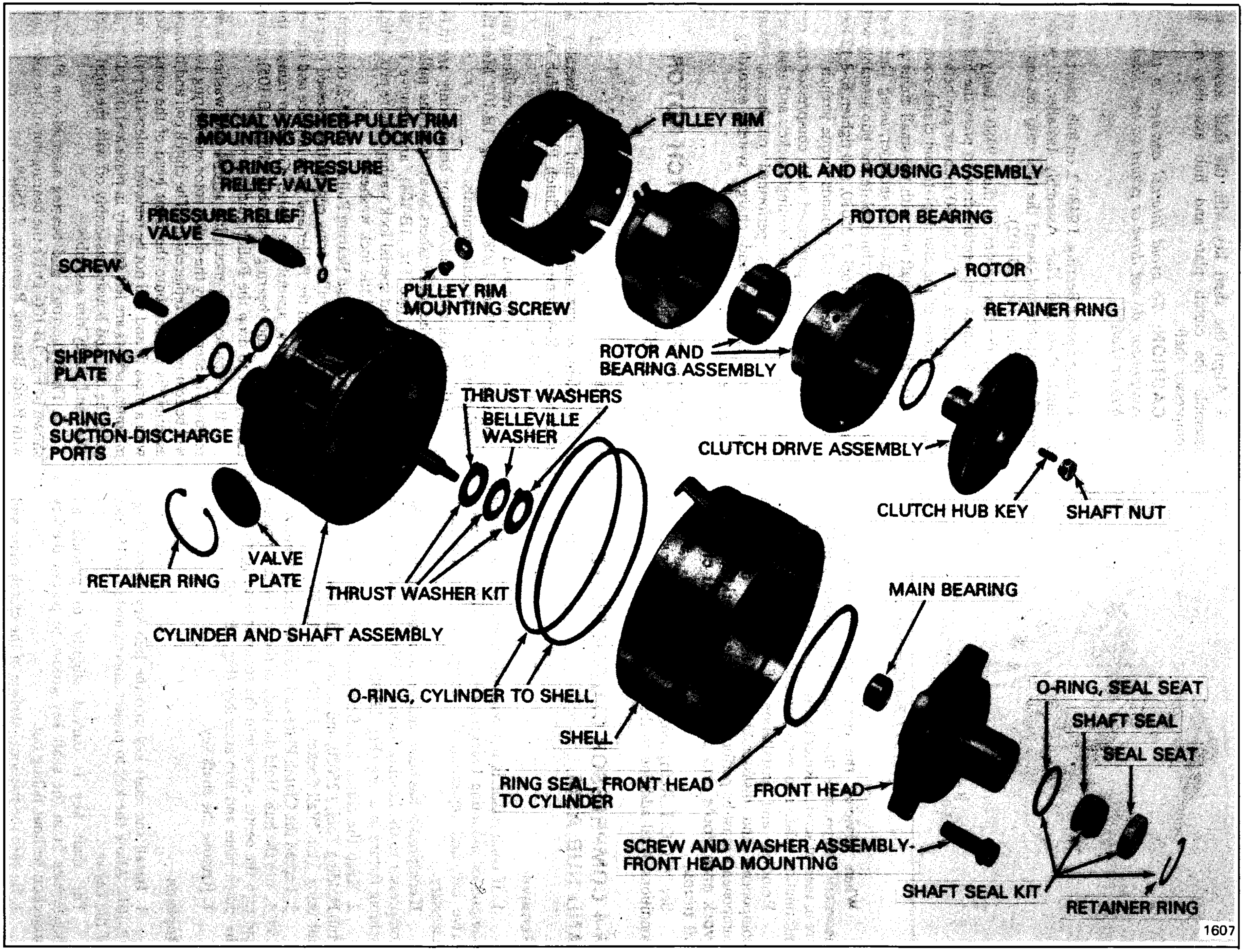


Fig. 1B-96 Exploded View of 1977 R-4 Compressor

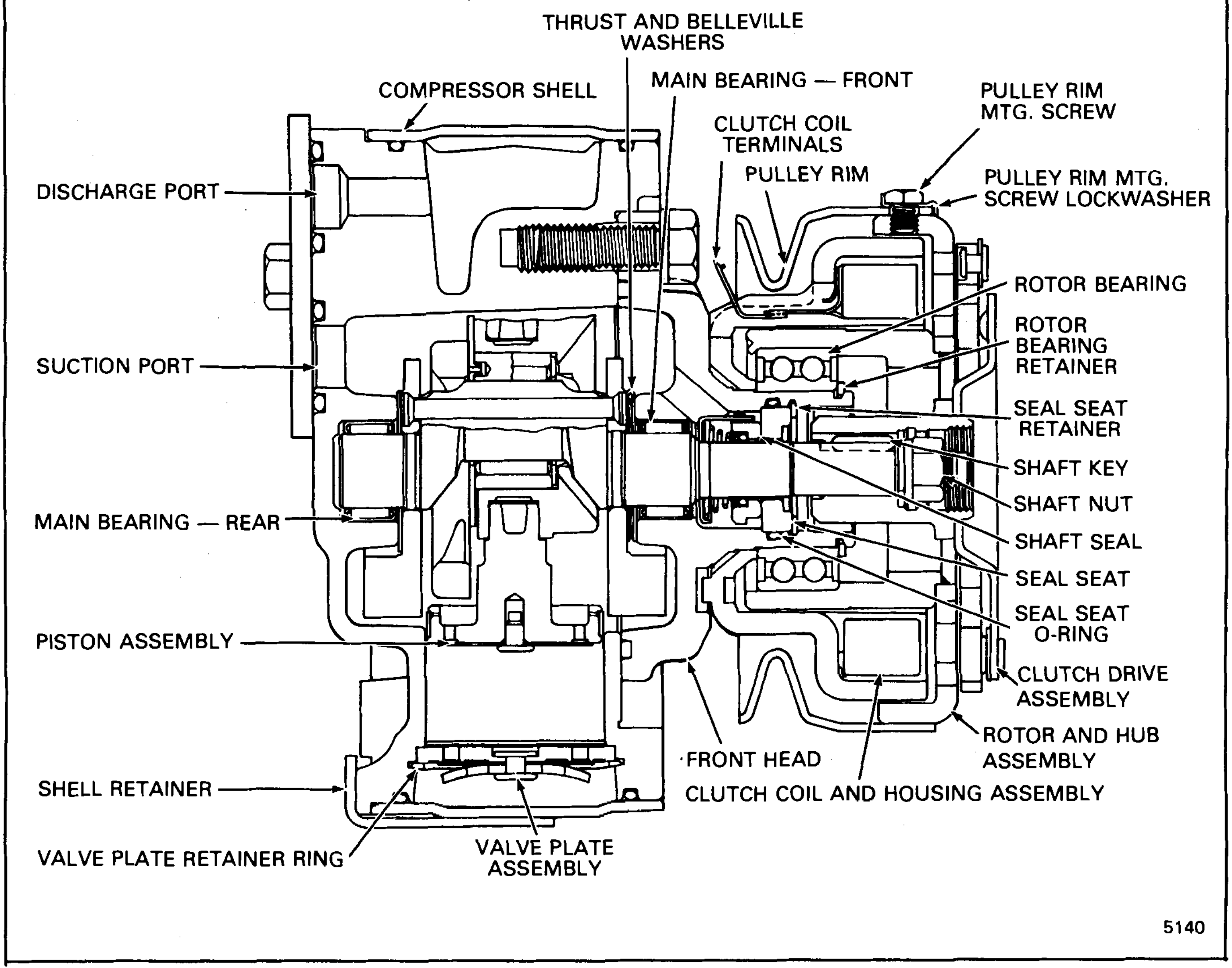


Fig. 1B-97 1977 R-4 Compressor Cross Section

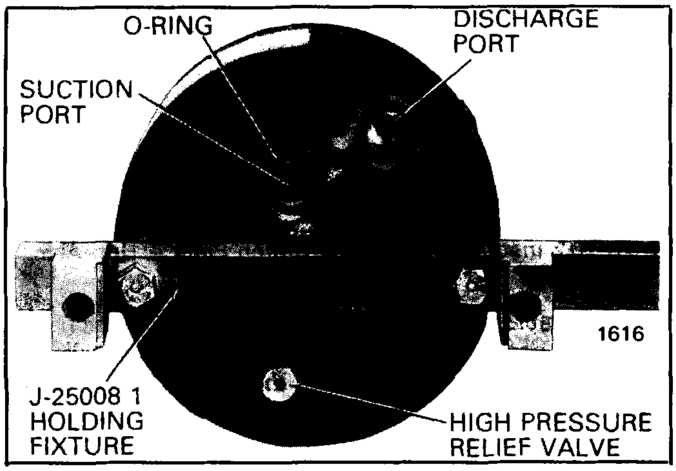


Fig. 1B-98 1977 R-4 In Holding Fixture

Replace

1. Place the rotor and hub assembly face down on a clean, flat and firm surface.

2. Align the new bearing squarely with the hub bore and using Pulley and Bearing Installer J 9481 with Universal Handle, drive the bearing fully into the hub (Fig. 1B-108). The Installer will apply force to the outer race of the bearing.

3. Using a center punch with a 45° angle point, stake (0.45"-.055") the bearing in three places 120° apart as shown in Fig. 1B-107, but do not stake too deeply and possibly distort the outer race of the bearing.

4. REPLACE ROTOR & BEARING ASM. (ON CAR)

NOTE: Rotor and bearing assembly removal and installation may be completed on the car without Discharging the A/C system.

A. Position the rotor and bearing assembly on the front head.

B. With Rotor & Bearing Installer J 26271 (without driver handle) in position and rotor and bearing assembly aligned with the front head as illustrated, drive the assembly part way onto the head (Fig. 1B-109).

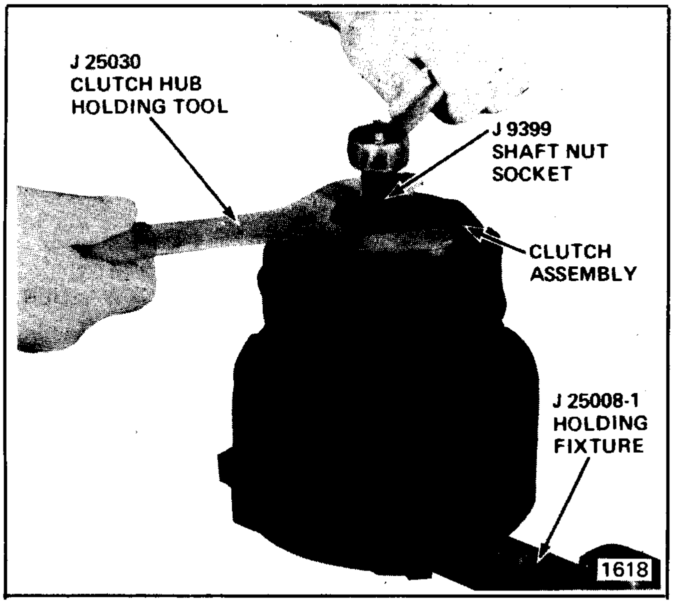


Fig. 1B-99 Removing 1977 R-4 Shaft Nut

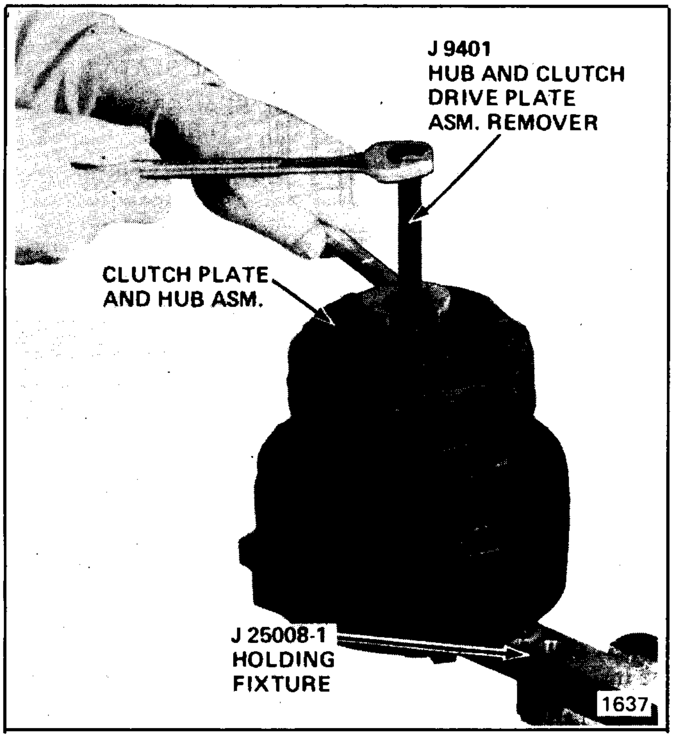


Fig. 1B-100 1977 R-4 Clutch Plate & Hub Asm. Removal

C. Plug clutch coil connector onto clutch coil.

D. Position the clutch coil so the 3 locating tabs will align with the holes in the head and continue to drive the rotor and bearing assembly onto the front head.

E. Install the retainer ring.

F. Reassemble the clutch plate and hub with the shaft key onto the shaft with Installer J 9480-1 until .020" to .040" air gap is obtained.

G. Install shaft lock nut. Torque to 12 ft. lbs.

4. REPLACE ROTOR & BEARING ASM. (ON BENCH)

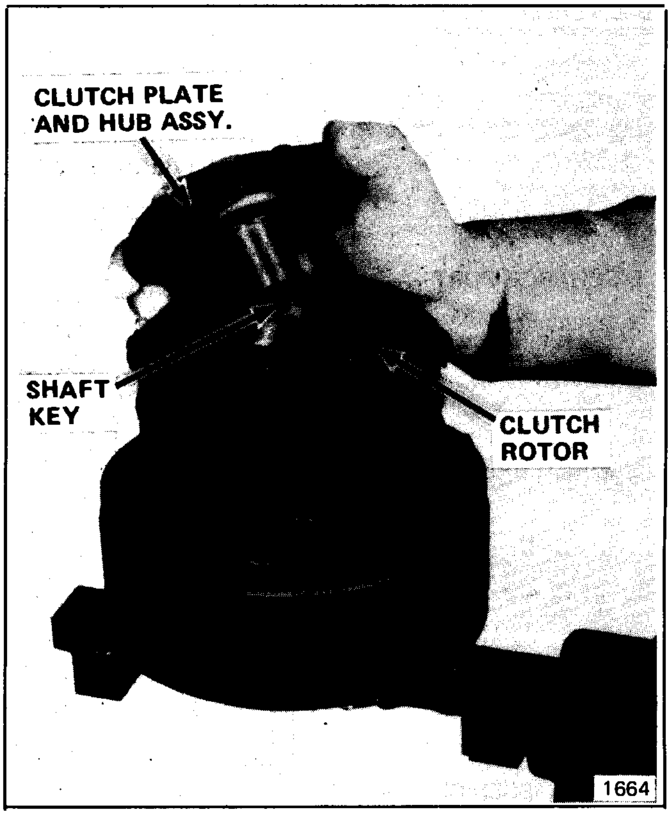


Fig. 1B-101 Installing 1977 R-4 Shaft Key

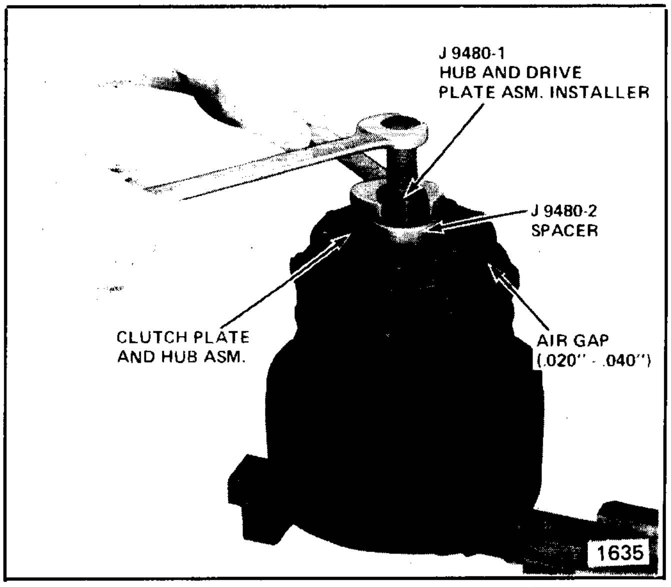


Fig. 1B-102 Installing 1977 R-4 Clutch Plate & Hub Asm.

Reassemble the rotor and bearing assembly to the front head of the compressor using Rotor & Bearing Installer J 26271. With Installer assembled to the Universal Handle, J 8092, as shown in Fig. 1B-110, force will be applied to the inner race of the bearing when installing the assembly on the front head of the compressor.

5. Install rotor and bearing assembly retainer ring using Snap Ring Pliers J 6083 (#24) (see Fig. 1B-103).

6. Apply sealer (Loctite RC-75 or equivalent) to threads of pulley rim mounting screws. Install screws and new special lock washers but do not torque the screws.

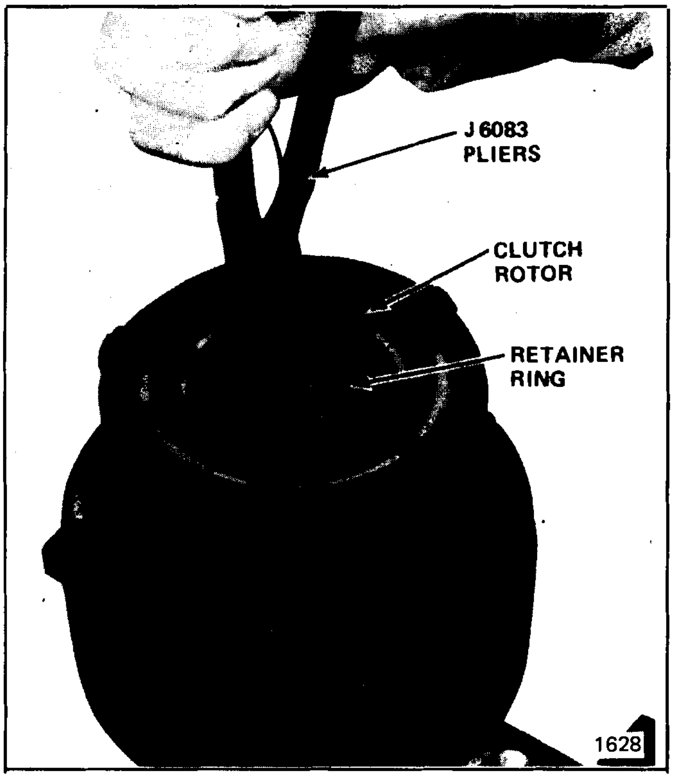


Fig. 1B-103 Removing 1977 R-4 Rotor & Bearing Asm. Retainer Ring

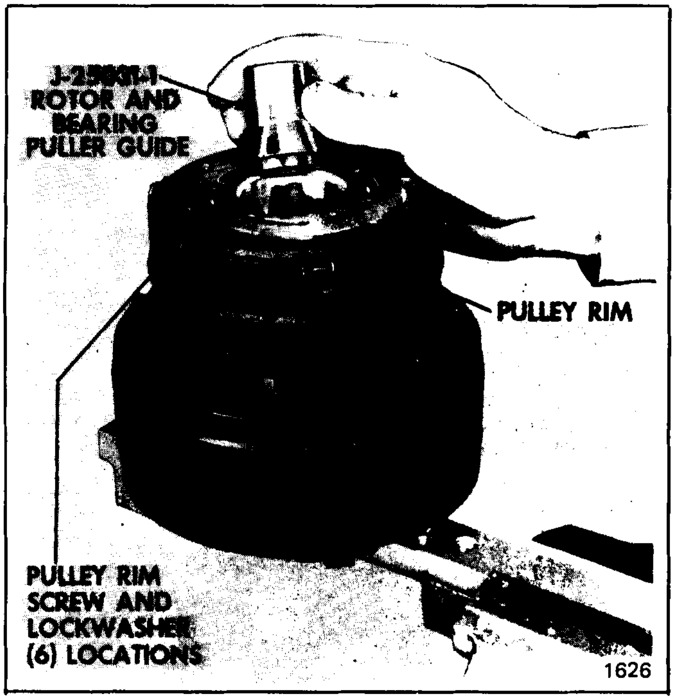


Fig. 1B-104 Installing 1977 R-4 Rotor & Bearing Puller Guide

7. Rotate the pulley rim and rotor to insure that pulley rim is rotating "in-line". If pulley rim is distorted (does not rotate in-line) adjust or replace pulley rim.

8. Tighten pulley rim mounting screws to 100 inch-pounds torque and lock screw heads in place by bending special lock washers (Fig. 1B-110).

9. Reinstall clutch plate and hub assembly according to its procedure.

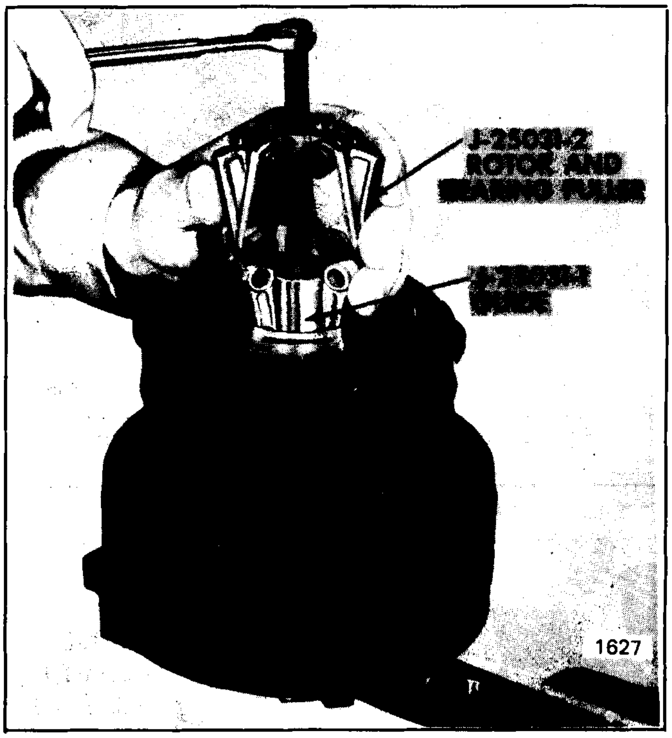


Fig. 1B-105 Removing 1977 R-4 Clutch Rotor Asm.

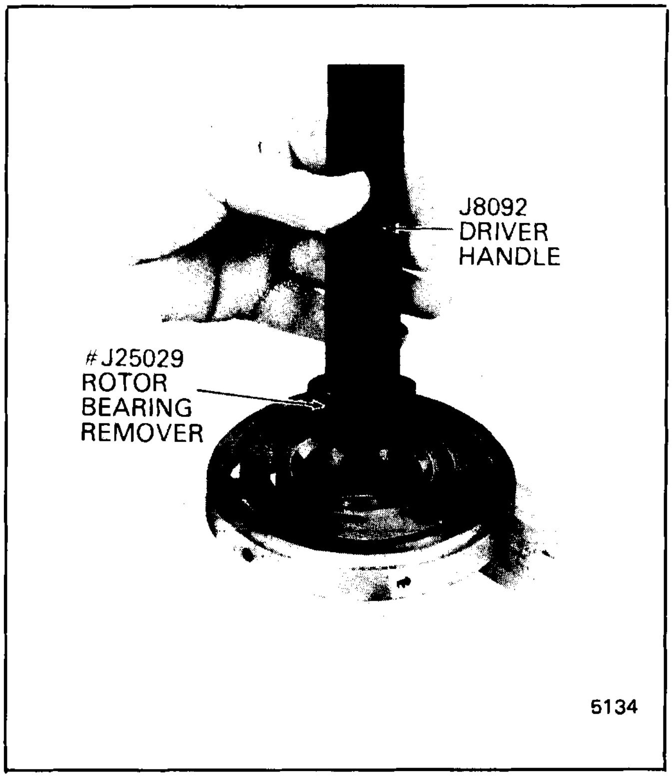


Fig. 1B-106 1977 R-4 Clutch Rotor Bearing Removal

R-4 COMPRESSOR CLUTCH COIL AND/ OR PULLEY RIM

Remove

1. Perform steps 1 through 4 of "Clutch Rotor and/or Bearing" Removal procedure but do not loosen or remove the pulley rim mounting screws until the clutch rotor, coil and

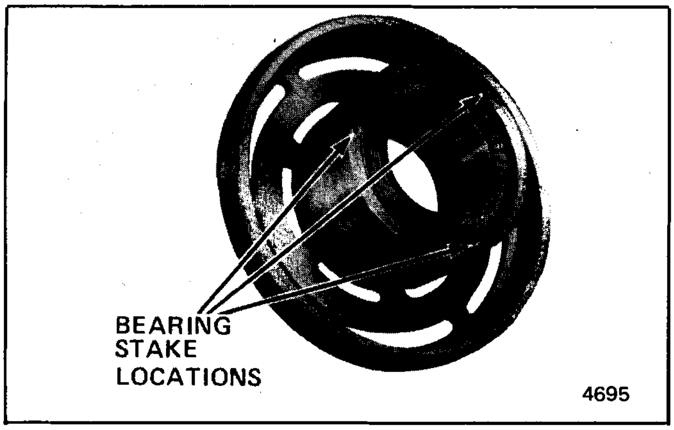


Fig. 1B-107 1977 R-4 Rotor & Bearing Asm.

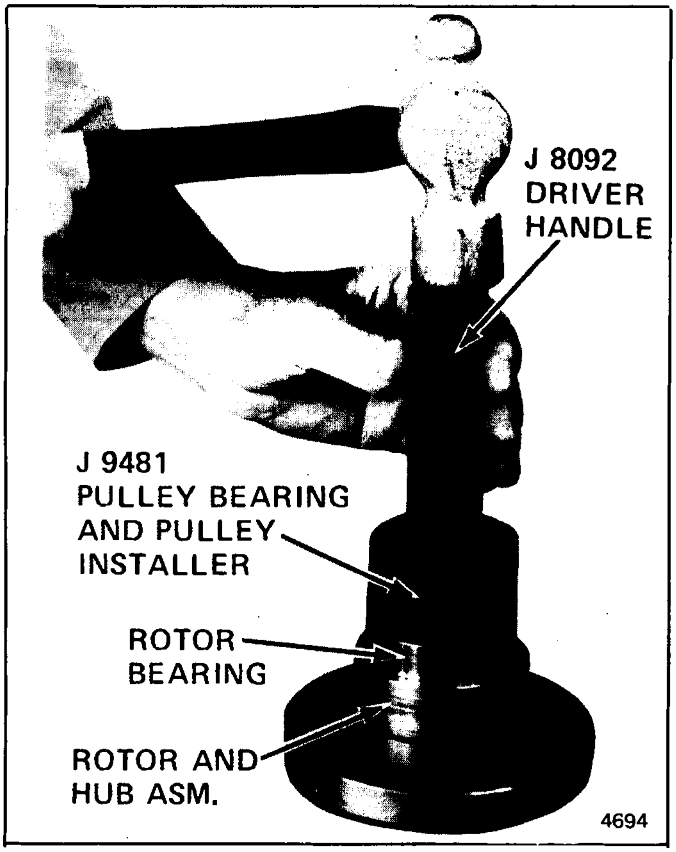


Fig. 1B-108 Installing 1977 R-4 Clutch Rotor Bearing

pulley rim assembly have been removed from the front head. Be careful not to drop the Puller Guide, J 25031-1 when removing the assembly.

2. Remove the pulley rim mounting screws and special lock washers. Discard the lock washers.

3. Slide the pulley rim off the rotor and hub assembly. The pulley rim and the clutch coil (Fig. 1B-111) are replaceable at this point.

Replace

1. Assemble the clutch coil, pulley rim and the clutch rotor and bearing assembly as shown in Fig. 1B-112. Use new special lock washers and apply sealer (Loctite RC-75 or equivalent) to screw threads but do not lock the screws in place.

Fig. 1B-109 Installing 1977 R-4 Rotor and Bearing Asm. (On Car)

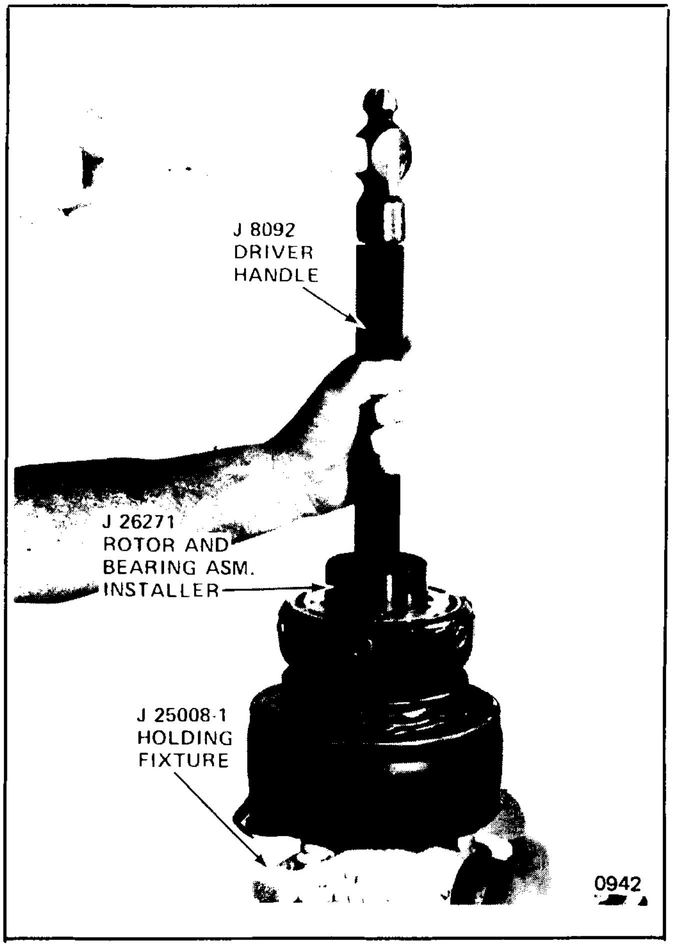


Fig. 1B-110 Installing 1977 R-4 Rotor & Bearing Asm. (On Bench)

2. Place the assembly on the neck of the front head and seat into place using Rotor & Bearing Installer, J 26271 (Fig. 1B-110).

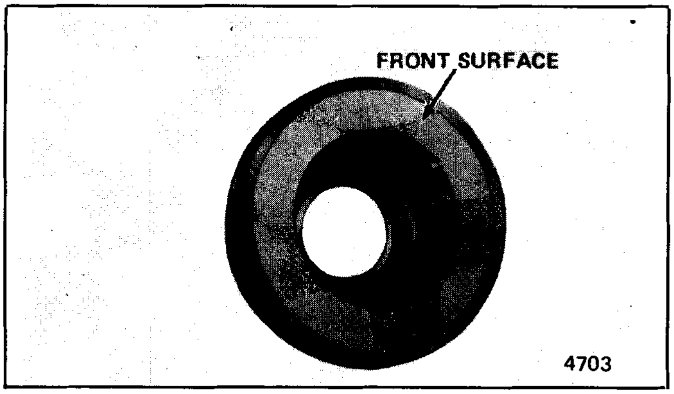


Fig. 1B-111 1977 R-4 Clutch Coil Asm.

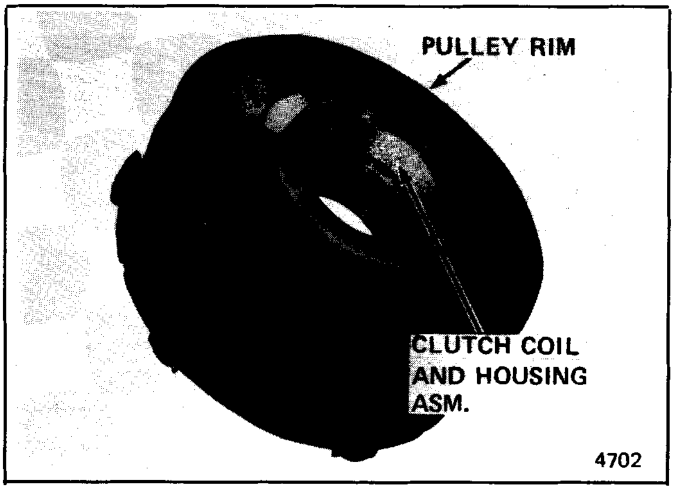


Fig. 1B-112 Assembling 1977 R-4 Clutch Coil, Pulley Rim and Rotor & Bearing

Before fully seating the assembly on the front head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the front head.

3. Install the rotor and bearing assembly retaining ring and reassemble the clutch plate and hub assembly. Check the clutch plate to clutch rotor air gap (.020 - .040 inches).

Rotate the pulley rim and rotor to be sure the pulley rim is rotating "in-line" and adjust or replace as required.

4. Tighten the pulley rim mounting screws to 100 inch-pounds torque and lock the screw heads in place by bending lock washers (Fig. 1B-110).

MAJOR R-4 COMPRESSOR REPAIR PROCEDURES

Service repair procedures to the Compressor Shaft Seal and Pressure Relief Valve or disassembly of the Internal Compressor Mechanism are considered "MAJOR" SINCE THE REFRIGERATION SYSTEM MUST BE COMPLETELY PURGED OR REFRIGERANT before proceeding and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of the proper, clean service tools. Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

These procedures are based on the use of the proper service tools and the condition that an adequate stock of service parts is available.

All parts required for servicing are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the mechanism assembly just as they are removed from the service package.

WHEN REPLACING THE SHAFT SEAL ASSEMBLY (see Fig. 1B-44), OR PRESSURE RELIEF VALVE, even if the compressor remains on the vehicle during the operation, IT WILL BE NECESSARY TO PURGE THE SYSTEM OF REFRIGERANT as outlined earlier in the Service Manual (see "Discharging, Evacuating and Charging Procedures for C.C.O.T. A/C Systems"). THE SAME HOLDS TRUE FOR ANY DISASSEMBLY OF THE INTERNAL R-4 COMPRESSOR MECHANISM.

R-4 COMPRESSOR SHAFT SEAL

SEAL LEAK DETECTION

A SHAFT SEAL SHOULD NOT BE CHANGED BECAUSE OF AN OIL-LINE ON THE HOOD INSULATOR. The seal is designed to seep some oil for lubrication purposes. Only change a shaft seal when a leak is detected by evidence of oil sprayed in large amounts and then only after actual refrigerant leakage is determined by test with Electronic Leak Detector, J 23400.

R-4 COMPRESSOR SHAFT SEAL REPLACEMENT (ON CAR)

Remove

1. "Discharge the Refrigerant System" according to the "DISCHARGING, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEM".

2. Loosen and reposition compressor in mounting brackets.

3. Remove clutch driven plate from compressor as described in "R-4 Compressor Clutch Plate & Hub Asm." Removal procedure.

4. Remove the shaft seal seat retainer using Snap Ring Pliers, J 5403 (#21).

5. Thoroughly clean inside of the compressor neck area surrounding the compressor shaft, seal seat and shaft, to remove all dirt and foreign material before removing the seal seat.

6. Insert Seal Seat Remover and Installer Tool J 23128 (Fig. 1B-113), over the shaft into the recessed area of the seal seat to tighten tool clockwise to securely engage the knurled tangs of the J 23128 Tool with the seat. Remove the seal seat with a twisting and pull motion. Discard the seat.

7. Insert the Seal Remover and Installer, J 9392 (Fig. 1B-114), over the shaft and engage the shaft seal by pressing downward on the tool to overcome the shaft seal spring pressure and turn the tool clockwise to engage the seal assembly tabs with the tangs of the J 9392 Tool. Remove the seal assembly by pulling straight out from the compressor shaft. Discard the seal.

8. Remove the seal seat O-ring from the compressor neck using Tool J 9553 (Fig. 1B-115). Discard the O-ring.

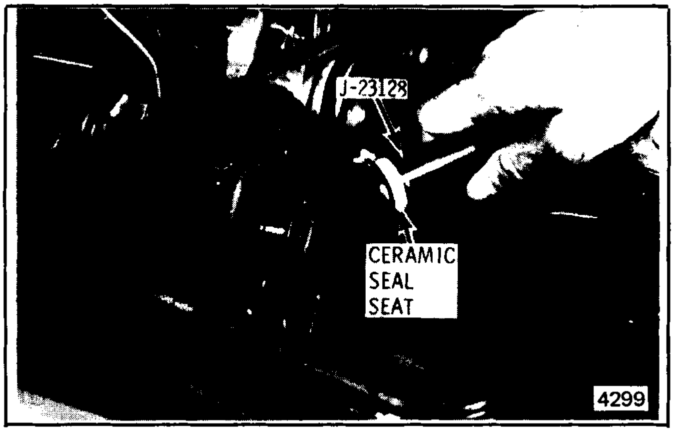


Fig. 1B-113 Removing 1977 R-4 Ceramic Seal Seat (On Car)

Replace

(See Fig. 1B-44 "Specification Seal Kit").

1. Dip the new seal seat O-ring in clean 525 viscosity oil and assembly onto O-ring Installer J 21508 as shown in Fig. 1B-116.

2. Insert the O-ring Installer J 21508 into the compressor neck until the tool "bottoms". Lower the movable slide of the O-ring installer to release the O-ring into the seal seat O-ring groove. Rotate the installer tool to seat the O-ring and remove the tool.

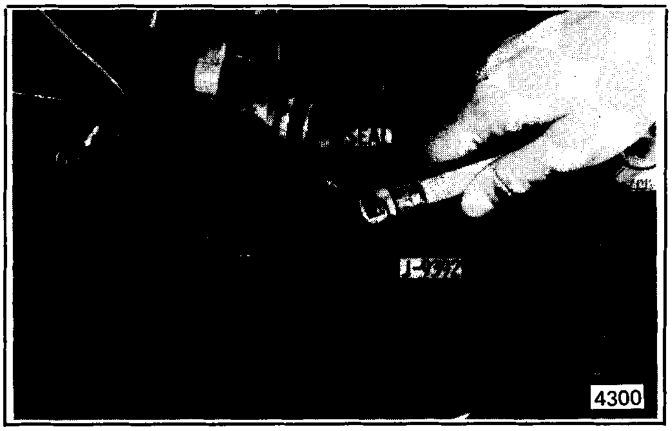


Fig. 1B-114 Removing 1977 R-4 Seal (On Car)

Fig. 1B-115 Removing 1977 R-4 O-Ring (On Car)

Fig. 1B-116 Installing 1977 R-4 O-Ring (On Car)

3. Dip the new shaft seal O-ring and seal face in clean 525 viscosity oil and carefully engage the shaft seal assembly with the locking tangs of Tool J 9392 Seal Remover and Installer as shown in Fig. 1B-117.

4. Install the Shaft Seal Protector J 22974 over the end of the compressor shaft and slide the shaft seal onto the compressor shaft. Slowly turn the tool clockwise while applying light pressure until the seal engages the flats of the compressor shaft and can be seated into place. Rotate the J 9392 Tool counterclockwise to disengage the tool from the seal tabs and remove the tool.

Fig. 1B-117 Installing 1977 R-4 Seal (On Car)

5. Attach the ceramic seal seat to the Seal Seat Remover and Installer J 23128 and dip the ceramic seat in clean 525 viscosity oil to coat the seal face and outer surface. Carefully install the seat over the compressor shaft and J 22974 Seal Protector and push the seat into place with a rotary motion (Fig. 1B-118). Remove Tools J 23128 and J 22974.

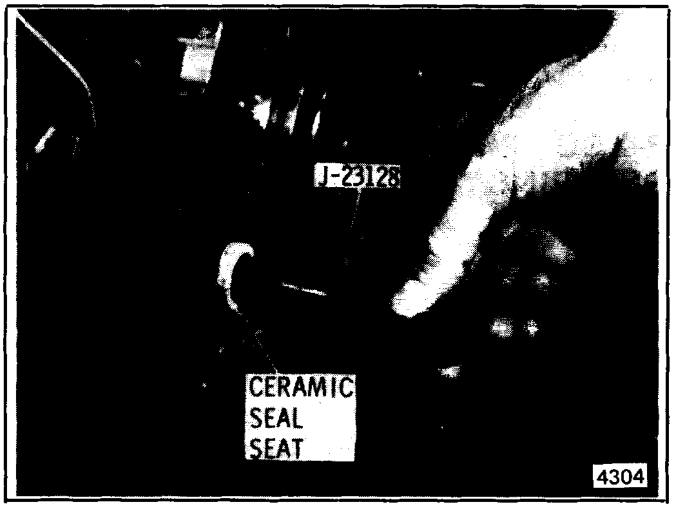


Fig. 1B-118 Installing 1977 R-4 Ceramic Seal Seat (On Car)

6. Install the new seal seat retainer ring with Snap Ring Pliers J 5403 (#21).

7. Install the clutch plate as described in "R-4 Compressor Clutch Plate & Hub Asm." Replacement procedure.

8. Re-install compressor belt and tighten bracketry.

9. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS.

R-4 COMPRESSOR SHAFT SEAL REPLACEMENT (OFF CAR)

Remove

1. Remove the clutch plate and hub assembly as described in "R-4 Compressor Clutch Plate & Hub Asm." Removal procedure.

2. Remove the shaft seal seat retainer ring using Snap Ring Pliers, J 5403 (#21).

3. Thoroughly clean the inside of the compressor neck area surrounding the compressor shaft seal, seal seat and shaft to remove all dirt and foreign material before removing the seal seat.

4. Insert Seal Seat Remover and Installer, J 23128 (Fig. 1B-119), over the shaft and into the recessed area of the seal seat. Tighten tool clockwise to securely engage the knurled tangs with the seal seat. Remoe the seal seat with a twisting and pull motion. Discard the seal seat.

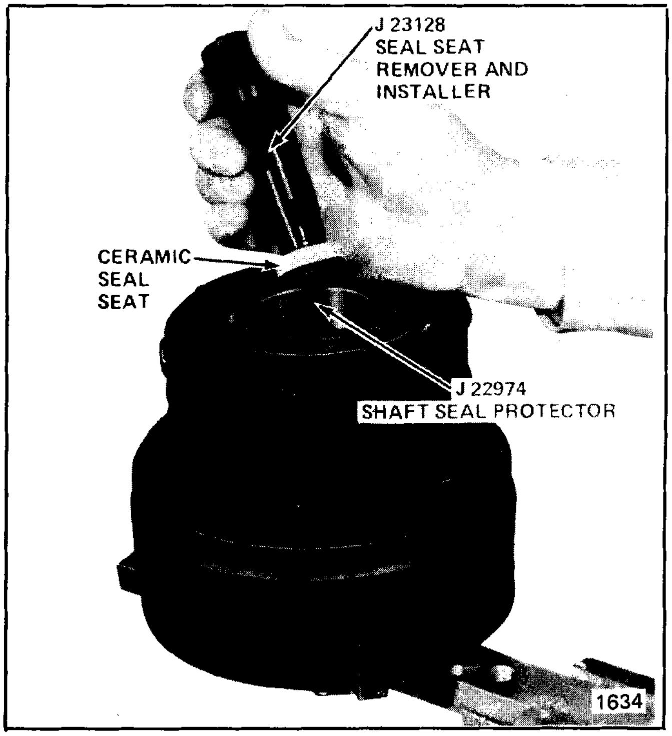


Fig. 1B-119 Removing & Installing 1977 R-4 Seal Seat (Off Car)

5. Insert Seal Remover and Installer, J 9392 (Fig. 1B-120), over the shaft and engage the shaft seal by pressing downward on the tool to overcome shaft seal spring pressure and turning the tool clockwise to engage the seal assembly tabs with the tangs of the J 9392. Remove the seal assembly by pulling straight out from the compressor shaft. Discard the seal.

6. Remove the seal seat O-ring from the compressor neck using O-ring Remover, J 9553. Discard the O-ring.

Replace

(See Fig. 1B-44 "Specification Seal Kit").

1. Dip the new seal seat O-ring in clean refrigerant oil and assemble onto O-ring Installer, J 21508, as shown in Fig. 1B-121.

2. Insert O-ring Installer, J 21508, into the compressor neck until the tool "bottoms". Lower the moveable slide of the O-ring Installer to release the O-ring into the seal seat O-ring groove. Rotate the installer to seat the O-ring and remove the tool. Inspect the internal neck area for cleanliness and proper O-ring positioning.

3. Dip the O-ring and seal face of the new shaft seal in clean refrigerant oil and carefully engage the shaft seal with

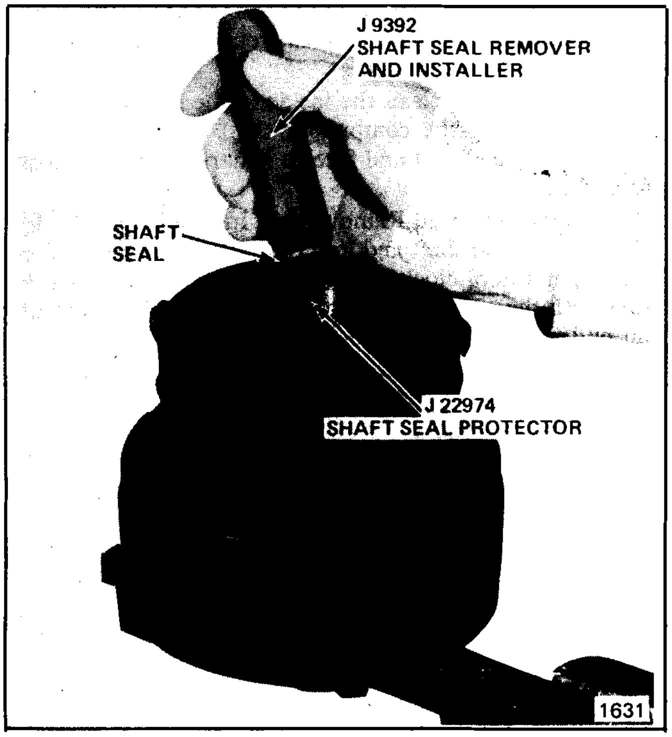


Fig. 1B-120 Removing & Installing 1977 R-4 Shaft Seal (Off Car)

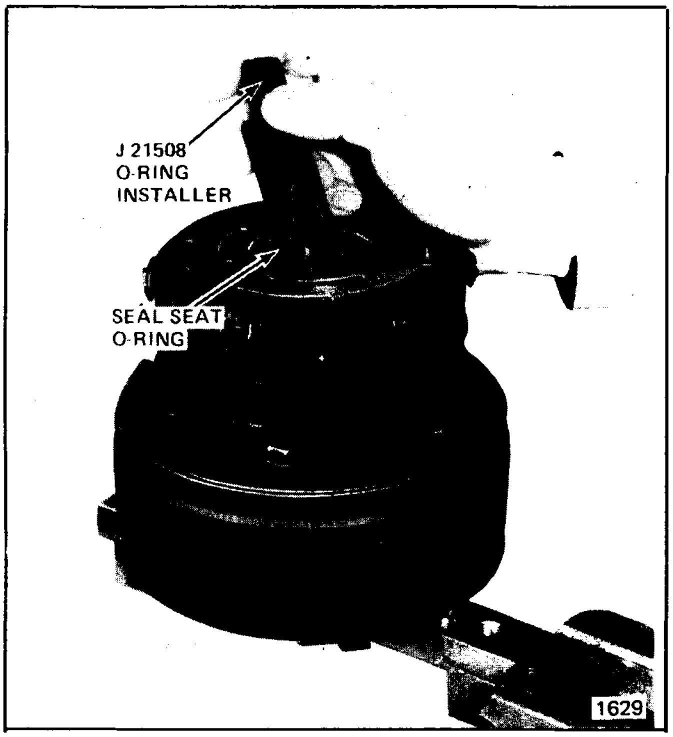


Fig. 1B-121 Installing 1977 R-4 Shaft Seal Seat O-Ring (Off Car)

the locking tangs of J 9392 Seal Remover and Installer as shown in Fig. 1B-121.

4. Install Shaft Seal Protector, J 22974, over the end of the compressor shaft and slide the shaft seal onto the shaft. Slowly turn the tool clockwise while applying light pressure until the seal engages the flats of the compressor shaft and can be seated into place. Rotate counterclockwise to disengage the tool from the seal tabs and remove the tool.

5. Attach the new ceramic seal seat to Seal Seat Remover and Installer, J 23128, and dip the seal seat in clean refrigerant oil to coat the seal face and outer surface. Carefully install the seal seat over the compressor shaft and seal protector and push the seat into place with a rotary motion. Remove J 23128 and J 22974.

6. Install the new seal seat retainer ring with Snap Ring Pliers, J 5403 (#21).

7. Reinstall the clutch plate and hub assembly.

R-4 COMPRESSOR PRESSURE RELIEF VALVE

Remove and Replace

1. "Discharge the Refrigerant System" according to the "DISCHARGING, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS".
2. Remove pressure relief valve from rear of compressor.
3. Remove and discard pressure relief valve O-ring seal.
4. Coat new O-ring seal with clean 525 viscosity refrigerant oil and install on valve.
5. Install pressure relief valve.
6. "Evacuate and Charge Refrigerant System" according to above procedures.

R-4 COMPRESSOR FRONT HEAD AND/ OR O-RING

Remove

1. Perform steps 1 through 4 of "Clutch Rotor and/or Bearing" Removal procedure (but do not loosen or remove the pulley rim mounting screws) to remove the clutch rotor, coil and pulley rim as a total assembly. Be careful not to drop the Puller Guide, J 25031, when removing the assembly.
2. Remove and discard the shaft seal kit parts according to procedure (see "Shaft Seal" Removal procedure).
3. Remove the four front head mounting screws (Fig. 1B-122) and remove the front head assembly (Fig. 1B-123).
4. Remove and discard the front head O-ring seal.

Replace

1. Check the front head and compressor cylinder area for any dirt, lint, etc. and clean, if necessary. Install a new thrust washer kit, if required, as described in "Thrust and Belleville Washers".
2. Dip the new front head O-ring seal in clean 525 viscosity refrigerant oil and install in the seal groove on the front head (Fig. 1B-123).
3. Position the oil hole in the front head to be "up" when assembled to the compressor cylinder to correspond with the "up" position of the compressor. Install the front head and tighten the front head mounting screws to an 18-22 foot pound torque.
4. Install new shaft seal kit parts (Fig. 1B-44) according to "Shaft Seal" Replacement procedure.
5. Install he clutch rotor and bearing assembly, clutch coil and pulley rim assembly to the front head using Rotor and Bearing Installer J 26271 (Fig. 1B-111).

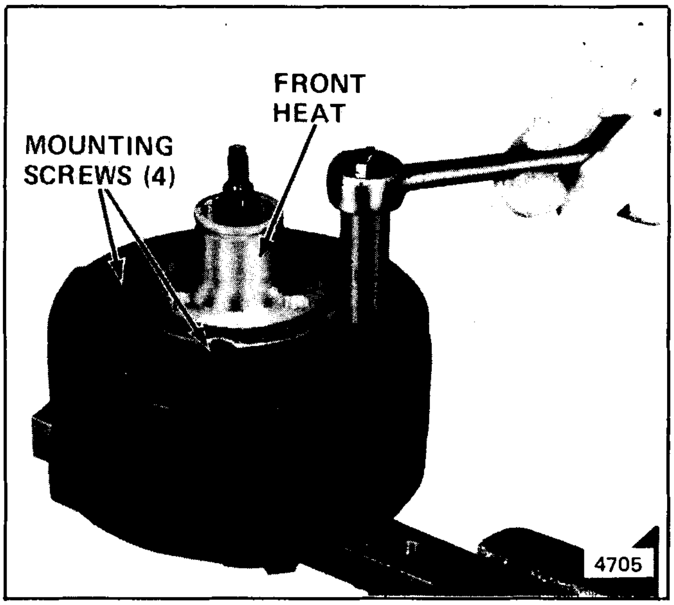


Fig. 1B-122 Removing 1977 R-4 Front Head Mounting Screws

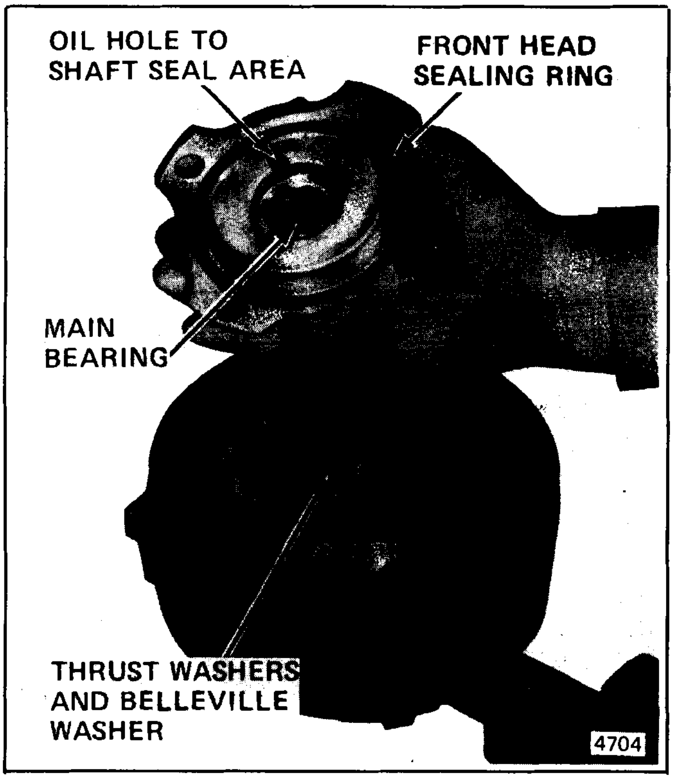


Fig. 1B-123 Removing 1977 R-4 Front Head Asm.

Before fully seating the assembly on the front head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the front head.

6. Install the rotor and bearing assembly retaining ring and reassemble the clutch plate and hub assembly using its proper procedure. Check the clutch plate to clutch rotor gap (.020 - .040 inches).

R-4 COMPRESOR THRUST AND BELLEVILLE WASHERS

Remove and Replace

1. Remove the front head assembly according to its procedure. Remove and discard the front head O-ring seal.
2. Remove the two thrust and one belleville washer from the compressor shaft. Note the assembled position of the washers.
3. Install a new thrust washer on the compressor shaft with the thrust washer tang pointing "up" (Fig. 1B-124).

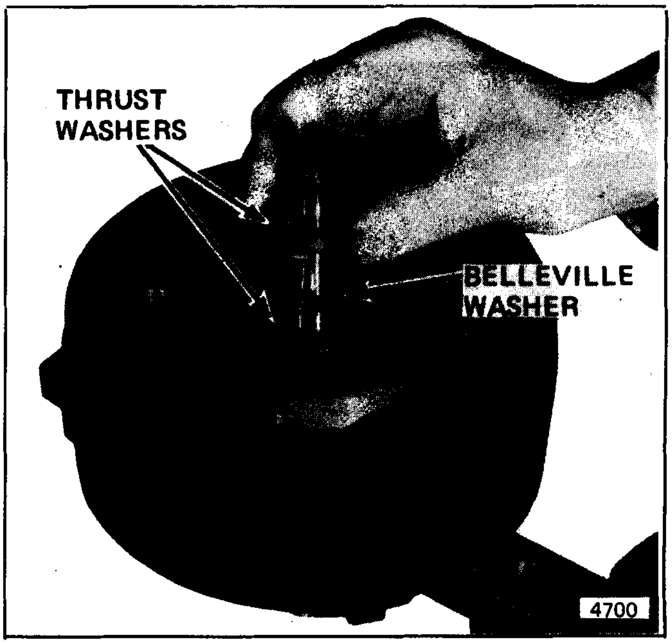


Fig. 1B-124 Replacing 1977 R-4 Thrust and Belleville Washers

4. Install the new belleville washer on the shaft with the high center of the washer "up".
5. Install the remaining thrust washer on the shaft with the tang pointing "down" (Fig. 1B-124).
6. Lubricate the three washers with clean 525 viscosity refrigerant oil and assemble the front head and new O-ring seal to the compressor according to its procedure.

R-4 COMPRESSOR MAIN BEARING

Remove

1. Remove the front head assembly according to its procedure. Discard front head O-ring seal.
2. Place the front head assembly on two blocks as shown in Fig. 1B-125, and use Main Bearing Remover, J 24896, to drive the bearing out of the front head.

Replace

1. Place the front head "with neck end down" on a flat, solid surface.
2. Align the new bearing and the Bearing Installer, J 24895, squarely with the bearing bore of the front head and drive the bearing into the front head. The J 24895 Installer must seat against the front head to insert the bearing to the proper clearance depth (see Fig. 1B-126).

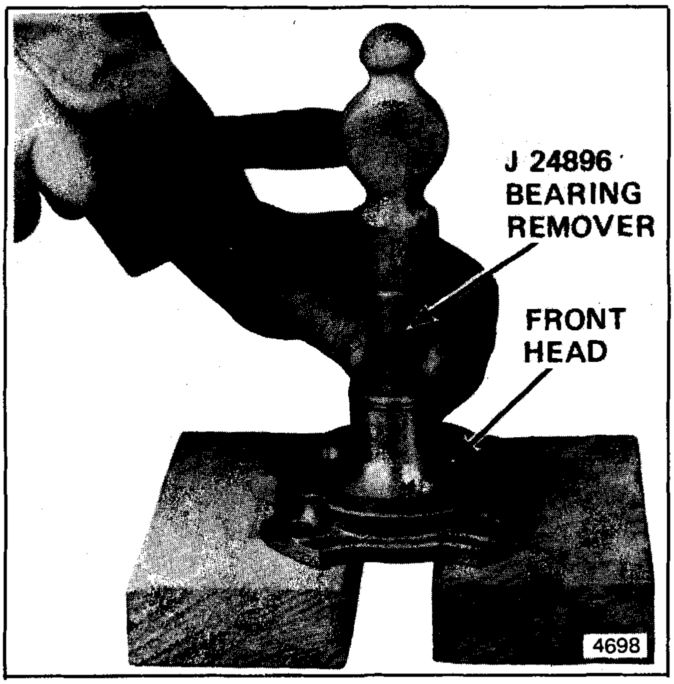


Fig. 1B-125 Removing 1977 R-4 Main Bearing

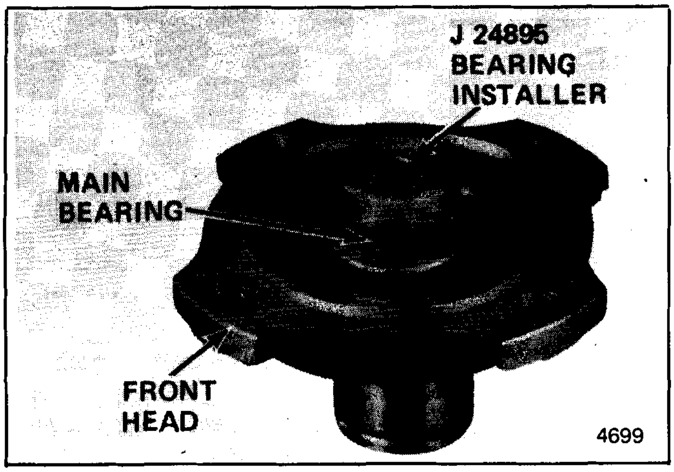


Fig. 1B-126 Installing 1977 R-4 Main Bearing

3. Assemble the front head to the cylinder using a new O-ring seal according to procedure for "Front Head" Replacement.

R-4 COMPRESSOR SHELL AND/OR O-RING SEALS

Remove

1. "Discharge the Refrigerant System" according to DISCHARING, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS.

2. Remove compressor from car according to procedure.

3. Clean exterior of compressor as thoroughly as possible to prevent dirt from getting into compressor during shell removal.

4. Attach compressor to J 25008-1 Holding Fixture and clamp holding fixture in a vise (Fig. 1B-98).

5. Keep clutch hub from turning with clutch Hub Holding Tool, J 25030. Remove and discard shaft nut using J 9399 Thin Wall Socket (Fig. 1B-99).

6. Thread Clutch Plate and Hub Asm. Remover, J 9401, into hub. Hold body of tool with a wrench and turn center screw into remover body to remove clutch plate and hub asm. (Fig. 1B-100).

7. Remove shaft key from groove in compressor shaft.

8. Mark location of clutch coil terminals and remove rotor and bearing assembly retainer ring using Snap-Ring Pliers, J 6083 (#24). See Figure 1B-103.

9. Do not remove pulley rim mounting screws and lock washers. Install Rotor and Bearing Puller Guide, J 25031-1, over the end of the compressor shaft and seat it on the front head (Fig. 1B-104).

10. Install Rotor and Bearing Puller, J 25031-2, down into the rotor until arms engage the recessed edge of the rotor hub. Hold puller and arms in place and tighten puller screw against Puller Guide (Fig. 1B-106) to remove rotor and bearing asm., clutch coil and pulley rim as an assembly. Be careful not to drop the Puller Guide when removing the assembly.

11. Pry the shell retaining strap away from the cylinder and position the strap high enough to clear the cylinder as the shell is removed (Fig. 1B-127).

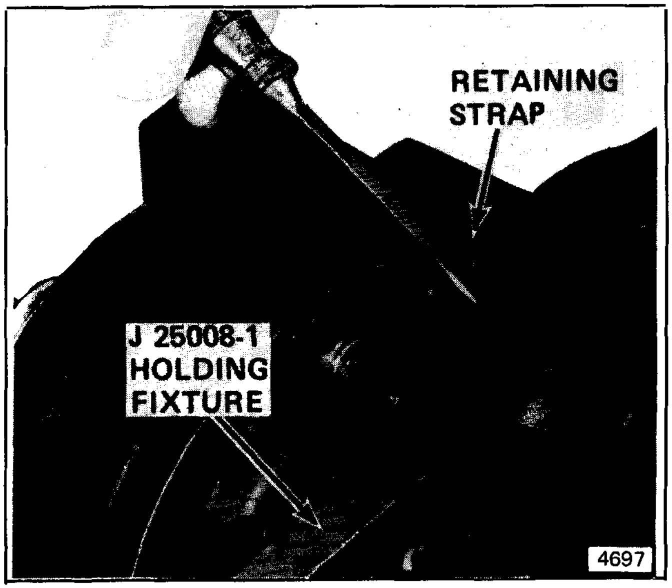


Fig. 1B-127 Releasing 1977 R-4 Shell Retaining Strap

12. Remove Compressor Holding Fixture, J 25008-1, and reverse fixture with step block protrusions engaging the compressor shell. Install the medium-length bolts through the holding fixture and thread them into the compressor cylinder until the step of the fixture protrusions contact the compressor shell, finger tight on both sides (Fig. 1B-128). With compressor at room temperature, check to be sure the step protrusions do not overlap the cylinder but will pass both sides.

13. Using a wrench, alternately tighten each bolt approximately 1/4 turn to push the shell free of the O-rings on the cylinder.

If one screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw

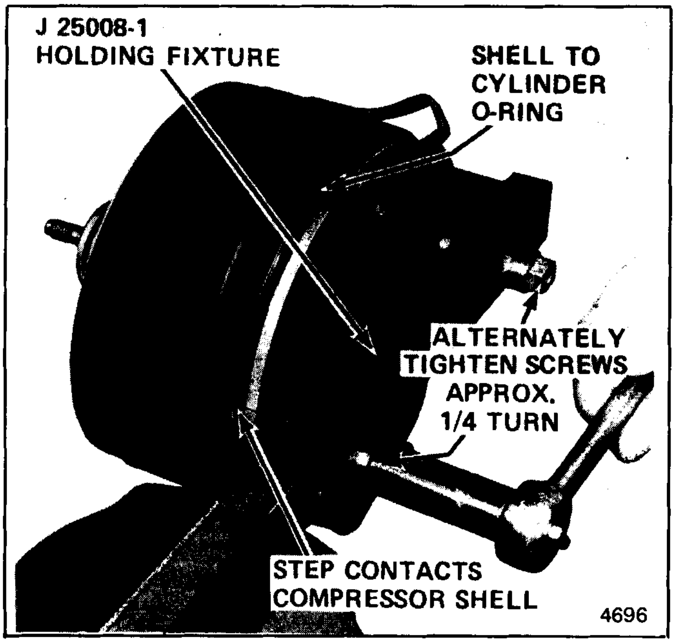


Fig. 1B-128 Removing 1977 R-4 Shell

threading sequence in-step or the shell will be cocked and made more difficult to remove. Normal removal does not require much force on the wrench if the screws are kept in-step while turning. The shell can be removed by hand as soon as the shell is free of the shell to cylinder O-rings. Do not turn the screws any further than necessary to release the shell.

14. Remove the compressor shell and remove the Holding Fixture, J 25008-1, from the compressor. Reverse the fixture to again hold the compressor by the opposite side using the short-length screws.

15. Remove and discard both cylinder to shell O-rings.

Replace

1. Check the compressor cylinder assembly and interior of the compressor shell to be sure they are free of lint, dirt, etc.

2. Dip a new cylinder-to-shell O-ring in clean 525 viscosity oil and install in the rear O-ring groove of the cylinder. Be careful in moving the O-ring across the cylinder surface to prevent damaging the O-ring.

3. Dip the remaining cylinder-to-shell O-ring in the oil and install it in the front O-ring groove of the cylinder.

4. Also coat inner surface of compressor shell with the oil and swab oil onto shell-to-cylinder O-rings. Place the compressor shell on the cylinder and rotate the retaining strap to its original location.

5. Attach the Shell Installing Fixture, J 25008-2, to the Holding Fixture, J 25008-1, using the long-bolts and plate washers of the tool set. Align the step projections of the Installing Fixture, J 25008-2, to contact the compressor shell evenly on both sides.

6. Push the compressor shell as close to the O-ring, Fig. 1B-129, as possible by hand and check for equal alignment of the shell around the cylinder. Tighten the fixture screws finger tight.

7. Using a wrench, alternately tighten each bolt approximately 1/4 turn to push the compressor shell over the O-rings and back against the shell stop flange at the rear of the compressor cylinder.

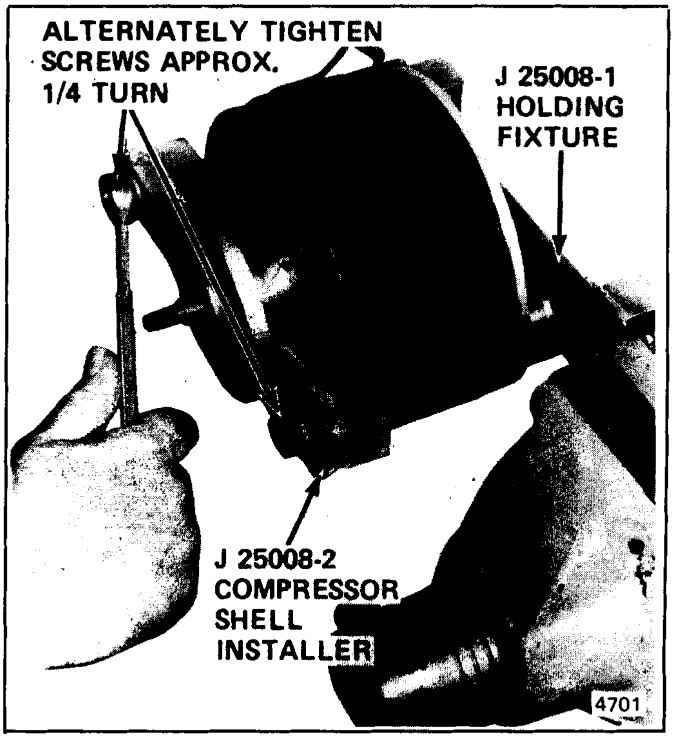


Fig. 1B-129 Installing 1977 R-4 Shell

If one screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in-step or the shell will be cocked and made more difficult to install. Normal installation does not require much force on the wrench if the screws are kept in step while turning.

8. When the shell is seated against the stops, bend the shell retaining strap down into place by tapping gently with a hammer. Remove the Shell Installing Fixture J 25008-2.

9. Re-install Clutch Rotor and Bearing Asm., Clutch Coil and Pulley Rim as an assembly, and the Clutch Plate & Hub Asm. with Installer J 26271 (Fig. 1B-110).

10. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS.

R-4 COMPRESSOR DISCHARGE VALVE PLATE AND/OR RETAINER

1. Remove compressor from car and remove compressor shell by performing steps 1 thru 15 of "Compressor Shell" Removal procedure.

2. Remove valve plate retainer ring using J 4245 (#23) Internal Snap Ring Pliers (#23), Fig. 1B-130. Remove compressor discharge valve plate (Fig. 1B-131) for valve plate replacement and/or piston inspection. Repeat this operation for additional valve plates and retainer rings. If all four valve plates and retainers are to be removed, remove two sets and then rotate compressor and holding fixture in vise for access to the remaining two valve plates and retainers.

3. Install discharge valve plates and/or retainers as shown in Figs. 1B-130 and 1B-131. Reposition compressor and holding fixture in vise as necessary for access.

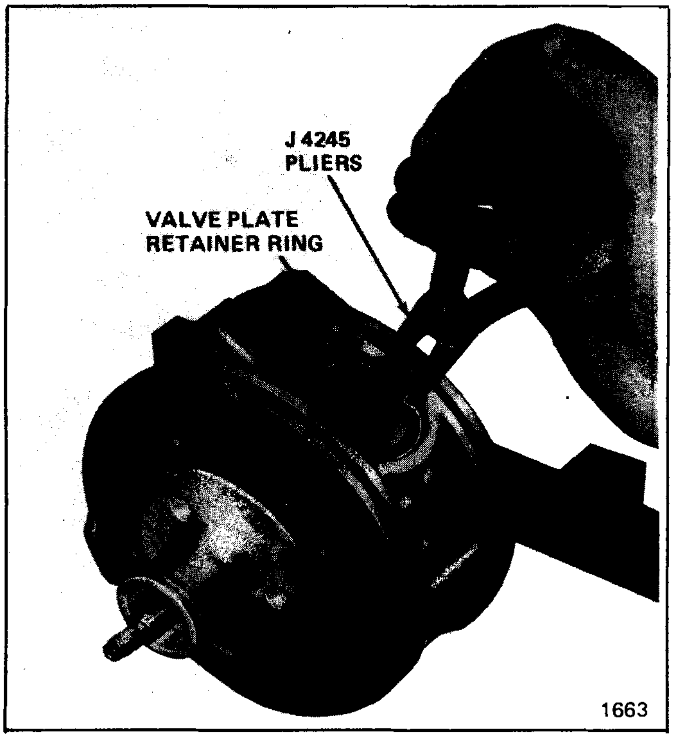


Fig. 1B-130 Replacing 1977 R-4 Valve Plate Retainer

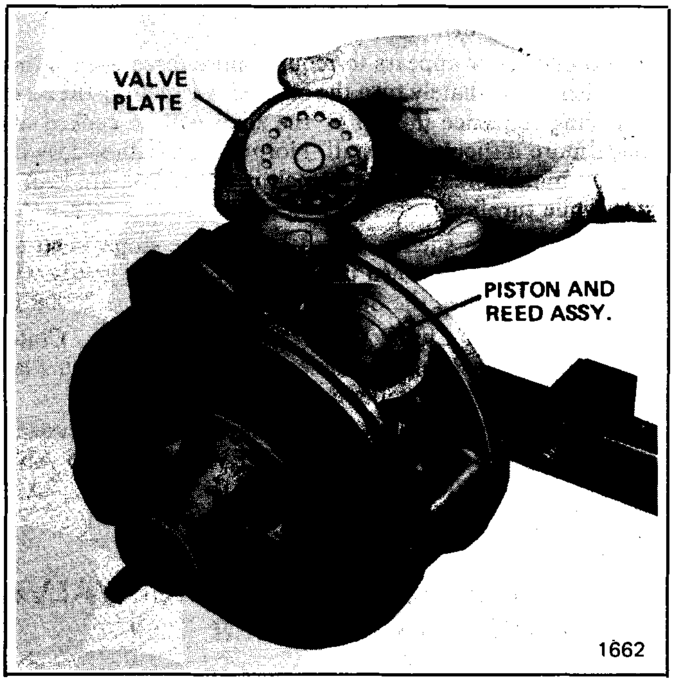


Fig. 1B-131 Replacing 1977 R-4 Discharge Valve Plate

4. Install compresor shell, install compressor on car and "Evacuate and Charge the Refrigerant System" according the Steps 1 thru 10 of "Compressor Shell" Replacement procedure.

R-4 COMPRESSOR CYLINDER AND SHAFT ASM.

Remove

1. "Discharge the Refrigerant System" according to the DISCHARGING, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS.
2. Remove compressor from car according to procedure.
3. Thoroughly clean exterior of compressor to prevent dirt from getting into compressor during disassembly.
4. Attach compressor to J 25008-1 Holding Fixture and clamp fixture in vise (Fig. 1B-98).
5. Keep clutch hub from turning with J 25030 Clutch Hub Holding Tool. Remove shaft nut using J 9399 Thin Wall Socket (Fig. 1B-99) and discard the nut.
6. Thread J 9401 Clutch Plate and Hub Asm. Remover into hub. Hold body of tool with a wrench and turn center screw into remover body to remove clutch plate and hub asm. (Fig. 1B-100).
7. Remove shaft key from keyway in compressor shaft.
8. Mark location of clutch coil terminals. Remove rotor and bearing assembly retainer ring, using J 6083 Snap-Ring Pliers (#24). See Figure 1B-103.
9. Do not remove pulley rim mounting screws and lock washers. Install J 25031-1 Rotor and Bearing Puller Guide over end of compressor shaft and seat it on the front head of the compressor (Fig. 1B-104).
10. Install J 25031-2 Rotor and Bearing Puller down into rotor until puller arms engage recessed edge of rotor hub. Hold puller and arms in place and tighten puller screw against Puller Guide (Fig. 1B-105) to remove rotor and bearing asm., clutch coil and pulley rim as an assembly. Be careful not to drop the Puller Guide when removing the assembly.
11. Remove shaft seal kit parts by performing steps 2 thru 6 of procedure for Compressor Shaft Seal Kit removal.
12. Remove (4) front head mounting screws and remove front head (Figs. 1B-122 and 1B-123).
13. Remove and discard front head O-ring seal.
14. Note assembled position of (2) thrust and (1) belleville washer and remove washers from compressor shaft.
15. Pry compressor shell retaining strap away from cylinder and position strap high enough to clear cylinder as shell is removed (Fig. 1B-127).
16. Remove J 25008-1 Holding Fixture and reverse fixture with step block protrusions engaging shell. Install medium length bolts through holding fixture. Thread bolts into compressor cylinder until step of fixture protrusions contact shell, finger tight on both sides (Fig. 1B-128). Be sure step protrusions do not overlap cylinder but pass both sides.
17. Using a wrench, alternately tighten each bolt approximately 1/4 turn to push shell free of O-rings on cylinder.

If one screw appears to require more force to turn than the other screw, immediately turn other screw to bring screw threading sequence in step or shell will be cocked and made more difficult to remove. If screws are kept in step while turning, not much force is required. The shell can be removed by hand as soon as shell is free of shell to cylinder O-rings. Do not turn screws any further than necessary to release shell.

18. Remove shell and remove holding fixture from compressor. Reverse holding fixture to again hold compressor by opposite side using short length screws.

19. Remove and discard both shell to cylinder O-rings.

20. Remove retainer rings using J 4245 Pliers (#23) and remove (2) discharge valve plates from cylinder (Figs. 1B-130 and 1B-131).

21. Rotate compressor and holding fixture in vise for access and remove remaining two valve plates and retainer rings.

22. Remove compressor high pressure relief valve and O-ring from cylinder. Discard O-ring.

23. Remove cylinder and shaft asm. from holding fixture for replacement. Leave holding fixture in vise.

Replace

1. Attach new cylinder and shaft asm. to holding fixture which is clamped in a vise.

2. Coat new pressure relief valve O-ring with clean refrigerant oil and install O-ring and valve.

3. Intall discharge valve plates and retainers. Rotate compressor and holding fixture for access as necessary.

4. Install compresor shell as described in Steps 1 thru 8 of COMPRESSOR SHELL-REPLACE.

5. Install thrust washer on shaft with tang pointing upward (Fig. 1B-124). Install belleville washer with high center of washer up and then install second thrust washer with tang pointing downward. Lurbicate all three washers with clean refrigerant oil.

6. Install front head and new O-ring by performing Steps 1 thru 3 of FRONT HEAD AND/OR O-RING-REPLACE.

7. Install new shaft seal kit parts (Steps 1 thru 6 of COMPRESSOR SHAFT SEAL KIT-REPLACE).

8. Install clutch rotor and bearing asm., clutch coil and pulley rim as an assembly onto the front head of the compressor using J 26271 Installer (Fig. 1B-110).

Before fully seating the assembly on the front head, be sure clutch coil terminals are in proper location and that the three protrusions on the rear of the coil align with the locator holes in the front head.

9. Install rotor and bearing asm. retainer ring using J 6083 Snap-Ring Pliers (#24). See Figure 1B-103.

10. Install the shaft key into the hub key groove (Fig. 1B-101). Allow key to project approximately 3/16 of an inch out of the keyway.

The shaft key is curved slightly to provide an interference fit in the shaft key groove. This allows the key to project without falling out.

11. Be sure frictional surfaces of clutch plate and clutch rotor are clean before installing clutch plate and hub asm. Align the shaft key with the shaft keyway and assemble the clutch plate and hub asm. on the compressor shaft.

CAUTION: *To avoid internal damage to compressor, do not drive or pound on clutch hub or shaft.*

12. Place J 9480-2 Spacer Bearing on hub, insert end of J 9480-1 Clutch Plate and Hub Asm. Installer through spacer and thread tool onto end of compressor shaft (Fig. 1B-102).

13. Hold hex portion of J 9480-1 body with a wrench and tighten center screw to press hub onto shaft until there is .020-.040 inch air gap between frictional surfaces of clutch plate and clutch rotor.

14. Install new shaft nut with small diameter boss of nut against crankshaft shoulder using J 9399 Socket. Hold clutch plate and hub asm. with J 25030 Holding Tool and tighten nut to 8-12 foot pounds torque using a 0-25 pounds torque wrench.

15. Remove compressor from J 25008-1 Holding Fixture and install on car according to appropriate service procedure.

16. "Evacuate and Charge the Refrigerant System" according to the DISCHARGING, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. SYSTEMS.

A-6 AND R-4 COMPRESSOR LEAK TESTING (EXTERNAL AND INTERNAL)

Bench-Check Procedure

1. Install Test Plate J 9625 on rear head of compressor.

2. Attach center hose of manifold gage set on Charging Station to a refrigerant drum standing in an upright position and open valve on drum.

3. Connect Charging Station HIGH and LOW pressure lines to corresponding fittings on Test Plate J 9625, using J 5420 Gage Adapters.

> **NOTE:** Suction port of compressor has large internal opening. Discharge port has smaller internal opening into compressor.

4. Open LOW pressure control, HIGH pressure control and REFRIGERANT control on Charging Station to allow refrigerant vapor to flow into compressor.

5. Using Electronic Leak Detector, J 23400, check for leaks at pressure relief valve, compressor shell to cylinder, compressor front head seal (and also rear head seal and oil charge port on A-6 compressor), and compressor shaft seal. After checking, shut off LOW pressure control and HIGH pressure control on Charging Station.

6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.

7. Loosen the manifold gage hose connections to the Gage Adapters J 5420 connected to the LOW and HIGH sides and allow the vapor pressure to release from the compressor.

8. Disconnect both Gage Adapters J 5420 from the Test Plate J 9625.

9. Rotate the COMPLETE compressor assembly (**not the crankshaft or drive plate hub)** slowly several turns to distribute oil to all cylinder and piston areas.

10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.

11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.

12. Connect the Charging Station HIGH pressure line or a HIGH pressure gage and Gage Adapter J 5420 to the Test Plate J 9625 HIGH side connector.

13. Attach a Adapter J 5420 to the suction or LOW pressure port of the Test Plate J 9625 to open the schrader-type valve.

NOTE: Oil will drain out of the compessor suction port adapter if the compressor is positioned with the suction port down.

14. Attach the compressor to the Holding Fixture J 25008-1 (R-4 compressor), and J 9396 (A-6 compressor), and clamp the fixture in a vise so that the compressor can be manually turned with a wrench.

15. Using a wrench, rotate the compressor crankshaft or drive plate hub 10-complete revolutions at a speed of approximately one-revolution per second.

NOTE: Turning the compressor at less than one-revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.

16. Observe the reading on HIGH pressure gage at the completion of the tenth revolution of the compressor. The pressure reading for a good pumping compressor should be 50 p.s.i. or above for the R-4 and 60 p.s.i. or above for the A-6 compressor. **A pressure reading of less than 45 p.s.i. for the R-4 or 50 p.s.i. for the A-6 would indicate one or more suction and/or discharge valves leaking, an internal leak, or an inoperative valve and the compressor should be disassembled and checked for cause of leak.** Repair as needed, reassemble and repeat the pump-up test. Externally leak test with Electronic Leak Detector J 23400.

17. When the pressure pump-up test is completed, release the air pressure from the HIGH side and remove the Gage Adapters J 5420 and Test Plate J 9625.

18. On the R-4, tilt the compressor so that the compressor suction and discharge ports are down. Drain the oil from the compressor.

On the A-6, remove oil charge screw and drain the oil sump.

19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of oil. The oil may be poured into the suction port.

NOTE: If further assembly or processing is required, a shipping plate or Test Plate J 9625 should be installed to keep out air, dirt and moisture until the compressor is installed.

1977 C60 TEMPERATURE CABLE ADJUSTMENT

A & G Series Turnbuckle-Type

NOTE: Adjustment is to be made after cable has been connected securely at both ends and all vacuum connections completed.

1. Place temperature control at "full" heat.
2. Adjust turnbuckle until temperature door seals.
3. Move temp. lever to "full" cold and back to "full" heat. Door seals at both ends of travel.
4. If door does not seal at both ends, repeat Steps 2 and 3 until cable is properly adjusted.

B Series Self-Adjusting Cable

1. Disengage temp. cable retaining clip from bellcrank post.
2. The temperature door's threaded operating rod should be snapped into the bellcrank's white nylon retaining button groove so that .4 inch of threaded rod end is exposed beyond the outer edge (towards you as you snap it into place) of the white button.
3. Re-engage temp. cable retaining cup to bellcrank's vertical post.
4. Move temp. control lever full travel in both directions (full HOT-full COLD) to automatically allow cable adjustment--you should be hearing temp. door "thud" at its open & closed position.

F Series Turnbuckle-Type

1. Place temperature lever 1/16 inch from "full" cold position (full left).
2. Adjust turnbuckle until temperature door is seated.
3. Move temperature lever full right and back to full left. Door should be heard hitting. Seat and lever should stop slightly short of end of slot.
4. If door is not heard seating or if lever is more than 1/8 inch from end of slot, repeat Steps 2 and 3 until cable is properly adjusted.

X Series Slotted-Clip Cables

1. Attach Cable to Control Asm.
2. Place Control temperature lever in "OFF" position.
3. Place opposite loop of cable on Heater Case temp. door post.
4. Push sheath toward Heater lever until temp. valve (door) seats and lash is out of cable and Control.
5. Tighten screw to secure cable.

Astre & Sunbird Slotted-Flag Type

1. Cable & Temp. lever to be in "OFF" position.
2. Adjust via slotted cable flag.
3. Tighten screw.

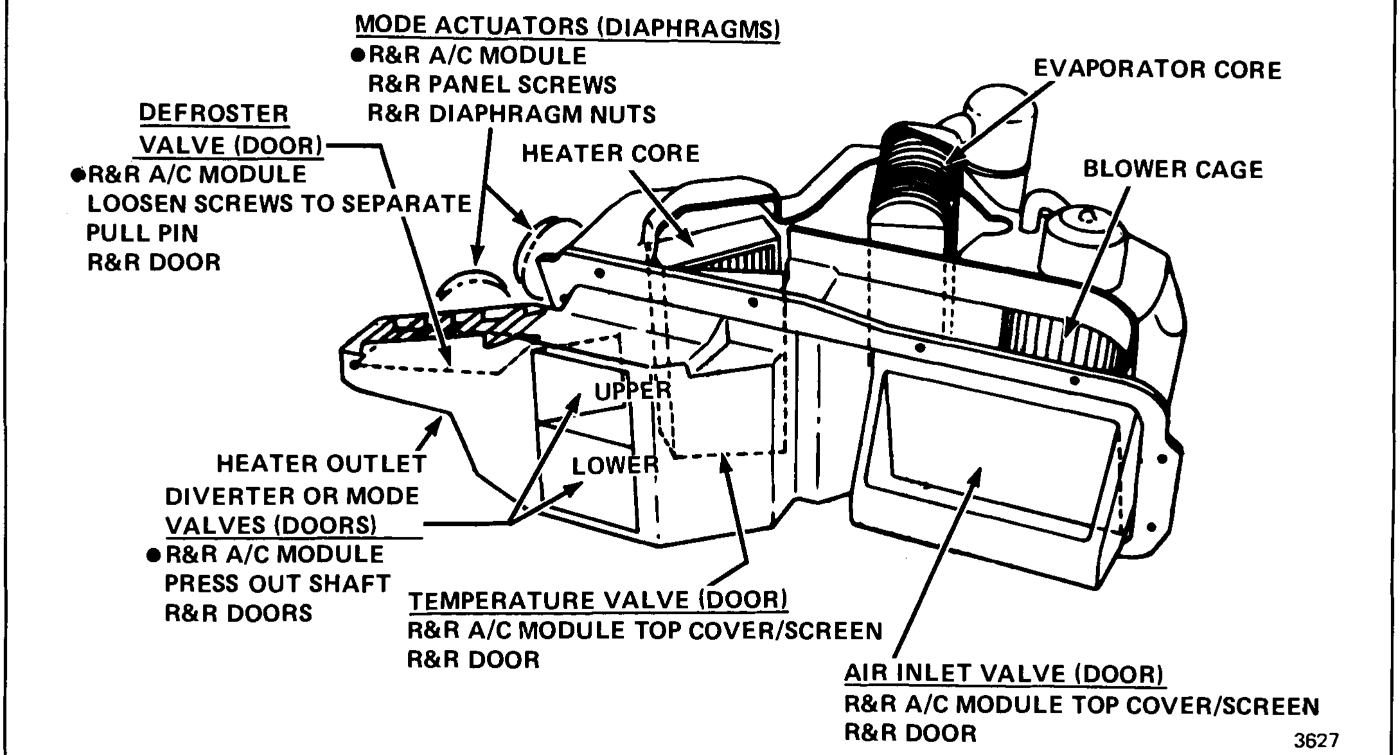
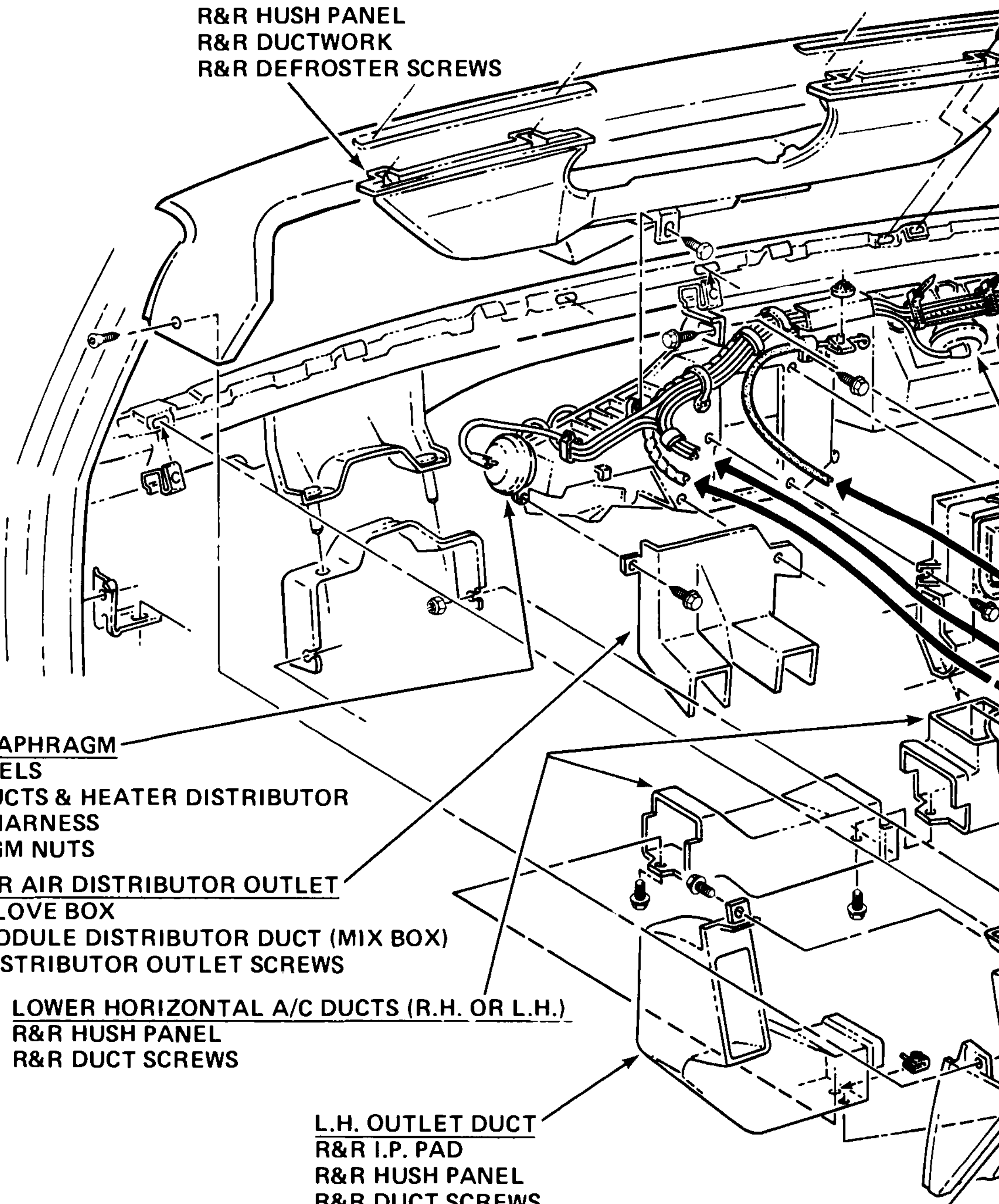


Fig. 1B-132 1977 B Series A/C Module



DEFROSTER DUCT
R&R I.P. PAD
R&R HUSH PANEL
R&R DUCTWORK
R&R DEFROSTER SCREWS

DEFROSTER DIAPHRAGM
R&R HUSH PANELS
R&R LOWER DUCTS & HEATER DISTRIBUTOR
D&C VACUUM HARNESS
R&R DIAPHRAGM NUTS

HEATER AIR DISTRIBUTOR OUTLET
R&R GLOVE BOX
R&R MODULE DISTRIBUTOR DUCT (MIX BOX)
R&R DISTRIBUTOR OUTLET SCREWS

LOWER HORIZONTAL A/C DUCTS (R.H. OR L.H.)
R&R HUSH PANEL
R&R DUCT SCREWS

L.H. OUTLET DUCT
R&R I.P. PAD
R&R HUSH PANEL
R&R DUCT SCREWS

AIR OUTLET DEFLECTORS
PRY OUT WITH
FLAT BLADE

L.H. CENTER
R&R I.P. PAD
R&R HUSH PA
R&R BOTH LC
R&R DUCT SC

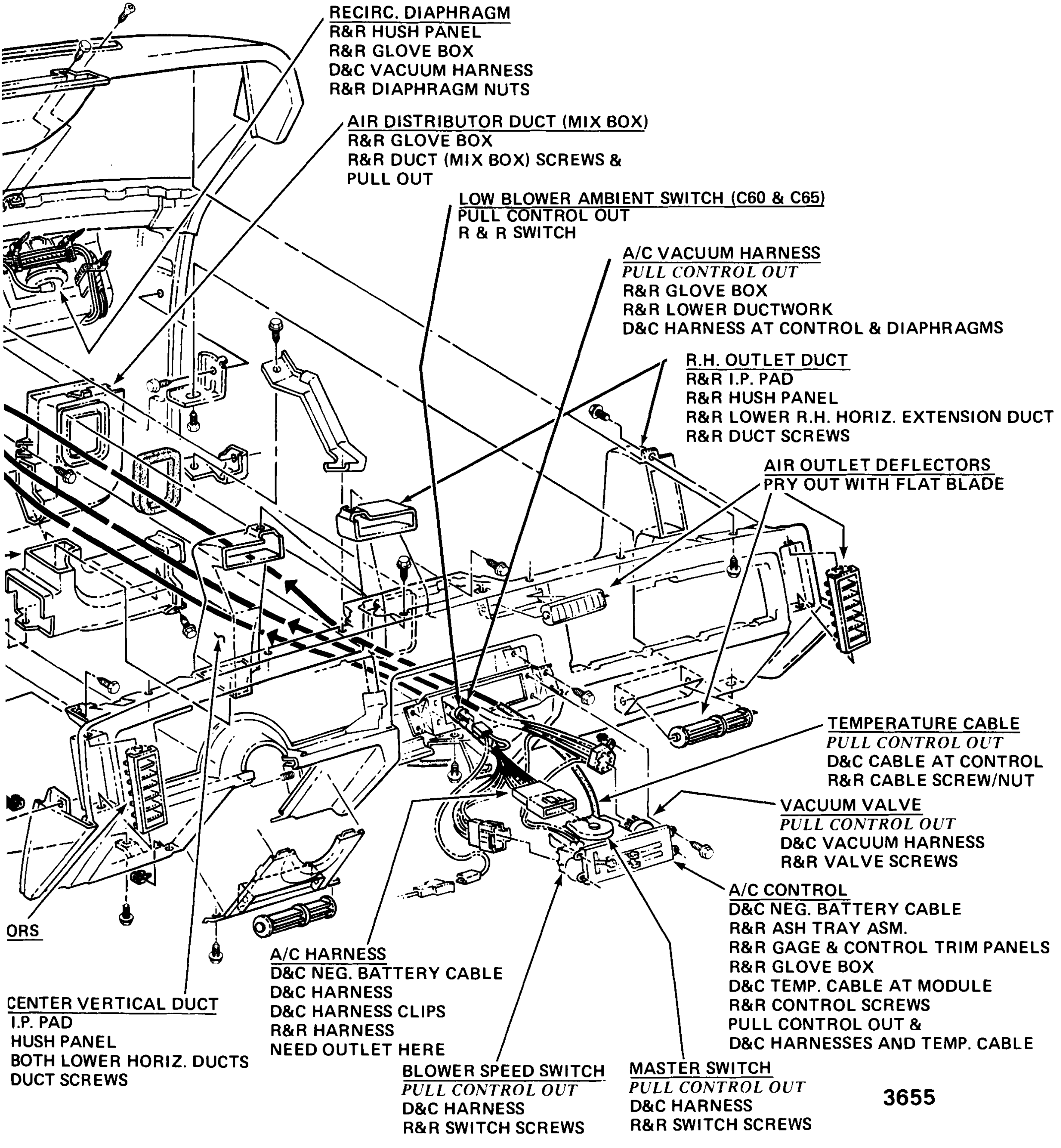
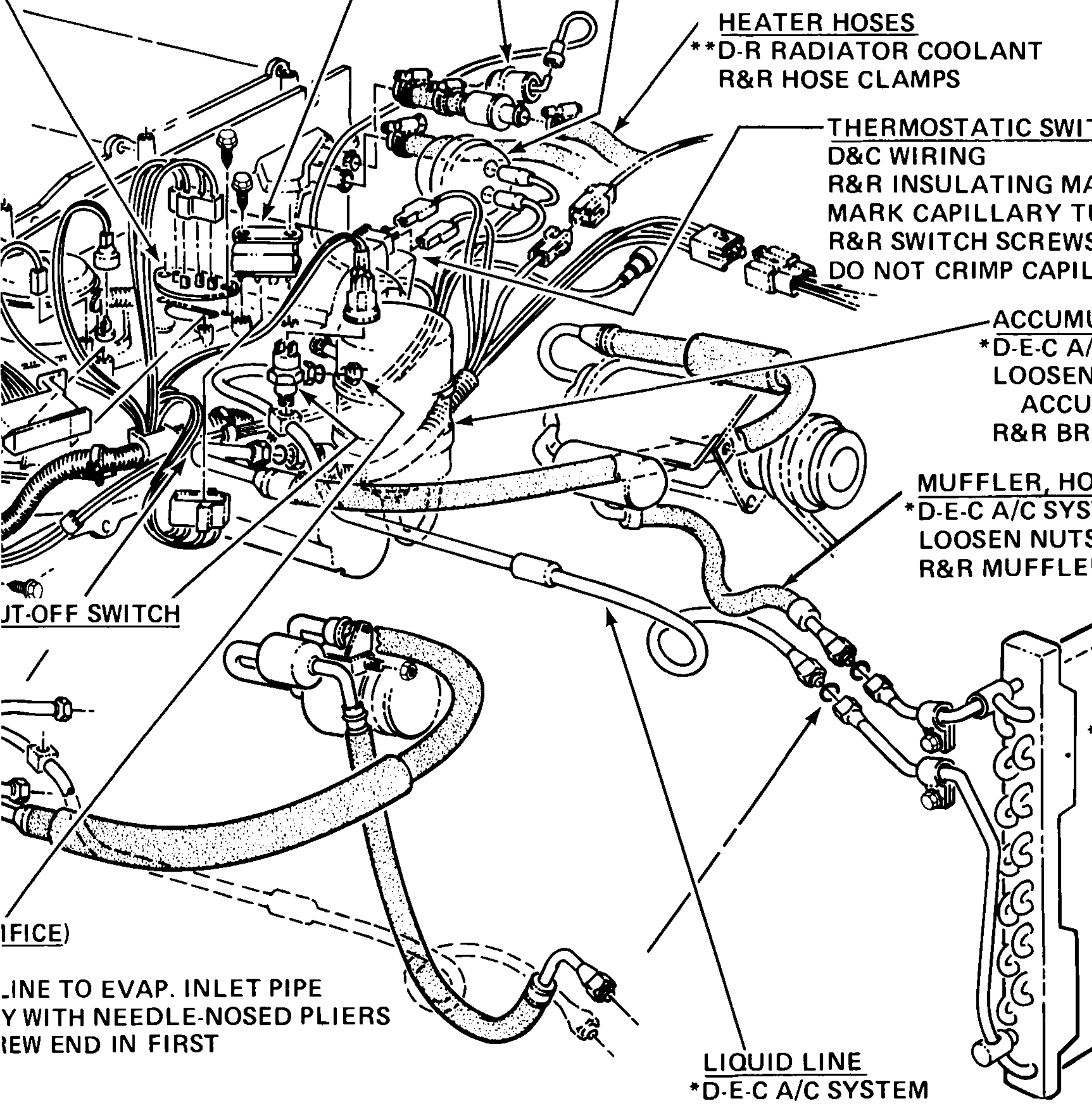


Fig. 1B-133 1977 B Series A/C Interior Service Procedures

ATER CORE
R RADIATOR COOLANT
C HOSES AT CORE PIPES
R RET. BRACKET & GROUND STRAP
C MODULE RUBBER SEAL
R MODULE SCREEN
R R.H. W/SHIELD. WIPER ARM
R DIAG. CONN., HI-BLOWER RELAY, THERM. SWITCH MNTG. SCREWS
C ALL ELECTRICAL CONNECTORS AT MODULE TOP
R MODULE TOP COVER
R CORE
PLY NEW SEALING MATERIAL



WATER VALVE
**D-R RADIATOR COOLANT
D&C VACUUM HARNESS
R&R HOSE CLAMPS

LOWER MOTOR RESISTOR
R&R SCREWS
D&C WIRING

HIGH BLOWER RELAY
R&R SCREWS
D&C WIRING

VACUUM RESERVE TANK
D&C VACUUM HARNESS
R&R TANK SCREWS

HEATER HOSES
**D-R RADIATOR COOLANT
R&R HOSE CLAMPS

THERMOSTATIC SWITCH
D&C WIRING
R&R INSULATING MATERIAL
MARK CAPILLARY TUBE LOCATION ON INLET PIPE
R&R SWITCH SCREWS AND CLAMP
DO NOT CRIMP CAPILLARY TUBE!

ACCUMULATOR
*D-E-C A/C SYSTEM
LOOSEN SUCTION HOSE NUT &
ACCUM. INLET PIPE NUT
R&R BRACKET, CLAMP SCREWS

MUFFLER, HOSE & FITTING ASM.
*D-E-C A/C SYSTEM
LOOSEN NUTS AT COND. PIPE & EVAP. INLET PIPE
R&R MUFFLER & FITTING BOLTS

JT-OFF SWITCH

CONDENSER
*D-E-C A/C SYSTEM
D&C REFRIG. LINES
R&R AIR CLEANER COLD AIR DUCT
FROM CORE SUPPORT
R&R UPPER 1/2 OF FAN SHROUD
R&R COND. TOP MNTG. BRACKETS
& RUBBER INSULATORS

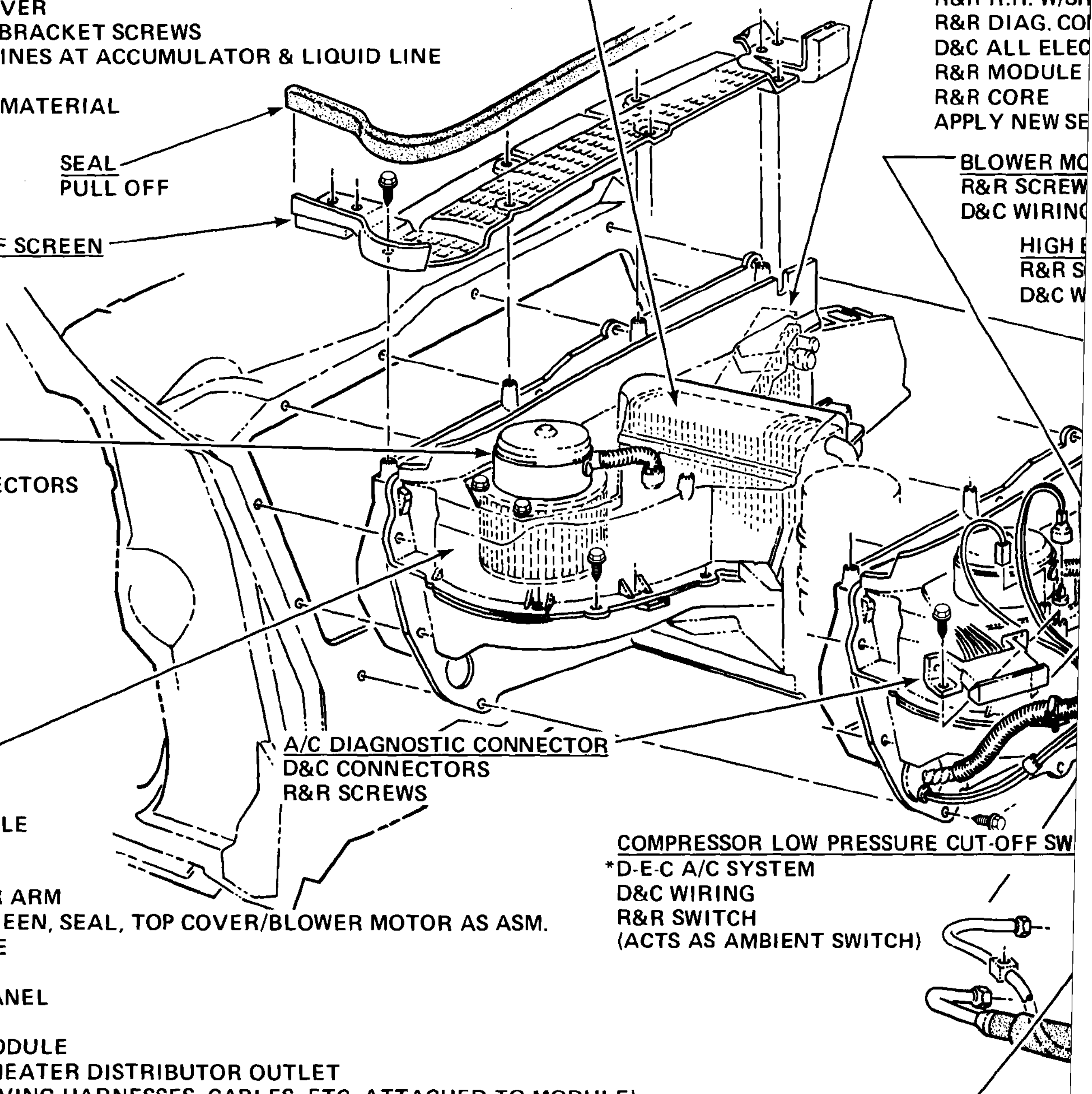
IFICE)

INE TO EVAP. INLET PIPE
Y WITH NEEDLE-NOSED PLIERS
IEW END IN FIRST

LIQUID LINE
*D-E-C A/C SYSTEM
LOOSEN NUTS AT COND. PIPE
& EVAP. INLET PIPE
BLOWER MOTOR TERMINALS

APE ALL OPEN REFRIGERANT LINES AND USE
IGS DIPPED IN CLEAN, 525 VISCOSITY
IANT OIL.

3656



EVAPORATOR CORE
D-E-C A/C SYSTEM
D&C MODULE RUBBER SEAL
R&R MODULE SCREEN
R&R R.H. W/SHLD. WIPER ARM ,
R&R DIAG. CONN., HI-BLOWER RELAY, THERM. SWITCH MNTG. SCREWS
D&C AIR ELECTRICAL CONNECTORS AT MODULE TOP
R&R MODULE TOP COVER
R&R ACCUMULATOR BRACKET SCREWS
D&C REFRIGERANT LINES AT ACCUMULATOR & LIQUID LINE
R&R CORE
APPLY NEW SEALING MATERIAL

HEATER CORE
**D-R RADIATOR
D&C HOSES AT
R&R RET. BRA
D&C MODULE
R&R MODULE
R&R R.H. W/SH
R&R DIAG. CO
D&C ALL ELEC
R&R MODULE
R&R CORE
APPLY NEW SE

SEAL
PULL OFF

BLOWER MO
R&R SCREW
D&C WIRING

MODULE LEAF SCREEN
R&R SCREWS

HIGH
R&R S
D&C W

BLOWER MOTOR
D&C COOLING TUBE
D&C ELECTRICAL CONNECTORS
R&R MOTOR SCREWS
R & R IMPELLER

A/C DIAGNOSTIC CONNECTOR
D&C CONNECTORS
R&R SCREWS

A/C MODULE
D&C NEG. BATTERY CABLE
*D-E-C A/C SYSTEM
R&R HOOD
R&R R.H. W/SHLD. WIPER ARM
R&R MODULE LEAF, SCREEN, SEAL, TOP COVER/BLOWER MOTOR AS ASM.
R&R EVAPORATOR CORE
R&R HEATER CORE
R&R PASS. SIDE HUSH PANEL
R&R GLOVE BOX
D&C TEMP. CABLE AT MODULE
R&R A/C DUCTWORK & HEATER DISTRIBUTOR OUTLET
R&R A/C CONTROL (LEAVING HARNESSES, CABLES, ETC. ATTACHED TO MODULE)
D&C COMPRESSOR & PRESSURE CUT-OUT SWITCH WIRING
R&R VACUUM RESERVE TANK
R&R ACCUMULATOR BRACKET
R&R MODULE TO COWL SCREWS
TRANSFER PARTS
APPLY NEW STRIP – CAULK
TYPE SEALING MATERIAL

COMPRESSOR LOW PRESSURE CUT-OFF SW
*D-E-C A/C SYSTEM
D&C WIRING
R&R SWITCH
(ACTS AS AMBIENT SWITCH)

EXPANSION TUBE (ORIFICE)
*D-E-C A/C SYSTEM
LOOSEN NUT AT LIQ. LINE TO E
R&R TUBE CAREFULLY WITH N
INSTALL SHORTER-SCREW END

*DISCHARGE-EVACUATE-CHARGE A/C SYSTEM—ALWAYS TAPE ALL
NEW O-RINGS DIPPE
REFRIGERANT OIL.

Fig. 1B-134 1977 B Series A/C Exterior Service Procedures

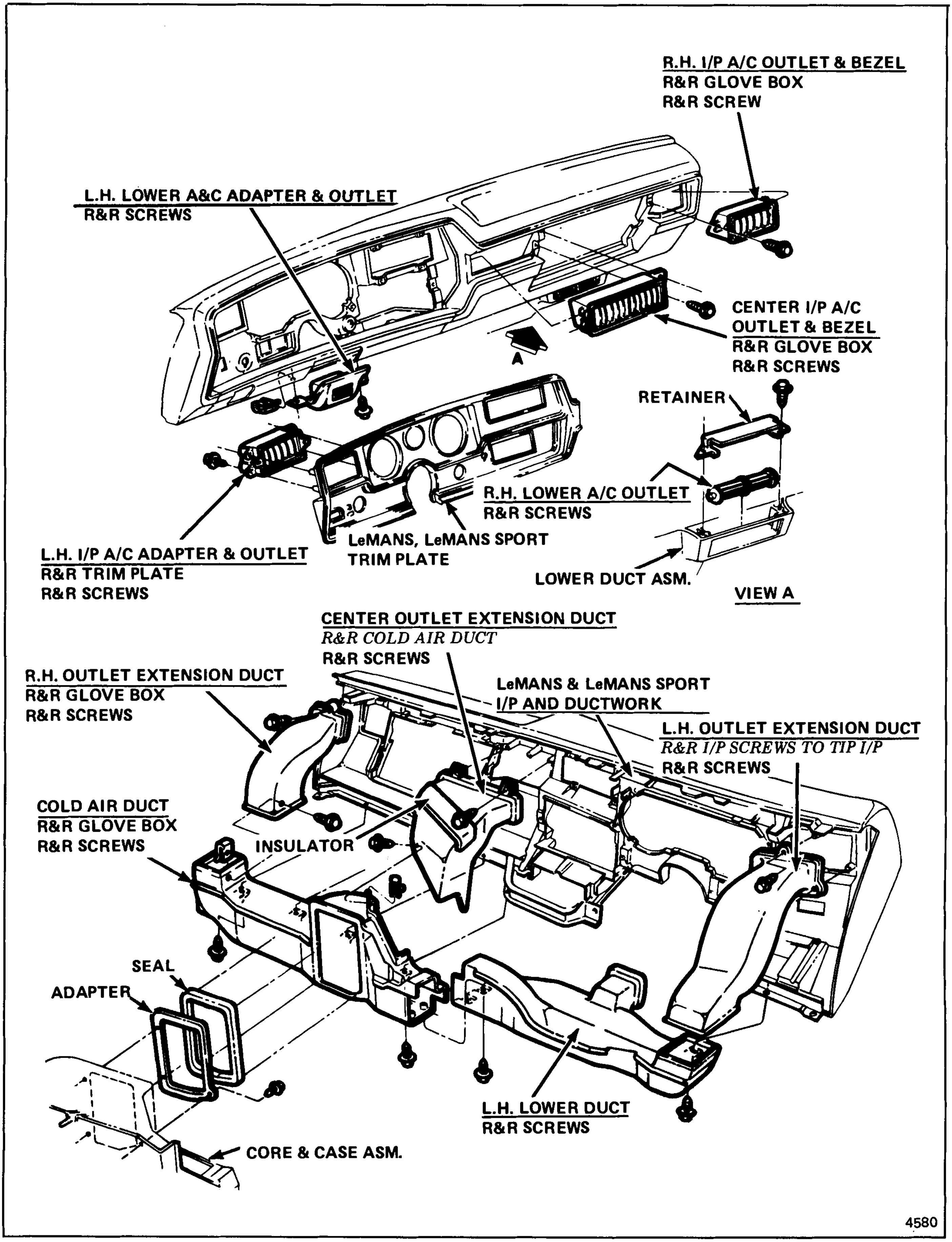


Fig. 1B-135 1977 A Series (LeMans-LeMans Sport) A/C Interior Proc. (No. 1 of 5)

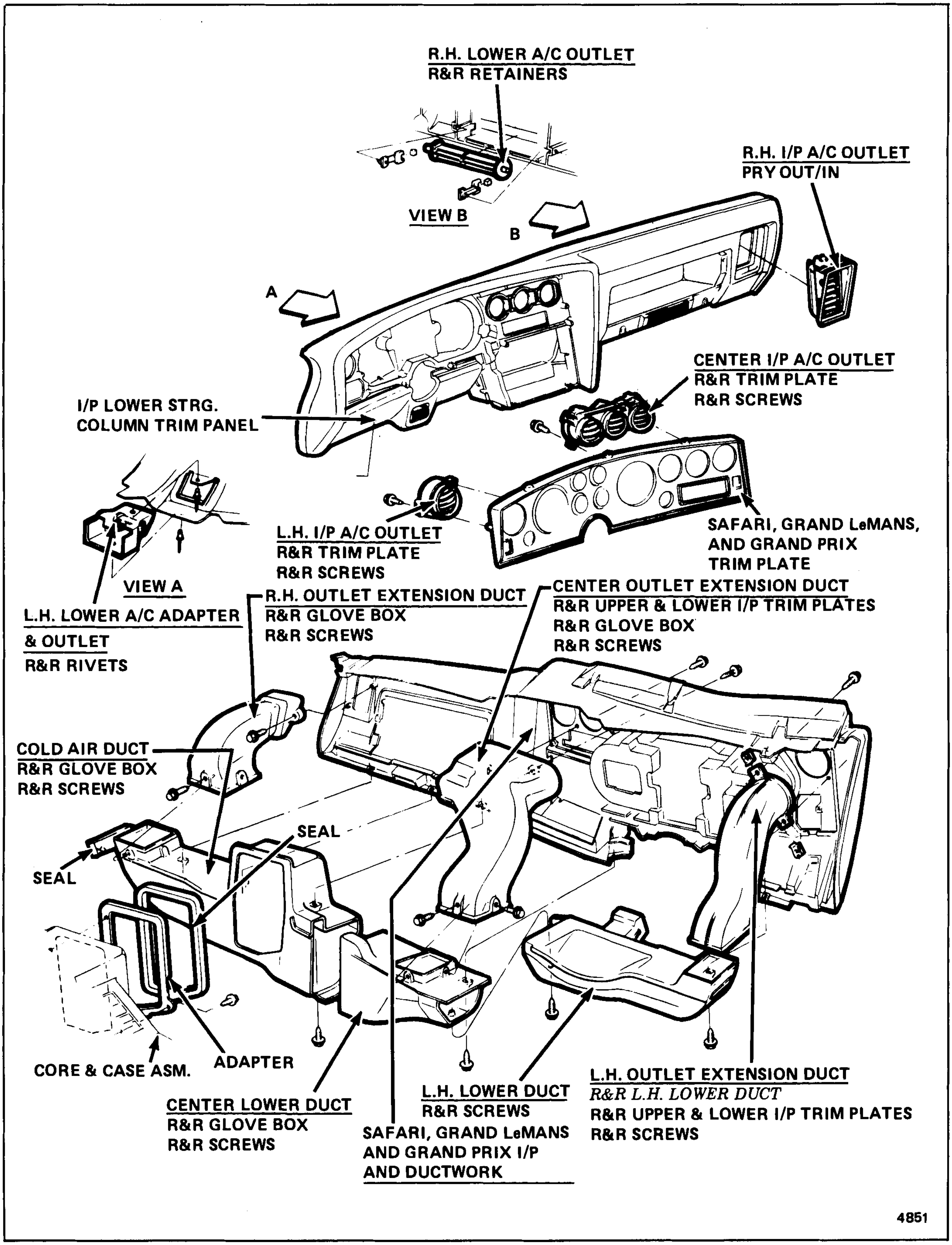
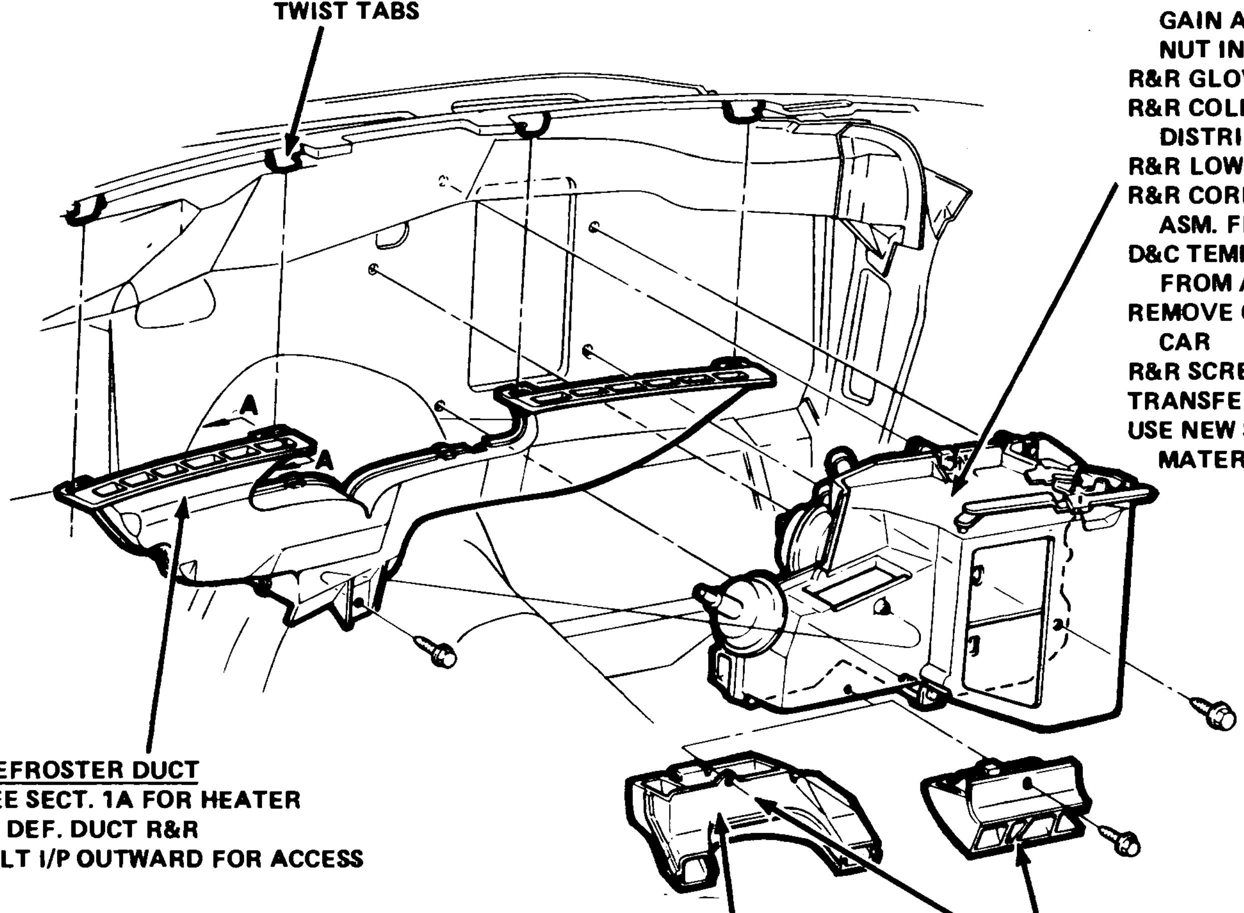


Fig. 1B-136 1977 A & G Series (Safari-Grand LeMans-Grand Prix) A/C Interior Proc. (No. 2 of 5)



HEATER CASE–CORE–DOORS

DRAIN RADIATOR
D&C AND PLUG HEATER HOSES AT CORE TUBES
R&R CORE STUD NUTS RETAINING CASE TO DASH
R&R BLOWER MOTOR RESISTOR TO GAIN ACCESS TO UPPER RETAINING NUT INSIDE OF EVAPORATOR CASE
R&R GLOVE BOX
R&R COLD AIR DUCT & HEATER DISTRIBUTOR
R&R LOWER DEFROSTER DUCT SCREW
R&R CORE/CASE RET. SCREW TO PULL ASM. FREE FROM COWL
D&C TEMP. CABLE & VACUUM HOSES FROM ASM.
REMOVE CORE AND CASE ASM. FROM CAR
R&R SCREWS TO PULL CORE DOORS, ETC.
TRANSFER PARTS
USE NEW STRIP-CAULK TYPE SEALING MATERIAL

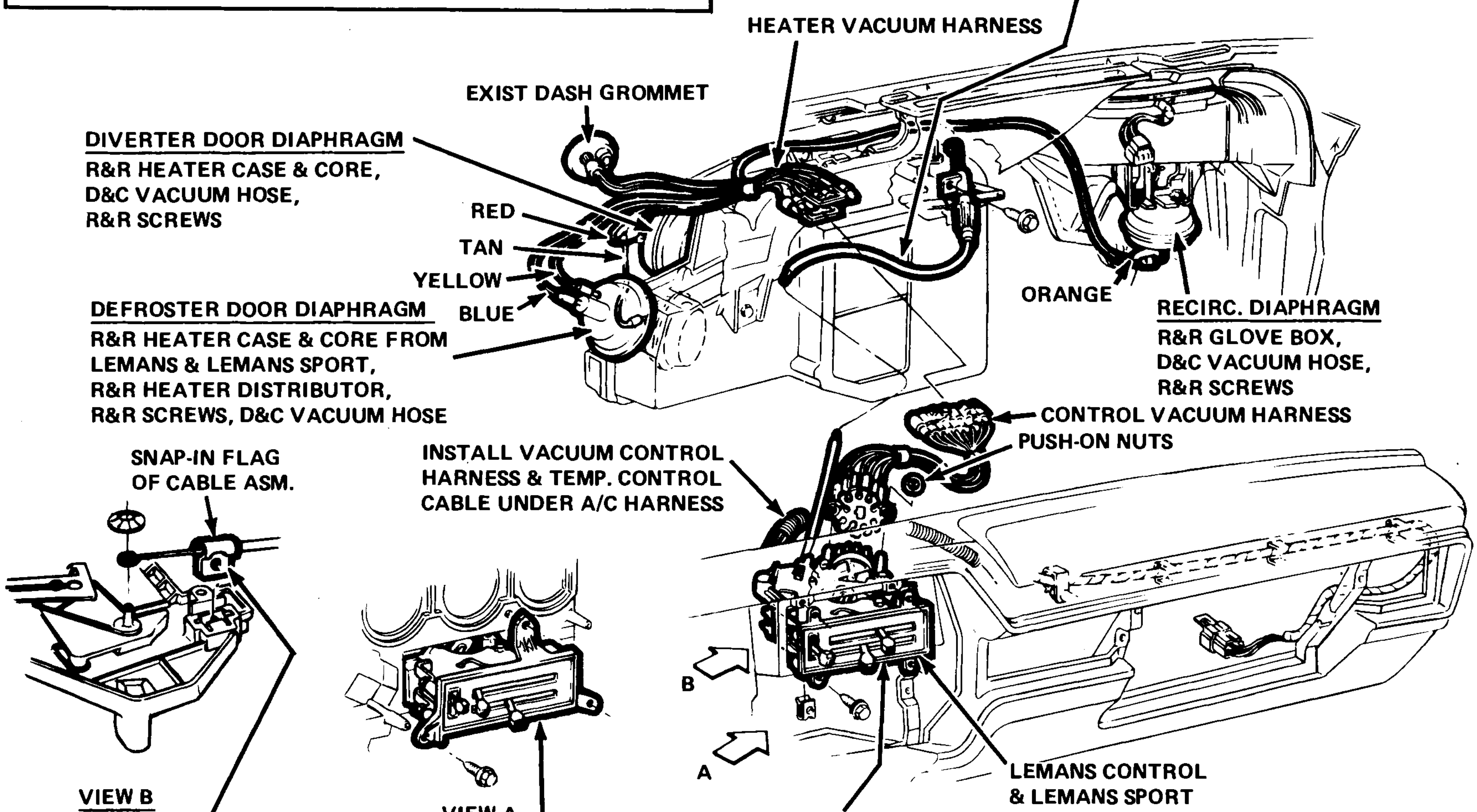
DEFROSTER DUCT

SEE SECT. 1A FOR HEATER DEF. DUCT R&R
TILT I/P OUTWARD FOR ACCESS

HEATER DISTRIBUTOR

R&R SCREWS

Fig. 1B-137 1977 A & G Series A/C Interior Service Procedures (No. 3 of 5)



REPAIR CABLE OR CONSTRUCT NEW CABLE OF EQUAL LENGTH USING PARTS FROM BOWDEN CABLE REPAIR KIT. USE CABLE HOUSING FROM ORIGINAL CABLE IF POSSIBLE. IN MOST INSTANCES, ONLY THE WIRE PORTION OF THE CABLE WILL REQUIRE REPLACEMENT.

TEMP. CABLE
R&R GLOVE BOX, D&C CABLE AT HEATER CASE,
R&R TRIM AND SCREWS TO PULL CONTROL OUT, D&C CABLE,
REPAIR & ADJUST (SEE "TEMPERATURE CABLE ADJUST.")

DIVERTER DOOR DIAPHRAGM
R&R HEATER CASE & CORE,
D&C VACUUM HOSE,
R&R SCREWS

DEFROSTER DOOR DIAPHRAGM
R&R HEATER CASE & CORE FROM
LEMANS & LEMANS SPORT,
R&R HEATER DISTRIBUTOR,
R&R SCREWS, D&C VACUUM HOSE

RECIRC. DIAPHRAGM
R&R GLOVE BOX,
D&C VACUUM HOSE,
R&R SCREWS

INSTALL VACUUM CONTROL HARNESS & TEMP. CONTROL CABLE UNDER A/C HARNESS

NOTE: PIN MUST ENGAGE WITH HOLE IN TAB

SAFARI, GRAND LEMANS, & GRAND PRIX CONTROL

A/C CONTROL
D&C BATTERY, R&R LOWER STRG. COL. TRIM PANEL, R&R I/P TRIM PLATE,
R&R CONTROL SCREWS, D&C VAC. HOSES, PULL CONTROL TO
D&C ELECT. CONN. AND TO D&C TEMP. CABLE, REPAIR.

Fig. 1B-138 1977 A & G Series A/C Interior Service Procedures (No. 4 of 5)

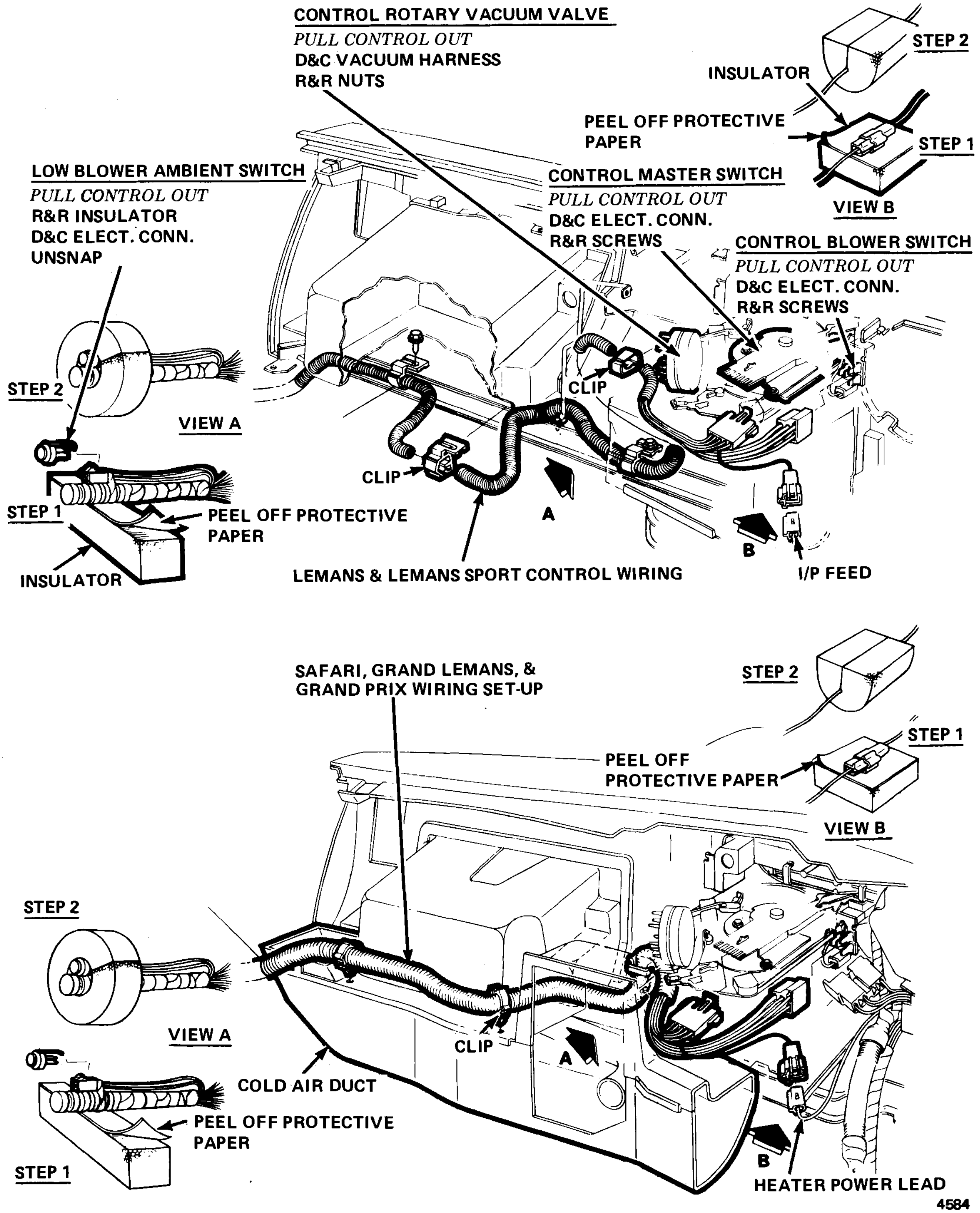
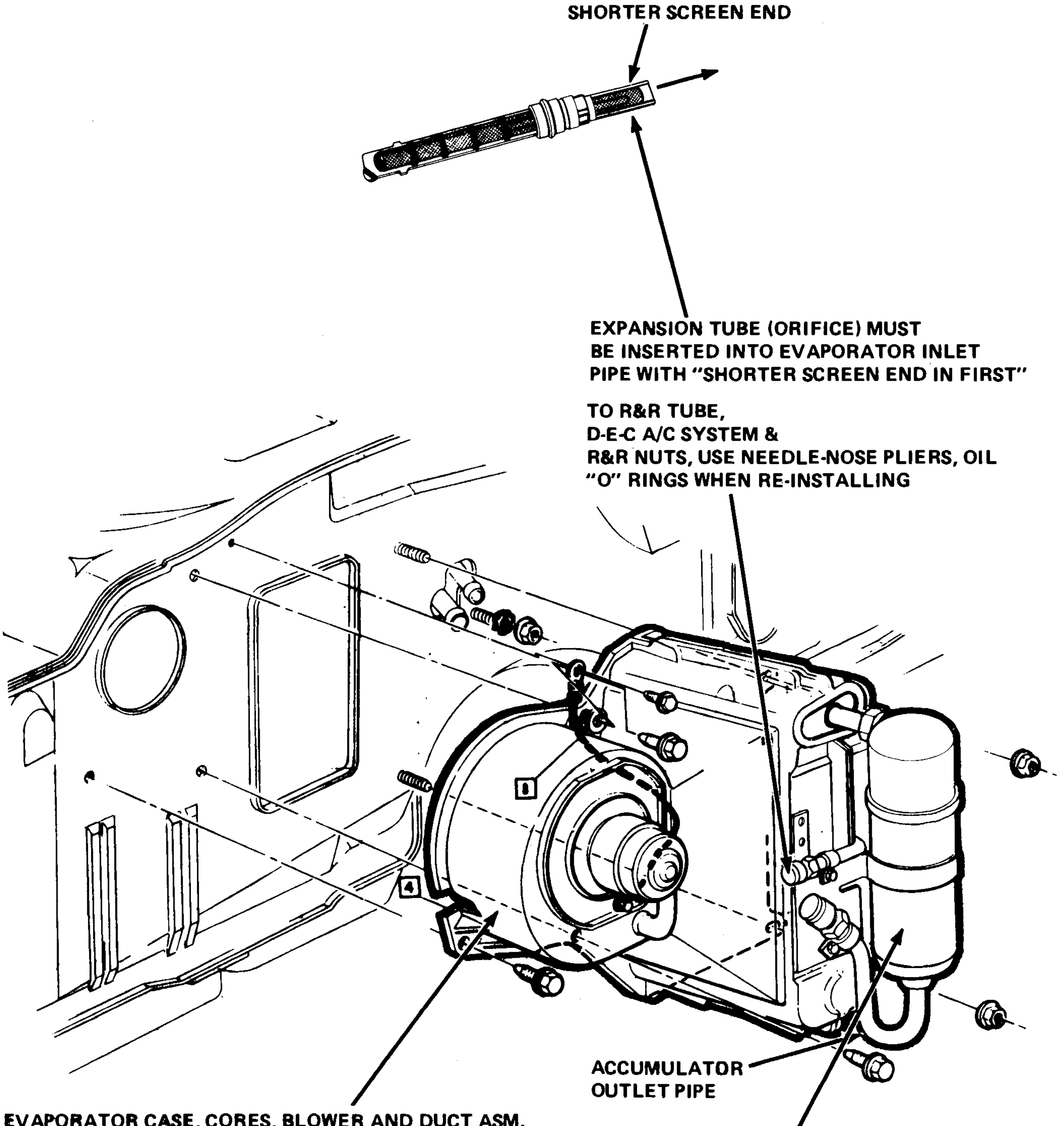


Fig. 1B-139 1977 A & G Series A/C Interior Service Procedures (No. 5 of 5)



SHORTER SCREEN END

EXPANSION TUBE (ORIFICE) MUST BE INSERTED INTO EVAPORATOR INLET PIPE WITH "SHORTER SCREEN END IN FIRST"

TO R&R TUBE,
D-E-C A/C SYSTEM &
R&R NUTS, USE NEEDLE-NOSE PLIERS, OIL
"O" RINGS WHEN RE-INSTALLING

ACCUMULATOR OUTLET PIPE

EVAPORATOR CASE, CORES, BLOWER AND DUCT ASM.

FOR BLOWER CASE R&R, USE HEATER SECTION 1A R&R
IN ADDIT. TO D&C ELECT. CONN. & COOLING TUBE
FOR EVAP. CASE, CORES AND DUCT ASM.,
D&C ALL ELECT. CONN. & COOLING TUBE,
D-E-C A/C SYSTEM, R&R SCREWS & NUTS,
USE NEW STRIP-CAULK TYPE SEALER MATERIAL
ADD 3 OZ. OIL FOR EVAP. CORE REPL.

ACCUMULATOR

D-E-C A/C SYSTEM
R&R ACCUM. NUTS
(SEE "C.C.O.T. REFRIG. OIL DISTRIB." FOR PROPER OIL ADDITION)

Fig. 1B-140 1977 A & G Series A/C Exterior Service Procedures (No. 1 of 3)

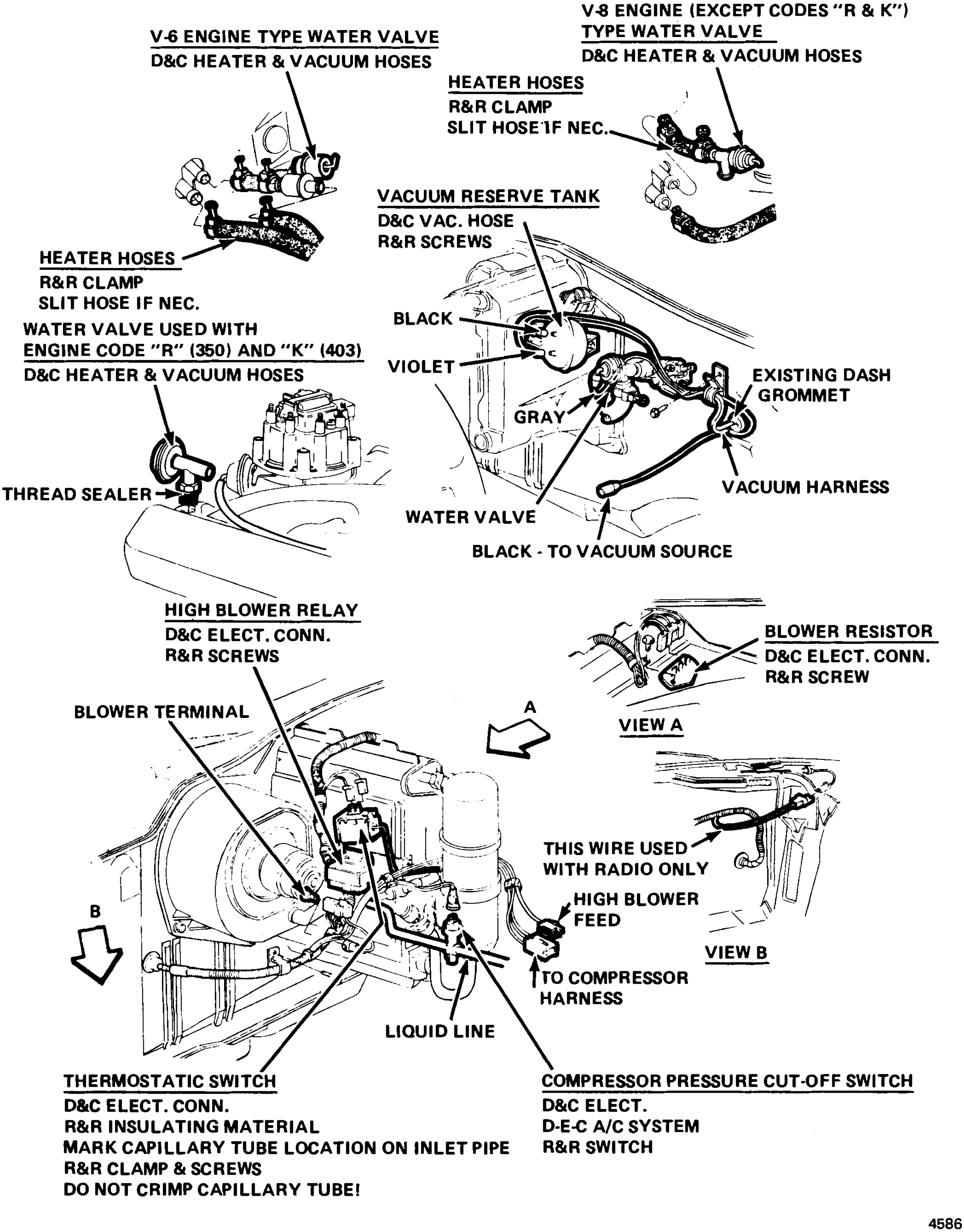
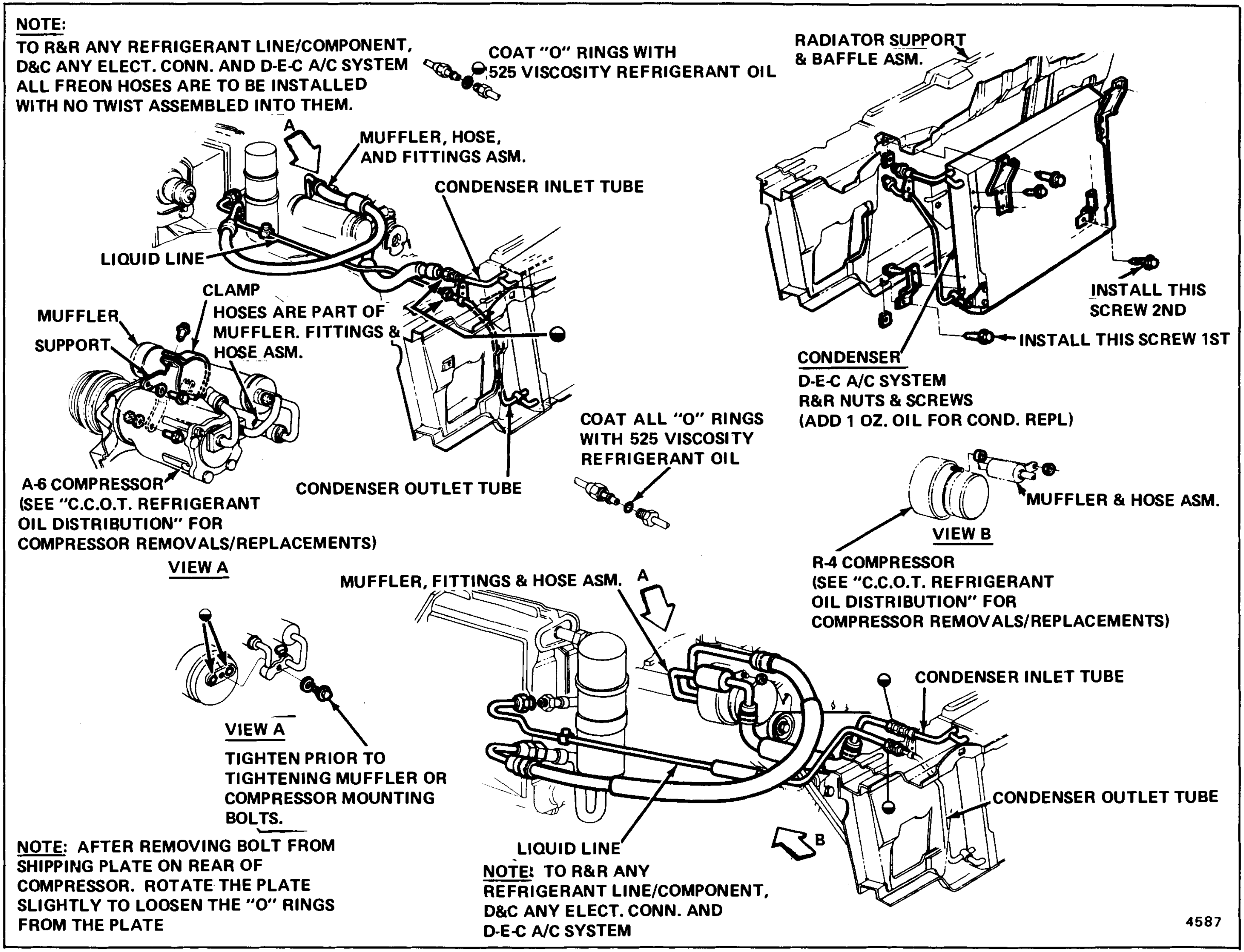


Fig. 1B-141 1977 A & G Series A/C Exterior Service Procedures (No. 2 of 3)



NOTE: TO R&R ANY REFRIGERANT LINE/COMPONENT, D&C ANY ELECT. CONN. AND D-E-C A/C SYSTEM ALL FREON HOSES ARE TO BE INSTALLED WITH NO TWIST ASSEMBLED INTO THEM.

COAT "O" RINGS WITH 525 VISCOSITY REFRIGERANT OIL

(SEE "C.C.O.T. REFRIGERANT OIL DISTRIBUTION" FOR COMPRESSOR REMOVALS/REPLACEMENTS)

D-E-C A/C SYSTEM R&R NUTS & SCREWS (ADD 1 OZ. OIL FOR COND. REPL)

COAT ALL "O" RINGS WITH 525 VISCOSITY REFRIGERANT OIL

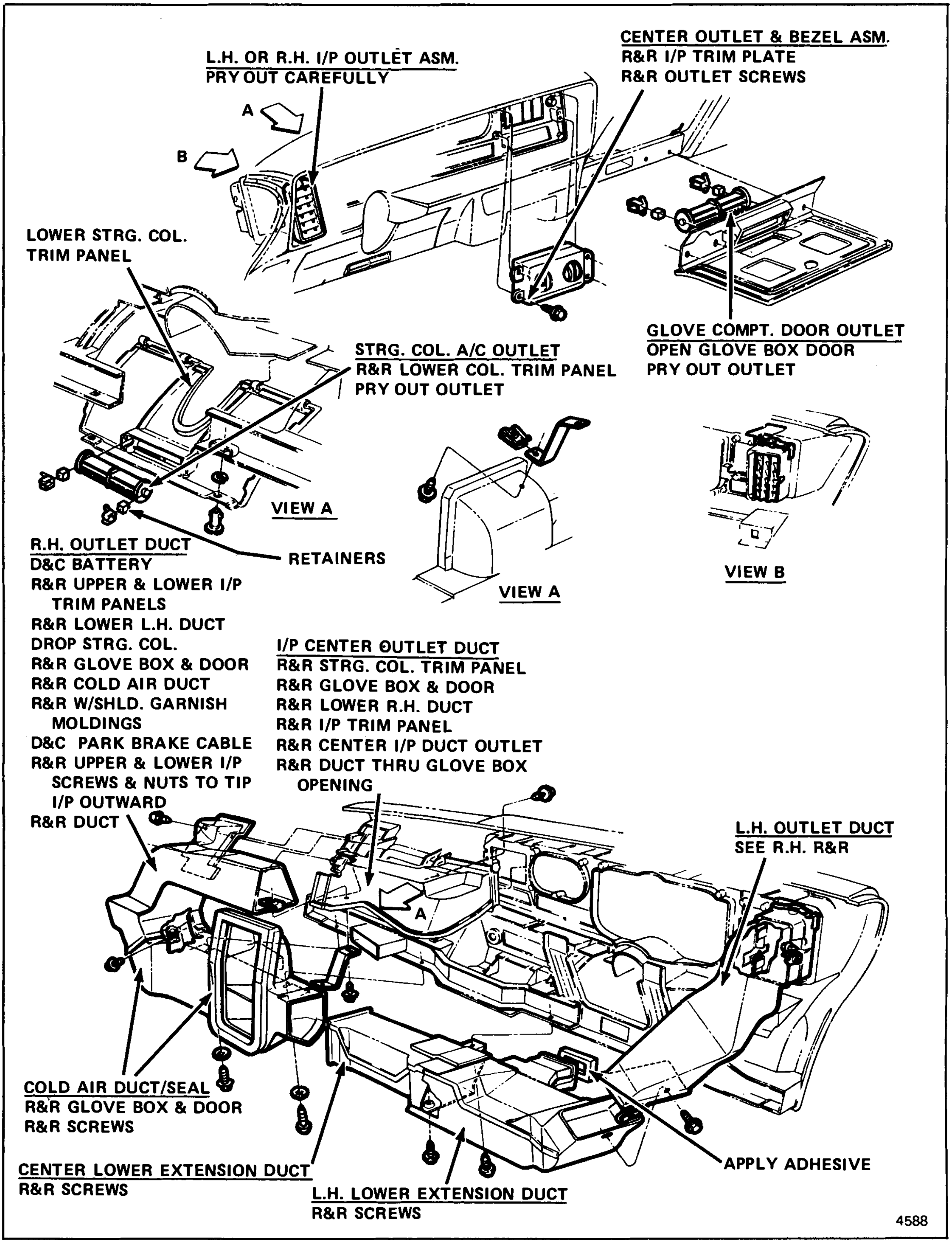
(SEE "C.C.O.T. REFRIGERANT OIL DISTRIBUTION" FOR COMPRESSOR REMOVALS/REPLACEMENTS)

TIGHTEN PRIOR TO TIGHTENING MUFFLER OR COMPRESSOR MOUNTING BOLTS.

NOTE: AFTER REMOVING BOLT FROM SHIPPING PLATE ON REAR OF COMPRESSOR. ROTATE THE PLATE SLIGHTLY TO LOOSEN THE "O" RINGS FROM THE PLATE

NOTE: TO R&R ANY REFRIGERANT LINE/COMPONENT, D&C ANY ELECT. CONN. AND D-E-C A/C SYSTEM

Fig. 1B-142 1977 A & G Series A/C Exterior Service Procedures (No. 3 of 3)



L.H. OR R.H. I/P OUTLET ASM.
PRY OUT CAREFULLY

CENTER OUTLET & BEZEL ASM.
R&R I/P TRIM PLATE
R&R OUTLET SCREWS

LOWER STRG. COL.
TRIM PANEL

STRG. COL. A/C OUTLET
R&R LOWER COL. TRIM PANEL
PRY OUT OUTLET

GLOVE COMPT. DOOR OUTLET
OPEN GLOVE BOX DOOR
PRY OUT OUTLET

RETAINERS

R.H. OUTLET DUCT
D&C BATTERY
R&R UPPER & LOWER I/P
TRIM PANELS
R&R LOWER L.H. DUCT
DROP STRG. COL.
R&R GLOVE BOX & DOOR
R&R COLD AIR DUCT
R&R W/SHLD. GARNISH
MOLDINGS
D&C PARK BRAKE CABLE
R&R UPPER & LOWER I/P
SCREWS & NUTS TO TIP
I/P OUTWARD
R&R DUCT

I/P CENTER OUTLET DUCT
R&R STRG. COL. TRIM PANEL
R&R GLOVE BOX & DOOR
R&R LOWER R.H. DUCT
R&R I/P TRIM PANEL
R&R CENTER I/P DUCT OUTLET
R&R DUCT THRU GLOVE BOX
OPENING

L.H. OUTLET DUCT
SEE R.H. R&R

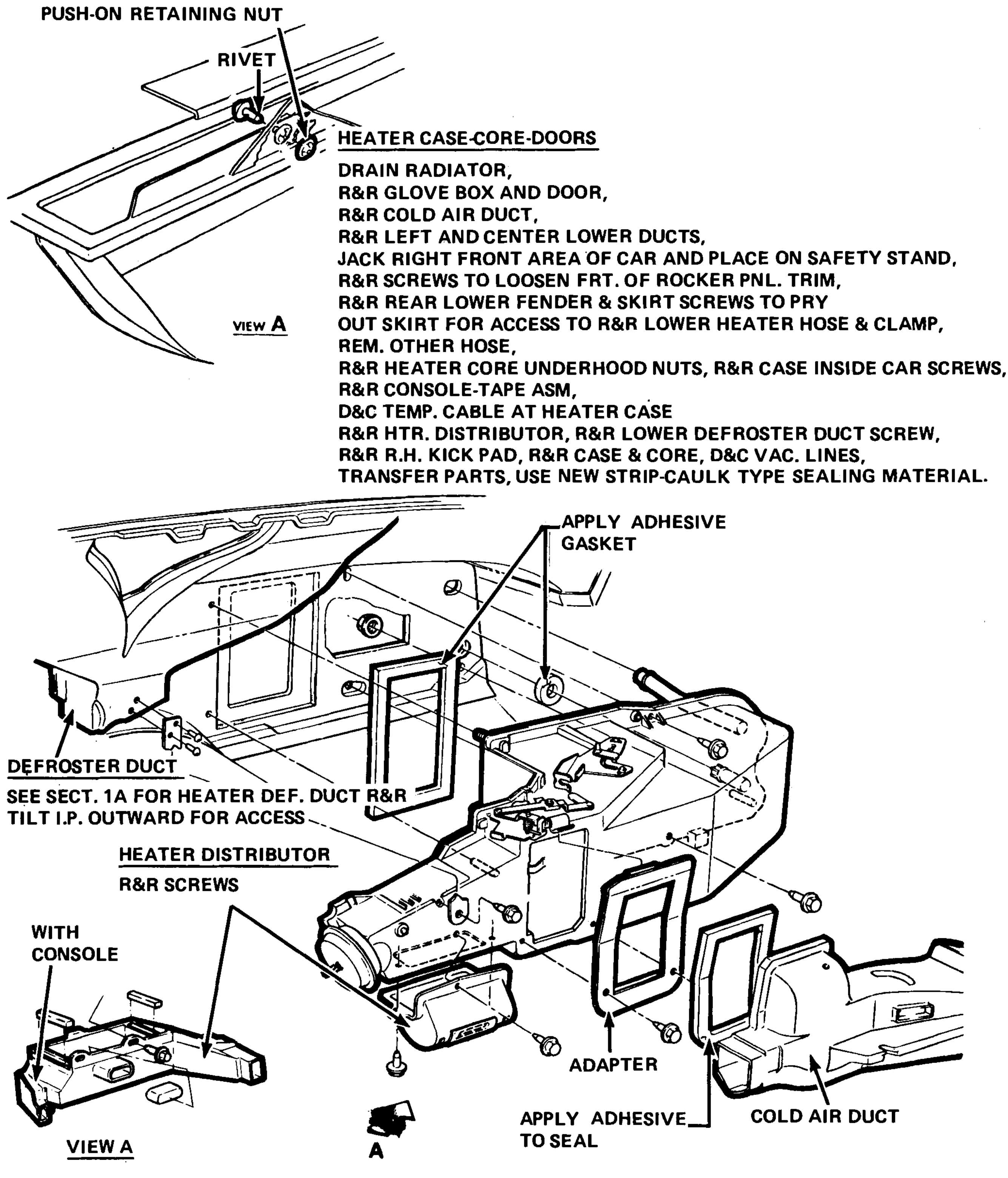
COLD AIR DUCT/SEAL
R&R GLOVE BOX & DOOR
R&R SCREWS

CENTER LOWER EXTENSION DUCT
R&R SCREWS

L.H. LOWER EXTENSION DUCT
R&R SCREWS

APPLY ADHESIVE

Fig. 1B-143 1977 F Series A/C Interior Service Procedures (No. 1 of 4)

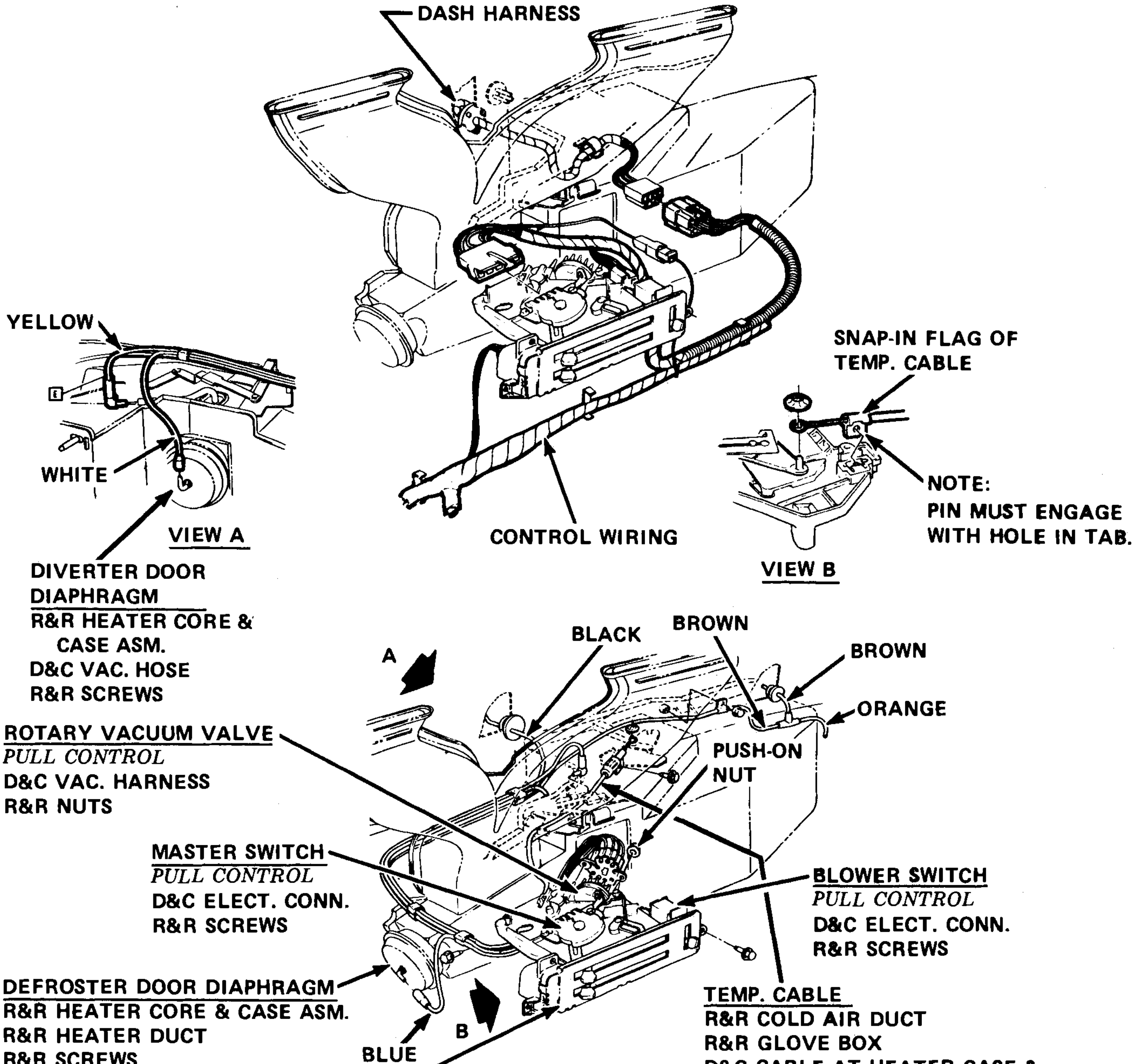


HEATER CASE-CORE-DOORS

DRAIN RADIATOR,
R&R GLOVE BOX AND DOOR,
R&R COLD AIR DUCT,
R&R LEFT AND CENTER LOWER DUCTS,
JACK RIGHT FRONT AREA OF CAR AND PLACE ON SAFETY STAND,
R&R SCREWS TO LOOSEN FRT. OF ROCKER PNL. TRIM,
R&R REAR LOWER FENDER & SKIRT SCREWS TO PRY
OUT SKIRT FOR ACCESS TO R&R LOWER HEATER HOSE & CLAMP,
REM. OTHER HOSE,
R&R HEATER CORE UNDERHOOD NUTS, R&R CASE INSIDE CAR SCREWS,
R&R CONSOLE-TAPE ASM,
D&C TEMP. CABLE AT HEATER CASE
R&R HTR. DISTRIBUTOR, R&R LOWER DEFROSTER DUCT SCREW,
R&R R.H. KICK PAD, R&R CASE & CORE, D&C VAC. LINES,
TRANSFER PARTS, USE NEW STRIP-CAULK TYPE SEALING MATERIAL.

SEE SECT. 1A FOR HEATER DEF. DUCT R&R
TILT I.P. OUTWARD FOR ACCESS

Fig. 1B-144 1977 F Series A/C Interior Service Procedures (No. 2 of 4)



NOTE:
PIN MUST ENGAGE WITH HOLE IN TAB.

DIVERTER DOOR DIAPHRAGM
R&R HEATER CORE & CASE ASM.
D&C VAC. HOSE
R&R SCREWS

ROTARY VACUUM VALVE
PULL CONTROL
D&C VAC. HARNESS
R&R NUTS

MASTER SWITCH
PULL CONTROL
D&C ELECT. CONN.
R&R SCREWS

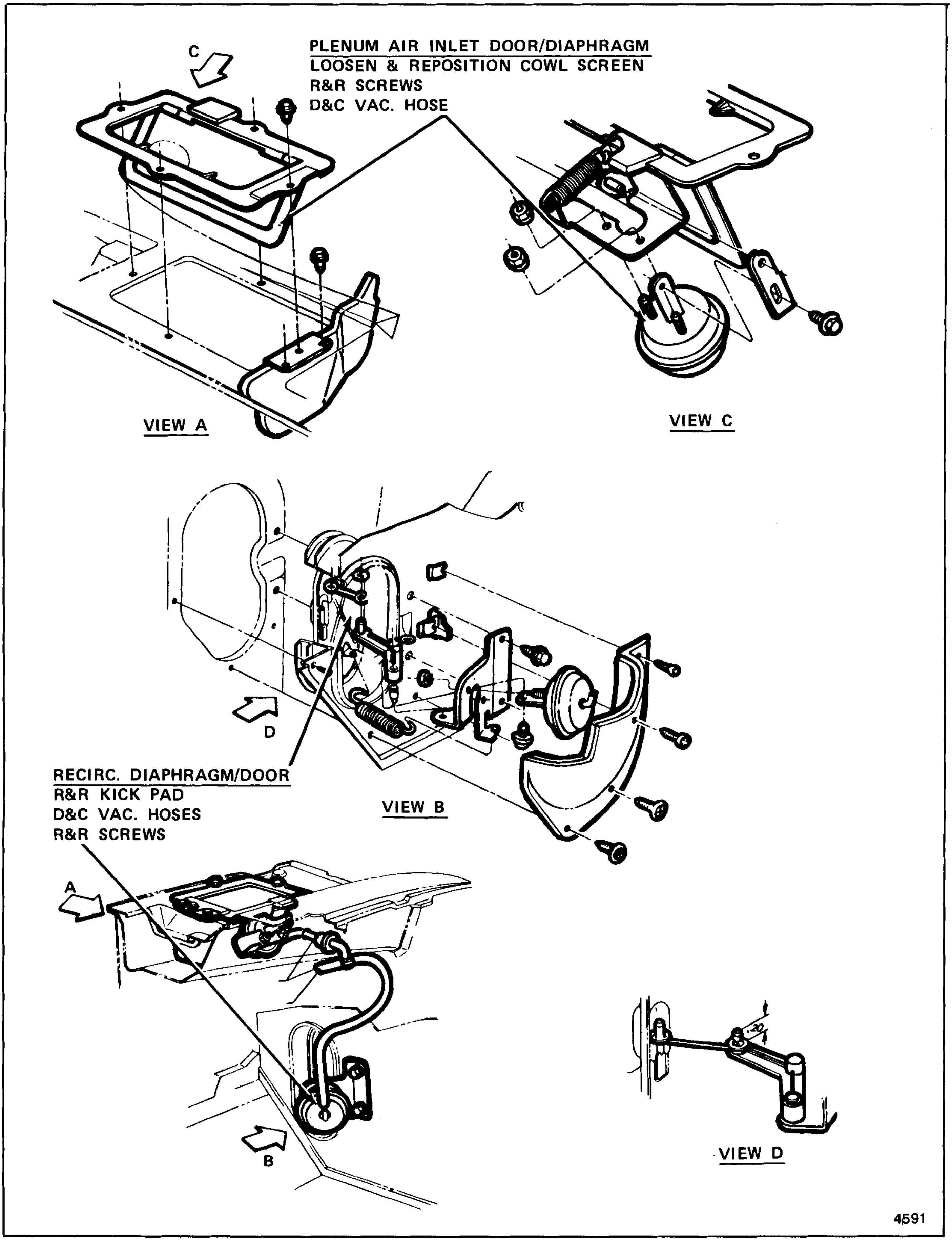
BLOWER SWITCH
PULL CONTROL
D&C ELECT. CONN.
R&R SCREWS

DEFROSTER DOOR DIAPHRAGM
R&R HEATER CORE & CASE ASM.
R&R HEATER DUCT
R&R SCREWS
D&C VAC. HOSE

TEMP. CABLE
R&R COLD AIR DUCT
R&R GLOVE BOX
D&C CABLE AT HEATER CASE & A/C CONTROL
REPAIR & ADJUST (SEE "TEMPERATURE CABLE ADJUST")
REPAIR CABLE OR CONSTRUCT NEW CABLE OF EQUAL LENGTH USING PARTS FROM BOWDEN CABLE REPAIR KIT. USE CABLE HOUSING FROM ORIGINAL CABLE IF POSSIBLE. IN MOST INSTANCES, ONLY THE WIRE PORTION OF THE CABLE WILL REQUIRE REPLACEMENT.

A/C CONTROL
D&C BATTERY
R&R LOWER STRG. COL. TRIMPANEL
R&R I/P TRIM PLATE
R&R RALLY GAGE CLUSTER
R&R GLOVE BOX
D&C TEMP. CABLE AT CASE
R&R CONTROL SCREWS
D&C VAC. HOSES & ELECT. CONN.
D&C TEMP. CABLE

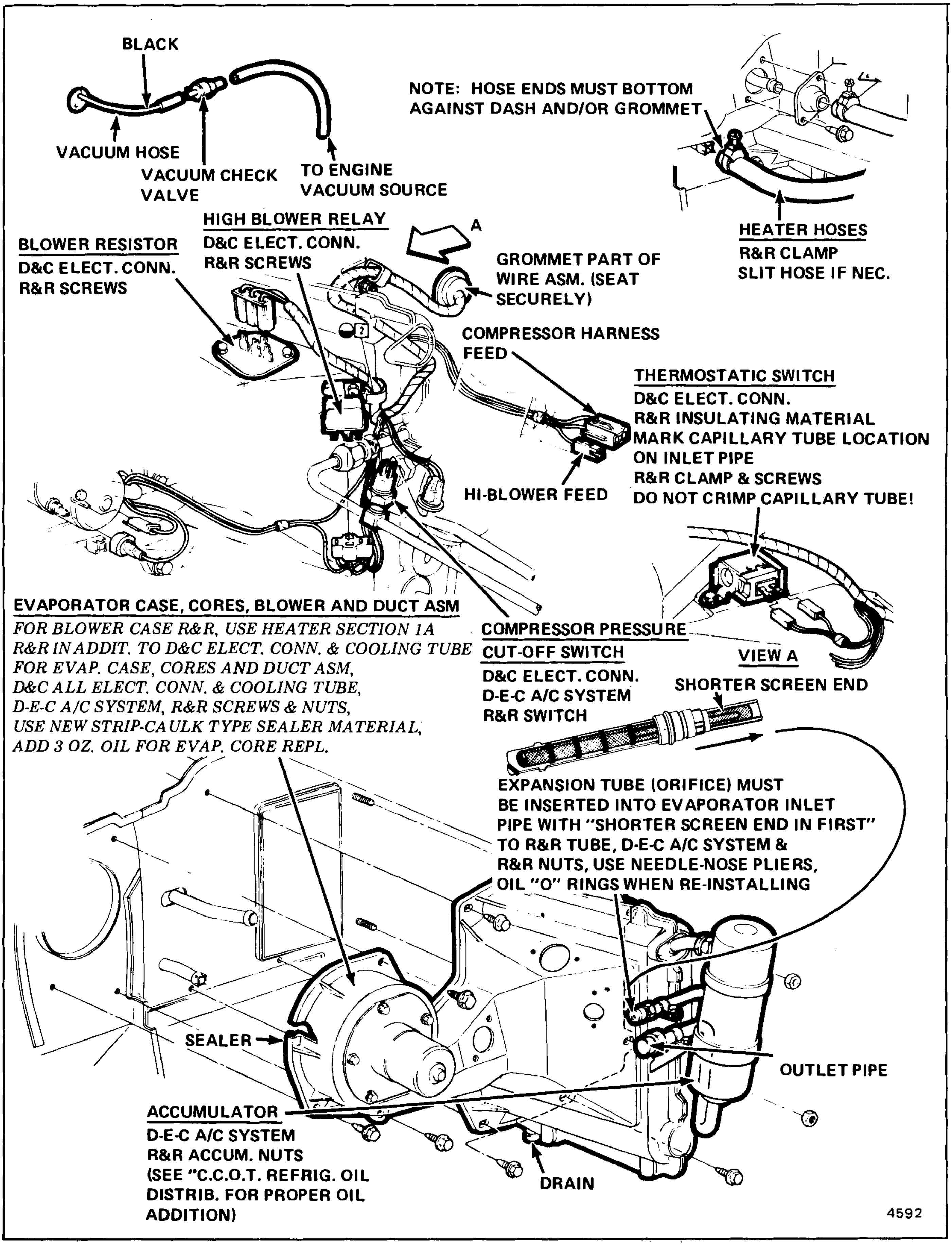
Fig. 1B-145 1977 F Series A/C Interior Service Procedures (No. 3 of 4)



PLENUM AIR INLET DOOR/DIAPHRAGM
LOOSEN & REPOSITION COWL SCREEN
R&R SCREWS
D&C VAC. HOSE

RECIRC. DIAPHRAGM/DOOR
R&R KICK PAD
D&C VAC. HOSES
R&R SCREWS

Fig. 1B-146 1977 F Series A/C Interior Service Procedures (No. 4 of 4)



NOTE: HOSE ENDS MUST BOTTOM AGAINST DASH AND/OR GROMMET

HEATER HOSES
R&R CLAMP
SLIT HOSE IF NEC.

HIGH BLOWER RELAY
D&C ELECT. CONN.
R&R SCREWS

BLOWER RESISTOR
D&C ELECT. CONN.
R&R SCREWS

GROMMET PART OF WIRE ASM. (SEAT SECURELY)

THERMOSTATIC SWITCH
D&C ELECT. CONN.
R&R INSULATING MATERIAL
MARK CAPILLARY TUBE LOCATION ON INLET PIPE
R&R CLAMP & SCREWS
DO NOT CRIMP CAPILLARY TUBE!

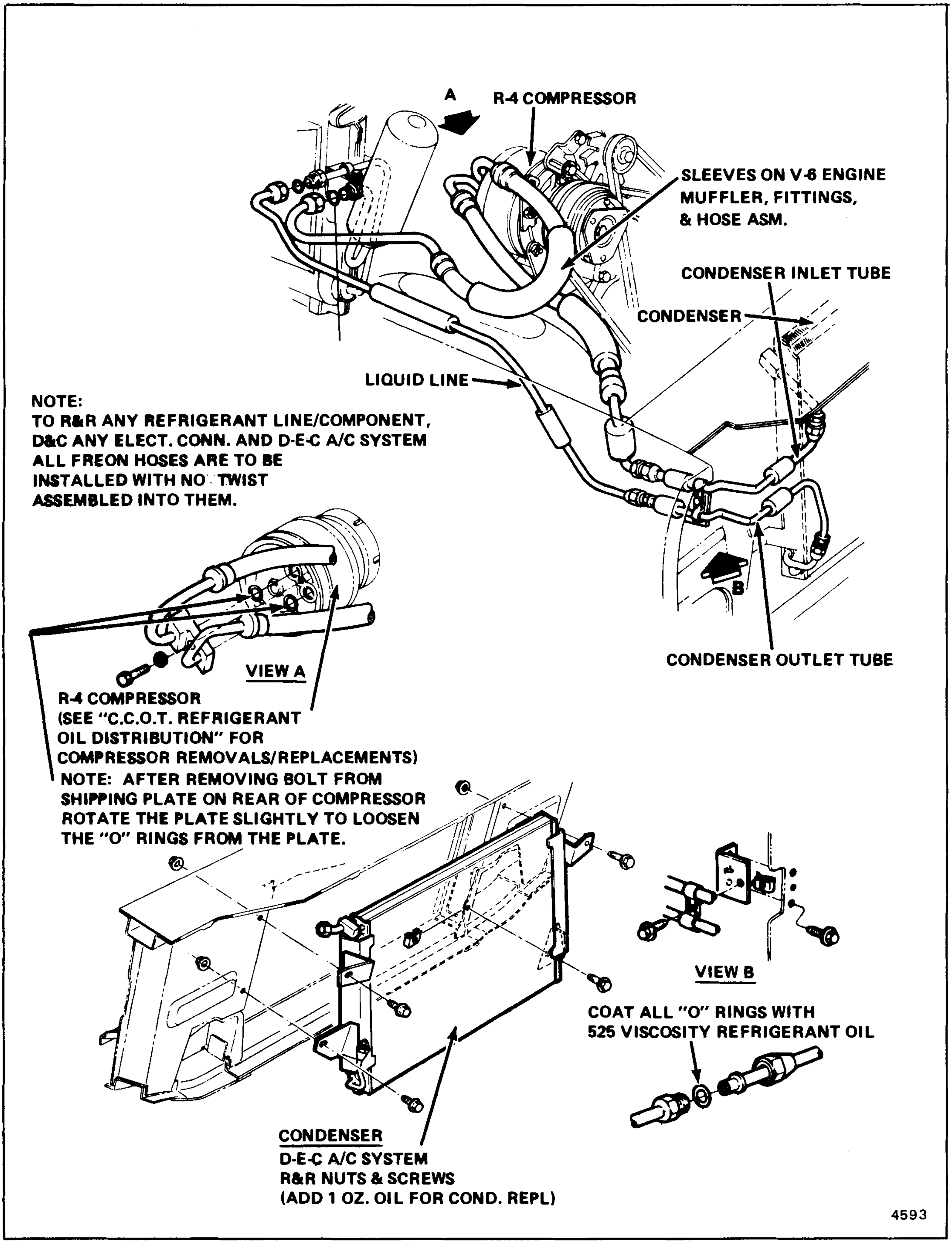
EVAPORATOR CASE, CORES, BLOWER AND DUCT ASM
FOR BLOWER CASE R&R, USE HEATER SECTION 1A
R&R IN ADDIT. TO D&C ELECT. CONN. & COOLING TUBE
FOR EVAP. CASE, CORES AND DUCT ASM,
D&C ALL ELECT. CONN. & COOLING TUBE,
D-E-C A/C SYSTEM, R&R SCREWS & NUTS,
USE NEW STRIP-CAULK TYPE SEALER MATERIAL,
ADD 3 OZ. OIL FOR EVAP. CORE REPL.

COMPRESSOR PRESSURE CUT-OFF SWITCH
D&C ELECT. CONN.
D-E-C A/C SYSTEM
R&R SWITCH

EXPANSION TUBE (ORIFICE) MUST BE INSERTED INTO EVAPORATOR INLET PIPE WITH "SHORTER SCREEN END IN FIRST" TO R&R TUBE, D-E-C A/C SYSTEM & R&R NUTS, USE NEEDLE-NOSE PLIERS, OIL "O" RINGS WHEN RE-INSTALLING

ACCUMULATOR
D-E-C A/C SYSTEM
R&R ACCUM. NUTS
(SEE "C.C.O.T. REFRIG. OIL DISTRIB. FOR PROPER OIL ADDITION)

Fig. 1B-147 1977 F Series A/C Exterior Service Procedures (No. 1 of 3)



NOTE:
TO R&R ANY REFRIGERANT LINE/COMPONENT, D&C ANY ELECT. CONN. AND D-E-C A/C SYSTEM ALL FREON HOSES ARE TO BE INSTALLED WITH NO TWIST ASSEMBLED INTO THEM.

R-4 COMPRESSOR
(SEE "C.C.O.T. REFRIGERANT OIL DISTRIBUTION" FOR COMPRESSOR REMOVALS/REPLACEMENTS)

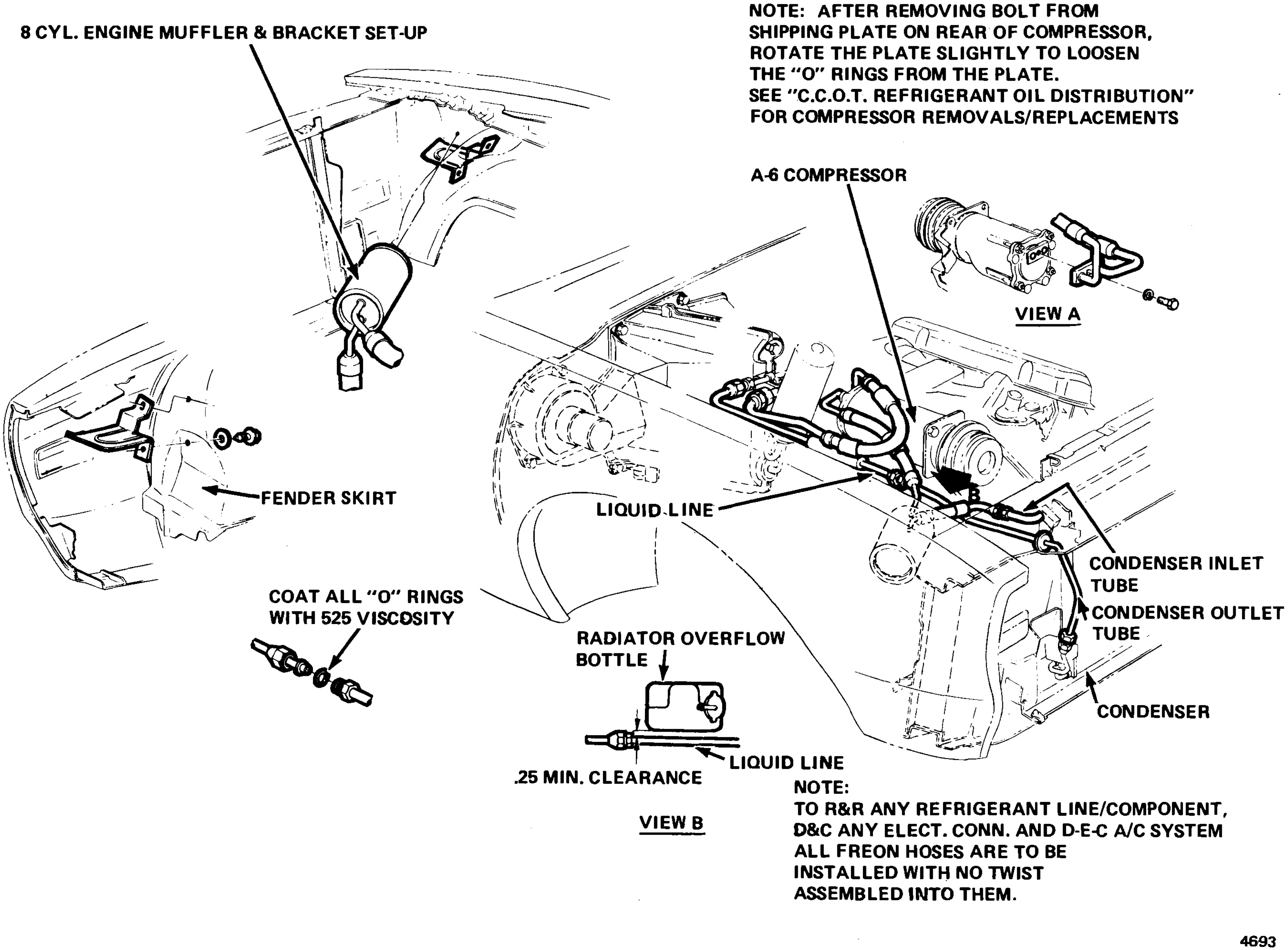
NOTE: AFTER REMOVING BOLT FROM SHIPPING PLATE ON REAR OF COMPRESSOR ROTATE THE PLATE SLIGHTLY TO LOOSEN THE "O" RINGS FROM THE PLATE.

COAT ALL "O" RINGS WITH 525 VISCOSITY REFRIGERANT OIL

CONDENSER
D-E-C A/C SYSTEM
R&R NUTS & SCREWS
(ADD 1 OZ. OIL FOR COND. REPL)

4593

Fig. 1B-148 1977 F Series A/C Exterior Service Procedures (No. 2 of 3)



NOTE: AFTER REMOVING BOLT FROM SHIPPING PLATE ON REAR OF COMPRESSOR, ROTATE THE PLATE SLIGHTLY TO LOOSEN THE "O" RINGS FROM THE PLATE. SEE "C.C.O.T. REFRIGERANT OIL DISTRIBUTION" FOR COMPRESSOR REMOVALS/REPLACEMENTS

COAT ALL "O" RINGS WITH 525 VISCOSITY

NOTE:
TO R&R ANY REFRIGERANT LINE/COMPONENT, D&C ANY ELECT. CONN. AND D-E-C A/C SYSTEM
ALL FREON HOSES ARE TO BE INSTALLED WITH NO TWIST ASSEMBLED INTO THEM.

Fig. 1B-149 1977 F Series A/C Exterior Service Procedures (No. 3 of 3)

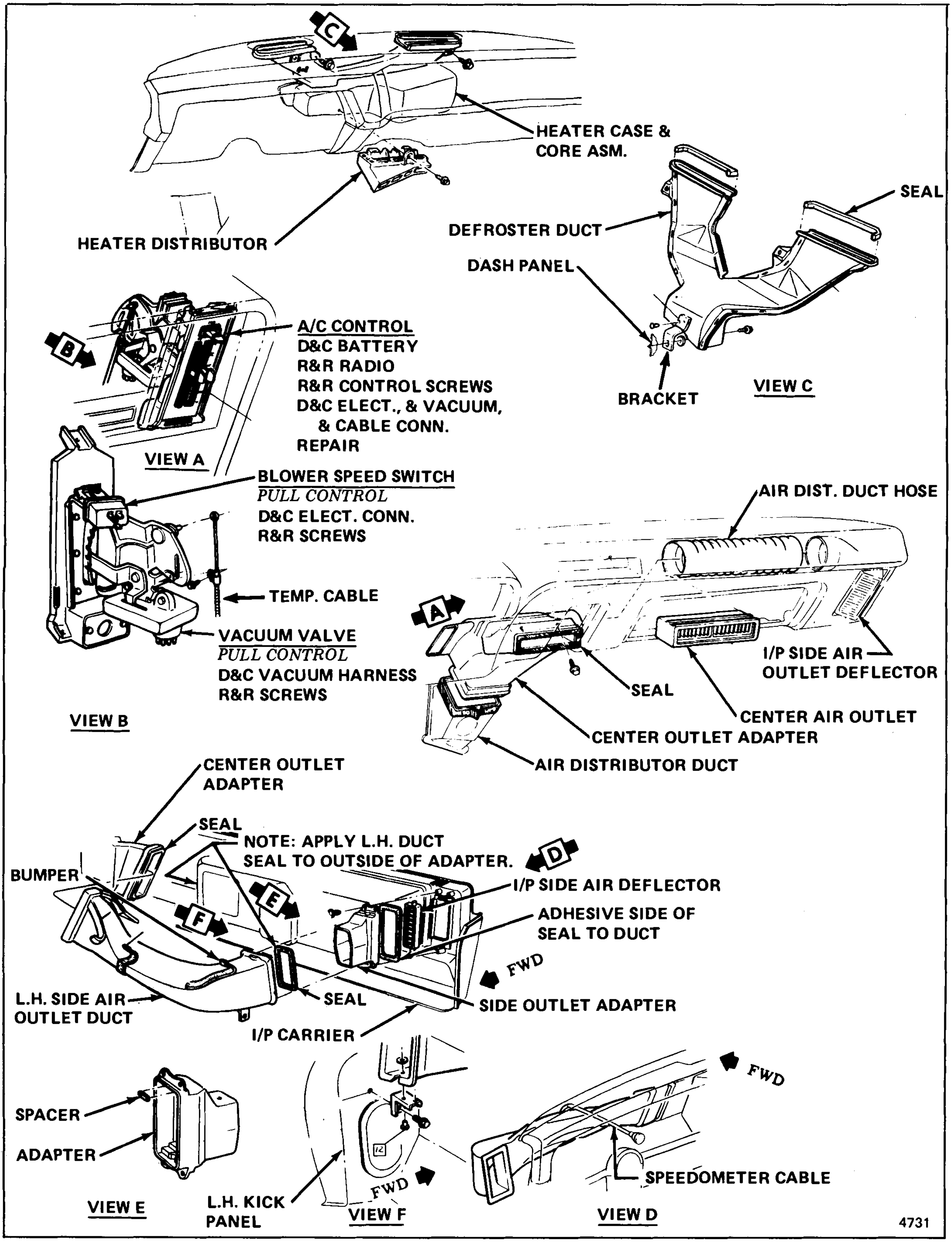
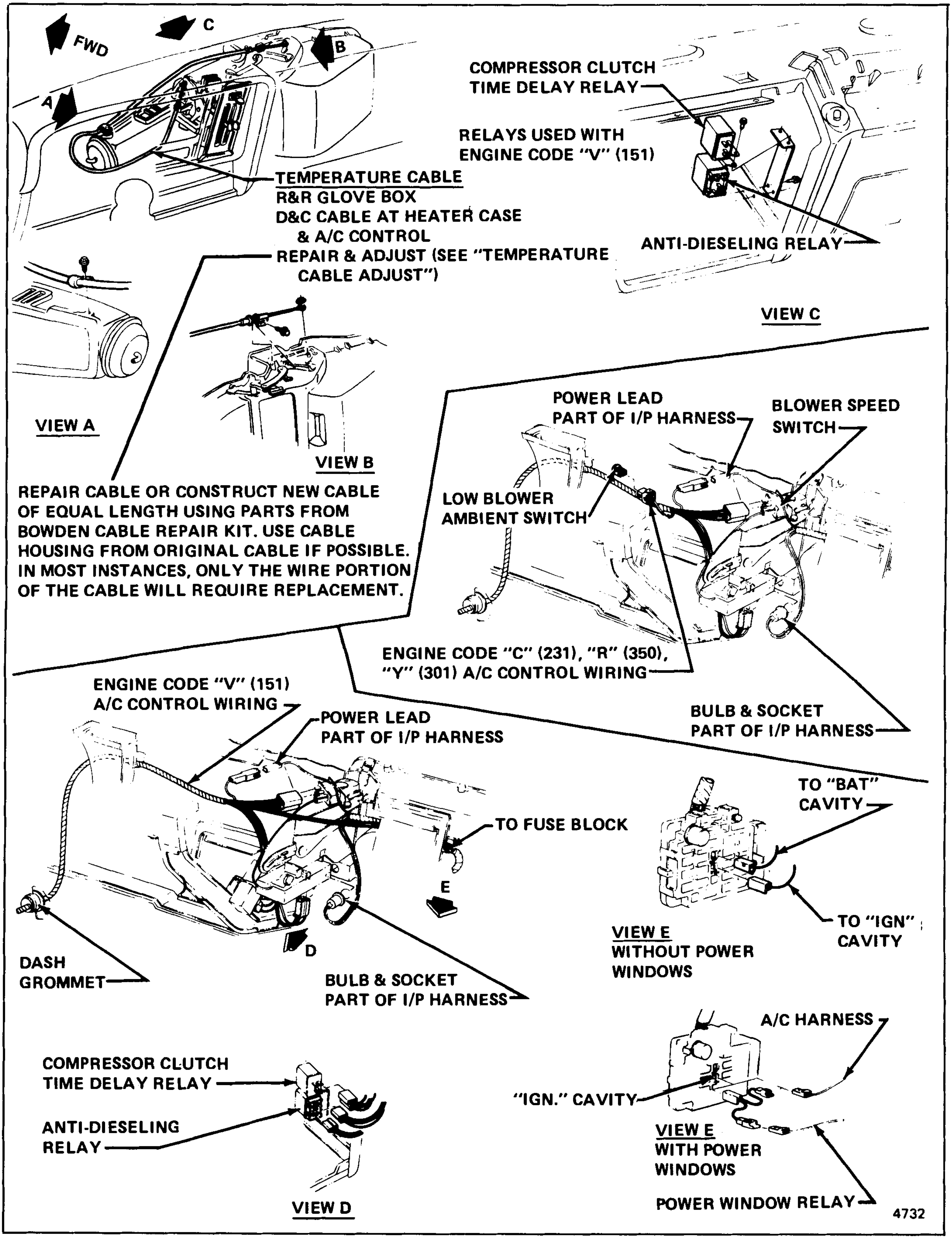


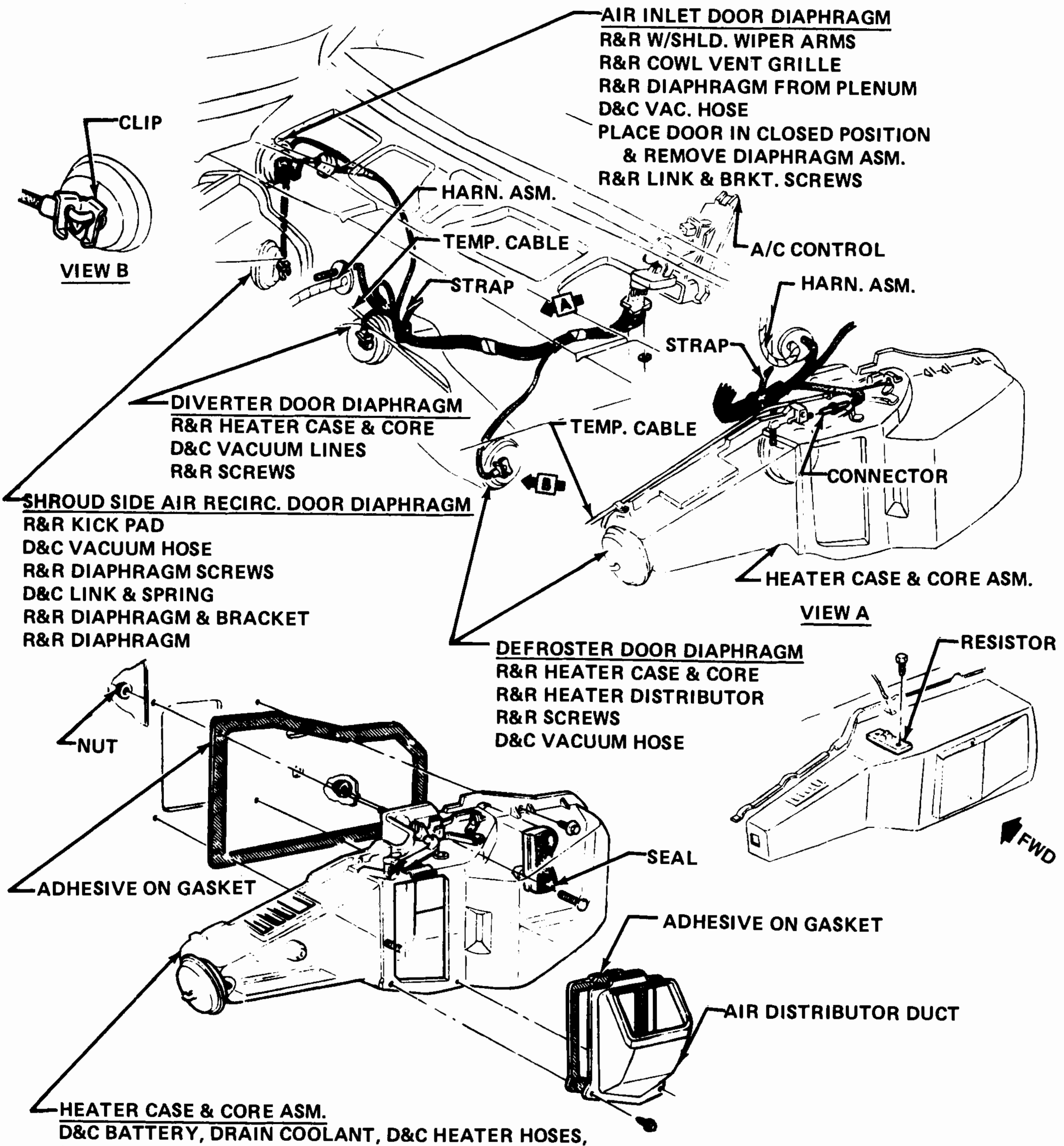
Fig. 1B-150 1977 X Series A/C Interior Service Procedures (No. 1 of 4)



TEMPERATURE CABLE
R&R GLOVE BOX
D&C CABLE AT HEATER CASE
& A/C CONTROL
REPAIR & ADJUST (SEE "TEMPERATURE CABLE ADJUST")

REPAIR CABLE OR CONSTRUCT NEW CABLE OF EQUAL LENGTH USING PARTS FROM BOWDEN CABLE REPAIR KIT. USE CABLE HOUSING FROM ORIGINAL CABLE IF POSSIBLE. IN MOST INSTANCES, ONLY THE WIRE PORTION OF THE CABLE WILL REQUIRE REPLACEMENT.

Fig. 1B-151 1977 X Series A/C Interior Service Procedures (No. 2 of 4)



AIR INLET DOOR DIAPHRAGM
R&R W/SHLD. WIPER ARMS
R&R COWL VENT GRILLE
R&R DIAPHRAGM FROM PLENUM
D&C VAC. HOSE
PLACE DOOR IN CLOSED POSITION
& REMOVE DIAPHRAGM ASM.
R&R LINK & BRKT. SCREWS

DIVERTER DOOR DIAPHRAGM
R&R HEATER CASE & CORE
D&C VACUUM LINES
R&R SCREWS

SHROUD SIDE AIR RECIRC. DOOR DIAPHRAGM
R&R KICK PAD
D&C VACUUM HOSE
R&R DIAPHRAGM SCREWS
D&C LINK & SPRING
R&R DIAPHRAGM & BRACKET
R&R DIAPHRAGM

DEFROSTER DOOR DIAPHRAGM
R&R HEATER CASE & CORE
R&R HEATER DISTRIBUTOR
R&R SCREWS
D&C VACUUM HOSE

HEATER CASE & CORE ASM.
D&C BATTERY, DRAIN COOLANT, D&C HEATER HOSES,
(NEC. TO BLOCK OUT FENDER SKIRT TO REACH LOWER
HOSE AND STUD NUT)
R&R CASE STUD NUTS FROM ENGINE COMPT. SIDE
R&R GLOVE BOX
R&R R.H. KICK PANEL RECIRC. DIAPHRAGM
R&R HEATER DISTRIBUTOR
R&R AIR DISTRIBUTOR DUCT
D&C ALL CABLES & ELECT. CONN. AT HEATER CASE
R&R ASM. & SEPARATE CORE FROM CASE
TRANSFER PARTS
USE NEW STRIP-CAULK TYPE SEALING MATERIAL

4733

Fig. 1B-152 1977 X Series A/C Interior Service Procedures (No. 3 of 4)

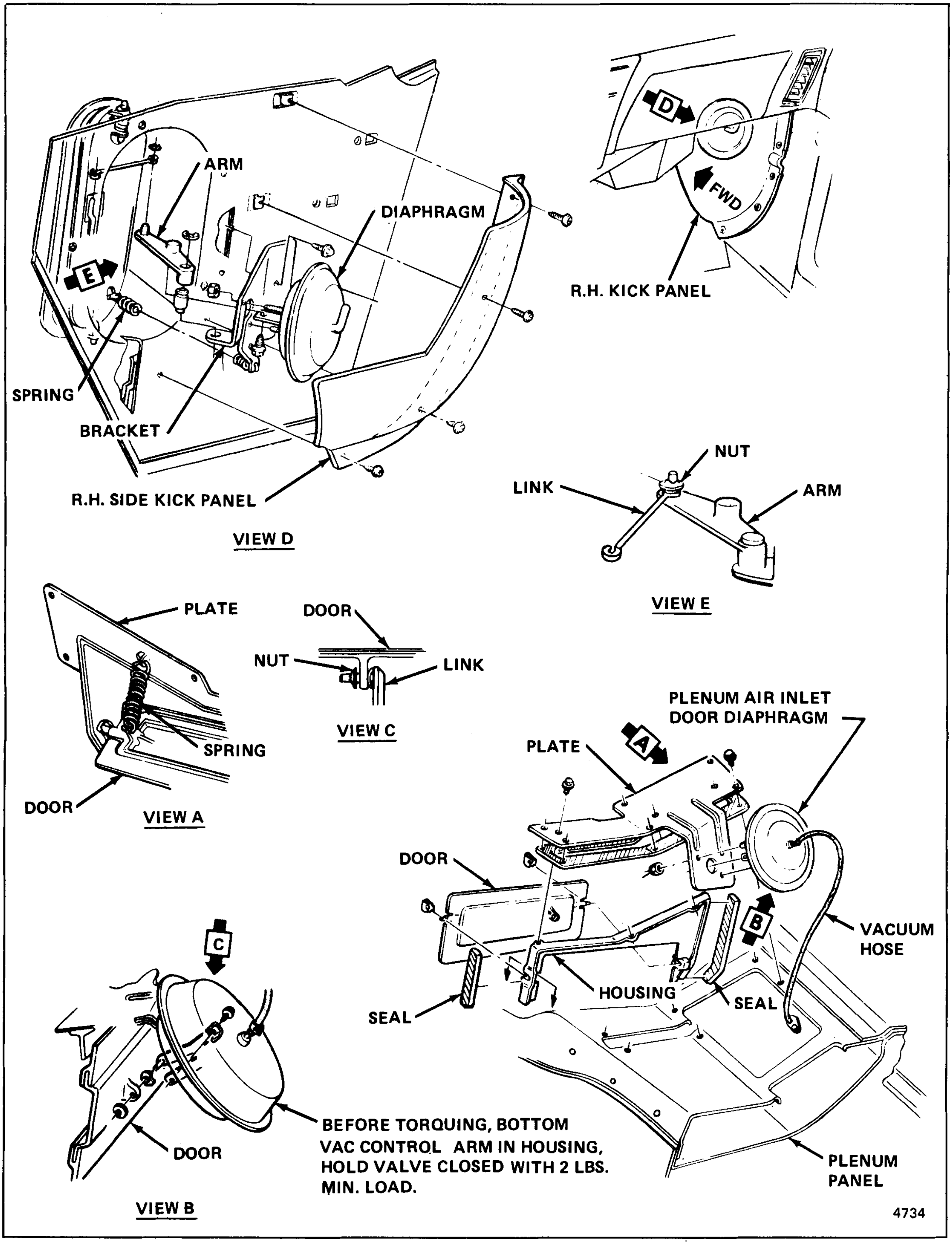
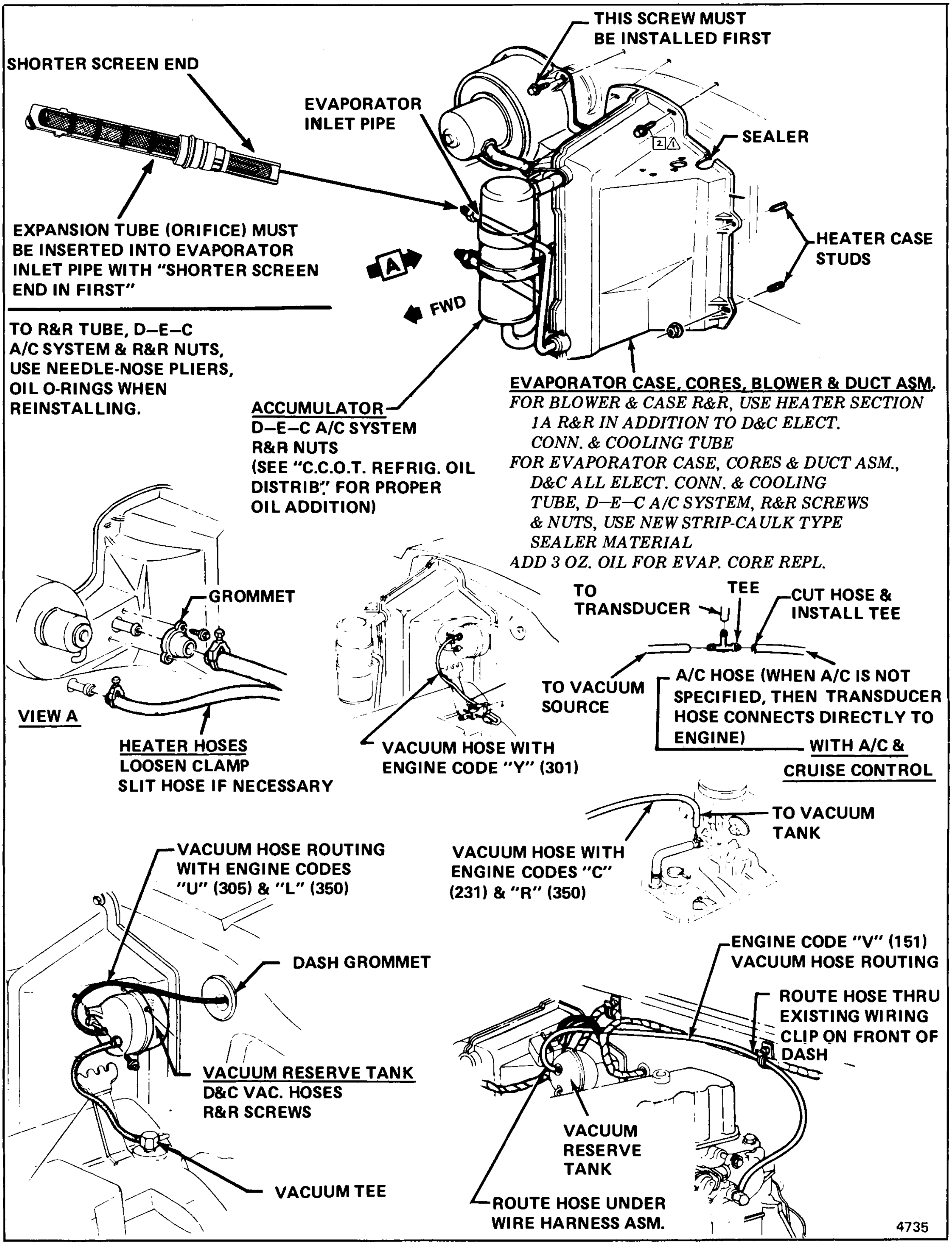


Fig. 1B-153 1977 X Series A/C Interior Service Procedures (No. 4 of 4)



EXPANSION TUBE (ORIFICE) MUST BE INSERTED INTO EVAPORATOR INLET PIPE WITH "SHORTER SCREEN END IN FIRST"

TO R&R TUBE, D–E–C A/C SYSTEM & R&R NUTS, USE NEEDLE-NOSE PLIERS, OIL O-RINGS WHEN REINSTALLING.

ACCUMULATOR
D–E–C A/C SYSTEM
R&R NUTS
(SEE "C.C.O.T. REFRIG. OIL DISTRIB." FOR PROPER OIL ADDITION)

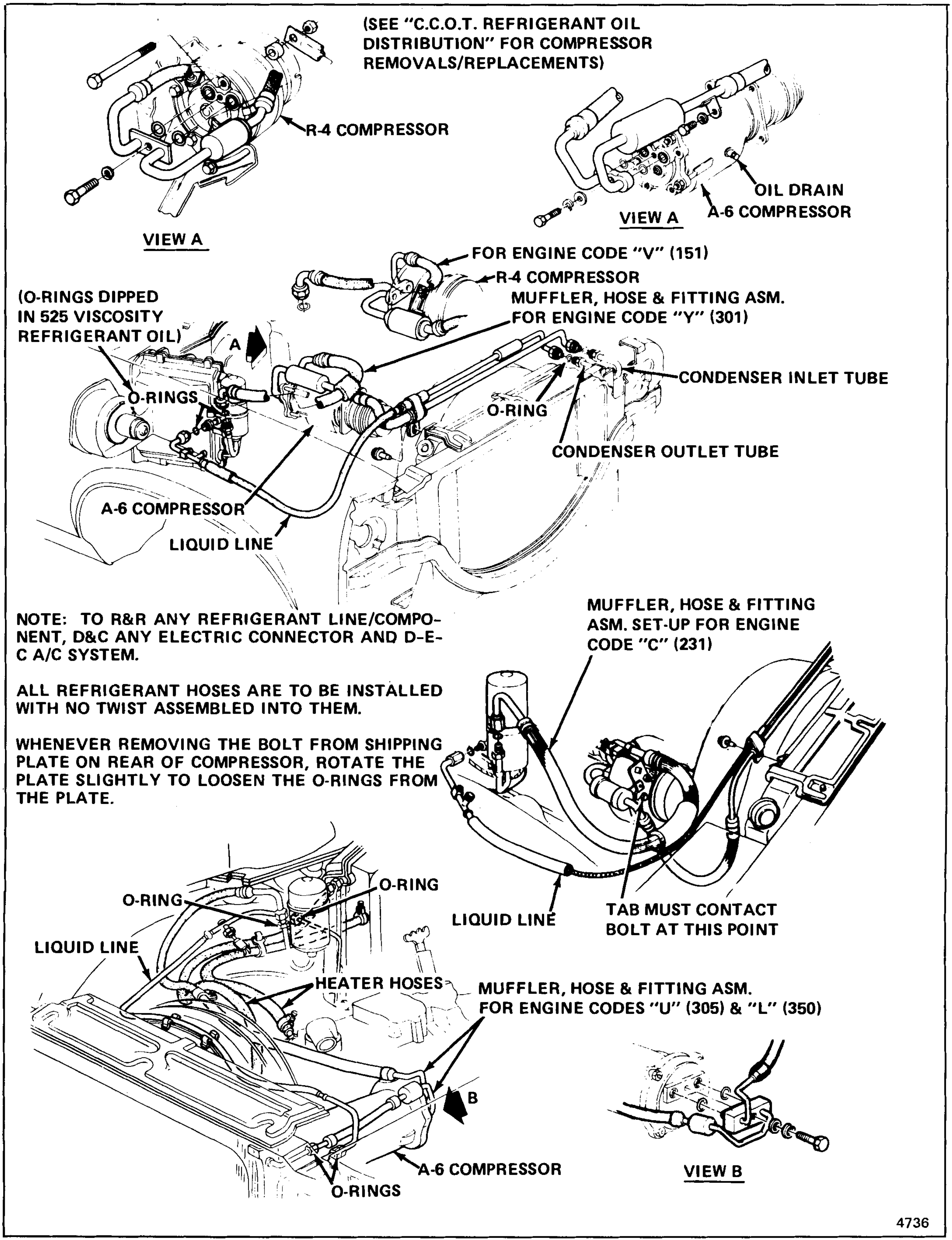
EVAPORATOR CASE, CORES, BLOWER & DUCT ASM.
FOR BLOWER & CASE R&R, USE HEATER SECTION 1A R&R IN ADDITION TO D&C ELECT. CONN. & COOLING TUBE
FOR EVAPORATOR CASE, CORES & DUCT ASM., D&C ALL ELECT. CONN. & COOLING TUBE, D–E–C A/C SYSTEM, R&R SCREWS & NUTS, USE NEW STRIP-CAULK TYPE SEALER MATERIAL
ADD 3 OZ. OIL FOR EVAP. CORE REPL.

HEATER HOSES
LOOSEN CLAMP
SLIT HOSE IF NECESSARY

A/C HOSE (WHEN A/C IS NOT SPECIFIED, THEN TRANSDUCER HOSE CONNECTS DIRECTLY TO ENGINE)

VACUUM RESERVE TANK
D&C VAC. HOSES
R&R SCREWS

Fig. 1B-154 1977 X Series A/C Exterior Service Procedures (No. 1 of 3)



NOTE: TO R&R ANY REFRIGERANT LINE/COMPONENT, D&C ANY ELECTRIC CONNECTOR AND D-E-C A/C SYSTEM.

ALL REFRIGERANT HOSES ARE TO BE INSTALLED WITH NO TWIST ASSEMBLED INTO THEM.

WHENEVER REMOVING THE BOLT FROM SHIPPING PLATE ON REAR OF COMPRESSOR, ROTATE THE PLATE SLIGHTLY TO LOOSEN THE O-RINGS FROM THE PLATE.

Fig. 1B-155 1977 X Series A/C Exterior Service Procedures (No. 2 of 3)

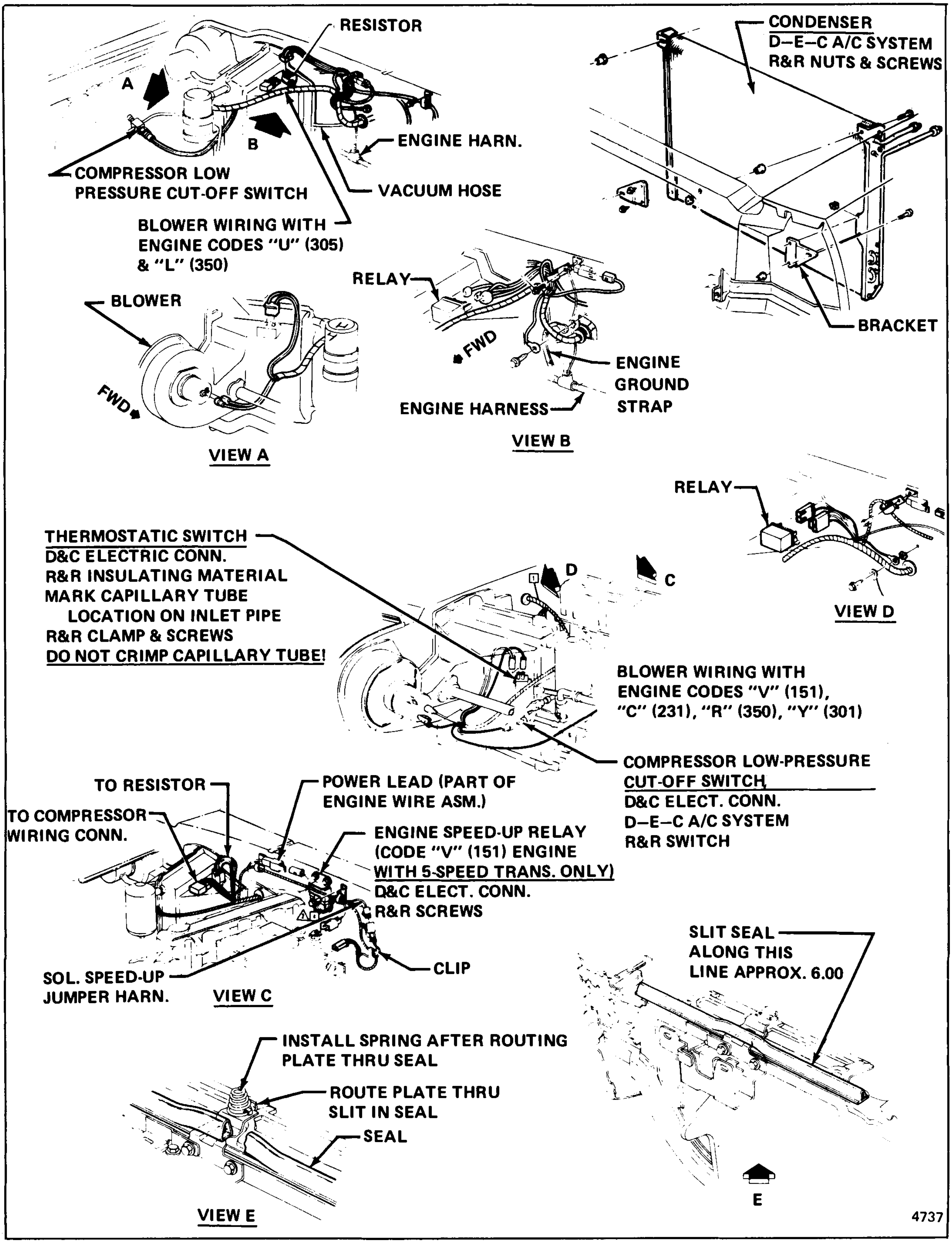
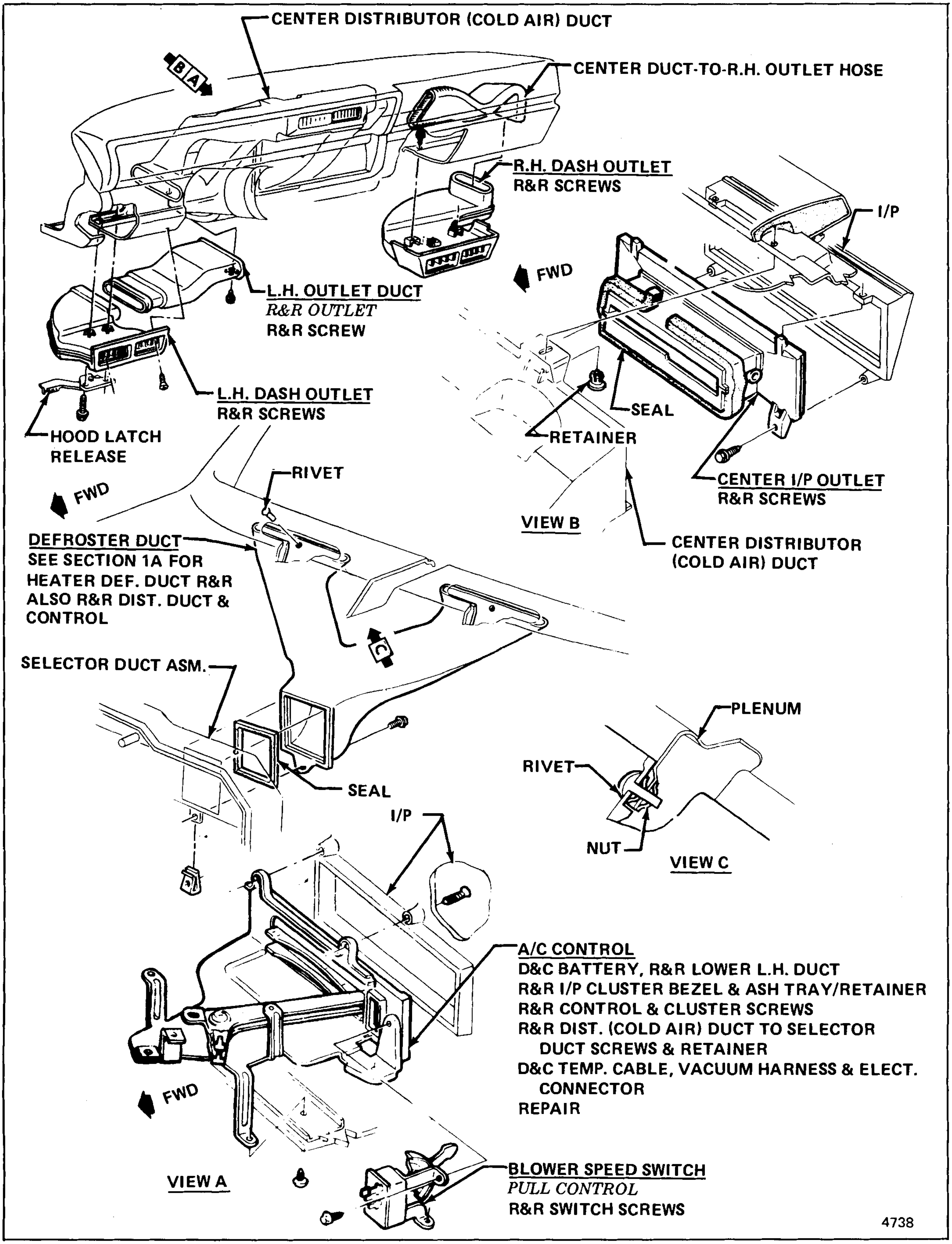


Fig. 1B-156 1977 X Series A/C Exterior Service Procedures (No. 3 of 3)



R.H. DASH OUTLET
R&R SCREWS

L.H. OUTLET DUCT
R&R OUTLET
R&R SCREW

L.H. DASH OUTLET
R&R SCREWS

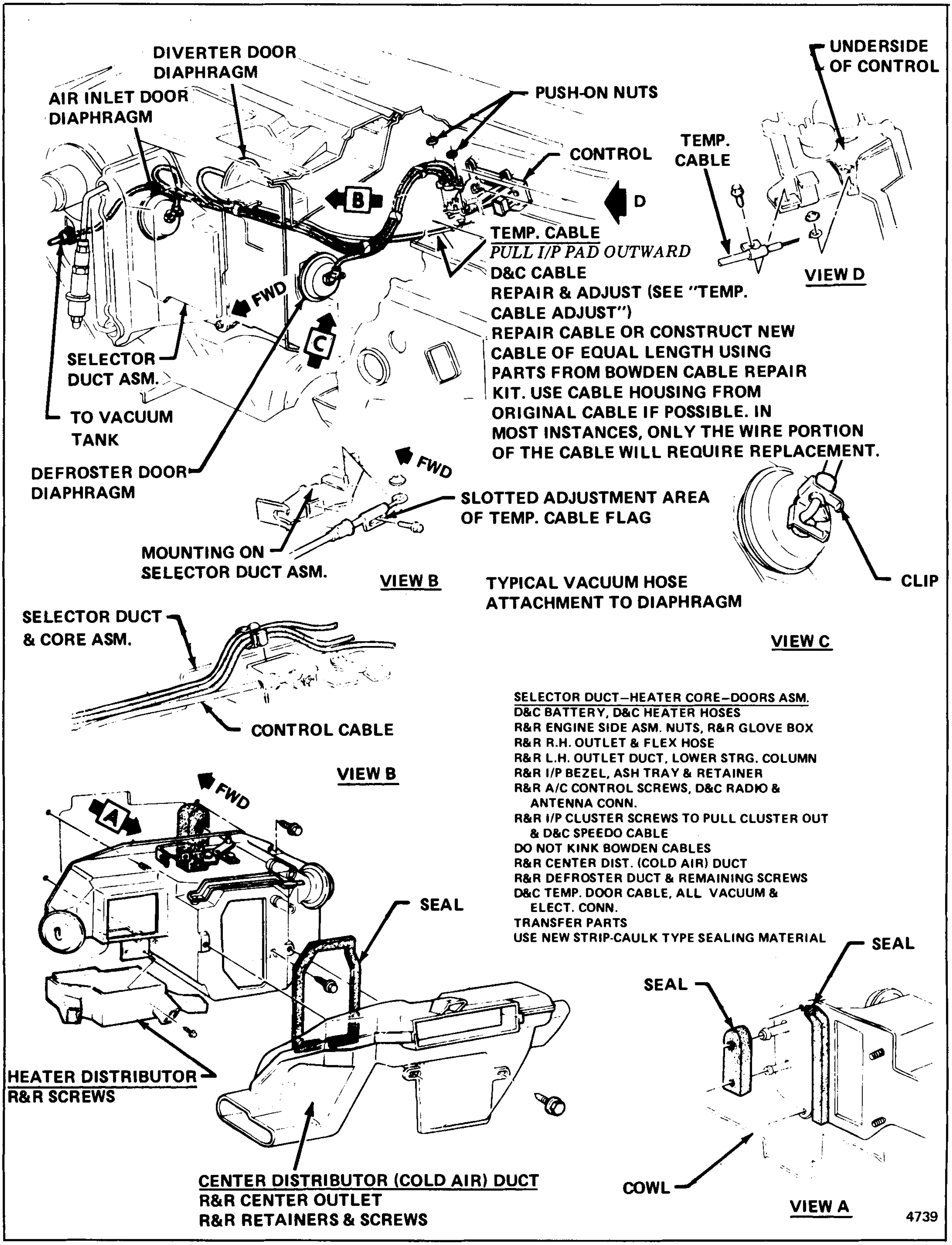
CENTER I/P OUTLET
R&R SCREWS

DEFROSTER DUCT
SEE SECTION 1A FOR
HEATER DEF. DUCT R&R
ALSO R&R DIST. DUCT &
CONTROL

A/C CONTROL
D&C BATTERY, R&R LOWER L.H. DUCT
R&R I/P CLUSTER BEZEL & ASH TRAY/RETAINER
R&R CONTROL & CLUSTER SCREWS
R&R DIST. (COLD AIR) DUCT TO SELECTOR DUCT SCREWS & RETAINER
D&C TEMP. CABLE, VACUUM HARNESS & ELECT. CONNECTOR
REPAIR

BLOWER SPEED SWITCH
PULL CONTROL
R&R SWITCH SCREWS

Fig. 1B-157 1977 Astre Series A/C Interior Service Procedures (No. 1 of 3)



TEMP. CABLE
PULL I/P PAD OUTWARD
D&C CABLE
REPAIR & ADJUST (SEE "TEMP. CABLE ADJUST")
REPAIR CABLE OR CONSTRUCT NEW CABLE OF EQUAL LENGTH USING PARTS FROM BOWDEN CABLE REPAIR KIT. USE CABLE HOUSING FROM ORIGINAL CABLE IF POSSIBLE. IN MOST INSTANCES, ONLY THE WIRE PORTION OF THE CABLE WILL REQUIRE REPLACEMENT.

SELECTOR DUCT—HEATER CORE—DOORS ASM.
D&C BATTERY, D&C HEATER HOSES
R&R ENGINE SIDE ASM. NUTS, R&R GLOVE BOX
R&R R.H. OUTLET & FLEX HOSE
R&R L.H. OUTLET DUCT, LOWER STRG. COLUMN
R&R I/P BEZEL, ASH TRAY & RETAINER
R&R A/C CONTROL SCREWS, D&C RADIO & ANTENNA CONN.
R&R I/P CLUSTER SCREWS TO PULL CLUSTER OUT & D&C SPEEDO CABLE
DO NOT KINK BOWDEN CABLES
R&R CENTER DIST. (COLD AIR) DUCT
R&R DEFROSTER DUCT & REMAINING SCREWS
D&C TEMP. DOOR CABLE, ALL VACUUM & ELECT. CONN.
TRANSFER PARTS
USE NEW STRIP-CAULK TYPE SEALING MATERIAL

Fig. 1B-158 1977 Astre Series A/C Interior Service Procedures (No. 2 of 3)

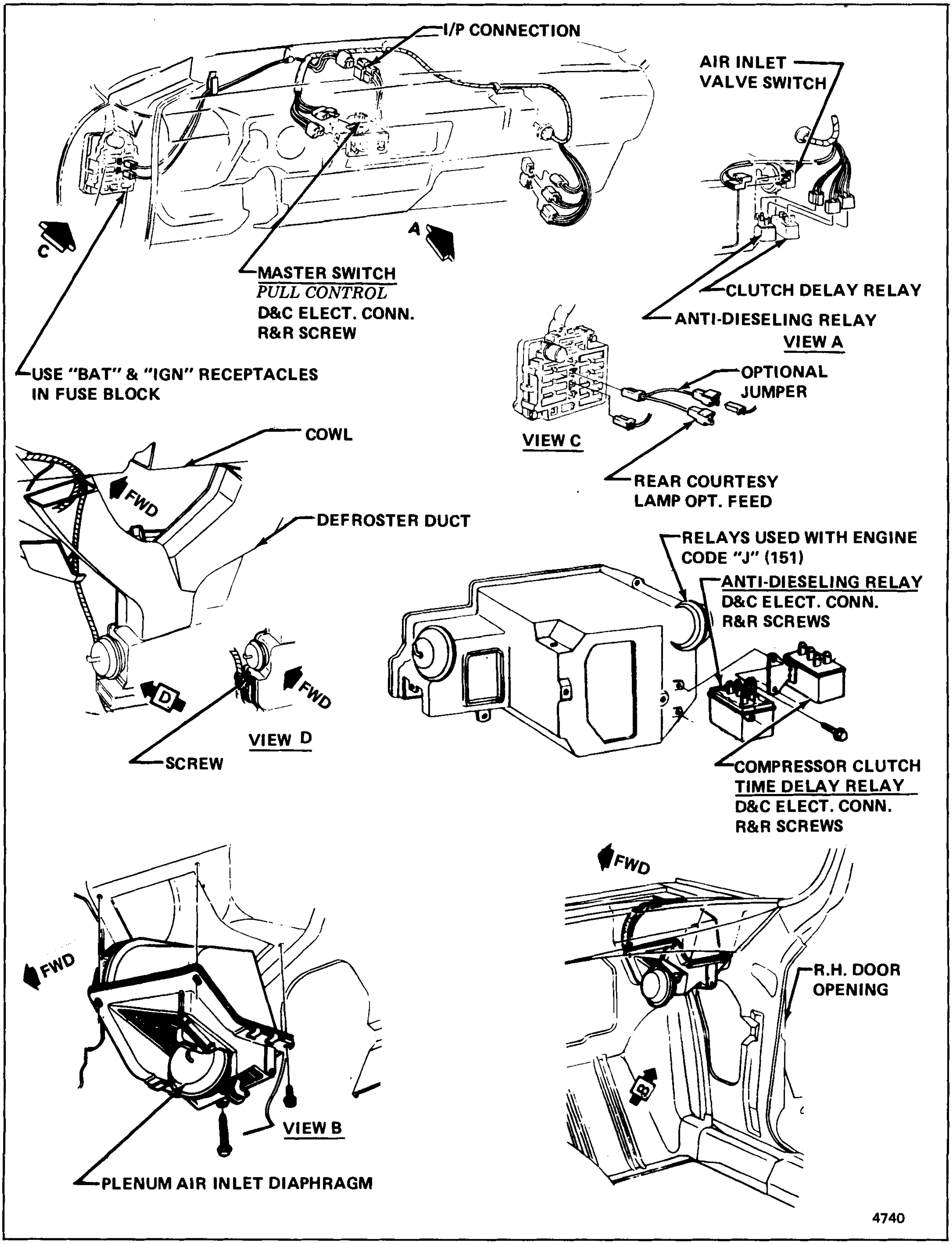
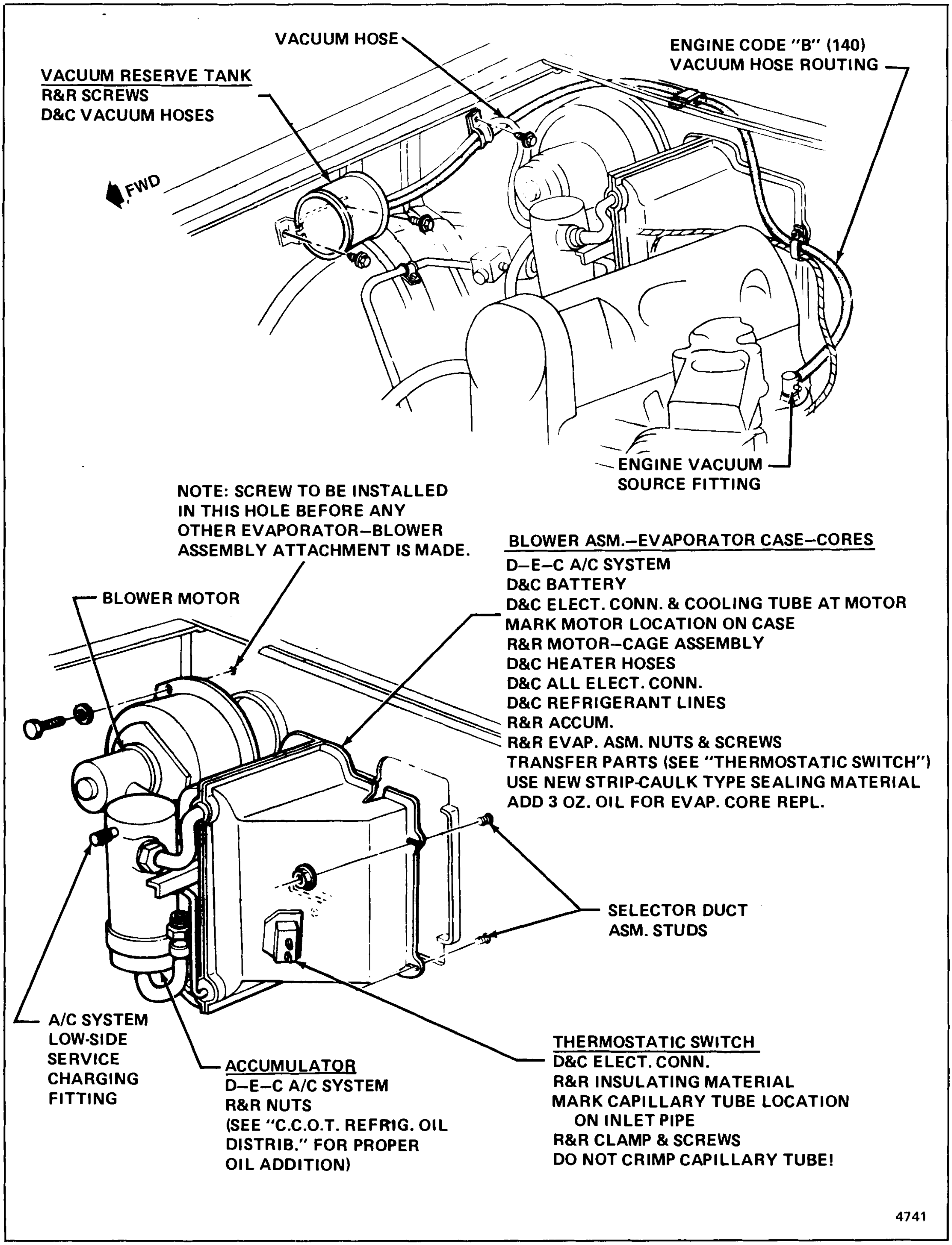


Fig. 1B-159 1977 Astre Series A/C Interior Service Procedures (No. 3 of 3)



ENGINE CODE "B" (140)
VACUUM HOSE ROUTING

VACUUM RESERVE TANK
R&R SCREWS
D&C VACUUM HOSES

NOTE: SCREW TO BE INSTALLED IN THIS HOLE BEFORE ANY OTHER EVAPORATOR–BLOWER ASSEMBLY ATTACHMENT IS MADE.

BLOWER ASM.–EVAPORATOR CASE–CORES
D–E–C A/C SYSTEM
D&C BATTERY
D&C ELECT. CONN. & COOLING TUBE AT MOTOR
MARK MOTOR LOCATION ON CASE
R&R MOTOR–CAGE ASSEMBLY
D&C HEATER HOSES
D&C ALL ELECT. CONN.
D&C REFRIGERANT LINES
R&R ACCUM.
R&R EVAP. ASM. NUTS & SCREWS
TRANSFER PARTS (SEE "THERMOSTATIC SWITCH")
USE NEW STRIP-CAULK TYPE SEALING MATERIAL
ADD 3 OZ. OIL FOR EVAP. CORE REPL.

ACCUMULATOR
D–E–C A/C SYSTEM
R&R NUTS
(SEE "C.C.O.T. REFRIG. OIL DISTRIB." FOR PROPER OIL ADDITION)

THERMOSTATIC SWITCH
D&C ELECT. CONN.
R&R INSULATING MATERIAL
MARK CAPILLARY TUBE LOCATION ON INLET PIPE
R&R CLAMP & SCREWS
DO NOT CRIMP CAPILLARY TUBE!

Fig. 1B-160 1977 Astre Series A/C Exterior Service Procedures (No. 1 of 3)

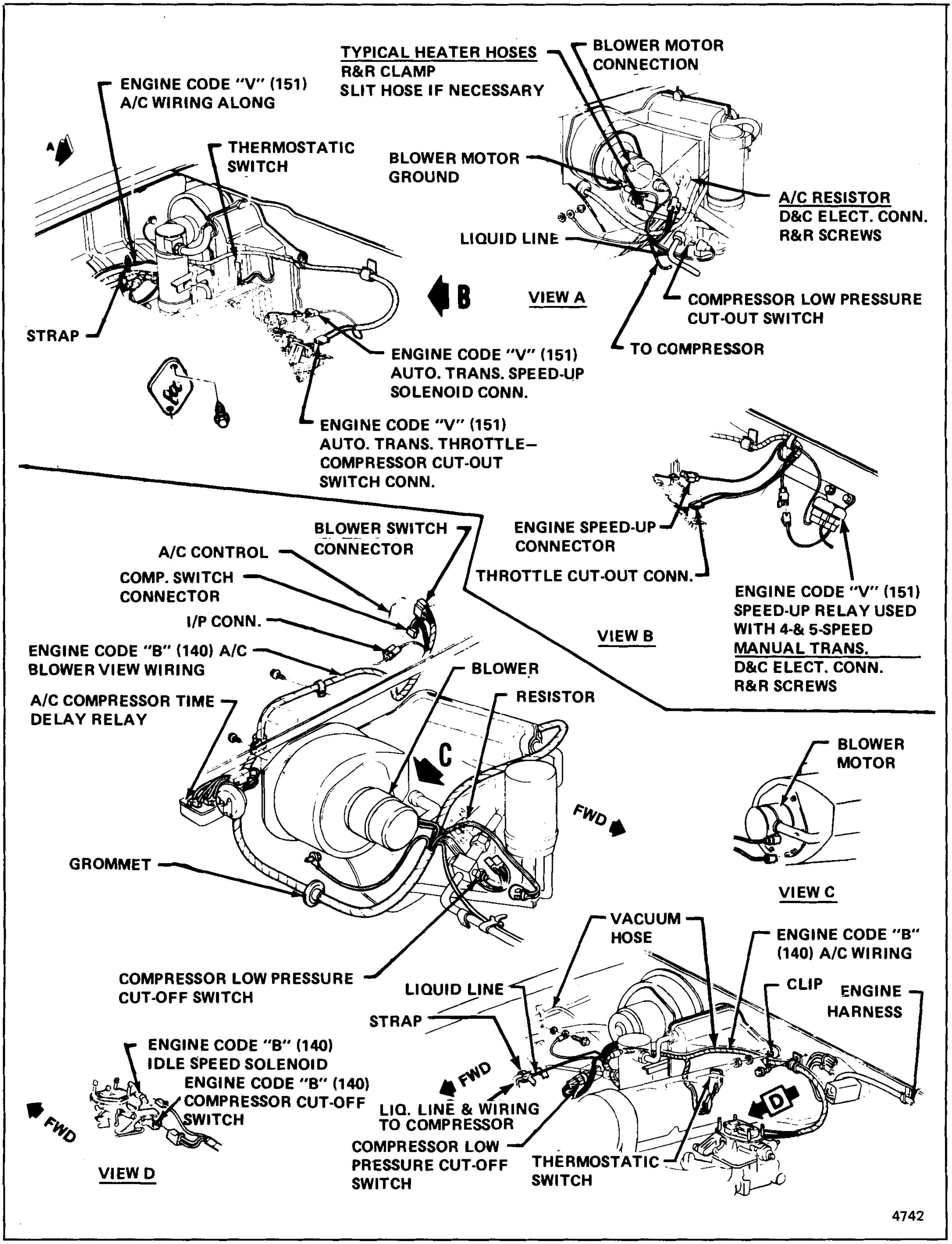
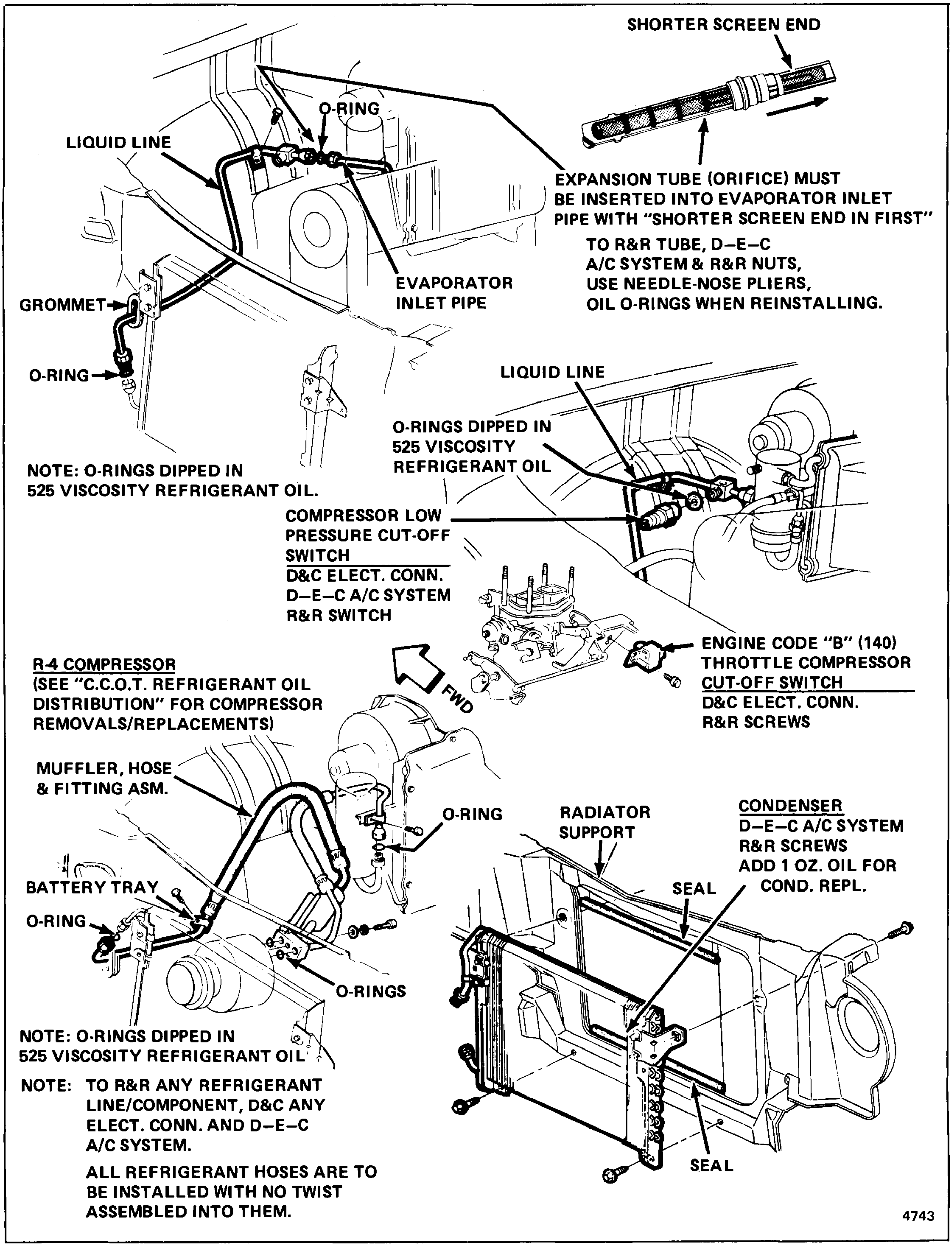


Fig. 1B-161 1977 Astre Series A/C Exterior Service Procedures (No. 2 of 3)



EXPANSION TUBE (ORIFICE) MUST BE INSERTED INTO EVAPORATOR INLET PIPE WITH "SHORTER SCREEN END IN FIRST"

TO R&R TUBE, D–E–C A/C SYSTEM & R&R NUTS, USE NEEDLE-NOSE PLIERS, OIL O-RINGS WHEN REINSTALLING.

NOTE: O-RINGS DIPPED IN 525 VISCOSITY REFRIGERANT OIL.

COMPRESSOR LOW PRESSURE CUT-OFF SWITCH

D&C ELECT. CONN.
D–E–C A/C SYSTEM
R&R SWITCH

ENGINE CODE "B" (140) THROTTLE COMPRESSOR CUT-OFF SWITCH

D&C ELECT. CONN.
R&R SCREWS

R-4 COMPRESSOR

(SEE "C.C.O.T. REFRIGERANT OIL DISTRIBUTION" FOR COMPRESSOR REMOVALS/REPLACEMENTS)

CONDENSER

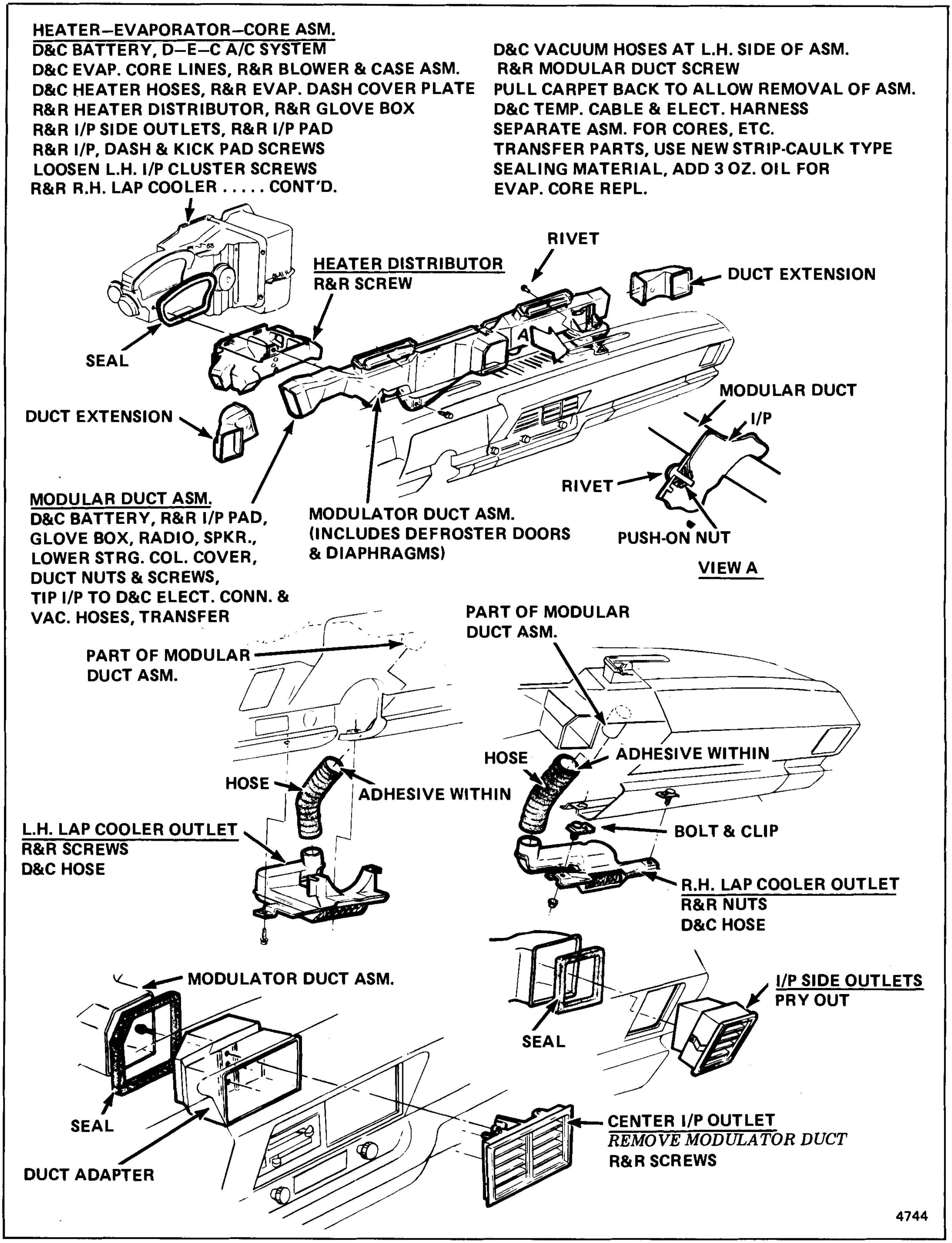
D–E–C A/C SYSTEM
R&R SCREWS
ADD 1 OZ. OIL FOR COND. REPL.

NOTE: O-RINGS DIPPED IN 525 VISCOSITY REFRIGERANT OIL

NOTE: TO R&R ANY REFRIGERANT LINE/COMPONENT, D&C ANY ELECT. CONN. AND D–E–C A/C SYSTEM.

ALL REFRIGERANT HOSES ARE TO BE INSTALLED WITH NO TWIST ASSEMBLED INTO THEM.

Fig. 1B-162 1977 Astre Series A/C Exterior Service Procedures (No. 3 of 3)



HEATER–EVAPORATOR–CORE ASM.
D&C BATTERY, D–E–C A/C SYSTEM
D&C EVAP. CORE LINES, R&R BLOWER & CASE ASM.
D&C HEATER HOSES, R&R EVAP. DASH COVER PLATE
R&R HEATER DISTRIBUTOR, R&R GLOVE BOX
R&R I/P SIDE OUTLETS, R&R I/P PAD
R&R I/P, DASH & KICK PAD SCREWS
LOOSEN L.H. I/P CLUSTER SCREWS
R&R R.H. LAP COOLER ..... CONT'D.
D&C VACUUM HOSES AT L.H. SIDE OF ASM.
R&R MODULAR DUCT SCREW
PULL CARPET BACK TO ALLOW REMOVAL OF ASM.
D&C TEMP. CABLE & ELECT. HARNESS
SEPARATE ASM. FOR CORES, ETC.
TRANSFER PARTS, USE NEW STRIP-CAULK TYPE
SEALING MATERIAL, ADD 3 OZ. OIL FOR
EVAP. CORE REPL.

HEATER DISTRIBUTOR
R&R SCREW

MODULAR DUCT ASM.
D&C BATTERY, R&R I/P PAD,
GLOVE BOX, RADIO, SPKR.,
LOWER STRG. COL. COVER,
DUCT NUTS & SCREWS,
TIP I/P TO D&C ELECT. CONN. &
VAC. HOSES, TRANSFER

MODULATOR DUCT ASM.
(INCLUDES DEFROSTER DOORS
& DIAPHRAGMS)

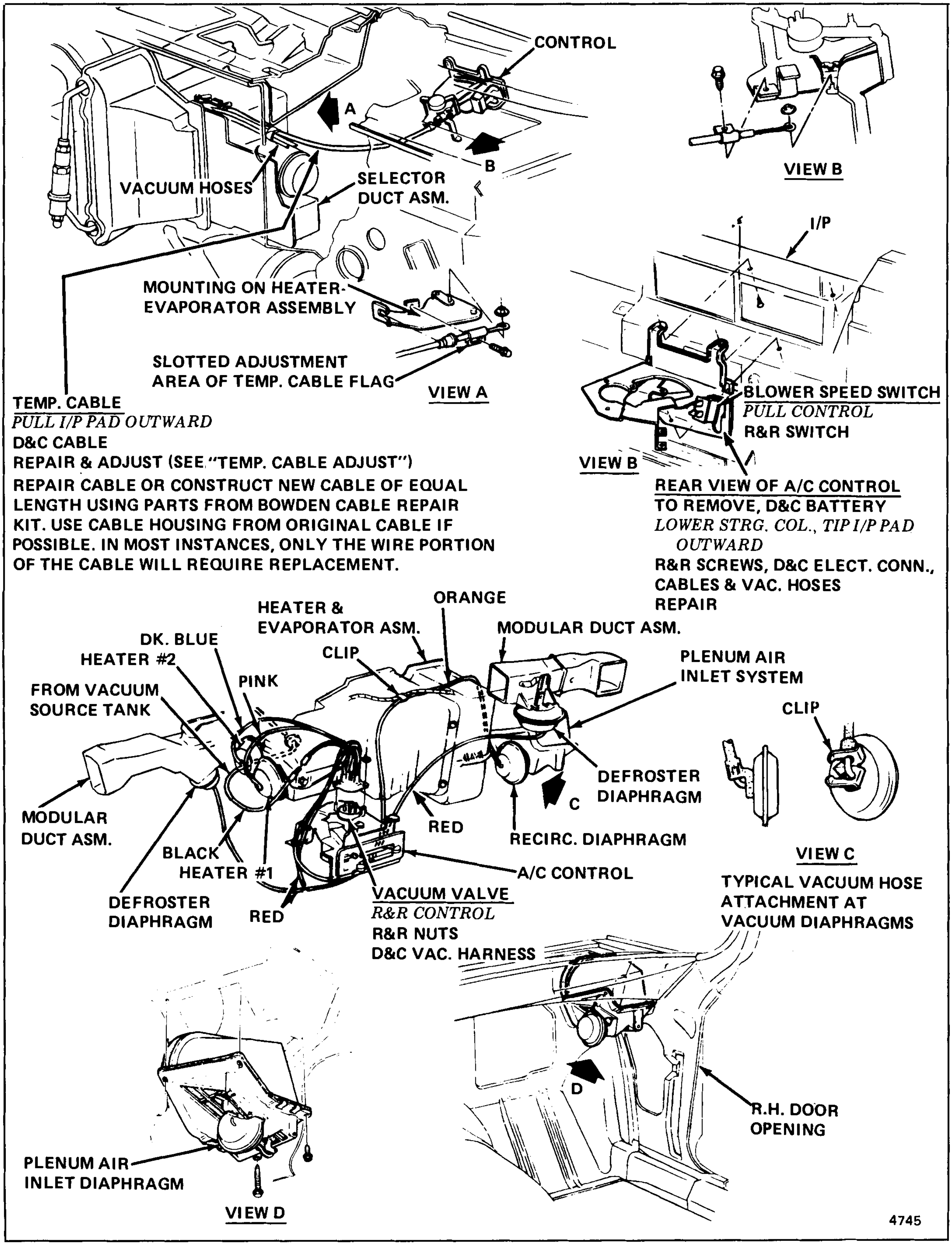
L.H. LAP COOLER OUTLET
R&R SCREWS
D&C HOSE

R.H. LAP COOLER OUTLET
R&R NUTS
D&C HOSE

I/P SIDE OUTLETS
PRY OUT

CENTER I/P OUTLET
REMOVE MODULATOR DUCT
R&R SCREWS

Fig. 1B-163 1977 Sunbird Series A/C Interior Service Procedures (No. 1 of 3)



TEMP. CABLE

PULL I/P PAD OUTWARD

D&C CABLE

REPAIR & ADJUST (SEE "TEMP. CABLE ADJUST")

REPAIR CABLE OR CONSTRUCT NEW CABLE OF EQUAL LENGTH USING PARTS FROM BOWDEN CABLE REPAIR KIT. USE CABLE HOUSING FROM ORIGINAL CABLE IF POSSIBLE. IN MOST INSTANCES, ONLY THE WIRE PORTION OF THE CABLE WILL REQUIRE REPLACEMENT.

BLOWER SPEED SWITCH

PULL CONTROL

R&R SWITCH

REAR VIEW OF A/C CONTROL

TO REMOVE, D&C BATTERY

LOWER STRG. COL., TIP I/P PAD OUTWARD

R&R SCREWS, D&C ELECT. CONN., CABLES & VAC. HOSES

REPAIR

VACUUM VALVE

R&R CONTROL

R&R NUTS

D&C VAC. HARNESS

TYPICAL VACUUM HOSE ATTACHMENT AT VACUUM DIAPHRAGMS

Fig. 1B-164 1977 Sunbird Series A/C Interior Service Procedures (No. 2 of 3)

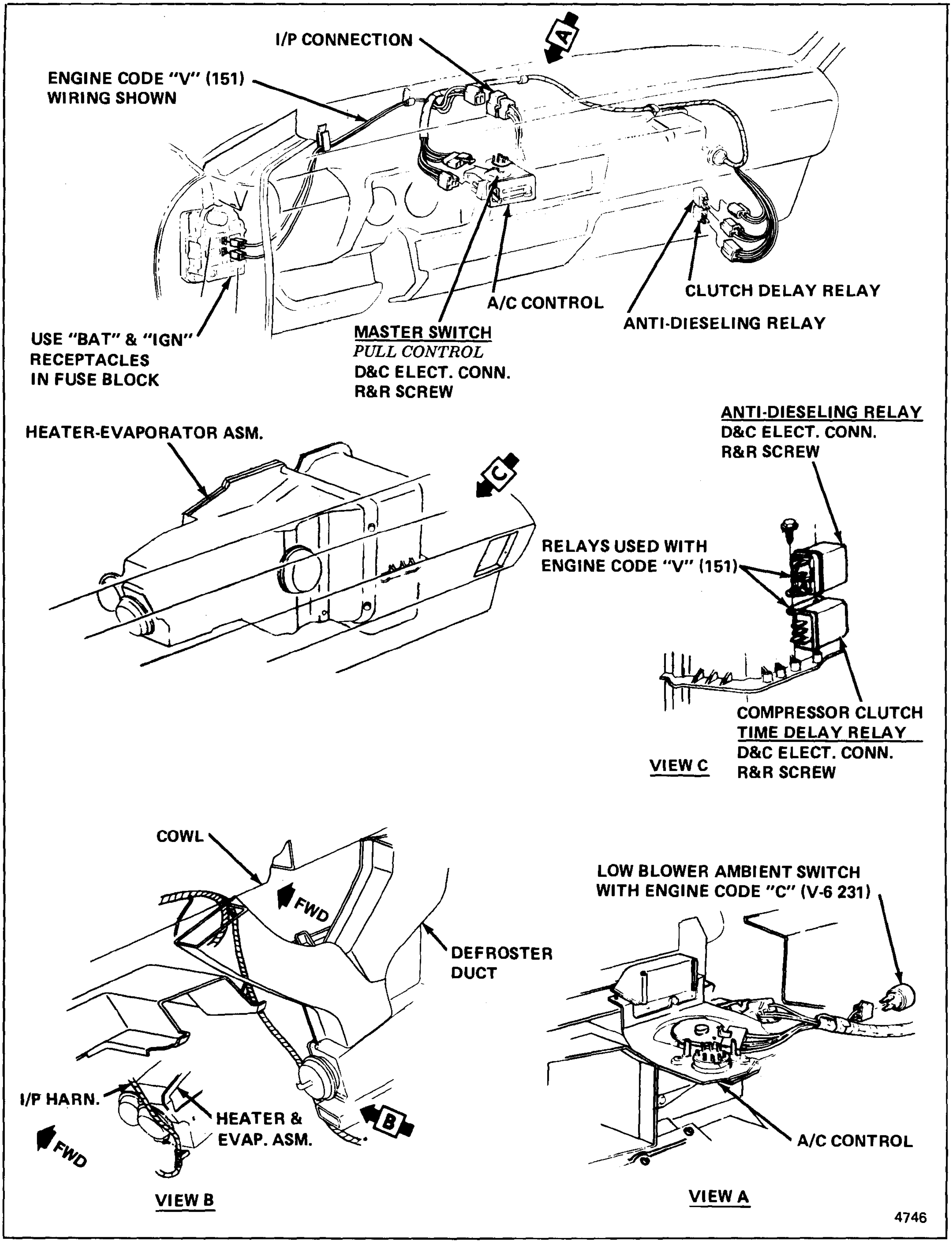


Fig. 1B-165 1977 Sunbird Series A/C Interior Service Procedures (No. 3 of 3)

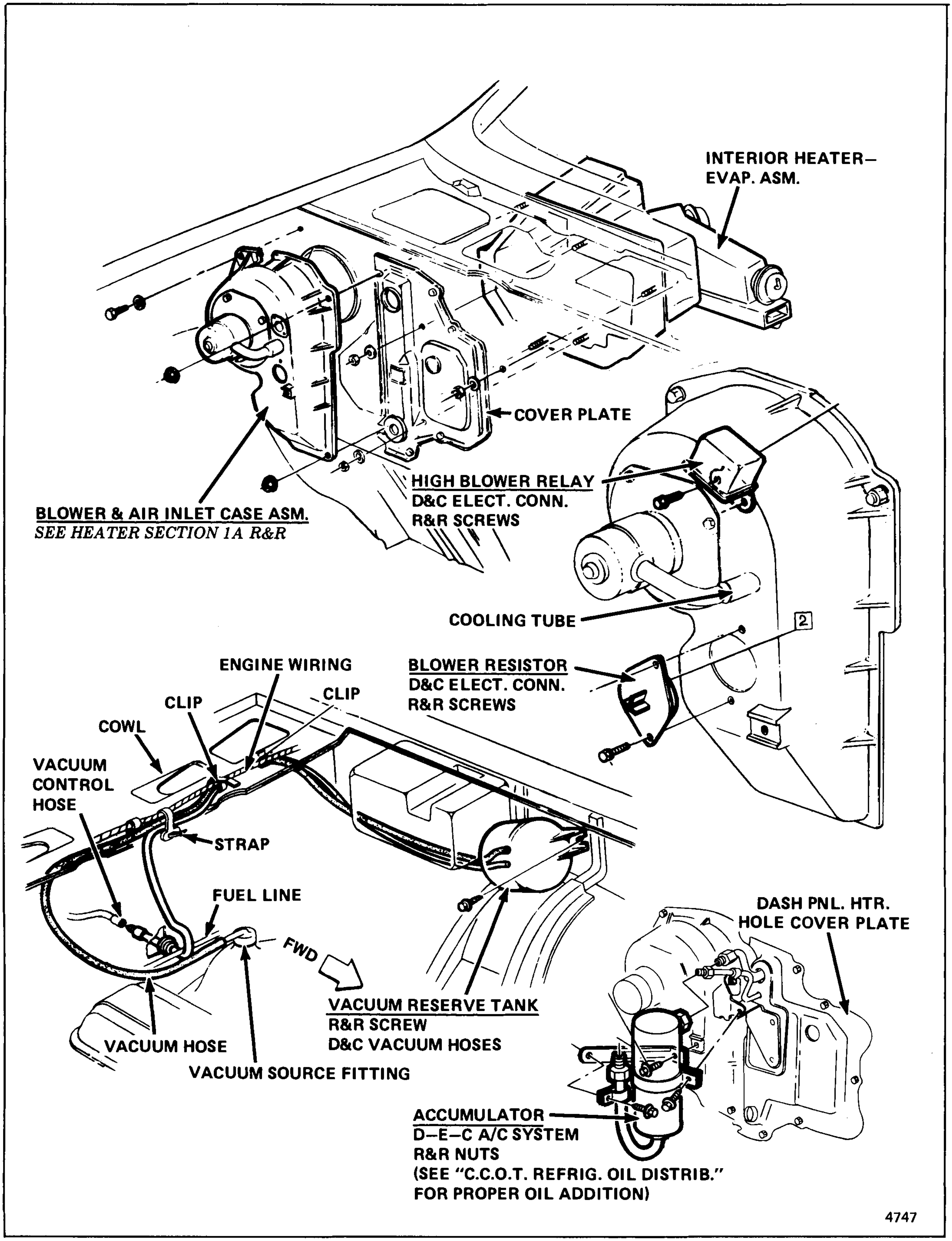


Fig. 1B-166 1977 Sunbird Series A/C Exterior Service Procedures (No. 1 of 3)

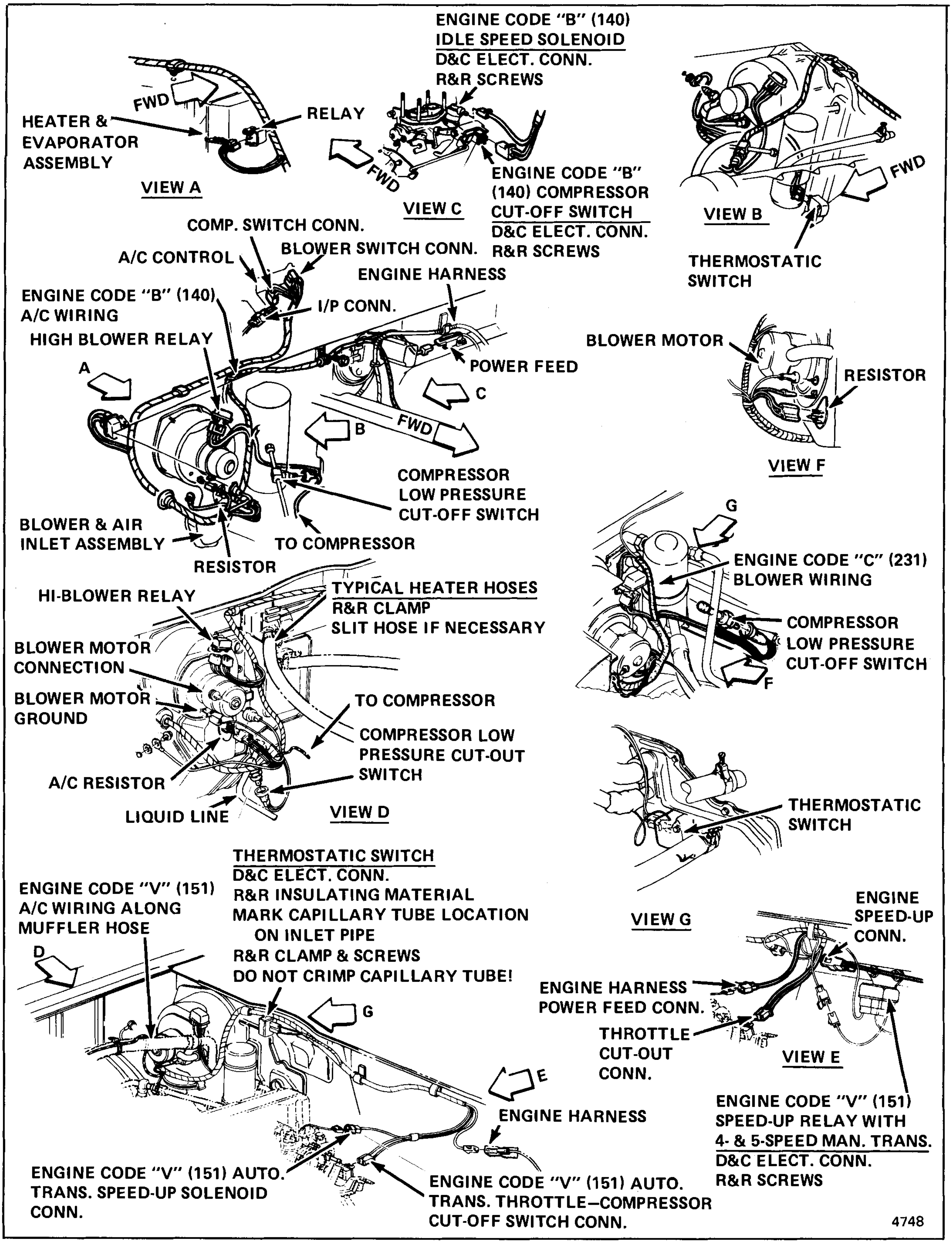
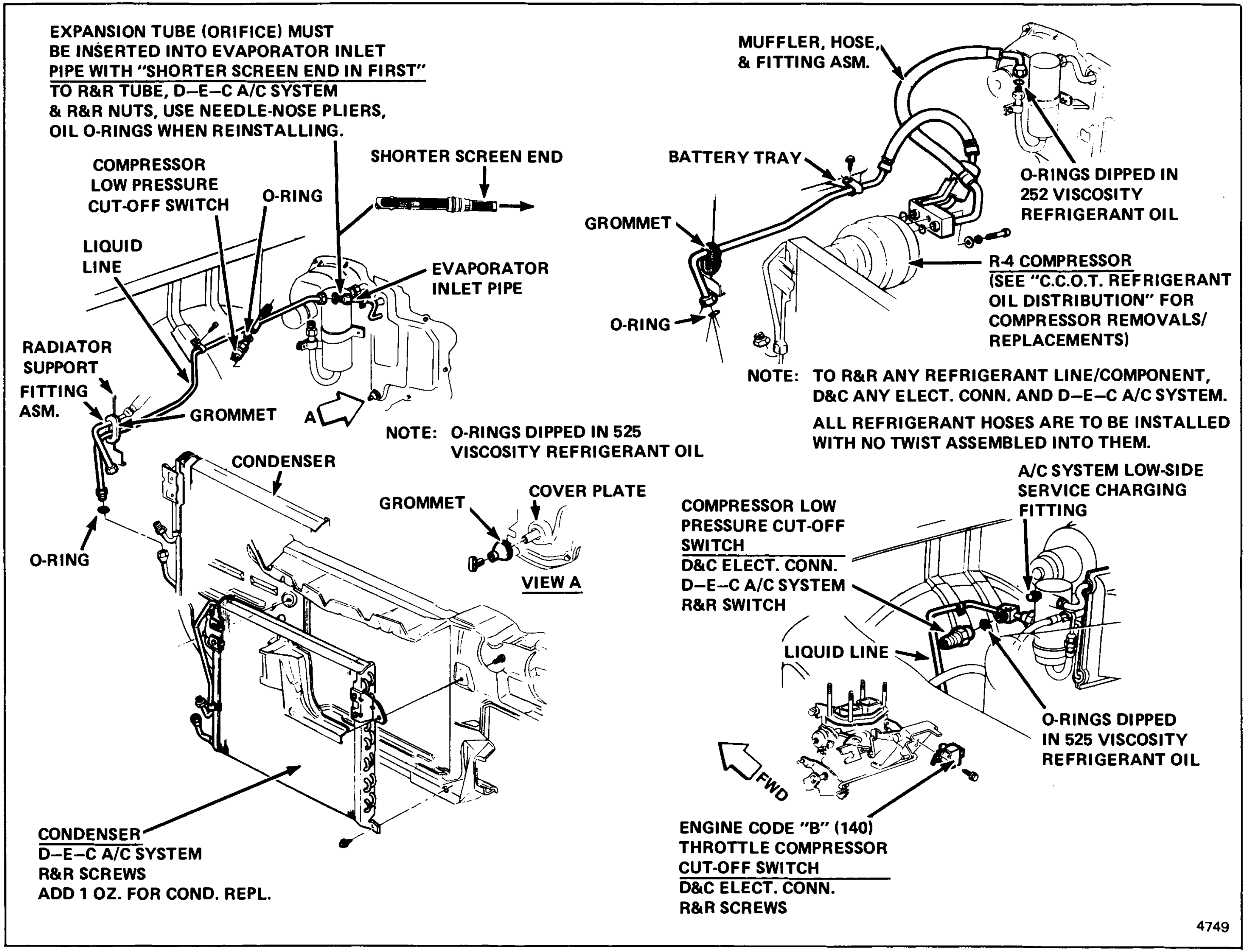


Fig. 1B-167 1977 Sunbird Series A/C Exterior Service Procedures (No. 2 of 3)



EXPANSION TUBE (ORIFICE) MUST BE INSERTED INTO EVAPORATOR INLET PIPE WITH "SHORTER SCREEN END IN FIRST"
TO R&R TUBE, D–E–C A/C SYSTEM & R&R NUTS, USE NEEDLE-NOSE PLIERS, OIL O-RINGS WHEN REINSTALLING.

NOTE: O-RINGS DIPPED IN 525 VISCOSITY REFRIGERANT OIL

NOTE: TO R&R ANY REFRIGERANT LINE/COMPONENT, D&C ANY ELECT. CONN. AND D–E–C A/C SYSTEM.
ALL REFRIGERANT HOSES ARE TO BE INSTALLED WITH NO TWIST ASSEMBLED INTO THEM.

R-4 COMPRESSOR
(SEE "C.C.O.T. REFRIGERANT OIL DISTRIBUTION" FOR COMPRESSOR REMOVALS/REPLACEMENTS)

CONDENSER
D–E–C A/C SYSTEM
R&R SCREWS
ADD 1 OZ. FOR COND. REPL.

COMPRESSOR LOW PRESSURE CUT-OFF SWITCH
D&C ELECT. CONN.
D–E–C A/C SYSTEM
R&R SWITCH

ENGINE CODE "B" (140) THROTTLE COMPRESSOR CUT-OFF SWITCH
D&C ELECT. CONN.
R&R SCREWS

Fig. 1B-168 1977 Sunbird Series A/C Exterior Service Procedures (No. 3 of 3)

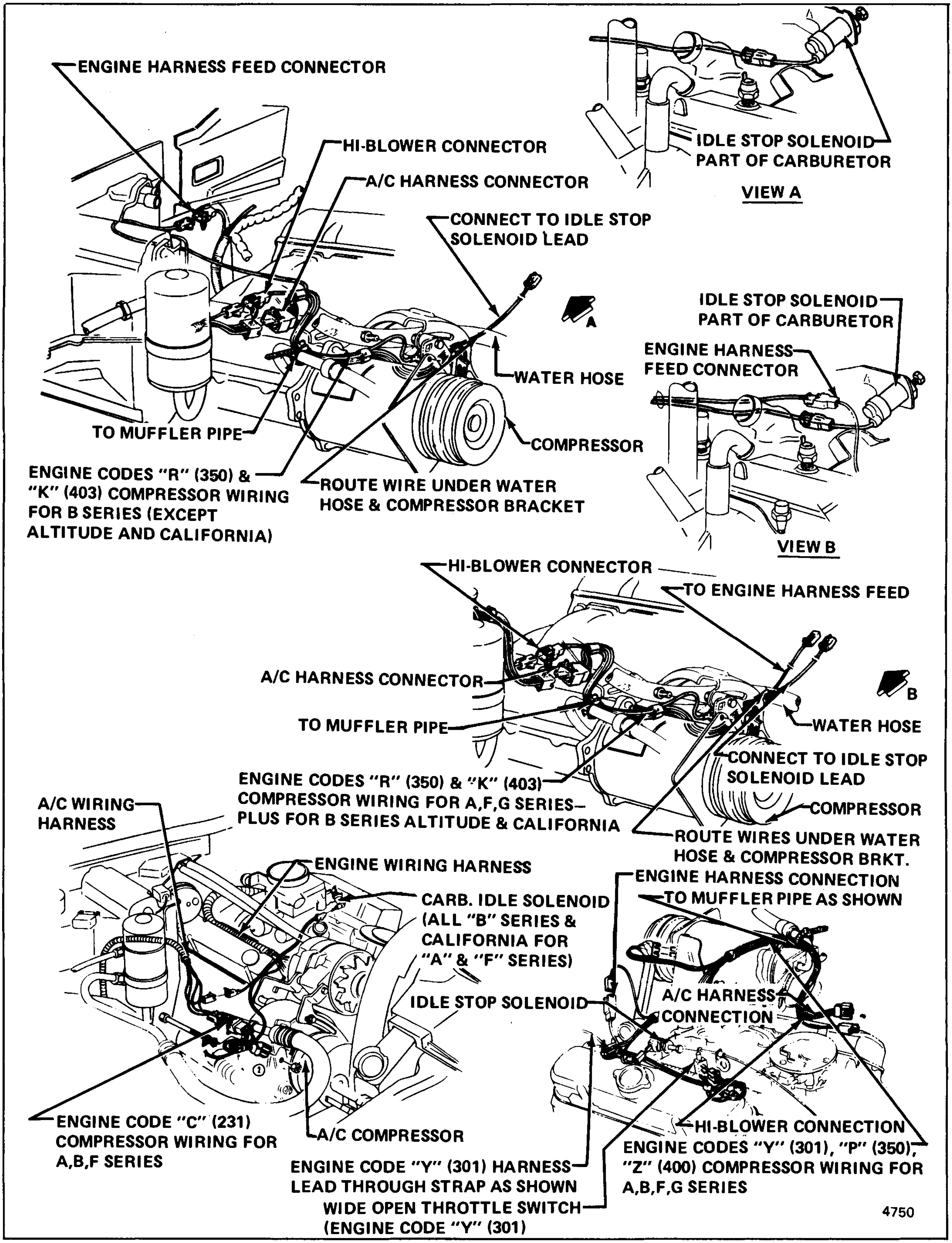


Fig. 1B-169 1977 A, B, F, G Series Compressor Wiring

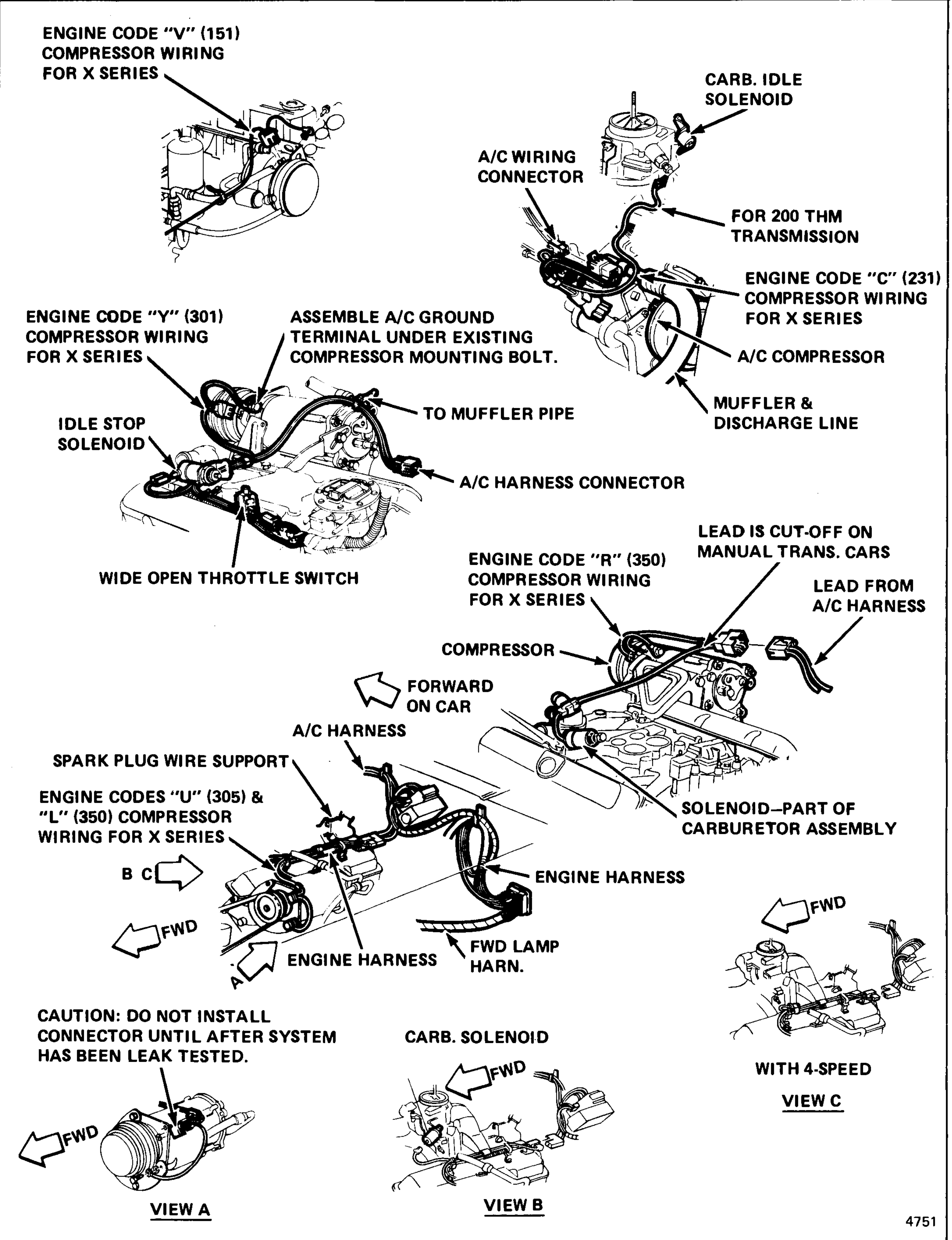


Fig. 1B-170 1977 X Series Compressor Wiring

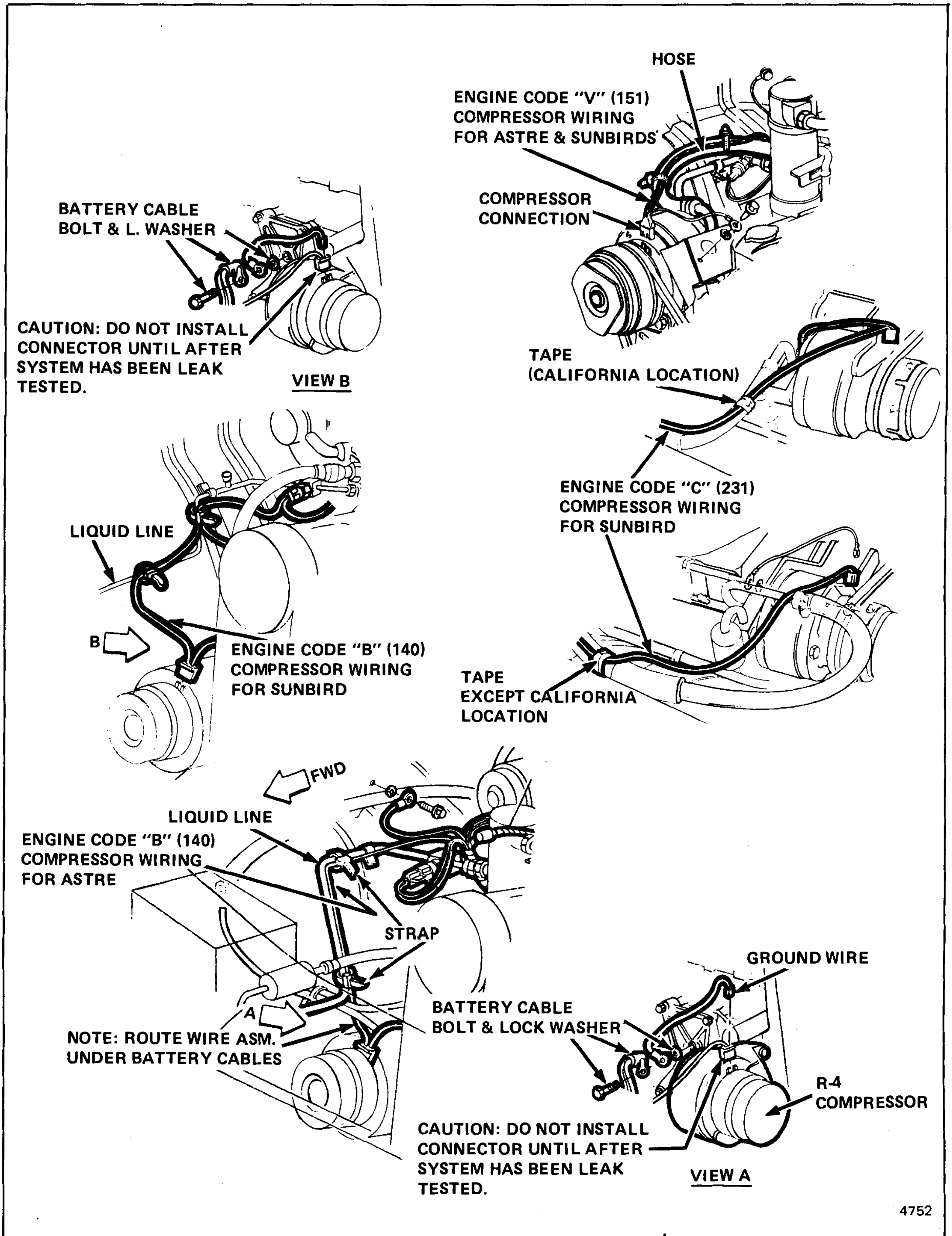


Fig. 1B-171 1977 Astre & Sunbird Compressor Wiring

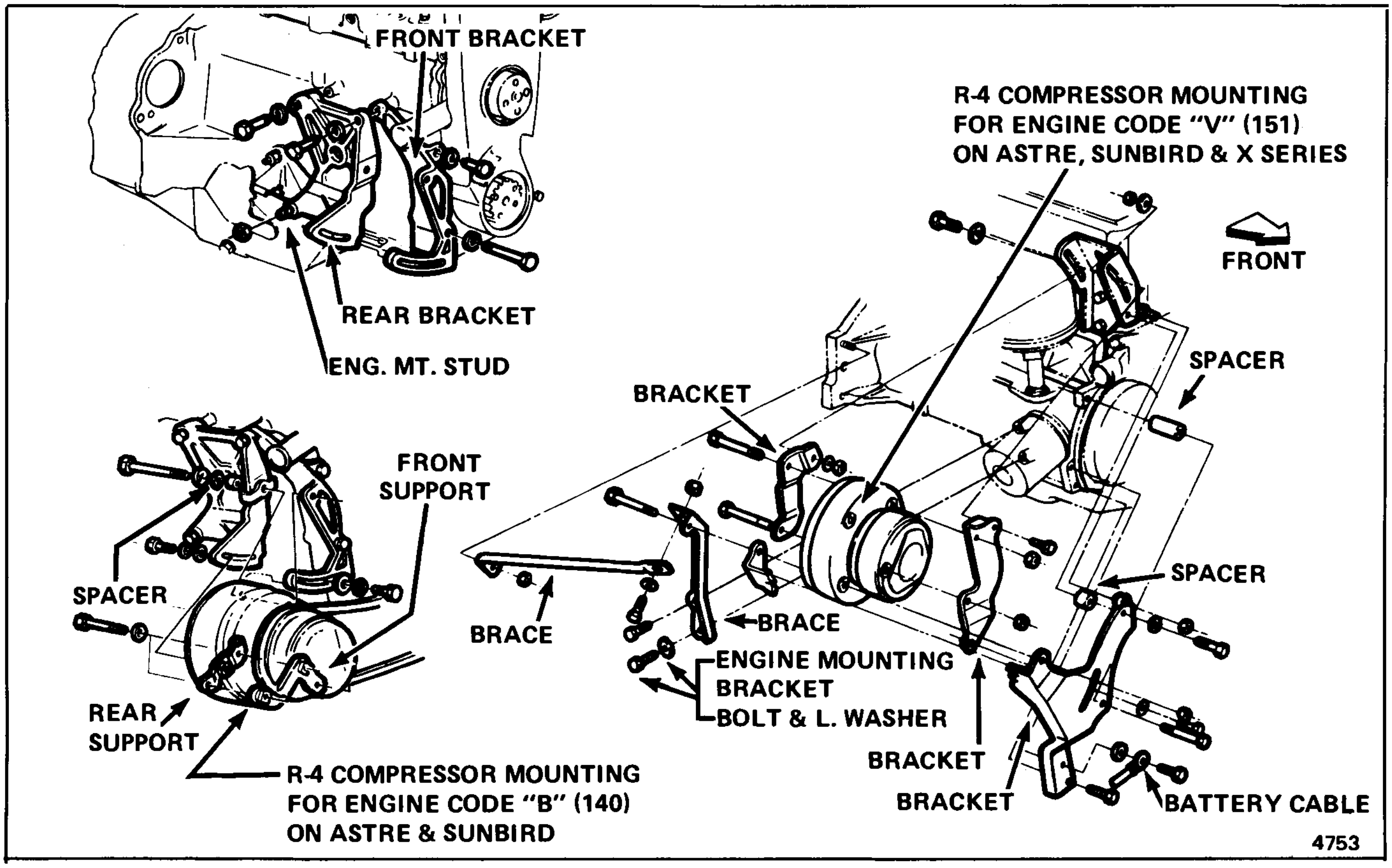


Fig. 1B-172 1977 Compressor Mounting No. 1 of 4 (Engine Codes B-140 and V-151)

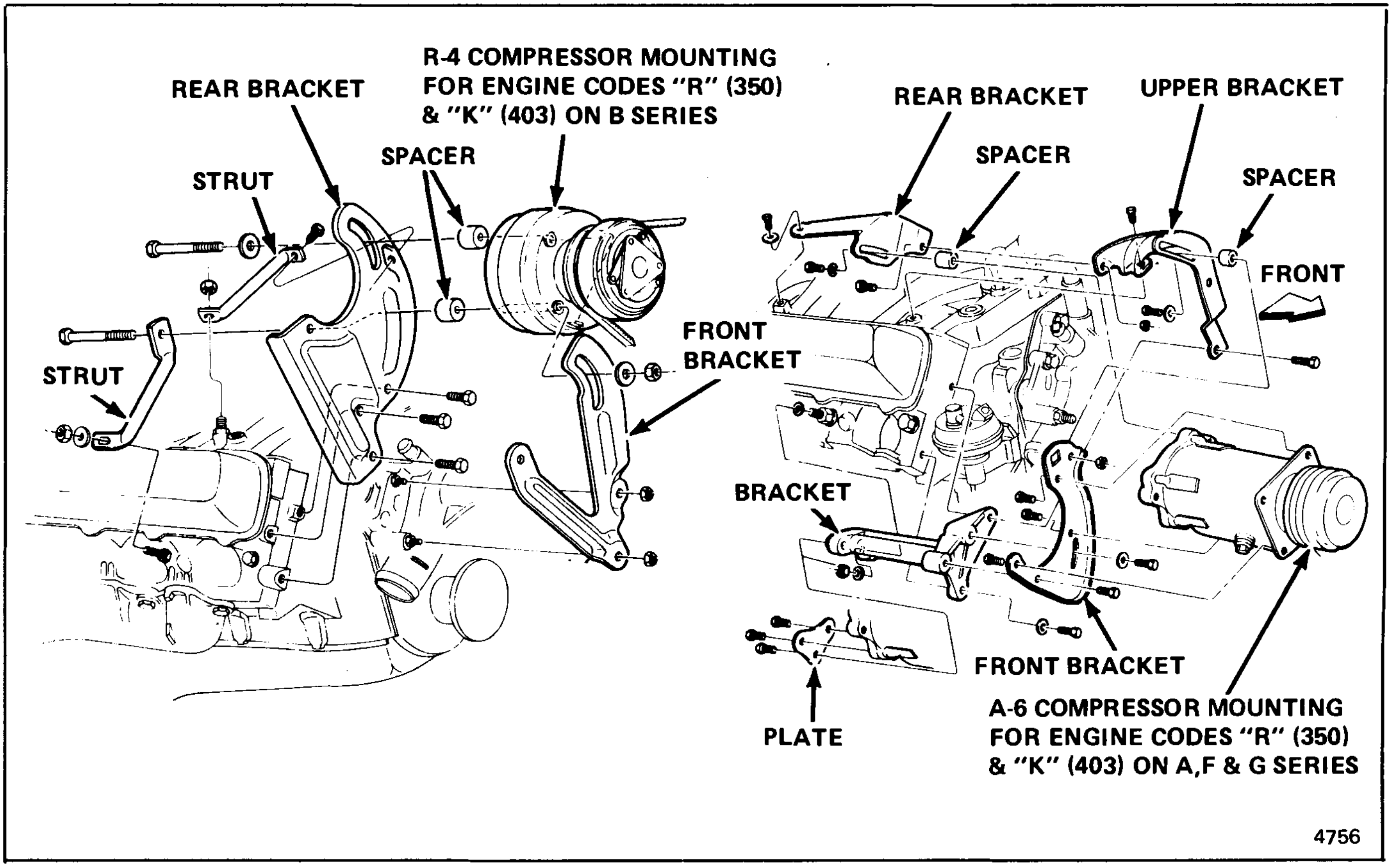


Fig. 1B-173 1977 Compressor Mounting No. 2 of 4 (Engine Codes R-350 and K-403)

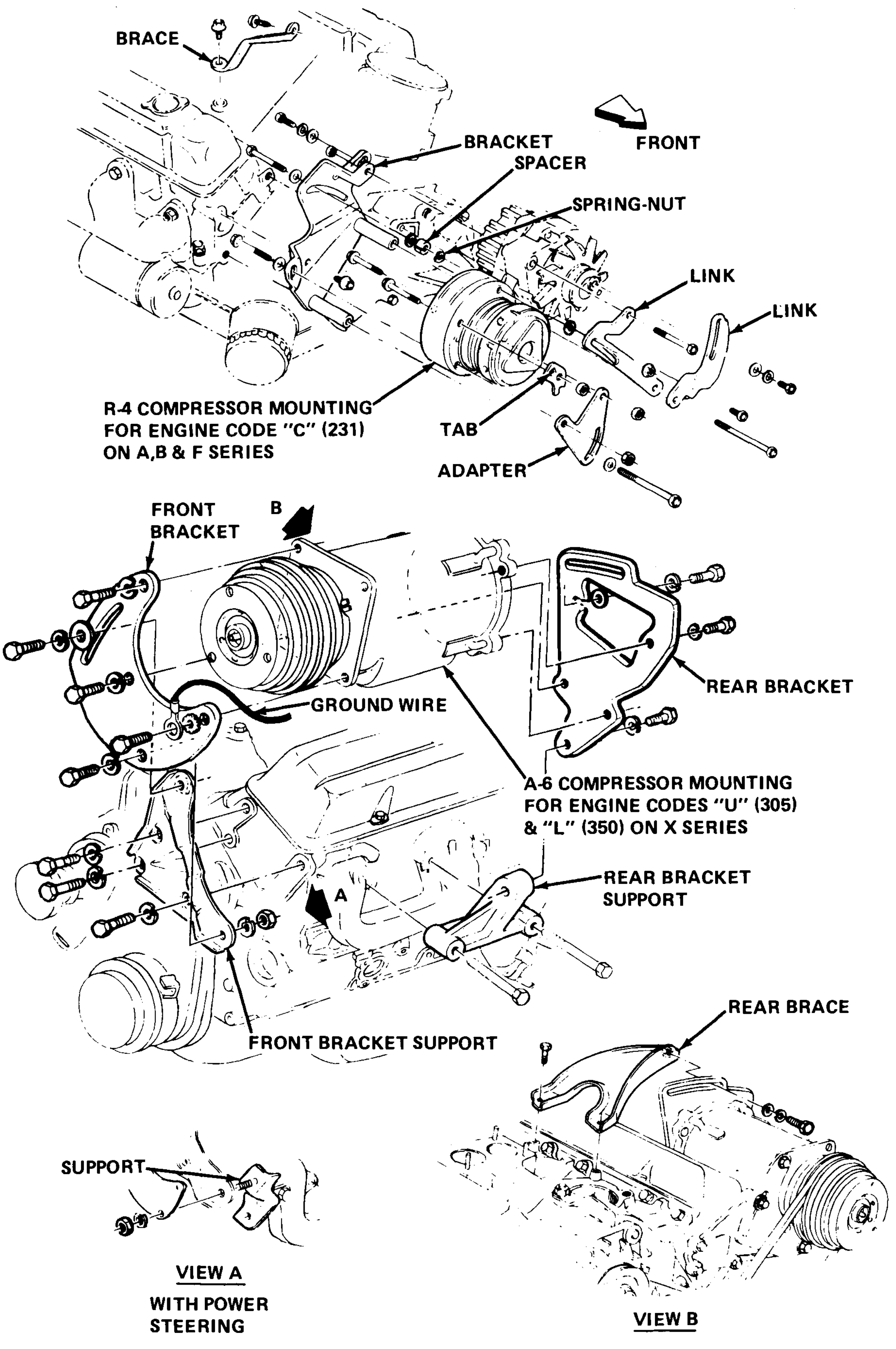


Fig. 1B-173 1977 Compressor Mounting No. 3 of 4 (Engine Codes C-231, U-305 and L-350)

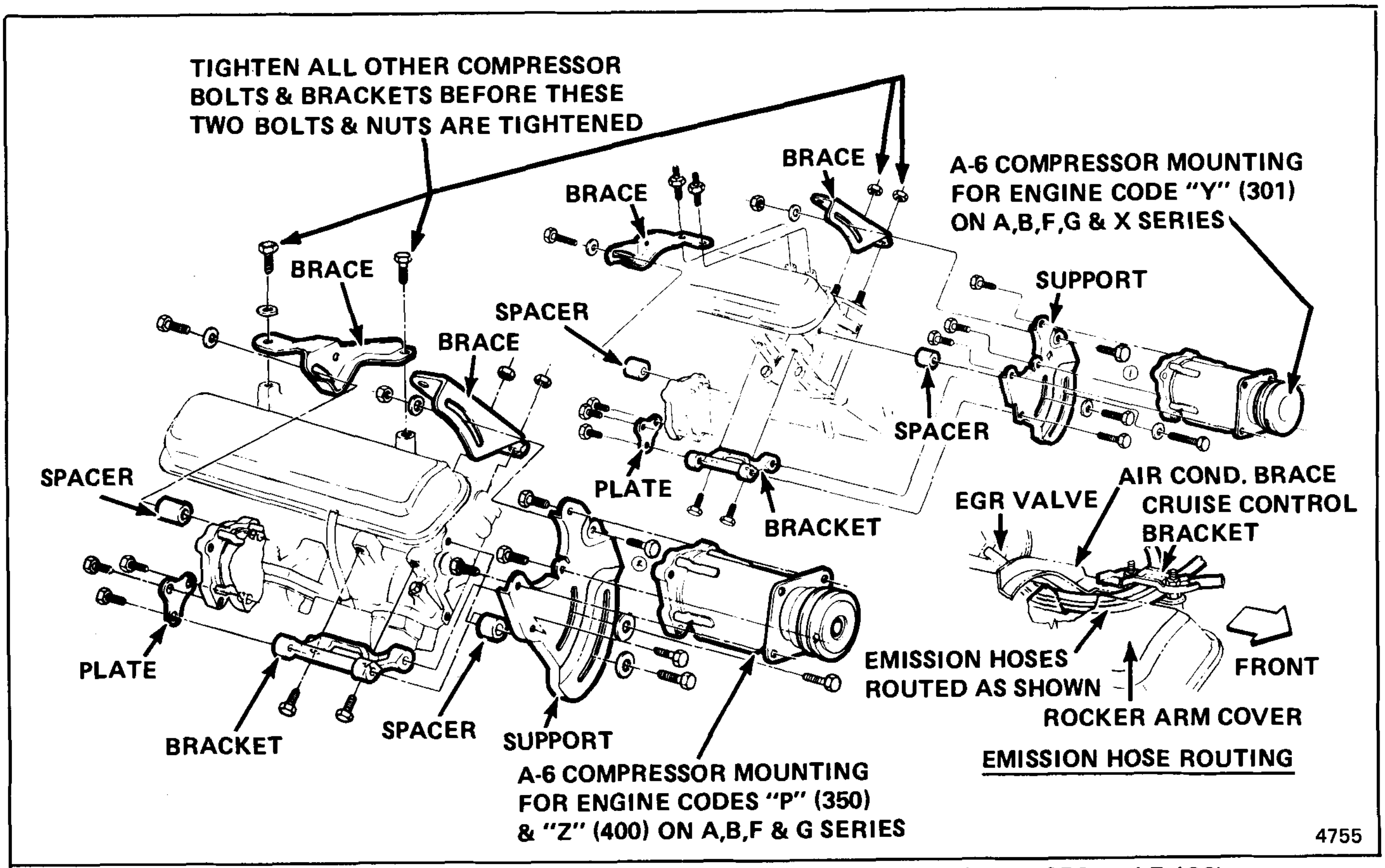
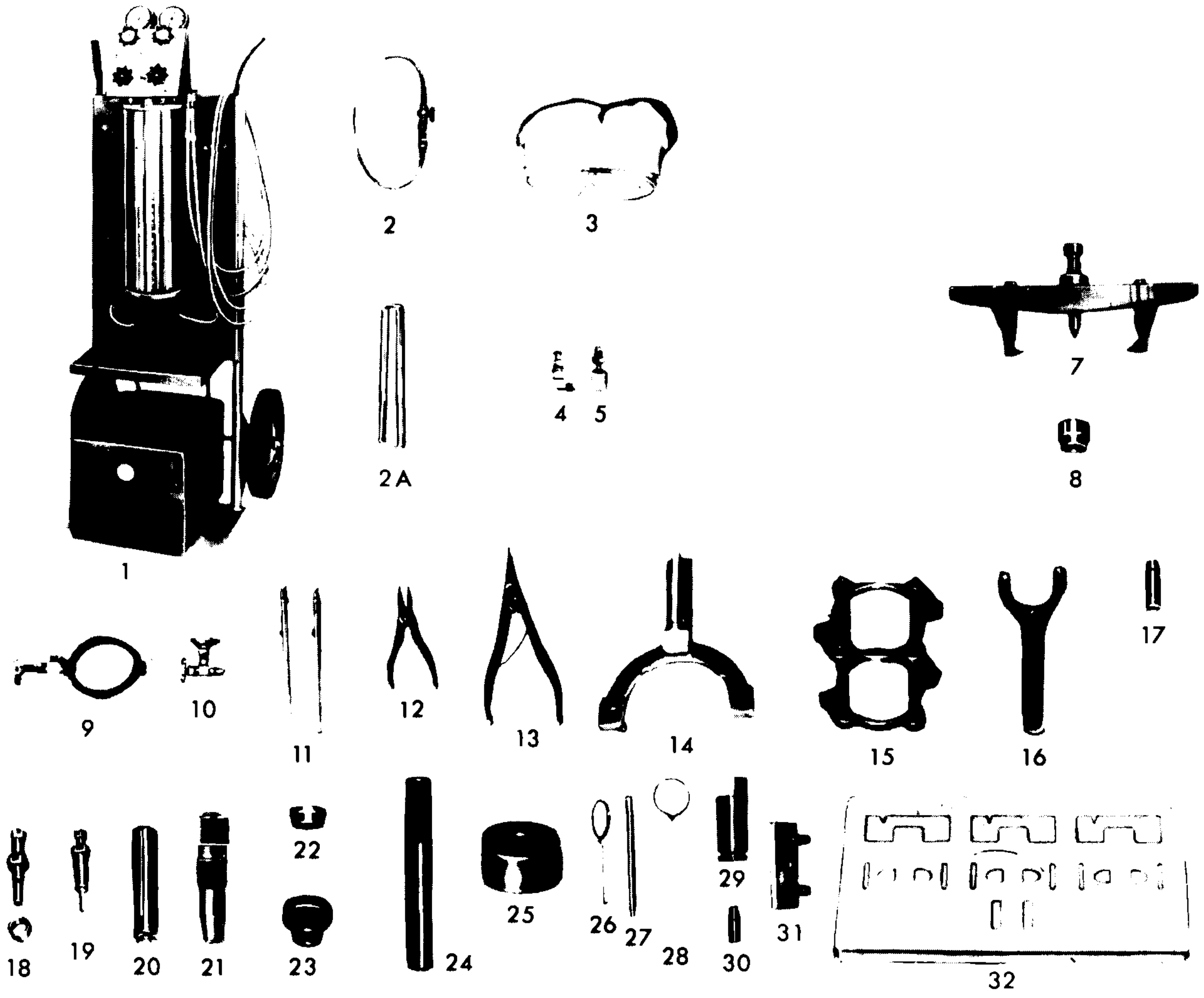


Fig. 1B-175 1977 Compressor Mounting No. 4 of 4 (Engine Codes Y-301, P-350 and Z-400)



1.	J 23500	Charging Station
2.	J 24095	Oil Inducer
2A.	J 9393	Super Heat Switch Remover
3.	J 5453	Goggles
4.	J 9459 — 7/16"–20 J 25499 — 3/8"–24	90° Gauge Line Adapter
5.	J 5420 — 7/16"–20 J 25498 — 3/8"–24	Straight Gauge Line Adapter
7.	J 8433	Puller
8.	J 9395	Puller Pilot
9.	J 23595	Refrigerant Can Valve (Side-Tap)
10.	J 6271-01	Refrigerant Can Valve (Top-Tap)
11.	J 5421-02	Pocket Thermometers (2)
12.	J 5403	No. 21 Snap Ring Pliers
13.	J 6435	No. 26 Snap Ring Pliers
14.	J 9396	Compressor Holding Fixture
15.	J 9397	Compressing Fixture
16.	J 25030	Clutch Hub Holding Tool
17.	J 9399	9/16" Thin Wall Socket
18.	J 9401	Hub and Drive Plate Assembly Remover
19.	J 9480-01	Hub and Drive Plate Assembly Installer
20.	J 9392	Seal Remover
21.	J 23128	Seal Seat Remover
22.	J 9398	Pulley Bearing Remover
23.	J 9481	Pulley and Bearing Installer
24.	J 8092	Handle
25.	J 21352	Internal Assembly Support Block
26.	J 5139	Oil Pickup Tube Remover
27.	J 9432	Needle Bearing Installer
28.	J 9553-01	Seal Seat "O" Ring Remover
29.	J 21508	Seal Seat "O" Ring Installer
30.	J 22974	Shaft Seal Protector
31.	J 9625	Pressure Test Connector
32.	J 9402	Parts Tray

0957

Fig. 1B-176 1977 A/C Special Tools

SECTION 1C

AUTOMATIC TEMPERATURE CONTROL

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

This section pertains to only the vacuum operated Automatic Temperature Control (C65) of the air conditioning system (Fig. 1C-1 and Fig. 1C-2). All other information is common to the manually controlled (C60) Custom A/C system in your car described in Section 1B.

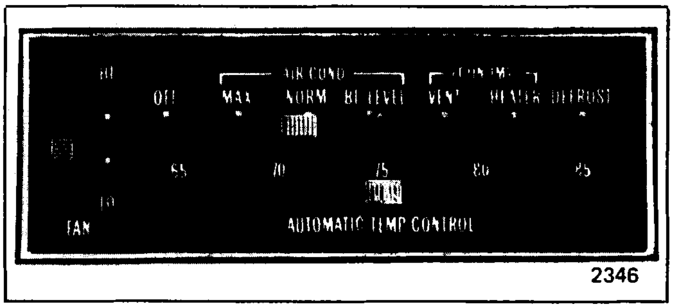


Fig. 1C-1 A and G Series C65 Control

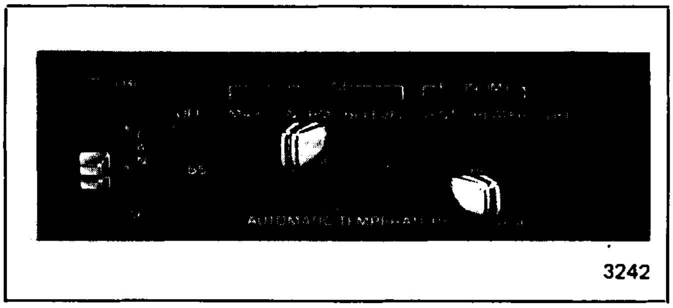


Fig. 1C-2 B Series C65 Control

C65 Automatic Temperature Control wiring diagrams are common with those found in the C60 Section 1B. Vacuum diagrams for C65 are illustrated in Figures 1C-3 and 1C-4.

DIAGNOSIS

C65 FUNCTIONAL TEST (B SERIES)

(FOR A & G SERIES, SEE C60 TEST IN SECTION 1B)

Prior to test initiation, the engine should idle off fast idle speed cam for about 20 minutes with the A/C Control blower control speed switch set to HI blower, the temperature lever at 65 ref., the mode lever in the NORM position and the vehicle doors closed for interior stabilization. Ambient temperature should be about 75°F. (24°C). Control lever efforts must be checked. These efforts should not be too low (below 2 lb. using pull-scale) or too high (about 6.5 lb.) or repair/adjustments then be made.

1. Slide mode lever to OFF. Set blower switch to HI and leave the temperature lever in the 65 reference position.

- Blower air at least the temperature of air outside the vehicle will be discharged from the heater outlet. The blower will run on LO speed only. The compressor is not running.

2. Slide the mode lever to NORM. Note the detent at each mode position and insure the lever efforts are within requirements above.

- Blower air increases to HI speed and exits from the A/C outlets. The compressor comes "on" and may cycle off-and-on. Air temperature is cooled from Step 1.

3. Slide the mode lever to BI-LEVEL.

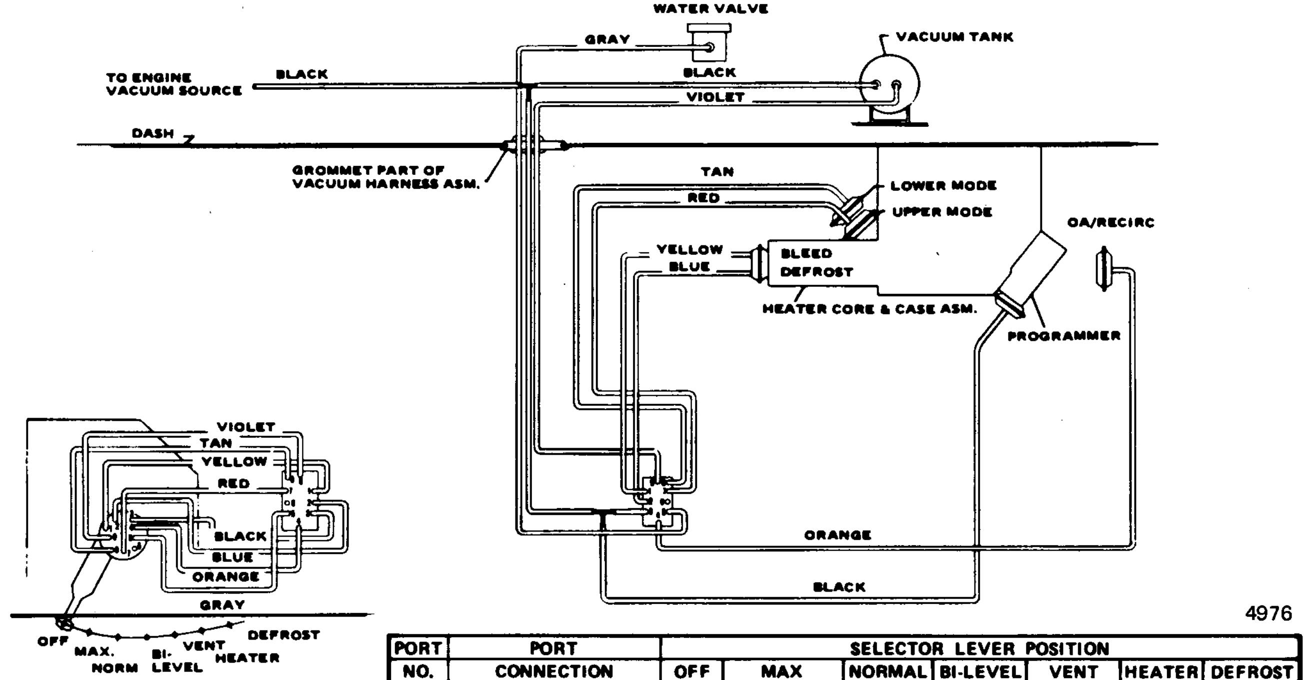
- Air exits from the A/C outlets and the heater outlet. The air speed from the A/C outlets decreases some from Step 2. The compressor comes "on" and may cycle off-and-on.

4. Slide the mode lever to VENT.

- Air exits from the A/C outlets only. The air speed should be HI (comparable to Step 2). The compressor is not running. Air temperature is warmed from Step 2 and is at least the temperature of air outside the vehicle.

5. Slide the mode lever to HEATER.

- Air exits mainly from the heater outlet with some air from the defroster nozzle. The compressor is not running. Air temperature should be at least the temperature of air outside the vehicle. Blower speed should still be HI.



PORT NO.	PORT CONNECTION	OFF	MAX	NORMAL	BI-LEVEL	VENT	HEATER	DEFROST
		SELECTOR LEVER POSITION						
1	BLEED	VENT	VENT	VENT	PORT 3	PORT 3	PORT 3	PORT 3
2	DEFROST	VENT	VENT	VENT	VENT	VENT	VENT	PORT 9
3	INPUT (UNCHECKED)	SEAL	SEAL	SEAL	PORT 1	PORT 1	PORT 1	PORT 1
4	OUTSIDE AIR (RECIRC)	VENT	PORT 5,7,8,9	VENT	VENT	VENT	VENT	VENT
5	WATER CONT. VALVE	VENT	PORT 4,7,8,9	VENT	VENT	VENT	VENT	VENT
6	(NOT USED							
7	UPPER MODE	VENT	PORT 4,5,8,9	PORT 8,9	VENT	PORT 8,9	VENT	VENT
8	LOWER MODE	VENT	PORT 4,5,7,9	PORT 7,9	PORT 9	PORT 7,9	VENT	VENT
9	INPUT (CHECKED)	SEAL	PORT 4,5,7,8	PORT 7,8	PORT 8	PORT 7,8	SEAL	PORT 2

Fig. 1C-3 A and G Series Vacuum Diagram

6. Slide the temperature lever from the 65 ref. setting to 85 ref. (far left to far right). Note the lever effort requirements above.

- The air temperature from the heater outlet should rise a noticeable amount, although it will not go over 115° F. (46°C.). Blower speed should still be HI.

7. Slide the mode lever to DEFROST.

- Air exits mainly from the defroster nozzle with some air from the heater outlet. The compressor comes "on" and may cycle off-and-on. Air temperature should be about 100°F. (37°C.) to 115°F. (46°C.). Blower speed should still be HI.

8. Move the blower switch to LO, pausing at each of the two intermediate positions.

- Blower speed and air flow should decrease as the switch lever is moved down through each position.

9. Slide the mode lever to MAX.

- Blower comes on HI speed. Air exits from the A/C outlets only. Air noise is heard from the right front corner of the passenger compartment as the system goes on "inside" air. The compressor comes "on" and may cycle off-and-on. Air temperature should be about 60°F. (16°C.) at the A/C outlets.

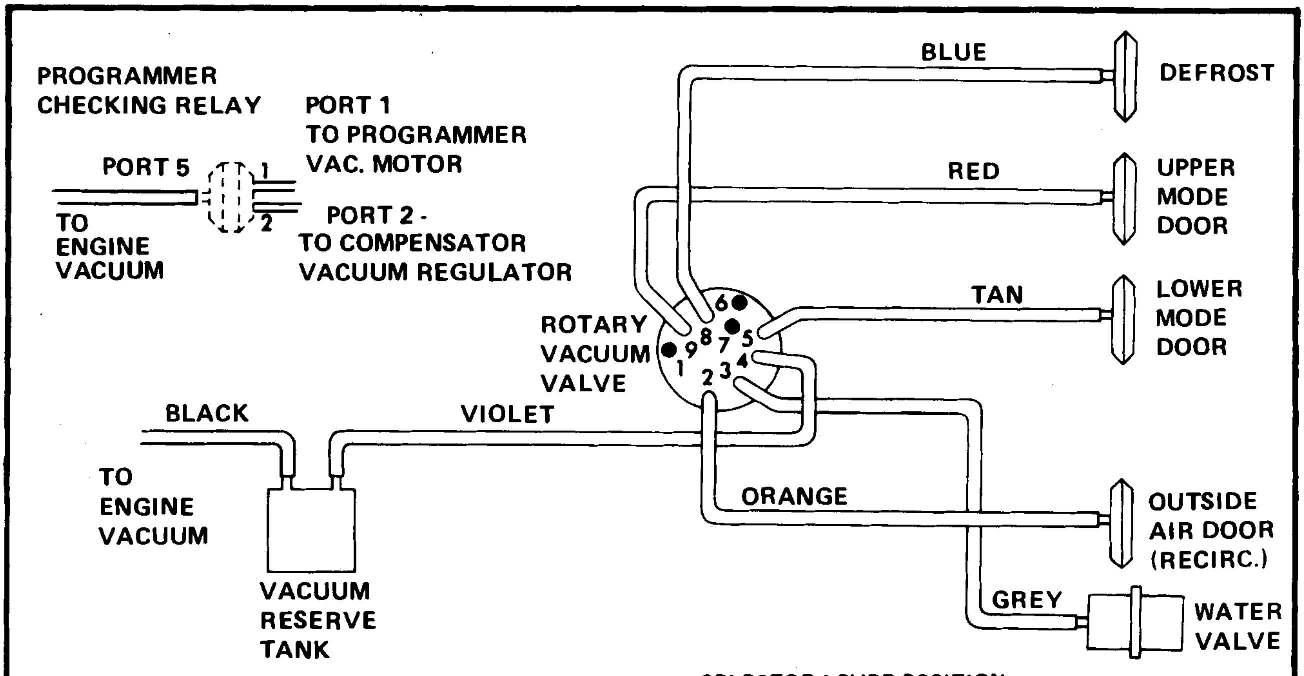
ON-CAR SERVICE PROCEDURE

C65 PROGRAMMER TEMPERATURE CABLE ADJUSTMENT

- Set and hold A/C Control temperature lever at the 75 reference point.
- Index holes in programmer control lever and programmer chassis should now be in alignment (see Fig. 1C-5).
- If holes do not align, check and correct cable routing if necessary.
- Make sure compensator link attaching nut is secure.
- If proper alignment is not found, bend programmer control lever with a screwdriver in provided slot to align holes (Fig. 1C-5).

C65 PROGRAMMER "REMOVAL-REPLACEMENT-ADJUSTMENT" PROCEDURE

- Remove glove compartment.
- Remove hush panel.
- Disconnect temperature cable, temperature door threaded operating rod, vacuum harness and sensor hose at programmer.



SELECTOR LEVER POSITION

PORT NO.	PORT	OFF	MAX	NORM	BI LEVEL	VENT	HEAT	DEFROST
1	NOT USED ••••••••••••							
2	OUTSIDE AIR (RECIRC)••		▨					
3	WATER CONTROL-VALVE		▨					
4	INPUT-CHECKED •••••••	▨	▨	▨	▨	▨	▨	▨
5	LOWER MODE DOOR ••••		▨	▨		▨		
6	NOT USED ••••••••••••							
7	NOT USED ••••••••••••							
8	DEFROSTER ••••••••••							▨
9	UPPER MODE DOOR ••••		▨	▨	▨	▨		

Fig. 1C-4 B Series Vacuum Diagram

- Remove programmer (3 screws).
- Re-install programmer.
- Connect sensor hose and vacuum harness.
- With outside vacuum source, apply 10"-12" vacuum to programmer motor input port (gives you "full heat" position). See Figure 1C-5.
- Pull temperature doors threaded operating rod toward yourself to hear door seating in "full" heat position.
- Snap temperture doors threaded operating rod into white nylon retainer on programmer output link. See Figure 1C-5 and 1C-6.
- Connect temperature cable at top of programmer control lever and snap-in the flag to module.
- Adjust temperature cable accord. to "C65 Programmer Temperature Cable Adjustment."
- Re-install hush panel and glove compartment.

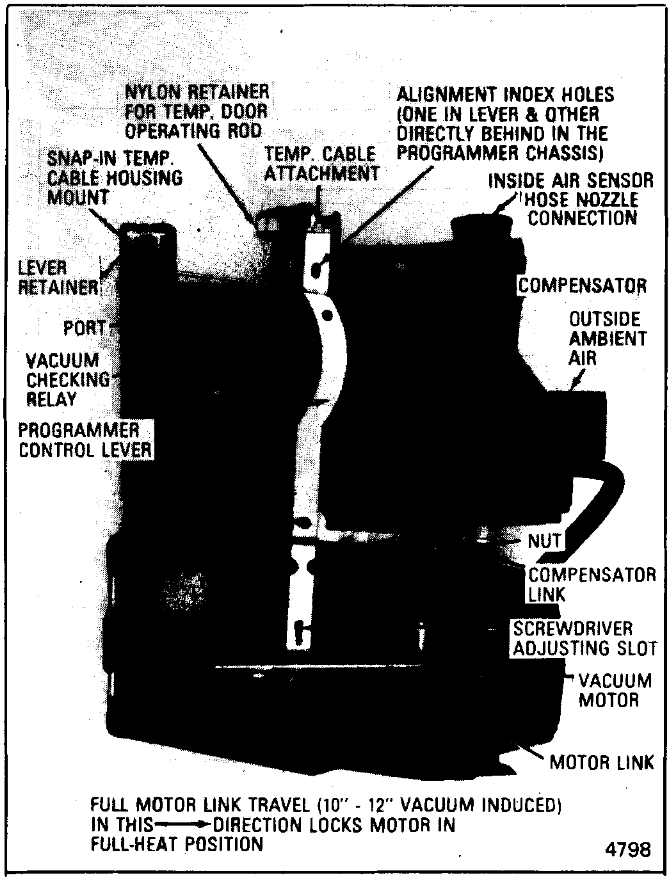


Fig. 1C-5 1977 B Series C65 Programmer-Front View

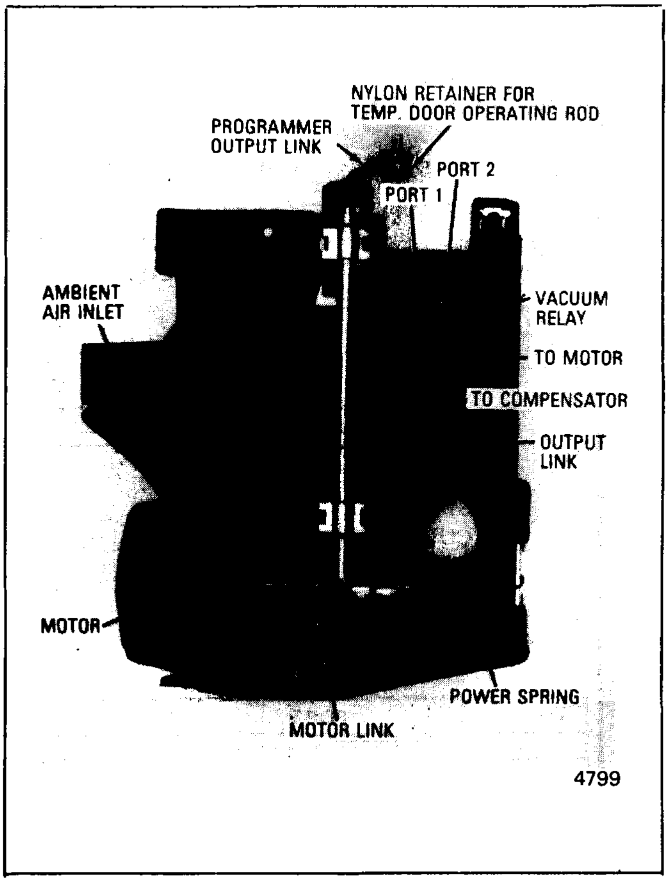


Fig. 1C-6 1977 B Series C65 Programmer-Rear View

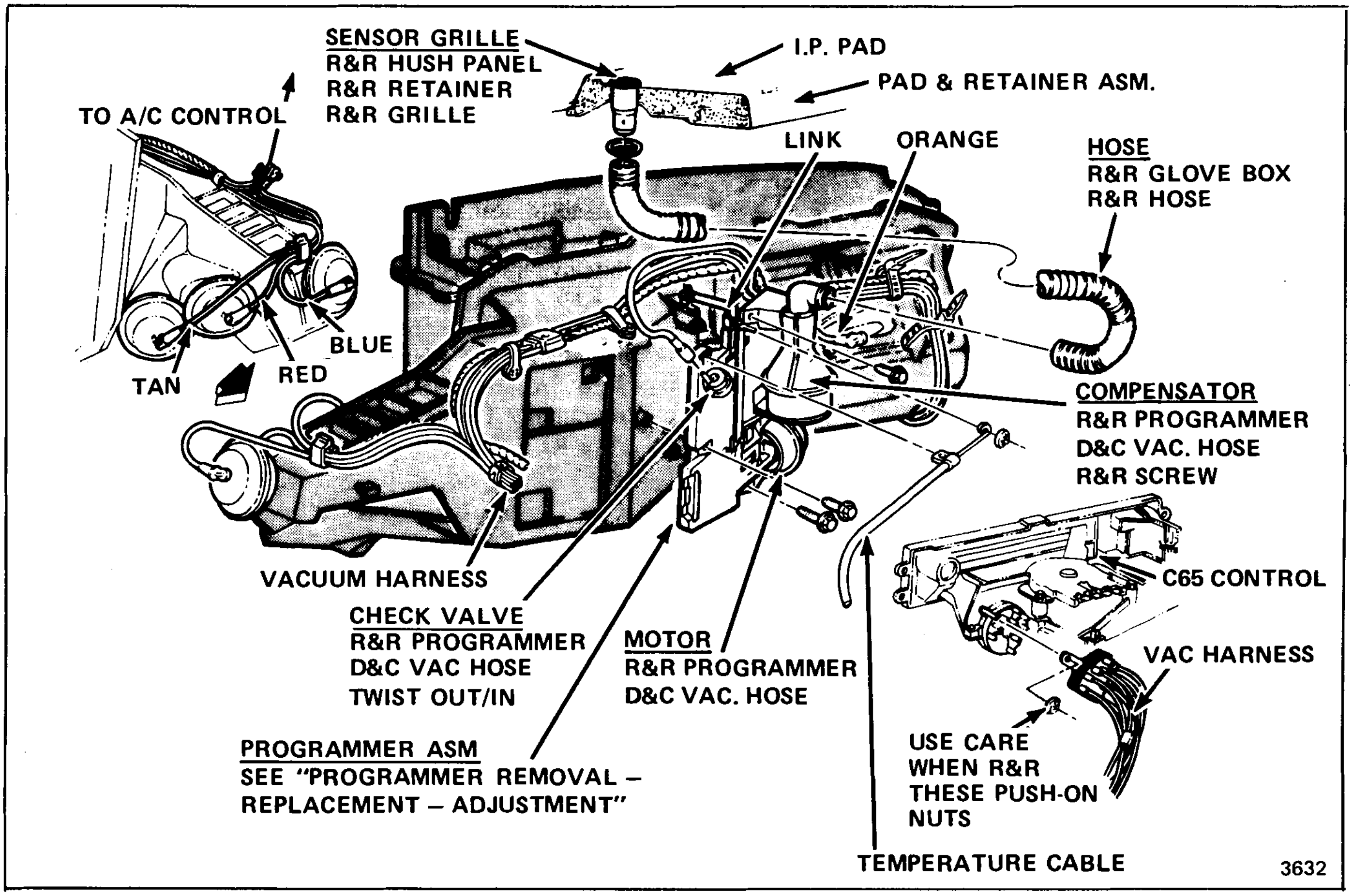
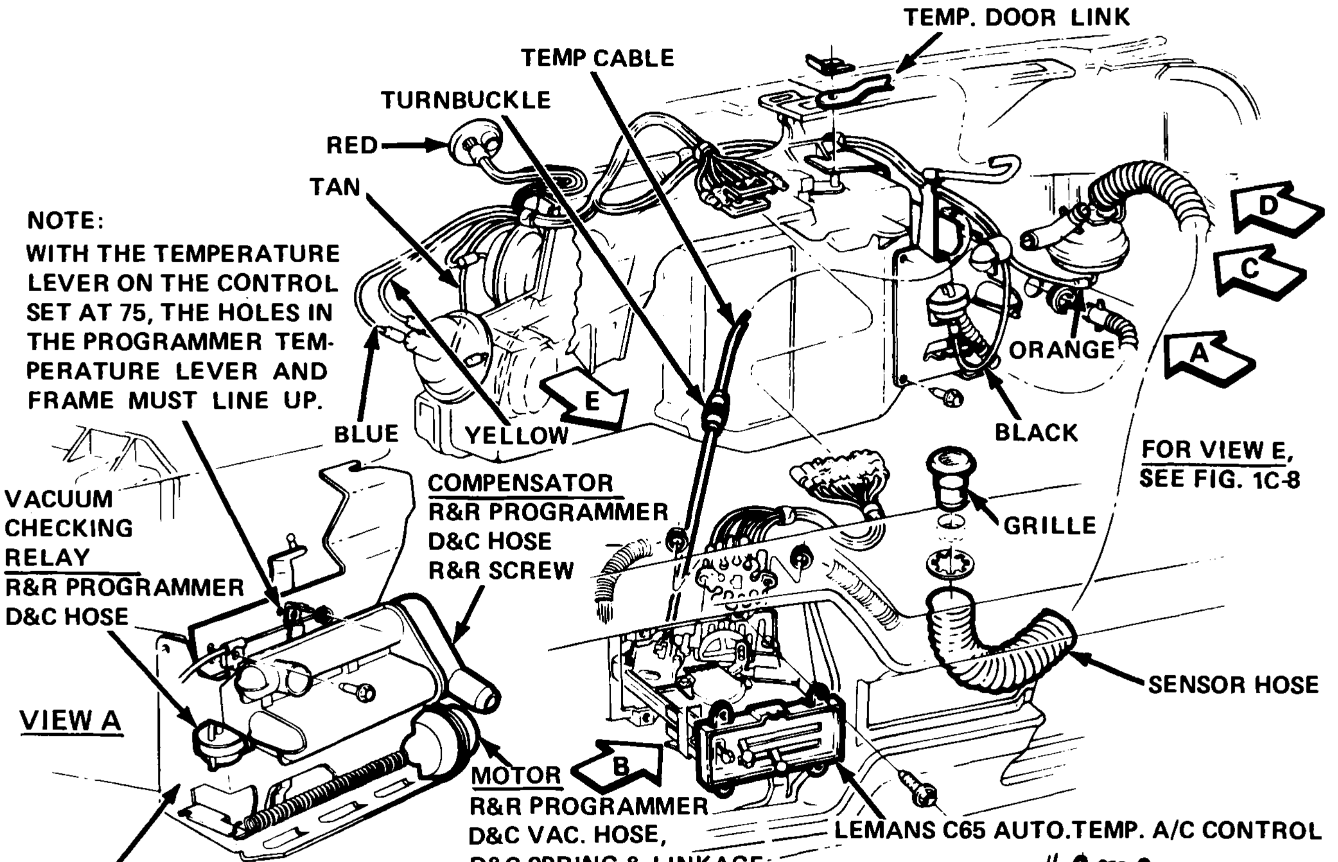
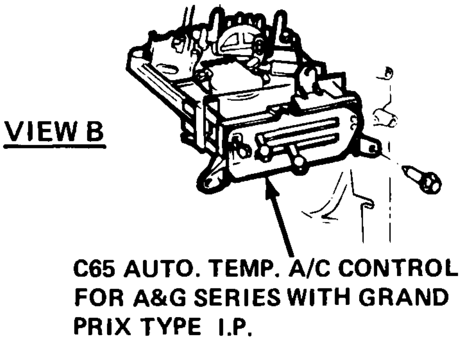


Fig. 1C-9 1977 B Series C65 Service Procedures

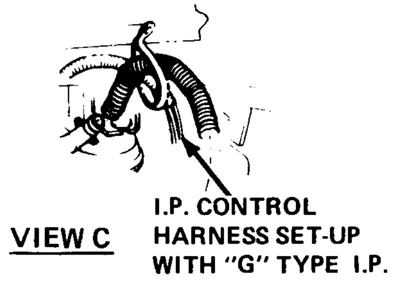


NOTE:
WITH THE TEMPERATURE LEVER ON THE CONTROL SET AT 75, THE HOLES IN THE PROGRAMMER TEMPERATURE LEVER AND FRAME MUST LINE UP.



TEMPERATURE CONTROL CABLE ADJUSTMENT

1. AFTER CONTROL END FLAG & EYELET HAVE BEEN SECURELY FASTENED. SECURELY ATTACH THE PROGRAMMER END FLAG.
2. WITH THE TEMPERATURE LEVER SET AT 75° ADJUST THE TURNBUCKLE UNTIL THE EYELET LINES UP WITH THE PIN (LEVER END) AT THE PROGRAMMER.
3. SLIP THE CABLE END OVER THE PIN AND PUSH THE TEMPERATURE LEVER TO 65° (LEFT END OF TRAVEL) TO RELEASE ASSEMBLY DETENT SPRING.



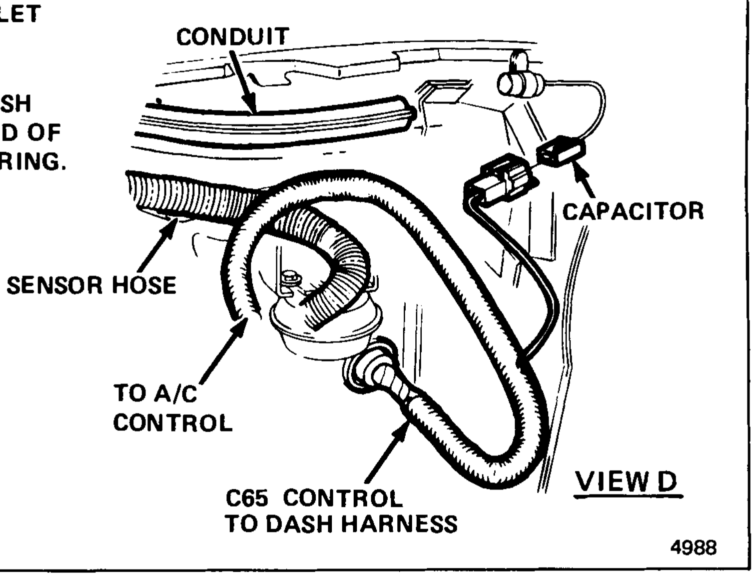


Fig. 1C-7 1977 A and G Series C65 Service Procedures (No. 1 of 2)

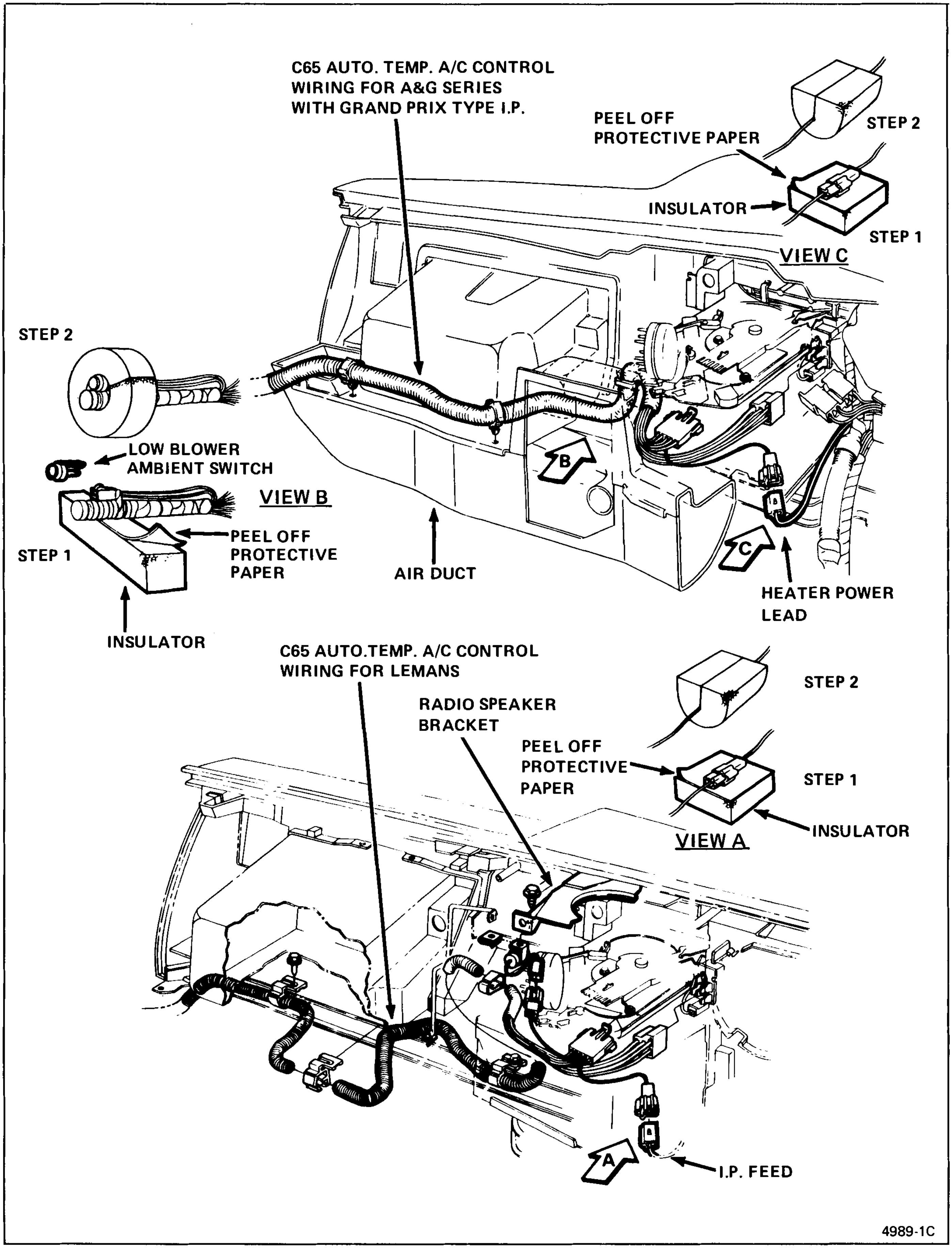


Fig. 1C-8 1977 A and G Series C65 Service Procedures—View "E" of Fig. 1C-7 (No. 2 of 2)

SECTION 2A

FRAME AND BODY MOUNTS

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

FRAME

Frames used on A, B and G Series are full frames and are basically the same, consisting of full length right and left side members joined laterally by crossmembers. Several different frames are used in each line to meet the various vehicle size and function requirements but the basic shape for each line remains the same. Differences between frames in a given line exists only in metal gauge, part size and numbers of parts necessary to meet the particular structural requirements of the models involved.

The H Series body is of unitized construction with integral front and rear frame side rails supporting the front end sheet metal, front and rear suspension systems and other mechanical components.

The F and X Series bodies are unitized construction but in addition, have a stub frame which supports the front end sheet metal, front suspension, engine and other mechanical components. Unitized construction demands that underbody components be properly aligned to assure correct suspension location. In the event of collision damage, it is important that the underbody be thoroughly checked, and, if necessary, realigned in order to accurately establish proper dimensions.

Since each individual underbody component contributes directly to the overall strength of the body, it is essential that proper welding, sealing and rust-proofing techniques be observed during service operations. The underbody components should be rust-proofed whenever body repair operations which destroy or damage the original rust-proofing are completed. When rust-proofing critical underbody components, it is essential that a good quality type of air dry primer be used (such as corrosion resistant zinc chromate). It is not advisable to use combination type primer-surfacers. There are many classifications of tools that may be employed to correct the average collision damage situation including frame straightening machines, lighter external pulling equipment and standard body jacks.

FRAME IDENTIFICATION

Frame identification tags are attached to one of the two locations shown in Fig. 2A-1.

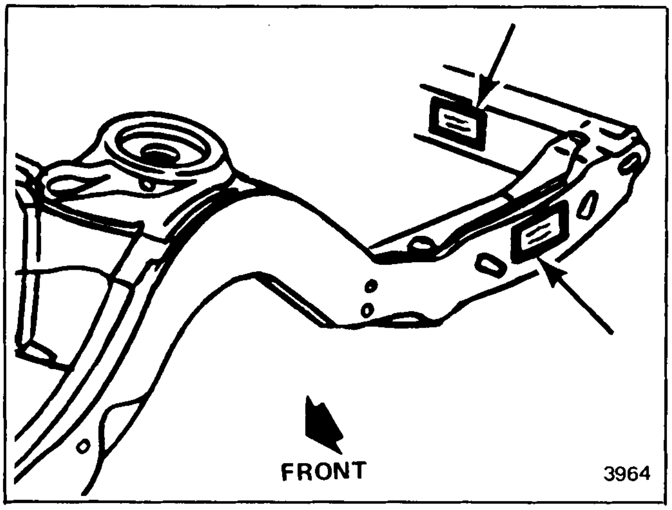


Fig. 2A-1 Frame Identification

ON CAR SERVICE

FRAME INSPECTION

1. Raise car on a hoist (preferably a twin-post type).
2. Check for obvious floor pan deterioration.
3. Check for loose dirt and rust around the inside of the frame rails, on top and at the ends where corrosion may exist in hidden areas. Check especially in the frame box sections for accumulation of debris.

UNDERBODY INSPECTION

1. Raise car on a hoist (preferably a twin-post type).
2. Check for obvious floor pan deterioration.
3. Check for loose dirt and rust around the inside of the floor pan reinforcement member access holes. This is the first indication that corrosion may exist in hidden areas, and that repairs may be required before the final cleaning and protective treatment is performed.
4. Using a chisel, ensure that the drain provisions in the floor pan reinforcement members are open. There are drain holes in the body side panels also. These holes can be opened by using a punch or drift. The side panel drain holes are in the rear section of the rocker panels, and in the lower rear quarter panels.

FRAME REPAIR

Frame Alignment

Vehicles involved in an accident of any nature which might result in a "bent" or "sprung" frame should always be checked for proper frame alignment in addition to steering geometry and wheel alignment. Fig. 2A-2 can be used to check the alignment of a frame that has been distorted. The reference points indicated are to be checked with a tram gauge. The dimensions between the various reference points will show where straightening operations are necessary. Corresponding measurements must be equal within 1/4 inch.

1. Measure X-X. If not equal, frame horn or front suspension crossmember is misaligned.
2. Measure Y-Y. If not equal, center portion of frame is misaligned.
3. Measure Z-Z. If not equal, rear end of frame is misaligned.

Tramming Sequence

When checking a frame for alignment in case of damage, the first step is horizontal "X" checking with a tram gauge as indicated above. Frame alignment checks on all models should be made with the tram gauge points set at the center of each locating point indicated and the cross bar level to insure accuracy.

If a tram gauge is not available, the "plumb bob" method of checking may be used. To assure any degree of accuracy when using this method, the car should be on a level floor.

By using this method, it is only necessary to have a piece of cord attached to an ordinary surveyor's plumb bob. When measuring the distance between two points, the free end of the cord should be placed on the reference point allowing the plumb bob to hang to the floor. A check mark should be made on the floor just under the tip of the plumb bob. This operation should then be repeated at all reference points. With these points located on the floor, they may be easily measured with a rule.

The second step is checking the vertical dimensions from the datum plane to the points to be trammed. With the proper settings, the tram bar will be on a plane parallel to that of the frame. The exception to this would be when one of the reference locations is included in the misaligned area; then the parallel plane between the frame and the tram bar may not prevail. After completion of the repairs, the tram gauge should be set at the specified dimension to check the accuracy of the repair operation.

Frame Dimensions

Frame dimensions for A, B and G Series are shown in Figs. 2A-3 and 2A-4.

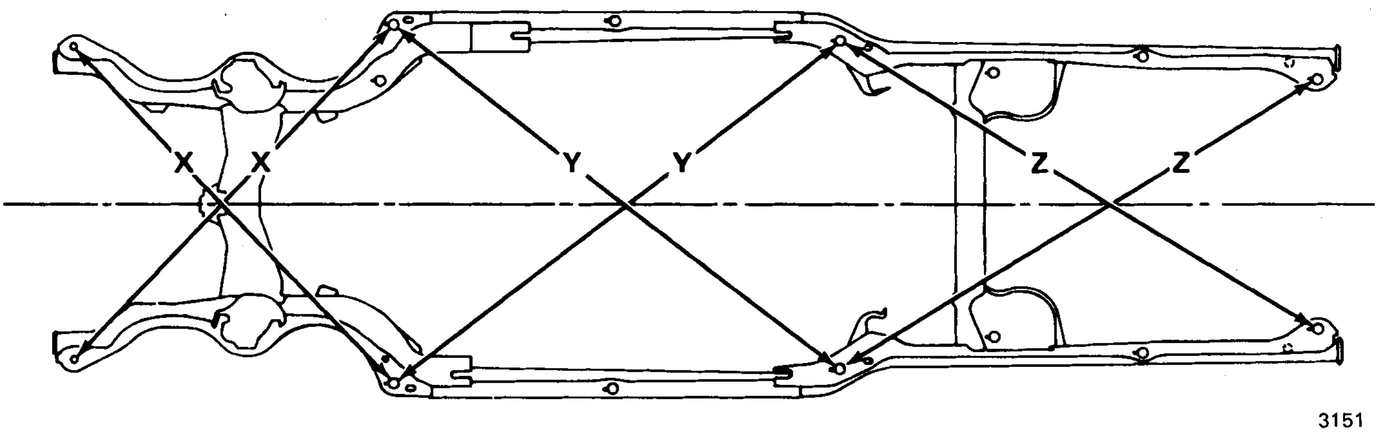
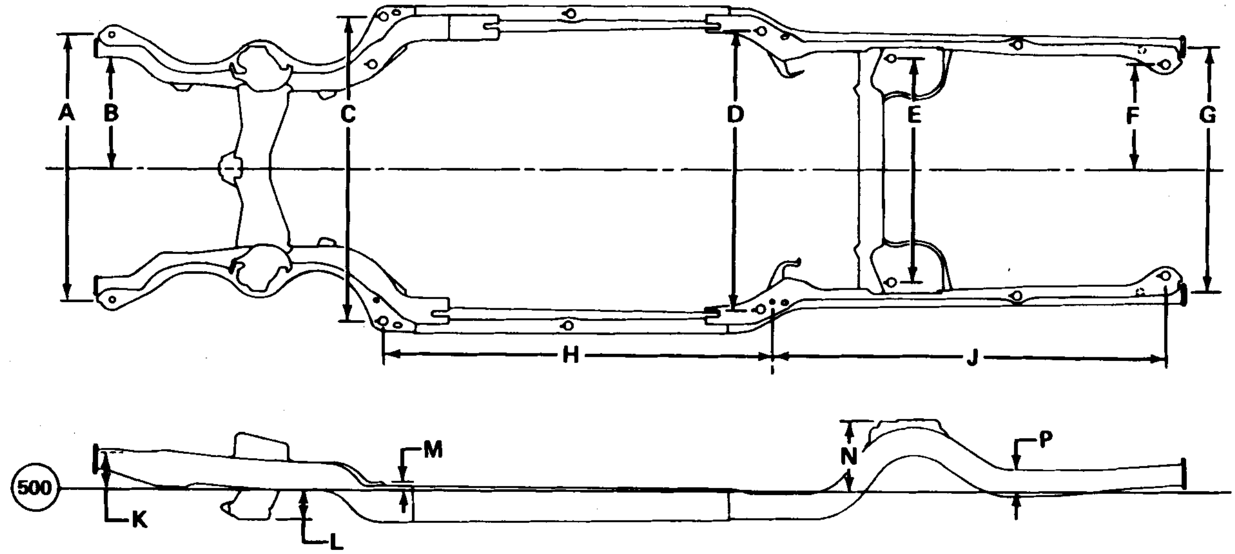


Fig. 2A-2 Typical Frame Alignment Checks



UPPER DIMENSIONS ARE IN MILLIMETRES
(LOWER DIMENSIONS ARE IN INCHES)

BODY STYLES	A	B	C	D	E	F	G	H	J	K	L	M	N	P
B SERIES EXCEPT STATION WAGON	1188.0 (46.77)	490.0 (19.29)	1364.0 (53.7)	1250.0 (49.21)	1002.0 (39.45)	472.0 (18.58)	1104.0 (43.46)	1726.5 (67.97)	1732.0 (68.19)	163.0 (6.42)	142.6 (5.61)	27.4 (1.08)	316.0 (12.44)	98.5 (3.88)
B SERIES STATION WAGON	1188.0 (46.77)	490.0 (19.29)	1364.0 (53.7)	1250.0 (49.21)	1080.0 (42.52)	500.0 (19.68)	1134.0 (44.65)	1726.5 (67.97)	1804.0 (71.02)	163.0 (6.42)	142.6 (5.61)	27.4 (1.08)	277.0 (10.9)	174.0 (6.85)

3150

Fig. 2A-3 B Series Frame Dimensions

BODY MOUNTS

The various types of body mounts and their application are shown in Figs. 2A-5 and 2A-6. Torque specifications are given in each illustration.

FRAME BRACES

For installation details of frame braces refer to Figs. 2A-7 through 2A-10.

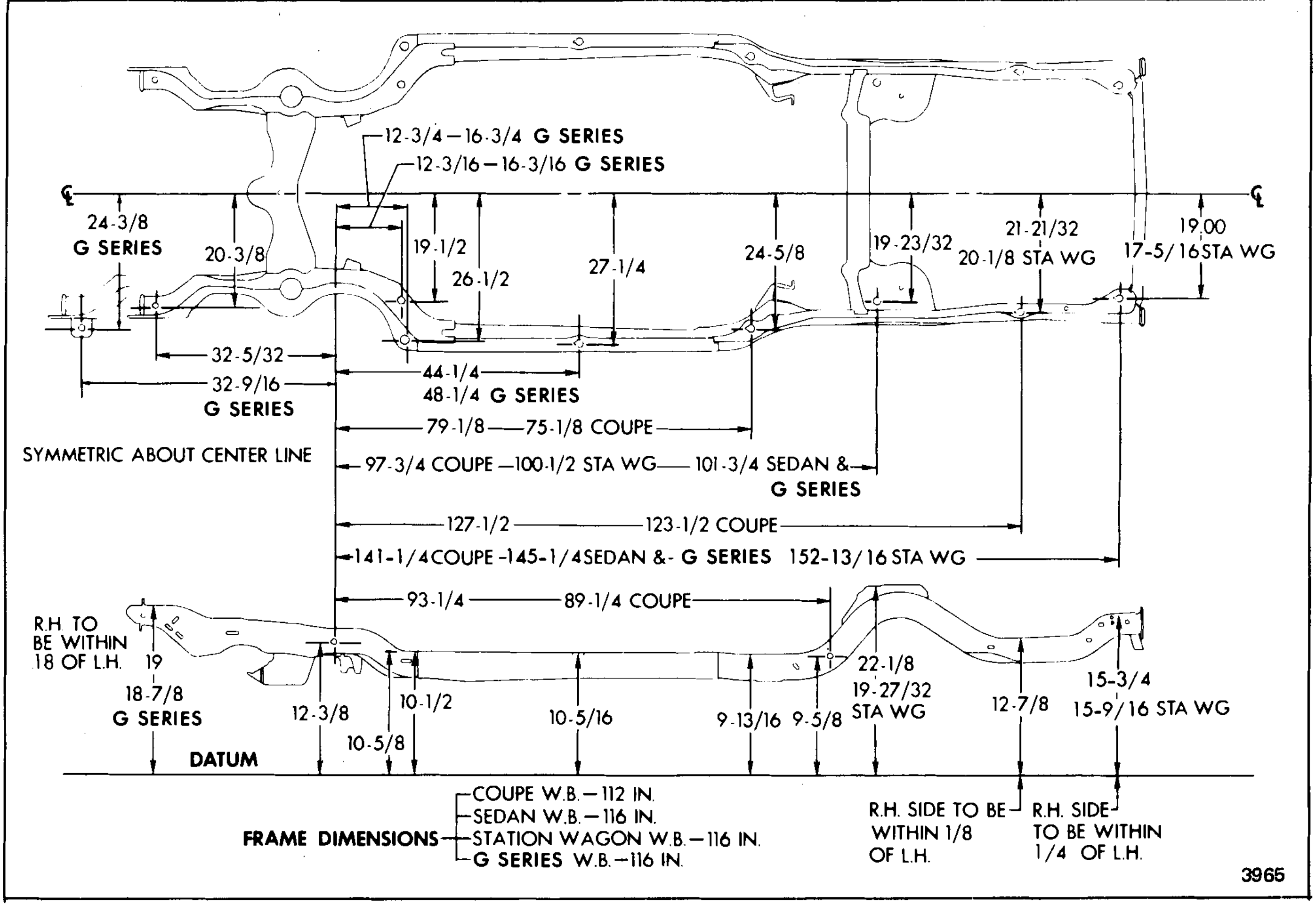
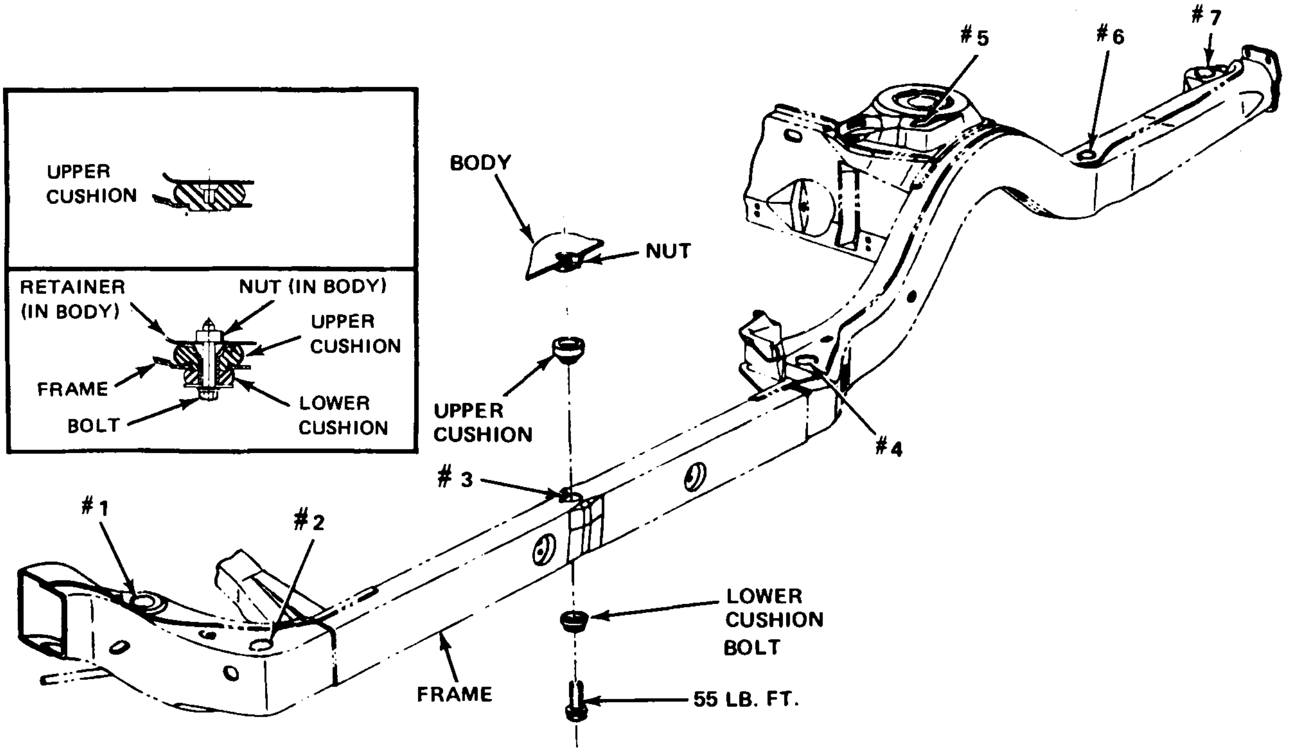


Fig. 2A-4 A and G Series Frame Dimensions

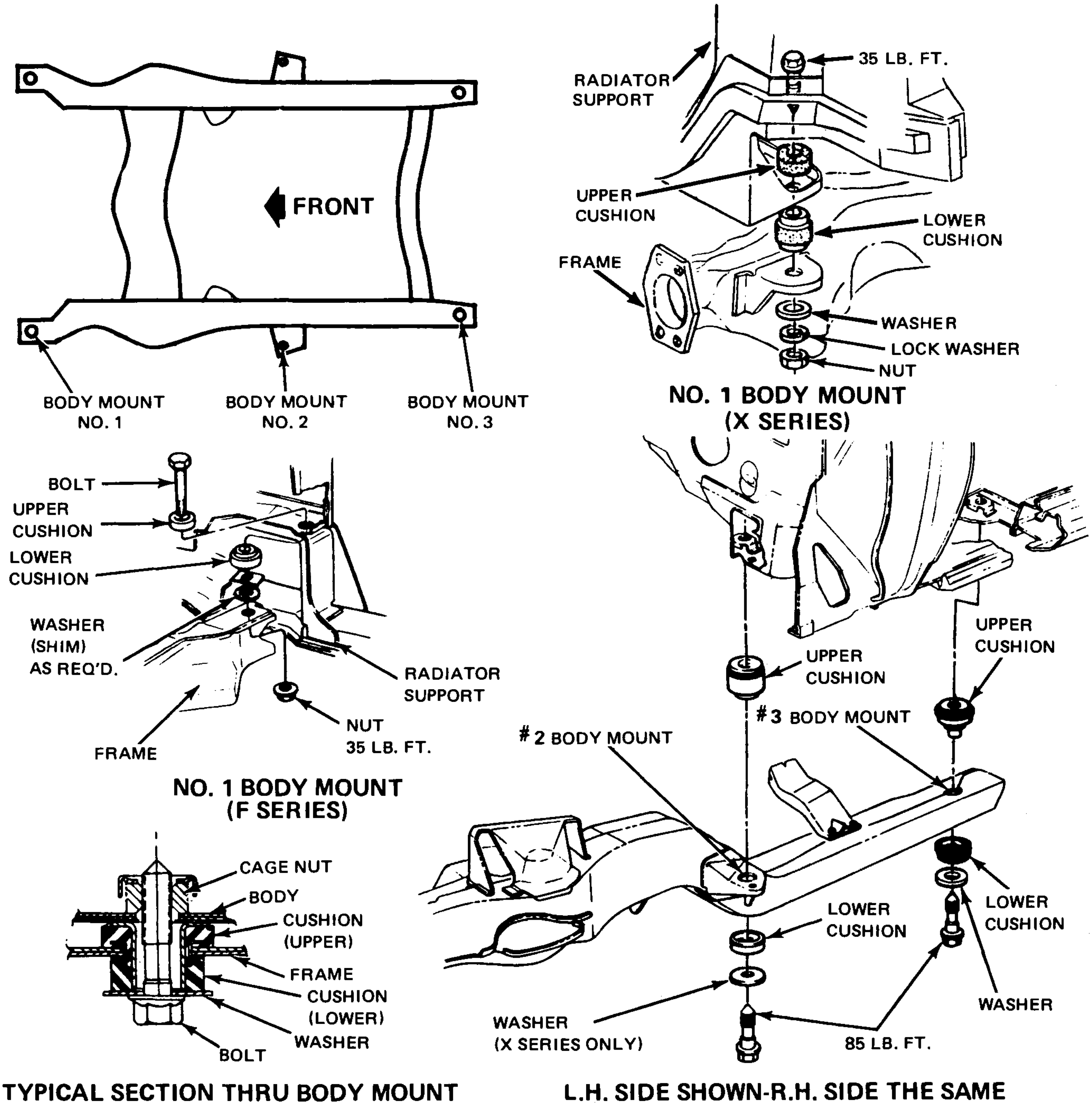


COMBINATION	UPPER CUSHION		LOWER CUSHION		BOLT
A	330951	ORANGE	377801	BLACK	343205
B	330951	ORANGE	330991	BROWN	343205
C	330951	ORANGE	457916	GRAY	343205
D	330951	ORANGE	377801	BLACK	11502600
E	334905	BROWN	377801	BLACK	343205
F	334905	BROWN	377801	BLACK	11502601
G	490724	BLUE	330991	BROWN	343205
H	490724	BLUE	377801	BLACK	11502601
I	330982	BLUE/YELLOW	3993679	YELLOW	6262247
J	330982	BLUE/YELLOW	3991291	BLUE	6262247
K	330953	BEIGE	3993679	YELLOW	6262247
L	488610	GRAY	NONE		NONE
M	371740	PINK/GREEN	377801	BLACK	343205
N	356941	VIOLET/YELLOW	457915	PINK	343205
O	356941	VIOLET/YELLOW	377801	BLACK	11502601
P	371741	RED/GOLD	457915	PINK	343205
Q	330942	YELLOW	457916	GRAY	343205
R	494909	ORANGE/GREEN	457915	PINK	343205
S	348080	GREEN/YELLOW	457941	DK. BLUE/WHITE	11502601
T	334902	BLACK	377801	BLACK	11502601
U	NONE		NONE		NONE
V	348080	GREEN/YELLOW	NONE (457911 WASHER)		11502601

MODEL	POSITION	1	2	3	4	5	6	7
A SERIES 2-DR.		A	B	I	U	L	M	N
A SERIES 4-DR.		A	B	K	U	L	M	P
A SERIES STATION WAGON		A	C	J	L	L	A	Q
GRAND PRIX		E	G	I	U	L	M	R
B SERIES 2-DR.		V	H	D	H	L	F	F
B SERIES 4-DR.		V	H	D	H	L	F	F
B SERIES WAGON		S	H	D	H	L	O	T

3105

Fig. 2A-5 Frame Body Mounts - A, B and G Series



NO. 1 BODY MOUNT (X SERIES)

NO. 1 BODY MOUNT (F SERIES)

TYPICAL SECTION THRU BODY MOUNT

L.H. SIDE SHOWN-R.H. SIDE THE SAME

BODY MOUNT CUSHION/INSULATOR USAGE

SERIES	#1 MOUNT		#2 MOUNT		#3 MOUNT	
	UPPER	LOWER	UPPER	LOWER	UPPER	LOWER
F	549235	549236	527847	332654	356513	356514
X (EXC. 4 CYL. ENGINE)	377801	348080	356549	356515	356513	356514
X (4 CYL. ENGINE)	377801	348080	356549	547645	547643	547644

3106

Fig. 2A-6 Frame Body Mounts - F and X Series

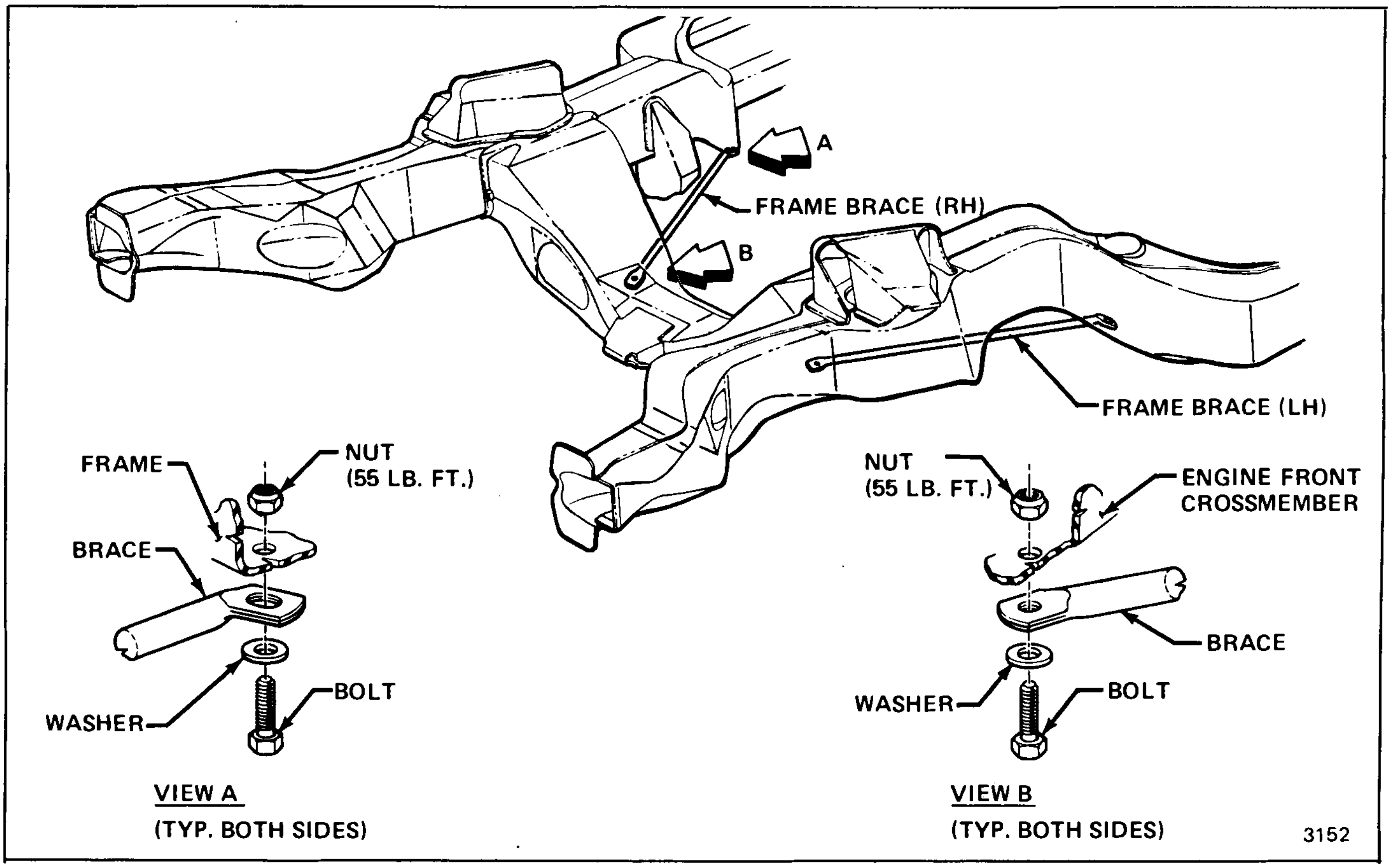


Fig. 2A-7 Frame Braces - B Series

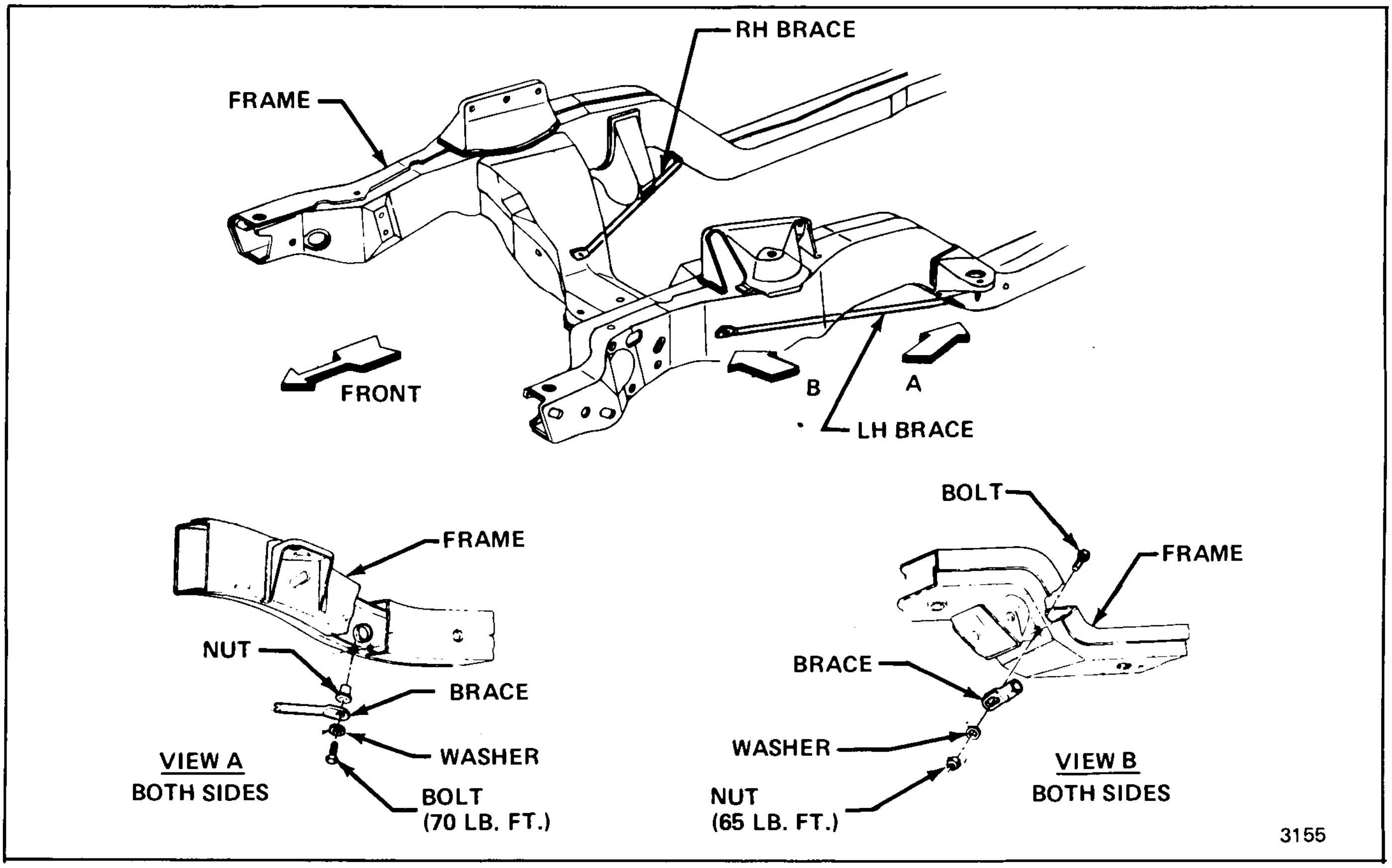


Fig. 2A-8 Frame Braces - F Series

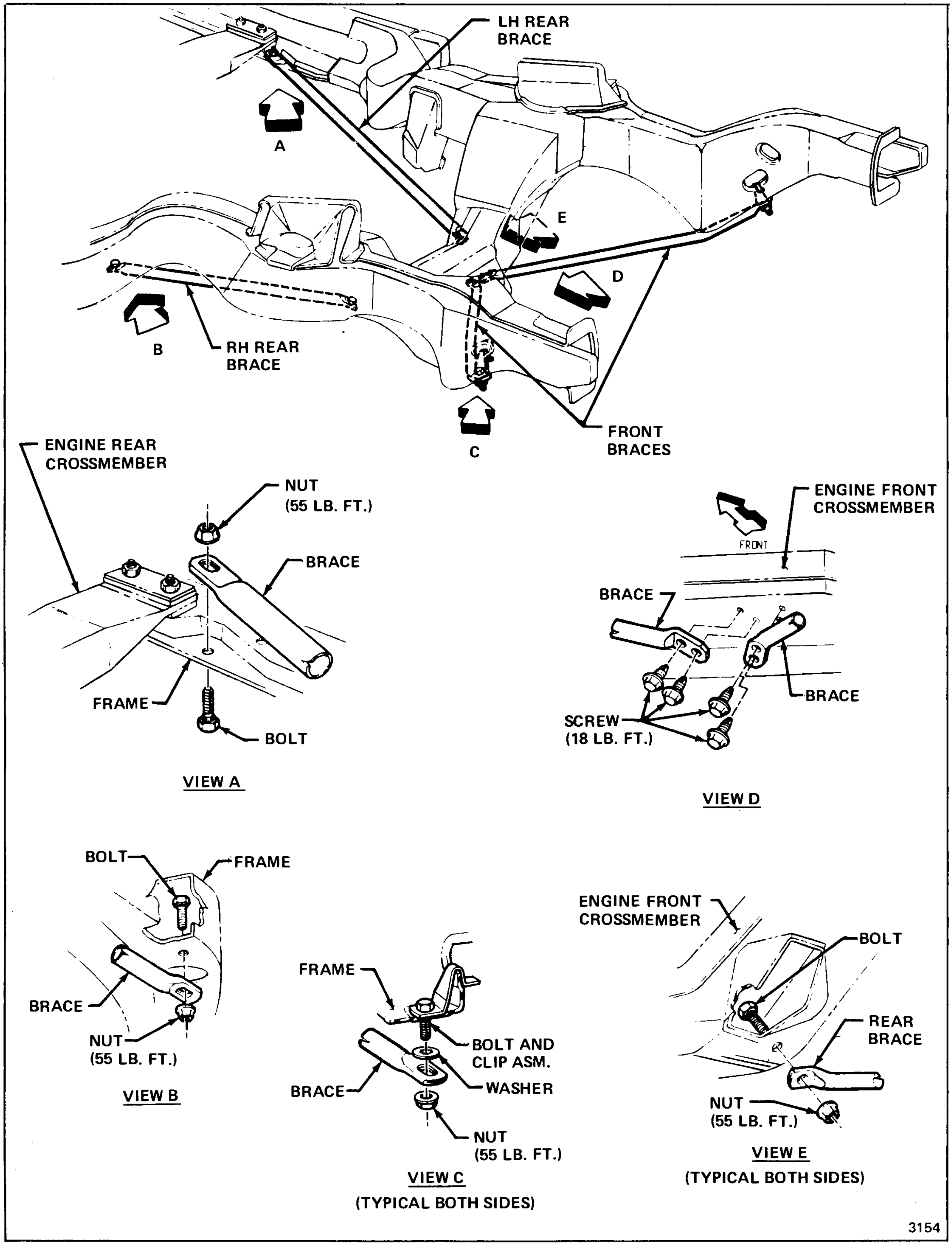


Fig. 2A-9 Frame Braces - G Series

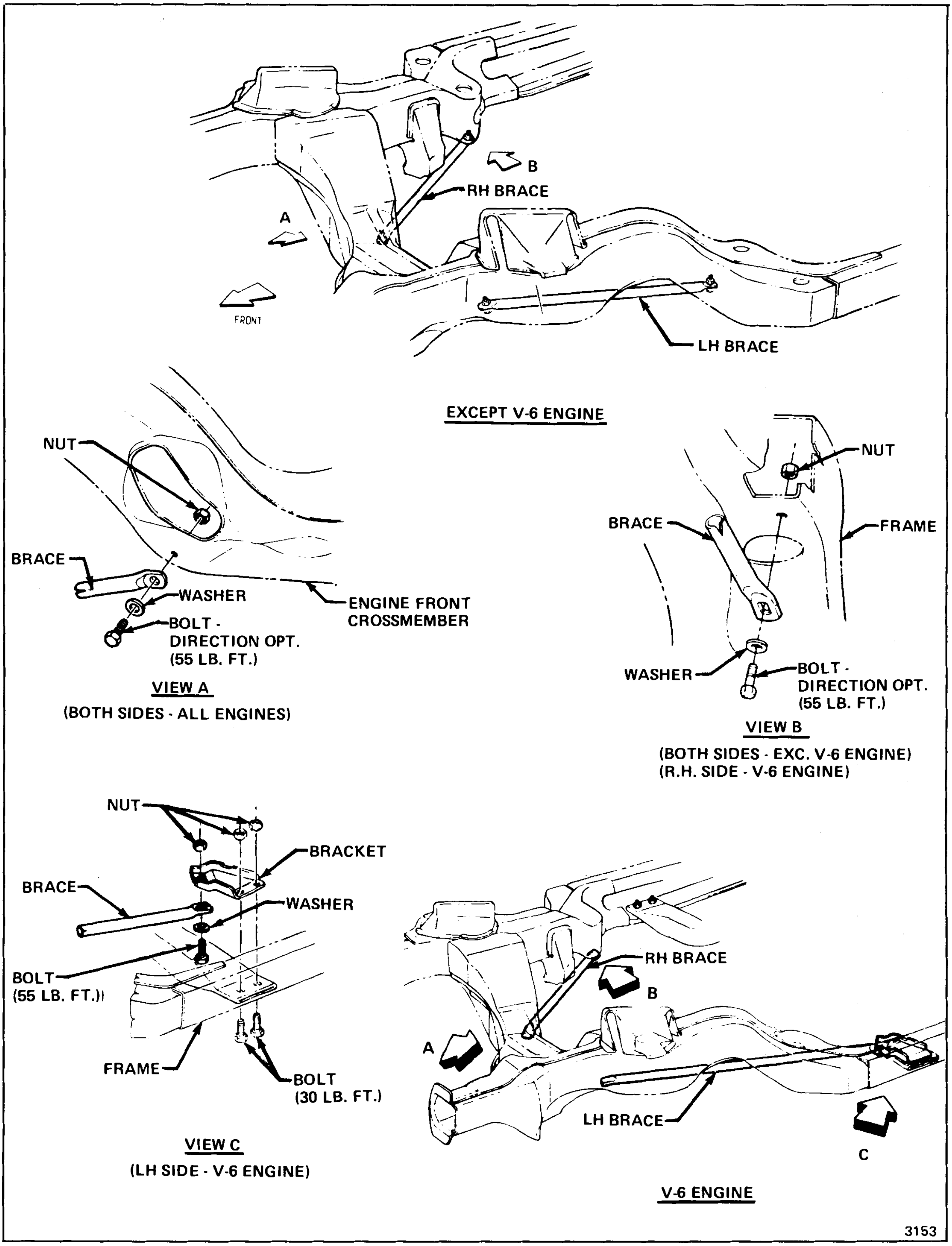


Fig. 2A-10 Frame Braces - A Series

SECTION 2B

FRONT & REAR BUMPERS

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The bumpers on all Pontiac automobiles are designed so that the vehicle can withstand a collision into a fixed barrier (at 5 mph) without damage. After absorbing the energy of the collision the bumpers restore themselves to their original position.

The H (Astre) Series uses the bumper spring assembly system, which forces the front or rear bumper back to its original position upon minor impact.

The F Series front and rear bumpers absorb energy by use of the urethane material that they are made of. Urethane will withstand minor impact and return to its original shape.

BUMPER ENERGY ABSORBING UNITS

The absorbing capability for both front and rear bumper systems on all Pontiacs (except F and H Series) is achieved through two energy absorbing devices in each bumper. These units convert the energy of an impact into heat and restoration.

The Energy Absorbing Device consists of two main subassemblies; the piston tube assembly and the cylinder tube assembly, Fig. 2B-1. The piston tube assembly is filled with an inert gas under pressure and consists of a bumper bracket, piston tube, orifice, seal, piston seal, piston, and stop-ring. The cylinder tube assembly is filled with a hydraulic fluid and consists of a frame bracket, cylinder tube, mounting stud, and metering pin.

Upon impact, as the energy absorber is collapsed, the hydraulic fluid in the cylinder tube is forced into the piston tube through the orifice, Fig. 2B-2. The metering pin controls the rate at which this fluid passes from the cylinder tube through the orifice and into the piston tube. This controlled passage of the fluid provides the energy absorbing action.

The hydraulic fluid that is forced from the cylinder tube into the piston tube displaces the floating piston, compressing the gas behind the floating piston. After impact, the pressure of the compressed gas behind the floating piston forces the hydraulic fluid back into the cylinder tube assembly extending the unit to its normal position.

A. TESTING FRONT OR REAR ENERGY ABSORBER OPERATION

The right and left Energy Absoring Devices are to be diagnosed separately. The following checks and separate judgments are to be made on each unit:

1. Leakage

Some oil wetting may be visible due to the grease packed in the crimp recess. Therefore, a stain or trace of oil on the piston tube near the crimp is normal. However, if oil is dripping continuously from the crimp or the stud end of the unit, a leak is indicated and the unit should be replaced.

2. Damage

Observe the bumper bracket, piston tube, frame bracket and cylinder tube for evidence of visible distortion. Scuffing of the piston tube will occur when the unit is stroked and is to be considered normal.

If there is obvious damage to the unit, it should be replaced.

3. On Car

a. Position car in front of a suitable fixed barrier such as a pillar, wall, post, or other anchorable fixture.

b. Turn ignition to Off, place selector lever in Park, set parking brake, and apply service brake.

c. Position a hydraulic or mechanical jack between bumper and barrier such that jack is positioned squarely with bumper directly in line with Energy Absorber to be checked. See Figure 2B-3.

d. Apply pressure to compress Energy Absorber at least 3/8" using an indicator to detect exact amount of travel.

e. Release pressure and check indicator to determine whether Energy Absorber returned to its original position. If not, replace Energy Absorber.

f. Repeat Steps c, d, and e for second Energy Absorber.

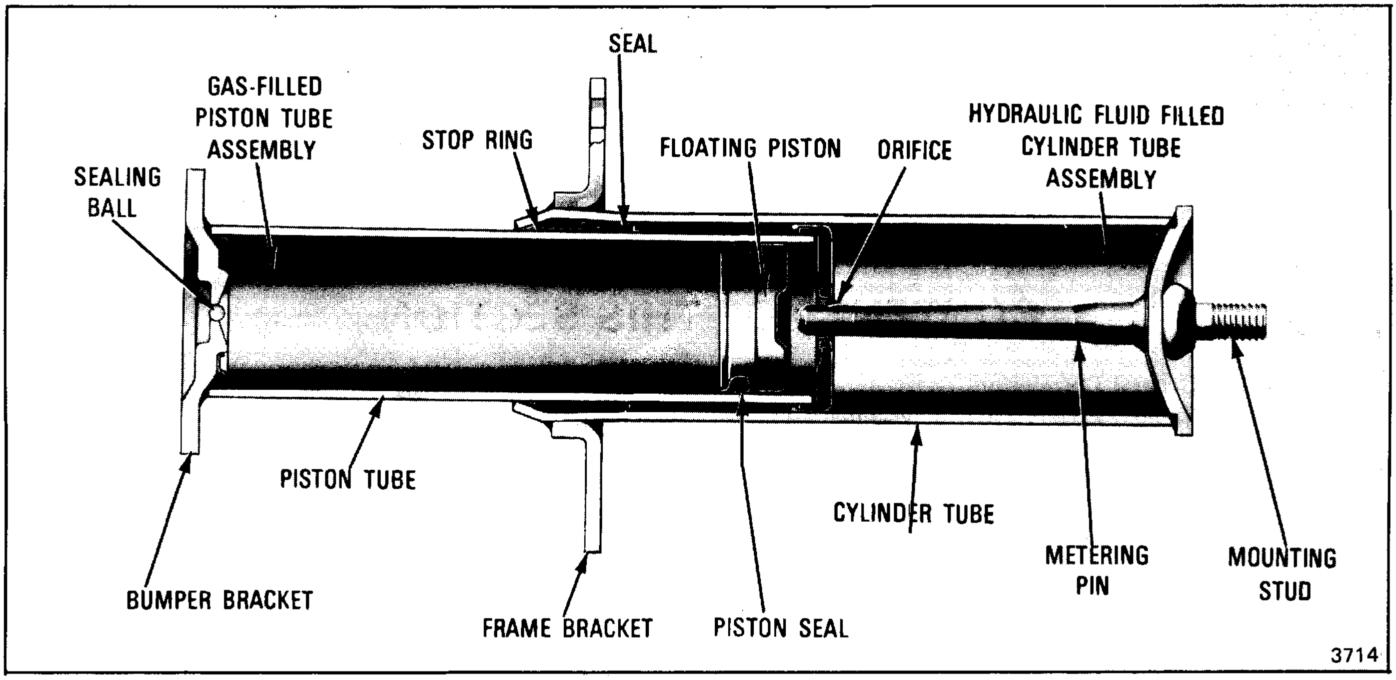


Fig. 2B-l Energy Absorbing Device - Extended

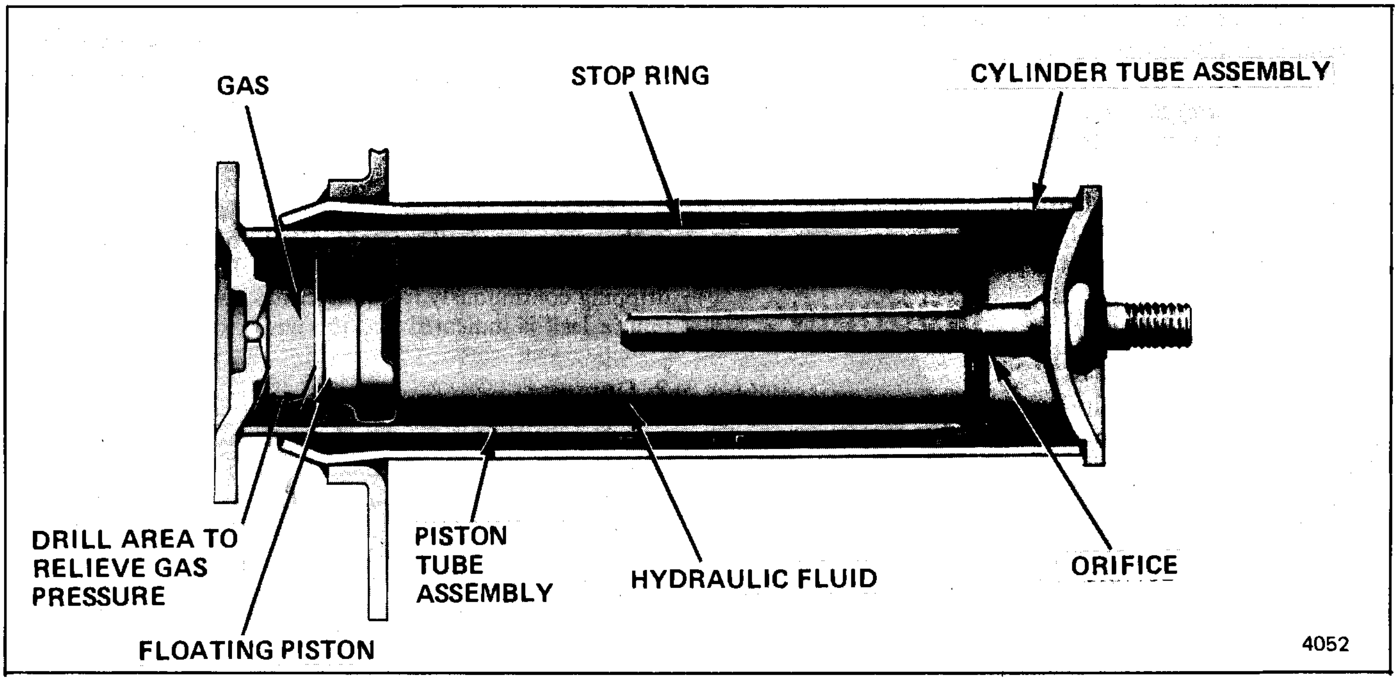


Fig. 2B-2 Energy Absorbing Device - Collapsed

WARNING: DRIVING INTO POSTS, WALLS, OR BARRIERS TO PERFORM THIS TEST IS NOT RECOMMENDED BECAUSE PERSONAL INJURY OR PROPERTY DAMAGE COULD RESULT.

4. On Bench

a. Position Energy Absorber lengthwise in arbor press.

b. Using a suitable measuring device, note original position of unit then use press to compress unit at least 3/8".

c. Release pressure and determine whether unit has returned to original position. If not, discard unit.

B. INSPECTION AFTER COLLISION

If the collision was so severe that the bumper did not return to its original position, the energy absorber(s) will require replacing.

a. Stand clear of the bumper.

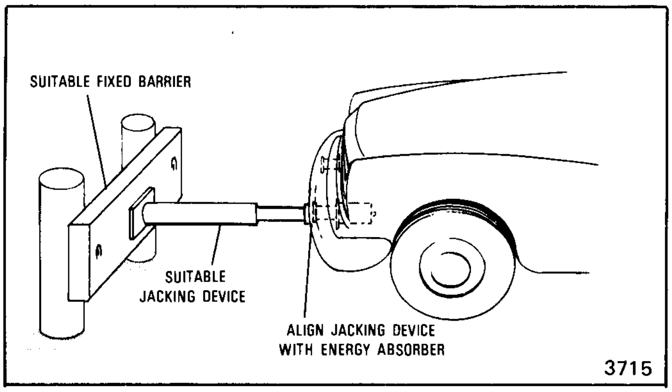


Fig. 2B-3 Testing Energy Absorber

b. Provide a positive restraint, such as a chain or cable to hold the bumper in the position it is in.

c. **WEARING SAFETY GLASSES,** drill a small hole in the piston tube near the bumper bracket, Fig. 2B-4, to relieve gas pressure.

d. Remove the energy absorber(s) after gas pressure has been relieved.

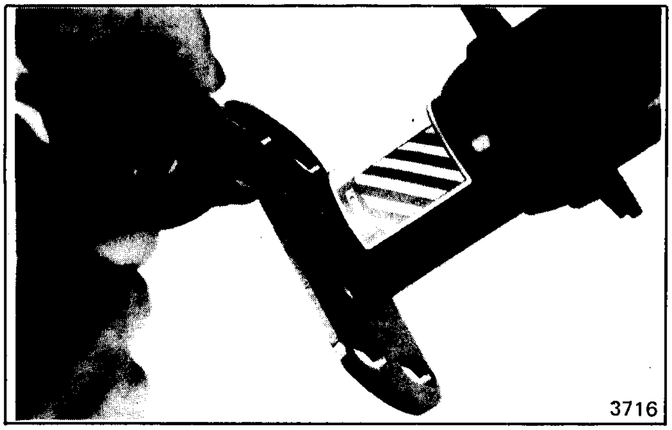


Fig. 2B-4 Scrapping Energy Absorber

WARNING: HEED THE FOLLOWING WHEN HANDLING ENERGY ABSORBING DEVICES OR PERSONAL INJURY MAY RESULT.

1. Do not apply heat to a unit.

2. Do not weld in the area of a unit.

3. Do not attempt to repair a damaged unit. Always replace with a new unit.

4. If unit is bound-up as a result of a collision such that it cannot extend, take precautions to avoid spring-back when bending sheet metal. See note 2.

5. If unit is to be scrapped, relieve the gas pressure prior to disposal of a unit. Make an identation with a center punch in the small cylinder section of the energy absorber, Fig. 2B-4.

Use a 1/8 inch drill to penetrate the small cylinder wall.

BE SAFE. PROTECT YOUR EYES. **WEAR APPROVED SAFETY GLASSES.**

CARE OF ALUMINUM BUMPERS

The front and rear bumpers on the Astre are made of aluminum. The surface finish of these aluminum bumpers is protected by an anodizing process.

Proper care of these bumpers is recommended to prolong their beauty and the protection of the surface finish.

Occasional washing and scrubbing with soap and water using soft fiber brushes is usually sufficient to remove most deposits of dirt, soot, and grime which may normally accumulate on the bumper surfaces. Where necessary, solvents may be used prior to scrubbing with soap and water. Strong acids and uninhibited alkaline cleaners must be avoided because they tend to attack the surface finish. For very difficult cleaning, mild abrasives such as 00 stainless steel wool lubricated with light oil or liquid wax will be helpful. Stubborn grease or dirt spots may be removed with benzene or naphtha without harming the finish.

Regardless of the cleaning method used, it is highly recommended and considered a good practice to finish off the sequence with a good waxing and polishing operation to prevent rapid re-accumulation of soiling materials.

CAUTION: *Don't polish with coarse abrasive such as rubbing compound, household cleanser, etc.*

Don't clean with strongly caustic cleaners as they may casue a cloudy or milky discoloration of the anodized layer.

Do use water and mild detergents and pre-soften waxes or equivalent.

SERVICE PROCEDURES

Following are the exploded service procedures for the front and rear bumpers.

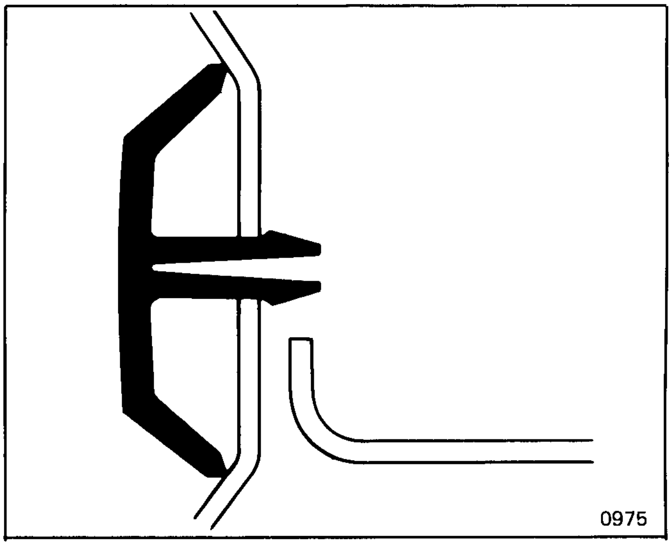


Fig. 2B-18 Typical Plastic (Surlyn) Bumper Rub Strip Attachment

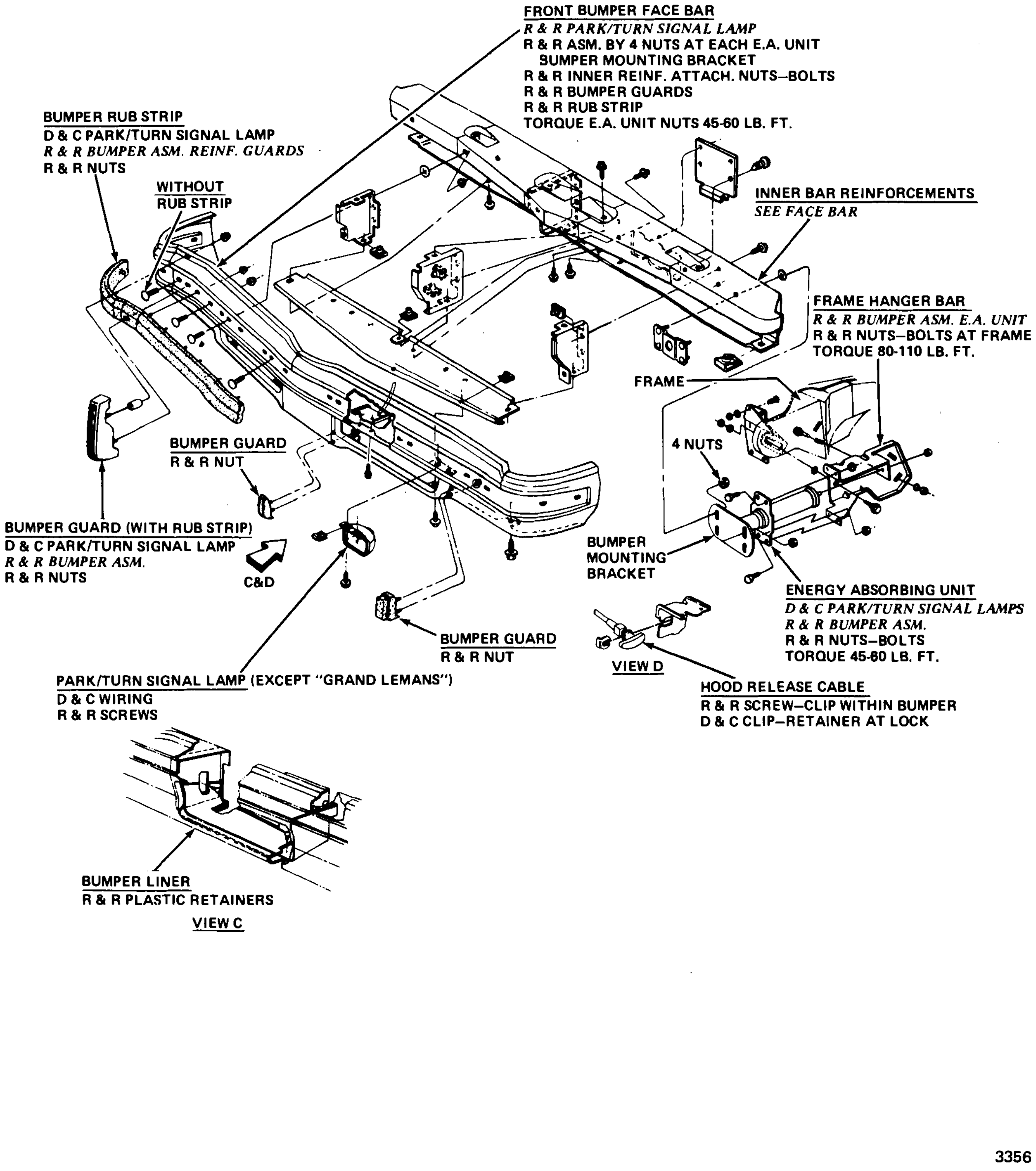


Fig. 2B-5 Exploded Service Procedures - "A" Series - Front Bumper

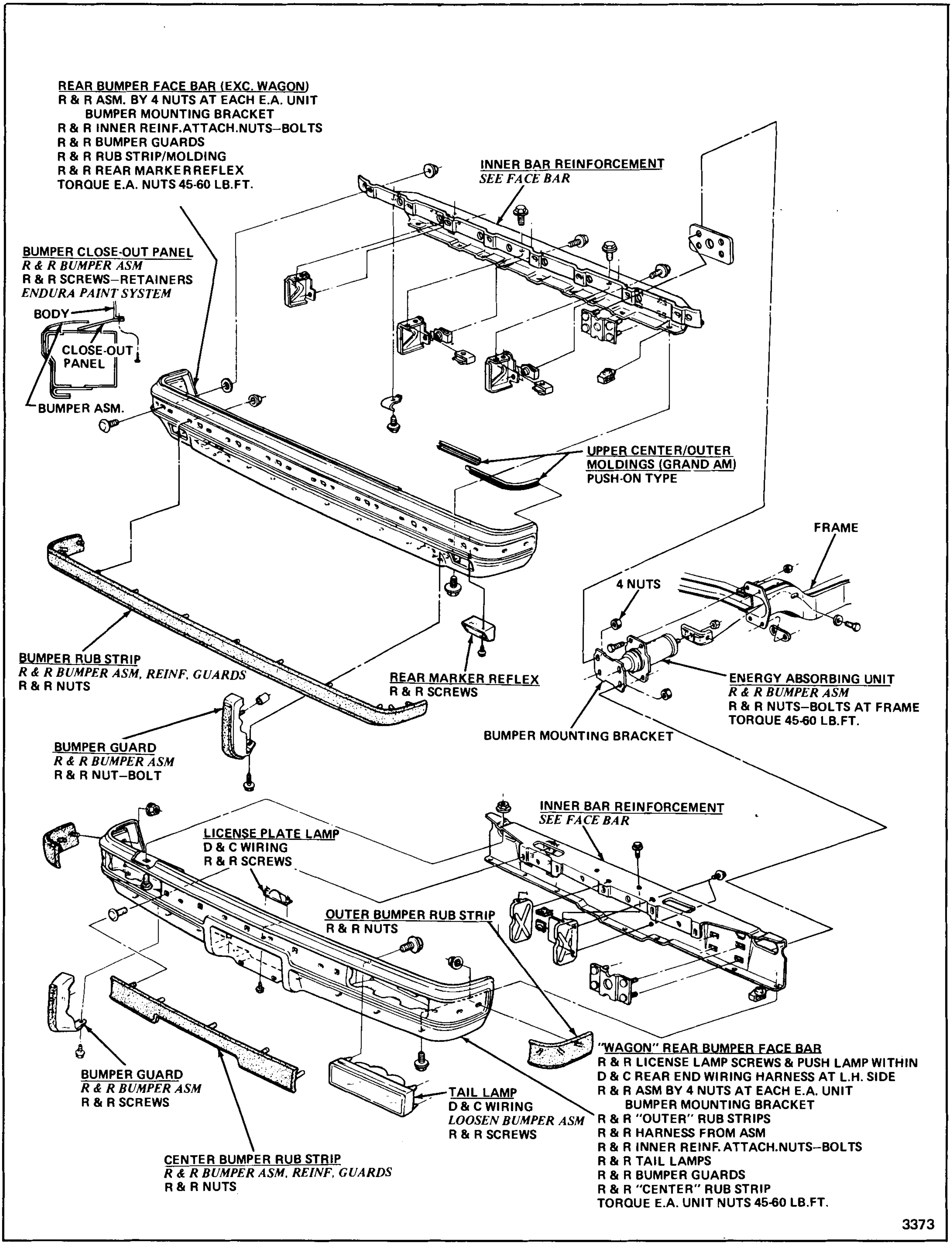
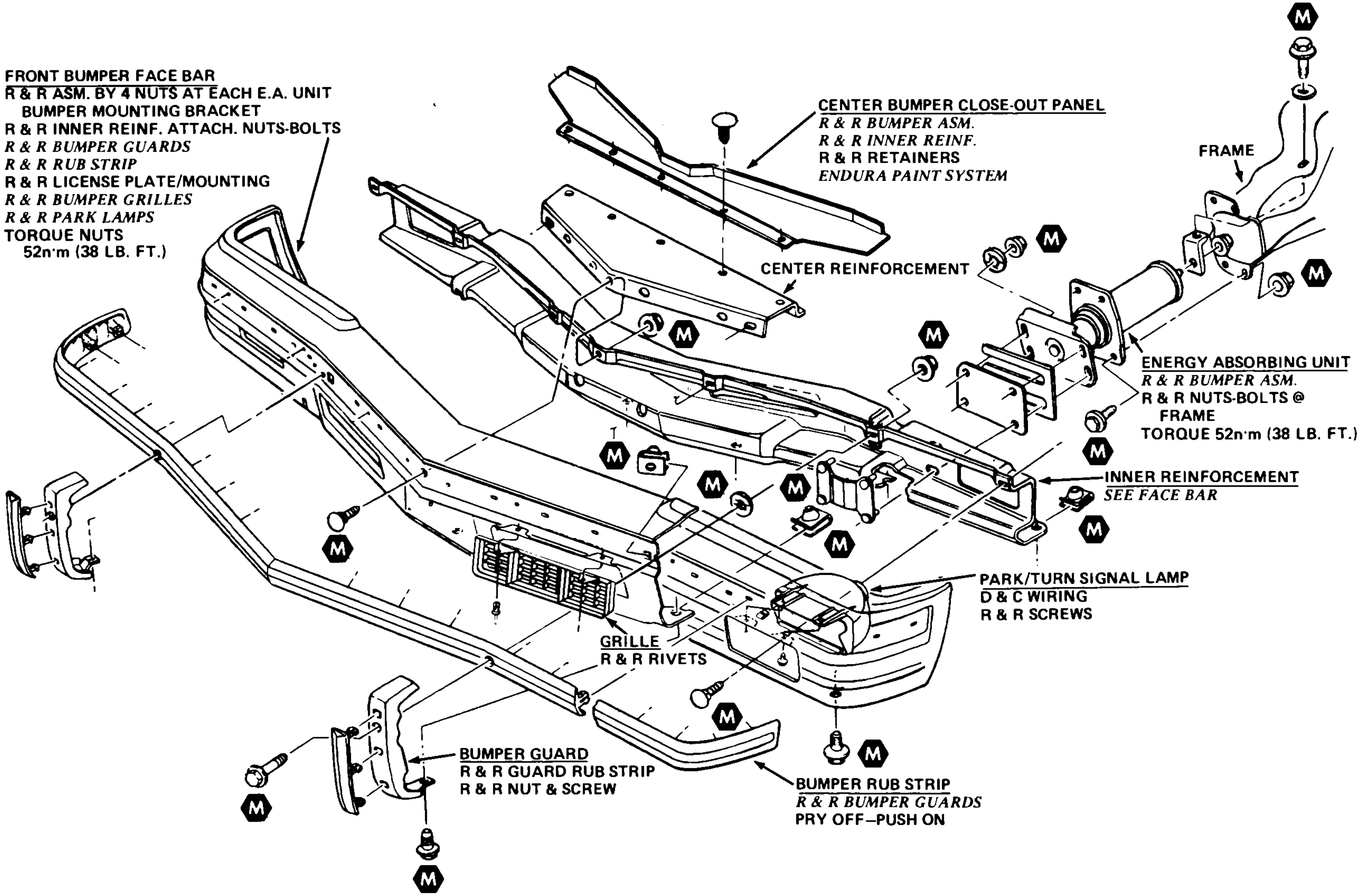


Fig. 2B-6 Exploded Service Procedures - "A" Series - Rear Bumper



FRONT BUMPER FACE BAR
R & R ASM. BY 4 NUTS AT EACH E.A. UNIT
BUMPER MOUNTING BRACKET
R & R INNER REINF. ATTACH. NUTS-BOLTS
R & R BUMPER GUARDS
R & R RUB STRIP
R & R LICENSE PLATE/MOUNTING
R & R BUMPER GRILLES
R & R PARK LAMPS
TORQUE NUTS
52n·m (38 LB. FT.)

CENTER BUMPER CLOSE-OUT PANEL
R & R BUMPER ASM.
R & R INNER REINF.
R & R RETAINERS
ENDURA PAINT SYSTEM

CENTER REINFORCEMENT

ENERGY ABSORBING UNIT
R & R BUMPER ASM.
R & R NUTS-BOLTS @
FRAME
TORQUE 52n·m (38 LB. FT.)

INNER REINFORCEMENT
SEE FACE BAR

PARK/TURN SIGNAL LAMP
D & C WIRING
R & R SCREWS

GRILLE
R & R RIVETS

BUMPER GUARD
R & R GUARD RUB STRIP
R & R NUT & SCREW

BUMPER RUB STRIP
R & R BUMPER GUARDS
PRY OFF—PUSH ON

Fig. 2B-7 Exploded Service Procedures - "B" Series - Front Bumper

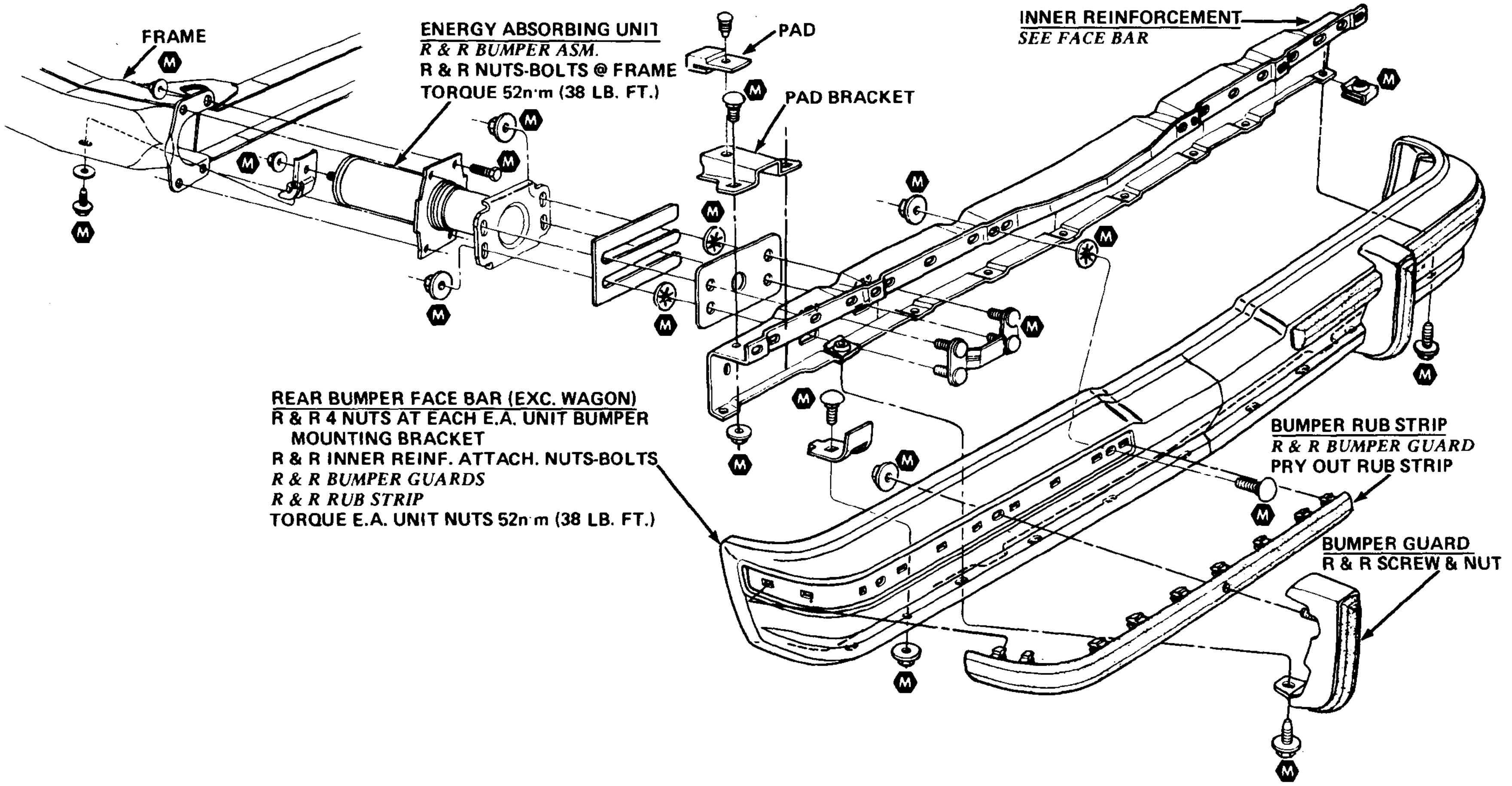
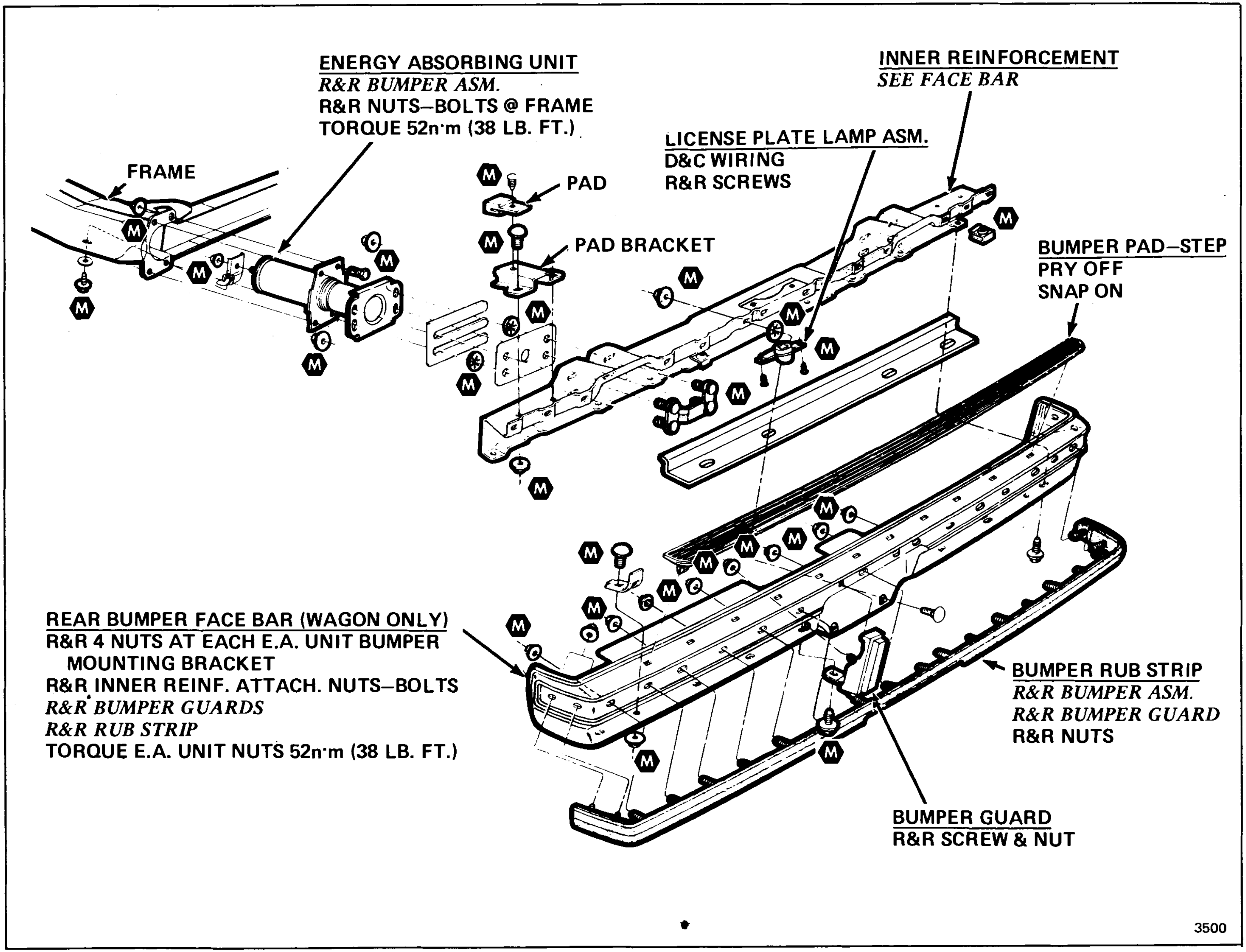


Fig. 2B-8 Exploded Service Procedures - "B" Series - Rear Bumper (Exc. Wagon)



ENERGY ABSORBING UNIT
R&R BUMPER ASM.
R&R NUTS–BOLTS @ FRAME
TORQUE 52n·m (38 LB. FT.)

INNER REINFORCEMENT
SEE FACE BAR

LICENSE PLATE LAMP ASM.
D&C WIRING
R&R SCREWS

BUMPER PAD–STEP
PRY OFF
SNAP ON

REAR BUMPER FACE BAR (WAGON ONLY)
R&R 4 NUTS AT EACH E.A. UNIT BUMPER MOUNTING BRACKET
R&R INNER REINF. ATTACH. NUTS–BOLTS
R&R BUMPER GUARDS
R&R RUB STRIP
TORQUE E.A. UNIT NUTS 52n·m (38 LB. FT.)

BUMPER RUB STRIP
R&R BUMPER ASM.
R&R BUMPER GUARD
R&R NUTS

BUMPER GUARD
R&R SCREW & NUT

Fig. 2B-9 Exploded Service Procedures - "B" Series - Rear Bumper (Wagon Only)

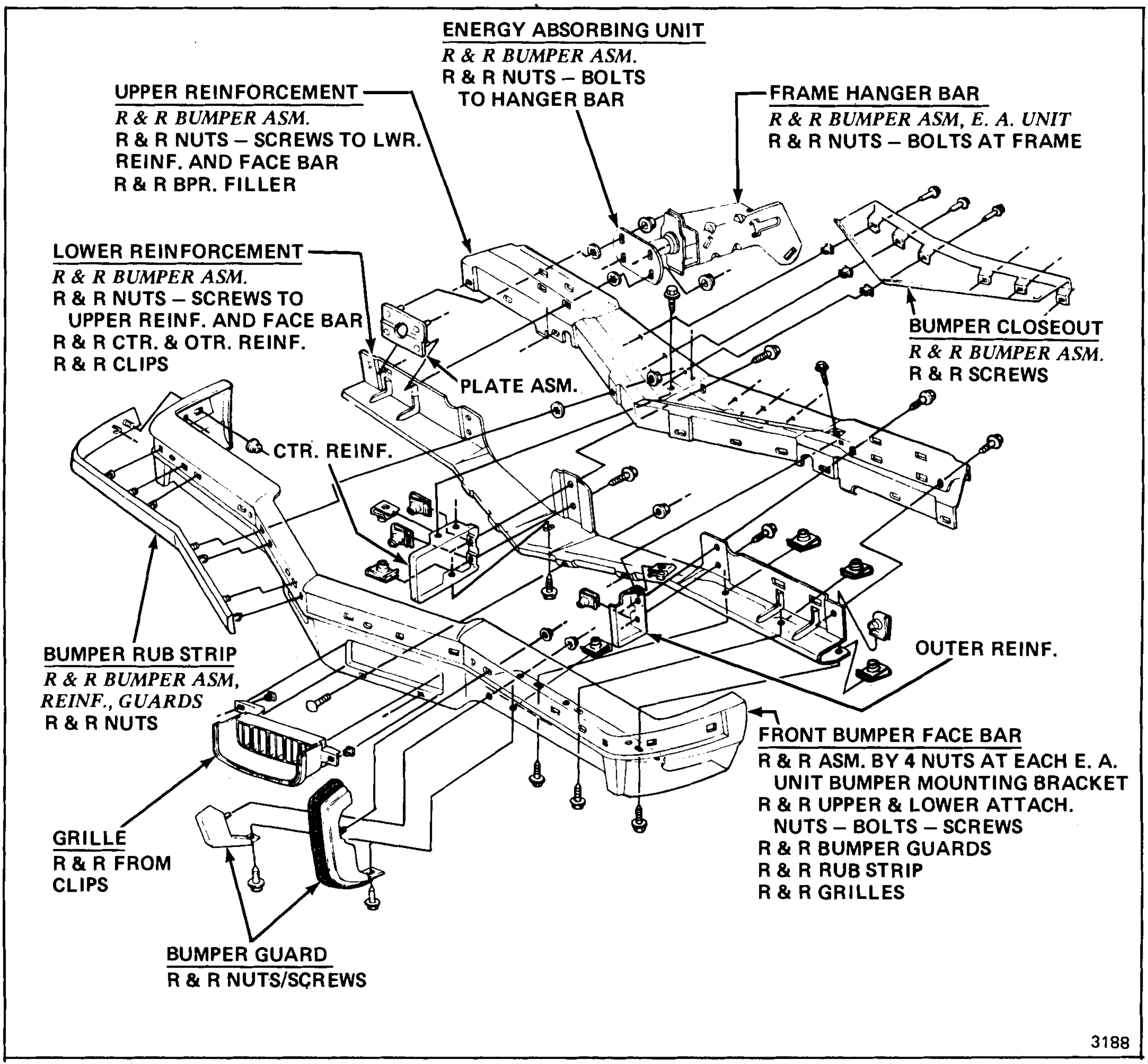


Fig. 2B-10 Exploded Service Procedures - "G" Series - Front Bumper

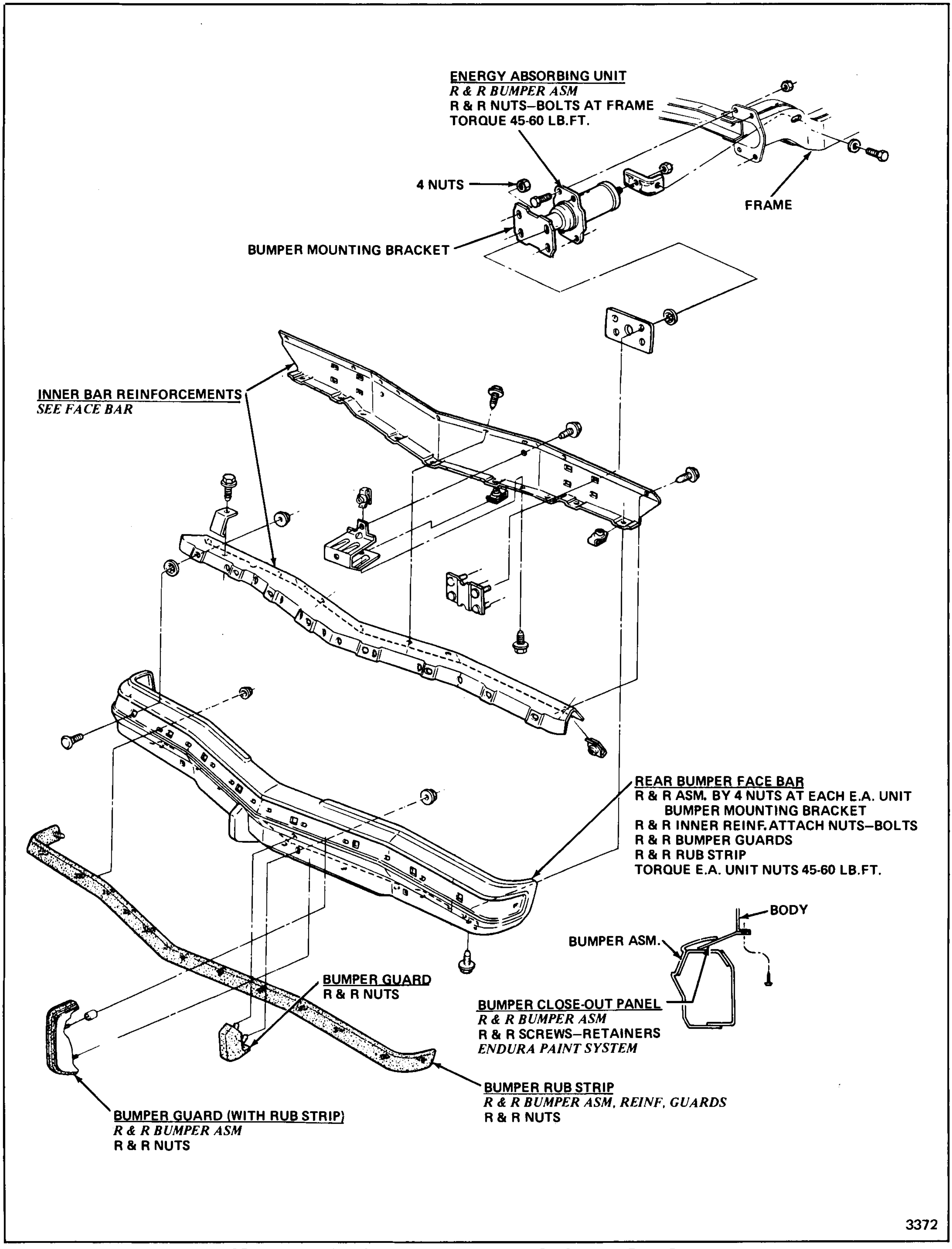


Fig. 2B-11 Exploded Service Procedures - "G" Series - Rear Bumper

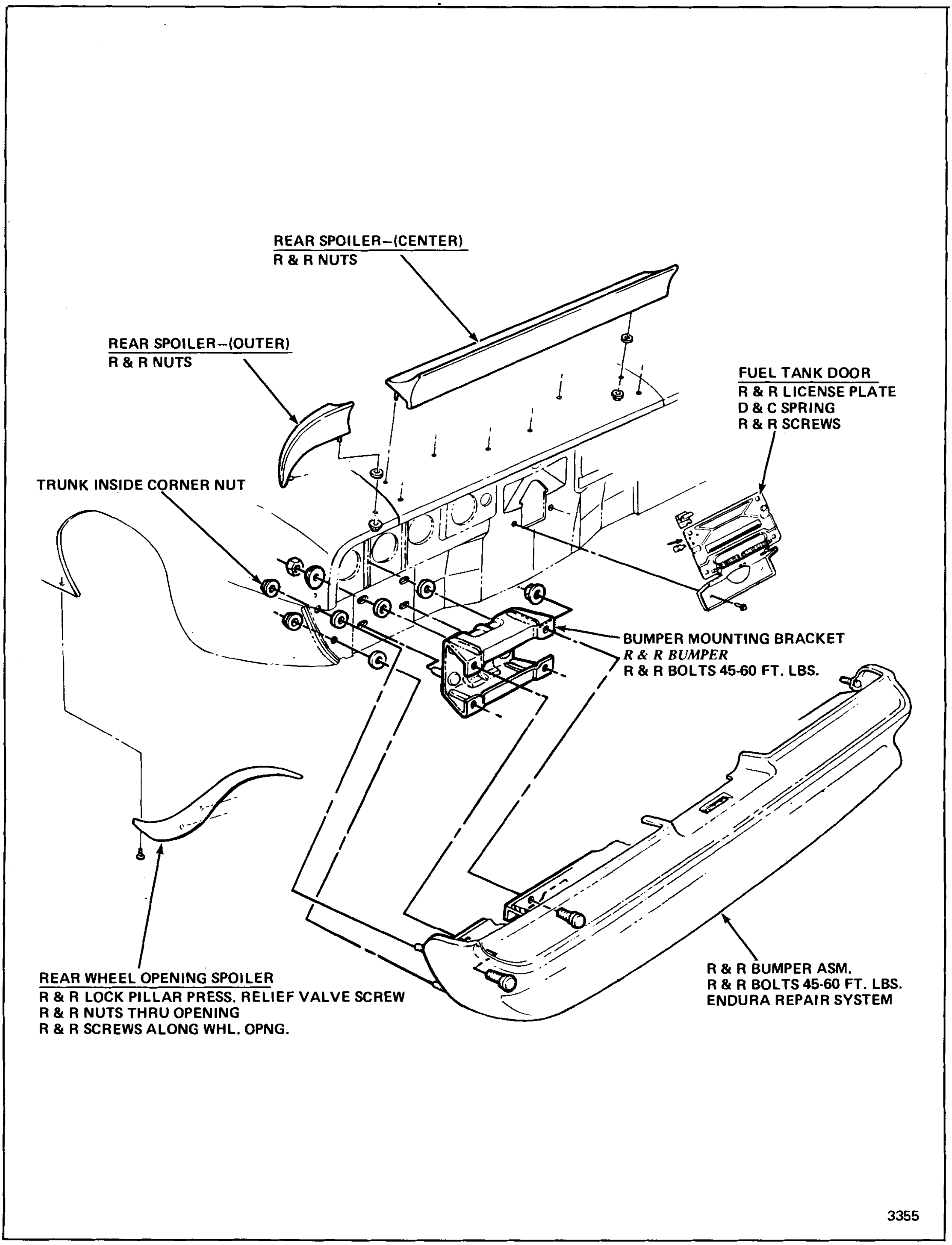


Fig. 2B-12 Exploded Service Procedures - "F" Series - Rear Bumper

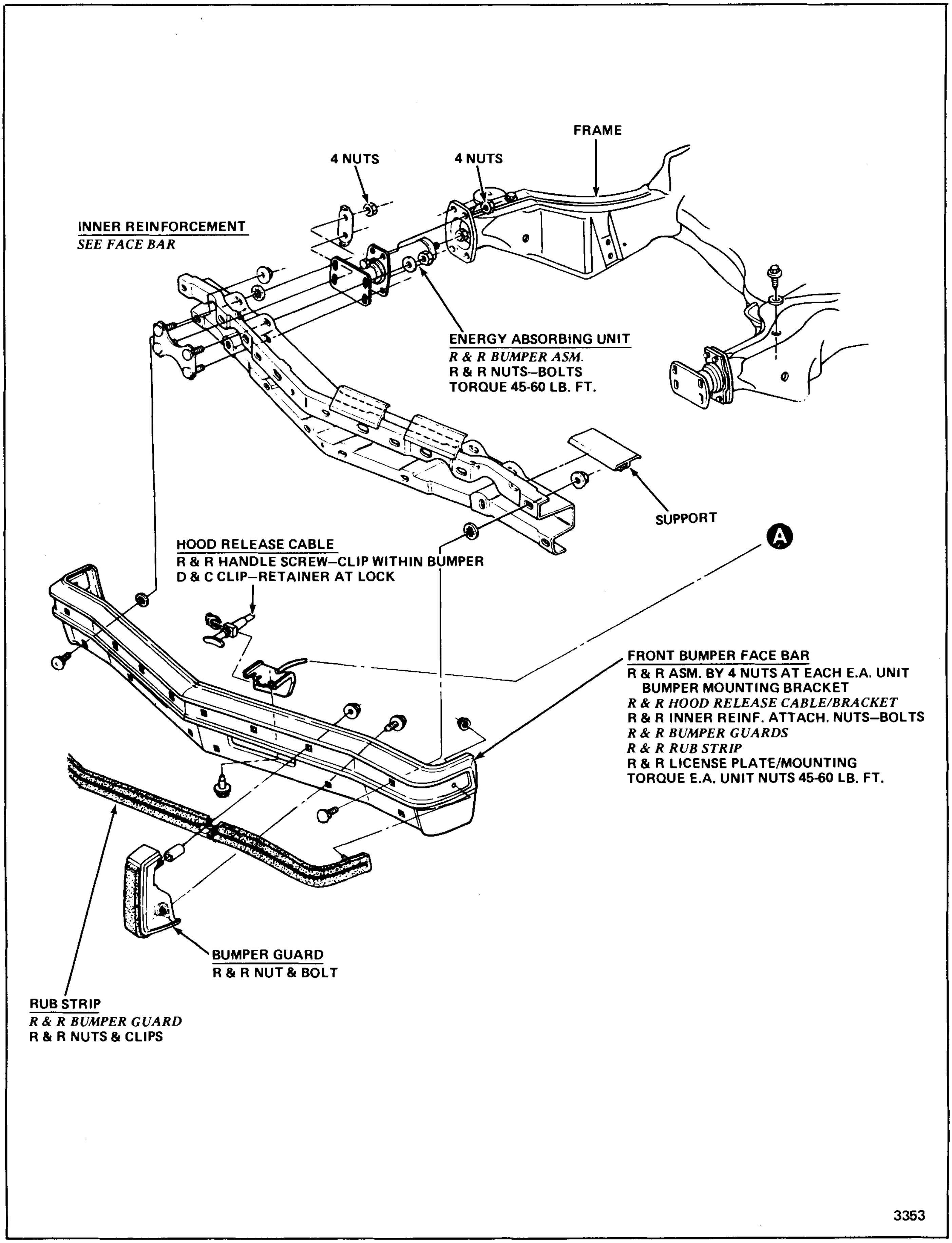


Fig. 2B-13 Exploded Service Procedures - "X" Series - Front Bumper

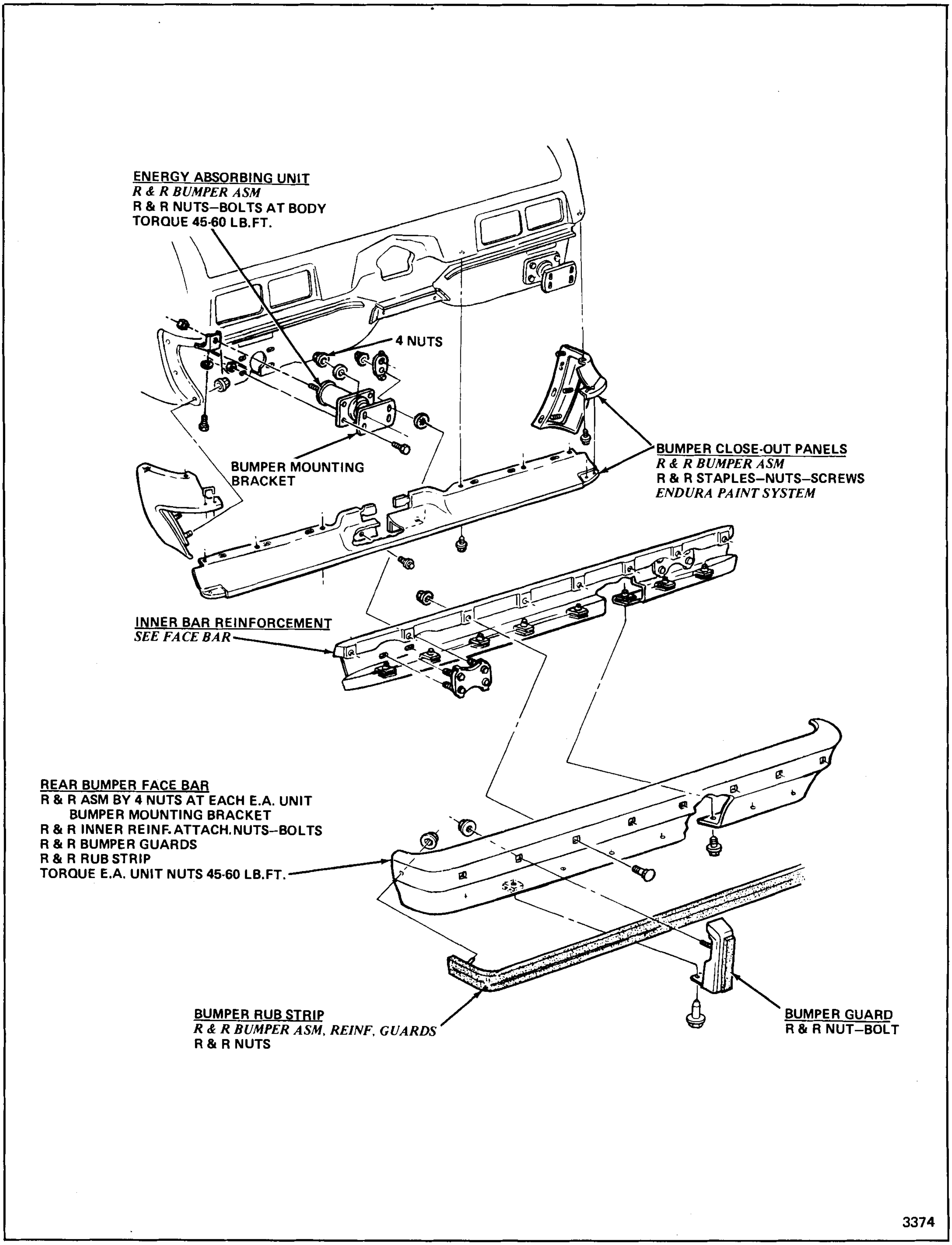


Fig. 2B-14 Exploded Service Procedures - "X" Series - Rear Bumper

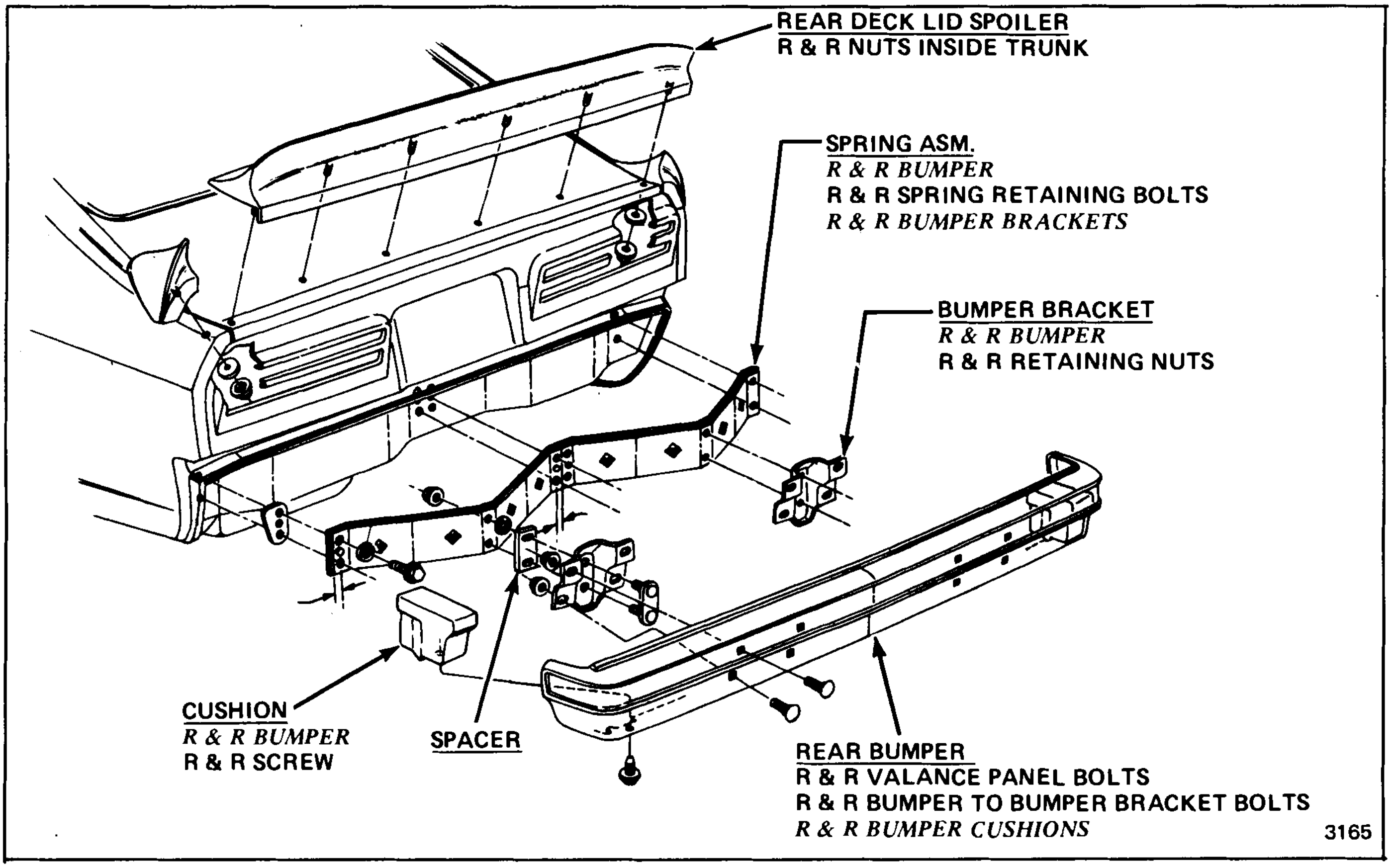


Fig. 2B-15 Exploded Service Procedures - "H" Series - Rear Bumper

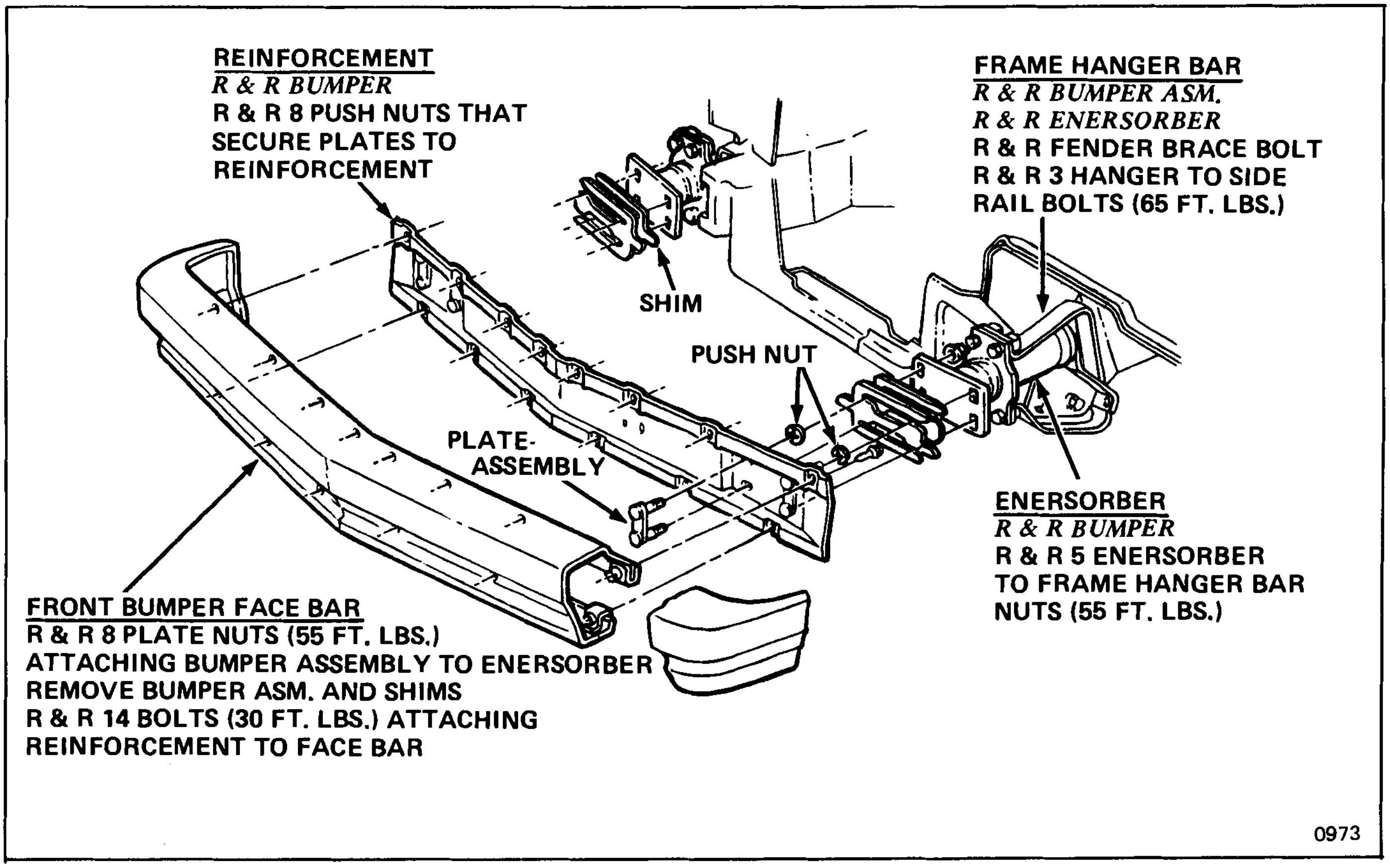


Fig. 2B-16 Exploded Service Procedures - "HM" Series - Front Bumper

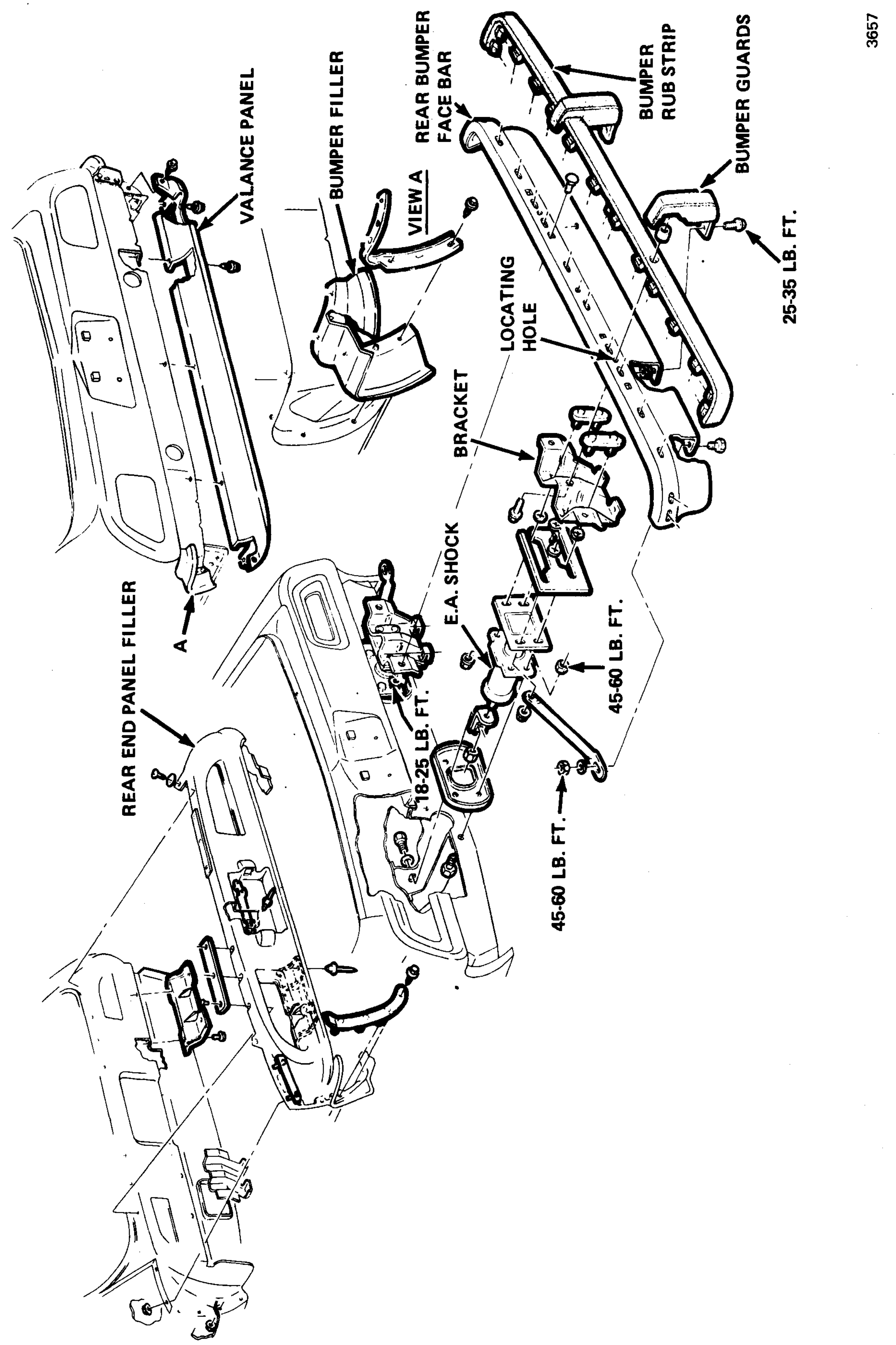
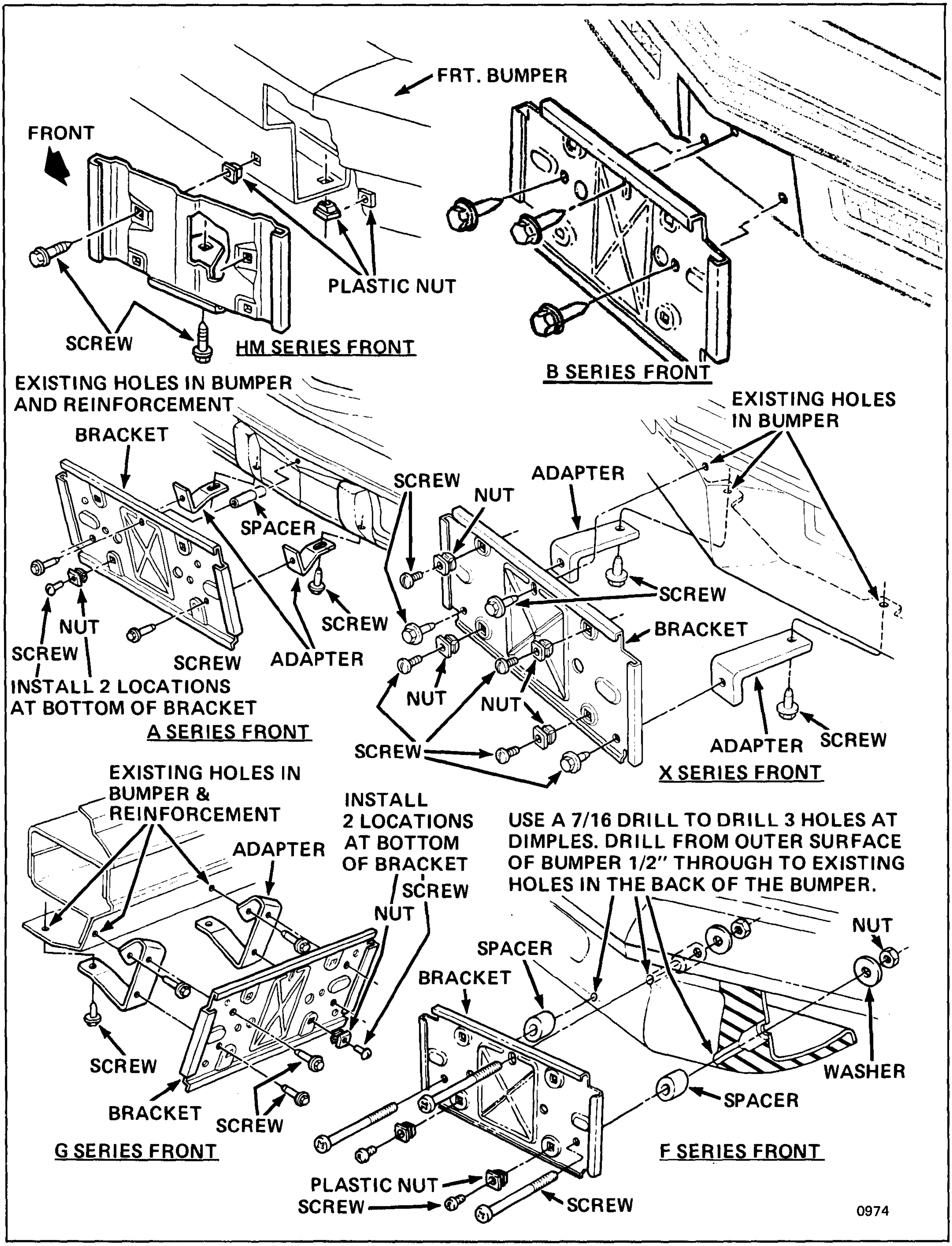


Fig. 2B-17 Exploded Service Procedures - "HM07" Rear End & "HM" Series Rear Bumper



USE A 7/16 DRILL TO DRILL 3 HOLES AT DIMPLES. DRILL FROM OUTER SURFACE OF BUMPER 1/2" THROUGH TO EXISTING HOLES IN THE BACK OF THE BUMPER.

Fig. 2B-19 Front License Plate Mounting Locations

SECTION 2C

CHASSIS METAL, PLASTICS, PAINT AND REPAIR

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

HOOD

The hood is composed of a single outer panel and a rugged inner panel reinforcement. Further rigidity is obtained by the insertion of reinforcement braces and brackets strategically located so as not to interfere with adjustments or service repair conditions.

ADJUST

Slotted holes are provided at all hood hinge attaching points (see Fig. 2C-1) for proper adjustment - both vertically and fore and aft.

NOTE: Adjust one side at a time.

TO LOWER THE REAR corners of the hood for proper alignment to the cowl and fenders, and to ensure contact with the hood side wedges, proceed as follows:

1. Loosen front end of hinge mounting bracket to fender at Screw No. 1 (Fig. 2C-1).
2. Force hood open as high as possible to move front of hinge upward.
3. Tighten fender connection to specifications.
4. If further adjustment is required, loosen rear end of hinge mounting bracket to fenders at Screw No. 2. Repeat steps 2 and 3.

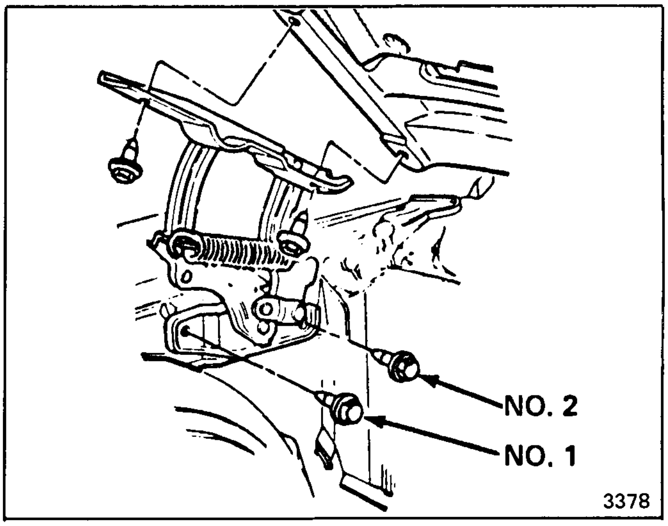


Fig. 2C-1 Typical Hood Hinge Replacement

5. If necessary, repeat procedure on opposite side of hood.

TO LOWER THE FRONT corners for proper alignment, proceed as follows:

1. Close hood firmly.
2. Determine the amount of adjustment necessary.
3. Open hood.
4. Loosen nut on adjustable hood bumper and raise or lower as required.
5. Tighten nut.

HOOD HINGE/SPRING

Hood hinges (see HINGE REPLACEMENT FIG. 2C-1) are fastened to the fender panel. Double assist overcenter springs are used (one at each hinge); one end of which is fastened to the front arm of the hinge, the other end to the base plate. This construction provides hold-open power. Forward and rearward adjustment of hood is provided by slotted holes in the hinge bracket.

Remove

1. Open hood.
2. Scribe line on hood inner panel to indicate original hinge position.
3. Block hood on side where hinge is to be removed.
4. Prop hood open and pull FRONT of spring off hinge.
5. Remove hinge-to-hood attaching screws and hinge-to-fender attaching screws.
6. Carefully remove hinge.

Replace

1. Mount new hinge on fender and tighten attaching screws.
2. Position hinge to hood using scribed line for location, install attaching screws and tighten.
3. Replace spring.

NOTE: WHEN REPLACING SPRING, HOOK REAR END of spring on pin FIRST - then stretch and hook at front.)

4. Carefully close hood and check for proper alignment.
5. If hood is misaligned, measure amount of misalignment.
   a. Open hood.
   b. Loosen hinge at hood and re-position to correct misalignment.
   c. Tighten securely and recheck.

HOOD LATCH

The B and G (optional on A) Series have a cable released, positive locking hood latch assembly located in the radiator support and baffle assembly, and locking with the hood-mounted striker. (The cable is of two-piece construction on G Series). A hand released secondary catch can be found mounted on the front underside of the hood to fully open the hood after the release cable's handle is pulled within the passenger compartment.

The A, HM, F and X Series also have a positive locking hood latch system. The latch assembly, being fastened to the radiator support and baffle assembly, locks securely with the latch plate mounted in the F Series hood and with the hood-mounted striker on the A, HM and X Series. A hood-mounted catch for hand releasing is also found on the A and X Series in the same position as found on B and G Series models.

A "pop-up" spring, located on top of the radiator support and baffle assembly, provides initial opening of the hood upon release for All Series.

RELEASING THE HOOD on the A, HM, F and X Series is achieved by reaching through the opening in the LH bumper cooling slot and pulling outward on the release rod.

The hood on the H Series can be opened by pulling the hood release handle located below the instrument panel on the left hand side of the car. To keep the hood open, insert the hood hold-open rod (located on the left fender) into the proper hole in the hood.

The B and G Series hood release handle is located inside the car at the left side plastic shroud kick panel. To fully open the hood on the F Series after the release rod has been pulled, first push down on the hood slightly and then, pull the release handle again past the detent position. After the release handles have been pulled on the A, B, G and X Series, the hood can be fully opened by releasing the hand catch on the hood underside.

NOTE: If the cable on the G Series should fail to release the hood latch when pulled, hood release can be made by reaching up between the bumper and radiator support to manually operate the latch.)

If the hood release cable is broken or disconnected on the B Series, the hood can be opened in the following manner:

1. Using a 1/2" socket and ratchet with 1/4" drive, reach up between the outboard side of the radiator and grille, and remove the two hood release latch assembly retaining screws.
2. With the two screws removed, raise the hood.
3. With the hood up, the hood release latch assembly can be removed.
4. Reassemble the hood latch assembly to the radiator support assembly.
5. Replace or repair the hood release cable as necessary.

After proper positioning of the hood bumpers, hood height is automatically controlled by the vertically self-adjusting hood latch assembly. Proper hood alignment is essential for ease of latch operation.

Adjust

1. Loosen latch attaching bolts to finger-tight.
2. Push down on hood, holding the hood closed while pulling the release lever.
3. Allow hood to open, and tighten latch bolts in new location.

HOOD RELEASE CABLE/ROD

The G Series hood latch release cable consists of two cables junctioned by means of a coupling which is mounted in the engine compartment on the left side inner fender skirt. The INNER cable (release handle to coupling) is mounted on the left side plastic shroud kick panel in the passenger compartment, then routed through the firewall, and up-along the left inner fender skirt in the engine compartment. The OUTER cable (coupling to release latch assembly) routes along that inner fender skirt, over to the radiator support, and then down into the release latch assembly.

The B Series hood latch release cable is routed the same way as the G Series, except it is of a one-piece construction.

The A, F, HM and X Series release cable is a one-piece design, mounted within the front bumper, and runs upwards to the release latch assembly located at the radiator support.

FRONT FENDER

Align

Vertical, fore, aft and lateral adjustment is provided at the rear of fender by enlarged holes in the reinforcement at attaching points, and the use of shims at these points.

1. Check the space between the front door to fender rear edge and adjust as necessary to obtain a parallel opening, also adjusting for proper fender to windshield molding and cowl vent grille clearance.
2. Check to insure that all fender attaching bolts are secure.

PAINTING AND REPAIRING NON-METAL EXTERIOR PARTS

FIBERGLASS/ABS PLASTIC PANEL REPAIR

A Plastic Solder Repair Kit can be used to repair cracks, dents, or pits in figerglass or ABS panels. A Glass Woven Cloth should be installed on the under side of a crack in the panel to structurally reinforce the panel. The following procedure can be used to repair the panels:

1. With a lacquer removing solvent, remove paint from damaged area down to the fiberglass or ABS material.
2. Scuff-sand area surrounding damaged area to provide a good bonding surface.
3. Clean area to be repaired.
4. Mix and apply the repair material by using a putty knife or rubber squeege.
5. Work the material into the repair and build up the desired contour. For deep filling, and on vertical surfaces, several layers may be required.
6. Feather-sand damaged area with No. 200 sandpaper and finish-sand with No. 320 sandpaper.
7. Prepare repaired area for refinishing. Refinish with acrylic lacquer per normal procedure.

NOTE: For a more detailed & illustrated repair procedure, see 1973 Pontiac Dealer Service Information Bulletin No. 73-I-13 Section 2 "Fiberglass Repair Procedures".

PAINTING FIBERGLASS/ABS PLASTICS

1. THOROUGHLY CLEAN the entire surface area, using Naphtha or equivalent solvent, to insure a surface free of contamination.
2. To promote paint adhesion, a light scuff-sanding of the surface with #400-grit sandpaper is recommended.
3. Repeat cleaning of the surface.
4. Color coat with acrylic lacquer for proper color match.
5. Allow to dry thoroughly and rub out polish.

ENDURA PAINT REFINISHING PROCEDURES FOR URETHANE, P.V.C. AND T.P.R. SURFACES

Urethane material will withstand minor impact and the resultant damage, such as occurs in parking lots, by recovering its original shape. Its Endura paint film responds to impact in a similar manner without cracking or splitting. If, however, an area of damage in the Urethane bumper or panel does not recover its shape or the surface is gouged, a repair system has been developed to restore the original shape and appearance of the Urethane-base material.

I. REPAIRING & REFINISHING URETHANE BUMPERS AND HEADLAMP MOUNTING PANELS

A. Required Materials:

1. Patch Pkg. - GM Part No. 1050951 or equivalent
(Part A - Flexible Resin)
(Part B - Resin Hardener)
2. Surfacer (Filler Putty) - GM No. 1050834 or equivalent
3. Dexlar (Dupont) Flexible Finish Enamel Color Coat or Equivalent
4. Dupont 792S Centari Hardener or Equivalent
5. Dupont 3608S Acrylic Lacquer Thinner or Equivalent

B. Equipment Needed:

1. Wooden Spatula (enclosed in Patch Pkg.)
2. Heat lamp(s)
3. #150, #220 and #400-grit sandpapers
4. DA Sander with 80-grit discs
5. Suction spray gun (same nozzle and air cap combination as used for acrylic application)

C. Repair & Refinish Procedure for Cuts or Gouges:

1. CLEAN the repair area, using Naphtha or equivalent solvent, to insure a surface free of contamination.
2. Cut away damaged area of Urethane (Endura) material, using a DA Sander and a clean #80-grit disc. Adjust the sander, using the #80-grit disc, to a feathering action and remove the paint in-and-around the area to be repaired (This is necessary because the patching compound will adhere only to the Urethane material.).
3. Wet-sand the paint film in this area with #220-grit paper, finishing up with #400-grit *and feathering edges well.* Tapering the edges minimizes the possibility of highlighting the repaired area.
4. Repeat Step No. 1 to remove sanding dust. This step will enhance the adhesion of the patching material to the area being repaired.
5. Mix the patching compound and hardening agent to the prescribed portion, as outlined in the procedure enclosed in GM Repair Patch Kit #1050951 (or equivalent).

6. Let the mixture set for approximately 5 minutes.

7. Place a length of masking tape under each side of the cut-away area, so that when folded back it will cover the area.

8. Fill the damaged area slightly above the area being repaired to allow for sanding. *Cover fill area with tape.* Deep holes should be filled in stages to avoid gassing or air entrapment. The patch will air-dry to a sanding state in approximately one (1) hour (Curing may be accelerated by careful exposure to heat.).

CAUTION: *Too-early removal of tape from filled area could possibly tear the patching material.*

9. Wet-sand the cured patch level with adjacent areas. If holes appear in patch area, repeat filling procedure.

10. If pitting occurs, fill pits by rubbing patch surface with Endura Surfacer GM #1050834 or equivalent.

11. Endura Surfacer should be applied in *light, even* coats. Allow to dry 15-20 minutes. Sand, using #400-grit paper (This step may have to be repeated several times to minimize the possibility of highlighting the repaired area.).

12. Wet-sand the entire bumper or panel with #150-grit sandpaper.

D. Coloring Procedure:

1. THOROUGHLY CLEAN the entire surface area, with 3919S Prepsol (Dupont) or equivalent solvent, to insure a surface free of contamination.

2. To promote paint adhesion and insure a smooth surface, a light scuff-sanding with #400-grit sandpaper (wet or dry) is recommended.

3. Repeat cleaning of the surface.

NOTE: Under no circumstances should acrylic lacquer paint be used in refinishing urethane or P.V.C. materials. Although the finish may appear satisfactory, it will crack from physical contact.

4. Mask off areas of car not to be painted using masking tape and paper.

5. Thoroughly mix four (4) parts color coat with one (1) part hardener and four (4) parts acrylic lacquer thinner (follow label directions).

NOTE: Mix only what is needed, noting that pot life is 2-3 hours.

CAUTION: *Because of the isocyanates contained in the hardener, it is mandatory that a Willson Paint Spray Respirator or equivalent respirator be worn during the entire painting process. Also, read entire label on hardener container before spraying as persons with respiratory problems or those allergic to isocyanates must not be exposed to the isocyanate vapors or spray mist.*

6. Using 35 lbs. of pressure at the gun, spray panel with 2 or 3 coats (depending on the need) allowing 2-3 minutes flash time between each coat.

NOTE: Use a final mist coat for metallics.

7. Allow paint to cure 2-4 hours before handling.

8. COMPOUNDING reduces the gloss. For this reason rubbing compound should be used **only if a reduction of gloss is desired.**

II. PAINTING PRIMED SERVICE REPLACEMENT URETHANE BUMPERS/ HEADLAMP MOUNTING PANELS & COLORED PLASTIC BUMPER CLOSE-OUT PANELS

Follow Steps 1 thru 8 of Section I-D "Coloring Procedure".

1977 NON-METAL EXTERIOR PAINTED PARTS

SERIES	PART NAME	MATERIAL MADE OF
A	Bumper Filler	Vinyl (use vinyl paint)
B	Headlamp Outer Bezel Panels	Fiberglass
B	Lower Tail Lamp Panel Inserts	Fiberglass
G	Header Panel	Fiberglass
G	Bumper Filler	T.P.R.
F	Formula Hood Scoops	Fiberglass
F	T/A Shaker Hood Scoop	Fiberglass
F	T/A Side Air Extractor	Fiberglass
F	Rear Air Spoiler & Extensions	Fiberglass
F	T/A Side Spoilers	ABS - Stocked in colors
F	Front Lower Air Spoiler	ABS
F	Front End Panel	Urethane
F	Rear Bumper	Urethane
X	Bumper Filler	Urethane
H & HM	Tail Panel	Urethane
H & HM	Lower Front Valance Panel	E.E.D. (Non Paintable) Service Part is T.P.R.

PROPER IDENTIFICATION AND PAINTING OF INTERIOR PLASTIC TRIM

The General Motors Parts Division has initiated a system of supplying a high percentage of interior plastic trim parts in only one color to reduce quantities of like parts in different colors. When a color change is required in service, it will be necessary to paint the parts at the dealership. This does not apply to most headlinings or to soft vinyl seat cushion and back cover assemblies, as they will continue to be furnished in colors (F, H & X Series molded headliner panels are to be vinyl spray colored).

G.M.P.D. will send the ordered color if available. If the desired color is not available, a black part will be sent which will need to be painted the proper color at the dealership.

INSTRUCTIONS ON HOW TO IDENTIFY each paintable plastic part, and how to apply the available paint materials are as follows:

Paintable plastic trim components, as used on General Motors interiors, can be divided into three general types:

Polypropylene Plastic

ABS Plastic

Vinyl Plastic

Excluding the soft vinyl seat cushion and seat back trim cover assemblies, the plastic used most widely on the interior of bodies is "POLYPROPYLENE" and, as noted later, requires special refinishing materials and procedures. Therefore, it is important for a painter to be able to identify each plastic in order to paint it satisfactorily. The purpose of the following tests is to determine the identity of a given plastic so that the proper paint procedure and refinishing materials will be used.

TEST PROCEDURE

Polypropylene, ABS or Vinyl Plastic

1. From a hidden backside portion of the part, remove a sliver of plastic with a sharp blade.
2. Holding the sliver with needle-nose pliers, put it to a flame and observe whether or not any smoke is given off when burning.
3. ABS PLASTIC will give off a HEAVY BLACK SMOKE, and POLYPROPYLENE will burn clean.
4. However, if a sliver gives off OTHER THAN HEAVY BLACK SMOKE, it is either DIRTY POLYPROPYLENE OR IS VINYL. To determine which it is, the following burn test should be made with the hot tip of a clean copper wire.
5. Heat the tip of the copper wire to a "red-glow" with a propane (gas) torch.
6. Touch the heated wire to a hidden portion of the plastic in question, to get some of the plastic on the wire.
7. Return the wire, with its now plastic-coated tip, to the flame and observe for flame color.
8. If the flame given off from the wire is of the GREEN-TURQUOISE-BLUE RANGE, then the PLASTIC IS VINYL. (Any other color flame would indicate the material is dirty polypropylene.)

PAINTING INTERIOR PLASTIC PARTS

Before painting, always check the body number plate of the car for the correct trim code color number for that model year. Your Fisher Body Service Manual will give you the plate's location. Interior color is color keyed to this "Trim Combination Number" on the body plate. Each paint supplier provides an interior color chart which indentifies his stock number, color name, gloss factor and trim combination number for each "conventional" interior color. Charted

1977 PONTIAC EXTERIOR COLORS

PAINT CODE	COLOR NAME	FISHER WA NUMBER	DU PONT "LUCITE" CODE	R-M "A" CODE	DITZLER "DDL" CODE	USAGE
11	Cameo White	3967	5538L	2080	2058	All
13	Sterling Silver Met.	4963	44716L	8680	2953	All
15	Gray Poly (Two-Tone Only)	4784	44146L	2928	2862	B,G–LJ & SJ
16	Medium Gray Met.	––	44723L	8681	––	B,G–LJ & SJ
19	Starlight Black	848	99L	946	9300	All
21	Lombard Blue	4779	44133L	2929	2815	H,F–Skybird
22	Glacier Blue Met.	4964	44717L	8682	2955	All (Exc. H & T/A)
29	Nautilus Blue Met.	4965	44718L	8685	2959	All (Exc. T/A)
32	Royal Lime	7000	44771LH	8686F	2960	H
36	Firethorn Red Met.	4748	43953LM	2916F	2811	All (Exc. T/A)
37	Cordovan Maroon Met. (Two-Tone Only)	4759	44131LM	2931G	2864	B,G–LJ & SJ
38	Aquamarine Met.	4984	44714L	8687	2961	F,X,H,H-SP (Exc. T/A)
44	Bahia Green Met.	4966	44719LH	8690	2964	All (Exc. H & T/A)
48	Berkshire Green Met.	4967	44720LH	8691	2965	A,B,G
50	Cream Gold	4890	44178L	2996	2884	A,B,G
51	Goldenrod Yellow	3893	44139LH	2936D	2094	F,X,H,H-SP
61	Mojave Tan	4891	44713L	2999	2869	All (Exc. T/A)
63	Buckskin Met.	4997	44722L	8695D	2970	All (Exc. H & T/A)
64	Fiesta Orange	4909	44790LH	8696R	2968	H
69	Brentwood Brown Met.	4968	44721LH	8698F	2972	All
72	Roman Red	4998	44770LH	8699F	2973	A,B,G
75	Buccaneer Red	4330	5485LM	2650F	2546	F,X,H,H-SP
78	Manderin Orange	4913	44715LM	8702F	2976	All (Exc. T/A)
–	Lower Skybird Blue	7016	44855	––	15109	Skybird Only
––	Lower Formula Black	––	––	––	9423	H & F Formula
––	Sp. Ed. T/A Gold (Whls., H/L Bezel, etc.) (Also Lower Formula Gold)	7015	44856L	––	82352	Sp. Ed. T/A Only Formula

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Fig. 2C-2 1977 Pontiac Exterior Colors

listing of "vinyl" interior colors are also provided.

"CONVENTIONAL" interior acrylic colors are designed for use only on hard trim parts, such as:

a. Steel parts (primer or sealer required on new service parts).

b. Hard POLYPROPYLENE plastic ("Special Primer" required-GM Part Number 1051497 or equivalent).

c. Hard ABS plastic (NO primer necessary).

"VINYL" interior colors are designed for soft and/or flexible trim parts, such as:

Instrument panel cover pad assemblies, upper door trim pad assemblies, molded headlining panels, head rests and assist handles. These colors require a final top of clear vinyl spray, with instrument panel pads requiring a "non-glare" clear final top coat. Other trim parts require a degree of gloss to match similar adjacent parts.

"POLYPROPYLENE" PLASTIC PARTS

The system for painting polypropylene parts involves the use of a special primer. It is essential that the service part be first primed with a coating of special POLYPROPYLENE PRIMER (G.M.P.D. Part Number 1051497, Detroit Auto #PP-2250, or equivalent) according to factory recommendations on the can. Because the primer acts as a bonding agent between the plastic and acrylic lacquer, failure to use it will result in color coat "lifting" and/or "peeling" problems. After priming, the part can be color coated with conventional interior acrylic lacquer.

PROCEDURE

1. Wash part throughly with a cleaning solvent ("Acryli-Clean", "Prep-Sol" or equivalent) that will not leave any greasy film.

2. Apply a thin, wet coat of the special polypropylene primer according to label directions on can. Wetness of primer is best determined by observing gloss reflection of spray application in adequate lighting. Be sure primer application includes all edges. Allow the primer to flash dry ONE (1) MINUTE MINIMUM and TEN (10) MINUTES MAXIMUM. (If the flash period before color coating should extend beyond ten minutes, the primer MUST be reapplied to avoid previously mentioned adhesion problems.)

3. During the above flash time period (1 to 10 minutes), apply appropriate "conventional" interior acrylic lacquer color as required and allow painted part to dry for 4 to 5 hours before installing on car.

"RIGID OR HARD ABS" PLASTIC PARTS

Rigid or hard ABS plastic requires no primer. "Conventional" interior acrylic lacquers adhere satisfactorily to hard ABS plastics.

PROCEDURE

1. Wash part thoroughly with a cleaning solvent ("Acrylic-Clean," "Pre-Kleano," "Prep-Sol" or equivalent) to remove any dirt or grease.

2. Apply appropriate "conventional" interior acrylic lacquer color.

3. Allow to dry and then install part.

NOTE: Apply only sufficient color for proper hiding to avoid washout of "grain" effect.

"VINYL AND FLEXIBLE (SOFT) ABS" PLASTIC PARTS

The outer cover or skin material of "flexible" instrument panel cover (pad) assemblies is made of an ABS/PVC plastic blend. The same is true of many "padded" door trim assemblies. The soft cushion padding under the I.P. skin is urethane foam plastic. The most widely used "flexible" vinyls (poly vinyl chloride) are coated fabrics, such as used in seat trim, some door trim assemblies, molded headlining panels and sun visors. Most head rests are "flexible" vinyls. Examples of "hard" vinyls are: door and front seat back assist handles and coat hooks.

The paint system of vinyl and flexible ABS plastic involves the use of interior "vinyl" color and a clear vinyl top coat.

NOTE: No primer or primer-sealer is required.

PROCEDURE

1. Wash part thoroughly with a vinyl cleaning and preparation solvent ("Vinyl Press"-Ditzler, "Vinyl Prep Conditioner"-Detroit Autobody or equivalent) to remove greasy film or silicone. Wipe off cleaner while still wet with clean, lint-free cloth.

2. Immediately after wiping face dry, apply interior " vinyl" color in wet coats allowing sufficient flash time between coats (see label directions on can). Use proper "vinyl" color as designated by interior trim combinations.

3. Before the final vinyl color coat has dried, apply two coats of clear vinyl top coat spray (instrument panels will require the "non-glare" clear top coat). Do not allow the first spray coat to completely dry before spraying on the second. Use top coat with appropriate gloss level to match adjacent similar components. This clear coat is necessary to control the gloss requirement and prevent "cracking" (rubbing-off) of the color coat after drying.

4. Allow to dry according to label directions before installing part.

NOTE: Apply only sufficient color for proper hiding to avoid washout of "grain" effect.)

SERVICE PROCEDURES

Following are the exploded service procedures for the front end and fenders and hood. Also, included are the various decal and molding attachment locations.

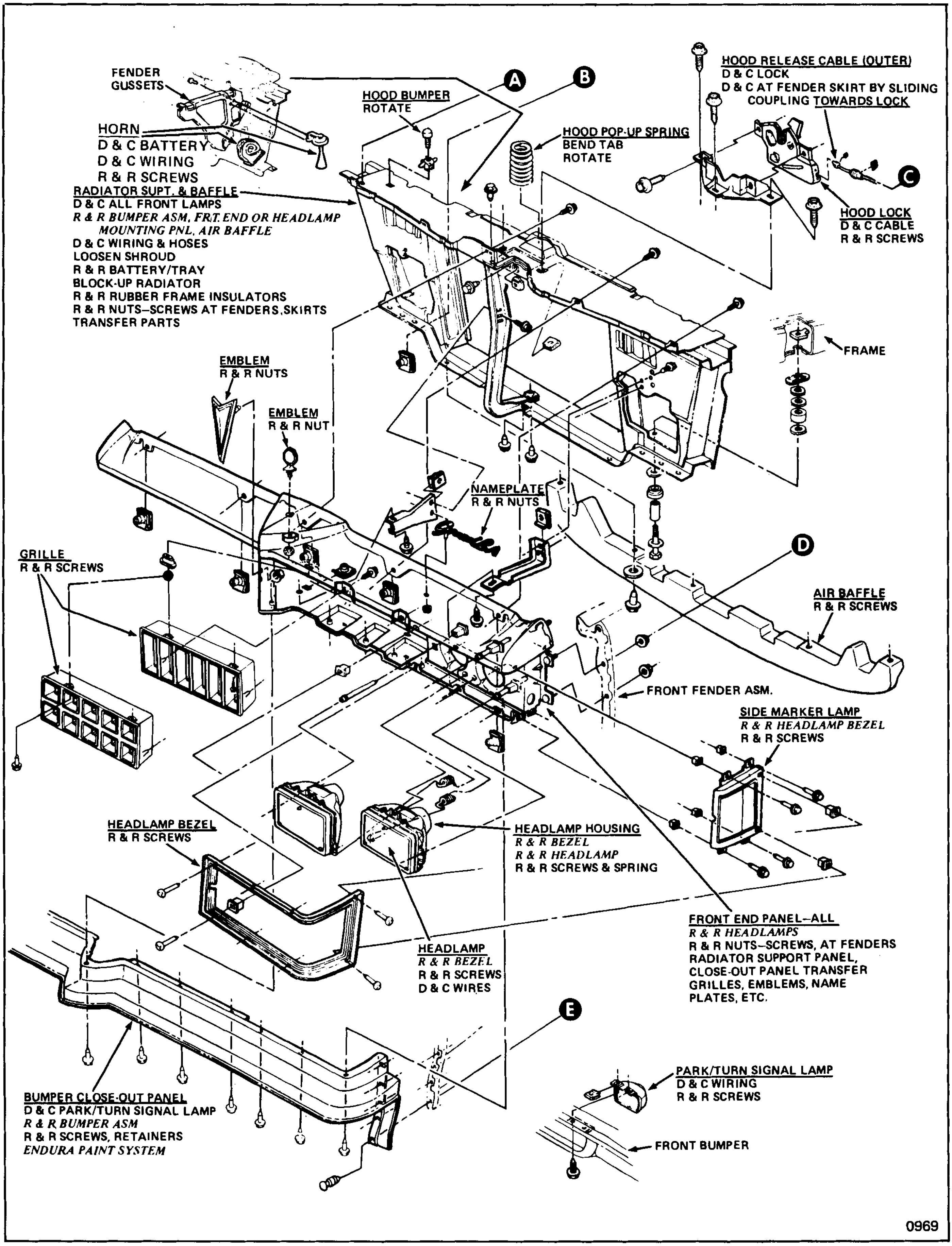


Fig. 2C-3 Exploded Service Procedures - "A" Series - Front End

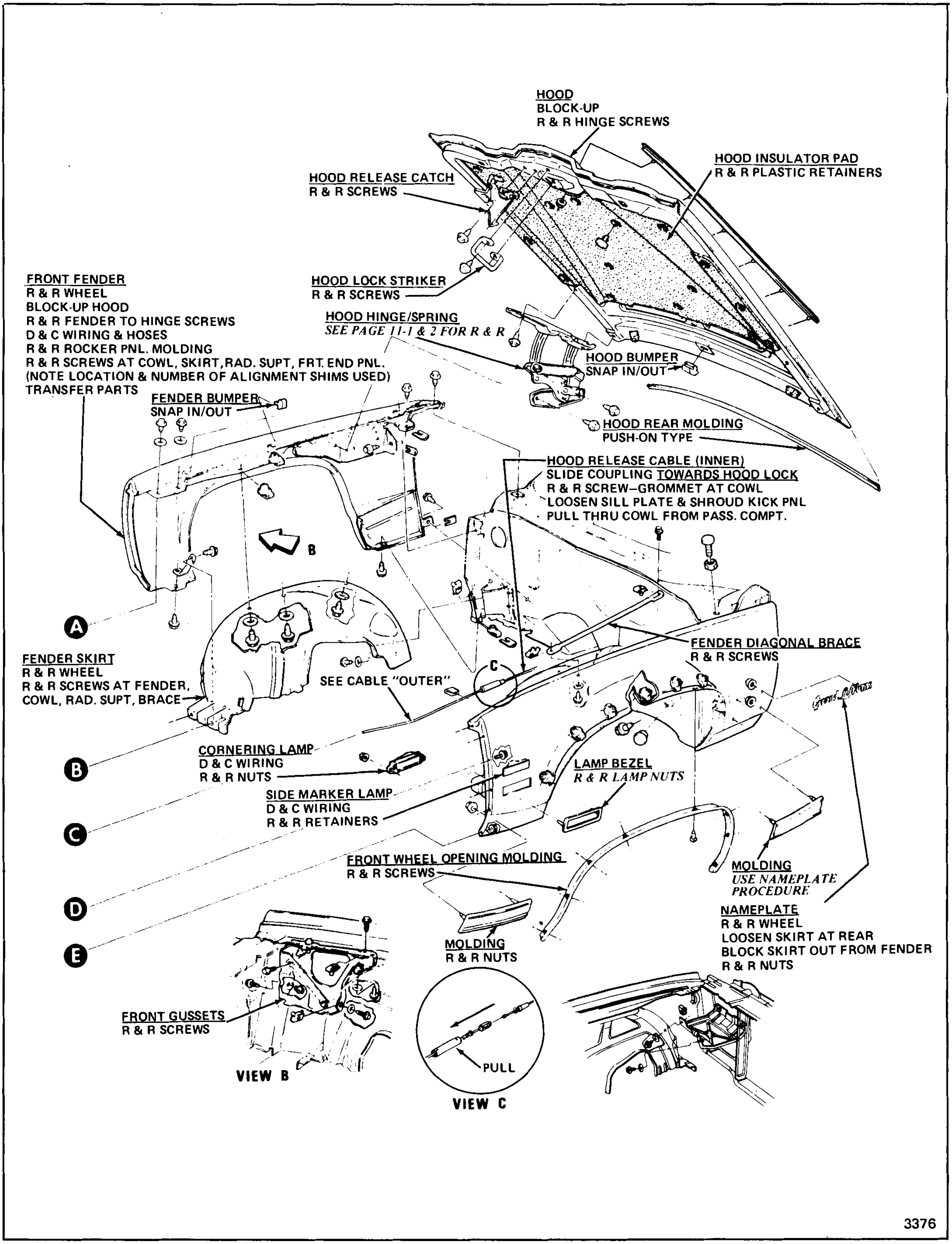


Fig. 2C-4 Exploded Service Procedures - "A" Series - Fenders and Hood

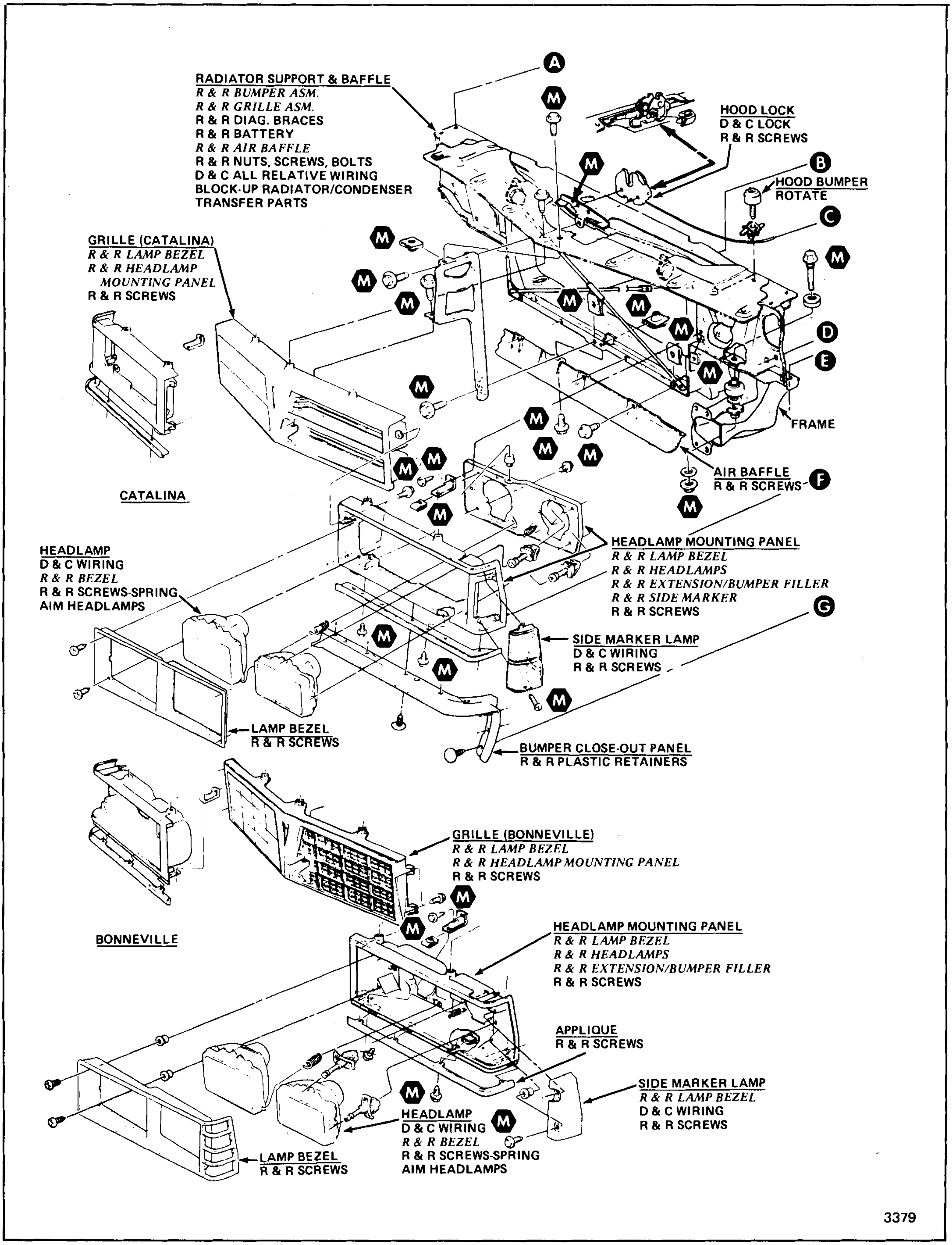


Fig. 2C-5 Exploded Service Procedures - "B" Series - Front End

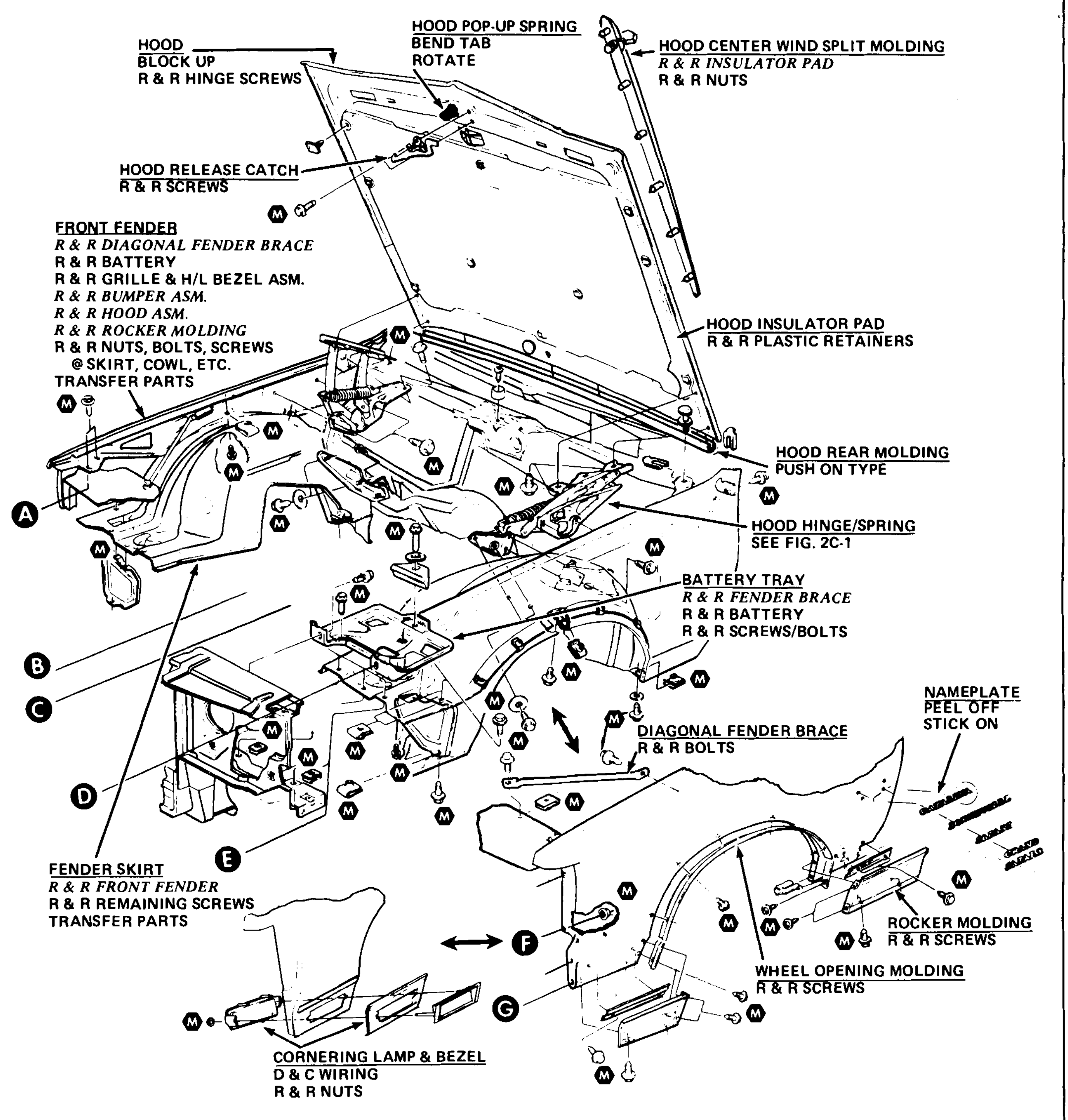


Fig. 2C-6 Exploded Service Procedures - "B" Series - Fenders and Hood

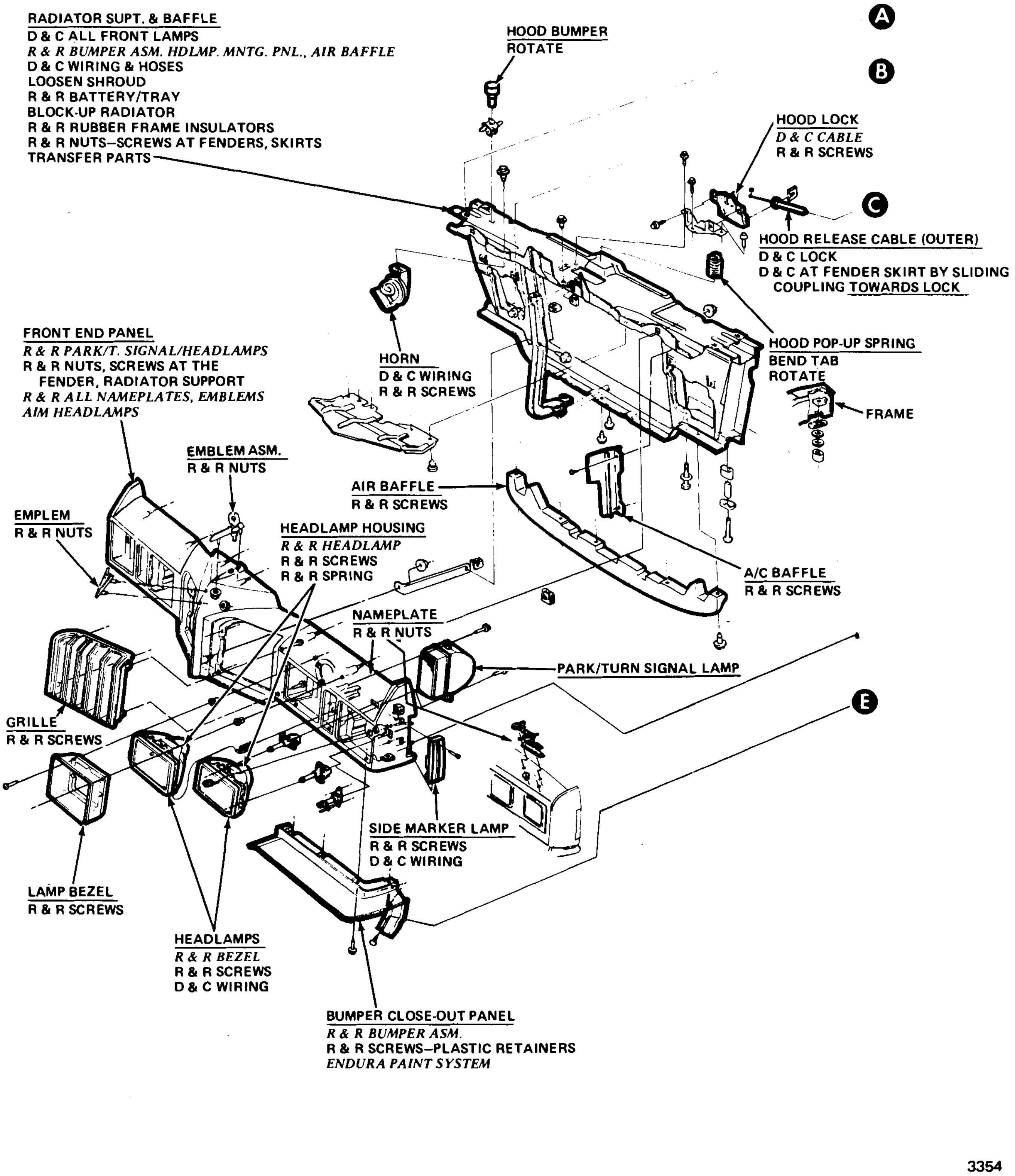


Fig. 2C-7 Exploded Service Procedures - "G" Series - Front End

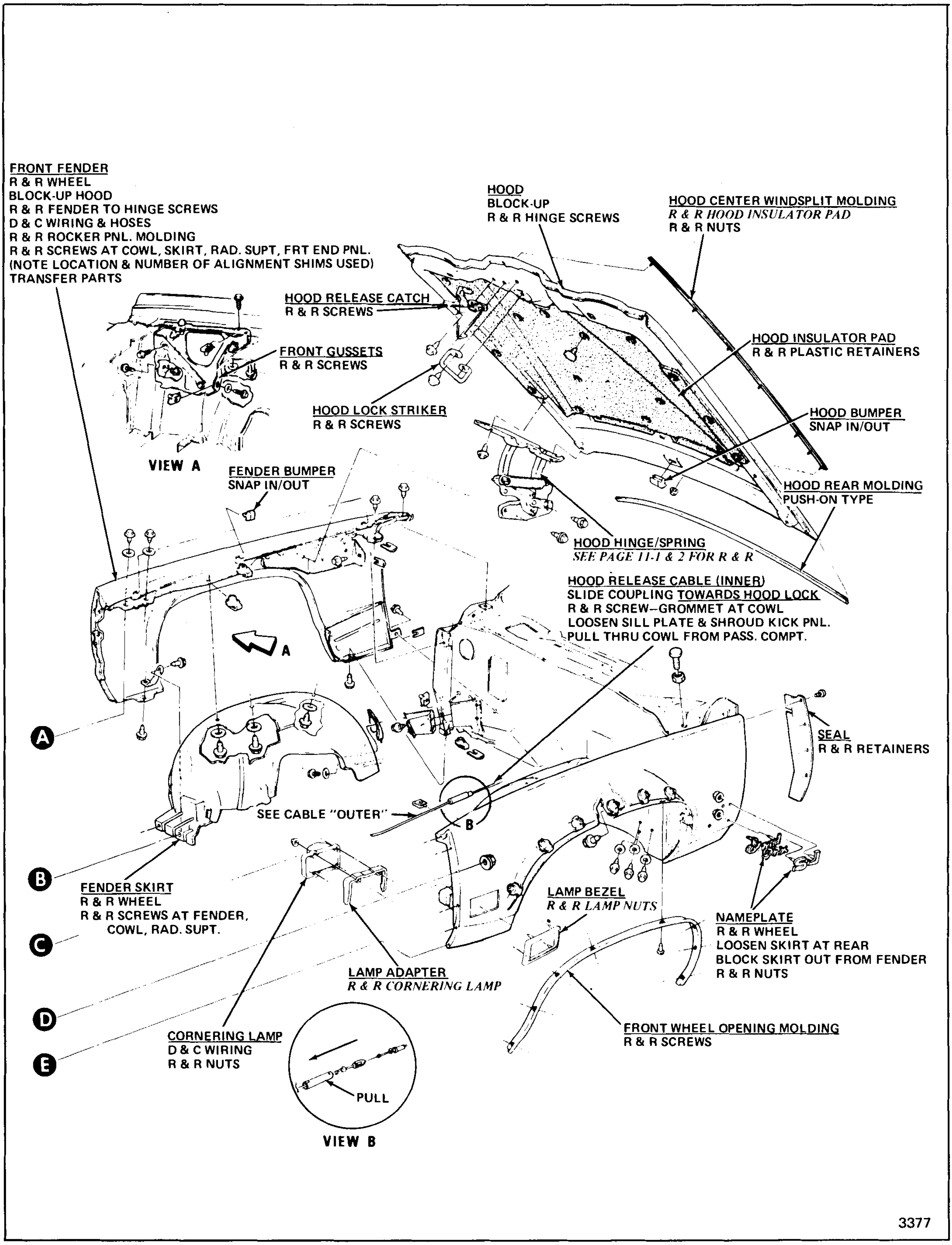
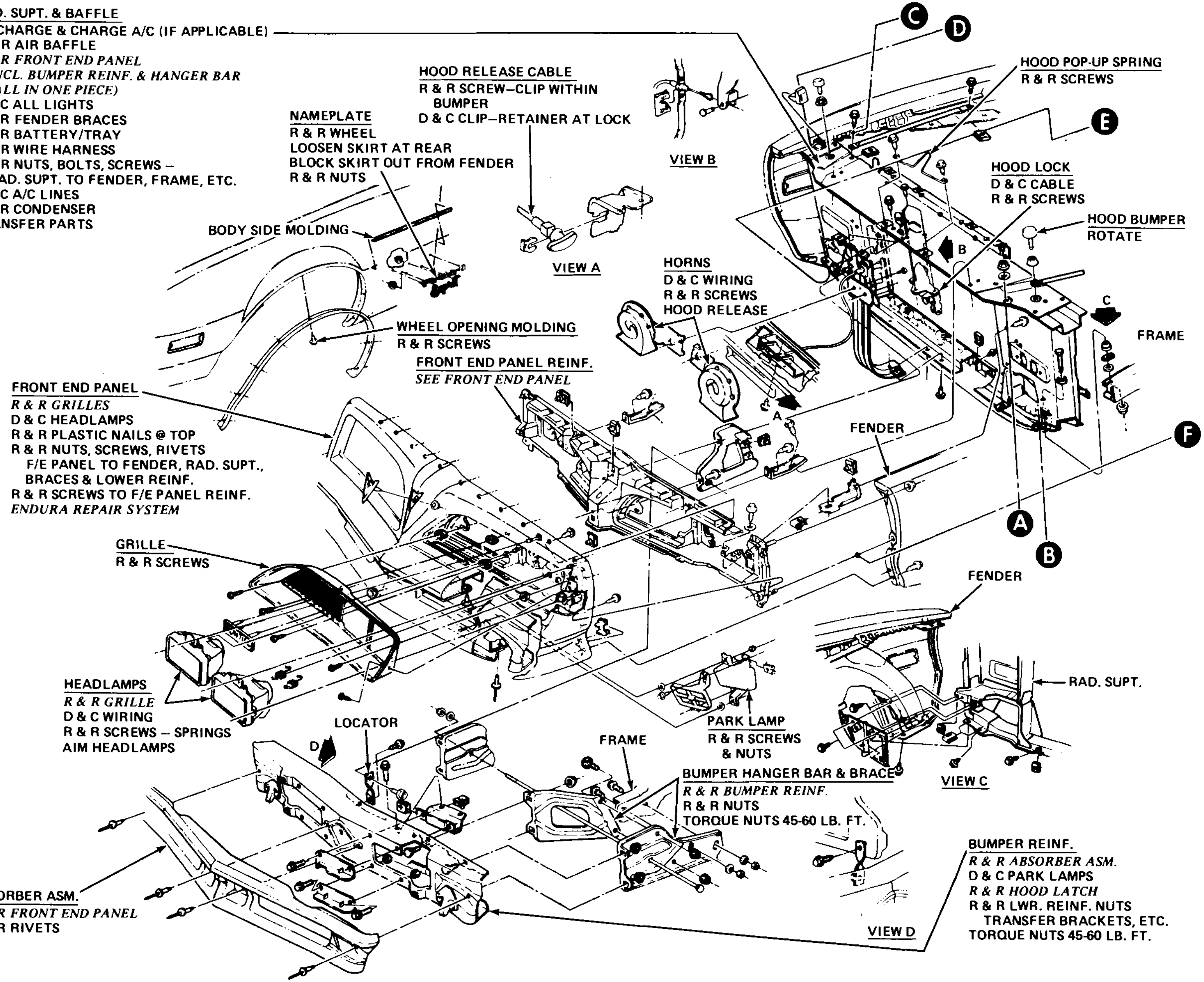


Fig. 2C-8 Exploded Service Procedures - "G" Series - Fenders and Hood



RAD. SUPT. & BAFFLE
DISCHARGE & CHARGE A/C (IF APPLICABLE)
R & R AIR BAFFLE
R & R FRONT END PANEL
INCL. BUMPER REINF. & HANGER BAR
(ALL IN ONE PIECE)
D & C ALL LIGHTS
R & R FENDER BRACES
R & R BATTERY/TRAY
R & R WIRE HARNESS
R & R NUTS, BOLTS, SCREWS –
RAD. SUPT. TO FENDER, FRAME, ETC.
D & C A/C LINES
R & R CONDENSER
TRANSFER PARTS

NAMEPLATE
R & R WHEEL
LOOSEN SKIRT AT REAR
BLOCK SKIRT OUT FROM FENDER
R & R NUTS

HOOD RELEASE CABLE
R & R SCREW–CLIP WITHIN
BUMPER
D & C CLIP–RETAINER AT LOCK

HOOD POP-UP SPRING
R & R SCREWS

HOOD LOCK
D & C CABLE
R & R SCREWS

HOOD BUMPER
ROTATE

HORNS
D & C WIRING
R & R SCREWS
HOOD RELEASE

BODY SIDE MOLDING

WHEEL OPENING MOLDING
R & R SCREWS

FRONT END PANEL REINF.
SEE FRONT END PANEL

FRONT END PANEL
R & R GRILLES
D & C HEADLAMPS
R & R PLASTIC NAILS @ TOP
R & R NUTS, SCREWS, RIVETS
F/E PANEL TO FENDER, RAD. SUPT.,
BRACES & LOWER REINF.
R & R SCREWS TO F/E PANEL REINF.
ENDURA REPAIR SYSTEM

GRILLE
R & R SCREWS

HEADLAMPS
R & R GRILLE
D & C WIRING
R & R SCREWS – SPRINGS
AIM HEADLAMPS

PARK LAMP
R & R SCREWS
& NUTS

BUMPER HANGER BAR & BRACE
R & R BUMPER REINF.
R & R NUTS
TORQUE NUTS 45-60 LB. FT.

BUMPER REINF.
R & R ABSORBER ASM.
D & C PARK LAMPS
R & R HOOD LATCH
R & R LWR. REINF. NUTS
TRANSFER BRACKETS, ETC.
TORQUE NUTS 45-60 LB. FT.

ABSORBER ASM.
R & R FRONT END PANEL
R & R RIVETS

Fig. 2C-9 Exploded Service Procedures - "F" Series - Front End and Front Bumper

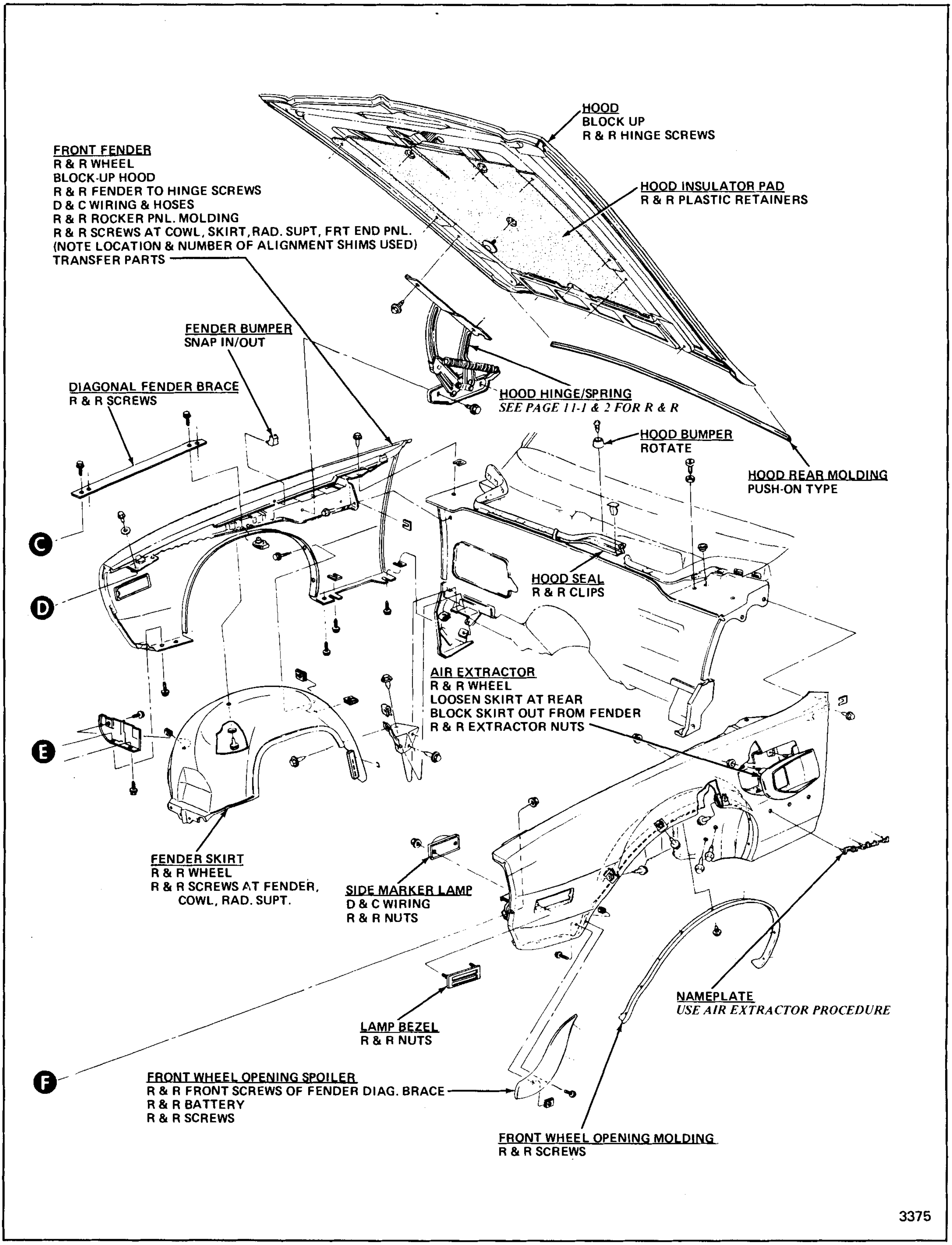


Fig. 2C-10 Exploded Service Procedures - "F" Series - Fenders and Hood

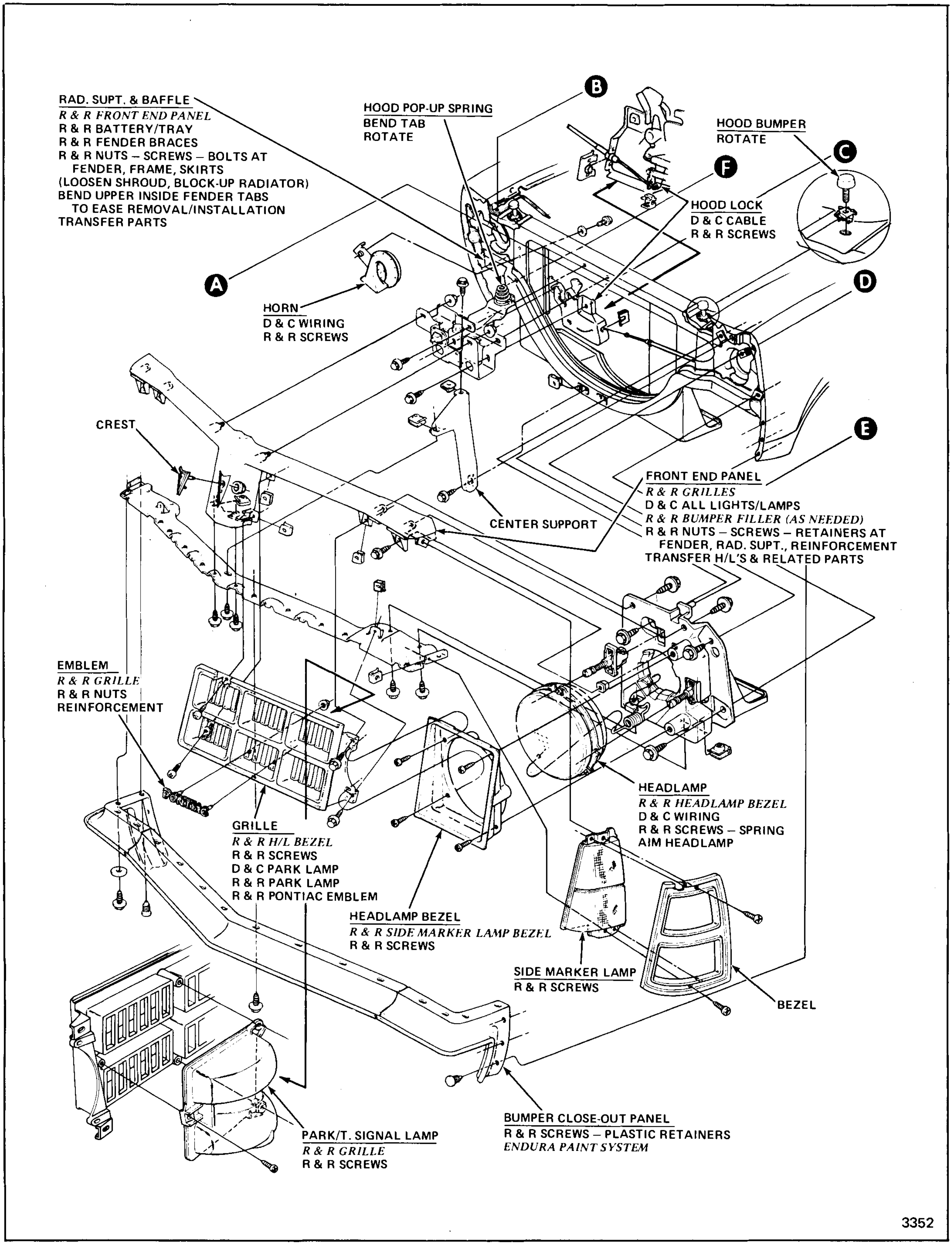


Fig. 2C-11 Exploded Service Procedures - "X" Series - Front End

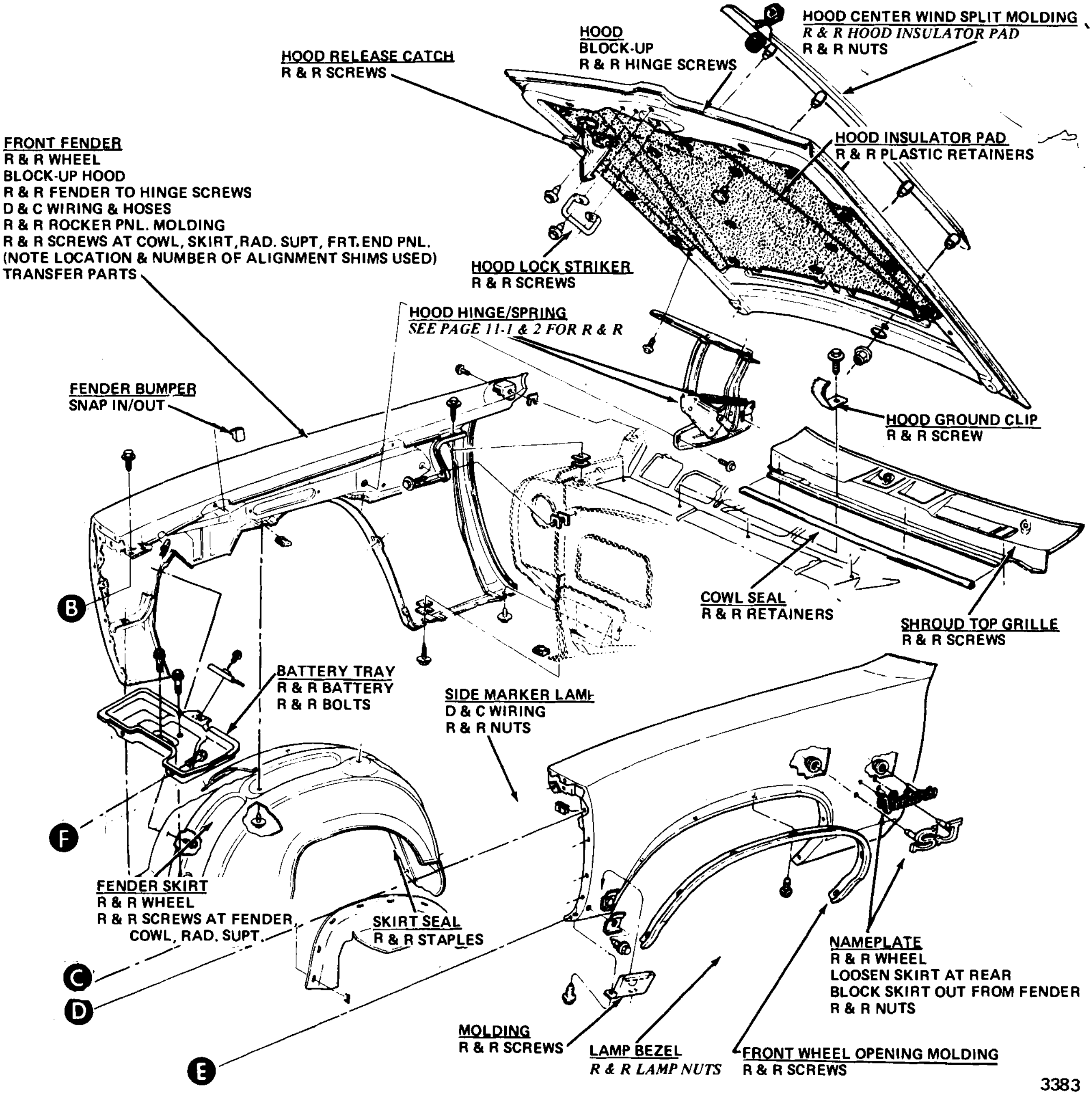


Fig. 2C-12 Exploded Service Procedures - "X" Series - Fenders and Hood

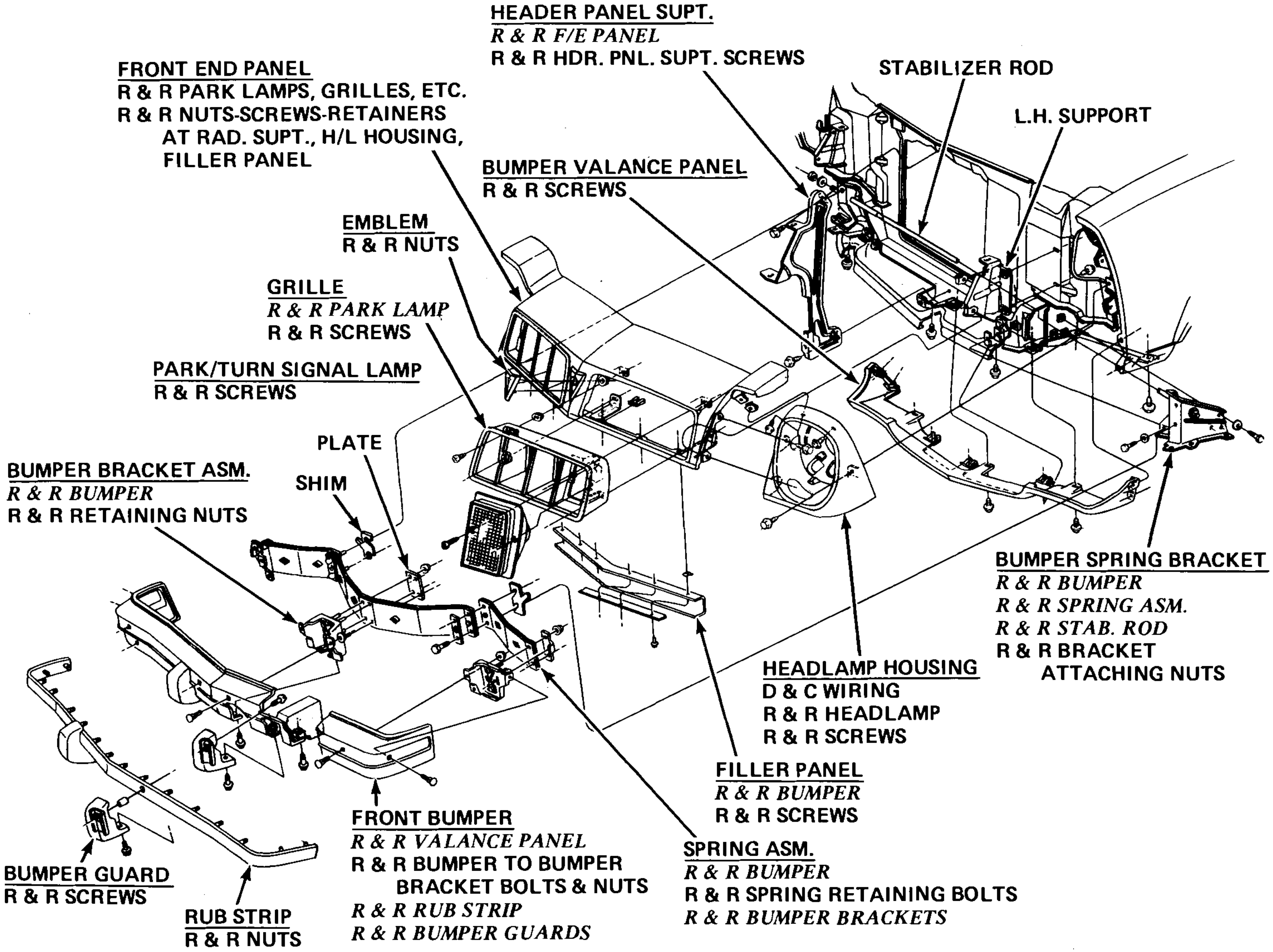


Fig. 2C-13 Exploded Service Procedures - "H" Series - Front End and Front Bumper

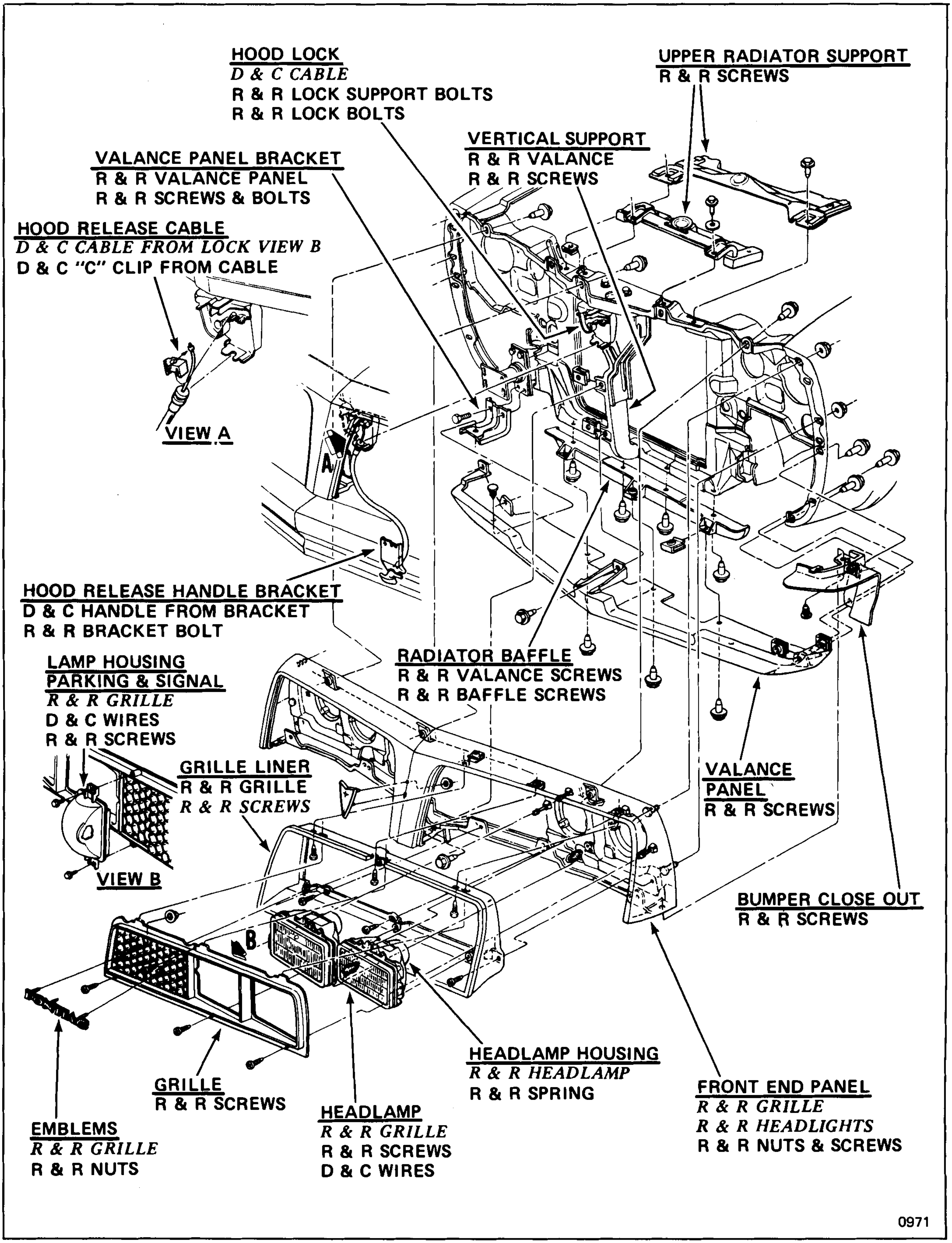


Fig. 2C-14 Exploded Service Procedures - "HM" Series - Front End

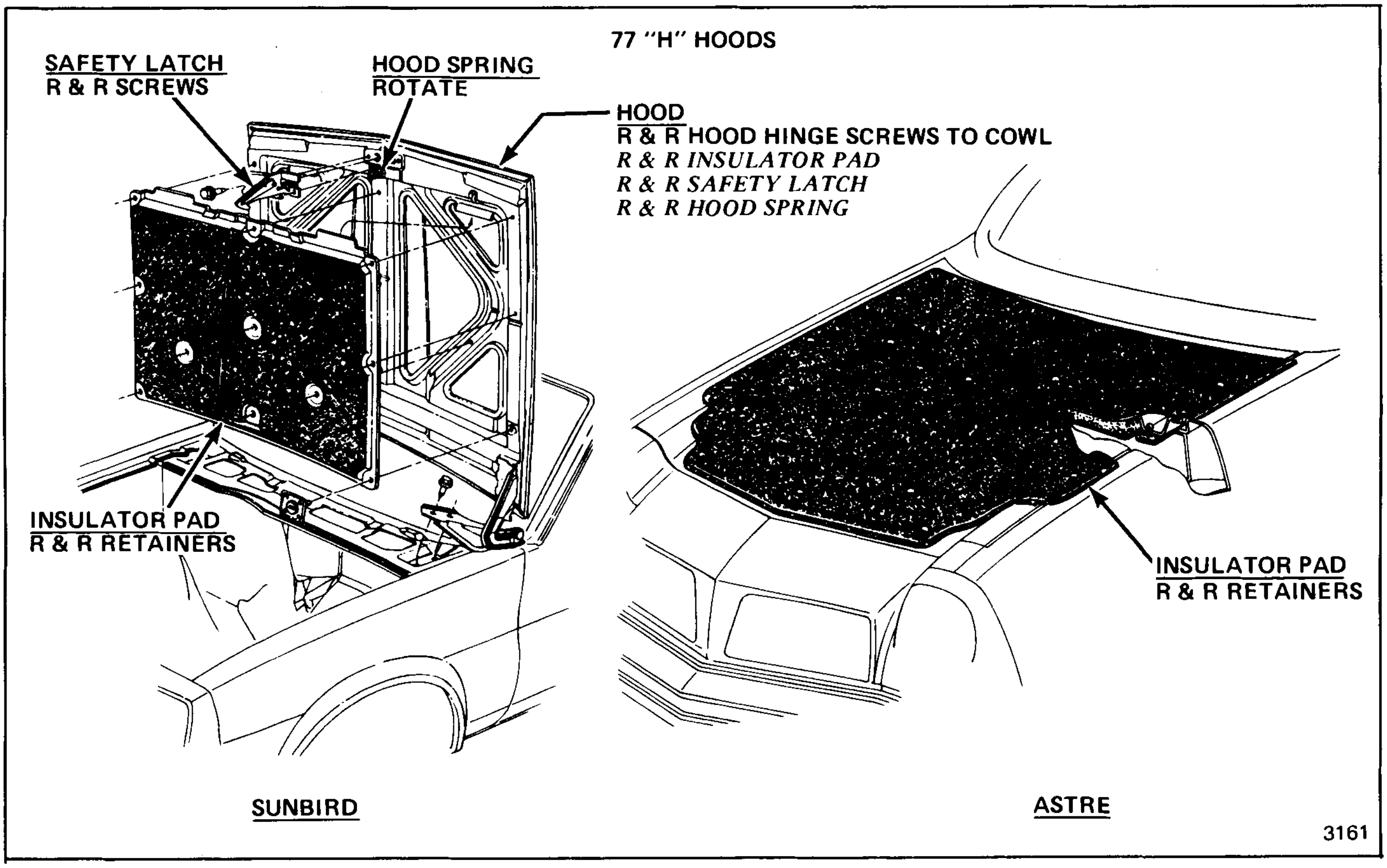


Fig. 2C-15 "H" Series and "HM" Series - Hoods

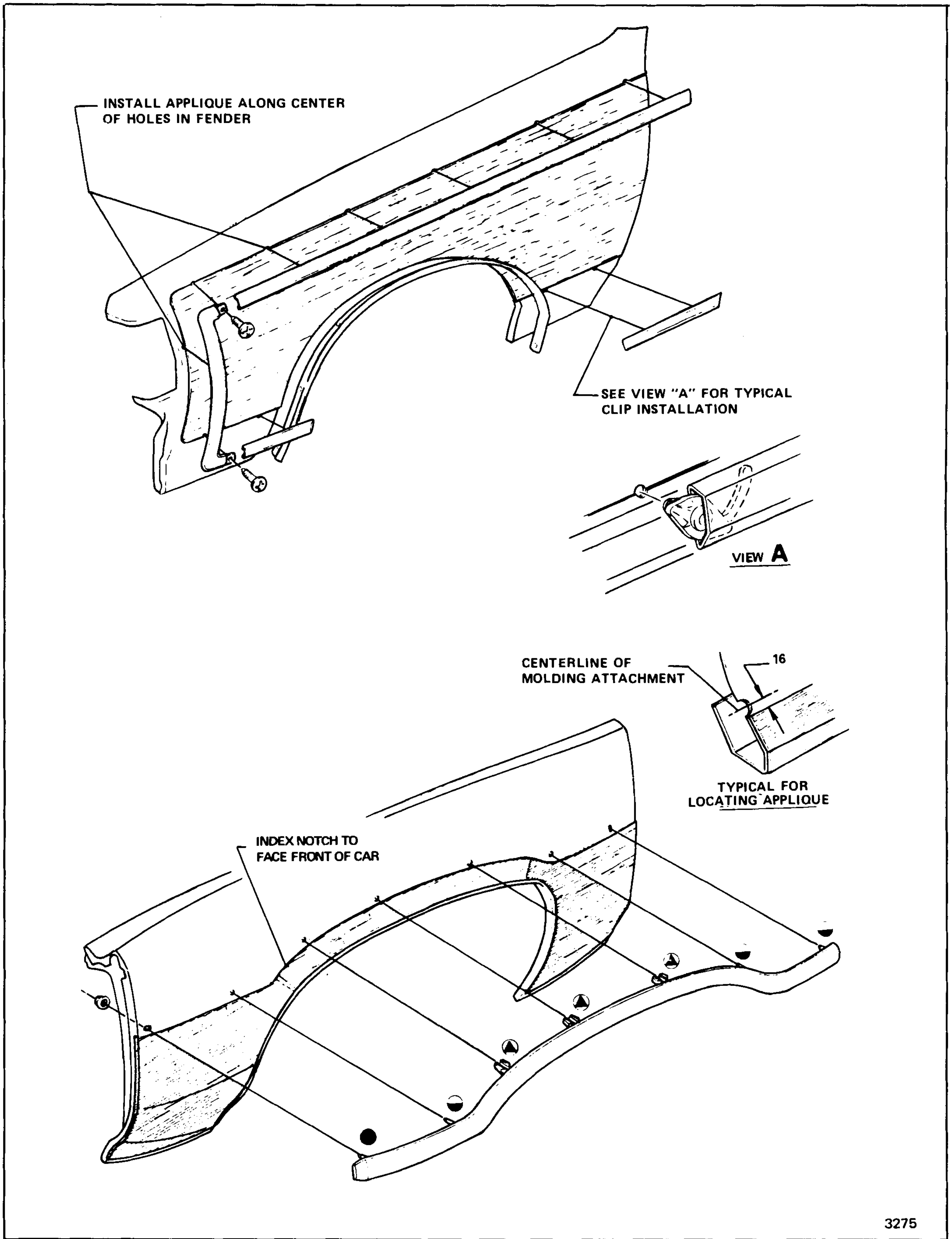


Fig. 2C-16 "A" Series and "B" Series - Woodgrain Molding Attachments

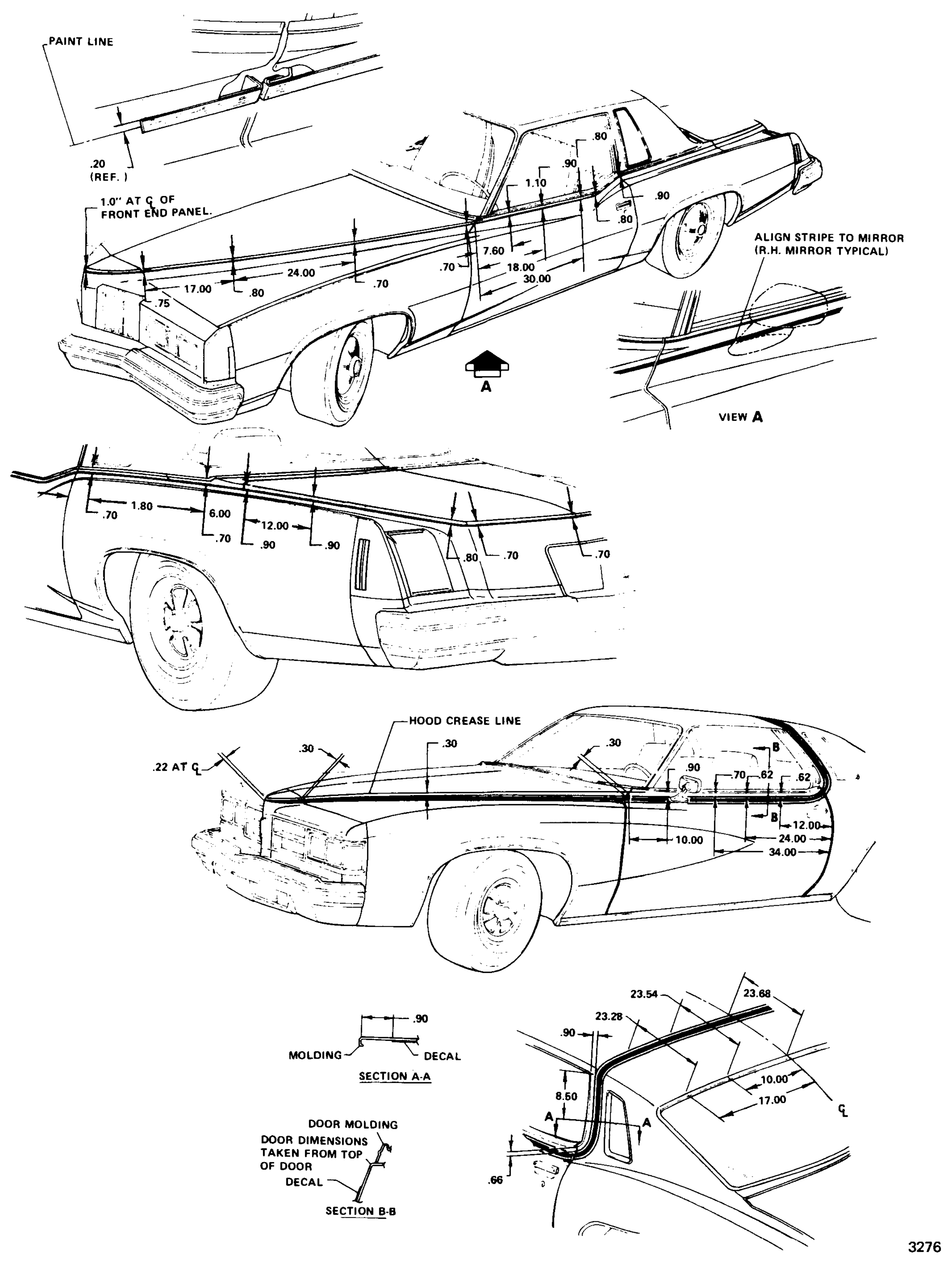
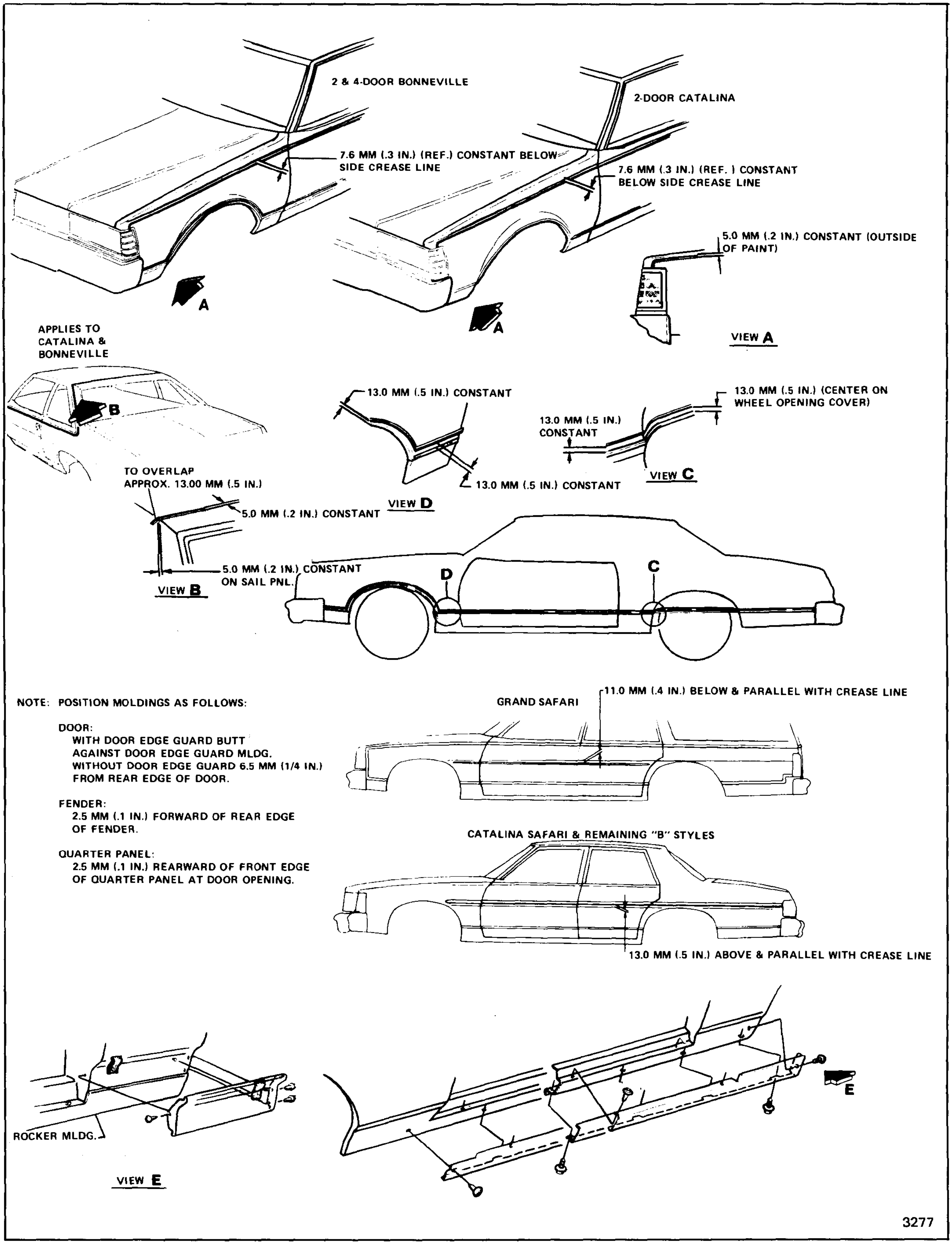


Fig. 2C-17 "A" Series and "G" Series - Stripe Decals



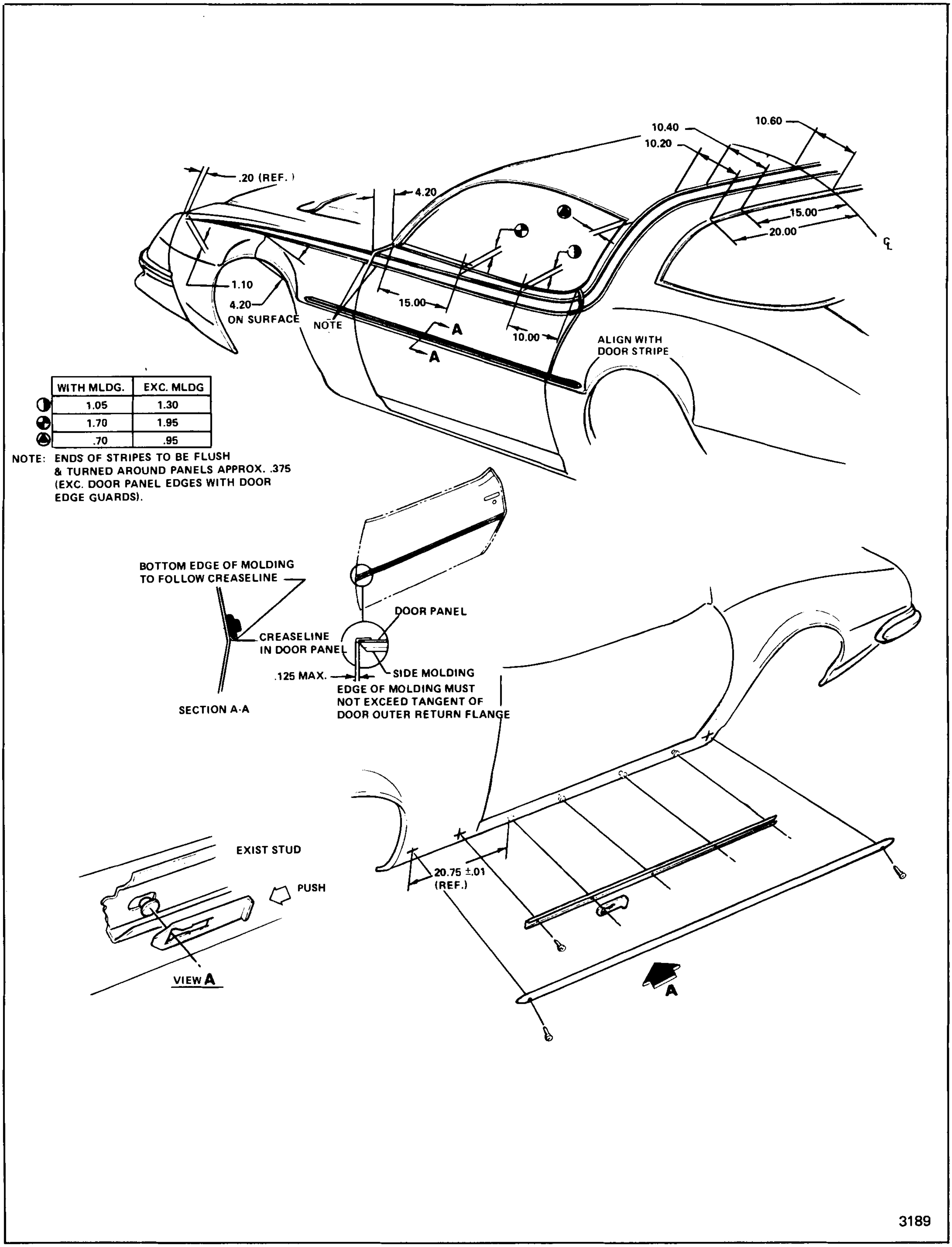
NOTE: POSITION MOLDINGS AS FOLLOWS:

DOOR:
WITH DOOR EDGE GUARD BUTT AGAINST DOOR EDGE GUARD MLDG.
WITHOUT DOOR EDGE GUARD 6.5 MM (1/4 IN.) FROM REAR EDGE OF DOOR.

FENDER:
2.5 MM (.1 IN.) FORWARD OF REAR EDGE OF FENDER.

QUARTER PANEL:
2.5 MM (.1 IN.) REARWARD OF FRONT EDGE OF QUARTER PANEL AT DOOR OPENING.

Fig. 2C-18 "B" Series - Stripe Decals and Moldings



	WITH MLDG.	EXC. MLDG
◑	1.05	1.30
⊕	1.70	1.95
◬	.70	.95

NOTE: ENDS OF STRIPES TO BE FLUSH & TURNED AROUND PANELS APPROX. .375 (EXC. DOOR PANEL EDGES WITH DOOR EDGE GUARDS).

Fig. 2C-19 "F" Series - Esprit - Stripe Decals and Moldings

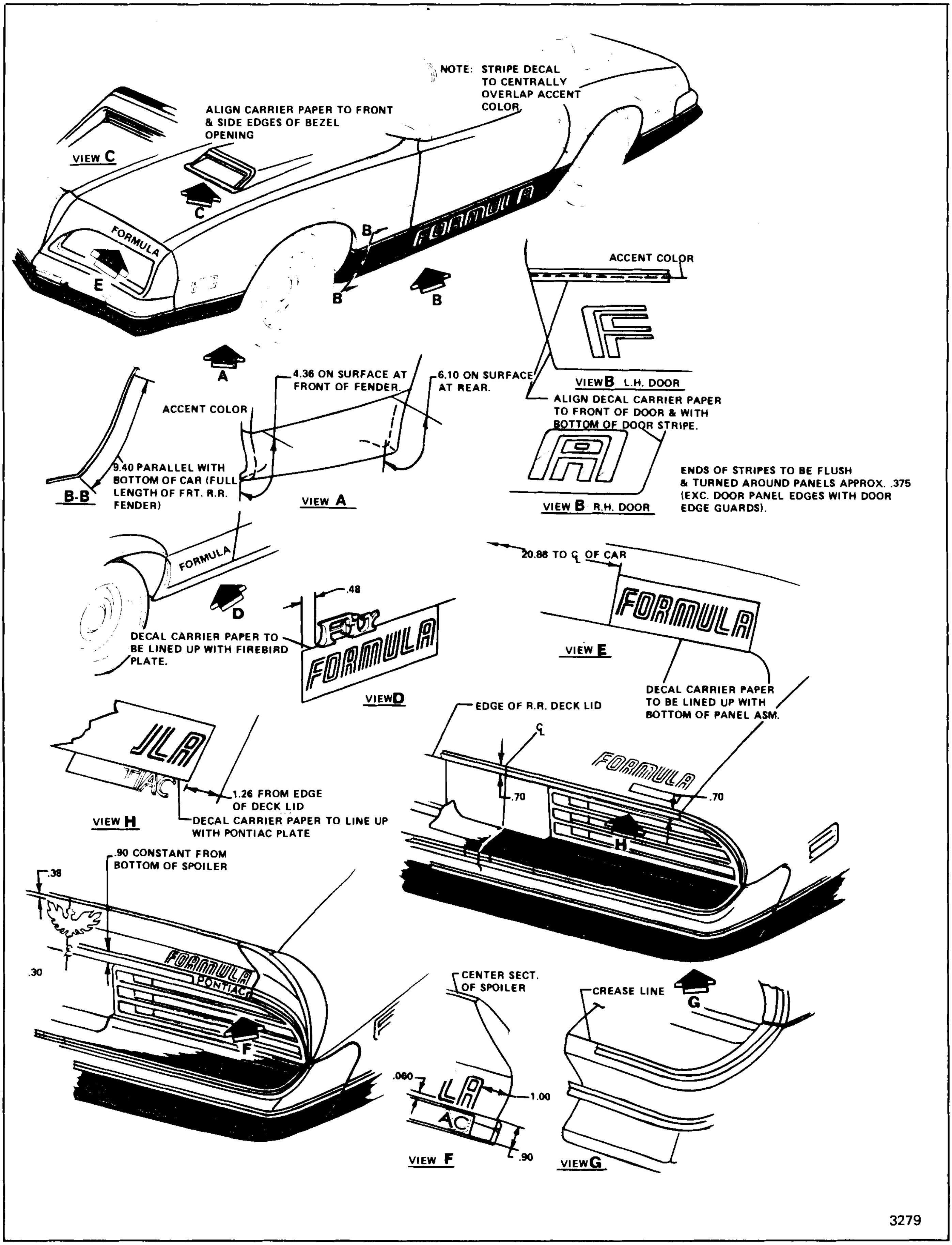


Fig. 2C-20 "F" Series - Formula - Decals

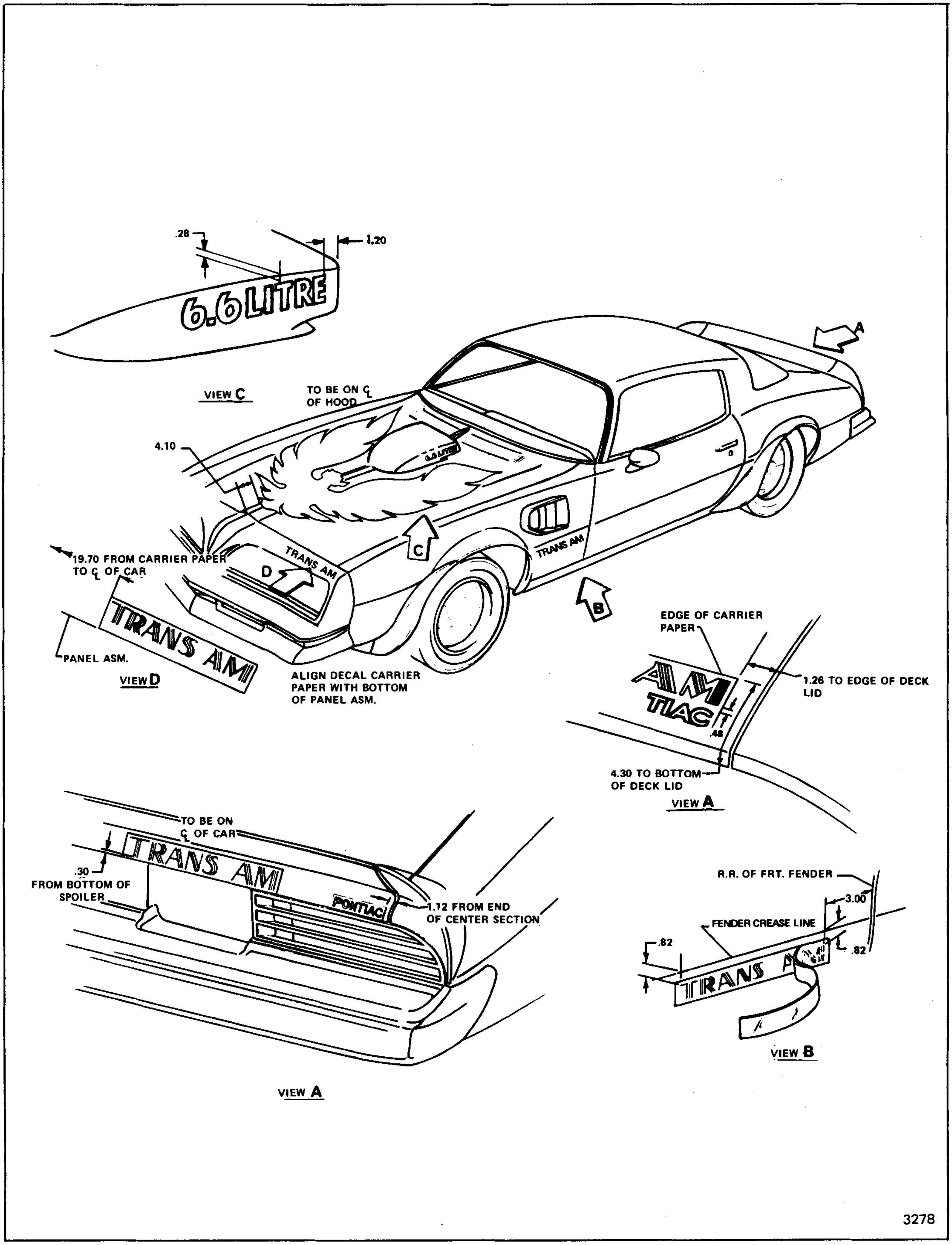
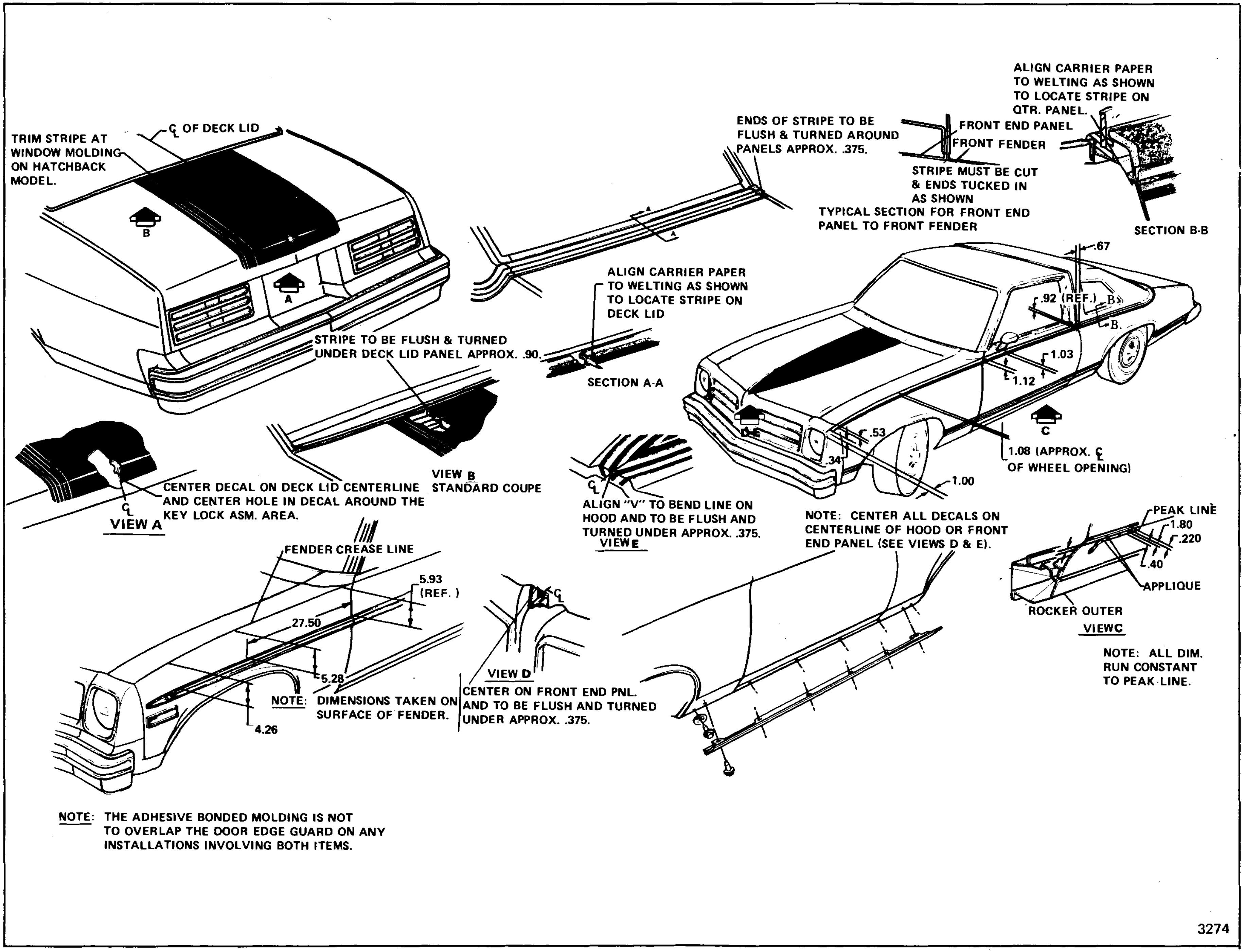


Fig. 2C-21 "F" Series - Trans Am - Decals



TRIM STRIPE AT WINDOW MOLDING ON HATCHBACK MODEL.

ENDS OF STRIPE TO BE FLUSH & TURNED AROUND PANELS APPROX. .375.

ALIGN CARRIER PAPER TO WELTING AS SHOWN TO LOCATE STRIPE ON QTR. PANEL.

STRIPE MUST BE CUT & ENDS TUCKED IN AS SHOWN

TYPICAL SECTION FOR FRONT END PANEL TO FRONT FENDER

ALIGN CARRIER PAPER TO WELTING AS SHOWN TO LOCATE STRIPE ON DECK LID

STRIPE TO BE FLUSH & TURNED UNDER DECK LID PANEL APPROX. .90.

CENTER DECAL ON DECK LID CENTERLINE AND CENTER HOLE IN DECAL AROUND THE KEY LOCK ASM. AREA.

ALIGN "V" TO BEND LINE ON HOOD AND TO BE FLUSH AND TURNED UNDER APPROX. .375.

NOTE: CENTER ALL DECALS ON CENTERLINE OF HOOD OR FRONT END PANEL (SEE VIEWS D & E).

NOTE: ALL DIM. RUN CONSTANT TO PEAK LINE.

NOTE: DIMENSIONS TAKEN ON SURFACE OF FENDER.

CENTER ON FRONT END PNL. AND TO BE FLUSH AND TURNED UNDER APPROX. .375.

NOTE: THE ADHESIVE BONDED MOLDING IS NOT TO OVERLAP THE DOOR EDGE GUARD ON ANY INSTALLATIONS INVOLVING BOTH ITEMS.

Fig. 2C-22 "X" Series - Decals and Moldings

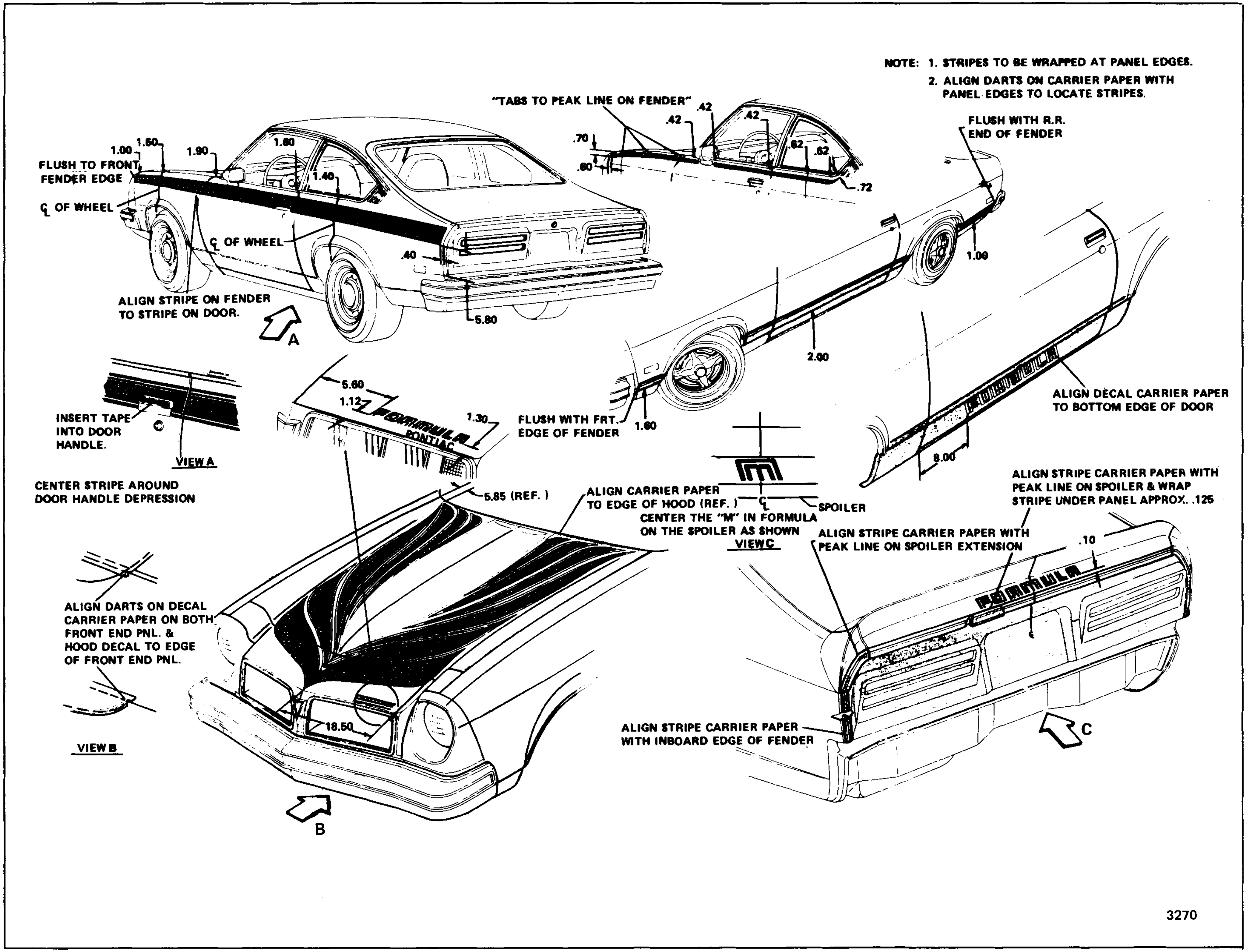


Fig. 2C-23 "H" Series - Astre - Decals

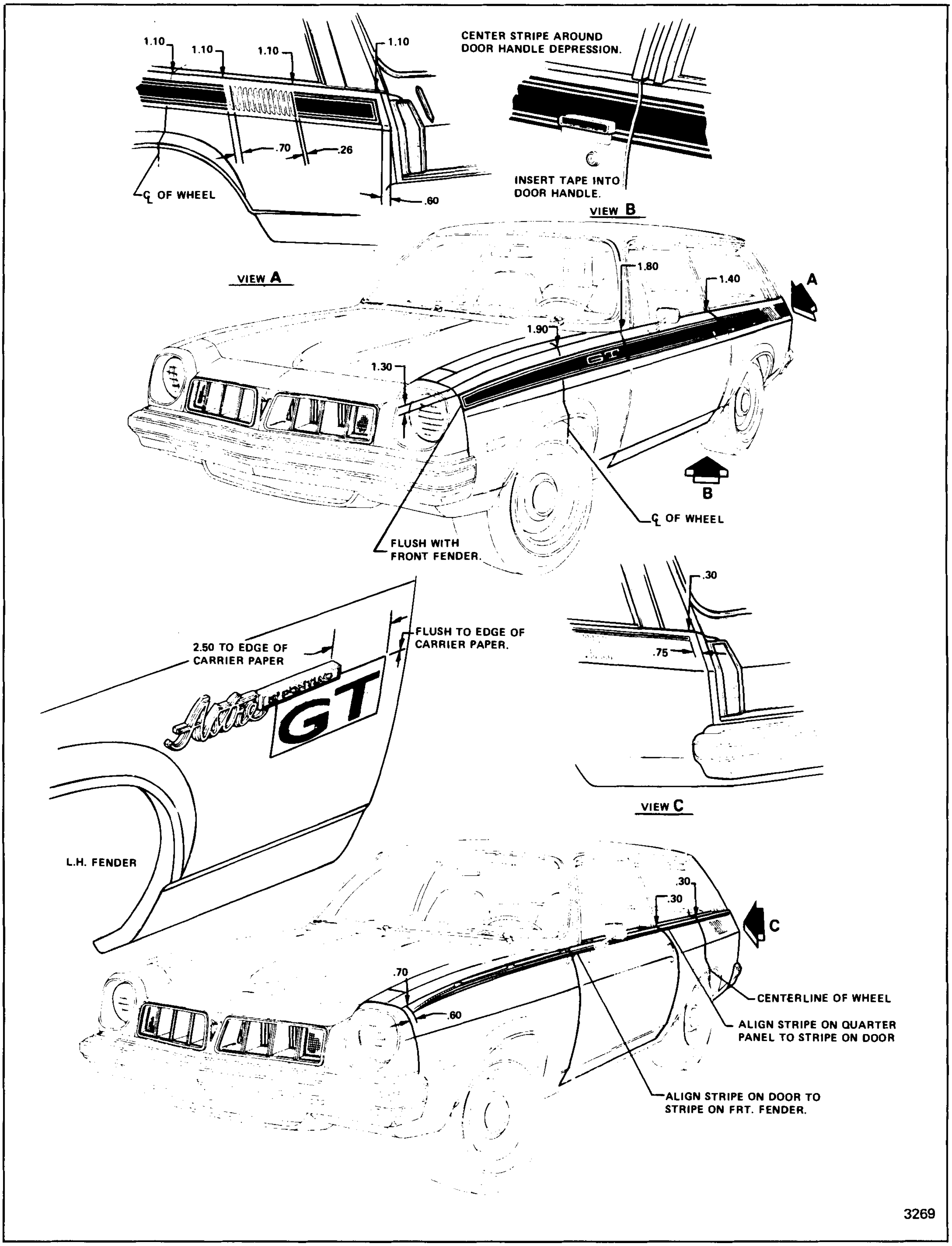


Fig. 2C-24 "H" Series - Wagon - Decals

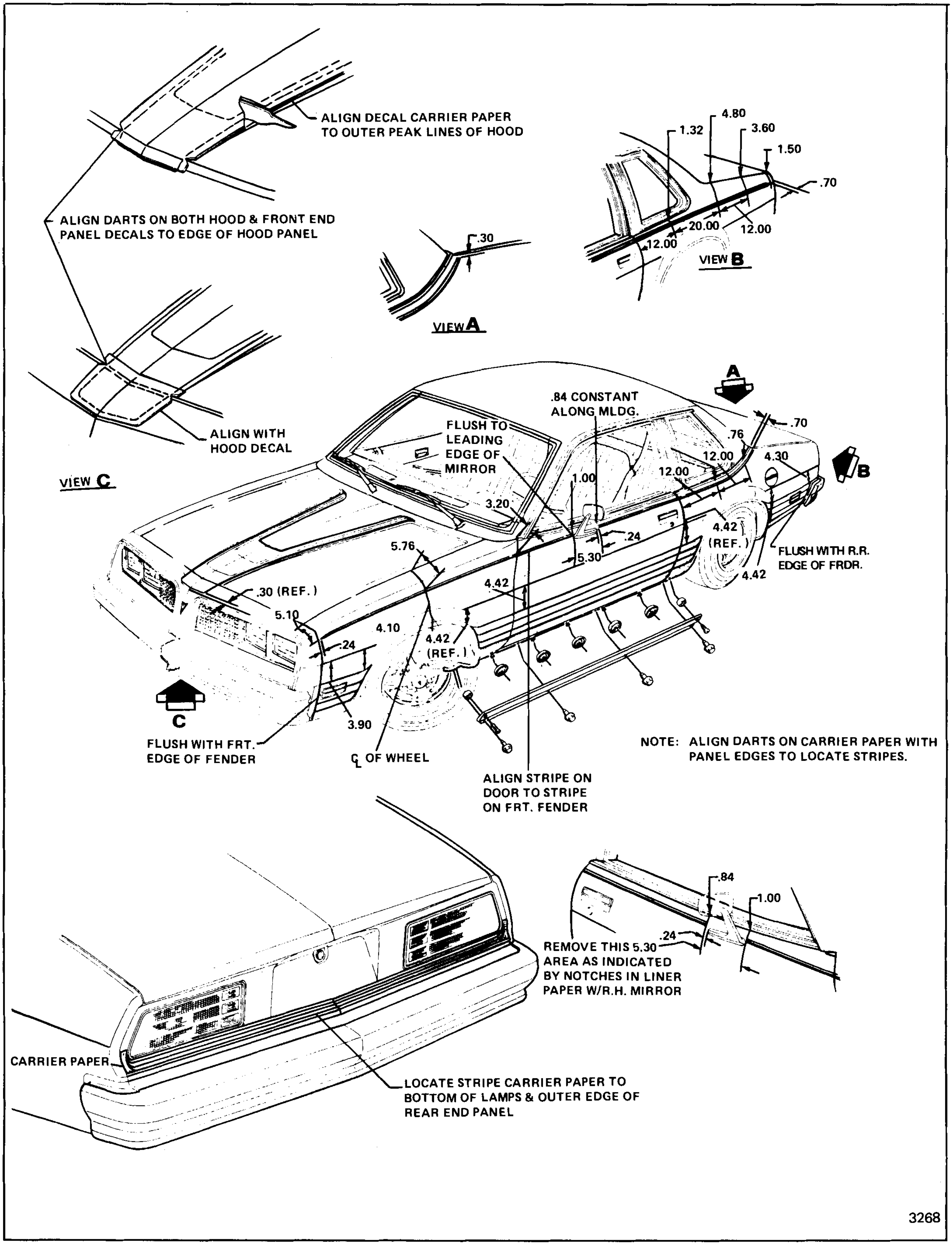


Fig. 2C-25 "HM" Series - Stripe Decals and Moldings

SECTION 3

STEERING, SUSPENSION, WHEELS AND TIRES

DIAGNOSIS

CONTENTS OF THIS SECTION

GENERAL DIAGNOSIS

Since the problems in steering, suspension, wheels and tires involve several systems, they must all be considered when diagnosing a complaint. To avoid using the wrong symptom, always road test the car first. Proceed with the following preliminary checks and correct any defects which are found.

1. Tires for proper pressure and uneven wear.

2. Steering couplings and universal joints from column to gear for loose connectors or wear.

3. Raise car on a hoist and check front and rear suspension and linkage for loose or damaged parts.

4. Spin front wheels. Check for out-of-round tires, out of balance tires, bent rims, loose and/or rough wheel bearings.

5. Oil leaks on power steering, power steering fluid level and pump drive belt tension.

Car Pulls (Leads)

1. Mismatched or uneven tires.
2. Broken or sagging springs.
3. Radial tire lateral force.
4. Front end alignment.
5. Rear axle alignment.
6. Steering gear valve off center (unbalanced).

Abnormal Tire Wear

1. Sagging or broken springs.
2. Tire out of balance.
3. Front end alignment.

Hard Steering (Manual)

1. Lack of lubrication-ball joints, linkage and steering gear.
2. Front end alignment.
3. Steering gear adjustment.

Hard Steering (Power)

1. Hydraulic system - Make test with gage J 5176-1.
2. Steering gear adjustment.
3. Malfunctioning steering gear pressure port poppet.

Too Much Play In Steering

1. Loose wheel bearings.
2. Steering gear loose on frame.
3. Worn or loose steering shaft coupling or joints.
4. Steering gear adjustments.

Poor Returnability (Manual)

1. Lack of lubrication-ball joints and linkage.
2. Bind in linkage or ball joints.
3. Bind in steering column.
4. Lack of lubricant-steering gear.
5. Front end alignment.
6. Steering gear adjustment.

Poor Returnability (Power)

1. Lack of lubrication-ball joints and linkage.
2. Lower coupling flange binding on adjusting plug.
3. Bind in linkage or ball joints.
4. Bind in steering column.
5. Front end alignment.
6. Steering gear adjustment.
7. Sticking valve.

Abnormal Noise, Power Steering

Pump Noise:

1. Groan
a. Low oil level.
b. Air in oil.
c. Pump mounting loose.
2. Rattle
a. Vane improperly installed.
b. Vane sticking in rotor.
3. Growl
a. Back pressure caused by restriction.
b. Scored pressure plates, thrust plate or rotor.
c. Badly worn cam ring.
4. Whine
a. Pump shaft bearing scored.
5. Squeal or Chirp
a. Loose belt.

Gear Noise:

1. Squawk
a. Cut dampener "O" ring on spool valve in gear.
2. Rattle or Chuckle
a. Gear loose on frame.
b. Steering linkage loose.
c. Pressure hose touching.
d. Loose pitman arm.
e. Gear adjustment.

Abnormal Noise, Front End

1. Lubrication-ball joints and linkage.
2. Faulty shock absorbers or mounting.
3. Worn control arm bushings or linkage pivots.
4. Loose stabilizer bar or missing link.
5. Spring improperly positioned.
6. Loose wheel nuts.
7. Loose suspension bolts.

Wander or Poor Steering Stability

1. Mismatched or uneven tires.
2. Lubrication-ball joints and linkage.
3. Faulty shock absorbers or mounting.
4. Loose stabilizer bar or link.
5. Broken or sagging springs.
6. Steering gear adjustment.
7. Front end alignment.

Erratic Steering When Braking

1. Loose wheel bearings.
2. Broken or sagging springs.
3. Leaking wheel cylinder or caliper (see Brakes, Section 5).
4. Steering gear off high point.
5. Incorrect or uneven caster.

Shimmy

1. Tire or wheel out of balance or out of round.
2. Loose wheel bearings.
3. Worn linkage pivots.
4. Worn upper and lower ball joints.

Power Steering Fluid Leaks

1. See Gear and Pump Leak Diagnosis.

Low Or Uneven Trim Height

1. Broken or sagging springs.
2. Overloaded car.
3. Incorrect springs.

Ride Too Soft

1. Faulty shock absorbers.

Ride Too Harsh

1. Incorrect shock absorbers.

2. Incorrect springs.

Body Leans Or Sways In Corners

1. Loose stabilizer bar or missing link.
2. Faulty shock absorbers or mounting.
3. Broken or sagging springs.
4. Overloaded car.

Suspension Bottoms

1. Overloaded car.
2. Faulty shock absorbers.
3. Incorrect, broken or sagging springs.

"Dog" Tracking

1. Damaged rear suspension arm or worn bushings.
2. Broken spring leaf.
3. Bent rear axle housing.
4. Frame or underbody alignment.

Steering Wheel Kick-Back (Power)

1. Air in system.
2. Worn or missing poppet valve (gear).
3. See "Too Much Play In Steering" for other possible causes.

Steering Wheel Surges Or Jerks (Power)

1. Hydraulic system-Make pressure test with gage J 5176-1.
2. Sluggish flow control valve.

Vehicle Pulls To One Side (No Braking Action)

1. Front or rear brake dragging.
2. Off center belt in tire casing.

Wheel Tramp

1. Blister or bump on tire.
2. Improper shock absorber action.

Excessive Or Uneven Tire Wear

1. Hard driving.
2. Overloaded car.

Scuffed Tires

1. Toe-in incorrect.
2. Excessive speed on turns.
3. Suspension arm bent or twisted.

Cupped Tires

1. Front shock absorbers defective.
2. Wheel bearing incorrectly adjusted or worn.
3. Excessive tire or wheel run-out.
4. Worn ball joint.

LINKAGE DIAGNOSIS

Excessive Play or Looseness in Steering System

1. Worn upper ball joints.
2. Steering gear worm bearings loosely adjusted.
3. Excessive pitman shaft to ball nut lash in steering gear.
4. Worn intermediate rod or tie rod sockets.

Excessive Looseness in Tie Rod or Intermediate Rod Pivots, or Excessive Vertical Lash in Idler Support

1. Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear.

Hard Steering (Excessive Effort Required At Steering Wheel)

1. Tight or frozen intermediate rod, tie rod or idler socket.
2. Steering gear adjusted too tight.

MANUAL STEERING GEAR DIAGNOSIS

Excessive Play or Looseness in Steering System

1. Worn upper ball joints.
2. Excessive pitman shaft to ball nut lash.
3. Worm bearings loosely adjusted.
4. Steering wheel loose on shaft; loose pitman arm, tie rods, steering arms or steering linkage ball studs.

Rattle or Chuck in Steering Gear

1. Insufficient or improper lubricant in steering gear.
2. Pitman arm loose on shaft or steering gear mounting bolt loose.
3. Loose or worn steering shaft bearing.
4. Excessive lash between ball nut and pitman shaft in straight ahead position or worm thrust bearings adjusted too loose.

> **NOTE:** On turns, a slight rattle may occur due to the increased lash between ball nut and pitman shaft as gear moves off the center of "high point" position. This is normal and lash must not be reduced to eliminate this slight rattle.

POWER STEERING PUMP AND GEAR DIAGNOSIS

Hissing Noise in Steering Gear

1. There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and performance of the steering. "Hiss" may be expected when steering wheel is at end of travel or when slowly turning at standstill. Do not replace valve unless "hiss" is extremely objectionable. A replacement valve will also exhibit slight noise and is not always a cure for the objection. Investigate clearance around coupling rivets. Be sure steering shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates. Any metal-to-metal contacts through flexible coupling will transmit valve "hiss" into passenger compartment through the steering column.

Rattle or Chuckle Noise in Steering Gear

1. Pressure hose touching other parts of car.
2. Loose pitman shaft over center adjustment.

NOTE: A slight rattle may occur on turns because of increased clearance off the "high point". This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.

Squawk Noise in Steering Gear When Turning or Recovering From a Turn

1. Dampener "O" ring on valve spool cut.

Growl Noise in Steering Pump

1. Excessive back pressure in hoses or steering gear caused by restriction.

Growl Noise in Steering Pump (Particularly Noticeable at Standstill Parking)

1. Scored pressure plates, thrust plate or rotor.
2. Extreme wear of cam ring.

Groan Noise in Steering Pump

1. Air in the oil. Poor pressure hose connection.

Rattle Noise in Steering Pump

1. Vanes not installed properly.
2. Vanes sticking in rotor slots.

Swish Noise in Steering Pump

1. Defective flow control valve.

Whine Noise in Steering Pump

1. Pump shaft bearing scored.

Poor Return of Steering Wheel to Center

1. Steering wheel rubbing against directional signal housing.
2. Lower coupling flange rubbing against steering gear adjuster plug.
3. Tight or frozen steering shaft bearings.
4. Steering gear adjustments over specifications.
5. Sticky or plugged spool valve.

Momentary Increase in Effort When Turning Wheel Fast to Right or Left.

1. High internal leakage.

Steering Wheel Surges or Jerks When Turning with Engine Running (Especially During Parking)

1. Steering linkage hitting engine oil pan at full turn.
2. Insufficient pump pressure.
3. Sticky flow control valve.

Excessive Wheel Kick-Back or Loose Steering

1. Air in system.
2. Steering gear flexible coupling loose on shaft or rubber disc mounting nuts loose.
3. Worn poppet valve (gear).
4. Loose thrust bearing preload adjustment (gear).
5. Excessive "over-center" lash.

Hard Steering or Lack of Assist (Especially During Parking)

1. Brakes applied when parking.
2. Lower coupling flange rubbing against steering gear adjuster plug.
3. Sticky flow control valve.
4. Insufficient pump pressure output.
5. Excessive internal pump leakage.
6. Excessive internal gear leakage.

Low Pressure Due to Steering Pump

1. Flow control valve stuck or inoperative.
2. Pressure plate not flat against cam ring.
3. Extreme wear of cam ring.
4. Scored pressure plate, thrust plate or rotor.
5. Vanes not installed properly.
6. Vanes sticking in rotor slots.
7. Cracked or broken thrust or pressure plate.

Foaming Milky Power Steering Fluid, Low Fluid Level and Possible Low Pressure

1. Air in the fluid and loss of fluid due to internal pump leakage causing overflow. Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeration should the oil level be low. If oil level is correct and pump still foams, remove pump from car and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.

Low Pressure Due to Steering Gear

1. Pressure loss in cylinder due to worn piston ring or scored housing bore.
2. Leakage at valve rings, valve body to worm seal.

STEERING COLUMN DIAGNOSIS
ALL COLUMNS (NO MARK)
TILT COLUMN ONLY-*
STANDARD COLUMN ONLY-**

LOCK SYSTEM

Will Not Unlock

1. Shear flange on sector shaft collapsed.
2. Lock bolt damaged.
3. Defective lock cylinder.
4. Damaged housing.
5. Damaged sector.
6. Damaged rack.

Will Not Lock

1. Lock bolt spring broken or defective.
2. Damaged sector.
3. Defective lock cylinder.
4. Burr on lock bolt.
5. Damaged housing.
6. Transmission linkage adjustment incorrect.
7. Damaged rack.
8. Interference between bowl and rack coupling*.
9. Ignition switch stuck.
10. Actuator rod restricted.
11. Sector installed incorrectly**.

High Lock Effort

1. Lock cylinder defective.
2. Ignition switch defective.
3. Rack preload spring broken or deformed.
4. Burrs on sector, rack, housing, support or actuator rod coupling.
5. Bent sector shaft.
6. Defective rack.
7. Extreme misalignment of housing to cover.*
8. Distorted coupling slot in rack.*
9. Bent actuator rod.
10. Ignition switch mounting bracket bent.
11. Actuator rod restricted.**
12. Improper shift linkage adjustment.

Will Stick in "Start"

1. Actuator rod deformed.
2. Check items under "High Lock Effort".

Key Cannot Be Removed in "Off-Lock"

1. Ignition switch is not set correctly.
2. Defective lock cylinder.

Lock Cylinder Can Be Removed Without Depressing Retainer

1. Lock cylinder with defective retainer.
2. Lock cylinder without retainer.
3. Burr over retainer slot in housing cover.

High Effort On Lock Cylinder Between "Off" and "Off-Lock"

1. Distorted rack.**

Lock Bolt Hits Shaft Lock In "Off" Position and "Park"

1. Ignition switch is not set correctly.**

Driver Can Lock Steering In Second Gear (Manual Transmission Only)

1. Defective upper shift lever.**
2. Defective shift lever gate.**
3. Loose relay lever on shift tube.**

COLUMN

Noise In Column

1. Coupling bolts not tightened. Tighten pinch bolts to 30 ft. lbs.
2. Column not correctly aligned.
3. Coupling pulled apart.
4. Broken lower joint.
5. Horn contact ring not lubricated.
6. Lack of grease on bearings.
7. Loose sight shields.*
8. Lower or upper shaft bearing worn or broken.
9. Shaft lock snap ring not seated.
10. Plastic spherical joint not lubricated.*

High Steering Shaft Effort

1. Column assembly misaligned.
2. Improperly installed or deformed dust seal.
3. Defective upper or lower bearing.
4. Flash on I.D. of shift tube from plastic joint.
5. Tight steering universal joint.

High Shift Effort (Automatic)

1. Column not aligned correctly in car.
2. Wave washer with burrs.*
3. Improperly installed dust seal.
4. Lack of grease on seal or bearing.
5. Improper screws used for ignition switch, neutral start switch or mounting bracket.
6. Burr on upper or lower end of shift tube.

7. Lower bowl bearing not assembled correctly.**

High Shift Effort (Manual Transmission)

1. Column not aligned correctly in car.**
2. Lower bowl bearing not assembled correctly.**
3. Improperly installed dust seal.**
4. Wave washer in lower bowl bearing defective.**
5. Improper adjustment of lower shift levers.**
6. Lack of grease on seal, bearing areas or levers.**
7. Damaged shift tube in bearing areas.**

Improper Transmission Shifting

1. Sheared shift tube joint or lower shift lever weld.
2. Improper transmission linkage adjustment.
3. Loose shift lever.**
4. Improper gate plate.

Lash In Mounted Column Assembly

1. I.P. to column bracket mounting bolts loose. Tighten to 20 ft. lbs.
2. Broken weld nuts on jacket.
3. I.P. bracket capsule sheared.
4. Loose shoes in housing.*
5. Loose tilt head pivot pins.*
6. Loose shoe lock pin in support.*
7. Loose support screws. Tighten to 60 in. lbs.*
8. Column bracket to jacket bolts loose. Tighten to 25 ft. lbs.

Housing Scraping On Bowl

1. Bowl bent or not concentric with hub.*

Steering Wheel Loose

1. Excessive clearance between holes in support or housing and pivot pin diameters.*
2. Defective or missing anti-lash spring in spheres.*
3. Upper bearing not seated in housing.*
4. Upper bearing inner race seal missing.*
5. Loose support screws. Tighten 60 in. lbs.
6. Bearing preload spring missing or broken.*

Steering Wheel Loose (Every Other Tilt Position)

1. Loose fit between shoe and shoe pivot pin.*
2. Shoe not free in slot.*

Steering Column Not Locking In Any Tilt Position

1. Shoe seized on its pivot pin.*
2. Shoe grooves may have burrs or dirt.*
3. Shoe lock spring weak or broken.*

Steering Wheel Fails To Return To Top Tilt Position

1. Pivot pins are bound up.*
2. Wheel tilt spring is defective.*
3. Turn signal switch wires too tight.*

Noise When Tilting Column

1. Upper tilt bumpers worn.*
2. Tilt spring rubbing in housing.*

Miscellaneous

1. Housing loose on jacket-will be noticed with ignition in "off-lock" and a torque applied to the steering wheel.
2. Shroud loose on shift bowl.**

Hazard Switch Cannot Be Turned Off

1. Foreign material between hazard support cancelling leg and yoke.

SIGNAL SWITCH

NOTE: This diagnosis covers mechanical problems only. See Section 8 of this manual for signal switch electrical diagnosis.

Turn Signal Will Not Stay In Turn Position

1. Foreign material or loose parts impeding movement of yoke.
2. Broken or missing detent or cancelling spring.
3. None of the above. Replace switch.

Turn Signal Will Not Cancel

1. Loose switch mounting screws. Tighten to 25 in. lbs.
2. Switch or anchor bosses broken.
3. Broken, missing or out of position detent, return or cancelling spring.
4. Uneven or incorrect cancelling cam to cancelling spring interference (.120 in./side).

Turn Signal Difficult To Operate

1. Actuator rod loose. Tighten mounting screw to 12 in. lbs.
2. Yoke broken or distorted. Replace switch.
3. Loose or misplaced springs.
4. Foreign parts and/or material.
5. Loose switch mounting screws. Tighten mounting screws to 25 in. lbs.

Turn Signal Will Not Indicate Lane Change

1. Broken lane change pressure pad or spring hanger.
2. Broken, missing or misplaced lane change spring.
3. Jammed base or wires.

Hazard Switch Cannot Be Turned Off

1. Foreign material between hazard support cancelling leg and yoke.
2. No foreign material; replace turn signal switch.

Hazard Switch Will Not Stay On or Difficult To Turn Off

1. Loose switch. Tighten mounting screws to 25 in. lbs.
2. Interference with other components.
3. Foreign material interference.

4. None of the above. Replace switch.

No Turn Signal Lights

1. Electrical failure in chassis harness.
2. Inoperative turn signal flasher. Refer to Section 8.
3. Loose chassis to column connector.

NOTE: Disconnect column to chassis connector. Connect new switch to chassis and operate switch by hand.

4. If car lights now operate normally, signal switch is inoperative.
5. If car lights do not operate, refer to Section 8.

Turn Indicator Lights On, But Not Flashing

1. Inoperative turn flasher.
2. Loose chassis or column connection.
3. Inoperative turn signal switch.

NOTE: To determine if turn signal switch is defective, substitute new switch into circuit and operate switch by hand.

If the car's lights operate normally, signal switch is inoperative.

Front or Rear Turn Signal Lights Not Flashing

1. Burned out or damaged turn signal bulb. Refer to Section 8.
2. High resistance connection to ground at bulb socket. Refer to Section 8.
3. Loose chassis to column connector.

NOTE: Disconnect column to chassis connector. Connect new switch into system and operate switch by hand.

4. If turn signal lights are now on and flash, turn signal switch is inoperative.
5. If car lights do not operate, refer to Section 8.

Stop Light Not On When Turn Indicated

1. Loose column to chassis connection.

NOTE: Disconnect column to chassis connector. Connect new switch into system without removing old.

2. Operate switch by hand.
3. If brake lights work with switch in the turn position, signal switch is defective.
4. If brake lights do not work, refer to Section 8.

Turn Indicator Panel Lights

1. Burned out bulbs or opens, grounds in wiring harness from front turn signal bulb socket to indicator lights, refer to Section 8.

Turn Signal Lights Flash Very Slowly

1. Loose chassis to column connection.
2. Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If flashing occurs at normal rate, the signal switch is defective.
3. If the flashing rate is still extremely slow, refer to Section 8.

Hazard Signal Lights Will Not Flash-Turn Signal Functions Normally

1. Blown fuse.
2. Inoperative hazard warning flasher.
3. Loose chassis to column connection.
4. Disconnect column to chassis connector. Connect new switch into system without removing old. Depress the hazard warning button and observe the hazard warning lights. If they now work normally, the turn signal switch is defective.
5. If the lights do not flash, check wiring harness. Refer to Section 8.

IGNITION SWITCH

Electrical System Will Not Function

1. Defective ignition switch.
2. Ignition switch not adjusted properly.

Switch Will Not Actuate Mechanically

1. Defective ignition switch.

Switch Cannot Be Set Correctly

1. Switch actuator rod deformed.
2. Sector to rack engaged in wrong tooth.*

KEY BUZZER

Buzzer Continues To Operate With Key Out, But Stops When Driver's Door Is Closed

1. Chips, foreign material in lock cylinder bore.
2. Sticky lock cylinder actuator tip.
3. Damaged or broken buzzer switch.

Buzzer Does Not Sound With Key Fully Inserted In Lock Cylinder With The Driver's Door Open

1. Power not avialable to horn relay, refer to Section 8.
2. Open in chassis wiring. Check by separating chassis to column connector. Connect "E" (black) and "F" (black w/pink stripe) female contacts on the chassis side (Fig. 3-1). A bent paper clip will work; if buzzer sounds, continue diagnosis. If not, locate and repair chassis wiring.

NOTE: (1) If the buzzer fault has not yet been detected, connect a continuity meter (light) to the male "E" and "F" connector contacts (Fig. 3-2). Insert the key with the full depth into the lock cylinder.

If light is on with the key in and off with key out, the function is normal.

If light is not on, the fault is in the column. Proceed to Note 2.

NOTE: (2) With the fault isolated in the column, disassemble the upper end of the column until the signal switch mounting screws have been removed. Lift the switch and check the probes of the buzzer switch to insure good contact with the pads on the signal switch. Bend probes, if required, then reseat the signal switch and drive the three screws. Check the function, as in

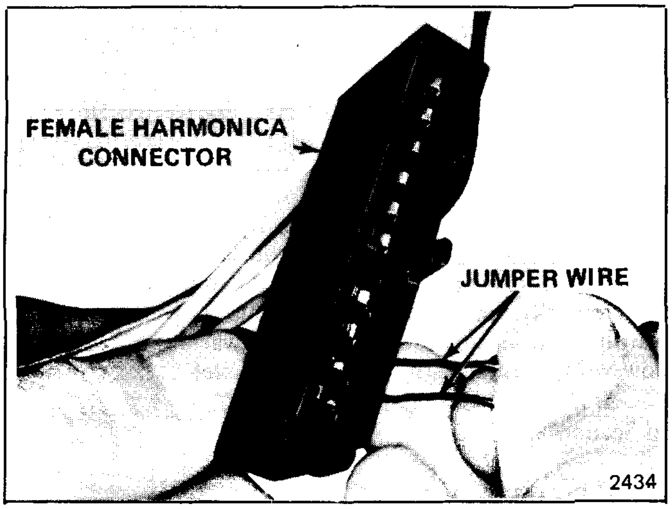


Fig. 3-1 Checking Buzzer at Chassis Connector

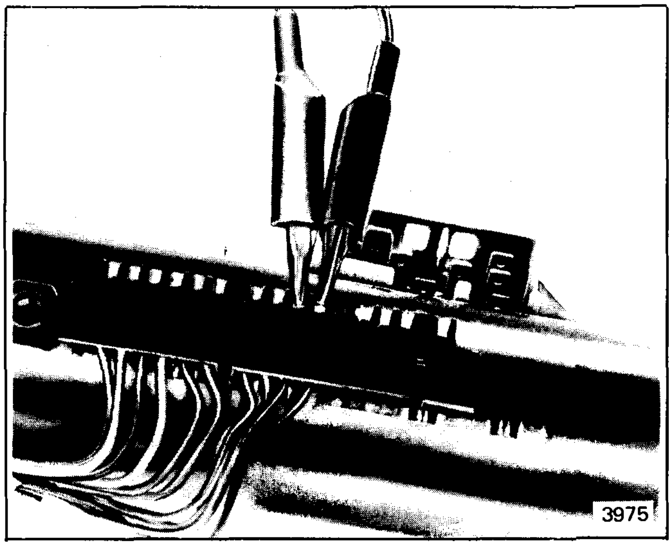


Fig. 3-2 Checking Buzzer Circuit at Column Connector

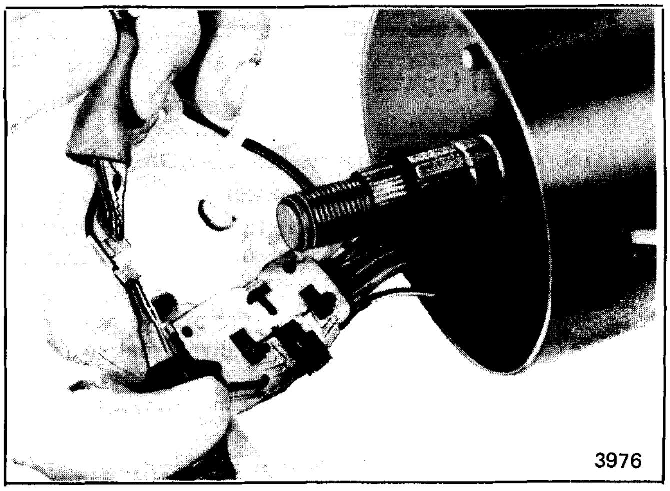


Fig. 3-3 Checking Buzzer Switch Pads

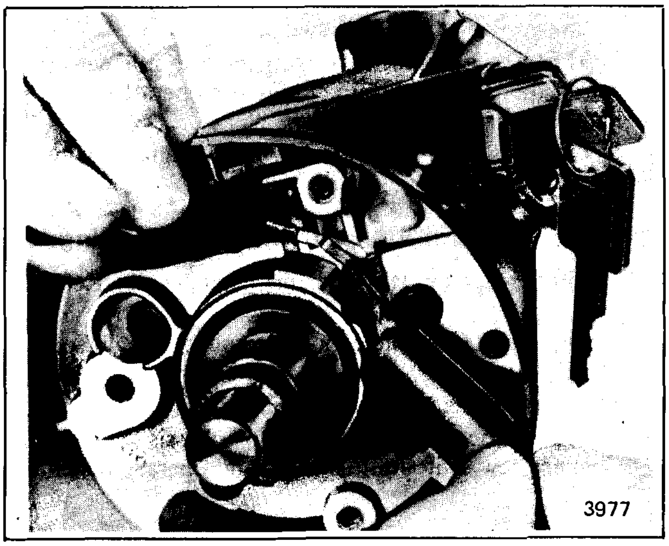


Fig. 3-4 Checking Buzzer Switch

Note 1.

3. Short or fault in signal switch wiring. Connect male "E" and "F" contacts of connector with jumper (Fig. 3-2). Check buzzer switch pads with continuity meter (Fig. 3-3). If contact is made, function is normal. If not, replace signal switch.

NOTE: (3) If the buzzer has not yet been isolated and repaired, connect a continuity meter (light) to the buzzer switch probes (Fig. 3-4). Fully insert and remove the key from the lock cylinder.

If light is on with the key in and is off with key out, the function is normal. Retrace diagnostic steps starting at Note 2.

If light is not on, the fault is in the lock cylinder or buzzer switch.

4. Chips, burrs, foreign material in lock cylinder preventing actuator tip function. Remove chips, burrs, etc. Reassemble and re-check. See Note 3.

CAUTION: *Key must be removed or cylinder placed in RUN position before removing lock cylinder.*

5. Defective lock cylinder. With the lock cylinder removed, fully insert and remove the key. The actuator tip (Figs. 3-5 and 3-6) should extend and retract smoothly. Total extension of tip should be .050". If not, replace lock cylinder. Remove and clean as required. Reassemble and re-check per Note 3.

6. Chips, foreign material in buzzer switch.

7. Damaged or broken buzzer switch.

8. Switch appears good but will not operate.

Buzzer Continues To Operate With Key In The Lock Cylinder With The driver's Door

1. Door jamb switch on driver's side misadjusted or inoperative.

2. Wire from signal switch to door jamb switch shorted.

NOTE: (4) This condition indicates the lock cylinder or buzzer switch is at fault. To verify, check for continuity at the "E" and "F" male connector contacts with the key removed from the lock cylinder (Fig. 3-2). If continuity exists, the fault is in the column.

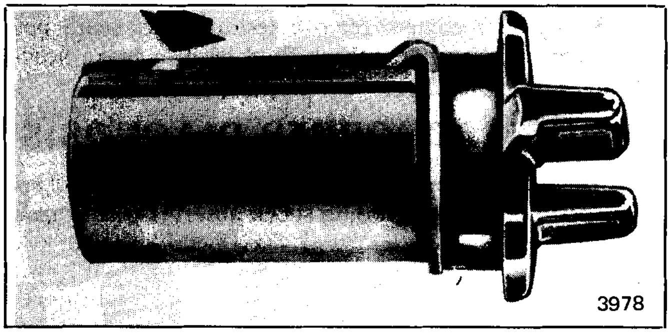


Fig. 3-5 Lock Cylinder Actuator (Key Removed)

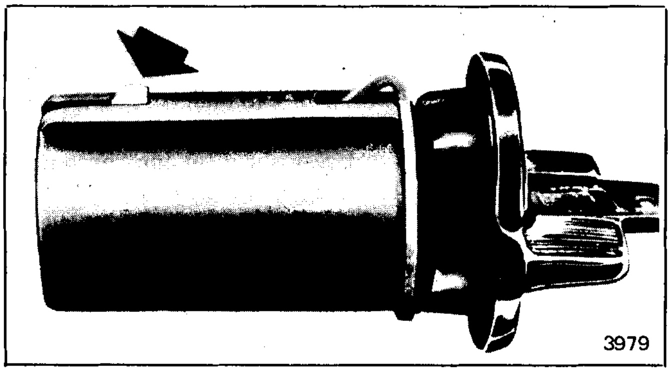


Fig. 3-6 Lock Cylinder Actuator (Key in Place)

3. Insert key into lock and turn lock toward START position. If buzzer stops in RUN position or when turned past RUN toward START, the problem is a sticky lock cylinder actuator.

COLUMN MOUNTED DIMMER SWITCH

1. Loose connector at dimmer switch.
2. Improper adjustment.
3. Internally damaged or worn switch.
4. Dimmer: Check continuity on switch at lt. blue-lt. green and at lt. blue-tan with full depression of plunger (audible click).
5. No continuity. Replace dimmer switch.
6. Continuity. Refer to Section 8.

POWER STEERING PUMP & GEAR

EXTERNAL LEAKAGE DIAGNOSIS

General Procedure

1. Wipe suspected area dry.
2. Check for overfilled reservoir.
3. Check for oil aeration and overflow.
4. Check hose connections. Tighten if necessary.
5. Verify exact point of leakage.

Example: Torsion bar, stub shaft and adjuster seals are close together; exact leakage point could be confused.

Example: The point oil drips from is not necessarily the leakage point - oil overflowing from reservoir for instance.

6. When service is required:
   a. Clean leakage area upon disassembly.
   b. Replace leaking seal.
   c. Check component sealing surfaces for damage.
   d. Reset bolt torque to specifications where required.

Some customer complaints with the power steering system may be reported as:

1. Oil leakage on garage floor.
2. Oil leaks visible on steering gear, pump or anywhere else on the left side of engine compartment.
3. Growling noise, especially when parking or when engine is cold.
4. Loss of power when parking.
5. Heavy steering effort.

When trouble shooting complaints of this nature, check for an external leak in the power steering system.

External Leakage Check (Fig. 3-7)

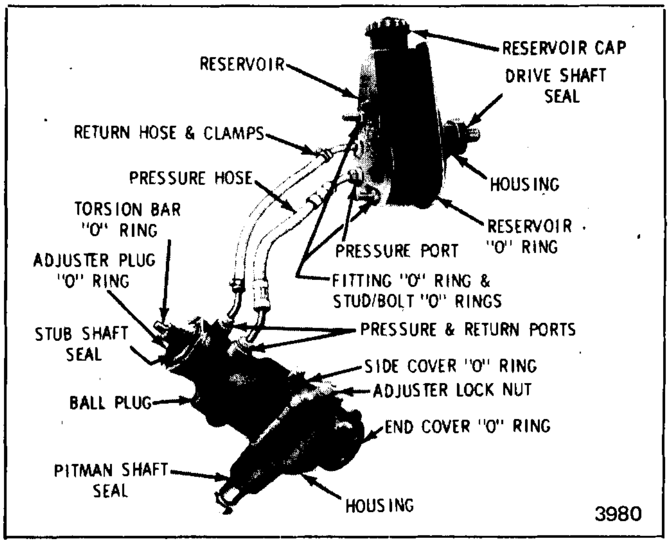


Fig. 3-7 Possible External Leakage Points

The purpose of the diagnostic procedure is to pinpoint the location of the leak. The method outlined can be followed to locate the leak and repair it.

In some cases you will be able to locate the leak easily. However, seepage type leaks may be more difficult to isolate. For seepage leaks, the following method is recommended.

1. With the engine off, wipe the complete power steering system dry (gear, pump, hoses and connections).
2. Check oil level in pump reservoir and add fluid if necessary.
3. Start engine and turn steering wheel from stop to stop several times. Do not hold in corner for any length of time as this can damage the power steering pump. It is easier if someone else operates the steering wheel while you search for the seepage.
4. Find the exact area of leakage.

Component Replacement Recommendations

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the steering gear at the pitman shaft, at the stub shaft, and on the drive shaft of the pump. When leakage occurs in one of these areas, always replace the seal(s), after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft only if very severe pitting is found. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by smoothing with crocus cloth first.

Housing Or Cover Seepage

Both the power steering gear and pump assemblies are leakage checked. However, occasionally oil seepage may occur from the gear or pump other than the seal areas. If this type of leakage is found, replace the leaking part.

Individual Leakage Breakdown

Fig. 3-8 shows areas to be checked for leakage. If leakage occurs, repair or replace as necessary.

POWER STEERING SYSTEM TEST PROCEDURE

1. Disconnect pressure hose at union of pump, use a small container to catch any fluid which might leak.

2. Connect a spare pressure hose to pump union.

3. Using pressure gage J 5176-01 and adapter fitting J 2236, connect gage to both hoses (Fig. 3-9).

NOTE: The power steering system may be tested using either J 5176-01 as described here or with available tool J 25323 Power Steering Analyzer which will measure flow rate in addition to pressure.

4. Open valve on gage.

5. Start engine, allow system to reach operating temperature and check fluid level adding fluid if required. When engine is at normal operating temperature, the pressure reading on the gage (valve open) should be in the 80-125 psi range. If this pressure is above 200 psi, check the hoses for restrictions and poppet valve for proper assembly.

6. Close valve fully 3 times. Record the highest pressure attained each time.

NOTE: Do not leave valve fully closed for more than 5 seconds as the pump could be damaged.

a. If the pressure recorded is within 50 psi, the pump is functioning within specifications.

b. If the pressures recorded are high, but do not repeat within 50 psi, the flow control valve in the pump is sticking. Remove the valve, clean it and remove any burrs using crocus cloth or fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and the gear must be completely disassembled,cleaned and reassembled before further usage.

c. If the pressures recorded are constant, but more than 100 psi below 1350 psi, replace the flow control valve and recheck. If the pressures are still low, replace the rotor and vanes.

7. If the pump checks to specification, leave the valve open and turn (or have turned) the steering wheel to both stops. Record the highest pressures and compare with the maximum pump pressure recorded. If pressure is not same (at both stops) as maximum pressure, the gear is leaking internally and must be disassembled and repaired.

8. Shut off engine, remove testing gage, spare hose, reconnect pressure hose, check fluid level or make needed repairs.

SHOCK ABSORBER DIAGNOSIS

This procedure includes both on-car and bench checks to be performed in diagnosing shock absorber performance.

ON-CAR CHECKS

Weak

1. Check and adjust tire pressures as specified.

2. Note load conditions under which car is normally operated.

3. If practical, ride with owner to understand complaint before proceeding to next step.

4. Test each front and rear shock in turn by quickly pushing down and then lifting up on the corner of the bumper nearest the shock being checked. Use the same amount of effort on each test and note the resistance provided by the shock on compression and rebound. Compare with a similar car having acceptable ride quality.

Both front shocks should provide the same feeling of resistance as should both rears. If there is any noticeable variation between right and left, proceed to the next step.

5. The front wheels must be supporting the weight of the car to obtain adequate shock stroke. Also, the rear axle should be supported at least enough to unload shock mounts.

6. Disconnect the lowest shock mountings. Stroke shocks at various rates of speed through maximum travel in both directions. Compare side to side for rebound and compression resistance. Rebound resistance is normally stronger than compression (approximately 2 to 1). It is mandatory that right and left shocks feel comparable. Differences between front and rear are normal. If in doubt about condition, compare with a known good shock.

Noisy

1. Check all mounting torques (bolt and/or nut). A loose mounting will very definitely cause a noise noticeable to the driver.

2. If all mountings are intact, jounce the car as in Step 4 (weak) to isolate the suspected unit.

3. If practical, ride car with owner to understand complaint before proceeding to next step.

4. Observe instructions on supporting front and rear wheels in Step 5 (weak). Disconnect the lower mounting of suspected shock. Completely extend to full rebound, then exert an extra pull.

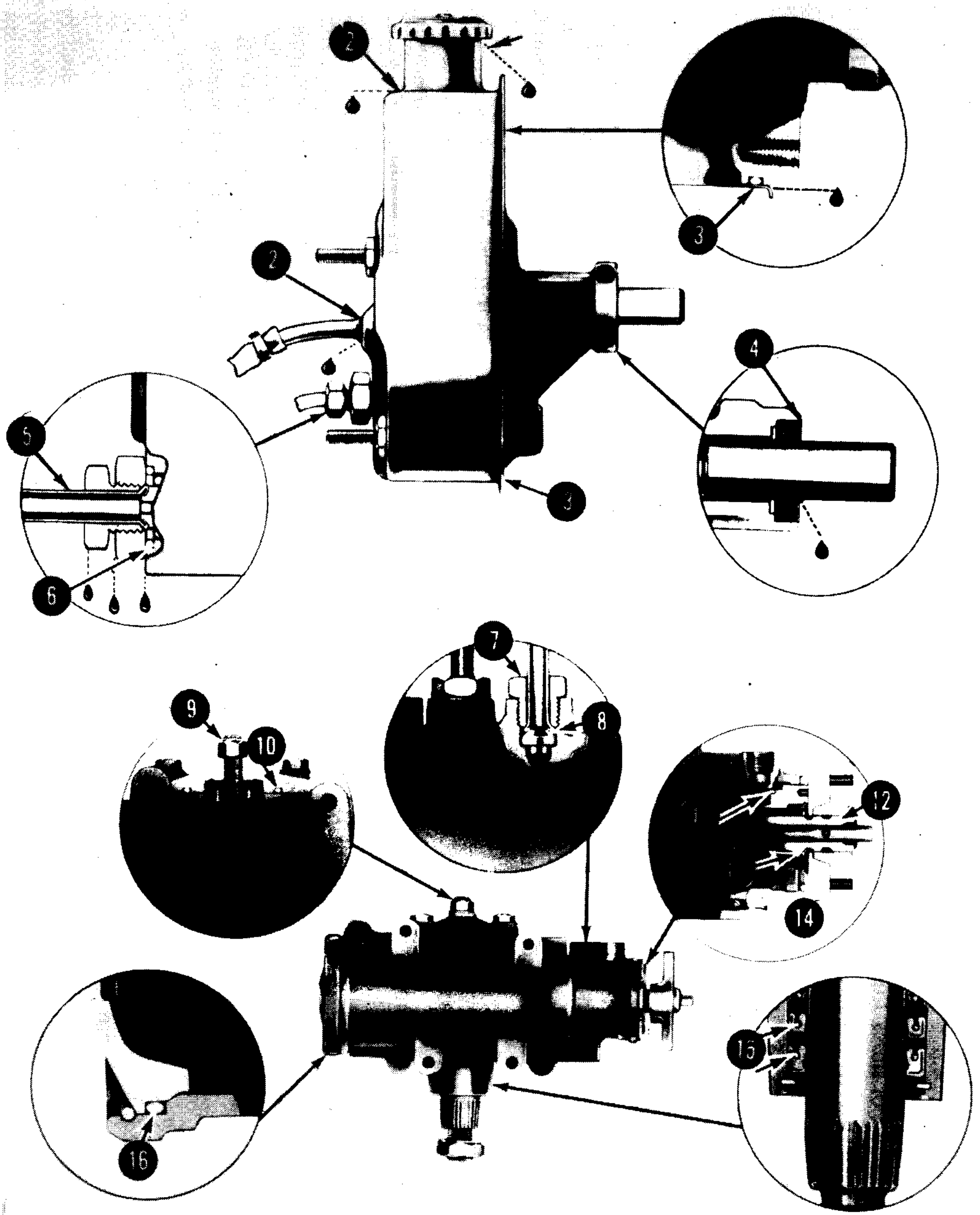
5. Other objectionable noises may be detected by stroking. A hissing noise (orifice swish) is considered normal. A grunt or squeal after one full stroke in both directions is abnormal. A clicking noise on fast reverse is abnormal. Abnormal conditions require replacement of the shock.

Leaks

1. Front shocks must be inspected through the coil springs preferably with the wheels unsupported.

2. Rear shocks should be inspected fully extended (axle unsupported) to expose the seal cover area.

GEAR AND PUMP LEAK DIAGNOSIS



1. CHECK OIL LEVEL. IF LEAKAGE PERSISTS WITH THE LEVEL CORRECT AND THE CAP TIGHT, REPLACE THE CAP.
2. CRACKED OR BENT RESERVOIR, REPLACE RESERVOIR.
3. REPLACE RESERVOIR "O" RING.
4. REPLACE FRONT SEAL. MAKE CERTAIN THAT DRIVE SHAFT IS CLEAN AND FREE OF PITTING IN SEAL RIDE AREA.
5. TORQUE HOSE FITTING NUT TO 40 FOOT POUNDS. IF LEAKAGE PERSISTS, REPLACE DISCHARGE FITTING AND REFACE HOSE TUBE FLARE OR REPLACE HOSE AS REQUIRED.
6. TORQUE FITTING TO 35 FOOT POUNDS. IF LEAKAGE PERSISTS, REPLACE BOTH "O" RING SEALS.

7 & 8. TORQUE THE FITTING NUT (40 FT. LBS.). IF LEAKAGE PERSISTS, REPLACE BRASS CONNECTOR AND REFACE HOSE TUBE FLARE. IF LEAKAGE IS DUE TO DAMAGED THREADS (CROSS THREADED), REPLACE BRASS CONNECTOR REPAIR FITTING NUT OR REPLACE HOSE AS REQUIRED. IF HOUSING THREADS ARE STRIPPED, REPLACE HOUSING.

9. TORQUE NUT TO 40 FOOT POUNDS. REPLACE NUT IF LEAKAGE PERSISTS.
10. TORQUE SIDE COVER BOLTS TO 45 FT. LBS. REPLACE SIDE COVER SEAL IF LEAKAGE PERSISTS.
11. REPLACE ADJUSTER PLUG "O" RING SEAL.
12. REPLACE ROTARY VALVE ASSEMBLY.
13. REPLACE ADJUSTER PLUG SEALS.
14. SEAT BALL FLUSH WITH PUNCH AND RESTAKE. IF SEEPAGE PERSISTS, REPLACE HOUSING.
15. REPLACE BOTH PITMAN SHAFT SEALS.
16. REPLACE END PLUG "O" RING SEAL.

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Fig. 3-8 Gear and Pump Leak Diagnosis

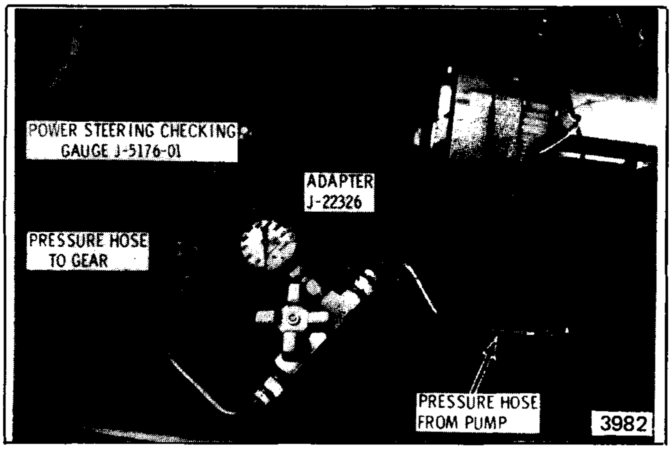


Fig. 3-9 Checking Oil Pressure (Example)

3. Visually inspect for evidence of leakage in the area of the seal cover (top of reservoir).

4. A slight trace of shock fluid is NOT cause for replacement as the seal permits some seepage for lubrication of the piston rod. The shock contains a fluid reserve to compensate for seepage.

5. Shocks are sometimes incorrectly diagnosed as leaking due to oil spray originating from some other source. If in doubt, wipe the wet area of the shock and reinspect after a brief road test (impractical on fronts). If a true shock leak, the fluid will reappear.

6. A shock that is truly leaking is easily detected as there will be evidence of shock fluid around the seal cover and on down the reservoir tube and shock should be replaced.

BENCH CHECKS

There are two bench check methods for the two (2) types of shocks:

a. Spiral groove reservoir (exc. firm ride)

b. Firm ride (smooth reservoir)

The reason for separate checks is that certain precautions must be taken to purge air from the pressure chamber on spiral groove reservoir shocks. In the case of firm ride there is no free air and consequently purging is not a factor.

Spiral Groove Reservoir

These type shocks should be initially exercised before attempting a bench check. When stored in a horizontal position, such as new units in stock, an air void will develop in the pressure chamber. This void can also result due to handling off the car if the unit is not continuously positioned vertically with the top end up.

Perform the following exercise to purge air from the pressure chamber:

- Extend in vertical position - top end up.
- Collapse in vertical position - top end down.
- Repeat above steps five (5) more times to make sure air is purged from the pressure chamber.

Proceed with the actual bench check as follows:

1. Clamp vise on bottom mount with shock vertical in vise - top end up (do not clamp on reservoir tube or mounting threads).

2. Pump shock by hand at various rates of speed and observe resistance.

3. Rebound resistance is normally stronger than compression (approximately 2 to 1). However, resistance should be smooth and constant for each stroking rate.

4. Compare with a known good shock.

5. It is normal to detect a hissing noise (orifice swish).

The following are considered abnormal and reason for replacement:

a. A skip or lag at reversal near mid-stroke.

b. A seize (except at either extreme end of travel).

c. A noise such as a grunt or squeal after completing one full stroke in both directions.

d. A clicking noise at fast reversal.

e. Fluid leakage.

Firm Ride Shocks

Firm ride shocks use a gas filled cell in the shock reservoir. This cell takes the place of air in the reservoir. Thus aeration or foaming of the fluid is eliminated as air and fluid cannot mix.

The bench check is the same as given in the spiral groove reservoir with the following exception:

Clamp shock UPSIDE DOWN in vise. If a lag is noticed when stroked, it means the gas-filled cell has ruptured and the shock should be replaced.

TIRE DIAGNOSIS

Irregular and/or Premature Wear (Fig. 3-12)

Irregular and premature wear has many causes. Some of them are: incorrect inflation pressures, lack of tire rotation, driving habits, improper alignment.

If the following conditions are noted, rotation is in order:

1. Front tire wear is different from rear.
2. Uneven wear exists across the tread of any tire.
3. Left front and right front tire wear is unequal.
4. Left rear and right rear tire wear is unequal.
5. There is cupping, flat spotting, etc.

A wheel alignment check is in order if the following conditions are noted:

1. Left front and right front tire wear is unequal.
2. Wear is uneven across the tread of any front tire.
3. Front tire treads have scuffed appearance with "feather" edges on one side of tread ribs or blocks.

Wear Indicators

The original equipment tires have built-in tread wear indicators to show when tires need replacement. These indicators will appear as 1/2" wide bands when the tire tread depth becomes 1/16 of an inch. When the indicators appear in 2 or more grooves at 3 locations, tire replacement is recommended (Fig. 3-13).

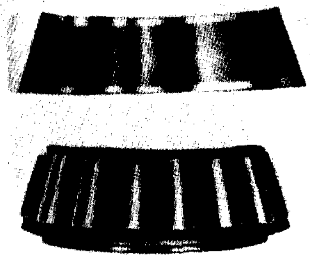
Radial Tire Waddle

Waddle is side to side movement at the front and/or rear of the car (Fig. 3-14). It is caused by the steel belt not being straight within the tire. It is most noticeable at low speed, 5 to 30 mph. It may also appear as a ride roughness at 50 to 70 mph.

FRONT WHEEL BEARING DIAGNOSIS

CONSIDER THE FOLLOWING FACTORS WHEN DIAGNOSING BEARING CONDITION:

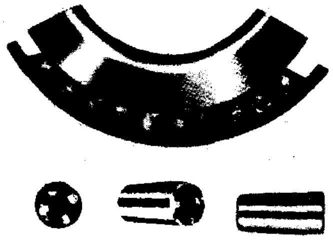
1. GENERAL CONDITION OF ALL PARTS DURING DISASSEMBLY AND INSPECTION.
2. CLASSIFY THE FAILURE WITH THE AID OF THE ILLUSTRATIONS.
3. DETERMINE THE CAUSE.
4. MAKE ALL REPAIRS FOLLOWING RECOMMENDED PROCEDURES.



ABRASIVE ROLLER WEAR

PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.

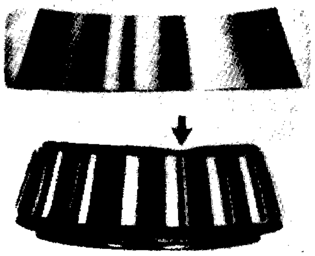
CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



GALLING

METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD (WAGON'S)

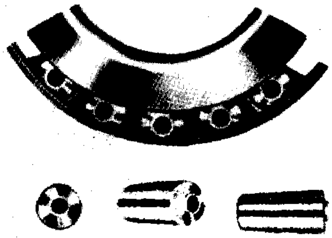
REPLACE BEARING -- CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

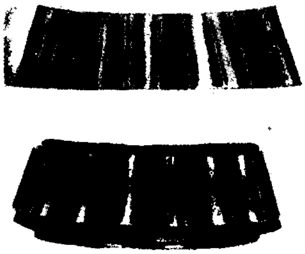
REPLACE BEARING.



ABRASIVE STEP WEAR

PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.

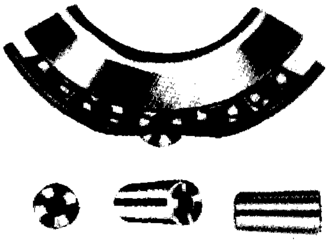
CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



ETCHING

BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING.

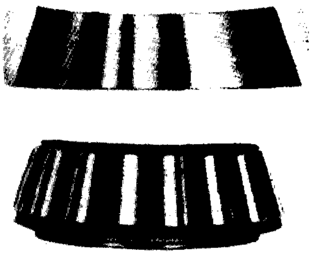
REPLACE BEARINGS -- CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

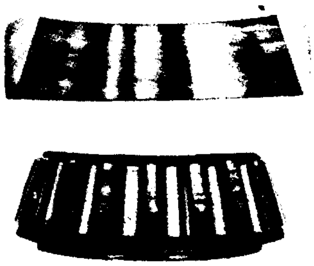
REPLACE BEARING.



INDENTATIONS

SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL.

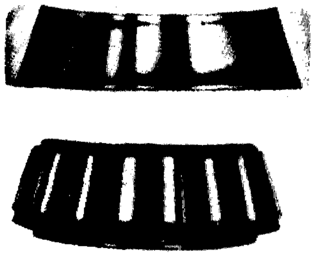
CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY.



CAGE WEAR

WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION.

CLEAN RELATED PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS.



MISALIGNMENT

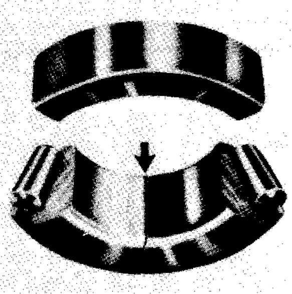
OUTER RACE MISALIGNMENT

CLEAN RELATED PARTS AND REPLACE BEARING. MAKE SURE RACES ARE PROPERLY SEATED.

1672

Fig. 3-10 Front Wheel Bearing Diagnosis

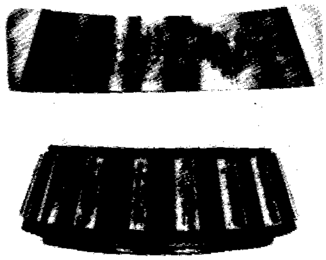
FRONT WHEEL BEARING DIAGNOSIS (CONT'D)



CRACKED INNER RACE

RACE CRACKED DUE TO IMPROPER FIT, COCKING, OR POOR BEARING SEATS.

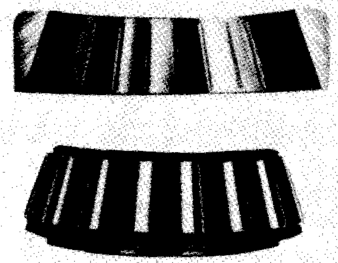
REPLACE BEARING AND CORRECT BEARING SEATS.



FATIGUE SPALLING

FLAKING OF SURFACE METAL RESULTING FROM FATIGUE.

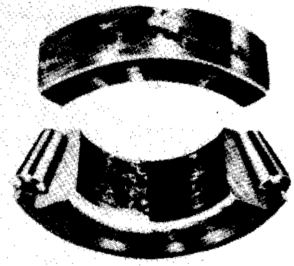
REPLACE BEARING -- CLEAN ALL RELATED PARTS.



BRINELLING

SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLLERS EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.

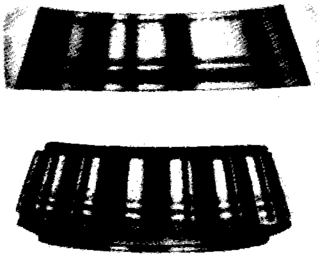
REPLACE BEARING IF ROUGH OR NOISY.



FRETTAGE

CORROSION SET UP BY SMALL RELATIVE MOVEMENT OF PARTS WITH NO LUBRICATION.

REPLACE BEARING. CLEAN RELATED PARTS. CHECK SEALS AND CHECK FOR PROPER LUBRICATION.

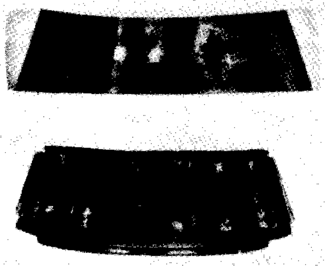


STAIN DISCOLORATION

DISCOLORATION CAN RANGE FROM LIGHT BROWN TO BLACK CAUSED BY INCORRECT LUBRICANT OR MOISTURE.

RE-USE BEARINGS IF STAINS CAN BE REMOVED BY LIGHT POLISHING OR IF NO EVIDENCE OF OVERHEATING IS OBSERVED.

CHECK SEALS AND RELATED PARTS FOR DAMAGE.



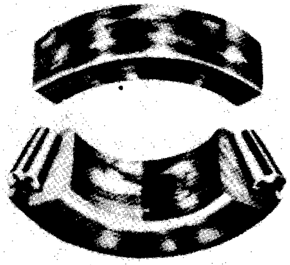
HEAT DISCOLORATION

HEAT DISCOLORATION CAN RANGE FROM FAINT YELLOW TO DARK BLUE RESULTING FROM OVERLOAD OR INCORRECT LUBRICANT.

EXCESSIVE HEAT CAN CAUSE SOFTENING OF RACES OR ROLLERS.

TO CHECK FOR LOSS OF TEMPER ON RACES OR ROLLERS A SIMPLE FILE TEST MAY BE MADE. A FILE DRAWN OVER A TEMPERED PART WILL GRAB AND CUT METAL, WHEREAS, A FILE DRAWN OVER A HARD PART WILL GLIDE READILY WITH NO METAL CUTTING.

REPLACE BEARINGS IF OVER HEATING DAMAGE IS INDICATED. CHECK SEALS AND OTHER PARTS.



SMEARS

SMEARING OF METAL DUE TO SLIPPAGE. SLIPPAGE CAN BE CAUSED BY POOR FITS, LUBRICATION, OVERHEATING, OVERLOADS OR HANDLING DAMAGE.

REPLACE BEARINGS, CLEAN RELATED PARTS AND CHECK FOR PROPER FITS AND LUBRICATION.

1673

Fig. 3-11 Front Wheel Bearing Diagnosis

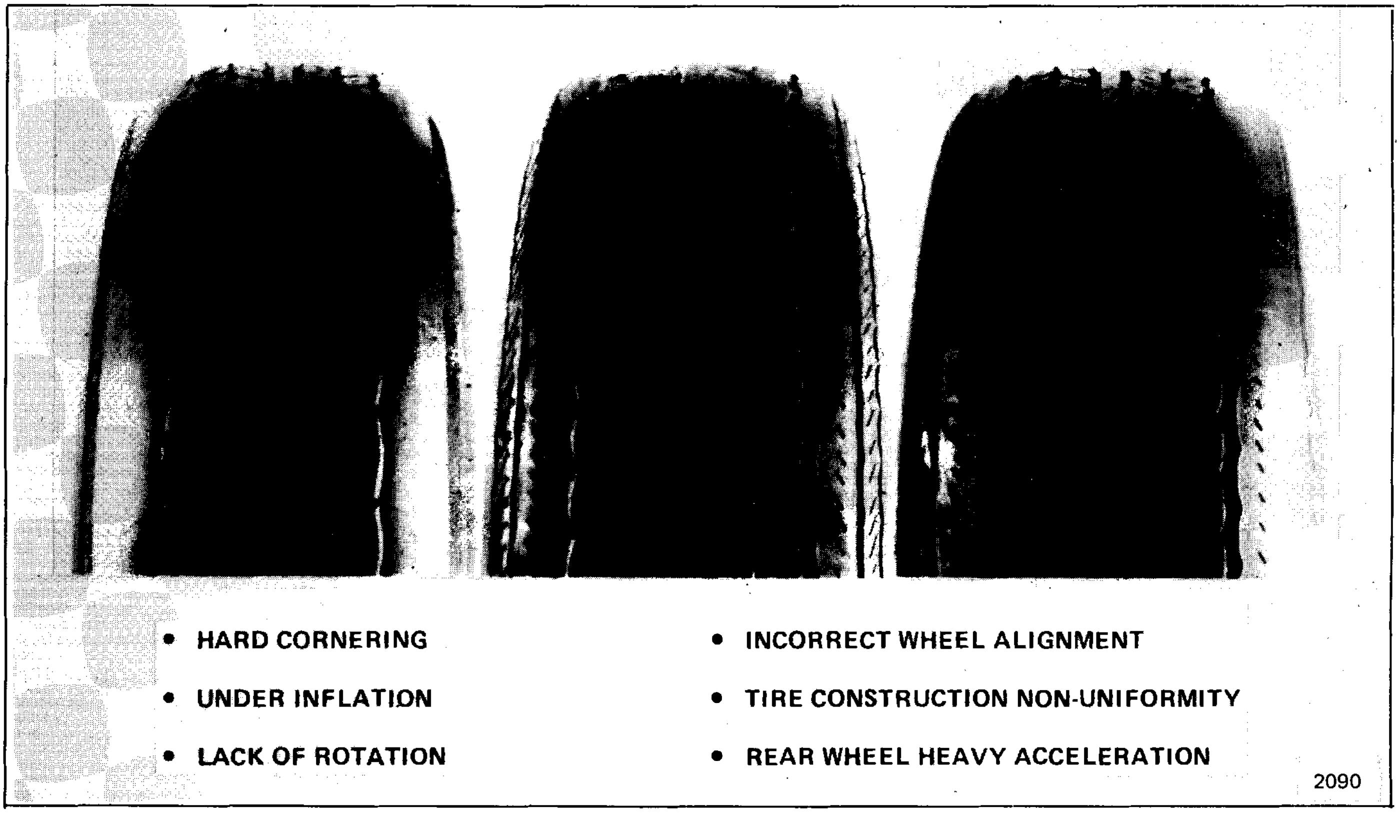


Fig. 3-12 Tire Wear Diagnosis

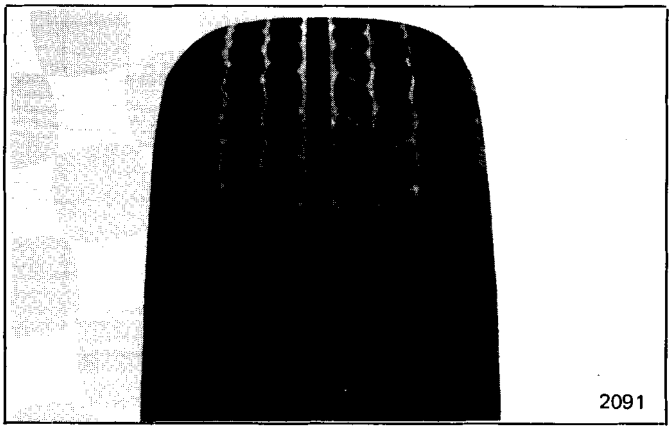


Fig. 3-13 Tread Wear Indicator

It is possible to road test a car and tell on which end of the car the faulty tire is located. If the waddle tire is on the rear, the rear end of the car will shake from side to side or "waddle". From the driver's seat it feels as though someone is pushing on the side of the car.

If the faulty tire is on the front, the waddle is more visual. The front sheet metal appears to be moving back and forth and the driver feels as though he is at the pivot point in the car.

Lead

Lead" is the deviation of the car from a straight path on a level road with no pressure on the steering wheel.

Lead is usually caused by:

1. Alignment.

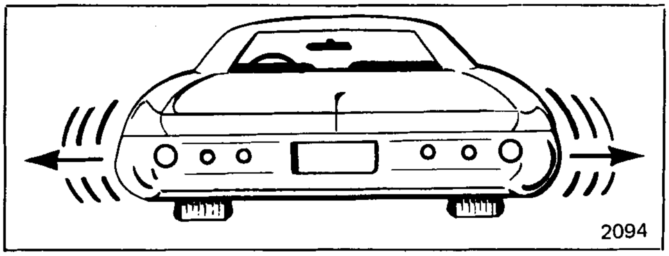


Fig. 3-14 Radial Tire Waddle

2. Uneven brake adjustment.
3. Tire construction.

The way in which a tire is built can produce lead in a car. An example of this is placement of the belt. Off center belts on radial tires can cause the tire to develop a side force while rolling straight down the road. If one side of the tire is a little larger diameter than the other, the tire will tend to roll to one side. This will develop a side force which can produce car lead.

The procedure in Fig. 3-15 should be used to make sure that front alignment is not mistaken for tire lead.

1. Part of the lead diagnosis procedure is different from the proper tire rotation pattern currently in the owner and service manuals. The manuals recommend front to rear rotation only; if a medium or high mileage tire is moved to the other side of the car, be sure to check that ride roughness has not developed.
2. Rear tires will not cause lead.

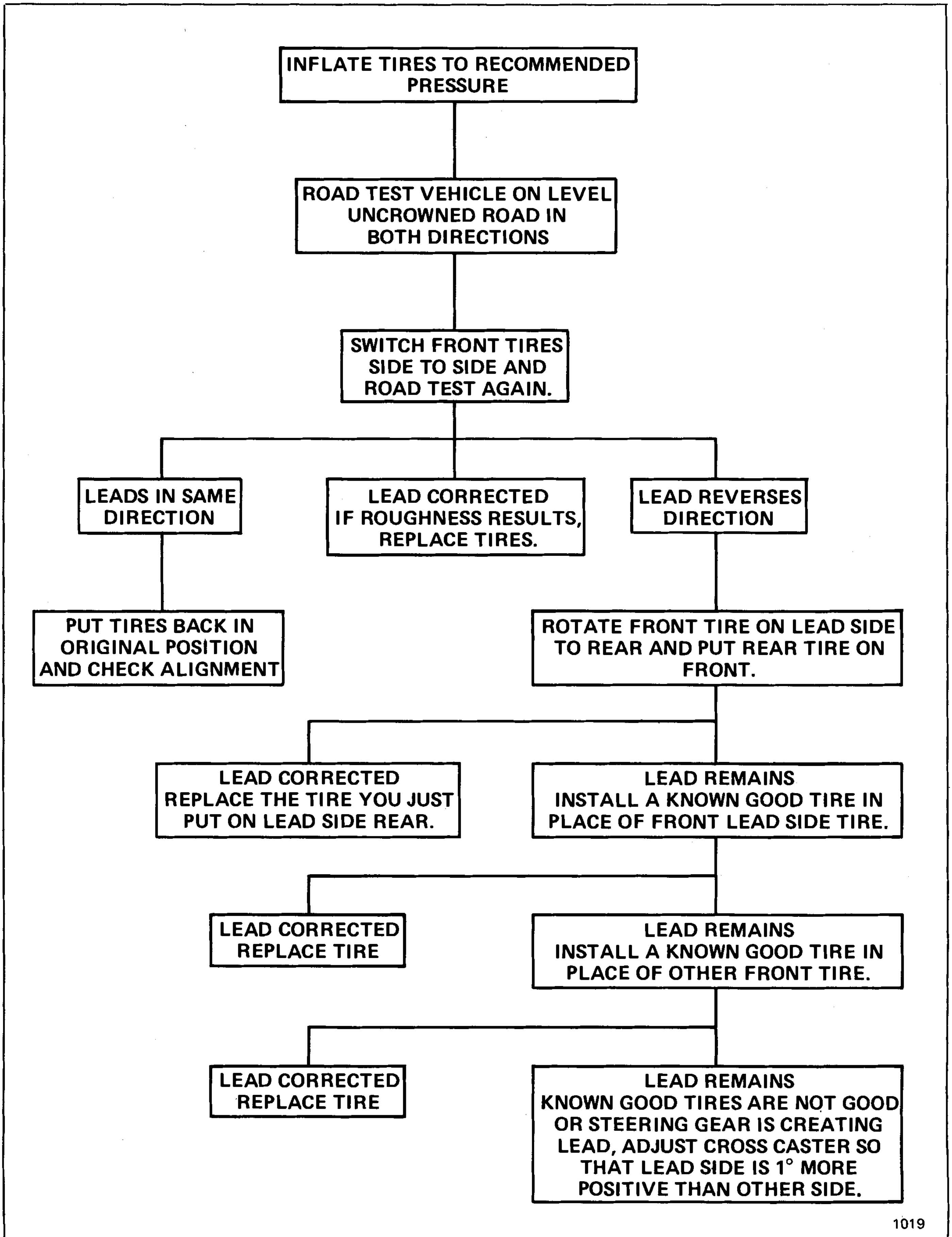
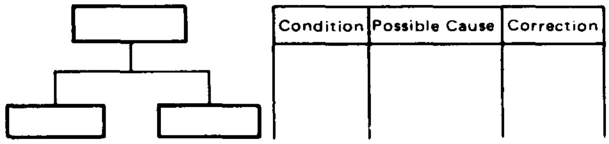


Fig. 3-15 Lead Diagnosis

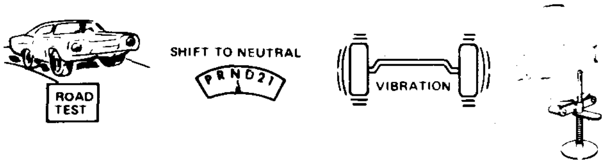
DIAGNOSIS CHARTS

Introduction

This section presents a systematic method of diagnosing and troubleshooting RADIAL–LATERAL VIBRATION. The charts you will be using are different from the ones you have used before. They aren't "go—no go" decision trees or tables.



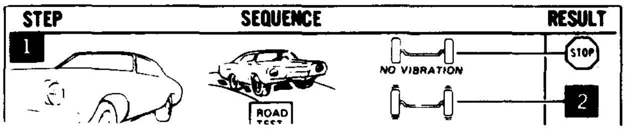
Instead the new diagnosis and troubleshooting charts use pictures plus a few words to help you solve a problem.



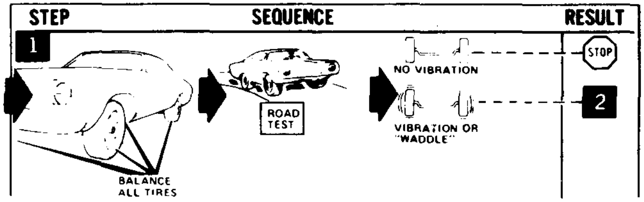
and symbols have replaced words.

Using the Charts

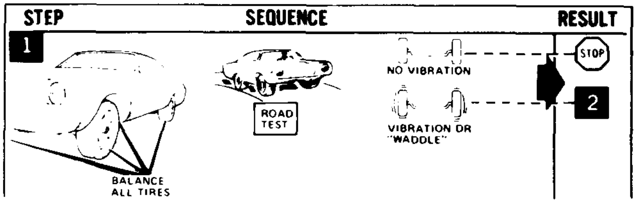
The charts are divided into three sections: step, sequence and result.



Always start at the first step and go through the complete sequence from left to right.

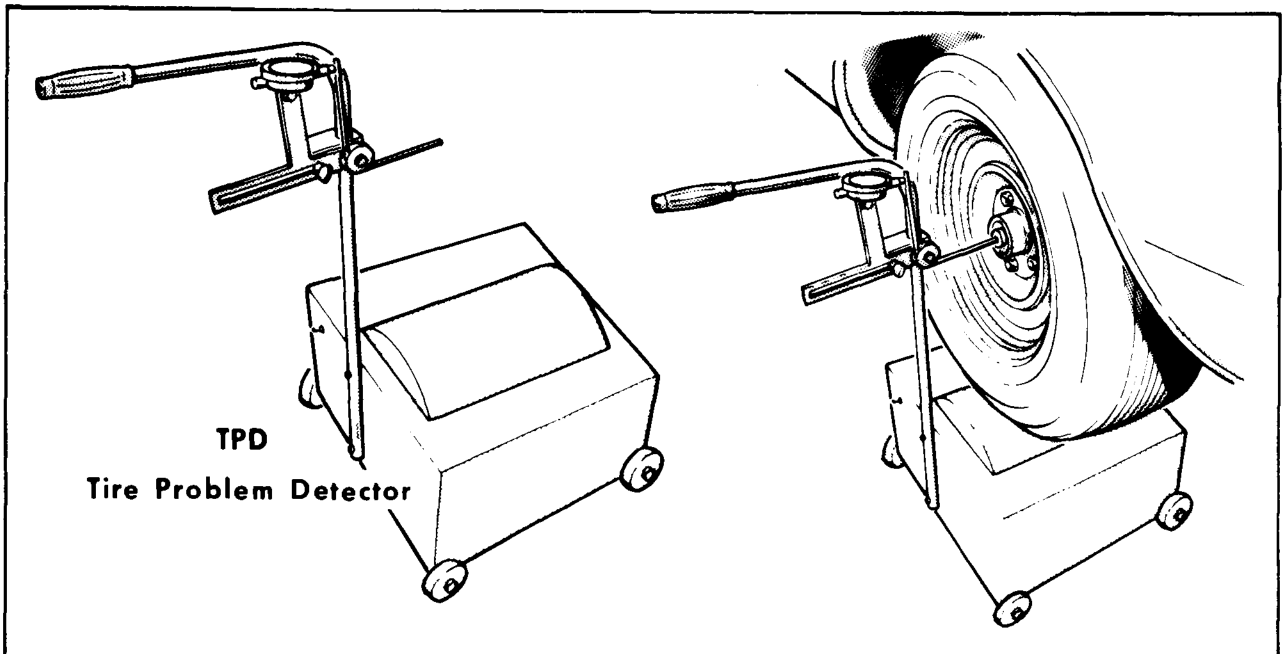


A sequence could be balancing tires and road testing for vibration. Each sequence ends with a result and tells you the next step to go to.



Work through each step of the diagnosis and troubleshooting charts till the system is repaired. STOP

Using the TPD for RADIAL-LATERAL VIBRATION



If TPD is not available use SUBSTITUTION METHOD shown at back of charts

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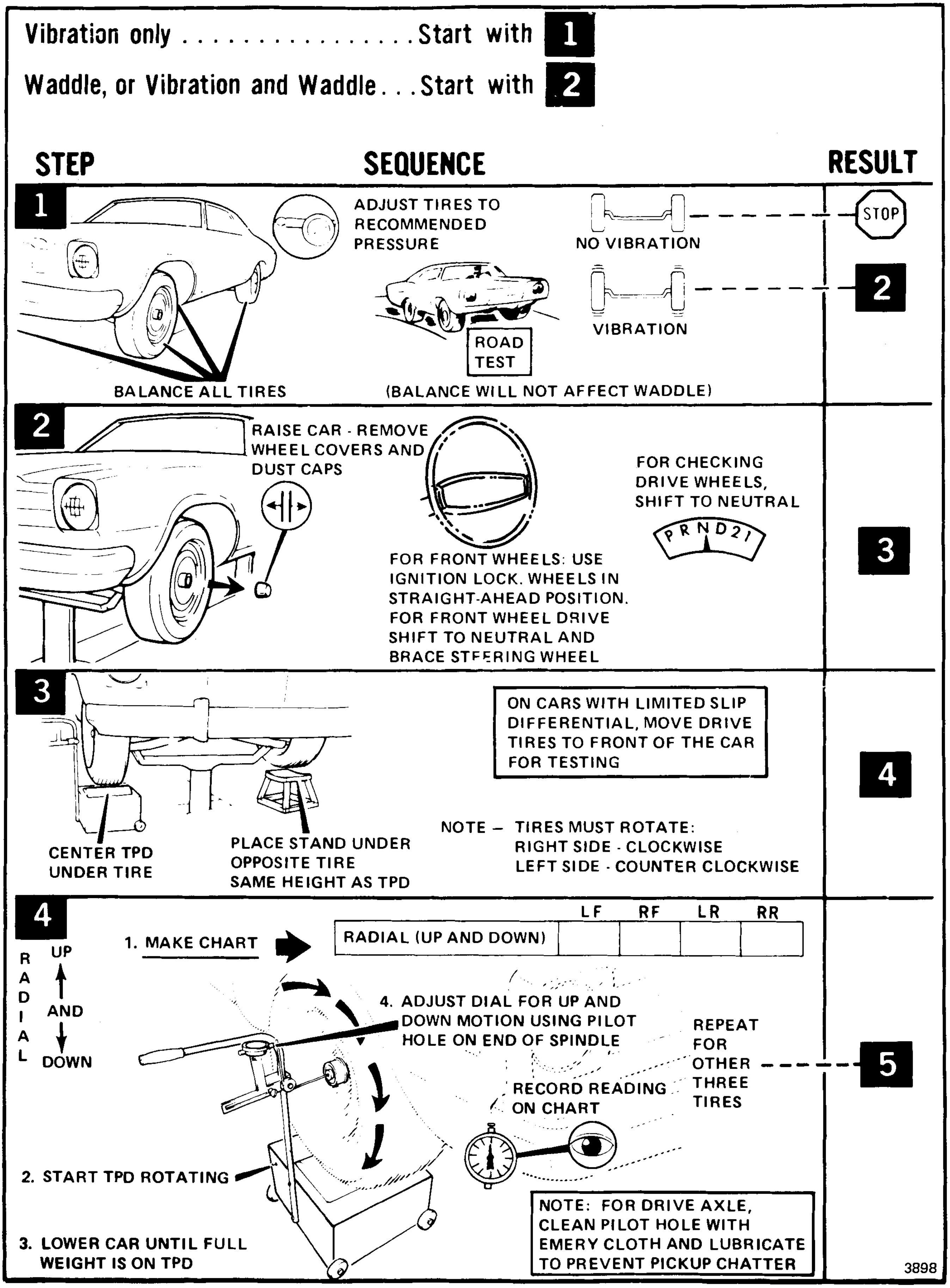
Fig. 3-16 Tire Diagnosis



Vibration only . . . . Start with 1

Waddle, or Vibration and Waddle . . . Start with 2

STEP	SEQUENCE	RESULT
1	ADJUST TIRES TO RECOMMENDED PRESSURE BALANCE ALL TIRES ROAD TEST (BALANCE WILL NOT AFFECT WADDLE) NO VIBRATION VIBRATION	STOP 2
2	RAISE CAR - REMOVE WHEEL COVERS AND DUST CAPS FOR FRONT WHEELS: USE IGNITION LOCK. WHEELS IN STRAIGHT-AHEAD POSITION. FOR FRONT WHEEL DRIVE SHIFT TO NEUTRAL AND BRACE STEERING WHEEL FOR CHECKING DRIVE WHEELS, SHIFT TO NEUTRAL	3
3	CENTER TPD UNDER TIRE PLACE STAND UNDER OPPOSITE TIRE SAME HEIGHT AS TPD ON CARS WITH LIMITED SLIP DIFFERENTIAL, MOVE DRIVE TIRES TO FRONT OF THE CAR FOR TESTING NOTE – TIRES MUST ROTATE: RIGHT SIDE - CLOCKWISE LEFT SIDE - COUNTER CLOCKWISE	4
4	1. MAKE CHART 2. START TPD ROTATING 3. LOWER CAR UNTIL FULL WEIGHT IS ON TPD 4. ADJUST DIAL FOR UP AND DOWN MOTION USING PILOT HOLE ON END OF SPINDLE RECORD READING ON CHART REPEAT FOR OTHER THREE TIRES	5

	LF	RF	LR	RR
RADIAL (UP AND DOWN)				

NOTE: FOR DRIVE AXLE, CLEAN PILOT HOLE WITH EMERY CLOTH AND LUBRICATE TO PREVENT PICKUP CHATTER

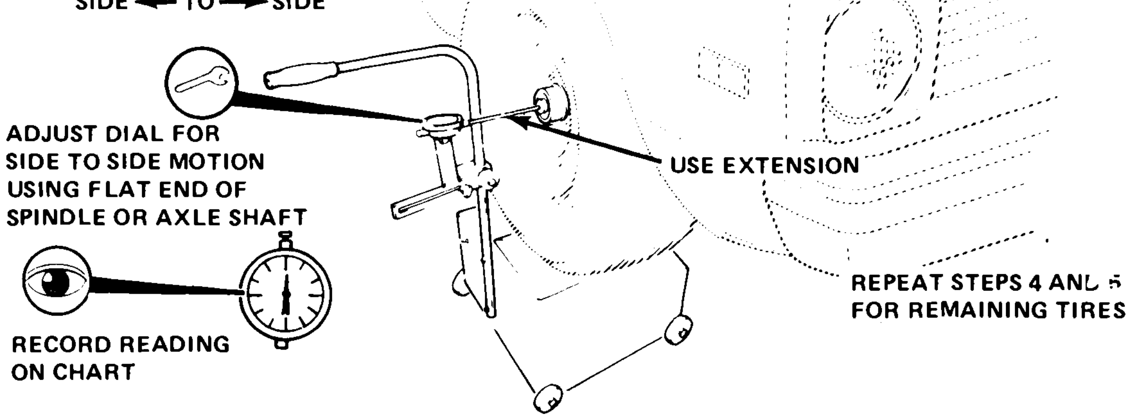
Fig. 3-17 Tire Diagnosis

STEP **SEQUENCE** **RESULT**

5

LATERAL
SIDE ← TO → SIDE

	LF	RF	LR	RR
LATERAL (SIDE TO SIDE)				



ADJUST DIAL FOR SIDE TO SIDE MOTION USING FLAT END OF SPINDLE OR AXLE SHAFT

USE EXTENSION

RECORD READING ON CHART

REPEAT STEPS 4 AND 5 FOR REMAINING TIRES

RESULT: **7**

6

RECHECK NEW ASSEMBLY PER STEPS 4 AND 5

REVISE TABLE

	LF	RF	LR	RR
RADIAL (UP AND DOWN)				
LATERAL (SIDE TO SIDE)				

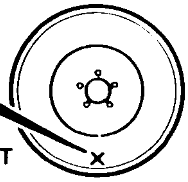
RESULT: **7**

7

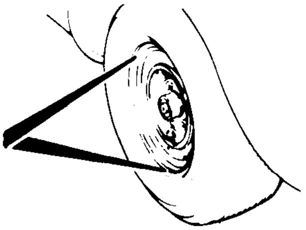
IF ALL RADIAL READINGS ARE LESS THAN .035 INCH/0.88 mm — — — **13**

IF ANY RADIAL READING IS MORE THAN .035 INCH/0.88 mm — — — **8**

8



MARK "X" ON TIRE AT 6 O'CLOCK WHEN DIAL INDICATOR IS AT MAX. SPINDLE LIFT

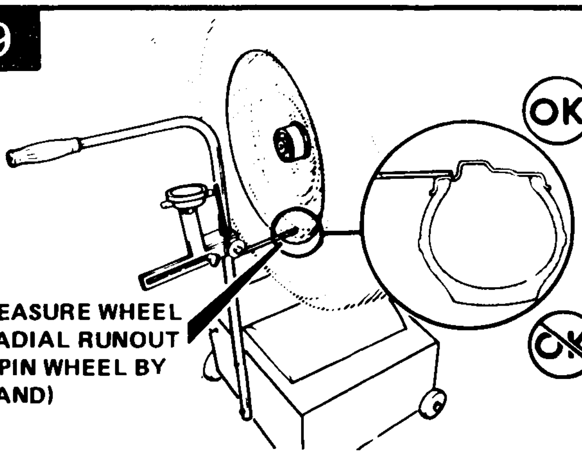


RAISE CAR OFF ROLLER

CLEAN WHEEL SURFACE

RESULT: **9**

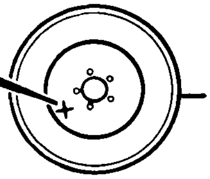
9



MEASURE WHEEL RADIAL RUNOUT (SPIN WHEEL BY HAND)

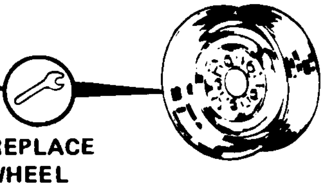
FOR STANDARD STEEL WHEELS: .025 INCH/0.63 mm
FOR OTHER: .035 INCH/0.88 mm

OK — MARK "X" ON WHEEL WHERE IT RUNS OUT LEAST



— — **10**

~~OK~~ — REPLACE WHEEL REBALANCE



— — — **6**

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Fig. 3-18 Tire Diagnosis

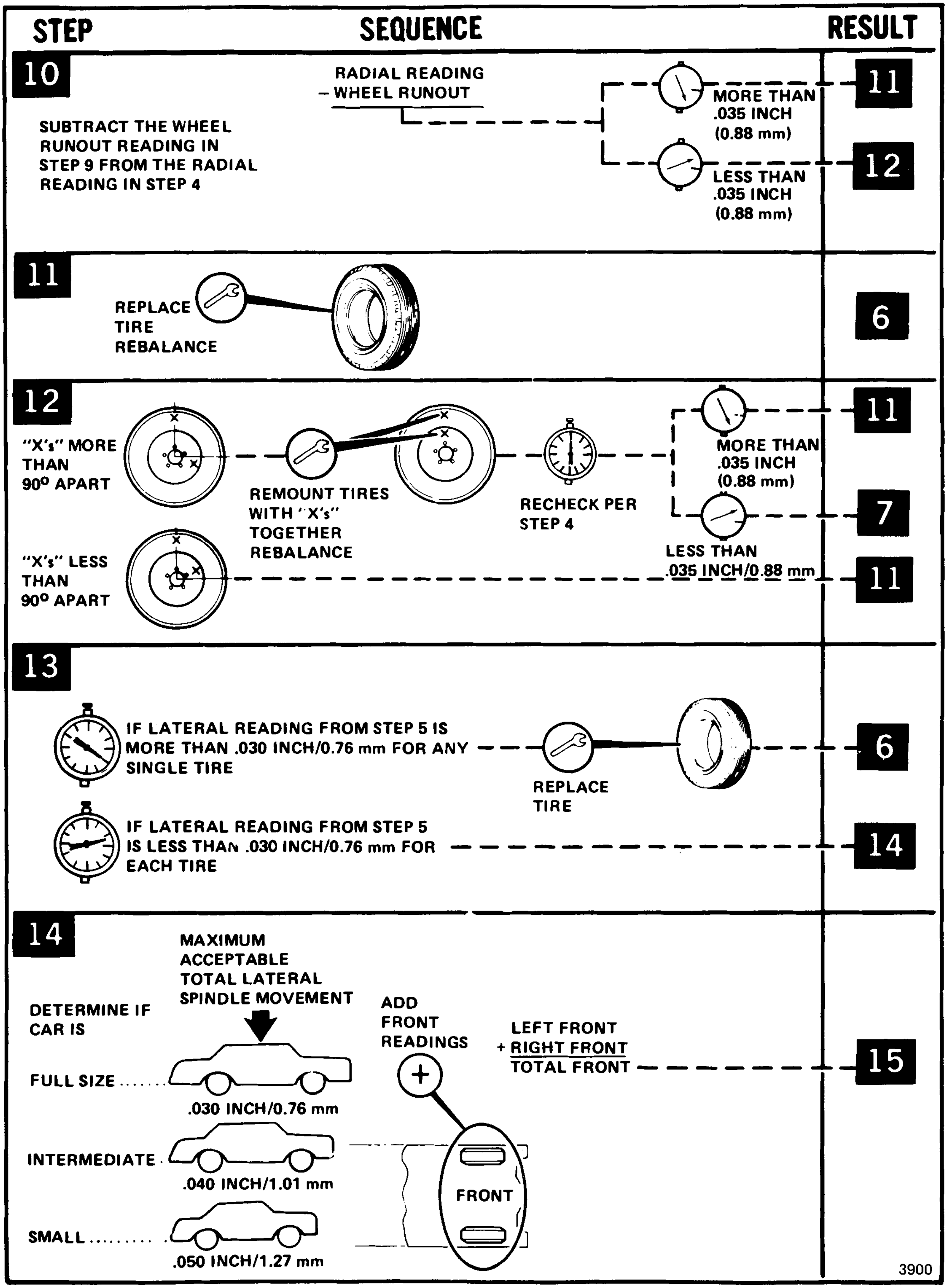
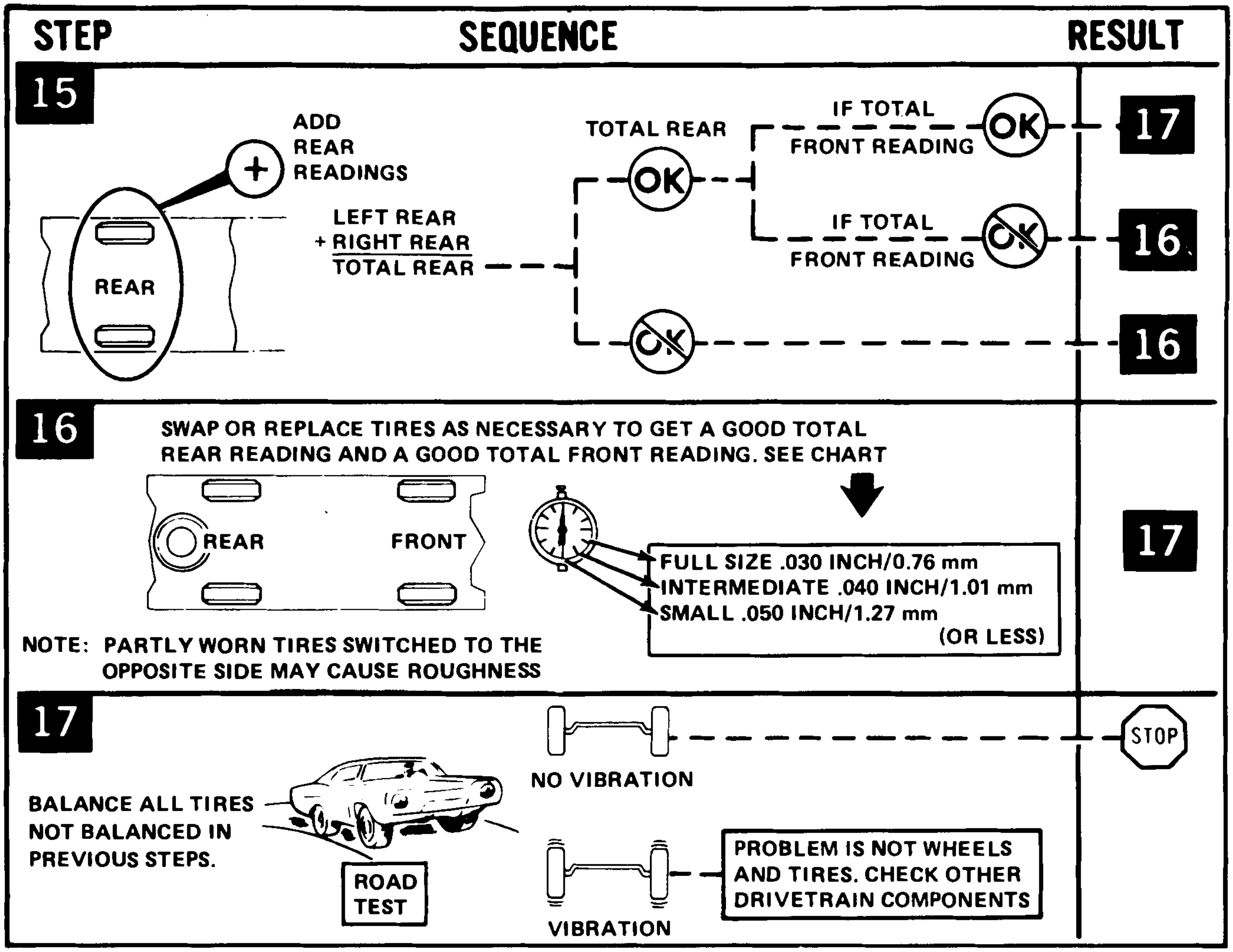


Fig. 3-19 Tire Diagnosis



SWAP OR REPLACE TIRES AS NECESSARY TO GET A GOOD TOTAL REAR READING AND A GOOD TOTAL FRONT READING. SEE CHART

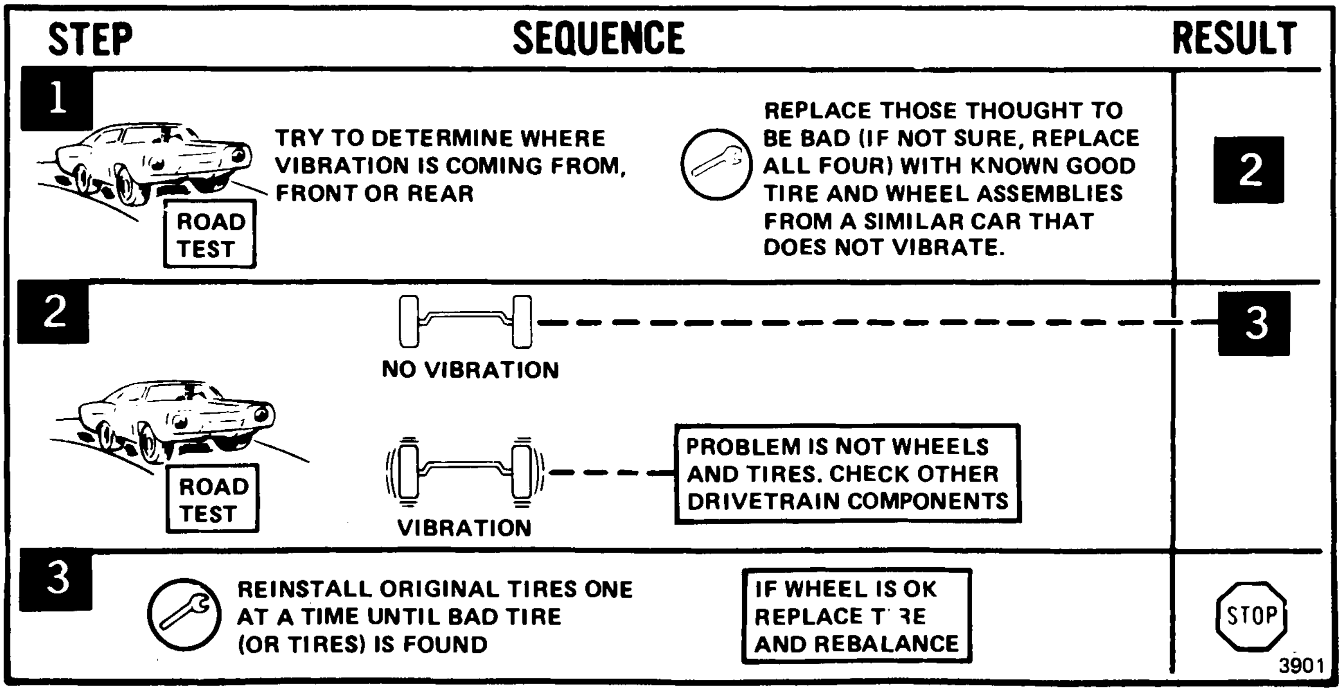
FULL SIZE .030 INCH/0.76 mm
INTERMEDIATE .040 INCH/1.01 mm
SMALL .050 INCH/1.27 mm
(OR LESS)

NOTE: PARTLY WORN TIRES SWITCHED TO THE OPPOSITE SIDE MAY CAUSE ROUGHNESS

BALANCE ALL TIRES NOT BALANCED IN PREVIOUS STEPS.

PROBLEM IS NOT WHEELS AND TIRES. CHECK OTHER DRIVETRAIN COMPONENTS

SUBSTITUTION METHOD



TRY TO DETERMINE WHERE VIBRATION IS COMING FROM, FRONT OR REAR

REPLACE THOSE THOUGHT TO BE BAD (IF NOT SURE, REPLACE ALL FOUR) WITH KNOWN GOOD TIRE AND WHEEL ASSEMBLIES FROM A SIMILAR CAR THAT DOES NOT VIBRATE.

PROBLEM IS NOT WHEELS AND TIRES. CHECK OTHER DRIVETRAIN COMPONENTS

REINSTALL ORIGINAL TIRES ONE AT A TIME UNTIL BAD TIRE (OR TIRES) IS FOUND

IF WHEEL IS OK REPLACE TIRE AND REBALANCE

Fig. 3-20 Tire Diagnosis

SECTION 3A

FRONT END ALIGNMENT

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

FRONT ALIGNMENT

Front alignment refers to the angular relationship between the front wheels, the front suspension attaching parts and the ground. The angle of the knuckle away from the vertical, the pointing in or "toe-in" of the front wheels, the tilt of the front wheels from vertical (when viewed from the front of the vehicle) and the tilt of the suspension members from the vertical (when viewed from the side of the vehicle), - all these are involved in front alignment.

CASTER (FIG. 3A-1)

Caster is the tilting of the front steering axis either forward or backward from the vertical (when viewed from the side of the vehicle). A backward tilt is said to be positive (+) and a forward tilt is said to be negative (-). On the short and long arm type suspension a caster angle can not be seen without a special instrument, but you can understand that if you look straight down from the top of the upper control arm to the ground you would find that the ball joints do not line up (fore and aft) when a caster angle other than 0° is present. If you had a positive caster angle the lower ball joint would be slightly ahead (toward the front of the vehicle) of the upper ball joint center line. In short then: caster is the forward or backward tilt of the steering axis as viewed from a side elevation. See caster copy under ADJUSTMENTS.

CAMBER (FIG. 3A-1)

Camber is the tilting of the front wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is said to be positive (+). When the wheels tilt inward at the top, the camber is said to be negative (-). The amount of tilt is measured in degrees from the vertical and this measurement is called the camber angle. See camber copy under ADJUSTMENTS.

TOE-IN (FIG. 3A-1)

Toe-in is the turning in of the front wheels. The actual amount of toe-in is normally only a fraction of an inch. The purpose of a toe specification is to insure parallel rolling of the front wheels (excessive toe-in or toe-out may increase tire wear). Toe-in also serves to offset the small deflections of the wheel support system which occurs when the vehicle is rolling forward. In other words, even when the wheels are set to toe-in slightly when the vehicle is standing still, they tend to roll parallel on the road when the vehicle is moving. See toe-in copy under ADJUSTMENTS.

MAINTENANCE AND ADJUSTMENTS

PRELIMINARY CHECKS PRIOR TO ADJUSTING FRONT ALIGNMENT

Steering and vibration complaints are not always the result of improper alignment.

An additional item to be checked is the possibility of tire lead due to worn or improperly manufactured tires. "Lead" is the deviation of the vehicle from a straight path on a level road without hand pressure on the steering wheel.

Section 3E of this manual, "Wheels and Tires", contains a procedure for determining the presence of a tire lead problem.

Before making any adjustment affecting caster, camber or toe-in, the following checks and inspections should be made to insure correctness of alignment readings and alignment adjustments:

1. Check all tires for proper inflation pressures and approximately the same tread wear.
2. Check front wheel bearings for proper adjustment and correct if necessary.
3. Check for loose ball joints by following the inspection procedure presented later; check tie rod ends and steering relay rods; if excessive looseness is noted, it must be corrected before adjusting.

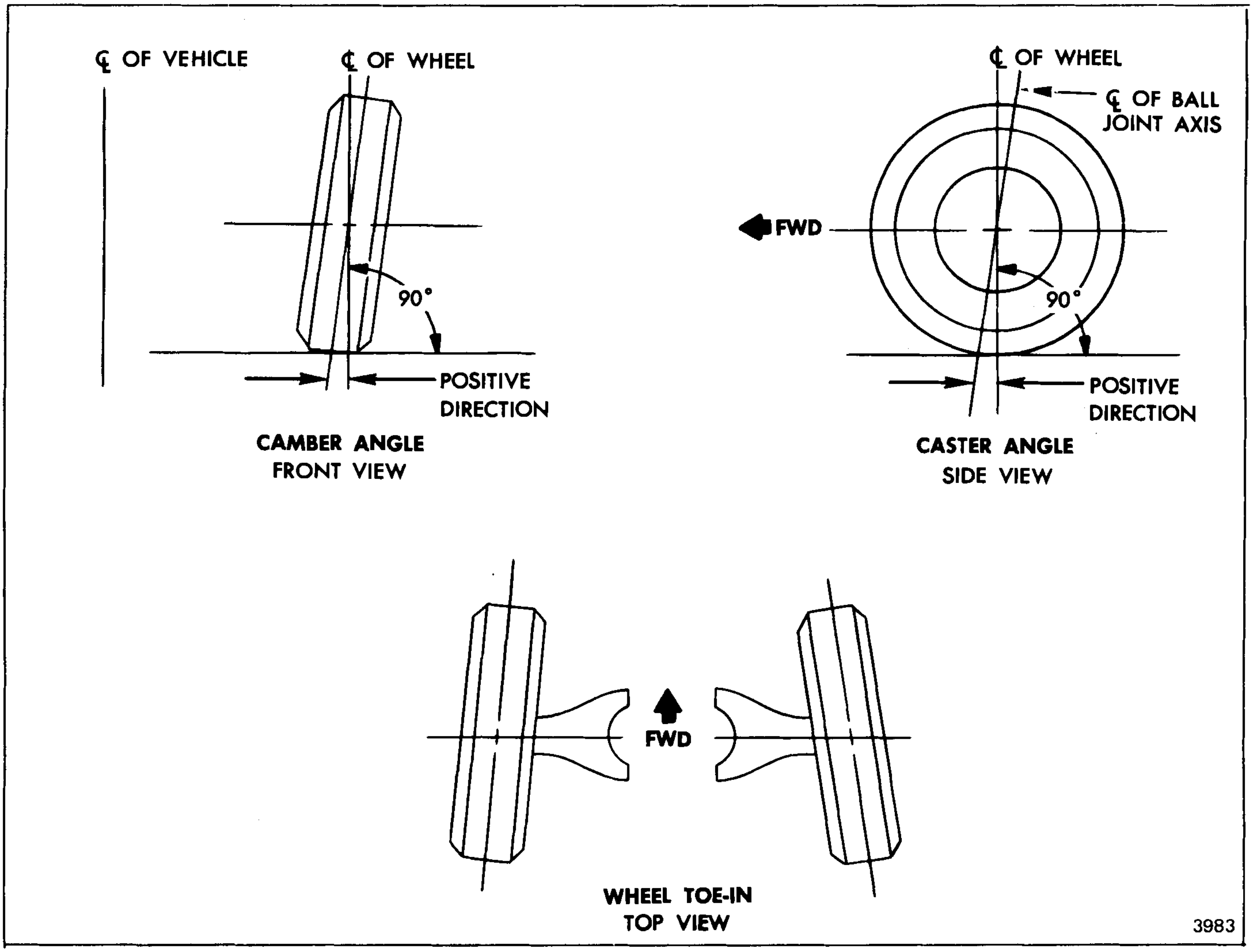


FIG.3A-1 CASTER, CAMBER AND TOE-IN

4. Check for run-out of wheels and tires.

5. Check vehicle trim heights; if out of limits and a correction is to be made, the correction must be made before adjusting caster, camber or toe-in.

NOTE: Good judgement should be exercised before replacing a spring when vehicle trim height is only slightly out of limits (± 3/4").

6. Check for steering gear looseness at frame.

7. Check for improperly operating shock absorbers.

8. Check for loose control arms.

9. Check for loose or missing stabilizer bar attachments.

10. Consideration must be given to excess loads, such as tool boxes. If this excess load is normally carried in the vehicle it should remain in the vehicle during alignment checks.

11. Consider the condition of the equipment being used to check alignment and follow the manufacturer's instructions.

12. Regardless of equipment used to check alignment, the vehicle must be on a level surface both fore and aft and transversely.

FRONT ALIGNMENT REQUIREMENTS

Satisfactory vehicle operation may occur over a wide range of front suspension alignment settings. Nevertheless, should settings vary beyond certain tolerances, readjustment of alignment is advisable. The specifications stated in column 1 of Fig. 3A-11 should be used by owners, dealers and repairmen as guidelines in vehicle diagnosis either for repairs under the new vehicle warranty or for maintenance service at customer's request. These specifications provide an acceptable all around operating range in that they prevent abnormal tire wear caused by wheel alignment.

Governmental Periodic Motor Vehicle Inspection programs usually include wheel alignment among items that are inspected. To provide useful information for such inspections, the specifications stated in column 2 of Fig. 3A-11 are given and these are well within the range of safe vehicle operation.

In the event the actual settings are beyond the specifications set forth in column 1 or 2 (whichever is applicable), or whenever for other reasons the alignment is being reset, the recommended specifications in column 3 of Fig. 3A-11 should be used.

ALIGNMENT ADJUSTMENTS-EXCEPT H SERIES

CASTER AND CAMBER

NOTE: Before adjusting caster and camber angles, the front bumper should be raised and released twice to allow vehicle to return to its normal height. See Trim Heights in this Section.

Caster and camber adjustments are made by means of shims inserted between the upper control arm shaft and the frame bracket (Fig. 3A-2). Shims may be added, subtracted or transferred to change the readings as follows:

1. CASTER - transfer shims, front to rear or rear to front.

The transfer of one shim to the front bolt from the rear bolt will decrease positive caster.

2. CAMBER - change shims at both the front and rear of the shaft.

Adding an equal number of shims at both front and rear of the support shaft will decrease positive camber.

NOTE: Caster and camber can be adjusted in one operation. Toe-in must be checked after changing camber or caster.

To adjust caster and camber, loosen the upper control arm shaft to frame nuts, add or subtract shims as required (see alignment correction charts - Figs. 3A-4 through 3A-8) and retorque nuts.

Caster, camber and toe-in specifications can be found in Fig. 3A-11.

NOTE: A normal shim pack will leave at least two (2) threads of the bolt exposed beyond the nut. Difference between front and rear shim packs must not exceed .40 inches.

If these requirements cannot be met in order to reach specifications, check for damaged control arms and related parts.

NOTE: Always tighten the thinner shim packs' nut first for improved shaft to frame clamping force and torque retention.

TOE-IN (FIG. 3A-3)

Toe-in, the inward pointing of both front wheels, is checked with the wheels in the straight ahead position and the steering wheel set straight ahead. It is the difference of the measurements between the front and rear of both front wheels. Correct toe-in specifications can be found in Fig. 3A-11.

NOTE: Toe-in must be adjusted after caster and camber adjustment.

1. If the equipment being used measures the toe-in of each wheel individually:

a. Set the steering gear on the high point, mark 12 o'clock position on the steering shaft and position the steering wheel for straight ahead driving.

b. Loosen the clamp bolt at each end of each tie rod and adjust to the total toe-in as given in Fig. 3A-11 at the end of this Section (1/2 of total per wheel).

2. If a tram gage is being used, proceed as follows:

a. Set the front wheels in the straight ahead position.

b. Loosen the clamp bolts on one tie rod and adjust for the proper toe-in as given in Fig. 3A-11.

c. Loosen the clamp bolts on the other tie rod. Turn both rods the same amount and in the same direction to place the steering gear on its high point and position the steering wheel in its straight ahead position.

3. After the adjustment has been made: See Section 3B1 of this manual for tie rod clamp orientation and positioning for each vehicle.

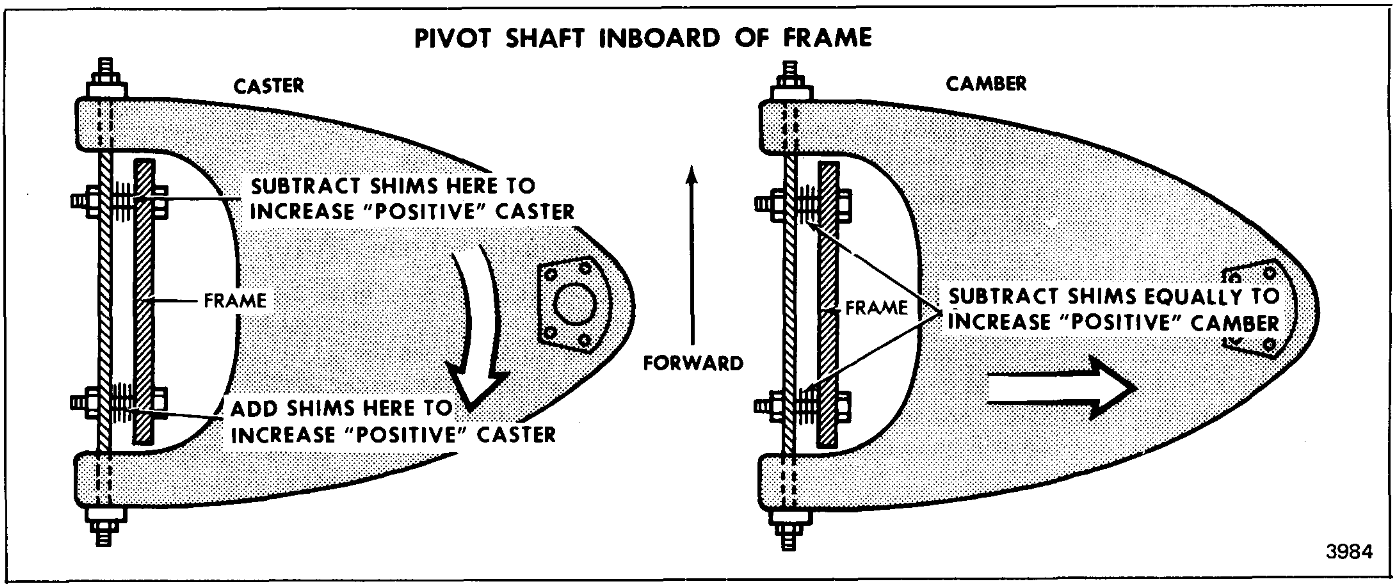


Fig. 3A-2 Caster and Camber Adjustment

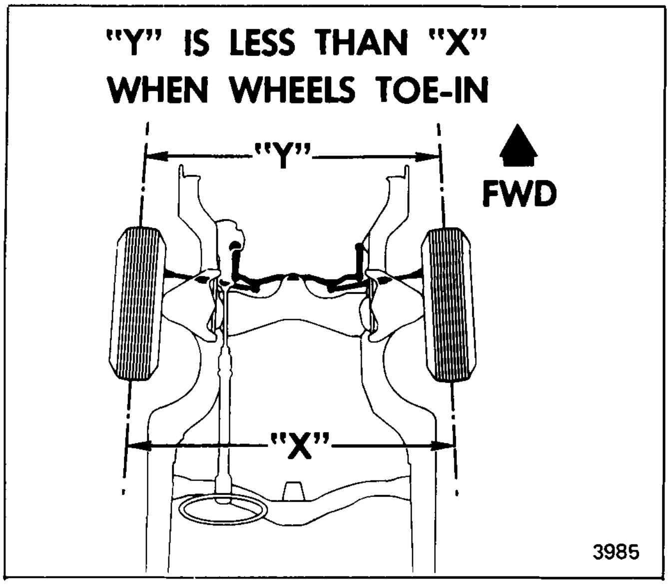


FIG. 3A-3 TOE-IN ADJUSTMENT

ALIGNMENT CORRECTION CHARTS - EXCEPT H SERIES

(Figs. 3A-4 through 3A-8)

To use the Front Alignment Correction Charts, first select the correct chart for the vehicle being aligned. Determine the present alignment of the subject vehicle. Find the camber reading on the chart (left or right side) and the caster reading (for the proper vehicle and options). Trace to the point of intersection. The three digit code for front and rear bolts indicates the shim change necessary to arrive at the proper specification. Add or subtract shims from the front or rear bolt as indicated. Retorque bolts and check corrected alignment setting.

> **NOTE:** A normal shim pack should contain a maximum of one small and one medium shim. Adjust shim pack as necessary without changing final dimension to meet this requirement.

Example Use of Correction Chart

1. G Series models should have Caster of +5° (±0.5°); left-side Camber of +1° (±0.5°); and right-side Camber of _0.5° (±0.5°).

2. Suppose the example vehicle shows +3 1/2° Caster and 0° Camber on the left side and +2 3/4° Caster and +1° Camber on the right side.

3. Specification in Fig. 3A-11 show realignment is advisable.

4. By using the chart we can determine that a left side shim pack change of two large and one medium shim subtracted from the front bolt and one medium and one small shim subtracted from the rear bolt will bring the left side to specifications.

5. On the right side subtract one medium shim from the front bolt and add two large and one small on the rear bolt.

6. These changes will bring the vehicle close to the exact specification and will certainly be within service reset tolerances.

ALIGNMENT ADJUSTMENTS - H SERIES

CASTER AND CAMBER

Cam Bolts (Fig. 3A-9)

Caster and camber adjustments are made by rotating, or changing the position of, the cam bolts. The H Series uses the front cam to adjust the camber setting and the rear cam to adjust the caster setting. The lower control arm is designed so that the camber setting should be made first. In other words, adjust camber, then caster, then toe-in.

The front cam tends to move the control arm in or out with respect to the vehicle. This movement will change caster.

Toe-in is conventional and is covered in this section.

Toe-In (Fig. 3A-10)

Toe-in can be increased or decreased by changing the length of the tie rods. A threaded sleeve is provided for this purpose.

The tie rods are mounted ahead of the steering knuckle and must be decreased in length in order to increase toe-in.

> **NOTE:** Camber and caster adjustment is made by the cam bolts which are the attachment for the lower control arm. The front cam adjusts the camber and must be made first. The rear cam adjusts the caster. Toe-in adjustment must be checked **after** camber and caster adjustment.

Camber Adjustment (Fig. 3A-9)

Camber angle is adjusted by loosening the front lower control arm pivot nut and rotating the cam until proper setting is reached. This eccentric cam action will move the lower control arm in or out, thereby varying the camber. Hold the cam bolt head while tightening the nut.

Caster Adjustment (Fig. 3A-9)

Caster angle is adjusted by loosening the rear lower control arm pivot nut and rotating the cam until proper setting is reached. This eccentric cam action will tend to move the lower control arm fore or aft thereby varying the caster.

Hold the cam bolt head while tightening the nut. Recheck camber after setting caster.

Toe-In Adjustment (Fig. 3A-10)

Toe-in is the difference in the distance measured between the front and rear of the front wheels. The wheels must be in the straight ahead position when adjusting toe-in. Toe-in must be checked **after** camber and or caster adjustment.

1. Loosen the clamp bolt nut at each end of each tie rod and rotate the sleeve until proper toe-in is reached.

2. Position the tie rod ball stud assembly straight on a center line through their attaching points.

3. See Section 3B1 for position of tie rod clamps and bolts after setting toe-in.

4. Tighten the clamp nuts.

MEASURED CASTER READING

MEASURED CAMBER READING

B-SERIES		4.60°	4.40°	4.20°	4.00°	3.80°	3.60°	3.40°	3.20°	3.00°	2.80°	2.60°	2.40°	2.20°	2.00°	1.80°	1.60°	1.40°
	BOLT																	
2.60°	FRONT	+311	+311	+310	+301	+301	+300	+300	+211	+211	+211	+210	+210	+201	+201	+200	+200	+111
	REAR	+110	+111	+111	+200	+201	+201	+210	+211	+211	+300	+301	+301	+310	+311	+400	+400	+401
2.40°	FRONT	+310	+301	+301	+300	+300	+211	+211	+210	+210	+201	+201	+200	+200	+200	+111	+111	+110
	REAR	+101	+101	+110	+111	+111	+200	+201	+201	+210	+211	+211	+300	+301	+310	+310	+311	+400
2.20°	FRONT	+301	+300	+300	+211	+211	+210	+210	+201	+201	+200	+200	+111	+111	+110	+110	+101	+101
	REAR	+100	+100	+101	+101	+110	+111	+111	+200	+201	+201	+210	+211	+300	+300	+301	+310	+311
2.00°	FRONT	+211	+211	+210	+210	+201	+201	+200	+200	+111	+111	+110	+110	+110	+101	+101	+100	+100
	REAR	+010	+011	+100	+100	+101	+110	+110	+111	+200	+200	+201	+210	+210	+211	+300	+301	+301
1.80°	FRONT	+210	+210	+201	+201	+200	+200	+111	+111	+110	+110	+101	+101	+100	+100	+011	+011	+011
	REAR	+001	+010	+010	+011	+100	+100	+101	+110	+110	+111	+200	+200	+201	+210	+211	+211	+300
1.60°	FRONT	+201	+200	+200	+111	+111	+110	+110	+101	+101	+100	+100	+100	+011	+011	+010	+010	+001
	REAR	-000	+000	+001	+010	+010	+011	+100	+100	+101	+110	+110	+111	+200	+201	+201	+210	+211
1.40°	FRONT	+200	+111	+111	+110	+110	+101	+101	+100	+100	+011	+011	+010	+010	+001	+001	+001	+000
	REAR	-001	-001	-000	+001	+001	+010	+010	+011	+100	+101	+101	+110	+111	+111	+200	+201	+210
1.20°	FRONT	+111	+110	+101	+101	+100	+100	+011	+011	+011	+010	+010	+001	+001	+000	-000	-001	-001
	REAR	-011	-010	-001	-001	-000	+001	+001	+010	+011	+011	+100	+101	+101	+110	+111	+200	+200
1.00°	FRONT	+101	+101	+100	+100	+011	+011	+010	+010	+001	+001	+000	-000	-001	-001	-001	-010	-010
	REAR	-100	-011	-011	-010	-001	-001	-000	+001	+001	+010	+011	+011	+100	+101	+110	+110	+111
0.80°	FRONT	+100	+100	+011	+011	+010	+010	+001	+001	000	-000	-001	-001	-010	-010	-011	-011	-011
	REAR	-101	-100	-100	-011	-011	-010	-001	-001	000	+001	+001	+010	+011	+100	+100	+101	+110
0.60°	FRONT	+011	+010	+010	+001	+001	+000	-000	-001	-001	-010	-010	-010	-011	-011	-100	-100	-101
	REAR	-110	-110	-101	-100	-100	-011	-010	-010	-001	-000	+000	+001	+010	+010	+011	+100	+101
0.40°	FRONT	+010	+001	+001	+000	-000	-001	-001	-010	-010	-011	-011	-100	-100	-101	-101	-101	-110
	REAR	-200	-111	-110	-110	-101	-100	-100	-011	-010	-010	-001	-000	+000	+001	+010	+011	+011
0.20°	FRONT	+001	-000	-001	-001	-010	-010	-011	-011	-100	-100	-100	-101	-101	-110	-110	-111	-111
	REAR	-201	-200	-200	-111	-110	-110	-101	-100	-100	-011	-010	-010	-001	-000	+001	+001	+010
-0.00°	FRONT	-001	-001	-010	-010	-011	-011	-100	-100	-101	-101	-110	-110	-111	-111	-111	-200	-200
	REAR	-210	-201	-201	-200	-111	-111	-110	-110	-101	-100	-011	-011	-010	-001	-001	+000	+001
-0.20°	FRONT	-010	-010	-011	-011	-100	-100	-101	-101	-110	-110	-111	-111	-200	-200	-201	-201	-201
	REAR	-211	-211	-210	-201	-201	-200	-111	-111	-110	-101	-101	-100	-011	-011	-010	-001	-000
-0.40°	FRONT	-011	-100	-100	-101	-101	-110	-110	-111	-111	-200	-200	-200	-201	-201	-210	-210	-211
	REAR	-300	-300	-211	-211	-210	-201	-201	-200	-111	-111	-110	-101	-101	-100	-011	-010	-010
-0.60°	FRONT	-100	-101	-101	-110	-110	-111	-111	-200	-200	-201	-201	-210	-210	-211	-211	-211	-300
	REAR	-310	-301	-300	-300	-211	-211	-210	-201	-201	-200	-111	-110	-110	-101	-100	-100	-011
-0.80°	FRONT	-101	-110	-110	-111	-200	-200	-201	-201	-201	-210	-210	-211	-211	-300	-300	-301	-301
	REAR	-311	-310	-310	-301	-300	-300	-211	-210	-210	-201	-200	-200	-111	-110	-110	-101	-100
-1.00°	FRONT	-111	-111	-200	-200	-201	-201	-210	-210	-211	-211	-300	-300	-300	-301	-301	-310	-310
	REAR	-400	-311	-311	-310	-310	-301	-300	-300	-211	-210	-210	-201	-200	-111	-111	-110	-101

FRONT = SHIM REQUIRED AT FRONT BOLT
REAR = SHIM REQUIRED AT REAR BOLT

\+ = SHIM ADDITION
\- = SHIM REMOVAL

EXAMPLE

3 0 1
= # OF SMALL (.03) SHIMS
= # OF MED. (.06) SHIMS
= # OF LARGE (.12) SHIMS

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Fig. 3A-4 B Series Alignment Correction Chart

MEASURED CASTER READING

MEASURED CAMBER READING

A SERIES	POW STR.	RADIAL	+4-1/2°	+4-1/4°	+4°	+3-3/4°	+3-1/2°	+3-1/4°	+3°	+2-3/4°	+2-1/2°	+2-1/4°	+2°	+1-3/4°	+1-1/2°	+1-1/4°	+1°	+3/4°	+1/2°	+1/4°	+0°	-1/4°
		BELTED	+3-1/2°	+3-1/4°	+3°	+2-3/4°	+2-1/2°	+2-1/4°	+2°	+1-3/4°	+1-1/2°	+1-1/4°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°	-1/2°	-3/4°	-1°	-1-1/4°
	MAN. STEER.		+3-1/2°	+3-1/4°	+3°	+2-3/4°	+2-1/2°	+2-1/4°	+2°	+1-3/4°	+1-1/2°	+1-1/4°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°	-1/2°	-3/4°	-1°	-1-1/4°
G SERIES			+7-1/2°	+7-1/4°	+7°	+6-3/4°	+6-1/2°	+6-1/4°	+6°	+5-3/4°	+5-1/2°	+5-1/4°	+5°	+4-3/4°	+4-1/2°	+4-1/4°	+4°	+3-3/4°	+3-1/2°	+3-1/4°	+3°	+2-3/4°
LEFT	RIGHT	BOLT																				
+3-1/4°	+2-3/4°	FRONT	+411	+410	+410	+401	+401	+400	+400	+311	+311	+310	+310	+310	+301	+300	+300	+211	+211	+210	+201	+201
		REAR	+110	+111	+200	+201	+210	+211	+211	+300	+301	+310	+311	+311	+311	+400	+401	+410	+410	+411	+500	+500
+3°	+2-1/2°	FRONT	+401	+401	+400	+400	+311	+311	+310	+310	+301	+301	+300	+300	+211	+211	+210	+210	+201	+200	+200	+111
		REAR	+101	+110	+110	+111	+200	+201	+210	+210	+211	+300	+301	+301	+310	+311	+311	+400	+401	+401	+410	+411
+2-3/4°	+2-1/4°	FRONT	+400	+311	+311	+310	+310	+301	+301	+300	+300	+211	+211	+210	+210	+201	+201	+200	+111	+111	+110	+110
		REAR	+011	+100	+101	+110	+110	+111	+200	+201	+210	+210	+211	+300	+300	+301	+310	+310	+311	+400	+400	+401
+2-1/2°	+2°	FRONT	+310	+310	+301	+301	+300	+300	+211	+211	+210	+210	+201	+201	+200	+200	+111	+111	+110	+101	+101	+100
		REAR	+010	+010	+011	+100	+101	+110	+110	+111	+200	+201	+201	+210	+211	+211	+300	+301	+301	+310	+311	+311
+2-1/4°	+1-3/4°	FRONT	+301	+300	+300	+211	+211	+210	+210	+201	+201	+200	+200	+111	+111	+110	+110	+101	+100	+100	+011	+010
		REAR	000	+001	+010	+010	+011	+100	+101	+110	+110	+111	+200	+200	+201	+210	+210	+211	+300	+301	+301	+310
+2°	+1-1/2°	FRONT	+211	+211	+210	+210	+201	+201	+201	+200	+111	+111	+110	+110	+101	+101	+100	+011	+011	+010	+010	+001
		REAR	-010	-001	000	+001	+010	+010	+011	+100	+101	+110	+110	+111	+111	+200	+201	+210	+210	+211	+300	+300
+1-3/4°	+1-1/4°	FRONT	+210	+201	+201	+200	+200	+111	+111	+110	+110	+101	+101	+100	+100	+011	+010	+010	+001	+001	000	-001
		REAR	-011	-010	-010	-001	000	+001	+010	+010	+011	+100	+101	+101	+110	+111	+111	+200	+201	+201	+210	+211
+1-1/2°	+1°	FRONT	+200	+200	+111	+111	+110	+110	+101	+101	+100	+100	+011	+011	+010	+010	+001	000	000	-001	-010	-010
		REAR	-101	-100	+011	-010	-010	-001	000	+001	+010	+010	+011	+011	+100	+101	+110	+110	+111	+200	+200	+201
+1-1/4°	+3/4°	FRONT	+110	+110	+110	+101	+101	+100	+100	+011	+010	+010	+001	+001	+001	000	-001	-001	-010	-010	-011	-100
		REAR	-111	-110	-101	-100	-011	-010	-010	-001	000	+001	+001	+010	+011	+011	+100	+101	+101	+110	+111	+111
+1°	+1/2°	FRONT	+101	+100	+100	+011	+011	+010	+010	+001	+001	000	000	000	-001	-010	-010	-011	-011	-100	-101	-101
		REAR	-200	-111	-110	-110	-101	-100	-011	-010	-010	-001	000	000	+001	+010	+010	+011	+100	+100	+101	+110
+3/4°	+1/4°	FRONT	+011	+011	+010	+010	+001	+001	000	000	-001	-001	-001	-010	-011	-011	-100	-100	-101	-110	-110	-111
		REAR	-210	-201	-200	-111	-110	-110	-101	-100	-011	-011	-010	-001	-001	000	+001	+010	+010	+011	+100	+100
+1/2°	0°	FRONT	+010	+001	+001	000	000	-001	-001	-010	-010	-011	-011	-100	-100	-101	-101	-110	-111	-111	-200	-200
		REAR	-211	-211	-210	-201	-200	-111	-110	-110	-101	-100	-100	-011	-010	-010	-001	000	+001	+001	+010	+011
+1/4°	-1/4°	FRONT	000	000	-001	-001	-010	-010	-011	-011	-100	-100	-101	-101	-110	-110	-111	-111	-200	-201	-201	-210
		REAR	-301	-300	-211	-210	-210	-201	-200	-111	-111	-110	-101	-101	-100	-011	-010	-010	-001	000	000	+001
0°	-1/2°	FRONT	-001	-010	-010	-011	-011	-100	-100	-101	-101	-110	-110	-111	-111	-200	-200	-201	-210	-210	-211	-300
		REAR	-311	-310	-301	-300	-211	-210	-210	-201	-200	-111	-111	-110	-101	-101	-100	-011	-011	-010	-001	-001
-1/4°	-3/4°	FRONT	-011	-011	-100	-100	-101	-101	-110	-110	-111	-111	-200	-200	-201	-201	-210	-211	-211	-300	-300	-301
		REAR	-400	-311	-311	-310	-301	-300	-211	-211	-210	-201	-201	-200	-111	-110	-110	-101	-100	-100	-011	-010
-1/2°	-1°	FRONT	-100	-101	-101	-110	-110	-111	-111	-200	-200	-201	-201	-210	-210	-211	-300	-300	-301	-301	-310	-311
		REAR	-410	-401	-400	-311	-311	-310	-301	-300	-211	-211	-210	-201	-201	-200	-111	-111	-110	-101	-100	-100
-3/4°	-1-1/4°	FRONT	-110	-110	-111	-111	-200	-200	-201	-201	-210	-211	-211	-211	-300	-301	-301	-310	-310	-311	-400	-400
		REAR	-411	-411	-410	-401	-400	-311	-311	-310	-301	-300	-300	-211	-210	-210	-201	-200	-111	-111	-110	-101
-1°	-1-1/2°	FRONT	-200	-200	-201	-201	-210	-210	-211	-211	-300	-300	-300	-301	-310	-310	-311	-311	-400	-401	-401	-410
		REAR	-501	-500	-411	-411	-410	-401	-400	-311	-311	-310	-301	-301	-300	-211	-210	-210	-201	-200	-200	-111
-1-1/4°	-1-3/4°	FRONT	-201	-210	-210	-211	-211	-300	-300	-301	-301	-310	-310	-311	-311	-400	-400	-401	-410	-410	-411	-411
		REAR	-511	-510	-501	-500	-411	-411	-410	-401	-400	-311	-311	-310	-310	-301	-300	-211	-211	-210	-201	-201

FRONT = SHIM REQUIRED AT FRONT BOLT
REAR = SHIM REQUIRED AT REAR BOLT

\+ = SHIM ADDITION
\- = SHIM REMOVAL

EXAMPLE

4 0 1
1 = # OF SMALL (.03) SHIMS
0 = # OF MED. (.06) SHIMS
4 = # OF LARGE (.12) SHIMS

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Fig. 3A-5 A & G Series Alignment Correction Chart

MEASURED CASTER READING

MEASURED CAMBER READING

F - SERIES		+3-1/4°	+3°	+2-3/4°	+2-1/2°	+2-1/4°	+2°	+1-3/4°	+1-1/2°	+1-1/4°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°	-1/2°	-3/4°	-1°	-1-1/4°
	BOLT																			
+3-1/4°	FRONT	+410	+401	+401	+401	+400	+400	+311	+311	+311	+310	+310	+301	+301	+301	+300	+300	+300	+300	+211
	REAR	+110	+111	+200	+201	+210	+211	+300	+301	+310	+310	+311	+400	+410	+411	+500	+501	+510	+511	+600
+3°	FRONT	+400	+400	+311	+311	+311	+310	+310	+301	+301	+301	+300	+300	+300	+211	+211	+211	+210	+210	+210
	REAR	+101	+101	+110	+111	+200	+201	+210	+211	+300	+301	+310	+311	+400	+401	+410	+411	+500	+501	+510
+2-3/4°	FRONT	+311	+310	+310	+301	+301	+301	+300	+300	+211	+211	+211	+210	+210	+210	+201	+201	+201	+200	+200
	REAR	+011	+100	+101	+110	+111	+111	+200	+201	+210	+211	+300	+301	+310	+311	+400	+401	+410	+500	+501
+2-1/2°	FRONT	+301	+301	+300	+300	+211	+211	+211	+210	+210	+201	+201	+201	+200	+200	+200	+111	+111	+111	+111
	REAR	+001	+010	+011	+100	+101	+110	+111	+200	+201	+210	+211	+300	+301	+310	+311	+400	+401	+410	+411
+2-1/4°	FRONT	+300	+211	+211	+210	+210	+201	+201	+201	+200	+200	+200	+111	+111	+111	+110	+110	+110	+101	+101
	REAR	000	+001	+010	+010	+011	+100	+101	+110	+111	+200	+201	+210	+211	+300	+301	+310	+311	+400	+401
+2°	FRONT	+210	+210	+201	+201	+200	+200	+200	+111	+111	+110	+110	+110	+101	+101	+101	+100	+100	+100	+011
	REAR	-010	-001	000	+001	+010	+011	+100	+101	+110	+110	+111	+200	+201	+211	+300	+301	+310	+311	+400
+1-3/4°	FRONT	+200	+200	+200	+111	+111	+110	+110	+110	+101	+101	+100	+100	+100	+011	+011	+011	+010	+010	+010
	REAR	-011	-011	-010	-001	000	+001	+010	+011	+100	+101	+110	+111	+200	+201	+210	+211	+300	+301	+310
+1-1/2°	FRONT	+111	+110	+110	+110	+101	+101	+100	+100	+100	+011	+011	+011	+010	+010	+010	+001	+001	+001	000
	REAR	-101	-100	-011	-010	-001	-001	000	+001	+010	+011	+100	+101	+110	+111	+200	+201	+210	+300	+301
+1-1/4°	FRONT	+101	+101	+100	+100	+100	+011	+011	+010	+010	+010	+001	+001	+001	000	000	000	-001	-001	-001
	REAR	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+011	+100	+101	+110	+111	+200	+201	+210	+211
+1°	FRONT	+100	+011	+011	+011	+010	+010	+001	+001	000	000	000	-001	-001	-001	-010	-010	-010	-011	-011
	REAR	-200	-111	-110	-110	-101	-100	-011	-010	-001	000	+001	+010	+011	+100	+101	+110	+111	+200	+201
+3/4°	FRONT	+010	+010	+001	+001	+001	000	000	-001	-001	-001	-010	-010	-010	-011	-011	-011	-100	-100	-100
	REAR	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+011	+100	+101	+110	+111	+200
+1/2°	FRONT	+001	000	000	-001	-001	-001	-010	-010	-011	-011	-011	-100	-100	-100	-101	-101	-101	-110	-110
	REAR	-211	-210	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+011	+100	+101	+110
+1/4°	FRONT	-001	-001	-010	-010	-011	-011	-011	-100	-100	-101	-101	-101	-110	-110	-110	-111	-111	-111	-111
	REAR	-301	-300	-211	-210	-201	-200	-200	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+100	+101
0°	FRONT	-010	-011	-011	-100	-100	-101	-101	-101	-110	-110	-110	-111	-111	-111	-200	-200	-200	-201	-201
	REAR	-311	-310	-301	-300	-211	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+011
-1/4°	FRONT	-100	-100	-101	-101	-110	-110	-110	-111	-111	-200	-200	-200	-201	-201	-201	-210	-210	-210	-211
	REAR	-400	-311	-310	-301	-301	-300	-211	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000	+001
-1/2°	FRONT	-101	-110	-110	-111	-111	-200	-200	-200	-201	-201	-210	-210	-210	-211	-211	-211	-300	-300	-300
	REAR	-410	-401	-400	-311	-310	-301	-300	-211	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000
-3/4°	FRONT	-111	-111	-200	-200	-201	-201	-210	-210	-210	-211	-211	-211	-300	-300	-300	-301	-301	-301	-310
	REAR	-411	-410	-410	-401	-400	-311	-310	-301	-300	-211	-210	-201	-200	-111	-110	-101	-100	-011	-010
-1°	FRONT	-201	-201	-201	-210	-210	-211	-211	-211	-300	-300	-301	-301	-301	-310	-310	-310	-311	-311	-311
	REAR	-501	-500	-411	-410	-401	-400	-311	-311	-310	-301	-300	-211	-210	-201	-200	-111	-101	-100	-011
-1-1/4°	FRONT	-210	-211	-211	-211	-300	-300	-301	-301	-301	-310	-310	-311	-311	-311	-400	-400	-400	-400	-401
	REAR	-510	-510	-501	-500	-411	-410	-401	-400	-311	-310	-301	-300	-211	-210	-201	-200	-111	-110	-101

FRONT = SHIM REQUIRED AT FRONT BOLT
REAR = SHIM REQUIRED AT REAR BOLT

\+ = SHIM ADDITION
\- = SHIM REMOVAL

EXAMPLE

4 0 1
1 = # OF SMALL (.03) SHIMS
0 = # OF MED. (.06) SHIMS
4 = # OF LARGE (.12) SHIMS

3972

Fig. 3A-6 F Series Alignment Correction Chart

MEASURED CASTER READING

MEASURED CAMBER READING

X - SERIES -with Manual Steering		+1-1/4°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°	-1/2°	-3/4°	-1°	-1-1/4°	-1-1/2°	-1-3/4°	-2°	-2-1/4°	-2-1/2°	-2-3/4°	-3°	-3-1/4°
	BOLT																			
+3°	FRONT	+500	+411	+411	+410	+401	+401	+400	+311	+311	+310	+301	+301	+300	+300	+211	+211	+210	+210	+201
	REAR	+010	+011	+101	+110	+200	+201	+210	+300	+301	+311	+400	+410	+411	+501	+510	+600	+601	+611	+701
+2-3/4°	FRONT	+410	+410	+401	+400	+400	+311	+310	+310	+301	+301	+300	+211	+211	+210	+210	+201	+201	+200	+111
	REAR	+001	+010	+011	+101	+110	+111	+201	+210	+300	+301	+310	+400	+401	+411	+501	+510	+600	+601	+611
+2-1/2°	FRONT	+401	+400	+311	+311	+310	+301	+301	+300	+300	+211	+210	+210	+201	+201	+200	+200	+111	+110	+110
	REAR	-001	000	+010	+011	+100	+110	+111	+201	+210	+211	+301	+310	+400	+401	+411	+500	+510	+600	+601
+2-1/4°	FRONT	+311	+311	+310	+301	+301	+300	+211	+211	+210	+201	+201	+200	+200	+111	+111	+110	+101	+101	+100
	REAR	-011	-001	000	+001	+011	+100	+101	+111	+200	+210	+211	+301	+310	+400	+401	+411	+500	+510	+600
+2°	FRONT	+310	+301	+300	+300	+211	+210	+210	+201	+200	+200	+111	+111	+110	+110	+101	+100	+100	+011	+011
	REAR	-100	-011	-010	000	+001	+010	+100	+101	+111	+200	+210	+211	+301	+310	+400	+401	+411	+500	+510
+1-3/4°	FRONT	+300	+211	+211	+210	+201	+201	+200	+200	+111	+110	+110	+101	+101	+100	+011	+011	+010	+010	+001
	REAR	-110	-101	-011	-010	000	+001	+010	+100	+101	+111	+200	+210	+211	+301	+310	+400	+401	+411	+500
+1-1/2°	FRONT	+211	+210	+201	+201	+200	+111	+111	+110	+101	+101	+100	+100	+011	+010	+010	+001	+001	000	000
	REAR	-111	-110	-101	-011	-010	-001	+001	+010	+100	+101	+110	+200	+201	+211	+300	+310	+400	+401	+411
+1-1/4°	FRONT	+201	+200	+200	+111	+110	+110	+101	+100	+100	+011	+011	+010	+001	+001	000	000	-001	-001	-010
	REAR	-201	-200	-110	-101	-100	-010	-001	000	+010	+011	+101	+110	+200	+201	+211	+300	+310	+400	+401
+1°	FRONT	+111	+111	+110	+101	+101	+100	+011	+011	+010	+010	+001	000	000	-001	-001	-010	-010	-011	-011
	REAR	-211	-201	-200	-111	-101	-100	-011	-001	000	+010	+011	+101	+110	+200	+201	+211	+300	+310	+400
+3/4°	FRONT	+110	+101	+101	+100	+011	+011	+010	+001	+001	000	000	-001	-010	-010	-011	-011	-100	-100	-101
	REAR	-300	-211	-210	-200	-111	-110	-100	-011	-001	000	+010	+011	+101	+110	+200	+201	+211	+300	+310
+1/2°	FRONT	+100	+100	+011	+010	+010	+001	000	000	-001	-001	-010	-011	-011	-100	-100	-101	-101	-110	-110
	REAR	-310	-301	-211	-210	-201	-111	-110	-100	-011	-001	000	+001	+011	+100	+110	+200	+201	+211	+300
+1/4°	FRONT	+011	+010	+001	+001	000	-001	-001	-010	-010	-011	-100	-100	-101	-101	-110	-110	-111	-111	-200
	REAR	-311	-310	-301	-211	-210	-201	-111	-110	-101	-011	-010	000	+001	+011	+100	+110	+111	+201	+211
0°	FRONT	+001	+001	000	-001	-001	-010	-011	-011	-100	-101	-101	-110	-110	-111	-111	-200	-200	-201	-210
	REAR	-401	-400	-310	-301	-300	-210	-201	-200	-110	-101	-011	-010	000	+001	+011	+100	+110	+111	+201
-1/4°	FRONT	000	-001	-010	-010	-011	-100	-100	-101	-101	-110	-111	-111	-200	-200	-201	-201	-210	-211	-211
	REAR	-411	-401	-400	-311	-301	-300	-211	-201	-200	-110	-101	-011	-010	000	+001	+011	+100	+110	+111
-1/2°	FRONT	-010	-010	-011	-100	-100	-101	-110	-110	-111	-200	-200	-201	-201	-210	-210	-211	-300	-300	-301
	REAR	-500	-411	-410	-400	-311	-310	-300	-211	-201	-200	110	-101	-100	-010	000	+001	+011	+100	+110
-3/4°	FRONT	-011	-100	-101	-101	-110	-111	-111	-200	-201	-201	-210	-210	-211	-211	-300	-301	-301	-310	-310
	REAR	-510	-501	-411	-410	-401	-311	-310	-300	-211	-210	-200	-111	-101	-100	-010	-001	+001	+011	+100
-1°	FRONT	-101	-110	-110	-111	-200	-200	-201	-201	-210	-211	-211	-300	-300	-301	-310	-310	-311	-311	-400
	REAR	-511	-510	-501	-411	-410	-401	-311	-310	-301	-211	-210	-200	-111	-101	-100	-010	-001	+001	+011
-1-1/4°	FRONT	-110	-111	-200	-200	-201	-210	-210	-211	-300	-300	-301	-301	-310	-310	-311	-400	-400	-401	-401
	REAR	-601	-600	-510	-501	-500	-410	-401	-400	-310	-301	-211	-210	-200	-111	-101	-100	-010	-001	+001
-1-1/2°	FRONT	-200	-201	-201	-210	-211	-211	-300	-300	-301	-310	-310	-311	-311	-400	-401	-401	-410	-410	-411
	REAR	-611	-601	-600	-511	-501	-500	-411	-401	-400	-310	-301	-211	-210	-200	-111	-101	-100	-010	-001

FRONT = SHIM REQUIRED AT FRONT BOLT
REAR = SHIM REQUIRED AT REAR BOLT

\+ = SHIM ADDITION
\- = SHIM REMOVAL

EXAMPLE

4 0 1
= # OF SMALL (.03) SHIMS
= # OF MED. (.06) SHIMS
= # OF LARGE (.12) SHIMS

3973

Fig. 3A-7 X Series Alignment Correction Chart (With Power Steering)

MEASURED CASTER READING

MEASURED CAMBER READING

X - SERIES -with Power Steering	BOLT	+3-1/4°	+3°	+2-3/4°	+2-1/2°	+2-1/4°	+2°	+1-3/4°	+1-1/2°	+1-1/4°	+1°	+3/4°	+1/2°	+1/4°	0°	-1/4°	-1/2°	-3/4°	-1°	-1-1/4°
+3°	FRONT	+410	+401	+401	+401	+400	+400	+311	+311	+311	+310	+310	+301	+301	+301	+300	+300	+300	+300	+211
	REAR	+110	+111	+200	+201	+210	+211	+300	+301	+310	+310	+311	+400	+410	+411	+500	+501	+510	+511	+600
+2-3/4°	FRONT	+400	+400	+311	+311	+311	+310	+310	+301	+301	+301	+300	+300	+300	+211	+211	+211	+210	+210	+210
	REAR	+101	+101	+110	+111	+200	+201	+210	+211	+300	+301	+310	+311	+400	+401	+410	+411	+500	+501	+510
+2-1/2°	FRONT	+311	+310	+310	+301	+301	+301	+300	+300	+211	+211	+211	+210	+210	+210	+201	+201	+201	+200	+200
	REAR	+011	+100	+101	+110	+111	+111	+200	+201	+210	+211	+300	+301	+310	+311	+400	+401	+410	+500	+501
+2-1/4°	FRONT	+301	+301	+300	+300	+211	+211	+211	+210	+210	+201	+201	+201	+200	+200	+200	+111	+111	+111	+111
	REAR	+001	+010	+011	+100	+101	+110	+111	+200	+201	+210	+211	+300	+301	+310	+311	+400	+401	+410	+411
+2°	FRONT	+300	+211	+211	+210	+210	+201	+201	+201	+200	+200	+200	+111	+111	+111	+110	+110	+110	+101	+101
	REAR	000	+001	+010	+010	+011	+100	+101	+110	+111	+200	+201	+210	+211	+300	+301	+310	+311	+400	+401
+1-3/4°	FRONT	+210	+210	+201	+201	+200	+200	+200	+111	+111	+110	+110	+110	+101	+101	+101	+100	+100	+100	+011
	REAR	-010	-001	000	+001	+010	+011	+100	+101	+110	+110	+111	+200	+201	+211	+300	+301	+310	+311	+400
+1-1/2°	FRONT	+200	+200	+200	+111	+111	+110	+110	+110	+101	+101	+100	+100	+100	+011	+011	+011	+010	+010	+010
	REAR	-011	-011	-010	-001	000	+001	+010	+011	+100	+101	+110	+111	+200	+201	+210	+211	+300	+301	+310
+1-1/4°	FRONT	+111	+110	+110	+110	+101	+101	+100	+100	+100	+011	+011	+011	+010	+010	+010	+001	+001	+001	000
	REAR	-101	-100	-011	-010	-001	-001	000	+001	+010	+011	+100	+101	+110	+111	+200	+201	+210	+300	+301
+1°	FRONT	+101	+101	+100	+100	+100	+011	+011	+010	+010	+010	+001	+001	+001	000	000	000	-001	-001	-001
	REAR	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+011	+100	+101	+110	+111	+200	+201	+210	+211
+3/4°	FRONT	+100	+011	+011	+011	+010	+010	+001	+001	000	000	000	-001	-001	-001	-010	-010	-010	-011	-011
	REAR	-200	-111	-110	-110	-101	-100	-011	-010	-001	000	+001	+010	+011	+100	+101	+110	+111	+200	+201
+1/2°	FRONT	+010	+010	+001	+001	+001	000	000	-001	-001	-001	-010	-010	-010	-011	-011	-011	-100	-100	-100
	REAR	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+011	+100	+101	+110	+111	+200
+1/4°	FRONT	+001	000	000	-001	-001	-001	-010	-010	-011	-011	-011	-100	-100	-100	-101	-101	-101	-110	-110
	REAR	-211	-210	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+011	+100	+101	+110
0°	FRONT	-001	-001	-010	-010	-011	-011	-011	-100	-100	-101	-101	-101	-110	-110	-110	-111	-111	-111	-111
	REAR	-301	-300	-211	-210	-201	-200	-200	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+100	+101
-1/4°	FRONT	-010	-011	-011	-100	-100	-101	-101	-101	-110	-110	-110	-111	-111	-111	-200	-200	-200	-201	-201
	REAR	-311	-310	-301	-300	-211	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000	+001	+010	+011
-1/2°	FRONT	-100	-100	-101	-101	-110	-110	-110	-111	-111	-200	-200	-200	-201	-201	-201	-210	-210	-210	-211
	REAR	-400	-311	-310	-301	-301	-300	-211	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000	+001
-3/4°	FRONT	-101	-110	-110	-111	-111	-200	-200	-200	-201	-201	-210	-210	-210	-211	-211	-211	-300	-300	-300
	REAR	-410	-401	-400	-311	-310	-301	-300	-211	-210	-201	-200	-111	-110	-101	-100	-011	-010	-001	000
-1°	FRONT	-111	-111	-200	-200	-201	-201	-210	-210	-210	-211	-211	-211	-300	-300	-300	-301	-301	-301	-310
	REAR	-411	-410	-410	-401	-400	-311	-310	-301	-300	-211	-210	-201	-200	-111	-110	-101	-100	-011	-010
-1-1/4°	FRONT	-201	-201	-201	-210	-210	-211	-211	-211	-300	-300	-301	-301	-301	-310	-310	-310	-311	-311	-311
	REAR	-501	-500	-411	-410	-401	-400	-311	-311	-310	-301	-300	-211	-210	-201	-200	-111	-101	-100	-011
-1-1/2°	FRONT	-210	-211	-211	-211	-300	-300	-301	-301	-301	-310	-310	-311	-311	-311	-400	-400	-400	-400	-401
	REAR	-510	-510	-501	-500	-411	-410	-401	-400	-311	-310	-301	-300	-211	-210	-201	-200	-111	-110	-101

FRONT = SHIM REQUIRED AT FRONT BOLT
REAR = SHIM REQUIRED AT REAR BOLT

\+ = SHIM ADDITION
\- = SHIM REMOVAL

EXAMPLE

4 0 1
1 = # OF SMALL (.03) SHIMS
0 = # OF MED. (.06) SHIMS
4 = # OF LARGE (.12) SHIMS

3974

Fig. 3A-8 X Series Alignment Correction Chart (Except Power Steering)

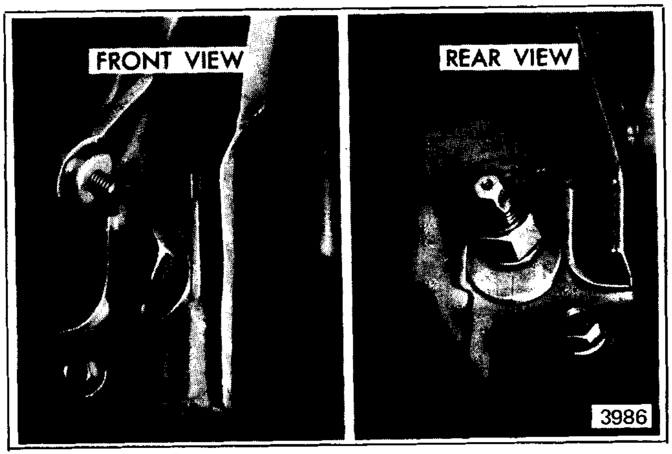


Fig. 3A-9 Cam Bolt Adjustment

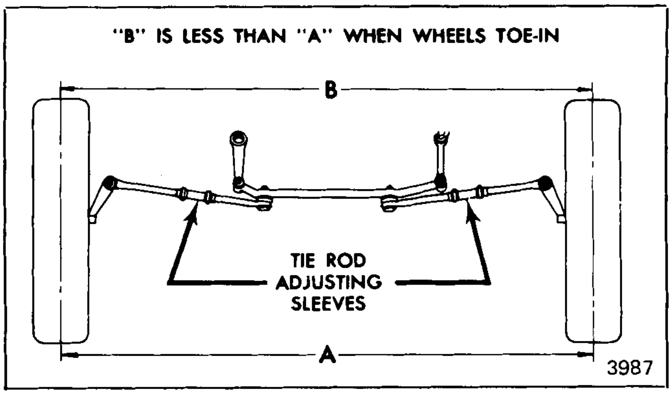
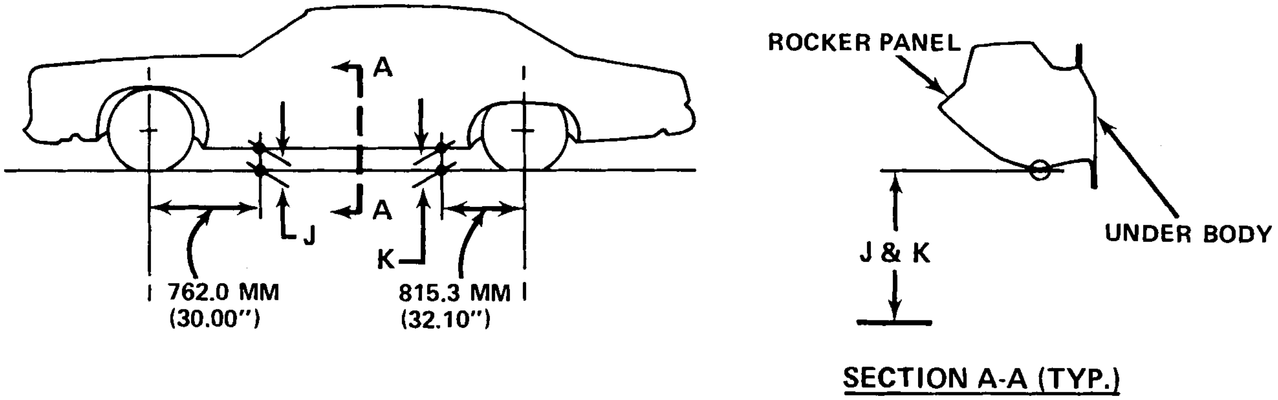


Fig. 3A-10 Toe-In Adjustment

TRIM HEIGHTS

For trim heights (rocker panel heights), refer to Figs. 3A-10A, 3A-10B and 3A-10C.

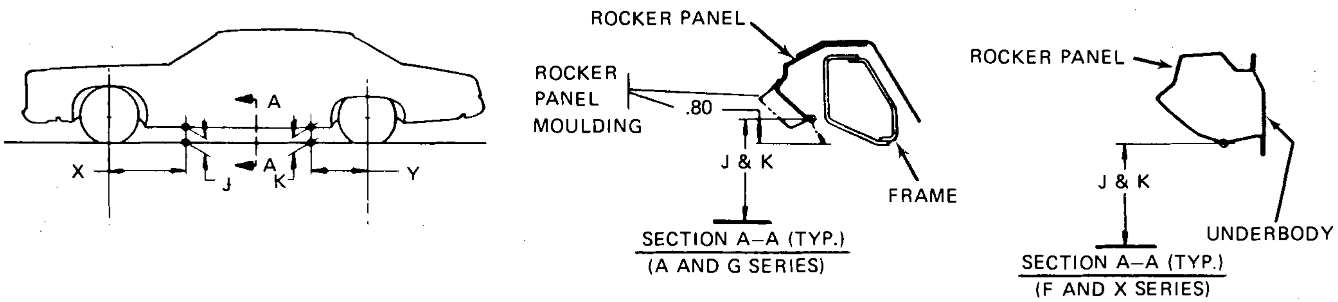


	J †	K †	J††	K††
MODEL	FRONT	REAR	FRONT	REAR
COUPE OR SEDAN (WITH MED. OR HVY. TRAILER PKG.)	257.3mm (10.13")	273.3mm (10.76")	256.0mm (10.08")	265.9mm (10.47")
COUPE OR SEDAN (EXC. TRAILER PKG. OR HANDLING PKG.)	254.8mm (10.03")	260.6mm (10.26")	252.7mm (9.95")	249.4mm (9.82")
COUPE OR SEDAN (WITH HANDLING PKG. OR LT. TRAILER PKG.)	254.8mm (10.03")	263.4mm (10.37")	252.7mm (9.95")	249.4mm (9.82")
WAGON (EXC. TRAILER PKG. OR HANDLING PKG.)	258.3mm (10.17")	272.0mm (10.71")	258.1mm (10.16")	264.4mm (10.41")
WAGON (WITH TRAILER PKG. OR HANDLING PKG.)	258.3mm (10.17")	270.5mm (10.65")	258.1mm (10.16")	264.4mm (10.41")

†WITH 11.4 LITERS (3.0 GAL.) FUEL IN FUEL TANK
††CURB CONDITION

5053

Fig. 3A-10A Trim Heights - B Series

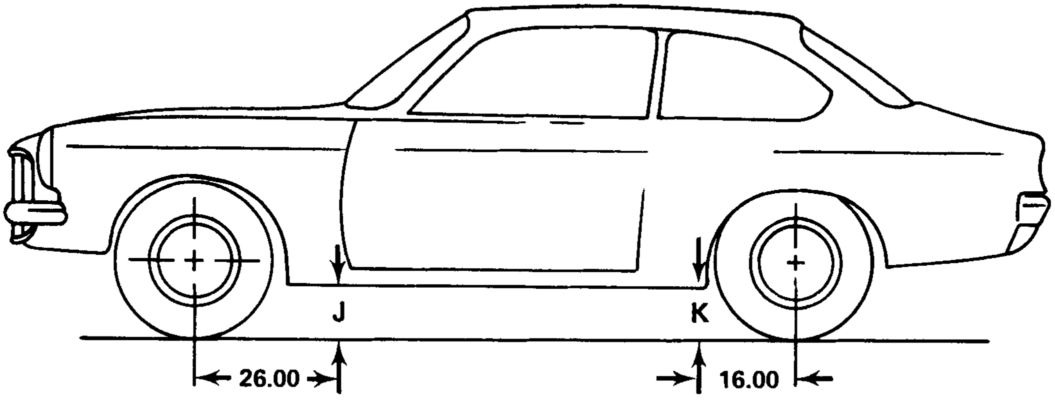


SERIES	MODEL	X FRONT	Y REAR	J† FRONT	K† REAR	J†† FRONT	K†† REAR
A	COUPE (EXC. HANDLING PKG. OR TRAILER PKG.)	30.00	27.00	10.29	10.35	10.22	9.92
	SEDAN (EXC. HANDLING PKG. OR TRAILER PKG.)	30.00	20.00	10.29	10.33	10.22	9.85
	STATION WAGON	30.00	20.00	10.69	11.06	10.70	10.70
	COUPE & SEDAN (WITH HANDLING PKG. OR TRAILER PKG.)	30.00	27.00C 20.00S	10.27	10.25	10.22	9.85–Sed. 9.92–Cpe.
G	EXCEPT HANDLING PKG. OR TRAILER PKG.	34.00	27.00	10.32	10.43	10.22	9.92
	WITH HANDLING PKG. OR TRAILER PKG.	34.00	27.00	10.31	10.35	10.22	9.92
F	WITH HANDLING PKG. OR TRAILER PKG.	36.30	16.70	8.64	8.38	8.52	7.90
	EXCEPT FORMULA, TRANS AM, HANDLING PKG., TRAILER PKG. OR 400 4-SPEED	36.30	16.70	8.69	8.57	8.52	7.90
	FORMULA OR TRANS AM (EXC. HANDLING PKG., TRAILER PKG. OR 400 4-SPEED)	36.30	16.70	8.66	8.48	8.52	7.90
	400 4-SPEED (EXC. HANDLING PKG. OR TRAILER PKG.)	36.30	16.70	8.62	8.38	8.52	7.90
X	EXCEPT HANDLING PKG. OR TRAILER PKG.	33.30	22.90	9.73	10.11	9.62	9.56
	WITH HANDLING PKG. OR TRAILER PKG.	33.30	22.90	9.73	10.01	9.62	9.56

† WITH 3.0 GALLONS FUEL IN FUEL TANK.
†† CURB CONDITION.

0840

Fig. 3A-10B Trim Heights - A, F, G and X Series



MODEL	TIRE USAGE	J †	K †	J††	K††
		FRONT	REAR	FRONT	REAR
ASTRE (EXCEPT WAGON)	NON-RADIAL	7.78	8.05	7.75	7.75
	BR78-13	7.78	8.07	7.75	7.75
	BR70-13	7.77	8.03	7.75	7.75
ASTRE WAGON	NON-RADIAL	7.78	8.05	7.75	7.75
	RADIAL	7.78	8.06	7.75	7.75
SUNBIRD	NON-RADIAL	7.78	8.11	7.75	7.75
	RADIAL	7.79	8.12	7.75	7.75

†WITH 3.0 GALLONS FUEL IN FUEL TANK
††CURB CONDITION

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Fig. 3A-10C Trim Heights - H Series

				(1) SPECIFICATIONS FOR DIAGNOSIS FOR WARRANTY REPAIRS OR CUSTOMER PAID SERVICE	(2) SPECIFICATIONS FOR PERIODIC MOTOR VEHICLE INSPECTION	(3) SPECIFICATIONS FOR RESETTING ALIGNMENT
B SERIES	CASTER			+2° TO +4°	+1° TO +5°	+3° ± 0.5°
	CAMBER			0° TO + 1.6°	-0.7° TO +2.3°	+0.8° ± 0.5°
	TOE-IN	DEG (PER WHEEL)		+0.07° TO +0.31°	-0.17° TO +0.55°	+0.19° ± 0.06°
		INCHES (TOTAL)		+1/16" TO +5/16"	-3/16" TO +9/16"	+3/16" ± 1/16"
A SERIES	CASTER	(A SERIES)	POWER STRG. RADIAL	+1° TO +3°	0° TO +4°	+2° ± 0.5°
			POWER STRG. BELTED	0° TO +2°	-1° TO +3°	+1° ± 0.5°
			MANUAL STRG.	0° TO +2°	-1° TO +3°	+1° ± 0.5°
		G SERIES		+4° TO +6°	+3° TO +7°	+5° ± 0.5°
	CAMBER	LEFT		+0.2° TO +1.8°	-0.5° TO +2.5°	+1° ± 0.5°
		RIGHT		-0.3° TO +1.3°	-1.0° TO +2.0°	+0.5° ± 0.5°
	TOE-IN	INCHES (TOTAL)		1/16" OUT TO 3/16" IN	5/16" OUT TO 7/16" IN	1/16" ± 1/16"
		DEG (PER WHEEL)		-0.06° TO +0.19°	-0.31° TO +0.42°	+0.06° ± 0.06°
F SERIES	CASTER			0° TO +2°	-1° TO +3°	+1° ± 0.5°
	CAMBER			+0.2° TO +1.8°	-0.5° TO +2.5°	+1° ± 0.5°
	TOE-IN	INCHES (TOTAL)		1/16" OUT TO 3/16" IN	5/16" OUT TO 7/16" IN	1/16" ± 1/16"
		DEG (PER WHEEL)		-0.06° TO +0.19°	-0.31° TO +0.42°	+0.06° ± 0.06°
X SERIES	CASTER	MAN. STR.		-2° TO 0°	-3° TO +1°	-1° ± 0.5°
		POW. STR.		0° TO +2°	-1° TO +3°	+1° ± 0.5°
	CAMBER			0° TO +1.6°	-0.7° TO +2.3°	+0.8° ± 0.5°
	TOE-IN	INCHES (TOTAL)		1/16" OUT TO 3/16" IN	5/16" OUT TO 7/16" IN	1/16" ± 1/16"
		DEG (PER WHEEL)		-0.06° TO +0.19°	-0.31° TO +0.42°	+0.06° ± 0.06°
H SERIES	CASTER			-1.8° TO +0.2°	-2.8° TO +1.2°	-0.8° ± 0.5°
	CAMBER			-0.6° TO +1.0°	-1.3° TO +1.7°	+0.2° ± 0.5°
	TOE-IN	INCHES (TOTAL)		3/16" OUT TO 1/16" IN	7/16" OUT TO 5/16" IN	1/16" TOE-OUT ± 1/16"
		DEG (PER WHEEL)		-0.19° TO +0.06°	-0.42° TO +0.31°	-0.06° ± 0.06°
ALL SERIES	CROSS CASTER			NO MORE THAN 1° SIDE TO SIDE VARIATION	———	NO MORE THAN 1/2° SIDE TO SIDE VARIATION
A,B,F,G SERIES	CROSS CAMBER			LH CAMBER +1/2° MORE THAN RH (LIMITS: LH CAMBER -1/2° TO +1-1/2° OF RH CAMBER)	———	LH CAMBER TO BE +1/4° TO +3/4° OF RH CAMBER
H & X SERIES	CROSS CAMBER			NO MORE THAN 1° SIDE TO SIDE VARIATION	———	NO MORE THAN 1/2° SIDE TO SIDE VARIATION

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Fig. 3A-11 Alignment Specifications Chart

SECTION 3B1

STEERING LINKAGE

CAUTION: *All steering linkages are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

CONTENTS OF THIS SECTION

DESCRIPTION AND OPERATION

Lubricate the steering linkage sockets whenever work is done on the linkage.

A parallelogram type steering linkage connects both front wheels to the steering gear through the pitman arm. The right and left tie rods are attached to steering arms at the wheels and to a forged intermediate rod by ball studs. The left end of the intermediate rod is supported by the pitman arm which is driven by the steering gear and the right end by an idler arm which pivots on a support attached to the frame. The pitman and idler arms are always parallel to each other and move through symmetrical arcs (Fig. 3B1-1).

SERVICE PROCEDURES

SUSPENSION AND STEERING LINKAGE CHECK

1. Raise car on one side at frame torque box located directly behind the front wheel so that tire is approximately one inch off the floor.
2. Position dial indicator as shown in Fig. 3B1-2.
3. Position steering wheel so that it is in the locked position.
4. Grasp front wheel as shown in Fig. 3B1-2. With wheels in straight ahead position, move wheel back and forth without moving steering wheel. Gage reading should not exceed .108".
5. If gage reading is not within specifications, a check should be made of all suspension and linkage parts.

TIE RODS

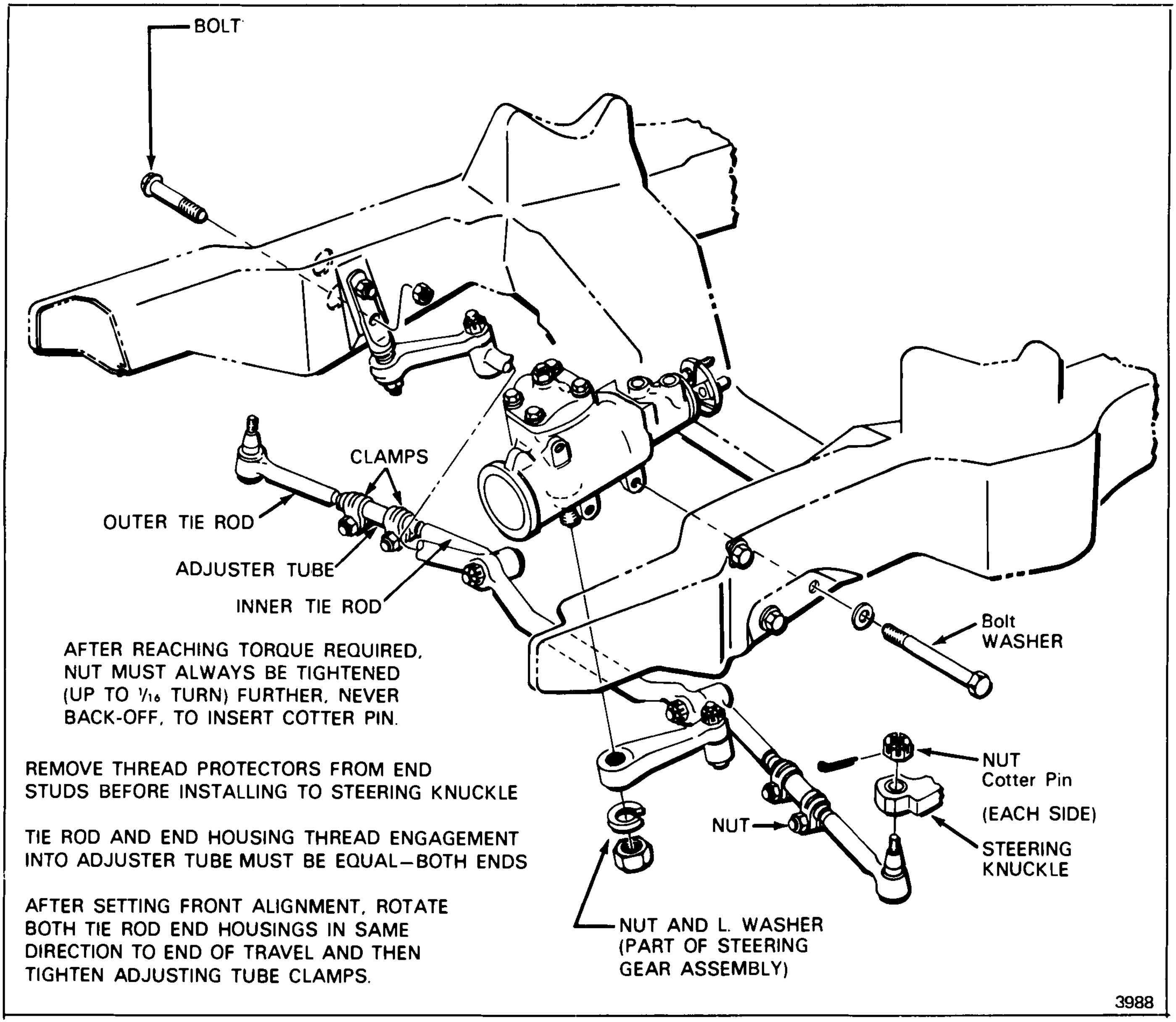
Removal

If any tie rod ends are replaced, front wheel toe alignment must be checked and reset as required.

1. Place car on hoist.

NOTE: Tie rod adjuster parts often become rusted in service. In such cases, it is recommended that if the torque required to remove the nut from the bolt after breakaway exceeds 7 ft. lbs., discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install new bolts and nuts having the same part number to assure proper clamping at the specified nut torque.

2. Remove cotter pins from ball studs and remove castellated nuts.
3. Disconnect tie rod end from steering arm on knuckle by using a tool such as BT-7101, BT-6320 or similar puller (Fig. 3B1-3).
4. Remove inner ball stud from intermediate rod using tool J 5504.
5. To remove tie rod ends from the adjuster tube, loosen clamp bolts and unscrew end assemblies.



AFTER REACHING TORQUE REQUIRED, NUT MUST ALWAYS BE TIGHTENED (UP TO 1/16 TURN) FURTHER, NEVER BACK-OFF, TO INSERT COTTER PIN.

REMOVE THREAD PROTECTORS FROM END STUDS BEFORE INSTALLING TO STEERING KNUCKLE

TIE ROD AND END HOUSING THREAD ENGAGEMENT INTO ADJUSTER TUBE MUST BE EQUAL—BOTH ENDS

AFTER SETTING FRONT ALIGNMENT, ROTATE BOTH TIE ROD END HOUSINGS IN SAME DIRECTION TO END OF TRAVEL AND THEN TIGHTEN ADJUSTING TUBE CLAMPS.

Fig. 3B1-1 Steering Linkage

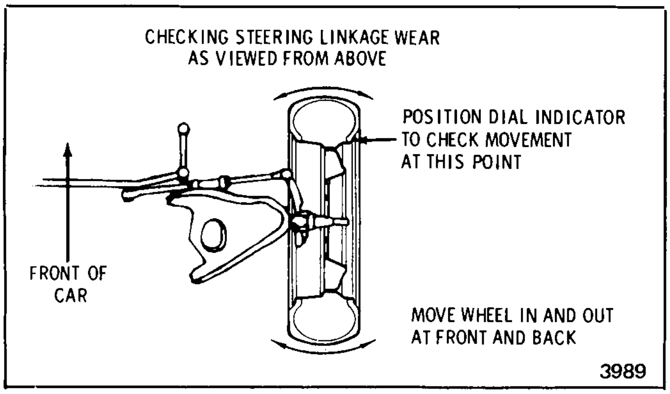


Fig. 3B1-2 Checking Linkage Wear

NOTE: When disconnecting a linkage joint, no attempt should be made to disengage the joint by driving a wedge between the joint and the attached part because seal damage will result.

Installation

See CAUTION on page 3B1-1 of this section.

1. If the tie rod ends are removed, lubricate the tie rod threads with EP Chassis lube and thread ends of tie rod into the adjuster tube making sure both ends are threaded an equal distance into the adjuster tube.

2. Make sure that threads on ball stud and in ball stud nuts are clean and smooth. The ball stud must have no nicks on the taper. Inspect and replace damaged seals as necessary.

NOTE: If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut.

3. Install ball studs in steering arm on knuckle and intermediate rod.

4. Install ball stud nuts and torque to specifications, then tighten nuts just enough to align slot in castellated nut with hole in stud and install cotter pins.

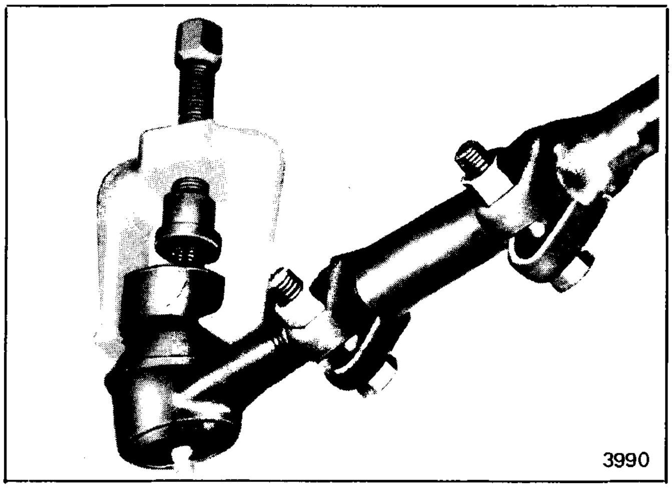


Fig. 3B1-3 Disconnecting Linkage Joint

NOTE: Before locking clamp bolts on the rods, make sure that the tie rod ends are in alignment with their ball studs by rotating both tie rod ends in the same direction as far as they will go and then torque adjuster tube clamps to specifications. Make certain that adjuster tubes and clamps are positioned as shown in Figs. 3B1-4 and 3B1-5.

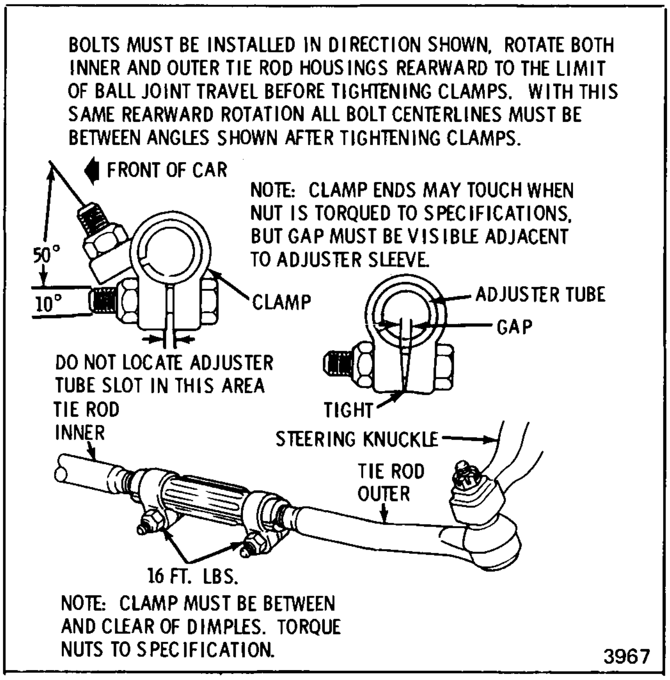


Fig. 3B1-4 Tie Rod Clamp and Adjuster Tube Positioning - Except H Series

5. Remove car from hoist.
6. Adjust toe-in.

INTERMEDIATE ROD

If intermediate rod is replaced, front wheel toe alignment must be checked and reset as required.

Removal

1. Place car on hoist.

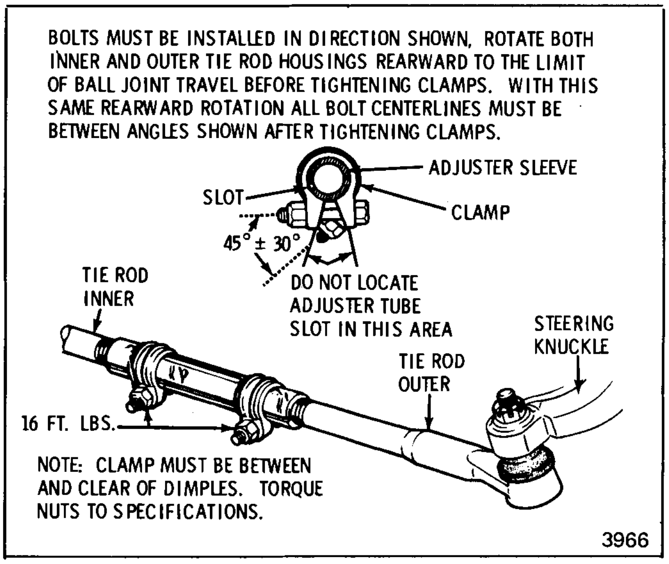


Fig. 3B1-5 Tie Rod Clamp and Adjuster Tube Positioning - H Series

2. Remove inner tie rods from intermediate rod as described under Tie Rod - Removal.
3. On H Series remove crossmember brace.
4. Remove cotter pin and nut from intermediate rod ball stud attachment at pitman arm.
5. Disconnect intermediate rod from pitman arm by using tool J 5504 or J 24319-01 or similar puller.
6. Shift steering linkage as required to free pitman arm from intermediate rod.
7. Remove cotter pin and nut from idler arm and remove intermediate rod from idler arm in the same manner as the intermediate rod is removed from the pitman arm in Step 5.
8. (A Series Manual Steering Only) Remove thru bolt and nut and disconnect shock absorber from intermediate rod (Fig. 3B1-6).

(X Series With 151 Engine Only) Remove cotter pin and nut and disconnect shock absorber from intermediate rod (Fig. 3B1-7).

Installation

See CAUTION on Page 3B1-1 of this Section.

1. Inspect and replace damaged seals as necessary.
2. Install intermediate rod to idler arm, making certain idler stud seal is in place, then install and tighten nut to specifications. Advance nut just enough to align castellation with cotter pin hole and install pin.
3. Raise end of rod and install on pitman arm. Tighten nut to specifications, then advance nut just enough to align slot in castellated nut with hole in stud and install cotter pin.
4. Install tie rod ends to intermediate rod as previously described under Tie Rods.
5. Install ball stud nuts and tighten to specifications, then advance nut just enough to align slot in castellated nut with hole in stud and install cotter pin.
6. (A Series Manual Steering and X Series With 151 Engine Only) Connect shock absorber to intermediate rod and torque nut to specifications.

(X Series With 151 Engine Only) Align slot in castellated nut with hole in stud and install cotter pin.

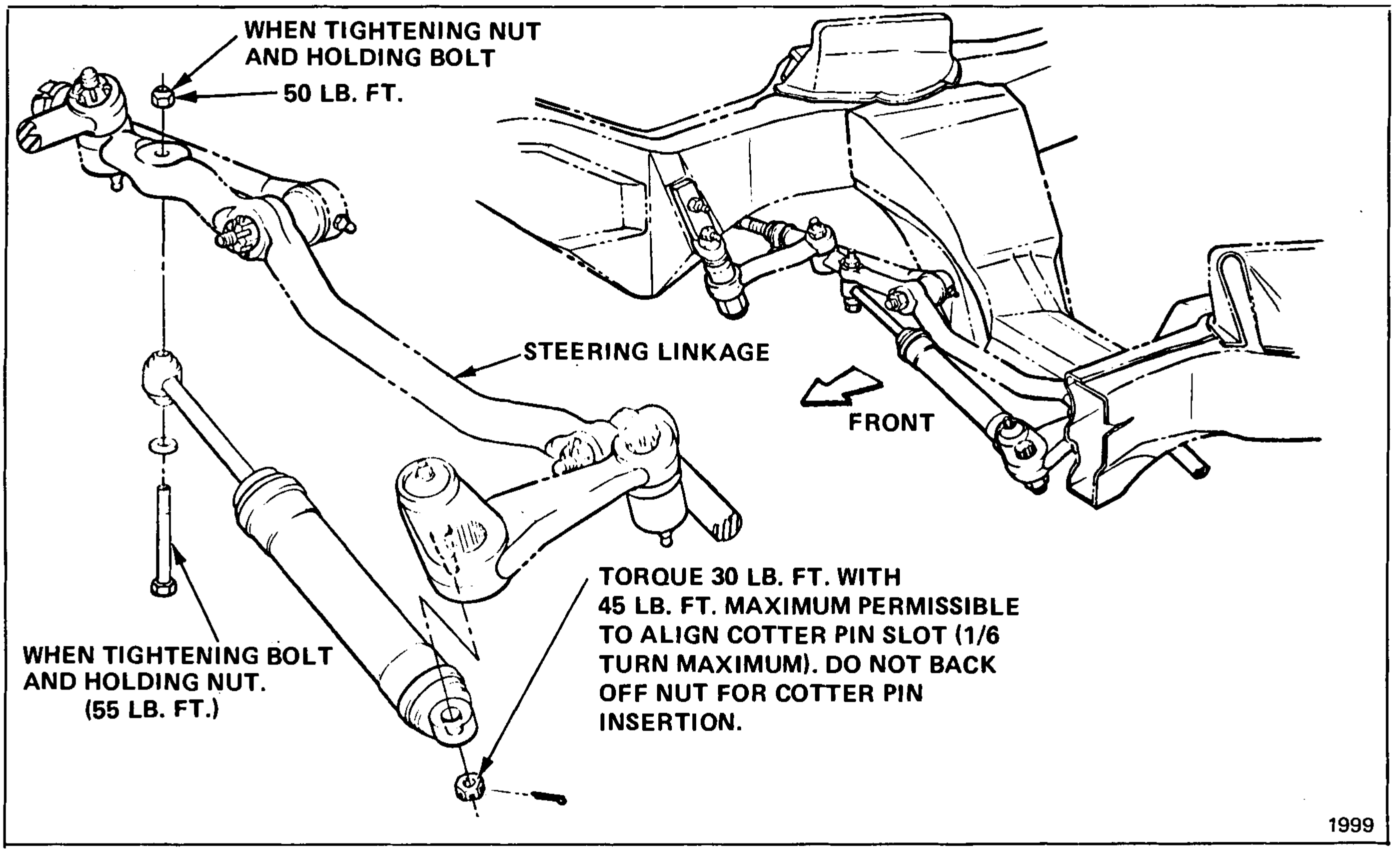


Fig. 3B1-6 Steering Linkage - A Series (Manual Steering)

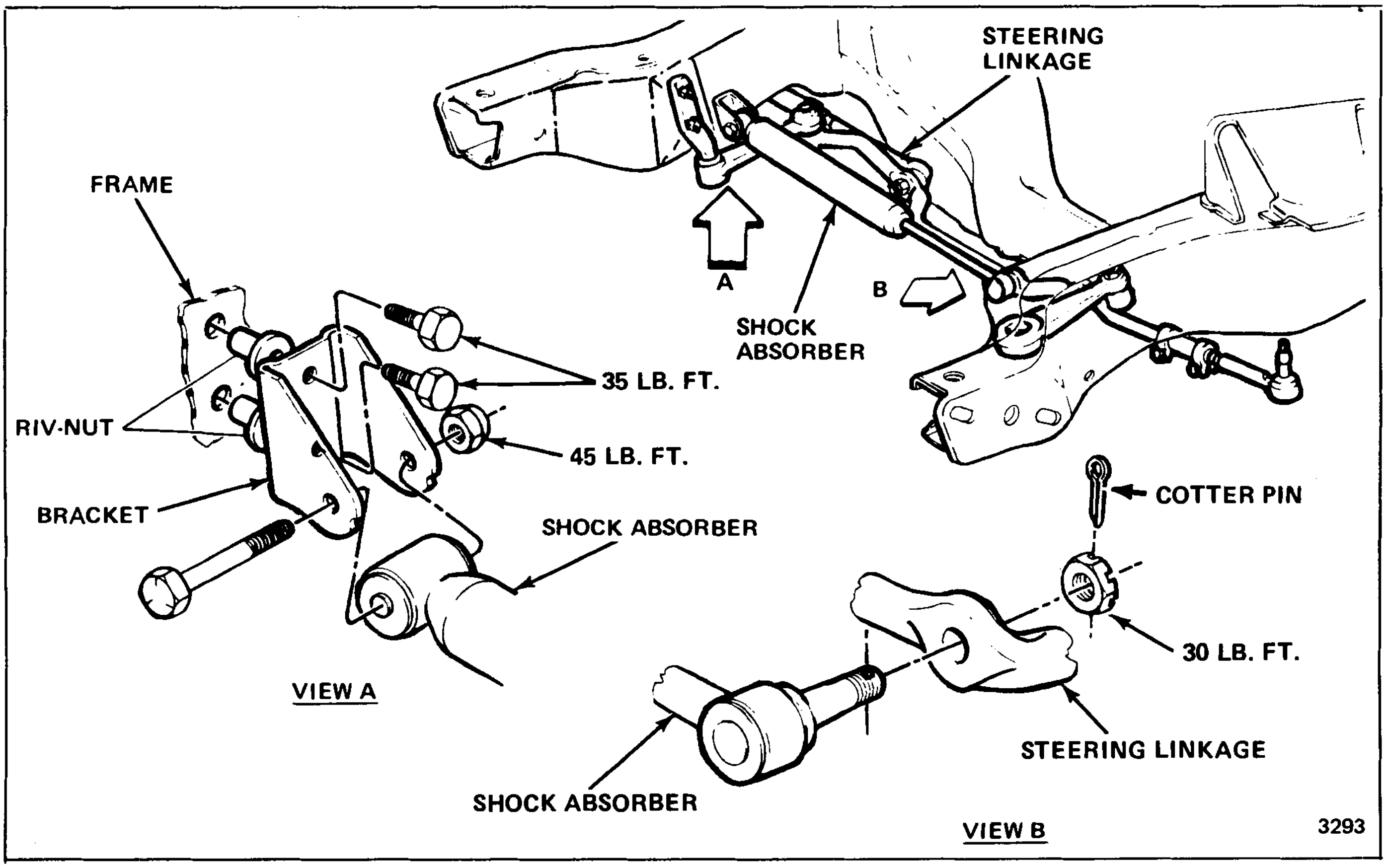


Fig. 3B1-7 Steering Linkage - X Series (151 Engine)

7. (H Series Only) Install crossmember brace.
8. Remove car from hoist.
9. Adjust toe-in and align steering wheel.

TIE ROD ADJUSTER TUBE

If tie rod adjuster tube is replaced, front wheel toe alignment must be checked and reset as required.

Removal

1. Place car on hoist.
2. Remove cotter pins from ball studs and remove castellated nuts.
3. Disconnect tie rod from steering arm or knuckle by using a tool such as BT-7101, BT-6320 or similar puller (Fig. 3B1-3).
4. Unthread tie rod end from adjuster tube.
5. Unthread adjuster tube from tie rod end still connected to intermediate rod.

NOTE: Tie rod adjuster parts often become rusted in service. In such cases, it is recommended that if the torque required to remove the nut from the bolt after breakaway exceeds 7 ft. lbs., discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install new bolts and nuts having the same part number to assure proper clamping at the specified nut torque.

Installation

See CAUTION on Page 3B1-1 of this Section.

1. Install parts in reverse order to removal.
2. Lubricate the tie rod threads with EP Chassis lube and thread ends of tie rod into the adjuster tube making sure both ends are threaded an equal distance into the adjuster tube.
3. Make sure that threads on ball stud and in ball stud nuts are perfectly clean and smooth. The ball stud must have no nicks on the taper. Inspect and replace damaged seals as necessary.

NOTE: If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut.

4. Install ball stud in steering arm.
5. Install ball stud nut and torque to specifications, then tighten nuts just enough to align slot in castellated nut with hole in stud and install cotter pins.

NOTE: Before locking clamp bolts on the rods, make sure that the tie rod ends are in alignment with their ball studs by rotating both tie rod ends in the same direction as far as they will go and then torque adjuster tube clamps to specifications. Make certain that adjuster tubes and clamps are positioned as shown in Figs. 3B1-4 and 3B1-5.

6. Remove car from hoist.
7. Adjust toe-in.

IDLER ARM

NOTE: The idler arm assembly should be replaced if, when an up and down force of 25 pounds is applied at the intermediate rod end of the idler arm, the vertical lash exceeds 1/8". If the idler arm support is dismounted from the frame for other work, wire the support to the idler arm so that it cannot turn from its existing position and possibly change the toe-in of the front wheels.

Removal

1. Place car on hoist.
2. Remove idler arm to frame nuts, washers and bolts.
3. Remove cotter pin and nut from idler arm to intermediate rod ball stud.
4. Remove idler arm from intermediate rod by using J 24319-01 or similar puller.
5. Remove idler arm.

Installation

See CAUTION on Page 3B1-1 of this Section.

The linkage requires proper location of the idler arm on its threaded support so that the idler arm ball socket will be level with the pitman arm ball socket. The support must be threaded into the idler arm bushing until the distance from the center of the lower mounting bolt hole to the top of the idler arm boss is as indicated in Fig. 3B1-9. The position of the idler arm must be set before the idler arm assembly is installed in the car.

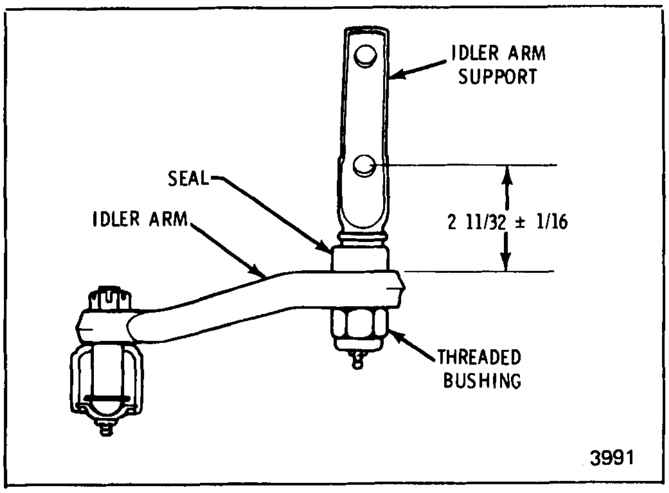


Fig. 3B1-8 Adjusting Idler Arm on Support

After setting, all idler supports must be free to rotate 90 degrees in a counter clockwise direction.

1. Position support against frame and secure with bolts, washers and nuts. Install and torque nuts to specifications.

2. Install intermediate rod to idler arm, making certain seal is on stud. Install and torque nut to specifications.

3. Tighten nut just enough to align slot in castellated nut with hole in stud and install cotter pin.

4. Remove car from hoist.

5. Check and adjust toe-in if necessary.

SHOCK ABSORBER (INTERMEDIATE ROD)

A steering linkage shock absorber is used on A Series with manual steering and on X Series with 151 engine.

Removal (A Series)

1. Remove bolt and nut retaining shock absorber at intermediate rod (Fig. 3B1-6).
2. Remove cotter pin and nut, separate shock absorber from pitman arm and remove shock absorber.

Removal (X Series)

1. Remove bolt and nut retaining shock absorber to bracket on frame rail (Fig. 3B1-7).
2. Remove cotter pin and nut, separate shock absorber from intermediate rod and remove shock absorber.

Installation (A and X Series)

See CAUTION on Page 3B1-1 of this Section.

1. Install shock absorber as shown in Figs. 3B1-6 and 3B1-7.
2. Torque bolts and nuts to specifications.
3. Tighten castellated nuts just enough to align slot in castellated nut with hole in stud and install cotter pin.

PITMAN ARM

Removal

1. Place car on hoist.
2. (H Series Only) Remove left crossmember brace.
3. Remove cotter pin from pitman arm ball stud and remove nut. (A Series Manual Steering Only) Remove cotter pin and nut and disconnect shock absorber from pitman arm.
4. Remove intermediate rod from pitman arm using tool J 5504, J 24319-01 or similar puller. Pull down on intermediate rod to remove stud.
5. Remove pitman arm nut and lock washer from pitman shaft and discard. Mark relation of arm position to shaft.
6. Remove pitman arm with Tool J 5504 or similar puller. DO NOT HAMMER ON PULLER.

Installation

See CAUTION on Page 3B1-1 of this Section.

1. Install pitman arm on pitman shaft, lining up the marks made upon removal.
2. Install pitman shaft nut and lock washer. Use new nut and lock washer. Torque to specifications.
3. Position intermediate rod to pitman arm. Install nut. Torque to specifications. Continue to tighten nut enough to align slot in castellated nut with hole in stud and install cotter pin.

   (A Series Manual Steering Only) Install shock absorber at pitman arm and torque nut to specifications; continue to tighten nut enough to align slot in castellated nut with hole in stud and install cotter pin.
4. (H Series Only) Install crossmember brace.
5. Remove car from hoist.

TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise specified.

Nut, Tie Rod to Steering Knuckle (50 lb. ft. max.)	30*
Nut, Pitman Arm to Pitman Shaft	
Except H Series	185
H Series (Power Steering)	185
H Series (Manual Steering)	140
Nut, Idler Arm Support to Frame	
Except H Series	50
H Series	30
Nut, Tie Rod Adjuster Sleeve Clamp	
Except H Series	14
H Series	130 lb. in.
Nut, Steering Linkage Shock Absorber to Pitman Arm	
A Series (Manual Steering)(45 lb. ft. max.)	30*
Nut, Steering Linkage Shock Absorber to Frame Bracket Bolt	
X Series (With 151 Engine)	40
Bolt, Linkage Shock Absorber Bracket to Frame	
X Series (With 151 Engine)	30
Nut, Pitman Arm to Intermediate Rod	
All Series	
(55 lb. ft. max. to insert cotter pin)	45*
Nut, Tie Rod to Intermediate Rod	
B, X & F Series	
(85 lb. ft. max. to insert cotter pin)	60*
A & G Series	
(55 lb. ft. max. to insert cotter pin)	40*
Nut, Idler Arm to Intermediate Rod	
X & F Series	
(50 lb. ft. max. to insert cotter pin)	40*
A, B & G Series	
(45 lb. ft. max. to insert cotter pin)	35*

*Maximum of 1/6 turn to align cotter pin. Maximum torque noted is maximum amount allowable to align cotter pin slot. Do not back off on nut to insert cotter pin.

SECTION 3B2

MANUAL STEERING GEAR

CAUTION: *All steering linkage and gear fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The steering gear is the recirculating ball worm and nut type. The worm is located on the lower end of the steering shaft. The ball nut is mounted on the worm and has mating spiral grooves in which steel balls circulate to provide a low-friction drive between worm and nut. (Fig. 3B2-1)

Teeth on the ball nut engage teeth on the pitman shaft sector. The teeth on the ball nut are made so that a "high point" or tighter fit exists between the ball nut and pitman shaft sector teeth when front wheels are in the straight ahead position. The sector teeth are slightly tapered so that a proper lash may be obtained by moving the pitman shaft endways by means of a lash adjuster screw which extends through the gear housing side cover. The head of the lash adjuster and a selectively fitted shim fit snugly into a T-slot in the end of the pitman shaft, so that the screw also controls end play of shaft (Fig. 3B2-2).

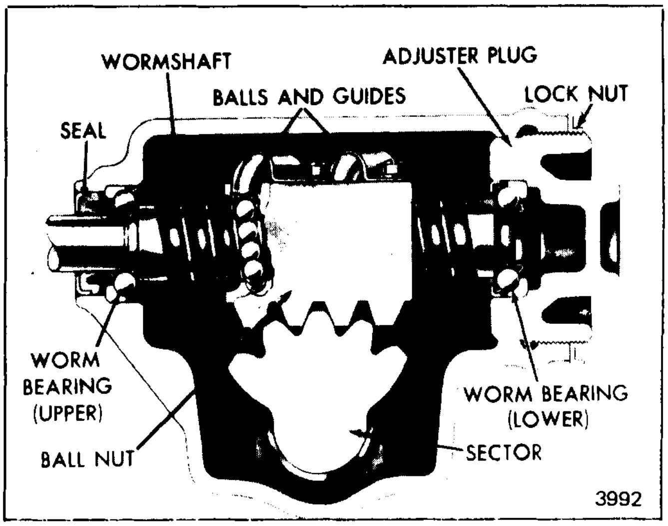


Fig. 3B2-1 Manual Steering Gear

SERVICE PROCEDURES

MANUAL GEAR ASSEMBLY

A producation Code Label for identification purpose is located as shown in Fig. 3B2-4.

H Series	AA
Except H Series	UW

Removal

1. Remove flexible coupling shield (Fig. 3B2-3), then remove the two flex coupling flange attaching nuts and lockwashers.

2. Hoist front of car and support car with floor stands under outer ends of lower control arms.

3. (H Series only) Remove crossmember brace.

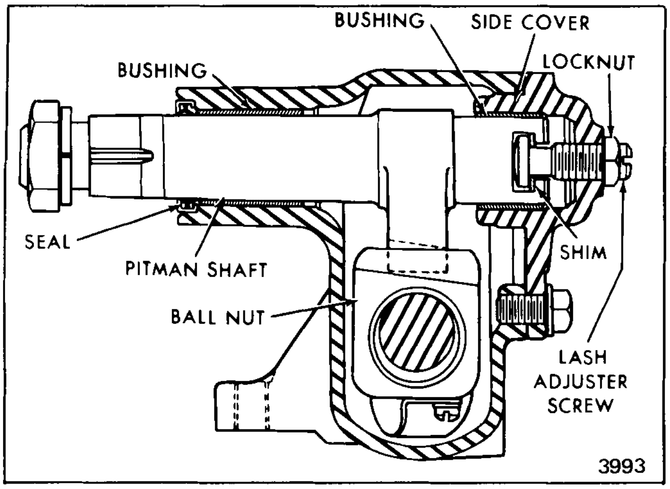


Fig. 3B2-2 Manual Steering Gear (Cross Section)

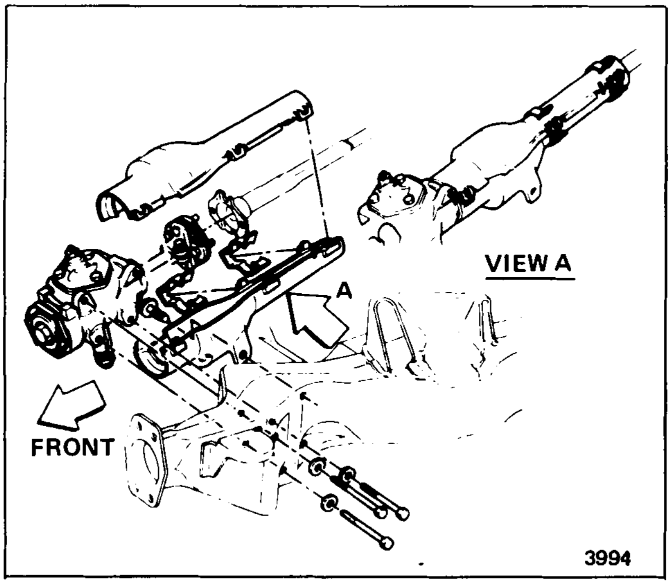


Fig. 3B2-3 Coupling Shield (X Series)

4. Remove pitman shaft nut and pull pitman arm from shaft using Tool J 5504 or a similar puller.

5. Remove gear to frame bolts, position steering linkage out of the way and withdraw gear assembly from under car.

NOTE: If mounting threads in housing are stripped, do not repair. Replace housing.

Installation

See CAUTION on Page 3B2-1 of this section.

1. Apply wheel bearing grease to the gear mounting pads to prevent gear to frame squeak.

2. Position gear and flex-coupling into position and install gear to frame bolts. Torque bolts to 80 ft. lbs.

3. Reconnect pitman arm to pitman shaft and using NEW lock washer and nut, torque nut to 210 ft. lbs. (exc. H Series) and 160 ft. lbs. (H Series).

4. On H Series, install crossmember brace.

5. Lower car and install the two flex-coupling to flange attaching lock washers and nuts. Torque nuts to 20 ft. lbs.

WORM SHAFT SEAL

(Gear Assembled)

Removal

1. Remove steering gear.

2. Punch a small hole in the metal portion of the seal and install a small metal screw approximately, two turns. Pry out seal with side cutters.

Installation

See CAUTION on page 3B2-1 of this section.

1. Drive new seal flush with housing using Tool J 21421-1 (Fig. 3B2-4).

2. Install steering gear.

DISASSEMBLY OF GEAR (FIG. 3B2-5)

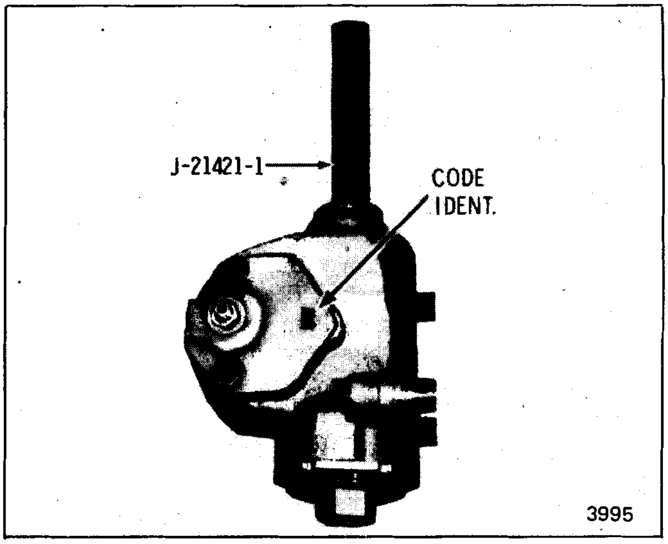


FIG. 3B2-4 INSTALLING WORM SHAFT SEAL

1. Mount steering gear on Holding Fixture J 5205.

2. Rotate worm shaft with flex-coupling until gear is in center of travel.

3. Remove the three side cover bolts.

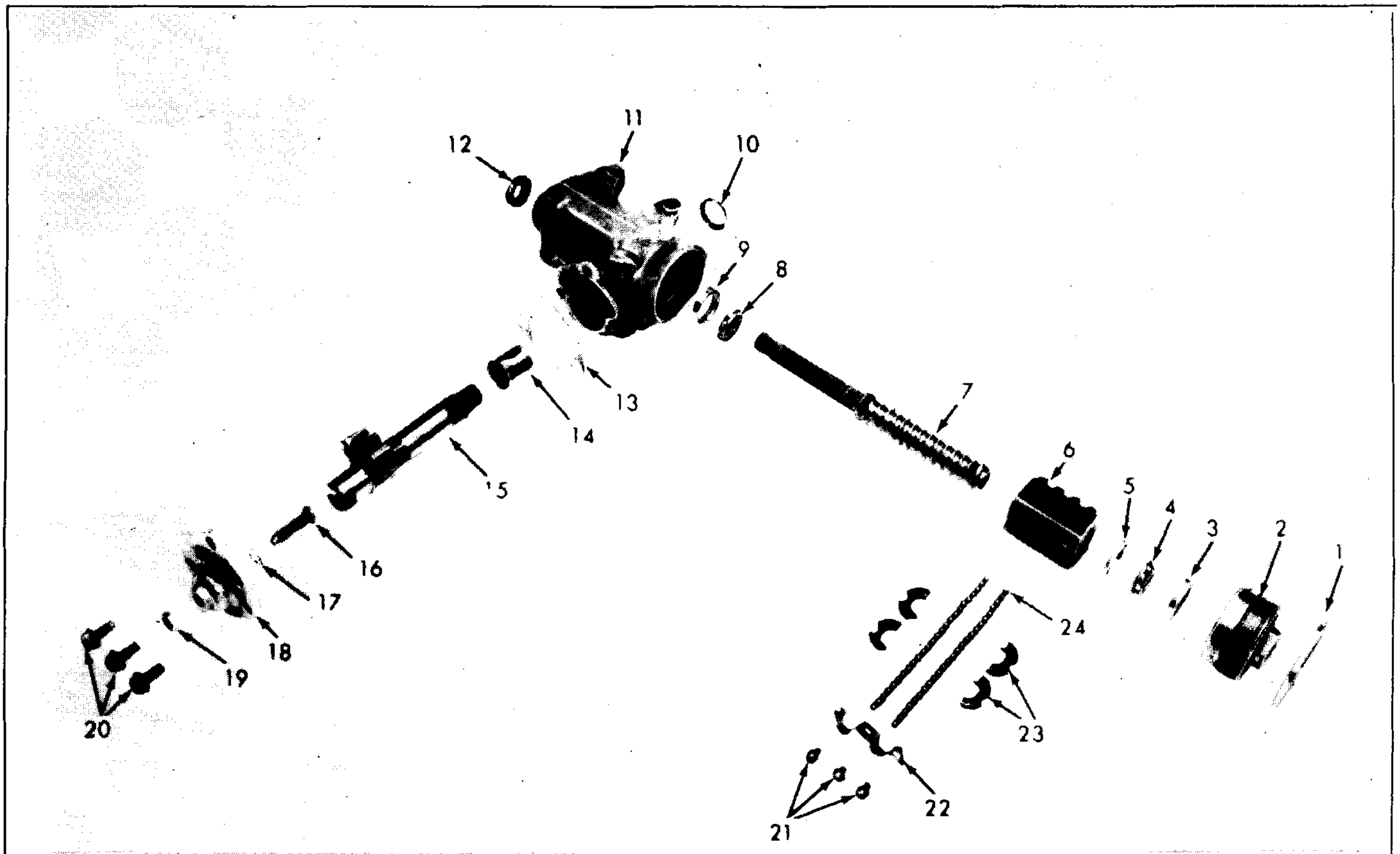
4. Tap lightly on the end of the pitman shaft with a plastic hammer and lift the side cover and pitman shaft assembly from the gear housing (Fig. 3B2-6).

NOTE: If the pitman shaft sector does not clear the opening in the housing easily, turn the wormshaft by hand until the sector will pass through the opening in the housing.

5. Loosen worm bearing adjuster lock nut with a brass drift (Fig. 3B2-7) and remove adjuster plug assembly.

6. Remove wormshaft assembly with ball nut attached through bottom of housing. Remove upper bearing from wormshaft (Fig. 3B2-8).

CAUTION: *Use care that the ball nut does not run down to either end of the worm. Damage may be done to the ends of the ball guides if the ball nut is allowed to rotate until stopped at the end of the worm.*



1. WORM BEARING ADJUSTER LOCKNUT
2. WORM BEARING ADJUSTER
3. LOWER WORM BEARING CUP
4. LOWER WORM BEARING
5. LOWER BEARING RETAINER
6. BALL NUT
7. WORMSHAFT
8. UPPER WORM BEARING
9. UPPER WORM BEARING CUP
10. PITMAN SHAFT SEAL
11. HOUSING
12. WORMSHAFT SEAL
13. SIDE COVER GASKET
14. PITMAN SHAFT BUSHING
15. PITMAN SHAFT
16. LASH ADJUSTER
17. LASH ADJUSTER SHIM
18. HOUSING SIDE COVER AND BUSHING ASSEMBLY
19. LASH ADJUSTER LOCKNUT
20. SIDE COVER BOLTS
21. BALL GUIDE CLAMP SCREWS
22. BALL GUIDE CLAMP
23. BALL GUIDES
24. BALLS

3996

FIG. 3B2-5 MANUAL STEERING GEAR (EXPLODED)

7. Use a suitable size screwdriver to pry the lower bearing retainer from the adjuster plug housing and remove the bearing (Fig. 3B2-9).

8. Remove the locknut from the adjuster plug.

9. Remove the locknut from the lash adjuster screw in the side cover. Remove the lash adjuster screw from the side cover by turning the screw clockwise. Slide the adjuster screw and shim out of the slot in the end of the pitman shaft.

10. Pry out and discard both the pitman shaft and wormshaft seals.

Inspection

With the steering gear completely disassembled, wash all parts in cleaning solvent. Dry them thoroughly with air. With a magnifying glass inspect the bearings and bearing races for signs of indentation. Also check for any signs of chipping or breakdown of the surface. Any parts that show signs of damage should be replaced.

Inspect all seals. Any seal that is worn or has been removed should be replaced.

Inspect the fit of the pitman shaft in bushings in side cover and housing. If these bushings are worn, a new side cover and bushing assembly or housing bushing should be installed.

Check steering gear wormshaft assembly for being bent or damaged in any way. NEVER ATTEMPT TO SALVAGE STEERING PARTS BY WELDING OR STRAIGHTENING.

Repairs

The double lipped pitmanshaft and wormshaft seals should be replaced each time a defective seal is indicated or the steering gear is disassembled.

1. Remove pitman shaft seal by prying seal out with a screwdriver (Fig. 3B2-10).

NOTE: Before installing a new seal, check the condition of the pitman shaft bushing(s) and the wormshaft bearing race installed in the gear housing.

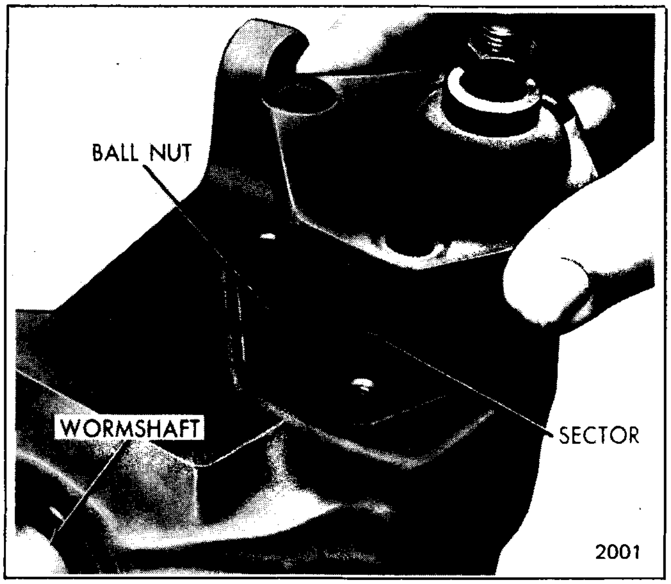


Fig. 3B2-6 Removing Pitman Shaft Assembly

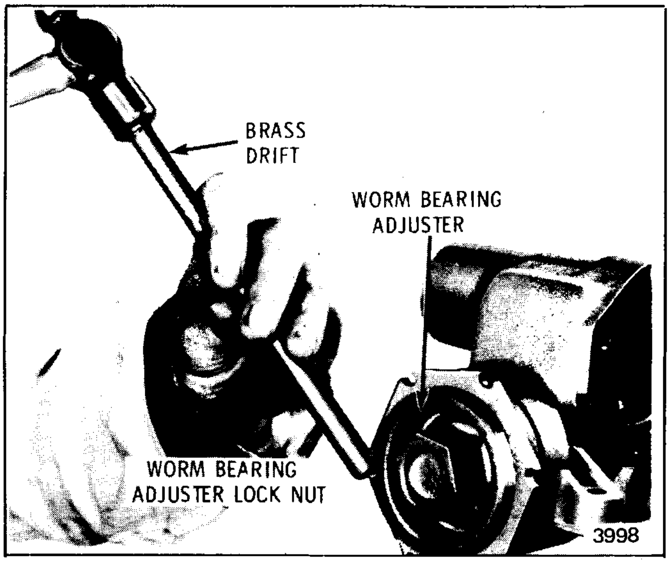


Fig. 3B2-7 Loosening Lock Nut

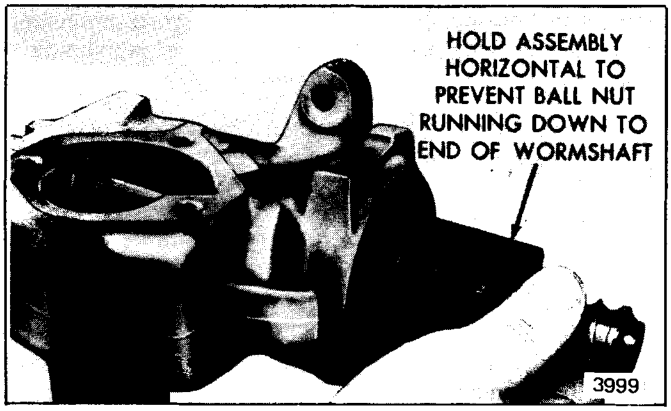


Fig. 3B2-8 Removing Worm Shaft and Ball Nut

2. Install NEW pitman shaft seal into gear housing with lip of seal outboard until seal bottoms in housing using Tool J 21421-1 (Fig. 3B2-11). Coat lip of seal with Seal Lubricant No. 1050169 or equivalent.

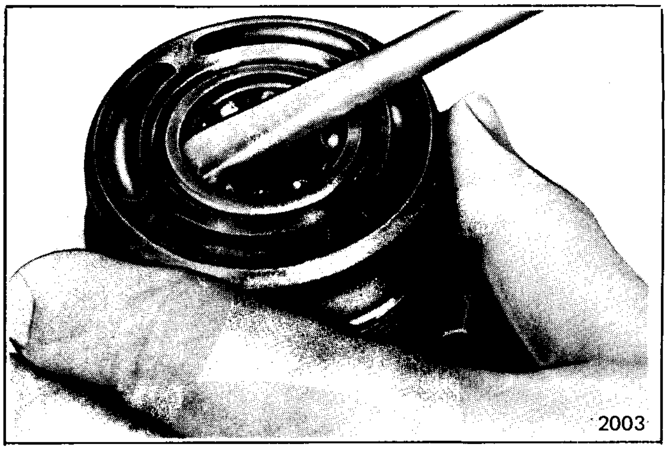


Fig. 3B2-9 Removing Lower Bearing Retainer

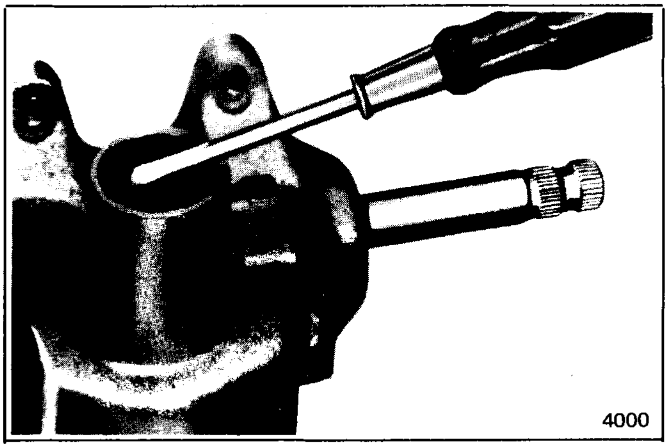


Fig. 3B2-10 Removing Pitman Shaft Seal

Care should be taken to insure that the new seal is not assembled in a cocked position.

PITMAN SHAFT BUSHING REPLACEMENT

Removal

1. Remove pitman shaft bushing in gear housing using Tool J 8810 with Driver J 8092 as shown in Fig. 3B2-12.

NOTE: Pitman shaft bushing in side cover is not serviced separately and must be replaced by a new side cover.

Installation

1. Install pitman shaft bushing in gear housing using Tool J 8810 with Driver J 8092 and drive bushing into housing until bushing is flush with shoulder of counterbore as shown in Fig. 3B2-13.

SIDE COVER BUSHING REPLACEMENT

The entire side cover assembly, including bushing, is serviced as a unit.

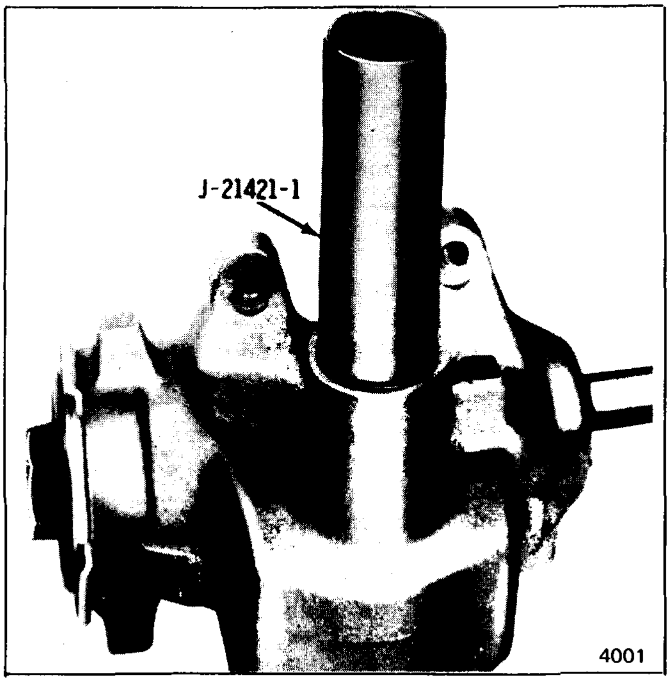


Fig. 3B2-11 Installing Pitman Shaft Seal

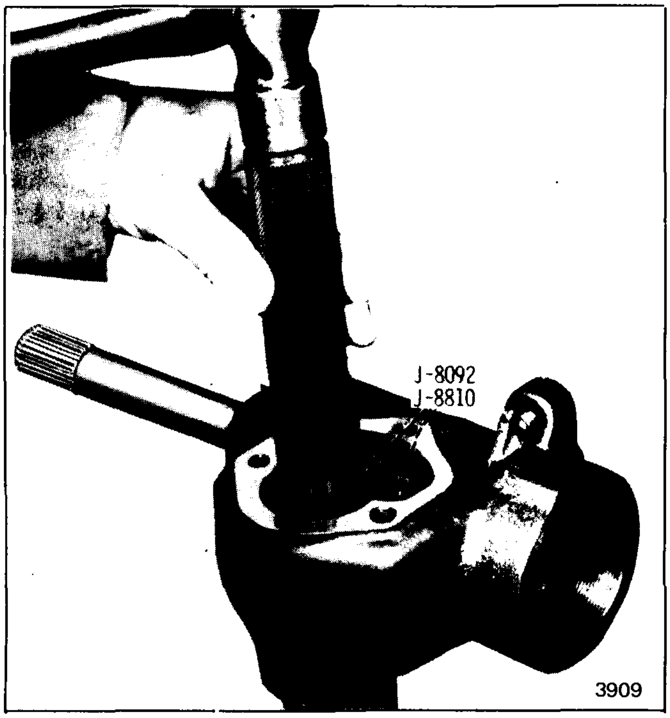


Fig. 3B2-12 Removing Pitman Shaft Bushing

WORMSHAFT BEARING RACE REPLACEMENT

Removal

1. Using a brass drift remove wormshaft race from housing.

Installation

1. Install wormshaft race in housing using Tool J 8811.

Fig. 3B2-13 Installing Pitman Shaft Bushing

ADJUSTER PLUG RACE

Removal

1. Remove bearing retainer from bearing adjuster. Bearing cup is a slip fit and will come out with bearing and belleville washer.

Installation

1. Install belleville washer, bearing cup, bearing and retainer in worm bearing adjuster.

BALL NUT SERVICING

As a rule, disassembly of the ball nut will not be necessary if it is perfectly free with no indication of binding or tightness when rotated on the worm. However, if there is any idnication of binding or tightness, the unit should be disassembled, cleaned and inspected as follows:

Disassembly

1. Remove screws and clamp retaining the ball guides in ball nut. Draw guides out of ball nut.
2. Turn the ball nut upside down and rotate the wormshaft back and forth until all the balls have dropped out of the ball nut into a clean pan. With the balls removed, the ball nut can be pulled endwise off the worm.

Cleaning and Inspection

Wash all parts in cleaning solvent and dry them thoroughly with air. Using a magnifying glass, inspect the worm and nut grooves and the surface of all balls for signs of indentation. Check all ball guides for damage at ends where they deflect or pick up the balls from the helical path. Any parts that show signs of damage should be replaced.

Assembly

1. Slip the ball nut over the worm with the ball guide holes up and the shallow end of the ball nut teeth to the left from the steering wheel position. Align the grooves in the worm and ball nut by sighting through the ball guide holes (Fig. 3B2-14).

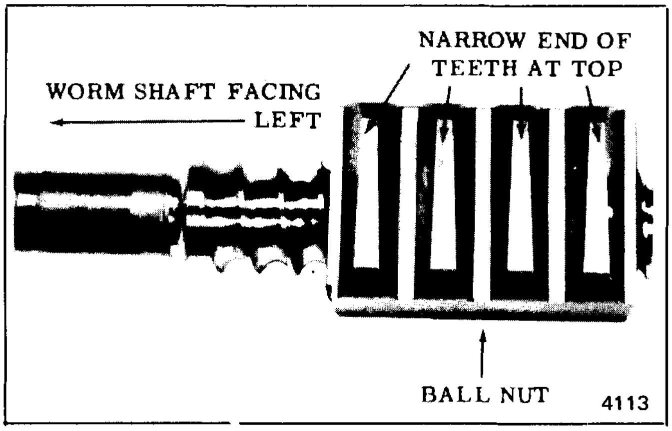


Fig. 3B2-14 Positioning Ball Nut on Worm Shaft

2. Place two ball guide halves together and insert them into the upper circuit in the ball nut. Place the remaining two guides together and insert them in the lower circuit. Count 25 balls into a suitable container. This is the proper number of balls for one circuit (Fig. 3B2-15).

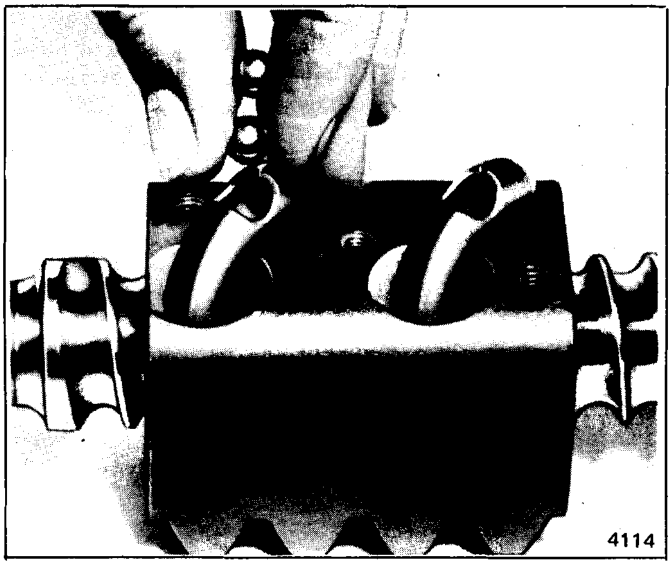


Fig. 3B2-15 Installing Balls in Circuit

3. Load the balls into one of the guide holes while turning the wormshaft gradually away from that hole. When all 25 of the balls have been installed, the circuit is complete.

4. Fill the remaining ball circuit in the same manner as described for the first circuit.

5. Assemble the ball guide clamp to the ball nut and tighten the screws to specified torque.

6. Check the assembly by rotating the ball nut on the worm to see that it moves freely. Do not rotate the ball nut to the end of the worm threads as this may damage the ball guides. If there is any "stickiness" in the motion of the ball nut, some slight damage to the ends of the ball guides or to other gear components may have been overlooked.

ASSEMBLY

After a major overhaul where all of the original factory installed lubricant has been washed out of the steering gear assembly, the threads of the adjuster plug, side cover bolts and lash adjuster may be coated with a suitable non-drying, oil resistant sealing compound such as Permatex No. 2 or equivalent. This is to prevent leakage of gear lubricant from the steering gear assembly. The compound should not be applied to female threads and extreme care should be exercised in applying this compound to the bearing adjuster, as the compound must be kept away from the wormshaft bearing. Also, apply steering gear lubricant meeting GM standard GM 4673M (or equivalent) to the wormshaft bearings, pitman shaft bushings and side cover bushing.

1. Place the steering gear housing with the wormshaft bore horizontal and the side cover opening up.

2. With the pitman shaft and worm shaft seals, pitman shaft bushings and wormshaft bearing races installed, and the ball nut installed on the wormshaft, proceed to Step 3.

3. Slip the upper ball bearing over the wormshaft and insert the wormshaft and ball nut assembly into the housing, feeding the end of the shaft through the upper ball bearing race and seal.

4. Place a ball bearing in the adjuster plug bearing cup and press the stamped retainer into place with a suitable socket.

5. Install the adjuster plug and locknut into the lower end of the housing (being careful to guide the end of the wormshaft into the bearing) until nearly all end play has been removed from the wormshaft.

6. Position the lash adjuster (with shim) in the slotted end of the pitman shaft. Check the end clearance, which should not be greater than .002" (Fig. 3B2-16). If clearance is greater than .002", a steering gear lash adjuster shim unit is available. It contains four shims - .063", .065", .067" and .069" thick.

7. Lubricate the steering gear with 11 oz. of lubricant meeting GM Specification GM 4573M (or equivalent). Rotate the wormshaft until the ball nut is at the end of its travel and then pack as much new lubricant into the housing as possible without losing it out the pitman shaft opening. Rotate the wormshaft until the ball nut is at the other end of its travel and pack as much lubricant into the opposite end as possible.

8. Rotate the wormshaft until the ball nut is in the center of travel. This is to make sure that the pitman shaft sector and ball nut will engage properly, with the center tooth of the sector entering the center tooth space in the ball nut.

9. Insert the pitman shaft assembly (with lash adjuster screw and shim but without side cover) into the housing so that the center tooth of the sector enters the center tooth space in the ball nut.

10. Pack the remaining portion of lubricant into the housing, and place a quantity in the side cover bushing hole.

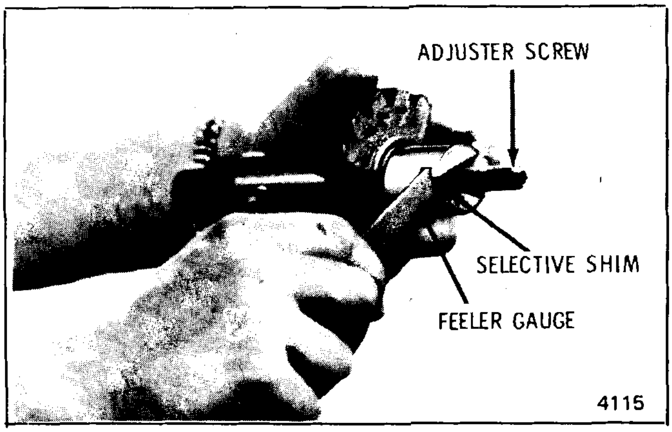


Fig. 3B2-16 Checking End Clearance

11. Place the side cover gasket on the housing.
12. Install the side cover onto the pitman shaft by reaching through the side cover with a screwriver and turning the lash adjuster screw counter-clockwise until the screw bottoms; back the screw off one-half turn. Loosely install a new locknut onto the adjuster screw.
13. Install and tighten the side cover bolts to specifications.
14. Adjust steering gear. Refer to Steering Gear Adjustment.

ADJUSTMENT SPECIFICATIONS-MANUAL STEERING

ADJUSTMENT	TORQUE TO TURN WORM SHAFT
Worm Bearing Preload	5-8 In. Lbs.
Sector Lash Adjustment	4-10 In. Lbs. in excess of Worm Bearing Preload
Total Steering Gear Preload	16 In. Lbs. Maximum
Ratio	24:1

RECOMMENDED TORQUE SPECIFICATIONS

MANUAL STEERING GEAR	FT. LB.
Gear to Frame Bolts	80
Pitman Shaft Nut	
H Series	160
Except H Series	210
Side Cover Bolts	30
Pitman Shaft Adjusting Screw Locknut	25
Bearing Pre-Load Adjuster Locknut	85
Coupling Flange Nuts	20
Coupling Flange Bolt	30
Steering Shaft to Gear Nut (H Series)	55

SECTION 3B3

POWER STEERING GEAR AND PUMP

CAUTION: *All Steering gear fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

POWER STEERING GEAR

The major internal components of the variable ratio steering gear (Fig. 3B3-1) are the rotary valve assembly, steering worm, rack-piston assembly and the pitman shaft. The movement of these parts, while turning or parking, is aided by hydraulic pressure supplied by the pump. Manual steering is always available at times when the engine is not running, or in the event of pump or belt failure. Steering effort is increased under such conditions.

The steering stub shaft rotary valve, worm shaft, and rack-piston assembly are all "in line". The rack-piston in the variable ratio steering gear is modified to accomodate the larger center tooth on the pitman shaft gear. All oil passages are internal within the gear housing, except for the pressure and return hoses between the gear and the pump.

The mechanical element of this steering gear is a low-friction, recirculating ball system in which steel balls act as a rolling thread between the steering worm and the rack-piston. The one piece rack-piston assembly is geared to the sector of the pitman shaft.

The hydraulic rotary valve is concentric with the input shaft and is contained in the upper section of the gear housing. It contains a spool that is held in neutral position by means of a torsion bar and the valve body into the other end. Twisting of the torsion bar allows the spool to rotate in relation to the valve body, thereby operating the valve (Fig. 3B3-1).

Under normal driving conditions the steering wheel effort will range from 1 to 1-1/2 pounds and parking effort will range from 2 to 2-1/2 pounds.

B Series models with firm ride option use a straight 14:1 ratio gear. All other models use a variable ratio (16:1 to 13:1) power steering gear.

A production code is stamped on the gear side cover for identification purposes.

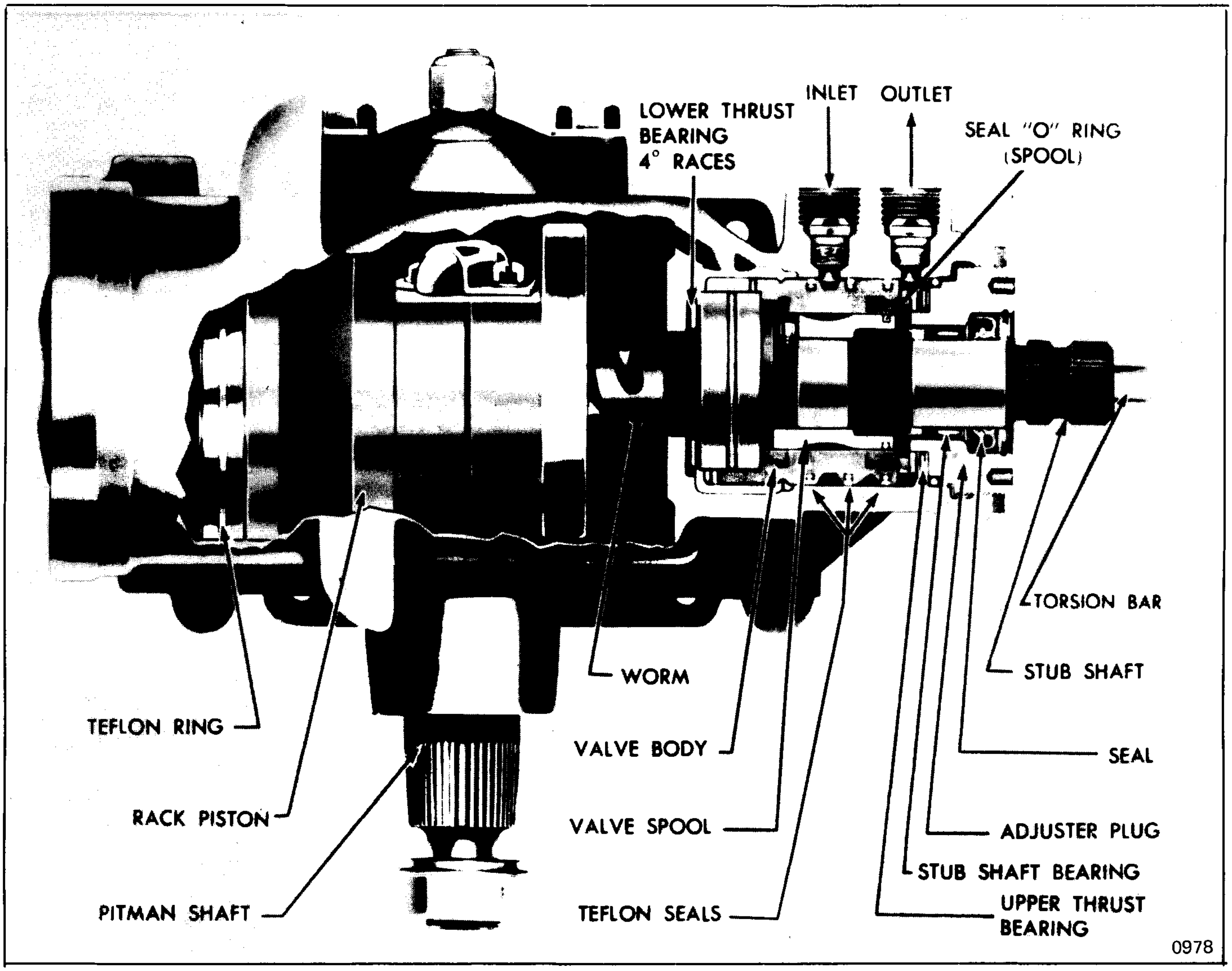


Fig. 3B3-1 Power Steering Gear

POWER STEERING PUMP

The major components of the power steering pump (Fig. 3B3-2) are the oil reservoir, drive shaft, pump housing, cam ring, pressure plate, thrust plate, flow control valve and rotor and vane assembly. The pump housing and component parts are encased in the oil reservoir. The reservoir filler cap has a dipstick attached to show the oil level in the reservoir.

There are two bore openings at the rear of the pump housing. The larger of these openings contains the cam ring, pressure plate, thrust plate, rotor and vane assembly, and end plate. The smaller opening contains the pressure line union, flow control valve and spring. The flow control orifice is part of the pressure line union. A pressure relief valve inside the flow control valve limits pump pressure. A magnet is installed in the pump housing attached by its magnetic force. The magnet will pick up metal impurities in the oil. If the pump is disassembled, the magnet should be cleaned.

COMPONENT REPLACEMENT RECOMMENDATIONS

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the steering gear at the pitman shaft, at the stub shaft, and on the drive shaft of the pump. When leakage occurs in one of these areas, always replace the seal(s), after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft only if very severe pitting is found. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by smoothing with crocus cloth first.

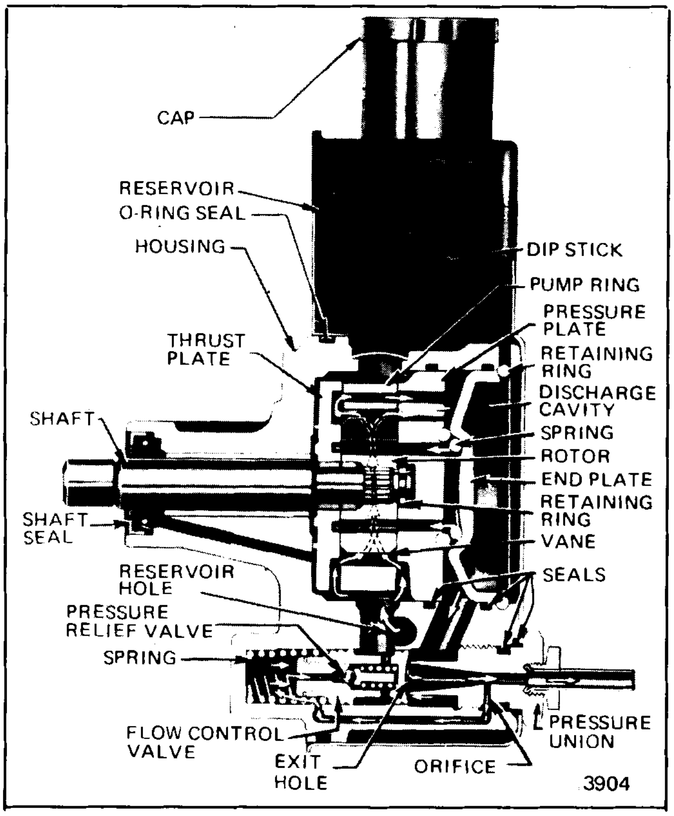


Fig. 3B3-2 Power Steering Pump

SERVICE PROCEDURES

PITMAN SHAFT SEALS

REMOVAL AND INSTALLATION

With Steering Gear In Car

Removal and Installation of Pitman Shaft Seals With Steering Gear In Car

If upon inspection of the gear, it is found that oil leakage exists at the pitman shaft seals, the seals may often be replaced without removing the gear assembly from the car as follows:

1. Remove pitman nut and disconnect pitman arm from pitman shaft using Puller J-5504. (DO NOT HAMMER ON END OF PULLER.)

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman shaft to insure that seals will not be cut by splines during assembly.

NOTE: Only one layer of tape should be used; an excessive amount of tape will not allow the seals to pass over it, due to the close tolerance between the seals and the pitman shaft.

3. Remove pitman shaft seal retaining ring with snap ring pliers.

4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Turn off engine.

NOTE: Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out.

5. Inspect seals for damage to rubber covering on O.D. If O.D. appears scored, inspect housing for burrs and remove before attempting new seal installation. Check seal surface of pitman shaft for roughness or pitting. If pitted, replacement of pitman shaft is recommended.

6. Clean end of housing thoroughly so that dirt will not enter housing with the installation of the new seals.

7. Lubricate the seals thoroughly with Power Steering Fluid No. 1050017 or equivalent. To install seals with installer (Fig. 3B3-31), install the inner single lip seal first, then a back-up washer. Drive seal in far enough to provide clearance for the outer seal, back-up washer and retaining ring. Make sure that the inner seal does not bottom on the counterbore. Install the outer double lip seal and the second back-up washer in only far enough to provide clearance for the retaining ring. Install retaining ring.

8. Fill pump reservoir to proper level with Power Steering Fluid, No. 1050017 or equivalent. Start engine and allow engine to idle for at lease three minutes without turning steering wheel. Turn wheel to left and check for leaks. Add Power Steering Fluid as required.

9. Remove tape and reconnect pitman arm.

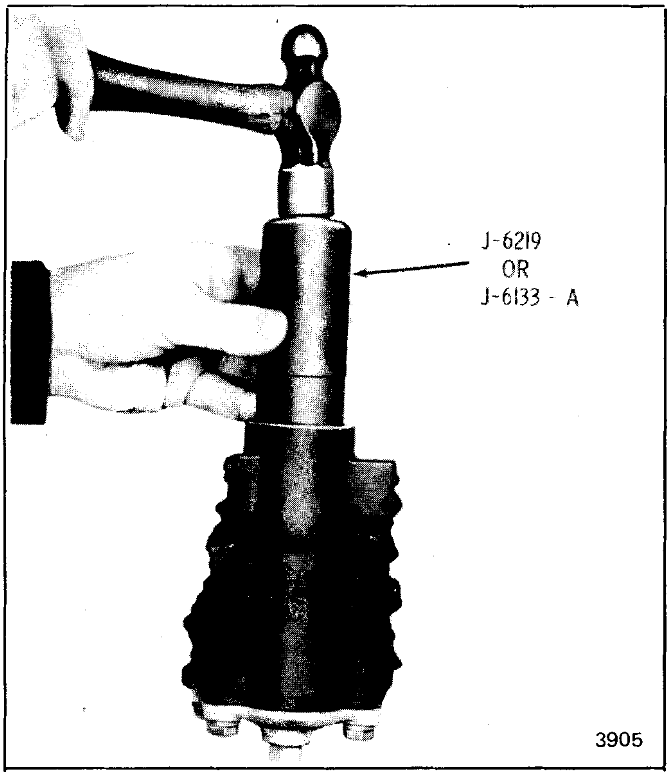


Fig. 3B3-3 Installing Seal (Pitman Shaft in Place)

See CAUTION on Page 3B3-1 of this Section.

STEERING GEAR

REMOVAL AND INSTALLATION

1. Remove or reposition flexible coupling shield (Figs. 3B3-4 thru 3B3-7).
2. Hoist the car.
3. Disconnect the hoses from the gear and cap the hose fittings.
4. Remove the pitman shaft nut, then disconnect the pitman arm from the pitman shaft using Puller J-5504 or a similar puller.

   NOTE: On H & HM Series it will be necessary to remove the crossmember brace.

5. Remove the three bolts attaching the gear to the frame side rail and remove the gear with the hoses attached.

   NOTE: If mounting threads are stripped, do not repair. Replace housing.

See CAUTION on Page 3B3-1 of this Section.

Before installing the steering gear, apply a sodium soap fine fiber grease to the gear mounting pads to prevent squeaks between the gear housing and the frame. Before positioning the gear, note the flat on the gear lower shaft must index with the flat in the coupling flange. Make certain there is a minimum of .040" clearance betweeen coupling hub and steering gear upper seal. Install the coupling flange hub bolt and torque to 30 ft. lbs. Before tightening the steering gear to frame bolts, shift the steering gear as necessary to place it in the same plane as the steering shaft so that the flexible coupling is not distorted. Tighten the steering gear to frame

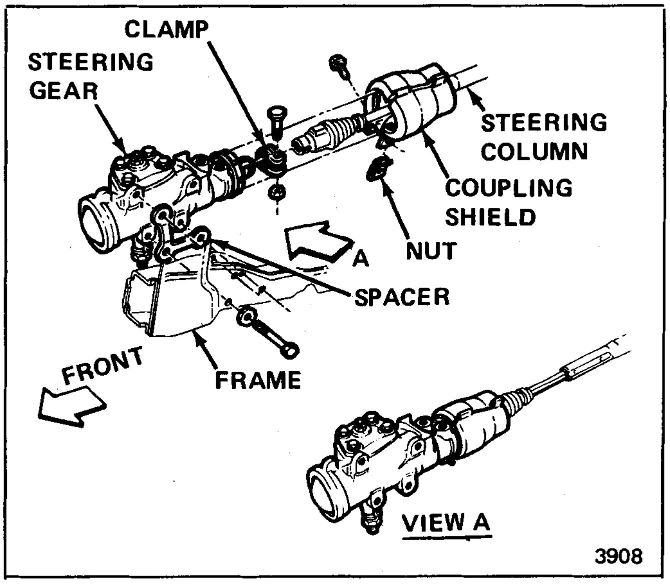


Fig. 3B3-4 Coupling Shield - H Series

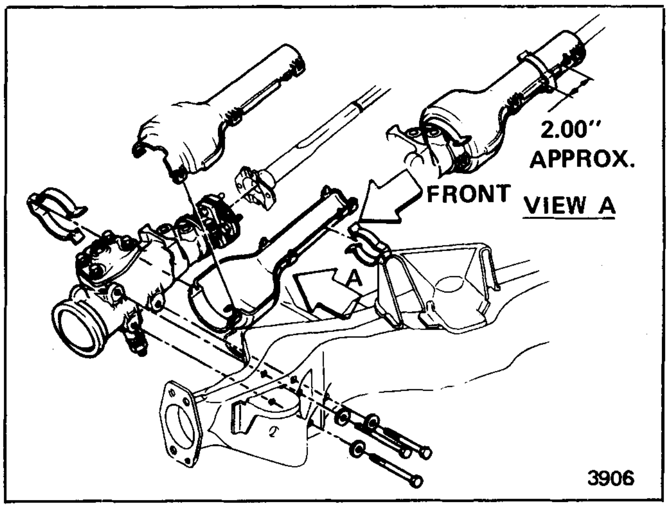
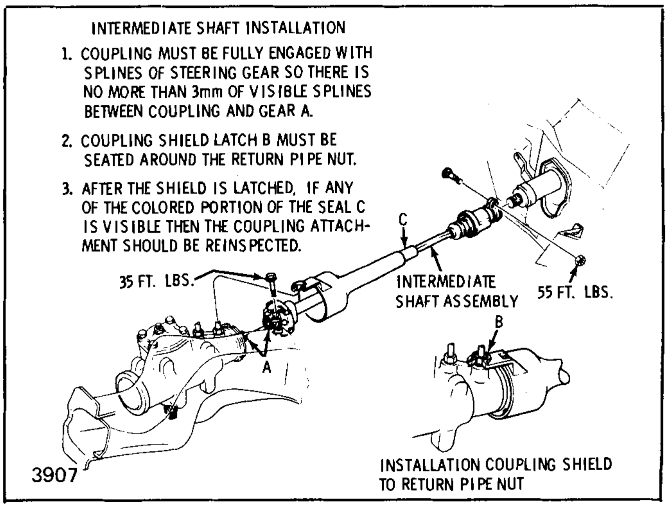


Fig. 3B3-5 Coupling Shield - X Series



INTERMEDIATE SHAFT INSTALLATION

1. COUPLING MUST BE FULLY ENGAGED WITH SPLINES OF STEERING GEAR SO THERE IS NO MORE THAN 3mm OF VISIBLE SPLINES BETWEEN COUPLING AND GEAR A.
2. COUPLING SHIELD LATCH B MUST BE SEATED AROUND THE RETURN PIPE NUT.
3. AFTER THE SHIELD IS LATCHED, IF ANY OF THE COLORED PORTION OF THE SEAL C IS VISIBLE THEN THE COUPLING ATTACHMENT SHOULD BE REINSPECTED.

Fig. 3B3-6 Coupling Shield - A, B and G Series

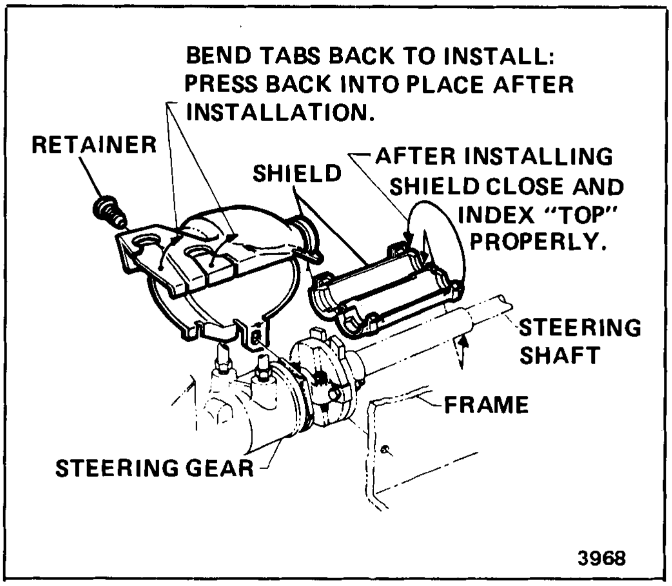


Fig. 3B3-7 Coupling Shield - F Series

bolts to 80 ft. lbs. and the pitman shaft nut to 210 ft. lbs.

After the hoses are connected to the pump, add Power Steering Fluid No. 1050017 or equivalent as necessary to bring the fluid level to the full COLD mark. Run engine at idle for 30 seconds, then run at fast idle for one minute before turning steering wheel. With the engine running, turn the steering wheel through its full travel two or three times to bleed air from the system. Recheck the oil level and add oil if necessary.

DISASSEMBLY

(Fig. 3B3-8)

NOTE: In many cases, complete disassembly of the gear will not be necessary since most of the component parts can be removed without complete disassembly of the gear. The procedure for such operations are not specifically outlined; however, the following basic procedure and specifications will apply.

To facilitate servicing of the gear, the gear should be mounted in vise as shown in Fig. 3B3-9.

1. Rotate end cover retainer ring so that one end of the ring is over the hole in the side of the housing. Force the end of the ring from its groove and remove ring (Fig. 3B3-10).

2. Turn the coupling flange counter-clockwise until the rack-piston just forces end cover out of housing. Remove cover and discard "O" ring.

NOTE: DO NOT turn stub shaft any further than absolutely necessary to remove the end plug, or balls from rack-piston and worm circuit may escape and lay loose inside the rack-piston chamber.

3. Remove the rack-piston end plug as shown in Fig. 3B3-11.

NOTE: To aid in loosening the aluminum end plug (female square drive) strike sharply using 1" diameter or larger brass drift and hammer.

4. Remove the pitman shaft and side cover as follows:

a. Loosen the over-center adjusting screw lock-nut and remove the 4 side cover attaching bolts.

b. Rotate the side cover until the rack-piston and pitman shaft teeth are visible, then turn the coupling flange until the pitman shaft teeth are centered in the housing opening. Tap the pitman shaft with a soft hammer and remove the pitman shaft and side cover from the housing. Remove the side cover gasket and discard.

5. Remove the rack-piston as follows:

a. Insert Ball Retainer Tool J-21552 into the rack-piston bore with pilot of tool seated in the end of the worm (Fig. 3B3-12). Turn stub shaft counter-clockwise while holding tool tightly against worm. The rack-piston will be forced onto the tool. Hold tool and pull rack-piston further onto tool to prevent end circuit balls from falling out.

b. Remove the rack-piston with Ball Retainer Tool J-21552 from gear housing.

6. Remove the adjuster plug as follows:

a. Loosen the adjuster plug locknut and remove (Fig. 3B3-13).

b. Remove adjuster plug assembly with Spanner Wrench J-7624 (Fig. 3B3-14).

c. Remove and discard the adjuster plug "O" ring.

7. Grasp the stub shaft and pull the valve assembly from the housing bore. Separate worm and valve and remove the lower shaft cap "O" ring. Discard "O" ring.

8. If the worm or the lower thrust bearing and race remained in the gear housing, remove them at this time.

SERVICING INDIVIDUAL UNITS

ADJUSTER PLUG ASSEMBLY (FIG. 3B3-15)

Disassembly

1. If the oil seal ONLY is to be replaced, and not the bearing, install the adjuster plug loosely in the gear housing.

Remove the retaining ring with internal pliers. With a screwdriver, pry the dust seal and oil seal from the bore of the adjuster plug being careful not to score the seal bore. Discard the oil seal.

2. If the thrust bearing ONLY is to be removed, pry the thrust bearing retainer at the two raised areas with a small screwdriver (Fig. 3B3-16). Remove the spacer, thrust bearing washer, thrust bearing and washer.

3. If the needle bearing is to be replaced, remove the retaining ring using internal pliers. Remove thrust bearing as outlined in Step 2 above. Drive needle bearing, dust seal and oil seal from adjuster plug using Bearing Remover J-5188 as shown in Fig. 3B3-17. Discard the seals.

4. Wash all parts in clean solvent and dry parts with compressed air.

5. Inspect thrust bearing spacer for wear or cracks. Replace if damaged.

6. Inspect thrust bearing rollers and thrust washers for wear, pitting or scoring. If any of these conditions exist, replace the bearing and thrust washers.

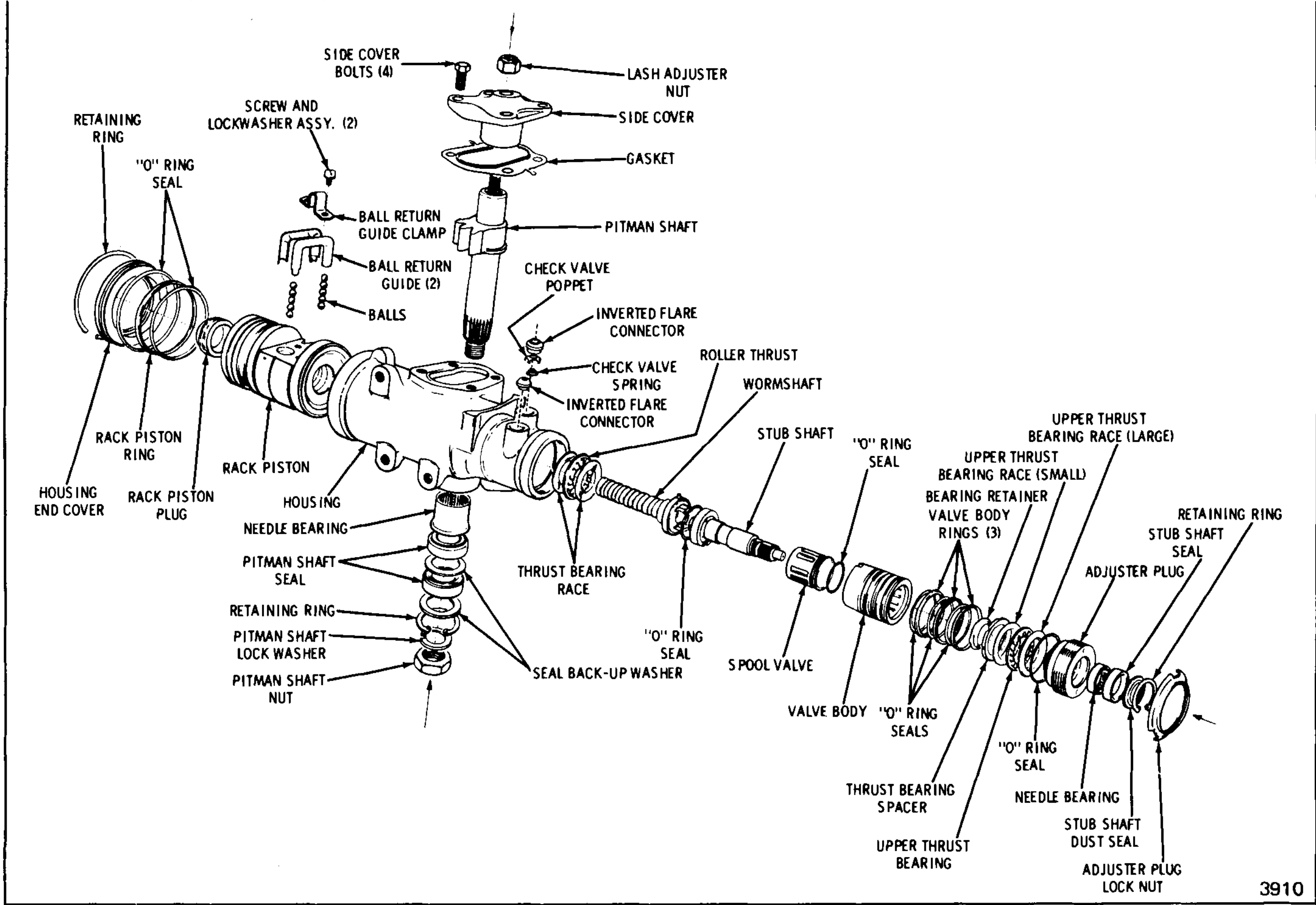


Fig. 3B3-8 Power Steering Gear (Exploded)

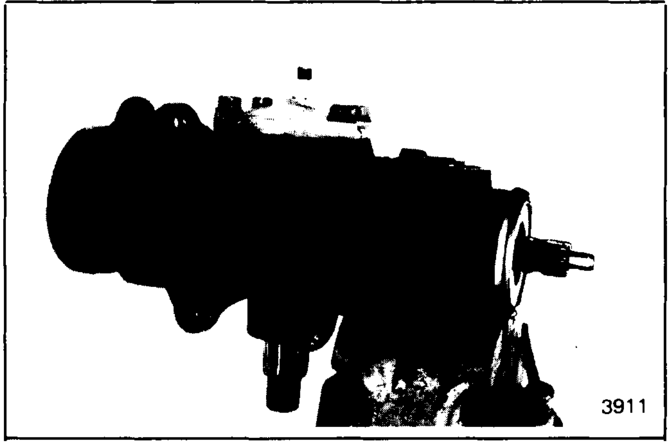


Fig. 3B3-9 Mounting Steering Gear in Vise

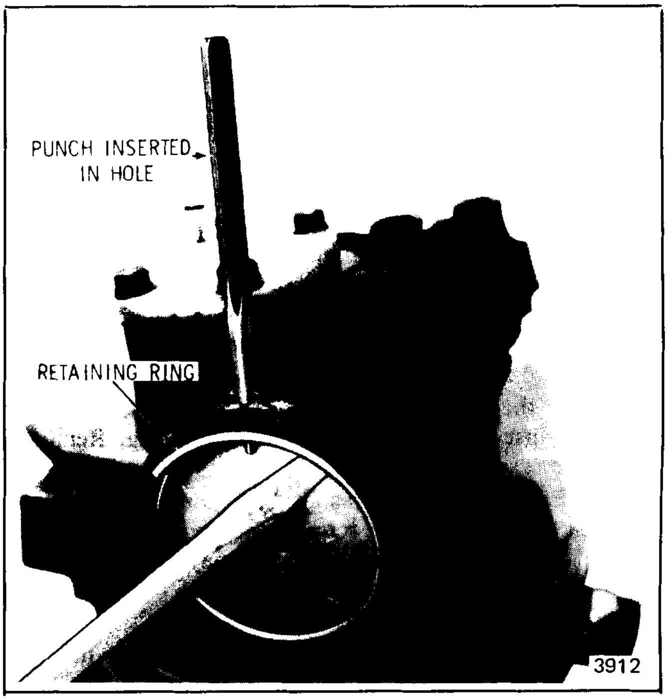


Fig. 3B3-10 Removing End Cover

Assembly

1. If the needle bearing was removed, place new needle bearing over Tool J-6221, with the bearing manufacturer's identification against the tool, and drive the bearing into the adjuster plug until it is flush with the surface of seal bore (Fig. 3B3-18).

CAUTION: *Place a block of wood under the adjuster plug to protect it during driving of the bearing.*

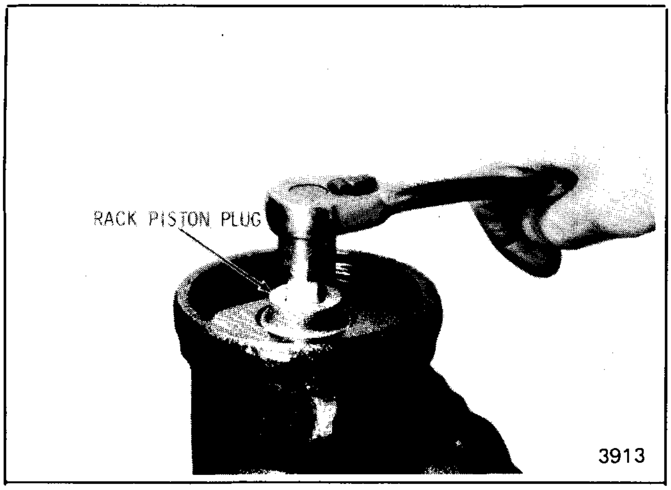
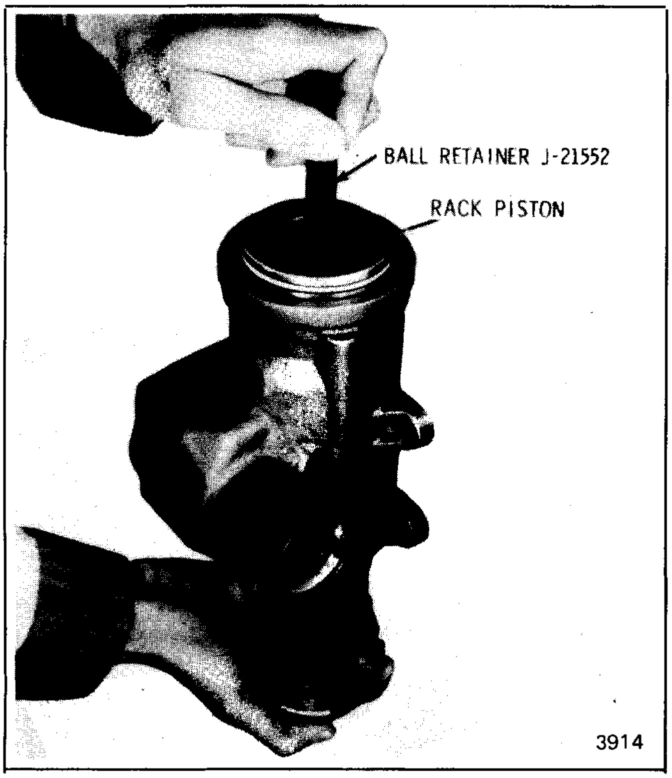


Fig. 3B3-11 Removing Rack Piston Plug



Gig. 3B3-12 Removing Rack Piston

2. Place dust seal and a new oil seal on Tool J-5188 (lip of seal away from tool). Lubricate seat with Power Steering Fluid No. 1050017 or equivalent and drive or press seals into adjuster plug until seated (Fig. 3B3-19). When properly installed, the oil seal is under the dust seal.

3. Install retaining ring with internal pliers.

4. Lubricate the thrust bearing assembly with Power Steering Fluid No. 1050017 or equivalent. Place the flanged thrust bearing washer on the adjuster plug hub, then install the upper thrust bearing, small bearing washer andd spacer (grooves of spacer away from bearing washer).

5. Install bearing retainer on the adjuster plug by carefully tapping on the flat surface of the retainer (Fig. 3B3-20).

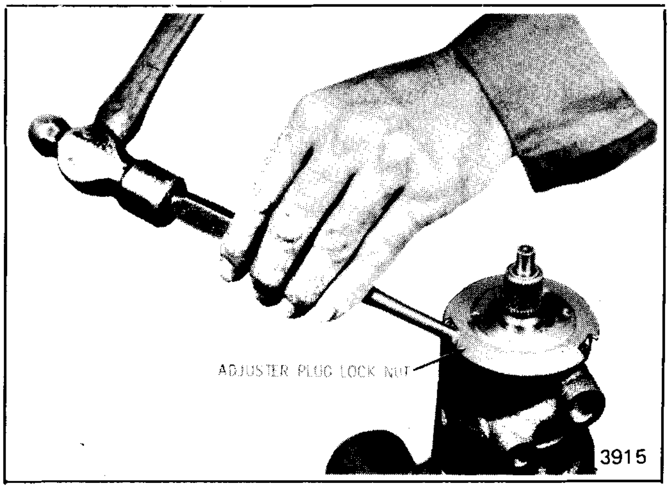


Fig. 3B3-13 Loosening Adjuster Plug Lock Nut

Fig. 3B3-14 Removing Adjuster Plug

NOTE: The projections must not extend beyond the spacer when the retainer is sealed. The spacer must be free to rotate.

VALVE AND STUB SHAFT ASSEMBLY

Disassembly (Fig. 3B3-21)

1. Remove and discard the "O" ring in the shaft cap end of the valve assembly.

2. To remove the stub shaft assembly from the valve body, proceed as follows:

a. While holding the assembly (stub shaft down), lightly tap the stub shaft against the bench until the shaft cap is free from the valve body (Fig. 3B3-22).

b. Pull the shaft assembly until the shaft cap clears the valve body approximately 1/4".

CAUTION: *Do not pull the shaft assembly out too far or the spool valve may become cocked in the valve body.*

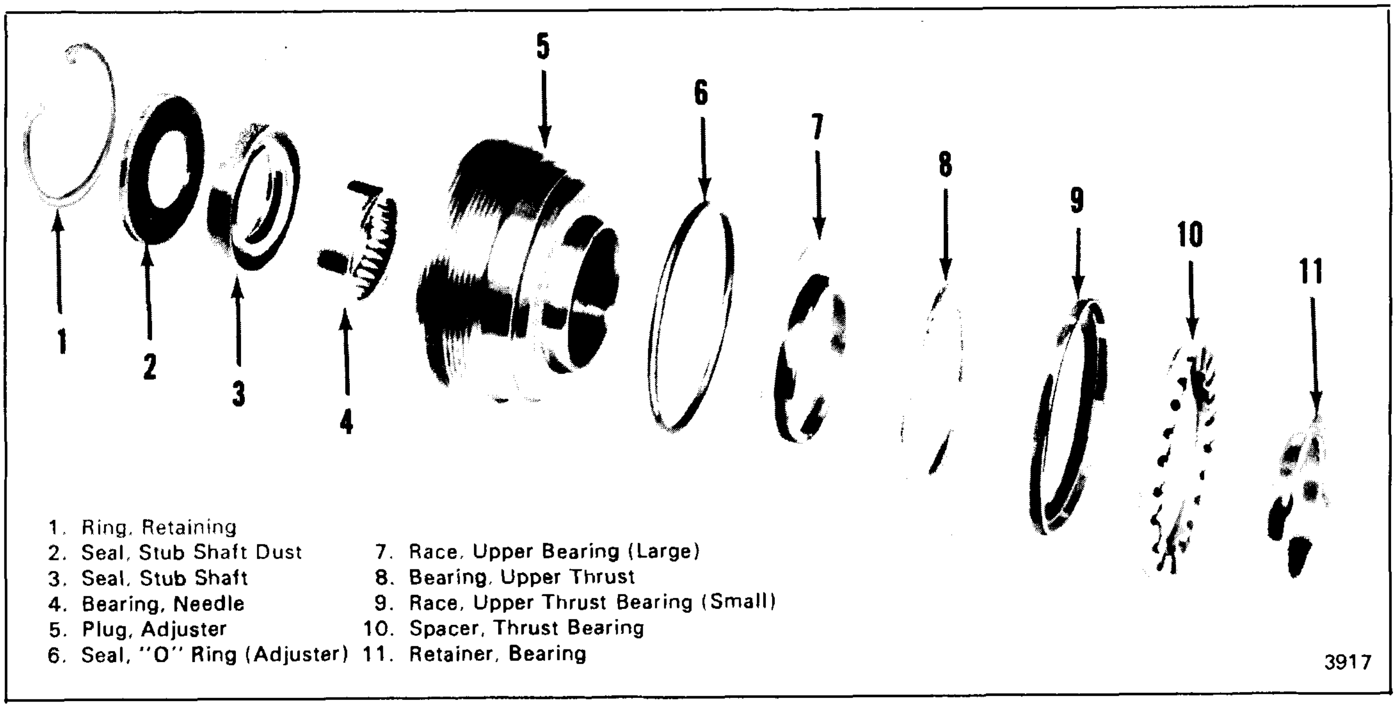


Fig. 3B3-15 Adjuster Plug Assembly

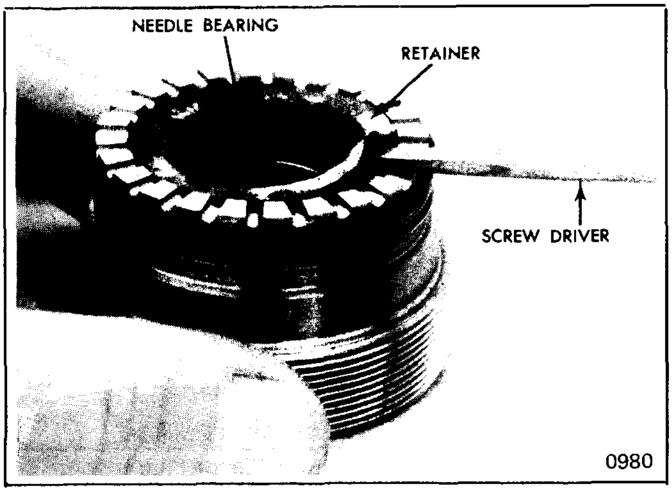


Fig. 3B3-16 Removing Thrust Bearing Retainer

c. Carefully disengage the shaft pin from the spool valve and remove the shaft assembly (Fig. 3B3-22).

3. Push the spool valve out of the flush end of the valve body until the dampener "O" ring is exposed, then carefully pull the spool from the valve body, while rotating the valve (Fig. 3B3-23). If the spool valve becomes cocked, carefully realign the spool valve, then remove.

4. Remove the dampener "O" ring from the spool valve and discard.

5. If the teflon oil rings are to be replaced, cut the 3 teflon oil rings and "O" rings from the valve body and discard.

Cleaning and Inspection

1. Wash all parts in clean solvent and blow out all oil holes with compressed air.

2. If the drive pin in the stub shaft or valve body is cracked, excessively worn or broken, replace the complete valve and shaft assembly.

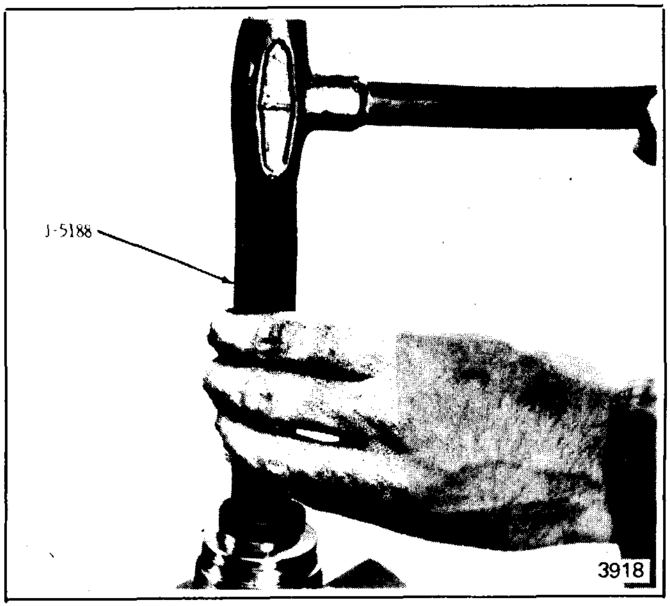


Fig. 3B3-17 Removing Seal and Bearing

3. If there is evidence of leakage between the torsion bar and the stub shaft or scores, nicks, or burrs on the ground surface of the stub shaft that cannot be cleaned up with crocus cloth, the entire valve assembly must be replaced.

4. Check the outside diameter of the spool valve and the inside diameter of the valve body for nicks, burrs or bad wear spots. If the irregularities cannot be cleaned up by the use of crocus cloth, the complete valve and shaft assembly will have to be replaced.

5. If the small notch in the skirt of the valve body is excessively worn, the complete valve assembly will have to be replaced.

6. Lubricate the spool valve with Power Steering Fluid No. 1050017 or equivalent and check the fit of the spool valve

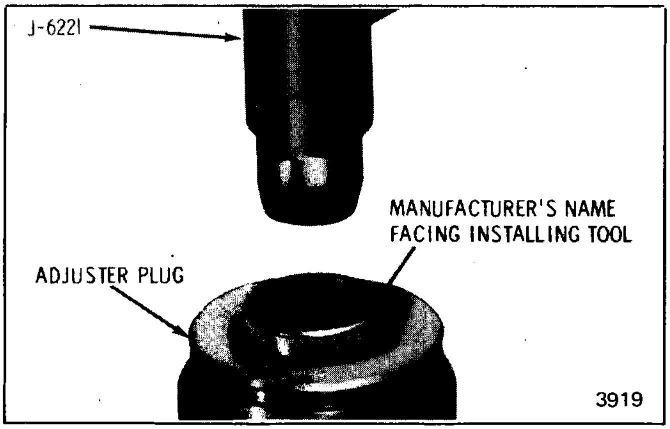


Fig. 3B3-18 Installing Bearing

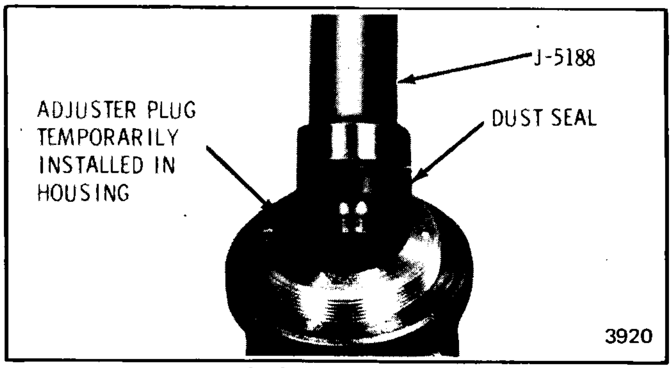


Fig. 3B3-19 Installing Seal

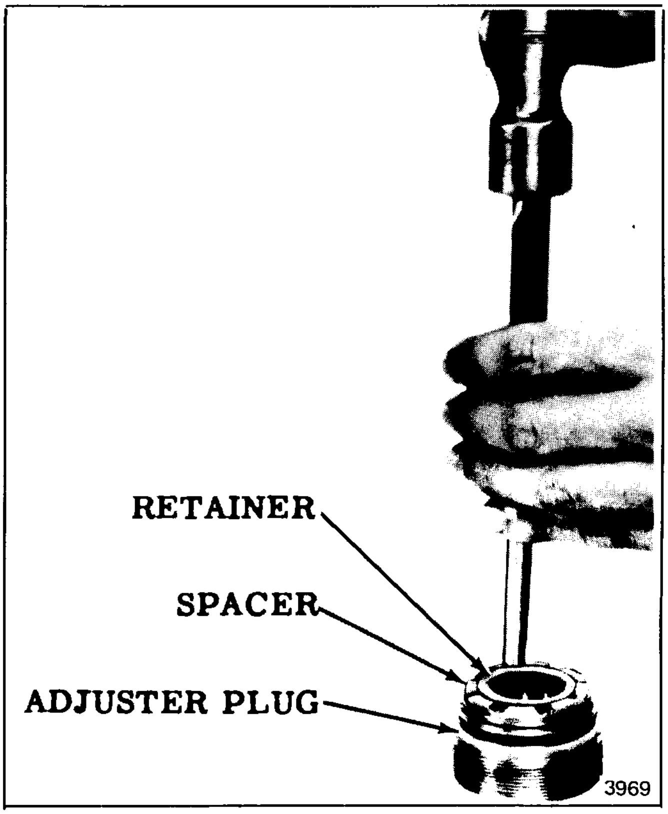


Fig. 3B3-20 Installing Bearing Retainer

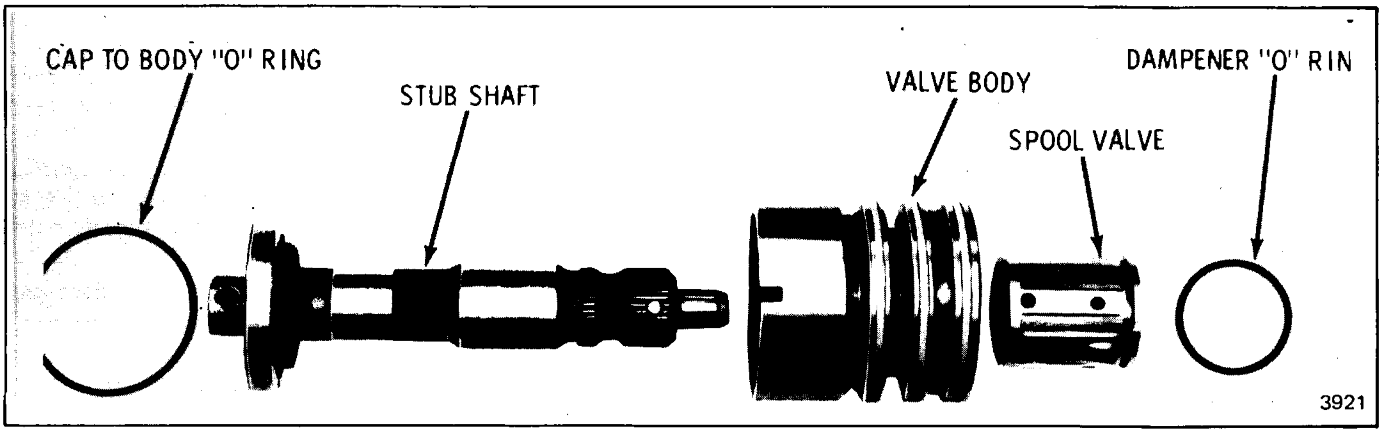


Fig. 3B3-21 Valve and Stud Shaft Assembly

in the valve body (with the spool valve dampener "O" ring removed). If the spool valve does not rotate freely without binding, the complete valve and shaft assembly will have to be replaced.

Assembly

1. If valve body "O" rings and teflon rings were removed, install 3 new "O" rings in the oil ring grooves and lubricate with Power Steering Fluid No. 1050017 or equivalent.

NOTE: as an aid to installation, the teflon rings may be heated for 5-10 minutes in boiling water. Dry well before installing.

2. Lubricate the 3 new teflon oil rings with Power Steering Fluid No. 1050017 or equivalent and install in grooves over "O" rings.

NOTE: The teflon rings may appear to be distorted, but the heat of the oil during operation of the gear will straighten them out.

3. Lubricate the spool valve dampener "O" ring with Power Steering Fluid No. 1050017 or equivalent and install over the spool valve.

4. Lubricate the spool valve and valve body with Power Steering Fluid No. 1050017 or equivalent and slide the spool valve into the valve body (Fig. 3B3-23). Rotate the spool valve while pushing it into the valve body being careful not to cut the dampener "O" ring. Push the spool valve on through the valve body until the shaft pin hole is visible from

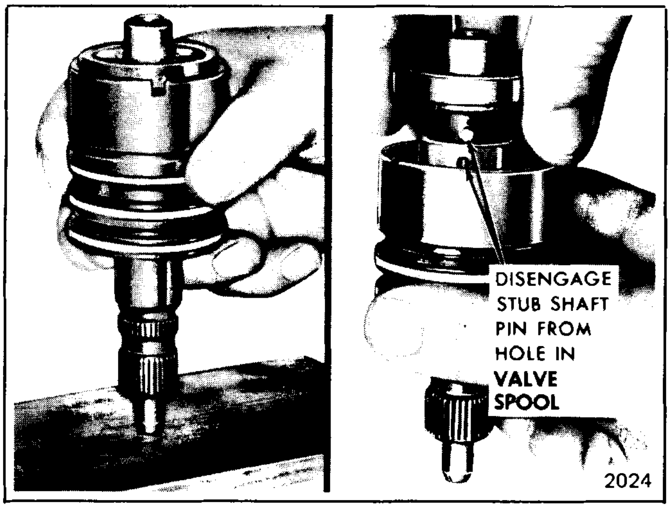


Fig. 3B3-22 Removing Stub Shaft Assembly

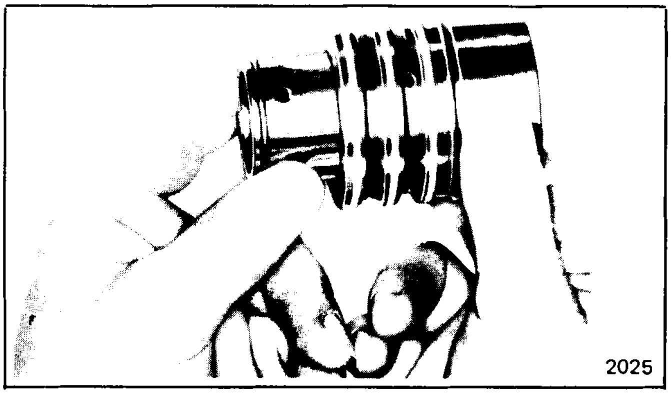


Fig. 3B3-23 Removing or Installing Spool Valve

the opposite end (spool valve flush with shaft cap end of valve body).

5. Lubricate the shaft assembly with Power Steering Fluid No. 1050017 or equivalent and carefully install it into the spool valve until the shaft pin can be placed into the spool valve.

6. Align the notch in the shaft cap with the pin in the valve body and press the spool valve and shaft assembly into the valve body (Fig. 3B3-24).

CAUTION: *Make sure that the shaft cap notch is mated with the valve body pin before installing valve body into the gear assembly.*

7. Lubricate a new cap to body "O" ring with Power Steering Fluid No. 1050017 or equivalent and install it in the shaft cap end of the valve body assembly.

PITMAN SHAFT AND SIDE COVER

Disassembly (Fig. 3B3-25)

Remove the locknut and unscrew the side cover from the adjusting screw. Do not attempt to disassemble pitman shaft. Discard locknut.

Cleaning and Inspection

1. Wash all parts in clean solvent and dry with compressed air.

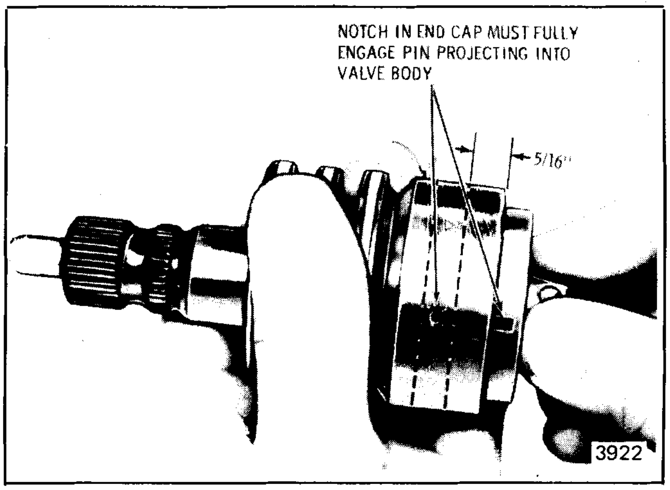


Fig. 3B3-24 Installing Stub Shaft Assembly

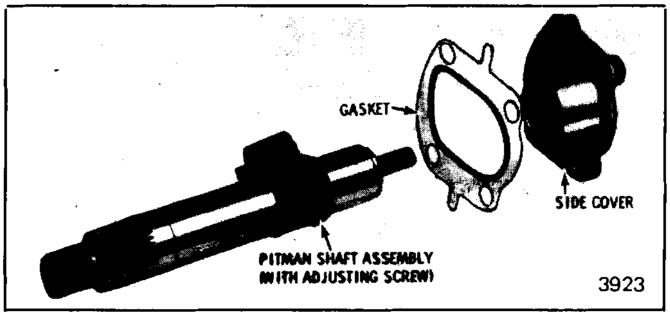


Fig. 3B3-25 Pitman Shaft and Side Cover

2. Check pitman shaft bearing surface in the side cover for scoring. If badly worn or scored, replace the side cover assembly.

3. Check the sealing and bearing surfaces of the pitman shaft for roughness, nicks, etc. If minor irregularities in surface cannot be cleaned by use of crocus cloth, replace the pitman shaft.

4. Replace pitman shaft assembly if teeth are damaged or if the bearing surfaces are pitted or scored.

5. Check pitman shaft lash adjusting screw. It must be free to turn with no perceptible end play. If adjusting screw is loose replace the pitman shaft assembly.

Assembly

Thread the side cover onto the pitman shaft adjusting screw until it bottoms and then turn in 1/2 turn. Install a new adjusting screw locknut, but do not tighten.

RACK-PISTON

Disassembly

1. Thread the worm out of the rack-piston, remove ball return guide clamp, guide halves and balls.

2. If necessary to replace the teflon oil seal and "O" ring, remove at this time.

Cleaning and Inspection

1. Wash all parts in clean solvent and dry with compressed air.

2. Inspect the worm and rack-piston grooves and all the balls for scoring. If either the worm or rack-piston needs replacing, both must be replaced as a matched assembly.

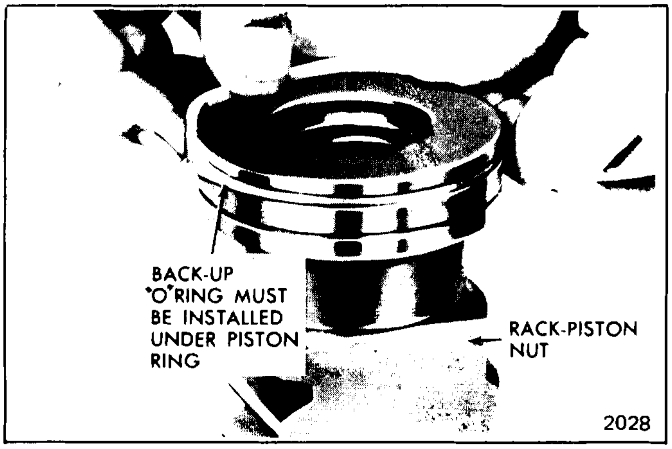
3. Inspect ball return guide halves, making sure that the ends where the balls enter and leave the guides are not damaged.

4. Inspect lower thrust bearing and washers for scoring or excessive wear. If any of these conditions are found, replace the thrust bearing and washers.

5. Inspect rack-piston teeth for scoring or excessive wear. Inspect the external ground surfaces for wear, scoring or burrs. If any of these conditions exist and are excessive, both the rack piston and worm must be replaced.

Assembly

1. If the teflon oil seal and "O" ring were removed, lubricate a new "O" ring and seal with Power Steering Fluid No. 1050017 or equivalent and install in groove on rack-piston. The teflon ring may be slightly loose after assembly, but will tighten up when subjected to the hot oil in the system (Fig. 3B3-26).



3B3-26 Installing Ring on Rack Piston

2. Slide the worm all the way into the rack-piston. It is not necessary to have the thrust bearing assembly on the worm at this time.

3. Turn the worm until the worm groove is aligned with the lower ball return guide hole (Fig. 3B3-27).

4. Lubricate the balls with Power Steering Fluid, No. 1050017 or equivalent, then feed 17 balls into the rack-piston, while slowly rotating the worm counter-clockwise.

NOTE: The black balls are .0005" smaller than the silver balls. The black and silver balls must be installed alternately into the rack-piston and return guide.

5. Alternaltely install 7 balls into the return guide and retain with grease at each end of guide (5 balls on constant ratio gear). Install the return guide clamp and tighten the 2 clamp screws to 6 ft. lbs.

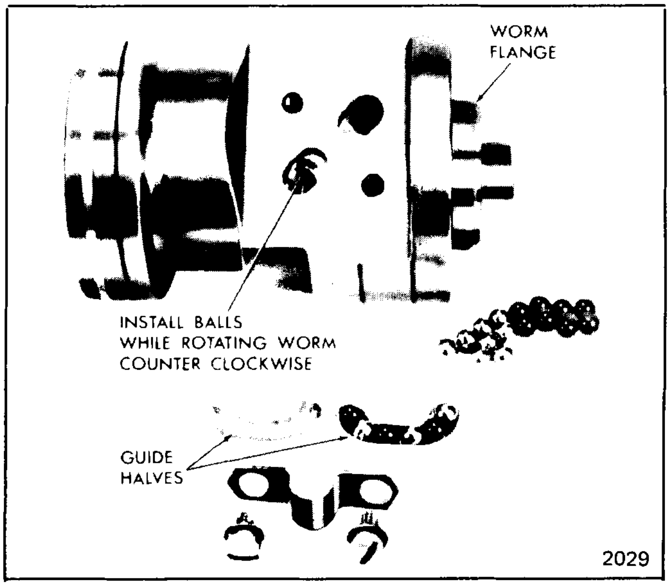


Fig. 3B3-27 Installing Balls in Rack Piston

STEERING GEAR HOSE CONNECTOR AND POPPET CHECK VALVE

Replacement

The following procedure is recommended for bench repairs only.

NOTE: When on car replacement is necessary, use a No. 4 easy-out or similar extractor with 1/4" ground off end to prevent bottoming (Fig. 3B3-28).

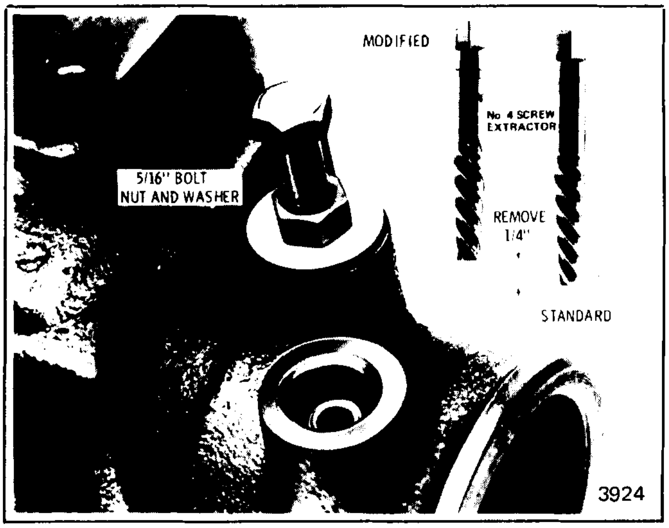


Fig. 3B3-28 Removing Connector Seat

1. Disconnect pressure and return line hoses at steering gear and secure hose ends in a raised position to prevent loss of fluid.

2. To prevent metal chips from becoming lodged in valve assembly, pack inside of connector seats of pressure and return ports with petrolatum.

3. Tap threads in connector seats, using a 5/16"-18 tap.

CAUTION: *Do not tap threads too deep in pressure hose connector seat as tap will bottom poppet valve against housing and damage it. It is* *necessary to tap only 2 or 3 threads deep.*

4. Thread a 5/16"-18 bolt with a nut and flat washer into tapped hole (Fig. 3B3-28).

5. To pull connector seat, hold bolt from rotating while turning nut off bolt. This will pull connector from housing. Discard connector seat.

NOTE: It is also possible to remove connector by using a No. 4 screw extractor.

6. Wipe petrolatum from housing and clean housing thoroughly to remove any metal chips or dirt.

7. Wipe petrolatum from housing and clean housing thoroughly to remove any metal chips or dirt.

8. Remove poppet check valve and spring from pressure port and discard.

9. Install new check valve spring in pressure port with large end down. Make sure spring is seated in counterbore in pressure port (Fig. 3B3-29).

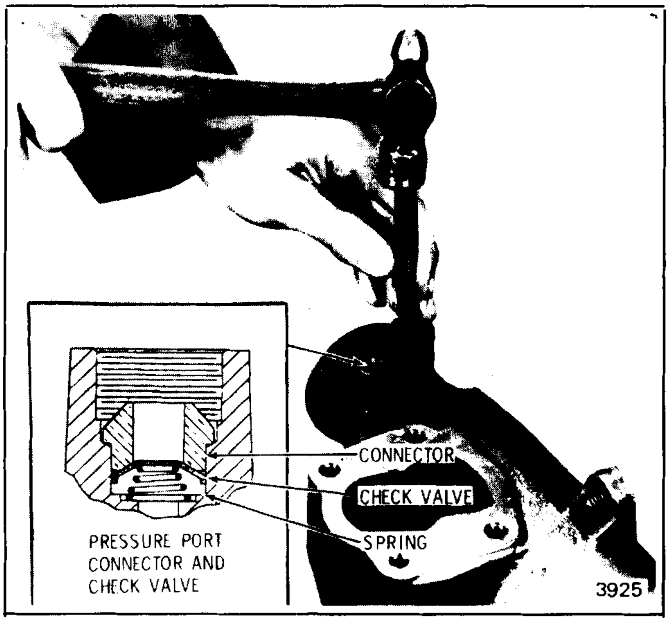


Fig. 3B3-29 Installing Connector Seat

10. Install new check valve over spring with tangs pointing down. Make sure valve is centered on small end of spring.

11. Install new connector seats, using petrolatum to hold connector seat on check valve in pressure port. Drive connector seats in place using Valve Connector Seat Installer J 6217 (Fig. 3B3-29).

12. Check operation of valve by pushing lightly against valve with a small punch or small rod. Valve should reseat itself against connector seat when pressure is removed from spring.

13. Connect pressure and return line hoses on steering gear. Tighten hose fittings to 35 ft. lbs.

14. Check fluid in pump reservoir and add fluid if necessary.

PITMAN SHAFT NEEDLE BEARING AND SEALS

Removal (Fig. 3B3-30)

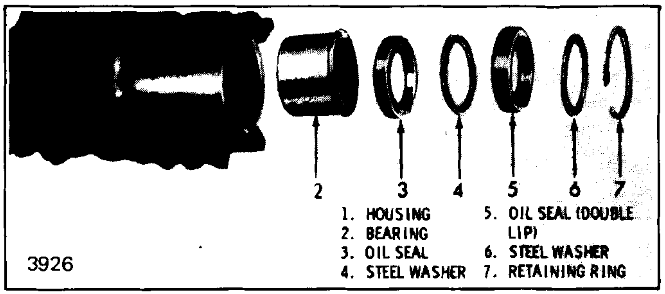


Fig. 3B3-30 Pitman Shaft Bearing Seals

CAUTION: *When prying out seals, be extremely careful not to score the housing bore.*

1. If pitman shaft seals ONLY are to be replaced, remove the seal retaining ring with internal pliers and remove back-up washer. Using screwdriver under lip of seal pry out the outer seal. Remove the back-up washer, then pry out the inner seal (Fig. 3B3-31). Discard seals.

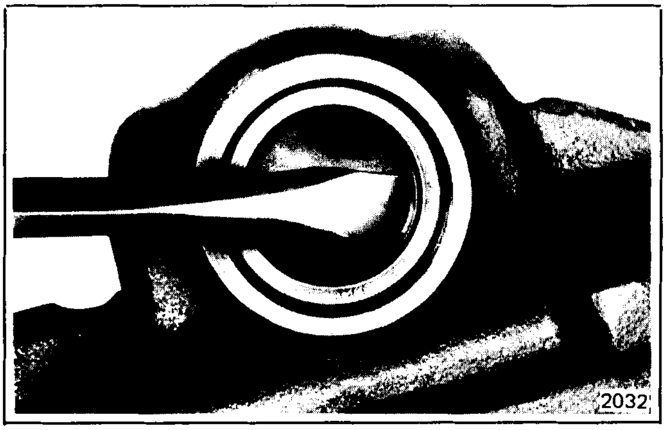


Fig. 3B3-31 Removing Pitman Shaft Seals

2. If pitman shaft needle bearing replacement is necessary, remove with Tool J-6278. Since this bearing is shouldered, it must be pressed out the pitman shaft end of the housing (Fig. 3B3-32).

Assembly

1. Thoroughly clean the parts and lubricate them with Power Steering Fluid, No. 1050017 or equivalent.

2. Install pitman shaft needle bearing on Bearing Installer J-22407, with shoulder of bearing against tool. Position bearing and tool in housing and press bearing into housing, until tool is bottomed out against hub of housing (Fig. 3B3-33).

3. Lubricate the lips of the oil seals with Power Steering Fluid, No. 1050017 or equivalent.

4. Install the pitman shaft oil seals as follows:

a. Place Adapter J-6278-2 over Tool J-6278, then install the outer seal (double lip), back-up washer, and inner seal with the lips of the seals facing away from the adapter (Seal identification toward adapter).

b. Drive the seals into the housing until the top of Adapter J-6278-2 is flush with the housing (Fig. 3B3-34).

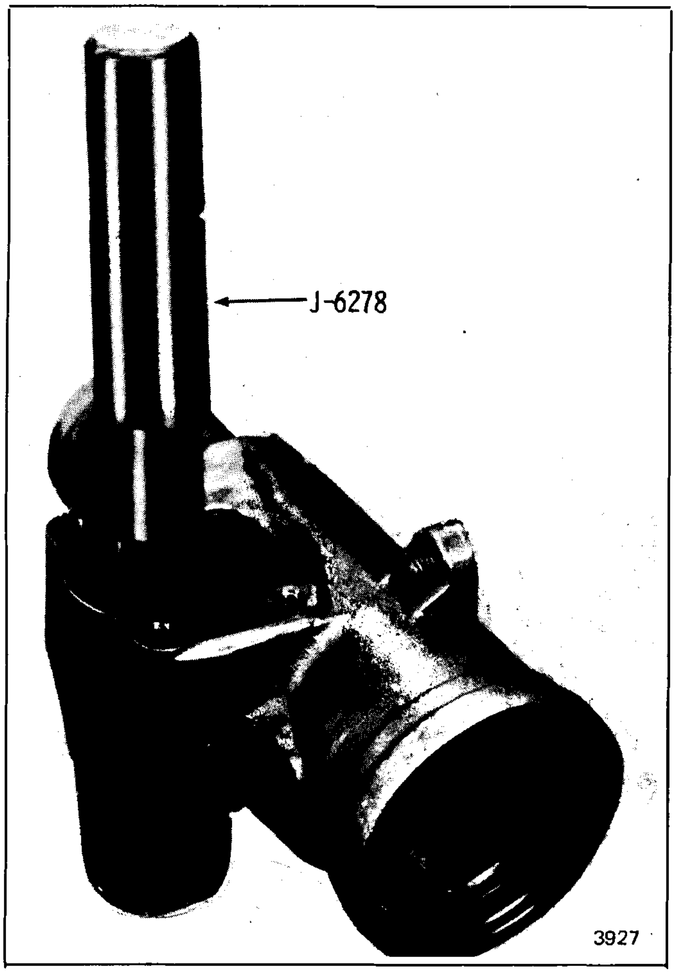


Fig. 3B3-32 Removing Bearing and Seals

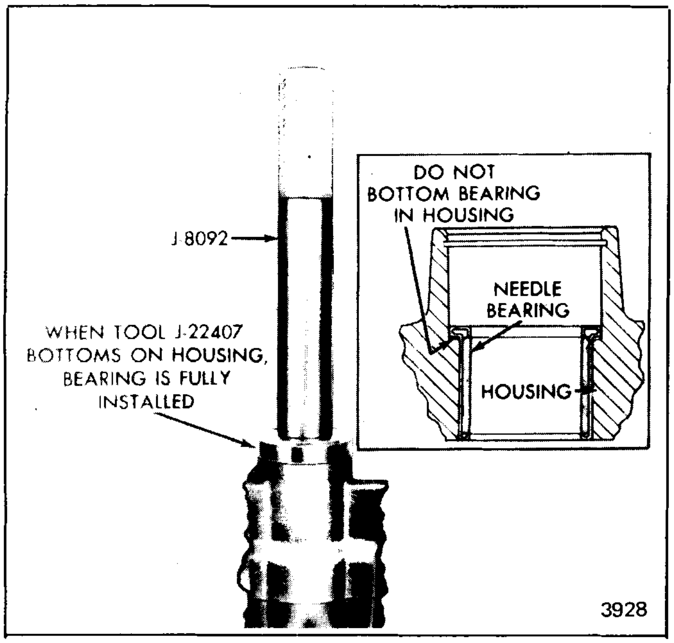


Fig. 3B3-33 Installing Needle Bearings

c. Remove the tool and adapter, then install the back-up washer and seal retaining ring. The retaining ring will not seat in the groove at this time.

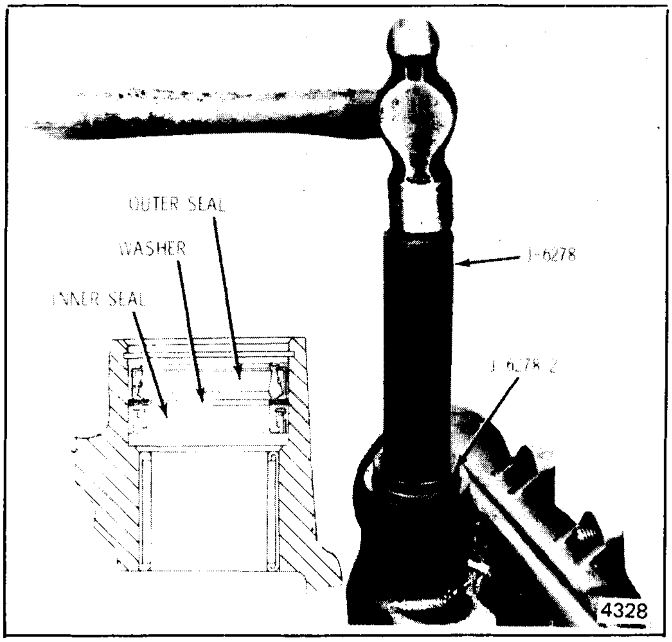


Fig. 3B3-34 Installing Seals (Gear Disassembled)

d. Reinsert Tool J-6278 with Adapter J-6278-2 and continue driving the seals until the retaining ring seats in its groove (Refer to Inset, Fig. 3B3-34) then remove the tool and adapter.

GEAR ASSEMBLY AND ADJUSTMENT

1. Lubricate the worm, lower thrust bearing and the two thrust washers with Power Steering Fluid, No. 1050017 or equivalent, then install one thrust washer, the bearing, and the other thrust washer over the end of the worm (Fig. 3B3-35).

2. Lubricate the valve body teflon rings and a new cap to body "O" ring with Power Steering Fluid, No. 1050017 or equivalent. Install the cap to body "O" ring in the valve body so it is seated against the lower shaft cap. Align the NARROW NOTCH in the valve body with pin in the worm, then install the valve and shaft assembly in the gear housing (Fig. 3B3-36). Apply pressure to the VALVE BODY when installing. If pressure is applied to the stub shaft during installation, the shaft may be forced out of the valve body (Fig. 3B3-37).

NOTE: The valve body is properly seated when the oil return hole in the housing is entirely uncovered (Fig. 3B3-38).

3. Lubricate a new adjuster plug "O" ring with Power Steering Fluid, No. 1050017 or equivalent, and install in groove in adjuster plug. Place Seal Protector J-6222 over stub shaft, then install the adjuster plug assembly in the housing unit until it seats against the valve body (Fig. 3B3-39). Remove Seal Protector.

4. Adjust the thrust bearing preload as follows:

a. Turn the adjuster plug in (clockwise) until the plug and thrust bearing are firmly bottomed - approximately 20 ft. lb. (Fig. 3B3-40).

b. Mark the housing even with one of the holes in the adjuster plug (Fig. 3B3-41).

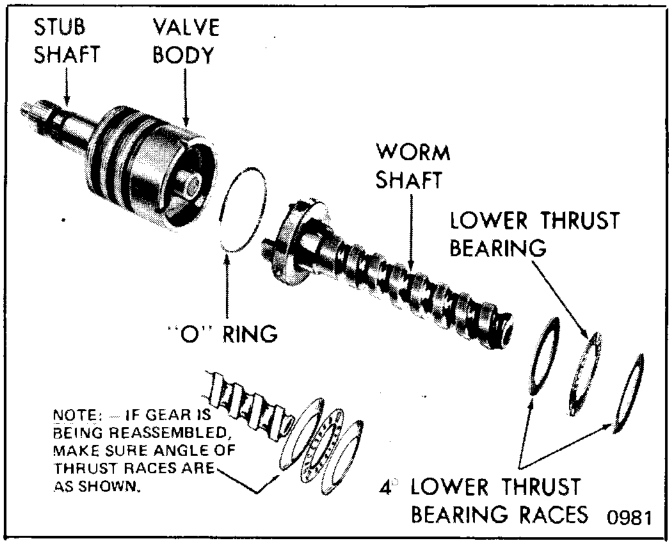


Fig. 3B3-35 Worm Shaft and Valve Body

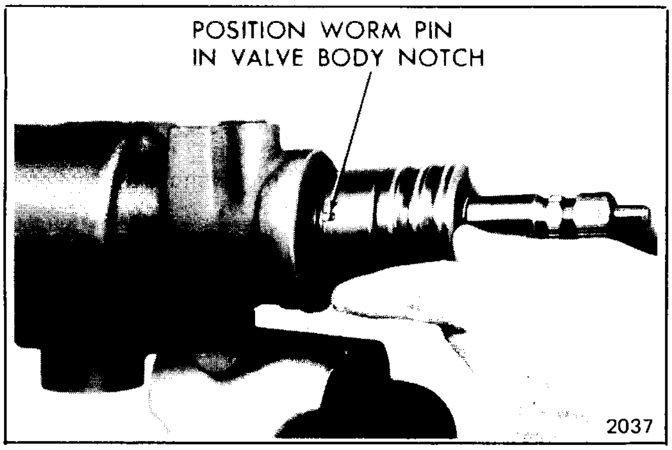


Fig. 3B3-36 Valve to Worm Alignment

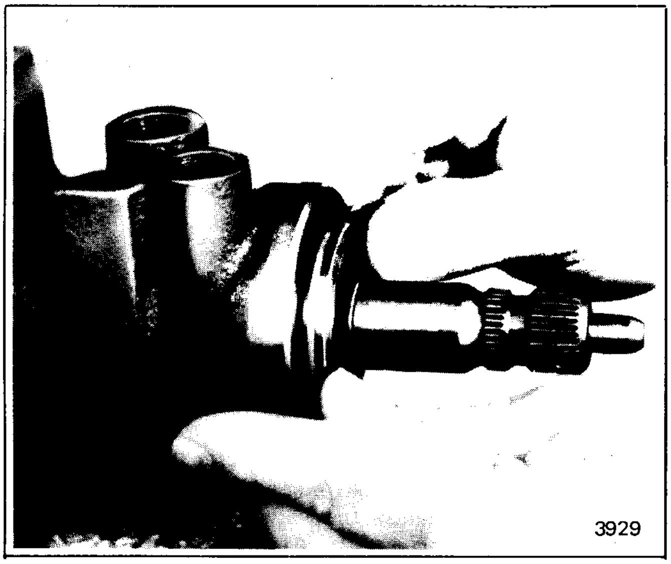


Fig. 3B3-37 Installing Valve Body

c. Measure back (counterclockwise direction) 1/2 inch and remark housing (Fig. 3B3-42).

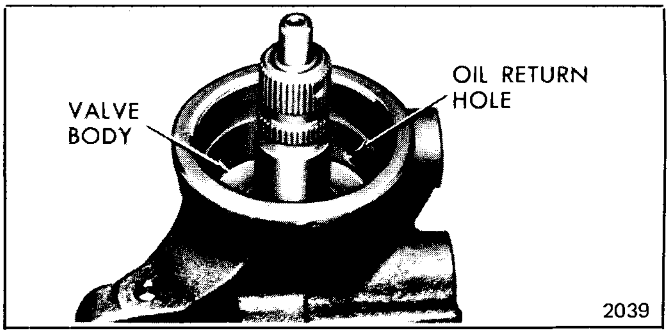


Fig. 3B3-38 Valve Body Properly Seated

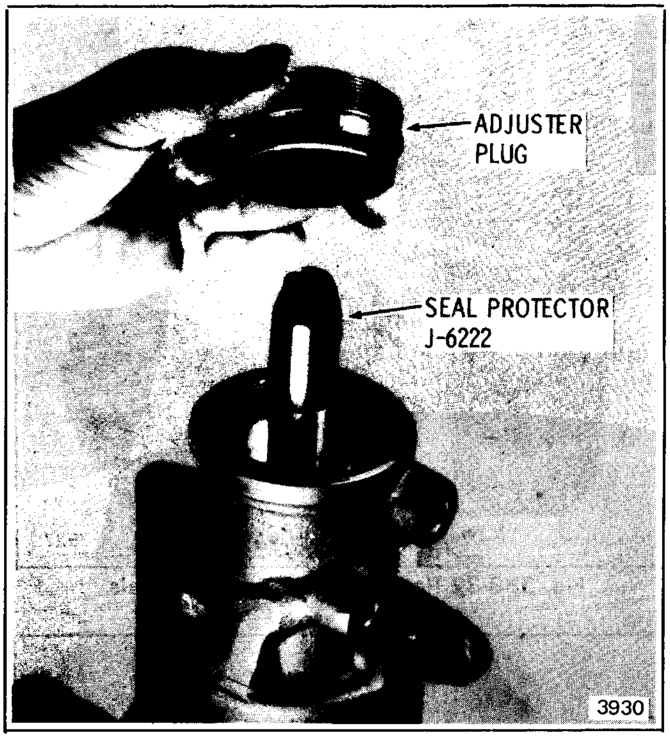


Fig. 3B3-39 Intalling Adjuster Plug

d. Rotate adjuster counterclockwise until hole in adjuster is in line with second mark (Fig. 3B3-43).

c. Tighten lock nut securely. Hold (or have held) adjuster plug to maintain alignment of hole with mark (Fig. 3B3-44).

f. Using an in. lb. torque wrench, turn the stub shaft and measure the torque. Reading should be 4-6 in. lbs. If torque is not within this range repeat "a" through "c" to obtain correct preload (Fig. 3B3-45).

5. Install the rack-piston as follows:

a. Lubricate the rack-piston teflon seal with Power Steering Fluid, No. 1050017 or equivalent.

b. Position Seal Compressor J-7576 or J-8947 against the shoulder in the housing.

c. With Ball Retainer J-21552 in place in the rack-piston, push the rack-piston (with teeth toward pitman shaft opening), into the housing until Tool J-21552 contacts the center of worm (Fig. 3B3-46).

d. Turn the stub shaft clockwise with a 3/4" twelve point socket or box end wrench to thread the rack-piston onto the worm while holding Tool J-21552 against the end of the worm.

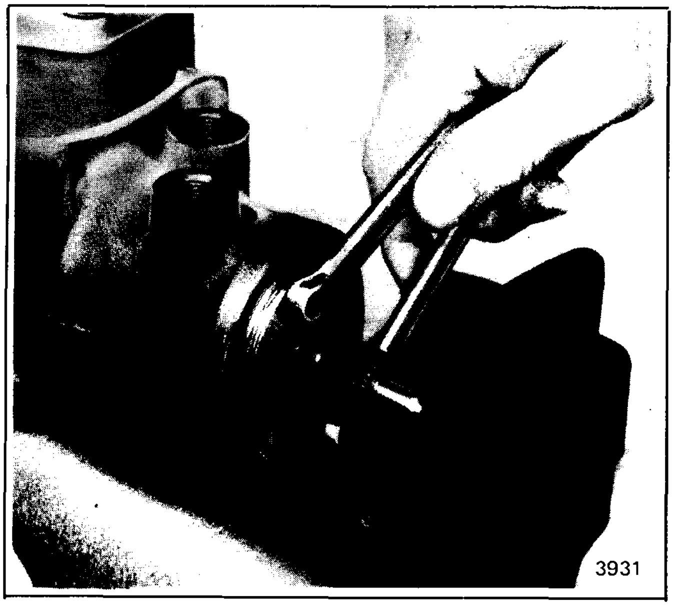


Fig. 3B3-40 Adjusting Thrust Bearing

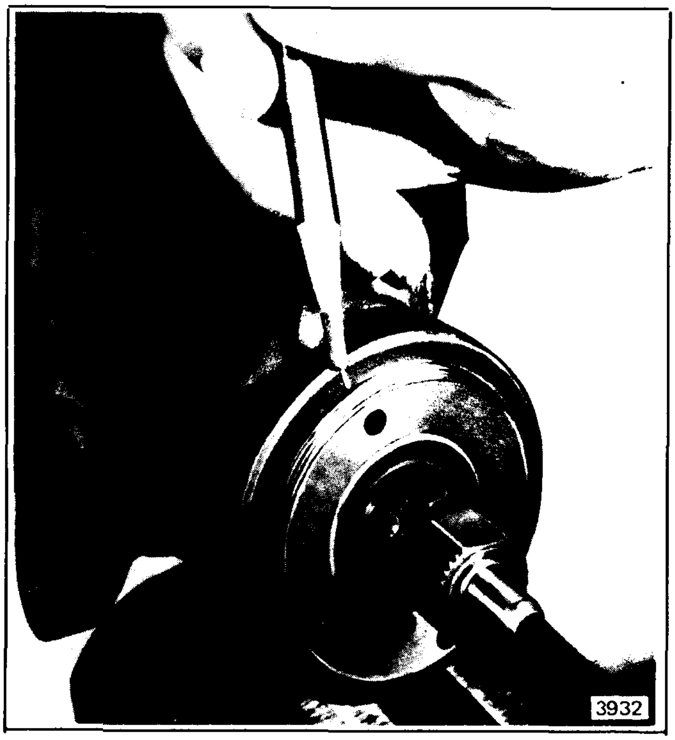


Fig. 3B3-41 Marking Gear Housing

Fig. 3B3-42 Measuring For Second Mark

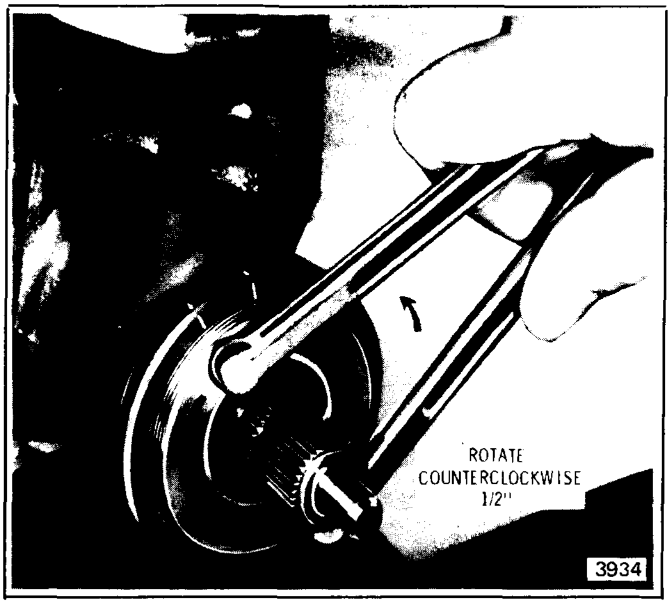


Fig. 3B3-43 Rotating Adjuster (CCW)

e. When the rack-piston is completely threaded on the worm, remove Ball Retainer J 21552 and Seal Compressor J-7576 or J-8947.

6. Install the pitman shaft and side cover as follows:

a. Install a new gasket seal in the side cover. Power steering gears are equipped with a side cover gasket seal. This seal is a metal gasket with a molded rubber section, which fits into the "O" ring groove in the side cover. When the gasket seal is correctly seated in the side cover "O" ring groove, the gasket cannot be rotated. If the wrong gasket face is against the side cover, the gasket will rotate freely. Two metal tabs are provided and are to be bent around the edges of the side cover. This secures the gasket in the proper position for handling and assembly.

b. Turn the stub shaft until the rack-piston teeth are centered in the pitman shaft opening, then install the pitman shaft and side cover so that the center tooth of the pitman shaft engages the center groove of the rack piston.

c. Back the over-center adjusting screw all the way out, and then turn it in 1/2 turn. Install side cover bolts and torque to 35 ft. lbs.

7. Install the rack piston plug in the rack piston and torque to 75 ft. lbs.

8. Install a new housing end cover "O" ring and lubricate it with Power Steering Fluid, No. 1050017 or equivalent. Install the end cover and retaining ring.

9. Adjust the over-center preload as follows:

a. Turn the stub shaft from stop to stop, counting the total number of turns. Divide this number by 2. Starting at either stop, turn the stub shaft 1/2 the total number of turns. This is the "center" of the gear. The flat on the stub shaft is normally up and parallel with the side cover when the gear

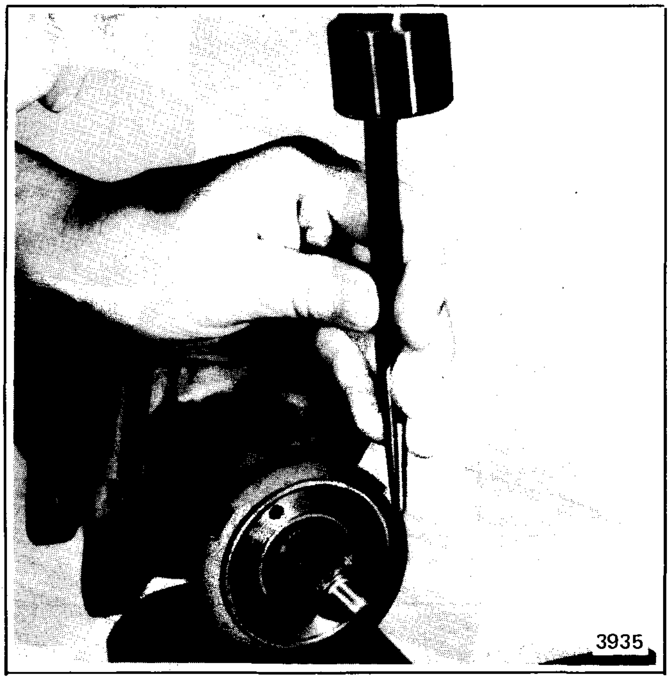


Fig. 3B3-44 Tightening Lock Nut

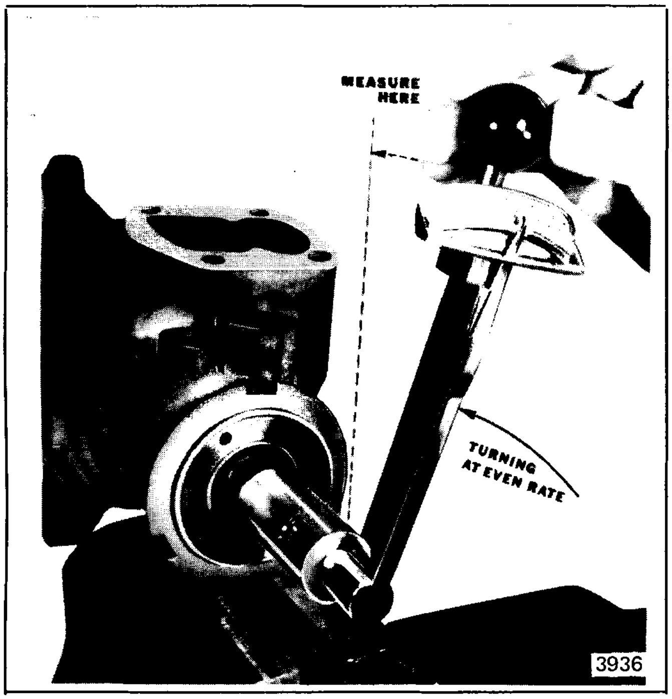


Fig. 3B3-45 Checking Preload

is "on center" (Fig. 3B3-47), and the block tooth on the pitman shaft is in line with the over-center preload adjuster (Fig. 3B3-48).

b. Rotate the torque wrench approximately 45 degrees each side of center, and "read" near or on center (highest reading). Be sure over center adjustment has been backed out. (Fib. 3B3-49) Loosen the lock nut and turn the preload adjusting screw clockwise until the correct over-center torque in excess of the reading just taken is obtained.

Limits for "new" and "used" gears are different, as follows:

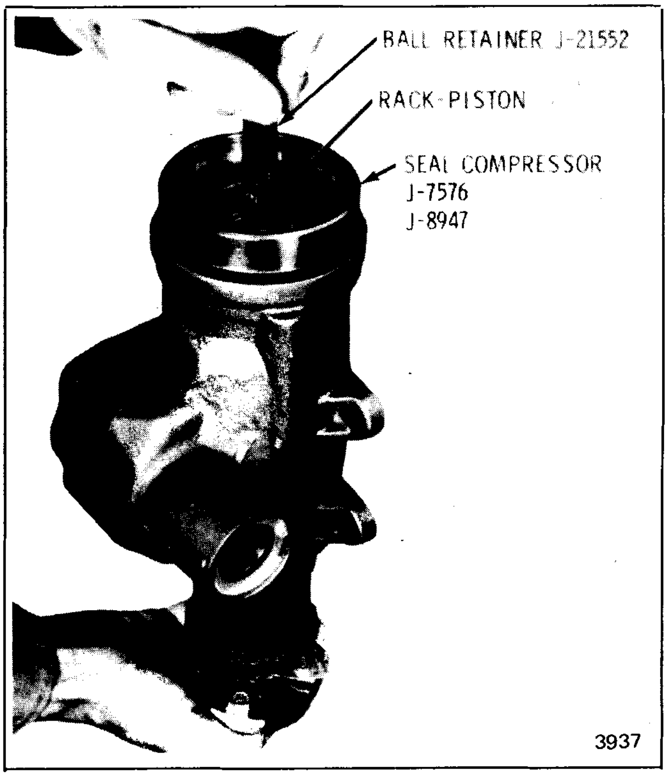


Fig. 3B3-46 Installing Rack Piston

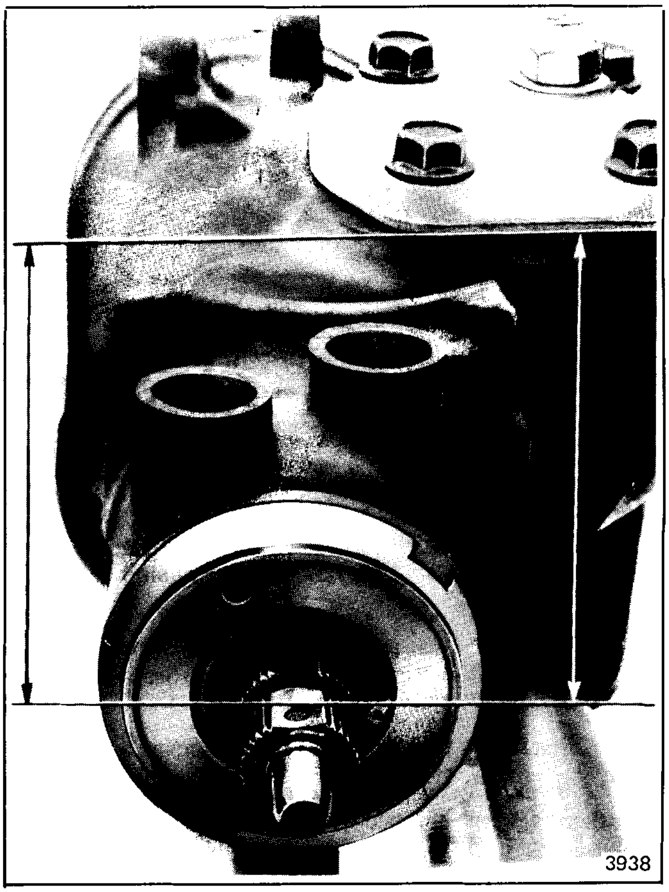


Fig. 3B3-47 Centering Stub Shaft

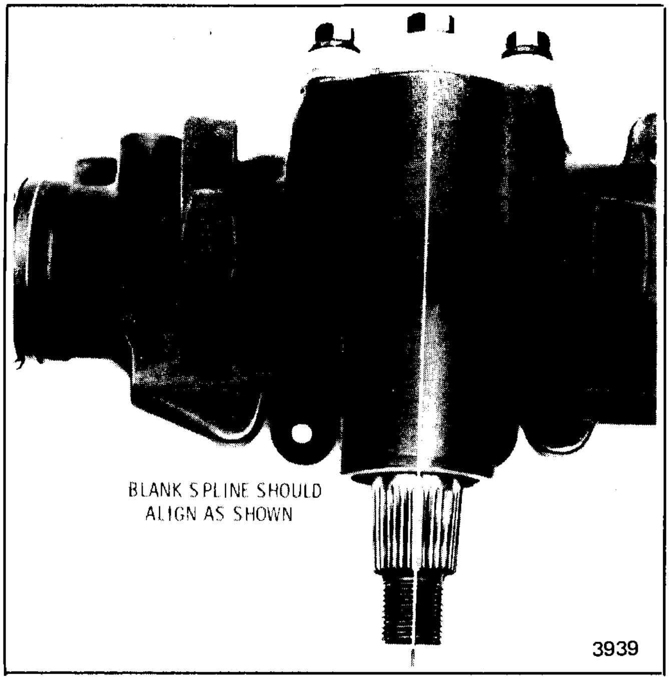


Fig. 3B3-48 Pitman Shaft Alignment

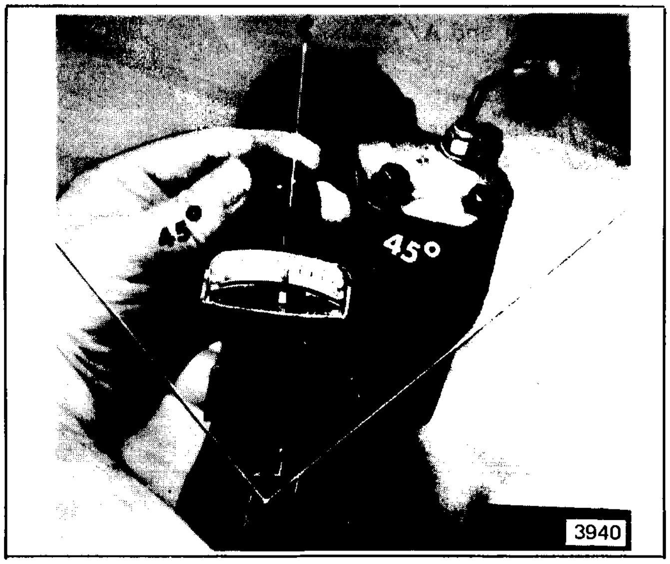


Fig. 3B3-49 Adjusting Over-Center Preload

"New" gear over-center torque to be 4-8 in. lbs. additional torque, but total over-center torque must not exceed 18 in. lbs.

"Used" gear (400 or more miles). Over-center torque to be 4 to 5 in. lbs. additional torque, but total over-center must not exceed 14 in. lbs.

Tighten the lock nut to 35 ft. lbs. while holding the preload adjust screw. Recheck the over-center adjustment.

POWER STEERING GEAR BALL PLUG

LEAK REPAIR

Leaks at the ball plug on power steering gears can be corrected by using the procedures listed below:

1. Refer to Steering Gear Removal.
2. Drain some oil from gear by rotating stub shaft from stop to stop once. It is not necessary to completely drain gear.
3. Clean ball plug area, then spray area with Loctite Solvent or equivalent.
4. Seat ball in housing using blunt-nosed punch, brass drift pin or similar tool as shown in Fig. 3B3-50.

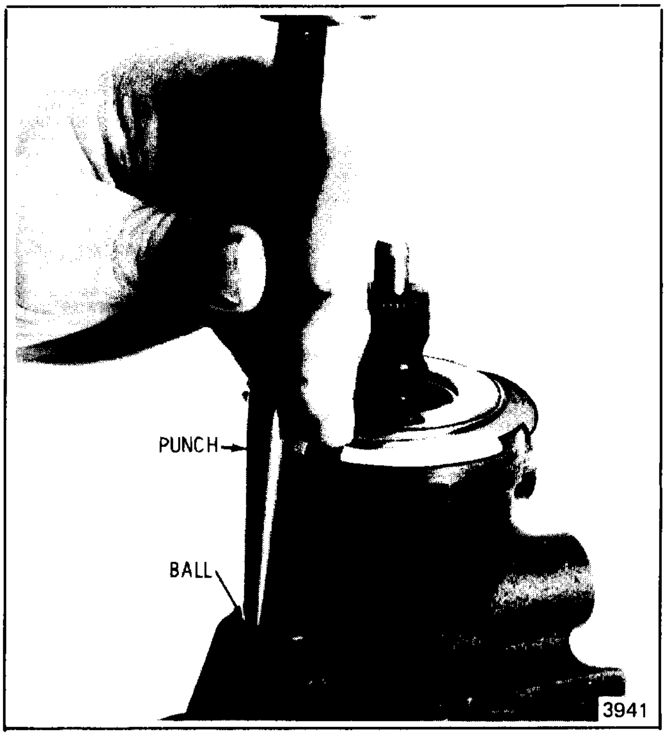


Fig. 3B3-50 Seat Ball in Housing

5. Air dry using compressed air (10-15 seconds). Ball area should appear frosty when dry.
6. Apply 3 or 4 drops of Loctite adhesive or equivalent over ball as shown in Fig. 3B3-51.
7. Let assembly sit undisturbed for approximately two hours in upright position before installing in car.
8. Refer to Steering Gear Installation.

PUMP BELT

ADJUSTMENT

When adjusting power steering pump belt, under no circumstances should the pump reservoir be used to pry against. The mounting bracket has either an ear made to pry against directly behind the pulley or a square hole into which a ratchet is installed (Fig. 3B3-52).

Checking

Position belt tension gage on pump belt as shown in Fig. 3B3-53. If the pointer of gauge does not index with correct mark, corresponding with the type of belt to be adjusted, the belt should be adjusted as follows:

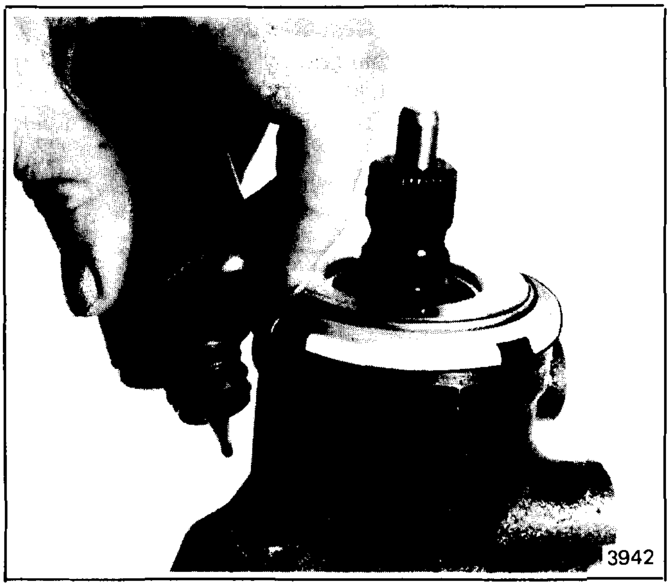


Fig. 3B3-51 Apply Adhesive Over Ball

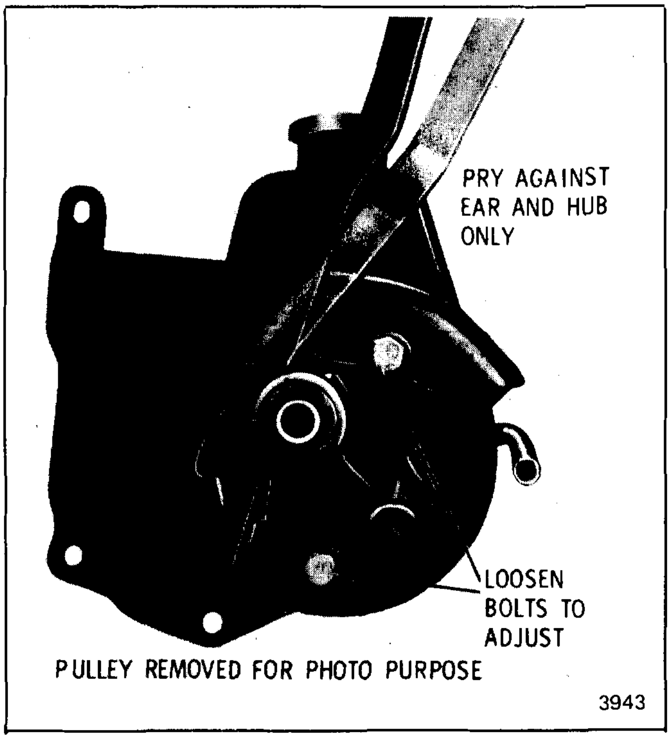


Fig. 3B3-52 Pry Points for Adjusting Belts (Typical)

Adjustment-All Single Groove Pulleys

With gage positioned on pump belt, loosen the pump attaching bolts and adjust the belt tension by moving the pump away from the engine.

Adjustment-Two Groove Pulleys

With gage positioned on pump belt, loosen generator attaching bolts and remove all tension on generator belt. Loosen pump attaching bolts and adjust the pump belt tension by moving the pump away from the engine. Remove gage from pump belt and position gage on generator belt and adjust to specified tension.

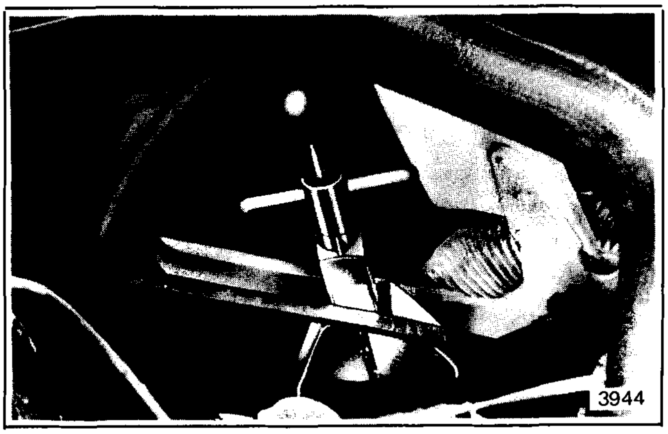


Fig. 3B3-53 Belt Tension

REPLACEMENT

Removal

1. Loosen high pressure hose fitting at pump slightly.
2. With A/C - Loosen generator attaching bolts.
3. Loosen power steering pump attaching bolts.
4. Remove power steering belt.

NOTE: Some models will also require removal of generator and A/C belts.

Installation

1. Install power steering belt.
2. Adjust belt. Refer to Pump Belt Adjustment.
3. Position high pressure hose pipe against pump brace, then tighten hose fitting securely.
4. Check pump fluid level, add fluid as necessary.

FLOW CONTROL VALVE

Removal Without Removing Pump Assembly From Car

1. Disconnect high pressure hose from pump union and drain oil.
2. Remove union and withdraw flow control valve and spring with a magnet.

Inspection

1. Flow control valve must slide freely in housing bore. If sticking occurs, check for dirt or burrs.
2. Check cap screw in the end of valve for looseness; if loose, tighten, being careful not to damage machined surfaces.
3. If the flow control plunger is suspected of being faulty, install new valve. This is serviced as a unit and is factory calibrated.

Installation

PUMP PULLEY

Removal

CAUTION: *When removing pulley from shaft, use care to prevent nicks on pump shaft ley hub. Do not hammer on pulley as this will damage pulley or pump.*

1. Loosen pump mounting bolts, reposition pump and disconnect pump belt from pulley.

2. Install J 25034 Pulley Remover on pulley as shown in Fig. 3B3-54.

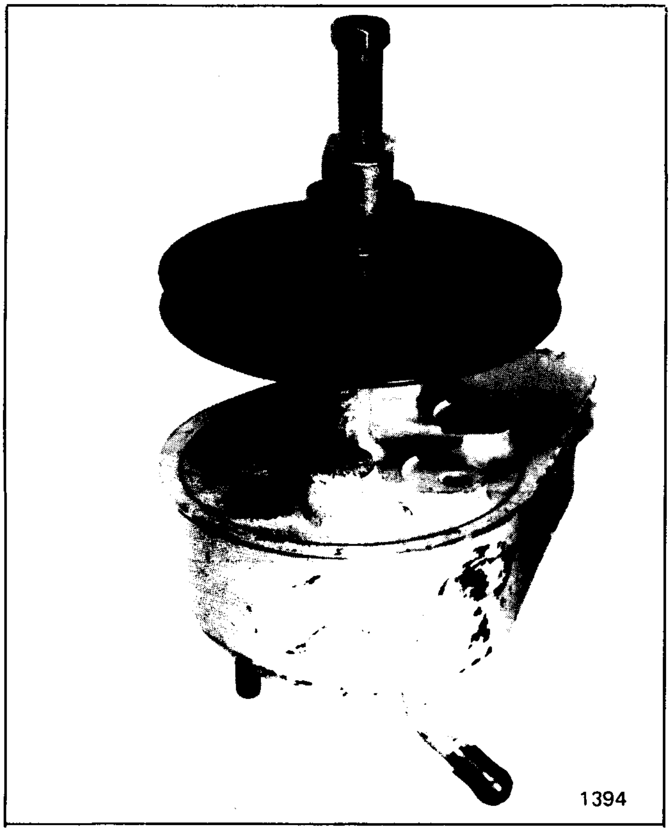


Fig. 3B3-54 Installing Pulley Remover

3. Remove pulley by turning forcing screw to J 25034 clockwise while holding jaw as shown in Fig. 3B3-54A.

Installation

CAUTION: *When installing pulley on shaft, use care to prevent nicks on pump shaft or pulley hub. Do not hammer on pulley as this will damage pulley or pump.*

1. Place pulley on end of pump shaft and install J 25033 Pulley Installer as shown in Fig. 3B3-55.

2. Install pulley by holding nut bearing assembly and turning screw clockwise as shown in Fig. 3B3-55A.

3. Install belt on pulley and adjust belt tension.

PUMP SHAFT OIL SEAL

REPLACEMENT

(WITHOUT DISASSEMBLING PUMP)

The pump shaft oil seal can be replaced without disassembling the pump as follows:

1. Remove the pump pulley as described in this section. Bend a piece of .005" shim stock (approximately 2-1/2" long) into a cylindrical shape and push the shim stock past seal until it bottoms in pump body (Fig. 3B3-56).

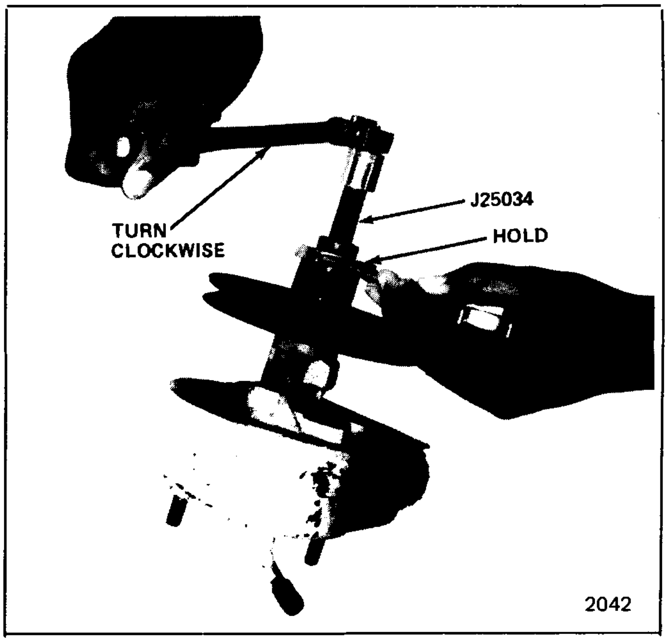


Fig. 3B3-54A Removing Pulley

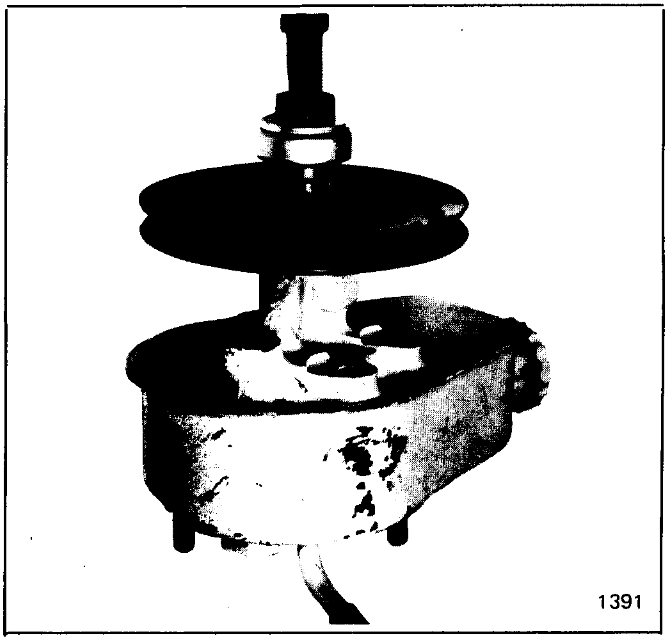


Fig. 3B3-55 Installing Pulley Installer

NOTE: The use of shim stock around the pump shaft will prevent damage to the machined surfaces of the shaft when removing seal.

2. Cut metal body of seal with a small chisel as shown in Fig. 3B3-56.

3. Tear metal body approximately 1" with diagonals. Force an awl between the pump body (Fig. 3B3-57). Remove shim stock.

4. Apply special seal lubricant No. 1050169 or equivalent to the sealing lip of a new seal, then install seal over pump shaft with metal side of seal outboard.

5. Slide Tool J-7132-2 over pump shaft, then drive seal into pump body (Fig. 3B3-58).

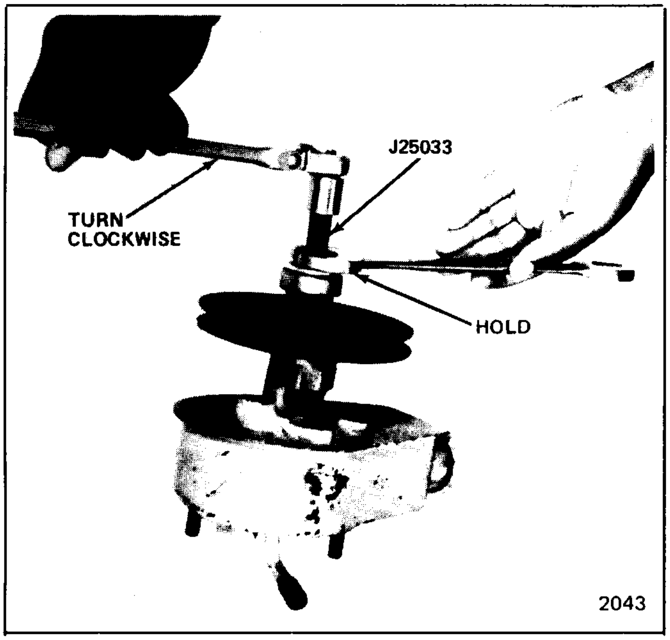


Fig. 3B3-55A Installing Pulley

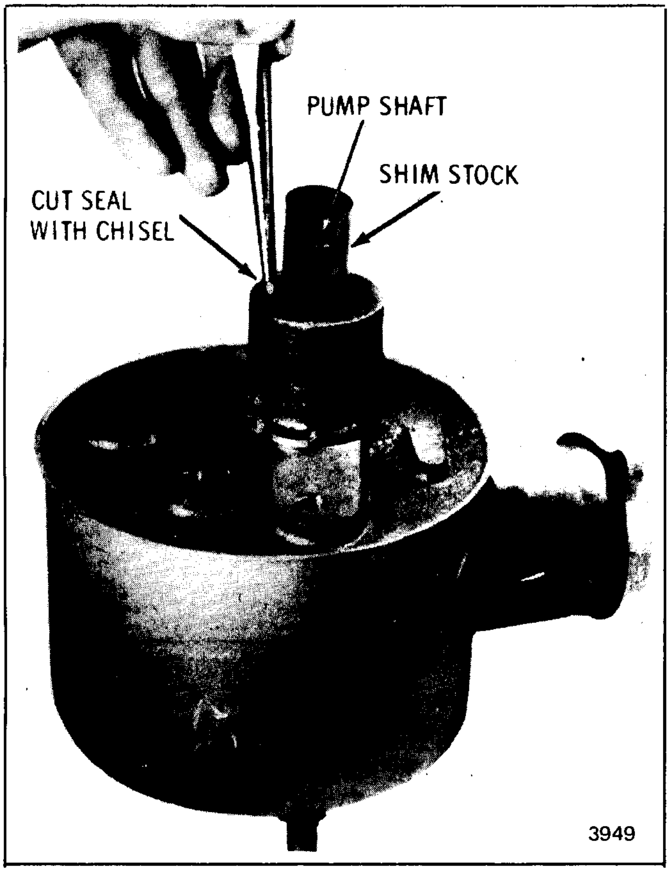


Fig. 3B3-56 Cutting Seal

6. Install pump pulley.

POWER STEERING PUMP

Removal

The power steering pump (Fig. 3B3-59) is attached as shown in Figs. 3B3-60 thru 3B3-62.

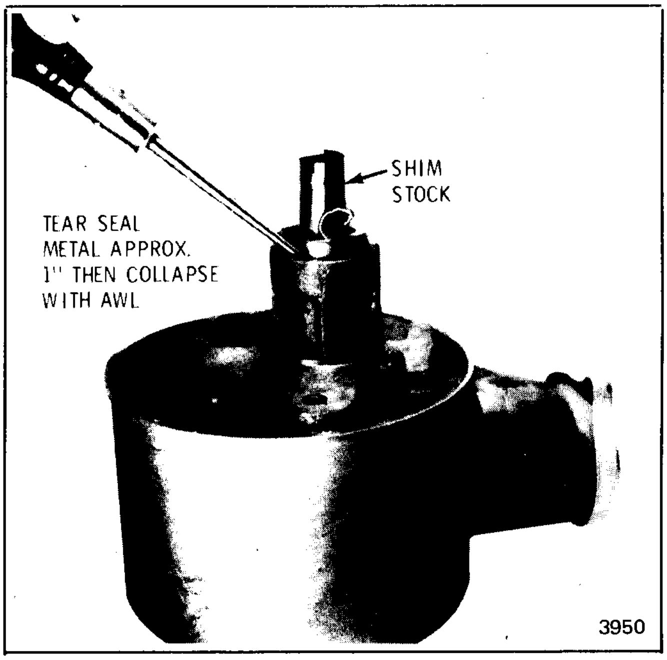


Fig. 3B3-57 Removing Pump Seal

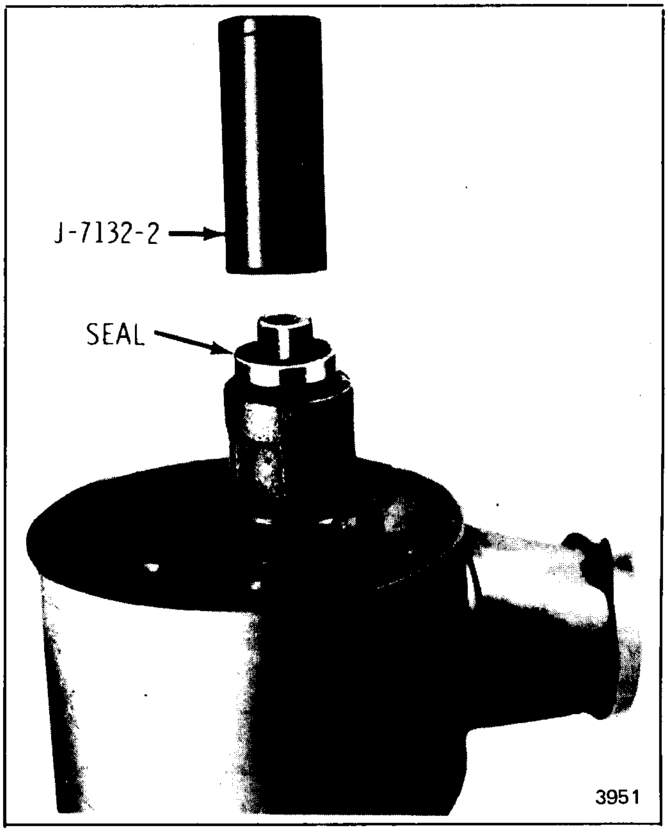


Fig. 3B3-58 Installing Pump Seal

1. Disconnect negative battery cable.

2. Remove power steering pump belt. (If equipped with A/C, loosen generator and remove belt from pulley.)

3. Remove pump pulley.

4. Disconnect both hoses at steering pump and cap hoses to prevent entry of foreign material.

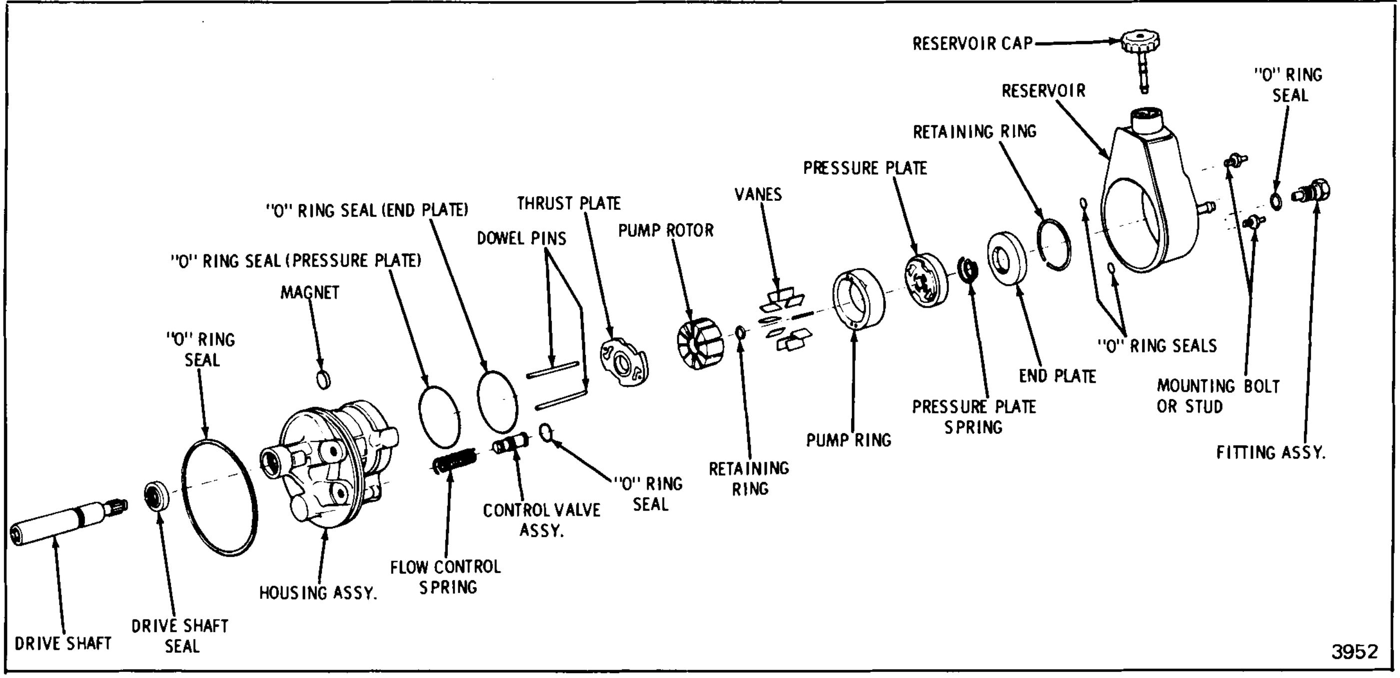


Fig. 3B3-59 Power Steering Pump (Exploded)

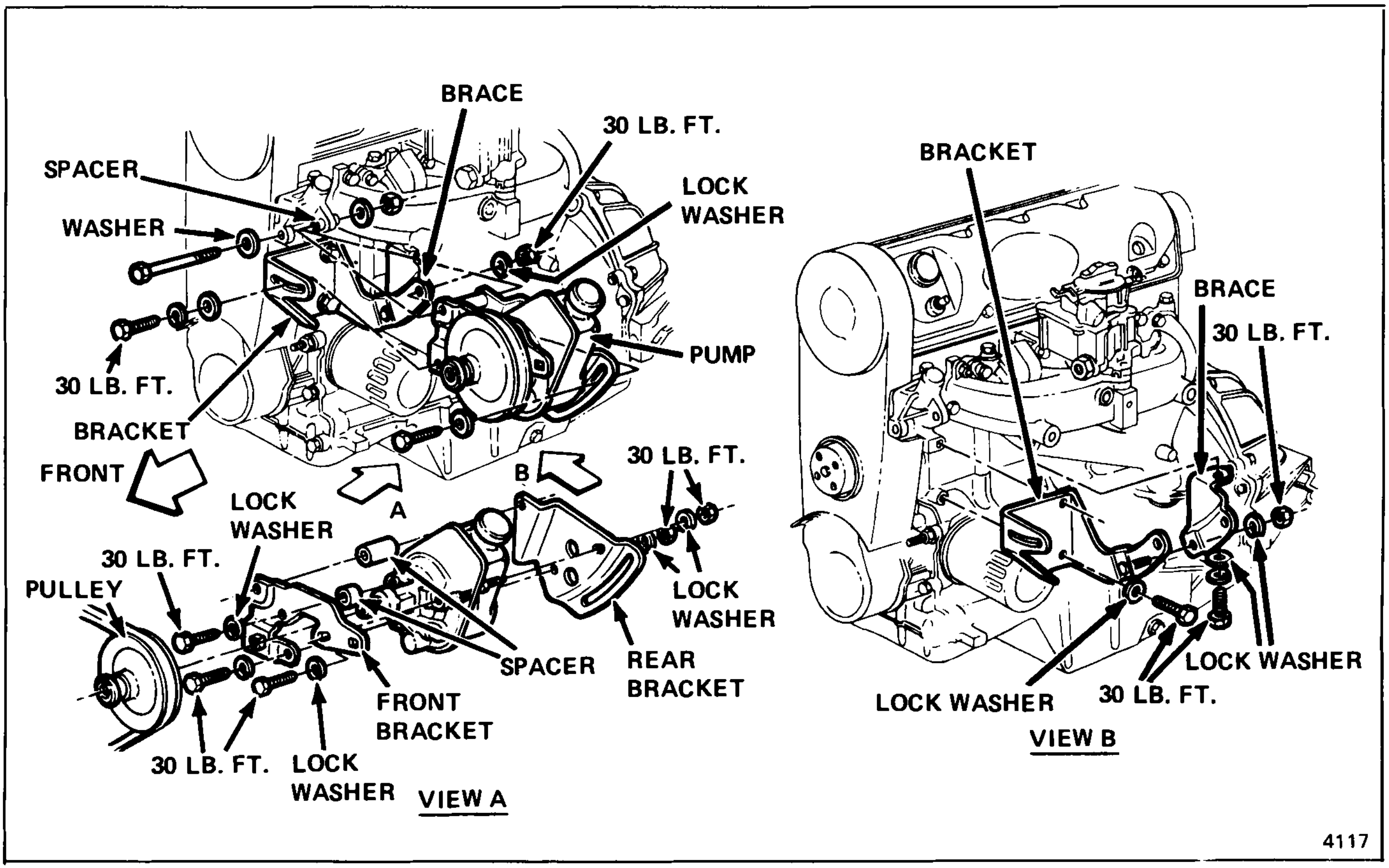


Fig. 3B3-60 Power Steering Pump Mounting - 140 Engine

5. Remove pump assembly from engine with link attached.

6. Remove hoses and link from pump.

Installation

1. Position pump assembly on mounting bracket with holes lined up and install bolts loosely.

2. Install pump pulley on pump shaft.

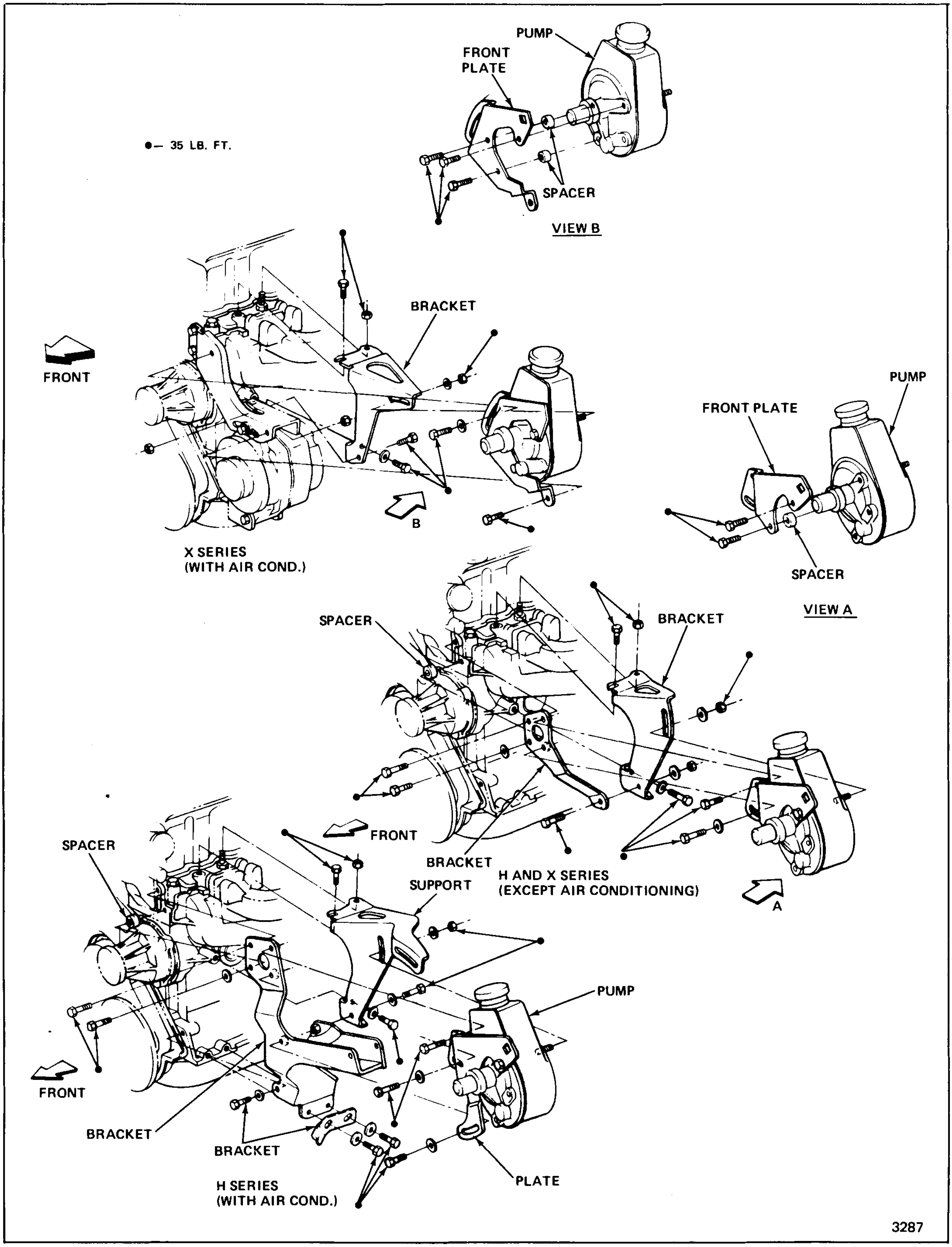


Fig. 3B3-61 Power Steering Pump Mounting - 151 Engine

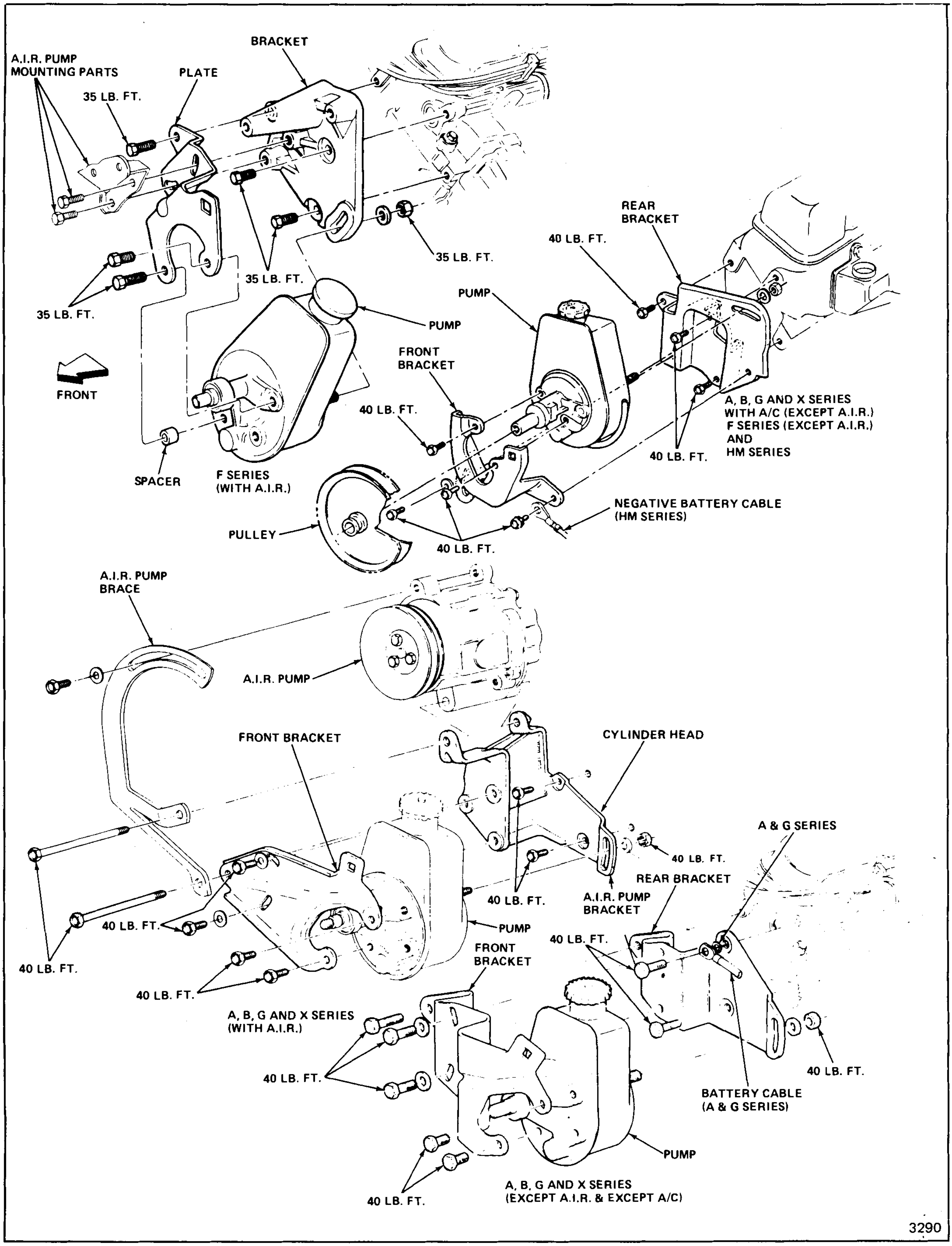


Fig. 3B3-62 Power Steering Pump Mounting - 231 Engine

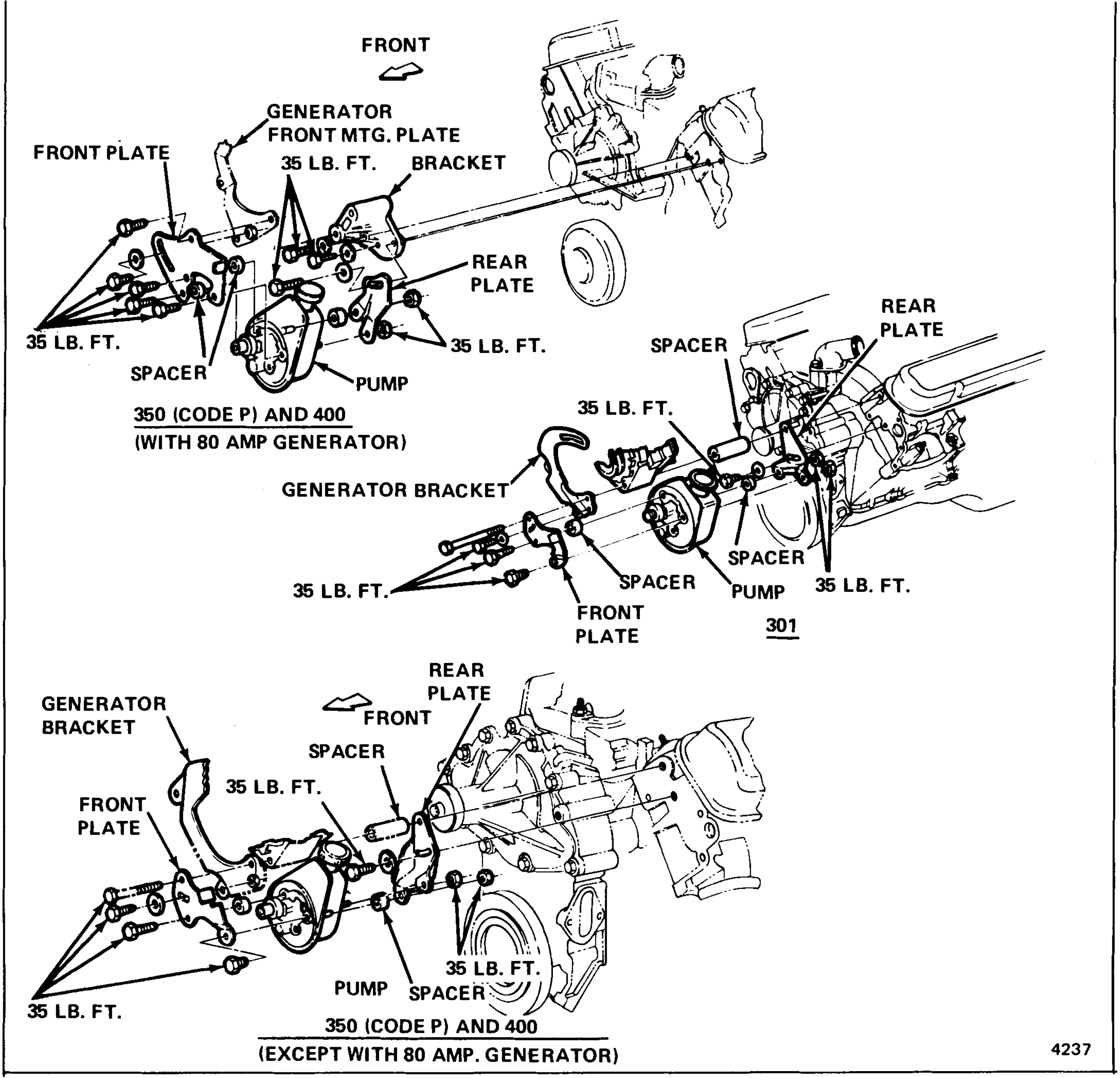


Fig. 3B3-63A Power Steering Pump Mounting - 301, 350 (Engine Code P) and 400 Engines

3. Connect and torque hose fittings to 35 ft. lbs. Refer to Figures 3B3-64A thru 3B3-64E for hose routing details.

4. Fill reservoir with fluid No. 1050017 or equivalent. Bleed pump by turning pulley backward (counterclockwise as viewed from front) until air bubbles cease to appear.

5. Install pump belt over pulley.

6. Move pump until belt is tight, then torque mounting screws. Do not pry on reservoir or pull on filler neck.

7. Adjust belts. Refer to Pump Belt Adjustment.

8. Bleed system. Refer to Bleeding Power Steering System.

Cleaning and Inspection

Carefully clean all pump parts in cleaning solvent. Replace any damaged or worn parts.

1. Inspect flow control valve assembly for score marks, wear, burrs or other damage.

2. Inspect castings for cracks or other visual evidence of damage. Check machined surfaces, especially mating surfaces on "O" ring seats, for scratches or burrs that might permit leaks. Examine the V-shaped notches at edges of discharge ports on pressure plate. These notches must be clean and undamaged if pump noise is to be avoided, as they cushion the hydraulic shock when each vane passes the port.

3. Inspect pump ring end surfaces for score marks.

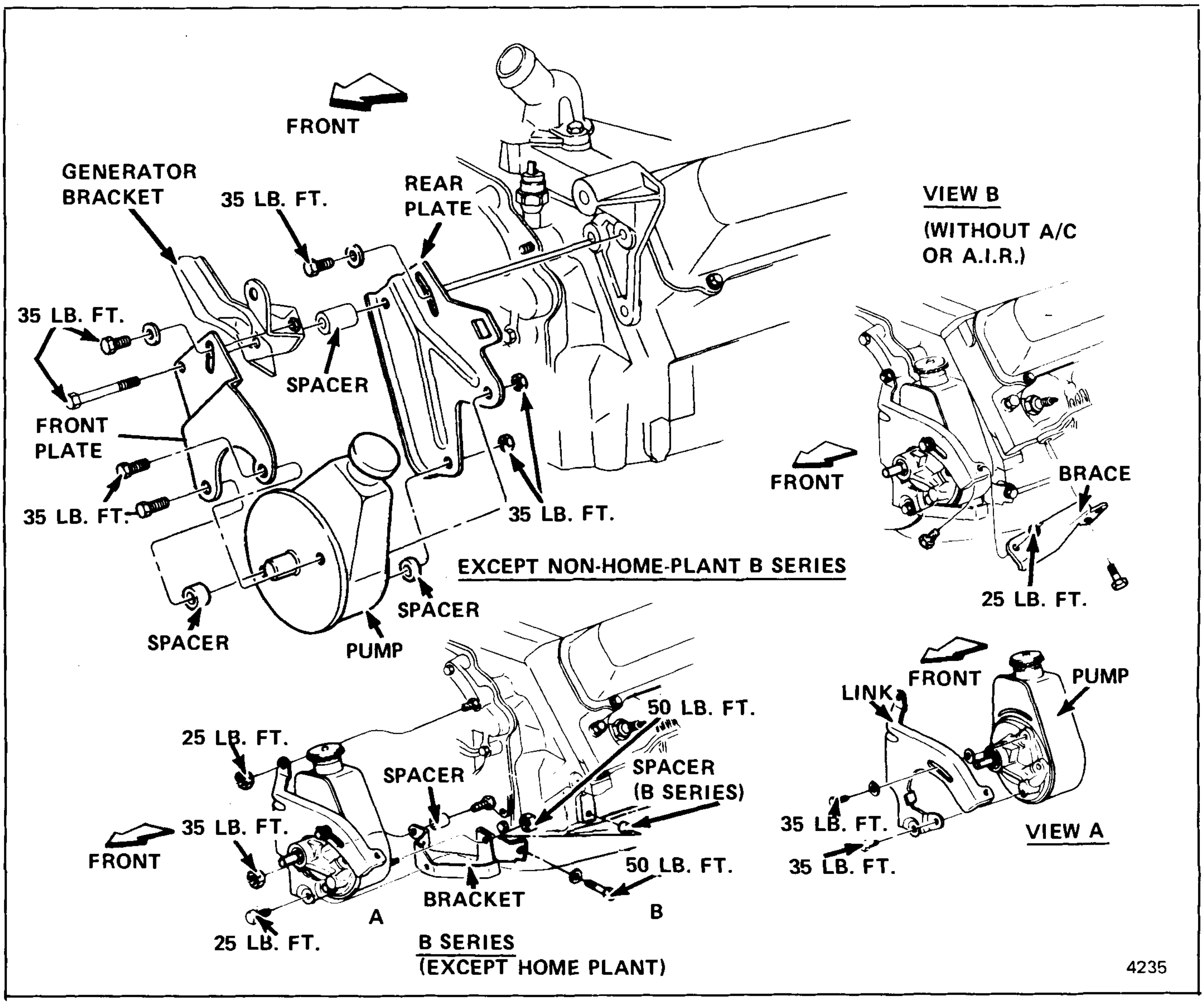


Fig. 3B3-63B Power Steering Pump Mounting - 350 (Engine Code R) and 403 Engines

NOTE: Pump ring is treated which leaves a dull gray-black finish on wear surface. Wavy grain appearance inside pump ring is normal.

4. Inspect pump shaft for score marks, excessive wear, or damage - particularly at splines, and at bearing and seal surfaces. Separate and inspect rotor and vanes for wear and general condition.

5. Inspect shaft bushing in pump housing, and replace pump housing if bushing is scored or excessively worn.

6. If any internal parts are found to be worn or damaged, flush steering gear or disassemble gear and clean internal parts.

Disassembly

Refer to Figures 3B3-65 thru 3B3-69 for pump disassembly and assembly.

BLEEDING POWER STEERING SYSTEM

Fluid Level

1. Run engine until power steering fluid reaches normal operating temperature, (approximately 170 degrees F.) then shut engine off. Remove reservoir filler cap and check oil level on dipstick.

2. If oil level is low, add fluid No. 1050017 or equivalent to proper level on dipstick and replace filler cap.

NOTE: When adding or making a complete fluid change, always use fluid No. 1050017 or equivalent.

3. When checking fluid level after the steering system has been serviced, air must be bled from the system. Proceed as follows:

a. With Wheels turned all the way to the left, add power steering fluid to "Cold" mark on dipstick.

b. Start engine, and running at fast idle, recheck fluid level. Add fluid if necessary to "Cold" mark on dipstick.

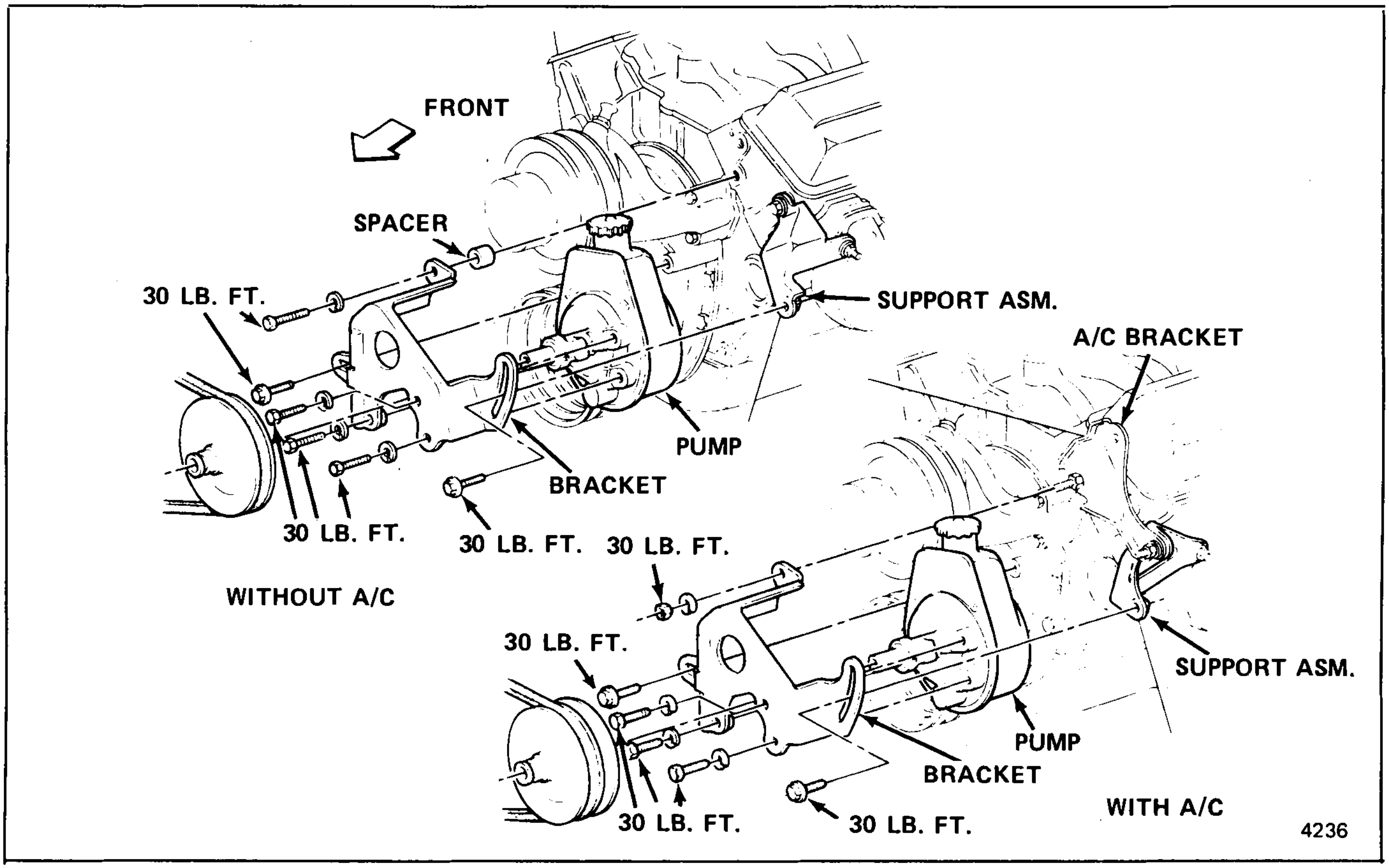


Fig. 3B3-63C Power Steering Pump Mounting - 305 and 350 (Engine Code L) Engines

c. Bleed system by turning wheels from side to side without hitting stops. Maintain fluid level just above internal pump casting. Fluid with air in it will have a light tan or red appearance. This air must be eliminated from fluid before normal steering action can be obtained.

d. Return wheels to center position and continue to run engine for two or three minutes, then shut engine off.

e. Road test car to make sure steering functions normally and is free from noise.

f. Recheck fluid level as described in steps 1 and 2, making sure fluid level is at "hot" mark on dipstick after the system has stabilized at its normal operating temperature.

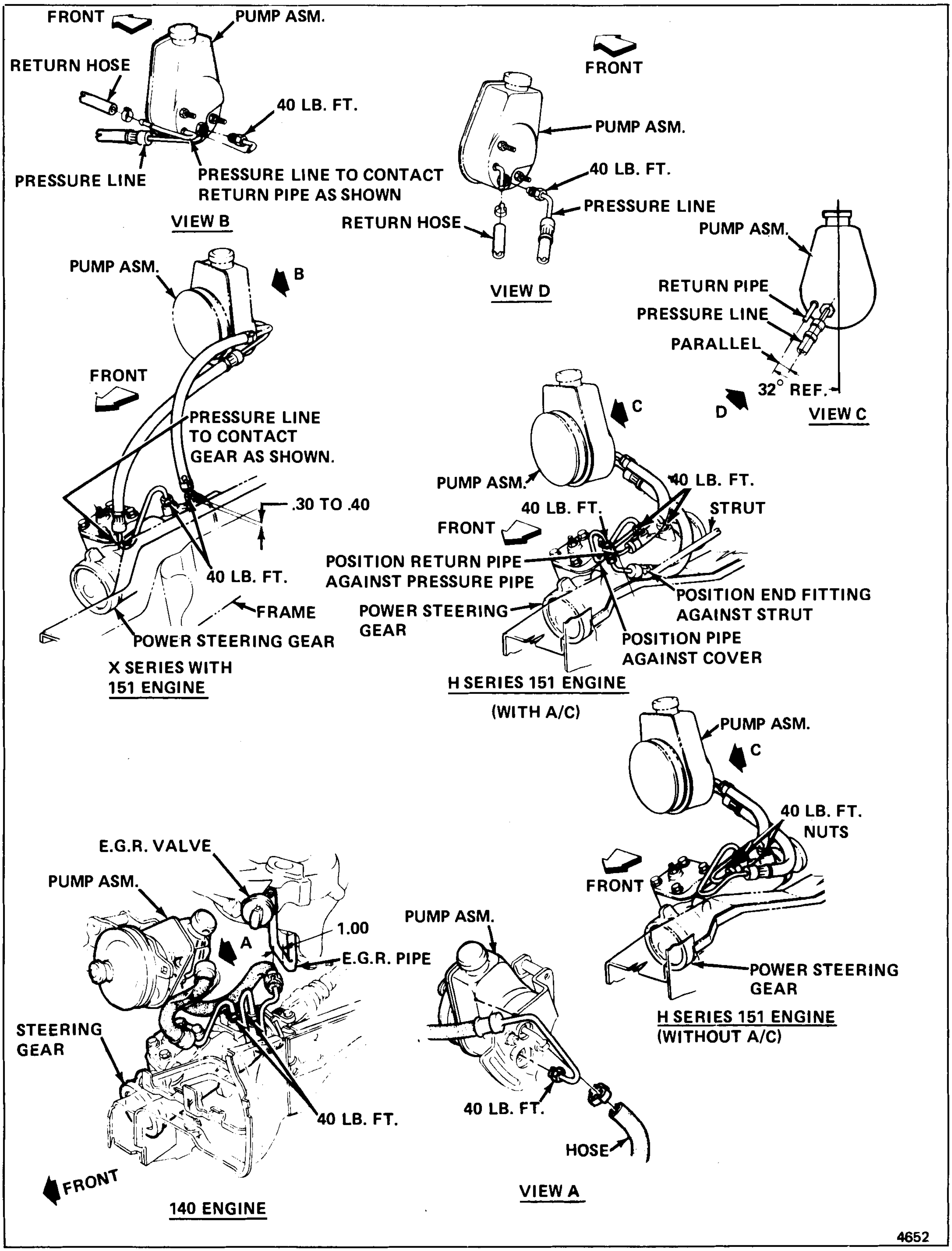
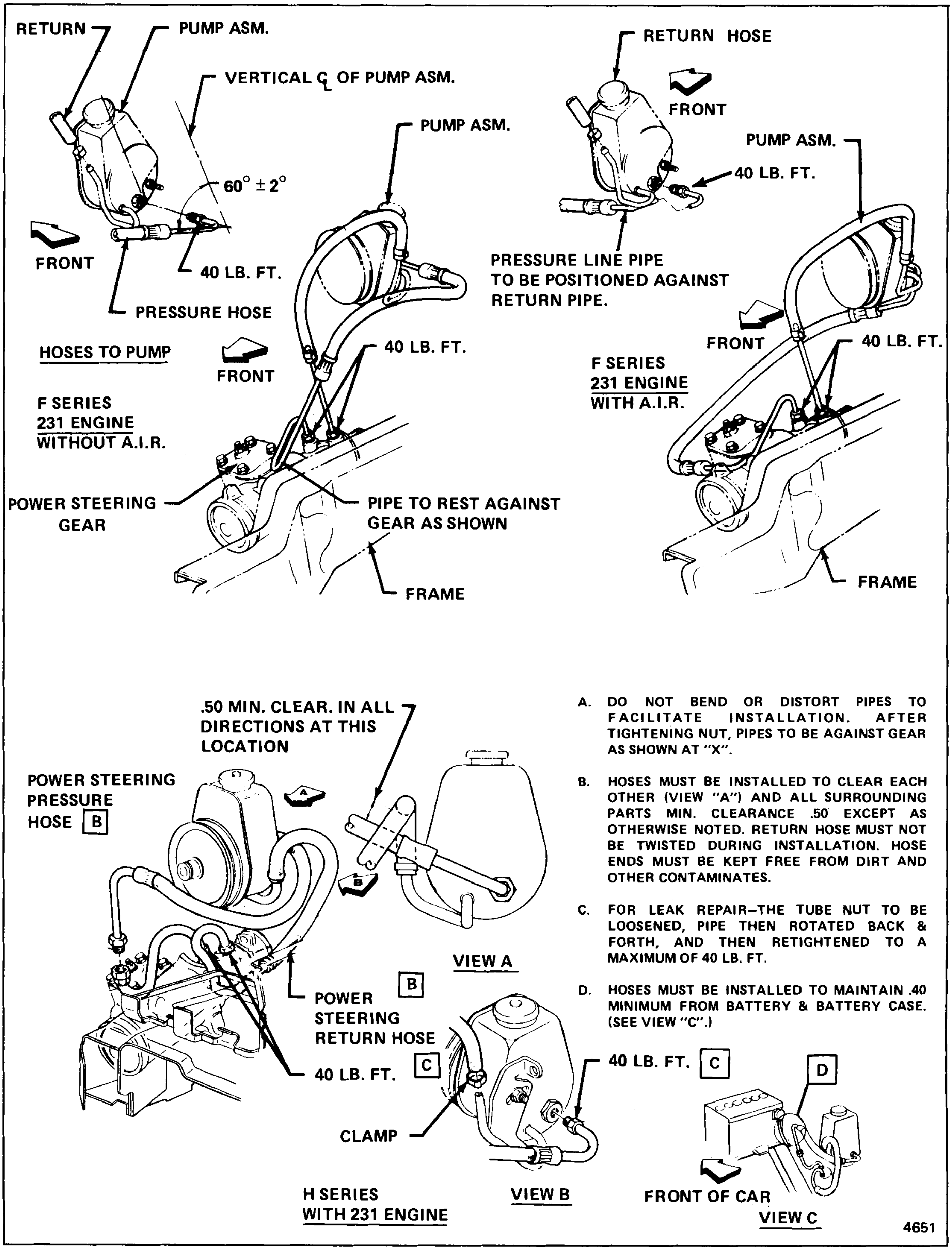


Fig. 3B3-64A Hose Routing (4 Cyl. Engine)



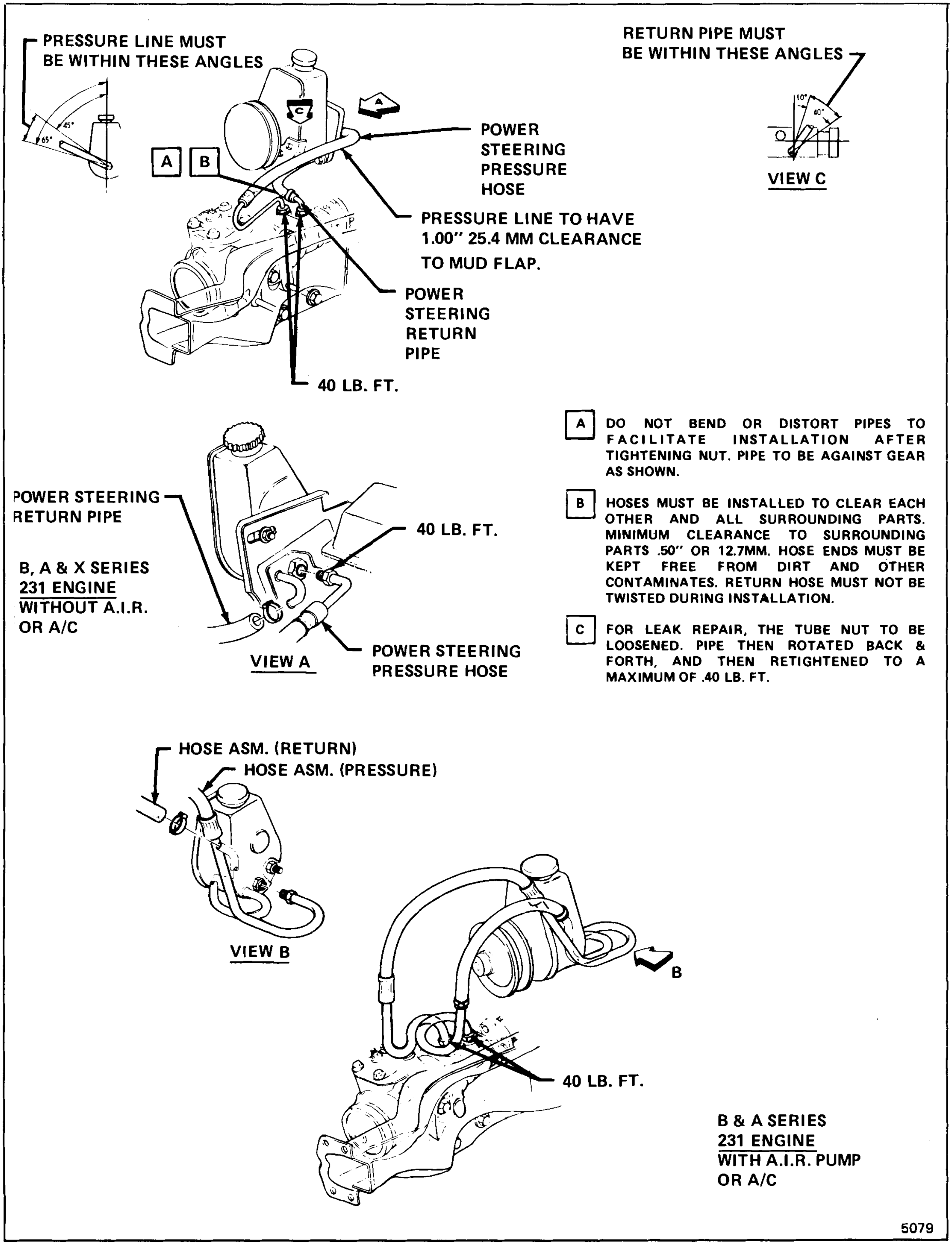
A. DO NOT BEND OR DISTORT PIPES TO FACILITATE INSTALLATION. AFTER TIGHTENING NUT, PIPES TO BE AGAINST GEAR AS SHOWN AT "X".

B. HOSES MUST BE INSTALLED TO CLEAR EACH OTHER (VIEW "A") AND ALL SURROUNDING PARTS MIN. CLEARANCE .50 EXCEPT AS OTHERWISE NOTED. RETURN HOSE MUST NOT BE TWISTED DURING INSTALLATION. HOSE ENDS MUST BE KEPT FREE FROM DIRT AND OTHER CONTAMINATES.

C. FOR LEAK REPAIR–THE TUBE NUT TO BE LOOSENED, PIPE THEN ROTATED BACK & FORTH, AND THEN RETIGHTENED TO A MAXIMUM OF 40 LB. FT.

D. HOSES MUST BE INSTALLED TO MAINTAIN .40 MINIMUM FROM BATTERY & BATTERY CASE. (SEE VIEW "C".)

Fig. 3B3-64B Hose Routing (V6 Engine)

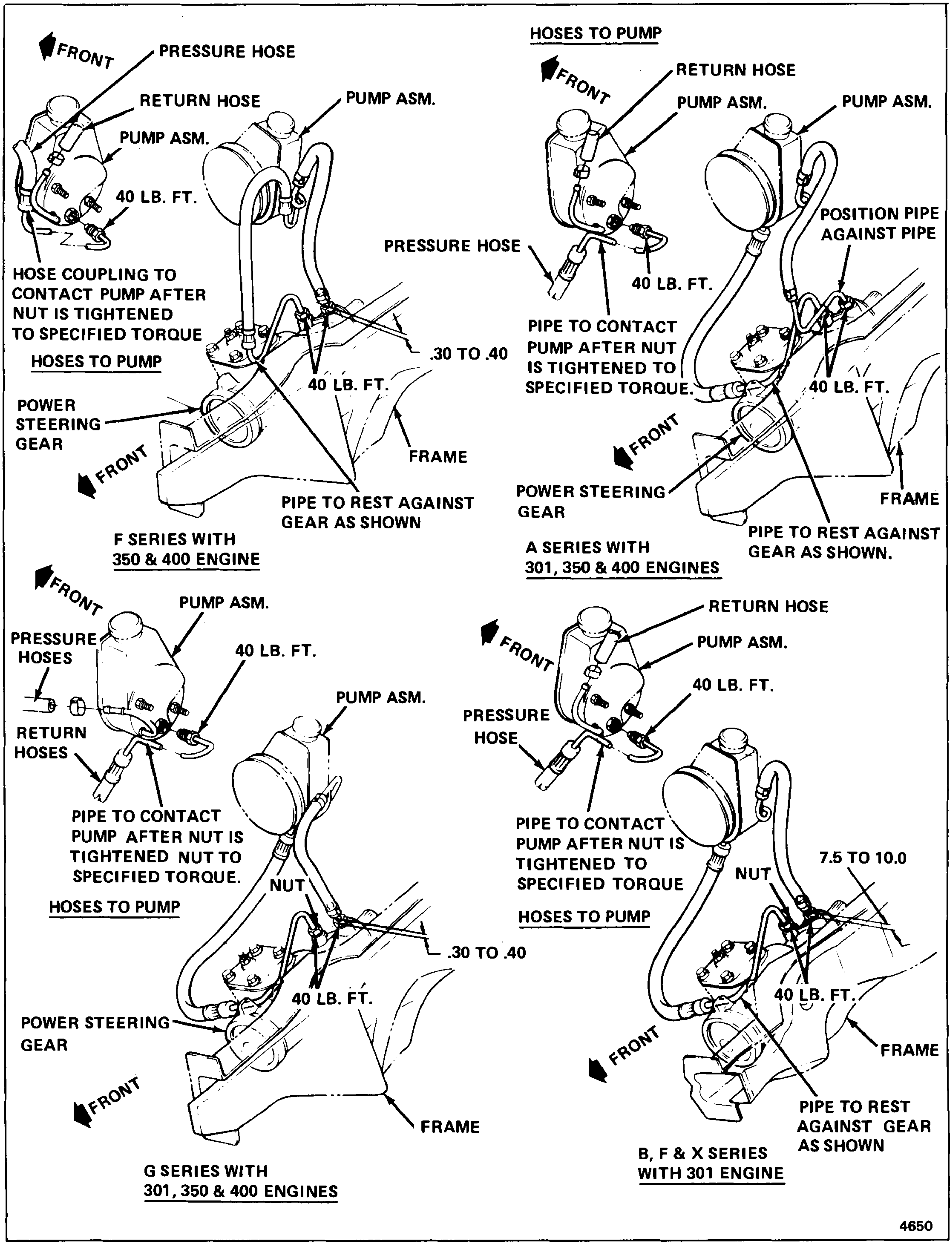


A DO NOT BEND OR DISTORT PIPES TO FACILITATE INSTALLATION AFTER TIGHTENING NUT. PIPE TO BE AGAINST GEAR AS SHOWN.

B HOSES MUST BE INSTALLED TO CLEAR EACH OTHER AND ALL SURROUNDING PARTS. MINIMUM CLEARANCE TO SURROUNDING PARTS .50" OR 12.7MM. HOSE ENDS MUST BE KEPT FREE FROM DIRT AND OTHER CONTAMINATES. RETURN HOSE MUST NOT BE TWISTED DURING INSTALLATION.

C FOR LEAK REPAIR, THE TUBE NUT TO BE LOOSENED. PIPE THEN ROTATED BACK & FORTH, AND THEN RETIGHTENED TO A MAXIMUM OF .40 LB. FT.

Fig. 3B3-64B Hose Routing (V6 Engine)


F SERIES WITH 350 & 400 ENGINE

A SERIES WITH 301, 350 & 400 ENGINES

G SERIES WITH 301, 350 & 400 ENGINES

B, F & X SERIES WITH 301 ENGINE

Fig. 3B3-64C Hose Routing - 301-350(P)-400 V8 Engines

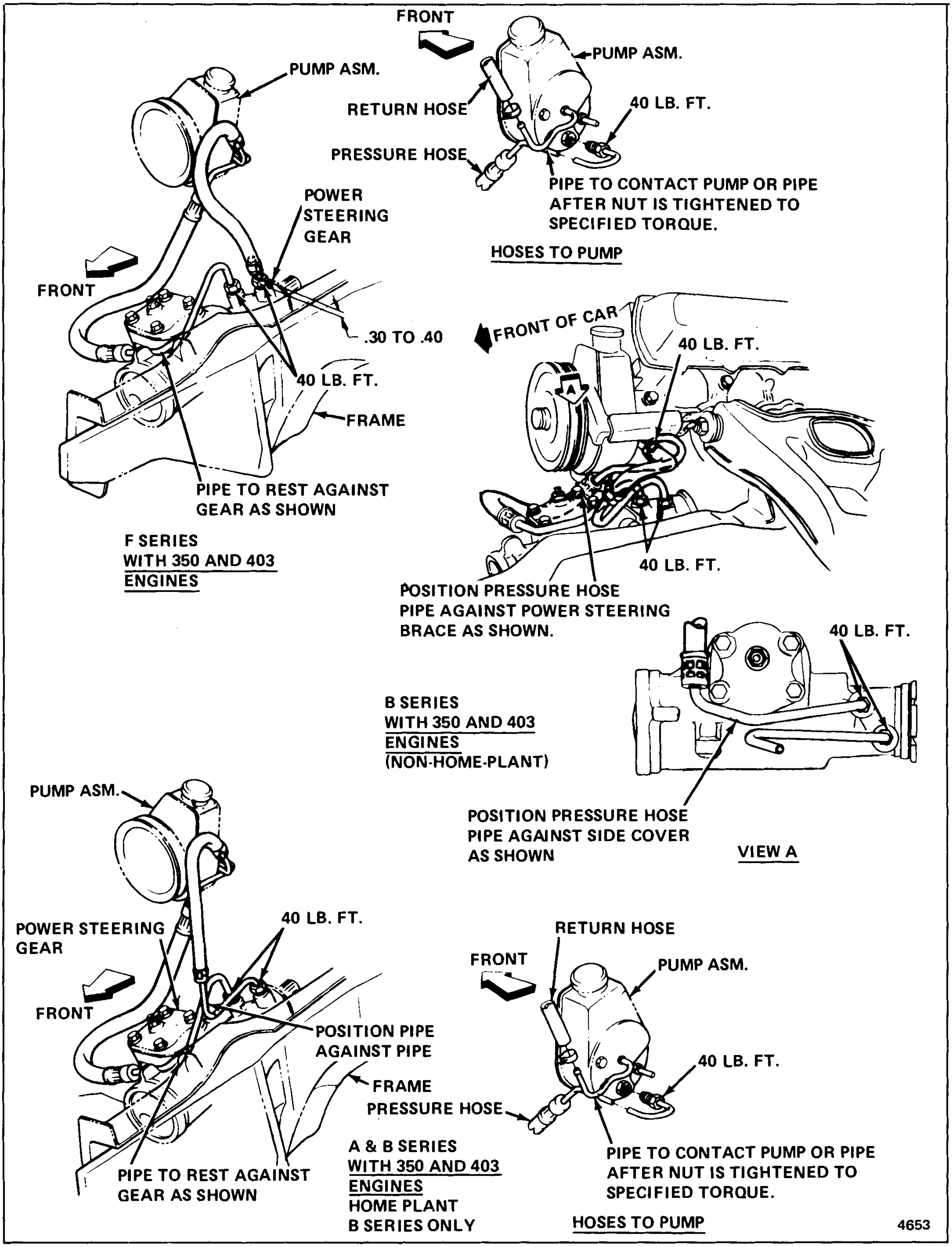


Fig. 3B3-64D Hose Routing - 350(R)-403 V8 Engines

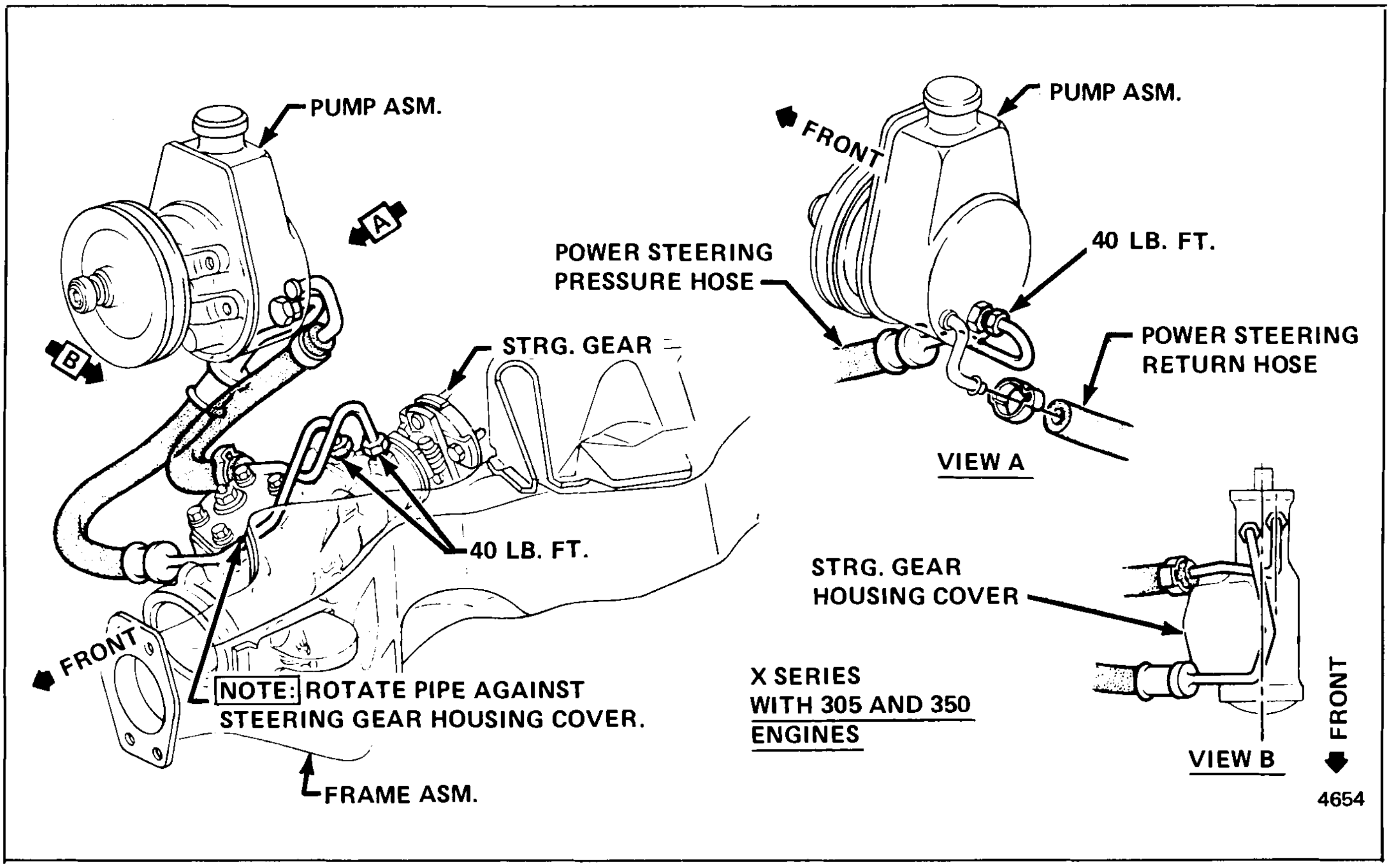
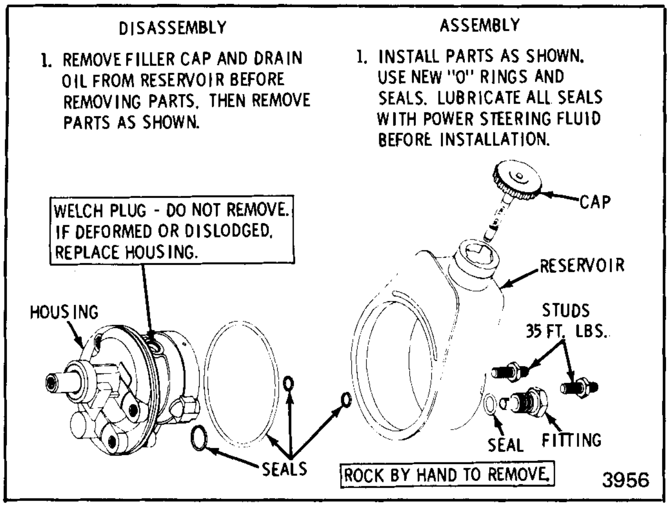


Fig. 3B3-64E Hose Routing - 305-350(L) V8 Engines



DISASSEMBLY

1. REMOVE FILLER CAP AND DRAIN OIL FROM RESERVOIR BEFORE REMOVING PARTS. THEN REMOVE PARTS AS SHOWN.

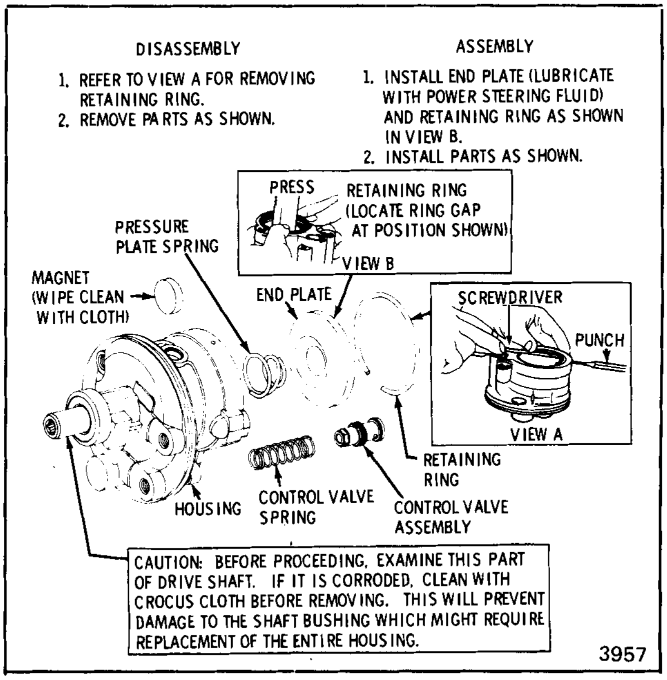
ASSEMBLY

1. INSTALL PARTS AS SHOWN. USE NEW "O" RINGS AND SEALS. LUBRICATE ALL SEALS WITH POWER STEERING FLUID BEFORE INSTALLATION.

WELCH PLUG - DO NOT REMOVE. IF DEFORMED OR DISLODGED, REPLACE HOUSING.

ROCK BY HAND TO REMOVE.

Fig. 3B3-65 Remove and Replace Reservoir



DISASSEMBLY

1. REFER TO VIEW A FOR REMOVING RETAINING RING.
2. REMOVE PARTS AS SHOWN.

ASSEMBLY

1. INSTALL END PLATE (LUBRICATE WITH POWER STEERING FLUID) AND RETAINING RING AS SHOWN IN VIEW B.
2. INSTALL PARTS AS SHOWN.

CAUTION: BEFORE PROCEEDING, EXAMINE THIS PART OF DRIVE SHAFT. IF IT IS CORRODED, CLEAN WITH CROCUS CLOTH BEFORE REMOVING. THIS WILL PREVENT DAMAGE TO THE SHAFT BUSHING WHICH MIGHT REQUIRE REPLACEMENT OF THE ENTIRE HOUSING.

Fig. 3B3-66 Remove and Replace Control Valve and End Plate

DISASSEMBLY

1. WITH PLASTIC HAMMER, TAP LIGHTLY UNTIL PRESSURE PLATE IS FREE.
2. REMOVE PARTS AS SHOWN.

ASSEMBLY

1. INSTALL RING AS SHOWN IN VIEW A.
2. INSTALL PARTS AS SHOWN.

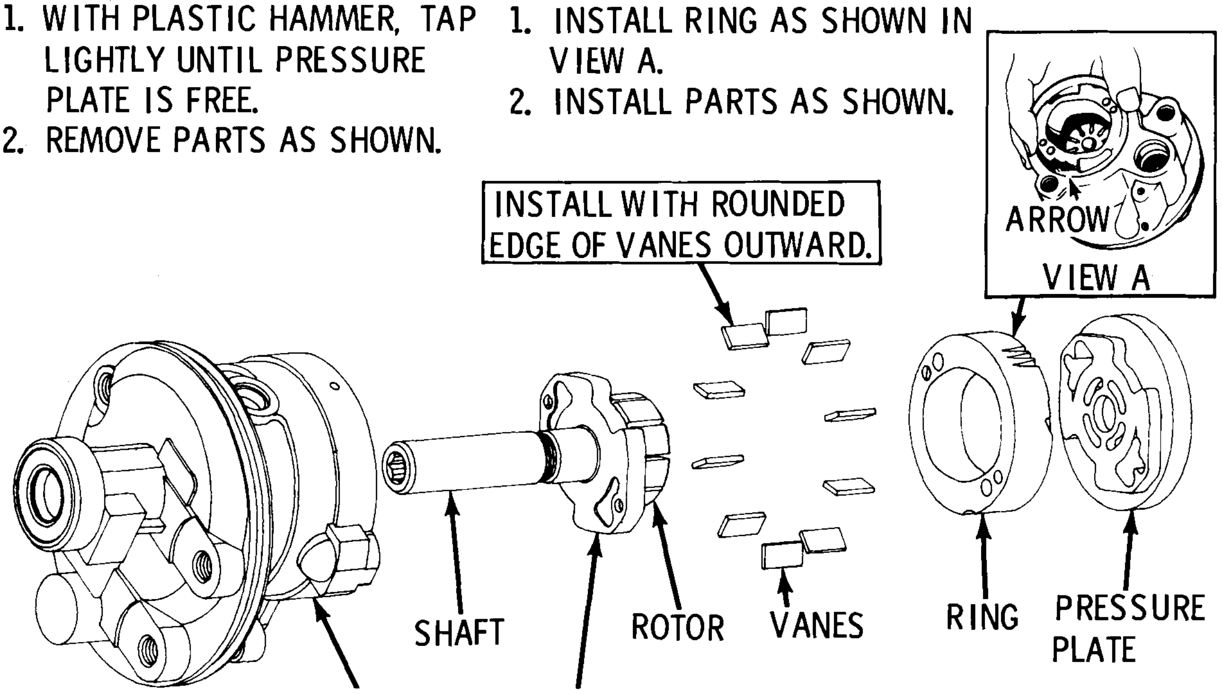

INSTALL WITH ROUNDED EDGE OF VANES OUTWARD.

Fig. 3B3-67 Remove and Replace Rotating Group

DISASSEMBLY

1. REMOVE PARTS AS SHOWN.

ASSEMBLY

1. INSTALL DRIVE SHAFT SEAL AS SHOWN IN VIEW A AND INSTALL PARTS AS SHOWN. USE NEW "O" RINGS AND SEALS. LUBRICATE "O" RINGS WITH POWER STEERING FLUID BEFORE INSTALLATION.

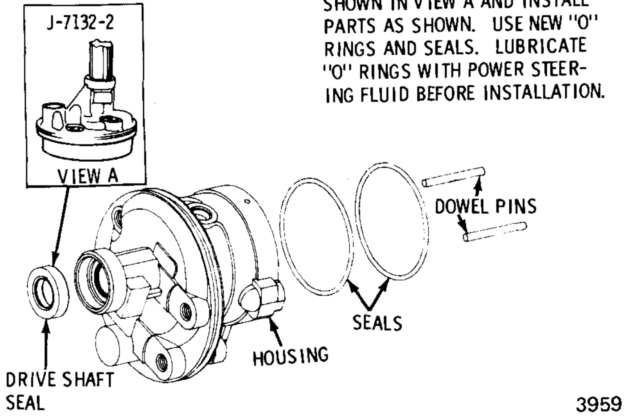


Fig. 3B3-68 Remove and Replace Seals

DISASSEMBLY

1. Remove retaining ring and discard, then remove parts as shown.

ASSEMBLY

1. Install parts as shown.

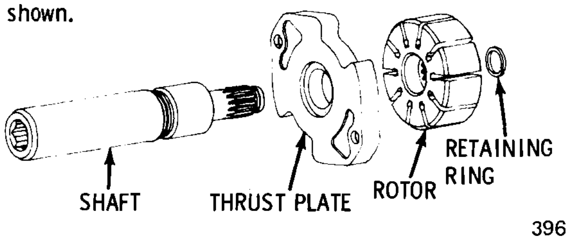


Fig. 3B3-69 Remove and Replace Thrust Plate and Rotor

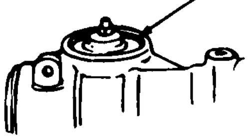
POWER STEERING GEAR (605 MODEL)

GENERAL DESCRIPTION

This Integral Power Steering Gear has a control valve which directs oil to either side of the rack piston. The rack piston converts hydraulic power into mechanical force. This force is transmitted to the mating pitman shaft teeth, through the pitman shaft to the steering linkage.

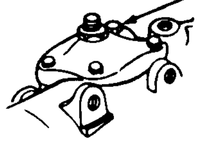
This is a small design steering gear. To determine this gear from our large steering gear see difference in side cover below.

NOTE: Whenever a part which forms a sealing surface for an "O" ring seal is removed, the "O" ring seal should also be removed and replaced with a new seal. Whenever one of the Pitman shaft or stub shaft seals are removed all adjacent seals should be removed and replaced with new seals. Lubricate all new seals with power steering fluid to ease assembly.



Round side cover — held in place with retaining ring

SMALL GEAR
(605 MODEL)



Rectangular side cover held in place with four bolts

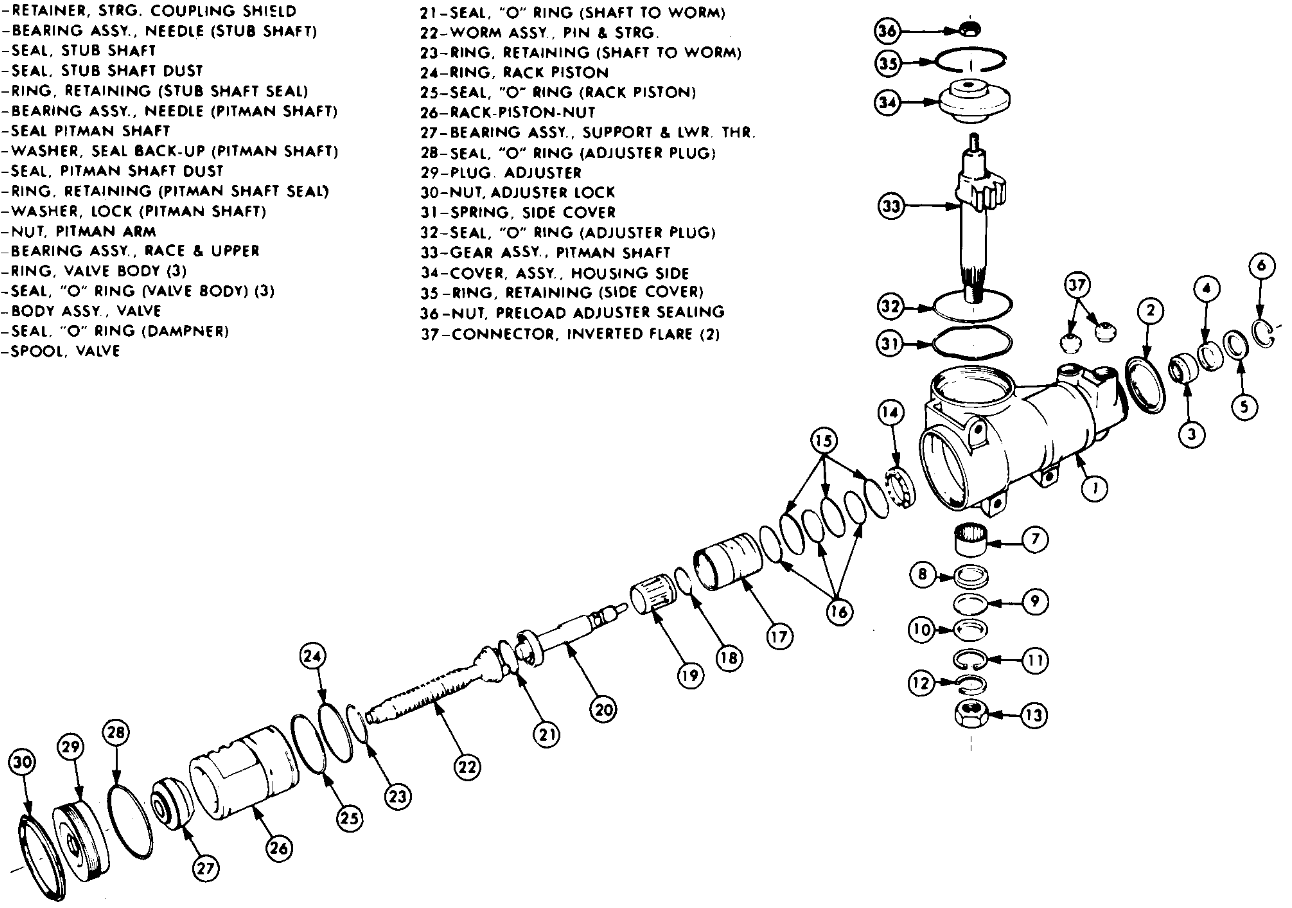
LARGE GEAR
(800-808 MODEL)

Key No. **Part Name**

1-HOUSING, STEERING GEAR
2-RETAINER, STRG. COUPLING SHIELD
3-BEARING ASSY., NEEDLE (STUB SHAFT)
4-SEAL, STUB SHAFT
5-SEAL, STUB SHAFT DUST
6-RING, RETAINING (STUB SHAFT SEAL)
7-BEARING ASSY., NEEDLE (PITMAN SHAFT)
8-SEAL PITMAN SHAFT
9-WASHER, SEAL BACK-UP (PITMAN SHAFT)
10-SEAL, PITMAN SHAFT DUST
11-RING, RETAINING (PITMAN SHAFT SEAL)
12-WASHER, LOCK (PITMAN SHAFT)
13-NUT, PITMAN ARM
14-BEARING ASSY., RACE & UPPER
15-RING, VALVE BODY (3)
16-SEAL, "O" RING (VALVE BODY) (3)
17-BODY ASSY., VALVE
18-SEAL, "O" RING (DAMPNER)
19-SPOOL, VALVE

Key No. **Part Name**

20-SHAFT ASSY., STUB
21-SEAL, "O" RING (SHAFT TO WORM)
22-WORM ASSY., PIN & STRG.
23-RING, RETAINING (SHAFT TO WORM)
24-RING, RACK PISTON
25-SEAL, "O" RING (RACK PISTON)
26-RACK-PISTON-NUT
27-BEARING ASSY., SUPPORT & LWR. THR.
28-SEAL, "O" RING (ADJUSTER PLUG)
29-PLUG, ADJUSTER
30-NUT, ADJUSTER LOCK
31-SPRING, SIDE COVER
32-SEAL, "O" RING (ADJUSTER PLUG)
33-GEAR ASSY., PITMAN SHAFT
34-COVER, ASSY., HOUSING SIDE
35-RING, RETAINING (SIDE COVER)
36-NUT, PRELOAD ADJUSTER SEALING
37-CONNECTOR, INVERTED FLARE (2)



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1. REMOVE AND INSTALL PITMAN SHAFT SEALS IN CAR

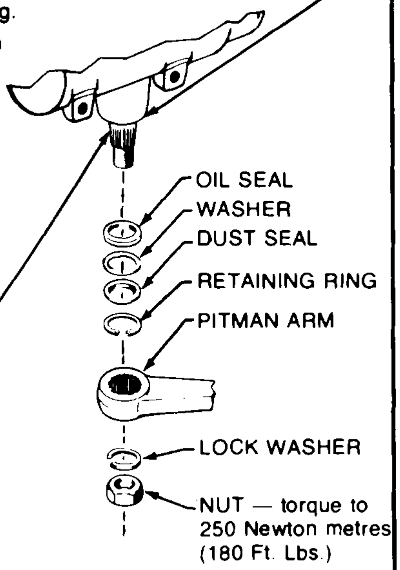
REMOVE

1. Clean exposed end of pitman shaft and end of housing after removing arm.
2. Remove retaining ring.
3. Start engine and turn wheels fully to the right to force seals and washer out.
4. Turn off engine.
5. Inspect housing and shaft.

INSTALL

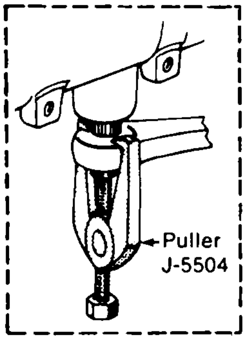
1. Install parts as shown.

HOUSING ASSEMBLY Inspect for burrs.

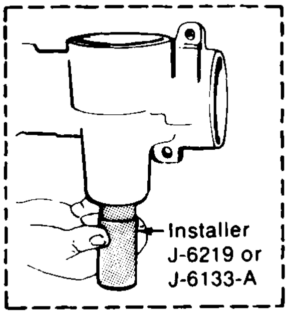


NUT — torque to 250 Newton metres (180 Ft. Lbs.)

PITMAN SHAFT — Inspect seal surface for roughness and pitting.



Remove Pitman Arm



Install Seals

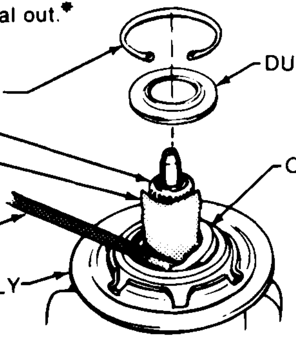
2. REMOVE AND INSTALL STUB SHAFT SEALS WITHOUT DISASSEMBLING GEAR

REMOVE

1. Remove retaining ring and dust seal. Take care not to scratch shaft.
2. Wrap 0.1mm to 0.2mm (.005" to .008") shim stock around shaft and insert between shaft and sealing lip until it bottoms. Pry seal out.*

INSTALL

1. Install stub shaft seal. Liberally coat top of seal with anhydrous calcium grease.
2. Install dust seal just deep enough to clear retaining ring groove, then install retaining ring.



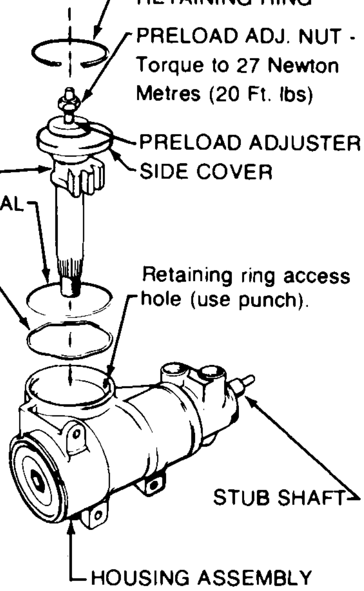
3. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

REMOVE

1. If pitman shaft and side cover are to be separated, remove preload adjuster nut. IT IS A LEFT HAND THREAD.
2. Rotate stub shaft to center gear, then remove parts as shown. Tap on thread end of pitman shaft with plastic hammer.

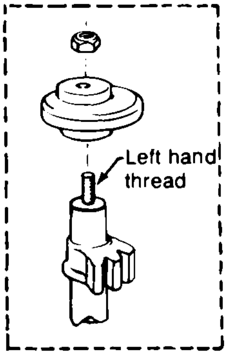
INSTALL

1. Install parts as shown. Use new retaining ring, make sure that open end of retaining ring is approx. 13mm (½") from access hole.
2. Depress side cover to make sure retaining ring seats properly.



PRELOAD ADJ. NUT - Torque to 27 Newton Metres (20 Ft. lbs)

Retaining ring access hole (use punch).



Separate pitman shaft from side cover if required.

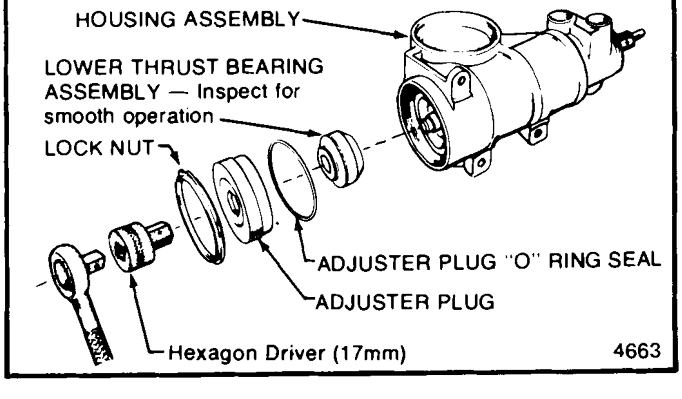
4. REMOVE AND INSTALL LOWER BEARING AND ADJUSTER

REMOVE

1. Loosen lock nut. Use punch against edge of one slot.
2. Remove parts as shown.
3. Inspect lower thrust bearing assembly.

INSTALL

1. Install parts as shown.
2. Adjust thrust bearing preload (see adjustment procedure) before tightening lock nut.



LOWER THRUST BEARING ASSEMBLY — Inspect for smooth operation

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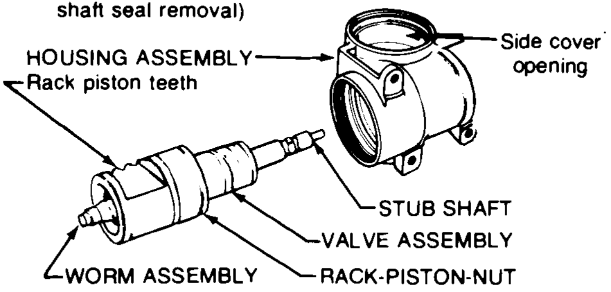
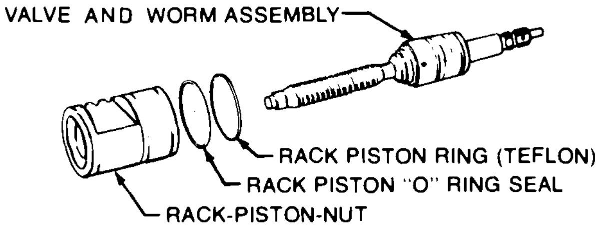
5. REMOVE AND INSTALL RACK PISTON AND VALVE ASSEMBLY

REMOVE	INSTALL
1. Remove parts as shown. Push on stub shaft. DO NOT remove upper bearing assembly (see stub shaft seal removal)	1. Install parts as shown. Make sure rack piston teeth are positioned toward side cover opening.



6. REMOVE AND INSTALL VALVE AND WORM ASSEMBLY FROM RACK PISTON

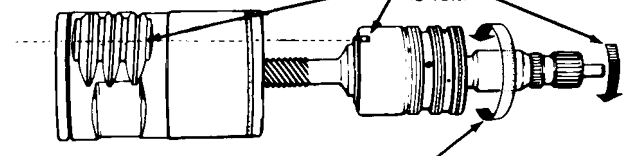
REMOVE	INSTALL
1. Unscrew valve and worm from rack.	1. Install "O" ring and teflon ring as shown.
2. Remove teflon ring and rack piston "O" ring from rack piston.	2. Screw worm and valve into rack piston. See procedure below.



A. Assemble worm and valve to rack piston

a. Hold rack teeth and worm drive pin in relation shown with light pressure to hold worm thread against piston.

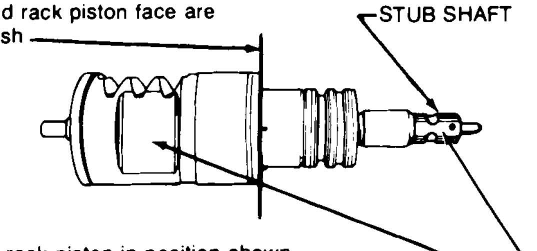
b. Turn worm and valve counterclockwise slowly until one "Click" is felt.



c. Turn worm and valve clockwise to complete assembly

B. Check relation of stub shaft and rack piston

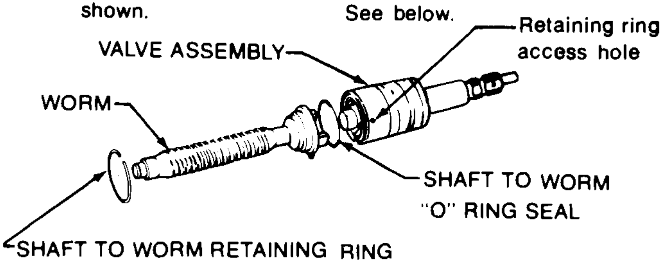
a. Screw worm and valve into rack piston until valve face and rack piston face are flush



b. With rack piston in position shown, flats on stub shaft and piston are to be parallel. If not parallel, disassemble and repeat "A." above.

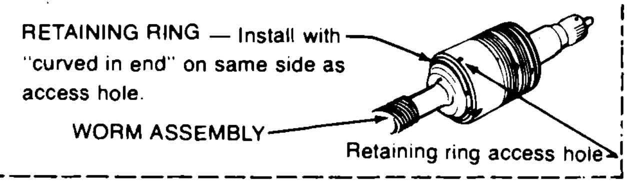
7. REMOVE AND INSTALL VALVE ASSEMBLY FROM WORM ASSEMBLY

REMOVE	INSTALL
1. Remove parts as shown.	1. Install parts as shown. See below.



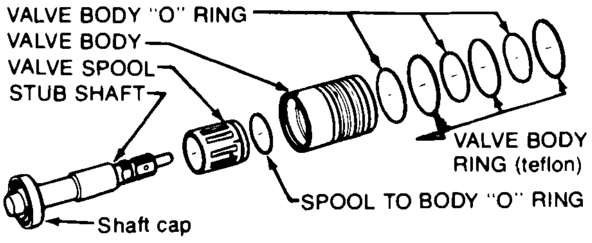
Assemble worm to valve

RETAINING RING — Install with "curved in end" on same side as access hole.

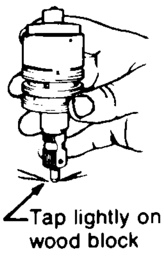


8. DISASSEMBLE AND ASSEMBLE VALVE

DISASSEMBLE	ASSEMBLE
1. Disassemble parts as shown.	2. Assemble parts as shown.



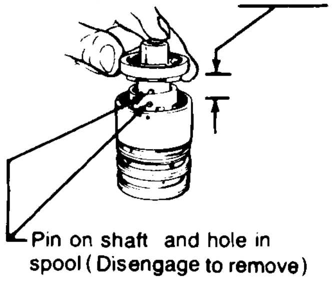
A. Loosen shaft cap



Tap lightly on wood block

B. Remove and install stub shaft.

Pull cap out approx. 6 mm(¼")



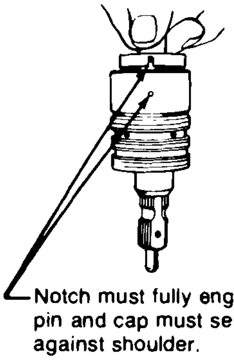
Pin on shaft and hole in spool (Disengage to remove)

C. Remove and install spool

Rotate while removing or installing

Lubricate spool and body with power steering fluid.

D. Engage stub shaft



Notch must fully engage pin and cap must seat against shoulder.

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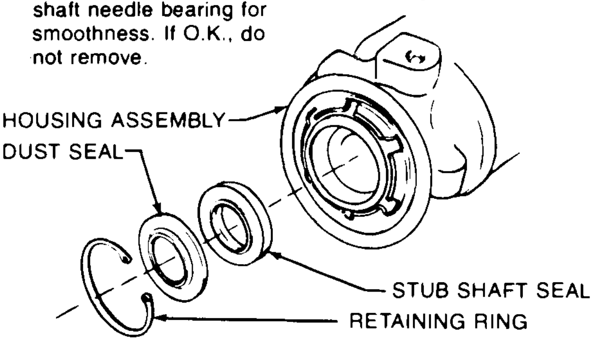
9. REMOVE AND INSTALL STUB SHAFT SEALS AND BEARINGS

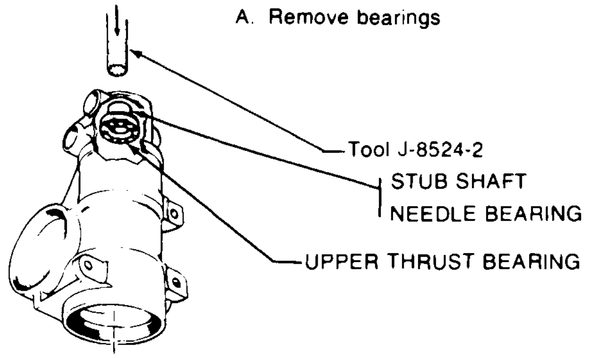
REMOVE

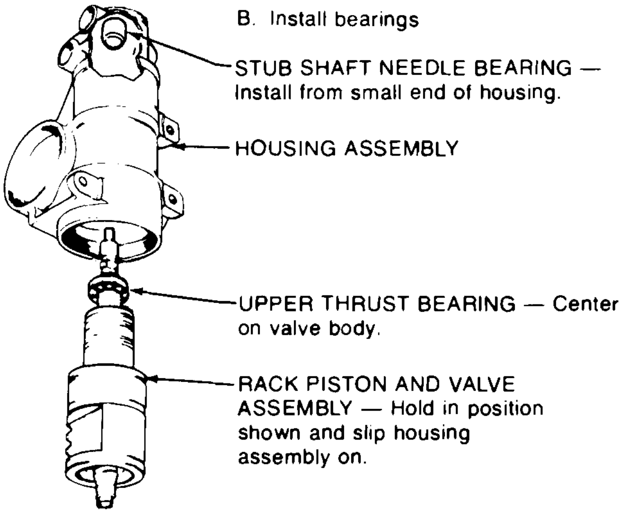
1. Clean end of housing to prevent dirt from entering gear.
2. Remove parts as shown, being careful not to score housing bore.
3. Remove stub shaft needle bearing and upper thrust bearing if required.
   Put a finger into the stub shaft cavity and hook it onto the upper thrust bearing race. Turn the race while pulling up. If bearing operation is smooth, it does not need removal. Check the stub shaft needle bearing for smoothness. If O.K., do not remove.

INSTALL

1. If removed, install new stub shaft needle bearing. Bottom tool on housing counterbore.
   NOTE: SERVICE thrust bearing DOES NOT SNAP ON needle bearing. If removed, install as shown below.
2. Install stub shaft seal. Liberally coat top of seal with anhydrous calcium grease.
3. Install dust seal just deep enough to clear retaining ring groove, then install retaining ring.




A. Remove bearings


B. Install bearings

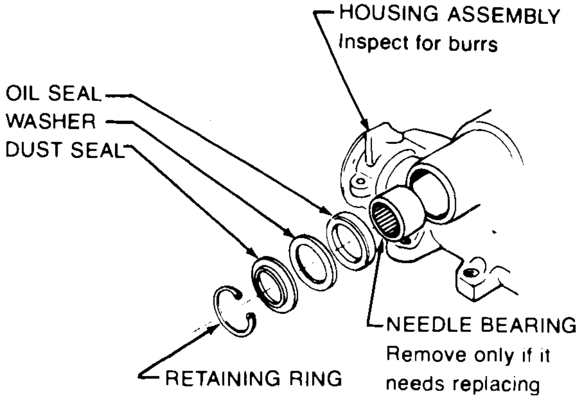
10. REMOVE AND INSTALL PITMAN SHAFT SEALS AND BEARING

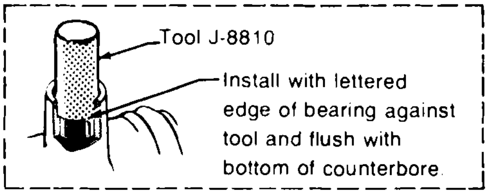
REMOVE

1. Remove parts as shown CAUTION: Do not damage housing bore.

INSTALL

1. Bottom oil seal in counterbore. Install washer. Coat seal lip and washer face with anhydrous calcium grease.
2. Install remaining parts as shown.





Remove and install bearing (not necessary unless bearing is to be replaced).

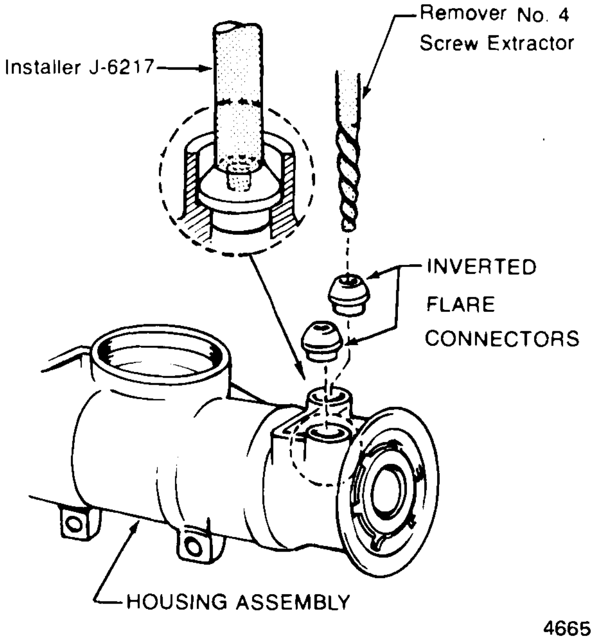
11. REMOVE AND INSTALL CONNECTORS

REMOVE

1. Remove Parts As Shown

INSTALL

1. Install Parts As Shown



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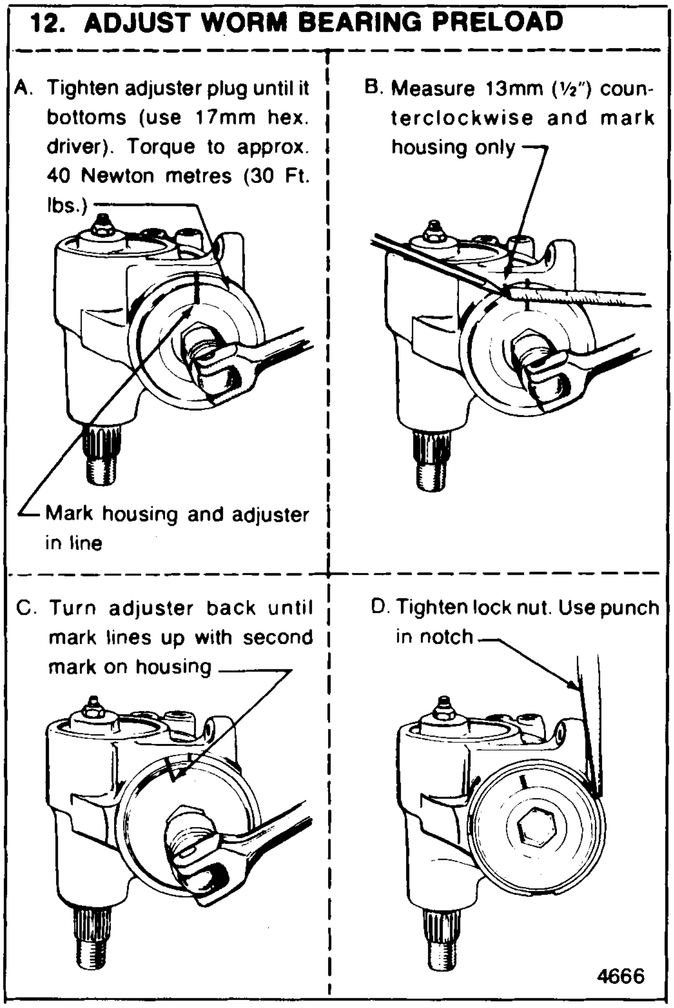

12. ADJUST WORM BEARING PRELOAD

A. Tighten adjuster plug until it bottoms (use 17mm hex. driver). Torque to approx. 40 Newton metres (30 Ft. lbs.)

Mark housing and adjuster in line

B. Measure 13mm (½") counterclockwise and mark housing only

C. Turn adjuster back until mark lines up with second mark on housing

D. Tighten lock nut. Use punch in notch

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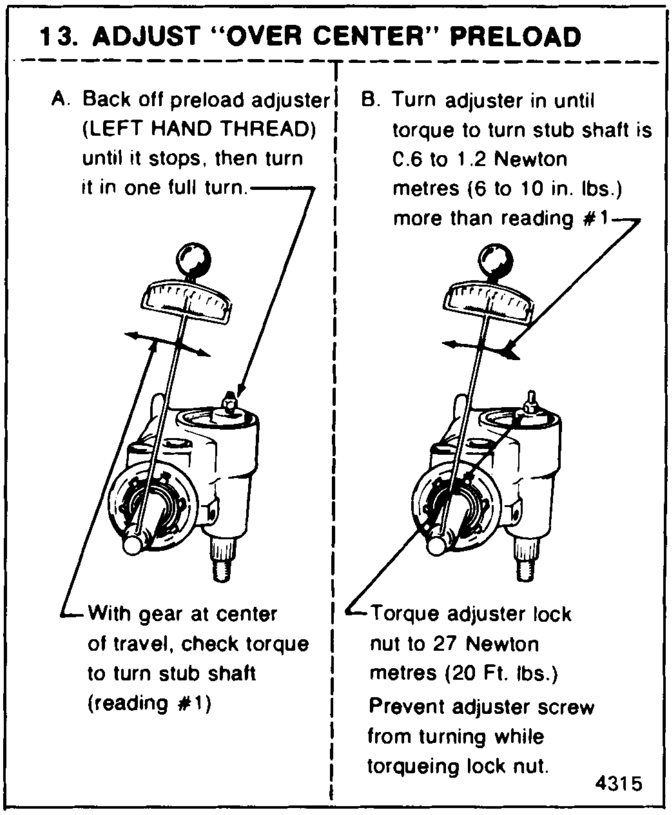

13. ADJUST "OVER CENTER" PRELOAD

A. Back off preload adjuster (LEFT HAND THREAD) until it stops, then turn it in one full turn.

With gear at center of travel, check torque to turn stub shaft (reading #1)

B. Turn adjuster in until torque to turn stub shaft is 0.6 to 1.2 Newton metres (6 to 10 in. lbs.) more than reading #1

Torque adjuster lock nut to 27 Newton metres (20 Ft. lbs.) Prevent adjuster screw from turning while torqueing lock nut.

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GENERAL SPECIFICATIONS

LUBRICATION

Lubricant	Power Steering Fluid No. 1050017 or equivalent
Capacity - Complete System	1-1/4 Qts.
Capacity - Pump Only	1/2 Qts.

ADJUSTMENTS

Valve Assembly and Seal Drag	1 to 4 in. lbs.
Thrust Bearing Preload	3 to 4 in. lbs. in excess of valve assembly and seal drag.
Overcenter Adjustment	4 to 8 in. lbs. (new gear) or 4 to 5 in. lbs. (used gear) in excess of combined thrust bearing preload.

NOTE: Adjustment of the steering gear in the car is not recommended because of the difficulty encountered in adjusting the worm thrust bearing preload and the confusing effects of the hydraulic fluid in the gear. Since a gear adjustment is made only as a correction and not as a periodic adjustment, it is better to take the extra time and make the adjustment correctly the first time.

Since a handling stability complaint can be caused by improperly adjusted worm thrust bearings as well as an improper gear over-center adjustment, is is necessary that the steering gear assembly be removed from the car and both thrust bearing and over-center preload be checked and corrected as necessary. An in-car check of the steering gear will not show a thrust bearing adjustment error.

TORQUE SPECIFICATIONS

Specified torque is maximum for installation of parts. Checking of torque during inspection may be 10% below that specified.

POWER STEERING GEAR	FT. LBS.
Gear to Frame Bolts	80
High Pressure Line Fitting (At Gear)	40
Oil Return Line Fitting (At Gear)	40
Pitman Shaft Adjusting Screw Locknut	35
Side Cover Bolts	35
Adjuster Plug Locknut	80
Coupling Flange Nuts	25
Return Guide Clamp Screws	5
Rack-Piston Plug	75
Pitman Shaft Nut	
H, HM & X Series (Manual gear)	160
All Others	210
Coupling Flange Bolt	30
POWER STEERING PUMP	FT-LB
Pump Mounting Bolt	35
Reservoir Bolt	35
Flow Control Fitting	35
Pressure Hose	40

SECTION 3B4

STEERING WHEELS AND COLUMNS

CAUTION: *All front suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

FUNCTION LOCKING COLUMNS

The function locking energy absorbing steering column includes three important features in addition to the steering function:

1. The column is energy absorbing, designed to compress in a front-end collision to minimize the possibility of injury to the driver of the car.
2. The ignition switch and lock are mounted conveniently on the column.
3. With the column mounted lock, the ignition, steering and gearshifting operation can be locked to inhibit theft of the automobile.

The function locking energy absorbing column may be easily disassembled and reassembled. The serviceman should be aware that it is important that only the specified screws, bolts and nuts be used as designated and that they are tightened to their specified torque. This precaution will insure the energy absorbing action of the assembly. Over-length bolts should not be used, as they may prevent a portion of the assembly from compressing under impact. Equally as important is correct torque of bolts and nuts. Care should be taken to assure that the bolts or nuts securing the column mounting bracket to the instrument panel are torqued to the proper specification in order that the bracket will break away under impact.

When the function locking energy absorbing column assembly is installed in a car, it is no more susceptible to damage through usage than an ordinary column; however, when the column is removed, special care must be taken in handling this assembly. Only the specified wheel puller should be used. When the column is removed from the car, such actions as a sharp blow on the end of the steering shaft or shift lever, leaning on the column assembly, or dropping of the assembly could shear or loosen the plastic fasteners that maintain column rigidity. It is, therefore, important that the removal and installation and the disassembly and reassembly procedures be carefully followed when servicing the assembly.

STEERING COLUMN WITH DIMMER SWITCH

The B Series steering columns have the dimmer switch mounted on the steering column near the ignition switch. It is actuated by a rod which extends up the side of the column, through the shift bowl into the steering column cover. The rod is actuated by the turn signal lever by pulling up and releasing the lever.

Disassembly, assembly and adjustment procedures for columns with dimmer switch remain the same as other columns with the exception of dimmer switch removal.

KEY RELEASE COLUMNS

H SERIES AND X SERIES W/5 SPEED

The key release energy-absorbing steering columns have the same features as the function locking columns except that no shifting (either standard or automatic) is performed on the column. This feature eliminates the shift-tube and back drive systems. The key release energy-absorbing steering column assembly is used on floor shift models only.

The operation of the lock is basically the same as before except it cannot be positioned (nor can the key be removed) in "off-lock" or "accessory" except by depressing the key release lever.

The tilt key release locking columns have several different steering wheel angle positions for ease of entry and driving comfort.

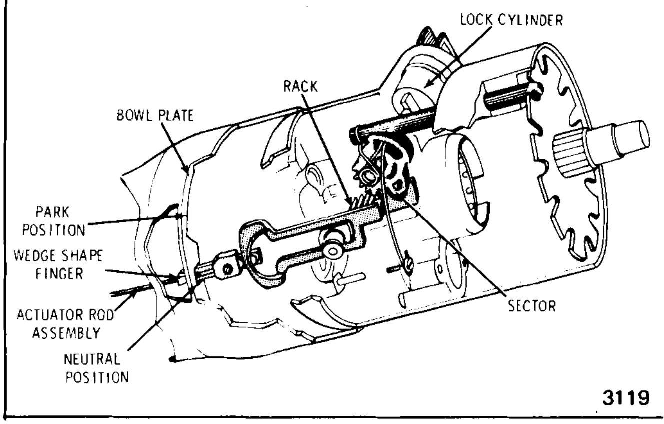


Fig. 3B4-1 Mechanical Neutral Start

MECHANICAL NEUTRAL START SYSTEM

(Fig. 3B4-1)

All steering columns for the B Series have a mechanical neutral start system. This system has a mechanical block instead of the electrical neutral start system to prevent starting the engine in other than PARK or NEUTRAL. The mechanical block is achieved by a wedge shape finger added to the ignition switch actuator rod. The finger will only pass through the bowl plate in "P" or "N". This prevents turning the lock cylinder to the start position.

In either "P" or "N" the finger passes through the bowl plate notches, allowing the lock cylinder to rotate to the start position.

SERVICE PROCEDURES

STEERING COLUMN (ALL SERIES)

NOTE: Once the steering column is removed from the car, the column is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic injections which maintain column rigidity. Leaning on the column assembly could cause the jacket to bend or deform. Any of the above damage could impair the column's collapse design. It it is necessary to remove the steering wheel, use standard wheel puller. Under no conditions should the end of the shaft be hammered upon as hammering could loosen plastic injections which maintain column rigidity.

Removal (Figs. 3B4-2 through 3B4-6)

1. Disconnect negative battery cable.

2. Remove clamp bolt from coupling at lower end of column shaft. (All cars with power steering and X Series with manual steering.)

NOTE: H Series with manual steering has the coupling clamped on the steering gear worm shaft.

3. Remove flex coupling shield.

4. All except H Series - Disconnect shift linkage from shift tube lever at lower end of steering column.

5. If column is to be replaced or repaired (out of car), remove steering wheel. Refer to STEERING WHEEL-Removal.

6. Remove cover and toe-pan attaching screws (Figs. 3B4-2 through 3B4-6).

7. Remove trim cap or lower trim panel from instrument panel.

8. If equipped with column shift (Automatic) remove shift indicator needle (cable on X Series and link on A Series) from shift bowl.

9. Disconnect neutral start, seat belt warning, and back-up light wiring from switch. Disconnect turn signal wiring connector.

10. Remove the two nuts "A" and "B" from bracket assembly, while holding column in position. Lower column until ignition switch wiring connectors can be disconnected.

NOTE: If spacers were used on bolts "A" and "B", retain for use when installing steering column.

11. Carefully remove steering column from inside of car.

12. If necessary to remove intermediate shaft, remove nut and bolt from shaft clamp and remove from steering gear shaft.

NOTE: Intermediate shaft on X Series may telescope as it does not use plastic injection.

Installation (A, B and G Series)

See CAUTION on Page 3B4-1 of this Section.

1. If intermediate shaft was removed, install on steering gear shaft, install bolt and nut and torque nut to 35 ft. lbs.

2. Carefully position steering column from inside of car through cowl and with the aid of a helper proceed as follows:

Helper will guide intermediate shaft coupling onto column shaft. Install clamp bolt and nut and torque to 55 ft. lbs.

3. Connect ignition switch, turn signal wiring and neutral start switch wiring.

4. Raise steering column into position and loosely install nuts "A" and "B". If spacers were removed, install equal thickness on each side.

5. Visually check flex-coupling alignment. If incorrect, it will be necessary to move column assembly.

NOTE: Flex coupling must be straight within 1/16" without bottoming intermediate shaft coupling.

6. Loosely install screw (No. 1) into lower toe-pan cover. (Figs. 3B4-2 and 3B4-3).

7. Install screw (No. 3), torque screws (No. 3 and No. 1) to 45 in. lbs.

8. Torque screws (No. 2) to 60 in. lbs. (Figs. 3B4-2 and 3B4-3).

9. Install screw (No. 4) into lower toe-pan cover and torque to 45 in. lbs. (Fig. 3B4-2).

10. Torque toe-pan cover bolt (No. 5) to 45 in.

11. Install screws (Nos. 6-7-8) torque to 45 in. lbs. (Fig. 3B4-3).

12. Torque nuts "A" and "B" to 25 ft. lbs. (Figs. 3B4-2 and 3B4-3).

13. If equipped with column shift (automatic), install shift indicator needle.

14. Visually check flex-coupling alignment and intermediate shaft coupling for bottoming. If either has occurred, it will be necessary to loosen toe-pan clamp bolts (No. 2) and nuts "A" and "B", then lift up and rearward on column assembly. Torque bolts (Toe-Pan clamp) to 60 in. lbs. and nuts "A" and "B" to 25 ft. lbs. (Figs. 3B4-2 and 3B4-3).

15. Install cover over inner and outer toe-pan covers.

16. Install trim cap or lower trim panel on instrument panel.

17. Connect neutral start and back-up light wiring to switch, if so equipped.

18. If steering wheel was removed, install steering wheel. Refer to STEERING WHEEL-Installation.

19. Install flex-coupling shield then connect negative battery cable to battery.

20. Adjust neutral start and back-up lamp switch as shown on Fig. 3B4-125.

Installation (F and X Series)

See CAUTION on Page 3B4-1 of this Section.

1. Carefully position steering column from inside of car through cowl.

2. Connect ignition switch and turn signal switch wiring connectors.

3. Raise steering column into position (lower portion of instrument panel) and loosely attach nuts "A" and "B" (Fig. 3B4-5).

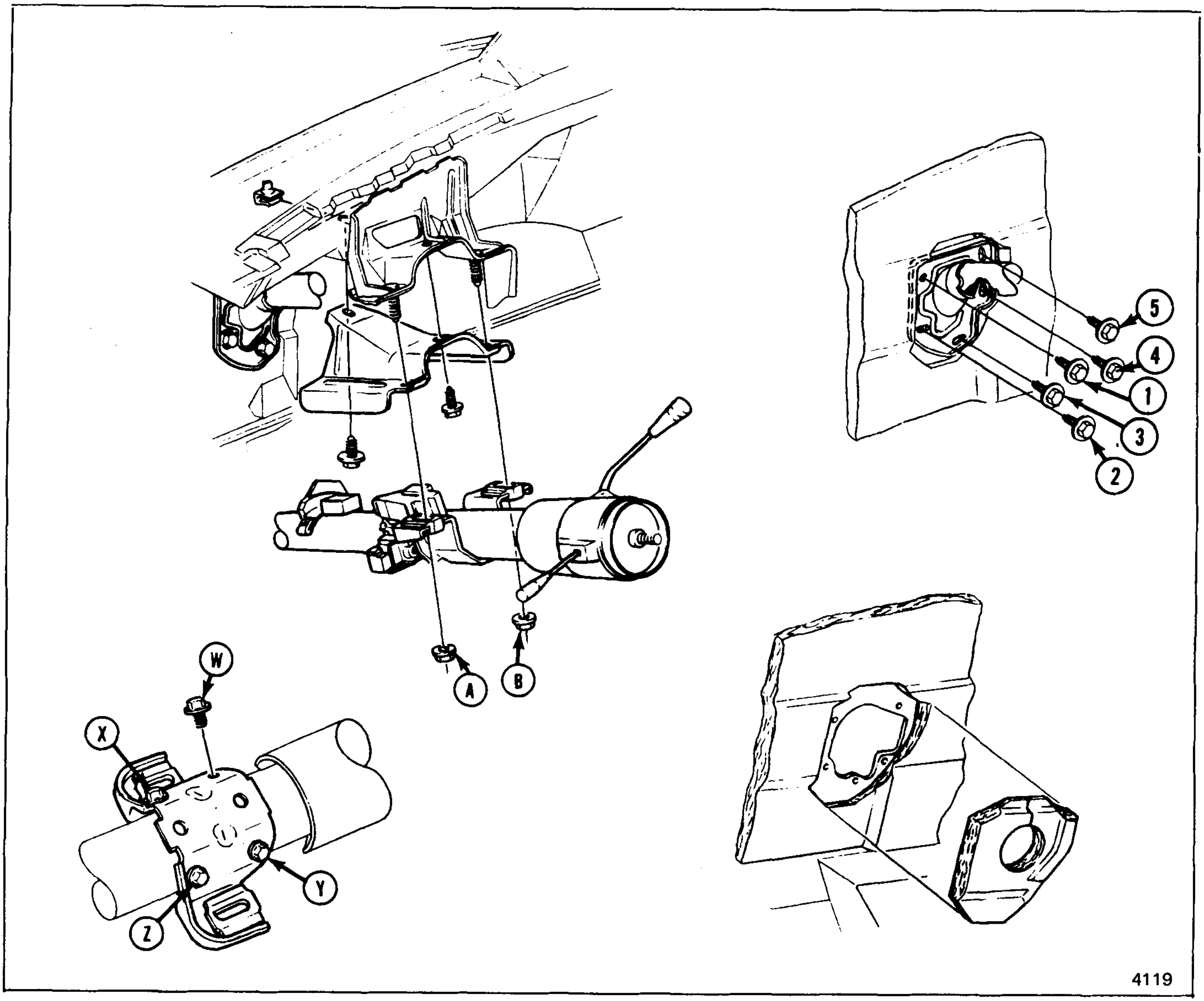


Fig. 3B4-2 Column Mounting - B Series

4. Loosely install screw (No. 1) in upper toe-pan cover (Fig. 3B4-4). Torque to 45 in. lbs.

5. Torque nuts "A" and "B" to 25 ft. lbs.

6. Install screws "2", "3" and "4" (Fig. 3B4-4) and torque to 45 in. lbs.

7. Extend intermediate shaft and connect to column shaft aligning index on clamp with paint stripe on shaft (Fig. 3B4-4).

CAUTION: *Do not substitute any bolt or nut for this application. Do not reuse nut after being torqued.*

8. Install special bolt and a new special self locking nut. Torque to 55 ft. lbs. while holding bolt head tight against clamp.

NOTE: Bolt aligns with flat on shaft when properly installed.

9. If equipped with column shift (automatic), connect shift indicator cable.

10. Install cover over upper and lower toe-pan covers.

11. Install trim cap on lower portion of instrument panel.

12. Connect neutral start and back-up light wiring to switch.

13. If steering wheel was removed, install steering wheel. Refer to STEERING WHEEL-Installation.

14. Connect negative battery cable to battery.

15. Adjust neutral start and back-up lamp switch as shown on Fig. 3B4-210.

Installation (H Series, Fig. 3B4-6)

1. Carefully place column into car. Assemble coupling to column shaft (with power steering) to worm shaft (without power steering). Torque to 30 ft. lbs.

2. Connect all electrical connections between the column and body.

3. Raise column and install both nuts "A" and "B". Torque to 25 ft. lbs.

4. Install the three toe plate screws and tighten to 45 in. lbs.

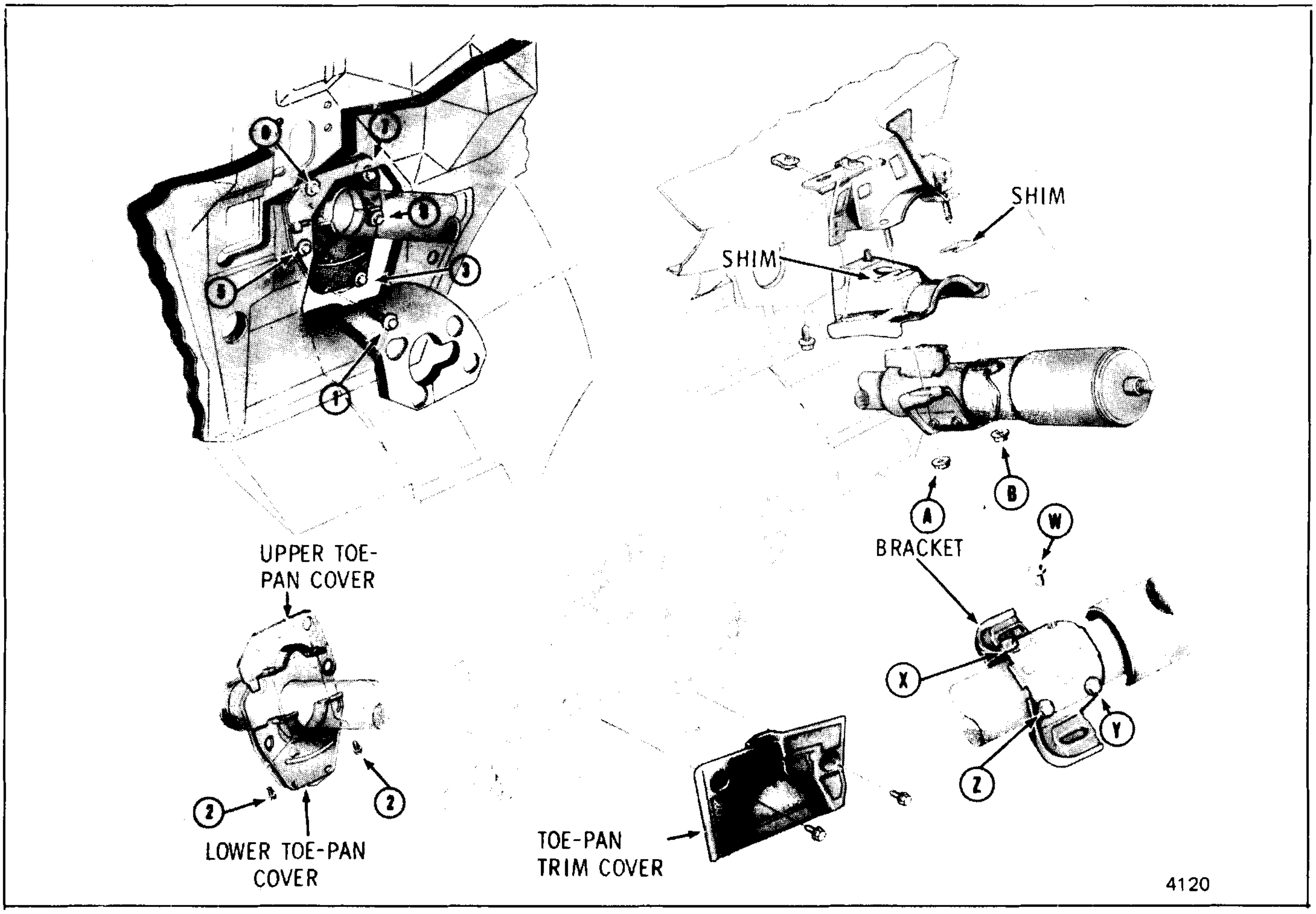


Fig. 3B4-3 Column Mounting - A and G Series

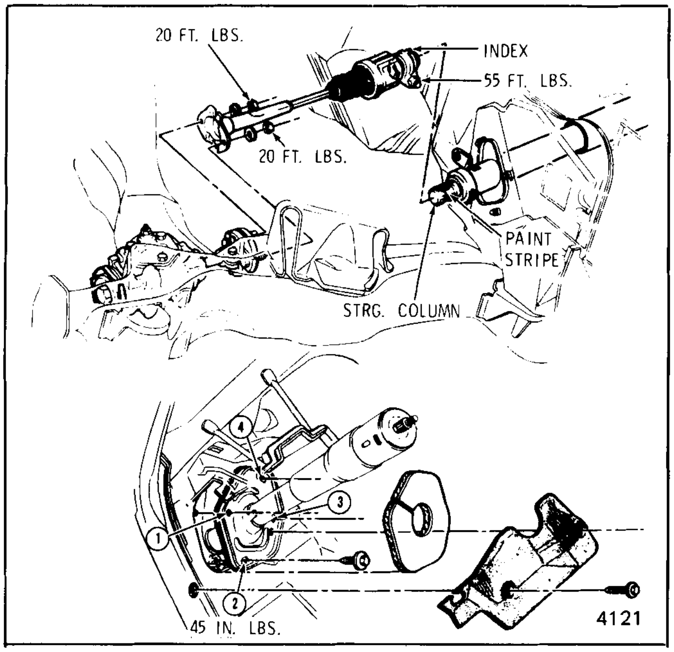


Fig. 3B4-4 Column Mounting - F and X Series

NOTE: On power steering columns be sure flange on toe plate aligns with opening in dash panel.

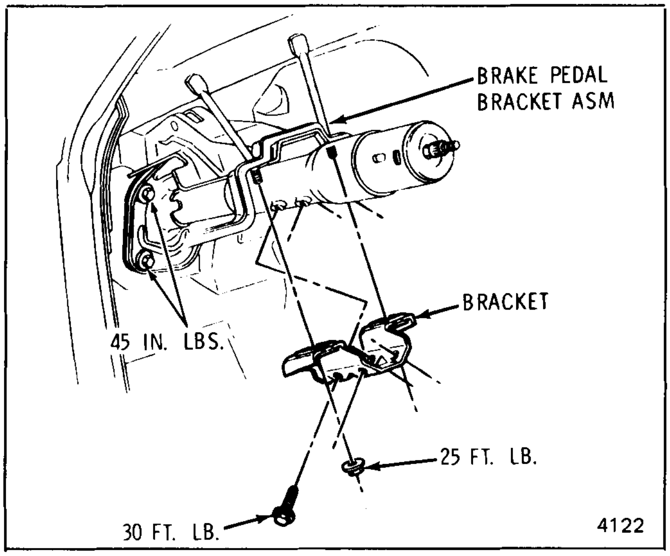


Fig. 3B4-5 Column Bracket - X Series

5. Visually check flex-coupling alignment and intermediate shaft coupling for bottoming. If either has occurred, it will be necessary to loosen toe-pan bolts and nuts "A" and "B", then lift up and rearward on column assembly. Torque toe pan bolts to 45 in. lbs. and nuts "A" and "B" to 25 ft. lbs. (Fig. 3B4-6)

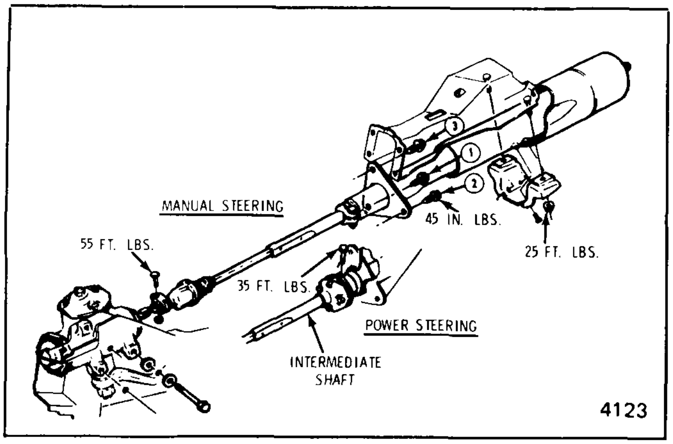


Fig. 3B4-6 Column Mounting - H Series

TILT-AWAY COLUMN AND KEY RELEASE

IN CAR PROCEDURES

NOTE: All elements of energy absorbing columns are sensitive to damage and must be handled with care. The following procedures apply to both the function locking and key release columns except as noted. Figs. 3B4-7 and 3B4-8.

LOCK PLATE AND/OR CANCELLING CAM (TILT-AWAY)

Removal

1. Disconnect negative cable from battery.
2. Refer to STEERING WHEEL-Removal.
3. Lock plate cover may be removed for replacement at this time by releasing as shown (Fig. 3B4-9).
4. Position Tool J 23653 over steering shaft and tighten nut until tool slightly depresses lock plate. Pry wire snap ring from shaft and discard (Fig. 3B4-10). Remove Tool J 24653.
5. Remove lock plate and cancelling cam (Fig. 3B4-11).

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Install cancelling cam and lock plate aligning splines in steering shaft with I.D. of lock plate (Fig. 3B4-11).
2. Position new wire snap ring over Tool J 23653. Install Tool J 23653 over shaft and tighten nut until wire snap ring can be installed in groove in steering shaft (Fig. 3B4-12).
3. If removed, reinstall cover on lock plate (Fig. 3B4-9).
4. Refer to STEERING WHEEL-Installation.
5. Connect negative battery cable.

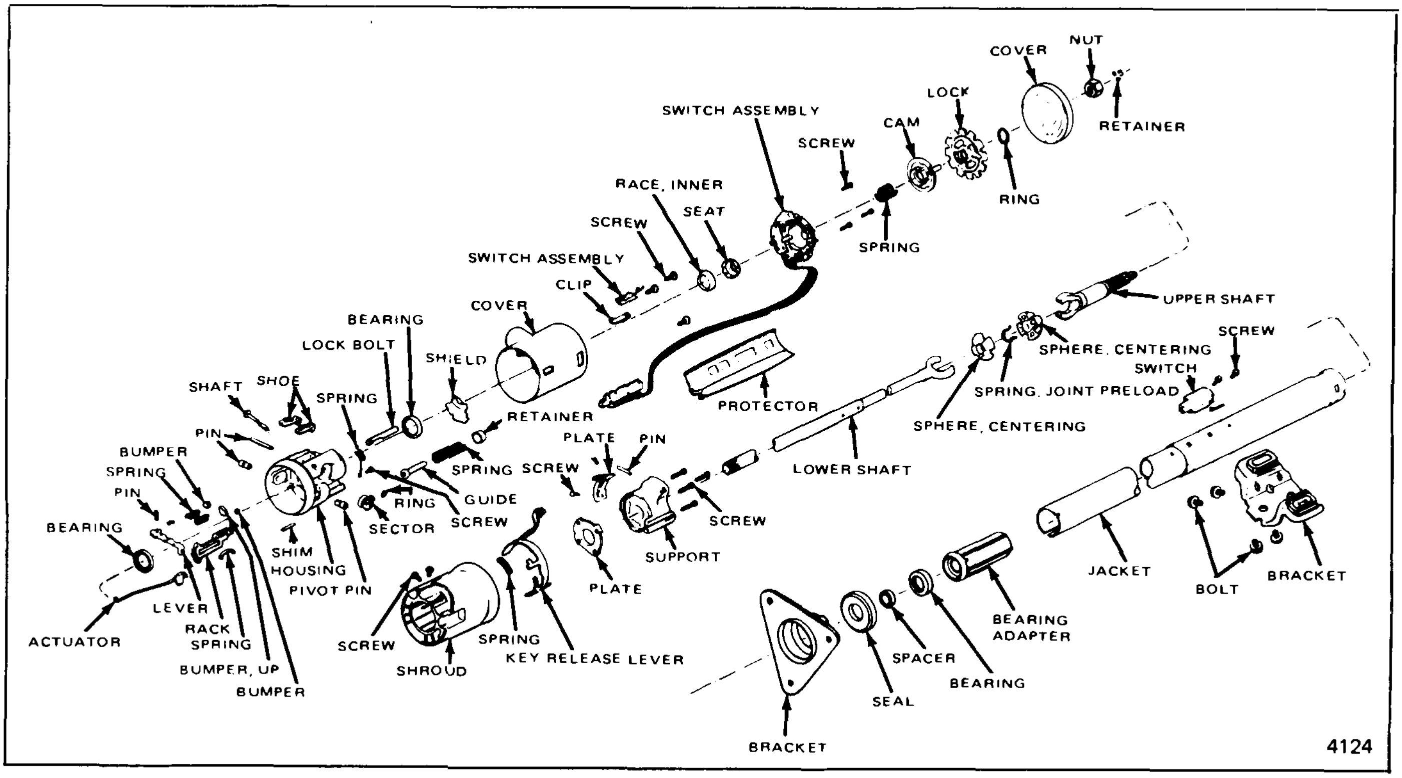


Fig. 3B4-7 Tilt-Away Key Release Column

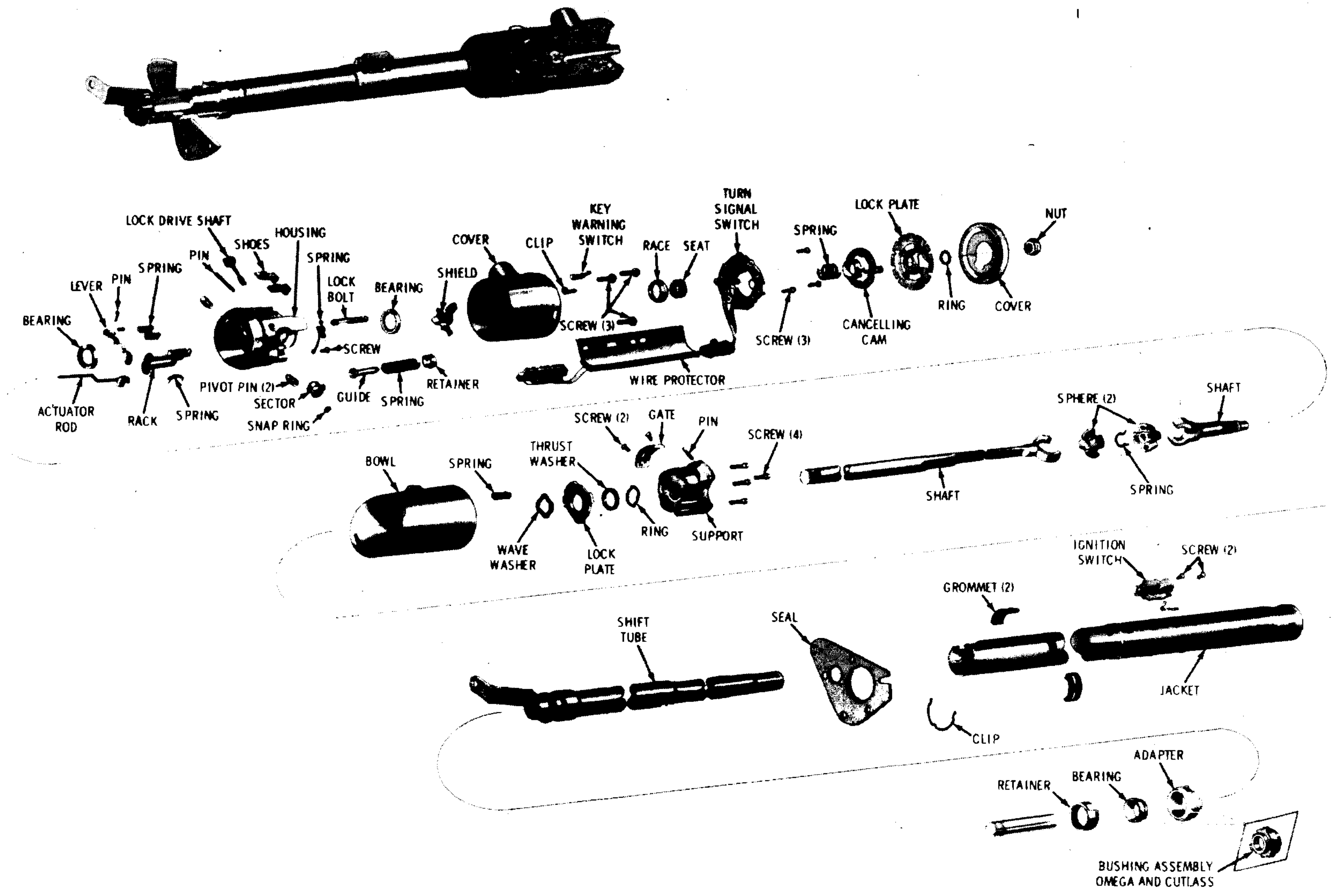


Fig. 3B4-8 Tilt-Away Column

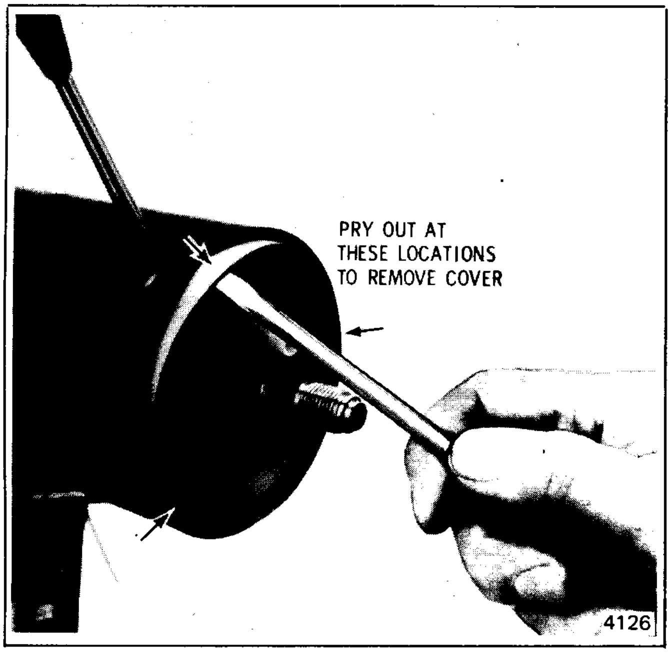


Fig. 3B4-9 Cover Attachment

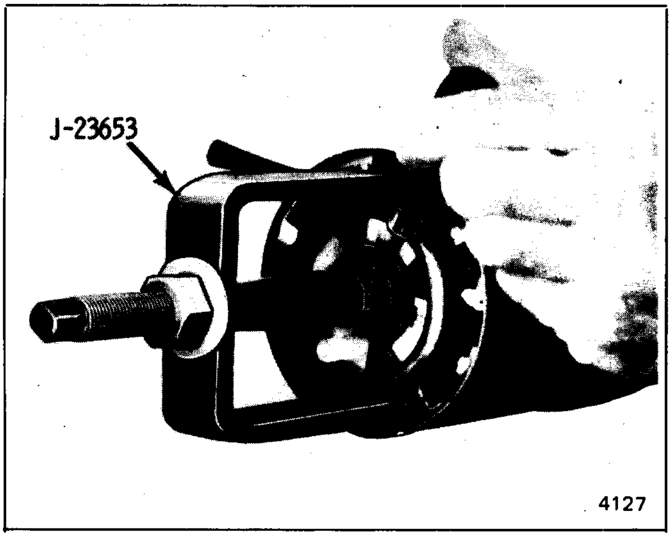


Fig. 3B4-10 Removing Wire Snap Ring

TURN SIGNAL SWITCH (TILT-AWAY)

Removal

1. Disconnect negative cable from battery.

2. Refer to STEERING WHEEL-Removal.

3. Lock plate cover may be removed for replacement at this time by releasing as shown (Fig. 3B4-9).

4. Position Tool J 23653 over steering shaft, tighten nut until tool slightly depresses lock plate. Pry wire snap ring from shaft and discard (Fig. 3B4-10). Remove Tool J 23653.

5. Remove lock plate and cancelling cam (Fig. 3B4-11).

6. Remove upper bearing preload spring.

7. Position turn signal lever in right turn position, then remove turn signal lever attaching screw and lever (Fig. 3B4-13).

8. Push in on hazard warning knob, then remove screw and hazard warning knob.

9. Lift up on tilt lever and position housing in center position, then remove the three turn signal switch attaching screws (Fig. 3B4-13).

10. Remove instrument panel lower trim cap or lower trim panel, then disconnect turn signal connector (Fig. 3B4-14) from mounting bracket on right side of jacket.

11. Remove the four bolts "W", "X", "Y" and "Z" attaching bracket assembly to jacket (Fig. 3B4-15).

12. Loosen shift indicator needle attaching screw and remove or disconnect if column shift (automatic) equipped.

13. Remove the two nuts "A" and "B" from bracket assembly while holding column in position. Remove bracket assembly and wire protector from turn signal wiring, then loosely install bracket using nuts "A" and "B" to hold column in place (Fig. 3B4-15).

14. Tape turn signal switch wires at connector, keeping wires flat and parallel, then carefully pull turn signal switch and wiring from top end of column.

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

1. With switch wiring taped flat at connector, carefully guide wiring into column.

2. Index switch into right turn position, then push switch straight down until seated in cover.

NOTE: Angling or cocking of switch can cause damage to buzzer terminal or can cause buzzer tangs to get under terminal pads on signal switch.

3. Install switch attaching screws (3) and torque to 35 in. lbs. (Fig. 3B4-13).

4. Position turn signal switch in the neutral position.

NOTE: If the signal switch is not placed in "neutral" position, assembly of the cancelling cam may cause damage to the turn signal cancel springs in the signal switch assembly.

5. Install hazard warning knob and turn signal switch lever and attaching screw.

6. Install upper bearing preload spring.

7. Install cancelling cam and lock plate (Fig. 3B4-11).

8. Position NEW wire snap ring over Tool J 24653. Install Tool J 23653 over shaft and tighten nut until wire snap ring can be installed in groove in steering shaft (Fig. 3B4-12). Remove Tool J 23653.

9. If removed, reinstall cover on lock plate (Fig. 3B4-9).

10 Refer to STEERING WHEEL-Installation.

11. While holding column in place, remove nuts "A" and "B" from bracket assembly. Insert wiring into wire protector until slots in protector will align with weld nuts on column. Then install bracket with bolts "W", "X", "Y" and "Z" and nuts "A" and "B" loosely (Fig. 3B4-15).

12. Torque bolt "W" first to 30 ft. lbs., bolt "X" second to 30 ft. lbs., bolts "Y" and "Z" next to 30 ft. lbs. and nuts "A" and "B" to 25 ft. lbs.

13. Install shift indicator needle or clip. Adjust as necessary (Figs. 3B4-16, 3B4-17 and 3B4-18).

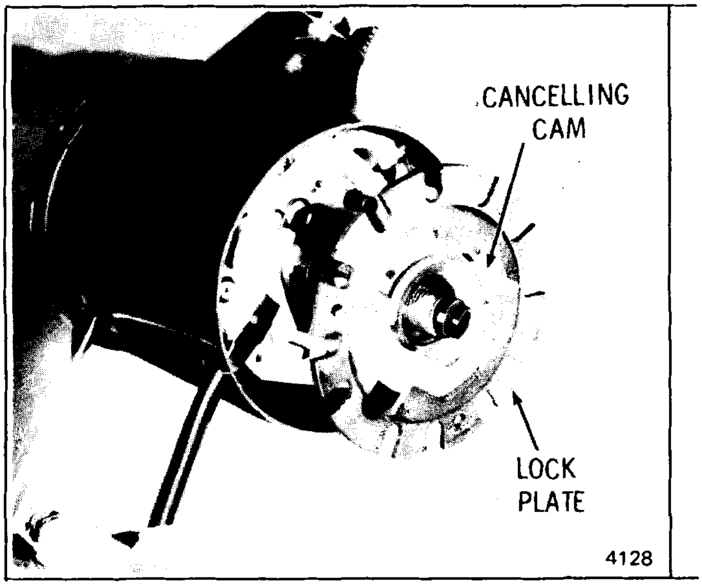


Fig. 3B4-11 Lock Plate and Cancelling Cam

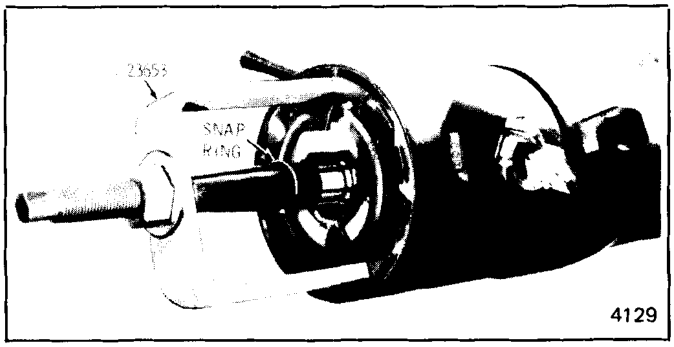


Fig. 3B4-12 Installing Wire Snap Ring

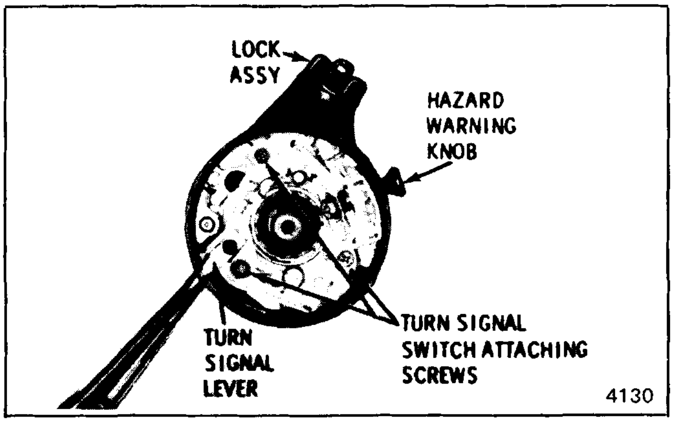


Fig. 3B4-13 Turn Signal Switch Attachment

14. Connect turn signal wiring connector to harness, then position connector into bracket on right side of jacket (Fig. 3B4-14).

15. Install instrument panel lower trim cap or lower trim panel.

16. Connect negative battery cable.

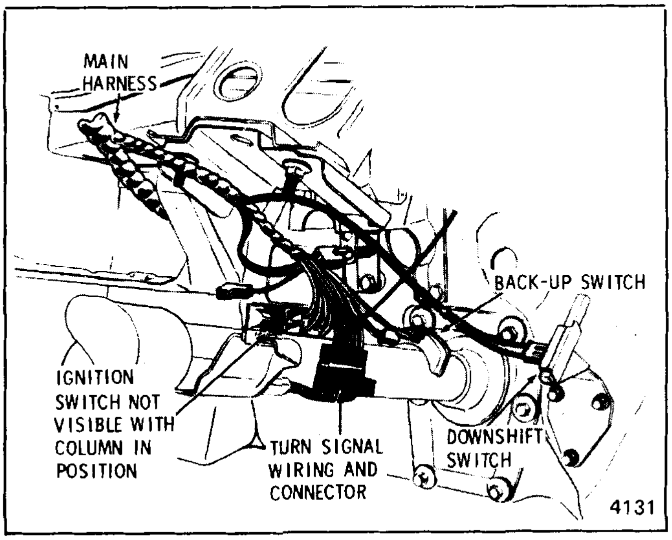


Fig. 3B4-14 Column Wiring Connectors

IGNITION LOCK ASSEMBLY (TILT-AWAY)

Removal

1. Disconnect negative cable from battery.
2. Refer to STEERING WHEEL-Removal.
3. Lock plate cover may be removed for replacement at this time by releasing as shown (Fig. 3B4-9).
4. Position Tool J 23653 over steering shaft. Tighten nut until tool slightly depresses lock plate. Pry wire snap ring from shaft and discard (Fig. 3B4-10). Remove Tool J 23653.
5. Remove lock plate and cancelling cam (Fig. 3B4-11).
6. Remove upper bearing preload spring.
7. Position turn signal lever in the right turn position, then remove turn signal lever attaching screw and lever (Fig. 3B4-13).
8. Push in on hazard warning knob, then remove screw and hazard warning knob.

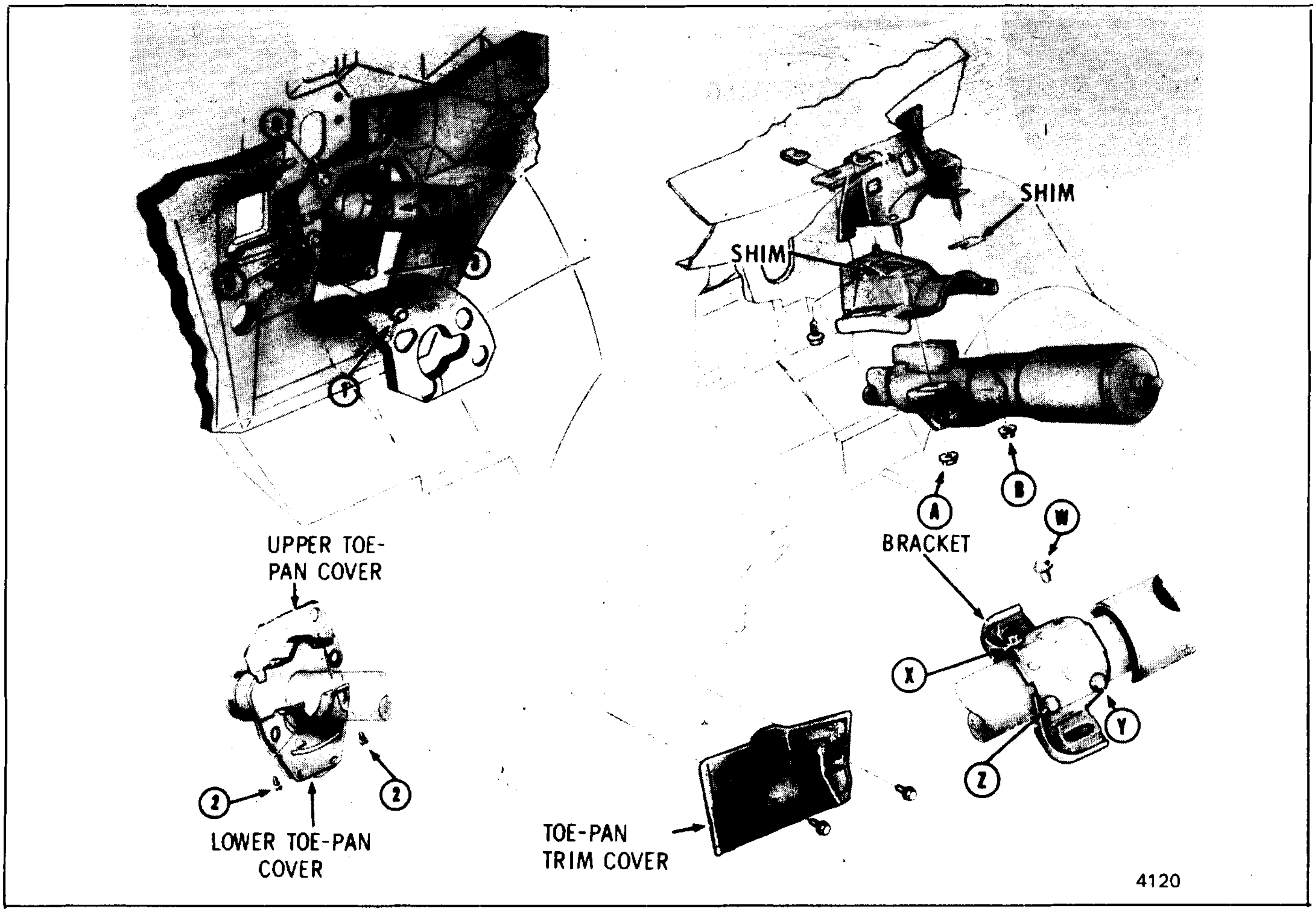


Fig. 3B4-15 Column Mounting A and G Series

9. Remove the three turn signal switch attaching screws (Fig. 3B4-13).

10. Disconnect turn signal connector from harnness (Fig. 3B4-14). Lift connector from mounting bracket on right side of jacket.

11. Pull up on turn signal switch until switch can be positioned as shown in Fig. 3B4-19.

12. Position lock assembly in "RUN" position, then insert a thin tool (small screwdriver or knife blade) into the slot next to the switch mounting screw boss (right hand slot) and depress retainer at bottom of slot, which releases lock. Remove lock (Fig. 3B4-20).

Installation

NOTE: Apply thin coat of lithium grease to all friction parts except ignition lock assembly.

1. Install lock, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into cover bore with key on cylinder sleeve aligned to keyway in housing (Fig. 3B4-21); push in until cylinder hits sector. Rotate knob counterclockwise, maintaining a light push inward on cylinder, until drive section of cylinder mates with drive shaft. Push in until snap ring pops into groove and lock cylinder is secured in cover. Check freedom of rotation.

2. While pulling slightly on turn signal wiring at connector, guide turn signal switch into inside of cover.

3. Index switch into right turn position, then push switch straight down until seated in cover.

NOTE: Angling or cocking of switch can cause damage to buzzer terminal or can cause buzzer tangs to get under terminal pads on signal switch.

4. Install switch attaching screws (3) and torque to 35 in. lbs. (Fig. 3B4-13).

5. Position turn signal switch in the "Neutral" position.

NOTE: If the signal switch is not placed in "neutral" position, assembly of the cancelling cam may cause damage to the turn signal cancel springs in the signal switch assembly.

6. Reconnect turn signal connector to harness and position connector in bracket on jacket.

7. Install hazard warning knob.

8. Install turn signal lever and attatching screw (Fig. 3B4-13).

9. Install upper bearing preload spring.

10. Install cancelling cam and lock plate aligning splines in steering shaft with I.D. of lock plate (Fig. 3B4-11).

11. Position NEW wire snap ring over Tool J 23653. Install Tool J 23653 over shaft and tighten nut until wire snap ring can be installed in groove in steering shaft (Fig. 3B4-12).

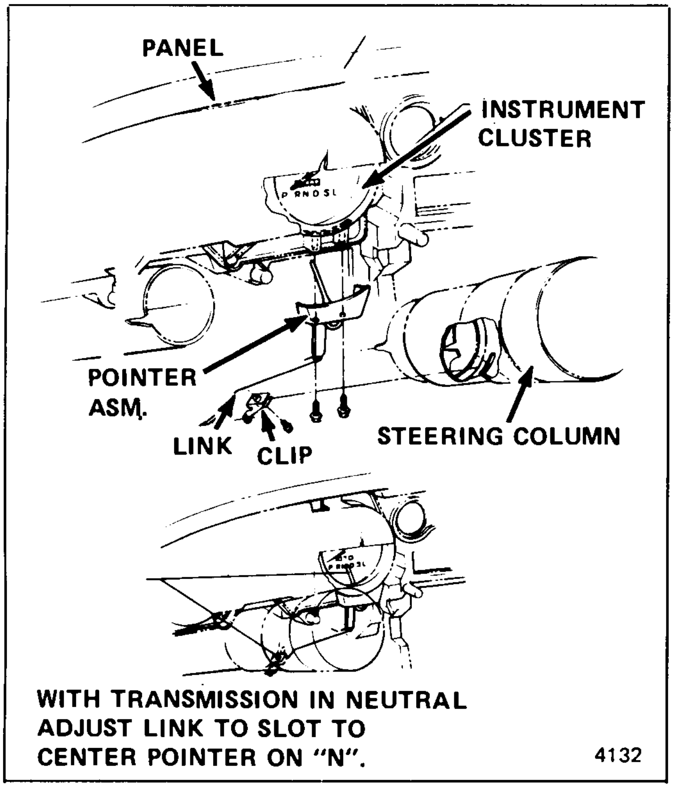


Fig. 3B4-16 Shift Indicator Link - A and G Series

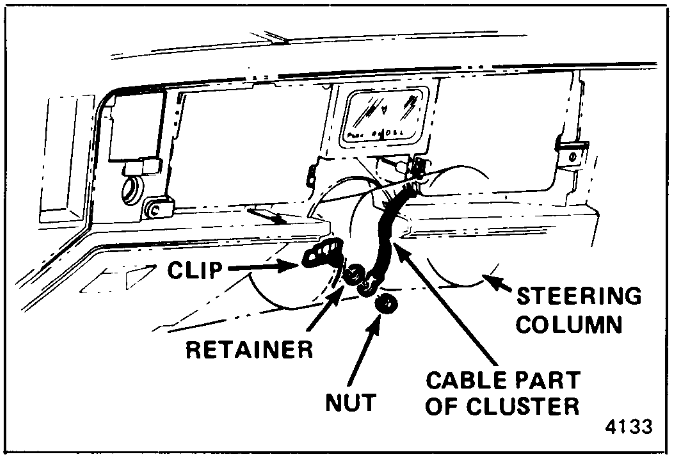


Fig. 3B4-17 Shift Indicator Needle - B Series

Remove Tool J 23653.

12. If removed, reinstall cover on lock plate (Fig. 3B4-9).
13. Refer to STEERING WHEEL-Installation.
14. Connect negative battery cable.

KEY WARNING BUZZER SWITCH (TILT-AWAY)

Removal

1. Refer to IGNITION LOCK ASSEMBLY (Tilt-Away)-Removal-Steps 1-12.

NOTE: Ignition lock assembly must be removed before key warning buzzer switch is removed.

2. Using needle nose pliers, remove key warning buzzer switch and spring clip (Fig. 3B4-22).

NOTE: Care must be exercised on removal of switch so that spring clip is not lost or damaged.

Installation

1. Assemble buzzer switch and spring clip with formed end of clip under end of switch and spring bowed away from switch on side opposite contact. Push switch and spring into hole in cover to the step with contacts toward lock cylinder bore (Fig. 3B4-23).

NOTE: Make sure terminal prongs are not bent downward during installation.

NOTE: Key warning buzzer switch must be installed before ignition lock assembly is installed.

2. Refer to IGNITION LOCK ASSEMBLY (Tilt-Away)-Installation-Steps 1-14.

COVER (TILT-AWAY)

Removal

1. Refer to TURN SIGNAL SWITCH (Tilt-Away)-Removal-Steps 1-14.

2. Position lock assembly in RUN position. Insert a thin tool (small screwdriver or knife blade) into the slot next to the switch mounting screw boss (right hand slot) and depress retainer at bottom of slot, which releases lock. Remove lock (Fig. 3B4-20).

NOTE: Ignition lock assembly must be removed before key warning buzzer switch is removed.

3. Using needle nose pliers, remove key warning buzzer switch and spring clip, if replacing cover (Fig. 3B4-22).

4. Unscrew tilt lever and remove.

5. Remove the three cover to housing attaching screws and remove cover (Fig. 3B4-24).

NOTE: It may be necessary to tap cover lightly with a plastic hammer to remove.

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Install cover. Torque the three cover to housing attaching screws to 100 in. lbs.

2. Install tilt lever.

3. If cover was replaced, assemble buzzer switch and spring clip with formed end of clip under end of switch and spring bowed away from switch on side opposite contact. Push switch and spring clip into hole in cover to the step with contacts toward lock cylinder bore (Fig. 3B4-23).

NOTE: Key warning buzzer switch must be installed before ignition lock assembly is installed.

4. Install lock, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into cover bore with key on cylinder sleeve aligned to keyway in housing (Fig. 3B4-21). Push into abutment of cylinder and sector. Rotate

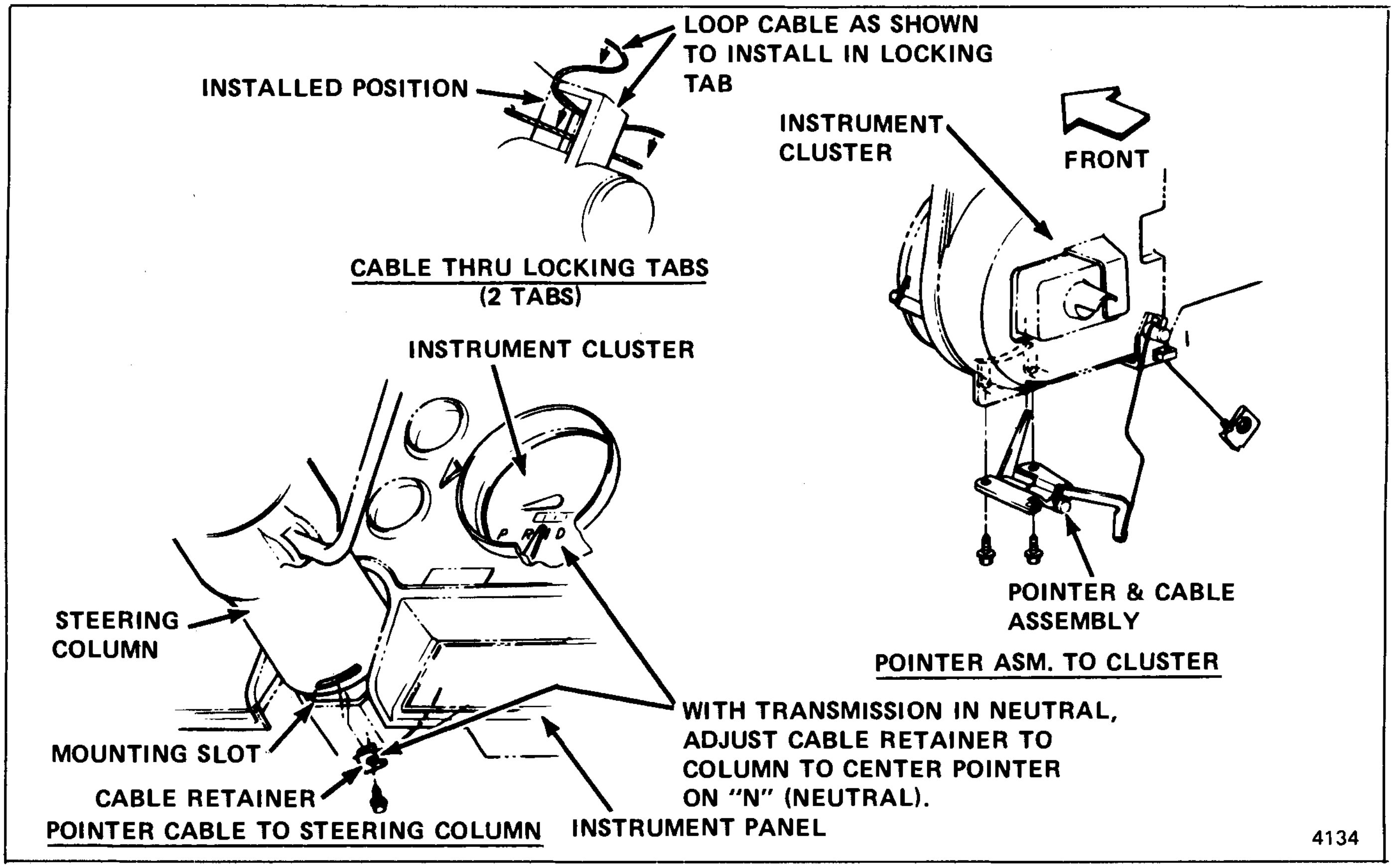


Fig. 3B4-18 Shift Indicator Cable - X Series

knob counterclockwise, maintaining a light push inward on cylinder, until drive section of cylinder mates with drive shaft. Push in until snap ring snaps into groove and lock cylinder is secured in cover. Check freedom of rotation.

5. Refer to TURN SIGNAL SWITCH (Tilt-Away)-Installation-Steps 1-16.

STEERING LOCK BOLT SPRING (TILT-AWAY)

Removal

1. Refer to COVER (Tilt-Away)-Removal-Steps 1-5.
2. Remove tilt lever opening shield from housing (Fig. 3B4-25).
3. Remove spring attaching screw (Fig. 3B4-25), then move rack assembly upward.
4. Turn spring clockwise until disconnected from steering shaft lock bolt. Remove spring (Fig. 3B4-26).

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Install lock bolt spring so that hook of spring engages lock bolt (in slot at lower end of lock bolt) and loop fits into slot in sector.
2. Position spring and install attaching screw (Fig. 3B4-25). Move rack assembly downward until stop is felt.
3. Install tilt lever opening shield into housing (Fig. 3B4-25).
4. Refer to COVER (Tilt-Away)-Installation-Steps 1-5.

SECTOR AND/OR LOCK BOLT (TILT-AWAY)

Removal

1. Refer to COVER (Tilt-Away)-Removal-Steps 1-5.
2. Remove tilt lever opening shield from housing (Fig. 3B4-25).
3. Remove lock bolt spring attaching screw (Fig. 3B4-25), then move rack assembly upward.
4. Turn spring clockwise until disconnected from steering shaft lock bolt. Remove spring (Fig. 3B4-26).
5. Using snap ring pliers, remove snap ring (Fig. 3B4-27).
6. Remove sector from housing by pulling straight out until sector is off lock drive shaft.
7. Lock bolt can now be removed from housing as shown in Fig. 3B4-28.

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Install lock bolt into housing with flat of lock bolt positioned as shown in Fig. 3B4-28.

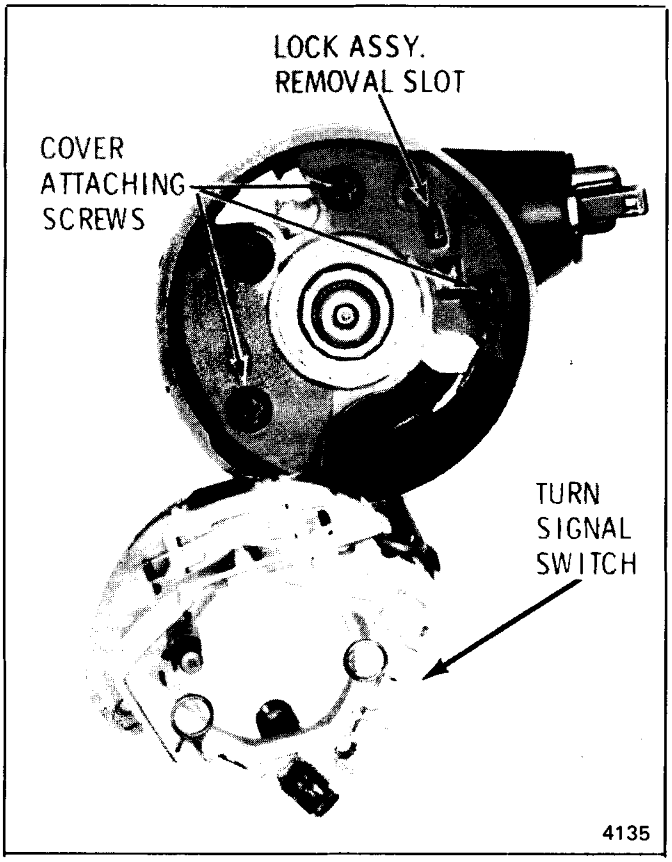


Fig. 3B4-19 Location of Switch for Lock Removal

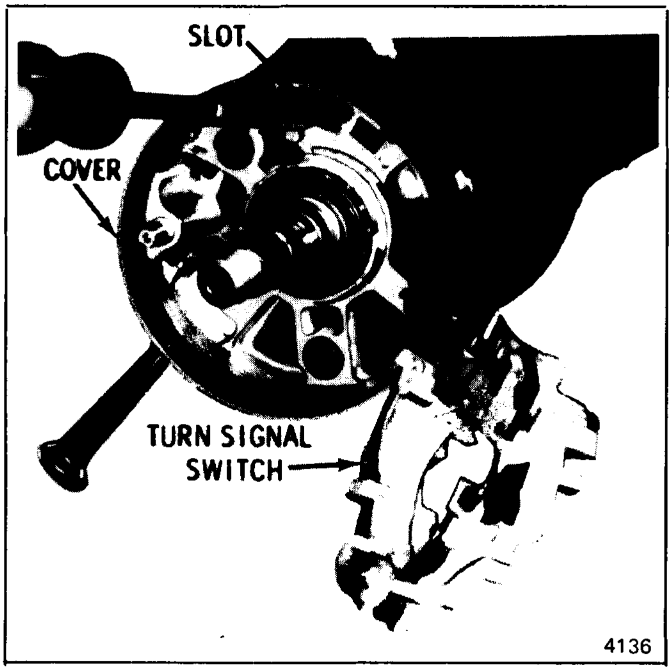


Fig. 3B4-20 Ignition Lock Removal

2. Install sector with large tooth of sector engaging large tooth of rack. While holding sector in place, align flats of lock drive shaft into sector. It may be necessary to tap lock drive shaft into sector.

NOTE: Flange of sector must engage lock bolt as shown in Fig. 3B4-27.

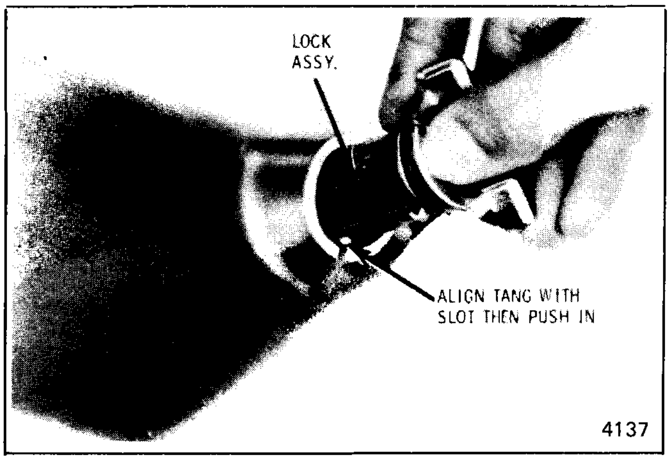


Fig. 3B4-21 Installing Ignition Lock

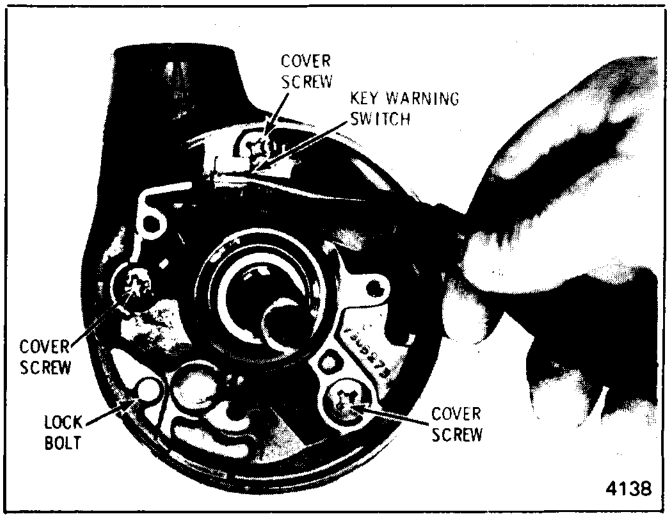


Fig. 3B4-22 Remove Key Warning Buzzer Switch

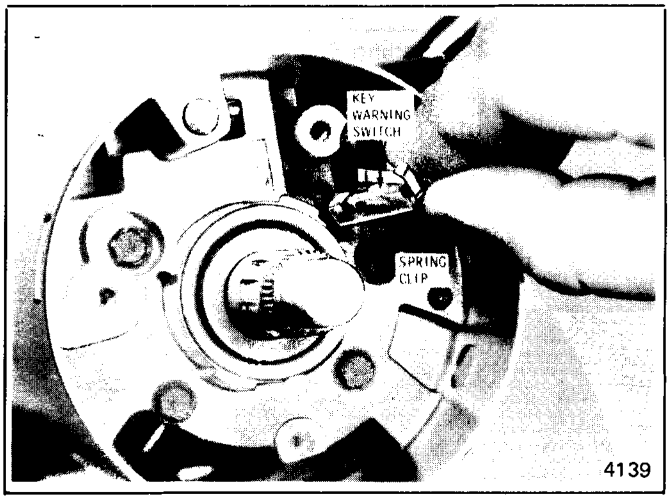


Fig. 3B4-23 Install Key Warning Buzzer Switch

3. Install snap ring as shown in Fig. 3B4-27.

4. Install lock bolt spring so that hook of spring engages lock bolt (in slot at lower end of lock bolt) and loop fits into slot in sector.

5. Position spring and install attaching screw (Fig. 3B4-25). Move rack assembly downward until stop is felt.

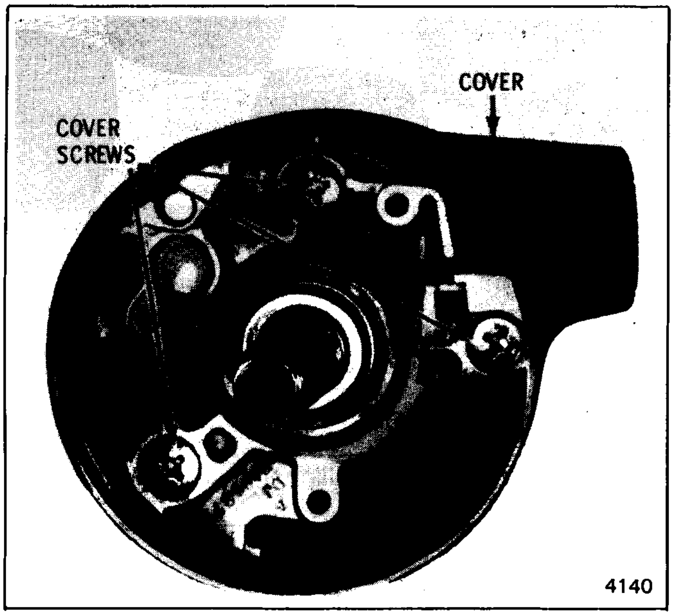


Fig. 3B4-24 Cover Attachment

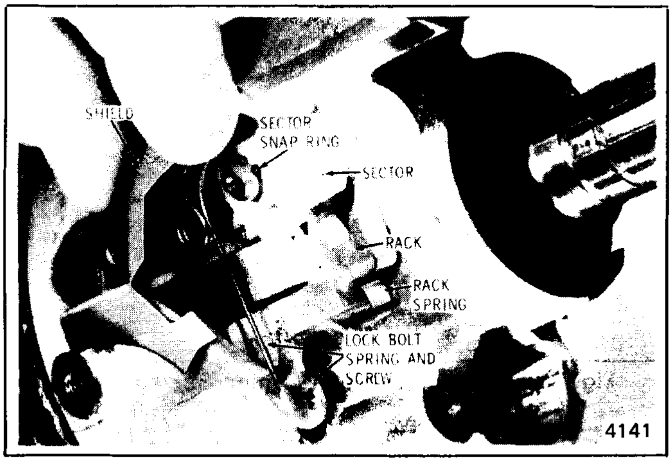


Fig. 3B4-25 Opening Shield and Lock Spring

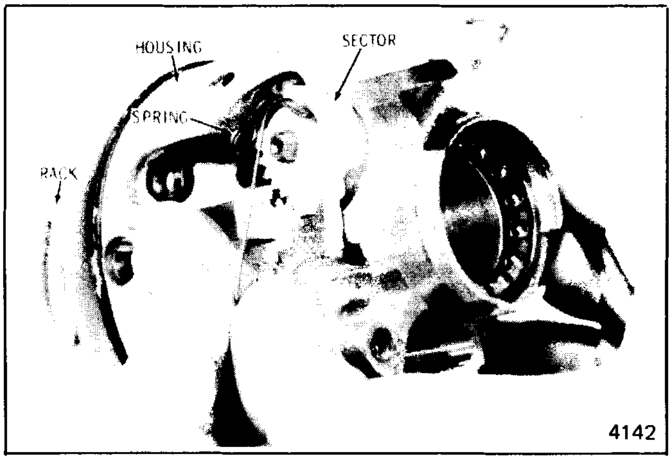


Fig.3B4-26 Removing Lock Bolt Spring

6. Install tilt lever opening shield into housing (Fig. 3B4-25).

7. Refer to COVER (Tilt-Away)-Installation-Steps 1-5.

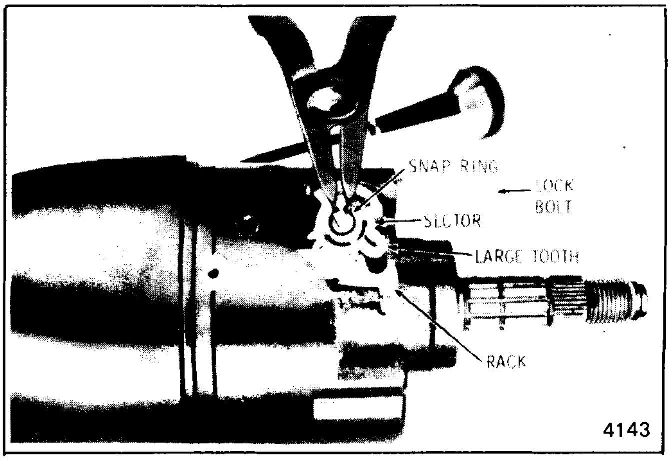


Fig. 3B4-27 Sector Snap Ring

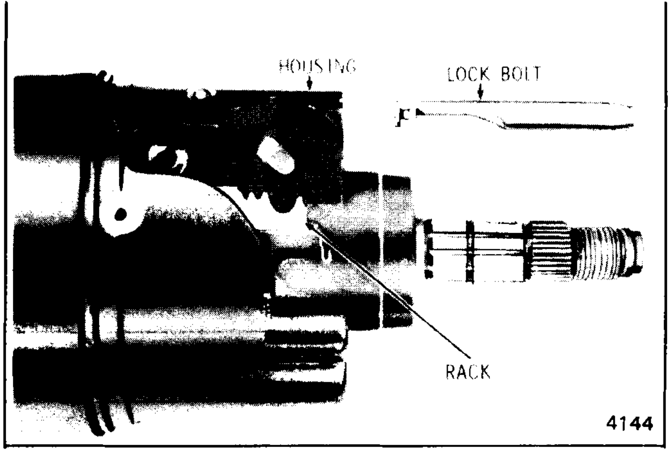


Fig. 3B4-28 Lock Bolt

LOCK DRIVE SHAFT

Removal

1. Refer to COVER (Tilt-Away)-Removal-Steps 1-5.
2. Remove tilt lever opening shield from housing (Fig. 3B4-25).
3. Remove lock bolt spring attaching screw (Fig. 3B4-25) the move rack assembly upward.
4. Turn spring clockwise until disconnected from steering shaft lock bolt. Remove spring (Fig. 3B4-26).
5. Using snap ring pliers, remove snap ring (Fig. 3B4-27).
6. Lock drive shaft may now be removed from sector through lock assembly opening.
7. Remove lock drive shaft (Fig. 3B4-29).

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Install lock drive shaft (Fig. 3B4-29).
2. Insert lock drive shaft into housing and, while holding sector, align flats of lock drive shaft into sector. It may be necessary to tap lock drive shaft into sector.
3. Install snap ring as shown in Fig. 3B4-27.

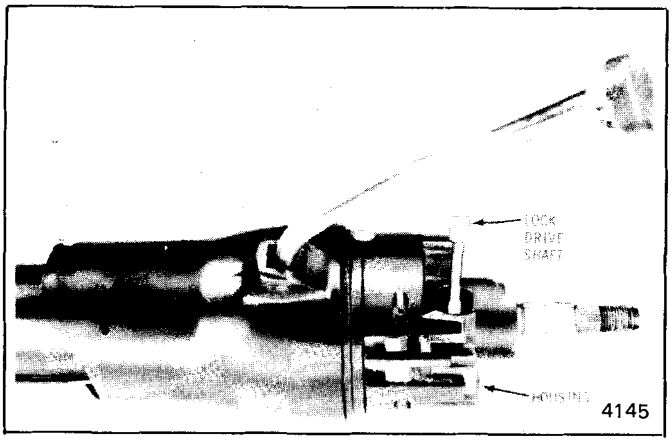


Fig. 3B4-29 Lock Drive Shaft

4. Install lock bolt spring so that hook of spring engages lock bolt (in slot at lower end of lock bolt) and fits into slot in sector.

5. Position spring and install attaching screw (Fig. 3B4-25).

6. Install tilt lever opening shield into housing (Fig. 3B4-25).

7. Refer to COVER (Tilt-Away)-Installation-Steps 1-5.

HOUSING (TILT-AWAY)

Removal

1. Refer to COVER (Tilt-Away)-Removal-Steps 1-5.
2. Remove seat and race as shown in Fig 3B4-30.

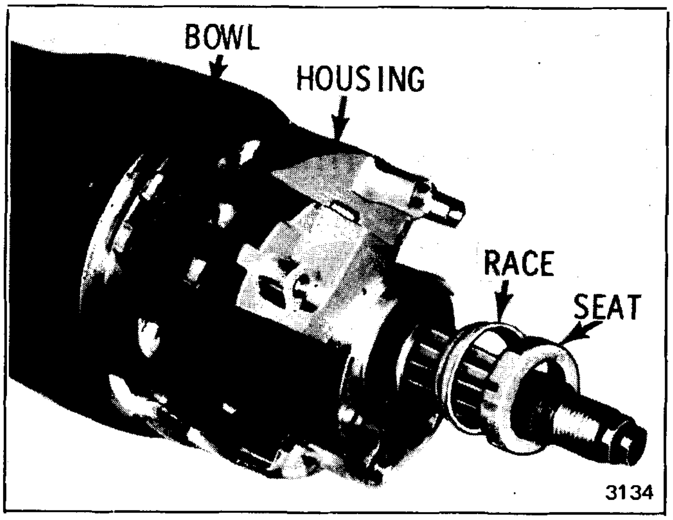


Fig. 3B4-30 Housing Seat and Race

3. Install tilt lever and position column in the full "UP" position.

4. Remove tilt spring retainer using screwdriver blade that fits into slot of retainer. Press in and turn approximately 1/8 turn counterclockwise (Fig. 3B4-31). Remove tilt spring retainer, spring and guide.

5. Install Tool J 21854-1 and remove pivot pins as shown in Fig. 3B4-32.

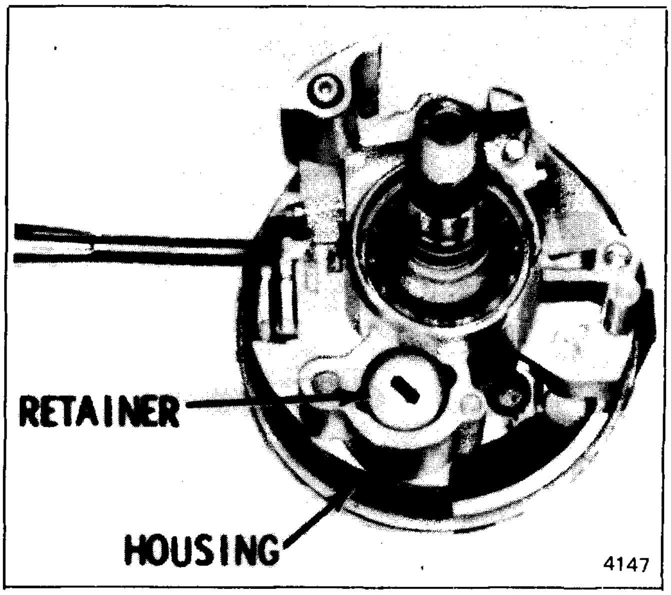


Fig. 3B4-31 Tilt Spring Retainer

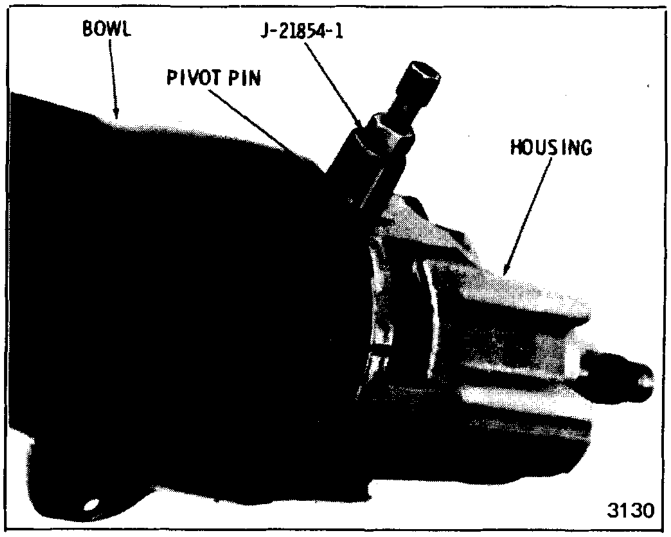


Fig. 3B4-32 Removing Pivot Pins

6. Lift tilt lever to release lock shoes. Pull upward on housing to extend rack fully down and by moving housing to the left to disengage rack from actuator. Then remove housing from column.

NOTE: If tilt release lever or lock shoes or spring are to be replaced they can be removed at this time. Using Tool J 22635, drive out tilt release lever pin, then remove lever and spring. Drive out lock shoe pin with Tool J 22635 and remove lock shoes and springs (Figs. 3B4-33 and 3B4-34).

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

NOTE: If tilt release lever and spring or lock shoes and springs were removed, they should be installed at this time. Refer to Figs. 3B4-33 and 3B4-34 for correct positioning.

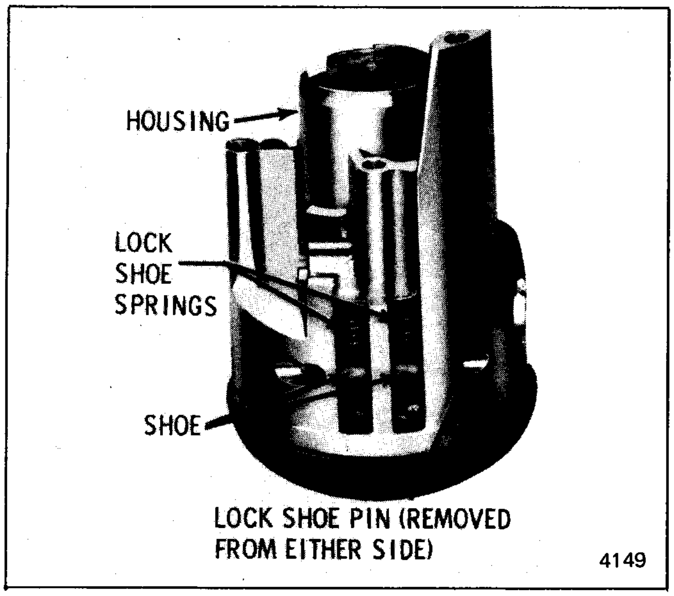


Fig. 3B4-33 Lock Shoe Attachment

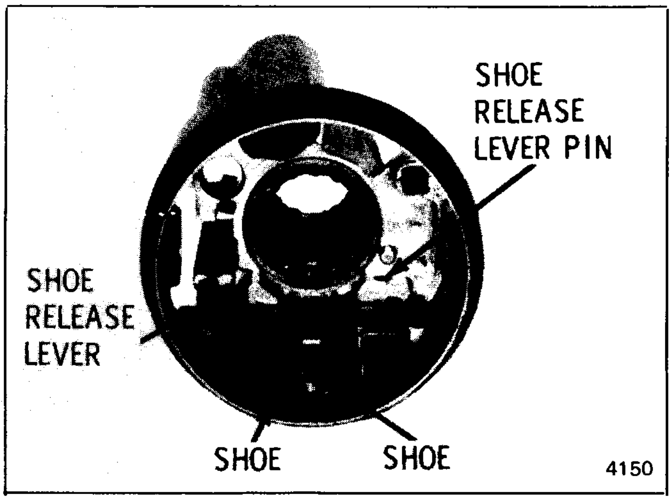


Fig. 3B4-34 Shoe Release Lever

1. While holding up on tilt lever to disengage lock shoes, install housing over steering shaft. Move rack downward and hold, tip housing to the left until rack engages pin on actuator rod, pushing housing down until pivot pin holes are in alignment.

NOTE: Housing bearings must be in position in housing for proper installation of housing. It bearings are out of race, snap ring cannot be installed.

2. Install pivot pins using a brass drift to fully seat pins.

3. By turning lock drive shaft back and forth at this time and watching actuator rod, you can determine if rack and actuator rod are correctly installed.

4. Lift up on tilt lever and position housing in the full "UP" position.

5. Install guide and spring into housing, then place tilt spring retainer over exposed end of spring. Using a screwdriver with a blade that fits into slot of retainer, press in and turn approximately 1/8 turn clockwise until retainer is engaged in housing.

6. Install race and seat as shown in Fig. 3B4-30.

7. Lift up on tilt lever and position housing in the center position. Remove tilt lever.

8. Refer to COVER (Tilt-Away)-Installation-Steps 1-5.

RACK AND/OR SPRING (TILT-AWAY)

Removal

1. Refer to HOUSING (Tilt-Away)-Removal-Steps 1-6.
2. Remove tilt lever.
3. Remove tilt lever opening shield from housing (Fig. 3B4-25).
4. Remove lock bolt spring attaching screw (Fig. 3B4-25).
5. Remove rack from lower end of housing.
6. Remove rack spring from guide to housing.

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Install rack spring into guide in housing with ears of spring over ends of rack guide so that spring will be retained in position.

2. Rotate sector clockwise until large tooth is pointing toward lower portion of housing. Install rack into housing guide and when large tooth of sector and large tooth of rack are in alignment, release sector and push rack into position.

3. Install lock bolt spring attaching screw (Fig. 3B4-25).

4. Install tilt lever opening shield into housing (Fig. 3B4-25).

5. Install tilt lever.

6. Refer to HOUSING (Tilt-Away)-Installation-Steps 1-8.

STEERING SHAFT (TILT-AWAY)

Removal

1. Refer to HOUSING (Tilt-Away)-Removal-Steps 1-6.

2. Remove attaching bolt from flange to steering shaft or bolt and nut from clamp to steering shaft located at lower end of steering shaft (Fig. 3B4-35).

3. Carefully pull steering shaft assembly from column inside of the car.

NOTE: On H Series, remove spacer from end of shaft before removing shaft (Fig. 3B4-36).

NOTE: If repair is to be done on centering spheres or centering sphere spring, it will not be necessary to remove steering shaft completely from column.

4. With steering shaft removed from column, turn upper shaft 90° to centerline of lower shaft, align flats on centering sphere with lower shaft and remove upper shaft with centering sphere (Fig. 3B4-37).

5. Remove centering sphere from upper shaft by rotating sphere so flats align with opening, then remove sphere.

6. A spring is used between spheres and must be positioned into indentations in spheres when installing (Fig. 3B4-38).

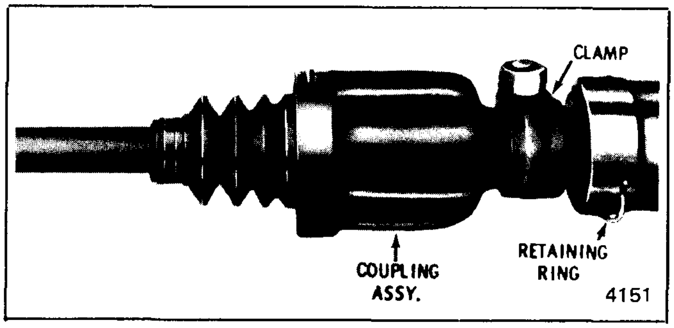


Fig. 3B4-35 Coupling Assembly

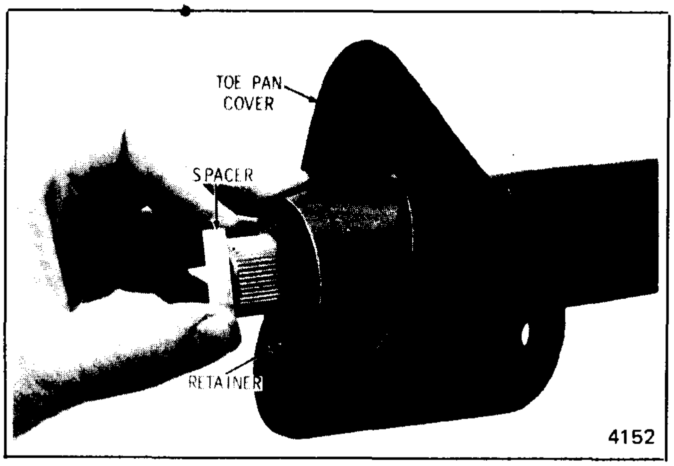


Fig. 3B4-36 Lower Shaft Spacer

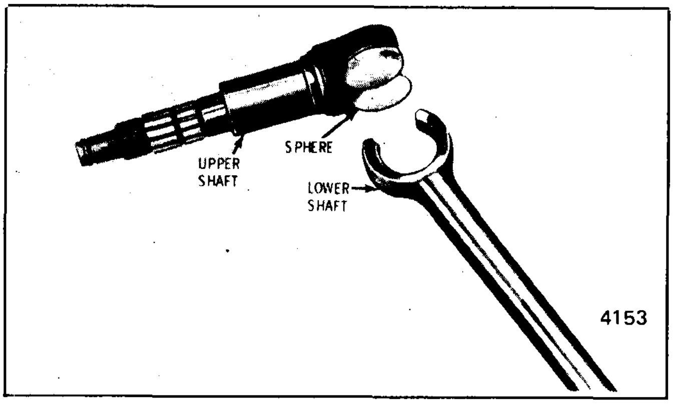


Fig. 3B4-37 Removing Spherical Joint

Installation

See CAUTION on Page 3B4-1 of this Section.

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Position spring into indentations of spheres and with flats aligned with yoke opening, then insert into yoke and rotate 90°.

2. Turn yoke 90° to centerline of lower shaft, align flat of spheres, then rotate yoke until assembled.

3. Install steering shaft (from inside of car) into column.

NOTE: It may be necessary to guide shaft through lower bearing from under hood of car.

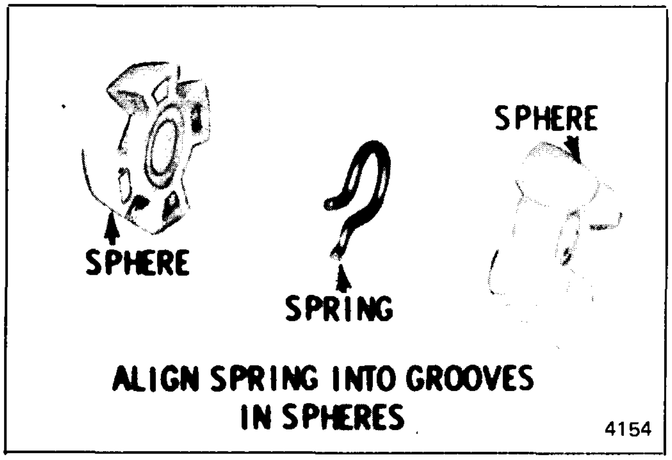


Fig. 3B4-38 Spherical Joint

4. Lift up on lower end of steering shaft and guide shaft into flange or coupling and install bolt and/or nut. Do not torque at this time.

NOTE: On H Series install spacer at lower end of steering shaft (Fig. 3B4-36).

5. Refer to HOUSING (Tilt-Away)-Installation-Steps 1-8.

6. (H Series) Torque flange bolt to 30 ft. lbs.

(Except H Series) Torque clamp to steering shaft nut to 55 ft. lbs.

SUPPORT AND/OR SHIFT GATE (TILT-AWAY)

Removal

1. Refer to HOUSING (Tilt-Away)-Removal-Steps 1-6.

2. Remove attaching bolt or bolt and nut at lower end of steering shaft (Fig. 3B4-35).

3. Carefully pull steering shaft assembly from column inside of the car.

4. Using a small punch, drive pin from shift lever and pull out on lever to remove.

5. Remove the four screws attaching support to lock plate (Fig. 3B4-39).

6. Lift up on support to remove.

7. Remove shift gate or retainer plate (on H Series) attaching screws and remove shift gate or retainer plate from support (Fig. 3B4-40).

8. H Series only - Remove 2 shroud retaining screws (Fig. 3B4-41) and remove shroud by working it straight off jacket.

NOTE: Shroud retaining screws may not be used on all H Series columns. When installing either a new shroud or jacket the screws will not be used.

9. Remove key release lever (Fig. 3B4-42):

a. Tilt lever handle slightly toward center to clear stop on shroud.

b. Move lever counterclockwise until it stops.

c. Lift lever straight out.

NOTE: Spring may be removed from lever for inspection.

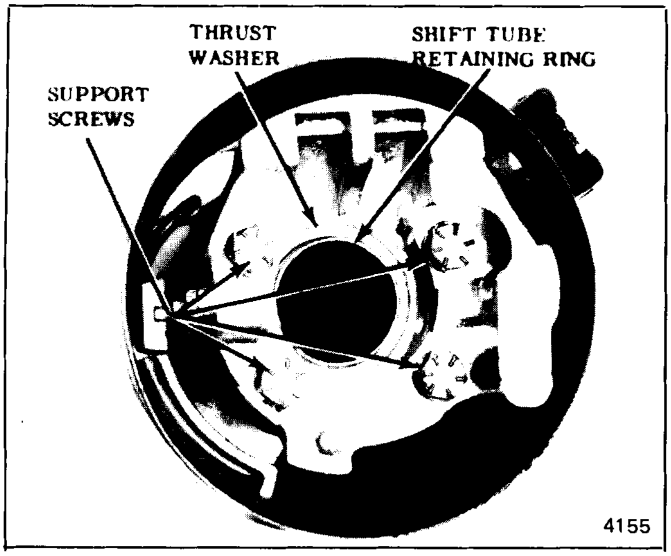


Fig. 3B4-39 Support Attachment

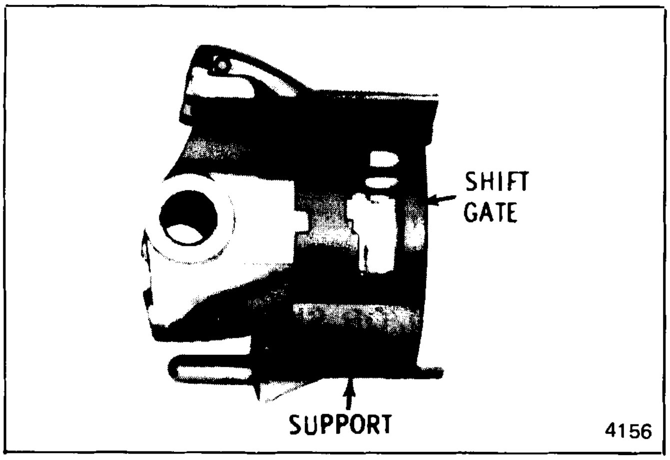


Fig. 3B4-40 Shift Gate Mounting

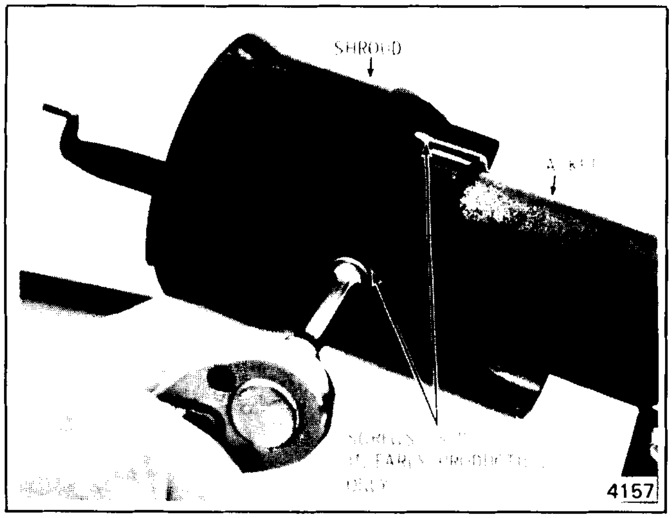


Fig. 3B4-41 Shroud Removal - H Series

Installation

See CAUTION on Page 3B4-1 of this Section.

NOTE: Apply thin coat of lithium grease to all friction parts.

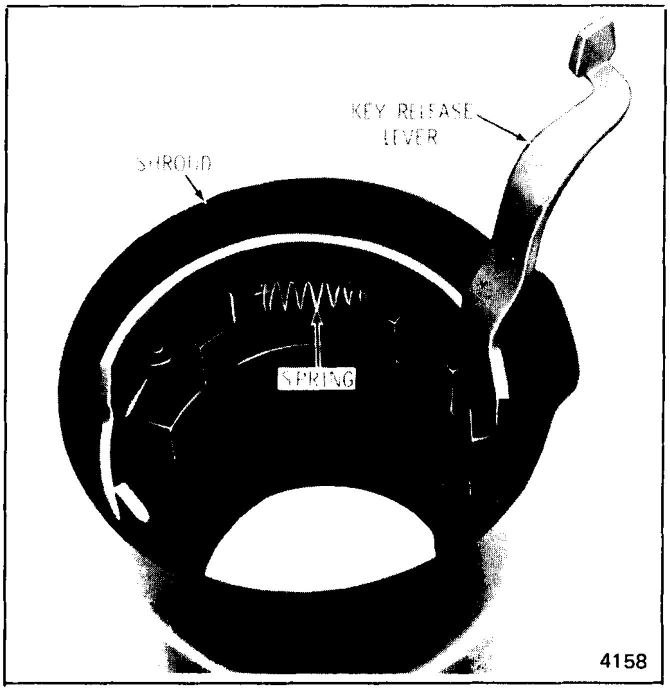


Fig. 3B4-42 Key Release Lever (Tilt-Away)

1. H Series Only - Install key release lever and spring assembly into shroud by locating spring in shroud slot. Compress spring and slip lever into shroud slot (Fig. 3B4-42).
2. H Series Only - Align shroud ribs with slots in jacket and push into position. Install shroud retaining screws if removed (Fig. 3B4-41).
3. Position shift gate (retainer plate on H Series) on support and install attaching screws (Fig. 3B4-40).
4. Install support by aligning "V" in support with notch in jacket (Fig. 3B4-43). Install the four screws through support into lock plate. Torque screws to 60 in. lbs.

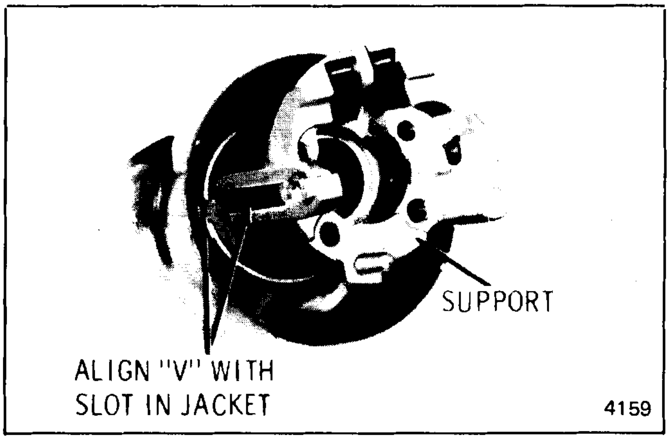
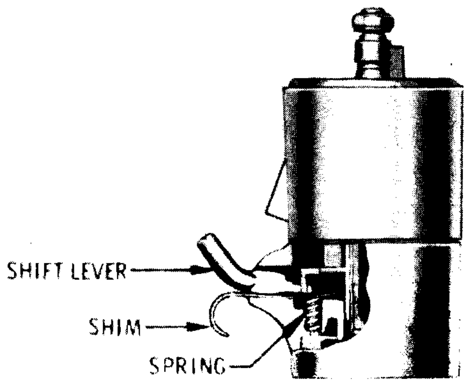


Fig. 3B4-43 Aligning "V" In Support

5. All except H Series - Install shift lever into bowl as shown in Fig. 3B4-44, then remove shim and drive shift lever retaining pin into place.

6. Install steering shaft (from inside of car) into column.

NOTE: It may be necessary to guide shaft through lower bearing from under hood of car.



1. INSERT SHIM OVER TOP OF SPRING.
2. INSERT SHIFT LEVER.
3. INSTALL PIVOT PIN.
4. REMOVE SHIM.

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Fig. 3B4-44 Shift Lever Installation

7. Lift up on lower end of steering shaft and guide shaft into flange (H Series) or coupling (except H Series) and install bolt and/or nut. Do not torque at this time.

8. Refer to HOUSING (Tilt-Away)-Installation-Steps 1-8.

9. (H Series) Torque flange bolt to 30 ft. lbs.

(X Series) Torque coupling bolt to 55 ft. lbs.

(A, B and G Series) Torque clamp to steering shaft nut to 55 ft. lbs.

IGNITION SWITCH (TILT-AWAY)

Removal

1. Disconnect negative cable from battery.

2. Position ignition lock cylinder in "ACC" position.

3. Remove trim cap or lower panel from lower portion of instrument panel. Remove toe-pan trim cover.

4. If equipped with column shift (automatic), remove shift indicator needle from shift bowl.

5. A and G Series - loosen toe-pan clamp bolts (No. 2), except A and G Series - Loosen toe-pan bolts, remove nuts "A" and "B" from bracket assembly and lower column until steering wheel rests on seat cushion (Figs. 3B4-2 through 3B4-5).

6. Remove the two switch attaching screws and lift switch off actuator rod.

7. Disconnect wiring from ignition switch.

Installation

See CAUTION on Page 3B4-1 of this Section.

1. With lock cylinder in "ACC" position, insert small screwdriver or awl into hole in switch and move sliding portion of switch until switch hole is positioned as shown in Fig. 3B4-45.

2. Fit the actuator rod into the slider hole and loosely assemble to the column with two screws. Lightly push switch down the column (away from the steering wheel), to take out lash in the acutator rod, and torque mounting screws to 35 in. lbs.

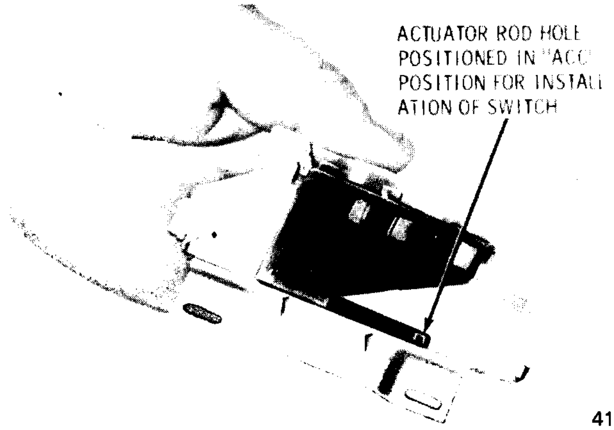


Fig. 3B4-45 Positioning Switch for ACC Position

NOTE: Care should be exercised to prevent moving the switch out of "ACC" detent. Use only the correct switch mounting screws.

3. Connect wiring connectors to ignition switch.

4. Raise column into approximate position and loosely install nuts "A" and "B". While holding column up and rearward, torque nuts "A" and "B" to 25 ft. lbs. Torque toe-pan clamp bolts (No. 2) to 60 in lbs. and toe-pan bolts to 45 in. lbs.

5. If equipped with column shift (automatic), install shift indicator needle and adjust. Connect clip (Fig. 3B4-16 through 3B4-18).

6. Install trim cap or lower panel on lower portion of instrument panel. Install toe-pan trim cover.

7. Connect negative battery cable.

ACTUATOR ROD (IGNITION SWITCH) TILT-AWAY

Removal

1. Refer to HOUSING (Tilt-Away)-Removal-Steps 1-6.

2. Position ignition lock cylinder in "ACC" position.

3. Remove trim cap or lower panel from lower portion of instrument panel. Remove toe-pan trim cover.

4. A and G Series - Loosen toe-pan clamp screws (no. 2), Except A and G Series - Loosen toe-pan screws, remove nuts "A" and "B" from bracket assembly and lower column until steering wheel rests on seat cushion (Figs. 3B4-2 through 3B4-6).

5. Remove the two switch attaching screws and lift switch off actuator rod.

6. Remove actuator rod through bowl (shroud on H Series) from upper end of column (Fig. 3B4-46).

Installation

See CAUTION on Page 3B4-1 of this Section.

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Install actuator rod through bowl from upper end of column as shown in Fig. 3B4-46.

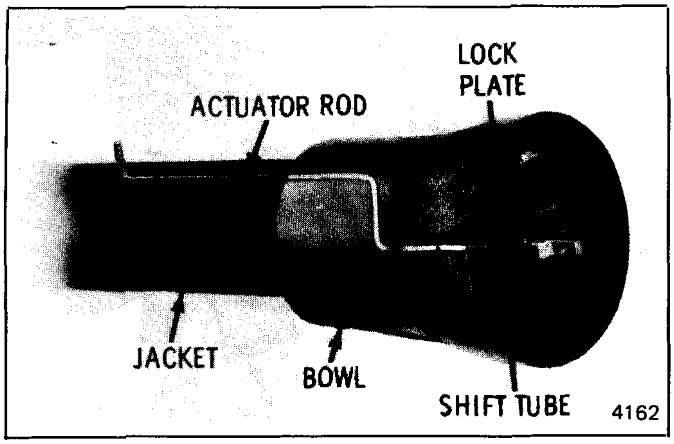


Fig. 3B4-46 Actuator Rod

2. Refer to HOUSING (Tilt-Away)-Installation-Steps 1-8.

3. With lock cylinder in "ACC" position, insert small screwdriver or awl into hole in switch and move sliding portion of switch until switch hole is positioned as shown in Fig. 3B4-45.

4. Fit the actuator rod into the slider hole and loosely assemble to the column with two screws. Lightly push the switch down the column (away from the steering wheel), to take out lash in the actuator rod, and torque mounting screw to 35 in. lbs.

NOTE: Care should be exercised to prevent moving the switch out of "ACC" detent. Use only the correct switch mounting screws.

5. Raise column into approximate position and loosely install nuts "A" and "B". While holding column up and rearward, torque nuts "A" and "B" to 25 ft. lbs. Torque bolts (No. 2) to 60 in. lbs. and toe-pan screws to 45 in. lbs. (Figs. 3B4-2 through 3B4-6).

6. Install trim cap or lower panel on lower portion of instrument panel. Install toe-pan trim cover.

7. Connect negative battery cable.

DIMMER SWITCH ADJUSTMENT OR REPLACEMENT (B SERIES)

Removal

1. Disconnect negative cable from battery.

2. Remove instrument panel lower trim cap or lower trim panel.

3. Remove toe-pan cover bolts (Fig. 3B4-2).

4. Remove the two nuts "A" and "B" from bracket assembly (Fig. 3B4-2) and lower column until column rests on (protected) front seat cushion.

5. If adjusting, loosen dimmer switch screw; if replacing dimmer switch, remove screw (Fig. 3B4-47), then dimmer switch. Tape rod to column and separate dimmer switch from rod by pulling.

Installation

1. If replacing dimmer switch, install new switch by pushing switch on rod and install screw. To adjust, depress dimmer switch slightly to install 3/32" drill to lock switch to body (Fig. 3B4-48). Force switch up to remove lash between switch and pivot. Tighten upper dimmer switch screw to 35 in. lbs. and remove tape from actuator rod. Remove drill and check dimmer switch function by actuating lever; if tilt column check function in full up, down and center tilt positions.

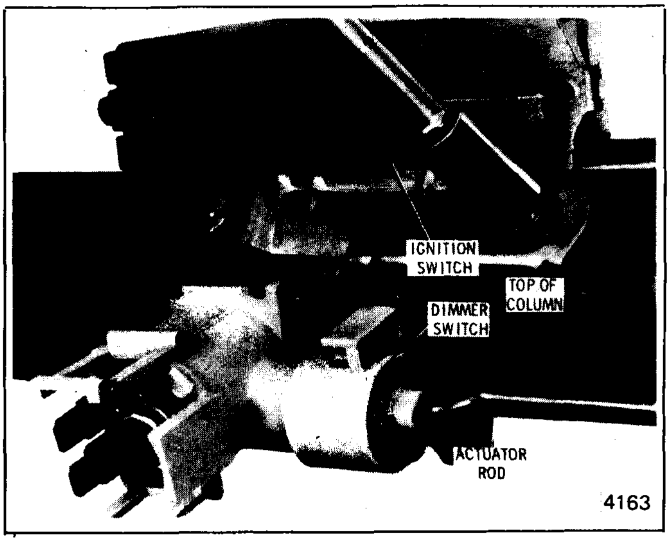


Fig. 3B4-47 Removing Dimmer Switch

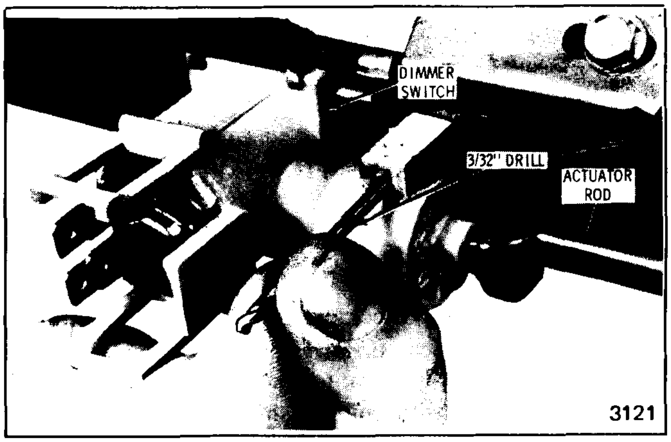


Fig. 3B4-48 Adjusting Dimmer Switch

2. Install nuts "A" and "B", torque to 25 ft. lbs. (Fig. 3B4-2).

3. Install toe-pan cover bolts and torque to 45 in. lbs.

4. Install instrument panel lower trim cap or lower trim panel.

5. Connect negative cable to battery.

TILT-AWAY COLUMN WITH DIMMER SWITCH

Dimmer Switch Linkage and Pivot

Removal

1. Refer to "TURN SIGNAL SWITCH" (Tilt-Away)-Removal-Steps 1-6.

2. Position turn signal switch in right turn position, then remove actuator arm screw and actuator arm (Fig. 3B4-49).

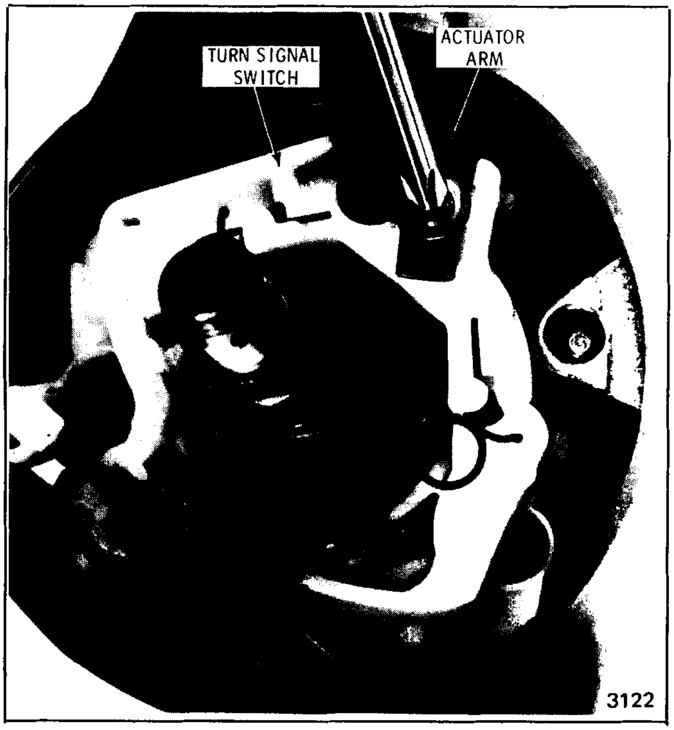


Fig. 3B4-49 Removing Actuator Screw

3. Remove turn signal switch lever, pull straight out to disengage (Fig. 3B4-50).

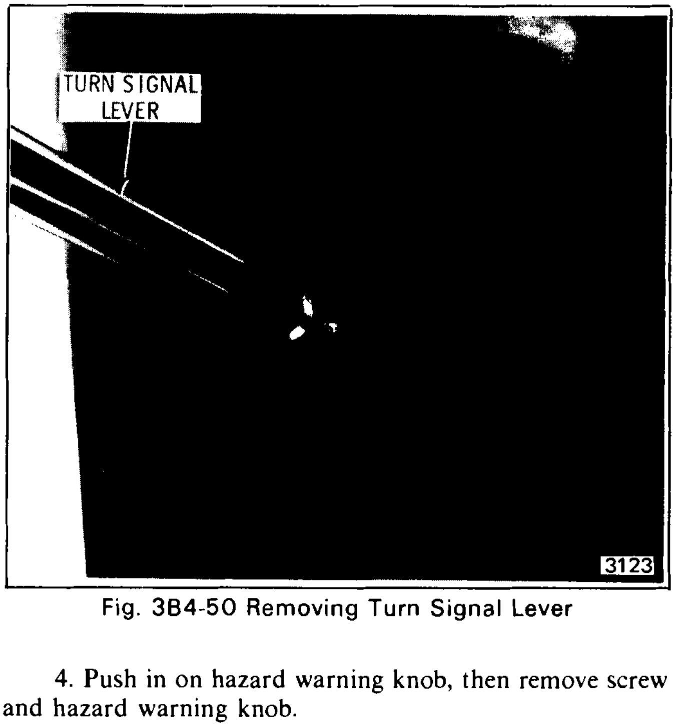


Fig. 3B4-50 Removing Turn Signal Lever

4. Push in on hazard warning knob, then remove screw and hazard warning knob.

5. Lift up on tilt lever and position housing in center position, then remove the three turn signal switch attaching screws (Fig. 3B4-51).

6. Remove instrument panel lower trim cap or lower trim panel, then disconnect turn signal connector from harness (Fig. 3B4-14). Lift connector from mounting bracket on right side of jacket.

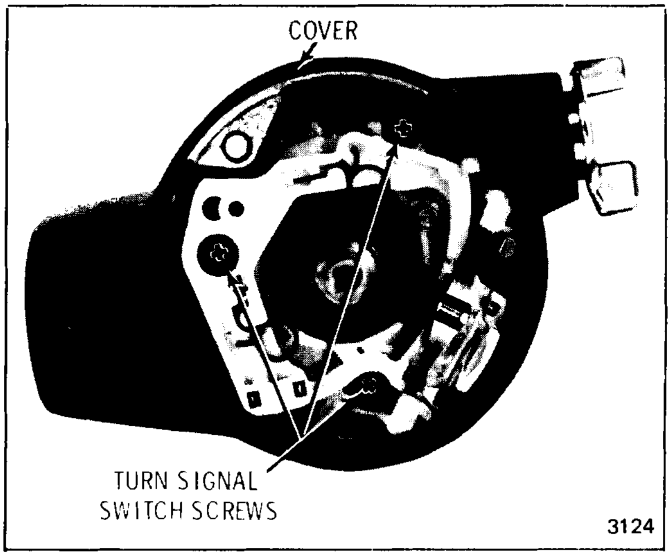


Fig. 3B4-51 Turn Signal Switch Screws

7. Remove toe-pan bolts.

8. Remove the four bolts "W", "X", "Y" and "Z" attaching bracket assembly to jacket (Fig. 3B4-2).

9. Remove shift indicator retaining clip.

10. Remove the two nuts "A" and "B" from bracket assembly. While holding column in position, remove bracket assembly, remove wire protector from turn signal wiring.

11. Tape turn signal switch wires at connector keeping wires flat and parallel, then carefully pull turn signal switch and wiring from top end of column.

12. Position lock assembly in "Run" position. Insert a thin tool (small screwdriver or knife blade) into the slot next to the switch mounting screw boss (right hand slot) and depress retainer at bottom of slot, which releases lock. Remove lock (Fig. 3B4-52).

13. Remove key warning buzzer switch out of housing using a straight paper clip or similar piece of stiff wire with a hook bent on one end (Fig. 3B4-53).

NOTE: It may be necessary to reach inside cover bore and depress contacts so switch can be removed.

14. Unscrew tilt lever and remove.

15. Remove the three cover to housing attaching screws and remove cover (Fig. 3B4-54).

16. With cover removed, cap and rod actuator may be removed (Fig. 3B4-55).

17. To remove pivot assembly, remove pivot pin, then pivot assembly from cover (Fig. 3B4-56).

18. Reinstall tilt release lever and place column, in full tilt "up" position. Remove tilt spring retainer using screwdriver blade that just fits into slot opening. Insert screwdriver in slot, press in approximately 3/16", turn approximately 1/8 turn counterclockwise until ears align with grooves in housing and remove spring and guide (Fig. 3B4-31).

19. Remove dimmer switch mounting screw and remove dimmer switch (Fig. 3B4-57).

20. Place ignition switch in the "ACC" position by pulling actuator rod with pliers in the full downward position towards ignition switch. Remove ignition switch.

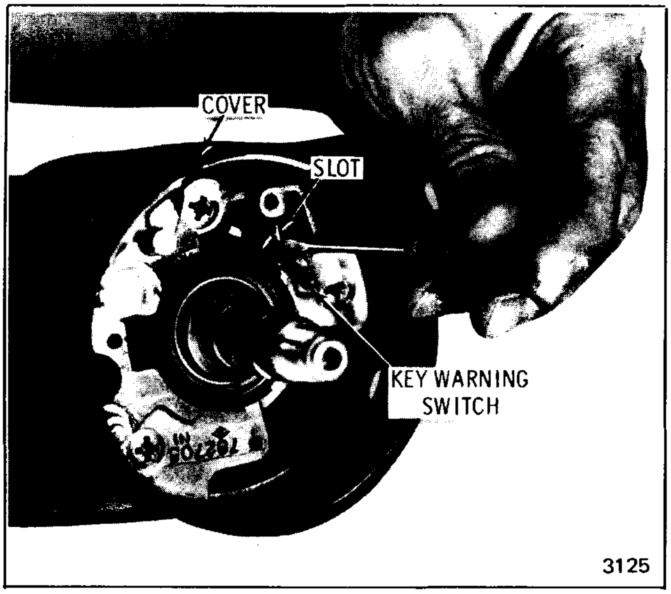


Fig. 3B4-52 Ignition Lock Removal

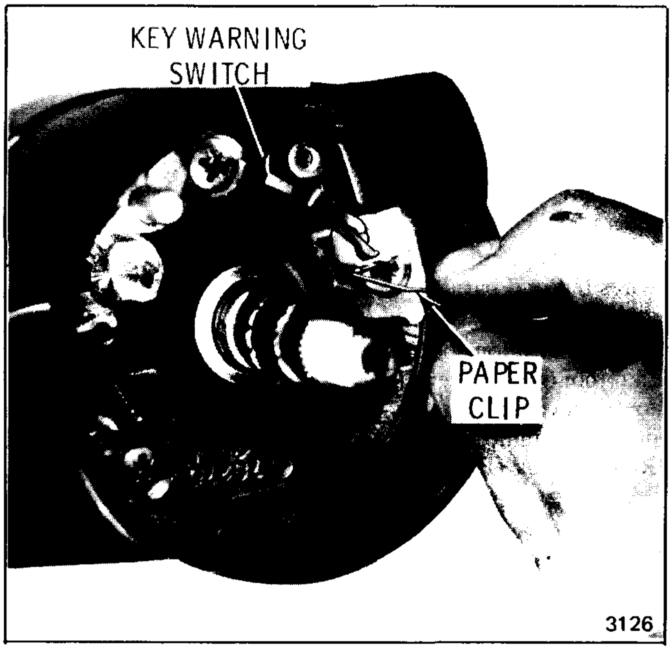


Fig. 3B4-53 Removing Key Warning Buzzer Switch

21. Remove upper bearing race and seat.

22. Install Tool J 21854-1 and remove pivot pins as shown in Fig. 3B4-32.

23. Lift tilt lever to release lock shoes. Pull upward on housing to extend rack fully down and moving housing to the left, disengage rack from actuator.

24. With housing disengaged, rotate it clockwise to free dimmer switch actuator rod (Fig. 3B4-58). Remove housing from column.

25. Refer to "SUPPORT AND/OR SHIFT GATE" (Tilt-Away)-Removal-Steps 2-5.

26. Remove dimmer switch actuator rod and support and separate rod from support (Fig. 3B4-59).

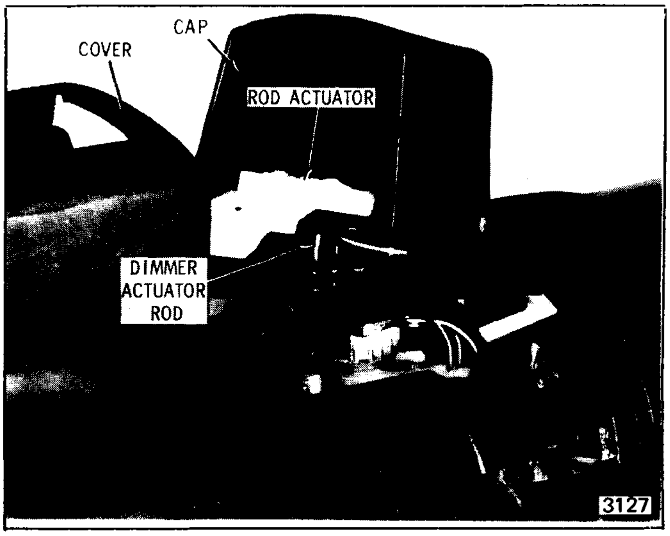


Fig. 3B4-54 Removing Cover

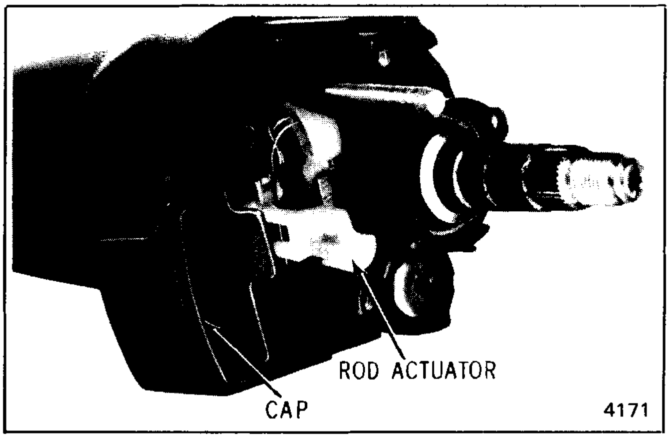


Fig. 3B4-55 Removing Cap and Rod Actuator

Installation

1. Slip dimmer switch actuator rod through hole in support. Install rod between bowl and jacket (Fig. 3B4-59).

2. Refer to "SUPPORT AND/OR SHIFT GATE" (Tilt-Away)-Installation-Steps 4-7.

3. Position access hole of bearing housing over end of actuator rod (Fig. 3B4-58). Rotate housing counterclockwise to install dimmer switch actuator rod and assembly over steering shaft.

4. Refer to "HOUSING" (Tilt-Away)-Installation-Steps 1-5.

5. Lift up on tilt lever and position housing in the center position. Remove tilt lever.

6. Install pivot assembly and pivot pin in cover. Apply grease to smooth portion of pivot pin.

7. Install rod actuator into cap and position cap over housing (Fig. 3B4-55).

8. Guide end of rod actuator into pivot slot during cover assembly (Fig. 3B4-60).

9. Install cover to housing attaching screws and torque to 100 in. lbs.

10. Install race and seat as shown in Fig. 3B4-30.

11. Install tilt lever.

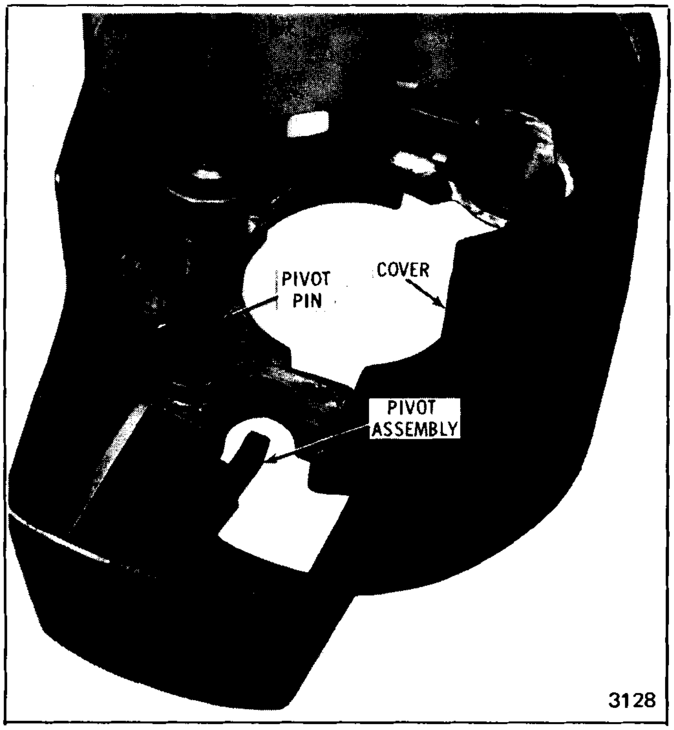


Fig. 3B4-56 Removing Pivot Pin

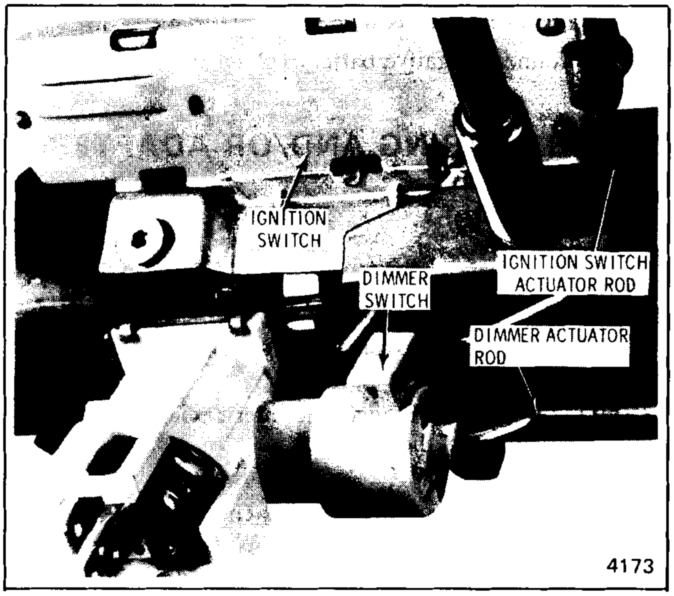


Fig. 3B4-57 Removing Dimmer Switch Mounting Screw

12. Install buzzer switch and spring clip.

NOTE: It may be necessary to reach inside cover bore and depress contacts so switch seats fully. Key warning buzzer switch must be installed before ignition lock assembly is installed.

13. Install lock, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into cover bore with key on cylinder sleeve aligned to keyway in sector. Rotate knob counterclockwise, maintaining a light push inward on cylinder, until drive section of cylinder mates with drive shaft. Push in until snap ring snaps into groove and lock cylinder is secured in cover. Check freedom of rotation.

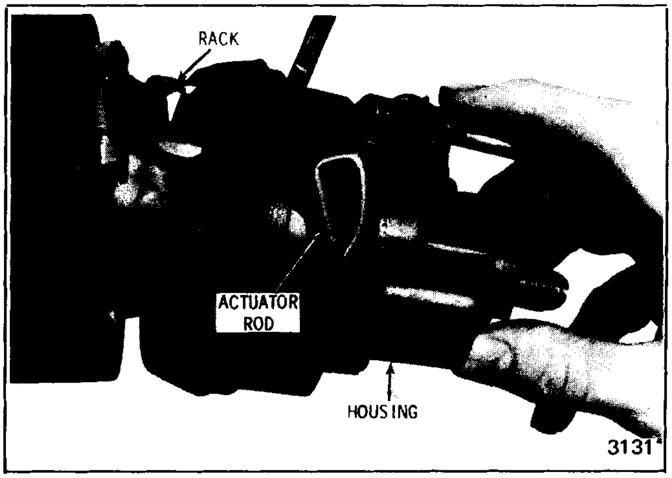


Fig. 3B4-58 Removing Housing

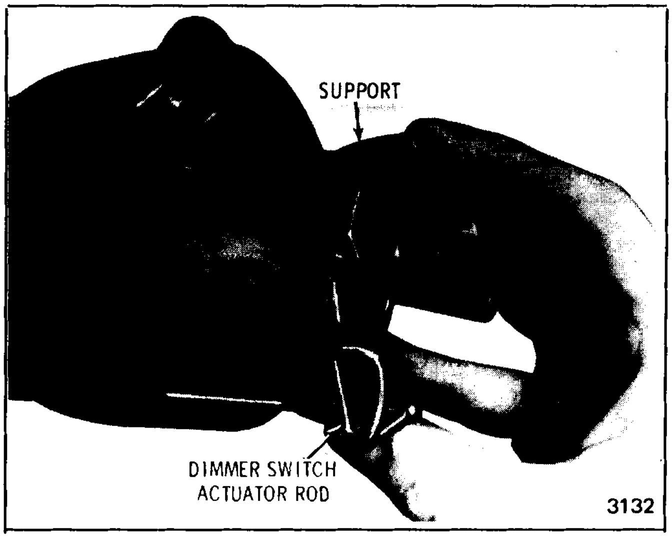


Fig. 3B4-59 Removing Dimmer Switch Rod and Support

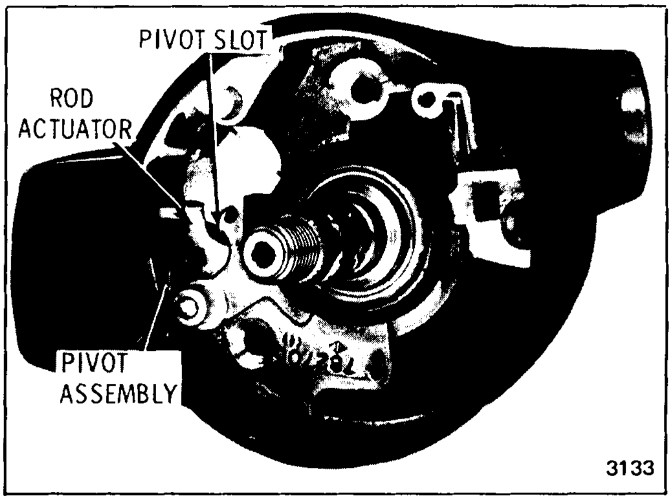


Fig. 3B4-60 Installing Rod Actuator

14. Refer to "TURN SIGNAL SWITCH" (Tilt-Away)-Installation-Steps 1-4.

15. Install hazard warning knob and screw.

16. Seat ball of actuator arm into pivot slot. Fit arm into signal switch slot, install screw and torque to 20 in. lbs. (Fig.

3B4-61).

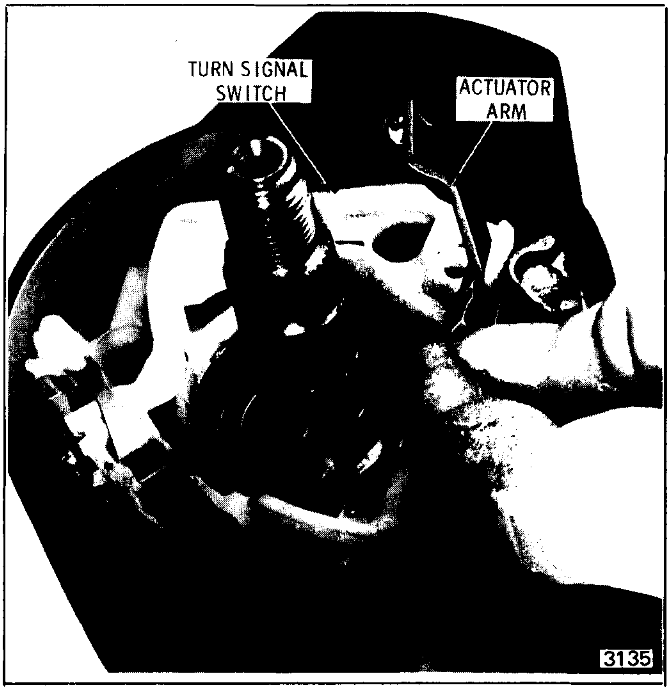


Fig. 3B4-61 Installing Actuator Arm

17. Install upper bearing preload spring.

18. Install cancelling cam and lock plate aligning splines in steering shaft with I.D. of lock plate (Fig. 3B4-11).

19. Position NEW wire snap ring over Tool J 23653. Install Tool J 23653 over shaft and tighten nut until wire snap ring can be installed in groove in steering shaft (Fig. 3B4-12). Remove Tool J 23653.

20. Install lock plate cover.

21. Install signal switch lever. Align pin in lever with pivot slot. Push in to stop.

22. Install tilt lever.

23. With ignition switch in "ACC" position, insert small screwdriver or awl into hole in switch and move sliding portion of switch until switch hole is positioned as shown in Fig. 3B4-45.

24.Fit the actuator rod into the slider hole and loosely assemble to the column with lower screw. Lightly push the switch down the column (away from the steering wheel) to take out lash in the actuator rod and torque mounting screw to 35 in. lbs.

NOTE: Care should be exercised to prevent moving the switch out of "ACC" detent. Use only the correct switch mounting screws.

25. To assemble and adjust dimmer switch, fit end of dimmer switch rod into dimmer switch. Install dimmer switch to column and install but do not tighten ignition switch screw. Depress dimmer switch slightly to feed 3/32" drill to lock switch to body (Fig. 3B4-62). Force switch up to remove lash between switch and pivot. Tighten screw to 35 in. lbs. Remove drill and check function in full up, down and center tilt positions.

26. Refer to "TURN SIGNAL SWITCH" (Tilt-Away)-Installation-Steps 10-15.

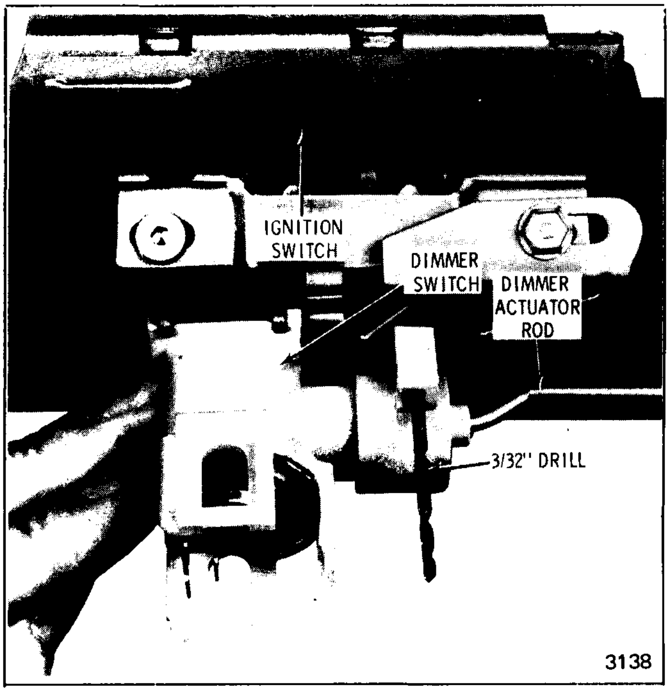


Fig. 3B4-62 Adjusting Dimmer Switch

27. Torque clamp to steering shaft nut to 55 ft. lbs.

28. Install toe-pan bolts and torque to 45 in. lbs.

29. Connect negative battery cable.

LOWER BEARING AND/OR ADAPTER (TILT-AWAY)

Removal

1. Remove flexible coupling nuts.

2. Remove coupling clamp to steering shaft attaching bolt and nut.

NOTE: On some models the intermediate shaft is free to telescope together.

3. Pull intermediate shaft off flex-coupling and then pull down on intermediate shaft until coupling is removed from steering shaft.

4. Using a screwdriver, pry lower bearing from adapter, if only bearing is to be replaced.

5. If adapter or bushing is to be replace, used screwdriver to pry off retaining clip, then remove adapter or bushing and cup. On B Series, the bearing may be removed from the adapter on the bench (Fig. 3B4-63).

NOTE: On H Series columns the bearing is part of the adapter. The adapter will be damaged if removed,therefore the adapter should be removed only when replacement is necessary Fig. 3B4-64.

Installation

See CAUTION on Page 3B4-1 of this Section

NOTE: Apply thin coat of lithium grease to all friction parts.

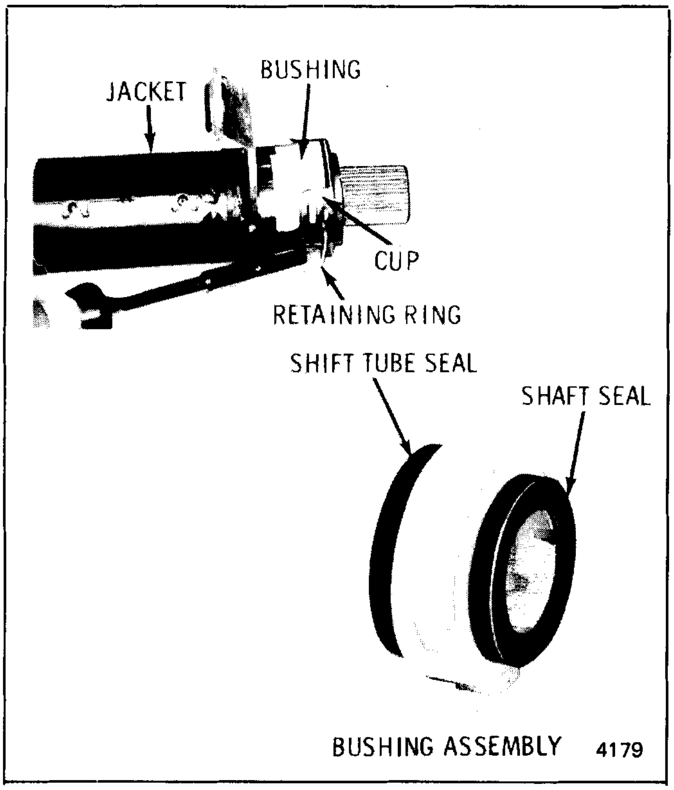


Fig. 3B4-63 Lower Bearing Attachment

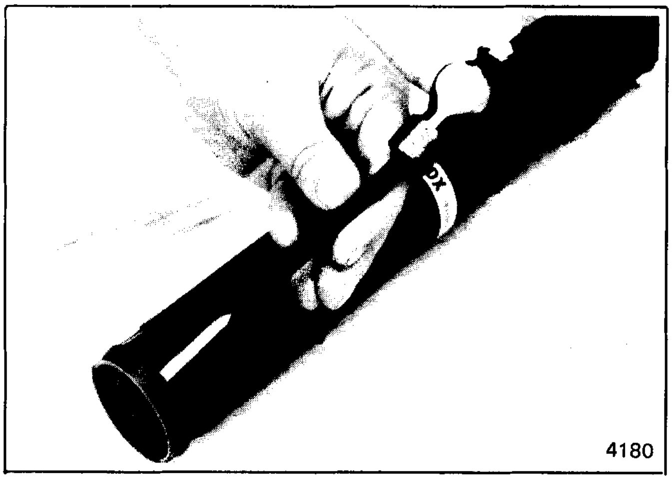


Fig. 3B4-64 Replacing Lower Bearing and Adapter - H Series

1. If adapter or bushing assembly was removed, push bearing (B Series) into adapter on the bench, then install assembly over steering shaft into position in jacket.

NOTE: H Series has no shift tube or retaining clip.

2. A, F, G and X Series Only - slide bushing assembly over end of shaft and retain with cup and retaining clip.

3. Position coupling slot in alignment with slot in lower end of steering shaft and install clamp bolt. Torque to 30 ft. lbs. on H Series, to 55 ft. lbs. (except H Series).

4. Push up on intermediate shaft until flex-coupling can be installed in position. Install flex-coupling lockwashers and nuts. Torque to 20 ft. lbs.

OUT OF CAR PROCEDURES

BOWL AND/OR SHIFT TUBE

All Except H Series (Tilt-Away)

Removal

1. Refer to STEERING COLUMN (All Series)-
2. If replacement is necessary, the shaft lock plate cover may be removed at this time (Fig. 3B4-9).
3. Position Tool J 23653 over steering shaft. Tighten nut until tool slightly depresses lock plate. Pry wire snap ring from shaft and discard (Fig. 3B4-10). Remove Tool J 23653.
4. Remove lock plate and cancelling cam.
5. Remove upper bearing preload spring.
6. Position turn signal lever in right turn position, then remove turn signal lever attaching screw and lever (Fig. 3B4-13).
7. Push in on hazard warning knob, then remove screw and hazard warning knob.
8. Lift up on tilt lever and position column in center position, then remove the three turn signal switch attaching screws (Fig. 3B4-13).
9. Tape turn signal switch wires at connector keeping wires flat, then carefully pull turn signal switch and wiring from top end of column.
10. Position lock assembly in RUN position. Insert a thin tool (small screwdriver or knife blade) into the slot next to the switch mounting screw boss (right hand slot) and depress retainer at bottom of slot, which releases lock. Remove lock (Fig. 3B4-20).
11. Unscrew tilt lever and remove.
12. Remove the three cover to housing attaching screws and remove cover.

    NOTE: It may be necessary to tap cover lightly with a plastic hammer to remove.

13. Remove seat and race as shown in Fig. 3B4-30.
14. Install tilt lever and position column in the full "UP" position.
15. Remove tilt spring retainer using a screwdriver blade that fits into slot of retainer. Press in and turn approximately 1/8 turn counterclockwise (Fig. 3B4-31). Remove tilt spring retainer, spring and guide.
16. Install Tool J 21854-1 and remove pivot pins as shown in Fig. 3B4-32.
17. Lift tilt lever to release lock shoes. Pull upward on housing to extend rack fully down and by moving housing to the left to disengage rack from actuator, remove housing from column.
18. Remove steering shaft assembly from upper end of column.
19. Using a small punch, drive pin from shift lever and pull out on shift lever to remove from bowl.
20. Remove the four screws attaching support to lock plate and remove support 3B4-39).
21. Remove the two screws attaching neutral start and back-up switch, if so equipped (Fig. 3B4-65). Remove switch.

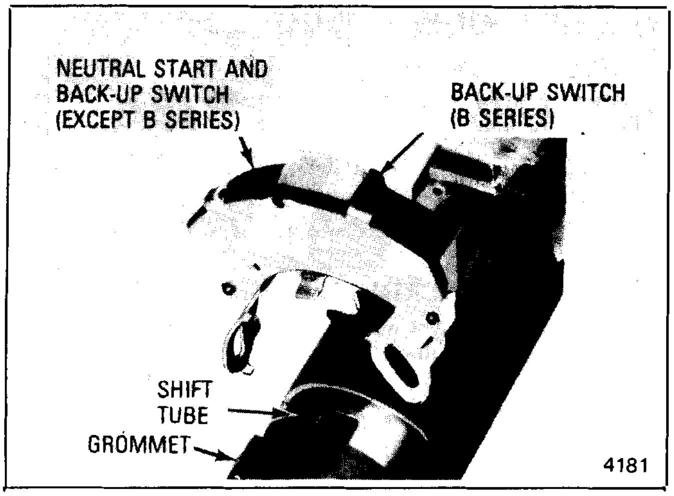


Fig. 3B4-65 Neutral Start Switch

22. Remove retaining ring, cup, bearing and adapter or bushing assembly from lower end of column (Fig. 3B4-63).

23. Remove retaining ring and thrust washer as shown in Fig. 3B4-66.

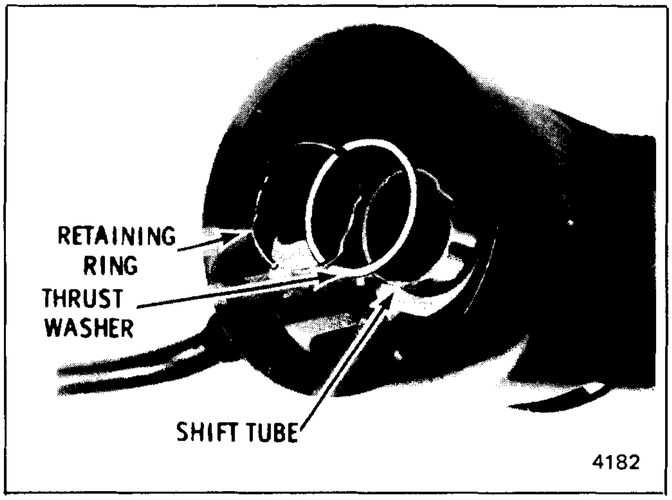


Fig. 3B4-66 Shift Tube Retainer and Thrust Washer

24. Position Tool J 23072 as shown in Fig. 3B4-67. Turn bolts into lock plate approximately 6 turns. Turn center bolt of tool, while guiding shift lever through slot in jacket (Fig. 3B4-68). Turn center of tool until shift tube and bowl are separated, then remove tool.

25. Mark lock plate with an awl then remove lock plate and washer (Fig. 3B4-69).

26. Remove bowl and slide shift tube out of lower end of jacket.

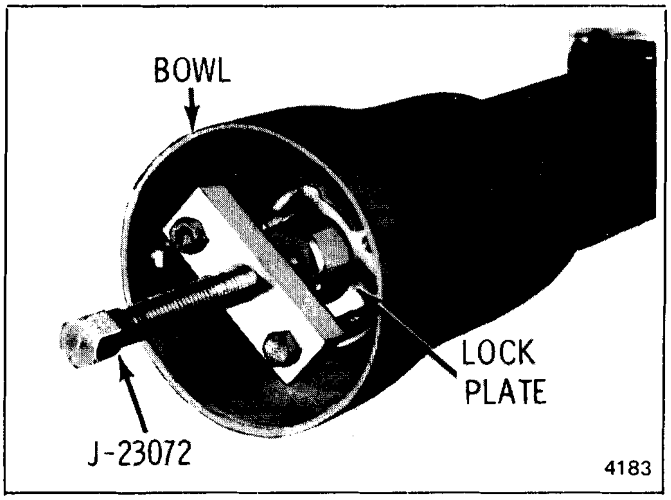


Fig. 3B4-67 Removing Shift Tube

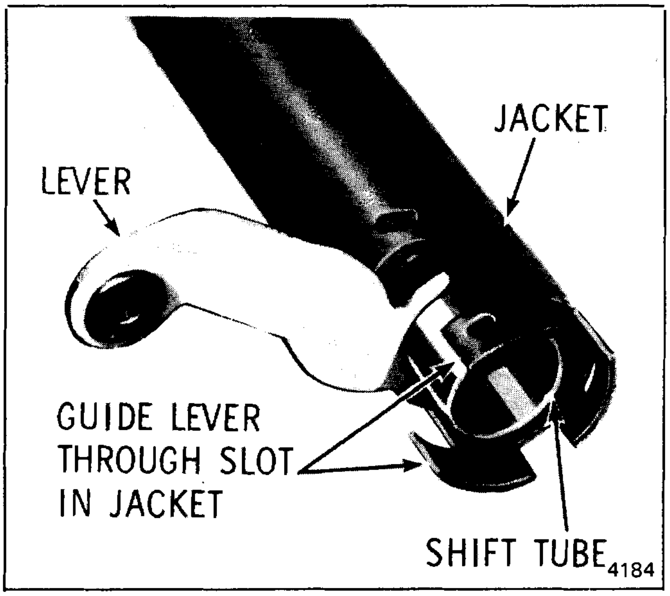


Fig. 3B4-68 Align Shift Tube in Jacket

Installation

See CAUTION on Page 3B4-1 of this Section.

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Install bowl into jacket.

2. Install wave washer and lock plate into bowl. Work lock plate into notches in jacket by tipping lock plate toward bowl hub at 12 o'clock position and under jacket opening. Slide lock plate into notches in jacket.

3. Install shift tube in lower end of jacket aligning key in tube with keyway in bowl.

NOTE: Do not force or hammer on end of shift tube.

4. Insert Tool J 23073-1 into upper end of shift tube and turn tool until swivel secures inside of shift tube. While holding tool, install Tool J 23073-2 over bolt end and slide down until Tool J 23073-2 is fitted inside of tube. Secure in position with a nut finger tight (Fig. 3B4-70). Install Tool J 23073-3 over bolt end and slide down against lock plate, installing remaining nut (Fig. 3B4-71). Turn nut with suitable

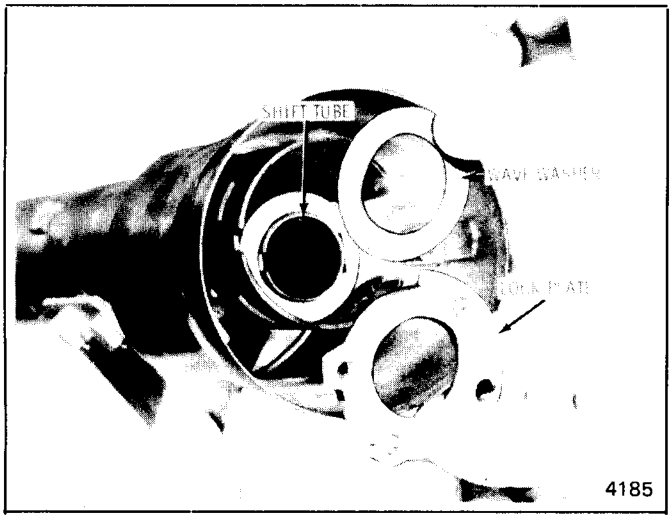


Fig. 3B4-69 Lock Plate and Wave Washer

wrench while guiding shift lever through slot in jacket (Fig. 3B4-68). Turn nut until a definite change in torque is felt. Shift tube should be in position at this time. Remove tool.

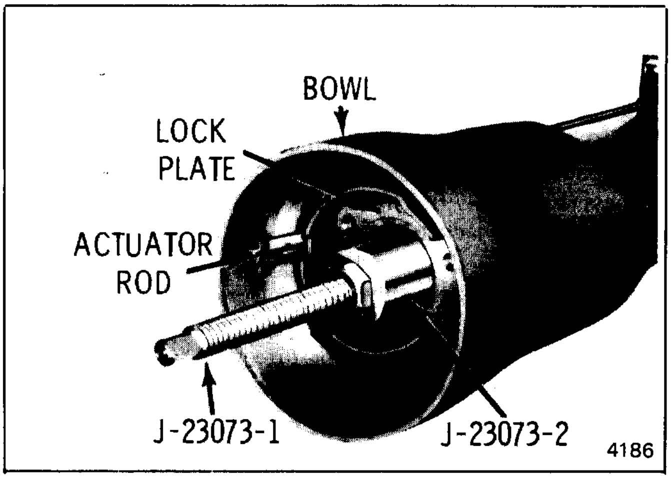


Fig. 3B4-70 Installing Tool J 23073-1

5. Install thrust washer and retaining ring (Fig. 3B4-66).

6. Install adapter or bushing assembly into position in jacket, then install cup and retaining ring.

7. Install neutral start and back-up switch. Do not tighten screws. Switch will be adjusted after installation of column into car. DO NOT USE SUBSTITUTE SCREWS.

8. Install support by aligning "V" in support with notch in jacket (Fig. 3B4-43). Install the four screws through support into lock plate. Torque screws to 5 ft. lbs. Actuator rod should be in slot at top aligning "V".

9. Install shift lever into bowl as shown in Fig. 3B4-44, then remove shim and drive shift lever retaining pin into place.

10. Install steering shaft into column. On H Series, slide spacer on bottom end of shaft.

NOTE: It may be necessary to guide shaft through lower bearing.

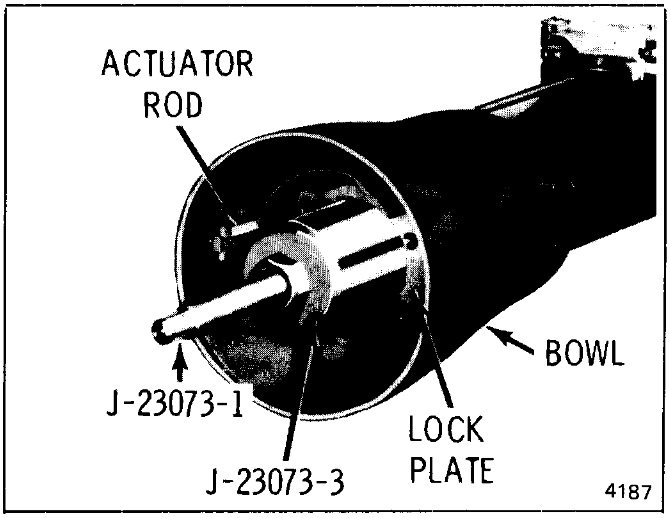


Fig. 3B4-71 Installing Shift Tube

11. Install housing while holding up on tilt lever to disengage lock shoes. Move rack downward and hold, tip housing to the left until rack engages pin on actuator rod, push housing down until pivot pin holes are in alignment.

NOTE: Housing bearings must be in position in housing for proper installation of housing.

12. Install pivot pins using a brass drift to fully seat pins.

13. Lift up on tilt lever and position housing in the full "UP" position.

14. Install guide and spring into housing, then place tilt spring retainer over exposed end of spring. Using a screwdriver with a blade that fits into slot of retainer, press in and turn approximately 1/8 turn clockwise until retainer is engaged in housing.

15. Install race and seat as shown in Fig. 3B4-30.

16. Lift up on tilt lever and position housing in the center position. Remove tilt lever.

17. Install cover. Torque the three attaching screws to 100 in. lbs. (Fig. 3B4-24).

18. Install tilt lever.

19. Install lock assembly, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into cover bore with key on cylinder sleeve aligned to keyway in housing (Fig. 3B4-21), push into abutment of cylinder and sector. Rotate knob counterclockwise, maintaining a light push inward on cylinder, until drive section of cylinder mates with drive shaft. Push in until snap ring pops into groove and lock cylinder is secured in cover. Check freedom of rotation.

20.Push hazard warning switch to the "ON" position and with turn signal wiring taped at connector, carefully guide wiring into column.

21. Index turn signal switch into the right turn position, then push switch straight down until seated in cover.

NOTE: Angling or cocking of switch can cause damage to buzzer terminal or can cause buzzer tangs to get under terminal pads on signal switch.

22. Install switch attaching screws (3) and torque to 35 in. lbs. (Fig. 3B4-13).

23. Position turn signal switch in the neutral position.

NOTE: If the signal switch is not placed in "netural" position, assembly of the cancelling cam may cause damage to the turn signal cancel springs in the signal switch assembly.

24. Install hazard warning knob and turn signal lever and attaching screws.

25. Install upper bearing spring.

26. Install cancelling cam and lock plate as shown in Fig. 3B4-11.

27. Position NEW wire snap ring over Tool J 23653, then install Tool J 23653 over shaft and tighten nut until wire snap ring can be installed in groove in steering shaft (Fig. 3B4-12). Remove Tool J 23653.

28. If removed, install cover on lock plate (Fig. 3B4-9).

29. Refer to STEERING COLUMN (All Series)-Installation.

REGULAR COLUMN AND KEY RELEASE

IN CAR PROCEDURES

NOTE: All elements of energy absorbing columns are sensitive to damage and must be handled with care. The following procedures apply to both function locking and key release columns except where noted (Figs. 3B4-72 and 3B4-73).

LOCK PLATE AND/OR CANCELLING CAM (REGULAR)

Removal

1. Disconnect negative cable from battery.

2. Refer to STEERING WHEEL-Removal.

3. Lock plate cover may be removed for replacement at this time by releasing as shown (Fig. 3B4-74).

4. Position Tool J 23131 over steering shaft and, using steering wheel attaching nut, tighten nut until tool slightly depresses lock plate. Pry wire snap ring from shaft and discard (Fig. 3B4-75). Remove Tool J 23131.

NOTE: Tool J 23653 may be used instead of Tool J 23131. Refer to Tilt-Away column procedures for usage.

5. Remove lock plate and cancelling cam (Fig. 3B4-75).

Installation

1. Install cancelling cam and lock plate aligning splines in steering shaft with I.D. of lock plate (Fig. 3B4-76).

2. Position new wire snap ring over steering shaft, then install Tool J 23131 over shaft and tighten steering wheel attaching nut until wire snap ring can be installed in groove in steering shaft (Fig. 3B4-77). Remove Tool J 23131.

NOTE: Tool J 23653 may be used instead of Tool J 23131. Refer to Tilt-Away column procedures for usage.

3. If removed, reinstall cover on lock plate.

NOTE: Cover screws must not be substituted.

4. Refer to STEERING WHEEL-Installation.

5. Connect negative battery cable.

TURN SIGNAL SWITCH (REGULAR)

Removal

1. Disconnect negative cable from battery.

2. Refer to STEERING WHEEL-Removal.

3. Lock plate cover may be removed for replacement at this time be releasing as shown (Fig. 3B4-74).

4. Position Tool J 23131 over steering shaft and, using steering wheel attaching nut, tighten nut until tool slightly depresses lock plate. Pry wire snap ring from shaft and discard (Fig. 3B4-75). Remove Tool J 23131.

NOTE: Tool J 23653 may be used instead of Tool J 23131. Refer to Tilt-Away column procedures for usage.

5. Remove lock plate and cancelling cam (Fig. 3B4-76).

6. Remove upper bearing preload spring.

7. Position turn signal lever in the right turn position, then remove turn signal lever attaching screw and lever (Fig. 3B4-78).

8. Push in on hazard warning knob, the remove screw and hazard warning knob.

9. Remove the three turn signal switch attaching screws (Fig. 3B4-78).

10. Remove instrument panel lower trim cap or lower trim panel, then disconnect turn signal connector from harness (Fig. 3B4-79). Lift connector from mounting bracket on right side of jacket.

11. Remove the four bolts "W", "X", "Y" and "Z" attaching bracket assembly to jacket (Fig. 3B4-80).

12. All exc. H Series - loosen shift indicator needle attaching screw and remove or disconnect if column shift (automatic) equipped.

13. Remove the two nuts "A" and "B" from bracket assembly while holding column in position, remove bracket assembly and wire protector from turn signal wiring, then loosely install bracket using nuts "A" and "B" to hold column in place (Fig. 3B4-80).

14. Tape turn signal switch wires at connector keeping wires flat and parallel, then carefully pull turn signal switch and wiring from top end of column.

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Install turn signal switch wiring into service wire protector (Fig. 3B4-81).

2. With switch wiring taped flat at connector, carefully guide wiring into column(Fig. 3B4-82).

3. Index switch into right turn position, then push switch straight down until seated in cover.

NOTE: Angling or cocking of switch can cause damage to buzzer terminal or can cause buzzer tangs to get under terminal pads on signal switch.

4. Install switch attaching screws (3) and torque to 35 in. lbs. (Fig. 3B4-78).

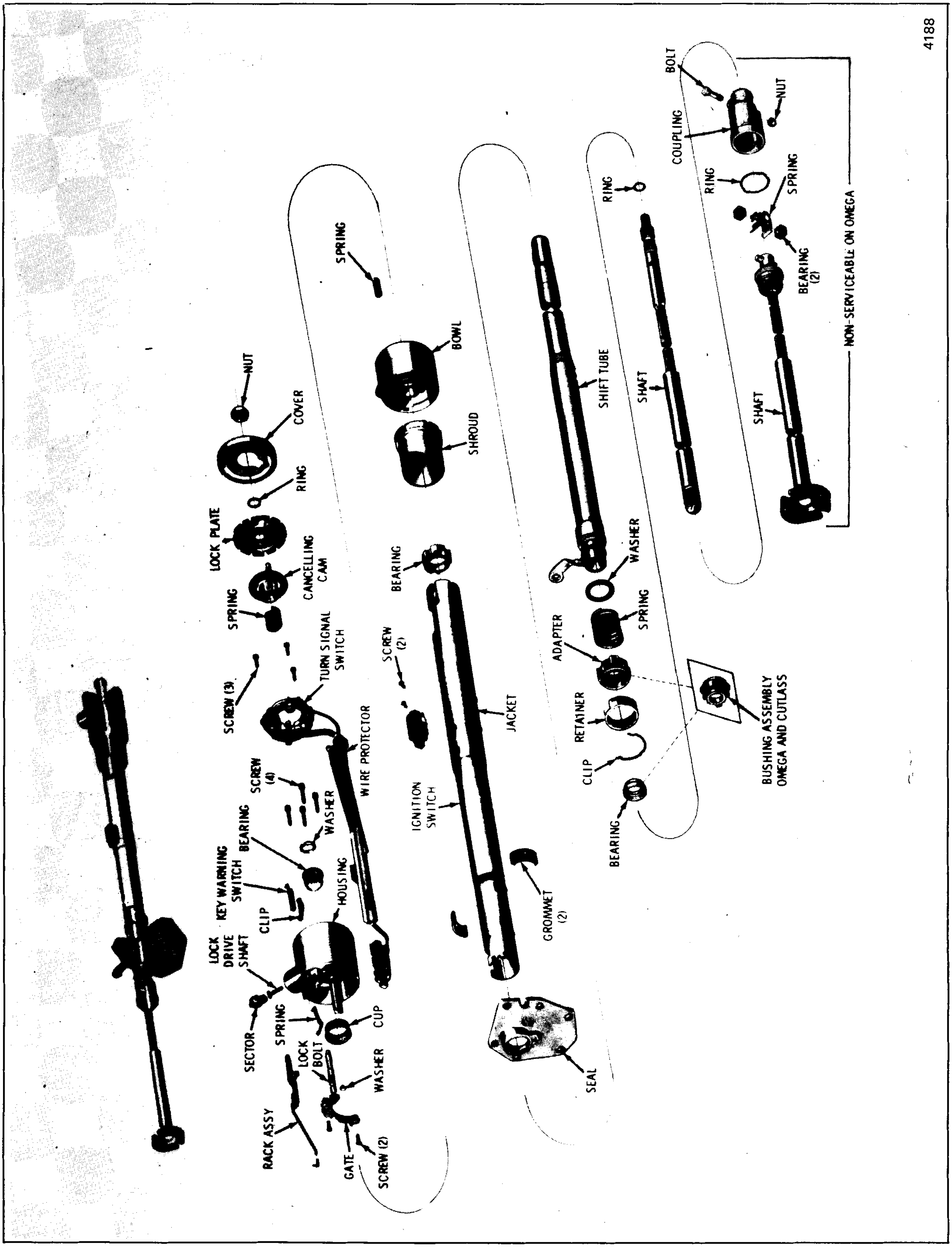


Fig. 3B4-72 Regular Column (Except H Series)

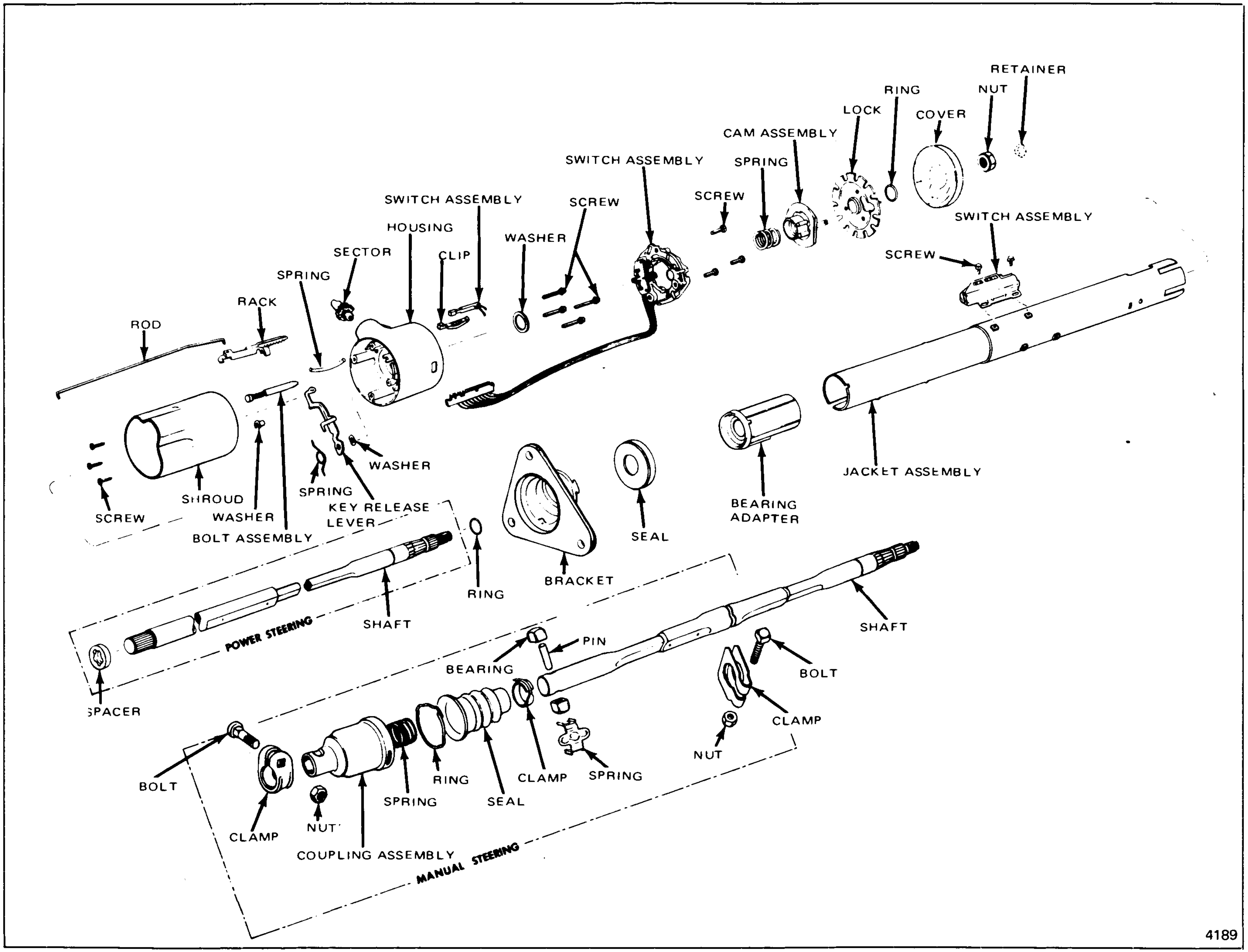


Fig. 3B4-73 Regular Key Release Column-H Series

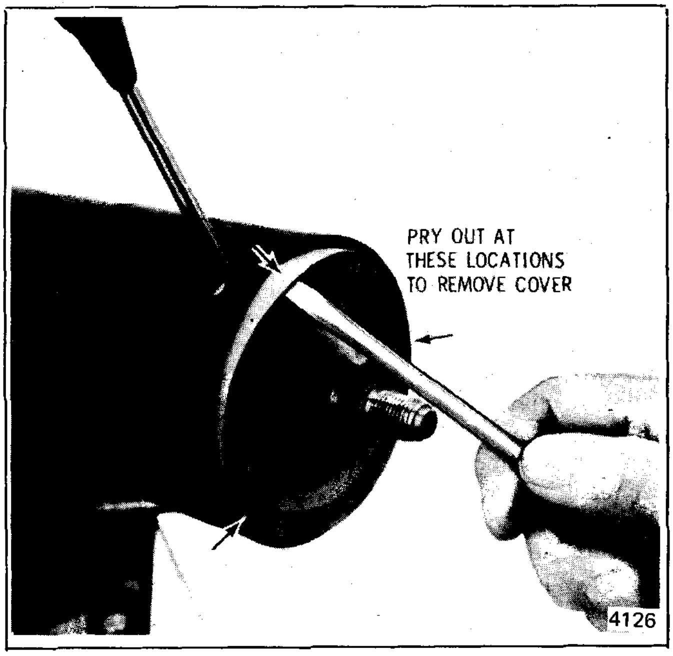


Fig. 3B4-74 Cover Attachment

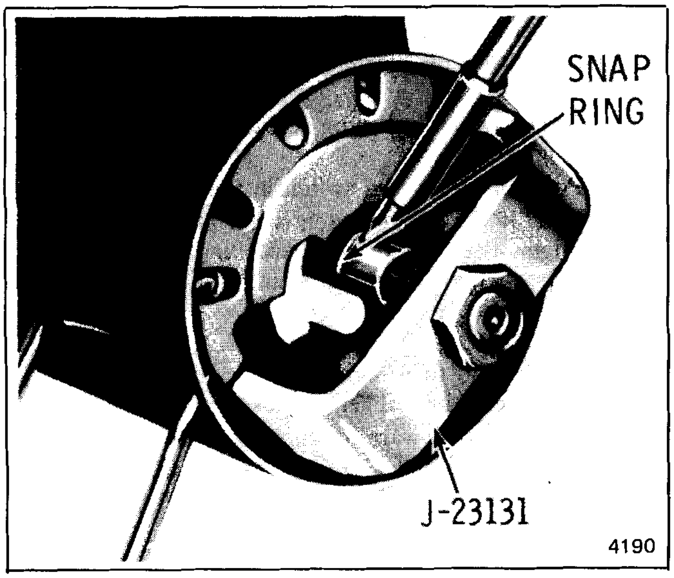


Fig. 3B4-75 Removing Wire Snap Ring

5. Position turn signal switch in the neutral position.

NOTE: If the signal switch is not placed in "neutral" position, assembly of the cancelling cam may cause damage to the turn signal cancel springs in the signal switch assembly.

6. Install hazard warning knob and turn signal switch lever and attaching screw.

7. Install upper bearing preload spring.

8. Install cancelling cam and lock plate as shown in Fig. 3B4-76.

9. Position new wire snap ring over steering shaft, then install Tool J 23131 over shaft and tighten steering wheel attaching nut until wire snap ring can be installed in groove in steering shaft (Fig. 3B4-77). Remove Tool J 23131.

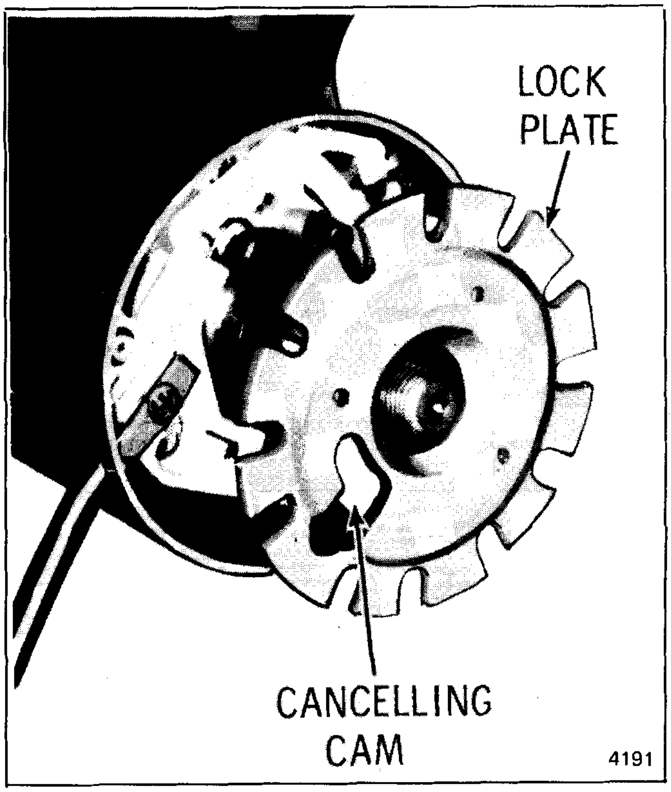


Fig. 3B4-76 Lock Plate and Cancelling Cam

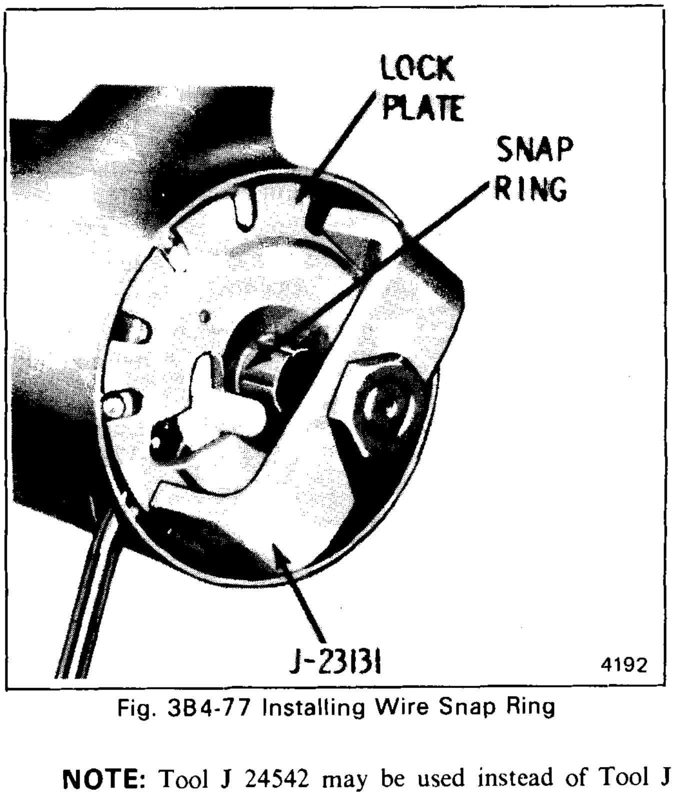


Fig. 3B4-77 Installing Wire Snap Ring

NOTE: Tool J 24542 may be used instead of Tool J 23131. Refer to Tilt-Away column procedures for usage.

10. If removed, install cover on lock plate (Fig. 3B4-74).

11. Refer to STEERING WHEEL-Installation.

12. While holding column in place, remove nuts "A" and "B" from bracket assembly. Insert wiring into wire protector until slots in protector will align with weld nuts on column.

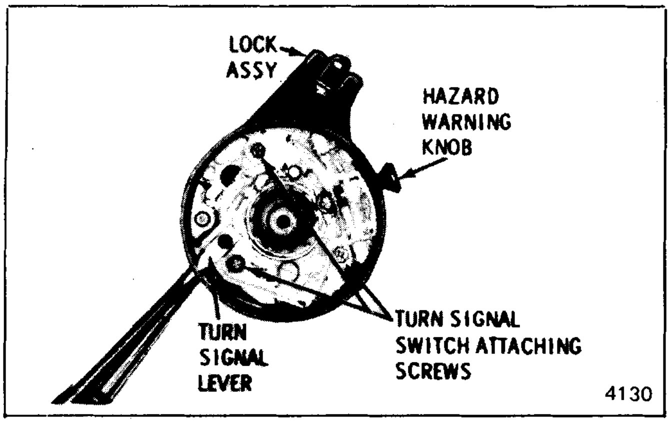


Fig. 3B4-78 Turn Signal Switch Attachment

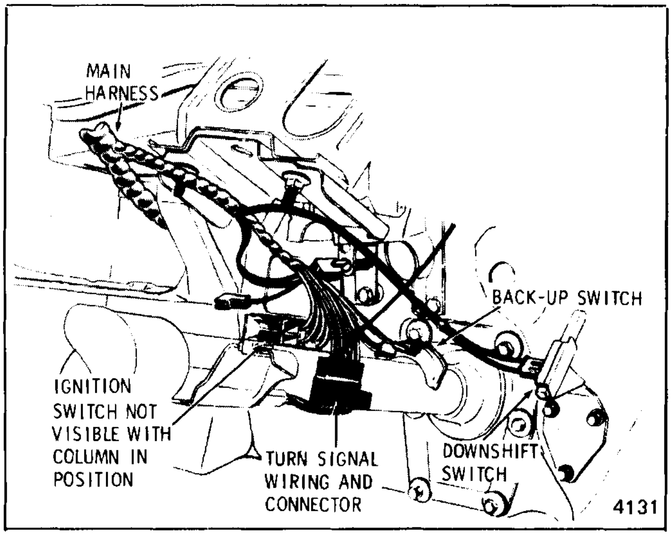


Fig. 3B4-79 Column Wiring Connectors

Then install bracket with bolts "W", "X", "Y" and "Z" and nuts "A" and "B" loosely (Fig. 3B4-80).

13. Torque bolt "W" first to 30 ft. lbs., bolt "X" second to 30 ft. lbs., bolts "Y" and "Z" next to 15 ft lbs. and nuts "A" and "B" to 25 ft. lbs.

14. Install shift indicator (exc. H Series) needle or clip. Adjust as necessary. Refer to Figs. 3B4-16, 3B4-17 and 3B4-18.

15. Connect turn signal wiring connector to harness, then position connector into bracket on right side on jacket (Fig. 3B4-79).

16. Install instrument panel lower trim cap or lower trim panel.

17. Connect negative battery cable.

IGNITION LOCK ASSEMBLY (REGULAR)

Removal

1. Refer to TURN SIGNAL SWITCH (Regular)-Removal-Steps 1-9.

2. Disconnect turn signal connector from harness and pull up on turn signal switch until switch can be positioned as shown in Fig. 3B4-83.

3. Position lock assembly in RUN position. Insert a thin tool (small screwdriver or knife blade) into the slot next to the switch mounting screw boss (right hand slot) and depress retainer at bottom of slot, which releases lock. Remove lock (Fig. 3B4-83).

Installation

NOTE: Apply thin coat of lithium grease to all friction parts except ignition lock assembly.

1. Install lock, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into cover bore with key on cylinder sleeve aligned to keyway in housing (Fig. 3B4-84); push into abutment of cylinder and sector. Rotate knob counterclockwise, maintaining a light push inward on cylinder, until drive section of cylinder mates with drive shaft. Push in until snap ring snaps into groove and lock cylinder is secured in cover. Check freedom of rotation.

2. While pulling slightly on turn signal wiring at connector, guide turn signal switch into inside of cover.

3. Index switch into right turn position, then push switch straight down until seated in cover.

NOTE: Angling or cocking of switch can cause damage to buzzer terminal or can cause buzzer tangs to get under terminal pads on signal switch.

4. Install switch attaching screws (3) and torque to 35 in. lbs. (Fig. 3B4-78).

5. Position turn signal switch in the Neutral position.

NOTE: If the signal switch is not placed in "neutral" position, assembly of the cancelling cam may cause damage to the turn signal cancel springs in the signal switch assembly.

6. Reconnect turn signal connector to harness and position connector in bracket on jacket.

7. Install hazard warning knob and screw.

8. Install turn signal lever and attaching screw (Fig. 3B4-78).

9. Install upper bearing preload spring.

10. Install cancelling cam and lock plate aligning splines in steering shaft with I.D. of lock plate (Fig. 3B4-76).

11. Position NEW wire snap ring over shaft, then install Tool J 23131 and tighten nut until wire snap ring can be installed in groove in steering shaft (Fig. 3B4-77). Remove Tool J-23131.

12. If removed, install cover on lock plate (Fig. 3B4-74).

13. Refer to STEERING WHEEL-Installation.

14. Connect negative battery cable.

KEY WARNING BUZZER SWITCH (REGULAR)

Removal

1. Refer to IGNITION LOCK ASSEMBLY (Regular)-Removal-Steps 1-3.

NOTE: Ignition lock assembly must be removed or placed in Run position, before key warning buzzer switch is removed.

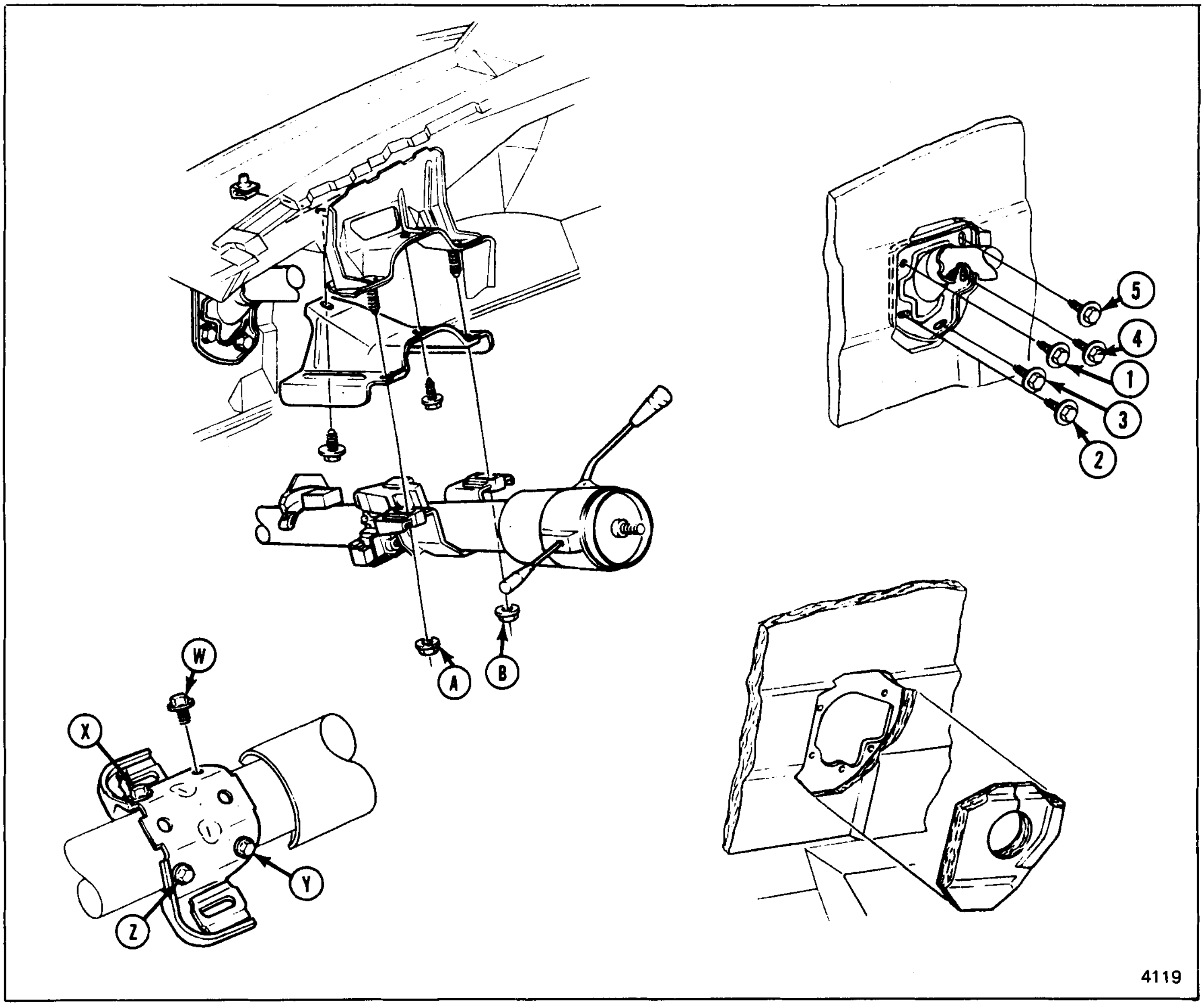


Fig. 3B4-80 Column Mounting - Typical

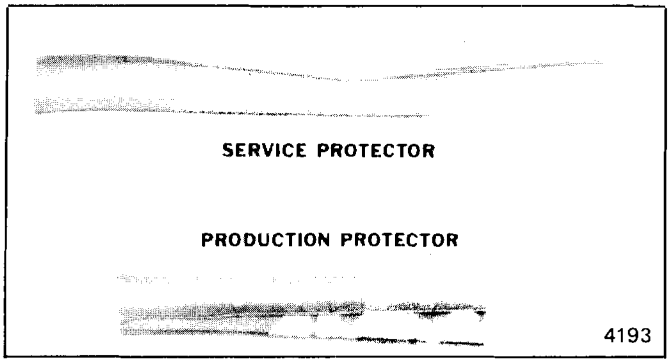


Fig. 3B4-81 Turn Signal Wire Protectors

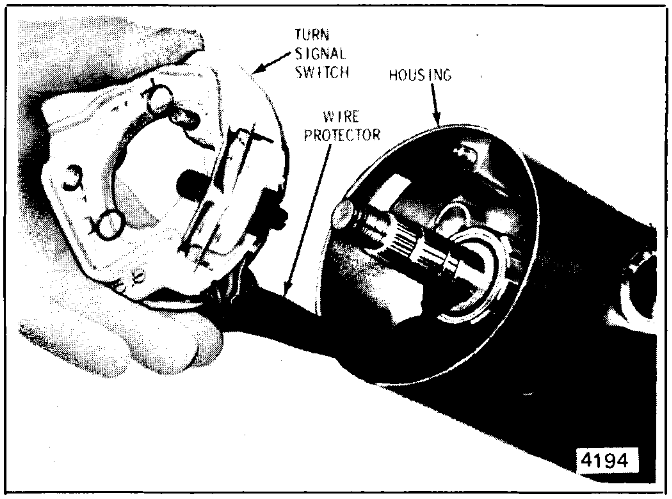


Fig. 3B4-82 Installing Turn Signal Switch

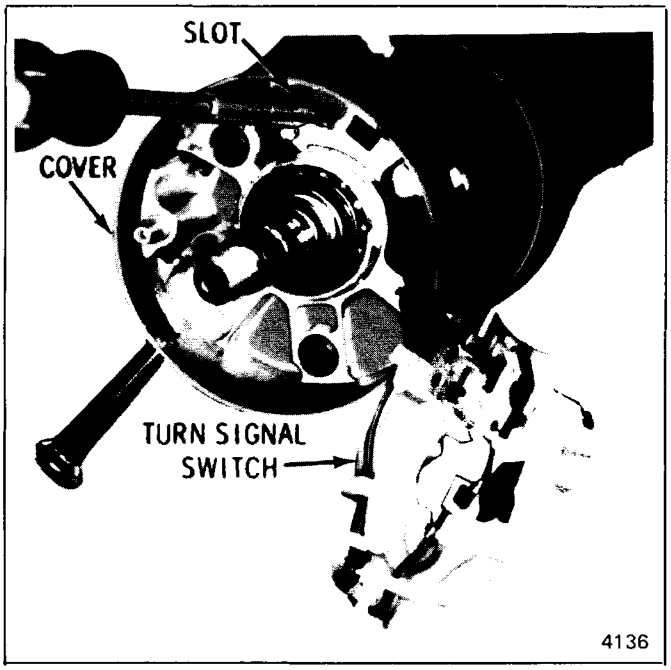


Fig. 3B4-83 Ignition Lock Removal

2. Using needle nose pliers, remove key warning buzzer switch and spring clip (Fig. 3B4-85).

NOTE: Care must be exercised on removal of switch so that spring clip is not lost or damaged.

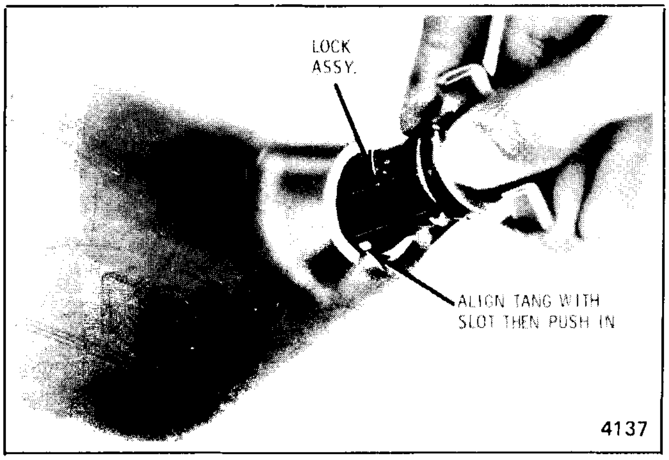


Fig. 3B4-84 Installing Ignition Lock

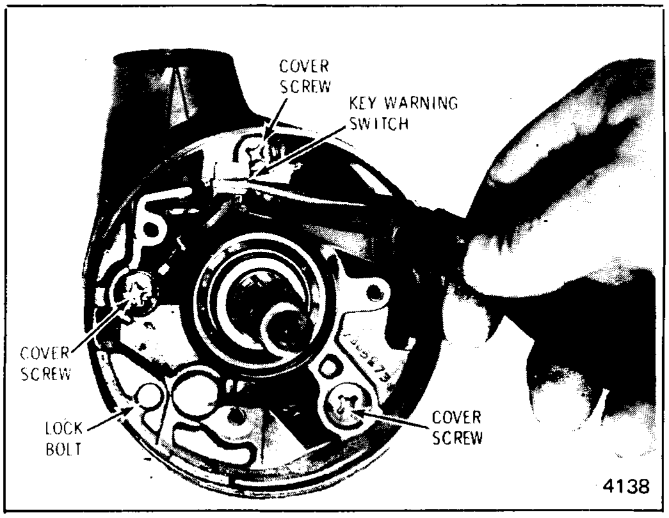


Fig. 3B4-85 Remove Key Warning Buzzer Switch

Installation

1. Assemble buzzer switch and spring clip with formed end of clip under end of switch and spring bowed away from switch on side opposite contact. Push switch and spring into hole in cover to the stop with contacts toward lock cylinder bore (Fig. 3B4-86).

NOTE: Make sure terminal prongs are not bent downward during isntallation.

NOTE: Key warning buzzer switch must be installed before ignition lock assembly is installed or the lock moved to Run position.

2. Refer to IGNITION LOCK ASSEMBLY (Regular)-Installation-Steps 1-14.

IGNITION SWITCH (REGULAR) EXC. X SERIES

Removal

1. Disconnect negative cable from battery.
2. Position ignition lock cylinder in "OFF-UNLOCKED" position.

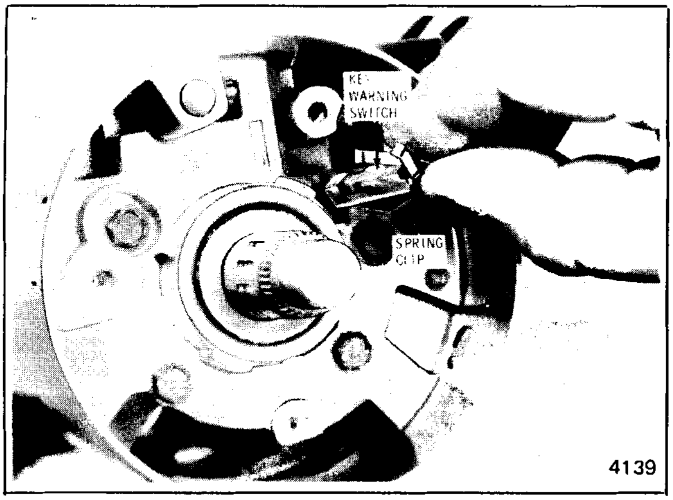


Fig. 3B4-86 Install Key Warning Buzzer Switch

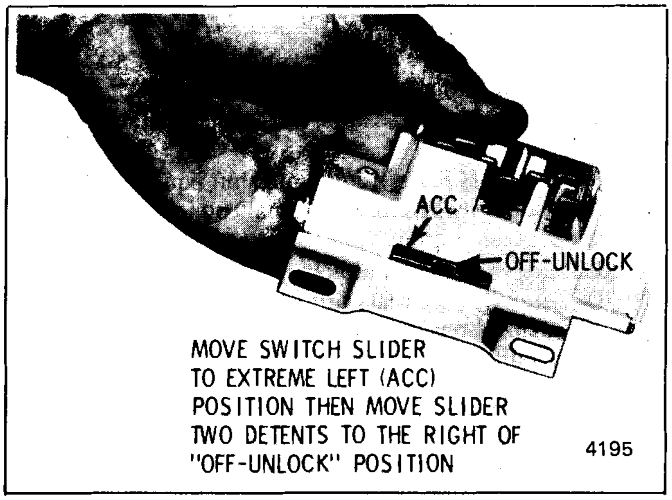


Fig. 3B4-87 Position Switch for OFF-UNLOCK Position

3. Remove toe-pan cover and loosen toe-pan clamp bolts.

NOTE: On H Series with manual steering remove toe-pan bolts.

4. Remove trim cap or lower cover from lower portion of instrument panel.

5. (All exc. H Series) If equipped with column shift (automatic) remove shift indicator needle or link from shift bowl.

6. Remove the two nuts "A" and "B" from bracket assembly (Fig. 3B4-80) and lower column until steering wheel rests on seat cushion. If spacers are used, retain for use on installation.

7. Remove the two switch attaching screws and lift switch off actuator rod.

8. Disconnect wiring from ignition switch.

Installation

1. (All exc. H Series) Position the shift bowl in any position except "Park" and rotate lock cylinder counterclockwise until the rack bottoms against the lower surface of the cast in bowl plate.

2. Move the switch slider to the extreme left (ACC) position then move slider 2 detents to the right from "ACC" to the "OFF-UNLOCK" position (Fig. 3B4-87).

3. Fit the actuator rod into the slider hole and assemble switch to the column with two screws. Torque to 35 in. lbs.

NOTE: Care should be exercised to prevent moving the switch out of detent. Use only the correct screws.

4. Connect wiring connectors to ignition switch.

5. Raise column into position and loosely install nuts "A" and "B" (Fig 3B4-80). If spacers were removed, install in equal amounts on each side.

6. Torque toe-pan clamp bolts to 60 in. lbs.

NOTE: On H Series install No. 1 bolt.

7. Torque nuts "A" and "B" to 25 ft. lbs. On H Series also tighten toe-pan bolts 2 and 3.

8. Install trim cover over toe-pan.

9. If equipped with column shift (automatic) install shift indicator needle or link on shift bowl and adjust as shown in Figs. 3B4-16 and 3B4-17.

10. Install trim cap or lower panel to lower portion of instrument panel.

11. Connect negative cable to battery.

HOUSING (REGULAR)

Removal

1. Refer to TURN SIGNAL SWITCH (Regular)-Removal-Steps 1-11.

2. Position lock assembly in RUN position. Insert a thin tool (small screwdriver or knife blade) into the slot next to the switch mounting screw boss (right hand slot) and depress retainer at bottom of slot, which releases lock. Remove lock (Fig. 3B4-83).

3. If replacing housing, use needle nose pliers and remove key warning buzzer switch and spring clip (Fig. 3B4-85).

NOTE: Care must be exercised on removal of switch so that spring clip is not lost or damaged.

4. Remove trim cap or lower trim panel from lower portion of instrument panel. Remove toe-pan trim cover.

5. (Exc. H and X Series) Loosen toe-pan clamp bolts.

(H and X Series) - Remove toe-pan cover bolts.

6. If equipped with column shift (automatic) remove shift indicator needle cable or link from shift bowl.

7. (Exc. H Series w/manual steering) Remove the two nuts "A" and "B" from bracket assembly (Fig. 3B4-80) and lower column until column rests on (protected) front seat cushion.

(H Series w/manual steering) Remove the two nuts "A" and "B" from bracket assembly and support so column will not be bent.

8. (Exc. H Series) With shift lever in "PARK" (Automatic) or "Reverse" (Manual) move ignition switch actuator rod up until switch would be in "ACC" position, then move actuator rod down two detent positions to the "OFF-UNLOCKED" position..

9. (H Series) Position switch in the "OFF-UNLOCKED" position by pulling actuator rod up to a definite stop then back two positions to "Off-Unlock" (Fig.

3B4-87).

10. Remove the two ignition switch attaching screws and lift switch off of actuator rod.

11. Lift column into position and loosely install nuts "A" and "B" (Fig. 3B4-80).

12. (All exc. H Series) If column shift equipped, remove shift lever from bowl by using a small punch and hammer to drive out retaining pin.

13. Remove the bolts attaching housing to jacket (Fig. 3B4-88). Carefully pull rearward on housing until free from jacket, then turn housing clockwise 90° so that actuator rod can now be pulled through bowl by the housing assembly.

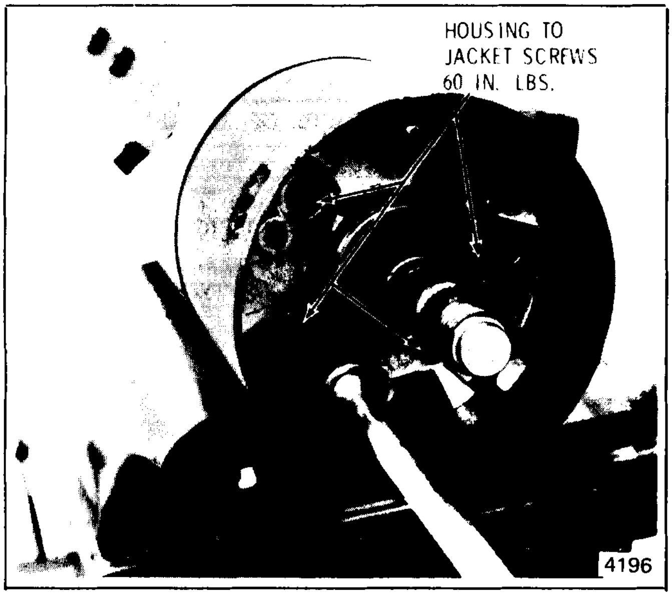


Fig. 3B4-88 Housing Attachment - H Series

NOTE: On H Series the shroud and housing will come off as an assembly.

14. (H Series Only) Remove 3 shroud to housing screws from inside housing and separate shroud from housing. Key release lever wave washer may stick to shroud. If not, remove from lever boss (Fig. 3B4-89).

15. (H Series Only) Remove key release lever and spring from boss on housing (Fig. 3B4-90).

NOTE: For disassembly of lock mechanism refer to specific part removal.

Installation

NOTE: Apply thin coat of lithium grease to all friction parts.

H Series ONLY:

1. Position lever return spring over tapped post as shown in Fig. 3B4-91. Slip lever finger into rack slot and over tapped post. Make sure inner end of spring contacts lever as shown.

2. Raise lever slightly. Slip end of spring between lever and boss, and then push lever and spring down to secure (Fig. 3B4-92).

3. Coat wave washer with chassis lube and place on tapped boss over release lever (Fig. 3B4-92).

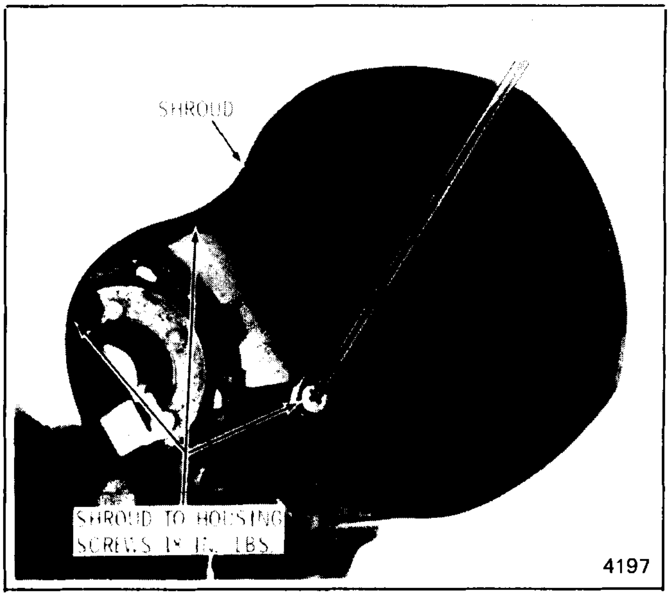


Fig. 3B4-89 Shroud Attachment - H Series

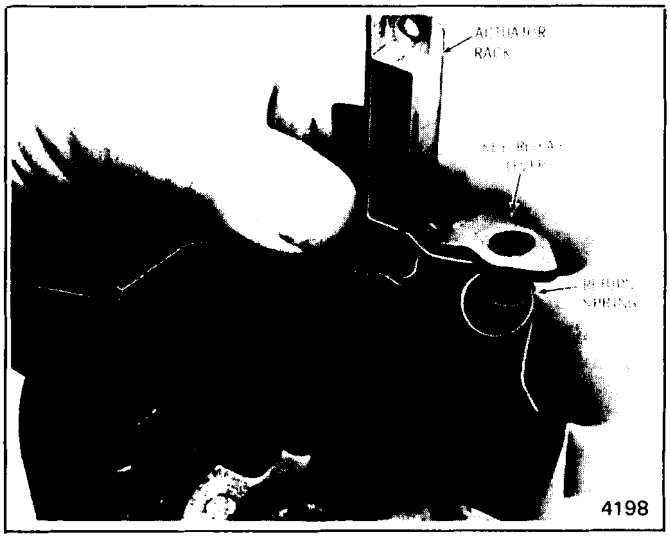


Fig. 3B4-90 Remove Key Release Lever and Spring

4. Carefully position shroud onto housing (so as not to unseat wave washer). Drive three screws (wave washer location first) and tighten to 18 in. lbs. (Fig. 3B4-89).

5. Place actuator rod into rack (short end of rod into rack).

6. Position housing and shroud assembly onto jacket and drive four screws (Fig. 3B4-88). Tighten to 60 in. lbs.

All Series

1. With actuator rod (switch end) horizontal, insert rod through bowl (exc. H Series) until housing is at top end of jacket. Turn counterclockwise 90° until rack assembly aligns with slot in lock plate. Slowly push forward on housing until the housing to jacket attaching bolts can be installed. Torque bolts to 60 in. lbs. (Fig. 3B4-88).

2. (Exc. H Series) If column shift equipped, install shift lever into bowl as shown in Fig. 3B4-93, then remove shim and drive shift lever retaining pin into place. Position shift lever in any position except "PARK" (Automatic), "REVERSE" (Manual).

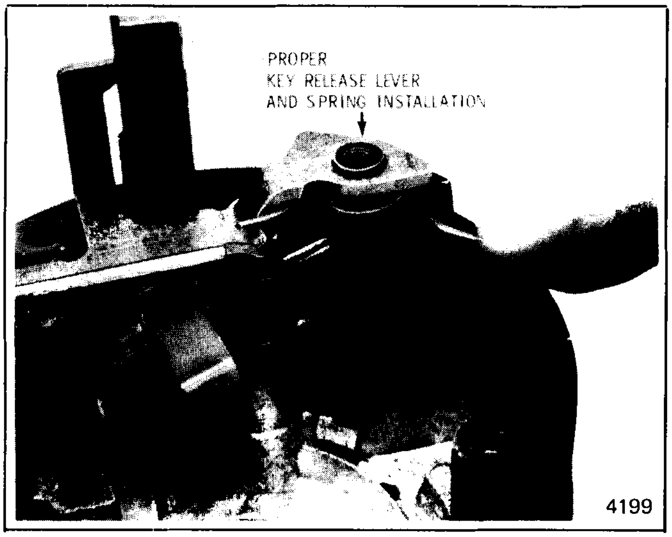


Fig. 3B4-91 Key Release Lever and Spring Position

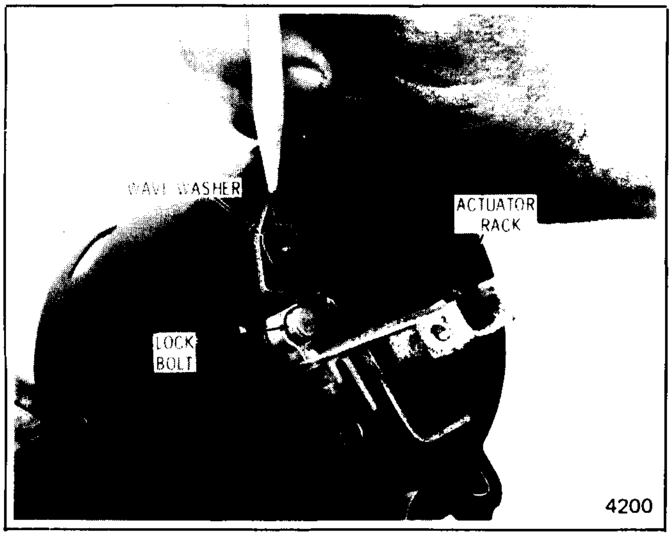


Fig. 3B4-92 Key Release Wave Washer

3. If key warning buzzer switch was removed, assemble buzzer switch and spring clip with formed end of clip under end of switch and spring clip bowed away from switch on side opposite contact. Push switch and spring into hole in housing to the stop with contacts toward lock cylinder bore (Fig. 3B4-86).

NOTE: Key warning buzzer switch must be installed before ignition lock assembly is installed.

4. (Exc. X, F and H Series) Remove the two nuts "A" and "B" from bracket assembly (Fig. 3B4-80) and lower column until column rests on seat cushion.

(F, X and H Series) Remove the two nuts "A" and "B" from bracket assembly (Fig. 3B4-80) and lower column until ignition switch can be installed.

5. Check ignition switch to be sure switch is in "OFF-UNLOCK" position, Fig. 3B4-87, then fit switch over actuator rod and install screws. Torque to 35 in. lbs.

6. Raise column into position and loosely install nuts "A" and "B". If spacers were removed, install in equal amounts on each side.

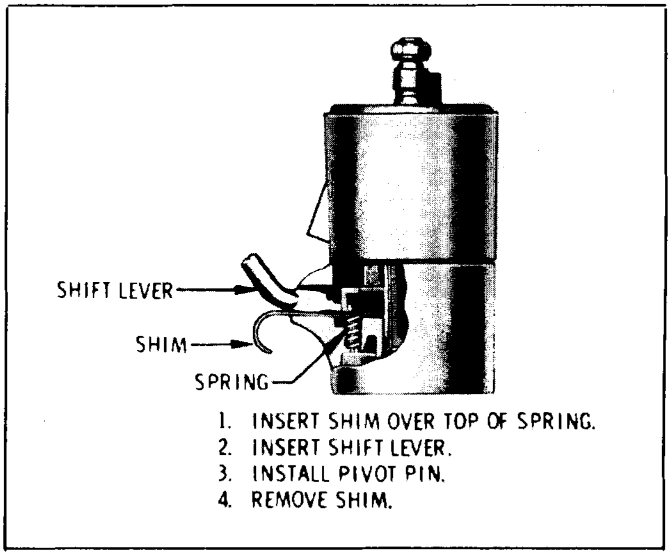


Fig. 3B4-93 Shift Lever Installation

7. Install lock, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into cover bore with key on cylinder sleeve aligned to keyway in housing (Fig. 3B4-84), push into abutment of cylinder and sector. Rotate knob counterclockwise, maintaining a light push inward on cylinder, until drive section of cylinder mates with drive shaft. Push in until snap ring pops into groove and lock cylinder is secured in cover. Check freedom of rotation.

8. Position lock assembly in "ACC" position.

9. Refer to TURN SIGNAL SWITCH (Regular)-Installation-Steps 2-11.

10. (Exc. F, X and H Series) Torque toe-pan clamp bolts to 60 in. lbs.

11. (Exc. F, X and H Series) Torque nuts "A" and "B" to 25 ft. lbs. (Fig. 3B4-80).

12. (F, X and H Series) Loosely install toe-pan bolts then torque nuts "A" and "B" to 25 ft. lbs.

13. Torque toe-pan bolts to 45 in. lbs.

14. Install trim cover over toe-pan.

15. If equipped with column shift (Automatic) install shift indicator needle, link or cable on shift bowl and adjust as shown in Figs. 3B4-16, 3B4-17 and 3B4-18.

16. Install trim cap or lower panel to lower portion of instrument panel.

17. Connect negative cable to battery.

SHIFT GATE (REGULAR) EXC. H SERIES

Removal

1. Refer to HOUSING (Regular)-Removal-Steps 1-12.

2. Remove two attaching screws and remove shift gate (Fig. 3B4-94).

Installation

1. Install shift gate as shown in Fig. 3B4-94.

2. Refer to HOUSING (Regular)-Installation-Steps 1-23.

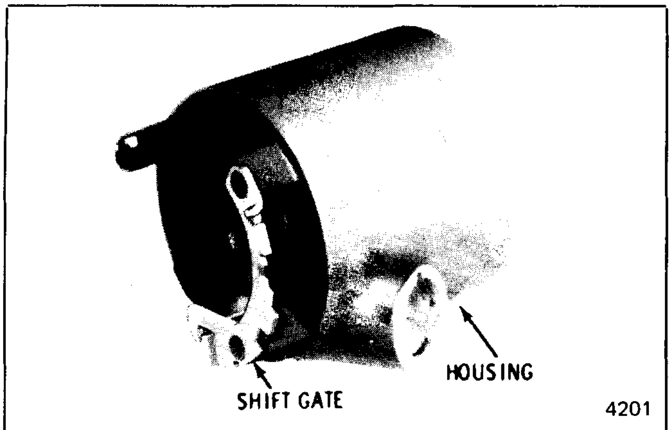


Fig. 3B4-94 Shift Gate Mounting (Exc. H Series)

SECTOR (REGULAR)

Removal

1. Refer to HOUSING (Regular)-Removal-Steps 1-12.
2. Lift rack assembly and lock bolt out of housing (Fig. 3B4-95).
3. Using a blunt punch, tap sector as shown in Figs. 3B4-96 and 3B4-97 and remove sector through hole where ignition lock cylinder was removed.

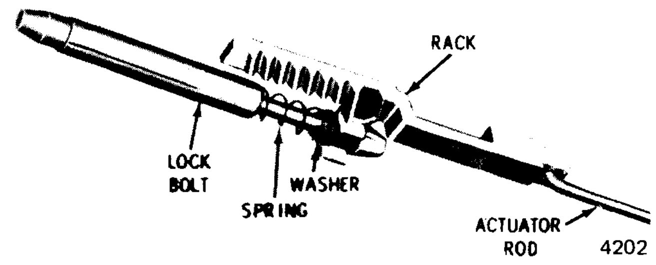


Fig. 3B4-95 Rack and Lock Bolt Assembly

Installation

1. Install sector through hole where igntiion lock cylinder was removed. Install sector on shaft and tap sector with a punch to engage sector to shaft (Fig. 3B4-98).
2. Insert rack and lock bolt assembly into housing (rack teeth toward sector). Slowly lower rack assembly and position sector so that the first tooth of rack assembly engages between first and second tooth of sector (Fig. 3B4-99).

NOTE: When rack and sector are properly aligned, large tooth of sector will align with large slot in rack.

3. Refer to HOUSING (Regular)-Installation-Steps 1-23.

LOCK BOLT AND/OR RACK (REGULAR)

Removal

1. Refer to HOUSING (Regular)-Removal-Steps 1-12.
2. Lift rack assembly and lock bolt out of housing.
3. Lock bolt will lift out of rack assembly.

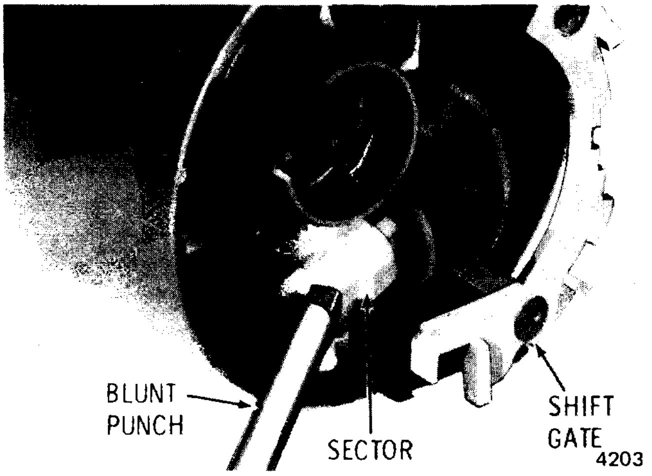


Fig. 3B4-96 Removing Sector

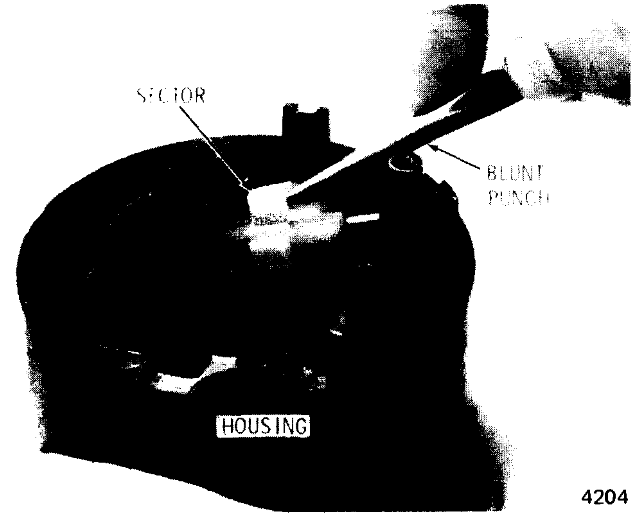


Fig. 3B4-97 Removing Sector (H Series)

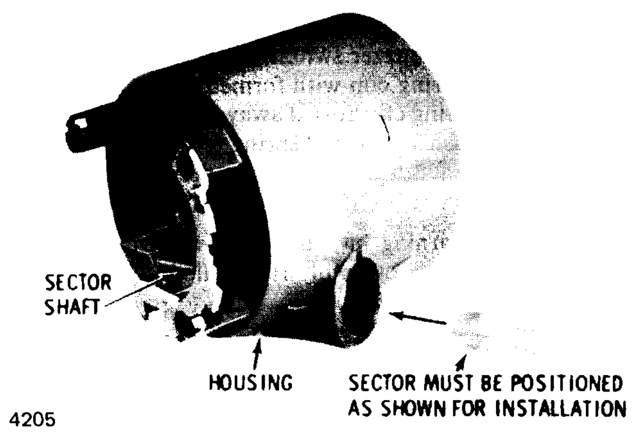


Fig. 3B4-98 Install Sector

4. Rack spring may be removed (Fig. 3B4-100).

Installation

1. Install rack spring as shown in Fig. 3B4-100.

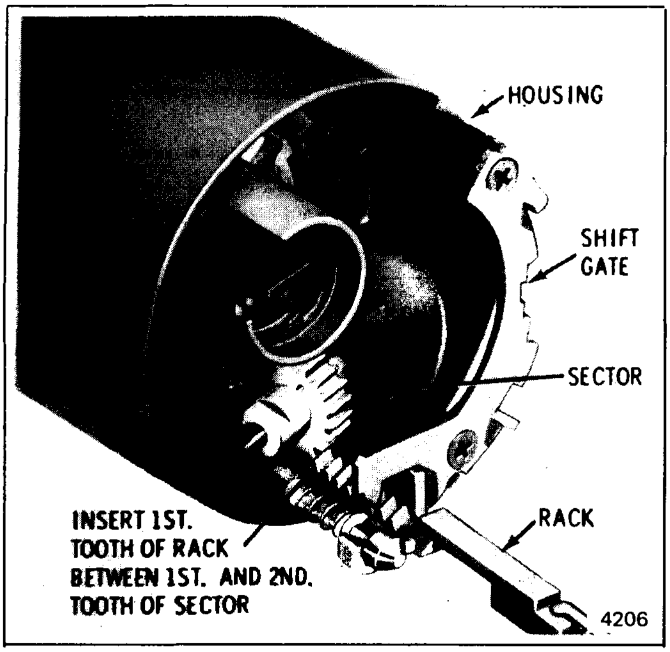


Fig. 3B4-99 Engage Rack and Sector

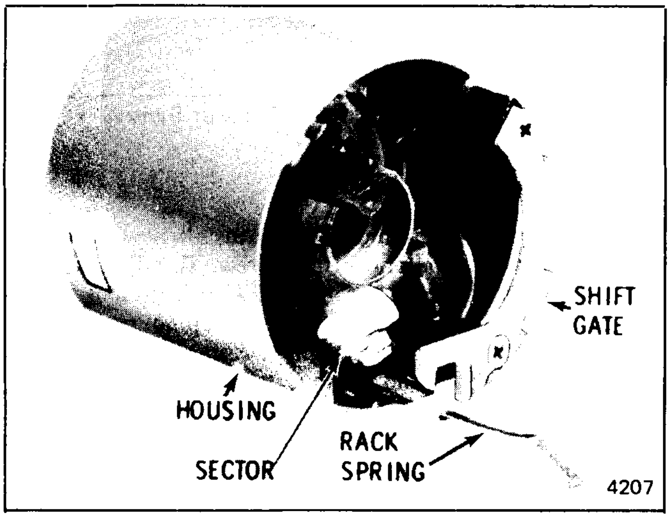


Fig. 3B4-100 Rack Spring

2. Push down on washer and spring and position lock bolt into rack assembly as shown in Fig. 3B4-95.

3. Insert rack and lock bolt assembly into housing (rack teeth toward sector). Slowly lower rack assembly and position sector so that the first tooth of rack assembly engages between first and second tooth of sector (Fig. 3B4-99).

NOTE: When rack and sector are properly aligned, large tooth of sector will align with large slot in rack.

4. Refer to HOUSING (Regular)-Installation-Steps 1-23.

BOWL (EXC. H SERIES)

Removal

1. Refer to HOUSING (Regular)-Removal-Steps 1-12.

2. Position bowl in "Reverse" and pull bowl up and rearward to remove.

3. If replacing bowl, remove shift lever spring from bowl. Remove thrust cup (Fig. 3B4-101).

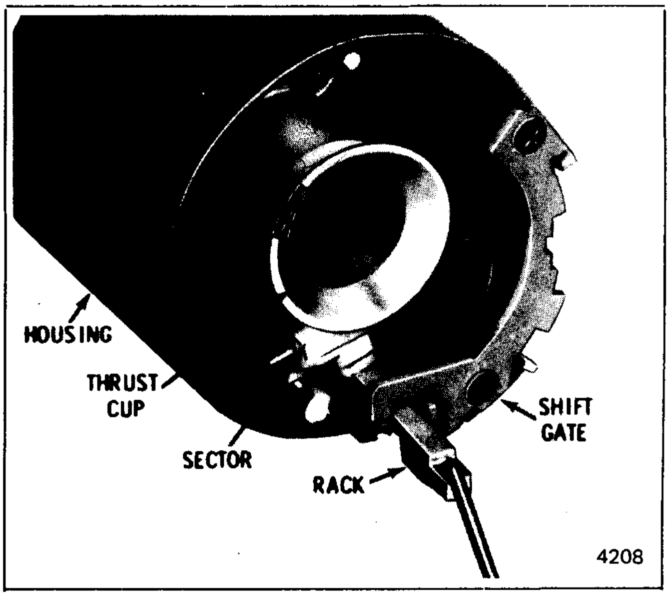


Fig. 3B4-101 Bowl Thrust Cup

Installation

1. With shift tube in "Reverse" position align slot in bowl hub with land on shift tube and push into place (Fig. 3B4-102).

NOTE: The bowl is a slip fit to the shift tube.

2. Refer to HOUSING (Regular)-Installation-Steps 1-23.

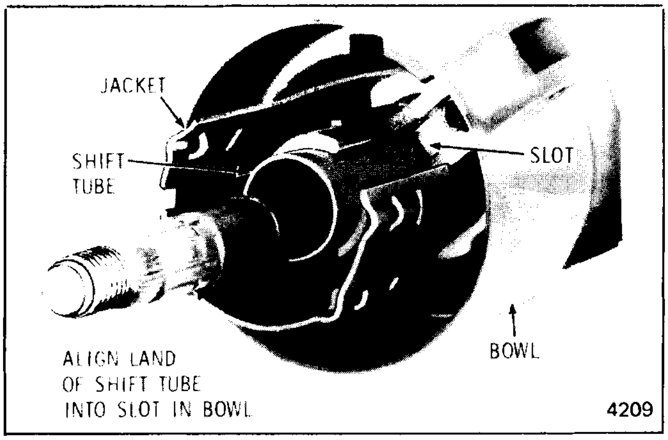


Fig. 3B4-102 Bowl Installation

LOWER BOWL BEARING (REGULAR)

Removal

1. Refer to HOUSING (Regular)-Removal-Steps 1-12.

2. Position bowl in "Reverse" and pull bowl up and rearward to remove.

3. Remove wave washer (Fig. 3B4-103).

4. Using needle nose pliers, remove lower bowl bearing from top of column aligning slots of bearing as shown in Fig. 3B4-104.

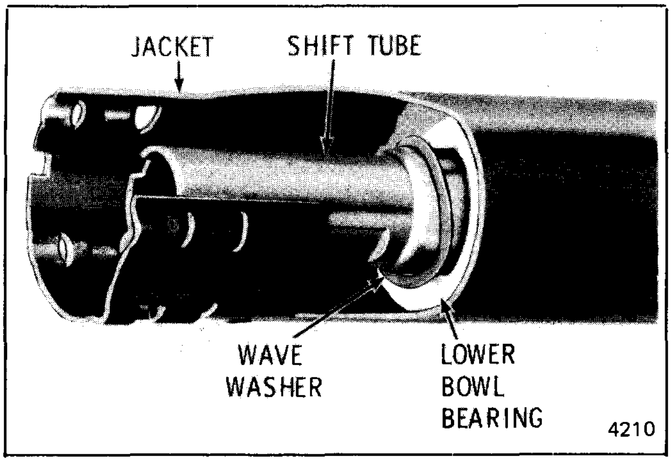


Fig. 3B4-103 Lower Bowl Bearing and Thrust Washer

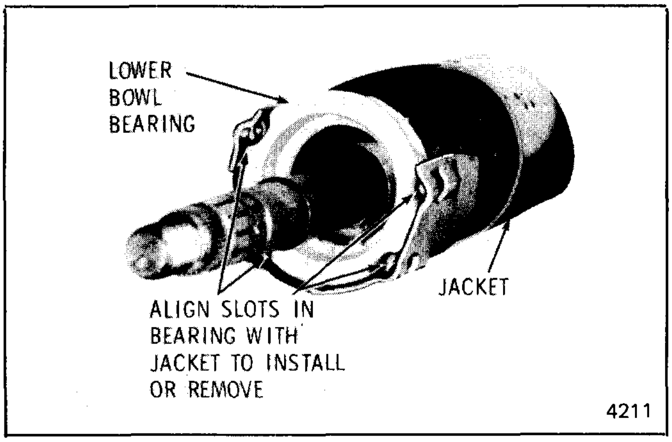


Fig. 3B4-104 Aligning Lower Bowl Bearing

Installation

1. Install lower bowl bearing into jacket aligning slots, then push bearing into place as shown in Fig. 3B4-104.

NOTE: Bearing slots must be positioned against stops (three) in jacket (Fig. 3B4-103).

2. Install wave washer.

3. With shift tube in "Reverse" position, align slot in bowl hub with land on shift tube and push into place (Fig. 3B4-102).

4. Refer to HOUSING (Regular)-Installation-Steps 1-23.

DIMMER SWITCH ADJUSTMENT OR REPLACEMENT (B SERIES)

Removal

1. Disconnect negative cable from battery.

2. Remove instrument panel lower trim cap or lower trim panel.

3. Remove toe-pan cover bolts (Fig. 3B4-80).

4. Remove the two nuts "A" and "B" from bracket assembly (Fig. 3B4-80) and lower column until column rests on (protected) front seat cushion.

5. If adjusting, loosen dimmer switch screw; if replacing dimmer switch, remove screw (Fig. 3B4-105), then dimmer switch. Tape rod to column and separate dimmer switch from rod by pulling.

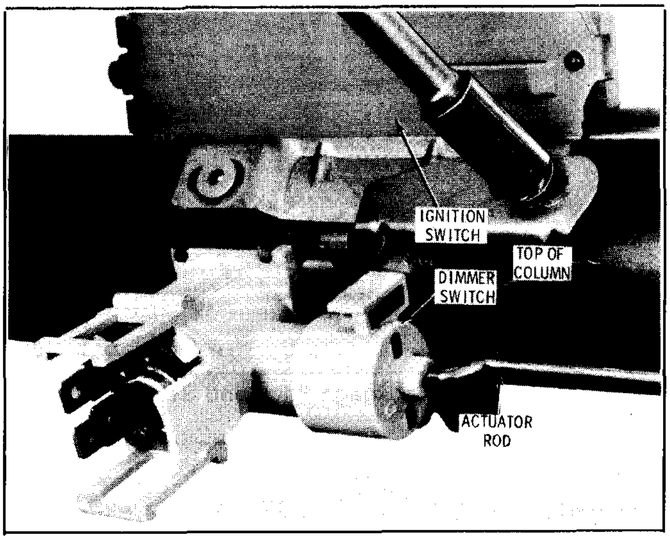


Fig. 3B4-105 Removing Dimmer Switch

Installation

1. If replacing dimmer switch, install new switch by pushing switch on rod and install screw. To adjust, depress dimmer switch slightly to install 3/32" drill to lock switch to body (Fig. 3B4-106). Force switch up to remove lash between switch and pivot. Tighten upper dimmer switch screw to 35 in. lbs. and remove tape from actuator rod. Remove drill and check dimmer switch function by actuating lever, if tilt column check function in full up, down and center tilt positions.

2. Install nuts "A" and "B", torque to 25 ft. lbs. (Fig. 3B4-80).

3. Install toe-pan cover bolts and torque to 45 in. lbs. (Fig. 3B4-80).

4. Install instrument panel lower trim cap or lower trim panel.

5. Connect negative cable to battery.

REGULAR COLUMN WITH DIMMER SWITCH

Dimmer Switch Linkage and Pivot

Removal

1. Refer to "TURN SIGNAL SWITCH " (Regular)-Removal-Steps 1-5.

2. Remove upper bearing preload spring and washer.

3. Position turn signal lever in the right turn position, then remove lever, pull straight out to disengage (Fig. 3B4-107).

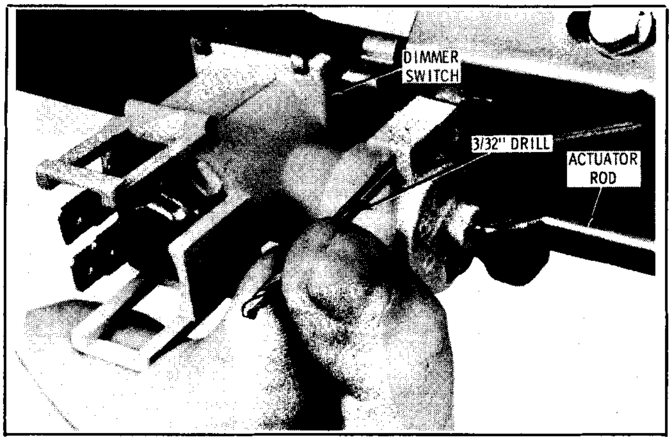


Fig. 3B4-106 Adjusting Dimmer Switch

4. Push in on hazard warning knob, then remove screw and hazard warning knob.

5. Remove switch actuator arm mounting screw, then remove arm (Fig. 3B4-108).

6. Remove the three turn signal switch attaching screws (Fig. 3B4-109).

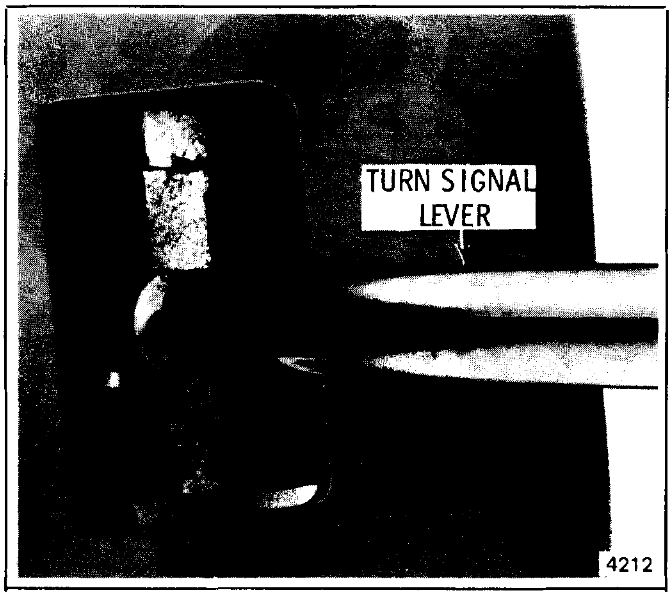


Fig. 3B4-107 Removing Turn Signal Lever

7. Remove instrument panel lower trim cap or lower trim panel, then disconnect turn signal connector from harness (Fig. 3B4-79). Lift connector from mounting bracket on right side of jacket and remove protector from the jacket and wires from it.

8. Remove the four bolts "W", "X", "Y" and "Z" attaching bracket assembly to jacket (Fig. 3B4-80).

9. Remove toe-pan cover bolts (Fig. 3B4-80).

10. Remove shift indicator retaining clip.

11. Remove the two nuts "A" and "B" from bracket assembly (Fig. 3B4-80) and lower column until column rests on (protected) front seat cushion.

12. Tape turn signal switch wires at connector keeping wires flat and parallel, then carefully pull signal switch and wiring from top end of column.

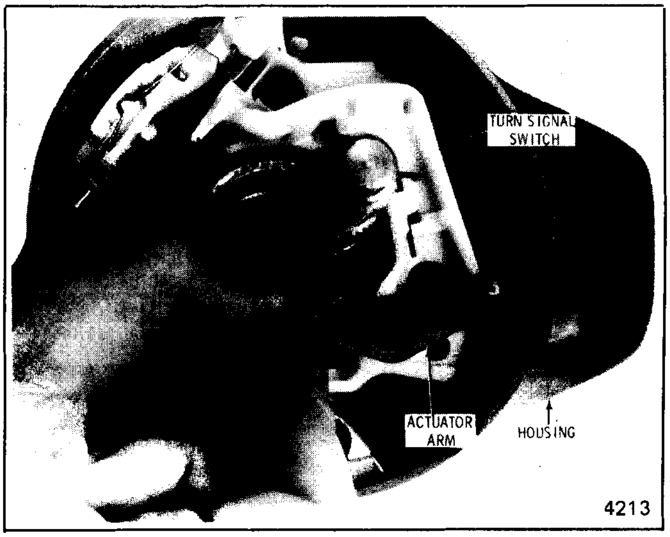


Fig. 3B4-108 Removing Actuator Arm

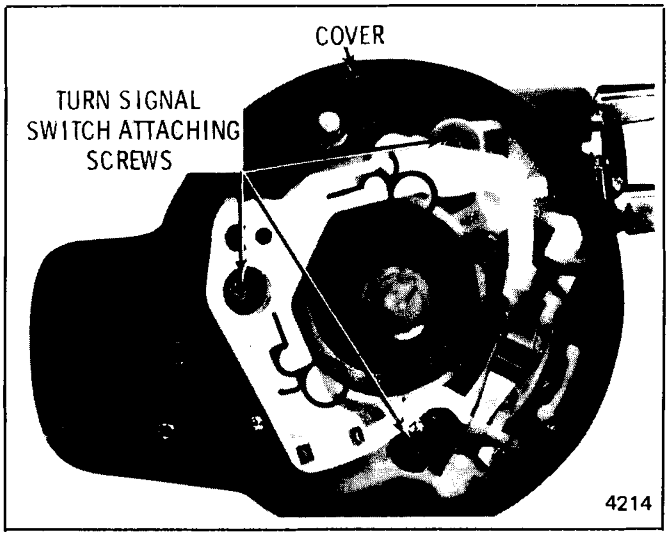


Fig. 3B4-109 Turn Signal Switch Screws

13. Remove dimmer switch mounting screw, then dimmer switch (Fig. 3B4-110).

14. With ignition switch in "OFF-UNLOCK" position remove the ignition switch attaching screw and remove the ignition switch.

15. Position lock assembly in "RUN" position. Insert a thin tool (small screwdriver or knife blade) into the slot next to the switch mounting screw boss (right hand slot) and depress retainer at bottom of slot, which releases lock. Remove lock (Fig. 3B4-111).

16. Remove shift lever from bowl by using a small punch and hammer to drive out retainer pin.

17. Push ignition switch actuator rod fully upward so locking pin extends from housing, remove the bolts attaching housing to jacket (Fig. 3B4-112).

18. Remove dimmer switch actuator rod.

19. While holding locking pin, carefully pull rearward on housing until free from jacket, then turn housing clockwise 90° so that actuator rod can now be pulled through bowl by the housing assembly.

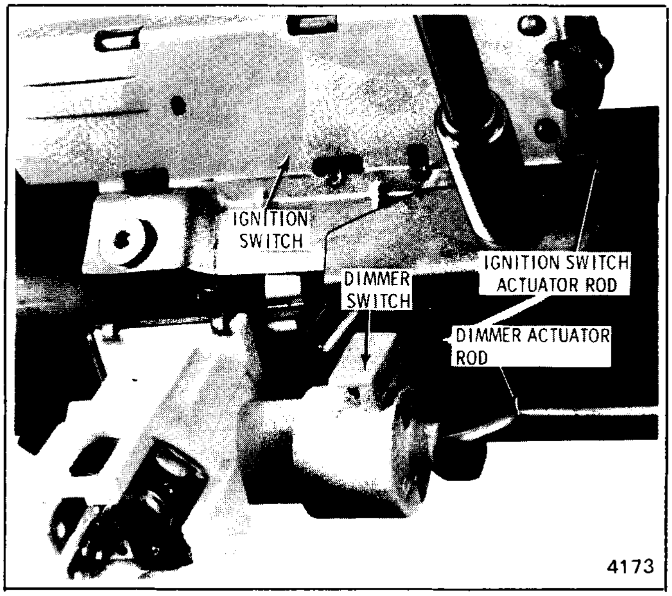


Fig. 3B4-110 Removing Dimmer Switch Mounting Screw

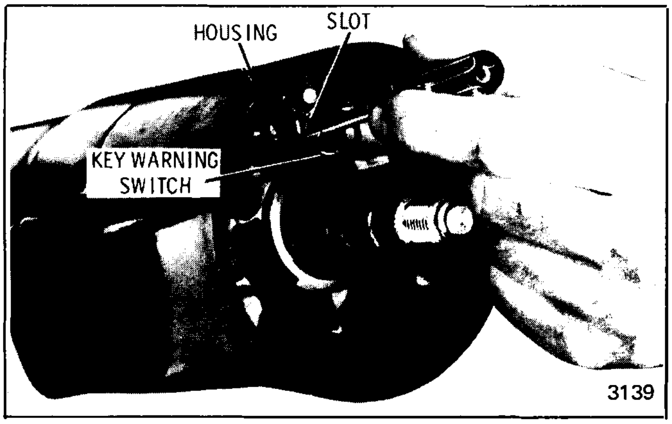


Fig. 3B4-111 Ignition Lock Removal

20. Remove cup from end of shift tube.
21. Remove screw and cover from housing (Fig. 3B4-113).
22. Remove pivot pin and pivot assembly (Fig. 3B4-114).

Installation

1. Install pivot assembly and pin and tighten to 35 ft. lbs.
2. Install pivot assembly cover and screw.
3. Install cup in rear of housing (Fig. 3B4-115).
4. Before installing housing, fit dimmer actuator rod into pivot, install rod between jacket and bowl while fitting housing.
5. With actuator rod (switch end) horizontal, insert rod through bowl until housing is at top end of jacket. Turn counterclockwise 90° until rack assembly aligns with slot in lock plate. Slowly push forward on housing until housing to jacket attaching bolts can be installed (Fig. 3B4-116). Torque bolts to 60 in. lbs.
6. Install shift lever into bowl as shown in Fig. 3B4-93, then remove shim and drive shift lever retaining pin into place. Position shift lever in any position except "PARK" (automatic).

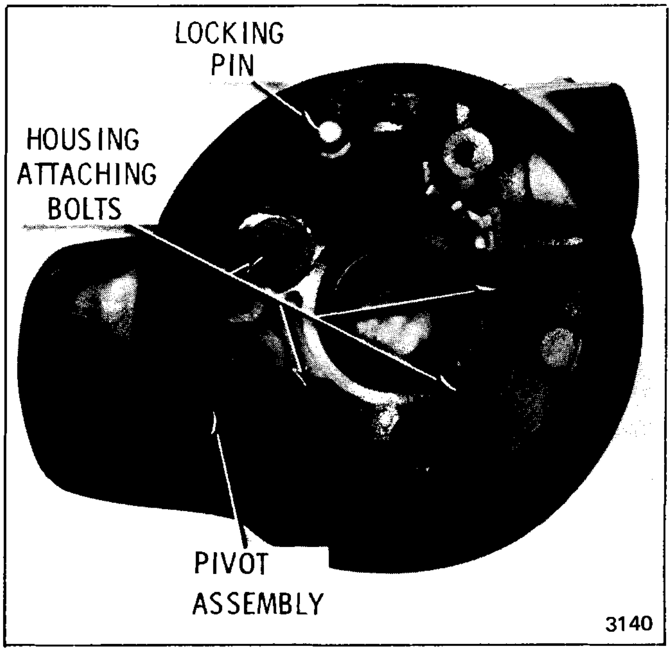


Fig. 3B4-112 Removing Housing Bolts

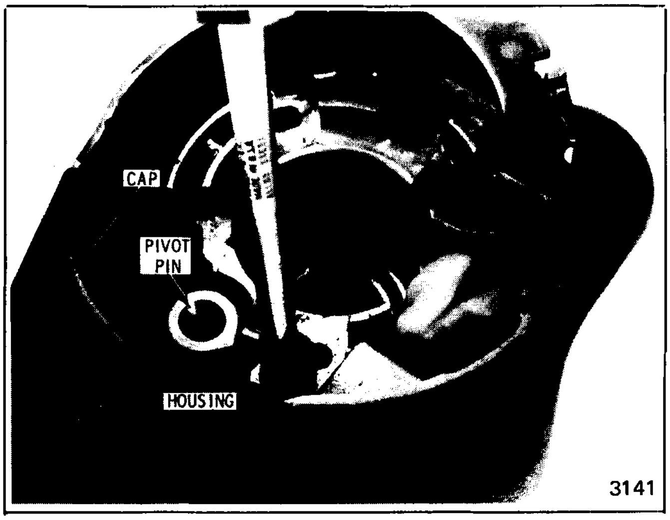


Fig. 3B4-113 Removing Cover and Screw

7. Install lock, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into cover and bore with key on cylinder sleeve aligned to keyway in housing (Fig. 3B4-84). Push into abutment of cylinder and sector. Rotate knob counterclockwise, maintaining a light push inward on cylinder until drive section of cylinder mates with drive shaft. Push in until snap ring snaps into groove and lock cylinder is secured in cover. Check freedom of rotation.

8. Check ignition switch to be sure switch is in "OFF-UNLOCK" position (Fig. 3B4-87), then fit switch over actuator rod and install lower screw. Torque to 35 in. lbs.

9. Install dimmer switch by pushing switch on rod and install attaching screw. Depress dimmer switch slightly to feed 3/32" drill to lock switch to body (Fig. 3B4-117). Force switch up to remove lash between switch and pivot. Tighten upper ignition switch screw to 35 in. lbs. Remove drill and check dimmer switch function by actuating lever.

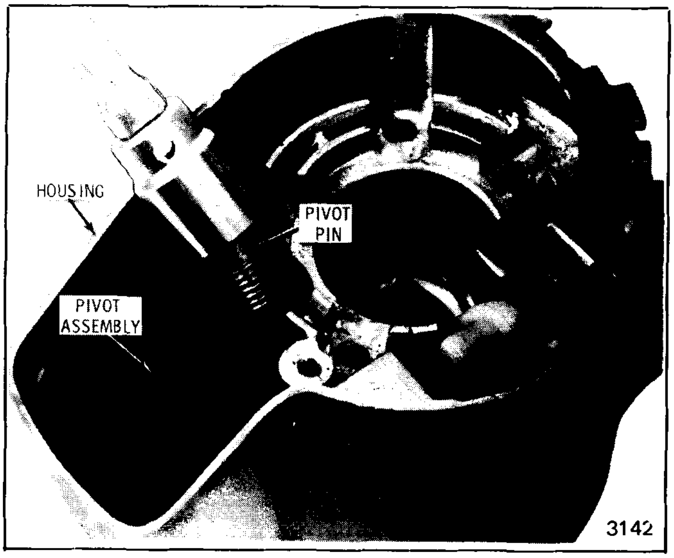


Fig. 3B4-114 Removing Pivot Pin

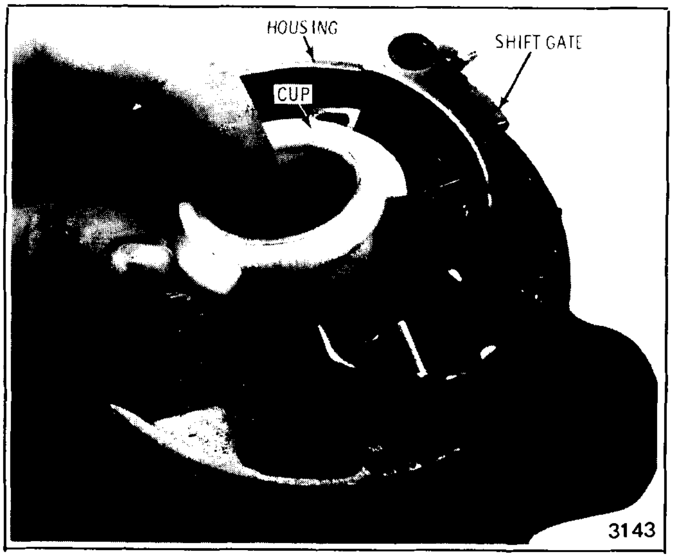


Fig. 3B4-115 Installing Cup

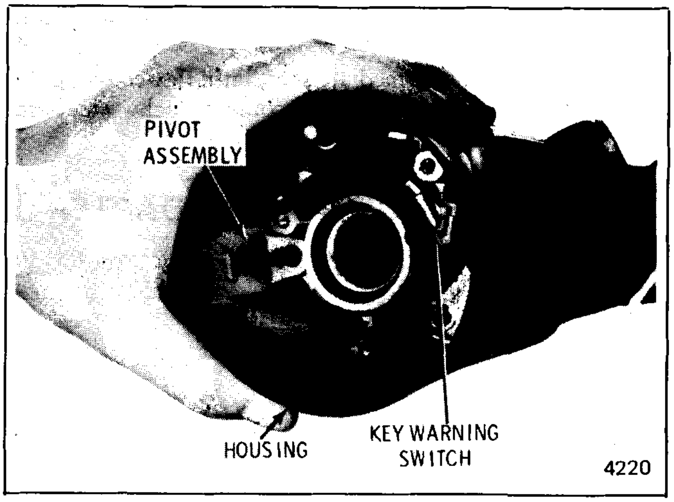


Fig.3B4-116 Installing Housing

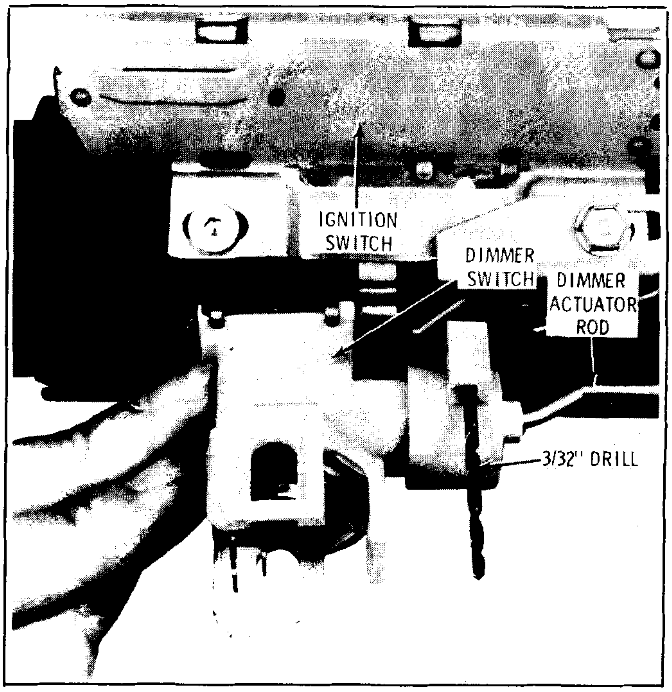


Fig. 3B4-117 Adjusting Dimmer Switch

10. With turn signal switch wiring taped flat at connector, carefully guide wiring into column.

11. Index switch into right turn position, then push switch straight down until seated in cover.

NOTE: Angling or cocking of switch can cause damage to buzzer terminal or can cause buzzer tangs to get under terminal pads on signal switch.

12. Install switch attaching screws (3) and torque to 35 in. lbs.

13. Install switch actuator arm and mounting screw and torque to 20 in. lbs. (Fig. 3B4-118).

14. Install turn signal lever by pushing straight in.

15. Install hazard warning knob and screw.

NOTE: If the signal switch is not placed in "Neutral" position, assembly of the cancelling cam may cause damage to the turn signal cancel springs in the signal switch assembly.

16. Install washer and upper bearing preload spring.

17. Refer to "TURN SIGNAL SWITCH" (Regular)-Installation-Steps 8-16.

18. Connect negative battery cable.

LOWER BEARING AND/OR ADAPTER OR BUSHING ASSEMBLY (REGULAR)

Removal

1. Remove flexible coupling nuts (exc. X Series).

2. Remove coupling clamp to steering shaft attaching bolt and nut.

3. Pull intermediate shaft off flex-coupling and then pull down on intermediate shaft until coupling is removed from steering shaft.

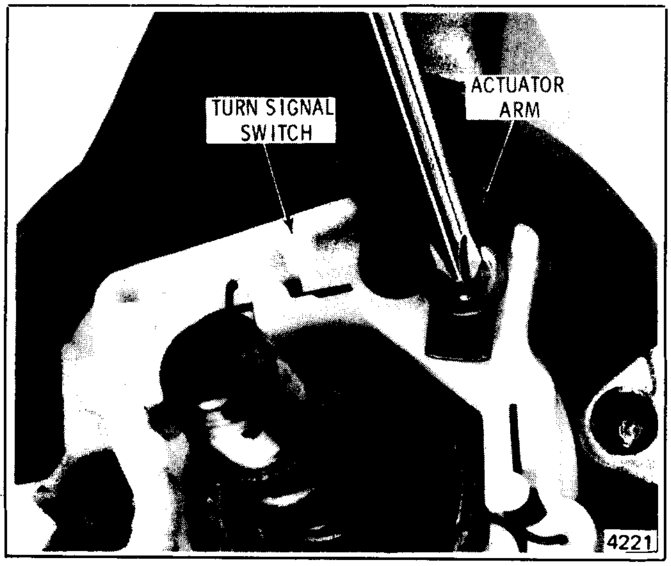


Fig. 3B4-118 Installing Actuator Arm

NOTE: F and X Series intermediate shaft will telescope for coupling removal from steering shaft.

4. Using a screwdriver, pry lower bearing from adapter (B Series), if only bearing is to be replaced (Fig. 3B4-119).

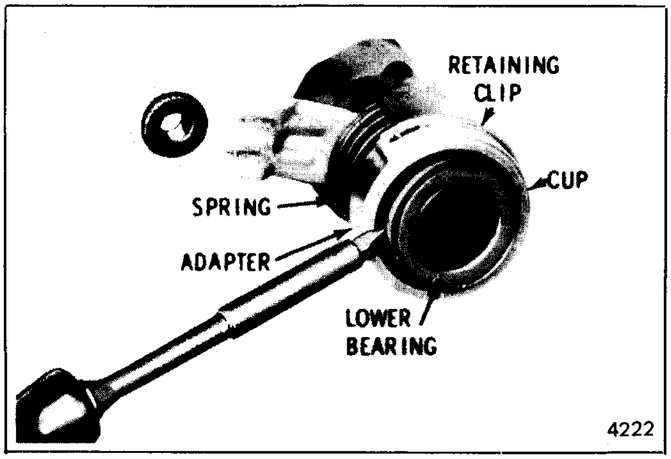


Fig. 3B4-119 Removing Lower Bearing

5. If adapter or bushing assembly (A, F, G and X Series) is to be replaced, use screwdriver to pry off retaining clip (exc. H Series) then remove adapter with bearing in place or bushing assembly and cup. Bearing can be removed from adapter on the bench (Fig. 3B4-120).

NOTE: On H Series adapter is made of plastic and cannot be reused.

Installation

See CAUTION on Page 3B4-1 of this Section.

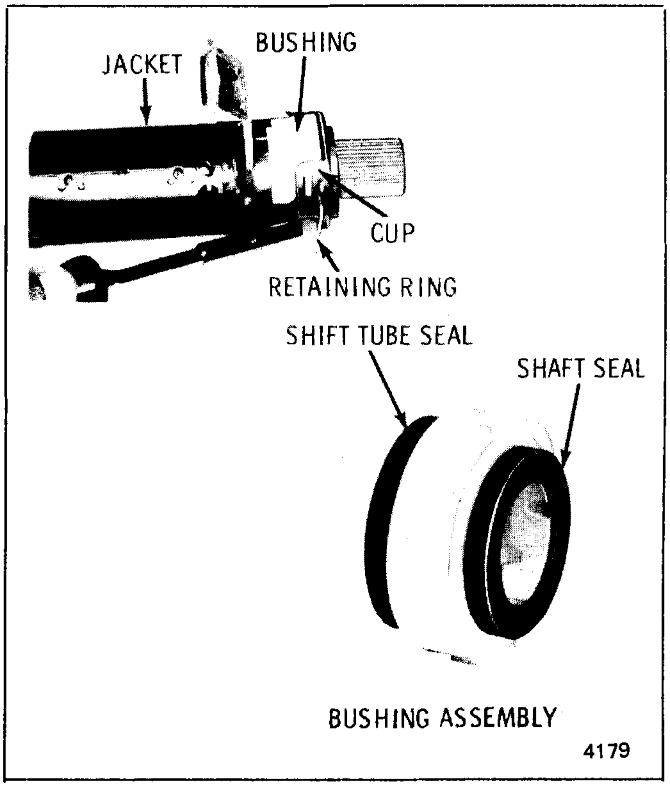


Fig. 3B4-120 Lower Bearing Attachment

NOTE: Apply thin coat of lithium grease to all friction parts.

1. If adapter or bushing assembly was removed, push bearing (B Series) into adapter on the bench, then install assembly over steering shaft into position in jacket. (On H Series push adapter into jacket with projection aligned with slot.) It may be necessary to move shift tube slightly to install adapter and cup. Retain with retaining clip.

2. If only bearing was removed, slide bearing over end of shaft and push into adapter.

3. Position coupling slot in alignment with slot in lower end of steering shaft and install clamp bolt. Torque to 55 ft. lbs.

4. Push up on intermediate shaft until flex-coupling can be installed in position. Install flex-coupling lockwashers and nuts. Torque to 20 ft. lbs.

LOWER BEARING AND/OR ADAPTER (REGULAR)

H SERIES W/MANUAL STEERING

Removal

1. Remove steering column. Refer to STEERING COLUMN (All Series) - Removal-Steps 1-10.

2. Lock plate cover may be removed for replacement at this time by releasing as shown in Fig. 3B4-74.

3. Position Tool J 23131 over steering shaft and, using steering wheel attaching nut, tighten nut until tool slightly depresses lock plate. Pry wire snap ring from shaft and discard (Fig. 3B4-75). Remove Tool J 23131.

NOTE: Tool J 23653 may be used instead of Tool J 23131. Refer to Tilt-Away column procedures for usage.

4. Remove steering shaft from lower end of column.

5. If adapter is to be replaced, use screwdriver to pry or tap adapter out of jacket (Figs. 3B4-120 and 3B4-121).

NOTE: Adapter is made of plastic and cannot be reused.

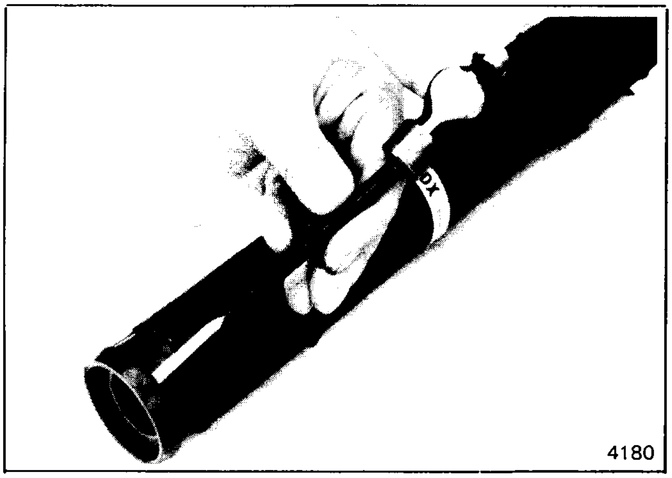


Fig. 3B4-121 Removing Lower Bearing and Adapter - H Series

Installation

See CAUTION on Page 3B4-1 of this Section.

NOTE: Apply thin coat of lithium grease to all friction parts.

1. If adapter was removed, push adapter into position in jacket, aligning projection on adapter with slot in jacket.

NOTE: Carefully clamp LOWER section of jacket in vise to prevent collapse of jacket when installing adapter.

2. Install steering shaft into column from lower end.

3. Position new wire snap ring over steering shaft, then install Tool J 23131 over shaft and tighten steering wheel attaching nut until wire snap ring can be installed in groove in steering shaft (Fig. 3B4-77). Remove Tool J 23131.

NOTE: Tool J 23653 may be used instead of Tool J 23131. Refer to Tilt-Away column procedures for usage.

5. If removed, install cover on lock plate (Fig. 3B4-74).

6. Install steering column. Refer to Steering Column-Installation (H Series)-Steps 1-20.

STEERING SHAFT (REGULAR)

Removal

1. Remove flexible coupling nuts.

2. Remove coupling clamp to steering shaft attaching bolt.

3. Pull intermediate shaft off flex-coupling and then pull down on intermediate shaft until coupling is removed from steering shaft.

4. Refer to LOCK PLATE and/or CANCELLING CAM (Regular)-Removal-Steps 1-4.

NOTE: Care should be exercised when Tool J 23131 or J 24653 is removed from steering shaft, as steering shaft may fall from column and be damaged.

5. Remove steering shaft from lower end of column.

6. Remove lock plate and cancelling cam from upper end of column.

Installation

See CAUTION on Page 3B4-1 of this Section.

1. Install steering shaft into lower end of column.

NOTE: A helper may be needed to hold steering shaft at lower end until wire snap ring at upper end of steering shaft has been installed.

2. Refer to LOCK PLATE and/or CANCELLING CAM (Regular)-Installation-Steps 1-5.

3. Position coupling slot in alignment with slot in lower end of steering shaft and install clamp bolt. Torque to 55 ft. lbs.

4. Push up on intermediate shaft until flex-coupling can be installed in position. Install flex-coupling lock washers and nuts. Torque to 20 ft. lbs.

SHIFT TUBE (REGULAR) EXC. H SERIES

AUTOMATIC TRANSMISSION

Removal

1. Refer to STEERING SHAFT (Regular)-Removal-Steps 1-6.

2. Position shift lever in "NEUTRAL" position if column shift equipped.

3. If column shift equipped, remove attaching screws from neutral start and back-up lamp switch.

4. Disconnect shift linkage from shift tube lever at lower end of steering column.

5. Using a screwdriver, pry off retaining clip (Fig. 3B4-120) and remove cup, adapter or bushing assembly, spring and washer from lower end of steering column.

6. Pull downward on shift tube, guiding lever through opening in jacket and remove shift tube (Fig. 3B4-122).

Installation

See CAUTION on Page 3B4-1 of this Section.

NOTE: Apply thin coat of lithium grease to all friction parts.

1. Insert shift tube into lower end of jacket and with the aid of a helper (inside of car) rotate bowl until shift tube key slides into bowl keyway.

2. Install washer, spring, adapter or bushing assembly and cup into lower end of column (Fig. 3B4-123), retain in position with retaining ring.

3. Connect shift linkage to shift tube lever.

4. Refer to STEERING SHAFT (Regular)-Installation - Steps 1-4.

5. If column shift equipped, install neutral start and back-up switch. Refer to Figs. 3B4-124 and 3B4-125 for

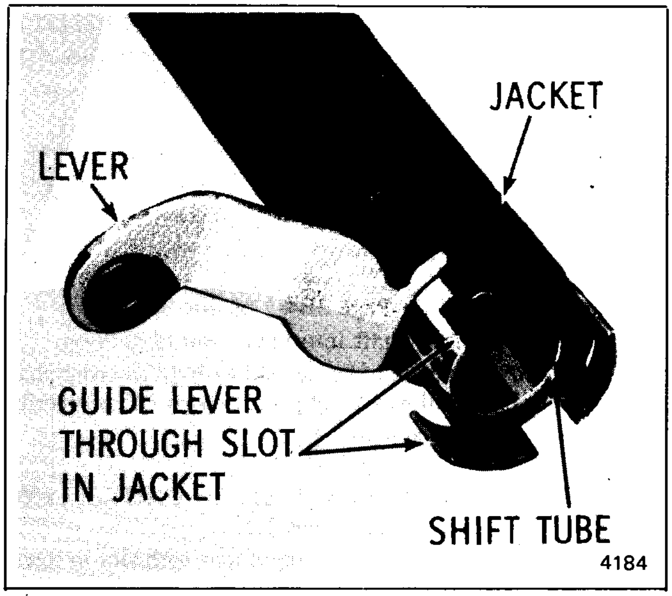


Fig. 3B4-122 Align Shift Tube in Jacket

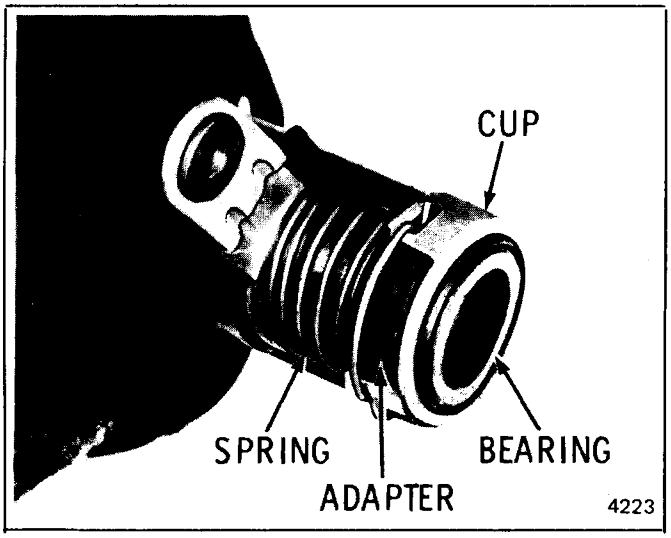


Fig. 3B4-123 Lower Bearing Assembly (Exc. H Series)

adjustment procedures. DO NOT USE SUBSTITUTE SCREWS.

SHIFT TUBE (REGULAR) F AND X SERIES

MANUAL TRANSMISSION

Removal

1. Refer to LOWER BEARING AND/OR ADAPTER OR BUSHING ASSEMBLY (Regular) F and X Series-Removal-Steps 1-6.
2. Position shift lever in "NEUTRAL" position.
3. Remove lock plate and cancelling cam from upper end of column.
4. Remove first and reverse lever (Fig. 3B4-126).
5. Remove three bolts from bearing at lower end of column (Fig. 3B4-127).

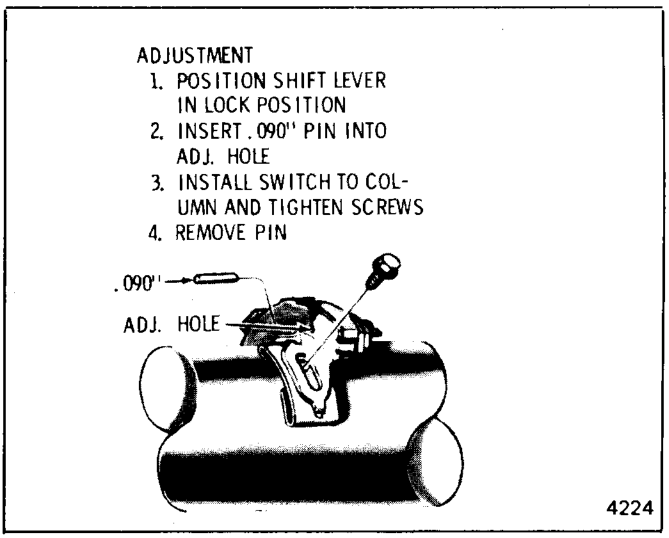


Fig. 3B4-124 Back-Up Switch (Manual Transmission)

6. Pull downward on shift tube, guiding lever through opening in jacket and remove shift tube.

Installation

See CAUTION on Page 3B4-1 of this Section.

NOTE: Apply thin coat of lithium grease to all friction parts.

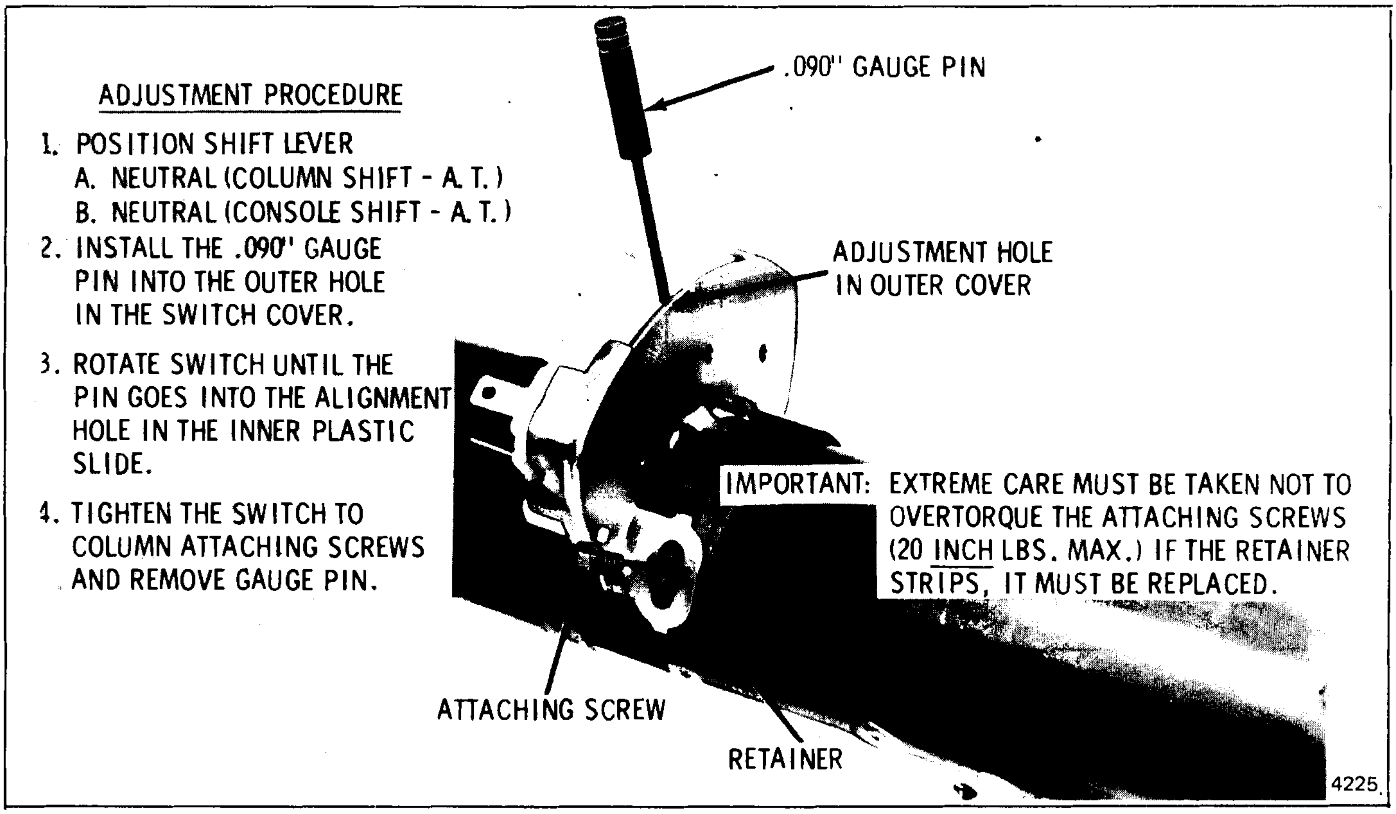
1. Insert shift tube into lower end of jacket and rotate bowl until shift tube key slides into bowl keyway.
2. Loosely install the three screws into bearing at lower end of column (Fig. 3B4-127).
3. Install first and reverse lever (Fig. 3B4-126).
4. Install bushing assembly and cup into jacket and retain with retaining clip (Fig. 3B4-126).
5. Insert a .005" shim between first and reverse lever and lever spacer (Fig. 3B4-128), then turn shift bearing down until bearing is against shim. Torque bolts to 10 ft. lbs. and remove shim.
6. Install steering shaft. Refer to LOWER BUSHING ASSEMBLY (F and X Series) Installation-Steps 1-6.

INTERMEDIATE SHAFT AND/OR STONE SHIELD REPLACEMENT

A, B AND G SERIES (FIG. 3B4-129)

Removal

1. Disengage stone shield from steering gear return hose nut. Remove pinch bolt from flexible coupling.
2. Remove coupling clamp to steering shaft attaching bolt and nut.
3. Push up on intermediate shaft to remove from steering gear stub shaft then pull down until coupling is removed from steering shaft.
4. Extend shaft to full length by pulling out on both couplings. Mark both couplings on one side to reassemble.
5. Separate shaft assembly by pressing through flexible coupling using 3/8" diameter rod 15" long. Support back of coupling during disassembly (Fig. 3B4-130).



ADJUSTMENT PROCEDURE

1. POSITION SHIFT LEVER
   A. NEUTRAL (COLUMN SHIFT - A. T.)
   B. NEUTRAL (CONSOLE SHIFT - A. T.)
2. INSTALL THE .090" GAUGE PIN INTO THE OUTER HOLE IN THE SWITCH COVER.
3. ROTATE SWITCH UNTIL THE PIN GOES INTO THE ALIGNMENT HOLE IN THE INNER PLASTIC SLIDE.
4. TIGHTEN THE SWITCH TO COLUMN ATTACHING SCREWS AND REMOVE GAUGE PIN.

IMPORTANT: EXTREME CARE MUST BE TAKEN NOT TO OVERTORQUE THE ATTACHING SCREWS (20 INCH LBS. MAX.) IF THE RETAINER STRIPS, IT MUST BE REPLACED.

Fig. 3B4-125 Neutral Start Switch

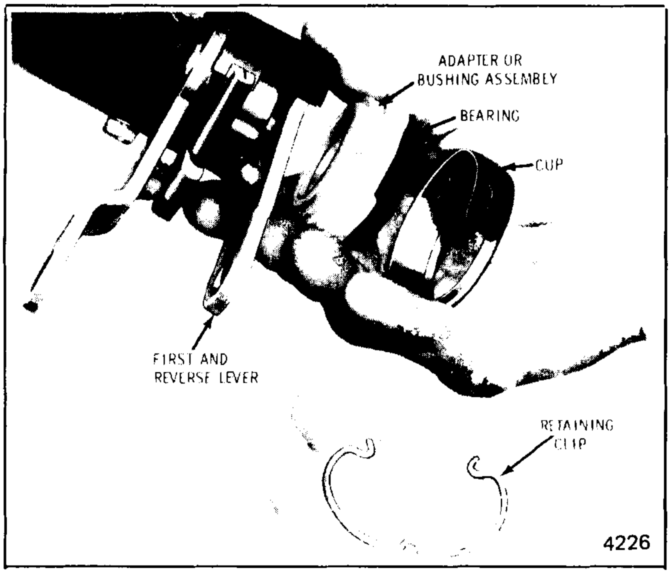


Fig. 3B4-126 Lower Bearing (Manual Transmission Column)

6. Remove stone shield.

7. Remove preload spring.

8. If slip shaft seal housing must be replaced, remove slip shaft seal housing and "O" ring by lightly tapping to remove from outer shaft (Fig. 3B4-131).

Installation

1. If replacing, install new slip shaft seal housing and "O" ring by lightly tapping with plastic hammer until seal housing is seated on outer shaft.

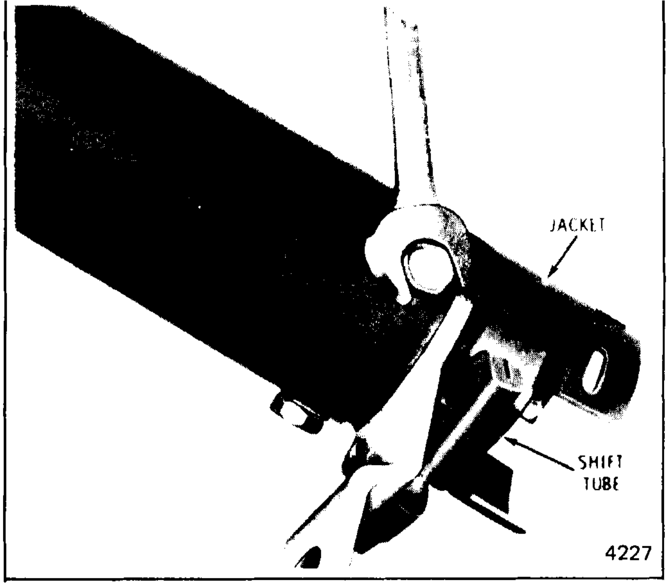


Fig. 3B4-127 Shift Tube (Manual Transmission Column)

2. Peen end of inner shaft to remove stake marks (Fig. 3B4-132).

3. Install preload spring and apply chassis lube to preload spring and shaft (Fig. 3B4-133).

4. Install stone shield on outer shaft.

5. While aligning marks on both couplings, install inner shaft into outer shaft. If replacing inner or outer shaft couplings must be aligned as shown in Fig. 3B4-134.

6. Install intermediate shaft on steering shaft and install clamp attaching bolt and nut and torque nut to 55 lt. lbs.

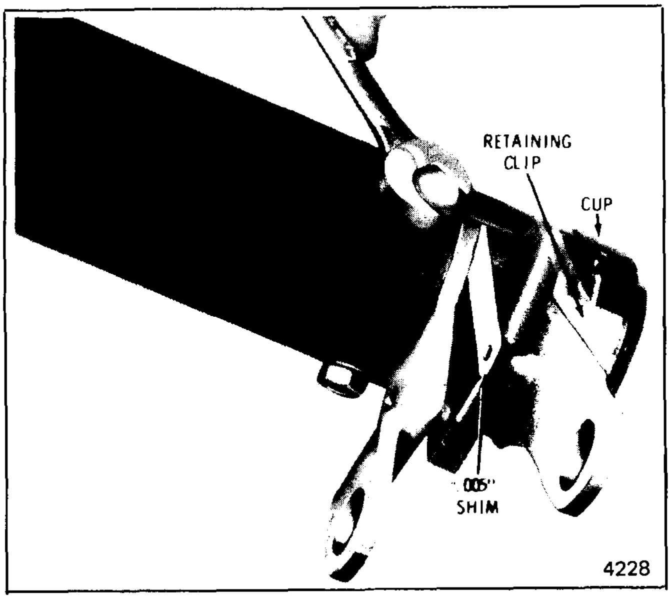


Fig. 3B4-128 Adjust Shift Levers (Manual Transmission)

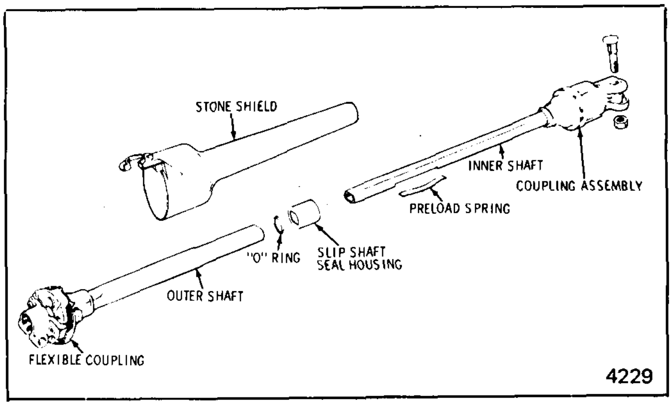


FIG. 3B4-129 INTERMEDIATE SHAFT ASSEMBLY

7. Pull down on intermediate shaft to install on steering gear stub shaft. Coupling must be fully seated so splines are not visible between coupling and gear.

8. Install pinch bolt in flexible coupling and torque to 48 N·m (35 ft. lbs.).

9. Engage stone shield on steering gear return hose nut.

INTERMEDIATE SHAFT AND COUPLING

H, X AND F SERIES

Removal (Fig. 3B4-135)

1. Remove flexible coupling nuts (Fig. 3B4-136).

2. Remove coupling clamp to steering shaft attaching bolt.

3. Pull intermediate shaft off flex-coupling and then pull down on intermediate shaft until coupling is removed from steering shaft.

NOTE: F and X Series intermediate shaft may be collapsed for removal as it is not plastic injected.

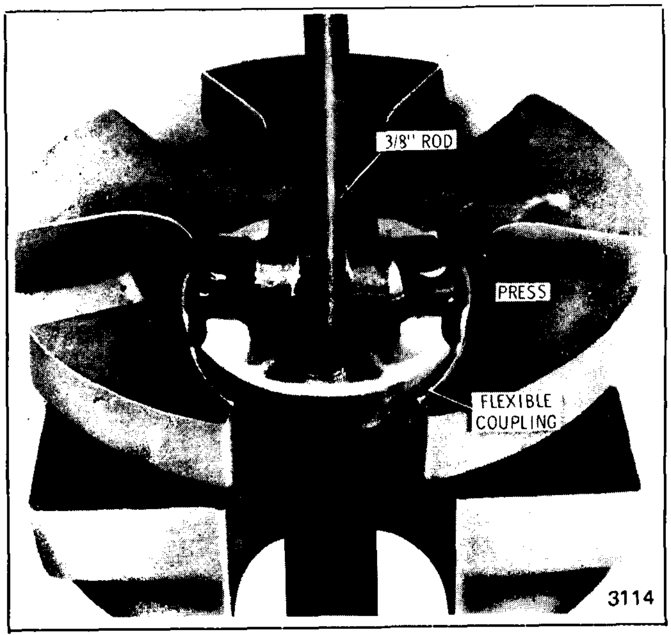


Fig. 3B4-130 Separating Intermediate Shaft

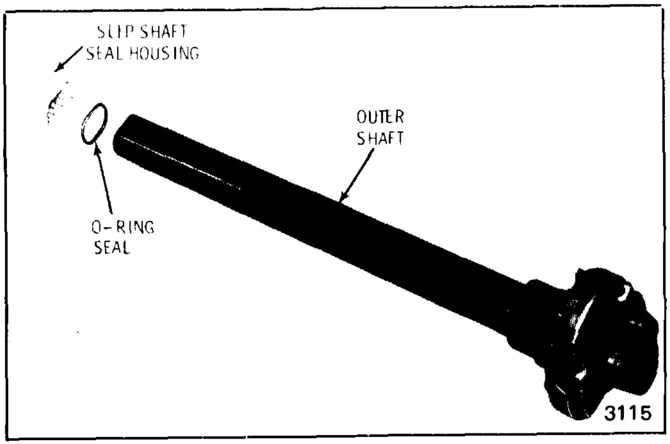


Fig. 3B4-131 Intermediate Slip Shaft Seal Housing and "O" Ring

Disassembly (Except F and X Series)

NOTE: The F and X Series intermediate shaft coupling is not servicable and the complete intermediate shaft must be replaced.

1. Remove seal retaining ring (Fig. 3B4-137).

2. Slide coupling housing off shaft.

3. Remove anti-click spring and both bearings from pivot shaft.

4. Clean and inspect parts for damage or excessive wear.

Assembly

1. Lubricate coupling parts and pack coupling housing with chassis lubricant.

2. Install bearings on pivot pin and position anti-click spring over bearings. Retain in position with lubricant.

3. Align slots in coupling housing with bearings and push together until seal can be seated in coupling housing.

4. Install seal retaining ring.

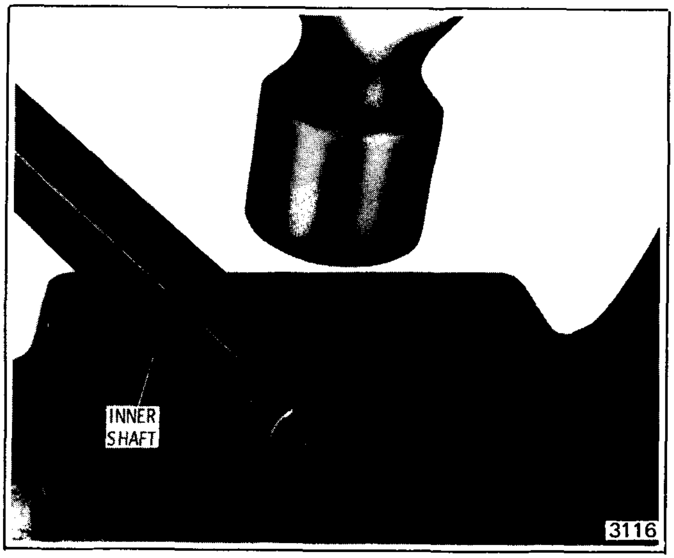


Fig. 3B4-132 Removing Stake Marks

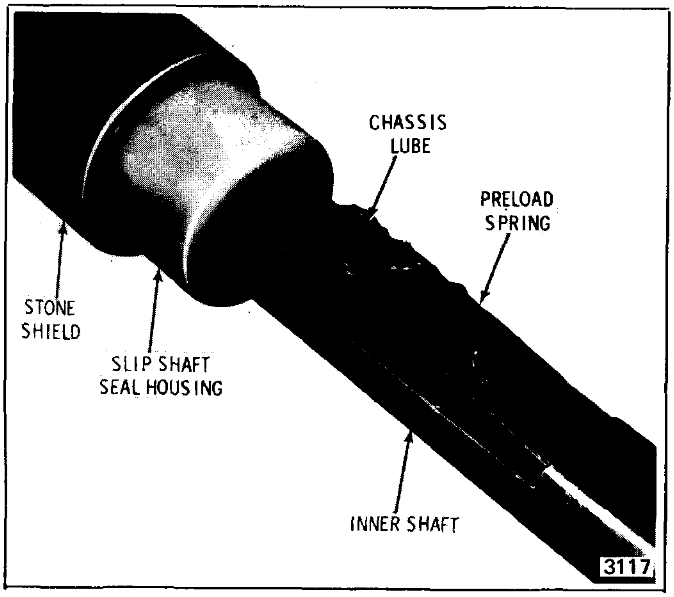


Fig. 3B4-133 Installing Preload Spring

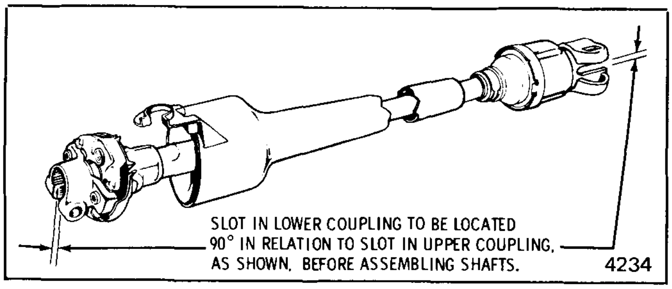


Fig. 3B4-134 Aligning Intermediate Shaft

Installation (Exc. F and X Series)

See CAUTION on Page 3B4-1 of this Section.

1. Position coupling slot in alignment with slot in lower end of steering shaft and install clamp bolt. Torque to 55 ft. lbs.

2. Push up on intermediate shaft until flex-coupling can be installed in position. Install flex-coupling lock washers and nuts. Torque to 20 ft. lbs.

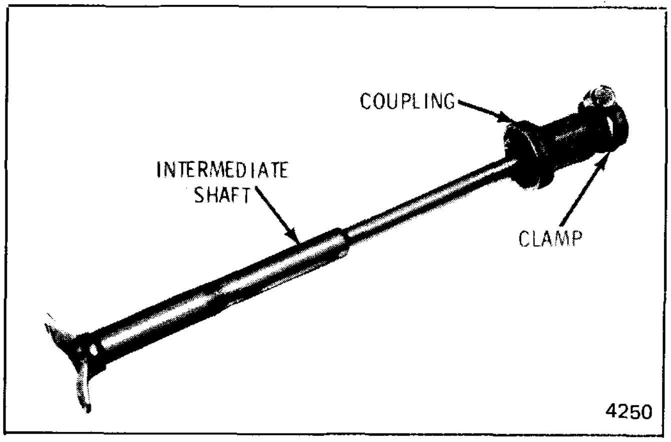


Fig. 3B4-135 Intermediate Shaft Assembly-X Series

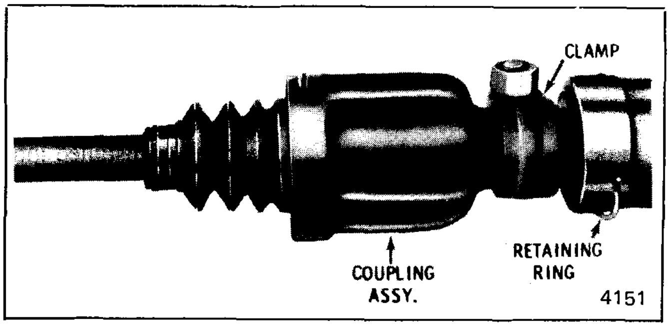


Fig. 3B4-136 Coupling Assembly

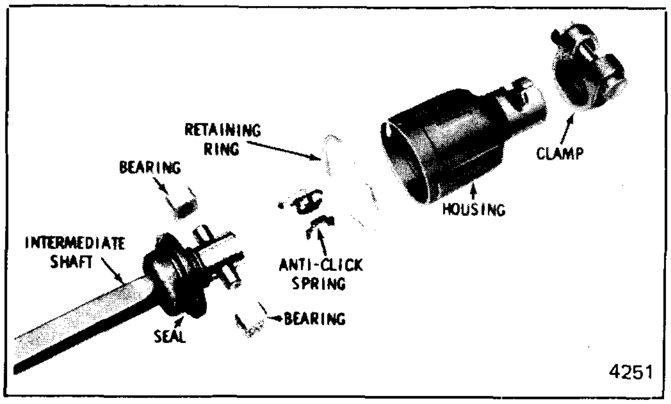


Fig. 3B4-137 Coupling Assembly (Exploded)

Installation (F and X Series)

1. Align index on coupling clamp with paint stripe on steering shaft and install on shaft using the special bolt and a new nut (special self locking nut) torque to 55 ft. lbs. WHILE HOLDING BOLT HEAD AGAINST CLAMP.

2. Assemble flex-coupling and lock washers and nuts. Torque to 20 ft. lbs.

IGNITION LOCK ASSEMBLY

The ignition lock assembly is not repairable due to staking of adapter lock to lock cylinder. Therefore a new lock assembly service package must be obtained for any failure.

Service Package (Fig. 3B4-138) Contains:

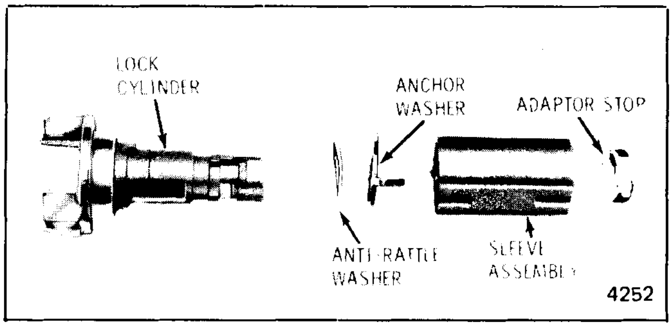


Fig. 3B4-138 Ignition Lock Service Package

1. Lock Cylinder (less tumblers, springs and retainer)
2. Adapter Stop
3. Anti-Rattle Washer
4. Anchor Washer
5. Sleeve Assembly

Tumblers,springs and spring retainer must be purhcased separately.

The ignition lock service package comes with the lock cylinder, anti-rattle washer and anchor washer installed into sleeve. Disassemble and assemble as follows:

1. Turn the lock cylinder to the accessory position, fully counterclockwise.

2. Depress the brass pin and turn lock cylinder counterclockwise; cylinder will pop out of sleeve approximately 1/4" (Fig. 3B4-139).

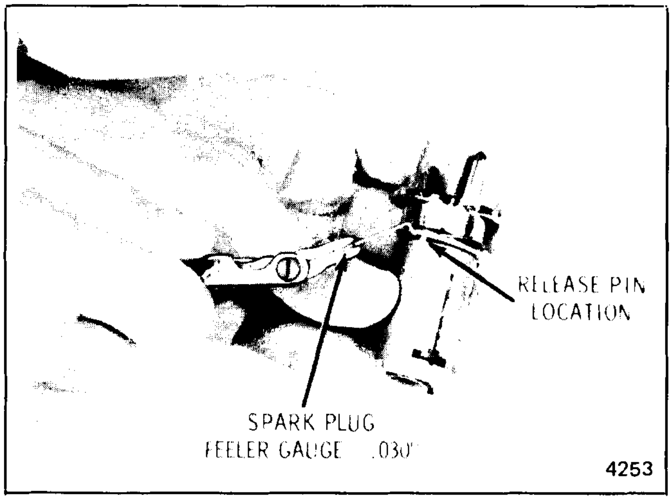


Fig. 3B4-139 Depress Brass Pin

3. Tap sleeve lightly on bench with lock snap ring down to drop warning buzzer cam inboard to clear cylinder sleeve. Cylinder cannot be removed until this cam is inboard (Fig. 3B4-140).

4. Remove lock cylinder, anchor washer and wave washer from sleeve.

5. To determine correct tumbler usage, key coding must be known. Refer to Body Service Manual - Key Code Diagram. Tumblers are precut and are packaged by number (Fig. 3B4-141). For example, if key coding is 132542, then insert a No. 1 tumbler in lock cylinder slot (at key end).

6. Insert remaining tumblers in their correct slots (Fig. 3B4-142). Insert tumbler spring in each slot (on top of tumblers). Position tumbler spring retainer into position and stake into place as shown in Fig. 3B4-143.

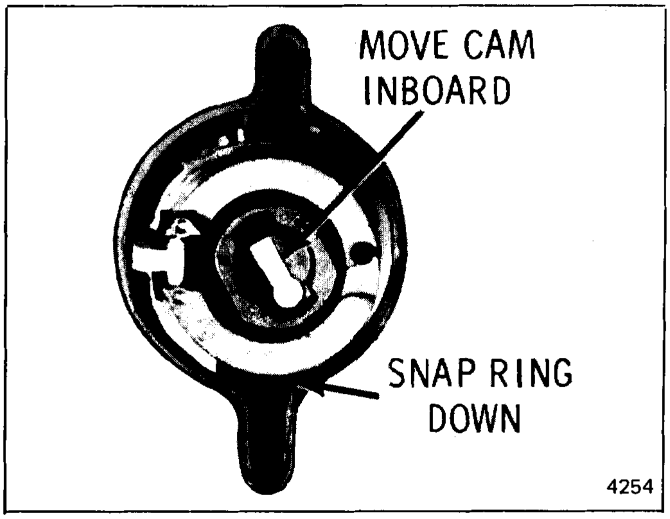


Fig. 3B4-140 Position Buzzer Cam for Removal

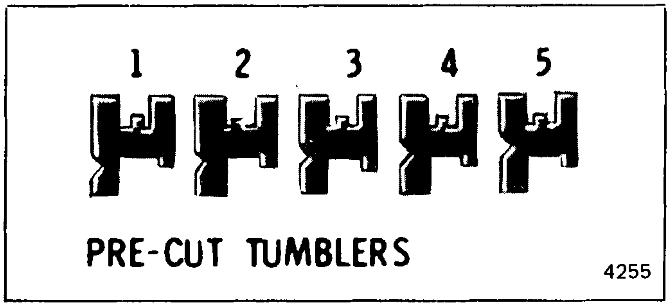


Fig. 3B4-141 Pre-Cut Tumblers

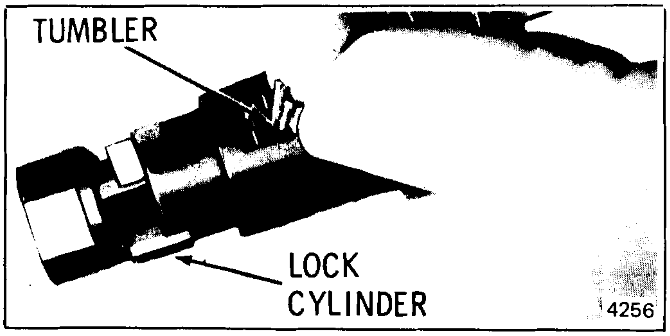


Fig. 3B4-142 Installing Tumblers

7. Install anti-rattle washer and anchor washer, with tang on anchor washer facing away from anti-rattle washer, over lock cylinder.

8. With key in lock, install lock cylinder into sleeve. Align locking bar and anchor washer tang with long slot in sleeve (Fig. 3B4-144).

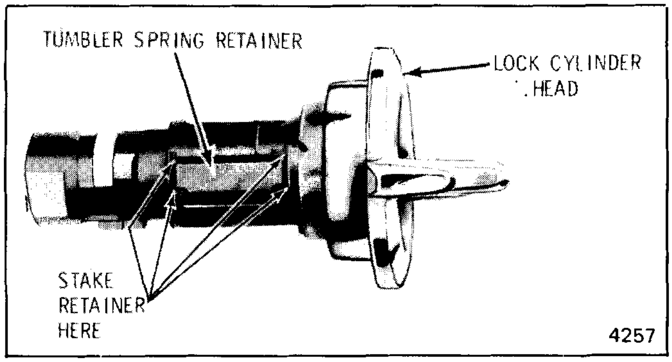


Fig. 3B4-143 Staking Tumbler Spring Retainer

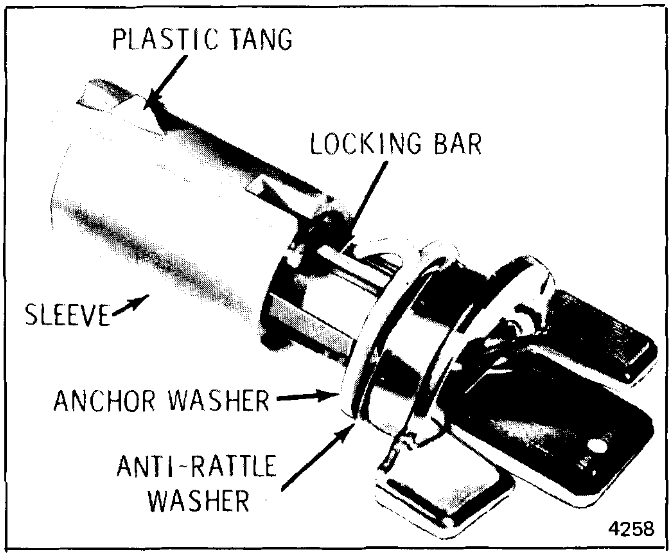


Fig. 3B4-144 Installing Lock Cylinder Into Sleeve

9. While pushing up on plastic tang from inside lock cylinder sleeve, push lock cylinder into sleeve and rotate clockwise. Check for free operation in sleeve.

10. Install adapter stop with stop against sleeve, then stake carefully as shown in Fig. 3B4-145.

STEERING WHEEL

Removal (Except Custom Sport or Formula)

1. Disconnect negative battery cable.

2. Remove three screws attaching horn pad assembly to steering wheel (Fig. 3B4-146). Disconnect horn contact from steering wheel.

3. Remove steering wheel nut retainer and attaching nut. Remove steering wheel using puller J 3044-1. Note Index of steering wheel to shaft.

Installation (Except Custom Sport or Formula)

See CAUTION on Page 3B4-1 of this Section.

1. With the alignment marks on the steering wheel hub and the steering shaft aligned, install the steering wheel and nut. Torque nut to 35 ft. lbs. and install nut retainer.

If spokes are not horizontal, it will be necessary to adjust the tie rod ends until steering wheel assumes its proper position.

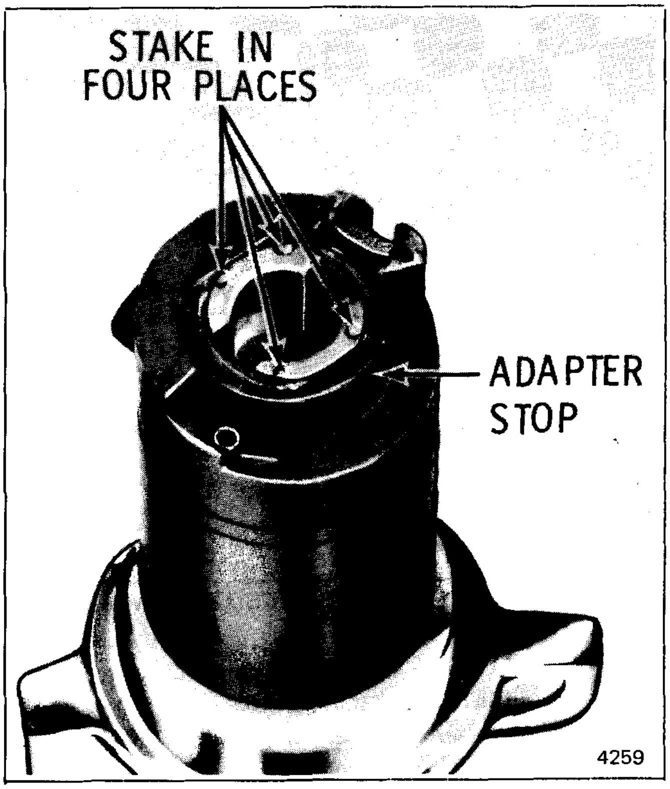


Fig. 3B4-145 Staking Adapter Stop

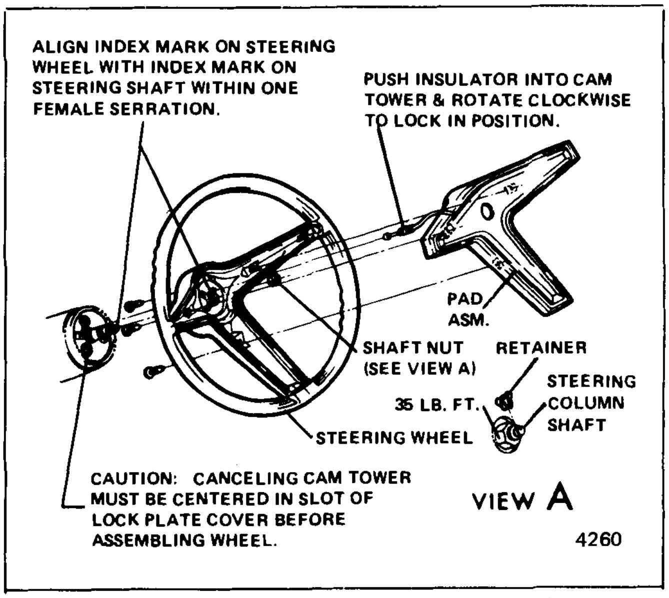


Fig. 3B4-146 Steering Wheel -Standard or Luxury Cushion

2. Connect horn contact wire at steering wheel.

3. Install three screws attaching steering wheel and pad assembly (Fig. 3B4-146).

4. Connect negative battery cable.

Removal (Custom Sport)

1. Disconnect negative battery cable.

2. Pull up on center ornament to remove from bezel (Fig. 3B4-147).

3. Remove steering wheel nut retainer and attaching nut.

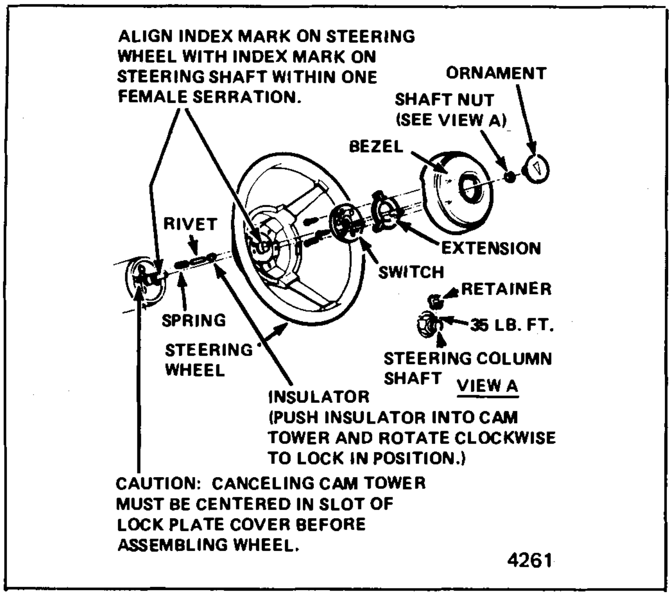


Fig. 3B4-147 Custom Sport Steering Wheel

4. Remove center bezel, extension and switch as an assembly by lifting from steering wheel.

5. Remove steering wheel using puller J 3044-1. Note index of Steering Wheel to Shaft.

6. If bezel, extension or switch require replacement, remove 3 screws from switch to bezel and separate parts.

Installation (Custom Sport)

See CAUTION on Page 3B4-1 of this Section.

1. If necessary, reassemble center bezel, extension and switch.

2. With the alignment mark on the steering wheel and index mark on the steering shaft aligned (within one female serration), install the steering wheel.

3. Install bezel extension and switch assembly and install steering wheel retaining nut on shaft. Torque nut to 35 ft. lbs. and install nut retainer.

4. Install center bezel ornament into bezel.

5. Connect negative battery cable.

Removal (Formula)

1. Disconnect negative battery cable.

2. Remove horn, button and ornament assembly by pulling up on assembly (Fig. 3B4-148).

3. Remove steering wheel nut retainer and attaching nut.

4. Remove insulator and switch assembly.

5. Using puller J 3044-1 remove steering wheel assembly. Note index of Steering Wheel to Shaft.

6. If necessary, remove 3 screws and separate switch from insulator.

Installation (Formula)

See CAUTION on Page 3B4-1 of this Section.

1. If necessary assemble switch and insulator (3 screws).

2. Install steering wheel, aligning alignment mark on steering wheel with index mark on end of shaft (within one female serration).

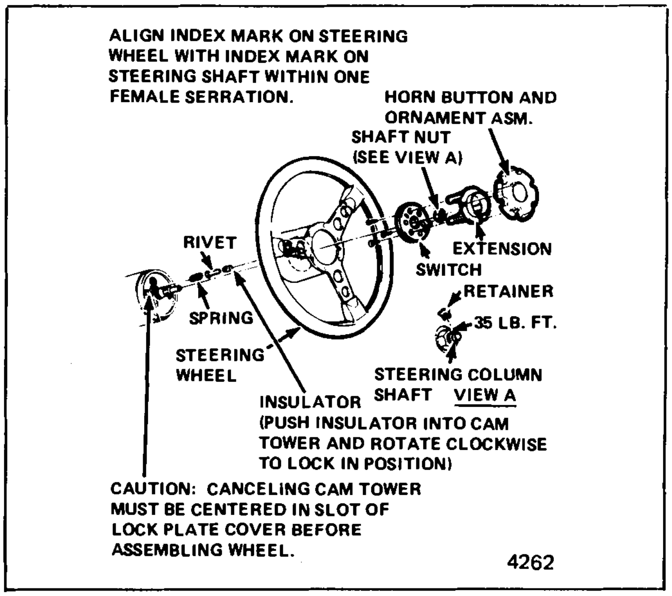


Fig. 3B4-148 Formula Steering Wheel

3. Install insulator and switch assembly into steering wheel hub.

4. Install steering wheel retiming nut on steering shaft. Torque nut to 35 ft. lbs. and install nut retainer.

5. Install horn button and ornament assembly by aligning tabs with slots on insulator and pushing in on horn button and ornament assembly.

CHECKING STEERING COLUMN FOR ACCIDENT DAMAGE

NOTE: Cars involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted may also have a damaged or misaligned steering column.

CHECKING PROCEDURE

1. Check capsules on steering column bracket assembly; all should be within 1/16" from the bottom of the slots (Fig. 3B4-149). If not, bracket should be replaced.

2. Check contact surface "A" (Fig. 3B4-150). The bolt head must not contact surface "A" or shear load would be increased. If contact is made, replace bracket.

3. On cars with automatic transmission and column shift, check operation of the shift lever. If you are able to move lever to "Park" position without raising lever, it is an indication that the upper shift tube plastic bearing is broken.

4. Check for mast jacket collapse by measuring the distance from edge of the neutral-start switch window to the lower edge of upper jacket. Refer to Fig. 3B4-151 for dimensions. If mast jacket dimensions are not within specifications a NEW mast jacket must be installed and shift tube and steering shaft visually inspected for sheared injected plastic. If shift tube shows sheared plastic a NEW shift tube must be installed (Fig. 3B4-152). If steering shaft or intermediate shaft shows sheared palstic and not bent, it can be repaired by using a Service Steering Shaft Repair Package. Package contains instructions and dimensions for all steering shafts (Fig. 3B4-153).

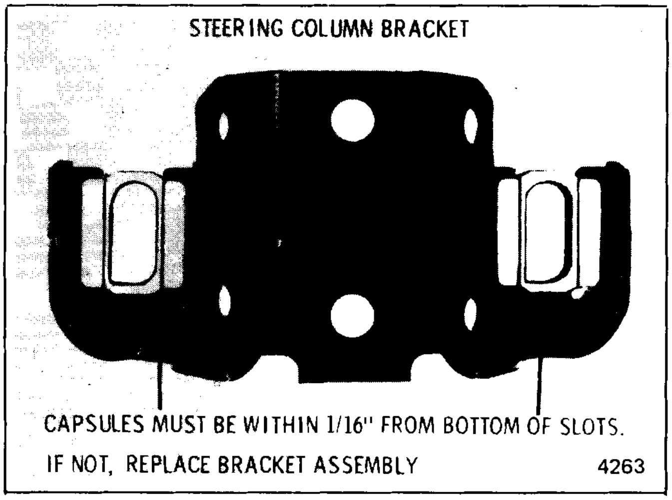


Fig. 3B4-149 Check Capsules in Bracket

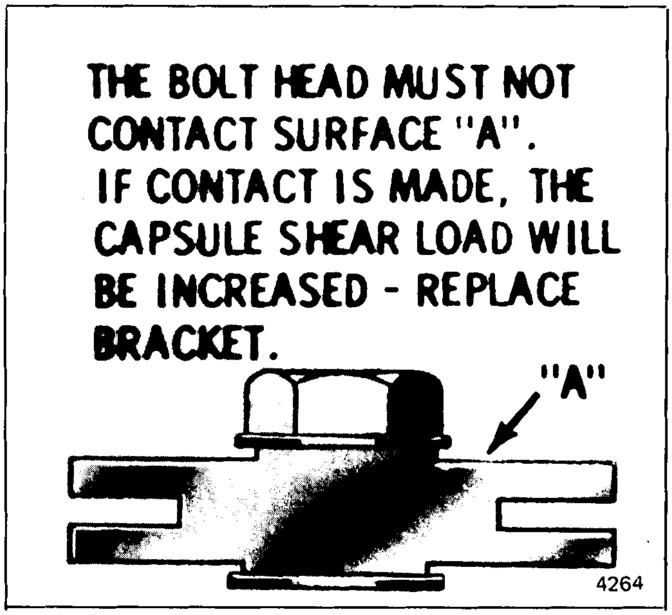


Fig. 3B4-150 Proper Bolt Installation

5. Check for broken plastic bearing adapter at lower end of steering shaft (all except column shift synchromesh transmission). If adapter is cracked or broken, it must be replaced.

6. Check steering gear flexible coupling for tears or for no pin engagement. This indicates possible misalignment or frame damage. If flexible coupling damage is evident, the coupling is to be replaced.

7. (A Series with Manual Steering) - Check for lower shaft collapse by measuring as shown in Fig. 3B4-154. If not within specifications, repair intermediate shaft using Service Steering Shaft Repair Package.

8. Any frame damage that could cause a bent steering shaft must have steering shaft runout checked in the following manner: Disconnect the intermediate shaft at flex-coupling, then remove bolt and nut from clamp of coupling assembly. Remove intermediate shaft. Hold ruler against lower end of steering shaft and have steering wheel rotated. Runout must not exceed 1/16". Dial indicator may be used instead of a ruler.

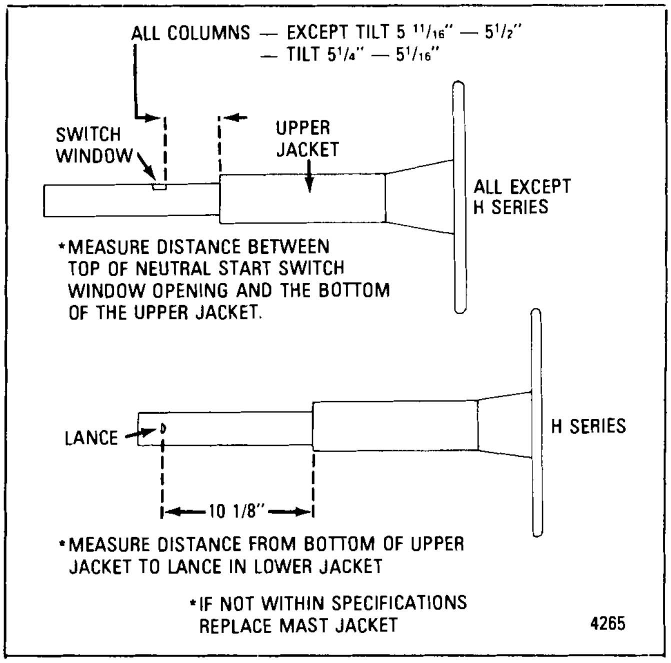


Fig. 3B4-151 Check Jacket for Collapse

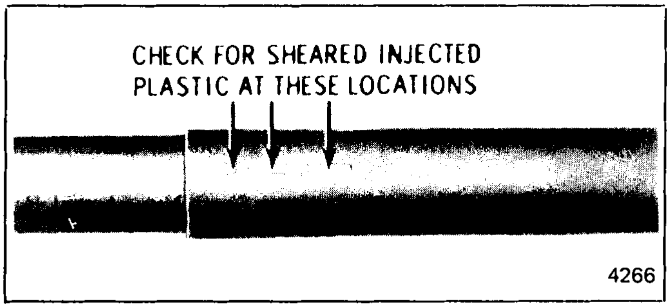


Fig. 3B4-152 Check Shift Tube Plastic Injections

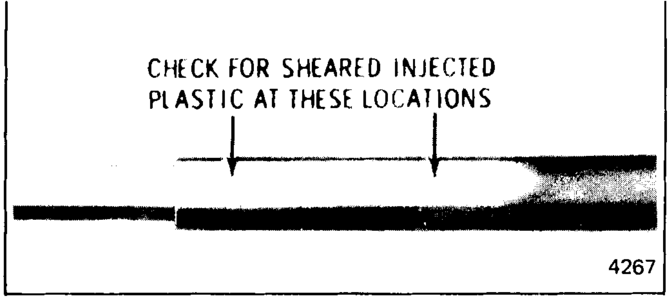


Fig. 3B4-153 Check Steering Shaft Injections

NOTE: This check cannot be made if the bearing adapter or bushing assembly is broken.

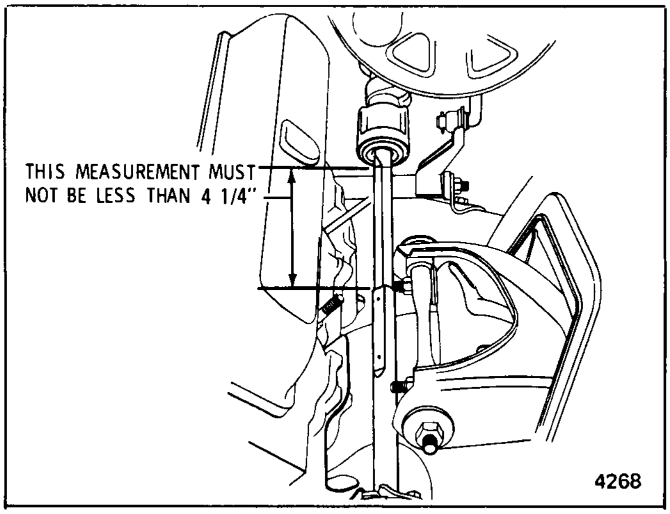


Fig. 3B4-154 Check Intermediate Shaft

TORQUE SPECIFICATIONS

APPLICATION	TORQUE
Steering wheel to Shaft Nut	35 Ft. Lbs.
Turn Signal Switch Attaching Screws	35 In. Lbs.
Ignition Switch Attaching Screws	35 In. Lbs.
Bracket to Steering Column Support Nuts	25 Ft. Lbs.
Toe-Pan to Dash Screws	45 In. Lbs.
Toe-Pan Clamp Screws	60 In. Lbs.
Bracket to Steering Column Bolt	30 Ft. Lbs.
Cover (Tilt) to Housing Screws	100 In. Lbs.
Clamp to Steering Shaft Nut (A and B Series)	55 Ft. Lbs.
Support to Lock Plate (Tilt) Screws	60 In. Lbs.
Joint Assembly to Steering Shaft Bolt (Toronado)	80 Ft. Lbs.
Flex Coupling Nuts	20 Ft. Lbs.
Flex Coupling to Shaft Bolt	30 Ft. Lbs.

FRONT SUSPENSION

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 1 of this Section".

> **CAUTION:** *This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

CONTENTS OF THIS SECTION

General Description

Service Procedures

GENERAL DESCRIPTION

EXCEPT H SERIES

The front suspension (Fig. 3C-1) is designed to allow each wheel to compensate for changes in the road surface level without appreciably affecting the opposite wheel. Each wheel is independently connected to the frame by a steering knuckle, ball joint assemblies, and upper and lower control arms. The control arms are specifically designed and positioned to allow the steering knuckles to move in a prescribed three dimensional arc. The front wheels are held in proper relationship to each other by tow tie rods which are connected to steering arms on the knuckles and to an intermediate rod.

Coil chassis springs are mounted between the spring housings on the frame and the lower control arms. Ride control is provided by double, direct acting shock absorbers mounted inside the coil springs and attached to the lower control arms by bolts and nuts. The upper portion of each shock absorber extends through the spring housing and is secured with two grommets, two grommet retainers, and a nut.

Side roll of the front suspension is controlled by a spring steel stabilier shaft. It is mounted in rubber bushings which are held to the frame side rails by brackets. The ends of the stabilizer are connected to the lower control arms. Rubber grommets at these connections provide flexibility and ride features.

The upper control arm is attached to a cross shaft through isolating rubber bushings. The cross shaft, in turn, is bolted to frame brackets.

A ball joint assembly is riveted to the outer end of the upper arm. It is pre-loaded by a rubber spring to insure proper seating of the ball in the socket. The upper ball joint is attached to the steering knuckle by a castellated nut.

The inner ends of the lower control arm have pressed-in bushings. Bolts, passing through the bushings, attach the arm to the frame.

The lower ball joint assembly is a press fit in the arm and attaches to the steering knuckle with a castellated nut that is retained with a cotter pin.

Rubber grease seals are provided at ball socket assemblies to keep dirt and moisture from entering the joint and damaging bearing surfaces.

GENERAL DESCRIPTION

H SERIES

The front suspension is of the A frame type with short and long control arms. (Fig. 3C-2) The upper control arm is bolted to the front end sheet metal at each inner pivot point. Rubber bushings are used for mounting.

The lower control arm attaches to the front end sheet metal, with two cam type bolts, through rubber bushings. The cam bolts adjust camber and caster. The front cam bolts adjust camber and the rear cam bolts adjust caster.

The upper ball joint is riveted to the upper control arm and the lower ball joint is pressed into the lower control arm.

The coil springs are mounted between the lower control arms and the shock absorber tower. The lower control arm and the shock absorber tower have helical spring seats which makes spring indexing easy since there is a stop on both seats.

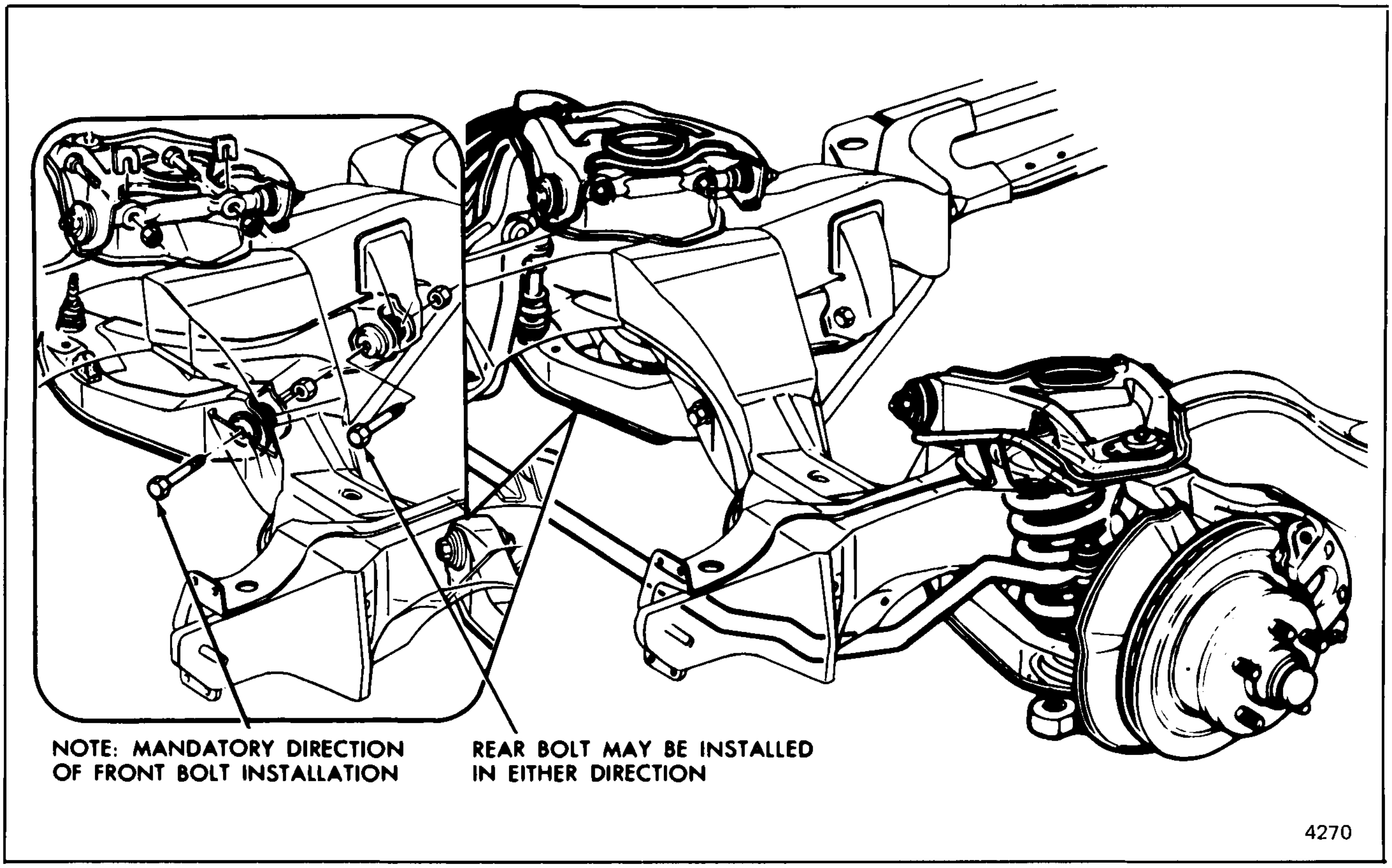


Fig. 3C-1 Front Suspension (Except H Series)

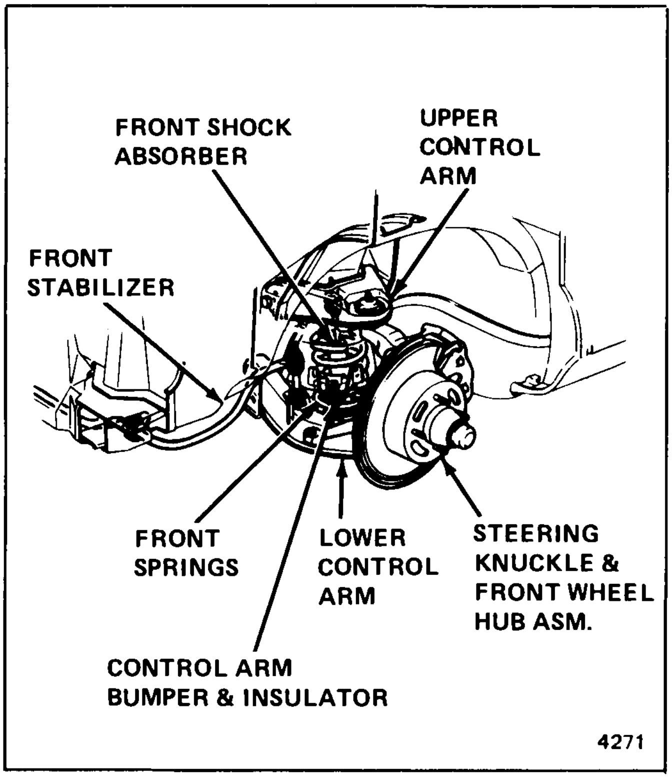


Fig. 3C-2 Front Suspension (H Series)

Shock absorbers mount to the lower control arm and run through the center of the coil spring to the shock absorber tower where the upper stem mounts.

The steering knuckle is nodular iron with an integral steering arm. The wheel hub is an integral part of the brake disc and mounts to the wheel spindle in the convetional manner with inner and outer wheel bearings.

MAINTENANCE AND ADJUSTMENTS

MAINTENANCE INTERVALS

Recommended intervals for maintenance of front suspension items are covered in Section O-B of this manual.

FRONT WHEEL BEARINGS

CAUTION: *Tapered roller bearings are used on all series vehicles and they have a slightly loose feel when properly adjusted. A design feature of front wheel tapered roller bearings is that they must NEVER be pre-loaded. Damage can result by the steady thrust on roller ends which comes from preloading.*

ADJUSTING FRONT WHEEL BEARINGS

The proper functioning of the front suspension cannot be maintaining unless the front wheel TAPER ROLLER BEARINGS are correctly adjusted. Cones must be a slip fit on the spindle and the inside diameter of cones should be lubricated to insure that the cones will creep. Spindle nut must be a free-running fit on threads.

CHECK ADJUSTMENT

1. Raise vehicle and support at front lower control arm.
2. Spin wheel to check for unusual noise or roughness.
3. If bearings are noisy, tight, or excessively loose, they should be cleaned, inspected and relubricated priot to adjustment. If it is necessary to inspec bearings, see Replacement of Wheel Bearings.

NOTE: To check for tight or loose bearings, grip the tire at the top and bottom and move the wheel assembly in and out on the spindle. Measure movement of hub assembly. If movement is less than .001" or greater than .005" adjust bearings per adjustment procedure.

ADJUSTMENT (FIG. 3C-3)

1. Remove hub cap or wheel disc from wheel.
2. Remove dust cap from hub.
3. Remove cotter pin from spindle and spindle nut.
4. Tighten the spindle nut to 12 ft. lbs. while turning the wheel assembly forward by hand to fully seat the bearings. This will remove any grease or burrs which could cause excessive wheel bearing play later. (See Fig. 3C-3).
5. Back off the nut to the "just loose" position.
6. Hand tighten the spindle nut. Loosen spindle nut until either hole in the spindle lines up with a slot in the nut. (Not more than 1/2 flat).
7. Install new cotter pin. Bend the ends of the cotter pin against nut, cut off extra length to ensure ends will not interfere with the dust cap.
8. Measure the looseness in the hub assembly. There will be from .001 to .005 inches end play when properly adjusted.
9. Install dust cap on hub.
10. Replace the wheel cover or hub cap.
11. Lower vehicle to floor.
12. Perform the same operation for each front wheel.

RIDING HEIGHT

See Specifications Section for information on riding heights on all series vehicles. Riding heights should be accurate to within ±3/4" of the specification.

SERVICE PROCEDURES EXCEPT H SERIES

FRONT WHEEL HUB

Replacement

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in the procedure below.*

1. Raise vehicle on hoist, remove hub caps. Remove wheel nuts, wheel and tire and brake drum or brake caliper (see Section 5).

NOTE: Vehicles equipped with disc brakes. Remove bolts holding brake caliper to its mounting and insert a fabricated block (1-1/16x1-1/16x2 inches in length), between the brake pads as the caliper is being removed. Once removed the caliper assembly can be wired or secured in some manner away from the concerned area.

2. Remove hub grease cap, cotter pin, spindle nut and washer, and remove hub or hub and disc. Do not drop wheel bearings.
3. Reverse the procedure to install and lower vehicle to floor.

Replacement of Wheel Hub Bolts (Fig. 3C-4)

It may be necessary to replace damaged wheel hub bolts. In ths case, service the hub in the following manner.

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to below.*

1. Remove the hub or hub and disc from the vehicle by the preceding procedure.
2. Remove the hub or disc bolts with a press. Do not damage wheel mounting surface on hub flange.
3. Install new serrated bolt into hole in hub. Tap lightly with a hammer to start bolt serrations in hole, making sure that bolt is square with hub flange.
4. Press bolt into flange until head is fully seated against hub flange.

CAUTION: *The brake disc must be supported with a piece of pipe or steel tubing as shown in Figure 3C-4 before pressing the wheel stud in or out.*

1. HAND SPIN WHEEL

2. TIGHTEN THE NUT TO 12 FT. LBS. FULLY SEAT BEARINGS- THIS OVERCOMES ANY BURRS ON THREADS.

3. BACK OFF NUT UNTIL JUST LOOSE POSITION.

4. HAND "SNUG-UP" THE NUT

5. LOOSEN NUT UNTIL EITHER HOLE IN THE SPINDLE LINES UP WITH A SLOT IN THE NUT—THEN INSERT COTTER PIN.

NOTE: BEND ENDS OF COTTER PIN AGAINST NUT, CUT OFF EXTRA LENGTH TO PREVENT INTERFERENCE WITH DUST CAP.

6. WHEN THE BEARING IS PROPERLY ADJUSTED THERE WILL BE FROM .001—.005 INCHES END-PLAY (LOOSENESS).

FIG. 3C-3 WHEEL BEARING ADJUSTMENT

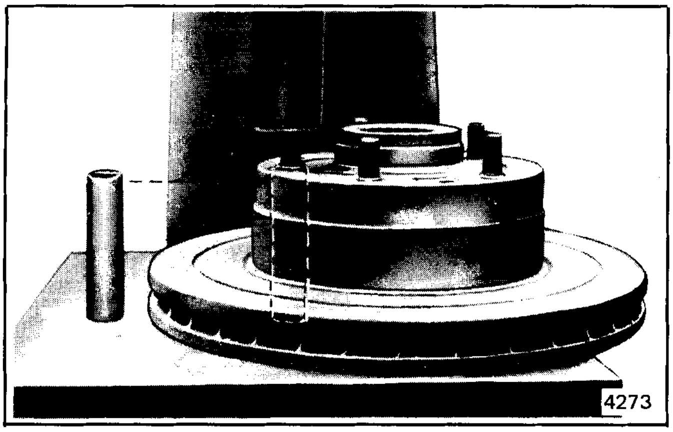


Fig. 3C-4 Pressing Front Hub Bolts (Typical)

FRONT WHEEL BEARINGS

Removal

1. Raise the Vehicle.
2. Remove hub or hub and disc assembly.

NOTE: Discard cotter pin. Install new cotter pin when assembling.

3. Remove outer roller bearing assembly from hub with fingers. The inner bearing assembly will remain in the hub and may be removed after prying out the inner bearing lip seal assembly. Discard seal.
4. Wash all parts thoroughly in cleaning solvent and blow dry.

Inspection

1. Check bearings for cracked separators or worn or pitted rollers and races.
2. Check brake disc or drum for scoring.
3. Check fit of bearing cups in hub.

Repairs

Replacement of Bearing Cups

If necessary to replace an outer race, drive out old race from the hub with a brass drift insert behind race in notches in hub. Install new race by driving it into hub with Tools J-8457 or J-8458 for B Series and Driver Handle J-8092. Remove the inner race in the same manner. Use Tools J-8849 and J-8850 on A, F and X Series.

NOTE: Use care when installing new race to start in squarely into hub, to avoid distortion and possible cracking.

Thoroughly lubricate bearing assemblies with high melting point wheel-bearing lubricant. Remove any excess lubricant.

NOTE: Be sure bearing parts have been thoroughly cleaned and air-dried.

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners refereed to in steps 6, 7 and 9.*

1. Apply a light coat of lubricant to spindle and instide surface of hub.
2. Place inner bearing in race of hub and install a new grease seal.
3. Carefully install hub or hub and disc assembly on spindle.
4. Install outer wheel bearing.
5. Install washer and adjusting nut.
6. Adjust wheel bearings as outlined under WHEEL BEARING ADJUSTMENT.
7. Position caliper, install and tighten two caliper mounting bolts to specificatins.
8. Install dust cap on hub.
9. Install wheel and tighten nuts to specifications. Install hubcap or wheel disc.
10. Lower vehicle to floor.

SHOCK ABSORBERS

Removal (Fig. 3C-5)

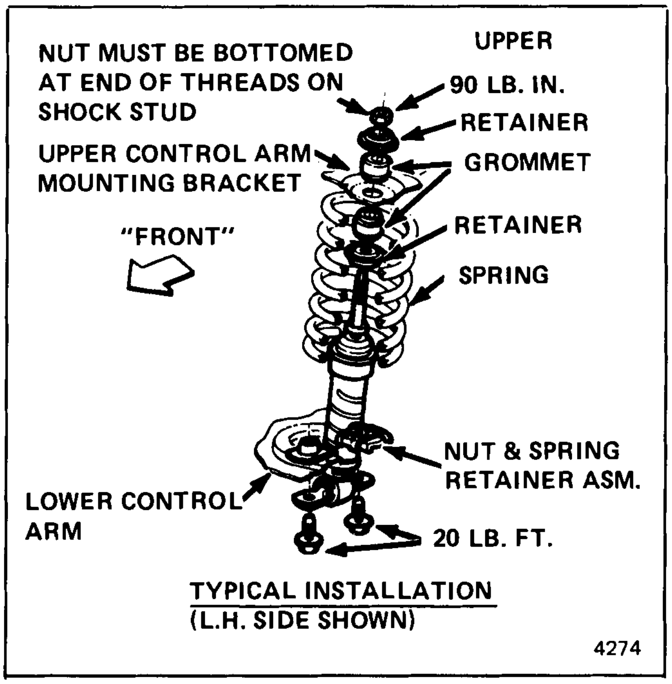


Fig. 3C-5 Shock Absorber Attachments

1. Raise vehicle on hoist and with an open end wrench hold the shock absorber upper stem from turning, and then remove the upper stem retaining nut, retainer and rubber grommet.
2. Remove the two bolts retaining the lower shock absorber pivot to the lower control arm and pull the shock absorber assembly out from the bottom.

Installation

1. With the lower retainer and rubber grommet in place over the upper stem, install the shock absorber (fully extended) up through the lower control arm and spring so that the upper stem passes through the mounting hole in the upper control arm frame bracket.

2. Install the upper rubber grommet, retainer and attaching nut over the shock absorber upper stem.

3. With an open end wrench, hold the upper stem from turning and tighten the retaining nut.

4. Install the retainers attaching the shock absorber lower pivot to the lower control arm, torque and lower vehicle to floor.

STABILIZER BAR

Removal (Fig. 3C-6)

1. Raise vehicle on hoist.
2. Disconnect stabilizer bar from lower control arm.
3. Remove stabilizer bar brackets from the frame and remove stabilizer.
4. Remove stabilizer link bolts, spacers and rubber grommets from lower arms or stabilizer bar.
5. Inspect rubber stabilizer link grommets and stabilizer frame insulator bushings for aging and wear. Replace if necessary. Also inspect retainers, spacers and link bolts.

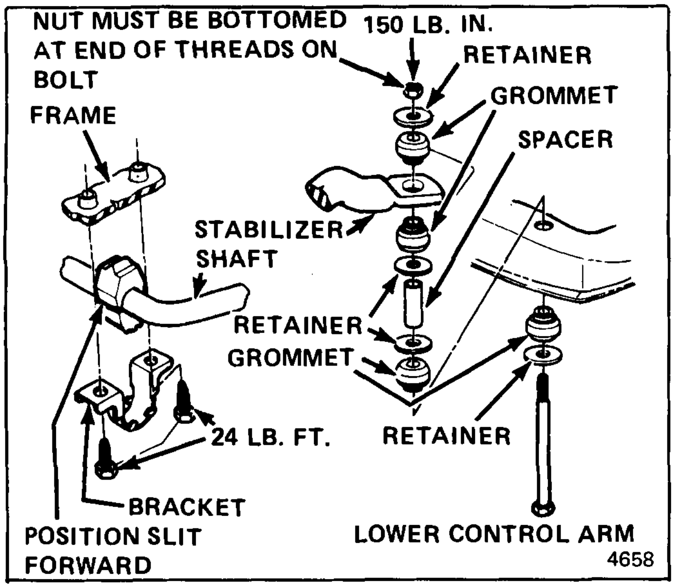


Fig. 3C-6 Stabilizer Bar-Typical

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners refereed to in step 2.*

1. If new frame bushings are necessary, slide frame bushings into position.

2. Insert stabilizer brackets over bushings and connect to frame. Do not torque at this point. Connect stabilizer ends to ling bolts on lower control arms.

Refer to Figure 3C-6 for mandatory method of installing link bolts. Bolts must be installed with nut on top.

NOTE: Be sure to center stabilizer bar on frame.

3. Torque bracket bolts and link bolt nuts as shown in the Specifications.

4. Lower vehicle to floor.

FRONT SPRING

Removal (Fig. 3C-7)

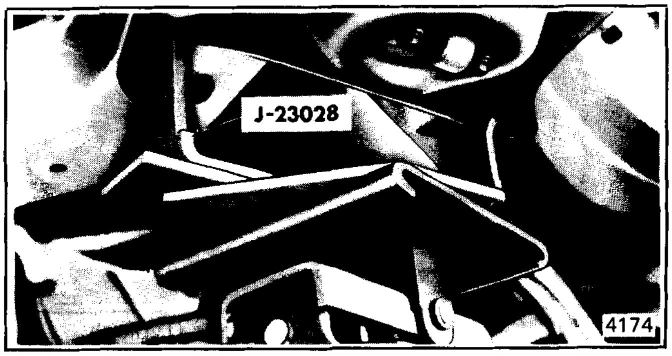


Fig. 3C-7 Removing Spring with Adapter J-23028

1. Raise vehicle on hoist.

2. Remove the two shock absorber screws and push shock up through control arm and into spring.

3. With the vehicle supported so that the control arms hang free, place Tool J-23028 into position cradling the inner bushings.

CAUTION: *Tool J-23028 should be secured to a suitable jack.*

4. Remove stabilizer to lower control arm attachment.

5. Raise the jack to remove the tension on the lower control arm pivot bolts. Install a chain around spring and through the control arm as a safety measure. Remove nuts and bolts - (Remove rear bolt first).

6. Lower control arm by slowly lowering jack.

7. When all compression is removed from the spring remove safety chain and spring.

CAUTION: *Do not apply force on the lower control arm and ball joint to remove spring. Proper maneuvering of the spring will allow for easy removal.*

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 3 and 4.*

1. Properly position spring on the control arm and lift control arm with Special Tool J-23028 (Fig. 3C-8)

NOTE: Take care that the spring is properly installed as shown in Fig. 3C-8.

2. Position control arm into frame and install pivot bolts (front bolt first) and nuts. Torque to specifications and lower jack.

CAUTION: *In order to maintain adequate steering linkage clearance, refer to mandatory bolt direction of installation is as shown in Figures 1 and 2.*

3. Replace the stabilizer bar link and shock absorber. Lower vehicle to floor.

4. Torque all fasteners to specifications.

BALL JOINT SERVICE

UPPER (FIG. 3C-9)

Removal

1. Raise vehicle on a hoist.
2. Remove the tire and wheel assembly.
3. Remove upper ball stud cotter pin.
4. Loosen, but do not remove, ball stud nut (nut should be loosened not more than one turn).
5. Install Tool J-23742-1 between ball studs as shown in Figure 3C-9 and turn threaded end of tool until the stud is free of steering knuckle.

NOTE: If a hoist is not used for this operation the lower control arm must be supported so the chassis spring cannot force the arm down.

6. Remove the upper ball joint stud nut and allow the knuckle to swing out of the way.
7. Lift the upper arm up and place a block of wood between the frame and the arm to act as a support.

Inspection

The upper ball joint is spring loaded internally to keep the bearing in position under vehicle loads and to provide wear take-up. Any looseness indicates a worn condition requiring replacement of the ball joint assembly.

1. Raise front suspension of vehicle by positioning lift or jacks under each lower control arm between the suspension spring pocket and the ball joint.
2. Grasp wheel at top and bottom and shake top of wheel in an"in-and-out" motion.
3. Observe for any movement of the steering knuckle relative to the control arm. This visual observation is necessary to avoid confusion with other conditions such as loose wheel bearings. Replace any upper ball joint found to be loose.

Replacement

Remove the rivets from the upper control arm using a grinding wheel. Remove the ball joint.

CAUTION: *Care must be used not to damage the control arm or ball joint seat.*

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 1, 4 and 5.*

1. Install the new ball joint in the arm and attach with bolt and nut assemblies provided. Insert the bolts from the bottom with the nut on top. Torque to specifications.
2. Turn the ball stud cotter pin hole fore and aft.
3. Remove the block of wood from the frame and control arm.

NOTE: Inspect the tapered hole in the steering knuckle. Remove any dirt and if any out-of-roundness, deformation or damage is noted the knuckle MUST be replaced.

4. Mate the ball stud to the steering knuckle and install the stud nut. Torque the nut and install a new cotter pin.

NOTE: Never back off nut to align the cotter pin. Also tighten nut to next slot that lines up with hole in the stud.

5. Install a lube fitting and lube the joint.
6. Install wheel and tire and lower vehicle to floor.

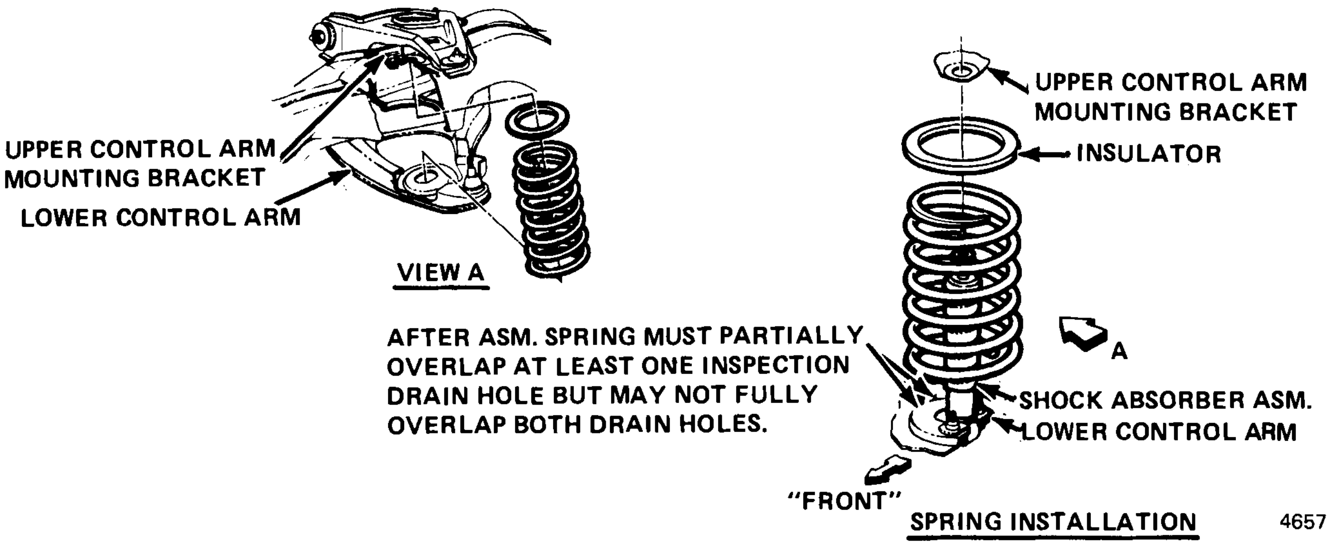


Fig. 3C-8 Coil Spring Positioning

FIG. 3C-9 PRESSING BALL JOINT FROM KNUCKLE (TYPICAL)

LOWER BALL JOINT

Removal (Fig. 3C-10)

1. Raise the vehicle on a hoist.
2. Remove lower ball stud cotter pin.
3. Loosen but do not remove, ball stud nut (nut should be loosened not more than one turn).
4. Install tool J 23742-1 between the ball studs and turn threaded end of tool until the stud is free of the steering knuckle.

CAUTION: *If a hoist is not used for this operation the lower control arm must be supported so the chassis spring cannot force the arm down.*

5. Remove the lower stud not.
6. Pull outward on the bottom of the tire and at the same time push the tire and wheel assembly upward to free the knuckle from the ball stud.
7. Remove the wheel and tire.
8. Lift up on the upper control arm, with the knuckle and hub assembly attached, and place a block of wood between the frame and upper control arm.

CAUTION: *Do not pull on the brake hose when lifting the knuckle and hub assembly.*

NOTE: Remove the tie rod end from the steering knuckle only if it is necessary.

Fig. 3C-10 Removing Lower Ball Joint From L.C.A.

9. Place tool J-9519-10 and J-9519-7 in position.
10. Turn hex bolt until the lower ball joint is pushed out of the control arm and remove tools.

Inspection

The above vehicles feature a new visual wear indicator (Fig. 3C-11) on the lower ball joint. The condition of the ball joint may be checked by the simple procedure that follows. Be sure to follow this procedure accurately to avoid unnecessary ball joint replacement.

The lower ball joints are inspected for wear by visual observation alone. Wear is indicated by the protrusion of the 1/2" diameter nipple into which the grease fitting is threaded. This round nipped projects .050" beyond the surface of the ball joint cover on a new, unworn joint. Normal wear will result in the surface of this nipple retreating very slowly inward.

To inspect, raise vehicle on a hoist. Vehicle must be supported on wheels or frame so that lower ball joint is in a loaded condition.

To inspect for wear, wipe the grease fitting and nipple free of dirt and grease as for a grease job. Observe or scrape a screwdriver scale or fingernail across the cover. If the round nipple is flush or inside the cover surface, replace the ball joint. See Figure 3C-11.

If the lower ball joint wear indicator shows that the lower joint should be replaced, it may be advisable to also replace the upper joints, unless there is obvious reason for early replacement of the lower joints, such as torn seal or damage.

Ball stud tightness in knuckle boss can be checked by shaking wheel and observe or feel for movement of stud end and/or nut at knuckle boss, or by removing cotter pin to check torque. Looseness can mean a bent stud or an "open up" hole in knuckle. Defective parts must be replaced.

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 5 and 6.*

1. Position ball joint in the lower control arm and install Tools J-9519-10 and J-9519-9 as shown in Fig. 3C-12.

NOTE: Position bleed vent in rubber boot of the new ball joint facing inward.

2. Turn down on hex head bolt until the new ball joint is seated in the control arm and then remove the tools.

3. Turn the ball stud cotter pin hole fore and aft.

4. Remove the block of wood holding the upper control arm up out of the way.

NOTE: Inspect the tapered hole in the steering knuckle. Remove any dirt and if any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

5. Mate the ball stud to the steering knuckle and install the stud nut. Torque the nut and install a new cotter pin.

NOTE: Never back off nut to align the cotter pin, always tighten nut to next slot that lines up with hole in stud.

6. Install a lube fitting and lube the joint.

7. Install wheel and tire and tie rod end oif removed ot steering knuckle, and lower vheicle to floor.

STEERING KNUCKLE

It is recommended that the vehicle be raised and supported on a twin-post hoist so that the front coil spring remains compressed, yet the wheel and steering knuckle assmelby remain accessible. If a frame hoist is used, support the lower control arm with an adjustable jack stand to retain spring in the curb height position.

Removal

1. Raise vehicle on a hoist and support the lower control arm.

2. Remove the wheel and tire assembly.

3. Remove the brake caliper and brake disc or brake drum.

4. Remove the backing plate or splash shield.

CAUTION: *Hang the brake backing plate or caliper assembly from the some part of the suspension assembly. Do not allow the unit to hang*

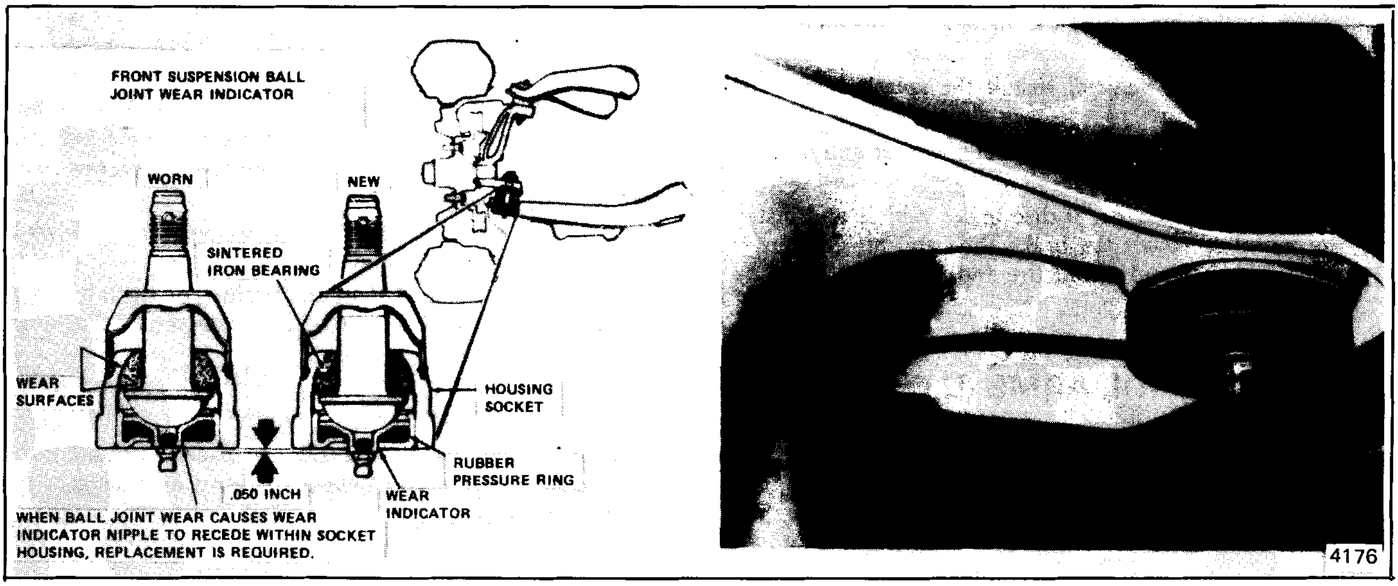


Fig. 3C-11 Wear Indicating Ball Joint

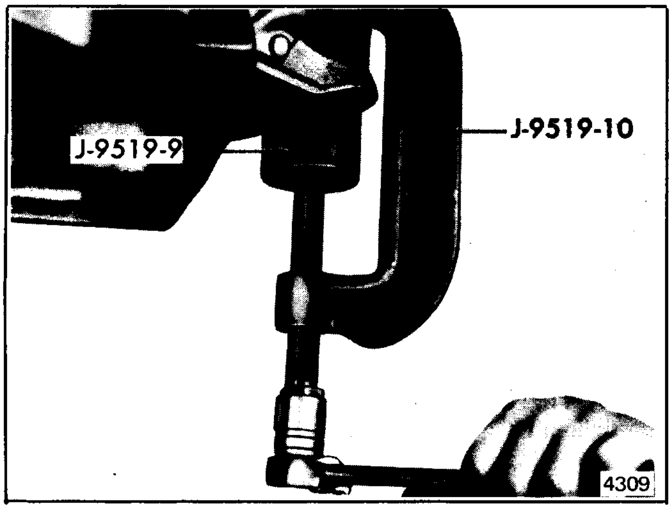


Fig. 3C-12 Installing Ball Joint to L.C.A.

by the hydraulic line.

5. Remove upper and lower ball stud cotter pins.

6. Remove ball studs from steering knuckle using Tool J-23742. See "Ball Joint Removal".

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 2, 4, 5 and 6.*

1. Place steering knuckle into position and insert upper and lower ball studs into knuckle bosses.

2. Install ball stud nuts and torque to specifications. Install cotter pin.

NOTE: Never back off nut to align the cotter pin. Always tighten nut to next slot that lines up with hole in the stud.

3. If drum brake vehicle: Place brake backing plate into position and install bolts, nuts and anchor pin. Install the hub assembly.

4. If disc brake vehicle: Install the splash shield and install hub and disc.

5. Install outer bearing and spindle washer and nut and adjust bearing.

6. Install brake caliper if disc brake vehicle and install tire and wheel or install the brake shoe and brake drum if drum brake vehicle and install tire and wheel.

7. Lower vehicle to floor.

UPPER CONTROL ARMS (U.C.A.)

U.C.A. Removal

1. Raise vehicle on hoist.

2. Support the lower control arm with a jack stand.

3. Remove tire and wheel assembly.

4. Separate the upper control arm ball stud from the steering knuckle.

5. Remove the two nuts securing the upper control arm shaft to the frame bracket.

NOTE: Tape the shims together and mark them for position from which they were removed.

It is necessary in some cases to remove the upper control arm attaching bolts to allow clearance to remove the upper control arm assembly. The attaching bolts are splined into the frame. To remove, proceed as follows:

a. Tap bolt down gently with brass drift as shown in Fig. 3C-13.

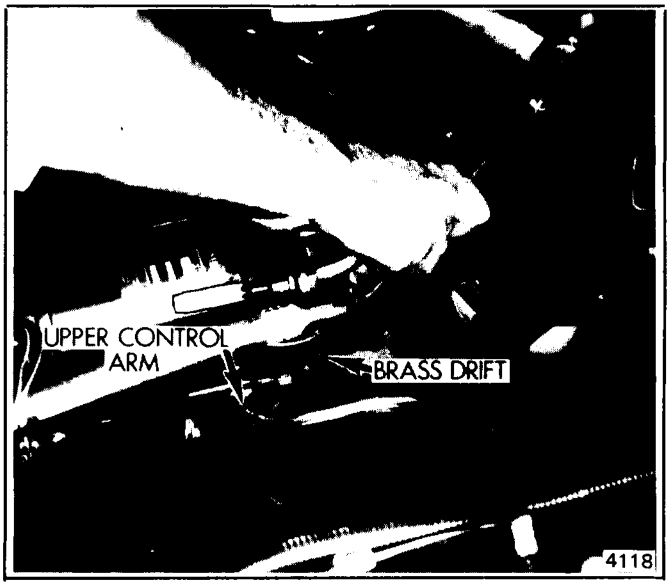


Fig. 3C-13 Loosening Upper Control Arm Bolts

b. Using a box wrench, gently pry bolt up.

c. Remove the nut and, using a suitable pry bar and block of wood, pry bolts from the frame as shown in Fig. 3C-14.

6. Remove arm from the car.

Shaft/Bushing-Replacement

1. Using J-22269-5 and J-24770-2 as shown in Fig. 3C-15, tighten J-22269-5 sufficiently to insert J-24770-3 onto the shaft.

2. Tighten screw against J-24770-2 to remove bushing.

3. To remove bushing from other side, install J-24770-2 and J-22269-5 as shown in Fig. 3C-16 and turn the screw until the bushing is pushed out.

4. Install either bushing with J-22269-5 and J-24770-1 as shown in Figs. 3C-17 and 18.

5. Install the support shaft and bushing on the other side of the control arm with J-22269-5 and Adapter J-24770-1 as shown in Fig. 3C-19.

U.C.A. Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 6, 7, 8 and 9.*

1. Loosen end shaft retainer bolts and/or nuts.

2. If removed, position new upper control arm attaching bolts loosely in the frame and install control arm cross shaft

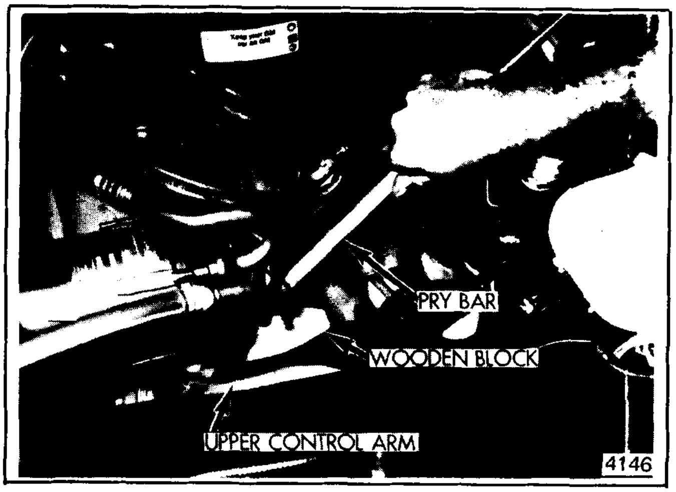


Fig. 3C-14 Removing Upper Control Arm Bolts

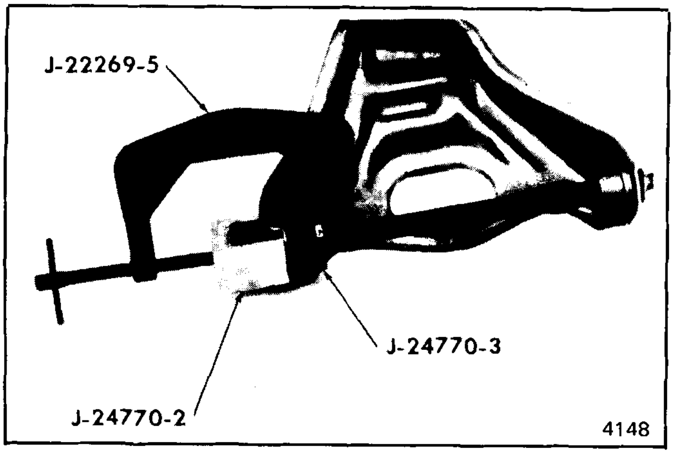


Fig. 3C-15 Removing First Upper Control Arm Bushing (Front or Rear)

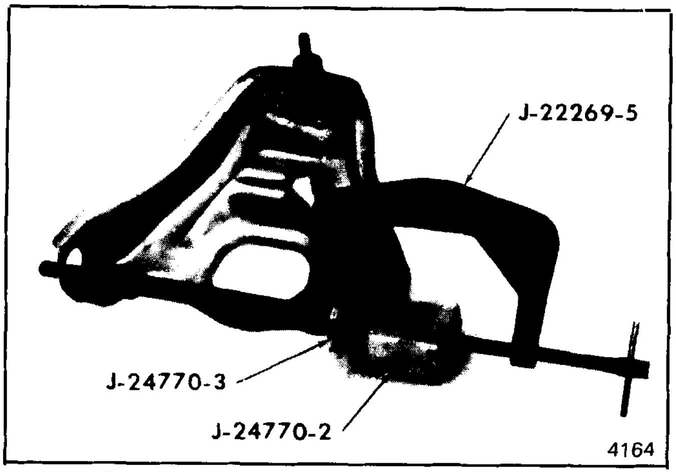


Fig. 3C-16 Removing Second Upper Control Arm Bushing (Front or Rear)

on the attaching bolts.

3. Using a free running nut instead of the regular locknut, tighten both nuts until serrated bolts are reseated.

4. Remove free running nuts and install the regular lock nuts.

5. Install the same number of shims to each bolt that were removed and taped together.

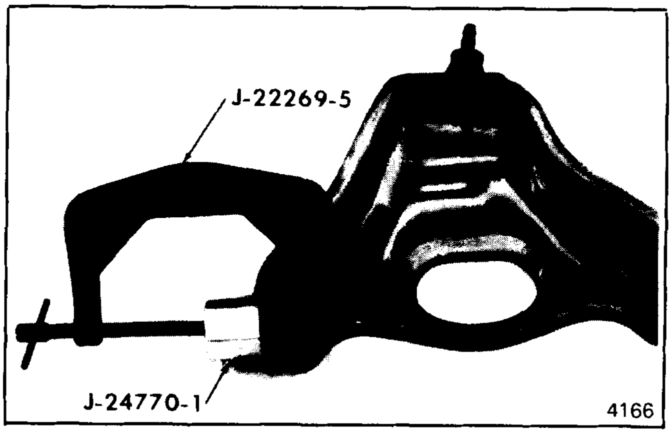


Fig.3C-17 Installing Upper Control Arm Front Bushing First

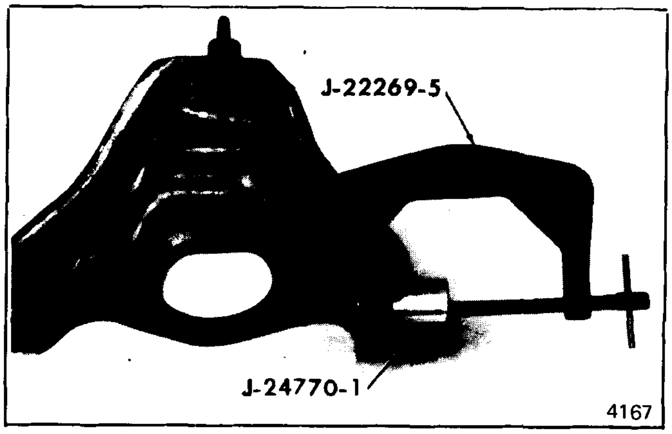


Fig. 3C-18 Installing Upper Control Arm Rear Bushing First

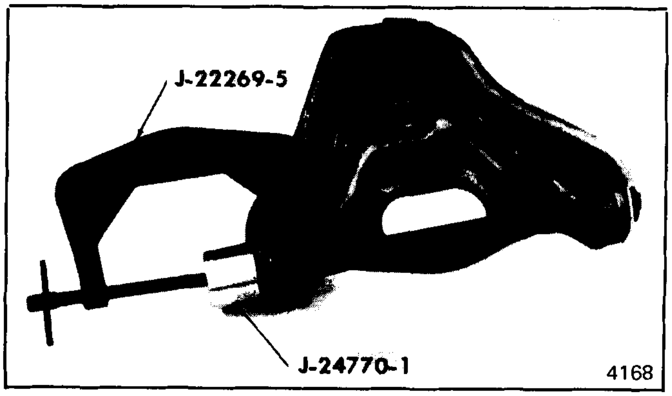


Fig. 3C-19 Intalling Upper Control Arm Second Bushing

6. Torque nuts to specifications.

NOTE: *Tighten the nut on the thinner shim pack first* for improved shaft-to-frame clamping force and torque retention.

7. Install ball stud through knuckle, torque not and install cotter pin.

NOTE: Never back off nut to align the cotter pin. Always tighten nut to next slot that lines up with hole in the stud.

8. Intall the tire and wheel and lower the vehicle to the floor.

9. With vehicle on the floor, torque the shaft retainer bolts and/or nuts to specifications.

LOWER CONTROL ARMS (L.C.A.)

L.C.A. Removal

1. Remove the coil spring as outlined earlier.
2. Remove the ball from the steering knuckle as outlined.
3. Remove the control arm from the car.

Rear Bushing Replacement

1. Raise vehicle on a hoist.
2. With the vehicle supported by the frame (with floor stands) so that the control arms hang free, remove the lower shock absorber bolts and push the shock absorber up through the coil spring.
3. Position Tool J-23028 to a suitable jack and place under lower control arm bushings so that bushings seat in the grooves of the tool.
4. Install a chain around the control arm and through a coil of the spring as a safety measure.
5. Remove the control arm pivot bolts and nuts. Remove rear bolt first.

NOTE: If bolts "hang up" between control arm and frame, use a pry bar to move the control arm so that bolts can be removed. Do not "hammer" bolts out.

6. Lower the control arm by slowly releasing the jack.
7. Install Spacer J-21474-12 as shown in Fig. 3C-20.

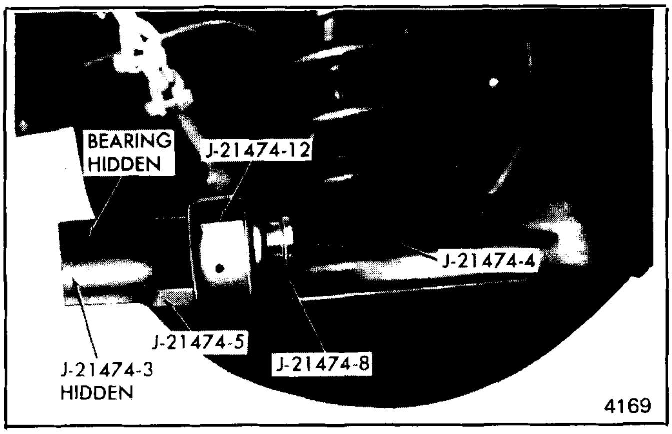


Fig. 3C-20 Removing L.C.A. Bushing

CAUTION: *Do not attempt to remove bushing without having the spacer in position. Distortion to the arm could result.*

8. Install remaining tools as shown in Fig. 8, and turn hex bolt and nut until the old bushing is removed.
9. Remove tools and discard bushing.
10. Start a new bushing in place and position tools, as shown in Fig. 3C-21.

NOTE: Spacer J-21474-12 should still be in position.

11. Turn hex bolt and nut until new bushing is properly seated.

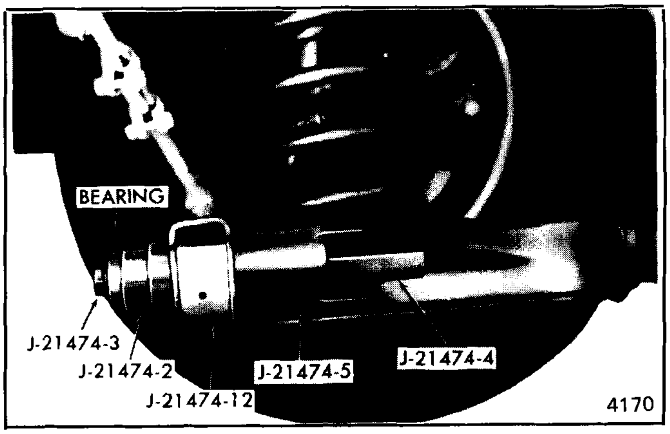


Fig. 3C-21 Installing L.C.A. Bushing

12. Remove tools.
13. Position Tool J-23028 under bushings and install control arm to vehicle frame.

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in Step 14.*

14. Install pivot bolts (front bolt first) and nuts, and torque nuts to specifications. Remove safety chain.

NOTE: The front pivot bolt must be installed with the head forward and the nut rearward.

15. Pull shock absorber lower end through the lower control arm and install mounting bolts. Torque bolts to specifications.
16. Remove tool J-23028 and position hoist under control arms to accept weight of vehicle.
17. Remove floor stands and lower vehicle to floor.

Front Bushing Replacement

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in Step 7.*

1. With control arm off vehicle, remove flare by tapping on edge with a hammer.
2. Install tools as shown in Fig. . Be sure spacer is in place.
3. Turn down on hex nut until old bushing is removed.
4. Start new bushing and install tools as shown in Fig. to press new bushing into position.
5. Remove Tool J-21474-5 and install flaring Tool J-23915.
6. Turn on hex nut until new bushing is flared. See Figs. 3C-22 and 23. Remove tools and inspect flare for good contact with control arm.
7. Install arm to vehicle following procedure outlined earlier in this section. Torque all fasteners to specifications.

L.C.A. Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 1, 2 and 3.*

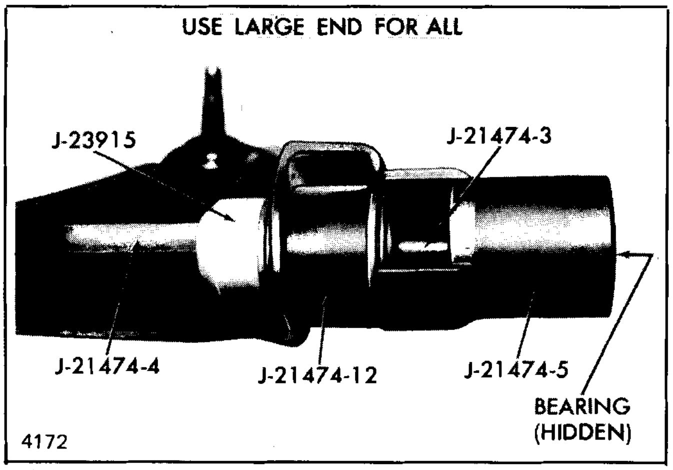


Fig. 3C-22 Forming Flare

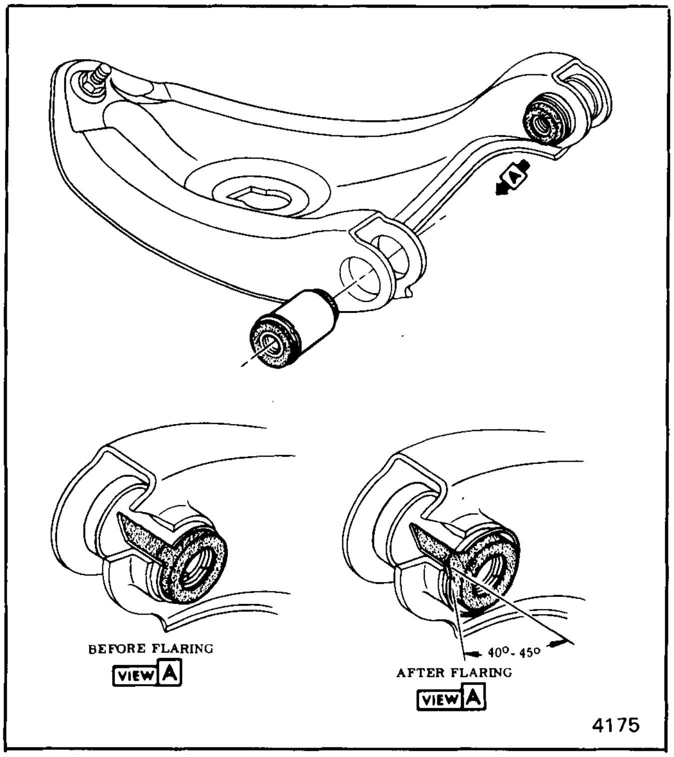


Fig. 3C-23 L.C.A. Front Bushing Flaring

1. Insert the lower control arm ball stud into the steering knuckle boss, install the ball stud nut, torque to specifications and insert new cotter pin.

NOTE: Never back off nut to align the cotter pin. Always tighten nut to next slot that lines up with hole in the stud.

2. Install the coil spring as outlined earler.

3. Torque nuts to specifications.

4. Lower vehicle to the floor.

SERVICE PROCEDURES

H SERIES

WHEEL HUB AND DISC

Removal (Fig. 3C-24)

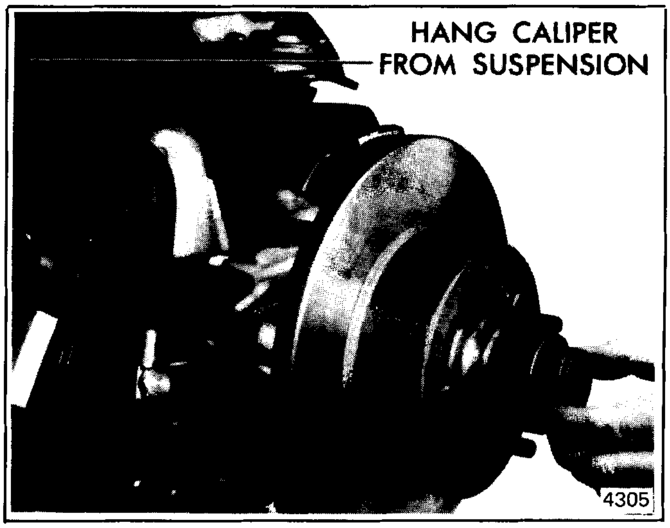


Fig. 3C-24 Front Hub and Disc Removal

1. Raise vehicle on a hoist.
2. Remove the wheel and tire assembly.
3. Remove the brake caliper from the disc. See Section 5.
4. Remove hub grease cup, cotter pin, spindle nut and washer and remove hub and bearing. Do not allow bearing to fall out of hub when removing hub from spindle.

Replacement of Bearings

1. Remove outer bearing with fingers.
2. Remove the inner bearing by prying out the grease seal. Discard seal.
3. Wash all parts thoroughly in cleaning solvent and blow dry.

Inspection

1. Check bearings for cracked separators or pitting.
2. Check races for scoring or pitting.

Repair

NOTE: If it is necessary to replace either the outer or inner bearing it will be necessary to replace the race for that bearing.

1. Drive out old race from hub with a brass drift inserted behind race in notches in hub.
2. Lubricate the new race with a light film of grease.
3. Start the race squarely into the hub and seat the race using J-8850 for the inner and J-8357 for the outer.

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 5 and 6.*

1. Pack both inner and outer bearings using high melting point wheel bearing lubricant.

2. Place inner bearing in hub and install a new grease seal. (Seal should be installed flush with hub surface.) Use a block of wood to seat seal.

3. Install wheel hub over spindle.

4. Install outer bearing, pressing it firmly into the hub by hand.

5. Install spindle washer and nut. Draw up nut and adjust as outlined under "Front Wheel Bearing Adjustment".

6. Install the brake caliper, wheel and tires.

7. Lower vehicle to floor.

Replacement of Wheel Hub Bolts (Fig. 3C-25)

It may be necessary to replace damaged wheel hub bolts. If so, service the hub in the following manner.

1. Remove the hub bolts with a press. Do not damage the wheel mounting surface on hub flange.

NOTE: Support the hub and disc assembly with a socket or similar tool while pressing out the hub bolt (Fig. 3C-25).

2. Install new serrated bolt into hole in hub. Tap lightly with a hammer to start the serrations into hole making sure that the bolt is square with hub flange.

3. Press bolt into flange until head is fully seated against flange.

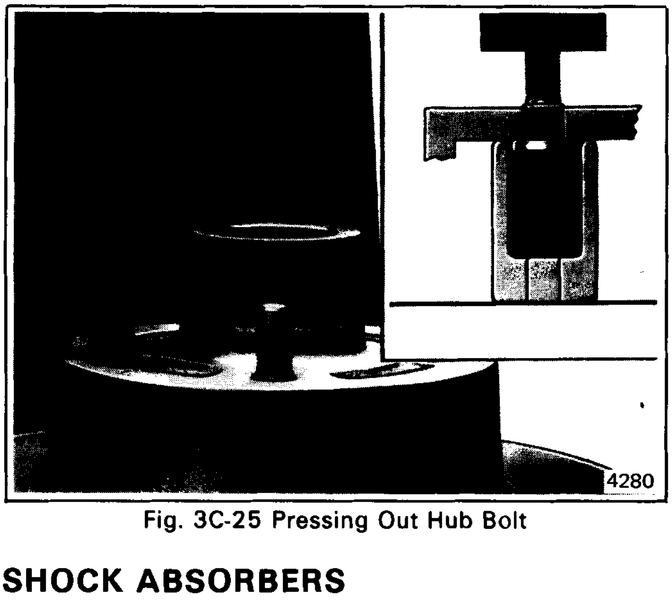


Fig. 3C-25 Pressing Out Hub Bolt

SHOCK ABSORBERS

Removal (Fig. 3C-26)

1. Hold the shock absorber stem and remove the nut, upper retainer and rubber grommet.

2. Raise vehicle on a hoist.

3. Remove the bolts from the lower end of the shock absorber.

4. Lower the shock absorber from the vehicle.

Installation

1. With the lower retainer and rubber grommet in position, extend the shock absorber stem and install the stem through the spring tower.

2. Install the lower bolts. Torque to 20 ft. lbs.

3. Lower the vehicle to the floor.

4. Install the upper rubber grommet, retainer and nut to the shock absorber stem.

5. Hold the stem and tighten the nut to 120 in. lbs.

STABILIZER BAR

Removal (Fig. 3C-27)

1. Raise the vehicle on a hoist.

2. Remove stabilizer bar nut and bolt from lower control arm.

3. Remove stabilizer bar bracket from body.

Installation

1. Hold stabilizer bar in place and install the body bushings and brackets.

2. Install the retainers, grommets and spacers to the lower control arm and install nuts.

3. Lower the vehicle to the floor.

COIL SPRINGS

Removal (Fig. 3C-28)

1. With shock absorber removed and stabilizer bar removed (if equipped) raise the vehicle and place jackstands under front braces.

1. Remove the wheel and tire assembly.

3. Place a hydraulic floor jack under the lower control arm and support the arm.

CAUTION: *Install a chain through the spring and around the control arm as a safety measure.*

4. Remove the lower ball stud from the steering knuckle. "See Ball Joint Removal".

5. Remove the tie rod end from the steering knuckle. See Section 3B.

WARNING: THE LOWER CONTROL ARM KEEPS THE SPRING COMPRESSED USE CARE WHEN LOWERING.

6. Lower the control arm by slowly releasing jack until the spring can be removed.

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 2, 3 and 6.*

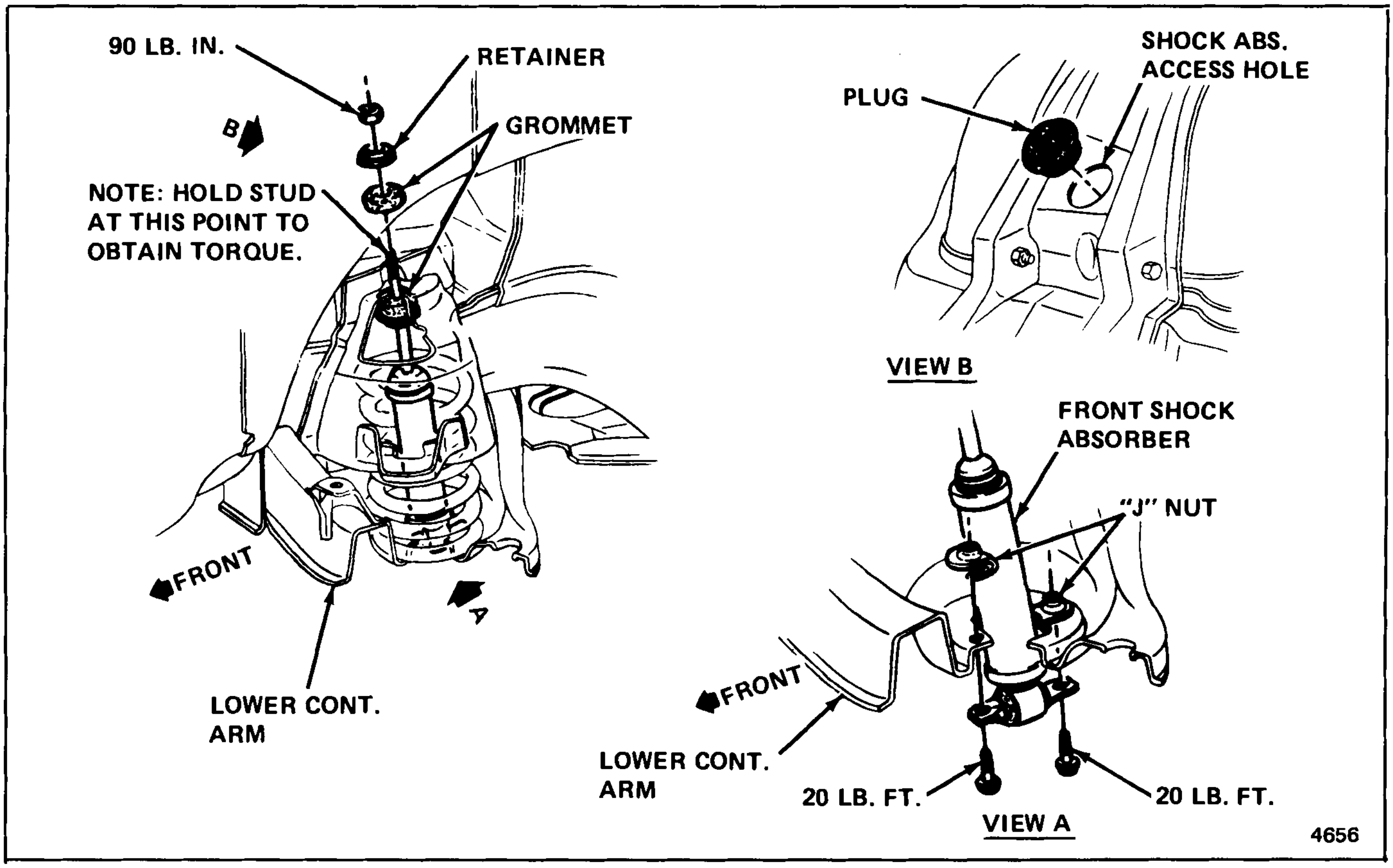
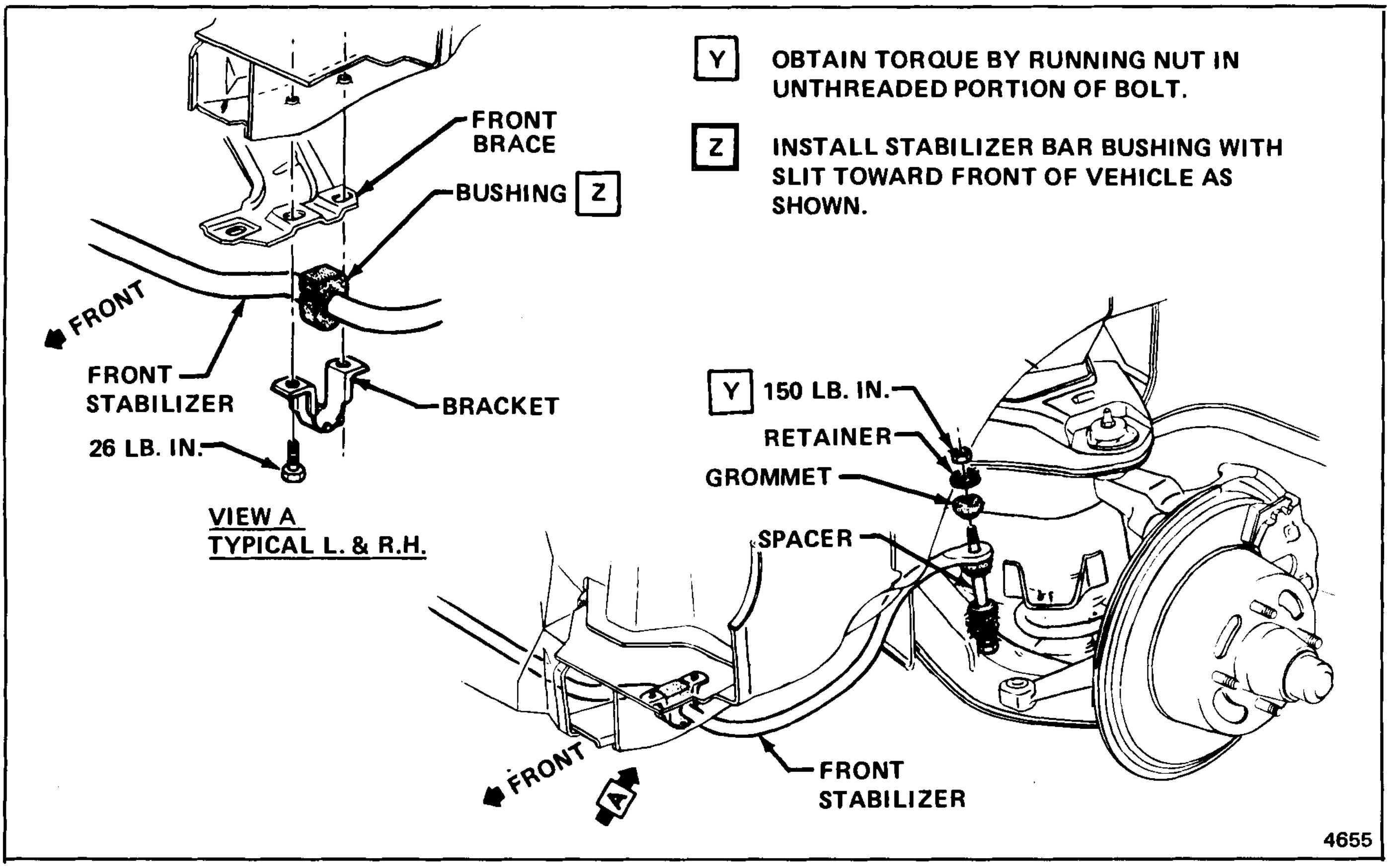


Fig. 3C-26 Shock Absorber Attachment



Y OBTAIN TORQUE BY RUNNING NUT IN UNTHREADED PORTION OF BOLT.

Z INSTALL STABILIZER BAR BUSHING WITH SLIT TOWARD FRONT OF VEHICLE AS SHOWN.

Fig. 3C-27 Front Stabilizer Bar

Fig. 3C-28 Removing Coil Spring

1. Properly position spring in spring tower and on control arm (Fig. 3C-29) and lift control arm with hydraulic jack. Be sure the insulator is indexed with the closed end located at the high point in the spring seat.

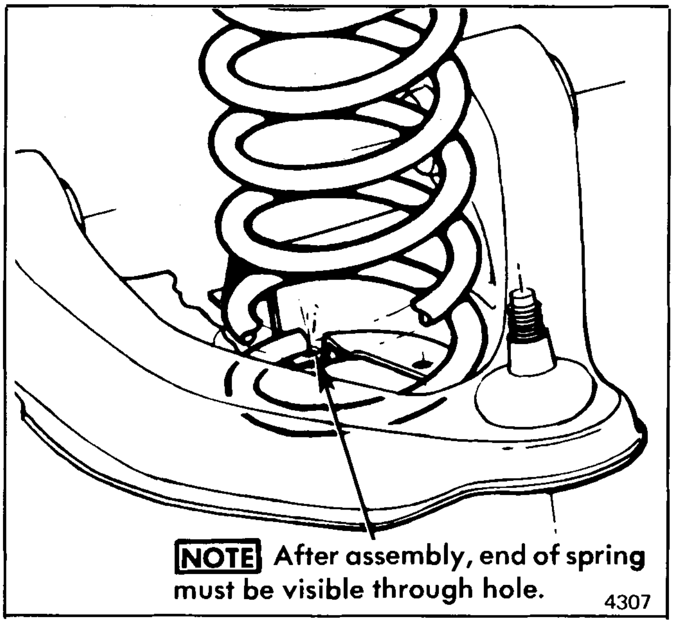


Fig. 3C-29 Coil Spring Positioning

2. Guide the lower control arm ball stud into the steering knuckle and install nut. Torque nut to specifications and insert cotter pin. Remove the safety chain.

NOTE: Do not back off nut to insert cotter pin. Advance nut to the next slot that lines up with the hole in the stud.

3. Install the tie rod end to the steering arm. See Section 3B.

4. Install the shock absorber.

5. Install the stabilizer bar if removed.

6. Install the wheel and tire assembly.

7. Remove the vehicle from the jackstands and lower to the floor. Install the upper end of the shock absorber.

BALL JOINTS

Upper Ball Joint - Removal From Knuckle (Fig. 3C-30)

1. Raise the vehicle on a hoist.
2. Remove the tire and wheel assembly.
3. Support the lower control arm with a floor jack.
4. Remove cotter pin from upper ball stud and loosen the ball stud nut but do not remove.
5. Install Tool J-23742 with the cup end over the lower ball stud nut.
6. Turn the threaded end of J-23742 until ball stud is free of steering knuckle.
7. Remove Tool J-23742 and remove nut from ball stud.

Replacement

CAUTION: *See CAUTION on page 1 of this section regarding the fastener referred to in step 2.*

1. Remove rivets from ball joint to control arm, by either center drilling the rivet heads and knocking off with a chisel, or using a grinding wheel to remove the heads.
2. Install new joint and secure with bolts and nuts supplied with service part.
3. Install a lube fitting and lube the new joint.

Installation To Knuckle

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 2 and 4.*

NOTE: Inspect the tapered hole in the steering knuckle. Remove any dirt and if any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

1. Mate the upper control arm ball stud to the steering knuckle.
2. Install the ball stud nut and torque to specifications.
3. Install the cotter pin. Do not back off nut to insert cotter pin.
4. Install the tire and wheel assembly.
5. Lower the vehicle to the floor.

Lower Ball Joint Inspection (Fig. 3C-31)

The lower ball joints incorporate wear indicators. The inspection of these indicators is as follows:

The lower ball joints are inspected for wear by visual observation alone. Wear is indicated by the protrusion of the 1/2" diameter nipple into which the grease fitting is threaded. This round nipple projects .050" beyond the surface of the ball joint cover on a new, unworn joint. Normal wear will result in the surface of this nipple retreating very slowly

Fig. 3C-30 Removing Ball Joints From Knuckle

inward.

Raise the vehicle on a hoist. Vehicle must be supported on wheels so that lower ball joint is in a loaded condition.

To inspect for wear, wipe the grease fitting and nipple free of dirt and grease as for a grease job. If the round nipple is flush or inside the cover surface, replace the ball joint.

Ball stud tightness in knuckle boss can be checked by shaking wheel and observe or feel for movement of stud end and/or nut at knuckle boss, or by removing cotter pin to check torque. Looseness can mean a bent stud or an "opened up" hole in knuckle. Defective parts must be replaced.

Removal From Knuckle

1. Raise vehicle on hoist.

2. Remove the tire and wheel assembly.

3. Support the lower control arm with a hydraulic floor jack.

4. Remove cotter pin from lower ball stud and loosen the ball stud nut but do not remove.

5. Install Tool J-23742 with the cup end over the upper ball stud nut.

6. Turn the threaded end of J-23742 until ball stud is free of steering knuckle.

7. Remove Tool J-12742 and remove nut from ball stud.

Replacement

1. Install Tools J-9519-10, J-9519-7 and J-9519-17 and turn hex head screw until ball joint is pushed out (Fig. 3C-32).

2. Position new ball joint so that bleed vent is facing inward and using Tools J-9510-10, J-9519-16 and J-9519-17 turn hex head screw until new ball joint is seated (Fig. 3C-33).

3. Install lube fitting and lube new joint.

Installation To Knuckle

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 2 and 4.*

NOTE: Inspect the tapered hole in the steering knuckle. Remove any dirt and if any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

1. Mate the lower control arm ball stud to the steering knuckle.

2. Install the ball stud nut and torque to specifications.

3. Install the cotter pin. Do not back off nut to insert cotter pin. Advance nut to the next slot that lines up with the hole in the stud.

4. Install the tire and wheel assembly.

5. Lower the vehicle to the floor.

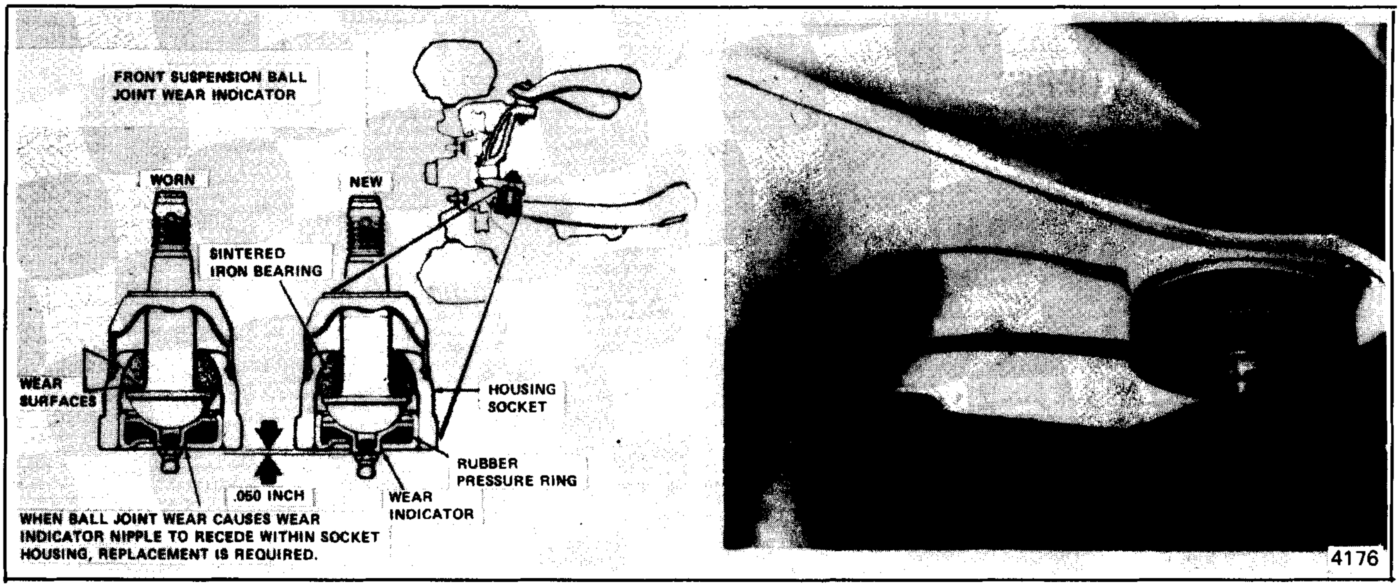


Fig. 3C-31 Wear Indicating Ball Joint

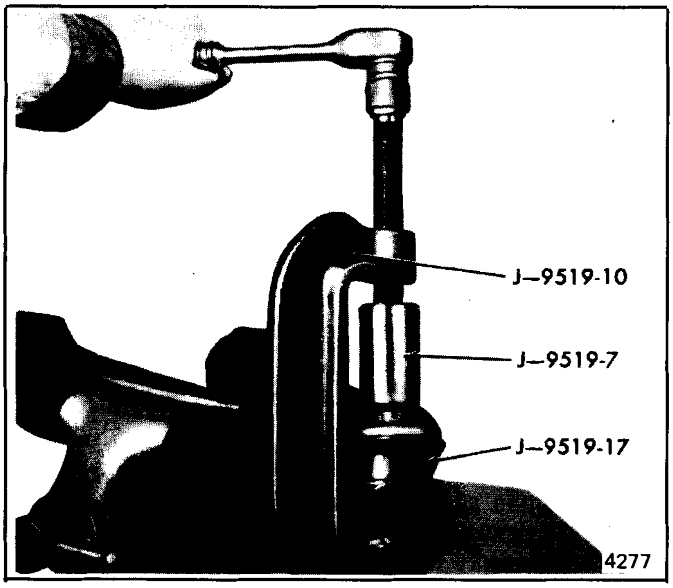


Fig. 3C-32 Removing Lower Control Arm Ball Joint

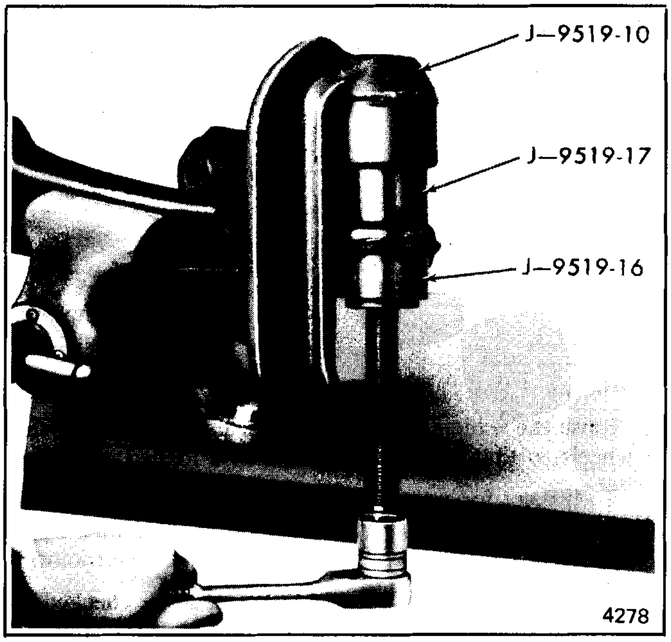


Fig. 3C-33 Installing Lower Control Arm Ball Joint

STEERING KNUCKLE

Removal

1. Raise vehicle on a hoist and support the lower control arm with a jackstand.

WARNING: THIS KEEPS THE COIL SPRING COMPRESSED. USE CARE TO SUPPORT ADEQUATELY.

2. Remove the tire and wheel assembly.
3. Remove the disc brake caliper.

CAUTION: *Secure the caliper to the suspension using wire. Do not allow the caliper to hang by the brake hose. Insert a piece of wood between the shoes to hold the piston in the caliper bore. (The block of wood should be about the same thickness as the brake disc.)*

4. Remove the hub and disc.
5. Remove the splash shield.
6. Remove the tie rod end from the steering knuckle.
7. Remove upper and lower ball stud cotter pins and loosen the ball stud nuts. (See Ball Joint Removal)
8. Using Tool J-23742 press the ball stud from the steering knuckle.
9. Reverse Tool J-23742 to the other ball stud and press the ball stud from the steering knuckle.
10. Remove ball stud nuts and remove the steering knuckle.

Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 2, 3, 4, 5, 6 and 7.*

1. Place steering knuckle in position and insert the upper and lower ball studs into knuckle bosses.
2. Install ball stud nuts and tighten to specifications (see Specifications Section). Install cotter pin.

NOTE: If necessary, tighten to the next slot to insert cotter pin. Never back off on a ball stud nut to align cotter pin.

3. Install splash shield to the steering knuckle. Torque to specifications.
4. Install the tie rod end to the steering knuckle. Torque to specifications.
5. Install the hub and disc, bearings and nut. Torque to specifications. Install cotter pin. See Note above.
6. Install the brake caliper.
7. Install the tire and wheel assembly.
8. Remove the jackstand and lower the vehicle to the floor.

UPPER CONTROL ARM (U.C.A.)

U.C.A. Removal

1. Raise vehicle on a hoist.
2. Remove the tire and wheel assembly.
3. Support the lower control arm with a floor jack.
4. Remove upper ball stud nut and remove ball stud from steering knuckle.
5. Remove control arm pivot bolts and remove control arm from vehicle.

U.C.A. Ball Joint - Inspection

NOTE: This inspection and replacement can be made without removing the control arm from the vehicle.

NOTE: Inspect the tapered hole in the steering knuckle. Remove any dirt and if any out-of-roundness, deformation or damage is noted the knuckle MUST be replaced.

The Upper ball stud is spring loaded in its socket. This minimumizes looseness at this point and compensates for normal wear. If the upper stud has any perceptible lateral or vertical free play, the upper ball joint should be replaced. Specified torque for a new joint is 1 to 4 ft. lbs. rotating torque.

U.C.A. Bushing Replacement (Fig. 3C-34 and 35)

1. Place the control arm in a vise and install Tools J-21473-3, J-21474-4, J-21474-13 and J-21474-5 as shown in Fig. 3C-34.
2. Tighten the bolt head until the bushing is free of control arm.
3. Separate the tools and discard the bushing.

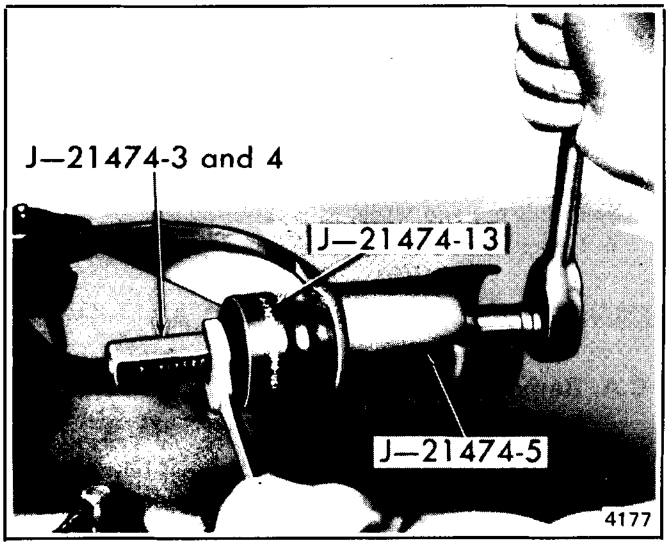


Fig. 3C-34 Removing Upper Control Arm Bushing

4. Start a new bushing in place and install Tools J-21474-3, J-21474-4, J-21474-13 and J-21474-13 and J-21474-5 as shown in Fig. 3C-35.

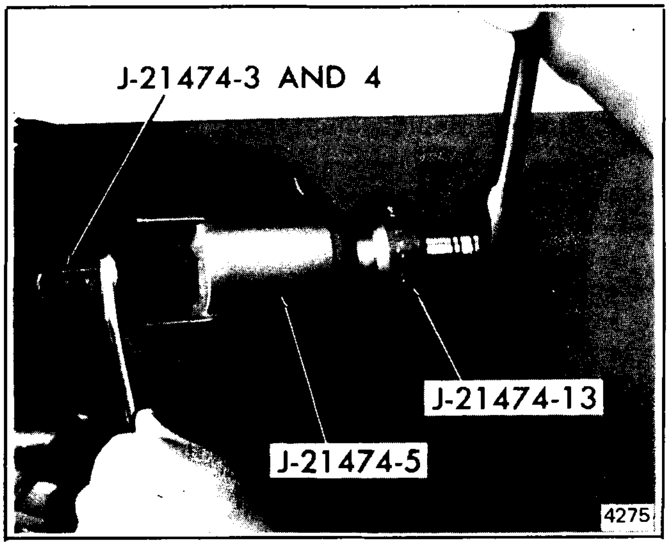


Fig. 3C-35 Installing Upper Control Arm Bushing

5. Tighten the bolt head until the bushing is seated in the control arm.
6. Remove the tools from the control arm.

U.C.A. Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in steps 3, 4 and 5.*

1. Install upper control arm to vehicle at inner pivot.

NOTE: The inner pivot bolts must be installed with the bolt heads to the front (on the front bushing) and to the rear, (on the rear bushing).

2. Install the inner pivot nuts.

3. Position the control arm in a horiztonal plane and torque the inner pivot nuts.

4. Install ball stud to steering knuckle, install nut, torque to specifications and install cotter pin. Do not back off nut to align cotter pin. Advance nut to the next slot that lines up with the hole in the stud.

5. Install tire and wheel assembly.

6. Lower vehicle to the floor.

LOWER CONTROL ARM (L.C.A.)

L.C.A. Removal

1. Raise vehicle on a hoist.
2. Remove shock absorber.
3. Remove ball stud from steering knuckle.
4. Remove coil spring.

NOTE: Steps 2, 3 and 4 above are covered elsewhere in this section.

5. Remove the inner pivot cam nuts and bolts.

NOTE: Mark the position of the cam bolts before loosening nuts. This step will aid in reassembling.

6. Remove the control arm from the vehicle.

L.C.A. Bushing Replacement (Figs. 3C-36 and 37)

1. Place the control arm in a vice and install Tools J-21474-2, J-21474-3, J-21474-4, J-21474-5 and J-22323-1 as shown in Fig. 3C-36.

2. Tighten the bolt head until the bushing is pushed free of control arm.

3. Separate the tools and discard the bushing.

4. Start a new bushing in position and install Tools J-21474-3, J-2474-4, J21474-5, J-21474-13 and J-22323-1 as shown in Fig. 3C-37.

5. Tighten the bolt head until the bushing is seated in the control arm.

6. Remove the tools from the control arm.

L.C.A. Installation

CAUTION: *See CAUTION on page 1 of this section regarding the fasteners referred to in step 6 in installation and replacement procedures.*

1. Install the control arm to the vehicle.

NOTE: Be sure that the control arm bushings have the metal caps installed.

2. Install the cam bolts through the control arm bushings.

CAUTION: *The front cam bolt (camber) must be installed with the head toward the front of the vehicle and the rear cam bolt (caster) must be installed, with the head toward the rear of the vchicle.*

3. Install the inner cams to the cam bolt.

4. Install the lock washer and nut.

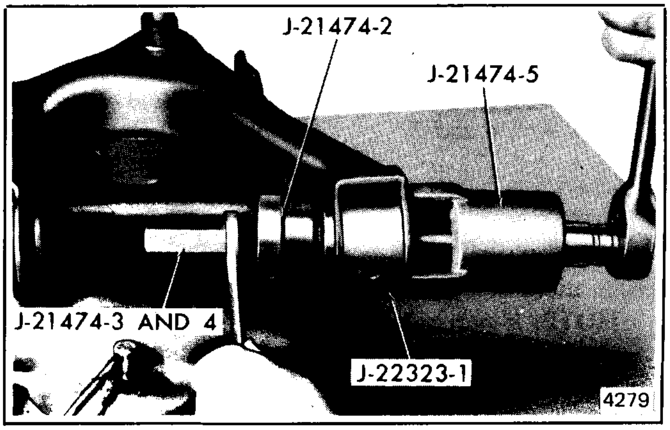


Fig. 3C-36 Removing Lower Control Arm Bushing

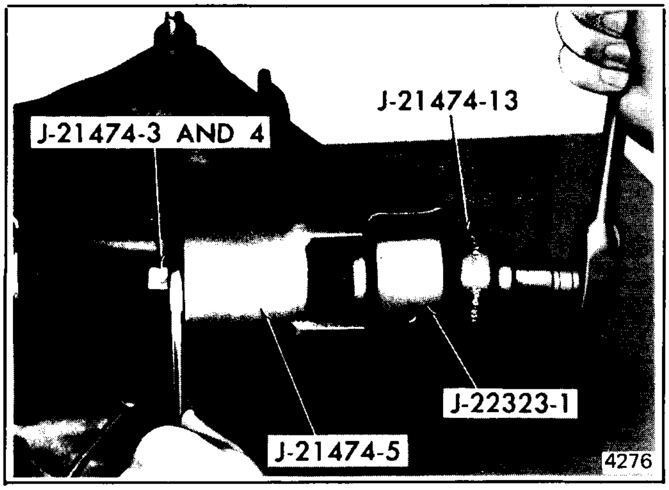


Fig. 3C-37 Installing Lower Control Arm Bushing

5. Set the cam bolts to the marks made before removal.

6. Install the coil spring. See "Front Spring"

7. Install the shock absorber.

8. Lower vehicle to the floor.

9. Check front alignment.

SPECIFICATIONS

FRONT SUSPENSION TORQUE SPECIFICATIONS

Lower Control Arm Pivot Bolt (Holding Nut)	
A and G Series	90
Nut (Holding Pivot Bolt)	
A, B and G Series	95
F Series	90
X Series	105
H Series	125
Upper Control Arm Nut, Shaft to Frame	
A, B and G Series	75
F and X Series	75
Nut, Bushing Except H Series	55
H Series	60
Nut, Lower Control Arm Bumper	
H Series (lb. in.)	120
Nut, Lower Ball Joint Stud[1]	
Except H Series	70
H Series	55
Except H Series	50
H Series	30
Nut, Shock Absorber Upper Stud	
A, B, F and G Series (lb. in.)	90
X and H Series (lb. in.)	90
Screw, Shock Absorber to Control Arm	
All Series	20
Nut, Stabilizer Link to Shaft	
All Series (lb. in.)	150
Screw, Stabilizer Shaft Bracket to Frame	
Except H Series	24
H Series	26
Nut, Tie Rod to Steering Knuckle Arm	35
Bolt, Splash Shield to Steering Knuckle	12
Bolt, Brake Caliper Assembly Mounting	35

[1] Maximum of 1/6 turn to align cotter pin.

CAUTION: *Turn nut to tightening direction only to align slot with hole in stud to insert cotter pin. DO NOT BACK OFF NUT TO ALIGN COTTER PIN.*

[2] 125 lb. ft. maximum torque to align cotter pin slot.

[3] 100 lb. ft. maximum torque to align cotter pin slot.

[4] Nut must be bottomed at end of threads.

[5] Hold shock stud to obtain specified torque.

SECTION 3D

REAR SUSPENSION

CAUTION: *All rear suspension fasteners are an important attaching part in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

A, B AND G SERIES

A four link rear suspension (Fig. 3D-1) is used on all models. The axle housing is connected to the frame by two upper and two lower control arms with rubber pivot bushings at each end of the control arm. The control arms maintain the geometrical relationships of the rear axle with the frame, oppose torque reaction on acceleration and braking and provide for optimum handling characteristics.

Two coil springs support the weight of the car in the rear suspension. They are retained between seats in the frame and brackets welded to each axle housing tube. A rubber insulator is used to isolate the coil spring upper end from the frame seat and the lower end sits directly on the axle tube mounted bracket.

Sealed shock absorbers are mounted between a bracket welded to each axle housing tube and the upper spring seat, with the top inclined toward the center of the car. The shock absorbers are externally the same for all models (except for length), but vary in hydraulic control to provide a well-controlled but soft ride.

A steel stabilizer shaft is used to improve side roll stability on models with handling option. The one-piece shaft attaches to the lower control arms and is positioned directly under the differential axle housing. The shaft will support the weight of the car when a two-post axle engaging hoist is used for lifting.

Rubber bumpers are mounted near the outer ends of the axle housing and at the center of the frame crossmember to prevent metal-to-metal contact during compression travel or bottoming of the suspension.

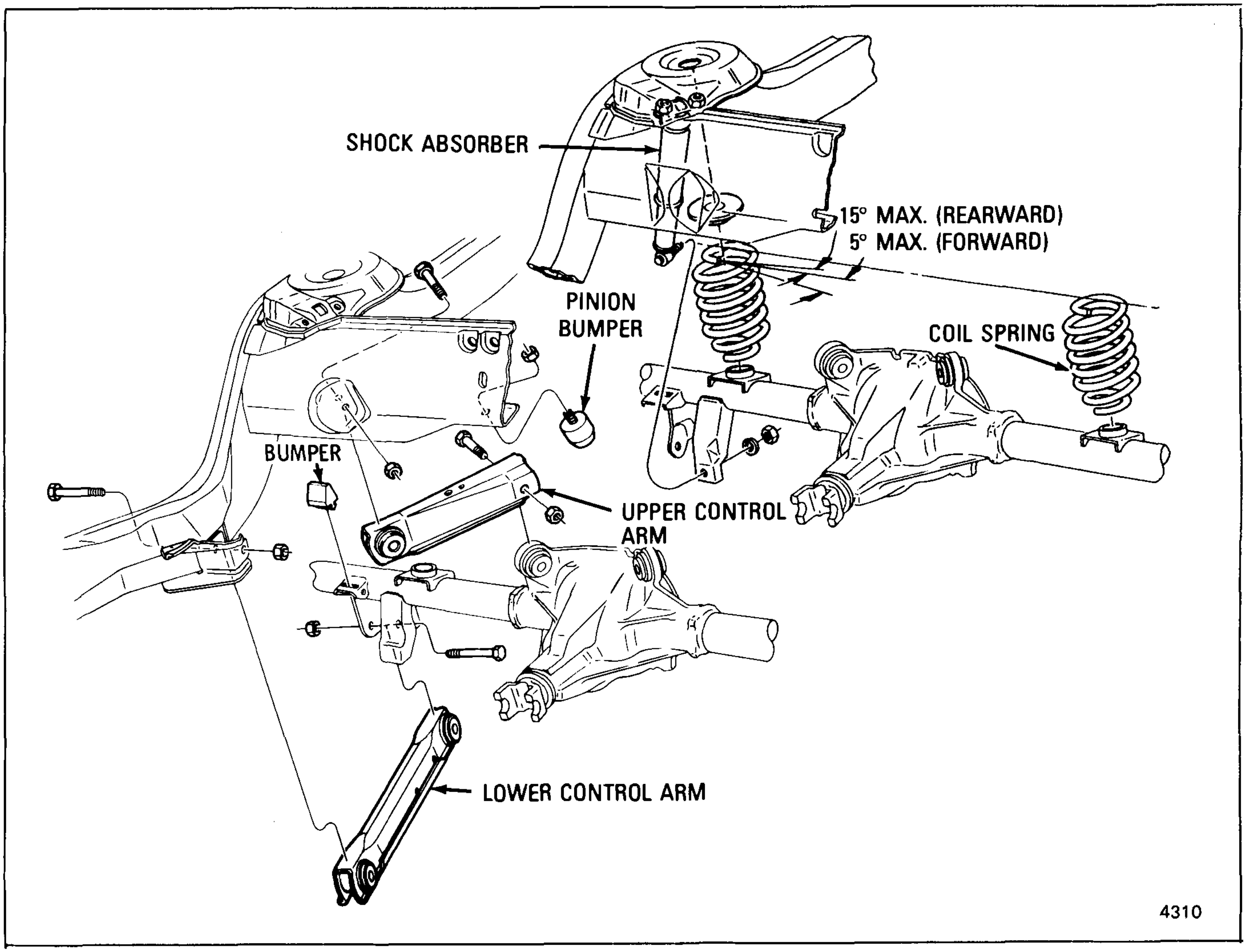


Fig. 3D-1 Rear Suspension - A, B and G Series

F AND X SERIES

The F and X Series rear suspension (Fig. 3D-2) consists of two uniformly stressed rear springs of multi-leaf design. Shock absorbers are stagger mounted to the spring lower seats. The right hand shock absorber is mounted forward of the axle with the left hand shock absorber mounted behind the axle.

H SERIES

On the H Series, the axle housing is connected to the body by two lower control arms and a tie-rod (track rod) (Fig. 3D-3). A single torque arm is used in place of upper control arms and is rigidly mounted to the differential housing at the rear and through a rubber bushing to the transmission at the front. Coil springs are used to support the weight of the car and ride control is provided by shock absorbers mounted to the rear of the axle housing. A stabilizer shaft is optional on the H and HM Series.

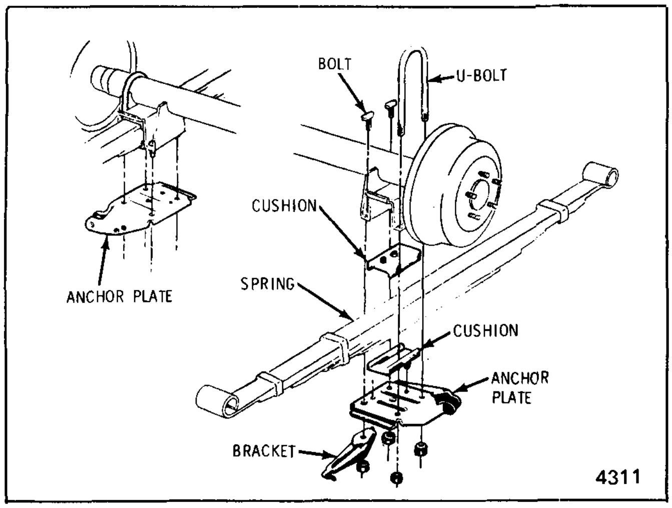


Fig. 3D-2 Rear Suspension - F and X Series

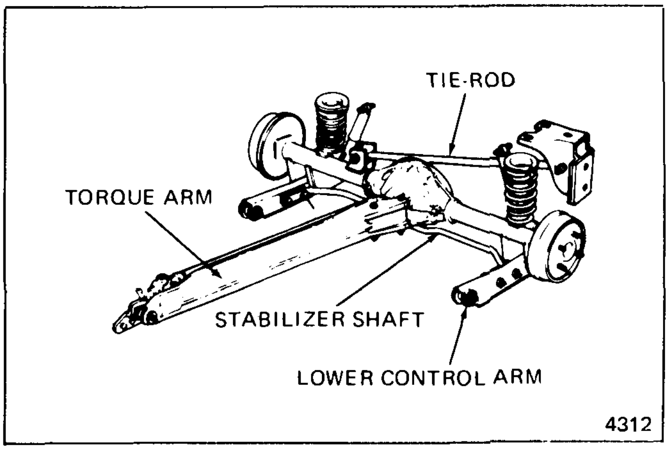


Fig. 3D-3 Rear Suspension - H Series

REAR SUSPENSION SERVICE OPERATIONS

SHOCK ABSORBERS

Double acting standard and heavy duty shock absorbers are filled with a calibrated amount of fluid and sealed during production. They are non-adjustable, non-refillable and cannot be disassembled. The only service they require is replacement if they have lost their resistance, are damaged or leaking oil. See Section 3C for operation and Section 3 for diagnosis of standard and heavy duty shock absorbers.

The double action shock absorbers are mounted by bolts through the frame at the top and to brackets welded on the axle housing at the bottom.

SHOCK ABSORBERS

Removal (A B and G Series)

If necessary to replace, raise car and support rear axle to prevent stretching of brake hose. The lower end has a stud which is an integral part of the shock. Remove the nut and tap shock free from bracket. To disconnect the shock at the top, on all models, remove the two bolts, nuts and lockwashers.

Removal (F, H and X Series)

1. Raise car on hoist and support rear axle.
2. Loosen and remove shock absorber lower mounting bolt from shock absorber eye.
3. Remove shock absorber upper mounting bracket bolts and withdraw shock absorber.

Installation (A, B and G Series)

See CAUTION on Page 3D-1 of this Section.

Loosely attach shock at both ends. Tighten upper bolts and nuts to 20 ft. lbs. Tighten lower nut to 65 ft. lbs.

Installation (F, H and X Series)

See CAUTION on Page 3D-1 of this Section.

1. Loosely install the two shock absorber upper attaching bolts.
2. Insert shock absorber eye into lower bracket, install bolt with nut to rear (to front on H Series) and torque to 43 lb. ft. H Series, 55 in. lbs. F Series, and 45 ft. lbs. X Series.
3. Torque upper bolts to 22 ft. lbs.
4. Lower car and remove from hoist.

UPPER CONTROL ARMS (A, B AND G SERIES)

WARNING: IF BOTH CONTROL ARMS ARE TO BE REPLACED, REMOVE AND REPLACE ONE CONTROL ARM AT A TIME TO PREVENT THE AXLE FROM ROLLING OR SLIPPING SIDEWAYS AS THIS MIGHT OCCUR WITH BOTH UPPER CONTROL ARMS REMOVED, MAKING REPLACEMENT DIFFICULT.

Removal

1. Remove nut from rear arm to differential housing bolt and, while rocking differential, remove the bolt (Fig. 3D-4).

   NOTE: On some cars disconnecting lower shock absorber stud will provide clearance. Use support under differential nose to aid in bolt removal.

2. Remove front and rear arm attaching nuts and bolts.
3. Remove suspension arm and inspect bushing for damage.

Installation

See CAUTION on Page 3D-1 of this Section.

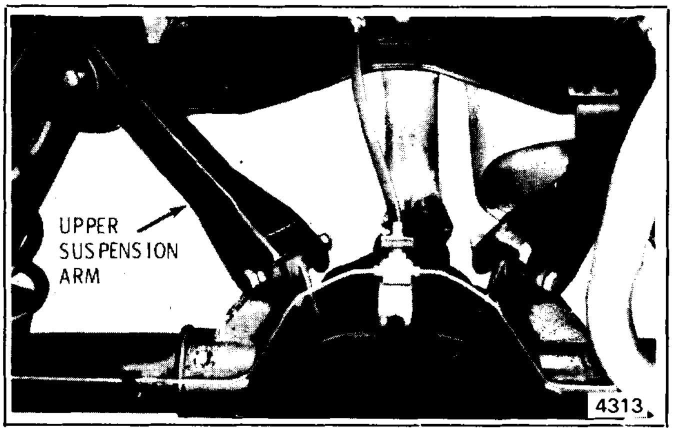


Fig. 3D-4 Upper Control Arm Attachment

To install, reverse removal procedure. Torque nuts to specifications with car resting at normal carrying height.

Service Replacement Parts - B Series

The control of drive line angles in production is achieved by selecting the appropriate stack-up of shims at the transmission to regulate front U-joint angles and by varying rear upper control arm length to control rear U-joint angles. Upper control arm length is regulated by the location of the control arm to axle pivot bolt hole.

Rear upper control arms on the B Series are identified by either a two letter code on one side of the arm and a single letter code (for angle variation) on the opposite side of the arm or by only a two letter code on one side and no code on the opposite side. The two letter code refers to bushing usage; bushings are selected by body style and options, and are serviced by only one replacement bushing for all applications.

The no letter or single letter code on the opposite side of the control arm identifies the location of the pivot bolt.

ANGLE EFFECT	CODE
+2°	H
+1°	A
+1/2°	B
0	C or No Letter Code
-1/2°	D
-1°	F
-2°	J

Three upper control arms are available for service. When replacing an upper control arm, note either the no letter code or the single letter code and select a replacement arm as follows.

CODE	PART NO.
A	526771
B	526773
C or No Letter Code	526773
D	526773
F	526775
H	526771
J	526775

It is not necessary to replace both upper control arms to match codes if the one arm being replaced is selected as described above.

NOTE: All no letter code upper control arms will have a XK or XH two letter code referring to bushing usage.

TORQUE ARM (H SERIES)

Removal (Figs. 3D-5 and 3D-6)

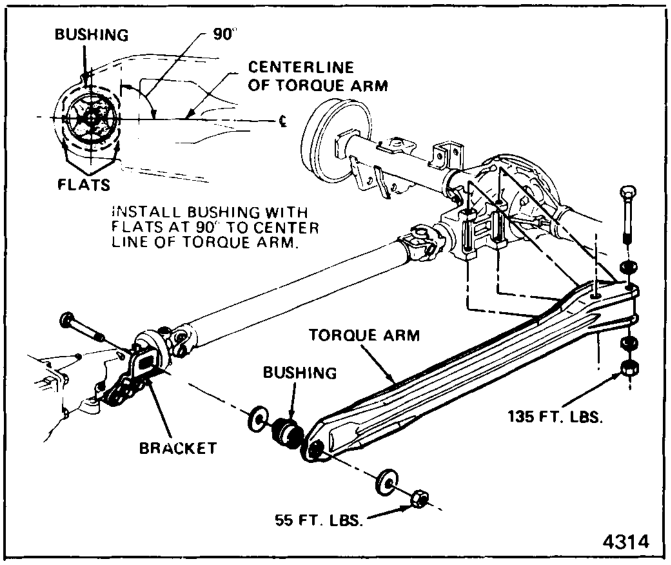


Fig. 3D-5 Torque Arm - H Series (Except 151 Engine)

1. Raise car on hoist and support rear axle.
2. Disconnect mounting bracket from the transmission. On models with 140 engine, remove the through-bolt and separate the bracket from the torque arm.
3. Remove the two torque arm to differential bolts and remove the torque arm.

Installation

See CAUTION on Page 3D-1 of this Section.

1. Loose assemble torque arm to differential.
2. Loose assemble bracket to torque arm bushing and to transmission.
3. Torque bolts to specifications with weight of car on rear axle.

TRACK ROD (H SERIES)

Removal (Fig. 3D-7)

1. Raise car on hoist and support the rear axle.
2. Remove bolt at body end of track rod.
3. Remove bolt at axle bracket and remove track rod.

Installation

See CAUTION on Page 3D-1 of this Section.

1. Position track rod in body and axle brackets (small end of rod in body bracket) and install bolts with nuts toward left side of car (front bolt) and ground (rear bolts).
2. Torque rear bolts to 115 ft. lbs. and front bolts to 50 ft. lbs. with weight of car on axle.

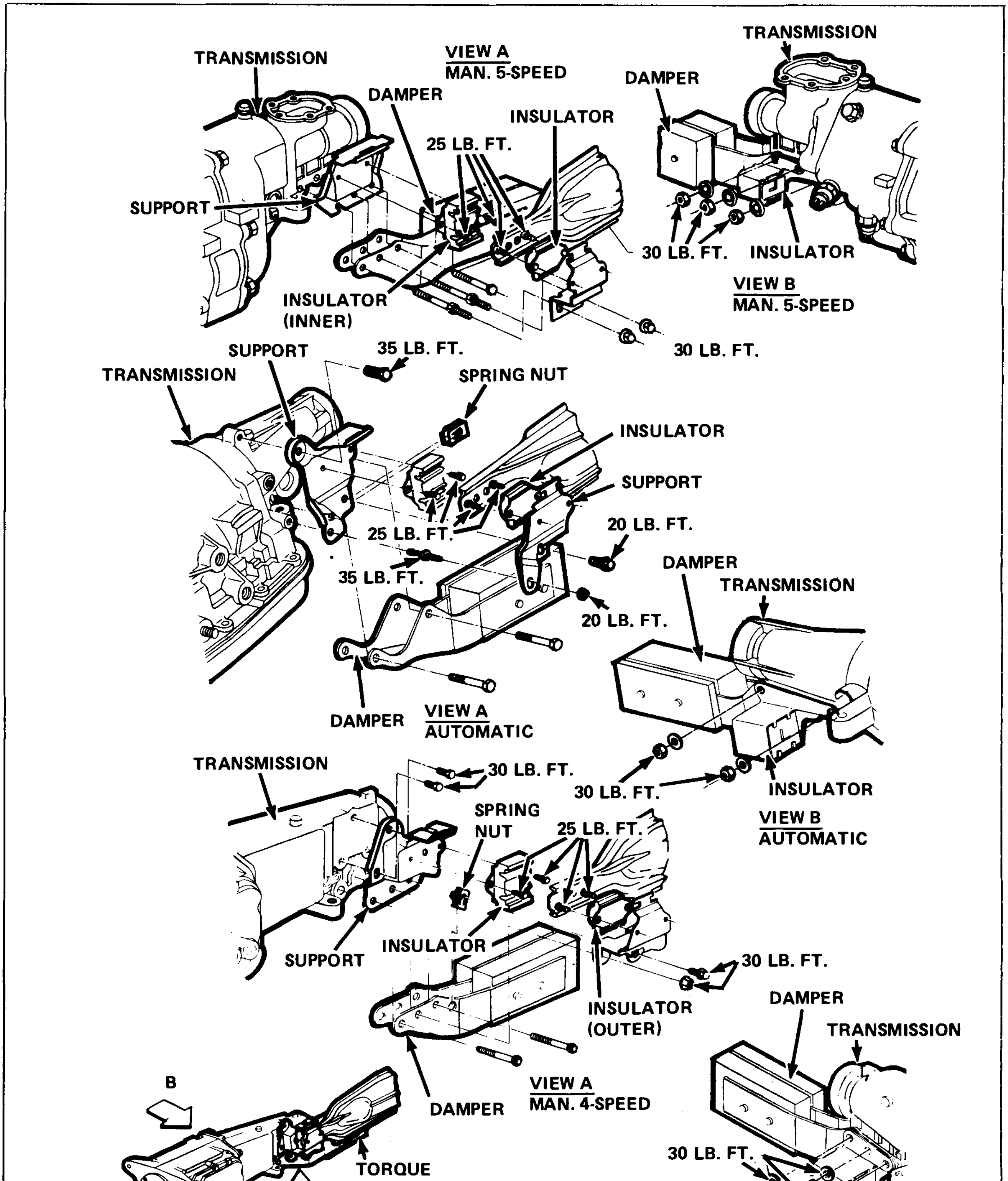


Fig. 3D-6 Torque Arm - H Series (151 Engine)

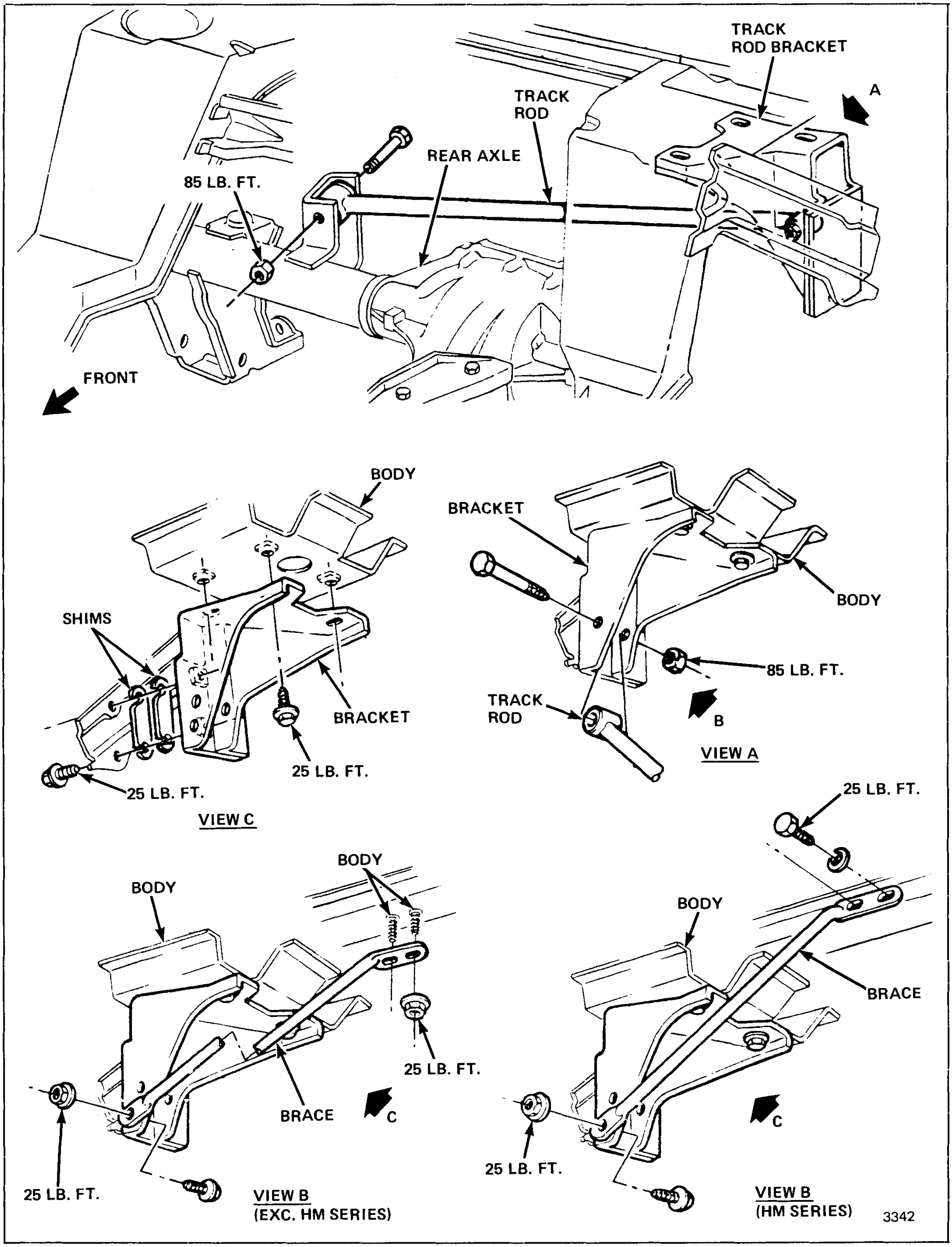


Fig. 3D-7 H Series Track Rod

LOWER CONTROL ARMS (EXC. F AND X SERIES)

WARNING: IF BOTH CONTROL ARMS ARE TO BE REPLACED, REMOVE AND REPLACE ONE CONTROL ARM AT A TIME TO PREVENT THE AXLE FROM ROLLING OR SLIPPING SIDEWAYS AS THIS MIGHT OCCUR WITH BOTH LOWER CONTROL ARMS REMOVED, MAKING REPLACEMENT DIFFICULT.

Removal

1. Raise car and support under axle housing.
2. Remove rear arm to axle housing bracket bolt (Fig. 3D-1).
3. Remove front arm to bracket bolts and remove lower control arm.

Installation

See CAUTION on Page 3D-1 of this Section.

To replace arm, reverse the removal sequence of operations. Tighten attaching nuts to specifications with the weight of the car on the rear springs.

BUSHINGS (EXC. F AND X SERIES)

The bushings in the differential carrier and the H Series torque arm are replaceable. The bushings in the control arms can only be serviced by replacing the complete arms.

TORQUE ARM BUSHING - H SERIES (EXCEPT 151 ENGINE)

Removal and Installation

1. Remove torque arm as described earlier in this section under Torque Arm Removal.
2. Place receiver J 25317-2 under the bushing.
3. Use an arbor press to force the bushing out of the arm, using large O.D. of a driver such as J 21465-8 contacting O.D. of bushing outer sleeve (Fig. 3D-8).
4. Place a new bushing into position with the flat sides of the flange toward the front and rear of the torque arm as shown in Fig. 3D-5.
5. Press bushing into arm, using installer J 25317-1 and receiver J 25317-2 (Fig. 3D-9).

See CAUTION on Page 3D-1 of this Section.

6. Place torque arm into position and install bolts at mounting locations. Torque to specifications with car at curb height.

BUSHING (DIFFERENTIAL CARRIER)

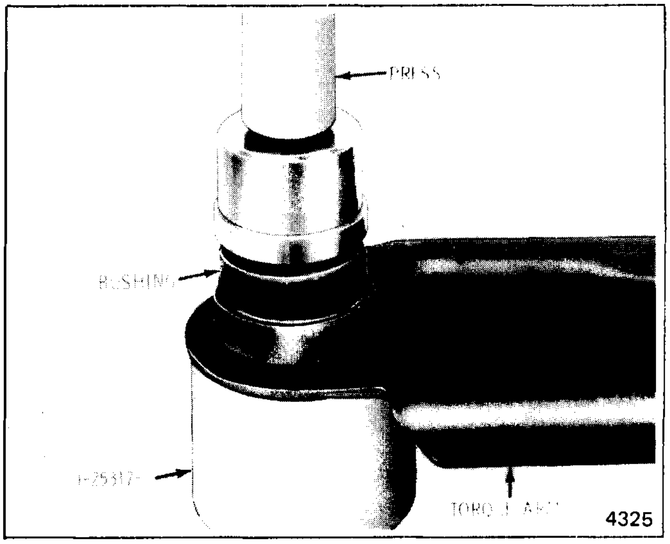


Fig. 3D-8 Bushing Removal - Torque Arm

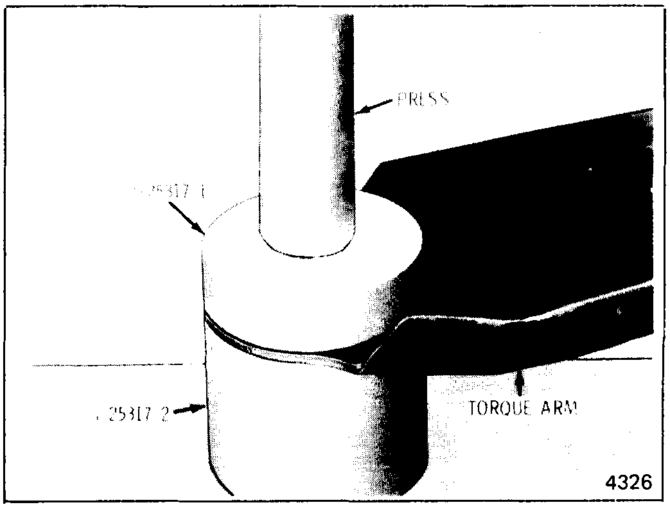


Fig. 3D-9 Installing Bushing

WARNING: IF BOTH BUSHINGS ARE TO BE REPLACED, REMOVE AND REPLACE ONE BUSHING AT A TIME TO PREVENT THE AXLE FROM ROLLING OR SLIPPING SIDEWAYS AS THIS MIGHT OCCUR WITH BOTH UPPER CONTROL ARMS DISCONNECTED.

Removal

The bushings in the differential carrier can be replaced as follows:

1. Raise car and support under frame; lower axle housing until proper clearance is obtained.
2. Disconnect upper arm at differential and hold it up and out of the way.
3. Position tools as shown in Fig. 3D-10 and remove bushing.

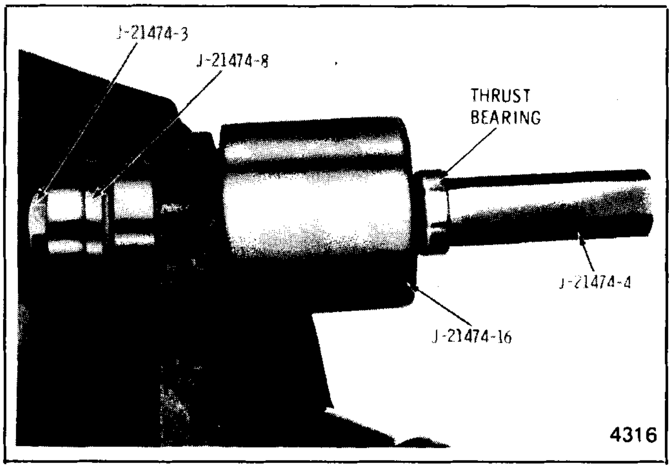


Fig. 3D-10 Bushing Removal

Installation

See CAUTION on Page 3D-1 of this Section.

To install the bushing, reverse the tool as shown in Fig. 3D-11 and pull bushing into position. Connect the upper control arms. Install bolt and torque nut to specifications with weight of car on wheels.

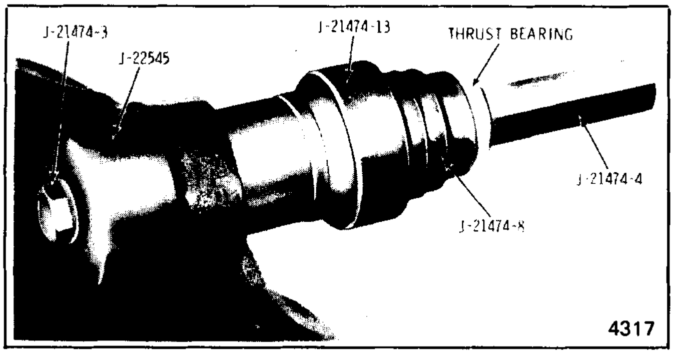


Fig. 3D-11 Bushing Installation

COIL SPRINGS (EXC. F AND X SERIES)

Removal (Fig. 3D-12)

1. Hoist rear of car on axle housing and support at frame rails with floor stands. Do not lower hoist at this time.
2. Remove brake line connector block bolt at axle housing.
3. Release brake line from clips along axle assembly as necessary.
4. Disconnect upper control arms or track rod (H Series) at differential housing.
5. Disconnect shock absorber at lower mount.
6. Lower hoist at rear axle.

NOTE: Do not allow the rear brake hose to become kinked or stretched.

7. When axle has been lowered sufficiently to allow clearance, remove springs.

Installation

1. Install coil spring.

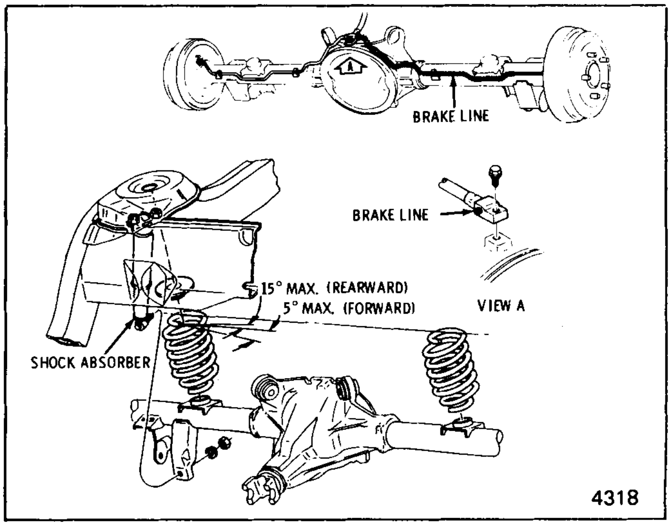


Fig. 3D-12 Coil Spring Mounting (Typical)

2. Raise hoist at rear axle.
3. Connect shock absorber at lower mount.
4. Install upper control arm or track rod bolts at differential housing and toruqe to 85 ft. lbs. (A and G Series), 80 ft. lbs. (B Series) or 85 ft. lbs. (H Series).
5. Install brake line connector block at differential housing. Torque Bolt.
6. Connect brake line and clips at axle housing.
7. Remove jack stands and lower car.

LEAF SPRING (F AND X SERIES)

Removal

1. Raise car on hoist. Support car so axle can be raised and lowered.
2. Raise axle assembly so that all tension is removed from spring.
3. Loosen and remove shock absorber lower attaching bolt (Fig. 3D-13).
4. Loosen the spring eye-to-bracket retaining bolt (Fig. 3D-14).
5. Remove the screws securing the spring retainer bracket to the underbody.
6. Lower axle assembly sufficiently to permit access to spring retainer bracket and remove bracket from spring.
7. Pry parking brake cable out of the retainer bracket mounted on the anchor plate (Fig. 3D-2).
8. Remove lower spring plate-to-axle bracket retaining nuts.
9. Remove upper and lower cushions and anchor plate.
10. Support spring, then remove lower bolt from spring rear shackle (Fig. 3D-15). Separate shackle and withdraw spring from car.
11. Remove rear spring shackle upper bolt and withdraw shackle bushings from frame.

Installation

See CAUTION on Page 3D-1 of this Section.

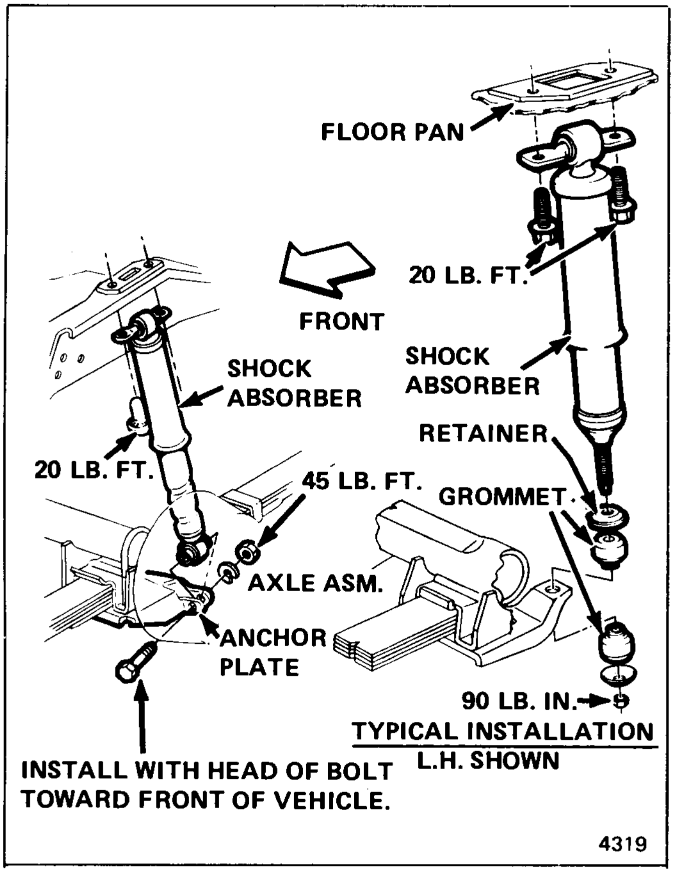


Fig. 3D-13 Shock Absorber Installation - F and X Series

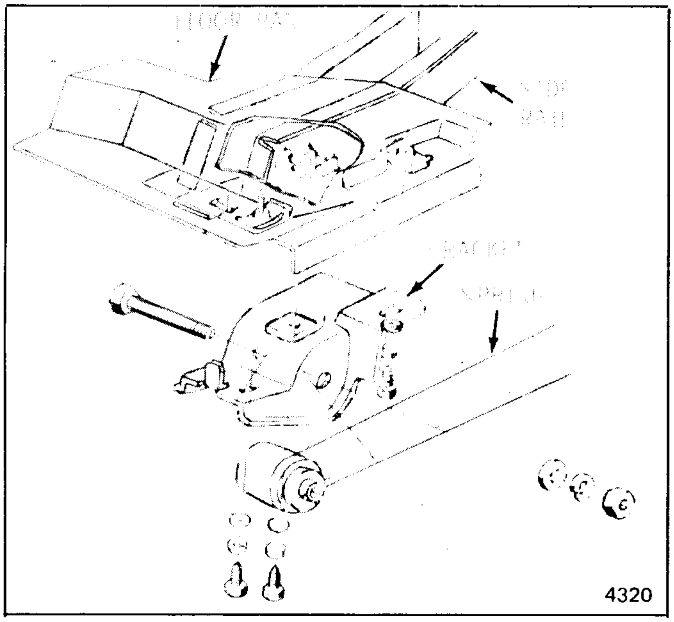


Fig. 3D-14 Leaf Spring Front Bracket Mounting

1. Position spring front mounting bracket to spring front eye. Spring attaching bolt must be installed so that head of bolt is toward center of car.

2. Position spring shackle upper bushings in frame. Position shackles to bushings and loosely install bolt and nut.

3. Install bushing halves in spring rear eye, place spring to shackles and loosely install shackle lower bolt and nut.

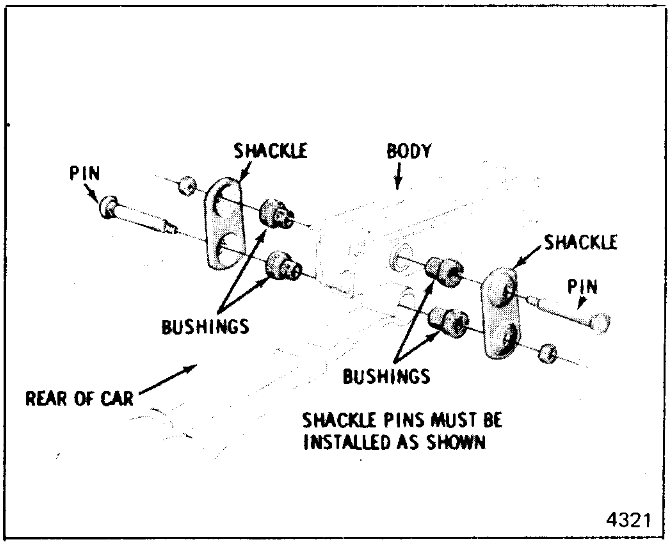


Fig. 3D-15 Leaf Spring Shackles and Bushings

NOTE: When installing spring, make sure spring is positioned so that parking brake cable is on underside of spring.

4. Raise front end of spring and position bracket to underbody. Guide spring into position so that it will index in the axle bracket and also make sure that the tab on spring bracket is indexed in slot provided in the underbody.

5. Loosely install spring-to-underbody bracket.

6. Position spring upper cushion between spring and axle bracket so that spring cushion ribs align with axle bracket location ribs.

7. Place lower spring cushion on spring so that cushion is indexed on locating dowel. Upper cushion and lower cushion will be aligned if installation is correct.

8. Place lower mounting plate (anchor plate) over locating dowel on spring lower pad and loosely install retaining nut.

9. If new mounting plate was installed, transfer parking brake cable retaining bracket to new plate.

10. Position shock absorber to spring mounting plate and loosely install eye bolt and nut; head of bolt should be toward front of car.

11. Position parking brake cable in retaining bracket and securely clamp bracket to retain cable.

12. Torque all affected parts to specifications with car weight on suspension components.

13. Lower car and remove from hoist.

AXLE HOUSING

For removal or installation of axle housing, refer to Section 4B.

RUBBER BUMPER (EXC. F AND X SERIES)

The rear axle bumper is located on the top of the axle housing and is attached by snapping into a bracket on the axle housing (Bolted on upper spring retainer of H Series) If found deteriorated or damaged, it must be replaced.

AXLE HOUSING ALIGNMENT

If rear tire wear indicates that the axle housing may be bent, the alignment can be checked as follows:

1. Back the car squarely onto an alignment machine.
2. Compensate for wheel runout the same as for checking front wheel toe-in.
3. Check camber reading which should be 1/4° negative to 1/2° positive.
4. On B Series, check the amount of toe-out which should be 0" to 1/16".
5. On A and G Series, check the amount of toe-out which should be 3/64" to 5/32".

NOTE: Due to the fact that the car is backed onto an alignment machine, the actual toe-out will be read on the scale as toe-in. However, if the toe-out is checked with a tram gage, disregard this note.

6. If a tram is used for checking toe-out, it will still be necessary to perform Steps 1 and 2 in order to check camber.

The necessary straightening operations may be performed using frame straightening equipment without removing the axle housing from the car. This procedure will allow checks during the straightening operation to determine when the housing is within the prescribed limits.

REAR STABILIZER SHAFT

The rear stabilizer shaft is available on A, B and G Series with handling option and available with handling option on F and X Series. It is standard on F Series Trans Am models. It is attached as shown in Figs. 3D-16, 3D-17 and 3D-18.

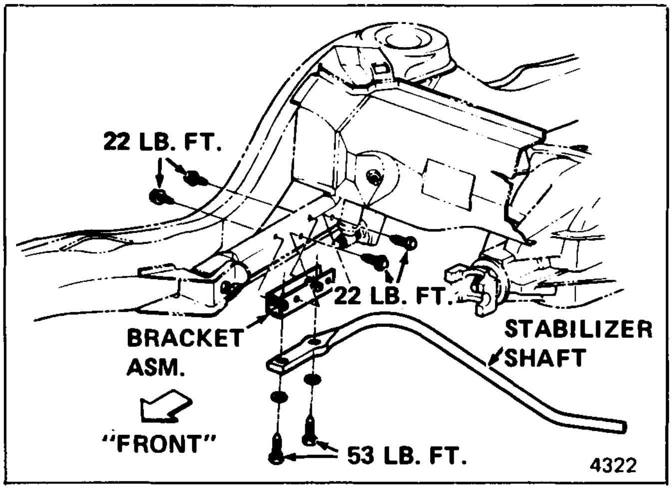


Fig. 3D-16 Rear Stabilizer Shaft - A, B and G Series

SUPERLIFT SHOCK ABSORBERS

DIAGNOSIS AND TESTING

Follow steps under diagnosis. If first step is O.K., proceed down list until problem is corrected.

SUPERLIFT SYSTEM LEAKS AIR PRESSURE

CAUSE	CORRECTION
a. Broken or cracked line.	a. Inflate system to approximately 90 psi and inspect lines for evidence of escaping air. If lines are leaking, repair as needed.
b. Loose connections or leaking valve core.	b. Apply a solution of soap and water to all connections and valve core. If air bubbles appear, repair leak.
c. Fill valve leaking.	c. Detach valve assembly from car with air pressure retained inside valve and immerse assembly in water. If air bubbles appear, repair leak.
d. Superlifts leaking.	d. Remove Superlifts from car and immerse in water with air pressure applied to Superlift. If air bubbles appear, Superlift is leaking and should be replaced.

SUPERLIFTS NOISY WHEN CAR

CAUSE	CORRECTION
a. Loose upper or lower mounting.	a. Inspect and tighten all connections.
b. Rubber mounting bushings worn or cracked.	b. Replace bushings if defective.
c. Internal failure of Superlift.	c. Road test car after above steps have been performed. If noise is still present, replac Superlifts.

GENERAL DESCRIPTION

The Superlift system is an assist-type leveling device which the owner controls manually by varying air pressure in the system. The leveling unit is a combination of a pliable neoprene boot and air cylinder built around a hydraulic shock absorber (Fig. 3D-19). As an integral part of the rear suspension, it offers the car owner added load-carrying flexibility. A level ride can be maintained when carrying abnormal loads by merely increasing air pressure in the system. When load is removed, the car can be lowered to its normal riding height by decreasing air pressure. Air pressure is adjusted by means of a tire-type valve conveniently located in the rear bumper area. Since one valve serves both units, air pressure is equal at all times. Superlifts are available on A, B and G Series.

LEVELING UNIT

The Superlift leveling unit is mounted in the same location as a conventional rear shock absorber. The units are designed so that shock absorber function is not impaired in the event of accidental air loss.

A fitting at the rear bumper contains a tire-type valve which provides a means of filling of shocks with air and exhausting air from the shocks.

LINES AND FITTINGS

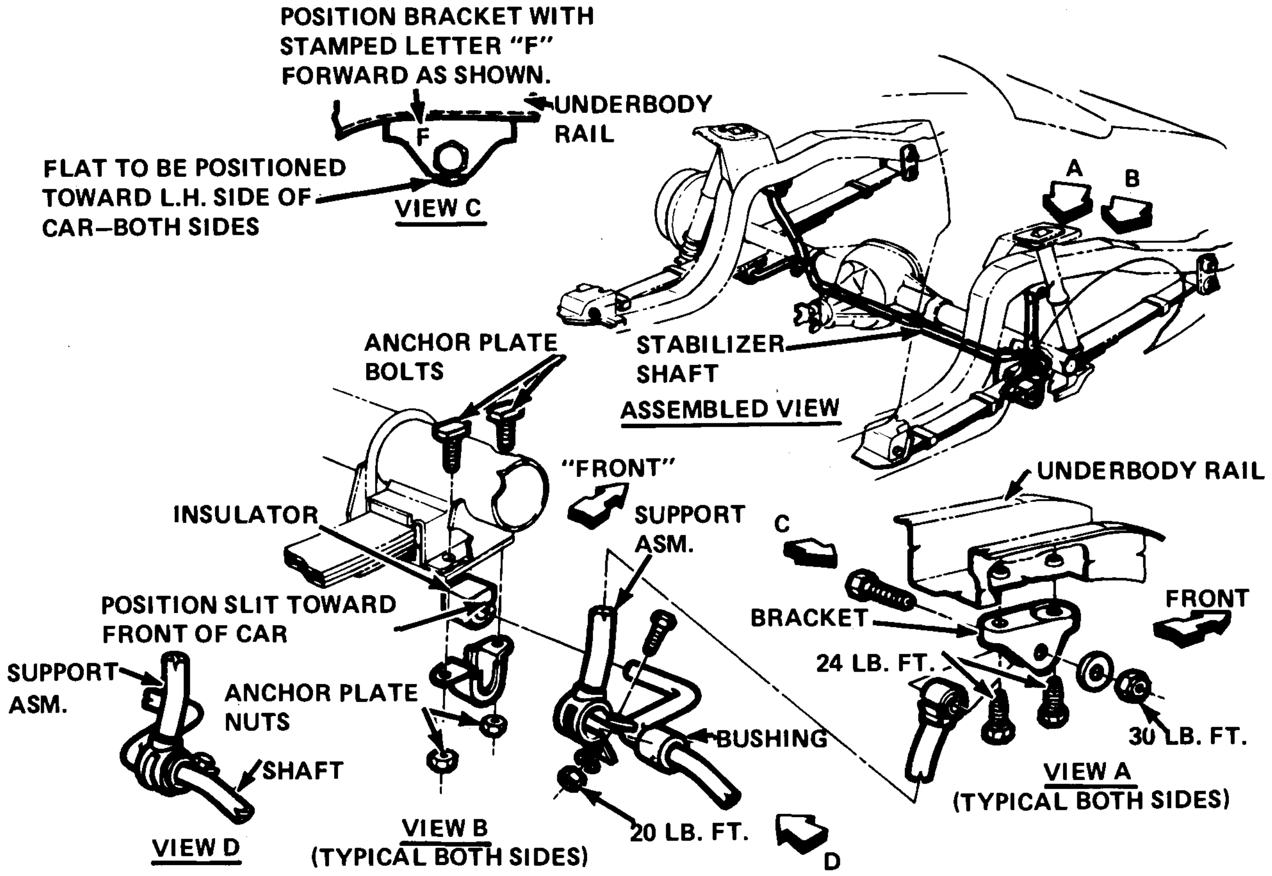
A 1/8" diameter flexible air line is used to allow for relative motion of shock absorbers with rear suspension movement. Connections to the Superlift leveling units and fill valve are made with compression fittings (Fig. 3D-20). Each fitting consists of a rubber seal, metal sleeve and nut. These parts are intended specifically for the 1/8" diameter line and must be used to affect a reliable seal.

NOTE: While the lines (Fig. 3D-21) are flexible for easy routing and handling, care should be taken not to kink them and to keep them from coming in contact with the exhaust system.

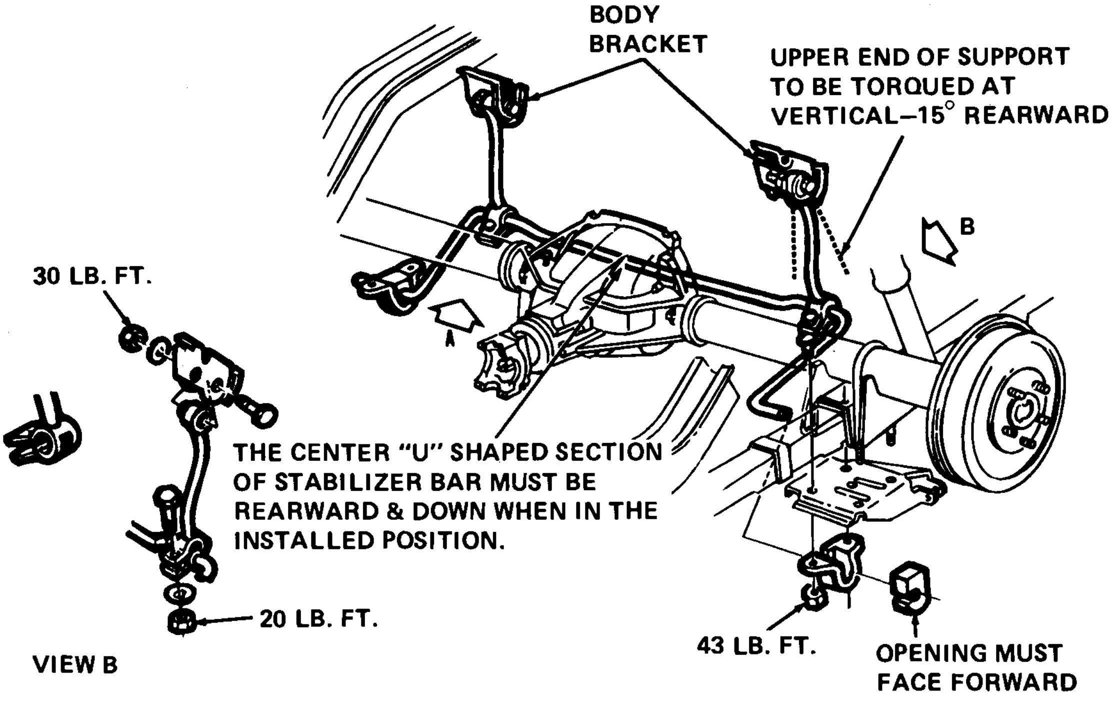
PRECAUTIONS

To insure satisfactory functioning of the Superlift system, observe the following precautions:

- Maintain a minimum of 10 psi for best ride characteristics with an empty car.
- Vary pressure up to a maximum of 90 psi to level the car with loads.



F SERIES



X SERIES

4323

Fig. 3D-17 Rear Stabilizer Shaft - F and X Series

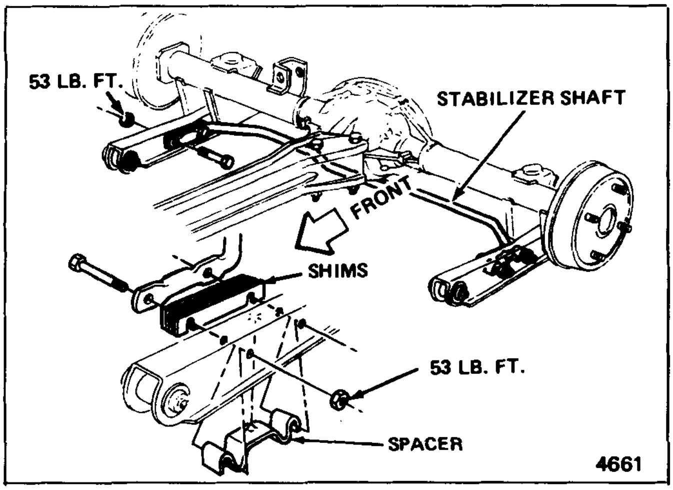


Fig. 3D-18 Rear Stabilizer Shaft - H Series

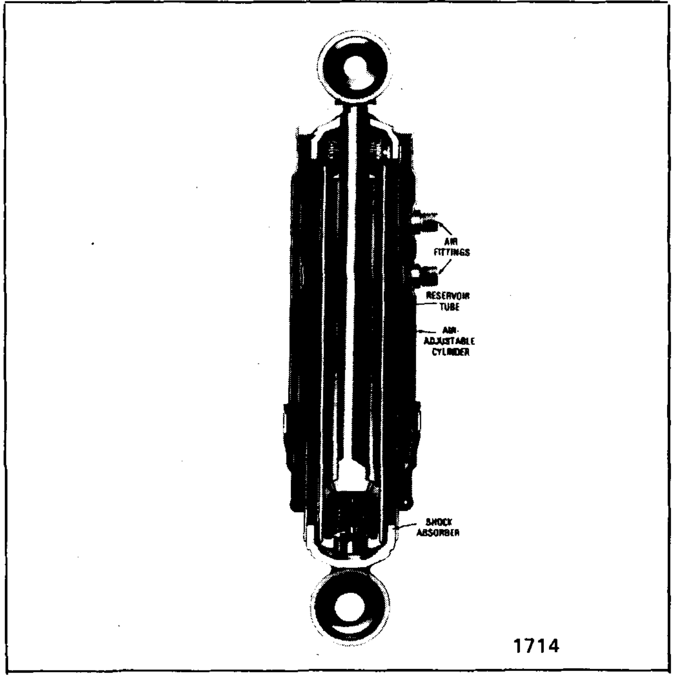


Fig. 3D-19 Superlift Shock Absorber

AUTOMATIC LEVEL CONTROL

COMPRESSOR RESERVOIR AND REGULATOR - LEAK TEST

1. Remove assembly intact.

2. Connect test gage to regulator. Inflate reservoir through service valve to 80-110 psi.

3. Route an 8" piece of rubber hose between vacuum and vent ports (Fig. 3D-32).

4. While holding assembly in a vertical position with reservoir end down, immerse in water until diaphragm is just submerged. Observe for air leaks at:

CAUTION: *Do not submerge completely, as water can enter around the cover gasket.*

- Reservoir weld seam.

INSTALLATION PARTS

INSTRUCTIONS FOR FASTENING TUBING

1. PREASSEMBLE METAL SLEEVE AND RUBBER SEAL.
2. DROP TUBE NUT ON TUBING.
3. INSERT TUBE INTO METAL SLEEVE AND RUBBER SEAL ASSEMBLY UNTIL IT BOTTOMS.
4. HOLDING TUBE IN BOTTOMED POSITION, TIGHTEN TUBE NUT SECURELY.

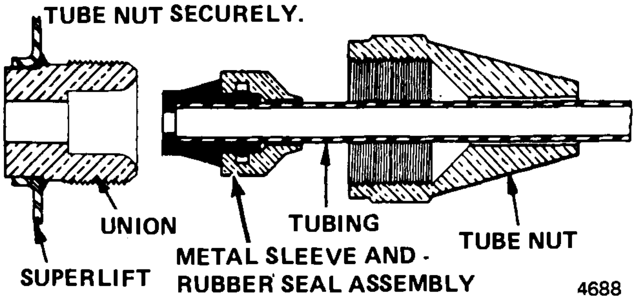


Fig. 3D-20 Instructions For Fastening Tubing

- Reservoir to compressor "O" ring. A stream of bubbles may appear in this area and then cease. The bubbles are caused by atmospheric air being purged from air pockets in the second stage housing. If the bubbles stop, there is no leak.
- Regulator boot--defective internal "O" ring.
- Diaphragm between first and second stage housings--tightening through-bolts may correct the leak.
- Service valve.
- Test gage connections.

5. Remove hose from vacuum port and submerge disconnected end in water. Cover vacuum port with finger. Do not permit water to enter through vacuum port. If bubbles are evident, the probable cause is a defective second stage housing check valve.

6. Correct any leaks by either tightening screws or replacing parts.

7. If the cover gasket area is inadvertently submerged, remove cover and tilt unit so that water may drain through openings by distributor valve mechanism. Move distributor valve from side to side until all water is purged. Blow dry with compressed air, both the distributor valve mechanism and interior of the cover. Replace cover.

NOTE: If the compressor passes this test, yet fails the output test, the compressor, reservoir and regulator needs to be overhauled.

HEIGHT CONTROL VALVE TEST--OFF CAR

1. Remove control valve from car.

2. Clean exterior of control valve thoroughly.

3. Connect test gage and air pressure source to intake adapter and open air pressure (80-110 psi).

4. Submerge unit in water. No air should escape if overtravel lever is in neutral position. If bubbles escape from Superlift port, replace control valve.

5. Shut off air pressure and detach test gage from air intake port. Plug intake port with fill valve from J 22695 adapter package.

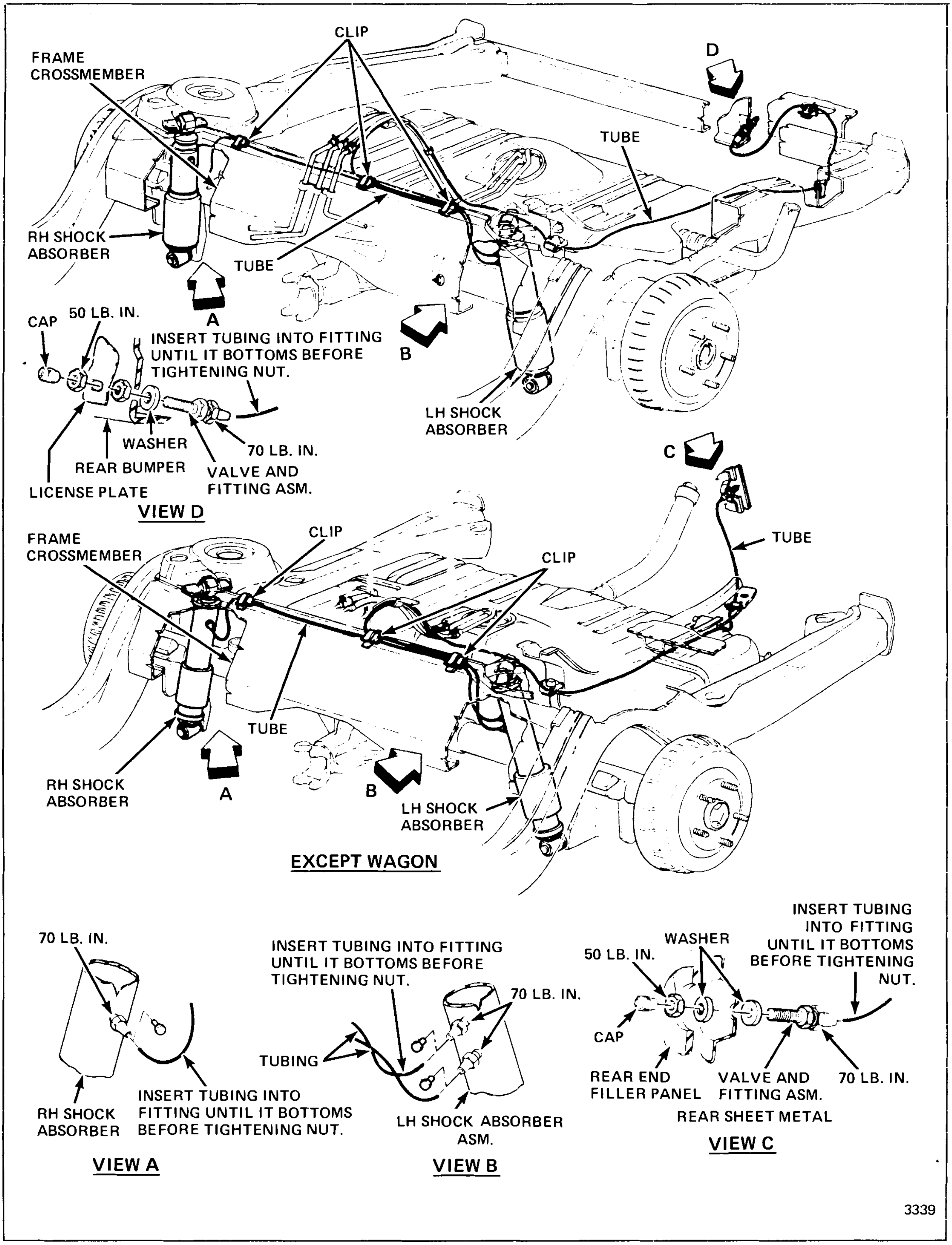


Fig. 3D-21 Superlift Shock Absorbers (Typical)

AUTOMATIC LEVEL CONTROL DIAGNOSIS

TROUBLE CHART

TROUBLE CONDITION	START WITH STEP
CAR LOADED, WILL NOT RAISE CAR SITS LOW	1
CAR LOADED, RAISES PARTIALLY	1
CAR LOADED, RAISES TO LEVEL THEN LEAKS DOWN	6
CAR UNLOADED, RIDES TOO HIGH IN REAR	13
COMPRESSOR CYCLES CONTINUOUSLY	5
EXTREMELY SLOW LEAK–OVER NIGHT LEAK DOWN DURING COLD WEATHER	11

STEP 1 – Check compressor tank pressure, refer to figure 1 for location of service valve on compressor.

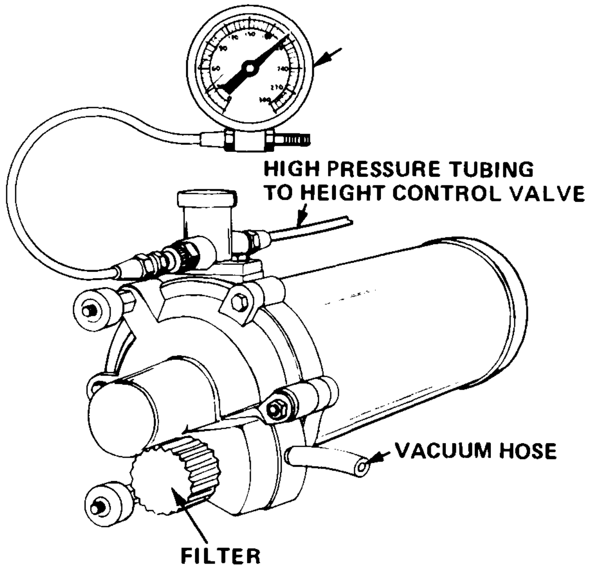


FIGURE 1–CHECKING TANK PRESSURE

Pressure Exceeds 150 P.S.I. → Proceed to Step 5C

Pressure 0 P.S.I. or Very Low → Proceed to Step 2

Pressure Less Than 150 P.S.I. → Proceed to Step 5

1700

FIG. 3D-22 AUTOMATIC LEVEL CONTROL DIAGNOSIS

STEP 2 – Start engine and observe if compressor is cycling.

Compressor cycling

Proceed to Step 5

Compressor Not Cycling

Proceed to Step 3

STEP 3 – Refer to Figure 2. Remove foam filter and observe if compressor cycles.

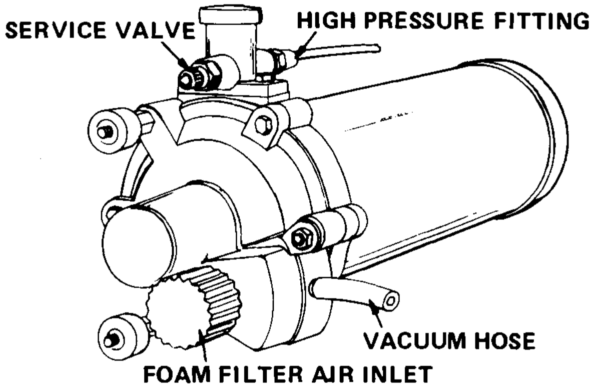


FIGURE 2–CHECKING VACUUM SUPPLY TO COMPRESSOR

Compressor Cycles

Replace Filter
Proceed to Step 5

Compressor Inoperative

Proceed to Step 4

STEP 4 – With engine running, remove vacuum hose from compressor vacuum port, Figure 2, and check for vacuum at end of hose.

Vacuum Present

Compressor Defective. Repair or Replace Compressor as required. See shop manual for disassembly procedure.

No Vacuum Present

1. Check for Kinked or Pinched Vacuum Hose
2. Check Where Vacuum is Being taken from →

1701

FIG. 3D-23 AUTOMATIC LEVEL CONTROL DIAGNOSIS

Make necessary corrections and recheck compressor operation

Compressor Inoperative

Compressor Defective, Repair or Replace Compressor as Required

Compressor Cycles

Proceed to Step 5

STEP 5 – A. Disconnect high pressure line at compressor regulator and attach gauge (J-22124) to compressor regulator fitting. Refer to Figure 3.

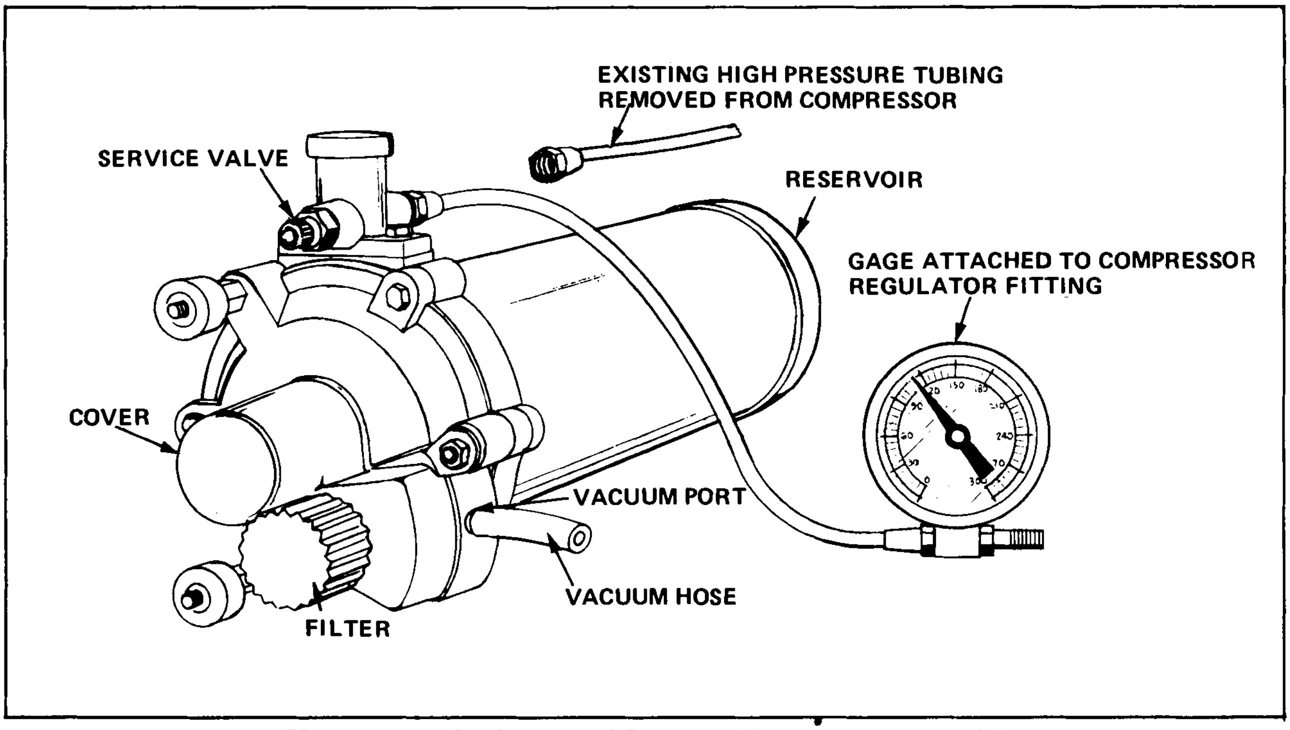


FIGURE 3–ATTACHING GAGE TO COMPRESSOR HIGH PRESSURE FITTING

B. Perform compressor output test.

1. Fill compressor reservoir to 70 PSI through service fill valve. Refer to Figure 3. Observe test gauge for evidence of air leak.
2. With engine running at idle, allow pressure to build up for 5 minutes. Reservoir pressure should reach 90 psi.

Compressor Cycles But Pressure Build up is Slow or not at all

If pressure build up is slow, recheck that vacuum hose, filter or air inlet hose have no restriction. If vacuum hose, filter or air inlet hose show no restriction, remove compressor from vehicle and repair or replace it as required.

Pressure Builds up Satisfactorily to 90 P.S.I.

Proceed to C

1702

FIG. 3D-24 AUTOMATIC LEVEL CONTROL DIAGNOSIS

C. Perform regulator test.

1. Allow engine to continue to run at idle speed. Pressure should level off between 115-130 P.S.I. when checked on regulated side of regulator. Refer to Figure 3.

Pressure levels off in specified range — Proceed to Step 6

Pressure does not level off in specified range — Replace regulator.

STEP 6 – Check system operation independent of compressor as follows:

A. Connect test gauge (J-22124) to high pressure line that attaches to compressor regulator. Figure 4.

B. Record rear trim height of unloaded vehicle at curb weight. (Basic car with full tank of gas).

C. Add approximately 250-300# to passenger car trunk. (Two people or equivalent weight. 3 people for station wagon.)

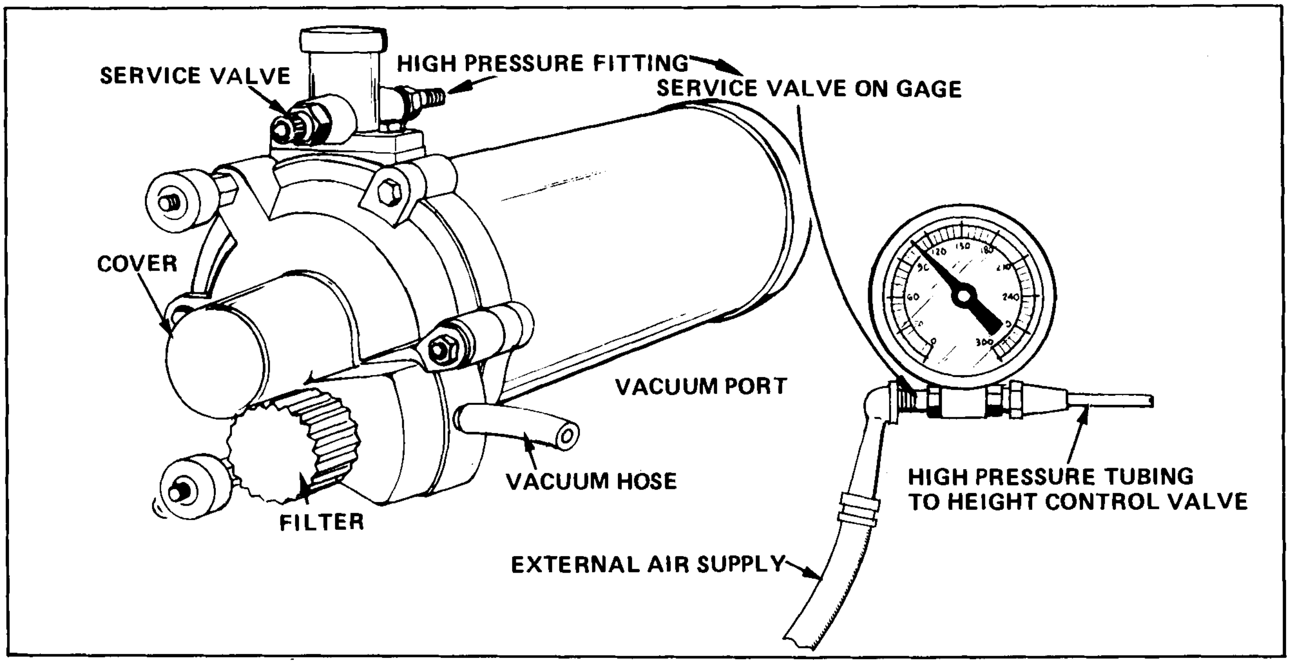


FIGURE 4–CHECKING SYSTEM OPERATION WITHOUT COMPRESSOR

D. With external compressed air supply, charge system to a maximum of 125 psi (if available) thru the gage fill valve. If vehicle returns to unloaded trim height, ±½" measured in Step B, also observe if pressure holds steady.

Vehicle raises to original or unloaded trim height. Pressure holds steady. — System okay, reconnect high pressure line to compressor and charge compressor to maximum available pressure thru fill valve on regulator

Vehicle raises but pressure drops off and car starts to lower immediately — Proceed to Step 7

Vehicle does not raise. Pressure holds steady. — Proceed to step 12

1703

FIG. 3D-25 AUTOMATIC LEVEL CONTROL DIAGNOSIS

STEP 7 – Check for leaks in high pressure line between compressor regulator and height control valve.

A. Remove gauge from high pressure line at compressor end and install plug J-21999 shown in Figure 5. Position it so it will be accessible when vehicle is lifted on hoist.
NOTE: Be sure valve in J-21999 does not leak.

B. Raise vehicle on hoist, disconnect high pressure line from height control valve and install gauge J-22124 to high pressure line. Refer to Figure 7 for location of height control valve high pressure fitting.

C. Using external air supply, charge high pressure line to 100 psi thru the gauge fitting and observe if pressure holds steady or drops off.

Pressure holds steady

Reconnect high pressure line to height control valve and proceed to step 8.

Pressure drops off

Replace or repair line as required.
Note: Check that inserts on plastic line fittings are properly installed.

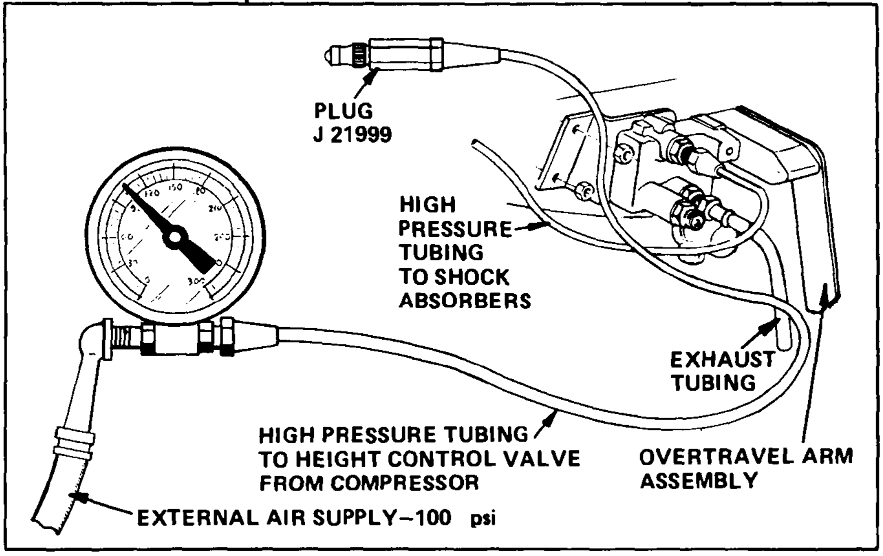


FIGURE 5–CHECKING FOR LEAKS

Recheck system per step 6.

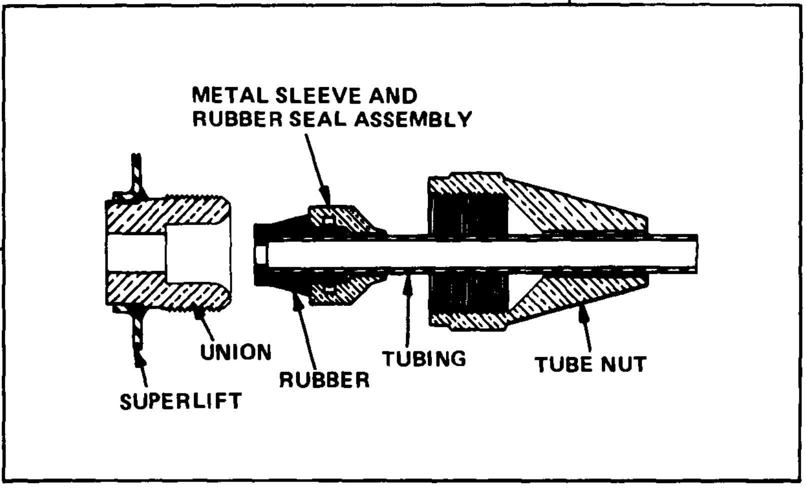


FIGURE 6–CHECKING FITTINGS

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FIG. 3D-26 AUTOMATIC LEVEL CONTROL DIAGNOSIS

STEP 8 – Inspect tubing and fittings from height control valve to shocks as follows:

A. Check for loose or improperly assembled fittings at shocks and/or height control valve. Figure 6.

B. Check for possible contact of plastic tubing with exhaust system.

Tubing and fittings okay	Tubing damaged by exhaust system and/or kinked	Fittings loose and/or improperly assembled
Proceed to Step 9	Replace tubing as required and repeat Step 6	Tighten and/or replace fittings as required and repeat Step 6. (Refer to Figure 6 for correct assembly of fittings)

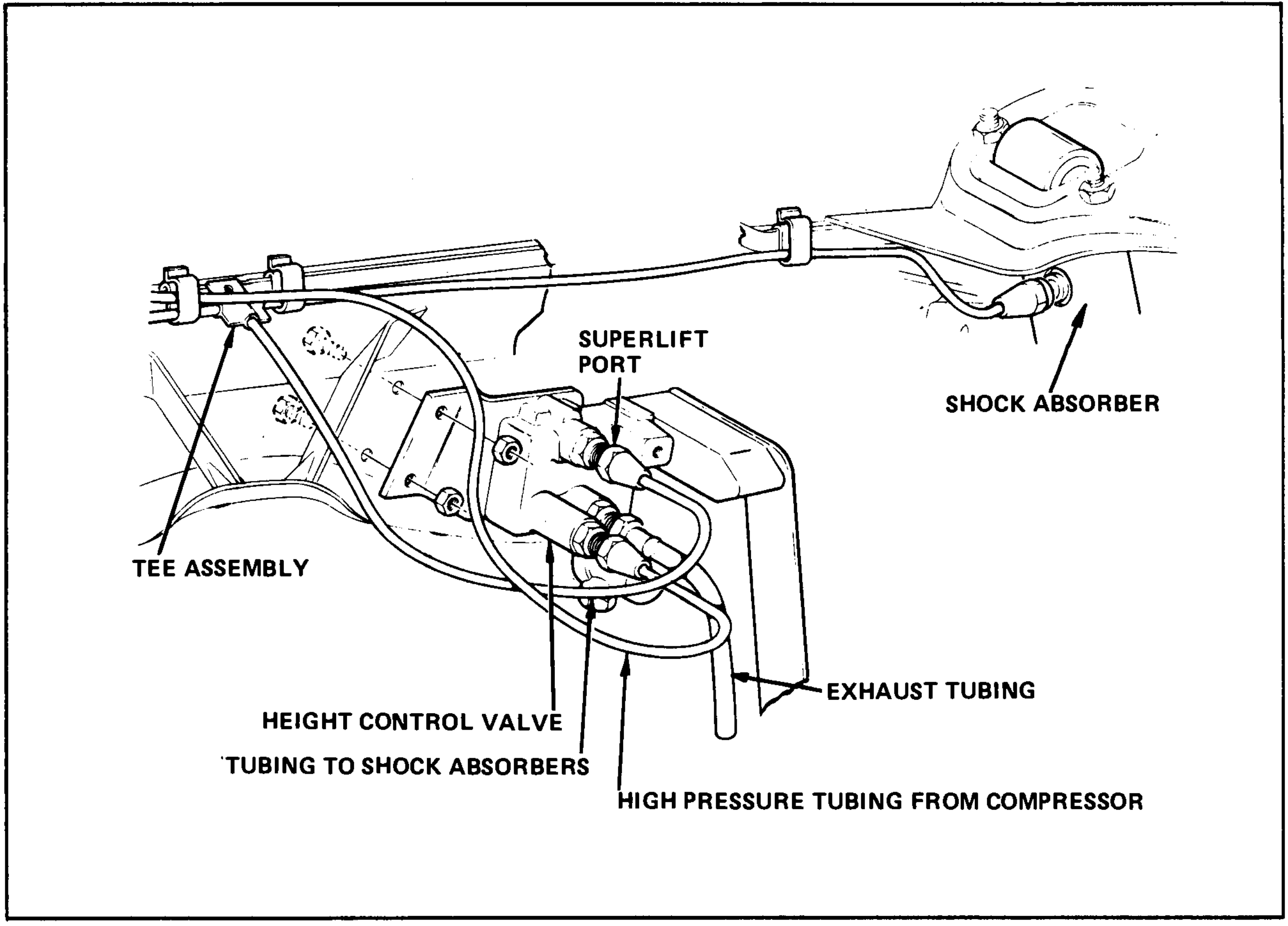


FIGURE 7–INSPECTING HEIGHT CONTROL VALVE

STEP 9 – Inspect each shock visually as follows:
Inspect each shock absorber rubber air sleeve for a rupture condition. NOTE: If rupture appears to be caused by rubbing or interference condition, be sure to correct this condition when installing replacement shock(s).

Shock air sleeves appear okay	Shock air sleeve(s) ruptured
Proceed to Step 10	Replace shock(s) and recheck system per Step 6

1705

FIG. 3D-27 AUTOMATIC LEVEL CONTROL DIAGNOSIS

STEP 10 – **Disconnect shock absorber air supply tubing from height control valve and attach gauge J-22124 to tubing. Using an external air supply, inflate shocks to 100 p.s.i. and observe if pressure holds steady or drops off. Refer to Figure 8. NOTE: Soap suds may be used to help locate leak condition.**

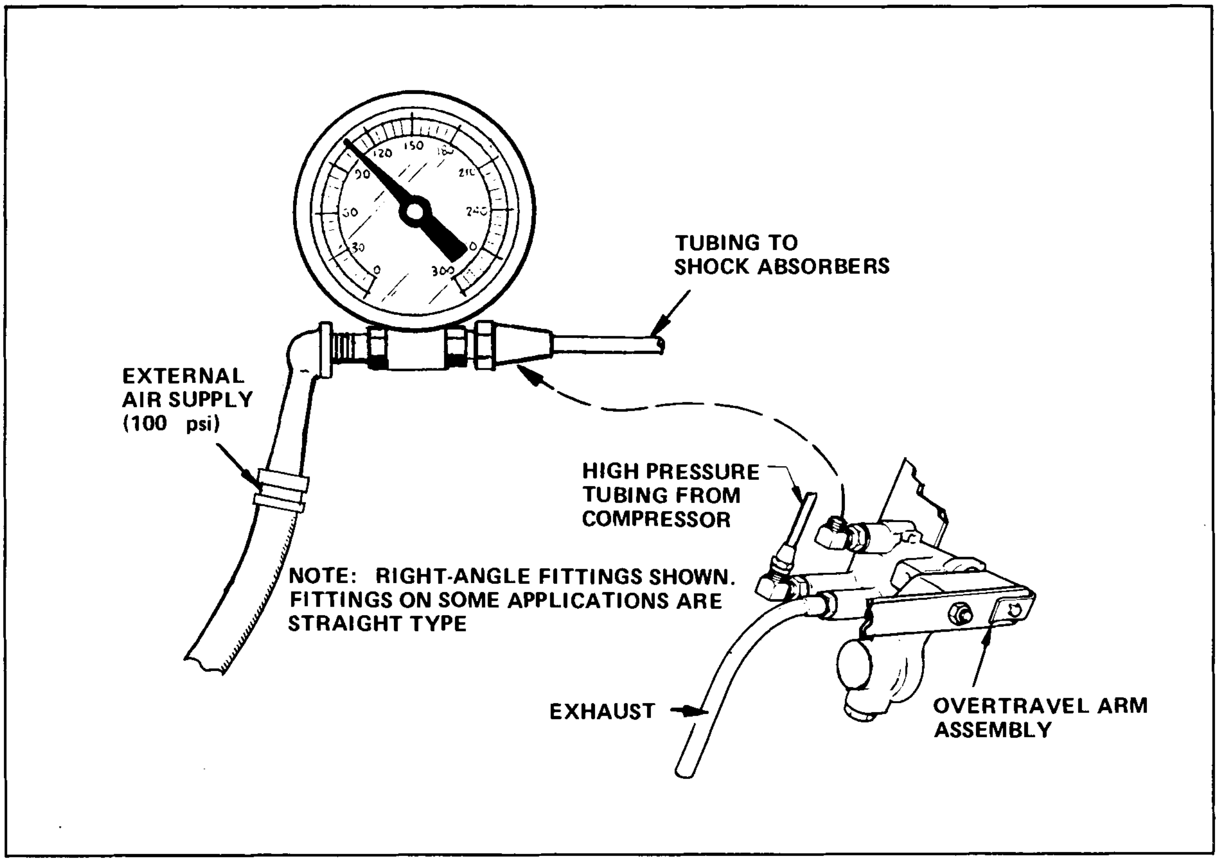


FIGURE 8–CHECKING OUT HEIGHT CONTROL VALVE

Vehicle Raises and pressure holds steady

Proceed to Step 12

Pressure drops off

Proceed to Step 11

STEP 11 – **Check each shock separately for leaks as follows: Connect test gauge J-22124 individually to each shock and inflate shock to 100 psi. Observe if pressure holds steady or drops off.**

Pressure holds steady

Recheck tubing and fittings per Step 8

Pressure drops off

Replace shock(s) as required and recheck system per step 6

IMPORTANT:

If extremely slow leak down condition occurs only during cold weather, one or both shocks may be the cause. To duplicate this type of leak condition requires that the shocks be as cold as the surrounding ambient temperature. By the time an owner drives to the service account or dealer the shocks develop heat and the leak usually disappears. A method to determine which shock or if both are leaking follows:

A. Attach a test gauge to each shock and inflate to 100 p.s.i.

B. Position or attach gauges so that they may be read without the vehicle on a hoist.

C. Move vehicle outside and recheck gauges periodically. NOTE: Pressure will decrease with temperature and gage will show this when vehicle is moved outside.

1706

FIG. 3D-28 AUTOMATIC LEVEL CONTROL DIAGNOSIS

STEP 13 – Check operation of height control valve as follows:

A. Reconnect tubing from height control valve to shocks

B. Disconnect link from height control valve over-travel arm, refer to figure 9 for typical link.

C. Connect test gauge J-22124 to height control valve intake port. Figure 10.

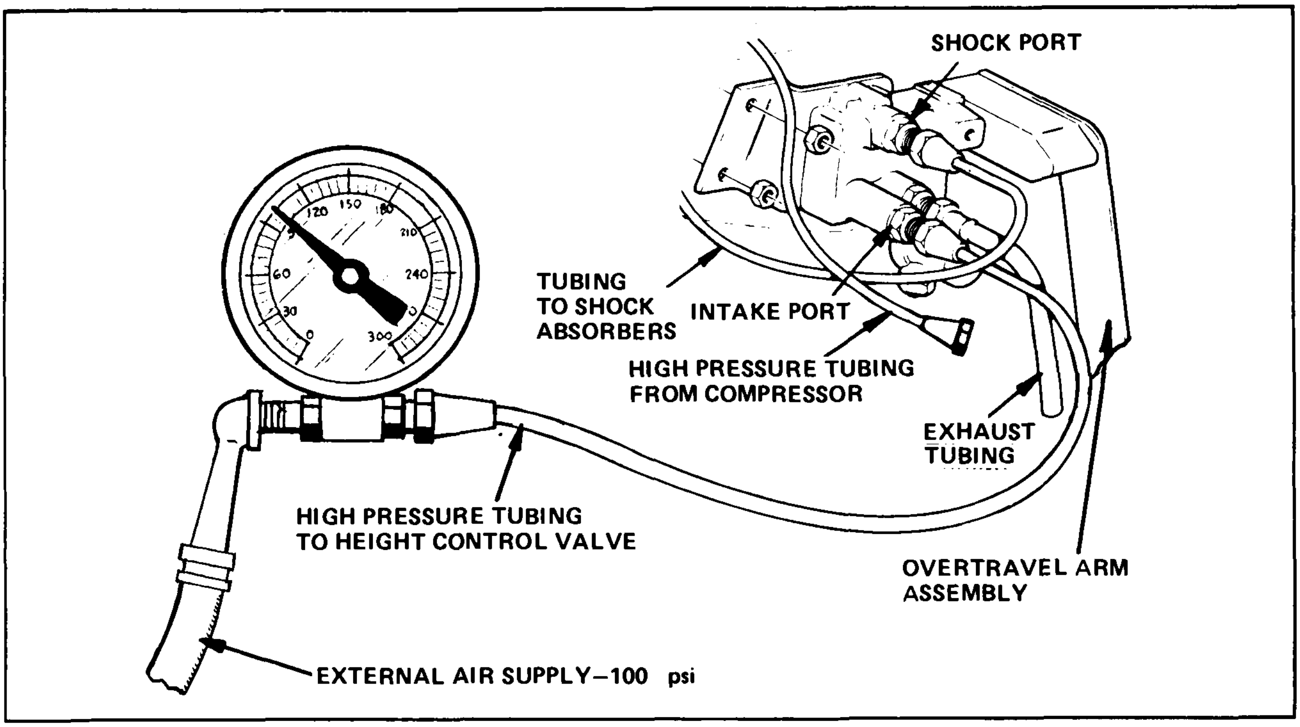
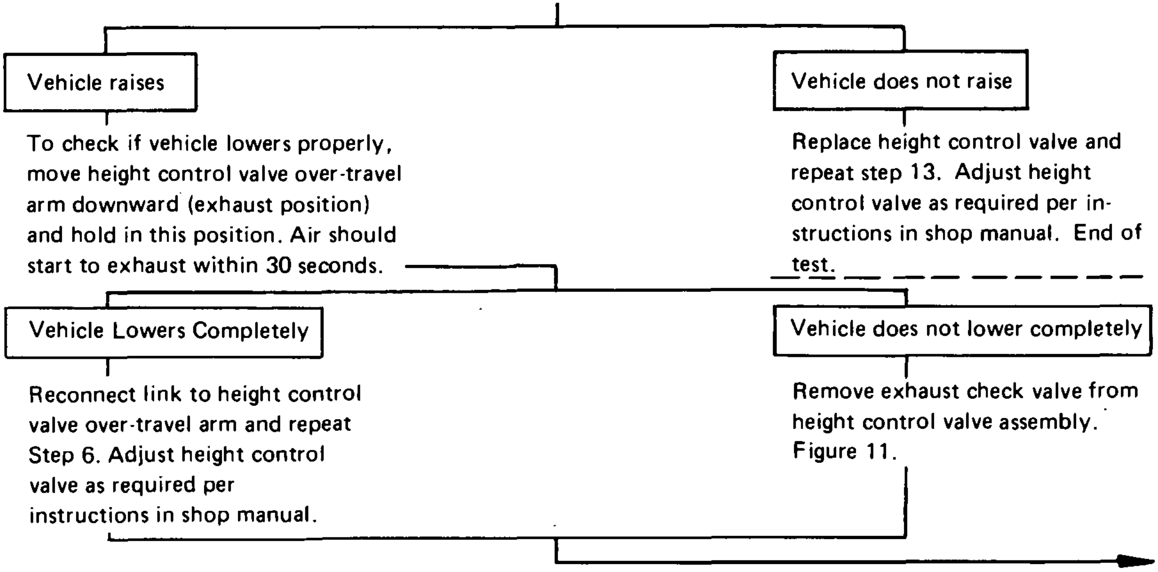


FIGURE 10–CHECKING OPERATION OF HEIGHT CONTROL VALVE

D. Attach 80-110 psi air source to gauge fill valve; move height control valve over-travel arm upward (intake position) and hold in this position for approximately 30 seconds.



Vehicle raises

To check if vehicle lowers properly, move height control valve over-travel arm downward (exhaust position) and hold in this position. Air should start to exhaust within 30 seconds.

Vehicle Lowers Completely

Reconnect link to height control valve over-travel arm and repeat Step 6. Adjust height control valve as required per instructions in shop manual.

Vehicle does not lower completely

Remove exhaust check valve from height control valve assembly. Figure 11.

Vehicle does not raise

Replace height control valve and repeat step 13. Adjust height control valve as required per instructions in shop manual. End of test.

1708

FIG. 3D-29 AUTOMATIC LEVEL CONTROL DIAGNOSIS

STEP 12 – Preliminary check of height control valve and attaching parts. Refer to Figure 9.

A. Check that link which attaches the height control valve over-travel arm to the vehicle's rear suspension component is properly installed in the correct over-travel arm hole. Check that attaching nut is secure.

B. Check that height control valve over-travel arm adjusting nut is tight.

Height control valve and attaching parts appear correct	Link missing, loose or worn,etc.
Proceed to Step 13	Make necessary corrections. Adjust height control valve and repeat Step 6.

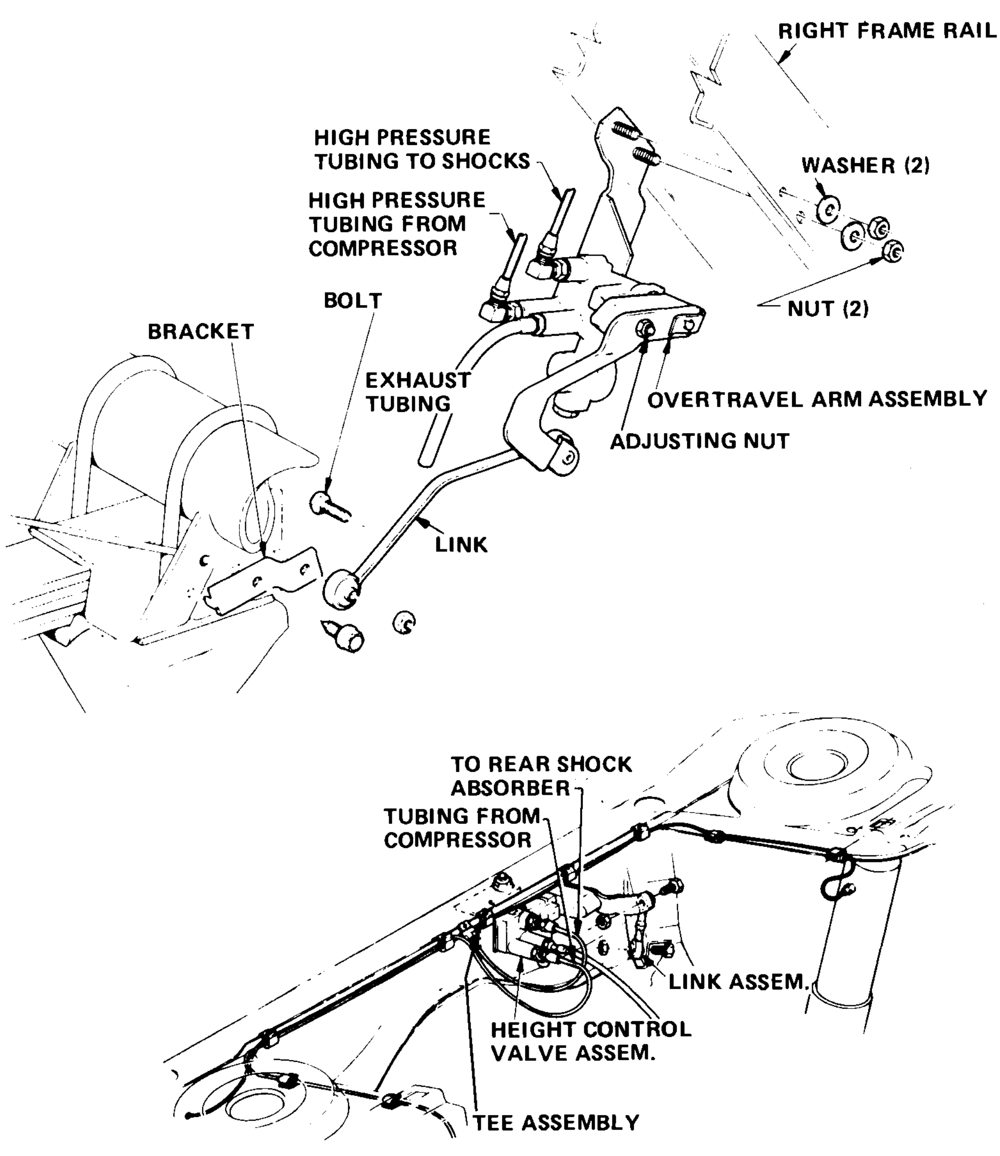


FIGURE 9–CHECKING ATTACHING PARTS TO HEIGHT CONTROL VALVE

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FIG. 3D-30 AUTOMATIC LEVEL CONTROL DIAGNOSIS

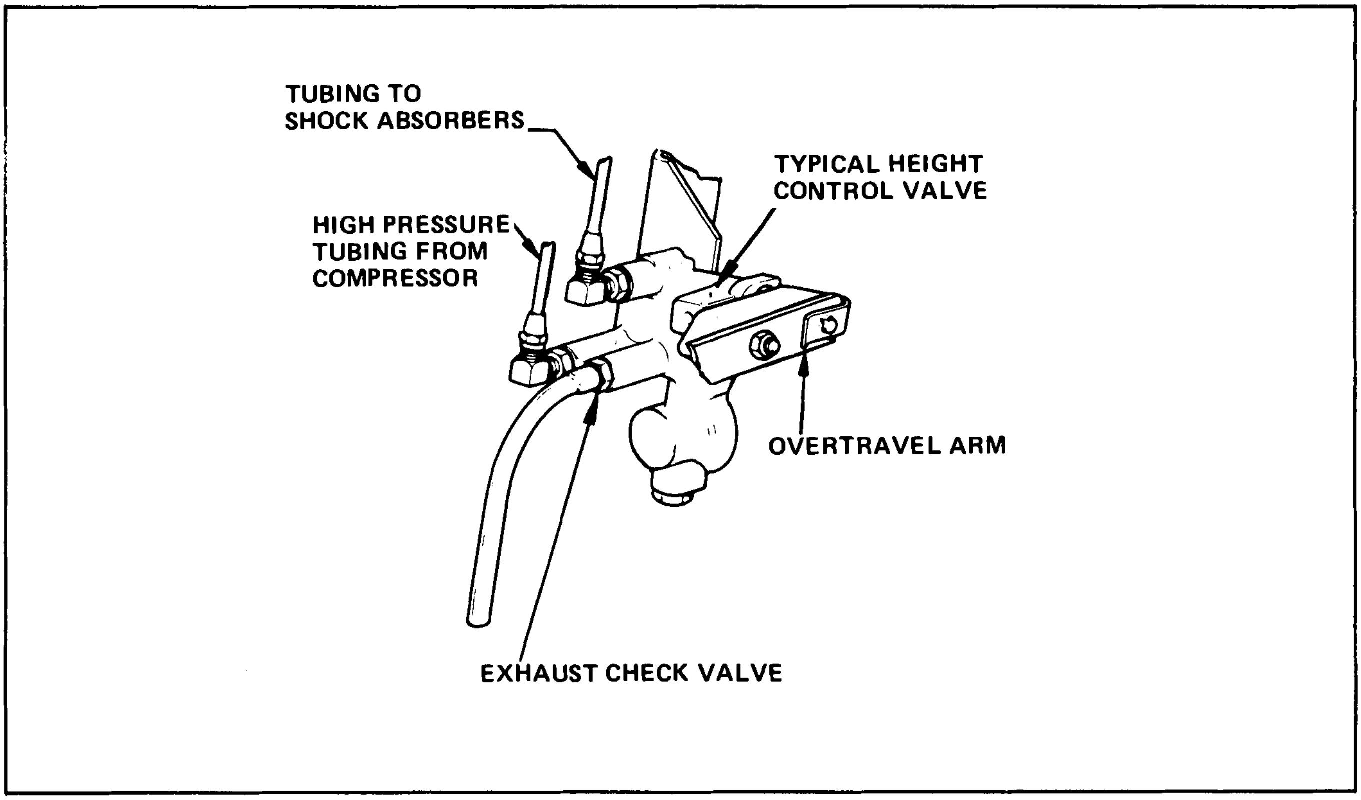

FIGURE 11– LOCATION OF EXHAUST CHECK VALVE

Vehicle Lowers

Replace exhaust check valve in height control valve and Repeat Step 13

Vehicle does not Lower Completely

Replace height control valve and repeat Step 13

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FIG. 3D-31 AUTOMATIC LEVEL CONTROL DIAGNOSIS

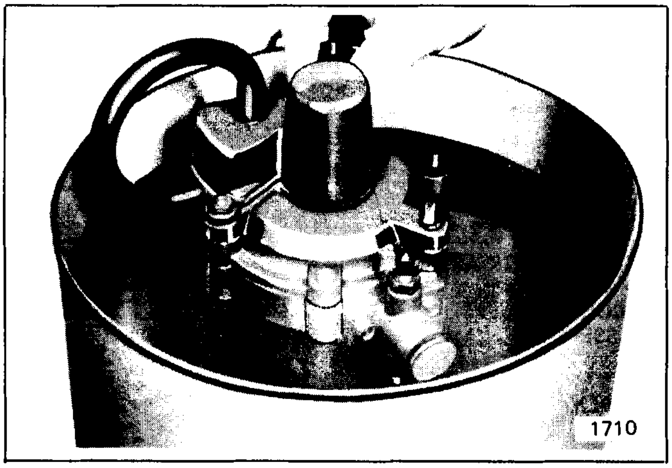


Fig. 3D-32 Checking Compressor, Reservoir and Regulator for Leaks

6. Connect test gage to Superlift port and open air pressure.

7. With overtravel lever in neutral position, no air should escape. If bubbles escape from exhaust port, replace control valve.

8. If air escapes around edge of cover plate, the gasket must be replaced.

9. Remove control valve from water. Actuate overtravel lever to expel any water from unit.

10. Shut off air pressure and remove line from Superlift port.

LINES AND FITTINGS - LEAK TEST

1. Disconnect overtravel lever from link.

2. Hold lever up in intake position for maximum Superlift inflation and release.

3. Leak check all connections with a soap and water solution.

SUPERLIFT - LEAK TEST

See SHOCK ABSORBER DIAGNOSIS in Section 3 of this manual.

GENERAL DESCRIPTION

Automatic Level Control (ALC), available as a factory or dealer installed option on B Series, automatically maintains the rear standing height of the car at a nearly constant position, regardless of load changes. The system consists of an air compressor, reservoir and pressure regulator assembly (Fig. 3D-33), height control valve, link, two Superlift rear shock absorbers and flexible air lines.

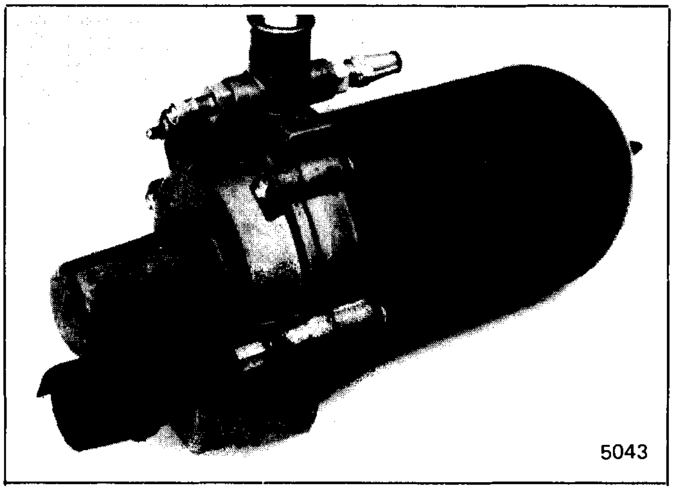


Fig. 3D-33 Compressor Assembly

The automatic level control (ALC) compressor is a two-stage, vacuum activated type and requires no lubrication. The compressor converts manifold vacuum taken from the positive crankcase ventilation hose into air pressure which is retained in the reservoir. As reservoir pressure drops due to ALC system air usage, the compressor begins to recycle and replenish reservoir air pressure. The pressure regulator valve is preset and limits reservoir outlet pressure to approximately 125 psi to avoid damage to the height control valve and/or Superlift shocks.

An air filter located on the compressor should be inspected periodically to see if it has become plugged.

HEIGHT CONTROL VALVE

The height control valve, which is mounted on the frame, senses rear car height through a link attached to the right rear upper control arm. When load is added to the car, the over-travel lever is forced up causing an internal lever to open the intake valve. When this valve is open, high pressure air is admitted to the Superlift shocks. As the car raises to level, the intake valve shuts off.

When load is removed from the car, the over-travel lever is forced down causing the internal arm to open the exhaust valve. As the car lowers to the level position, the exhaust valve shuts off.

A 4-18 second time delay mechanism, which is built into the height control valve, prevents air transfer due to normal ride movements. The over-travel lever, which pivots around the control valve shaft, rides off the flat side of the control valve shaft and does not have time to react to the rapid changes or normal ride motions.

During changes due to loading, the time delay mechanism will allow the over-travel shaft to open either the intake or exhaust valve as required, since this is not a rapid movement.

SUPERLIFT SHOCK ABSORBER

The Superlift shock absorber used with ALC will extend when inflated and retract when deflated by the height control valve. Each unit is connected to the control valve by a common flexible air line. The common line equalizes air pressure in the two Superlifts.

An 8-15 psi air pressure is maintained in the Superlift at all times to minimize boot friction. This is accomplished by a check valve in the exhaust fitting on the control valve. Neither shock absorber function nor conventional ride motions through the rear suspension springs is impaired in the event of accidental air pressure loss.

Shock absorbers do not require lubrication and in case of leaks or malfunction, they should be replaced.

LINES AND FITTINGS.

Flexible air lines are used throughout the system. The line is 1/8" diameter tubing. Each fitting consists of a rubber seal, metal sleeve and nut. These parts are intended specifically for the 1/8" diameter line and must be used to affect a reliable seal.

NOTE: While the lines are flexible for easy routing and handling, care should be taken not to kink them and to keep them from coming in contact with the exhaust system.

ON-CAR SERVICE

Precautions

The precautions outlined below should be heeded to insure satisfactory function of the system:

- MINIMUM PRESSURE For best ride characteristics with an empty car, a minimum pressure of 10 psi should be maintained.
- MAXIMUM PRESSURE - the pressure may be varied to a maximum of 90 psi to level the car with loads.
- LINES AND FITTINGS - The air lines cannot withstand exhaust system temperatures. At least 1 1/2" clearance should be maintained between the air lines and any portion of the exhaust system.
- Flexible air lines are used throughout the system and are 1/8" diameter tubing. Each fitting consists of a rubber seal, metal sleeve and nut (Fig. 3D-21). These parts are intended specifically for the 1/8" diameter line and must be used to affect a reliable seal.
- While the lines are flexible for easy routing and handling, care should be taken not to kink them and to keep them from coming in contact with the exhaust system (Fig. 3D-34).

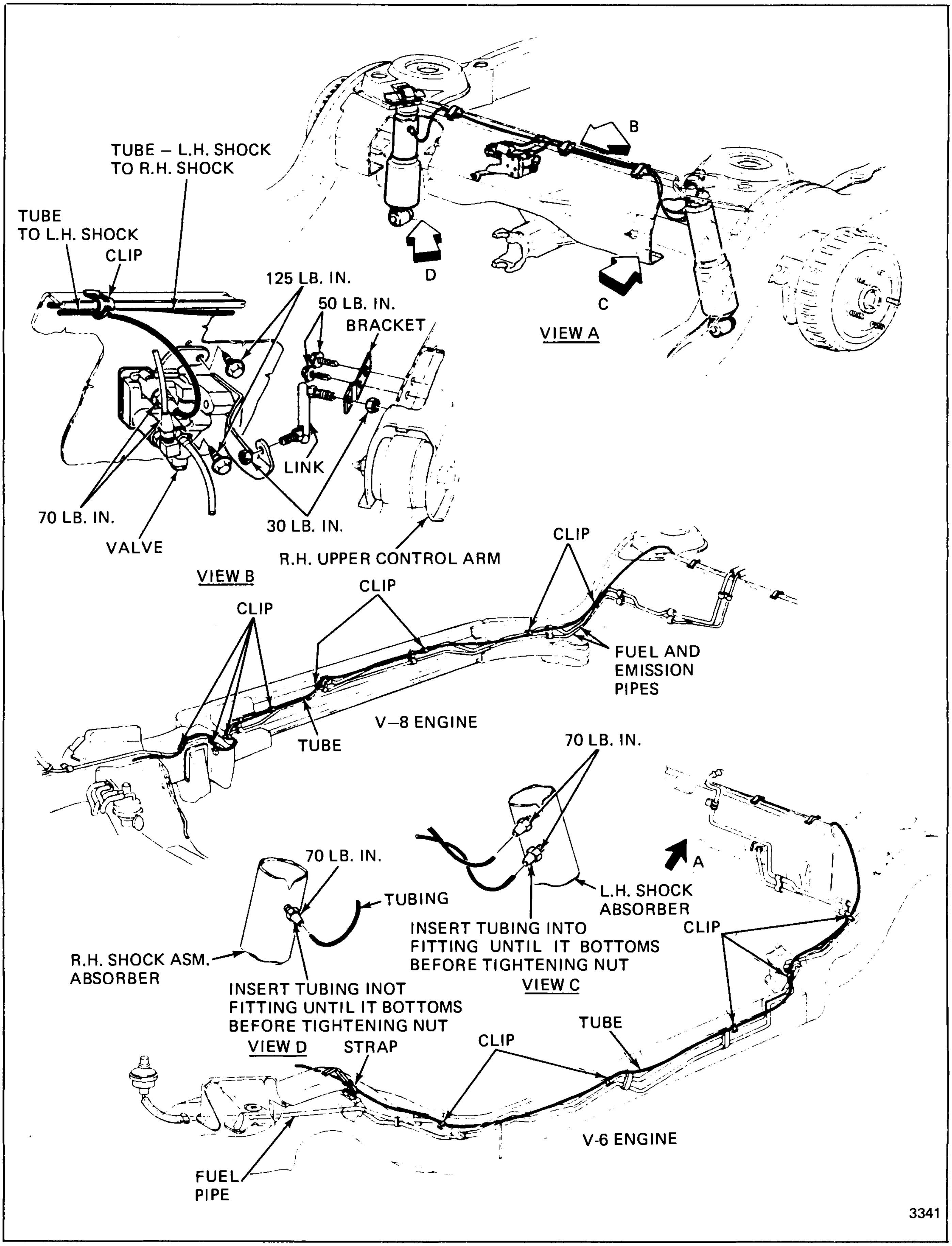


Fig. 3D-34 Automatic Level Control Valve and Shocks

TUBING

Remove

Tubing may be removed by simply unscrewing the nut.

CAUTION: *Be sure system is deflated through service valve before separating air lines. When installing tubing at any fitting be careful not to kink line.*

Install

1. Preassemble metal sleeve and rubber seal.
2. Place nut on tubing.
3. Insert tube into metal sleeve and rubber seal until tube buttoms.
4. Hold tube in bottom position and tighten the tube nut to 70 lb. in. torque.

NOTE: Tubing may be reinstalled at its connections. If tubing is cracked at end, it will be necessary to cut flush and use a new metal sleeve and rubber seal to assemble as described above. Be careful not to remove too much or tubing may be kinked or broken at full suspension travel. Care should be taken that proper routing is followed in areas close to the exhaust system to prevent burning the tubing. Note particularly the areas at rear suspension crossmember.

COMPRESSOR, RESERVOIR AND REGULATOR VALVE ASSEMBLY

Remove

1. Deflate system through service valve (Fig. 3D-35).
2. Disconnect high pressure line at pressure regulator valve. Also disconnect vacuum line at compressor.
3. Remove bracket screws securing assembly to car (Fig. 3D-36) and withdraw assembly.

Install

1. Install assembly in bracket and tighten nuts to 20 lb. in. torque.
2. Install assembly in car and tighten bracket attaching screws to 70 lb. in. torque.
3. Connect high pressure line to regulator valve and tighten fitting nut to 70 lb. in. torque.
4. Install vacuum line to compressor.
5. Inflate system through service valve to maximum available pressure.

NOTE: If available pressure is less than 140 psi, start engine to build up reservoir to this pressure.

Disassemble

The compressor (Fig. 3D-35) is a precision-built mechanism that should be carefully handled and assembled. Care must be taken to prevent entrance of dirt or other foreign matter.

CAUTION: *This unit must not be lubricated as it is designed to operate dry.*

1. Remove compressor as outlined above.
2. Remove two adapters and flexible mounts on compressor end of assembly.
3. Remove nuts from three reservoir retaining (long) bolts. The bolts enter from reservoir flange side of unit.
4. Remove nuts from three compressor retaining (short) bolts. These bolts enter from compressor side of unit.

CAUTION: *DO NOT attempt to turn shor bolts as they have a second nut hidden between reservoir flange and second stage housing. Always remove nuts from bolts while holding bolts stationary.*

5. Spearate compressor assembly and reservoir. Discard reservoir sealing "O" ring.
6. Remove cover retaining screw. Remove cover and discard cover gasket.
7. Remove three compressor retaining (short) bolts that hold first and second stage housings together.
8. Separate first and second stage housings by sliding second stage housing straight off piston.
9. Remove two pressure regulator valve assembly retaining screws.
10. Remove valve assembly from second stage housing and discard "O" ring seal.
11. Disconnect distributor arm tension spring from swivel arm.
12. Remove actuating arm retaining screw and arm.
13. Piston and diaghram assembly can not be removed from first stage housing by carefully sliding the assembly straight out of housing.

PISTON--DIAPHRAGM ASSEMBLY

Disassemble

1. Remove snap ring retainer with snap ring pliers and retain retainer (Fig. 3D-37).
2. Remove diaphragm plate, diaphragm, second diaphragm plate and corprene washer. The diaphragm and washer can be discarded.
3. Remove and discard piston seals and "O" rings from piston.

CAUTION: *Be careful not to damage piston.*

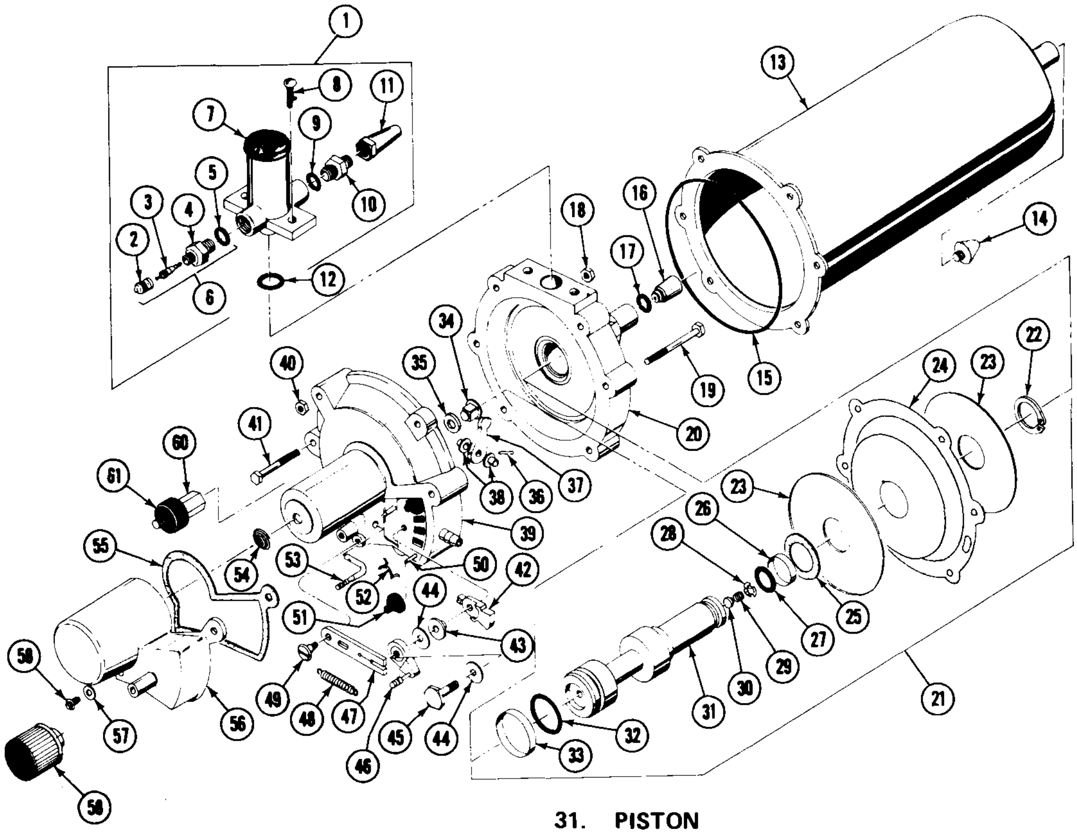
4. Remove check valve in second stage end of piston by inserting a suitable punch or piece of 3/32" welding rod through air passage from first stage and taping.

FIRST STAGE HOUSING AND VALVE MECHANISM

Disassemble

Actuate distributor valve with finger. Valve tension spring should press against distributor valve, holding it against either stop. If valve action is not free and positive, it will be necessary to rebuild using new parts in Distributor Valve and Arm Package. If action is free and positive and upon disassembly there are no damaged parts, parts may be re-used.

1. Remove screw, washer, distributor arm assembly, washer and distributor valve bushing (Fig. 3D-38).



1. REGULATOR ASSEMBLY
2. CAP
3. VALVE CORE
4. ADAPTER
5. O-RING
6. SERVICE VALVE
7. BOOT
8. REGULATOR RETAINING SCREW
9. O-RING
10. ADAPTER
11. TUBE FITTING
12. O-RING
13. RESERVOIR TANK
14. MOUNTING
15. O-RING
16. CHECK VALVE CAPSULE
17. O-RING
18. COMPRESSOR THROUGH BOLT NUT
19. RESERVOIR RETAINING THROUGH BOLT
20. SECOND STAGE HOUSING
21. PISTON ASSEMBLY
22. SNAP RING
23. DIAPHRAGM PLATE
24. DIAPHRAGM
25. WASHER
26. SEAL
27. O-RING
28. EXPANSION PLUG RETAINER
29. SPRING
30. CHECK VALVE
31. PISTON
32. O-RING
33. SEAL
34. INTAKE VALVE
35. WASHER
36. ROCKER ARM RETAINING PIN
37. ROCKER ARM
38. BUSHING
39. FIRST STAGE HOUSING
40. RESERVOIR THROUGH BOLT NUT
41. COMPRESSOR RETAINING THROUGH BOLT
42. DISTRIBUTOR VALVE
43. VALVE BUSHING
44. WASHER
45. SCREW
46. DISTRIBUTOR ARM ASSEMBLY
47. ACTUATING ARM
48. ARM TENSION SPRING
49. ARM PIVOT SCREW
50. BUSHING RETAINING PIN
51. DISTRIBUTOR VALVE STOP BUSHING
52. VALVE TENSION SPRING
53. SWIVEL ARM
54. INTAKE VALVE RETAINING SPRING
55. GASKET
56. COVER
57. COVER GASKET
58. COVER RETAINING SCREW
59. FILTER
60. ADAPTER
61. MOUNTING

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Fig. 3D-35 Exploded View of Compressor

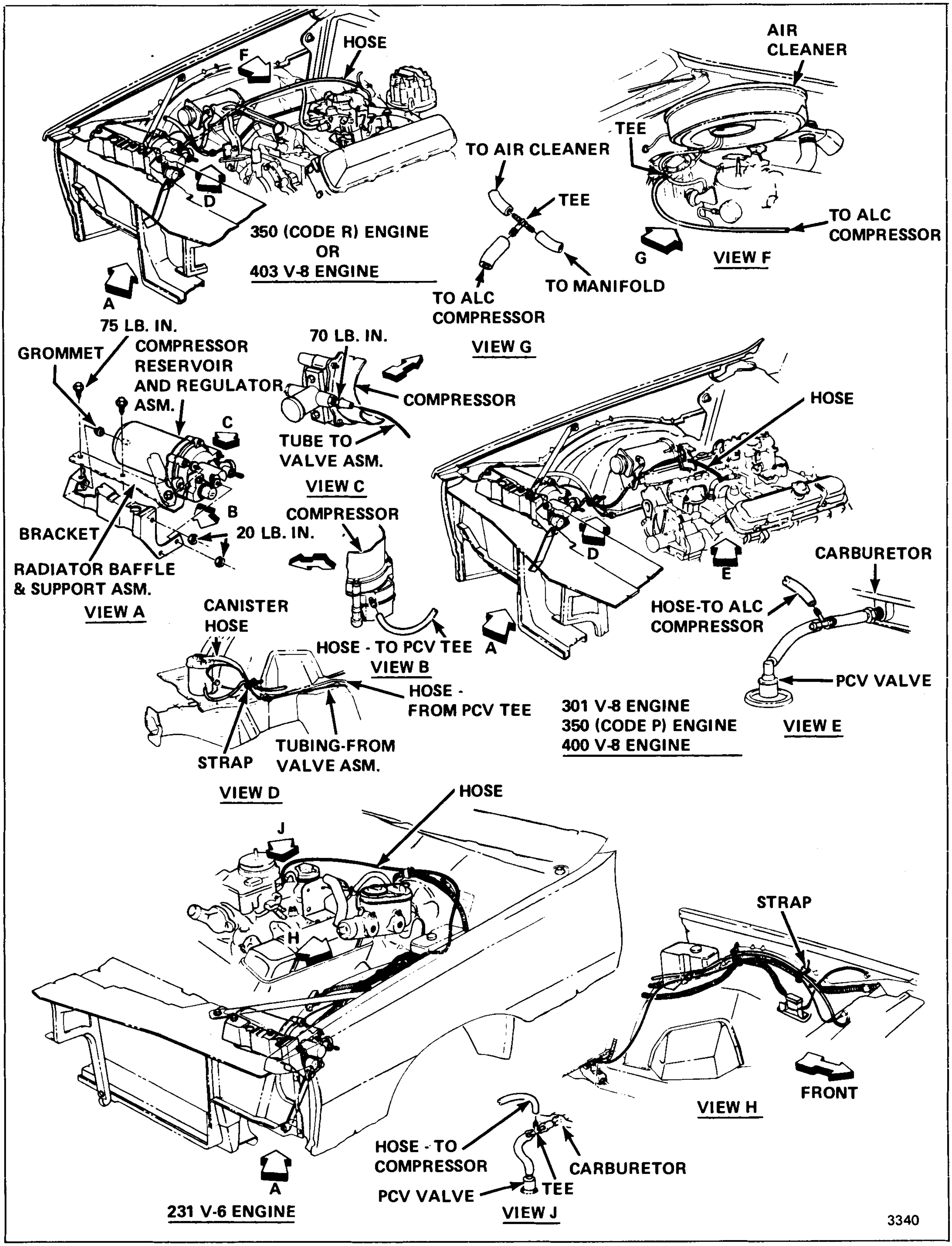
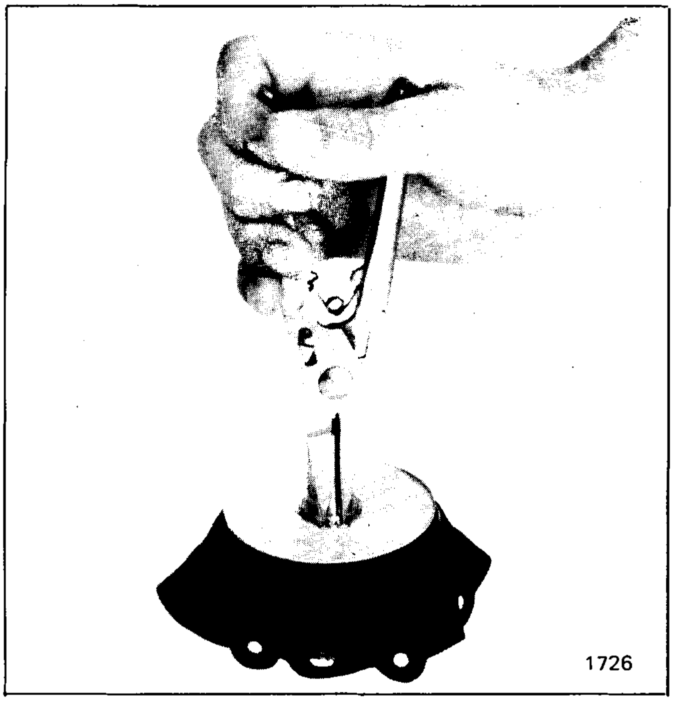


Fig. 3D-36 Automatic Level Control Compressor Installation



Dig. 3D-37 Removing Diaphragm Retainer

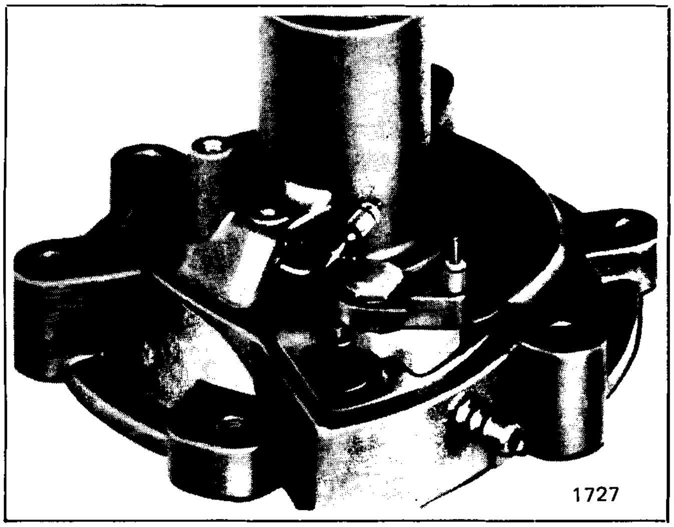


Fig. 3D-38 Distributor Valve Assembly

2. Remove two arm assembly stop bushings and two distributor valve stop bushings.

3. Remove distributor valve, being careful not to distort valve tension spring.

4. Carefully remove valve tension spring from boss. Do not distort spring.

> **NOTE:** Tension spring has one short foot and one long foot. The short foot fits under the distributor valve and the long foot fits into a hole drilled at an angle in the boss (See Fig. 3D-39).

5. Remove intake check valve retaining spring, intake check valve and washer, using a pocket.

6. If necessary, remove rocker and swivel arms. Grip pin with pliers and remove pin (Fig. 3D-40).

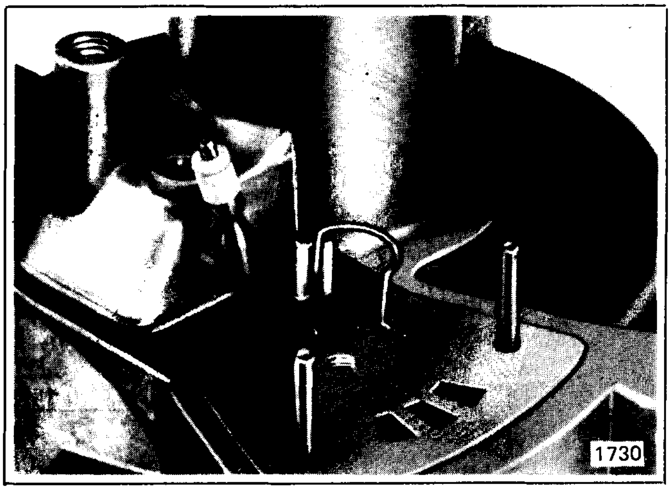


Fig. 3D-39 Installing Valve Tension Spring in Boss

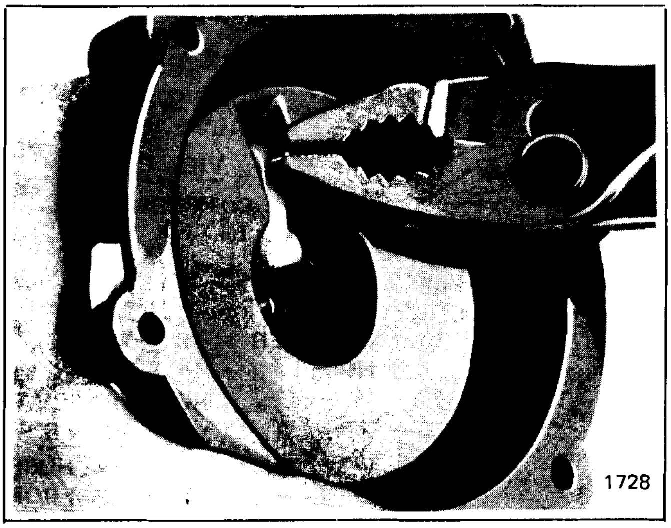


Fig. 3D-40 Removing Rocker Arm Pin

SECOND STAGE HOUSING

Disassemble

Remove check valve from second stage housing as follows:

1. Support housing casting in a vise.
2. Carefully drive check valve assembly out of casting using a short piece of 5/16" drill rod (Fig. 3D-41).
3. Remove and discard the "O" ring.

CLEAN AND INSPECT PARTS

All metal parts should be cleaned in clean solvent and blown dry with compressed air.

PISTON AND DIAPHRAGM ASSEMBLY

1. Inspect piston for scoring. Replace if necessary.
2. Inspect check valve seat. Seat should be smooth and clean.
3. Inspect diaphragm for holes, looseness or other defects. Replace if necessary.

FIRST STAGE HOUSING AND VALVE MECHANISM

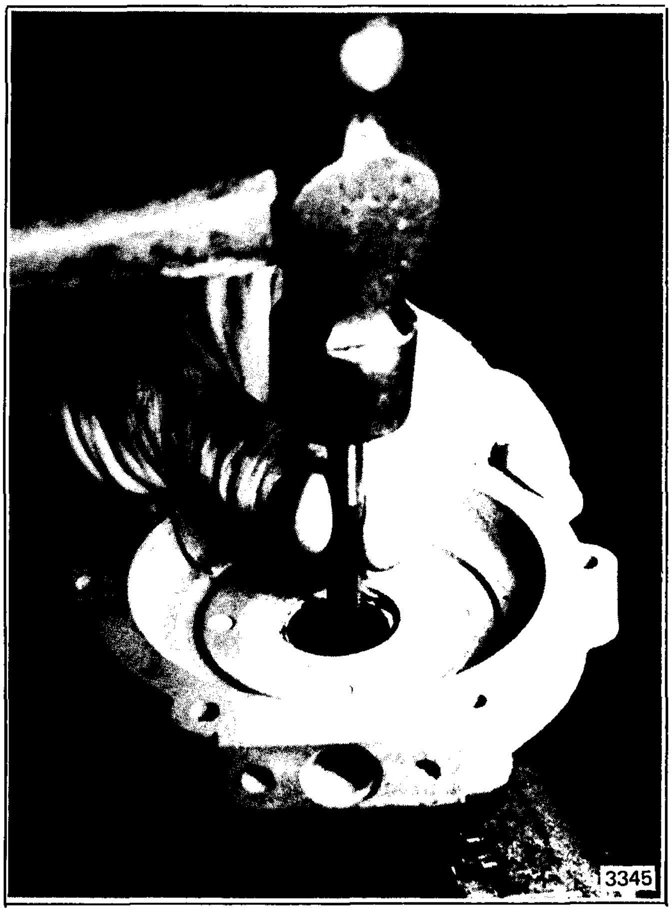


Fig. 3D-41 Removing Check Valve

1. Inspect housing for cracks or damage and replace if necessary.

2. Inspect piston bore. Replace housing if scored.

3. Inspect check valve seat. Seat should be smooth and clean.

4. Inspect distributor valve parts for wear and replace if necessary.

5. Inspect distributor valve seat on housing for wear. Replace housing if necessary.

SECOND STAGE HOUSING

1. Inspect piston bore; replace housing if scored.

2. Inspect housing for cracks or damage and replace if necessary.

SECOND STAGE HOUSING

Assemble

1. Install new "O" ring in a casting cavity.

2. Smear a light coating of "O" ring lube on the second "step" of the check valve capsule and carefully start it into the casting cavity.

3. Use a arbor press or drill press to apply a slight pressure of the check valve capsule against the "O" ring so that the top surface of the capsule is slightly below the top edge of the casting cavity (Fig. 3D-42).

4. With capsule positioned as shown in Fig. 3D-42, stake capsule into position. Stake capsule in four places 90° apart using the side of a screwdriver blade and a hammer to place stake marks on casting.

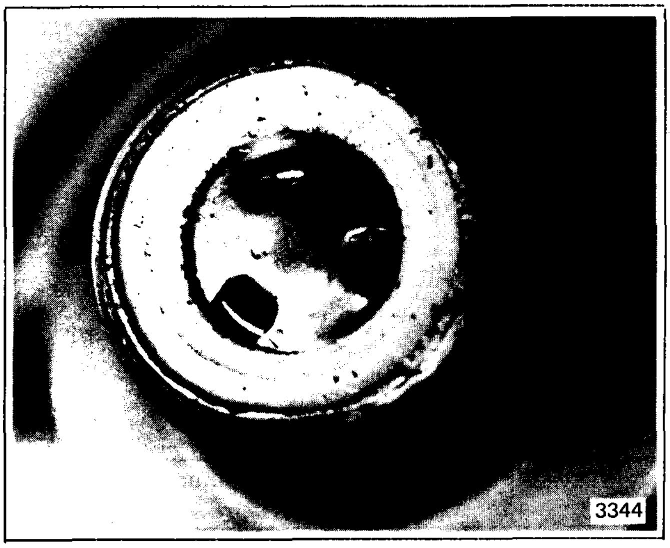


Fig. 3D-42 Positioning Check Valve

FIRST STAGE HOUSING AND VALVE MECHANISM

Assembly

1. If removed, position bushings in first stage housing and install rocker arm and swivel arm. Align holes in rocker and swivel arms and install retaining pin, small end first.

CAUTION: *If distributor mechanism failed to operate properly or one or more parts were found defective, use new parts in Distributor Valve and Arm Package during remaining reassembly.*

2. Install washer on intake valve and install in first stage housing with intake valve retaining spring.

3. Install longer foot of valve tension spring in boss on first stage housing, being careful not to distort spring (Fig. 3D-39).

4. Position distributor valve so that short foot of tension spring fits under valve and vertical leg is in slot (Fig. 3D-43).

5. Install distributor valve bushing, washer, distributor arm assembly, washer and secure with screw (Fig. 3D-44). Tighten screw to 12 lb. in. torque.

6. Install two distributor valve stop bushings and two arm assembly stop bushings.

NOTE: Do not install actuating arm, arm tension spring or arm pivot screw at this time as rocker arm must be free to permit entrance of piston into first stage housing.

PISTON--DIAPHRAGM ASSEMBLY

Assemble

1. Install new corprene washer, old plate (unless damaged), new diaphragm (with outer lip toward second stage end of piston) and second plate.

2. Using a 13/16" deep socket as a retainer installer, press against the piston shoulder on the first stage housing side with wood blocks to seat retainer. The wood blocks used in the illustration are each 3/4" x 3/4" x 12" (Fig. 3D-45).

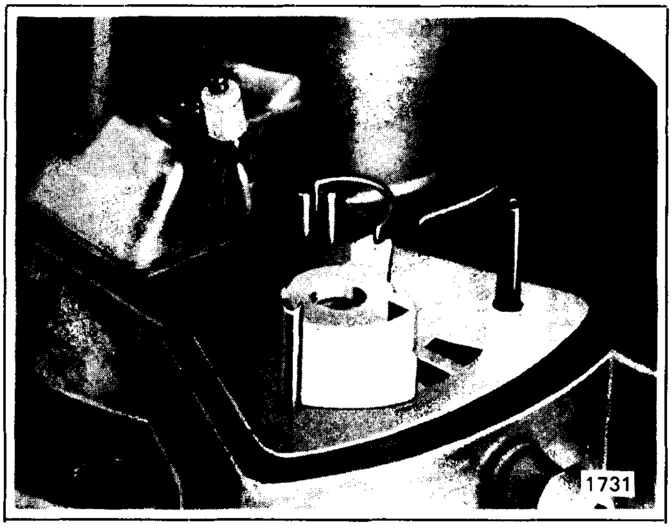


Fig. 3D-43 Positioning Distributor Valve

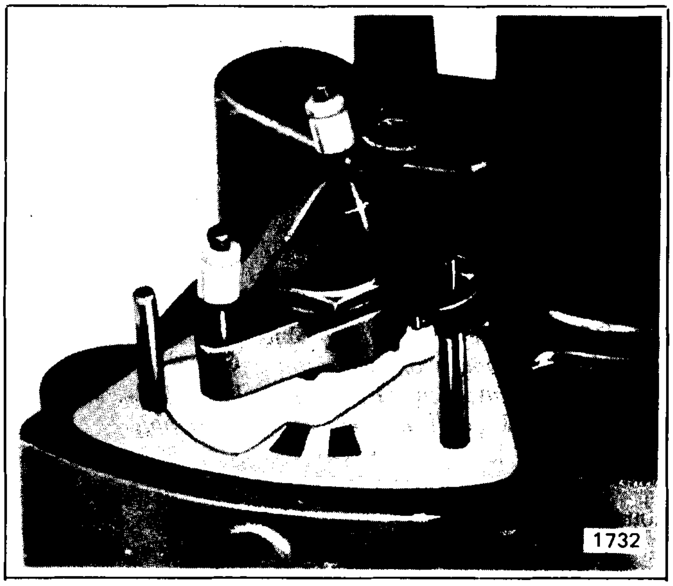


Fig. 3D-44 Installing Distributor Arm

CAUTION: *Be sure retainer is securely seated in order to affect an air tight seal against the corprene seal.*

3. Install new "O" rings by rolling into groove. Relieve any resulting twist.

4. Install new seals, using a piece of .020" shim stock (Fig. 3D-46).

CAUTION: *Make sure shim stock has no sharp edges that may cut seat. Do not stretch seal more than is necessary to install. Seals must be installed so they are not twisted.*

MAJOR COMPONENTS

Assemble

1. Slide piston assembly straight into first stage (large diameter) housing.

2. Install actuating arm and secure to first stage housing with arm pivot screw. Tighten to 12 lb. in. torque.

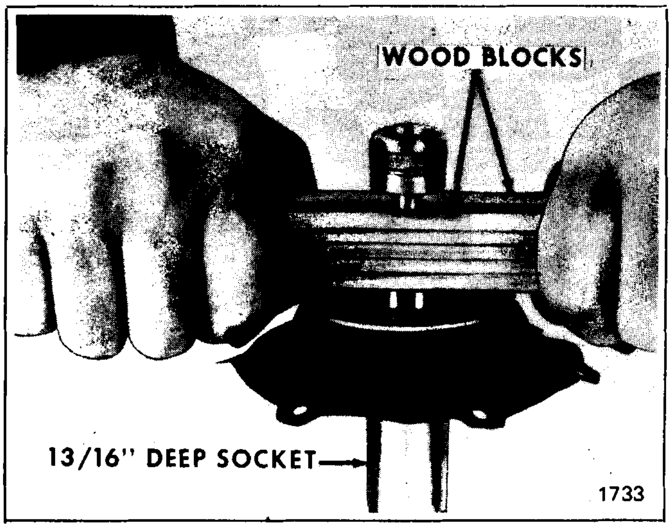


Fig. 3D-45 Installing Diaphragm Retainer

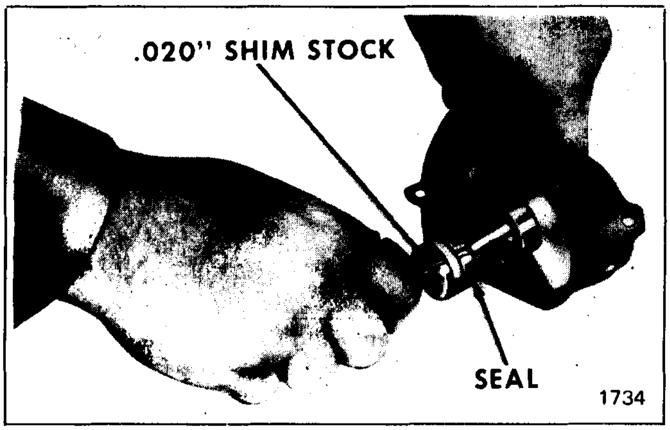


Fig. 3D-46 Installing Piston Seal

3. Connect arm tension spring to swivel arm.

4. Rotate piston in first stage housing to align elongated hole in diaphragm with vent port in housing.

5. Install second stage housing by sliding straight onto second stage piston.

6. Install three compressor retaining (short) bolts from the first stage housing side, through the second stage housing hex shaped, recessed holes. The first and second stage housings will align one way only. Position three small nuts in hex recesses and tighten bolts to 28 lb. in. torque.

7. Install new "O" ring on second stage housing. Install reservoir on second stage housing with three large nuts. Tighten to 28 lb. in. Install the two reservoir retaining (long) bolts, from reservoir side, that do not go through cover. Tighten to 28 lb. in. torque.

8. Install new gasket and cover and secure with retaining screw. Tighten screw to 35 lb. in. Install third reservoir retaining (long) bolt. Tighten to 28 lb. in.

9. Install new "O" ring on pressure regulator and secure with two retaining screws with high pressure fitting toward reservoir. Tighten to 35 lb. In. torque.

10. Install two adapters and flexible mounts on the two reservoir (long) bolts that do not go through cover. Tighten to 28 lb. in. torque.

11. Compressor should be output tested before installation on car (see COMPRESSOR OUTPUT TEST ON CAR).

12. If compressor passes output test, install Compressor, Reservoir and Regulator Valve Assembly on car.

TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise specified.

COIL SPRING SUSPENSION (A, B AND G SERIES)

Bolt, Upper Control Arm Pivot (at Frame)	
B Series	125
A and G Series	90
Nut, Upper Control Arm Pivot Bolt (at Frame)	
B Series	95
A and G Series	80
Bolt, Upper Control Arm Pivot (at Axle)	85
Nut, Upper Control Arm Pivot Bolt (at Axle)	75
Bolt, Lower Control Arm Pivot (at Frame)	90
Nut, Lower Control Arm Pivot Bolt (at Frame)	
B Series	95
A and G Series	80
Bolt, Lower Control Arm Pivot (at Axle)	
B Series	125
A and G Series	85
Nut, Lower Control Arm Pivot Bolt (at Axle)	
B Series	95
A and G Series	75
Nut, Shock Absorber to Upper Mount	140 lb. in.
Bolt, Shock Absorber to Upper Mount	20
Nut, Shock Absorber to Lower Mount	65
Nut, Pinion Nose Bumper	15
Screw, Stabilizer Shaft Mounting Bracket to Lower Control Arm	22
Bolt, Stabilizer Shaft to Mounting Bracket	55
Nut, Upper Spring Seat Pilot Mounting Bolt	
A Series (Police)	55

LEAF SPRING SUSPENSION (F AND X SERIES)

Nut, Anchor Plate to Axle	45
Bolt, Spring Front Eye Bracket to Body	30
Nut, Spring Front Eye Pivot Bolt	75
Nut, Spring Rear Shackle Pin	50
Screws, Shock Absorber to Upper Mount	
F Series	20
X Series	18
Nut, Shock Absorber to Lower Mount	
F Series	90 lb. in.
X Series	45
Screw, Pinion Nose Bumper Mounting	100 lb. in.
Nut, Axle Bumper (RH or LH) to Bracket	18
Screw, Axle Bumper Bracket (RH or LH) Mounting	24
Nut, Support (Strut) to Stabilizer Shaft	20
Nut, Support (Strut) to Side Rail Pivot Bracket	30
Screw, Support (Strut) Pivot Bracket to Side Rail	
F Series	24
Nut, Spring Center Locating Bolt	30

TORQUE ARM SUSPENSION (H SERIES)

Bolt, Lower Control Arm Pivot	80
Screw, Shock Absorber to Upper Mount	18
Nut, Shock Absorber to Lower Mount	45
Nut, Track Rod Pivot Bolt	85
Screw, Track Rod Body Bracket Mounting	25
Nut, Track Rod Body Bracket Brace Mounting	25
Nut or Bolt, Torque Arm to Axle Mounting	115
Nut, Torque Arm Front Mounting Bolt (Except 151 Engine	50
Nut, Torque Arm Front Mounting Bracket to Transmission Case (Except 151 Engine)	30
Screw, Torque Arm Front Insulator to Support (151 Engine)	25 lb. in.
Nut or Bolt, Torque Arm Outer Insulator Support Attaching	
Automatic Transmission	20
Manual Transmission	30
Bolt, Torque Arm Inner Insulator Support Attaching	
Automatic Transmission	35
4-Speed Manual Transmission	30
Nut, Axle Bumper Retaining	26
Nut, Stabilizer Shaft to Lower Control Arm	55

SUPERLIFT SHOCK ABSORBER (A, B AND G SERIES)

Nut, Fill Valve Retaining	50 lb. in.
Nut, Air Line Fitting	70 lb. in.

AUTOMATIC LEVEL CONTROL (B SERIES)

Nut, Air Line Fitting	70 lb. in.
Screw, Height Control Valve Mounting	125 lb. in.
Screw, Compressor Bracket to Radiator Support	75 lb. in.
Nut, Upper and Lower Link	30 lb. in.
Nut, Compressor Mounting Stud to Compressor Bracket	20 lb. in.
Screw, Link Bracket to Upper Control Arm	50 lb. in.

SECTION 3E

WHEELS AND TIRES

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The factory installed tires and wheels are designed to operate satisfactorily with loads up to and including the full rated load capacity when inflated to the recommended inflation pressures.

Correct tire pressures and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessary sharp braking increase tire wear.

REPLACEMENT TIRES

When replacing tires, only the size, load range, and contstruction type (bias, bias-belted or radial) originally installed on the car are recommended. Use of any other tire size or type tire may seriously affect ride, handling, speedometer/odometer calibration, car ground clearance and tire clearance to the body and chassis. The following also should be considered when replacing tires:

WARNING: DO NOT MIX DIFFERENT TYPES OF TIRES ON THE SAME CAR SUCH AS RADIAL, BIAS, AND BIAS-BELTED TIRES EXCEPT IN EMERGENCIES, BECAUSE CAR HANDLING MAY BE SERIOUSLY AFFECTED AND MAY RESULT IN LOSS OF CONTROL.

1. It is recommended that new tires be installed in pairs on the same axle.

2. If necessary to replace only one tire, it should be paired with the tire having the most tread, to equalize braking traction.

3. A TPC Spec. No. (Tire Performance Criteria Specification Number) is molded into the sidewall of most original equipment radial tires next to the tire size designation. Replacement tires with the same TPC number will meet G.M. size and performance specifications for each specific model.

REPLACEMENT WHEELS

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, leak air through welds, have elongated bolt holes, if lug nuts won't stay tight, or if they are heavily rusted. Wheels with greater runout than shown in Figure 3E-1 may cause objectional vibrations.

Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset, and mounting configuration. A wheel of improper size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, car ground clearance, and tire clearance to the body and chassis.

A cast aluminum wheel is available in a 15" size for A, F and G Series and B Series Sedans with 4 3/4" bolt circle (7/16" wheel stud) and in a 13" size for H Series. The cast aluminum wheel (Fig. 3E-2) requires specific balance weights, wheel nut torque and alignment equipment (such as a Bear Alignment Adaptor) or equivalent.

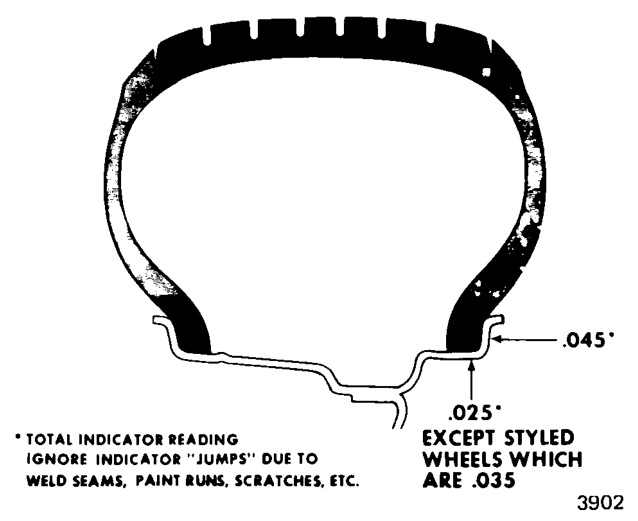


Fig. 3E-1 Measuring Runout

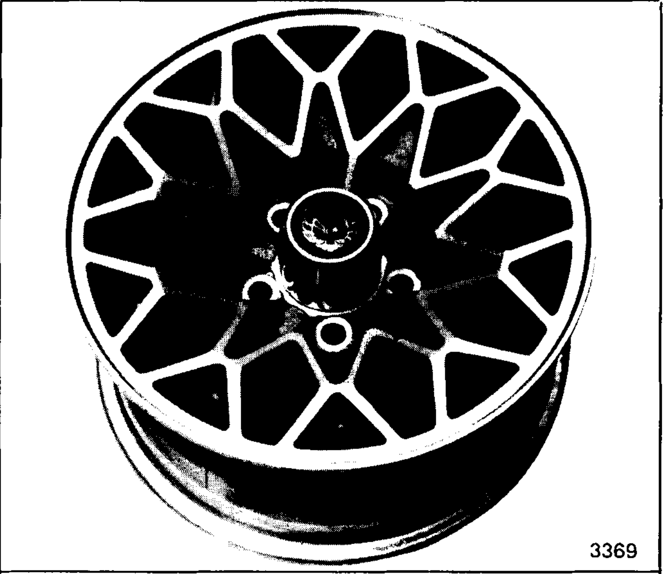


Fig. 3E-2 Cast Aluminum Wheel

F Series cast aluminum wheels are available in four colors as well as the standard cast aluminum (gray) wheel; service replacement wheels are available and painting of wheels in service is not necessary.

MAINTENANCE AND MINOR ADJUSTMENTS

Wheel Maintenance

Wheel repairs that use welding, heating, or peening are not approved. An inner tube is not an acceptable repair for leaky wheels or tires.

Wheel Attaching Studs

If a broken stud is found, see Section 4B (rear) or Section 3C (Front) for Caution and Replacement procedure.

Inflation of Tires

The pressure recommended for any model is carefully calculated to give a satisfactory ride, stability, steering, tread wear, tire life and resistance to bruises.

Tire pressure, with tires cold (after car has set for three hours or more or driven less than one mile), should be checked monthly or before any extended trip and set to the specifications on the tire placard located on rear face of driver's door (except A and G Series); inside glove box door on A and G Series.

Valve caps or extensions should be on the valve to keep dust and water out.

1. For continuous high speed operation (over 75 mph) increase pressure 4 psi up to maximum of 32 psi cold for load range B tires.

Sustained speeds above 75 mph are not recommended when the 4 psi adjustment would require pressures greater than maximum.

2. Tire pressures may increase as much as 6 psi when hot.

Higher than recommended pressure can cause:
- Hard ride
- Tire bruising or carcass damage
- Rapid tread wear at center of tire

Lower than recommended pressure can cause:
- Tire squeal on turns
- Hard steering
- Rapid and uneven wear on the edges of the tread
- Tire rim bruises and rupture
- Tire cord breakage
- High tire temperatures
- Reduced handling
- High fuel consumption

Unequal pressure on same axle can cause:
- Uneven braking
- Steering lead
- Reduced handling
- Swerve on acceleration

Tire Rotation

To equalize wear, rotate tires according to Fig. 3E-3. Do not use the X method on radial tires as roughness and irregular wear can result. Radial tires should be rotated at the first 7500 miles and then at least every 15,000 miles. Bias-belted tires should be rotated every 7500 miles.

NOTE: Due to their design, radial tires tend to wear faster in the shoulder area particularly in front position. This makes regular rotation especially necessary.

Use 4-wheel rotation when car is equipped with stowaway spare and/or styled (Rally or Cast Aluminum) wheels.

Cast Aluminum Wheels

Avoid use of strong, caustic cleaners when cleaning cast aluminum wheels. Clean pocket areas with mild soap and water. Use aluminum cleaner to highlight machined gloss surfaces of wheel.

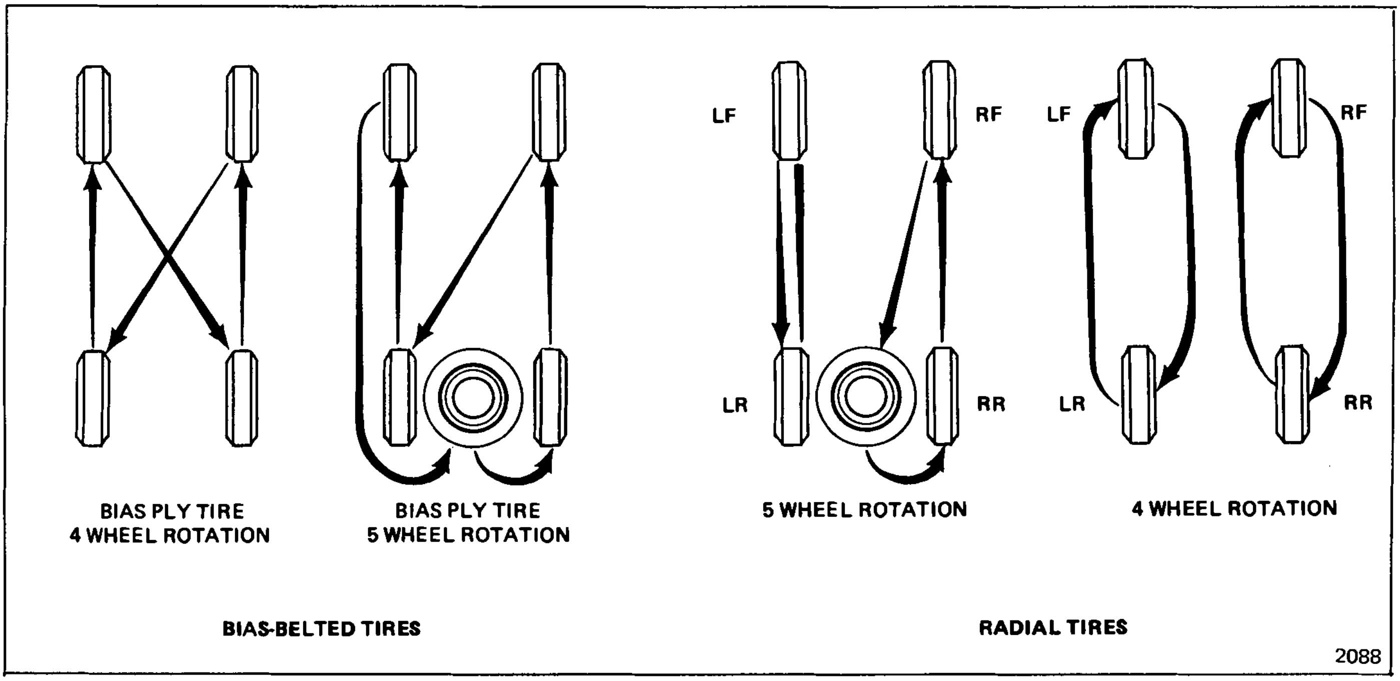


Fig. 3E-3 Tire Rotation Diagram

Stowaway Spare Maintenance

It is recommended that repair or replacement of the stowaway spare tire be made only by an authorized tire dealer.

There are two types of stowaway inflators used on 1977 cars. The aerosol-type freon canister is not refillable. The CO2 filled canister (painted blue) is refillable by using tool number J 26696.

SERVICE PROCEDURES

WHEEL AND TIRE ASSEMBLY

WARNING: BEFORE RE-INSTALLING ALUMINUM WHEELS, ANY BUILD UP OF CORROSION ON THE WHEEL MOUNTING SURFACE AND BRAKE DRUM OR DISC MOUNTING SURFACE SHOULD BE REMOVED BY SCRAPING AND WIRE BRUSHING. INSTALLATION OF ALUMINUM WHEELS WITHOUT GOOD METAL-TO-METAL CONTACT AT THE MOUNTING SURFACES CAN RESULT IN LOOSENING OF THE WHEEL NUTS WHICH CAN EVENTUALLY ALLOW THE WHEEL TO COME OFF WHILE THE VEHICLE IS IN MOTION, CAUSING LOSS OF CONTROL.

Wheels can be hard to remove from the car due to rusting or a tight fit between the wheel center hole and the axle or rotor. These wheels can be removed without damage as follows:

1. Retighten all lug nuts on the affected wheel, then loosen each nut two turns.
2. Lower vehicle onto floor.
3. Rock the car from "drive" to "reverse" allowing car to move several feet in each direction. Apply quick, hard jabs on the brake pedal to loosen the wheel.
4. Raise the car. Remove the lug nuts and the wheel.

Penetrating oil has not been found to be effective in removing tight wheels. However, if it is used it should be applied only to the hub surface.

WARNING: DO NOT ALLOW THE PENETRATING OIL TO GET ON THE VERTICAL SURFACES BETWEEEN THE WHEEL AND THE DRUM (OR ROTOR) BECAUSE PENETRATING OIL IN THIS AREA COULD CAUSE THE WHEEL TO WORK LOOSE AS THE CAR IS DRIVEN CAUSING LOSS OF CONTROL.

Never use heat to loosen a tight wheel because the application of heat to the wheel can shorten the life of the wheel.

Wheel nuts must be tightened in sequence and to proper torque to avoid bending wheel or brake drum or rotor (Fig. 3E-4).

Tire Mounting and Demounting

Use a tire changing machine to mount or demount tires. Follow the equipment manufacturer's instructions. Do not use hand tools or tire irons alone to change tires as they may damage the tire beads or wheel rim.

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove lubricant, old rubber, and light rust. Before mounting or demounting a tire, the bead area

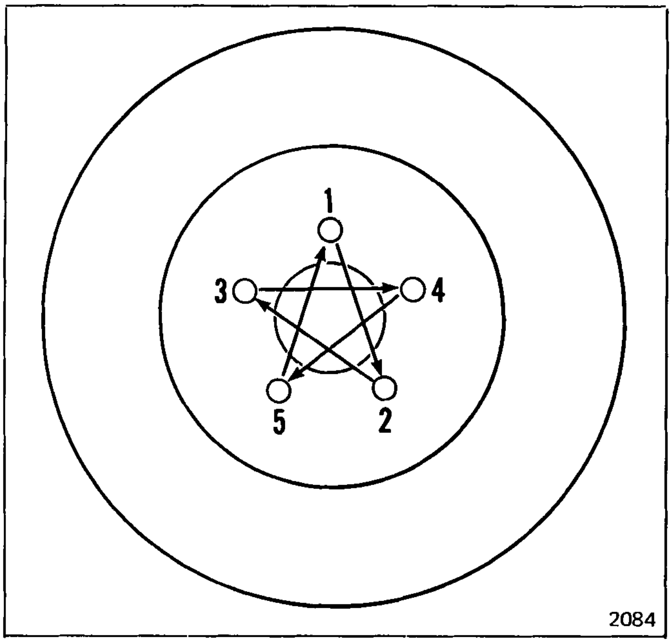


Fig. 3E-4 Wheel Nut Tightening Sequence

should be well lubricated with an approved tire lubricant.

After mounting, inflate to 40 psi so that beads are completely seated.

WARNING: DO NOT STAND OVER TIRE WHEN INFLATING. BEAD MAY BREAK WHEN BEAD SNAPS OVER SAFETY HUMP AND CAUSE SERIOUS PERSONAL INJURY.

WARNING: DO NOT EXCEED 40 PSI PRESSURE WHEN INFLATING. IF 40 PSI PRESSURE WILL NOT SEAT BEADS, DEFLATE, RE-LUBRICATE AND REINFLATE. OVER INFLATION MAY CAUSE THE BEAD TO BREAK AND CAUSE SERIOUS PERSONAL INJURY.

Install valve core and inflate to proper pressure. Check the locating rings of the tire to be sure they show around the rim flanges on both sides (Fig. 3E-5).

Tire Repair

There are many different materials and techniques on the market to repair tires. As not all of these work on all types of tire, tire manufacturers have published detailed instructions on how and when to repair tires. These instructions can be obtained from the tire manufacturer.

BALANCING WHEELS

There are two types of wheel and tire balance: static (Fig. 3E-6) and dynamic (Fig. 3E-7). Static balance is the equal distribution of weight around the wheel. Wheels that are statically unbalanced cause a bouncing action called shake. This condition will eventually cause uneven tire wear.

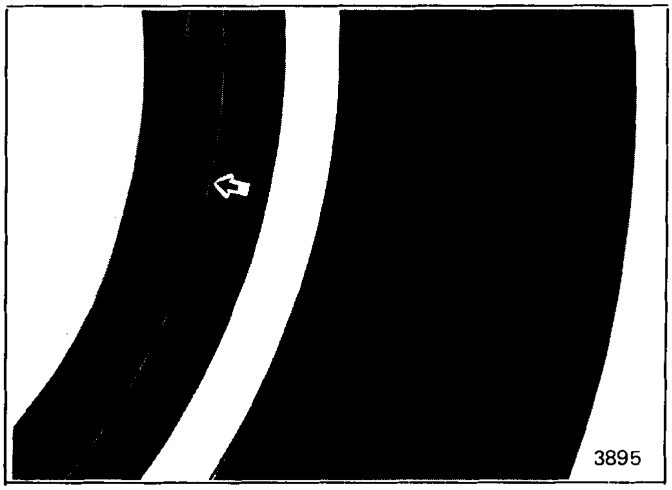


Fig. 3E-5 Locating Rings

Dynamic balance is the equal distribution of weight on each side of the centerline so that when the tire spins there is no tendency for the assembly to move from side to side. Wheels that are dynamically unbalanced may cause shimmy.

General Balance Precautions

Deposits of mud, etc. must be cleaned from the inside of the rim. Stones should be removed from the tread in order to avoid operator injury during spin balancing and to obtain a good balance. The tire should be inspected for any damage, then balanced according to the equipment manufacturer's recommendation.

Off-Car Balancing

When balancing wheels off the car, use a balancer which pilots the wheel by the center hole (not the lug holes) if possible.

Some electronic off-car balancers are more accurate than the on-car spin balancers, but do not correct drum or rotor unbalance. If the vibration is off-car balance, an on-car balance may also be needed. When doing this additional balance, do not remove the wheel weights from the electronic off-car balance. Instead, split the new on-car weights equally between the inner and outer rim flanges (to avoid disturbing the dynamic balance from the off-car balancer).

On-Car Balancing

Front Wheels - Lift front of car with floor jack under front cross member in center of car to allow car to vibrate while balancing.

The lower control arm should be supported as far outboard as possible.

If the above method is not used, front tires should be balanced on rear positions, or on an off-car balancer.

NOTE: Front wheels should be spun with the engine. Follow warning (below) 35 mph drive wheel speed limit.

Rear Wheels - To distinguish between standard axle and anti-spin on passenger cars, raise rear of vehicle so both wheels are clear of ground. With the transmission in park (in gear with manual transmission), attempt to turn one wheel

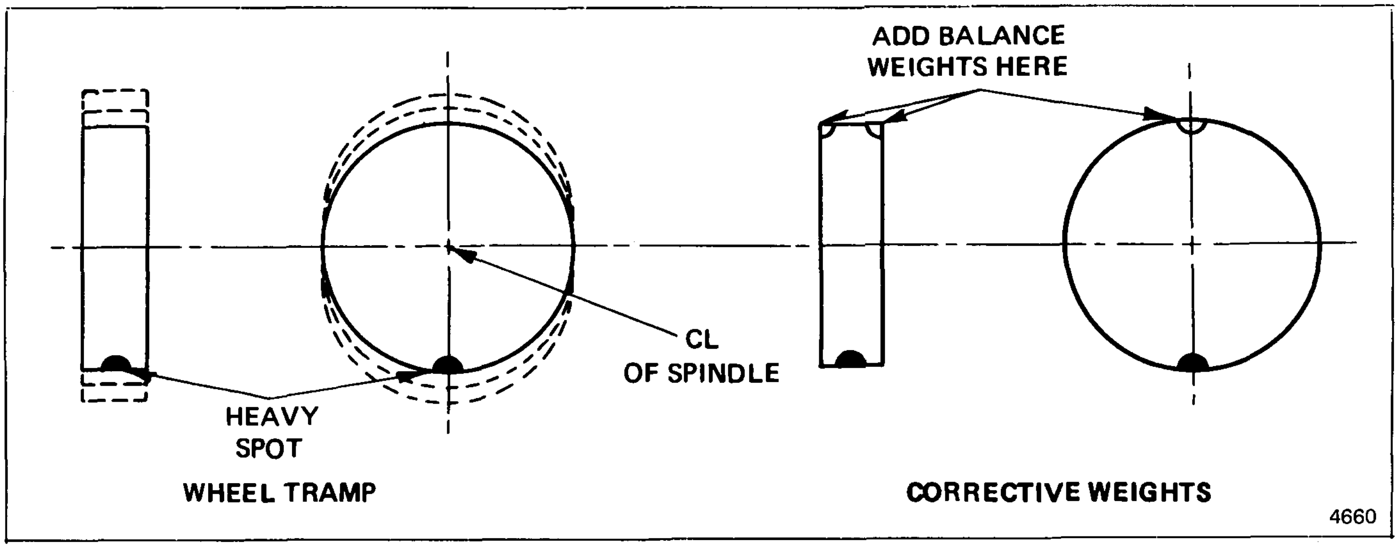


Fig. 3E-6 Static Unbalance Correction

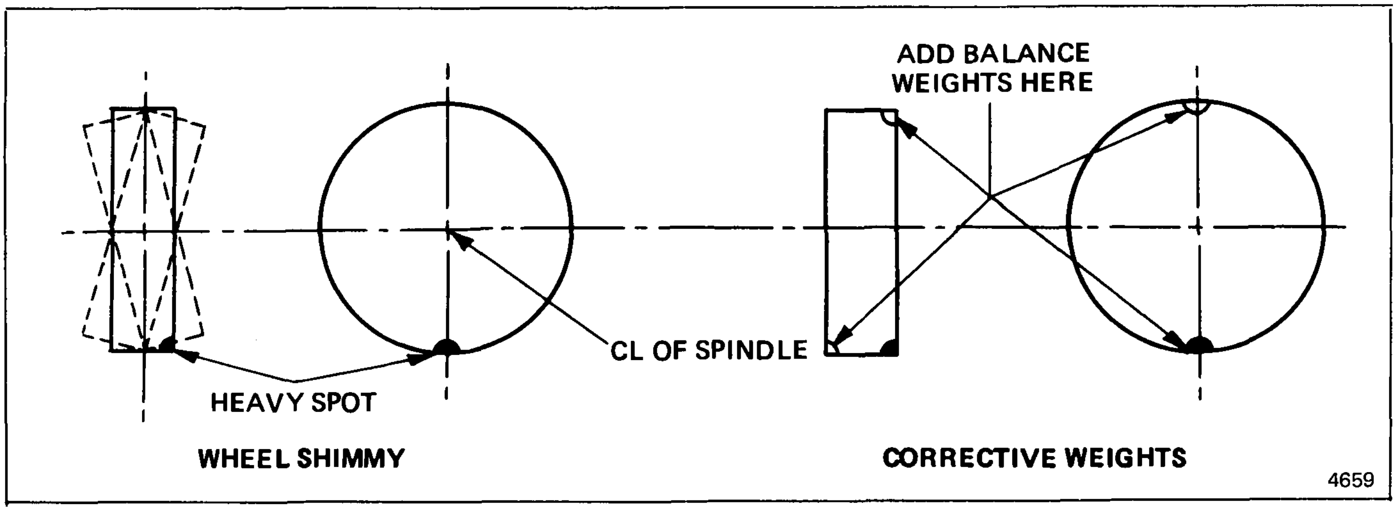


Fig. 3E-7 Dynamic Unbalance Correction

by hand. If the wheel can be turned, it is a standard axle; if the wheel cannot be turned, it is an anti-spin differential.

Standard Axle

On vehicles equipped with standard axle, raise rear of vehicle with floor jack under differential. This must be done to allow car to vibrate while balancing. Place a block under the opposing wheel and let vehicle down so opposing wheel sits on block and the wheel to be balanced is at least two inches off the ground (Fig. 3E-8). This is to allow only one wheel to spin. Proceed with balance using engine power to spin the wheel.

WARNING: ON CARS WHICH DO NOT HAVE ANTI-SPIN DIFFERENTIAL, DRIVE WHEEL SPIN SHOULD BE LIMITED TO 35 MPH AS INDICATED ON THE SPEEDOMETER. THIS LIMIT IS NECESSARY BECAUSE THE SPEEDOMETER ONLY INDICATES ONE-HALF OF THE ACTUAL WHEEL SPEED WHEN ONE DRIVE WHEEL IS SPINNING AND THE OTHER DRIVE WHEEL IS STOPPED. UNLESS CARE IS TAKEN IN LIMITING DRIVE WHEEL SPIN, THE SPINNING WHEEL CAN REACH EXCESSIVE SPEEDS. THIS CAN RESULT IN POSSIBLE TIRE DISINTEGRATION OR DIFFERENTIAL FAILURE, WHICH COULD CAUSE SERIOUS PERSONAL INJURY OR EXTENSIVE CAR DAMAGE.

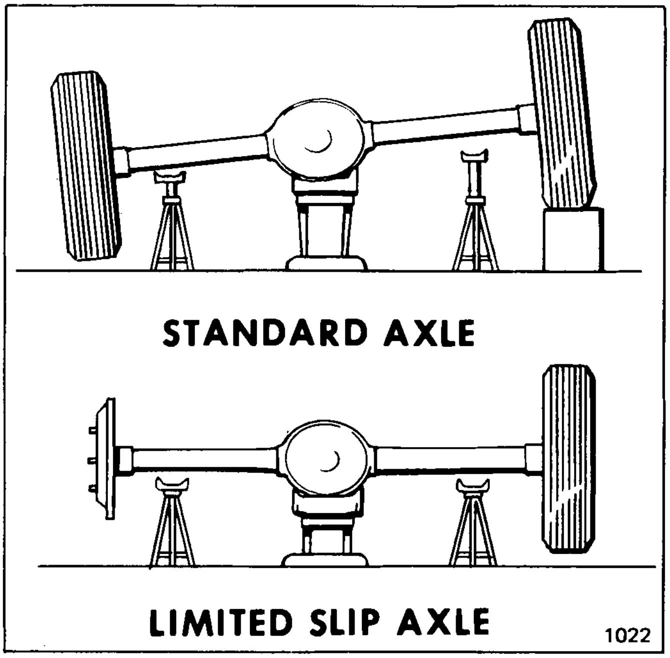


Fig. 3E-8 Rear Wheel Balance Jacking Set-Up

Anti-Spin Axle

On cars equipped with an anti-spin differential, the following procedure should be used (Fig. 3E-8).

1. Raise both rear wheels with a jack under the differential. Put jack stands under axle as a safety measure, but do not put car weight on stands.

WARNING: DO NOT ATTEMPT TO BALANCE A TIRE ON A DRIVE WHEEL WITH THE OTHER DRIVE WHEEL ON THE GROUND. THE CAR MAY DRIVE THROUGH THIS WHEEL AND CAUSE THE CAR TO MOVE UNEXPECTEDLY, RESULTING IN PERSONAL INJURY AND PROPERTY DAMAGE.

2. Remove one wheel.

3. Reinstall lug nuts and tighten securely to retain the brake drum.

4. Balance the remaining wheel using engine power to spin the wheel.

WARNING: ON CARS WHICH HAVE ANTI-SPIN DIFFERENTIAL, DRIVE WHEEL SPIN SHOULD BE LIMITED TO 70 MPH. THIS IS TO PREVENT TIRE DISINTEGRATION RESULTING IN SERIOUS PERSONAL INJURY AND EXTENSIVE PROPERTY DAMAGE.

5. Reinstall the second wheel and balance.

VIBRATION

Wheel unbalance causes most of the highway speed vibration problems. However, if a vibration remains after on-car balancing, it can be caused by three things (Fig. 3E-9).

1. Tire runout
2. Wheel runout
3. Tire Stiffness variation

Measuring tire and/or wheel free runout will uncover only part of the problem. All three causes are easily checked by using a Tire Problem Detector (TPD). If a TPD is not available, the more time-consuming method of substituting known good tire and wheel assemblies on the problem vehicle can be used.

Correction Non-Uniform Tires

If a replacement tire cannot be obtained, there are several ways to correct tires which cause a vibration even though they are properly balanced. The best method uses an automatic machine which buffs small amounts of rubber from selected spot on the outer two tread rows. Correction by this method is usually permanent and, if done properly, does not significantly affect the appearance or tire tread life. Tire truing with a blade-type machine is not recommended as this reduces the tread life substantially and often does not permanently correct the problem.

Another method which quite often works is to dismount the tire and rotate it 180 degrees on the rim. It is important that this be done on tire assemblies which are known to be causing a vibration as it is just as likely to make good assemblies worse.

STYLED WHEEL HUB CAP

RALLY WHEEL

Remove and Install

WARNING: BEFORE RE-INSTALLING ALUMINUM WHEELS, ANY BUILD UP OF CORROSION ON THE WHEEL MOUNTING SURFACE AND BRAKE DRUM OR DISC MOUNTING SURFACE SHOULD BE REMOVED BY SCRAPING AND WIRE BRUSHING. INSTALLATION OF ALUMINUM WHEELS WITHOUT GOOD METAL-TO-METAL CONTACT AT THE MOUNTING SURFACES CAN RESULT IN LOOSENING OF THE WHEEL NUTS WHICH CAN EVENTUALLY ALLOW THE WHEEL TO COME OFF WHILE THE VEHICLE IS IN MOTION, CAUSING LOSS OF CONTROL.

1. Remove wheel and tire assembly from car.
2. Depress spring retainers on cap using screwdriver from rear side of cap and remove the cap.
3. Replace cap by placing one or two spring retainers into wheel opening and then use screwdriver to guide

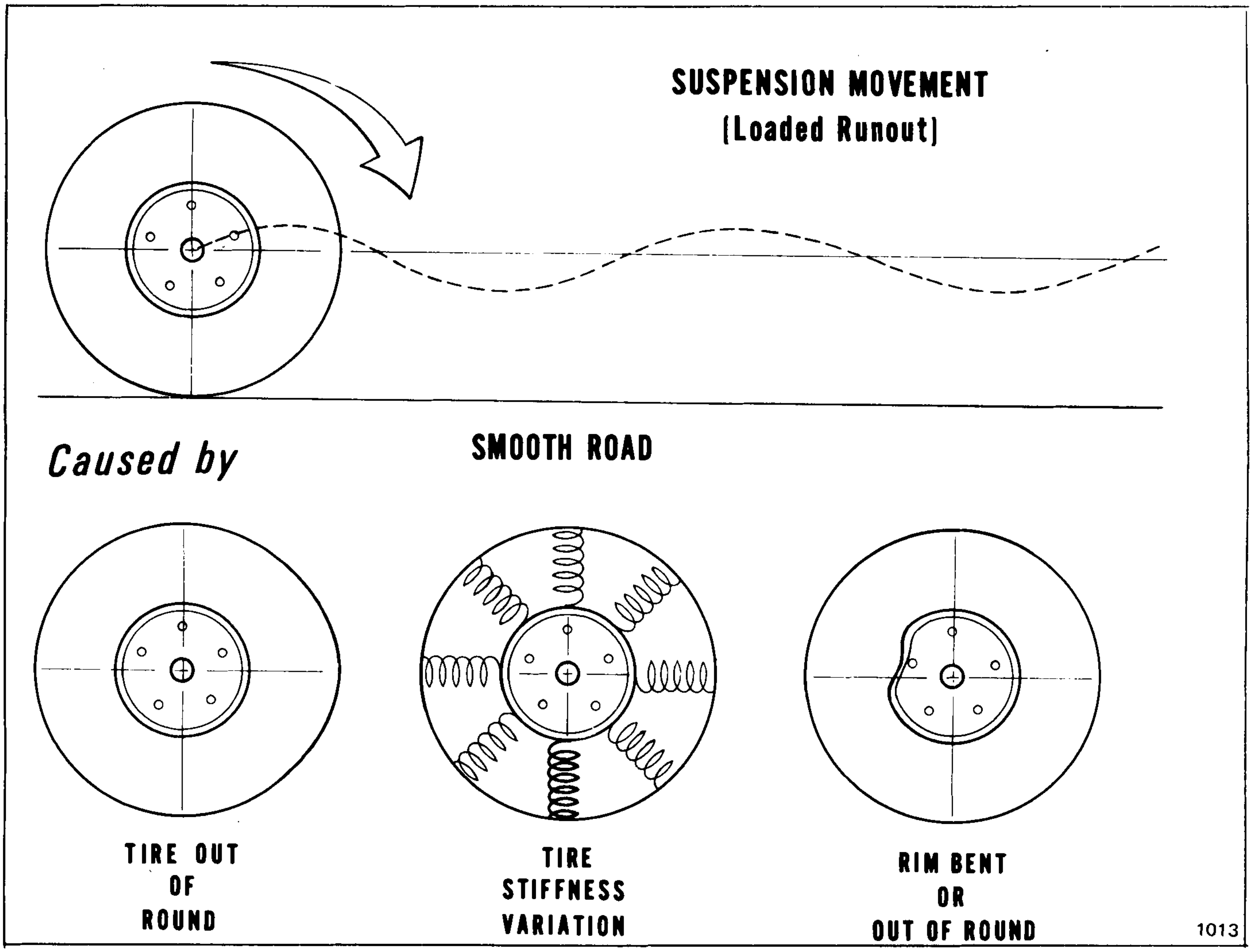


Fig. 3E-9 Vibration

remaining spring retainers into wheel opening.

NOTE: H Series Rally Wheel caps have six spring retainers; all other Rally Wheel caps have three.

4. Install wheel and tire assembly.

CAST ALUMINUM WHEEL

Remove and Install

WARNING: BEFORE RE-INSTALLING ALUMINUM WHEELS, ANY BUILD UP OF CORROSION ON THE WHEEL MOUNTING SURFACE AND BRAKE DRUM OR DISC MOUNTING SURFACE SHOULD BE REMOVED BY SCRAPING AND WIRE BRUSHING. INSTALLATION OF ALUMINUM WHEELS WITHOUT GOOD METAL-TO-METAL CONTACT AT THE MOUNTING SURFACES CAN RESULT IN LOOSENING OF THE WHEEL NUTS WHICH CAN EVENTUALLY ALLOW THE WHEEL TO COME OFF WHILE THE VEHICLE IS IN MOTION, CAUSING LOSS OF CONTROL.

1. Remove wheel and tire assembly from car.

2. Place a block of wood 2.5" in diameter with a squared-off end against the back surface of the cap. A sharp hammer blow on the block of wood will remove cap (Fig. 3E-10).

CAUTION: *Failure to hit cap squarely without the load distributed evenly could result in permanent damage to the cap.*

3. Place cap into position at wheel opening and place a block of wood at least three inches in diameter against cap face. Install cap by striking block of wood with hammer (Fig. 3E-11).

4. Install wheel and tire assembly.

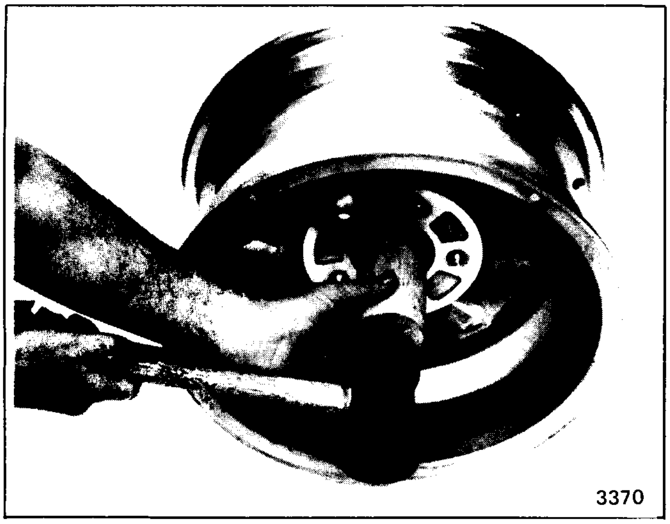


Fig. 3E-10 Removing Cast Aluminum Wheel Cap

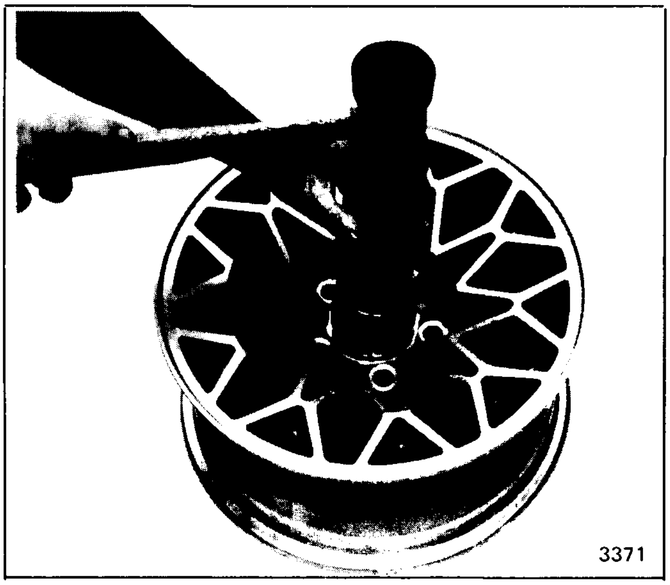


Fig. 3E-11 Installing Cast Aluminum Wheel Cap

RECHARGING CO2 INFLATOR CANISTER

The CO2 Inflator Canister is designed to be recharged only from a syphon type CO2 storage tank. The discharge tool should be mounted such that all discharging is done with the canister in an upright position. The following procedure should be used to recharge the canister:

1. Attach inflator tool J 26696 to storage tank (Fig. 3E-12), making sure seal washer is in place between tool and tank. Open valve (Fig. 3E-12) on storage tank.

2. Fully discharge CO2 canister using discharge tool. Place empty canister on scale and adjust face of scale to zero.

3. Attach empty CO2 canister to inflator tool, being careful not to damage "O" ring on tool. Tighten knurled nut finger-tight.

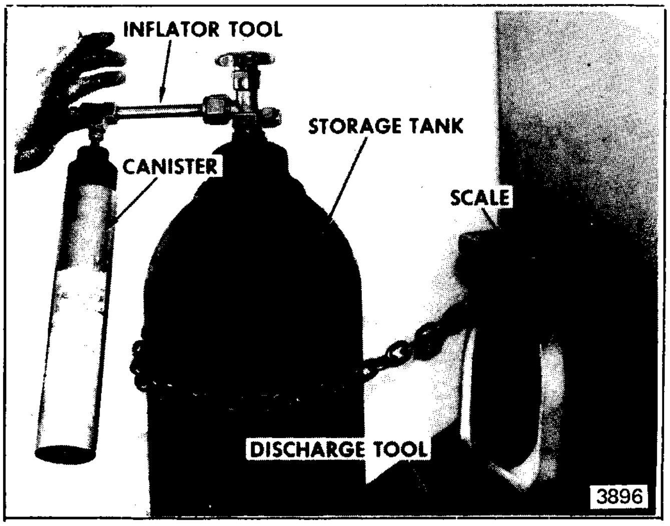


Fig. 3E-12 Recharging Canister

4. Press knob for approximately 15 seconds to charge canister.

5. Release knob and remove canister from tool.

6. Discharge canister completely with discharge tool.
NOTE: This is done to cool canister, enabling it to accept a full charge. Discharge canister in an upright position to minimize freezing.

7. Again attach empty CO2 canister to inflator tool and charge for approximately 30 seconds.

8. Remove canister from inflator tool and place canister on scale. Adjust the fill of canister by either discharging or further charging until specified weight of CO2 is obtained.

WARNING: CLOSE VALVE BEFORE REMOVING TOOL FROM STORAGE TANK. TANK CONTAINS GAS UNDER PRESSURE WHICH COULD ESCAPE RAPIDLY CAUSING PERSONAL INJURY.

SPECIFICATIONS

WHEEL NUT TORQUE

Except Cast Aluminum Wheel	
B Series (4 3/4" Bolt Circle)	80 lb. ft.
B Series (5" Bolt Circle)	100 lb. ft.
A, F and G Series	80 lb. ft.
H and X Series	80 lb. ft.
Cast Aluminum Wheel	
B Series (4 3/4" Bolt Circle)	90 lb. ft.
A, F and G Series	90 lb. ft.
H Series	90 lb. ft.

SECTION 4A

PROPELLER SHAFT

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

One type of propeller shaft is being used in 1977. The type being used on all series is a one-piece shaft with two single cardan universal joints.

A universal joint and splined slip yoke are located at the transmission end of the shaft, where they are held in alignment by a bushing in the transmission rear extension. The slip yoke permits fore and aft movement of the drive shaft, as the differential assembly moves up and down. The spline is lubricated internally by transmission lubricant. An oil seal at the transmission prevents leakage and protects the slip yoke from dust, dirt, and other harmful material.

The universal joints are lubricated for life and cannot be lubricated while on the car. A service kit, which consists of a spider with bearing assemblies and snap rings, must be installed on the car if a universal joint becomes worn or noisy. If it becomes necessary to repair a universal joint, the entire propeller shaft must be removed from the car. Care should be taken to avoid jamming, bending, or over-angulating of any parts of the assembly.

If a car is to be undercoated, the propeller shaft must be kept completely free of undercoating material. Undercoating material or any other foreign material will upset the propeller shaft balance and produce serious vibration.

On all series cars, except H and X, production universal joint bearing are retained by a nylon injection ring instead of the conventional snap ring. The H and X Series cars use the snap rings. All service universal joints, however, will use snap rings.

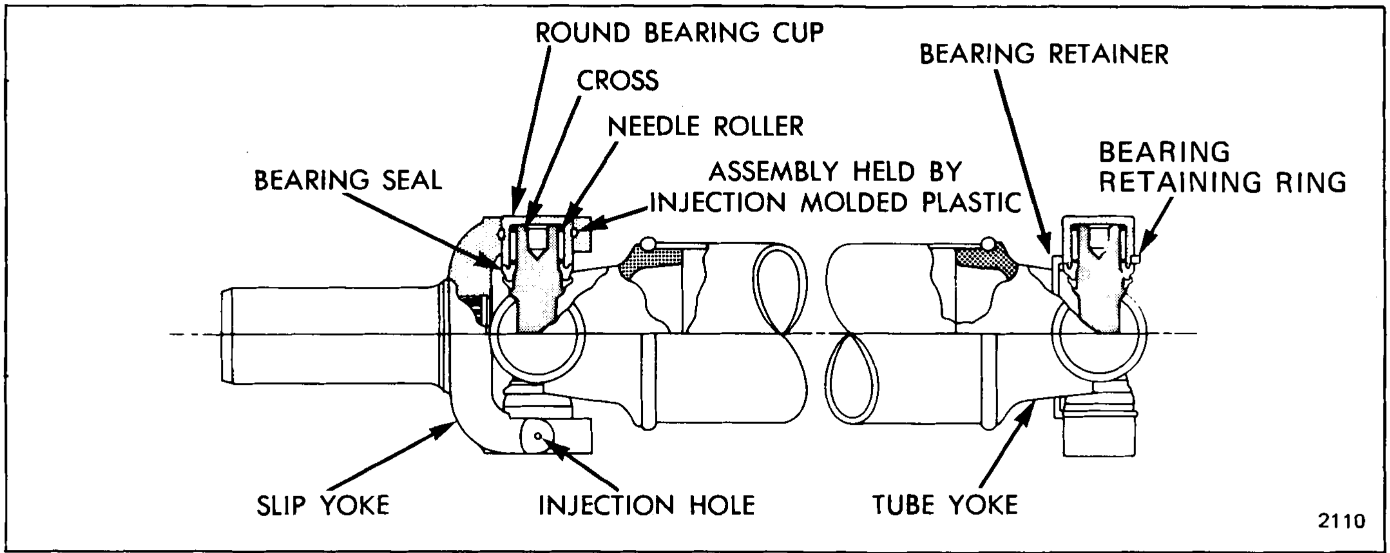


Fig. 4A-1 Propeller Shaft - Cross Section

DIAGNOSIS

PROPELLER SHAFT TROUBLE DIAGNOSIS

Condition	Possible Cause	Correction
Leak at front slip yoke. (An occasional drop of lubricant leaking from splined yoke is normal and requires no attention.)	1. Rough outside surface on slip yoke.	1. Replace seal if cut by burrs on yoke. Minor burrs can be smoothed by careful use of crocus cloth or honing with a fine stone. Replace yoke if outside surface is rough or burred badly.
	2. Defective transmission rear oil seal.	2. Replace transmission rear oil seal. Bring transmission oil up to proper level after correction.
Knock in drive line clunking noise when car is operated under float condition at 10 mph in high gear or "Neutral".	1. Worn or damaged universal joints.	1. Replace
	2. Side gear hub counterbore in differential worn oversize.	2. Replace differential case and/or side gears as required.
Ping, snap or click in drive line.	1. Loose upper or lower control arm bushing bolts.	1. Tighten bolts to specified torque.
	2. Worn or damaged Universal joints.	2. Replace.
Scraping noise.	Slinger, pinion flange, or end yoke rubbing on rear axle carrier.	Straighten slinger to remove interference.

Objectional vibration, roughness, rumble or boom can be caused by the input from a number of systems. The chart (Fig. 4A-2) provides a systematic approach to finding the vehicle problem.

To determine whether the propeller shaft is causing the problem, drive vehicle through speed range and note speed (vehicle and/or engine) at which problem is most pronounced (tachometer may be used). Shift transmission into a lower gear range and drive vehicle at same engine speed as when problem was most pronounced in direct drive. Note effect on problem.

To determine engine speed, if tachometer is not used, divide vehicle speed by the transmission gear ratio in which the problem occurs.

Example: With the THM 350 in Low range, divide by 1.52. If problem is not pronounced in direct drive at 55 mph, the same engine speed would be produced in in Low range(THM 350) at 55/1.52 ° 36 mph.

If the problem is still present at the same engine speed whether in direct drive or in the lower gear range, since the propeller shaft speed varies, it cannot be at fault. If problem decreases or is eliminated in a different gear range but at the same engine speed, check the possible causes in Fig. 4A-2.

PROPELLER SHAFT DIAGNOSIS
VIBRATION, ROUGHNESS, RUMBLE AND/OR BOOM

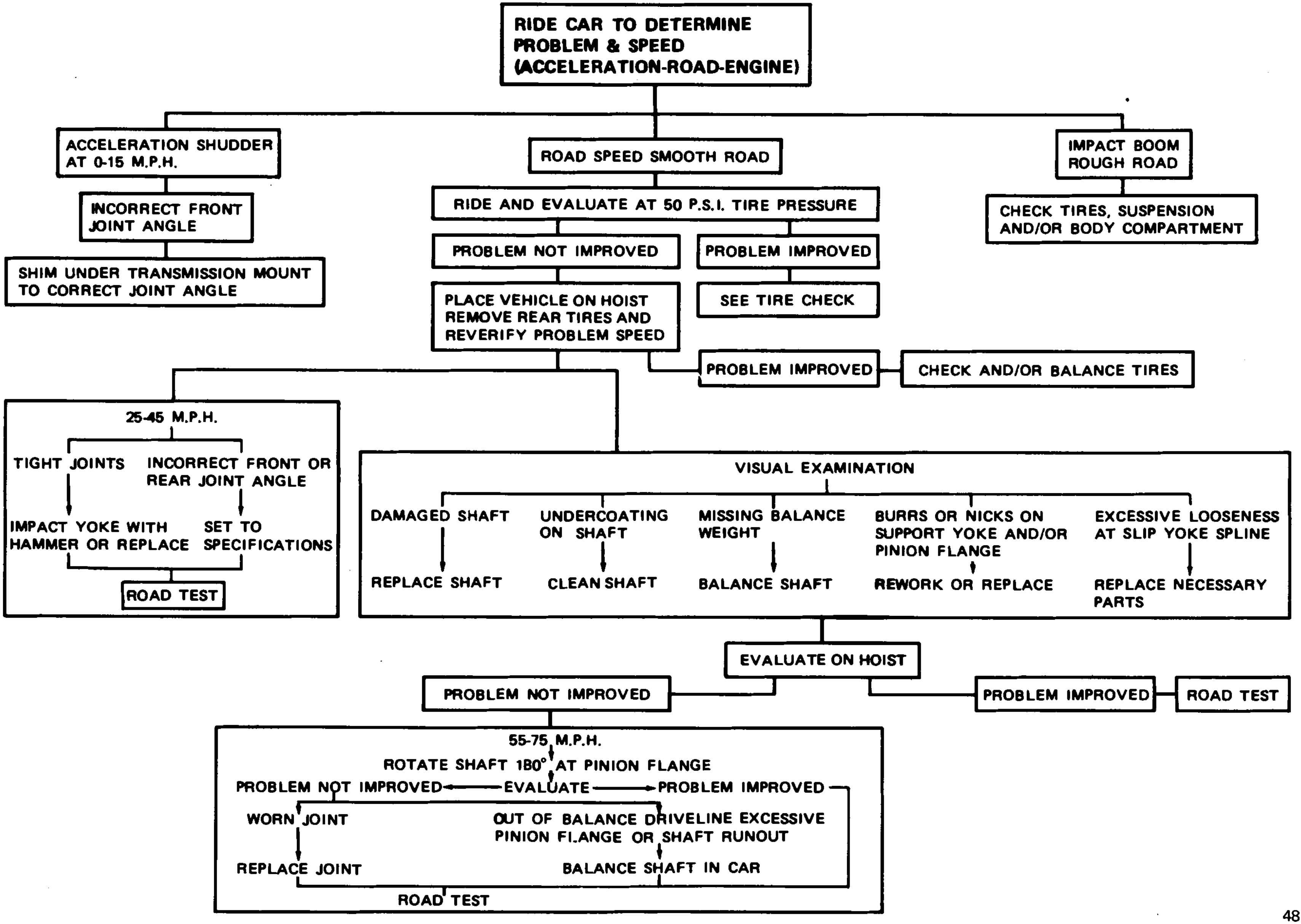


Fig. 4A-2 Trouble Diagnosis Chart

MAINTENANCE AND ADJUSTMENTS

CHECKING REAR UNIVERSAL JOINT ANGLE

When torque is transmitted through any ordinary universal joint, the driven yoke fluctuates slightly in speed. In other words, although the driving yoke rotates at a constant speed, the driven yoke speeds up and slows down twice per revolution. This fluctuation of the driven yoke is in direct proportion to the angle through which the universal joint is operating; the greater the angle, the greater the fluctuation.

Whenever two universal joints are used, this fluctuation effect can be eliminated by staggering the joints so that the two driving yokes are 90 degrees apart provided the two joints are transmitting torque through the same angle.

Therefore, when two universal joints are used, the angles through which they operate must be very nearly the same. This allows the alternate acceleration and deceleration of one joint to be offset by the alternate deceleration and acceleration of the second joint. When the two joints do not run at approximately the same angle, operation is rough and an objectionable vibration is produced.

The actual optimum angles desired must also consider the effects of various passenger loadings and rear axle windup during acceleration so that it is unlikely that the front and rear joints will be found to be the same in actual practice.

In addition, universal joints are designed to operate safely and efficiently within certain angles. If the designed angle is exceeded, the joint may be broken or otherwise damaged.

The front universal joint angle is actually the angle between the engine-transmission centerline and the propeller shaft. This angle is determined by the design of the frame assembly and may be altered by adding or removing shims between the transmission rear bearing retainer and the transmission mount.

Because sensitivity to pinion angle adjustment has been reduced, non-adjustable rear upper control arms are installed at the best pinion angle during factory installation.

Minor rear joint angle corrections can be made by shimming between the spring plates on X Series cars or by loosening all of the rear suspension control arm bolts on all other cars and repositioning the pinion nose up or down. This takes advantage of all the bolt hole tolerances in the brackets.

All complaints of propeller vibration should be accompanied by rear trim height measurements at curb weight. An incorrect trim height may cause some vibration. If vibration is severe enough, removal or installation of spring shims may be required. If any irregular roughness or vibration is detectable in the drive line, the rear universal joint angle should be checked. Also, if a car is involved in a severe rear end collision or if the rear axle housing is replaced, the rear universal joint angle should be checked and arms replaced if necessary.

INCLINOMETER METHOD

This method can be used with the car over a pit or on a drive-on platform hoist as long as the car is at curb weight with a full tank of gasoline. Jounce car up and down to assure curb height.

Readings should be taken at the following locations in the following manner:

Angle At Rear Universal Joint

1. Place inclinometer (J 23498) on rear propeller shaft bearing cup (Fig. 4A-3). Center bubble in sight glass and record measurement. Bearing cup must be straight up and down and free of dirt or other foreign material to obtain an accurate measurement.

2. Rotate propeller shaft 90 degrees and place inclinometer on companion flange yoke bearing cup (Fig. 4A-4). Center buffle in sight glass and record measurement.

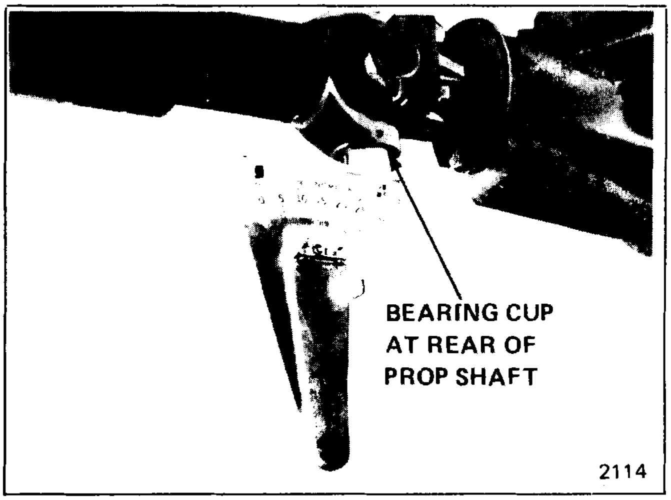


Fig. 4A-3 Measuring Angle at Rear Propeller Shaft Bearing Cup

3. Subtract both figures to obtain existing rear joint angle.

4. For installation of shims to correct angle on the X and F Series, use the following procedure:

a. With rear wheels or axle housing supported, place floor stands forward of the front leaf spring attaching points.

b. Loosen, but do not remove, the "U" bolt attaching nuts. "U" bolt nuts should be loosened 3 or 4 threads beyond the bottom of the "U" bolts. Perform operation on one side at a time.

c. Install proper degree shim between the upper spring plate cushion and the spring. To decrease the angle, install shim with the thick end toward the front of the car. If it is necessary to increase the angle, install shim with thick end toward the rear of car.

d. Install the spacers between the upper and lower spring plates with the thick end in the same direction as the thick end of shim.

e. Torque "U" bolt nuts to 45 lb.ft.

f. Recheck angle for proper correction.

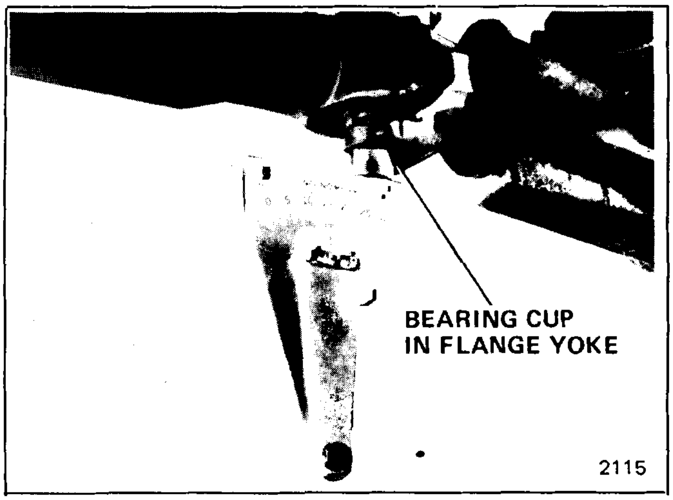


Fig. 4A-4 Measuring Angle At Companion Flange Yoke Bearing Cup

g. Correct angles may be found in Fig. 4A-5.

Angle At Front Universal Joint

1. Place inclinometer on front propeller shaft bearing cup (Fig. 4A-6). Center bubble in sight and record measurement.
2. Rotate propeller shaft 90 degrees and place inclinometer on front slip yoke bearing cup (Fig. 4A-7). Center bubble on sight glass and record measurement.
3. Subtract smaller figure from larger figure to obtain existing front universal joint angle.

PROPELLER SHAFT BALANCING PROCEDURE

HOSE CLAMP METHOD

1. Place the car on a twin post hoist so that the rear of the car is supported on the rear axle housing and the rear wheels are free to rotate. Remove both rear tire and wheel assemblies and reinstall wheel lug nuts with flat side next to drum.

2. Mark and number propeller shaft at four (4) points 90 degrees apart at rear of shaft just forward of balance weight.

3. Install two (2) hose clamps on the rear of the propeller shaft and slide them rearward until the clamps stop at the nearest balance weight welded to the tube. Align both clamps to any one of the four marks made on shaft in Step 2. Tighten the clamps (Fig. 4A-8). Be sure sufficient clearance is maintained so that clamp heads do not contact floor pan of car when axle is in contact with rebound bumper in frame. In order to gain sufficient clearance, it may be necessary to position the clamps over the balance weights.

4. Run the car through the speed range to 50-55 mph. Note amount of unbalance.

CAUTION: *Never run car higher than 55 pmh. Also all personnel should stay clear of driveline.*

5. Loosen clamps and rotate clamp heads 90 degrees to the next mark on shaft. Tighten clamps and repeat Step 4.

6. Repeat Step 5 until car has been run with clamp heads located at all four marks on shaft.

7. Position clamps at point of minimum unbalance. Rotate the clamp heads away from each other 45 degrees. (One each way from the point of minimum unbalance). Run the car and note if unbalance has improved (Fig. 4A-9).

In some cases it may be necessary to use one clamp or possibly three clamps in order to obtain a good balance.

Replace shaft if three hose clamps do not improve the imbalance.

8. Continue to rotate the clamps apart in smaller angular increments until the car feel for unbalance is best.

Do not run car on hoist for extended periods due to danger of overheating the transmission or engine.

9. Reinstall tire and wheel assemblies and road test the car for final check of balance. Vibration felt in the car on the hoist may not show up in a road test which is the final determining factor.

SERIES	MODEL	RESTRICTION	UNIVERSAL JOINT ANGLES[1]		JOUNCE PIN LENGTH[2]
			FRONT	REAR	
A & G	WAGON	NONE	2° 19′	3° 14′	5.125″
	CPE. & SEDAN		2° 52′	2° 59′	
B	WAGON		2° 54′	2° 42′	3.90″
	CPE. & SEDAN	7½″ AXLE	3° 5′	2° 10′	4.80″
		8½″ AXLE	2° 36′	2° 36′	
F	COUPE	231 ENGINE	0° 25′	3° 45′	5.20″
		301 ENGINE	0° 53′	3° 49′	
		305 ENGINE	0° 17′	3° 41′	
		350 (L34)			
		350 (L76)	0° 53′	3° 49′	
		400 ENGINE			
		403 ENGINE	0° 17′	3° 41′	
X	ALL	151 ENGINE	0° 38′	2° 17′	5.125[3]
		231 ENGINE	0° 50′		
		301 & 305	1° 13′	2° 35′	
		350 (LM1)			
		350 (L34)	1° 20′	2° 12′	

(LM1) = CHEVROLET BUILT (CODED "L")
(L34) = OLDSMOBILE BUILT (CODED "R")
(L76) = PONTIAC BUILT (CODED "P")

[1] Angles may be plus or minus 30 minutes (30′).

[2] Vertical dimension from top of Axle Tube to bottom surface of Frame Rail (Except "X" Series).

[3] Vertical dimension from top of Axle Tube to bottom of Jounce Restrictor Bracket beneath Frame Rail.

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Fig. 4A-5 Universal Joint Angles

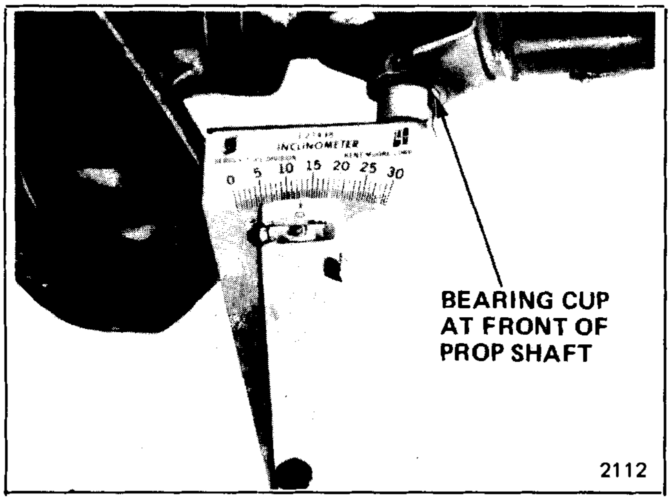


Fig. 4A-6 Measuring Angle at Front Propeller Shaft Bearing Cup

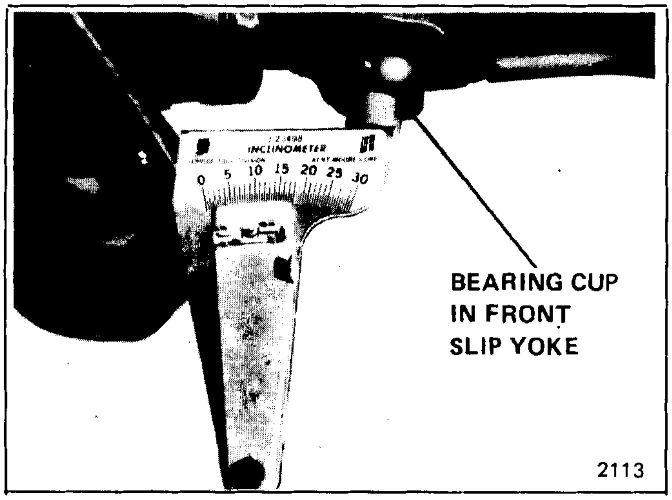


Fig. 4A-7 Measuring Angle at Front Slip Yoke Bearing Cup

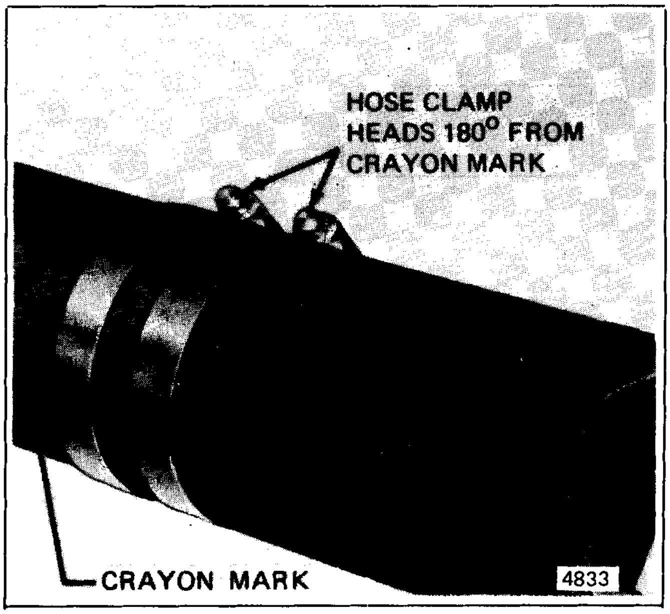


Fig. 4A-8 Balance Hose Clamps in Place

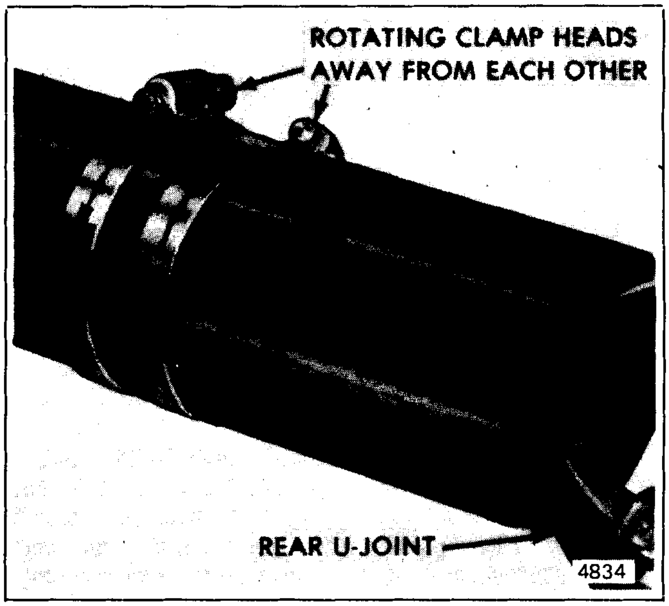


Fig. 4A-9 Rotating Balance Hose Clamps

STROBE LIGHT - WHEEL BALANCE AND HOSE CLAMP METHOD

If a wheel balancer of the type that is equipped with a strobe light is available, the use of such a unit will facilitate the balancing of the drive shaft. The balance pick-up unit should be placed directly under the nose of the rear axle carrier and as far forward as possible.

1. Place the car on a twin post hoist so that the rear of the car is supported on the rear axle housing and the rear wheels are free to rotate. Lower rear post hoist and allow axle tube to rest on axle stands. The vee groove of the rear post hoist could clamp the axle and destroy the sensitivity of the operation. Remove both rear tire and wheel assemblies and reinstall wheel lug nuts with flat side next to drum.

2. Mark and number drive shaft at 4 points, 90 degrees apart, at rear of shaft just forward of balance weights as shown in Fig. 4A-10.

3. Place strobe light wheel balancer pick-up under the nose of the differential (Fig. 4A-11).

4. With car running in gear at car speed where disturbance is at its peak, allow the driveline to stabilize by holding at constant speed. Point strobe light up at the spinning shaft and note position of one of these reference numbers. Shut off engine and position the drive shaft so that the reference numbers will be in the same position as was noted while the shaft was rotating.

> **CAUTION**: *Never run car higher than 55 mph. Do not run car on hoist for extended periods due to danger of overheating the transmission or engine. All personnel stay clear of driveline, joint and balance weight area.*

When strobe light flashed, the heaviest point of the shaft was down (6 o'clock) and to balance this shaft, it will be necessary to apply the balancing weight 180 degrees away from the heaviest point or at the top of the shaft (12 o'clock).

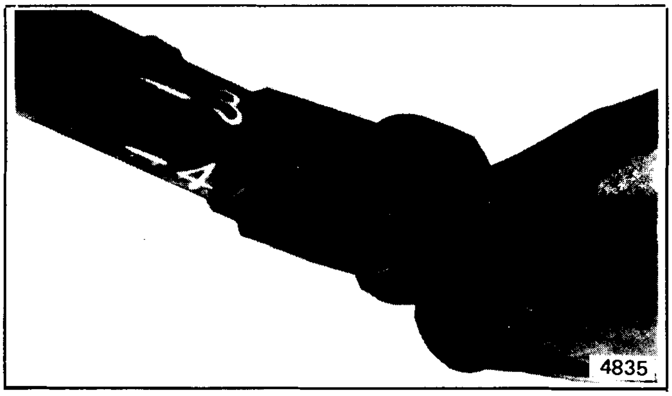


Fig. 4A-10 Reference Marks on Drive Shaft

5. Install two screw-type hose clamps on the drive shaft as close to the rear as possible. Position both clamp heads 180 degrees from the heaviest point of drive shaft as indicated by strobe light. Tighten clamps (Fig. 4A-12).

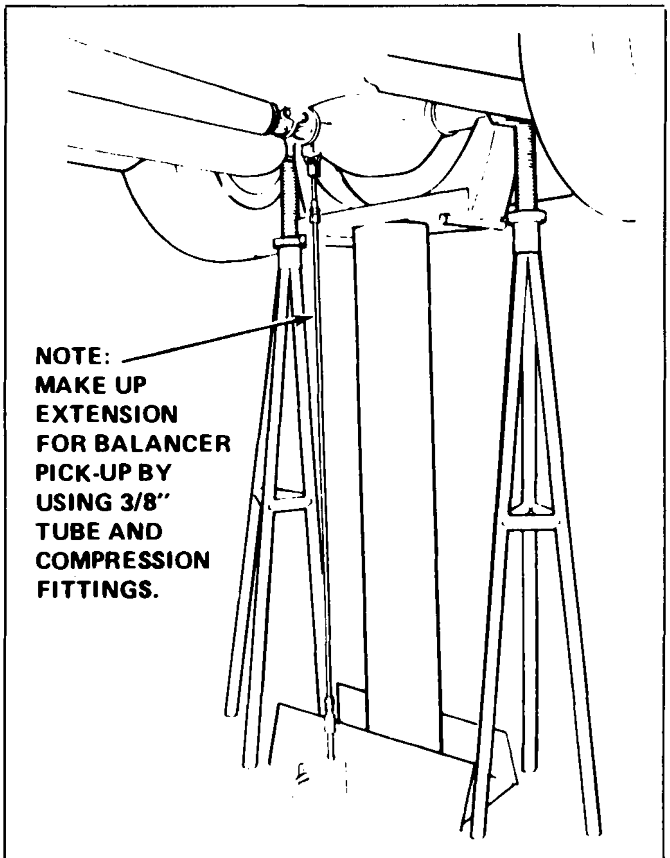
> **CAUTION:** *Be sure sufficient clearance is maintained so that clamp heads do not contact floor pan of car when axle is in contact with rebound bumper in frame. In order to gain sufficient clearance, it may be necessary to position the clamps over the balance weights.*

6. Run car through the speed range 50-55 mph. If disturbance is gone, nothing further need be done on the hoist. If the disturbance is not gone and the strobe light shows the two clamp heads at the top of the shaft, add one more hose clamp and recheck. If the strobe light still shows the two clamp heads at the top of the shaft, remove the shaft and reinstall it 180 degrees on the rear flange. Recheck balance with no clamps. Repeat balance starting with Step 5. If the shaft still needs more than three hose clamps at the same clock position, replace the shaft. However, if the clamps are also 180 degrees from the original position after the shaft was rotated 180 degrees, the drive flange on the axle is out of balance and must be replaced. DO NOT use more than three hose clamps to balance the shaft. If the strobe light shows the hose clamps at the bottom of the shaft, but the disturbance still exists, go to Step 7.

7. Rotate two of the hose clamps equally away from each other toward the top (one each way from the original position as shown in Fig. 4A-13), in small increments until best balance is achieved.

In some cases, it may be necessary to use one clamp or possibly three clamps in order to obtain a good balance.

Replace shaft if three hose clamps do not correct problem.



NOTE: MAKE UP EXTENSION FOR BALANCER PICK-UP BY USING 3/8" TUBE AND COMPRESSION FITTINGS.

DROP TWIN POST HOIST JUST ENOUGH TO ALLOW THE VEE OF THE HOIST TO CLEAR THE AXLE THUS PLACING THE WEIGHT OF THE CAR ON THE STANDS. THE SYSTEM WILL THEN BE RELEASED AND FREE TO RESPOND TO PROPELLER.

Fig. 4A-11 Pick-Up Unit at Differential Pinion Nose

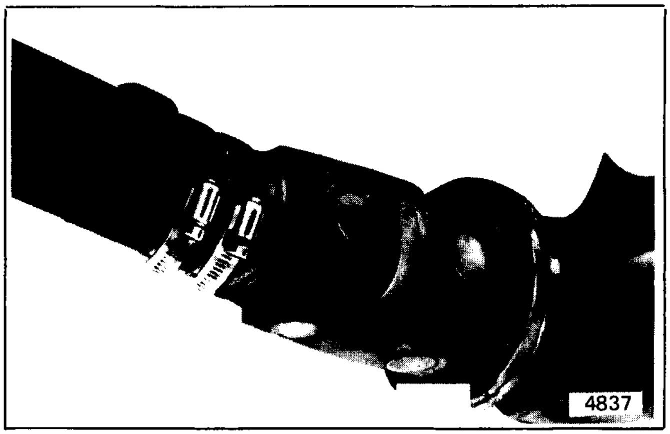


Fig. 4A-12 Balance Hose Clamps in Place

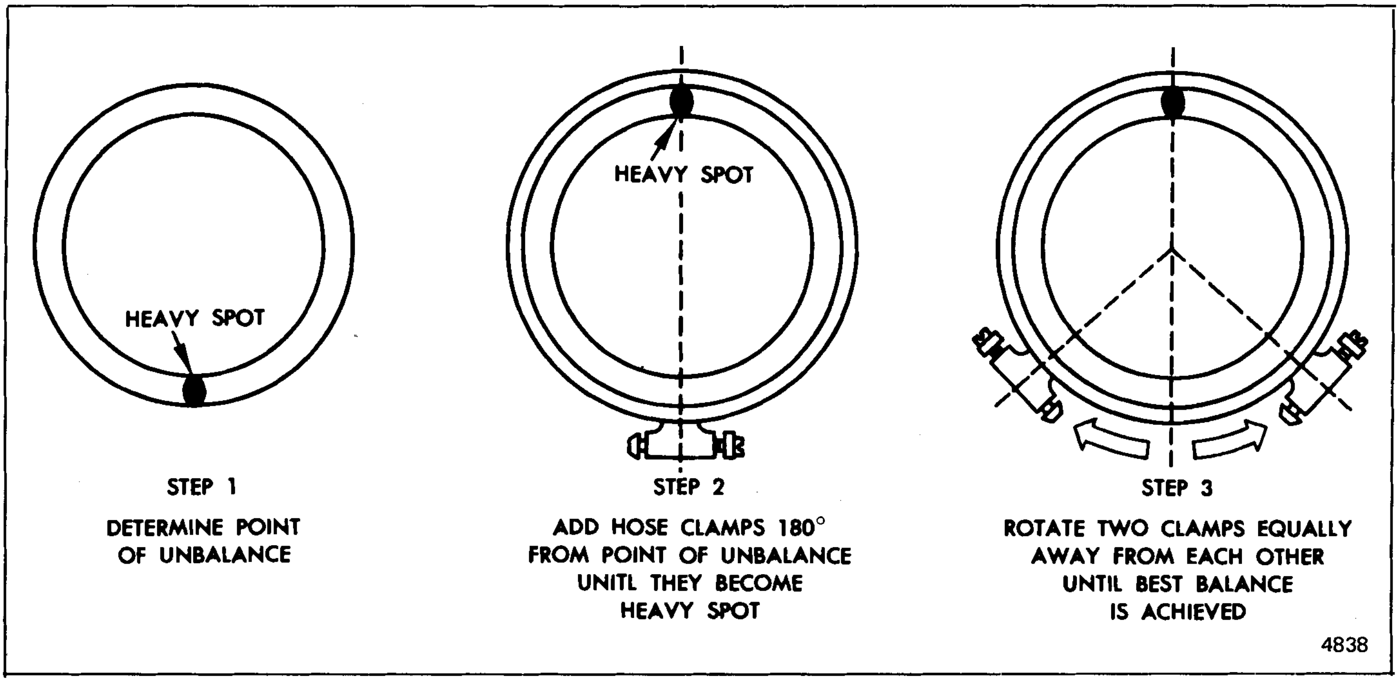


Fig. 4A-13 Positioning Hose Clamp to Achieve Best Balance

8. Install rear drums and wheels and road test car for final check of balance.

Vibration felt in the car on the hoist may not show up in a road test which is the final determining factor.'

UNIT REPAIR

REMOVAL OF PROPELLER SHAFT

CAUTION: *Do not pound on original propeller shaft yoke ears as injection joints may fracture.*

There are two methods of attachment of the rear of the drive shaft to the differential pinion flange or end yoke. One method is a pair of strap and the other is a pair of U-bolts.

Before removing the propeller shaft on the H Series cars, the upper control arm that goes from the differential to the transmission will have to be disconnected from the differential end. Refer to Section 3D for this procedure.

1. Raise vehicle on hoist. Mark relationship of shaft to pinion flange and disconnect the rear universal joint by removing straps or U-bolts. If bearing cups are loose, tape together to prevent dropping and loss of bearing rollers.

2. Withdraw propeller shaft slip yoke from transmission by moving shaft rearward, passing it under the axle housing. Do not allow drive shaft to drop or allow universal joints to bend to extreme angle, as this might fracture injected joints internally. Support propeller shaft during removal.

INSTALLATION OF PROPELLER SHAFT ASSEMBLY

The propeller shaft must be supported carefully during handling to avoid jamming or bending any of the parts.

1. Inspect outer diameter of splined yoke to ensure that it is not burred, as this will damage transmission seal. Inspect splines of slip yoke for damage.

2. Apply engine oil to all splined propeller shaft yokes, then slide yoke and drive shaft assembly onto transmission output shaft.

CAUTION: *Do not drive propeller shaft in place with hammer. Check for burrs on transmission output shaft spline, twisted slip yoke splines or possibly the wrong U-joint yoke. Make sure that the splines agree in number and fit.*

When making rear shaft connection, be sure to align mark on pinion flange or end yoke with mark on drive shaft rear yoke.

3. Position rear universal joint to rear axle pinion flange, making sure bearings are properly seated in pinion flange yoke.

4. Install rear joint fasteners and tighten evenly to torque specified. On H Series cars, reconnect upper control arm.

CAUTION: *These propeller shaft to pinion flange or end yoke fasteners are important attaching parts in that they may affect the performance of vital components and systems, which may result in major repair expense. They must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of* *these parts.*

DISASSEMBLY OF PROPELLER SHAFT

Disassembly of Universal Joint - A, B Series

When disassembling a propeller shaft, one or both of the two types of universal joints, as shown in Fig. 4A-14, may be found.

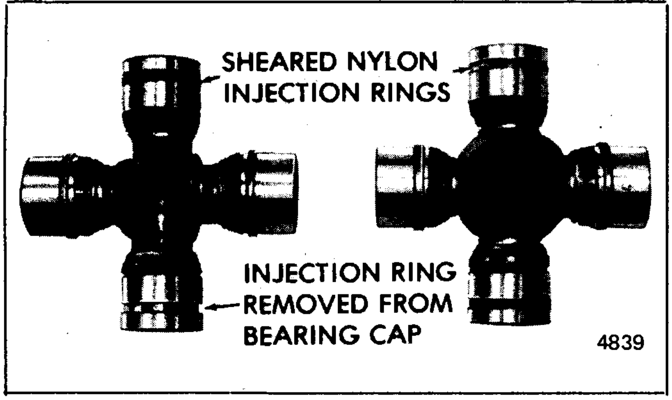


Fig. 4A-14 Production Universal Joints

1. Position propeller shaft and spider press J 9522-3 in power ram equipped with base plate J 8853 and ram screw adapter J 9522-2 (Fig. 4A-15).

2. Actuate the pump to force the spider and bearing to shear the nylon retaining ring and remove the bearing.

3. Release pump valve, rotate propeller shaft 1/2 revolution and install spider guide J 9522-7 into yoke bore of removed bearing and onto the journal end of the spider.

4. Position propeller shaft as before and use spider press and power ram hydraulic pump to shear the nylon injection ring and remove the opposite bearing (Fig. 4A-16).

The above procedures should also be used to disassemble the front universal joint.

Once a production universal joint is disassembled, it cannot be reassembled as there are no snap ring grooves provided in the bearing cap.

Disassembly of Universal Joint - H and X Series

The universal joints are of the extended life design and do not require periodic inspection or lubrication; however, when these joints are disassembled, repack bearings and lubricant reservoir at end of spider with high-melting point wheel bearing lubricant and replace the dust seals.

1. Remove bearing cap snap ring from yoke.

2. Support rear yoke on a piece of 1-1/4" I.D. pipe on an arbor press.

3. Using a suitable socket or rod, press on spider until bearing cap is almost out. Grasp cap in vise and work cup out of yoke.

The bearing cap cannot be fully pressed out.

4. Rotate propeller 1/2 revolution and remove opposite bearing cap using the procedure in step 3.

5. Clean and inspect all parts and relubricate bearings.

The above procedure should also be used to disassemble front universal joint.

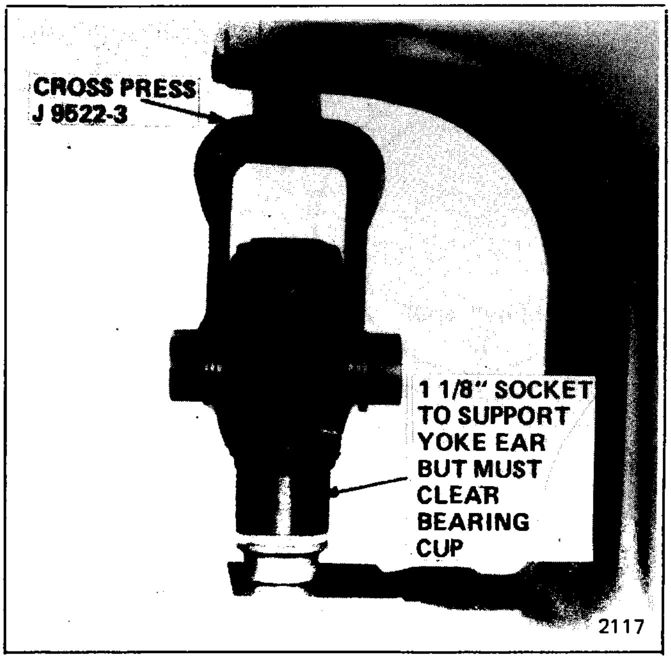


Fig. 4A-15 Pressing Out U-Joint Bearing

ASSEMBLY OF PROPELLER SHAFT

Assemble of Universal Joint - A and B Series

When reassembling a propeller shaft, install complete universal joint repair kits. Repair kits are listed in the Pontiac Master Parts Catalog under Group 5.442 and include a spike, four bearing assemblies, four delrin spacers, four seals and four shields. The four bearings come equipped with snap rings (Fig. 4A-17).

1. Make certain the shields and seals are in firm position and not damaged on the spider and install the spider in the yoke. The spider may face in either direction.

2. Install spider guide J 9522-7 into one yoke bore and position spider journal into the guide. Push guide in far enough for opposite journal to extend slightly above yoke bore. Spiker journals and bearings must be free of dirt or foreign material (Fig. 4A-18).

3. Place the propeller shaft and yoke assembly in position with the Power Ram and Pump. Inspect bearing cup to see that all needle bearings are in place and lubricated. Make certain the Delrin Washer is in place against the needle bearings. Position bearing straight over yoke bore and onto spider journal. Failure to pilot the spider journal into the bearing could cause the bearing needles to become dislodged during installation of the bearing cup (Fig. 4A-19).

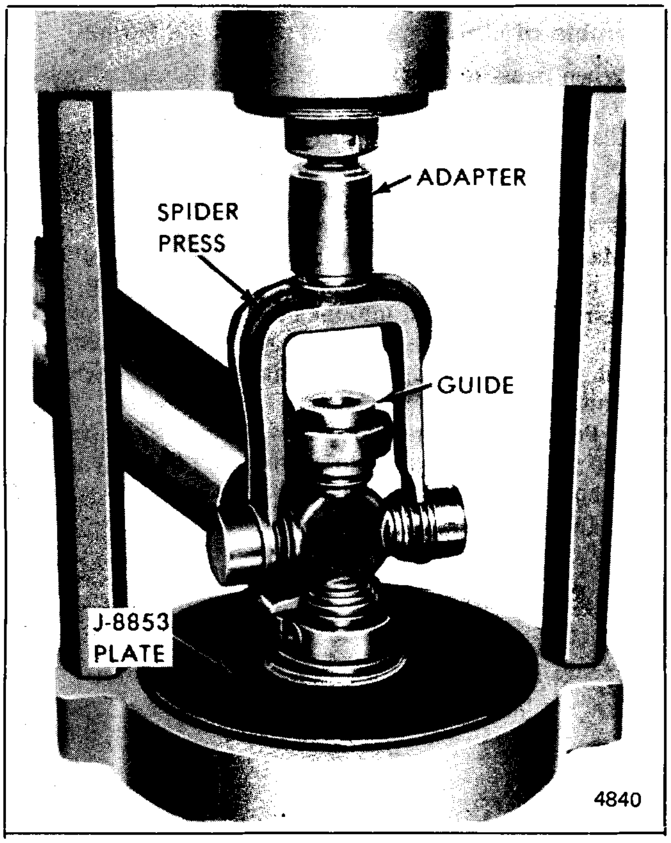


Fig. 4A-16 Pressing Out U-Joing Bearing With Guide Installed

With the pump, force the bearing into the yoke. As the bearing nears the end of its required travel, it will cause the spider to push the guide outward without damage to the seal or shield. The bearing cup is properly positioned in the yoke when the snap ring groove is exposed enough to install the snap ring. When the bearing is correctly positioned in the yoke, turn the assembly over, remove the guide J 9522-7 and again place bearing over the bore in the yoke. Carefully slide the spider partially out of the previously seated bearing and start it carefully into the bearing being installed. This prevents the bearing needles from burring the edge of the spider journal if forced over journal other than straight. Even

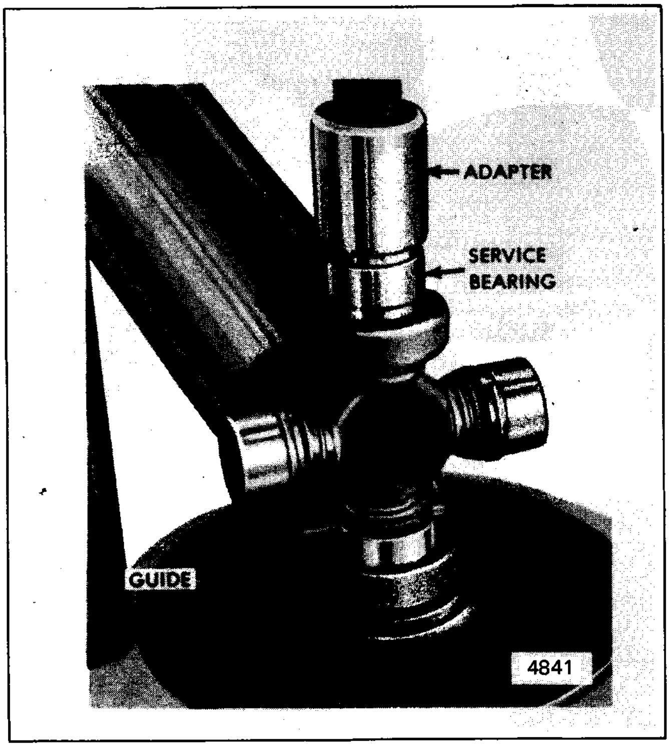


Fig. 4A-18 Installing U-Joint Bearing With Guide in Place

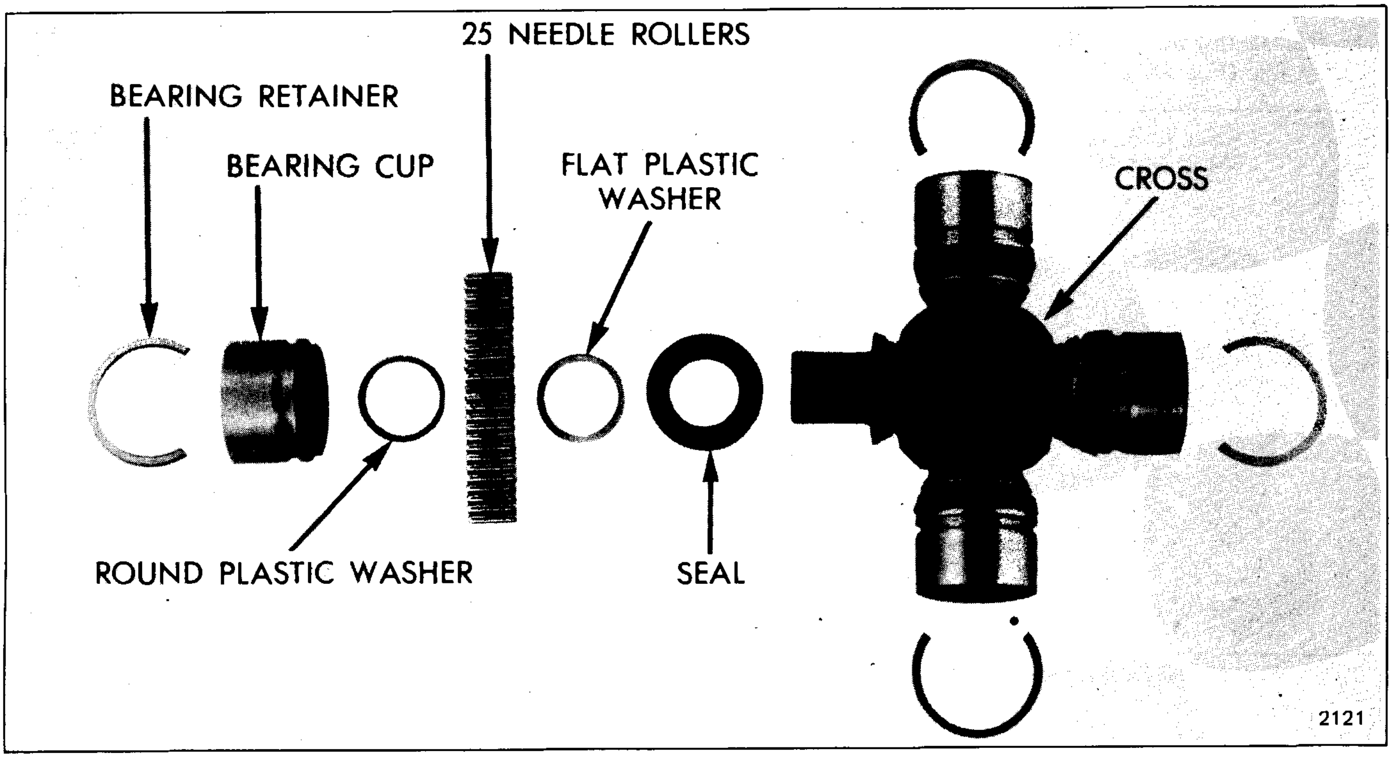


Fig. 4A-17 Service Universal Joint

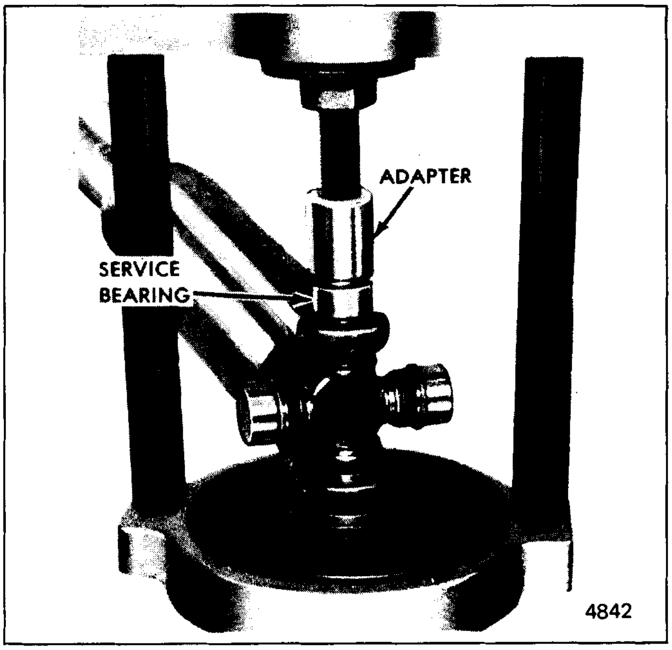


Fig. 4A-19 Installing U-Joint Bearing

slight burring of the journal can cause premature failure.

While pressing bearings into position, move the spider back and forth to make certain that the spider journals engage the bearings squarely to avoid damage and binding. If binding exists, remove the bearings and spider and examine for dislodged rollers or damaged journals.

If excessive resistance is encountered, the bearings should be removed as this is an indication that one or more of the needles are out of place.

4. While observing the previous precautions, install the balance of the bearings necessary to complete the assembly and install snap rings.

5. Strike the yoke firmly with a hammer to fully seat the snap rings against the yoke. Turn the spider to make certain that it is free (Fig. 4A-20).

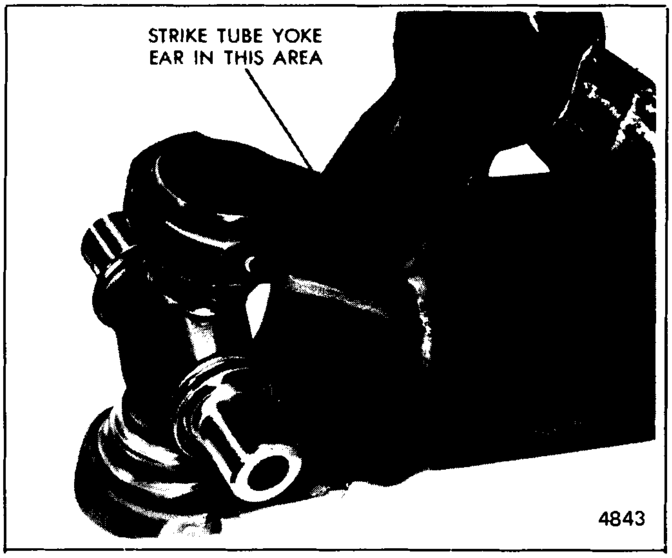


Fig. 4A-20 Seating U-Joint Snap Rings

Assemble of Universal Joint - H and X Series

When reassembling a propeller shaft, use complete universal joint repair kit (Fig. 4A-21).

Place dust seals on spider with the cavity of seal toward end of spacer. Press seal onto spider, exercising caution during installation to prevent seal distortion and to assure proper seating of seal on spider.

Make sure that the lubricant reservoir at the end of each spider is completely filled with lubricant. In filling these reservoirs, pack lubricant into the holes so as to fill from the bottom. The use of a squeeze bottle is recommended. This will prevent air pockets and ensure an adequate supply of lubricant.

1. Position spider into yoke. Partially install one bearing cap into yoke. Start spider into bearing cap. Partially install other cap, align spider into cap and press caps into yoke.
2. Install snap rings.

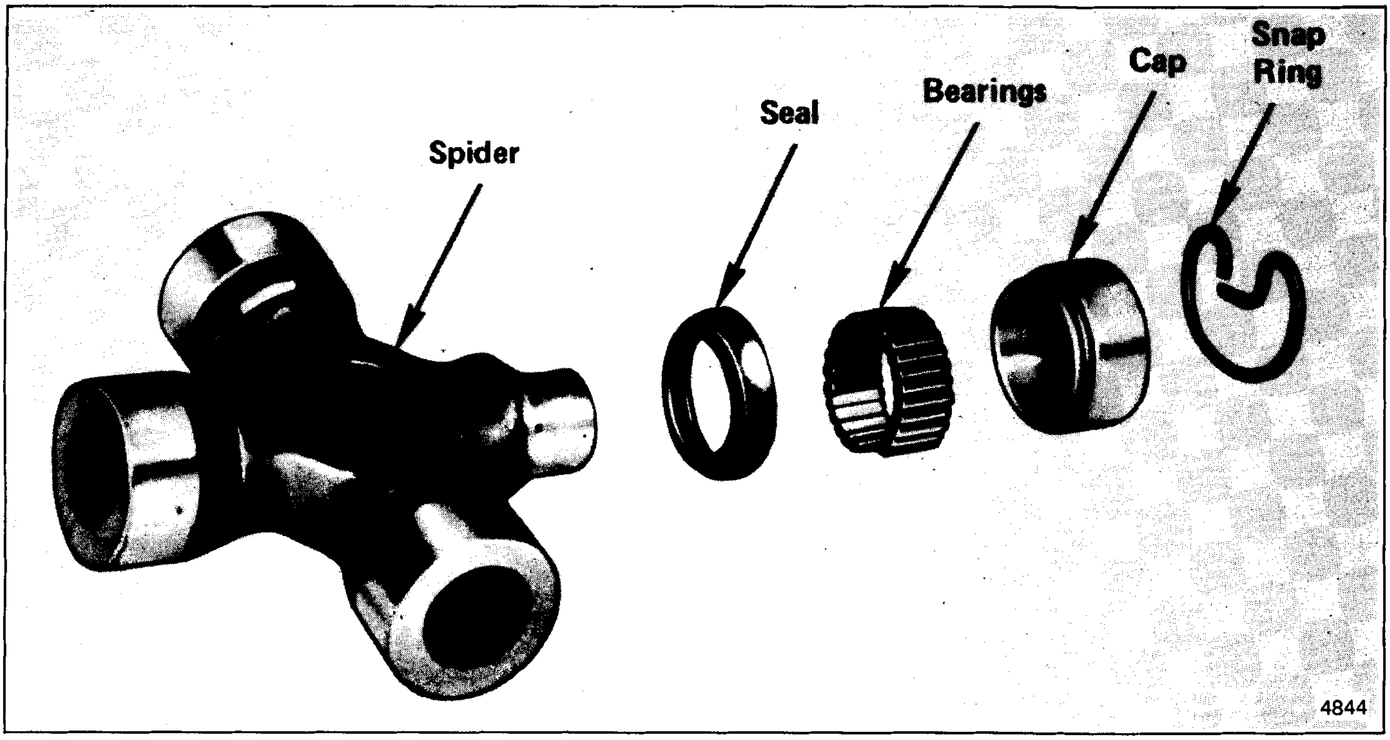


Fig. 4A-21 Universal Joint Repair Kit - H and X Series

SPECIFICATIONS

PROPELLER SHAFT SPECIFICATIONS

Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightening without straining or distorting parts. These specifications are for clean and lightly-lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

TORQUE

	LB. FT.
Rear U-Joint to Pinion Flange A, B and X Series	15
Rear U-Joint to Pinion Flange H Series	15

SPECIAL TOOLS

J 8853	Base Plate
J 9522-2	Adaptor
J 9522-3	Cross Press
J 9522-7	Guide
J 23498	Inclinometer (or J 22910-01 may be used)

SECTION 4B

DIFFERENTIAL

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

DESCRIPTION AND OPERATION OF STANDARD AND POSITIVE TRACTION DIFFERENTIAL

STANDARD DIFFERENTIAL DESCRIPTION

The differential assembly is of the semi-floating type in which the car weight is carried on the axle housing. The differential assembly is designed for use with an open drive line and coil or leaf springs. The differential has a hypoid type ring gear and pinion with the centerline of the pinion gear below the centerline of the ring gear.

All parts necessary to transmit power from the propeller shaft to the rear wheels are enclosed in a salisbury type axle housing (a carrier casting with tubes pressed and welded into the carrier to form a complete carrier and tube assembly). A removable steel cover bolted to the rear of the carrier permits service of the differential without removing the entire assembly from the car.

A universal joint connects the rear end of the propeller shaft to a pinion flange, having a splined end which fits over and drives the hypoid pinion gear. Two pre-loaded tapered roller bearings support the hypoid pinion gear in the carrier. The inner race of the rear bearing is a tight press fit on the pinion stem. The inner race of the front bearing combines a light press fit to a close sliding fit on the pinion flange end of the pinion stem. The outer race of each bearing is pressed against a shoulder recessed in the carrier. Tightening the pinion nut compresses a collapsible spacer which bears against the inner race of the front bearing and a shoulder on the pinion stem. This spacer is used to enable accurate bearing pre-load adjustment and maintain a pre-load on both front and rear pinion bearings. Adjustment of the fore and aft position of the pinion is obtained by placing shims between the head of the drive pinion and the rear pinion bearing. The differential case is of one-piece construction and is supported in the carrier by two tapered roller side bearings. These are pre-loaded by inserting shims between the bearings and the carrier. The differential case assembly is positioned for proper ring gear to pinion backlash by varying the shim thickness from side to side. The ring gear is bolted to the case. Two side gears have splined bores for driving the axle shafts. They are positioned to run in counterbored cavities in the case. The two differential pinions have smooth bores and are held in position by a solid pinion cross shaft, mounted and locked in the differential case. All four gears are in mesh with each other and because the pinion gears turn freely on their shaft, they are as idler gears when the rear wheels are turning at different speeds. The pinions and side gears are backed by steel thrust washers.

POSITIVE TRACTION DIFFERENTIAL DESCRIPTION

The positive traction differential differs from the standard differential in that a different type of case assembly is used. The positive traction case assembly provides increased resistance to differential action and multiplies the tractive force available at the wheel with the least traction. This multiplied force is then available to the wheel with the better traction.

Three types of positive traction differential case assemblies are used: 1) Cone clutch type; 2) Plate clutch type (waffle pattern plates and rounded ear lugs); and 3) Plate clutch type (swirl pattern plates and square ear lugs). The cone clutch type is only serviced as a complete case assembly. The plate clutch type case assemblies are serviced individually; the internal parts are not interchangeable between types of differentials.

Rear axle assemblies having positive traction differentials may be identified by a rectangular stainless steel tag on the five o'clock inspection cover bolt or by a red plastic triangular tag on the filler plug. In addition, identification may be made by reading the code letters from the forward side of the right axle tube, three inches outboard of the carrier.

Axle Shaft and Wheel Bearings--Two types of axle shafts and wheel bearings are used. One type rolls directly on the axle shaft. With this type, the shaft is retained in the housing by "C"-Locks in the differential side gears. This type may be identified by reading the code letters from the forward side of the right rear axle tube three inches outboard of the carrier. The third letter "C", "G", "K", "O" (7 1/2" ring gear axle) or "P" identifies this type. For example, the code letters "WCG" would indicate a 3.08 ratio, standard differential, and direct-on type roller bearing, "C"-Lock retained axle shaft. The second type wheel bearing has its own inner race and is retained on the axle shaft by a retainer ring. This type may be identified by reading the code letters on the right rear axle tube. The third letter "B" or "O" (8 1/2" ring gear axle) identified this type. For example, the code letters "KWB" would indicate a 3.08 ratio, standard differential, unit roller wheel bearing retained in the axle housing by an outer retainer plate bolted to the housing end flange and retained on the shaft by a pressed on ring.

OPERATION - STANDARD DIFFERENTIAL (FIG. 4B-1)

Power from the engine is transferred to the transmission via clutch or a fluid coupling. The transmission then provides the transfer of power to its output shaft, which is splined to the propeller shaft by means of a universal joint connection. Since the rear of the propeller shaft is connected to the differential drive pinion through the pinion flange, the transmission output shaft, propeller shaft, and differential drive pinion all turn at the same speed.

Power from the drive pinion gear is transmitted to the ring gear which is bolted to the differential case. When driving in a straight line and there is equal resistance on each rear wheel, the force through the drive pinion and ring gear turns the axle shafts at the same rate of speed and there is no movement between differential pinions and side gears.

When the vehicle turns a corner, the outer rear wheel must turn faster than the inner wheel. The inner wheel, turning slower with respect to the outer wheel, slows its differential side gear (as the axle shaft is splined to the side gear) and the differential pinion gears will roll around the slowed differential side gear driving the other differential side gear and wheel faster.

OPERATION - POSITIVE TRACTION DIFFERENTIAL (FIG. 4B-2)

The operation of the positive traction differential is the same as the standard differential, except that there is additional friction provided by the clutches (cone or plate type). Under ordinary driving and cornering conditions, the clutches slip, allowing the outside wheel to turn faster than the inner. Under poor traction conditions, such as ice, snow, or loose gravel under one driving wheel, the increased friction provided by the clutches increases the driving torque available to the wheel with the better traction. The clutches (cone or plate type) are spring loaded to provide the increased driving torque under extremely low tractive conditions.

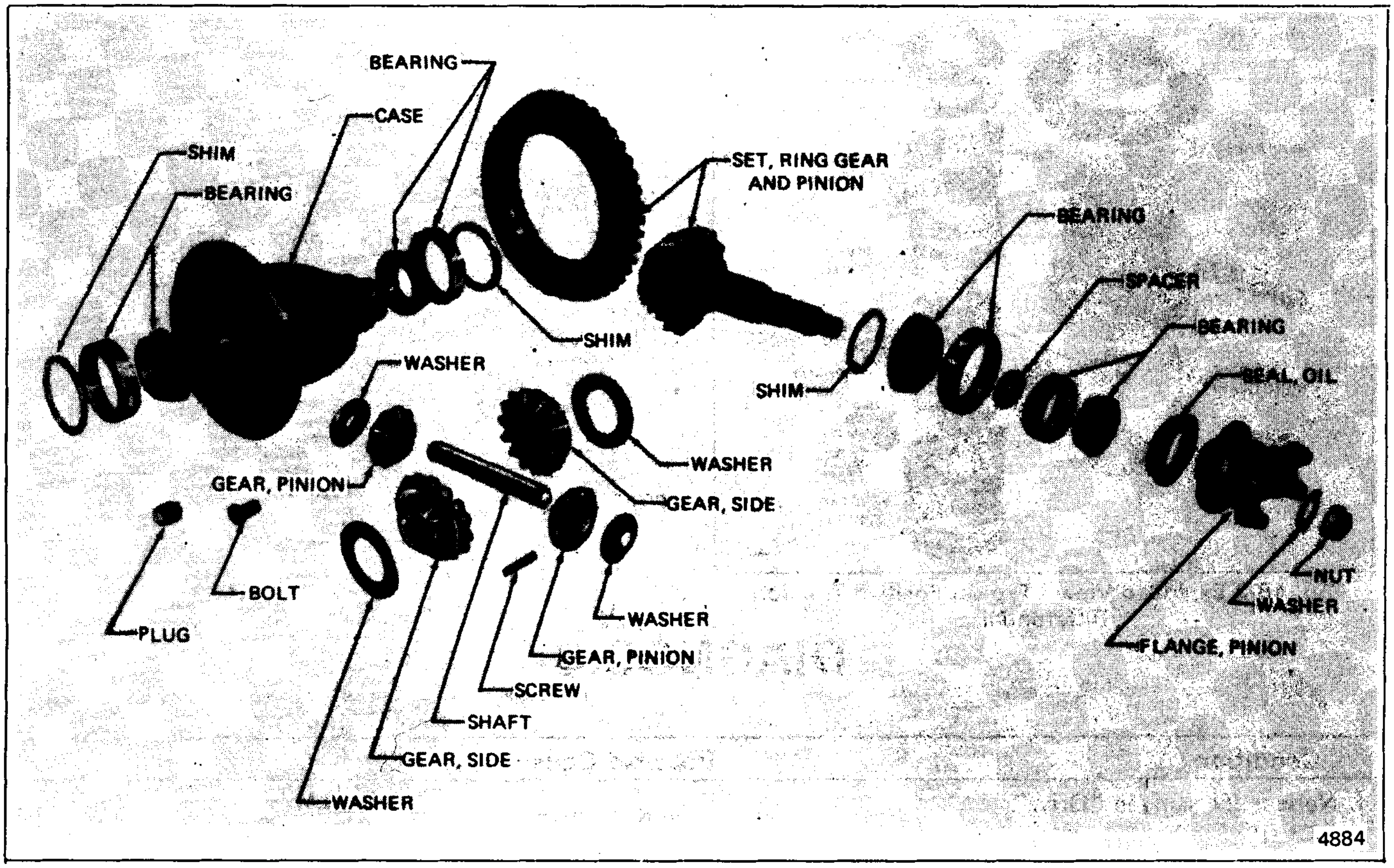


Fig. 4B-1 Exploded View - Typical Standard Differential

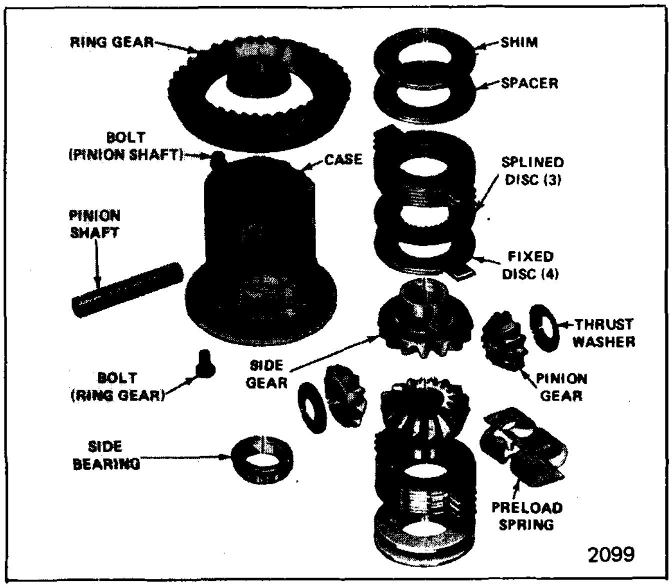


Fig. 4B-2 Exploded View - Typical Positive Traction Differential

DIAGNOSIS

Condition	Possible Cause
1. Noise is the same in "Drive" or "Coast"	1.a. Road noise b. Tire noise c. Front wheel bearing noise d. Front or rear U-joint angle too great
2. Noise changes on a different type of road	2.a. Road noise b. Tire noise
3. Noise lowers tone as car speed is lowered	3. Tire noise
4. Similar noise is produced with car standing and driving	4.a. Engine noise b. Transmission noise c. Driveline angle
5. Vibration	5.a. Rough rear wheel bearing b. Unbalanced or damaged propeller shaft c. Tire unbalance d. Worn universal joint in propeller shaft e. Front or rear U-joint angle too great f. Mix-indexed propeller shaft at pinion flange g. Pinion flange runout too great
6. A knock or click approximately every two revolutions of rear wheel	6. A brinelled rear wheel bearing
7. Noise most pronounced on turns	7. Differential side gear and pinion

8. A continuous low pitch whirring or scraping noise starting at relatively low speed	8. Pinion bearing
9. Drive noise, coast noise or float noise	9. Ring and pinion gear
10. Clunk on acceleration or deceleration	10.a. Worn differential cross shaft in case b. Engine dash pot out of adjustment
11. Grunt on stops	11. No grease in propeller shaft slip yoke
12. Groan in "Forward" or "Reverse"	12. Wrong lube in differential
13. Chatter on turns	13.a. Wrong lube in differential b. Clutch plates worn
14. Clunk or knock on rough road operation	14. Excessive end play of axle shafts to differential cross shaft

PRE-REPAIR INVESTIGATION AND TROUBLE DIAGNOSIS

A close examination of the differential prior to disassembly will often reveal valuable information as to the extent and type of repairs or adjustments necessary. The information thus gained, coupled with the report of malfunctioning, will provide a basis for determining the degree of disassembly required. Since frequent cause of axle noise are improper backlash, pinion bearing pre-load, or side bearing pre-load, or a combination, a few simple adjustments may be all that are necessary to correct a problem.

Therefore, before removing the differential from the housing, the following checks should be made with the results recorded and analyzed: 1) Backlash; 2) Total Assembly Preload; and 3) Tooth Contact Pattern Test.

Use care at all times to keep dirt and other foreign matter, such as grinder dust, soot or sand, away from differential to prevent possibility of subsequent failure.

The pinion and ring gear must be completely assembled, installed, and all pre-load and backlash adjustments completed prior to the start of this method of pinion depth setting. The following procedure can be used in place of the gage method of pinion depth setting.

GEAR TOOTH NOMENCLATURE

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end.

The end of the tooth farthest away from the center is the "heel" end. Toe end of tooth is smaller than heel end. It is very important that tooth contact be tested before the differential carrier assembly is disassembled. Variations in the carrier or pinion rear bearing may cause the pinion to be too far away from, or close to, the ring gear. Thus, the tooth contact must be tested and corrected, if necessary, or the gears may be noisy.

TOOTH CONTACT PATTERN TEST

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.

2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth, using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.

3. Tighten bearing cap bolts to 55 lb. ft.

4. Expand brake shoes until a torque of 40-50 lb. ft. is required to turn the pinion.

A test made without loading the gears will not give a satisfactory pattern. Turn pinion flange with wrench so that ring gear rotates one full revolution, then reverse rotation so that ring gear rotates one revolution in opposite direction.

5. Observe pattern on ring gear teeth and compare with Figs. 4B-3.

EFFECTS OF INCREASING LOAD ON TEETH CONTACT PATTERN

When "load" on ring and pinion gear is increased, such as when car is accelerated forward from standstill or from normal drive, the tooth contact will tend to spread out and, under very heavy load, will extend from near toe to near heel on the drive side. The entire contact also tends to shift toward heel under increasingly heavier loads and will become somewhat broader with respect to tops and bottoms of teeth. The patterns obtained by this tooth contact pattern test approximate a light load and, for this reason, they will extend

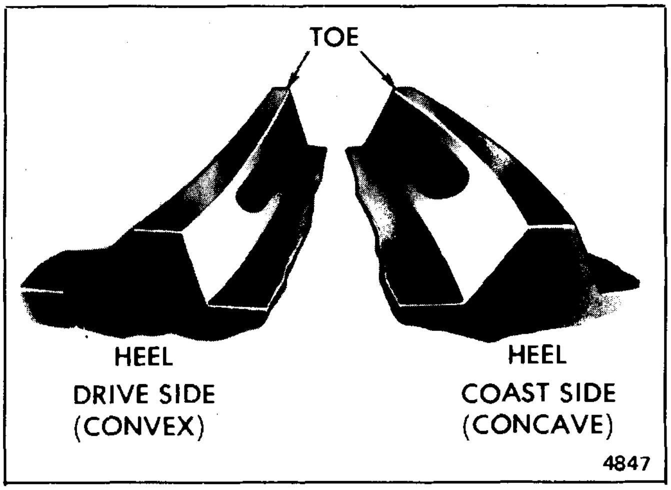


Fig. 4B-3 Gear Teeth Nomenclature

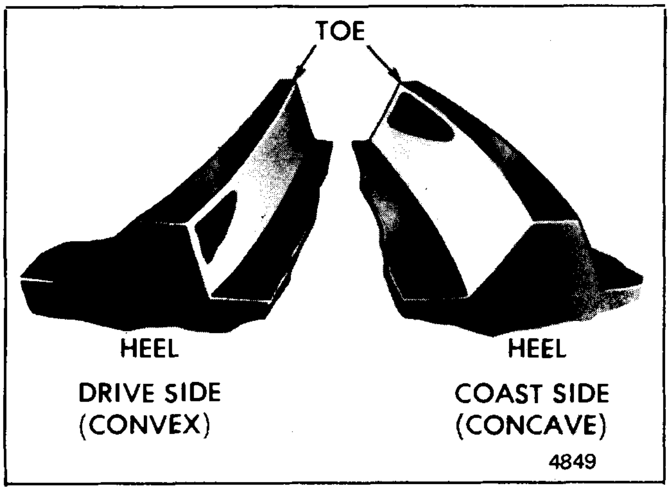


Fig. 4B-4 Tooth Pattern - Pinion Too Far Away From Ring

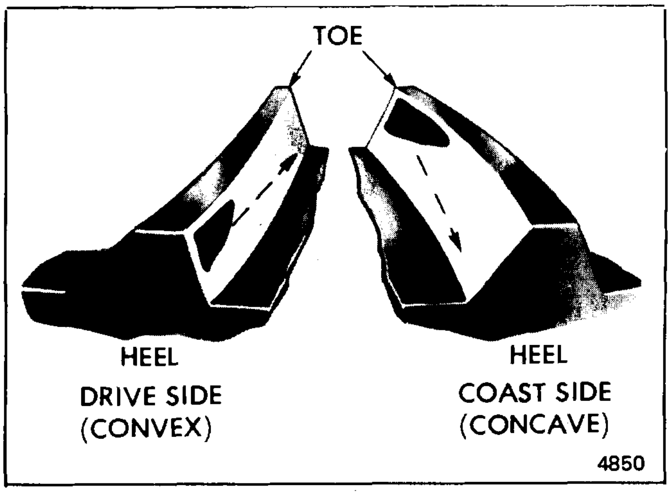


Fig. 4B-5 Effect on Pattern as Shim Thickness is Increased

only about halfway.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will affect tooth contact pattern, backlash, and position of drive pinion in carrier. The effects of bearing pre-loads ae not readily apparent on (hand-loaded) tooth contact pattern tests; however, these adjustments should be within specificatons before proceeding with backlash and drive pinion adjustments.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from, the drive pinion. (The adjusting shims are also used to set side bearing pre-load.) The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

EFFECTS OF PINION POSITION ON TOOTH PATTERN

When the drive pinion is too far away from centerline of the ring gear, the pattern will be a high heel contact on the drive side and high toe contact on coast side. (Fig. 4B-4). Moving the pinion closer to centerline of the ring gear by increasing shim thickness will cause the high heel contact on drive side to lower and move toward the toe; the high toe contact on coast side will lower and move toward the heel (Fig. 4B-5).

When the pinion is too close to the centerline of the ring gear, the pattern will be a low toe contact on drive side, and a low heel contact on coast (Fig. 4B-6). Moving the pinion farther away from the ring gear by decreasing shim thickness will cause low toe contact on drive side to raise and move toward the heel; the low heel contact on coast side will raise and move toward the toe (Fig. 4B-7).

Whenever the rear axle is overhauled to the point of requiring a new ring gear and pinion set, the rear axle should be filled ONLY with the lubricant included with the gear set. Whenever the rear axle is overhauled to the point of requiring only pinion and/or side bearings, it is recommended that lubricant 1050081, or equivalent, be used to refill for positive traction units and for regular units.

ELIMINATION OF EXTERNAL NOISES

When a rear axle is suspected of being noisy, it is advisable to make a thorough test to determine whether the noise originates in the tires, road surface, front wheel bearings, engine, transmission or rear axle assembly. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly.

Road Noise - Some road surfaces, such as brick or rough-surfaced concrete, cause noise which may be mistaken for tire or rear axle noise. Driving on a different type of road, such as smooth asphalt or dirt, will quickly show whether the road surface is the cause of noise. Road noise usually is the same on drive or coast.

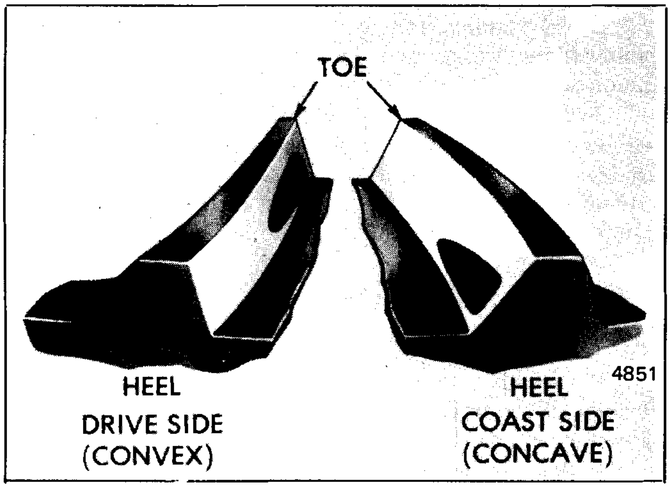


Fig. 4B-6 Tooth Pattern - Pinion Too Close To Ring Gear (Excessive Shim Thickness)

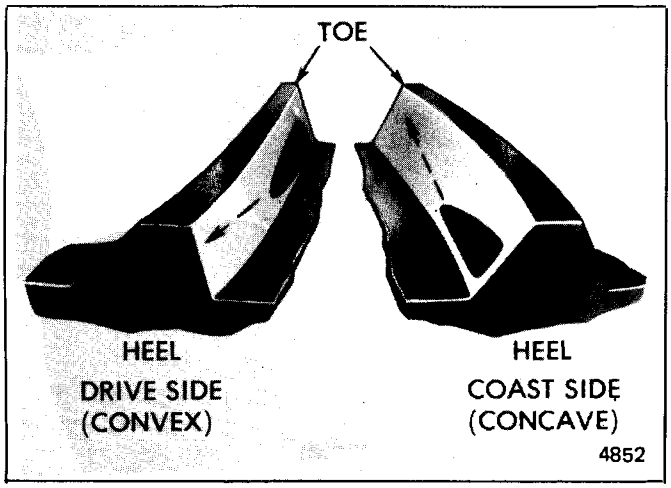


Fig. 4B-7 Effect on Tooth Pattern As Shim Thickness is Decreased

Tire Noise - Tire noise may easily be mistaken for rear axle noise, even though the noisy tires may be located on the front wheels. Tires worn unevenly, or having surfaces on non-skid divisions worn in saw-tooth fashion, are usually noisy and may produce vibrations which seem to originate elsewhere in the vehicle. This is particularly true with low tire pressure.

Test for Tire Noise - Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 50 pounds pressure, for *test purposes only*, will materially alter noise caused by tires but will not affect noise caused by rear axle. Rear axle noise usually ceases when coasting at speeds under 30 miles per hour; however, tire noise continues but with lower tone as car speed is reduced: Rear axle noise usually changes when comparing "pull" and "coast", but tire noise remains about the same.

Front Wheel Bearing Noise - Loose or rough front wheel bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing "pull" and "coast". Light application of brake, while holding car speed steady, will often cause wheel bearing noise to diminish, as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, and also by shaking wheels to determine if bearings are excessively loose.

Engine and Transmission Noises - Sometimes a noise which seems to originate in the rear axle is actually caused by the engine or transmission. To determine which unit is actually causing the noise, observe approximate car speeds and conditions under which the noise is most pronounced; then stop car in a quite place to avoid inferferring noises. With transmission in neutral, run engine slowly up and down through engine speeds corresponding to car speed at which the noise was most pronounced. If a similar noise is produced with car standing, it is caused by the engine or transmission and not the rear axle.

REAR AXLE NOISES

If a careful test of car shows that noise is not caused by external items, as described above, it is then reasonable to assume that noise is caused by rear axle assembly. The rear axle should be tested on a smooth level road to avoid road noise. It is not advisable to test rear axle for noise by running with rear wheels jacked up.

Noises in rear axle assembly may be caused by a faulty propeller shaft, faulty rear wheel bearings, faulty differential or pinion shaft bearings, misalignment between two U-joints, or worn differential side gears and pinions; noises may also be caused by mismatched, improperly adjust or scored ring and pinion gear set.

Rear Wheel Bearing Noise - A rough rear wheel bearing produces a vibration or growl which continues with car coasting and transmission in neutral. A brinelled rear wheel bearing causes a knock or click approximately every two revolutions of rear wheel, since the bearing rollers do not travel at the same speed as the rear axle and wheel. With rear wheels jacked up, spin rear wheels

by hand while listening at hubs for evidence of rough or brinelled wheel bearing.

Differential Side Gear and Pinion Noise - Differential side gears and pinions seldom cause noise, since their movement is relatively slight on straight-ahead driving. Noise produced by these gears will be most pronounced on turns.

Pinion Bearing Noise - Rough or brinelled pinion bearings produce a continuous low pitch whirring or scraping noise starting at relatively low speed.

Ring and Pinion Gear Noise - Noise produced by the ring and pinion gear set generally shows up as drive noise, coast noise or float noise. Drive noise is noise produced during vehicle acceleration; coast noise is noise produced while allowing car to coast with throttle closed; and float noise is noise occurring while just maintaining constant car speed at light throttle on a level road. Drive, coast and float noises will vary in tone with speed and will be very rough and irregular if the differential or pinion shaft bearings are rough, worn or loose.

BODY BOOM NOISE OR VIBRATION

Objectional "body boom" noise or vibration can be caused by an unbalanced propeller shaft. Excessive looseness at the spline can contribute to this unbalance.

Other items that may also contribute to the noise problem are as follows:

1. Undercoating or mud on the shaft, causing unbalance.
2. Shaft or pinion flange balance weights missing.
3. Shaft damage, such as bending, dents or nicks.
4. Tire-type roughness. Switch tires from a known good car to determine tire fault.

OIL LEAKS

It is difficult to determine the source of some oil leaks. When there is evidence of an oil leak, determine source as follows:

1. Oil coming from the axle housing at the brake backing plate is caused by a leaking axle shaft seal.
2. Oil coming from between the pinion flange or the pinion flange slinger and the carrier is caused by a leaking pinion seal.
3. Oil leaking at the junction of the axle tubes to the carrier, or at the puddle weld holes are difficult to repair. Under no circumstances should any welding be done in attempts to stop leaks in these areas. If the leak is severe, the complete rear axle housing should be replaced.

TESTING POSITIVE TRACTION DIFFERENTIAL

If there is a doubt that a Pontiac is equipped with a Positive Traction Differential, or to determine if this option is performing satisfactorily, a simple test can be performed:

1. Place transmission in neutral.
2. Raise one wheel off floor and place a block of wood in front and rear of opposite wheel.
3. Remove wheel cover and install torque wrench with extension on lug nut.
4. Disregard breakaway torque and observe only torque required to continuously turn wheel smoothly. If differential assembly is equipped with Positive Traction Differential, the rotating torque will be at least 35 lb. ft.

ON CAR SERVICE

POSITIVE TRACTION FLUSHING PROCEDURE

The following procedure is established for flushing the Positive Traction Differential in the event the wrong lubricant is accidentally added:

1. Drain original lubricant from differential housing.
2. Fill axle with a light, non-detergent engine oil.
3. Raise both rear wheels off floor.
4. With car properly supported, run car in "Drive" range for three to four minutes. Do not exceed 30 mph on speedometer or accelerate or decelerate rapidly.
5. Remove oil from axle.
6. Repeat Steps 2, 3, 4 and 5. It is important that the axle be flushed two times to ensure complete removal of the original lubricant.
7. Fill differential housing with positive traction lubricant, GM Part No. 1052271, or equivalent.

CORRECTING REAR AXLE COMPANION FLANGE SPLINE LEAKS

Check and confirm that it is not a pinion seal I.D. or O.D. leak, but a leak around the companion flange washer or nut:

1. Mark propshaft and companion flange to permit proper alignment at reinstallation. Disconnect propshaft from companion flange and support shaft out of the way. If U-joint bearing cups are not held by a retainer strap, use a piece of wire or tape to retain bearing cups in place.
2. Mark the position of the companion flange, companion shaft, and nut so the proper companion bearing pre-load can be maintained.
3. Remove companion flange nut and washer.
4. Clean cavity under companion flange washer with lacquer thinner or equivalent (Fig. 4B-8).

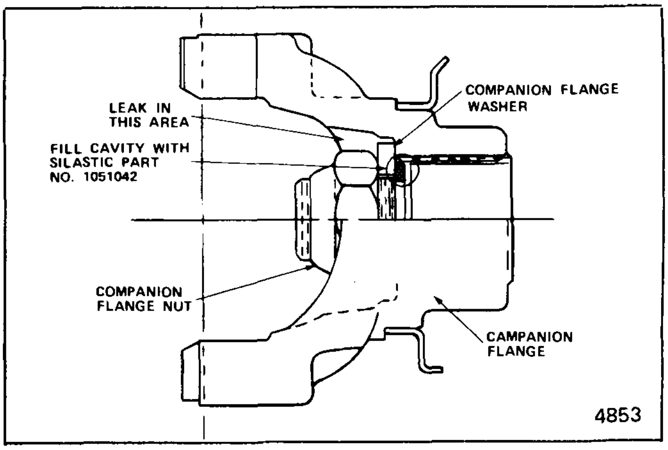


Fig. 4B-8 Area to be Filled with Silastic

5. Fill cavity over full with Group 8.800, Part No. 1051042 (Silastic 732 R.T.V.) or equivalent so that when the washer is reinstalled, the sealer will ooze out around the washer.
6. Install companion flange nut and tighten to the same position as marked in Step 2. While holding companion flange, tighten nut 1/16" beyond alignment marks.

7. Connect propshaft to companion flange using alignment marks made in Step 1 as an index guide. Torque the four bolts to 15 lb.ft.

UNIT REPAIR

REMOVAL AND INSTALLATION OF DIFFERENTIAL ASSEMBLY

It is not necessary to remove the rear axle assembly for any normal repairs. However, if the housing is damaged, the rear axle assembly may be removed and installed, using the following procedure.

REMOVAL OF REAR AXLE ASSEMBLY

1. Raise rear of car high enough to permit working underneath. Place a floor jack under center of axle housing so it just starts to raise rear axle assembly. Place jack stands solidly under frame members on both sides.

2. Mark rear universal joint and companion flange for proper reassembly, then disconnect rear universal joint from flange by removing four bolts and two straps or U-bolts.

On the H car it will be necessary to disconnect the upper control arm from the differential end before propeller shaft can be disconnected.

3. Disconnect parking brake cables by removing adjusting nuts at equalizer. Slide center cable rearward and disconnect two rear cables at connectors to free from body.

4. Disconnect rear brake hose at floor pan. Cover brake hose and pipe openings to prevent entrance of dirt.

5. On vehicles equipped with coil springs, disconnect shock absorbers at lower end and push shock absorbers up out of the way. Lower jack under housing until rear springs can be removed.

6. On vehicles equipped with leaf springs, proceed as follows:

a. Raise car on host.

b. Disconnect shock at lower end by removing nut.

c. Support car by placing jack stands at frame in front of leaf springs and at rear of leaf springs at bumper.

d. Remove lower spring plate attaching nuts.

e. Remove front and rear attaching bolts and remove spring.

7. Roll assembly out from under car.

INSTALLATION OF REAR AXLE ASSEMBLY

CAUTION: *Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

1. Connect lower control arms to housing. Control arm bushing bolts and shock absorbers to be tightened with suspension in normal load position.

2. Connect upper control arms to housing.

3. On vehicles equipped with coil springs place rear springs in position and jack axle housing upward until shock absorbers will reach. Connect shock absorbers.

4. On vehicles equipped with leaf springs, proceed as follows:

a. Connect leaf spring at front attachment.

b. Attach lower spring plate. It may be necessary to lower axle to attach spring plate. Be sure spring cushions are in plate. Tighten nuts to specified torque.

c. Attach leaf spring at rear shackle. Tighten nut to specified torque.

d. Tighten nut at front attachment to specified torque.

e. Reconnect shock.

5. Connect upper and lower control arm bolts. Tighten to specified torque.

6. Connect and adjust parking brake cable.

7. Connect rear universal joint to companion flange aligning marks previously made. Tighten bolts evenly to 15 lb.ft.

8. Connect rear brake hose at floor pan. Bleed both rear brakes and refill master cylinder.

9. Fill rear axle with specified gear lubricant.

REMOVAL AND INSTALLATION OF AXLE SHAFT, WHEEL BEARING OR OIL SEAL

Most rear axle service repairs can be made with the rear axle assembly in the car by raising the rear end of the car with the rear axle hanging on the shock absorbers.

REMOVE AXLE SHAFT ASSEMBLIES

Design allows for maximum axle shaft end play of .018" on the "B" and "O" (with 8 1/2" ring gear) axles, .022" on "C", "G", "K" or "O" (with 7 1/2" ring gear) axles and .032" on the "P" axle. This end play can be checked with the wheel and brake drum removed by measuring the difference between the end of the housing and the axle shaft flange while moving the axle shaft in and out by hand.

End play over the design specification is excessive. Compensating for all of the end play by inserting a shim inboard of the bearing in the housing is not recommended, since it ignores the end play of the bearing itself and may result in improper seating of the backing plate against the axle tube flange. If the end play is excessive, the axle shaft and bearing assembly should be removed and the cause of the excessive end play determined and corrected.

1. Remove wheels.
2. Remove brake drums.
3. For the "C"-Lock type axles, proceed as follows:

a. Remove bolts and differential carrier cover and allow lubricant to drain.

b. Remove pinion shaft lock bolt and pinion shaft (Fig. 4B-9).

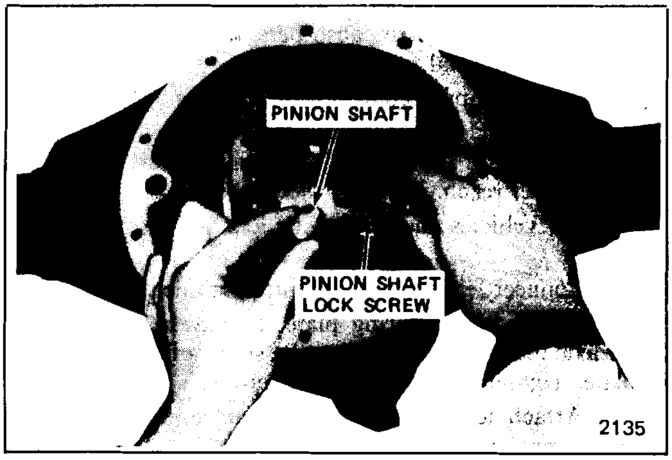


Fig. 4B-9 Pinion Shaft Lock Bolt

c. Push axle shafts inward to permit removal of "C" locks, then remove axle shafts (Fig. 4B-10).

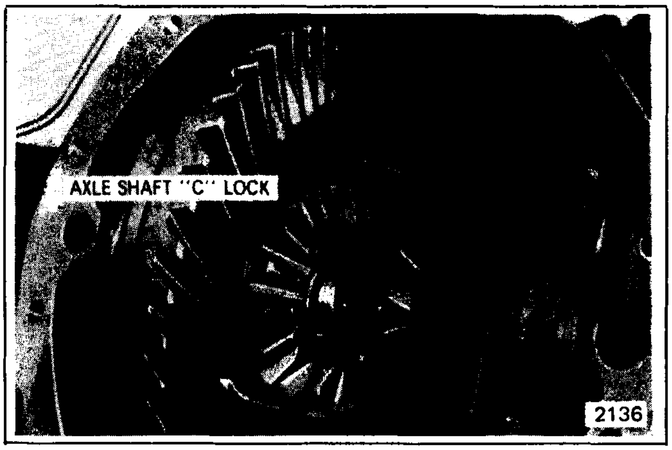


Fig. 4B-10 Axle Shaft "C" Locks

4. For the Non "C" Lock type axles, proceed as follows:

a. Remove nuts holding retainer plates to brake backing plates. Pull retainers clear of bolts and reinstall two opposite nuts finger tight to hold brake backing plate in position.

b. Pull out axle shaft assemblies, using Puller J 21579 with a slide hammer (Fig. 4B-11).

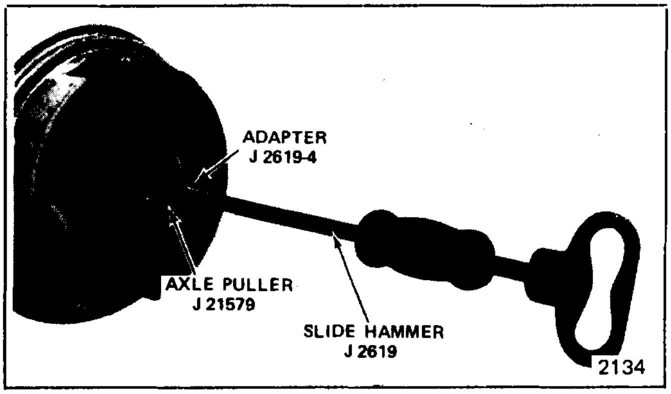


Fig. 4B-11 Removing Non "C" Lock Type Axle Shaft

REMOVE AND INSTALL AXLE SHAFT BEARING AND/OR SEAL (NON "C" LOCK TYPE AXLES)

The rear wheel bearing and bearing retainer ring both have a heavy press fit on the axle shaft. Because of this fit, they should be removed or installed separately. Both the retainer ring and the bearing must be removed to replace the seal.

1. Position and tighten axle shaft in vise so that the retainer ring rests on vise jaws. Use a heavy chisel and hammer to crack retainer ring (Fig. 4B-12). Do not use torch.

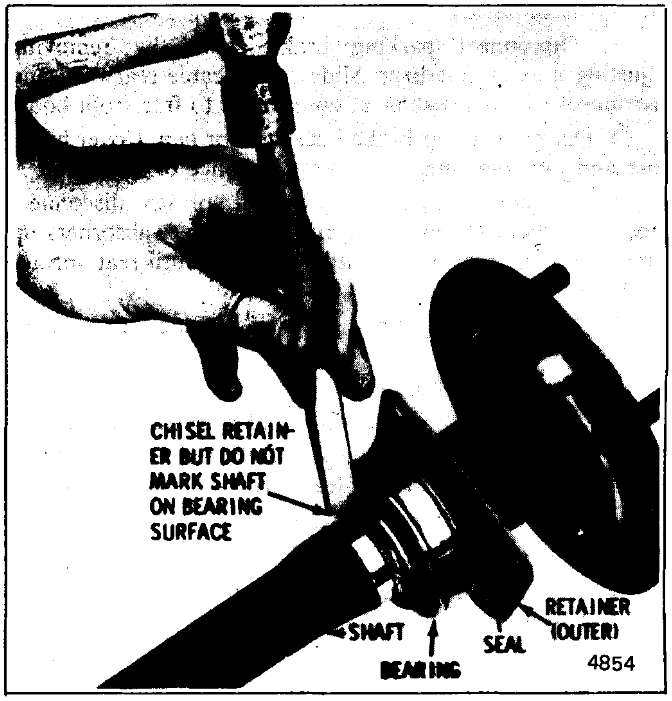


Fig. 4B-12 Removing Axle Shaft Bearing Retainer Ring

2.a. On A or G Series vehicles press off axle shaft bearing by using Remover J 23469 in press plate holder J 6407-1 (Fig. 4B-13).

b. On B Series vehicles, press bearing from axle by using Remover J 23674 (Fig. 4B-14).

CAUTION: *Avoid damaging seal when removing bearing.*

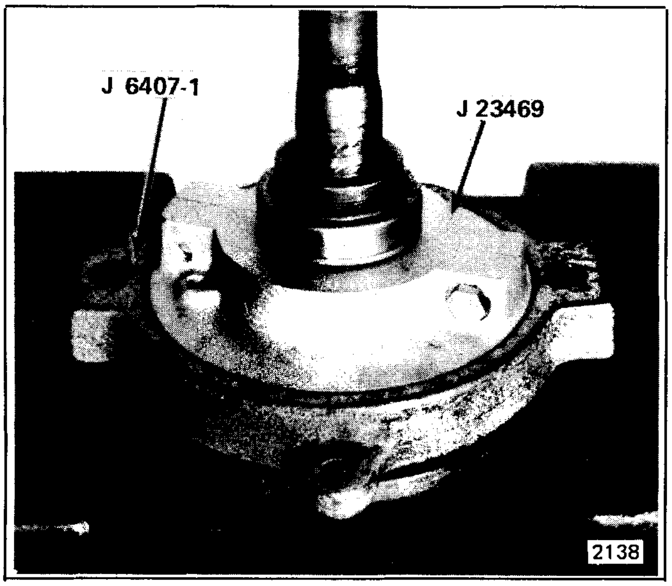


Fig. 4B-13 Removing Axle Shaft Bearing (A or G Series)

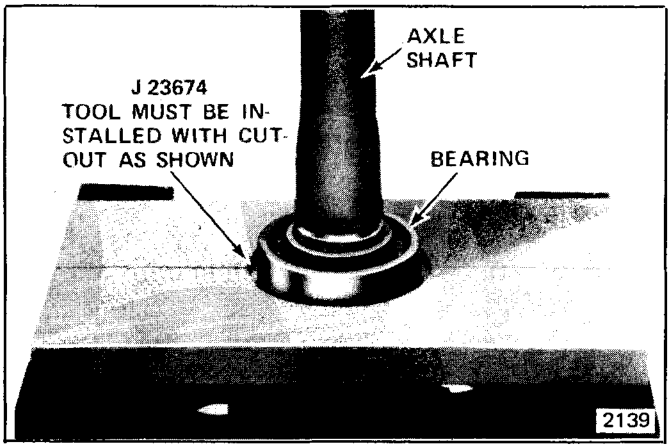


Fig. 4B-14 Removing Axle Shaft Bearing (B Series)

3. Remove axle shaft seal and examine seal running surface for bad spots. If necessary, install new seal, applying a small amount of grease between seal lips. Insure against damaging the seal lip. Retainer plate which retains axle shaft in housing must be installed on axle shaft before seal and bearing are installed.

NOTE: Whenever a bearing or wheel seat is replaced, new inner and outer retainers must be used.

4.a. On A or G Series vehicles, press bearing against shoulder of axle shaft, using Press Plate Holder J 6704-1 and Installer J 23469. Then, position new service retainer ring over shaft and press it against inner race of bearing (Fig. 4B-15).

b. On B Series vehicles, press bearing against shoulder of axle shaft, using Installer J 23674. Then position new service retainer ring over shaft and press it against inner race of bearing (Fig. 4B-16).

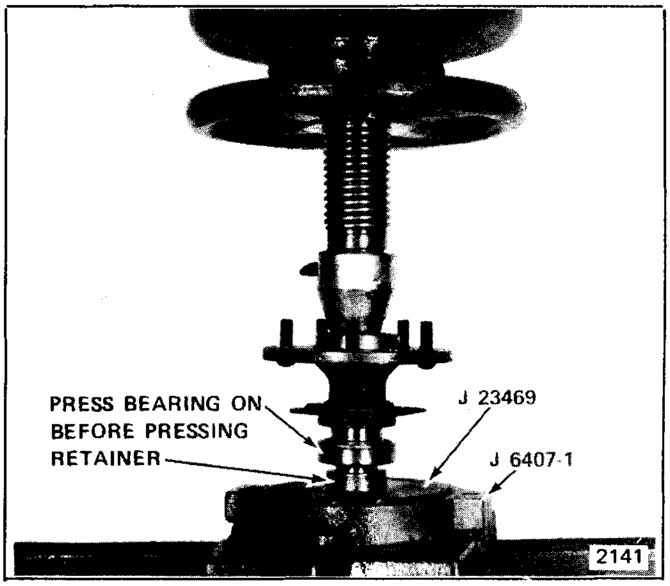


Fig. 4B-15 Pressing New Retainer Ring Against Bearing

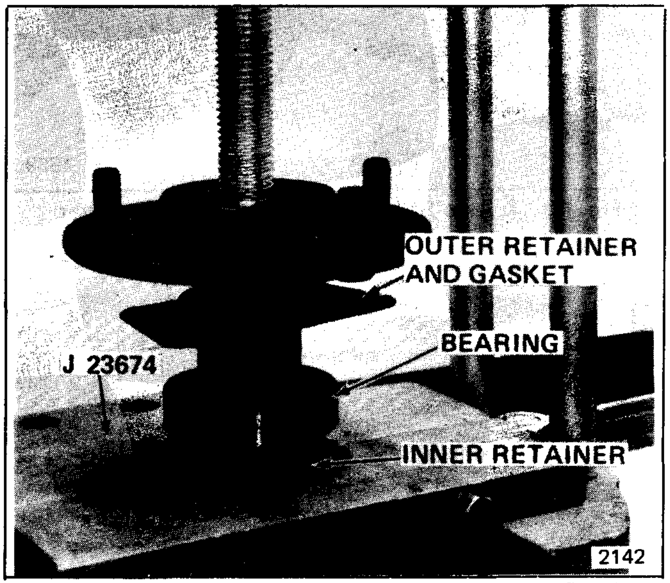


Fig. 4B-16 Pressing New Retainer Ring Against Bearing (B Series)

REMOVE AND INSTALL AXLE SHAFT BEARING AND/OR SEAL ("C" LOCK TYPE AXLES)

Install axle shaft bearing and seal Remover J 22813-01 and remove bearing and seal (Figs. 4B-17 and 4B-18).

Using axle shaft bearing Installer J 23765 (or J 21491 for 6 1/2" R.G. axle), install the bearing. Make sure that tool contacts end of tube to assure that bearing is at proper depth (Fig. 4B-19).

3. Install new seal, using seal Installer J 23771 (or J 21491 for 6 1/2" R.G. axle).

REMOVE AND INSTALL REAR WHEEL BOLT

1. Raise rear of vehicle remove wheel and brake drum. Using Remover J 5504, press bolt from axle flange (Fig. 4B-20).

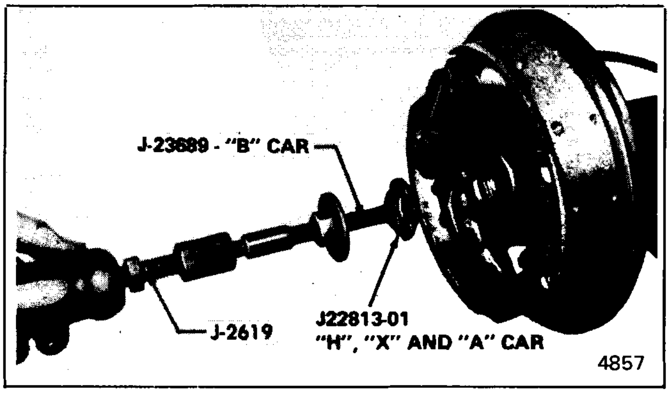


Fig. 4B-17 Axle Shaft Bearing and Seal Remover

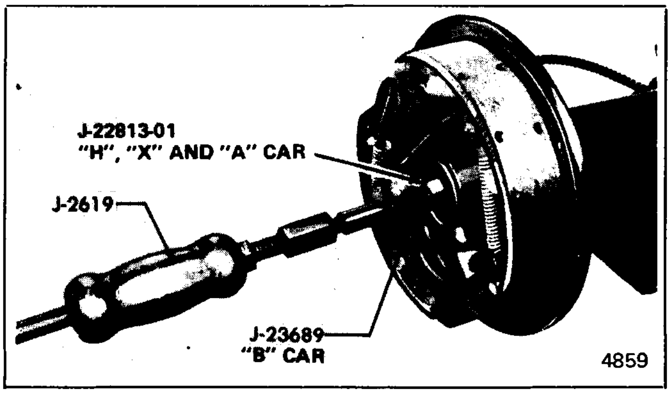


Fig. 4B-18 Axle Shaft Bearing and Seal Remover Installed

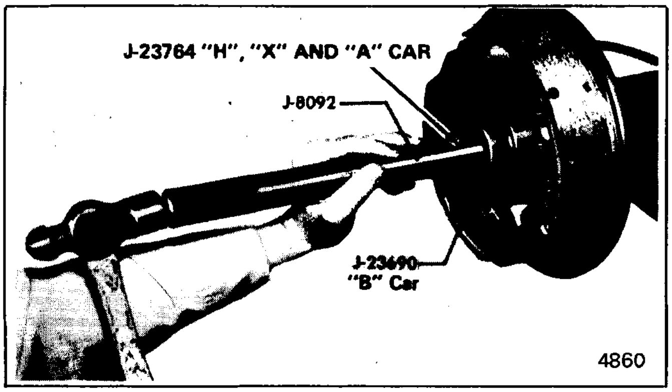


Fig. 4B-19 Installing Axle Shaft Bearing

2. Start new rear wheel bolt through the axle flange. Using a flat washer and flat side of wheel bolt nut over end of bolt tighten nut to pull wheel bolt into place (Fig. 4B-21).

INSTALL AXLE SHAFT ASSEMBLY

NOTE: Axle shafts are not interchangeable between sides.

1. Apply a light coat of wheel bearing grease in wheel bearing and seal recess of housing.

2. On the Non "C" Lock type axles, apply gear lubricant to the splines at the inner end of the axle shaft. Apply a coat of wheel bearing grease on the seal surface of the shaft. Install axle shaft.

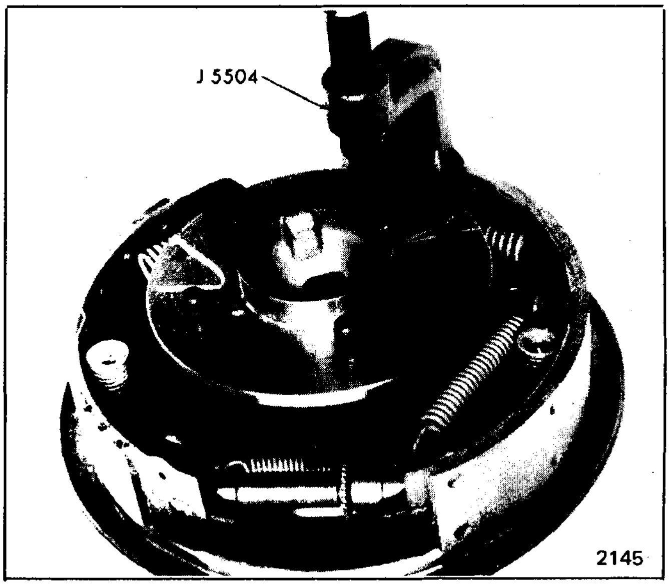


Fig. 4B-20 Removing Rear Wheel Bolt

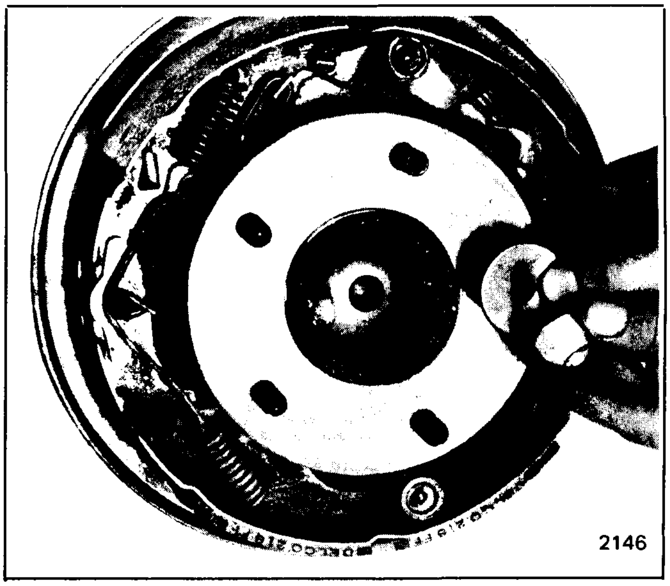


Fig. 4B-21 Installing Rear Wheel Bolt

3. For "C" Lock type axles, proceed as follows:

a. Insert axle shaft through the seal and bearing and, as far as possible, through the side gear. Do not let shaft drag across seal lip. It is necessary to apply a small amount of grease between seal lips.

b. Install "C" lock onto axle shaft. Move axle shaft and "C" lock outward to bottom the "C" lock in the recess of the side gear.

c. Install pinion shaft and secure with lock bolt (15 lb. ft.).

d. Install new gasket and cover, torque bolts to 30 lb. ft.). After 20 minutes, retorque bolts to 30 lb. ft.

e. Install specified quantity and type of lubricant.

CAUTION: *Fasteners in Steps 4 and 5 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number, or with an equivalent part, if replacement* *becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

4. Install retainer nuts and tighten to specified torque.

5. Install drum and wheel. Tighten lug nuts to specified torque.

REMOVAL AND DISASSEMBLY OF DIFFERENTIAL CASE ASSEMBLY

REMOVAL OF DIFFERENTIAL CASE ASSEMBLY - DIFFERENTIAL IN CAR

1. Raise rear of car and support securely under rear of frame.

2. Loosen parking brake cables so that brake is not applied when axle assembly is lowered.

3. Mark rear universal joint and pinion flange for proper alignment at reassembly. Disconnect rear universal joint. On H Series cars it will be necessary to disconnect upper control arm at differential end.

4. Lower differential carrier assembly just far enough to clear lower portion of fuel tank.

The following steps also apply when making repairs with differential assembly removed from car.

5. Remove bolts securing cover to housing to drain lubrciant.

6. While lubricant is draining, remove rear wheels and drums.

7. Remove rear axle shafts

Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash (Fig. 4B-22). This will indicate gear or bearing wear or an error in backlash or pre-load setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

8. Mark side bearing caps for proper installation at reassembly. Remove bolts holding differential side bearing caps to housing.

WARNING: DO NOT DROP CASE ASSEMBLY, AS THIS MAY CAUSE INJURY OR DAMAGE PARTS.

9. Differential case assembly can now be removed by prying against ring gear bolt, using a suitable pry bar (Fig. 4B-23). Remove case assembly and place right and left bearing outer races and shims in sets with marked bearing caps so that they can be reinstalled in their original positions.

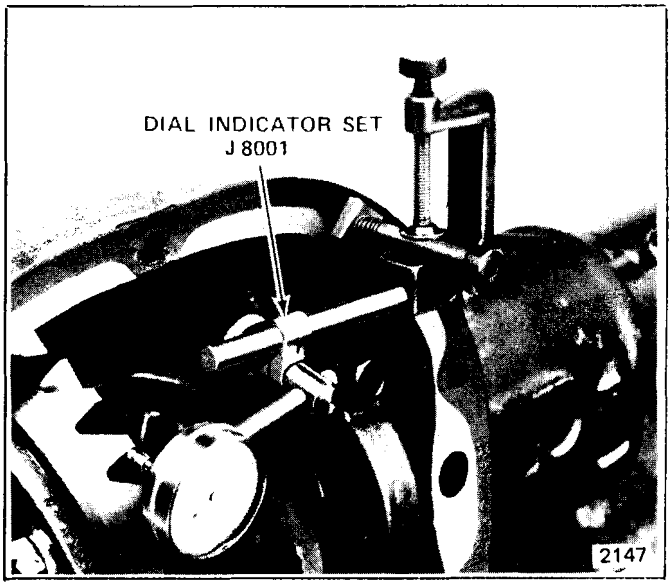


Fig. 4B-22 Checking Ring Gear to Pinion Backlash

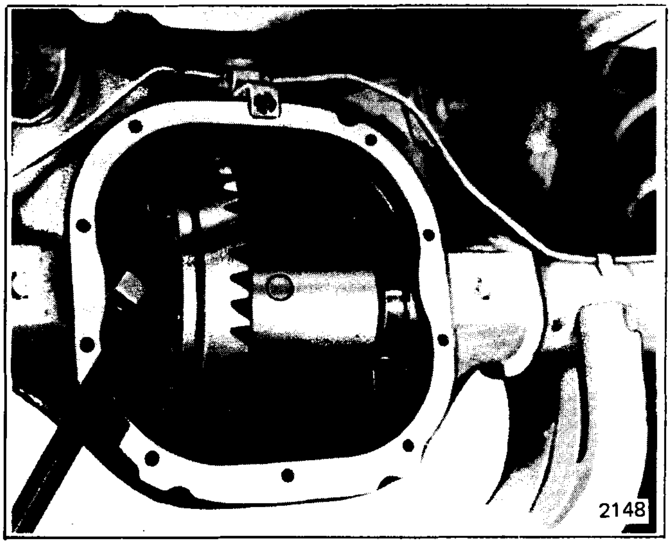


Fig. 4B-23 Removing Differential Case Assembly

DISASSEMBLE STANDARD DIFFERENTIAL CASE ASSEMBLY

1. If differential side bearings are to be replaced, insert Remover Adapter J 8107-2 or J 23598 in center hole and pull bearing using Puller J 22888 (Fig. 4B-24).

2. Remove bolt that retains differential pinion shaft (Fig. 4B-25). Remove differential pinions, side gears and thrust washers from case.

3. If ring gear is to be replaced and it is tight on case after removing bolts, tap it off using a soft hammer; do not pry between ring gear and case.

DISASSEMBLE PLATE TYPE POSITIVE TRACTION DIFFERENTIAL CASE ASSEMBLY

1. Remove screw that retains differential pinion shaft and remove differential cross shaft. Remove pre-load spring thrust blocks and springs from the case (Fig. 4B-26).

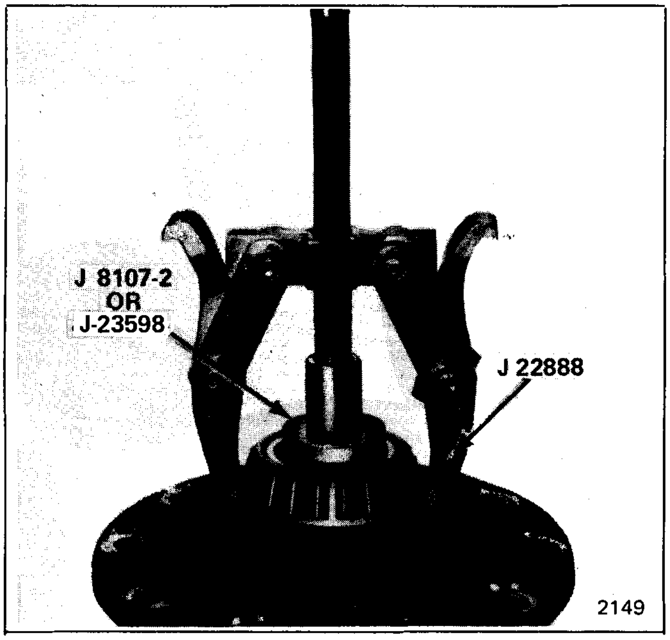


Fig. 4B-24 Removing Differential Side Bearings

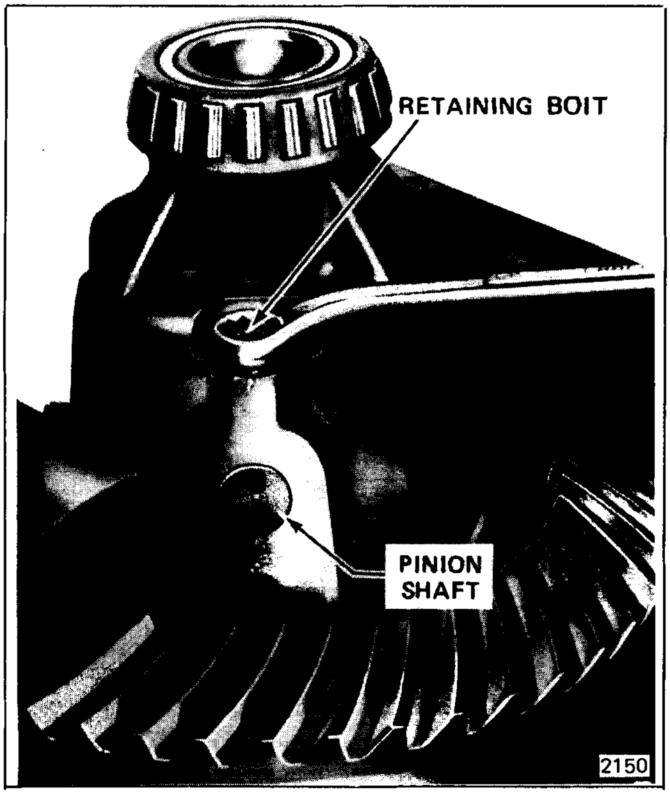


Fig. 4B-25 Removing Pinion Shaft Retaining Bolt

2. Rotate side gears until the pinions are in the open area of the case, remove the pinions and thrust washers.

3. Remove a side gear, clutch pack and shims from the case, noting location to aid in reassembly. Remove the side gear, clutch pack and shims from the opposite side.

4. Remove clutch plates from side gears, keeping plates in their original location in the pack.

REMOVAL OF PINION AND BEARINGS

1. Check pinion bearing pre-load.

If there is no pre-load reading, check for looseness of pinion assembly by shaking. Looseness indicates need for bearing replacement. If assembly is run long with very loose bearings, ring and pinion will also require replacement.

2. Install Holder J 8614-10 on flange by using two 5/16-24X2 bolts with flat washers. Holding companion flange stationary, remove pinion nut and washer (Fig. 4B-27).

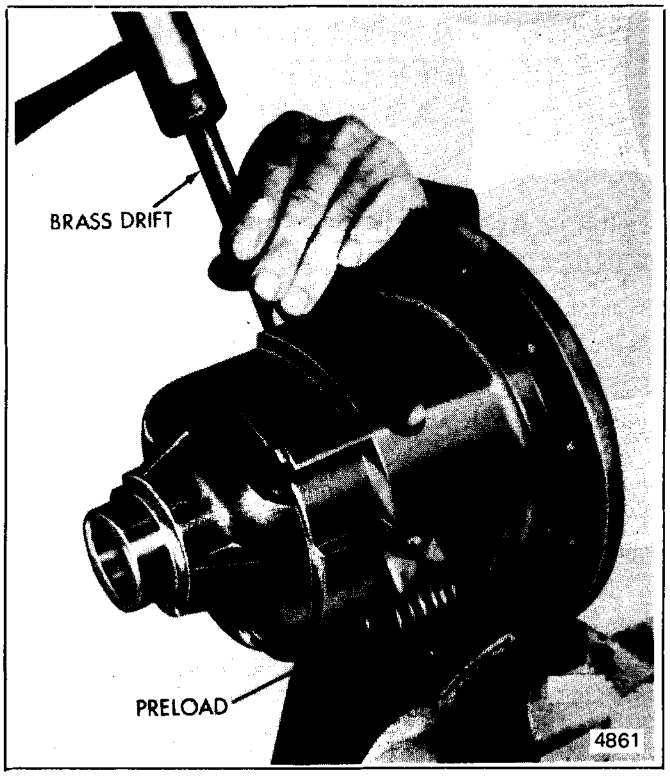


Fig. 4B-26 Removing Preload Thrust Blocks and Springs

3. Pull companion flange from pinion, using Puller J 8614-2 and 3. To install puller, back out puller screw, insert puller through holder and rotate 1/8 turn (Fig. 4B-28).

4. Remove pinion assembly. If necessary, tap pinion out with soft hammer, while being careful to guide pinion with hand to avoid damage to bearing outer races.

5. If rear pinion bearing is to be replaced, remove rear pinion bearing from pinion shaft using Remover J 22912 on 6 1/2" ring gear axles, Remover J 25320 on 7 1/2" ring gear axles or Remover J 8612 on 8-1/2" or 8-3/4" ring gear axles with Holder J 6407-1 (Fig. 4B-29).

6. Pry pinion oil seal from carrier and remove front pinion bearing. If this bearing is to be replaced, drive outer race from carrier by using a brass drift.

7. If rear pinion bearing is to be replaced, drive outer race from carrier by using a brass drift in slots provided for this purpose.

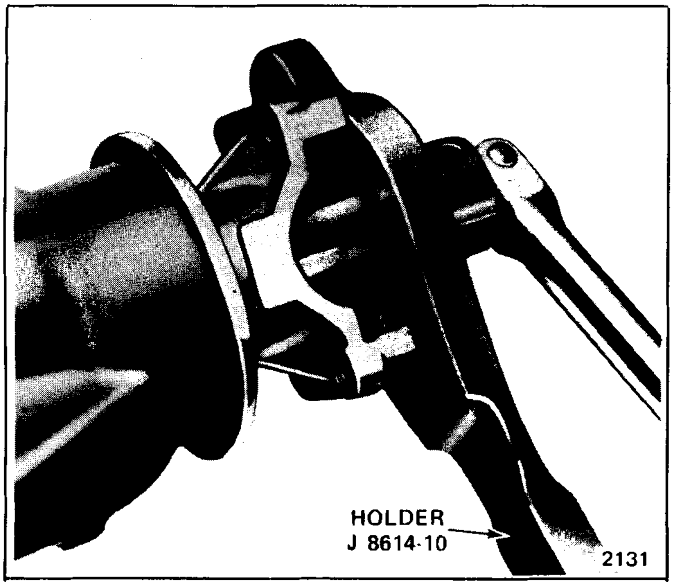


Fig. 4B-27 Removing Pinion Nut

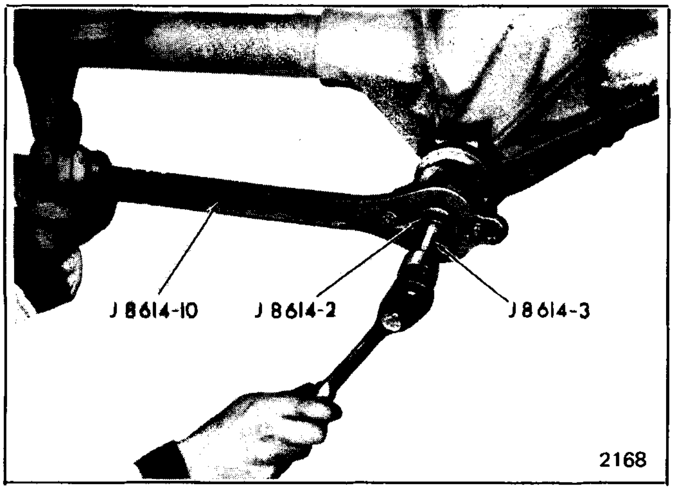


Fig. 4B-28 Removing Companion Flange

ASSEMBLY AND INSTALLATION OF DIFFERENTIAL CASE ASSEMBLY

Before installation of any parts, examine the wearing surfaces of all parts for scoring or unusual wear. Make certain that the interior of the carrier housing is absolutely clean and dry. Also make certain that the parts to be assembled are absolutely clean and that there are no burred edges. Lubricate all parts with the specified rear axle lubricant just before assembly.

If the ring gear and pinion are changed, only factory hypoid lubricant should be used for filling because of its special anti-scoring properties. For this reason, the proper lubricant is included in the carton with the replacement gears as received.

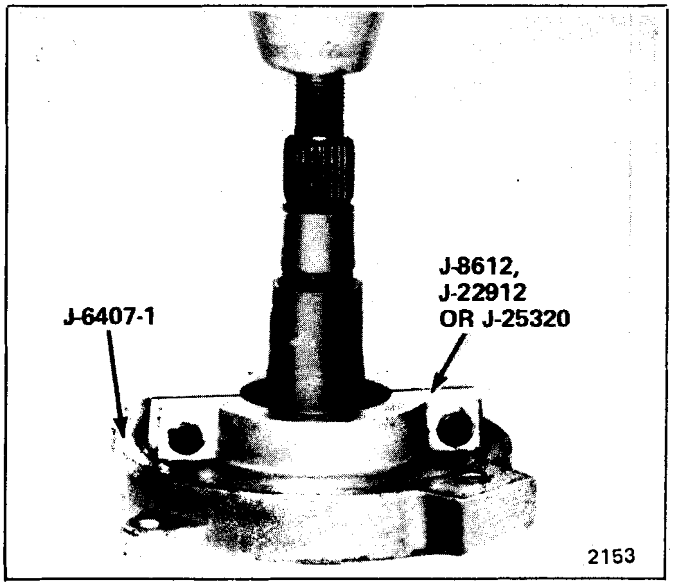


Fig. 4B-29 Removing Rear Pinion Bearing

INSTALL PINION BEARING OUTER RACES IN CARRIER

1. If rear pinion bearing race is to be replaced,, use Installer J 8611-01 on 6 1/2" ring gear axles, J 7818 on 7-1/2" ring gear axles or J 8608 on 8-1/2" or 8-3/4" ring gear axles with Driver Handle J 8092 (Fig. 4B-30).

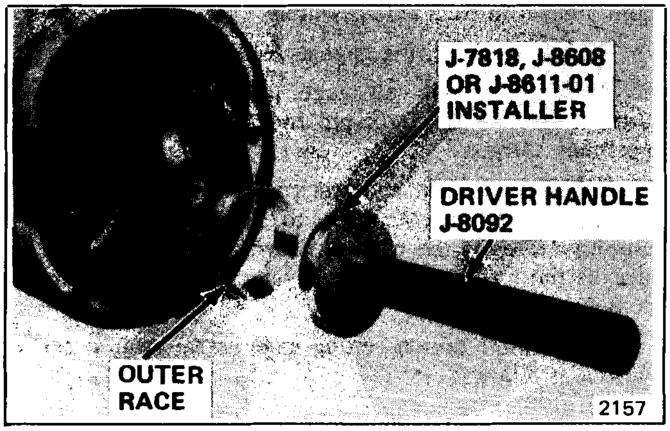


Fig. 4B-30 Installing Rear Pinion Bearing Outer Race

2. If front pinion bearing race is to be replaced, install new outer race using Installer J 7817 on 6 1/2" and 7 1/2" ring gear axles and Installer J 8611-01 on 8 1/2" and 8 3/4" ring gear axles with Driver Handle J 8092 (Fig. 4B-31).

SET PINION DEPTH

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in machining the parts. However, most production pinions and all pinions used for service replacement are zero or nominal pinions.

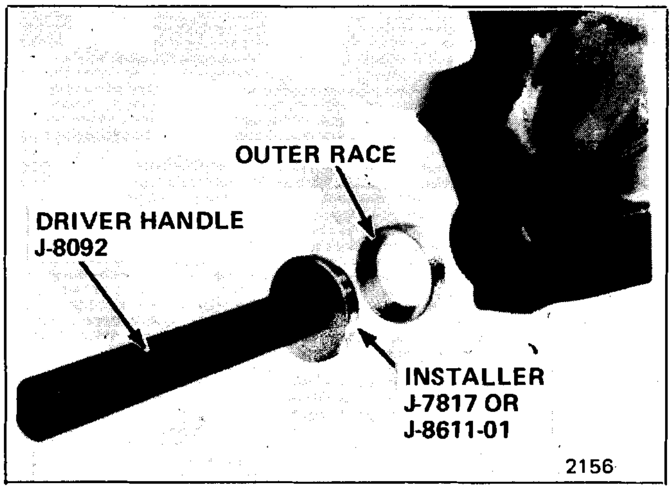


Fig. 4B-31 Installing Front Pinion Bearing Outer Race

If during repair, a pinion is found having a plus or minus reading recorded in thousands on the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure of gaging the carrier and shimming the pinion has been developed. After gaging a carrier, the assembler is able to install a shim between the front face of the pinion and its bearing so that pinion depth can be adjusted to an exact required specification for best tooth contact in each axle assembly.

Set up pinion setting gage as follows:

1. Make certain all gage parts are clean. Check particularly the discs, gage pin ends, dial indicator tip and gage plate surface.

2. Lubricate front and rear pinion bearings which will be used in final reassembly and position them in their respective races in the carrier. Bearings used with gage set must be those to be installed in vehicle, in order to insure accurate reading.

3. Assemble pinion setting gage assembly into carrier housing as follows:

Step 1

a. For 8 1/2" or 8 3/4" ring gear axles, install Pinion Bearing Pre-Load Stud J 8619-13 through Pilot J 21777-35 and into Gage Plate J 21777-26.

For 7 1/2" ring gear axles, install Pinion Bearing Pre-Load Stud J 21777-43 through Pilot J 23597-12 and into Gage Plate J 23597-11.

For 6 1/2" ring gear axles, install Pinion Bearing Pre-Load Stud J 21777-43 through Pilot J 23597-13 and into Gage Plate J 23597-11.

b. Install stud and plate assembly into housing (shown in Fig. 4B-32) and install Front Pinion Bearing Pilot J 8619-12 (or J 21777-42) and hex nut over end of stud, tightening nut until snug and rotate gage plate to make sure that both pinion bearings are properly seated.

c. Hold end of stud with wrench on its flats and tighten hex nut until 20 lb. in. torque is required to keep gage plate in rotation.

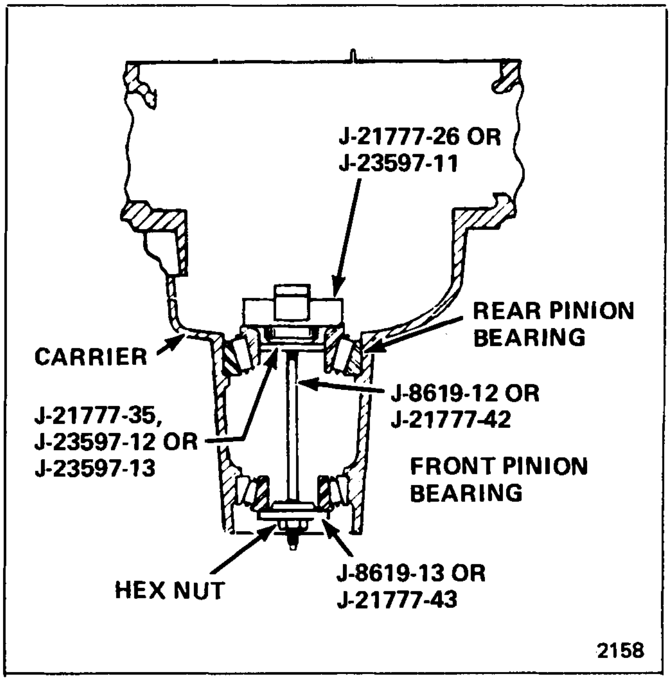


Fig. 4B-32 Pinion Gage Tools - Step 1

Step 2

a. For 8 1/2" or 8 3/4" ring gear axles, install Side Bearing Discs J 8619-10 onto ends of Arbor Plunger Assembly J 21777-1.

For 7 1/2" ring gear axles, install Side Bearing Discs J 21777-45 onto ends of Arbor Plunger Assembly J 23597-1.

For 6 1/2" ring gear axles, install Side Bearing Discs J 23597-4 onto ends of Arbor Plunger Assembly J 23597-1.

b. Make certain that carrier housing side bearing bores are clean, free of burrs and position arbor into housing so that discs are properly seated in bores and dial indicator plunger rod is centered over "gaging area" of gage plate (shown in Fig. 4B-33).

c. Install side bearing caps over discs and torque bolts to 70 lb. ft.

4. Set dial indicator at ZERO. Then, position indicator on mounting post of the arbor with the contact button touching the plunger pad. Push dial indicator downward until the needle rotates approximately 3/4 turn clockwise. Tighten the dial indicator in this position and recheck.

5. Rotate arbor slowly back and forth until the dial indicator reads the greatest deflection. At the point of greatest deflection, set the dial indicator to ZERO. Repeat rock action of gage shaft to verify the ZERO setting.

6. After the ZERO setting is obtained, arbor until the plunger rod does not touch the gage plate. Dial indicator now reads the pinion depth directly.

7. Record dial reading at pointer (off gage plate) position. EXAMPLE: If pointer moved counterclockwise .067" to a dial reading of .033", this indicates a shim thickness of .033".

8. Select correct pinion shim to be used during pinion reassembly on the following basis:

NOTE: All pinions will be marked in one of three places. See Fig. 4B-34 for areas of pinion depth setting marking.

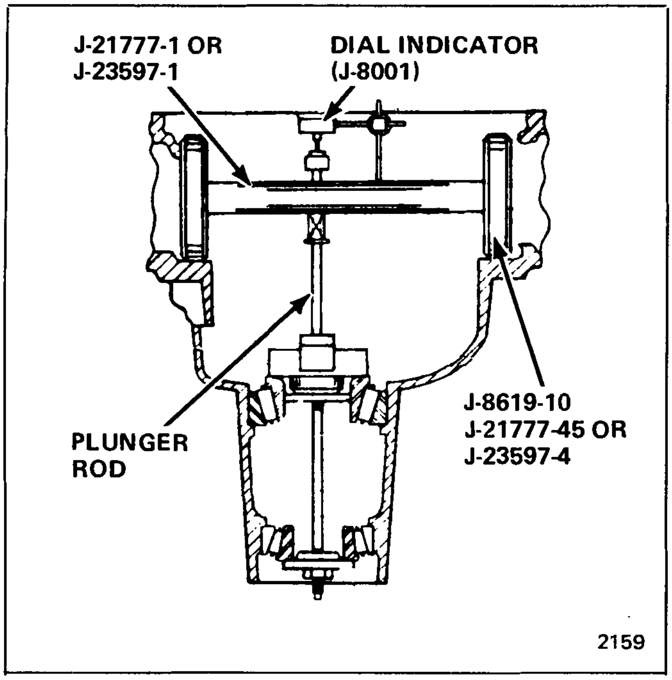


Fig. 4B-33 Pinion Gage Tools - Step 2

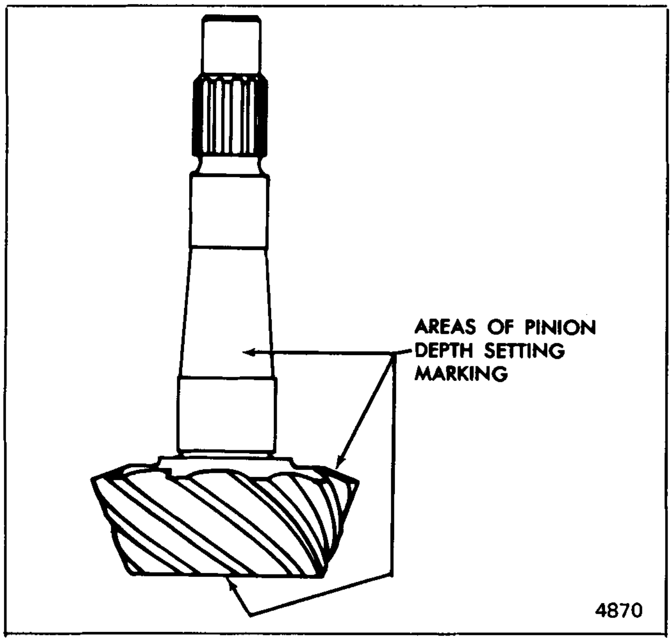


Fig. 4B-34 Pinion Marking All Axles

1) If reusing production pinion and pinion is marked "+" (plus) correct shim will have a thickness equal to gage reading, plus the amount specified on pinion.

2) If production pinion is marked "-" (minus), correct shim will have a thickness equal to gage reading, less the amount specified on pinion.

3) If using production or service pinion which has no marking, the correct shim will have a thickness equal to the gage reading.

9. Remove pinion gage assembly and both pinion bearings from case.

10. Position correct shim on pinion shaft and install rear pinion bearing. Use Installer J 21022-02 on 6 1/2" and 7-1/2" ring gear axles, or J 8609 on 8-1/2" and 8-3/4" ring gear axles (Fig. 4B-35).

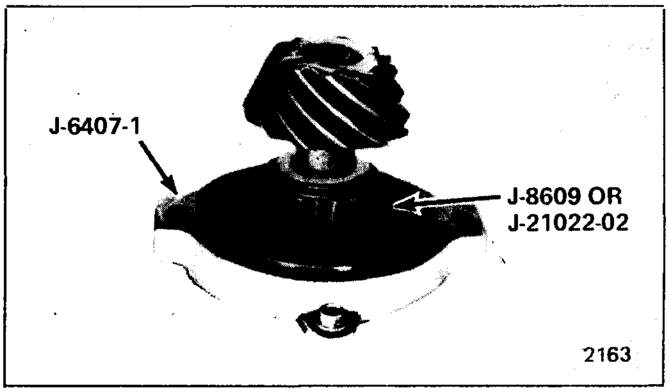


Fig. 4B-35 Installing Rear Pinion Bearing

INSTALL PINION ASSEMBLY AND ADJUST PINION PRELOAD

1. Position pinion assembly in carrier and install collapsible spacer.

2. Place front pinion bearing in position on pinion. Hold pinion fully forward and drive bearing over pinion until seated. Use Installer J 22388.

3. On 8 1/2" or 8 3/4" ring gear axles install pinion oil seal using Installer J 22388 (Fig. 4B-36). A correctly installed pinion seal having a flanged case should be flush with nose of carrier casting.

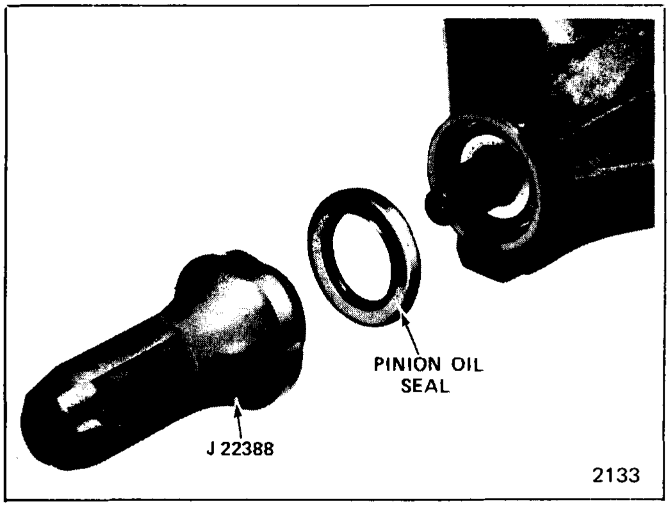


Fig. 4B-36 Installing Pinion Oil Seal on 8 1/2" and 8 3/4" Axles

On 6 1/2" and 7 1/2" ring gear axles, install pinion oil seal seal by placing spacer J 22804-2 over seal and against seal flange. The spacer insures proper seating of seal in carrier bore. Using Installer J 23911, press seal into carrier shoulder and seal flange. Turn spacer 180 degrees from installed position; seal must be square in carrier bore.

4. Coat lips of pinion oil seal and seal surface of pinion flange with gear lube. Install pinion flange on pinion by tapping with a soft hammer until a few pinion threads project through flange.

5. Coat pinion flange splines with silastic and install pinion washer and nut. Hold pinion flange with Holder J 8614-10. While intermittently rotating pinion to seat bearings, tighten pinion nut until end play begins to be taken

up (Fig. 4B-37). When no further end play is detectable, and when Holder J 8614-10 will no longer pivot freely as pinion is rotated pre-load specifications are being neared. Further tightening should be done only after pre-load has been checked.

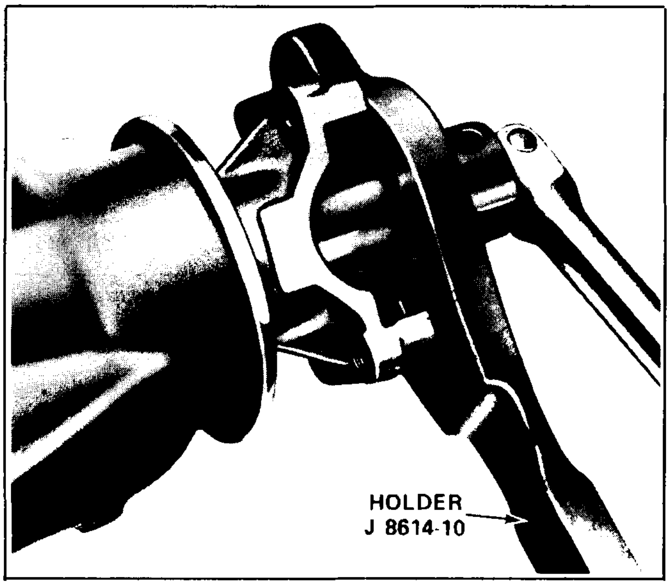


Fig. 4B-37 Installing Pinion Nut

6. Check pre-load by using a pound inch torque wrench (Fig. 4B-38).

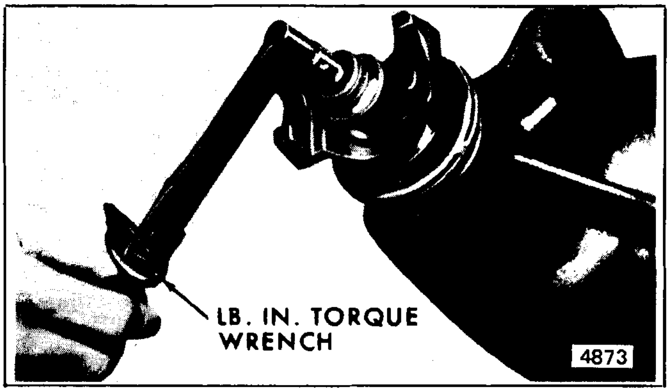


Fig. 4B-38 Checking Pinion Preload

After pre-load has been checked, final tightening should be done very cautiously. For example, if when checking pre-load was found to be 5 pound inches, additional tightening of the pinion nut as little as 1/8 turn can add 5 additional pound inches drag. Therefore, the pinion nut should be further tightened only a little at a time and pre-load should be checked after each slight amount of tightening. Exceeding pre-load specifications will compress the collapsible spacer too far and requires its replacement.

7. While observing the preceding caution, carefully set pre-load drag at 20-25 lb.in. on new bearings or 10-15 lb.in. on reused bearings.

8. Rotate pinion several times to assure that bearings have been seated. Check pre-load again. If drag has been reduced by rotating pinion, re-set pre-load to specification.

ASSEMBLE STANDARD DIFFERENTIAL CASE ASSEMBLY

Before assembling the differential, examine the wearing surfaces of all parts for scoring or unusual wear. Also make certain that all parts are absolutely clean. Lubricate parts with rear axle lubricant just before assembly.

1. Place side gear thrust washers over side gear hubs and install side gears in case. If same parts are reused, replace in original sides.

2. Install the two pinion gears and washers, through the two big windows in the case, into mesh with the side gears, making sure the pinion gear bores are 180 degrees apart.

3. Rotate the side and pinion gears as one assembly until the pinion gear bores are in alignment with the pinion shaft bores in the case.

4. Install pinion shaft and lock bolt. Torque to 15 lb.ft.

5. After making certain that mating surfaces of case and ring gear are clean and free of burrs, thread two 7/16 x 20 x 2 (LH) studs into opposite sides of ring gear, then install ring gear on case (Fig. 4B-39). Install ring gear attaching bolts just snug. Torque bolts alternately in progressive stages to 85 lb.ft.

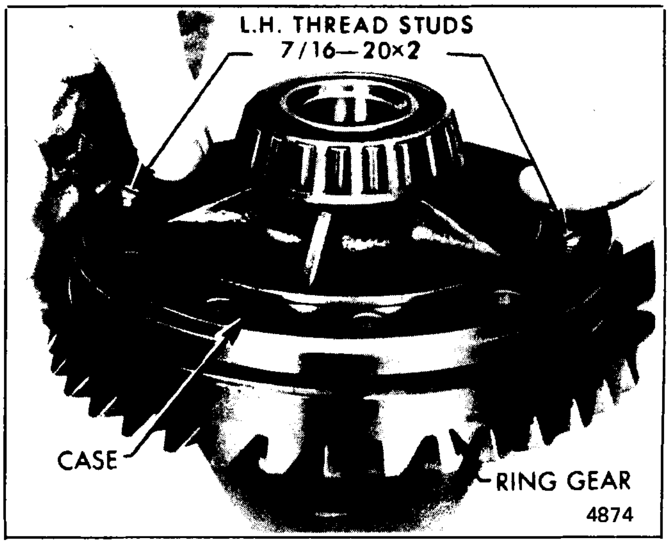


Fig. 4B-39 Installing Ring Gear on Differential Case

6. If differential side bearings were removed, install new bearings using Installer J 23610 on 6 1/2" ring gear axles, J 25299 on 7 1/2" ring gear axles or J 22761 on 8 1/2" and 8-3/4" ring gear axles with Driver Handle J 8092 (Fig. 4B-40).

ASSEMBLE PLATE TYPE POSITIVE TRACTION DIFFERENTIAL CASE ASSEMBLY

1. Inspect cross shaft, pinions and side gears. Replace any parts which are excessively scored, pitted or worn. Inspect clutch discs and plates for worn, cracked or distorted condition. If any of these defects exist, new clutch packs must be installed.

2. Apply lubricant to the clutch plates.

3. Assembly the clutch packs as follows: Alternately position clutch plates on each side gear starting and ending

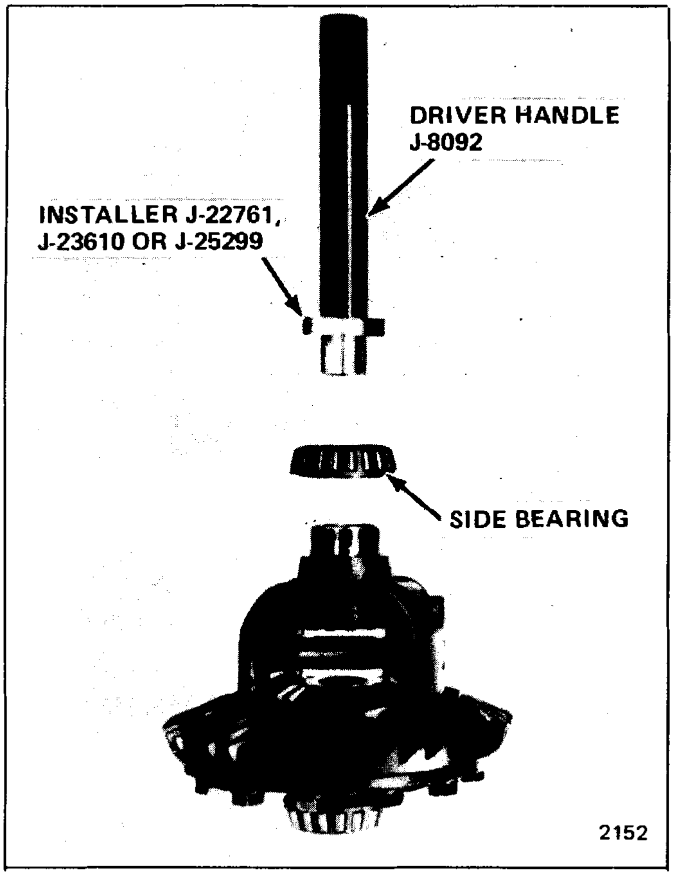


Fig. 4B-40 Installing Differential Side Bearings

with a clutch plate having external lugs. Assemble original spacer plate and shim to complete the stack.

4. On plate clutch type having rounded ear lugs, install car guides over the lugs. The square ear lug type requires no guides.

5. Install side gears and clutch pack assemblies into case on the same side from which they were removed. Install pinions, pinion thrust washers and cross shaft.

6. Check the pinion to side gear backlash as follows:

a. Compress one clutch pack by inserting screwdriver or wedge between the cross shaft and side gear (Fig. 4B-41).

b. Mount dial indicator with contact button against tooth of pinion gear. Rotate pinion. Backlash should be .001" to .006".

c. If backlash is more than .006", add shims between clutch pack and case. If backlash is less than .001", remove shims. A .002" shim will change backlash approximately .001".

d. Repeat procedure with opposite side gear.

7. Remove cross shaft. Drive pre-load spring into position between the side gears (Fig. 4B-42).

8. Assemble the cross shaft and lockscrew; torque to 15 lb. ft.

INSTALL DIFFERENTIAL CASE AND ADJUST SIDE BEARING PRELOAD

Differential side bearing pre-load is adjusted by changing the thickness of both the right and left shims by an equal amount. By changing the thickness of both shims equally, the original backlash will be maintained. All differential side bearing pre-load shims used in production are cast. Shims used during service repairs of the differential are of a stamped steel design and are used along with a production type, nominal thickness, cast shim. Stamped steel service shims must be used when differential repairs are made that require changing side bearing pre-load. Service, steel, adjusting shims are available in thicknesses ranging from .040" to .100" in increments of .002".

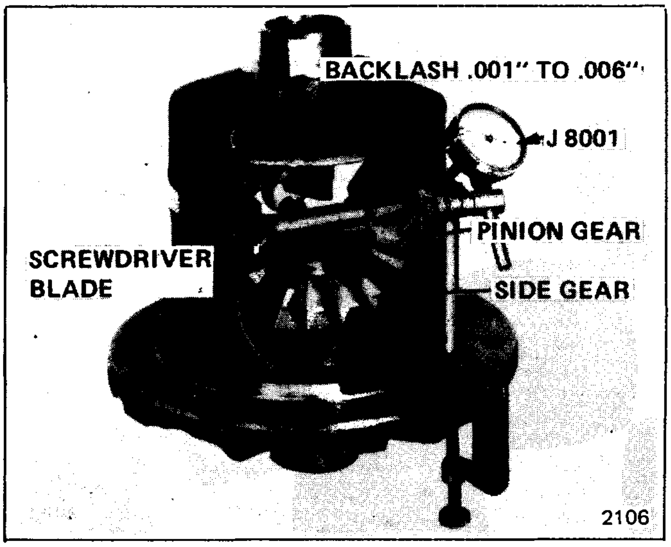


Fig. 4B-41 Checking Side Gear to Pinion Gear Backlash

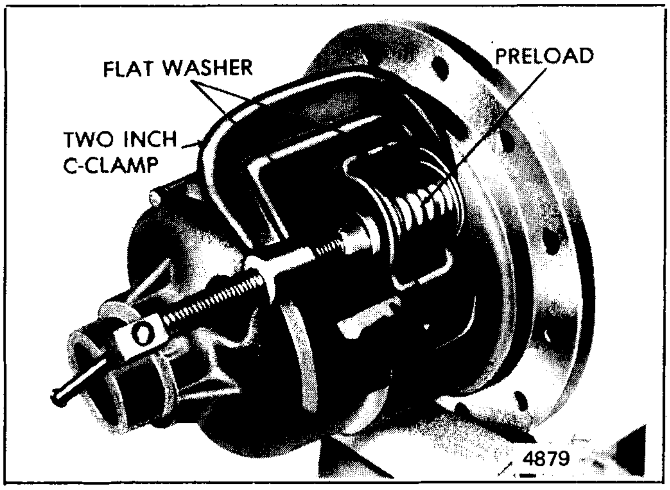


Fig. 4B-42 Compressing Preload Springs

1. Before installation of case assembly, make sure that side bearing surfaces in carrier are clean and free of burrs. Side bearings must be oiled with gear lube and if same bearings are being reused, they must have original outer races in place.

2. Place differential case and bearing assembly in position in carrier. Use service type adjusting shim totaling same thickness as original production type adjusting shims if either new or reused bearings are to be used. Slip left shims in position at left bearing with steel shim next to bearing, then place nominal thickness shim for right side in position and drive steel shim carefully into position between bearing and cast shim, using a soft hammer (Fig. 4B-43).

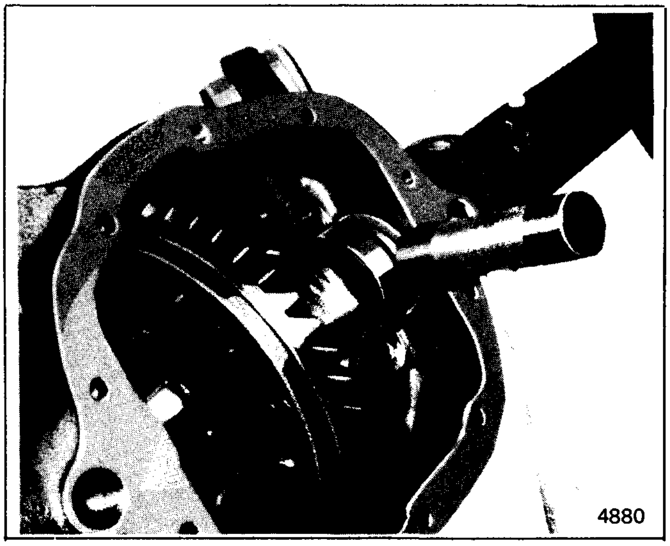


Fig. 4B-43 Installing Differential Adjusting Shims

Install side bearing caps, as previously marked, and tighten bolts to 55 lb.ft. before checking side bearing pre-load or backlash.

3. Rotate differential case assembly several complete turns to seat bearings. Check bearing pre-load, using an inch pound torque wrench connected at pinion nut.

Bearing pre-load should read 35-40 lb.in. of rotating torque with new bearings or 20-25 lb.in. of rotating torque with reused bearings. If pre-load is not according to these specifications, increase shim thickness on each side .002" for each additional 10 lb. in. pre-load desired, or decrease shim thickness .002" on each side for each 10 lb. in. pre-load to be subtracted.

ADJUST DIFFERENTIAL BACKLASH

1. Rotate differential case several times to seat bearings, then mount dial indicator as shown in Fig. 4B-44. Use a small button on indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that stem is as nearly as possible in line with gear rotation and perpendicular to tooth angle for accurate backlash reading.

2. With pinion locked to carrier, check gear lash at 3 or 4 points around ring gear. Lash must not vary over .001" around ring gear. If variation is over .001", check for burrs, uneven bolting conditions or distorted case flange and make corrections as necessary.

3. Gear lash at the point of minimum lash should be .006" to .008" for all new gears. If adjustment is necessary, adjust to .007".

If original gear set having a wear pattern is being reinstalled, original gear lash should be maintained within plus or minus .001".

4. If gear backlash is not within specifications, correct by increasing thickness of one differential shim and decreasing thickness of other shim the same amount. In this way, correct differential bearing pre-load will be maintained.

Shift .002" in shim thickness for each .001" change in backlash desired. If backlash is .002" too much, decrease thickness of right shim .004" and increase thickness of left shim .004". If backlash is .002" too little, increase thickness of right shim .004" and decrease thickness of left shim .004".

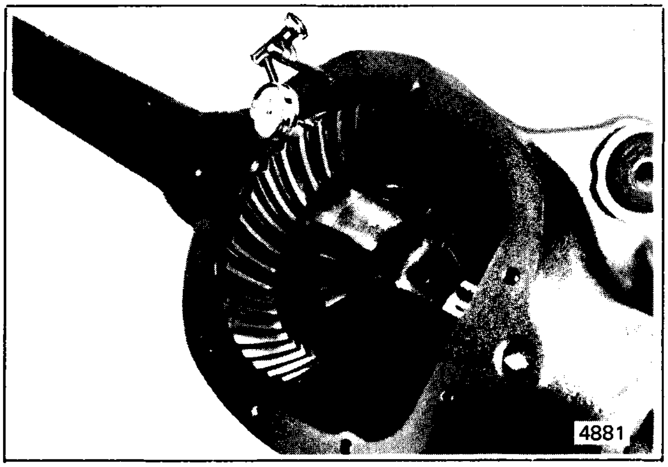


Fig. 4B-44 Checking Ring Gear to Pinion Backlash

5. Install new cover, gasket and cover torquing bolts to 30 lb.ft.

After waiting 20 minutes, retorque bolts to 30 lb.ft.

INSTALL AXLE SHAFT ASSEMBLIES

1. Apply a coat of wheel bearing grease in bearing recesses of housing.

2. On Non "C" Lock type axles, apply gear lubricant to the splines at the inner end of the axle shaft. Carefully install axle shaft assemblies until splines engage in differential to avoid damage to seals.

3. For "C" Lock type axles, proceed as follows:

a. Add a small amount of grease between seal lips and insert axle shaft through the seal and bearing and, as far as possible, through the side gear. Do not drag shaft across seal lip.

b. Install "C" lock onto axle shaft. Move axle shaft and "C" lock outward to bottom the "C" lock in the recess of the side gear.

c. Install pinion shaft and secure with lock bolt (15 lb.ft.).

d. Install new gasket and cover, torque bolts to 30 lb.ft.

e. After 20 minutes, retorque bolts to 30 lb.ft.

f. Install specified quantity and type of lubricant.

CAUTION: *Fasteners in steps 4 and 6 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. These must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

4. Place retainer over studs and install nuts. Tighten to specified torque.

5. Install brake drums over wheel bolts.

6. Install wheels and tighten wheel nuts to specified torque.

INSTALL PINION OIL SEAL WITH DIFFERENTIAL INSTALLED IN CAR

REMOVAL

In case of pinion oil seal leak, remove old oil seal and install new one (with differential remaining in car) as follows:

1. With rear wheels off floor, turn rear wheels and tap brake backing plates with a soft hammer to ensure that brakes are free.

2. Mark location of universl joint to pinion flange and remove retaining bolts which hold rear universal joint to pinion flange. Use a beavy rubber band or tape to hold bearings onto journal to prevent loss of bearing rollers when joint is disconnected if tie wire has been removed.

3. Scribe a line on end of pinion stem, extending down along side of stem threads and onto pinion flange nut to assure that parts are reassembled in the same relative position.

4. Punch a small mark on the line at pinion stem end and at top of lock nut, close to pinion stem threads.

5. Count the number of exposed threads from top of pinion stem to lock nut. Remove lock nut with a heavy duty socket, while holding pinion flange with Holder J 8614-10 (Fig. 4B-37).

6. Remove pinion flange.

When removing seal, use care to keep dirt and other foreign matter out of exposed front pinion bearing.

7. Remove oil seal by prying it out of carrier with a pointed tool, using care to keep tool away from the exposed front bearing. Discard seal. Do not damage seal bore in carrier.

REPLACE

1. Lubricate lip of new seal with clean gear lube. Install seal by tapping into place, using J 22388 or J 22804-2 and J 23911.

2. Before installing pinion flange, inspect for nicks, scratches or burred surfaces that may damage the seal. If any such damage is evident, hone carefully or install new flange.

a. If inspection shows the original pinion flange to be satisfactory, replace by holding companion flange with J 8614-10 and install nut to exactly the same position as before. Make sure punched boles and scribe line are in alignment. Tighten lock nut an additional 1/16" beyond this alignment.

If new pinion flange is required, see procedure for adjusting pinion bearing pre-load.

DO NOT exceed the additional tightening of the nut by a distance of more than 1/16" from its original position, as tightening the nut in excess of this amount will disturb the pinion and ring gear tooth contact pattern.

3. Align universal joint to pinion flange and tighten to specified torque.

PINION FLANGE - R & R ALL SERIES

DIFFERENTIAL INSTALLED IN CAR

1. Raise car and remove both rear wheel and drums, then disconnect propeller and support by wiring shaft to exhaust pipe. Use a heavy rubber band or tape to hold bearings onto journal to prevent loss of bearing rollers when joint is disconnected if the wire has been removed.

2. Check pinion bearing pre-load with an inch pound torque wrench and record reading and remove pinion flange.

3. Coat the pinion flange splines with silastic and install pinion flange on pinion by tapping with a soft hammer until a few pinion threads project through flange.

4. Install pinion flange washer and nut while holding pinion flange with holder. Tighten the nut a little at a time while intermittently rotating pinion to seat bearing. Check pre-load until pre-load is 3-5 inch pound more than reading obtained in Step 2.

5. Connect propeller shaft to pinion flange and tighten to specified torque.

6. Install wheels and drums. Check and add lubricant as necessary.

SPECIFICATIONS

DIFFERENTIAL SPECIFICATIONS

TIGHTENING SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed to insure proper tightening without staining or distorting parts. These specifications are to clean and lightly-lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

TORQUE

Ring Gear to Case Bolts	85 lb. ft.
Side Bearing Cap Bolts	55 lb. ft.
Differential Cover Bolts	30 lb. ft.
Pinion Shaft Lock Bolt or Screw	15 lb. ft.
Companion Flange Bolts or Nuts	15 lb. ft.

BEARING PRELOAD

Pinion Brgs.-Except "H" Series-New.	20-25 lb. in. rotating
Reused	10-15 lb. in. rotating
"H" Series Only-New	10-25 lb. in rotating
Reused	8-12 lb. in rotating
Total Assembly-W/New Bearings	35-40 lb. in rotating
W/Reused Bearings	20-25 lb. in rotating

GEAR BACKLASH

Ring Gear to Pinion Gear	.006"-.008"
Pinion Gear to Side Gear	.001"-.006"

AXLE SHAFT END PLAY

"B" and "O" (8 1/2") Axles	.018" max.
"C", "G", "K" and "O" (7 1/2") Axles	.022" max.
"P" Axles	.032" max.

DIFFERENTIAL GEAR RATIOS

Rear axle ratio, differential type, manufacturer and build date information is stamped on the right rear axle tube on the forward side. Refer to Fig. 4B-45. Any reports made on rear axle assemblies must include the full code letters and build date numbers.

Axle manufacture identification can also be made by looking at the differential cover as shown in Fig. 4B-46.

SERIES	GEAR RATIO	RING GEAR —VS— PINION TEETH	RING GEAR SIZE	AXLE CODES		
				DIFFERENTIAL TYPE[1]		MANU-[2] FACTURER
				STANDARD	LOCKING	
A & G SEDAN	2.41	41:17	8 1/2"	AA	CA	B,[3] O[3] OR C
				AL	CL	
	2.56	41:16		AB	CB	
				AJ	CJ	
	2.73	41:15		AX	CX	
				AS	—	
	3.08	40:13		AU	CU	
				AK	—	
	3.23	41:13		AR	CR	
				AT	CT	
A WAGON	2.56	41:16	8 3/4"	ZD	ZU	P
	2.73	41:15		ZE	ZW	
	3.23	41:13		ZK	ZZ	
B SEDAN	2.41	41:17	7 1/2"	GH	—	P OR K
	2.41	41:17	8 1/2"	LA	NR	B,[3] G OR K
				KJ	KS	
				MN	MZ	
	2.56	41:16		KK	KR	
	2.73	41:15		LX	NX	
	3.08	40:13		MP	MY	
	3.23	41:13		LT	NT	
				MQ	MX	
B WAGON	2.56	41:16	8 3/4"	YD	YU	P
	2.73	41:15		YE	YW	
	3.08	40:13		YJ	YY	
	3.23	41:13		YK	YZ	
F SEDAN	2.41	41:17	8 1/2"	PJ	PS	G
	2.56	41:16		PH	PT	
	3.08	40:13		PC	PW	
	3.23	41:13		PD	PX	
H SERIES	2.92	38:13	6 1/2"	HK	HM	C
	2.56	41:16	7 1/2"	DY	EY	K
	2.73	41:15		DR	DE	
	2.93	41:14		DX	EX	
	3.42	41:12		DU	EU	
X SEDAN	2.41	41:17	7 1/2"	FH	FS	O
	2.56	41:16		FB	FY	
			8 1/2"[4]	TA	TZ	C
	3.08	40:13		TC	TX	
			7 1/2"	FK	FQ	O
				FG	FT	
	3.23	41:13		FE	FV	
	3.42	41:12		FL	FR	

3841

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[1] FIRST TWO LETTERS OF AXLE CODE, STAMPED ON RIGHT-HAND AXLE TUBE (ADJACENT TO CARRIER), IDENTIFYING GEAR RATIO AND DIFFERENTIAL TYPE.

[2] THIRD LETTER OF AXLE CODE IDENTIFYING AXLE MANUFACTURER:
B=BUICK C=CHEVROLET-BUFFALO GEAR G=CHEVROLET-DETROIT GEAR & AXLE
K=G.M. OF CANADA O=OLDSMOBILE P=PONTIAC

[3] ALL B AND O BUILT AXLES WITH 8 1/2" RING GEARS ARE UNIT BEARING (NON 'C' LOCK) AXLES. ALL OTHERS ARE DIRECT-ON BEARING ('C' LOCK) AXLES.

[4] 8 1/2" RING GEAR AXLES ARE AVAILABLE WITH LM1 ENGINES (CHEV. 350) ONLY.

Fig. 4B-45 Axle Usage Chart

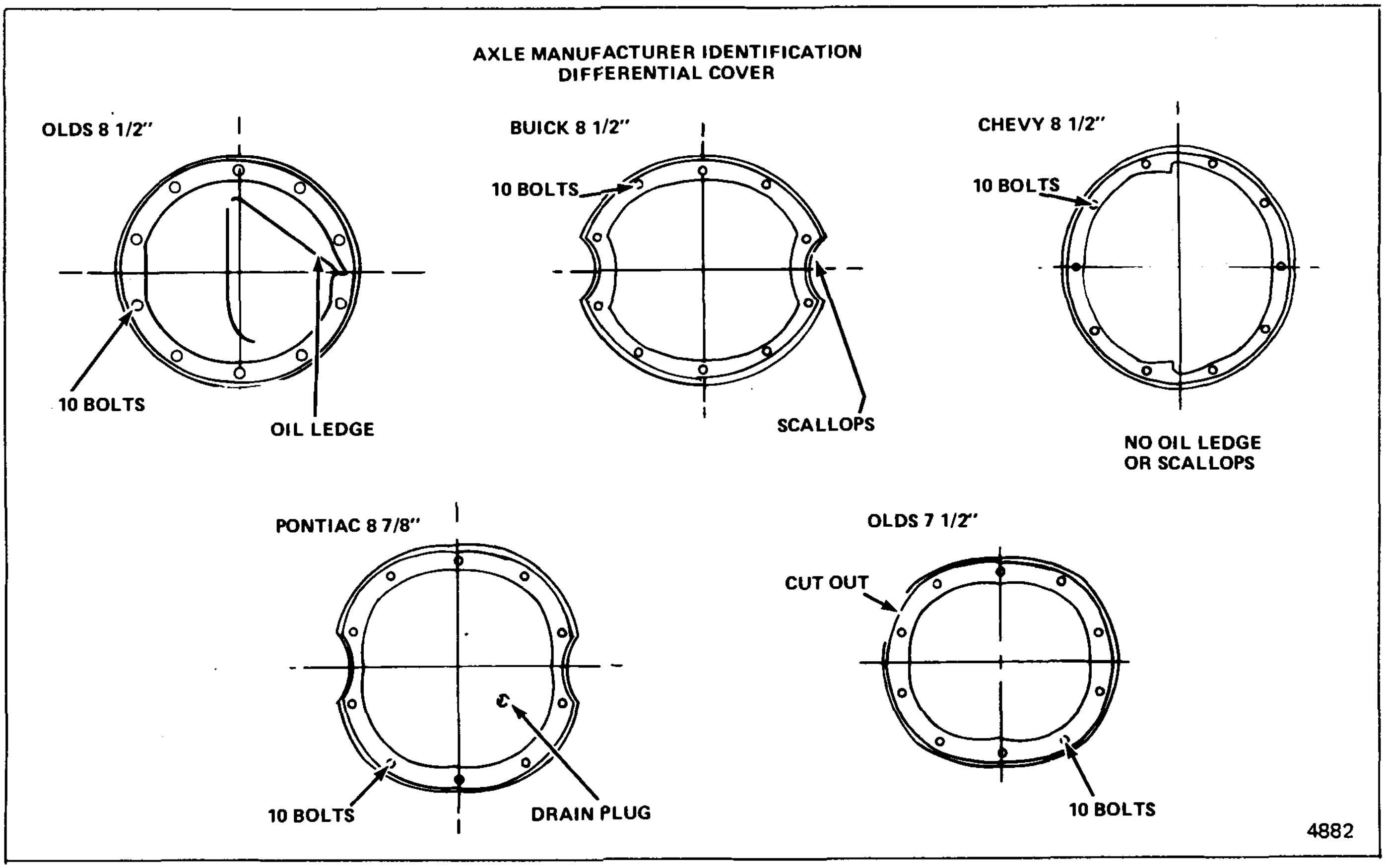


Fig. 4B-46 Axle Manufacturer Identification

SPECIAL TOOLS

Remover	J 5504
Holder	J 6407-1
Installer	J 7817
Installer	J 7818
Dial Indicator	J 8001
Handle	J 8092
Adaptor	J 8107-2
Installer	J 8608
Installer	J 8609
Installer	J 8611-01
Remover	J 8612
Puller	J 8614-2
Puller	J 8614-3
Holder	J 8614-10
Discs	J 8619-10
Pilot	J 8619-12
Stud	J 8619-13
Installer	J 21022-02
Installer	J 21491
Puller	J 21579
Arbor	J 21777-1
Plate	J 21777-26
Pilot	J 21777-35
Pilot	J 21777-42
Stud	J 21777-43
Discs	J 21777-45
Installer	J 22388
Installer	J 22761
Spacer	J 22804-2
Remover	J 22813-01
Puller	J 22888
Remover	J 22912
Remover & Installer	J 23469
Arbor	J 23597-1
Discs	J 23597-4
Plate	J 23597-11
Pilot	J 23597-13
Adaptor	J 23598
Installer	J 23610
Remover & Installer	J 23674
Installer	J 23765
Installer	J 23771
Installer	J 23911
Installer	J 25299
Remover	J 25320

SECTION 5

BRAKES

WARNING: WHEN SERVICING WHEEL BRAKE PARTS, DO NOT CREATE DUST BY GRINDING OR SANDING BRAKE LININGS OR BY CLEANING WHEEL BRAKE PARTS WITH A DRY BRUSH OR WITH COMPRESSED AIR. (A WATER DAMPENED CLOTH SHOULD BE USED.) MANY WHEEL BRAKE PARTS CONTAIN ASBESTOS FIBERS WHICH CAN BECOME AIRBORNE IF DUST IS CREATED DURING SERVICING. BREATHING DUST CONTAINING ASBESTOS FIBERS MAY CAUSE SERIOUS BODILY HARM.

CONTENTS OF THIS SECTION

Unit Repair

GENERAL DESCRIPTION

When the brake pedal is depressed, the pistons in the master cylinder force brake fluid under pressure to the wheel cylinders or caliper pistons at each wheel. This forces the against the brake drum or rotor, which slows and/or stops rotation of the wheel assembly.

DIAGNOSIS

INSPECTION AND TESTING BRAKES

Testing Brakes

Brakes should be tested on dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if roadway is wet, greasy or covered with loose dirt so that all tires do not grip the road equally. Testing will also be adversely affected if roadway is crowned so as to throw weight of car toward wheels on one side or if roadway is so rough that wheels tend to bounce.

Test brakes at different car speeds with both light and heavy pedal pressure; however, avoid locking the wheels and sliding the tires on roadway. Locked wheels and sliding tires do not indicate brake efficiency since heavily braked, but turning wheels will stop car in less distance than locked wheels. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

External Conditions that Affect Brake Performance

1. Tires. Tires having unequal contact and grip on road will cause unequal braking. Tires must be equally inflated and tread pattern of right and left tires must be approximately equal.

2. Car Loading. When car has unequal loading, the most heavily loaded wheels require more braking power than others. A heavily loaded car requires more braking effort.

3. Front Wheel Bearings. A loose front wheel bearing permits the drum to tilt and have spotty contact with the brake shoe linings causing erratic brake action.

4. Front End Alignment. Misalingment of the front end particularily in regard to limits on camber and theoretical king pin inclination will cause the brakes to pull to one side.

Condition	Possible Cause	Correction
Pulls	1. Incorrect tire pressures.	1. Inflate evenly on both sides to the recommended pressures.
	2. Front end out of line.	2. Check and align to manufacturer's specifications.
	3. Unmatched tires on same axle. For radial tire lead refer to Section 3.	3. Tires with approximately the same amount of tread should be used on the same axle.
	4. Restricted brake tubes or hoses.	4. Check for soft hoses and damaged lines. Replace with new hoses and new double-walled steel brake tubing.
	5. Malfunctioning caliper assembly.	5. Check for stuck or sluggish pistons, proper lubrication.
	6. Defective or damaged shoe and lining (grease or brake fluid on lining or bent shoe).	6. Install new shoe and lining in complete axle sets.
	7. Malfunctioning rear brakes.	7. Check for inoperative auto adjusting mechanism, defective lining (grease or brake fluid on lining) or defective wheel cylinders. Repair as necessary.
	8. Loose suspension parts.	8. Check all suspension mountings.
	9. Loose calipers.	9. Check and torque bolts to specifications.
Noise (high pitched without brake applied).	1. Front linings worn out.	1. Replace linings.
Brake Roughness or or Chatter (Pedal Pulsates)	1. Excessive lateral runout.	1. Check per instructions and replace or machine the rotor, if not within specifications.
	2. Parallelism not within specifications.	2. Check per instructions and replace or machine the rotor, if not within specifications.
	3. Wheel bearings not adjusted.	3. Adjust wheel bearings to correct specifications.
	4. Rear drums out of round.	4. Check runout and, if not within specifications, turn the drums (not over maximum of 0.060 on the diameter).

	5. Shoe reversed (steel against iron).	5. Replace shoe and lining and machine rotor within specifications.
Excessive Pedal Effort	1. Malfunctioning power brake.	1. Check power brake and repair if necessary.
	2. Partial system failure.	2. Check front and rear brake system and repair, if necessary. Also, check brake warning light, if a failed system is found and light did not function.
	3. Excessively worn shoe and lining.	3. Check and replace in axle sets.
	4. Piston in caliper stuck or sluggish.	4. Remove caliper and rebuild.
	5. Fading brakes due to incorrect lining.	5. Remove and replace with original equipment lining.
Excessive Pedal Travel	1. Partial brake system failure.	1. Check both front and rear system for a failure and repair. Also check warning light. It should have indicated a failure.
	2. Insufficient fluid in master cylinder.	2. Fill reservoirs with approved brake fluid. Check for leaks. Check warning light.
	3. Air trapped in system.	3. Bleed system.
	4. Rear brake not adjusting.	4. Adjust rear brakes and repair auto adjusters.
	5. Bent shoe and lining.	5. Replace axle set of shoe and lining.
Dragging Brakes (A very light drag is present in all disc brakes immediately after pedal is released.)	1. Master cylinder pistons not returning correctly.	1. With reservoir cover off, check for fluid spurt at bypass holes as pedal is depressed. Adjust push rod, if necessary, or rebuild master cylinder.
	2. Restricted brake tubes or hoses.	2. Check for soft hoses or damaged tubes and replace with new hoses and new double-walled steel brake tubing.
	3. Incorrect parking brake adjustment on rear brakes.	3. Check and readjust to correct specifications.
	4. Check valve installed in outlet to front disc brakes.	4. Check master cylinder outlet and remove check valve if present.
Grabbing or Uneven Braking Action	1. All conditions listed under "PULLS".	1. All corrections listed under "PULLS".

	2. Malfunction of combination valve.	2. Replace and bleed system.
	3. Malfunction of power brake unit.	3. Check operation and repair, if necessary.
	4. Binding brake pedal mechanism.	4. Check and lubricate, if necessary. Possibly replace pedal bushing and/or spacer.
Pulsation (roughness) Felt in car during normal brake application.	1. Uneven pad wear caused by caliper not sliding due to improper clearance or dirt.	1. Remove caliper and correct as necessary.
	2. Uneven Rotor wear causing a thickness variation between the two braking surfaces.	2. Machine Rotor as follows: a. Machine rotors to obtain a thickness variation no greater than .0005" and a lateral runout no greater than .004". b. Check caliper freeness. With rotor removed, install caliper and mounting bolts (pins). Check for .005"-.012" clearance at both top and bottom of caliper. See Figure 5-1. If less than .005" is found, file with a flat file until at least .005" is obtained. DO NOT EXCEED A MAXIMUM of .012" per end or .024" total clearance. Caliper clearance to inboard reaction pads must be equal within .004" both at the top and bottom of the caliper. This is to ensure correct alignment of caliper to knuckle during a brake application. c. Remove caliper after freeness check. Clean pins and sleeves, replace "O" rings, and apply a light coating of silicone grease or equivalent to all contact points and "O" rings.

SYMPTOM CAUSE	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	Brake Tell-Tale Glows During Stop
Leaking Brake Line or Connection	X	XX							X						XX
Leaking Wheel Cylinder or Piston Seal	X	XX		X				X							X
Leaking Master Cylinder	X	XX													X
Air In Brake System	XX								X						XX
Contaminated or Improper Brake Fluid					X	X	X								X
Leaking Vacuum System			XX		X										
Restricted Air Passage in Power Head			X		XX	X									
Damaged Power Head			X	X	X	X	X								
Improperly Assembled Power Head Valving			X	X	X	X	XX								
Worn Out Brake Lining - Replace			X	X				X	X	X	X	X		X	
Uneven Brake Lining Wear - Replace and Correct	X			X				X	X	X	X	XX		X	X
Glazed Brake Lining			XX		X			X	X		X	X			
Incorrect Lining Material - Replace			X	X				X	X			X		X	
Contaminated Brake Lining - Replace				XX				XX	XX	X	X	X		X	
Linings Damaged by Abusive Use - Replace			X	XX				X	X	X	X	X		X	
Excessive Brake Lining Dust			X	XX				XX	XX		X	XX		X	
Heat Spotted or Scored Brake Drums or Rotors				X				X	X		X	X	XX	X	
Out-of-Round or Vibrating Brake Drums												X	XX		
Out-of-Parallel Brake Rotors													XX		
Excessive Rotor Run-Out													X		
Faulty Automatic Adjusters	X						X	X	X						X
Incorrect Wheel Cylinder Sizes			X	X				X	X						
Weak or Incorrect Brake Shoe Retention Springs				X		X	XX	X	X	XX	X	XX			
Brake Assembly Attachments - Missing or Loose	X						X	X	X	X		X	X	X	
Insufficient Brake Shoe Guide Lubricant						X	X	X	X	XX	XX				
Restricted Brake Fluid Passage or Sticking Wheel Cylinder Piston		X	X		X	X	X	X	X						
Faulty Metering Valve	X		X	X	X	X	X		X						X
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X								
Drums Tapered or Threaded										XX					
Incorrect Front End Alignment								XX							
Incorrect Tire Pressure								X	X						
Incorrect Wheel Bearing Adjustment	X									X			X		
Loose Front Suspension Attachments								X		XX			X	X	
Out-of-Balance Wheel Assemblies													XX		
Operator Riding Brake Pedal	X	X	X				X		X					X	
Improperly Adjusted Master Cylinder Push Rod	X					X	XX								X
Sticking Wheel Cylinder or Caliper Pistons			X			X	X	X	X						
Faulty Proportioning Valve			X		X	X	X								

XX - Indicates more probable cause(s) X - Indicates causes 4599

Fig.5-1 Brake Diagnosis

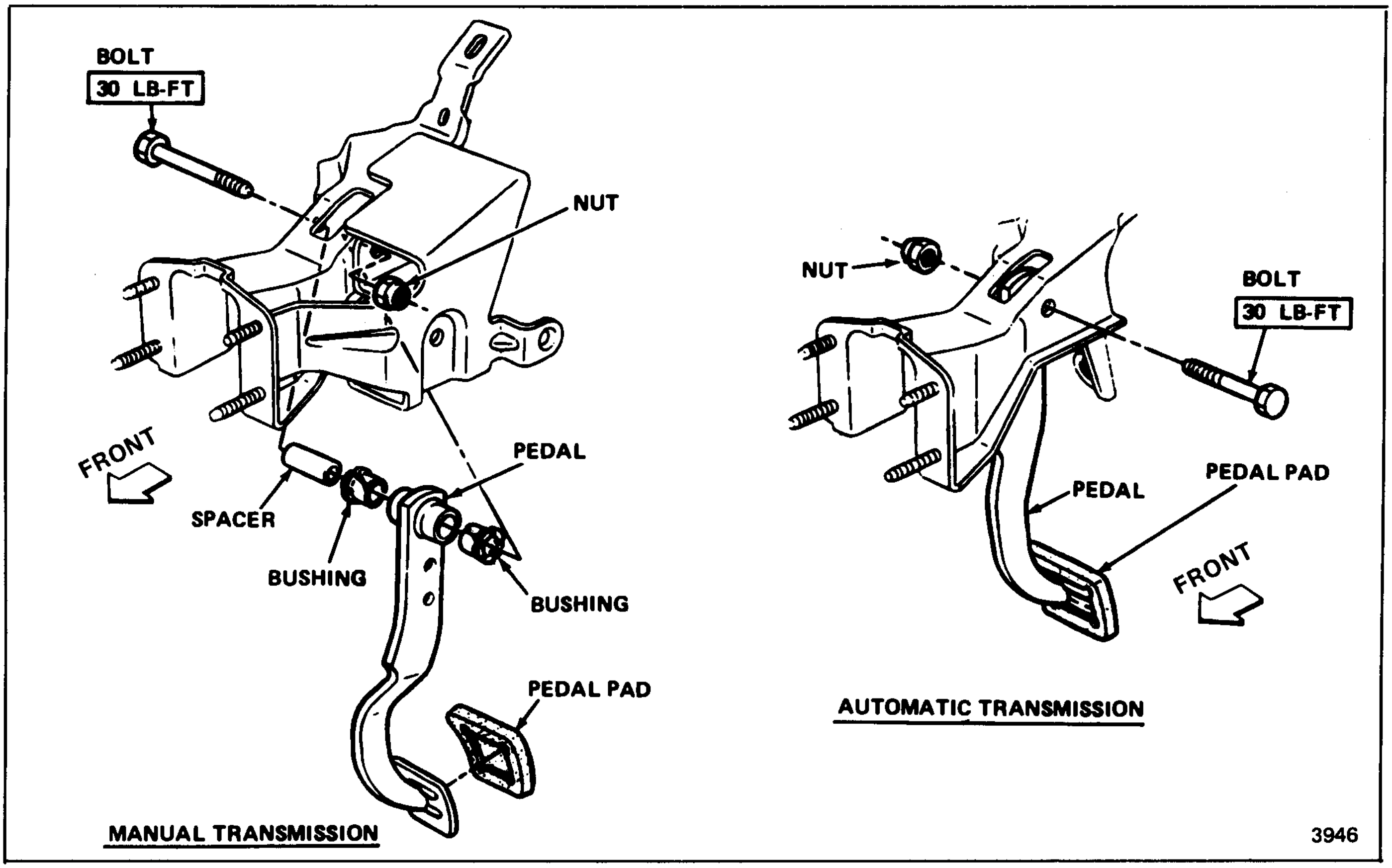


Fig. 5-2 Brake Pedal Mounting - H Series

ON CAR SERVICE

PEDAL TRAVEL

1. At reasonable frequent intervals, the brakes should be inspected for pedal travel, which is the distance the pedal moves toward the floor from a fully-released position. Inspection should be made with the brake pedal firmly depressed (approximately 50 lbs. on manual brakes or 100 lbs. on power brakes while the brakes are cold.

H and X Series Manual	3-1/2"
A Series Manual	5-7/8"
H and X Series Power	2-3/4"
A, B and G Series Power	2-1/4"

On power brake-equipped cars, pump the pedal a minimum of 3 times with the engine off before making pedal travel checks. This exhausts all vacuum from the power booster.

STOP LIGHT SWITCH

A, B AND G SERIES

With pedal in fully released position, the stop light switch plunger should be fully depressed against the pedal shank. Adjust switch by moving in or out as necessary.

H AND X SERIES

The stop light switch is mounted on a flange protruding from the brake pedal support.

1. Release the brake pedal to its normal position.
2. Adjust switch by turning in or out as necessary.

Electrical contact should be made when the brake pedal is depressed 3/8" - 5/8" from its fully released position.

BLEEDING AND FLUSHING BRAKE SYSTEM

BLEEDING BRAKE HYDRAULIC SYSTEM

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system.

It may be necessary to bleed the hydraulic system at all four wheel cylinders if air has been introduced through low fluid level or by disconnecting brake pipes at master cylinder. If brake pipe is disconnected at any wheel cylinder, then that wheel cylinder only need be bled. If pipes are disconnected at any fitting located between master cylinder and wheel cylinders, then all wheel cylinders serviced by the disconnected pipe must be bled.

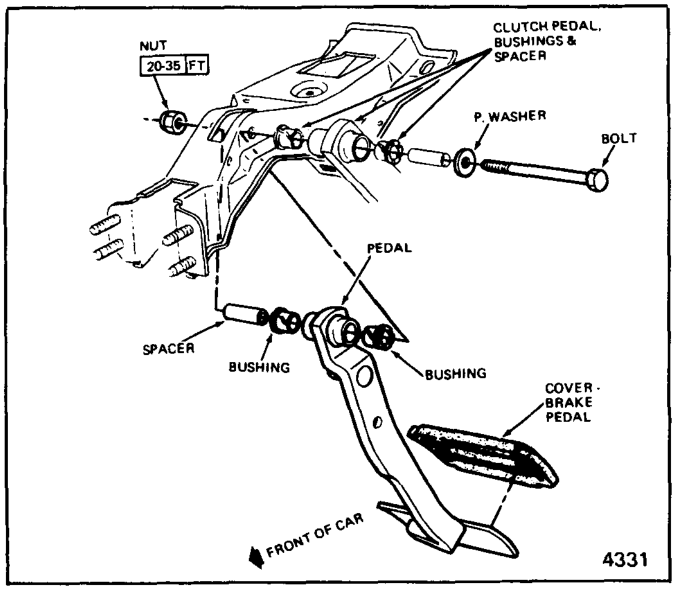


Fig. 5-3 Brake Pedal Mounting - X Series

MANUAL BLEED

If the car is equipped with power brakes, deplete the vacuum reserve by apply the brakes several times.

1. Fill master cylinder with brake fluid and keep at least one-half full of fluid during bleeding operation.

Bleed right rear brake, left rear brake, right front brake and left front brake.

2. With the proper size box end wrench or tool J 21472 over bleeder valve, attach bleeder tube to valve and allow tube to hang submerged in brake fluid in a clean glass jar. See Fig. 5-2.

3. Open the bleeder valve and fully depress the brake pedal.

4. Close bleeder valve and release brake pedal.

5. Repeat steps 3 and 4 until all air is evacuated.

Check and refill master cylinder reservoir as required to prevent air from being drawn through master cylinder.

6. Repeat the bleeding procedure at all wheels if the entire system is to be bled.

7. Check the brake pedal, feel for "sponginess" and repeat entire bleeding procedure if necessary.

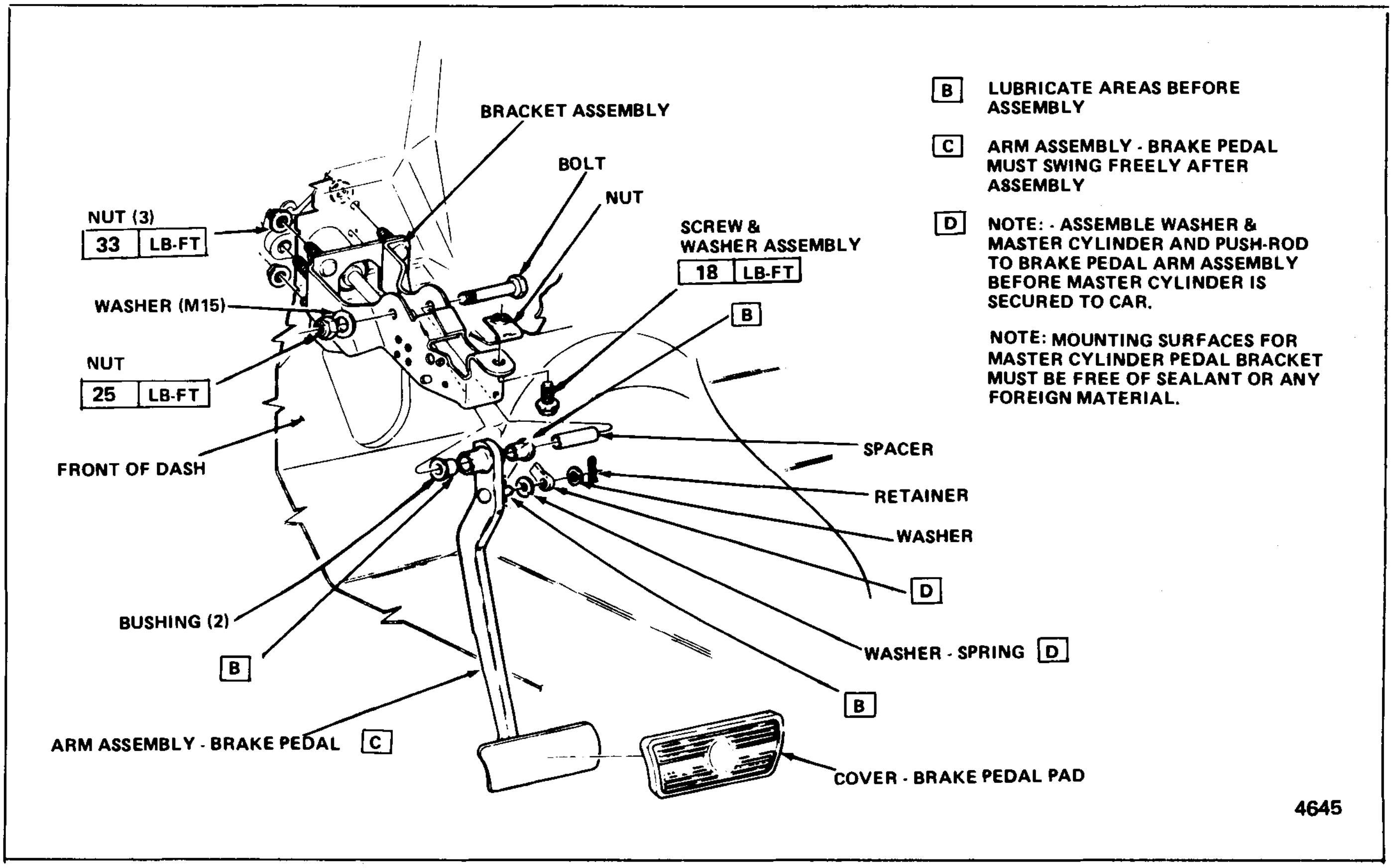
FLUSHING BRAKE HYDRAULIC SYSTEM

It is recommended that the entire hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system.

Flushing is also recommended if there is any doubt as to the grade of fluid in the system. If fluid has been used which contains the slightest trace of mineral oil, all rubber parts that have been subjected to the contaminated fluid should be replaced.

BRAKE PIPES

REPLACE



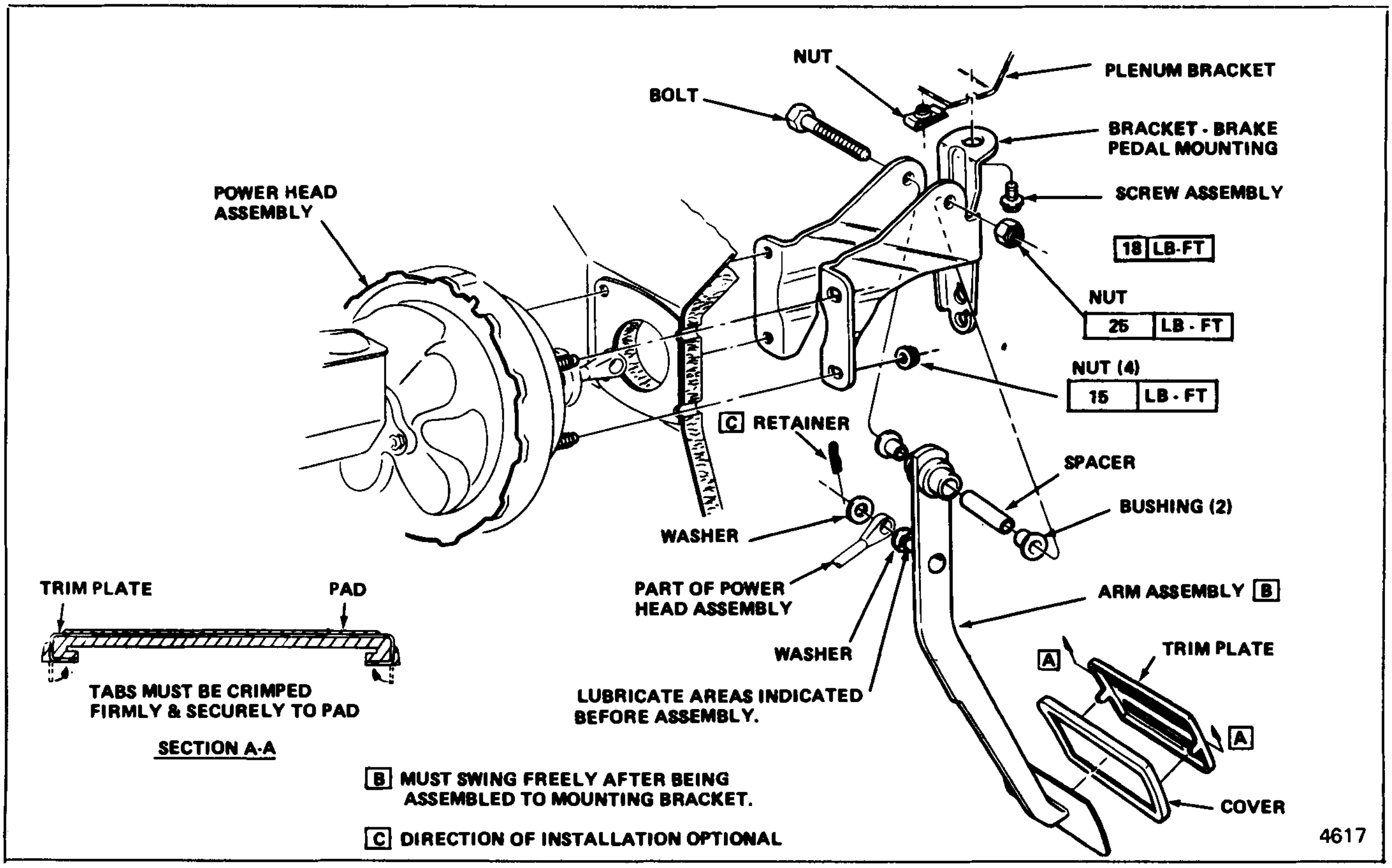
B LUBRICATE AREAS BEFORE ASSEMBLY

C ARM ASSEMBLY - BRAKE PEDAL MUST SWING FREELY AFTER ASSEMBLY

D NOTE: - ASSEMBLE WASHER & MASTER CYLINDER AND PUSH-ROD TO BRAKE PEDAL ARM ASSEMBLY BEFORE MASTER CYLINDER IS SECURED TO CAR.

NOTE: MOUNTING SURFACES FOR MASTER CYLINDER PEDAL BRACKET MUST BE FREE OF SEALANT OR ANY FOREIGN MATERIAL.

Fig. 5-4 Brake Pedal Mounting - A & G Series



TABS MUST BE CRIMPED FIRMLY & SECURELY TO PAD

SECTION A-A

LUBRICATE AREAS INDICATED BEFORE ASSEMBLY.

B MUST SWING FREELY AFTER BEING ASSEMBLED TO MOUNTING BRACKET.

C DIRECTION OF INSTALLATION OPTIONAL

Fig. 5-5 Brake Pedal Mounting - B Series

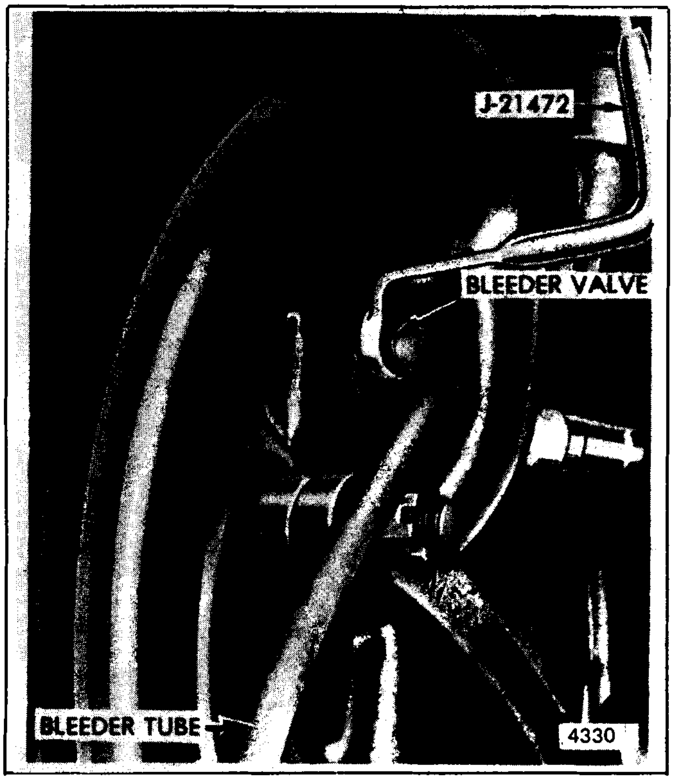


Fig. 5-6 Bleeding Wheel Cylinder

WARNING: NEVER USE COPPER TUBING BECAUSE COPPER IS SUBJECT TO FATIGUE CRACKING AND CORROSION WHICH COULD RESULT IN BRAKE FAILURE.

1. Procure the recommended tubing and steel fitting nuts of the correct size (outside diameter of tubing is used to specify size).

2. Cut tubing to length. Correct length may be determined by measuring old pipe using a cord and adding 1/8" for each double flare.

3. Double flare tubing ends using a suitable flaring tool such as J 23530. Follow instructions included in tool set.

Make sure fittings are installed before starting second flare.

WARNING: DOUBLE FLARING TOOL MUST BE USED AS SINGLE FLARING TOOLS CANNOT PRODUCE A FLARE STRONG ENOUGH TO HOLD THE NECESSARY PRESSURE.

4. Bend pipe assembly to match old pipe using a tubing bender. Clearance of .750 must be maintained to all moving or vibrating parts.

5. Route pipes as shown in Figures 5-7 through 5-18

BRAKE HOSES

The flexible hydraulic brake hose, which transmits hydraulic pressure from the steel brake line on the body to the rear axle and to the calipers, should be inspected at least twice a year when the car is on a lift for lubrication. The brake hose assembly should be checked for road hazard damage, for cracks and chafing of the outer cover, and for leaks and blisters. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose it will be necessary to replace it.

FRONT BRAKE HOSE

Removal

1. Clean dirt and foreign material from both hose and fittings.
2. Disconnect brake pipe from hose fitting using a back-up wrench on fitting. Be careful not to bend frame bracket or brake pipe. It may be necessary to soak the connections with penetrating oil. See Figures 5-7, 5-10, 5-13 and 5-15.
3. Remove "U" clip from female fitting at bracket and remove hose from bracket.
4. Remove bolt from caliper end of hose. Remove hose from caliper and discard the two copper gaskets on either side of fitting block.

Installation

1. Use new copper gaskets on both sides of fitting block; wet bolt threads with brake fluid. With fitting orientation flange engaged with the caliper orientation ledge, fasten hose to caliper and torque to specifications.
2. With weight of car on suspension, pass female fitting through frame bracket or crossmember. Fitting fits the bracket in only one position. With least amount of twist in hose install fitting in this position. There should be no kinks in hose.
3. Install "U" clip to female fitting at frame bracket.
4. Attach brake pipe to hose fitting using a backup wrench on fitting. Torque to specification.
5. Inspect to see that hose doesn't make contact with any part of suspension. Check in extreme right hand and extreme left hand turn conditions. If hose makes any contact, remove and correct.
6. Bleed brake system.

REAR BRAKE HOSE

Removal

1. Remove all three brake pipes from hose; two at junction block and, with the use of a back-up wrench, one on the female fitting at bracket. Be careful not to bend bracket or pipes; use penetrating oil if necessary. See Figures 5-9, 5-12, 5-15 and 5-18.
2. Remove "U" clip and take female fitting out of bracket.
3. Observe position at which junction block is mounted to the axle. When installing new hose, be sure this junction block is in the same position.

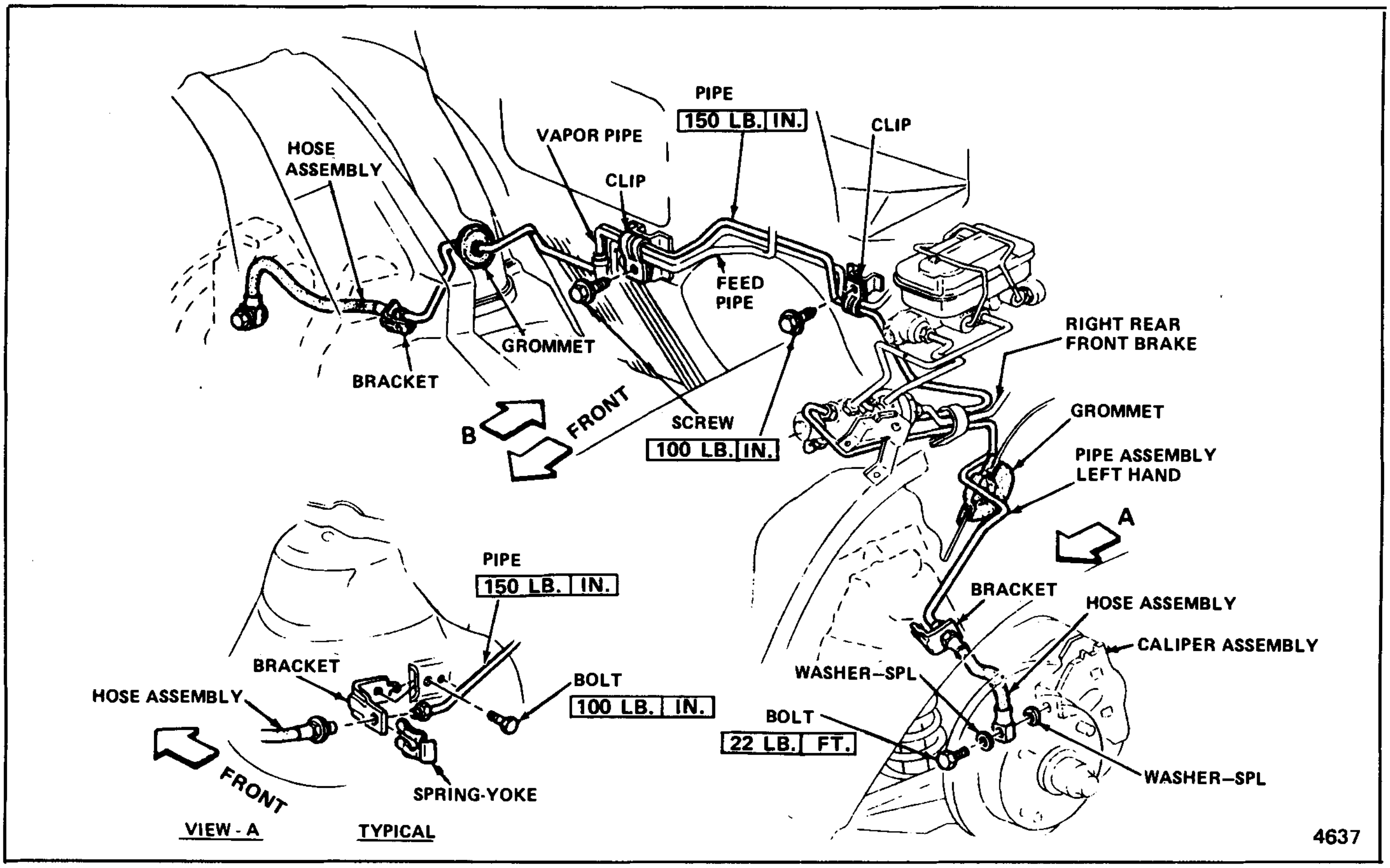


Fig. 5-7 Front Brake Pipes - H Series

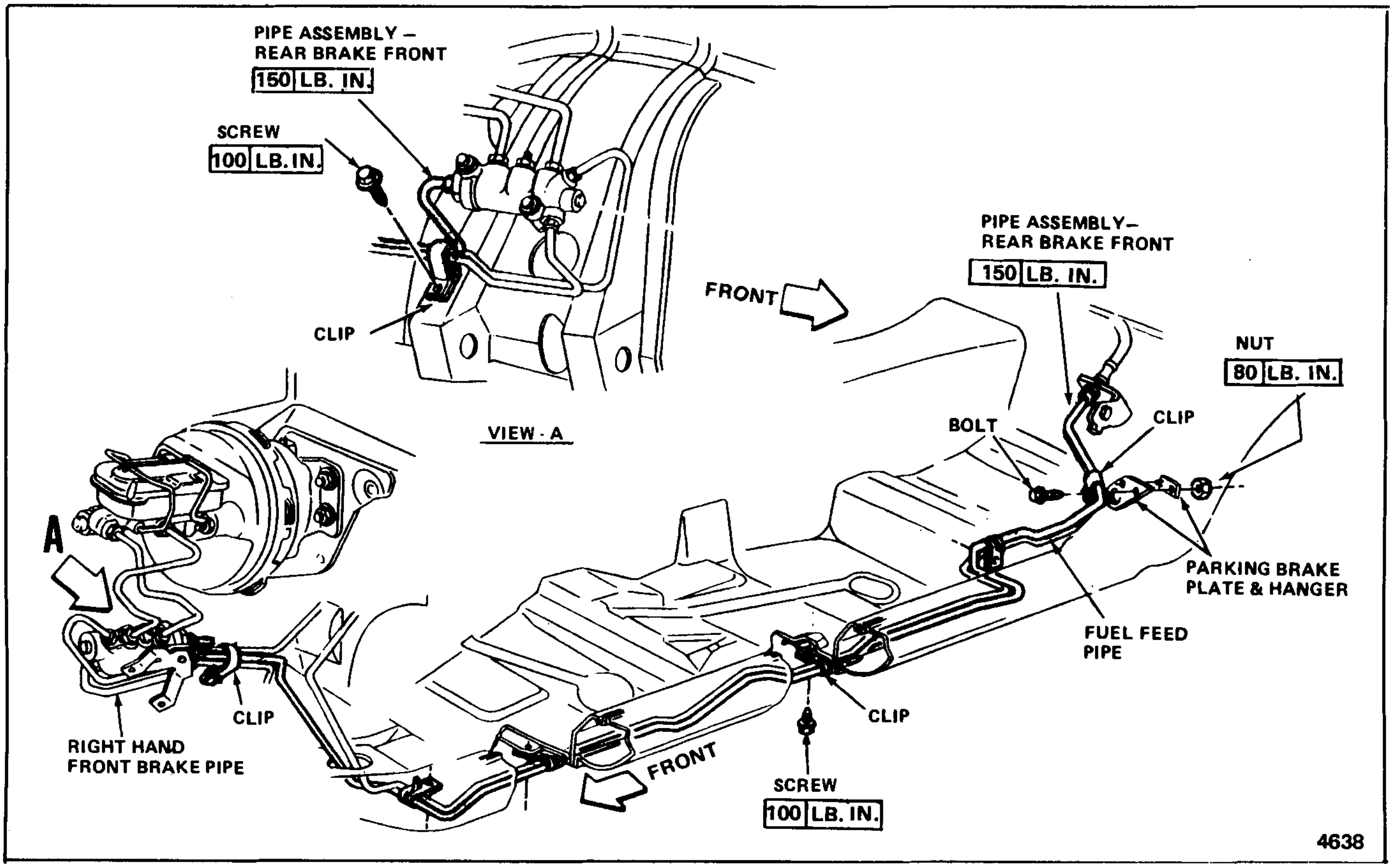


Fig. 5-8 Center Brake Pipes - H Series

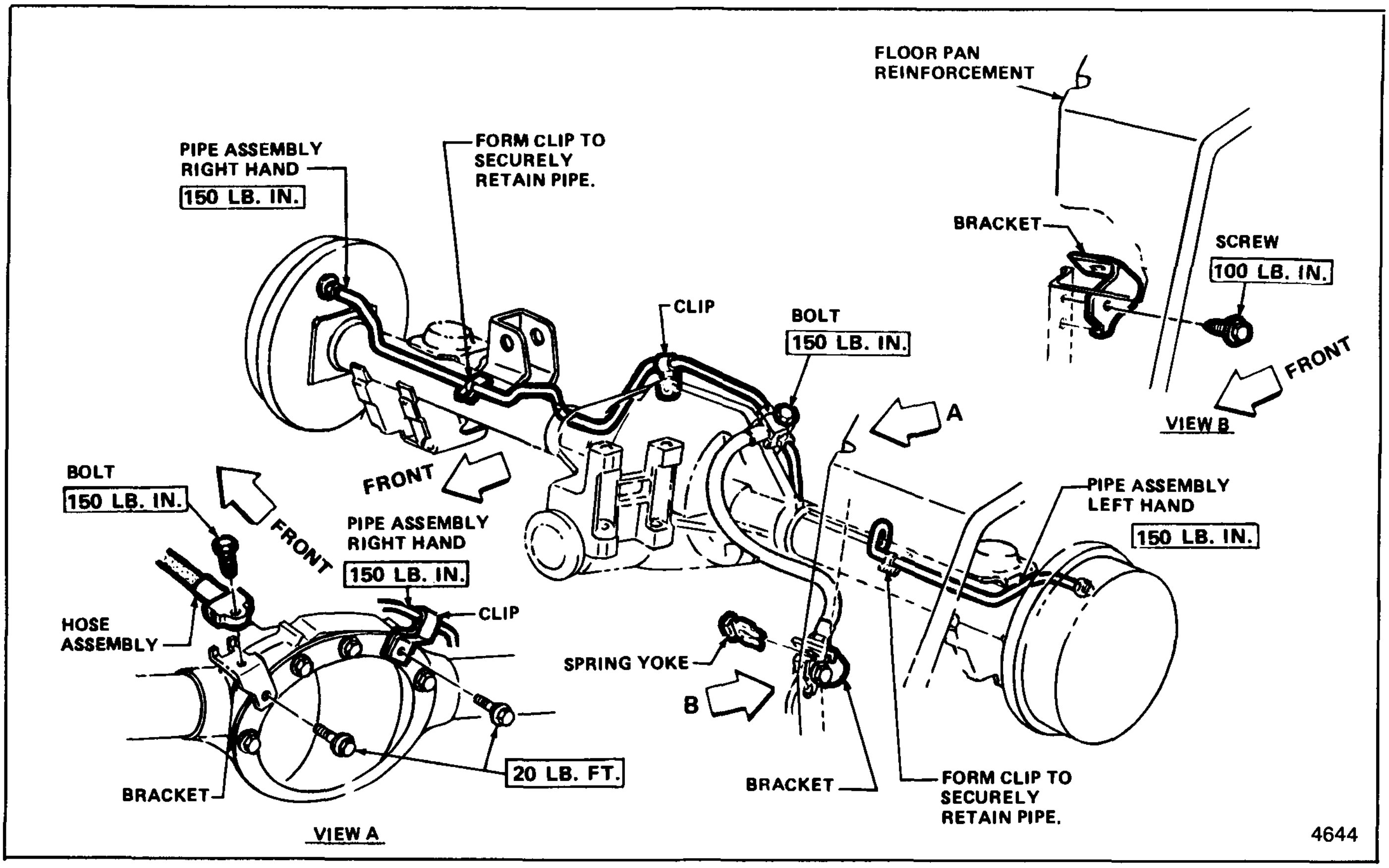


Fig. 5-9 Rear Brake Pipes - H Series

4. Remove bolt attaching junction block to axle.

Installation

1. Thread both rear axle pipes into junction block.
2. Bolt junction block to axle and then torque rear pipes into block.
3. Pass female end of hose through frame bracket. Female fitting will fit bracket in only one position; without twisting hose, position female end in bracket.
4. Install "U" clip.
5. Attach pipe to female fitting using a back-up wrench on fitting, torque to specification, again be careful not to bend bracket or pipe. Check to see that hose installation did not loosen frame bracket. Re-torque bracket if necessary.
6. Bleed system.

PARKING BRAKE CABLES

REPLACE (EXCEPT B SERIES)

Front Cable

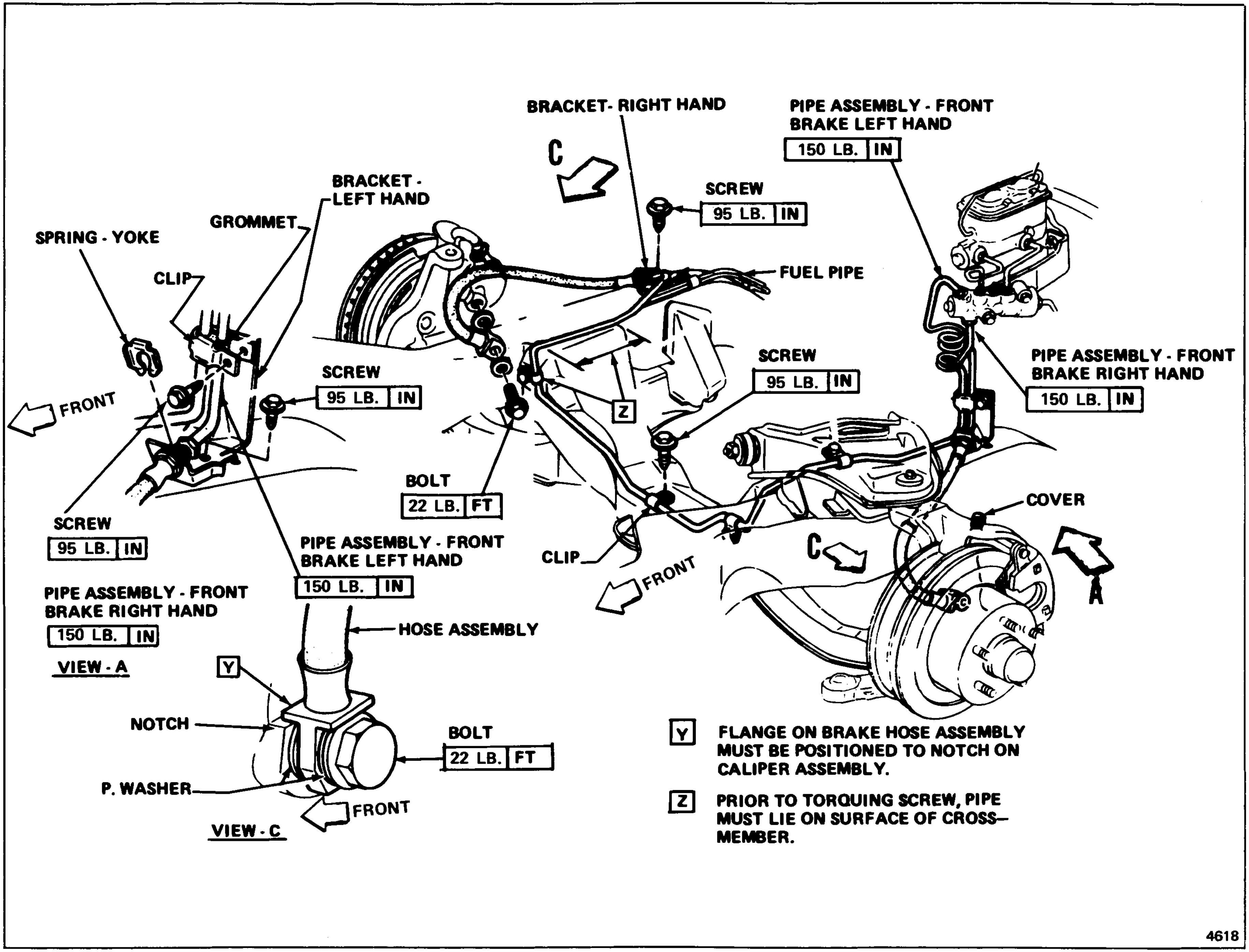
1. Raise Car.
2. Remove adjusting nut from equalizer. See Figures 5-19 and 5-20.
3. Remove retainer clip from rear portion of front cable at frame and from lever arm.
4. Disconnect front brake cable from parking brake pedal or lever assembly. Remove front brake cable. On some models it may assist installation of new cable if a heavy cord is tied to either end of cable in order to guide new cable through proper routing.
5. Install cable by reversing removal procedure.
6. Adjust parking brake.

Center Cable

1. Raise Car.
2. Remove adjusting nut from equalizer.
3. Unhook connector at each end and disengage hooks and guides.
4. Install new cable by reversing removal procedure.
5. Adjust parking brake.
6. Apply parking brake 3 times with heavy pressure and repeat adjustment.

Rear Cable

1. Raise Car.
2. Remove rear wheel and brake drum.
3. Loosen adjusting nut at equalizer.
4. Disengage rear cable at connector. See Figures 5-22 and 5-23.
5. Bend retainer fingers.
6. Disengage cable at brake shoe operating lever.
7. Install new cable by reversing removal procedure.
8. Adjust parking brake.



Y FLANGE ON BRAKE HOSE ASSEMBLY MUST BE POSITIONED TO NOTCH ON CALIPER ASSEMBLY.

Z PRIOR TO TORQUING SCREW, PIPE MUST LIE ON SURFACE OF CROSS-MEMBER.

Fig. 5-10 Front Brake Pipes - X Series

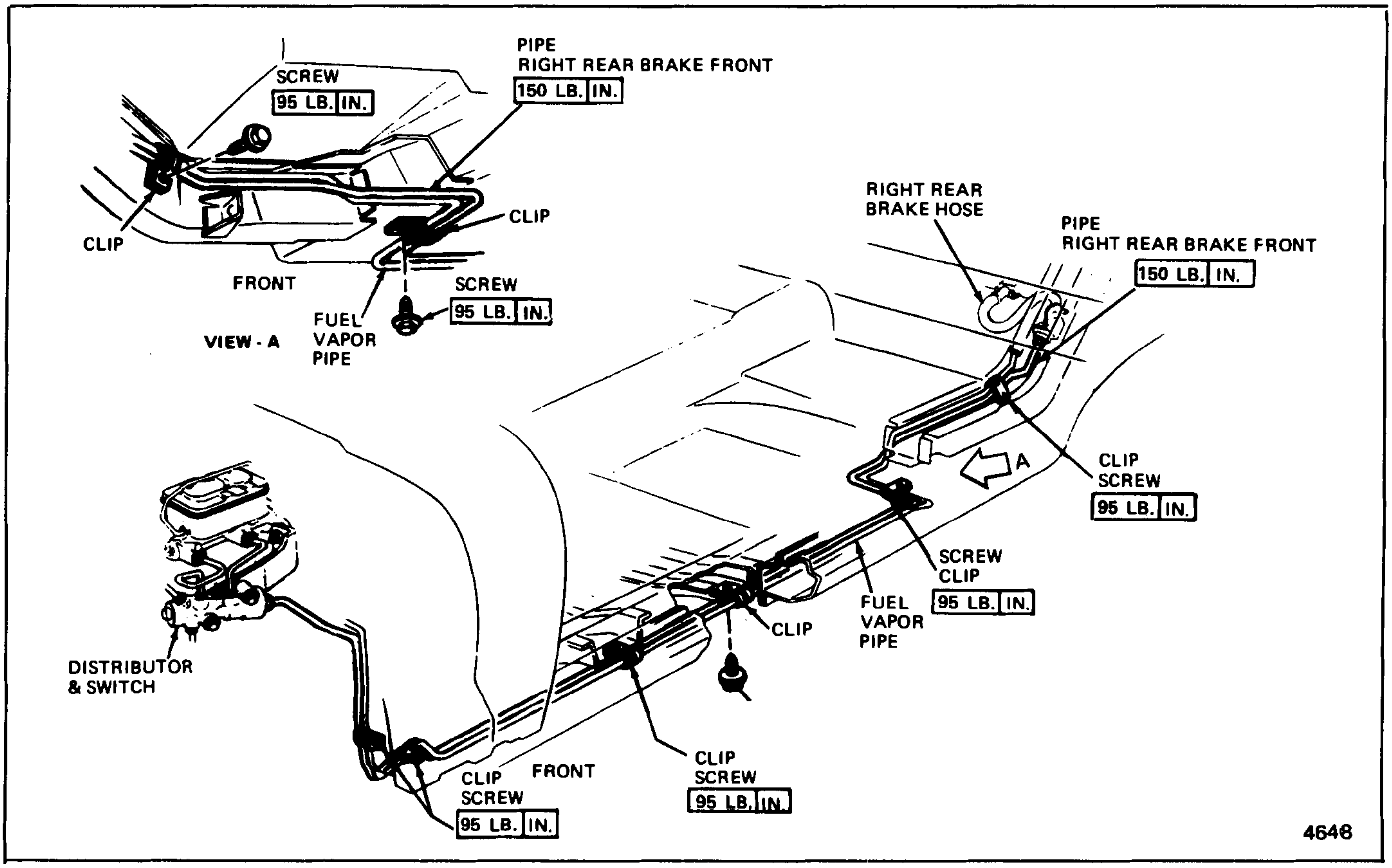


Fig. 5-11 Center Brake Pipes - X Series

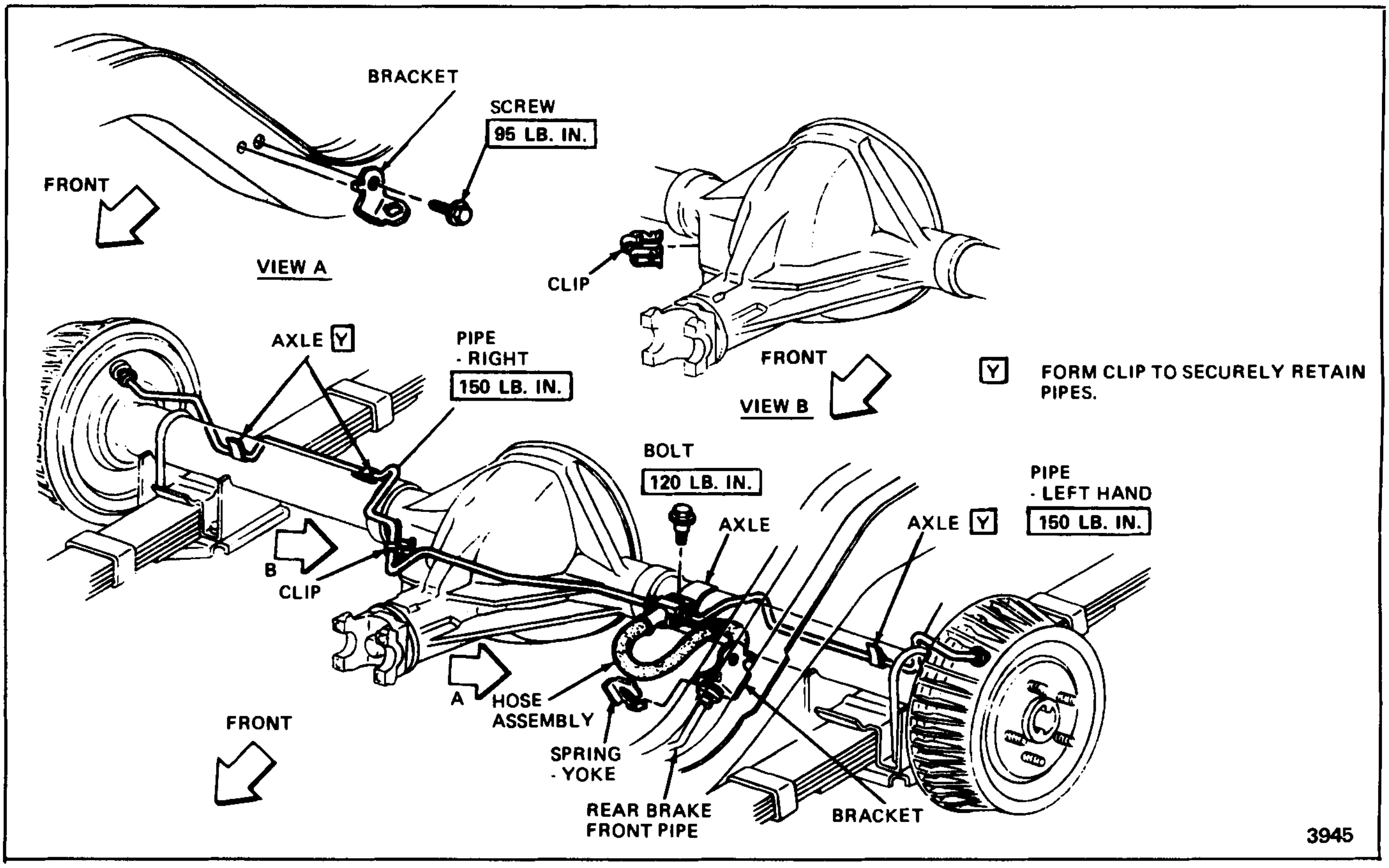


Fig. 5-12 Rear Brake Pipes - X Series

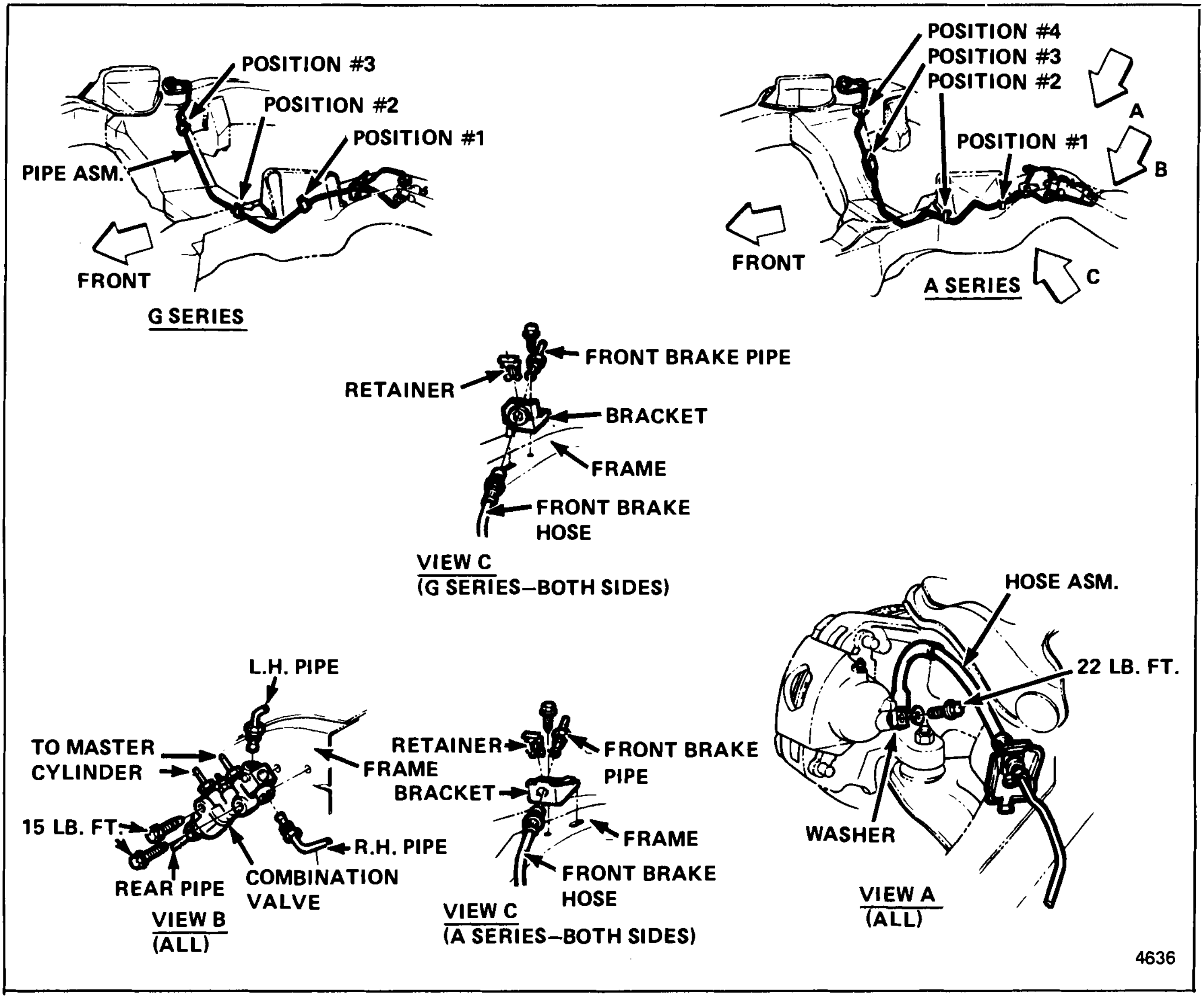


Fig. 5-13 Front Brake Pipes - A and G Series

B SERIES

B series right hand rear drum brakes have a rear parking brake cable entry and the strut spring is installed between the lever and secondary shoe. See illustrations for rest of installation Figures 5-24 and 5-25.

PARKING BRAKE ADJUSTMENT

Except H Series

Adjustment of parking brake cable is necessary whenever the rear brake cables have been disconnected. Need for parking brake adjustment is indicated if the hydraulic brake system operates with good reserve but the parking brake pedal travel is less than 9 ratchet clicks or more than 16 ratchet clicks under heavy foot pressures - all series.

1. Depress parking brake pedal exactly two ratchet clicks on the X Series, three ratchet clicks on the A Series, and six ratchet clicks on the B Series.

2. Tighten adjusting nut until the left rear wheel can just be turned rearward using two hands but is locked when forward rotation is attempted.

3. With mechanism totally disengaged, rear wheels should turn freely in either direction with no brake drag.

It is very important that parking brake cables are not adjusted too tightly to cause brake drag.

H Series

1. Raise vehicle on hoist.

2. Apply parking brake 1 notch from fully released position.

3. Loosen equalizer check nut and tighten the adjusting nut until a light drag is felt when the rear wheels are rotated. It will be necessary to remove the propeller shaft to gain access to parking brake equalizer.

4. Tighten the check nut securely.

5. Fully release parking brake and rotate the rear wheels. No drag should be present.

6. Lower vehicle to floor.

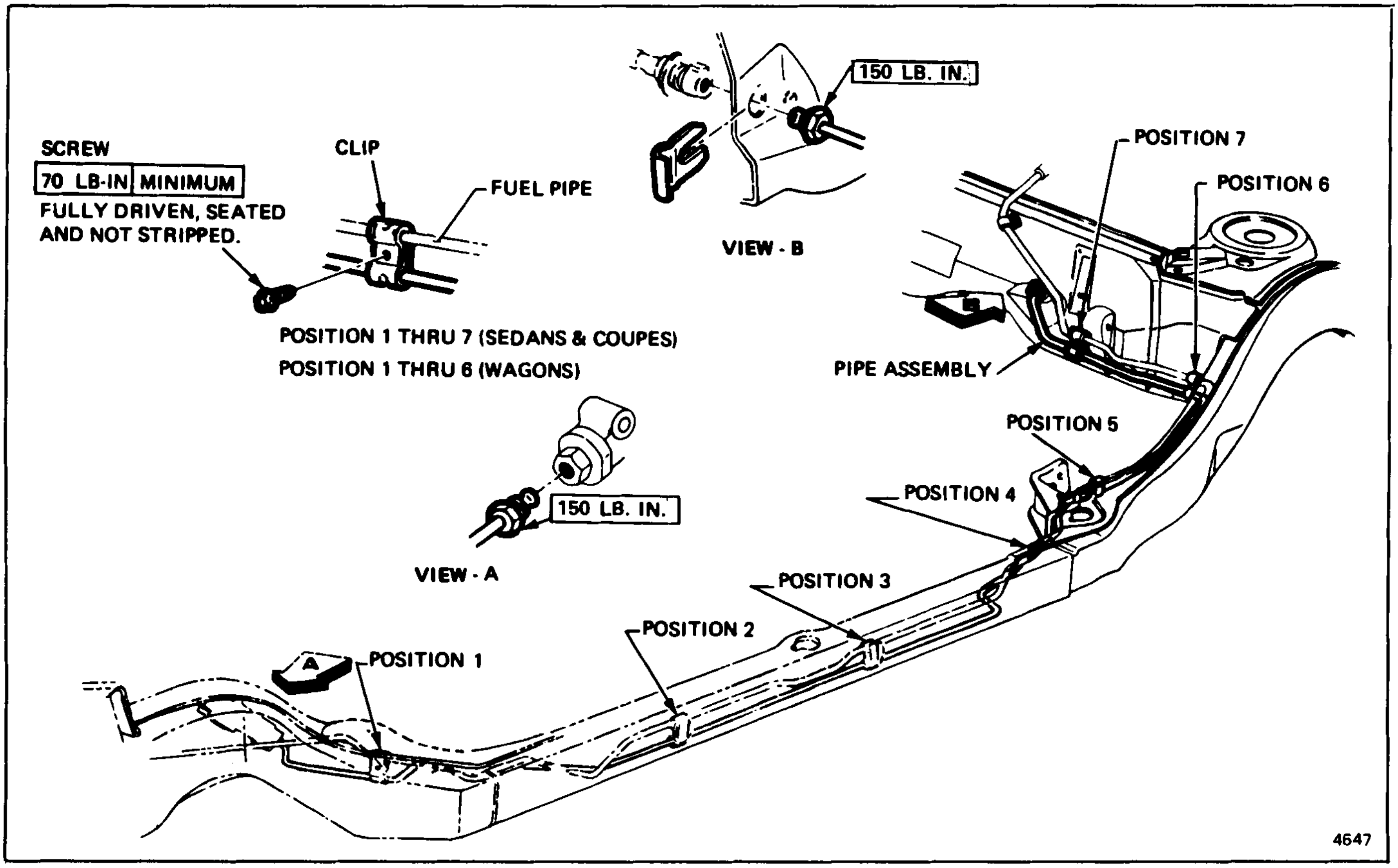


Fig. 5-14 Center Brake Pipes - A and G Series

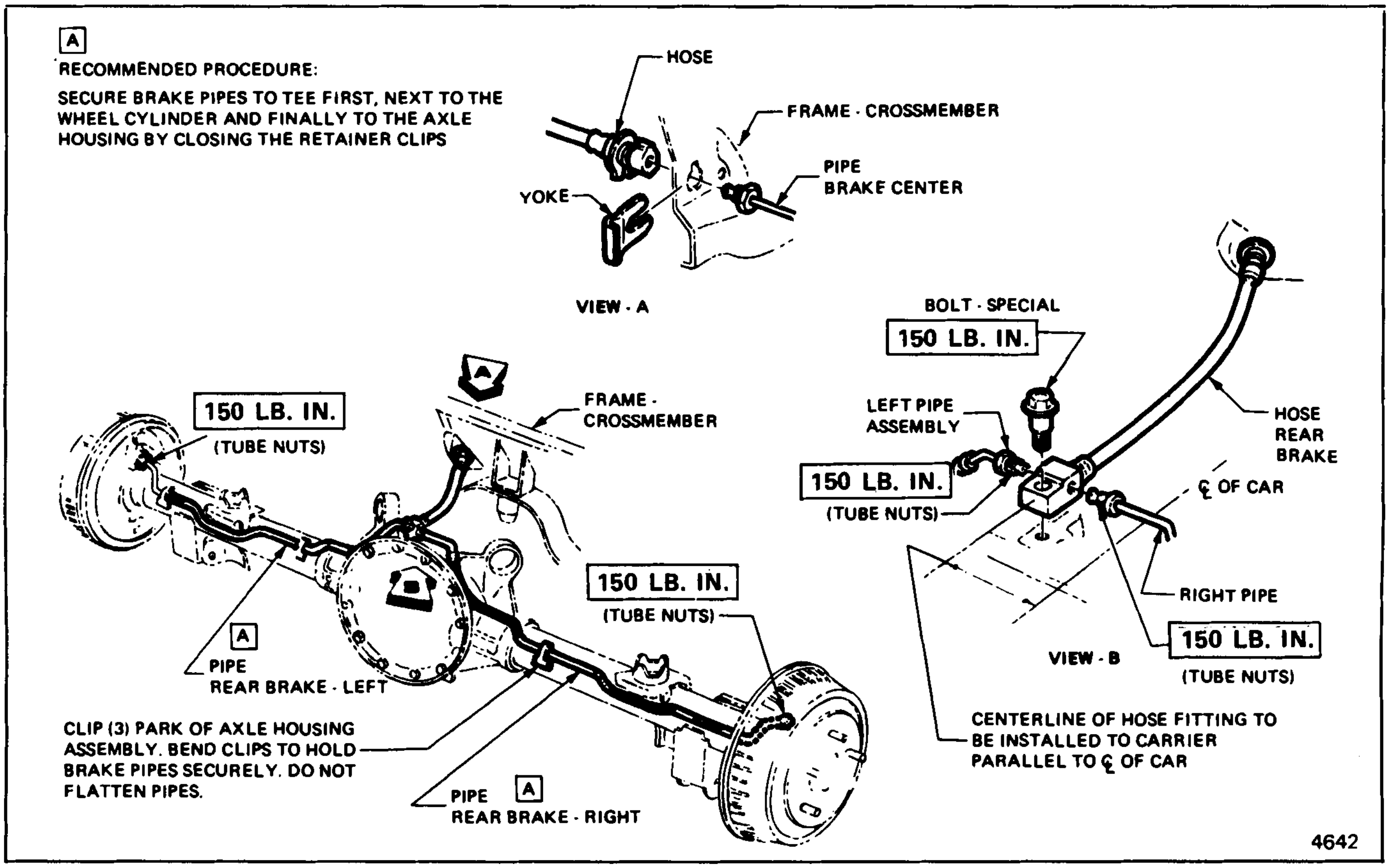


Fig. 5-15 Rear Brake Pipes - A and G Series

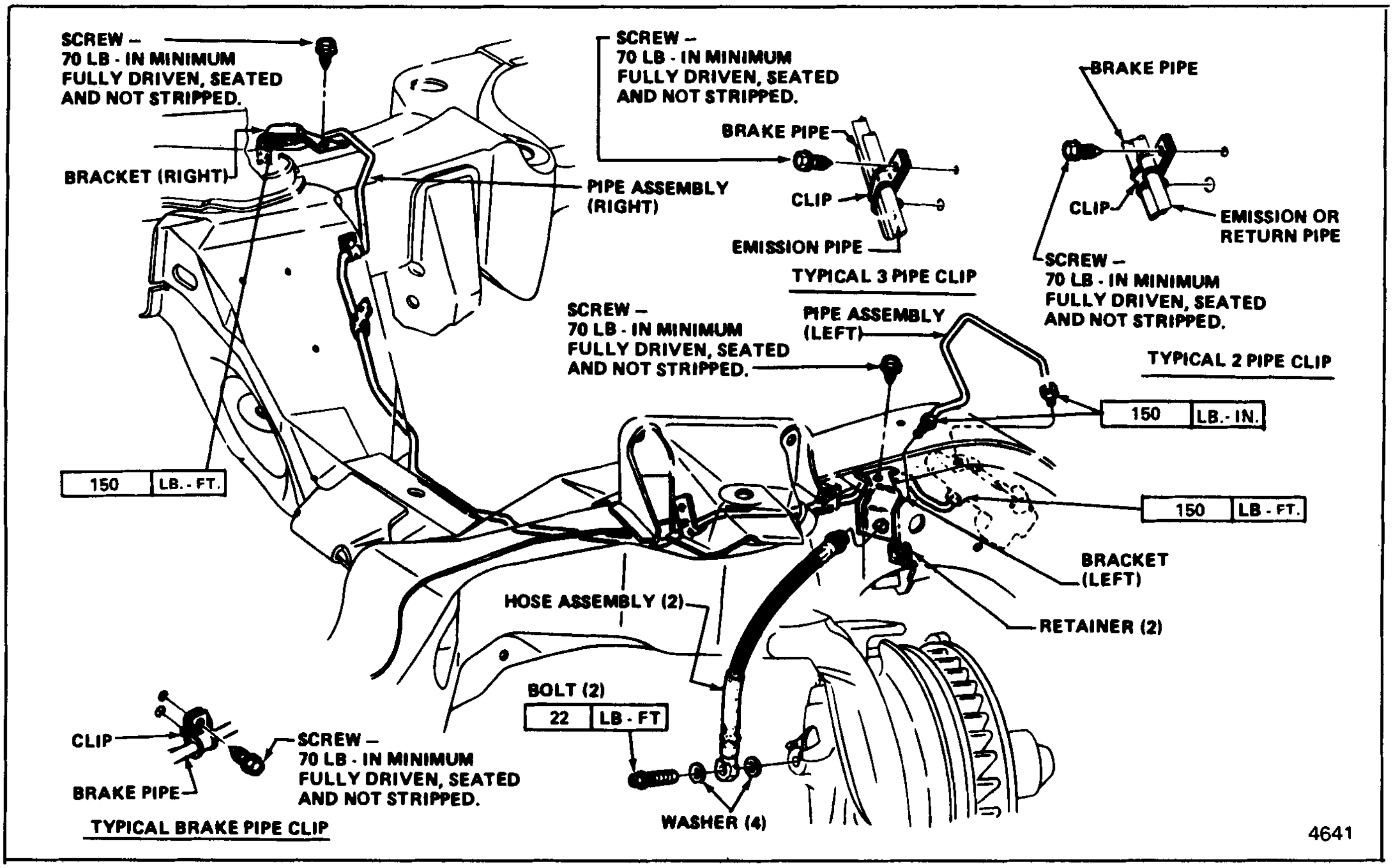


Fig. 5-16 Front Brake Pipes - B Series

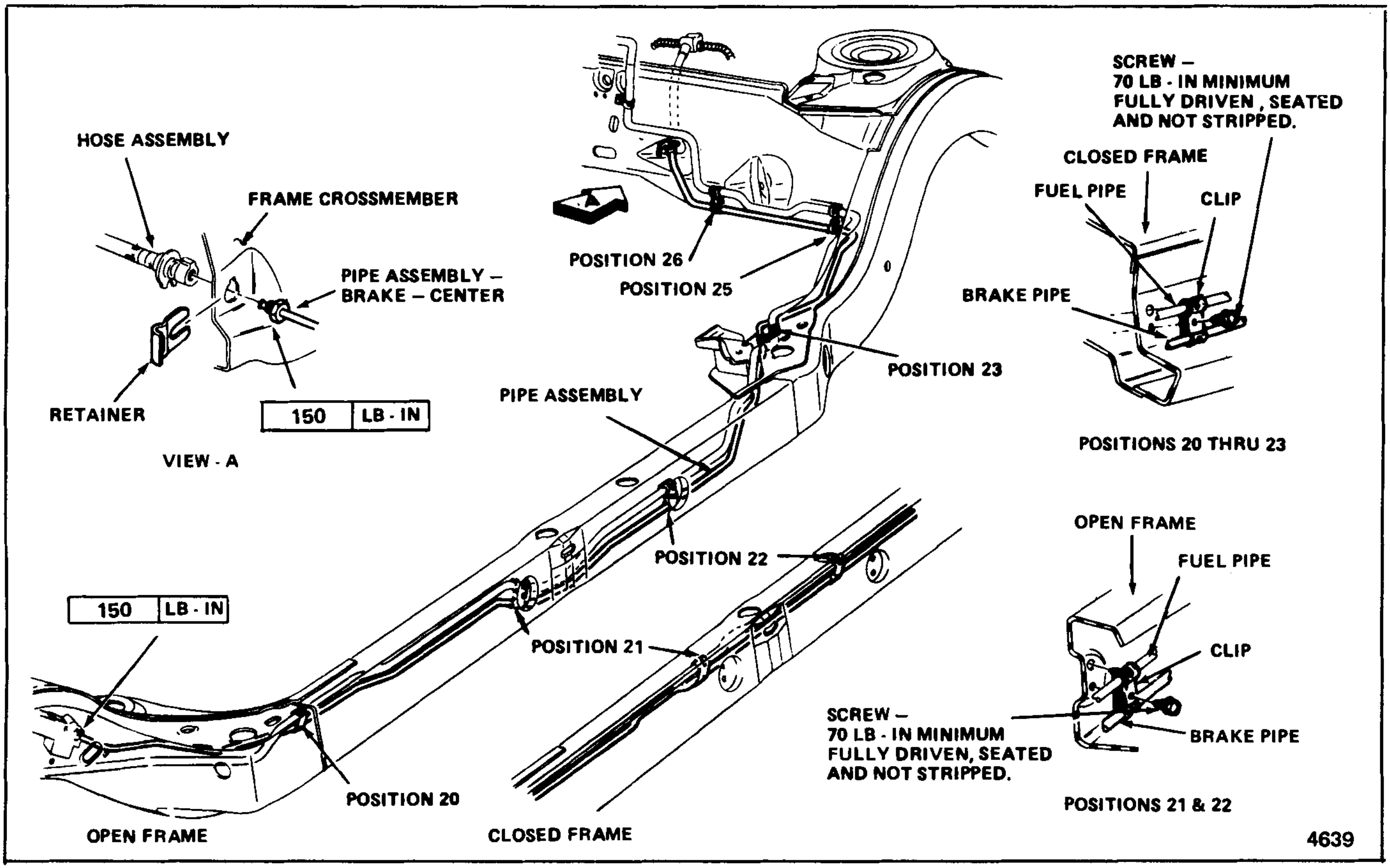
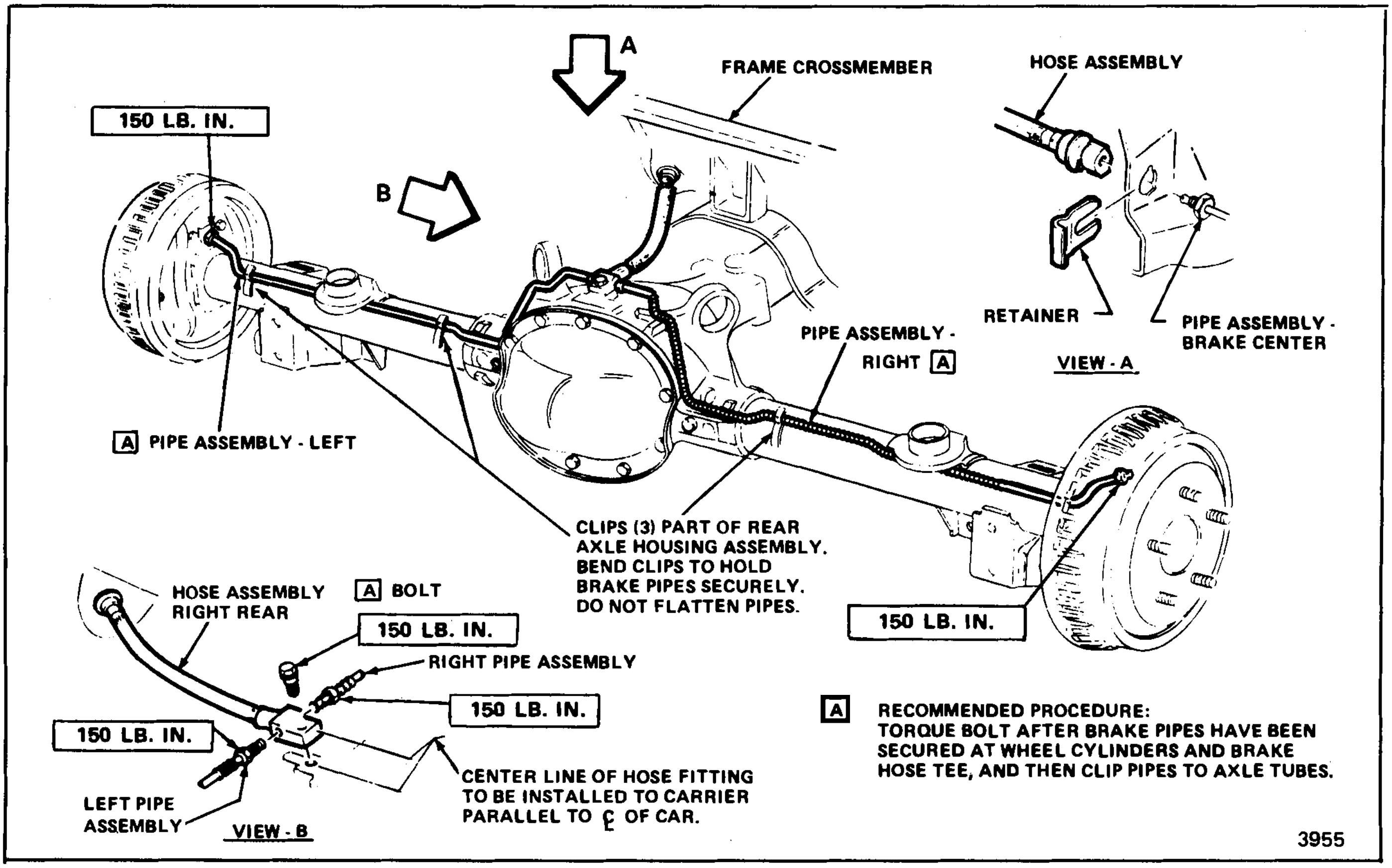


Fig. 5-17 Center Brake Pipes - B Series



[A] RECOMMENDED PROCEDURE: TORQUE BOLT AFTER BRAKE PIPES HAVE BEEN SECURED AT WHEEL CYLINDERS AND BRAKE HOSE TEE, AND THEN CLIP PIPES TO AXLE TUBES.

Fig. 5-18 Rear Brake Pipes - B Series

PARKING BRAKE SWITCH

ADJUSTMENT

H Series

With the ignition switch "On", the brake warning light should not light with the parking brake lever fully released but should light with the lever applied in the first notch (click).

1. Check that the brake warning light (on the dash) does not light with the parking brake lever fully released (ignition "On").
2. Apply the parking brake lever (1) notch; the brake light should come on.
3. If the light remained on in Step 1 or did not come on in Step 2, lift up on the rear of the lever cover.
4. Adjust the switch, as necessary, by bending the tab on the driver side of the lever assembly. Recheck switch operation.

Avoid excessive bending of the tab. Check the tab for cracks; if cracking is evident, the lever assembly must be replaced.

COMBINATION VALVE

Testing Electrical Circuit of Combination Valve

1. Disconnect wire from switch terminal and use a jumper to connect wire to a good ground.
2. Turn ignition key to "On" - warning lamp should light. If lamp does not light, bulb is burned out or electrical circuit is defective. Replace bulb or repair electrical circuit as necessary.
3. When warning lamp lights, turn ignition switch off. Disconnect jumper and reconnect wire to switch terminal.

Testing Warning Light Switch Portion of

Combination Valve

1. Attach a bleeder hose to a rear brake bleed screw and immerse the other end of the hose in a container partially filled with clean brake fluid. Be sure master cylinder reservoirs are full.
2. Turn ignition switch to "On" - open bleeder screw while a helper applies moderate pressure to the brake pedal. Warning lamp should light. Close bleeder screw before helper releases brake pedal. Reapply brake pedal with moderate-to-heavy pressure. Light should go out.
3. Attach the bleeder hose to a front brake bleeder screw and repeat above test. Warning lamp action should be the same as in Step No. 2. Turn ignition switch off.
4. If warning lamp does not light during Steps 2 and 3 but does light when a jumper is connected to ground, the warning light switch portion of the combination valve is defective. Do not attempt to disassemble the combination valve. If any portion of the combination valve is defective, it must be replaced with a new combination valve.

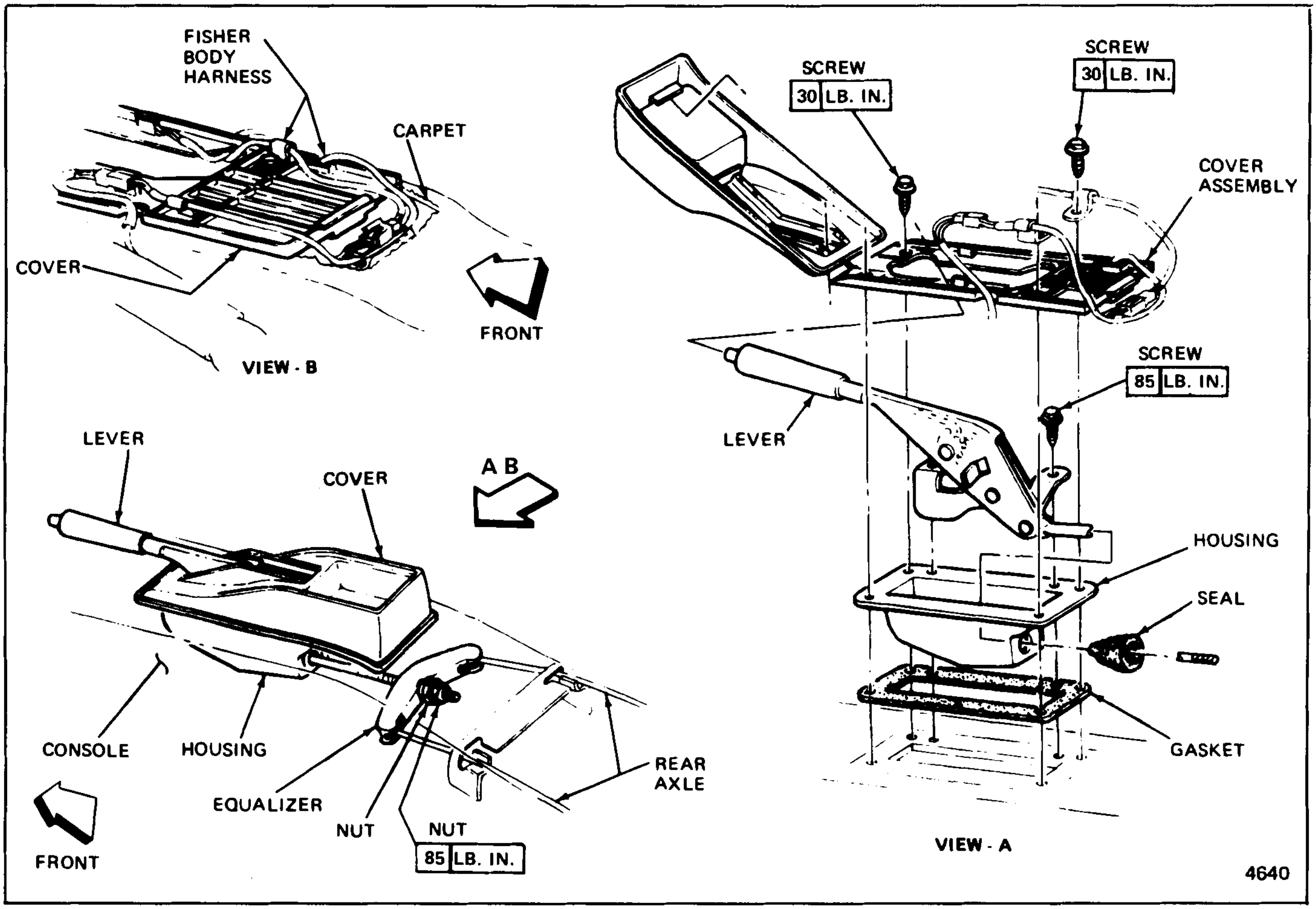


Fig. 5-19 Parking Brake Lever and Equalizer - H Series

Combination Valve Replacement

The combination valve is not repairable and must be serviced as a complete assembly.

1. Disconnect hydraulic lines at combination valve. Plug lines to prevent loss of fluid and entrance of dirt. Disconnect warning switch wiring harness from valve switch terminal. See Figures 5-26, 5-27, 5-28 and 5-29.
2. Remove combination valve.
3. Install combination valve by reversing removal steps.
4. Bleed entire brake system. Do not move car until a firm brake pedal is obtained.

MASTER CYLINDER

FILLING BRAKE MASTER CYLINDER

The master cylinder must be kept properly filled to insure adequate reserve and to prevent air from entering the hydraulic system. However, because of expansion due to heat absorbed from brakes and from engine, master cylinder must not be overfilled.

The brake fluid reservoir is on the master cylinder which is located under the hood on the left side of the dash.

Thoroughly clean reservoir cover before removal to avoid getting dirt into reservoir. Remove cover and diaphragm.

Add fluid as required to bring level to 1/4" (plus or minus 1/8") from the lowest portion of the top of each reservoir. Use Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent.

Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil or a container which is wet from rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent water contamination.

MASTER CYLINDER OVERHAUL

Removal of Brake Master Cylinder

1. Disconnect brake pipes from master cylinder and tape end of pipes to prevent entrance of dirt.
2. (Manual brake only) Disconnect brake pedal from master cylinder push rod.
3. Remove two nuts holding master cylinder to dash or power cylinder and remove master cylinder from car. Be careful not to drip brake fluid on exterior paint.

Disassembly of Brake Master Cylinder

1. Clean outside of master cylinder thoroughly. Remove reservoir cover and diaphragm. Turn cylinder over and pump push rod by hand to drain all brake fluid. Always discard used fluid.

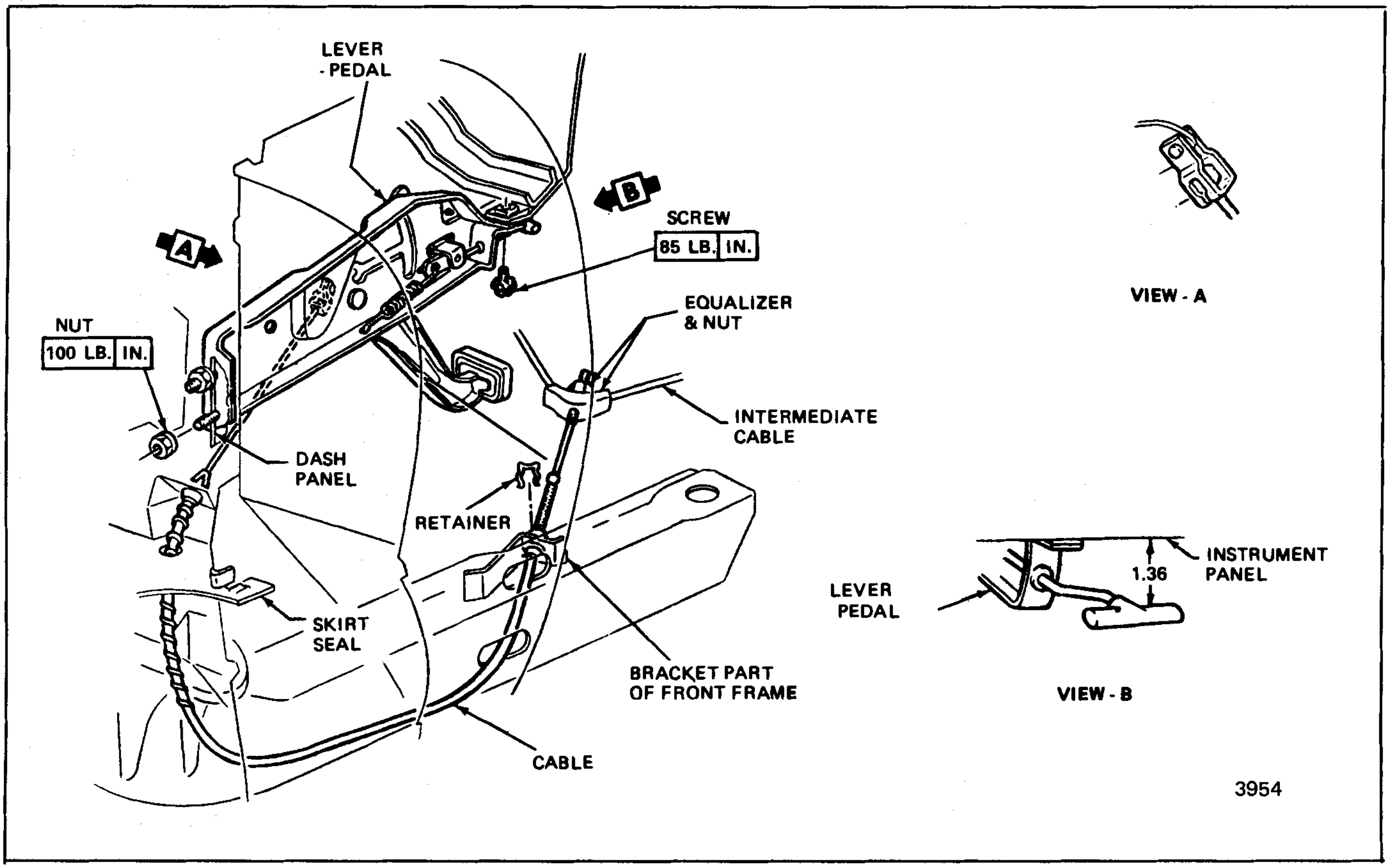


Fig. 5-20 Parking Brake Control Assembly - X Series

2. (Manual brake only) Pull boot away from master cylinder to uncover push rod retainer. The retainer has a small, depressed tab in the side. This tab must be pried up to release retainer.

3. Depress piston and remove secondary piston stop bolt from bottom of front fluid reservoir.

4. Place master cylinder in vise so that lock ring can be removed from groove in the inside diameter of bore. Remove lock ring and primary piston assembly. Remove secondary piston, secondary piston spring and retainer by blowing air through the stop bolt hole. If no air is available, a piece of wire may be used. Bend about 1/4" of one end into a right angle. Hook this end under edge of the secondary piston and pull it out.

5. Place master cylinder in vise, so that outlet holes are up. Enlarge hole in tube fitting insert using a 13/64" drill. Place a heavy washer over outlet on master cylinder and thread a 1/4-20 x 3/4" screw into the insert. Tighten screw until insert is unseated. Remove insert, screw, and washer.

6. Remove primary seal, and secondary seal from secondary piston.

7. Use clean brake fluid to clean all metal brake parts thoroughly. Air dry and place cleaned parts on clean paper or lint free clean cloth.

Do not use anti-freeze alcohol, gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil.

Inspection of Brake Master Cylinder

Inspect cylinder bore for scoring or corrosion. It is best to replace a corroded cylinder. Corrosion can be identified as pits or excessive roughness.

Polish any discolored or stained area with crocus cloth by revolving cylinder on cloth supported by a finger.

Rinse cylinder in clean brake fluid. Shake excess rinsing fluid from cylinder. Do not use a rag to dry cylinder, as lint from rag cannot be kept from cylinder bore surfaces.

Make certain that compensating port in cylinder is clear.

If scratches or corroded spots are too deep to be polished satisfactorily, the cylinder should be replaced.

Assembly of Brake Master Cylinder

1. Place brass tube fitting insert (new parts) in outlet holes, so that it is in a position to be pressed into outlet hole. The recommended method of inserting tube fitting insert is to thread a spare brake line tube nut into outlet hole and turn nut down until tube fitting insert bottoms. Remove tube nut and check outlet hole for loose burrs, which might have been turned up when tube fitting insert was pressed down.

2. Put new secondary seal in groove in end of secondary piston. See Fig. 5-34.

3. Assemble a new primary seal over end of secondary piston, so that flat side of the seal seats against flange of piston. See Fig. 5-34.

4. Assemble new secondary seal into groove on end of the secondary piston.

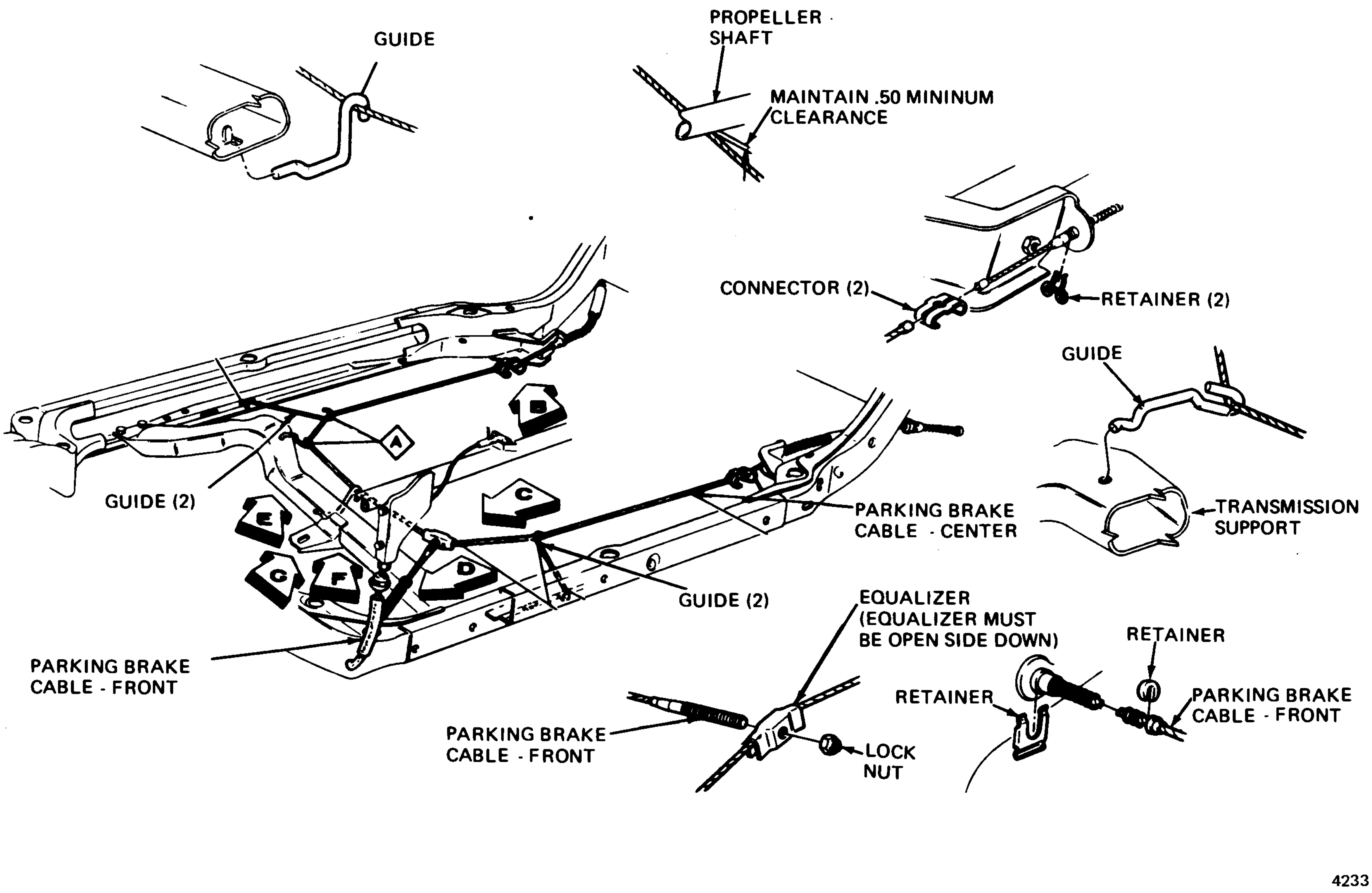


Fig. 5-21 Parking Brake Cable Assembly - A and G Series

5. In order to insure correct assembly of the primary assembly, a complete primary piston assembly is included in the repair kits.

6. Coat bore of master cylinder with clean brake fluid. Coat primary and secondary seals on secondary piston with clean brake fluid. Insert the secondary piston spring retainer into secondary piston spring. Place retainer and spring over end of secondary piston, so that retainer locates inside lip of primary cup.

7. Hold master cylinder with open end of bore down, push secondary piston into bore, so that spring will seat against closed end of bore.

8. Place master cylinder in a vise with open end of bore up. Coat primary and secondary seal on primary piston with clean brake fluid. Push primary piston assembly, spring end first, into bore of master cylinder. Hold the piston down and snap lock ring into position in groove in inside diameter of bore.

9. Continue to hold primary piston down and install stop screw. (If so equipped)

10. Install a new reservoir diaphragm in reservoir cover where needed, and install cover on master cylinder. Beaded side faces master cylinder casting to insure positive sealing. The bail wire is not pushed into position to hold reservoir cover.

11. (Manual brake only.) Assemble push rod through push rod retainer, if it has been disassembled. Push retainer over end of master cylinder. Assemble new boot over push rod and press it down over the push rod retainer. Thread jam nut down to shoulder on push rod. Thread clevis down to jam nut. Torque nut against clevis to 14 lb. ft.

Installation of Brake Master Cylinder

1. (Manual Brake only) Connect push rod to brake pedal pin and install retainer while holding master cylinder in place. See Fig. 5-35.

2. Install master cylinder on dash or power cylinder. Torque nuts to 25 lb. ft.

> **CAUTION:** *This brake master cylinder to cowl fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number, or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

3. Connect brake pipes to master cylinder.

4. Bleed hydraulic system.

5. Road test car for proper brake performance.

DISC BRAKES

MAINTENANCE AND ADJUSTMENTS

Lining Inspection

Inspect the brake linings every 6,000 miles and any time that the wheels are removed (tire rotation, etc.). Check both ends of the outboard shoe by looking in at each end of the caliper. See Fig. 5-37. These are the points at which the highest rate of wear normally occurs. However, at the same time, check the lining thickness on the inboard shoe to make sure that is has not worn prematurely. Look down through the inspection hole in the top of the caliper to view the inboard shoe. Whenever the thickness of any lining is worn to within .020 on X, A, B, or .030 on H of rivet at either end of the shoe, all disc brake shoe and lining assemblies should be replaced at the same time. See Fig. 5-38.

CALIPER REMOVAL AND INSTALLATION

EXCEPT H SERIES

Caliper Removal

See Warning Page 5-1

1. Remove two thirds of the total fluid capacity from the front master cylinder reservoir. Removal of the fluid is necessary to prevent reservoir overflow when the caliper piston is pushed back in its bore to remove the caliper. This may be done by breaking the front line connection at the master cylinder and bleeding down the fluid level. Do not remove the brake line or completely empty the reservoir or it will be necessary to bleed the hydraulic system. Discard -- do not attempt to reuse -- the brake fluid removed.

2. Raise the car and remove the wheel covers and wheel assemblies. Position a 7 inch "C" clamp on the caliper so that the solid side of the clamp rests against the inside of the caliper and the screw end rests against the metal part of the outboard shoe. See Fig. 5-39. Tighten the "C" clamp until the caliper moves away from the car far enough to push the piston to the bottom of the piston bore. This will allow the shoes to back off from the rotor surfaces. Remove the "C" clamp.

3. It is not necessary to disconnect the brake hose for shoe and lining replacement. Remove the two mounting bolts which attach the caliper to the support bracket. See Figure 5-40. Lift the caliper off the rotor and remove the inboard shoe. *Dislodge the outboard shoe and position the caliper on the front suspension arm so that the brake hose will not support the weight of the caliper. Remove the shoe support spring from the cavity in the piston.*

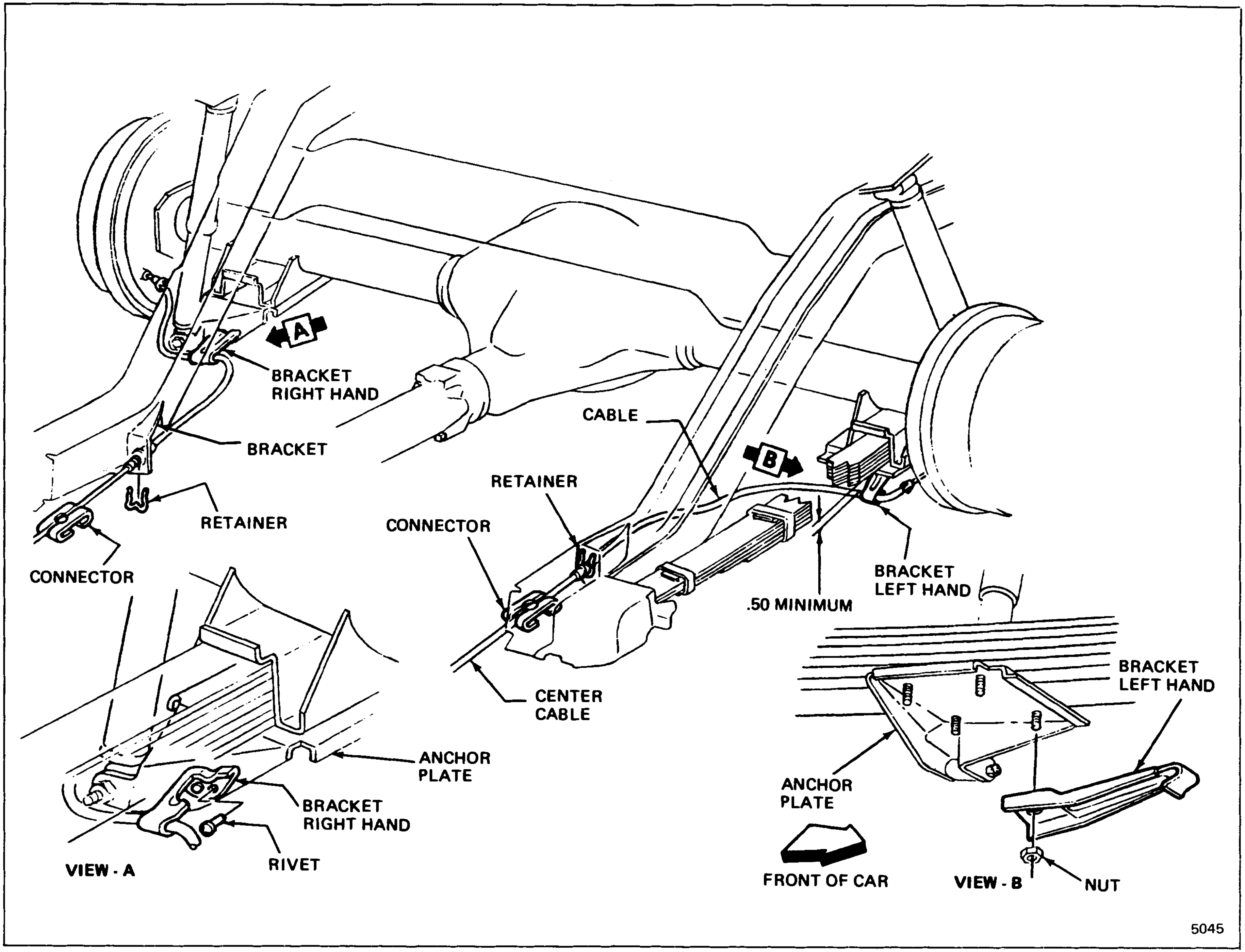


Fig. 5-22 Parking Brake Rear Cables - X Series

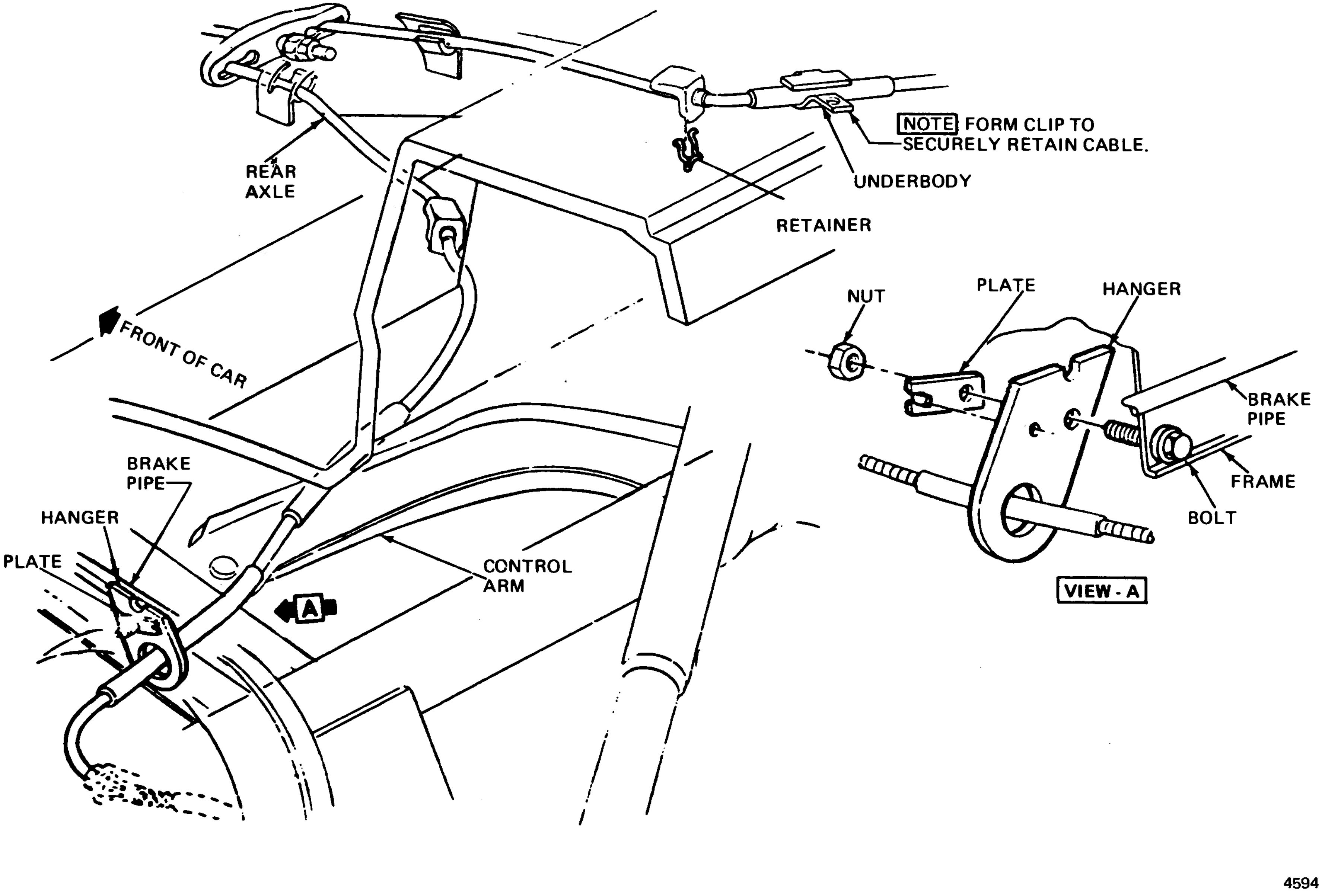
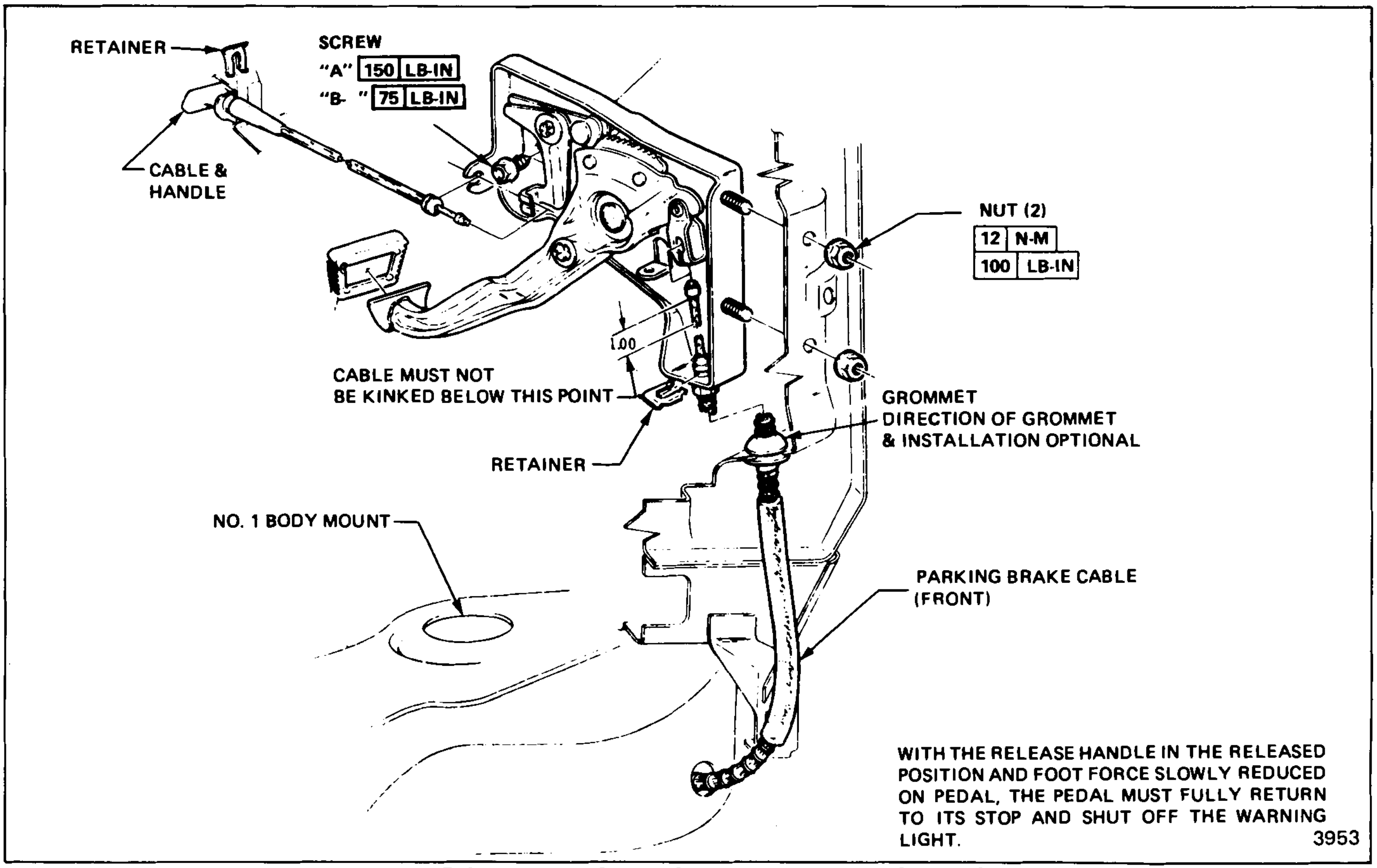


Fig. 5-23 Parking Brake Rear Cables - H Series



WITH THE RELEASE HANDLE IN THE RELEASED POSITION AND FOOT FORCE SLOWLY REDUCED ON PEDAL, THE PEDAL MUST FULLY RETURN TO ITS STOP AND SHUT OFF THE WARNING LIGHT.

Fig. 5-24 Parking Brake Control Assmbly A, B and G Series

4. Using tool, No. J 22835, remove the sleeves from the inboard ears of the caliper. See Fig. 5-41. Next, remove the rubber bushings from the grooves in each of the four caliper ears.

Cleaning and Inspection

1. Thoroughly clean the holes and the bushing grooves in the caliper ears. Wipe all dirt from the mounting bolts. Do not use abrasives on the bolts since this will damage the plating. If the bolts are corroded, or damaged, they should be replaced.

2. Examine the inside of the caliper for evidence of fluid leakage. If leakage is noted, the caliper should be over hauled. Wipe the inside of the caliper clean, including the exterior of the dust boot. Check the boot for cuts, cracks or other damage. Make sure that the boot is properly engaged in the groove in the piston and also in the caliper counter-bore. See Fig. 5-43.

> **CAUTION:** *Do not use compressed air to clean the inside of the caliper since this may cause the dust boot to become unseated.*

3. If the vehicle has a brake problem and diagnosis points to the rotor, it should be inspected and checked for runout at this time.

Caliper Installation

1. Install rubber bushings in all four caliper ears.

> **CAUTION:** *It is essential that the new sleeves and rubber bushings be used in order to insure the proper functioning of the sliding caliper design.*

2. Use Tool, J 22835, to install the sleeves. See Fig. 5-44. Position the sleeves so that the end toward the shoe and lining assemblies is flush with the machined surface of the ear.

3. Install the shoe support spring by replacing the single tang end of the spring over the notch in the center of the edge of the shoe. Then press the two tangs at the spring end of the inboard shoe spring over the bottom edge of the shoe so that they engage the shoe securely, as shown in Fig. 5-45.

4. Position the inboard shoe and lining assembly (with spring attached) on the caliper so that the ear end of the shoe and lining is down and the bottom end up at an angle with the spring resting on the piston I.D. See Fig. 5-46. Press down on both ends of the shoe until the shoe is in a flat position, resting on the piston. The spring end of the inboard shoe support spring should be resting on the I.D. of the piston.

> **CAUTION:** *On inboard shoes there is a specific left hand and right hand shoe. When properly installed the wear sensor will be toward rear of caliper.*

5. Position the outboard shoe in the caliper, with the ears at the top of the shoe over the caliper ears and the tab at the bottom of the shoe engaged in the caliper cut-out. See Fig. 5-47. Be sure to note right and left brake shoes.

6. Position the caliper over the rotor, lining up the holes in the caliper ears with the holes in the mounting bracket.

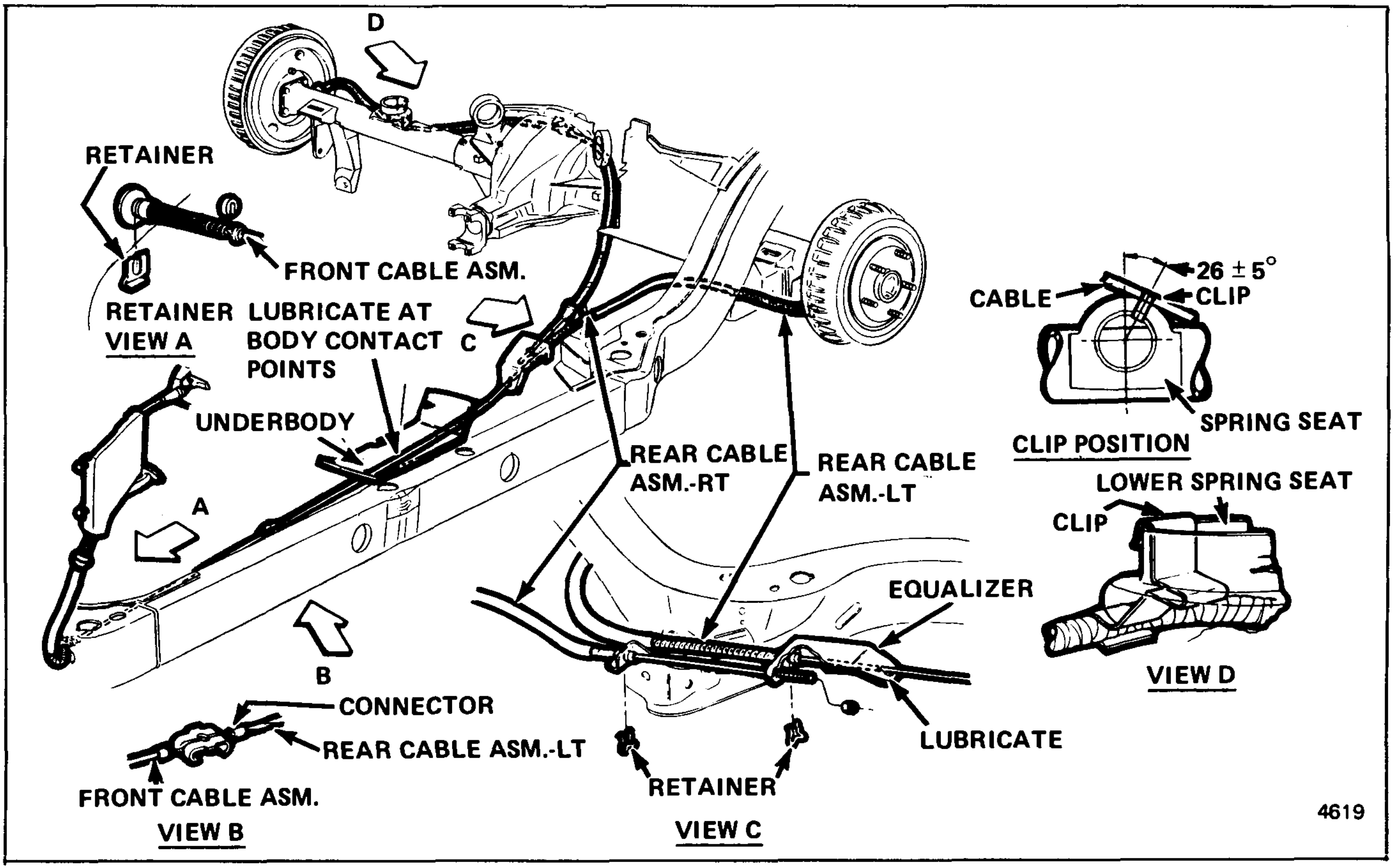


Fig. 5-25 Parking Brake Cable Assembly - B Series

CAUTION: *When reinstalling caliper be sure you haven't turned it over, end over end. This would cause a severe twist in the brake hose. After positioning caliper on disc, observe brake hose being sure it is not twisted.*

Start the bolts through the sleeves in the inboard caliper ears and through the mounting bracket, making sure that the ends of the bolts pass under the retaining ears on the inboard shoe. See Fig. 5-48. Push bolts on through to engage the holes in the outboard shoes and the outboard caliper ears at the same time, threading the bolts into the mounting bracket. Torque the bolts to 35 lb. ft.

CAUTION: *This disc brake caliper attachments fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number, or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

7. Add fresh approved brake fluid to the master cylinder reservoirs to bring the level up to within 1/8 inch of the top.
8. Pump brake pedal to seal linings against rotor.
9. Clinch upper ears of outboard shoe by positioning channel lock pliers with one jaw on top of upper ear and one jaw in notch on bottom of shoe opposite upper ear. See Fig. 5-49.
10. After clinching ears are to be flat against caliper housing with no radial clearance.
11. If radial clearance exists, repeat clinching procedure.

Completion

1. Replace the shoe and linings on the other front wheel disc brake in exactly the same manner as just described. Relining is to be done in full axle sets only. When completed, reinstall the wheel and tire assemblies. Torque wheel nuts to 10 lb. ft. Install wheel covers and lower the car to the floor.

CAUTION: *This wheel to brake drum and/or axle shaft fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number, or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

2. Whenever the front wheel disc brakes are relined, the rear drum brakes should be checked also.

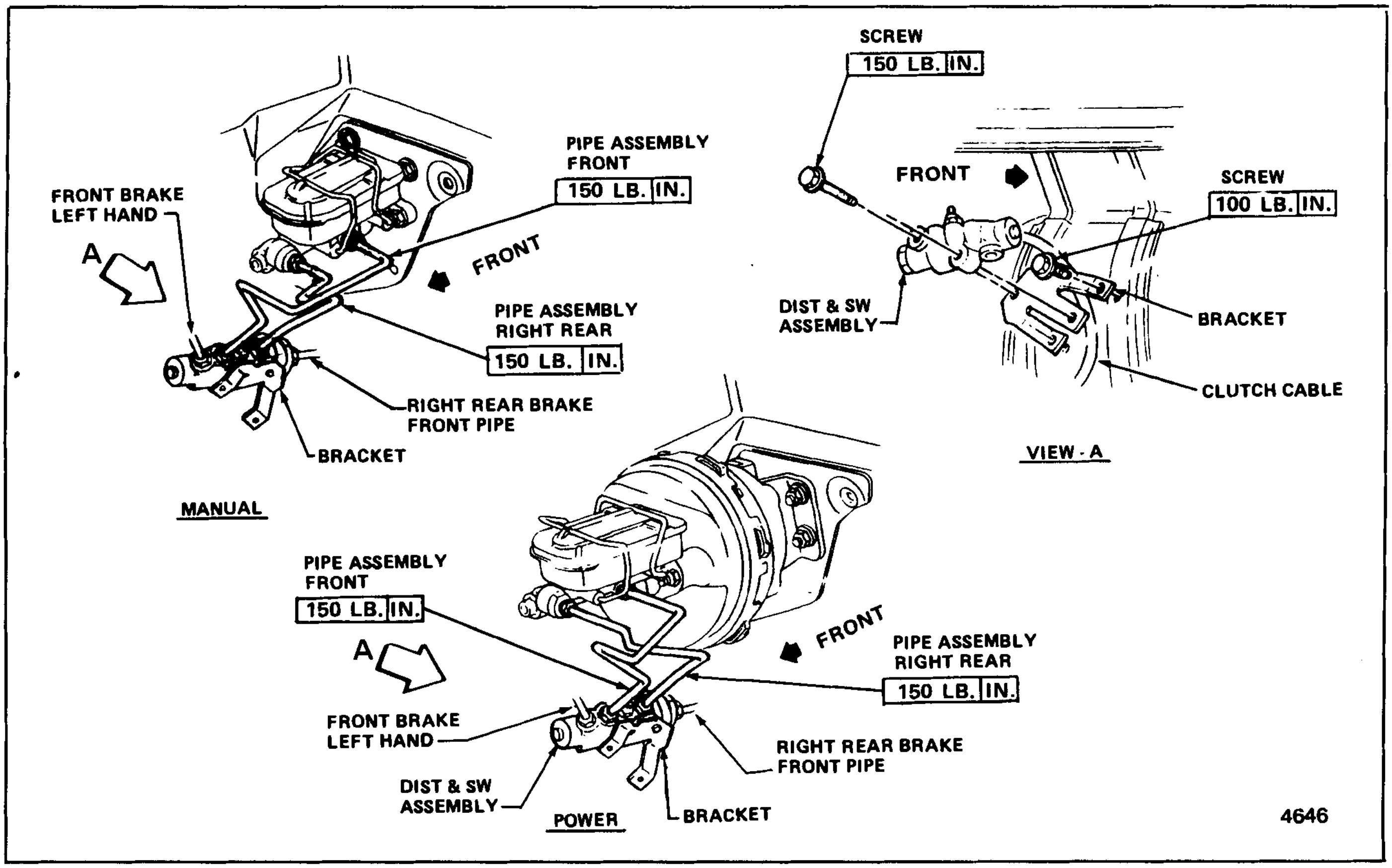


Fig. 5-26 Distributor Switch to Master Cylinder Mounting - H Series

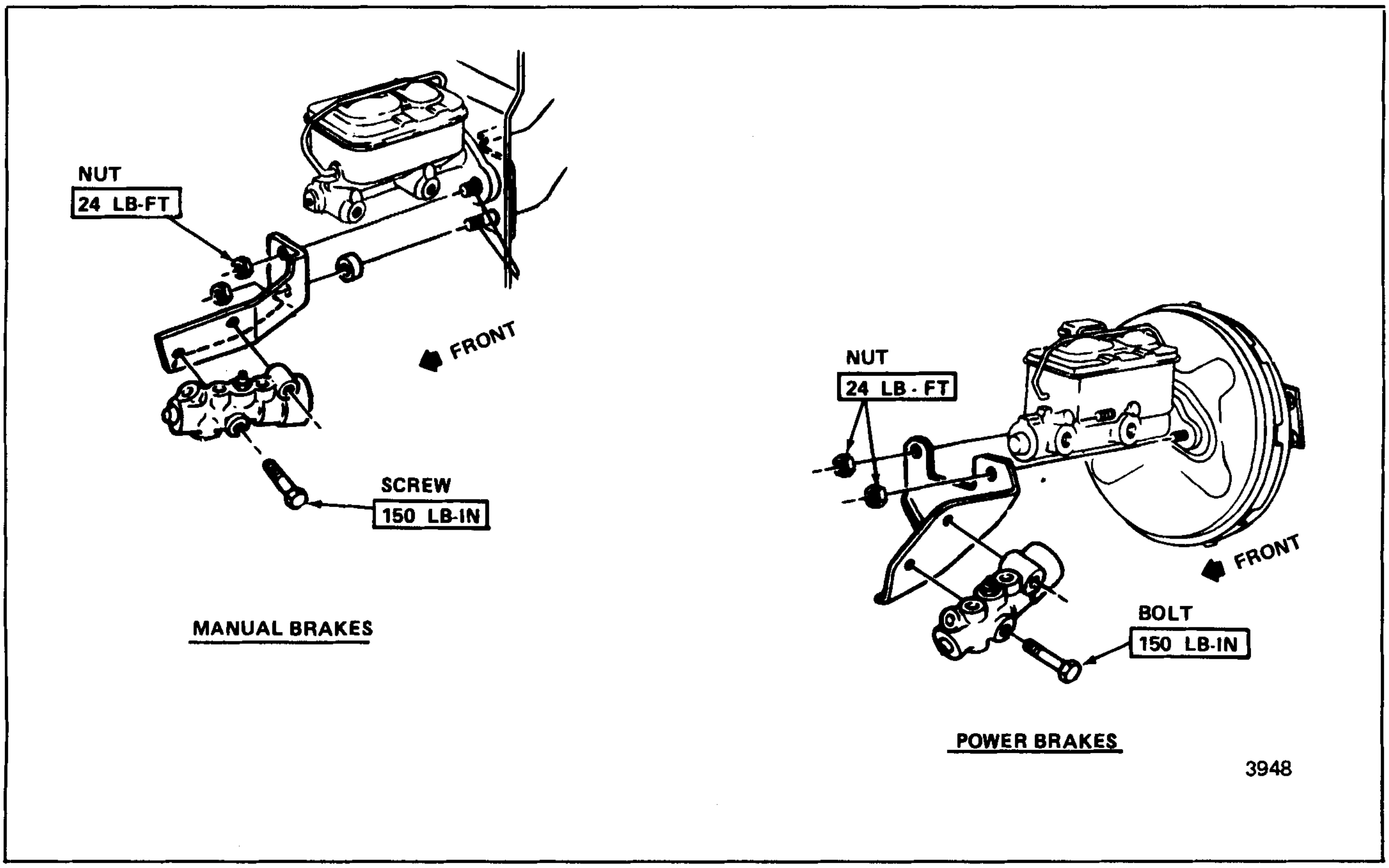
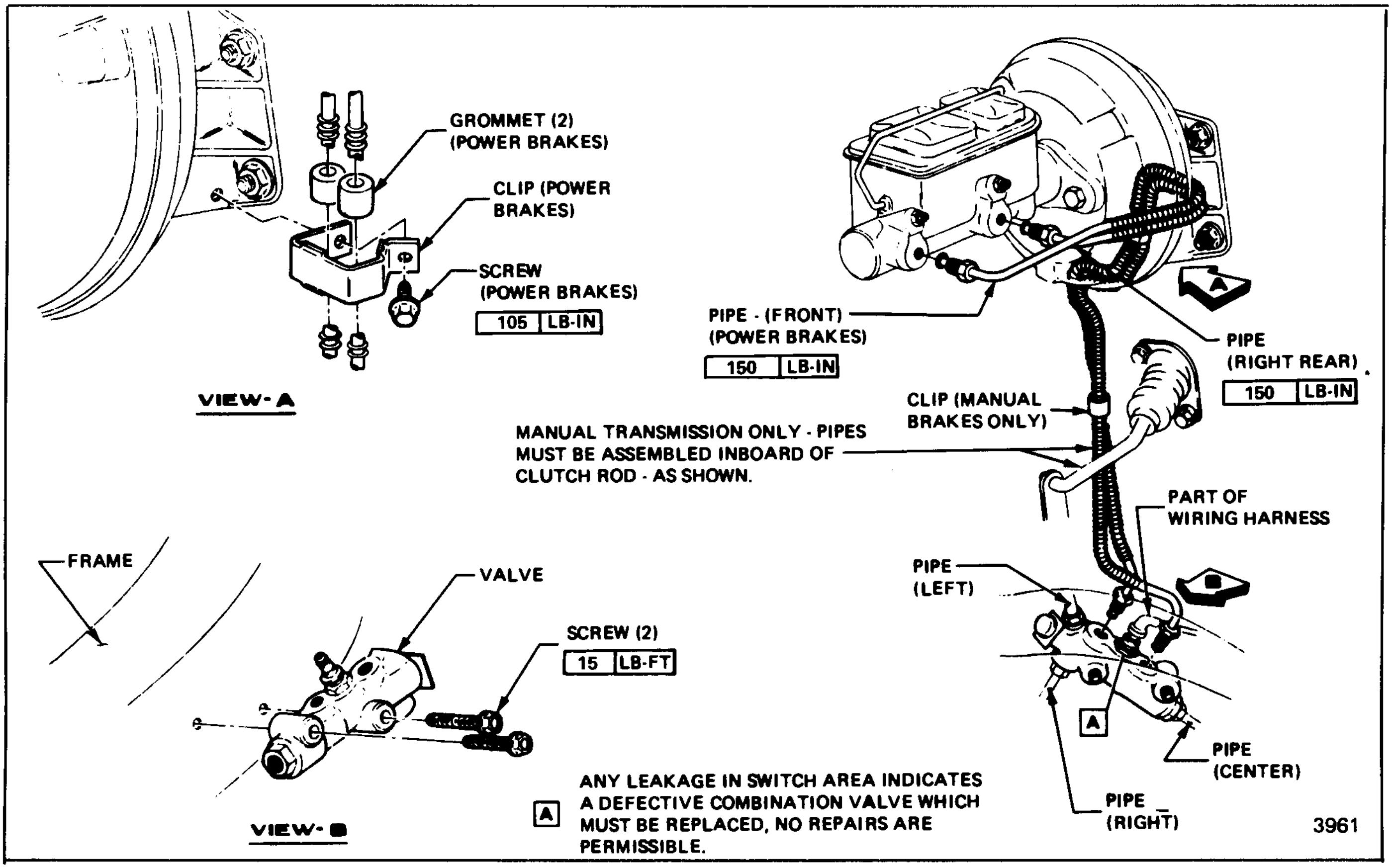
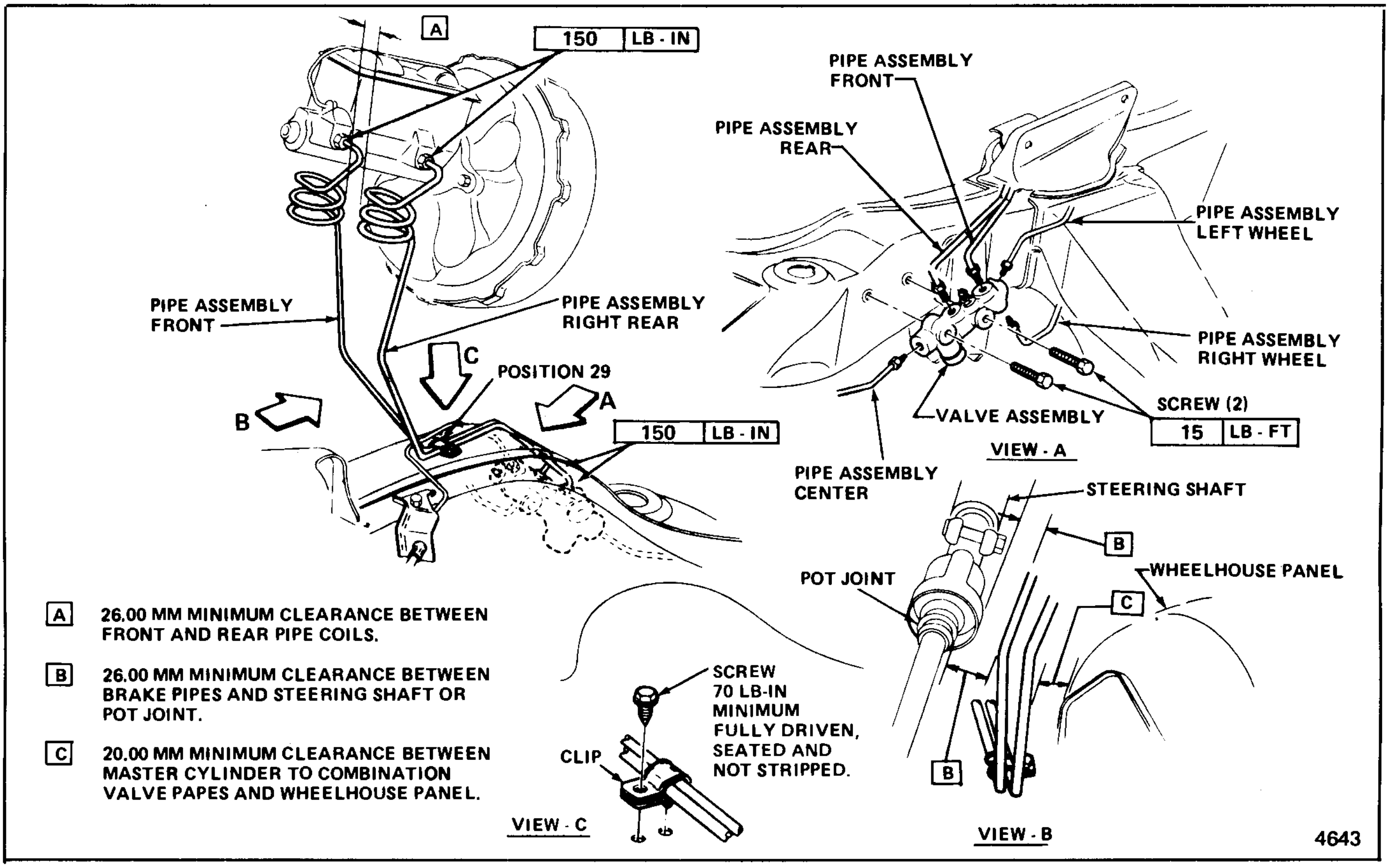


Fig. 5-27 Combination Valve to Master Cylinder Mounting - X Series



A ANY LEAKAGE IN SWITCH AREA INDICATES A DEFECTIVE COMBINATION VALVE WHICH MUST BE REPLACED, NO REPAIRS ARE PERMISSIBLE.

Fig. 5-28 Brake Lines - Master Cylinder to Combination Valve - A & G Series



A 26.00 MM MINIMUM CLEARANCE BETWEEN FRONT AND REAR PIPE COILS.

B 26.00 MM MINIMUM CLEARANCE BETWEEN BRAKE PIPES AND STEERING SHAFT OR POT JOINT.

C 20.00 MM MINIMUM CLEARANCE BETWEEN MASTER CYLINDER TO COMBINATION VALVE PAPES AND WHEELHOUSE PANEL.

Fig. 5-29 Brake Lines - Master Cylinder to Combination Valve - B Series

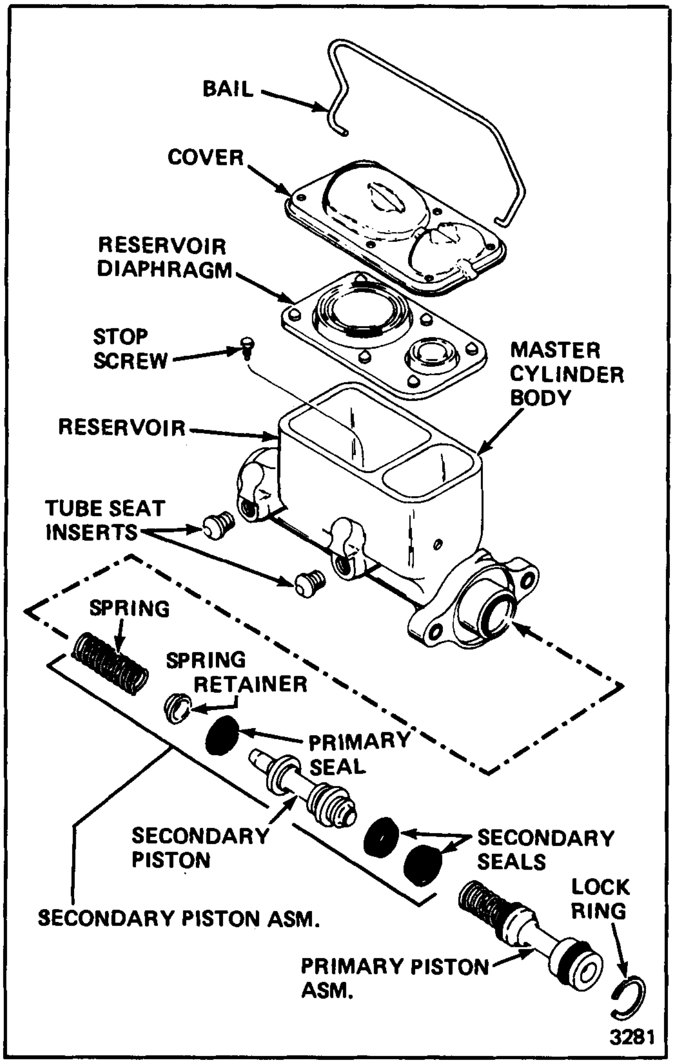


Fig. 5-30 Exploded View - Power Brake Master Cylinder A, B, G, F and X Series

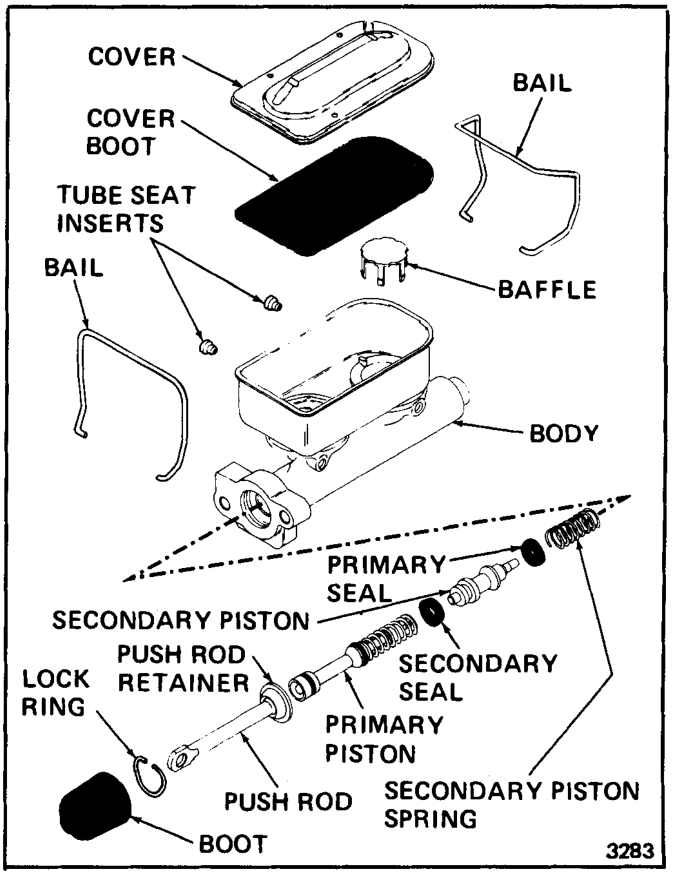


Fig. 5-31 Explided View Master Cylinder H Series Manual Brakes

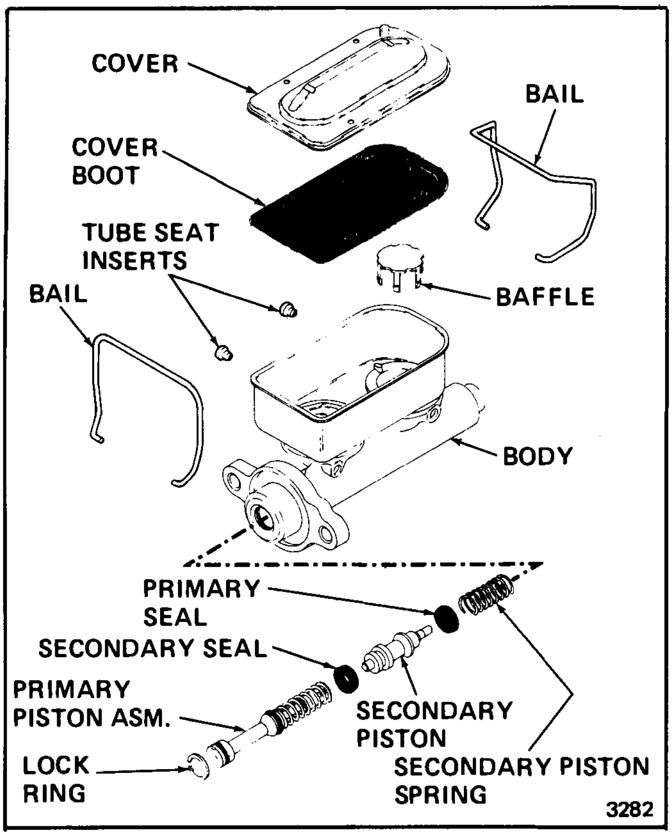


Fig. 5-32 Power Brake Master Cylinder Exploded - H Series

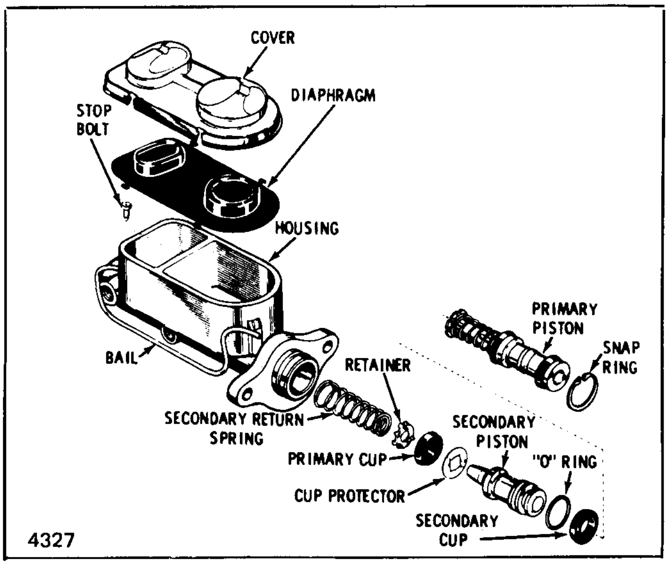


Fig. 5-33 Exploded View-Manual Brake Master Cylinder - A Series

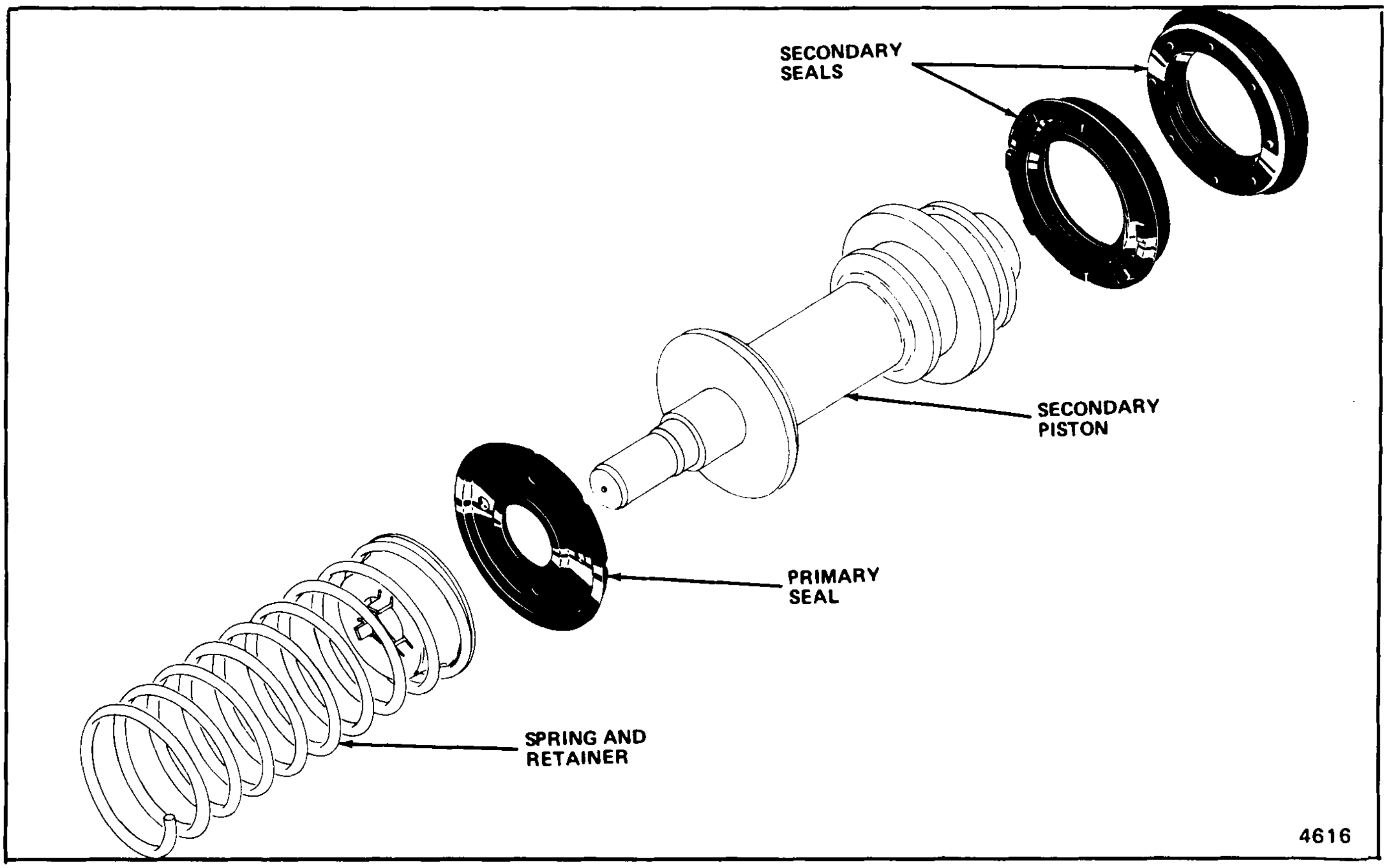


Fig. 5-34 Secondary Piston - Exploded View

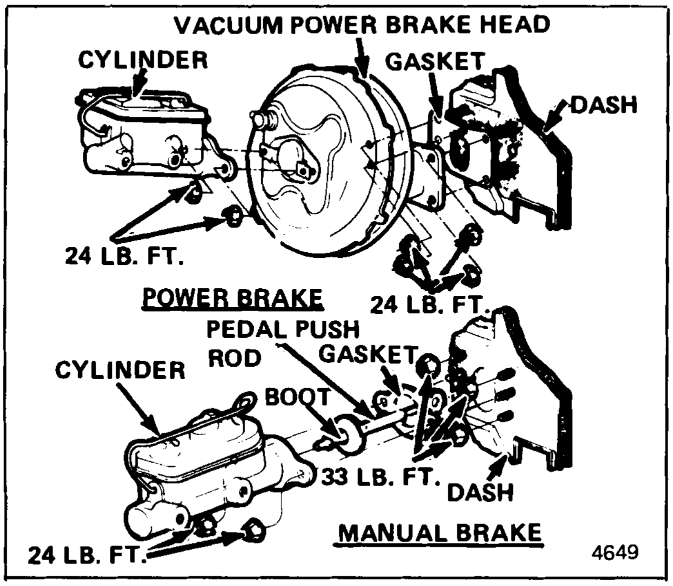


Fig. 5-35 Master Cylinder Mounting - Typical

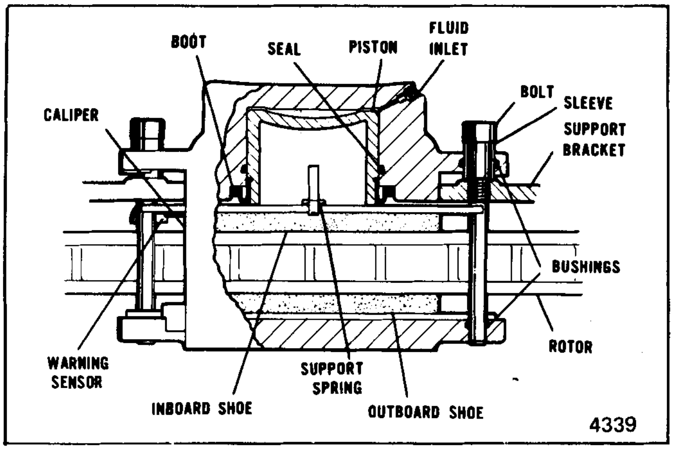


Fig. 5-36 Single Piston Disc Brake

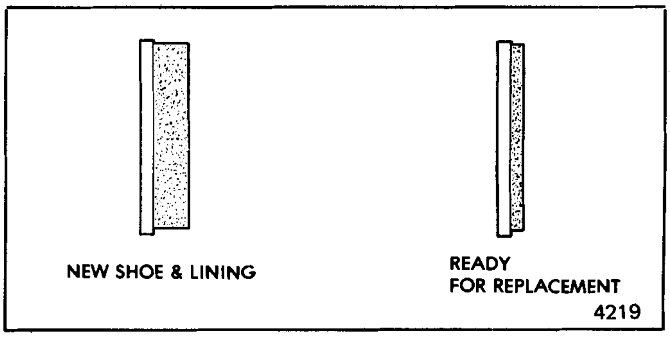


Fig. 5-38 New and Worn Linings

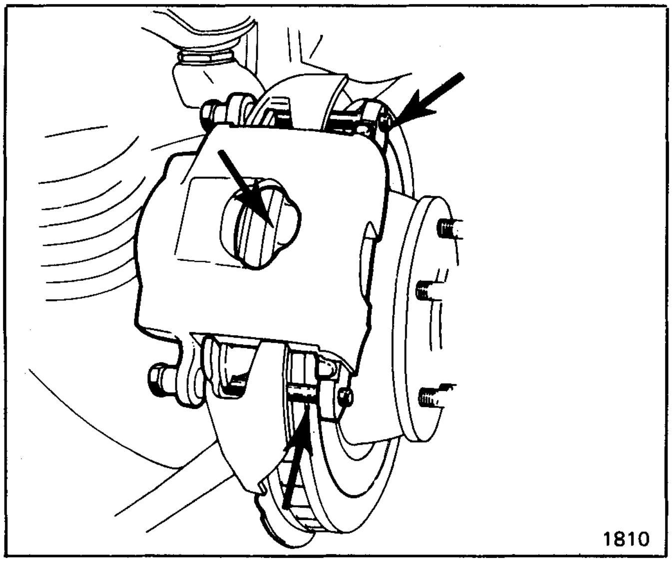


Fig. 5-37 Lining Inspection

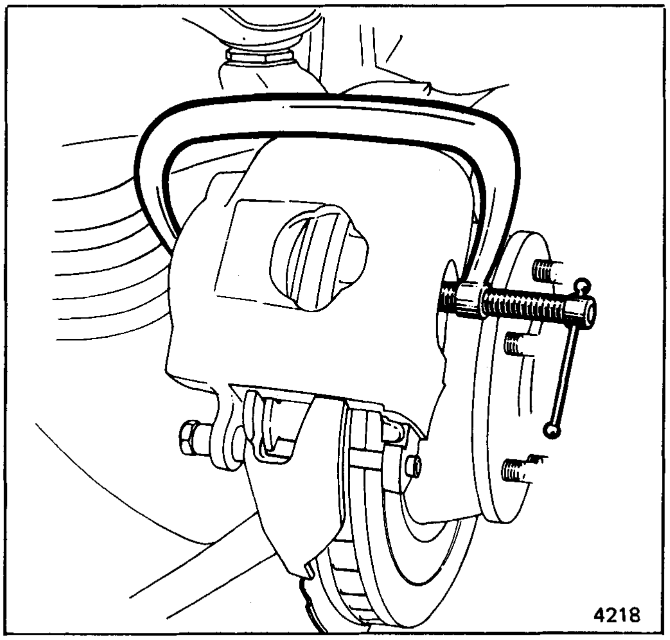


Fig. 5-39 Use of C Clamp

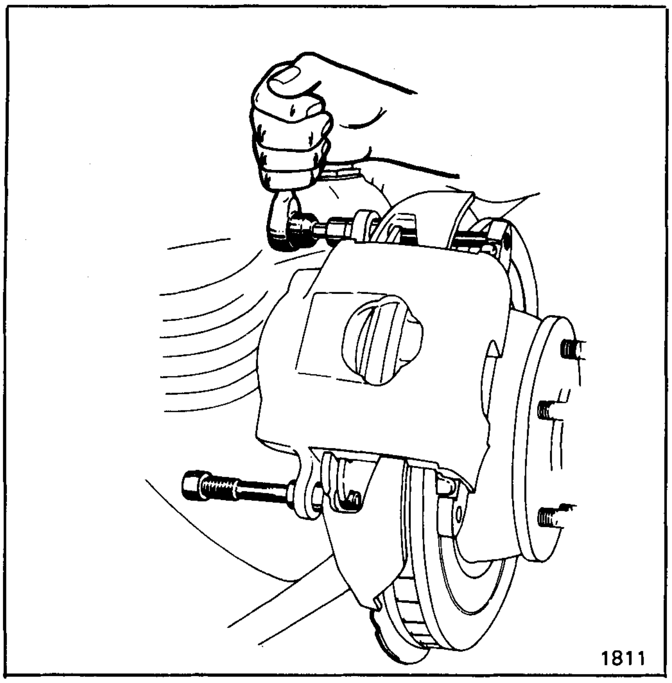


Fig. 5-40 Removing Mounting Bolts

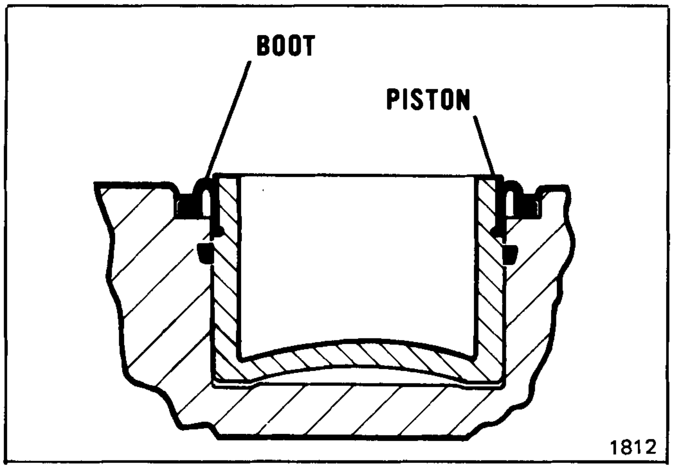


Fig. 5-43 Boot Installation

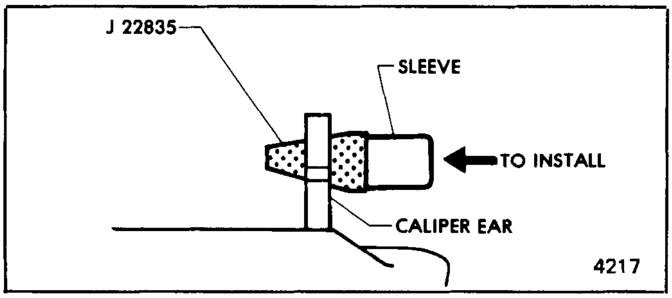


Fig. 5-44 Sleeve Installation

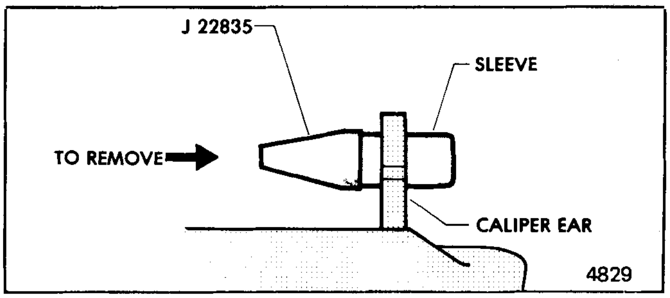
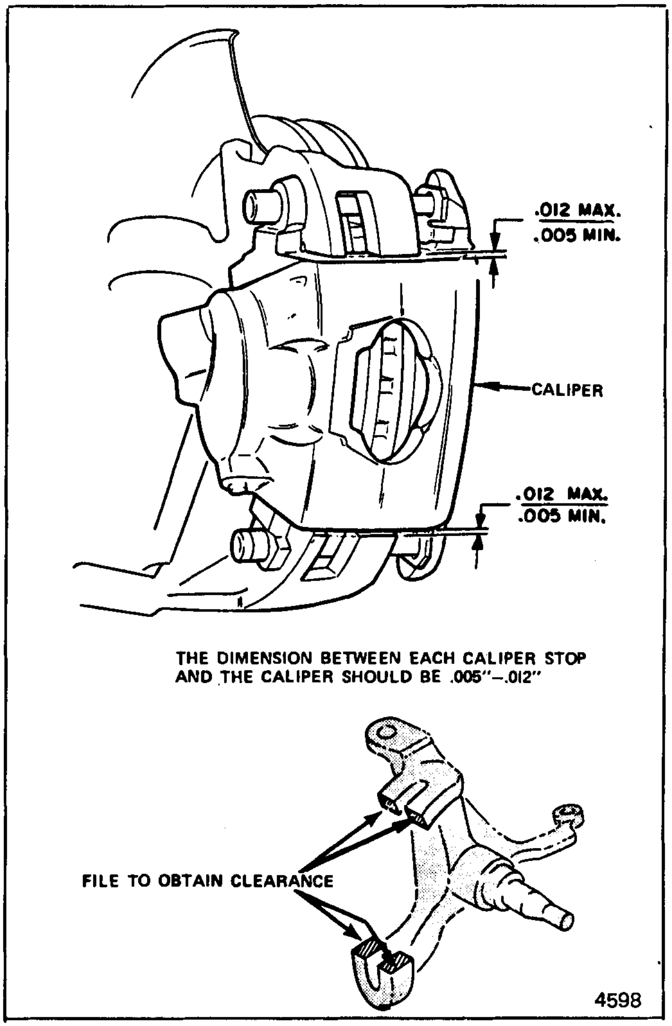


Fig. 5-41 Remove Sleeves



THE DIMENSION BETWEEN EACH CALIPER STOP AND THE CALIPER SHOULD BE .005"–.012"

Fig. 5-42 Caliper to Knuckle Clearance

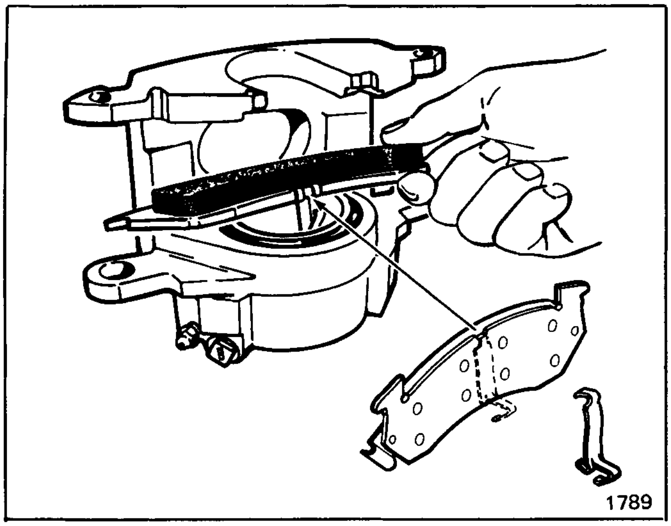


Fig. 5-45 Inserting Shoe Support Spring

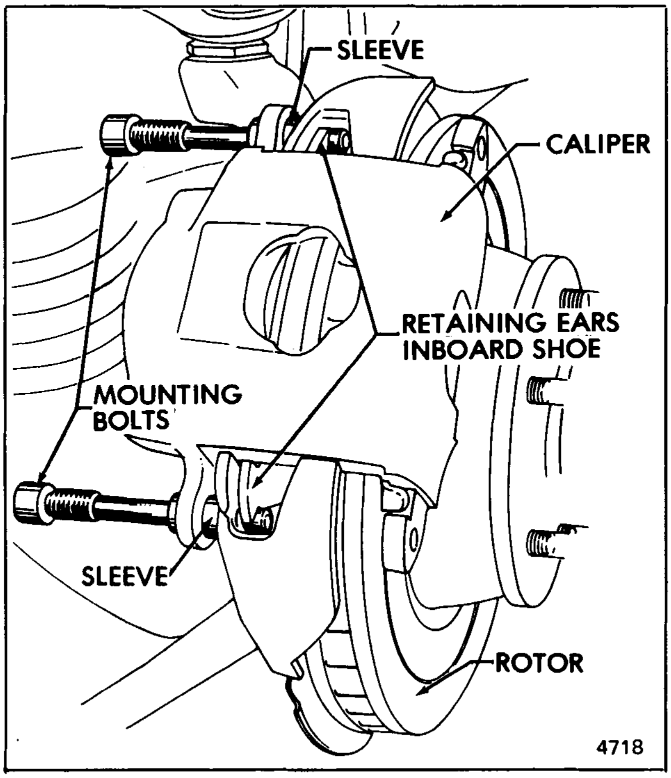


Fig. 5-48 Installing Mounting Bolts

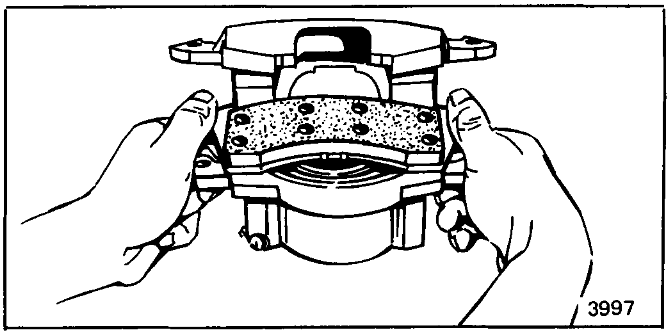


Fig. 5-46 Installing Inboard Shoe

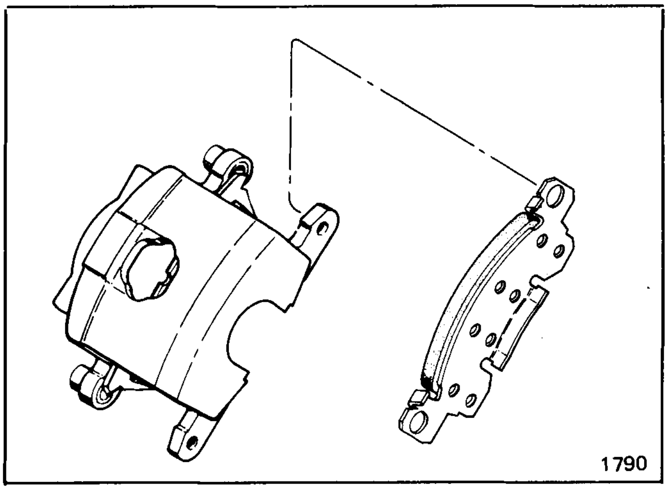


Fig. 5-47 Installing Outboard Shoe

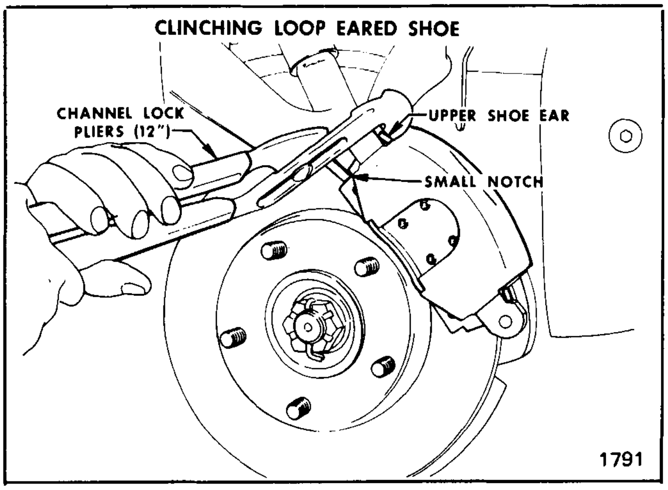


Fig. 5-49 Clinching Outboard Shoe

H SERIES

Caliper Removal

See warning on page 5-1.

1. Raise the car on a hoist and remove the wheel covers and wheel assemblies.

It is not necessary to remove the hydraulic brake hose when removing the caliper; however, do not let the caliper hang from the suspension by the hydraulic brake hose. Lay the caliper on the suspension members for support or hang from wire.

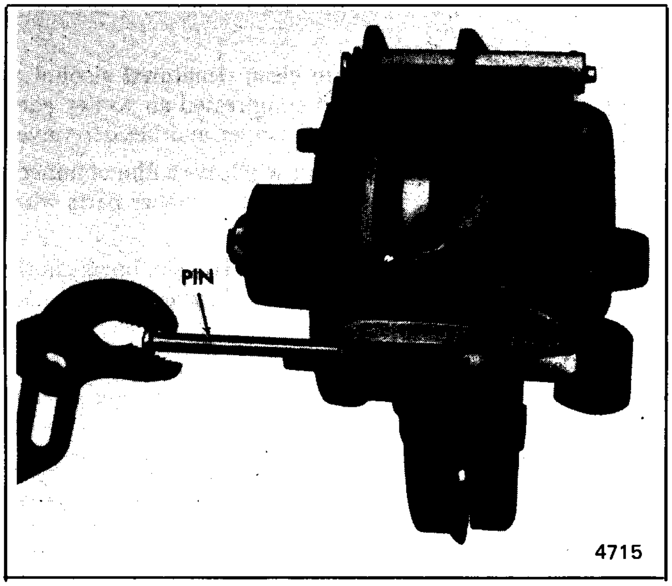


Fig. 5-50 Removing Mounting Pins

2. Remove snap rings and mounting pins.

3. Lift caliper off the disc and remove inboard and outboard shoes by sliding the shoes to the mounting sleeve opening. See Fig. 5-51.

Mark disc pad position if pads are to be reused.

4. Remove the mounting sleeves and bushing assemblies.

Cleaning and Inspection

1. Examine the inside of the caliper for evidence of fluid leakage. If leakage is noted, the caliper should be overhauled.

2. Wipe the inside of the caliper clean including the exterior of the dust boot. Check the boot for cuts, cracks or other damage.

CAUTION: *Do not use compressed air to clean the caliper. This could cause the dust boot to become unseated.*

3. Clean caliper sliding surfaces with a wire brush to remove rust and other foreign material.

Installation

1. Install the new sleeves with bushings on the caliper grooves. The "shouldered end" of the sleeve must be installed toward the outside. See Fig. 5-52.

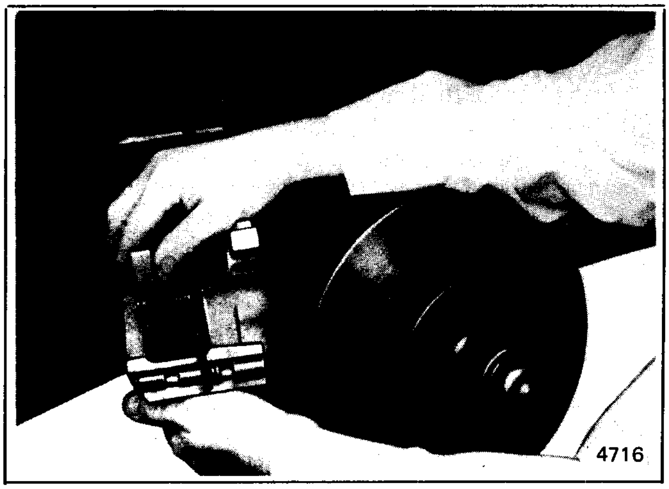


Fig. 5-51 Removing or Installing Shoes

Fig. 5-52 Mounting Sleeve

2. Install the inner shoe to the caliper and slid the shoe ears over the sleeve. Install the outer shoe in the same manner.

CAUTION: *If pads are being re-used, they must be installed in original position (as marked at removal).*

3. Mount the caliper to the vehicle.

It may be necessary to remove 1/2 of the brake fluid from the master cylinder before installing new shoes. This is especially true if replacing worn out shoes with new shoes.

CAUTION: *When reinstalling caliper be sure you haven't turned it over, end over end. This would cause a severe twist in the brake hose. After positioning caliper on disc, observe brake hose being sure it is not twisted.*

4. Install the mounting pins in a direction from outside to inside.

5. Install snap rings.
6. Install the front wheels and lower the vehicle.
7. Add brake fluid to bring level within 1/4 inch of top of master cylinder.
8. Test brake operation before moving vehicle. This initial application is necessary to move the front shoes against the disc, thereby "adjusting" the front brakes.

CALIPER OVERHAUL

Removal

1. Removal of the caliper for overhaul is the same as for shoe and lining replacement except that it will be necessary to disconnect the brake hose. (Refer to front brake hose replacement).

2. First, disconnect the hose from the steel brake line and cap the fittings to prevent dirt from entering the line or the hose. Then, remove the U-shaped retainer from the hose fitting. Withdraw the hose from the frame support bracket and remove the caliper -- with hose attached -- to a work bence for overhaul.

Disassembly

1. Before beginning disassembly, thoroughly clean the exterior of the caliber using brake cleaner. Place the caliper on a clean work surface.

2. Remove the brake hose from the caliper, discarding the copper gasket. Check the hose for worn spots, cracks or other signs of deterioration. Discard the hose, if damaged, to be replaced with a new hose at reassembly. Drain brake fluid from the caliper.

3. Use clean shop towels to pad the interior of the caliper and remove the piston by directing compressed air into the caliper inlet hole. See Fig. 5-53.

CAUTION: *Use just enough air pressure to ease the piston out of the bore. If the piston is blown out--even with padding provided--it may become damaged.*

WARNING: DO NOT PLACE THE FINGERS IN FRONT OF THE PISTON IN AN ATTEMPT TO CATCH OR PROTECT IT WHEN APPLYING COMPRESSED AIR. THIS COULD RESULT IN SERIOUS INJURY.

4. Use a screwdriver to pry the boot out of the caliper. Extend the screwdriver across the caliper bore, under the boot, and pry up. Be careful not to scratch the caliper bore.

5. Use a piece of wood or plastic -- a plastic toothpick is ideal -- to remove the piston seal from its groove in the caliper bore. DO NOT USE A METAL TOOL OF ANY TYPE FOR THIS OPERATION.

Cleaning and Inspection

1. The boot, piston seal, rubber bushings and sleeves are to be replaced each time the caliper is overhauled. Discard, do not bother to clean and inspect, these parts.

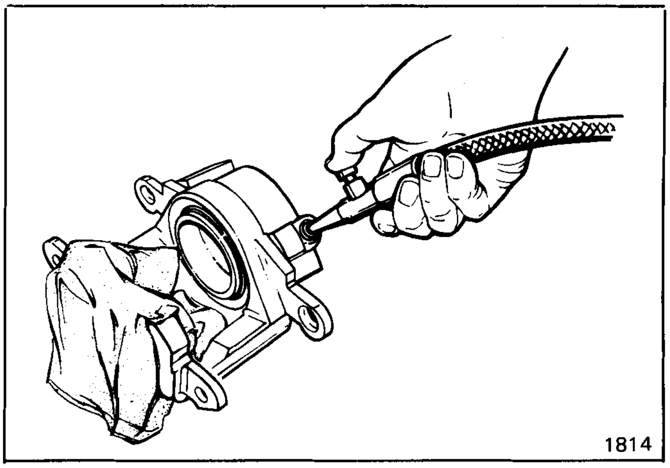


Fig. 5-53 Removing Piston

2. Clean all other parts in clean denatured alcohol or brake cleaner. Use dry, filtered compressed air to dry parts and blow out all passages in the caliper and bleeder valves.

The use of lubricated shop air will leave a film of mineral oil on the metal parts. This may damage rubber parts when they come in contact after reassembly.

3. Check the mounting bolts for corrosion, breaks in the plating or other damage. Do not use abrasives in an attempt to clean the bolts -- replace them.

4. Carefully examine the piston OD for scoring, nicks, corrosion and worn or damaged chrome plating. If any surface defects are detected, replace the piston.

5. Check the bore in the caliper for the same defects as the piston with the exception of plating damage. The piston bore is not plated and stains or minor corrosion can be polished with crocus cloth. Do not use emery cloth. Thoroughly clean the caliper after the use of crocus cloth. If the bore cannot be cleaned up in this manner, replace the caliper.

Reassembly

1. Lubricate the bore in the caliper and the new piston seal with clean brake fluid. Position the seal in the caliper bore groove. Lubricate the piston with clean brake fluid and assemble a new boot into the groove in the piston so that the fold faces the open end of the piston. Insert the piston into the caliper bore, using care not to unseat the seal and force down to the bottom in the bore. This will require a force of 50 to 100 pounds. Position the OD of the boot in the caliper counterbore and seat with tool No. J 22904. See Fig. 5-54.

2. Check the boot installation to make sure that the retaining ring molded into the boot is not bent and that the boot is installed fully, below the caliper face, and evenly all around. Otherwise dirt or moisture may enter the bore and cause damage or corrosion.

3. Install the brake hose in the caliper inlet using a new copper gasket.

Installation

1. Installation of the caliper and mounting parts (rubber bushing, sleeves, shoe and lining assemblies, and bolts) is the same as for lining replacement except for the following:

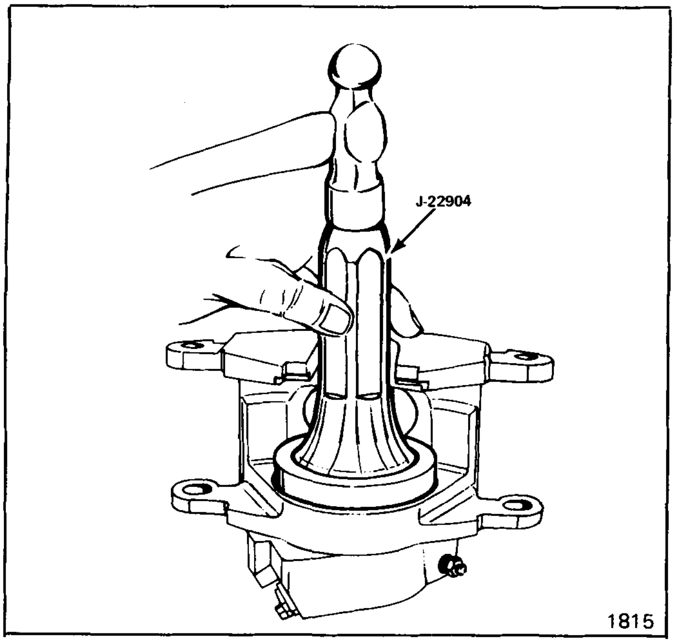


Fig. 5-54 Seating Boot

(a) The brake hose must be connected to the brake line at the frame bracket.

Use extreme care to orient the hose so that the keyed hose end fitting aligns with the slot in the bracket without twisting or kinking the hose.

(b) After overhaul -- or any time that the brake hose or line is disconnected -- the calipers must be bled.

ROTOR SERVICING

Checking Lateral Runout

1. Lateral runout is the movement of the rotor from side to side as it rotates on the steering knuckle spindle. This could be described as "rotor wobble."

2. The movement of the rotor from side to side in the lateral plane causes the brake shoe and lining and pistons to be knocked back into their bores. This results in additional pedal travel required and a vibration during the braking action.

3. To check lateral runout, first tighten the wheel bearings until all of the play is out of the bearings. Fasten a dial indicator to some portion of the suspension so that the point of the stylus contacts the rotor face approximately one inch from the rotor edge. See Fig. 5-55. Set the dial at zero. Move the rotor one complete rotation, checking the indicator as the rotor moves.

4. Lateral runout should not be over .004 total indicator reading.

Parallelism Check

1. Parallelism is the measurement of the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor.

2. A rotor that varies over .0005 causes pedal vibration, as well as front end vibration during brake applications. A rotor that does not meet these specifications may be refinished to specifications if precision equipment is available.

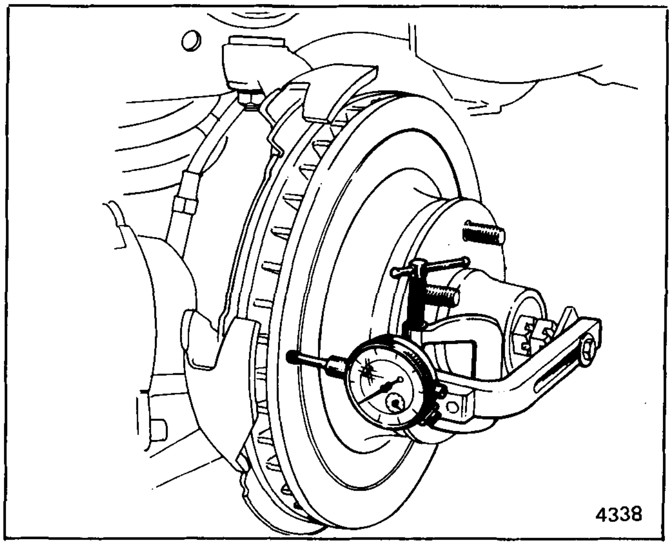


Fig. 5-55 Checking Rotor For Lateral Runout

Rotor Tolerance and Surface Finish

In manufacturing the brake rotor, tolerances of the rubbing surfaces for flatness, for parallelism and for lateral runout are held very close. The maintenance of these close controls on the shape of the rubbing surfaces is necessary to prevent brake roughness.

In addition to these tolerance the surface finish must be held to specific range. The control of the rubbing surface finish is necessary to avoid pulls and erratic performance and to extended lining life.

Light scoring of the rotor surfaces not exceeding .015 in depth, which may result from normal use, is not detrimental to brake operation.

Machining

Since accurate control of the rotor tolerances is necessary for proper performance of the disc brakes, machining of the rotor should be done only with precision equipment.

WARNING: ALL BRAKE ROTORS HAVE A MINIMUM THICKNESS DIMENSION CAST INTO THEM. THE DIMENSION IS THE MINIMUM WEAR DIMENSION AND NOT A REFINISH DIMENSION. DO NOT USE A BRAKE ROTOR THAT WILL NOT MEET THE SPECIFICATIONS, AS SHOWN BELOW, AFTER REFINISHING. REPLACE WITH NEW BRAKE ROTOR.

ROTOR THICKNESS

H Series

Maximum	.880
Refinish	.820
Discard	.815

Except H Series

Maximum	1.040
Refinish	.980
Discard	.965

WHEEL BOLT REMOVAL AND INSTALLATION

Disc Brakes

1. Remove hub and rotor assembly from car.

2. Mark rotor to hub location and remove 5 bolts attaching hub to rotor.

3. The wheel bolts on disc brakes can be pressed out from the outside of the hub and installed from inside the rotor by pressing into place. No drilling or cutting is required.

4. Reinstall assembly and adjust wheel bearings.

DRUM BRAKES

REPLACE OR RELINE BRAKE SHOES

Removal and Inspecting

See warning page 5-1

1. Jack up car and remove wheel and brake drum (rear). It may be necessary to back off the brake shoe adjustment before the brake drums can be removed. To back off shoe adjustment, rotate shoe adjusting screw upward.

2. Unhook the primary and secondary shoe return springs using large pliers.

3. Remove shoe hold down springs.

4. Lift up on actuator, unhook actuating link from anchor pin, then remove.

5. Spread shoes to clear wheel cylinder connecting links, remove parking brake strut and spring, disconnect cable from parking brake lever, remove shoes from the backing plate.

6. Spearate the brake shoes by removing adjusting-screw and lock spring. Remove parking brake lever and secondary brake shoe.

7. Clean all dirt out of brake drum, using care to avoid getting dirt into front wheel bearings. Inspect drums and replace or recondition if required.

8. Clean all dirt from brake assemblies and inspect for any unusual condition.

9. Wheel cylinders having torn, cut, or heat-cracked boots should be completely overhauled.

Inspection for leakage may be accomplished at the boot center hole after removal of link pin. Fluid coatings on piston within cylinder and on end of link pin removed from boot are normal, as cylinder contains a porous DUREX PISTON WHICH IS IMPREGNATED WITH A CORROSION INHIBITING FLUID. Fluid spilling from boot center hole, after link pin is removed, indicates cup leakage and necessity for completely over-hauling cylinder.

10. If working at rear wheels, inspect backing plate for oil leak past wheel bearing oil seals. Correct any leak by installation of new seals (Group 4).

11. Check all backing plate attaching bolts to make sure they are tight. Using fine emery cloth, clean all rust and dirt from shoe contact surfaces on plate.

Relining Brake Shoes

If old brake shoes are to be relined, inspect shoes for distortion and for looseness between the rim and web, these are causes for discarding any shoe. If shoes are serviceable, be governed by the following points in installing new linings:

1. Remove old linings by drilling out rivets. Punching rivets out will distort shoe rim. Thoroughly clean surface of shoe rim and file off any burrs or high spots.

2. Use Pontiac brake lining or equivalent and the rivets included in lining package which are of the correct size. The rivets must fit the holes with the solid body of rivet extending through the shoe rim, but no farther.

Keep hands clean while handling brake lining.

3. Start riveting at center of shoe and lining and work toward the ends. Use a roll set for riveting, a star set might split the tubular end and then the rivet would not fill the hole. The primary lining is shorter than secondary lining; therefore, the rivet holes at each end of the shoe rim are not used.

4. After riveting is completed, lining must seat snugly against shoe with no more than .005" separation midway between rivets. Check with a .004" (go) and a .006" (No Go) feeler gage.

Installation and Adjustment

1. Lubricate fulcrum end of parking brake lever with Delco Brake Lubricant or equivalent, then attach lever to secondary shoe. Make sure that lever is free moving.

2. Connect brake shoes together with adjusting screw spring, then place adjusting screw in position. When installing the adjusting screw spring and adjusting screw, make sure the spring does not touch the starwheel portion of the adjusting screw; and, also, when installing adjusting screw, make sure right hand thread adjusting screw is on left side of car and left hand thread adjusting screw is on right side of car. Make certain starwheel lines up with adjusting hole in backing plate.

3. Lubricate shoe contact surfaces on backing plate with a thin coating of Delco Brake Lubricant or equivalent. On rear brakes, sparingly apply same lubricant where brake cable contacts backing plate.

4. Place brake shoes on backing plate, at the same time engaging shoes with wheel cylinder links. The primary shoe (short lining) goes toward front of car. On rear brakes, connect cable to parking brake lever and install strut and spring between lever and primary shoe. On B Series the right side rear brake the strut spring installs between the lever and the secondary shoe.

5. Install actuator, actuator return spring and actuating link. If old brake shoe return springs are nicked, distorted or of doubtful strength (discolored from heat), it is advisable to install new parts.

6. Install shoe hold down springs.

7. Install the primary and secondary shoe return springs using large pliers. Be careful not to distort springs.

8. Measure brake drum I.D. using inside caliper portion of Tool J 21177. Adjust brake shoes to dimension obtained on outside caliper portion of Tool J 21177.

9. Install brake drums and wheels.

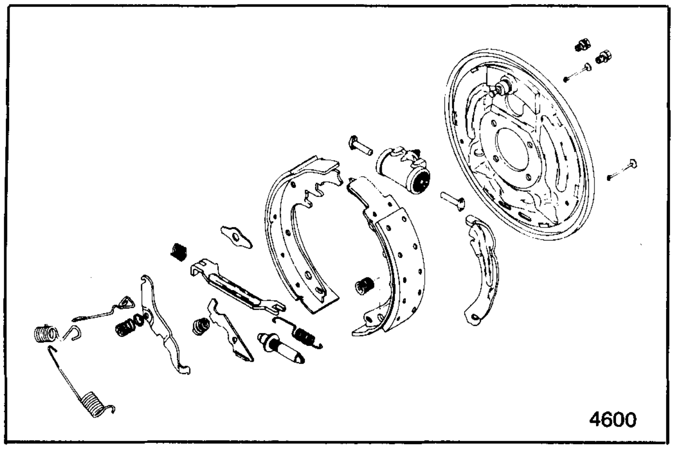


Fig. 5-56 Typical Drum Brake Assembly

10. If any hydraulic connections were disturbed, bleed hydraulic system.

11. Adjust parking brake.

12. Inspect all brake pipes, hoses and connections for evidence of fluid leakage. Tighten any leaking connection. Then apply heavy pedal pressure to brake pedal and recheck connections.

13. Check fluid level in master cylinder and add fluid if necessary.

14. Check brake pedal for proper feel and for proper return.

15. Remove jacks and road test car for proper brake action. Brakes must not be severely applied immediately after installation of new brake shoes or linings. Severe application may permanently damage new linings and may score brake drums. When linings are new, they must be given moderate use for several hundred miles of burnishing.

Repair Brake Lining

This procedure is to be used when brake action is unequal, severe, hard, noisy or otherwise unsatisfactory and when brake linings have had little wear.

1. Check fluid in master cylinder and add fluid if necessary.

2. Check brake pedal for proper feel and for proper return.

3. Jack up car in a safe manner and remove all wheels.

4. Remove all brake drums. Brake pedal must not be operated while drums are removed.

See Warning page 5-1.

5. Clean all dirt out of brake drums, using care to avoid getting dirt into front wheel bearings. Inspect drums and replace or recondition if required.

6. Clean all dirt from brake assemblies, then inspect brake linings for uneven wear, oil soaking, loose rivets or imbedded foreign particles. If linings are oil soaked, replacement is required.

7. If linings are otherwise serviceable, tighten or replace loose rivets and thoroughly clean all steel or other imbedded particles from surfaces and rivet counterbores of linings.

8. Check all backing plate bolts to make sure they are tight.

9. Measure brake drum I.D. using inside caliper portion of Tool J 21177. Adjust brake shoes to dimension obtained, on outside caliper portion of Tool J 21177. See Figures 5-57 and 5-58.

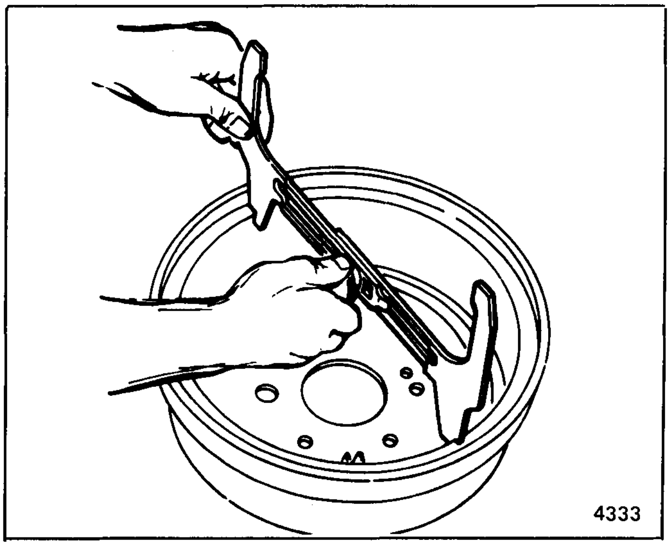


Fig. 5-57 Measuring Brake Drum I.D.

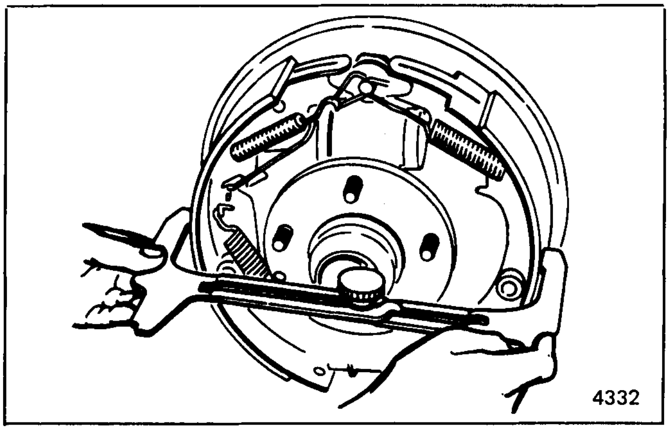


Fig. 5-58 Adjusting Brake Shoes

10. Install drum and wheel and tire assemblies.

11. Remove jacks and road test car for proper brake action. Brakes must not be severely applied immediately after installation of reground brake shoes or linings. Severe application may permanently damage new linings and may score brake drums. When linings are new, they must be given moderate use for several hundred miles of burnishing.

INSPECTION AND RECONDITIONING BRAKE DRUMS

Whenever brake drums are removed, they should be thoroughly cleaned and inspected for cracks, scores, deep grooves and out-of-round.

Cracked, Scored, or Grooved Drum

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it will probably be necessary to rebore in order to true up the braking surface.

If the brake linings are slightly worn and the drum is grooved, the drum should be polished with fin emery cloth but should not be turned. At this stage, eliminating all grooves in drum and smoothing the ridges on lining would necessitate removal of too much metal and lining, while if left alone, the grooves and ridges match and satisfactory service can be obtained. If brake linings are to be replaced, a grooved drum should be turned for use with oversize linings. A grooved drum, if used with new lining, will not only wear the lining, but will make it difficult, if not impossible to obtain efficient brake performance.

Out-Of-Round or Tapered Drum

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as a pulsating brake pedal. When the braking surface of a brake drum exceeds the factory specification limits in taper (and/or) being out-of-round, the drum should be turned to true up the braking surface. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round, taper and wear, take measurements at the open and closed edges of machined surface and at right angles to each other.

Turning Brake Drums

If a drum is to be turned, only enough metal should be removed to obtain a true, smooth braking surface. If a drum does not clean-up when turned to a maximum diameter as shown in the general specification, it must be replaced. Removal of more metal will affect dissipation of heat and may cause distortion of the drum.

All brake drums have a maximum diameter cast into them. This diameter is the maximum wear diameter and not a refinish diameter. Do no refinish a brake drum that will not meet the specifications, as shown below, after refinishing.

Brake Drum Balance

During manufacture, brake drums are balanced within three ounce inches. These weights must not be removed.

After drums are turned, or if difficulty is experienced in maintaining proper wheel balance, it is recommended that brake drums be checked for balance. Brake drums may be checked for balance on most off-the-car balancers.

DRUM DIAMETERS

9.500" Drum	
Maximum Rebore	9.560"
Discard	9.590"
11.000" Drum	
Maximum Rebore	11.060"
Discard	11.090"

WHEEL BOLT REMOVAL AND INSTALLATION

Drum Brakes

1. Remove hub and drum assembly from car.

2. Secure hub and drum assembly in a vise and mark center of the bolt head with a center punch. Drill 1/8" pilot hole in head of bolt; redrill head using a 9/16" bit. Cut off any remaining portion of bolthead using a chisel and then drive out bolt with drift. See Fig. 5-59.

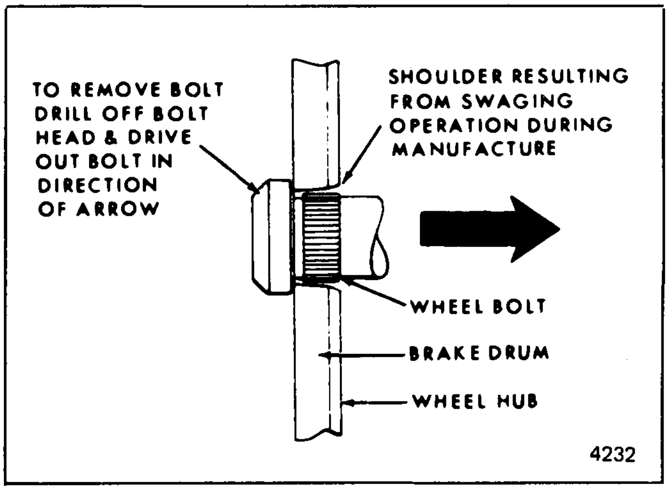


Fig. 5-59 Bolt Pressed Into Place

3. Press new wheel bolt into place in drum and reinstall assembly onto car.

4. Refer to Group 3 for correct wheel bearing adjustment.

WHEEL CYLINDER OVERHAUL

Removal of Brake Wheel Cylinder

1. Remove wheel, drum and brake shoes. Be careful not to get grease or dirt on brake lining.

2. Remove wheel cylinder from backing plate.

Disassembly of Brake Wheel Cylinder

1. Inspect cylinder bore for scoring or corrosion. It is best to replace corroded cylinder.

2. Polish any discolored or stained area with crocus cloth by revolving cylinder on cloth supported by a finger.

3. Rinse cylinder in clean brake fluid.

4. Shake excessive rinsing fluid from cylinder. Do not use a rag to dry cylinder, as lint from the rag cannot be kept from cylinder base surfaces.

Assembly of Brake Wheel Cylinder

1. Lubricate cylinder bore and counterbore with clean brake fluid and insert spring-expander assembly.

2. Install new cups. (Be sure cups are lint and dirt free). Do not lubricate cups prior to assembly.

3. Install new Durex pistons.

4. Press new boots into cylinder counterbores by hand. Do not lubricate boots prior to assembly.

Installation of Brake Wheel Cylinder

1. Install wheel cylinder on brake backing plate and connect brake pipe or hose. Torque rear wheel brake pipe to wheel cylinder to 100 lb. in.

2. Install brake shoes, drum and wheel; then flush and bleed hydraulic system.

Adjustment at Rear Wheels

1. Using a punch, knock out lanced area in brake backing plate. If this is done with the drum installed on the car, the drum must be moved and all metal cleaned out of the brake compartment. Be sure to procure a new hole cover and install it in the backing plate after adjustment to prevent dirt and water from getting into the brakes. Use J 6166 to turn brake adjusting screw; expand brake shoes at each wheel until the wheel can just be turned by hand. The drag should be equal at all wheels.

2. Back off brake adjusting screw at each wheel 30 notches. If shoes still drag lightly on drum, back off adjusting screw one or two additional notches. Brakes should be free of drag when screw has been backed off approximately 12 notches. Heavy drag at this point indicates tight parking brake cables.

3. Install adjusting hole cover in brake backing plate.

4. Check parking brake adjustment.

UNIT REPAIR

POWER BRAKE UNITS

CONTENTS

REMOVAL AND INSTALLATION OF POWER BRAKE UNITS

1. Remove two nuts holding master cylinder to power cylinder and position it away from power cylinder.

On the H car also remove the brake pipe distribution and switch mounting bolt before moving master cylinder away from power cylinder.

CAUTION: *Do not disconnect hydraulic brake lines; be careful not to bend or kink lines.*

2. Disconnect the vacuum hose from the vacuum check valve on the front housing of the power head. Plug vacuum hose to prevent dust and dirt from entering hose.

3. Disconnect the power brake push rod from the brake pedal.

4. Remove the four nuts from the mounting studs which hold the power brake to the cowl.

5. Carry the power brake to a clean work area and clean the exterior of the power brake prior to disassembly.

CAUTION: *Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems and/or could result in major repair expense. It must be replaced with one of the same part number, or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque valves must be used as specified during reassembly to assure proper retention of this part.*

6. Mount power brake assembly to cowl and torque nuts to specified torque.

7. Connect power brake push rod to brake pedal.

8. Connect vacuum hose to vacuum check valve.

9. Connect master cylinder to power cylinder and torque nuts to 24 lb. ft. On the H car install the distribution and switch mounting bolt.

DISASSEMBLY OF DELCO MORAINE TANDEM POWER BRAKE UNIT

Disassembly of overall Unit

Scribe a line across front and rear housings to facilitate reassembly.

1. Mount Unlock Tool J 23456 in a vise. Position housing assembly on tool so that four studs fit in holes provided. See Fig. 5-60.

2. Position handle over two studs with tubular projections downward. Rotate screw to apply downward pressure to handle, then rotate front housing counterclockwise to unlock housings. It is normal for this operation to require heavy pressure to unlock housings.

3. Rotate screw to release spring tension and remove front housing group.

Disassembly of Front Housing Group

1. Remove the power piston return spring. The retainer plate may come out of the power piston return spring. Remove the vacuum check valve and grommet from the front housing, if the check valve is defective or the grommet cracked, cut or damaged.

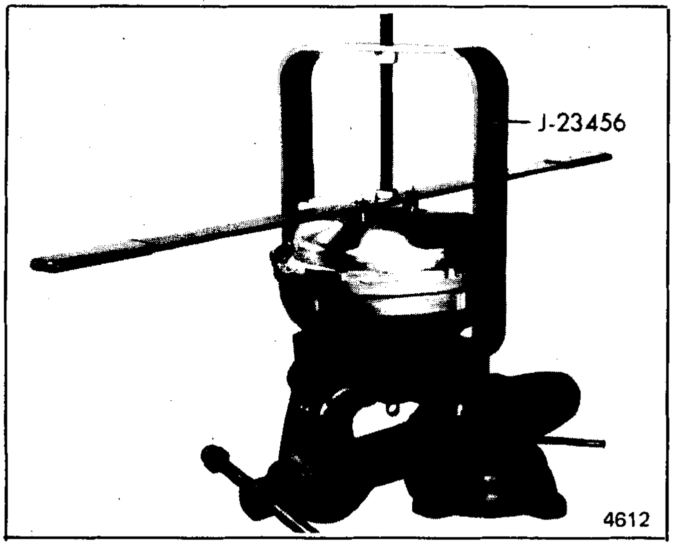


Fig. 5-60 Unlocking Front and Rear Housings

Disassembly of Rear Housing Group

1. Remove the boot and boot retainer from the rear housing and push rod. Remove the felt silencer from inside the boot.

2. Remove the power piston group from the rear housing and remove the primary power piston bearing from the center opening of the rear housing.

Disassembly of Power Piston Group

1. Remove the piston rod retainer and piston rod from the secondary piston (Fig. 61).

NOTE: Due to an optional construction design on the primary and secondary power pistons, special tool J 23101 will have to be reworked, as shown in Fig. 5-62.

2. Mount doubled-ended tool J 23101 (with large diameter end up) in a vise. Position the secondary power piston so that the two radial slots in the piston fit over ears (tangs) of the tool. See Fig. 5-63.

3. Fold back primary diaphragm from the O.D. of the primary support plate. Grip the edge of the support plate and rotate counterclockwise to unscrew the primary power piston from the secondary power piston. Note: It is possible that the primary support plate will unlock from the primary piston before the primary piston unscrews from the secondary piston. If this happens, continue to turn the primary support plate counterclockwise. Tabs ("stops") on the primary support plate will temporarily lock the primary support plate to the primary power piston and permit continued counterclockwise rotation to unscrew the primary power piston from the secondary power piston. See Fig. 5-65.

4. Remove the housing divider from the secondary power piston. Remove the secondary power piston bearing from the housing divider.

5. The secondary power piston should still be positioned on tool J 23101. Jold back secondary diaphragm from O.D. of secondary support plate. Grip the edges of the support plate and rotate clockwise to unlock the secondary support plate from the secondary power piston. See Fig. 5-65.

6. Remove the secondary diaphragm from the secondary support plate.

7. Remove the reaction piston and reaction disc from the center of the secondary power piston by pushing down on the end of the reaction piston with a small object, such as a pencil, wooden dowel, or metal rod. See Fig. 5-66.

8. Remove the air valve spring from the end of the air valve (if it didn't come off during disassembly of the power piston).

9. Mount Tool J 23101 in a vise *(with small diameter end up)*. Position the primary power piston so that the two radial slots in the piston fit over the ears (tangs) of the tool. See Fig. 5-67.

10. Fold back primary diaphragm from the support plate. Grip the edge of the support plate and rotate in a counter-clockwise direction to unlock the primary support plate from the primary power piston. See Fig. 5-68.

11. Remove the primary diaphragm from the primary support plate.

12. Remove the air filter and push rod limiter washer from the tubular section of the primary power piston.

13. Remove the power head silencer from the neck of the power piston tube.

14. Remove the rubber reaction bumper from the end of the air valve.

15. Using Truarc No. 2 pliers (J 4880), remove the retaining ring from the air valve. See Fig. 5-69.

16. Remove the air valve-push rod assembly from the tube end of the primary power piston. The following removal methods are recommended:

(a) Place the primary power piston in an arbor press, and press the air valve push rod assembly out the bottom of the power piston tube with a rod not exceeding 1/2" in diameter.

(b) An alternate method would be the use of a heavy, round shanked screwdriver. Insert screwdriver on both sides of the push rod, and pull the air valve push rod assembly straight out. A considerable force will be required.

(c) Another method requires the use of Truarc No. 22 pliers. Approximately 5/8" from the pointed ends of the pliers, file or saw a small slot (approximately 1/32" - 1/16" wide and 1/10" deep) on each half of the pliers. Round off the pointed ends of the pliers. Slip the slots in the pliers into tangs on the control valve spring retainer. Grip the pliers and pull the air valve push rod assembly straight out.

17. Removal of the air valve push rod assembly will disassemble the control valve retainer.

18. Remover the "O" ring seal from the air valve.

19. Models using air valve push rod assemblies with a formed eye on he end of the push rod will be serviced using a complete assembly, since the floating control valve cannot be removed over the eye end of the push rod.

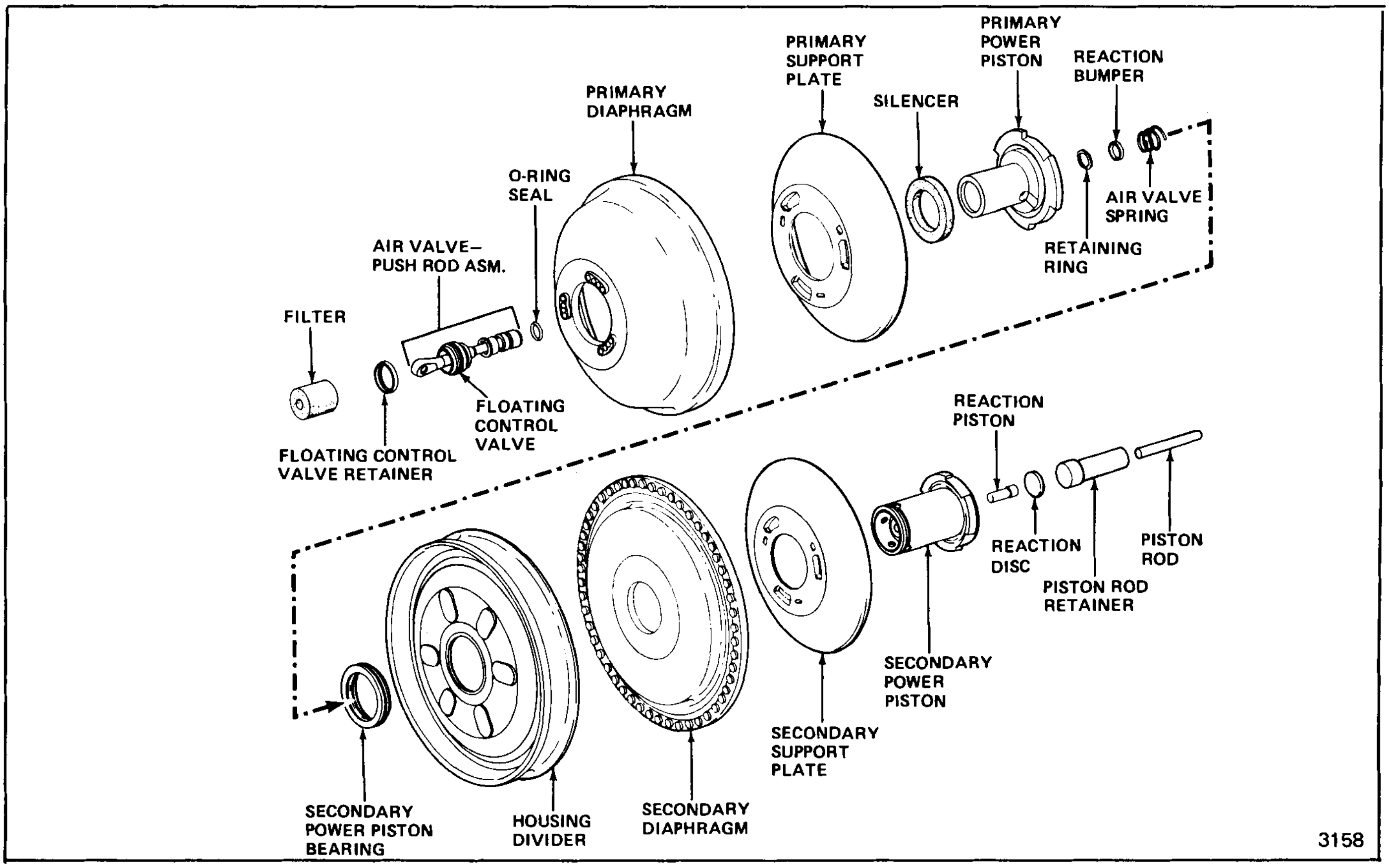


Fig. 5-61 Power Piston Group

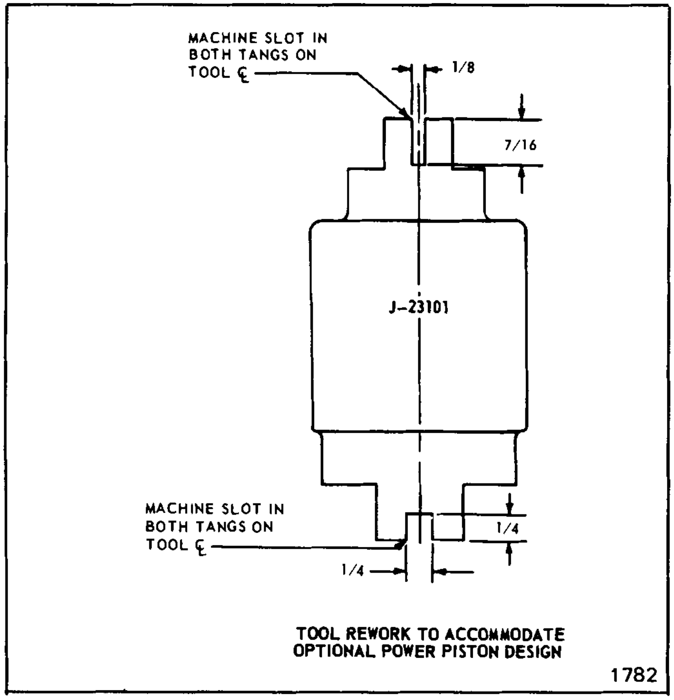


Fig. 5-62 Tool Rework - J 23101

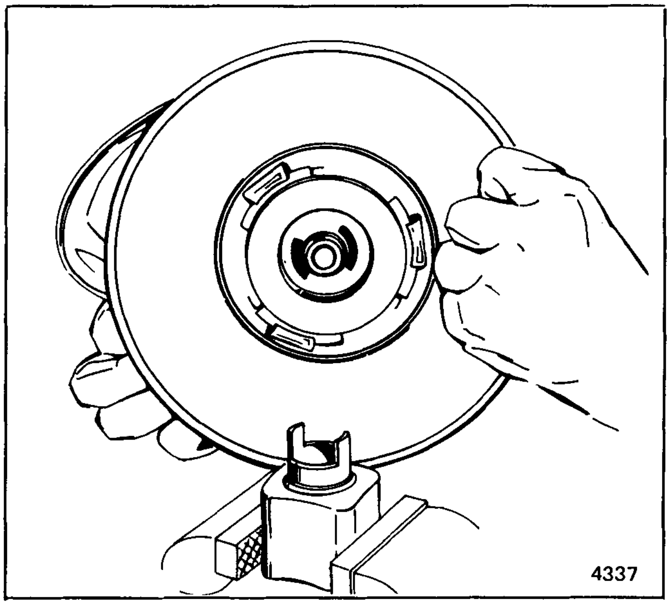


Fig. 5-63 Positioning Secondary Power Piston in Tool J

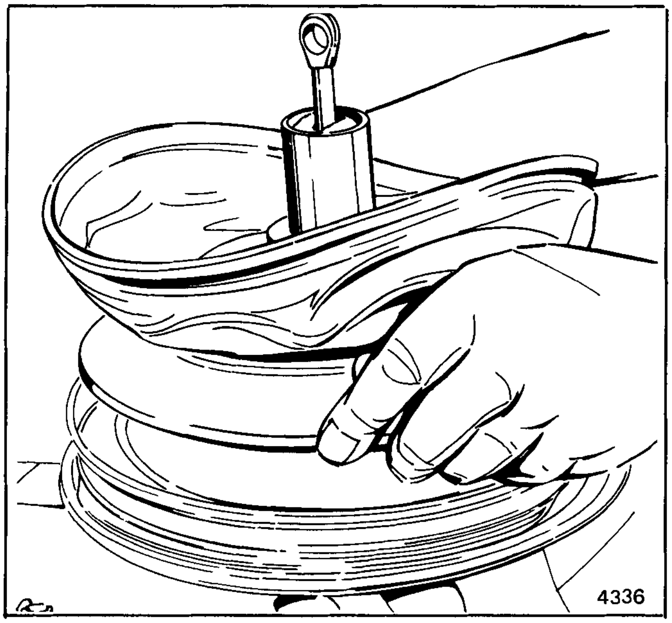


Fig. 5-64 Locking or Unlocking Primary and Secondary Power Pistons

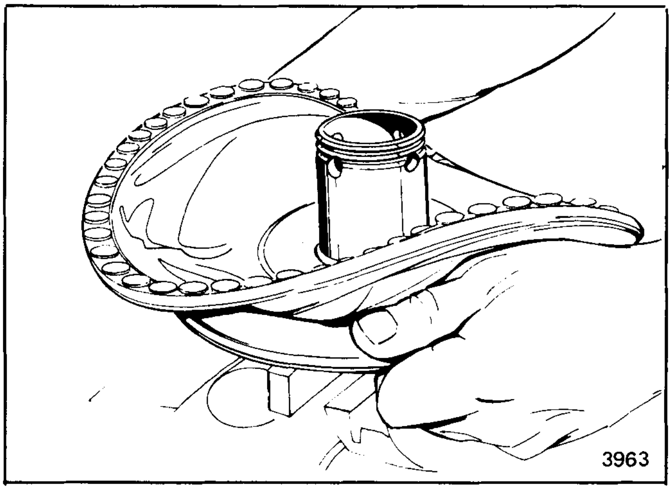


Fig. 5-65 Locking or Unlocking Secondary Support Plate and Secondary Power Piston

CLEANING AND INSPECTION OF DELCO MORAINE TANDEM POWER BRAKE UNIT

Cleaning

Use Declene or clean brake fluid to thoroughly clean all reusable brake parts. Immerse in the cleaning fluid and brush metal parts with hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. Air dry and place cleaned parts on clean paper or lint free clean cloth. If slight rust is found inside either the front or rear half housing assemblies, polish clean with crocus cloth or fine emery paper, washing clean afterwards. Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean until re-assembly. Re-wash at re-assembly if there is any occasion to doubt cleanliness--such as parts dropped or left exposed for eight hours or longer.

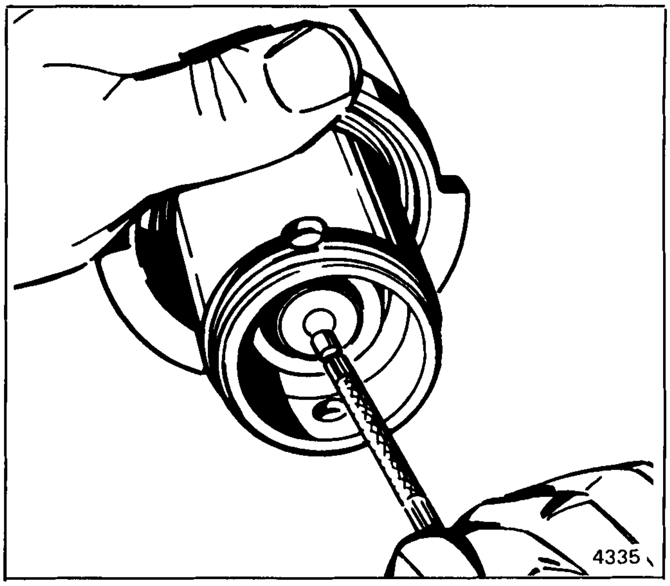


Fig. 5-66 Removing Reaction Piston and Reaction Disc

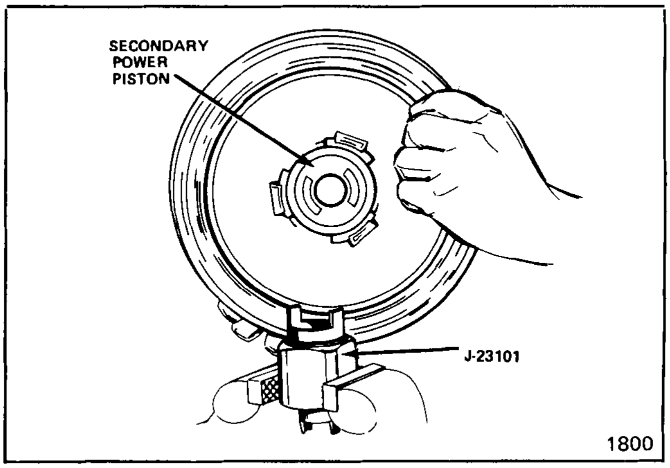


Fig. 5-67 Positioning Primary Power Piston In Tool J 23101 (Small Diameter End Up) Mounted in Vise

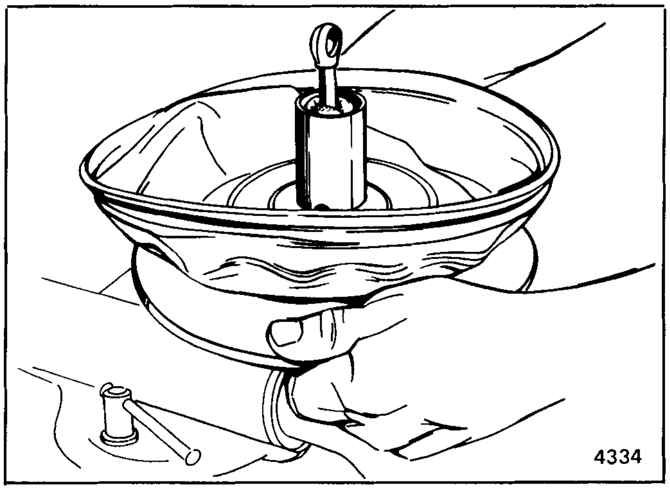


Fig. 5-68 Locking or Unlocking Primary Support Plate From Primary Power Piston

CAUTION: *If there is any suspicion of contamination or any evidence of corrosion, completely flush the car hydraulic brake system. Failure to clean the hydraulic brake system can result in early repetition of trouble. Use of gasoline,*

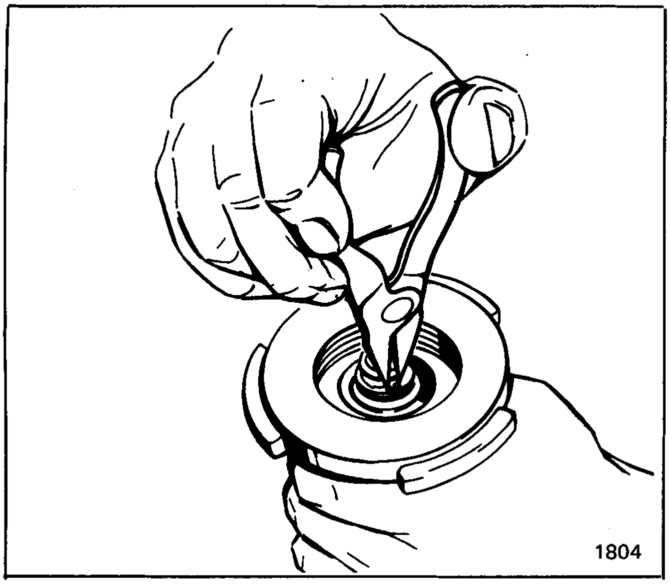


Fig. 5-69 Removing Retaining Ring From Air Valve

kerosene, anti-freeze, alcohol or any other cleaner, with even a trace of mineral oil, will damage rubber parts.

Inspecting Rubber Parts

Wipe fluid from the rubber parts and carefully inspect each rubber part for cuts, nicks, or other damage. These parts are the key to the control of fluid or air flow, if the unit is in for overhaul, or if there is any question as to the serviceability of rubber parts, REPLACE them.

Inspection Metal Parts

BADLY DAMAGED ITEMS, OR THOSE WHICH WOULD TAKE EXTENSIVE WORK OR TIME TO REPAIR, SHOULD BE REPLACED. In case of doubt, install new parts. Do not rely on the brake unit being overhauled at an early or proper interval. New parts will provide more satisfactory service, even if the brake unit is allowed to go beyond the desired overhaul period.

REASSEMBLY OF DELCO MORAINE TANDEM POWER BRAKE UNIT

General

1. Be careful during the rebuild procedure that no grease or mineral oil comes in contact with the rubber parts of the power brake unit.

2. Lubricate power head parts, as outlined below, with power brake silicone lubricant. This lubricant is provided in the service repair kit.

Reassembly of Front Housing Group

1. If the grommet was removed for replacement, insert the new grommet in the front housing.

2. Press the vacuum check valve through the grommet.

Reassembly of Power Piston Group

1. Lubricate the I.D. and O.D. of the "O" ring seal with silicone lubricant and place on the air valve.

2. Wipe a thin film of silicone lubricant on the large and small O.D. of the floating control valve.

3. If the floating control valve needs replacement, it will be necessary to replace the complete air valve push rod assembly, since the floating control valve is a component part of this assembly and cannot be disassembled from the push rod.

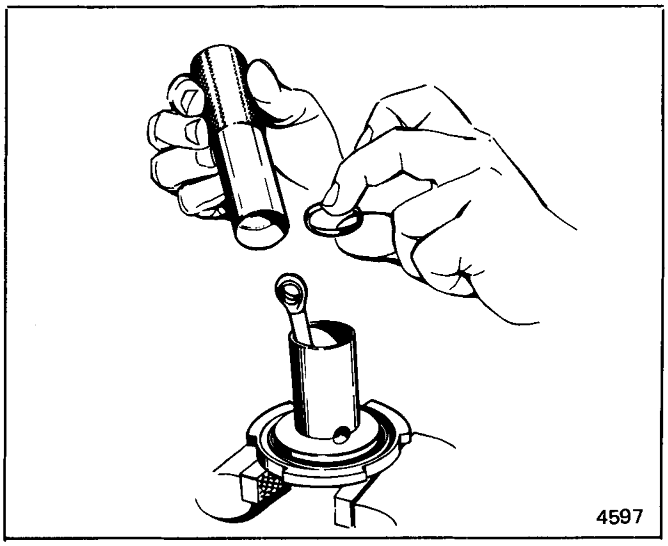


Fig. 5-70 Installing Floating Control Valve Retainer With Installer J 23175

4. Place the air valve end of the air valve push rod assembly into the tube of the primary power piston. Manually press the air valve push rod assembly so that the floating control valve bottoms on the tube section of the primary power piston. Installer tool J 23175 can be used to manually press the floating control valve to its seat.

5. Place the I.D. of the floating control valve retainer on the O.D. of floating control valve retainer installer J 23175. See Fig. 5-70. Place over the push rod so that the closed side of the retainer seats on the floating control valve. With Installer J 23175, manually press the retainer and floating control valve assembly to seat in the primary power piston tube. See Fig. 5-71.

6. After the floating control valve is seated, place the push rod limiter washer over the push rod and position on the floating control valve.

7. The filter element can now be streached over the push rod eye and pressed into the primary power piston tube.

8. Using Truarc No. 2 plier (J 4880), place the retaining ring into the groove in the air valve. See Fig. 5-69.

9. Position the rubber reaction bumper on the end of the air valve.

10. *Tolerances of those component parts affecting output of the tandem power brake are very critical.* Always use the factory gauged power piston kit, containing both the primary and secondary power pistons with factory gauged reaction piston, when replacement of any of these parts is required.

12. After determination of the correct reaction piston, apply a light film of silicone lubricant to the O.D. of the rubber reaction disc.

13. Place the rubber reaction disc in the large cavity of the secondary power piston and push the disc down to seat on the reaction piston.

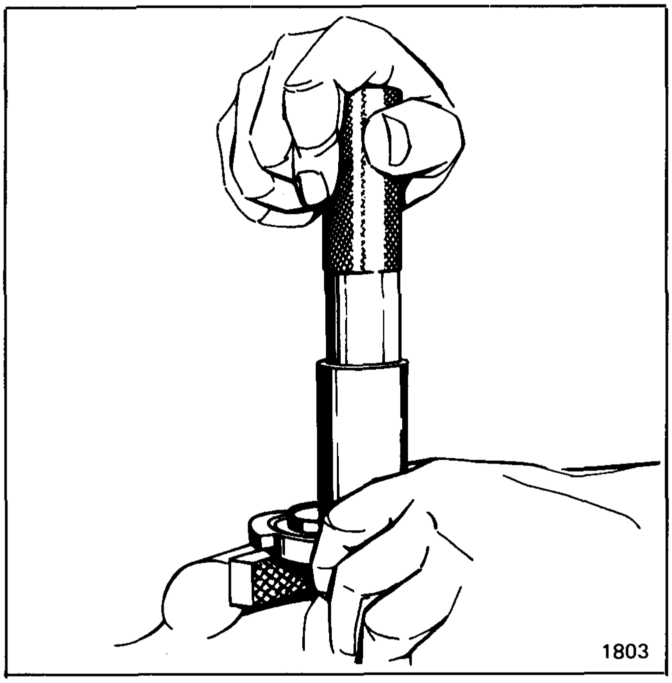


Fig. 5-71 Seating Floating Control Valve Assembly With Installer J 23175

14. Unlock the secondary power piston from the primary power piston.

15. Assemble the primary diaphragm to the primary support plate from the side of the support plate opposite the locking tangs. Press the raised flange on the I.D. of the diaphragm through the center hole of the support plate. Be sure that the edge of the support plate center hole fits into the groove in the raised flange of the diaphragm. Lubricate the diaphragm I.D. and the raised surface of the flange (that fits into a groove in the primary power piston) with a light coat of silicone lubricant.

16. Mount Tool J 23101 (small diameter end up) in a vise. Position the primary power piston so that the two radial slots in the piston fit over the ears (tangs) of the tool. See Fig. 5-67.

17. Fold the primary diaphragm away from the O.D. of the primary support plate.

18. Holding the edges of the support plate, with the locking tangs down, place the primary support plate and diaphragm assembly over the tube of the primary power piston. The flange of the I.D. of the primary diaphragm will fit into a groove in the primary power piston.

19. Grip the edges of the primary support plate, press down, and rotate clockwise until the tabs on the primary power piston contact the stops on the support plate. See Fig. 5-68.

20. Place the power head silencer on the tube of the primary power piston so that the holes at the base of the tube are covered.

21. Apply silicone lubricant to the O.D. of the primary power piston tube.

22. Remove the primary piston assembly from Tool J 23101 and lay it aside.

23. Assemble the secondary diaphragm to the secondary support plate from the side of the support plate opposite the locking tangs. Press the raised flange on the I.D. of the diaphragm through the center hole of the support plate. Be sure that the edge of the support plate center hole fits into the groove in the raised flange of the diaphragm. Apply a thin coat of silicone lubricant to the I.D. of the secondary diaphragm and the raised surface of the flange (that fits into a groove in the secondary power piston).

24. Mount Tool J 23101 (With large diameter end up) in a vise. Position the secondary power piston so that the radial slots in the piston fit over the ears (tangs) of the tool. Apply a light coat of silicone lubricant to the tube of the secondary power piston. See Fig. 5-63.

25. Fold the secondary diaphragm away from the O.D. of the secondary support plate.

26. Holding the edges of the support plate, with the locking tangs down, place the secondary diaphragm and support plate assembly over the tube of the secondary power piston. The flange on the I.D. of the secondary diaphragm will fit into the groove in the secondary piston.

27. Grip the edges of the secondary support plate, press down, and rotate counterclockwise until the tabs on the secondary power piston contact the stops on the support plate. Hold the secondary diaphragm back into position on the secondary support plate. Leave the secondary power piston assembly on Tool J 23101 in the vise. See Fig. 5-65.

28. Apply a light coat of talcum powder or silicone lubricant to the bead on the O.D. of the secondary diaphragm. This will facilitate reassembly of front and rear housings.

30. Hold the housing divider so that the formed over flange (that holds the primary diaphragm) of the divider faces down. Place the secondary bearing in the I.D. of the divider so that the extended lip of the bearing faces up.

31. Lubricate the I.D. of the secondary bearing with silicone lubricant.

32. Position secondary bearing protector Tool J 23188 on the threaded end of the secondary power piston. See Fig. 5-72.

33. Hold the housing divider so that six oblong protrusions on the middle of divider faces up. Press the divider down over the tool and onto the secondary power piston tube where it will rest against the diaphragm support ring. Remove Tool J 23188 from secondary power piston; however, do not remove the secondary power piston subassembly from Tool J 23101.

34. Pick up the primary power piston assembly and fold the primary diaphragm away from the O.D. of the primary support plate.

35. Position the small end of the air valve return spring on the air valve so that it contacts the air valve retaining ring.

36. Position the primary power piston on the tubular portion of the secondary power piston, making sure that the air valve return spring seats down over the raised center section of the secondary piston.

37. Grip the edge of the primary support plate, press down, and start the threads on the secondary power piston into the threaded portion of the primary power piston by rotating in clockwise direction. See Fig. 5-64.

38. Continue to tighten the primary power piston until it is securely attached (approximately 5-15 ft. pounds) to the secondary power piston.

39. Fold the primary diaphragm back into position on the primary support plate and pull the diaphragm O.D. over the formed flange of the housing divider. Check that the bead

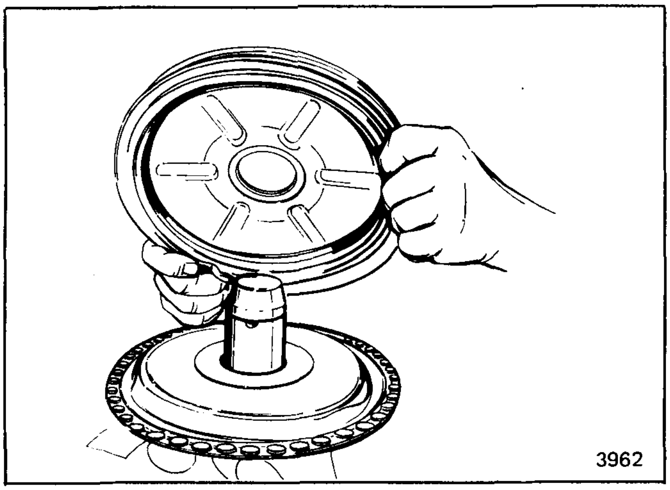


Fig. 5-72 Positioning Housing Divider Over Secondary Bearing Protector Tool J 23188

on the diaphragm is seated evenly around the complete circumference.

40. Wipe a thin film of silicone lubricant on the O.D. of the piston rod retainer. Insert the master cylinder piston rod retainer into the cavity in the secondary power piston so that the flat end bottoms against the rubber reaction disc in the bottom of the cavity.

Reassembly of Rear Housing Group

1. Place the primary power piston bearing in rear housing center hole so that the formed flange of the housing center hole fits into the groove of the primary power piston bearing. The thin lip of the bearing will protrude to the outside of the housing.

2. Coat the I.D. of the primary power piston bearing with silicone lubricant.

Final Assembly

1. Mount the front housing assembly in a vise.

2. Position the power piston return spring over the inset in the front housing.

3. Assemble the power piston group to the rear housing by pressing the tube of the primary piston through the rear housing bearing. Press down until the housing divider seats in the rear housing and the primary power piston bottoms against the housing.

4. Place the piston rod retainer plate on the end of the power piston return spring in the front housing.

5. Hold the rear housing assembly (with mounting studs up) over the front housing. (Make sure that the piston rod retainer does not dislodge from the secondary power piston during this operation.) Position the rear housing so that when the tangs on the edge of the front housing are locked in the slots on the edge of the front housing, the scribe marks on the top of the housings will be in line.

6. Lower the rear housing assembly onto the front housing. The power piston spring must seat in the depression in the face of the secondary power piston. Check that the bead on the O.D. of the secondary diaphragm is positioned between the edges of the housing.

7. Continue to press down on the rear housing and fit the slots in the appropriate tangs on the front housing.

8. To facilitate locking, position front housing seal in the depression in the front housing and apply a vacuum source to the vacuum check valve in the front housing. Using Tool J 23456, press down and rotate the rear housing clockwise into the locked position. Remove Tool J 23456; remove the vacuum source. See Fig. 5-60.

9. Place the silencer in the closed end of the power head boot. Push the boot retainer over the boot. Stretch the boot over the push rod and over the flange in the center of the rear housing.

GAGING DELCO MORAINE TANDEM POWER BRAKE UNIT

1. Place the power head assembly in a padded vise (front housing up). *Do not clamp tight.*

2. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.

3. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.

4. Remove the front housing seal to assure that no vacuum is in the power head will gaging.

5. Place Gage J 22647 over the piston rod in a position which will allow the gage to be slipped to the left or right without contacting the studs. See Fig. 5-73.

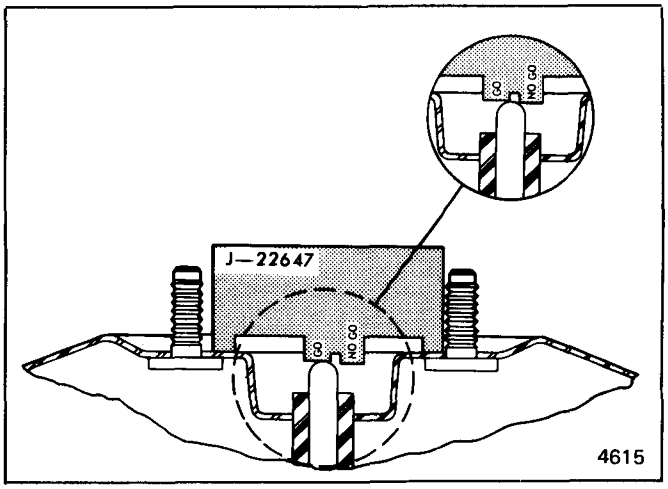


Fig. 5-73 Gaging Piston Rod

6. The center section of the gage has two levels. The piston rod should always contact the longer section (lower level) of the gage. The piston rod should *never* contact the shorter section (higher level) of the gage. Move gage from side to side to check piston rod height.

7. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod and adjusting the self-locking screw to meet the gaging specifications.

8. Wipe a thin film of silicone lubricant on the I.D. of the front housing seal and position seal in the depression in the housing.

DISASSEMBLY OF BENDIX TANDEM POWER BRAKE UNIT

Disassembly of Overall Unit

1. Scribe a line across front and rear housings to facilitate reassembly.

2. Carefully remove hydraulic push rod and seal and slide seal from rod.

3. Remove vacuum check valve and grommet, if required.

4. Remove dust boot and silencer from operating valve rod.

5. Remove dust guard retainer, dust guard and silencers from rear plate hub with an awl. Then, reinstall steel retainer on hub.

6. Squirt alcohol down operating valve rod to lubricate rubber grommet in the valve plunger.

7. Position two small blocks of wood on either side of air valve rod and install end of air valve rod in vise, leaving just enough clearance to position two (2) open end wrenches between vise and retainer on hub of rear plate.

8. Using the wrench nearest the vise as a pry, force the valve plunger grommet off from the ball end of the rod. Do not damage plastic hub or allow vacuum cylinder to fall to the floor. See Figures 5-74 and 5-75.

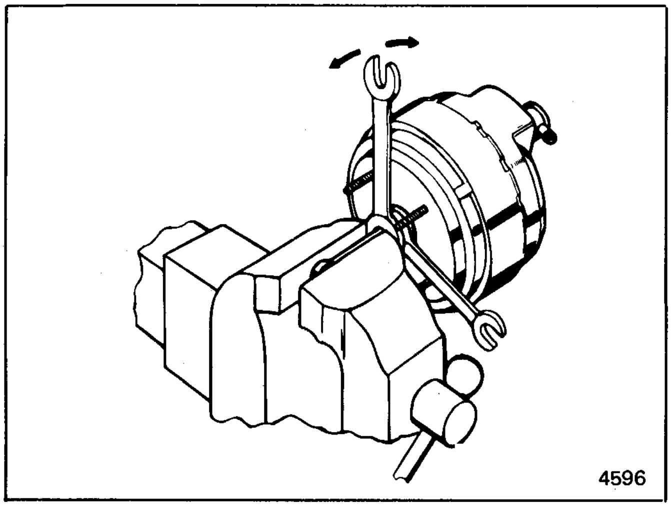


Fig. 5-74 Removing Air Valve Rod

9. The edge of the rear shell contains twelve (12) lances. Four (4) of these lances (one in each quadrant) are deeper than the other lances. The metal that forms the four (4) deep lances must be partially straightened so that the lances will clear the cutouts in the front shell. If the metal tabs that form the lances break during straightening, the shell must be replaced. See Fig. 5-76.

10. Remove the hydraulic push rod and vacuum seal from the front shell.

11. Mount Tool J 23456 in a vise, and position the power section on the tool so that the four (4) studs on the rear shell fit into holes in the tool. See Fig. 5-77.

12. Position the handle over the two (2) studs on the front shell and tighten the screw to apply a downward pressure on the front shell. Then, rotate the wrench and front shell counterclockwise until the lances in the edge of the rear shell are aligned with cutouts in the front shell. Considerable effort may be required to rotate the front shell.

13. Slowly release the screw of the tool to permit the two (2) shells to separate.

WARNING: THE DIAPHRAGM RETURN SPRING IS COMPRESSED IN THE POWER SECTION AND EXPANDS AS THE PRESSURE ON THE SHELLS IS REMOVED. IF THE SHELLS DO NOT SPEARATE WHEN THE SCREW HAS BEEN TURNED SLIGHTLY TO REDUCE THE PRESSURE, TAP THE SHELLS WITH A RUBBER HAMMER TO BREAK THE BOND.

14. Continue to release the screw until diaphragm spring tension has been removed.

15. Remove the front shell and return spring.

16. Work edges of front diaphragm from under lances of rear housing and remove complete vacuum assembly from rear housing, using care not to damage rear housing seal. Bosses on center plate must be aligned with cutouts in rear housing to remove the assembly.

17. Wet the rear diaphragm retainer with alcohol and remove the retainer using fingers only.

18. Clamp Tool J 22839 in a vise. Place the diaphragm and plate assembly on the tool with the tool seated in the hex opening in the front plate.

19. Twist the rear diaphragm plate counterclockwise, using hand leverage on the outer edge of the plate. It may be necessary to use a 1" x 1-3/16" x 8" wood strip as a lever in cover slot on outside circumference of rear plate.

20. After the two (2) plates have been loosened, remove the plates from Tool J 22839 and place on a bench with the front plate down. Unscrew the rear plate completely and carefully lift it off the front plate hub, grasping the valve plunger and valve return spring as the parts are separated. See Fig. 5-78.

21. Remove the square section "O"-ring from the shoulder of the front diaphragm plate hub.

22. Remove the reaction disc from inside the front diaphragm plate hub. Carefully slide the center plate off the hub of the front plate.

23. Remove the diaphragms from the plates.

24. If rear housing seal requires replacement, use a blunt punch or 1-1/4" socket to drive seal from housing. See Figures 5-79 and 5-80.

CLEANING AND INSPECTION BENDIX TANDEM POWER BRAKE UNIT

Power Section

All parts to be reused should be washed in alcohol or brake fluid. Dry the parts with compressed air and place them on clean paper or lintfree cloth.

Small rust spots inside the shells may be removed with crocus cloth or fine emery cloth. Be sure to clean thoroughly

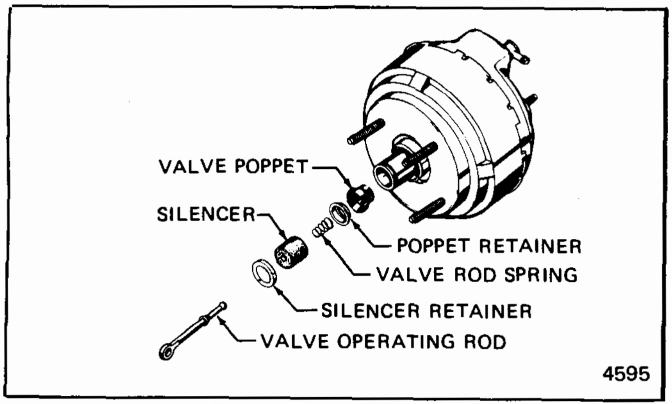


Fig. 5-75 Removing Air Valve Rod

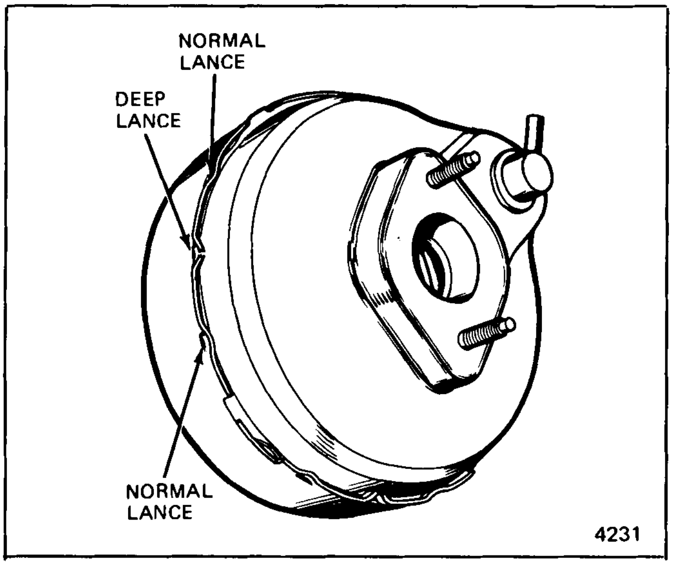


Fig. 5-76 Lances in Front Shell

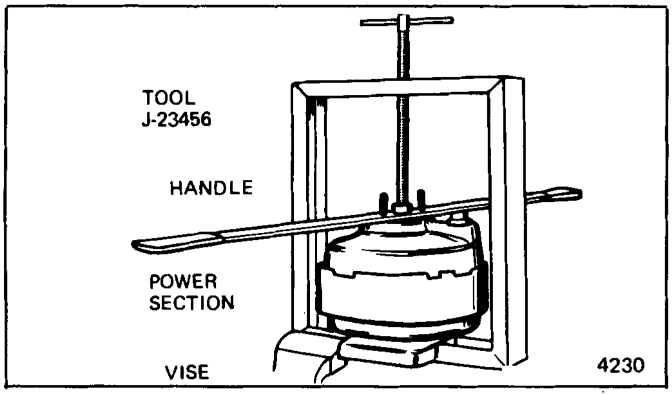


Fig. 5-77 Unlocking Front and Rear Housings

after using any abrasive.

Inspect all parts and replace any that are damaged or show excessive wear.

REASSEMBLY OF BENDIX TANDEM POWER BRAKE UNIT

1. If the rear bearing and seal were removed, press new bearing and seal into this cavity in the rear shell using Too J 22677. See Fig. 5-81. The flat rubber surface of the seal should be 5/16" below the flat, inside surface of the rear shell.

2. Install reaction disc in hub of front plate with small tip toward hole. Use rounded rod to seat disc.

3. Mount Tool J 22839 in vise.

4. Install front diaphragm on front plate. Long fold of diaphragm must be facing down.

5. Install Tool J 22733 over threads on front plate hub. See Figure 5-82.

6. Apply a light film of special seal lubricant to front plate hub and to seal in center plate, then guide center plate, seal first on to the front plate hub, being careful not to damage center plate seal.

7. Apply special seal lubricant lightly to front and rear bearing surfaces of air valve plunger, being careful not to apply lubricant to rubber grommet inside plunger. Install vacuum seal "O"-ring on shoulder of front plate hub and valve plunger return spring and plunger in base of front plate hub. See Fig. 5-83.

8. Set rear plate over hub of front plate and, using hands only, screw plate on hub, making sure that valve and spring are properly aligned. Hand torque plates to 150 in. lb. Check travel of valve plunger with index finger.

9. Assemble rear diaphragm to rear plate and place lip of diaphragm in groove in rear plate. Install diaphragm retainer over rear diaphragm and lip of center plate. Using fingers, press retainer until it seats on shoulder of center plate. See Fig. 5-84.

10. Apply talcum powder to inside wall of rear housing and special seal lubricant to the scalloped cutouts of front housing and to seal in rear housing; assemble diaphragm and plate assembly in rear housing by carefully guiding rear plate hub through seal in rear housing. Bosses on center plate must be aligned between lances in rear housing for reassembly. Work outer rim of front diaphragm into rear housing with screwdriver blade so that it is under lances in housing.

11. Install rear housing in Tool J 23456.

12. Install diaphragm return spring in rear housing.

13. Place front housing over rear housing and align scribe marks.

14. Tighten until diaphragm edge is fully compressed and tangs on front housing against slots on rear housing.

15. Rotate bar clockwise until housings are locked together. Remove from tool.

16. Bend the tabs of the four deep lances back to their original position.

17. Wet poppet valve with alcohol and assemble in rear plate hub, small end first; wet poppet retainer with alcohol and assemble with shoulder inside poppet. Assemble retainer, filters, silencer over ridge on rod and return spring over ball end of operating valve rod. Wet grommet in valve plunger with alcohol and guide air valve rod into valve plunger. Tap end of operating valve rod with plastic hammer to lock ball in grommet. Press filters and silencers into hub and install retainer on hub.

18. Assemble silencer in dust boot, wet dust boot opening with alcohol and assemble over operating valve rod and over flange of rear housing.

19. Install check valve and grommet, if removed.

20. Apply special seal lubricant to piston end of hydraulic push rod and insert in cavity in front plate. Twist rod to eliminate air bubbles at reaction disc. Assemble seal over push rod and press into recess in front housing.

GAGING OF BENDIX TANDEM POWER BRAKE UNIT

1. Place the power head assembly in a padded vise (front housing up). *Do not clamp tight.*

2. Insert the master cylinder piston rod, flat end first, into the piston rod retainer.

3. Press down on the master cylinder piston rod (with approximately a 40-50 pound load) to be sure it is properly seated.

4. Remove the front housing seal to assure that no vacuum is in the power head while gaging.

5. Place Gauge J 22647 over the piston rod in a position which will allow the gauge to be slipped to the left or right

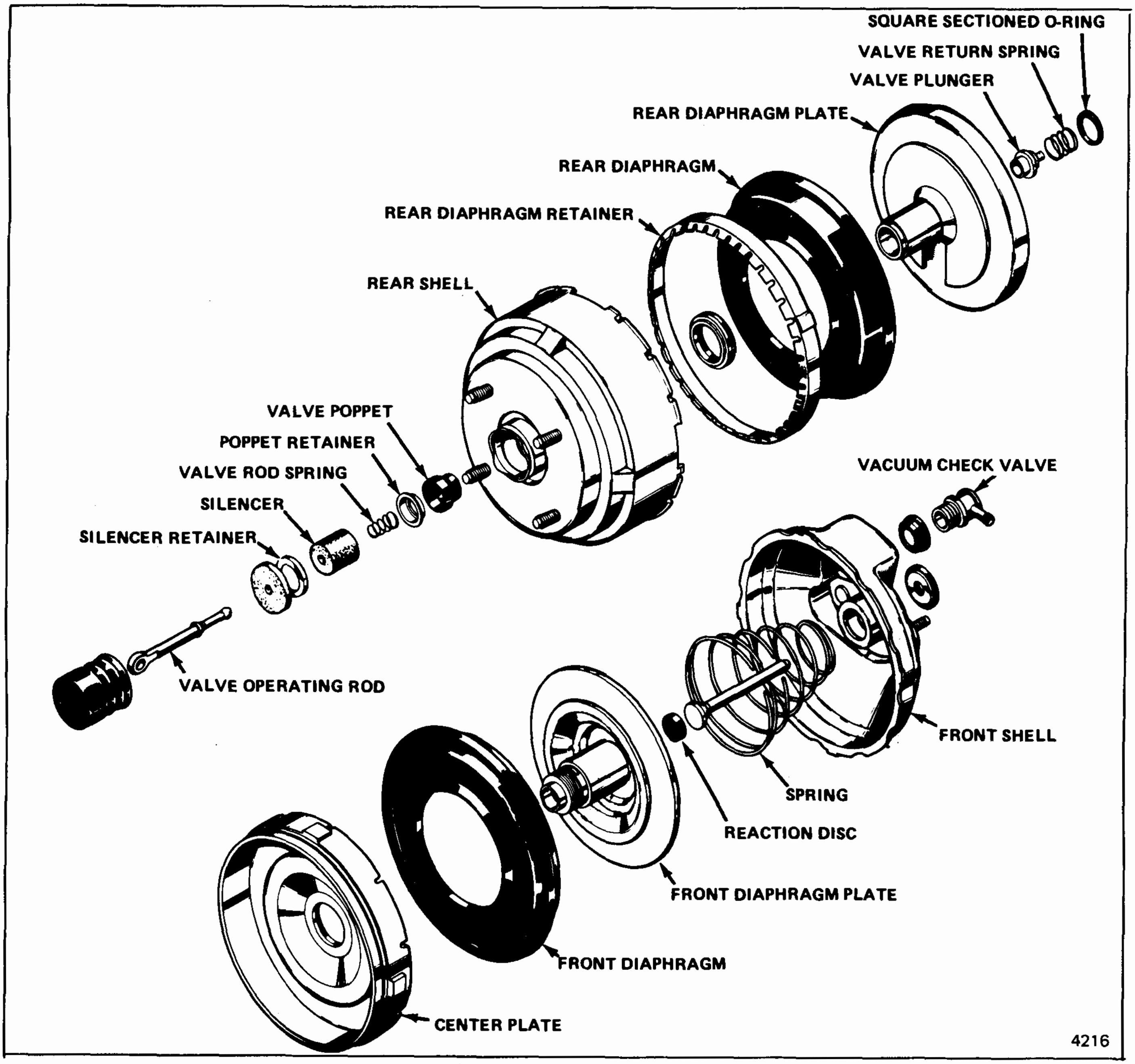


Fig. 5-78 Diaphragm and Plates

without contacting the studs. See Fig. 5-85.

6. The center section of the gauge has two levels. The piston rod should always contact the longer section (lower level) of the gauge. The piston rod should never contact the shorter section (higher level) of the gauge. Move gauge from side to side to check piston rod height.

7. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod and adjusting the self-locking screw to meet the gaging specifications.

8. Wipe a thin film of silicone lubricant on the I.D. of the front housing seal and position seal in the depression in the housing.

DISASSEMBLY OF DELCO MORAINE POWER BRAKE UNIT

F and X Series

On the X Series cars only, the single diaphragm booster can be separated with the booster on the car.

1. Scribe a line across front and rear housing to facilitate reassebmly.

2. Install Tool J 22805-01 at front housing. Insert a 22" long x 1-1/4" square channel tube in end of tool.

3. Using a 14" crescent wrench or equivalent, twist the square channel tube counterclockwise enough to separate front housing from rear housing.

4. Remove front housing & power position return spring.

Fig. 5-79 Removing Rear Seal

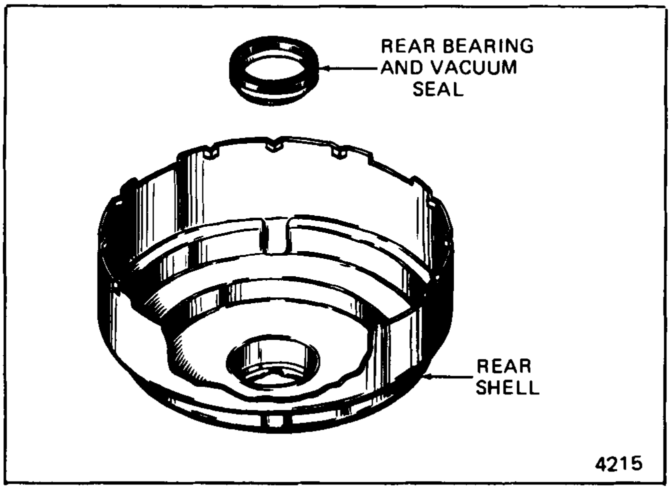


Fig. 5-80 Rear Bearing and Rear Shell

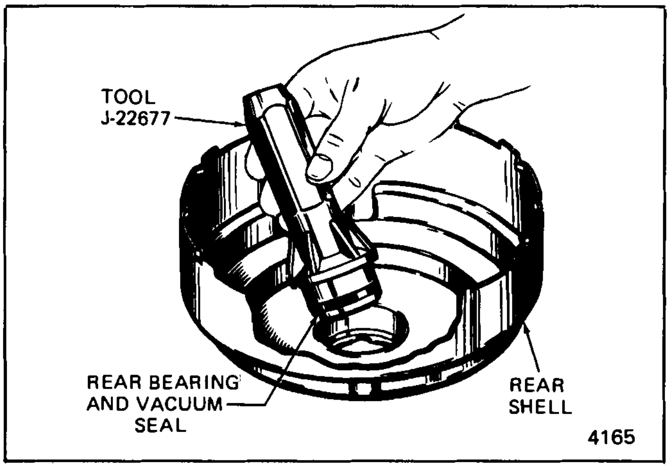


Fig. 5-81 Installing Rear Bearing and Vacuum Seal

5. Remove clevis pin retainer and pin at brake pedal.

6. Remove clevis and lock nut from push rod.

Disassembly of Power Brake Unit - All Except X Car

1. Scribe a mark on bottom center of front and rear housings to facilitate reassembly.

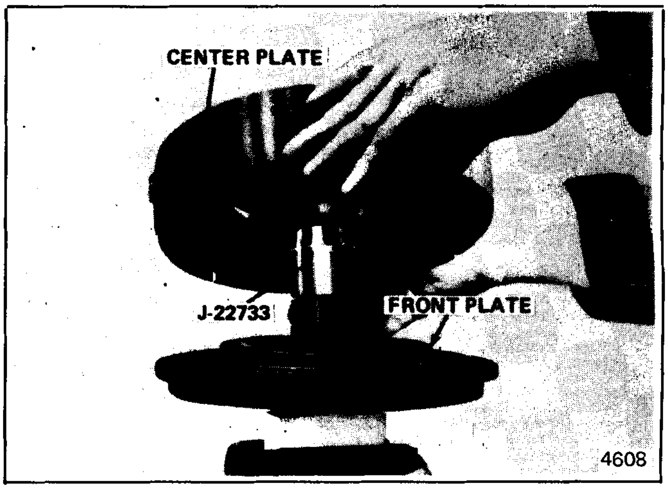


Fig. 5-82 Seal Protector Tool J 22733

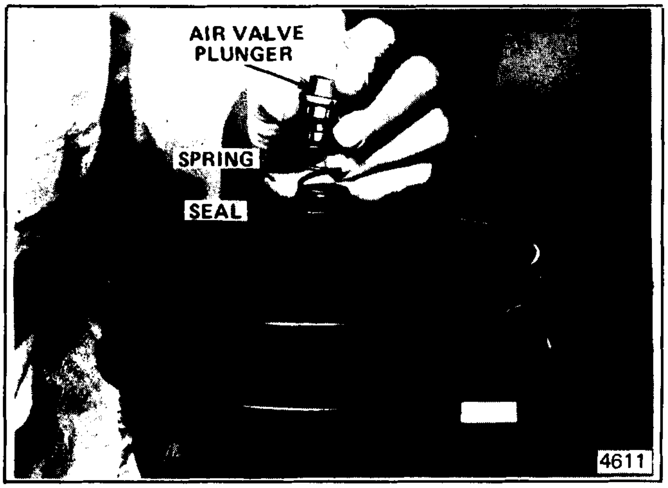


Fig. 5-83 Installing Air Valve Plunger

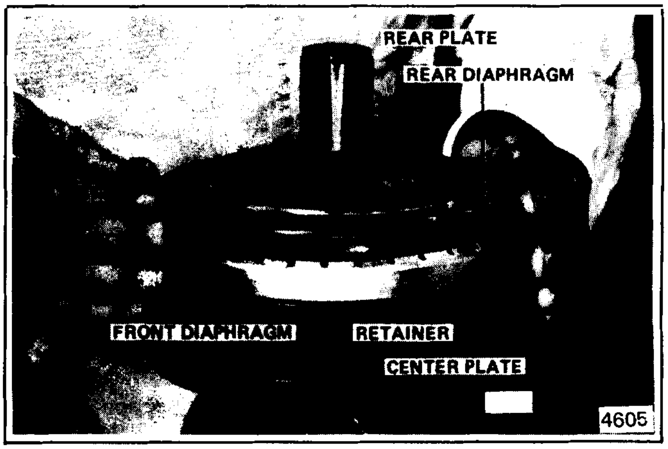


Fig. 5-84 Installing Rear Diaphragm Retainer

2. Using holder J 22805-01 and Handle J 9504-01, rotate rear housing counterclockwise to unlocked position. See Figure 5-87. Loosen housing carefully as it is springloaded.

3. Lift rear housing and power piston assembly from unit. Then remove return spring.

4. Remove clevis and jam nut from push rod. Remove retaining ring on push rod that holds silencer in place on push rod. Remove silencer.

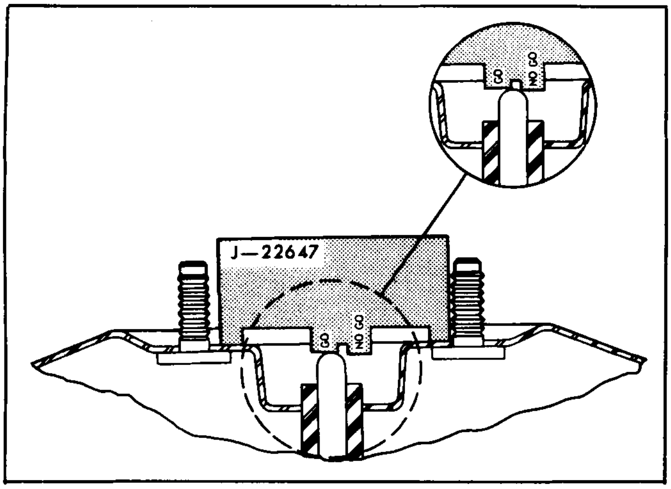


Fig. 5-85 Gaging Piston Rod

5. Remove seal from front housing, and if defective, vacuum check valve.

Disassembly of Power Piston Assembly

CAUTION: *Care must be used in handling the diaphragm of power piston assembly. Guard diaphragm against grease, oil, foreign matter and nicks or cuts.*

1. Remove power piston assembly from rear housing.

2. Remove silencer from neck of power piston tube.

3. Remove lock ring from power piston by prying one end out from under large divided locking lug and then proceed to pull ring from under other two locking lugs on power piston. See Fig. 5-89.

4. Remove reaction retainer, piston, reaction plate, three (3) reaction levers and air valve spring. Also remove reaction bumper and air valve spring retainer from air valve. See Fig. 5-90.

5. Place power piston Wrench J 21524 with square shank in vise. Hold support plate and power piston with tube of power piston up. See Fig. 5-91.

6. Pull diaphragm edges away from support plate so hands can grip steel support plate. Position assembly on power piston Wrench J 21524 so three lugs on tool fit into three notches in power piston. See Fig. 5-92.

7. Press down on support plate and rotate counterclockwise until support plate separates from power piston. See Fig. 5-93.

8. Remove diaphragm from support plate and lay both parts aside.

9. Position power piston, tube down, in a tool, fabricated from a piece of wood, 2" x 4" x 8" long with a 1-3/8" hole in center, clamped in a vise. Do not clamp tube in vise.

10. Use No. 22 Truare Pliers or J 4880 to remove snap ring on air valve. See Fig. 5-94.

11. Set up Power Ram and Hydraulic Pump with J 9746 Press Plat. Insert power piston, tube down, in press plate and remove air valve assembly using a 3/8" drive extension as a remover. See Fig. 5-95.

12. Removal of air valve push rod assembly disassembles the following parts from power piston: floating control valve assembly, floating valve retainer, push rod limiter washer and air filter.

13. Remove floating control valve assembly from push rod as it must be replaced by a new floating control valve assembly at rebuild.

14. The master cylinder push rod can now be pushed from center of reaction retainer. Remove "O" ring from groove in master cylinder piston rod.

CLEANING AND INSPECTION OF DELCO MORAINE POWER

BRAKE UNIT

Cleaning of Parts

1. Use Declene or denatured alcohol to clean thoroughly all metal brake parts. Immerse in cleaning fluid and brush with hair brush to remove foreign matter. Blow out all passages, orifice and valve holes. Air dry and place cleaned parts on clean paper or lint free clean cloth.

2. If slight rust is around inside either front or rear housing assemblies, polish clean with crocus cloth or fine emery paper, washing clean afterwards with specified cleaning fluid.

CAUTION: *If there is any suspicion of contamination or any evidence of corrosion, completely flush hydraulic brake system. Failure to clean hydraulic brake system can result in early repetition of trouble. Use of gasoline, kerosene, anti-freeze alcohol or any other cleaner with even a trace of mineral oil will damage rubber parts.*

Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean. Rewash at reassembly if there is any occasion to doubt cleanliness--such as parts dropped or left exposed for eight hours or longer.

Inspection and Replacement of Parts

1. Inspect all rubber parts. Wipe free of fluid and carefully inspect each rubber part for cuts, nicks or other damage. These parts are the key to control of fluid or air flow and should account for the majority of troubles traceable to leakage. Re-use rubber parts only if a fairly new unit is dissassembled for some particular trouble and only then if there is no doubt that the parts are in equal-to-new condition. Badly damaged items or those which would take extensive work or time to repair should be replaced. In case of doubt, install new parts for safety and for ultimate lower cost.

2. Inspect in accordance with Inspection Table: (The table is organized by power brake unit groups.)

INSPECTION TABLE

Part	Inspect For	Corrective Action
Power Piston and Support Plate and Reaction Retainer	1. Cracks, distortion, chipping, damaged lever seats, pitted or rough holes.	1. Clean up or replace.
	2. Worn seal surfaces (tubes).	2. Replace
	3. Rough or uneven floating valve seat.	3. Replace
	4. Open passages and flow holes.	4. Clean
Reaction Levers or Plates	1. Cracks, distortion, tears and heavy wear.	1. Replace
Floating Control	1. Deterioration of rubber or warped value face.	1. Replace.
Air Valve-Push Rod Assembly	1. Air valve: scratches, dents, distortion, I.D. or O.D. All seats to be smooth and free of nicks and dents.	1. Do not repair - replace.
	2. Push rod must move freely in air valve, but must not pull out.	2. If worn, replace air valve - push rod assembly.
Front and Rear Housing	1. Scratches, scores, pits, dents, or other damage affecting rolling or sealing of diaphragm or other seals.	1. Replace, unless easily repaired.
	2. Cracks, damage at ears, damaged threads on studs.	2. Replace, unless easily repaired.
	3. Bent or nicked locking lugs.	3. Replace, unless easily repaired.
	4. Loose studs.	4. Replace or repair.
Air Filters and Silencer	1. Dirty	1. Replace

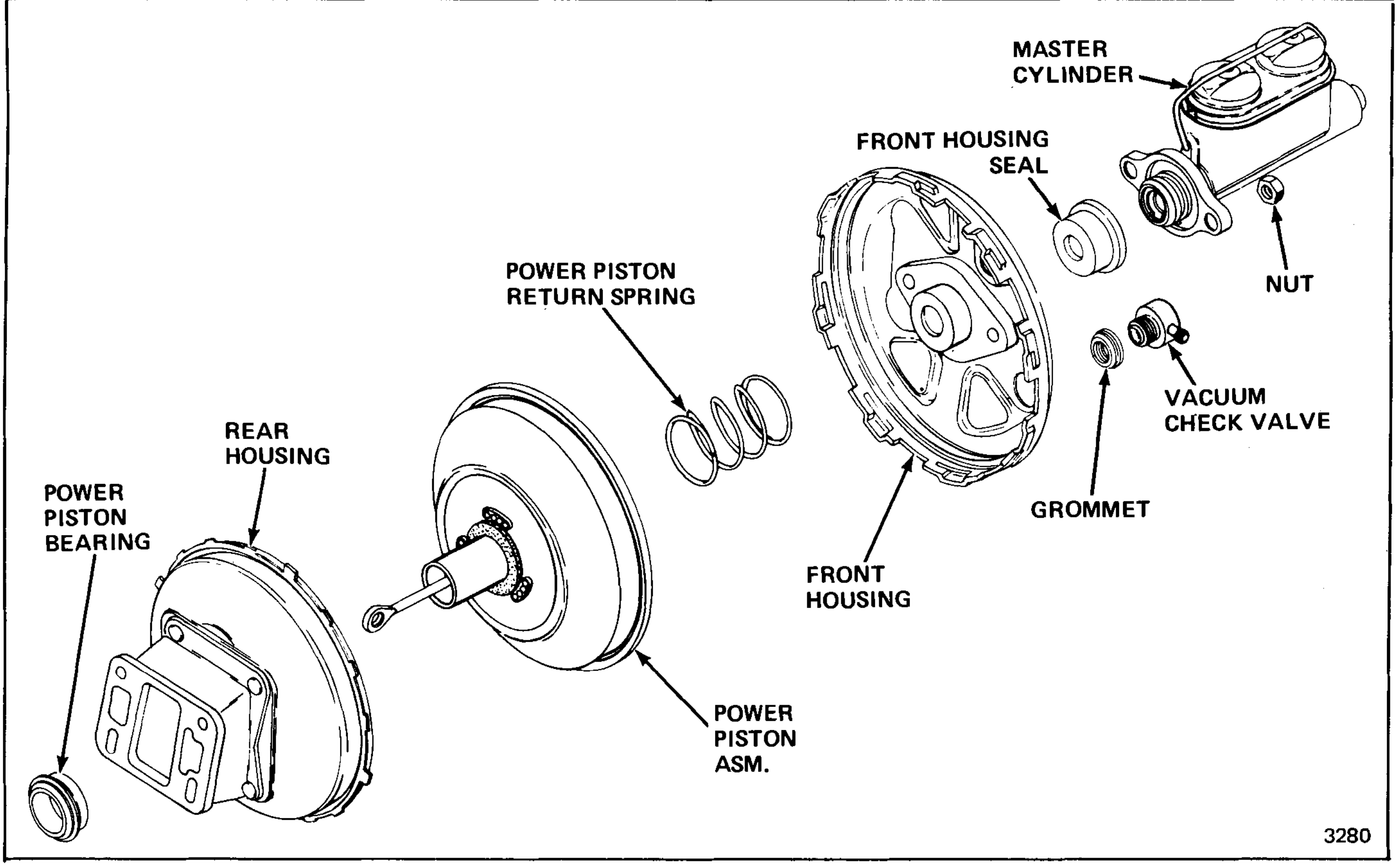


Fig. 5-86 Power Brake Unit - Exploded View

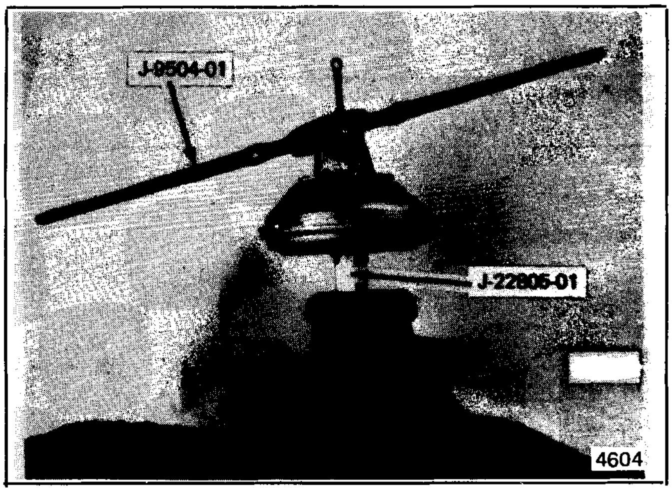


Fig. 5-87 Separating Power Brake Unit

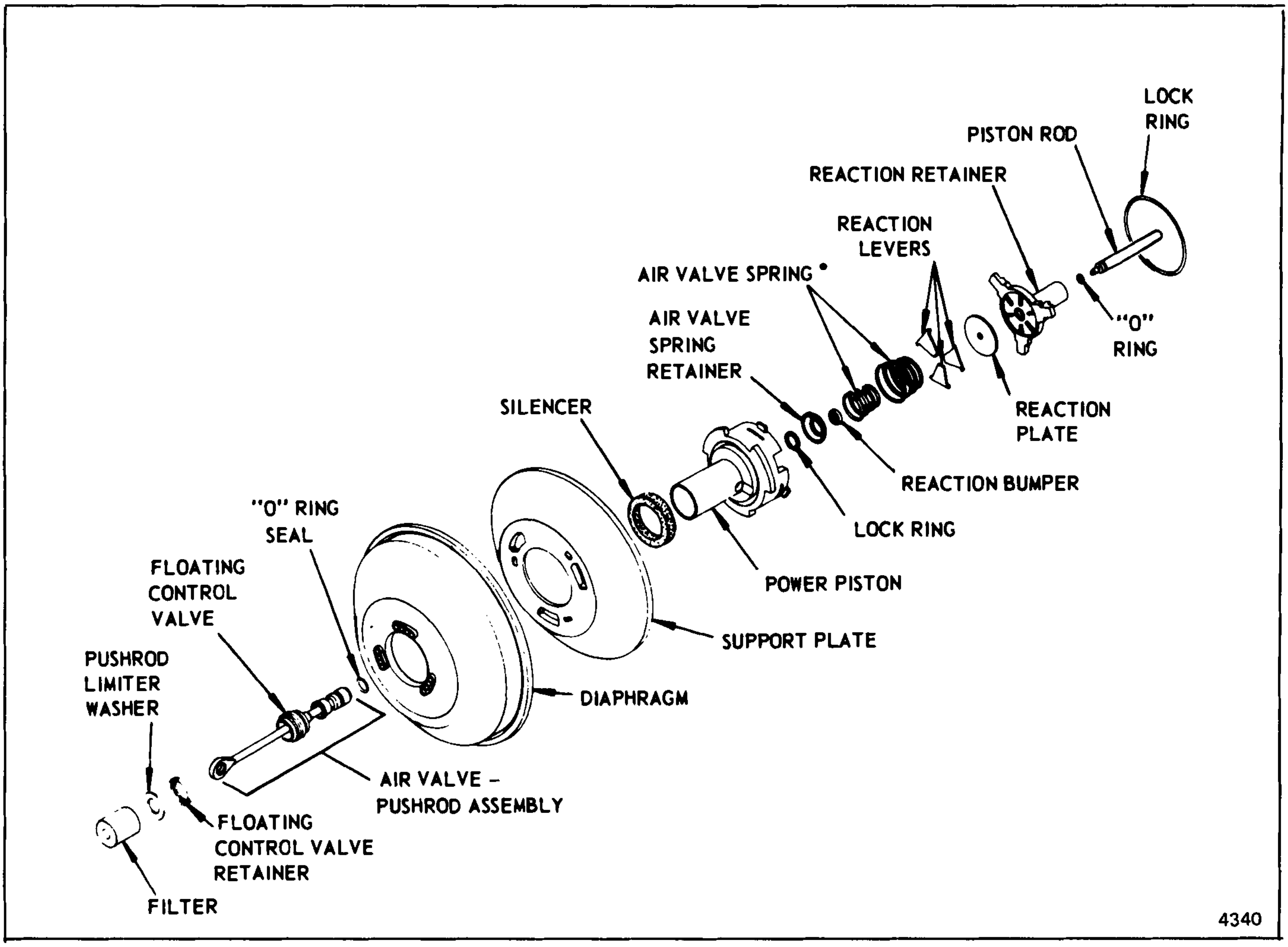


Fig. 5-88 Power Piston Assembly - Exploded View

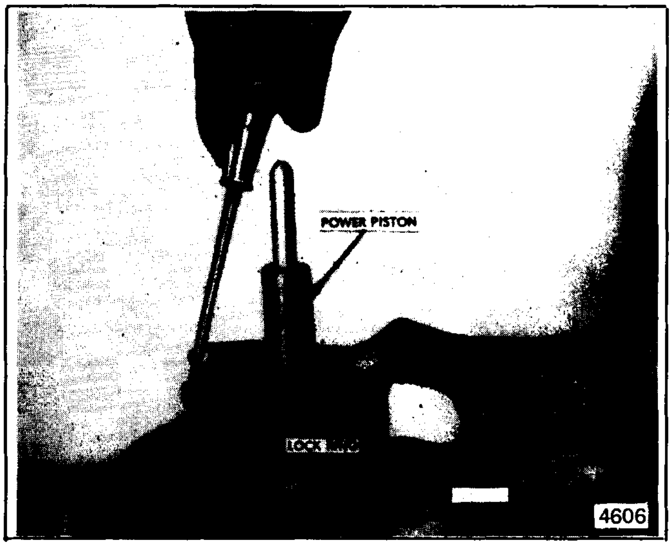


Fig. 5-89 Removing Lock Ring From Power Piston

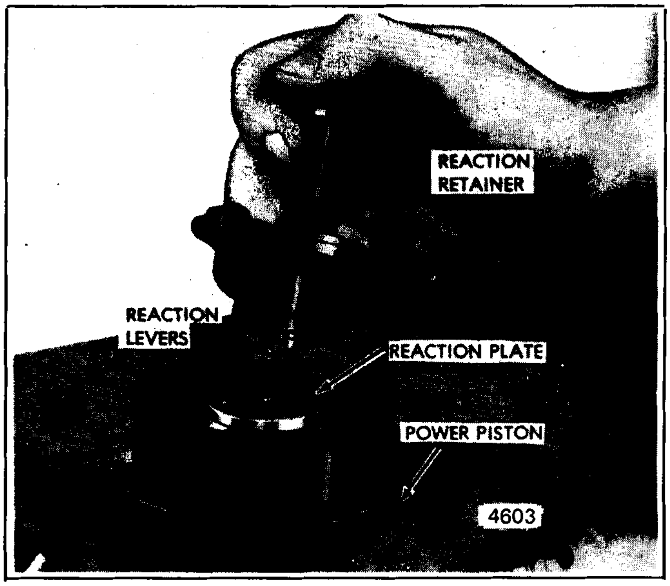


Fig. 5-90 Removing Reaction Retainer

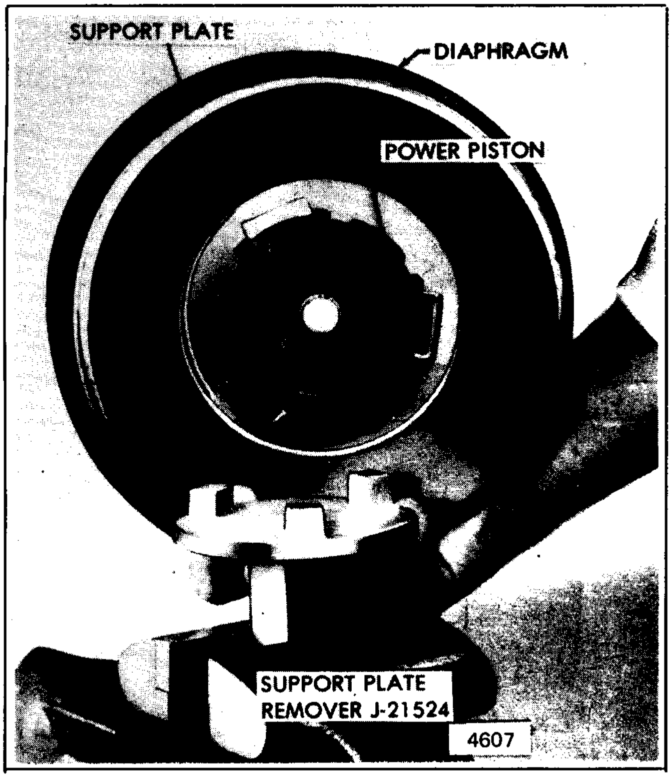


Fig. 5-91 Positioning Support Plate Retainer in Vise

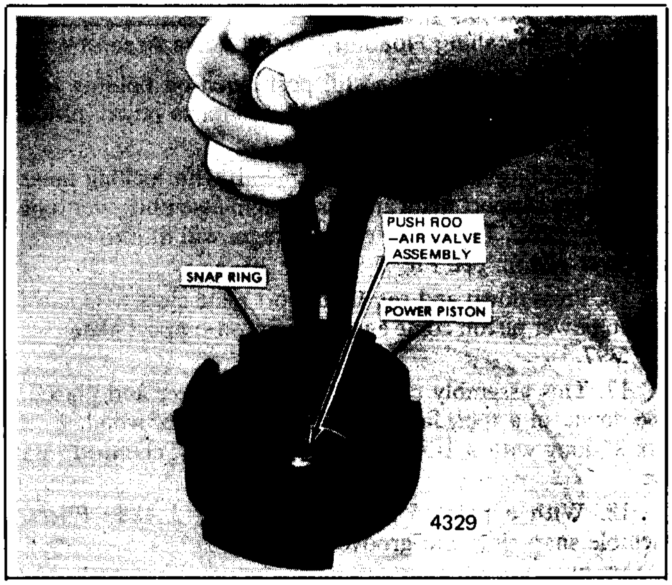


Fig. 5-94 Removing Power Piston Snap Ring

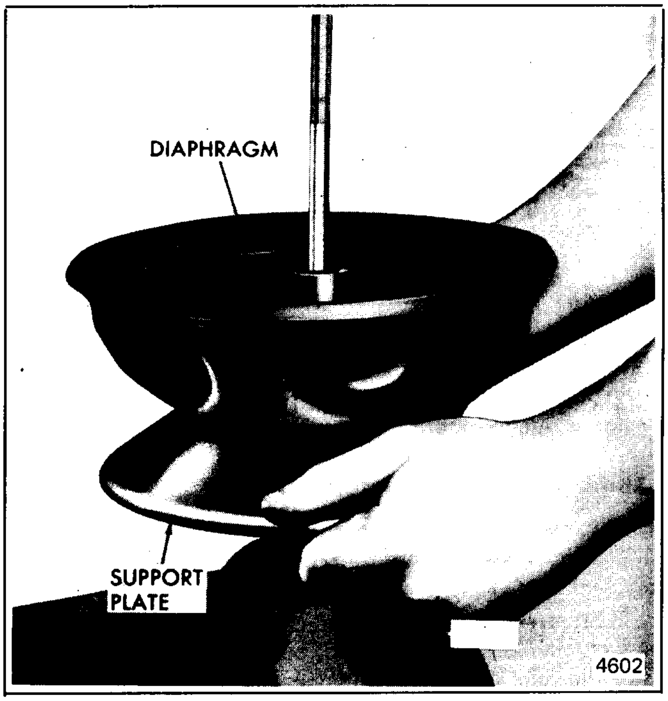


Fig. 5-92 Positioning Power Piston on Support Plate Remover

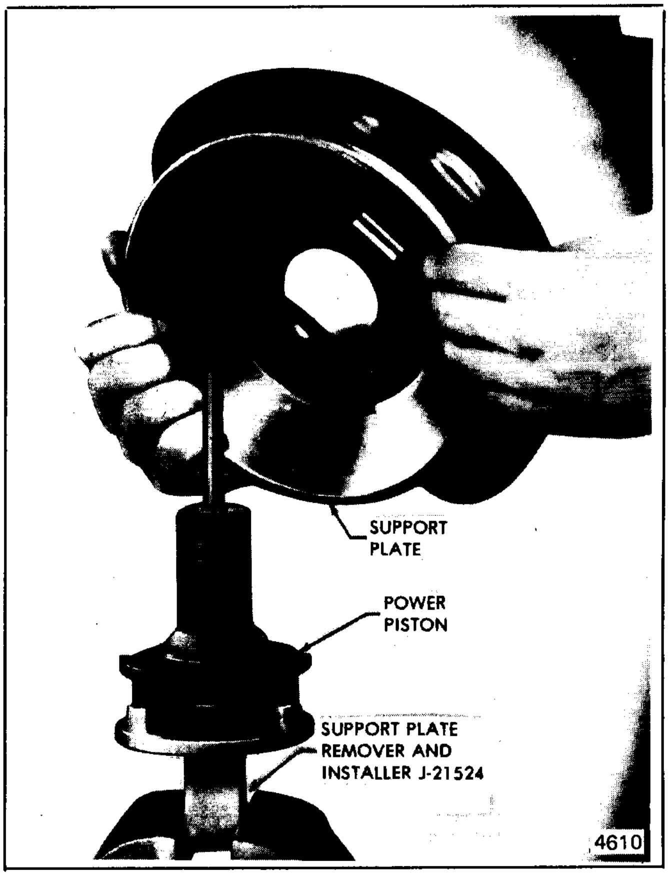


Fig. 5-93 Removing Support Plate

ASSEMBLY OF DELCO MORAINE POWER BRAKE UNIT

Be certain that all rubber parts are clean at reassembly. Rewash in specified cleaning fluid if there is any doubt of cleanliness. Be careful during rebuild process that no grease or mineral oil comes in contact with rubber parts of power brake unit. Lubricate rubber parts with Delco Moraine approved lubricant or equivalent.

Assembly of Front Housing Group

1. Replace vacuum check valve using a new grommet if old one is cracked or damaged.
2. Place new front housing seal in housing so flat surface of cup lies against bottom of depression in housing.

Assembly of Power Piston Group

1. Place new "O" ring in groove on the master cylinder piston rod. Wipe a thin film of Power Brake Lube or equivalent on "O" ring.
2. Master cylinder piston rod is not inserted through the reaction retainer so round end of piston rod protrudes from end of the tube on reaction retainer.
3. Place J 21524 power piston wrench in a vise. Position power piston on wrench with three lugs fitting into notches in power piston.
4. Position new "O" ring on air valve in second groove from push rod end.
5. On reassembly of power piston, floating control valve assembly must be replaced with a new one since the force required to remove it distorts component parts.
6. Place floating control valve on push rod-air valve assembly so flat face of valve will seat against valve seat on air valve.
7. Wipe a thin film of Power Brake Lube on large O.D. of floating control valve and on "O" ring on air valve.
8. Press air valve push rod assembly, air valve first, onto its seat in tube of power piston.
9. Place floating control valve retainer over push rod so flat side seats on floating control valve.
10. Start floating control valve and its retainer into power piston tube. Press the floating control valve to seat in the tube, by placing J 21601-01 Floating Control Valve Retainer Installer on top of retainer and pushing down by hand. See Fig. 5-96.
11. After floating control valve is seated, position push rod limiter washer over push rod and down onto floating control valve. Air filter element can now be streached over end of push rod and pressed into power piston tube.
12. Assembly power piston diaphragm to diaphragm support plate from side of support plate opposite locking tangs. The raised flange of diaphragm is pressed through hole in center of support plate. Be sure that edge of center hole fits into groove in flange of diaphragm.
13. Pull diaphragm away from O.D. of support plate support plate can be gripped with hands.

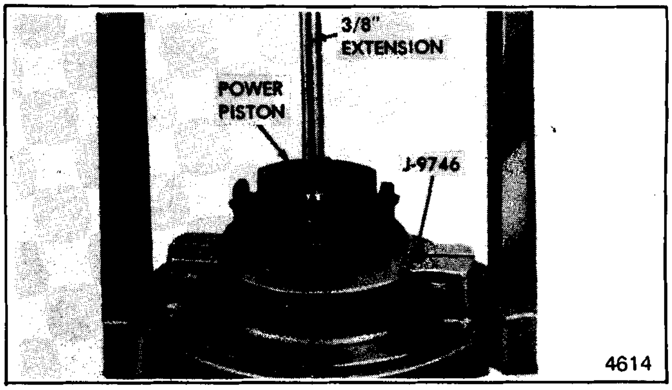


Fig. 5-95 Removing Air Valve Assembly

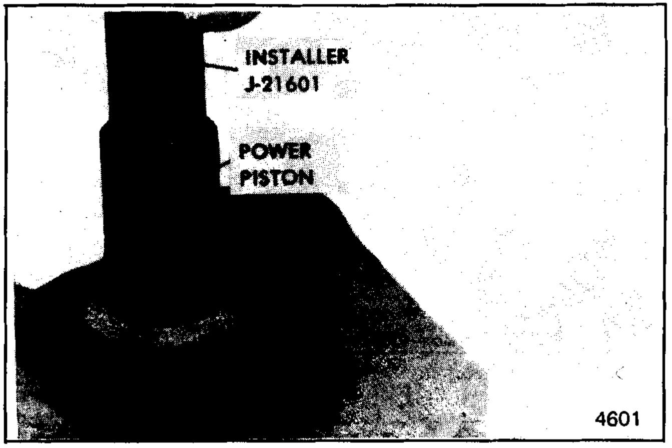


Fig. 5-96 Installing Floating Control Valve Assembly

14. With power piston still positioned on holding tool in vise, coat bead of diaphragm that contacts power piston with Power Brake Lube.
15. Holding support plate by metal, with locking tangs down, place support plate and diaphragm assembly over tube of power piston. The flange of diaphragm will fit into groove on power piston. See Fig. 5-97.
16. Press down and rotate support plate clockwise, until lugs on power piston come against stops on support plate. See Fig. 5-97.
17. This assembly can now be turned over and placed, tube down, in a tool, fabricated from a piece of wood, 2" x 4" x 8" long with a 1-3/8" hole in the center, clamped in a vise.
18. With a pair of No. 22 Truare or J 4880 Pliers, assemble snap ring into groove in air valve.
19. Place air valve spring retainer on snap ring. Assemble reaction bumper into groove in end of air valve.
20. Position air valve return spring, large end down, on spring retainer.
21. The three reaction levers are now placed into position with ears on wide end in slots in power piston. The narrow ends will rest on top of air valve return spring.
22. Position reaction plate (with numbered side up) on top of reaction levers. Press down on plate until large ends of reaction levers pop up so plate rests flat on levers. Be sure reaction plate is centered.
23. Master cylinder piston rod and reaction retainer assembly is now assembled to the power piston.

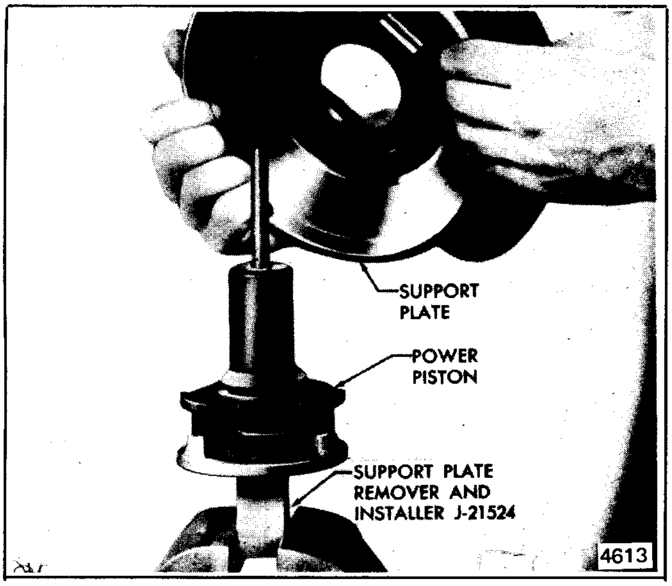


Fig. 5-97 Installing Power Piston into Support Plate

24. With round end of piston rod up, and with reaction retainer held toward top of piston rod, place small end of piston rod in hole in center of reaction plate. Line up ears on reaction retainer with notches in power piston and push reaction retainer down until ears seat in notches.

25. Maintain pressure on reaction retainer and position large lock ring down over master cylinder push rod.

26. There is a lug on the power piston which has a raised divider in the center. One end of lock ring goes under lug and on one side of divider.

27. As you work your way around power piston (either way), the lock ring goes over ear of reaction retainer, under a lug on power piston, and so forth, until other end of lock ring is seated under lug with raised divider.

Be sure both ends of lock ring are securely under large lug.

Assembly of Rear Housing Group

1. Place a new power piston bearing in center of rear housing so flange on center hole of housing fits into groove of power piston bearing. The large flange on power piston bearing will be on stud side of housing.

2. Coat inside of power piston bearing with Power Brake Lube.

Final Assembly of Power Brake Unit - X Car

1. Wipe power piston hub with power brake lube.

2. Push hub of power piston through rear housing seal.

3. Wipe O.D. of reaction retainer with power brake lube.

4. Place new front housing seal in center of front housing so that flat surface of cup lies against bottom of depression in housing.

5. Install new vacuum check valve grommet.

6. Attach Tool J 22805-01 to front housing. Lubricate I.D. of support plate seal with power brake lube.

7. Hold power piston return spring in position between front housing and power piston, then start front housing into final position with hands, making sure that scribe marks align on front and rear shells.

8. Insert square channel tube in end of tool J 22805-01 and using a crescent wrench, turn front housing clockwise until fully locked.

Final Assembly of Power Brake Unit All Except X Car

1. Place air silencer over holes on tube of power piston. Wipe tube of power piston with Power Brake Lube.

2. Assemble power piston to rear housing.

3. Wipe tube of reaction retainer with Power Brake Lube and lay assembly aside.

4. Place front housing in a vise. Position power piston return spring over inset in front housing. Lubricate the I.D. of support plate seal with Power Brake Lube.

5. Lightly lubricate beaded edge of diaphragm with Power Brake Lube. Hold rear housing and power piston assembly over front housing with master cylinder push rod down. Position rear housing so that when rotated into locked position, scribe marks on housings will be in line.

6. Using Holder J 22805-01 and Wrench J 9504-01 lock housings together. Do not break studs loose in rear housing or put pressure on power piston tube when locking housings.

7. Push felt silencer over push rod to seat against end of power piston tube. Snap ring retainer is now placed on push rod so it can hold silencer against power piston tube. Plastic boot is now pushed to seat against rear housing. Raised tabs on side of boot will locate in holes in center of brackets. The jam nut and clevis can now be reassembled to push rod.

GAGING OF DELCO MORAINE POWER BRAKE UNIT

The following gaging operation is necessary only when a major structural part such as front or rear housing, power piston assembly, master cylinder piston or master cylinder assembly is replaced with new part. The gauge measures how far the master cylinder push rod projects from front housing. This dimension must be correct to insure proper clearance in master cylinder between primary cup and compensating port.

Make check as follows:

1. Place gage over piston rod in a position which will allow gage to be slipped to left or right without contacting studs.

The center section of gage has two levels. The piston rod end should always touch the longer section gage which extends into front housing. The piston rod end should never touch the shorter section of gage. See Fig. 5-98.

2. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod, and adjusting the screw in end to match height of gage.

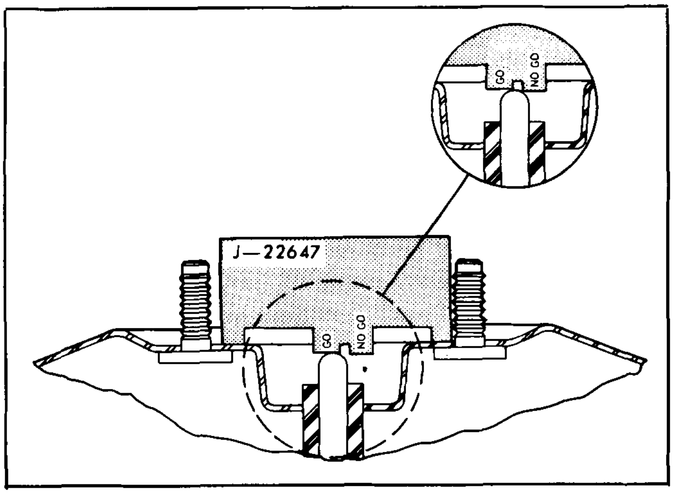


Fig. 5-98 Gaging Master Cylinder Push Rod

SPECIFICATIONS

B SERIES

APPLICATION	TORQUE
Bolt-Wheel Cylinder to Backing Plate (Rear)	14 1/2
Bolt and Nut-Rear Brake to Axle Housing	35
Screw-Wheel Cylinder Bleeder	100 lb. in max.
Bolt and Nut-Brake and Clutch Pedal Shaft	30
Nut-Brake and Clutch Pedal Mtg. Bracket to Dash	25
Bolt-Parking Brake Lever to Side Bracket	12
Panel	8
Nut-Parking Brake Lever to Dash	8
Nut-Brake Master Cylinder to Dash	25
Bolt-Parking Brake Rear Cable Anchor to Brake	25
Screw-Front Brake Hose Bracket to Frame	6
Screw-Rear Brake Hose Bracket to Axle Housing	8
Screw-Brake Pipe Distributor Block to Frame	13
Nut-Brake Pipe Connector	17

A, F AND G SERIES

APPLICATION	TORQUE
Rear Brake to axle Housing Bolt and Nut	35
Brake Master Cylinder to Dash Nut	25
Wheel Cylinder to Backing Plate Bolt	8
Wheel brake cylinder bleeder screw	100 lb. in. max.
Parking Brake Lever to Dash Nut	8
Parking Brake Front Cable to Equalizer Nut	6
Parking Brake Lever to Side Bracket Bolt	12
Screw-Front Brake Hose Bracket To Frame A, G	12
Screw-Front Brake Hose Bracket to Frame F	8
Screw-Rear Brake Hose Bracket to Axle Housing	8
Screw-Brake Pipe Distributor Block to Frame	13

X SERIES

APPLICATION	TORQUE
Front Brake to Steering Knuckle Lower Bolt	70
Front Brake to Steering Knuckle Upper Bolt	115
Rear Brake to Axle Housing Bolt	35
Master Cylinder to Dash	24
Wheel Cylinder to Backing Plate	50 in. lbs.
Bleeder Screws	100 lb. in. max.
Parking Brake Assembly to Dash	8
Parking Brake Cable to Equalizer	90 in. lbs.
Screw Brake Line to Frame	8
Combination Valve Mounting	13

POWER BRAKES

APPLICATION	TORQUE
Power Cylinder Housing to Master Cylinder Nuts	24 lb. ft.
Rear Housing to Pedal Bracket Nuts	24 lb. ft.
Push Rod Clevis	90 lb. in.
Power Cylinder to Master Cylinder Attaching Nuts	24 lb. ft.
Power Cylinder to Dash Attaching Nuts	24 lb. ft.

DISC BRAKES

APPLICATION	TORQUE
Bolt-Caliper to Mounting Bracket or Steering Knuckle	35 lb. ft.
Bolt-Splash Shield to Steering Knuckle	12 lb. ft.
Screw-Caliper Bleeder	65 lb. in.

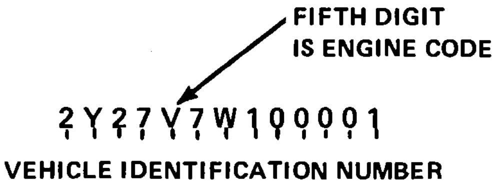
SECTION 6

ENGINE

CONTENTS OF THIS SECTION

ENGINE IDENTIFICATION CODES

Throughout this section, engines will be identified by the vehicle identification code letter, as well as the size and type. The fifth digit of the vehicle identification number is the engine code designator.



CODE	TYPE	DISP.	MECHANICAL SECTION
B	L-4	140	6A1
V	L-4	151	6A2
C	V-6	231	6A3
R	V-8	350	6A4
P	V-8	350	6A5
Y	V-8	301	6A5
K	V-8	403	6A4
Z	V-8	400	6A5
U	V-8	305	6A6
L	V-8	350	6A6

3516

Fig. 6-1 VI Illustration

Engine build code locations are as follows:

ENGINE	LOCATIONS
140 L4 Codes A-B	Machined pad on the right side of the block at the head parting line.
151 L4 Code V	Distributor mounting pad.
231 V6 Code C	Machined surface on the front of the block below right cylinder head.
301-350-400 V8 Codes Y-P-Z	Machined surface on the front of the block below right cylinder head.
350-403 V8 Codes R-K	On the oil fill tube.
305-350 V8 Codes U-L	Machined surface on the front of the block below right cylinder head.

NOTE: Engine codes may also be obtained from the scanner labels located on the covers of most V8 and V6 engines.

See Figs. 6-2 and 6-3.

ENGINE PERFORMANCE DIAGNOSIS

INTRODUCTION

Engine Performance Diagnosis procedures are guides that will lead to the most probable causes of engine performance complaints. They consider all of the components of the fuel, ignition, and mechanical systems that could cause a particular complaint, and then outline repairs in a logical sequence.

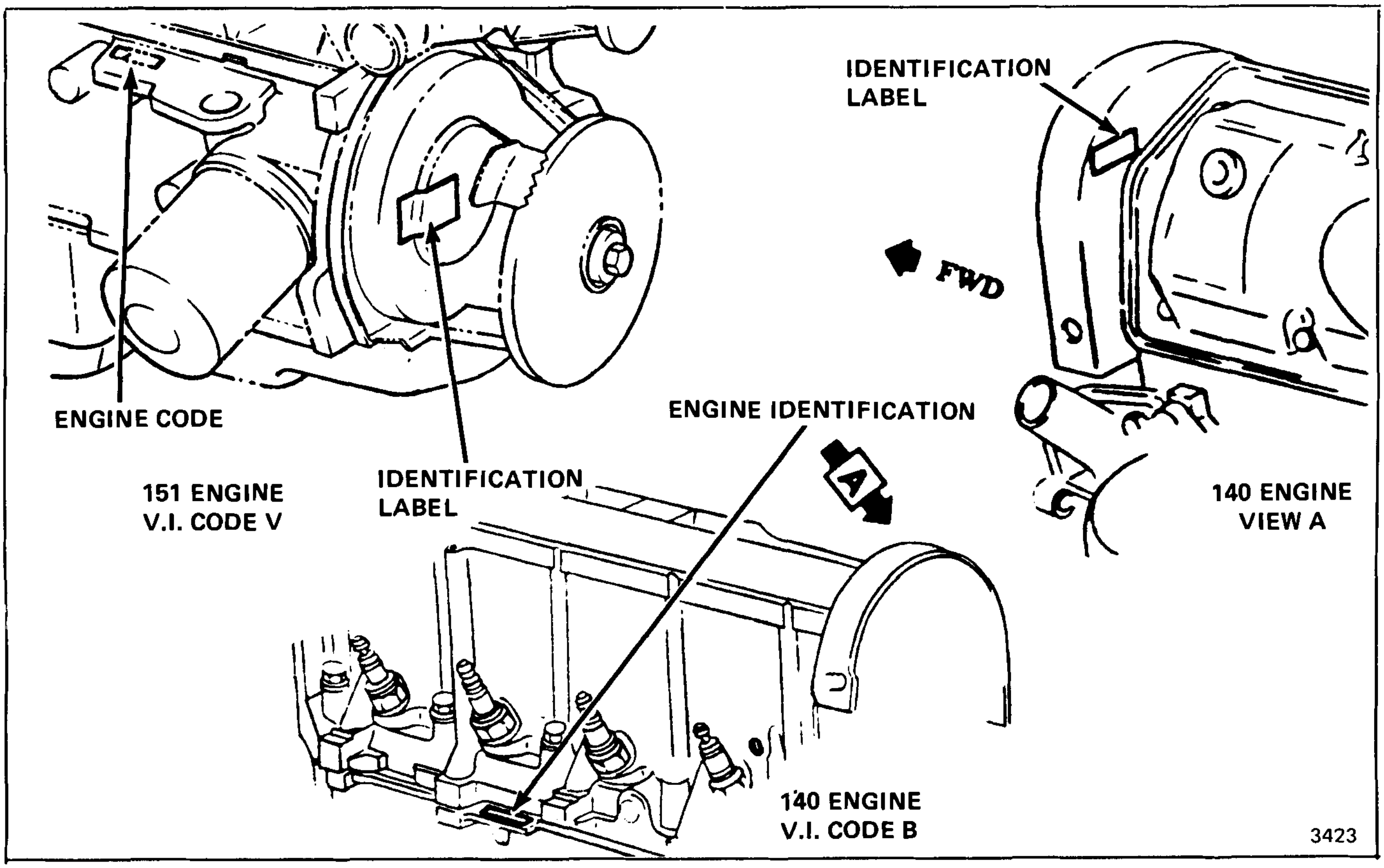


Fig. 6-2 Engine Code Locations 4 Cyl.

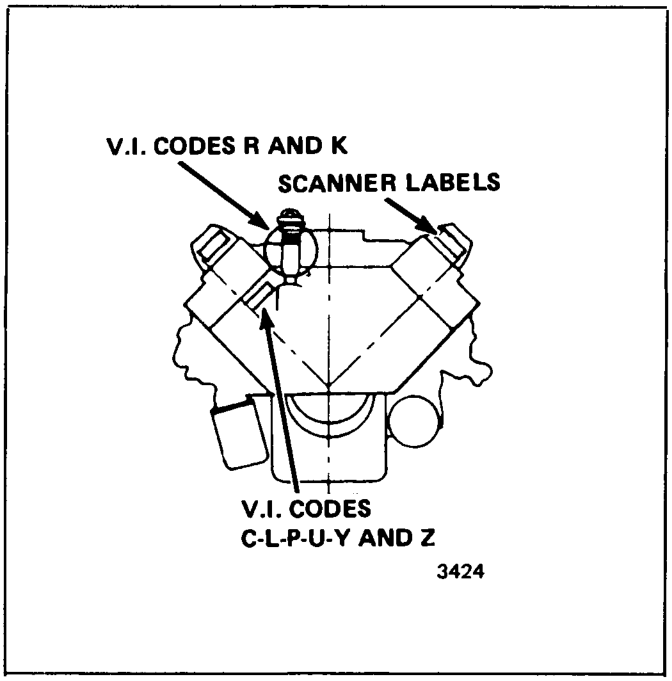


Fig. 6-3 Engine Code Locations V6 and V8

The procedures are based on Symptoms that are listed in the Table of Contents.

Each Symptom is defined, and it is vital that the correct one be selected based on the complaints reported or found.

Review the Symptoms and their definition to be sure that only the correct terms are used.

The words used may not be what you are used to in all cases, but because these terms have been used interchangeably for so long, it was necessary to decide on the most common usage and then define them. If the definition is not understood, and the exact Symptom is not used, the Diagnostic procedure will not work.

It is important to keep two facts in mind:

1. The procedures are written to diagnose problems on cars that have "run well at one time" and that time and wear have created the condition.

2. All possible causes cannot be covered, particularly with regard to emission controls that affect vacuum advance. If doing the work prescribed does not correct the complaint, then either the wrong Symptom was used or a more detailed analysis will have to be made.

All of the Symptoms can be caused by worn out or defective parts such as Spark Plugs, Ignition Wiring, etc. If time and/or mileage indicate that parts should be replaced, it is recommended that it be done.

SYMPTOM	DEFINITION
A. Dieseling	Engine continues to run after the switch is turned off. It runs unevenly and makes knocking noises.
B. Detonation	A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.
C. Stalls	The engine quits running. It may be at idle or while driving.
C. Rough Idle	The engine runs unevenly at idle. If bad enough, it may make the car shake.
D. Miss	Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. Not nromally felt above 1500 rpm or 30 mph. The exhaust has a steady spitting sound at idle or low speed.
E. Hesitates	Momentary lack of response as the accelerator is depressed. Can occur at all car speeds. Usually most severe when first trying to make the car move, as from a stop sign. May cause the engine to stall if severe enough.
F. Surges	Engine Power variation under steady throttle or cruise. Feels like the car speeds up and slows down with no change in the accelerator pedal.
G. Sluggish	Engine delivers limited power under load or at high speed. Won't accelerate as fast as normal; loses too much speed going up hills, or has less top speed than normal.
G. Spongy	Less than the anticipated response to incresed throttle opening. Little or no increase in speed when the accelerator pedal is pushed down a little to increase cruising speed. Continuing to push the pedal down will finally give an increase in speed.
H. Poor Gas Mileage	Self describing.
I. Cuts Out	Temporary complete loss of power. The engine quits at sharp, irregular intervals. May occur repeatedly, or intermittently. Usually worse under heavy acceleration.
J. Hard Start - Cold	Self describing
K. Hard Start - Hot	Self Describing

ENGINE PERFORMANCE DIAGNOSIS

A. Dieseling	1. Make visual checks of the following for sticking. a. Carburetor, choke, and throttle linkage b. Fast idle cam See cleaning, inspection, and adjustment of carburetor, Section 6C. 2. Check and reset ignition timing, idle, rpm and check idle solenoid for proper operation. Refer to emission label. 3. Remove carbon with top engine cleaner. Follow instructions on can. If condition still exists, suggest that owner try different gasoline.
B. Detonation	1. Check for obvious overheating problems. a. Low coolant b. Loose fan belt c. Restricted air flow, etc. 2. Check ignition timing per emission control information label. NOTE: If timing is too early - speed up engine to see if timing mark moves. If not, check for stuck mechanical advance. Refer to Section 6D. Repair as necessary and recheck timing. 3. Remove carbon with top engine cleaner. Follow instructions on can. If condition still exists, suggest that owner try different gasoline.

C. Stalls or Rough Idle - Cold	1. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close it if engine is too warm. If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor. 2. Visually check the following: a. Hot air tube to air cleaner connection and condition of hot air stove. b. Vacuum hoses for splits, kinks and proper connections. Se Hose Routing charts, Section 6E. c. Air leaks at carburetor mounting and intake manifold. d. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary. 3. Check the following for sticking: a. Carburetor, choke, and throttle linkage. b. Fast idle cam. c. Carburetor flooding. See cleaning, inspection and adjustment of carburetor, Section 6C. 4. With engine running, visually check vacuum break linkage for movement while removing and reinstalling vacuum hose. If the linkage does not move and vacuum is at hose, replace vacuum break assembly. 5. With engine off, check all choke adjustments. See Section 6C. 6. Check engine timing and idle speed. See emission control information label. 7. Remove vacuum hose from E.H.R. valve and connect an extra hose from any manifold vacuum source to valve. If rpm doesn't drop, valve is leaking. See E.G.R. Section 6E for further functional tests, cleaning, and/or replacement. 8. Check E.F.E. valve. Disconnect E.F.E. hose from tube and connect an extra vacuum hose from any manifold vacuum source to E.F.E. tube. Observe actuator linkage for movement. If no movement, repair as necessary. Refer to Section 6E for further test and/or repair.

D. Stalls or Rough Idle - Hot	1. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be open. If closed and engine is hot, check temperature operation of sensor unit. See air cleaner temperature test, Section 6E. 2. Visually check the following: a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Section 6E. b. Air leaks at carburetor mounting and intake manifold. c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary. 3. Check engine timing and idle speed. See emission control information label. 4. Check P.C.V. valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve. 5. Remove vacuum hose from E.G.R. valve and connect an extra hose from any manifold source to valve. If rpm doesn't drop, valve is leaking. See E.G.R. Section 6E for further functional tests, cleaning and/or replacement. 6. Adjust carburetor idle speed and mixture screws. Refer to emission control information label for idle speed. If idle mixture adjustment is necessary-refer to carburetor adjustment at the end of Section 6C. 7. Remove carbon with top engine cleaner. Follow instructions on can. If idle is still rough, run a cylinder compression check.

E. Miss

1. Visually check the following:
a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Section 6E.
b. Air leaks at curburetor mounting and intake manifold.
c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.
2. Disconnect air cleaner and E.G.R. vacuum hoses and cap both vacuum sources.
3. Remove one spark plug wire at a time with insulated pliers. If there is an rpm drop on all cylinders, go to rough idle (hot) diagnosis charts.
4. If there is no rpm drop on one or more cylinders, remove spark plug(s) and check for:
A. Cracks
B. Wear
C. Improper gap
D. Burned Electrodes
E. Heavy Deposits
Repair or replace as necessary.
5. Check spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 50,000 ohms, replace wire(s).
6. Visually check distributor cap and rotor for moisture, dust, cracks, carbon tracks, burns, etc. Clean and/or repair as necessary.
7. Perform compression check on questionable cylinder(s). If compression is low, repair as necessary.
8. Remove rocker covers. Check for bent push rods, worn rocker arms, broken valve springs, worn cam shaft lobes. Repair as necessary.

F. Hesitates	1. Visually check the following: a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Section 6E. b. Air leaks at carburetor mounting and intake manifold. c. Check ignition wires for cracking, hardness and proper connections. Repair and replace as necessary. 2. Note: Cold Engine Only Check the following for sticking or faulty operation: a. Carburetor, choke, and throttle linkage. b. Fast idle cam. See cleaning, inspection and adjustment of carburetor, Section 6C. 3. Check carburetor accelerator pump operation. With air cleaner removed and engine off, hold choke valve open and look for gas squirt in carburetor bore while moving throttle. If weak or no pump squirt, check and adjust the following. Pump rod adjustment, see Carburetor Adjustment Section 6C. 4. If no pump squirt, remove carburetor air horn and repair pump system as necessary. See air horn removal, cleaning and inspection, Section 6C for proper procedures. Check float level adjustment before replacing air horn and pump rod adjustment after assembly. See Float Adjustment, Section 6C. 5. Disconnect and plug vacuum advance hose, connect tachometer and timing light. Set ignition timing and idle speed to specs on emission label. 6. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close if engine is too warm. If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor.

G. Surges

1. With engine running, remove air cleaner cover and filter. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close if engine is too warm.
2. Visually check the following:
a. Vacuum hoses for plits, kinks and proper connections. See hose routing charts, Section 6E.
b. Air leaks at carburetor mounting and intake manifold.
c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary.
3. Check ignition timing per emission control information label. Vacuum advance hose should be disconnected and plugged.
NOTE: To check mechanical advance, observe timing marks. It should advance as throttle is opened and return to mark as throttle is closed.
4. With engine off, remove vacuum hose from distributor vacuum advance. Connect vacuum pump and apply 15" vacuum. Vacuum should hold steady for 15 seconds. If vacuum drops, replace vacuum advance unit.
5. Check carburetor fuel inlet filter. Replace if dirty or plugged.
6. Test fuel pump by connectning hose from carburetor fuel feed line to a suitable container.
Start engine and let idle for 15 seconds.
a. Mechanical pump should supply 1/2 pint or more. If not, go to step 7. If OK, go to step 9.
b. If electric pump supplies less than 1/2 pint, check fuel lines to tank for kinks or dirt. If OK, go to step 9.
NOTE: Check electric supply to pump. If less than 12.2 volts, check pump wiring circuit. See Section 6C.
7. To check mechanical fuel pump, disconnect inlet hose at pump and connect a vacuum gage. Crank or run engine until maximum vacuum is reached. If less than 12 inches, replace pump. If vacuum reading is 12 inches or more, go to step 8.
8. Check fule lines and hoses for splits, leaks or kinks by disconnecting each section of line and connect vacuum gage. Crank or run engine until vacuum gage peaks. Vacuum should be at least 12 inches. If less, repair or replace defective line or hose.
9. If fuel lines and pump check OK, remove tank unit, replace strainer and clean fuel tank, if necessary.
10. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes,

	wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary. 11. Remove carburetor, clean and adjust. See carburetor Section 6C.
H. Sluggish or Spongy	1. Remove air cleaner and check air filter for dirt or being plugged. Replace as necessary. 2. With engine running, damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close if engine is too warm. If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor. 3. Check ignition timing per emission label. Disconnect and plug vacuum advance hose. NOTE: To check mechanical advance, observe timing marks. It should advance as throttle is closed. 4. Remove air cleaner and check for full throttle valve opening in carburetor by depressing accelerator pedal to floor; also check for full choke valve opening and free operating air valve (if equipped). Repair as necessary. See carburetor cleaning and inspection, Section 6C. 5. Remove vacuum hose from E.G.R. valve and connect an extra hose from any manifold vacuum source to valve. If rpm doesn't drop, valve is leaking. See E.G.R. Section 6E for further functional tests, cleaning, and and/or replacement. 6. With engine off, remove vacuum hose from distributor vacuum advance. Connect vacuum pump and apply 15" vacuum. Vacuum should hold steady for 15 seconds. If vacuum drops, replace vacuum advance unit. 7. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary. 8. Remove carburetor air horn and check the following: a. Power piston for freeness b. Dirt in carburetor c. Float adjustment d. Metering rods e. Power valve(s) Refer to carburetor cleaning and inspection, Section 6C.

I. Poor Gasoline Mileage	1. Wih engine running, remove air cleaner cover and filter. Check filter for dirt or being plugged. Replace as necessary. Damper door in air cleaner snorkel should be closed when engine is cold. It may be necessary to place cold wet rag over sensor to close it if engine is too warm. If damper door does not close, apply vacuum directly to vacuum motor. If door closes, replace sensor. If door stays open, replace vacuum motor. 2. Visually check the following: a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Section 6E. b. Air leaks at carburetor mounting and intake manifold. c. Ignition wires for cracking, hardness and proper connections. Repair or replace as necessary. 3. Check ignition timing per emission control information label. Disconnect and plug vacuum advance hose. NOTE: To check mechanical advance, observe timing mark. It should advance as throttle is opened and return to mark as throttle is closed. 4. Check carburetor choke linkage and settings. Clean and repair as necessary. See carubretor choke adjustments, cleaning and inspection, Section 6C. 5. With engine off, remove vacuum hose from distributor vacuum advance. Connect vacuum pump and apply 15″ vacuum. Vacuum should hold steady for 15 seconds. If vacuum drops, replace vacuum advance unit. 6. Remove spark plugs, check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary. 7. If in previous checks, adjustments have not been made that could improve mileage, remove carburetor air horn and check the following: a. Power piston for freeness b. Dirt in jets and metering passages c. Metering rods d. Power valve(s) e. Float adjustment See carburetor cleaning, inspection, and adjustments, Section 6C. 8. Suggest owner fill tank and recheck mileage.

J. Cuts Out

1. Check ignition wires, boots, cap and coil for:
a. Damage
b. Deterioration
c. Loose connections
d. Carbon tracking
Clean, tighten and/or replace defective parts as necessary.
2. Connect secondary voltage output meter or scope to engine.
Using insulated pliers, check output as each spark plug wire is removed output voltage should read:
a. 25 KV or above
b. No arcing should occur
If any reading is below specification or arcing occurs, with engine off, remove distributor cap and visually inspect for moisture, dust, cracks, burns, etc.
Check distributor for:
a. Worn shaft
b. Bare or shorted wires
c. Faulty pick up coil, module, ignition coil, and condenser. Repair or replace defective parts as necessary.
3. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.
4. Check carburetor fuel inlet filter.
Replace if dirty or plugged.
5. Test fuel pump by connecting hose from carburetor fuel feed line to a suitable container.
Start engine and let idle for 15 seconds.
a. Mechanical pump should supply 1/2 pint or more. If not, go to step 7.
b. If electric pump supplies less than 1/2 pint, check fuel lines to tank for kinks or dirt. If OK, go to step 8.
NOTE: Check electric supply to pump. If less than 12.2 volts, check pump wiring circuit. See Section 6C.
6. To check mechanical fule pump, disconnect inlet hose at pump and connect a vacuum gage. Crank or run engine until maximum vacuum is reached. If less than 12 inches, replace pump. If vacuum reading is 12 inches or more, go to step 8.
7. Check fuel lines and hoses for splits, leaks or kinks by disconnecting each section of line and connecting a vacuum gage. Crank or run engine until vacuum gage peaks. Vacuum should be at least 12 inches. If less, repair or replace defective line or hose as necessary.
8. If fuel pump and fuel lines check OK, remove tank unit, replace strainer and clean fuel tank, if necessary.

K. Hard Starting - Cold (Engine Cranks OK)	1. Visually check the following: a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Section 6E. b. Air leaks at carburetor mounting and intake manifold. c. Ignition wires for cracking, hardness, proper connections, and carbon tracking. Repair or replace as necessary. 2. Check ignition timing per emission control information label. NOTE: If timing is too early - speed up engine to see if timing mark moves. If not, check for stuck mechanical advance. Refer to Section 6D. Repair as necessary and recheck timing. 3. Check the following: a. Choke, throttle linkage and fast idle cam for sticking. b. Carburetor flooding. Clean and repair as necessary. If repairs are necessary, see carburetor, cleaning and inspection, Section 6C. 4. Connect secondary voltage output meter or scope to engine. Using insulated pliers, check output with spark plug wire removed. Output voltage should read 25 KV or above. If any reading is below speicifcations or arcing occurs, stop engine, remove distributor cap and visually inspect for moisture, dust, cracks, burns, etc. Check distributor for: a. Worn shaft b. Bare and shorted wires c. Faulty pick up coil, module, ignition coil and shorted condenser. Repair or replace as necessary. 5. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary. 6. Test fuel pump by connecting hose from carburetor fuel feed line to a suitable container. Start engine and let idle for 15 seconds. Pump should supply 1/2 pint or more. If more than 1/2 pint, check filter in carburetor. Replace if necessary. If less than 1/2 pint, for mechanical pump go to step 7. Go to step 9 for electric pump. NOTE: Check current to electric pump. If less than 12.2 volts, check pump wiring circuit. See Section 6C. 7. Disconnect inlet hose at pump and connect a vacuum gage. Crank or run engine until maximum vacuum is reached. If less than 12 inches, replace pump. If more than 12 inches, go to step 8.

	8. Check fuel lines and hoses for splits, leaks or kinks by disconnecting each section of line and connect vacuum gage. Crank or run engine until vacuum gage peaks. Vacuum should be at least 12 inches. If less, repair or replace defective line or hose. 9. If fuel lines and pump check OK, remove tank unit, replace strainer and clean fuel tank, if necessary.
L. Hard Starting - Hot (Engine cranks OK)	1. Visually check the following: a. Vacuum hoses for splits, kinks and proper connections. See hose routing charts, Section 6E. b. Air leaks at carburetor mounting and intake manifold. c. Ignition wires for cracking, hardness, proper connections, and carbon tracking. Repair or replace as necessary. 2. Check ignition timing per emission control information label. NOTE: If timing is too early - speed up engine to see if timing mark moves. If not, check for stuck mechanical advance. Refer to Section 6D. Repair as necessary and recheck timing. 3. Check the following: a. Choke, throttle linkage and fast idle cam for sticking. b. Carburetor flooding. Clean and repair as necessary. If repairs are necessary, see carburetor, cleaning and inspection, Section 6C. 4. Connect secondary voltage output meter or scope to engine. Using insulated pliers, check output with spark plug wire removed. Output voltage should read 25 KV or above. If any reading is below specifications or arcing occurs, turn off engine, remove distributor cap and visually inspect for dust, cracks, burns, etc. Check distributor for: a. Worn shaft b. Bare and shorted wires c. Faulty pick up coil, module, ignition coil, and shorted condenser. Repair or replace as necessary. 5. Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary. 6. Also check steps 6, 7, 8, 9 - Hard Starting - Cold.

SECTION 6A

ENGINE MECHANICAL

L-4, V6 AND V8 ENGINES

CONTENTS OF THIS SECTION

GENERAL INFORMATION

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten thousands of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

GENERAL INFORMATION ON ENGINE SERVICE

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen resulting in a damaged oil pick-up unit.

It should be kept in mind, while working on the engine, that the 12-volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.

Any time the carburetor or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

IN THE MECHANICAL PROCEDURES DESCRIBED IN THIS SECTION, GENERALLY NO REFERENCES WILL BE MADE TO THE REMOVAL OF OPTIONAL EQUIPMENT SUCH AS POWER STEERING PUMP, AIR CONDITIONING COMPRESSOR, ETC.

SHOULD IT BECOME NECESSARY TO REMOVE ANY SUCH ITEM TO PERFORM OTHER SERVICE, REFER TO THE APPROPRIATE SECTION OF THIS SERVICE MANUAL FOR SPECIFIC INFORMATION.

TROUBLE DIAGNOSIS

The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made, the problem should be corrected by adjustment, repair or part replacement as required. Refer to the appropriate section of the manual for these procedures.

ENGINE MECHANICAL DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Oil Loss	a. External oil leaks.	1. Tighten bolts and/or replace gaskets and seals as necessary.
	b. Improper reading of dipstick.	1. Check oil with car on a level surface and allow adequate drain down time. NOTE: On 140 L-4 engines, oil check should be made 30 minutes after hot shut off.
	c. Improper oil viscosity.	1. Use recommended S.A.E. viscosity for prevailing temperatures.
	d. Continuous high speed driving and/or severe usage such as trailer hauling.	1. Continuous high speed operation and/or severe usage will normally cause decreased oil mileage.
	e. P.C.V. system malfunctioning.	1. Service as necessary.
	f. Valve guides and/or valve stem seals worn.	1. Ream guides and install oversize service valves and/or new valve stem seals.
	g. Piston rings not seated, broken or worn.	1. Allow adequate time for rings to seat. 2. Replace broken or worn rings as necessary.
Low Oil Pressure	a. Incorrect or malfunctioning oil pressure switch.	1. Replace with proper switch.
	b. Slow idle speed.	1. Set idle speed to spec.
	c. Improper oil viscosity or diluted oil.	1. Install oil of proper viscosity for expected temperature. 2. Install new oil if diluted with moisture or unburned fuel mixtures.
	d. Oil pump worn or dirty.	1. Clean pump and replace worn parts as necessary.
	e. Plugged oil filter.	1. Replace filter and oil.
	f. Oil pickup screen loose or plugged.	1. Clean or replace screen as necessary.
	g. Hole in oil pickup tube.	1. Replace tube.
	h. Excessive bearing clearance.	1. Replace as necessary.
	i. Cracked or porous oil galleys.	1. Repair or replace block.
	j. Poor seal at timing cover gasket (231 engine only).	1. Replace gasket.

Valve Train Noise	a. Low oil pressure.	1. Repair as necessary. (See diagnosis for low oil pressure.)
	b. Loose rocker arm attachments.	1. Inspect and repair as necessary.
	c. Worn rocker arm and/or pushrod.	1. Replace as necessary.
	d. Broken valve spring.	1. Replace spring.
	e. Sticking valves.	1. Free valves.
	f. Lifters worn, dirty or defective.	1. Clean, inspect, test and replace as necessary.
	g. Camshaft worn or poor machining.	1. Replace camshaft.
	h. Worn valve guides.	1. Repair as necessary.

ENGINE KNOCK DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
a. Engine knocks cold and continues for two to three minutes. Knock increases with torque.	1. EFE equipped engines may have valve knock.	1. Replace EFE valve.
	2. Flywheel contacting splash shield.	2. Reposition splash shield.
	3. Loose or broken balancer or drive pulleys.	3. Tighten or replace as necessary.
	4. Excessive piston to bore clearance.[1]	4. Replace piston.
b. Engine has heavy knock hot with torque applied.	1. Broken balancer or pulley hub.	1. Replace parts as necessary.
	2. Loose torque converter bolts.	2. Tighten bolts.
	3. Accessory belts too tight or nicked.	3. Replace and/or tension to specs as necessary.
	4. Exhaust system grounded.	4. Reposition as necessary.
	5. Excessive main bearings clearance.	5. Replace as necessary.
c. Engine has light knock hot in light load conditions.	1. Detonation or spark knock.	1. Check ignition timing and fuel quality.
	2. Loose torque converter bolts.	2. Tighten bolts.
	3. Exhaust leak at manifold.	3. Tighten bolts and/or replace gasket.
	4. Excessive rod bearing clearance.	4. Replace bearings as necessary.

d. Engine knocks on initial start up but only lasts a few seconds.	1. Fuel pump.	1. Replace pump.
	2. Improper oil viscosity.	2. Install proper oil viscosity for expected temperatures.
	3. Hydraulic lifter bleed down.[2]	3. Clean, test and replace as necessary.
	4. Excessive crankshaft end clearance.	4. Replace crankshaft thrust bearing.
e. Engine knocks at idle hot.	1. Loose or worn drive belts.	1. Tension and/or replace as necessary.
	2. Compressor or generator bearing.	2. Replace as necessary.
	3. Fuel pump.	3. Replace pump.
	4. Valve train.	4. Replace parts as necessary.
	5. Improper oil viscosity.	5. Install proper viscosity oil for expected temperature.
	6. Excessive piston pin clearance.	6. Ream and install oversize pins.
	7. Connecting rod alignment.	7. Check and replace rods as necessary.
	8. Insufficient piston to bore clearance.	8. Hone and fit new piston.

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[1] Cold engine piston knock usually disappears when the cylinder is grounded out. Cold engine piston knock which disappears in 1.5 minutes should be considered acceptable.

[2] When the engine is stopped, some valves will be open. Spring pressure against lifters will tend to bleed lifter down. Attempts to repair should be made only if the problem is consistent and appears each time engine is started.

SECTION 6A1

2.2 LITRE 140 CU. IN. ENGINE, VIN CODE - B

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

CYLINDER BLOCK (FIG. 6A1-1)

The cylinder block is made of cast aluminum and has four cylinders arranged in-line. The block is a high silicon content aluminum alloy throughout for exceptional wear characteristics. Five main bearings support the crankshaft which is retained by recessed bearing caps that are machined with the block for proper alignment and clearances.

CYLINDER HEAD

The cast iron cylinder head provides a compression ratio of 8.0:1. It is cast with idividual intake and exhaust ports for each cylinder. Valve guides are integral. A main head oil gallery runs along the right side of the head which supplies oil to the hydraulic lifters and to the camshaft bearings.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by five main bearings. Number four bearing is the thrust bearing. Main bearings are lubricated from oil holes which intersect the main oil gallery. The main oil gallery is rifle drilled down the left side of the block.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by five bearings. The camshaft is driven through a system of the sprockets and a fiberglass reinforced rubber timing belt by the crankshaft. The crankshaft sprocket is sintered iron and the camshaft sprocket is cast iron. The timing belt drive system also drives the water pump and fan. Camshaft bearings are lubricated through oil holes which intersect the main head oil gallery.

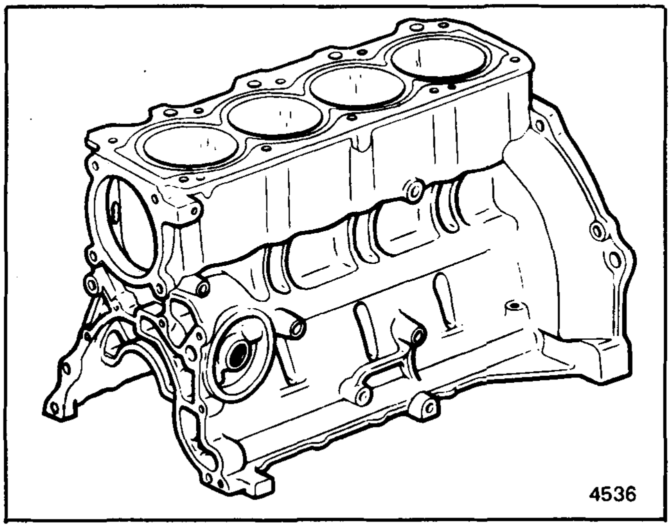


FIG. 6A1-1 CYLINDER BLOCK

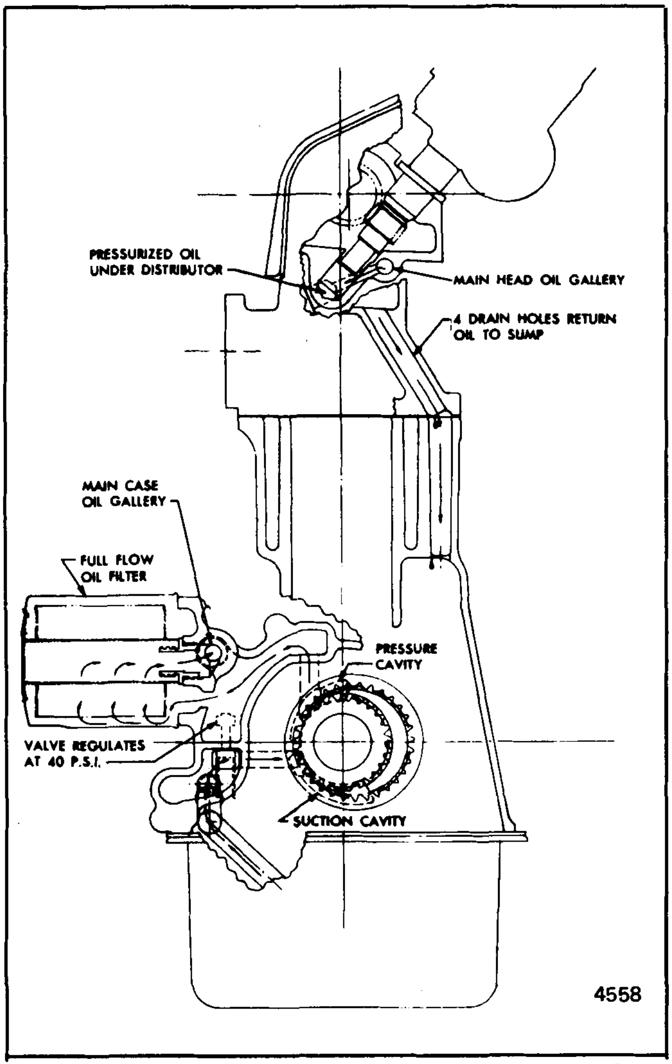


FIG. 6A1-2 OIL FILTER AND DISTRIBUTOR OILING

The main head oil gallery is rifle drilled down the right hand side of the head.

PISTONS AND CONNECTING RODS

The pistons are made of cast aluminum alloy having an outer iron coating of .0005" min. Two compression rings and one oil control ring are used for positive piston to wall sealing. Piston pins are offset 1/16" toward the thrust side (right hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Piston pins are Chromium steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit. Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maxium lubrication just prior to full bearing load.

VALVE TRAIN

An overhead cam, direct action design is used. Motion is transmitted from the camshaft through the hydraulic lifter to the valve.

HYDRAULIC VALVE LIFTERS

Hydarulic Valve Lifters are used to keep all parts of the valve train in constant contact. The hydraulic lifter assembly consists of: the lifter body, which rides in the cylinder head boss, a plunger, a metering valve, a plunger spring, a check ball and a check ball retainer. When the lifter is riding on the low point of the cam, the plunger spring and oil pressure keeps the plunger in contact with the valve stem. When the lifter body begins to ride up the cam lobe, the check ball cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then move as a unit, pushing the valve open. As the lifter body rides down the other side of the cam, the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the valve. The ball check valve will then move off its seat and its lifter reservoir will remain full.

INTAKE MANIFOLD

The intake manifold is of cast iron single level design for efficient fuel distribution. The carburetor pad is centrally located. An EGR port is also cast into the manifold for the induction of exhaust gases into the inducted fuel air mixture.

EXHAUST MANIFOLD

The cast iron exhaust manifold directs the exhaust gasses from the combustion chamber to the vehicle exhaust system. A sheet metal heat stove preheats the air drawn into the air cleaner during cold operation for better fuel vaporization.

COMBUSTION CHAMBERS

Combustion Chambers are cast to insure uniform shape for all cylinders. Spark plugs are located on the right hand side between the intake and exhaust valves.

ENGINE SERVICE

The following information is important in preventing engine damage and in contributing to reliable engine performance. When raising or supporting the engine for any

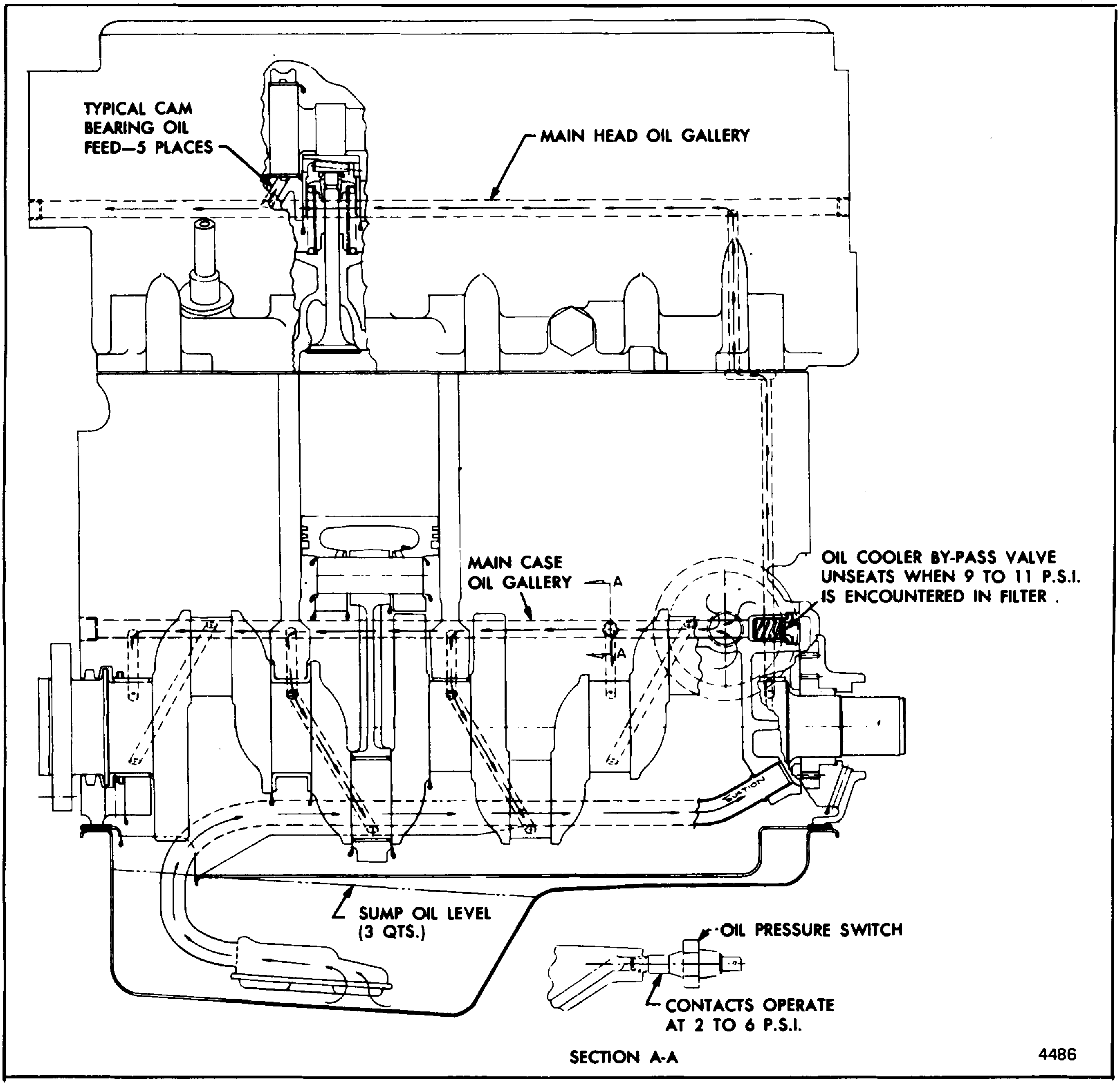


FIG. 6A1-3 MAIN OIL CIRCUIT

reason, do not use a jack under the oil pan or crankshaft pulley. Due to the small clearance between the oil pan and oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pick-up unit. It should be kept in mind, while working on the engine, that the 12-volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery. Any time the carburetor or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

ENGINE LUBRICATION

(Fig. 6A1-2, 6A1-3 and 6A1-4)

A crankshaft-driven, externally mounted, eccentric gear oil pump supplies the engine with controlled full pressure oil at 40-45 psi. Oil is taken from the top of the gear set through the high pressure side of the regulator valve and into the full-flow oil filter. Main and connecting rod bearings are oiled from the main gallery located along the left side of the block. Overhead oiling for camshaft and valve train is from the front main bearing, which acts as a metering device, through vertical passages in the block and head to the camshaft bearing gallery. Oil from the cam bearings lubricates the tappets and valve train. Four oil drain back passages are

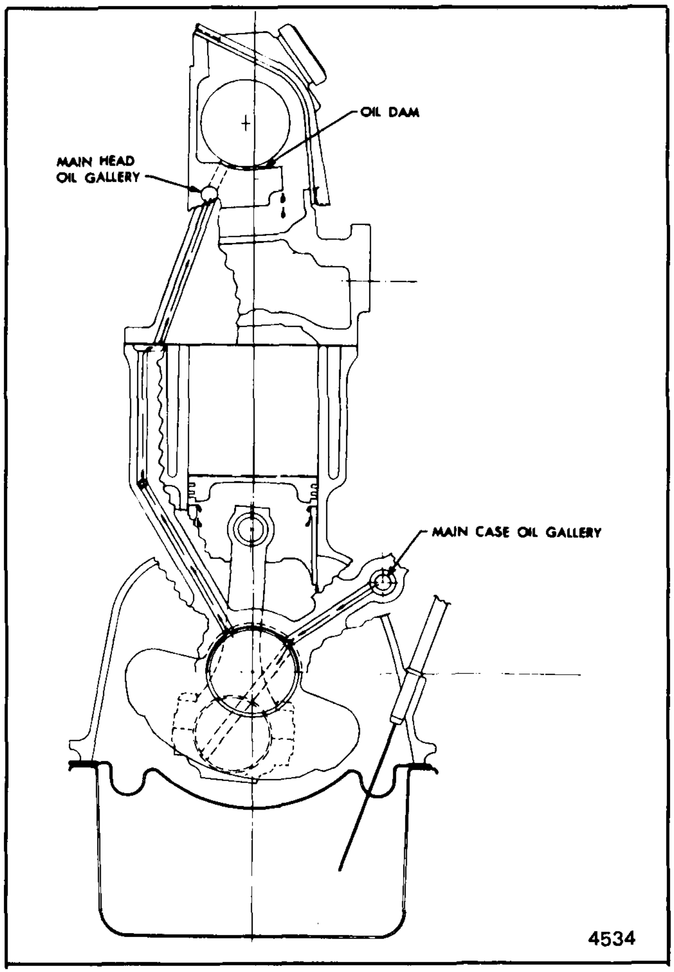


FIG. 6A1-4 BEARING OIL FEEDS

provided, one of which has a tubular extension to assure positive drain back directly to the sump.

ON CAR SERVICE

ENGINE FRONT COVER

Removal

1. Raise the hood.
2. Disconnect negative cable at battery.
3. Remove engine fan and spacer.
4. Remove accessory drive belts.
5. Remove the two cover lower screws, then remove the cover upper retaining screw, nut and cover.

Installation

1. Position the cover over water pump hub.
2. Position screw slots on lower portion of cover over screws and tighten loosely against cover.
3. Install the cover upper screw and nut; torque upper and lower screws to 50 lbs. in.
4. Install accessory drive belts and tighten to specification.
5. Install fan spacer and fan; torque bolts to 20 lbs. ft.
6. Connect battery negative cable.

ACCESSORY DRIVE PULLEY

Removal

1. Raise hood.
2. Disconnect negative cable at battery.
3. Loosen generator and air conditioning compressor and remove drive belts.
4. Remove crankshaft-to-pulley bolt; then remove four sprocket-to-pulley bolts. Remove pulley and washer.

Installation

1. Position pulley and washer to sprocket aligning tang on pulley with keyway on crankshaft.
2. Loosely install the four sprocket bolts; then install crankshaft bolt. Torque the four sprocket bolts to 15 lbs. ft. and the crankshaft bolt to 80 lbs. ft.
3. Install generator and air conditioning compressor belts and adjust belts to specifications.

4. Connect battery negative cable and close hood.

TIMING BELT AND WATER PUMP

Removal

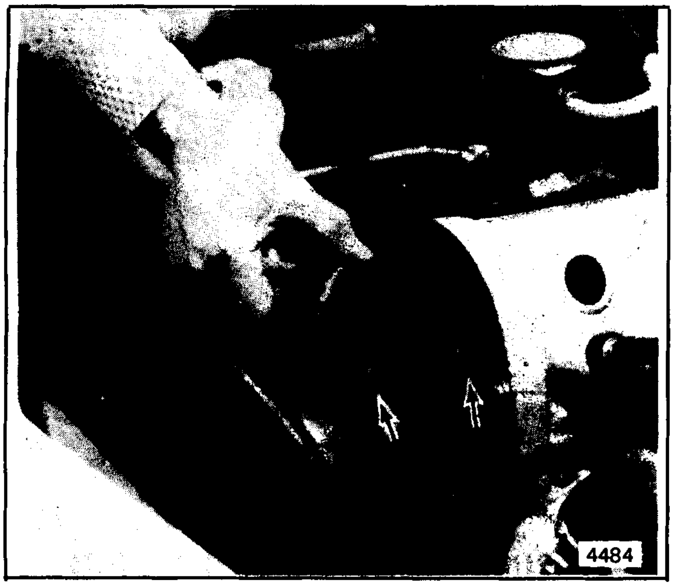


Fig. 6A1-5 Sprocket Alignment Marks

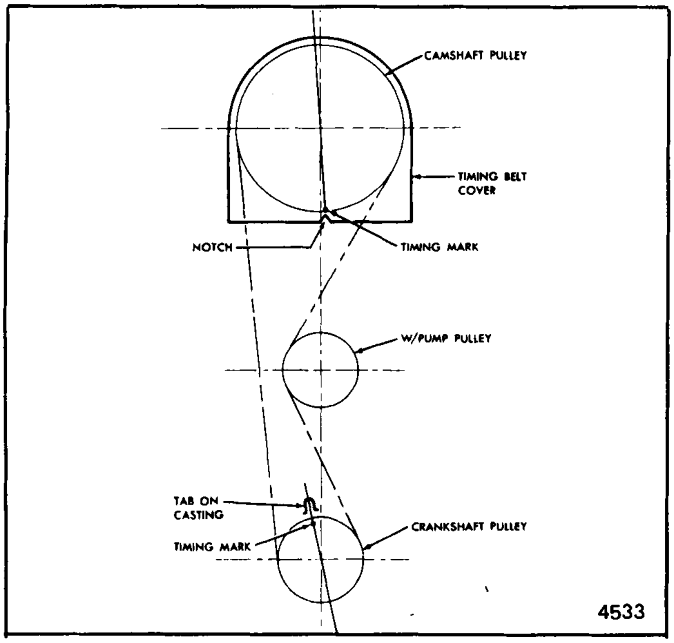


Fig. 6A1-6 Timing Sprocket Alignment Marks

1. Remove engine front cover and accessory drive pulley as previously outlined.

2. Drain engine coolant and loosen water pump bolts to relieve tension in timing belt.

3. Remove the timing belt lower cover; then remove timing belt from camshaft and crankshaft sprockets.

4. Disconnect water pump outlet hose, remove water pump retaining bolts and remove water pump.

Installation

1. Clean gasket surfaces and loosely install water pump, using a new gasket.

NOTE: Apply an approved anti-seize compound to the water pump retaining bolts before installing.

2. Align timing mark on cam sprocket with notch on timing belt upper cover (Fig. 6A1-5)

3. Align crankshaft sprocket timing mark with cast tag on oil pump cover. (Fig. 6A1-6).

4. Install timing belt on crankshaft sprocket; position back of belt in water pump track; then install belt to camshaft sprocket, making sure that both timing sprockets maintain their indexed positions.

5. Install timing belt lower cover. Adjust belt tension as described under "Timing Belt Adjustment".

6. Fill engine cooling system, install accessory drive pulley, adjust accessory drive belts to specifications and install engine front cover.

Checking Timing Belt Tension

Check timing belt for correct tension, using timing belt tension gage Tool J 26486 as follows:

1. Loosen (but do not remove) the two engine front cover lower screws; cover is slotted.

2. Remove the two cover upper retaining screws and position cover to one side to permit access to timing belt.

3. Position timing belt tension gage onto timing belt so that center prong is between cogs and feet of the gage are on grooved side of belt.

4. Press and release the gage rapidly while positioned on the belt until indicated tension value reading is constant.

NOTE: If gage reading does not fall within the listed operating range then readjust the timing belt to the adjustment specification.

5. Reinstall engine front cover.

TIMING BELT ADJUSTMENT

Proper belt tensioning is accomplished by use of a foot pound torque wrench and belt tension adapter Tool J 23654.

1. Drain cooling system to prevent loss of coolant as water pump is loosened in Step 4.

2. Remove engine fan and extension.

3. Remove engine front cover.

4. Loosen water pump retaining bolts.

5. Position Tool J 23654 in gage hole adjacent to left side of water pump (Fig. 6A1-8).

6. Apply 15 lbs. ft. of torque to water pump as shown in Figure 6A1-9. Tighten water pump bolts to 15 lbs. ft. while maintaining torque on side of pump.

7. Reinstall engine front cover, fan and extension, and fill cooling system.

CAMSHAFT TIMING SPROCKET

Removal

1. Disconnect negative cable at battery.

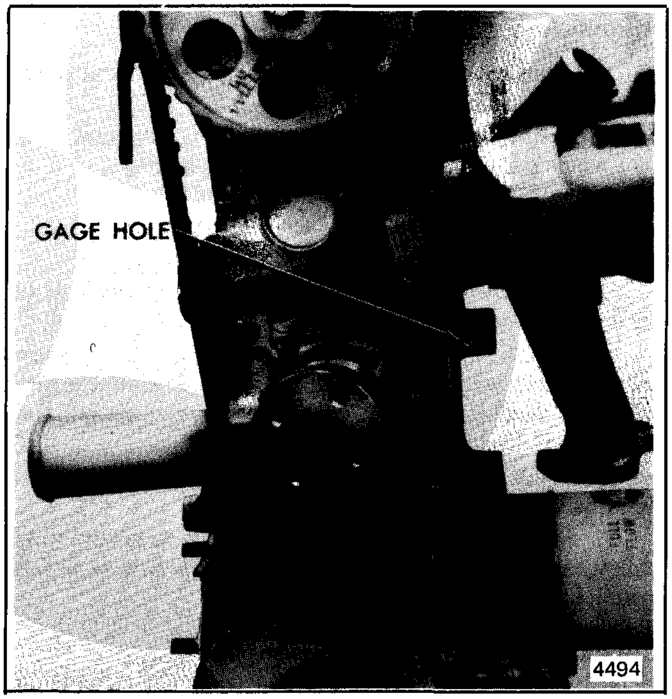


Fig. 6A1-8 Tension Adapter Locating Hole

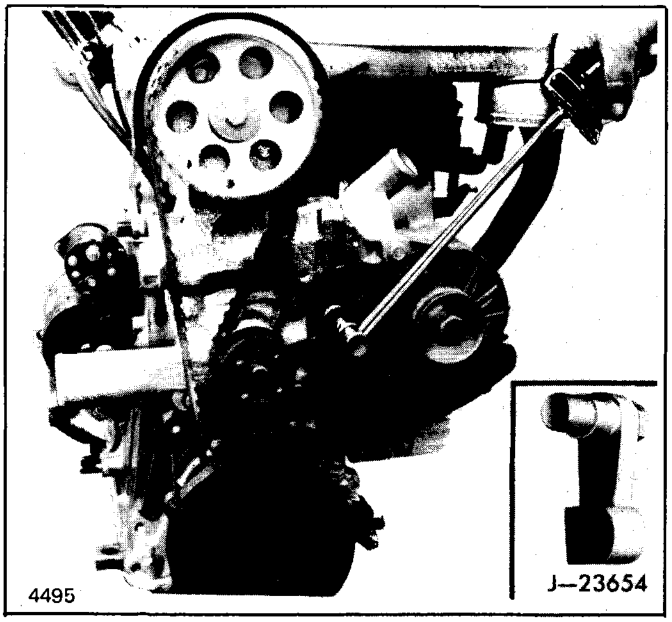


Fig. 6A1-9 Adjusting Timing Belt

2. Remove generator drive belt.

3. Remove upper timing belt cover bolts and pull cover forward (Fig. 6A1-10).

4. Remove camshaft sprocket and timing belt.

Installation

1. Install camshaft sprocket and timing belt as an assembly.

NOTE: Be sure alignment pin in camshaft sprocket corresponds to hole in camshaft hub. Inspect timing belt installation to be sure belt is in proper grooves in water pump.

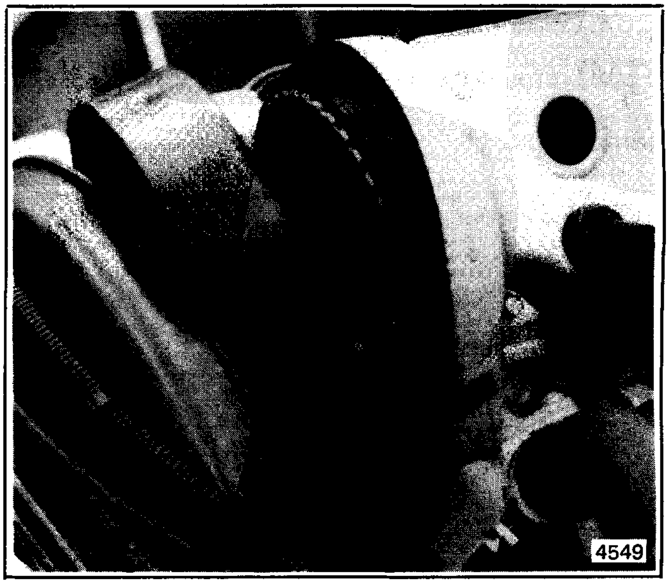


Fig. 6A1-10 Timing Belt Cover Pulled Forward

2. Install timing belt cover.

3. Install generator drive belt.

TIMING BELT COVER UPPER (CAMSHAFT)

Removal

1. Remove front cover, timing belt and camshaft timing sprocket as previously outlined.

2. Remove the three screws securing the camshaft seal and retainer assembly and timing cover to the cylinder head.

3. Examine seal to determine if it is good. If new seal is needed, pry it from retainer and install new seal using a flat plate to position seal flush with retainer.

Installation

1. Position and align a new gasket over end of camshaft and against cylinder head.

2. Install timing belt cover, seal and retainer assembly and retaining screws. Torque screws to 18 lbs. ft.

3. Install camshaft timing sprocket, timing belt and engine front cover as previously outlined.

LOWER (CRANKSHAFT)

Removal

1. Remove accessory drive pulley as previously outlined.

2. Remove the two screws retaining the engine front cover to the lower timing cover.

3. Remove the two bolts holding the timing cover to engine.

Installation

1. Install timing belt cover; torque bolts to 15 lbs. ft.

NOTE: Apply an approved anti-seize compound to the timing cover bolts before installation.

2. Install the two screws holding the front cover to the lower timing cover. Torque to 15 lbs. ft.

3. Install accessory drive pulley; install and adjust drive belts to specifications; then install engine front cover.

CRANKSHAFT TIMING SPROCKET

Removal

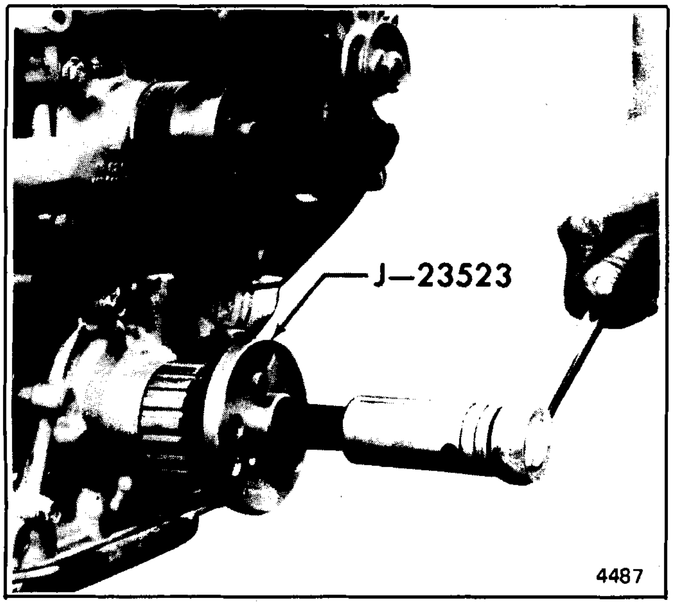


Fig. 6A1-12 Removing Crankshaft Sprocket

1. Remove engine front cover, accessory drive pulley, timing belt and timing belt lower cover.

2. Lubricate threads and tip of puller Tool J 23523 with a heavy body lubricant; then install puller to crankshaft sprocket.

3. Remove sprocket by turning puller screw of J 23523 to force sprocket from crankshaft (Fig. 6A1-12). Remove tool from sprocket.

Installation

1. Position sprocket on end of crankshaft, aligning keyway with key on crankshaft and making sure that timing mark on sprocket is facing outward.

2. Thread puller screw from Tool J 23624 into end of crankshaft. Pull sprocket onto crankshaft until flush with end by tightening nut against large washer and thrust bearing (Fig. 6A1-13).

3. Install timing belt (adjust tension), timing belt lower cover, accessory drive pulley and engine front cover.

OIL PUMP (CRANKCASE FRONT COVER) SEAL

Replacement

1. Remove engine front cover, accessory drive pulley, timing belt, timing belt lower cover and crankshaft timing sprocket as outlined in previous procedures.

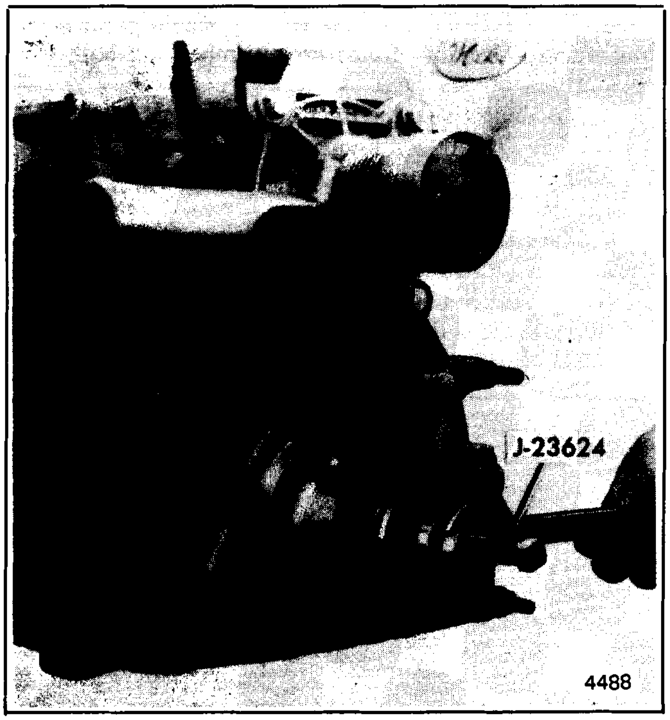


Fig. 6A1-13 Installing Crankshaft Sprocket

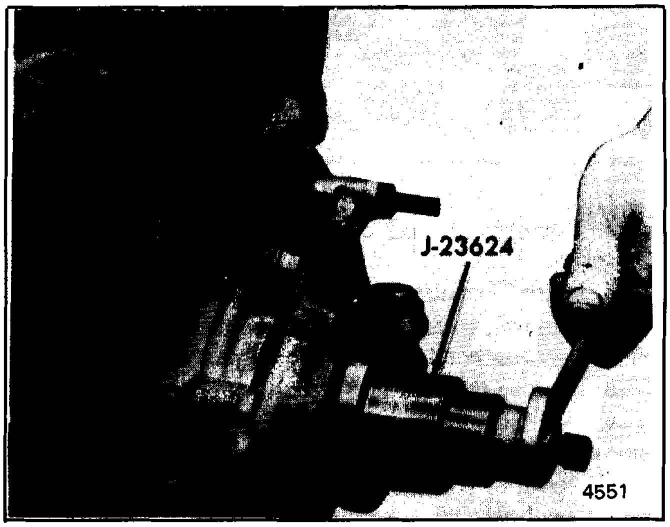


Fig. 6A1-14 Installing Crankshaft Front Seal

2. Pry old seal from front cover being careful not to damage seal housing or seal lip contact surfaces.

3. Coat seal lips with light engine oil and apply an approved sealing compound to outside diameter of seal.

4. Position seal, closed end outward, onto crankshaft; then install seal into bore, using Tool J 23624 as shown in Fig. 6A1-14.

5. Install crankshaft timing sprocket, timing belt lower cover, timing belt, accessory drive pulley and engine front cover.

OIL PAN AND BAFFLE

Removal

1. Raise car on hoist and drain engine oil.

2. Support front of engine so that weight is off engine front mounts. Remove frame crossmember and both front crossmember braces.

3. Disconnect steering idler arm at frame side rail.

NOTE: On air conditioned equipped cars disconnect idler arm at relay rod.

4. Mark relationship of steering linkage pitman arm to steering gear pitman shaft and remove pitman arm.

NOTE: Do not rotate steering gear pitman shaft while steering arm is disconnected as this will change steering wheel alignment.

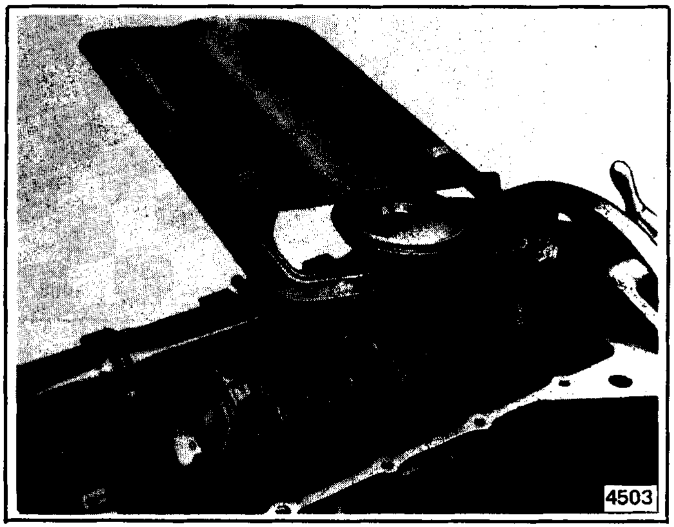


Fig. 6A1-15 Removing Oil Pan Baffles

5. Remove flywheel cover or converter underpan as applicable.

6. Loosen exhaust pipe at manifold and move to side.

7. Remove pan-to-cylinder case bolts, tap oil pan lightly to break sealing bond and remove oil pan from car.

8. Remove the pick-up screen-to-support bolt.

9. Remove pick-up screen-to-baffle support bolts. Remove support from baffle.

10. Remove bolt securing oil drain back tube to baffle; then rotate baffle 90° towards left side of car and remove baffle from pick-up screen (Fig. 6A1-15).

Installation

1. Thoroughly clean all gasket surfaces.

2. Apply an approved sealing compound to the gasket mating surface of the oil pump assembly.

3. Position baffle gasket to baffle; then position baffle to engine. Install two pan bolts to temporarily retain baffle to engine.

4. Install oil drain back tube-to-baffle retaining bolt.

Torque to 50 lbs. in.

5. Install pick-up tube support and secure with bolts. Secure screen to support. Torque bolts to 50 lbs. in.

6. Position gasket on oil pan. Remove pan bolts installed in Step 3 to temporarily retain baffle and install oil pan and pan bolts. Torque pan bolts to 15 lbs. ft.; torque bolts alternately and evenly to provide a uniform draw on pan and gasket.

NOTE: Apply an approved anti-seize compound to the pan bolt threads before installation.

7. Install flywheel cover.

8. Install steering linkage pitman arm to steering gear pitman shaft.

9. Connect steering idler arm to frame side rail (or relay rod).

10. Install frame front crossmember and both front crossmember braces. Torque bolts to 38 lbs. ft. and 25 lbs. ft. respectively.

11. Remove support placed under engine and lower car on hoist. Fill engine with specified type and quantity of oil (See owner's manual); start engine and check for leaks.

OIL PUMP SCREEN AND PICK-UP TUBE

Removal

1. Remove the engine oil pan and baffle as previously outlined.

2. Remove the self-locking bolt retaining the pick-up tube to the cylinder block.

3. Tap the "U" shaped section of the pick-up tube lightly with a soft faced hammer to remove tube from casting.

CAUTION: *Use extreme care in removing tube to prevent elongation of the pick- up tube bore in cylinder case.*

4. Clean sealing compound from tube bore.

Installation

NOTE: The oil pick-up tube and screen assembly should be replaced; with a new part, once it has been removed. Loss of press fit condition could result in an air leak, loss of oil pressure and hydraulic lifter noise.

1. Apply an approved sealing compound to the pick-up tube sealing surface between tube end and tube boss.

2. Install tube in bore, aligning retaining brackets with case tapped holes. Seat tube boss against cylinder case, using an open end wrench as shown in Fig. 6A1-16.

3. Apply an approved anti-seize compound to retaining bolts; install bolts and torque to 15 lbs. ft.

4. Install the engine oil pan and baffle as previously outlined.

OIL SEAL (REAR MAIN)

Replacement

1. Remove the engine oil pan and baffle as previously outlined.

2. Remove rear bearing cap and discard lower seal.

3. Loosen the remaining bearing cap bolts slightly to allow crankshaft to be lowered.

NOTE: Due to possible static friction between pistons and cylinder walls, the crankshaft may not drop enough to allow removal and installation of the upper seal. It will be necessary in such cases, to place a lever between the crankshaft and block to force the crankshaft down

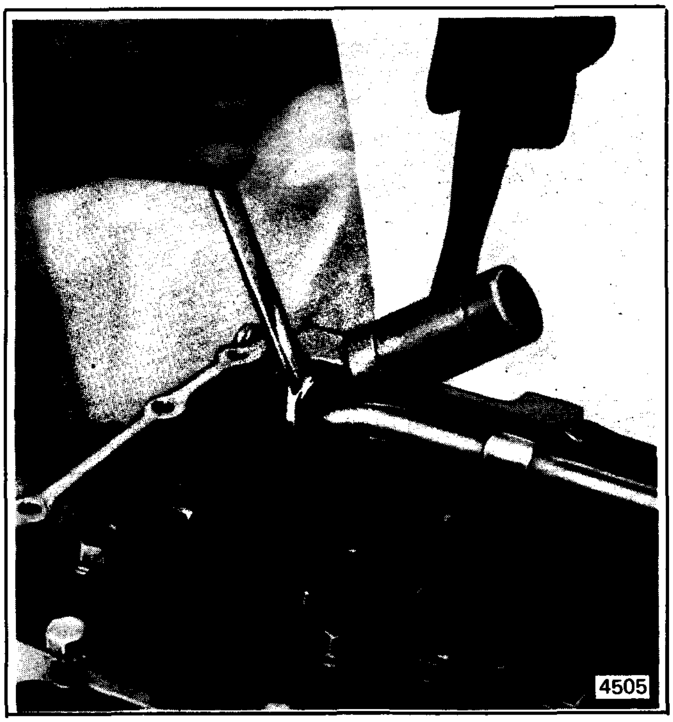


Fig. 6A1-16 Installing Oil Pickup Tube and Screen

into the space provided by loosening the bearing caps.

4. Use a suitable punch to push seal out of upper bearing enough to permit removal with a pair of pliers. It may be necessary to rotate crankshaft while pulling on seal to aid in removal.

5. Pre-form a new braided fabric upper seal in the bearing cap using Tool J 23625.

6. Taper end of seal and insert a piece of soft wire through seal at a position approximately 1/4" from end. Wrap wire around seal to form a secure attachment.

7. Insert wire attached to seal through seal opening in crankcase and around crankshaft. Then, using a screwdriver or similar tool, start seal into opening.

8. Pull seal into position with wire, while working seal back and forth at the point of contact with seal opening. Continue working seal back and forth, turning crankshaft if needed until seal is in position.

9. Torque all bearing caps, except the rear main, to 65 lbs. ft. Cut ends of seal flush to 1/64" below bearing edge, making a clean cut and leaving no raveled edges.

10. Install seal in bearing cap using Tool J 23625; cut ends of seal flush with cap (Fig. 6A1-17).

11. Place a piece of gaging plastic the full width of crankpin and parallel to crankshaft on the journal. Install the bearing cap and evenly torque nuts to 65 lbs. ft. Do not turn crankshaft with the gaging plastic installed.

12. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduation on the gaging plastic envelope.

13. If the clearance is within specifications, the seal is seated properly. Remove gaging material; install and torque bearing cap.

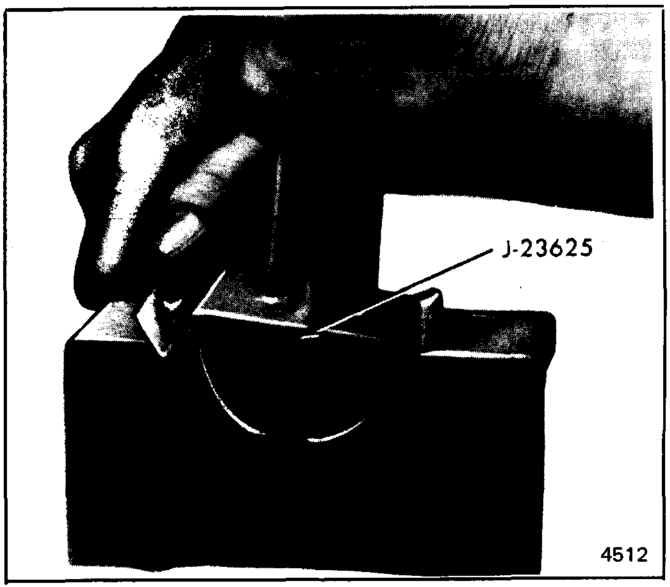


Fig. 6A1-17 Cutting Bearing Cap Rope Seal

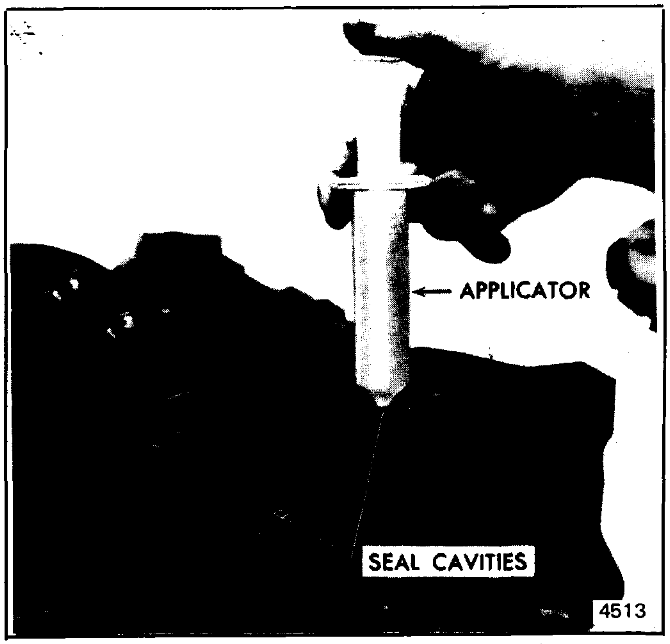


Fig. 6A1-18 Applying Bearing Cap Sealant

14. Install rear main bearing cap vertical split line sealant; follow instructions received with sealant kit to ensure proper mixture of curing agent and base material. Apply sealing compound to cavity forcing it firmly into place to ensure that no air gaps exist (Fig. 6A1-18).

15. Install the engine oil pan and baffle as previously outlined.

OIL PUMP (CRANKCASE FRONT COVER)

Removal

1. Remove engine front cover, accessory drive pulley, timing belt, timing belt lower cover and crankshaft timing sprocket.

2. Remove the three front oil pan bolts that secure into the oil pump.

3. Remove the bolts and stud securing oil pump assembly to the cylinder case.

Inspection

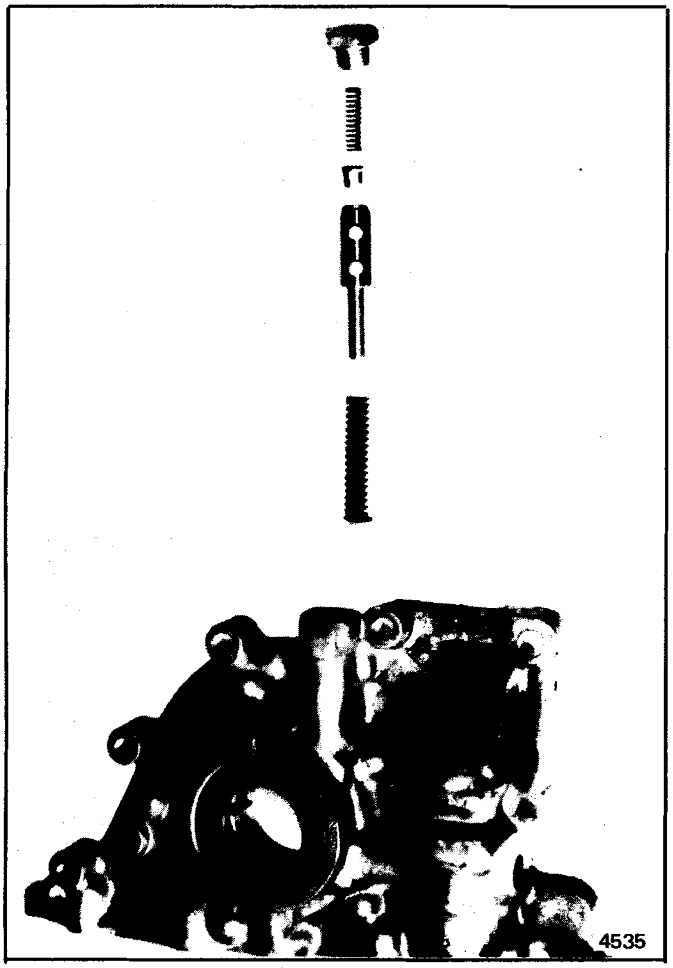


Fig. 6A1-19 Oil Pump Pressure Regulator

1. Clean gasket surfaces; then wash parts in an approved cleaning solvent and blow out all oil passages.

2. Check pressure regulator for free operation; replace if necessary (Fig. 6A1-19).

3. Inspect pump gears for nicks, broken parts and other damage.

4. Check clearance between outside diameter of driven gear and pump; clearance should be .003 - .006 (Fig. 6A1-20).

5. Check clearance between outside diameter of drive gear and crescent; clearance should be .002 - .009 (Fig. 6A1-21).

6. Check clearance between inside diameter of driven gear and pump crescent; clearance should be .006 - .014 (Fig. 6A1-22).

7. Check gear end clearance; clearance should be .001 - .002 (Fig. 6A1-23).

NOTE: The pump gears and body are not serviced separately. If pump gears or body are worn, replacement of the entire oil pump is necessary.

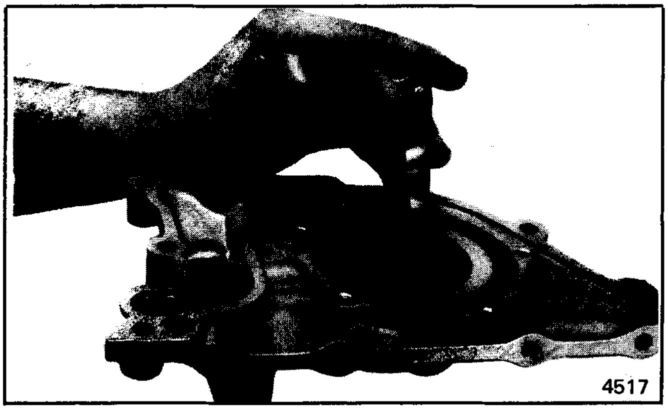


Fig. 6A1-20 Checking Driven Gear-To-Housing Clearance

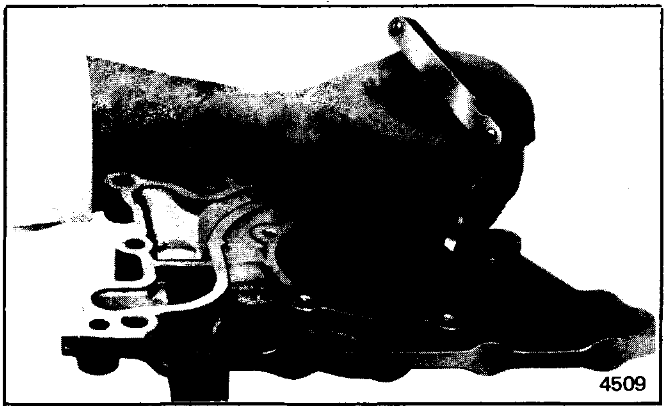


Fig. 6A1-21 Checking Drive Gear-To-Crescent Clearance

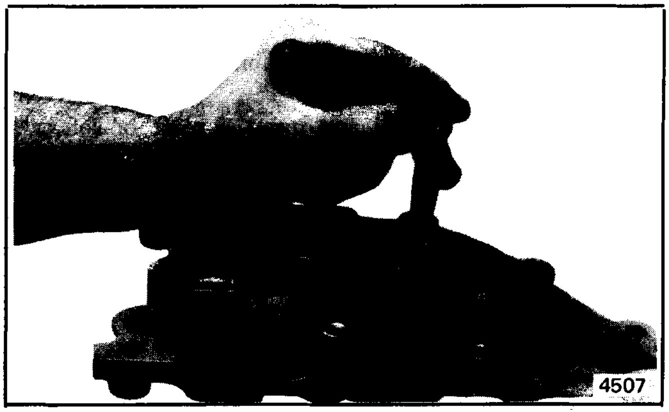


Fig. 6A1-22 Checking Driven Gear-To-Crescent Clearance

8. If oil seal is damaged (and the pump body is good) pry seal from bore and clean bore surface.

a. Coat seal lips with light engine oil and apply an approved sealing compound to outside diameter of seal.

b. Position seal, closed end outward, into bore and install seal until it is flush with pump body, using Tool J 23624 (Fig. 6A1-24).

Installation

1. Clean gasket surface on cylinder block and front portion of oil pan. Install new oil pump to cylinder block gasket and cut front portion of oil pan gasket and apply RTV sealing compound (or equivalent) to cut off portion of oil pan gasket. Lubricate pump gears and oil seal with engine oil.

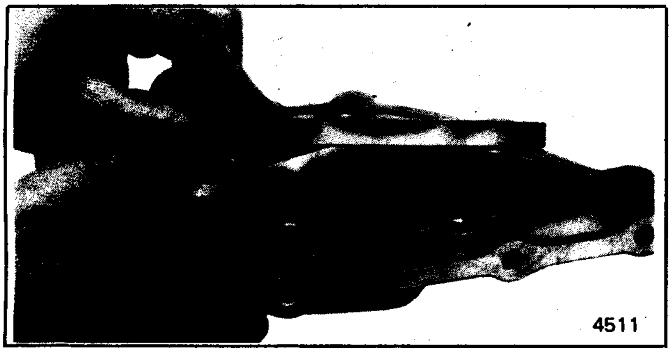


Fig. 6A1-23 Checking Gear End Clearance

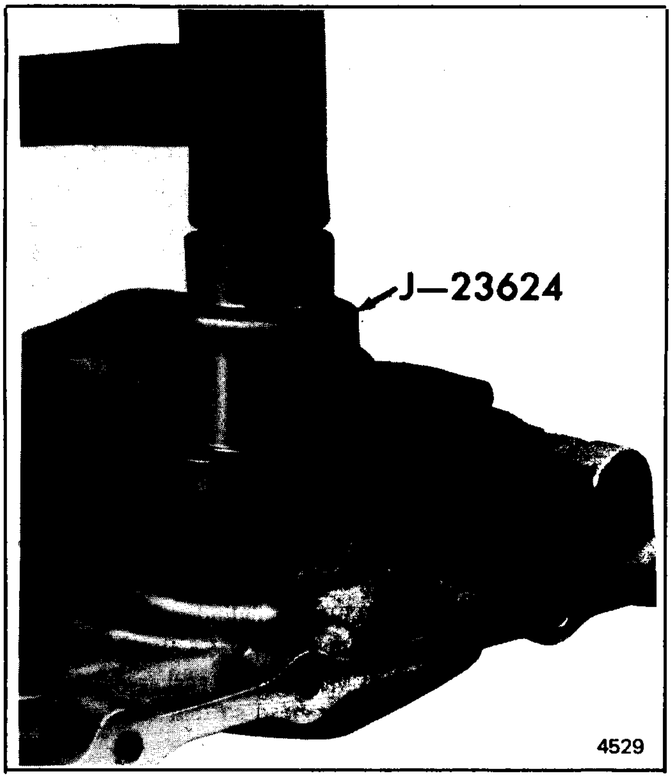


Fig. 6A1-24 Installing Oil Pump Seal

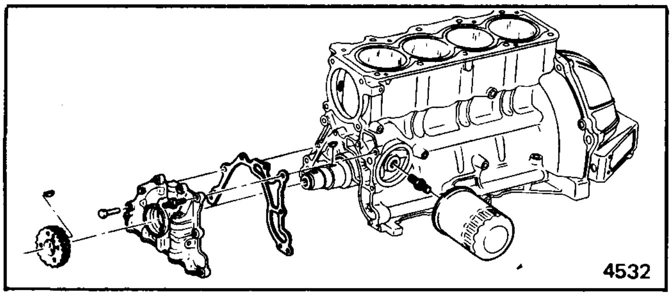


Fig. 6A1-25 Oil Pump-To-Cylinder Block Installation

2. Install pump drive key in crankshaft, align pump driven gear with key and install pump to case (Fig. 6A1-25).

3. Coat threads of pump retaining bolts and stud with an approved anti-seize compound and secure pump to case. Torque bolts to 15 lbs. ft. and the stud to 30 lbs. ft. - stud is located in upper right (facing engine). Do not install timing cover bolts at this time.

4. Install the three front oil pan bolts and torque to 15 lbs. ft.

5. Install crankshaft timing sprocket, timing belt lower cover, accessory drive pulley and engine front cover.

CAMSHAFT COVER

Removal

1. Raise the hood.
2. Disconnect battery negative cable at battery.
3. Disconnect ventilation tube at cam cover or air cleaner, then remove air cleaner from carburetor.
4. Remove positive crankcase ventilation valve from grommet at front of cover.
5. Remove the cover-to-cylinder head bolts and withdraw cover from engine.

Installation

1. The cover gasket is reusable and need not be replaced unless damaged. Inspect oil filler cap and grommets for further serviceability and replace as required.
2. Install cover to cylinder head - PCV valve towards front of engine - and torque cover bolts to 35 lbs. in.
3. Connect positive crankcase ventilation valve and hose to cover grommet.
4. Install ventilation tube to air cleaner and cam cover while positioning air cleaner to carburetor.
5. Connect battery negative cable and close hood.

CAMSHAFT

Measuring Lobe Lift

1. Remove camshaft cover as previously outlined.
2. Install dial indicator to cylinder head so that intake and exhaust valve of the same cylinder can be measured. Measure the lift of each lobe in consecutive order and record the values obtained as specified in the following procedures.

   a. Rotate the crankshaft in the direction of rotation until the dial indicator is on the heel of the cam lobe (Fig. 6A1-26).

   b. Set dial indicator on zero and rotate camshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until indicator is reflecting the fully raised position.

   NOTE: Disconnect the primary lead from the coil.

   c. Continue to rotate the crankshaft until the indicator reads zero. This will be a check on the accuracy of the original indicator reading.

   d. Compare the total lift recorded for each lobe with specifications ± .002" intake .400" and exhaust .415".

3. Remove dial indicator and reinstall camshaft cover as outlined in previous procedures.

Removal

1. Raise hood.
2. Drain Cooling System.
3. Remove the camshaft timing sprocket as previously outlined.
4. Remove timing belt upper cover and cam retainer and seal assembly as outlined.

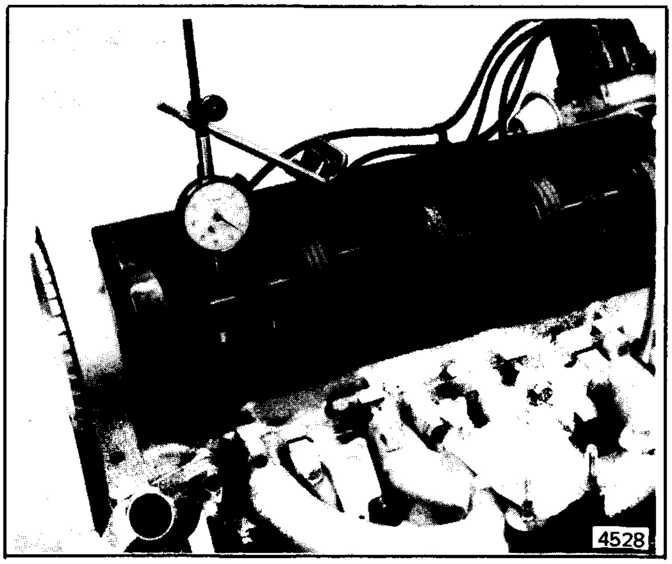


Fig. 6A1-26 Measuring Camshaft Lobe Lift

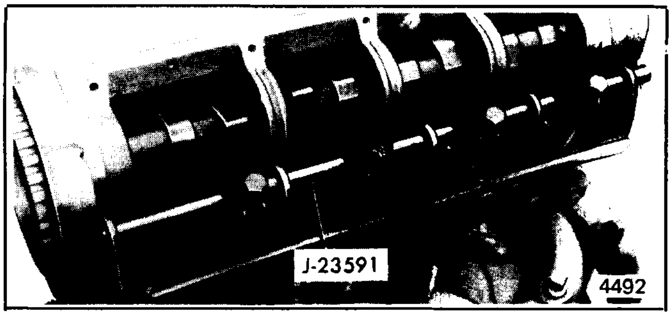


Fig. 6A1-27 Camshaft Removal Tool Installed

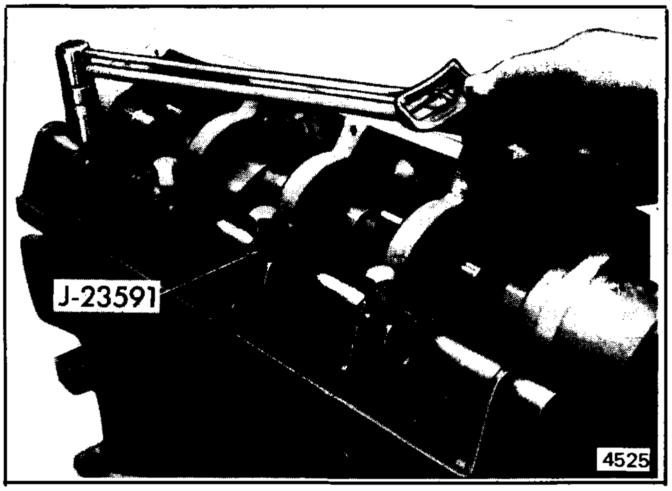


Fig. 6A1-28 Depressing Valve Lifters

5. Remove camshaft cover as previously outlined.
6. Disconnect fuel line at carburetor.
7. Remove Pulse A.I.R. tubing.
8. Remove EGR thermal vacuum switch.
9. Remove ignition distributor.
10. Raise the car on a hoist, then disconnect the engine from mounts at body attachment. Raise front of engine and install wood blocks, approximately 1 1/2 inches thick, between engine mounts and body then lower the car.

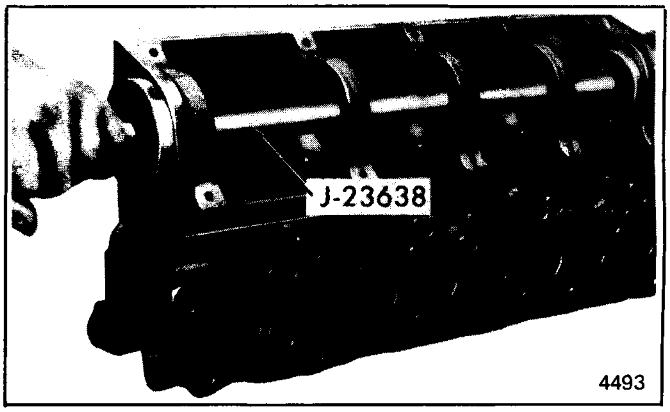


Fig. 6A1-29 Replacing Camshaft Bearings

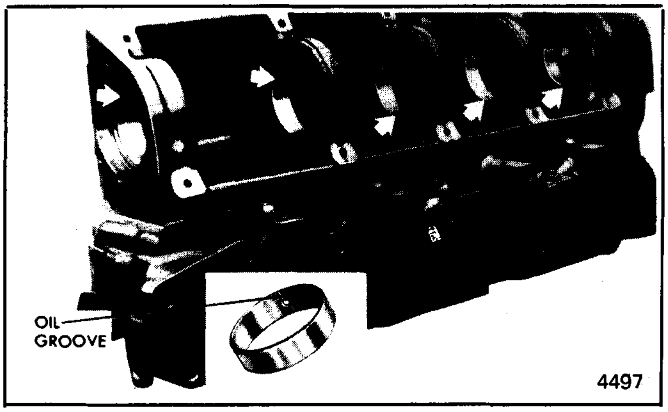


Fig. 6A1-30 Camshaft Bearing Alignment

11. Install camshaft removal Tool J 23591 (Fig. 6A1-27) to cylinder head as follows:

a. Position Tool J 23591 to cylinder head so that attaching holes align with cam cover lower attaching holes.

NOTE: Make sure all valve cover gasket material is removed from the cylinder head so that the tool seats properly.

b. Align valve lifter depressing levers on Tool J 23591 so that each lever will depress both the intake and exhaust valve for their respective cylinder (lever should fit squarely in notches adjacent to valve lifters).

c. With Tool J 23591 aligned as in Step b, make sure screws in bottom of tool are backed-off so that they do not make contact with bosses beneath tool.

d. Install hardened screws, supplied with tool, to attach J 23591 to cylinder head; torque screws securely.

e. Turn screws in bottom of tool downward until they just seat against corresponding bosses on cylinder head.

f. Apply a heavy body lubricant to ball end of lever depressing screws and tighten screws to depress the valve lifters.

NOTE: Set engine timing mark to 12 o'clock before depressing valves. Use a torque wrench on pivot arm screws (Fig. 6A1-28).

DO NOT EXCEED 12 lbs. ft. OF TORQUE to depress valves. If more than 12 lbs. ft. is required, check tool for proper installation then proceed cautiously to prevent damage to depressing lever.

12. The camshaft can be removed by sliding it forward until it clears the head.

Bearing Replacement

1. With the camshaft removed and the camshaft removal Tool J 23591 installed, all camshaft bearings can be replaced without removing camshaft end plug.

2. Install remover-installer plate of Tool J 23638 into front bearing and tap bearing from bore using driver handle supplied with J 23638.

3. To remove the remaining bearings, install guide plate (supplied with J 23638) into front bore of head; then remove cam bearings as described in Step 2 (Fig. 6A1-29).

CAUTION: *Tap the rear bearing slowly into distributor shaft housing being careful not to unseat end plug. Crush bearing to remove from housing.*

4. Install new bearings beginning with rear bearing and working forward.

CAUTION: *Oil holes in the three rear bearings must be aligned with the oil holes in the case. Oil holes in the first two bearings should be placed in the 11 o'clock position (as viewed from front of engine) and oil groove in number one bearing toward front of engine (Fig. 6A1-30).*

Installation

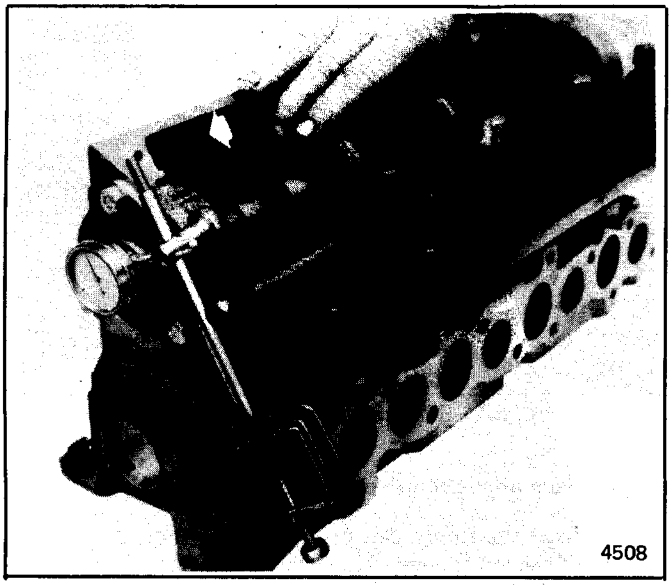


Fig. 6A1-31 Measuring Camshaft End Play

1. Position camshaft into cylinder head until journals are seated in their respective bore.

2. Raise the car on a hoist; raise front of engine and remove wood blocks from engine front mounts. Install engine front mounts and lower car on hoist.

3. Install a new gasket, timing belt upper cover and retainer plate and seal assembly to retain camshaft. Torque retainer screws to 18 lbs. ft.

4. Attach a dial indicator to cylinder head so that indicator plunger can follow camshaft movement. Move camshaft forward and rearward and record movement (Fig. 6A1-31). If not within .004 to .012 inch. select a new camshaft retainer, using the following procedure:

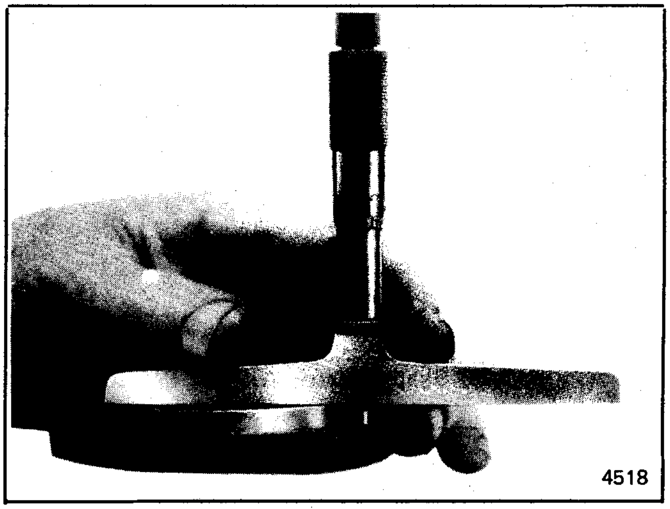


Fig. 6A1-32 Measuring Camshaft Retainer

a. Remove camshaft retainer and measure thickness of cam locator on retainer. A depth gage or one inch micrometers may be used (Fig. 6A1-32).

b. Select a suitable retainer from parts stock that will provide the proper end play (Thicker retainer will provide less end play). Camshaft retainers are available in three sizes:

.228" - .230"
.230" - .232"
.232" - .234

c. In selecting the proper retainer, measure the thickness of camshaft locator and compare with that of the retainer being replaced (Fig. 6A1-32).

NOTE: If no camshaft end play was measured and the retainer removed measured .234", replace with a thinner retainer (.230").

5. Remove Tool J 23591 by first releasing the valve lifter depressing levers; then remove screws holding tool to the cylinder head.

6. Install camshaft timing sprocket, timing belt and front cover.

7. Install ignition distributor.

8. Start engine and set timing to specification.

VALVE STEM OIL SEAL AND/OR VALVE SPRING

Removal

1. Remove camshaft as previously outlined.

2. Release spring tension on the lifters, position the lever to one side and remove each lifter.

NOTE: Keep lifters in order so they can be returned to the same location.

3. Remove spark plug at the cylinder(s) to be serviced.

4. Install air line adapter Tool J 23590 to spark plug port and apply compressed air to adapter to hold valves in place (Fig. 6A1-33).

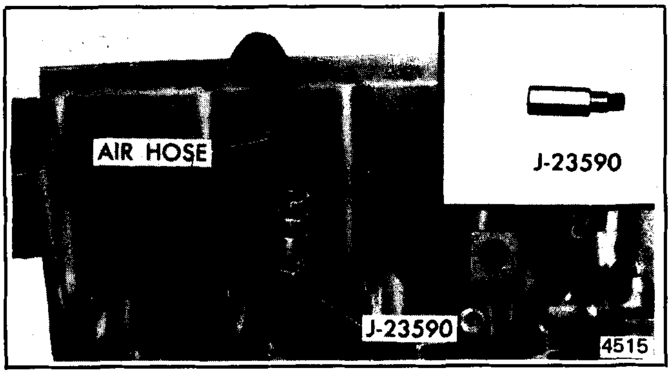


Fig. 6A1-33 Seating Valve With Air Pressure

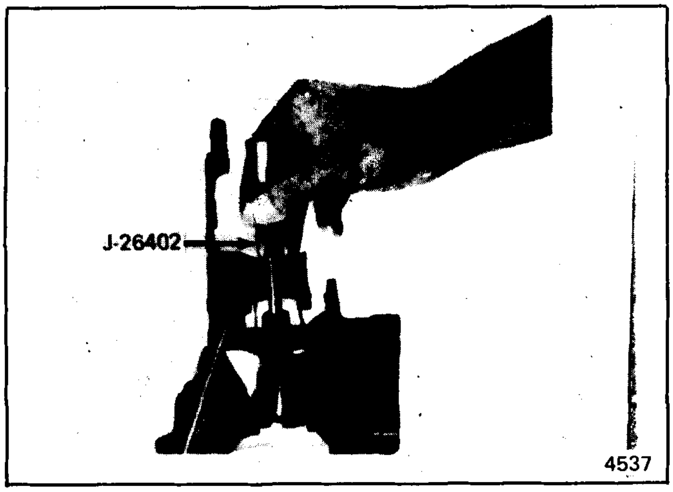


Fig. 6A1-34 Installing Tool J 26402

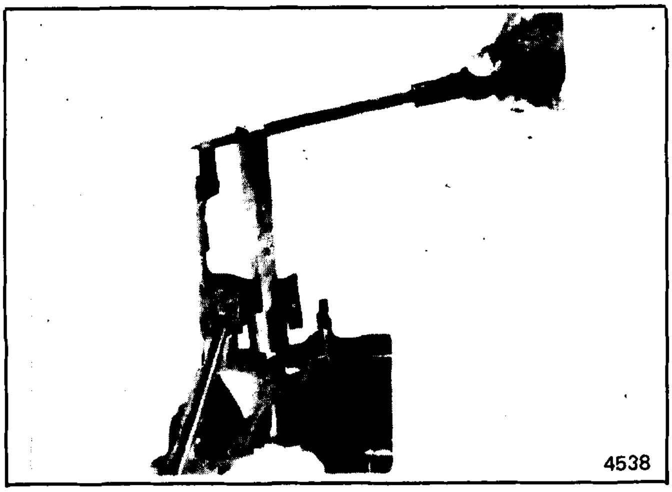


Fig. 6A1-35 Seal Removal

5. Using Tool J 23995 to compress the valve spring, remove the valve locks and release compression on spring and remove tool.

6. Remove the valve cap, valve spring and damper assembly.

7. Slide the pipe sleeve, tool Kit J 26402, over the end of the jaws and as far up the removal tool as possible.

8. While spreading the jaws of the tool, insert it into the valve spring pocket with the jaws of the tongs placed on either side of and beneath the edge of the seal (Fig. 6A1-34).

9. With the removal tool in place, slide the pipe sleeve down around the seal. This will keep the jaws in place.

10. Remove the seal by pulling straight up on the removal tool (Fig. 6A1-35).

Installation

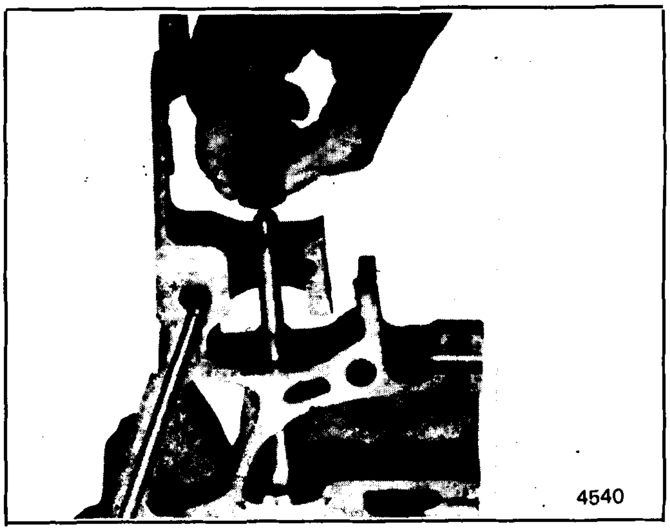


Fig. 6A1-36 Installing New Seal

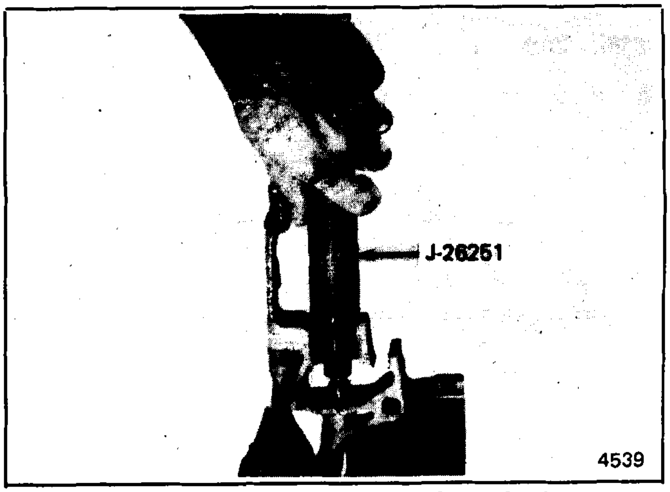


Fig. 6A1-37 Seating Valve Stem Seal

Replace all eight valve stem seals.

1. Place the safety cap provided with the seal kit over the end of the valve stem. This is important and will protect the seal from being damaged by the sharp edge of the valve stem.

2. Slip the new seal over the cap and down the valve stem (Fig. 6A1-36). A light coat of oil will help prevent the seal from twisting.

3. Remove the safety cap and fit the installation tool J 26251 over the valve stem above the oil seal.

4. Depress the seal down the valve stem until the upper white line on the tool, marked "HYD" for "hydraulic", aligns with the boss on the cylinder head. The lower white line, marked "ADJ", provides an alignment guide when working on engines with adjustable lifters (Fig. 6A1-37).

5. Maintain pressure momentarily, then back off the tool, making sure the oil seal remains seated.

6. Install the valve spring and damper assembly and valve cap valve stem.

7. Compress valve spring, using Tool J 23995; install valve locks, making sure that locks seat properly in the valve stem groove. Release spring and remove tool.

NOTE: Grease may be used to hold the locks in place while releasing the spring.

8. Remove air line adapter Tool J 23590. Install spark plug and torque to 15 lbs. ft.

9. Install valve lifter assembly.

10. Remove tool J 23591 from the head.

INTAKE MANIFOLD

Removal

1. Raise the hood and secure open.
2. Disconnect battery negative cable at battery.
3. Remove air cleaner, disconnecting vent tube at camshaft cover.
4. Remove air cleaner silencer-to-heat stove tube retaining screw and remove silencer.
5. Disconnect power steering pump brace at manifold (if equipped).
6. Remove generator-to-thermostat housing through bolt and loosen swivel bolt, position generator to obtain access to manifold bolt.
7. Remove clamps securing exhaust gas recirculation (E.G.R.) tube at both the intake and exhaust manifolds.
8. Remove the E.G.R. tube, using Tool J 24311.
9. Drain cooling system and disconnect heater hose at fitting on inlet manifold.
10. Disconnect:
    a. P.C.V. valve at cam cover.
    b. Fuel line at carburetor.
    c. Throttle linkage and transmission detent linkage.
    d. Vacuum lines from manifold vacuum fitting.
11. Remove the four intake manifold retaining bolts and withdraw manifold from vehicle.

Installation

NOTE: If a new manifold is being installed, transfer the following from the old unit:
a. Carburetor with linkage mounting plate
b. EGR valve - with new gasket
c. Vacuum fitting(s)
d. Heater hose fitting

1. Clean gasket surfaces on cylinder head and manifold.
2. Position new gasket over manifold locating dowels on head and carefully install the manifold, making sure that the gasket remains in place.
3. Install and torque retaining bolts to 30 lbs. ft.
4. Connect:
    a. PCV valve at cam cover
    b. Fuel line at carburetor
    c. Throttle linkage and transmission detent linkage
    d. Vacuum lines from manifold vacuum fitting
5. Connect power steering pump brace to manifold (if equipped).
6. Install generator-to-thermostat housing through bolt and adjust belt tension.
7. Install air cleaner silencer and secure to heat stove tube.
8. Install air cleaner-connect vent tube at camshaft cover.
9. Connect heater hose to inlet manifold fitting and fill cooling system.
10. Raise vehicle on a hoist and install exhaust gas recirculating tube, using Tool J 26A1-40A11 as shown in Figure 6A1-39).
11. Install clamps to secure exhaust gas recirculating tube at both the intake and exhaust manifolds - lower vehicle.
12. Connect battery negative cable, start engine, check for leaks and adjust carburetor.
13. Check and adjust ignition timing and dwell.
14. Remove hood hold open link and close hood.

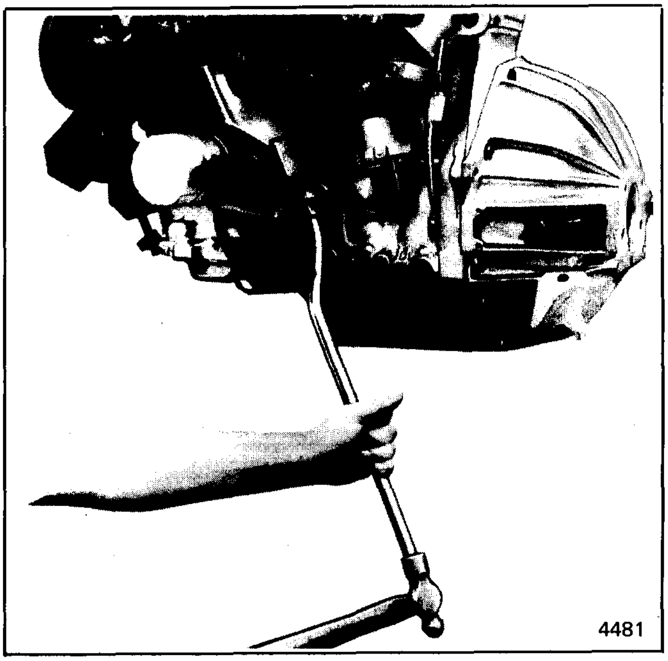


Fig. 6A1-39 Installing Exhaust Gas Recirculating Tube

EXHAUST MANIFOLD

Removal

1. Raise the car on a hoist. Disconnect the exhaust pipe at the manifold. Lower the car.
2. Remove intake manifold as previously outlined.
3. Disconnect oil level dipstick bracket at exhaust manifold.
4. Remove the exhaust manifold-to-cylinder head bolts and remove manifold and carburetor heater assembly.

Installation

NOTE: If installing a new manifold, transfer carburetor heat stove and tube to new manifold. Manifold upper attaching bolts are 1 1/2" long: lower attaching bolts are

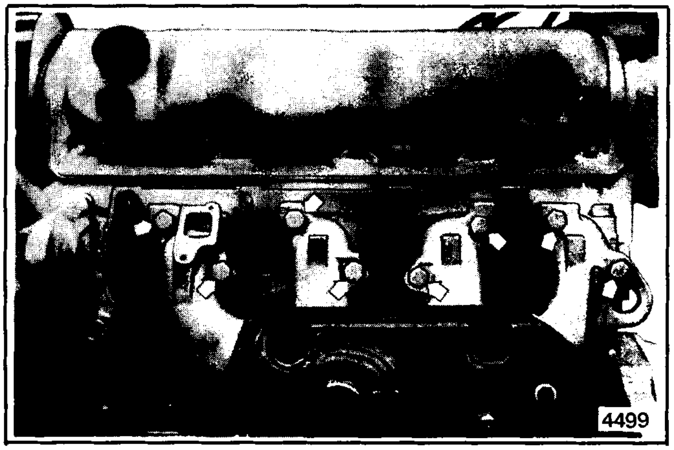


Fig. 6A1-40 Exhaust Manifold Bolts

2" long. Number one and number four cylinder attaching bolts are self-locking.

1. Position manifold to head and loosely install bolts.
2. Torque bolts to 30 lbs. ft. (Fig. 6A1-40).
3. Connect oil level dipstick to exhaust manifold.
4. Raise car on a hoist and connect exhaust pipe.
5. Install intake manifold.

CYLINDER HEAD ASSEMBLY

Removal

1. Raise hood and secure open.
2. Disconnect battery negative cable at battery.
3. Drain cooling system.
4. Remove engine front cover and camshaft cover.
5. Remove timing belt and camshaft timing sprocket.
6. Disconnect coolant hose at thermostat housing (water outlet).
7. Remove cylinder head bolts; then, with the aid of an assistant, remove manifolds and cylinder head assembly and gasket. Place cylinder head on two blocks of wood to prevent damage to valves.

Disassembly

1. Remove intake and exhaust manifolds.
2. Remove camshaft retainer and timing belt upper cover.
3. Install camshaft removal Tool J 23591.
4. Remove camshaft, valve lifters, valve springs, valve stem seals and valves.
5. Remove camshaft removal Tool J 23591.
6. Remove spark plugs.
7. Remove thermostat housing.

Cleaning

1. Clean all carbon from combustion chambers and valve ports using Tool J 8089 (Fig. 6A1-41).
2. Thoroughly clean the valve guides using Tool J 8101 (Fig. 6A1-42).
3. Clean valve stems and heads on a buffing wheel.

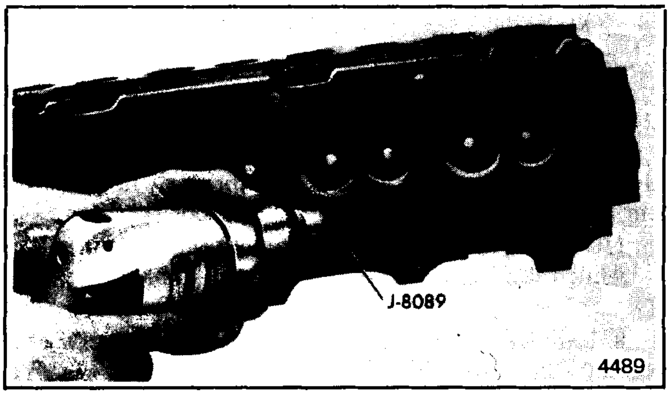


Fig. 6A1-41 Cleaning Combustion Chamber

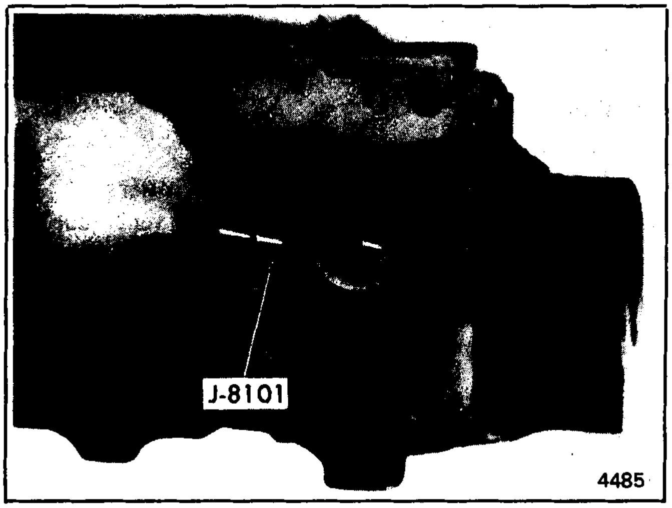


Fig. 6A1-42 Cleaning Valve Guide

4. Clean carbon deposits from head gasket mating surface.
5. Remove valve spring dampers and clean in an approved cleaning solvent.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports or combustion chambers or external cracks to the water chamber.
2. Inspect the valves for burned heads, cracked faces and damaged stems.

NOTE: Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky valves and rough engine idle.

3. Measure valve stem clearance (Fig. 6A1-43). Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide. With the head of the valve dropped off the valve seat approximately 1/16", move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves.

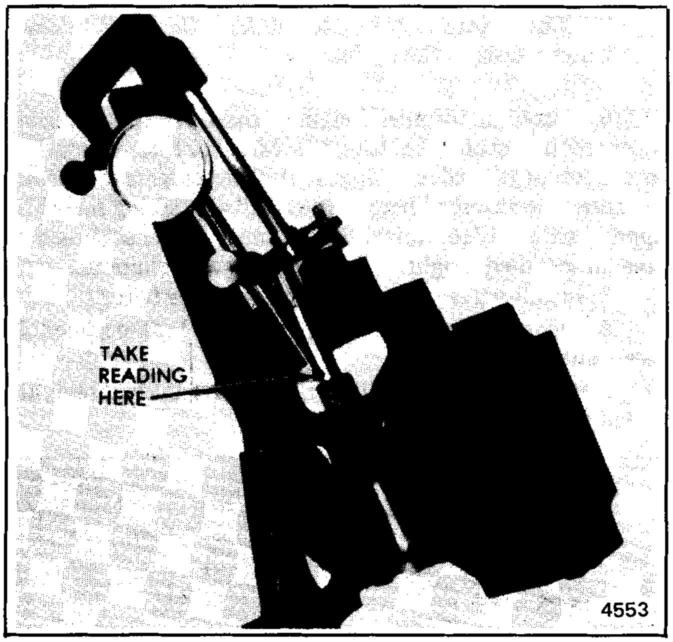


Fig. 6A1-43 Measuring Valve Stem Clearance

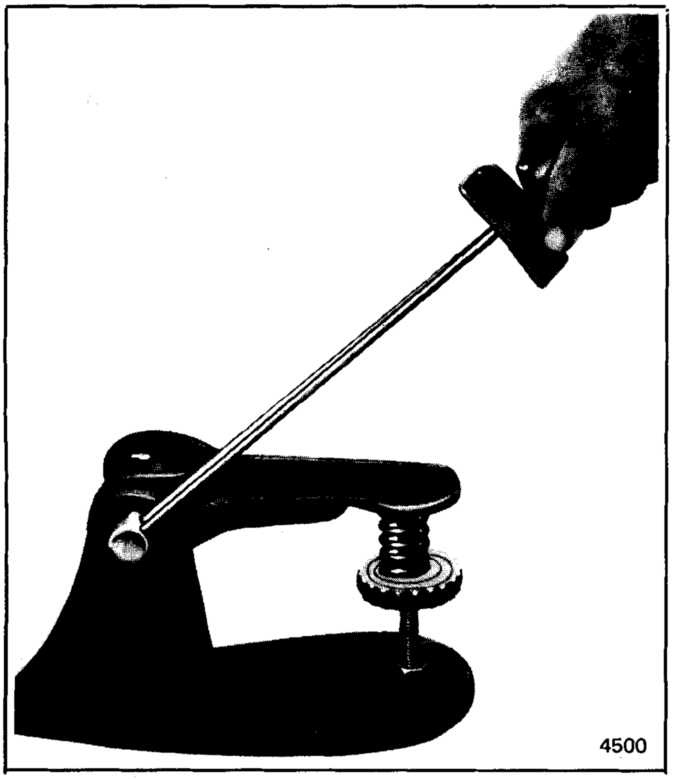


Fig. 6A1-44 Checking Valve Spring Tension

4. Check valve spring tension with Tool J 8056 spring tester (Fig. 6A1-44).

NOTE: Springs should be compressed to the specified height and checked against specifications. Springs should be replaced if not within 10 lbs. of the specified load (without dampers).

5. The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

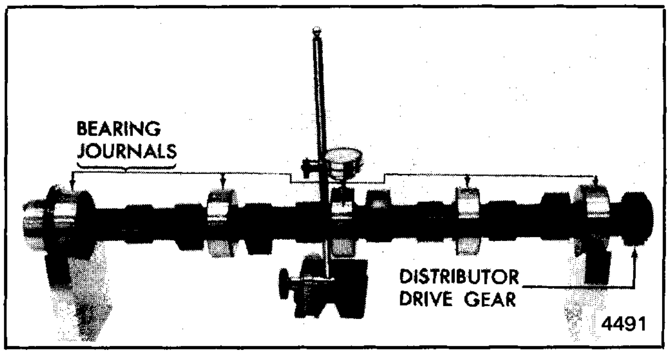


Fig. 6A1-45 Checking Camshaft Alignment

6. The camshaft should also be checked for alignment. The best method is by use of "V" blocks and a dial indicator (Fig. 6A1-45). The dial indicator will indicate the exact amount the camshaft is out of true. If it is out more than .0015" dial indicator reading, the camshaft should be replaced.

7. Inspect the camshaft gear for wear or damage.

Repairs

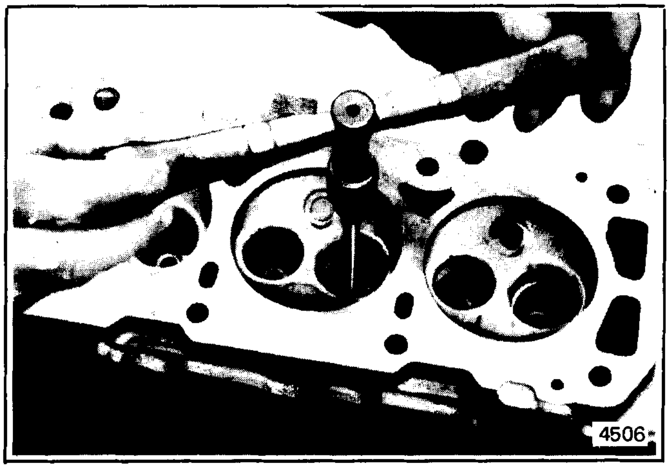


Fig. 6A1-46 Reaming Valve Guide

Valve Guide Bores

Valves with oversize stems are available in three sizes (.003 - .015 - .020) for service replacement. To ream the valve guide bores for oversize valves, use Tool J 5830-1 for .003; J 5830-2 for .015 and J 5830-3 for .030 (Fig. 6A1-46).

NOTE: If installing valves with oversize stems, be sure to install oversize valve stem seals.

Valve Seats

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is required to insure that the heat in the valve head will be properly carried away.

Valve seats should be concentric within .002" total indicator reading and can be checked as shown in Fig. 6A1-47. The relation of valve and seat angles is shown in Fig. 6A1-48.

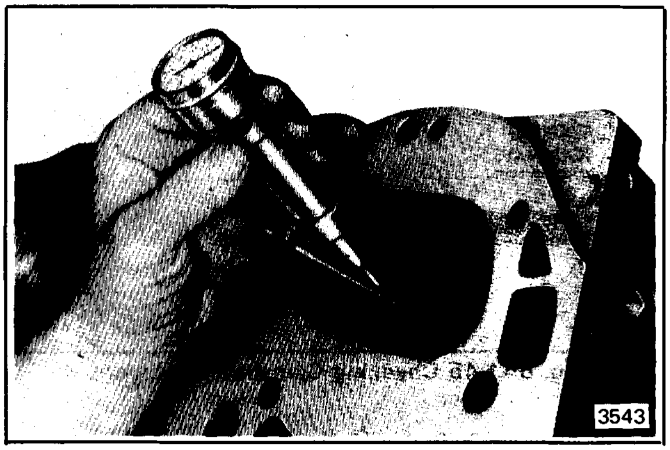


Fig. 6A1-47 Measuring Valve Seat Concentricity

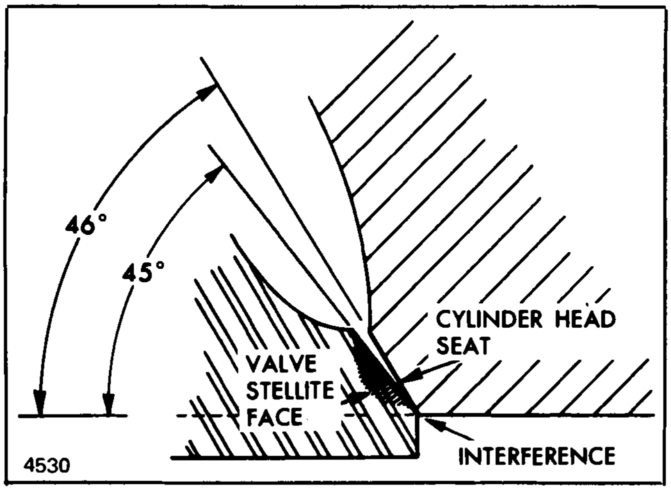


Fig. 6A1-48 Relation of Valve and Seat Angles

Intake valves are coated with a nickel-chrome alloy. Do not grind more than .005 from valve. If removal of more than .005 is required to reface valve it must be replaced.

Grind valve (not more than .005) until the valve face is true and smooth all around the valve. If this makes the valve head thin (1/32" minimum) the valve must be replaced as the valve will overheat and burn.

Assembly

NOTE: If valves have been serviced, it is essential that proper valve stem heights are maintained. A suggested method for checking installed height is using Tool J 26480 or similar gage.

1. Install camshaft removal Tool J 23591 to cylinder head so that lifter depressing fingers are in position, but not tightened.
2. Insert a valve in the proper port.
3. Install a new valve stem oil seal over valve guide using Tool J 26257.
4. Install the valve spring and damper assembly and valve cap over valve stem.
5. Compress valve spring, using Tool J 23592, and install valve locks, making sure that locks seat properly in the valve stem groove. Release spring and repeat procedure for remaining valves.

NOTE: Grease may be used to hold the locks in place while releasing the spring.

6. Check the installed height of the valve springs, using a narrow thin scale (Fig. 6A1-50). Measure from spring seat to the top of the valve spring. If this measurement is found to exceed the specified height, install a valve spring seat shim approximately 1/16" thick. Spring must not be shimmed to give an installed height under the specified minimum.
7. Install valve lifters in their respective bore.
8. Depress lifters using Tool J 23591 as outlined in disassembly procedures.
9. Position camshaft into cylinder head until journals are seated in their respective bore.

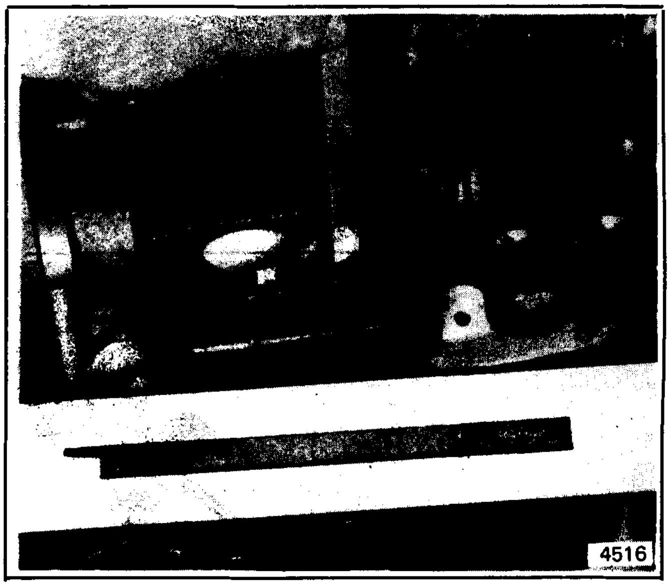


Fig. 6A1-50 Measuring Valve Spring Installed Height

10. Install a new gasket, timing belt upper cover and retainer plate and seal assembly to retain camshaft. Torque bolts to specifications.
11. Clean, adjust, install and torque spark plugs to 15 ft. lbs.
12. Clean thermostat housing gasket surface and install housing to head, using a new gasket.
13. Clean top of pistons and clean gasket surface of cylinder block.
14. Install intake and exhaust manifolds.

Installation

1. Install cylinder head gasket over dowel pins with smooth side of gasket up; then, with the aid of an assistant, carefully guide manifolds and cylinder head assembly into place over dowel pins and gasket.
2. Coat threads of cylinder head bolts with an approved anti-seize compound and install finger tight; install lifting bracket under second bolt head from front on spark plug side.

NOTE: Cylinder head bolts vary in length. Bolts on manifold side are approximately 6 3/8" long; bolts on spark plug side are approximately 5 5/8" long.

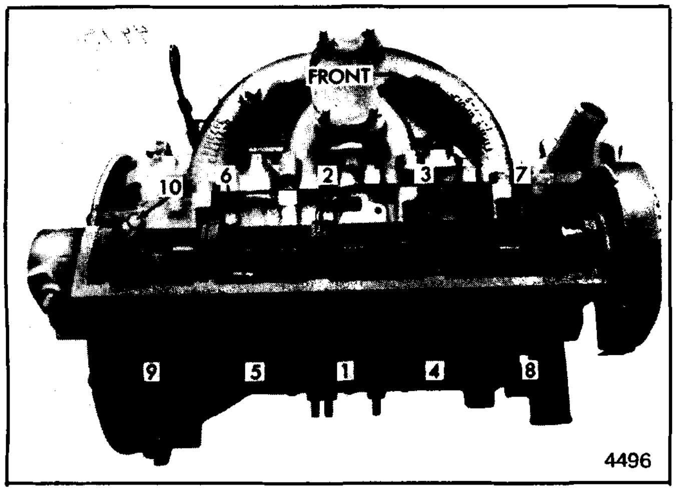


Fig. 6A1-51 Cylinder Head Bolt Torque Sequence

3. Tighten cylinder head bolts a little at a time in the sequence shown in Fig. 6A1-51, until the specified torque is reached (60 lbs. ft.).

4. Connect coolant hose to thermostat housing.

5. Install timing belt. See "Camshaft Timing Sprocket".

6. Install engine front cover and camshaft cover.

FLYWHEEL

Removal

With transmission and/or clutch housing and clutch removed from engine, remove the flywheel.

Repair

The only repair recommended on flywheel used with conventional clutch is replacement of starter gear in event gear is worn or otherwise damaged.

Uniformly heat the flywheel gear to temperature which will expand gear to permit installation (temperature must not exceed 400°F, 204°C).

As soon as gear has been heated, install on flywheel with chamfered teeth toward engine side of flywheel.

CAUTION: *NEVER heat starter gear red hot as this will ruin it.*

Installation

1. Clean the mating surfaces of flywheel and crankshaft to make certain there are no burrs.

2. Install flywheel on crankshaft and position to align dowel hole of crankshaft flange and flywheel.

NOTE: On automatic transmission equipped engines, the flywheel must be installed with the flange collar to transmission side.

ENGINE MOUNTS

Engine mounts (Fig. 6A1-53) are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line.

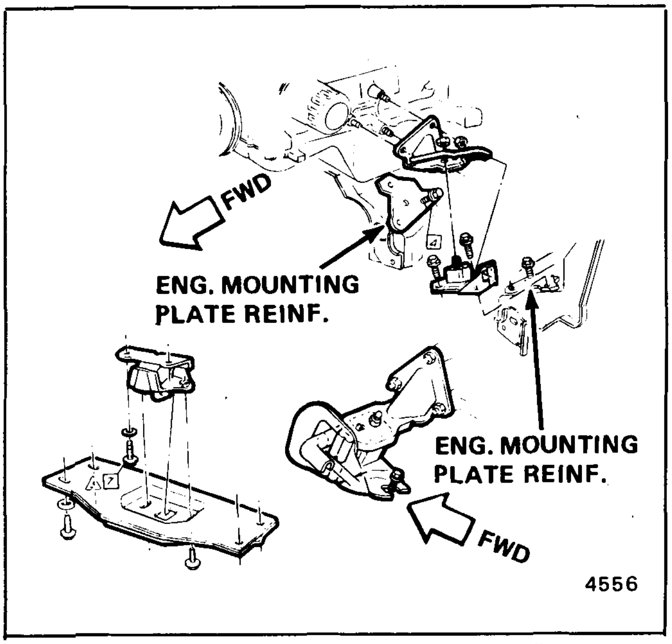


Fig. 6A1-53 Engine Mounts (Typical)

CHECKING ENGINE MOUNTS

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. Replace an engine mount if mount has:

a. Hard rubber surface covered with heat check cracks.

b. Rubber separated from a metal plate of the mount.

c. Rubber split through center.

If there is movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame or bracket.

Rear Mount

Raise the car on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottomed out), replace the mount. If there is movement between a metal plate of the mount and its attaching point, tighten the screws of nuts attaching the mount to the transmission or crossmember.

Front Mount Replacement

1. Raise the car on a hoist and support front of engine to take weight off front mounts.

2. If only one mount is being replaced, remove the mount-to-engine bracket nut on the mount not being replaced.

3. Remove the stud nut and two bolts securing mount to housing support.

4. Remove the three stud nuts securing bracket to engine. On right side, remove starter brace at starter and, on air conditioned equipped cars remove compressor rear lower brace at compressor.

5. Raise front of engine to provide maximum clearance without imposing stress on associated engine parts.

6. Remove mount and bracket as a unit and separate by removing stud nut.

7. Assemble new mount to bracket and position bracket to engine studs, then install starter brace and air conditioning compressor brace.

8. Loosely install mount and bracket stud nuts and bolts. Lower engine to place weight on mounts and measure bracket clearance from side to side and fore and aft (Fig. 6A1-53). Position mount to obtain best fit; torque bolts and nuts to specifications.

9. Install bracket-to-mount nut removed from opposite side and torque to specifications.

10. Remove support from front of engine and lower car on hoist.

Rear Mount Replacement

The engine rear mount serves to locate the power train fore and aft and from side to side; therefore, mark relationship of rear mount to transmission support crossmember to ensure proper alignment when a new mount is installed.

1. Remove crossmember-to-mount bolts.

2. Raise transmission at extension to release weight from mount.

3. Remove mount-to-transmission bolts; then remove mount.

4. Install new mount to transmission.

5. While lowering transmission, align and start crossmember-to-mount bolts.

6. Lower transmission. Align mount-to-crossmember to maintain alignment of front mounts and tighten all mounting bolts to specified torque.

CONNECTING ROD AND PISTON ASSEMBLIES

Removal

1. Use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.

NOTE: Before ridge and/or deposits are removed, turn crankshaft until piston is at the bottom of stroke and place a cloth on top of piston to collect the cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke and remove cloth and cuttings.

2. Inspect connecting rods and connecting rod caps for cylinder identification. If necessary, mark them.

3. Remove connecting rod cap and install Tool J 23627 on studs. Push connecting rod and piston assembly out of top of cylinder block (Fig. 6A1-54).

NOTE: It will be necessary to turn the crankshaft slightly to disconnect some of the connecting rod and piston assemblies and push them out of the cylinder.

Disassembly

1. Remove connecting rod bearings from connecting rods and caps.

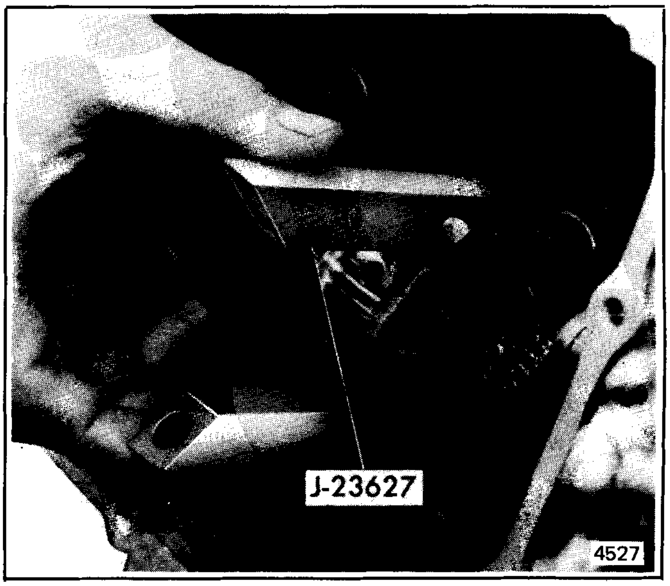


Fig. 6A1-54 Removing Connecting Rod and Piston Assembly

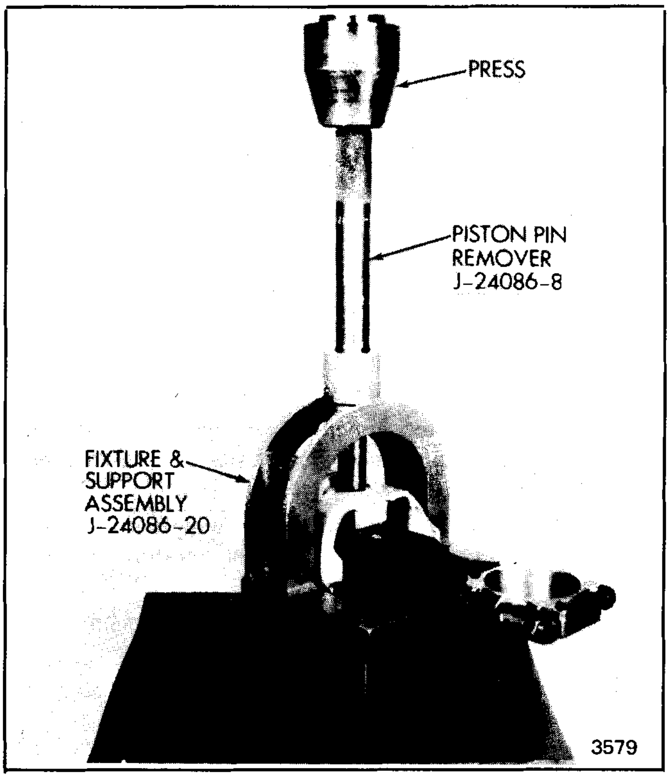


Fig. 6A1-55 Removing Piston Pin

NOTE: If connecting rod bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.

2. Remove piston rings by expanding and sliding them off the pistons. Tool J 22249 is available for this purpose.

3. Place connecting rod and piston assembly on Tool J 24086-20. Using an arbor press and piston pin remover, J 24086-8, press the piston pin out of connecting rod and piston (Fig. 6A1-55).

Cleaning and Inspection

Wash connecting rods in cleaning solvent and dry with compressed air.

Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Clean varnish from piston skirts and pins with a cleaning solvent.

DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial gage or an inside micrometer. If clearance is in excess of the .001" wear limit, the piston and piston pin assembly should be replaced.

Piston Selection

1. Check used piston to cylinder bore clearance as follows:

a. Measure the cylinder bore diameter with a telescope gage (2 1/2" from top of cylinder bore) (Fig. 6A1-56).

b. Measure the piston diameter (at skirt across centerline of piston pin, Fig. 6A1-57).

c. Subtract piston diameter to determine piston-to-bore clearance.

d. Compare piston-to-bore clearance obtained with those clearances recommended in specifications section and determine if piston-to-bore clearance is acceptable range.

2. If used piston is not acceptable, check piston size (Fig. 6A1-58) And determine if a new piston can be selected to fit cylinder bore.

Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.

2. Place connecting rod in piston and hold in place with piston pin guide and piston pin. Place assembly on fixture and support assembly.

3. Using piston pin installer, J 24086-7, press the piston pin into the piston and connecting rod (Fig. 6A1-60).

NOTE: The piston pin installer is a variable insertion length tool designed to be applicable to all GM piston assemblies. The insertion length is varied by rotating the hub on the shaft much like adjusting a micrometer. An alpha-numeric scale is used to determine the desired length for a given piston pin assembly. Use Pin Guide J 24086-7, Installer G-8 with pin size .927.

Fig. 6A1-56 Measuring Cylinder Bore

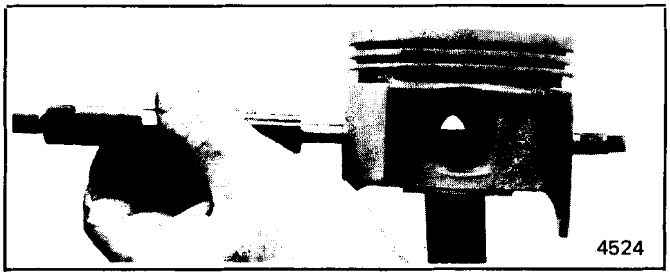


Fig. 6A1-57 Measuring Piston Diameter

PISTONS AVAILABLE					
				OVERSIZE	
STANDARD				.010	.020
3.4977	3.4982	3.4987	3.4992	3.5075	3.5175
3.4982	3.4987	3.4992	3.4997	3.5095	3.5195

4490

Fig. 6A1-58 Piston Size Chart

CAUTION: *After installer hub bottoms on support assembly, do not exceed 6000 psi pressure, as this could cause structural damage to the tool.*

4. Remove piston and connecting rod assembly from tool and check piston for freedom of movement on piston pin.

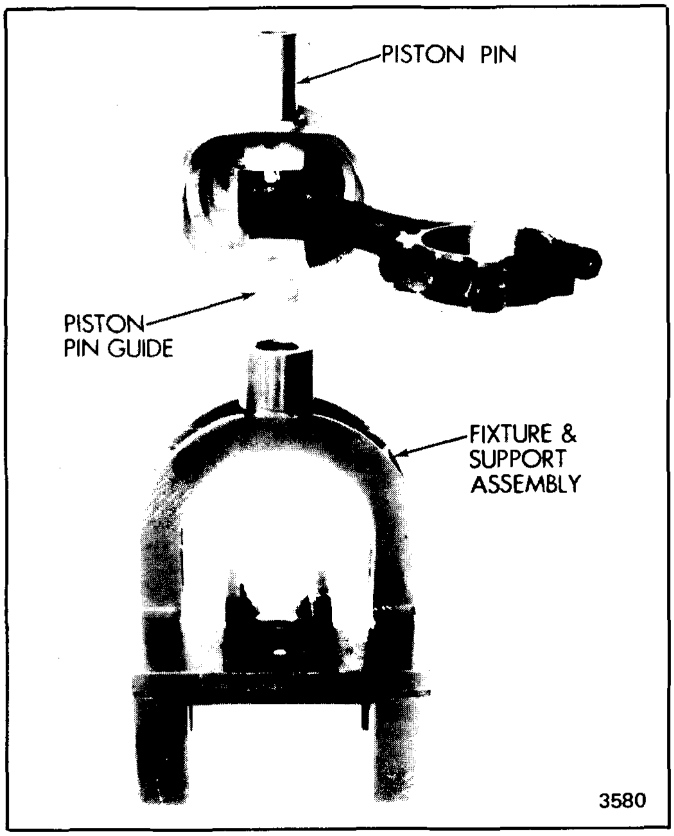


Fig. 6A1-59 Tool and Support Assembly

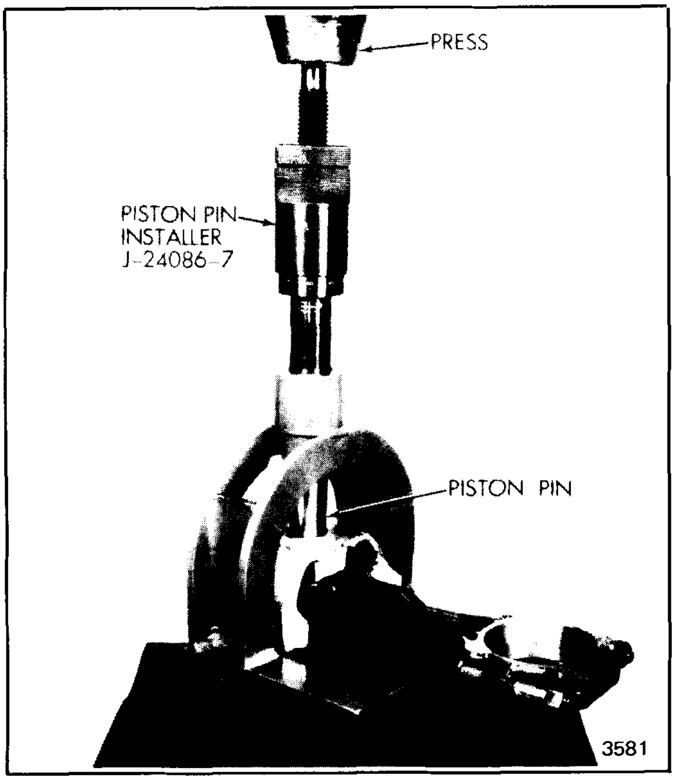


Fig. 6A1-60 Installing Piston Pin

Piston Rings

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston.

The top ring is chrome faced, or treated with molybdenum for maximum life.

The oil control rings are of the three-piece type, consisting of two segments (rails) and a spacer.

Fig. 6A1-61 Measuring Ring Gap

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 1/4" (above ring travel). Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gage (Fig. 6A1-61).
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as outlined, do so.
7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove (Fig. 6A1-62) to make sure that the ring is free. If binding occurs at any point, the cause should be determined and, if caused by ring groove, remove by dressing with a fine cut file. If the binding is caused by a distorted ring, use a new ring.
8. Install piston rings as follows (Fig. 6A1-63).
   a. Install oil ring spacer in groove.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined and, if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, use a new ring.

Fig. 6A1-62 Checking Ring in Groove

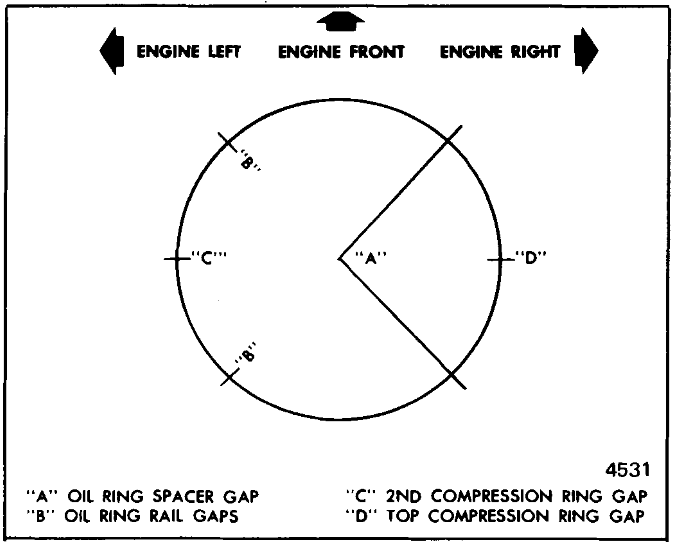


Fig. 6A1-63 Ring Gap Location

e. Install second compression ring expander, then ring with gaps properly located.

f. Install top compression ring with gap properly located.

9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the clearances between the surfaces of the ring and groove should be measured (Fig. 6A1-64). See Specifications.

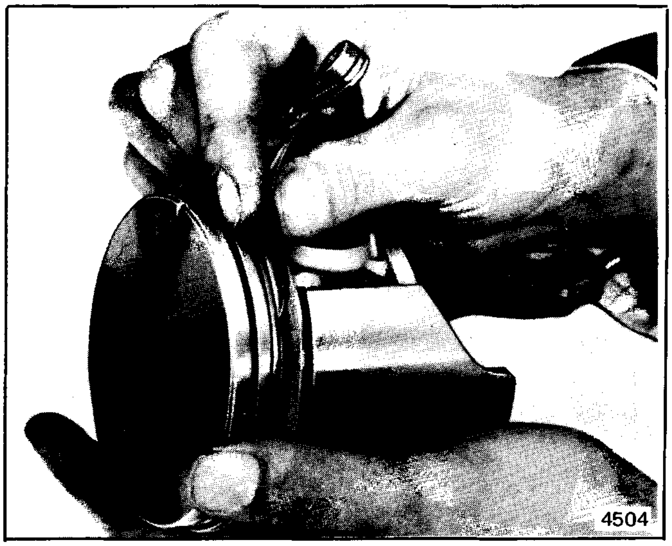


Fig. 6A1-64 Measuring Ring Groove Clearance

Installation

NOTE: Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.

2. Lightly coat pistons, rings and cylinder walls with light engine oil.

3. With bearing caps removed, install Tool J 23627 on connecting rod bolts.

CAUTION: *Be sure ring gaps are properly positioned as previously outlined.*

4. Install each connecting rod and piston assembly in its respective bore. Install with "F" on piston facing front of engine (Fig. 6A1-65). Use Tool J 8910 to compress the rings (Fig. 6A1-66). Guide the connecting rod into place on the crankshaft journal with Tool J 23627. Use a hammer handle and light taps to install the piston into the bore (Fig. 6A1-67). Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore (Fig. 6A1-67).

5. Remove Tool J 23627.

6. Install the bearing caps and torque nuts to 35 lbs. ft.

NOTE: If bearing replacement is required refer to "Connecting Rod Bearings".

Be sure to install new pistons in the same cylinders for which they were fitted, and used pistons in the same cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

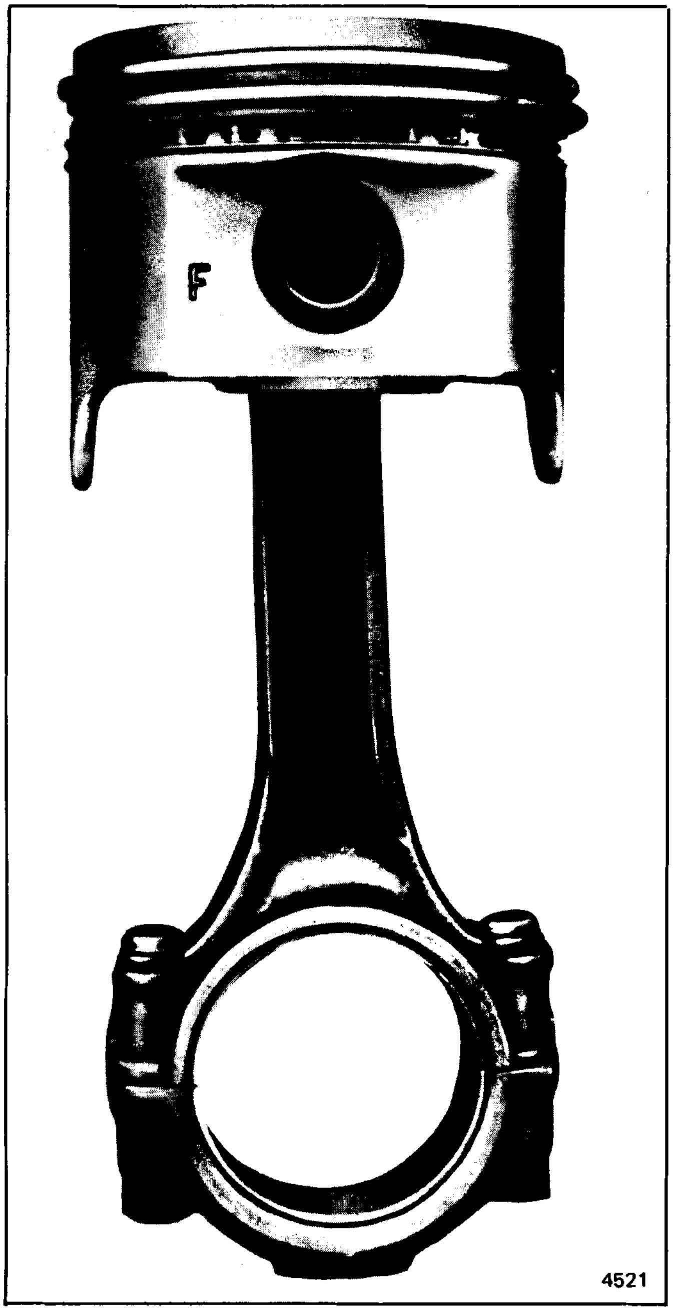


Fig. 6A1-65 Piston Alignment Reference

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not use shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive, a new bearing will be required. Bearings are available in standard size and .001" and .002" undersize for use with new and used standard size crankshafts, and in .010" and .020" undersize for use with reconditioned crankshafts.

Inspection and Replacement

1. Remove the connecting rod cap and bearing.
2. Inspect the bearing for evidence of wear or damage.
3. Wipe the bearings and crankpin clean of oil.
4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications, replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.

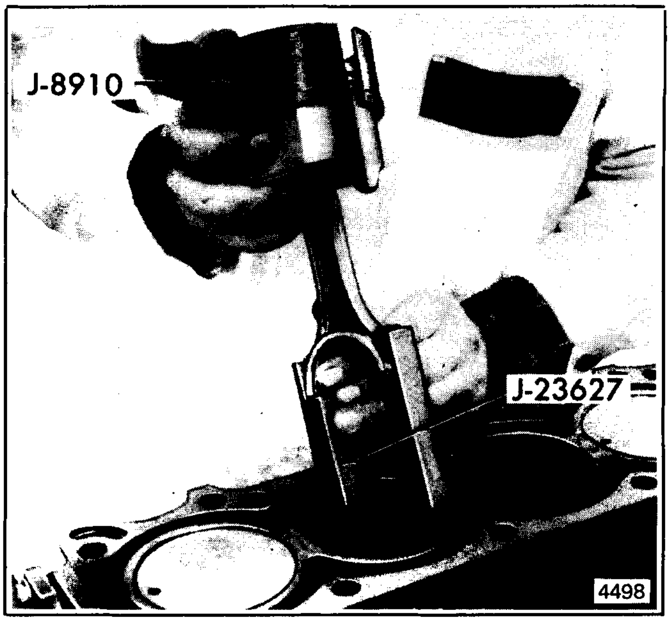


Fig. 6A1-66 Installing Connecting Rod

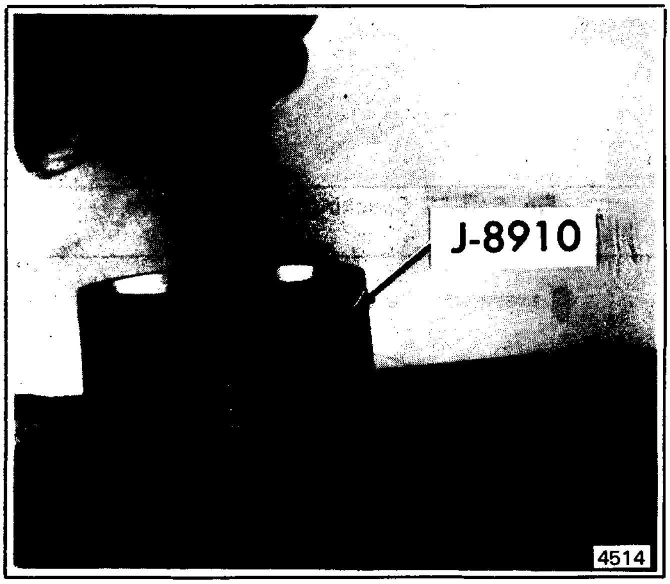


Fig. 6A1-67 Installing Piston Assembly

5. If within specifications, measure new or used bearing clearances with gaging plastic.

NOTE: If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001", interference between the bearing and crankpin will result in rapid bearing failure.

a. Place a piece of gaging plastic the full width of the crankpin, parallel to the crankshaft (Fig. 6A1-68).

b. Install the bearing in the connecting rod and cap.

c. Install the bearing cap and evenly torque nuts to 65 lbs. ft.

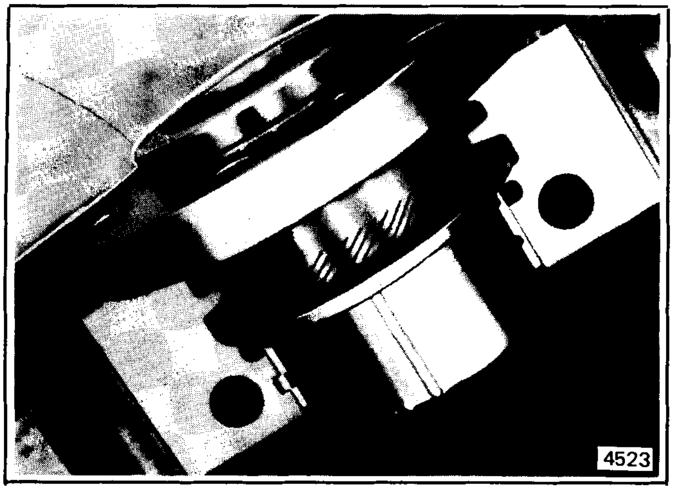


Fig. 6A1-68 Gauging Plastic On Crankpin

CAUTION: *Do not turn the crankshaft with the gaging plastic installed.*

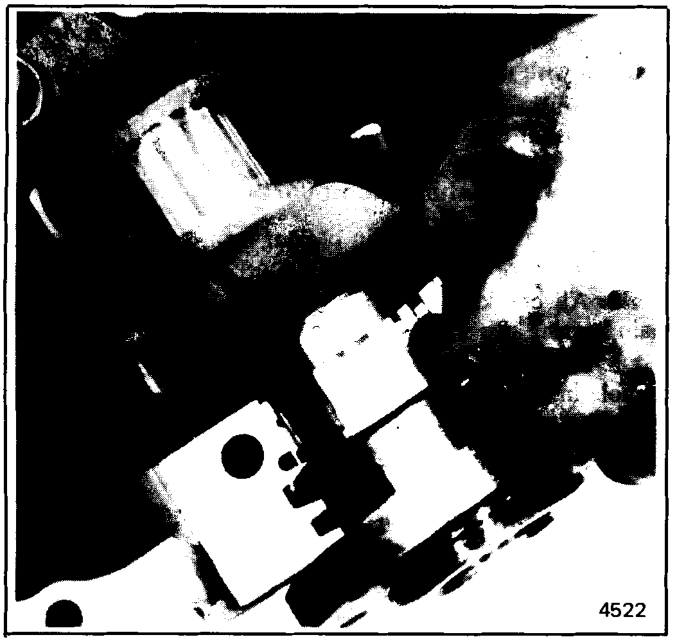


Fig. 6A1-69 Measuring Gauging Plastic

d. Remove the bearing cap and, using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point (Fig. 6A1-69).

6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.

7. Coat the bearing surface with oil, install the rod cap and torque nuts to 35 lbs. ft.

8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to the crankpin) to make sure they have clearance.

9. Measure all connecting rod side clearances (see specifications), between the connecting rod cap and side of crankpin (Fig. 6A1-70).

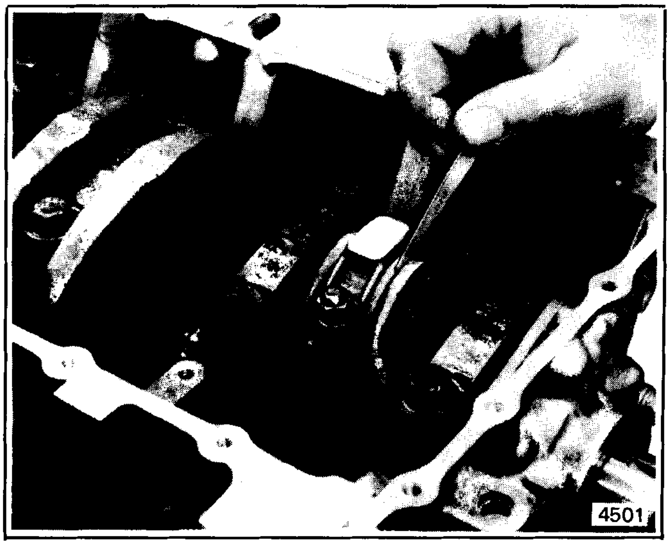


Fig. 6A1-70 Measuring Connecting Rod Side Clearance

MAIN BEARINGS

Main bearings are of the precision insert type and do not use shims for adjustments. If clearances are found to be excessive, a new bearing (both upper and lower halves) will be required. Bearings are available in standard size and .001", .002", .010" and .020" undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain proper oil clearances. For this reason you may find one half of a standard insert with one half of a .001" undersize insert which will decrease the clearance .0005" from using a full standard bearing.

NOTE: If, for any reason, main bearing caps are replaced, shimming may be necessary. Laminated shims for each cap are available for service. Shim requirement will be determined by bearing clearance.

Inspection

In general, the lower half of the bearing, except No. 1 bearing, shows a greater wear. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearance

To obtain the most accurate results with a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed. If the engine is out of the car and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the car, the crankshaft should be supported both front and rear to remove the clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

NOTE: To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, before checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. Starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.

2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal (Fig. 6A1-68).

CAUTION: *Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.*

3. Install the bearing cap and evenly torque the retaining bolts to 65 lbs. ft.

4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.

5. On the edge of gaging plastic envelope there is a graduated scale which is correleated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope (Fig. 6A1-69).

NOTE: Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001" max.), be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure.

If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001" difference.

6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit.

NOTE: If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks; if none are found, then install shims as required.

7. A standard .001" or .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.

8. Proceed to the next bearing. After all bearings have been checked, rotate the crankshaft to see that there is no excessive drag.

9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the number 4 bearing with a feeler gage (Fig. 6A1-71).

10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

REPLACEMENT

NOTE: Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removed

1. Remove and inspect the crankshaft.

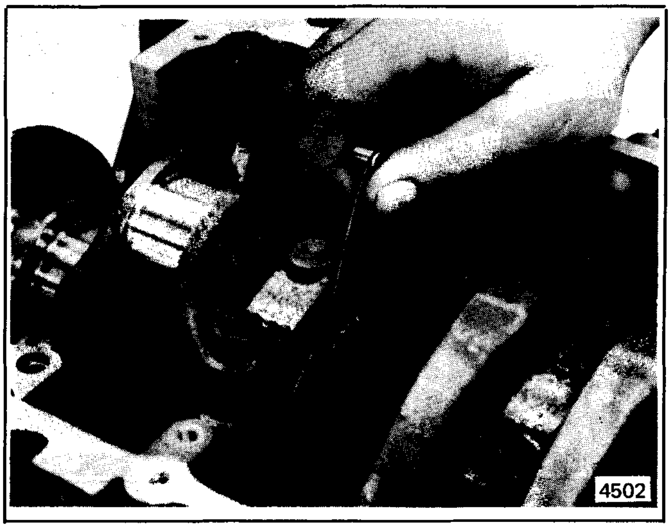


Fig. 6A1-71 Measuring Crankshaft End Play

2. Remove the main bearings from the cylinder block and main bearing caps.

3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.

4. Install the crankshaft.

Without Crankshaft Removal

1. Remove cap on main bearing requiring replacement and remove bearing from cap.

2. All crankshaft journals have oil holes. Replace the main bearing upper half as follows:

a. Install a main bearing removing and installing tool in oil hole in crankshaft journal.

NOTE: If such a tool is not available, a cotter pin may be bent as required to do the job.

b. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.

c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.

3. Oil new lower bearing and install in bearing cap.

4. Install main bearing cap with "F" pointing toward front of engine.

5. Torque main bearing cap bolts to 65 lbs. ft.

CRANKSHAFT

The crankshaft can be removed while the engine is disassembled for overhaul as previously outlined or without complete disassembly as outlined below.

Removal

1. With the engine removed from the car and the transmission and/or clutch housing removed from the engine, mount engine in overhaul stand and clamp securely.

2. Remove spark plugs.

3. Remove the oil dip stick, starter and brace and flywheel.

4. Remove engine front cover, accessory drive pulley, timing belt lower cover and crankshaft timing sprocket, using Tool J 23523.

5. Remove oil pan and baffle and oil pick-up tube.

6. Remove oil pump (crankcase front cover).

7. Check the connecting rod caps for cylinder number identification. If necessary, mark caps with corresponding cylinder number.

8. Remove the connecting rod caps and push the pistons to top of bores.

9. Remove main bearing caps and lift crankshaft out of cylinder block.

10. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.

2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize (see specification).

3. Check crankshaft for run-out by supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator.

4. Replace or recondition the crankshaft if out of specifications.

CYLINDER BLOCK

Cleaning and Inspection

1. Remove engine and disassemble as outlined under Crankshaft Removal.

2. Remove the cylinder head assembly.

3. Wash cylinder block thoroughly in an approved noncaustic cleaning solvent.

4. Clean and inspect all gasket surfaces.

5. Remove oil gallery plugs and clean all oil passages.

NOTE: These plugs may be removed with a sharp punch or they may be drilled and pried out.

6. Use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.

7. Clean cylinder bores with a hot water and detergent wash. After cleaning the cylinder bores should be swabbed several times with light engine oil and a clean cloth, and then wiped with a clean dry cloth. Cylinders should not be cleaned with kerosene or gasoline.

8. Measure the cylinder walls for taper and out-of-round. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about 1/4" when installing gage in bore. Center gage in cylinder and turn dial to zero. Carefully work gage up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition.

Oil Filter Bypass Valve

With the oil pump removed, check the spring and fiber valve for operation. Inspect for a cracked or broken valve. If replacement is necessary, remove valve by prying it out with a screwdriver. Install and seat a new valve by tapping it in place, using a 9/16" thin-wall deep socket.

REPAIRS

Cylinder Conditioning

In the event that bores are excessively scored or worn, they can be honed in the conventional manner with either manual or machine honing equipment for oversize pistons; however, the finishing step must be a silicon lapping process to achieve the finished bore surface required. The silcon lap is used to remove a sufficient amount of aluminum, leaving pure silicon particles prominent to form the bore wear surfaces.

Honing Procedures

Conventional honing equipment - either manual or machine - can be used. The manufacturers of this equipment are familiar with the requirements and can supply the required information and material for their equipment. Use only a fatty base honing oil (Sunnen Man-845 or equivalent). Do not use mineral seal type oil. Use commercially available honing equipment which will operate at approximately 350 rpm.

Roughing Operation

Use a 280 grit roughing stone set (manual - Sunnen MM33-J63, machine - Sunnen C30-A53-81; or equivalent). Stock removal rate will be approximately .0035" per minute. Hone to within .003" of finished size; surface finish will be approxmiately 25-30 micro inches. During the honign operation, flood cylinder with specified honing oil, using a continual spray pump or apply continuously with an oil squirt can.

Finishing Operation

Use a 400 grit finishing stone set (manual - Sunnen MM33-J85, machine - Sunnen C30-J84-81; or equivalent). Stock removal rate will be approximately .002" per minute. Remove approximately .002" stock, surface finish will be approximately 20-25 micro inches. Flood with specified honing oil same as during roughing operations.

Polishing Operation

Prior to this operation, be sure that all traces of the previous finishing operation abrasives are removed. Use a 600 grit polishing stone set (manual - Sunnen MM33-C05, machine - Sunnen C30-C03-81; or equivalent). Stock removal rate is approximately .0007" per minute with a maximum surface finish of 8 micro inches. Keep stone tension against cylinder wall fairly tight and remove approximately .001". Flood bore with specified honing oil.

Silicon Lap

For silicon lapping, mount felt lapping pads in hone in place of stones. Remove guides or replace with lapping pads. Generously coat cylinders and pads with lapping compound (Sunnen M33 or equivalent). Tighten pinion adjustment as snugly as possible with fingers. Lap for two minutes using no oil. Surface finish will be approximately 12-35 micro inches. There will be no significant stock removal during the lapping operation. Carefully clean block of all abrasive material and lapping compound.

NOTE: It should be re-emphasized that the final operation is silicon lap. The roughing, finishing, and polishing operations leave a surface finish consisting of both silicon particles and aluminum. The silicon lap removes all surface aluminum leaving purse silicon particles to form the bore wear surfaces.

Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

CAUTION: *Handle the pistons with care and to not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.*

Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil, the bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

Cylinder Case Threads

A cylinder and case thread repair unit is released through service parts - the repair unit as well as individual components are available separately.

Size	Usage	Torque
1/4-14	Engine Front Cover	50 in. lbs.
1/4-20	Cam Cover	35 in. lbs.
	Oil Screen-to-Support	50 in. lbs.
	Clutch Housing Dust Cover	80 in. lbs.
	Convertor Housing Underpan	95 in. lbs.
	Oil Screen Support-to-Baffle	50 in. lbs.
	Oil Drain Back Tube-to-Baffle	50 in. lbs.
5/16-18	Fan Blade to Pump	20 ft. lbs.
	Clutch Pressure Plate-to-Flywheel	20 ft. lbs.
	Oil Pick-up Tube-to-Case	25 ft. lbs.
	Crankshaft Damper/Pulley-to-Sprocket	15 ft. lbs.
	Oil Pump-to-Case (Bolt)	15 ft. lbs.
	Water Pump-to-Case	15 ft. lbs.
	Oil Pan-to-Case	15 ft. lbs.
	Cam Retainer	15 ft. lbs.
5/16-24	Exhaust Gas Recirculation Valve to Manifold	20 ft. lbs.
11/32-24	Connecting Rod Cap	35 ft. lbs.
3/8-16	Oil Pump-to-Case (Stud)	30 ft. lbs.
	Distributor Clamp Nut	25 ft. lbs.
	Water Outlet-to-Head	30 ft. lbs.
	Manifold (Bolts)	30 ft. lbs.
	Clutch Housing-to-Case	25 ft. lbs.
	Clutch Pressure Plate-to-Flywheel	35 ft. lbs.
3/8-18	Inlet Manifold-to-Head (Stud)	30 ft. lbs.
7/16-14	Engine Mount Stud-To-Block	20 ft. lbs.
	Main Bearing Caps	65 ft. lbs.
	Cylinder Head	60 ft. lbs.
7/16-20	Flywheel-to-Crank	60 ft. lbs.
1/2-13	Cam Sprocket-to-Cam	80 ft. lbs.
	Damper/Pulley-to-Crank	80 ft. lbs.
1/2-20	Oil Pan Drain Plug	20 ft. lbs.
1.00-12	Oil Filter Connector-to-Case	30 ft. lbs.
	Oil Filter	Handtight
14MM	Spark Plug	15 ft. lbs.

1900

Fig. 6A1-72 Engine Torques

ENGINE – GENERAL SPECIFICATIONS

Type, no. cyls., valve arr.		In Line, 4 Cyl.
Bore and stroke (nominal)		Overhead Cam
		3.501 X 3.625
Piston displacement, cu. in.		140
Bore spacing (C/L to C/L)		4.00
No. system (front to rear)	L. Bank	1–2–3–4
	R. Bank	––
Firing Order		1–3–4–2
Cylinder Head Material		Cast Iron Alloy
Cylinder Block Material		Die Cast Aluminum
Cyl. Sleeve-Wet, dry, none		None
Number of mtg. points	Front	Two
	Rear	One
Engine installation angle		3.83
Recommended fuel regular – premium		Unleaded–91 (or higher)
Cylinder Head Volume (cc)		73.5
Head Gasket Thickness (Compressed)		.049
Head Gasket Volume (cc)		8.08
Deck Clearance (minimum) (above or below block)		.0025 (below)
Minimum Combustion Chamber Volume (cc)		72.0

ENGINE – PISTONS

Material			
Description and finish			Flat Head Open Skirt Iron Plated
Weight (piston only) oz.			14.08
Clearance (limits)	Top land		.0300 – .0360
	Skirt	Top	.0018 – .0028 (a)
		Bottom	––
Ring groove diameter	No. 1 ring		3.130 – 3.140
	No. 2 ring		3.130 – 3.140
	No. 3 ring		3.080 – 3.090

(a) Measured 1.50 below top of piston

ENGINE – PISTON RINGS

Function (top to bottom)	No. 1, oil or comp.	Compression
	No. 2, oil or comp.	Compression
	No. 3, oil or comp.	Oil
Compression	Description – material, coating, etc.	(a)
	Width	.0775 – .0780
	Gap	(c)
Oil	Description – material, coating, etc.	Multi-piece (2 rails and 1 spacer-expander) Rails: Steel with chrome plated O.D. Expander: Stainless steel
	Width	.187 – .189
	Gap	.010 – .030
Expanders		In Oil Ring Assembly

(a) Cast iron, barrel face: No. 1 – chrome plated
No. 2 – chrome plated, inside bevel
(c) No. 1–.015–.025; No. 2–.009–.019

ENGINE – PISTON PINS

Material			Chromium Steel
Length			2.75
Diameter			.9270 – .9273
Type	Locked in rod, in piston, floating, etc.		Locked in Rod
	Bushing	In rod or piston	None
		Material	––
Clearance	In piston		.0003 – .0004
	In rod		Press Fit
Direction & amount offset in piston			To Right .060

ENGINE – CRANKSHAFT

Material			Nodular Iron
Vibration damper type			None
End thrust taken by bearing (No.)			4
Crankshaft end play			.002 – .008
Main bearing	Material & type		Premium Aluminum
	Clearance		.0003 – .0029
	Journal dia. and bearing overall length	No. 1	2.30 X .752
		No. 2	2.30 X .752
		No. 3	2.30 X .752
		No. 4	2.30 X .760
		No. 5	2.30 X .864
		No. 6	None
		No. 7	None
	Dir. & amt. cyl. offset		None
	No. bolts/main brg. cap		2
Crankpin journal diameter			2.00

ENGINE – CAMSHAFT

Location			In Cyl. Head
Material			Cast Alloy Iron
Bearings	Material		Babbit on Steel
	Number		5
Type of Drive	Gear or chain		(a)
	Crankshaft gear or sprocket material		Sintered Iron
	Camshaft gear or sprocket material		Sintered Iron
	Timing chain	No. of links	91 Teeth
		Width	.954 – 1.031
		Pitch	.500

(a) Timing belt–fiberglass reinforced cog

ENGINE – VALVE SYSTEM

Hydraulic lifters (Std., opt., NA)			NA
Timing (based on top of ramp points)	Intake	Opens (°BTC)	34°
		Closes (°ABC)	74°
		Duration (deg)	288°
	Exhaust	Opens (°BBC)	76°
		Closes (°ATC)	36°
		Duration (deg)	292°
	Valve open overlap (deg)		70°
Intake	Material		Alloy Steel (a)
	Overall length		4.590 – 4.610
	Actual overall head dia.		1.615 – 1.625
	Angle of seat & face (deg)		46° ST; 45° FACE
	Stem diameter		.3410 – .3417
	Stem to guide clearance		.0010 – .0027
	Lift (@ zero lash)		.4000
	Outer spring press & length	Valve closed (lb. @ in.)	71 – 79 @ 1.746
		Valve open (lb. @ in.)	183 – 197 @ 1.310
Exhaust	Material		Alloy Steel (a)
	Overall length		4.576 – 4.596
	Actual overall head dia.		1.370 – 1.380
	Angle of seat & face (deg)		46° ST; 45° FACE
	Seat insert material		Not Used
	Stem diameter		.3410 – .3417
	Stem to guide clearance		.0010 – .0027
	Lift (@ zero lash)		.4150
	Outer spring press & length	Valve closed (lb. @ in.)	71 – 79 @ 1.746
		Valve open (lb. @ in.)	183 – 197 @ 1.310

(a) Stellite Face

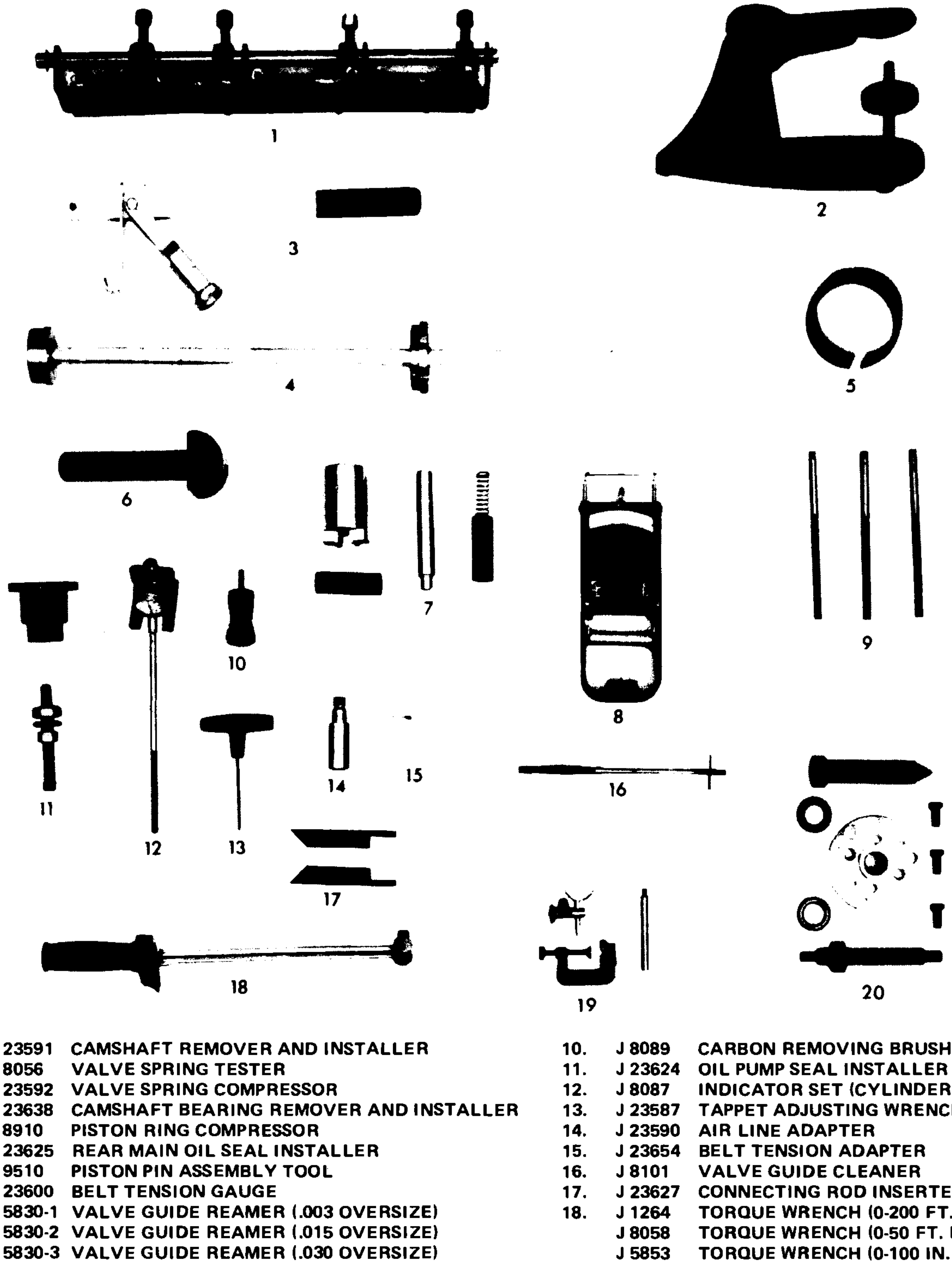
ENGINE – CONNECTING RODS

Material		Forged Steel
Weight (oz.)		14.24
Length (center to center)		5.70
Bearing	Material & Type	Premium Aluminum
	Overall length	.807
	Clearance (limits)	.0007 – .0027
	End Play	.009 – .013

4686

Fig. 6A1-73 Engine Specifications

SPECIAL TOOLS



1.	J 23591	CAMSHAFT REMOVER AND INSTALLER
2.	J 8056	VALVE SPRING TESTER
3.	J 23592	VALVE SPRING COMPRESSOR
4.	J 23638	CAMSHAFT BEARING REMOVER AND INSTALLER
5.	J 8910	PISTON RING COMPRESSOR
6.	J 23625	REAR MAIN OIL SEAL INSTALLER
7.	J 9510	PISTON PIN ASSEMBLY TOOL
8.	J 23600	BELT TENSION GAUGE
9.	J 5830-1	VALVE GUIDE REAMER (.003 OVERSIZE)
	J 5830-2	VALVE GUIDE REAMER (.015 OVERSIZE)
	J 5830-3	VALVE GUIDE REAMER (.030 OVERSIZE)
10.	J 8089	CARBON REMOVING BRUSH
11.	J 23624	OIL PUMP SEAL INSTALLER
12.	J 8087	INDICATOR SET (CYLINDER BORE)
13.	J 23587	TAPPET ADJUSTING WRENCH
14.	J 23590	AIR LINE ADAPTER
15.	J 23654	BELT TENSION ADAPTER
16.	J 8101	VALVE GUIDE CLEANER
17.	J 23627	CONNECTING ROD INSERTER
18.	J 1264	TORQUE WRENCH (0-200 FT. LB.)
	J 8058	TORQUE WRENCH (0-50 FT. LB.)
	J 5853	TORQUE WRENCH (0-100 IN. LB.)
19.	J 8001	INDICATOR SET (UNIVERSAL)
20.	J 23523	CRANKSHAFT SPROCKET REMOVER

TOOLS NOT ILLUSTRATED

J 24311 EXHAUST GAS RECIRCULATION TUBE–REMOVER & INSTALLER

4876

Fig. 6A1-74 Engine Special Tools

SECTION 6A2

2.5 LITRE 151 CU. IN. L4 ENGINE

(V.I. CODE V)

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast iron and has 4 in line cylinders which are numbered from front to rear, 1 through 4. Five main bearings support the crankshaft which is retained by recessed bearing caps that are machined with the block for proper alignment and clearances.

Cylinders are completely encircled by coolant jackets. For details of engine cooling system, see ENGINE COOLING, Section 6B.

CYLINDER HEAD

The cast iron cylinder head provides a compression ratio of 8.25:1.

It is cast with individual intake and exhaust ports for each cylinder. Valve guides are integral and rocker arms are retained on individual threaded studs.

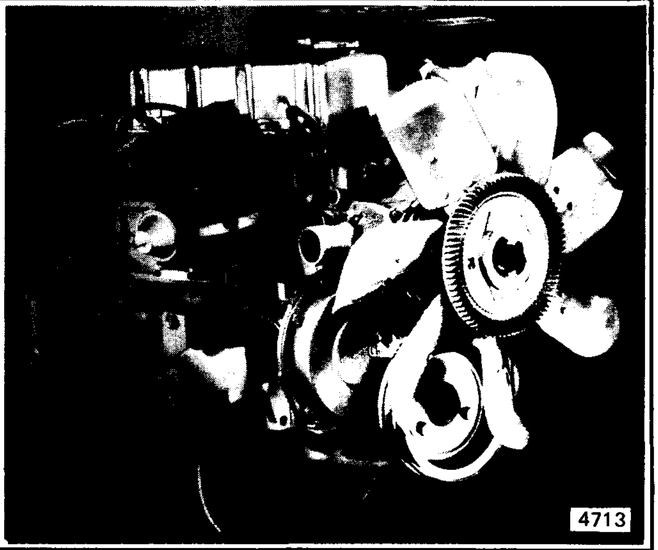


FIG. 6A2-1 L4 ENGINE

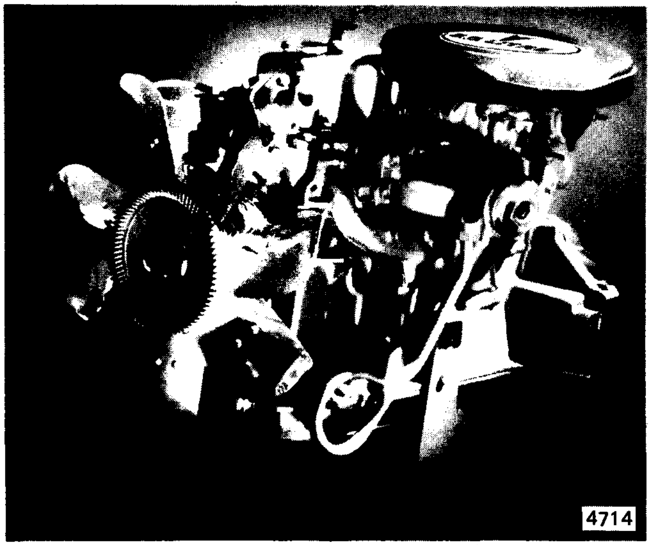


FIG. 6A2-2 L4 ENGINE

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by five main bearings. Number five bearing is the thrust bearing.

Main bearings are lubricated from oil holes which intersect the main oil gallery which runs parallel to the crankshaft bores along the right side of the block.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by three bearings and is gear driven. A cast iron crankshaft gear drives the camshaft through a bakelite fabric composition gear with a steel hub (Fig. 6A2-3).

Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifter, causes valve lifters to rotate.

Camshaft bearings are lubricated (through oil holes which intersect the main gallery).

PISTONS AND CONNECTING RODS

The pistons are of a light weight cast all aluminum slipper skirt type and cam ground so that the diameter across the thrust faces is larger than the diameter fore and aft of the engine. Two compression rings and one oil control ring are used, all of which are located above the piston pin. (Fig. 6A2-4).

Piston pins are offset toward thrust side (right-hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins are tempered steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

Connecting rods are made of Armasteel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

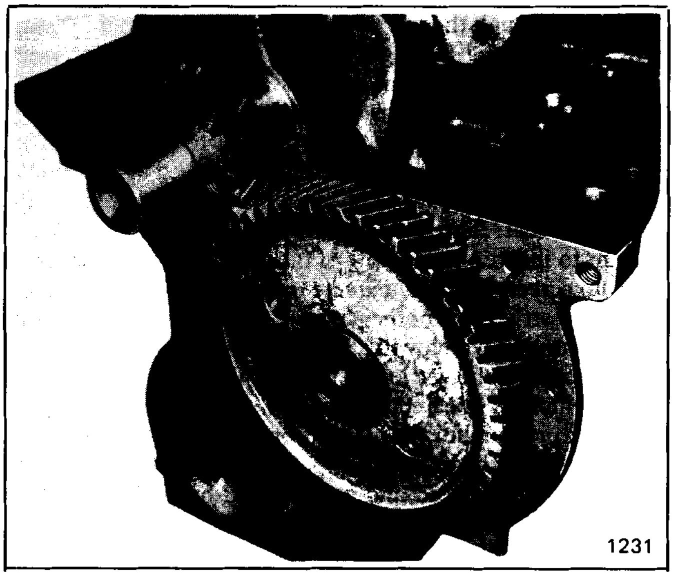


Fig. 6A2-3 Camshaft and Crankshaft Gears

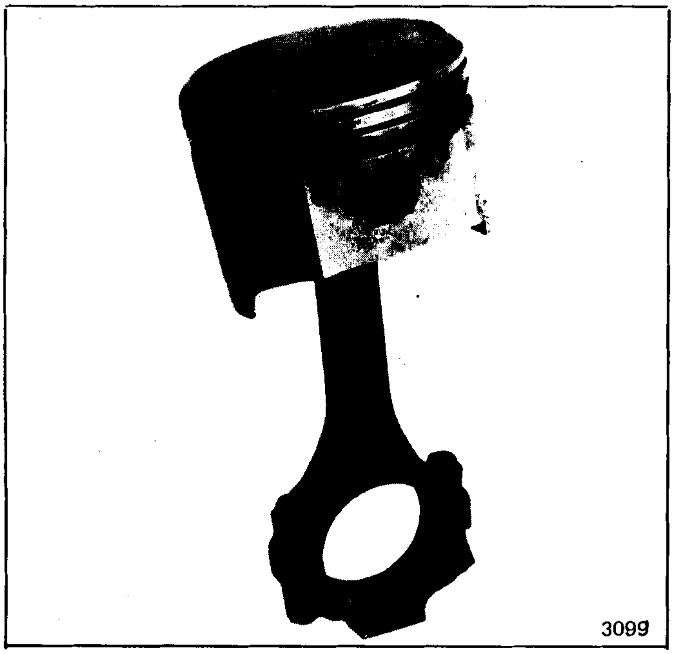


Fig. 6A2-4 Piston and Rod Assembly

VALVE TRAIN

A very simple ball pivot-type train is used (Fig. 6A2-5). Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker-arm ball is retained by a nut.

The cylinder head has straight valve guides cast integrally. External shields are used on both intake and exhaust valves to reduce the amount of oil splashed against the stems. Valve stem seals are used on intake and exhaust valves to prevent an excess of oil from entering the valve guides.

A single valve spring is used with an internal damper

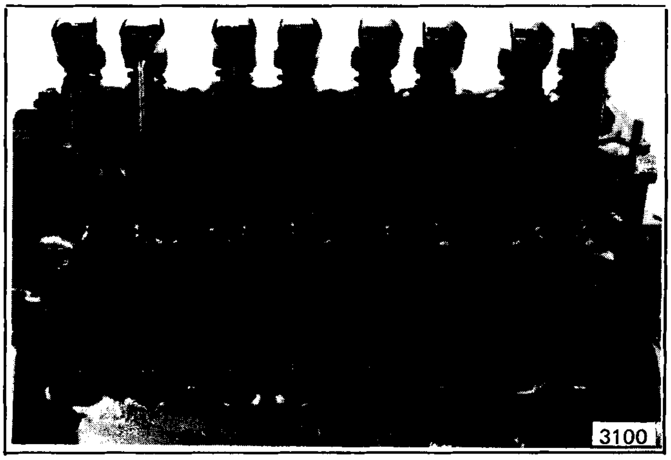


Fig. 6A2-5 Valve Train

HYDRAULIC VALVE LIFTERS

Hydraulic valve lifters are used to keep all parts of the valve train in constant contact. Each letter is an automatic adjuster maintaining zero lash under all conditions.

The hydraulic lifter assembly (Fig. 6A2-6) consists of a steel body with a wear resistant foot which rides in the cylinder block boss, the plunger, push rod seat, metering valve, plunger spring, ball check valve and spring, ball check valve retainer, and retainer ring.

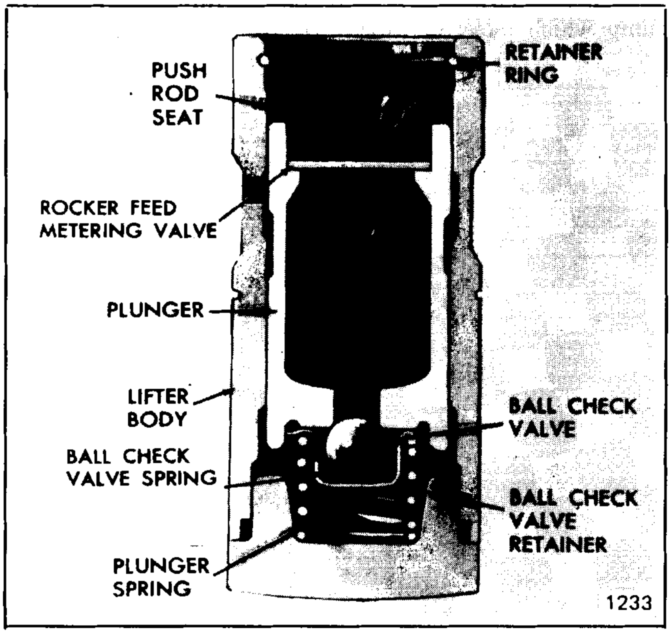


Fig. 6A2-6 Valve Lifter

INTAKE AND EXHAUST MANIFOLDS

Intake and exhaust manifolds are fastened together to utilize exhaust heat for intake and carburetor warm up. The intake manifold is a single level design. An EGR port is cast into the intake manifold and receives exhaust gases through an external connector pipe fastened between the two manifolds (Fig. 6A2-7).

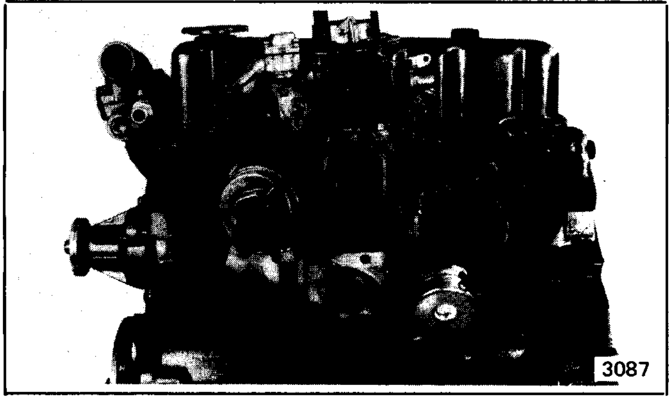


Fig. 6A2-7 Intake and Exhaust Manifolds

COMBUSTION CHAMBERS

Combustion chambers are cast to insure uniform shape for all cylinders. Spark plugs are located near intake valves for maximum power and to properly fire economically lean mixtures.

Intake valves are large and have 46° seat angles to further provide easy breathing for high combustion efficiency. Exhaust valve seat angle is also 46°. The 46° seat secures valve to seat contact at the outer diameter of the seat.

LUBRICATION SYSTEM

Engine lubrication is accomplished through a gear type pump which picks up engine oil from the oil pan sump, pumps it through the full flow oil filter and into an oil passage which runs along the right side of the block and intersects the lifter bosses. Oil from this passage is then routed to the crankshaft main bearings and camshaft bearings through smaller drilled passages. Oil is supplied to the rocker arms through holes in the hydraulic lifter which feed up the tubular pushrods to the rocker. The oil is metered by miscs under push rod seat. Three valves are incorporated into the oil system to insure proper flow of oil. A bypass valve in the oil pick up screen insures adequate oil flow if the screen should become restricted. Another bypass valve is located at the oil filter mounting which will allow oil flow in the event that the filter becomes plugged or restricted. The pressure regulator valve which is located in the oil pump body maintains adequate pressure for the lubrication system and bypasses any excess back to the oil pan sump. Many internal engine parts have no direct oil feed and are supplied by either gravity or splash from other direct feed components. Timing gears are lubricated by oil which is supplied through a passage from the front of the camshaft to a calibrated nozzle above the crankshaft gear. Engine lubrication diagram is shown in Fig. 6A2-8.

OIL FILTER

A full flow oil filter is standard equipment on the engine. The filter is mounted on a machined boss on the right front side. All oil from the pump passes through the filter before going to the engine oil galleries. In the filter, the oil passes through a filtering element where dirt and foreign particles are removed.

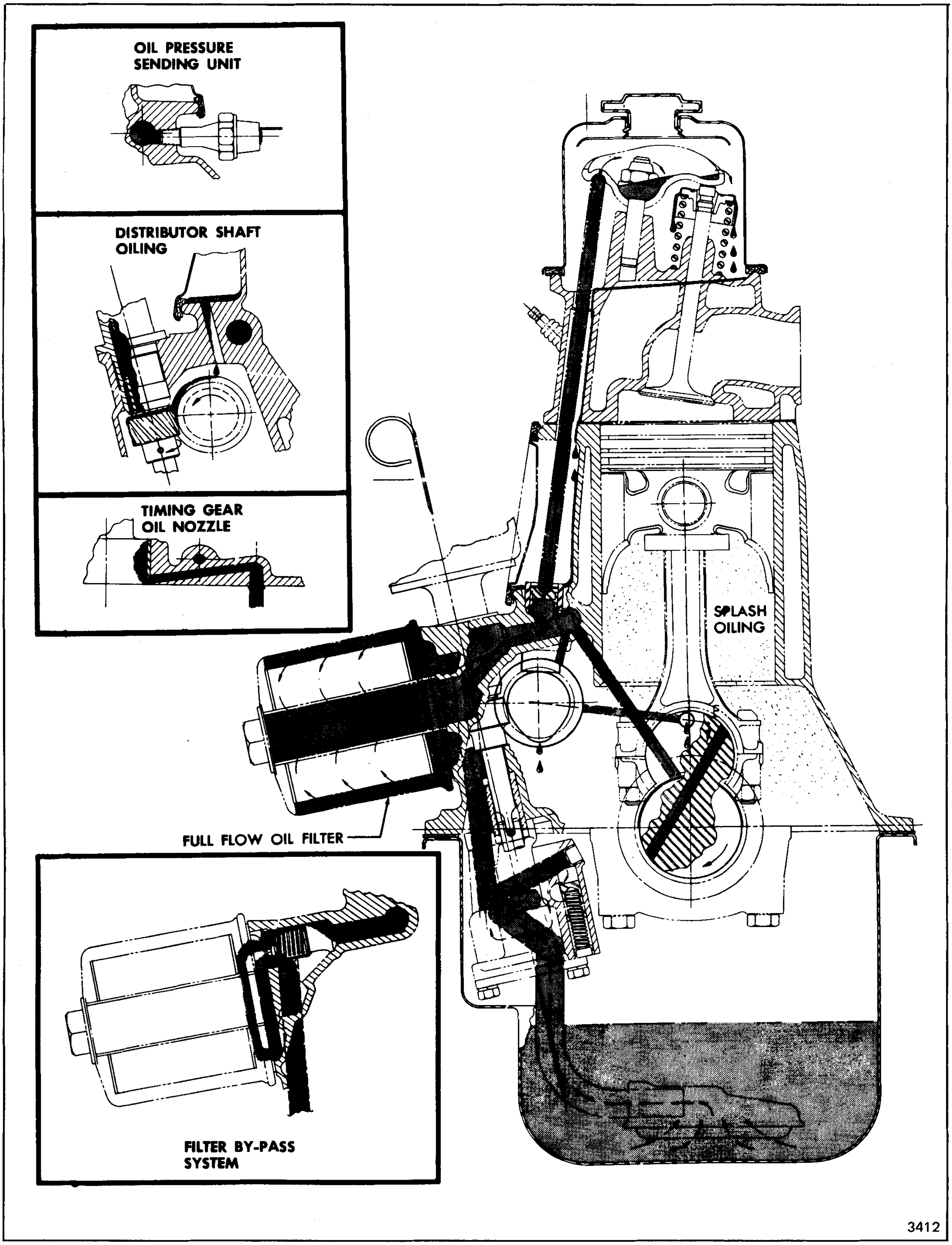


Fig. 6A2-8 Engine Lubrication (L4)

ON-CAR SERVICE

ENGINE INSULATORS

FRONT INSULATORS

REMOVE AND REPLACE

H Series

1. Remove bracket to engine bolts and chassis to mount attaching nut.
2. Lift engine using suitable equipment until insulator is free.
3. Remove insulator and separate from engine bracket.
4. Replace insulator by reversing procedure.

X Series

1. Remove insulator to engine bracket through bolt.
2. Raise engine in suitable manner until mount is free from bracket.
3. Remove insulator to frame bolts and remove insulator.
4. To replace reverse procedure.

NOTE: Engine lift tool J-23515 and adapter J-23515-3 can be used to lift engine on X Series.

REAR INSULATOR

REMOVE AND REPLACE

1. Remove crossmember to rear insulator bolts.
2. Raise rear of engine and transmission with suitable lifting equipment.
3. Remove insulator to transmission extension bolts (Figs. 6A2-9 and 6A2-10).
4. Replace insulator and install insulator to transmission housing bolts. Tighten to 30 lb. ft.
5. Lower engine and transmission into position.
6. Install crossmember to insulator bolts and tighten to 40 lb. ft.

INTAKE AND EXHAUST MANIFOLD

Remove

1. Remove air cleaner and inlet ducts.
2. Disconnect fuel lines, vacuum lines and electrical connectors.
3. Disconnect carburetor throttle linkage, remove carburetor and heat shield.

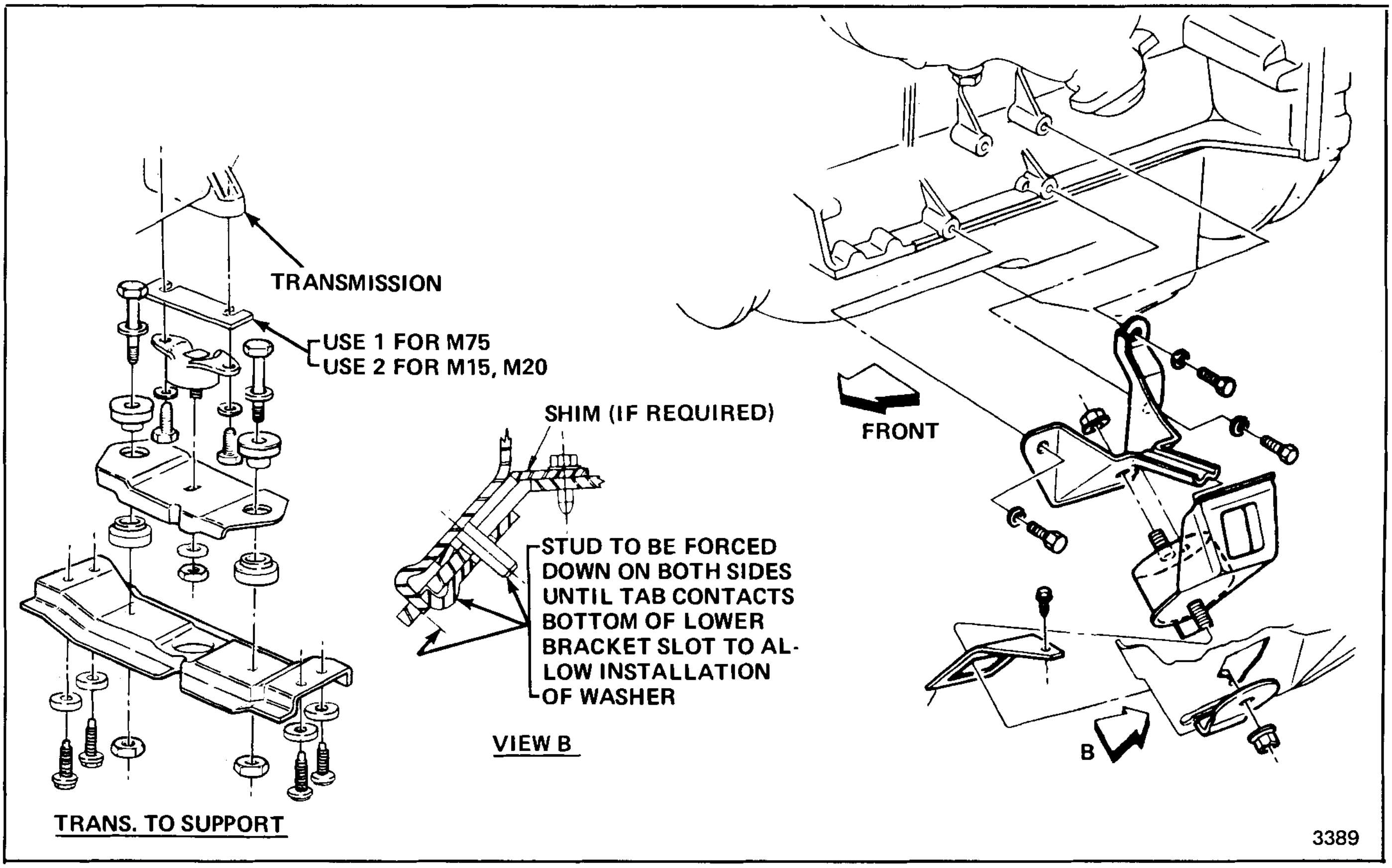


FIG. 6A2-9 ENGINE INSULATORS - L4 H SERIES

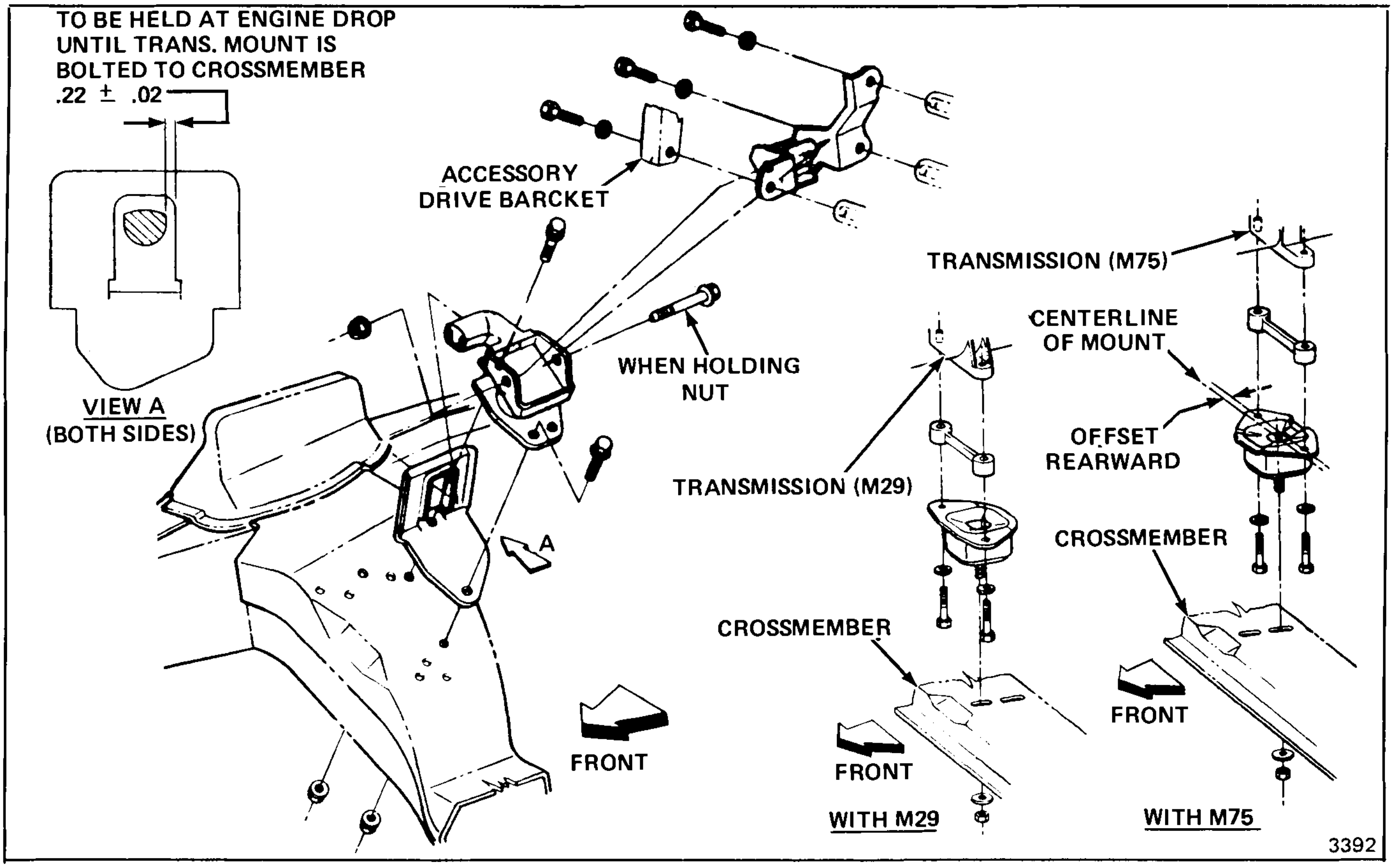


FIG. 6A2-10 ENGINE INSULATORS L4 X SERIES

4. Remove exhaust pipe to manifold attachments.
5. Remove manifold to cylinder head bolts and nuts.
6. Remove intake and exhaust manifold assembly.

NOTE: It may be necessary to remove the generator rear bracket to remove manifold assembly.

To separate intake and exhaust manifolds, disconnect E.G.R. pipe and remove the four (4) bolts at the center of the manifold.

NOTE: Whenever manifolds are separated, a new gasket must be installed between the two sections. Install the gasket with the perforated side toward intake manifold.

CAUTION: *When assembling the manifolds together, install the four bolts loosely. Place the manifolds on a straight, flat surface and hold securely during tightening and final torque. This will assure the proper mating of surfaces when installing the manifold assembly on the head. Failure to assemble manifolds in this manner could result in failure of manifolds from stress cracking (torque bolts to 35 lb. ft.)*

When replacing exhaust manifold be sure insulator gasket is in place between E.F.E. bracket and manifold (Fig. 6A2-11).

Replace

1. Install manifold assembly on cylinder head being sure guides are in place.

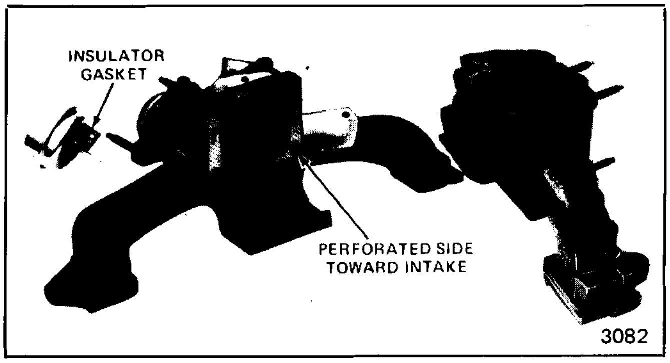


Fig. 6A2-11 Intake and Exhaust Manifolds

2. Start all bolts.
3. Torque manifold to cylinder head bolts using torque sequence shown in Fig. 6A2-12.
4. Complete installation by reversing removal procedures.

ROCKER ARM COVER

Remove

1. Remove air cleaner.

1a. Remove for line clips on R.H. side.

1b. Remove PCV valve or hose.

2. Remove rocker cover bolts.
3. Remove rocker cover by rapping with a rubber hammer to break gasket seal. Do not pry on cover.

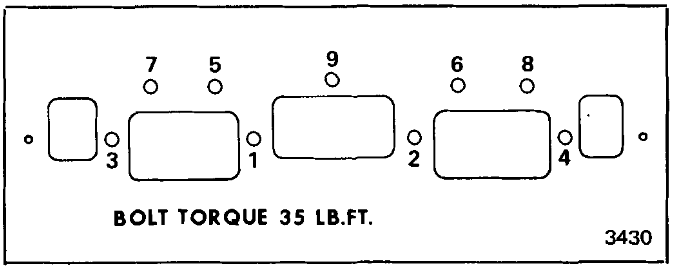


Fig. 6A2-12 Manifold Bolt Torque Sequence

Replace

1. Install new gasket on cover - glue gasket to cover.
2. Install cover bolts (torque to 7 lb. ft.). Reinforcements must be installed with bow up.
3. Install air cleaner.
4. Install fuel line clips and PCV system.

ROCKER ARM, PUSH ROD AND/OR ROCKER STUD

Remove

1. Remove rocker cover.
2. Remove rocker arm nut and ball.
3. Remove rocker arm.

NOTE: If only the push rod is to be replaced, loosen rocker nut and swing arm away from pushrod. Remove pushrod by pulling it up through the hole in the head.

4. Remove rocker stud using a deep socket and turning stud out of head.

Replace

1. Install rocker stud in head and torque to 60 lb. ft.
2. Install pushrod through the hole in the head and into lifter seat.
3. Install rocker arm, arm ball and nut. Torque nut to 20 lb. ft.
4. Install rocker cover.

VALVE SPRINGS, SHIELD AND/OR SEALS

Remove

1. Remove rocker arm cover.
2. Remove rocker arms on cylinder to be serviced.
3. Remove spark plug from cylinder of valve(s) to be serviced.
4. Install air hose adapter J-22794 into spark plug hole and apply air pressure to hold valves in place.
5. After removing rocker arm, thread rocker arm nut on rocker arm stud. Insert slotted end of tool J-5892-1 under rocker arm nut. Compress valve spring (Fig. 6A2-13) and hold to allow removal of valve spring retainer cup locks. Remove tool, valve spring retainer cup shield and valve stem seal.

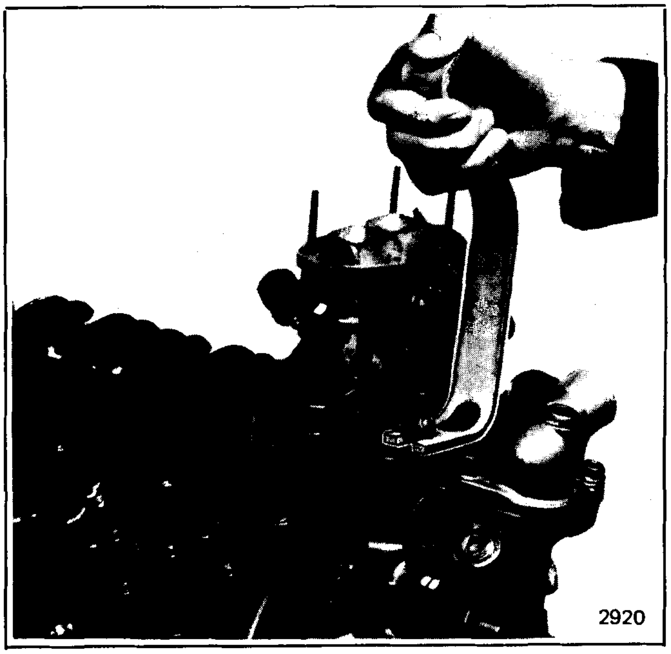


Fig. 6A2-13 Compressing Valve Springs

Replace

1. Install any new parts by reversing removal procedure steps 2-5. Torque rocker nuts to 20 lb. ft.

NOTE: Always install a new valve stem oil seal whenever spring locks have been disturbed.

2. Install spark plug and rocker cover.

PUSH ROD COVER OR GASKET

Remove

1. Remove fuel line clip.
2. Remove push rod cover bolts and remove cover.

Replace

1. Glue new gasket on push rod cover.
2. Install cover and cover to block bolts.
3. Install fuel line clip.

VALVE LIFTER

Remove

1. Remove rocker arm cover.
2. Loosen rocker arm and rotate it for clearance from push rod.
3. Remove push rod.
4. Remove push rod cover.
5. Remove lifter. Hydraulic valve lifter remover J-3049 may facilitate removal of lifter.

If new lifter is to be installed, be sure to remove all sealer coating from inside of new lifter and check leak-down rate.

Replace

1. Place lifter in lifter boss.

2. Replace push rod.
3. Position rocker arm on push rod.
4. With lifter on base circle of camshaft, tighten rocker arm nut to 20 lb. ft.
5. Replace pushrod cover.
6. Install rocker arm cover.

HYDRAULIC VALVE LIFTERS

Recondition

Because of the important part hydraulic valve lifters play in the operation of an engine and the close tolerances to which they are manufactured, proper handling, and above all, cleanliness cannot be overstressed when servicing these parts.

New lifters are serviced as individual units packaged with a plastic coating. Leave the coating on until ready to check leak-down rate. It is not necessary to remove the oil from new lifters prior to checking leak-down rate since special leak-down oil is already in new lifters.

Wash tank and tray, J-5821, is recommended for cleaning valve lifters. This tank should be used only for valve lifters and should be kept covered when not in use. All servicing should be done in an area removed from grinders or other sources of dust and foreign material.

Lifters should at all times be stored in a covered box which will aid in keeping them clean. The lifter box should be kept dry and as free of oil as possible.

Disassemble

1. Remove push rod seat retainer ring by holding seat down with push rod while dislodging ring from lifter body with a pointed tool (Fig. 6A2-14).

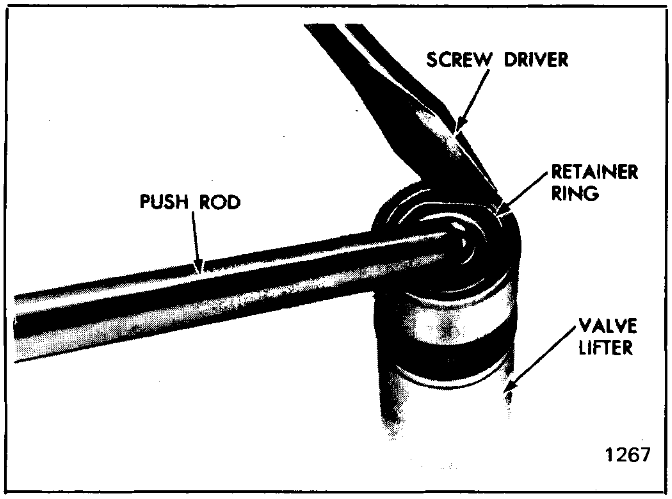


Fig. 6A2-14 Removing Push Rod Seat Retainer

2. Invert lifter and allow push rod seat and plunger to slide out of body. If plunger sticks in body, place lifter in large end of hydraulic valve lifter plunger remover, J-4160-A, with push rod end of lifter downward. Hold tool firmly in hand with thumb over lifter body and sharply strike tool against a block of wood (Fig. 6A2-15) until plunger falls out. (It may be necessary to soak a lifter having a stuck plunger in cleaning solvent for several minutes in order to remove the plunger).

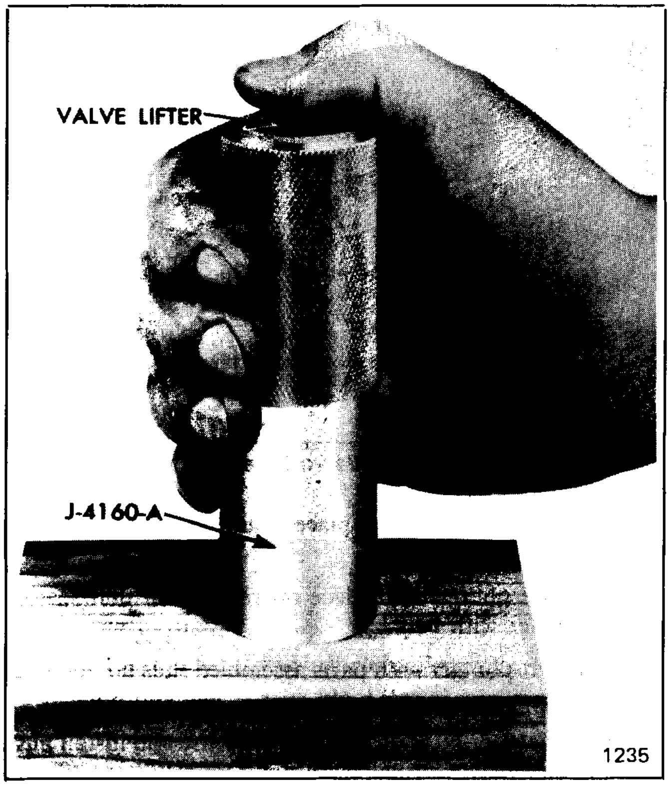


Fig. 6A2-15 Removing Stuck Plunger

3. Drain oil out of lifter body and place all valve lifter parts in separate compartment of tray from wash tank J-5821.

CAUTION: *Valve lifter body and plunger are selectively fitted and must not be interchanged with parts of other lifters. Keeping all parts of lifters together will also aid in trouble diagnosis.*

Clean and Inspect

Thoroughly clean and inspect lifter surfaces for nicks, scratches or scores. Inspection of the check ball and seat should be done with a magnifying glass. The lifter base should also be inspected for wear. If heavy wear is indicated on the cam mating surface, the same lobe of the cam should also be checked.

CAUTION: *Clean lifters using only approved solvent and a soft brush. Never use a wire brush or sand paper.*

Assemble

All parts must be absolutely clean when assembling a hydraulic lifter. Since lint and dust may adhere to parts, they should not be blown off with air or wiped with cloths. All parts should be rinsed in clean kerosene and assembled without drying. A small container with clean kerosene (separate from cleaning tank) should be used for each set of lifters being overhauled.

Figure 6A2-16 shows the relative position of component parts of valve lifters. The recommended procedure for assembly is given in the following steps.

1. Rinse plunger spring and ball retainer and position retainer in spring.

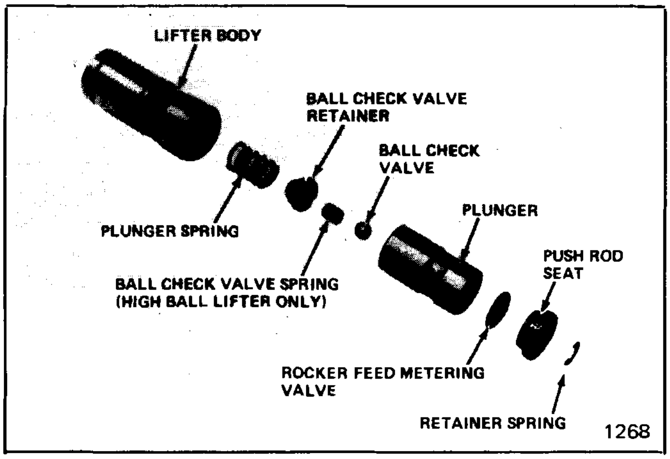


Fig. 6A2-16 Hydraulic Valve Lifter - Exploded View

2. Rinse lifter ball and place it and the small spring in retainer.

3. Rinse plunger and place on retainer so that seat on plunger mates with ball.

4. Invert plunger with parts assembled thus far and after rinsing lifter body, install body over spring and plunger.

5. Place lifter body on clean paper, rinse and install push rod seat and retainer ring.

6. After lifter has been assembled, place in lifter box and close lid to preserve cleanliness.

Test Leak-Down Rate

After all lifters have been assembled, the leak-down rate must be checked before they are installed in the engine. Valve lifter leak-down tester J-5790 (Fig. 6A2-17) is designed to test leak-down rate of lifters to determine whether or not they are within specified limits. As with previous service operations concerned with lifters, cleanliness is paramount. The tester cup and ram should be thoroughly cleaned, and testing should be done in an area free of dust and dirt. The testing procedure is described in the following steps:

1. Fill tester cup to approximately one inch from top with special fluid which is available from tester manufacturer.

2. Swing weight arm up out of the way, raise ram, and position lifter into boss in center of tester cup.

3. Adjust ram (with weight arm clear of ram) so that the point is positioned on the set line (marked "S"). Tighten jam nut to maintain setting.

4. Operate lifter through full travel of plunger by pumping weight arm to fill lifter with test fluid and force out air. (Lifter must be completely submerged at all times.) Continue pumping for several strokes after definite resistance is detected.

5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and commence turning crank slowly (1 revolution every 2 seconds).

Time indicator travel from lower line (first line above set line) to line marked .094 or 3/32", while still rotating cup with crank (Fig. 6A2-17). Lifter is satisfactory if rate is between 12 and 90 seconds.

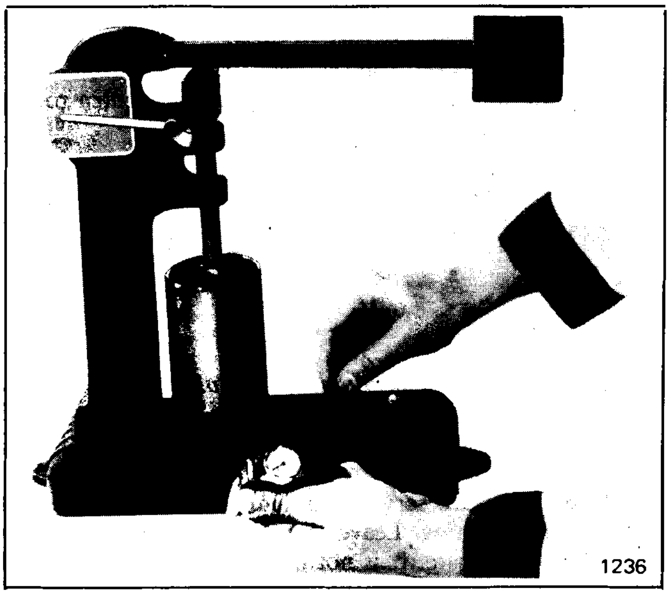


Fig. 6A2-17 Testing Leak-Down Rate

CYLINDER HEAD OR GASKET

Remove

1. Drain cooling system and remove air cleaner.

2. Disconnect accelerator cable at bell crank on manifold and fuel and vacuum lines at carburetor.

3. Remove intake and exhaust manifolds as previously described.

4. Remove generator to cylinder head bracket bolts.

NOTE: If vehicle is equipped with power steering or A/C, it will be necessary to remove the right side front bracket completely in order to remove the cylinder head.

5. Disconnect wire harness from temperature sending unit, leaving harness clear of clips on rocker arm cover.

6. Disconnect radiator and heater hoses at water outlet housing and ground strap at cylinder head.

7. Disconnect spark plug wires and remove spark plugs.

8. Remove rocker arm cover. Back off rocker arm nuts, pivot rocker arms to clear push rods and remove push rods.

9. Remove the cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Replace

1. Place a new cylinder head gasket in position over dowel pins on cylinder block (Fig. 6A2-18).

2. Carefully guide cylinder head into place over dowel pins and gasket.

3. Coat heads and threads of cylinder head bolts with sealing compound, part number 1052080 **, or equivalent, and install finger tight** (Fig. 6A2-19).

4. Tighten the cylinder head gradually with a torque wrench. Tighten bolts following sequence in Fig. 6A2-20. The final torque should be 95 lb. ft.

5. Complete installation by reversing removal procedure.

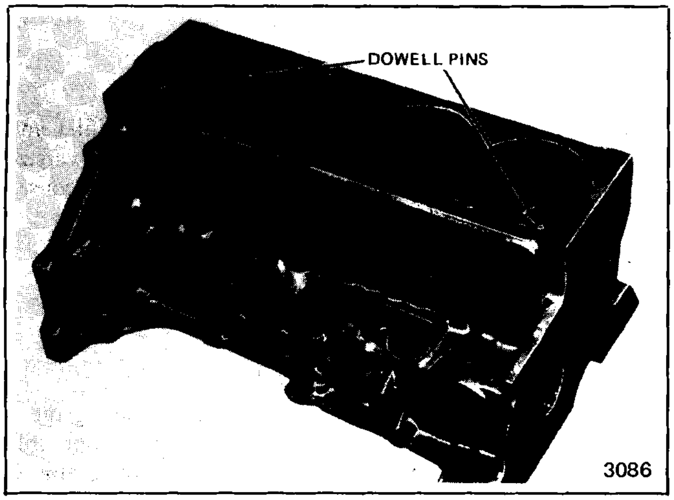


Fig. 6A2-18 Cylinder Head Dowell Pins

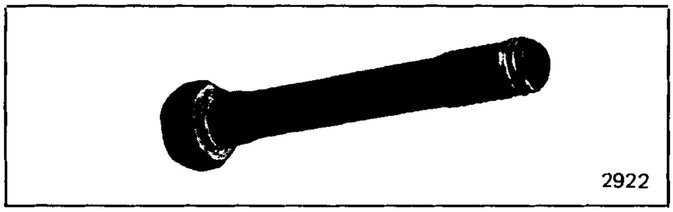


Fig. 6A2-19 Head Bolt With Sealer Applied

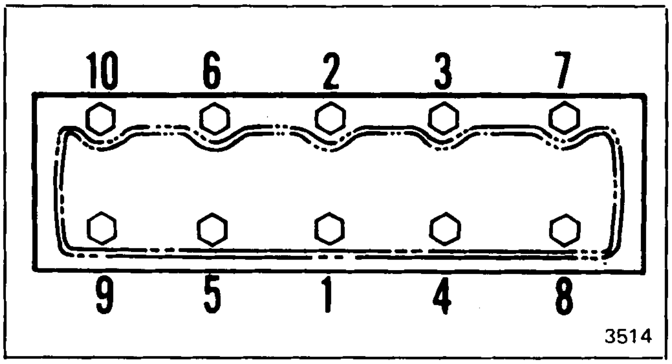


Fig. 6A2-20 Cylinder Head Tightening Sequence

Disassemble

1. Remove the cylinder head and gasket as previously described. Place cylinder head on two blocks of wood to prevent damage.

2. Remove rocker arms.

3. Using valve spring compressor, compress the valve springs and remove valve locks. Remove spring caps, spring seats, oil seals, springs and spring dampers (Fig. 6A2-21).

4. Remove valves from bottom of cylinder head and place them in a rack in their proper sequence so they can be assembled in their original positions.

Clean and Inspect

1. Clean all carbon from combustion chambers and valve ports.

2. Thoroughly clean the valve guides (Fig. 6A2-22).

3. Clean all carbon and sludge from push rods and rocker arms.

4. Clean valve stems and heads on a buffing wheel.

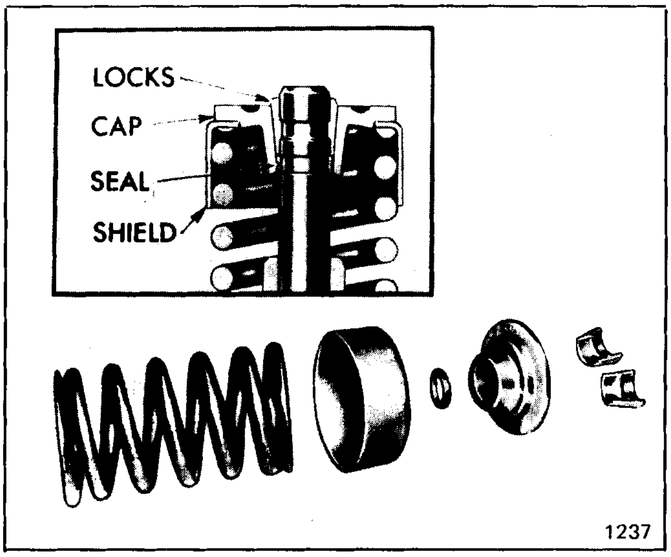


Fig. 6A2-21 Upper Valve Train Parts

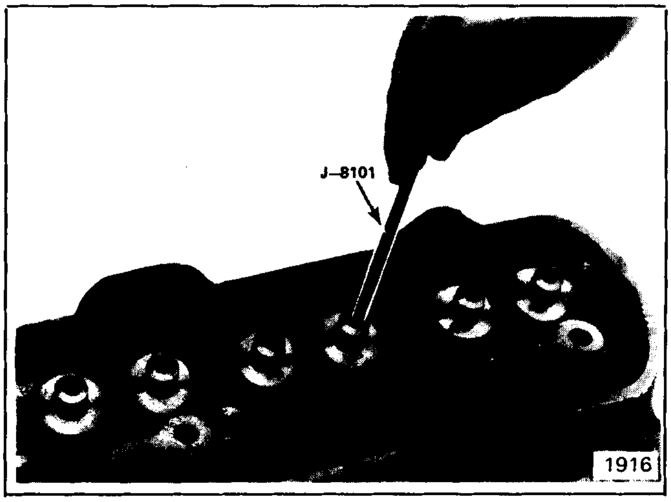


Fig. 6A2-22 Cleaning Valve Guide Bore (Typical)

5. Clean carbon deposits from head gasket mating surfaces.

6. Wash all parts in cleaning solvent and dry them thoroughly.

7. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks in the water chamber.

8. Inspect the valves for burned heads, cracked faces or damaged stems.

9. Check fit of valve stems in their respective bores. (Excessive valve stem to bore clearance will cause lack of power, rough idling and noisy valves, and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness of operation).

By using a micrometer and a suitable telescope hole gage, check the diameter of the valve stem in three places; top, center and bottom.

NOTE: Exhaust valves have tapered stems and are approximately .001 larger at top of stem then at head end.

Insert telescope hole gage in valve guide bore center diameter to obtain valve to valve guide clearance. If clearance is not within limits, use next oversize valve and ream bore to fit using suitable reamer of tool J-5830-02 (Fig. 6A2-23).

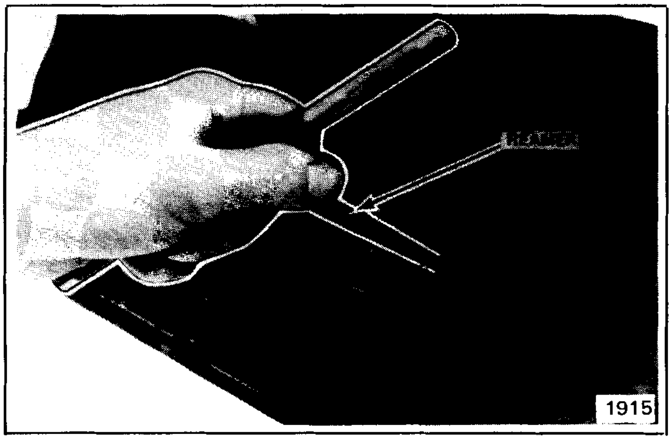


Fig. 6A2-23 Reaming Valve Guide Bore (Typical)

10. Check valve spring tension with suitable tester (Fig. 6A2-24).

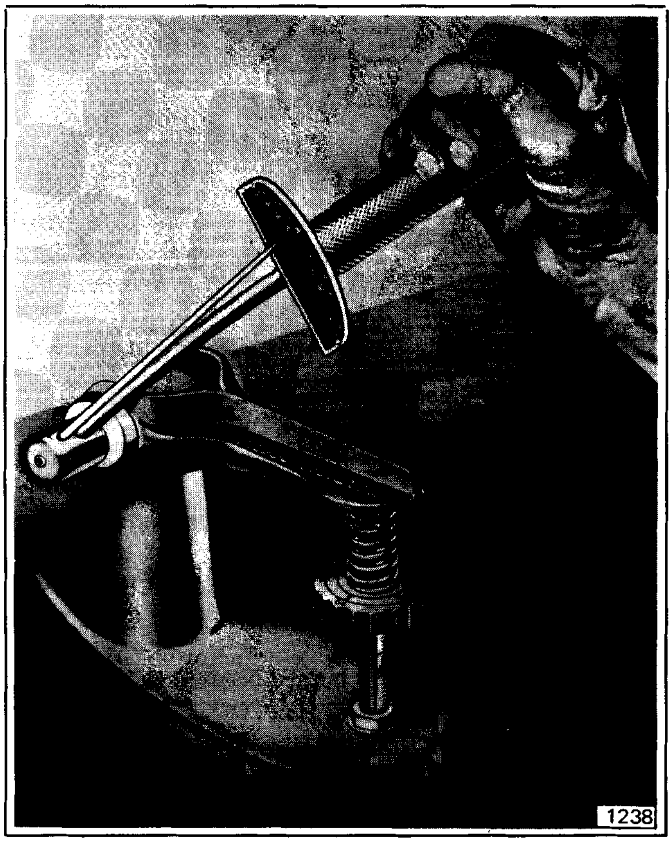


Fig. 6A2-24 Checking Valve Spring Tension

11. Springs should be checked by compressing to a specified height, and measuring force required to maintain that height. (See Specifications) Weak springs affect power and economy and should be replaced if below specified pressure.

VALVE GUIDE BORE

Recondition

Valves with oversize stems are available for inlet and exhaust valves. Guides should be reamed and new oversize valves installed whenever clearances exceed specifications.

VALVES AND SEATS

Recondition

1. Reface valves and seats as follows:

Valves should be ground on a special bench grinder designed specifically for this purpose and built by a reputable manufacturer. Valve seats should be ground with reputable power grinding equipment having stones of the correct seat angle and a suitable pilot which pilots in the valve stem guide. To ensure positive sealing of the valve face to its seat, the grinding stones should be carefully refaced before any grinding is done.

Valve seat angles should be 46° and valve face angles 45° for proper seating.

Assemble

1. Starting with No. 1 cylinder, place the exhaust valve in the port and place the valve spring damper assembly and cap in position. Then using suitable spring compressor, compress the spring and install new oil seal and valve locks. See that the seal is flat and not twisted in the valve stem groove and that the seat locks properly in the valve stem groove (Fig. 6A2-21).

2. Assemble the remaining valves, valve spring and damper assembly, shields, spring caps, new oil seals and valve locks in the cylinder head. Check seals by placing a vacuum cup over valve stem and cap.

3. Install cylinder head as previously described.

CRANK PULLEY HUB AND/OR OIL SEAL

Remove

1. Remove drive belts.

4. Remove center bolt and slide hub and pulleys from shaft.

3. Carefully pry oil seal from front cover with a large screwdriver. Do not distort the sheet metal timing chain cover.

Replace

1. Install new seal with helical lip toward rear of engine. Drive seal carefully into place using tool J-23042.

2. Coat front cover oil seal contact area of balancer with engine oil.

3. Position hub on crankshaft and slide into position until it bottoms against crankshaft gear.

4. Install center bolt and torque to 160 lb. ft.

5. Install belt drive pulleys.

6. Install belts and adjust tensions.

NOTE: Pulley to hub bolts have a locking agent applied to thread area. Bolts should be coated with **Drylock #299 or equivalent** whenever they are removed. Special bolt part number 549787 has the locking agent already applied for service replacement.

TIMING GEAR COVER

Remove

1. Remove hub as outlined.
2. Remove the two, oil pan-to-front cover attaching screws.
3. Remove the front cover-to-block attaching screws.
4. Pull the cover slightly forward only enough to permit cutting of oil pan front seal.
5. Using a sharp knife or other suitable cutting tool, cut oil pan front seal flush with cylinder block at both sides of cover (Fig. 6A2-25).

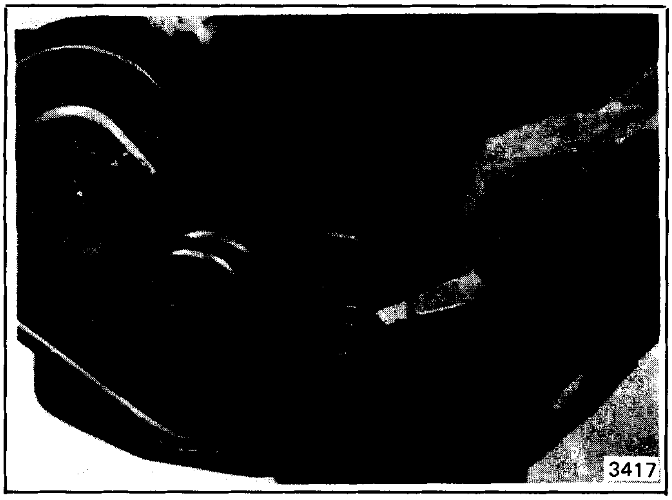


Fig. 6A2-25 Cutting Pan Gasket

6. Remove front cover and attached portion of oil pan front seal. Remove front cover gasket.

Install

1. Clean gasket surfaces on block and crankcase front cover.
2. Cut tabs from the new oil pan front seal (Fig. 6A2-26) use a sharp instrument to ensure a clean cut.
3. Install seal to front cover, pressing tips into holes provided in cover.
4. Coat the gasket with gasket sealer and place in position on cover.
5. Apply a 1/8 inch bead of silicone rubber sealer to the joint formed at the oil pan and cylinder block (Fig. 6A2-27).
6. Install centering tool J-23042 in crankcase front cover seal (Fig. 6A2-28).

NOTE: It is important that centering tool be used to align crankcase front cover so that hub installation will not damage seal and so that seal is positioned evenly around hub.

7. Install crankcase front cover to block. Install and partially tighten the two, oil pan-to-front cover screws.

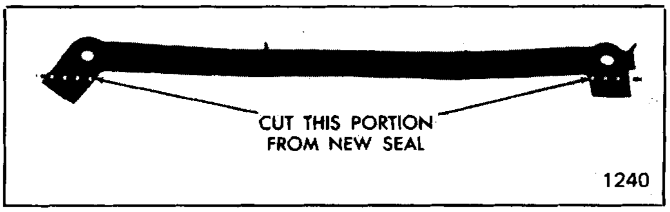


Fig. 6A2-26 Oil Pan Front Seal Modification

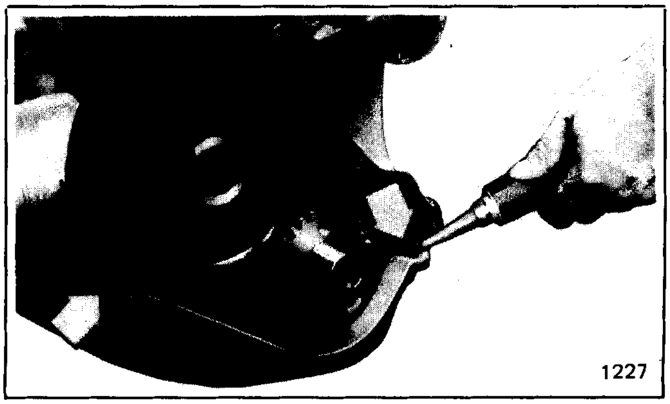


Fig. 6A2-27 Applying Front Cover Sealant

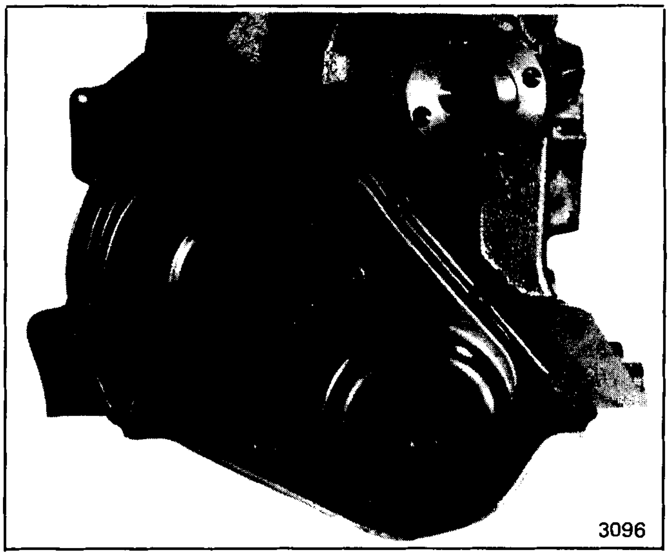


Fig. 6A2-28 Installing Timing Cover

8. Install the front cover-to-block attaching screws.
9. Torque all cover attaching screws to specifications and remove centering tool J-23042.
10. Install hub as outlined.

CAMSHAFT

Remove

1. Drain crankcase and radiator.
2. Remove radiator as described in Section 6B.
3. Remove fan and water pump pulley.
4. Remove grille assembly on H Series (See Sec. 14).
5. Remove valve cover and gasket, loosen valve rocker arm nuts and pivot rocker arms clear of push rods.
6. Remove distributor, spark plugs and fuel pump.
7. Remove push rod cover and gasket. Remove push rods and valve lifters.

8. Remove hub as described and remove timing gear cover.

9. Remove the two camshaft thrust plate screws by working through holes in the camshaft gear (Fig. 6A2-29).

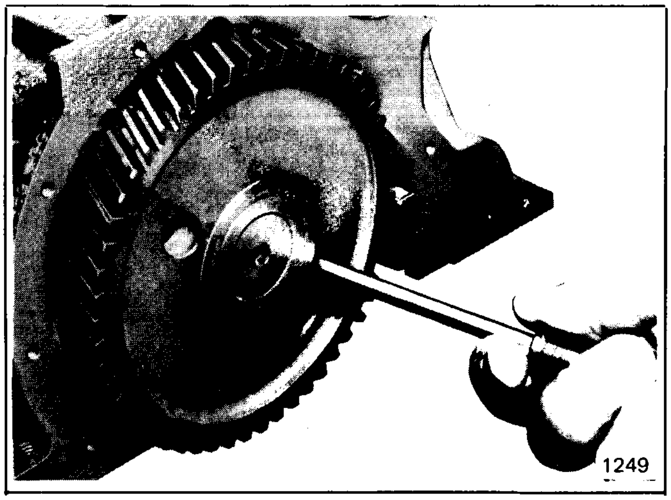


Fig. 6A2-29 Removing Camshaft Thrust Plate Screws

10. Remove the camshaft and gear assembly by pulling it out through the front of the block. (Support shaft carefully when removing so as not to damage camshaft bearings).

Disassemble

1. If the gear must be removed from the shaft, use press plate and adaptor J-971 on press.

2. Place tools on table of a press. Place the camshaft through the opening in the tools. Press shaft out of gear using socket or other suitable tool (Fig. 6A2-30).

CAUTION: *Thrust plate must be so positioned that woodruff key in shaft does not damage it when the shaft is pressed out of gear.*

Assemble

To assemble camshaft gear, thrust plate and gear spacer ring to camshaft, proceed as follows:

1. Firmly support shaft at back of front journal in an arbor press using press plate adaptors.

2. Place gear spacer ring and thrust plate over end of shaft, and install woodruff key in shaft keyway.

3. Install camshaft gear and press it onto the shaft until it bottoms against the gear spacer ring. The end clearance of the thrust plate should be .0015" to .0050" (Fig. 6A2-31). If less than .0015", the spacer ring should be replaced. If more than .0050", the thrust plate should be replaced.

Replace

1. Install the camshaft assembly in the engine block, being careful not to damage bearings or cam .

2. Turn crankshaft and camshaft so that the valve timing marks on the gear teeth will line up. Install camshaft thrust plate to block screws and tighten to 75 lb. in.

3. Install timing gear cover and gasket.

4. Install hub.

5. Line up keyway in hub with key on crankshaft and slide hub onto shaft. Install center bolt and torque to 160 lb. ft.

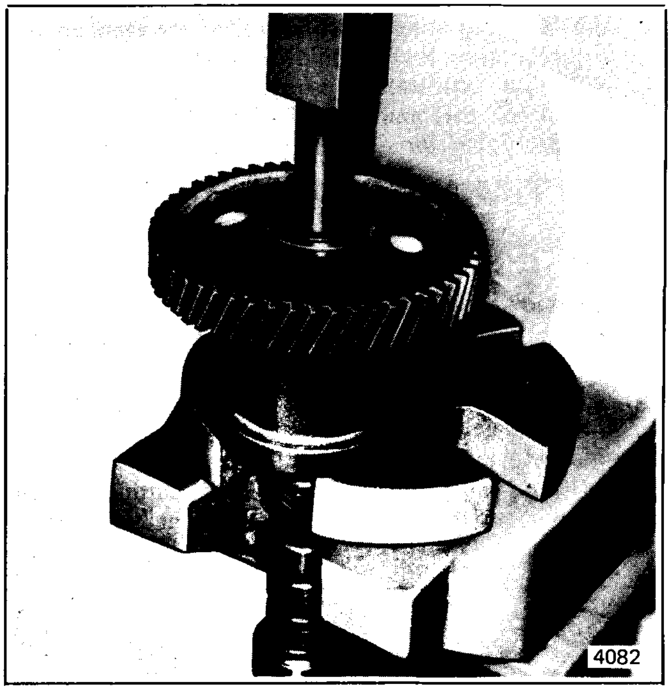


Fig. 6A2-30 Removing Camshaft Timing Gear

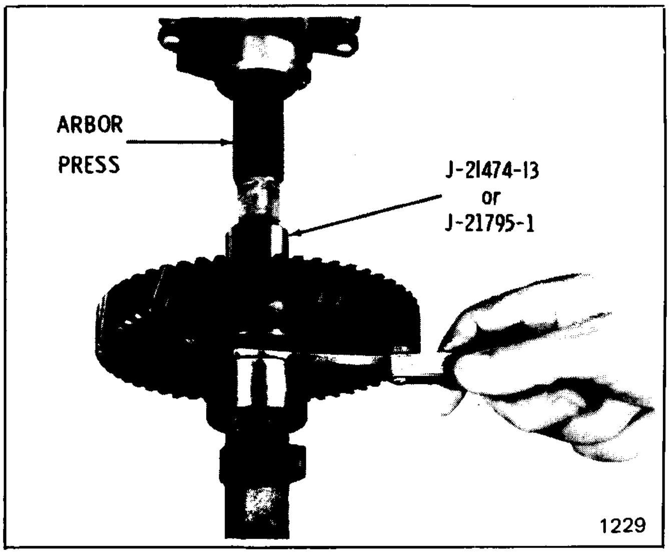


Fig. 6A2-31 Installing Camshaft Timing Gear and Checking Thrust Plate End Clearance

6. Install valve lifters and push rods. Install side cover with a new gasket. Install distributor as follows:

Turn crankshaft to firing position of number one cylinder (number one exhaust and intake valve lifters both on base circle of camshaft and timing mark on harmonic balancer indexed with top dead center mark on timing pad).

Install distributor in its original position and align shaft so that rotor arm points toward number one cylinder spark plug contact. It will also be necessary to turn oil pump drive shaft so it will index with distributor shaft.

7. Install fuel pump.

8. Pivot rocker arms over push rods. With lifters on base circle of camshaft, tighten rocker arm nut.

9. Install spark plugs.

10. Add oil to engine. Install water pump pulley and fan belt and adjust using tension gage.

11. Install the radiator as described in Section 6B and fill cooling system.

12. Install grille assembly on H Series.

13. Start engine and check for leaks.

14. Check and adjust timing.

CAMSHAFT BEARINGS

Remove

Camshaft bearings can be replaced while the engine is disassembled for overhaul, or without complete disassembly of the engine after transmission and flywheel have been removed.

1. With camshaft, oil pan and flywheel removed, drive out expansion plug from rear cam bearing by driving from inside.

2. Using bearing remover J-21473-1, drive out front bearing toward rear and rear bearing toward front.

3. Install extension J-21054-1 and drive center bearing out toward rear (Fig. 6A2-32).

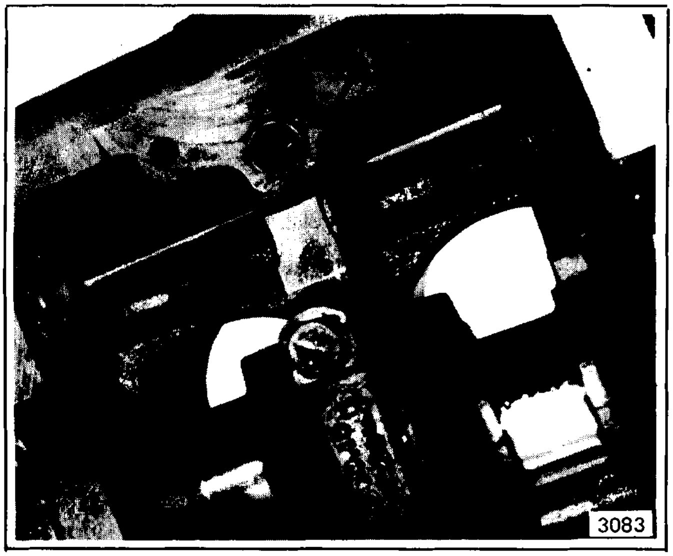


Fig. 6A2-32 Removing Center Camshaft Bearing (Typical)

Replace

1. Install each new bearing on tool.

2. Install bearings reversing procedure making sure oil holes are aligned.

CAUTION: *The front bearing must be driven approximately 1/8" behind front of cylinder block to uncover oil hole to timing gear oil nozzle.*

OIL PAN

Remove

1. Disconnect negative battery cable.

2. Remove engine fan on X series.

3. Raise vehicle and drain crankcase.

4. Remove rear section of frame crossmember on H series.

5. Disconnect exhaust pipe at manifold and loosen hanger bracket.

6. Remove starter and set to one side.

7. Remove flywheel housing inspection cover. On H series, proceed to step 10.

8. Remove hub bolt and install engine lift support tool (J-23515-1) and adapter J-23515-3 and after wrapping chains around frame (Fig. 6A2-33), raise engine to remove weight from engine mounts; remove both bracket to engine mount bolts.

9. Remove oil pan bolts; raise engine just enough to allow oil pan removal.

CAUTION: *Do not exceed 35 lb. ft. torque on lifting tool screw.*

10. On H series, disconnect steering linkage at steering gear and idler arm support. Remove oil pan bolts and remove pan.

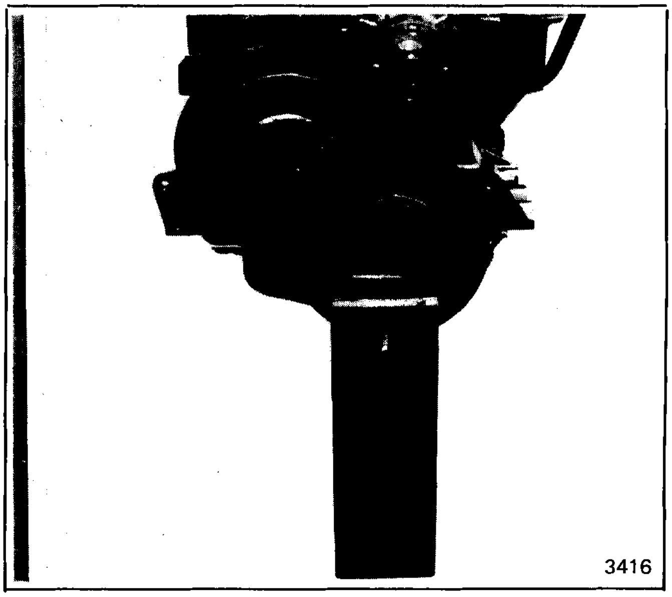


Fig. 6A2-33 Engine Lifting Tool

Replace

1. Thoroughly clean all gasket sealing surfaces.

2. Install rear oil pan gasket in rear main bearing cap.

3. Install front oil pan gasket on timing gear cover pressing tips into holes provided in cover.

4. Install side gaskets on oil pan using grease as a retainer.

5. Install oil pan. (Bolts into timing gear cover should be installed last. They are installed at an angle and holes line up after rest of pan bolts are snugged up).

6. For remainder of installation, reverse steps 1 through 9 of removal.

OIL PUMP

Remove

1. Drain oil and remove oil pan as previously outlined.

2. Remove two flange mounting bolts and nut from main bearing cap bolt and remove pump and screen as an assembly.

Replace

1. Align oil pump drive shaft to match with distributor tang, then install oil pump to block positioning flange over distributor lower bushing. Use no gasket. Tighten bolts to 115 lb. in. (Oil pump should slide easily into place. If not, remove and relocate slot or locate other problem).

2. Install oil pan using new gaskets and seals as outlined under Oil Pan Installation.

ENGINE OIL PUMP RECONDITION

1. Remove 4 cover attaching screws, cover, idler gear and drive gear and shaft (Fig. 6A2-34).

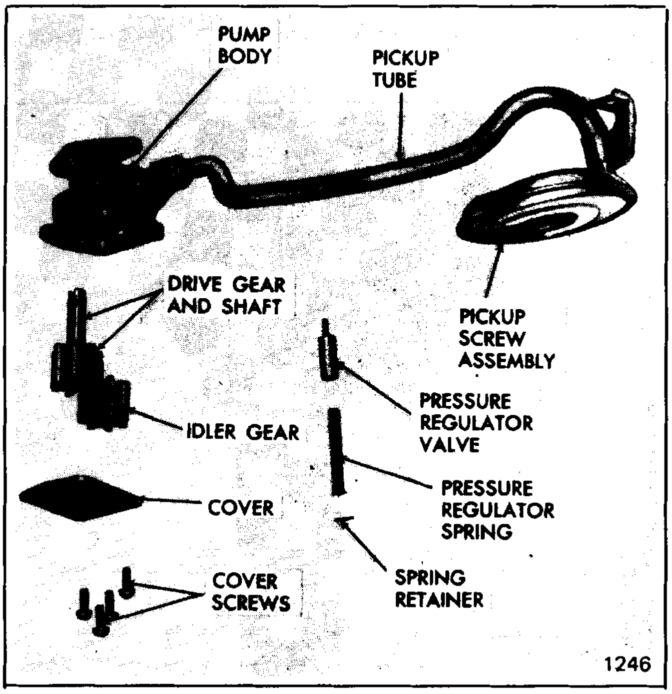


Fig. 6A2-34 Oil Pump - Exploded View

2. Remove pressure regulator valve and valve parts.

CAUTION: *Do not disturb oil pickup pipe on screen or body. This pipe is located at assembly.*

Inspect

Should any of the following conditions be found during inspection operations, the pump assembly should be replaced.

1. Inspect pump body for cracks or excessive wear.

2. Inspect oil pump gears for excessive wear or damage.

3. Check shaft for looseness in the housing.

4. Check inside of cover for wear that would permit oil to leak past the ends of gears.

5. Check the oil pick-up screen for damage to screen, or relief grommet.

6. Check pressure regulator valve plunger for fit in body.

Replace

1. Place drive gear and shaft in pump body.

2. Install idler gear so that smooth side of gear will be toward the cover.

3. Install cover and attaching screws. Tighten screws to 105 lb. in. and check to see that shaft turns freely.

4. Install regulator valve plunger, spring, retainer and pin.

CONNECTING ROD BEARINGS

Connecting rod bearing inserts are available in standard size and undersizes of .001" and .002". When clearances become excessive the next undersize bearing insert should be used.

Remove

1. Remove oil pan.

2. Rotate crankshaft as necessary to bring crankpin carrying bearing to be replaced straight toward bottom of block.

3. Remove bearing cap.

4. Install connecting rod bolt guide set J-6305-11 on connecting rod bolts. Push piston and rod assembly up far enough to remove upper bearing.

5. Remove bearings from cap and rod.

6. Inspect crankpin for damage, out-of-round and taper.

CONNECTING ROD BEARING CLEARANCE

1. Remove the cap of the bearing to be checked. Wipe the bearing and the crankpin free of oil.

2. Place a piece of plastic gage, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface (Fig. 6A2-35).

NOTE: Plastic gage should be positioned exactly in the middle of the upper or lower bearing shell (bearings) are eccentric and a false reading could occur.

Install the cap and tighten cap bolts to torque. (Do not turn crankshaft with plastic gage in place).

3. Remove bearing cap and using plastic gage scale on envelope, measure width of compressed plastic gage before removing it from the crankpin or bearing (Fig. 6A2-36). If the clearance is excessive, replace the bearing with the next undersize bearing and recheck clearance. Bearings are available in standard, .001" and .002" undersize.

4. Rotate the crankshaft after bearing adjustment to be sure bearings are not tight.

5. Check connecting rod end clearance between connecting rod cap and side of crankpin. (Fig. 6A2-37). If clearance is excessive, replace connecting rod.

Replace

1. Install oil pan using new gaskets and seals.

REAR MAIN BEARING OIL SEAL

REMOVE AND REPLACE

The rear main bearing oil seal (Fig. 6A2-38) can be removed (both halves) without removal of the crankshaft.

Always replace both upper and lower seal together.

1. Remove engine oil pan.

2. Remove rear bearing cap.

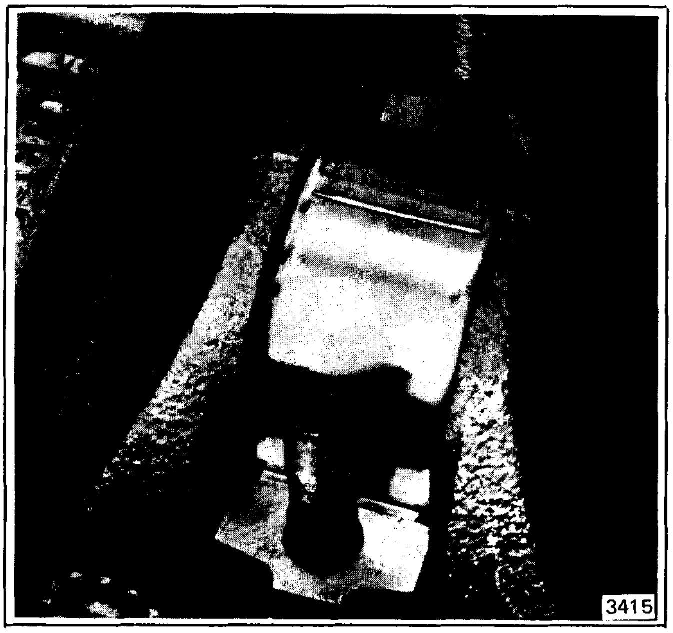


Fig. 6A2-35 Plastic Gage On Rod Journal

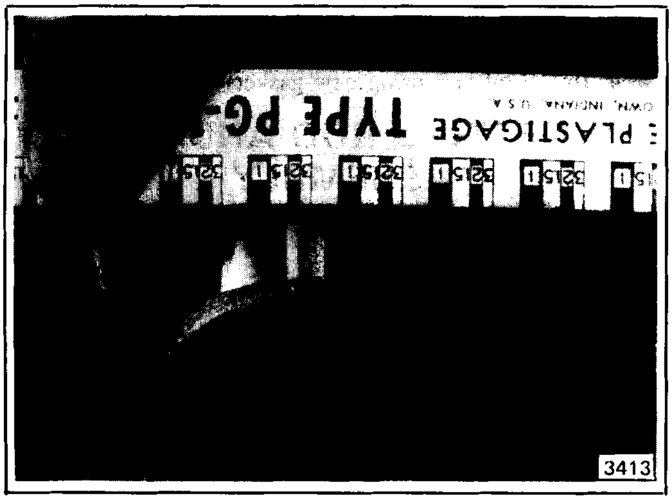


Fig. 6A2-36 Measuring Plastic Gage

Fig. 6A2-37 Checking Connecting Rod Side Clearance

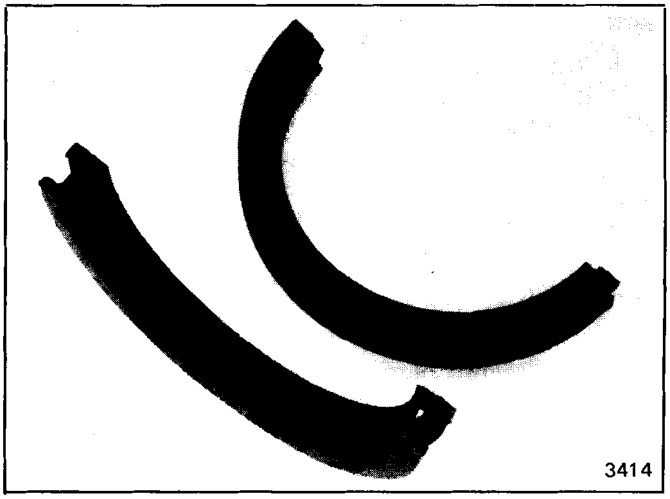


Fig. 6A2-38 Rear Main Bearing Oil Seal

3. Remove oil seal from groove, prying from bottom, using a small screwdriver. (Always clean crankshaft surface before installing a new seal).

4. Insert a new seal well lubricated with engine oil in bearing cap groove (keep oil off of parting line surface, as this surface is treated with sealing compound) gradually push with a hammer handle until seal is rolled into place.

5. To remove the upper half of the seal, use a small hammer and a soft blunt punch to tap one end of oil seal (Fig. 6A2-39) until it protrudes far enough to be removed with pliers. Push new seal into place with lip toward engine front.

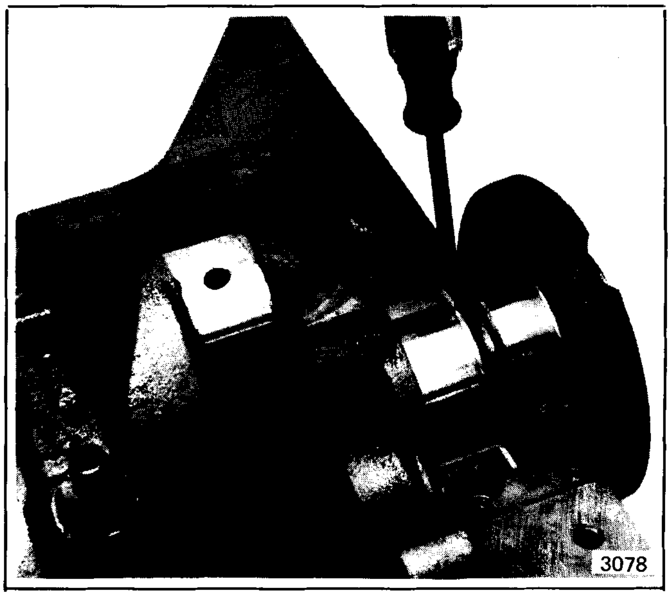


Fig. 6A2-39 Removing Rear Seal Upper Half

6. Install bearing cap and torque bearing cap bolts to 65 lb. ft.

7. Install oil pan.

MAIN BEARINGS

The main bearings are of the precision insert type and do not utilize shims for adjustment. If the clearances are found to be excessive, a new standard or undersize bearing insert, both upper and lower halves, will be required.

Remove

1. Remove oil pan.
2. Remove cap on main bearing requiring replacement and remove bearing.
3. Using a thin object such as a small screwdriver, rotate the upper half of the bearing in the direction of the tab and slide bearing out. It may be necessary to loosen other main bearings to gain clearance.

Main Bearing Clearance

1. Place a .002" brass shim between the crankshaft journal and the lower bearing in each bearing cap next to the one being checked. This causes the crankshaft to be forced against the upper bearing and insures an accurate measurement of the total clearance.
2. Remove the bearing cap of the bearing to be checked. Wipe the bearing and the journal free of oil.
3. Place a piece of plastic gage, the length of the bearing (parallel to the crankshaft), on the journal or bearing surface (Fig. 6A2-40).

NOTE: Plastic gage should be positioned exactly in the middle of the upper or lower bearing shell. Bearings are eccentric and a false reading could occur.

Install the cap and tighten cap bolts to proper torque. (Do not turn crankshaft with plastic gage in place).

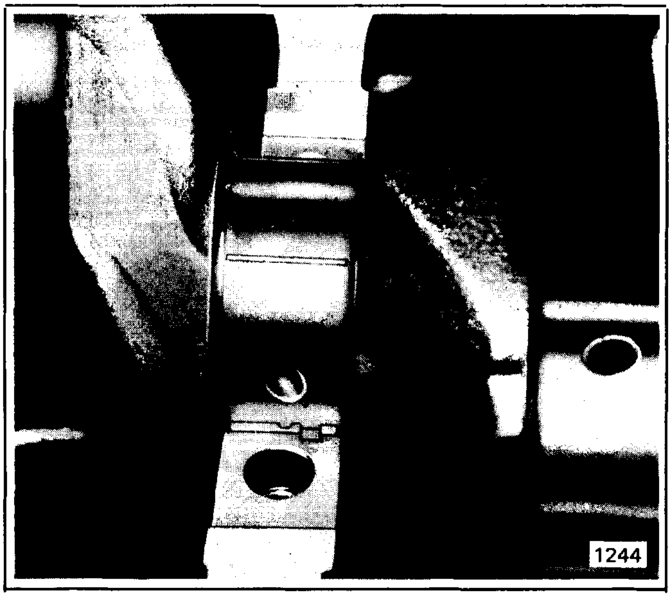


Fig. 6A2-40 Plastic Gage On Journal

4. Remove bearing cap and using plastic gage scale on envelope measure width of compressed plastic gage before removing it from the bearing or journal (Fig. 6A2-41). If the clearance is excessive, replace the bearing with the next undersize bearing and recheck clearance. Bearings are available in standard size, .001" and .002" undersize.

5. Install a new rear main bearing oil seal in the cylinder block and main bearing cap if the rear main bearing was checked and/or replaced.

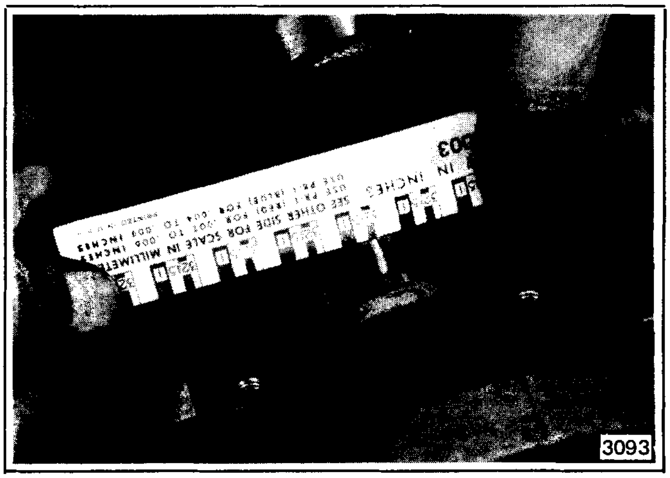


Fig. 6A2-41 Measuring Plastic Gage

Replace

1. Oil new upper bearing shell and insert plain (unnotched) end of shell between crankshaft and indented or notched side. Rotate the bearing into place.
2. Install new bearing shell in bearing cap.
3. Check bearing clearance using plastic gage method.
4. Install oil pan using new gaskets and seals.

CONNECTING ROD AND PISTON ASSEMBLY

Remove

1. Remove cylinder head as described in cylinder head or gasket.
2. Remove oil pan as described in oil pan remove.
3. Check connecting rod and piston for cylinder number identification and if necessary, mark them.
4. Remove bearing cap and install connecting rod bolt guide set, J6305-11.
5. Carefully remove connecting rod and piston assembly by pushing out with knurled handle of long guide.

PISTON RINGS

Install

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore, they should have the proper gap. It should not be necessary to alter ring gap by filing.

4. Install rings on piston, using suitable ring installing tool to prevent breakage or fracture of rings, or damage to pistons.
5. Measure side clearance of rings in ring groove (Fig. 6A2-43) as each ring is installed.

If side clearance is excessive, piston should be replaced.

PISTON AND ROD ASSEMBLY

Disassemble

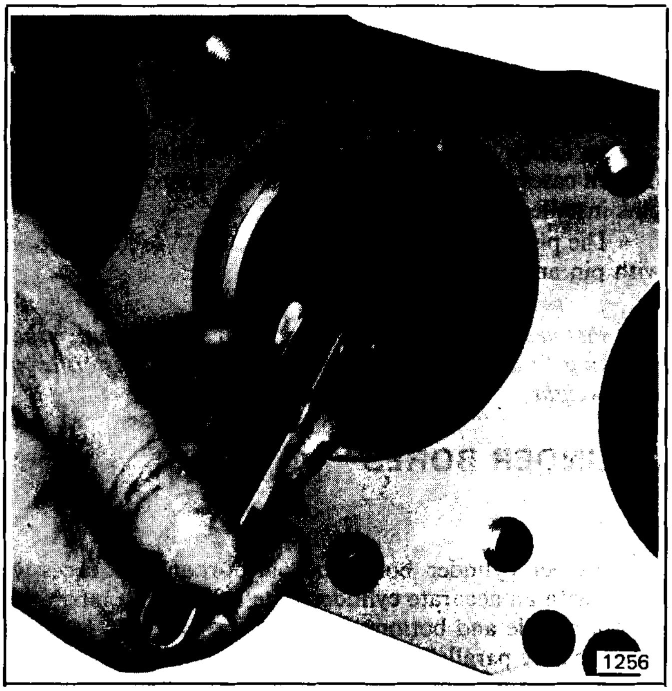


Fig. 6A2-42 Checking Ring Gap

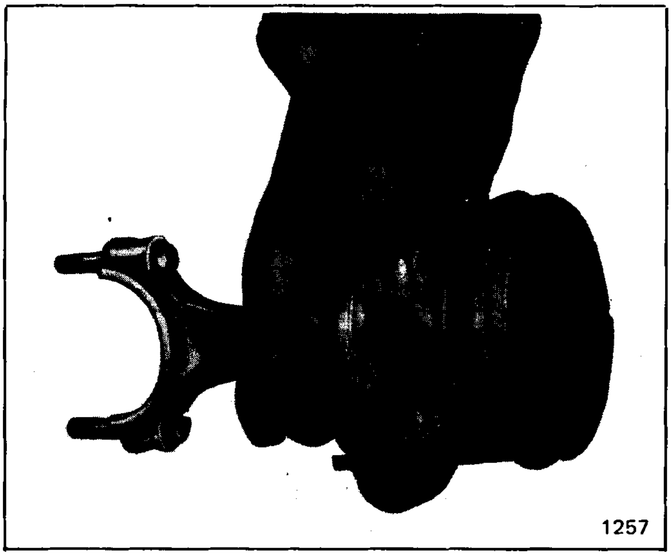


Fig. 6A2-43 Checking Side Clearance (Typical)

CAUTION: *Use care at all times when handling and servicing connecting rods and pistons. To prevent possible damage to these units, do not clamp rod or piston in vise since they may become distorted. Do not allow pistons to strike against one another, against hard objects or bench surfaces, since distortion of piston contour or nicks in the soft aluminum material may result.*

1. Remove piston rings using suitable piston ring remover.

2. Install pilot of piston pin removing and installing tool

3. Install piston and connecting rod assembly on support and place assembly in an arbor press (Fig. 6A2-44). Press pin out of connecting rod. Use piston pin tool J-24086 or BT-7612.

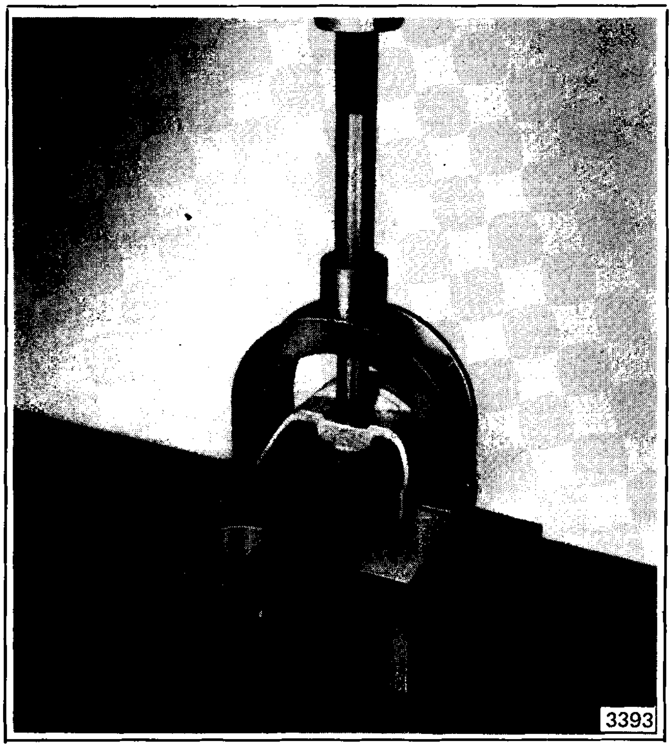


Fig. 6A2-44 Removing Piston Pin

4. Remove assembly from press, remove piston pin from support and remove tool from piston and rod.

Clean and Inspect

1. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

2. Clean piston pin, rod, cap, bolts and nuts in suitable solvent. Reinstall cap on connecting rod to prevent subsequent mixing of caps and connecting rods.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; and scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

4. Inspect piston pin for scoring, roughness, or uneven wear and proper fit.

5. Inspect bearing shells to see that they are not damaged. Fit of bearings should be checked when engine is being assembled.

Assemble

There is a notch cast in the top of all piston heads to facilitate proper installation. The piston assemblies should always be installed with the notch toward the front of the engine.

1. Lubricate piston pin holes in piston and connecting rod lightly with graphite lubricant.

2. Position connecting rod in its respective piston so that raised notch side of rod at bearing end is opposite the notch in the piston when installed (Fig. 6A2-46).

3. Install piston pin on installer and pilot spring and pilot in support (Fig. 6A2-45). Use piston pin removing and installing tool J-24086 or BT-7612.

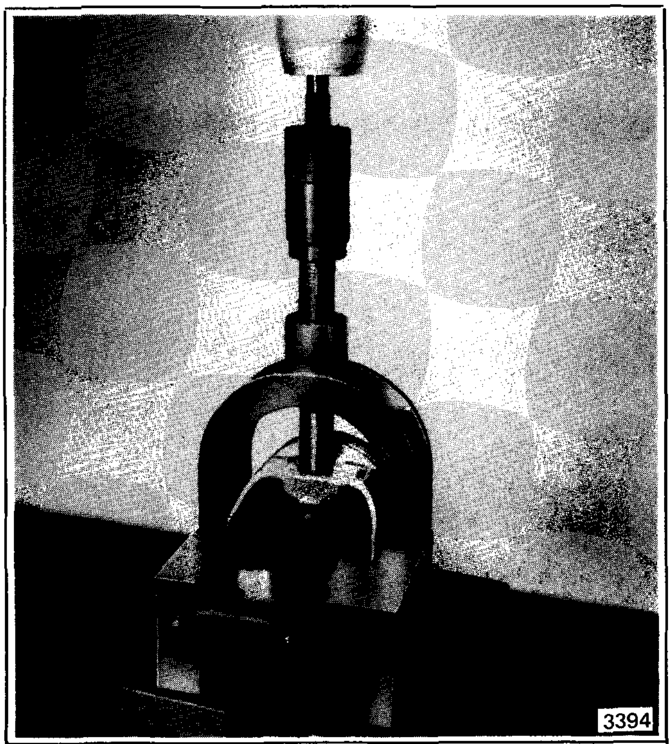


Fig. 6A2-45 Piston Pin Replacement

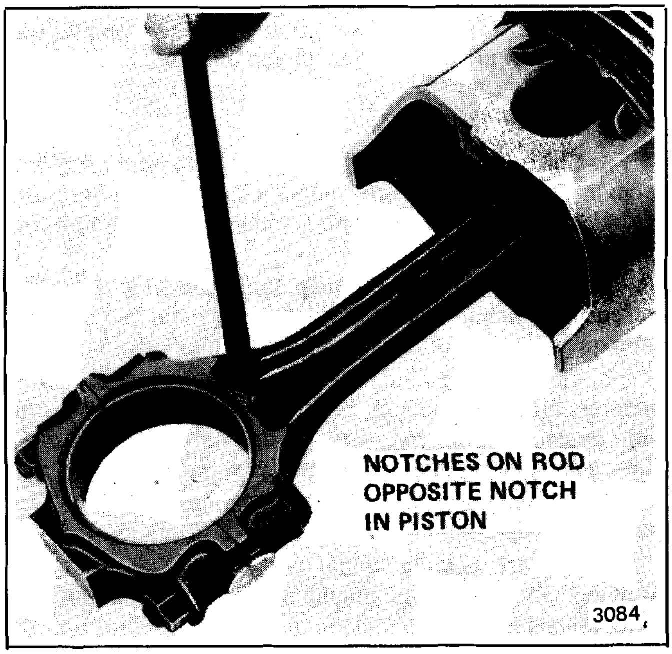


Fig. 6A2-46 Connecting Rod Identification

4. Install piston and rod on support, indexing pilot through piston and rod.

5. Place support on arbor press, start pin into position and press on installer until pin pilot bottoms.

6. Remove installer and support assembly from piston and connecting rod assembly.

7. Check piston pin for freedom of movement in piston bore.

PISTON PIN

Fit

Piston pins normally do not become loose enough to cause a knock or tapping until after very high mileage and in such cases the piston and rod can be reamed and oversize pins installed.

The piston pin fit in the piston is .0002" to .0004" loose with pin and bosses clean and dry.

Piston and pin must be at room temperature when checking fit and pin must be able to fall from piston by its own weight.

CYLINDER BORES

Inspect

Inspect cylinder bores for out-of-round or excessive taper, with an accurate cylinder gage J-8087 or comparable, at top, middle and bottom of bore. (Fig. 6A2-47). Measure cylinder bore parallel and at right angles to the centerline of the engine to determine out-of-round. Variation in measure from top to bottom of cylinder indicates the taper in the cylinder. Fig. 6A2-48 illustrates area in cylinder where normal wear occurs. If dimension "A" is larger than dimension "B" by .003", it indicates the necessity of cylinder boring and installing new rings and pistons. Cylinder bores can be measured by setting the cylinder gage dial at zero in the cylinder at the point of desired measurement. Lock dial indicator at zero before removing from cylinder, and measure across the gage contact points with outside micrometer, with the gage at the same zero setting when removed from the cylinder (Fig. 6A2-49).

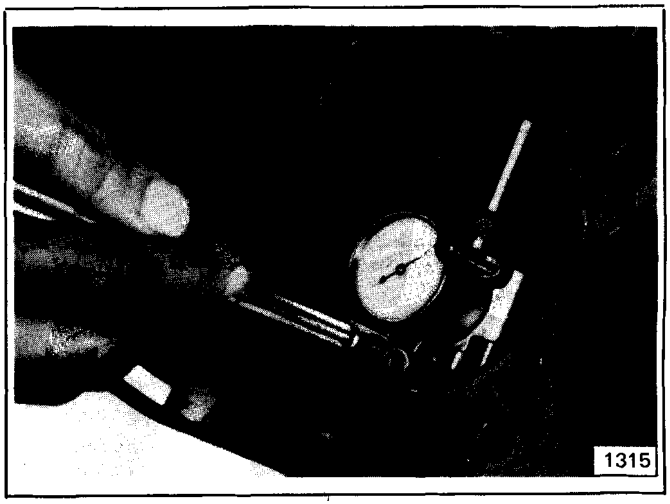


Fig. 6A2-47 Measuring Cylinder Bore (Typical)

Fine vertical scratches made by ring ends will not by themselves cause excessive oil consumption, therefore, honing to remove them is unnecessary.

Honing or Boring

If a piston other than standard size is to be installed, the cylinder should be bored, rather than honed, to effect a true bore.

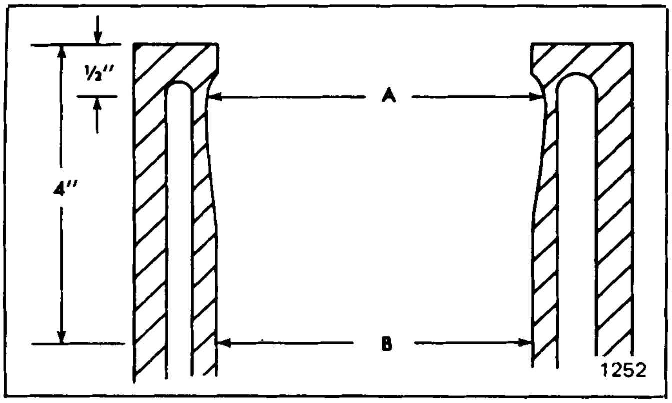


Fig. 6A2-48 Normal Cylinder Wear Pattern

Fig. 6A2-49 Measuring Cylinder Gage

When honing to eliminate taper in the cylinder full strokes of the hone in the cylinder should be made in addition to checking measurement at top, middle and bottom of bore repeatedly.

When boring, always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. Crankshaft bearings and other internal parts must be covered or taped to protect them during boring or honing operation. When taking the final cut with a boring bar, leave .001" on the diameter for finish honing to give the required piston to cylinder clearance specifications. (Honing or boring operation must be done carefully so that specified clearance between pistons, rings, and cylinder bores is maintained).

NOTE: Honing finish should not exceed 7 to 15 micro.

By measuring the piston to be installed at the sizing points (Fig. 6A2-50) and adding the mean of the clearance specification, the finish hone cylinder measurement can be determined. It is important that both the block and piston be measured at normal room temperature.

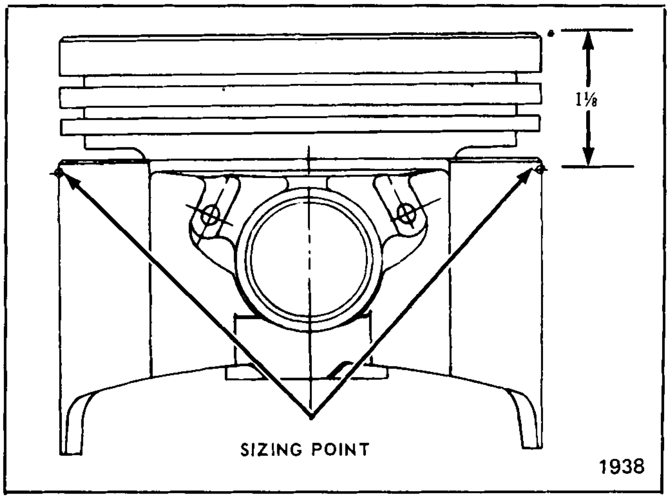


Fig. 6A2-50 Piston Sizing Points

After final honing and before the piston is checked for fit each cylinder bore must be thoroughly cleaned. Use soapy water solution and wipe dry to remove all traces of abrasive. If all traces of abrasive are not removed, rapid wear of new rings and piston will result.

Intermixing different size pistons has no effect on engine balance as all pistons from standard size, up to .030" oversize, weigh exactly the same.

PISTON

Fit and Replace

Pistons should be fitted in the bores by actually measuring the fit (measure O.D. of piston at sizing point and I.D. of cylinder bore). See engine specifications for clearances. If cylinder bores have been reconditioned, or if pistons are being replaced, reconditioning of bores and fitting of pistons should be closely coordinated.

If bore has been honed, it should be washed thoroughly with hot, soapy water and a stiff bristle brush.

Using a cylinder checking gage, measure the cylinder bore crosswise of the block to find the smallest diameter. Record the smallest diameter of each bore.

CAUTION: *When measuring cylinder bores and pistons, it is very important that the block and pistons be at room temperature. If any or all of the parts are hotter or colder than normal room temperature, improper fitting will result.*

Measure the piston skirt perpendicular to the piston pin boss (piston pin removed) and at the sizing point indicated in Fig. 6A2-51.

Make sure the micrometer is in full contact.

As the pistons are measured they should be marked for size identification and the measurements recorded.

If there is excessive clearance between a cylinder bore and the piston which was installed in that bore, a new piston should be used.

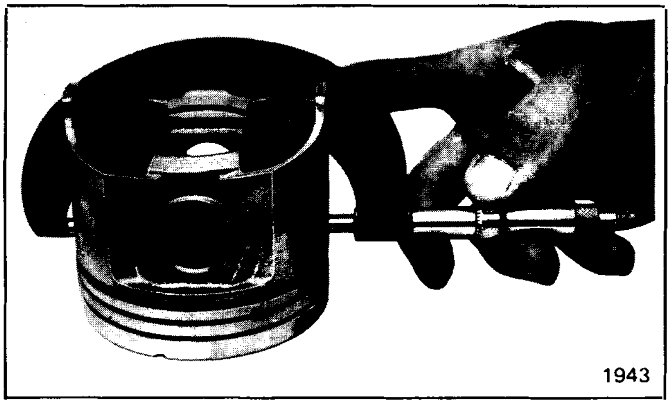


Fig. 6A2-51 Measuring Piston

New pistons are serviced in standard size and oversize. See parts listings.

Since these are nominal or basic sizes, it is important that new pistons be measured to ensure proper fit. All new pistons are serviced with selectively fitted piston pins.

After all measurements have been made, match the new pistons with the cylinders where they will fit with proper clearance. Honing of cylinder bore may be necessary to effect a proper fit. When properly mated, mark the pistons with the cylinder numbers they fit so they will not become mixed.

CONNECTING ROD AND PISTON ASSEMBLY

Replace

1. Install connecting rod bolt guide set J-6305-11 on connecting rod bolts (Fig. 6A2-52).
2. Using a suitable piston ring compressor insert rod and piston assembly into cylinder so that notch in top of piston is facing front of engine (Fig. 6A2-53).
3. From beneath engine, pull connecting rod with bearing into place against crankpin.
4. Remove guide set J-6305-11 and install bearing cap. Tighten cap nuts to 32 lb. ft.
5. Install oil pan.
6. Install cylinder head, intake and exhaust manifold.
7. Connect fuel line and vacuum lines to carburetor.
8. Install push rods, move rocker arms into position and tighten rocker arm nuts.
9. Install rocker arm cover.

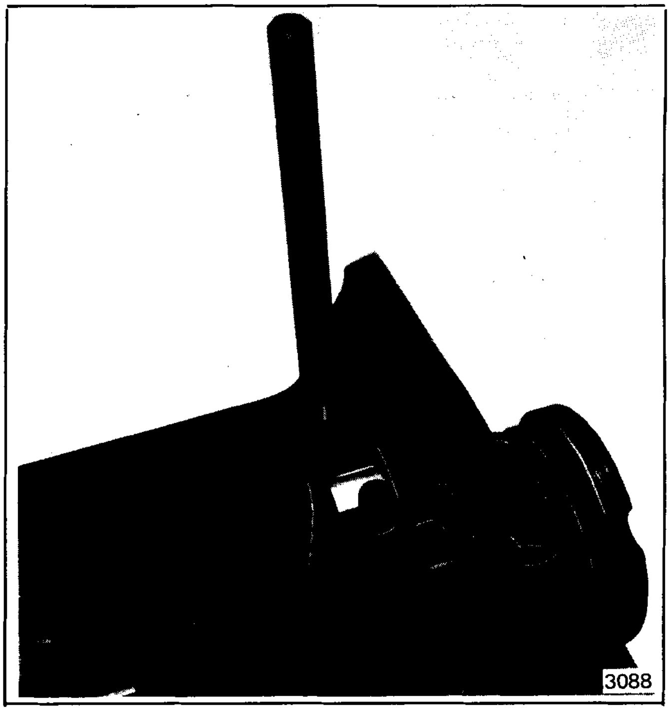


Fig. 6A2-52 Guide Tool Installed

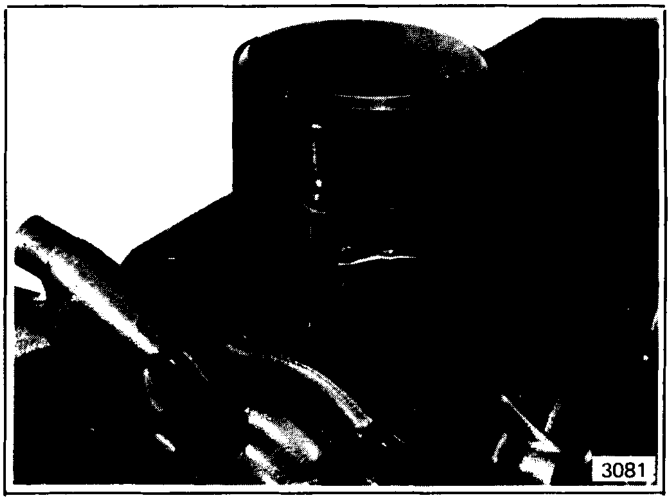


Fig. 6A2-53 Installing Piston

ENGINE

Remove

1. Disconnect battery cables at battery.
2. Drain cooling system.
3. Scribe alignment marks on hood around hood hinges and remove hood from hinges.
4. Disconnect distributor, starter and generator wires, engine-to-body ground strap, oil pressure and engine temperature sender wires, and all external vacuum hoses.
5. Remove air cleaner.
6. Remove radiator shroud shield assembly.
7. Disconnect radiator hoses and heater hoses at engine attachment.
8. Remove engine fan.
9. Disconnect accelerator control linkage.
10. If equipped with power steering or air conditioning, remove pump and compressor from mounting brackets and set aside. Do not disconnect hoses.
11. Disconnect gas lines.
12. Raise vehicle on hoist and drain crankcase.
13. Disconnect exhaust pipe from manifold.
14. If equipped with automatic transmission, remove converter cover, remove three converter retaining bolts and slide converter to rear.
15. If equipped with manual transmission, disconnect clutch linkage and remove clutch cross shaft.
16. Remove four lower bell housing bolts (two each side).

17. Disconnect transmission filler tube support and starter wire harness.

18. Remove front motor mount bolts.

19. Lower vehicle.

20. Using jack and block of wood, support transmission.

21. Support weight of engine with chain fall.

22. Remove two remaining bell housing bolts.

23. Raise transmission slightly.

24. Position engine forward to free it from transmission; remove from car by tilting front of engine up.

25. Install engine on stand.

Replace

1. Install engine lifting equipment to engine and lower engine into chassis, guiding engine to align with bell housing.

2. With engine supported by lifting equipment, install two upper bell housing bolts.

CAUTION: *Do not lower engine completely while jack is supporting transmission.*

3. Remove transmission support jack.

4. Lower engine and remove lifting equipment.

5. Raise vehicle.

6. Install remaining bell housing bolts.

7. Replace front motor mount bolts.

8. For remaining installation procedures, reverse steps 1 through 18.

CRANKSHAFT

Remove

1. Remove engine from vehicle.

2. Mount engine on suitable stand.

3. Remove spark plugs.

4. Remove fan pulley.

5. Remove hub.

6. Remove oil pan and oil pump assembly.

7. Remove timing gear cover.

8. Remove crankshaft timing gear.

9. Remove connecting rod bearing caps with bearings and identify each for reinstallation.

10. Push connecting rod and piston assemblies away from crankshaft.

11. Remove main bearing caps with bearings and identify for reinstallation.

12. Remove crankshaft.

Replace

1. With new upper bearings and rear oil seal installed position crankshaft in block.

2. Install main bearing caps (with new lower bearings and seal), but do not tighten cap bolts.

3. Pull connecting rods (with new upper bearings installed) and pistons into place.

4. Install rod bearing caps (with new bearings), but do not tighten nuts.

5. With rubber mallet hit both ends of crankshaft to center thrust bearing rearward first - then forward last.

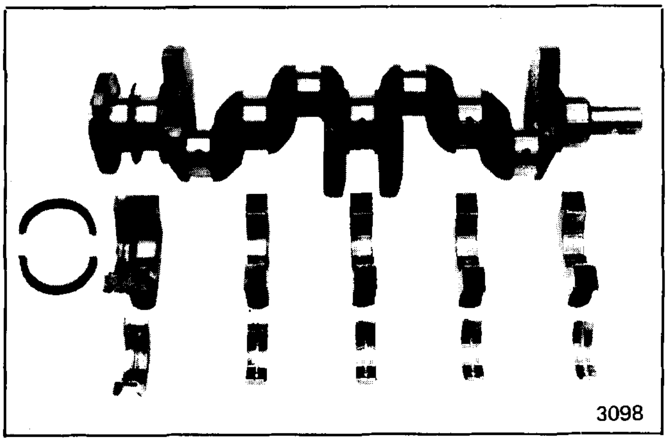


Fig. 6A2-54 Crankshaft With Bearings and Seal

6. Tighten main bearing caps then check crank end play. It should be between .0015 and .0085.

7. Tighten connecting rod bearing caps.

8. Recheck bearing clearances using plastic gage method.

9. Install key from old crankshaft keyway in new crankshaft.

10. Install crankshaft timing gear.

IMPORTANT: ALIGN TIMING MARKS ON TIMING GEARS BY ROTATING CRANKSHAFT IF NECESSARY

11. Install timing gear cover using new seal and gaskets.

12. Install oil pump assembly and oil pan using new rear seal in rear main bearing cap and new front seal on timing gear cover. Press front seal tips into holes in timing gear cover.

13. Coat front cover oil seal contact area of hub with oil and push hub into position.

14. Install fan pulley and fan.

15. Install spark plugs.

16. Remove engine from stand.

17. Install engine in vehicle.

SPECIFICATIONS

BOLT TORQUE

Bolt Main Bearing to Block	65 lb.ft.
Nut Connecting Rod	30 lb.ft.
Bolt Oil Pan Front	45 lb.in.
Bolt Oil Pan Side	80 lb.in.
Plug Oil Pan Drain	20 lb.ft.
Nut Oil Screen Support	25 lb.ft.
Bolt Oil Pump to Block	115 lb.in.
Bolt Oil Pump Cover	105 lb.in.
Bolt Push Rod Cover To Block	75 lb.in.
Bolt Harmonic Balancer	160 lb.ft.
Bolt Flywheel To Crankshaft	55 lb.ft.
Nut Carburetor to Manifold	12 lb.ft.
Bolt Intake To Exhaust Manifold	40 lb.ft.
Nut Manifold To Cylinder Head	30 lb.ft.
Bolt Manifold To Cylinder Head	40 lb.ft.
Nut EGR Feed Tube	60 lb.ft.
Bolt Fuel Pump To Block	15 lb.ft.
Bolt Distributor Hold Down	22 lb.ft.
Bolt EGR Valve to Manifold	20 lb.ft.
Bolt Water Outlet Housing	20 lb.ft.
Bolt Water Pump To Block	18 lb.ft.[1]
Bolt Timing Cover To Block	80 lb.in.
Bolt Timing Cover To Oil Pan	45 lb.in.
Bolt Fan & Pulley To Water Pump	18 lb.ft.
Clamps Radiator Hoses All	17 lb.in.
Stud Rocker Arm To Cylinder Head	60 lb.ft.
Bolt Cylinder Head To Block	95 lb.ft.[1]
Nut Rocker Arm To Stud	20 lb.ft.
Bolt Rocker Arm Cover	85 lb.in.
Bolt Camshaft Thrust Plate To Block	75 lb.in.

[1] Requires thread sealer.

ENGINE

Type	In-Line
Valve Arrangement	In Head
Bore and Stroke	4.00" X 3.00"
Piston Displacement	151 cu. in.
Compression Ratio	8.25:1
Compression Pressure at Cranking Speed Wide-Open Throttle	140 psi @ 160 rpm
Firing Order	1-3-4-2
Production Engine Number	Pad at Right Side by Distributor Shaft Hole
Cylinder Numbers-Front to Rear	1-2-3-4

CAMSHAFT

Material-Camshaft	Hardened Alloy Cast Iron
Material-Cam Bearings	Babbet on Steel
Journal Diameter	1.869"
Bearing Clearance	.0007" - .0027"
End Play	.0015" - .0050"

CONNECTING RODS

Material-Connecting Rods	Arma-Steel
Length, Center to Center	6.050"
Bearing Clearance on Crankpin-Limits When New	.0005" - .0026"
End Play of Connecting Rod on Crankpin	.006" - .022"

CRANKSHAFT

Material-Crankshaft	Cast Nodular Iron
Journal Diameter	2. 2983" - 2. 2993"
Thrust Taken On	#5
Crankpin Journal Diameter	2. 000"
End Play-Limits When New	.0015" - .0085"
Main Bearing Clearance-Limits When New	.0002" - .0022"

PISTONS AND CYLINDERS

Cylinder Bore Diameter	4.00"
Piston Material	Tin Plated Cast Aluminum Alloy
Piston Clearance in Cylinder	.0025" - .0033"
Piston Ring Gap	.010" - .020"
Piston Ring to Groove Clearance Compression Rings Upper and Lower	.0015" - .0035"

PISTON PINS

Piston Pin Material	SAE 1016
Fit in Piston	.0002" - .0004" loose
Fit in Rod	Press Fit
Diameter (Selective)	.942 - .938
Length	3.000

SPROCKETS

Camshaft-Material	Bakelite and Fabric Composition with Steel Hub
-Number of Teeth	54
Crankshaft-Material	Cast Iron
-Number of Teeth	26

VALVE TIMING (IN CRANKSHAFT DEGREES)

Intake	
Opens	33° BTC
Closes	81° ABC
Duration	294°
Lift (@ Zero Lash)	.406"
Exhaust	
Opens	76° BBC
Closes	38° ATC
Duration	294°
Lift (@ Zero Lash)	.406"

VALVES

Material	Intake-1541 Steel Exhaust 21-2N Steel
Lash-Intake & Exhaust	0
Head Diameter-Intake	1.72"
-Exhaust	1.50"
Stem Diameter Intake & Exhaust	.34"
Face Angle-Intake & Exhaust	45°

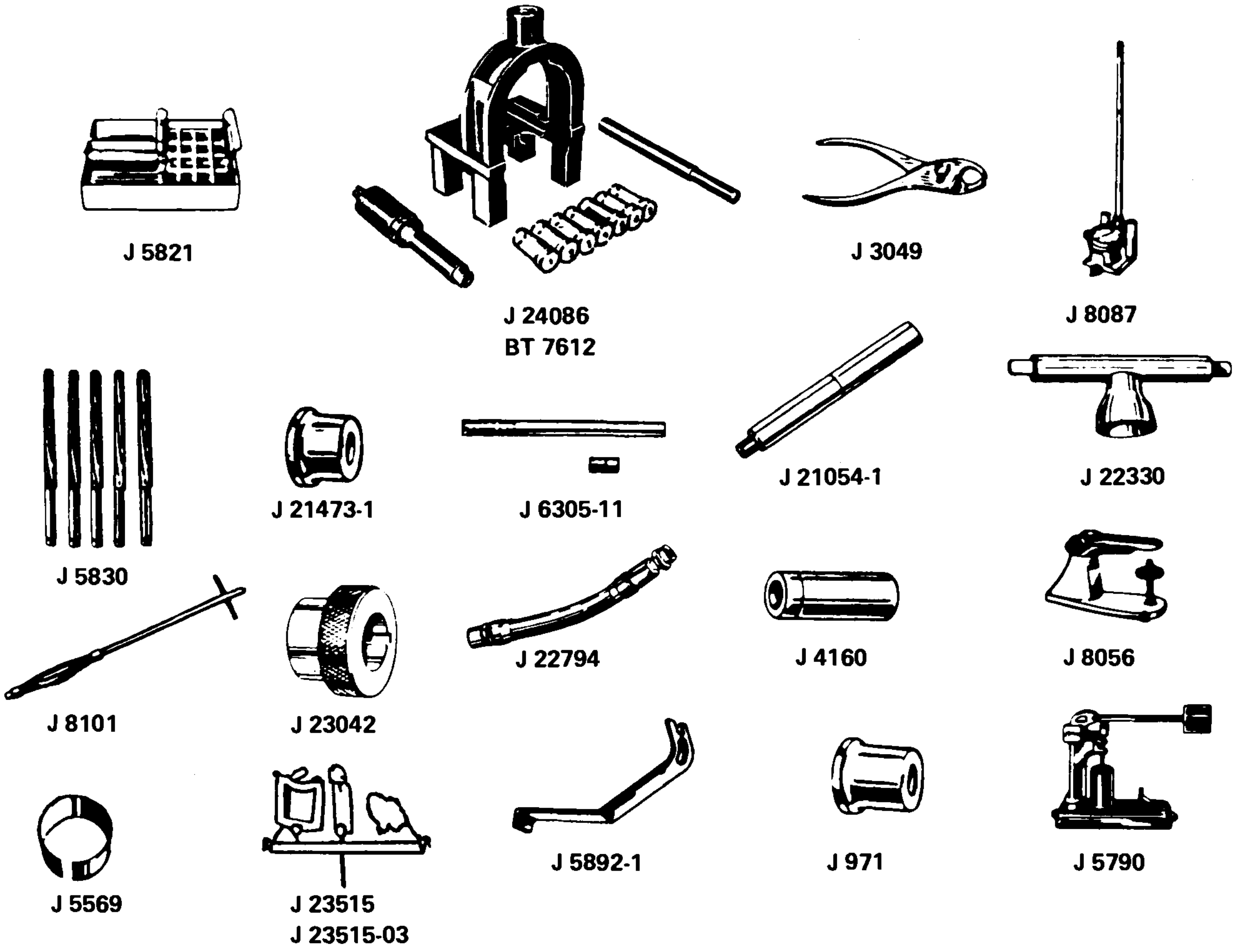
Seat Angle-Intake & Exhaust	46°
Stem to Guide Clearance	Intake .0010/.0027 Exhaust Top .0010/.0027 Exhaust Bottom .0020/.0037
Overall Length	4.92″
Springs (Force @ Length)	78-86 lbs. Without internal damper @ 1.66″
Installed Height	1.69″

VALVE TRAIN

Lifter-Leak Down Rate	12-90 seconds with 50 lbs. load
-Plunger Travel	.125″ (Gage)
Pushrod-Material	Ball End Steel Tubing
-Length	9.70″
Rocker Arm-Material	Stamped Steel
-Ratio	1. 75:1

LUBRICATON SYSTEM

Oil Pump	Gear Type
Oil Pressure	36 - 41 lb. @ 2000 rpm
Oil Filter	Full Flow
Filter Type	PF25
Crankcase Capacity Less Filter	3 qt.
Crankcase Capacity With Filter	4 qt.



TOOL NO.	NAME	TOOL NO.	NAME
J 5821	VALVE LIFTER CLEANING TANK	J 23042	TIME COVER SEAL ALIGNER & INSTALLER
J 24086 BT 7612	PISTON PIN TOOL	J 22794	AIR LINE ADAPTER
J 3049	VALVE LIFTER REMOVER	J 4160	HYDRAULIC VALVE LIFTER PLUNGER REMOVER
J 8087	CYLINDER BORE CHECKING GAUGE (RANGE 2-1/2"–9")	J 8056	VALVE & CLUTCH SPRING TESTER
J 5830	VALVE GUIDE REAMER SET	J 5569	PISTON RING COMPRESSOR (4")
J 21473-1	CAMSHAFT BUSHING REMOVER & INSTALLER ADAPTER (USE WITH J 21054-1)	J 23515 J 23515-03	ENGINE LIFTING FIXTURE ADAPTER
J 6305-11	CONNECTING ROD BOLT GUIDE SET	J 5892-1	VALVE SPRING COMPRESSOR
J 21054-1	HANDLE (CAMSHAFT BUSHING REMOVER & INSTALLER) (USE WITH J 21473-1)	J 971	CAMSHAFT GEAR REMOVER
J 22330	VALVE SEAL INSTALLER & TESTER	J 5790	HYDRAULIC VALVE LIFTER LEAKDOWN TESTER (INCLUDES ONE GALLON J 5268 TEST OIL)
J 8101	VALVE GUIDE CLEANING TOOL		

3515

Fig. 6A2-55 Special Tools (L4)

SECTION 6A3

3.8 LITRE 231 CUBIC INCH ENGINE - V.I. CODE C

CONTENTS OF THIS SECTION

ENGINE CONSTRUCTION

The left bank of cylinders (as viewed from rear) is set slightly forward of the right bank so that connecting rods of opposite sides can be connected to the same crankpin. Starting at the front of the engine, cylinders in the **left** bank are numbered 1-3-5 and cylinders in the **right** bank are numbered 2-4-6.

The **crankshaft,** nodular cast iron, is supported in the crankcase by four bearings which are identical except number 2, which takes end thrust and the rear main which has a different width and material. See Fig. 6A3-1.

The **crankshaft** is counterbalanced by weights cast integral with the crankshaft. Additional counterbalancing is obtained from the flywheel and harmonic balancer.

The tin plated **aluminum alloy pistons** have full skirts and are cam ground. Two transverse slots in the oil ring grooves extend through the piston wall and permit drain back of oil collected by the oil ring.

The **camshaft** is supported in the crankcase by five steel-backed babbitt-lined bearings. It is driven from the crankshaft by sprockets and chain.

Fig. 6A3-1 Engine Crankshaft and Bearings

The **cylinder heads** are cast iron and incorporate integral valve stem guides and rocker arm shaft pedestals. Right and left cylinder heads are identical and interchangeable, although in service, it is good practice to reinstall the cylinder heads on the side from which they are removed.

The **intake manifold** utilizes a low restriction, dual intake manifold. It is bolted to the inner edges of both cylinder heads so that it connects with all inlet ports. Since the intake manifold is cast iron, as is the carburetor throttle body, the manifold incorporates a special exhaust heat passage to warm the throttle body.

The E.G.R. System, used has a cast passage from the exhaust heat passage to the E.G.R. valve and from the valve to a hole in the floor of the intake manifold under the carburetor.

Each **exhaust and intake valve** has a spring of ample capacity to insure positive seating throughout the operating speed range.

The **valve rocker arms** for each bank of cylinders are mounted on a tubular steel shaft supported on the cylinder head by three pedestals. The rocker arms are stamped steel.

Hydraulic valve lifters and tubular push rods are used to operate overhead rocker arms and valves of both banks of cylinders from a single camshaft. This system requires no lash adjustment at time of assembly or in service. Construction and operation of hydraulic valve lifters are described below.

In addition to its normal function of a cam follower, each hydraulic valve lifter also serves as an automatic adjuster which maintains zero lash in the valve train under all operating conditions. By eliminating all lash in the valve train and also providing a cushion of oil to absorb operating shocks, the hydraulic valve lifter promotes quiet valve operation. It also eliminates the need for periodic valve adjustment to compensate for wear of parts.

As shown in Fig. 6A3-2 all parts of a hydraulic lifter are housed in the lifter body, which is the cam follower.

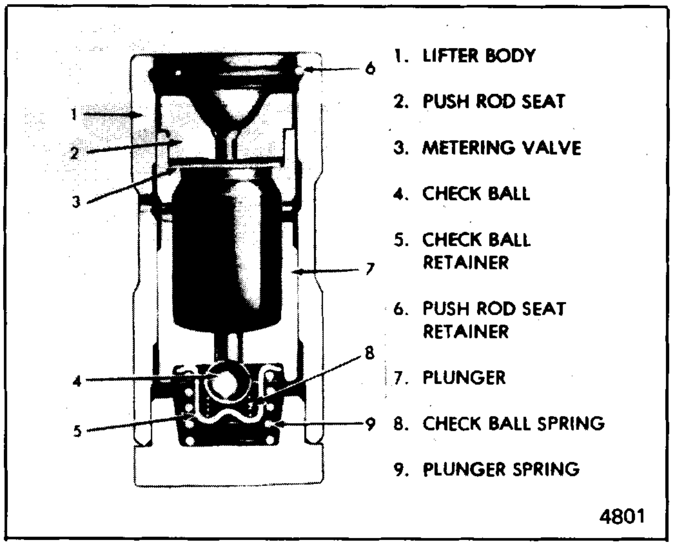


Fig. 6A3-2 Hydraulic Valve Lifter

Oil is fed to all lifters through galleries in the crankcase. Oil enters each lifter through grooves and oil holes in the lifter body and plunger, flows down into the chamber below the plunger through the feed hole and around the check ball. The first few cycles of operation after the engine is started forces out all air and completely fills the plunger and lower chamber of each lifter with oil.

LUBRICATION SYSTEM

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to crankshaft, connecting rods, and camshaft bearings, and is supplied under controlled volume to the rocker arms, and push rods. All other moving parts are lubricated by gravity flow or splash. See Fig. 6A3-3.

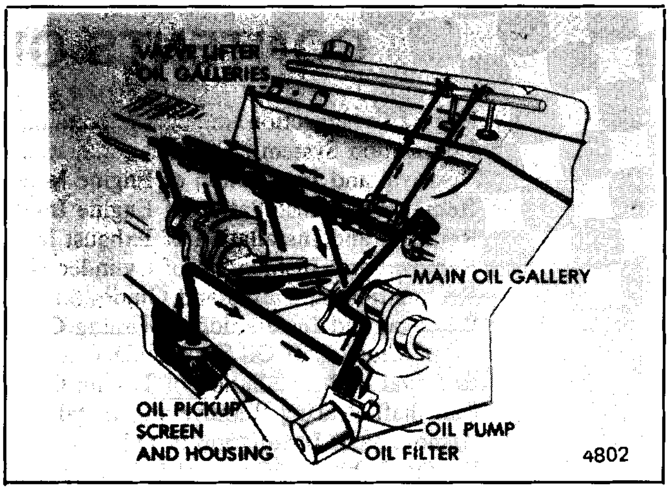


Fig. 6A3-3 Schematic Diagram of Engine Oil Flow

The supply of oil is carried in the lower crankcase (oil pan) which is filled through a filler opening in the left rocker arm cover. A removable oil gage rod on the left side of the crankcase is provided to check oil level.

The **oil pump** is located in the timing chain cover where it is connected by a drilled passage in the cylinder crankcase to an oil screen housing and pipe assembly. The screen is submerged in the oil supply and has ample area for all operating conditions. If the screen should become clogged for any reason, oil may be drawn into the system through the relief valve in the screen.

Oil is drawn into the pump through the **screen and pipe assembly** and a drilled passage in the crankcase which connects to drilled passages in the timing chain cover. **All** oil is discharged from the pump to the oil pump cover assembly. The cover assembly consists of an oil pressure relief valve, an oil filter by-pass valve and a nipple for installation of an oil filter. The spring loaded oil pressure relief valve limits the oil pressure. The oil filter by-pass valve opens when the filter has become clogged, to the extent that approximately 10-15 pounds pressure difference exists between the filter inlet and discharge, to by-pass the oil filter and channel unfiltered oil directly to the main oil galleries of the engine.

An **AC full flow oil filter** is externally mounted to the oil filter cover nipple on the lower right front side of the engine. Normally, all engine oil passes through the filter element, however, if the element becomes restricted, a spring loaded by-pass valve opens as mentioned above.

The **main oil galleries** run the full length of the crankcase and cut into the valve lifter guide holes to supply oil at full pressure to the lifters. Holes drilled from the crankshaft bearings to the main gallery intersect the cam bearing bores to supply oil to the cam bearings.

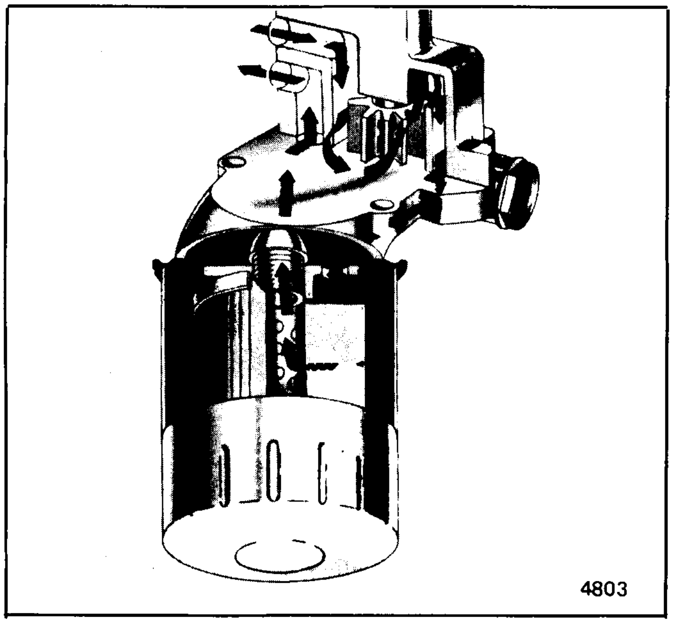


Fig. 6A3-4 Oil Pump and Filter Assembly

Holes drilled in the crankshaft carry oil from the crankshaft bearings to the connecting rod bearings. Pistons and cylinder walls are lubricated by oil thrown off the crankshaft and connecting rod splash. Piston pins are lubricated by splash.

In the **231 engine** a drilled hole in the camshaft connects the front camshaft bearing journal to the front of the camshaft. Oil flows from the journal through a passage to an outlet between the camshaft sprocket and distributor gear.

The oil stream strikes the distributor gear and provides ample lubrication of the timing chain and sprockets by splash.

Each rocker arm and valve is supplied with oil through the tubular push rod. This oil comes from the inside of the lifter, passing around the metering valve and through a hole in the lifter push rod seat. Oil from the push rod passes through a hole in the rocker arm push rod seat, and emerges on top of the push rod seat boss. See Fig. 6A3-6.

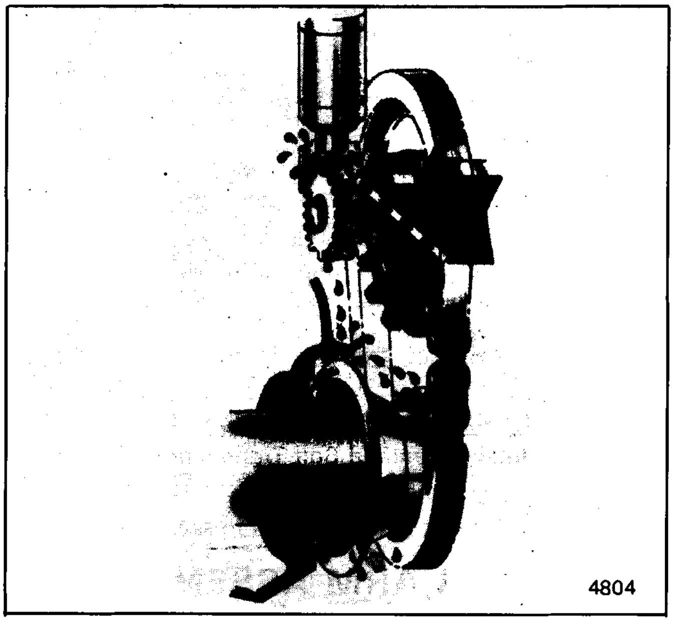


Fig. 6A3-5 Front End Lubrication

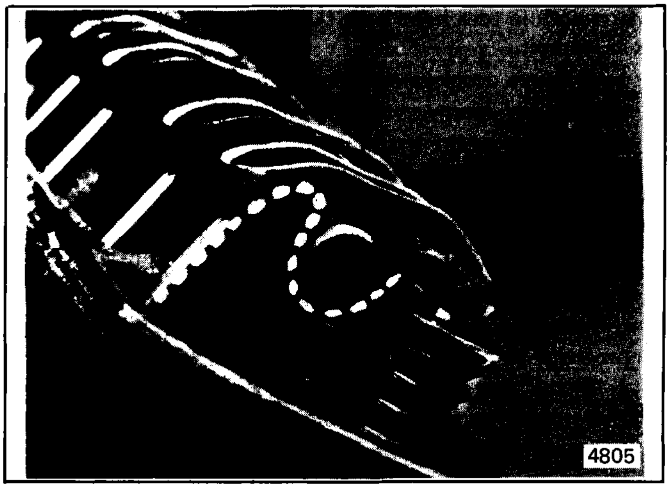


Fig. 6A3-6 Overhead Lubrication

UNIT REPAIR

ENGINE MOUNTS

Removal

1. Raise car and provide frame support at front of car.
2. Support weight of engine at forward edge of oil pan.
3. Remove mount to engine block bolts. Raise engine slightly and remove mount to mount bracket bolt and nut. Remove mount.

Installation

1. Install mount to engine block bolts and torque to specification.
2. Lower engine so mounts rest on frame cross member in normal manner. Install mount to bracket bolt and torque to specification.
3. Remove frame support and lower car.

ENGINE INTAKE MANIFOLD OR GASKET

Removal

1. Disconnect battery.
2. Drain radiator.
3. Remove air cleaner.
4. Disconnect:

a. Upper radiator hose at manifold.

b. Accelerator linkage at carburetor and linkage bracket at manifold and cruise control chain if equipped.

c. Booster vacuum pipe at manifold.

d. Fuel line at carburetor.

e. Transmission vacuum modulator line.

f. Idle stop solenoid wire (if equipped).

g. Distributor wires.

h. Temperature sending unit wire.

i. Vacuum hoses from distributor T.V.S. and EFE valve pipe from carburetor to vacuum manifold, fuel economy and load leveler hose if equipped.

j. Disconnect coolant by-pass hose at manifold.

5. Remove distributor cap and rotor to gain access to left intake manifold torx head bolt. (Use Tool J 24394) to remove torx head bolt.
6. Remove accelerator linkage springs.
7. Remove compressor top bracket if equipped.
8. Remove intake manifold

Installation

1. Place new intake manifold gasket and rubber manifold seals in position at front and rear rails of cylinder block. Be sure pointed end of seal fits snugly against block and head. Before installing intake manifold seals apply Silastic Sealer or equivalent to ends of seals. See Fig. 6A3-7.
2. Install one piece manifold gasket and carefully set intake manifold on the engine block dowel pin.
3. Install manifold to cylinder head bolts.

New intake manifold gasket and seals must be used whenever a manifold is removed.

When installing manifold, start with the No. 1 and No. 2 bolts. Gradually tighten both bolts until snug. Then continue with the rest of the bolts in the sequence shown in Fig. 6A3-8. Torque bolts to specifications.

4. Reverse removal procedure for installation.
5. Connect battery.
6. Close drain plug and fill radiator to proper level.

EXHAUST MANIFOLD

Removal

1. Support vehicle on stands.
2. Remove crossover pipe.
3. Right side-disconnect choke pipe.
4. Left side-disconnect EFE pipe.
5. Remove exhaust manifold bolts and exhaust

Installation

1. Install manifold by reversing above procedures.

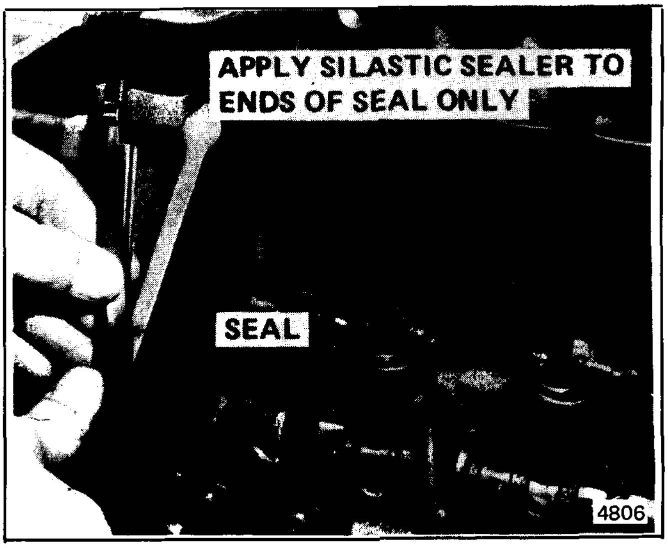


Fig. 6A3-7 Intake Manifold Seal Installation

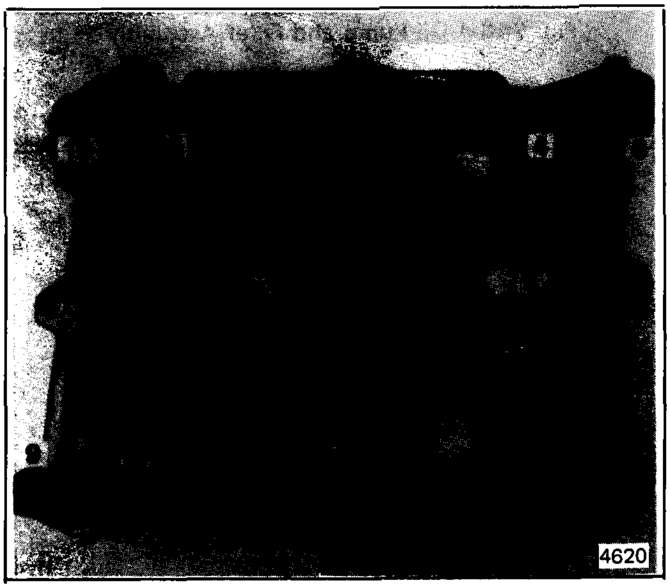


Fig. 6A3-8 Intake Manifold Bolt Tightening Sequence 231 Engine

2. Torque exhaust manifold bolts to specifications.

ROCKER ARM ASSEMBLY

Removal

1. Remove rocker arm cover and remove rocker arm and shaft assembly to cylinder head bolts. Remove shaft assembly.
2. Place assembly on a clean surface.
3. Remove nylon arm retainers by prying them out using a pair of channel locks. See Fig. 6A3-9.
4. Remove rocker arms and clean in suitable solution. Inspect for wear. Remove retainer pieces from inside shaft.

Installation

1. Install rocker arms on shaft lubricating all parts as they are assembled with engine oil. V6 engine rocker arms are installed in production with rights and lefts and must never be interchanged.

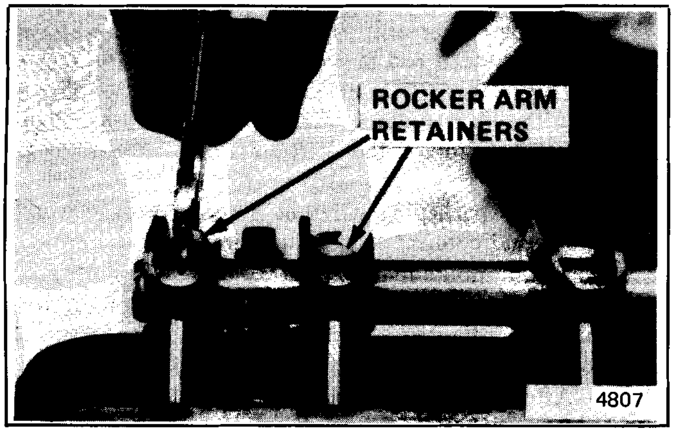


Fig. 6A3-9 Removing Nylon Retainer

Should it become necessary to replace one or more rocker arms, it must be noted that all service rocker arms are stamped (R) right (L) left. See Fig. 6A3-10 .

Fig. 6A3-10 Service Rocker Arms

When installing service rocker arms care must be taken to insure rocker arms are installed on the rocker arm shaft in the correct sequence. See Fig. 6A3-11.

2. Center each arm on the 1/4" hole in the shaft. Install new nylon rocker arm retainers in the 1/4" holes using a drift of at least 1/2" dia.

3. Install rocker arm assembly.

CYLINDER HEAD

Removal

1. Remove intake manifold.

2. When removing RIGHT cylinder head:

a. Loosen and remove belt(s).

b. Remove wires from Delcotron.

c. If equipped with air conditioning compressor, remove compressor from mounting bracket and position it out of the way with hoses connected, then remove Delcotron with mounting bracket.

3. When removing LEFT cylinder head: (Except X Series)

a. Remove oil gage rod.

b. Remove power steering gear pump with mounting bracket if present, and move it out of the way with hoses attached.

4. Disconnect wires from spark plugs, and remove the spark plug wire clips from the rocker arm cover studs.

5. Remove exhaust manifold bolts from head being removed.

6. With air hose and cloths, clean dirt off cylinder head and adjacent area to avoid getting dirt into engine. **It is extremely important to avoid getting dirt into the hydraulic valve lifters.**

7. Remove rocker arm cover and rocker arm and shaft assembly from cylinder head. Lift out push rods.

If lifters are to be serviced, remove them at this time. Otherwise, protect lifters and camshaft from dirt by covering area with a clean cloth. Whenever lifters or push rods are removed, place in a wooden block with numbered holes or similar device to keep them identified as to position in engine.

8. Loosen all cylinder head bolts, then remove bolts and lift off the cylinder head.

9. With cylinder head on bench, remove all spark plugs for cleaning and to avoid damage during work on the head.

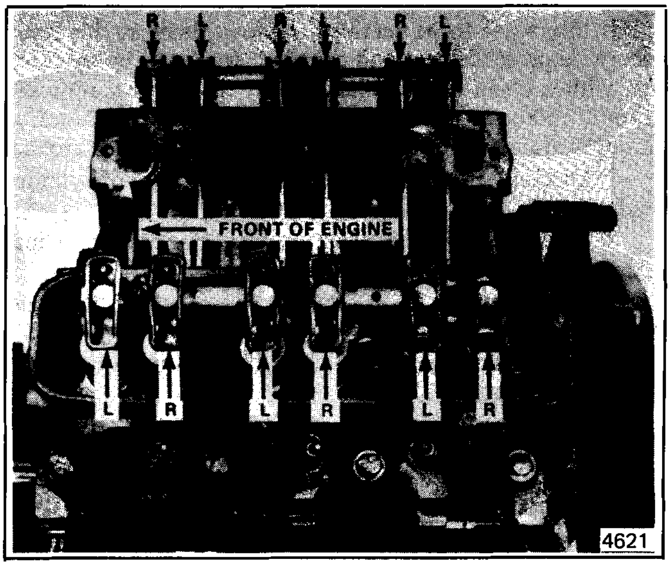


Fig. 6A3-11 Position on Service Rocker Arms on Shaft

LEFT CYLINDER HEAD REMOVAL

X SERIES

1. Remove intake manifold.

2. Remove oil gage rod.

3. Remove power steering pump with hoses connected and swing out of way.

4. Remove power steering pump bracket if equipped.

5. Disconnect spark plug wires and swing out of the way.

6. Remove rocker arm cover, rocker arm and shaft assembly from cylinder head. Lift out push rods.

If lifters are to be serviced, remove them at this time. Otherwise protect lifters and camshaft from dirt by covering area with a clean cloth. Whenever lifters or push rods are removed, place in a wooden block with numbered holes or similar device to keep them identified as to position in engine.

7. Disconnect power brake unit hose at rear of cylinder head.

8. Raise vehicle and place on jack stands, disconnect exhaust crossover pipes and support.

9. Remove left front engine mount thru bolt and "loosen" right front engine mount thru bolt.

10. Raise the engine (if chain fall is used hood will have to be removed).

11. Remove cylinder head bolts and remove cylinder head.

If exhaust manifold does not clean steering gear, engine may have to be raised further.

CYLINDER HEAD INSTALLATION

1. Thoroughly clean off engine block gasket surface and be certain no foreign material has fallen in the cylinder bores, bolt holes, or in the valve lifter area. It is good practice to clean out bolt holes with an air hose.

2. Install new head gasket with the bead down toward the cylinder block. Dowels in the block will hold the gasket in place. Always handle gaskets carefully to avoid kinking or damage to the surface of the gasket.

3. Clean gasket surface of cylinder head and carefully set in place on the engine block dowel pins.

4. Use a heavy body thread sealer on the head bolts since the bolt holes are through into the coolant.

Use an accurate torque wrench when installing head bolts. Uneven tightening of the cylinder head bolts can distort the cylinder bores, causing compression loss and excessive oil comsumption.

5. Install head bolts. Tighten the bolts a little at a time about three times around in the sequence shown in Fig. 6A3-12. Give bolts a final torque in the same sequence. Torque to 80 lb. ft.

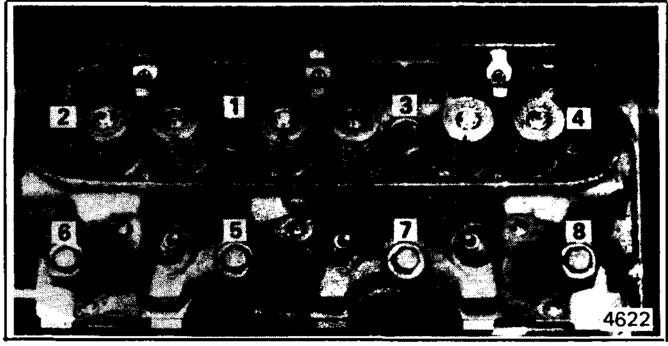


Fig. 6A3-12 Cylinder Head Bolt Tightening Sequence 231 Engine

6. Assemble exhaust manifolds to heads. Torque bolts to specifications.

7. Wipe rocker arm shaft and bosses on cylinder head with a clean cloth.

8. Install push rods.

9. Tilt the rocker arm toward the push rod and locate the top of each push rod in its rocker arm seat.

10. Draw down the rocker arm and shaft assembly by tightening the shaft bolts a little at a time. Use a reliable torque wrench to torque the shaft bolts to specifications Do not overtighten.

11. Place spark plug wires in position on rocker arm cover studs and connect spark plug wires.

12. Install intake manifold.

13. Replace components removed in cylinder head removal and tighten belt(s). See Cooling Systems Specifications Section.

14. After installation is completed and engine has been warmed up to operating temperature, recheck cylinder head bolt torque.

15. Install rocker arm cover and new gasket, torque bolts to 4 lb.ft.

RECONDITIONING VALVES AND GUIDES

1. Remove cylinder head. Place on a clean surface.

2. Using suitable spring compressor, such as J 8062, compress valve spring and remove valve spring cap key. Release tool and remove spring and cap. See Fig. 6A3-13.

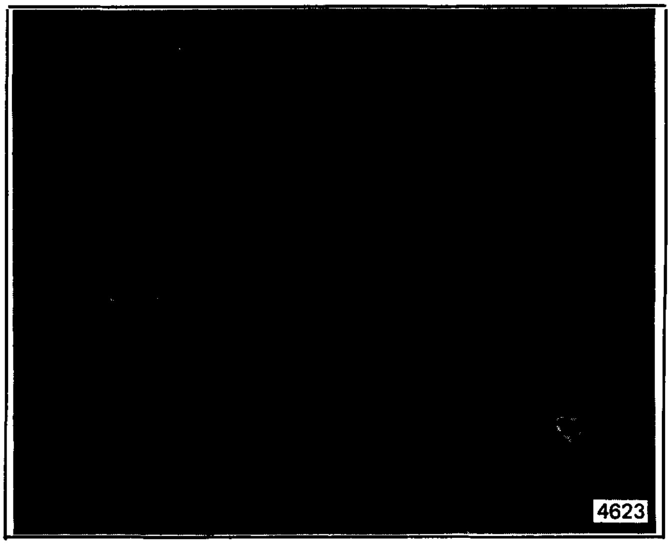


Fig. 6A3-13 Removing Valve Cap Retainers

3. Remove valve seals from intake valve guides. Seals must be discarded. Remove valves. Place valves in numerical order so that they can be reinstalled in original location.

4. Remove all carbon from combustion chambers, piston heads, and valves. When using scrapers or wire brushes for removing carbon, avoid scratching valve seats and valve faces. A soft wire brush (such as J 8358) is suitable for this purpose.

5. Clean carbon and gum deposits from valve guide bores. Use Reamer J 8101.

6. Inspect valve faces and seats for pits, burned spots or other evidences of poor seating. If a valve head must be ground until the outer edge is sharp in order to true up the face, discard the valve because the sharp edge will run too hot. 45° is the correct angle for valve faces.

7. If valve stem has too much clearance in its guide, the guide should be reamed to using a .003 and .006" oversize Reamer. See Fig. 6A3-14.

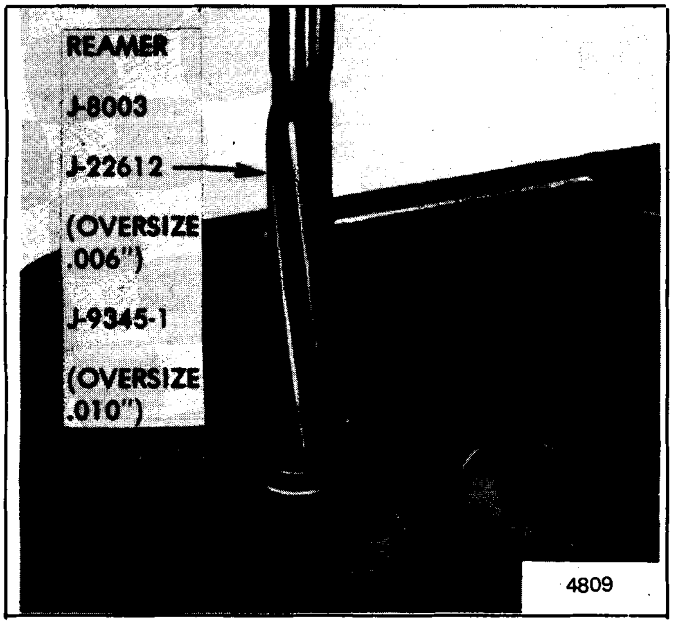


Fig. 6A3-14 Reaming Valve Guide

Oversize valve are identified by the oversize marking stamped on the valve head.

The Parts Department stocks .006" oversize valves for replacement purposes. See Fig. 6A3-15.

8. True up valve seats to 45°. Cutting a valve seat results in lowering the valve spring pressure and increases the width of the seat. The nominal width of the intake valve seat is 1/16". If the intake valve seat is over 5/64" wide after truing up it should be narrowed to specified width by the use of 20° and 70° stones. The nominal width of the exhaust valve seat is 3/32". If the exhaust valve is over 7/64" wide after truing it should be narrowed to the specified width. Use 20 degree and 70 degree stones to narrow the valve seats to the specified widths.

Improper hydraulic valve lifter operation may result if valve and seat have been refinished enough to allow the end of valve stem to raise approximately .050" above normal position. In this case it will be necessary to grind off end of valve stem or replace parts.

9. Lightly lap the valves into seats with the fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that a minimum of lapping is required. Excessive lapping will groove the valve face preventing a good seat when hot.

New valves should not be lapped under any condition as the .0002" - .0015" aluminum alloy surface on the intakes or the .0004" to .0015" nickel-plated surface on the exhausts will be removed.

10. Test valves for concentricity with seats and for tight seating. The usual test is to coat the valve face lightly with Prussian blue, or equivalanet, and turn the valve against seat. If the valve face is concentric with the valve stem a mark will be made all around the face, while if the face is not concentric with the stem, a mark will be made on only one side of the **face.** Next, coat the valve seat lightly with Prussian blue, or equivalent, Rotate the valve against the seat to determine if the valve seat is concentric with the valve guide, and if the valve is seating all the way around. Both of these tests are necessary to prove that a proper seat is being obtained.

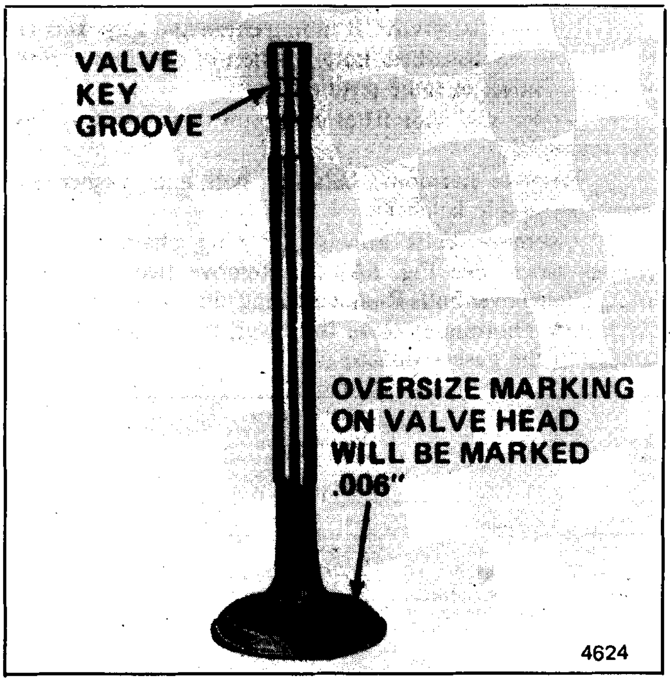


Fig. 6A3-15 Oversize Valve Identification

11. Remove any burrs from valve stem with a fine stone and polish with crocus cloth.

12. Lubricate valve stems and guides with engine oil and reinstall valves.

13. Install new intake valve seals.

Do not install exhaust valve guide seals.

a. Start valve seal carefully over valve stem. Push seal down until it touches top of guide.

b. Use installation tool J 22509 to push seal over valve guide until upper inside surface of seal touches top of guide.

COMPRESS SPRINGS ONLY ENOUGH TO INSTALL KEEPERS. EXCESS COMPRESSION CAN CAUSE SPRING RETAINER TO DAMAGE VALVE SEAL.

14. All valve springs may be installed with either end up.

15. Reinstall valve spring, cap and cap retainer, using same equipment used for removal.

16. Install cylinder head.

TIMING CHAIN COVER

Removal

1. Drain radiator.
2. Disconnect upper and lower radiator hose and heater return hose at water pump.
3. Remove fan, fan pulleys and belt(s).
4. Remove fan driving pulley (crankshaft).
5. Disconnect fuel lines and remove fuel pump.
6. Remove Delcotron generator and brackets.

7. Remove distributor. If timing chain and sprockets are not going to be disturbed, note position of distributor rotor for reinstallation in same position.

8. Loosen and slide front clamp on thermostat by-pass hose rearward.

9. Remove harmonic balancer bolt and washer and remove harmonic balancer.

10. Remove bolts attaching timing chain cover to cylinder block. See Fig. 6A3-16. Remove two oil pan to timing chain cover bolts Remove timing chain cover assembly and gasket. Thoroughly clean the cover, taking care to avoid damage to the gasket surface.

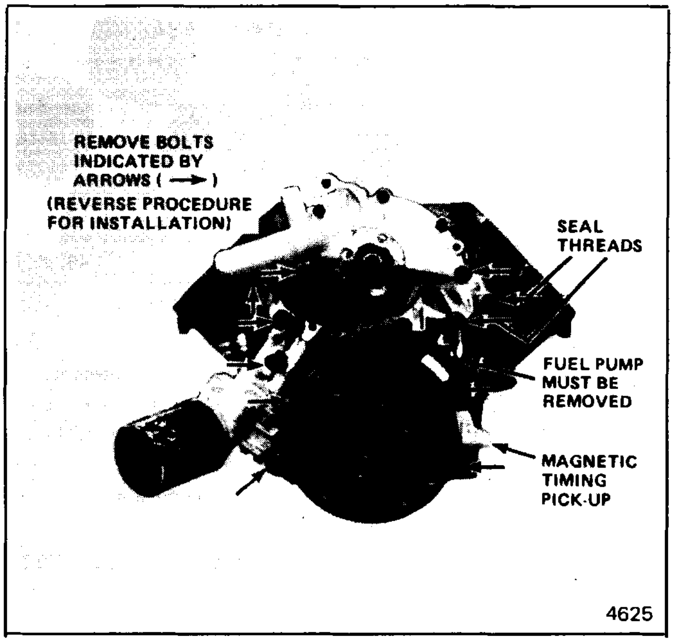


Fig. 6A3-16 Timing Chain Cover Removal and Installation

Installation

Reinstall timing chain cover by reversing removal procedure, paying particular attention to the following points.

1. Remove oil pump cover and pack the space around the oil pump gears completely full of petroleum jelly. There must be no air space left inside the pump. Reinstall cover using new gasket. This step is very important as the oil pump may "lose its prime"whenever the pump, pump cover or timing chain cover is disturbed. If the pump is not packed, it may not begin to pump oil as soon as the engine is started.

2. The gasket surface of the block and timing chain cover must be smooth and clean. Use a new gasket and be certain it is positioned correctly.

3. Position timing chain cover against block and be certain dowel pins engage dowel pin holes before starting bolts.

4. Apply sealer to bolt threads as shown in Fig. 6A3-16.

5. Install harmonic balancer, bolt and washer. By using a screwdriver or other suitable tool, lock flywheel and torque bolt to specification. See Fig. 6A3-17.

Fig. 6A3-17 Locking Flywheel to Torque Harmonic

FRONT CRANKSHAFT OIL SEAL REPLACEMENT

1. Use a punch to drive out old seal and shedder. Drive from the front toward the rear of the timing chain cover.

2. Coil new packing around opening so ends of packing are at top. Drive in shedder using suitable punch. Stake the shedder in place in at least three places.

3. Size the packing by rotating a hammer handle or similar tool around the packing until the balancer hub can be inserted through the opening.

TIMING CHAIN AND SPROCKET

Removal

1. With timing chain cover removed temporarily install harmonic balancer bolt and washer in end of crankshaft. Turn crankshaft so sprockets are positioned as shown in Fig. 6A3-18. Remove harmonic balancer bolt and washer using a sharp blow on the wrench handle, so that the bolt can be started out without changing position of sprockets.

2. Remove front crankshaft oil slinger.

3. Remove camshaft sprocket bolts.

4. Use two large screwdrivers to alternately pry the camshaft sprocket then the crankshaft sprocket forward until the camshaft sprocket is free, then remove the camshaft sprocket and chain and finish working crankshaft sprocket off crankshaft.

5. Thoroughly clean the timing chain, sprockets, distributor drive gear, fuel pump eccentric and crankshaft oil slinger.

Installation

1. Turn crankshaft so that Number 1 piston is at top dead center.

2. Turn camshaft so with sprocket temporarily installed, timing mark is straight down. See Fig. 6A3-18. Remove Sprocket.

3. Assemble timing chain on sprockets and slide the sprocket and chain assembly on the shafts with the timing marks in their closest together position and in line with the

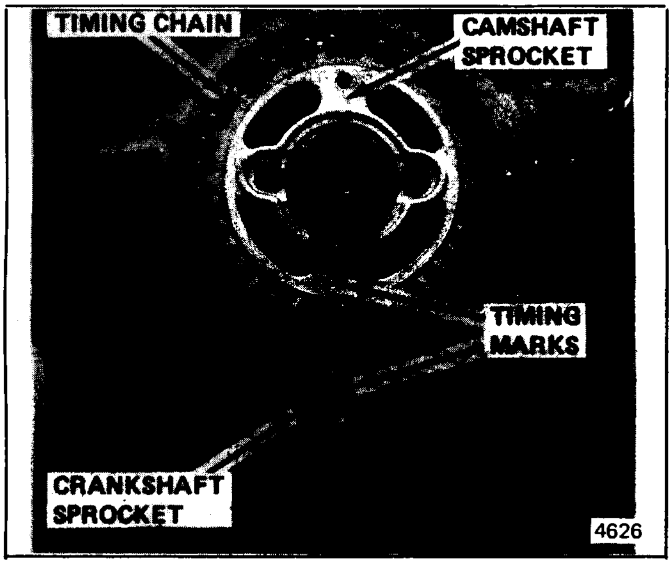


Fig. 6A3-18 Installation of Timing Chain and Sprocket

sprocket hubs. See Fig. 6A3-18.

4. Assemble slinger on crankshaft with I.D. against sprocket (concave side toward front of engine). See Fig. 6A3-19.

5. Install camshaft sprocket bolts torque to specifications.

6. Install camshaft thrust button, spring and timing chain dampers.

7. Install timing chain cover.

CAMSHAFT

Removal

1. Remove intake manifold.
2. Remove rocker arm covers.
3. Remove rocker arm and shaft assemblies, push rods and valve lifters.
4. Remove timing chain cover, timing chain and sprocket.
5. Align timing marks of camshaft and crankshaft sprocket. This avoids burring of the camshaft journals by the crankshaft during removal. Slide camshaft forward out of bearing bores carefully to avoid marring the bearing surfaces.

Installation

1. When replacing camshaft, take particular care to avoid marring the bearing surfaces.
2. Install by reversing above procedures.

CAMSHAFT BEARING

Bearing Removal

Care must be exercised during bearing removal and installation, not to damage bearings that are not being replaced.

1. Remove camshaft and crankshaft.
2. Assemble puller screw to required length.
3. Select proper size expanding collet and back-up nut.

Fig. 6A3-19 Oil Slinger Installation

4. Install expanding collet on expanding mandrel. Install back-up nut.

5. Insert this assembly into camshaft bearing to be removed. Tighten back-up nut to expand collet to fit I.D. of bearing.

6. Thread end of puller screw assembly into end of expanding mandrel and collet assembly.

7. Install pulling plate, thrust bearing, and pulling nut on threaded end of puller screw.

8. Bearing can then be removed by turning pulling nut. See Fig. 6A3-20.

Make certain to grip the 5/8" hex end of the puller screw with a wrench to keep it from rotating when the pulling nut is turned. Failure to do this will result in the "locking up"of all threads in the pulling assembly and possible over expansion of the collet.

9. Repeat the above procedure to remove any other bearings, except the front bearing, which may be pulled from the rear of the engine.

When removing rear cam bearing, it is necessary to remove welch plug at the back of cam bore. However, if only the front bearing is being replaced, it is not necessary to remove the engine or welch plug. The front bearing can be removed by using a spacer between the pulling plate and the cylinder block.

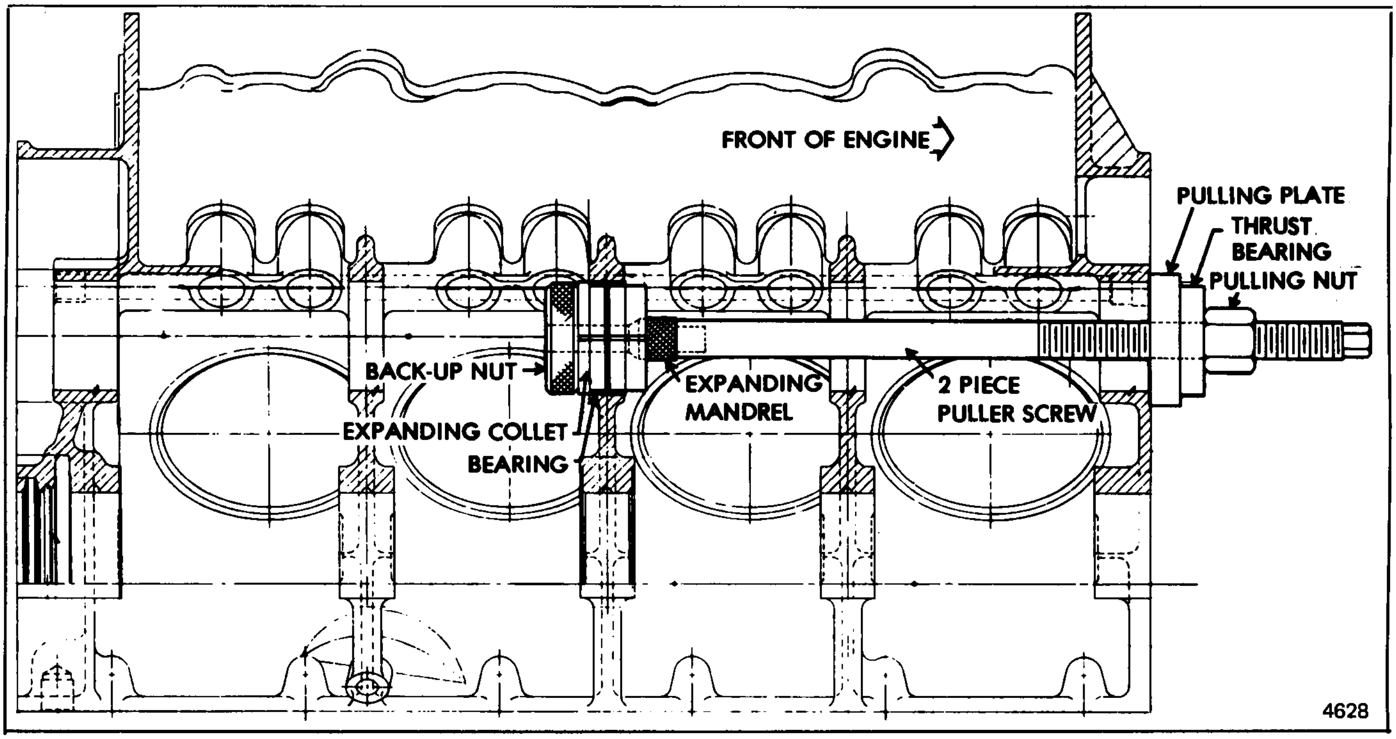


Fig. 6A3-20 Removing and Installing Camshaft Bearings

Camshaft Bearing Service

Slightly scored camshaft bearings will be satisfactory if the surfaces of camshaft journals are polished and bearings are cleaned up to remove burrs, and the fit of shaft in bearings is free and within the specification.

Should the bearing be gauled beyond repair, the bearing will have to be replaced.

To install precision replacement cam bearing, special Tool J 27408 is required. To remove and install replacement bearing proceed as follows:

Bearing Installation

1. Assemble puller screw to required length.
2. Select proper size expanding collet and back-up nut.
3. Install expanding collet on expanding mandrel.
4. Install back-up nut.
5. Place new camshaft bearing on collet and GENTLY hand tighten back-up nut to expand collet to fit bearing. Do not over tighten back-up nut. A loose sliding fit between collet and bearing surface is adequate. This will provide just enough clearance to allow for the "collapse"which will occur when the new bearing is pulled into the engine block.
6. Slide mandrel assembly and bearing into bearing bore as far as it will go without force.
7. Thread end of puller screw onto the end of the mandrel.

Make certain to align oil holes in bearing and block properly. One of the collet separation lines may be used as a reference point.

8. Install pulling plate, thrust bearing and pulling nut on threaded end of puller screw.
9. Install bearing in the same manner as described in Steps 8 and 9 under "Bearing Removal".

When installing rear cam bearing, install new welch plug at back of cam bore. Coat O.D. of plug with non-harding sealer before installation.

OIL PAN

Removal

1. Raise vehicle.
2. Drain oil.
3. Remove flywheel cover.
4. Remove crossover pipe.
5. Remove oil pan.

Installation

For installation, reverse procedures of oil pan removal observing the following:

1. Clean oil pan. Make sure the gasket surfaces on pan and block are clean.
2. Apply silastic sealer to a few spots on a new pan gasket and install on block.
3. Install oil pan. Torque bolts to specifications. DO NOT overtighten.

OIL PUMP PIPE AND SCREEN ASSEMBLY

REMOVAL AND INSPECTION

Removal

1. Remove oil pan
2. Remove oil pump pipe and screen assembly to cylinder block bolts.

3. Clean the screen and housing thoroughly in solvent and blow dry with air.

Installation

Install by reversing removal procedure, paying particular attention to the following points.

1. Make sure oil pump pipe flange gasket surface of block is smooth and free of dirt.

2. Use new gasket and tighten bolts to specifications. See Fig. 6A3-21.

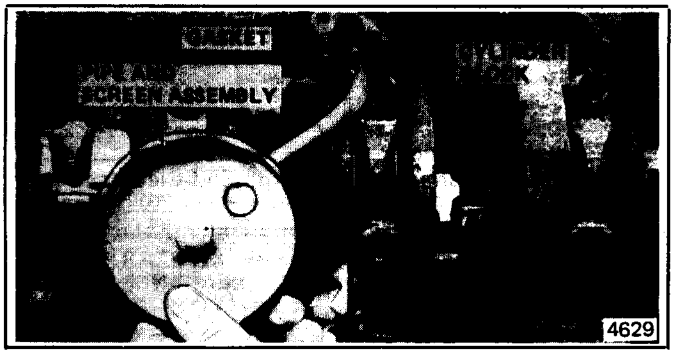


Fig. 6A3-21 Oil Pickup Pipe and Screen

3. Install oil pan.

TESTING OIL PRESSURE

If low oil pressure is suspected, the pressure can be checked on the car with tool set J 25087.

1. Check oil level.

2. Raise vehicle and remove oil filter.

3. Assemble plunger valve in the large hole of the tester base and the hose in the small hole of the tester base. Connect guage to the end of the hose.

4. Insert the flat side of the rubber plug, for ease of installation, in the by-pass valve without depressing the by-pass valve itself.

5. Install the tester on filter mounting pad.

6. Start engine to check overall pressure, sender switch, or noisy lifters. Pressure should be as follows:

NOTE: Engine should be at operating temperature before checking oil pressure.

231 cu. in. V6 37 psi @ 2600 rpm.

7. If adequate oil pressure is indicated, check pressure sending switch.

8. If a low reading is indicated, depress the valve on tester base to isolate the oil pump and/or its components from the lubricating system. An adequate reading at this time would indicate a good pump and the previous low pressure was due to worn bearings etc. A low reading while depressing the valve would indicate a faulty pump.

PRIMING THE OIL PUMP WITH TOOL J 25087

1. Assemble plunger valve in the large hole of the tester base and the hose in the small hole of the tester base. Connect guage to the end of the hose.

2. Insert the flat side of the rubber plug, for ease of installation, in the by-pass valve without depressing the by-pass valve itself.

3. Install the tool on filter mounting pad.

4. Connect a pressurized air supply to the primer attachment.

5. Depress lever on primer attachment while at the same time holding valve on tester base down to assure that oil will be lifted instead of air being drawn from bearings etc. Hold these positions until a light spray of oil emits from the nozzle verifying that the oil pump has been primed.

6. Remove primer assembly, install filter and start engine.

NOTE: In the event of failure to raise oil during priming operation, check for vented system, such as a cracked or broken pump body or relief valve in open position. If oil can be lifted during priming operation, but pump fails to function, check for worn or broken pump drives. A broken or twisted pump drive may indicate a lock-up (frozen) oil pump.

7. Inspect and replace as necessary.

OIL PUMP AND RELIEF VALVE CLEANING

At times an oil pump or oil pump relief valve may be stuck due to the presence of foreign particles. They may be cleaned in the following manner:

1. Blow compressed air through the oil channel (between the pump and filter pad), with short blasts this will further open the relief valve allowing these particles to be forced from the pump. If this operation is successful, the oil pump will once again be able to deliver pressure.

2. Follow procedure for priming oil pump.

NOTE: Failure to prime at this time will necessitate oil pump overhaul or replacement.

OIL PUMP COVER AND GEARS

REMOVAL, INSPECTION AND INSTALLATION

Removal

1. Remove oil filter.

2. Remove screws attaching oil pump cover assembly to timing chain cover. Remove cover assembly and slide out oil pump gears.

3. Wash off gears and inspect for wear, scoring, etc. Replace any gears not found serviceable.

4. Remove the oil pressure relief valve cap, spring and valve. See Fig. 6A3-22. Oil filter by-pass valve and spring are staked in place and should not be removed.

5. Wash the parts thoroughly and inspect the relief valve for wear or scoring. Check the relief valve spring to see that it is not worn on its side or collapsed. Replace any relief valve spring that is questionable.

6. Check the relief valve in its bore in the cover. The valve should have no more clearance than an easy slip fit. If any perceptible side shake can be felt the valve and/or cover should be replaced.

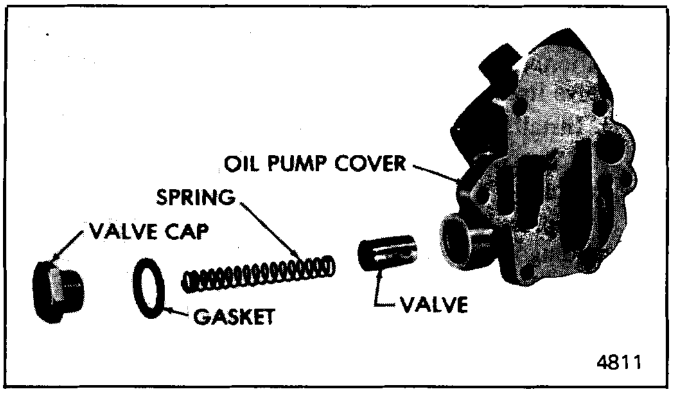


Fig. 6A3-22 Oil Pump Cover and Pressure-Relief Valve

7. Check filter by-pass valve for cracks, nicks, or warping. The valve should be flat and free of nicks or scratches.

Installation

1. Lubricate and install pressure relief valve and spring in bore of oil pump cover. See Fig. 6A3- 22. Install cap and gasket. Torque cap to specification with a reliable torque wrench. Do not over-tighten.

2. Install oil pump gears and shaft in oil pump body section of timing chain cover to check gear end clearance and side clearance.

a. Check oil pump end clearance by placing a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. See Fig. 6A3-23. Clearance should be between .002" and .006". (If clearance is less than .002" measure gears and pocket to determine which is out of specification. See Fig.s 6A3-25 and 6A3-26).

b. Check oil pump side clearance as shown in Fig. 6A3-24. Clearance should be between .0025 - .0050. (If clearance is greater than .0050 measure gears and pocket to determine which is out of specification). See Fig.s 6A3-25 and 6A3-26.

c. Check oil pump cover flatness by placing a straight edge across the cover face, using a feeler gage between straight edge and pump cover. If clearance is .001" or more the pump cover must be replaced.

3. If gear end clearance and oil pump cover is flat and side clearance is satisfactory, remove gears and pack gear pocket full of petroleum jelly. Do not use chassis lube.

4. Reinstall gears so petroleum jelly is forced into every cavity of the gear pocket and between the teeth of the gears. Place **new** gasket in position. This step is very important. Unless the pump is packed with petroleum jelly it may not prime itself when the engine is started.

5. Install cover assembly screws. Tighten alternately and evenly to torque specifications.

6. Install filter on nipple.

CONNECTING ROD BEARINGS

A connecting rod bearing consists of two halves or shells which are interchangeable in rod and cap. When the shells are placed in position, the ends extend slightly beyond the parting surfaces so that when the rod bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. **The ends of the bearing shells must never be filed flush with parting**

Fig. 6A3-23 Checking Oil Pump End Clearance

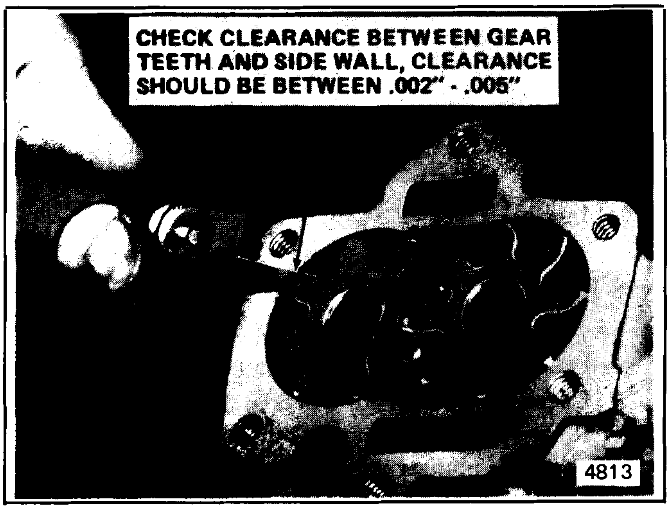


Fig. 6A3-24 Measuring Oil Pump Side Clearance

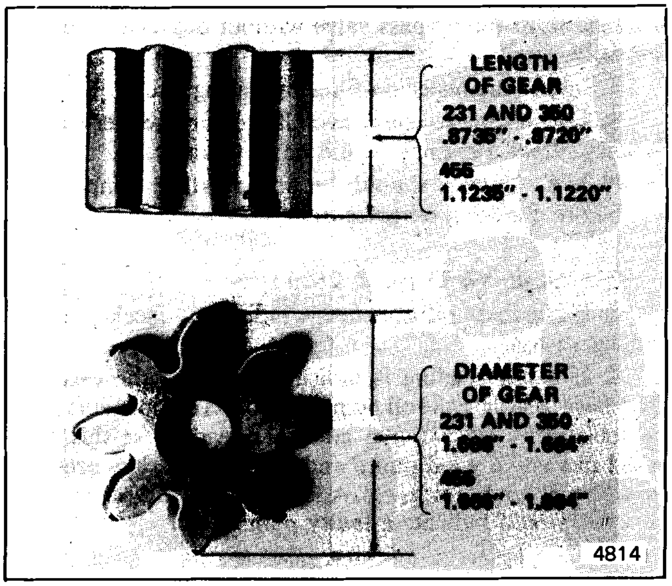


Fig. 6A3-25 Measuring Gears For Wear

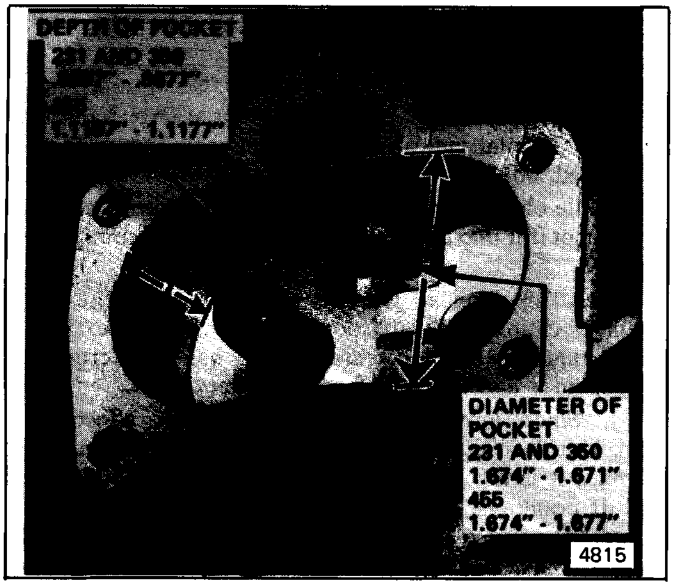


Fig. 6A3-26 Measuring Gear Pocket For Wear

surface of rod or cap.

If a rod bearing becomes noisy or is worn so that clearance on the crankpin is excessive, a new bearing of proper size must be selected and installed since no provision is made for adjustment. **Under no circumstances should the connecting rod or cap be filed to adjust the bearing clearance.**

INSPECTION OF CONNECTING ROD BEARINGS AND CRANKPIN JOURNALS

After removal of engine oil pan, disconnect two connecting rods at a time from crankshaft and inspect the bearings and crankpin journals. While turning crankshaft it is necessary to temporarily reconnect the rods to crankpin to avoid possibility of damaging the journals through contact with loose rods. Do not interchange rod caps with rods.

If connecting rod bearings are scored or show flaking, they should be replaced. If bearings are in good physical condition check for proper clearance on crankpin.

If crankpin journals are scored or ridged the crankshaft must be replaced, or reground for undersize bearings, to insure satisfactory life of connecting rod bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil. Burrs may be honed off with a fine oil stone.

Use an outside micrometer to check crankpins for out-of-round. If crankpins are more than .0015" out-of-round, satisfactory life of new bearings cannot be expected.

Checking Clearance and Selecting Replacement Bearings

Service bearings are furnished in standard size and several undersizes (including undersizes for re-ground crankpins).

The clearance of connecting rod (and crankshaft) bearings may be checked by use of Plastic-Type Gage which has a range of .001" to .003".

1. Remove connecting rod cap with bearing shell. Wipe oil from bearing and crankpin journal, also blow oil out of hole in crankshaft. Plastic-type gage is soluble in oil.

2. Place a piece of plastic-type gage lengthwise along the bottom center of the lower bearing shell (Fig. 6A3-27, View A), then install cap with shell and torque bolt nuts to specifications.

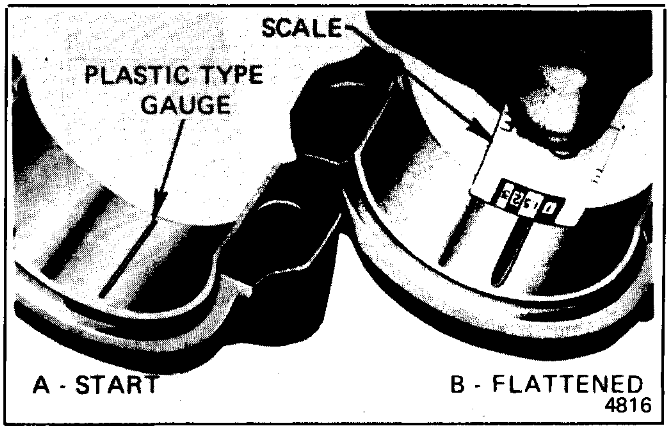


Fig. 6A3-27 Checking Bearing Clearance With Plastic-Type Gage

Conical boss on web of rod must be toward rear of engine on all rods in left bank and toward front of engine in right bank. Cap installation can be only one direction since it is dictated by bolt centerline onset.

3. DO NOT TURN CRANKSHAFT with plastic-type gage in bearing.

4. Remove bearing cap with bearing shell, the flattened plastic-type gage will be found adhering to either the bearing shell or the crankpin. **Do not remove it.**

5. Using the scale printed on the plastic-type gage envelope, measure the flattened plastic-type gage at its widest point. The number within the graduation which most closely corresponds to the width of plastic-type gage indicates the bearing clearance in thousandths of an inch. See Fig. 6A3-27, View B.

6. The desired clearance with a new bearing is .0005" to .0026". If bearing has been in service it is advisable to install a new bearing if the clearance exceeds .003"; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

7. If a new bearing is being selected, try a standard size, then each undersize bearing in turn until one is found that is within the specified limits when checked for clearance with plastic-type gage. Each undersize bearing shell has a number stamped on the outer surface to indicate amount of undersize. See Fig. 6A3-28.

8. After the proper size bearing has been selected, clean off the plastic-type gage, oil the bearing thoroughly, reinstall cap with bearing shell and torque bolt nuts to specifications. See Step 2.

9. With selected bearing installed and bolts tightened, it should be possible to move connecting rod freely back and forth on crankpin as allowed by end clearance. If rod cannot be moved, either the bearing is too much undersize or a misaligned rod is indicated.

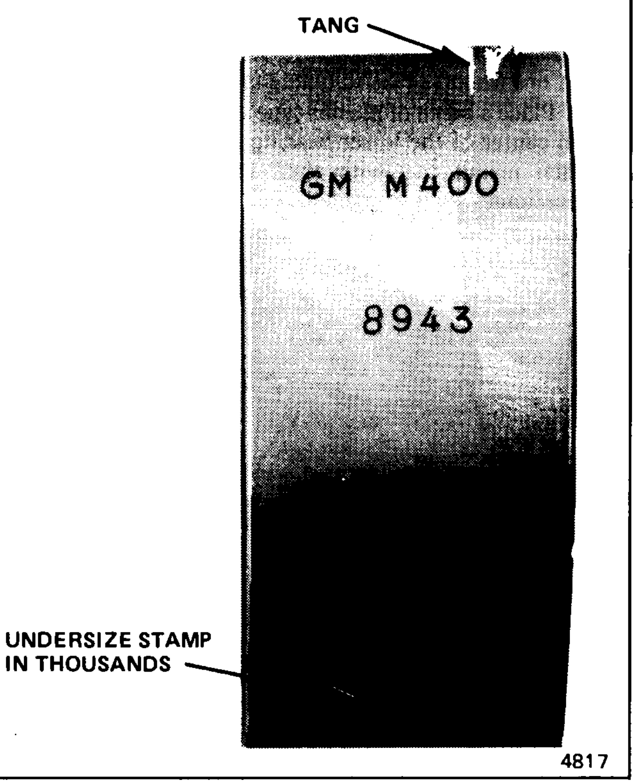


Fig. 6A3-28 Location of Undersize Mark on Bearing Shell

CRANKSHAFT BEARINGS AND SEALS

Replacement of Crankshaft Bearings

A crankshaft bearing consists of two halves or shells which are not alike and not interchangeable in cap and crankcase. The upper (crankcase) half of the bearing is grooved to supply oil to the connecting rod bearings while the lower (bearing cap) half of the shell is not grooved. The two bearing halves must not be interchanged. All crankshaft bearings except the thrust bearing and rear main upper are identical. The thrust bearing (No. 2)is flanged to take end thrust and the rear main upper bearing groove does not extend the full arc of the bearing. When the shells are placed in crankcase and bearing cap, the ends extend slightly beyond the parting surfaces so that when cap bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. **The ends of shells must never be filed flush with parting surface of crankcase or bearing cap.**

Crankshaft bearings are the precision type which do not require reaming to size. Shims are not provided for adjustment since worn bearings are readily replaced with new bearings of proper size. Bearings for service replacement are furnished in standard size and undersizes. **Under no circumstances should crankshaft bearing caps be filed to adjust for wear in old bearings.**

After removal of oil pan, pipe and screen assembly, and oil pan baffle, perform the following removal, inspection and installation operations on each crankshaft bearing in turn so that the crankshaft will be well supported by the other bearings.

If crankshaft has been removed to check straightness the following procedure is suggested.

Rest crankshaft on "V-blocks" at (No. 1 and No. 4 bearing journals). Check indicator runout at (No. 2 and No. 3 journals). Total indicator readings at each journal should not exceed .0015.

While checking runout at each journal note relation of "high"spot (for maximum eccentricity) on each journal to the others.

"High"spot on all journals should come at the same angular location. If "high"spots do not come at nearly the same angular location, crankshaft has a "crook"or "dogleg"in it and is unsatisfactory for service.

1. Since any service condition which affects the crankshaft bearings may also affect the connecting rod bearings, it is advisable to inspect connecting rod bearings first. If crankpins are worn to the extent that crankshaft should be replaced or reground, replacement of crankshaft bearings only will not be satisfactory. If replacement of cylinder block or crankshaft is required, always check main bearing clearance with plastic-type gage to obtain specified limits.

2. Remove one bearing cap, then clean and inspect lower bearing shell and the crankshaft journal. If journal surface is scored or ridged, the crankshaft must be replaced or reground to insure satisfactory operation with new bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil, and burrs may be honed off with a fine stone.

3. If condition of lower bearing shell and crankshaft journal is satisfactory, check the bearing clearance with plastic-type gage as described for the connecting rod bearing.

4. When checking a crankshaft bearing with plastic-type gage, turn crankshaft so that oil hole is up to avoid dripping of oil on plastic-type gage. Place paper shims in lower halves of adjacent bearings and tighten cap bolts to take the weight of crankshaft off the lower shell of bearing being checked. Arrow on cap must point to front of engine.

5. If bearing clearance exceeds .003", it is advisable to install a new bearing; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

6. Loosen all crankshaft bearing cap bolts 1/2 turn, and remove cap of bearing to be replaced.

7. Remove upper bearing shell by inserting Bearing Shell Remover and Installer J 8080 in oil hole in crankshaft, then slowly turning crankshaft so that the tool rotates the shell out of place by pushing against the end without the tang. See Fig. 6A3-29.

When turning crankshaft with rear bearing cap removed, hold oil seal to prevent it from rotating out of position in crankcase.

8. The crankshaft journal cannot be measured with an outside micrometer when shaft is in place; however, when upper bearing shell is removed the journal may be checked for out-of-round by using a special crankshaft caliper and inside micrometer. The caliper should not be applied to journal in line with oil hole.

If crankshaft journal is more than .0015" out-of-round, the crankshaft should be replaced since the full mileage cannot be expected from bearings used with an excessively out-of-round crankshaft.

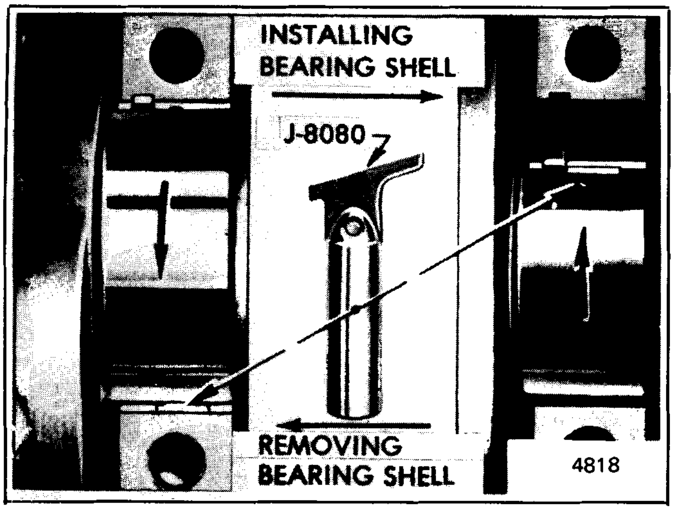


Fig. 6A3-29 Removal and Installation of Crankshaft Bearing Upper Shell

9. Before installation of bearing shells make sure that crankshaft journal and the bearing seats in crankcase and cap are thoroughly cleaned.

10. Coat inside surface of upper bearing shell with engine oil and place shell against crankshaft journal so that tang on shell will engage notch in crankcase when shell is rotated into place. Upper bearing shells have an oil groove in their center, while lower shells are not grooved. They must not be interchanged.

11. Rotate bearing shell into place as far as possible by hand, then insert Installer J 8080 in crankshaft oil hole and rotate crankshaft to push shell into place. Bearing shells should move into place with very little pressure. If heavy pressure is required, shell was not started squarely and will be distorted if forced into place.

12. Place lower bearing shell in bearing cap, then check clearance with plastic-type gage, as previously described.

13. The desired clearance with a new bearing is .0004" to .0015". If this clearance cannot be obtained with a standard size bearing, insert an undersize bearing and check again with plastic-type gage.

Each undersize shell has a number stamped on outer surface on or near the tang to indicate amount of undersize.

14. When the proper size bearing has been selected, clean out all plastic-type gages, oil the lower shell and reinstall bearing cap. Clean the bolt holes and lube bolts, then torque cap bolts to specification.

The crankshaft should turn freely at flywheel rim; however, a very slight drag is permissible.

15. If the **thrust** bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel serveral times (last movement fore) with the thrust bearing cap bolts finger tight.

16. After bearing is installed and tested, loosen all bearing cap bolts 1/2 turn and continue with other bearings. When bearings have been installed and tested, tighten all bearing cap bolts to specified torque.

17. Replace rear main bearing oil seals.

18. Install oil pan baffle, pipe and screen assembly, and oil pan.

Installation of Rear Bearing Oil Seals

Braided fabric seals are pressed into grooves formed in crankcase and rear bearing cap to rear of the oil collecting groove, to seal against leakage of oil around the crankshaft. See Fig. 6A3-30.

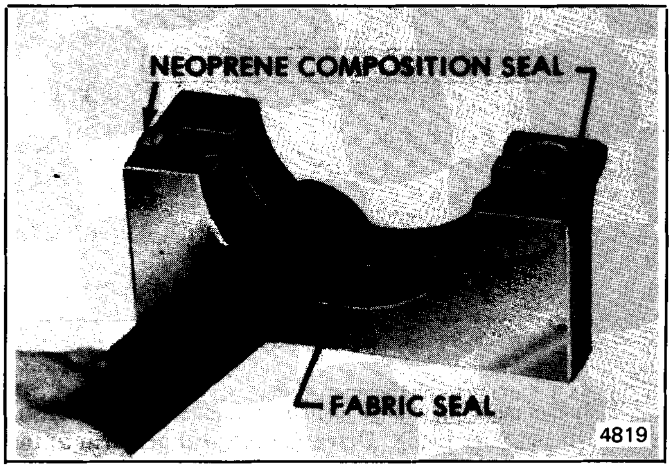


Fig. 6A3-30 Installing Rear Bearing Oil Seals

A new braided fabric seal can be installed in crankcase only when crankshaft is removed, but it can be repaired while crankshaft is installed, as outlined under Rear Main Bearing Upper Oil Seal Repair. The seal can be replaced in cap whenever the cap is removed. Remove old seal and place new seal in groove with both ends projecting above parting surface of cap. Force seal into groove by rubbing down with hammer handle or smooth stick until seal projects above the groove not more than 1/16". Cut ends off flush with surface of cap, using sharp knife or razor blade. See Fig. 6A3-30.

The engine must be operated at slow speed when first started after a new braided seal is installed.

Neoprene composition seals are placed in grooves in the sides of bearing cap to seal against leakage in the joints between cap and crankcase. The neoprene composition swells in the presence of oil and heat. The seals are undersize when newly installed and may even leak for a short time until the seals have had time to swell and seal the opening. See Fig. 6A3-30.

The neoprene seals are slightly longer than the grooves in the bearing cap. The seals must not be cut to length. Before installation of seals, soak for 1 to 2 minutes in light oil or kerosene. After installation of bearing cap in crankcase, install seal in bearing cap.

To help eliminate oil leakage at the joint where the cap meets the crankcase, apply silastic sealer to the rear main bearing cap split line. When applying sealer, use only a thin coat as an over abundance will not allow the cap to seat properly. See Fig. 6A3-31.

After seal is installed, force seals up into the cap with a blunt instrument to be sure of a seal at the upper parting line between the cap and case.

REAR MAIN BEARING UPPER OIL SEAL REPAIR

1. Remove oil pan.

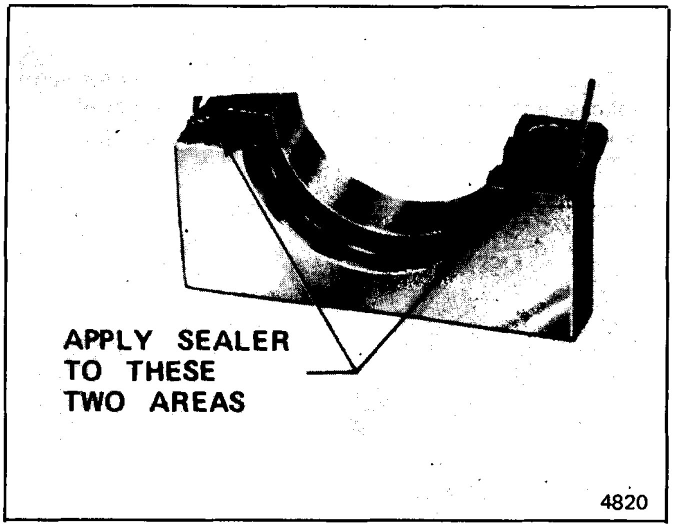


Fig. 6A3-31 Sealer Applied to Split Line

2. Insert packing tool (J 21526-2) against one end of the seal in the cylinder block. Drive the old seal gently into the groove until it is packed tight. This varies from 1/4"to 3/4"depending on the amount of pack required. See Fig. 6A3-32.

Fig. 6A3-32 Packing Seal Into Cylinder Block

3. Repeat Step 2 on the other end of the seal in the cylinder block.

4. Measure the amount the seal was driven up on one side and add 1/16", using a single edge razor blade cut that length from the old seal removed from the rear main bearing cap. Repeat the procedure for the other side. Use the rear main bearing cap as a holding fixture when cutting the seal.

5. Install Guide Tool (J 21526-1) onto cylinder block. See Fig. 6A3-33.

Fig. 6A3-33 Guide Tool Installed

Fig. 6A3-34 Packing Short Pieces of Rope Seal Into Guide Tool and Cylinder Block

6. Using packing tool, work the short pieces cut in Step 4 into the guide tool and then pack into cylinder block. The guide tool and packing tool have been machined to provide a built-in stop. Use this procedure for both sides. See Fig.s 6A3-33 and 6A3-34.

It may help to use oil on the short pieces of the rope seal when packing into the cylinder block.

7. Remove the guide tool.

8. Install a new fabric seal in the rear main bearing cap. Install cap and torque to specifications.

9. Install oil pan.

PISTONS, RINGS, AND CONNECTING RODS

PISTON AND ROD ASSEMBLIES

Replacement, Disassembly and Inspection

1. Remove cylinder heads.
2. Examine the cylinder bores above the ring travel. If bores are worn so that a shoulder or ridge exists at the top of the cylinder, remove the ridges with a ridge reamer to avoid damaging rings or cracking ring lands in pistons during removal. See Fig. 6A3-35.

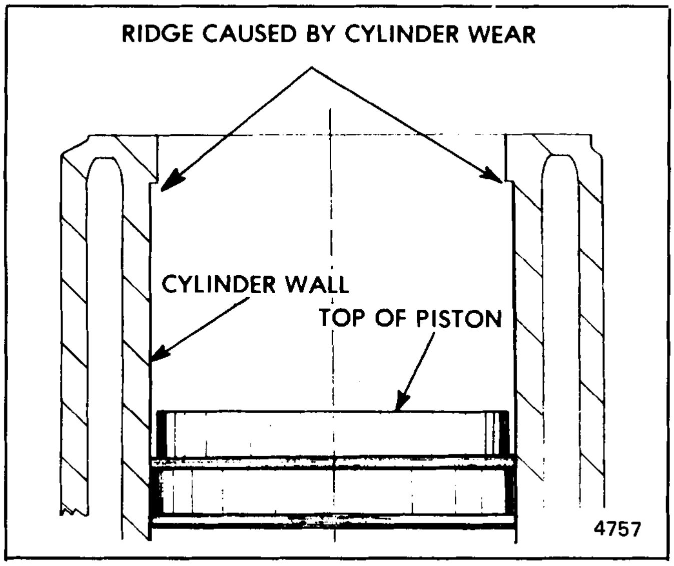


Fig. 6A3-35 Ridge Formed by Rings at Top of Travel

3. Use a silver pencil or quick drying paint to mark the cylinder number on all pistons, connecting rods and caps. Starting at the front end of the crankcase the cylinders in the right bank are numbered 2-4-6. Those in the left bank are numbered 1-3-5.
4. To remove piston and rod assemblies:

With No. 1 crankpin straight down, remove the cap with bearing shell from No. 1 connecting rod, install the "short"connecting rod guide Tool J 24567-1 in the connecting rod hole above the crankpin. Install the "long" connecting rod guide Tool J 24567-2 in remaining hole. Turn guides down fully to hold the upper bearing shell in place while removing the piston and rod assembly. See Fig. 6A3-36.

5. Use the long guide to push the piston and rod assembly out of the cylinder, then remove guides and reinstall cap with bearing shell on rod.
6. Remove all other piston and rod assemblies in the same manner.
7. Remove compression rings and remove oil ring.
8. To remove piston pin:

a. Use piston pin remover and installer J 24086.

b. Install pilot of J 24086 on piston pin.

c. Install piston and connecting rod assembly on support and place in a press. See Fig. 6A3-37 press pin from rod and piston.

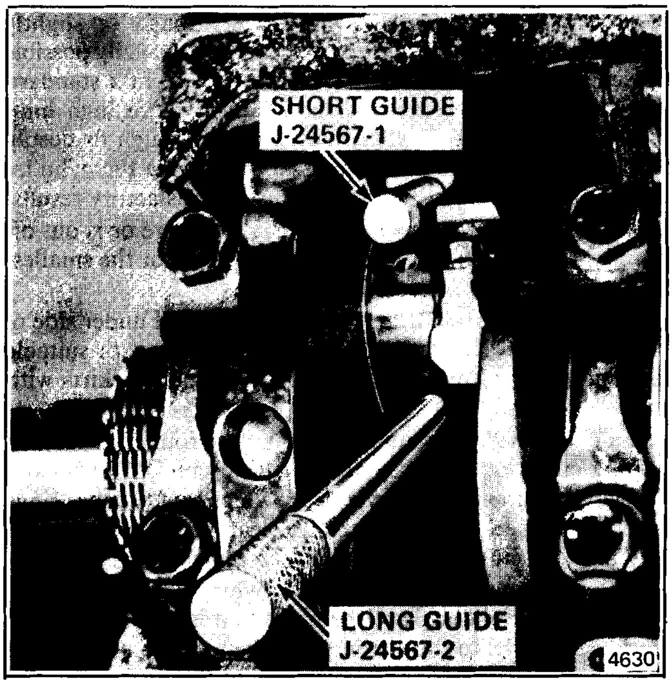


Fig. 6A3-36 Connecting Rod Bolt Guides Installed

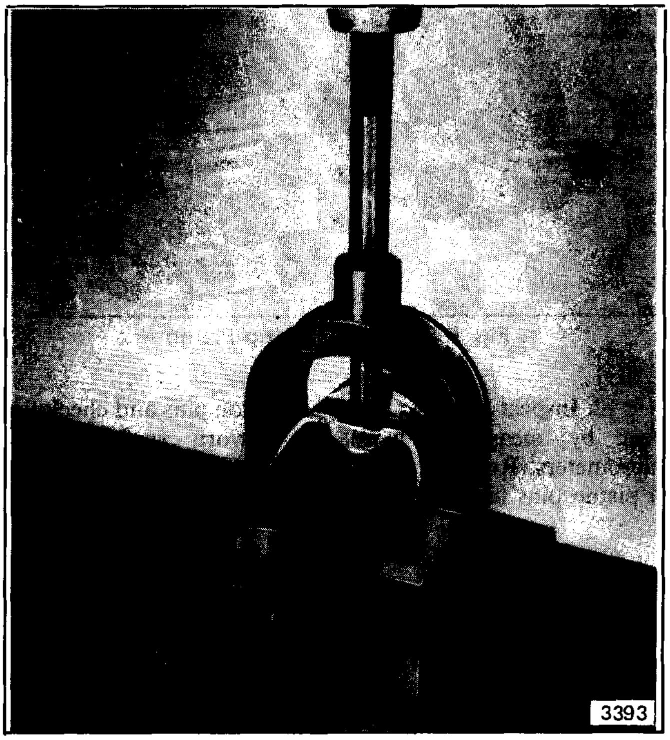


Fig. 6A3-37 Removing Piston Pin

9. Inspect cylinder walls for scoring, roughness, or ridges which indicate excessive wear. Check cylinder bores for taper and out-of-round with an accurate cylinder gage at top, middle and bottom of bore, both parallel and at right angles to the centerline of the engine. The diameter of the cylinder bores at any point may be measured with an inside micrometer or setting the cylinder gage dial at "O"and measuring across the gage contact points with outside micrometer while the gage is at same "O"setting.

a. If a cylinder bore is moderately rough or slightly scored but is not out-of-round or tapered, it is usually possible to remedy the situation by honing the bore to fit a standard service piston since standard service pistons are high limit production pistons. If cylinder bore is very rough or deeply scored, however, it may be necessary to rebore the cylinder to fit an oversize piston in order to insure satisfactory results.

b. If cylinder bore is tapered .005" or more or is out-of-round .003" or more, it is advisable to rebore for the smallest possible oversize piston and rings.

10. Clean carbon from piston surfaces and under side of piston heads. Clean carbon from ring grooves with suitable tool and remove any gum or varnish from piston skirts with suitable solvent.

11. Carefully examine pistons for rough or scored bearing surfaces, cracks in skirt or head cracked or broken ring lands, chipping or uneven wear which would cause rings to seat improperly or have excessive clearance in ring grooves. Damaged or faulty pistons should be replaced.

The pistons are cam ground, which means that the diameter at a right angle to the piston pin is greater than the diameter parallel to the piston pin. When a piston is checked for size, it must be done at points 90° to the piston pin. See Fig. 6A3-38. The piston should be checked (for fitting purposes) 1/4" below the bottom of the oil ring groove.

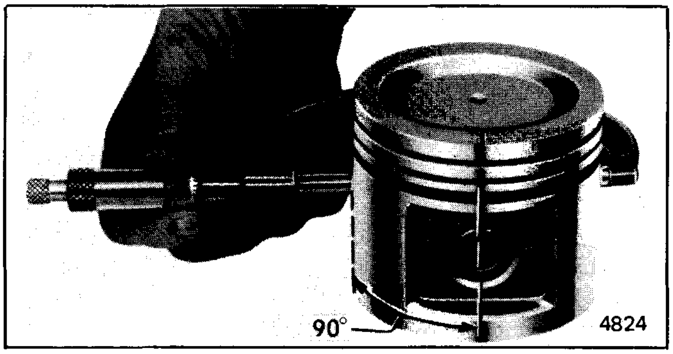


Fig. 6A3-38 Measuring Piston

12. Inspect bearing surfaces of piston pins and check for wear by measuring worn or unworn surfaces with micrometers. Rough or worn pins should be replaced. Test fit piston pins in piston bosses.

Occasionally pins will be found tight due to gum or varnish deposits. This may be corrected by removing the deposit with a suitable solvent. If piston bosses are worn out-of-round or oversize, the piston and pin assembly must be replaced. Oversize pins are not practical due to the pin being a press fit in the connecting rod. Piston pins must fit the piston with an easy finger push at 70° F (21° C)(.0004" to .0007" clearance).

13. Examine all piston rings for scores, chips or cracks. Check compression rings for tension by comparing with new rings. Check gap of compression rings by placing rings in bore at bottom of ring travel. Measure gap with feeler gage. Gap should be between .010" and .020". If gaps are excessive (over .020") it indicates the rings have worn considerably and should be replaced. Bore wear should be checked before rings are replaced, .005" bore wear will result in .015" increase in ring gap.

REBORING CYLINDER AND FITTING NEW PISTONS

If one or more cylinder bores are rough, scored, or worn beyond limits, it will be necessary to smooth or true up such bores to fit new pistons.

If relatively few bores require correction it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance, since all oversize service pistons are held to the same weights as standard size pistons.

Standard size service pistons are high limit or maximum diameter; therefore, they can usually be used with a slight amount of honing to correct slight scoring or excessive clearances in engines having relatively low mileage. All service pistons are diamond bored and selectively fitted with piston pins; pistons are not furnished without pins.

No attempt should be made to cut down oversize pistons to fit cylinder bores as this will destroy the surface treatment and affect the weight. The smallest possible oversize service pistons should be used and the cylinder bores should be honed to size for proper clearances.

Before the honing or reboring operation is started, measure all new pistons with micrometer contacting at points exactly 90° to piston pin (Fig. 6A3-38) then select the smallest piston for the first fitting. The slight variation usually found between pistons in a set may provide for correction in case the first piston is fitted too free.

If wear at top of cylinder does not exceed .005" on the diameter or exceed .003" out-of-round, honing is recommended for truing the bore. If wear or out-of- round exceeds these limits, the bore should be trued up with a boring bar of the fly cutter type, then finish honed.

When reboring cylinders, all crankshaft bearing caps must be in place and tightened to proper torque to avoid distortion of bores in final assembly. Always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. When taking the final cut with boring bar leave .001" on the diameter for finish honing to give the required clearance specified below.

When honing cylinders use clean sharp stones of proper grade for the amount of metal to be removed, in accordance with instructions of the hone manufacturer. Dull or dirty stones cut unevenly and generate excessive heat. When using coarse or medium grade stones use care to leave sufficient metal so that all stone marks may be removed with the fine stones used for finishing to provide proper clearance.

When finish honing, pass the hone through the entire length of cylinder at the rate of approximately 60 cycles per minute. This should produce the desired 45 degree cross hatch pattern on cylinder walls which will insure maximum ring life and minimum oil consumption.

It is of the greatest importance that refinished cylinder bores are trued up to have not over .0005" out-of-round or taper. Each bore must be final honed to remove all stone or cutter marks and provide a smooth surface. During final honing, each piston must be fitted individually to the bore in which it will be installed and should be marked to insure correct installation.

After final honing and before the piston is checked for fit, each cylinder bore must be **thoroughly** washed to remove all traces of abrasive and then dried thoroughly. The dry bore should then be brushed clean with a power-driven fiber brush. If all traces of abrasive are not removed, rapid wear of new pistons and rings will result. A satisfactory method of fitting pistons is as follows:

1. Remove all rings from pistons which will be fitted. It is not necessary to separate rods from pistons. If an excess amount of varnish or carbon appears as a ridge at the top of the cylinder, remove by scraping or sanding.

2. Wipe bores and pistons clean, removing oil or other foreign material. Select a piston-rod assembly for the bore to be fitted (or piston and pin if a new piston is being fitted) and position down into the bore with the top of piston down. See Fig. 6A3-39. The piston should fall free by its own weight through the bore when the bottom of the piston skirt is 1/2" to 1" from top of block. See Fig. 6A3-40. Caution must be used to insure piston is not damaged when it "falls" through the cylinder. If it doesn't, the piston fit is too tight and another piston should be selected until the piston will slide freely through the bore without any force being applied. Mark piston and bore for proper assembly.

3. After a piston has been selected, which will slide freely through a bore, it must be determined if piston fit will be too loose. This is done by placing a .0025" feeler gage for used pistons, and a .002" feeler gage for new pistons at least 6" long and not over 1/2" wide, down into the same bore with selected piston while holding feeler to top of the bore. See Fig. 6A3-41.

Position selected piston and feeler down into the bore until the bottom of the skirt is again 1/2" to 1" from top of block, being sure that the feeler gage is 90 degrees from the pin. If the piston hangs on the feeler gage and does not fall free, it indicates that the piston is correctly fitted to that respective bore. See Fig. 6A3-42 and 6A3-43. Mark both piston and bore before going to the next bore. If the piston fell free during this check with the .0025" feeler gage (.002" feeler gage for new pistons) then that particular piston is too samall for the bore and a larger diameter piston will be required.

> **NOTE:** When checking more than one bore, it is very possible that what may be a piston too small for one bore will be a correct fit in another. It is very improbable that any engine will require all 6 or 8 pistons to be changed.

FITTING NEW PISTON RINGS

When new piston rings are installed without reboring cylinders, the glazed cylinder walls should be slightly dulled, but without increasing the bore diameter, by means of the finest grade of stones in a cylinder hone.

New piston rings must be checked for clearance in piston grooves and for gap in cylinder bores. The cylinder bores and piston grooves must be clean, dry and free of carbon and burrs.

With rings installed, check clearance in grooves by inserting feeler gages between each ring and its **lower** land because any wear that occurs forms a step at inner portion of the lower land.

If the piston grooves have worn to the extent that relatively high steps exist on the lower lands, the piston should be replaced because the steps will interfere with the operation of new rings and the ring clearances will be excessive. Piston rings are not furnished in oversize widths to compensate for ring groove wear.

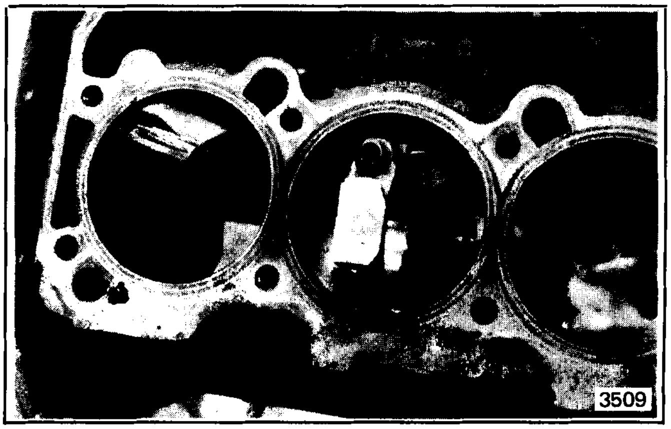


Fig. 6A3-39 Positioning Piston in Bore

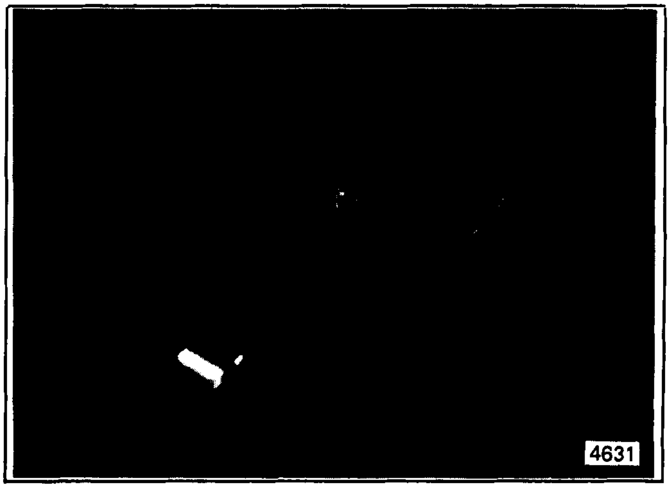


Fig. 6A3-40 Piston Fall

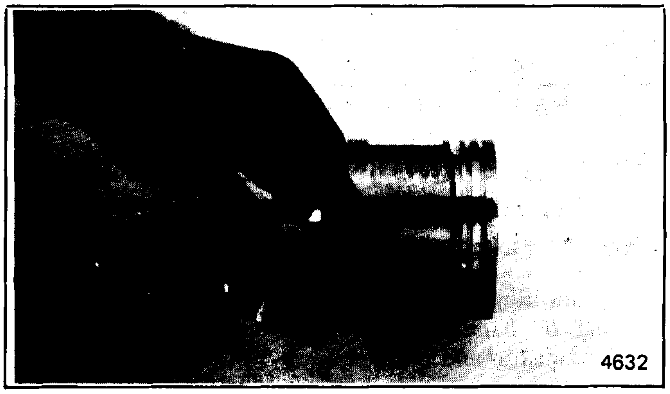


Fig. 6A3-41 Positioning Feeler Gage

When fitting new rings to new pistons the side clearance of the compression rings should be .003" to .005" and side clearance of the oil ring should not exceed .0035".

To check the end gap of compression rings, place the ring in the cylinder in which it will be used, square it in the bore by tapping with the lower end of a piston, then measure gap with feeler gages. Piston rings should not have less than .010" (compression rings) and .015" (oil ring) gap when placed in cylinder bores. If gap is less than specified, file the ends of rings carefully with a smooth file to obtain proper gap.

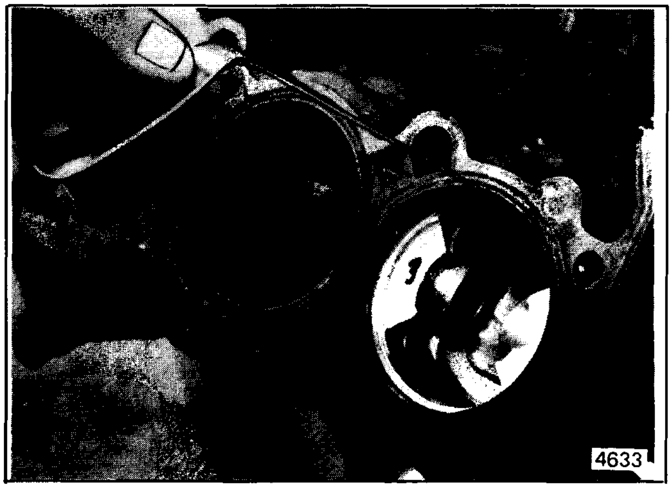


Fig. 6A3-42 Correctly Fitted New Piston

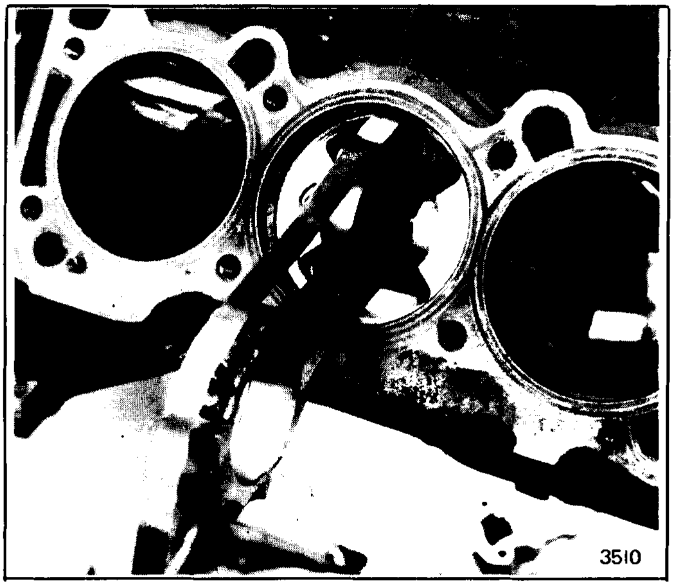


Fig. 6A3-43 Correctly Fitted Used Piston

ASSEMBLY AND INSTALLATION OF PISTON AND CONNECTING ROD ASSEMBLIES

Connecting rods may be sprung out of alignment in shipping or handling. Always check a new rod before installing piston and pin.

Check bend and twist on an accurate rod aligning fixture using Guide Pin J 6047-20 in place of wrist pin. Press V-block firmly and evenly against guide pin to prevent cocking pin in eye of rod which may be up to .00125" tight on pin.

1. To assemble piston and pin to connecting rod, use piston pin remover and installer J 24086.

2. If the piston and rod assembly is to be installed in the **left** bank, the assembly must be made as shown in Fig.s 6A3-44.

3. If the piston and rod assembly is to be installed in the **right** bank, the assembly must be made as shown in Fig.s 6A3-45.

4. Lubricate piston pin to avoid damage when pressing into connecting rod.

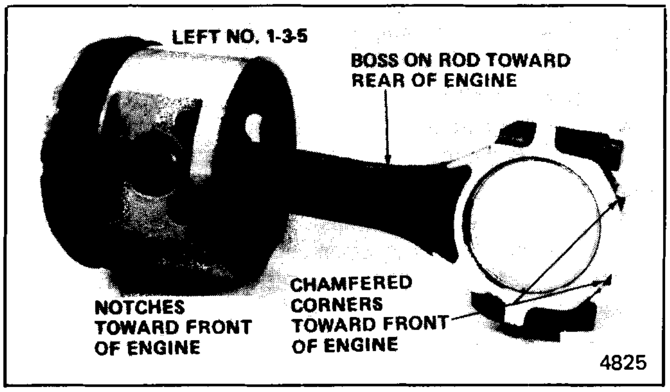


Fig. 6A3-44 Left Bank Piston and Rod Assembly

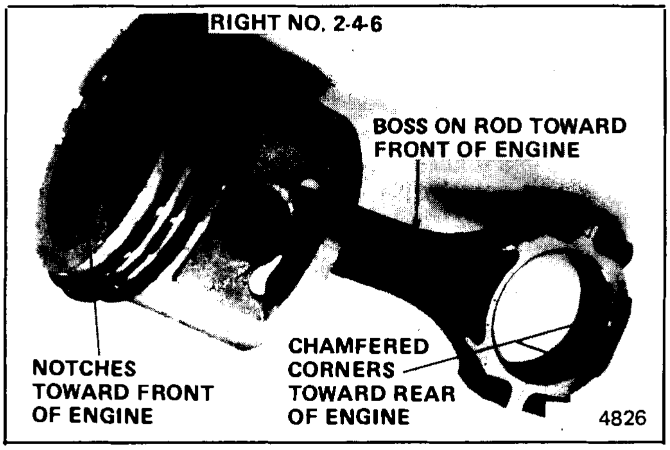


Fig. 6A3-45 Right Bank Piston and Rod Assembly

5. Install piston pin on installer and pilot spring and pilot in support. See Fig. 6A3-46.

6. Install piston and rod on support, indexing pilot through piston and rod.

7. Place support on press, start pin into position and press on installer until pin pilot bottoms.

8. Remove piston and rod assembly from press. Rotate piston on pin to be sure pin was not damaged during the pressing operaton.

9. Install piston rings as shown in Fig.s 6A3-47. Position expander ends over piston pin. Install oil ring rail spacer, and oil ring rails. Position gaps in rails so that when piston is installed in its bore the gap will point toward the camshaft. Install compression rings in upper two grooves.

a. Top compressing ring - When installed, the manufacturer's indentification mark ("O", "DOT"or "TOP") facing up.

b. Second compression ring - When installed, the manufacturer's identification mark ("O", "DOT"or "TOP") facing up.

c. Oil ring - Can be installed with either rail facing up. Some engines have a 2 piece oil ring, which has only one rail. The rail must be installed at the top of the oil ring groove.

d. Ring gaps - All three ring gaps must be 90° apart. See Fig. 6A3-47.

10. Make sure cylinder bores, pistons, connecting rod bearings and crankshaft journals are absolutely clean, then coat all bearing surfaces with engine oil.

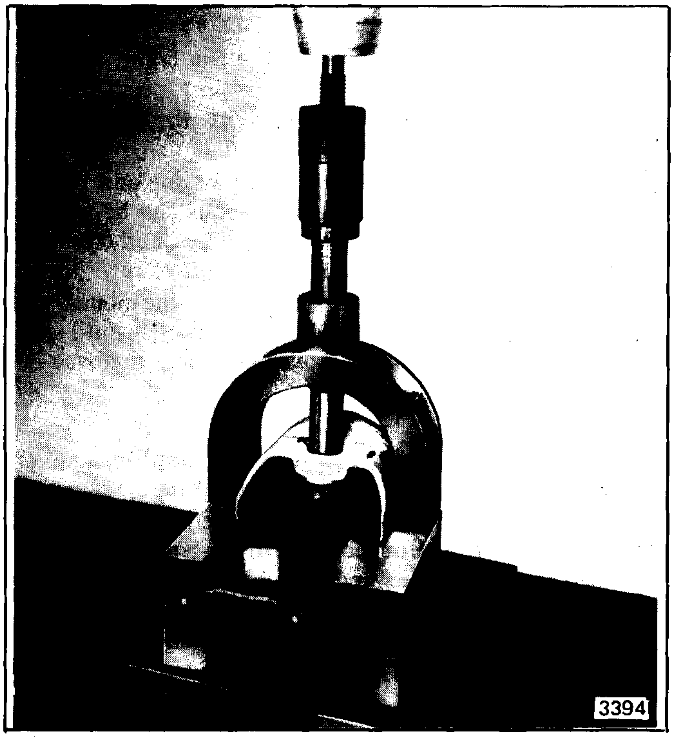


Fig. 6A3-46 Installing Piston Pin

11. Before installation of a piston and rod assembly in its bore, position the crankpin straight down.

12. Remove cap, and with bearing upper shell seated in connecting rod, install the **long** Guide J 24567-1 in bolt hole which is on same side of rod as the notch for the tang of the bearing insert. Install short Guide J 24567-2 in the other bolt hole.

These guides hold the upper bearing shell in place and protect the crankpin journal from damage during installation of connecting rod and piston assembly.

13. Make sure the gap in the oil ring rails is "up" position toward center of engine and the gaps of the compression rings are positioned as shown in Fig. 6A3-47.

14. Lubricate the piston and rings and install in bore by compressing the rings either with a "wrap around" compressor or a ring type such as shown in Fig. 6A3-48.

15. Select new connecting rod bearing, if necessary.Otherwise install cap with bearing lower shell on rod and tighten bolt nuts to specifications.

16. Install all other piston and rod assemblies in the same manner:

When piston and rod assemblies are properly installed, the notches on "all"the pistons will point towards the front of the engine. The boss on the connecting rods in the "right bank"will point towards the front of the engine and the chamfers on the rod caps will point towards the rear of the engine. The boss on the connecting rods in the "left bank"will point towards the rear of the engine and the chamfers on the rod caps will point towards the front of the engine. See Fig.s 6A3-44 and 6A3-45.

17. Check end clearance between connecting rods on each crankpin using feeler gages. Clearance should be between .006" and .020".

18. Install cylinder head. Install oil screen and engine oil pan.

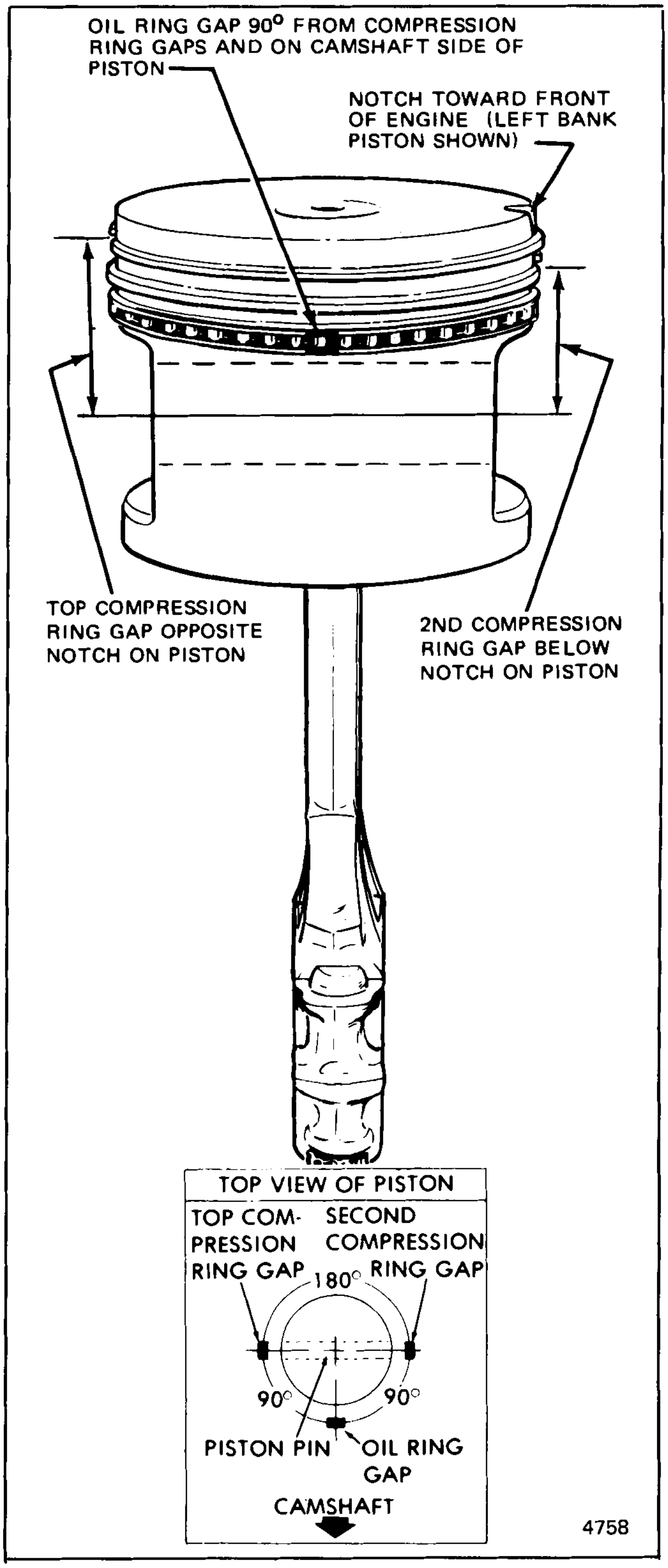


Fig. 6A3-47 Piston Ring Gap Positioning

After installation of new pistons and rings, care should be used in starting the engine and running it for the first hour. Avoid high speeds until the parts have had a reasonable amount of "break in"time. This practice will avoid unnecessary "scuffing"of new parts.

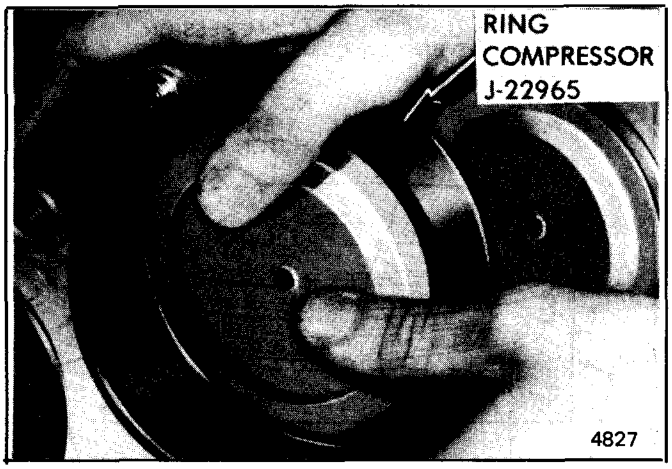


Fig. 6A3-48 Installing Piston With Ring Compressor Installed

ENGINE

REMOVAL AND INSTALLATION

Removal

1. Remove hood; for easier installation, scribe marks should be made at hood hinge and the hinge bracket.
2. Disconnect battery.
3. Drain coolant into a suitable container.
4. Remove air cleaner.
5. On cars equipped with air conditioning, disconnect compressor ground wire from the mounting bracket. Remove the electrical connector from the compressor clutch, remove the compressor to mounting bracket attaching bolts, and position the compressor out of the way.
6. Remove fan blade, pulleys, and belts.
7. Disconnect radiator and heater hoses from engine and fasten them out of the way.
8. Remove fan shroud assembly.
9. Remove power steering pump to mounting bracket bolts and position pump assembly out of the way.
10. Disconnect fuel pump hoses and plug hoses.
11. Disconnect battery ground cable from engine.
12. Disconnect the vacuum supply hose from carburetor to the vacuum manifold. On cars so equipped, the vacuum modulator, load leveler, and power brake vacuum hoses should all be disconnected at the engine.
13. Disconnect throttle control cable at carburetor.
14. Disconnect alternator oil and coolant sending unit switch connections at the engine and remove alternator.
15. Disconnect engine to body ground strap(s) at engine.
16. Raise car, disconnect starter cables, and disconnect the cable shield from the engine (if so equipped).
17. Disconnect exhaust pipes from exhaust manifolds.
18. Remove lower flywheel or converter cover.
19. Remove flywheel to converter attaching bolts. Scribe chalk mark on the flywheel and converter for reassembly alignment (this is not necessary on manual transmissions.Remove manual transmission with engine).
20. Remove transmission to engine attaching bolts on automatic transmissions. On manual transmissions disconnect propeller shaft, shift linkage, clutch equalizer shaft and transmission mount.
21. Remove motor mount through bolts and cruise control bracket if equipped.
22. Lower the car and support the transmission, (automatic transmission only).
23. Attach a lifting device to the engine and raise the engine enough so mounting through-bolts can be removed. Make certain wiring harness, vacuum hoses, and other parts are free and clear before lifting engine out of car.
24. Raise engine far enough to clear engine mounts, raise transmission support accordingly and alternately until engine can be disengaged from the transmission and removed.

Installation

1. Slowly lower engine into car until engine and transmission are engaged and scribe marks are aligned.
2. It may be necessary to alternately raise and lower transmission to fit motor mount through-bolts into position. Install through-bolt nuts and torque to specifications.
3. Raise car and install transmission to engine attaching bolts. Torque flywheel housing to engine bolts to specifications. Install flywheel cover and torque bolts to specifications.
4. Connect crossover pipe to exhaust manifold and torque bolts to specifications.
5. Connect the starter cables to the starter and cable shield to the engine block.
6. Lower the car and reconnect the body ground strap to the engine, the coolant and oil switch sending unit connectors, the throttle control cable, all vacuum and water hoses, and the emission control line from the canister to the air cleaner.
7. Connect the battery ground cable to the engine.
8. Connect the fuel lines to the fuel pump.
9. Reposition the power steering pump into the pump brackets and secure.
10. Install fan shroud.
11. Install pulley, fan, and belts. Adjust belt tension as specified in the Cooling System Section.
12. Reinstall air conditioning compressor to bracket.
13. Reinstall air cleaner.
14. Reinstall coolant and check to make certain proper level is attained.

After complete engine assembly, start engine and recheck for proper fill.

15. Reinstall hood, noting proper alignment of scribe marks.
16. Connect battery.

AUTOMATIC TRANSMISSION FLYWHEEL

REMOVAL AND INSTALLATION

1. Remove transmission (refer to Transmission Group).
2. Remove six bolts attaching flywheel to crankshaft flange.
3. Inspect flywheel; if cracked, replace flywheel.
4. Inspect crankshaft flange and flywheel for burrs. Remove any burrs with a mill file.

5. Install flywheel. Bolt holes are unevenly spaced so all flywheel bolts can be installed with flywheel in correct position. Install bolts and torque to specifications.

6. Mount dial indicator on engine block and check flywheel run-out at three attaching bosses. Run-out should not exceed .015". The crankshaft end play must be held in one direction during this check.

7. If run-out exceeds .015", attempt to correct by tapping high side with mallet. If this does not correct, remove flywheel and check for burrs between flywheel and crankshaft mounting flange.

FLYWHEEL OR RING GEAR ON MANUAL TRANSMISSION ENGINE

Replacement

1. Remove transmission and clutch assembly, being certain to mark clutch cover and flywheel so clutch may be reinstalled in original position.

2. Remove flywheel. Flywheel is located in a predetermined location on crankshaft by attaching bolts, which are unevenly spaced.

3. If ring gear is to be replaced, drill a hole between two teeth and split gear with a cold chisel.

4. Heat and shrink a new gear in place as follows:

a. Polish several spots on ring with emery cloth.

b. Use a hot plate or slowly moving torch to heat the ring until the polished spots turn blue (approximately 600° F. 316 ° C.). Heating the ring in excess of 800° F. 427° C. will destroy the heat treatment.

c. Quickly place ring in position against shoulder of flywheel with chamfered inner edge of ring gear toward flywheel shoulder. Allow ring to cool slowly until it contracts and is firmly held in place.

5. Make certain the flywheel and crankshaft flange are free from burrs that would cause run-out. Install flywheel.

AUTOMATIC TRANSMISSION FLYWHEEL BALANCE

Clips are available from the Parts Department that will serve as balance weights for automatic transmission flywheels. These clips are secured by their clamping pressure to the flywheel. See Fig. 6A3-49 for clip installation locations.

If a flywheel is found to be out of balance, it can be corrected in the following manner.

1. Remove lower flywheel housing. Mark the flywheel at four locations, 90° apart.

2. Install one clip at one of the marked locations. Run engine with transmission in neutral and note vibration.

a. If vibration increases, remove clip and relocate 180° from original location.

b. If vibration decreases, install another clip next to the original.

c. If no change is noted, move clip 90° and recheck.

3. Continue this procedure until a reduction in vibration is noted. Fine adjustments can be made by moving the clips, by small increments, to different locations. Be certain that the tangs on the clip are set in the flywheel. Otherwise, the clip(s) may shift when the flywheel is turned at high speeds.

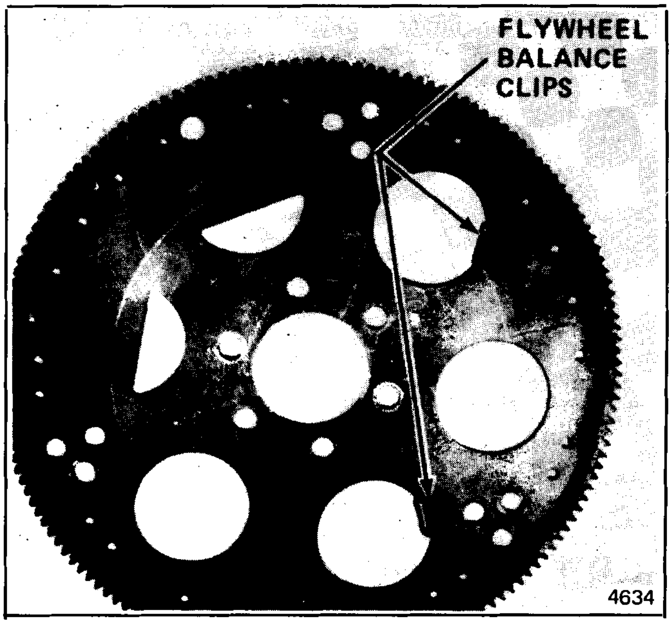


Fig. 6A3-49 Automatic Transmission Flywheel Clip Location

MANUAL TRANSMISSION FLYWHEEL BALANCE

All manual transmission flywheels are balanced at the factory by drilling holes at various points on the flywheel surface.

No attempt should be made to balance a flywheel after the initial factory balance.

HARMONIC BALANCER

If the harmonic balancer is suspected of being a cause of vibration, it can be checked and/or balanced by following the outline below:

1. Using a tachometer, determine the engine speed at which the greatest amount of vibration occurs.

2. Place an amount of body putty or similar material on the inside surface of the fan driving pulley. Run engine at critical speed and note vibration.

3. Repeat Step 1 above using varying amounts of putty at different locations until the vibration is diminished to a minimum.

4. When point of minimum vibration is found, mark the nearest hole drilled in the balancer at that point.

5. Cut a piece of 7/16" iron rod approximately 1/2" long. Use a chisel, upset a small amount of material on the side of the piece of rod. See Fig. 6A3-50.

6. Install iron rod into hole marked in Step 4.

7. Additional weight should be added (if necessary) in adjoining holes.

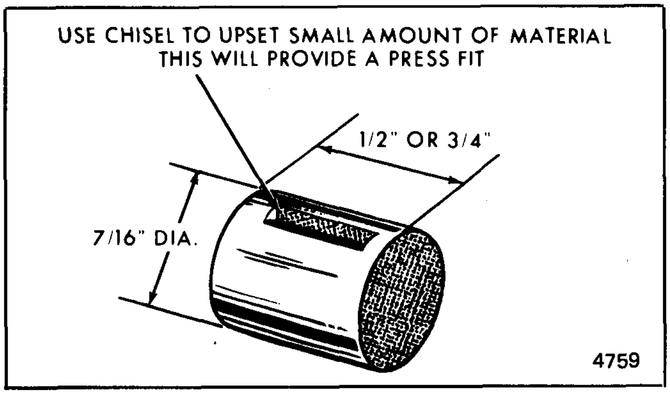


Fig. 6A3-50 Harmonic Balancer - Balance Weight Details

SPECIFICATIONS

BOLT TORQUE SPECIFICATIONS

Use a reliable torque wrench to obtain the figures listed below. This will prevent straining or distorting the parts, as well as preventing thread damage. These specifications are for clean and lightly-lubricated threads only. Dry or dirty threads produce friction which prevents accurate measurements of the actual torque. It is important that these specifications be strictly observed. Overtightening can damage threads. This will prevent attainment of the proper torque and will require replacement of the damaged part.

Area	Torque (Lb. Ft.)
Spark Plugs	20
Crankshaft Bearing Caps to Cylinder Block	100
Connecting Rods	40
Cylinder Head to Cylinder Block	80
Harmonic Balancer to Crankshaft	175 Min.
Fan Driving Pulley to Harmonic Balancer	20
Flywheel to Crankshaft (Auto. and Manual)	60
Oil Pan to Cylinder Block	14
Oil Pan Drain Plug	30
Oil Pump Cover to Timing Chain Cover	10
Oil Pump Pressure Regulator Retainer	35
Oil Screen Housing to Cylinder Block	8
Oil Gallery Plugs	25
Oil Pressure Switch to Cylinder Block	23
Filter Assembly to Pump Cover	20
Timing Chain Cover to Block	30
Water Pump Cover to Timing Chain Cover	7
Fan Drive Pulley	20
Thermostat Housing to Intake Manifold	13
Intake Manifold to Cylinder Head	45
Exhaust Manifold to Cylinder Head	25
Carburetor to Intake Manifold	15
Fuel Pump to Cylinder Block	20
Motor Mount to Cylinder Block	55
Fuel Pump Eccentric and Timing Chain Sprocket to Camshaft	22
Rocker Arm Cover to Cylinder Head	4
Rocker Arm Shaft to Cylinder Head	30
Delcotron Bracket to Cylinder Head	35
Delcotron Adjusting Bracket to Water Pump	20
Starting Motor to Block	35
Disbributor Hold-Down Clamp	13
Lower Flywheel Housing Cover Manual	10
Lower Flywheel Housing Cover (Automatic	4
Bellhousing	25
Timing Chain Dampener to Cylinder Block Bolt	8
Bolt - Special Moveable Timing Chain Dampener	12
Automatic Transmission to Cylinder Block	35

GENERAL SPECIFICATIONS

Piston and Pin Specifications

Piston Material	Cast Aluminum Alloy
Type	Divorced Skirt
Finish	Cam Ground
Piston Pin Material	Extruded SAE-1018
Type	Pressed in Rod

Connecting Rods

Material	Pearlite Malleable Cast Iron
Rod Bearing	Removable Steel Backed M/400 Aluminum

Piston Ring Specifications

#1 Compression	Cast Iron Molybdenum Coated
#2 Compression	Cast Iron - Lubrited
Oil Control	Uncoated Steel
Oil Ring Expander	Abutment Type
Ring Locations	Above Pin

Crankshaft Specifications

Material	Nodular Iron
Bearings	Replaceable Steel Backed
Bearing Material	M/100 Durex
Bearing Taking End Thrust	No. 2

Camshaft Specifications

Material	Cast Alloy Iron
Bearings	Steel Backed Babbitt
Number of Bearings	4
Drive	Chain
Number of Links	54
Crankshaft Sprocket	Sintered Iron
Camshaft Sprocket	Nylon Coated Aluminum

Valve Specifications

Intake Valve Material	SAE 1041 Steel Chrome Flashed Stem

Exhaust Valve Material	21-2 Nickel-Plated Face and Chrome Flashed Stem
Valve Lifter Mechanism	Hydraulic
Valve Springs	Intake - Single Helical
Valve Springs	Exhaust - Helical with Dampener

LUBRICATION SYSTEM SPECIFICATIONS

Type of Lubrication

Main Bearings	Pressure
Connecting Rods	Pressure
Piston Pins	Splash
Camshaft Bearing	Pressure
Timing Chain	Drop From Front Cam Bearing
Cylinder Walls	Splash
Oil Pump Type	Gear Driven
Normal Oil Pressure	37 lbs. at 2600 rpm
Oil Pressure Sending Unit	Electrical
Oil Intake	Stationary
Oil Filter System	Full Flow
Filter Type	Throw-Away Element and Can
Crankcase Capacity - With Filter	5 Quarts
Crankcase Capacity - Less Filter	4 Quarts

ENGINE DIMENSIONS AND FITS

General

Piston Clearance Limits	
Top Land	.026-.034
Skirt Top	.0008-.0020
Skirt Bottom	.0013-.0035
Ring Groove Depth	
#1 - Compression Ring	.184-.194
#2 - Compression Ring	.186-.194
#3 - Oil Ring	.188-.196
Ring Width	
#1 - Compression Ring	.168-.178
#2 - Compression Ring	.168-.178
#3 - Oil Ring	.135-.142
Ring Gap	
#1 - Compression Ring	.010-.020
#2 - Compression Ring	.010-.020
#3 - Oil Ring	.015-.035
Piston Pin Length	3.060
Diameter of Pin	.9391-.9394
Clearance	
In Piston (Selected)	.0004-.0007
Press Fit In Rod	.0007-.0017
Direction and Amount Offset in Piston	040 Major Thrust Side

All measurements in inches, unless otherwise specified.

CONNECTING ROD SPECIFICATIONS

Bearing Length	.737
Bearing Clearance (Limits)	.0005
End Play - Total for Both Rods	.006-.027

CRANKSHAFT SPECIFICATIONS

End Play at Thrust Bearing	.004-.008
Main Bearing Journal Diameter	2.4995
Crankpin Journal Diameter	1.991-2.0000
Main Bearing Overall Length	
#1	.864
#2	.1057
#3	.864
#4	.864
Main Bearing to Journal Clearance	.0004-.0015

CAMSHAFT SPECIFICATIONS

Bearing Journal Diameter	
#1	1.785-1.786
#2	1.785-1.786
#3	1.785-1.786
#4	1.785-1.786
#5	1.785-1.786
Journal Clearance in Bearings	.0005-.0025 (#1) .0005-.0035 (#2, #3, #4)

VALVE SYSTEM SPECIFICATIONS

231 CU. IN	
Rocker Arm Ratio	1.55 to 1
Valve Lifter Diameter	.8420"-.8427"
Valve Lifter Clearance in Crankcase	.0008"-.0025"
Intake Valve	
Head Diameter	1.630"-1.620"
Seat Angle	.45"
Stem Diameter	.3412"-.3405"
Clearance in Guide	.0015"-.0032"
Exhaust Valve	
Head diameter	1.430"-1.420"
Seat Angle	.45"
Stem Diameter	.3412"-.3405"
Clearance in Guide	.0015"-.0032"
Valve Spring	
Valve Closed - Pounds @ Length Net Including Dampener	645@1.727"
Valve Open - Pounds @ Length Not Including Dampener	1686@1.327"

ENGINE	231-2
ENGINE TYPE	90° V-6
BORE AND STROKE	3.800 x 3.400
PISTON DISPLACEMENT	231 CU. IN.
CARBURETOR TYPE	2-BBL. ROCHESTER
COMPRESSION RATIO	8.0:1
FUEL REQUIREMENTS	UNLEADED
OCTANE REQUIREMENTS–MOTOR	82
OCTANE REQUIREMENTS–RESEARCH	91
CYLINDER NUMBERS–FRONT TO REAR–RIGHT BANK	2-4-6
CYLINDER NUMBERS–FRONT TO REAR–LEFT BANK	1-3-5
FIRING ORDER	1-6-5-4-3-2
CYLINDER BLOCK MATERIAL	CAST IRON
CYLINDER HEAD MATERIAL	CAST IRON
INTAKE MANIFOLD MATERIAL	CAST IRON

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Fig. 6A3-51 General Specifications

SECTION 6A4

5.7 LITRE 350 CU. IN. AND 6.6 LITRE 403 CU. IN. ENGINES

(VI CODES R AND K)

CONTENTS OF THIS SECTION

DESCRIPTION

The same basic V-8 engine is used in the 350 (VIN-R), and 403 (VIN-K) engines, (Fig. 6A4-1) with the exception of stroke and cylinder bore size. Because of the similarity among these engines, the service procedures and illustrations, unless otherwise specified, will be combined.

The left bank of cylinder (as viewed from the driver's seat) are numbered (from front to rear) 1-3-5-7. Cylinders in the right bank are numbered (from front to rear) 2-4-6-8. (Fig. 6A4-2)

The required engine unit numbers and engine identification is outlined in Section 6 of this manual. The engine specifications are listed at the back of this section.

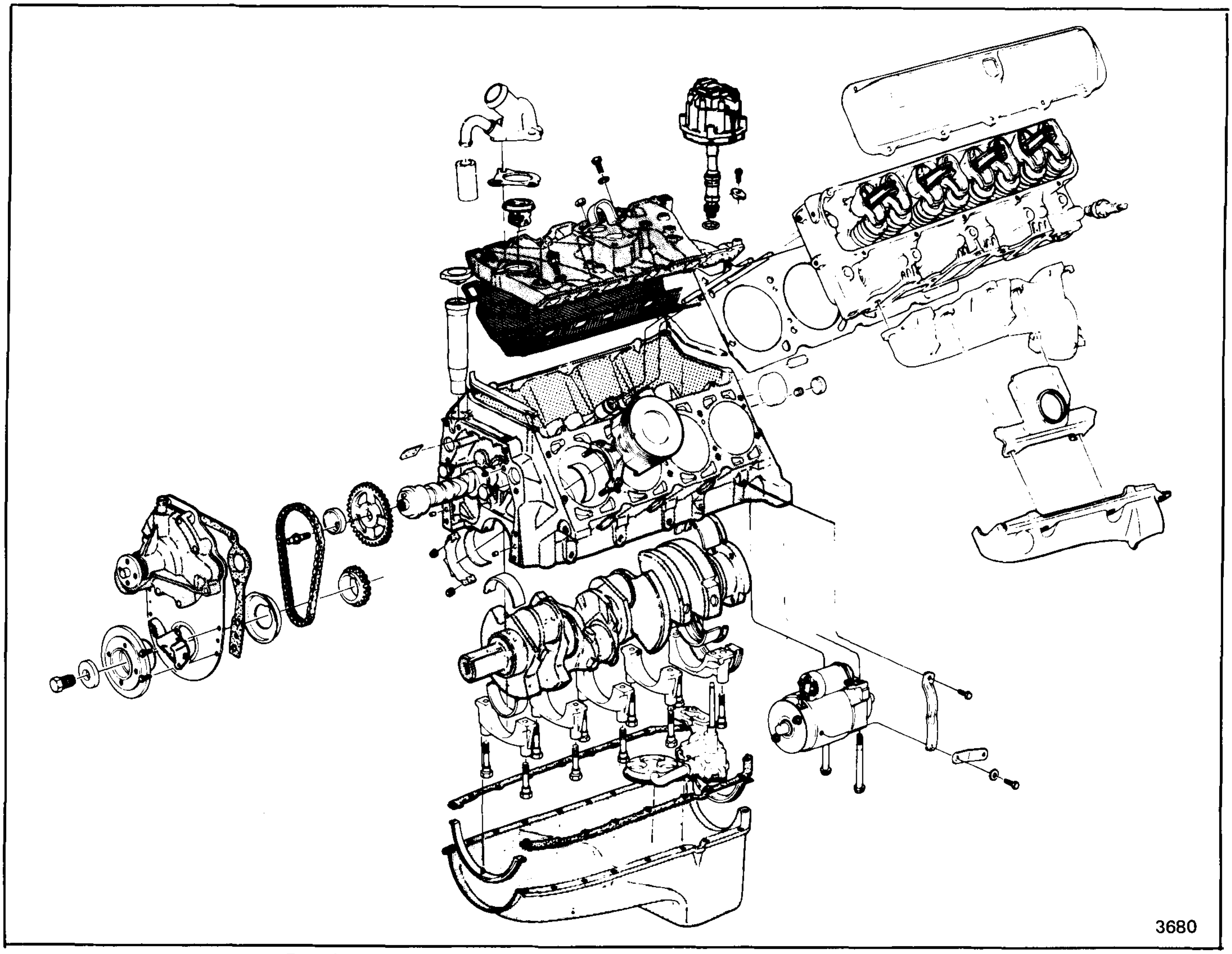


Fig. 6A4-1 350 (VIN R) and 403 (VIN K) Engines (Exploded View)

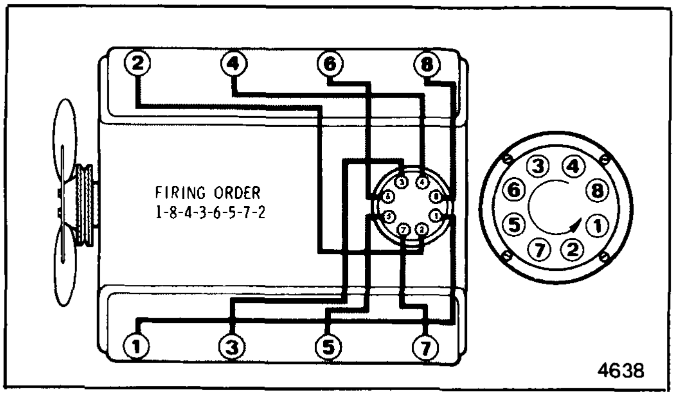


Fig. 6A4-2 Cylinder Numbers

ENGINE LUBRICATION SYSTEM

(Fig. 6A4-3)

The engine oil pan forms a reservoir for engine oil to provide lubrication and also hydraulic fluid to operate the valve lifters. Oil pressure for lubrication is furnished by a gear type oil pump that is bolted to the rear main bearing cap and driven by the camshaft gear through a hexagonal drive shaft.

Oil enters the pump through a screened inlet located near the bottom rear of the oil pan. The pressurized oil from the pump passes through the oil filter located on the right rear side of the engine block. The oil filter base has a by-pass valve which in the event of filter restriction will open at 5.3 to 6.3 psi. Oil then enters the right oil galley where it is distributed to the five main bearings. The right bank valve lifters receive oil from this galley from eight feed holes that intersect the galley.

The five camshaft bearings are lubricated from vertical passages intersecting the main bearing oil passages. At the front main bearing a third passage connects the right main oil galley to the left galley which then feeds the left bank of valve lifters.

The engine oil pressure warning light switch is connected to the front of the left oil galley. The switch is calibrated to turn on the instrument panel warning light when engine oil pressure is too low. The switch, normally closed, is set to open at 2-6 psi. The rear oil galley plug has a .040" orifice to help purge contaminants from the galley.

The front end of the right galley, a small orifice sprays oil to lubricate the fuel pump eccentric cam and the timing chain.

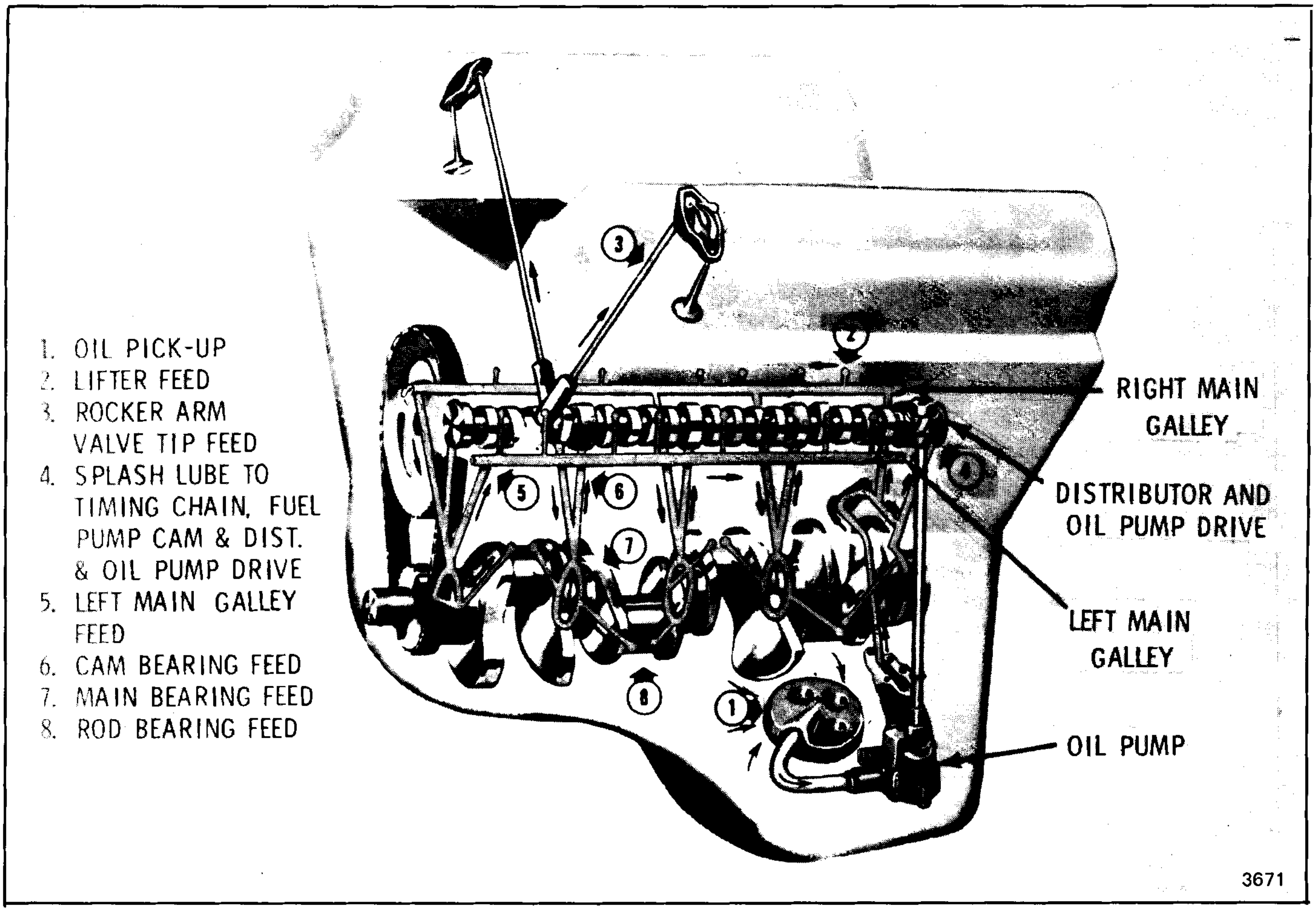


Fig. 6A4-3 Engine Lubrication System

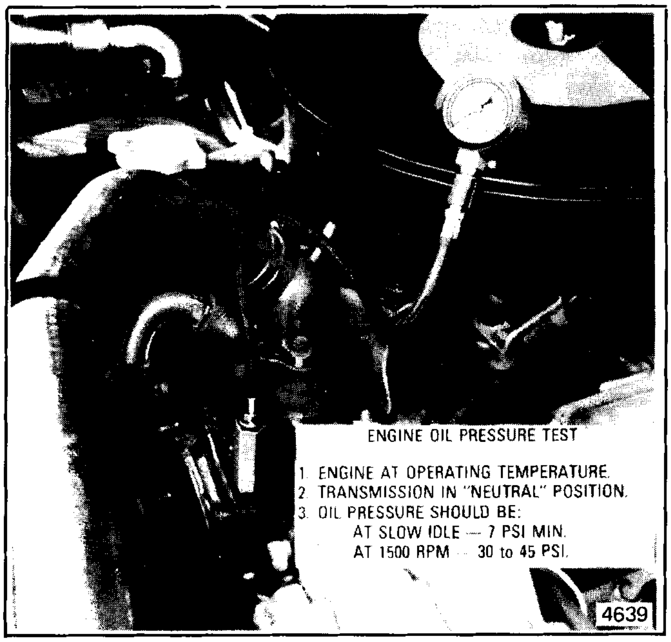
The distributor drive gear is lubricated by oil from the left rear oil galley.

The rocker arms and valve tips are lubricated by oil furnished through the hydraulic lifters and hollow push-rods. A disc valve in the lifter meters oil to the push rods.

The connecting rod bearings are oiled by constant oil flow from passages drilled through the crankshaft connecting the main journals to the rod journals. A groove around each main bearing furnishes oil to the drilled crankshaft passages.

Oil returns to the oil pan reservoir from the rocker arms through passages at each end of the cylinder heads. Oil from the valve lifter compartment returns through clearance holes in the lower portion of the compartment near the camshaft. The timing chain compartment drains directly into the oil pan.

NOTE: To check engine oil pressure see Fig. 6A4-4.



ENGINE OIL PRESSURE TEST

1. ENGINE AT OPERATING TEMPERATURE.
2. TRANSMISSION IN "NEUTRAL" POSITION.
3. OIL PRESSURE SHOULD BE:
   AT SLOW IDLE — 7 PSI MIN.
   AT 1500 RPM 30 to 45 PSI.

Fig. 6A4-4 Engine Oil Pressure (Typical)

OIL FILTER BASE

(Fig. 6A4-5)

B SERIES

Removal

1. Bend exhaust manifold lock tabs away from bolts.
2. Hoist car.
3. Disconnect exhaust system from exhaust manifold.
4. Remove exhaust manifold.

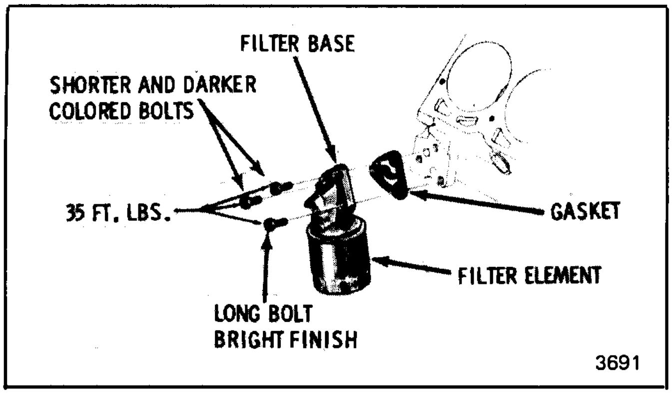


Fig. 6A4-5 Oil Filter Base

5. Remove oil filter base retaining bolts and remove base.

Installation

If a new oil filter element is installed, add one quart of oil. Clean sealing surfaces and re-bend manifold bolt lock tabs. Start engine, check for leaks and proper oil level. Torque oil filter base attaching bolts to 35 ft. lbs. Torque exhaust manifold bolts to 25 ft. lbs.

A AND G SERIES

Removal

1. Hoist Car and remove R.F. wheel.
2. Disconnect exhaust crossover and exhaust pipe from right exhaust manifold.
3. Straighten lock tab on bolts, then remove exhaust manifold attaching bolts.
4. Remove exhaust manifold.
5. Remove bolts securing oil filter base and remove base and gasket.

Installation

Clean manifold and oil filter base sealing surfaces. Bend all lock tabs to retain exhaust manifold bolts after installation. Torque oil filter base bolts to 35 ft. lbs. and exhaust manifold bolts to 25 ft. lbs. Start engine, check for possible leaks. Check for porper engine oil level.

ENGINE OIL DIPSTICK AND DIPSTICK GUIDES

(Fig. 6A4-6)

Removal

Removal of the dipstick guide will assist in easier removal and isntallation of the left cylinder head. Before removing the left cylinder head, the guide can be removed using the following procedure:

1. Position the slide hammer from Tool J-2619 on a 1/4" diameter 6" long bolt.
2. Insert the threaded end of the bolt into the oil dipstick guide and clamp with a vise type pliers.
3. Use slide hammer to tap out tube.

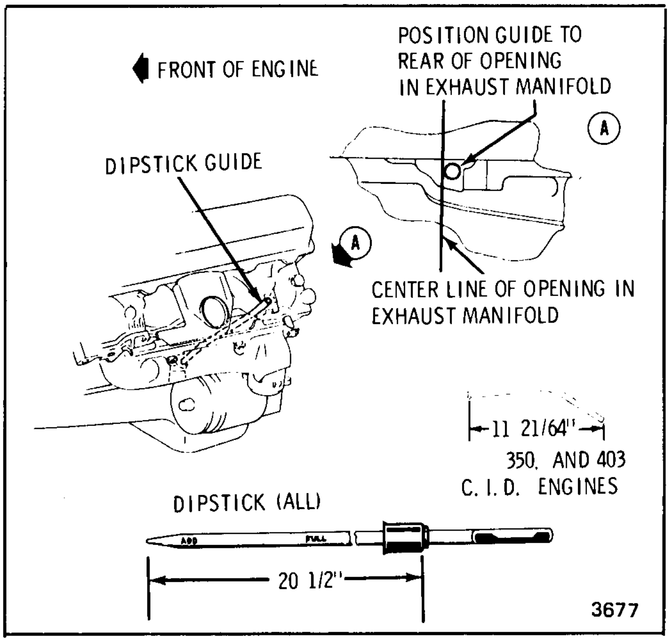


Fig. 6A4-6 Engine Oil Dipstick and Dipstick Guide

To install, insert a 1/4" diameter x 1/2" long bolt into the tube and tap on the bolt head to drive tube into the block.

ENGINE MOUNTING

Refer to Figs. 6A4-7 and 8.

INTAKE MANIFOLD

Removal

1. Remove air cleaner assembly.
2. Drain radiator, then disconnect upper radiator hose and thermostat bypass hose from water outlet. Also, disconnect heater hose at rear of manifold.
3. Disconnect throttle cable.
4. Remove fuel and all vacuum lines.
5. Disconnect and/or remove generator and air conditioning compressor brackets as necessary.
6. Disconnect temperature gauge wire.
7. Remove intake manifold bolts; then remove manifold with carburetor attached.
8. Clean machined surfaces of cylinder head and intake manifold with a putty knife. Use care not to gouge or scratch machined surface.

Installation

1. Coat both sides of gasket sealing surface that seal the intake manifold to the head with 1050805 Sealer or equivalent and position intake manifold gasket.
2. Install end seals, making sure that ends are positioned under cylinder heads as shown in Fig. 6A4-9.
3. Position intake manifold on engine (Fig. 6A3-10) and connect thermostat bypass hose to water pump.
4. Dip intake manifold bolts in engine oil and torque in sequence shown to 15 ft. lbs. Then re-torque to 40 ft. lbs. (Fig. 6A4-11).

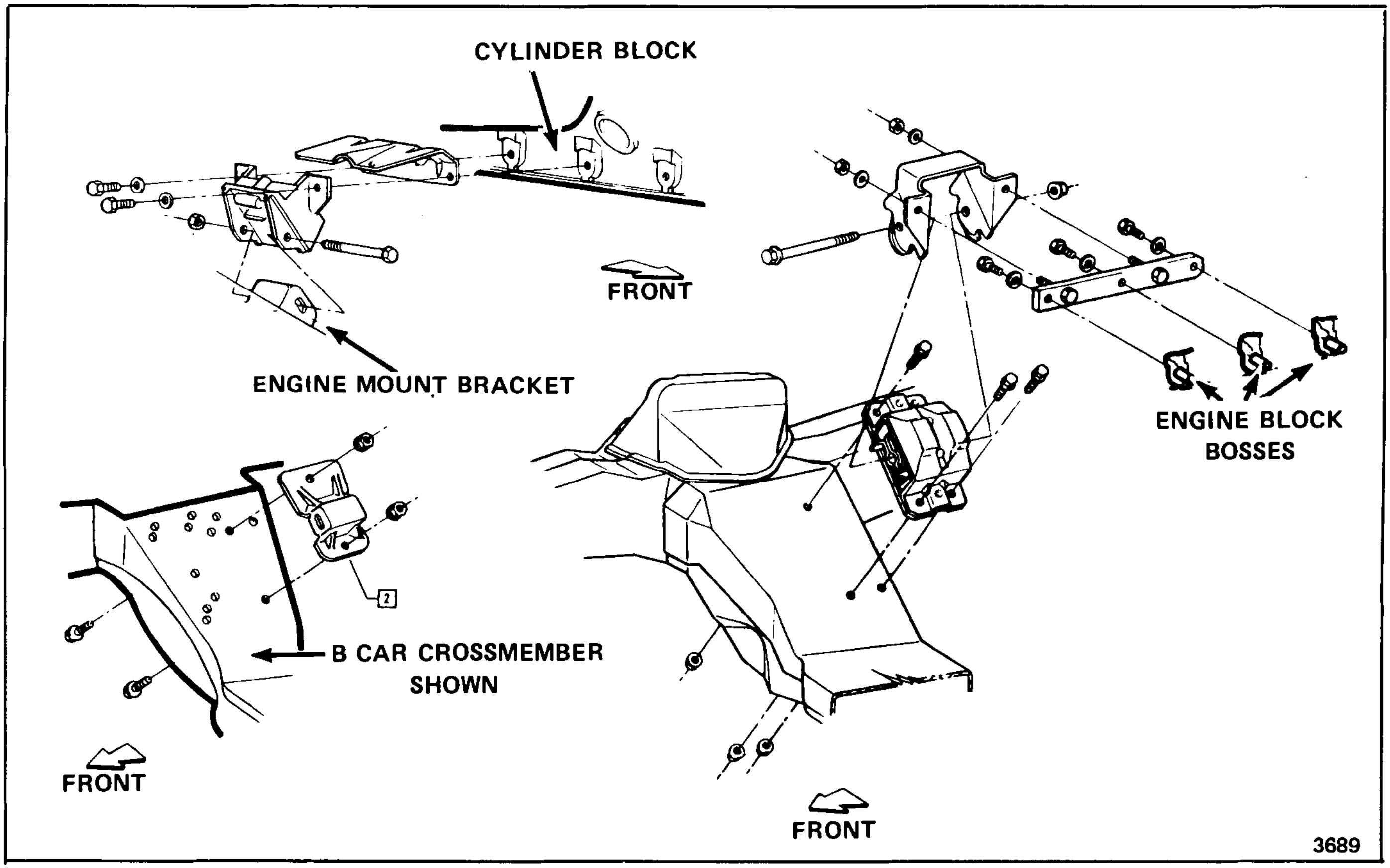


Fig. 6A4-7 Front Engine Mounts (Typical)

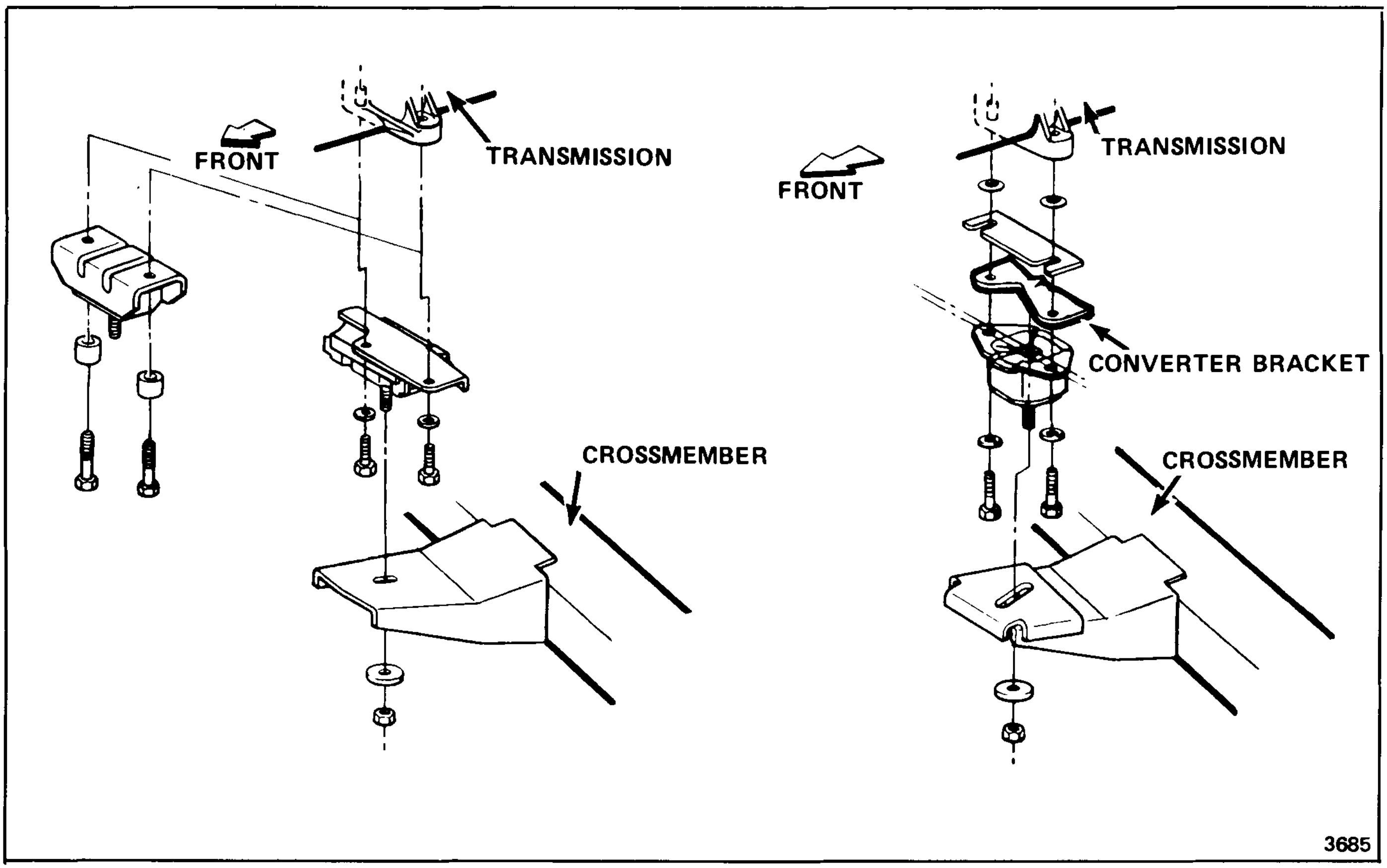


Fig. 6A4-8 Rear Engine Mounts (Typical)

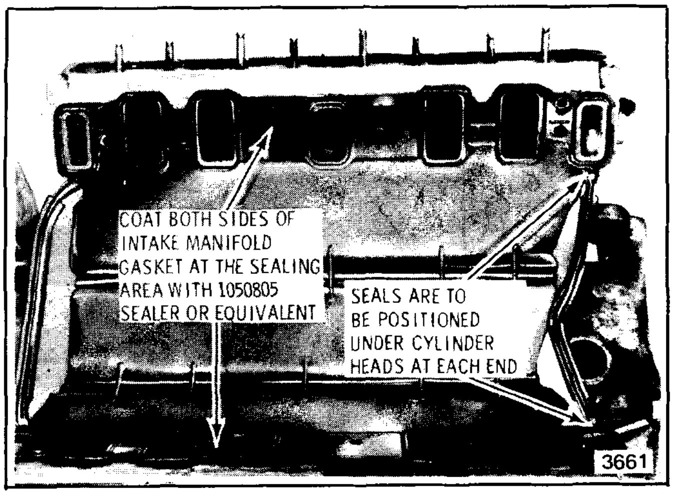


Fig. 6A4-9 End Seals Installed

5. Position EGR gasket on intake manifold. Install EGR valve or adapter and torque bolts to 25 ft. lbs. See Figure 6A4-10.

6. Connect temperature gauge wire.

7. Install fuel and vacuum lines.

8. Connect upper radiator hose, spark plug wires, heater hose, throttle linkage and install air cleaner assembly.

9. Fill cooling system.

NOTE: Refer to Section 6-B for Cooling System recommendations.

EXHAUST MANIFOLD

L.H. EXHAUST MANIFOLD

B Series

1. Remove air cleaner.
2. Remove hot air shroud (Fig. 6A4-12).
3. Remove lower generator bracket.
4. Hoist car.
5. Remove crossover pipe.
6. Lower car.
7. Remove exhaust manifold from above.

To install reverse removal procedure. Refer to Torque Chart for proper bolt torque.

R.H. EXHAUST MANIFOLD

B Series

1. Hoist Car.
2. Remove crossover pipe.
3. Disconnect exhaust pipe.
4. Remove R.F. wheel.
5. Remove exhaust manifold from under car.

To install, reverse removal procedure. Refer to torque chart for proper bolt torque.

R.H. EXHAUST MANIFOLD

A Series

1. Hoist Car.
2. Remove crossover pipe.
3. Disconnect exhaust pipe.
4. Remove R.F. Wheel.
5. Remove the lower engine mounting bolt and slightly raise the engine.
6. Remove exhaust manifold from under car.

To install, reverse removal procedure. Refer to Torque Chart for proper bolt torque.

L.H. EXHAUST MANIFOLD

A Series

1. Remove air cleaner.
2. Remove hot air shroud. See Figure 6A4-12.
3. Remove lower geneator bracket.
4. Hoist car.
5. Remove crossover pipe.
6. Lower car.
7. Remove exhaust manifold from above.

To install, reverse removal procedure. Refer to Torque Chart for proper bolt torque.

VALVE COVER

Removal

1. Disconnect positive crankcase ventilation from valve cover.

2. Disconnect spark plug wires and move away from valve cover.

3. Remove valve cover to cylinder head attaching screws. Remove accessory mounting brackets as necessary and remove valve cover. (Fig. 6A4-13)

Installation

1. Thoroughly clean the head and valve cover gasket surface then apply 1051435 RTV (Room Temperature Vulcanizing) sealer or equivalent to the valve cover. (Fig. 6A4-14)

2. Replace valve cover and torque attaching screws to fully driven, seated and not stripped.

3. Connect spark plug wires and replace accessory mounting brackets previously removed. Torque attaching bolts as follows:

5/16″ Thread	25 ft. lbs.
3/8″ Thread	35 ft. lbs.
7/16″ Thread	50 ft. lbs.

4. Connect positive crankcase ventilation to valve cover.

ROCKER ARM ASSEMBLIES

Removal

1. Remove valve cover.

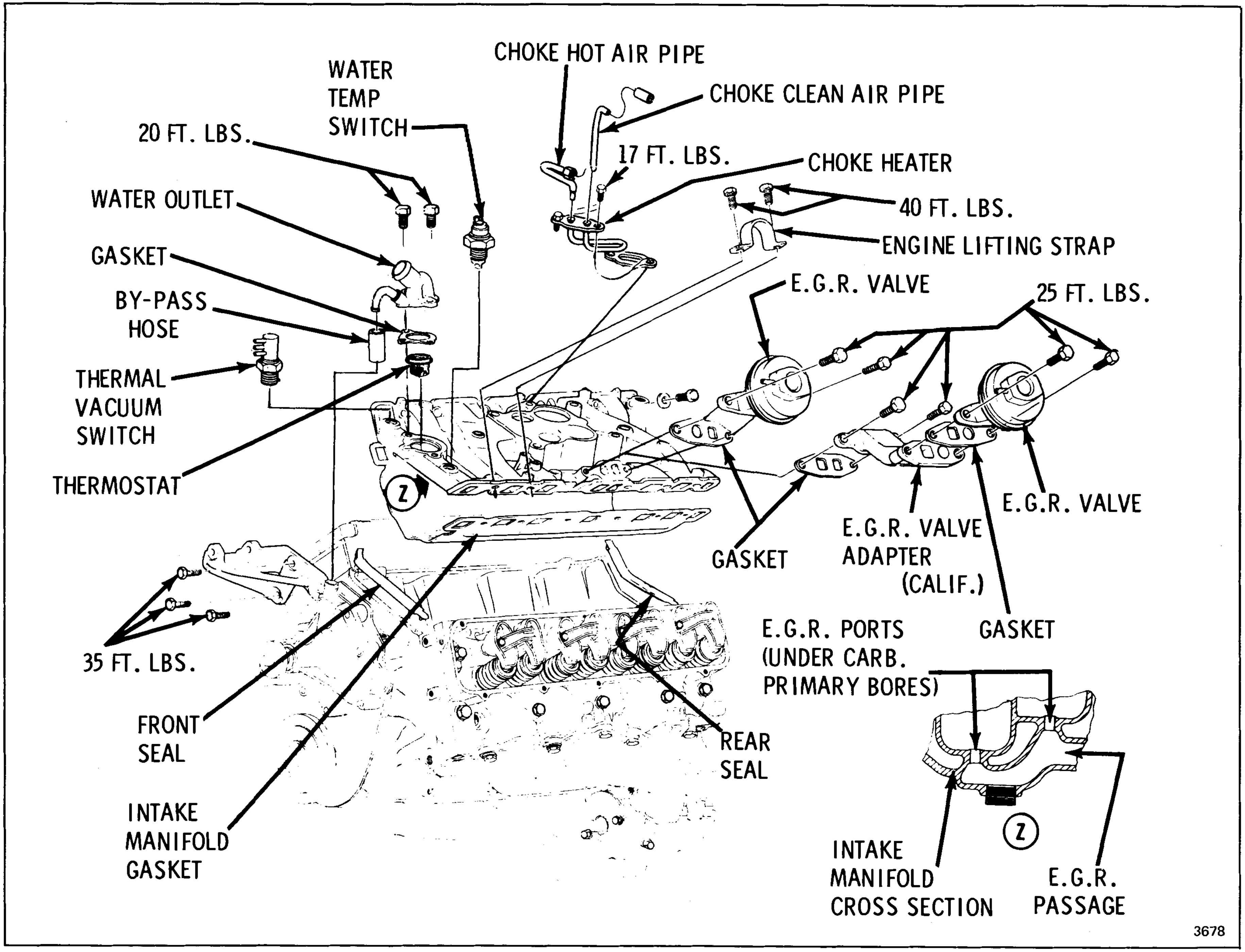
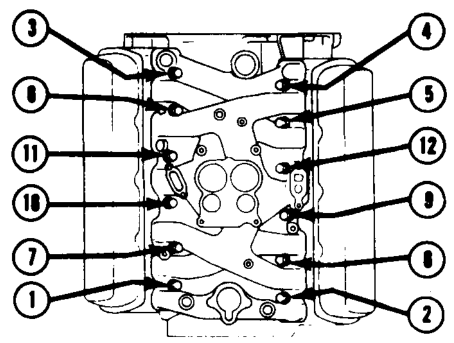


Fig. 6A4-10 Intake Manifold Installation



1. LUBRICATE ENTIRE BOLT IN ENGINE OIL.
2. TORQUE ALL BOLTS IN SEQUENCE SHOWN TO 15 FT. LBS.
3. RE-TORQUE IN SEQUENCE SHOWN TO 40 FT. LBS.

Fig. 6A4-11 Intake Manifold Torque Sequence

2. Remove rocker arm, flanged bolts, pivot and rocker arms.

NOTE: Remove each set (one set per cylinder) as a unit.

Installation

1. Position a set of rocker arms (for one cylinder) in the proper location.
2. Lubricate wear points with 1050169 Lubricant or equivalent and install the pivots.
3. Install the hardened flanged bolts and tighten alternately. Torque bolts to 25 ft. lbs.

REPLACING VALVE SPRING (HEAD ON ENGINE)

To replace a worn or broken valve spring without removing the cylinder head proceed as follows:

Removal

1. Remove rocker arm assemblies.
2. Remove spark plug and install Tool BT-72-1-B into spark plug hole and attach to an air hose to hold the valve against its seat.
3. Install Tool BT-6413 (Fig. 6A4-16) and compress the valve spring until valve keys are accessible; then remove keys, valve rotators and springs.

NOTE: If valve spring does not compress, tap tool with a mallet to break bind at rotator and keys.

CHECKING ROTATORS

The rotators cannot be disassembled and require replacement only when they fail to rotate the valve.

Rotator action can be checked by applying a daub of paint across the top of the body and down the collar. Run engine approximately 1500 rpm, there should appear to be motion between the body and collar, the body will appear to "walk" around the collar. Rotator action can be either clockwise or counterclockwise, sometimes on removal and reinstallation; the direction of rotation will change but this does not matter so long as it rotates.

Anytime the valves are removed for service the tips should be inspected for improper pattern which could indicate valve rotator malfunction. See Figure 6A4-17.

Installation

1. Install valve spring and rotor. Using Tool BT 6413, compress the valve spring until the valve keys can be installed.
2. Install spark plugs. Torque to 25 lbs. ft.
3. Install rocker arm assemblies.

VALVE LIFTERS

Operation

Oil is supplied to the lifter through a hole in the side of the lifter body which indexes with a groove and hole in the lifter plunger. Oil is then metered past the oil metering valve in the lifter, through the push-rods to the rocker arms. (Fig. 6A4-18)

When the lifter begins to ride up the cam lobe, the ball check is held against its seat in the plunger by the ball check spring which traps the oil in the base of the lifter body below the plunger. The plunger and lifter body then raise as a unit, pushing up the push-rod to open the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and push-rod causes a slight amount of leakage between the plunger and lifter body. This "leak-down" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rides down the other side of the cam lobe and reaches the base circle or "valve closed" position, the plunger spring quickly moves the plunger back (up) to its original position. This movement causes the ball check to open against the ball spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash.

Removal

NOTE: Valve lifters and push-rods should be kept in order so they can be reinstalled in their original position. Some engines will have both standard and .010" oversize valve lifters, the .010" oversize lifter is etched "O" in the side of the lifter. The cylinder block will also be marked if the oversize lifter is used. (Fig. 6A4-19)

1. Remove intake manifold and gasket.
2. Remove valve covers, rocker arm assemblies and push-rods.
3. If lifters are varnished, apply carburetor cleaning solution to the lifter body. Allow five minutes for solution to remove varnish.

CAUTION: *Carburetor cleaning solvent should be used in a well ventilated room. Avoid contact with skin and prolonged breathing of fumes.*

4. Remove lifters. Use of Tool BT-6407 will aid in removal of varnished lifters. See Figure 6A4-19.

Disassembly

1. Remove retainer ring with small screwdriver.
2. Remove push-rod seat and oil metering valve.

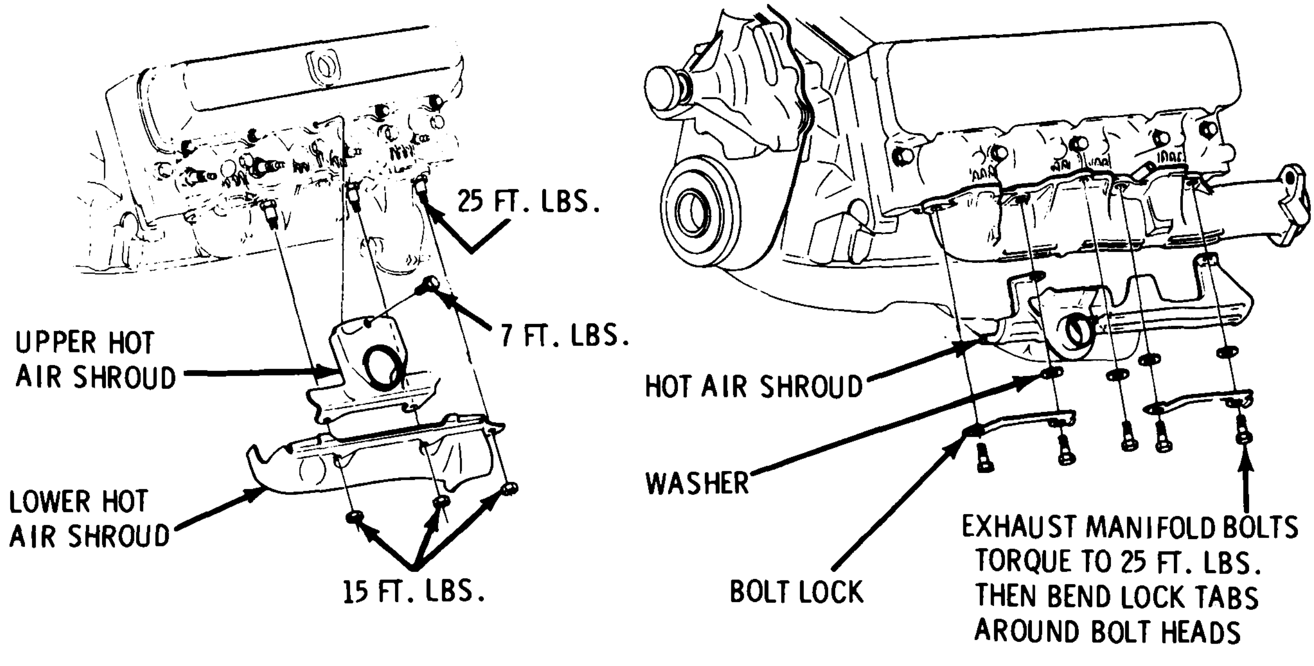


Fig. 6A4-12 Removing Hot Air Shrouds

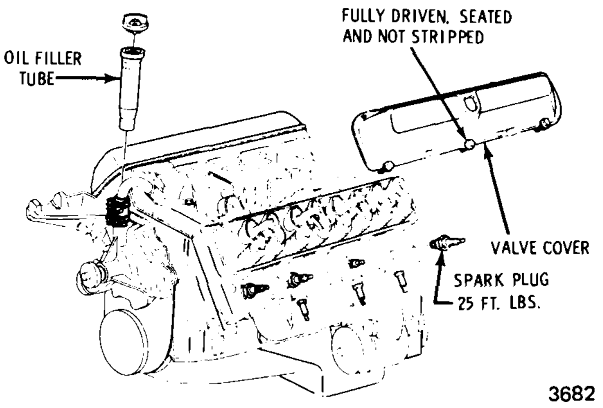


Fig. 6A4-13 Valve Cover

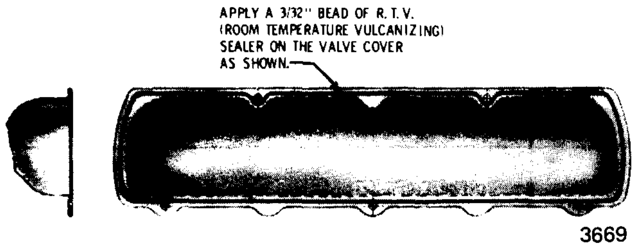


Fig. 6A4-14 Applying Sealer on Valve Cover

3. Remove plunger and plunger spring. If plunger is stuck tight, allow lifter to soak in carburetor cleaning solvent for approximately five minutes, then remove. Available Tool BT-6438 can be used to remove plunger.

4. Remove ball check retainer from plunger, then remove ball and spring.

Cleaning and Inspection

After lifters are disassembled, all parts should be cleaned in clean solvent. A small particle of foreign material under the ball check valve will cause malfunctioning of the lifter. Close inspection should be made for nicks, burrs or scoring of parts. If either the body or plunger is defective, replace with a new lifter assembly.

Whenever lifters are removed, check the lifter foot for abnormal wear as follows:

1. Place a straight edge across the lifter foot.

NOTE: Lifter foot must be clean and dry.

2. While holding the lifter at eye level, check for light between the straight edge and lifter foot.

3. If light indicates a concave surface of the lifter foot, the lifter should be replaced and the camshaft inspected for wear. Wear at the CENTER of the cam base circle is NORMAL. The camshaft should be replaced ONLY when wear is present across FULL WIDTH of cam base circle. Full wear across the nose of the cam is normal.

4. Assemble ball check, spring and retainer into plunger. (Fig. 6A4-20) Make sure retainer flange is pressed tight against bottom of recess in plunger.

5. Install plunger spring over ball check retainer.

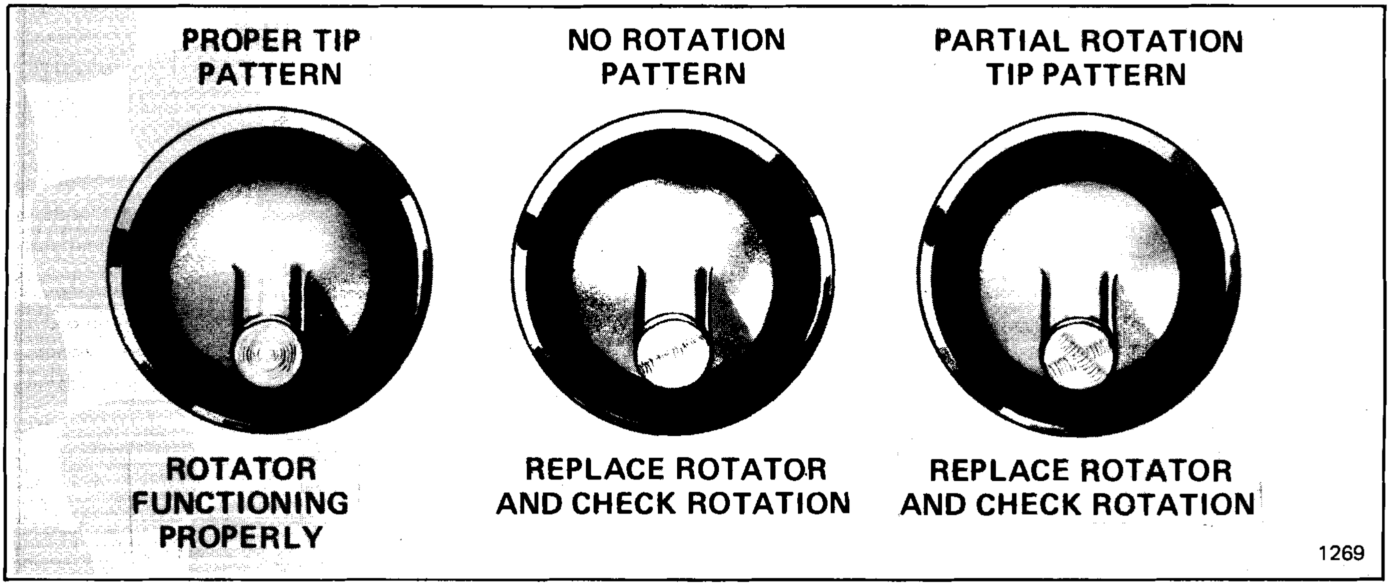


Fig. 6A4-17 Valve Rotation Pattern

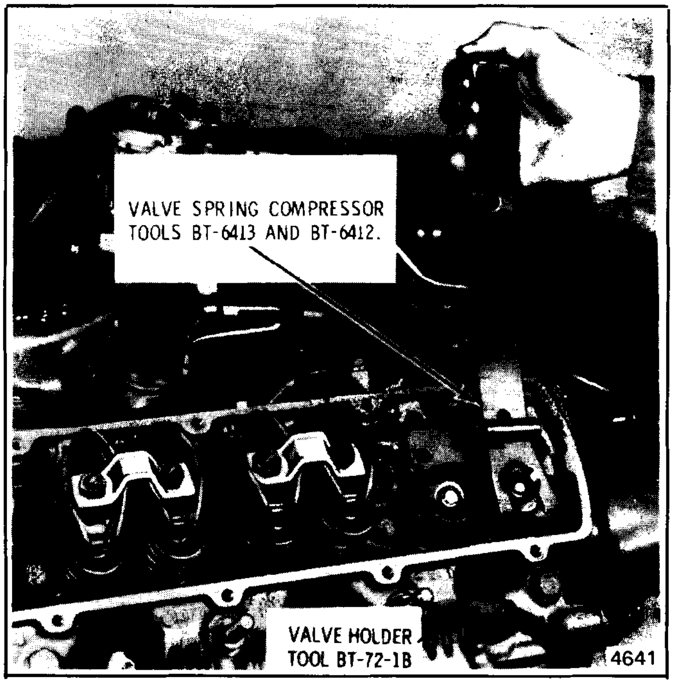


Fig. 6A4-16 Removing Valve Springs

6. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.

7. Assemble oil metering valve and push rod seat and seat retaining ring in groove.

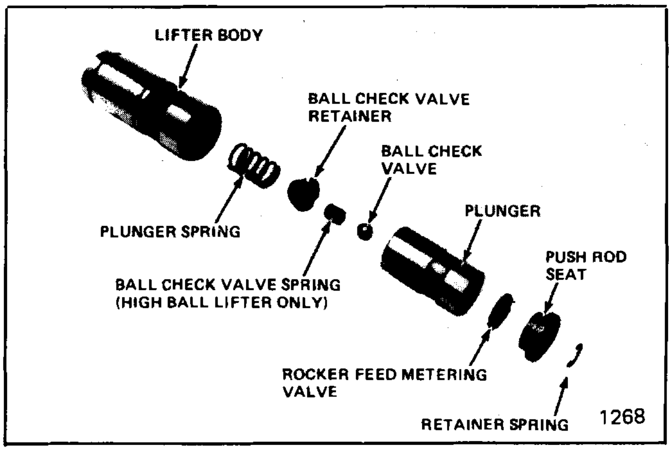


Fig. 6A4-18 Valve Lifter (Cutaway View)

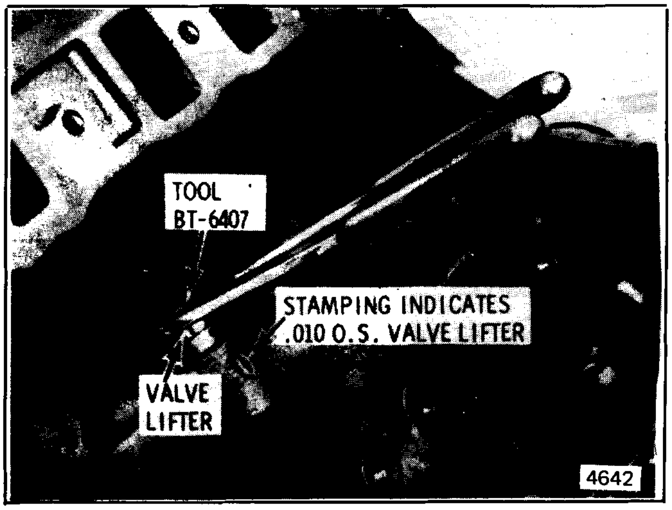


Fig. 6A4-19 Removing Valve Lifter

NOTE: Lifters must be assembled while submerged in Hydraulic Lifter Test Fluid BT-59 and leak-down tested before placing into service.

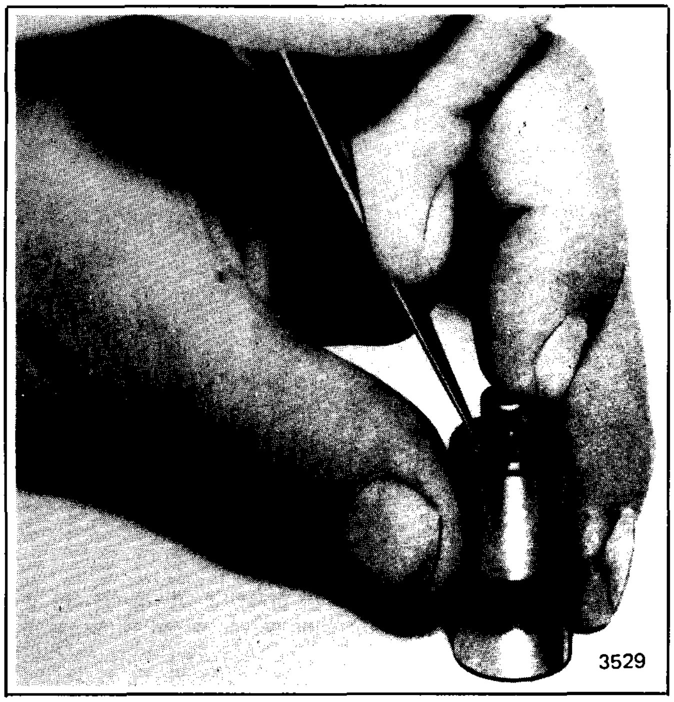


Fig. 6A4-20 Installing Ball Check Valve

8. Install adapter BT-105-2 in reservoir of Tester BT-60, then fill reservoir with Hydraulic Lifter Test Fluid BT-59 to 1/2" below top of reservoir.

9. Place assembly into the tester cup.

10 Position the 1/4" steel ball on the push-rod seat. Lower tester ram until it contacts the steel ball.

11. Allow ram to move downward by its own weight until air bubbles disappear.

12. Raise ram, then allow to lower. Repeat Step 11 several times or until all air is expelled from lifter.

NOTE: Do not attempt to expell air from lifter by pumping on ram.

13. Adjust ram screw so that it contacts the steel ball in the push-rod seat when the pointer is at the start line.

14. Raise arm, then start test by resting ram on steel ball. Rotate reservoir one revolution every two seconds and time the indicator from the start to the stop line. (Fig. 6A4-21) Allowable leak-down rate is six seconds minimum for used lifters and 9 to 60 seconds for new lifters.

15. If leak-down tolerance is within specifications, the lifter can be placed in service without removing test fluid.

Installation

NOTE: Prime new lifters by working lifter plunger while submerged in new engine oil. Lifters could be damaged when starting engine if dry.

1. Install lifters and push rods into original position in cylinder block. See note under Removal.

2. Install manifold gaskets and manifold.

3. Position rocker arms, pivots and bolts on cylinder head.

4. Install valve covers, connect spark plug wires and install air cleaner.

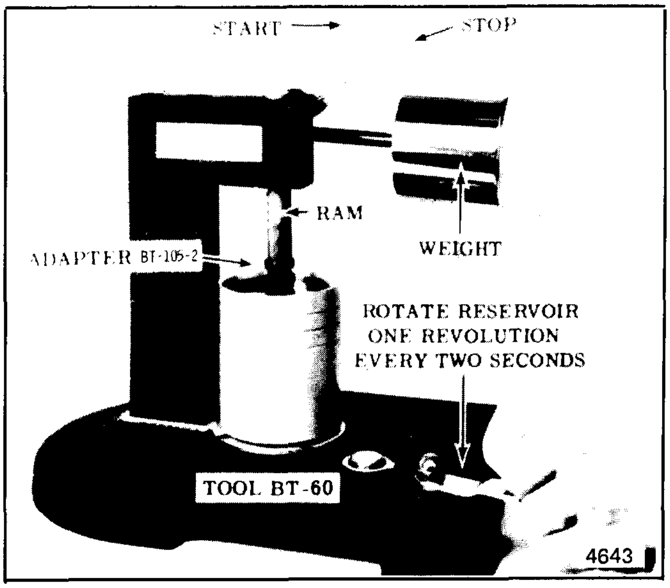


Fig. 6A4-21 Valve Lifter Testing

CYLINDER HEAD AND GASKET

Removal

1. Drain radiator. By raising the rear wheels at least 24", the block will drain enough coolant to remove the heads.

2. Remove intake manifold.

3. Remove exhaust manifold, see "EXHAUST MANIFOLD REMOVAL".

4. Remove valve cover.

NOTE: Loosen or remove any accessory brackets which interfere.

5. Remove ground strap from left cylinder head.

6. Remove rocker arm bolts, pivots, rocker arms and push rods. (See Note, Step 7)

NOTE: Scribe pivots and keep rocker arms separated so they can be installed in their original locations.

7. Remove cylinder head bolts and remove cylinder head.

NOTE: If a clearance problem is encountered for number 7 or 8 cylinder head bolts or push rods, pull these out far enough to clear the block, secure with rubber bands and remove or install with the cylinder heads.

VALVES AND SPRING WITH HEAD REMOVED

(FIG. 6A4-22)

Removal

1. Remove spark plugs.

2. Remove valve keys by compressing valve spring with a tool such as BT-6413-2.

3. Remove valve spring rotators or retainers and springs.

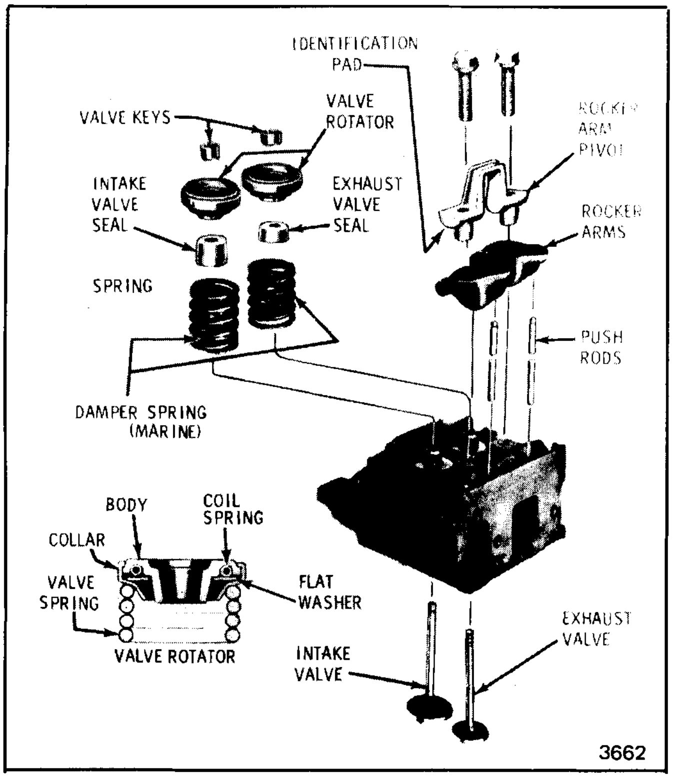


Fig. 6A4-22 Cylinder Head - Exploded View

4. Remove oil seals from valve stems.

5. Remove valves. Keep valves separated so they can be installed in their original locations. (Fig. 6A4-23)

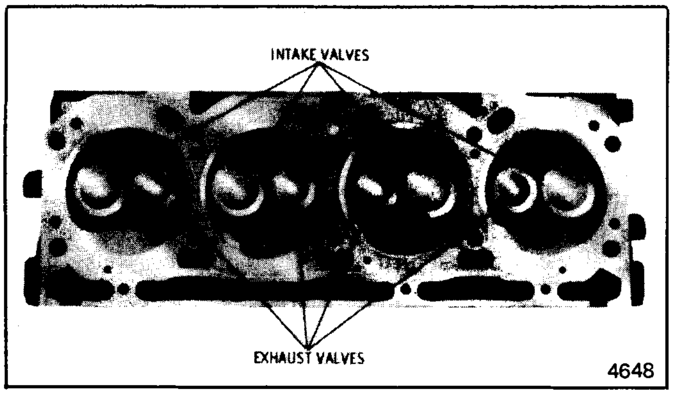


Fig. 6A4-23 Valve Location

Installation

1. Install valves in their respective guides.

VALVE SEAL IDENTIFICATION

Intake

Std. - .005" O.S. - Gray Colored

.010" - .013" O.S.- Orange Colored

Exhaust

Std. - .005" O.S. - Ivory Colored

.010" - .013" O.S.- Blue Colored

2. Install new oil seals over valve stem, using Tool BT-6804 (Fig. 6A4-24).

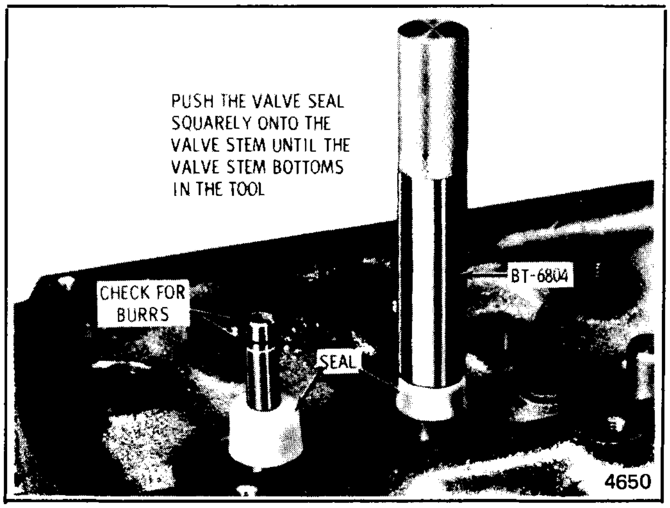


Fig. 6A4-24 Valve Seal Location

Position seals down as far as possible on valve stem. The seals will correctly position themselves when the engine is started.

NOTE: Inspect seal for cracks after installation.

3. Position valve springs over valve stems.

4. Install valve rotators then compress springs with a tool such as BT-6413-2 and install valve stem keys.

5. Check valve springs and keys to be sure they are properly seated.

Installation

Head gaskets are a special composition gasket that must be used WITHOUT a sealer. These gaskets are to be installed with the contrasting color stripe facing "up" (Fig. 6A4-25).

1. Clean and dip cylinder head bolts in engine oil, torque bolts to 100 ft. lbs. in sequence shown, then re-torque the head bolts to 130 ft. lbs. (Fig. 6A4-26).

2. Complete installation by reversing removal procedure.

Reconditioning Valves

When reconditioning valves and valve seats, clean carbon from cylinder heads and valves using care not to gouge or scratch machined surfaces. A soft wire brush is suitable for this purpose. Whenever valves are replaced or new valves installed, the valve seats must be reconditioned. (Fig. 6A3-27)

Narrow the valve seats to the specified width.

NOTE: This operation is done by grinding with a 30° stone to lower the seat and a 60° stone to raise the seat.

See "engine specification" chart for valve seat width.

NOTE: Exhaust valve seats are induction hardened and must be ground, not cut.

If valve guide bores are worn excessively, they can be reamed oversize. This will require replacement of the valves with oversize valves (stems). The guide bores should be reamed before grinding the valve seats. Valve clearance in guide bore should be 0015" to .0032" (exhaust) or .002" to .0027" for the intake valve.

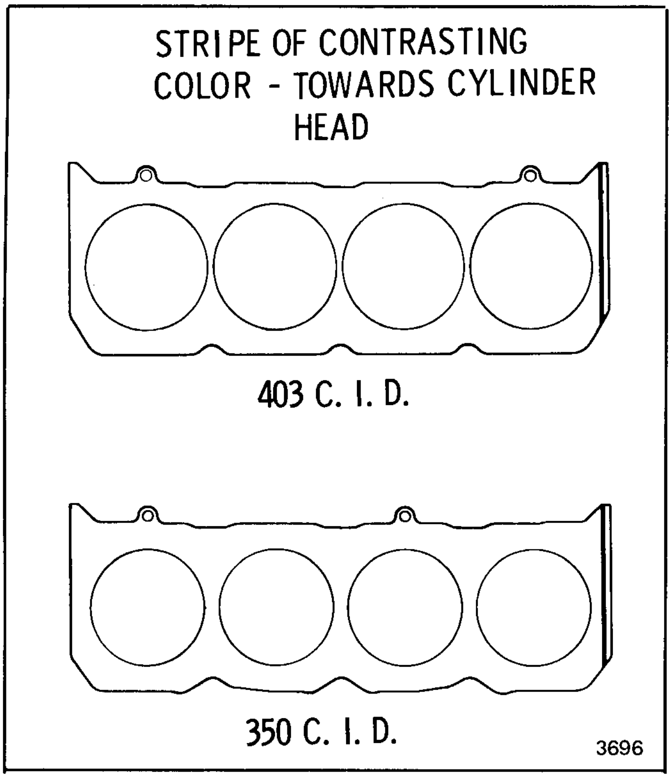


Fig. 6A4-25 Cylinder Head Gasket

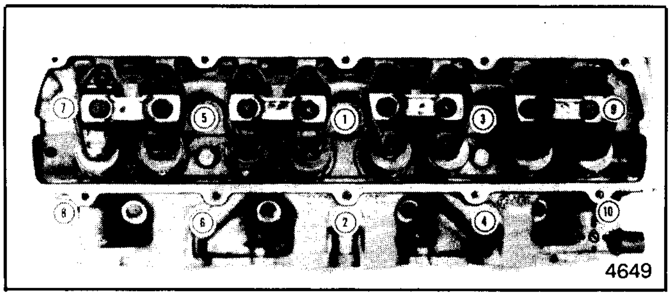


Fig. 6A4-26 Cylinder Head Torque Sequence

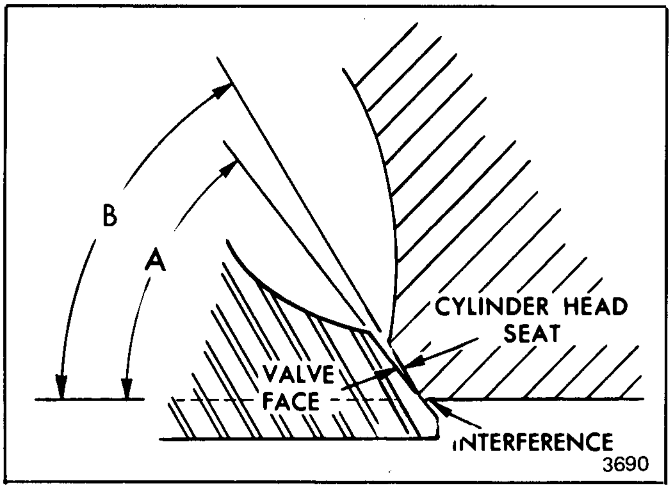


Fig. 6A4-27 Relation of Valve and Seat Angles

Measuring Valve Stem Height

Whenever a new valve is installed, or after grinding valves, it will be necessary to measure valve stem height as follows:

Install Gauge BT-6428 as shown in Fig. 6A4-28.

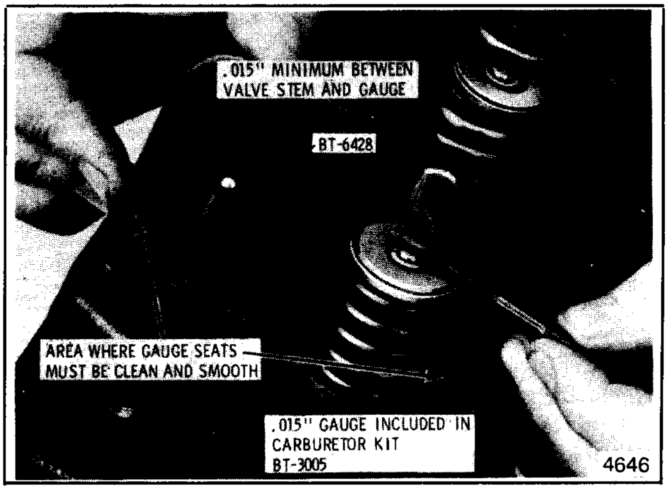


Fig. 6A4-28 Measuring Valve Stem Height

There should be at least .015″ clearance on all valves between gauge surface and end of valve stem. (Valve stem can be gauged with or without the valve rotator on the valve). If clearance is less than .015″, remove valve and grind tip of valve stems as required on a valve refacing machine using the "Vee" block attachment to insure a smooth 90° end. Also be certain to break sharp edge on ground valve tip. Observe an original valve to determine chamfer.

After all valve keys have been installed on valves, tap each valve stem end with a hammer to seat valve rotators and keys. Using Gauge BT-6428 as shown in Figs. 6A4-28 and 6A4-29, re-gauge all valves between valve stem and gauge (.015″ minimum) and valve rotator and gauge. (.030″ minimum). If any valve stem end is less than .005″ above rotator, the valve is too short and a new valve must be installed.

EXAMPLE:

Valve Rotator to Gauge Clearance	38″
Minus Valve Stem to Gauge Clearance	.035″ -.003″

This is less than .005″ and a new valve should be installed.

NOTE: There must be a minimum of .030″ clearance between valve rotator and gauge. Failure to maintain this clearance will cause rocker arm and valve rotator interference.

VALVE GUIDE BORES

As previously stated, if the valve guide bores are worn excessively, they can be reamed oversize. The following reamers are available:

BT-6414-1	.003" Oversize Valve Guide Reamer
BT-6414-4	.005" Oversize Valve Guide Reamer
BT-6414-3	.013″ Oversize Valve Guide Reamer

If a standard or .003″ O.S. valve guide bore is being reamed, use the .003' oversize reamer. For the .005″ oversize valve guide bore, use the .005″ oversize reamer, use the .013″

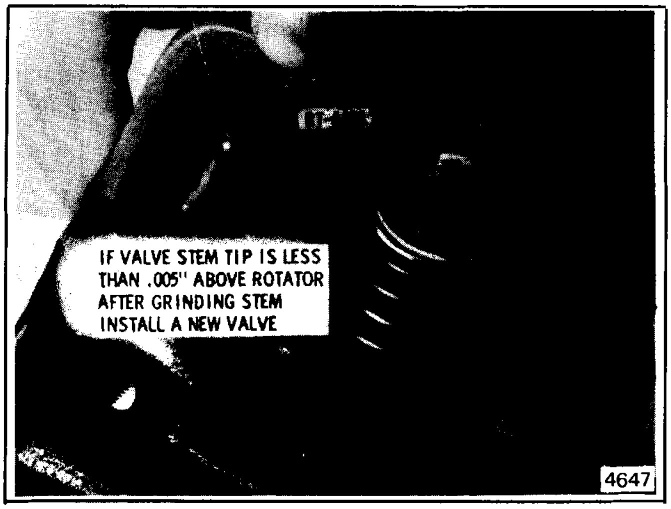


Fig. 6A4-29 Measuring Rotor Height

reamer for the .010" or .013" O.S. valve guide bore. If too large a reamer is used and the spiraling is removed, it is problable that the valve will not receive the proper lubrication.

Occasionally a valve guide bore will be oversize as manufactured. These are marked on the inboard side of the cylinder heads on the machined surface just above the intake manifold surface. (Fig. 6A4-30) These markings are visible without removing any parts other than the air cleaner assembly. Before removing the cylinder heads to perform service to either the valve or valve guide bores, the cylinder heads should be inspected to determine if these markings are present. If no markings are present, the guide bores are standard. If oversize markings are present, any valve replacement will require an oversize valve. If the oversize marking is present, only that particular bore would be oversize, not all bores in that cylinder head. Service valves are available in five differenct stem diameters: Standard, .003" oversize, .005" oversize, .010" oversize, and .013" oversize.

REAMING PROCEDURE

Before attempting to ream the valve guide bores they should be cleaned using Tool BT-6415 as shown in Fig. 6A4-31.

The procedure to ream valve guide bores using Tool BT-6414 is shown in Fig. 6A4-32. Use care to hold reamer straight in valve guide bore.

CRANKSHAFT PULLEY

Removal

1. Remove belts.
2. Hoist Car.
3. Remove four pulley bolts and pulley.

Installation

1. Install pulley, and four bolts. Torque to 10 ft. lbs.
2. Install belt(s). Adjust belts using Tool BT-6002-3.

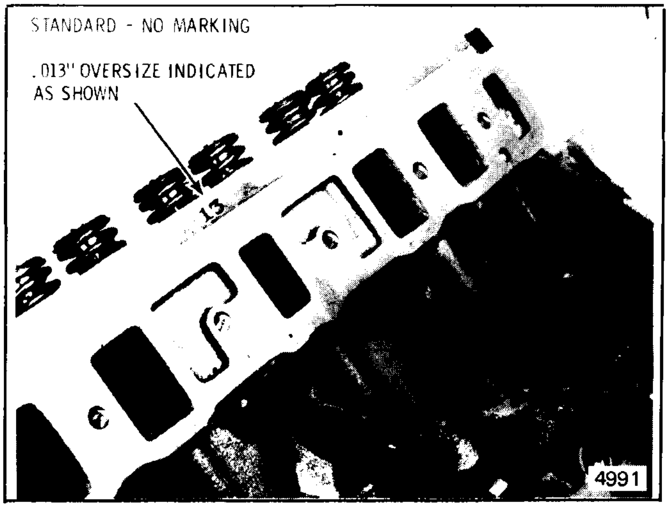


Fig. 6A4-30 Valve Guide Bore Markings

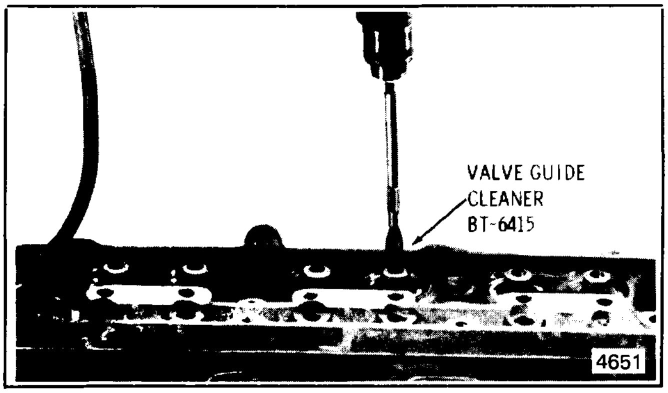


Fig. 6A4-31 Cleaning Valve Guide Bores

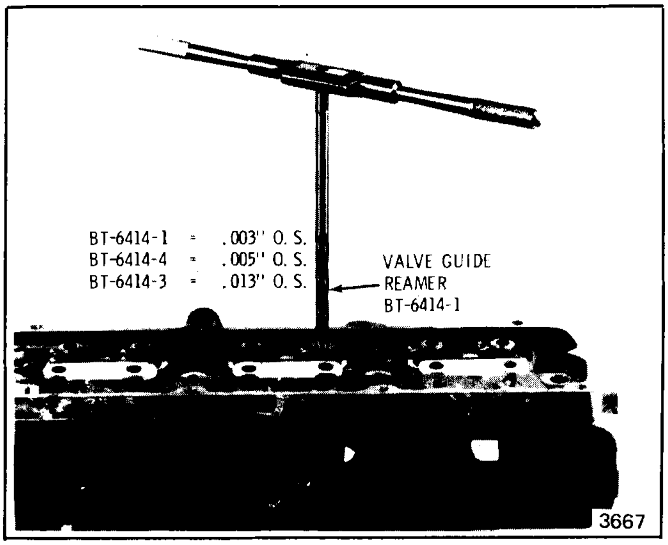


Fig. 6A4-32 Reaming Valve Guide Bores

BALANCER

Removal

1. Remove belt and crankshaft pulley.
2. Remove balancer hub bolt and washer.

3. Using balancer puller, remove balancer as shown in Fig. 6A4-33.

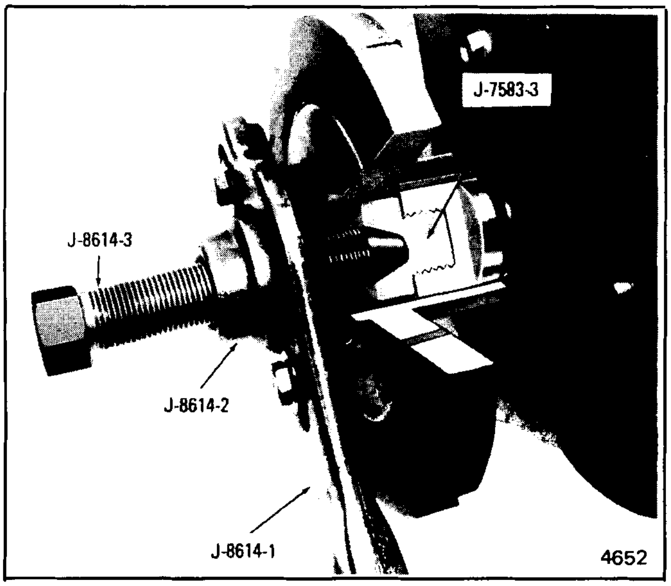


Fig. 6A4-33 Removing Balancer

CAUTION: *Use of any other type puller such as a universal claw type which pulls on the outside of the hub can destroy the harmonic balancer. The outside ring of the balancer is bonded in rubber to the hub; by pulling on the outside, rather than the hub, it is possible to break the bond. The timing mark is on the outside ring of the balancer; if the bond between the hub and the outside ring is broken, the outisde ring could slip which would change the location of the timing mark.*

If it is suspected that the bond between the sections of the harmonic balancer has been broken and the timing mark changed, it can be visually checked as shown in Fig. 6A4-34. The center of the keyway should be approximately 16° from the center of the timing slot. In addition there are chisel aligning marks between the weight and hub, marks should be together.

Installation

1. Apply sealer 1050805 or equivalent, to inside diameter of pulley hub and to crankshaft key to prevent possible oil leakage. Coat outside area of crankshaft pulley hub which enters seal with Special Seal Lubricant No. 1050169, or equivalent.

2. Install balancer on crankshaft. (Fig. 6A4-35)

NOTE: Balancer to crankshaft fit is .001" tight to .0007" loose.

3. Install washer and bolt. Torque 200-310 ft. lbs.

4. Install pulley and belt(s). Adjust belts using belt adjusting gauge BT-7002-3.

FRONT COVER

Removal

1. Drain cooling system. Disconnect radiator hoses and bypass hose.

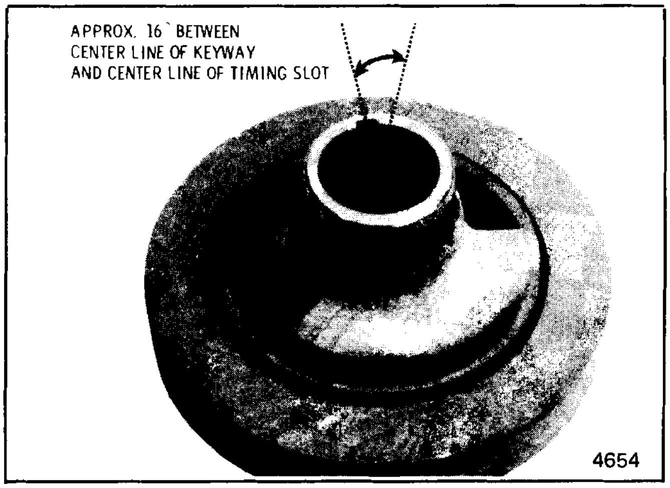


Fig. 6A4-34 350-403 CID Harmonic Balancer

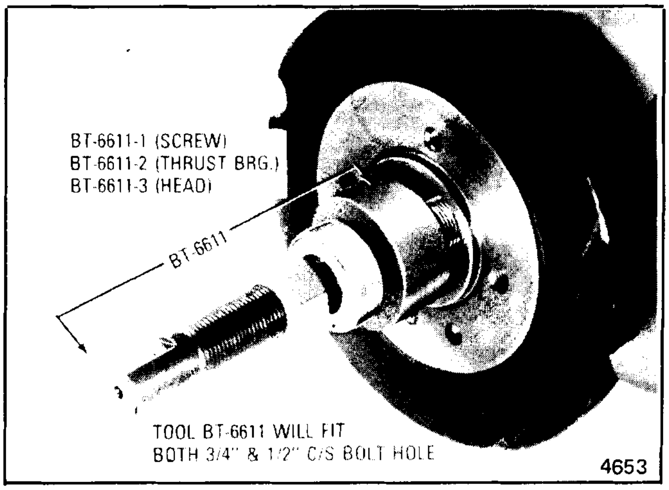


Fig. 6A4-35 Installing Balancer

2. Remove radiator upper support and radiator.

3. Remove all belts, fan and fan pulley, crankshaft pulley and harmonic balancer.

4. Remove cover to block attaching bolts and remove cover, timing idicator and water pump assembly. (Fig. 6A4-36)

5. Remove front cover and both dowel pins. It may be necessary to grind a flat on the pins to get a rough surface for gripping.

Installation

1. Grind a chamfer on one end of each dowel pin as shown in Fig. 6A4-37.

2. Cut excess material from front end of oil pan gasket on each side of engine block.

3. Clean block, oil pan and front cover mating surfaces with solvent.

4. Trim about 1/8" from each end of new front pan seal, using a sharp tool as shown in Fig. 6A4-38.

5. Install new front cover gasket on engine block and new front seal on front cover. Apply 1050805 or equivalent sealer to gasket around coolant holes and place on block.

6. Apply R.T.V. sealer at junction of block, pan and front cover as shown in Figure 6A4-39.

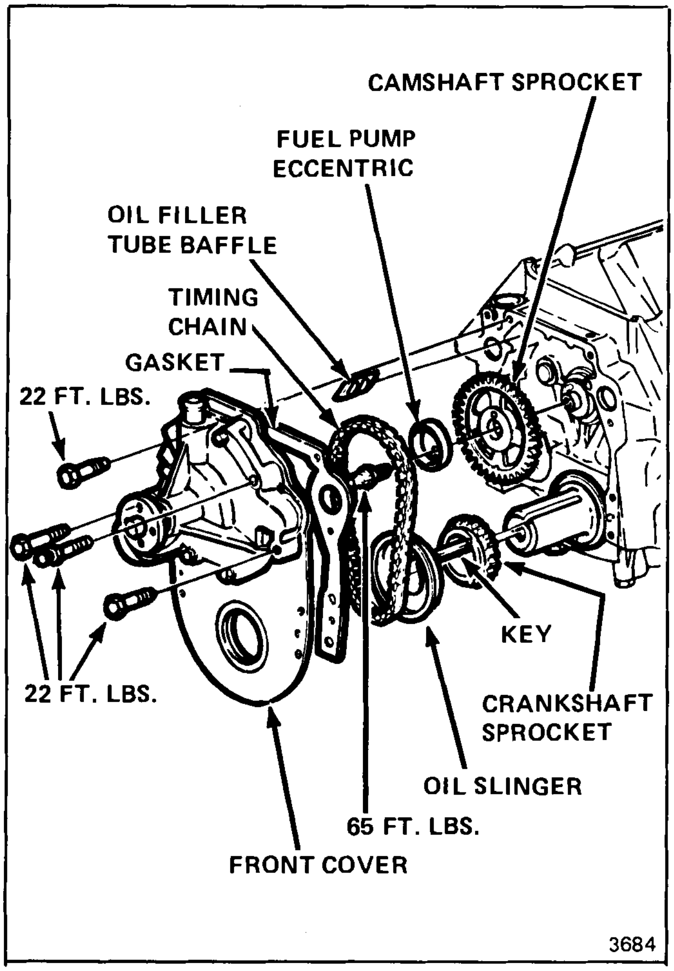


Fig. 6A4-36 Engine Front Cover

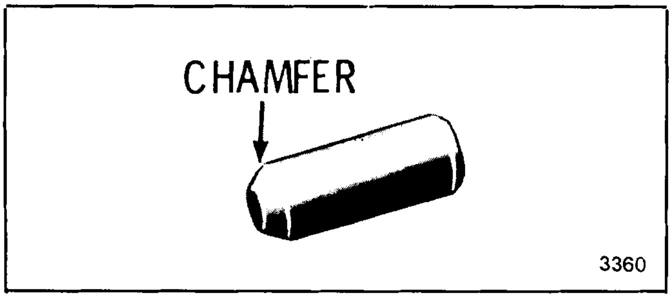


Fig. 6A4-37 Dowel Pin With Chamfer

7. Place cover on front of block and press downward to compress seal. Rotate cover left and right and guide pan seal into cavity using a small screwdriver as shown in Fig. 6A4-40.

8. Apply engine oil to bolts (threads and heads).

9. Install two bolts finger tight to hold cover in place.

10. Install two dowel pins (chamfered end first).

11. Install timing indicator and water pump assembly. Then torque bolts evenly as indicated in Fig. 6A4-41.

12. Apply lubricant 1050169 or equivalent on balancer seal surface.

13. Install balancer and balancer bolt. Torque to 200-300 ft. lbs.

14. Connect bypass hose and radiator hoses.

15. Install crankshaft pulley and four attaching bolts. Torque to 10 ft. lbs.

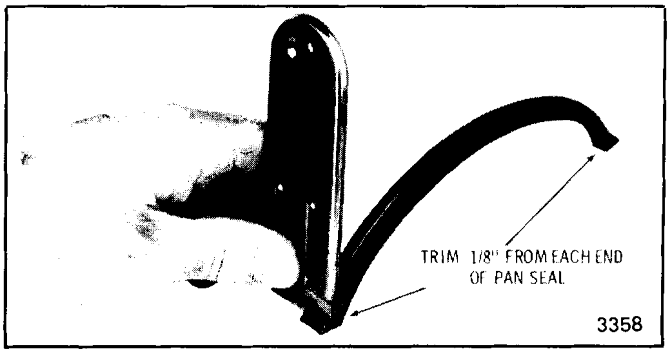


Fig. 6A4-38 Rework Pan Seal

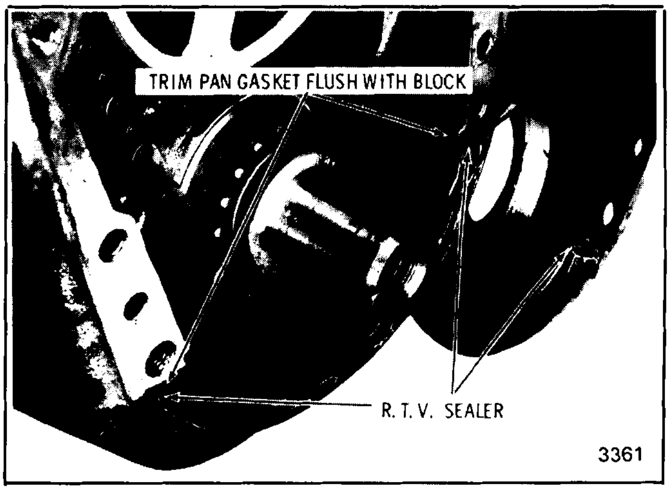


Fig. 6A4-39 Sealer On Pan and Cover

16. Install fan pulley, fan and four attaching bolts. Torque bolts to 20 ft. lbs.

17. Install belts and adjust using Tool BT-7002-3.

18. Fill radiator and crankcase.

19. Road test car and check for leaks. Use of spray foot powder or equivalent may aid in detecting leaks.

OIL SEAL

Removal (Front Cover Installed)

1. Remove the belts.
2. Remove the crankshaft pulley and pulley hub.
3. Using Tool BT-6406, remove oil seal.

Installation

1. Apply 1050805 Sealer or equivalent, to outside diameter of seal.
2. Using Tool BT-6405, install oil seal as shown in Fig. 6A4-43.
3. Install the pulley hub and crankshaft pulley.
4. Install and adjust belts using tool BT-6002-3.

TIMING CHAIN AND GEARS (WITH FRONT COVER REMOVED)

Removal

1. Remove fuel pump eccentric.

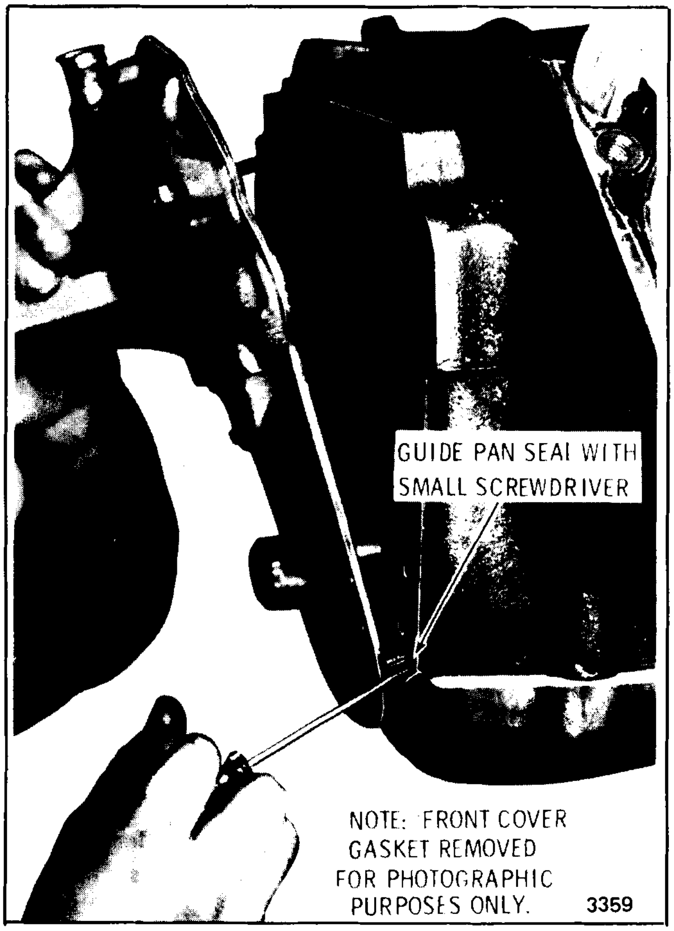


Fig. 6A4-40 Installing Timing Cover

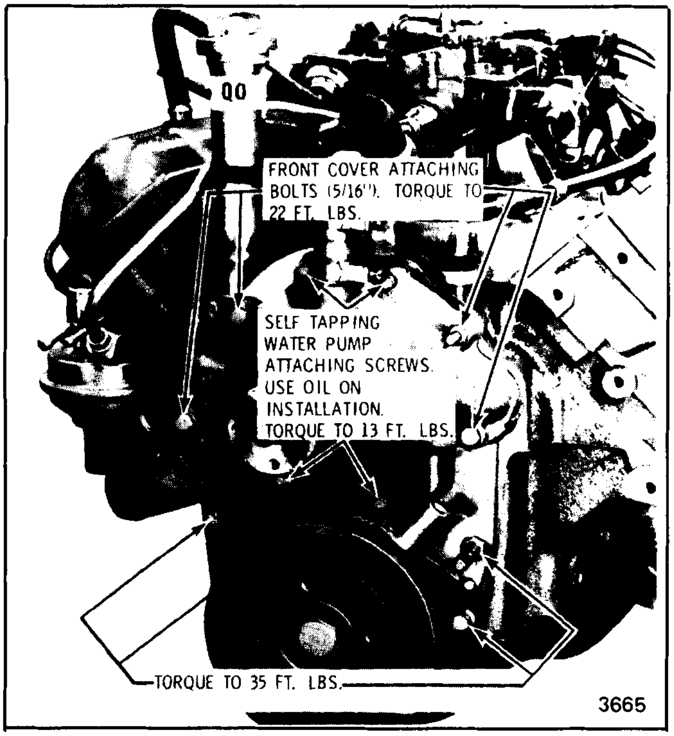


Fig. 6A4-41 Engine Front Cover Bolts

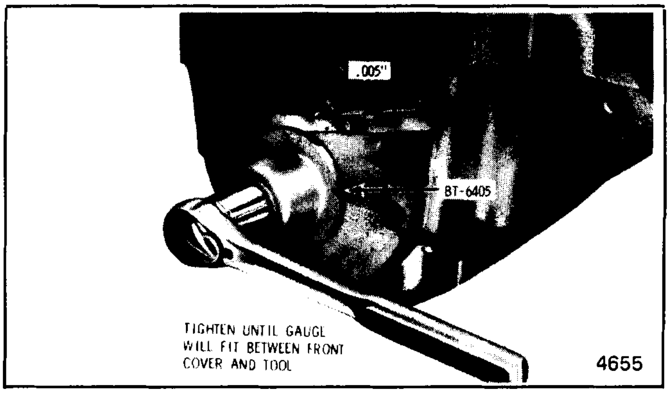


Fig. 6A4-43 Front Oil Seal Installation

2. Remove oil slinger, cam gear and timing chain.

3. Remove key then crankshaft gear.

NOTE: Gear to crankshaft fit tolerances may be such that a puller is necessary. Fig. 6A4-44

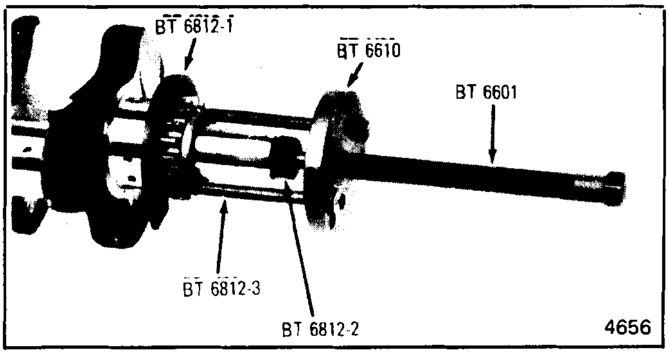


Fig. 6A4-44 Crankshaft Gear Removal

CAUTION: *Remove crankshaft key, if possible before using puller; if not, align puller so that BT-6812 does NOT overlap end of key when using puller, keyway is machined only part way in crankshaft gear and breakage would occur.*

Installation

1. Install camshaft gear, crankshaft gear and timing chain together and align timing marks Fig. 6A4-45.

NOTE: When the two marks are in alignment (Fig. 6A4-45), Number six is at T.D.C. To obtain T.D.C. for Number one cylinder, slowly rotate crankshaft one rotation, this will bring the cam mark to the top, number one then will be in firing position.

2. Install fuel pump eccentric with flat side rearward (Fig. 6A4-46).

3. Drive key in with a brass hammer until it bottoms in gear.

4. Install oil slinger.

CHECKING VALVE TIMING WITHOUT REMOVING FRONT COVER

1. Remove distributor cap, right valve cover, No. 4 cylinder intake and exhaust rocker arms and pivot.

2. Remove wire from "Bat." terminal of H.E.I. distributor.

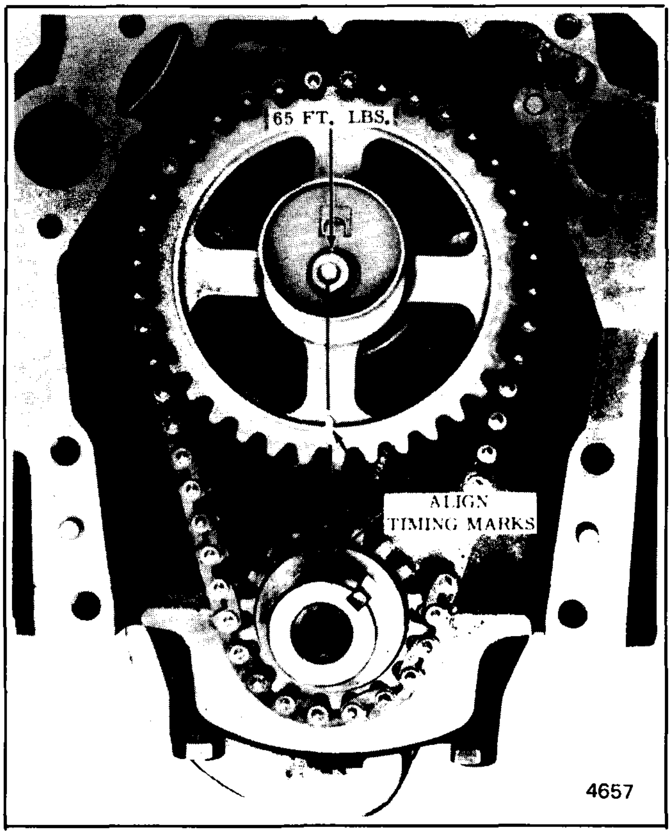


Fig. 6A4-45 Aligning Timing Marks

Fig. 6A4-46 Fuel Pump Eccentric

3. Turn ignition switch on. Crank engine until rotor is in line with No. 4 spark plug wire position. No. 4 piston will be approximately at the top of cylinder.

4. Measure from pivot boss on head surface to top of No. 4 intake push-rod. Record measurement. (Fig. 6A4-47)

5. Slowly turn engine 1-1/2 revolutions until rotor approaches No. 1 spark plug wire position. Continue to turn engine until timing mark on crank puller is aligned with O on indicator. This is top dead center of No. 1 piston.

6. Again measure from pivot boss surface to top of No. 4 cylinder intake push-rod. (Fig. 6A4-47)

7. Measurement should increase over the first measurement as shown on chart. (Fig. 6A4-47)

8. If measurement increase is not within 1/32" of that shown on chart, camshaft is advanced or retarded.

CAMSHAFT

Removal

1. Disconnect battery.
2. Drain radiator coolant.
3. Remove upper radiator baffle.
4. Disconnect upper radiator hose at water outlet.
5. Disconnect upper radiator hose support clamp.
6. Disconnect transmission cooler lines at radiator.
7. Remove radiator fan shroud.
8. Remove radiator.
9. Disconnect fuel line at fuel pump.
10. Remove air cleaner and disconnect throttle cable.
11. Loosen generator belt adjusting bolt, remove belt.
12. Remove generator bracket attaching bolts, move generator to one side for access.
13. Remove power steering pump bracket attaching bolts and remove pump, support pump to the side for access.
14. Remove air conditioning compressor mounting bracket attaching bolts and support compressor to side for access.

NOTE: The air conditioning lines at the compressor are flexible and should be left attached to the compressor.

15. Disconnect thermostat bypass hose at water pump.
16. Disconnect electrical and vacuum connections.
17. Remove distributor with cap and wiring intact.
18. Remove balancer pulley.
19. Remove balancer attaching bolt.
20. Using tools as shown in Fig. 6A4-33, remove balancer.
21. Remove engine front cover.
22. Remove both valve covers.
23. Remove intake manifold and gasket, front and rear seal.
24. Remove rocker arms, push rods and valve lifters.

NOTE: Parts position should be noted so they will be installed in their original position.

25. If equipped with air conditioning, discharge A/C system remove condenser attaching bolts and remove condenser.
26. Remove bolt securing fuel pump eccentric, remove eccentric, camshaft gear, oil slinger and timing chain.
27. Remove camshaft by carefully sliding it out the front of the engine.

NOTE: Do not force shaft as damage can occur to camshaft bearings. Refer to Fig. 6A4-48 for camshaft identification.

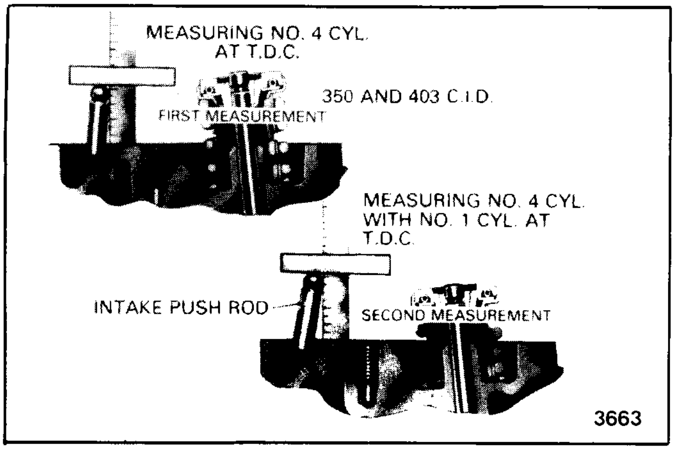


Fig. 6A4-47 Checking Valve Timing

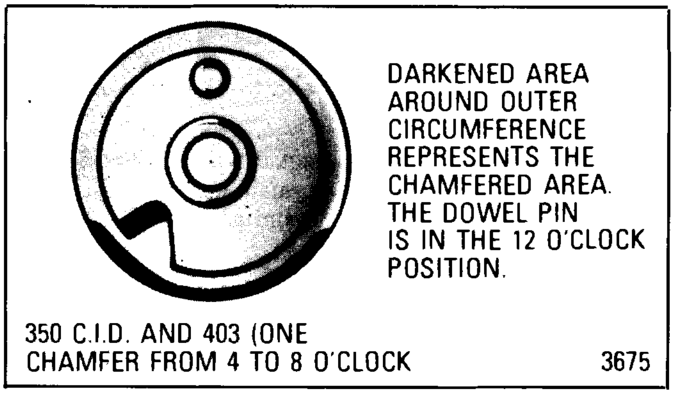


Fig. 6A4-48 Camshaft Identification

Installation

Coat camshaft and bearings liberally with No. 1051396 or equivalent before installing. Camshaft gear and crankshaft gear must be aligned as shown in Fig. 6A4-45. Before installing distributor, refer to ENGINE ELECTRICAL Section.

Timing indicator attaching stud must be installed and properly torqued before installing power steering pump bracket. Start engine, recharge A/C system, check for possible leaks.

CAMSHAFT BEARINGS

The camshaft bearings must be replaced in complete sets. All bearings must be removed before any can be installed. No. 1 bearing must be removed first, then No. 2, then 3, 4, and 5. When installing the bearings, No. 5 must be installed first, then 4, 3, 2 and 1.

Camshaft Bearing Remover and Installer Set BT-6409 is an available tool.

This set can be used to remove cam bearings with the engine either in or out of the car. To replace bearings with engine in car, proceed as follows:

Removal

1. Install No. 1 Cam Bearing Remover and Installer BT-6409-1 on Handle J-8092 and drive out front cam bearing.

2. Place Pilot BT-6409-6 on Driver BT-6409-7 and install No. 2 Cam Bearing Tool BT-6409-2 on driver and drive out No. 2 bearing.

3. Remove No. 3 and 4 bearings in the same manner, using BT-6409-3 and BT-6409-4 removers.

4. To remove No. 5 bearing with engine in chassis, use Puller BT 6409-8.

Installation

NOTE: To aid aligning bearings with oil passages, place each bearing in the front bore with tapered edge toward block and align the oil hole in the bearing with the center of the oil slot in the bore. Mark top of bearing. When Installing the bearings the mark will act as a guide.

1. Place new No. 5 bearing on BT-6409-5 and drive bearing in until the last white line on the driver is flush with the front face of the pilot. (Fig. 6A4-49)

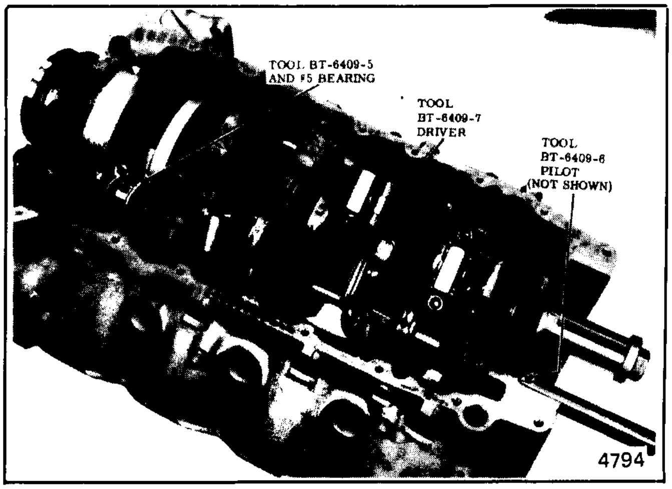


Fig. 6A4-49 Installing Rear Cam Bearing

2. Use BT-6409-9 to check oil hole opening as shown in Fig. 6A4-50.

3. Remove BT-6409-5 Installer and install BT-6409-4. Place No. 4 bearing on installer and drive in until the next to last white line on driver is flush with pilot.

4. Follow the same procedure to install No. 3 and No.2.

5. Install Tool BT-4609-1 on Handle J-9092 and place No. 1 bearing on installer. Drive Bearing in until white line on Installer BT-6409 is flush with front face of block. (Fig. 6A4-51)

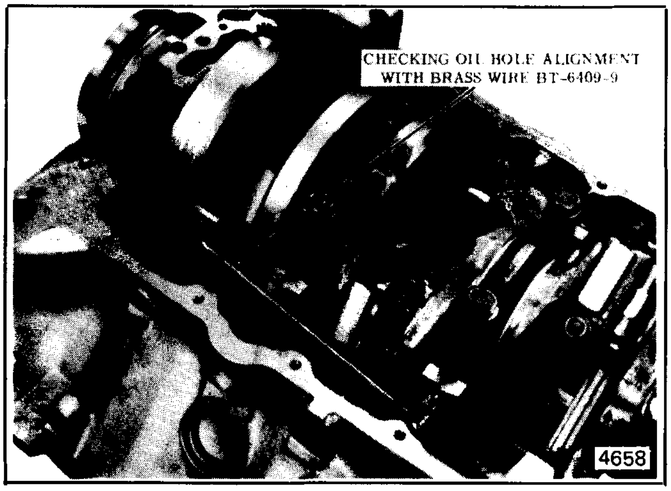


Fig. 6A4-50 Checking No. 5 Oil Hole

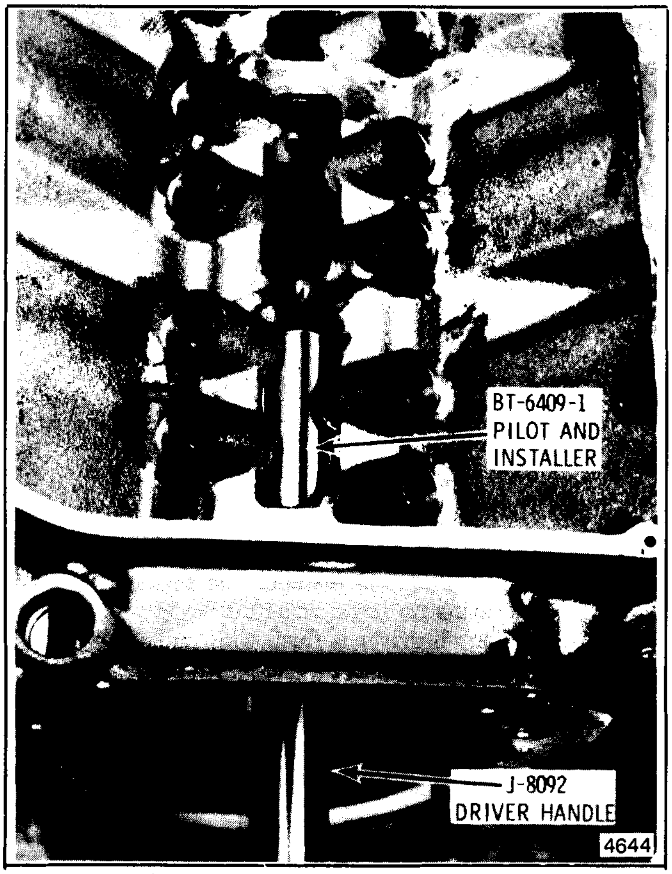


Fig. 6A4-51 Installing No. 1 Cam Bearing

6. Use BT-6409-9 to check all oil hole openings. Wire must enter hole or the bearing will not receive sufficient lubrication. (Fig. 6A4-50)

Camshaft and Oil Galley Plugs (Fig. 6A4-52)

The left hand rear oil galley plug is not shown. It is a threaded plug in the end of the left galley just rearward of the distributor. A small hole is provided in the plug for distributor lubrication. The cup plug shown provides access to the threaded plug.

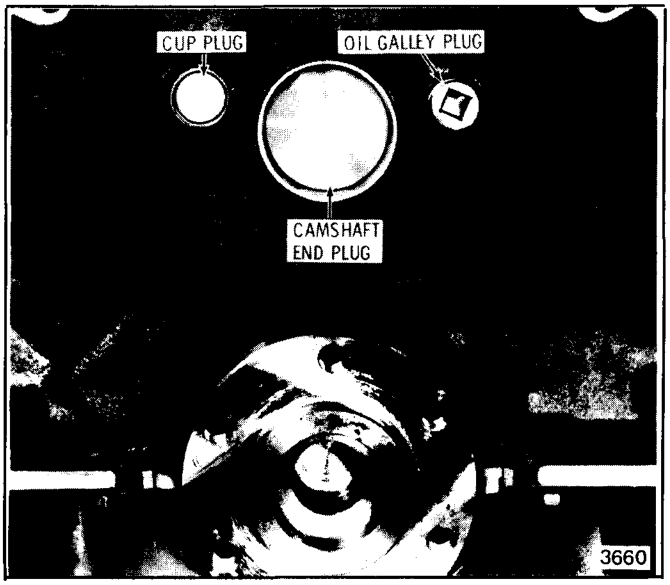


Fig. 6A4-52 Camshaft and Oil Gallery Plug

The front oil galley plugs (not shown) are threaded. The plug on the right side has a small hole which provides lubrication for the timing chain and gears.

To find out if the camshaft plug at the rear of the engine is properly instaled: Place a straight edge across the machined surface of the rear of the block and measure from the straight edge to the lip of the plug. Dimension should be .250" maximum to .160" minimim.

OIL PAN

Removal

1. Remove distributor cap and align rotor in the number one firing position.
2. Disconnect battery cable. Remove the dip stick.
3. Remove upper radiator support and fan shroud attaching screws.
4. Hoist the car and drain oil.
5. Remove flywheel cover.
6. Disconnect exhaust and crossover pipes.
7. Remove starter assembly.
8. Remove engine mounts from engine block, then jack front of engine up as far as possible using Engine Support Tool J-23515 and Adapter J-23515-20 or BT-6501 (Fig. 6A4-53)
9. Remove oil pan attaching bolts and remove oil pan.

Installation (Fig. 6A4-54)

1. Apply 1050805 Sealer or equivalent to both sides of pan gaskets and install on block.
2. Install front and rear seal (rubber).
3. Wipe lube, 1050805, or equivalent on seal area and install pan. Torque bolts to 10 ft. lbs. Reverse the removal procedure. Fill crankcase.

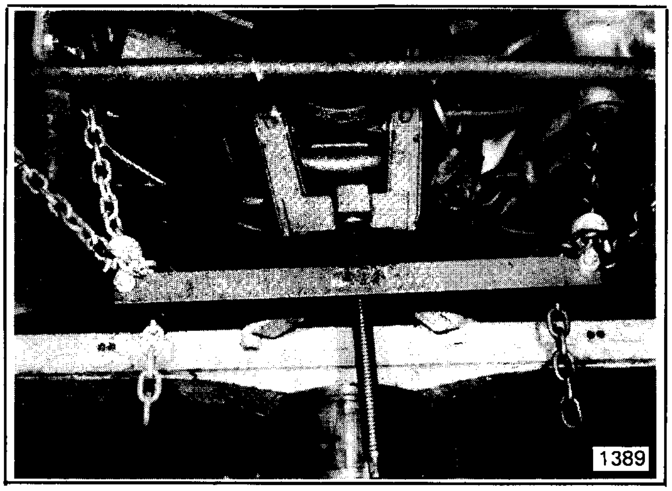


Fig. 6A4-53 Engine Support Tool (Typical)

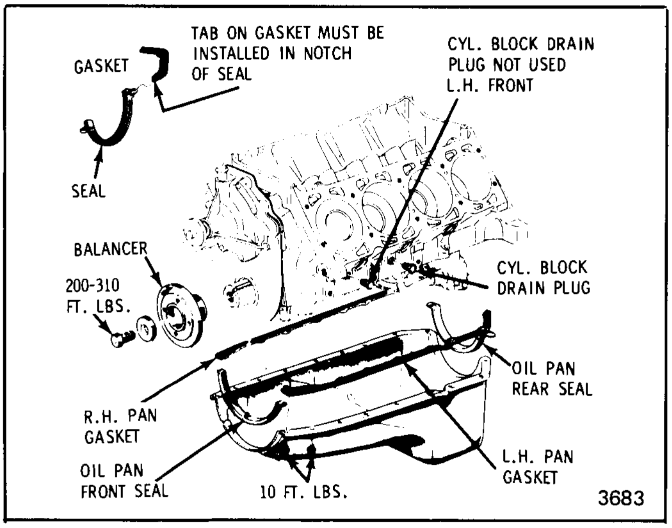


Fig. 6A4-54 Oil Pan Assembly

OIL PUMP

Removal

1. Remove oil pan. (Refer to OIL PAN Removal)

2. Remove the oil pump to rear main bearing cap attaching bolts, then remove pump and drive shaft extension.

Disassembly (Fig. 6A4-55)

1. Remove the oil pump drive shaft extension.

NOTE: Do not attempt to remove the washers from the drive shaft extension. The drive shaft extension and washers must be serviced as an assembly. Fig. 6A4-56

2. Remove the cotter pin, spring and the pressure regulator valve.

NOTE: Position thumb over pressure regulator bore before removing cotter pin, as the spring is under pressure.

3. Remove the oil pump cover attaching screws and remove the oil pump cover and gasket.

4. Remove the drive gear and idler gear from the pump body.

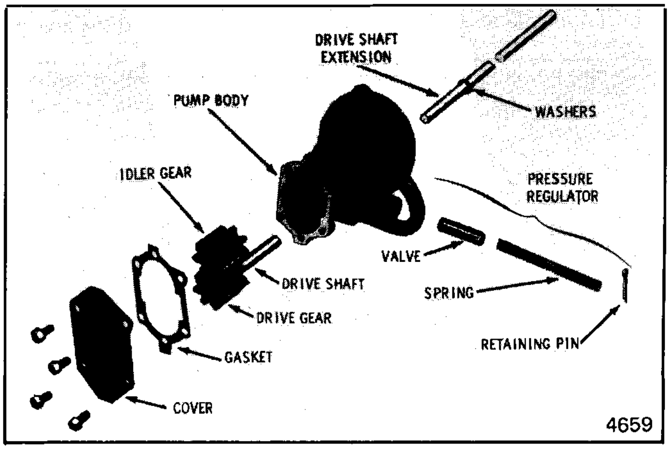


Fig. 6A4-55 Oil Pump Exploded View

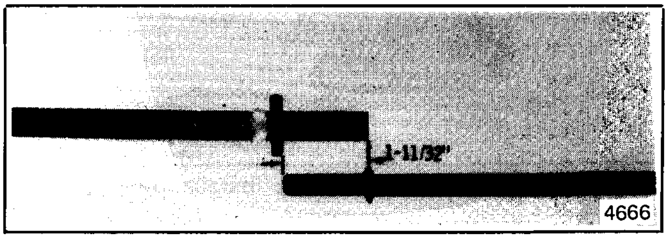


Fig. 6A4-56 Oil Pump Drive Shaft Extension

Inspection

Check the gears for scoring or other damage. If they are damaged, new gears should be installed. During assembly, the gear end clearance should be gauged. Proper end clearance is .0015" to .0085". Also check the pressure regulator valve, valve spring and bore for damage. Proper valve to bore-clearance is .0025" to .0050". The checking of gear end clearance will be covered in "Assembly".

Assembly

1. Install the gears and shaft in the oil pump body and check the gear end clearance by placing a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. The clearance should be between .0015" to .0086". If the end clearance is near the excessive reading check for scores in the cover that would bring the total clearance over the specified amount.

2. Install the cover screws and tighten alternately and evenly. The torque is 8 ft. lbs.

3. Position the pressure regulator valve into the pump cover, closed end first, then install the spring and retaining pin.

NOTE: When assembling the drive shaft extension to the drive shaft, THE END OF THE EXTENSION NEAREST THE WASHERS MUST BE INSERTED INTO THE DRIVE SHAFT.

Installation

1. Insert the drive shaft extension through the opening in the main bearing cap and block until the shaft mates into the distributor drive gear.

2. Position pump onto the rear main bearing cap and install attaching bolts. Torque bolts to 35 ft. lbs. (Fig. 6A4-57)

3. Install the oil pan. Refer to OIL PAN Installation.

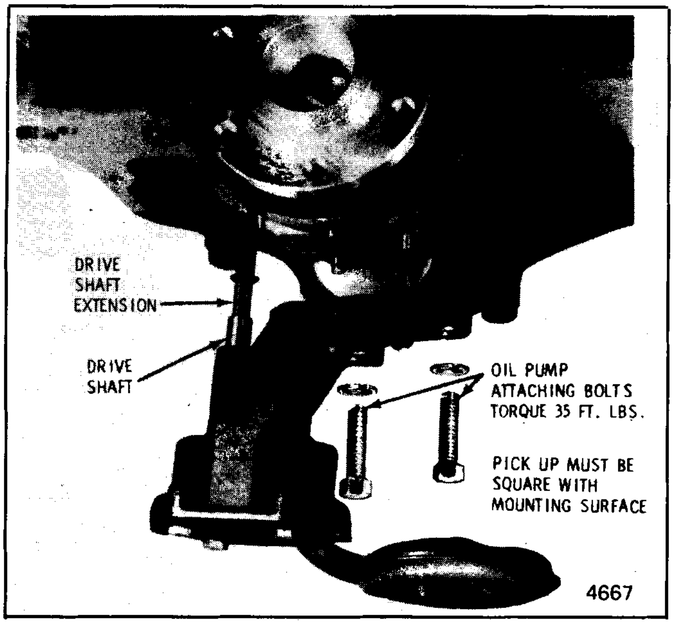


Fig. 6A4-57 Oil Pump Installation

CONNECTING ROD AND PISTON ASSEMBLY

Removal

1. Remove intake manifold, head or heads.
2. Remove oil pan.
3. Remove oil pump assembly.

NOTE: Stamp cylinder number on the machined surfaces of the bolt bosses of the connecting rod and cap for identification when reinstalling. If the pistons are to be removed from the connecting rod, mark cylinder number on piston with a silver pencil or quick drying paint for proper cylinder identification and cap to rod location. The right bank is numbered 2-4-6-8, left bank 1-3-5-7.

Examine the cylinder bore above ring travel. If ridge exists, remove ridge with ridge reamer before attempting to remove the piston and rod assembly.

4. Remove rod bearing cap and bearing.
5. Install guide hose over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads. (Fig. 6A4-58)
6. Remove rod and piston assembly through the top of the cylinder bore.
7. Remove other rod and piston assemblies in the same manner.

ROD BEARINGS

The connecting rod bearings are designed to have a slight projection above the rod and cap faces to insure a positive contact.

Connecting rod bearings can be replaced without removing the rod and piston assembly from the engine.

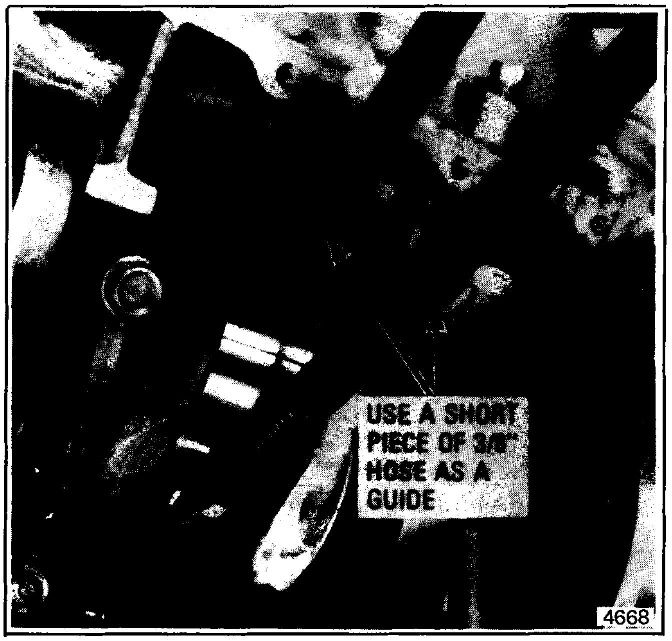


Fig. 6A4-58 Connecting Rod Bolt Guide

1. Remove oil pan.

NOTE: It may be necessary to remove oil pump to provide access to rear connecting rod bearings.

2. With connecting rod journal at the bottom, stamp cylinder number on machined surfaces of connecting rod and cap for identification when reinstalling, then remove caps.
3. Inspect journals for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone by moving the stone on the journal circumference. Do not move the stone back and forth across the journal. If the journals are scored or ridged, the crankshaft must be replaced.
4. The connecting rod journals should be checked for out-of-round and correct size with a micrometer. Maximum out-of-round must not exceed .0015".

NOTE: Refer to ENGINE SPECIFICATIONS Chart at the back of this section.

NOTE: Crankshaft rod journals will normally be standard size, if any undersized crankshafts are used, all will be .010" U.S. and an "X" will be stamped on the pad at the L.F. upper corner of the block.

If plastic gauging material is to be used:

5. Clean oil from journal bearing cap, connecting rod and outer and inner surface of bearing inserts. Position insert so that tang is properly aligned with notch in rod and cap. (Fig. 6A4-59)
6. Place a piece of plastic gauging material in the center of lower bearing shell.
7. Reinstall bearing cap and torque to 42 ft. lbs.
8. Remove bearing cap and determine bearing clearances by comparing the width of the flattened plastic gauging material at its widest point with the graduation on the container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch. If this

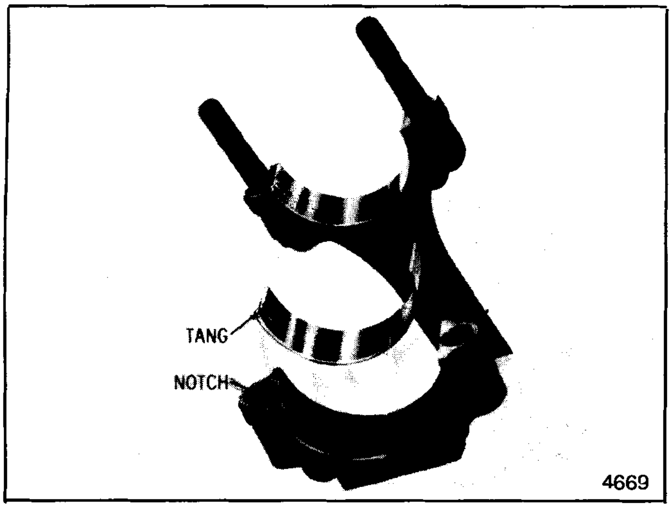


Fig. 6A4-59 Bearing Tang and Notch

clearance is greater than .0035", replace the bearing and recheck clearance with plastic gauging material.

> **NOTE:** Lubricate bearing with engine oil before installation. Repeat Steps 3 through 8 on remaining connecting rod bearings. All rods must be connected to their journals when rotating the crankshaft to prevent engine damage.

NOTE: Bearings are identified as shown in Fig. 6A4-60.

9. Measure the rod side clearance as shown in Fig. 6A4-61.

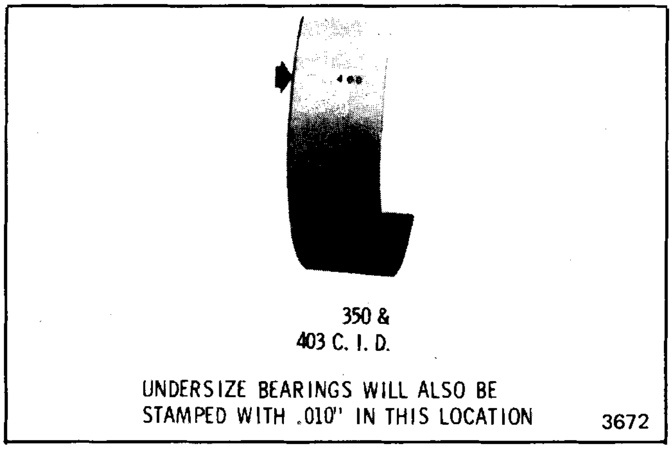


Fig. 6A4-60 Bearing Identification

MAIN BEARINGS

Main bearing clearance must not exceed .0035" on all bearings. The .0035" clearance is permissible only if the engine is disassembled for other than a bearing noise condition. If bearings are noisy or if a visual inspection indicates defective bearings, new bearings must be installed within the specifications outlined under MAIN BEARINGS-REPLACE.

Bearings which fall within the .0035" specifications should not be rejected if the bearings show a normal wear pattern or slight radial grooves, unless it has been established to be defective.

Fig. 6A4-61 Connecting Rod Side Clearance

Checking Bearing Clearances

1. Remove bearing cap and wipe oil from crankshaft journal and outer and inner surfaces of bearing shell.

2. Place a piece of plastic gauging material in the center of bearing.

3. Use a floor jack or other means to hold crankshaft against upper bearing shell. This is necessary to obtain accurate clearance readings when using plastic gauging material.

4. Reinstall bearing cap and bearing. Replace engine oil on cap bolts and install.

Torque Nos. 1,2,3 and 4 bolts to 80 ft. lbs. and No. 5 bolt to 120 ft. lbs.

5. Remove bearing cap and determine bearing clearnace by comparing the width of the flattened plastic gauging material at its widest point with graduations on the gauging meterial container. See Figure 6A4-62. The number within the graduation on the envelope indicates the clearance. If greater than .0035", REPLACE BOTH BEARING SHELLS AS A SET. Recheck clearance after replacing shells. (Refer to MAIN BEARINGS-REPLACE)

> **NOTE:** Main bearing end thrust cleanace should be .0035" to .0135" as checked with a dial indicator.

Main Bearing Replacement

Main bearing clearances must be corrected by the use of selective upper and lower shells. UNDER NO CURCUMSTANCES should the use of shims behind the shells, to compensate for wear, be attempted.

> **NOTE:** The upper and lower shells must be installed in pairs. Sizes of the bearings are located on the tang. (Fig. 6A4-63) It is possible to have more than one bearing size in the same engine.

To install main bearing shells, proceed as follows:

1. Loosen all main bearing caps.

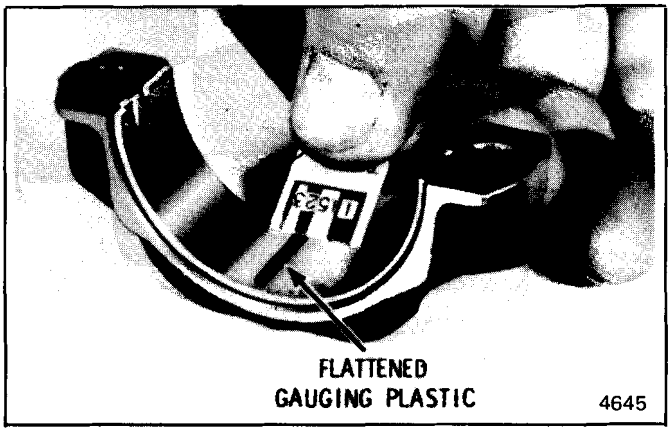


Fig. 6A4-62 Checking Bearing Clearances

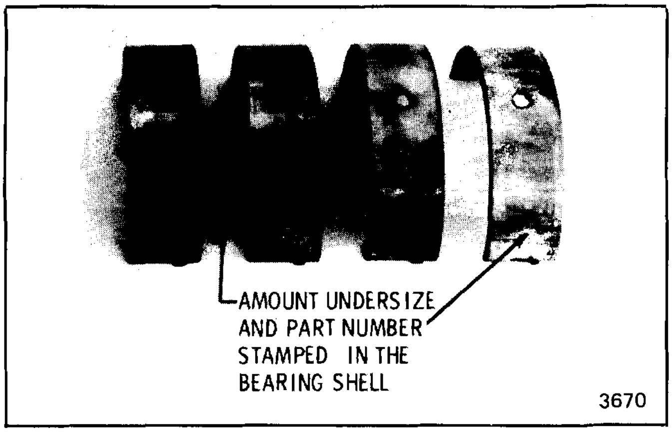


Fig. 6A4-63 Main Bearing Identification

2. Remove bearing cap and remove lower shell.

3. Insert a flattened cotter pin or roll out pin in the oil passage hole in the crankshaft, then rotate the crankshaft in the direction opposite to cranking rotation. The pin will contact the upper shell and roll it out.

4. The main bearing journals should be checked for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone. If the journals are scored or ridged, the crankshaft must be replaced.

> **NOTE:** The journals can be measured for out-of-round with the crankshaft installed by using a crankshaft caliper and inside micrometer or a main bearing micrometer. The upper bearing shell must be removed when measuring the crankshaft journals. Maximum out-of-round of the crankshaft journals must not exceed .0015".

5. Clean crankshaft journals and bearing caps thoroughly before installing new main bearings.

6. Apply Special Lubricant, No. 1050169 or equivalent to the thrust flanges of bearing shells on No. 3 bearing.

7. Place new upper shell on crankshaft journal with locating tang in correct position and rotate shaft to turn it into place using cotter pin or roll out pin as during removal.

8. Place new bearing shell in bearing cap.

9. No. 5 bearing - Install new asbestos oil seal in the rear main bearing cap. (REAR MAIN BEARING OIL SEAL) (Fig. 6A4-64) Install 1050805 or equivalent sealer on cap as shown.

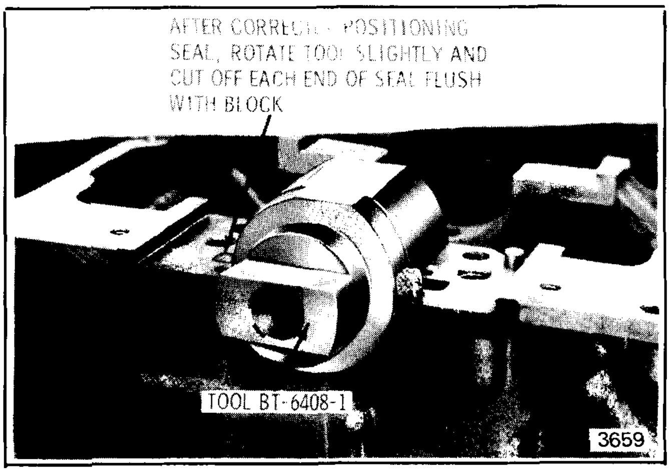


Fig. 6A4-64 Installing Rear Main Oil Seal

10. Install bearing caps, lubricate bolt threads with engine oil, then install.

Torque Nos. 1 through 4 to 80 ft. lbs. and No. 5 to 120 ft. lbs.

REAR MAIN BEARING UPPER OIL SEAL

Repair

Tools have been released to provide a means of correcting engine rear main bearing upper seal leaks without the necessity of removing the crankshaft. The procedure for seal leak correction is listed below.

1. Drain oil and remove oil pan and rear main bearing cap.

2. Insert Packing Tool BT-6433 against one end seal in cylinder block and drive the old seal gently into the groove until it is packed tight. This vaires from 1/4" to 3/4" depending on the amount of pack required. (Fig. 6A4-65)

3. Repeat this on the other end of the seal in the cylinder block.

4. Measure the amount the seal was driven up on one side; add 1/16", then cut this length from the old seal removed from the main bearing cap with a single edge razor blade.

5. Place a drop of 1050805 Sealer or equivalent, on each end of seal and cap as indicated.

6. Work these two pieces of seal into the cylinder block (one piece on each side) with two small screwdrivers. Using Packing Tool, pack these short pieces up into the block. Use Seal Trimming Tool BT-6436 to trim seal flush with block as shown in Fig. 6A4-66.

> **NOTE:** Place a piece of shim stock between seal and crankshaft to protect bearing surface before trimming.

7. Form a new rope seal in the rear main bearing cap as outlined.

8. Assemble the cap to the block and torque to specifications.

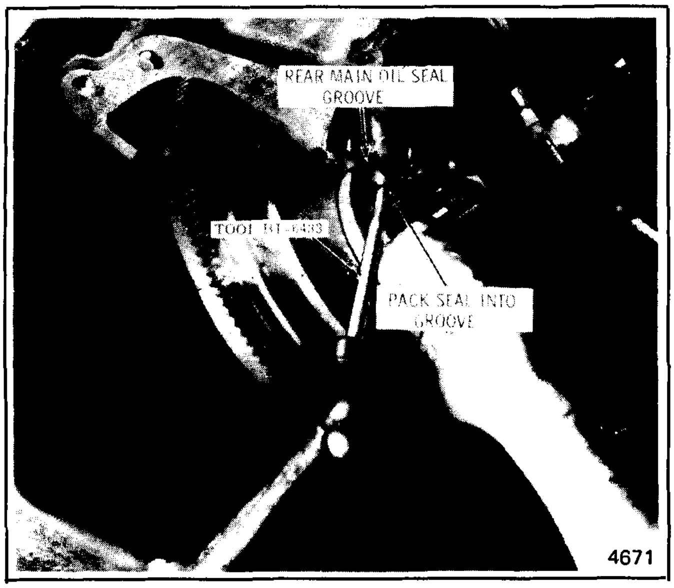


Fig. 6A4-65 Packing Oil Seal

Fig. 6A4-66 Cutting Off Upper Seal Ends

REAR MAIN LOWER OIL SEAL

Removal

1. Remove oil pan.
2. Remove the rear main bearing cap.
3. Remove rear main bearing insert and old seal.
4. Clean bearing cap and seal grooves and inspect for cracks.

Installation

1. Install seal into bearing cap, packing by hand.
2. Using seal installer, hammer seal into groove (Fig. 6A4-64).

NOTE: To check if seal is fully seated in the bearing cap, slide the tool away from seal. With tool fully seated in the bearing cap, slide tool against the seal. If undercut area of tool slides over the seal, the seal is fully seated. If tool butts against the seal, the seal must be driven further into the seal groove. Rotate tool before cutting off excess seal packing.

3. With tool slightly rotated, cut seal flush with mating surface. With screwdriver, pack seal end fibers towards center, away from edges. Rotate seat installer when cutting seal to avoid damage to tool
4. Clean bearing insert and install in bearing cap.
5. Clean crankshaft bearing journal and seal contact. Install sealer on cap as shown.
6. Install bearing caps, lubricate bolt threads with engine oil and install. Torque No. 5 to 120 ft. lbs.
7. Install pan with new gaskets.
8. Install lower flywheel cover.

ROD ASSEMBLY

If a rod is twisted or bent, a new rod must be installed. NO ATTEMPT SHOULD BE MADE TO STRAIGHTEN CONNECTING RODS.

PISTON (FIG.6A4-67)

MEASURING PISTON

NOTE: Refer to PISTON INFORMATION Chart.

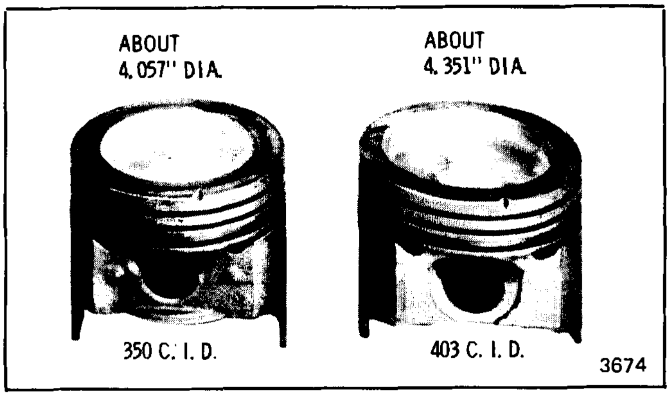


Fig. 6A4-67 Piston Identification

When replacing pistons, the original cylinder size is stamped with a code letter on the block near each cylinder on the cylinder head surface or on the oil pan rail (Fig. 6A4-68).

When measuring piston for size or taper, measurement must be made on skirt 90° from piston pin hole (with the piston pin removed). (Fig. 6A4-69)

When measuring taper, the largest reading must be at the bottom of the skirt. Allowable taper is .000" to .0001".

The piston and cylinder bore must be free of oil and at the same temperature.

NOTE: On some cars, oversize pistons may be found. These pistons will be .010" oversize.

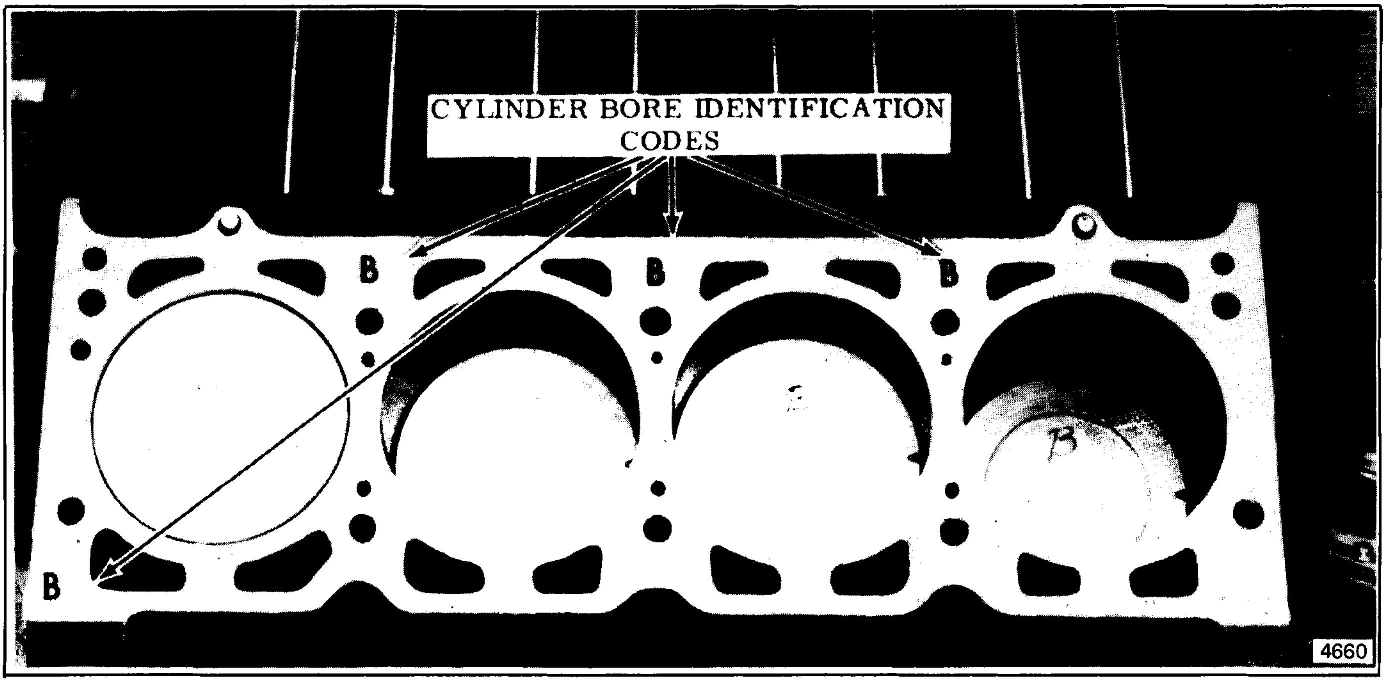


Fig. 6A4-68 Cylinder Bore Marking

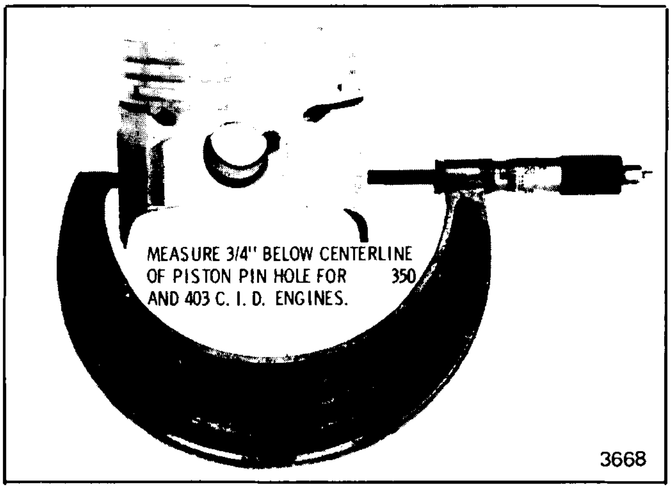


Fig. 6A4-69 Measuring Piston

1. Place a strip of .0015" feeler gauge against the upper side of the bore, at 90° to the normal piston pin location. Attach Scale J-5515 to feeler gauge. (Fig. 6A4-70)

2. Insert piston upside down with pin and rings removed, into bore.

3. While holding the piston in the center of its normal travel, slowly pull the scale in a straight line and note the reading on the scale. The reading should be between between 3 to 12 pounds while pulling the feeler gauge out of the bore.

Each piston should be fitted to its individual cylinder and marked for that cylinder.

CHECKING CYLINDER BORE

NOTE: Refer to PISTON INFORMATION Chart.

Cylinder bore size can be measured with inside micrometers or a cylinder gauge. Maximum allowable taper of the cylinder bore is .001". The most wear will occur at the top of the ring travel.

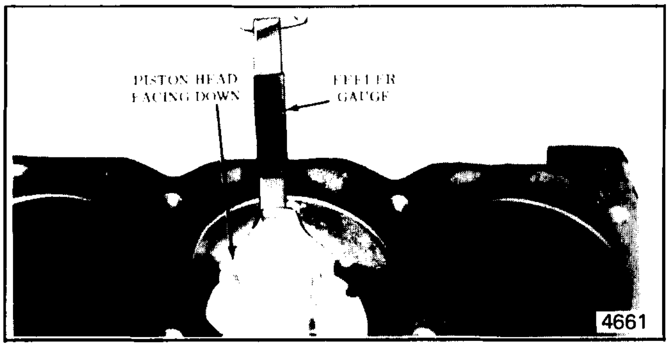


Fig. 6A4-70 Checking Piston Clearance

Reconditioned cylinder bores should be held to not more than .001" out-of-round and .001" taper.

If the cylinder bores are smooth, the cylinder walls should not be deglazed. If the cylinder walls are scored, the walls may have to be honed before installing new rings. It is important that reconditioned cylinder bores be thoroughly washed with a soap and water solution to remove all traces of abrasive material to eliminate premature wear.

CLEANING PISTON

Clean the pistons by scraping carbon off the top of the piston. Deposits in the ring grooves should be removed with a suitable ring groove cleaning tool. It is important that the ring grooves be completely free of deposits.

PISTON RINGS

The pistons have three rings (two compression rings and one oil ring). The oil ring consists of two rails and an expander.

Ring Tolerances

When installing new rings, ring gap and side clearance should be checked as follows:

Piston Ring and Rail Gap

Each ring and rail gap must be measured with the ring or rail positioned squarely and at the bottom of the ring-travel area of the bore. (Fig. 6A4-72)

The end gap measurement should be .013" to .023" for compression rings and .015" to .055" for oil rings.

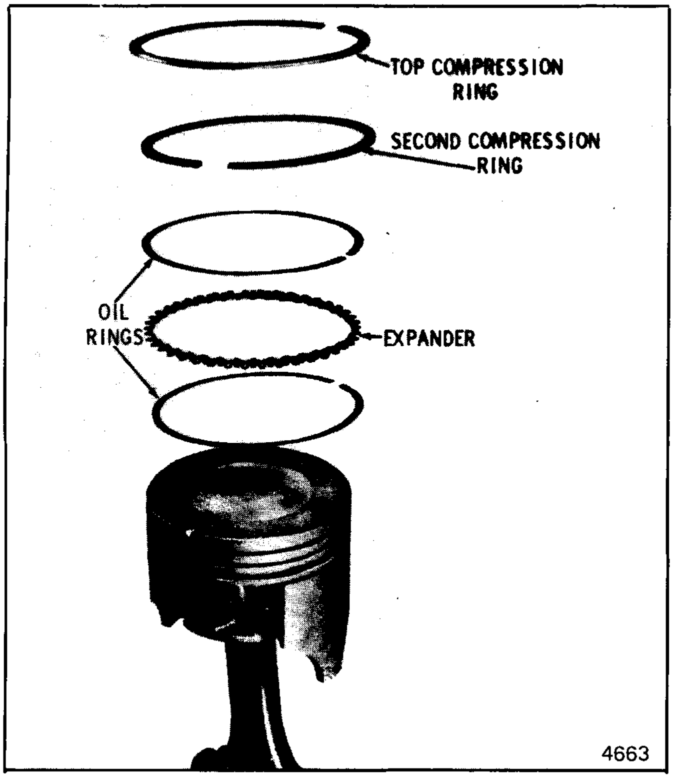


Fig. 6A4-71 Piston Rings

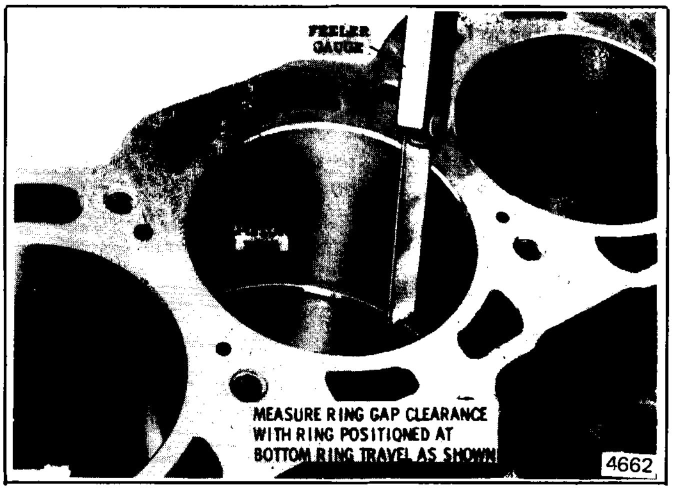


Fig. 6A4-72 Measuring Piston Ring Gap

Side Clearance

Each ring must be checked for side clearance in its respective piston groove by inserting a feeler gauge between the ring and its upper land. (Fig. 6A4-73) The piston grooves must be cleaned before checking ring for side clearance.

NOTE: To check oil ring side clearance, the oil rings must be installed on the piston.

ALLOWABLE SIDE CLEARANCE

Compression Rings - .002" to .004"

Oil Rings - .001" to .005"

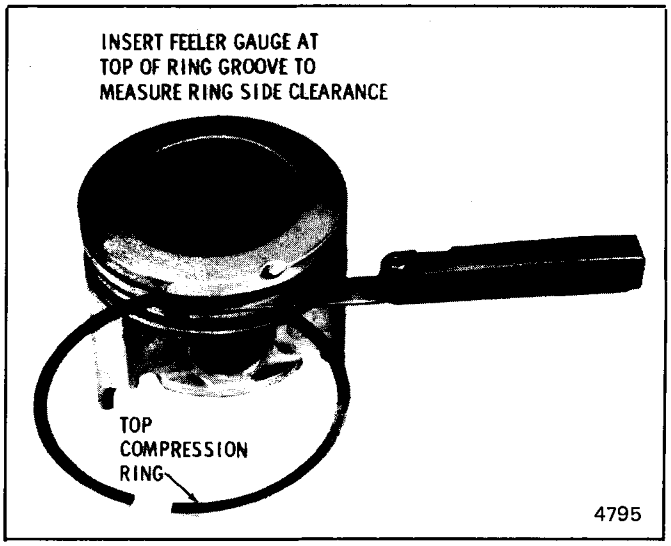


Fig. 6A4-73 Piston Ring Side Clearance

RING IDENTIFICATION AND INSTALLATION (FIG. 6A4-74)

NOTE: For service ring specifications and detailed installation instructions, refer to the instructions furnished with the parts package.

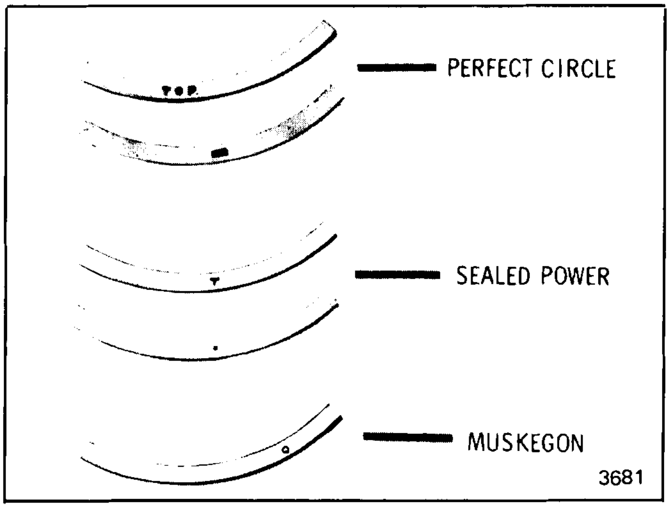


Fig. 6A4-74 Piston Ring Identification

ROD AND PISTON ASSEMBLY

Installation

1. Install connecting rod bolt guide hose over rod bolt threads. (Fig. 6A4-75)

2. Apply engine oil to rings and piston, then install piston ring compressing tool on piston. (Fig. 6A4-76)

3. Install assembly in its respective cylinder bore so notch cast in top of piston is towards the front of engine.

4. Lubricate the crankshaft journal with engine oil and install connecting rod bearing and cap, with bearing index tang in rod and cap on same side.

NOTE: When more than one rod and piston assembly is being installed, the connecting rod cap attaching nuts should only be tightened enough to keep each rod in position until all have been installed. This will facilitate

Fig. 6A4-75 Connecting Rod Guide Bolt

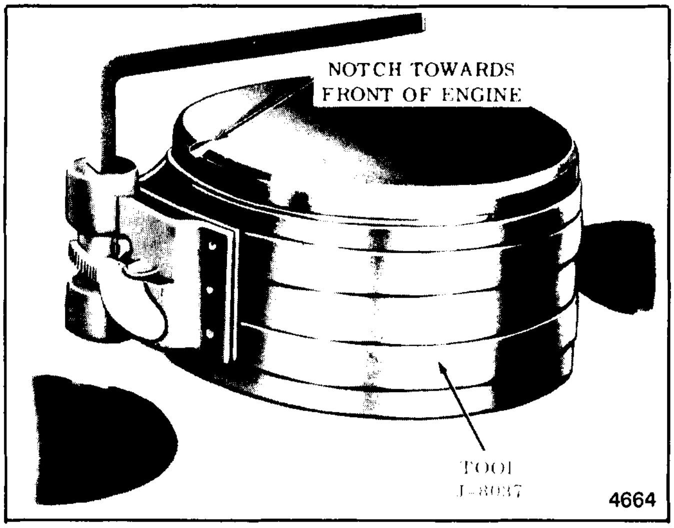


Fig. 6A4-76 Piston Ring Compressor

installation of remaining piston assemblies.

The clearance between the adjacent rods, when checked with a feeler gauge on each crankpin, should be from .006" to .020". (Fig. 6A4-77)

5. Torque rod bolt nuts to 42 ft. lbs.

PISTON PINS

The correct piston pin fit in the piston is .0003" to .0005" loose. If the pin to piston clearance is to the high limit (.0005"), the pin can be inserted in the piston with very little hand pressure and will fall through the piston by its own weight. If the clearance is .0003", the pin will not fall through. It is important that the piston pin hole be clean and free of oil when checking pin fit. The pin is a press fit in the connecting rod.

Whenever the replacement of a piston pin is necessary, use the following procedure.

Fig. 6A4-77 Connecting Rod Side Clearance

Removal (Fig. 6A4-78)

Only use the Front Rod Support, Guide Tube and Base during the pin removal process. Remove Threaded Plug, Spring and Piston Pin Guide assembly prior to using the tool. Piston Pin should fall through center of Guide Tube after it is pushed through connecting rod.

CAUTION: *Always be sure Piston Pin is in contact with inside radius of Front Rod Support. Piston Pin may bind on lower Guide Tube if allowed to move too far forward. This provides proper alignment for Piston Pin to enter lower Guide Tube. (Fig. 6A4-78)*

Installation

1. Consult depth gauge chart for proper gauge to pre-set distance from Front Rod Support to Piston Pin Guide.
2. Thread Stop Nut into bottom of Guide Tube.
3. Drop Guide Body and Piston Pin Guide into Guide Tube without spring.
4. Adjust Threaded Stop Nut until it touches tip of gauge.
5. Install spring between Guide Body and Threaded Stop Nut.
6. Select Piston Pin Guide which fits snug in Piston Pin bore.
7. Slip Piston Pin Guide over Guide Body.
8. Place piston and connecting rod into place on Front Rod Support. Piston Pin Guide should come up into Piston Pin bore and be free to move.
9. Place Piston Pin into pin hole in Piston.
10. Place driver into end of Piston Pin.
11. Push driver until pin comes to stop.

NOTE: During Pin installation, Piston must have free movement on Piston Pin.

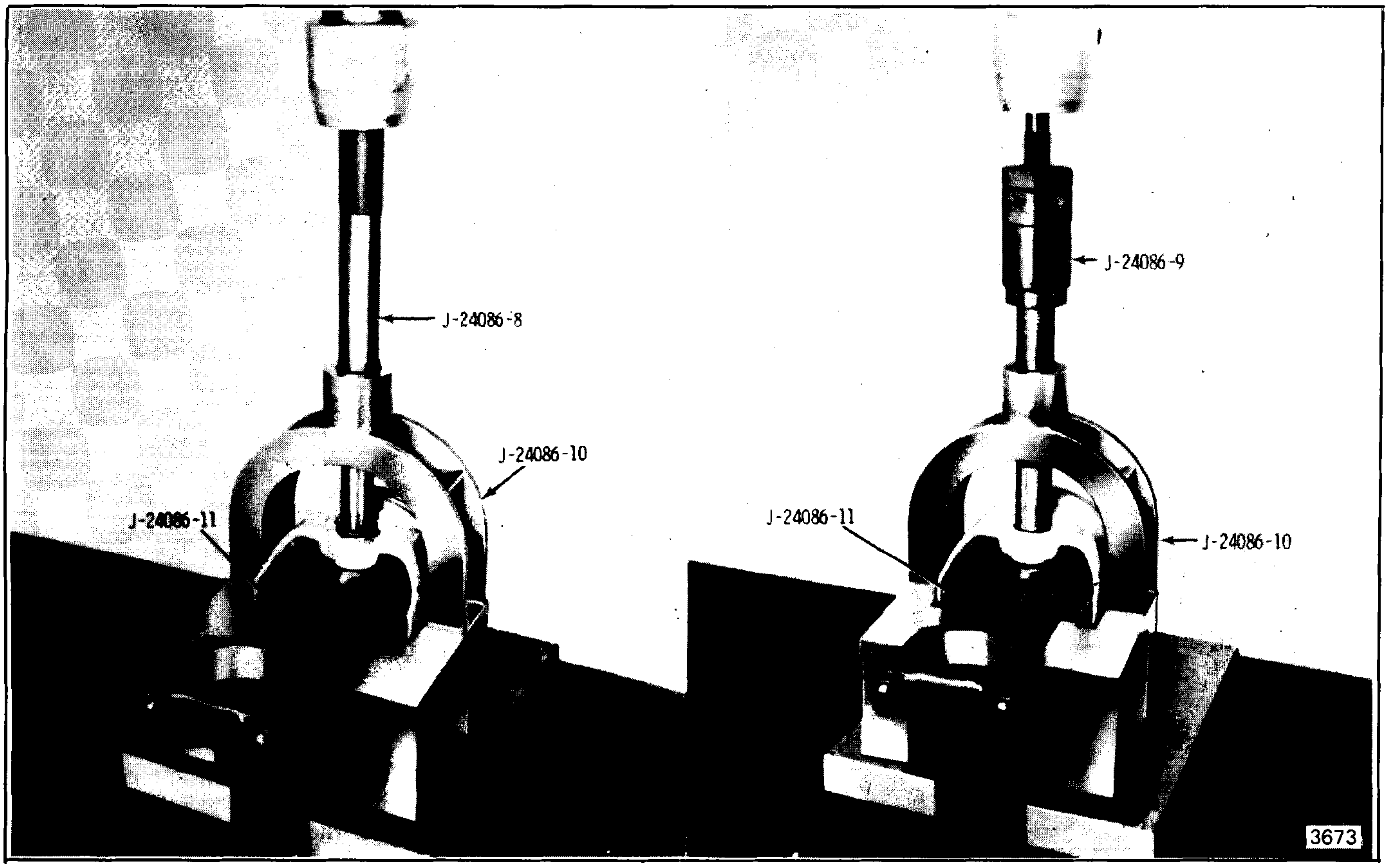


Fig. 6A4-78 Piston Pin Removal and Piston Pin Replace

12. Check centering of Piston Pin in connecting rod and piston. If pin is not centered, adjust Threaded Plug up or down to obtain proper center.

CAUTION: *Support for connecting rod at crank journal area is an assembly aid only. There should be 1/32" clearance between top of support and connecting rod during installation process. If support is too high, misalignment of Piston Pin to Piston Pin Guide may result.*

ENGINE ASSEMBLY

Removal

1. Drain cooling system.
2. Remove air cleaner and hot air pipe.
3. Remove hood from hinges, mark hood for reassembly.
4. Disconnect battery negative cable at battery and ground wire at inner fender panel. Disconnect engine ground strap, right head to cowl.
5. Disconnect radiator hoses, automatic transmission cooler lines, heater hoses, vacuum hoses, power steering hose bracket from engine, air conditioning compressor with brackets and hoses attached, fuel hose from fuel line, wiring and throttle cable.
6. Remove upper radiator support and radiator.
7. Raise car.
8. Disconnect exhaust pipes at manifold.
9. Remove torque converter cover and three bolts holding converter to flywheel.
10. Remove engine mount bolts or nuts.
11. Remove three bolts, transmission to engine on the right side. Remove starter with wires attached. then support the starter with the frame.
12. Lower car. Secure lift chain to engine. (Fig. 6A4-79)
13. Place board on top of jack and slightly raise transmission. Remove three left transmission to engine bolts. Remove engine.
14. If car is to be moved, install converter holding tool J-21654 and support transmission with chain support.

Installation

1. Fasten chain to engine.
2. Install engine in place. Locate engine dowels into transmission and position through bolts into mounts and tighten. Install three left transmission to engine bolts. Remove support chains and jack.
3. Raise car. Replace three bolts, transmission to engine on the right side. Replace starter and attaching bolts.
4. Install three converter to flywheel bolts and torque converter cover.
5. Connect exhaust pipes and lower car.
6. Install radiator and upper radiator support.
7. Connect radiator hoses, automatic transmission cooler lines, heater hoses, vacuum hoses, power steering pump hoses at pump, power steering hose bracket to engine, air conditioning compressor, fuel hose to fuel line wiring and accelerator linkage.
8. Install air cleaner and hot air pipe.

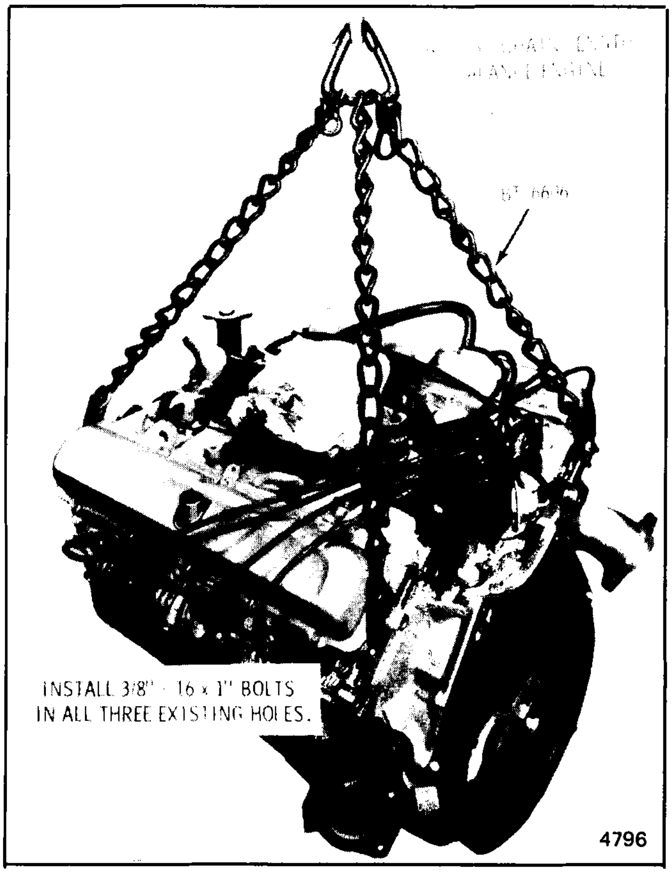


Fig. 6A4-79 Engine Lift Fixture

9. Install and align hood with scribe marks.
10. Connect battery cable and ground wires.
11. Add engine oil and coolant.
12. Adjust carburetor idle speeds if necessary.

CRANKSHAFT

Removal (Cylinder Heads On)

1. With engine on stand and oil pan, oil pump and front cover removed, rotate crankshaft to the position where the connecting rod nuts are most accessible. Fig. 6A4-80 shows the engine with the No. 3 and No. 4 rods in the fully extended position.

2. Remove main bearing caps.

3. Remove connecting rod caps and install threaded protectors.

4. Note position of keyway in crankshaft so it can be installed in the same position.

5. Lift crankshaft out of block. Rods will pivot to the center of the engine when the crankshaft is removed.

Do not allow pistons to move in their bore during or after crankshaft removal.

Installation

1. Install sufficient oil pan bolts in pan rails to align rods with rubber bands as shown in Fig. 6A4-80.

Align rods so that the inner thread protectors of adjacent rods overlap approximately one inch as shown. Alignment can be adjusted by increasing tension on rubber bands with additional turns around the pan bolts or thread protectors.

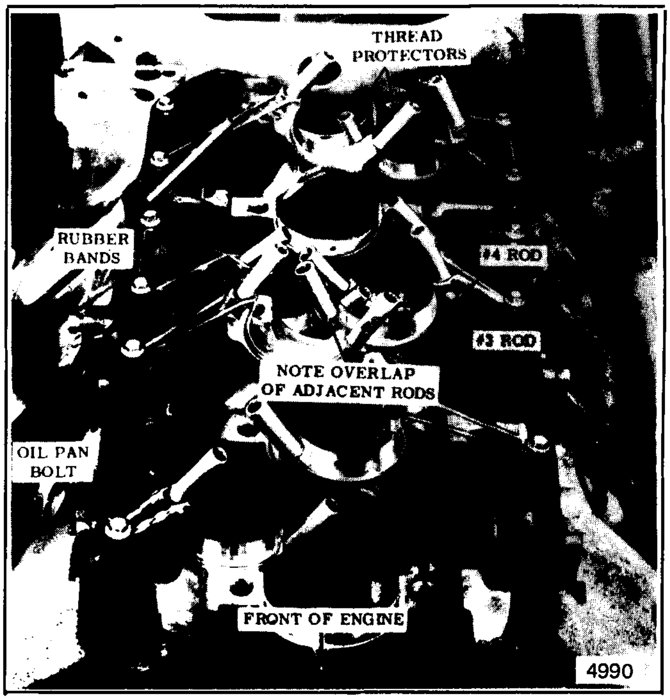


Fig. 6A4-80 Crankshaft Removal

2. Position crankshaft keyway in the same position as removed and lower into block. The connecting rods will follow the crank pins into the correct position as the crankshaft is lowered.

3. Remove rubber bands, thread protectors and pan bolts and assemble engine.

Removal (Cylinder Heads Removed)

1. With engine on stand, remove oil pan, front cover, connecting rods, and oil pump.

2. Remove main bearing caps and lift crankshaft out of block. (Fig. 6A4-81)

Installation

1. Measure the crankshaft journals with a micrometer to determine the correct size rod and main bearings to be used.

> **NOTE:** Whenever a new or reconditioned crankshaft is installed, new connecting rod bearings and main bearings should be installed.

2. Position upper half of main bearings in block and lubricate with engine oil.

3. Install a new rear main bearing seal. (Fig. 6A4-82)

4. After oil passages into crankshaft have been checked for being open and shaft is clean, place shaft in block. Lubricate thrust flanges of the center bearing with 1050169 Lubricant or equivalent. Install caps with lower half of bearing lubricated with engine oil. Lubricate cap bolts with engine oil and install, but do not tighten.

5. With a block of wood (Fig. 6A4-83) bump shaft in each direction to align thrust flanges of center main bearing.

> **NOTE:** After bumping shaft in each direction, wedge the shaft to the front and hold it while torquing No. 3 cap bolts.

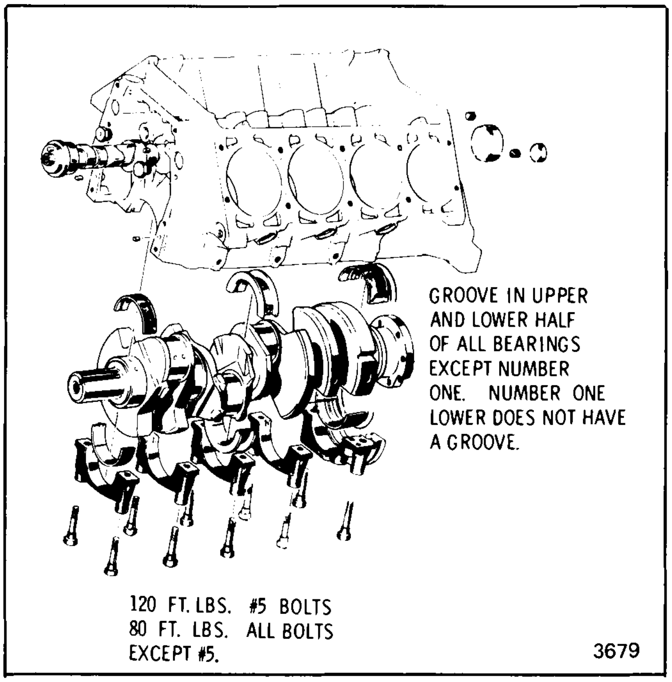


Fig. 6A4-81 Crankshaft Exploded View

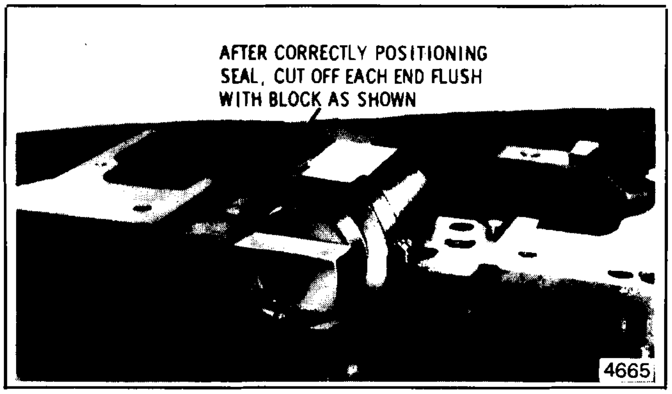


Fig. 6A4-82 Installing Rear Main Oil Seal Upper Half

6. Torque Nos. 1,2,3 and 4 main bearing cap bolts to 80 ft. lbs. and No. 5 bolt to 120 ft. lbs.

7. Reassemble engine and install in chassis.

FLYWHEEL

One bolt hole in the flywheel is offset and the flywheel will attach to the crankshaft in only one position. The flywheel ring gear is not replaceable.

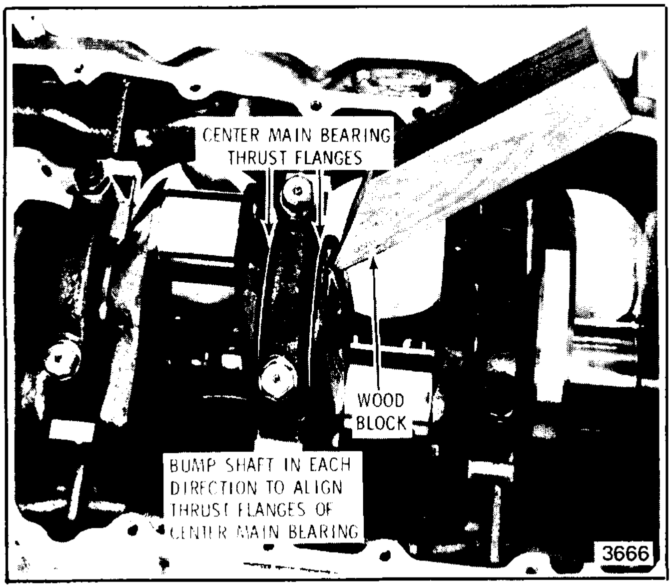


Fig. 6A4-83 Aligning Center Main Bearing Flang

TORQUE SPECIFICATIONS

NOTE: Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below specification.

Application	Ft. Lbs.
FUEL PUMP	
Fuel Pump to Block Bolt and Nut	25
Fuel Pump Eccentric to Camshaft	65
EXHAUST SYSTEM	20
ENGINE	
Crankshaft Bearing Cap Bolts Nos. 1, 2, 3 & 4	80
Crankshaft Bearing No. 5	120
EGR Valve to Intake Manifold	25
Flywheel to Crankshaft (With Automatic Transmission)	60
Flywheel to Crankshaft (With Manual Transmission)	90
Oil Pump to Bearing Cap Bolts	35
Oil Pump Cover to Pump Bolts	8
Rocker Arm Pivot Bolt to Head	25
Valve Cover Bolts	Fully Driven, Seated, not Stripped
Oil Pan Bolts	10
Oil Pan Drain Plug	30
Crankshaft Balancer to Crankshaft Bolt	200-310
Oil Filter Element to Base	20
Oil Filter Assembly to Cylinder Block Bolts	35
Support/Front Cover to Cylinder Block Bolts 3/8"	35
Fan Driven Pulley to Hub Bolts	20
Fan Driving Pulley to Balancer Bolts	20
Water Pump to Front Cover Bolts	13
Water Outlet to Manifold Bolts	20
Intake Manifold to Cylinder Head Bolts *	40
Exhaust Manifold to Cylinder Head Bolts	25
Carburetor to Intake Manifold Bolts	10
Choke Tube and Plate to Intake Manifold Bolts	15
Air Cleaner to Carburetor Stud	5
Engine Mount to Cylinder Block Bolts	75
Engine Mount to Frame Mount	50
Starter to Cylinder Block Bolts	35
Starter Brace to Cylinder Block Bolts	25
Starter Brace to Starter Bolt	15
Starter Brace to Starter Stud	8
Distributor Clamp to Cylinder Block Bolt	17
Spark Plugs	25
Cylinder Head Bolts *	130
Connecting Rod Nuts	42

*Clean and dip entire bolt in engine oil before tightening to obtain a correct torque reading.

ENGINE SPECIFICATIONS

FLYWHEEL

No. of Teeth on Starter Gear	166
No. of Teeth on Starter Pinion	9

LUBRICATION SYSTEM

Crankcase Capacity Drain and Refill	4 Qts.
Drain & Refill with Filter Change	5 Qts.
Oil Pump	
Clearance Pressure Relief Valve in Bore	.0025"-.0050"
End Clearance-Gear	.0025"-.0065"

TIMING CHAIN

Width	Morse-.627, Linkbelt-.720"-750"
No. Links	48
Pitch	.500"

CYLINDER BLOCK

Engine Type	90° V-Type
No. of Cylinders	8
Bore and Stroke	4.057" x 3.385" (350)
	4.351" x 3.385" (403)
Piston Displacement	350 or 403 C.I.D.
Compression Ratio	8.5:1 (350)
	8.5:1 (403)
Firing Order	1-8-4-3-6-5-7-2
Main Bearing Bore (I.D.)	2.687" - 2.688"

CRANKSHAFT

Diameter-Main Bearing Journal	2.4995" - 2.4985" (2,3,4,5)
	2.4998" - 2.4988" (1)
Width-Main Bearing Journal (with fillets)	
No. 1	1.185"
No. 2 & 4	1.156" - 1.166"
No. 3	1.1985" - 2.0015"
No. 5	1.882"
Diameter-Connecting Rod Bearing Journal	2.1248" - 2.1238"
Width-Connecting Rod Bearing (with fillets)	1.877" - 1.887"
Length-Overall Crankshaft	26.470"
Diameter - Oil Holes in Crankshaft	1.250"
Clearance - Crankshaft End	1.0035" - .0135"

MAIN BEARINGS

Bearing Clearance - Crankshaft 1,2,3, & 4	.005" - .021"
Bearing Clearance - (Vertical) 5	.0015" - .0031"
Width-Bearing Shell	
No. 1, 2 and 4	.970" - .980"
No. 3	1.193" - 1.195"
No. 5	1.624"

CONNECTING RODS

Length-Center to Center	5.998/6.002"
Diameter-Connecting Rod Bore	2.2495" - 2.2500"
Diameter-Pin Bore	.9789" - .9795"
Bearing Clearance - (Vertical)	.0004" - .0033"
Side Clearance - Big End	.006" - .020"

PISTON

Diameter Nominal Outside	4.057" (350)
	4.351" (403)
Top of Piston to Center of Pin	1.617/1.613"
Clearance at Thrust Surface (selective)	.001" - .002"
Weight Less Pin & Rings (all)	641 ± 2 g (350)
	700 ± 2 g (403)
Skirt Taper	.0005" - .0015" Larger at Bottom (350)
	.0003" - .0017" Larger at Bottom (403)
Ring Width (2 compression)	.0798" - .0808"
Ring Width (1 Oil)	.1881" - .1891"

PISTON PINS

Diameter	.9803" - 9807"
Pin to Piston Clearance	.0003" - .0005"
Pin to Rod Fit	.0008" - .0018" Press

PISTON RINGS

No. of Compression Rings (per piston)	2
Width of Compression Rings (top & bottom)	.0780" - .0770"
Gap Clearance Compression Rings	.010" - .023"
Clearance in Groove Compression Rings-Upper	.0020" - .0040"
Clearance in Groove Compression Rings-Lower	.0020" - .0040"
No. of Oil Rings (per piston)	1
Gap Clearance, Oil Ring	.015" - .055"

CAMSHAFT

Bearing Journal Diameters	
No. 1	2.0365" - 2.0357"
No. 2	2.0165" - 2.0157"
No. 3	1.9965" - 1.9957"
No. 4	1.9765" - 1.9757"
No. 5	1.9565" - 1.9557"
Width (including chamfers)	
No. 1	.810"
No. 2, 3 and 4	.741"
No. 5	.788"
Journal Clearance in Bearing (all)	.0020" - .0058"
End Clearance	.011" - .077"
Push Rod - Length	8.265"

VALVE - INTAKE

Diameter Head	1.880" - 1.870" (350)
	2.000" - 1.990" (403)
Diameter - Stem	.3425" - .3432"
Angle - Valve	44°
Angle - Valve Seat	45°
Width - Valve Seat (Cylinder Head)	.037" - .075"
Overall Length	4.667"
Clearance in Guide	.0010" - .0027"
Lash	Hydraulic

VALVE - EXHAUST

Diameter - Head	1.497" - 1.507" (350)
	1.497" - 1.507" (403)
Diameter - Stem	.3420" - .3427"
Angle - Valve	30°
Angle - Valve Seat	31°
Width - Valve Seat (Cylinder Head)	.050" - .090"
Overall Length	4.675"
Clearance In Guide	.0015" - .0032"
Lash	Hydraulic

VALVE SPRINGS

Length	1.96"
Diameter - Wire	.192"
Inside Diameter	1.065" - 1.041"
Load	76-84 Lbs. @ 1.670"
Load @ 1.270"	180-194 Lbs.

VALVE LIFTERS

Diameter - Body	.8422" - .8427"
Length - Overall	2.000"
Clearance in Boss	.0005" - .0020"

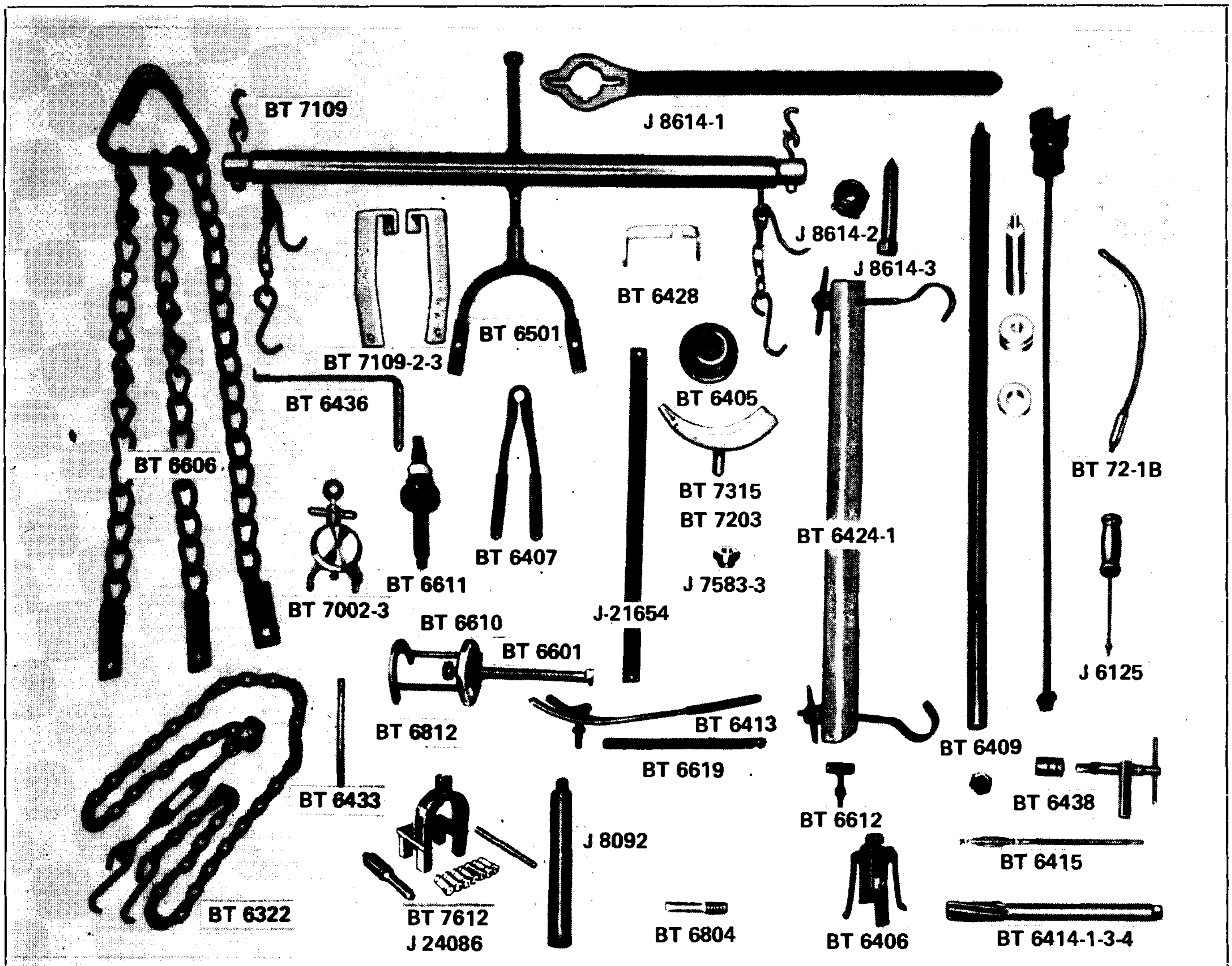
Also available in .010" Over Size

CAMSHAFT SPROCKET

Width of Sprocket	.420" - .400"
Pitch	.500"
No. of Teeth	36

CRANKSHAFT SPROCKET

Width of Sprocket	.410" - .400"
Overall Width of Gear	1.001" - .991"
Pitch	.500"
No. of Teeth	18



BT 72-1B	VALVE HOLDER (AIR)
BT 6125	SLIDE HAMMER
BT 6322	TRANSMISSION SUPPORT CHAIN
BT 6405	FRONT COVER SEAL INSTALLER
BT 6406	FRONT COVER SEAL REMOVER
BT 6407	VALVE LIFTER REMOVER
BT 6409	CAMSHAFT BEARING SET
BT 6413	VALVE SPRING COMPRESSOR
BT 6414-1-3-4	VALVE GUIDE REAMER
BT 6415	VALVE GUIDE CLEANER
BT 6424-1	ENGINE SUPPORT BAR
BT 6428	VALVE STEM HEIGHT GAUGE
BT 6433	REAR MAIN BRG. OIL SEAL PUNCH
BT 6436	REAR MAIN BRG. SEAL CUT OFF TOOL
BT 6438	VALVE LIFTER PLUNGER PULLER
BT 6501	ENGINE SUPPORT BAR TO REMOVE OIL PAN
	-1 YOKE
	-2 SCREW
	-3 TUBE
	-4 CHAIN
BT 7612 J 24086	PISTON PIN TOOL

	BT 7203 YOKE
	CRANKSHAFT GEAR REMOVAL
BT 6601	JACK SCREW
BT 6606	ENGINE LIFT CHAIN
BT 6610	REMOVER PLATE
BT 6611	CRANKSHAFT PULLEY INSTALLER
BT 6612	VALVE SPRING COMPRESSOR ADAPTER
BT 6619	CLUTCH PILOT BEARING REMOVER
BT 6804	VALVE SEAL INSTALLER
BT 6812-1	PULLING JAW
BT 6812-2	PILOT
BT 6812-3	PULLING BOLTS
BT 7002-3	BELT ADJUSTER GAUGE
BT 7109	SUPPORT BAR ADAPTER
	-2 L.H. FRAME HOOK
	-3 R.H. FRAME HOOK
J 7583-3	PILOT SCREW (USED WITH J 8614)
J 8092	DRIVER HANDLE
J 8614	HARMONIC BALANCER REMOVER
	-1 HANDLE
	-2 PLATE
	-3 SCREW
J 21654	CONVERTER HOLDING TOOL

3676

Fig. 6A4-84 Special Tools

SECTION 6A5

5 LITRE 301, 5.7 LITRE 350, 6.6 LITRE 400 V8 ENGINES - V.I. CODES P, Y AND Z

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

IDENTIFICATION

301-350-400 engines may be identified from the vehicle identification number. The code letter Y, P or Z in the fifth digit location identifies the engine as a 301, 350 or 400 V8. Specific engines may be identified by first noting the engine code on the front of the block, stamped on a machined pad on the right bank of cylinders. and then referring to the charts in Section 6.

CYLINDER BLOCK

The cylinder block has two banks of four cylinders each, cast at 90° to each other. Left bank cylinders are numbered 1-3-5-7 from front to back and right bank cylinders are numbered 2-4-6-8.

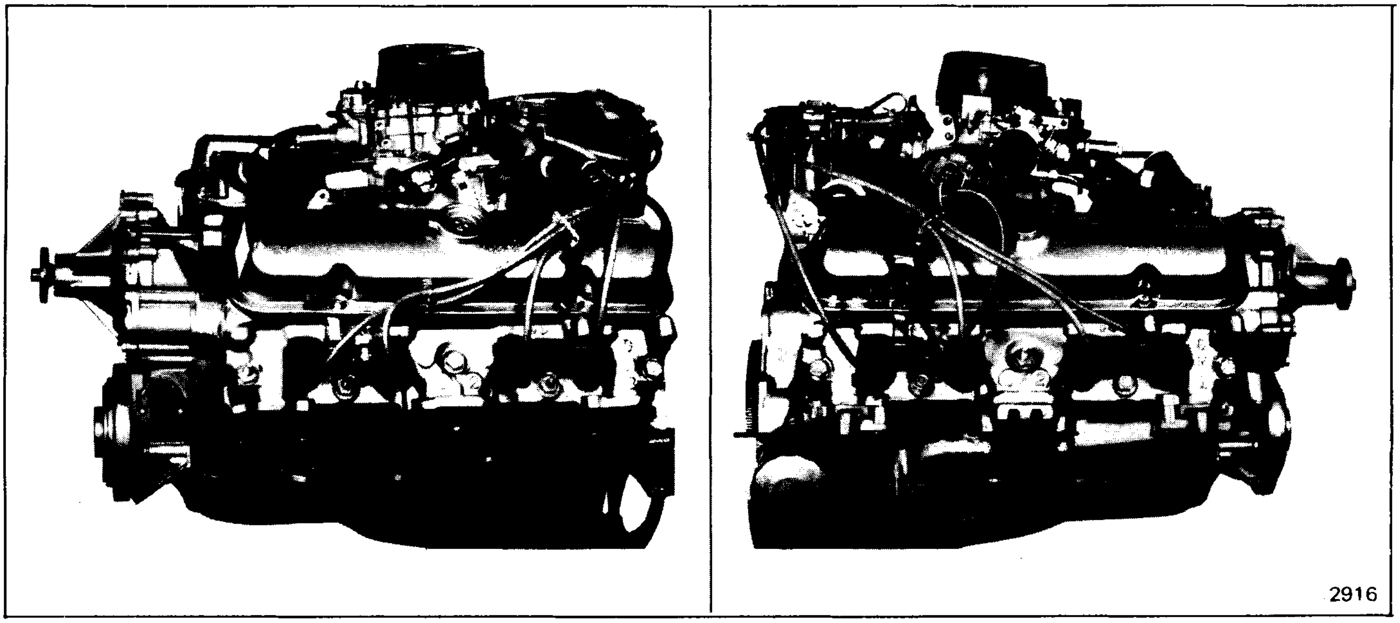


FIG. 6A5-01 V8 SIDE VIEW - TYPICAL

All main bearing caps are doweled to the cylinder block to assure accurate alignment and facilitate assembly.

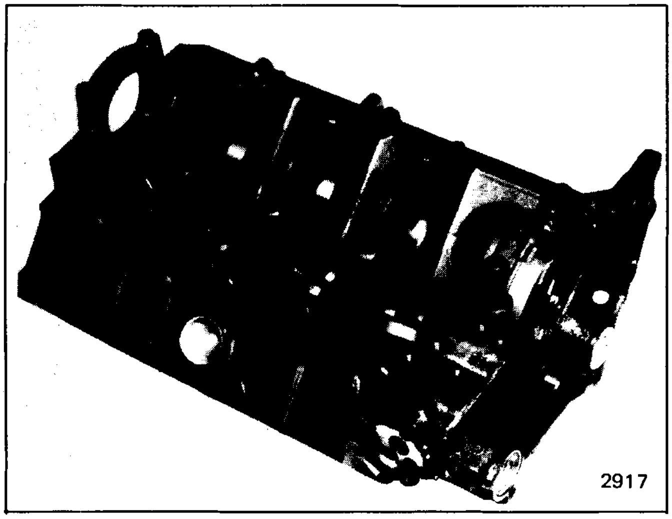


Fig. 6A5-02 Cylinder Block 301

CYLINDER HEAD

Cylinder heads (Fig. 6A5-04) have fully machined combustion chambers. In addition, all exhaust valve seats are induction hardened, making them more resistant to wear. Valve guides are cast integral with the cylinder head.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by five main bearings. The rear main bearing shells have two oil grooves. When replacing main bearings, it is very important that bearings are installed with the recommended material (M400-A) located in the proper position on the crankshaft (upper & lower).

The rear main bearing is sealed by a packing, seated in a groove in the block and bearing cap. A slinger on the crankshaft in front of the seal and the drain groove in the rear main bearing prevent an excess of oil from getting to the seal.

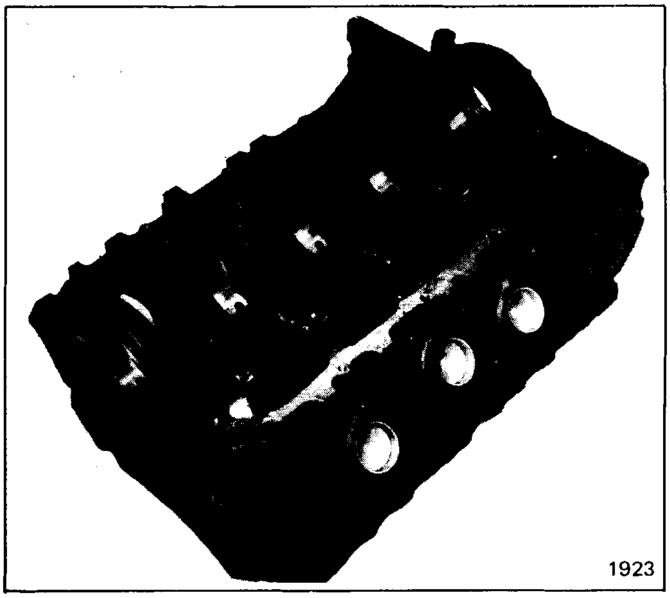


Fig. 6A5-03 Cylinder Block 350-400

CAMSHAFT AND DRIVE

Camshafts may be identified by a letter stamped on the rear end of the shaft.

Camshafts are cast from alloy iron and cam lobes are ground and hardened. The camshaft is driven by a combination of metal gears and a link chain.

PISTONS AND CONNECTING RODS

Pistons are of a light weight cast all aluminum slipper skirt type. These pistons maintain thermal control through contour grinding. Two compression rings and one oil control ring are used, all of which are located above the piston pin. (Fig. 6A5-05).

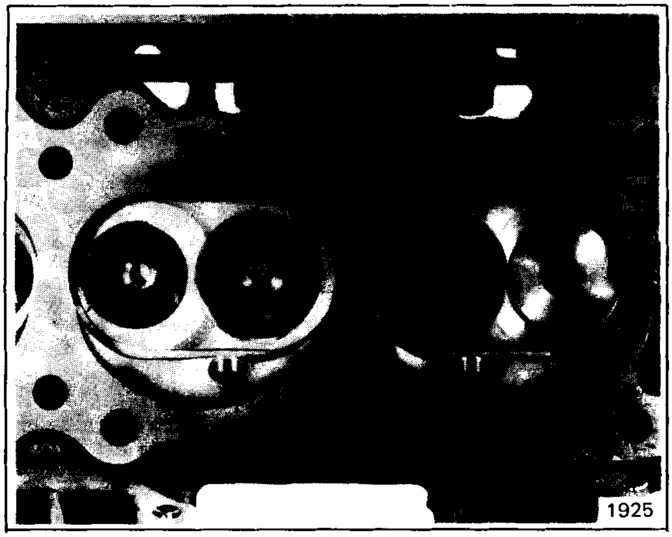


Fig. 6A5-04 Cylinder Head - Typical

Piston pins are offset toward thrust side (right-hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path (Fig. 6A5-05). Pins are hardened steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

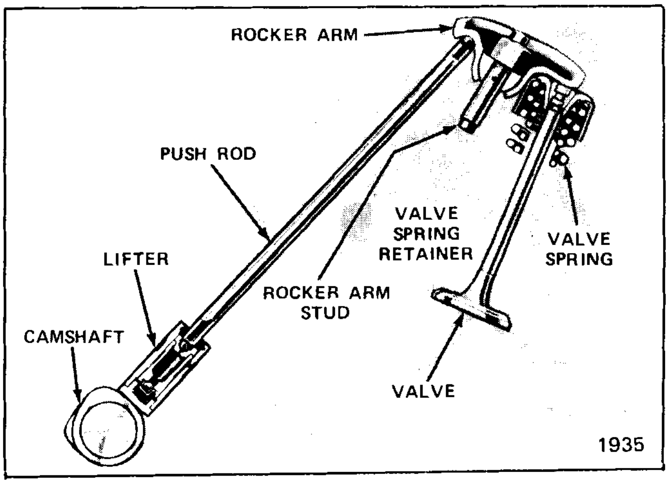


Fig. 6A5-06 Valve Train

Dual valve springs are used on V-350 and V-400. A single valve spring with internal damper is used on the V-301.

HYDRAULIC VALVE LIFTERS

Hydraulic lifters are used to keep all parts of the valve train in constant contact. Each lifter is an automatic adjuster maintaining zero lash under all conditions.

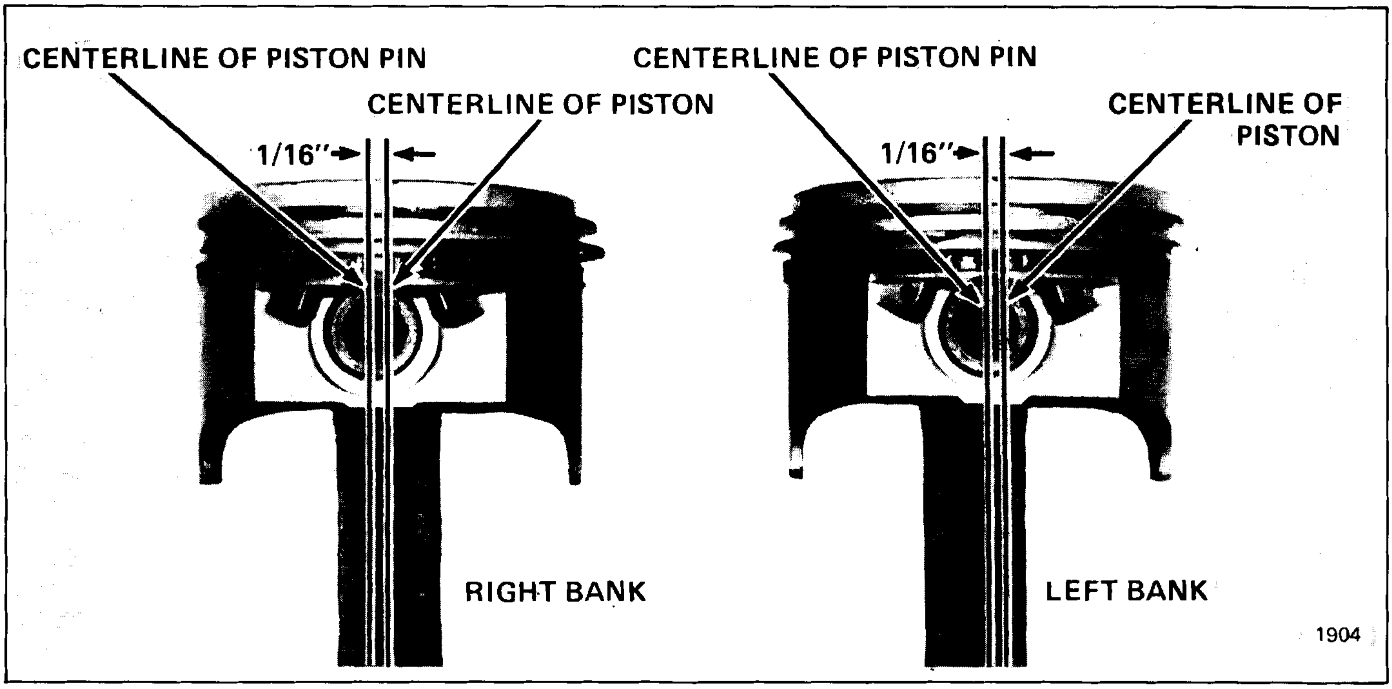


Fig. 6A5-05 Connecting Rod and Piston Assembly - Typical

VALVE TRAIN

A very simple ball pivot-type valve train is used (Fig. 6A5-06). Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker arm ball is retained by a nut which locks against a chamfer on the stud.

External shields are used on both intake and exhaust valve springs to reduce the amount of oil splashed against stems. Valve stem seals are used on exhaust as well as intake valves to prevent excessive oil from entering the valve guides.

FUEL DISTRIBUTION SYSTEM

The intake manifolds, are cast in iron and contain passages for coolant, exhaust crossover and exhaust gas recirculation as well as air fuel mixture. The 301 manifold is of a single level design. The 350 and 400 manifolds are a split level design with individual runners for each cylinder. (Figs. 6A5-07 and 6A5-08)

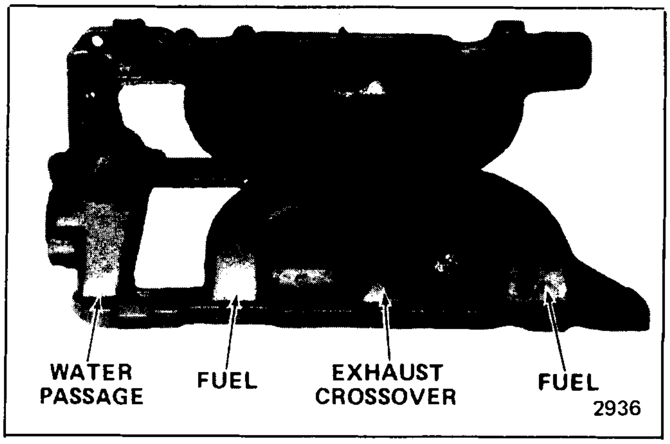


Fig. 6A5-07 Intake Manifold 301

EXHAUST SYSTEM

Two cast iron exhaust manifolds are used, one for each bank of cylinders. A vacuum operated valve on the left manifold effects exhaust crossover for intake manifold warming.

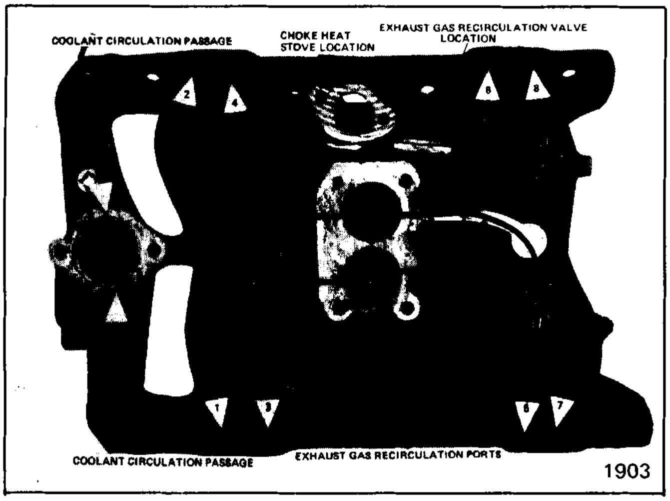


Fig. 6A5-08 Intake Manifold 350-400

LUBRICATION SYSTEM

OIL PUMP

Oil is circulated under pressure by a spur gear-type pump. The pump is mounted on the right rear bottom of the cylinder block and is driven by the distributor drive gear. Maximum oil pressure is regulated by a spring-loaded, ball-type, pressure regulator valve. No adjustment of the pressure regulator valve is provided.

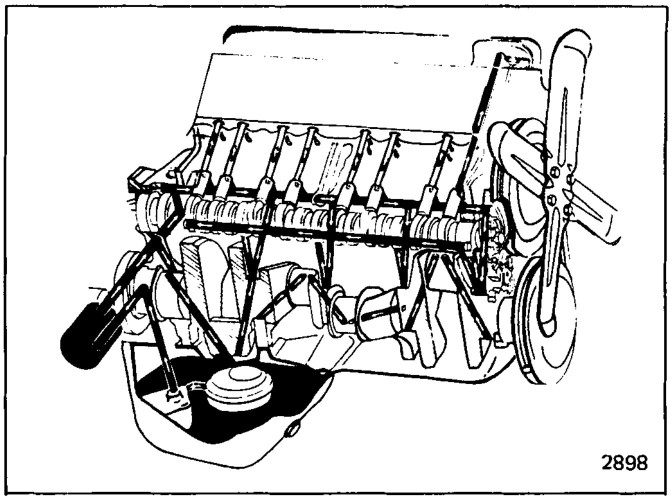


Fig. 6A5-09 Engine Lubrication - Typical

Oil is taken into the pump through a stationary-type oil intake. All oil entering the intake passes through a screen. As a safety precaution, a large hole is provided in the center of screen. During normal operation, no oil can pass through this hole since the grommet around the hole is seated against a baffle. If the screen should become plugged, however, pump suction will cause the screen to move away from the baffle and oil will flow through the large center hole.

The positive pressure system delivers oil under pressure to the crankshaft, connecting rods, camshaft bearings and to valve train parts. Splash off the crankshaft lubricates piston pins. Timing chain and sprockets receive metered jet lubrication, as do the fuel pump eccentric and rocker arms. All oil passes through the full flow oil filter located at the right rear of the block. A bypass valve is located at the filter mounting to insure oil circulation even if the filter becomes plugged.

In the mechanical procedures described in this section, generally no references will be made to the removal of optional equipment such as power steering pump, air conditioning compressor, etc. should it become necessary to remove any such item to perform other service refer to the appropriate section of the manual for specific information.

SERVICE OPERATIONS

ENGINE MOUNTINGS

FRONT MOUNTINGS

Remove and Replace

If a new rear mount is also to be installed, it should be installed first since the engine locates from the rear mount.

1. Raise hood and, using J-23515-1, J-23515-2 and J-23515-16 engine lifting tools, take weight of engine off front mounts (Fig. 6A5-11). Proper Engine Lifting procedure will be found under OIL PAN AND/OR GASKET - REMOVE.

CAUTION: *Disconnect battery ground strap before raising engine.*

2. Remove bolt which fastens mount to engine bracket.
3. Raise engine just clear of mount.
4. Remove mount to frame bolts and remove mount.
5. Position new mount against frame and install attaching screws and washers.

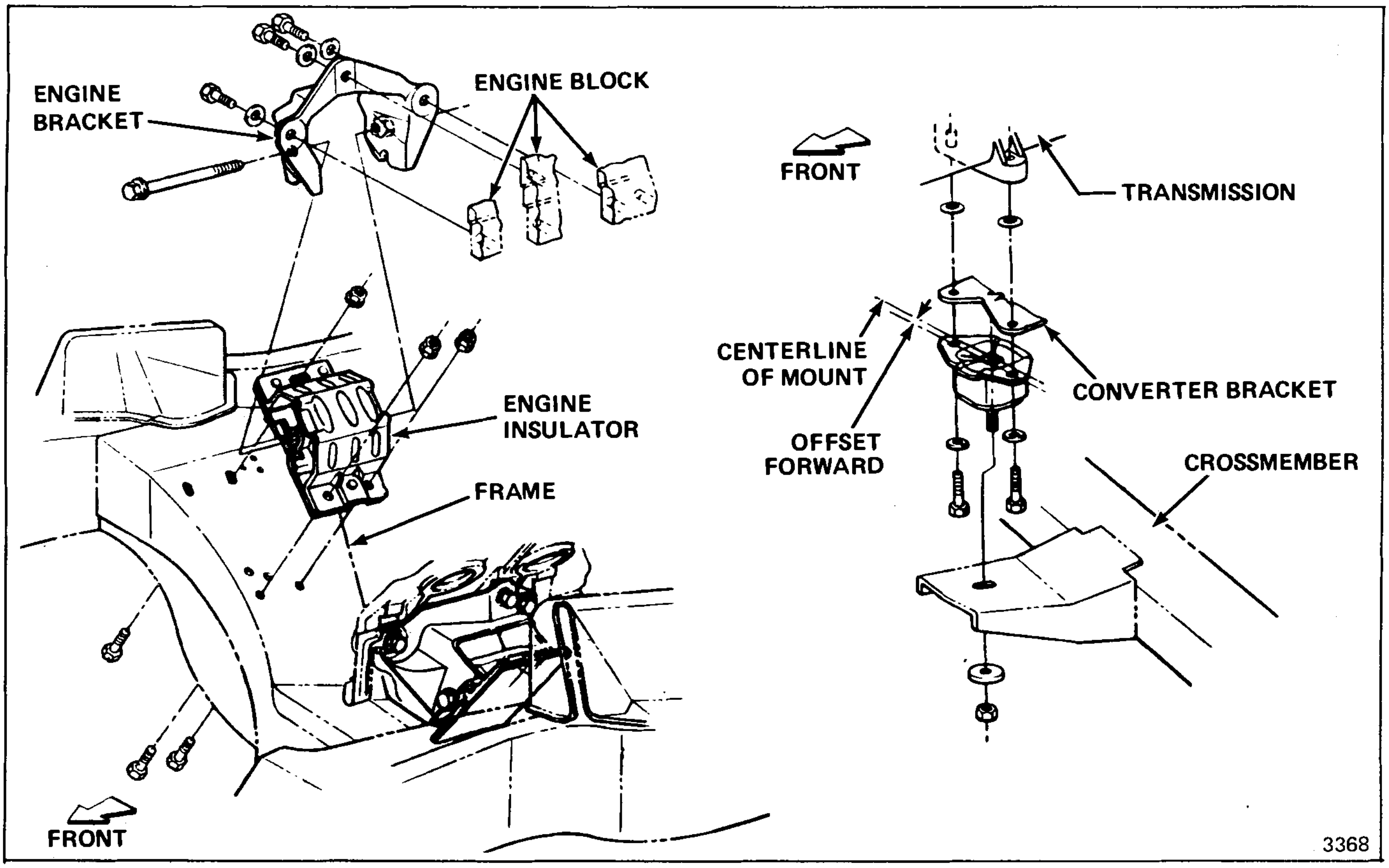


FIG. 6A5-10 ENGINE MOUNTINGS - TYPICAL

6. Lower engine.
7. Install engine bracket to mount bolt and tighten.

REAR MOUNT

Remove and Replace

1. Support transmission at rear to remove engine weight from rear mount, using suitable lifting equipment.
2. Remove attaching nuts or bolts at mount/crossmember, and raise transmission until mount is clear of lower cross member support.
3. Remove mount upper retainer bolts from transmission extension.
4. Remove mount assembly. (Retain shim when used for reinstallation)
5. Install by reversing above procedure, torquing all nuts and bolts to 30 lb. ft.

RIGHT SIDE EXHAUST MANIFOLD OR GASKET

Remove

1. Disconnect exhaust pipe from manifold.
2. Remove manifold attaching bolts, manifold, and gaskets.

NOTE: It may be necessary to loosen flange bolts on opposite side manifold to gain clearance for removal.

Replace

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold.
2. Install exhaust manifold and new gasket.
3. Place manifold outlet in position over end of exhaust pipe but do not permit weight of manifold to rest on exhaust pipe. Since the end holes of gasket are slotted, installation of gasket may be simplified by first installing manifold, using only the front and rear bolts to retain manifold. Allow clearance of about 1/8" between cylinder head and exhaust manifold. After inserting gasket between head and manifold, the remaining bolts may be installed.
4. Tighten all bolts evenly and securely to 40 lb. ft.
5. Attach exhaust pipe to manifold with bolts and tighten to 30 lb. ft.

LEFT SIDE EXHAUST MANIFOLD OR GASKET

Remove

1. Remove carburetor air pre-heater shroud.
2. Raise vehicle and disconnect exhaust pipe from manifold.
3. Remove manifold attaching bolts and remove manifold.

NOTE: It may be necessary to loosen flange bolts on opposite side manifold to gain clearance for removal.

Fig. 6A5-11 Engine Lifting Tools Installed - Typical

Replace

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold.
2. Place manifold in position against cylinder head and install two end bolts, leaving about 1/8" clearance between head and manifold.
3. Slide gasket between manifold and cylinder head.
4. Install remaining bolts.
5. Tighten all bolts evenly and securely to 40 lb. ft.
6. Attach exhaust pipe to manifold and tighten to 30 lb. ft.
7. Install carburetor air pre-heater shroud.

INTAKE MANIFOLD OR GASKET

NOTE: EGR valve removal is necessary before removal of the intake manifold can be accomplished.

Remove

1. Drain water from radiator.
2. Remove air cleaner and disconnect closed ventilation pipe at air cleaner, air cleaner vacuum source at manifold and hot air duct.
3. Remove water outlet fitting bolts and position fitting out of way, leaving radiator hose attached.
4. Disconnect electrical wires and vacuum hoses from emission switches and solenoids.
5. Remove spark plug wires from brackets.
6. On cars equipped with power brakes, remove power brake vacuum hose.
7. Disconnect carburetor vacuum hoses.
8. Disconnect fuel line connecting carburetor and fuel pump.
9. Disconnect crankcase vent hose.
10. Disconnect throttle cable from carburetor and manifold.
11. Remove attaching bolts and manifold.

Replace

When a new manifold is to be installed, transfer carburetor, adapter, thermostat, choke stove, stove to carburetor pipes, and thermal vacuum valves.

CAUTION: *Care should be taken to avoid damage to thermal vacuum valve when removing and installing.*

Use new gaskets on those units requiring gaskets and new O-ring seal between manifold and timing chain cover.

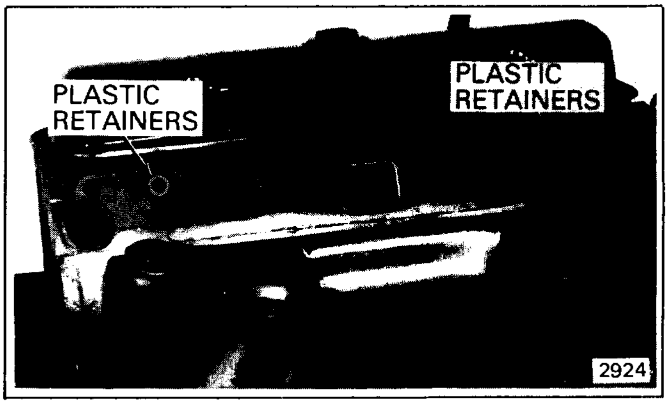


Fig. 6A5-12 Intake Manifold Gasket and Retainers 301

1. Install new gaskets on cylinder heads, positioning them with plastic retainers (Fig. 6A5-12).
2. Install O-ring seal.
3. Install intake manifold on engine.
4. Install cap bolts loosely.
5. Position throttle control bracket assembly on manifold and install cap bolts.
6. Tighten timing chain cover to intake manifold bolt until both units are metal-to-metal (15 lb. ft.).
7. Tighten manifold to head bolts evenly to 40 lb. ft.
8. Connect throttle cable to carburetor.
9. On cars equipped with power brakes, install vacuum hose to carburetor.
10. Install fuel pipe connecting carburetor to fuel pump.
11. Install crankcase vent hose.
12. Install water outlet fitting.
13. Connect electrical wires and vacuum hoses.
14. Install spark plug wires on brackets.
15. Install air cleaner, attaching closed ventilation pipe, vacuum source and hot air duct.
16. Close drain plugs and fill radiator to proper level.

PUSH ROD COVER OR GASKET

Remove

1. Remove intake manifold.
2. Remove crankcase ventilator hose.
3. Remove screws from push rod cover and remove cover.

Replace

1. Place a continuous 1/8 inch diameter bead of RTV sealer on push rod cover to replace gasket.
2. Install push rod cover with RTV wet and tighten screws using new rubber coated sealing washers to 7 lb. ft.
3. Install positive crankcase ventilation hose.
4. Install intake manifold and new O-ring seal.

ROCKER ARM COVER OR GASKET

Remove

1. Remove air cleaner.
2. Disconnect crankcase ventilation hoses (as required).
3. Disconnect electrical wire(s) from rocker arm cover clips.
4. Remove rocker cover.

CAUTION: *DO NOT pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping end of rocker arm cover rearward with palm of hand or a rubber mallet.*

Replace

1. Using a new gasket, install rocker arm cover and torque bolts to 7 lb ft. Gasket should be glued to R. A. cover.

NOTE: If rocker arm covers are equipped with single oil deflector tabs be sure they are pointed toward top of engine.

2. Connect crankcase ventilation hoses (if disconnected).
3. Connect electrical wire(s) at rocker arm cover clips.
4. Install air cleaner.

VALVE SPRINGS, SHIELD OR SEAL

Remove

1. Remove rocker arm cover, spark plug and distributor cap.
2. Turn engine until distributor rotor is in position to fire cylinder being serviced.
3. Install air fitting J-22278 in spark plug hole and attach air line.
4. Remove rocker arm.
5. After removing rocker arm, thread valve spring compressor stud J-8929 on rocker arm stud and compress valve spring, using compressor and nut. Remove valve spring retainer cup locks and then remove valve spring compressor, valve spring retainer cup shield and valve stem seal.

Replace

1. Install new part or parts, compress springs with valve spring compressor.

Install valve stem seal (Fig. 6A5-13) and retainer cap locks. Remove spring compressor and valve holder, then test valve stem seal using suction cup end of tool J-22330 (Fig. 6A5-14).

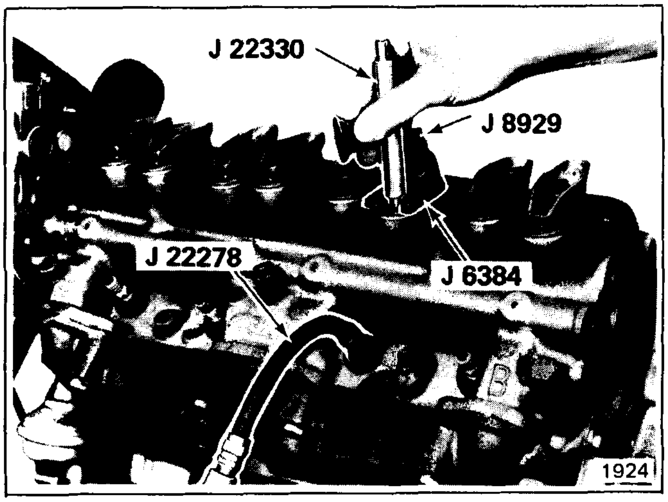


Fig. 6A5-13 Installing Valve Stem Seal

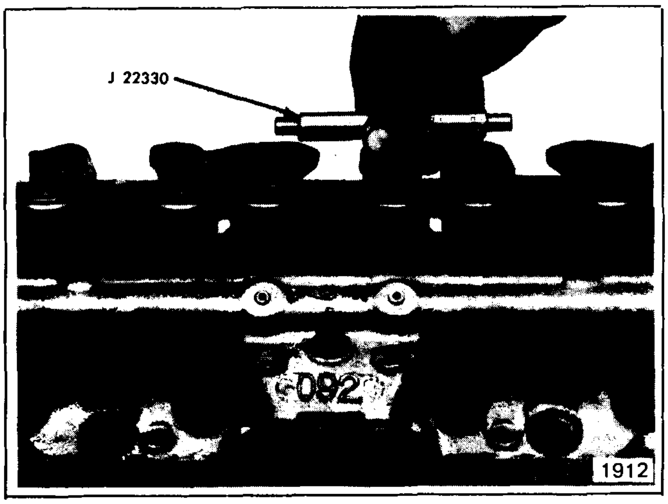


Fig. 6A5-14 Checking Valve Stem Seal

2. Install rocker arm, tighten rocker arm ball retaining nut to 20 lb. ft.
3. Remove air fitting J-22794.
4. Install rocker arm cover, spark plug, distributor cap and connect spark plug wire.

ROCKER ARM STUDS

Remove

1. Drain radiator (301 engine only).
2. Remove rocker arm cover.
3. Remover rocker arm and nut.
4. Using a deep well socket, remove rocker stud.

Replace

1. Coat lower stud threads with Pt. #1052080 thread sealer or equivalent (301 engine only).
2. Install new stud and tighten to 50 lb. ft.
3. Install rocker arm and tighten nut to 20 lb. ft.
4. Install rocker arm cover using new gasket.
5. Fill radiator (301 only).

VALVE LIFTER

Remove

1. Remove intake manifold.
2. Remove push rod cover.
3. Remove rocker arm cover.
4. Loosen rocker arm ball nut and move rocker arm off push rod.
5. Remove push rod.
6. Remove lifter. Hydraulic valve lifter remover J-3049 may facilitate removal of lifter.

Replace

If new lifter is to be installed, be sure to remove all sealer coating from inside of new lifter and check leak-down rate.

1. Place new lifter in lifter boss.
2. Install push rod exactly as removed (same end against rocker arm).
3. Position rocker arm on push rod and tighten rocker arm ball retaining nut to 20 lb. ft.
4. Install rocker arm cover.
5. Install pushrod cover using a continuous 1/8 inch diameter bead of RTV sealer in place of gasket.
6. Install intake manifold using new gaskets and O-ring seal.

HYDRAULIC VALVE LIFTERS

Recondition

Because of the important part hydraulic valve lifters play in the operation of an engine and the close tolerances to which they are manufactured, proper handling, and above all, cleanliness cannot be overstressed when servicing these parts.

New lifters are serviced as individual units packaged with a plastic coating. Leave the coating on until ready to check leak-down rate. It is not necessary to remove the oil from new lifters prior to checking leak-down rate since special leak-down oil is already in new lifters.

Wash tank and tray, J-5821, is recommended for cleaning valve lifters. This tank should be used only for valve lifters and should be kept covered when not in use. All servicing should be done in an area removed from grinders or other sources of dust and foreign material.

Lifters should at all times be stored in a covered box which will aid in keeping them clean. The lifter box should be kept dry and as free of oil as possible.

VALVE LIFTER

Disassemble

1. Remove push rod seat retainer ring by holding seat down with push rod while dislodging ring from lifter body with a pointed tool (Fig. 6A5-15).

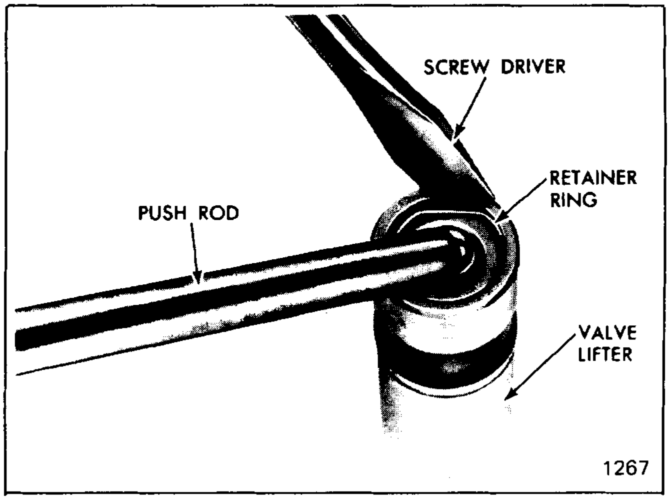


Fig. 6A5-15 Removing Push Rod Seat Retainer

2. Invert lifter and allow push rod seat and plunger to slide out of body. If plunger sticks in body, place lifter in large end of hydraulic valve lifter plunger remover, J-4160, with push rod end of lifter downward. Hold tool firmly in hand with thumb over lifter body and sharply strike tool against a block of wood (Fig. 6A5-16) until plunger falls out. (It may be necessary to soak a lifter having a stuck plunger in cleaning solvent for several minutes in order to remove the plunger).
3. Drain oil out of lifter body and place all valve lifter parts in separate compartment of tray from wash tank J-5821.

CAUTION: *Valve lifter body and plunger are selectively fitted and must not be interchanged with parts of other lifters. Keeping all parts of lifters together will also aid in trouble diagnosis.*

Clean and Inspect

Thoroughly clean and inspect lifter surfaces for nicks, scratches or scores. Inspection of the check ball and seat should be done with a magnifying glass. The lifter base should also be inspected for wear. If heavy wear is indicated on the cam mating surface, the same lobe of the cam should also be checked.

CAUTION: *Clean lifters using only approved solvent and a soft brush. Never use a wire brush or sandpaper.*

Assemble

All parts must be absolutely clean when assembling a hydraulic lifter. Since lint and dust may adhere to parts, they should not be blown off with air or wiped with cloths. All parts should be rinsed in clean kerosene and assembled without drying. A small container with clean kerosene (separate from cleaning tank) should be used for each set of lifters being overhauled.

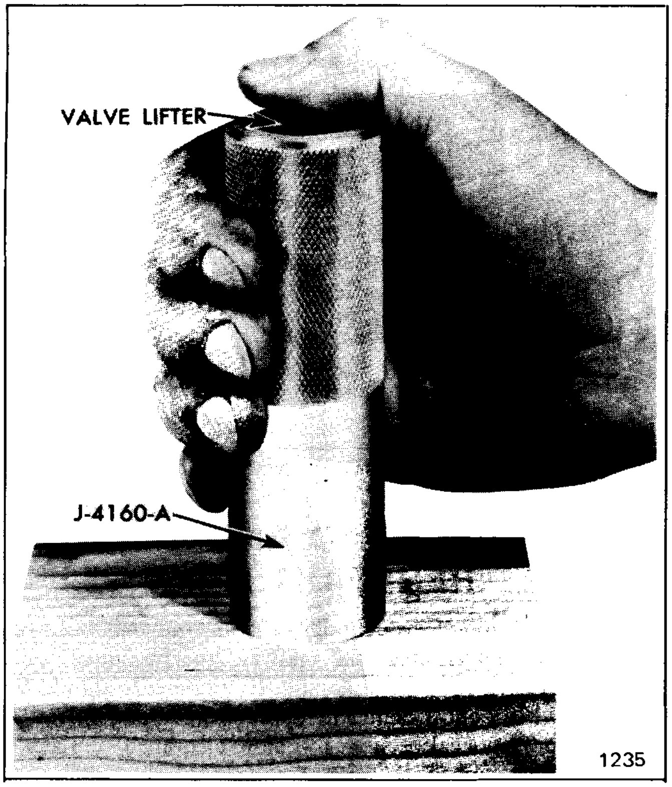


Fig. 6A5-16 Removing Stuck Plunger

Figure 6A5-17 shows the relative position of component parts of valve lifters. The recommended procedure for assembly is given in the following steps.

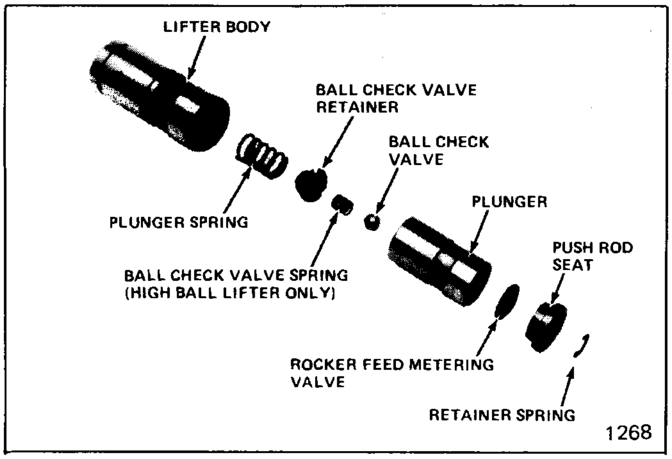


Fig. 6A5-17 Hydraulic Valve Lifter - Exploded View

1. Rinse plunger spring and ball retainer and position retainer in spring.

2. Rinse lifter ball and place it and the small spring in retainer.

3. Rinse plunger and place on retainer so that seat on plunger mates with ball.

4. Invert plunger with parts assembled thus far and after rinsing lifter body, install body over spring and plunger.

5. Place lifter body on clean paper, rinse and install push rod seat and retainer ring.

6. After lifter has been assembled, place in lifter box and close lid to preserve cleanliness.

Test Leak-Down Rate

After all lifters have been assembled, the leak-down rate must be checked before they are installed in the engine. Valve lifter leak-down tester J-5790 (Fig. 6A5-18) is designed to test leak-down rate of lifters to determine whether or not they are within specified limits. As with previous service operations concerned with lifters, cleanliness is paramount. The tester cup and ram should be thoroughly cleaned, and testing should be done in an area free of dust and dirt. The testing procedure is described in the following steps:

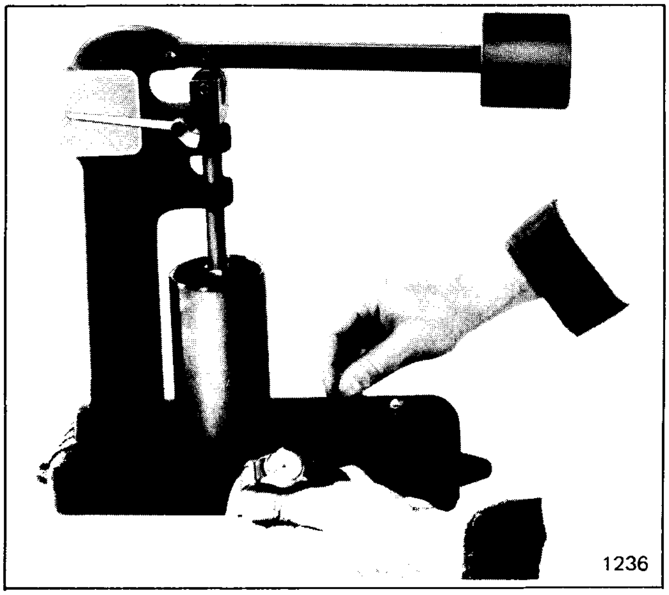


Fig. 6A5-18 Testing Leak-Down Rate

1. Fill tester cup to approximately one inch from top with special fluid which is available from tester manufacturer.

2. Swing weight arm up out of the way, raise ram, and position lifter into boss in center of tester cup.

3. Adjust ram (with weight arm clear of ram) so that the point is positioned on the set line (marked "S"). Tighten jam nut to maintain setting.

4. Operate lifter through full travel of plunger by pumping weight arm to fill lifter with test fluid and force out air. (Lifter must be completely submerged at all times.) Continue pumping for several strokes after definite resistance is detected.

5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and commence turning crank slowly (1 revolution every 2 seconds).

Time indicator travel from lower line (first line above set line) to line marked .094 or 3/32", while still rotating cup with crank (Fig. 6A5-18). Lifter is satisfactory if rate is between 12 and 90 seconds.

CYLINDER HEAD OR GASKET

Remove

1. Drain cooling system, including block.

2. Remove intake manifold, push rod cover, and rocker arm cover.

3. Loosen all rocker arm retaining nuts and move rocker arms off push rods.

4. Remove battery ground cable and engine ground strap or engine ground strap and automatic transmission oil level indicator tube bracket on head to be removed.

5. Remove exhaust pipe to manifold bolts.

6. Remove cylinder head bolts (dowel pins will hold head in place) and remove head with exhaust manifold attached. (If left head is being removed, it will be necessary to raise head off dowel pins, move it forward and maneuver the head in order to clear the power steering and power brake equipment if car is so equipped).

CAUTION: *Extreme care should be taken when handling or storing cylinder heads as the rocker arm studs are hardened and may crack if struck.*

7. Remove cylinder head gasket.

Replace

Right and left cylinder heads are the same.

When installing new head, core plug or heater water outlet fitting must be positioned in rear of head depending on right or left side of engine - transfer all serviceable parts to new head, using new seals on intake and exhaust valve stems, and new exhaust manifold gasket.

CAUTION: *On 301 engine coat all rocker stud lower threads and cylinder head bolts with PT #1052080 thread sealer or equivalent.*

1. Thoroughly clean gasket surfaces of head and block. Place new gasket on block, and install cylinder head.

2. On 301 engines coat cylinder head bolts with Pt #1052080 thread sealer or equivalent on threads and lower side of heads. (Fig. 6A5-19)

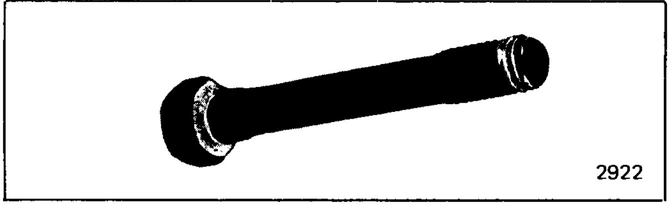


Fig. 6A5-19 301 Cylinder Head Bolt With Sealer Applied

3. Start all bolts and then tighten to 95 lb. ft. using sequence in Fig. 6A5-20.

4. Install push rods.

5. Reposition rocker arms and tighten rocker arm ball retaining nuts to 20 lb. ft.

6. Install rocker arm cover and tighten screws.

7. Install push rod cover and tighten screws.

8. Install battery ground strap and engine ground strap or engine ground strap and automatic transmission oil level indicator tube bracket Also install the engine oil level indicator.

9. Install intake manifold using new gaskets and "O" ring seal.

10.Install exhaust-pipe-to-manifold attaching nuts.

11. Refill cooling system.

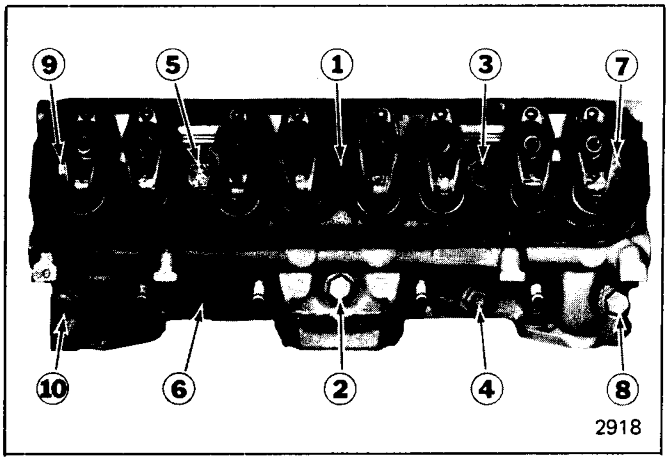


Fig. 6A5-20 Head Bolt Torque Sequence

CYLINDER HEAD AND VALVES RECONDITION

The condition of the cylinder head and valve mechanism significantly determines the power, performance and economy of a valve-in-head engine. Extreme care should be exercised when conditioning the cylinder head and valves to maintain correct valve stem-to-guide clearance, correctly ground valves, and valve seats of correct width.

Disassemble

1. Remove the cylinder head and gasket as previously described. Place cylinder head on two blocks of wood to prevent damage.

2. Remove rocker arms.

3. Using valve spring compressor, compress the valve springs and remove valve locks. Remove spring caps, spring seats, oil seals, springs and spring dampers (Fig. 6A5-21).

4. Remove valves from bottom of cylinder head and place them in a rack in their proper sequence so they can be assembled in their original positions.

Clean and Inspect

1. Clean all carbon from combustion chambers and valve ports.

2. Thoroughly clean the valve guides (Fig. 6A5-22).

3. Clean all carbon and sludge from push rods and rocker arms.

4. Clean valve stems and heads on a buffing wheel.

5. Clean carbon deposits from head gasket mating surfaces.

6. Wash all parts in cleaning solvent and dry them thoroughly.

7. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks in the water chamber.

8. Inspect the valves for burned heads, cracked faces or damaged stems.

9. Check fit of valve stems in their respective bores. (Excessive valve stem to bore clearance will cause lack of power, rough idling and noisy valves, and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness of operation).

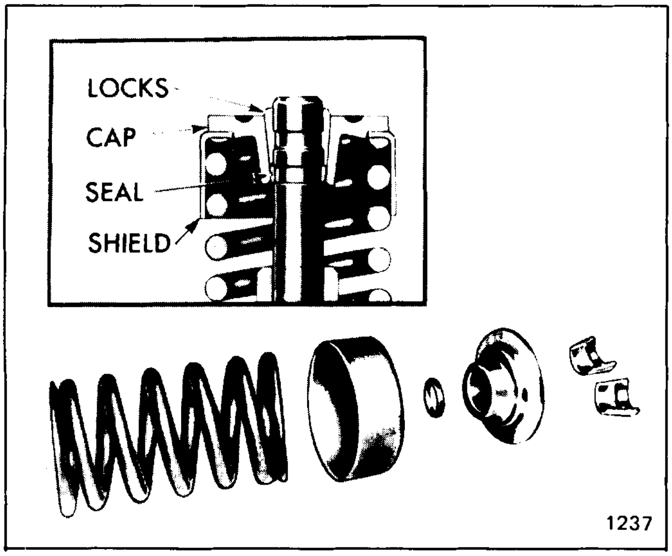


Fig. 6A5-21 Upper Valve Train Parts

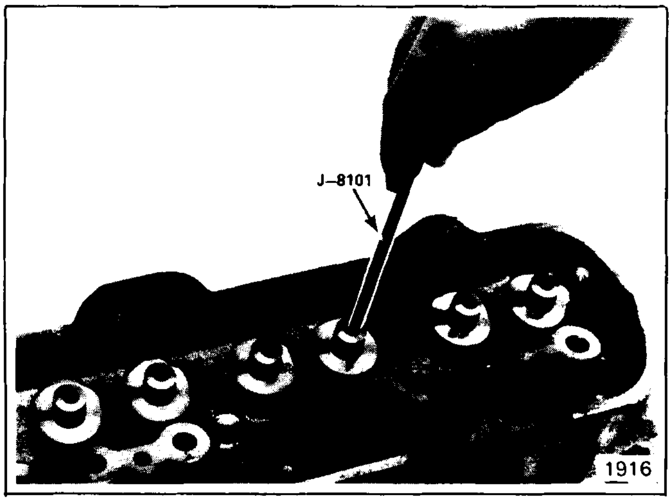


Fig. 6A5-22 Cleaning Valve Guide Bore - Typical

By using a micrometer and a suitable telescope hole gage, check the diameter of the valve stem in three places; top, center and bottom.

NOTE: Exhaust valves in 301 have tapered stems and are .001 larger at the top than at the head end.

Insert telescope hole gage in valve guide bore center diameter to obtain valve to valve guide clearance. If clearance is not within limits, use next oversize valve and ream bore to fit using suitable reamer of tool J-5830 (Fig. 6A5-23).

10. Check valve spring tension with suitable tester (Fig. 6A5-24).

11. Springs should be checked by compressing to a special height, and measuring force required to maintain that height (See Specifications). Weak springs affect power and economy and should be replaced if below specified pressure.

VALVE GUIDE BORE

Recondition

Valves with .003" oversize stems are available for inlet and exhaust valves. Guides should be reamed and new oversize valves installed whenever clearances exceed specifications.

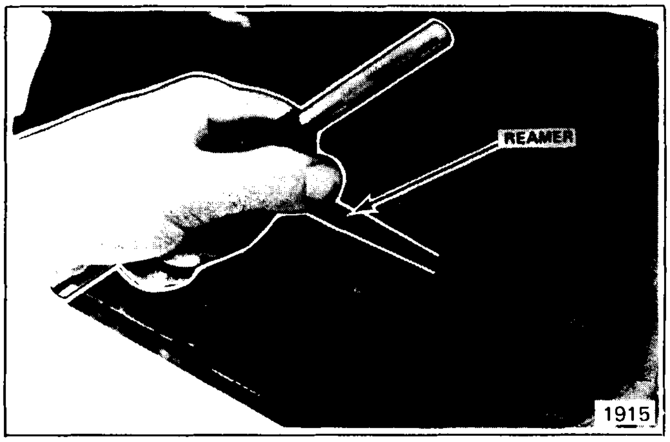


Fig. 6A5-23 Reaming Valve Guide Bore - Typical

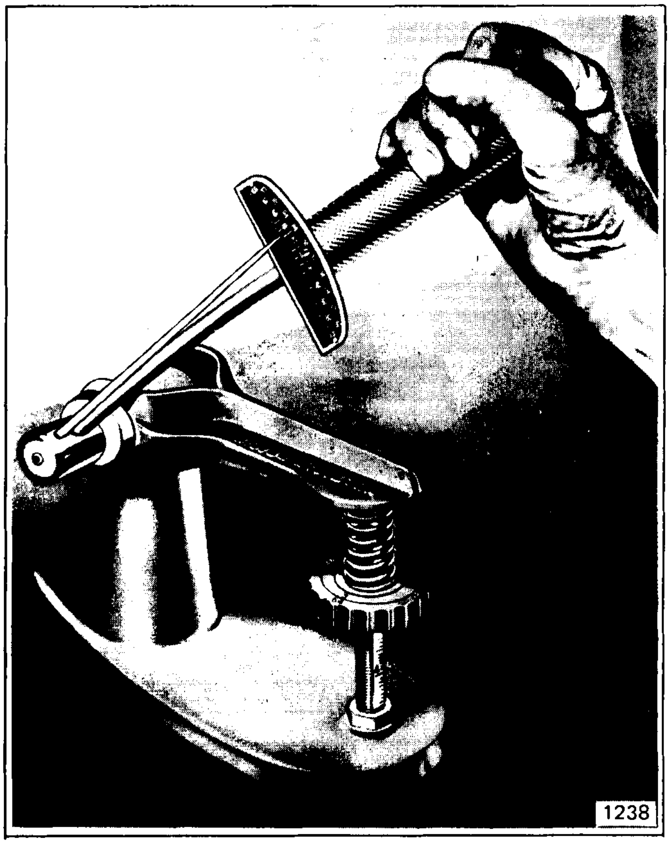


Fig. 6A5-24 Checking Valve Spring Tension

VALVES AND SEATS

Recondition

Valves should be ground on a special bench grinder designed specifically for this purpose and built by a reputable manufacturer. Valve seats should be ground with reputable power grinding equipment having stones of the correct seat angle and a suitable pilot which pilots in the valve stem guide. To ensure positive sealing of the valve face to its seat, the grinding stones should be carefully refaced before any grinding is done. Valve seat angles should be 46° and valve face angles 45° for proper seating.

Assemble

1. Starting with the end cylinder, place the exhaust valve in the port and place the valve spring and cap in position. Then using suitable spring compressor, compress the spring and install new oil seal and valve locks. See that the seal is flat and not twisted in the valve stem groove and that the seat locks properly in the valve stem groove (Fig. 6A5-13).

2. Assemble the remaining valves, valve springs, shields, spring caps, new oil seals and valve locks in the cylinder head. Check seals by placing a vacuum cup over valve stem and cap (Fig. 6A5-14).

3. Install cylinder head as previously described.

HARMONIC BALANCER OR PULLEY HUB

Remove and Replace

NOTE: Some engines will have a pulley hub rather than a balancer. In either case procedures for removal are the same.

1. Remove all drive belts.

2. Position fan so wide angles will be at top and bottom allowing access to balancer (Fig. 6A5-25).

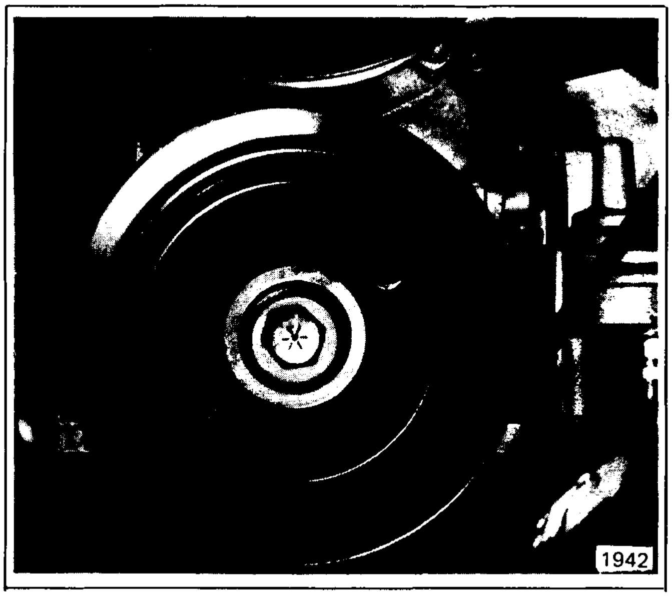


Fig. 6A5-25 Balancer and Pulley - Typical

3. Remove harmonic balancer attaching bolt and retainer washer.

4. Remove harmonic balancer by sliding it off end of crankshaft.

5. Remove crank pulleys and reinforcing plate.

CAUTION: *Do not pry on O.D. of harmonic balancer. The harmonic balancer is a rubber mounted inertia member and balance could be affected.*

6. Install new harmonic balancer by reversing above steps, lining up keyway in balancer with key on crankshaft.

7. Tighten harmonic balancer attaching bolt to 160 lb. ft. (Remove flywheel cover and lock flywheel before tightening balancer bolt).

8. Install drive belts and adjust to specifications.

TIMING CHAIN COVER SEAL

Remove and Replace

1. Remove fan and accessory drive belts.

2. Remove harmonic balancer.

3. Remove timing chain cover seal by prying out of bore with a pry bar (Fig. 6A5-26).

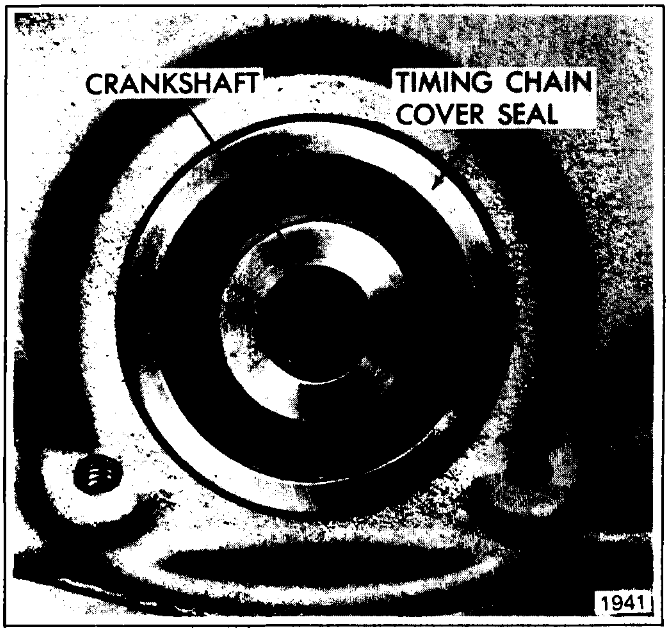


Fig. 6A5-26 Timing Chain Cover Seal

4. Install new seal with helical lip of seal inward, using seal installer J-21147.

5. Install harmonic balancer.

6. Install fan and drive belts and adjust to proper tension (see Section 6B).

TIMING CHAIN COVER, GASKET OR FUEL PUMP ECCENTRIC

Remove and Replace

1. Drain radiator and cylinder block.
2. Remove fan belt and accessory drive belts.
3. Remove fan and pulley from hub of water pump.
4. Disconnect lower radiator hose.
5. Remove fuel pump.
6. Remove harmonic balancer.
7. Remove front four oil pan-to-timing chain cover screws.
8. Remove timing chain cover to block attaching bolts and nuts and timing chain cover to intake manifold bolt.
9. Pull timing chain cover forward to clear studs and remove.

10. Remove O-ring seal from recess in intake manifold water recirculation passage.

11. Remove timing chain cover gasket and thoroughly clean gasket surfaces on block and cover. Use care to prevent gasket particles and other foreign material from falling into oil pan.

12. Inspect front oil pan gasket and replace if damaged. If new gasket is installed, it should be cemented to oil pan.

13. If new fuel pump eccentric and bushing are to be installed, remove camshaft sprocket retainer bolt and retaining washer and remove the eccentric and bushing. Place fuel pump bushing over eccentric with rolled flange toward camshaft sprocket (Fig. 6A5-27).

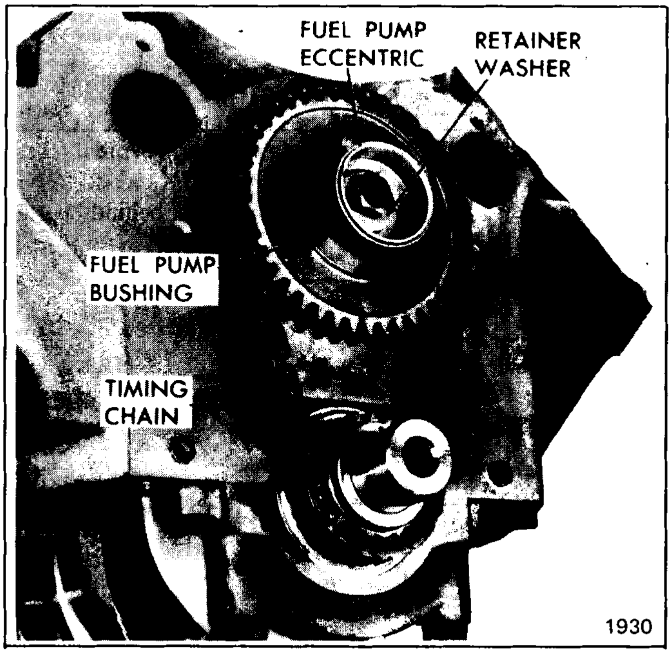


Fig. 6A5-27 Fuel Pump Drive

CAUTION: *Bushing retaining flange should be between eccentric and sprocket for retention of bushing during operation.*

Install bushing and eccentric, indexing tang on eccentric with hole in camshaft sprocket. Insert retaining screw with retainer washer and tighten securely.

Replace

1. Position new timing chain cover gasket over studs against block.

2. Transfer water pump to new timing chain cover if new cover is to be installed.

3. Install new O-ring seal in water recirculation passage of intake manifold.

4. Position timing chain cover on engine indexing over dowels. If mounting studs are removed from the block it will be necessary to coat threads with Pt #1052080 thread sealer or equivalent. Install bolts and nuts and tighten securely.

5. Install four oil pan to timing chain cover screws and tighten to 12 lb. ft.

6. Install harmonic balancer, retainer bolt with retainer, and tighten to 160 lb. ft.

7. Connect lower radiator hose to pump inlet.

8. Position pulley and fan on water pump hub and install attaching bolts. Tighten to 20 lb. ft..

9. Install fan belt and accessory drive belts. Adjust to proper tension (see Section 6B).

10. Install fuel pump.

11. Refill cooling system and check for leaks.

TIMING CHAIN AND SPROCKETS

Remove and Replace

1. Remove timing chain cover.

2. Remove fuel pump eccentric and bushing.

3. Align timing marks to simplify proper positioning of sprockets during reassembly (Fig. 6A5-28).

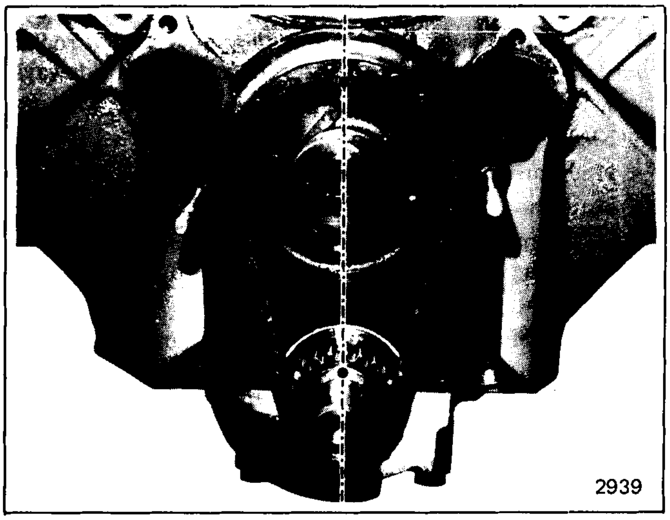


Fig. 6A5-28 Timing Marks Aligned at No. 1 T.D.C.

4. Slide timing chain and sprockets off ends of crankshaft and camshaft at the same time.

5. Install new timing chain and/or sprockets, making sure marks on timing sprockets are aligned exactly on a straight line passing through the shaft centers (Fig. 6A5-28). Camshaft should extend through sprocket so that hole in fuel pump eccentric will locate on shaft.

6. Install fuel pump eccentric and bushing, indexing tang on eccentric with hole in sprocket. Install retainer bolt with retainer washer and tighten securely.

7. Place timing chain cover gasket over studs and dowels.

NOTE: If studs were removed from block coat threads with Pt #1052080 thread sealer or equivalent before installation.

8. Install timing chain cover, water pump and harmonic balancer making sure new O-ring seal is in place.

CAMSHAFT AND/OR CAMSHAFT BEARING

The camshaft and camshaft bearings can be replaced with engine installed in car or with engine removed and disassembled for overhaul; however, to replace the rear camshaft bearing without removing and completely disassembling engine, the transmission and flywheel must first be removed. To replace the camshaft and/or the rear center, center, front center or front camshaft bearing without removing and completely disassembling the engine, proceed as follows:

CAMSHAFT

Remove

1. Drain radiator.
2. Remove hood latch brace.
3. Remove radiator.
4. Remove both rocker arm covers and gaskets.
5. Remove distributor hold-down clamp and remove distributor.
6. Remove intake manifold and gaskets.
7. Remove push rod cover.
8. Loosen rocker arm ball retaining nuts so that rocker arms can be disengaged from push rods and turned sideways.
9. Remove push rods and hydraulic lifters.
10. Remove harmonic balancer.
11. Remove timing chain cover and gasket.
12. Remove fuel pump eccentric and fuel pump bushing.
13. Align timing marks on timing chain sprockets and remove timing chain and sprockets. Refer to Fig. 6A5-27.
14. Remove camshaft thrust plate.
15. Carefully pull camshaft from engine, exercising caution so as not to damage bearings in block.

The clearance for camshaft removal is very limited and, in cases where engine mounts are worn excessively, it may be necessary to raise the front of the engine to permit removal.

CAUTION: *It is imperative that operator exercise extreme caution when inserting bearing remover adapters or key through openings in engine block to prevent them from dropping into engine.*

CAMSHAFT BEARING

Remove

1. Insert remover adapter J-6173-4 into front bearing to act as a support for shaft J-6173-1 (Fig. 6A5-29).

If front bearing is to be replaced, insert installer adapter in center bearing to act as support for shaft.

If rear bearing is to be removed, it will be necessary to remove camshaft rear plug.

2. Insert replacer adapter J-6173-3 into rear of bearing to be removed so that shoulder on remover bears against rear edge of bearing.
3. Place indexing collar J-6173-6 on threaded end of shaft with open side toward unthreaded end and start thrust washer and nut on shaft (Fig. 6A5-30).
4. Insert shaft and indexing collar through remover and replacer adapters and position lug on indexing collar in ventilator hole in front of block. This indexes shaft so that it cannot rotate.

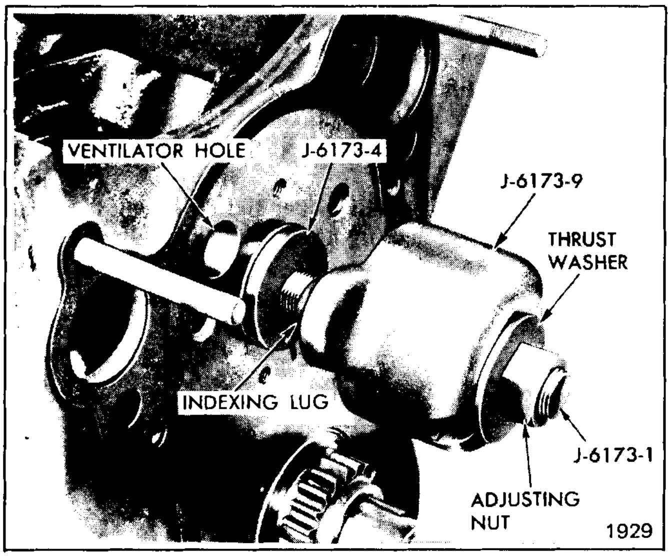


Fig. 6A5-29 Positioning Index Collar - Typical

5. Slip key J-6173-5 into notches in shaft behind bearing to be removed.

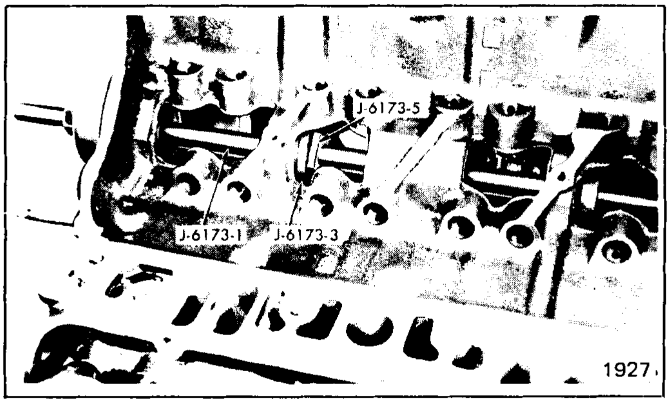


Fig. 6A5-30 Removing Camshaft Bearing - Typical

6. Turn nut on front of shaft to pull key against remover adapter J-6173-4, then continue to turn nut until bearing is pulled out of its hole.

Replace

1. Place a clean rag against each side of transverse member just below bearing hole to catch any shavings and carefully clean up hole.

All scratches or nicks in cast iron should be smoothed with a scraper or file.

Chamfer the edge of hole slightly in which bearing is being installed to reduce possibility of scoring the outer diameter of bearing when it is installed.

2. Insert remover adapter J-6173-4 into front bearing to act as a support for the shaft.

NOTE: If front bearing is being replaced, insert remover adapter in center bearing to act as support for the shaft.

3. Insert pilot J-6173-7 into hole in which bearing is to be installed.
4. Coat outside of new bearing with oil and place it over replacer adapter J-6173-3, indexing notch in edge of bearing with pin on replacer adapter.

CAUTION: *The notch in edge of bearing is used to properly position the bearing with respect to oil holes, when it is installed. When bearings are installed in production, notches all face front except the one in rear bearing.*
In service it is necessary to install bearings with notch facing the rear.

5. Position replacer adapter J-6173-3, with bearing in position against shoulder, against rear of hole in which bearing is to be installed (Fig. 6A5-31). Index mark on shoulder of replacer must point down (toward crankshaft side) to properly position bearing.

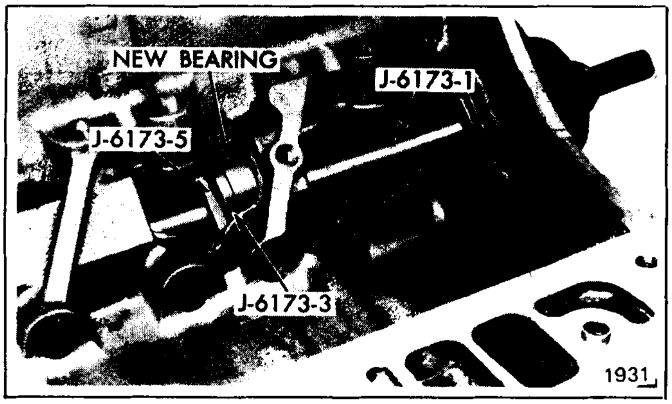


Fig. 6A5-31 Installing Camshaft Bearing - Typical

6. Insert shaft with indexing collar, thrust washer, and nut through remover, pilot and replacer adapters. Index lug on collar with ventilation hole in front of block (Fig. 6A5-29).

7. Slip key J-6173-5 into notches in shaft behind replacer adapter J-6173-3 and tighten nut to start bearing into hole (Fig. 6A5-30). Continue to tighten nut until bearing has been pulled completely into its hole. When properly positioned, it will be approximately flush with both sides of the transverse member.

Rear bearing should be pulled in until front edge is flush with block. This will leave shoulder at end of counter bore for camshaft rear plug visible behind bearing.

8. Remove remover and replacer set J-6173.

9. Visually observe that holes in bearing line up with drillings in block.

10. Carefully remove all metal particles from block surfaces and oil drillings.

CAMSHAFT

Replace

1. Coat inner diameters of all camshaft bearings with oil.

A. Coat camshaft lobes with E.O.S.

B. Carefully install camshaft.

C. Rotate camshaft through several revolutions to make sure it is completely free.

If any tight spots are found, remove camshaft and very carefully polish down the center journal slightly. If still not free, polish the front and rear journals slightly.

If any particular bearing causes binding of the camshaft, replace that bearing also.

Front center and rear center journals should not be polished except to remove slight roughness or scratches. Slight warpage of the camshaft is not harmful, provided the journals are polished down until the camshaft rotates freely in its bearings.

2. With camshaft properly seated, install camshaft thrust plate and tighten bolts to 20 lb. ft.

3. Install timing chain sprockets and timing chain, making sure marks on sprockets are aligned properly. Refer to Fig. 6A5-28.

4. Install fuel pump eccentric and bushing. Insert tang on eccentric into hole in camshaft sprocket. Tighten camshaft sprocket retaining bolt to 40 lb. ft.

5. Install timing chain cover dowels and new gasket and tighten bolts and nuts to 30 lb. ft.

6. Insert four oil-pan-to-timing-chain-cover screws and tighten to 12 lb. ft.

7. Install fuel pump and tighten bolts to 25 lb. ft.

8. Install harmonic balancer. Tighten bolt to 160 lb. ft..

9. Coat base of lifters with E.O.S. Install hydraulic lifters and push rods, making certain they are replaced in their original positions.

10. Engage rocker arms on push rods and tighten rocker arm ball retaining nuts to 20 lb. ft.

11. Install push rod cover.

12. Install intake manifold and gasket. Tighten bolts to 40 lb. ft..

NOTE: New O-ring seal must be installed between intake manifold and timing chain cover before manifold is securely positioned.

13. Install distributor, positioning rotor to fire number one cylinder, and install distributor hold-down clamp. (Distributor housing will be properly positioned when vacuum advance unit is at right angles, facing R.H. side, to centerline of crankshaft). Tighten clamp retaining screw to 30 lb. ft. after ignition timing has been set.

14. Install crankcase ventilator outlet pipe and both rocker arm covers and gaskets. Tighten cover bolts to 65 lb. in.

15. Install fan and pulleys.

16. Install radiator, tightening all bolts securely.

17. Install hood latch bracket and tighten bolts.

18. Connect carburetor linkage, fuel lines and thermogage unit.

19. Connect all water hoses, vacuum hose and spark plug wires.

20. Install carburetor air filter.

21. Refill cooling system and check for leaks.

OIL PAN AND/OR OIL PAN GASKET

Remove

NOTE: Oil pans on the 301 and 350 engines have no inner baffle. 400 engines have oil pan baffles only when equipped with axle ratios above 2.93 to 1.

1. Disconnect battery cable at battery.
2. Remove Engine fan.
3. Inspect hoses and wiring harness routings for adequate clearances to avoid stretching or binding during lift.
4. On some air conditioned models, it may be necessary to remove A/C compressor and move aside for clearance.
5. Remove distributor cap.
6. Raise vehicle and drain crankcase.
7. Disconnect exhaust pipes from manifolds.
8. Remove starter assembly and flywheel inspection cover.
9. Rotate crankshaft until number one cylinder is at bottom dead center.

NOTE: It will be necessary to loosen fuel pump to timing cover bolts to permit clearance of engine lifting tool adapter (J-23515-2).

10. Position ENGINE LIFTING TOOL J-23515-2 to engine with adapter J23515-16 bolted to lifting tool (Fig. 6A5-11). Securely tighten tool to timing chain cover with bolts.
11. Thread jackscrew through crossbar and position engine lifting crossbar (J-23515-1) to adapter (J-23515-2) and attach nut to jackscrew to hold it to the adapter.

NOTE: Be sure thrust bearing is in place.

12. Slip chain around left frame rail in front of steering gear and attach to hook. Attach remaining chain around right frame rail at point where crossbar is now positioned. Make sure crossbar is parallel to ground (Fig. 6A5-11).
13. Place loose ends of chain across top of support to prevent chain from slipping out of hooks.
14. Remove both frame bracket-to-engine mount through bolts.
15. Remove oil pan bolts and, ALLOWING TOOL TO SWING FREELY, raise engine (using jack screw in tool) until pan can be removed.

CAUTION: *Do not exceed 35 lb. ft. torque on screw.*

WARNING: WHENEVER ENGINE IS RAISED OFF ENGINE MOUNTS, SUPPORT ENGINE BLOCK WITH SUITABLE BLOCKS OF WOOD.

Replace

1. Thoroughly clean all gasket sealing surfaces.
2. Clean sludge from oil pan and oil pump pick-up screen.
3. Install new gaskets on oil pan (Figs. 6A5-32 and 6A5-33).

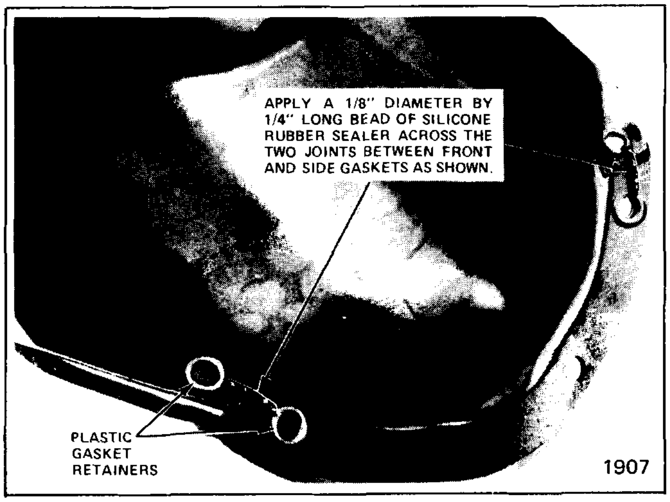


Fig. 6A5-32 Front Oil Pan and Gasket

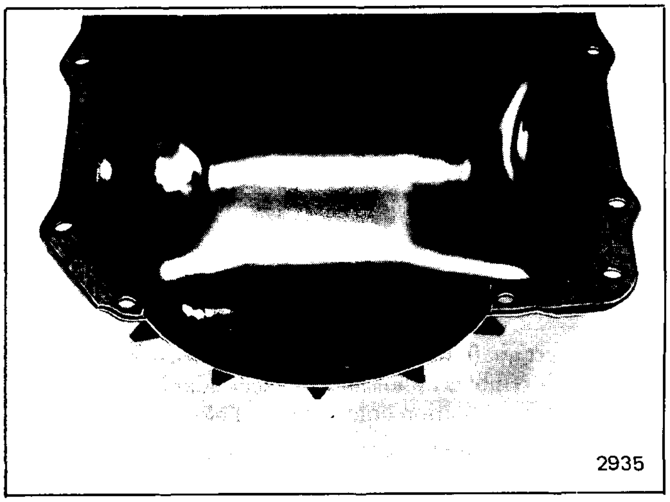


Fig. 6A5-33 Rear Oil Pan Gasket Installation

4. Apply 1/8" diameter of RTV sealer at front gasket parting lines as shown in Figure 6A5-32 and apply a light coat of soft grease on rear rubber seal.
5. Install oil pan. Tighten retaining bolts to 12 lb. ft.
6. Lower engine and install frame bracket-to-motor mount through bolts.
7. Remove engine lifting equipment.
8. Install flywheel inspection cover and starter.
9. Install exhaust pipes.
10. Tighten fuel pump bolts.
11. Lower vehicle.
12. Install fan.
13. Install distributor cap.
14. Connect battery cable.
15. Refill engine crankcase.

OIL PUMP

Remove

1. Remove engine oil pan (see OIL PAN - REMOVE AND REPLACE).
2. Remove oil pump attaching bolts while holding oil pump in place. Carefully lower oil pump away from block with one hand while removing oil pump drive shaft with other

hand (Fig. 6A5-34).

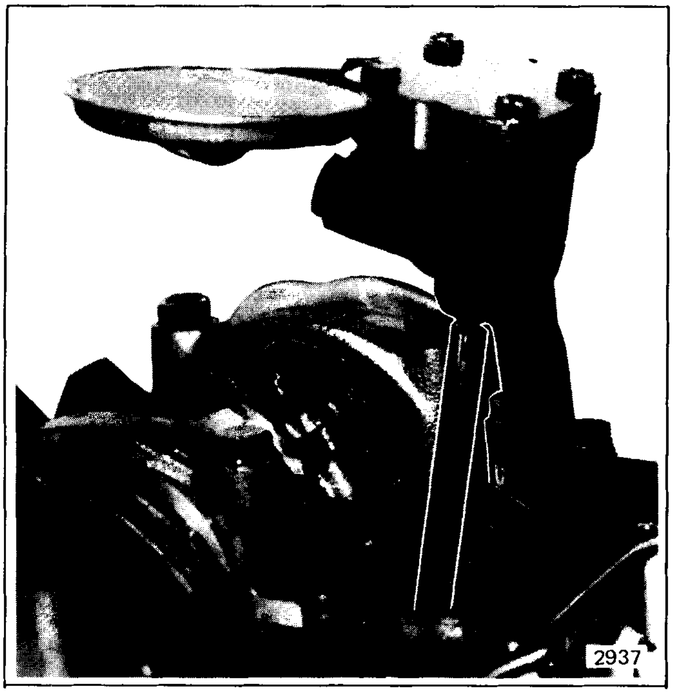


Fig. 6A5-34 Oil Pump and Oil Pump Drive Shaft

Replace

1. Position drive shaft in distributor and oil pump drive gears.

Place pump against block, using new gasket between pump and block.

Index drive shaft with pump drive gear shaft. Install two attaching screws with lockwashers and tighten securely. (Removal and installation of pump does not affect ignition timing, since the oil pump and distributor drive gear is mounted on the distributor shaft).

2. Install oil pan.

ENGINE OIL PUMP

Recondition

1. Remove 4 cover attaching screws, cover, idler gear and drive gear and shaft (Fig. 6A5-35).

2. Remove pressure regulator valve and valve parts.

CAUTION: *Do not disturb oil pickup pipe on screen or body. This pipe is located at assembly.*

Inspect

Should any of the following conditions be found during inspection operations, the pump assembly should be replaced.

1. Inspect pump body for cracks or excessive wear.
2. Inspect oil pump gears for excessive wear or damage.
3. Check shaft for looseness in the housing.
4. Check inside of cover for wear that would permit oil to leak past the ends of gears.
5. Check the oil pick-up screen for damage to screen, or relief grommet.
6. Check pressure regulator valve plunger for fit in body.

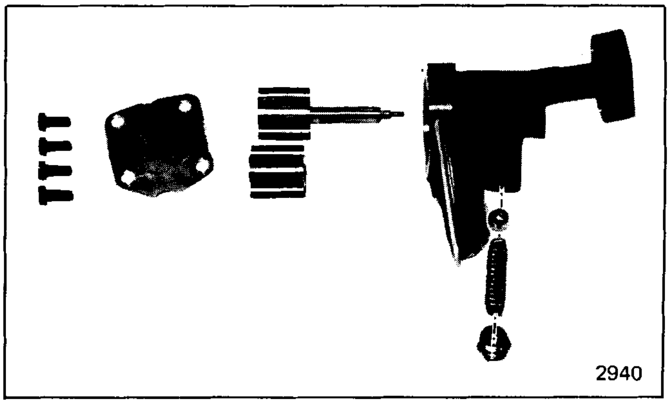


Fig. 6A5-35 Oil Pump - Exploded View

Replace

1. Place drive gear and shaft in pump body.
2. Install idler gear so that smooth side of gear will be toward the cover.
3. Install cover and attaching screws. Tighten screws to 105 lb. in. and check to see that shaft turns freely.
4. Install regulator valve plunger, spring, retainer and pin.

CONNECTING ROD BEARING CLEARANCE

1. After removing oil pan, remove the cap of the bearing to be checked. Wipe the bearing and the crankpin free of oil.

2. Place a piece of plastic gage, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface.

> **NOTE:** Plastic gage should be positioned exactly in the middle of upper or lower bearing shell. (Bearings are eccentric and false reading could occur.)

Install the cap and tighten cap bolts to torque. (Do not turn crankshaft with plastic gage in place).

3. Remove bearing cap and using plastic gage scale on envelope, measure width of compressed plastic gage before removing it from the crankpin or bearing (Fig. 6A5-36).

If the clearance is excessive, replace the bearing with the next undersize bearing and recheck clearance. Bearings are available in standard, .001" and .002" undersize.

4. Rotate the crankshaft after bearing adjustment to be sure bearings are not tight.

5. Check connecting rod end clearance between connecting rod cap and side of crankpin. If clearance is excessive, replace connecting rod.

MAIN BEARING CLEARANCE

1. Place a .002" brass shim between the crankshaft journal and the lower bearing in each bearing cap next to the one being checked. This causes the crankshaft to be forced against the upper bearing and insures an accurate measurement of the total clearance.

2. Remove the bearing cap of the bearing to be checked. Wipe the bearing and the journal free of oil.

3. Place a piece of plastic gage, the length of the bearing (parallel to the crankshaft), on the journal or bearing surface.

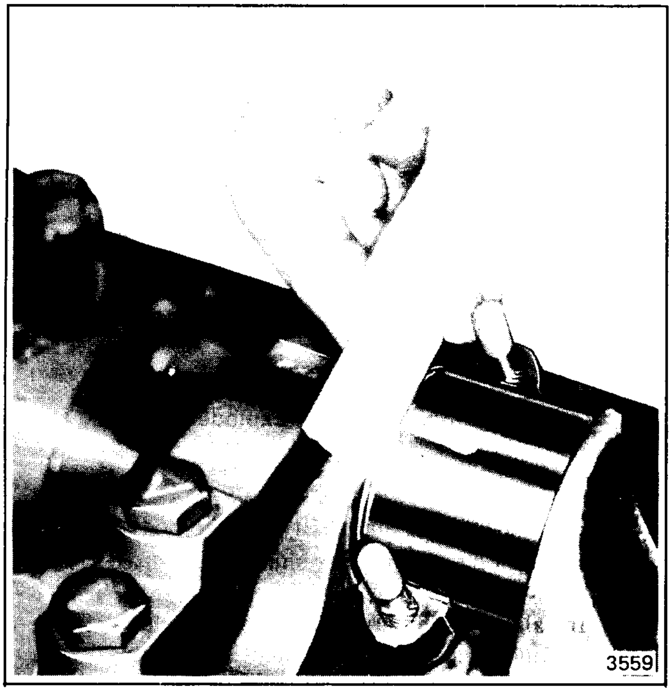


Fig. 6A5-36 Measuring Plastic Gage (Rod Bearings) - Typical

NOTE: Plastic gage should be positioned exactly in the middle of upper or lower bearing shell. Bearings are excentric and false readings could occur.

Install the cap and tighten cap bolts to proper torque. (Do not turn crankshaft with plastic gage in place).

4. Remove bearing cap and using plastic gage scale on envelope measure width of compressed plastic gage before removing it from the bearing or journal (Fig. 6A5-37).

If the clearance is excessive, replace the bearing with the next undersize bearing and recheck clearance. Bearings are available in standard size, .001" and .002" undersize.

5. Repack the rear main bearing oil seal in the cylinder block and install a new rear main bearing oil seal in the cap if the rear main bearing was checked and/or replaced.

REAR MAIN BEARING OIL SEAL

Remove

1. Remove oil pan (see OIL PAN - REMOVE AND REPLACE).
2. Remove oil pump.
3. Remove rear main bearing cap.
4. Use tool shown in Fig. 6A5-38 made from brass bar stock to pack upper seal as follows:

a. Insert tool against one end of the oil seal in the cylinder block and drive the seal gently into the groove until the tool bottoms.

b. Remove the tool and repeat at the other end of the seal in the cylinder block.

c. Clean the block and bearing cap parting line thoroughly.

d. Form a new seal in the cap (Fig. 6A5-39).

e. Remove the newly formed seal from the cap and cut four (4) pieces approximately 3/8" long from this seal.

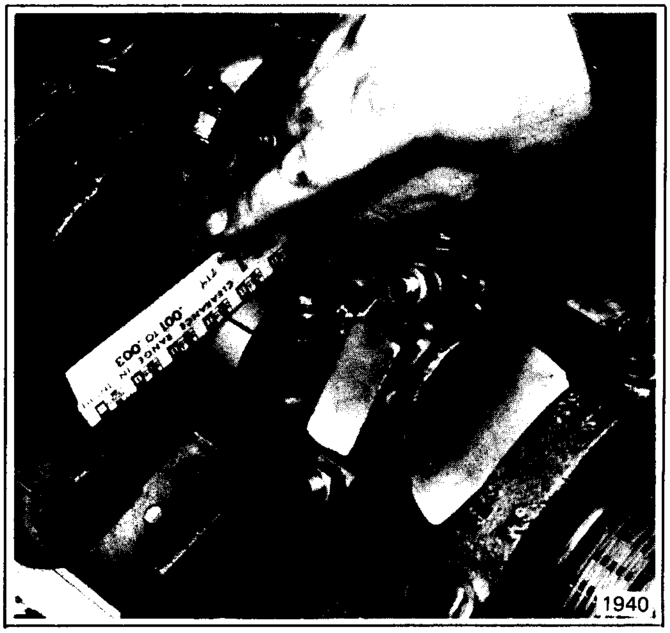


Fig. 6A5-37 Measuring Plastic Gage (Main Bearings) - Typical

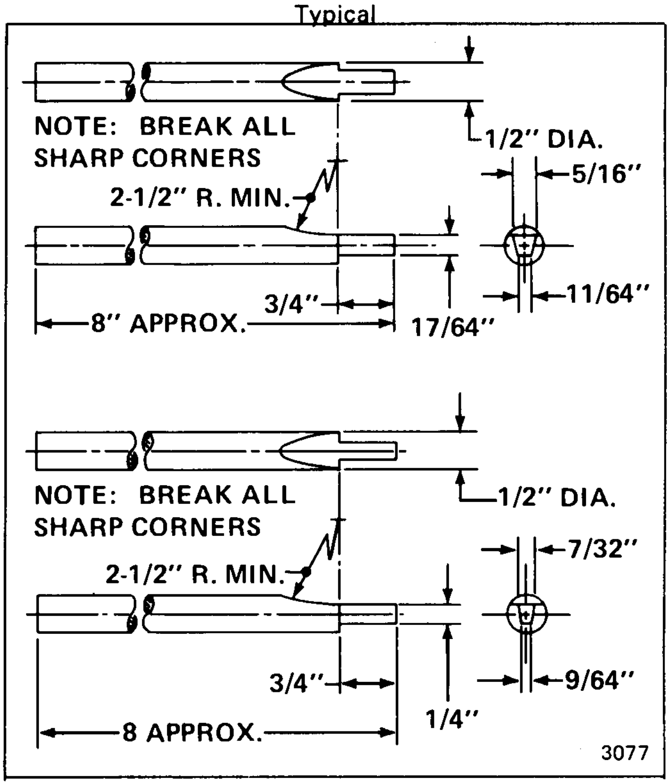


Fig. 6A5-38 Upper Rear Main Bearing Seal Tool

f. Work two 3/8" pieces into each of the gaps which have been made at the end of the seal in the cylinder block. Without cutting off the ends, work these seal pieces in until flush with the parting line and until no fibers are protruding over the metal adjacent to the groove.

g. Form another new seal in the cap (Fig. 6A5-39).

h. Assemble the cap to the block and tighten to 100 lb. ft.

i. Remove the cap and inspect the parting line to insure that no seal material has been compressed between the block and the cap. Clean as necessary.

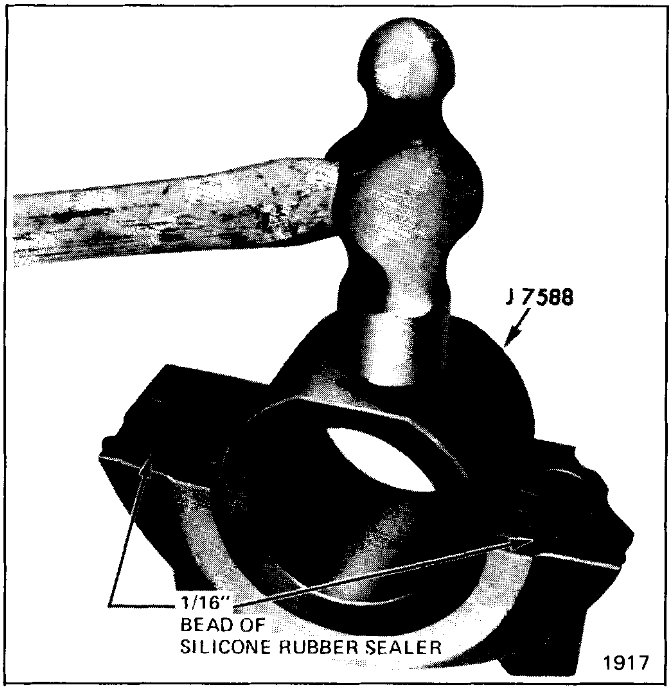


Fig. 6A5-39 Forming New Seal In Cap - Typical

j. Apply a 1/16" bead of silicone rubber sealer to cap parting line. Extend sealer continuously from center of seal (packing) to the outer gasket groove.

k. Reassemble the cap. Tighten to 100 lb. ft.

5. Install oil pump.
6. Install oil pan.

CONNECTING ROD AND PISTON ASSEMBLY

Remove

1. Remove oil pan and oil pump when necessary (see OIL PAN - REMOVE AND REPLACE).
2. Remove intake manifold and cylinder head on bank from which piston is to be removed.
3. Rotate crankshaft so crank pin carrying assembly to be replaced projects straight downward.
4. Remove bearing cap and install rubber hoses on connecting rod bolts.
5. Carefully remove connecting rod and piston assembly by pushing out.

Replace

1. Install rubber hoses on connecting rod bolts.
2. Using proper ring compressor, insert piston connecting rod assembly into cylinder so that notch in top of piston is toward front of engine. (Fig. 6A5-41) One face of the rod has dimples, see Fig. 6A5-42. Rods are assembled on the crank with the dimples facing rear on the both banks (301 engine) and forward on the right bank and rearward on the left bank of the 350 and 400 engine.
3. From beneath engine, pull connecting rod, with bearing shell in place, into position against crankpin.
4. Remove rubber hoses. Install bearing cap and cap nuts and tighten to 30 lb. ft.

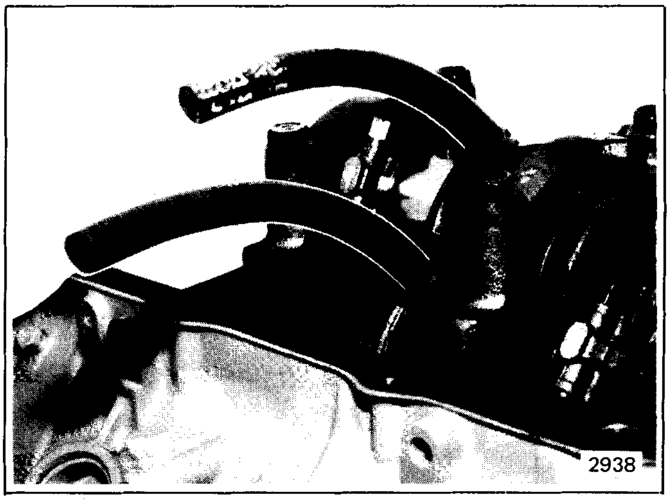


Fig. 6A5-40 Connecting Rod With Hose Protectors

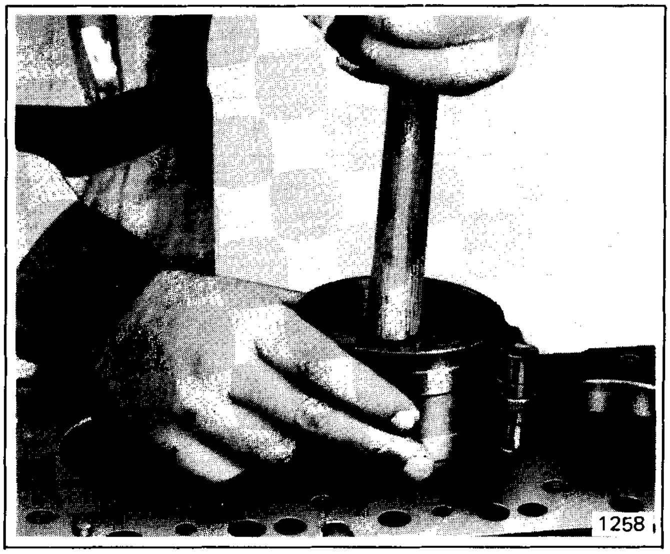


Fig. 6A5-41 Installing Piston Assembly - Typical

5. Replace oil pump if removed and oil pan.
6. Install cylinder head and intake manifold.

CONNECTING ROD AND PISTON

Disassemble

CAUTION: *Use care at all times when handling and servicing connecting rods and pistons. To prevent possible damage to these units, do not clamp rod or piston in vise since they may become distorted. Do not allow pistons to strike against one another, against hard objects or bench surfaces, since distortion of piston contour or nicks in the soft aluminum material may result.*

1. Remove piston rings using suitable piston ring remover.
2. Install pilot of piston pin removing and installing tool on piston pin.
3. Install piston and connecting rod assembly on support and place assembly in an arbor press (Fig. 6A5-43). Press pin out of connecting rod.

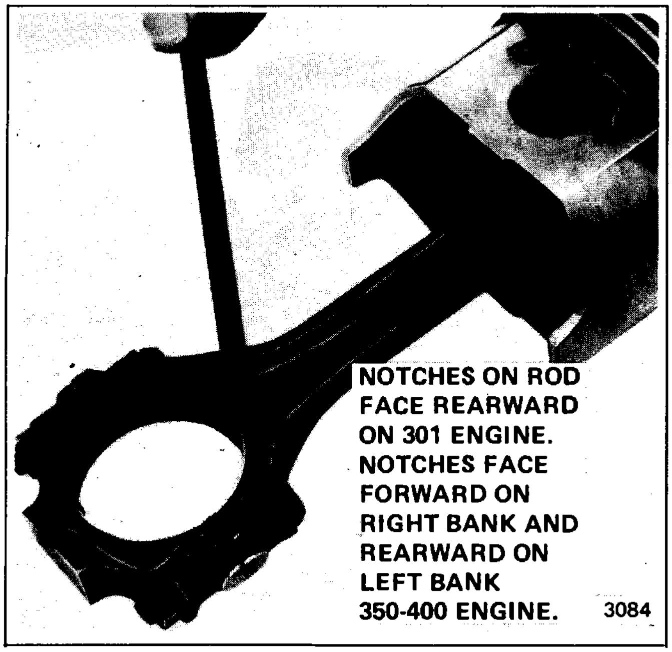


Fig. 6A5-42 Rod Identification

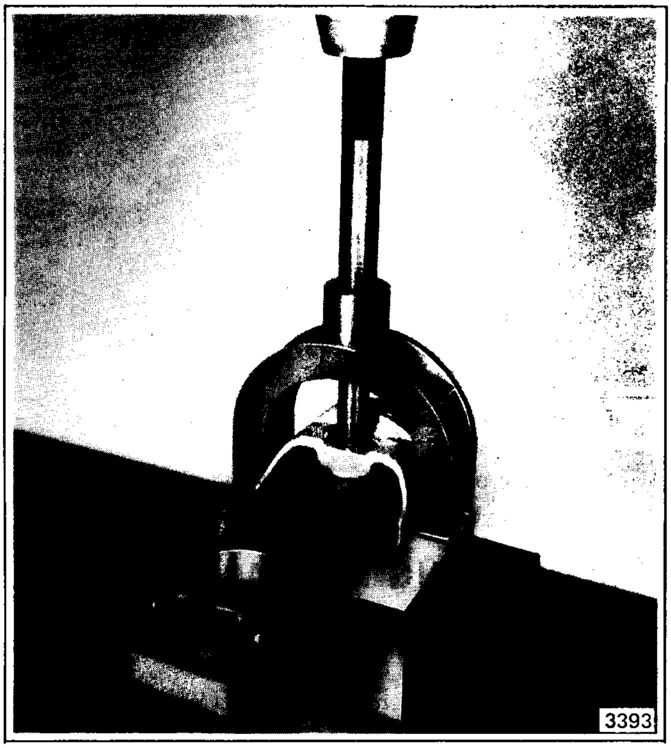


Fig. 6A5-43 Removing Piston Pin - Typical

4. Remove assembly from press, remove piston pin from support and remove tool from piston and rod.

Clean and Inspect

1. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

2. Clean piston pin, rod, cap, bolts and nuts in suitable solvent. Reinstall cap on connecting rod to prevent subsequent mixing of caps and connecting rods.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; and scored, galled, or worn piston bosses. Damaged pistons should be replaced.

4. Inspect piston pin for scoring, roughness, or uneven wear and proper fit.

5. Inspect bearing shells to see that they are not damaged. Fit of bearings should be checked when engine is being assembled.

Assemble

There is a notch cast in the top of all piston heads to facilitate proper installation. The piston assemblies should always be installed with the notch toward the front of the engine.

1. Lubricate piston pin holes in piston and connecting rod lightly with graphite lubricant.

2. Position connecting rod in its respective piston so that raised notches at bearing end will be rearward in 301 engine. Forward on the right bank and rearward on the left bank in 350 or 400 engine. Fig. 6A5-40

3. Install piston pin on installer and pilot spring and pilot in support (Fig. 6A5-44). Use piston pin removing and installing tool.

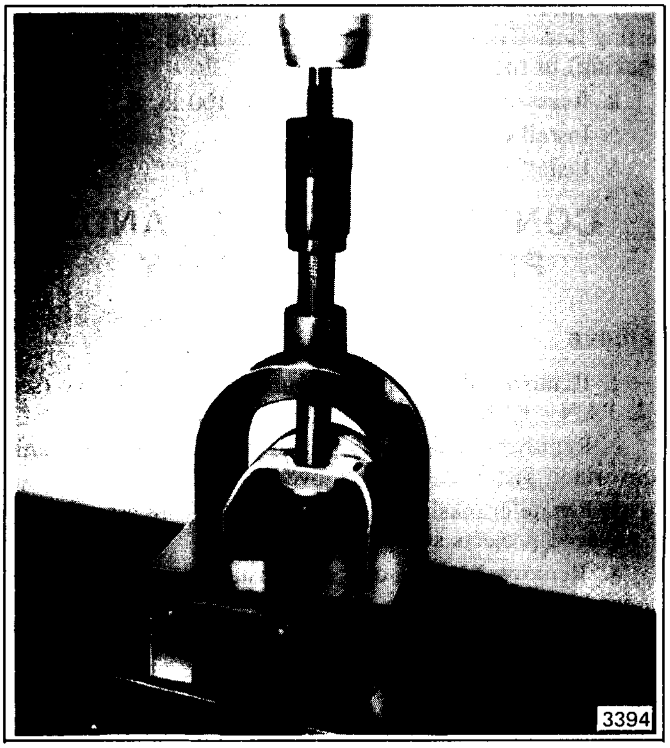


Fig. 6A5-44 Piston Pin Replacement (Typical)

4. Install piston and rod on support, indexing pilot through piston and rod.

5. Place support on arbor press, start pin into position and press on installer until pin pilot bottoms.

6. Remove installer and support assembly from piston and connecting rod assembly.

7. Check piston pin for freedom of movement in piston bore.

PISTON PIN

Fit

Piston pins normally do not become loose enough to cause a knock or tapping until after very high mileage and in such cases the piston and rod can be reamed and oversize pins installed.

The piston pin fit in the piston is .0003" to .0005" loose with pin and bosses clean and dry.

Piston and pin must be at room temperature when checking fit and pin must be able to fall from piston by its own weight.

CYLINDER BORES

Inspect

IMPORTANT: (301 engine only) final bore operations are done in production using a deck plate which simulates the cylinder head in its installed position. For this reason, bore measurements may vary from area to area when gaged with the head removed. Accurate measurements and/or piston fit data can be obtained by gaging bores only at right angles from the crankshaft or piston pin centerline.

Inspect cylinder bores for wear or excessive taper, with an accurate cylinder gage J-8087 or comparable, at top, middle and bottom of bore. (Fig. 6A5-45). Measure cylinder bore at right angles to the centerline of the piston pin. Variation in measure from top to bottom of cylinder indicates the taper in the cylinder. If the top of the cylinder bore is larger than the bottom by .003", the cylinder should be rebored and a new piston fit. Cylinder bores can be measured by setting the cylinder gage dial at zero in the cylinder at the point of desired measurement. Lock dial indicator at zero before removing from cylinder, and measure across the gage contact points with outside micrometer, with the gage at the same zero setting when removed from the cylinder (Fig. 6A5-46).

Fine vertical scratches made by ring ends will not by themselves cause excessive oil consumption, therefore, honing to remove them is unnecessary.

HONING OR BORING

If a piston other than standard size is to be installed, the cylinder should be bored, rather than honed, to effect a true bore.

When honing to eliminate taper in the cylinder full strokes of the hone in the cylinder should be made in addition to checking measurement at top, middle and bottom of bore repeatedly.

NOTE: Surface finish should not exceed 7 to 15 micro.

When boring, always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. Crankshaft bearings and other internal parts must be covered or taped to protect them during boring or honing operation. When taking the final cut with a boring bar, leave .001" on the diameter for finish honing to give the required piston to cylinder clearance specifications. (Honing or boring operation must be done carefully so that specified clearance between pistons, rings, and cylinder bores is maintained).

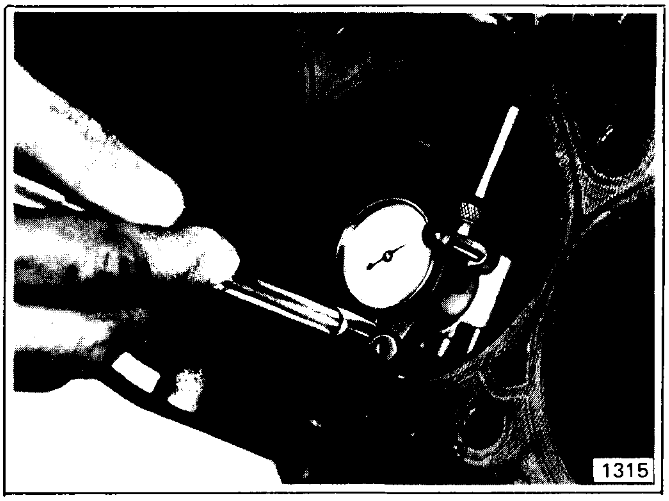


Fig. 6A5-45 Measuring Cylinder Bore - Typical

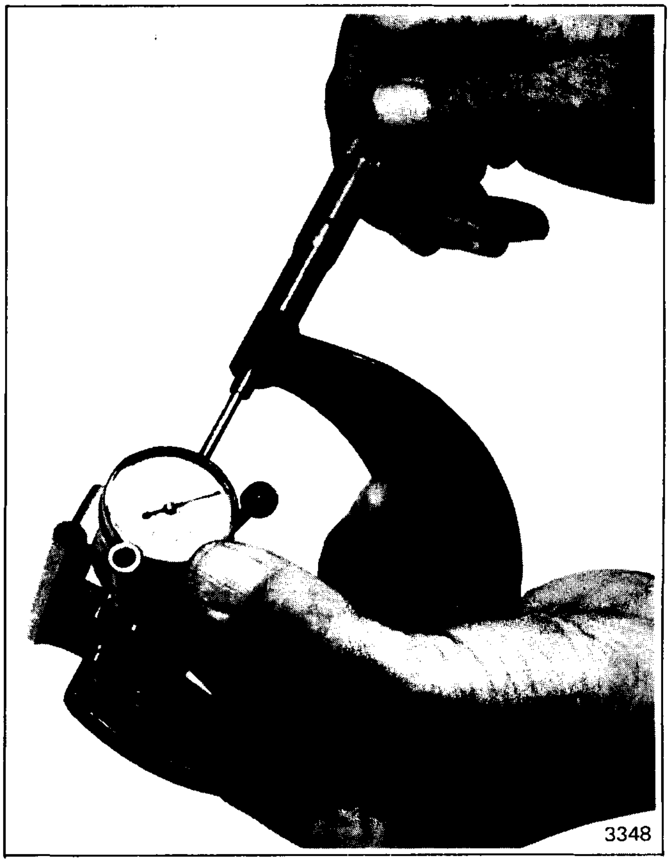


Fig. 6A5-46 Measuring Cylinder Bore Gage

IMPORTANT: (301 engine only) boring of the block should not be attempted without the use of a deck plate to simulate the cylinder head in its installed position.

By measuring the piston to be installed at the sizing points (Fig. 6A5-47) and adding the mean of the clearance specification, the finish hone cylinder measurement can be determined. It is important that both the block and piston be measured at normal room temperature.

After final honing and before the piston is checked for fit each cylinder bore must be thoroughly cleaned. Use soapy water solution and wipe dry to remove all traces of abrasive. If all traces of abrasive are not removed, rapid wear of new rings and piston will result.

Intermixing different size pistons has no effect on engine balance as all pistons from standard size, up to .030" oversize, weigh exactly the same.

PISTON

Fit and Replace

Pistons should be fitted in the bores by actually measuring the fit (measure O.D. of piston at sizing point and I.D. of cylinder bore). See engine specifications for clearances. If cylinder bores have been reconditioned, or if pistons are being replaced, reconditioning of bores and fitting of pistons should be closely coordinated.

If bore has been honed, it should be washed thoroughly with hot, soapy water and a stiff bristle brush.

Using a cylinder checking gage, measure the cylinder bore at right angles to piston pin to find the smallest diameter. Record the diameter of each bore.

CAUTION: *When measuring cylinder bores and pistons, it is very important that the block and pistons be at room temperature. If any or all of the parts are hotter or colder than normal room temperature, improper fitting will result.*

Measure the piston skirt perpendicular to the piston pin boss (piston pin removed) and at the sizing point indicated in Fig. 6A5-47.

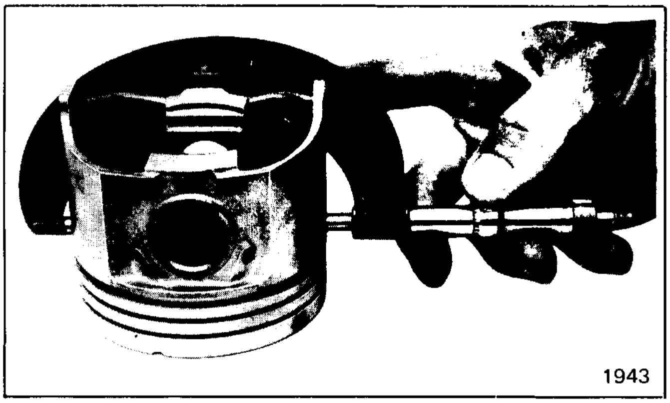


Fig. 6A5-47 Measuring Piston - Typical

Make sure the micrometer is in full contact.

As the pistons are measured they should be marked for size identification and the measurements recorded.

If there is excessive clearance between a cylinder bore and the piston which was installed in that bore, a new piston should be used.

New pistons are serviced in standard size and oversize. See parts listings

Since these are nominal or basic sizes, it is important that new pistons be measured to ensure proper fit. All new pistons are serviced with selectively fitted piston pins.

After all measurements have been made, match the new pistons with the cylinders where they will fit with proper clearance. Honing of cylinder bore may be necessary to effect a proper fit. (See Note in Honing and Boring Section.) When properly mated, mark the pistons with the cylinder numbers they fit so they will not become mixed.

PISTON RINGS

Install

Two compression rings and one 3-piece oil control ring, all above the piston pin, are used on pistons. The top compression rings are barrel faced and also have either a step or a chamfer on the inside diameter of the bottom side. The lower compression ring had a step also.

Always install compression rings with the side marked with letters "GM" toward the top of the piston.

New rings are serviced for the standard size pistons, and for .010", .020" and .030" oversize pistons. When selecting rings be sure they match the size of the piston on which they are to be installed, i.e. standard rings for standard pistons, .010" oversize rings for .010" oversize pistons, etc. Ring gap and side clearance should be checked while installing rings as follows:

1. Check pistons to see that ring grooves and oil return holes have been properly cleaned.
2. Place ring down at the bottom of the ring traveled part of the cylinder bore in which it will be used. Square ring in bore by pushing it into position with head of piston.
3. Measure gap between ends of ring with feeler gage (Fig. 6A5-48).

Fig. 6A5-48 Checking Ring Gap - Typical

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore, they should have the proper gap. It should not be necessary to alter ring gap by filing.

4. Install rings on piston, using suitable ring installing tool to prevent breakage or fracture of rings, or damage to pistons.

NOTE: Stagger ring end locations equially around pistons.

5. Measure side clearance of rings in ring groove (Fig. 6A5-49) as each ring is installed.

If side clearance is excessive, piston should be replaced.

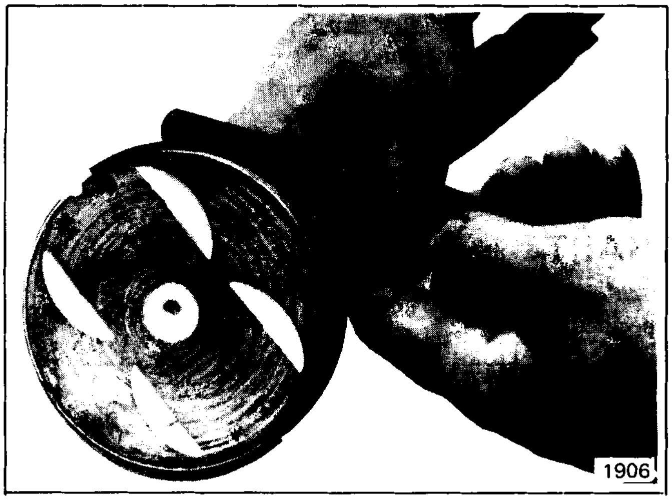


Fig. 6A5-49 Checking Side Clearance - Typical

ENGINE ASSEMBLY

Remove

1. Disconnect battery cables at battery.

2. Drain cooling system.

3. Scribe alignment marks on hood around hood hinges and remove hood from hinges.

4. Disconnect engine wire harness and engine to body ground straps.

5. Remove air cleaner.

6. Disconnect radiator and heater hoses at engine.

7. If equipped with power steering or air conditioning, remove pump and compressor from mounting brackets and set aside. Do not disconnect hoses.

8. Remove engine fan and pulley.

9. Disconnect accelerator control linkage and move cable to one side.

10. Disconnect transmission vacuum modulator line (automatic) and power brake vacuum line at carburetor.

CAUTION: *Do not fold the metal transmission modulator line.*

11. Raise vehicle and drain crankcase.

12. Disconnect fuel lines at fuel pump.

13. Disconnect exhaust pipes from manifolds.

14. Disconnect starter wires.

15. If equipped with automatic transmission, remove converter cover, remove three converter retaining bolts and slide converter to rear.

16. If equipped with manual transmission, disconnect clutch linkage, remove clutch cross shaft, starter and lower flywheel cover.

17. Remove four lower bell housing bolts (two each side).

18. Disconnect transmission filler tube support (automatic transmission).

19. Remove two front motor mount bolts.

20. Lower vehicle.

21. Using jack and block of wood, support transmission.

22. Remove two remaining bell housing bolts.

23. Raise transmission slightly.

24. Using suitable lifting equipment, remove engine.

INSTALL

1. Install engine lifting equipment to engine and lower engine into chassis, guiding engine to align with bell housing.

2. With engine supported by lifting equipment, install two upper bell housing bolts.

CAUTION: *Do not lower engine completely while jack is supporting transmission.*

3. Remove transmission support jack.

4. Lower engine and remove lifting equipment.

5. Raise vehicle.

6. Install remaining bell housing bolts.

7. Replace two front motor mount to frame bolts.

8. For remaining installation procedures, reverse steps 1 thru 17.

CRANKSHAFT

Remove

1. Remove engine from vehicle.

2. Mount engine on suitable stand.

3. Remove spark plugs.

4. Remove fan and fan pulley.

5. Remove harmonic balancer.

6. Remove oil pan and oil pump assembly.

7. Remove timing gear cover.

6. Remove crankshaft timing gear.

9. Remove connecting rod bearing caps with bearings and identify each for reinstallation.

10. Push connecting rod and piston assemblies away from crankshaft.

11. Remove main bearing caps with bearings and identify for reinstallation.

12. Remove crankshaft.

Replace

1. With new upper bearings and rear oil seal installed position crankshaft in block.

2. Install main bearing caps (with new lower bearings), but do not tighten cap bolts.

3. Pull connecting rods (with new upper bearings installed) and pistons into place.

4. Install rod bearing caps (with new bearings), but do not tighten nuts.

5. With rubber mallet hit both ends of crankshaft to center thrust bearing. Rearward first than forward last.

6. Tighten main bearing caps.

7. Tighten connecting rod bearing caps.

6. Recheck bearing clearances using plastic gage method.

9. Install key from old crankshaft keyway in new crankshaft.

10. Install crankshaft timing gear.

IMPORTANT: ALIGN TIMING MARKS ON TIMING GEARS BY ROTATING CRANKSHAFT IF NECESSARY

11. Install timing gear cover using new seal and gaskets.

12. Install oil pump assembly and oil pan.
13. Coat front cover oil seal contact area of balancer with oil and drive balancer into position.
14. Install fan pulley and fan.
15. Install spark plugs.
16. Remove engine from stand.
17. Install engine in vehicle.

TORQUE CHART

Torque in lb. ft. unless otherwise specified.

APPLICATION	TORQUE (301)	TORQUE (350-400)
Bolt-Main Bearing Cap to Block (Except Wear)	70	100
Bolt-Rear Main Bearing Cap to Block	100	120
Bolt-Cylinder Head	85	100
Bolt-Flywheel to Crankshaft	95	95
Nut-Connecting Rod Bearing Cap	30	40
Bolt-Oil Pan to Block	12	12
Bolt-Oil Pump to Block	30	30
Bolt-Harmonic Balancer to Crankshaft	160	160
Bolt-Exhaust Manifold to Head	40	40
Bolt-Intake Manifold to Head	35	35
Bolt-Camshaft to Sprocket	40	40
Nut-Rocker Arm to Stud	20	20
Stud-Rocker Arm	15	15
Spark Plug to Head	15	15
Bolt-Rocker Cover	7	7

SPECIFICATIONS

Type	90° V8 O.H. Valve
Bore and Stroke	
301 Engine	4.00" X 3.00"
350 Engine	3.87" x 3.75"
400 Engine	4.12" x 3.75"
Compression Ratio	
301 Engine	8.2
350-400 Engine	7.6
400 TA Engine	8.0
Compression Pressure at Cranking Speed (Wide Open Throttle)	120-160 PSI @ 155-175 RPM
Cylinder Nos.-Front to Rear	
Left Bank	1-3-5-7
Right Bank	2-4-6-8
Firing Order	1-8-4-3-6-5-7-2

CYLINDER BLOCK

Material	Alloy Cast Iron

CYLINDER HEADS

Material	Alloy Cast Iron
Combustion Chamber	Quench Type

Fully Machined

PISTONS

Material	Cast Aluminum Alloy, Tin-Plated
Type	Cam and Contour Ground-Slipper Skirt
Measurement Taken At	Top of Skirt
Clearance in Cylinder	.0025" - .0033"

NOTE: Cylinder block and pistons must be at 70° to 80°F. to 23.2°C.) at time of fitting pistons to cylinder.

PISTON RINGS

Compression Rings	Two - Cast Iron Reverse Twist, Barrel Face (upper), and Taper Face (lower)
Material	
Upper	Channel Moly Filled
Lower	Tin Plated
Ring Gap	
Upper	.010"-.020"
Lower	.010"-.020"
Side Clearance	.0015"-.0035"
Oil Ring	Three Piece
Material	
Steel-Chrome	
Ring Gap	.035"
Side Clearance	.0015"-.0035"

PISTON PIN

Material	Extruded SAE 1016 Steel
Diameter (301 Engine)	.927"
Diameter (350-400)	.980"
Length (301 Engine)	3. 00"
Length (350-400 Engine)	3.25"
Fit in Piston (301 Engine)	.0002" - .0004"
Fit in Piston (350-400)	.0003" - .0005"
Fit in Rod	Press

CONNECTING ROD

Material	Arma Steel
Weight (301 Eingine	21.9 oz/
Weight (350-400 Engine)	31.7 oz.
Length (Center to Center) (301 Engine)	6.050"
Length (Center to Center) (350 Engine)	6.625"
Length (Center to Center) (400 Engine)	6.625"
Bearings	
Clearance	.0005" - .0025"
Material	Moraine 400-A
End Play on Crankshaft	
(Total for Two) (301 Engine)	.006"-.022"
(350-400 Engine)	.012"-.017"

VALVES

Material	
Intake (301 Engine)	SAE 1541 Steel
Intake (350-400 Engine)	1541 Steel
Exhaust	21-2N Steel
Diameter of Head	
Intake (301 Engine)	1.72"
Intake (350-400)	2.10"
Exhaust (301)	1.50"
Exhaust (350-400)	1.65"
Overall Length	
Intake (301)	5.07"
Intake (350-400)	4.86"
Exhaust (301)	5.07"
Exhaust (350-400)	4.86"
Diameter of Stem	.34"
Stem to Guide Clearance (301 Eng.)	
Intake	.0010/.0027
Top Exhaust	.0010/.0027
Bottom Exhaust	.0020/.0037
(350-400 Eng.) Intake	.0016-.0033
Stem to Guide Clearance	
(350-400 Eng.) Exhaust	.0021"-.0038"
Valve Seat Angle	
Intake	46°
Exhaust	46°
Valve Face Angle	
Intake	45°
Exhaust	45°

CRANKSHAFT

Material	Nodular Iron
No. of Bearings	5
Main Bearing Type	Moraine 400-A
Thrust Taken On	No. 4
Crankshaft Endplay	.003" - .009"
Journal Diameter	3.00"
Main Bearing Clearance	
All	.0004" - .0020"
Crankpin Diameter (350-400)	2.25"
Crankpin Diameter (301)	2.00

FLYWHEEL AND SPROCKETS

Flywheel	
Material	
Manual	Cast Iron
Automatic	Stamped Steel
No. of Teeth	166
Starter Motor Drive	
No. of Teeth	9
Crankshaft Sprocket	
Material	Hardened Sintered Iron
No. of Teeth	21
Camshaft Sprocket	
Material	Heat Treated Cast Iron
No. of Teeth	42
Timing Chain	Link Type - Single Side Guide
No. of Links	60

CAMSHAFT

Material	Hardened Alloy Cast Iron
Bearings	
Number	5
Type	Steel Backed Babbitt
Diameter - All	1.9"

VALVE SYSTEM

Valve Lifter	
Type	Hydraulic
Leak-Down Rate	
All	12-90 sec. @ 50 lb. load
Plunger Travel (For Gaging Purposes)	.125"
Pushrod	
Material	Ball Ended - Steel Tubing
Length (301 Eng.)	8.12"
Length (350-400 Eng.)	9.17"

Rocker Arm	
Material	Stamped Steel
Ratio (301 Eng.)	1.5 to 1
Ratio (350 Eng.)	1.6 to 1
Ratio (400 Eng.)	1.5 to 1
Rocker Arm Stud	Screwed into Head
Valve Spring Tension (301 Eng.)	165 lb. @ 1.29"
Valve Spring Tension Outer (350-400 Eng.)	135 lb. @ 1.18"
Valve Spring Tension Inner (350-400 Eng.)	97 lb. @ 1.14"
Installed Height (301 Eng.)	1.66"
Installed Height (350-400 Eng.)	1.54"

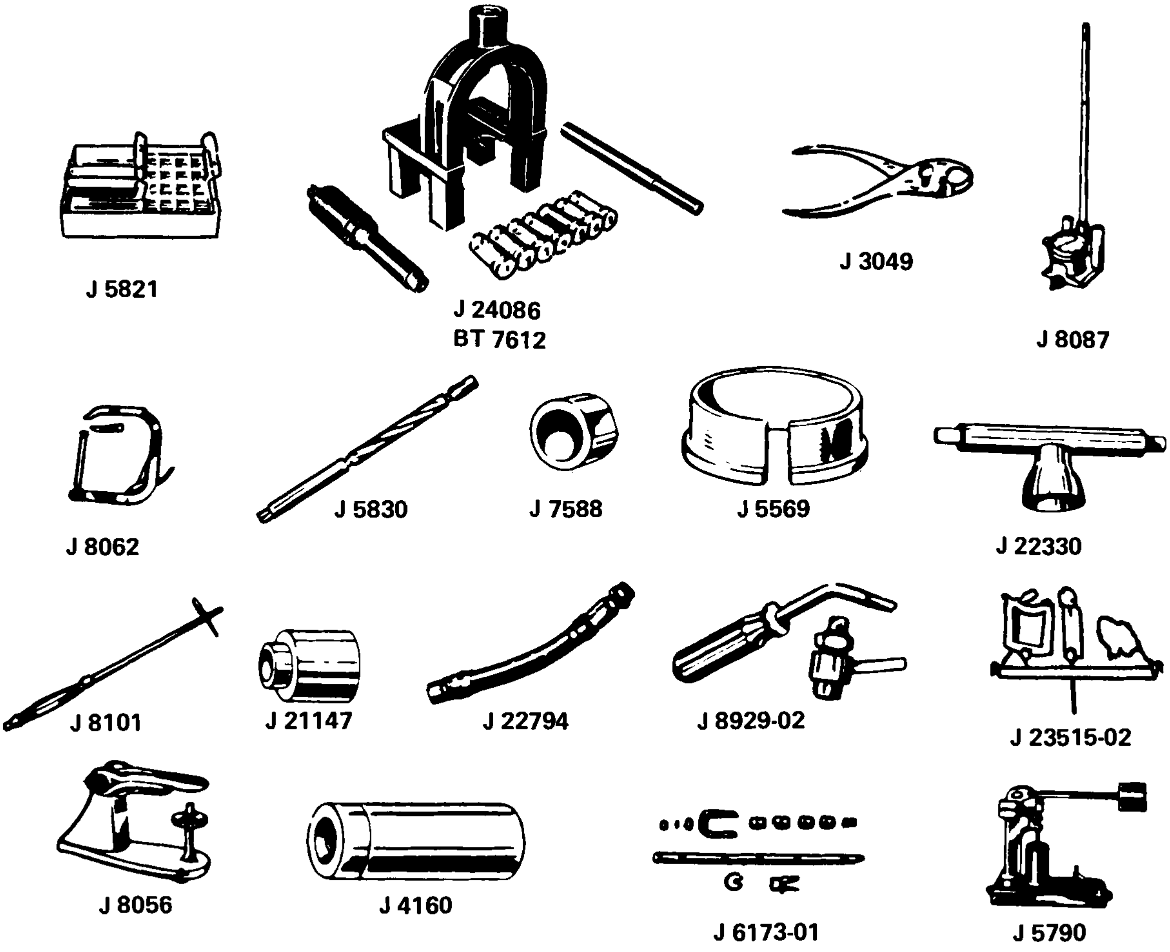
LUBRICATION SYSTEM

Type of Lubrication	
Main Bearings	Pressure
Connecting Rods	Pressure
Piston Pins	Splash
Camshaft Bearings	Pressure
Lifters and Rocker Arms	Pressure
Timing Gears and Chain	Metered Jet
Cylinder Walls	Splash

OIL PUMP

Type	Spur Gear
Oil Pickup	Stationary Screen
Pressure (301 Eng.)	55-60 PSI @ 2600 RPM
Pressure (350-400 Eng.)	38-42 PSI @ 2600 RPM
Oil Capacity	5 Qts.
With Filter	6 Qts.

*400 engines with axle ratios above 2.93 to 1 and syncromesh transmission applications have 60 pumps.



TOOL NO.	NAME
J 5821	VALVE LIFTER CLEANING TANK
J 24086 BT 7612	PISTON PIN TOOL
J 3049	HYDRAULIC VALVE LIFTER REMOVER
J 8087	CYLINDER BORE CHECKING GAUGE
J 8062	VALVE SPRING COMPRESSOR
J 5830	11/32" VALVE GUIDE REAMER
J 7588	REAR MAIN BEARING OIL SEAL INSTALLER
J 5569	PISTON RING COMPRESSOR (4")
J 22330	VALVE SEAL INSTALLER & TESTER
J 8101	VALVE GUIDE CLEANING TOOL
J 21147	TIMING CHAIN COVER OIL SEAL INSTALLER
J 22794	AIR LINE ADAPTER-VALVE SPRING COMPRESSOR 14MM (USE WITH J 8929-01)
J 8929-02	VALVE SPRING COMPRESSOR
J 23515-02	ENGINE LIFTING FIXTURE
J 8056	VALVE & CLUTCH SPRING TESTER
J 4160	HYDRAULIC VALVE LIFTER PLUNGER REMOVER
J 6173-01	CAMSHAFT BEARING REMOVER & INSTALLER
J 5790	HYDRAULIC VALVE LIFTER LEAKDOWN TESTER (INCLUDES ONE GALLON J 5268 TEST OIL)

3502

Fig. 6A5-50 Special Tools

SECTION 6A6

5 LITRE 305 CU. IN. AND 5.7 LITRE 350 CU. IN ENGINE

VI CODES U AND L X-SERIES ONLY

CONTENTS

GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast iron and has 8 cylinders arranged in a "V" shape with 4-cylinders in each bank. Five main bearings support the crankshaft which is retained by recessed bearing caps that are machined with the block for proper alignment and clearances. Cylinders are completely encircled by coolant jackets.

CYLINDER HEAD

The cast iron cylinder heads provide a compression ratio of 8.5:1. They are cast with individual intake and exhaust ports for each cylinder. Valve guides are integral, and rocker arms are retained on individual studs.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by five main bearings. Number five bearing is the end thrust bearing.

Main bearings are lubricated from oil holes which intersect the camshaft bearings. The camshaft bearings are fed oil by the main oil gallery which is rifle drilled down the center of the block, above the camshaft. Two additional oil galleries are on either side of the main oil gallery to provide an oil supply for the hydraulic lifters.

A harmonic balancer on the forward end of the crankshaft dampens any engine torsional vibrations.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by five bearings and is chain driven. A steel crankshaft gear drives the timing chain which in turn drives the camshaft through a bakelite fabric composition gear with a steel hub.

Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifter, causes the valve lifters to rotate.

Camshaft bearings are lubricated through oil holes which intersect the main oil gallery. The main oil gallery is rifle drilled down the center of the block, above the camshaft.

PISTONS AND CONNECTING RODS

The pistons are made of cast aluminum alloy using two compression rings and one oil control ring.

Piston pins are offset 1/16" toward the thrust side (right hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins are chromium steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

VALVE TRAIN

A very simple ball pivot-type train is used. Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker arm ball is retained by a nut.

HYDRAULIC VALVE LIFTERS

Hydraulic valve lifters are used to keep all parts of the valve train in constant contact.

The hydraulic lifter assembly consists of: the lifter body, which rides in the cylinder block boss, a plunger, a push rod seat, a metering valve, a plunger spring, a check ball and spring, a check ball retainer and a push rod seat retainer.

When the lifter is riding on the low point of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the check ball cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then rise as a unit, pushing up the push rod and opening the valve.

As the lifter body rides down the other side of the cam, the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will remain full.

INTAKE MANIFOLD

The intake manifold is of cast iron double level design for efficient fuel distribution. The carburetor pad is centrally located with a passage running underneath the pad (E.F.E.) through which exhaust gases are forced to promote faster fuel vaporization when the engine is cold. An EGR port is also cast into the manifold for the induction of exhaust gases into the inducted fuel.

EXHAUST MANIFOLDS

Two cast nodular iron exhaust manifolds are used to direct exhaust gases from the combustion chambers. The right hand side manifold receives a heat shield that is used to route heated air to the air cleaner for better fuel vaporization.

COMBUSTION CHAMBERS

Combustion chambers are cast to insure uniform shape for all cylinders. Spark plugs are located between the intake and exhaust valves.

The contoured wedge shape of the combustion chamber minimizes the possibility of detonation, facilitates breathing and provides swirling turbulence for smooth, complete combustion.

ENGINE SERVICE

NOTE: The following information is important in preventing engine damage and in contributing to reliable engine performance.

When raising or supporting the engine for any reason, do not use a jack under the oil pan or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pick-up unit.

It should be kept in mind, while working on the engine, that the 12-volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.

Any time the carburetor or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

ENGINE LUBRICATION

Full pressure lubrication through a full flow oil filter, is furnished by a gear-type oil pump. The distributor, driven by a helical gear on the camshaft, drives the oil pump. The main oil gallery feeds oil, through drilled passages, to the camshaft and crankshaft to lubricate the bearings. The valve lifter oil gallery feeds the valve lifters which, through hollow push rods, feed the individually mounted rocker arms (Fig. 6A6-1).

SERVICE PROCEDURES

ENGINE MOUNTS

Engine mounts are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

CHECKING ENGINE MOUNTS

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. If an engine mount exhibits:

a. Hard rubber surface covered with heat check cracks;

b. Rubber separated from a metal plate of the mount; or

c. Rubber split through center.

Replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame or bracket.

Rear Mount

Raise the vehicle on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottom out) replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

FRONT MOUNT REPLACEMENT

1. Remove mount retaining bolt from below frame mounting bracket.
2. Raise front of engine and remove mount-to-engine bolts and remove mount.

CAUTION: *Raise engine only enough for sufficient clearance. Check for interference between rear of engine and cowl panel.*

3. Replace mount to engine and lower engine into place.
4. Install retaining bolt and torque all bolts to specifications.

REAR MOUNT REPLACEMENT

1. Support engine weight to relieve rear mounts.
2. Remove crossmember-to-mount bolts.
3. Remove mount-to-transmission bolts, then remove mount.
4. Install new mount on transmission.
5. While lowering transmission, align and start crossmember-to-mount bolts.
6. Torque bolts to specifications then bend lock tabs to bolt head as applicable.

INTAKE MANIFOLD

Removal

1. Drain radiator and remove air cleaner.
2. Disconnect:
   - Battery negative cable at battery.
   - Radiator upper hose and heater hose at manifold.
   - Accelerator linkage at carburetor.
   - Fuel line at carburetor.
   - Crankcase ventilation lines.
   - Spark advance hose at distributor.
3. Remove distributor cap and mark rotor position with chalk, then remove distributor.
4. Remove (as required) air cleaner bracket, accelerator return spring and bracket, and accelerator bellcrank.
5. Remove generator upper mounting bracket.
6. Remove manifold attaching bolts, then remove manifold and carburetor as an assembly. Discard gaskets and seals.
7. If manifold is to be replaced, transfer:
   - Carburetor and carburetor attaching bolts.
   - Temperature sending unit.
   - Thermostat with housing (use new gasket).
   - Heater hose and water pump by-pass adapters.
   - EGR Valve (use new gasket).
   - TVS Switch (if applicable).
   - Vacuum fittings(s).
   - Choke Spring Assembly (where applicable).

Installation

1. Clean gasket and seal surfaces on manifold, block, and cylinder heads.
2. Install manifold seals on block and gaskets on cylinder heads (Fig. 6A6-2). Use sealer at water passages and where seals butt to gaskets.

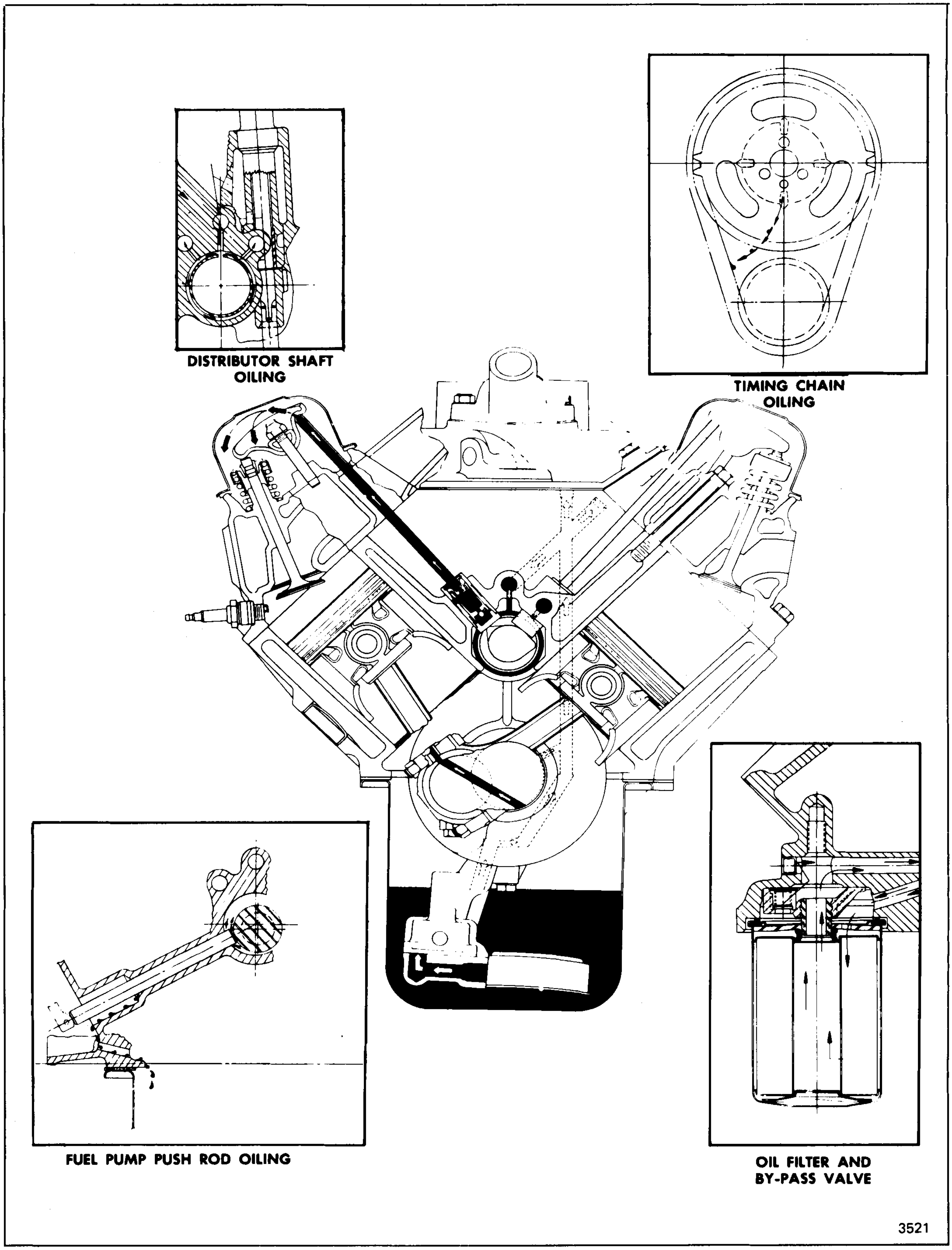


FIG. 6A6-1 ENGINE LUBRICATION

3. Install manifold and torque bolts to specifications in the sequence outlined in Fig. 6A6-3.

4. Install (if removed) air cleaner bracket, accelerator return spring and bracket and accelerator bellcrank.

5. Install distributor, positioning rotor at chalk mark, then install distributor cap.

6. Connect:

- Spark advance hose at distributor.
- Crankcase ventilation lines.
- Fuel line at carburetor.

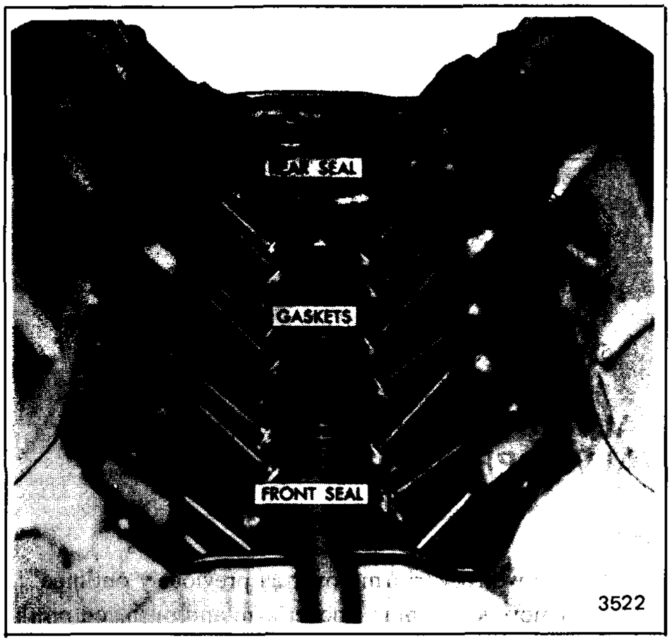


Fig. 6A6-2 Intake Manifold Gasket and Seal Location

- Accelerator linkage at carburetor.
- Battery negative cable at battery.

7. Install air cleaner.

8. Fill with coolant, start engine, adjust ignition timing and carburetor idle speed and check for leaks.

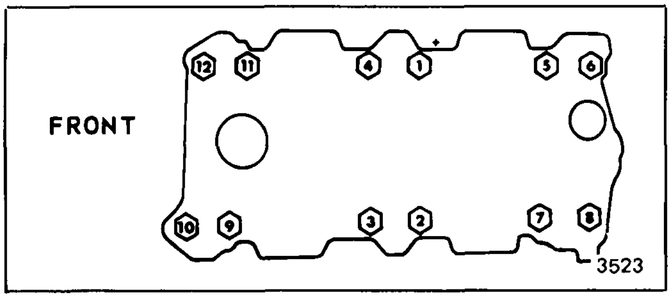


Fig. 6A6-3 Manifold Bolt Torque Sequence

EXHAUST MANIFOLD

Removal

1. Remove carburetor heat stove pipe.

2. Remove the spark plug wiring heatshields.

3. Disconnect exhaust pipe from manifold and hang exhaust pipe from frame with wire.

4. Remove end bolts, then remove center bolts and remove manifold.

Installation

NOTE: If installing a new right side manifold, the carburetor heat stove must be transferred from the old unit (Fig. 6A6-4).

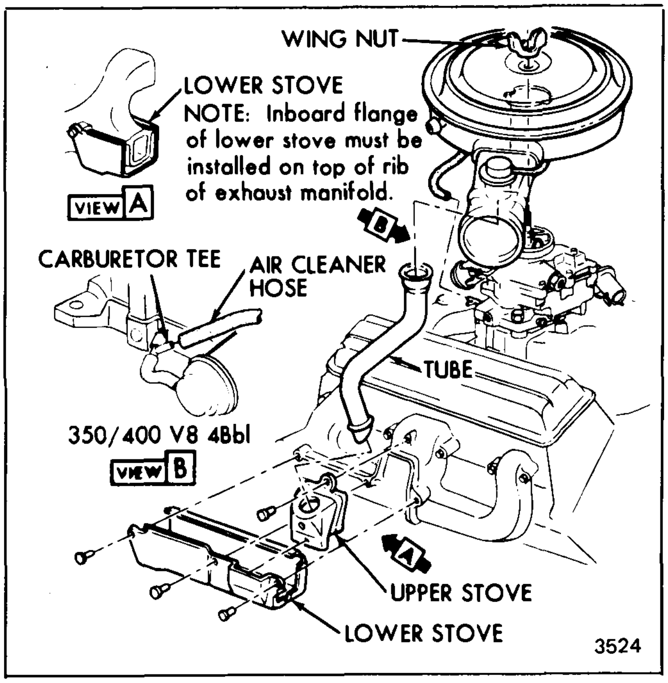


Fig. 6A6-4 Choke Stove Installation

1. Clean mating surfaces on manifold and head, then install manifold in position and install bolts (fingertight).

2. Torque manifold bolts to specifications in the sequence shown on torque chart at end of section.

3. Connect exhaust pipe to manifold. Use new gasket or packing.

4. Install carburetor heat stove pipe.

5. Install spark plug wiring heatshields.

6. Start engine and check for leaks.

ROCKER ARM COVER

Removal

1. Remove air cleaner.

2. Disconnect crankcase ventilation hoses at rocker arm covers.

3. Disconnect electrical wiring harness from rocker cover clips.

4. Remove carburetor heat stove pipe from right exhaust manifold.

5. If the vehicle is equipped with air conditioning, remove the A/C compressor rear brace.

6. Remove rocker arm cover to head attaching bolts and remove rocker arm cover.

CAUTION: *Do not pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping end of rocker arm cover rearward with palm of hand or a rubber* *mallet.*

Installation

1. Clean gasket surfaces on cylinder head and rocker arm cover with degreaser then, using a new gasket, place rocker arm cover on the head, install retaining bolts, and torque to specifications.

2. On A/C equipped vehicles, install the A/C compressor rear brace. Adjust pulley belt to specifications.

3. Install carburetor heat stove pipe.

4. Connect electrical wiring harness at clips on rocker arm cover.

5. Connect crankcase ventilation hoses.

6. Install air cleaner, start engine and check for leaks.

VALVE MECHANISM

Removal

1. Remove rocker arm covers as previously outlined.

2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods.

NOTE: Place rocker arms, rocker arm balls and push rods in a rack so they may be reinstalled in the same locations.

Installation and Adjustment

NOTE: Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter sockets.

2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.

3. Adjust valves when lifter is on base circle of camshaft lobe as follows:

a. Crank engine until mark on torsional damper lines up with center or "O" mark on the timing tab fastened to the crankcase front cover and the engine is in the number 1 firing position. This may be determined by placing fingers on the number 1 valve as the mark on the damper comes near the "O" mark on the crankcase front cover. If the valves are not moving, the engine is in the number 1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in number 6 firing position and should be turned over one more time to reach the number 1 position.

b. With the engine in the number 1 firing position as determined above, the following valves may be adjusted.

Exhaust - 1, 3, 4, 8
Intake - 1, 2, 5, 7

c. Back out adjusting nut until lash is felt at the push rod, then turn in adjusting nut until all lash is removed. This can be determined by checking push rod side play while turning adjusting nut (Fig. 6A6-5). When play has been removed, turn adjusting nut in one full additional turn (to center lifter plunger).

d. Crank the engine one revolution until the pointer "O" mark and torsional damper mark are again in alignment. This is number 6 firing position. With the engine in this positon, the following valves may be adjusted.

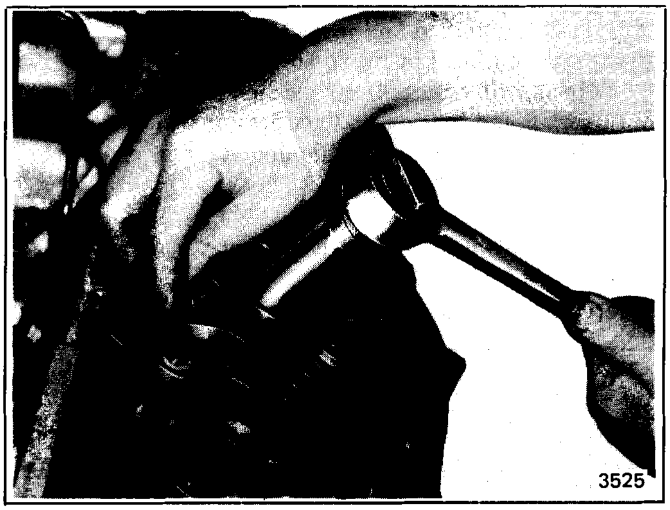


Fig. 6A6-5 Valve Adjustment (Typical)

Exhaust - 2, 5, 6, 7
Intake - 3, 4, 6, 8

4. Install rocker arm covers as previously outlined.

5. Start engine and adjust carburetor idle speed.

VALVE STEM OIL SEAL AND/OR VALVE SPRING

Removal

1. Remove rocker arm cover as previously outlined.

2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.

3. Install air line adapter Tool J 23590 to spark plug port and apply compressed air to hold the valves in place.

4. Using Tool J 5892 to compress the valve spring, remove the valve locks, valve cap and valve spring and damper (Fig. 6A6-6).

5. Remove the valve stem oil seal.

Installation

NOTE: A light coat of oil on the seal will help prevent twisting.

2. Install the valve locks and release the compressor tool making sure the locks seat properly in the upper groove of the valve stem.

NOTE: Grease may be used to hold the locks in place while releasing the compressor tool.

3. Install spark plug and torque to specification.

4. Install and adjust valve mechanism as previously outlined.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts (see Diagnosis section).

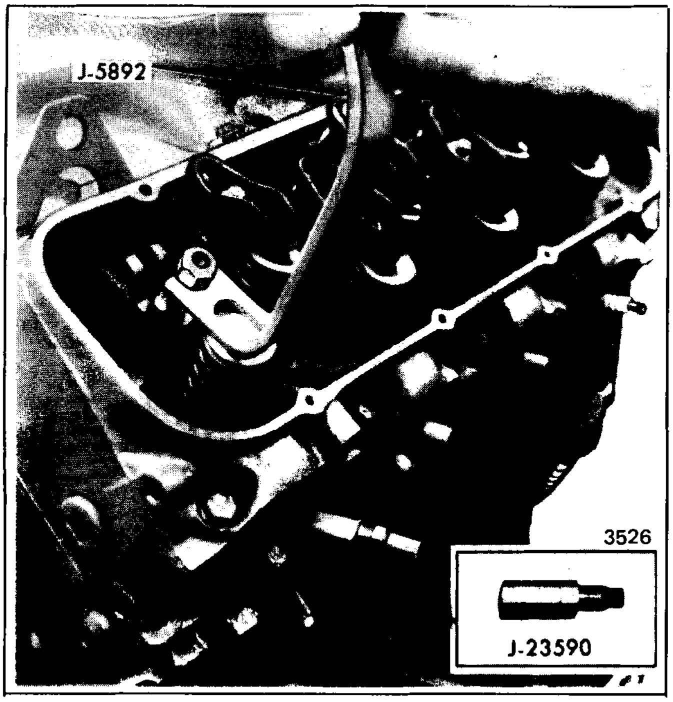


Fig. 6A6-6 Compressing Valve Spring (Typical)

Removal

1. Remove intake manifold as previously outlined.
2. Remove valve mechanism as previously outlined.
3. Remove valve lifters.

NOTE: Place valve lifters in a rack so that they may be reinstalled in the same location.

Installation

1. Install valve lifters.

NOTE: Whenever new valve lifters are being installed, coat foot of valve lifters with "Molykote" or its equivalent.

2. Install intake manifold as previously outlined.
3. Install and adjust valve mechanism as outlined.

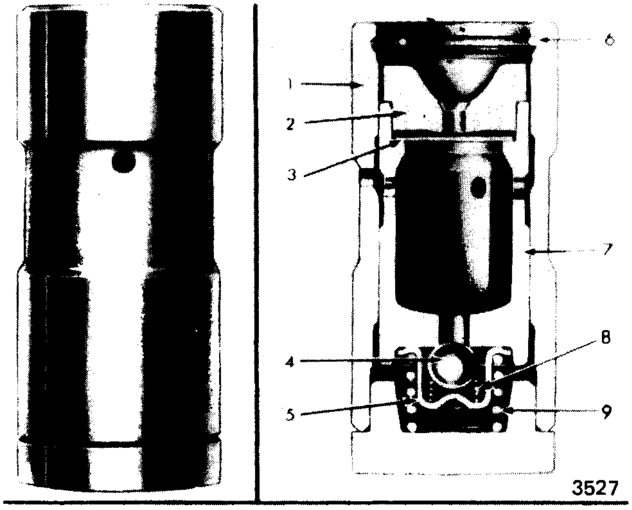
VALVE LIFTERS

Disassembly

1. Hold the plunger down with a push rod, and using the blade of a small screwdriver, remove the push rod seat retainer.
2. Remove the push rod seat and metering valve (Fig. 6A6-7).
3. Remove the plunger, ball check valve assembly and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screwdriver (Fig. 6A6-8).

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced. If the lifter body wall is scuffed or worn, inspect the cylinder block lifter bore. If the bottom of the lifter is scuffed or worn, inspect the camshaft lobe. If the push rod seat is scuffed or worn, inspect the push rod. An additive containing EP lube, such as EOS, should always be added to crankcase oil for run-in when any new camshaft or lifters are installed. All damaged or worn lifters should be replaced.



1. Lifter Body
2. Push Rod Seat
3. Metering Valve
4. Check Ball
5. Check Ball Retainer
6. Push Rod Seat Retainer
7. Plunger
8. Check Ball Spring
9. Plunger Spring

Fig. 6A6-7 Hydraulic Valve Lifter

Fig. 6A6-8 Removing Ball Check Valve Retainer

Assembly

1. Place the check ball on small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screwdriver (Fig. 6A6-9).
3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.

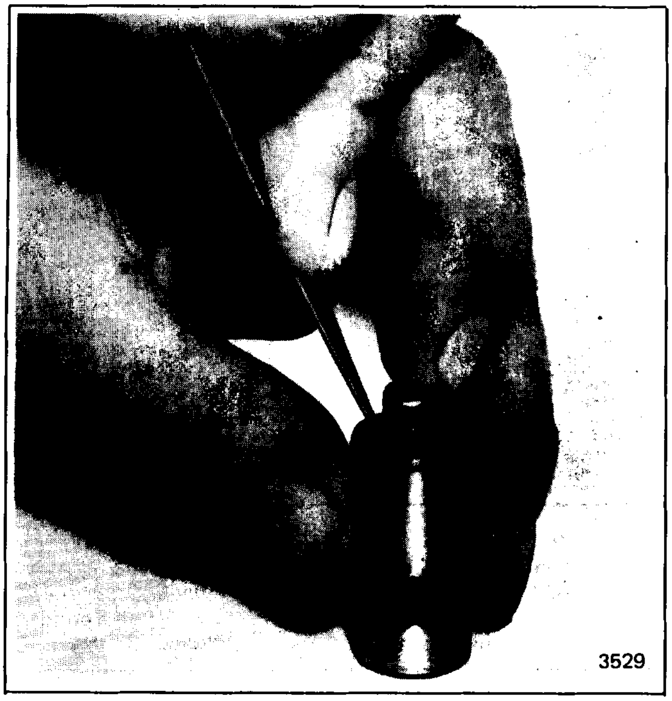


Fig. 6A6-9 Installing Ball Check Valve

4. Fill the assembly with SAE 10 oil, then insert the end of a 1/8" drift pin into the plunger and press down solid. At this point oil holes in the lifter body and plunger assembly will be aligned (Fig. 6A6-10).

CAUTION: *Do not attempt to force or pump the plunger.*

5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension (Fig. 6A6-10).

6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.

7. Install the metering valve and push rod seat (Fig. 6A6-7).

8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" drift pin from the oil holes. The lifter is now completely assembled, filled with oil and ready for installation.

NOTE: Before installing lifters, coat the bottom of the lifter with "Molykote" or its equivalent.

CYLINDER HEAD ASSEMBLY

Removal

1. Remove intake manifold as previously outlined.

2. Remove generator lower mounting bolt and lay unit aside.

3. Remove exhaust manifolds as previously outlined.

4. If vehicle is equipped with A/C, remove A/C compressor and forward mounting bracket. Lay unit aside.

NOTE: On vehicles equipped with A.I.R., disconnect the rubber hosing at the injection tubing check valve. In this manner, the tubing will not have to be removed from the exhaust manifold.

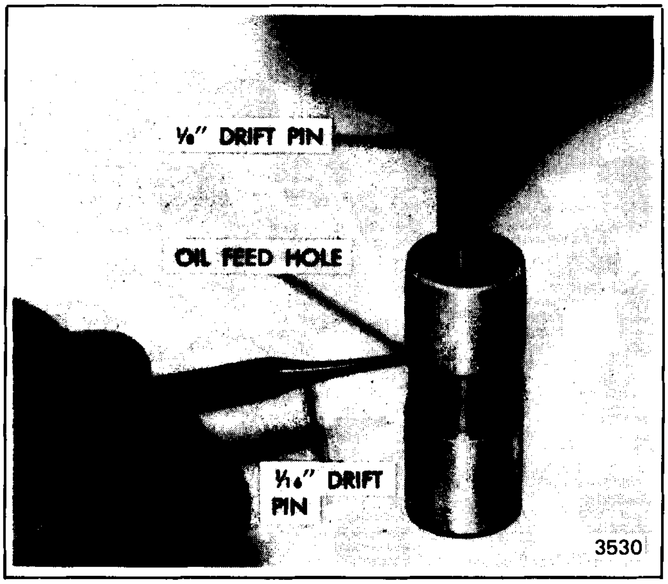


Fig. 6A6-10 Assembling Hydraulic Lifter

5. Remove valve mechanism as previously outlined.

6. Drain cylinder block of coolant.

7. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Disassembly

1. With cylinder head removed, remove valve rocker arm nuts, balls and rocker arms (if not previously done).

2. Using Tool J 8062, compress the valve springs (Fig. 6A6-11) and remove valve keys. Release the compressor tool and remove spring caps, spring shields, springs and spring damper. Then remove oil seals.

3. Remove valves from cylinder head and place them in a rack in their proper sequence so that they can be assembled in their original positions.

Cleaning

1. Clean all carbon from combustion chambers and valve ports using Tool J 8089 (Fig. 6A6-12).

2. Thoroughly clean the valve guides using Tool J 8101 (Fig. 6A6-13).

3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.

4. Clean valve stems and heads on a buffing wheel.

5. Clean carbon deposits from head gasket mating surface.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.

2. Inspect the valves for burned heads, cracked faces or damaged stems.

NOTE: Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness.

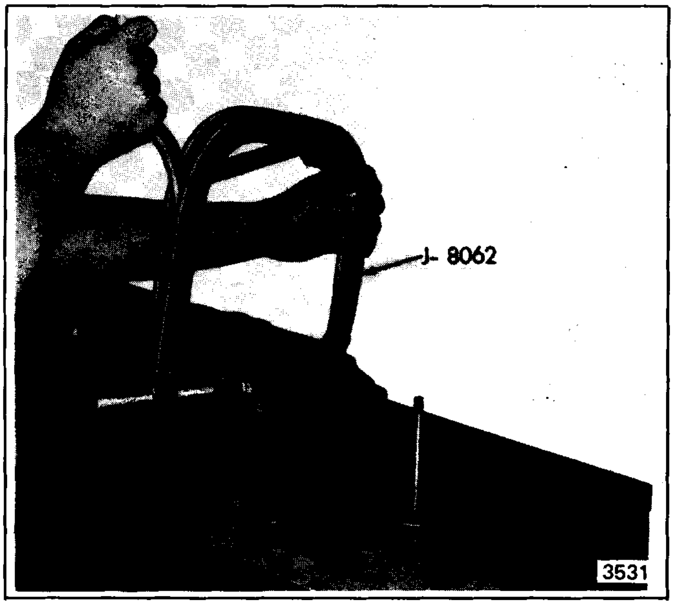


Fig. 6A6-11 Compressing Valve Spring

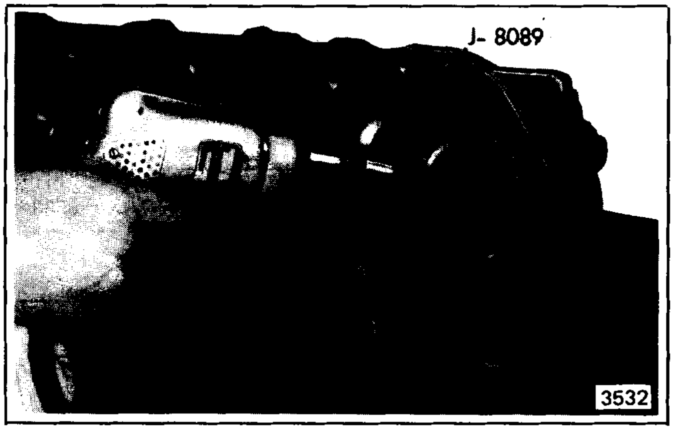


Fig. 6A6-12 Cleaning Combustion Chambers

3. Measure valve stem clearance (Fig. 6A6-14) as follows:

Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail, locating the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide. With the valve head dropped about 1/16" off the valve seat; move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications it will be necessary to ream valve guides for oversize valves as outlined.

4. Check valve spring tension with Tool J 8056 spring tester (Fig. 6A6-15).

NOTE: Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not within 10 lbs. of the specified load (without dampers).

5. Inspect rocker arm studs for wear or damage.

Assembly

1. Insert a valve in the proper port.

Fig. 6A6-13 Cleaning Valve Guides

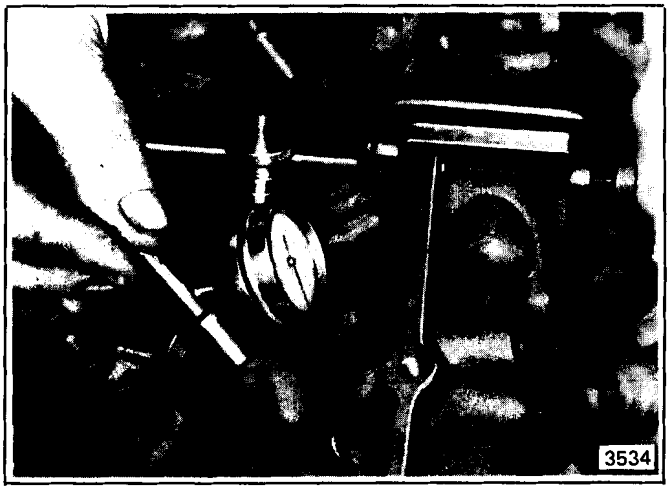


Fig. 6A6-14 Measuring Valve Stem Clearance (Typical)

2. Assemble the valve spring and related parts as follows:

a. Set the valve spring (with damper if used), valve shield and valve cap in place (Fig. 6A6-16).

b. Compress the spring with Tool J 8062.

c. Install oil seal in the lower groove of the stem, making sure that the seal is flat and not twisted.

d. Install the valve locks and release the compressor tool, making sure that the locks seat properly in the upper groove of the valve stem.

3. Install the remaining valves.

4. Check each valve stem oil seal by placing Valve Seal Leak Detector (Tool J 23994) over the end of the valve stem and against the cap. Operate the vacuum pump and make sure no air leaks past the seal (Fig. 6A6-17).

5. Check the installed height of the valve springs, using a narrow thin scale. A cutaway scale will help (Fig. 6A6-18). Measure from the top of the shim or the spring seat to the top of the valve spring or valve spring shield (Fig. 6A6-19). If this is found to exceed the specified height, install a valve

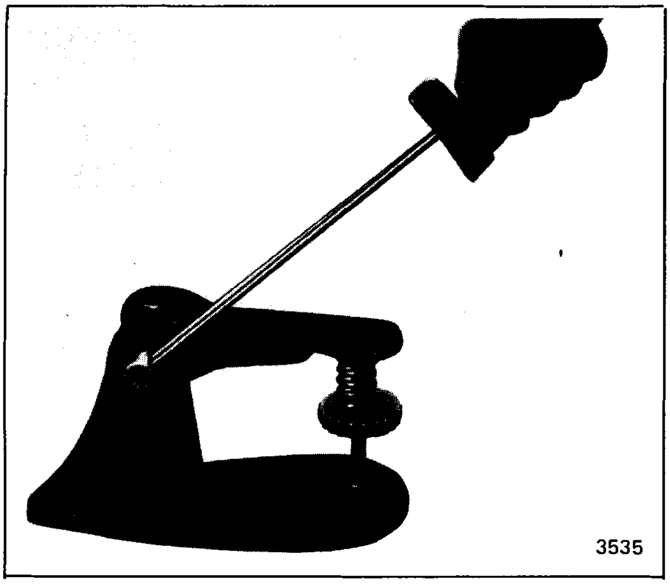


Fig. 6A6-15 Checking Valve Spring Tension

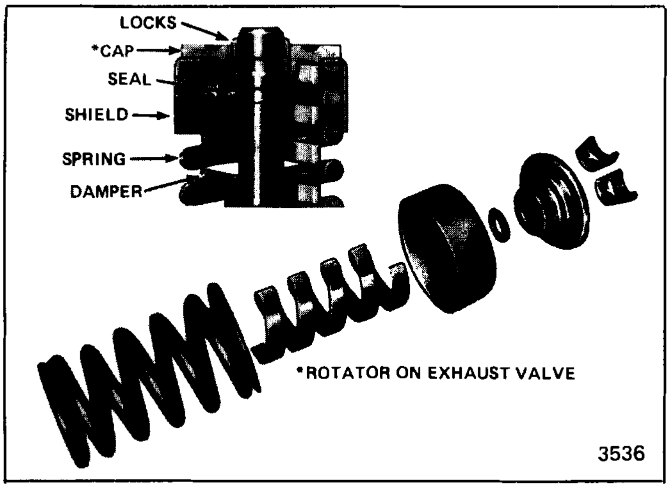


Fig. 6A6-16 Valve Spring Installation

spring seat shim approximately 1/16" thick. At no time should the spring be shimmed to give an installed height under the minimum specified.

Installation

CAUTION: *The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolts must be clean. (Dirt will affect bolt torque).*

1. On engines using a STEEL gasket, coat both sides of a new gasket with a good sealer. Spread the sealer thin and even. One method of applying the sealer that will assure the proper coat is with the use of a paint roller. Too much sealer may hold the gasket away from the head or block.

CAUTION: *Use no sealer on engines using a composition STEEL ASBESTOS gasket.*

2. Place the gasket in position over the dowel pins with the bead up.

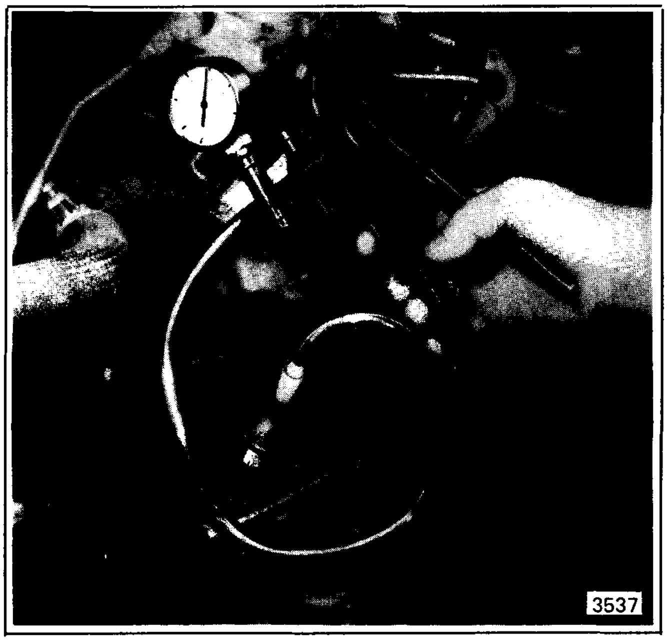


Fig. 6A6-17 Checking Valve Stem Oil Seals

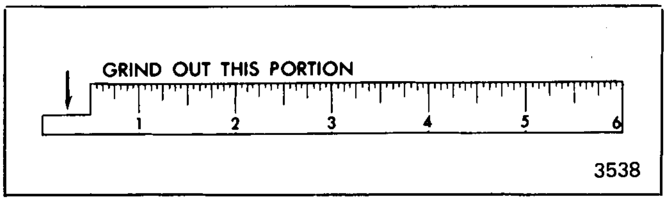


Fig. 6A6-18 Cutaway Scale

Fig. 6A6-19 Measuring Valve Spring Installed Height (Typical)

3. Carefully guide the cylinder head into place over the dowel pins and gasket.

4. Coat threads of cylinder head bolts with sealing compound and install bolts finger tight.

5. Tighten each cylinder head bolt a little at a time in the sequence shown in the torque sequence chart until the specified torque is reached (Fig. 6A6-20).

6. Install exhaust manifolds as previously outlined.

7. Install intake manifold as previously outlined.

8. Install and adjust valve mechanism as previously outlined.

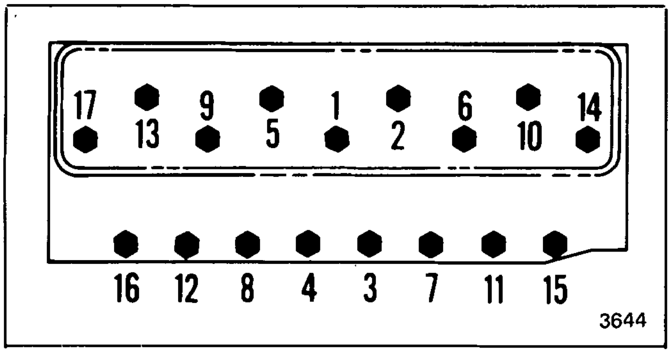


Fig. 6A6-20 Cylinder Head Bolt Torque Sequence

ROCKER ARM STUDS

Replacement

Rocker arm studs that have damaged threads or are loose in cylinder heads should be replaced with new studs available in .003" and .013" oversize. Studs may be installed after reaming the holes as follows:

1. Remove old stud by placing Tool J 5802-1 over the stud, installing nut and flat washer and removing stud by turning nut (Fig. 6A6-21).

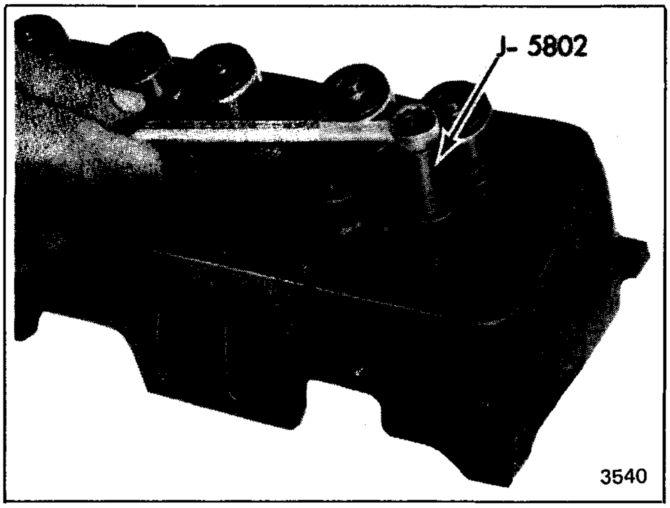


Fig. 6A6-21 Removing Rocker Arm Stud

2. Ream hole for oversize stud using Tool J 5715 for .003" oversize or Tool J 6036 for .013" oversize (Fig. 6A6-22).

CAUTION: *Do not attempt to install an oversize stud without reaming stud hole.*

3. Coat press-fit area of stud with hypoid axle lubricant. Install new stud, using Tool J 6880 as a guide. Gauge should bottom on head (Fig. 6A6-23).

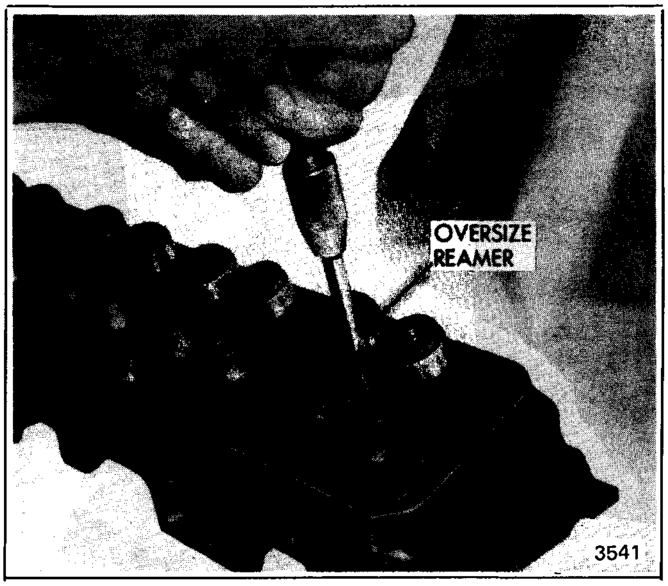


Fig. 6A6-22 Reaming Rocker Arm Stud Bore

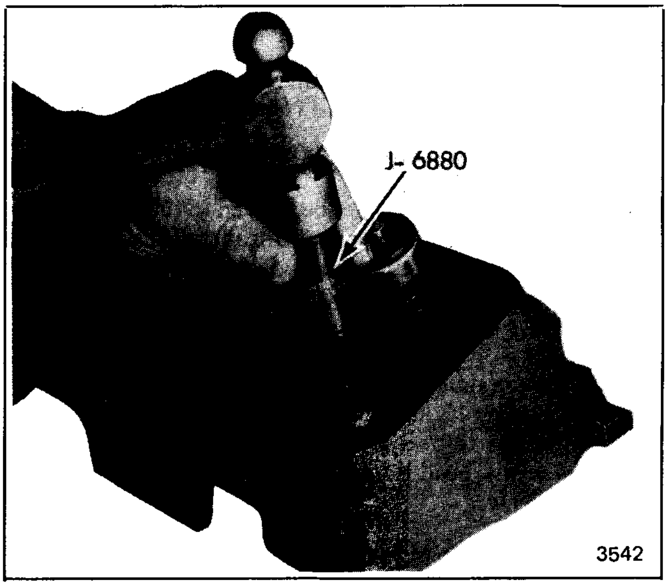


Fig. 6A6-23 Installing Rocker Arm Stud

VALVE GUIDE BORES

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves use Tool Set J 5830.

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valve seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

It is important that valve seat concentricity be measured. Valve seats should be concentric to within .002" total indicator reading (Fig. 6A6-24).

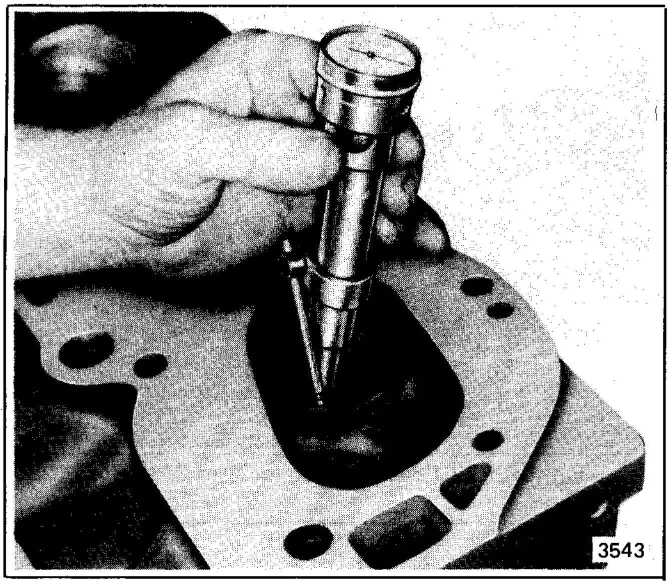


Fig. 6A6-24 Measuring Valve Seat Concentricity

VALVES

Valves that are pitted can be refaced to the proper angle. Insure correct relation between the head and stem on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less that 1/32" thick after grinding, replace the valve.

TORSIONAL DAMPER

Removal

1. Remove fan belt, fan and pulley.
2. Remove the radiator shroud assembly as outlined in Section 6B.

NOTE: If additional operations (such as camshaft removal) are not being performed, the radiator removal will not be necessary.

3. Remove accessory drive pulley then remove damper retaining bolt.
4. Install Tool J 23523 on damper then, turning puller screw, remove damper (Fig. 6A6-25).

Installation

CAUTION: *The inertial weight section of the torsional damper is assembled to the hub with a rubber type material. The installation procedures (with proper tool) must be followed or movement of the inertia weight section on the hub will destroy the tuning of the torsional damper.*

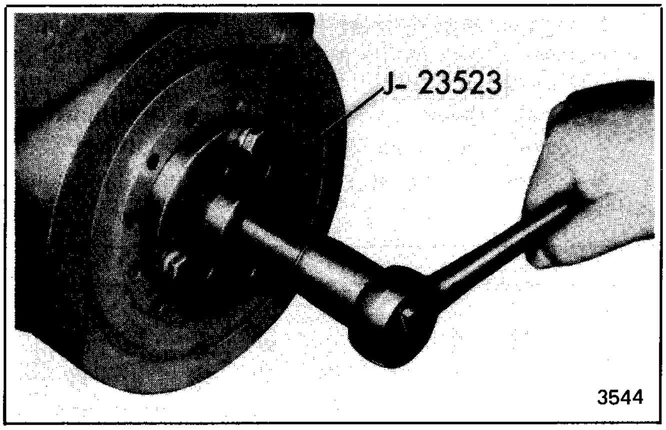


Fig. 6A6-25 Removing Torsional Damper

1. Coat front cover seal contact area (on damper) with engine oil.
2. Place damper in position over key on crankshaft.
3. Pull damper onto crankshaft as follows:

a. Install appropriate threaded end of Tool J 23523 into crankshaft.

CAUTION: *Install tool in crankshaft so that at least 1/2" of thread engagement is obtained.*

b. Install plate, thrust bearing and nut to complete tool installation.

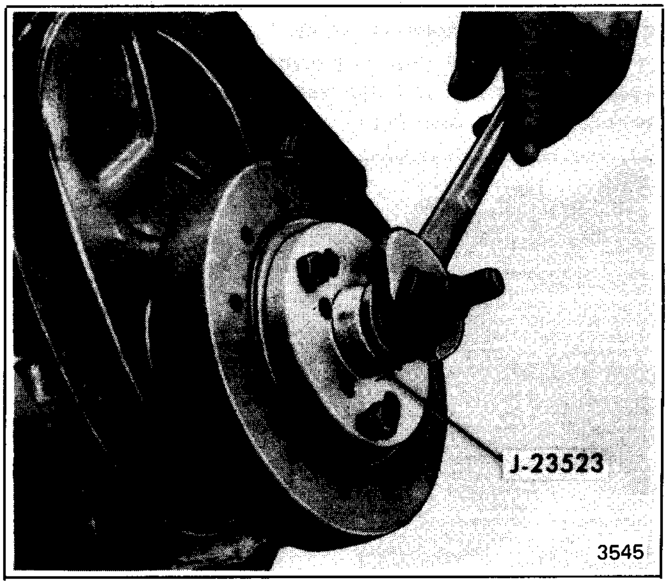


Fig. 6A6-26 Installing Torsional Damper

c. Pull damper into position as shown in Figure 6A6-26.

d. Remove tool from crankshaft then install damper retaining bolt and torque to specifications.

4. Install accessory drive pulley.
5. Install radiator shroud as outlined in Section 6B.
6. Install fan and pulley to water pump hub and tighten securely.
7. Install fan belt and adjust to specifications using strand tension gage.
8. Fill cooling system (if necessary), start engine and check for leaks.

CRANKCASE FRONT COVER

Removal

1. Remove torsional damper as previously outlined.
2. Remove water pump as outlined in Section 6B.
3. Remove crankcase front cover attaching screws and remove front cover and gasket, then discard gasket.

Installation

1. Clean gasket surface on block and crankcase front cover.
2. Use a sharp knife or other suitable cutting tool to remove any excess oil pan gasket material that may be protruding at the oil pan to engine block junction.
3. Apply a 1/8 inch bead of silicone rubber sealer, part #1051435 (or equivalent), to the joint formed at the oil pan and cylinder block.
4. Coat the cover gasket with gasket sealer and place in position on cover.
5. Install cover-to-oil pan seal, lightly coat bottom of seal with engine oil and position cover over crankshaft end.
6. Loosely install the cover-to-block upper attaching screws.
7. Tighten screws alternately and evenly while pressing downward on cover so that dowels in block are aligned with corresponding holes in cover.

   NOTE: Position cover so that dowels enter holes in cover without binding. Do not force cover over dowels so that cover flange or holes are distorted.

8. Install remaining cover screws and torque to specifications.
9. Install torsional damper and water pump as previoulsy outlined.

OIL SEAL (FRONT COVER)

REPLACEMENT WITH COVER REMOVED

1. With cover removed, pry oil seal out of cover from the front with a large screwdriver.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J 23053 (Fig. 6A6-27).

   CAUTION: *Support cover at seal area. (Tool J 971 may be used as support).*

REPLACEMENT WITH COVER INSTALLED

1. With torsional damper removed, pry seal out of cover from the front with a large screwdriver, being careful not to damage the surface on the crankshaft.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J 23042 (Fig 6A6-28).

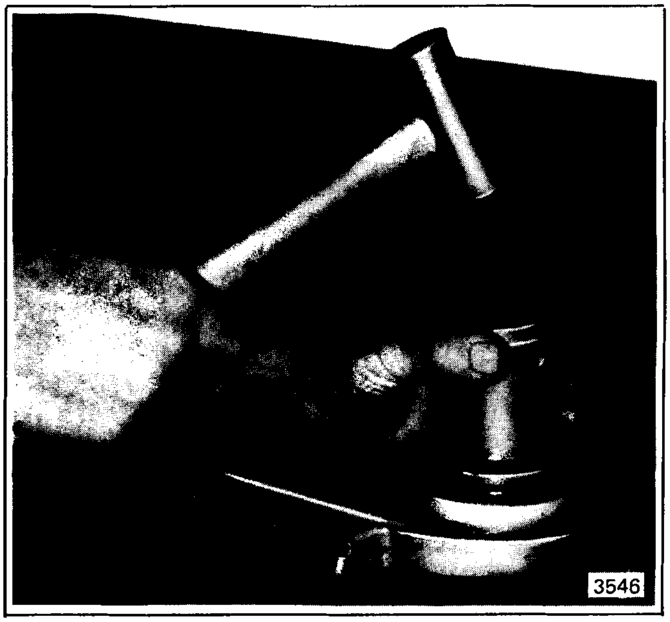


Fig. 6A6-27 Installing Oil Seal (Cover Removed)

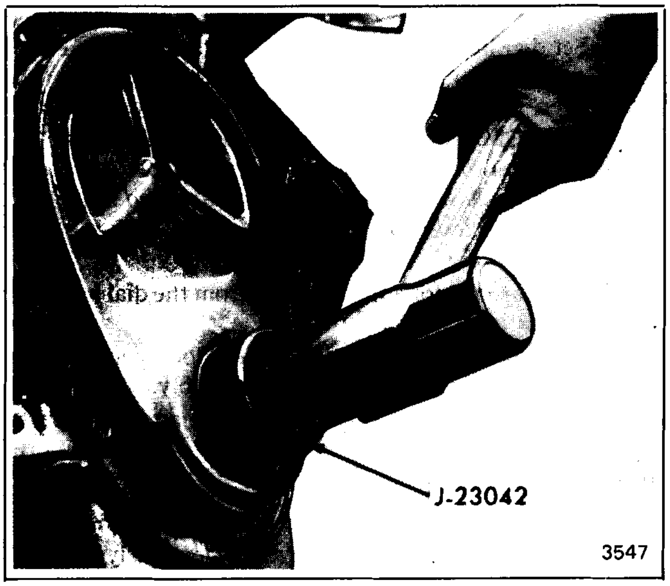


Fig. 6A6-28 Installing Oil Seal (Cover Installed)

CAMSHAFT

MEASURING LOBE LIFT

NOTE: Procedure is similar to that used for checking valve timing. If improper valve operation is indicated, measure the lift of each push rod in consecutive order and record the readings.

1. Remove the valve mechanism as previously outlined.
2. Position indicator with ball socket adapter (Tool J 8520) on push rod (Fig. 6A6-29).

   NOTE: Make sure push rod is in the lifter socket.

3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.

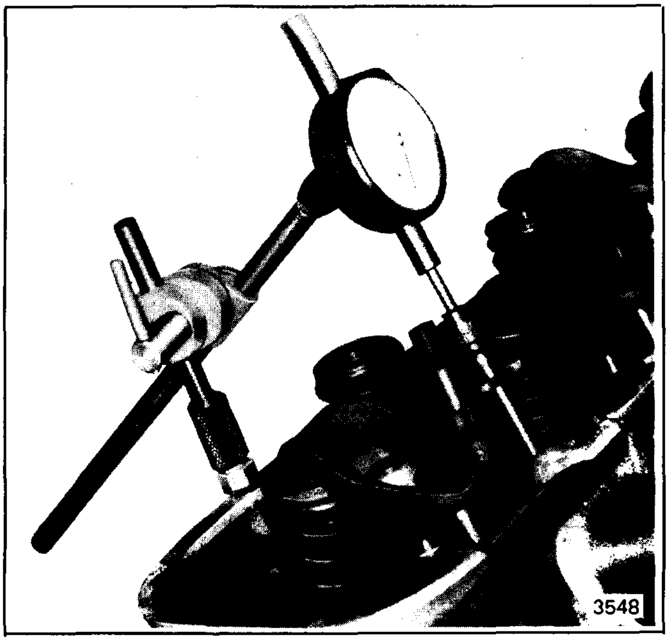


Fig. 6A6-29 Measuring Lobe Lift

4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxilliary starter switch and "bump" the engine over, until the push rod is in fully raised position.

CAUTION: *Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the distributor primary lead must be disconnected from the coil.*

5. Compare the total lift recorded from the dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install and adjust valve mechanism as outlined.

Removal

1. Remove valve lifters as previously outlined.
2. Remove crankcase from cover as previously outlined.
3. Remove grille as outlined in Section 2C.
4. Remove fuel pump push rod as outlined in Section 6C.
5. Complete camshaft removal as follows:

NOTE: Sprocket is a light fit on camshaft. If sprocket does not come off easily a light blow on the lower edge of the sprocket (with a plastic mallet) should dislodge the sprocket.

6. Install two 5/16" x 18 x 4" bolts in camshaft bolt holes then remove camshaft (Fig. 6A6-30).

CAUTION: *All camshaft journals are the same diameter and care must be used in removing camshaft to avoid damage to bearings.*

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

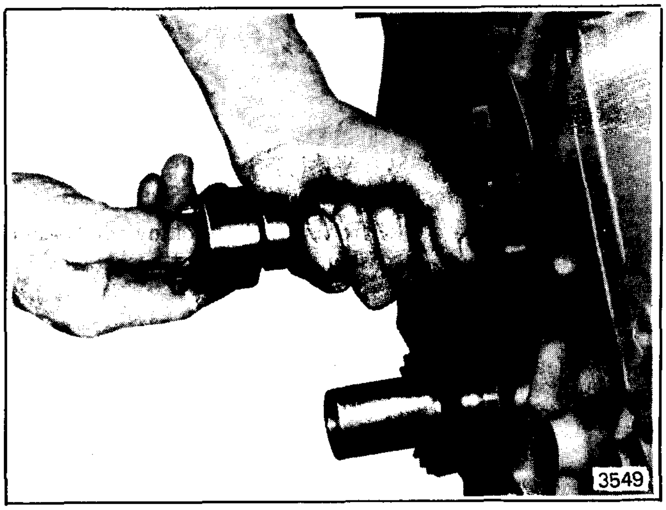


Fig. 6A6-30 Removing Camshaft

The camshaft should also be checked for alignment. The best method is by use of "V" blocks and a dial indicator (Fig. 6A6-31). The dial indicator will indicate the exact amount the camshaft is out of true. If it is out more than .0015" dial indicator reading, the camshaft should be replaced.

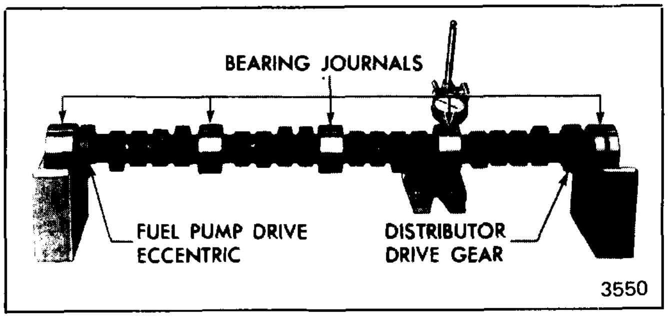


Fig. 6A6-31 Checking Camshaft Alignment

Installation

NOTE: Whenever a new camshaft is installed coat camshaft lobes with "Molykote" or its equivalent.

Whenever a new camshaft is installed, replacement of all valve lifters is recommended to insure durability of the camshaft lobes and lifter feet.

1. Lubricate camshaft journals with engine oil and install camshaft.
2. Install timing chain on camshaft sprocket. Hold the sprocket vertically with the chain hanging down, and align marks on camshaft and crankshaft sprockets. (Refer to Figs. 6A6-32 and 6A6-33).
3. Align dowel in camshaft with dowel hole in camshaft sprocket then install sprocket on camshaft.
4. Draw the camshaft sprocket onto camshaft using the mounting bolts. Torque to specifications.
5. Lubricate timing chain with engine oil.
6. Install fuel pump push rod as outlined in Section 6C.
7. Install grille as outlined in Section 2C.
8. Install crankcase front cover as previously outlined.
9. Install valve lifters as previously outlined.

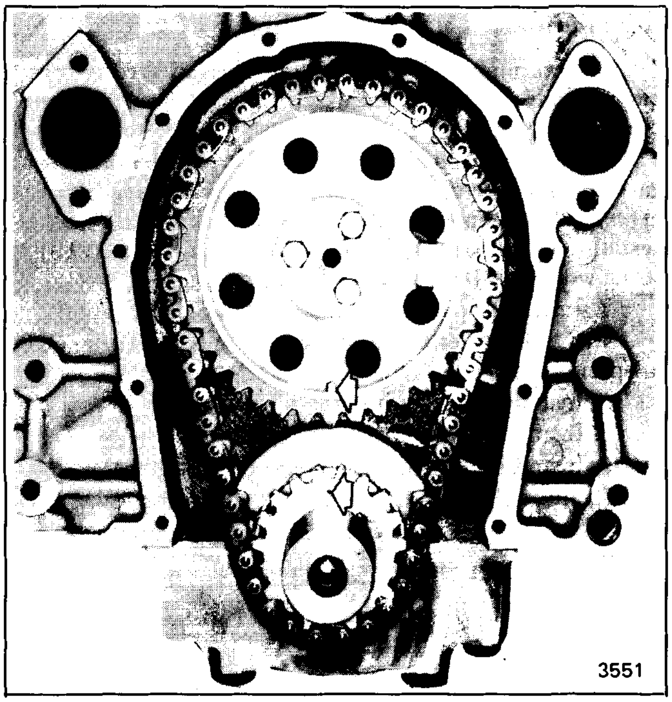


Fig. 6A6-32 Timing Sprocket Alignment Marks

Fig. 6A6-33 Installing Timing Chain

CAMSHAFT BEARINGS

Removal

Camshaft bearings can be replaced while engine is disassembled for overhaul, or without complete disassembly of the engine. To replace bearings without complete disassembly remove the camshaft and crankshaft leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rods against sides of engine so they will not be in the way while replacing camshaft bearings.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.

NOTE: This procedure is based on removal of the bearings nearest center of the engine first. With this method a minimum amount of turns are necessary to remove all bearings.

2. Using Tool Set J 6098, with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Install remover and install tool with shoulder toward bearing, making sure a sufficient amount of threads are engaged.
4. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (Fig. 6A6-34).

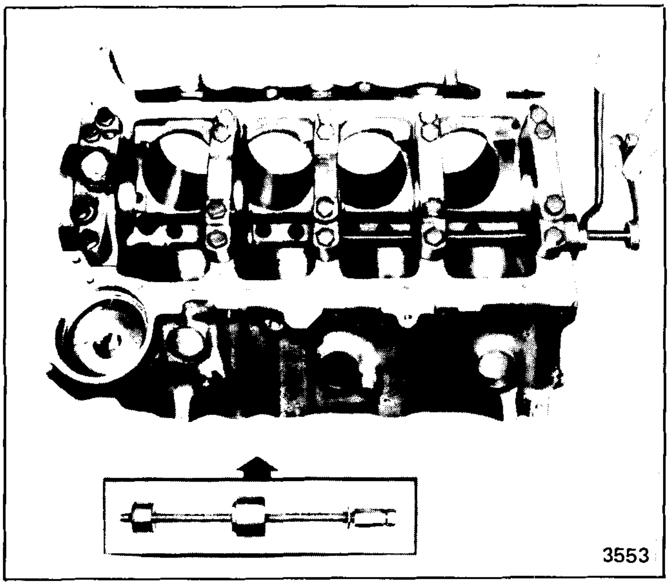


Fig. 6A6-34 Camshaft Bearing Removal

5. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.
6. Assemble remover and installer tool on driver handle and remove camshaft front and rear bearings by driving toward center of cylinder block (Fig. 6A6-35).

Installation

The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving toward center of cylinder block.

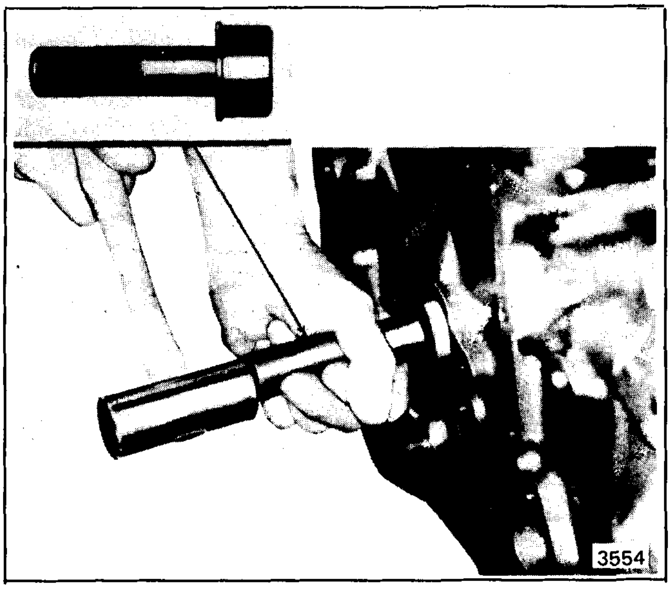


Fig. 6A6-35 Replacing Camshaft Front Bearing

2. Using Tool set J 6098, with nut then thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.

3. Index camshaft bearing in bore (with oil hole aligned as outlined below), then install remover and installer tool on puller screw with shoulder toward bearing.

NOTE: Number one cam bearing oil hole must be positioned so that oil holes are equidistant from 6 o'clock position. Number two through number four bearing oil holes must be positioned at 5 o'clock position (toward left side of engine and at a position even with bottom of cylinder bore). Number five bearing oil hole must be in 12 o'clock position.

4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw and check alignment of oil hole in camshaft bearing.

5. Install remaining bearings in the same manner. It will be necessary to index pilot in the camshaft rear bearing to install the rear intermediate bearing.

6. Install a new camshaft rear plug.

NOTE: Plug should be installed flush to 1/32" deep and be parallel with rear surface of cylinder block.

OIL PAN

Removal

1. Drain engine oil.
2. Remove oil dip stick and tube.
3. Remove exhaust crossover pipe.
4. On vehicles equipped with automatic transmission remove converter housing under pan.
5. Remove starter brace and inboard bolt, swing starter aside.
6. Remove oil pan and discard gaskets and seals.

Installation

1. Thoroughly clean all gasket and seal surfaces on oil pan, cylinder block, crankcase front cover and rear main bearing cap.
2. Install new oil pan side gaskets on cylinder block using gasket sealer as a retainer. Install new oil pan rear seal in rear main bearing cap groove, with ends butting side gaskets. Install new oil pan front seal in groove in crankcase front cover with ends butting side gaskets (Fig. 6A6-36).
3. Install oil pan and torque bolts to specifications.
4. Install starter brace and attaching bolts. Torque bolts to specifications.
5. Install converter housing under pan.
6. Install exhaust crossover pipe.
7. Install oil dip stick tube and dip stick.
8. Fill with oil, start engine and check for leaks.

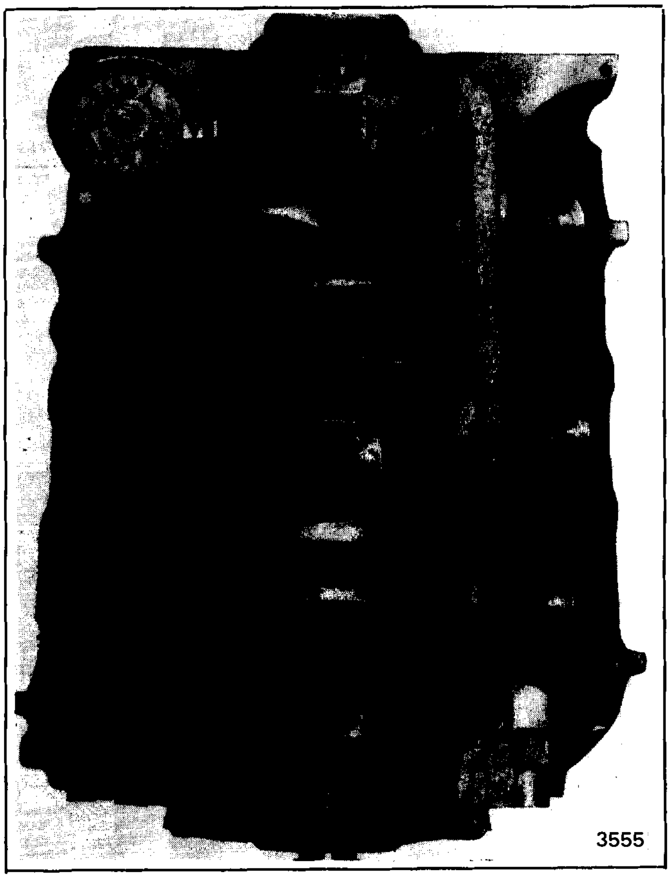


Fig. 6A6-36 Installing Oil Pan

OIL PUMP

Removal

1. Remove oil pan as previously outlined.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

Disassembly

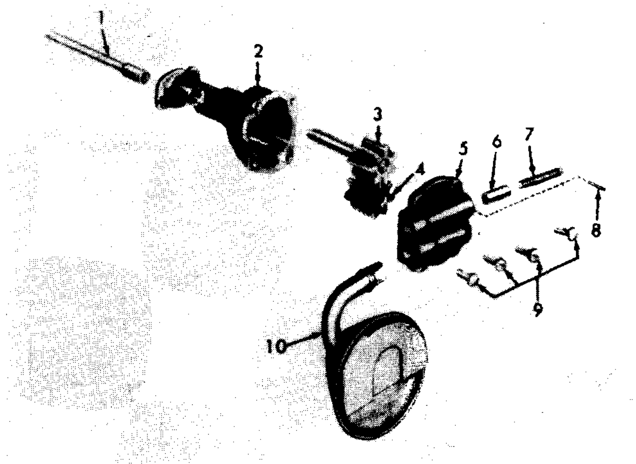
REFER TO FIGURE 6A6-37

1. Remove the pump cover attaching screws and the pump cover.

NOTE: Mark gear teeth so they may be reassembled with the same teeth indexing.

2. Remove the idler gear and the drive gear and shaft from the pump body.
3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.
4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump.

CAUTION: *Do not disturb the pickup screen on the pipe. This is serviced as an assembly.*



1. **Shaft Extension**
2. **Pump Body**
3. **Drive Gear and Shaft**
4. **Idler Gear**
5. **Pump Cover**
6. **Pressure Regulator Valve**
7. **Pressure Regulator Spring**
8. **Retaining Pin**
9. **Screws**
10. **Pickup Screen and Pipe**

Fig. 6A6-37 Oil Pump

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.
6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.
7. Check the pressure regulator valve for fit.

NOTE: The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.

Assembly

REFER TO FIGURE 6A6-37

1. If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure. Mount the pump in a soft-jawed vise, apply sealer to end of pipe, and using Tool J 8369 (Fig. 6A6-38), tap the pipe in place with a plastic hammer.

CAUTION: *Be careful of twisting, shearing or collapsing pipe while installing in pump.*

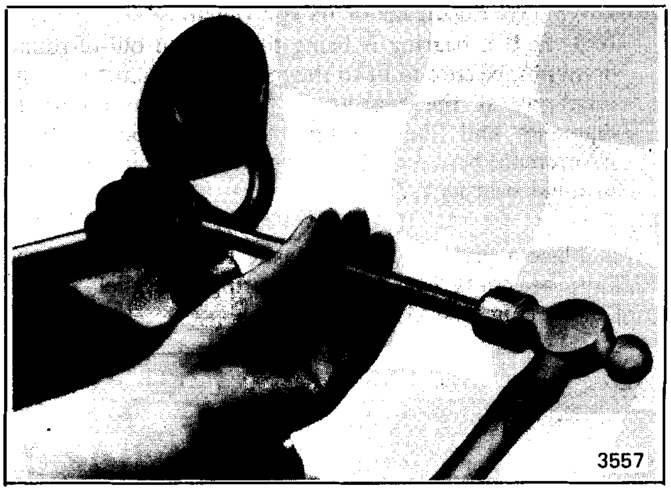


Fig. 6A6-38 Installing Screen

2. Install the pressure regulator valve and related parts.
3. Install the drive gear and shaft in the pump body.
4. Install the idler gear in the pump body with the smooth side of gear toward pump cover opening.
5. Install the pump cover and torque attaching screws to specification.
6. Turn drive shaft by hand to check for smooth operation.

Installation

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
2. Install pump to rear bearing cap bolt and torque to specifications.

NOTE: Installed position of oil pump screen is with bottom edge parallel to oil pan rails.

3. Install oil pan as previously outlined.

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive a new bearing will be required. Bearings are available in standard size and .001" and .002" undersize for use with new and used standard size crankshafts, and in .010" and .020" undersize for use with reconditioned crankshafts.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.
2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe the bearings and crankpin clean of oil.

4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications, replace or recondition the crankshaft. If within specifications, a new bearing is to be installed; measure the maximum diameter of the crankpin to determine new bearing size required.

5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent.

NOTE: If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round, .001" interference between the bearing and crankpin will result in rapid bearing failure.

a. Place a piece of gaging plastic the full width of the crankpin as contacted by the bearing (parallel to the crankshaft) (Fig. 6A6-39).

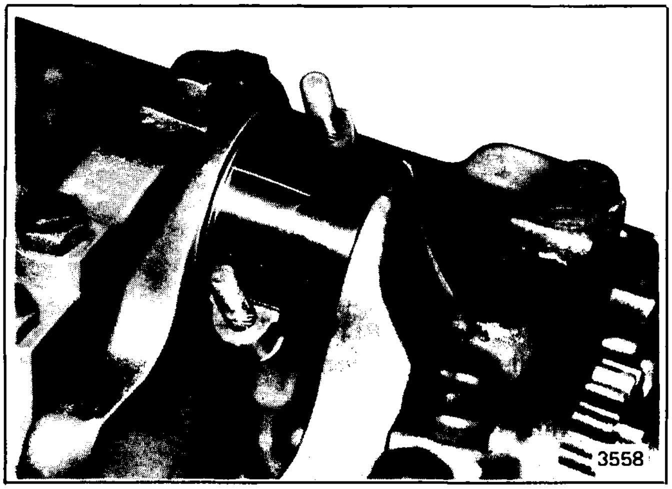


Fig. 6A6-39 Gaging Plastic On Crankpin

b. Install the bearing in the connecting rod and cap.

c. Install the bearing cap and evenly torque nuts to specifications.

CAUTION: *Do not turn the crankshaft with the gaging plastic installed.*

d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point (Fig. 6A6-40).

6. If the clearance exceeds specifications, select a new, correct size bearing and remeasure the clearance.

7. Coat the bearing surface with oil, install the rod cap and torque nuts to specifications.

8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to the crankpin) to make sure they have clearance.

9. Measure all connecting rod side clearances (see specifications) between connecting rod caps (Fig. 6A6-41).

MAIN BEARINGS

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Bearings are available in standard size and .001", .002", .009", .010" and .020" undersize.

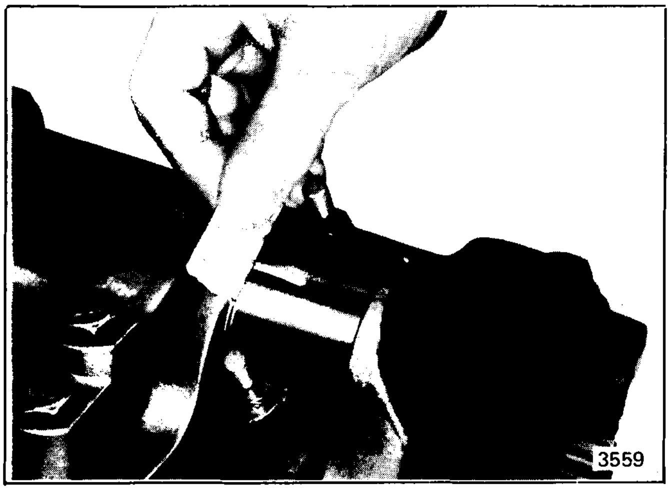


Fig. 6A6-40 Measuring Gaging Plastic

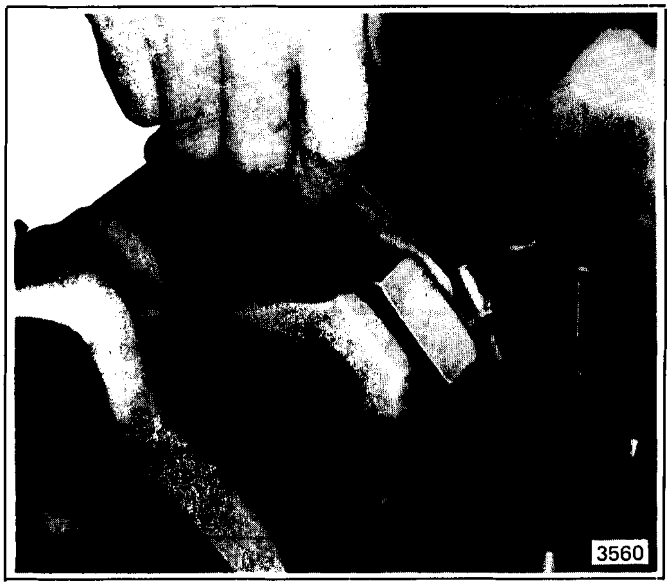


Fig. 6A6-41 Measuring Connecting Rod Side Clearance

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001" undersize insert which will decrease the clearance .0005" from using a full standard bearing.

When a production crankshaft cannot be precision fitted by this method, it is then ground .009" undersize on main journals only. A .009" undersize bearing and .010" undersize bearing may be used for precision fitting in the same manner as previously described. Any engine fitted with a .009" undersize crankshaft will be identified by the following markings.

- ".009" will be stamped on the crankshaft counterweight forward of the center main journal.
- A figure "9" will be stamped on the block at the left front oil pan rail.

NOTE: If, for any reason, main bearing caps are replaced, shimming may be necessary. Laminated shims for each cap are available for service. Shim requirement will be determined by bearing clearance.

Inspection

In general, the lower half of the bearing (except No. 1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearance

To obtain the most accurate results with "Plastigage" (or its equivalent), a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed. If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft should be supported both front and rear (damper and flywheel) to remove the clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

NOTE: To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, before checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.

2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal (Fig. 6A6-42).

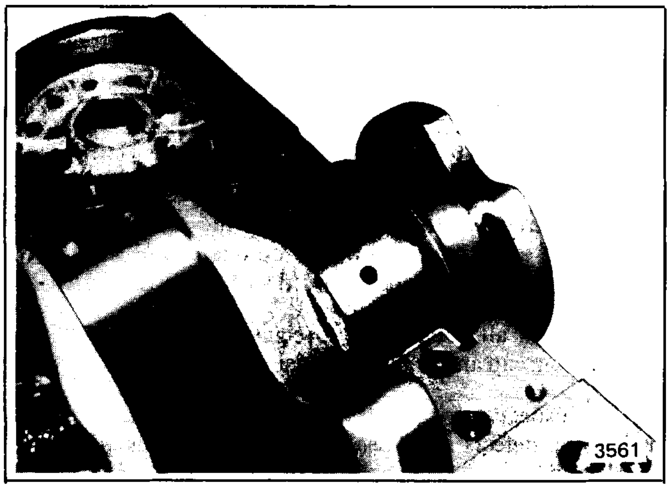


Fig. 6A6-42 Gaging Plastic On Journal

CAUTION: *Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.*

3. Install the bearing cap and evenly torque the retaining bolts to specifications.

4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.

5. On the edge of gaging plastic envelope there is a graduated scale which is displayed in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope (Fig. 6A6-43).

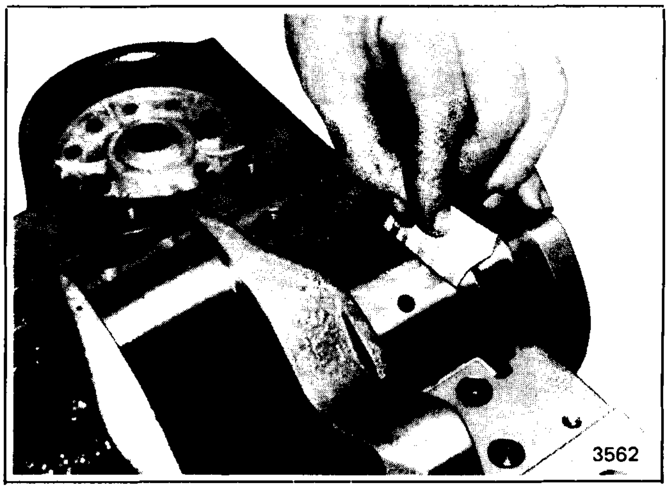


Fig. 6A6-43 Measuring Gauging Plastic

NOTE: Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001" max.), be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001" difference.

6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit.

NOTE: If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks; if none are found then install shims as required.

7. A standard, .001" or .002" undersize bearing should produce the proper clearance.

8. Proceed to the next bearing. After all bearings have been checked, rotate the crankshaft to see that there is no excessive drag.

9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage (Fig. 6A6-44).

20. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

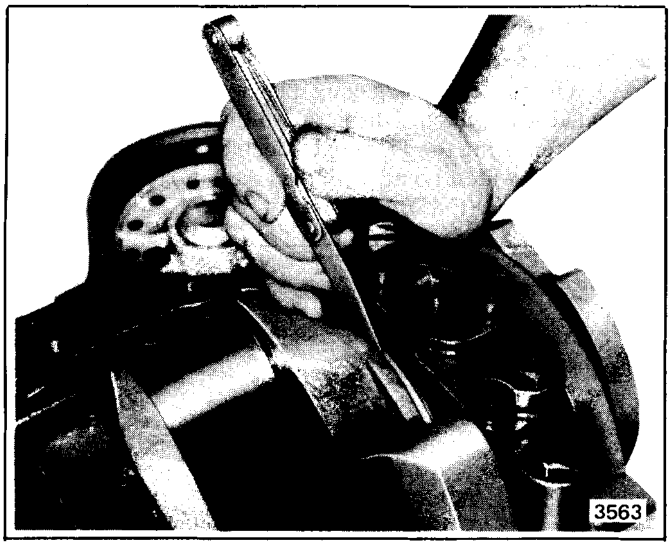


Fig. 6A6-44 Measuring Crankshaft End Play

Replacement

NOTE: Main Bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removal

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Install a main bearing removing and installing tool in oil hole in crankshaft journal.

NOTE: If such a tool is not available, a cotter pin may be bent as required to do the job.

3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap with arrows pointing toward front of engine.
7. Torque main bearing cap bolts to specifications.

OIL SEAL (REAR MAIN)

Replacement

NOTE: Always replace the upper and lower seal as a unit. Install seal with lip facing front of engine.

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal. An installation tool (Fig. 6A6-45) can be used to protect the seal bead when positioning seal as follows:

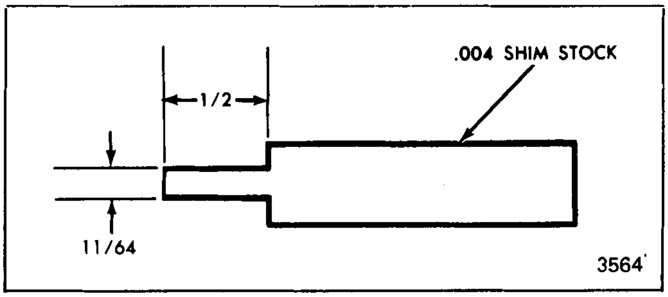


Fig. 6A6-45 Oil Seal Installation Tool

1. With the oil pan and oil pump removed, remove the rear main bearing cap.
2. Remove oil seal from the bearing cap by prying from the bottom with a small screwdriver (Fig. 6A6-46).

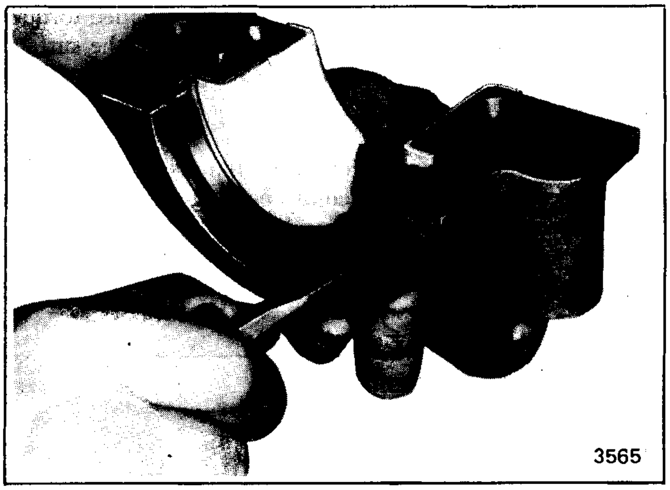


Fig. 6A6-46 Removing Oil Seal (Lower Half)

3. To remove the upper half of the seal, use a small hammer to tap a brass pin punch on one end of seal until it protrudes far enough to be removed with pliers (Fig. 6A6-47).
4. Clean all sealant and foreign material from cylinder case bearing cap and crankshaft, using a non-abrasive cleaner.
5. Inspect components for nicks, scratches, burrs and machining defects at all sealing surfaces, case assembly and crankshaft.
6. Coat seal lips and seal bead with light engine oil - keep oil off seal mating ends.
7. Position tip of tool between crankshaft and seal seat in cylinder case.
8. Position seal between crankshaft and tip of tool so that seal bead contacts tip of tool.

NOTE: Make sure that oil-seal lip is positioned toward front of engine (Fig. 6A6-48).

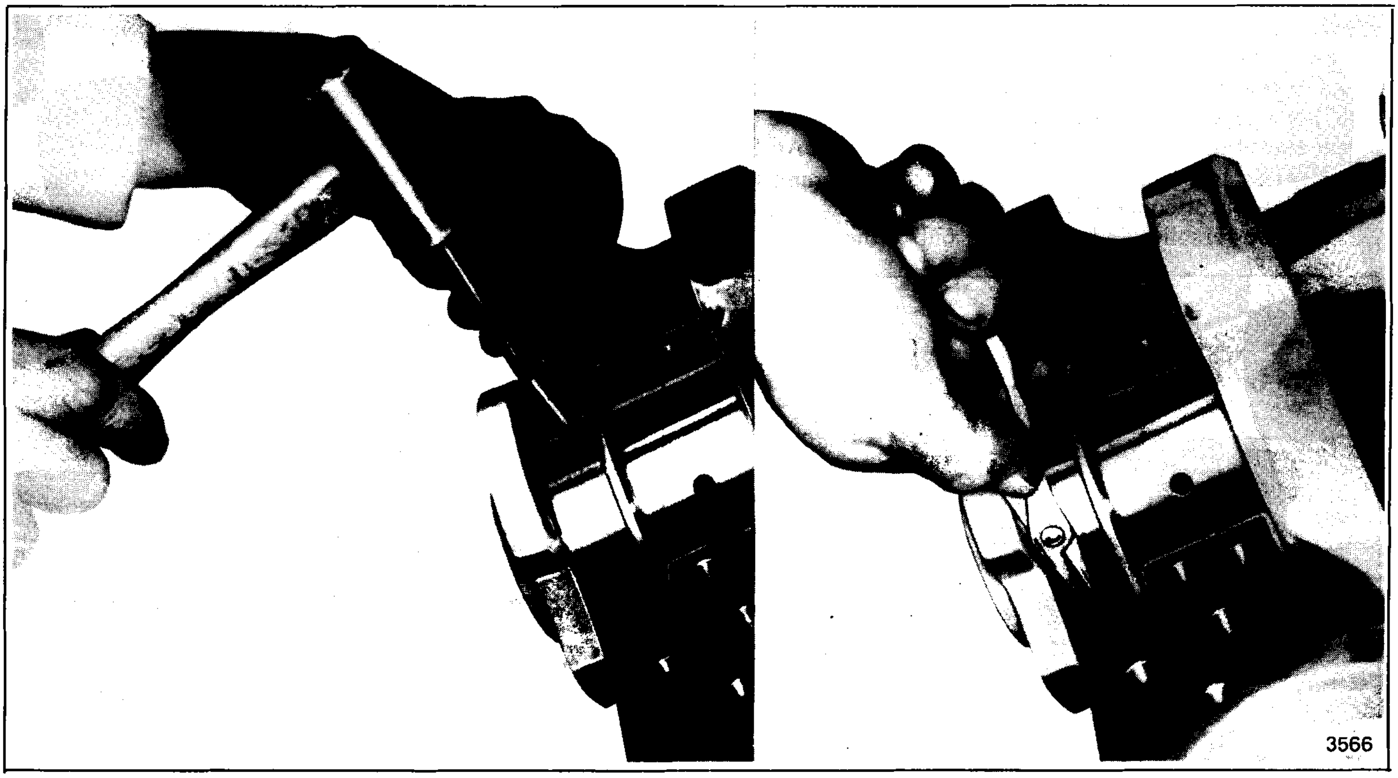


Fig. 6A6-47 Removing Oil Seal (Upper Half)

9. Rotate seal around crankshaft using tool as a "shoehorn" to protect seal bead from sharp corner of seal seat surface in cylinder case.

CAUTION: *Installation tool must remain in position until seal is properly positioned with both ends flush with block.*

10. Remove tool, being careful not to withdraw seal.

11. Install seal half in bearing cap, again using tool as a "shoehorn", feeding seal into cap using light pressure with thumb and finger.

12. Install bearing cap to case with sealant applied to the cap-to-case interface being careful to keep sealant off the seal split line (Fig. 6A6-49).

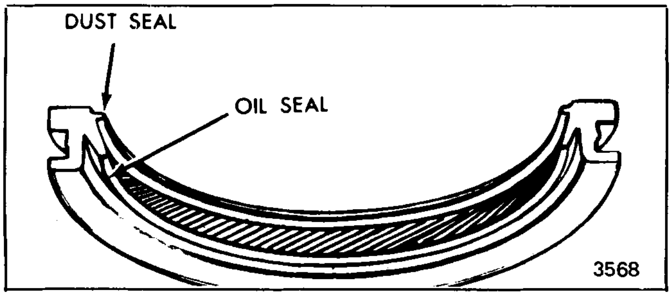


Fig. 6A6-48 Crankshaft Oil Seal (Rear Main)

13. Install the rear main bearing cap (with new seal) and torque to specifications.

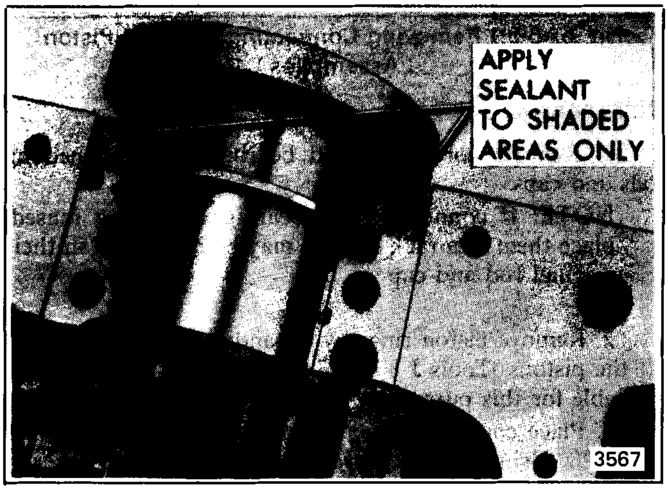


Fig. 6A6-49 Sealing Bearing Cap

CONNECTING ROD AND PISTON ASSEMBLIES

Removal

1. With oil pan, oil pump and cylinder head removed, use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.

NOTE: Before ridge and/or deposits are removed, turn crankshaft until piston is at the bottom of stroke and place a cloth on top of piston to collect the cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke and remove cloth and cuttings.

2. Inspect connecting rods and connecting rod caps for cylinder identification. If necessary mark them.

3. Remove connecting rod cap and install Tool J 5239 (3/8") or J 6305 (11/32") on studs. Push connecting rod and piston assembly out of top of cylinder block (Fig. 6A6-50).

NOTE: It will be necessary to turn the crankshaft slightly to disconnect some of the connecting rod and piston assemblies and push them out of the cylinder.

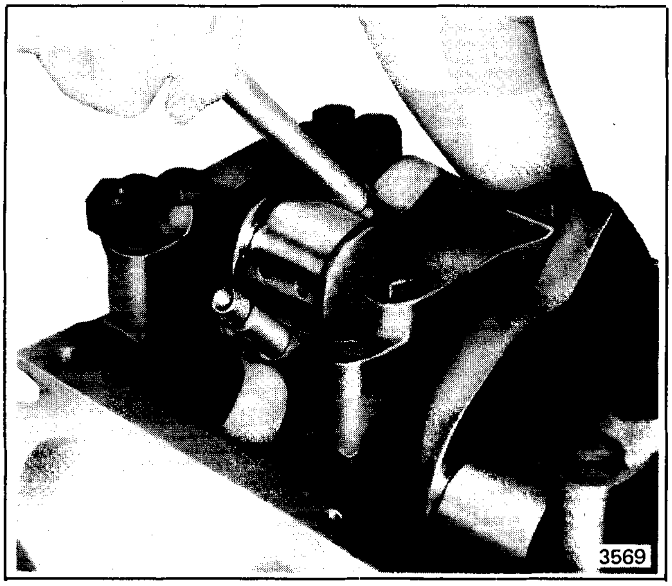


Fig. 6A6-50 Removing Connecting Rod and Piston Assemblies

Disassembly

1. Remove connecting rod bearings from connecting rods and caps.

NOTE: If connecting rod bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.

2. Remove piston rings by expanding and sliding them off the pistons. Tools J 8020 (3-9/16") and J 8032 (4") are available for this purpose.

3. Place connecting rod and piston assembly on tool J 24086-20. Using an arbor press and piston pin remover, J 24086-8, press the piston pin out of connecting rod and piston (Fig. 6A6-51).

CONNECTING RODS

Cleaning and Inspection

Wash connecting rods in cleaning solvent and dry with compressed air.

Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

PISTONS

Cleaning and Inspection

Clean varnish from piston skirts and pins with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

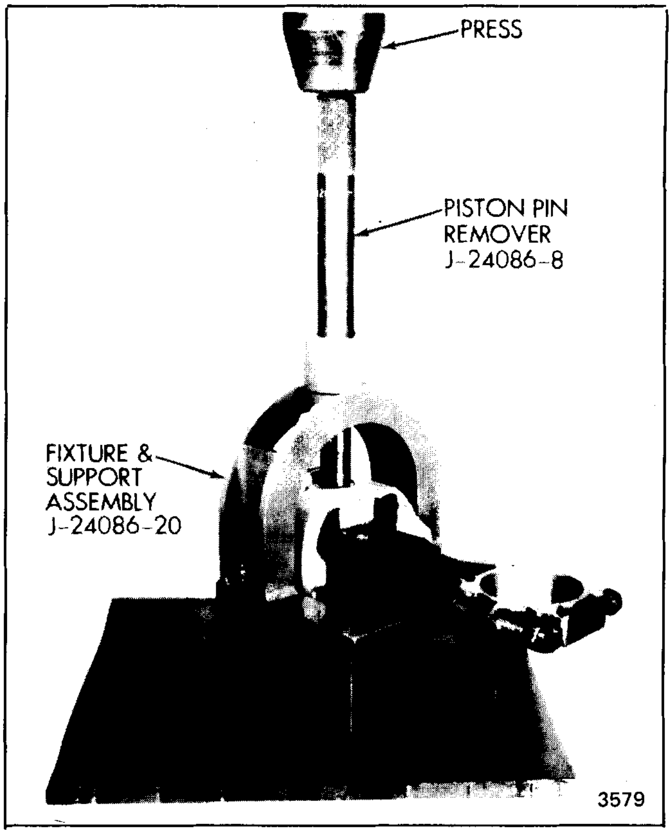


Fig. 6A6-51 Disassembling Connecting Rod and Piston Assemblies

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance as outlined under "Piston Selection".

PISTON PINS

Cleaning and Inspection

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial bore gage or an inside micrometer. If clearance is in excess of the .001" wear limit, the piston and piston pin assembly should be replaced.

Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.

2. Place connecting rod in piston and hold in place with piston pin guide and piston pin. Place assembly on fixture and support assembly (Fig. 6A6-52).

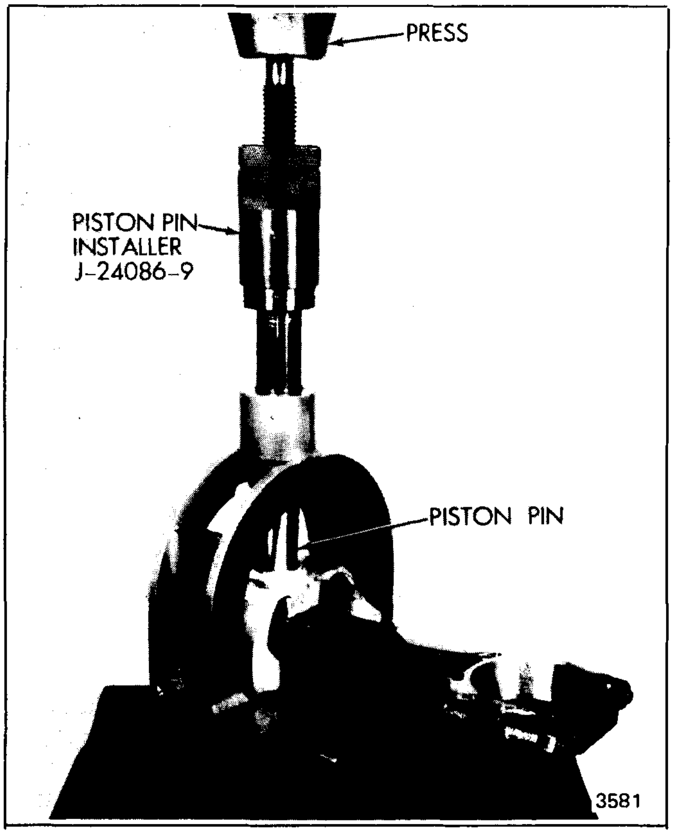


Fig. 6A6-52 Assembling Connecting Rod and Piston Assemblies

3. Using piston pin installer, pin guide J 24086-7 (violet), and installer setting G-8 press the piston pin into the piston and connecting rod (Fig. 6A6-52).

> **NOTE:** The piston pin installer is a variable insertion length tool designed to be applicable to all GM piston assemblies. The insertion length is varied by rotating the hub on the shaft much like adjusting a micrometer. An alpha-numeric scale is used to determine the desired length for a given piston pin assembly.

> **CAUTION:** *After installer hub bottoms on support assembly, do not exceed 6000 psi pressure, as this could cause structural damage to the tool.*

4. Remove piston and connecting rod assembly from tool and check piston for freedom of movement on piston pin.

PISTON RINGS

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is chrome faced, or treated with molybdenum for maximum life.

The oil control rings are of three piece type, consisting of two segments (rails) and a spacer.

1. Select rings comparable in size to the piston being used.

2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 1/4 inch (below upper ring travel). Be sure ring is square with cylinder wall.

3. Measure the space or gap between the ends of the ring with a feeler gage (Fig. 6A6-53).

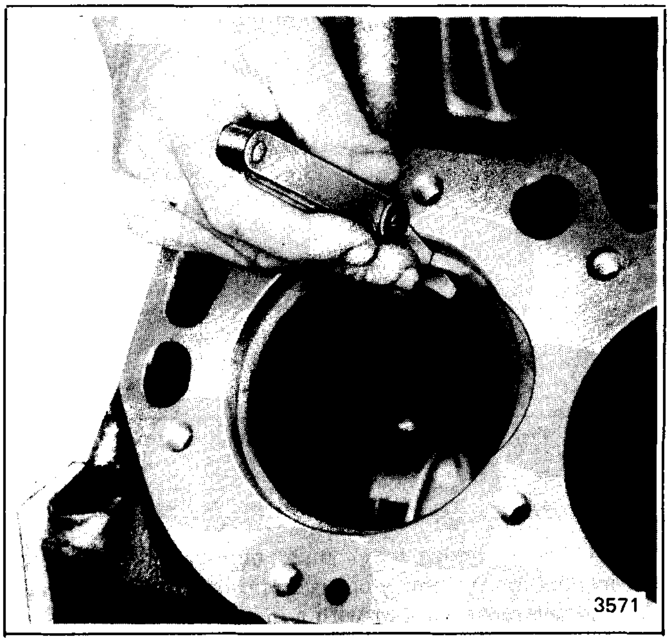


Fig. 6A6-53 Measuring Ring Gap

4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.

5. Fit each compression ring to the cylinder in which it is going to be used.

6. If the pistons have not been cleaned and inspected as previously outlined, do so.

7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove (Fig. 6A6-54) to make sure that the ring is free. If binding occurs at any point, the cause should be determined and, if caused by ring groove, remove by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.

8. Install piston rings as follows (Fig. 6A6-55).

a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.

b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.

c. Install upper steel oil ring rail with gap properly located.

d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined and, if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.

e. Install second compression ring expander: then ring with gaps properly located.

f. Install top compression ring with gap properly located.

9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the clearances between the surfaces of the ring and groove should be measured (Fig. 6A6-56) (See Specifications).

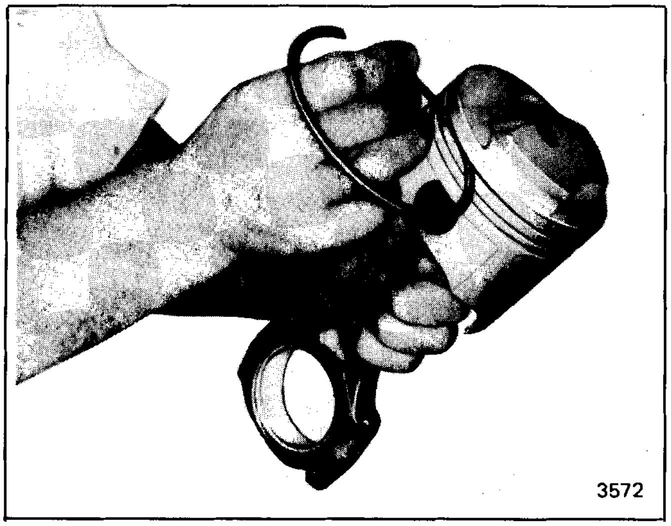


Fig. 6A6-54 Checking Ring In Groove

Installation

NOTE: Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash or with a light honing as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.

2. Lightly coat pistons, rings and cylinder walls with light engine oil.

3. With bearing caps removed, install Tool J 5239 (3/8") or J 6305 (11/32") on connecting rod bolts.

CAUTION: *Be sure ring gaps are properly positioned as previously outlined.*

4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tang slots on side opposite camshaft (Fig. 6A6-57).

Tool J 8037 to compress the rings (Fig. 6A6-58). Guide the connecting rod into place on the crankshaft journal with Tool J 5239 (3/8") or J 6305 (11/32"). Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.

5. Remove Tool J 5239 or J 6305.

6. Install the bearing caps and torque nuts to specifications.

NOTE: If bearing replacement is required refer to "Connecting Rod Bearings".

NOTE: Be sure to install new pistons in the same cylinders for which they were fitted and used pistons in the same cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. On V8 engines 1, 3, 5 and 7 in the left bank and 2, 4, 6 and 8 in the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever moved from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

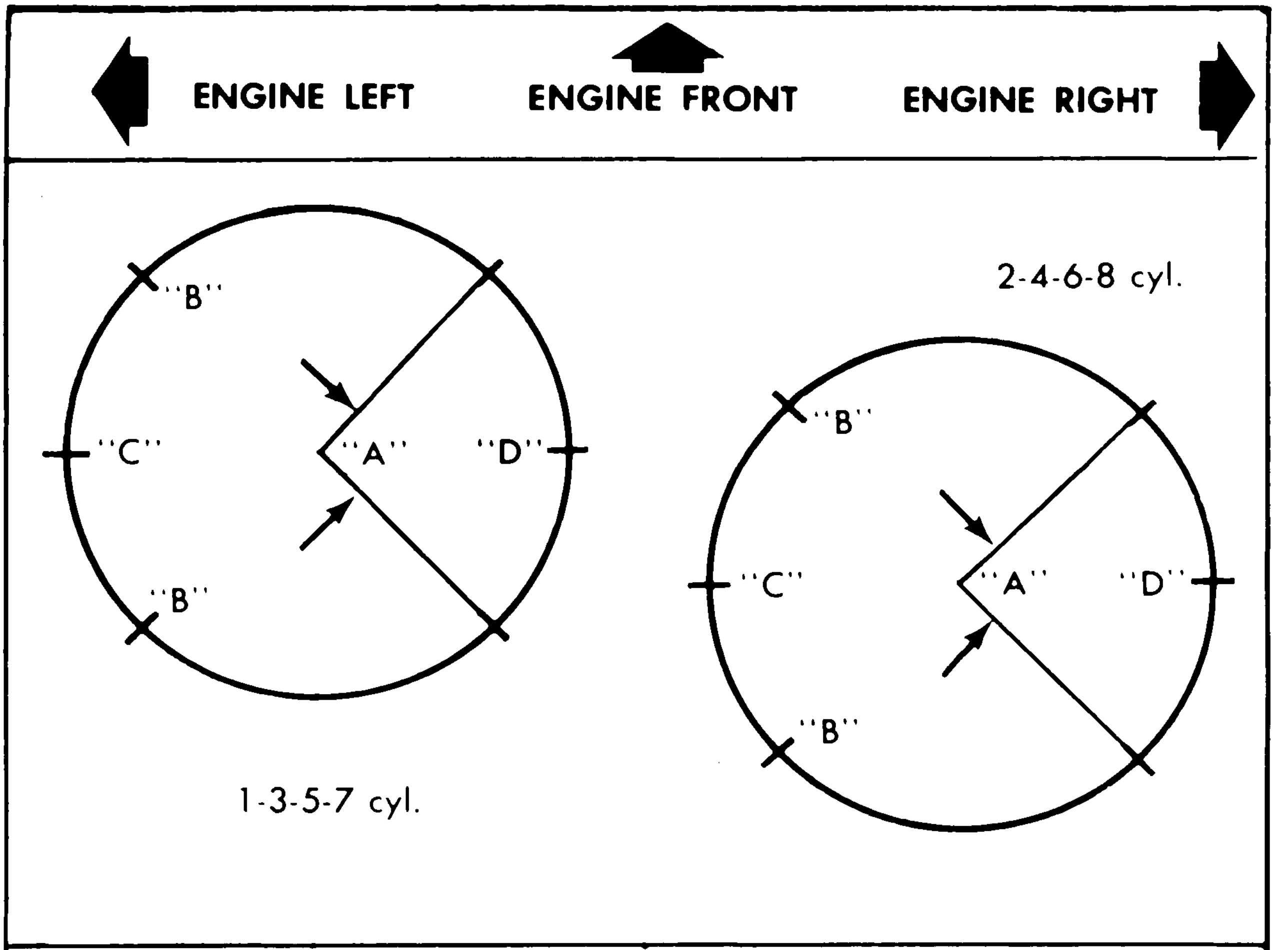
ENGINE ASSEMBLY

Removal

1. Remove hood.
2. Disconnect battery cables at battery.
3. Remove air cleaner.
4. Drain radiator and block.
5. Disconnect radiator and heater hoses and remove radiator and fan shroud.
6. Disconnect wires:
   a. Starter solenoid
   b. Delcotron
   c. Temperature switch
   d. Oil pressure switch
   e. Coil
7. Disconnect:
   a. Accelerator linkage at inlet manifold
   b. Fuel line from tank, at fuel pump
   c. Hoses at fuel vapor storage canister (if applicable)
   d. Vacuum line to power brake unit at manifold, if so equipped.
8. Remove power steering pump and lay aside, if so equipped.
9. Raise vehicle on hoist.
10. Drain crankcase.
11. Disconnect exhaust pipe at manifold and, if so equipped, converter bracket at transmission rear mount.
12. Remove starter.
13. Remove flywheel splash shield or converter housing cover as applicable.
14. On vehicles with automatic transmissions, remove converter to flywheel attaching bolts.
15. Remove mount "through" bolts.
16. Remove bell housing bolts.
17. Lower vehicle on hoist.
18. Raise transmission using floor jack.
19. Attach engine lifting devices, raise engine.
20. Remove motor mount to engine brackets.
21. Remove engine assembly.

Installation

1. Position engine assembly in vehicle.
2. Attach motor mount to engine brackets and lower engine in place.
3. Remove engine lifting device.
4. Remove transmission floor jack.
5. Raise vehicle on hoist.
6. Install mount "through" bolts. Torque to specifications.
7. Install bell housing bolts. Torque to specifications.
8. On vehicles with automatic transmissions, install converter to flywheel attaching bolts. Torque to specifications.
9. Install flywheel splash shield to converter housing cover as applicable. Torque attaching bolts to specifications.



"A" OIL RING SPACER GAP
(Tang in Hole or Slot within Arc)

"B" OIL RING RAIL GAPS

"C" 2ND COMPRESSION RING GAP

"D" TOP COMPRESSION RING GAP

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Fig. 6A6-55 Ring Gap Location

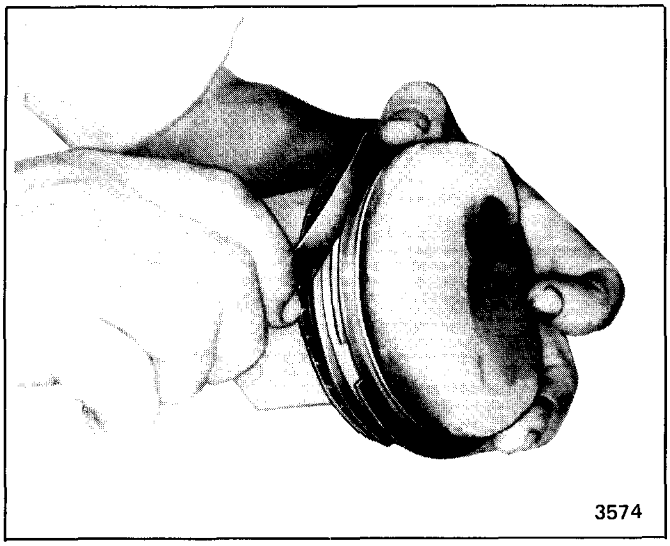

Fig. 6A6-56 Measuring Ring Groove Clearance

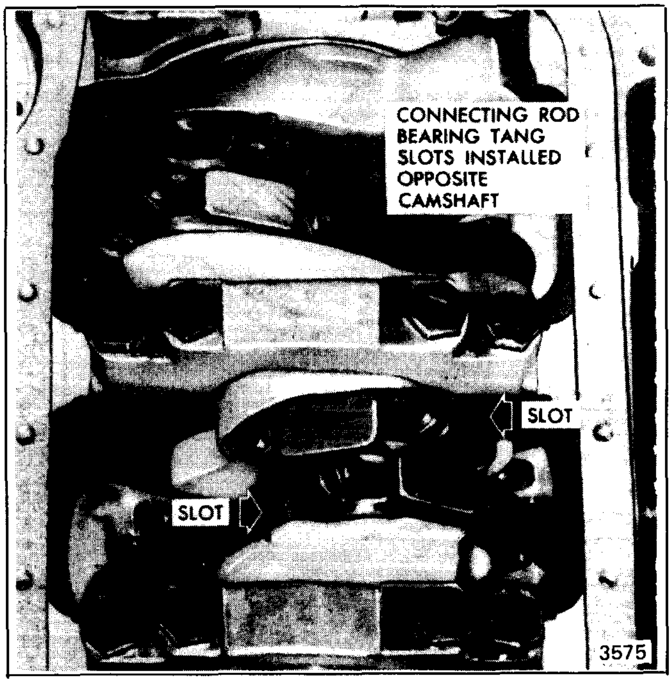

Fig. 6A6-57 Connecting Rods – Installed Position

10. Install starter.

11. Connect exhaust pipe at manifold and converter bracket at transmission rear mount.

12. Lower vehicle on hoist.

13. Reinstall power steering pump, if so equipped.

14. Connect:

a. Accelerator linkage at inlet manifold

b. Fuel line, from tank, at fuel pump

c. Hoses at fuel vapor storage canister

d. Vacuum line to power brake unit at manifold, if so equipped.

15. Connect wires at:

a. Starter solenoid

b. Delcotron

c. Temperature switch

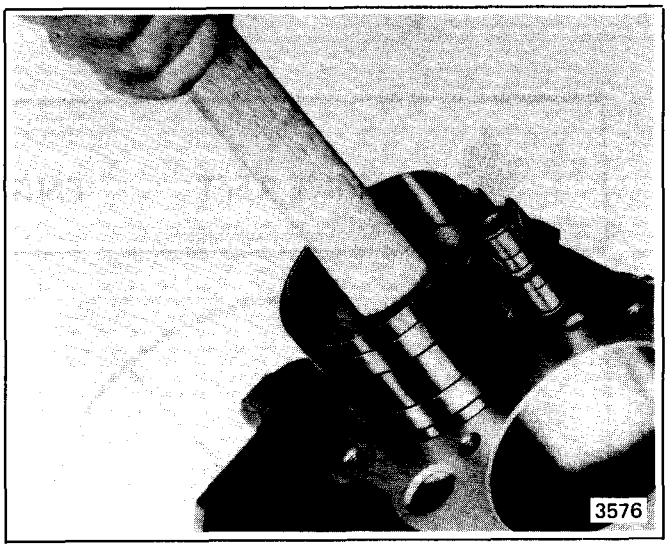

Fig. 6A6-58 Installing Connecting Rod and Piston Assemblies

d. Oil pressure switch

e. Coil

16. Install radiator and fan shroud and reconnect radiator and heater hoses.

17. Fill cooling system.

18. Fill crankcase with oil. See owners manual for specifications.

19. Install air cleaner.

20. Install hood.

21. Connect battery cables.

NOTE: To avoid possible arcing of battery, connect positive battery cable first.

22. Start engine, check for leaks and check timing.

CRANKSHAFT

The crankshaft can be removed while the engine is disassembled for overhaul, as previously outlined, or without complete disassembly as outlined below.

Removal

1. With the engine removed from the vehicle and the transmission and/or clutch housing removed from the engine, mount engine in stand and clamp securely.

2. Remove the oil dip stick and oil dip stick tube (if applicable).

3. Remove the starting motor, clutch assembly (if equipped) and flywheel.

4. Remove the spark plugs.

5. Remove crankshaft pulley and torsional damper.

6. Remove oil pan and oil pump.

7. Remove crankcase front cover and timing chain and camshaft sprocket.

8. Check the connecting rod caps for cylinder number identification. If necessary, mark them.

9. Remove the connecting rod caps and push the pistons to top of bores.

10. Remove main bearing caps and lift crankshaft out of cylinder block.

11. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize. (See Specifications.)
3. Check crankshaft for round-out by supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator. (See Specifications.)
4. Replace or recondition the crankshaft if out of specifications.

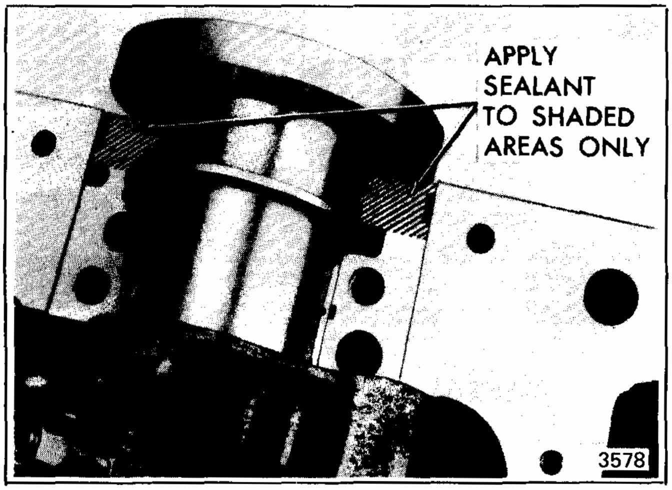

Fig. 6A6-60 Sealing Bearing Cap and Block

Remove crankshaft sprocket using Tool J 5825; install using Tool J 5590.

Installation

1. Install rear main bearing oil seal in cylinder block and rear main bearing cap grooves. Install with lip of seal toward front of engine. Where seal has two lips, install lip with helix toward front of engine.
2. Lubricate lips of seal with engine oil. Keep oil off parting line surface.
3. Install main bearings in cylinder block and main bearing caps then lubricate bearing surface with engine oil.
4. Install crankshaft, being careful not to damage bearing surfaces.
5. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only (Fig. 6A6-60). Do not allow sealer on crankshaft or seal.
6. Install main bearing caps with arrows pointing toward front of engine.
7. Torque all except rear main bearing cap bolts to specifications. Torque rear main bearing cap bolts to 10-12 ft. lbs. then tap end of crankshaft, first rearward then forward, with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.
8. Measure crankshaft end play with a feeler gage. Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface.
9. Install flywheel and torque to specifications. A wood block placed between the crankshaft and cylinder block will prevent crankshaft from rotating.

   NOTE: Align dowel hole in flywheel with dowel hole in crankshaft. On vehicles equipped with automatic transmissions, install flywheel with the converter attaching pads toward transmission.

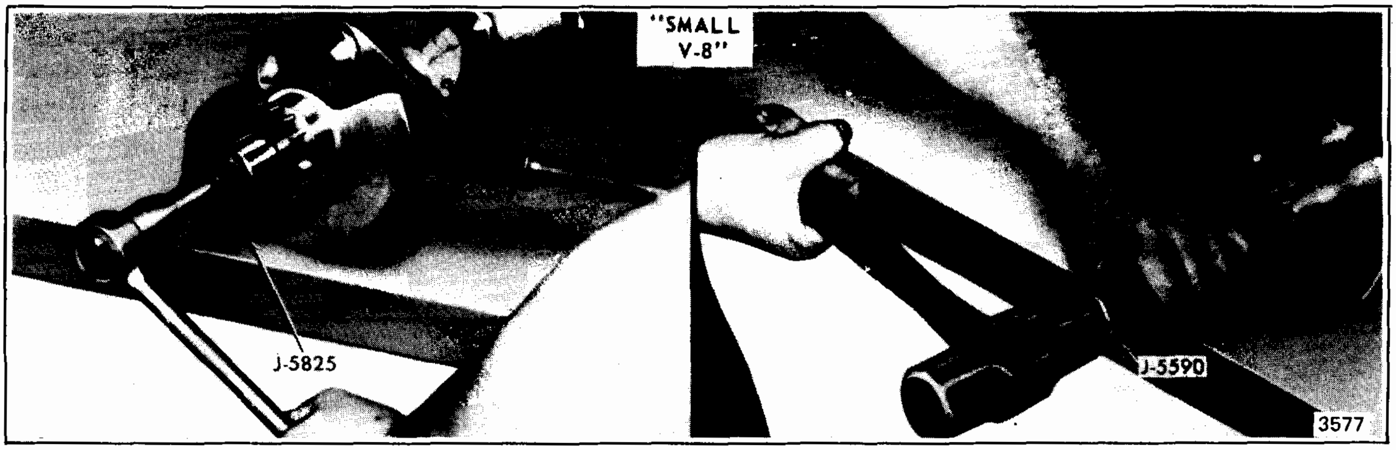

Fig. 6A6-59 Sprocket or Gear Replacement

SIZE	USAGE	TORQUE
1/4–20	CRANKCASE FRONT COVER	80 LB. IN.
	FLYWHEEL HOUSING COVER	80 LB. IN.
	OIL FILTER BYPASS VALVE	80 LB. IN.
	OIL PAN (TO CRANKCASE)	80 LB. IN.
	OIL PUMP COVER	80 LB. IN.
	ROCKER ARM COVER	45 LB. IN.
5/16–18	CAMSHAFT SPROCKET	20 LB. FT.
	OIL PAN (TO CRANKCASE)	265 LB. IN.
3/8–16	CLUTCH PRESSURE PLATE	35 LB. FT.
	DISTRIBUTOR CLAMP	20 LB. FT.
	FLYWHEEL HOUSING	30 LB. FT.
	MANIFOLD (EXHAUST)	20 LB. FT.
	MANIFOLD (INLET)	30 LB. FT.
	WATER OUTLET	30 LB. FT.
	WATER PUMP	30 LB. FT.
3/8–24	CONNECTING ROD CAP	45 LB. FT.
7/16–14	CYLINDER HEAD	65 LB. FT.
	MAIN BEARING CAP	70 LB. FT.
	OIL PUMP	65 LB. FT.
7/16–20	FLYWHEEL	60 LB. FT.
	TORSIONAL DAMPER	60 LB. FT.
1/2–14	TEMPERATURE SENDING UNIT	20 LB. FT.
1/2–20	OIL FILTER	25 LB. FT.
	OIL PAN DRAIN PLUG	20 LB. FT.
14MM 5/8	SPARK PLUG	15 LB. FT.

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Fig. 6A6-61 Engine Torques

	305	350
BORE SIZE	3.735"	4.00"
STROKE	3.48"	3.48"
COMPRESSION RATIO	8.5:1	8.5:1
FIRING ORDER	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2
BORE OUT-OF-ROUND MAXIMUM	.002"	.002"
BORE TAPER MAXIMUM	.005"	.005"
PISTON TO BORE CLEARANCE	.0007"–.0027"	.0007"–.0027"
RING GROOVE CLEARANCE (COMPRESSION)	.0012"–.0042"	.0012"–.0042"
RING GROOVE CLEARANCE (OIL)	.002"–.008"	.002"–.008"
RING END CLEARANCE (COMPRESSION)	.010"–.035"	.010"–.035"
RING END CLEARANCE (OIL)	.015"–.065"	.015"–.065"
PISTON PIN DIAMETER	.9270"	.9270"
PISTON PIN CLEARANCE	.00025"–.00135"	.00025"–.00135"
PISTON PIN TO ROD	PRESSED FIT	PRESSED FIT
MAIN BEARING JOURNAL DIAMETER #1	2.4484"–2.4493"	2.4484"–2.4493"
MAIN BEARING JOURNAL DIAMETER #2, 3, 4	2.4481"–2.4490"	2.4481"–2.4490"
MAIN BEARING JOURNAL DIAMETER #5	2.4479"–2.4488"	2.4479"–2.4488"
MAXIMUM TAPER (MAINS)	.001"	.001"
MAXIMUM OUT-OF-ROUND (MAINS)	.001"	.001"
MAIN BEARING CLEARANCE #1	.0010"–.0015"	.0008"–.0020"
MAIN BEARING CLEARANCE #2, 3, 4	.0011"–.0035"	.0011"–.0035"
MAIN BEARING CLEARANCE #5	.0017"–.0035"	.0017"–.0035"
CRANKSHAFT END CLEARANCE	.002"–.006"	.002"–.006"
ROD JOURNAL DIAMETER	2.199"–2.200"	2.199"–2.200"
MAXIMUM TAPER (ROD JOURNAL)	.001"	.001"
OUT-OF-ROUND (ROD JOURNAL)	.001"	.001"
ROD BEARING CLEARANCE	.0013"–.0035"	.0013"–.0035"
ROD SIDE CLEARANCE	.008"–.014"	.008"–.014"
CAMSHAFT JOURNAL DIAMETER	1.8682"–1.8692"	1.8682"–1.8692"
MAXIMUM RUNOUT (CAMSHAFT)	.0015"	.0015"
MAXIMUM VALVE LIFT (INTAKE)	.2485"	.2600"
MAXIMUM VALVE LIFT (EXHAUST)	.2733"	.2733"
VALVE LIFTERS	HYDRAULIC	HYDRAULIC
ROCKER ARM RATIO	1.5:1	1.5:1
VALVE LASH	0" PLUS ONE TURN	0" PLUS ONE TURN
VALVE FACE ANGLE (ALL)	45°	45°
VALVE SEAT ANGLE (ALL)	46°	46°
MAXIMUM VALVE SEAT RUNOUT	.002"	.002"
VALVE SEAT WIDTH (INTAKE)	1/32"–1/16"	1/32"–1/16"
VALVE SEAT WIDTH (EXHAUST)	1/16"–3/32"	1/16"–3/32"
VALVE STEM CLEARANCE (INTAKE)	.001"–.0037"	.001"–.0037"
VALVE STEM CLEARANCE (EXHAUST)	.001"–.0047"	.001"–.0047"
VALVE SPRING TENSION (CLOSED)	76-84 LB. @ 1.70"	76-84 LB. @ 1.70"
VALVE SPRING TENSION (OPEN)	194-206 LB. @ 1.25"	194-206 LB. @ 1.25"
INSTALLED HEIGHT (INTAKE)	1–23/32"	1–23/32"
INSTALLED HEIGHT (EXHAUST)	1–19/32"	1–19/32"
VALVE SPRING FREE LENGTH	2.03"	2.03"
SPRING DAMPER FREE LENGTH	1.86"	1.86"

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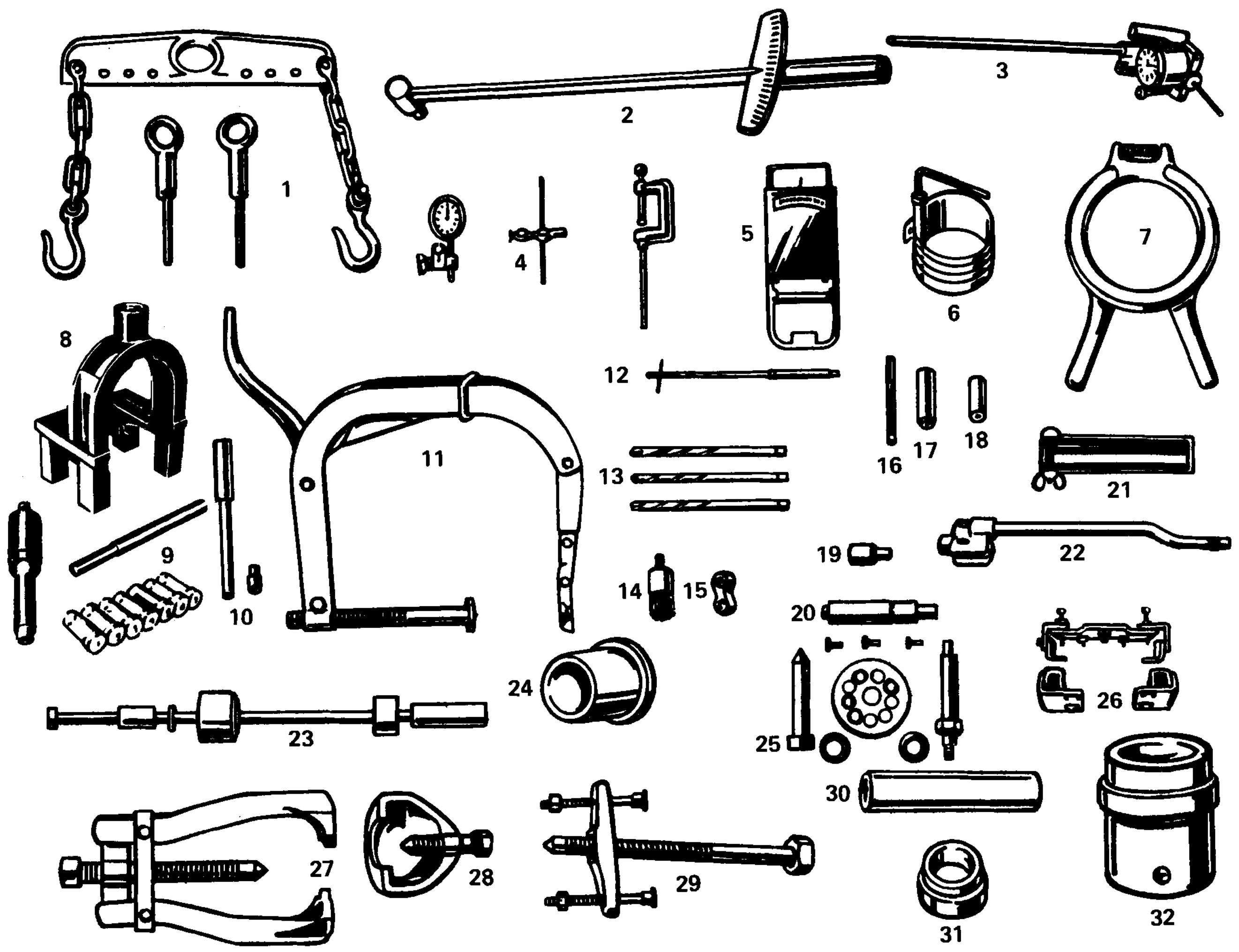
Fig. 6A6-62 Specifications



1.	J 4536	ENGINE LIFT KIT
2.	J 1264	(0-200 FT. LB.) TORQUE WRENCH
	J 8058	(0-50 FT. LB.)
	J 5853	(0-100 IN. LB.)
3.	J 8087	INDICATOR SET (CYLINDER BORE)
4.	J 8001	INDICATOR SET (UNIVERSAL)
5.	J 23600	BELT TENSION GAUGE
6.	J 8037	PISTON RING COMPRESSOR
7.	J 8020	(3-9/16") PISTON RING EXPANDER
	J 8021	(3-7/8")
	J 8032	(4")
	J 22249	(3-15/16")
	J 22147	(4-3/32")
	J 22250	(4-1/4")
8.	J 24086	PISTON PIN ASSEMBLY TOOL
9.	J 5239	(3/8") CONNECTING ROD GUIDE SET
	J 6305	(11/32")
10.	J 8062	VALVE SPRING COMPRESSOR
11.	J 8101	VALVE GUIDE CLEANER
12.	J 5830	(11/32") VALVE GUIDE REAMER SET
	J 7049	(3/8")

13.	J 8089	CARBON REMOVING BRUSH
14.	J 5860	CYLINDER HEAD BOLT WRENCH
15.	J 5715	(.003") ROCKER ARM STUD REAMER
	J 6036	(.013")
16.	J 6880	ROCKER ARM STUD INSTALLER
17.	J 5802	ROCKER ARM STUD REMOVER
18.	J 9534	DISTRIBUTOR LOWER BUSHING REMOVER
19.	J 9535	DISTRIBUTOR LOWER BUSHING INSTALLER
20.	J 22144	OIL PICK-UP SCREEN INSTALLER
21.	J 8369	OIL PICK-UP SCREEN INSTALLER
22.	J 6098	CAM BEARING TOOL
23.	J 0971	CAMSHAFT GEAR SUPPORT
24.	J 23523	TORSIONAL DAMPER PULLER
25.	J 22197	TORSIONAL DAMPER INSTALLER
26.	J 1619	CRANKSHAFT SPROCKET PULLER
27.	J 5825	CRANKSHAFT SPROCKET PULLER
28.	J 8105	CRANKSHAFT GEAR PULLER
29.	J 5590	CRANKSHAFT SPROCKET OR GEAR INSTALLER
30.	J 23042	CRANKCASE COVER CENTERING GAUGE AND SEAL INSTALLER
31.	J 22102	CRANKCASE COVER SEAL INSTALLER
TOOLS NOT ILLUSTRATED		
	J 23994	VALVE SEAL LEAK DETECTOR

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Fig. 6A6-63 Special Tools

SECTION 6B

ENGINE COOLING

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The cooling system consists of the radiator cap, radiator, reservoir, hoses, water pump, cooling fan, pellet-type thermostat and suitable passages for water circulation through the engine.

RADIATOR

A cross-flow radiator is used on all models. Tanks in this type radiator are located to the right and left of the core, instead of above and below (Fig. 6B-1).

Radiators used with automatic transmissions except some H Series have oil coolers built into the right hand tank with inlet and outlet fittings for transmission fluid circulation. Synchromesh-equipped cars utilized radiators without oil coolers. Vehicles equipped with air conditioning use a radiator with extra cooling capacity for greater cooling demands.

RADIATOR CAP

A pressure-vent cap is used on the cross-flow radiator to allow a build-up of 15 psi in the cooling system. This pressure raises the boiling point of coolant to approximately 258°F. (125°C.) at sea level.

Do not remove radiator cap to check engine coolant level; check coolant visually at the see-through coolant reservoir. Coolant should be added only to the reservoir.

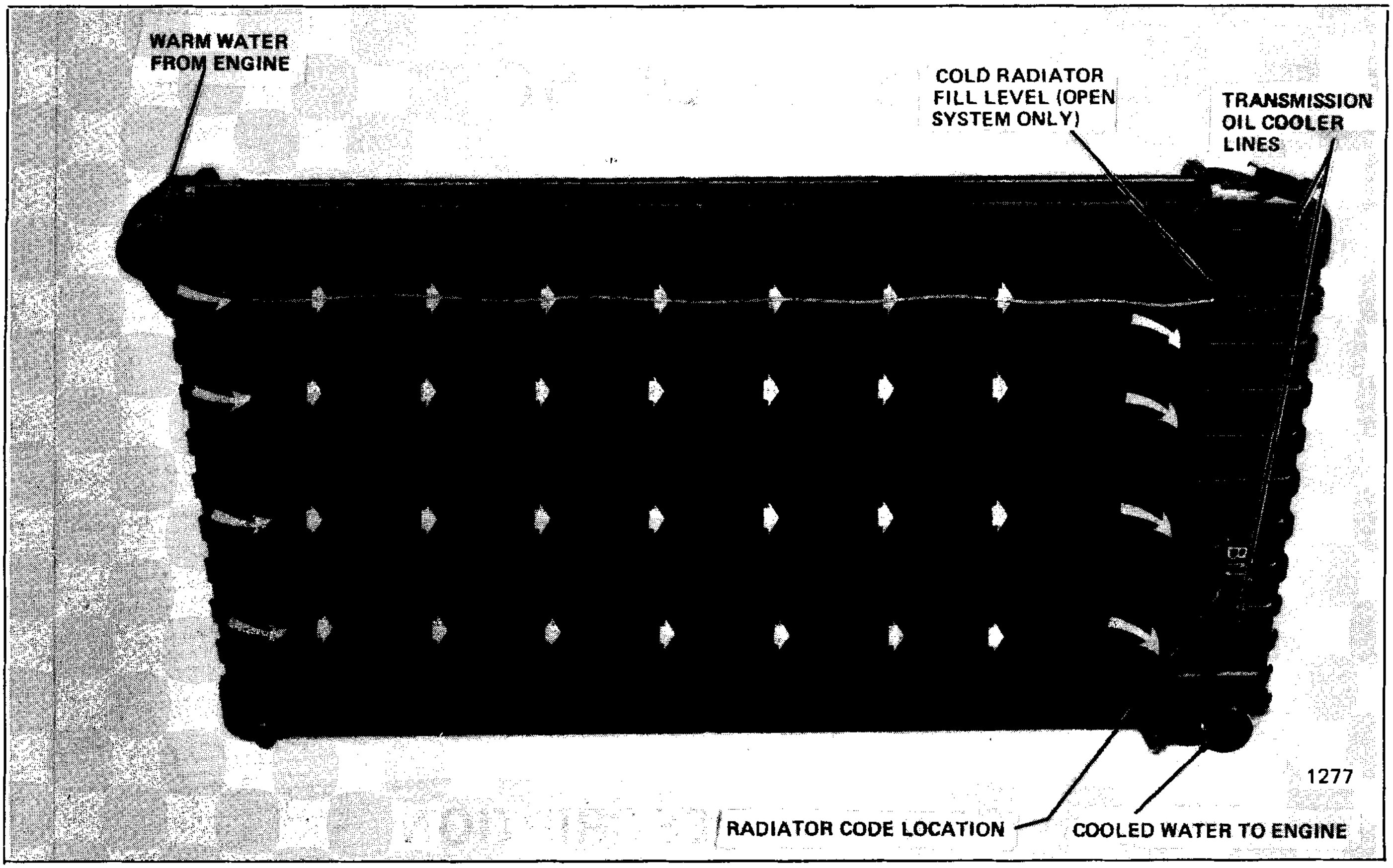

Fig. 6B-1 Cross-Flow Radiator

WARNING: AS LONG AS THERE IS PRESSURE IN THE COOLING SYSTEM, THE TEMPERATURE CAN BE CONSIDERABLY HIGHER THAN THE BOILING TEMPERATURE OF THE SOLUTION IN THE RADIATOR WITHOUT CAUSING THE SOLUTION TO BOIL. REMOVAL OF THE RADIATOR CAP WHILE ENGINE IS HOT AND PRESSURE IS HIGH WILL CAUSE THE SOLUTION TO BOIL INSTANTANEOUSLY AND POSSIBLY WITH EXPLOSIVE FORCE, SPEWING THE SOLUTION OVER ENGINE, FENDERS AND PERSON REMOVING CAP. IF THE SOLUTION CONTAINS FLAMMABLE ANTI-FREEZE SUCH AS ALCOHOL (NOT RECOMMENDED FOR USE AT ANY TIME), THERE IS ALSO THE POSSIBILITY OF CAUSING A SERIOUS FIRE. THE PRESSURE-TYPE RADIATOR FILLER CAP CONTAINS A BLOW OFF OR PRESSURE VALVE AND A VACUUM OR ATMOSPHERIC VALVE (FIG. 6B-2). THE PRESSURE VALVE IS HELD AGAINST ITS SEAT BY A SPRING OF PRE-DETERMINED STRENGTH WHICH PROTECTS THE RADIATOR BY RELIEVING THE PRESSURE IF AN EXTREME CASE OF INTERNAL PRESSURE SHOULD EXCEED THAT FOR WHICH THE COOLING SYSTEM IS DESIGNED. THE VACUUM VALVE IS HELD AGAINST ITS SEAT BY A LIGHT SPRING WHICH PERMITS OPENING OF THE VALVE TO RELIEVE VACUUM CREATED IN THE SYSTEM WHEN IT COOLS OFF AND WHICH OTHERWISE MIGHT CAUSE THE RADIATOR TO COLLAPSE.

The design of the radiator cap is to discourage inadvertent removal. The finger grips have been removed so the cap is round in shape. It must be pushed downward before it can be removed. A rubber asbestos gasket is added to the diaphragm spring at the top of the cap. Also, embossed on the cap is a caution against its being opened and arrows indicating the proper closed position.

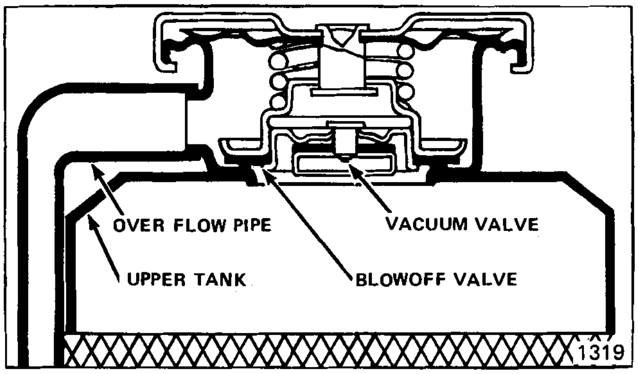

FIG. 6B-2 PRESSURE-TYPE RADIATOR CAP

RESERVOIR

A "see-through"plastic reservoir, similar to the familiar windshield washer jar, is connected to the radiator by a hose. As the car is driven, the coolant is heated and expands. The portion of the fluid displaced by this expansion flows from the radiator into the reservoir. When the car is stopped and the coolant cools and contracts, the displaced coolant is drawn back into the radiator by vacuum. Thus, the radiator is kept filled with coolant to the desired level at all times, resulting in increased cooling efficiency. Coolant level should be between "ADD"and "FULL"marks on reservoir. These marks are approximately two quarts apart so that a 50/50 mixture can be added (one quart of ethylene glycol anti-freeze and one quart of water).

WATER PUMP

V6 AND V8

The water pump impeller turns on a steel shaft mounted on a double row of permanently lubricated, sealed ball bearings (Fig. 6B-3). A bellows-type seal is seated in the water pump body between the bearing and the impeller. The seal surface is a phenolic washer which is held by the spring-loaded bellows against a ceramic seal seat.

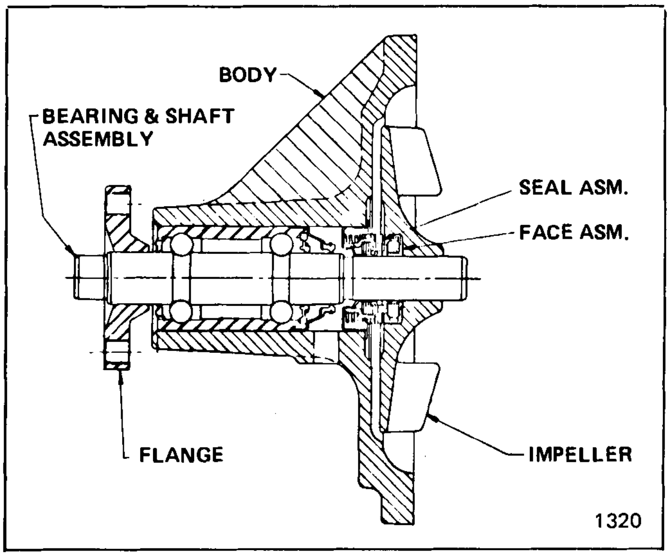

Fig. 6B-3 Cross Section of Water Pump Typical V6-V8

The inlet side of the pump is connected to the right radiator tank by means of a hose. A water leg in the intake manifold connects to the timing chain cover to provide recirculation of water when the thermostat is closed. The timing chain cover also has a heater water return connection.

L-4

The centrifugal-type water pump contains an impeller which turns on a steel shaft which rotates in a ball bearing (Fig. 6B-4). A bellows-type seal is seated in the water pump body between the bearing and the impeller.

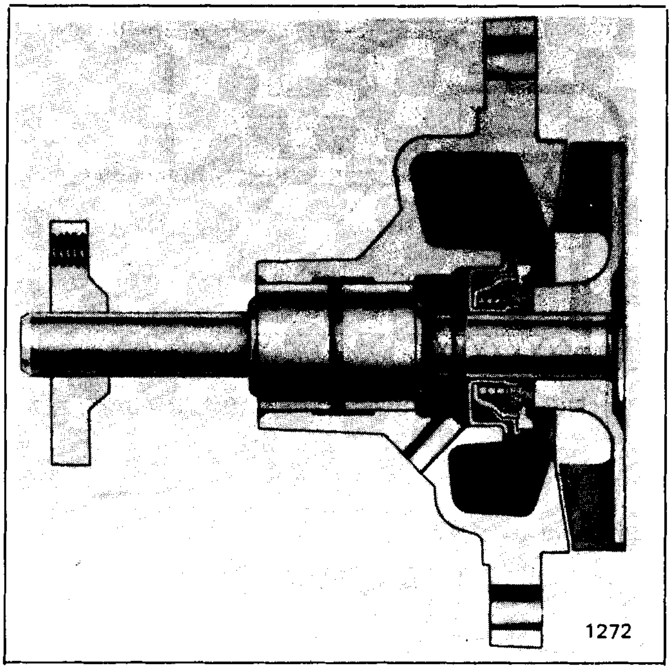

Fig. 6B-4 Cross Section of Water Pump (L-4 Typical)

The inlet side of the pump is connected to the right radiator tank by a hose. The inlet from the heater core is located above the pump inlet from the radiator.

FAN

The engine fan is used to increase the air flow through the radiator at all speeds (Fig. 6B-5).

CAUTION: *If a fan blade is bent or damaged in any way, no attempt should be made to repair and reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new fan assembly. It is essential that fan assemblies remain in proper balance and proper balance cannot be assured once a fan assembly has been bent or damaged. A fan assembly that is not in proper balance could fail and fly apart during subsequent use, creating an extremely dangerous condition. The majority of non A/C cars use a fan which has four blades which are unevenly spaced and have curled tips to provide minimum noise. A fan shroud is used to prevent recirculation of air around the fan on most cars.*

POWER FLEX FAN

The five blade variable pitch fan is designed to reduce fan noise and increase cooling capacity. At high rpm, air flow through the grille is sufficient to maintain adequate engine cooling and the blades tend to straighten out, reducing the pitch angle by 50% at 5000 rpm. A five blade power flex fan is used on cars with police or trailer options, and some A/C applications.

THERMOSTATICALLY CONTROLLED FLUID CLUTCH FAN

A thermostatically controlled fluid clutch fan is used on some air conditioned equipped V-8's and operates only when additional air flow is required to reduce radiator coolant temperatures. This clutch is of a simple functional design and is made of lightweight metal filled with silicone oil which is hermetically sealed. The finned (rear) housing contains a hub assembly (secured to the housing bearing) which attaches to the engine water pump (Fig. 6B-6). Four bosses with tapped holes in the rear face provide for attachment of the engine fan. The front surface of the housing has six deep circular grooves which index with six matching bosses on the rear face of a floating clutch. A separator plate and front cover with thermostatic coil control complete the clutch assembly.

Function

NOTE: Testing a clutch fan by holding the small hub with one hand and rotating the aluminum housing in a clockwise/counter- clockwise motion will cause the clutch to freewheel, which is a normal condition when operated in this manner. This should not be considered

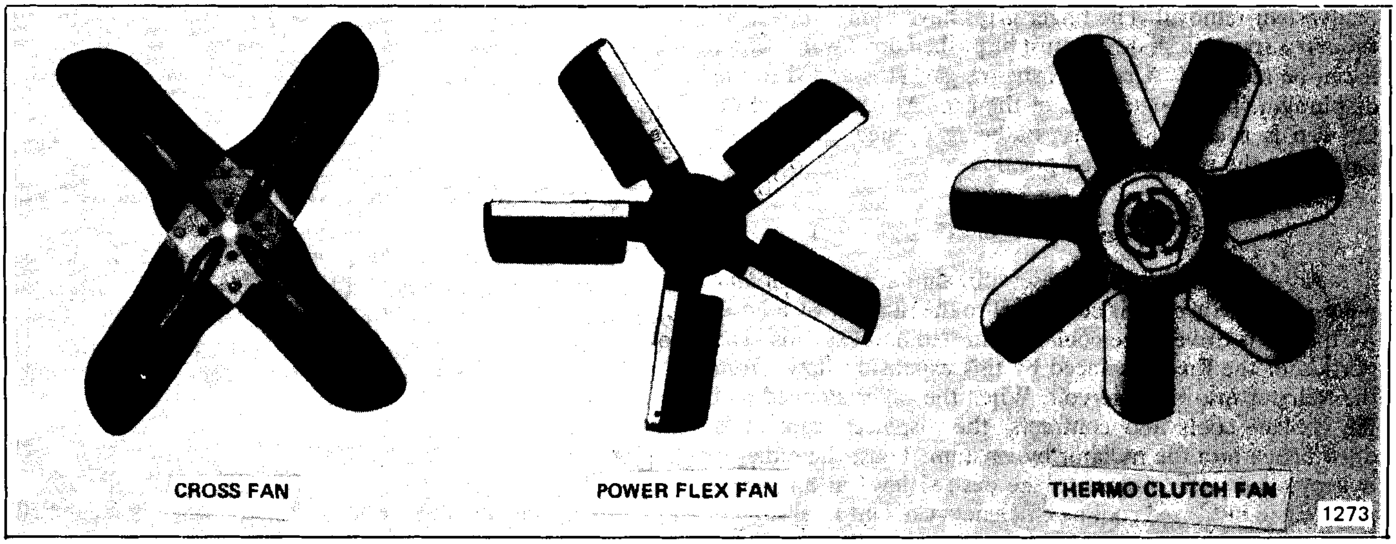

Fig. 6B-5 Engine Fans (Typical)

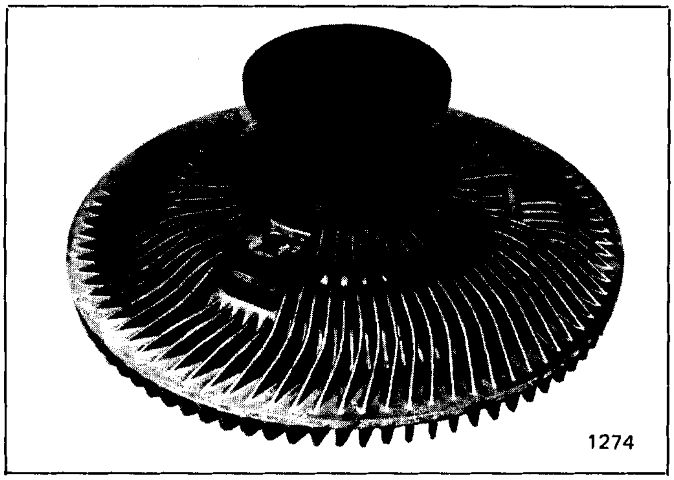

Fig. 6B-6 Fluid Clutch Fan Assembly

a test by which replacement is determined.

THERMOSTAT

A pellet-type thermostat is used in the water outlet passage to control the flow of coolant, providing fast engine warm-up and regulating coolant temperatures (Fig. 6B-7). A wax pellet or power element in the thermostat expands when heated and contracts when cooled. The pellet is connected through a piston to a valve and, when the pellet is heated, pressure is exerted against a rubber diaphragm which forces the valve to open. As the pellet is cooled, the contraction allows a spring to close the valve. Thus, the valve remains closed while the coolant is cold, preventing circulation of coolant through the radiator but allowing the coolant to circulate throughout the engine to warm it quickly and evenly.

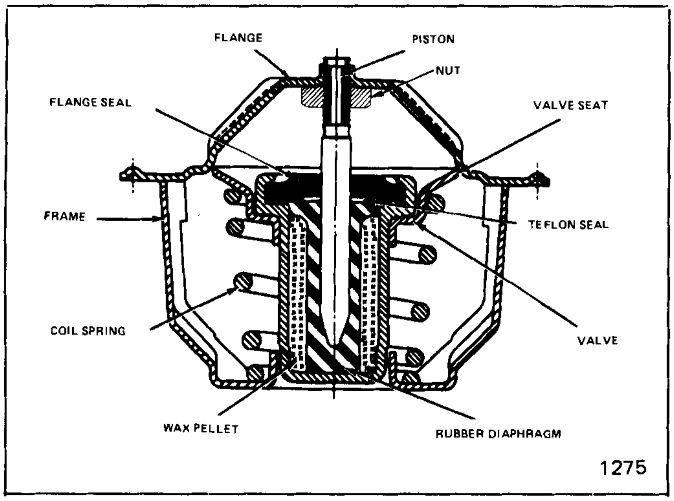

Fig. 6B-7 Pellet-Type Thermostat

As the engine becomes warm, the pellet expands and the thermostat valve opens, permitting the coolant to flow through the radiator where heat is passed through the radiator walls. This opening and closing of the thermostat valve permits enough coolant to enter the radiator to keep the engine within specified temperature limits. Engine thermostat control temperatures vary as coolant mixtures vary; therefore, a 195°F. (91°C.) thermostat is installed as standard equipment and is used with glycol-type coolant.

NOTE: Higher temperature thermostats will not provide faster warm-up, since their valves remain tightly closed until the control temperatures are reached, as does a lower temperature thermostat.

NOTE: All thermostats are not alike. Check parts catalog for proper application. Improper thermostat application can cause overheating and engine damage.

COOLING SYSTEM CIRCULATION

V-8

Water circulation is provided by a single impeller, specially designed water pump which provides a balanced flow of water into each bank of the cylinder block. Water circulation during warm-up (thermostat closed) is from pump to each bank of the cylinder block, up into cylinder heads, into front of intake manifold and back to inlet of pump via an internal or external recirculation passage. Water circulation after normal operating temperatures are reached (thermostat open) takes two courses. Part of the water will always recirculate as outlined above. A major portion of the water, however, will circulate into a passange in the intake manifold as above but will then pass directly into the radiator, via the outlet passage and hose above the thermostat, and then back to the pump inlet. The water pump and water transfer holes between the block and cylinder heads have been designed to provide an equitable flow of coolant and provide temperature balance in both banks of the engine and within each bank and its cylinder head.

L-4

The water pump discharges coolant into the water jacket chamber between the front face of the block and the number one cylinder. Coolant then flows through the block toward the rear, passing through two large cast openings into the cylinder head to cool the valve seats and forward to the front of the head. Coolant then flows through the coolant outlet and the pellet-type thermostat to the radiator.

TROUBLE DIAGNOSIS

The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made the problem should be corrected by part replacement, adjustment, or repair as required. Refer to the appropriate section of the service manual for these procedures.

FAN CLUTCH DIAGNOSTIC PROCEDURE

1. NOISE

Fan noise is sometimes evident under the following normal conditions:

a. When clutch is engaged for maximum cooling.

b. During first few minutes after start-up until the clutch can re-distribute the silicone fluid back to its normal disengaged operating condition after overnight settling.

However, fan noise or an excessive roar will generally occur continuously under all high engine speed conditions (2500 r.p.m. and up) if the clutch assembly is locked up due to an internal failure. If the fan cannot be rotated by hand or there is a rough grating feel as the fan is turned, the clutch should be replaced.

2. LOOSENESS

Under various temperature conditions, there is a visible lateral movement that can be observed at the tip of the fan blade. This is a normal condition due to the type of bearing used. Approximately 1/4" maximum lateral movement measured at the fan tip is allowable. This is not cause for replacement.

3. SILICONE FLUID LEAK

The operation of the unit is generally not affected by small fluid leaks which may occur in the area around the bearing assembly. However, if the degree of leakage appears excessive, proceed to item 4.

4. ENGINE OVERHEATING

a. Start with a cool engine to insure complete fan clutch disengagement.

b. If the fan and clutch assembly free-wheels with no drag (revolves over 5 times when spun by hand), the clutch should be replaced. If clutch performs properly with a slight drag go to step c.

NOTE: Testing a fan clutch by holding the small hub with one hand and rotating the aluminum housing in a clockwise/counterclockwise motion will cause the clutch to free-wheel, which is a normal condition when operated in this manner. This should not be considered a test by which replacement is determined.

c. Use dial type thermometer J 23640, or similar type.

NOTE: J 23640 reads to 220° F. (115°C.), therefore, allow approximately 3/16" pointer movement for each

NOTE: pointer movement for each 10° (6°C.) over 180°F. (82°C.).

Position thermometer so that the thermomoeter sensor is centered in the space between the fan blades and radiator. This can be achieved by inserting the sensor through one of the existing holes in the fan shroud or fan guard, or by placing between the radiator and the shroud. On some models, it may be necessary to drill a 3/16" hole in the fan shroud to insert J 6742-01.

CAUTION: *Check for adequate clearance between fan blades and thermometer sensor before starting engine.*

d. Cover radiator grille sufficiently to induce a high engine temperature. Start engine and turn on A/C if equipped. Maintain a position in front of the vehicle to observe the thermometer reading while engine is running at approximately 2000 r.p.m. Use tachometer if available.

e. Observe thermometer reading when clutch engages. It will take approximately 5 to 10 minutes for the temperature to become high enough to allow engagement of the fan clutch. This will be indicated by an increase or roar in fan air noise and by a drop in the thermometer reading of approximately 5-15°F. (3-8°C.) If the clutch did not engage between 150-190°F. (65-88°C.), the unit should be replaced.

NOTE: Be sure fan clutch was disengaged at beginning of test.

If no sharp increase in fan noise or temperature drop was observed and the fan noise level was constantly high from start of test to 190°F. (88°C.) the unit should be replaced.

CAUTION: *Do not continue test past a thermometer reading of 190°F. (88°C.) to prevent engine overheating.*

f. As soon as the clutch engages, remove the radiator grille cover and turn off the A/C to assist in engine cooling. The engine should be run at approximately 1500 r.p.m.

g. After several minutes the fan clutch should disengage, as indicated by a reduction in fan speed and roar.

ENGINE COOLING SYSTEM COMPLAINT

TO AVOID NEEDLESS TIME AND COST IN DIAGNOSING COOLING SYSTEM COMPLAINTS, THE CUSTOMER SHOULD BE QUESTIONED ABOUT DRIVING CONDITIONS THAT PLACE ABNORMAL LOADS ON THE COOLING SYSTEM.

1. DOES OVERHEATING OCCUR WHILE PULLING A TRAILER?

   IF ANSWER IS "YES" – HOW HEAVY IS TRAILER? IF TRAILER WEIGHT IS GREATER THAN 2,000 LBS. & CAR IS EQUIPPED WITH NORMAL DUTY COOLING SYSTEM, A HEAVY DUTY COOLING PACKAGE IS REQUIRED [PER MFR'S TRAILER HAULING SPECS.]. FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

2. IS CAR EQUIPPED WITH ADD–ON OR AFTER MARKET AIR CONDITIONING SYSTEM?

   IF ANSWER IS "YES" – WAS HEAVY DUTY RADIATOR INSTALLED WITH THE SYSTEM? IF NOT, INSTALL HEAVY DUTY AIR CONDITIONING RADIATOR FOR THE CAR MODEL INVOLVED [PER MANUFACTURER'S SPECS.]. FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

3. IS OVERHEATING OCCURRING AFTER PROLONGED IDLE, IN GEAR, A/C SYSTEM OPERATING?

   IF ANSWER IS "YES" – INSTRUCT OWNER ON DRIVING TECHNIQUES THAT WOULD AVOID OVERHEATING SUCH AS:
   a. IDLE IN NEUTRAL AS MUCH AS POSSIBLE – INCREASE ENGINE R.P.M. TO GET HIGHER AIR FLOW & WATER FLOW THROUGH RADIATOR.
   b. TURN A/C SYSTEM OFF DURING EXTENDED IDLES IF OVERHEATING IS INDICATED BY HOT LIGHT OR TEMP. GAGE.
   FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

4. IS OVERHEATING OCCURRING AFTER PROLONGED DRIVING IN SLOW CITY TRAFFIC, TRAFFIC JAMS, PARADES, ETC.?

   IF ANSWER IS "YES" – INSTRUCT OWNER ON DRIVING TECHNIQUES THAT WOULD AVOID OVERHEATING – SAME AS FOR PROLONGED IDLES – NO. 3. FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

IF NONE OF THE ABOVE APPLY, GO TO DIAGNOSTIC CHART

TO EFFECTIVELY USE THIS CHART, QUESTION THE OWNER TO DETERMINE WHICH OF THE FOLLOWING [3] CATEGORIES APPLIES TO THE COMPLAINT:

1. HOT LIGHT OR HOT INDICATION ON TEMPERATURE GAGE
2. BOILING
3. COOLANT LOSS

1. IF COMPLAINT IS HOT LIGHT OR HOT INDICATION ON TEMPERATURE GAGE –

   WAS HOT LIGHT ACCOMPANIED BY BOILING? IF ANSWER IS "YES", GO TO BOILING ON CHART
   IF ANSWER IS "NO", GO TO HOT LIGHT ON CHART

2. IF COMPLAINT IS BOILING – GO TO BOILING ON CHART

3. IF COMPLAINT IS COOLANT LOSS –

   DETERMINE IF CUSTOMER IS OVERFILLING THE SYSTEM, THIS WOULD NORMALLY RESULT IN SMALL AMOUNTS OF COOLANT LOSS THROUGH THE OVERFLOW TUBE. IF THIS IS THE CASE, INSTRUCT THE CUSTOMER ON PROPER FILL LEVEL & NO FURTHER DIAGNOSTIC CHECKS SHOULD BE REQUIRED.

   IF OVERFILLING IS NOT THE PROBLEM, GO TO COOLANT LOSS ON CHART.

WARNING – THE COOLING SYSTEM IS DESIGNED TO OPERATE AT 15 P.S.I. PRESSURE & TEMPERATURES EXCEEDING 200° F. CAUTION SHOULD BE EXCERCISED WHEN REMOVING PRESSURE CAP OR SERVICING THE SYSTEM.

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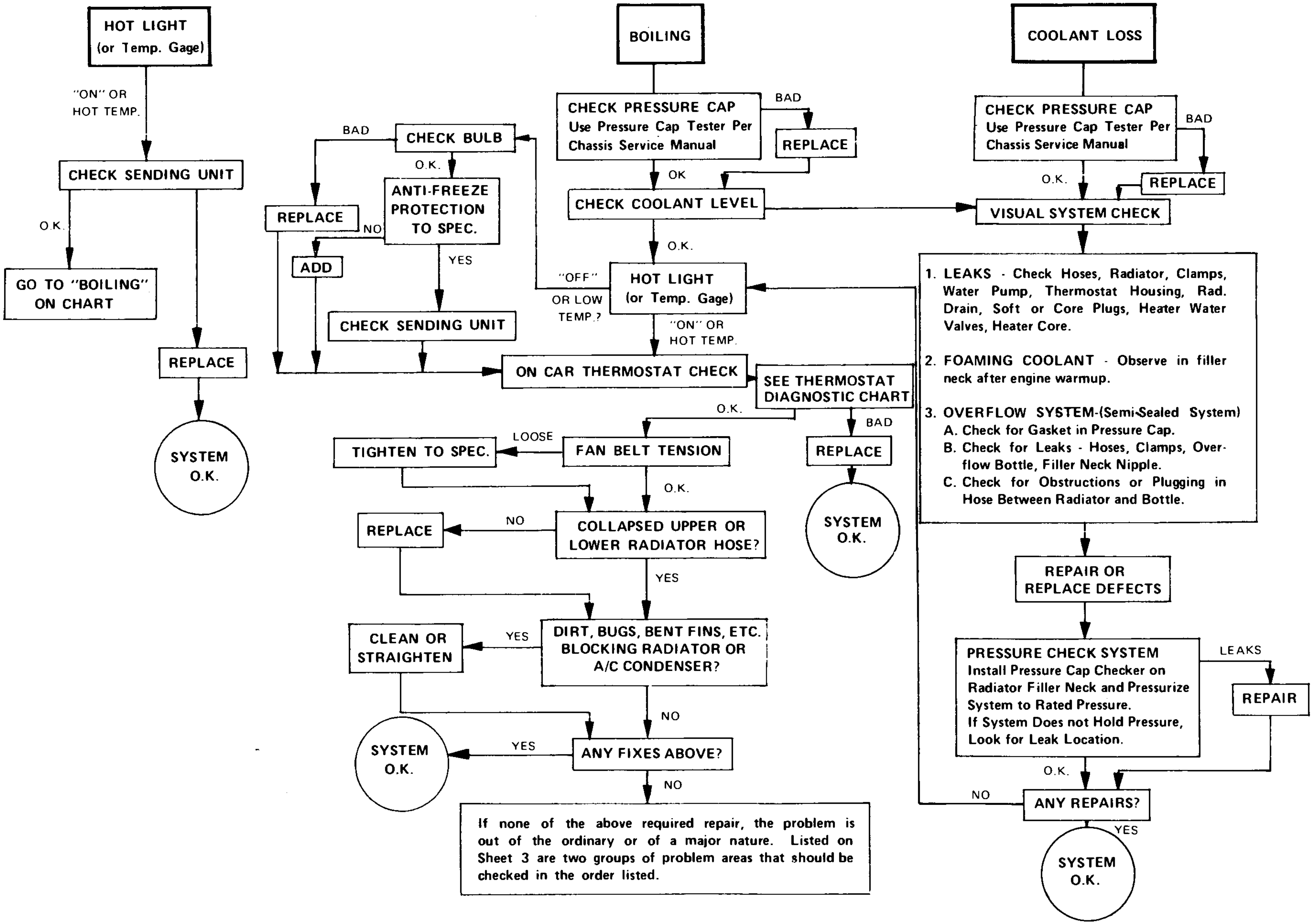
Fig. 6B-8 Cooling System Diagnosis Chart

DIAGNOSIS CHART



1. LEAKS - Check Hoses, Radiator, Clamps, Water Pump, Thermostat Housing, Rad. Drain, Soft or Core Plugs, Heater Water Valves, Heater Core.

2. FOAMING COOLANT - Observe in filler neck after engine warmup.

3. OVERFLOW SYSTEM-(Semi-Sealed System)
   A. Check for Gasket in Pressure Cap.
   B. Check for Leaks - Hoses, Clamps, Overflow Bottle, Filler Neck Nipple.
   C. Check for Obstructions or Plugging in Hose Between Radiator and Bottle.

PRESSURE CHECK SYSTEM
Install Pressure Cap Checker on Radiator Filler Neck and Pressurize System to Rated Pressure.
If System Does not Hold Pressure, Look for Leak Location.

If none of the above required repair, the problem is out of the ordinary or of a major nature. Listed on Sheet 3 are two groups of problem areas that should be checked in the order listed.

Fig. 6B-9 Cooling System Diagnosis Chart

A. PROBLEMS NOT REQUIRING DISASSEMBLY OF COOLING SYSTEM –

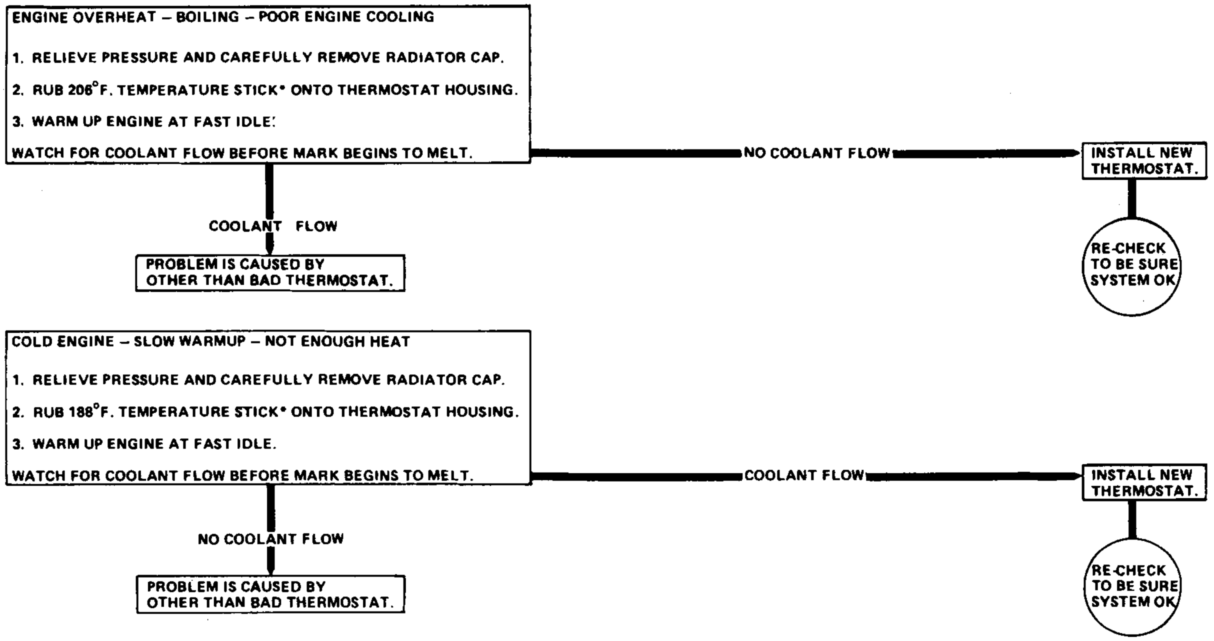
1. LARGE OBSTRUCTIONS BLOCKING RADIATOR OR CONDENSER
   - a. AUXILIARY OIL COOLERS ⎤
   - b. LICENSE PLATES ⎬ RELOCATE
   - c. SPARE TIRES ⎦
   - d. ICE, MUD OR SNOW OBSTRUCTING GRILLE – REMOVE
2. ENGINE OIL OVERFILL – CHECK ENGINE OIL DIPSTICK
3. WRONG RADIATOR FOR APPLICATION – CHECK PART NO. AGAINST PARTS LIST
4. LOOSE, DAMAGED OR MISSING AIR SEALS – SEE BODY SERVICE MANUAL
5. MISSING OR DAMAGED LOWER AIR BAFFLE – SEE BODY SERVICE MANUAL
6. WRONG IGNITION TIMING – SEE CHASSIS SERVICE MANUAL

B. PROBLEMS REQUIRING DISASSEMBLY OF COOLING SYSTEM –

1. INCORRECT OR DAMAGED FAN – CHECK PART NO. AGAINST PARTS LIST
2. FAULTY EMISSION SYSTEM COMPONENTS (COULD CAUSE OVERHEATING AT IDLE)
   - a. PCV VALVE ⎤ SEE CHASSIS SERVICE MANUAL
   - b. TVS OR TCS ⎦
3. PRESSURE CHECK COOLING SYSTEM WITH PRESSURE CAP INSTALLED – WILL SHOW IF PRESSURE CAP LEAKS BECAUSE OF RADIATOR FILLER NECK DAMAGE
4. DEFECTIVE WATER PUMP
   - a. ERODED OR BROKEN IMPELLER VANES
   - b. FAILED BEARING OR SEAL – CHECK FOR SHAFT OR BEARING PLAY
5. PLUGGED RADIATOR TUBES – SEND TO RADIATOR REPAIR SHOP FOR FLOW CHECK
6. INTERNAL SYSTEM LEAKS
   - a. HEAD GASKET – SEE CHASSIS SERVICE MANUAL
   - b. CRACKED BLOCK
   - c. TIMING CHAIN COVER
   - d. INTAKE MANIFOLD GASKET
7. PLUGGED COOLANT PASSAGES IN CYLINDER HEADS – REMOVE HEADS AND CHECK VISUALLY

1381

Fig. 6B-10 Cooling System Diagnosis Chart



*NOTE: THE TEMPERATURE STICK IS A PENCIL LIKE DEVICE WHICH HAS A WAX MATERIAL CONTAINING CERTAIN CHEMICALS WHICH MELT AT A GIVEN TEMPERATURE. THEMPERATURE STICKS CAN BE USED TO DETERMINE A THERMOSTAT'S OPERATING TEMPERATURE BY RUBBING 188°F. AND 206°F. STICKS ON THE THERMOSTAT HOUSING. THE MARKS MADE BY THE STICKS SHOULD MELT WHEN COOLANT TEMPERATURES OF 188°F. AND 206°F. ARE REACHED, RESPECTIVELY. THESE TEMPERATURES ARE THE NORMAL OPERATING RANGE OF THE THERMOSTAT, THEREFORE, IF THE COOLANT FLOWS AS INDICATED ON THE DIAGNOSIS CHART, THE THERMOSTAT MAY BE DEFECTIVE.

4719

Fig. 6B-11 Thermostat Diagnosis Chart

SERVICE OPERATIONS

COOLING SYSTEM

CHECKING AND FILLING

The cooling system requires little care except for maintaining an adequate coolant level and periodic service as outlined below. The recovery type cooling system is standard on all Pontiac passenger cars and is designed to maintain the engine at proper operating temperatures. The recovery tank collects coolant that expands with rising temperature that would otherwise overflow from the system. When the system temperature drops, the coolant is drawn from the recovery tank back into the radiator by the suction created by coolant contraction. The cooling system has been filled at the factory with a high-quality, inhibited, year-around coolant that meets the standards of General Motors Specification 1899-M. This coolant solution provides freezing protection to -20°F. (-24°C.) (-35°F. [-36°C.] in Canada), and it has been formulated to be used for two full calendar years or 30,000 miles, whichever first occurs, of normal operation without replacement, provided the proper concentration of coolant is maintained.

COOLING SYSTEM CARE

The radiator cap should not be removed to check coolant level. Check the coolant level visually in the see thru coolant recovery tank everytime hood is up. Level should be below "ADD"mark when the system is cold. At normal operating temperature the coolant level should be between the "FULL"and "ADD"marks on the recovery tank. Coolant should be added only to the reservoir to raise level to the "FULL"mark. Use a 50/50 mixture of high-quality ethylene glycol antifreeze and water for coolant additions.

NOTE: If recommended quality anti-freeze is used, supplemental inhibitors or additives claiming to provide increased cooling capability are not necessary. They may be detrimental to the efficient operation of the system, and represent an unnecessary operating expense.

Every 12 months or 15,000 miles, the cooling system should be serviced as follows:

1. Wash radiator cap and filler neck with clean water.
2. Check coolant for proper level and freeze protection.
3. Pressure test system and radiator cap for proper pressure holding capacity (15 psi). If replacement of cap is required, use the proper cap specified for car model.
4. Tighten hose clamps and inspect all hoses. Replace hoses whenever checked, swollen or otherwise deteriorated.
5. Clean frontal area of radiator core and air conditioning condenser.

Draining and refilling the cooling system: Replace hoses every 24 months or 30,000 miles or earlier if checked, swollen or otherwise deteriorated. Every two years or 30,000 miles, whichever first occurs, the cooling system should be flushed and refilled using the following recommended procedure:

1. Remove radiator cap when engine is cool by:

- Slowly rotating cap counterclockwise to detent. (Do not press down while rotating).
- Wait until any residual pressure (indicated by a hissing sound) is relieved.
- After all hissing ceases, press down on cap while continuing to rotate counterclockwise.

CAUTION: *To avoid the danger of being burned, do not remove radiator cap while engine and radiator are still hot because scalding fluid and steam will be blown out under pressure.*

2. Open radiator drain valve and block drain plugs to drain coolant.
3. Close valve, install block drain plugs, and add sufficient water to fill system.
4. Run engine, drain and refill the system, as described in steps 1, 2, 3 and 4, a sufficient number of times until the drained liquid is nearly colorless.
5. Allow system to drain completely and then close radiator drain valve tightly, and install block drain plugs.
6. Remove recovery cap leaving hoses in place. Remove coolant recovery tank and empty of fluid. Flush tank with clean water, drain and reinstall.
7. Add sufficient ethylene glycol coolant, meeting GM specification, 1799-M, to provide the required freezing and corrosion protection - at least 44 percent solution (20°F. [-29°C.]). Fill radiator to the base of the radiator fill neck and add sufficient coolant to the recovery tank to raise level to the "FULL"mark. Reinstall recovery tank cap.
8. Run engine, with radiator cap removed, until normal operating temperature is reached. (Radiator upper hose becomes hot).
9. With engine idling, add coolant until level reaches bottom of filler neck and install radiator cap making certain arrows line up with overflow tube.

It is the owner's responsibility to keep the freeze protection at a level commensurate with the temperatures which may occur in the area of vehicle operation. ● Maintain cooling system freeze protection at -20°F. (-29°C.) or below to ensure protection against corrosion and loss of coolant from boiling even though freezing temperatures are not expected. ● Add ethylene glycol base coolant that meets GM Specification 1899-M when coolant additions are required because of coolant loss or to provide additional protection against freezing at temperatures lower than -20°F. (-29°C.) (-35°F. [-38°C.] in Canada).

NOTE: Alcohol or methanol base coolants or plain water are not recommended at any time.

TESTING COOLANT

Two recommended methods of testing coolant are available, the hydrometer test and the refractometer test (J-23688): In using a hydrometer to determine the freezing point of radiator solution, make sure correct hydrometer markings are read. Unless hydrometer is provided with means for temperature correction, test should be made at temperature at which hydrometer is calibrated, for if the solution is warmer or colder, large errors may result (in some cases as much as 30°F. [17°C.]). Most good hydrometers are equipped with a thermometer and temperature correction scale which allows an accurate test of freezing point over a range of temperatures. The manufacturer's instructions on use of their hydrometer should be closely followed as large differences in readings can occur due to temperature calibration.

Refractometer Test

CLEANING

Before each use, swing back the plastic cover at the slanted end of the Tester, exposing both the measuring window and the bottom of the plastic cover. WIPE BOTH CLEAN AND DRY with tissue or clean soft cloth. Close the plastic cover (Fig. 6B-12).

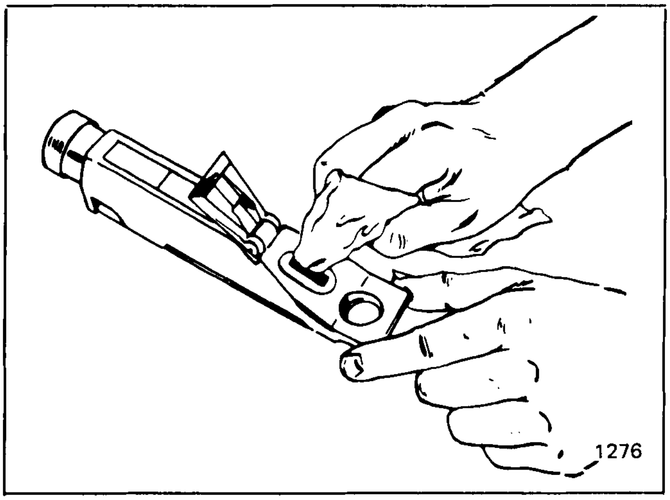


Fig. 6B-12 Cleaning Refractometer

TESTING

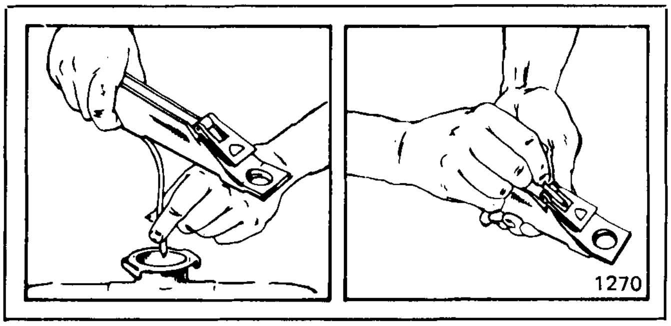


Fig. 6B-13 Procedure for Collecting Coolant Sample

Do not remove clear plastic pump from Tester. Release tip of pump from Tester housing and insert into radiator filler neck. Be sure to insert well below level of fluid. Press and release bulb to draw up a sample of coolant (Fig. 6B-13). Bend plastic tube around Tester so that tip can be inserted in cover plate opening. Eject a few drops of coolant into measuring surface by pressing bulb (Fig. 6B-13).

NOTE: Never open plastic cover when taking readings. Evaporation of water from the fluid sample being tested can affect the reading.

READING

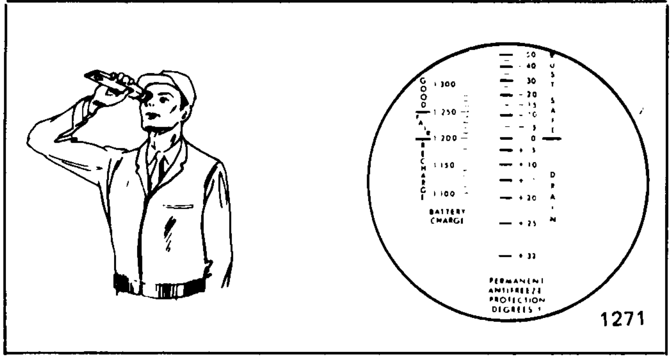


Fig. 6B-14 Reading Refractometer

Point the instrument toward any light source and look into eyepiece (Fig. 6B-14). The anti-freeze protection reading is at the point where the dividing line between light and dark (edge of the shadow) crosses the scale; anti-freeze on right hand scale, battery charge on left.

NOTE: The Tester temperature scale is reversed from a standard thermometer scale; below zero readings are on upper half of scale (Fig. 6B-14). Readings on lower half of scale (above zero readings) indicate solutions without enough anti-freeze concentration to provide adequate rust protection.

A little experience will enable you to obtain quickly the best contrast between the light and dark portions of the field of view. Tilt the instrument toward the light source until best results are obtained. If the "edge of the shadow"is not sharp, the measuring surfaces were not sufficiently well cleaned or dried. Wipe dry as explained above and make new test.

THERMOSTAT

REMOVE AND INSTALL

1. Drain radiator level to below thermostat and remove water outlet assembly.

2. Remove thermostat. Unless obviously defective, test thermostat as follows before replacing with new one:

a. Immerse unit and thermometer in container of 50/50 glycol/water over a heater. While heating water, do not rest either the thermometer or thermostat on bottom of container as this will cause them to be at a higher temperature than the water.

b. Agitate water to insure uniform temperature of water, thermostat and thermometer.

A new thermostat (195° [91°C.]) valve should start to open (.002" [91°C.]) at a temperature of 192°F. (89°C.) to 198°F. (92°C.) and should be fully open (5/16" or more) at a temperature not in excess of 222°F. (106°C.).

A used thermostat can be about 10°F. (7°C.) above or below this setting (185° - 205°) (85° - 96°C.) without adverse effect and should not be replaced. If thermostat does not operate at specified temperatures, it should be replaced as it cannot be adjusted.

3. Clean gasket surfaces on housing and intake manifold.

4. Install thermostat with pellet or cartridge projecting down into water passage.

5. Using new gasket, install water outlet fitting. Tighten bolts to 30 lb. ft.

6. Refill radiator to approximately 3" below filler neck for all models.

WATER PUMP

IMPORTANT: If a water pump is overhauled or replaced, be sure to fill the cooling system before starting the engine. Operating the pump in a dry condition for only a few seconds can cause seal damage and early failure.

V6 AND V8

Replace

1. Disconnect battery.
2. Drain radiator.
3. Loosen generator and other accessories at adjusting straps and remove fan belts from fan pulley.
4. Remove fan and pulley.
5. Remove any accessory brackets that might interfere with pump removal.
6. Remove heater hose and radiator hose at pump.
7. Remove water pump retaining bolts and remove pump.
8. Install pump by reversing above steps.
9. Tighten water pump attaching bolts to 15 lb. ft. torque.
10. Adjust belt for proper tension on chart at end of this section.

L-4 151

Remove

1. Drain cooling system and remove water inlet and heater hoses.
2. Remove all fan and accessory drive belts.
3. Remove fan and pump pulley.
4. Remove water pump to cylinder block attaching bolts and remove pump from engine.

Install

1. Clean gasket surfaces and install new gaskets.
2. Install pump and attaching bolts. Coat threaded area of bolts with part #1052080 sealer or equivalent. Tighten to 20 lb. ft. torque.
3. Replace fan and pump pulley.
4. Install all fan and accessory drive belts.
5. Install water inlet and heater hoses on water pump.

6. Refill cooling system with coolant.

L-4 140

Remove

1. Disconnect battery negative cable at battery.
2. Remove engine fan and spacer.
3. Loosen (but do not remove) the two timing cover lower screws - cover is slotted to permit easy removal.
4. Remove the two cover upper retaining screws and withdraw cover from vehicle.
5. Drain engine coolant and loosen water pump bolts to relieve tension in timing belt.
6. Remove radiator lower hose and heater hose at water pump.
7. Remove water pump retaining bolts and remove pump and old gasket from engine.
8. Clean old gasket material from water pump and cylinder case.

Install

1. Install a new water pump gasket to water pump, position water pump to cylinder case and loosely install water pump retaining bolts, making sure that "V" grooves in timing belt are aligned with grooves in water pump.

   NOTE: Apply an approved anti-seize compound to the water pump retaining bolts before installation.

2. Position Tool J 23654 in gage hole adjacent to left side of water pump.
3. Apply 15 ft. lbs. of torque to water pump. Tighten water pump bolts while maintaining torque on side of pump.
4. Install radiator lower hose and heater hose to water pump.
5. Position engine front cover between accessory drive belts and water pump and over water pump hub.
6. Position screw slots on lower portion of cover over screws and tighten loosely against cover.
7. Install the two, cover upper screws and torque upper and lower screws to specifications.
8. Install fan spacer and fan - torque bolts to specifications.
9. Fill engine cooling system, connect battery negative cable, start engine and check for leaks.

WATER PUMP OVERHAUL

V8 ENGINES Y, P & Z

Disassemble

1. Remove water pump.
2. Position pump on arbor press with impeller facing upward.
3. Press bearing out of pump body and impeller with one pressing operation.
4. Pry seal from pump body and discard all parts except pump body.
5. Clean gasket material and other dirt, grease, etc. from pump body.

Assemble Using Special Service Tools

1. Position new bearing and shaft assembly on arbor press.
2. Position pump body on bearing with gasket surface facing up.
3. Press pump body down onto bearing until it bottoms out.
4. Place new seal assembly over bearing shaft and slide it down to the pump body.
5. Press seal assembly into pump body.
6. Place new ceramic seal onto bearing shaft with the rubber up. (Lubricate rubber seal with anti-freeze before placing on shaft.)
7. Position new impeller on bearing shaft and press on until gage legs contact pump body gasket surface.

   NOTE: Impeller may rub on pump body if pressed too far. (Clearance should be approximately 1/8 inch.)

8. Install water pump.

RADIATOR

REMOVE AND INSTALL

Figs. 6B-15, 6B-16, 6B-17, 6B-18, 6B-19, 6B-20

Replace

1. Drain radiator.
2. Remove fan.
3. Disconnect upper and lower radiator hoses.
4. On vehicles equipped with automatic transmission, disconnect and plug transmission cooler lines.
5. Remove fan shield assembly if applicable.
6. Remove radiator and shroud assembly by lifting straight up.

   NOTE: The radiator assembly is held at the bottom by two cradles secured to the radiator support.

7. If installing new radiator, transfer fittings from old radiator to new radiator. 8. Replace radiator assembly by reversing the above steps, checking to assure radiator lower cradles are located properly in radiator recess. 9. Refill radiator. Run engine for a short period of time and check for leaks. If automatic transmission radiator, recheck transmission oil level.

COOLANT RESERVOIR

REMOVE AND REPLACE

Figs. 6B-21, 6B-22 and 6B-23

NOTE: On some models it may be necessary to remove charcoal canister to provide clearance for reservoir removal.

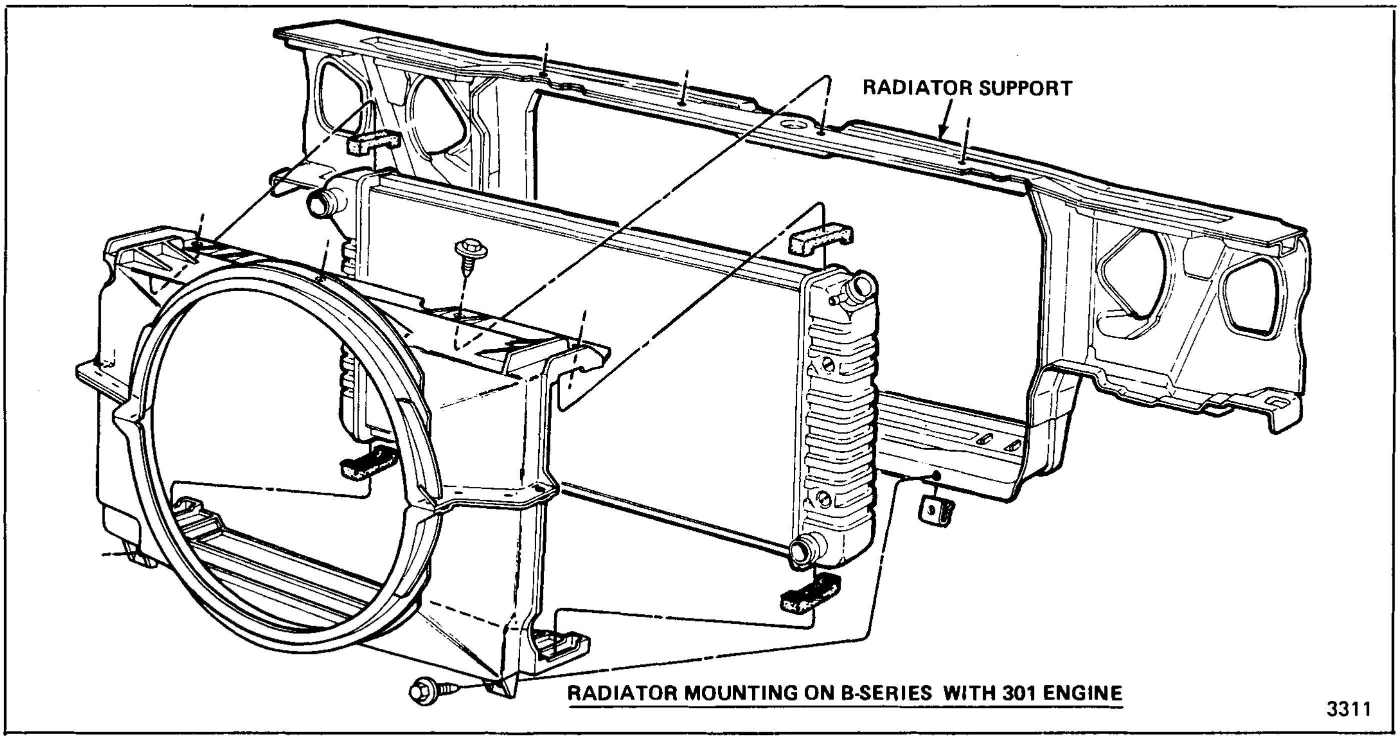


Fig. 6B-15 Radiator Mountings - B Series Typical

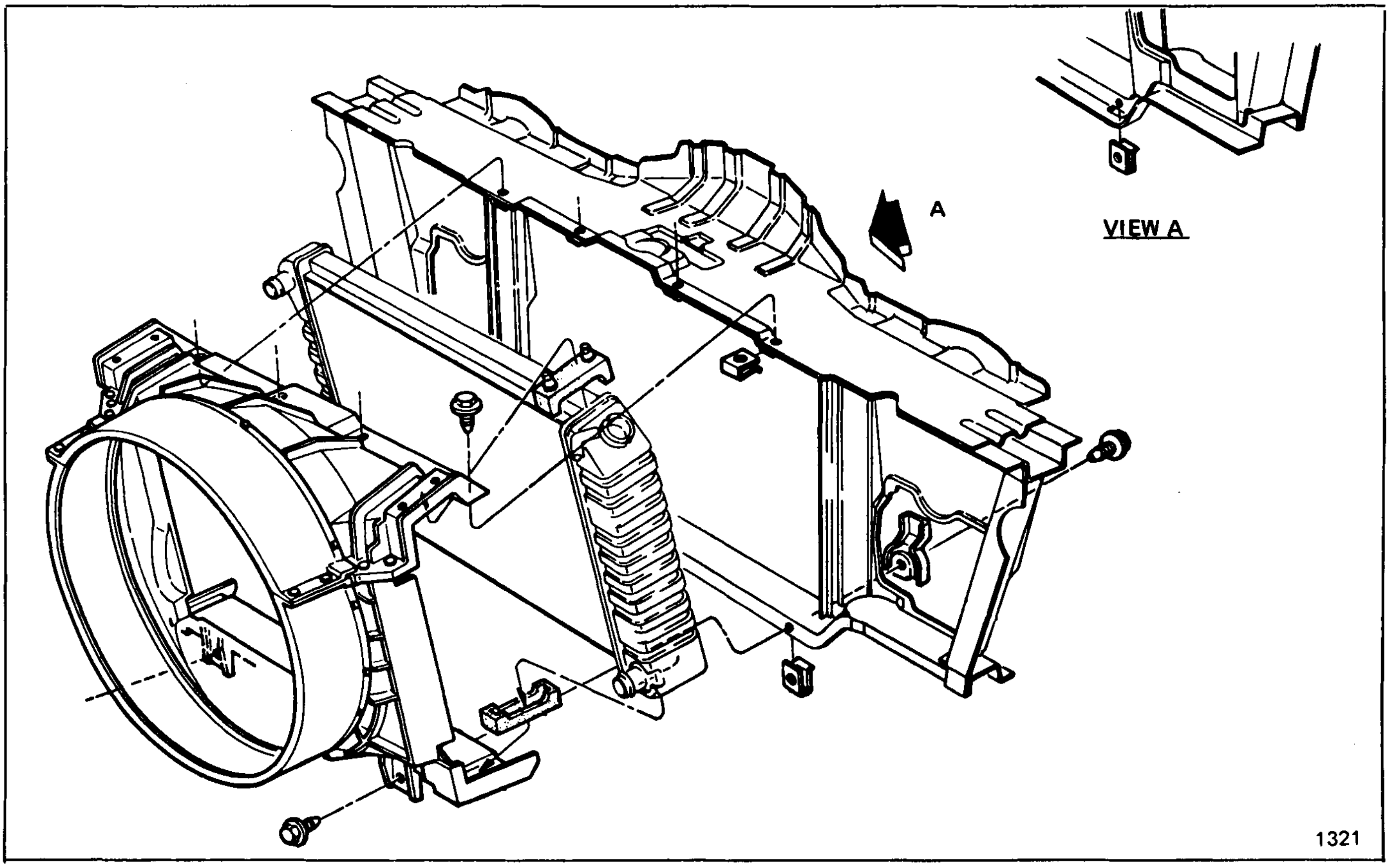


Fig. 6B-16 Radiator Mountings - G and A Series Typical

Remove

1. Remove cap and tube from coolant reservoir.
2. Remove retaining screws.
3. Remove coolant reservoir.

Install

1. Place coolant reservoir in position and install retaining screws.
2. Install cap and tube in reservoir.

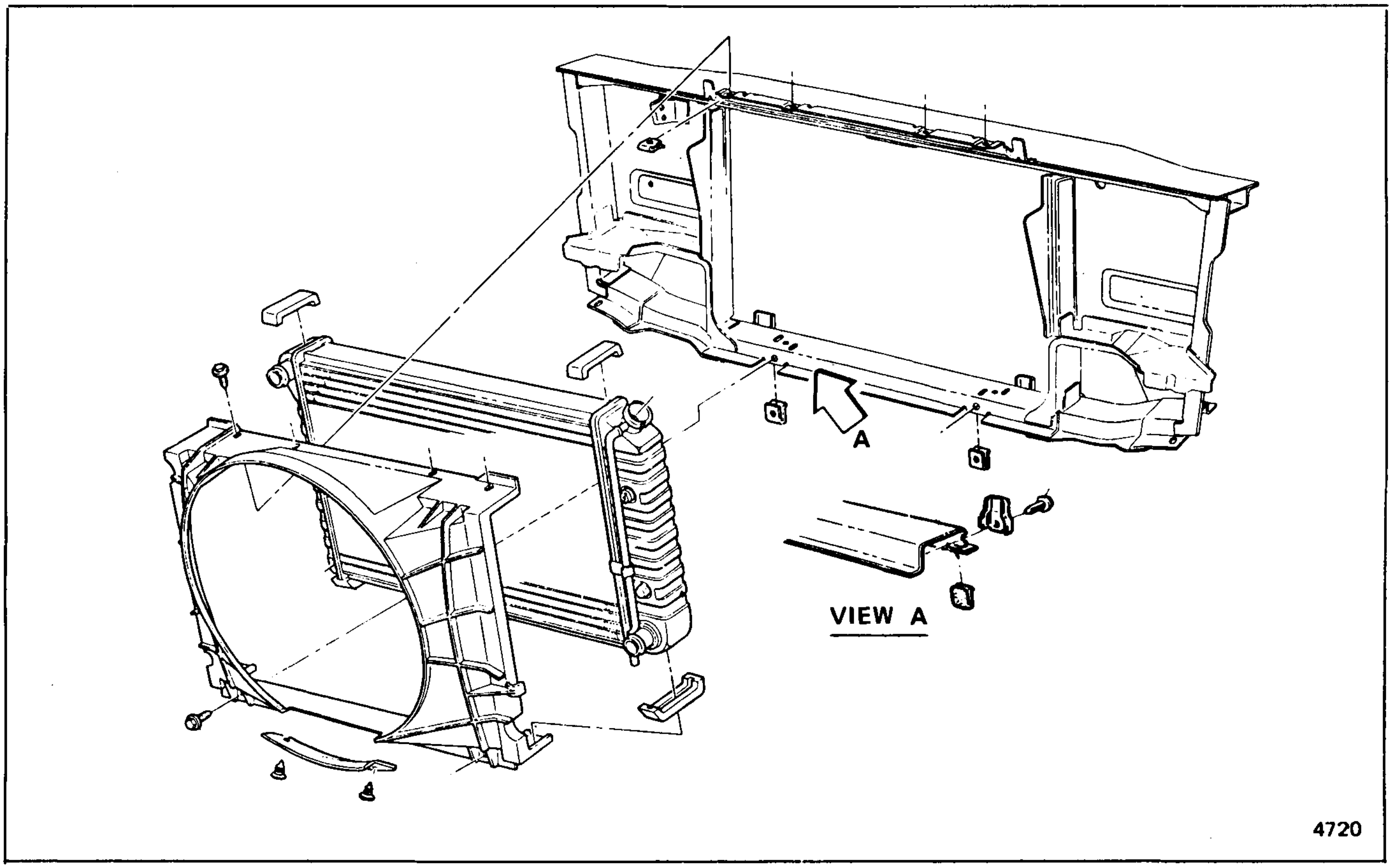


Fig. 6B-17 Radiator Mountings - F Series Typical

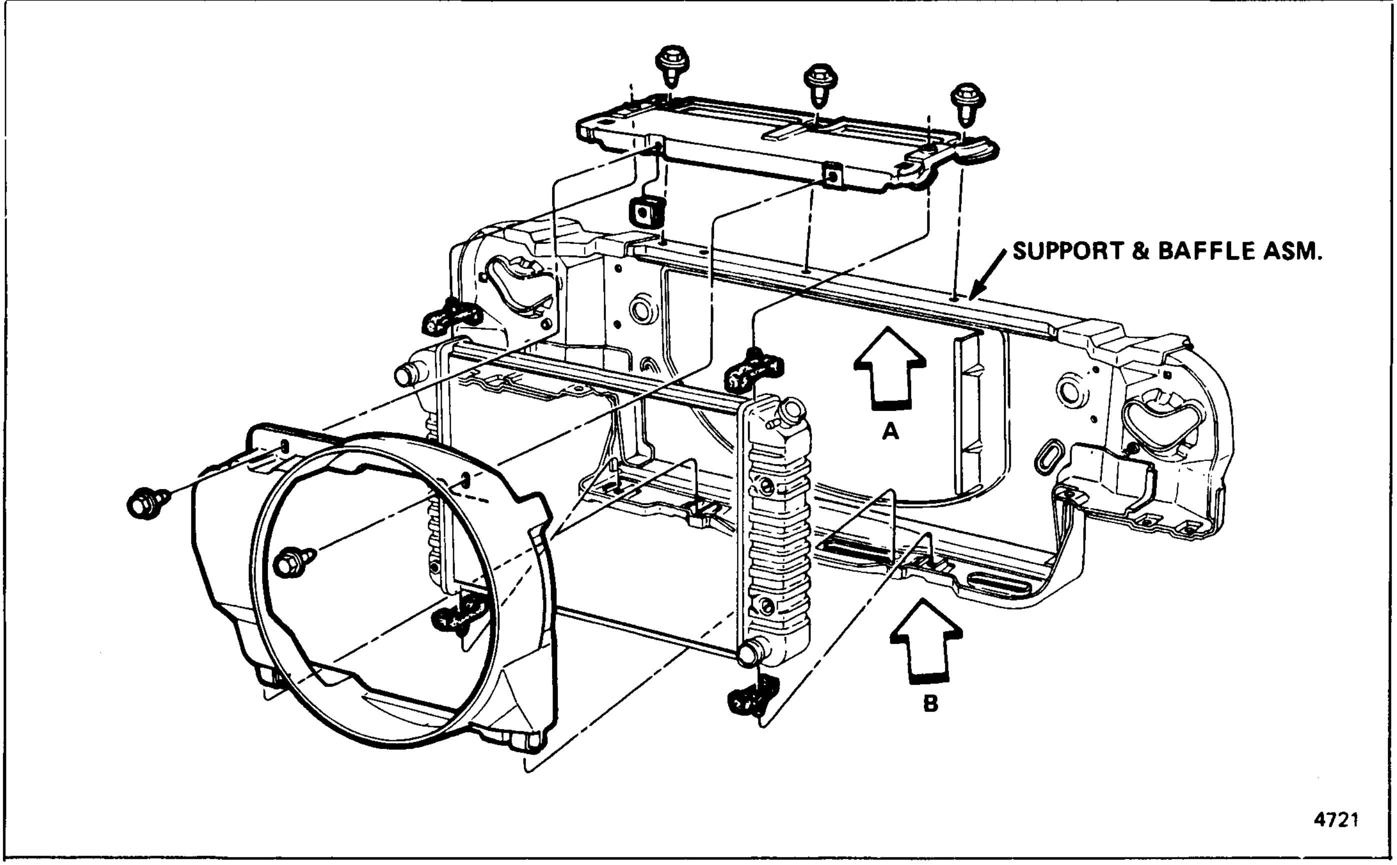


Fig. 6B-18 Radiator Mountings - X Series Typical

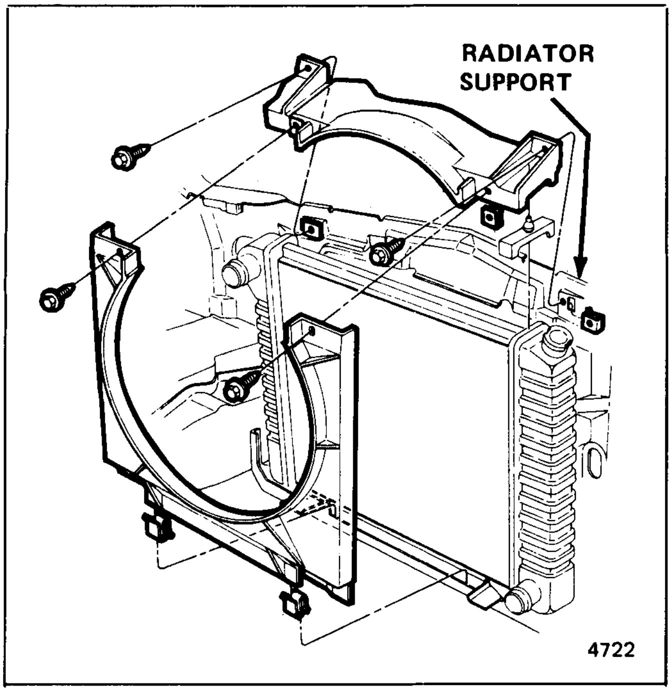


Fig. 6B-19 Radiator Mountings - H Series Typical

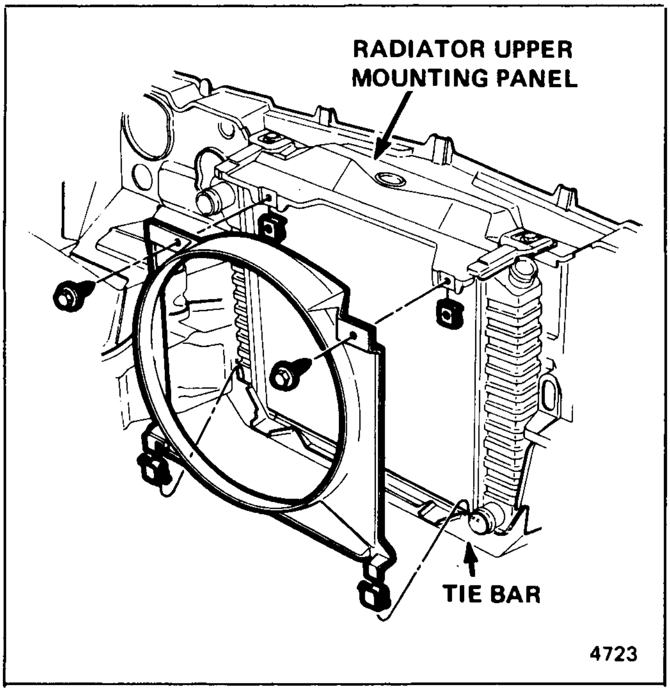


Fig. 6B-20 Radiator Mountings - HM Series Typical

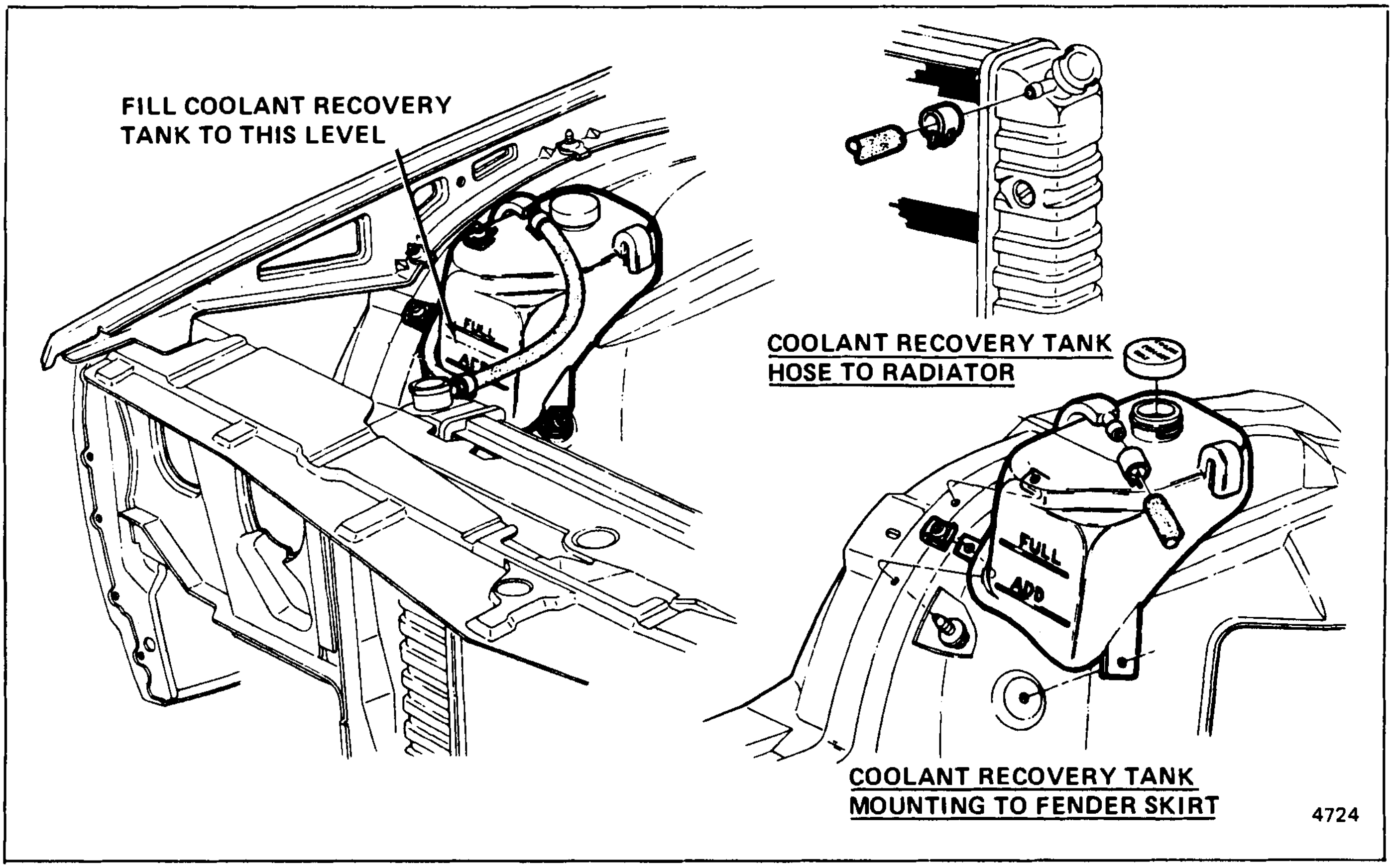


Fig. 6B-21 Coolant Reservoir Tank Mounting - B Series Typical

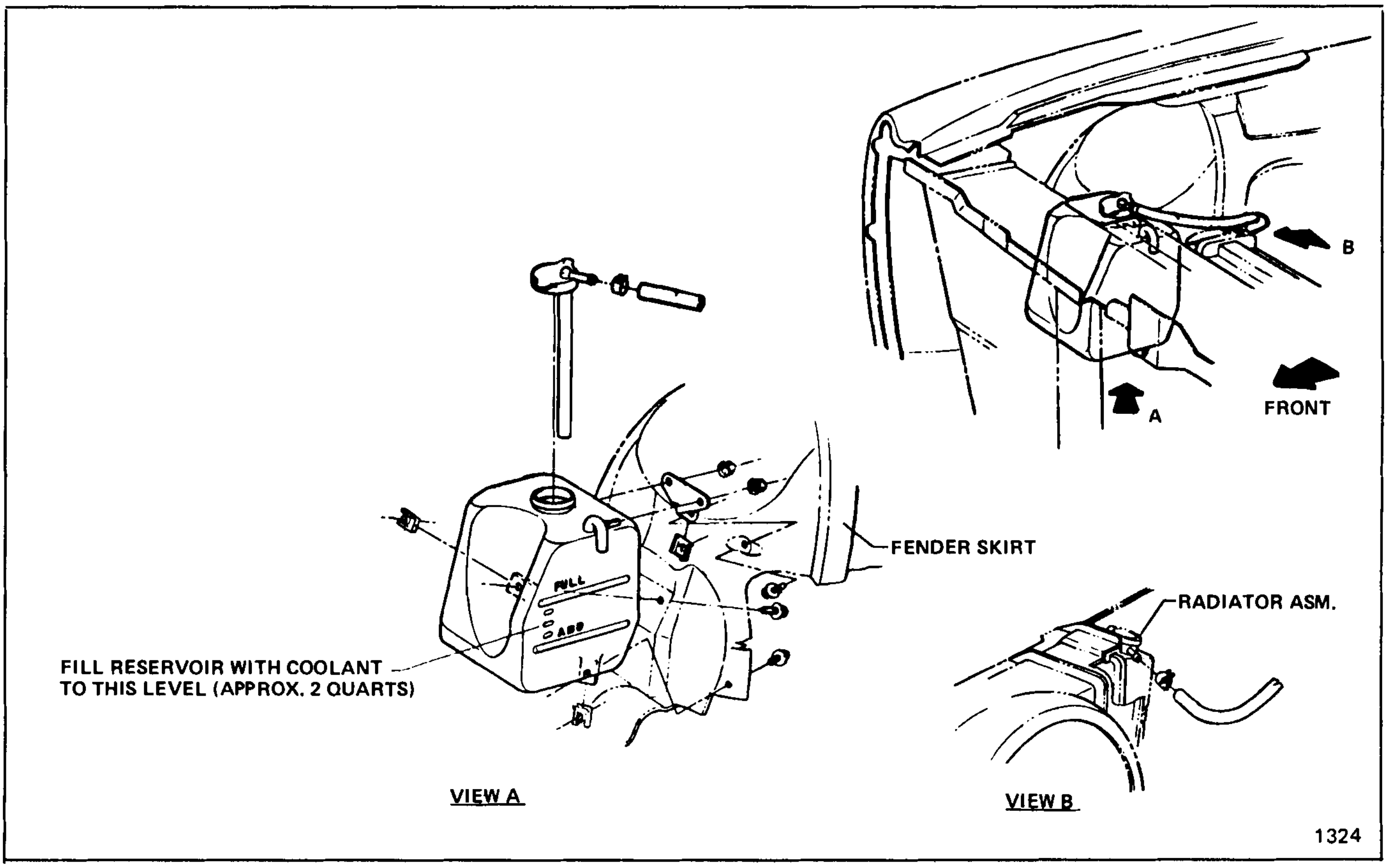


Fig. 6B-22 Coolant Reservoir Tank Mounting - G and A Series Typical

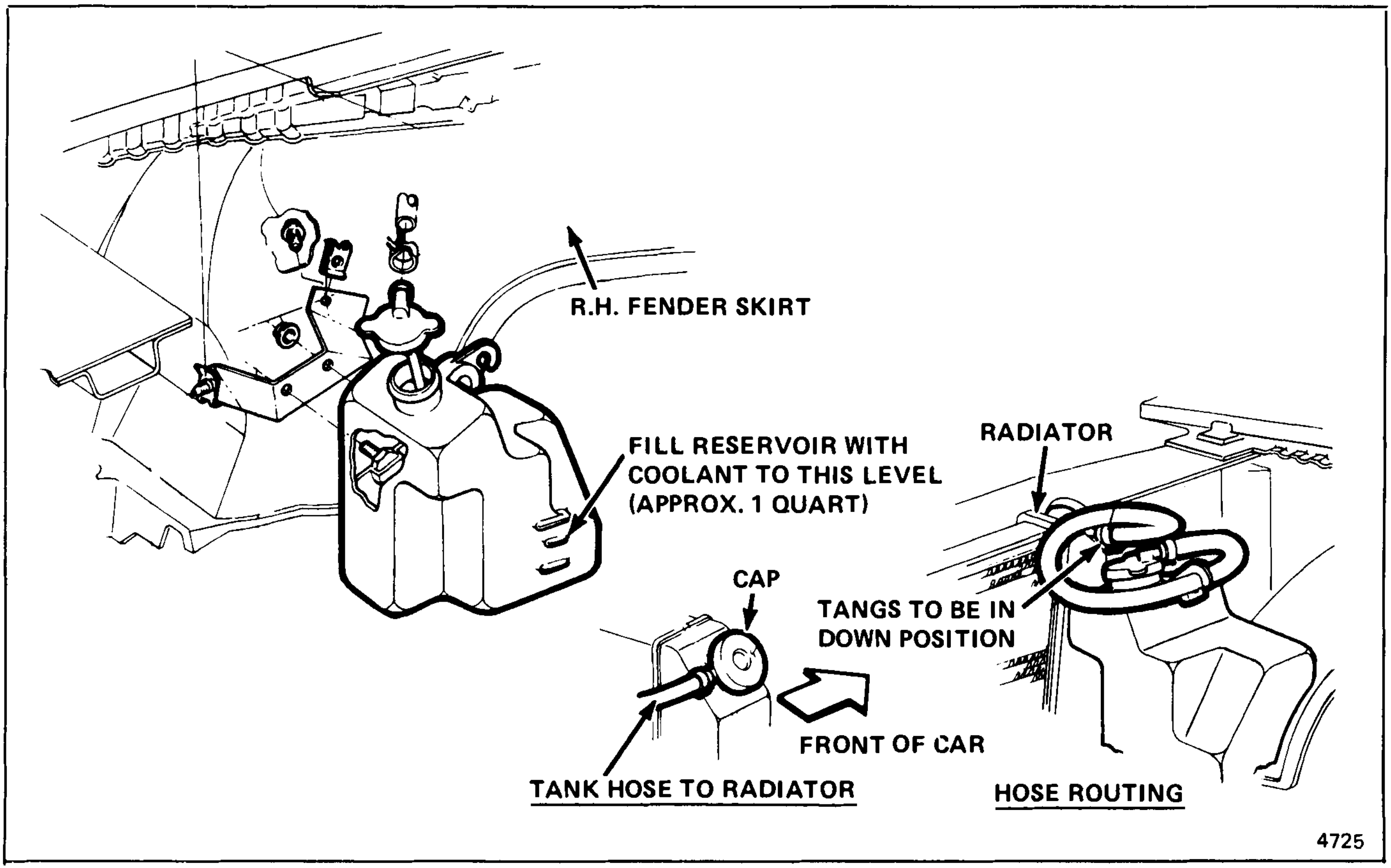


Fig. 6B-23 Coolant Reservoir Tank Mounting - F Series Typical

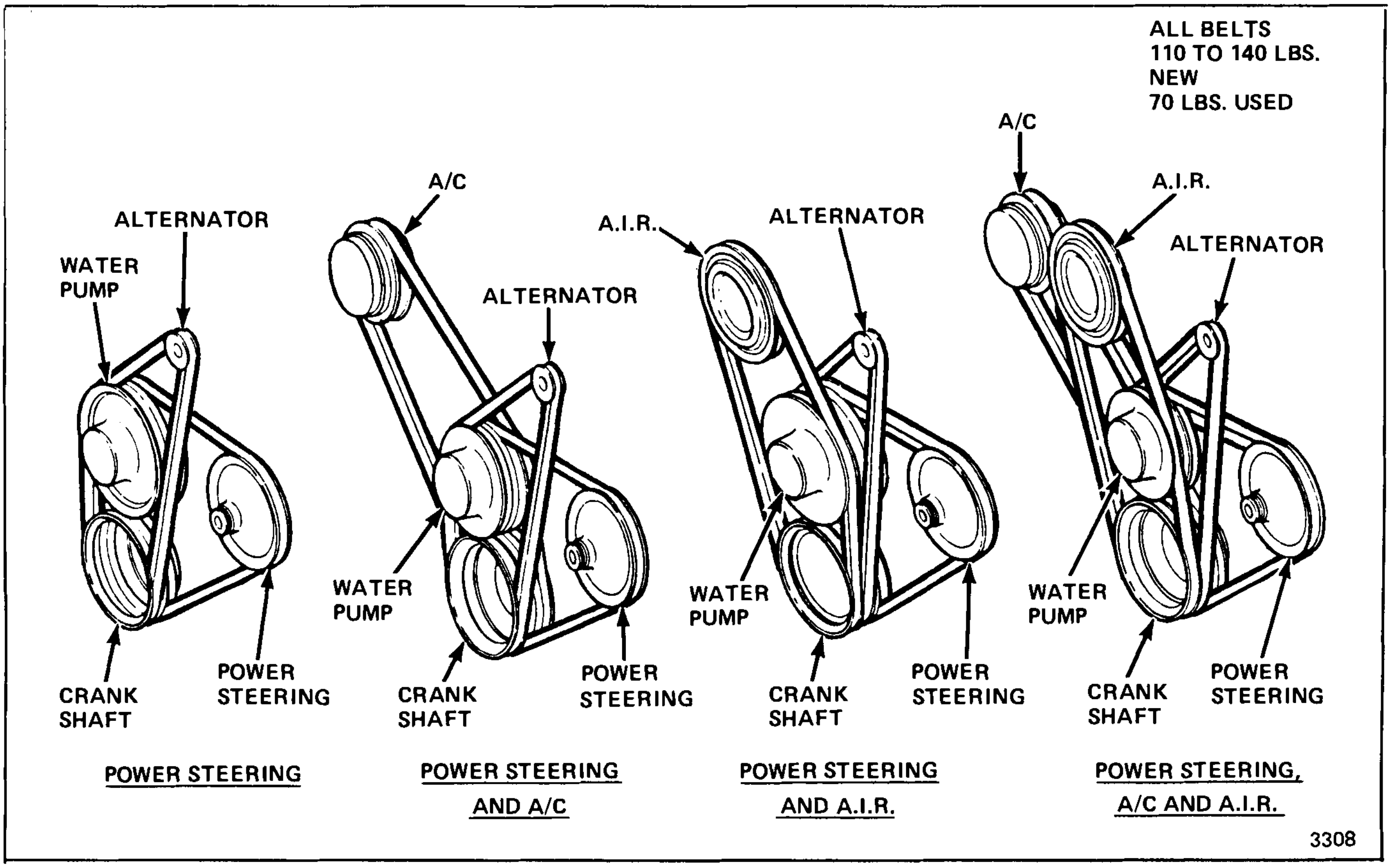
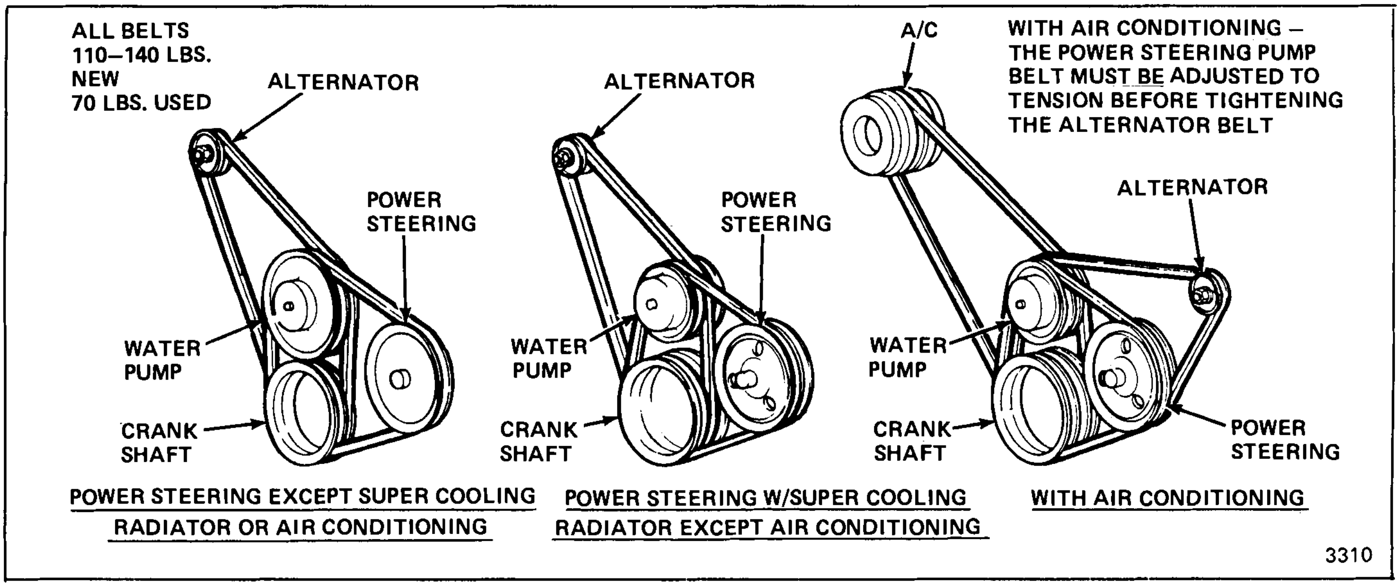


Fig. 6B-24 Belt and Pulley Diagrams - 350 & 403 Engine, VI Codes R & K, Except B Series



ALL BELTS 110–140 LBS. NEW 70 LBS. USED

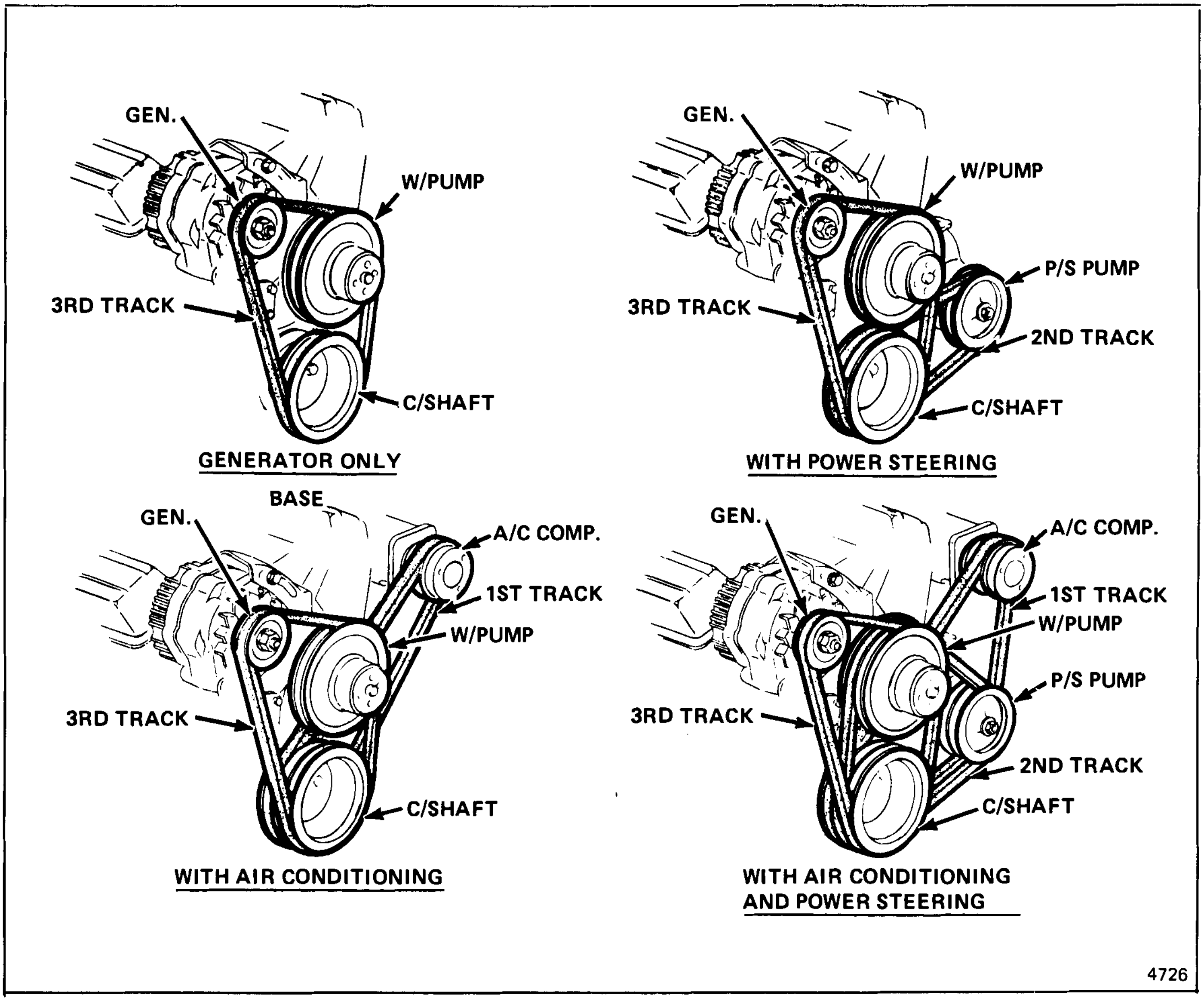
WITH AIR CONDITIONING – THE POWER STEERING PUMP BELT MUST BE ADJUSTED TO TENSION BEFORE TIGHTENING THE ALTERNATOR BELT

POWER STEERING EXCEPT SUPER COOLING RADIATOR OR AIR CONDITIONING

POWER STEERING W/SUPER COOLING RADIATOR EXCEPT AIR CONDITIONING

WITH AIR CONDITIONING

Figb. 6B-25 Belt and Pulley Diagrams - 350-403 Engines, VI Codes R & K (B Series Only)



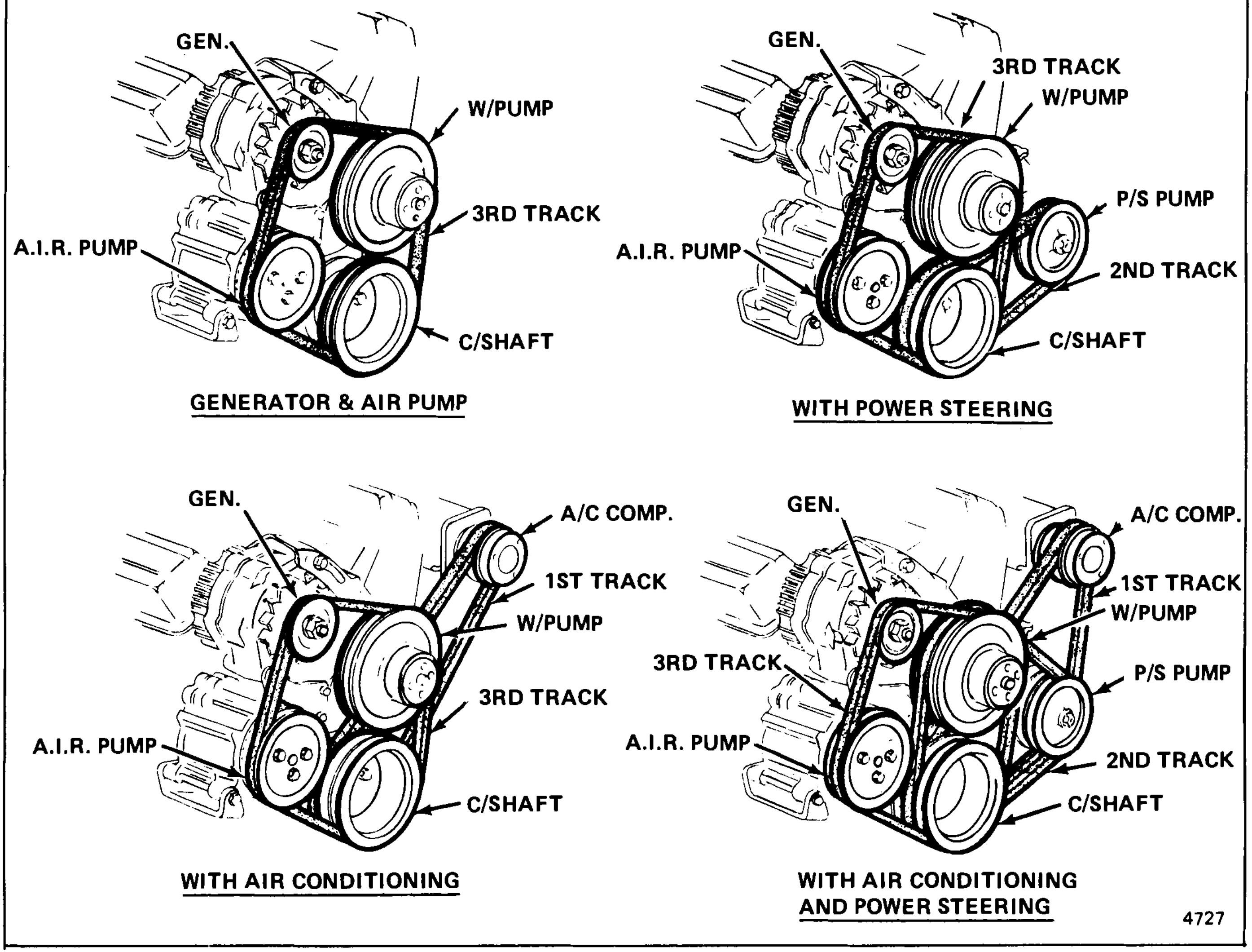
GENERATOR ONLY

WITH POWER STEERING

WITH AIR CONDITIONING

WITH AIR CONDITIONING AND POWER STEERING

Fig. 6B-26 Belt and Pulley Diagrams - 305 Engine, VI Code U



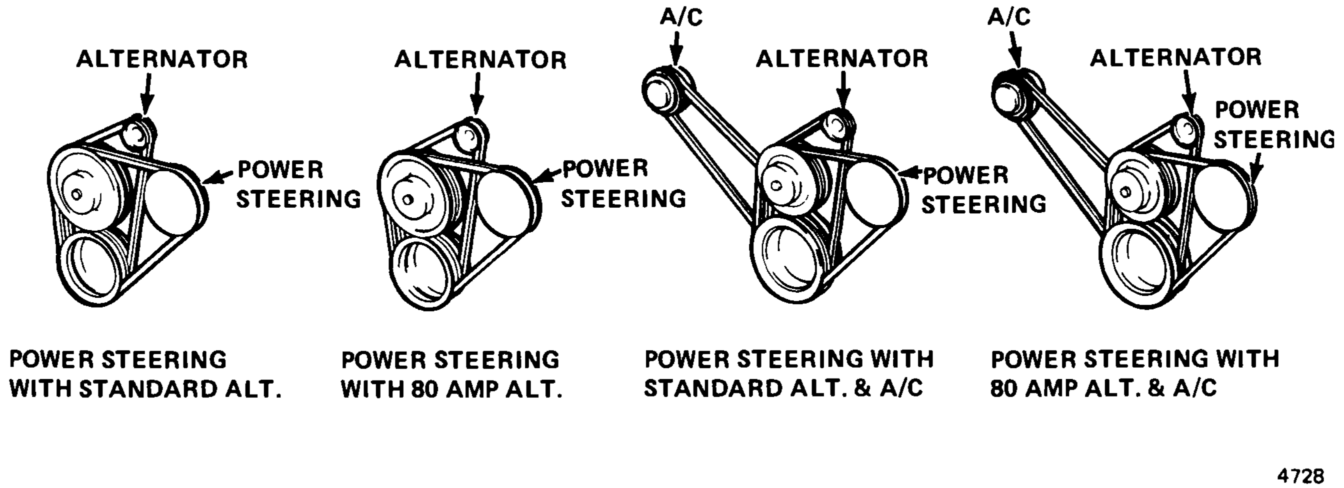
GENERATOR & AIR PUMP

WITH POWER STEERING

WITH AIR CONDITIONING

WITH AIR CONDITIONING AND POWER STEERING

Fig. 6B-27 Belt and Pulley Diagrams - 350 Engine, VI Code L (Cal. Only)



POWER STEERING WITH STANDARD ALT.

POWER STEERING WITH 80 AMP ALT.

POWER STEERING WITH STANDARD ALT. & A/C

POWER STEERING WITH 80 AMP ALT. & A/C

Fig. 6B-28 Belt and Pulley Diagrams - 301-350-400 Engines, VI Codes Y, P & Z

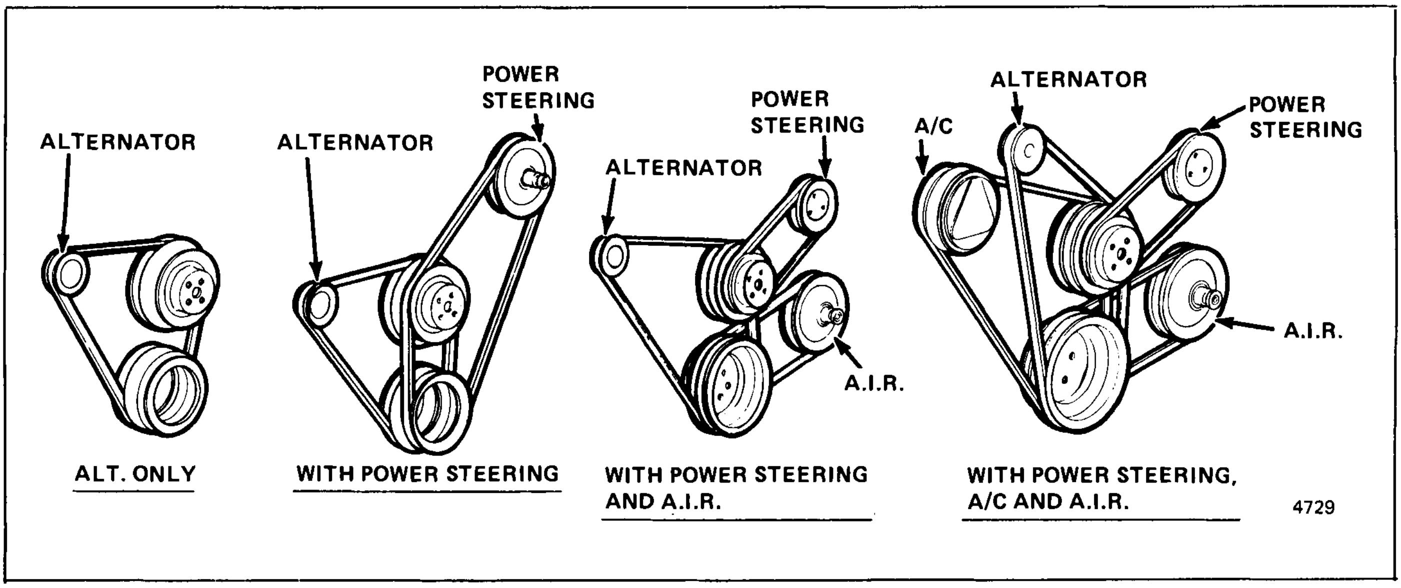


Fig. 6B-29 Belt and Pulley Diagrams - 231 Engine, VI Code C

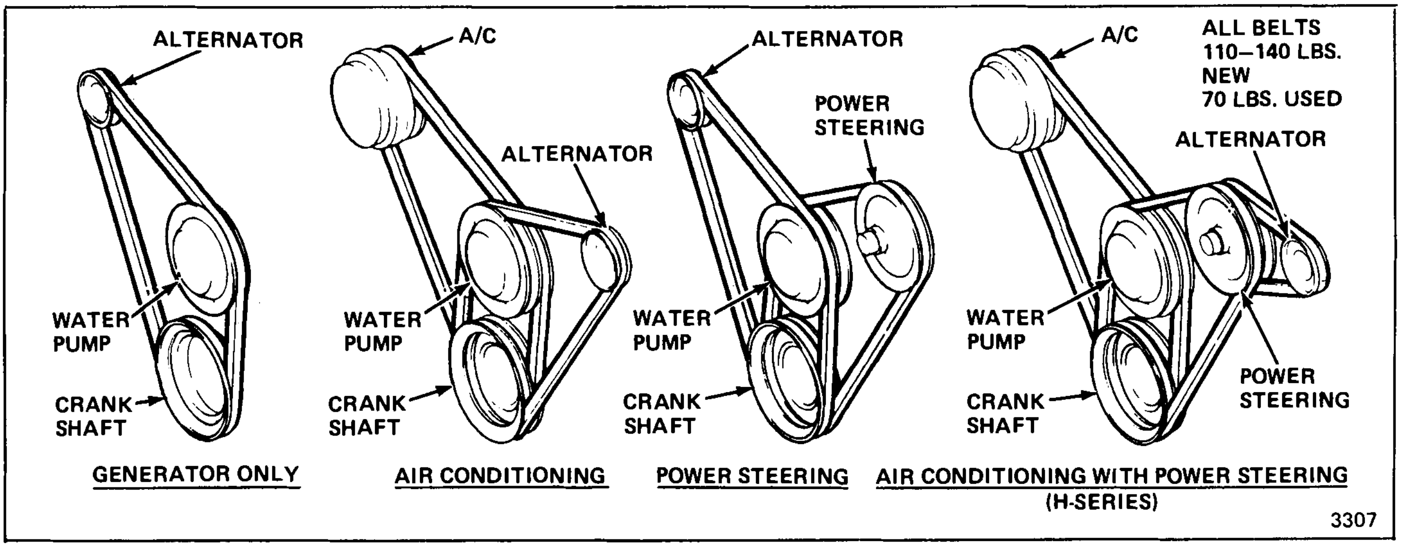


Fig. 6B-30 Belt and Pulley Diagrams - 151 L4 Engine, VI Code V (X and H Series Only)

MODEL	ENGINE	V.I. CODE	TRANSMISSION	RADIATOR	HEATER	A/C	QUARTS	LITRES
B SERIES	231	C	AUTO	STD.	X	X	12.9	12.1
ALL	231	C	AUTO	HD	X	X	12.9	12.1
	301	Y	AUTO	STD.	X	X	18.6	17.5
	301	Y	AUTO	HD	X	X	19.8	18.6
	350	R	AUTO	STD.	X	X	15.0	14.1
	350	R	AUTO	HD	X	X	16.2	15.2
	350	P	AUTO	STD.	X	X	19.8	18.6
	350	P	AUTO	HD	X	X	21.0	19.7
	400	Z	AUTO	STD.	X		19.8	18.6
	400	Z	AUTO	STD.		X	21.0	19.7
	400	Z	AUTO	HD	X	X	21.0	19.7
	403	K	AUTO	STD.	X	X	16.1	15.1
	403	K	AUTO	HD	X	X	17.3	16.3
A SERIES	231	C	MAN	STD.	X	X	14.6	13.7
ALL	231	C	MAN	HD	X	X	14.6	13.7
	231	C	AUTO	STD.	X	X	14.5	13.6
	231	C	AUTO	HD	X	X	14.5	13.6
	301	Y	AUTO	STD.	X	X	20.2	19.0
	301	Y	AUTO	HD	X	X	20.8	19.5
	350	R	AUTO	STD.	X	X	16.7	15.7
	350	R	AUTO	HD	X	X	17.5	16.5
	350	P	AUTO	STD.	X		21.4	20.1
	350	P	AUTO	STD.		X	22.0	20.7
	350	P	AUTO	HD	X	X	23.9	22.5
	400	Z	AUTO	STD.	X		21.4	20.1
	400	Z	AUTO	STD.		X	22.0	20.7
	400	Z	AUTO	HD	X	X	23.9	22.5
	403	K	AUTO	STD.	X	X	17.9	16.8
	403	K	AUTO	HD	X	X	18.7	17.6
G SERIES	301	Y	AUTO	STD.	X	X	20.5	19.3
ALL	301	Y	AUTO	HD	X	X	21.1	19.8
	350	R	AUTO	STD.	X	X	17.0	16.0
	350	R	AUTO	HD	X	X	17.8	16.7
	350	P	AUTO	STD.	X		21.6	20.3
	350	P	AUTO	STD.		X	22.1	20.8
	350	P	AUTO	HD	X	X	24.1	22.7
	400	Z	AUTO	STD.	X		21.6	20.3
	400	Z	AUTO	STD.		X	22.1	20.8
	400	Z	AUTO	HD	X	X	24.1	22.7
	403	K	AUTO	STD.	X	X	18.2	17.1
	403	K	AUTO	HD	X	X	19.0	17.9
F SERIES	231	C	ALL	ALL	X	X	13.2	12.4
ALL	301	Y	MAN	STD.	X		19.2	18.0
	301	Y	MAN	STD.		X	19.5	18.3
	301	Y	MAN	HD	X	X	20.0	18.8
	301	Y	AUTO	STD.	X		19.1	17.6
	301	Y	AUTO	STD.		X	20.0	18.8
	301	Y	AUTO	HD	X		19.7	18.5
	301	Y	AUTO	HD		X	20.0	18.8
	350	R	AUTO	STD.	X		15.6	14.7
	350	R	AUTO	STD.		X	16.4	15.4
	350	R	AUTO	HD	X	X	18.2	17.1
	350	P	AUTO	STD.	X	X	20.3	19.0
	350	P	AUTO	HD	X	X	23.0	21.6
	400	Z	MAN	STD.	X		21.1	19.8
	400	Z	MAN	STD.		X	22.9	21.5
	400	Z	MAN	HD	X	X	22.9	21.5
	400	Z	AUTO	STD.	X		20.4	19.1
	400	Z	AUTO	STD.		X	21.2	19.9
	400	Z	AUTO	HD	X	X	23.0	21.6
	403	K	AUTO	STD.	X		16.8	15.8
	403	K	AUTO	STD.		X	17.5	16.4
	403	K	AUTO	HD	X	X	19.4	18.2
X SERIES	151	V	ALL	STD.	X	X	12.4	11.7
	231	C	ALL	ALL	X	X	13.8	13.0
	301	Y	MAN	STD.	X		19.6	18.4
	301	Y	MAN	STD.		X	20.3	19.0
	301	Y	MAN	HD	X	X	20.3	19.0
	301	Y	AUTO	STD.	X		19.5	18.3
	301	Y	AUTO	STD.		X	20.2	19.0
	301	Y	AUTO	HD	X	X	20.2	19.0
	305	U	AUTO	ALL	X	X	17.2	16.2
	350	R	AUTO	ALL	X	X	16.6	15.6
	350	L	AUTO	ALL	X	X	17.3	16.3
H SERIES	140	B	MAN	ALL	X	X	8.9	8.4
EXCEPT	140	B	AUTO	ALL	X	X	8.8	8.3
HM	151	V	ALL	ALL	X	X	11.2	10.5
HM SERIES	151	V	ALL	ALL	X	X	12.5	11.8
ALL	231	C	ALL	ALL	X		12.9	12.1
	231	C	ALL	ALL		X	13.3	12.5

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Fig. 6B-31 Radiator Usage

SPECIFICATIONS

TORQUE

Torque in lb. ft. unless otherwise specified.

APPLICATION	TORQUE
Bolt-Fan to Water Pump	20
Bolt Water Pump (1/4")	12
Bolt Water Pump (5/16")	20
Bolt Water Pump (3/8")	30

COOLING SYSTEM

Type	Pressure with vent
Operating Pressure	14-17 PSI
Pump Type	Centrifugal
Pump and Fan Drive Except 140 Eng.	V-Belt
Pump and Fan Drive 140 Eng.	Ground Side of Timing Belt
Pump Bearings	Sealed Ball Bearings
Radiator	Tube and Center
Thermostat	Pellet type opening @ 195°F (91°C.)

NOTE: Some altitude engines require 180°F. (82°C.)

MODEL	ENGINE	V.I. CODE	HEATER		A/C		SUPER COOLING	
			M.T.	A.T.	M.T.	A.T.	M.T.	A.T.
B SERIES EXCEPT WAGON	231*	C		BL		BA		BC
	231#	C		BB		BF		BD
	301	Y		YA		YW		YF
	350*	R		YR		YX		YF
	350#	R		YX		YB		YF
	350	P		YW		YB		YF
	400	Z		YW		YM		YF
	403	K		YC		YB		YF
	403#	K		YB		YM		YF
B SERIES WAGON	301	Y		YC		YB		YF
	403*	K		YC		YY		YF
	350#	R		YX		YB		YF
	400	Z		YW		YM		YF
	403#	K		YB		YM		YF
A SERIES EXCEPT WAGON	231*	C	OW	OE	SJ	SK	SI	SI
	231#	C	CL	CH	CX	CZ	CE	CE
	301	Y		SI		CI		CA
	350	R		OF		CU		SF
	350	P		CI		CA		PC
	400	Z		CI		CA		PC
	403	K		OF		CI		SF
A SERIES WAGON	301	Y		CO		CR		SF
	350	R		CU		CB		SF
	400	Z		CR		OC		PC
	403	K		CU		CB		SF
G SERIES	301	Y		SI		CI		CA
	350	R		OF		CU		SF
	350	P		CI		CA		PC
	400	Z		CI		CA		PC
	403	K		OF		CI		SF
F SERIES	231*	C	FJ	FJ	FW	FW	FX	FX
	231#	C	FJ	FJ	FY	FY	FN	FN
	301	Y	FY	FY	FZ	FZ	FO	FO
	350	R		FN		FI		FU
	350	P		FN		FI		FU
	400	Z	FI	FN	FA	FO	FA	FU
	403	K		FN		FI		FU
X SERIES	151	V	DH	DI	DJ	DK	— —	— —
	231*	C	LA	LY	EC	LU	LW	LW
	231#	C	EJ	EN	ED	ET	EU	EU
	301	Y	LL	LH	LQ	LQ	ES	ES
	305	U	DC	DU	LL	LH	LT	LT
	350	R		LQ		ES		ES
	350	L	LC	LD	LL	LG	LT	LT
H SERIES EXCEPT HM	140	B	HW	HW	US	US	US	US
	151	V	UM	UN	UR	UE	UR	UE
HM SERIES	140#	B	TR	TR	TS	TS	TS	TS
	151	V	HA	HB	HJ	HI	HJ	HI
	231	C	TJ	TK	HH	HG	HH	HG

* EXCEPT CALIFORNIA AND HIGH ALTITUDE

\# CALIFORNIA AND HIGH ALTITUDE

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Fig. 6B-32 Cooling System Capacity

SECTION 6C

FUEL SYSTEM

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

DIAGNOSIS

CARBURETION

FUEL SUPPLY

All new 1977 Pontiacs are certified by the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new motor vehicles. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for setting ignition timing, and low idle must be followed exactly when adjustments are made.

GENERAL DESCRIPTION

FUEL SYSTEM

CAUTION: *All engines require the use of unleaded fuel only. Use of leaded and/or low lead fuels can result in engine damage and reduce the effectiveness of the Emission Control Systems.*

CARBURETOR

All engines are equipped with either a 2 barrel or 4 barrel carburetor attached to the intake manifold.

FUEL FILTER

All engines have a pleated paper fuel filter and check valve assembly located in the carburetor inlet.

All cars have a woven plastic fuel filter in the fuel tank on the lower end of the pick-up pipe.

ELECTRIC FUEL PUMP

The electric fuel pump is located in the fuel tank integral with the gage unit, but is separately serviceable.

MECHANICAL FUEL PUMP

All models except H-Series are equipped with mechanical fuel pumps located near the front of the engine. These pumps are driven by an eccentric on or attached to the camshaft. Motion is transmitted either through direct pump arm contact or by means of a push rod between the cam and the pump arm.

FUEL TANK AND LINES

In all models, except A-body station wagons, the fuel tank is attached under the rear body pan by two (2) straps.

"A" station wagons have a fuel tank mounted in the left rear quarter panel area. To fill the tank, lift the spring-loaded filler door and remove the filler cap.

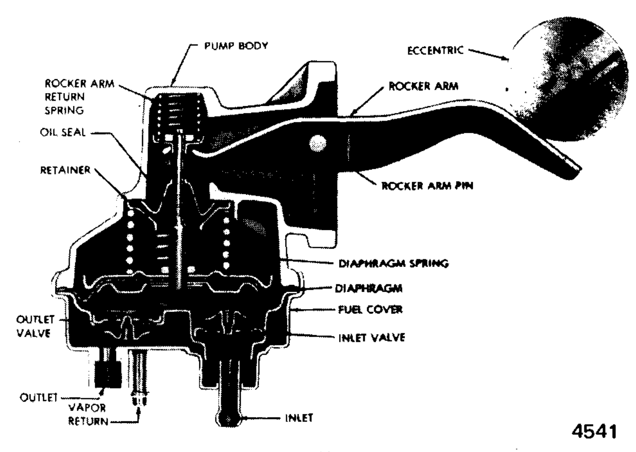

Fig. 6C-1 Mechanical Fuel Pump

Filler necks are soldered into the tank on all series cars. All filler necks have restrictors to prevent the entry of leaded fuel nozzles.

In all series except A-Series station wagons, the tank is vented during filling by an internal baffle inside the filler.

In A-Series station wagons, the tank is vented during filling by the filler neck.

In all series the tank outlet consists of a combination fuel pickup, filter and fuel gage tank unit. The tank unit can be removed by removing a cam ring which retains the unit.

The fuel line is coated, welded steel tubing. Connections from the tank unit to the line and from the line to the fuel pump are made with synthetic rubber hose attached with spring clamps.

FUEL CAP

The fuel cap is a screw on type for all series (except H Series) and incorporates a ratchet action which prevents over tightening.

The "H" series fuel cap is equipped with a double set of locking tangs plus a pressure-vacuum safety relief valve.

EVAPORATIVE EMISSION CONTROL SYSTEM (EEC)

The Evaporative Emission Control System is a closed system that prevents gasoline vapors in the fuel tank and carburetor from entering the atmosphere.

DIAGNOSIS

FUEL SYSTEM

All diagnosis related to the fuel system not found in this diagnosis section can be found in the Engine Performance Diagnosis located at the front of Section 6.

EVAPORATIVE EMISSION SYSTEM

Condition	Possible Cause	Correction
Fuel Odor	1. Vapor leak from Evap. system.	1. Inspect and correct as necessary fuel and evaporation hoses and pipes, fuel sender sealing gasket and fuel cap.

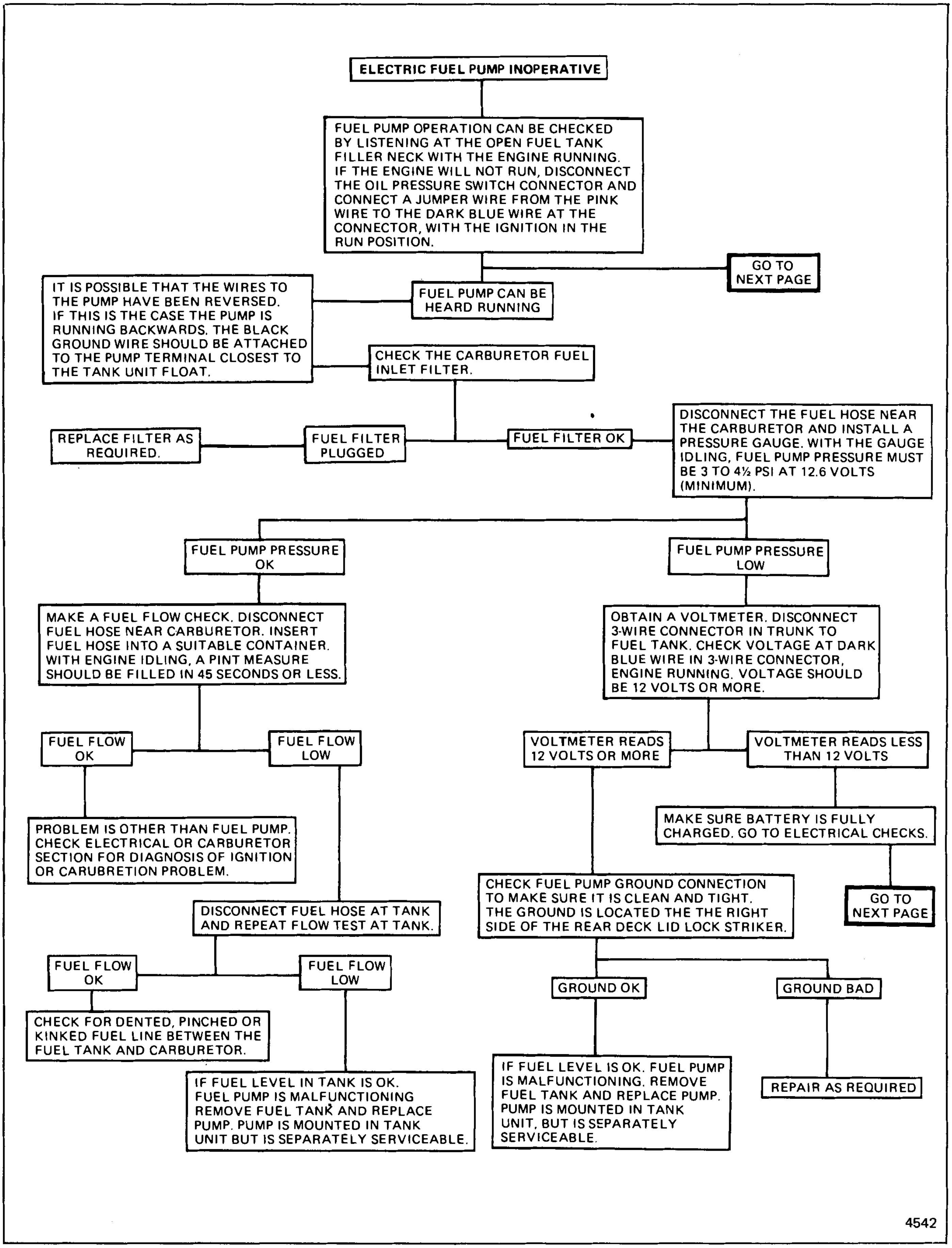

Fig. 6C-2 Electric Fuel Pump, Temperature-Pressure Indicator Lamp, And Key Buzzer Diagnosis

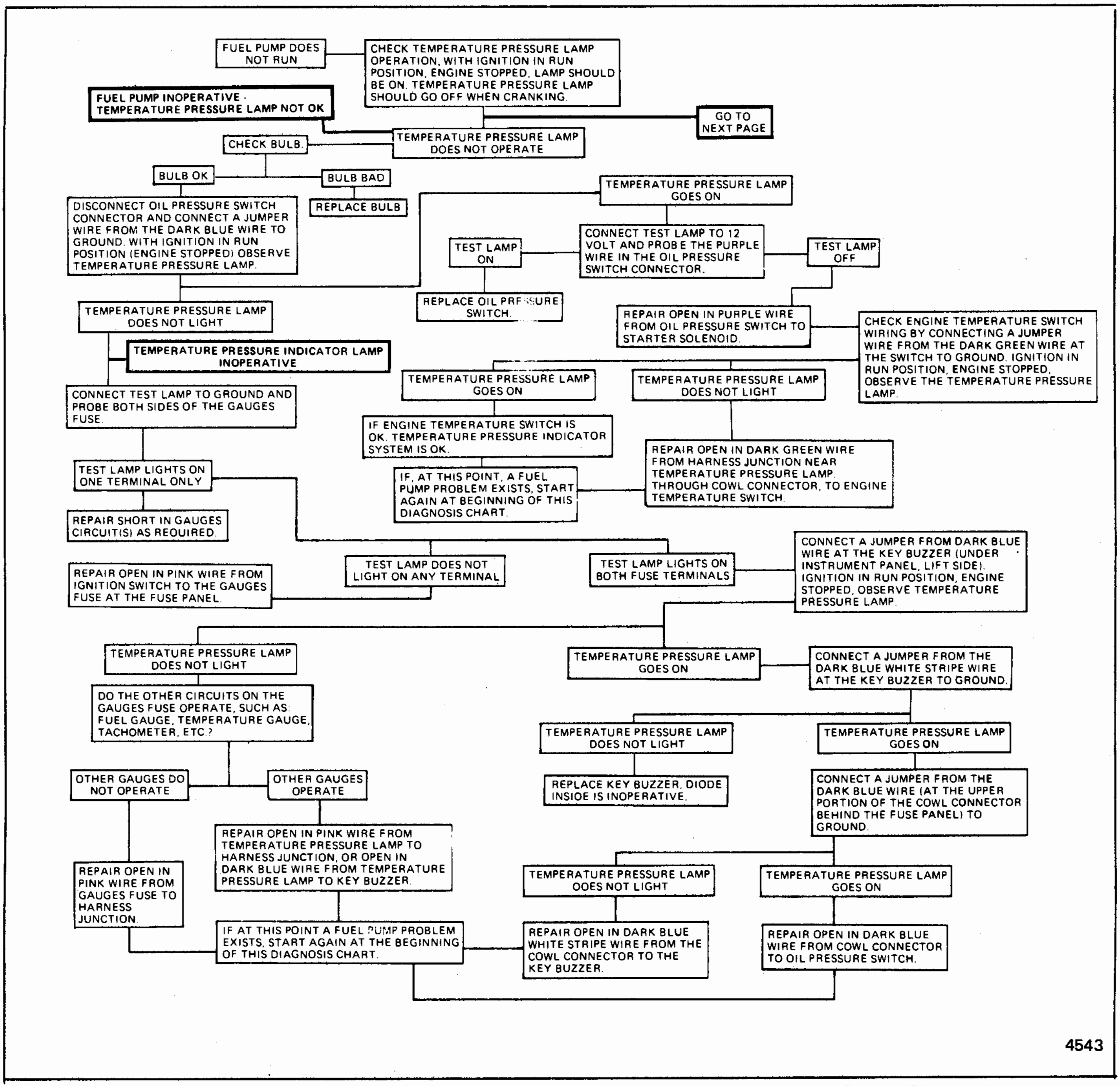

Fig. 6C-3 Electric Fuel Pump, Temperature-Pressure Indicator Lamp, And Key Buzzer Diagnosis

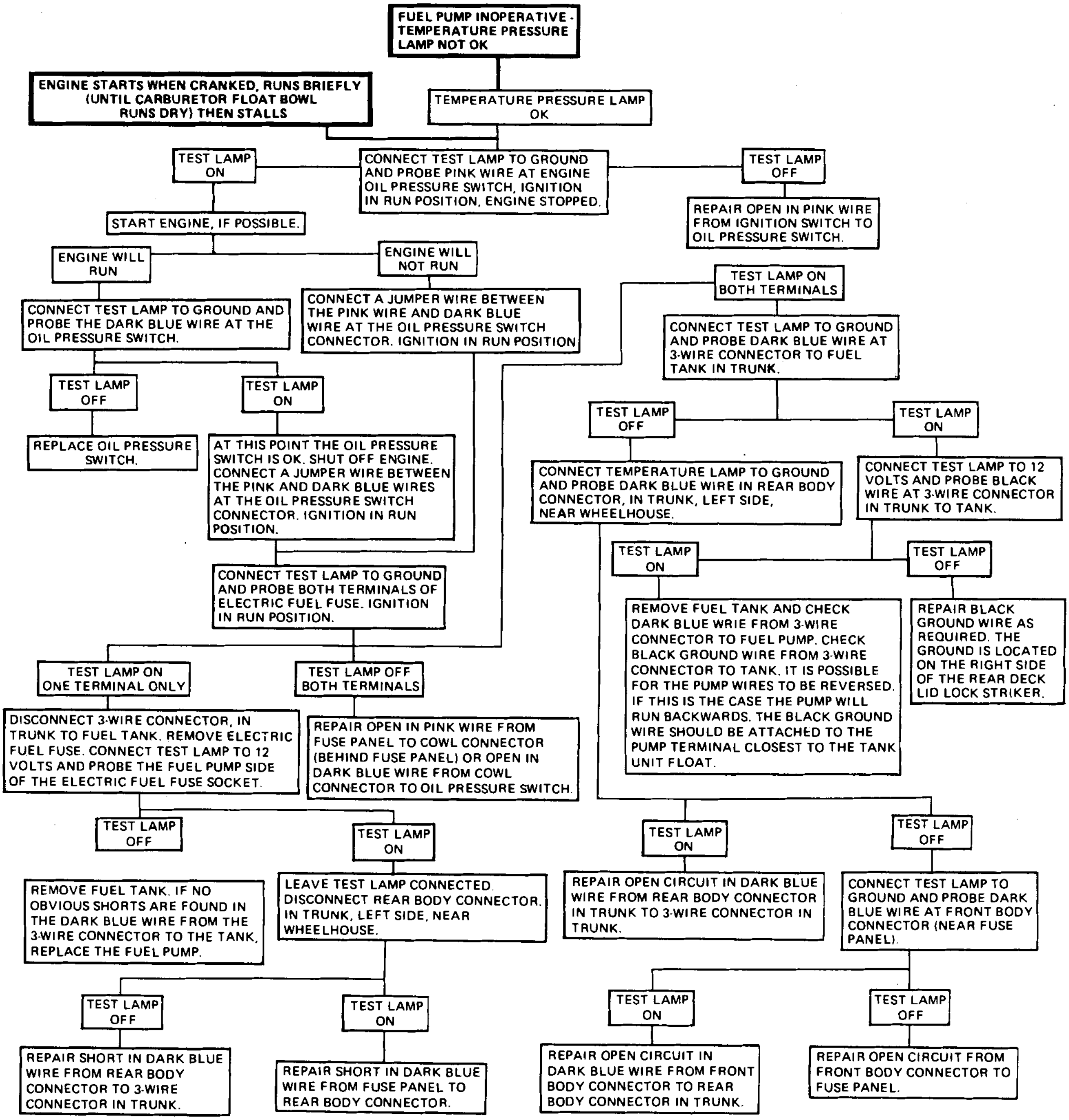

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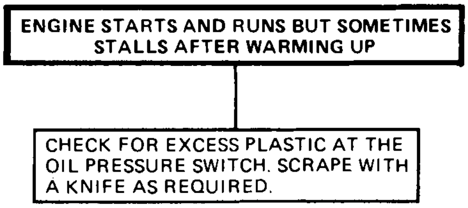
Fig. 6C-4 Electric Fuel Pump, Temperature-Pressure Indicator Lamp, And Key Buzzer Disgnosis



ENGINE STARTS AND RUNS BUT SOMETIMES STALLS AFTER WARMING UP

CHECK FOR EXCESS PLASTIC AT THE OIL PRESSURE SWITCH. SCRAPE WITH A KNIFE AS REQUIRED.

ELECTRIC FUEL PUMP, TEMPERATURE PRESSURE AND KEY BUZZER OPERATION

THE ELECTRIC FUEL PUMP IS LOCATED IN THE FUEL TANK INTEGRAL WITH THE GAUGE UNIT, BUT IS SEPARATELY SERVICEABLE. THE PUMP OPERATES UNDER THE FOLLOWING TWO CONDITIONS:

1. IGNITION IN START POSITION, NO OIL PRESSURE
2. IGNITION IN RUN POSITION, OIL PRESSURE (ENGINE RUNNING).

THE TWO-POSITION OIL PRESSURE SWITCH CONTROLS PUMP OPERATION. WITH NO OIL PRESSURE, DURING CRANKING, CURRENT FROM THE STARTER SOLENOID PURPLE WIRE FEED, GOES THROUGH THE OIL PRESSURE SWITCH, TO THE DARK BLUE WIRE TO THE COWL CONNECTOR, THEN THROUGH THE PINK WIRE TO THE ELECTRIC FUEL FUSE IN THE FUSE PANEL TO THE DARK BLUE WIRE TO THE FUEL PUMP. ONCE THE ENGINE STARTS, AND THERE IS OIL PRESSURE, THE OIL PRESSURE SWITCH DIRECTS CURRENT FROM THE PINK WIRE (FROM THE IGNITION SWITCH) TO THE DARK BLUE WIRE, THROUGH THE FUSE, AND TO THE PUMP.

THE TEMPERATURE PRESSURE LAMP LIGHTS UNDER THE FOLLOWING CONDITIONS:

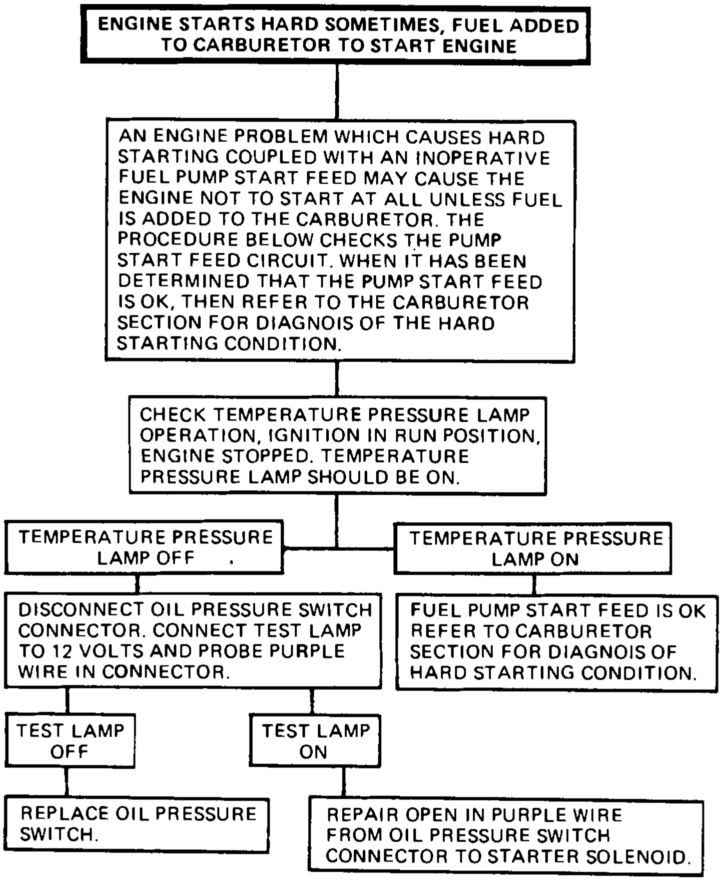
1. NO OIL PRESSURE, IGNITION IN RUN
2. ENGINE OVERHEATED, IGNITION IN RUN

THE TEMPERATURE PRESSURE LAMP RECEIVES ITS FEED THROUGH THE PINK WIRE FROM THE GAUGES FUSE AT THE FUSE PANEL.
THE GROUND SIDE IS COMPLETED THROUGH THE FOLLOWING TWO POSSIBLE PATHS:

1. THROUGH THE DARK BLUE WIRE TO THE KEY BUZZER, THROUGH THE DIODE IN THE KEY BUZZER, THROUGH THE DARK BLUE WHITE STRIPE WIRE TO THE COWL CONNECTOR (WHERE IT JUNCTIONS WITH THE DARK BLUE WIRE TO THE OIL PRESSURE SWITCH, AND THE PINK WIRE TO THE ELECTRIC FUEL FUSE), THROUGH THE DARK BLUE WIRE TO THE OIL PRESSURE SWITCH, THROUGH THE OIL PRESSURE SWITCH TO THE PURPLE WIRE (NO OIL PRESSURE) TO THE STARTER SOLENOID, TO GROUND THROUGH THE STARTER SOLENOID.
2. OR THROUGH THE DARK BLUE WIRE TO THE HARNESS JUNCTION, THROUGH THE DARK GREEN WIRE, TO THE TEMPERATURE SWITCH TO GROUND (SWITCH CLOSED, ENGINE OVERHEATED).

THE KEY BUZZER IS FED BY THE ORANGE WIRE FROM THE CLOCK LIGHTER COURTESY FUSE AT THE FUSE PANEL. IT BUZZES WHEN THE PINK BLACK STRIPE WIRE IS GROUNDED THROUGH THE KEY SWITCH IN THE STEERING COLUMN (KEY IN IGNITION) AND DRIVER'S DOOR JUMP SWITCH (DOOR OPEN).

THE FUEL GAUGE OPERATES IDENTICALLY TO THAT IN OTHER BUICKS. THE INSTRUMENT PANEL GAUGE UNIT GETS FEED THROUGH THE PINK WIRE FROM THE GAUGES FUSE. THE TAN WIRE CONNECTS THE GAUGE TO A VARIABLE RESISTANCE GROUND THROUGH THE SENDING UNIT IN THE FUEL TANK.



ENGINE STARTS HARD SOMETIMES, FUEL ADDED TO CARBURETOR TO START ENGINE

AN ENGINE PROBLEM WHICH CAUSES HARD STARTING COUPLED WITH AN INOPERATIVE FUEL PUMP START FEED MAY CAUSE THE ENGINE NOT TO START AT ALL UNLESS FUEL IS ADDED TO THE CARBURETOR. THE PROCEDURE BELOW CHECKS THE PUMP START FEED CIRCUIT. WHEN IT HAS BEEN DETERMINED THAT THE PUMP START FEED IS OK, THEN REFER TO THE CARBURETOR SECTION FOR DIAGNOIS OF THE HARD STARTING CONDITION.

CHECK TEMPERATURE PRESSURE LAMP OPERATION, IGNITION IN RUN POSITION, ENGINE STOPPED. TEMPERATURE PRESSURE LAMP SHOULD BE ON.

TEMPERATURE PRESSURE LAMP OFF

DISCONNECT OIL PRESSURE SWITCH CONNECTOR. CONNECT TEST LAMP TO 12 VOLTS AND PROBE PURPLE WIRE IN CONNECTOR.

TEST LAMP OFF

REPLACE OIL PRESSURE SWITCH.

TEST LAMP ON

REPAIR OPEN IN PURPLE WIRE FROM OIL PRESSURE SWITCH CONNECTOR TO STARTER SOLENOID.

TEMPERATURE PRESSURE LAMP ON

FUEL PUMP START FEED IS OK REFER TO CARBURETOR SECTION FOR DIAGNOIS OF HARD STARTING CONDITION.

ELECTRIC FUEL PUMP, TEMPERATURE PRESSURE INDICATOR, INDICATOR, AND KEY BUZZER SCHEMATIC

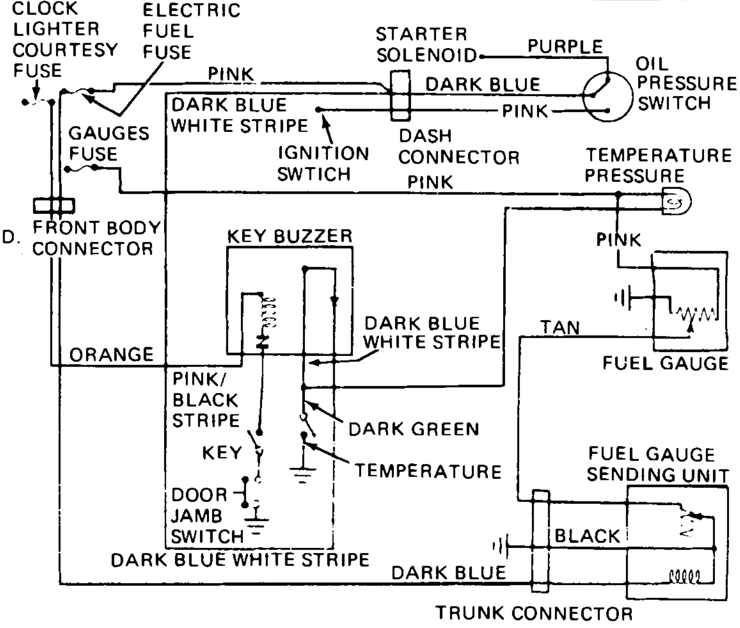


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Fig. 6C-5 Electric Fuel Pump, Temperature-Pressure Indicator Lamp, And Key Buzzer Diagnosis

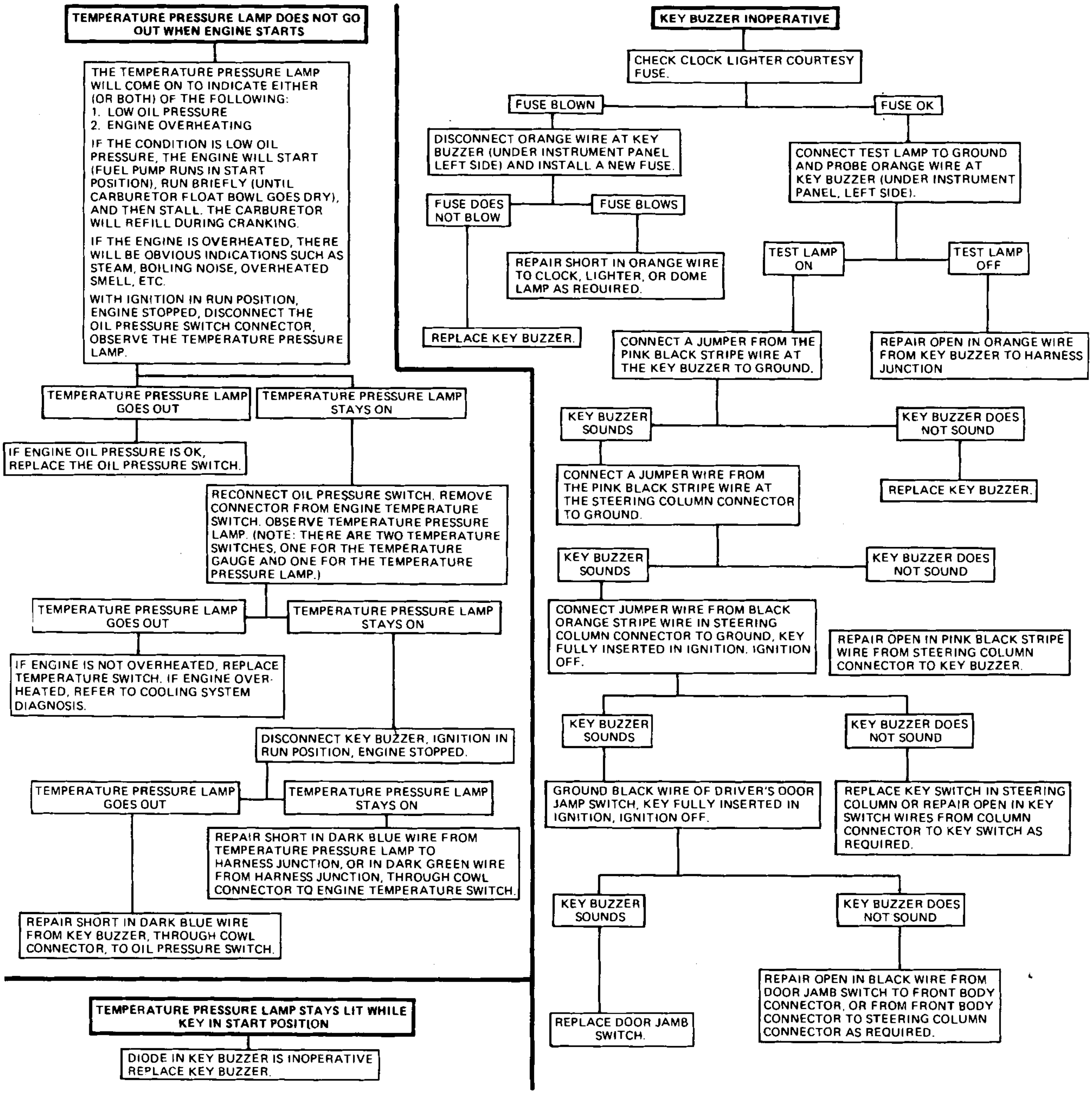


Fig. 6C-6 Electric Fuel Pump, Temperature-Pressure Indicator Lamp, And Key Buzzer Diagnosis

MODEL 5210-C CARBURETOR

CONTENTS

GENERAL DESCRIPTION

The Model 5210-C carburetor (Figs. 6C-7 and 8) is a staged two-barrel design with the primary bore smaller in size than the secondary bore. The secondary throttle is mechanically operated through inter-connecting throttle linkage.

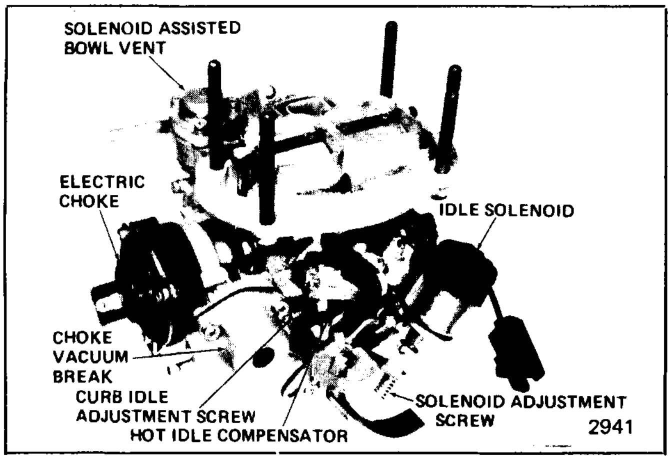


Fig. 6C-7 Model 5210-C Carburetor

The fuel inlet filter has an integral check valve to meet Federal safety regulations for fuel loss, during vehicle roll-over. The filter is not interchangeable with non-check filters.

The Model 5210-C carburetor utilizes four basic fuel metering systems. They are the idle system, the primary and secondary main metering system, the accelerating system, and the power enrichment system.

The primary idle system (Fig. 6C-10) is a separate and adjustable system capable of providing a proper air/fuel mixture for both idle and low speed operation.

The main metering system (Fig. 6C-11) provides the correct air/fuel mixture for all normal cruising speeds.

Extra fuel for smooth acceleration is supplied by a mechanically operated accelerating system (Fig. 6C-12) to the primary stage of the carburetor.

The power enrichment system (Figs. 6C-13 and 14) consists of: 1) a vacuum operated fuel-enrichment valve, 2) accelerator pump discharge nozzle pullover and 3) a secondary stage airflow regulated pullover system. These systems are used in conjunction with the main metering systems to provide satisfactory performance during periods of moderate to heavy accelerations.

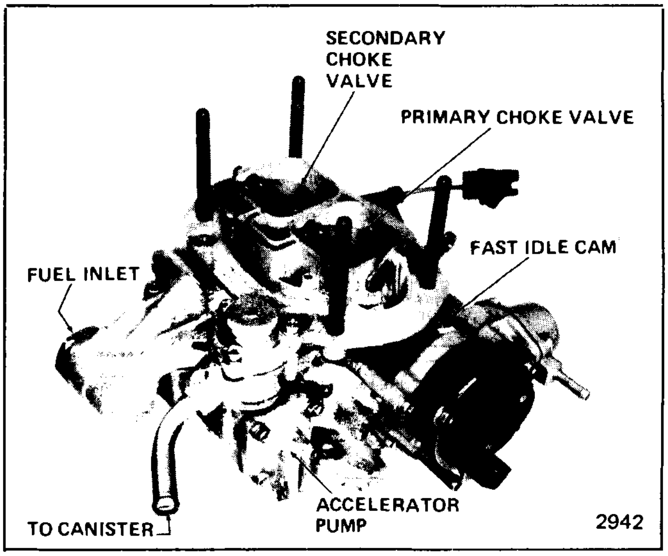


Fig. 6C-8 Model 5210-C Carburetor

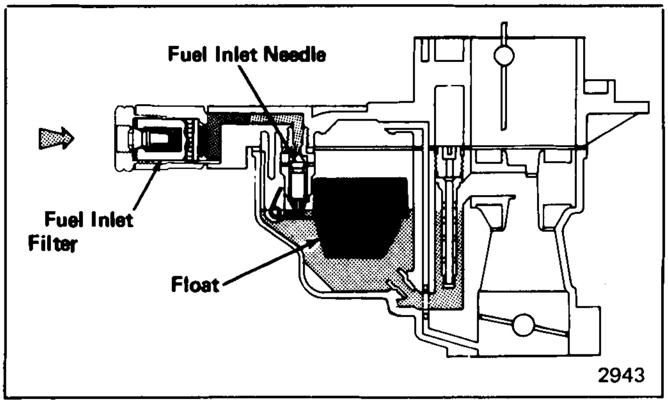


Fig. 6C-9 Fuel Inlet and Float System

Located in the primary bore are one or two vacuum ports for distributor vacuum spark advance, EGR vacuum, and vapor canister purge depending on emission control system. Refer to Section 6E, Emission Controls, for specific usage.

For improved hot engine starts a vacuum operated bowl vent is used (Fig. 6C-15) to vent the fuel vapors to the canister and not into the engine when the engine is not running. The bowl vent on the L4-151 is solenoid assisted. This feature is used in conjunction with existing internal venting through the air horn.

A coolant heated, for L4-140, or electrically heated, for L4-151, automatic choke system is used to provide correct air/fuel mixtures for cold start and warm-up operation. The L4-140 is equipped with a vacuum break (Fig. 6C-16) and a secondary vacuum break on California and high altitude vehicles to prevent prolonged fast idle. The L4-151 is equipped with a vacuum break controlled by an external vacuum supply and vacuum delay valve.

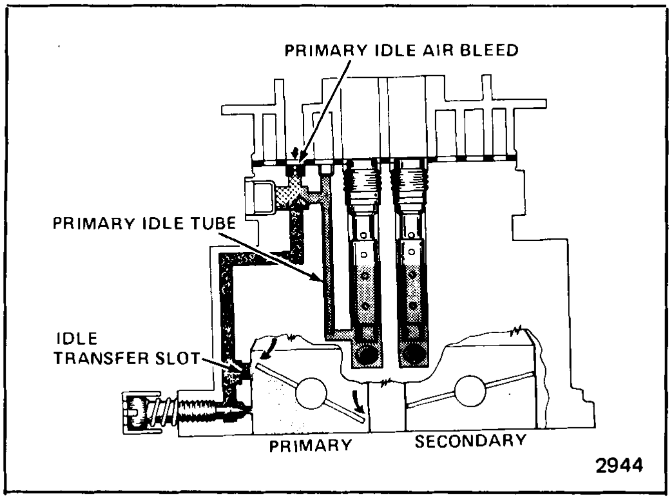


Fig. 6C-10 Idle System

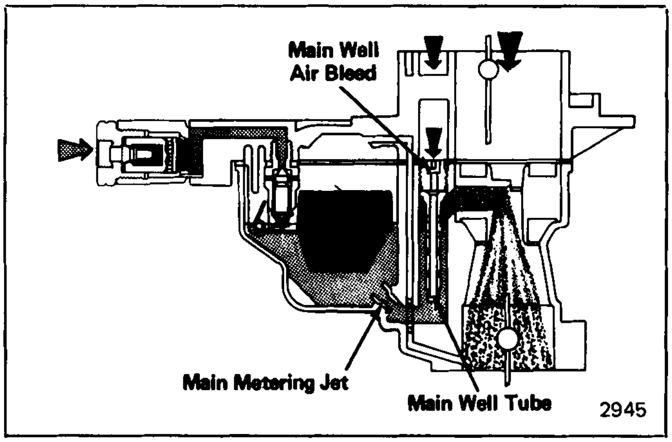


Fig. 6C-11 Main Metering System

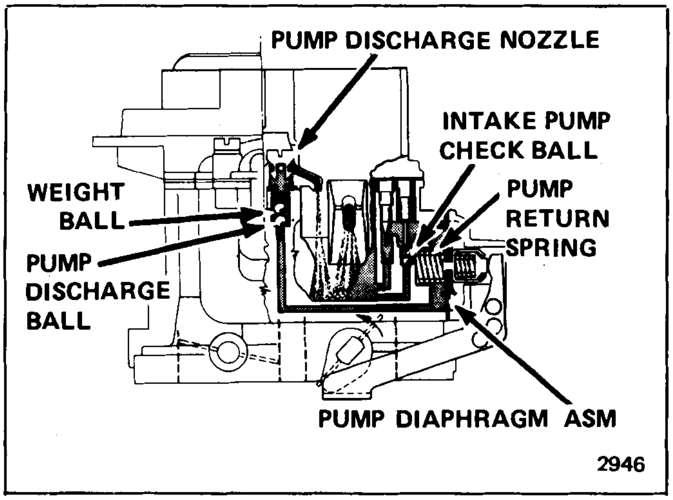


Fig. 6C-12 Accelerating System

ELECTRIC CHOKE L4-151 ENGINE (FIG. 6C-17)

A ceramic resistor in the electric choke assembly is heated by electric current and the resistor warms the thermostatic coil for precise timing of choke valve opening for good engine warm-up performance.

The electric choke operates as follows:

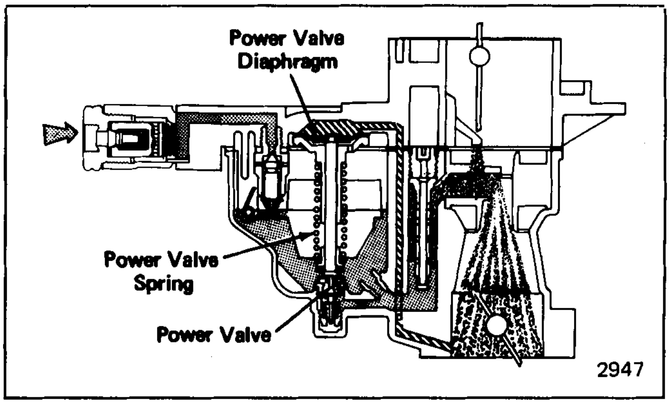


Fig. 6C-13 Primary Power Enrichment System

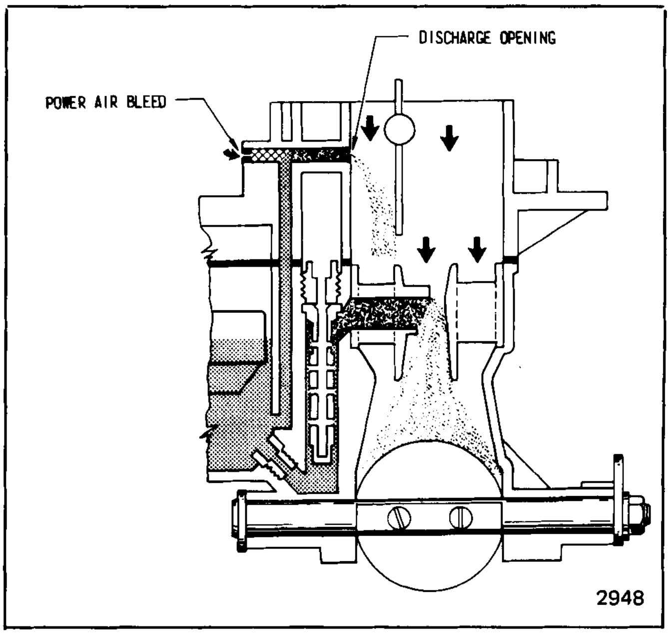


Fig. 6C-14 Secondary Power Enrichment System

The electric choke receives electric current operating through the engine oil pressure switch whenever the engine is running. The electric current flows to a ceramic resistor that is divided into two separate sections - a small center section for gradual heating of the thermostatic coil, and a large outer section for additional rapid heating of the thermostatic coil.

The ceramic resistor functions as follows:

AIR TEMPERATURE BELOW 50°F., (10°C.)

Electric current, applied to the small section of the ceramic resistor causes the section to heat up and warm the thermostatic coil which allows gradual opening of the choke valve for good cold engine warm-up performance. As the small section of the ceramic resistor continues to produce heat, a temperature-sensitive bi-metal disk causes a spring loaded contact to close also applying electric current to the large section of the ceramic resistor causing the large section to heat up. Heat from the larger section of the ceramic resistor increases the rate of heat flow to the thermostatic coil for more rapid opening of the choke valve.

AIR TEMPERATURE 70°F. (21°C.) AND ABOVE

Electric current is applied directly to both the small section and through the spring contact to the large section of the ceramic resistor to provide a rapid heating of the

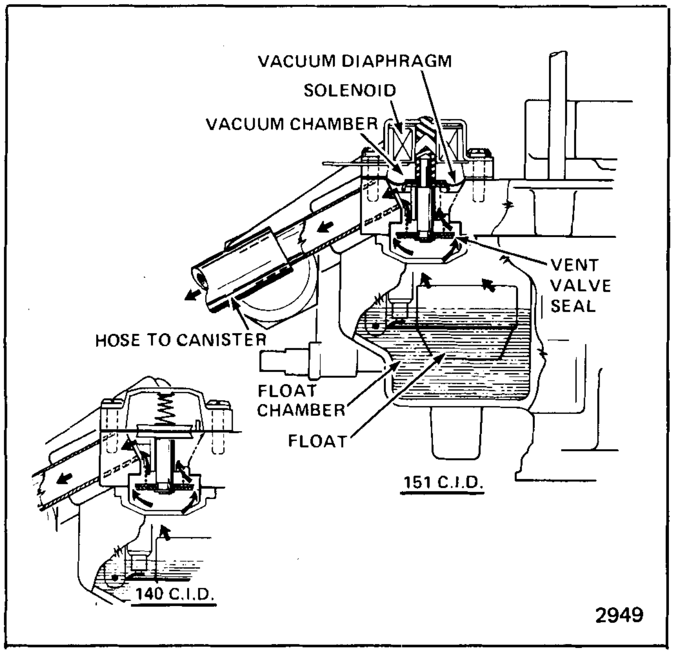


Fig. 6C-15 Bowl Vent

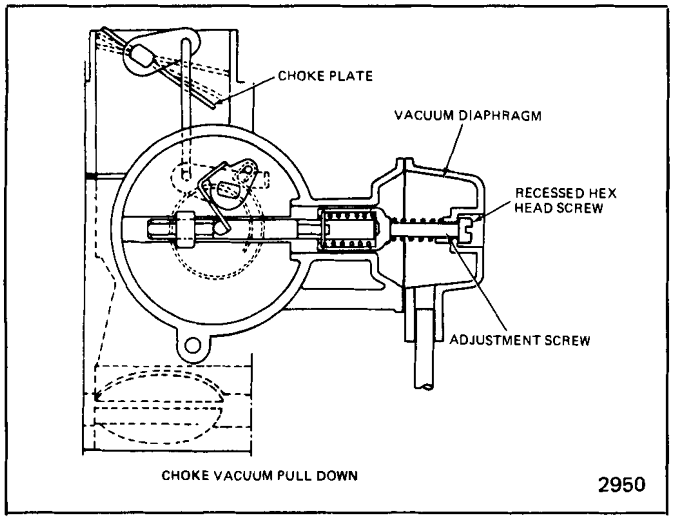


Fig. 6C-16 Vacuum Break

thermostatic coil for greater choke valve opening when leaner air/fuel mixtures are desired at warmer ambient temperatures.

NOTE: Ground contact for the electric choke is provided by a metal plate located at the rear of the choke assembly. DO NOT INSTALL A CHOKE COVER GASKET BETWEEN THE ELECTRIC CHOKE ASSEMBLY AND THE CHOKE HOUSING.

The electric choke assembly is indexed properly by aligning the scribe mark on the front cover with the specified index mark on the choke housing. (See Carburetor Adjustments)

The electric choke and thermostatic coil are serviced as a complete assembly.

VACUUM BREAK DELAY L4-151 ENGINE

The L4-151 engine vacuum break is controlled by a vacuum delay valve (Fig. 6C-18). This valve causes delayed application of manifold vacuum to the carburetor vacuum break unit when the engine starts.

The valve incorporates a check valve feature which allows a quick release of vacuum in the vacuum break unit should a stall occur or during engine shut down. This allows the choke blade to close quickly.

Refer to on-car service in this section for functional test of the vacuum delay valve. Refer to Section 6E, for proper installation of the valve.

SECONDARY VACUUM BREAK L4-140 CALIFORNIA AND HIGH ALTITUDE

The L4-140 California or high altitude certified vehicle is equipped with a secondary vacuum break designed to pull the choke blade to a wider position after the engine has reached 105°F. coolant temperature. There are two modes of operation dependent upon initial engine coolant temperature as follows:

1. Engine Coolant Temperature Below 105°F.

The coolant thermal vacuum switch is closed and the actuator is de-energized. When the specified coolant temperature is reached, the TVS opens and the activator energizes, pulling the choke blade to a second vacuum break position.

2. Engine Coolant Temperature Above 105°F.

The TVS is open and the actuator energizes immediately after the engine starts.

Refer to on-car service in this section for functional test of the TVS. Refer to Section 6E, for proper installation of the vacuum hoses.

The secondary vacuum break TVS also controls the distributor vacuum advance. Service of the vacuum advance portion of the valve is in Section 6D.

DIAGNOSIS

Refer to engine performance diagnosis, Section 6, and/or cleaning and inspection under unit overhaul in this section.

ON-CAR SERVICE

Carburetor Choke and Hoses

Check choke mechanism and vacuum break for proper operation at the recommended maintenance intervals. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.

Choke Check Procedure

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.

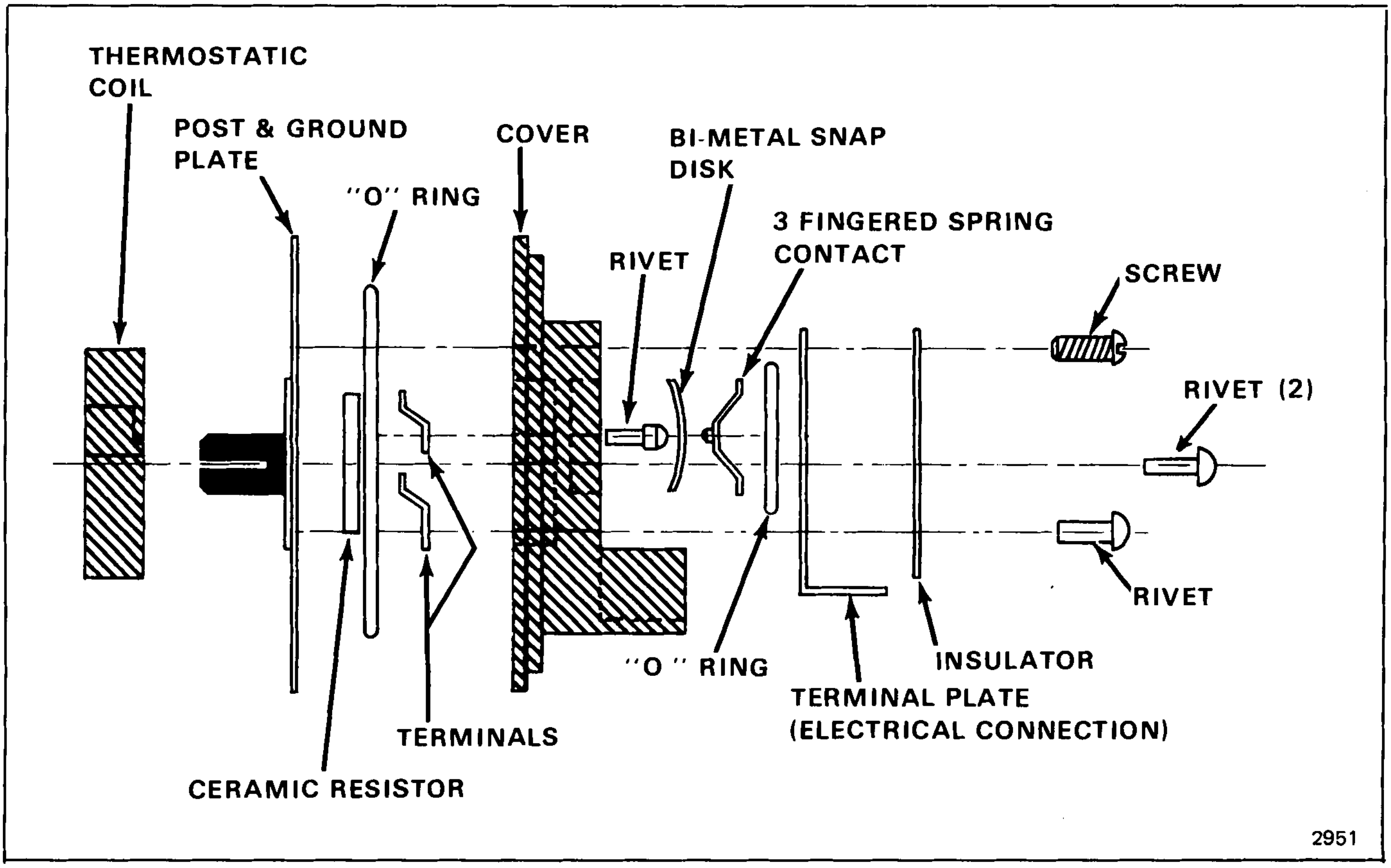


Fig. 6C-17 Electric Choke Assembly

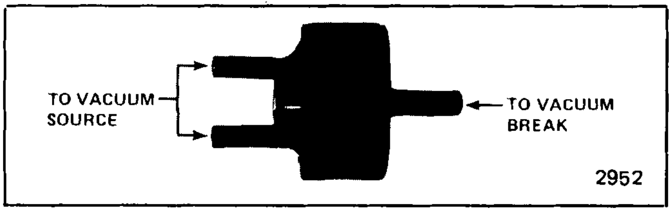


Fig. 6C-18 L4-151 Vacuum Break Delay

2. If choke or linkage binds, sticks or works sluggishly, clean with United Delco Choke Cleaner X-20-A or equivalent. Use cleaner as directed on can. If cleaning does not correct, replace binding parts.

3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasion, hardness or signs of deterioration. Replace or correct as necessary.

4. Make sure vacuum break diaphragm shafts are fully extended when engine is off. If shafts are not fully extended, replace vacuum break assembly. Start engine, primary vacuum break diaphragm shaft should fully retract. If unit fails to retract, replace vacuum break assembly.

NOTE: The choke coil and cover assembly must be removed to observe movement of the primary vacuum break diaphragm shaft. Due to the vacuum delay valve, the primary break on L4-151 engines will not retract as quickly as on L4-140 engines.

5. L4-140 California and High Altitude certified engines are equipped with a secondary vacuum break. The secondary vacuum break diaphragm shaft will retract when the engine coolant temperature is above 115°F. If the shaft does not retract with the engine running at normal operating temperature, check for presence of vacuum at the SVB-TVS. If there is no vacuum, replace the TVS. If there is vacuum, replace the secondary vacuum break unit.

Electric Choke - L4-151

If the electric choke fails to open, the following checks should be made:

1. Check voltage at the choke heater connection with the engine running. If voltage is between 12 and 15 volts, replace the electrical choke unit.

2. If the voltage is low or zero, check all wires and connections. If the connection at the oil pressure switch is faulty, the temperature pressure warning light will be off with the key "on" and the engine not running. Repair wires as required.

3. If steps 1 & 2 check OK, replace oil pressure switch.

ADJUSTMENTS

Idle Speed Adjustment - L4-140 and 151 Engines

Refer to Vehicle Emission Control Information label on vehicle for latest certified specification information.

1. With engine at normal operating temperature, choke full open, and air conditioning OFF, connect a tachometer and timing device to engine.

2. Set parking brake and block drive wheels.

3. Disconnect and plug PCV hose from vapor canister.

4. Disconnect and plug vacuum advance hose at distributor.

5. Start engine and position transmission in drive with automatic transmission or neutral with manual transmission.

6. Check and/or adjust ignition timing.

7. Unplug and reconnect vacuum advance hose and adjust idle speed.

8. Automatic transmission or manual transmission with A/C -- Adjust carburetor screw as specified above. Disconnect electrical connection at W.O.T. air conditioning override switch located on accelerator linkage bracket. Set air conditioning to "ON" position. Momentarily open throttle to allow solenoid plunger to fully extend. Adjust solenoid screw to specified rpm. Reconnect air conditioning override switch. Turn air conditioning "OFF".

9. Position transmission in neutral or park.

10. Adjust fast idle speed.

11. Unplug and reconnect PCV hose at canister.

12. Shut off engine and remove tachometer.

Carburetor Adjustments

Refer to Figs. 6C-19, 20 and 21 for carburetor adjustment procedures and specifications.

L4-151 2-Port or 3-port Vacuum Delay Valve - Choke Vacuum Break Functional Test

1. Verify correct installation per vacuum hose schematic Sec. 6F or on vehicle emission control information label.

2. Then "Tee" a vacuum gage into the hose between the VDV and the choke vacuum break.

3. When checking 3-port VDV's, disconnect the hose between the VDV and the TVS at the VDV and cap the port on the VDV.

4. Start the engine. Disconnect the vacuum hose at the input to the VDV and hold a finger on the end of the vacuum hose. The vacuum gage should read ZERO.

5. Re-connect the vacuum hose while observing the vacuum gage.

The vacuum reading should not increase immediately, but should rise slowly (taking about 40 seconds to reach manifold vacuum).

6. If the vacuum rises too fast or too slowly, the VDV is defective.

7. The maximum vacuum reading should be within 1 inch of manifold vacuum. If not, there is a leak either in the VDV, vacuum break unit, or hose connection.

8. Re-connect vacuum hoses per vacuum hose schematic.

L4-140 California and High Altitude Secondary Vacuum Break TVS Functional Test (Fig. 6C-26)

The TVS can be checked on or off the vehicle. Verify correct installation before and after test by referring to vacuum hose schematic on vehicle emission control information label.

On-Car Check

1. Allow engine to cool long enough for the engine coolant temperature to be below 105°F. In warmer climates this may require that the car be parked over night. If this is not possible, remove the TVS from engine and follow the off-car check.

2. Start engine and check for vacuum at port #3, there should be no vacuum. If there is vacuum, verify that coolant temperature is below 105°F. and recheck for vacuum. If there is vacuum, replace TVS.

3. Let engine idle until coolant temperature is above 105°F.

4. Check for vacuum at port #3, there should be vacuum. If there is no vacuum, check for vacuum at hose connected to the #1 port. If there is vacuum at hose, replace TVS. If there is no vacuum at hose, trace vacuum hose to source, determine cause for no vacuum and correct as necessary. Then recheck TVS.

Off-Car Check

1. With TVS out of car, cool TVS below 105°F. by running cold tap water over it.

2. Apply vacuum to port #1. TVS should hold vacuum. If it does not, replace TVS.

3. Warm TVS above 105°F. by running hot tap water over it.

4. Apply vacuum to port #1. Vacuum should be present at both ports #2 and #3. If not, replace TVS.

CARBURETOR REPLACEMENT

Removal

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, the, carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

1. Remove air cleaner and gasket.

2. Disconnect fuel and vacuum lines from carburetor.

3. On L4-140 disconnect choke water housing and choke thermostat housing.

4. Disconnect accelerator linkage and electrical connectors.

5. If equipped with automatic transmission, disconnect downshift linkage.

6. Remove carburetor attaching nuts and remove carburetor and solenoid assembly attachment.

7. Remove insulator gasket, air cleaner bracket and flange gasket.

Installation

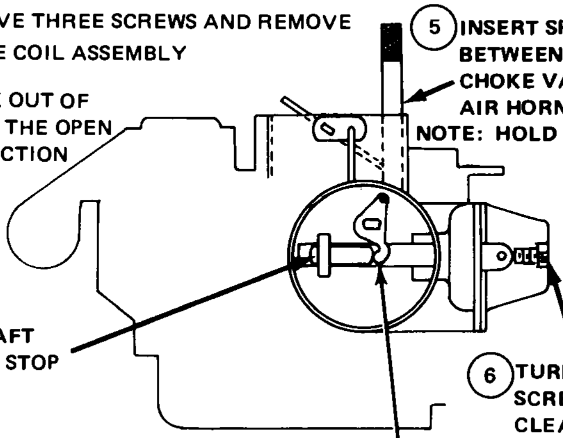
Fill carburetor bowl before installing carburetor. This reduces strain on starting motor and battery and reduces the possibility of backfiring while attempting to start engine. A small supply of no-lead fuel will enable carburetor to be filled and the operation of float and inlet needle and seat to be checked. Operate throttle lever several times and check discharge from pump jets before installing carburetor.

1

① REMOVE THREE SCREWS AND REMOVE CHOKE COIL ASSEMBLY

④ TAKE SLACK OUT OF LINKAGE IN THE OPEN CHOKE DIRECTION

⑤ INSERT SPECIFIED GAUGE BETWEEN LOWER EDGE OF CHOKE VALVE & INSIDE AIR HORN WALL
NOTE: HOLD GAUGE VERTICAL



③ PUSH SHAFT AGAINST STOP

⑥ TURN ADJUSTING SCREW TO OBTAIN CLEARANCE

⑦ INSTALL CHOKE COIL ASSEMBLY AND SET TO SPEC.

② PUSH INSIDE CHOKE COIL LEVER CLOCKWISE TO CLOSE CHOKE VALVE

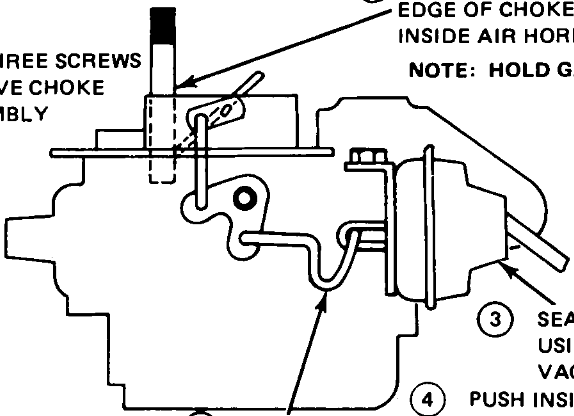
VACUUM BREAK ADJUSTMENT

CARB. NO.	PLUG GAUGE	
458 102	.250	
103	"	
104	"	
105	"	
107	.275	
109	"	
110	.300	
112	"	
527 200	.275	
201	.300	
202	.275	
203	.300	
204	.275	
206	.275	

2

⑤ PLACE GAUGE BETWEEN LOWER EDGE OF CHOKE VALVE AND INSIDE AIR HORN WALL.
NOTE: HOLD GAUGE VERTICAL

① REMOVE THREE SCREWS AND REMOVE CHOKE COIL ASSEMBLY



③ SEAT DIAPHRAGM USING OUTSIDE VACUUM SOURCE

④ PUSH INSIDE CHOKE COIL LEVER CLOCKWISE TO CLOSE CHOKE VALVE

② PLACE CAM FOLLOWER ON HIGHEST STEP OF FAST IDLE CAM

⑥ BEND ROD TO ADJUST

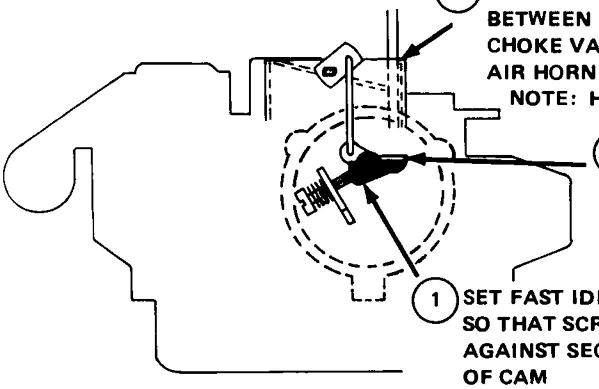
⑦ INSTALL CHOKE COIL ASSEMBLY AND SET TO SPEC.

SECONDARY VACUUM BREAK ADJUSTMENT

CARB.NO.	PLUG GAUGE	
458 107	.400"	min.
109	"	"
110	"	"
112	"	"

3

② INSERT SPECIFIED GAUGE BETWEEN LOWER EDGE OF CHOKE VALVE & INSIDE AIR HORN WALL
NOTE: HOLD GAUGE VERTICAL



③ BEND TANG IF ADJUSTMENT IS REQUIRED:

① SET FAST IDLE CAM SO THAT SCREW IS HELD AGAINST SECOND HIGH STEP OF CAM

FAST IDLE CAM ADJUSTMENT

CARB. NO.	PLUG GAUGE	
458 102	.085"	
103	"	
104	"	
105	"	
107	.125"	
109	"	
110	.120"	
112	"	
527 200	.150"	
201	"	
202	"	
203	"	
204	"	
206	"	

2953

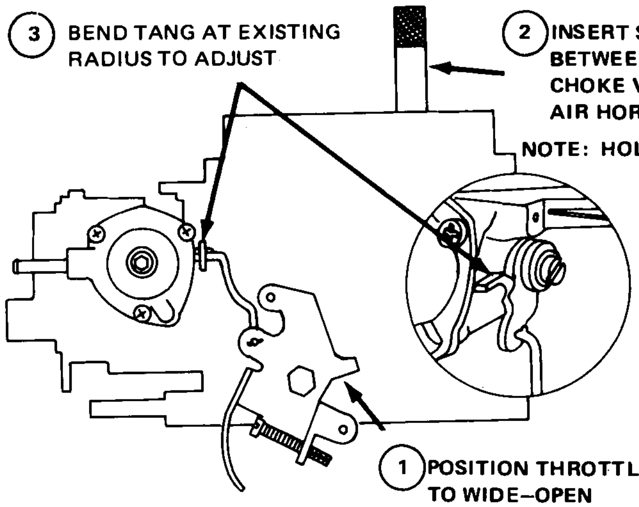
Fig. 6C-19 5210-C Adjustment Procedures

4

③ BEND TANG AT EXISTING RADIUS TO ADJUST

② INSERT SPECIFIED GAUGE BETWEEN LOWER EDGE OF CHOKE VALVE & INSIDE AIR HORN WALL

NOTE: HOLD GAUGE VERTICAL



① POSITION THROTTLE LEVER TO WIDE–OPEN

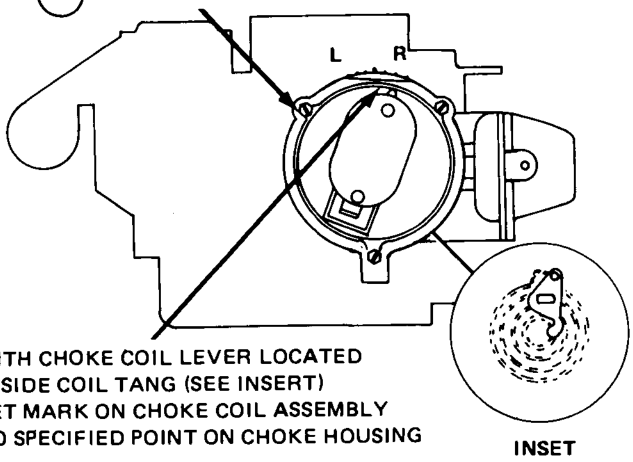
UNLOADER ADJUSTMENT

CARB. NO.	PLUG GAUGE	
458 102	.350"	
103	.350"	
104	.350"	
105	.350"	
107	.350"	
109	.350"	
110	.350"	
112	.350"	
527 200	.400"	
201	.400"	
202	.400"	
203	.400"	
204	.400"	
206	.400"	

5

① LOOSEN RETAINING SCREWS

③ TIGHTEN RETAINING SCREWS



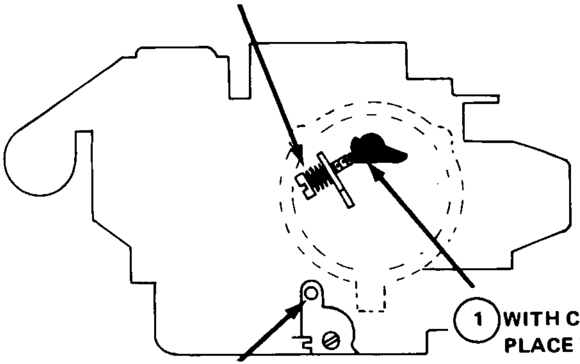
② WITH CHOKE COIL LEVER LOCATED INSIDE COIL TANG (SEE INSERT) SET MARK ON CHOKE COIL ASSEMBLY TO SPECIFIED POINT ON CHOKE HOUSING

CHOKE INDEX SETTING

CARB. NO.	INDEX MARK	
458 102	3NR	
103	3NR	
104	3NR	
105	3NR	
107	3NR	
109	3NR	
110	3NR	
112	3NR	
527 200	4NR	
201	4NR	
202	4NR	
203	4NR	
204	2NR	
206	2NR	

6

③ ADJUST FAST IDLE SCREW TO SPECIFICATION



① WITH CURB IDLE SPEED CORRECT, PLACE TRANSMISSION IN PARK OR NEUTRAL AND SET FAST IDLE SCREW ON HIGH STEP OF FAST IDLE CAM

② DISCONNECT AND PLUG EGR PORT

FAST IDLE ADJUSTMENT

CARB. NO.	RPM	
458 102	2500	
103	"	
104	"	
105	"	
107	"	
109	"	
110	"	
112	"	
527 200	2400	
201		
202		
203		
204		
206		

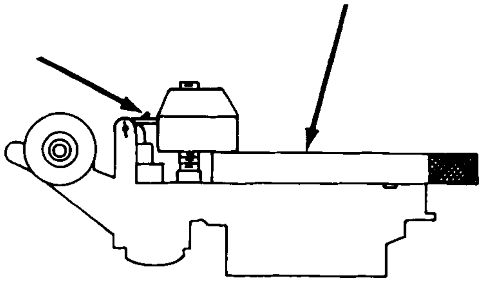
2956

Fig. 6C-20 5210-C Adjustment Procedures

7

② BEND TANG TO ADJUST

① WITH AIR HORN INVERTED INSERT SPECIFIED PLUG GAUGE BETWEEN FLOAT AND AIR HORN

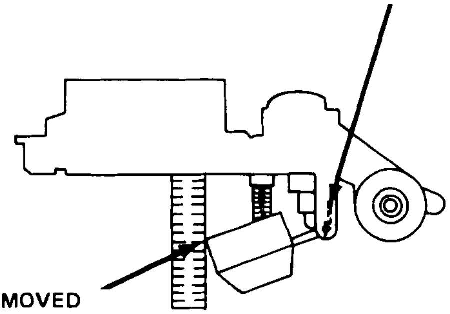


FLOAT LEVEL ADJUSTMENT

CARB. NO.	PLUG GAUGE
458 102	.420
103	"
104	"
105	"
107	"
109	"
110	"
112	"
527 200	.520"
201	"
202	"
203	"
204	"
206	"

8

② BEND TANG IF ADJUSTMENT REQUIRED

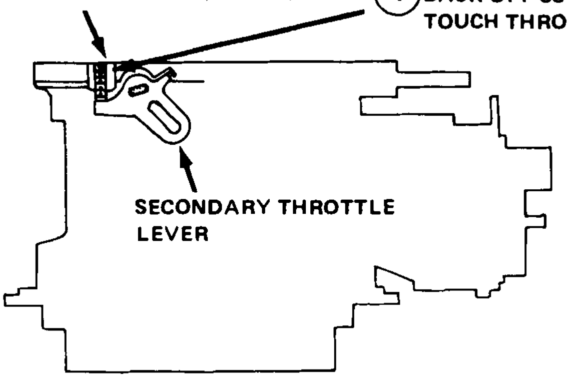


① WITH AIR HORN REMOVED DISTANCE FROM BOTTOM OF AIR HORN TO TOP OF FLOAT SHOULD BE 1" ±1/8"

FLOAT DROP SETTING

② TURN SCREW IN UNTIL IT TOUCHES SECONDARY THROTTLE LEVER & THEN TURN SCREW AN ADDITIONAL 1/4 TURN

① BACK OFF SCREW UNTIL IT DOES NOT TOUCH THROTTLE LEVER



SECONDARY THROTTLE STOP SCREW ADJUSTMENT

2959

Fig. 6C-21 5210-C Adjustment Procedures

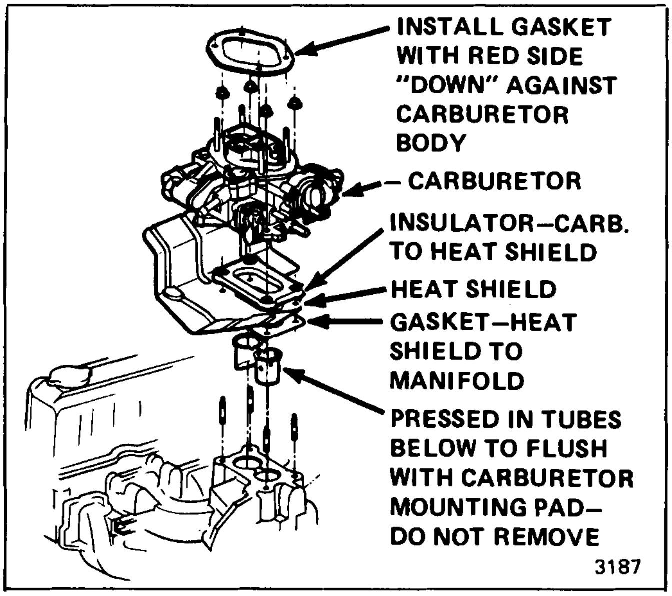


Fig. 6C-22 Carburetor Replacement

1. Be certain throttle body and intake manifold sealing surfaces are clean.
2. Install carburetor to manifold gasket.
3. Install brace for air cleaner and then install insulator.
4. Install carburetor over manifold studs.
5. Install vacuum lines and loosely connect fuel line.
6. Install attaching nuts and tighten to 145 in. lbs.
7. Tighten fuel inlet nut to 300 inch pounds.
8. Connect and adjust accelerator linkage.
9. Install choke water housing and choke thermostat housing assembly on L4-140 engines.
10. Connect electrical connectors.
11. Guide vent tube into rocker cover and install air cleaner.
12. Refer to idle adjustment procedure to set idle speeds.

FUEL FILTER

Replacement

A plugged fuel filter will restrict fuel flow into carburetor and will result in a loss of engine power.

1. Disconnect fuel line connection at inlet fuel filter nut.
2. Remove inlet fuel filter nut from carburetor.
3. Remove filter and spring.
4. Install spring and filter element in carburetor with hole in filter toward nut.
5. Install new gasket on inlet fitting nut and install nut in carburetor and tighten securely.
6. Install fuel line and tighten connector to 300 inch pounds.

SOLENOID OR SOLENOID/DASHPOT

The solenoid or solenoid/dashpot should be checked to assure that the solenoid plunger extends when the solenoid is energized. An inoperative solenoid should be replaced.

Removal

1. Remove carburetor air cleaner.

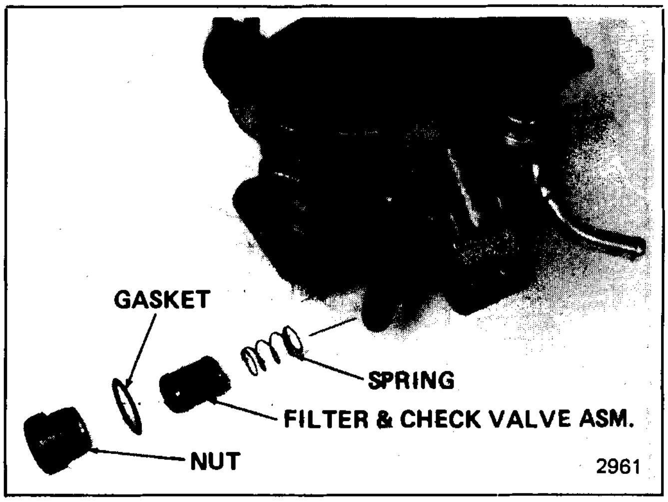


Fig. 6C-23 Fuel Filter

2. Disconnect electrical connector at solenoid.
3. Remove 2 bracket screws and lock washers and remove solenoid or solenoid/dashpot and bracket assembly.

Installation

1. Install solenoid or solenoid/dashpot and bracket assembly.
2. Connect electrical connector.
3. Install air cleaner.
4. Refer to vehicle emission control information label and adjust idle speed.

CHOKE HOSE

Replacement (L4-140)

Refer to Fig. 6C-24 for replacement of choke hose.

UNIT OVERHAUL

GENERAL

The procedures below apply to the complete overhaul with the carburetor removed from the engine.

However, in many cases service adjustments of individual systems may be completed without removing the carburetor from the engine. (Refer to "On-Car Service").

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection and replacement of all gaskets, diaphragms, seals and worn or damaged parts.

DISASSEMBLY

Choke Secondary Vacuum Break L4-140 (Fig. 6C-25) (Calif. & High Alt. Only)

Remove two screws and lockwasher and remove choke vacuum break and rod.

Air Horn

1. Remove fuel inlet filter plug and filter assembly (Fig. 6C-23).

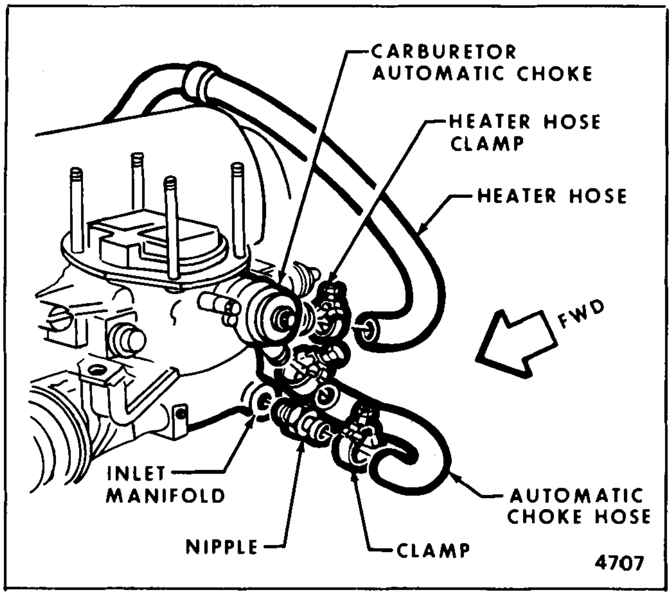


Fig. 6C-24 Choke Hose

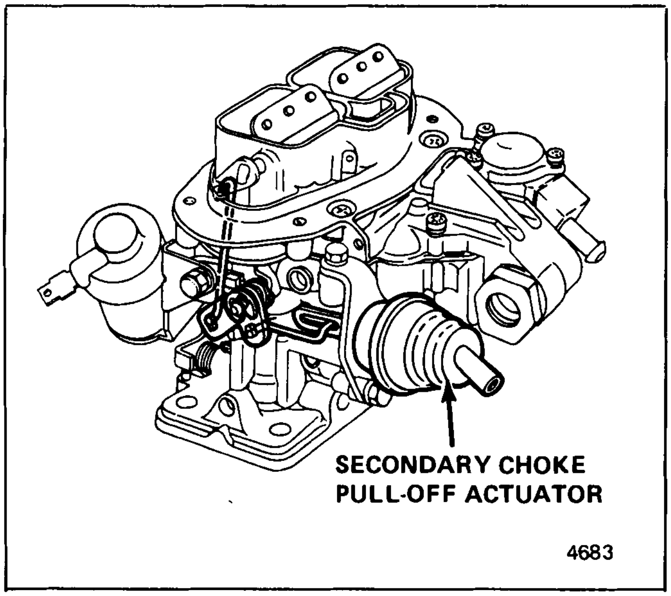


Fig. 6C-25 Choke Secondary Vacuum Break

2. Remove retainer clips and choke operating rod. Then remove five air horn screws and lock washers and remove the air horn.

3. Remove float hinge pin, float and fuel inlet needle. Remove fuel inlet seat and gasket. The inlet needle and seat are an assembly on L4-151 engines. Remove power valve economizer (Fig. 6C-26).

4. Remove bowl vent diaphragm (Fig. 6C-27).

5. Unless damage has occurred to the choke plates, shaft or lever, no further disassembly of the air horn is necessary.

Choke Bi-Metal Coil L4-140

1. Remove choke water housing retaining screw, washer, housing and gasket.

2. Remove three choke bi-metal retaining screws, retainer ring, thermostat housing and gasket.

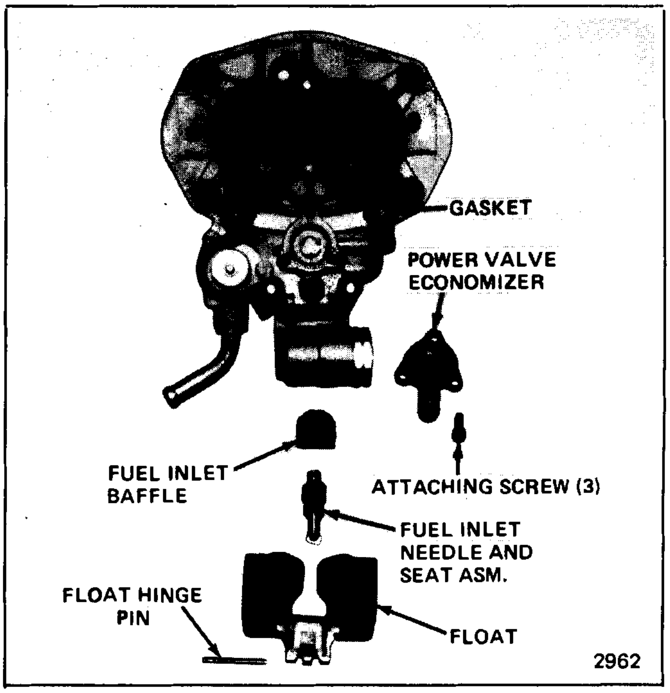


Fig. 6C-26 Float and Power Valve Economizer

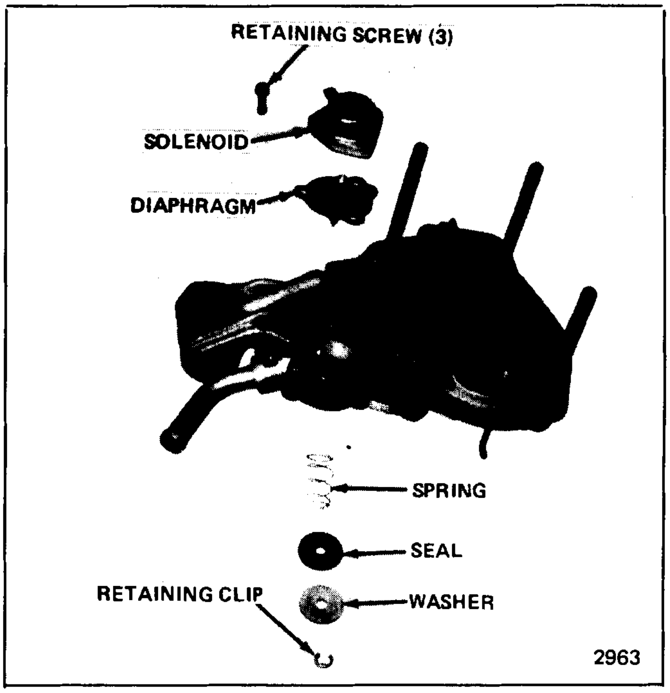


Fig. 6C-27 Bown Vent

Choke Bi-Metal Coil L4-151

1. Remove three screws and remove retainer, element, ground ring, and coil housing from choke housing (Fig. 6C-29).

Choke Housing

1. Remove three screws from choke housing and remove housing and disengage fast idle rod (Fig. 6C-30).

2. Remove "O" ring from vacuum passage (Fig. 6C-31).

3. Remove choke housing shaft nut, lock washer, lever, spring retainer and cam from choke housing shaft.

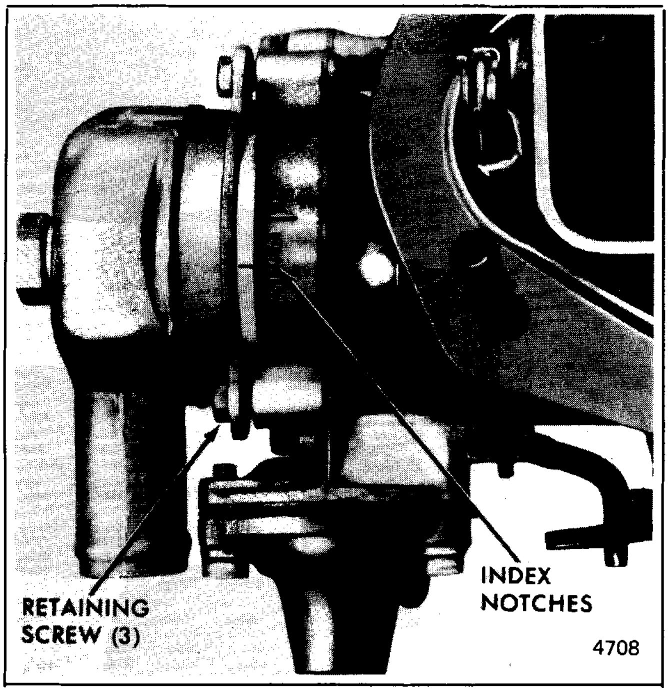


Fig. 6C-28 Choke Water and Thermostat Housing

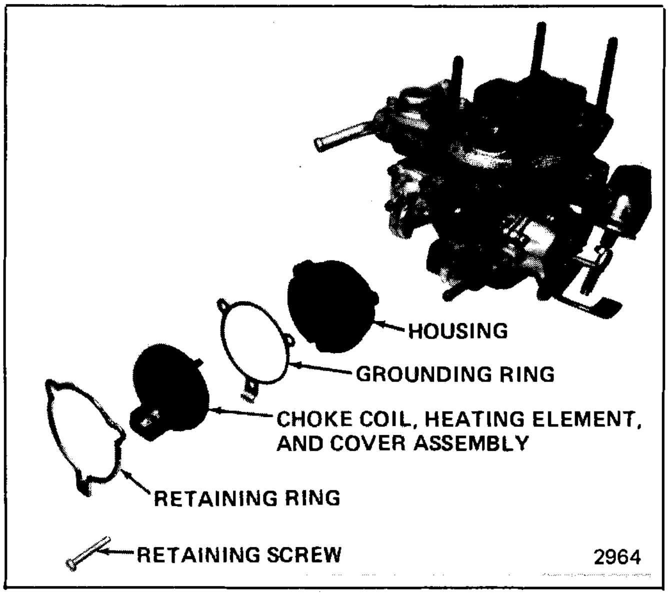


Fig. 6C-29 Choke Bi-Metal Coil Removal

4. Remove screw and lockwasher and remove bushing, spring washer, fast idle lever and washer from housing.

5. Remove three screws and remove diaphragm cover spring and diaphragm and shaft from housing.

6. Remove diaphragm adjusting screw from cover.

Accelerator Pump (Fig. 6C-32)

Remove three screws and remove pump cover, diaphragm and return spring from housing.

Carburetor Body (Fig. 6C-33)

1. Remove primary high speed bleed and main well tube.

Remove secondary high speed bleed and main well tube.

Write down sizes of air bleed restrictions and main well tubes so that primary and secondary can be reinstalled in the proper channels.

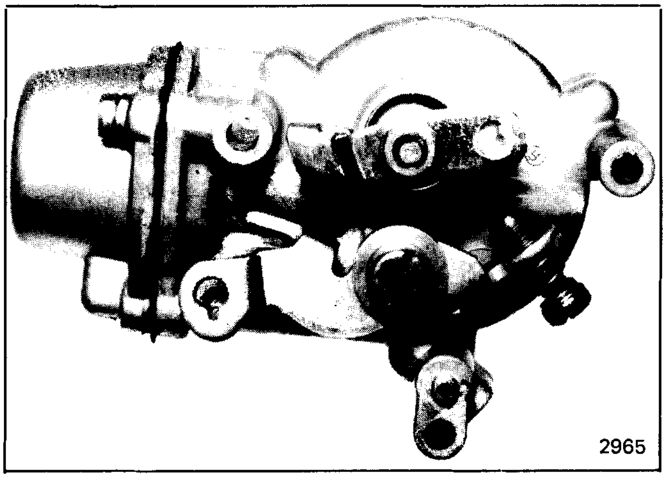


Fig. 6C-30 Choke Housing - Assembled View

2. Remove primary and secondary main metering jet, noting their size so they may be installed properly.

3. Remove power valve assembly.

4. Remove pump discharge nozzle and pump discharge check and weight balls.

Throttle Lever, Solenoid or Dashpot, and Hot Idle Compensator (Fig. 6C-34)

1. Remove two screws and remove solenoid or dashpot and bracket.

2. Straighten lock washer and remove nut, lock washer, primary throttle lever, washer, secondary operating lever, spring and idle stop lever.

3. Remove two screws and remove cover, hot idle compensator and gaskets.

CLEANING AND INSPECTION

1. Thoroughly clean all carburetor castings and metal parts in cold immersion type cleaner.

CAUTION: *Any rubber parts, plastic parts including float, diaphragms, pump plunger, dashpot and solenoid should not be immersed in carburetor cleaner, as they will swell, harden or distort.*

Clean the pump plunger in clean gasoline and the diaphragm unit by wiping with a rag only.

2. Blow all passages in castings dry with compressed air.

CAUTION: *Do not pass drills or wires through passages as this may distort passages and seriously affect carburetor calibration.*

3. Check, repair or replace the following parts if the following problems were encountered.

A. Flooding

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arm and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

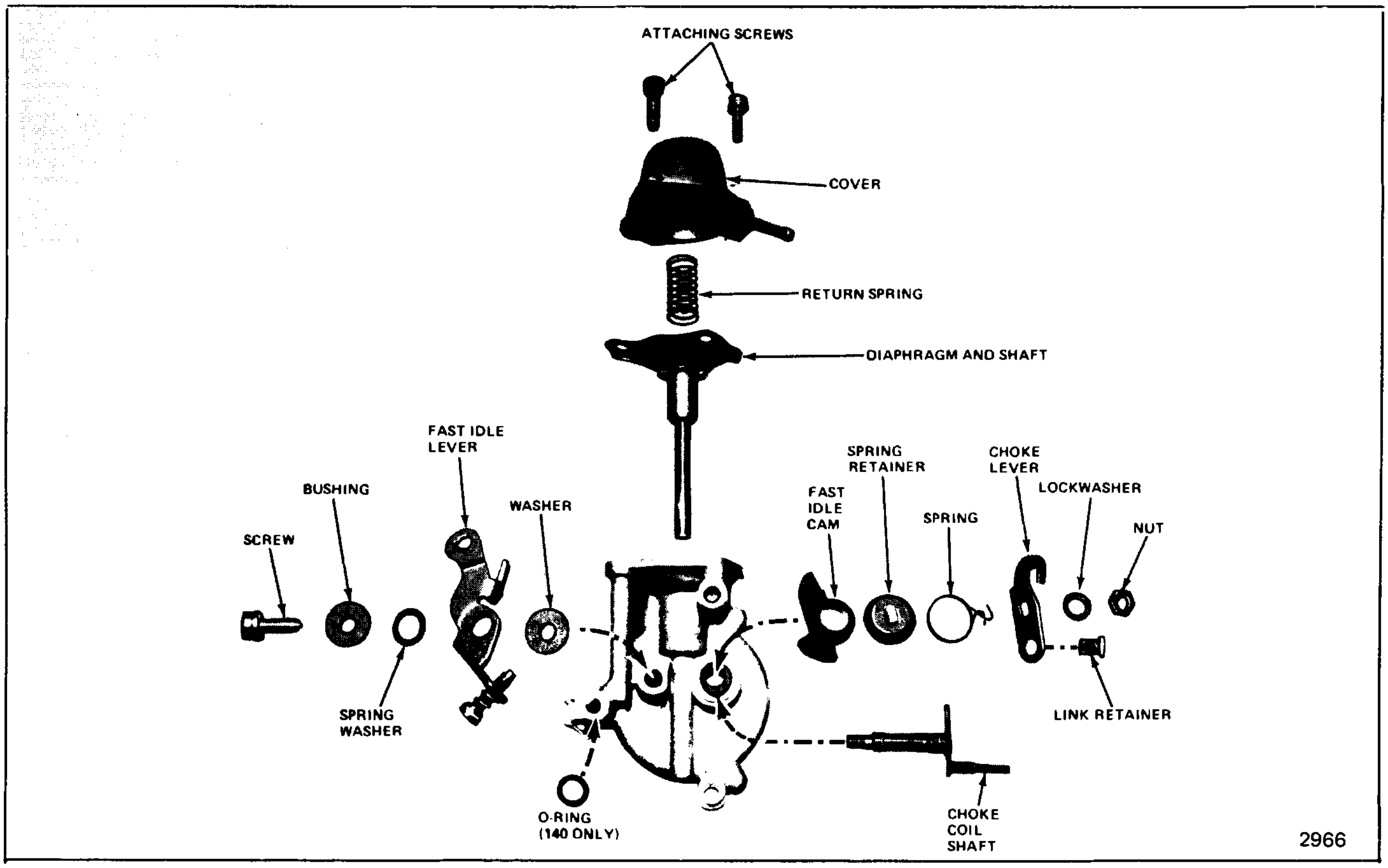


Fig. 6C-31 Choke Housing - Disassembled

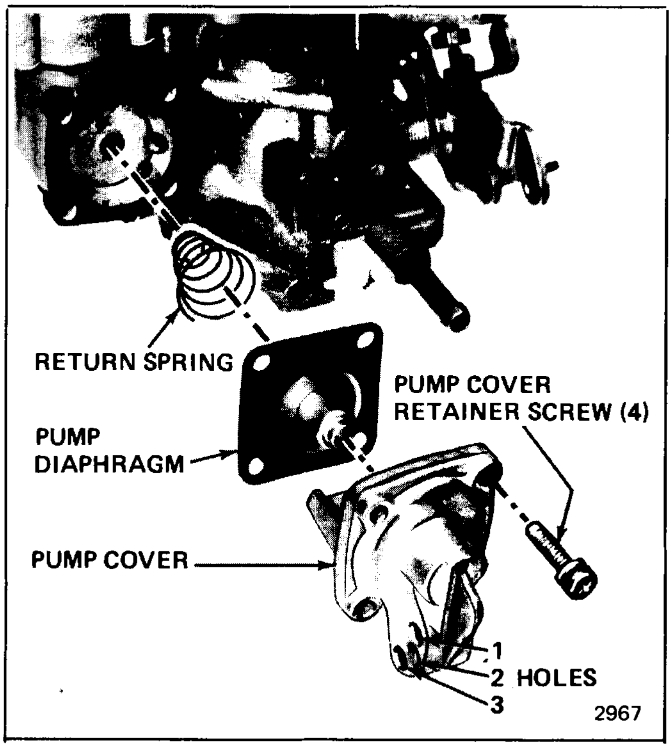


Fig. 6C-32 Accelerator Pump

B. Hesitation

1. Inspect pump diaphragm for cracks, scores or excessive wear.

2. Inspect pump return spring for being weak or distorted.

3. Check all pump passages and jets for dirt and improper seating inlet or discharge balls.

4. Check pump linkage for excessive wear, repair or replace as necessary.

C. Hard Starting - Poor Cold Operation

1. Check choke valve and linkage for excessive wear, binds or distortion.

2. Inspect choke vacuum diaphragms for leaks.

3. Clean or replace carburetor filter.

4. Inspect inlet needle and seat assembly for sticking, dirt, etc.

5. Examine fast idle cam for wear or damage.

6. Also check items under "flooding".

D. Poor Performance - Poor Gas Mileage

1. Check power piston and power valve for dirt, sticking, binding, damaged parts or excessive wear.

2. Clean all fuel and vacuum passages in castings.

E. Rough Idle

1. Inspect idle needle for ridges, burrs or being bent.

2. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks and burrs.

3. Clean all idle fuel passages.

4. Check throttle lever and valves for binds, nicks and other damage.

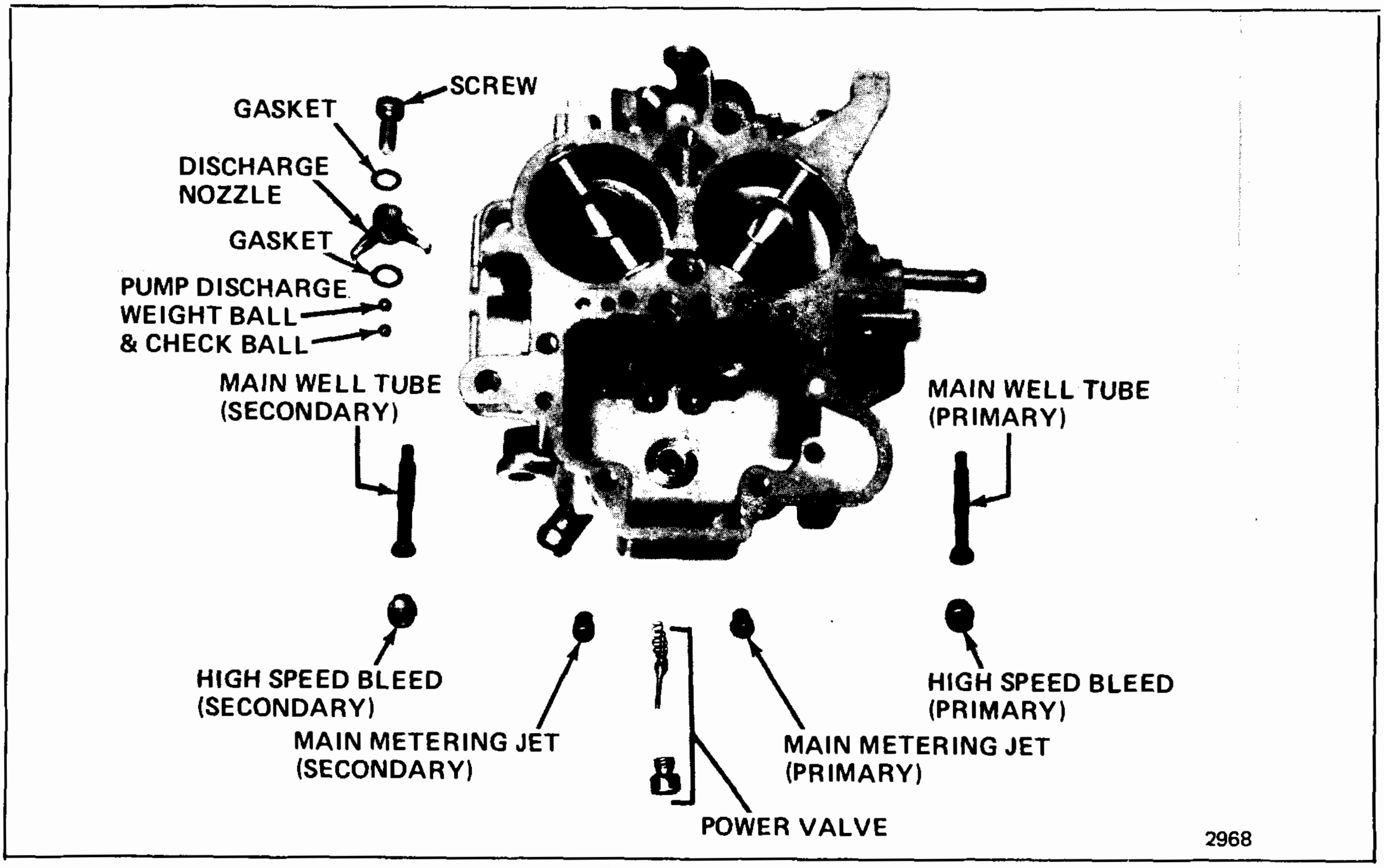


Fig. 6C-33 Carburetor Body

ASSEMBLY

Refer to disassembly illustrations and reverse disassembly procedure.

When float has been assembled to air horn, adjust float for float level and float drop (Fig. 6C-19)

After assembly, adjust secondary throttle stop screw (Fig. 6C-21).

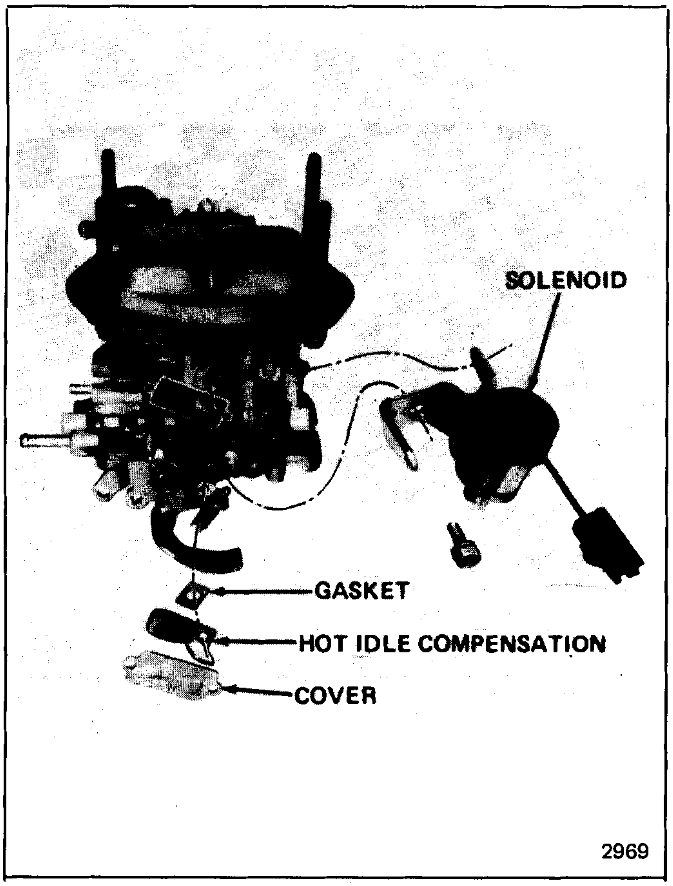


Fig. 6C-34 Throttle Lever. Solenoid and Hot Idel Compensator

MODEL 2GC-2GE CARBURETOR
CONTENTS

GENERAL DESCRIPTION

MODEL 2GE

The model 2GE (Fig. 6C-36) used on 1977 V6 engines is similar to the 2GC except for an electrically heated choke coil instead of the hot air choke. The dual vacuum break is used for good control of carburetor mixtures during engine warm up. Teflon coating is used on the choke rod to reduce friction on the operating parts.

The combination vacuum and mechanically operated power system, consisting of two power valves, provides accurate control of air/fuel mixtures for emission requirements. One power valve is located in the bottom of the accelerating pump well and the other in the bottom of the fuel bowl. The 2GE carburetor for altitude option engines will not use the power valve in the bottom of the float bowl. A blank valve body will be used instead.

An electrically operated idle speed solenoid is used on 2GE models for all air conditioned equipped cars (also manual transmission models with and without A/C) to maintain proper idle speed when the air conditioning is in operation. New idle setting procedures are required with these models.

MODEL 2GC

The model 2GC (Fig. 6C-37) is used on the new 305" V8 engine for 1977. This model includes the conventinal hot air choke, with single vacuum break, for cold engine driveaway; performance. An electrically operated idle speed solenoid is used on 2GC models equipped with automatic transmission air conditioning. The solenoid maintains proper idle speed with the air conditioning in operation.

All models (except California) use full vacuum for distributor advance (tube location "H" in float bowl). On California models, timed vacuum for distributor advance is supplied through a punched horizontal port in the throttle

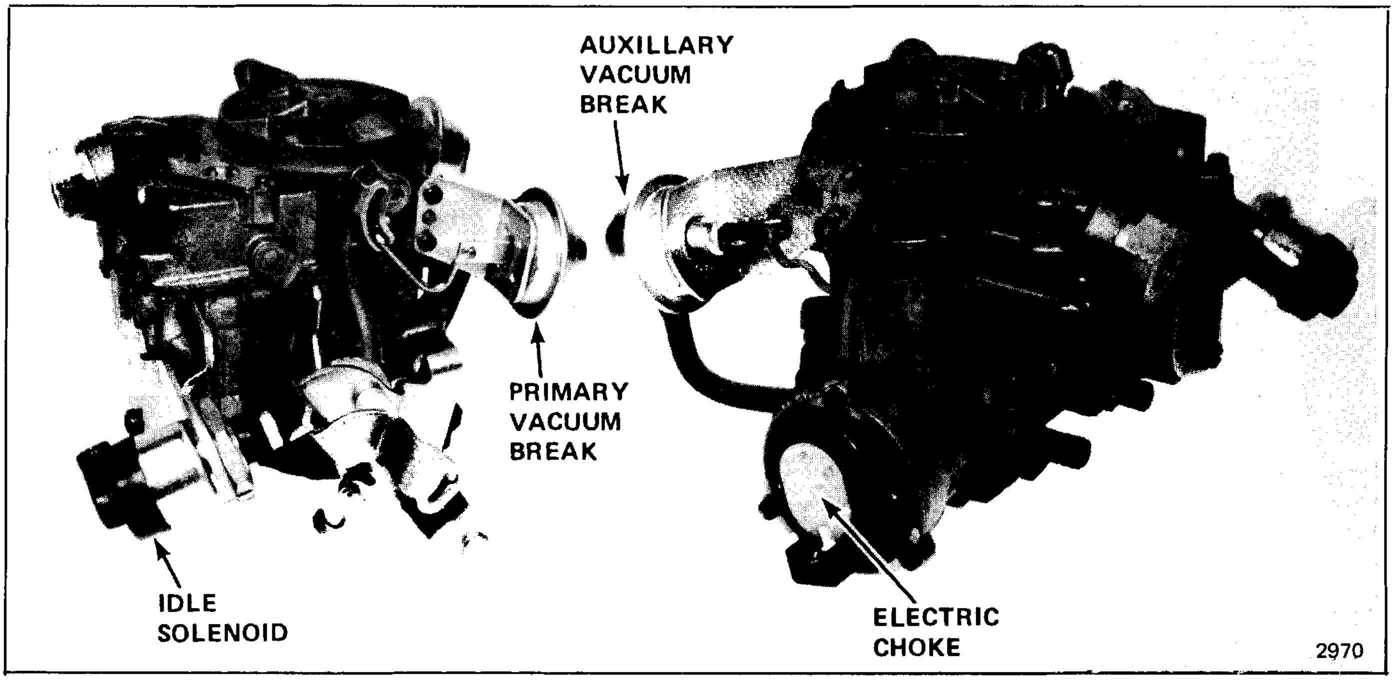


Fig. 6C-36 2GE Carburetor

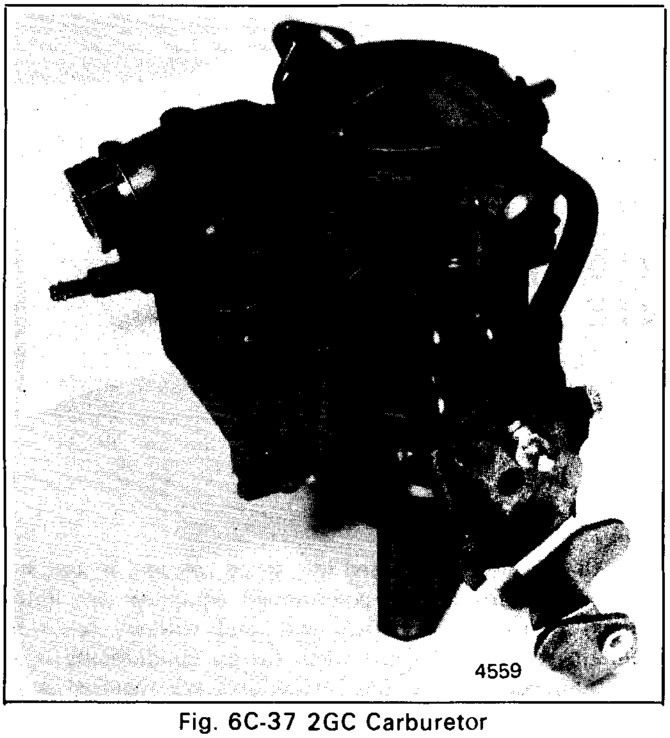


Fig. 6C-37 2GC Carburetor

body located just above the throttle valve.

An Exhaust Gas Recirculation (E.G.R.) system is used to meet emission requirements for oxides of nitrogen (NOX). Vacuum for E.G.R. is supplied through a tube in the float bowl (location "J"). On 2GC V8 models, a small cup restriction is located behind the E.G.R. vacuum tube to slightly delay E.G.R. valve operation in the off-idle range.

The combination vacuum and mechanically operated power systems, consisting of two power valves, provides accurate control of air/fuel mixtures for emission requirements. One power valve is located in the bottom of the accelerating pump well and the other in the bottom of the fuel bowl.

ALL MODELS

The float needle seat windows have been removed from all models for improved fuel vapor handling during hot engine operation. On California 2GC models, the float valve is rubber tipped and uses a pull clip for smooth operation of the valve in the seat. A fuel inlet filter check valve is used to shut off fuel flow to the carburetor float bowl to prevent fuel leaks if a vehicle roll-over should occur.

Fuel for the pump system is obtained through a hole located in a raised cast-in boss on the floor of the float bowl which prevents the entry of dirt into the accelerator pump - power valve fuel inlet passage. The pump plunger head is designed with an expander spring beneath the pump cup to maintain good pump wall contact during pump operation.

On 2GE models, except 17057180-17057182, the pump plunger head includes a small by-pass orifice. During heavy acceleration when the duration spring is compressed, the tension of the spring is not sufficient to seat the plunger stem inside the plunger head. When this happens, fuel in the pump well, beneath the plunger head, is forced through the by-pass orifice into the plunger head and around the unseated plunger stem where it passes on up into the float bowl to slightly reduce pump fuel delivery to the venturi area on heavy acceleration.

CAUTION: *The by-pass type accelerator pump assembly must not be interchanged with other models, unless specified; to do so may cause serious performanace complaints.*

The end of the pump plunger stem is upset in manufacturing to provide the "clipless" retaining feature. The pump plunger assembly may be removed from the inner lever by twisting upset end with small pliers until it breaks. The service pump assembly has a grooved end and is provided with a retaining clip.

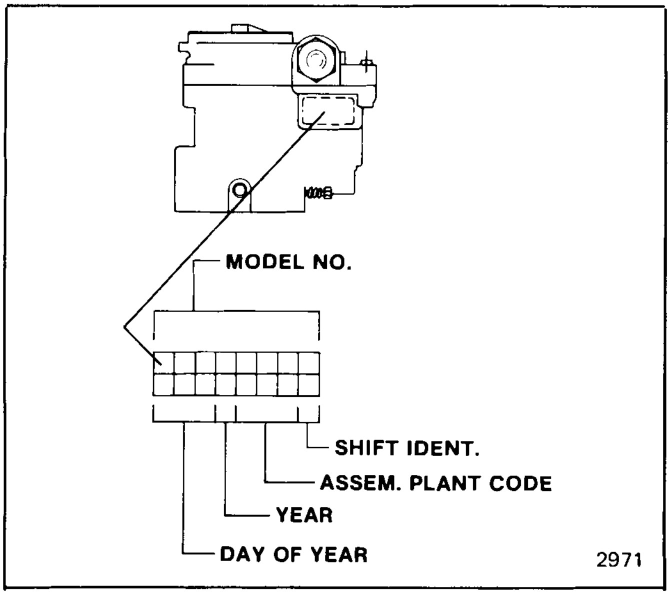


Fig. 6C-38 Carburetor Identification

Alphabetical code letters have been added to all castings next to the vacuum and air tubes for improved identification of all hose connections. The code letters are alphabetical and should be referred to during carburetor installation on the engine.

The carburetor part number is stamped on the flat section of the float bowl next to the fuel inlet nut (Fig. 6C-38). When servicing the carburetor unit, refer to the Adjustment section for proper procedures and specifications.

Incorporated in the Model 2GC and 2GE carburetor are six basic systems. They are Float, Idle, Main Metering, Power, Pump and Choke (Figs. 6C-39 through 6C-50).

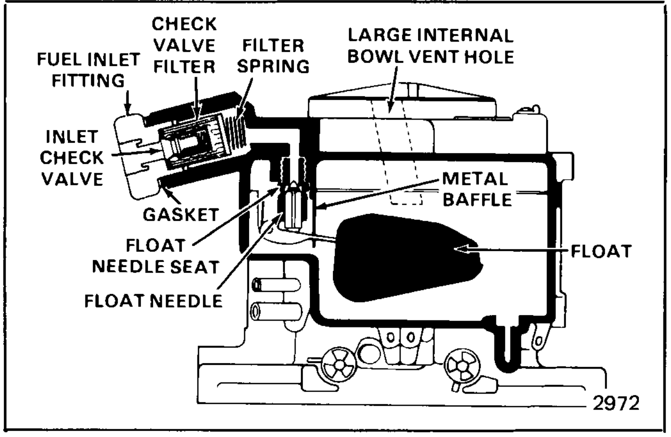


Fig. 6C-39 Float System (Typical)

ELECTRIC CHOKE (FIG. 6C-51)

A ceramic resistor in the electric choke assembly is heated by electric current and the resistor warms the thermostatic coil for precise timing of choke valve opening for good engine warm-up performance.

The electric choke operates as follows:

The electric choke receives electric current operating through the engine oil pressure switch whenever the engine is running. The electric current flows to a ceramic resistor that is divided into separate sections - a small center section for gradual heating of the thermostatic coil, and a large outer section for additional rapid heating of the thermostatic coil.

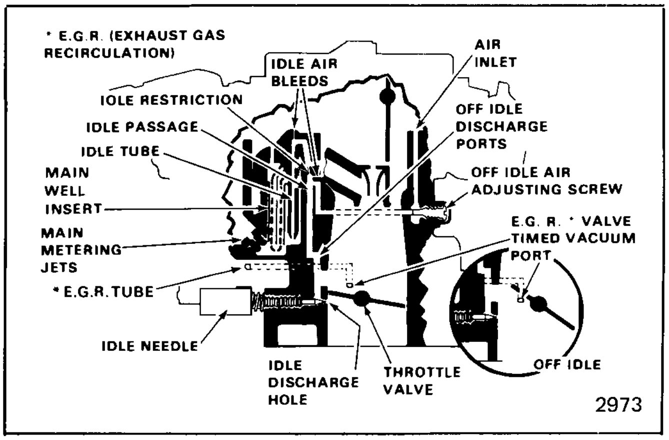


Fig. 6C-40 Idle System 2GE

The ceramic resistor functions as follows:

AIR TEMPERATURE BELOW 50°F. (10°C.)

Electric current, applied to the small section of the ceramic resistor causes the section to heat up and warm the thermostatic coil which allows gradual opening of the choke valve for good cold engine warm-up performance. As the small section of the ceramic resistor continues to produce heat, a temperature-sensitive bi-metal disk causes a spring loaded contact to close also applying electric current to the large section of the ceramic resistor causing the large section to heat up. Heat from the larger section of the ceramic resistor increases the rate of heat flow to the thermostatic coil for more rapid opening of the choke valve.

AIR TEMPERATURE 70°F. (21°C.) AND ABOVE

Electric current is applied directly to both the small section, and through the spring contact, to the large section of the ceramic resistor to provide a rapid heating of the thermostatic coil for greater choke valve opening when leaner air/fuel mixtures are desired at warmer ambient temperatures.

NOTE: Ground contact for the electric choke is provided by a metal plate located at the rear of the choke assembly. DO NOT INSTALL A CHOKE COVER GASKET BETWEEN THE ELECTRIC CHOKE ASSEMBLY AND THE CHOKE HOUSING.

The electric choke assembly is indexed properly by aligning the scribe mark on the front cover with the specified index mark on the choke housing. (See Fig. 6C-51).

The electric choke and thermostatic coil are serviced as a complete assembly.

DIAGNOSIS

Refer to engine performance diagnosis, Section 6, and/or cleaning and inspection under unit overhaul in this section.

ON-CAR SERVICE

Carburetor Choke and Hoses

Check choke mechanism and vacuum break for proper operation at the recommended maintenance intervals. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper

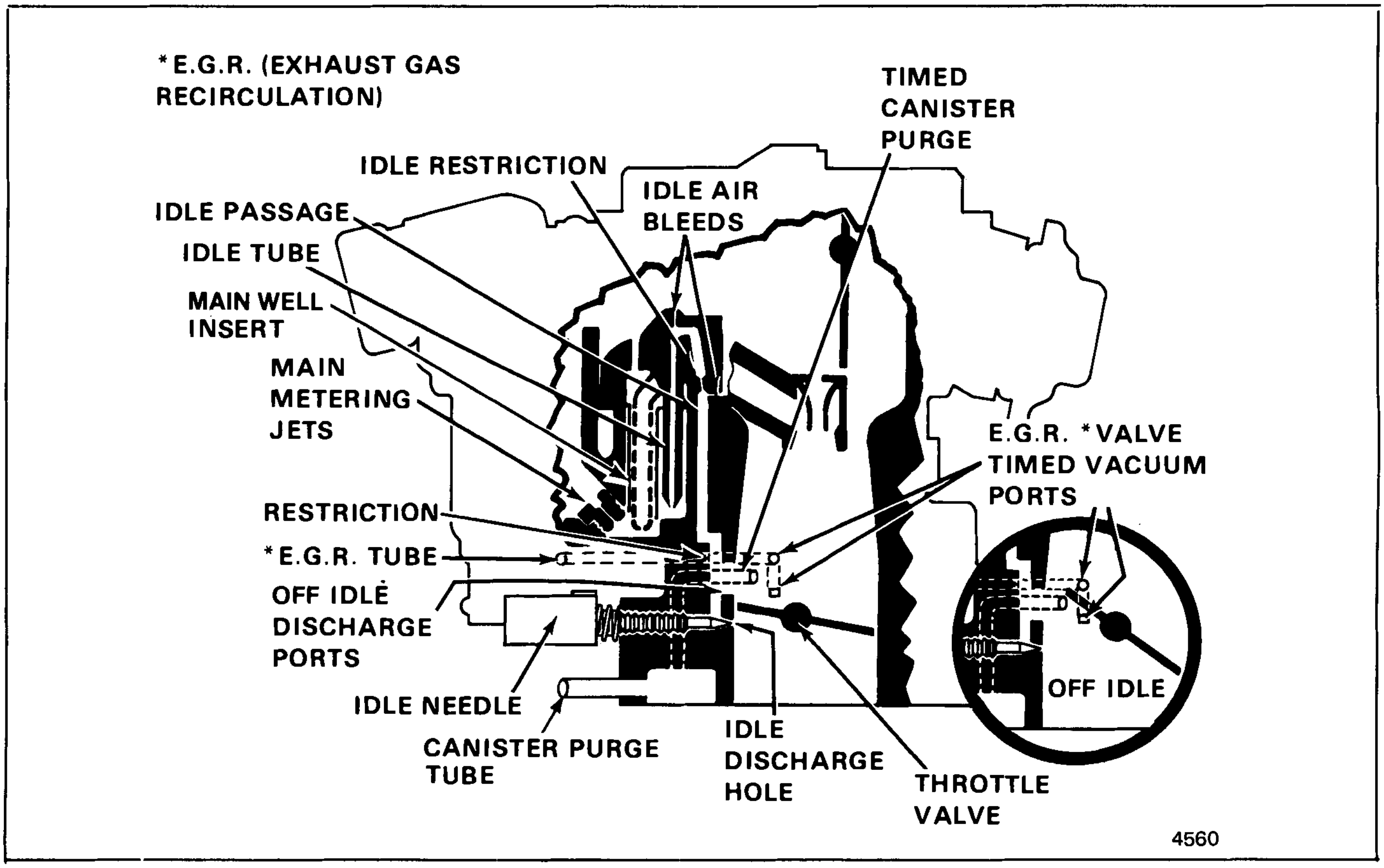


Fig. 6C-41 Idle System 2GC Except California

connection, cracking, abrasion or deterioration and correct or replace as necessary.

Choke Check Procedure

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.

2. If choke or linkage binds, sticks or works sluggishly, clean with United Delco Choke Cleaner X-20-A or equivalent. Use cleaner as directed on can. If cleaning does not correct, replace binding parts.

3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasion, hardness or signs of deterioration. Replace or correct as necessary.

4. Make sure vacuum break diaphragm shafts are fully extended when engine is off. If shafts are not fully extended, replace vacuum break assembly. Start engine, primary vacuum break diaphragm shaft should fully retract. If unit fails to retract, replace vacuum break assembly.

Electric Choke

If the electric choke fails to open, the following checks should be made:

1. Check voltage at the choke heater connection with the engine running. If voltage is between 12 and 15 volts, replace the electrical choke unit.

2. If the voltage is low or zero, check all wires and connections. If the connection at the oil pressure switch is faulty, the temperature pressure warning light will be off with the key "on" and the engine not running. Repair wires as required.

3. If steps 1 & 2 check OK, replace oil pressure switch.

ADJUSTMENTS

Idle Speed Adjustment

Refer to Vehicle Emission Control Information label on vehicle for latest certified specification information.

1. With engine at normal operating temperature, choke full open, and air conditioning OFF, connect a tachometer to engine.

2. Set parking brake and block drive wheels.

3. Disconnect and plug hoses from vapor canister and EGR valve.

4. Start engine and position transmission in PARK or NEUTRAL.

5. Disconnect vacuum advance hose and set ignition timing at specified rpm.

6. Reconnect advance line and adjust idle speed.

8. Unplug and reconnect hose from vapor canister and EGR valve.

8. Shut off engine and remove tachometer.

Carburetor Adjustments

Refer to Figs. 6C-52 thru 55 for carburetor adjustment procedures and specifications.

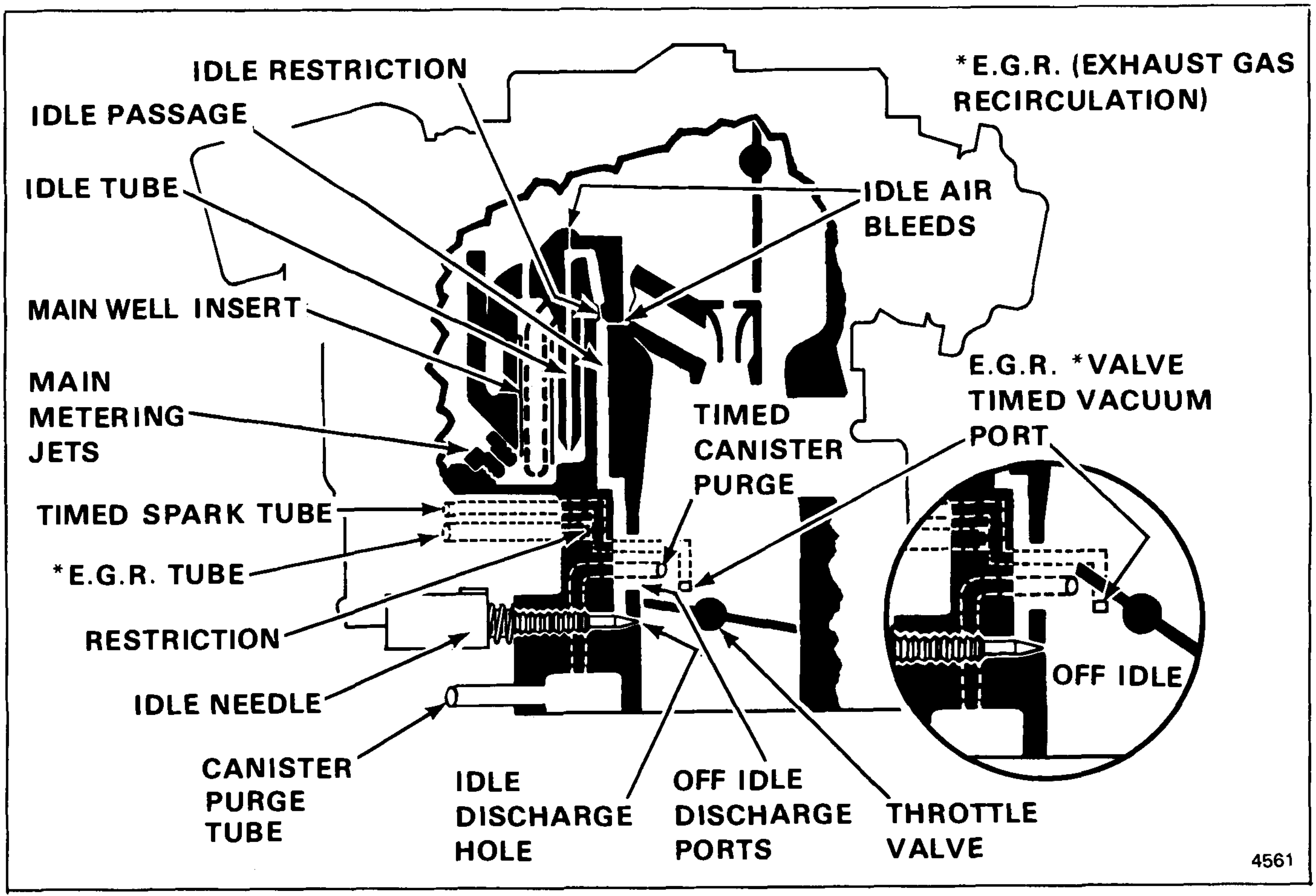


Fig. 6C-42 Idle System 2GC California

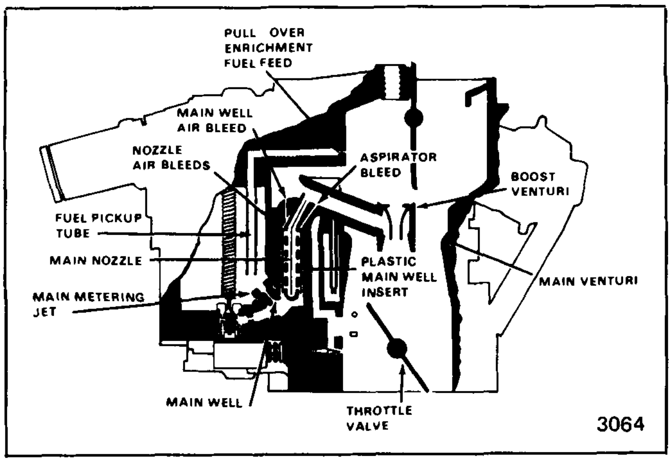


Fig. 6C-43 Idle System 2GE

Idle Mixture

See idle mixture adjustments at the end of this section.

Carburetor Replacement

Removal

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, the carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

1. Remove air cleaner and gasket.
2. Disconnect fuel and vacuum lines from carburetor.
3. Disconnect accelerator linkage and electrical connectors.
4. Remove carburetor attaching bolts and remove carburetor and gasket.

Installation

Fill carburetor bowl before installing carburetor. This reduces strain on starting motor and battery and reduces the possibility of backfiring while attempting to start engine. A small supply of no-lead fuel will enable carburetor to be filled and the operation of float and inlet needle and seat to be checked. Operate throttle lever several times and check discharge from pump jets before installing carburetor.

1. Be certain throttle body and intake manifold sealing surfaces are clean.
2. Install carburetor to manifold gasket.
3. Place carburetor in position and loosely install four attaching bolts.
4. Install vacuum lines and loosely connect fuel line.
5. Tighten four attaching bolts to 145 in. lbs.
6. Tighten fuel inlet nut to 300 inch pounds.
7. Connect accelerator linkage and downshift controls if so equipped.

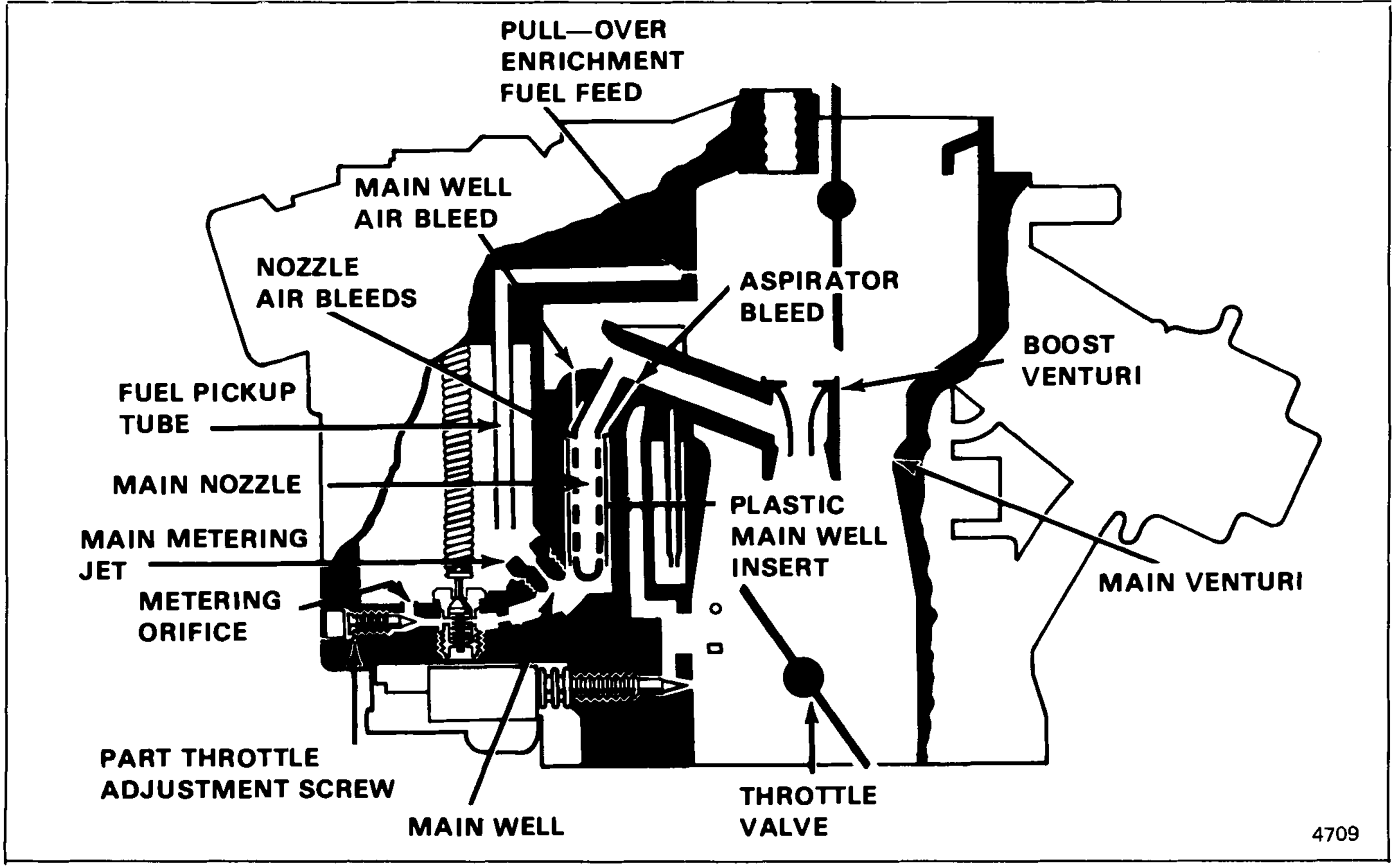


Fig. 6C-44 Main Metering System 2GC

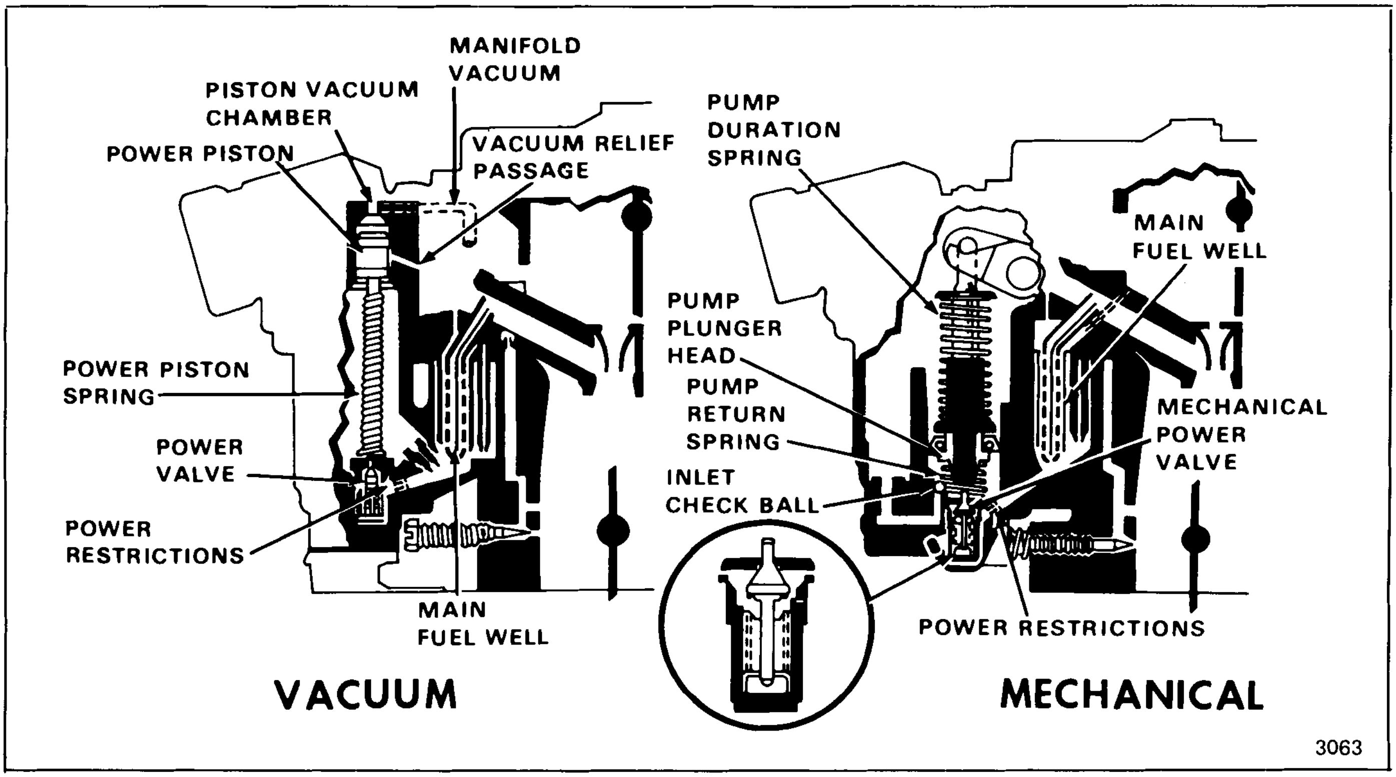


Fig. 6C-45 Power System 2GE

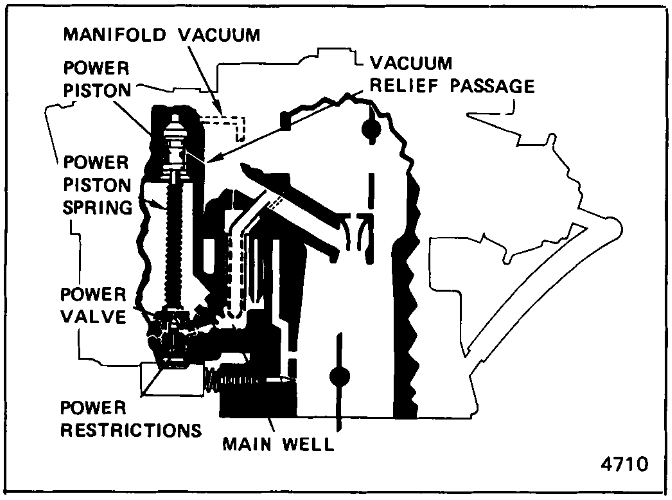


Fig. 6C-46 Power System 2GC

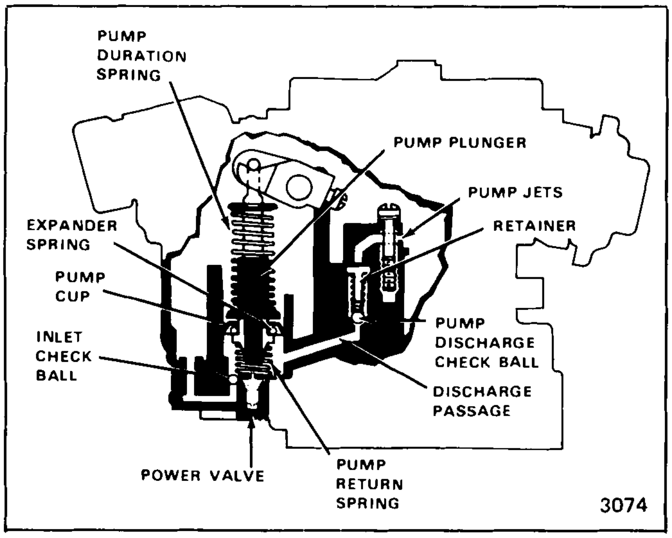


Fig. 6C-47 Pump System 2GE

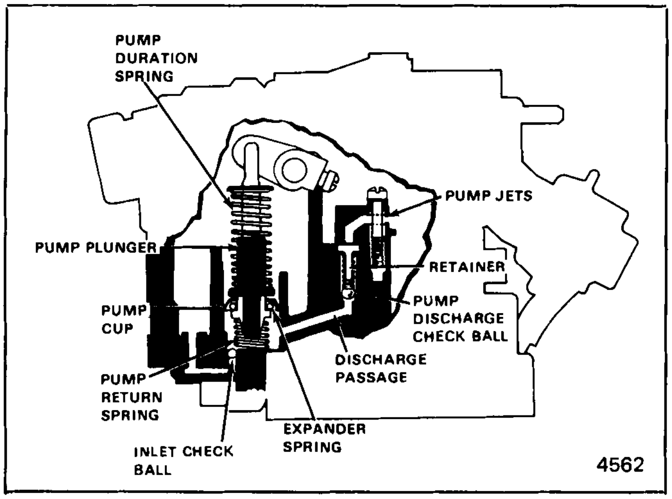


Fig. 6C-48 Pump System 2GC

8. Adjust idle speeds.
9. Install air cleaner.

Fuel Filter Replacement

A plugged fuel filter will restrict fuel flow into carburetor and will result in a loss of engine power.

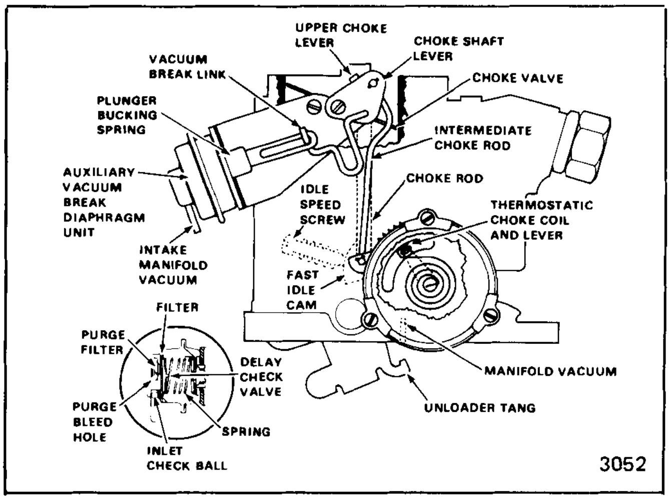


Fig. 6C-49 Choke System 2GE

1. Disconnect fuel line connection at inlet fuel filter nut.
2. Remove inlet fuel filter nut from carburetor.
3. Remove filter and spring.
4. Install spring and filter element in carburetor with hole in filter toward nut.
5. Install new gasket on inlet fitting nut and install nut in carburetor and tighten securely.
6. Install fuel line and tighten connector.

Idle Stop Solenoid Assembly (If Used)

CAUTION: *The electrically operated idle stop solenoid should be removed from the float bowl for complete carburetor disassembly and should not be immersed in any type of carburetor cleaner.*

To remove the idle stop solenoid assembly, bend back the retaining tabs on lockwasher; then remove large nut which retains the stop solenoid to the carburetor bracket. It is not necessary to remove the bracket from the float bowl assembly unless replacement of the bracket is necessary. Adjust idle speeds after solenoid replacement.

UNIT OVERHAUL

GENERAL

The procedures below apply to the complete overhaul with the carburetor removed from the engine.

However, in many cases service adjustments of individual systems may be completed without removing the carburetor from the engine. (Refer to "On-Car Service").

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection and replacement of all gaskets, diaphragms, seals and worn or damaged parts.

DISASSEMBLY

Air Horn

1. Mount carburetor on holding fixture.
2. Remove bowl vent valve cover and gasket by removing two attaching screws.

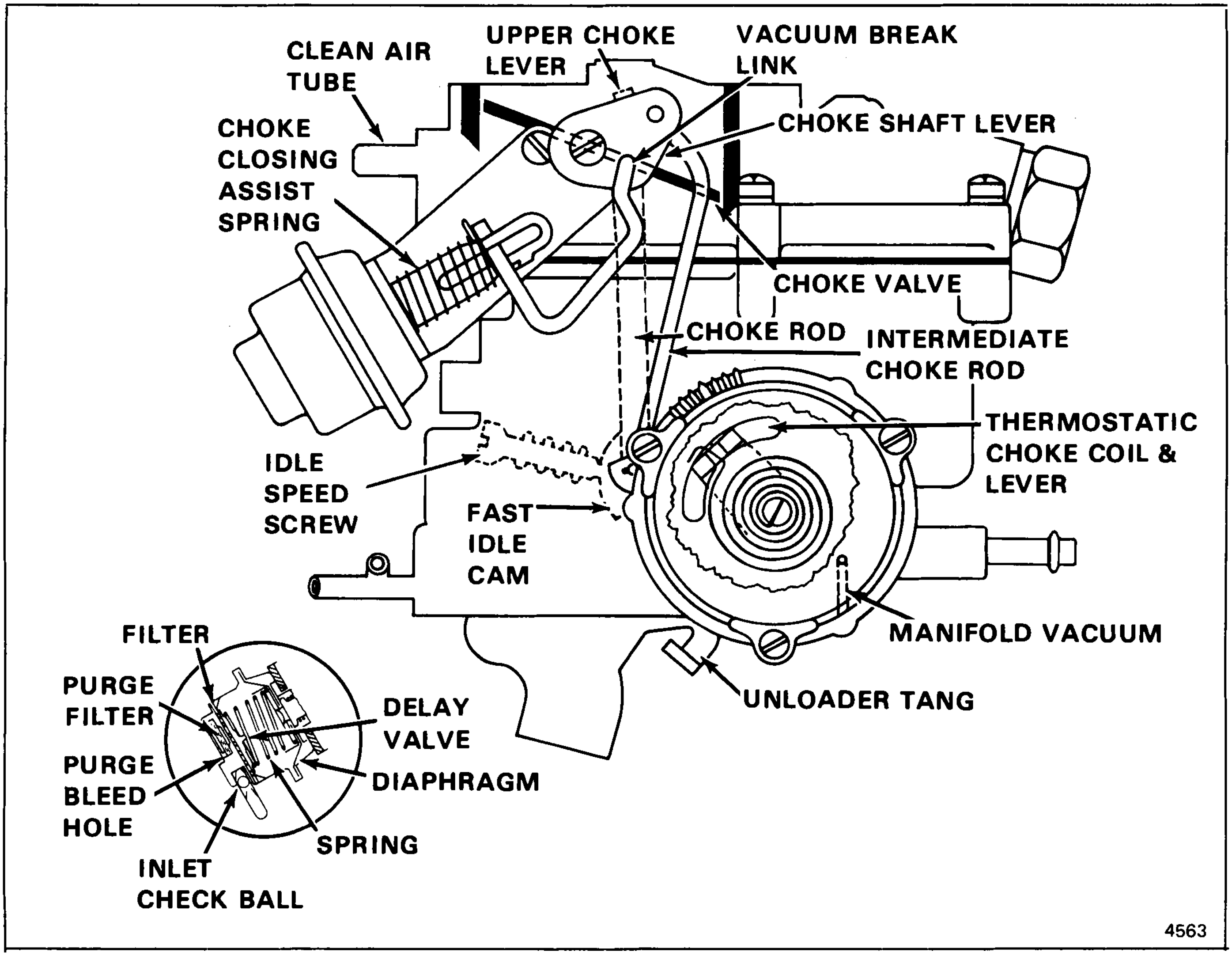


Fig. 6C-50 Choke System 2GC

3. Remove fuel inlet nut, filter and spring.

4. Disconnect lower end of pump rod from throttle lever by removing spring clip.

5. Remove upper end of pump rod from pump lever by rotating rod out of hole in lever.

6. 2GE models (throttle lever side) - Remove the primary vacuum break diaphragm hose from tube on throttle body and tube on vacuum break diaphragm unit. Then remove the vacuum break diaphragm assembly from air horn by removing two attaching screws. Remove primary diaphragm and link assembly from lever on end of choke shaft.

7. 2GE-2GC models (choke housing side) - Remove vacuum break diaphragm hose from the choke vacuum break unit. Then remove the vacuum break diaphragm assembly from air horn by removing two attaching screws. Remove diaphragm and link assembly from upper choke lever on end of choke shaft.

8. Remove vacuum break lever from end of choke shaft by removing retaining screw in end of shaft. Then, remove the intermediate choke rod from the vacuum break lever and from the lever on the thermostatic coil housing.

9. Remove fast idle cam attaching screw from side of float bowl (Fig. 6C-58). Remove fast idle cam from end of choke rod by rotating rod out of hole in fast idle cam. Remove choke rod from upper choke lever by rotating rod out of hole in lever.

NOTE: On 2GC models, the upper end of the choke rod cannot be removed from the choke shaft lever until after the air horn has been removed from the float bowl.

10 Remove eight air horn attaching screws and lockwashers, then lift air horn from float bowl.

11. On 2GC models, rotate choke rod to remove upper end of rod from the choke shaft lever.

12. Place air horn on flat surface. Remove float hinge pin and lift float from air horn. Float needle may now be removed from needle seat or from float assembly (if pull clip is used).

13. Remove float needle seat and gasket with a wide blade screwdriver or tool J-22769.

14. Remove power piston by depressing stem and allowing it to snap free (Fig. 6C-58). Use care not to bend the power piston stem.

15. Remove the pump plunger assembly and inner pump lever from pump shaft by loosening set screw on inner lever. To remove the pump plunger stem from the inner pump lever it will be necessary to break off the swedged or flattened end of the pump plunger stem. This should not be done unless pump assembly replacement is necessary, such as during

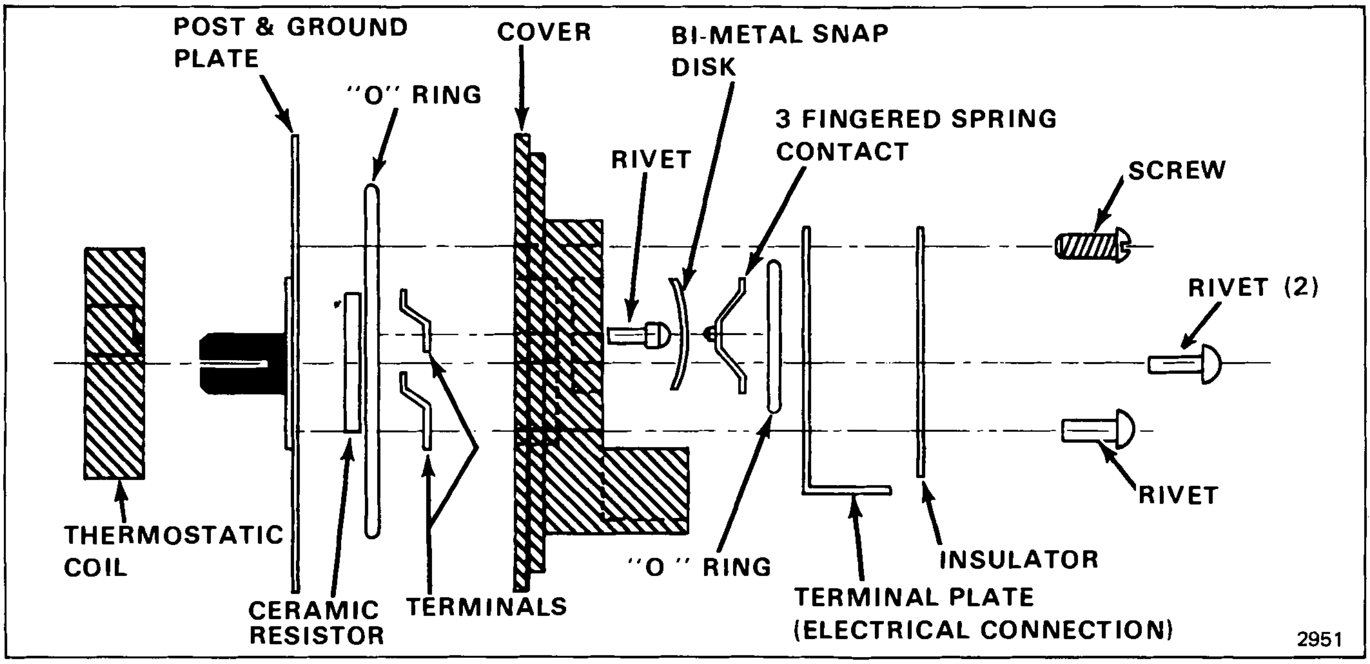


Fig. 6C-51 Electric Choke Assembly 2GE

overhaul.

The service pump assembly uses a grooved pump plunger stem and retaining clip. After removing the inner pump lever and pump assembly, remove the outer pump lever and shaft assembly from air horn. Remove the plastic washer on pump plunger shaft.

16. Remove air horn gasket from air horn.

17. Remove fuel inlet baffle next to needle seat.

18. Remove two choke valve attaching screws, then remove choke valve. Care should be taken when removing attaching screws so that the choke shaft will not be bent. It may be necessary to file off staked ends on choke valve screws before removing.

19. Remove choke valve shaft from air horn.

20. Remove fast idle cam rod and lever from the choke shaft.

Float Bowl (Fig. 6C-60)

CAUTION: *The electrically operated idle stop solenoid should be removed from the float bowl for complete carburetor disassembly and should not be immersed in any type of carburetor cleaner.*

1. Remove pump plunger return spring from inside of pump well. Then remove aluminum check ball from bottom of pump well by inverting bowl.

2. Remove mechanical power valve and gasket from bottom of pump well.

3. Remove main metering jets, vacuum power valve and gasket from inside of float bowl.

4. Remove three screws holding venturi cluster to float bowl and remove cluster and gasket. Then remove the plastic main well inserts in the main well cavity.

5. Using a pair of long nosed pliers, remove pump discharge spring retainer (Fig. 6C-61). Then, spring and check ball may also be removed from discharge passage.

6. Invert carburetor and remove three large throttle body to bowl attaching screws and lockwashers (Fig. 6C-62). Throttle body and gasket may now be removed.

Throttle Body

1. Remove the three choke cover attaching screws and retainers, then remove thermostatic coil and cover assembly from choke housing.

CAUTION: *On hot air choke models, do not remove cup baffle from beneath thermostatic coil cover because coil distortion may result.*

2. Remove the two choke housing attaching screws from inside choke housing, then remove choke housing and gasket from throttle body casting.

3. Remove screw from end of intermediate choke shaft and remove intermediate choke lever from shaft. Remove inner choke coil lever and shaft assembly from choke housing. Remove rubber dust seal from inside choke housing.

4. Using a pair of side cutter pliers, clip off the limit tang on the limiter cap, and unscrew the idle mixture screw and spring from throttle body. If new idle mixture needles are installed, no plastic limiter caps are required. No further disassembly of the throttle body is necessary.

CAUTION: *NO ATTEMPT SHOULD BE MADE TO REMOVE THE THROTTLE VALVES OR SHAFT AS IT MAY BE IMPOSSIBLE TO REASSEMBLE THE THROTTLE VALVES CORRECTLY IN RELATION TO THE IDLE DISCHARGE ORIFICES.*

CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

CAUTION: *The electric choke, solenoid, rubber parts, plastic parts, diaphragms, pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort.*

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.

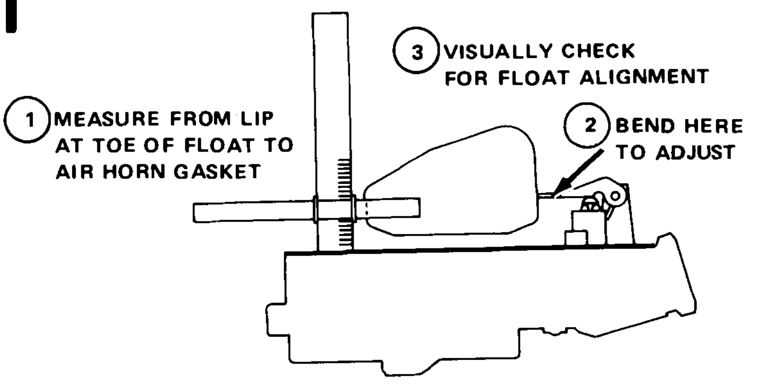
2. Check, repair or replace the following parts if the following problems were encountered.

A. **Flooding**

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arm and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

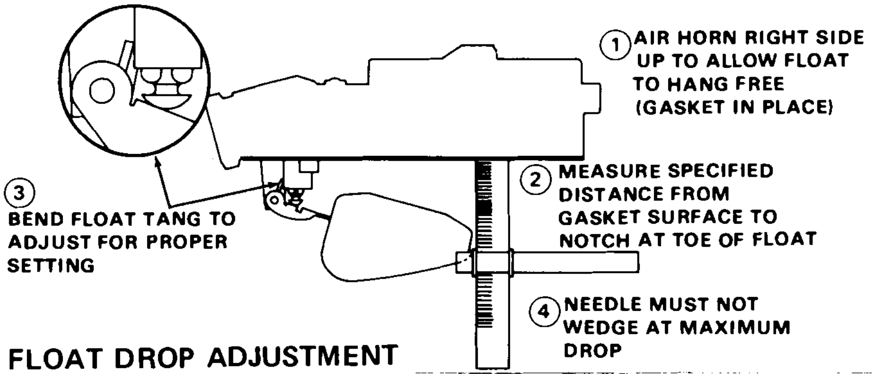
1



FLOAT LEVEL ADJUSTMENT

CARB. NO.	GAUGE
17057143	7/16"
144	7/16"
145	7/16"
146	7/16"
148	7/16"
446	7/16"
447	7/16"
448	7/16"
108	5/8"
110	5/8"

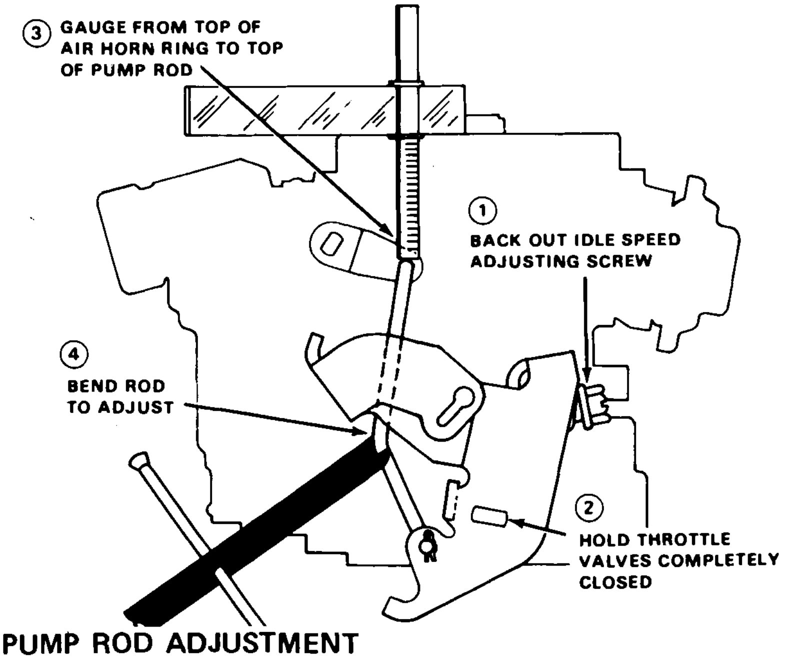
2



FLOAT DROP ADJUSTMENT

CARB. NO.	GAUGE
17057143	1-5/32"
144	1-5/32"
145	1-5/32"
146	1-5/32"
148	1-5/32"
446	1-5/32"
447	1-5/32"
448	1-5/32"
108	1-1/4"
110	1-1/4"

3



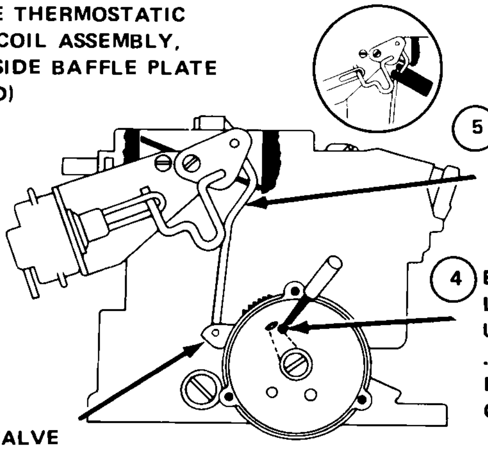
PUMP ROD ADJUSTMENT

CARB. NO.	GAUGE
17057143	1-19/32"
144	1-19/32"
145	1-19/32"
146	1-9/16"
148	1-9/16"
446	1-19/32"
447	1-19/32"
448	1-19/32"
108	1-5/8"
110	1-5/8"

4566

Fig. 6C-52 2GC-2GE Adjustment Procedures

4



① REMOVE THERMOSTATIC COVER COIL ASSEMBLY, AND INSIDE BAFFLE PLATE (IF USED)

② PLACE IDLE SPEED SCREW ON HIGHEST STEP OF FAST IDLE CAM

③ CLOSE CHOKE VALVE BY PUSHING UP ON LEVER

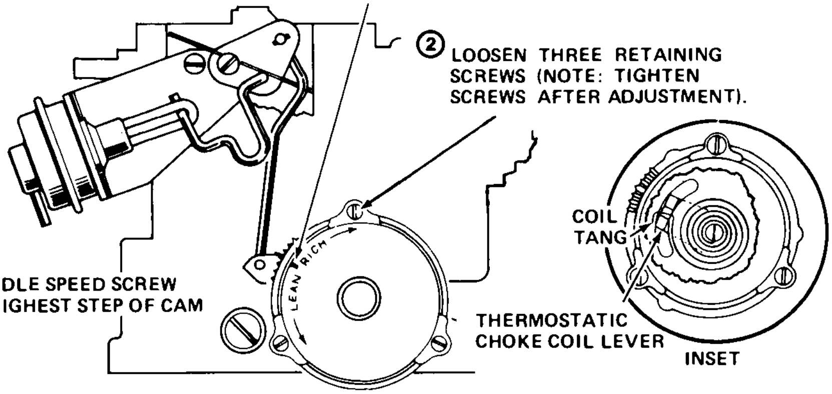
④ EDGE OF COIL LEVER MUST LINE UP WITH EDGE OF .120" PLUG GAUGE IN HOLE INSIDE CHOKE HOUSING

⑤ BEND ROD HERE TO ADJUST (SEE INSET)

CHOKE COIL LEVER ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17057143	.120"	
144	.120"	
145	.120"	
146	.120"	
148	.120"	
446	.120"	
448	.120"	
108	.120"	
110	.120"	

5



① SET IDLE SPEED SCREW ON HIGHEST STEP OF CAM

② LOOSEN THREE RETAINING SCREWS (NOTE: TIGHTEN SCREWS AFTER ADJUSTMENT).

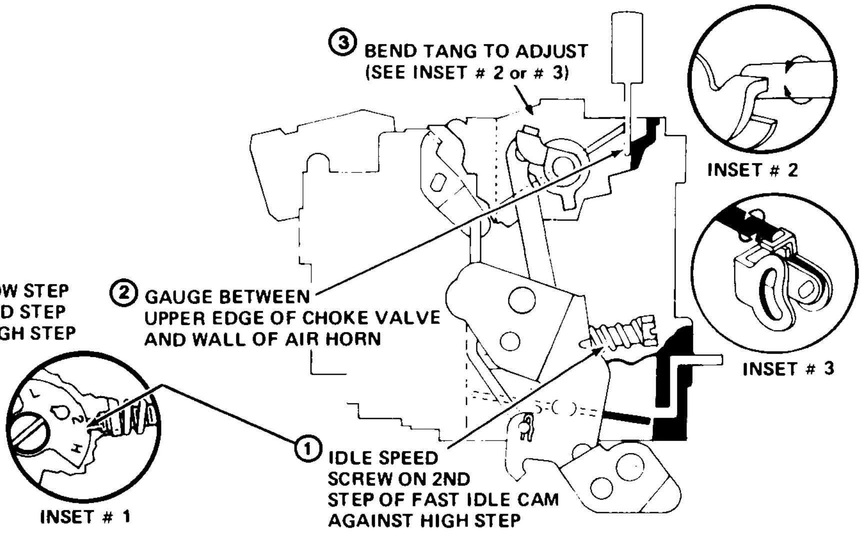
③ WITH CHOKE VALVE WIDE OPEN (ENGINE COLD) ROTATE COVER AGAINST COIL TENSION UNTIL CHOKE VALVE CLOSES. SET MARK ON COVER TO SPECIFIED POINT ON CHOKE HOUSING. NOTE: ON MODELS WITH SLOTTED COIL PICK-UP LEVER, MAKE SURE COIL TANG IS INSTALLED IN SLOT IN LEVER (SEE INSET).

THERMOSTATIC CHOKE COIL LEVER

AUTOMATIC CHOKE COIL ADJUSTMENT

CARB. NO.	INDEX MARK	
17057143	1NR	
144	1NR	
145	1NR	
146	1NR	
148	1NR	
446	1NR	
448	1NR	
108	INDEX	
110	INDEX	

6



L - LOW STEP
2 - 2ND STEP
H - HIGH STEP

① IDLE SPEED SCREW ON 2ND STEP OF FAST IDLE CAM AGAINST HIGH STEP

② GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE AND WALL OF AIR HORN

③ BEND TANG TO ADJUST (SEE INSET # 2 or # 3)

CHOKE ROD (FAST IDLE CAM) ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057143	.080"	
144	.080"	
145	.080"	
146	.080"	
148	.080"	
446	.080"	
448	.080"	
108	.260"	
110	.260"	

Fig. 6C-53 2GC-2GE Adjustment Procedures

4565

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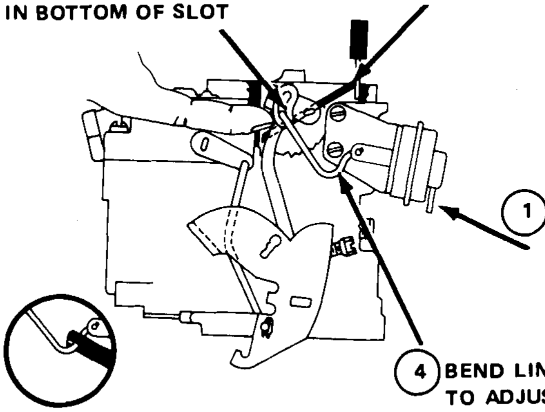


② HOLD CHOKE VALVE CLOSED WITH ROD IN BOTTOM OF SLOT

③ PLACE GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE AND AIR HORN WALL

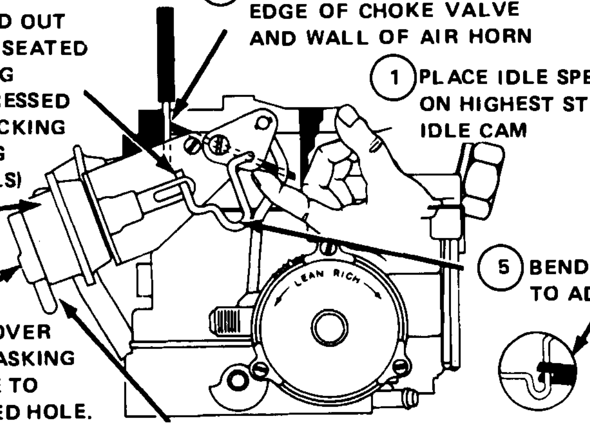
① SEAT DIAPHRAGM PLUNGER USING OUTSIDE VACUUM SOURCE

④ BEND LINK TO ADJUST (SEE INSET)

VACUUM BREAK ADJUSTMENT (THROTTLE LEVER SIDE)

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057143	.130"	
144	.130"	
145	.110"	
146	.110"	
148	.110"	
446	.130"	
448	.130"	
108	* .130"	
110	* .130"	
*AT 22,500 TUNE UP	.160"	

8



③ STEM PULLED OUT UNTIL SEATED (SPRING COMPRESSED ON BUCKING SPRING MODELS)

④ GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE AND WALL OF AIR HORN

① PLACE IDLE SPEED SCREW ON HIGHEST STEP OF FAST IDLE CAM

VACUUM DIAPHRAGM SEATED

⑤ BEND ROD TO ADJUST

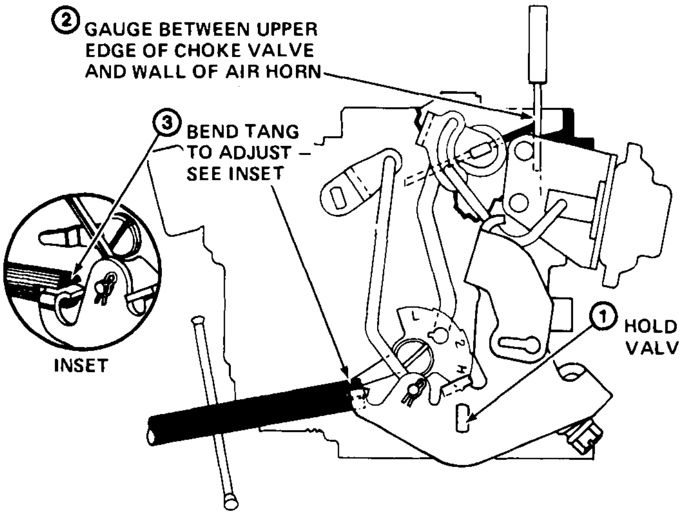
NOTE: PLUG END COVER WITH A PIECE OF MASKING TAPE MAKING SURE TO COVER PURGE BLEED HOLE. REMOVE TAPE AFTER ADJUSTMENT.

② USE OUTSIDE VACUUM SOURCE

VACUUM BREAK ADJUSTMENT (CHOKE SIDE)

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057143	.100"	
144	.100"	
145	.040"	
146	.040"	
148	.030"	
446	.110"	
448	.110"	
108	--	
110	--	

9



② GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE AND WALL OF AIR HORN

③ BEND TANG TO ADJUST – SEE INSET

INSET

① HOLD THROTTLE VALVE WIDE OPEN

CHOKE UNLOADER ADJUSTMENT

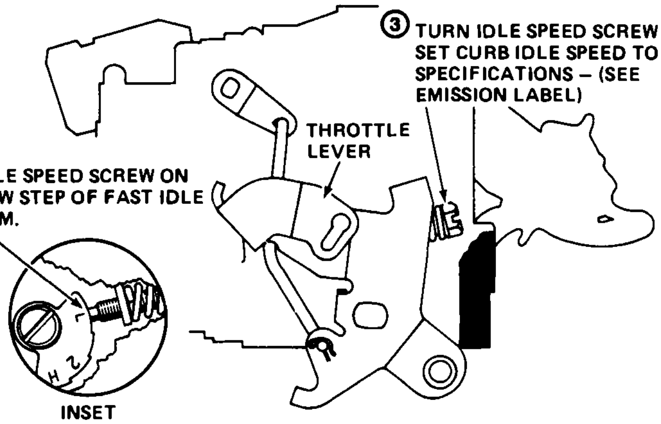
CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057143	.140"	
144	.140"	
146	.140"	
148	.140"	
446	.140"	
448	.140"	
108	.325"	
110	.325"	

4564

Fig. 6C-54 2GC-2GE Adjustment Procedures

10

① PREPARE VEHICLE FOR ADJUSTMENTS – SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL.



② IDLE SPEED SCREW ON LOW STEP OF FAST IDLE CAM.

③ TURN IDLE SPEED SCREW TO SET CURB IDLE SPEED TO SPECIFICATIONS – (SEE EMISSION LABEL)

IDLE SPEED ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057143		
144		
145		
146		
148		
446		
448		
108		
110		

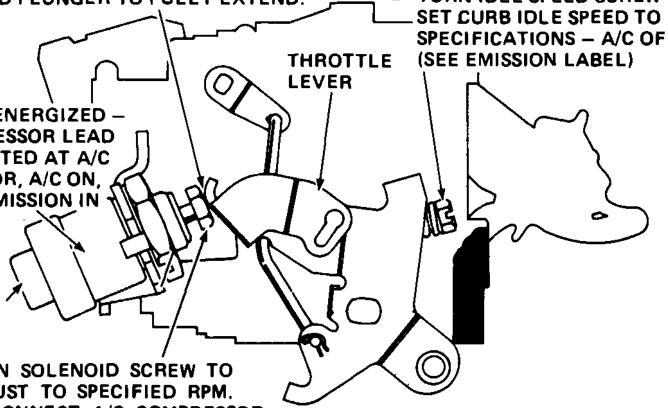
11

① PREPARE VEHICLE FOR ADJUSTMENTS – SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL.

② TURN IDLE SPEED SCREW TO SET CURB IDLE SPEED TO SPECIFICATIONS – A/C OFF (SEE EMISSION LABEL)

③ SOLENOID ENERGIZED – A/C COMPRESSOR LEAD DISCONNECTED AT A/C COMPRESSOR, A/C ON, A/T TRANSMISSION IN DRIVE.

④ OPEN THROTTLE SLIGHTLY TO ALLOW SOLENOID PLUNGER TO FULLY EXTEND.



⑤ TURN SOLENOID SCREW TO ADJUST TO SPECIFIED RPM. (RECONNECT A/C COMPRESSOR LEAD AFTER ADJUSTMENT)

A/C IDLE SPEED ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
WHERE APPLICABLE		

4567

Fig. 6C-55 2GC-2GE Adjustment Procedures

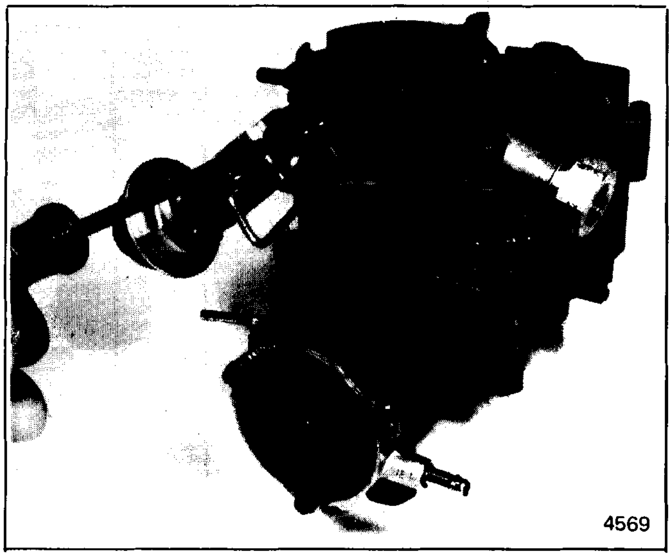


Fig. 6C-56 Removing Choke Lever (Typical)

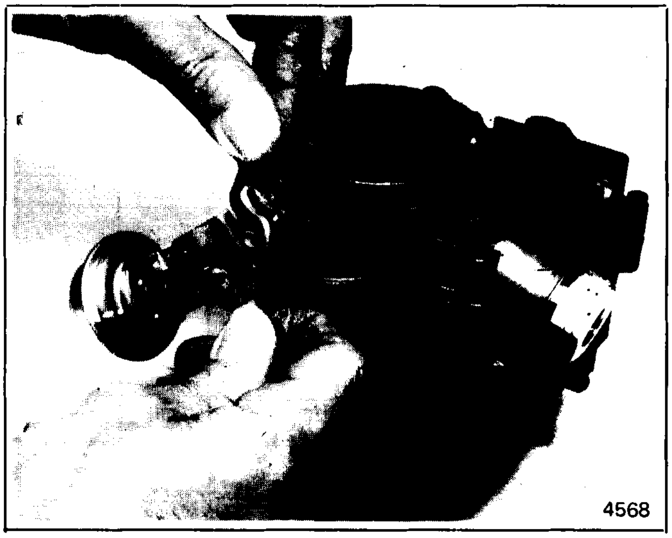


Fig. 6C-57 Removing Intermediate Choke Rod (Typical)

B. Hesitation

1. Inspect pump plunger for cracks, scores or excessive cup wear. A used pump cup will shrink when dry. Soak in fuel for 8 hrs. before testing if dried out.

2. Inspect pump duration and return spring for being weak or distorted.

3. Check for dirt in pump passages and jets, improper seating of inlet or discharge balls, and scores in pump well.

4. Check pump linkage for excessive wear, repair or replace as necessary.

5. Check power valve in pump well for leakage and proper installation.

C. Hard Starting - Poor Cold Operation

1. Check choke valve and linkage for excessive wear, binds or distortion.

2. Inspect choke vacuum diaphragms for leaks.

3. Clean or replace carburetor filter.

4. Inspect inlet needle for sticking, dirt, etc.

5. Examine fast idle cam for wear or damage.

6. Also check items under "flooding".

Fig. 6C-58 Removing Fast Idle Cam

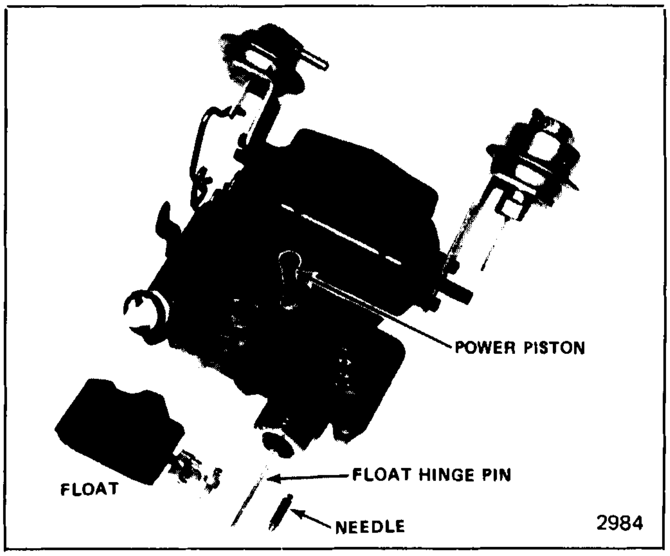


Fig. 6C-59 Power Piston

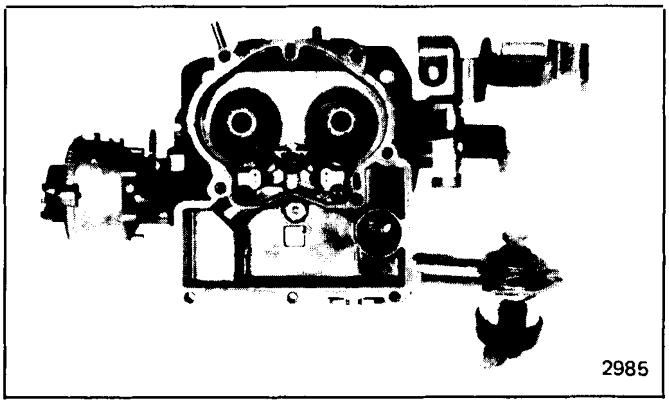


Fig. 6C-60 Float Bowl

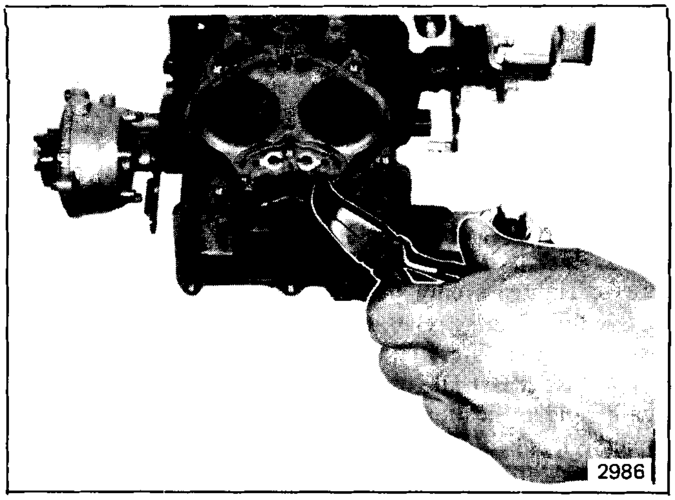


Fig. 6C-61 Pump Discharge "T" Retainer

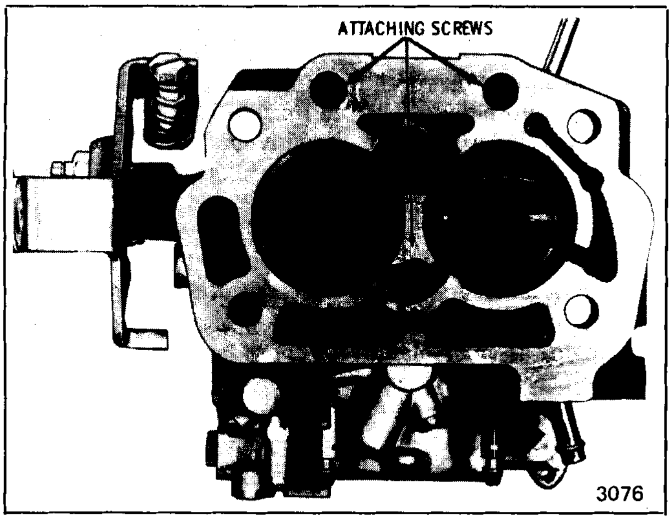


Fig. 6C-62 Throttle Body Attaching Screws

D. Poor Performance - Poor Gas Mileage

1. Check power piston and power valve for dirt, sticking, binding, damaged parts or excessive wear.

2. Clean all fuel and vacuum passages in castings.

E. Rough Idle

1. Inspect idle needle for ridges, burrs or being bent.

2. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks and other damage.

3. Clean all idle fuel passages.

4. Check throttle lever and valves for binds, nicks and other damage.

CARBURETOR ASSEMBLY

Throttle Body

1. Install idle stop screw and spring assembly in throttle lever if removed.

2. Install the idle mixture screws and springs into the throttle body until finger tight and seated. Back out screws three turns as a preliminary idle adjustment.

3. Install new rubber dust seal into cavity inside choke housing. Lip on seal faces toward carburetor after the housing is installed.

4. Install inner choke coil lever and shaft assembly into choke housing.

5. With the choke coil lever and shaft assembly installed into housing, install the intermediate choke lever on flats of intermediate choke shaft and retain with screw. Tighten securely.

6. Install new choke housing to carburetor gasket.

7. Position choke housing on throttle body and retain with two attaching screws. Tighten securely.

8. Before installing the choke cover coil assembly, the intermediate choke rod should be adjusted so that with the choke valve closed, the lever inside the choke housing lines up with gage as shown in adjustment chart (intermediate choke rod adjustment).

9. Install choke thermostatic coil and cover assembly with new gasket (where used), and end of coil below plastic tang on the inner choke housing lever. Refer to adjustment chart (choke coil setting). Install three choke thermostatic coil retainers and screws. Tighten securely.

NOTE: Ground contact for the electric choke is provided by a metal plate located at the rear of the choke assembly. DO NOT INSTALL A CHOKE COVER GASKET BETWEEN THE ELECTRIC CHOKE ASSEMBLY AND THE CHOKE HOUSING.

10. Place a new gasket on the bottom of the float bowl with holes in gasket aligned with holes in casting, then position the throttle body on gasket and install the three attaching screws. Tighten screws evenly and securely.

Float Bowl

1. Install mechanical power valve and gasket into bottom of pump will (when used). Tighten securely.

NOTE: The mechanical power valve in the pump well can be identified from the vacuum power valve used in the float bowl as follows: The pump well power valve is longer, has four feed holes located in the side of the valve, plus a much stronger valve spring than the vacuum operated power valve.

CAUTION: *THE TWO POWER VALVES SHOULD NOT BE MIXED DURING ASSEMBLY AS SERIOUS PERFORMANCE PROBLEMS COULD RESULT*

2. Drop small aluminum inlet check ball into hole in pump well.

3. Install pump return spring, pressing with finger to center in pump well.

CAUTION: *RETURN SPRING MUST BE INSTALLED WITH LARGER END AT BOTTOM OF PUMP WELL; OTHERWISE, PUMP FAILURE CAN RESULT.*

4. Drop steel pump discharge ball into pump discharge hole located beneath the venturi cluster. Ball is 3/16" diameter (do not confuse with aluminum inlet ball). Install pump discharge ball spring and retainer.

5. Install plastic main well inserts into the main fuel wells located beneath the venturi cluster and make sure they are seated in recesses provided. Then install venturi cluster and

gasket, tighten three screws evenly and securely. Make certain center screw is fitted with a gasket to prevent pump discharge leakage.

6. Install two main metering jets and vacuum operated power valve into bottom of float bowl.

Air Horn

1. Install the upper choke rod lever and collar assembly onto choke shaft. Install the choke shaft assembly into the air horn from the throttle lever side. Then install the choke valve onto the choke shaft with the letters RP or part number facing upward.

Install the choke valve attaching screws. Center the choke valve before tightening choke valve screws. Tighten choke valve screws and stake lightly in place. Check choke valve and shaft for freedom of movement.

2. If removed, install the outer pump shaft and lever assembly into air horn casting. Make sure the plastic washer is in place before installing the outer pump shaft and lever assembly.

3. Install the pump plunger to the inner lever and retain with clip provided in the repair kit. End of pump plunger shaft should point inward towards center of carburetor when installed correctly. Install inner pump lever onto the pump shaft and tighten set screw securely.

4. Position the float needle seat gasket on the needle seat and install seat in the air horn using Tool J-22769. Tighten securely.

5. Install the power piston assembly into the air horn casting and lightly stake the retaining washer to casting. Make sure the piston travels up and down freely and is not bent.

6. Install fuel inlet baffle next to needle seat. Make sure baffle is seated in grooves in air horn casting.

7. Install air horn gasket onto air horn casting.

8. Install float needle into needle seat. On 2GC models with pull clip, install pull clip and needle, in slot on float arm. Then install float assembly on air horn and insert hinge pin. Check float action and for free movement of needle in the seat.

9. Check float level and drop adjustments. See adjustment chart.

10. Install choke rod in upper choke lever and collar assembly rotating rod until tang on end of rod aligns with slot in lever.

Completion of Carburetor Assembly

1. Place the air horn assembly on bowl, making certain that the accelerator pump plunger is correctly positioned into pump well and will move freely.

2. Install lockwashers and eight air horn attaching screws. Tighten evenly and securely.

3. Install filter relief spring into air horn casting, then install fuel inlet filter and fuel inlet nut. Tighten to 25 ft. lbs.

4. Install fast idle cam to lower end of choke rod (part number identification faces out toward fast idle cam assembly). Then install the fast idle cam to float bowl retaining with the fast idle cam attaching screw. Tighten securely.

NOTE: Move linkage up and down to make sure that it will fall freely.

5. Install pump rod into upper pump lever by rotating offset end into hole in lever and install lower end of pump rod to throttle lever and retain with spring clip.

6. 2GE models (throttle lever side) - Install primary vacuum break diaphragm link into lever on choke shaft and other end of link to vacuum break diaphragm stem. Then install the vacuum break diaphragm assembly onto air horn with two attaching screws. Tighten securely.

7. 2GE-2GC (choke housing side) - Install vacuum break diaphragm assembly onto air horn securing with two attaching screws. Tighten securely.

8. Install lower end of intermediate choke rod into intermediate choke lever on choke housing and connect upper end of rod to upper choke lever. Install vacuum break diaphragm link into stem of vacuum break diaphragm and upper choke lever.

9. Install the upper choke lever onto end of choke shaft making sure that the lever fits over flats on shaft. Install attaching screw and tighten securely.

10. Connect vacuum break hoses to each diaphragm unit.

11. On 2GE models, install the vent valve cover and gasket. Install two attaching screws and tighten securely.

12. Torque choke pipe nut to 15 lbs.

NOTE: After complete carburetor assembly, check and reset, if necessary, all choke adjustments and pump rod adjustments as outlined in adjustment charts.

MODEL M2MC 200 CARBURETOR

CONTENTS

GENERAL DESCRIPTION

The model M2MC 200 carburetor for 1977 is a 2-barrel single stage carburetor of downdraft design (Fig. 6C-63). It has the proven design features of the primary side of the M4MC carburetor.

The triple venturi, with small 1-3/8" bores, makes the model M2MC 200 especially adaptable to smaller engine sizes. The triple venturi stack up, plus smaller bores, results in good fuel metering control during all periods of operation.

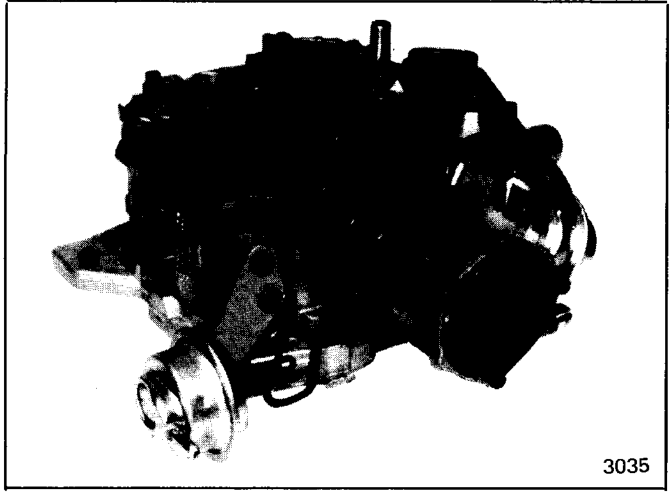


Fig. 6C-63 M2MC 200 Carburetor

The main metering system has separate main wells to feed each main nozzle for good fuel flow through the venturi.

For ease of service, alphabetical code letters are cast in the air horn, float bowl, and throttle body at external tube locations to identify air and vacuum hose connections.

An adjustable part throttle screw is used in the float bowl to aid in refinement of fuel mixtures for good emission control. This screw is preset at the factory and should not be adjusted in service. If it becomes necessary to replace the float bowl, the new service float bowl will include an adjustable part throttle screw which has been preset at the factory. An aneroid cavity insert is used in the float bowl.

CAUTION: *The insert is required to reduce fuel slosh in the float bowl.*

During off-idle and part throttle operation, fuel metering is accomplished by two tapered metering rods, operating in the main metering jets, positioned by a manifold vacuum responsive piston. During greater throttle openings when additional fuel is needed for power, the two rods are positioned mechanically by a lever operated off the center of the throttle shaft. The use of both a mechanical and vacuum enrichment more accurately controls fuel metering during light and heavy power requirements.

This model uses a plastic float with a windowless type needle seat for better fuel handling. A plastic filler block is used above the float chamber to reduce fuel slosh in the float bowl.

A 2 inch paper fuel filter with check valve is used to shut off fuel flow to the carburetor and prevent fuel leaks if a car roll-over should occur.

The carburetor part number is stamped on a vertical section of the float bowl, near the secondary throttle lever (Fig. 6C-64).

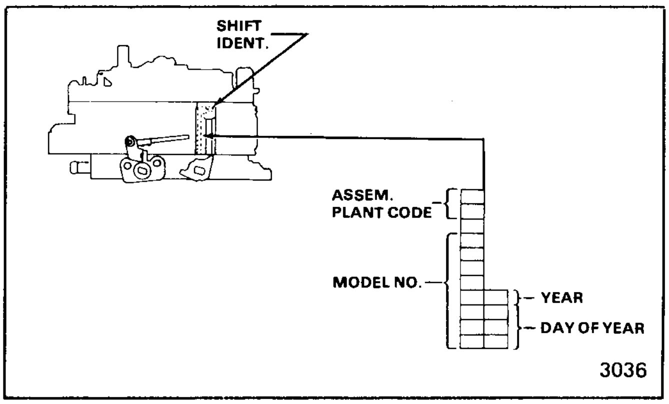


Fig. 6C-64 Identification

Refer to the part number on the bowl when servicing the carburetor.

There are six basic systems used in the M2MC 200 carburetor: Float, Idle, Main Metering, Power, Pump and Choke (Figs. 6C-65 thru 70).

The M2MC 200 uses a bowl mounted hot air choke with a fresh air modulator (Fig. 6C-71) and primary and secondary vacuum breaks. The secondary vacuum break is controlled by a TVS mounted in the air cleaner. The TVS (Fig. 6C-72) is closed when carburetor air inlet temperature is below 62°F. When inlet air temperature is above 62°F., vacuum is applied to the secondary vacuum break and the choke blade is opened to a wider position. Refer to On-Car Service in this section for a functional test of the TVS. Refer to Section 6E, for vacuum hose connections to the secondary vacuum break TVS. The fresh air modulator restricts air flow to the choke coil when the temperature in the air cleaner is below approximately 60°F. for good cold driveability. Above approximately 60°F., the air flow is unrestricted and choke opening is quicker. Refer to On-Car Service in this section for functional test and replacement procedures of the fresh air modulator valve.

DIAGNOSIS

Refer to engine performance diagnosis, Section 6, and/or cleaning and inspection under unit overhaul in this section.

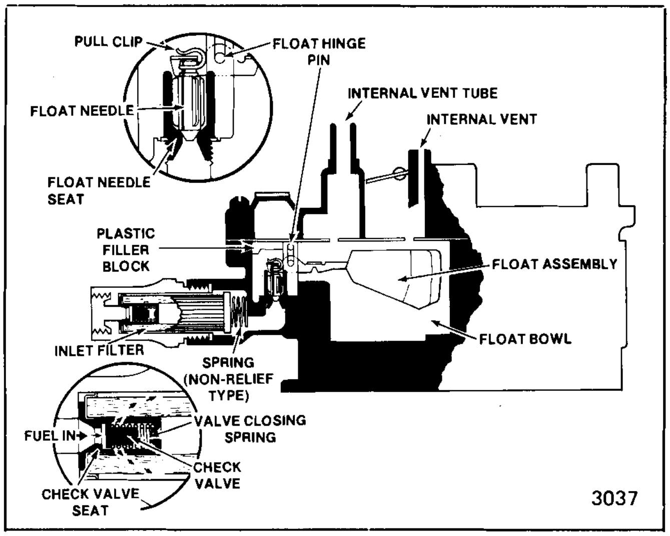


Fig. 6C-65 Float System

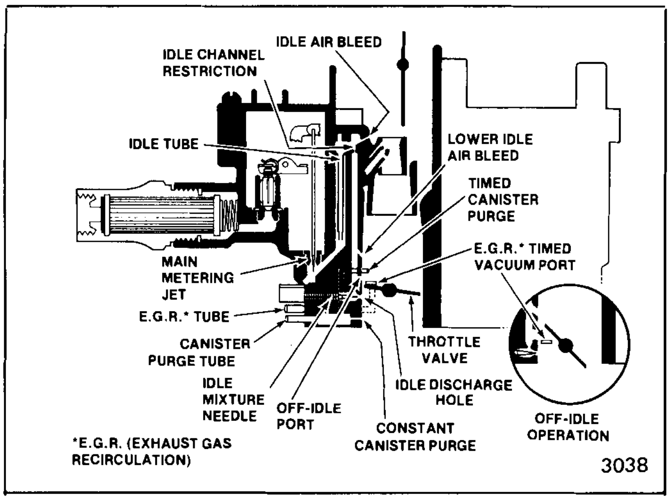


Fig. 6C-66 Idle System

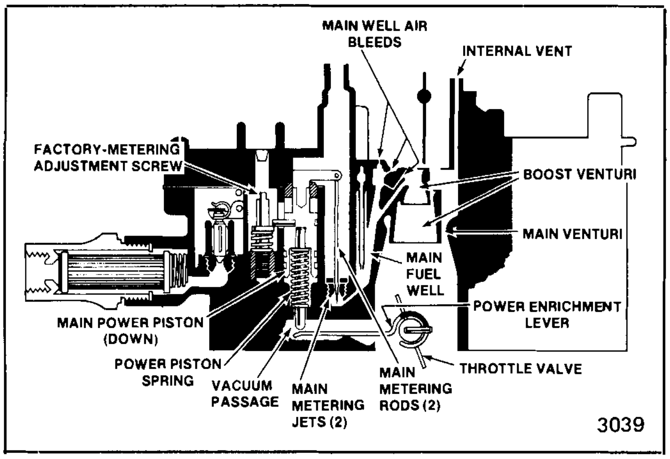


Fig. 6C-67 Main Metering System

ON-CAR SERVICE

Carburetor Choke and Hoses

Check choke mechanism and vacuum break for proper operation at the recommended maintenance intervals. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.

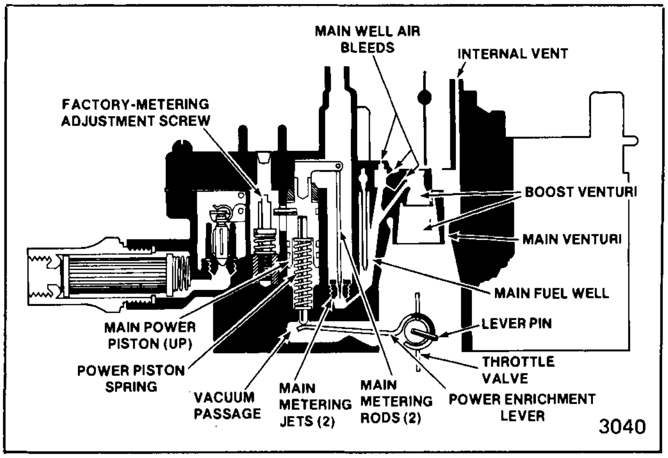


Fig. 6C-68 Power System

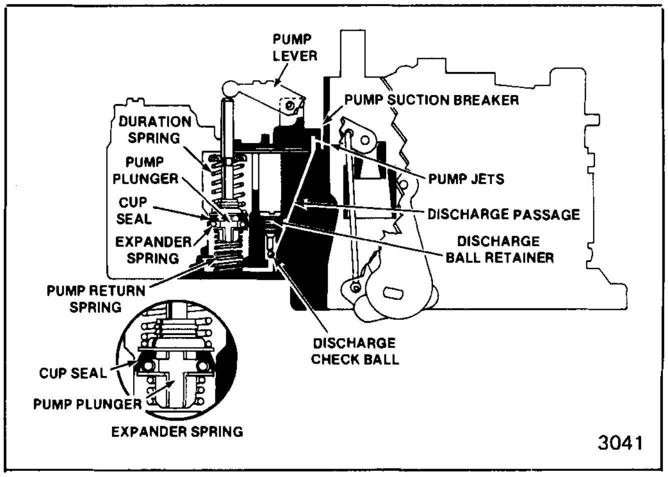


Fig. 6C-69 Pump System

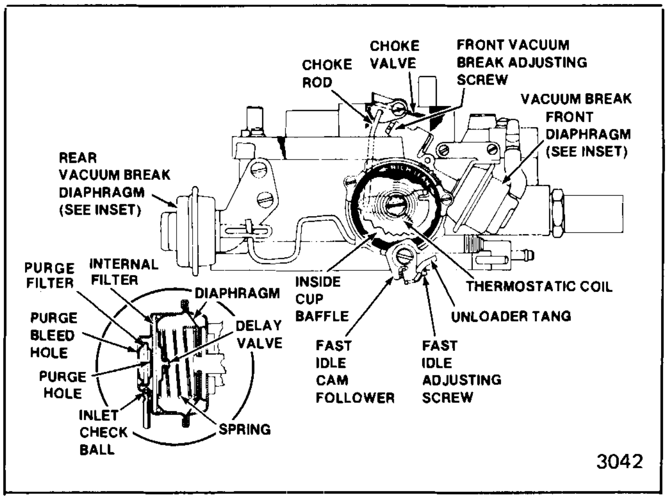


Fig. 6C-70 Choke System

Choke Check Procedure

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of

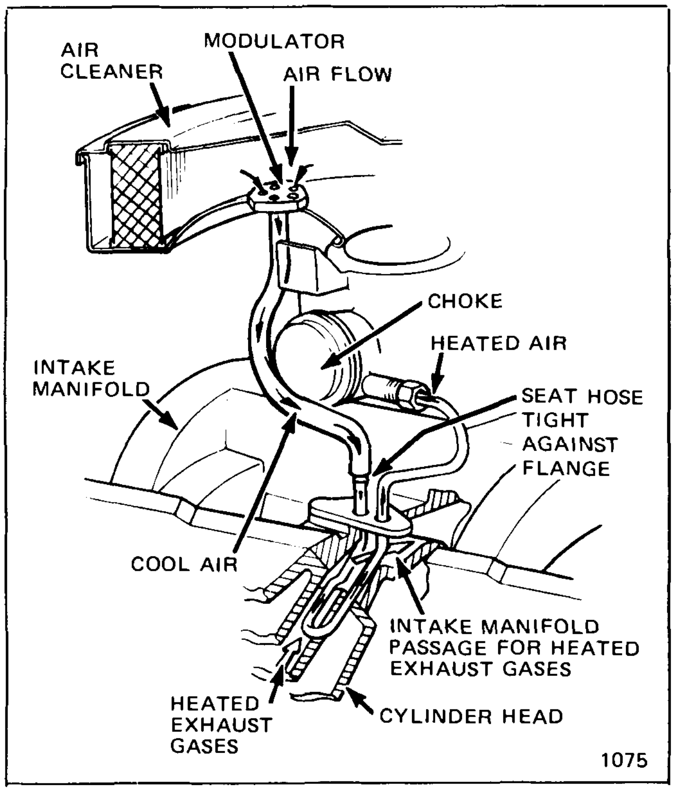


Fig. 6C-71 Choke Fresh Air Modulator

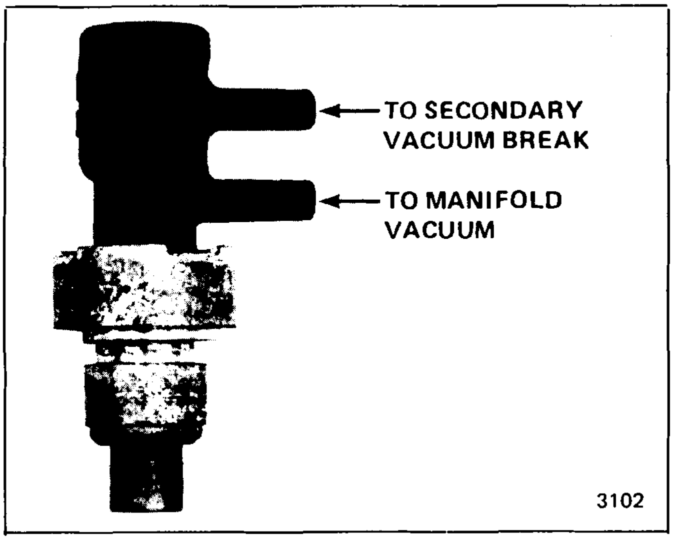


Fig. 6C-72 Secondary Vacuum Break Thermal Vacuum Switch - SVEB-TVS

damage.

2. If choke or linkage binds, sticks or works sluggishly, clean with United Delco Choke Cleaner X-20-A or equivalent. Use cleaner as directed on can. If cleaning does not correct, replace binding parts.

3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasion, hardness or signs of deterioration. Replace or correct as necessary.

4. Make sure vacuum break diaphragm shafts are fully extended when engine is off. If shafts are not fully extended, replace vacuum break assembly. Start engine, primary vacuum break diaphragm shaft should fully retract. If unit fails to retract, replace vacuum break assembly.

5. With engine at normal operating temperature, the SVB-TVS must be open. Check by applying either engine vacuum or auxiliary vacuum to the inlet port on hot TVS and checking for vacuum at the outlet. If there is no vacuum, replace the TVS.

6. Apply a vacuum to the vacuum break diaphragm and observe for movement to the full travel position. Due to the orifice in the unit, it will take up to 20 seconds to reach full travel. If full travel is not obtained, the orifice is plugged and the diaphragm must be replaced.

ADJUSTMENTS

Idle Speed Adjustment

Refer to Vehicle Emission Control Information label on vehicle for latest certified specification information.

1. With engine at normal operating temperature, choke full open, and air conditioning OFF, connect a tachometer to engine.
2. Set parking brake and block drive wheels.
3. Disconnect and plug hoses from vapor canister and EGR valve.
4. Disconnect A/C compressor clutch connector.
5. Start engine and position transmission in PARK or NEUTRAL.
6. Disconnect and plug distributor vacuum advance hose.
7. Set ignition timing at specified rpm
8. Unplug and reconnect distributor vacuum line.
9. Adjust idle speed:
10. With A/C - Adjust idle stop screw to specified rpm Turn A/C "ON" and disconnect electrical connector at A/C compressor. Open throttle momentarily to ensure solenoid plunger is fully extended. Adjust solenoid screw to specified rpm Reconnect A/C compressor electrical connector.
11. Unplug and reconnect hose from vapor canister and EGR valve.
12. Shut off engine and remove tachometer.
13. Connect A/C compressor clutch.

Procedure For Using Carburetor Choke Valve Angle Measuring Gage

1. Choke valve angle measuring gage J-26701 tool may be used with carburetor on or off engine. If off engine, place carburetor on holding fixture so that it will remain in the same position when gage is in place.
2. Rotate degree scale until zero (0) is opposite pointer.
3. With choke valve completely closed, place magnet squarely on top of choke valve. See Figure 6C-73.
4. Rotate bubble until it is centered.
5. Rotate scale so that degree specified for the particular adjustment is opposite pointer. See Figure 6C-74.
6. Adjust the choke linkage to center the bubble. This completes adjustment.

Carburetor Adjustments

Refer to Figs. 6C-75, 76 and 77 for cabruretor adjustment procedures and specifications. The choke value angle gage is the preferred method for making all carburetor external adjustments. The following procedure can be used

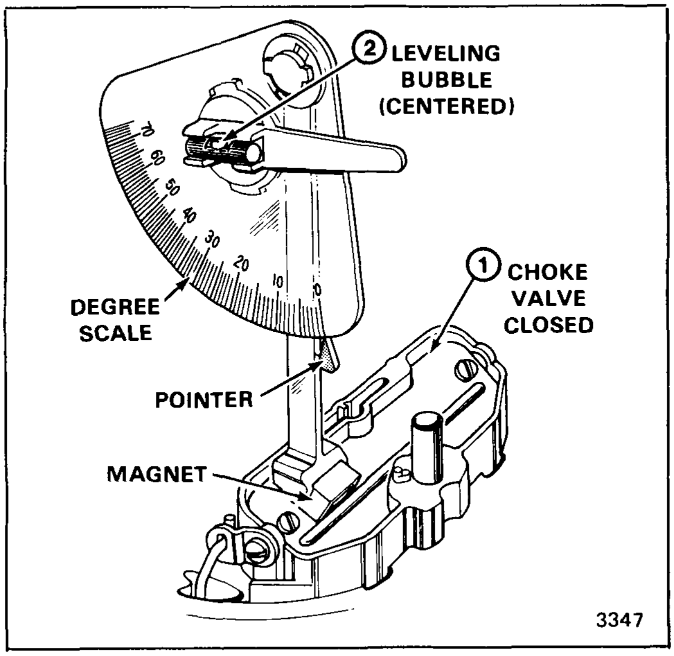


Fig. 6C-73 Choke Valve Angle Gage

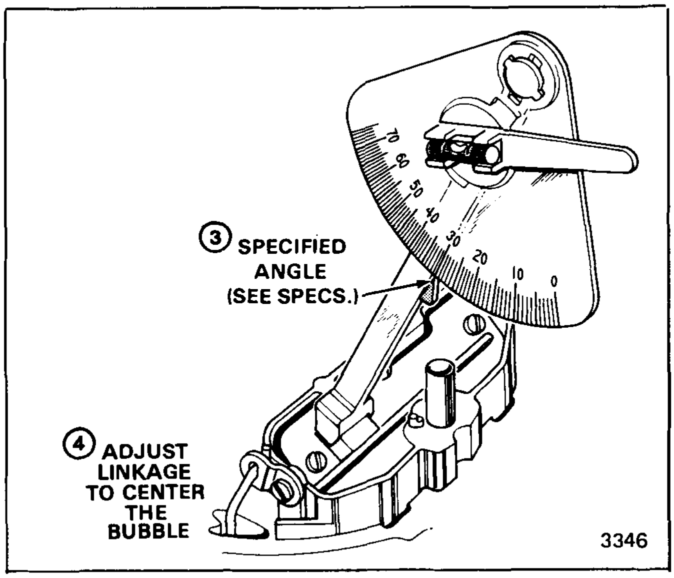


Fig. 6C-74 Choke Valve Angle Gage

on all types of carburetors for all adjustments.

Idle Mixture

See idle mixture procedures at the end of this section.

Choke Fresh Air Modulator

Functional Check

1. Cool engine off until air cleaner assembly is below 50° F.
2. "TEE" vacuum gage between fresh modulator and choke stove.
3. Start engine. Vacuum gage should read more than 5 inches of vacuum. If not, replace modulator or locate vacuum leak.
4. Allow engine to reach normal operating temperature. Vacuum gage should read less than 5 inches of vacuum. If not, replace modulator.
5. Remove vacuum gage and connect fresh air hose.

Removal

1. Remove air cleaner.
2. Detach hose at modulator.
3. Pry up tabs on modulator retaining clip; remove clip and modulator from air cleaner.

Replace

1. Install modulator and gasket assembly in position.
2. Press retainer clip on hose connector.
3. Connect vacuum hose and install air cleaner on engine.

Carburetor Replacement (Fig. 6C-78)

Removal

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, the carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

1. Remove air cleaner and gasket.
2. Disconnect fuel and vacuum lines from carburetor.
3. Disconnect accelerator linkage and electrical connectors.
4. Remove carburetor attaching bolts and remove carburetor and gasket.

Installation

Fill carburetor bowl before installing carburetor. This reduces strain on starting motor and battery and reduces the possibility of backfiring while attempting to start engine. A small supply of no-lead fuel will enable carburetor to be filled and the operation of float and inlet needle and seat to be checked. Operate throttle lever several times and check discharge from pump jets before installing carburetor.

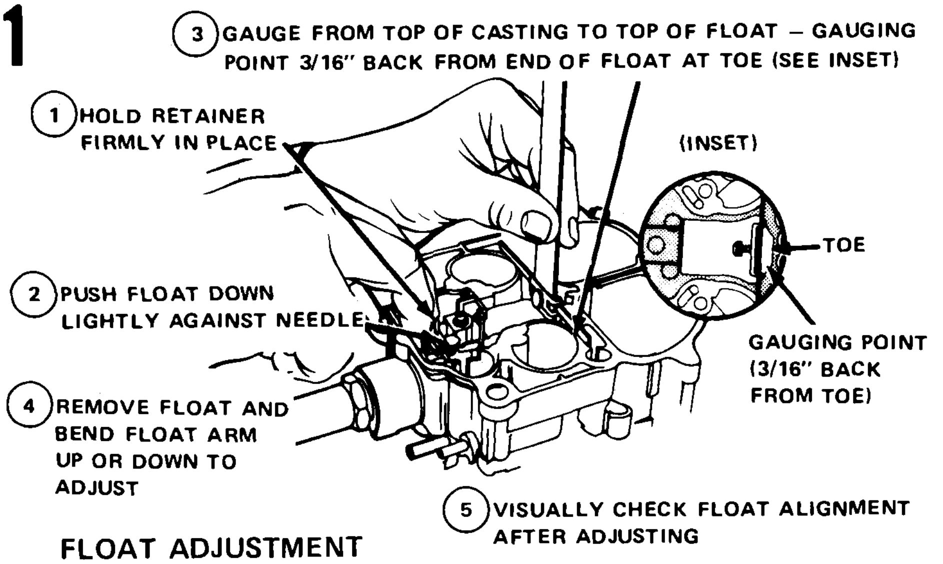
1. Be certain throttle body and intake manifold sealing surfaces are clean.
2. Install carburetor to manifold gasket.
4. Place carburetor in position and loosely install four attaching bolts.
5. Install vacuum lines and loosely connect fuel line.
6. Tighten four attaching bolts to 145 in. lbs.
7. Tighten fuel inlet nut to 300 inch pounds.
8. Connect accelerator linkage and downshift controls if so equipped.
9. Adjust idle speeds.
10. Install air cleaner.

Fuel Filter Replacement

A plugged fuel filter will restrict fuel flow into carburetor and will result in a loss of engine power.

1. Disconnect fuel line connection at inlet fuel filter nut.
2. Remove inlet fuel filter nut from carburetor.

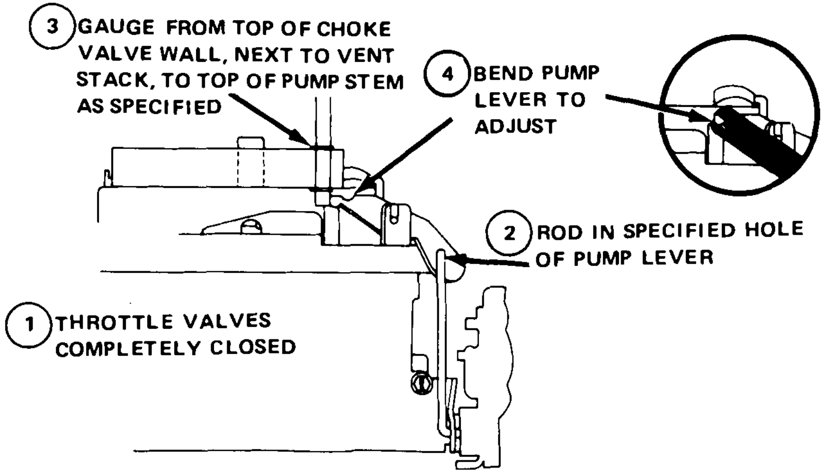
1



FLOAT ADJUSTMENT

CARB. NO.	GAUGE	
17057172	11/32	
17057173	11/32	

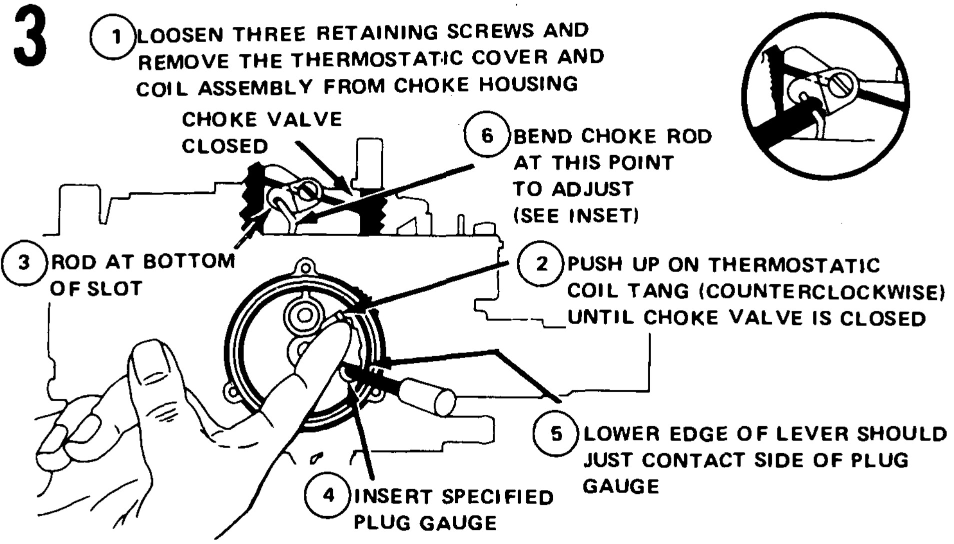
2



PUMP ADJUSTMENT

CARB. NO.	GAUGE	HOLE LOC.
17057172	3/8	OUTER
17057173	3/8	OUTER

3



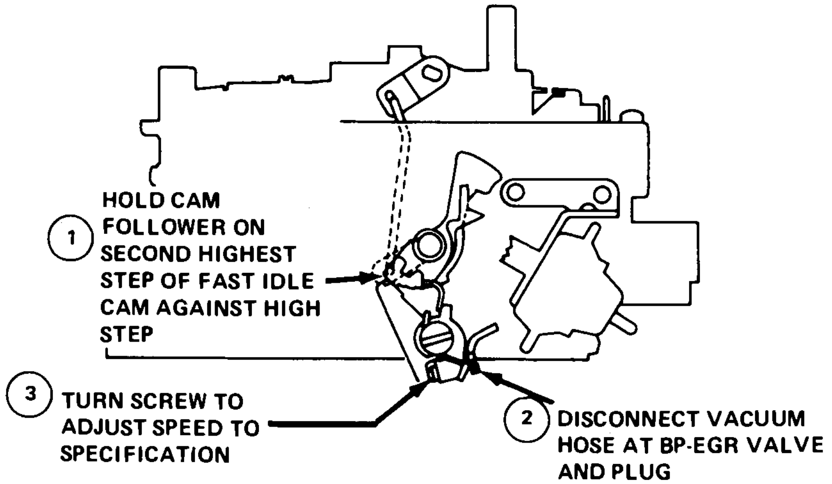
CHOKE COIL LEVER ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17057172	.120"	
17057173	.120"	

Fig. 6C-75 M2MC 200 Adjustment Procedures

3362

4



FAST IDLE ADJUSTMENT

CARB. NO.	RPM	
17057172	1750	
17057173	1750	

5

FIGURE 1

1. USE CHOKE VALVE MEASURING GAUGE J_26701 ____. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
6. SEAT CHOKE VACUUM DIAPHRAGM USING VACUUM SOURCE.
7. WITH CHOKE COIL REMOVED, ROTATE INSIDE COIL LEVER COUNTERCLOCKWISE. MAKE SURE PLUNGER BUCKING SPRING IS COMPRESSED AND SEATED.
8. TO ADJUST, BEND LINK UNTIL BUBBLE IS CENTERED.
9. REMOVE GAUGE.

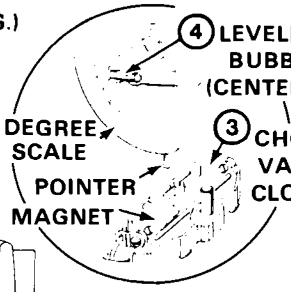


FIGURE 1

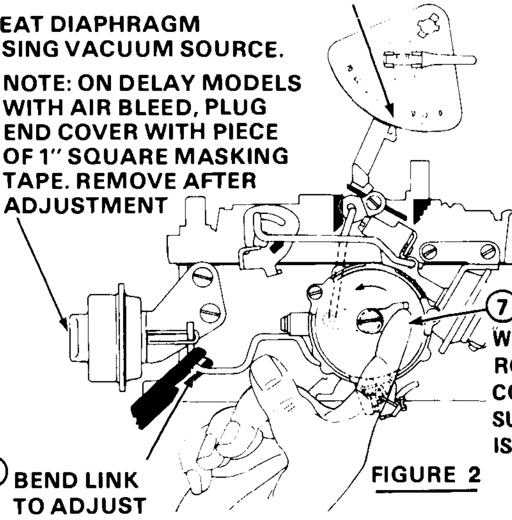


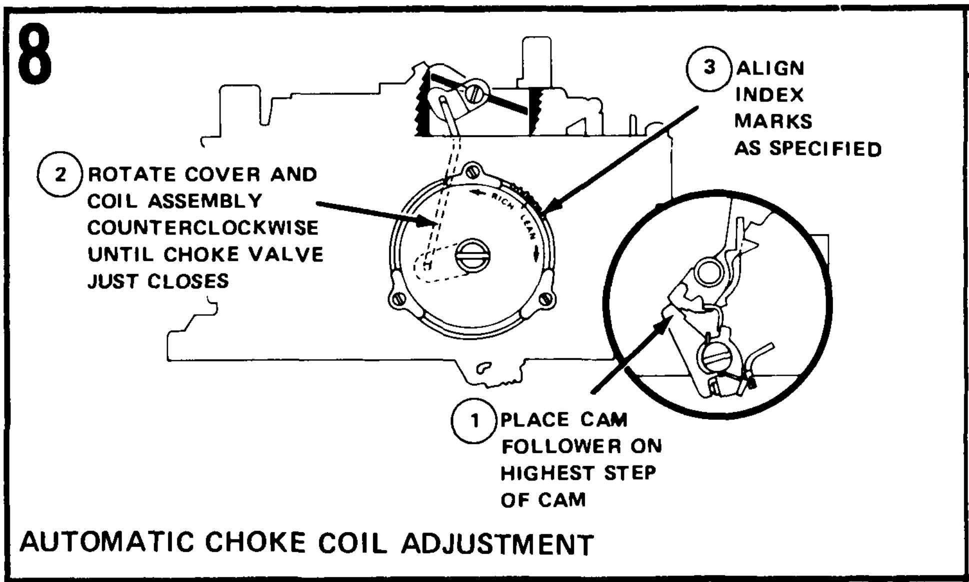
FIGURE 2

M2MC DUALJET 200
REAR VACUUM BREAK ADJUSTMENT–ANGLE GAUGE METHOD

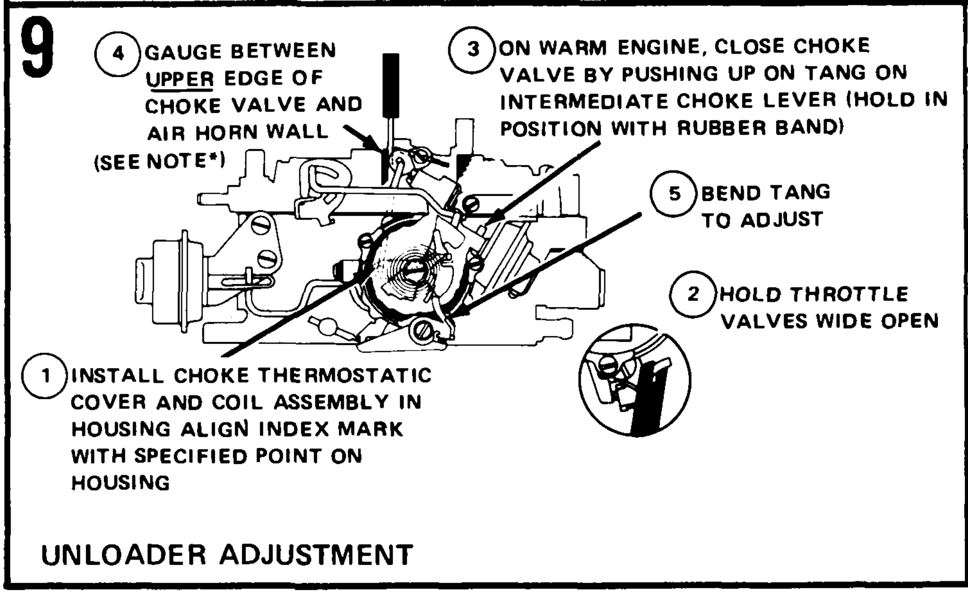
CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057172	.225"	36°
17057173	.225"	36°
AT 22,500 MILE TUNE-UP ADJUST TO:		
17057172	.240"	38°
17057173	.240"	38°

Fig. 6C-76 M2MC 200 Adjustment Procedures

3363



CARB. NO.	INDEX MARK	
17057172	2NR	
17057173	2NR	



CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057172	.240"	38°
17057173	.240"	38°

Fig. 6C-77 M2MC 200 Adjustment Procedures

3. Remove filter and spring.
4. Install spring and filter element in carburetor with hole in filter toward nut.
5. Install new gasket on inlet fitting nut and install nut in carburetor and tighten securely.
6. Install fuel line and tighten connector.

Solenoid Replacement

The solenoid should be checked to assure that the solenoid plunger extends when the solenoid is energized. An inoperative solenoid should be replaced.

Removal

1. Remove carburetor air cleaner.
2. Disconnect electrical connector at solenoid.
3. Remove 2 bracket screws and remove solenoid and bracket assembly.

Installation

1. Install solenoid and bracket assembly.
2. Connect electrical connector.
3. Install air cleaner.
4. Refer to vehicle emission control information label and adjust idle speed.

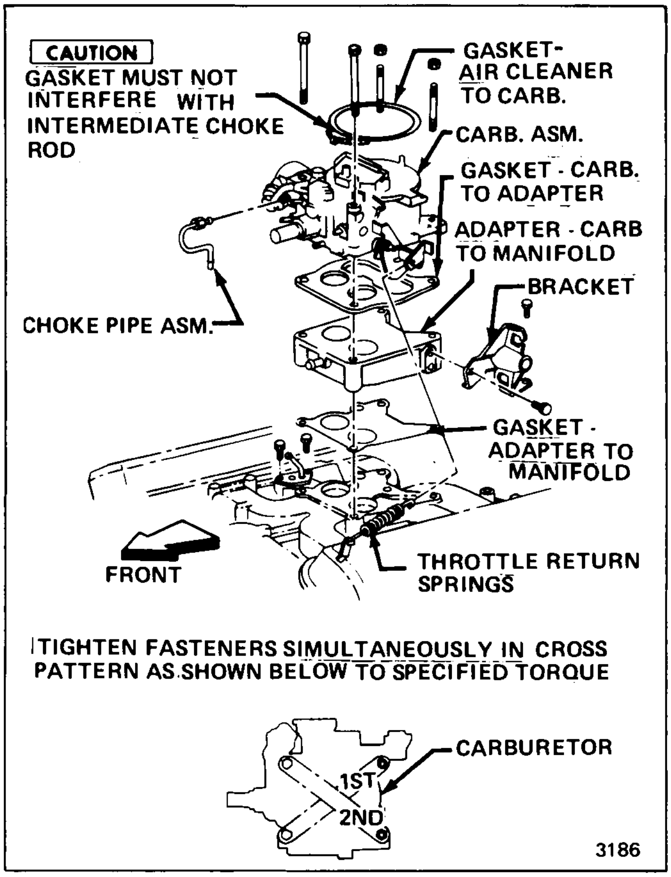


Fig. 6C-78 M2MC 200 Carburetor Removal

UNIT OVERHAUL

GENERAL

The procedures below apply to the complete overhaul with the carburetor removed from the engine.

However, in many cases service adjustments of individual systems may be completed without removing the carburetor from the engine. (Refer to "On-Car Service").

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection and replacement of all gaskets, diaphragms, seals and worn or damaged parts.

DISASSEMBLY

NOTE: Before performing any service on the carburetor, it is essential that the carburetor be placed on a holding fixture such as Tool J-8328-1. Without the use of the holding fixture, it is possible to bend or nick throttle valves.

Air Horn - Removal

1. Remove upper choke lever from the end of choke shaft by removing retaining screw. Then rotate upper choke lever to remove choke rod from slot in lever.

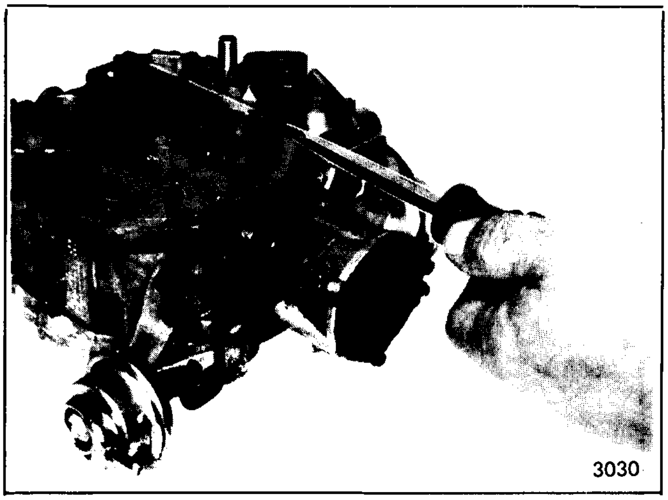


Fig. 6C-79 Choke Lever and Rod

2. Remove choke rod from lower lever inside float bowl casting.

NOTE: Remove rod by holding lower lever outward with small screwdriver and twisting rod counterclockwise.

3. Remove vacuum hose from front vacuum break unit.

4. With Tool J-25322 drive roll pin (pump lever pivot pin) inward just until pump lever can be removed from air horn. Then remove pump lever from pump rod (Fig. 6C-80). Note location of accelerator pump rod for reassembly.

CAUTION: *Use care in removing small roll pin to prevent damage to pump lever casting bosses in air horn.*

5. Remove nine air horn to bowl attaching screws: two attaching screws are located next to the venturi. (Two long screws, four short screws, one longer screw in front location, and two countersunk screws.)

6. Remove air horn from float bowl by lifting straight up. The air horn gasket should remain on the float bowl for removal later.

CAUTION: *When removing air horn from float bowl, use care to prevent bending the small tubes protruding from the air horn. These tubes are permanently pressed into the air horn casting. DO NOT REMOVE.*

Air Horn - Disassembly

1. Remove front vacuum break hose. Then remove two attaching screws and remove vacuum break control and bracket assembly. Do not place vacuum break assembly in carburetor cleaner.

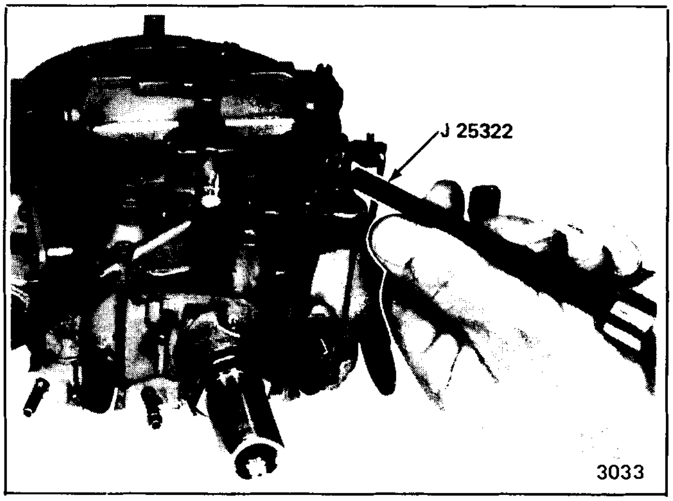


Fig. 6C-80 Pump Lever Pivot Pin Removal

Further disassembly of the air horn is not required for cleaning purposes. If part replacement is required, remove staking on two choke valve attaching screws. Remove screws, choke valve and shaft from air horn.

Float Bowl - Disassembly

1. Carefully lift one corner of the air horn gasket and remove pump plunger from pump well.
2. Remove air horn gasket by lifting out of dowel locating pins and lifting tab of gasket from beneath the power piston hanger, being careful not to distort springs holding the metering rods.
3. Remove pump return spring from pump well.
4. Remove power piston and metering rods by depressing piston stem and allowing it to snap free.

NOTE: The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the retainer. This procedure may have to be repeated several times.

CAUTION: *Do not remove power piston by using pliers on metering rod hanger.*

5. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotate rod to remove from hanger.

CAUTION: *Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully position of tension spring for later reassembly (Fig. 6C-71).*
Remove the power piston spring from the well.

CAUTION: *The A.P.T. metering rod adjustment screw is pre-set at the factory and no attempt should be made to change this adjustment in service. If float bowl replacement is required during service, the new bowl assembly will be supplied with an A.P.T. metering screw which will be pre-set as required.*

6. Remove plastic filler block over float assembly.

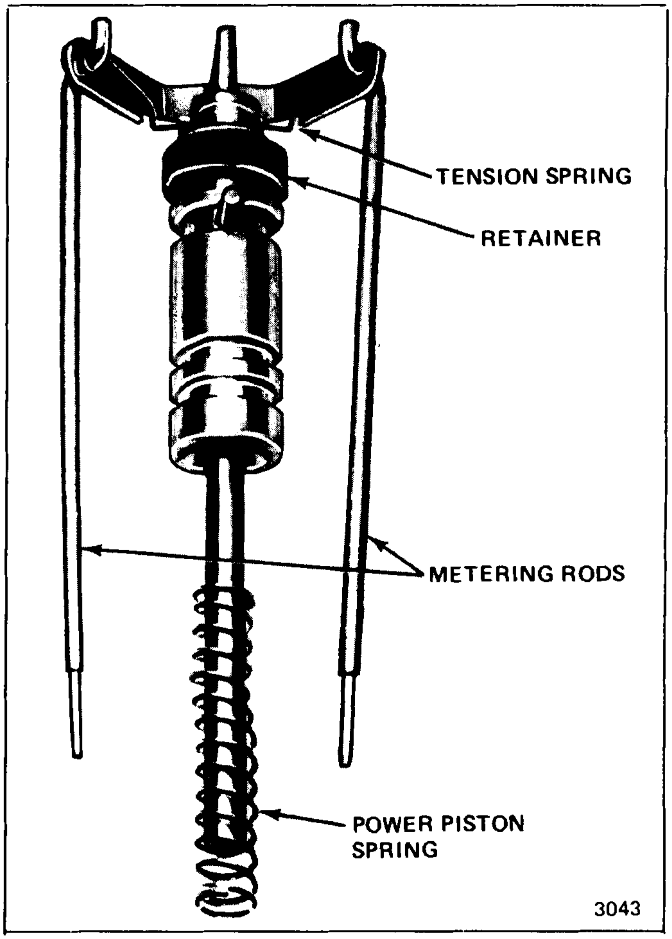


Fig. 6C-81 Power Piston

7. Remove float assembly and float needle valve by pulling up on retaining pin. Remove inlet needle seat and gasket using Tool J-22769 (Fig. 6C-82).
8. Remove aneroid cavity insert from float bowl.
9. Remove primary metering jets (only if required).
10. Remove pump discharge check ball retainer and check ball.
11. Remove baffle from side of pump well.
12. Remove two screws from rear vacuum break bracket and rotate the assembly to remove vacuum break rod from slot in plunger (Fig. 6C-83).

CAUTION: *Do not place vacuum break assembly in carburetor cleaner.*

13. Remove vacuum break rod by holding down on fast idle cam (hot idle position); move end of vacuum break rod away from float bowl, then disengage rod from hole in intermediate choke lever.
14. Remove fuel inlet nut, gasket, filter and spring.
15. Remove throttle body by removing throttle body to bowl attaching screws (Fig. 6C-84).
16. Remove throttle body to bowl insulator gasket.

Choke Disassembly

1. Remove three attaching screws and retainers from choke cover and coil assembly. Then pull straight outward and remove cover and coil assembly from choke housing. Remove choke cover gasket.

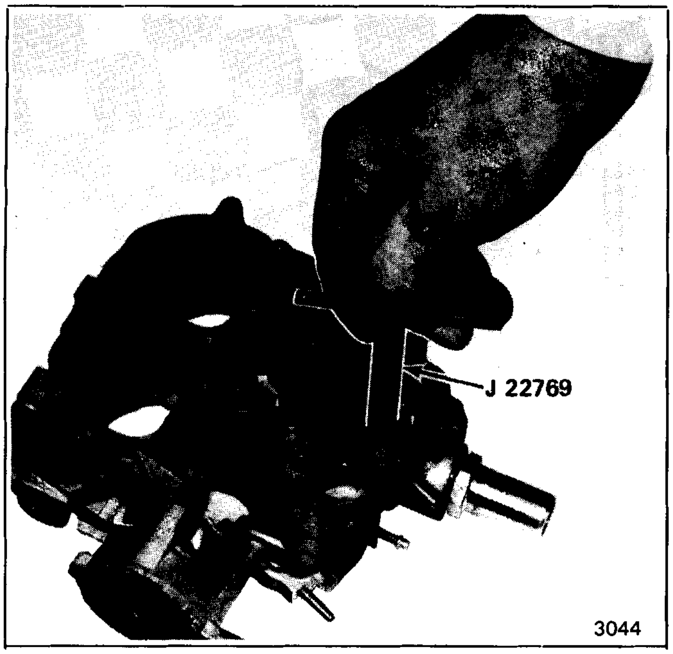


Fig. 6C-82 Removing Inlet Needle Seat

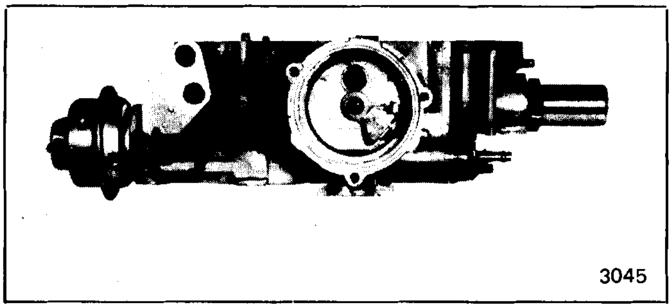


Fig. 6C-83 Rear Vacuum Break

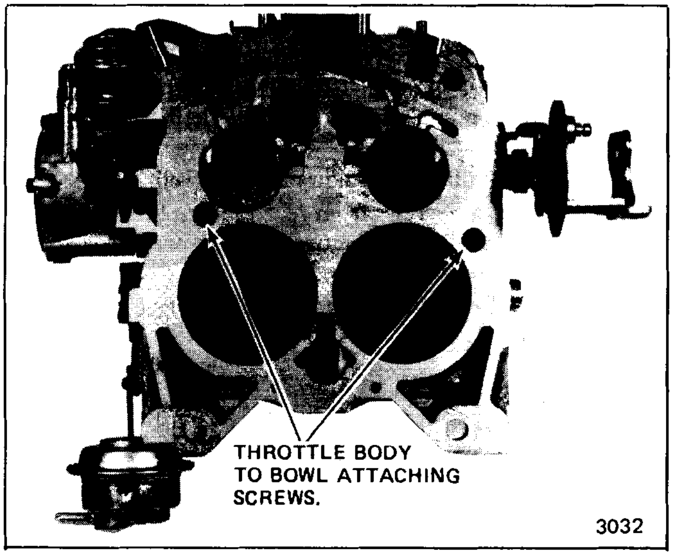


Fig. 6C-84 Throttle Body Attaching Screws

NOTE: It is not necessary to remove baffle plate from beneath the thermostatic coil. Distortion of the thermostatic coil may result if forced off the center retaining post on the choke cover.

2. Remove choke housing assembly from float bowl by removing retaining screw and washer inside the choke housing (Fig. 6C-85). The complete choke assembly can be removed from the float bowl by sliding outward.

3. Remove lower choke lever from inside float bowl cavity by inverting bowl.

4. Remove plastic tube seal from choke housing or float bowl.

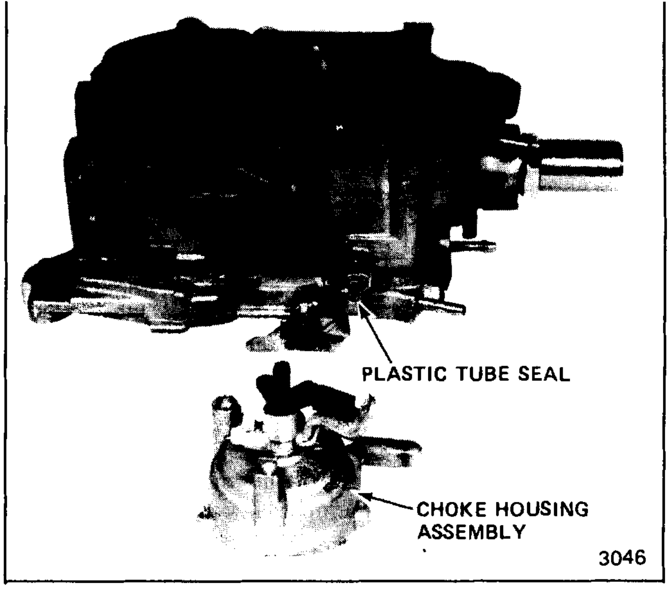


Fig. 6C-85 Choke Housing

CAUTION: *Plastic tube seal should not be immersed in carburetor cleaner.*

5. To disassemble intermediate choke shaft from choke housing, remove coil lever retaining screw at end of shaft inside the choke housing. Then remove thermostatic coil lever from flats on intermediate choke shaft. Remove intermediate choke shaft from the choke housing by sliding outward. The fast idle cam can now be removed from the intermediate choke shaft.

CAUTION: *Remove the cup seal from inside choke housing shaft hole if the housing is to be immersed in carburetor cleaner. Also, remove the cup seal from the float bowl plastic insert for bowl cleaning purposes. DO NOT ATTEMPT TO REMOVE PLASTIC INSERT.*

Throttle Body

1. Remove pump rod from throttle lever.
2. Remove idle mixture screws and springs.

CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

CAUTION: *The solenoid, rubber parts, plastic parts, diaphragms and pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort. The bushing in the bowl will withstand normal cleaning. Rinse thoroughly after cleaning.*

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.

2. Check, repair or replace the following parts if the following problems were encountered.

A. **Flooding**

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arms and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

B. **Hesitation**

1. Inspect pump plunger for cracks, scores or excessive cup wear. A used pump cup will shrink when dry. Soak in fuel for 8 hrs. before testing if dried out.

2. Inspect pump duration and return spring for being weak or distorted.

3. Check for dirt in pump passages and jets, improper seating of inlet or discharge balls, and scores in pump well.

4. Check pump linkage for excessive wear, repair or replace as necessary.

C. **Hard Starting - Poor Cold Operation**

1. Check choke valve and linkage for excessive wear, binds or distortion.

2. Inspect choke vacuum diaphragms for leaks.

3. Clean or replace carburetor filter.

4. Inspect inlet needle for sticking, dirt, etc.

5. Examine fast idle cam for wear or damage.

6. Also check items under "flooding".

D. **Poor Performance - Poor Gas Mileage**

1. Check power piston, and metering rods for dirt, sticking, binding, damaged parts or excessive wear.

2. Clean all fuel and vacuum passages in castings.

E. **Rough Idle**

1. Inspect idle needle for ridges, burrs or being bent.

2. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks and other damage.

3. Clean all idle fuel passages.

4. Check throttle lever and valves for binds, nicks and other damage.

CARBURETOR ASSEMBLY

Throttle Body

1. If removed, install idle mixture needles and springs until seated. Back out the mixture needles three turns as a preliminary idle adjustment. Final adjustment must be made on the engine using the procedures described in idle mixture adjustment procedure at the end of this section.

2. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outwards towards throttle lever.

Float Bowl

NOTE: If a new float bowl assembly is used, stamp or engrave the model number on the new float bowl. See Fig. 6C-64).

1. Install new throttle body to bowl gasket over two locating dowels on bowl.

2. Install throttle body making certain throttle body is properly located over dowels on float bowl, then install throttle body to bowl screws and lock washers and tighten evenly and securely (Fig. 6C-84).

3. Place carburetor on proper holding fixtures such as J 83281-1.

4. Install fuel inlet filter spring, filter and nut. Tighten nut securely (18 ft. lbs). (Fig. 6C-86).

CAUTION: *Tightening beyond specified torque can damage nylon gasket.*

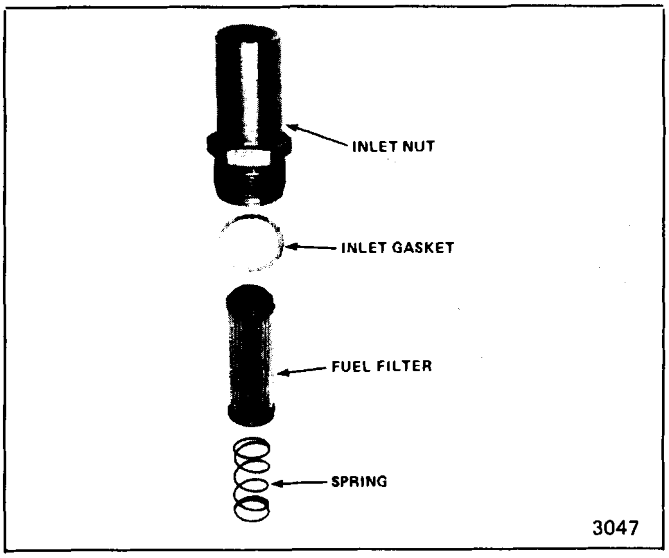


Fig. 6C-86 Fuel Filter

Choke Housing To Float Bowl

1. Install new cup seal into plastic insert on side of float bowl for intermediate choke shaft. Lip on cup seal faces outward.

2. Install new cup seal into inside choke housing shaft hole. Lips on seal faces inward, towards inside of housing.

3. Install fast idle cam onto the intermediate choke shaft (steps on fast idle cam face downward).

4. Carefully install fast idle cam and intermediate choke shaft assembly through seal in choke housing, then install thermostatic coil lever onto flats on intermediate choke shaft. The thermostatic choke coil lever is properly aligned when both inside and outside levers face towards fuel inlet. Install inside lever retaining screw into end of intermediate choke shaft. Tighten securely.

5. Install lower choke rod inner lever into cavity in float bowl. Install plastic tube seal into cavity on choke housing before assembling choke housing to bowl. Install choke housing to bowl sliding intermediate choke shaft into lower choke inner lever.

NOTE: Tool J-23417 can be used to hold the lower choke lever in correct position while installing the choke housing (Fig. 6C-87).

6. Install choke housing retaining screw and washer and tighten securely.

NOTE: The intermediate choke shaft lever and fast idle cam are in correct position when the tang on lever is beneath the fast idle cam. Do not install choke cover and

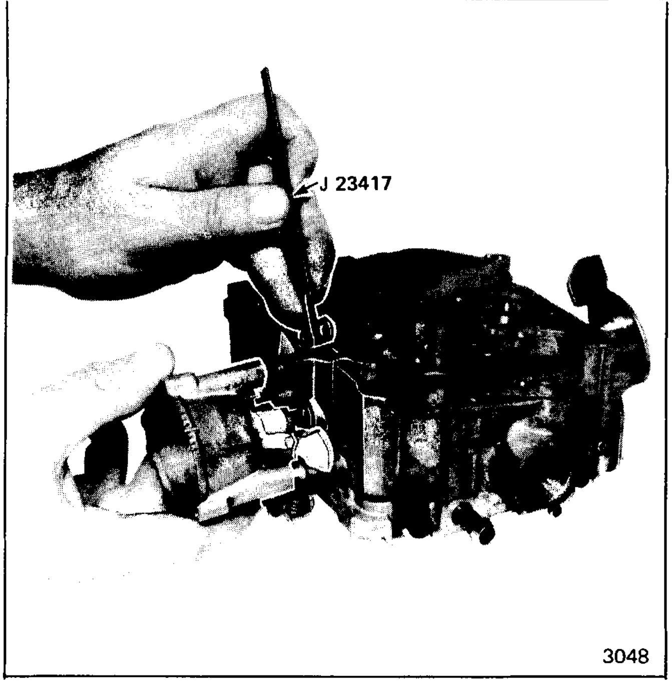


Fig. 6C-87 Choke Housing Installation

coil assembly until inside coil lever is adjusted. See Adjustments.

7. Holding down on fast idle cam (hot idle position), install end of vacuum break rod in hole in intermediate choke lever.

8. Install end of vacuum break rod in slot in rear vacuum break plunger. Then install rear vacuum break and bracket assembly to float bowl using two attaching screws (Fig. 6C-83). Tighten securely.

NOTE: Do not attach vacuum break hose until after the vacuum break adjustment is completed. See Adjustments.

9. Install pump discharge check ball and retainer in passage next to pump well. Tighten retainer securely.

10. Install primary metering jets.

11. Install new needle seat assembly, with gasket, using Tool J-22769.

12. To make adjustment easier, bend float arm upward at notch in arm before assembly. Install float by sliding float lever under pull clip from front to back. With float lever in pull clip, hold float assembly at toe and install retaining pin toward pump well side.

CAUTION: *Do not install float needle pull clip into holes in float (Fig. 6C-88).*

Float Level Adjustment (Fig. 6C-66)

1. Hold float retainer firmly in place.

2. Push float down lightly against needle.

3. With adjustable T-scale, gage from top of float bowl casting (air horn gasket removed) to top of float at toe-gaging point 3/16" back from toe.

4. Bend float arm as necessary for proper adjustment by pushing on pontoon.

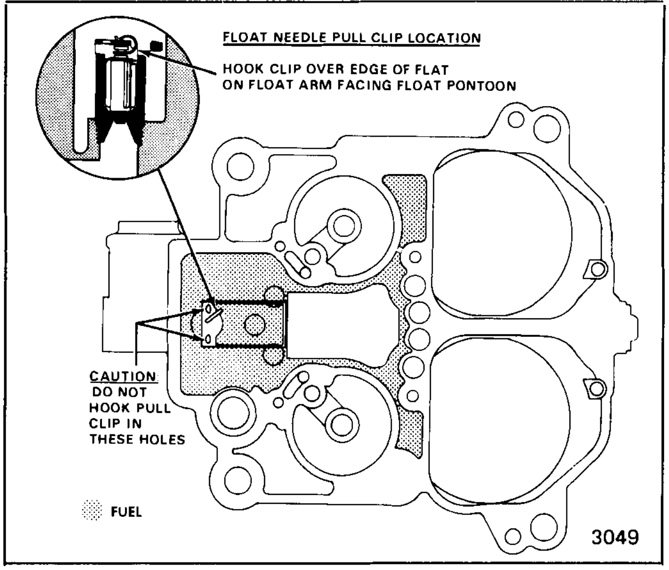


Fig. 6C-88 Float Needle Pull Clip Location

5. Visually check float alignment after adjustment.

6. Install plastic filler block over float needle, pressing downward until properly seated.

7. Install power piston spring in power piston well.

If metering rods were removed from hanger, reinstall making sure tension spring is connected to top of each rod (Fig. 6C-71). Install power piston assembly in well with metering rods properly positioned in metering jets. Press down firmly on plastic power piston retainer to make sure that the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, tap retainer lightly in place.

8. Install aneroid cavity insert into float bowl.

9. Install pump return spring in pump well.

10. Install air horn gasket by carefully sliding tab of gasket beneath the power piston hanger. Position gasket over the two dowel pins on the float bowl.

Carefully lift one corner of the air horn gasket and install pump plunger in the pump well by pushing the plunger to the bottom of the well against return spring tension. While holding in this position, align pump plunger stem with hole in gasket.

Air Horn

1. If removed, install choke shaft, choke valve and two attaching screws. Tighten screws securely and stake lightly in place.

NOTE: Check choke valve for freedom of movement and proper alignment before staking screws in place.

2. Holding down on air horn gasket at pump plunger location, carefully lower air horn assembly onto float bowl making sure that the bleed tubes, and pump plunger stem are positioned properly through the holes in the air horn gasket.

CAUTION: *Do not force the air horn assembly onto the bowl but rather lightly lower in place.*

3. Install two long air horn screws, four short screws, and two countersunk screws into primary venturi area. Install longer (front) air horn screw.

All air horn screws must be tightened evenly and securely. See Fig. 6C-89 for proper tightening sequence.

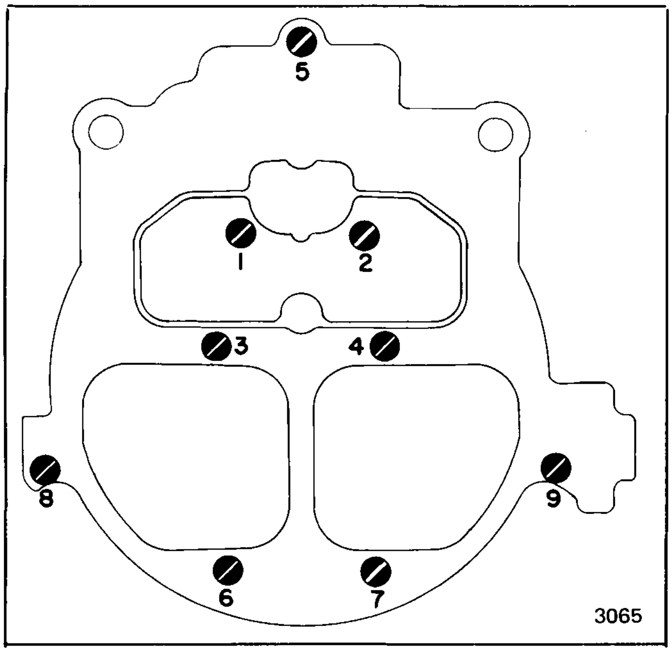


Fig. 6C-89 Air Horn Screw Tightening Sequence

4. Install front vacuum break diaphragm and bracket assembly to float bowl using two retaining screws through the bracket. Tighten screws securely.

NOTE: Do not attach vacuum break hose until vacuum break adjustment is completed. See Adjustments.

5. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever, noted at disassembly. Align hole in pump lever with hole in air horn casting using Tool J-25322. Using screwdriver, push pump lever roll pin back through casting until end of pin is flush with casting bosses in air horn (Fig. 6C-90).

CAUTION: *Use care installing the small roll pin to prevent damage to pump lever casting bosses.*

6. Connect choke rod into lower choke lever inside bowl cavity; then install choke rod into slot in upper choke lever and retain the choke lever to the end of the choke shaft with attaching screw. Tighten securely (Fig. 6C-79).

NOTE: Make sure that the flats on the end of the choke shaft align with flats in the choke lever.

NOTE: The front and rear vacuum break fast idle cam adjustments must be performed, and the thermostatic coil lever inside the choke housing has to be indexed properly before installing the choke thermostatic coil and cover assembly and gasket. Refer to the Adjustment Procedures.

7. After the vacuum break, fast idle cam, and inside thermostatic coil lever are adjusted, the thermostatic coil and cover assembly and gasket should be installed and the cover assembly rotated until the choke valve just closes. At this point, the index cover should be adjusted. Install three choke cover retainers and screws, and tighten securely.

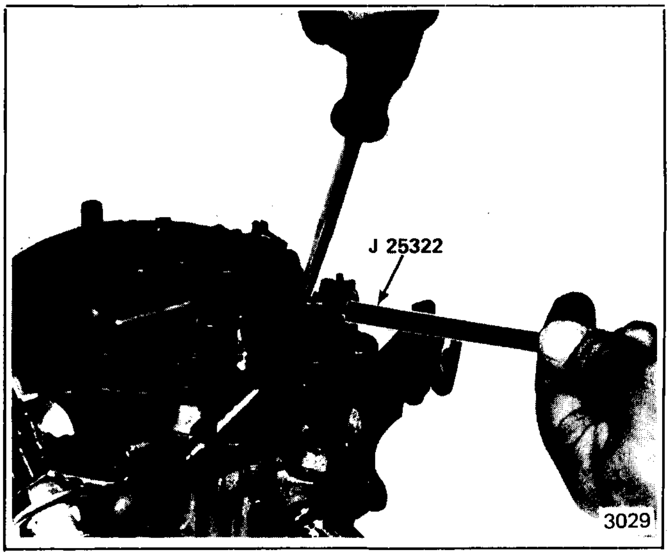


Fig. 6C-90 Pump Lever Pivot Pin

MODEL M4MC CARBURETOR

CONTENTS

GENERAL DESCRIPTION

The M4MC model carburetor (Fig. 6C-83) is a two stage carburetor of downdraft design. The triple venturi system is used on the primary side of the carburetor with 1-3/8" throttle valve bores.

The secondary side has two large bores (2-1/4"). Using the air valve principle in the secondary side, fuel is metered in direct proportion to the air passing through the secondary bores.

Some models have a baffle added to the secondary side of the air horn above the main well bleed tubes to deflect incoming air to improve secondary nozzle performance on heavy acceleration.

The float assembly is used with a window-less type needle seat for better fuel handling in the float bowl. Also, a plastic filler block is used above the float chamber to reduce fuel slosh in this area. A fuel inlet filter check valve is used to shut off fuel flow to the carburetor float bowl to prevent fuel leaks if a car roll over should occur (Fig. 6C-92).

An electrical idle speed solenoid is used on air conditioned cars (except 400" V8 with Manual Transmission) to increase idle speed slightly when the air conditioning is in operation. The solenoid, energized by the A/C compressor, allows the engine to idle at the same speed when the air conditioning is in operation as when it is off.

The main metering system on all models uses separate main wells to feed each fuel nozzle for improved fuel flow in the venturi system.

An adjustable part throttle screw is used in the float bowl to aid in refinement of fuel mixtures for good emission control. This screw is preset at the factory and should not be adjusted in service. If it becomes necessary to replace the float bowl, the new service float bowl will include an adjustable part throttle screw which has been preset at the factory. An aneroid cavity insert is used in the float bowl.

CAUTION: *The insert is required to reduce fuel slosh in the float bowl.*

All models use a bowl mounted fresh air choke with thermostatic control assembly. Some models use a fresh air modulator valve in the air cleaner. In addition, a dual vacuum

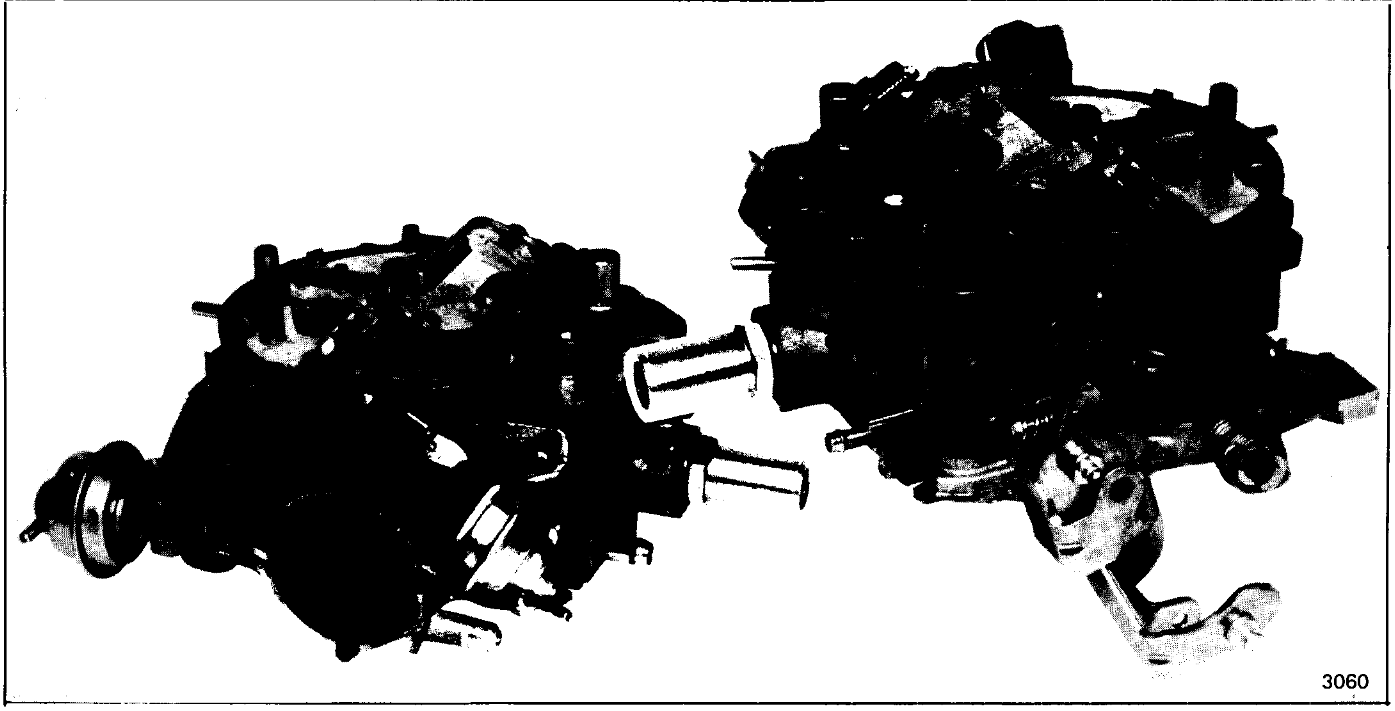


Fig. 6C-91 M4MC Carburetor

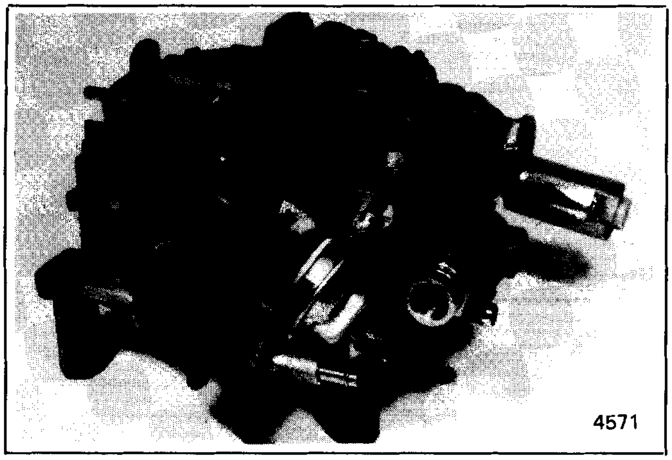


Fig. 6C-91A M4MC Carb 350 X Series VI Code L

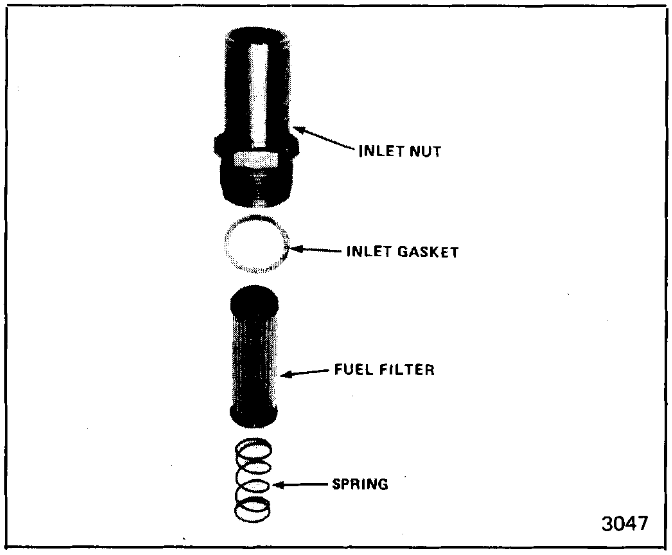


Fig. 6C-92 Fuel Filter

break system is used on most models for improved cold engine warm-up and drive-away performance. The choke shaft and certain other parts of the choke system are Teflon coated to insure smooth choke operation.

The carburetor part number is stamped on a vertical section of the float bowl, near the secondary throttle lever (Fig. 6C-93). Refer to the part number on the bowl when servicing the carburetor. When replacing the float bowl assembly, follow the instructions contained in the service package. Stamp or engrave the model number on the new float bowl.

The primary side of the carburtor has six systems of operation. They are float, idle, main metering, power, pump and choke. The secondary side has one metering system which supplements the primary main metering system and receives fuel from a common float chamber. (See Figs. 6C-94 thru 6C-101).

DIAGNOSIS

Refer to engine performance diagnosis, Section 6, and/or cleaning and inspection under unit overhaul in this section.

ON-CAR SERVICE

Carburetor Choke and Hoses

Check choke mechanism and vacuum break for proper operation at the recommended maintenance intervals. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.

Choke Check Procedure

1. Remove air cleaner. With engine off, hold throttle half open. Open and close choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.
2. If choke or linkage binds, sticks or works sluggishly, clean with United Delco Choke Cleaner X-20-A or equivalent. Use cleaner as directed on can. If cleaning does not correct, replace binding parts.
3. Visually inspect carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasion, hardness or signs of deterioration. Replace or correct as necessary.
4. Make sure vacuum break diaphragm shafts are fully extended when engine is off. If shafts are not fully extended, replace vacuum break assembly. Start engine, primary vacuum break diaphragm shaft should fully retract. If unit fails to retract, replace vacuum break assembly.
5. With engine at normal operating temperature, the SVB TVS must be open. Check by applying either engine vacuum or auxiliary vacuum to the inlet port on hot TVS and checking for vacuum at the outlet. If there is no vacuum, replace the TVS.
6. Apply a vacuum to the vacuum break diaphragm and observe for movement to the full travel position. Due to the orifice in the unit, it will take up to 20 seconds to reach full travel. If full travel is not obtained, the orifice is plugged and the diaphragm must be replaced.

ADJUSTMENTS

Idle Speed Adjustment

Refer to Vehicle Emission Control Information label on vehicle for latest certified specification information.

1. With engine at normal operating temperature, choke full open, and air conditioning OFF, connect a tachometer to engine.
2. Set parking brake and block drive wheels.
3. Disconnect and plug hoses from vapor canister and EGR valve.
4. Turn A/C off.
5. Start engine and position transmission in PARK or NEUTRAL.
6. Disconnect vacuum advance line.
7. Check and adjust engine timing at specified rpm
8. Reconnect vacuum advance line.
9. Place transmission in drive (automatic) or neutral (standard transmission) and adjust idle speed.

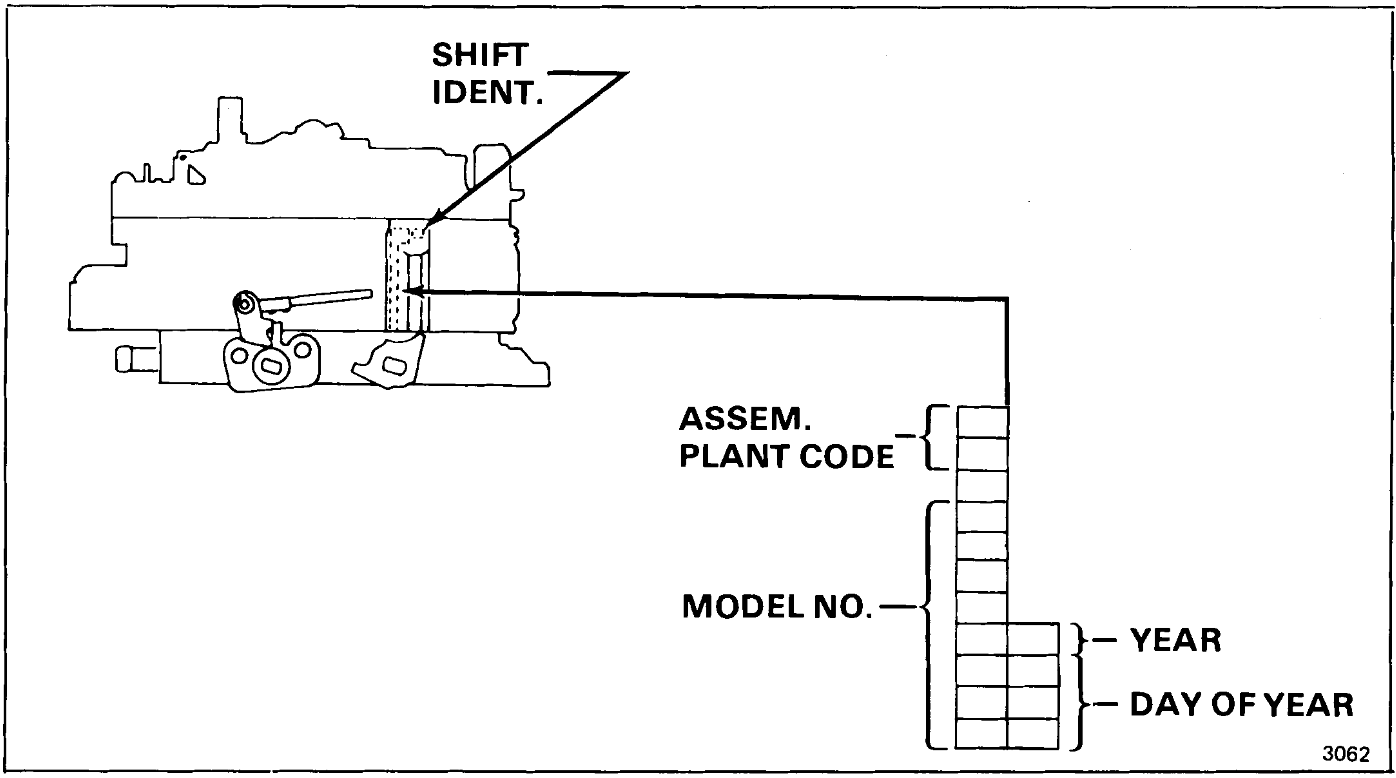


Fig. 6C-93 M4MC Carburetor Identification

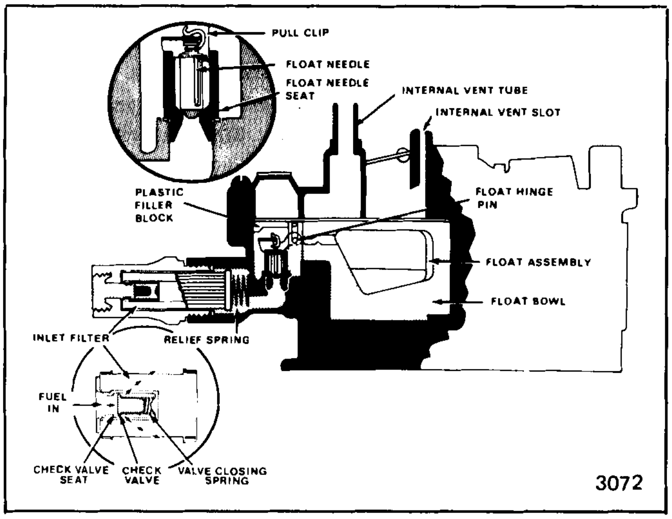


Fig. 6C-94 M4MC Float System

On cars equipped with air conditioning, turn A/C "on" and disconnect electrical connector at A/C compressor clutch. Open throttle momentarily to ensure solenoid plunger is fully extended. Adjust solenoid screw to specified rpm. Reconnect A/C compressor clutch electrical connector and turn A/C "OFF".

Manual transmission - adjust idle stop screw to specified rpm.

10. Unplug and reconnect hose from vapor canister and EGR valve.

11. Shut off engine and remove tachometer.

Carburetor Adjustments

Refer to Figs. 6C-102 thru 106 for carburetor adjustment procedures and specifications.

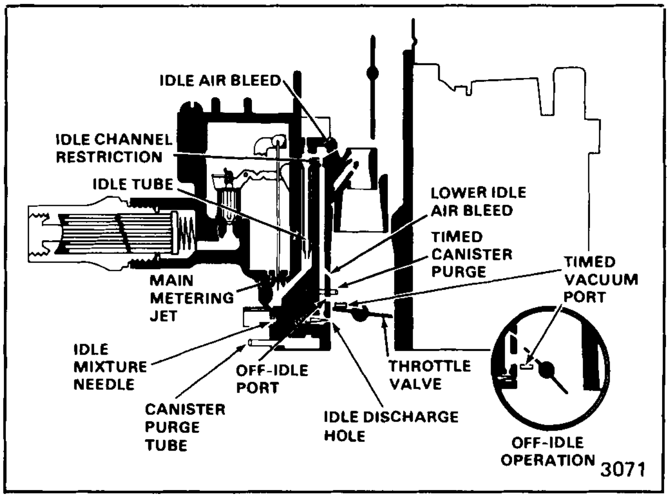


Fig. 6C-95 M4MC Idle System Exc. X Series VI Code L

Idle Mixture

See Idle Mixture Adjustments at the end of this section.

Choke Fresh Air Modulator - VIN Engine Codes P & Z

Functional Check

1. Cool engine off until air cleaner assembly is below 50° F.

2. "TEE" vacuum gage between fresh modulator and choke stove.

3. Start engine. Vacuum gage should read more than 5 inches mercury of vacuum. If not, replace modulator or locate vacuum leak.

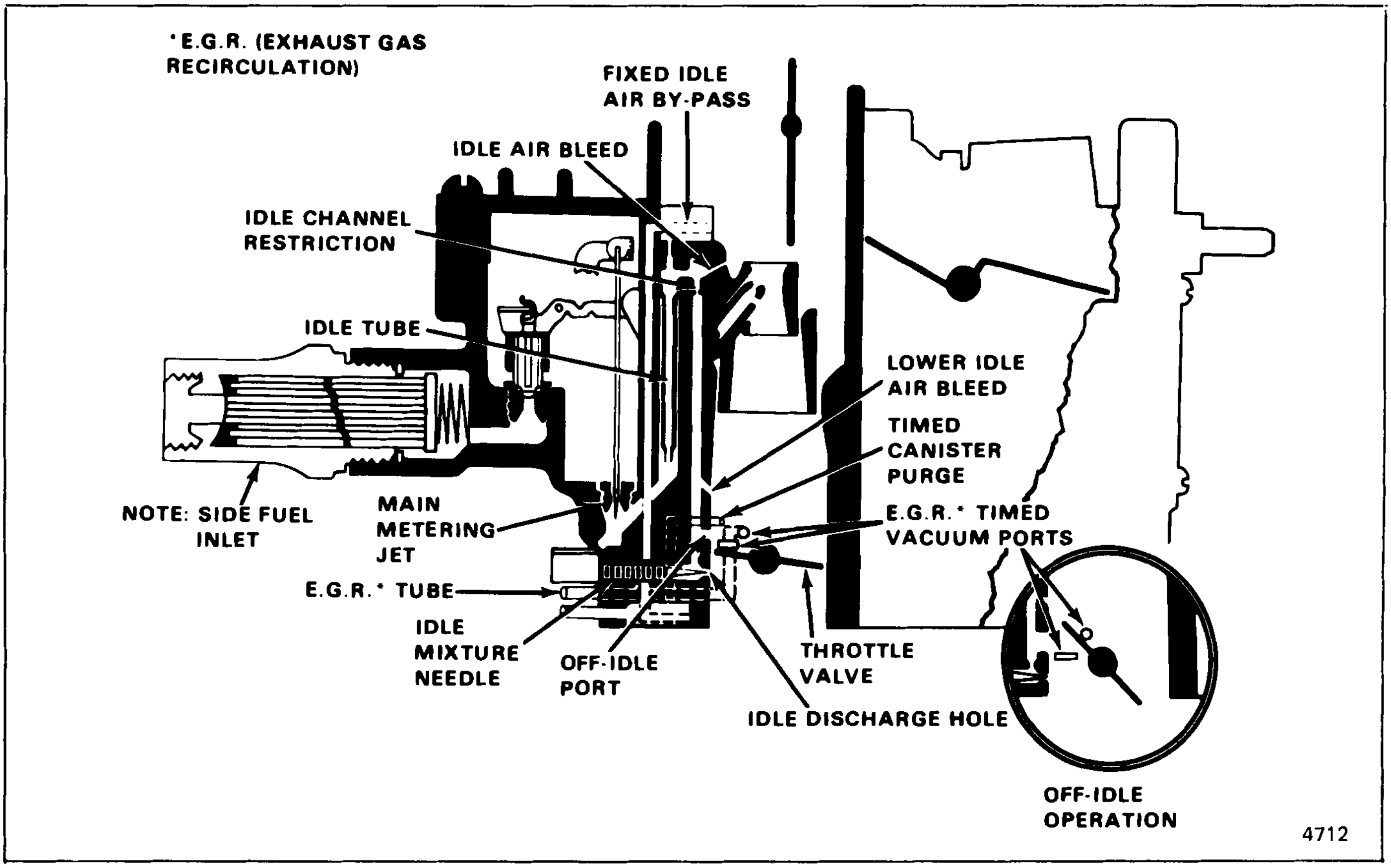


Fig. 6C-96 Idle System M4MC X Series VI Code L

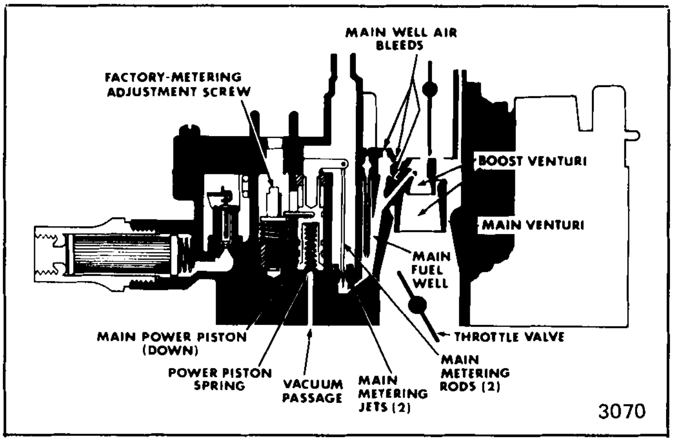


Fig. 6C-97 M4MC Main Metering System

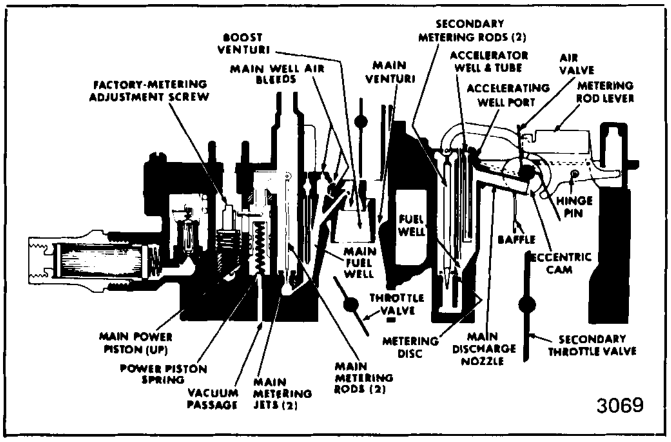


Fig. 6C-98 M4MC Power System

4. Allow engine to reach normal operating temperature. Vacuum gage should read less than 5 inches of vacuum. If not, replace modulator.

5. Remove vacuum gage and connect fresh air hose.

Removal

1. Remove air cleaner.
2. Detach hose at modulator.
3. Pry up tabs on modulator retaining clip; remove clip and modulator from air cleaner.

Replace

1. Install modulator and gasket assembly in position.
2. Press retainer clip on hose connector.
3. Connect vacuum hose and install air cleaner on engine.

Carburetor Replacement

Removal

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, the carburetor should be carefully removed from engine without draining fuel from bowl. Contents of fuel bowl may then be examined for contamination as carburetor is disassembled. Check filter.

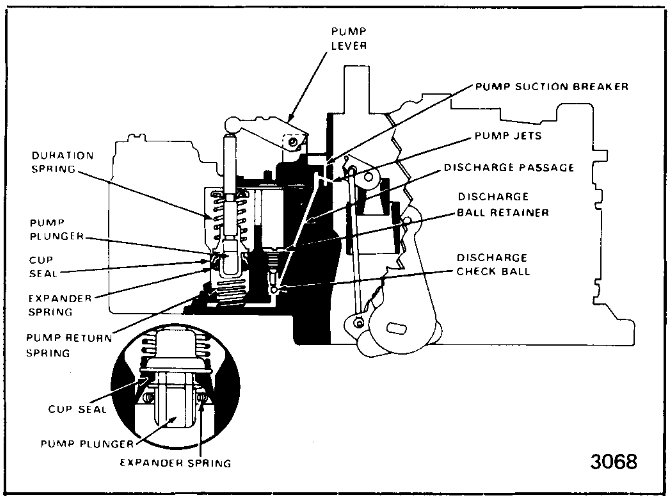


Fig. 6C-99 M4MC Pump System

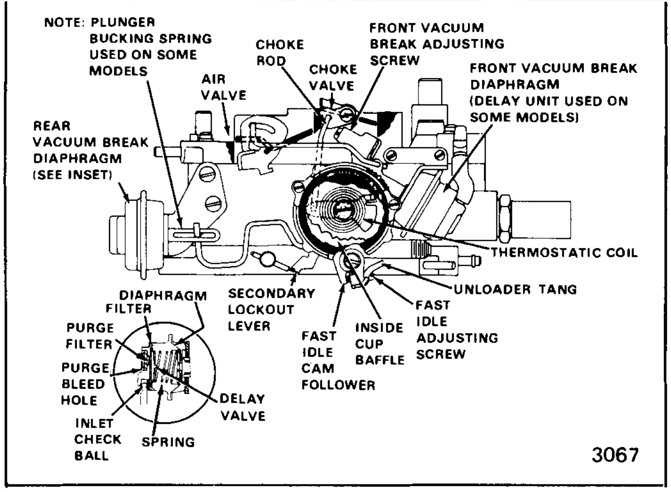


Fig. 6C-100 M4MC Choke System Exc. X Series VI Code L

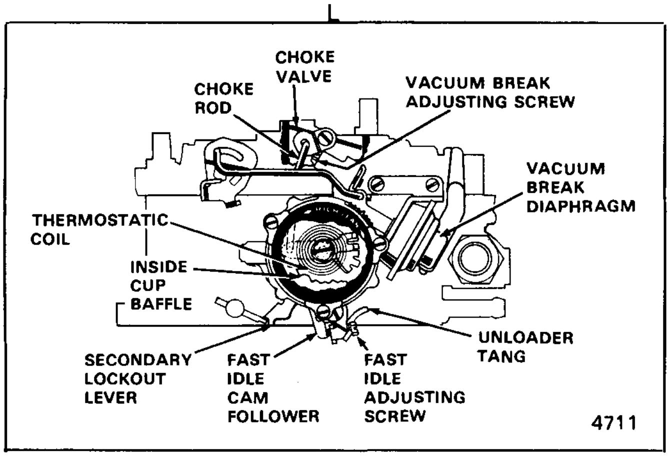


Fig. 6C-101 Choke System M4MC X Series VI Code L

1. Remove air cleaner and gasket.

2. Disconnect fuel and vacuum lines from carburetor.

3. Disconnect accelerator linkage and electrical connectors.

4. Remove carburetor attaching bolts and remove carburetor and gasket.

Installation

Fill carburetor bowl before installing carburetor. This reduces strain on starting motor and battery and reduces the possibility of backfiring while attempting to start engine. A small supply of no-lead fuel will enable carburetor to be filled and the operation of float and inlet needle and seat to be checked. Operate throttle lever several times and check discharge from pump jets before installing carburetor.

1. Be certain throttle body and intake manifold sealing surfaces are clean.
2. Install carburetor to manifold gasket.
4. Place carburetor in position and loosely install four attaching bolts.
5. Install vacuum lines and loosely connect fuel line.
6. Tighten four attaching bolts to 145 in. lbs.
7. Tighten fuel inlet nut to 300 inch pounds.
8. Connect accelerator linkage and downshift controls if so equipped.
9. Adjust idle speeds.
10. Install air cleaner.

Fuel Filter Replacement

A plugged fuel filter will restrict fuel flow into carburetor and will result in a loss of engine power.

1. Disconnect fuel line connection at inlet fuel filter nut.
2. Remove inlet fuel filter nut from carburetor.
3. Remove filter and spring.
4. Install spring and filter element in carburetor with hole in filter toward nut.
5. Install new gasket on inlet fitting nut and install nut in carburetor and tighten securely.
6. Install fuel line and tighten connector.

Solenoid Replacement

The solenoid should be checked to assure that the solenoid plunger extends when the solenoid is energized. An inoperative solenoid should be replaced.

Removal

1. Remove carburetor air cleaner.
2. Disconnect electrical connector at solenoid.
3. Remove 2 bracket screws and remove solenoid and bracket assembly.

Installation

1. Install solenoid and bracket assembly.
2. Connect electrical connector.
3. Install air cleaner.
4. Refer to vehicle emission control information label and adjust idle speed.

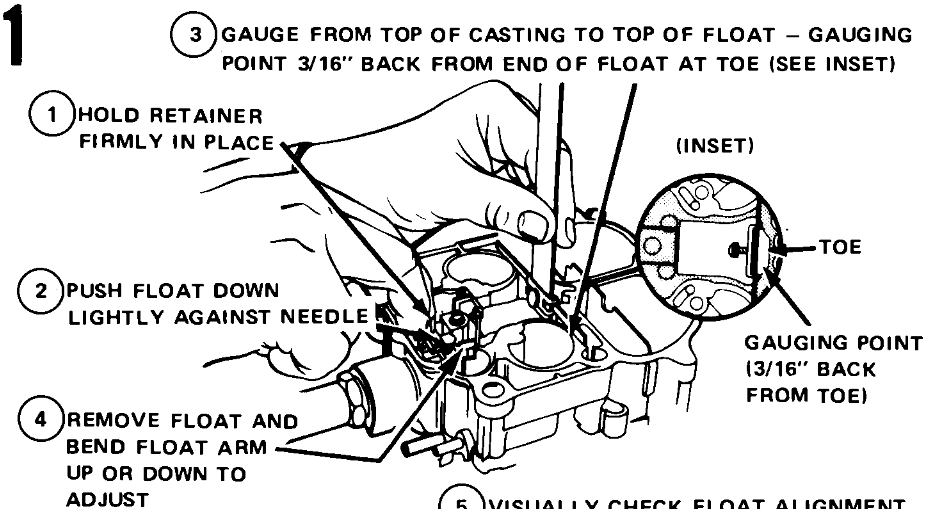
UNIT OVERHAUL

GENERAL

The procedures below apply to the complete overhaul with the carburetor removed from the engine.

However, in many cases service adjustments of individual systems may be completed without removing the carburetor from the engine. (Refer to "On-Car Service").

1

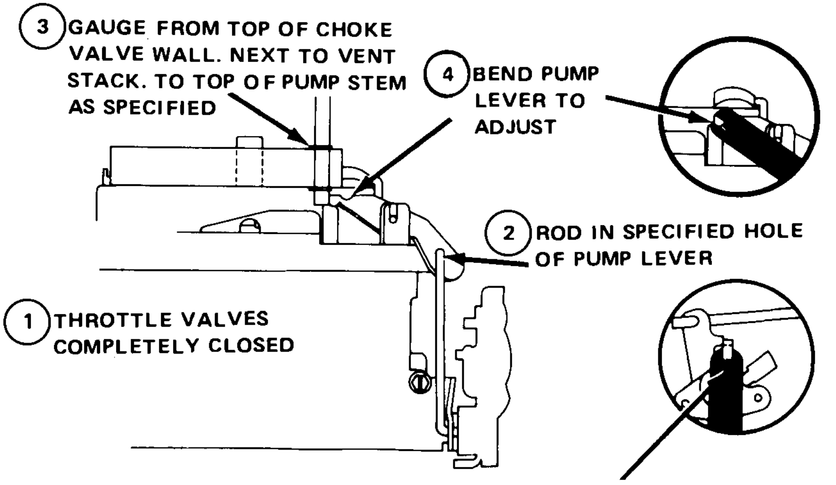


⑤ VISUALLY CHECK FLOAT ALIGNMENT AFTER ADJUSTING

FLOAT ADJUSTMENT

CARB. NO.	GAUGE	
17057250	13/32"	
253	13/32"	
255	13/32"	
256	13/32"	
258	13/32"	
262	17/32"	
263	17/32"	
266	17/32"	
274	17/32"	
550	13/32"	
553	13/32"	

2



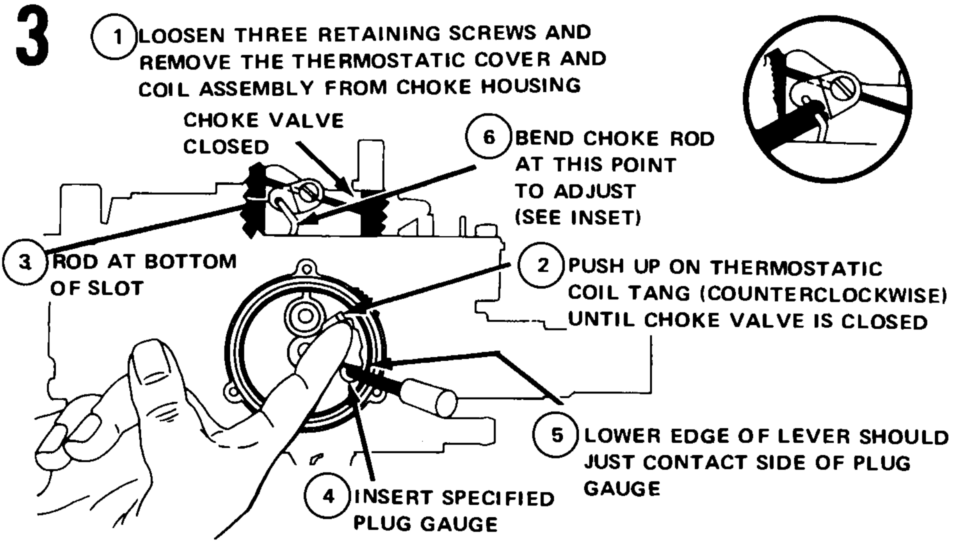
IF NECESSARY, BEND SECONDARY CLOSING TANG AWAY TO CLOSE PRIMARY VALVES. THEN RE ADJUST

PUMP ADJUSTMENT

CARB. NO.	GAUGE	HOLE LOC.
17057250	9/32"	INNER
253	9/32"	INNER
255	9/32"	INNER
256	9/32"	INNER
258	9/32"	INNER
262	3/8"	OUTER
263	3/8"	OUTER
266	3/8"	OUTER
274	3/8"	OUTER
550	9/32"	INNER
553	9/32"	INNER

3

① LOOSEN THREE RETAINING SCREWS AND REMOVE THE THERMOSTATIC COVER AND COIL ASSEMBLY FROM CHOKE HOUSING



CHOKE COIL LEVER ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17057250		
253	.120"	
255		
256	ALL	
258		
262		
263		
266		
274		
550		
553		

M4MC—M4ME CARBURETOR OVERHAUL ADJUSTMENTS

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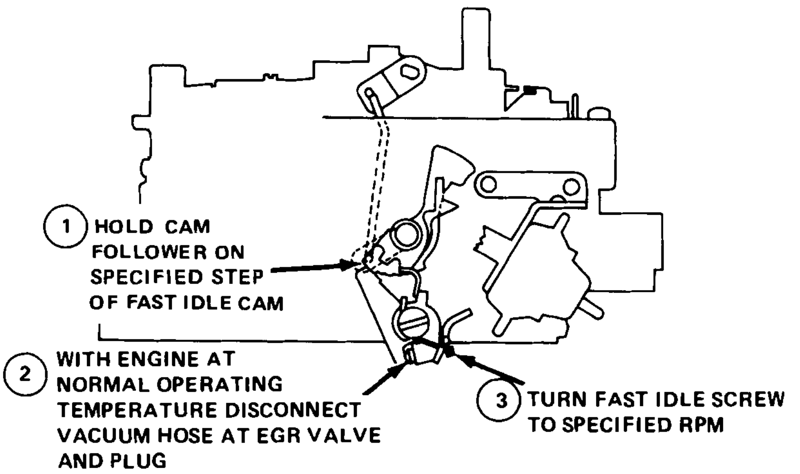
Fig. 6C-102 M4MC Adjustment Procedures

NOTE*: ANGLE GAUGE METHOD CAN BE USED – SEE PAGE 6C-39

4



① HOLD CAM FOLLOWER ON SPECIFIED STEP OF FAST IDLE CAM

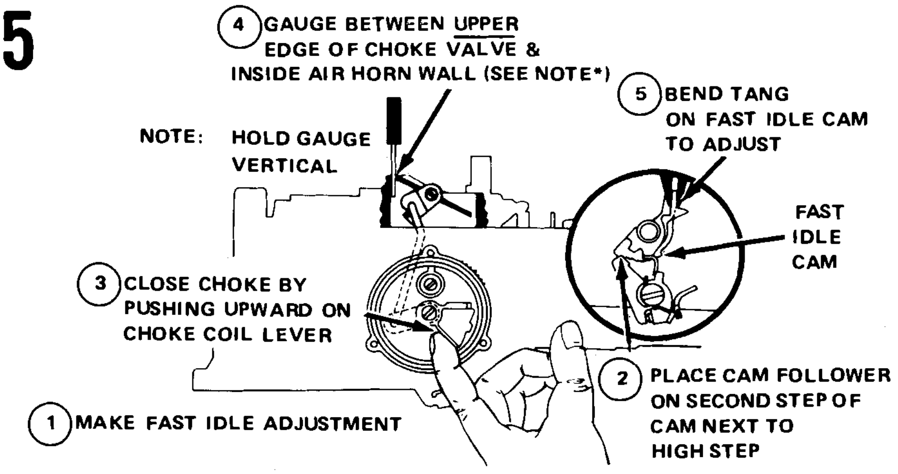
② WITH ENGINE AT NORMAL OPERATING TEMPERATURE DISCONNECT VACUUM HOSE AT EGR VALVE AND PLUG

③ TURN FAST IDLE SCREW TO SPECIFIED RPM

FAST IDLE ADJUSTMENT

CARB. NO.	RPM	STEP
17057250	900	LOW
253	900	LOW
255	900	LOW
256	900	LOW
258	1000	LOW
262	1800	HIGH
263	1800	HIGH
266	1800	HIGH
274	1800	HIGH
502	1600	HIGH
504	1600	HIGH
550	1000	LOW
553	1000	LOW
582	1600	HIGH
584	1600	HIGH

5



④ GAUGE BETWEEN UPPER EDGE OF CHOKE VALVE & INSIDE AIR HORN WALL (SEE NOTE*)

NOTE: HOLD GAUGE VERTICAL

⑤ BEND TANG ON FAST IDLE CAM TO ADJUST

③ CLOSE CHOKE BY PUSHING UPWARD ON CHOKE COIL LEVER

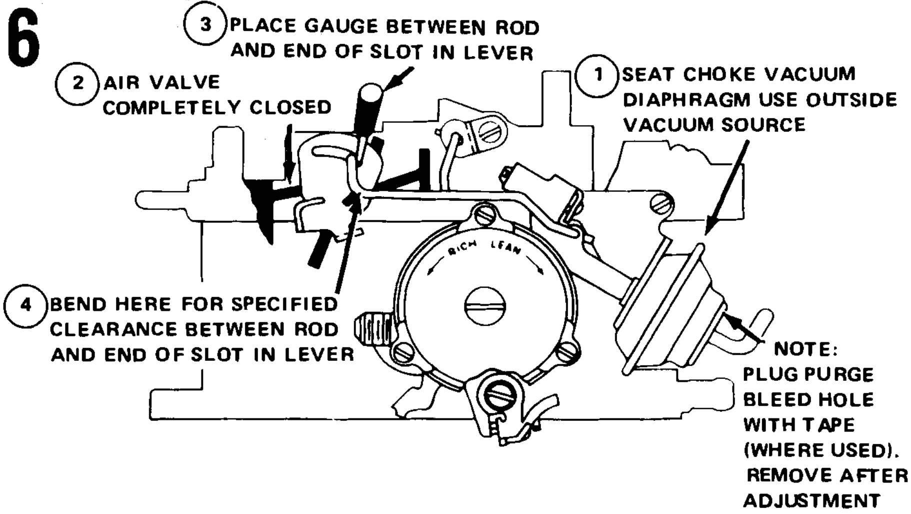
② PLACE CAM FOLLOWER ON SECOND STEP OF CAM NEXT TO HIGH STEP

① MAKE FAST IDLE ADJUSTMENT

CHOKE ROD (FAST IDLE CAM) ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057250	.095"	19°
253	.095"	19°
255	.095"	19°
256	.095"	19°
258	.095"	19°
262	.130"	23.5°
263	.130"	23.5°
266	.130"	23.5°
274	.130"	23.5°
502	.325"	46°
504	.325"	46°
550	.095"	19°
553	.095"	19°
582	.325"	46°
584	.325"	46°

6



③ PLACE GAUGE BETWEEN ROD AND END OF SLOT IN LEVER

② AIR VALVE COMPLETELY CLOSED

① SEAT CHOKE VACUUM DIAPHRAGM USE OUTSIDE VACUUM SOURCE

④ BEND HERE FOR SPECIFIED CLEARANCE BETWEEN ROD AND END OF SLOT IN LEVER

NOTE: PLUG PURGE BLEED HOLE WITH TAPE (WHERE USED). REMOVE AFTER ADJUSTMENT

AIR VALVE ROD ADJUSTMENT

CARB. NO.	PLUG GAUGE
17057250	.030"
253	.030"
255	.030"
256	.030"
258	.030"
262	.030"
263	.030"
266	.030"
274	.030"
502	.030"
504	.030"
550	.030"
553	.030"
582	.030"
584	.030"

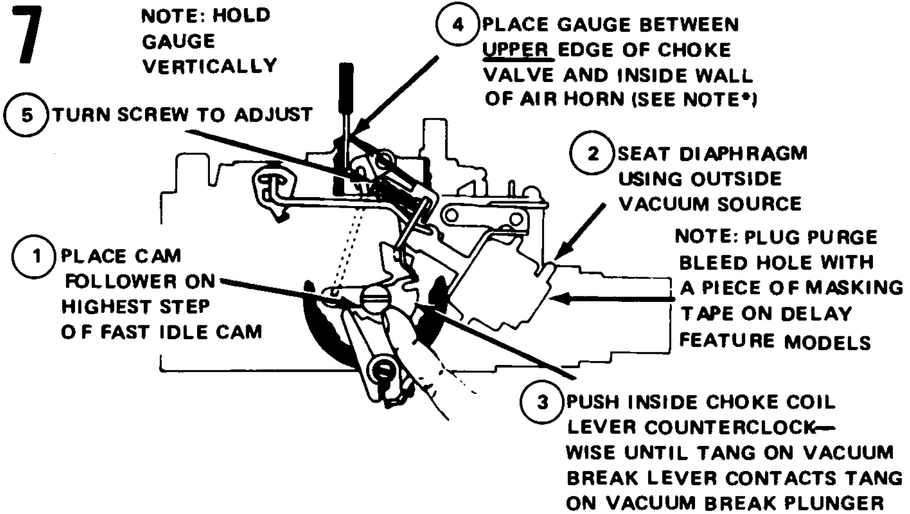
M4MC–M4ME CARBURETOR OVERHAUL ADJUSTMENTS

3419

Fig. 6C-103 M4MC Adjustment Procedures

NOTE*: ANGLE GAUGE METHOD CAN ALSO BE USED – SEE PAGE 6C-39

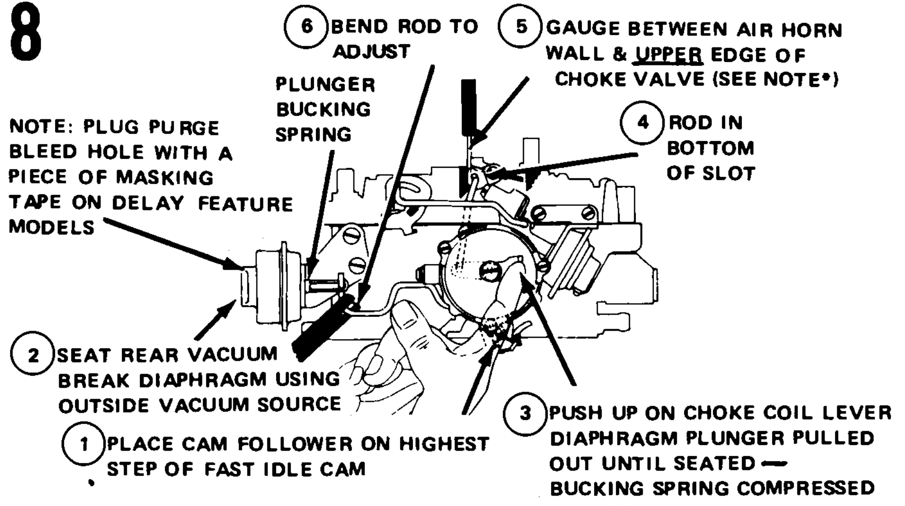
7



FRONT VACUUM BREAK ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057250	.125"	24°
253	.125"	24°
255	.125"	24°
256	.125"	24°
258	.125"	24°
262	.150"	26°
263	.165"	28°
266	.150"	26°
274	.150"	26°
502	.165"	28.5°
504	.165"	28.5°
550	.125"	24°
553	.125"	24°
582	.165"	28.5°
584	.165"	28.5°

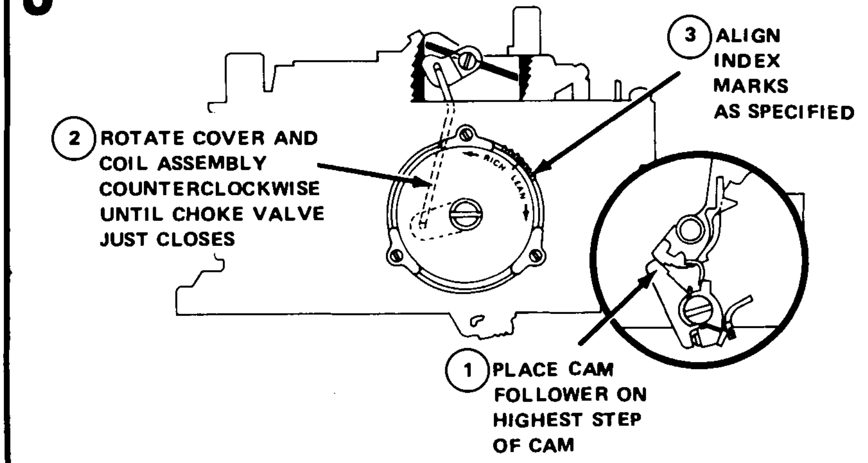
8



REAR VACUUM BREAK ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057250	.170"	30.5°
253	.170"	30.5°
255	.170"	30.5°
256	.170"	30.5°
258	.215"	36.5°
262	.240"	38°
263	.240"	38°
266	.240"	38°
274	.240"	38°
502	—	—
504	—	—
550	.215"	36.5°
553	.215"	36.5°
582	—	—
584	—	—

9



AUTOMATIC CHOKE COIL ADJUSTMENT

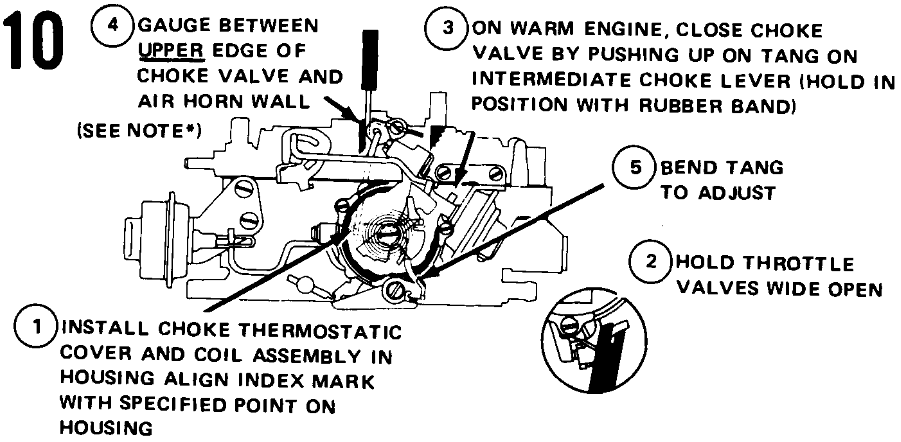
CARB. NO.	INDEX MARK
17057250	2NR
253	2NR
255	2NR
256	2NR
258	2NR
262	1NR
263	1NR
266	1NR
274	1NR
502	2NL
504	2NL
550	2NR
553	2NR
582	2NL
584	2NL

3420

M4MC—CARBURETOR OVERHAUL ADJUSTMENTS
Fig. 6C-104 M4MC Adjustment Procedures

NOTE*: ANGLE GAUGE METHOD CAN ALSO BE USED – SEE PAGE 6C-39

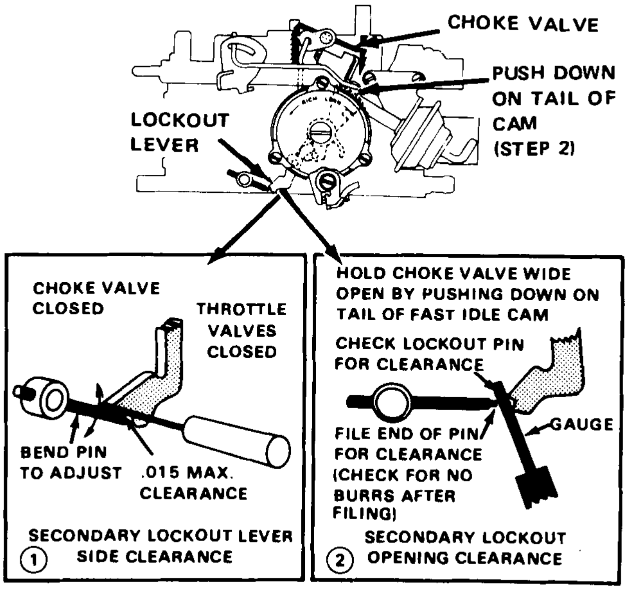
10



UNLOADER ADJUSTMENT

CARB. NO.	PLUG GAUGE	ANGLE GAUGE
17057250	.205"	35°
253	.205"	35°
255	.205"	35°
256	.205"	35°
258	.205"	35°
262	.220"	35°
263	.220"	35°
266	.220"	35°
274	.220"	35°
502	.280"	42°
554	.280"	42°
550	.200"	34.5°
553	.200"	34.5°
582	.280"	42°
584	.280"	42°

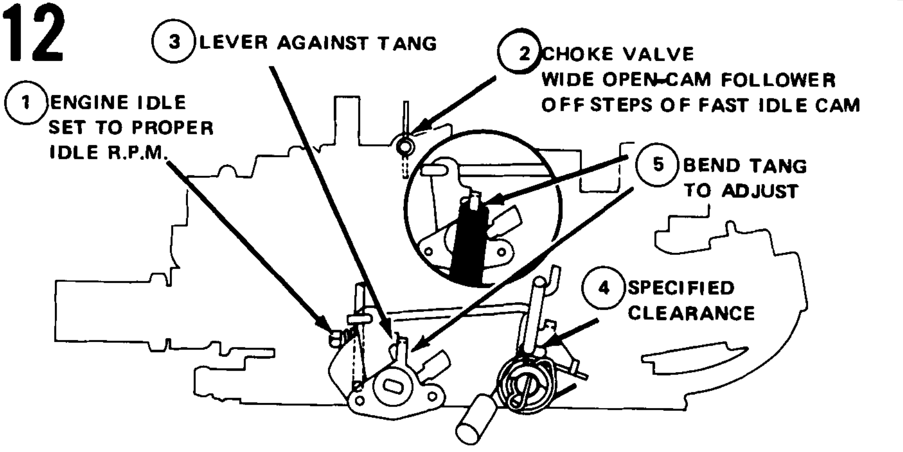
11



SECONDARY LOCKOUT ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17057250	.015"	
253		
255	ALL	
256		
258		
262		
263		
266		
274		
502		
534		
550		
553		
582		
584		

12



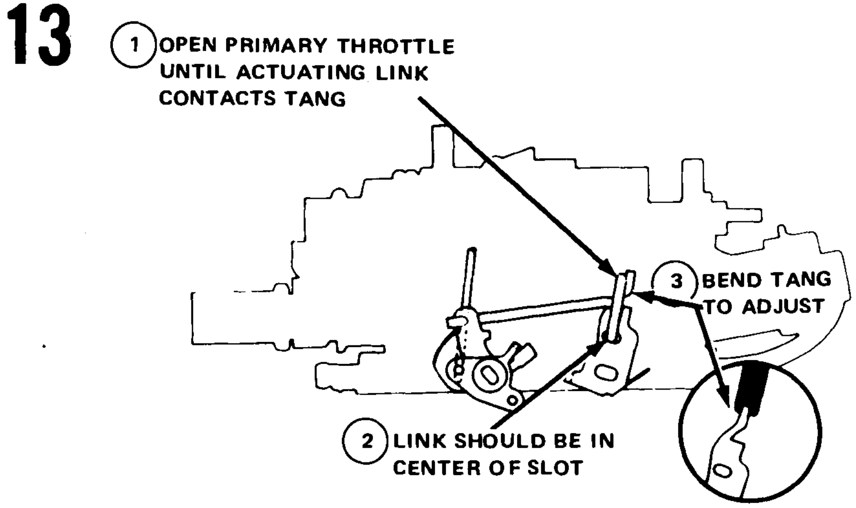
SECONDARY CLOSING ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17057250	.030"	
253		
255	ALL	
256		
258		
262		
263		
266		
274		
502		
504		
550		
553		
582		
584		

3421

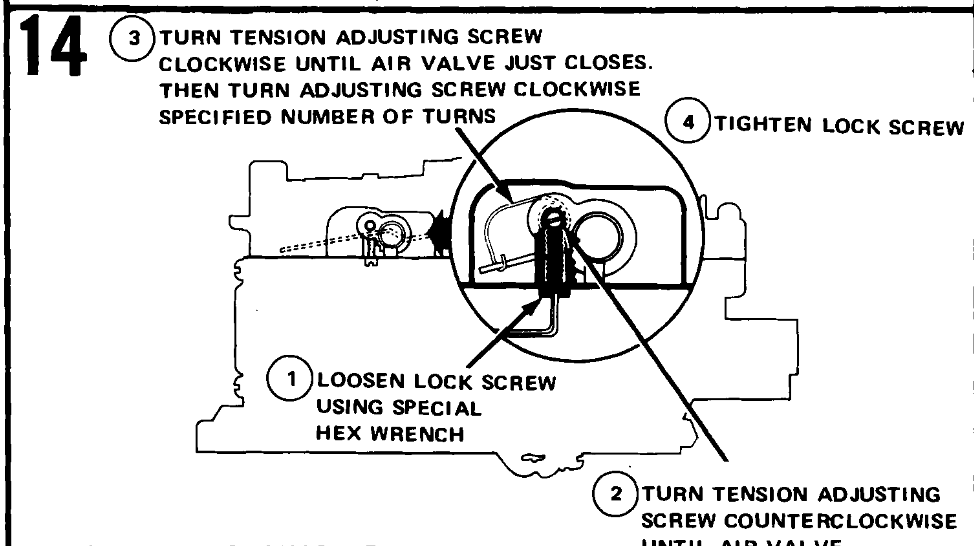
M4MC–M4ME CARBURETOR OVERHAUL ADJUSTMENTS

Fig. 6C-105 M4MC Adjustment Procedures



SECONDARY OPENING ADJUSTMENT

(See Figure)



AIR VALVE SPRING ADJUSTMENT

CARB. NO.	NO TURNS	
17057250	1/2"	
253	1/2"	
255	1/2"	
256	1/2"	
258	1/2"	
262	1/2"	
263	5/8"	
266	1/2"	
274	1/2"	
550	1/2"	
553	1/2"	

M4MC–M4ME CARBURETOR OVERHAUL ADJUSTMENTS

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Fig. 6C-106 M4MC Adjustment Procedures

A complete carburetor overhaul includes disassembly, thorough cleaning, inspection and replacement of all gaskets, diaphragms, seals and worn or damaged parts.

DISASSEMBLY

NOTE: Before performing any service on the carburetor, it is essential that the carburetor be placed on a holding fixture such as Tool J 8328-1. Without the use of the holding fixture, it is possible to bend or nick throttle valves.

Solenoid Removal (if equipped)

Remove screws securing the solenoid and bracket to float bowl and remove solenoid and bracket assembly.

CAUTION: *The solenoid should not be immersed in any type of carburetor cleaner and should always be removed before complete carburetor overhaul.*

Air Horn

Removal

1. Remove upper choke lever from the end of choke shaft by removing retaining screw (Fig. 6C-107). Then rotate upper choke lever to remove choke rod from slot in lever.
2. Remove choke rod from lower lever inside the float bowl casting by holding lower lever outward with small screwdriver and twisting rod counterclockwise.
3. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger. Lift upward on metering rod hanger until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger (Fig. 6C-108).
4. Using special tool J-25322, drive small roll pin (pump lever pivot pin) inward just until pump lever can be removed from air horn. Then remove pump lever from pump rod (Fig.

6C-109)

CAUTION: *Use care in removing small roll pin to prevent damage to pump lever casting bosses in air horn.*

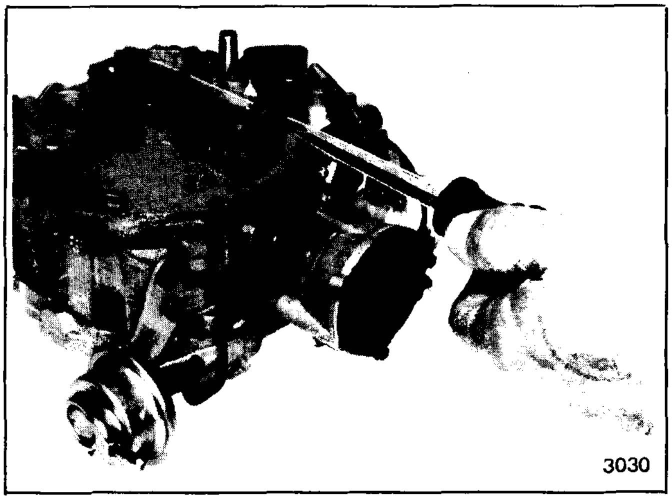


Fig. 6C-107 Removing Upper Choke Lever

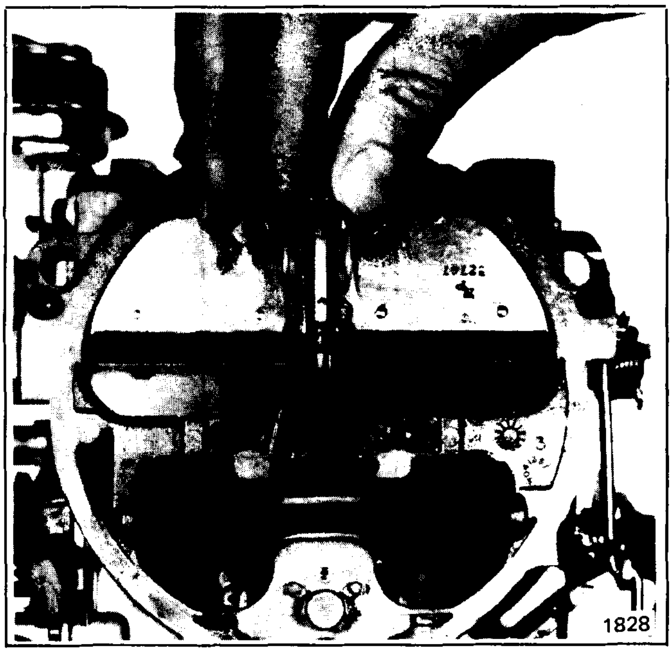


Fig. 6C-108 Removing Secondary Metering Rods

5. Remove nine air horn to bowl attaching screws; two attaching screws are located next to the venturi. (Two long screws, five short screws, and two countersunk screws.) (Fig. 6C-110) Remove secondary air baffle deflector from beneath the two center air horn screws (where used).

6. Remove air horn from float bowl by lifting straight up. The air horn gasket should remain on the float bowl for removal later (Fig. 6C-111).

CAUTION: *When removing air horn from float bowl, use care to prevent bending the small tubes protruding from the air horn. These tubes are permentntly pressed into the air horn casting. DO NOT REMOVE.*

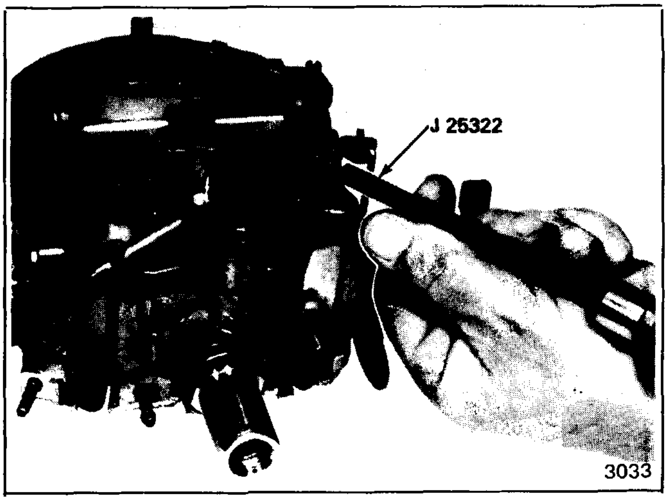


Fig. 6C-109 Removing Pump Lever

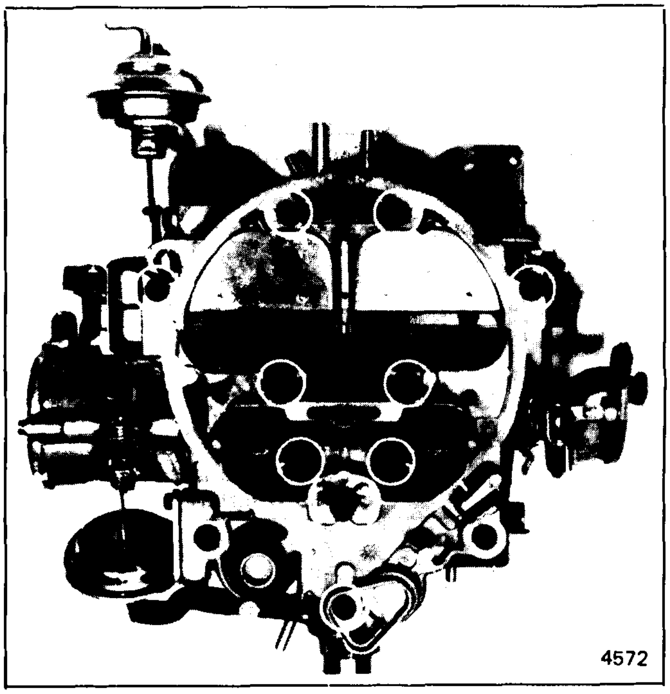


Fig. 6C-110 Air Horn Screws

Air Horn

Disassembly

Remove front vacuum break attaching screws. The diaphragm assembly may now be removed from the air valve dashpot rod and the dashpot rod from the air valve lever (Fig. 6C-112). Do not place vacuum break assembly in carburetor cleaner.

Further disassembly of the air horn is not required for cleaning purposes. If part replacement is required, proceed as follows:

1. Remove staking on two choke valve attaching screws, then remove choke valve and shaft from air horn.

2. Secondary air valves and air valve shaft should not be removed.

3. If it is necessary to replace the air valve closing spring or center plastic eccentric cam, a repair kit is available. (Part Number 7035344) or equivalent. Instructions are included in

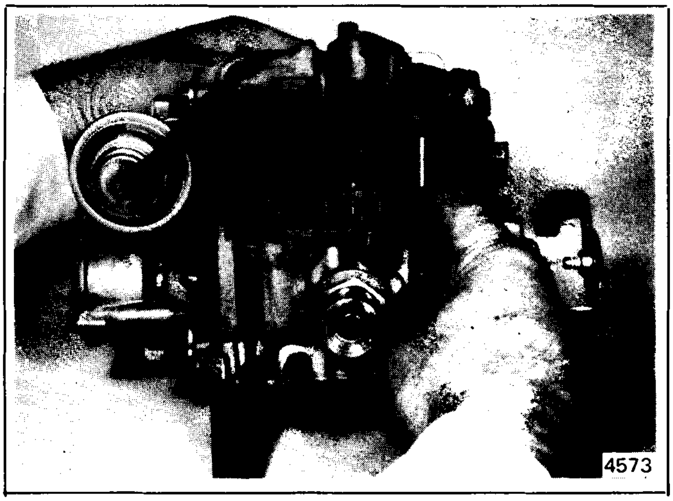


Fig. 6C-111 Removing Air Horn

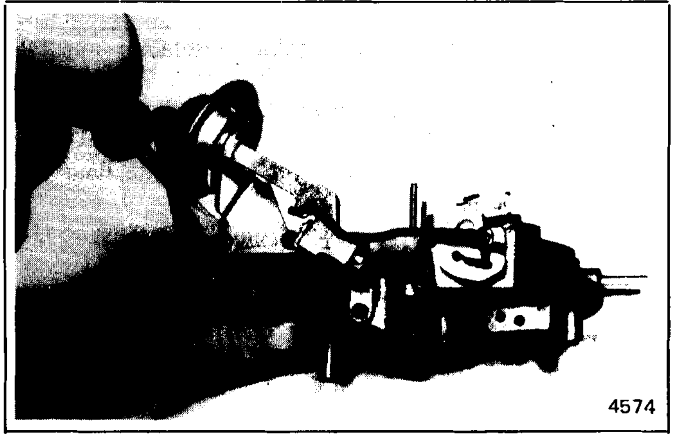


Fig. 6C-112 Removing Front Vacuum Break

the repair kit.

Float Bowl Disassembly (Fig. 6C-113).

1. Remove air horn gasket by lifting off of dowel locating pins and lifting tab of gasket from beneath the power piston hanger, being careful not to distort springs holding the main metering rods.
2. Remove pump plunger from pump well.
3. Remove pump return spring from pump well.
4. Remove power piston and metering rods by depressing piston stem and allowing it to snap free.

The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the retainer. This procedure may have to be repeated several times.

CAUTION: *Do not remove power piston by using pliers on metering rod hanger.*

5. Remove the power piston spring from the well.

CAUTION: *The A.P.T. metering rod adjustment screw is pre-set at the factory and no attempt should be made to change this adjustment in service. If float bowl replacement is required during service, the new bowl assembly will be suppleed with an A.P.T. metering rod screw which will be pre-set as required.*

6. Remove metering rods from power piston by disconnecting tension spring from top of each rod, then rotate rod to remove from hanger (Fig. 6C-114).

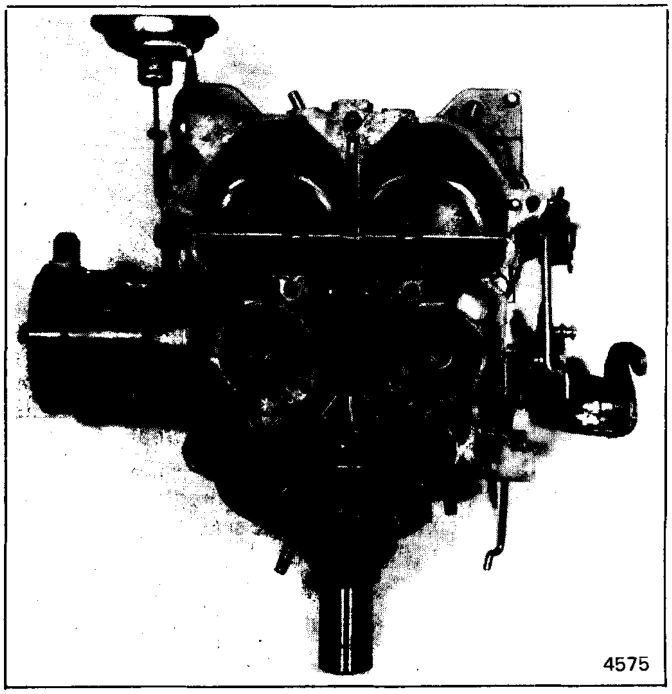


Fig. 6C-113 Float Bowl

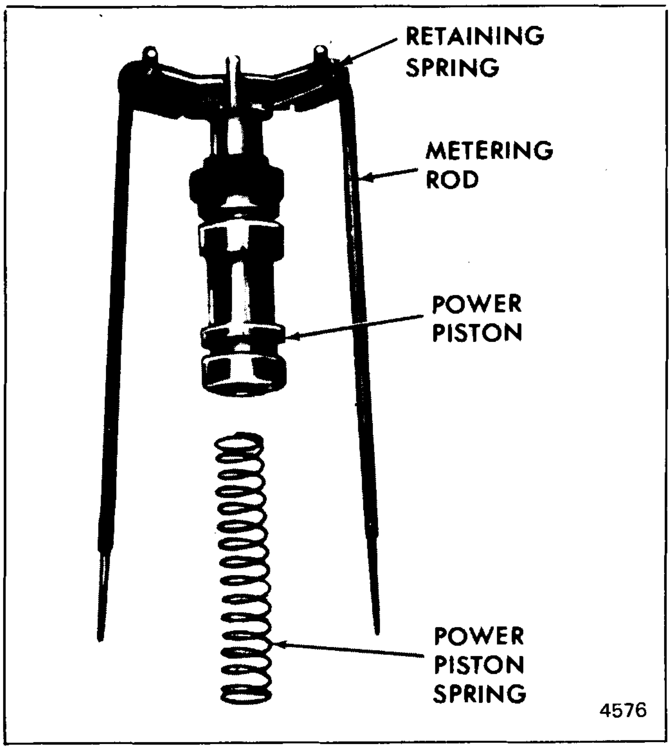


Fig. 6C-114 Power Piston and Metering Rods

CAUTION: *Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully position of tension spring for later reassembly.*

7. Remove plastic filler block over float.

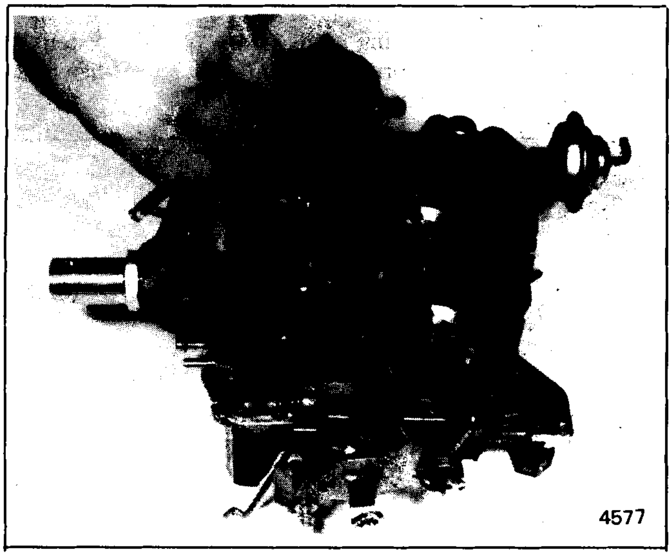


Fig. 6C-115 Removing Needle Seat

8. Remove float assembly and float needle by pulling up on retaining pin. Remove float needle seat and gasket, using seat remover J-22769 (Fig. 6C-115).

9. Remove aneroid cavity insert from float bowl.

10. Remove primary main metering jets, only if necessary.

NOTE: No attempt should be made to remove the secondary metering jets (metering orifice plates). These jets are fixed and, if damaged, bowl replacement is required.

11. Remove pump discharge check ball retainer and check ball (Fig. 6C-116).

12. Remove secondary air baffle, if replacement is required.

13. Remove pump well fill slot baffle.

14. Remove hose from rear vacuum break control assembly. Remove two screws from rear vacuum break bracket and rotate the assembly to remove vacuum break rod from slot in plunger head.

CAUTION: *Do not place vacuum break assembly in carburetor cleaner.*

15. Remove vacuum break rod by holding down on fast idle cam (hot idle position); move end of vacuum break rod away from float bowl; then disengage rod from hole in intermediate choke lever.

Choke

1. Remove three attaching screws and retainers from choke cover and coil assembly. Then pull straight outward and remove cover and choke assembly from choke housing. Remove choke cover gasket. Do not remove baffle plate from beneath the thermostatic coil. Distortion of the thermostatic coil may result if forced off the center retaining post on the choke cover.

2. Remove choke housing assembly from float bowl by removing retaining screw and washer inside the choke housing (Fig. 6C-117). The complete choke assembly can be removed from the float bowl by sliding outward.

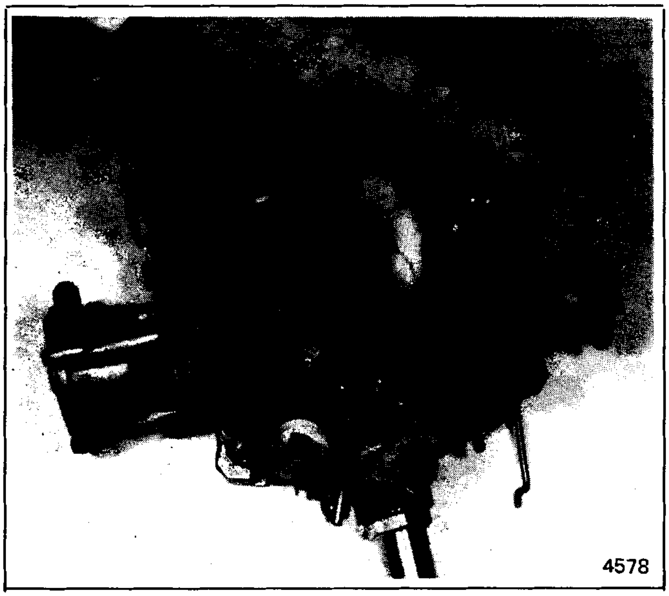


Fig. 6C-116 Remove Pump Discharge Retainer and Ball

3. Remove secondary throttle valve lockout lever from float bowl (Fig. 6C-117).

4. Remove lower choke lever from inside float bowl cavity by inverting bowl.

5. Remove plastic tube seal from choke housing (Fig. 6C-117).

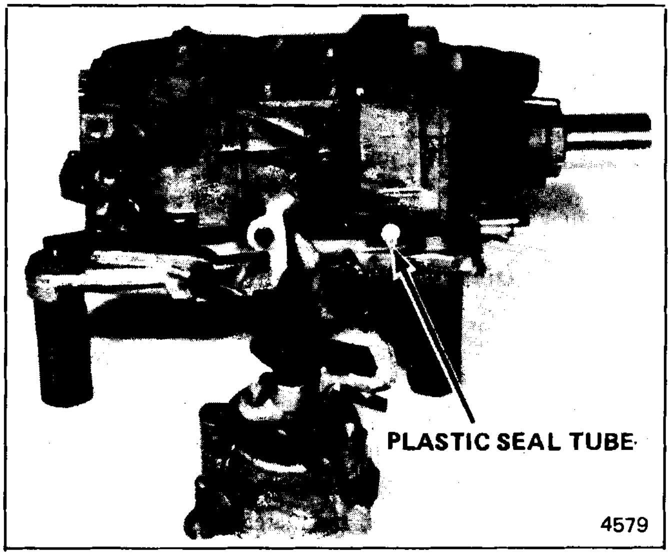


Fig. 6C-117 Choke Housing

CAUTION: *Plastic tube seal should not be immersed in carburetor cleaner.*

6. To disassemble intermediate choke shaft from choke housing, remove coil lever retaining screw at end of shaft inside the choke housing Then remove thermostatic coil lever from flats on intermediate choke shaft. Remove intermediate choke shaft from the choke housing by sliding outward. The fast idle cam can now be removed from the intermediate choke shaft.

CAUTION: *Remove the cup seal from inside choke housing shaft hole if the housing is to be immersed in carburetor cleaner. Also, remove the* *cup seal from the float bowl plastic insert for bowl cleaning purposes. DO NOT ATTEMPT TO REMOVE PLASTIC INSERT.*

7. Remove fuel inlet nut, gasket, check valve filter assembly and spring.

8. Remove throttle body by removing body to bowl attaching screws (Fig. 6C-118).

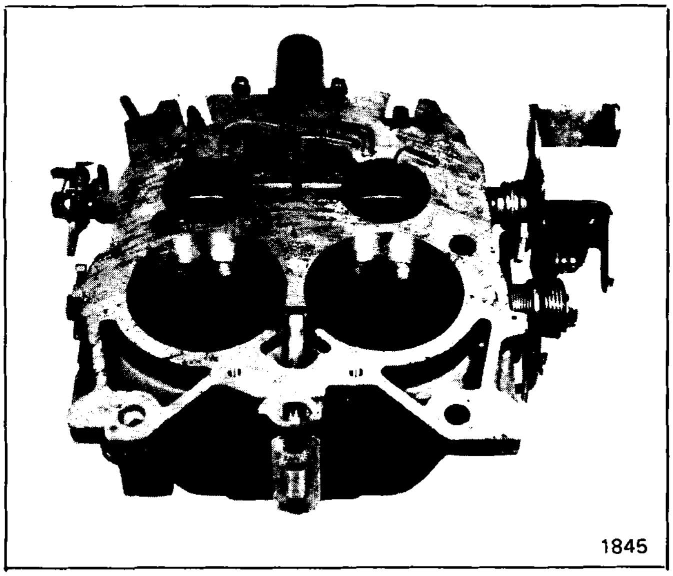


Fig. 6C-118 Throttle Body

9. Remove throttle body to bowl insulator gasket (Fig. 6C-119).

Throttle Body Disassembly

1. Remove pump rod from throttle lever.
2. Remove idle mixture limiter caps, screws and springs.

CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

CAUTION: *The solenoid, rubber parts, plastic parts, diaphragms, pump plungers, should not be put in immersion type cleaner as they will swell, harden or distort. The bushing in the bowl will withstand normal cleaning. Rinse thoroughly after cleaning.*

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.

2. Check, repair or replace the following parts if the following problems were encountered.

A. **Flooding**

1. Inspect float needle seat for dirt, deep wear grooves, scores and proper seating.

2. Inspect float, float arms and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

B. **Hesitation**

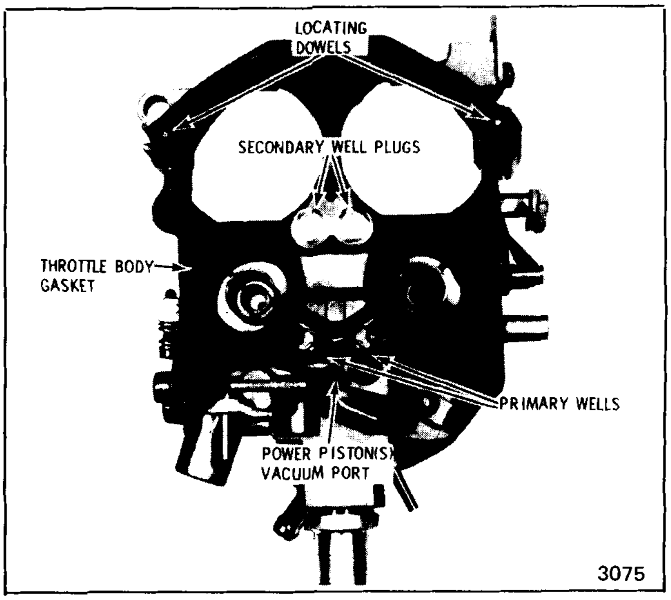


Fig. 6C-119 Throttle Body Gasket

1. Inspect pump plunger for cracks, scores or excessive cup wear. A used pump cup will shrink when dry. Soak in fuel for 8 hrs. before testing if dried out.

2. Inspect pump duration and return spring for being weak or distorted.

3. Check for dirt in pump passages and jets, improper seating of inlet or discharge balls, and scores in pump well.

4. Check pump linkage for excessive wear, repair or replace as necessary.

C. **Hard Starting - Poor Cold Operation**

1. Check choke valve and linkage for excessive wear, binds or distortion.
2. Inspect choke vacuum diaphragms for leaks.
3. Clean or replace carburetor filter.
4. Inspect inlet needle for sticking, dirt, etc.
5. Examine fast idle cam for wear or damage.
6. Also check items under "flooding".

D. **Poor Performance - Poor Gas Mileage**

1. Check power piston, and metering rods for dirt, sticking, binding, damaged parts or excessive wear.
2. Clean all fuel and vacuum passages in castings.

E. **Rough Idle**

1. Inspect idle needle for ridges, burrs or being bent.
2. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks and other damage.
3. Clean all idle fuel passages.
4. Check throttle lever and valves for binds, nicks and other damage.

CARBURETOR ASSEMBLY

Throttle Body

1. If removed, install idle mixture needles and springs until seated. Back out the mixture needles three turns as a preliminary idle adjustment. Final adjustment must be made on the engine using the procedures described under idle mixture adjustment.

2. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point outwards toward throttle lever.

Float Bowl

NOTE: If a new float bowl assembly is used, stamp or engrave the model number on the new float bowl. See Fig. 6C-93.

1. Install new throttle body to bowl gasket over two locating dowels on bowl.

2. Install throttle body making certain throttle body is properly located over dowels on float bowl, then install throttle body to bowl screws and tighten evenly and securely (Fig. 6C-118).

3. Place carburetor on proper holding fixture J 8328-1.

4. Install fuel inlet filter spring, check valve filter assembly, new gasket and inlet nut and tighten nut to 18 ft. lbs.

CAUTION: *The fuel inlet check valve filter assembly is required to meet motor vehicle safety standards (M.V.S.S.) for roll-over. New service replacement filter includes the check valve.*

NOTE: Ribs on closed end of filter element prevent filter from being installed incorrectly unless forced.

CAUTION: *Tightening beyond specified torque can damage nylon gasket.*

5. Install new cup seal into plastic insert on side of float bowl for intermediate choke shaft. Lip on cup seal faces outward.

6. Install secondary throttle valve lockout lever on boss on float bowl with recess in hole in lever facing inward.

7. Install new cup seal into inside choke housing shaft hole. Lips on seal face inward, towards inside of housing.

8. Install fast idle cam onto the intermediate choke shaft (steps on fast idle cam face downward). (Fig. 6C-117).

9. Carefully install fast idle cam and intermediate choke shaft assembly through seal in choke housing; then install thermostatic coil lever onto flats on intermediate choke shaft. Inside thermostatic choke coil lever is properly aligned when both inside and outside levers face towards fuel inlet. Install inside lever retaining screw into end of intermediate choke shaft. Tighten securely.

10. Using Tool J-23417, install lower choke rod lever into cavity in float bowl. Install plastic tube seal into cavity on choke housing before assembling choke housing to bowl. Install choke housing to bowl sliding intermediate choke shaft into lower choke lever (Fig. 6C-120).

NOTE: The intermediate choke shaft lever and fast idle cam are in correct relation when the tang on lever is beneath the fast idle cam. Do not install choke cover and coil assembly until inside coil lever is adjusted (see Adjustments).

11. Holding down on fast idle cam (hot idle position), install end of rear vacuum break rod in hole in intermediate choke lever.

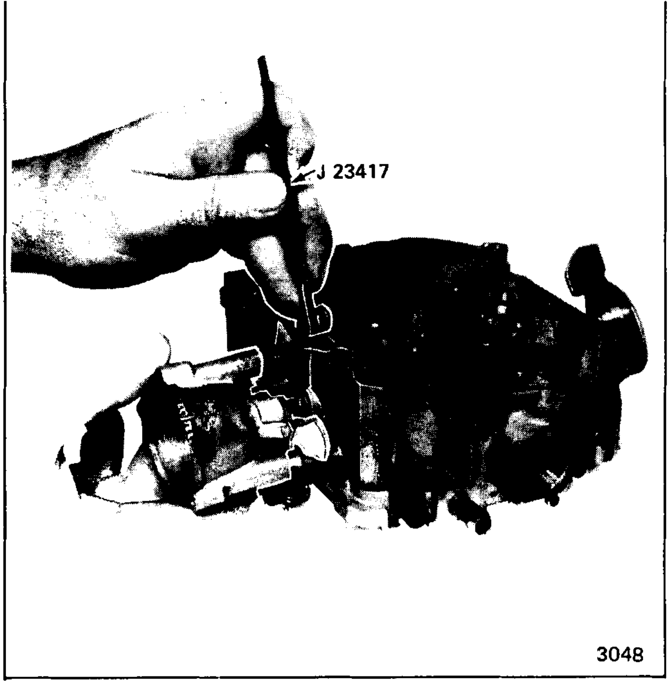


Fig. 6C-120 Choke Lever and Housing

12. Install end of vacuum break rod in slot in rear vacuum break plunger head. Then install rear vacuum break control and bracket assembly to float bowl using two attaching screws. Tighten securely.

NOTE: Do not attach vacuum break hose until after the vacuum break adjustment is complete. Refer to adjustment procedure.

13. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be flush with bowl casting.

14. Install baffle inside of pump well with slot toward bottom.

15. Install pump discharge check ball and retainer in passage next to pump well. Tighten retainer securely.

16. Install primary main metering jets, if removed.

17. Install aneroid cavity insert into float bowl.

18. Install new needle seat assembly, with gasket, using seat installer J-22769.

19. To make float adjustment easier, carefully bend float arm upward at notch in arm before assembly.

Install needle by sliding float lever under needle pull clip -- correct installation of the needle pull clip is to hook the clip over the edge of the float on the float arm facing the float pontoon (Fig. 6C-121). With float lever in pull clip, hold float assembly at toe and install retaining pin from aneroid cavity side (ends of retaining pin face the accelerating pump well).

CAUTION: *Do not install float needle pull clip into holes in float arm.*

a. Hold float retainer firmly in place.

b. Push float down lightly against needle.

c. With adjustable T-scale, gage from top of float bowl casting (air horn gasket removed) to top of float gaging point 3/16" back from end of float at toe.

d. Bend float arm as necessary for proper adjustment by pushing on pontoon. Refer to adjustment chart for specification.

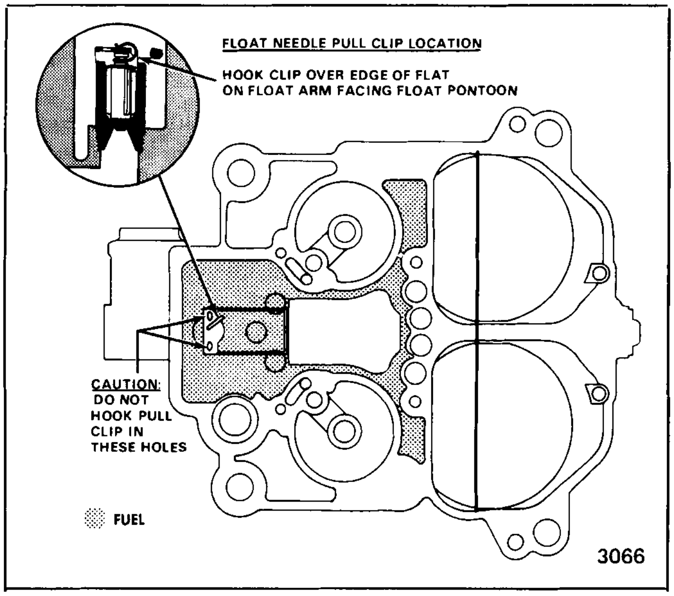


Fig. 6C-121 Pull Clip Location

e. Visually check float alignment after adjustment.

20. Install plastic filler block over float needle, pressing downward until properly seated.

21. Install power piston spring in power piston well. If main metering rods were removed from hanger, reinstall making sure tension spring is connected to top of each rod. Install power piston assembly in well (aligning pin on piston with slot in well) with metering rods properly positioned in metering jets. Press down firmly on plastic power piston retainer to make sure the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, tap retainer lightly in place.

22. Install pump return spring in pump well.

23. Install air horn gasket by carefully sliding tab of gasket around main metering rods and beneath the power piston hanger. Position gasket over the two dowel pins on the float bowl.

24. Carefully lift corner of the air horn gasket and install pump plunger in the pump well by pushing the plunger to the bottom of the well against return spring tension. While holding in this position, align pump plunger stem with hole in gasket.

AIR HORN ASSEMBLY

1. If removed, install choke shaft, choke valve, and two attaching screws. Tighten screws securely and stake lightly in place.

2. Check choke valve for freedom of movement and proper alignment before staking screws in place.

AIR HORN TO BOWL INSTALLATION

1. Holding down on air horn gasket at pump plunger location, carefully lower air horn assembly onto float bowl making sure that the bleed tubes, accelerating well tubes, pullover enrichment tubes (if used), and pump plunger stem are positioned properly through the holes in the air horn gasket.

CAUTION: *Do not force the air horn assembly onto the bowl.*

2. Install two long air horn screws, five short screws, and two countersunk screws into primary venturi area.

NOTE: Install secondary air baffle beneath screws no. 3 and 4 (where used).

All air horn screws must be tightened evenly and securely. See Fig. 6C-122 for proper tightening sequence.

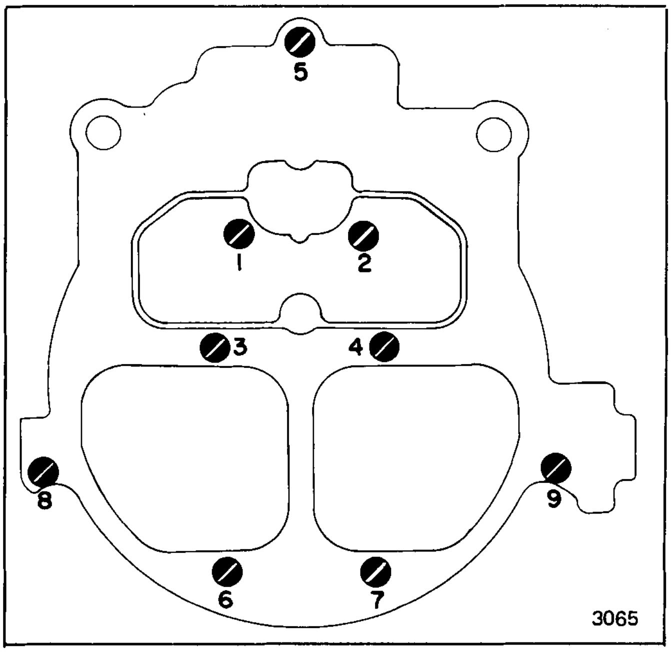


Fig. 6C-122 Air Horn Tightening Sequence

3. Install vacuum break diaphragm rod into the slot in lever on the end of the air valve shaft. Then install the other end of rod into hole in the front vacuum break diaphragm plunger. Install front vacuum break control and bracket assembly to air horn using two retaining screws through the bracket. Tighten screws securely.

NOTE: Do not attach vacuum break hose until vacuum break adjustment is completed. Refer to adjustment procedure.

4. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever. Align hole in pump lever with hole in air horn casting using J-25322. Using small screwdriver, push pump lever roll pin back through casting until end of pin is flush with casting bosses in air horn (Fig. 6C-123).

CAUTION: *Use care installing the small roll pin to prevent damage to pump lever casting bosses.*

5. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod holder, with rods, onto air valve cam follower. Install retaining screw and tighten securely, Fig. 6C-108. Work air valves up and down several times to make sure they are free in all positions.

6. Connect choke rod into lower lever inside bowl cavity; then install choke rod into slot in upper choke lever and retain the choke lever to the end of the choke shaft with attaching

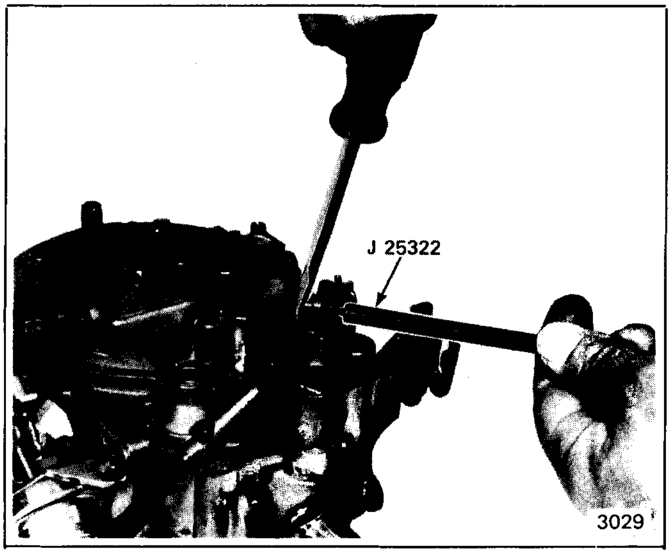


Fig. 6C-123 Installing Pump Lever

screw. Tighten securely. When properly installed, the lever will point to the rear of the carburetor and the number on the lever will face outward (Fig. 6C-107).

Make sure that the flats on the end of the choke shaft align with flats in the choke lever.

7. The front and rear vacuum break units, fast idle cam (choke rod), and inside thermostatic choke coil lever must be adjusted properly before installing the choke thermostatic coil and cover assembly and gasket. Refer to the Adjustment Procedures.

8. After the vacuum break, fast idle cam (choke rod), and inside thermostatic coil lever are adjusted, the thermostatic coil and cover, and gasket should be installed and the cover assembly rotated counterclockwise toward the closed choke valve position. Align scribe mark on cover with the specified notch on housing (See Automatic Choke Coil Adjustment). Install three cover retainers and screws and tighten securely.

9. If solenoid was removed, install solenoid and bracket assembly with two screws to float bowl. Tighten securely.

10. After making vacuum break settings, connect the front and rear vacuum break hoses.

FUEL SUPPLY

CONTENTS

GENERAL DESCRIPTION

ON-CAR SERVICE

GENERAL DESCRIPTION

Fuel Filter

All engine fuel filters are located in the carburetor fuel inlet. These fuel filter elements are of pleated paper. Elements are placed in the inlet hole with the gasket surface outward. A spring holds the element outward, sealing it by compressing a gasket surface against the inlet fitting. If the filter should ever become plugged, the engine will stop. An engine stoppage caused by a plugged filter element will be preceeded by a hesitation or sluggish operation.

Fuel Pump - Electric

The pump operates under the following two conditions:

1. Ignition in START position, no oil pressure.
2. Ignition in RUN position, oil pressure (engine running).

The two position oil pressure switch controls pump operation. With no oil pressure, during cranking, current from the starter solenoid PURPLE wire feed, goes through the oil pressure switch, to the DK BLUE wire to the cowl connector, then through the PINK wire to the ELECTRIC FUEL fuse in the fuse panel to the DK BLUE wire to the fuel pump. Once the engine starts, and there is oil pressure, the oil pressure switch directs current from the PINK wire (from the ignition switch) to the DK BLUE wire, through the fuse, and to the pump.

THE TEMP PRESS lamp lights under the following conditions:

1. No oil pressure, ignition in RUN.
2. Engine overheated, ignition in RUN.

The TEMP PRESS lamp receives its feed through the PINK wire from the GAUGES fuse at the fuse panel. The ground side is completed through the following two possible paths:

1. Through the DK BLUE wire to the Key Buzzer, through the diode in the Key Buzzer, through the DK BLUE WHT STR wire to the cowl connector (where it junctions with the DK BLUE wire to the oil pressure switch, and the PINK wire to the ELECTRIC FUEL fuse), through the DK BLUE wire to the oil pressure switch, through the oil pressure switch to the PURPLE wire (no oil pressure) to the starter solenoid, the ground through the starter solenoid

2. Or through the DK BLUE wire to the harness junction, through the DK GREEN wire, to the temperature switch to ground (switch closed, engine overheated).

The Key Buzzer is fed by the ORANGE wire from the CLOCK LIGHTER COURTESY fuse at the fuse panel. It buzzes when the PINK BLK STR wire is grounded through the Key switch in the steering column (key in ignition) and driver's door jamb switch (door open).

The instrument panel gage unit gets feed through the PINK wire from the GAUGES fuse. The TAN wire connects the gage to a variable resistance ground through the sending unit in the fuel tank.

Fuel Pump - Mechanical

The fuel pump is a diaphragm type pump and is actuated by the rocker arm through a link and a pull rod (see Fig. 6C-1).

Many cars have a special fuel pump which has a metering outlet for a vapor return system. Any vapor which forms is returned to the fuel tank along with hot fuel through a separate line. This greatly reduces any possibility of vapor lock by keeping cool fuel from the tank constantly circulating through the fuel pump.

Fuel Tank and Lines

All series have a fuel tank mounted in the rear of the vehicle. All fuel tanks have an emission pipe going to the charcoal canister for venting purposes and a fuel feed pipe for delivery of fuel to the engine. Some vehicles have a third pipe, called vapor return pipe, which returns fuel and vapors from the fuel pump to the fuel tank. The vapor return pipe permits continuous circulation of fuel through the fuel feed pipe and reduces the possibility of vapor lock. The fuel feed pipe is 3/8" diameter. The emission pipe is 5/16" diameter. The vapor return pipe is 1/4" diameter.

Evaporative Emission Control System (EEC)

All Pontiacs are equipped with a system designed to prevent escape of fuel vapor to the atmosphere. Vapor generated by evaporation of fuel in the tank, previously exhausted to atmosphere, is transferred by an emission line to the engine compartment. During periods of operation, vapors are fed directly to the engine for consumption. During periods of inoperation, an activated charcoail canister located in the emission line stores any vapor generated for consumption during the next period of operation.

The amount of vapor drawn into the engine at any time is too small to have any effect on fuel economy or engine operation.

With this closed system it is extremely important that only vapors be transferred to the engine. To avoid the possibility of liquid fuel being drawn into the system, these following features are included as part of the total system:

1. A fuel tank overfill protector is provided on all series to assure adequate room for expansion of liquid fuel volume with temperature changes.

2. A one point fuel tank venting system is provided on all series to assure that the tank will be vented under any conceivable car attitude. This is accomplished by using a dome type fuel tank on Sedans and Coupes.

3. To protect the tank from mechanical damage in the event of excessive internal or external pressures resulting from the operation of this closed system, a pressure-vacuum relief valve, located in the gas cap, will control the tank internal pressure.

ON-CAR SERVICE

Fuel Filter

The carburetor inlet fuel filter should be replaced every 15,000 miles or 12 months.

After assembling any filter element in the carburetor, always start the engine and check for leaks in the fuel line and fittings before installing the air cleaner.

Other Filters or Strainers

A woven plastic filter is located on the lower end of the fuel pickup pipe in the gas tank. This filter prevents dirt from entering the fuel line and also stops water unless the filter becomes completely submerged in water. This filter is self cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the gas tank contains an abnormal amount of sediment or water; the tank should therefore be removed and thoroughly cleaned.

Fuel Pump Inspection and Test

If the fuel system is suspected of delivering an improper amount of fuel to the carburetor, it should be inspected and tested in the car, as follows:

Inspection of Fuel System

1. Make certain that there is gasoline in the tank.

2. With the engine running, inspect for leaks at all gasoline feed hose connections from fuel tank to carburetor. Tighten any loose connections. Inspect all hoses for flattening or kinks which would restrict the flow of fuel. Air leaks or restrictions on suction side of mechanical fuel pump will seriously affect pump output.

3. Inspect for leaks at fuel pump diaphragm flange.

4. Disconnect feed pipe near carburetor. Disconnect distributor feed wire so that engine can be cranked without firing. Place suitable container at end of pipe and crank engine a few revolutions. If no gasoline, or only a little flows from the pipe, the feed line is clogged or fuel pump is inoperative. Before suspecting the fuel pump, disconnect feed line at both ends and blow through it with air hose to make certain the fuel pipe is clear. Re-check fuel pump capacity.

Fuel Pump Pressure Test

1.Disconnect gasoline line near carburetor and connect a suitable pressure gage (such as Pressure-Leakdown Tester J-22109).

2. Start engine and check pressure with engine running at slow idle speed. Fuel pump pressure should be as specified at the end of this section. On cars equipped with a vapor return system, squeeze off the return hose so that an accurate reading can be obtained.

3. If fuel pump pressure is below minimum, pump must be replaced.

Fuel Pump Flow Test

1. Disconnect fuel line from carburetor. Run fuel line into a suitable measuring container.

2. While observing the sweep second hand of a clock or watch, run the engine at idle until there is one pint of fuel in the container. One pint should be pumped in 30 seconds or less.

3. If flow is below minimum, check for restriction in the line.

REMOVAL AND INSTALLATION OF ELECTRIC FUEL PUMP

Removal

H Series

CAUTION: *Remove battery negative cable from battery post before attempting fuel pump removal.*

1. Disconnect meter and pump wires at rear wiring harness connector.
2. Raise vehicle on hoist.
3. Drain fuel tank.
4. Disconnect fuel line hose at gage unit pickup line.
5. Disconnect tank vent line to vapor separator.
6. Remove gage ground wire screw at underbody floor pan.
7. Remove tank straps bolts and lower tank carefully.
8. Unscrew retaining can ring using Spanner Wrench J-24187 and remove fuel pump-tank unit assembly.
9. Remove flat wire conductor from plastic clip on fuel tube.
10. Squeeze clamp and pull pump straight back approximately one-half inch.
11. Remove two nuts and lockwashers and conductor wires from pump terminals.
12. Squeeze clamp and pull pump straight back to remove it from tank unit - take care to prevent bending of circular support bracket.
13. Slide replacement pump through circular support bracket until it rests against rubber coupling - make sure pump has rubber isolator and saran strainer are attached (supplied in service package).
14. Attach two conductor wires to pump terminals, using the two lockwashers and nuts furnished - make certain flat conductor is attached to terminal located on side away from float arm.
15. Squeeze clamp and push pump into rubber coupling.
16. Replace flat wire conductor in plastic clip on fuel pickup tube.

Installation

1. Install fuel pump-tank assembly in fuel tank. Install retaining cam ring using Spanner Wrench J-24187.
2. Reinstall wires and fuel tank by reversing removal steps 1 thru 5.
3. Lower vehicle.
4. Connect battery cable.
5. Start engine and check for leaks.

Removal and Installation of Mechanical Fuel Pump

Removal

All Series

1. Disconnect negative battery cable.
2. Disconnect fuel inlet hose from pump. Disconnect vapor return hose, if so equipped.
3. Disconnect fuel outlet pipe.
4. Remove two 1/2 inch hex head bolts, using a 3/8 inch drive deep socket and a ratchet handle.
5. Remove fuel pump.

Installation

1. Install new fuel pump with new gasket.
2. Install two 1/2 inch hex head bolts, turning them in alternately and evenly.
3. Install fuel outlet pipe. If it is difficult to start fitting, time can be saved by disconnecting upper end of pipe from carburetor. Tighten fitting securely, meanwhile holding fuel pump nut with a wrench. Install and tighten fitting at carburetor, if removed.
4. Install fuel inlet hose. Install vapor return hose, if so equipped.
5. Connect negative battery cable.
6. Start engine and check for leaks.

FUEL TANK AND LINES

Removal and Installation of Fuel Tank or Fuel Gage Tank Unit

All Series (Except "A" Station Wagons)

The fuel gage tank unit is combined with the pickup pipe and the tank filter. All series require lowering the fuel tank to replace the tank unit.

To lower a fuel tank, proceed as follows:

1. Disconnect battery.
2. Syphon all fuel from tank into a clean container.
3. Disconnect fuel hose and vapor return hose from gage tank unit.
4. Remove ground wire screw.
5. Unplug wire from gage unit.
6. Disconnect vent hose.
7. Disconnect support straps and lower tank.

Installation

1. To install fuel tank, reverse removal procedure.

To remove fuel gage tank unit, proceed as follows:

1. Unscrew cam ring using Wrench J-24187 for all series.
2. Remove fuel gage tank unit. Install new tank unit, being careful not to bend or damage it.
3. Complete gage unit installation by reversing above steps. Make sure electrical connections are clean and tight.

"A" Series Wagons

Removal

1. Disconnect battery.
2. Drain gas from tank into suitable container and disconnect fuel gage tank wire.
3. Raise car on hoist.
4. Remove left rear tire and wheel assembly.

5. Remove left quarter panel to wheelhouse filler panel (mud deflector) and bend lower attaching tab out of way.

6. Disconnect gas tank to wheelhouse ground wire.

7. Disconnect tail pipe hanger.

8. Disconnect fuel lines from gas tank.

9. Remove the end of bottom tank support straps.

10. Work tank forward and remove.

11. For installation reverse removal steps.

FUEL LINE REPAIR

1. Do not use rubber hose within 4" of any part of the exhaust system.

2. In repairable areas, cut a piece of fuel hose 4" longer than portion of line removed.

NOTE: Fuel hose is 3/8" I.D. and fuel return hose is 1/4" I.D.)

3. Slide clamps onto pipe and push hose 2" onto each portion of fuel pipe. Tighten clamps on each side of repair.

CLEANING FUEL SYSTEM - ALL SERIES

If trouble is due to contaminated fuel or foreign material that has been put into the tank, it can usually be cleaned. If tank is rusted internally, it should be replaced.

1. Disconnect battery negative cable and distributor feed wire.

2. Drain fuel tank.

3. Remove fuel tank.

4. Remove fuel inlet filter at carburetor and inspect for contamination. If filter is plugged, replace (leave fuel line disconnected).

5. Locate tank away from heat, flame, or other source of ignition. Remove fuel gage tank unit and inspect condition of filter. If filter is contaminated, a new filter should be installed upon reassembly.

6. Complete draining of tank by rocking it and allowing fuel to run out of tank unit hole.

7. Purge fuel tank with steam or running hot water for at least five minutes. Pour water out of tank unit hole (rock tank to assure complete removal of water).

WARNING: THIS PROCEDURE WILL NOT REMOVE FUEL VAPOR. DO NOT ATTEMPT ANY REPAIR ON TANK OR FILLER NECK WHERE HEAT OR FLAME IS REQUIRED.

8. Disconnect inlet fuel line at pump and use air pressure to clean fuel line and fuel return line (if equipped). Apply air pressure in the direction fuel normally flows through line.

9. Use low air pressure to clean pipes on tank unit.

10. Clean filter on fuel tank unit, if required. Install fuel tank gage unit (with new gasket) into tank and install tank. Connect tank unit wires and all fuel lines, except pump to carburetor line (see "Removal of Tank" for proper procedure).

11. Connect a hose to fuel line at carburetor; insert other end of hose into a one gallon fuel can.

12. Connect battery cable. Make sure distributor feed wire is disconnected.

13. Put six gallons of clean fuel in tank and operate starter to pump two quarts of fuel into fuel can. This will purge fuel pump.

14. Remove hose and connect fuel line to carburetor.

15. Connect distributor feed wire.

16. Check all connections for leaks.

FUEL TANK FILLER CAP

H Series

Removal

1. Rotate cap one-half turn counterclockwise to clear the first set of tanks from the slots inside the filler neck.

2. This will allow any residual pressure to escape.

3. Pull the cap outward and rotate one-quarter turn counterclockwise to clear second set of tangs, and remove the cap.

4. To install, reverse this procedure.

If a fuel cap requires a replacement, only a cap with these same features should be used. Failure to use the correct cap can result in a serious malfunction of the system. Correct replacement caps may be obtained from your dealer.

EVAPORATIVE EMISSION CONTROL SYSTEM

Maintenance requirements demand only that the oiled fiber-glass filter assembled in the bottom of the canister, be replaced every 30,000 miles or 24 months. Under extremely dusty conditions, more frequent attention may be required.

ACCELERATOR CONTROLS

GENERAL

The accelerator control system is cable type. There are no linkage adjustments. Check for correct opening and closing positions by operating accelerator pedal. If any binding is present, check routing of cable.

ACCELERATOR CONTROLS

Refer to Fig. 6C-124 through 6C-136 for installation of accelerator controls.

IDLE MIXTURE ADJUSTMENT

Idle mixture screws have been preset at the factory and capped. Do not remove the caps during normal engine maintenance.

Before suspecting the carburetor as the cause of poor engine performance or rough idle, check ignition system including distributor, timing, spark plugs and wires. Inspect air cleaner, evaporative emission system, EFE system, PCV system, EGR system, and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and

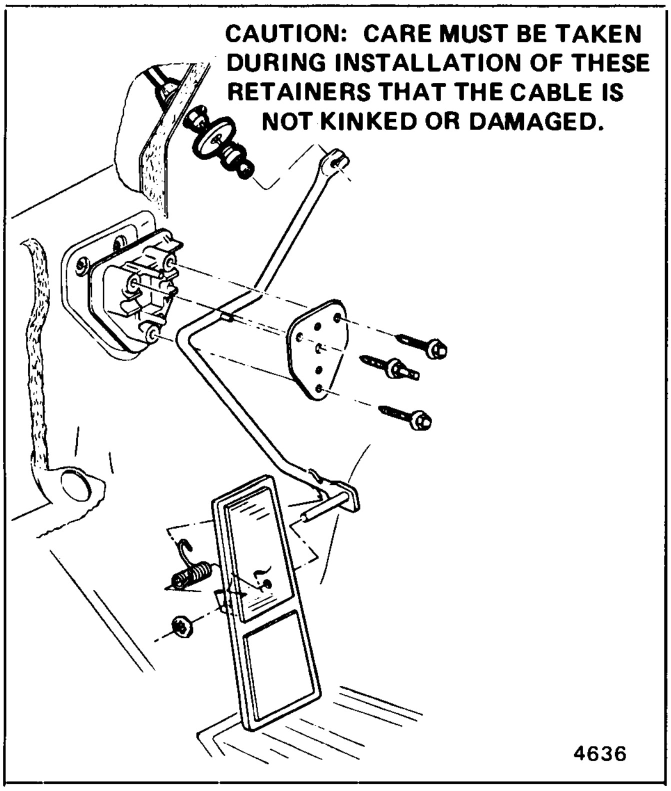

CAUTION: CARE MUST BE TAKEN DURING INSTALLATION OF THESE RETAINERS THAT THE CABLE IS NOT KINKED OR DAMAGED.

Fig. 6C-124 Accelerator Controls B Series

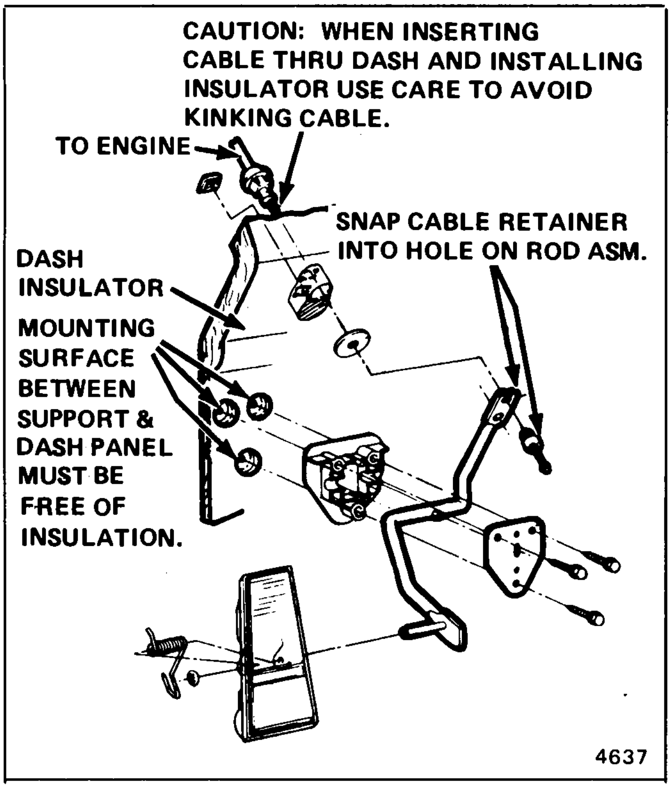

CAUTION: WHEN INSERTING CABLE THRU DASH AND INSTALLING INSULATOR USE CARE TO AVOID KINKING CABLE.

Fig. 6C-125 Accelerator Controls A and G Series

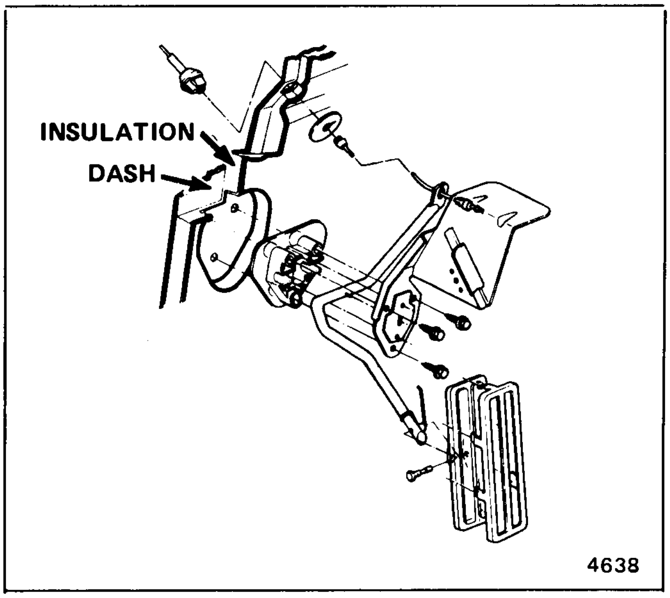
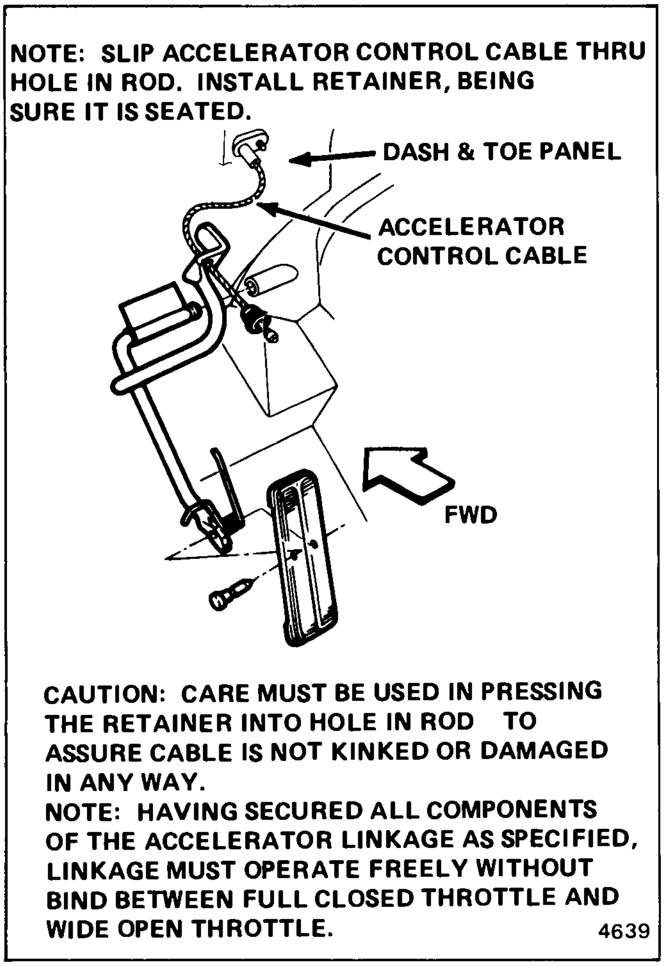


Fig. 6C-126 Accelerator Controls F Series


NOTE: SLIP ACCELERATOR CONTROL CABLE THRU HOLE IN ROD. INSTALL RETAINER, BEING SURE IT IS SEATED.

CAUTION: CARE MUST BE USED IN PRESSING THE RETAINER INTO HOLE IN ROD TO ASSURE CABLE IS NOT KINKED OR DAMAGED IN ANY WAY.
NOTE: HAVING SECURED ALL COMPONENTS OF THE ACCELERATOR LINKAGE AS SPECIFIED, LINKAGE MUST OPERATE FREELY WITHOUT BIND BETWEEN FULL CLOSED THROTTLE AND WIDE OPEN THROTTLE.

Fig. 6C-127 Accelerator Controls X Series

check torque of carburetor mounting bolts/nuts.

In the case of major carburetor overhaul, throttle body replacement or high idle CO as indicated by state or local emission inspection, then idle mixture may be adjusted. Adjusting mixture by other than the following method may violate Federal and/or California or other state or Provincial laws. The following procedure MUST be followed.

Procedure

1. Set parking brake and block drive wheels.

2. Remove air cleaner for access to carburetor, but keep vacuum hoses connected. On cars with automatic level control, disconnect and plug vacuum hose to compressor.

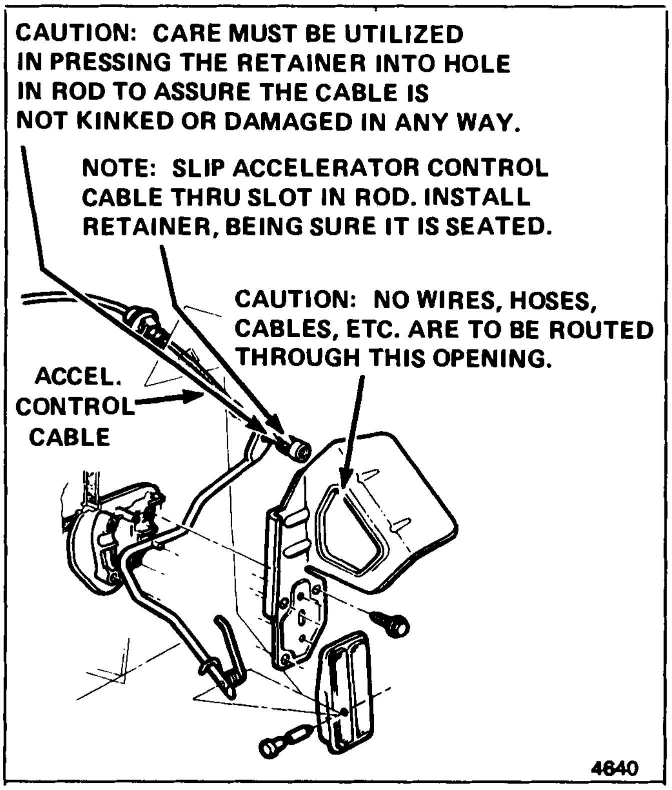


Fig. 6C-128 Accelerator Controls H Series

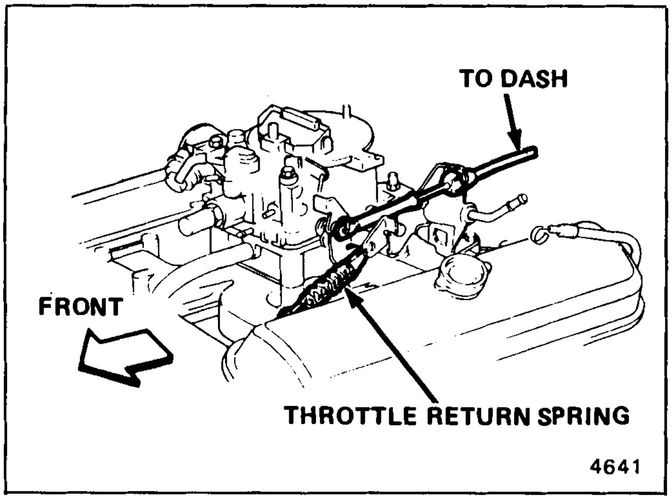


Fig. 6C-129 Accelerator Control Cable 301 Engine VI Code Y

3. Disconnect and plug other hoses as directed on Emission Control Information Label under the hood.

4. Engine must be at normal operating temperature, choke open, air conditioning off.

5. Connect an ACCURATE tachometer to engine.

6. Disconnect vacuum advance and plug hose. Check ignition timing. If necessary, adjust to specification shown on Emission Control Information Label. Reconnect vacuum advance.

NOTE: On cars with electronic spark timing, follow instructions on Emission Control Information Label very carefully.

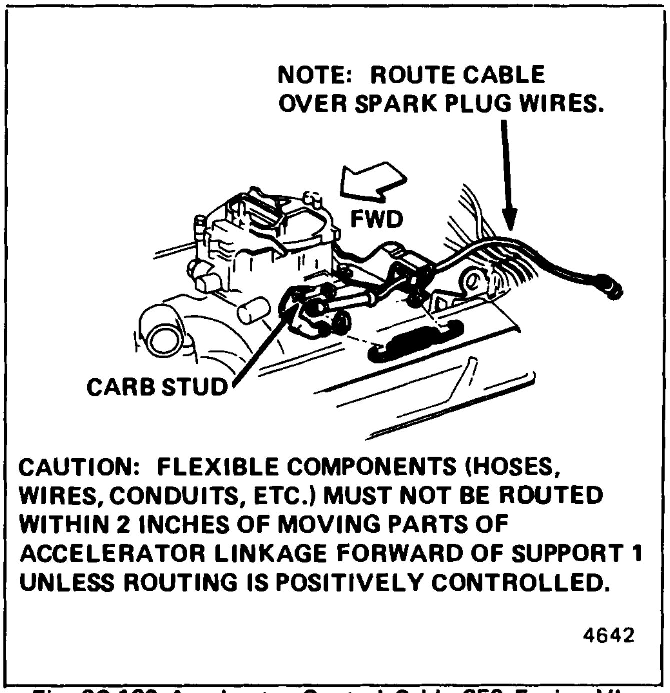


Fig. 6C-130 Accelerator Control Cable 350 Engine VI Code L

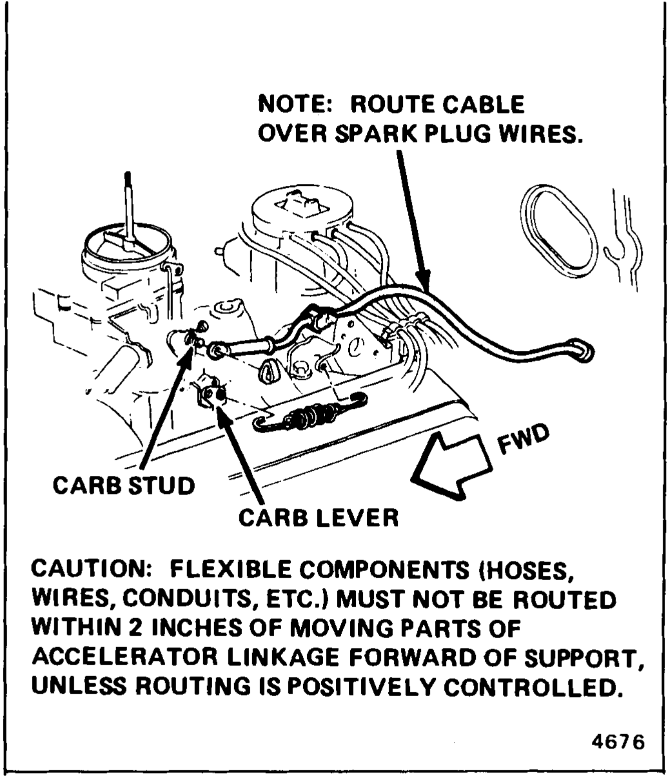


Fig. 6C-131 Accelerator Control Cable 305 Engine VI Code U

7. Carefully remove caps from idle mixture screws. Be careful not to bend screws. Lightly seat screws, then back out EQUALLY just enough so engine will run.

8. Place transmission in Drive (automatics) or Neutral (manuals).

9. Back each screw out (richen) 1/8 turn at a time until maximum idle speed is obtained. Then set idle speed screw to value shown in Chart Column A. Repleat Step 9 to be certain you have maximum idle speed.

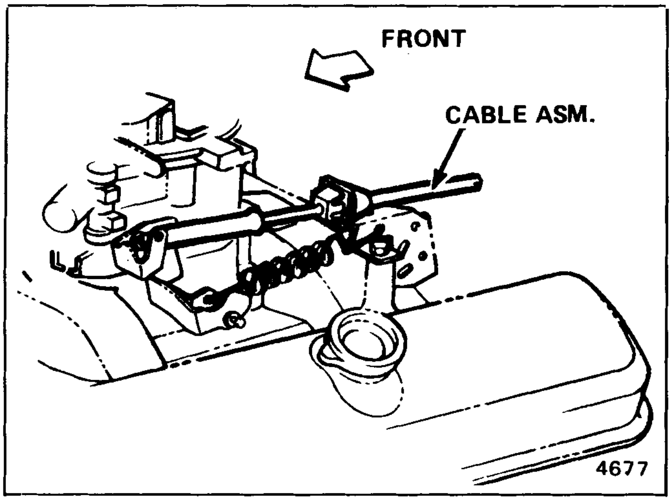


Fig. 6C-132 Accelerator Control Cable 350-400 Engine VI Codes P and Z

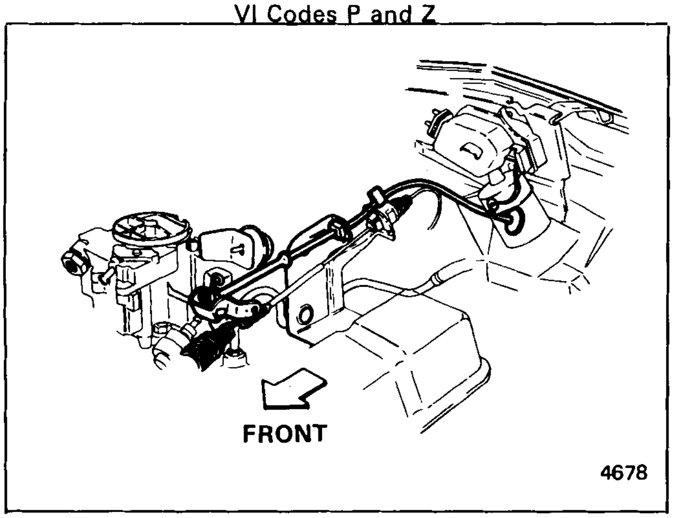


Fig. 6C-133 Accelerator Control Cable 231 Engine VI Code C

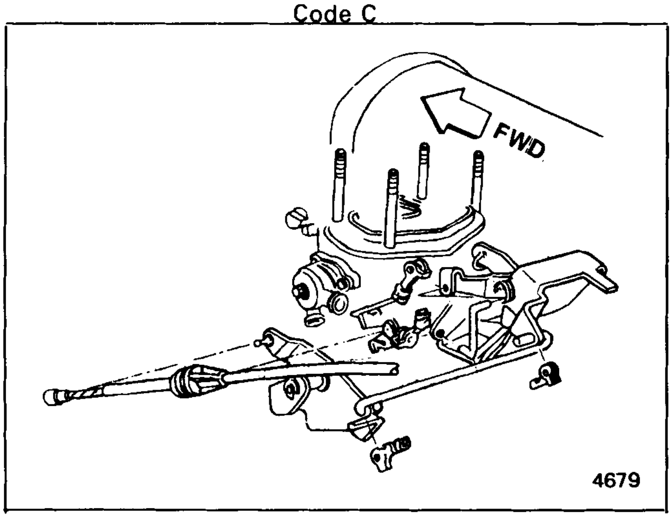


Fig. 6C-134 Accelerator Control Cable 140 Engine VI Code B

10. Turn each screw in (lean) with 1/8 turn increments until idle speed reaches value shown in Chart Column B.

11. Reset idle speed to specification shown on Emission Control Information Label.

NOTE: This number may be different than the value shown on Chart Column B.

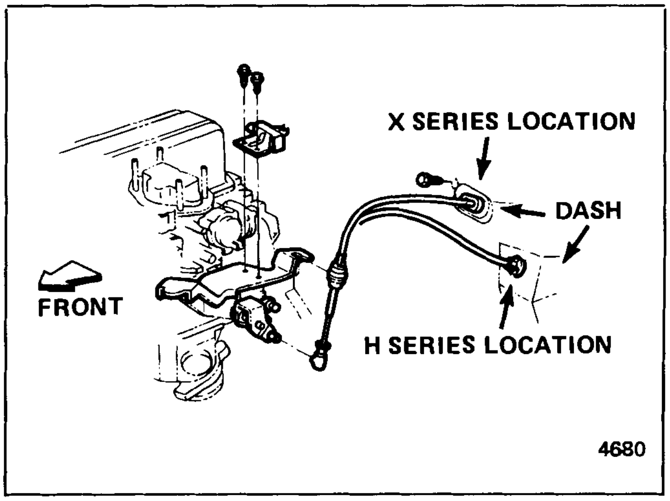


Fig. 6C-135 Accelerator Control Cable 151 Engine VI Code V

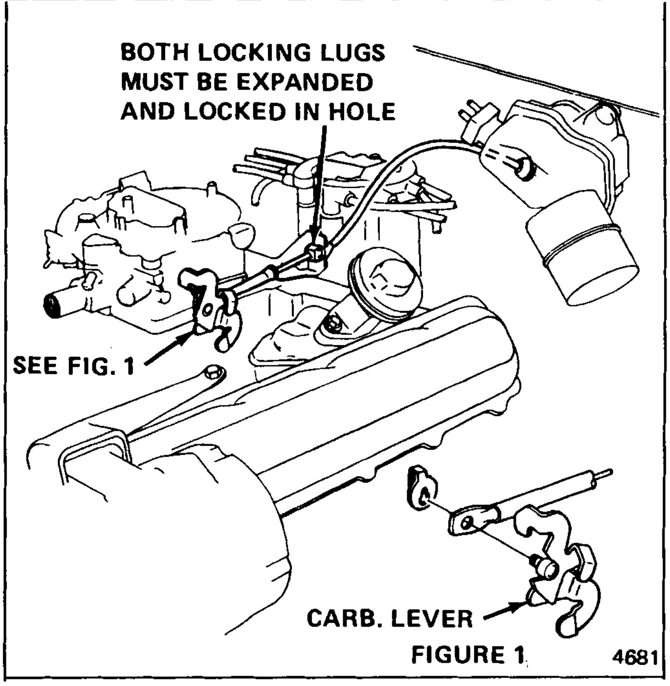


Fig. 6C-136 Accelerator Control Cable 350-403 Engines VI Codes R and K

12. Check and adjust fast idle as described on the Emission Control Information Label.

13. Reconnect vacuum hoses. Install air cleaner.

14. Recheck idle speed. If necessary reset to specification.

ENGINE—CARB. APPLICATION	TRANS.	SERIES	A	B	V.I.N. CODE
140 2-BBL. LOW ALT. AND CALIF.	AUTO	H	680	650	B
140 2-BBL. LOW ALT.	MAN.	H	780	700	B
140 2-BBL. HIGH ALT.	AUTO	H	730	700	B
140 2-BBL. HIGH ALT. AND CALIF.	MAN	H	880	800	B
151 2-BBL. LOW ALT. AND CALIF.	AUTO	H-X	685	650	V
151 2-BBL. LOW ALT.	MAN.	H-X	1250	1000	V
231 2-BBL. LOW ALT.	AUTO	A-B-F-X-H	640	600	C
231 2-BBL. LOW ALT.	MAN.	A-F-X-H	860	800	C
231 2-BBL. HIGH ALT. AND CALIF.	MAN.	A-F-X-H	810	800	C
231 2-BBL. HIGH ALT. AND CALIF.	AUTO	A-B-F-X-H	610	600	C
301 2-BBL. LOW ALT.	AUTO	A-B-F-G-X	590	550	Y
301 2-BBL. LOW ALT.	MAN.	F-X	870	750	Y
305 2-BBL. LOW ALT.	AUTO	X	530	500	U
350 4-BBL. LOW ALT.	AUTO	A-B-F-G	600	575	P
350 4-BBL. HIGH ALT.	AUTO	A-B-F-G-X	625	600	R
350 4-BBL. CALIF.	AUTO	A-B-F-G-X	575	550	R
350 4-BBL. LOW ALT.	AUTO	B	580	550	R
350 4-BBL. CALIF.	AUTO	X	550	500	L
350 4-BBL. HIGH ALT.	AUTO	X	650	600	L
400 4-BBL. LOW ALT.	AUTO	A-B-F-G*	615	575	Z
400 4-BBL. LOW ALT.	AUTO	F**	640	600	Z
400 4-BBL. LOW ALT.	MAN.	F	970	775	Z
403 4-BBL. LOW ALT.	AUTO	B	580	550	K
403 4-BBL. HIGH ALT.	AUTO	A-B-F-G	625	600	K
403 4-BBL. CALIF.	AUTO	A-B-F-G	575	550	K

8 *EXCEPT "F" SERIES WITH W/72 ENGINE (CODE Y6) 4682

**"F" SERIES WITH W/72 ENGINE (CODE Y6)

Fig. 6C-137 Idle Mixture Specifications

SPECIFICATIONS

Fuel Tank Capacity (Approximately)	
H Series	16.0 Gal.
HM Series	18.5 Gal.
X Series	21.0 Gal.
A Series All and B Series Station Wagon	22.0 Gal.
B Series	*21.0 Gal.
Fuel Gage Type	Electric
Fuel Pump Type and Location	
Engine Code B - 140 H Series	Electric - Fuel Tank
Engine Code V - 151 H & X Series	Mechanical-Right Front of Engine
Engine Code C - 231 H Series	Electric-Fuel Tank
Engine Code C - 231 A, X, F & B Series	Mechanical-Left Front of Engine
Engine Code Y - 301 All	Mechanical-Left Front of Engine
Engine Code P & Z - 350 & 400 All	Mechanical-Left Front of Engine
Engine Code R & K - 350 & 403 All	Mechanical-Right Front of Engine
Fuel Pump Pressure - At Carburetor Level	
H Series (Exc. 151)	3-4.5 PSI
151 Eng. All	4-5.5 PSI
231 Eng. (Exc. H Series)	4.2-5.7 PSI
301-350-400 Eng. VI Codes Y-P-Z	7-8.5 PSI
350-403 Eng. VI Codes R-K	5.5-6.5 PSI
305-350 Eng. VI Codes U-L	7.5-9.0 PSI

*Early B Series Sedans with 400 and 403 engines may have 24.5 gal. tank capacity.

SECTION 6D

ENGINE ELECTRICAL

CONTENTS OF THIS SECTION

DIAGNOSTIC CONNECTOR

GENERAL DESCRIPTION

All 1977 Pontiac "B" series cars will be equipped with an engine diagnostic connector, which is used to simplify engine electrical system diagnosis. A second diagnostic connector will be used if the vehicle is equipped with air conditioning (see Section 1B for further information on the air conditioning connector). Figure 6D-1 illustrates the location of the engine electrical connector. The connector provides access to several test points within the starting, charging, and ignition systems. Figure 6D-2 and 6D-3 show the engine electrical diagnostic connector, diagnostic procedures and the connector circuitry.

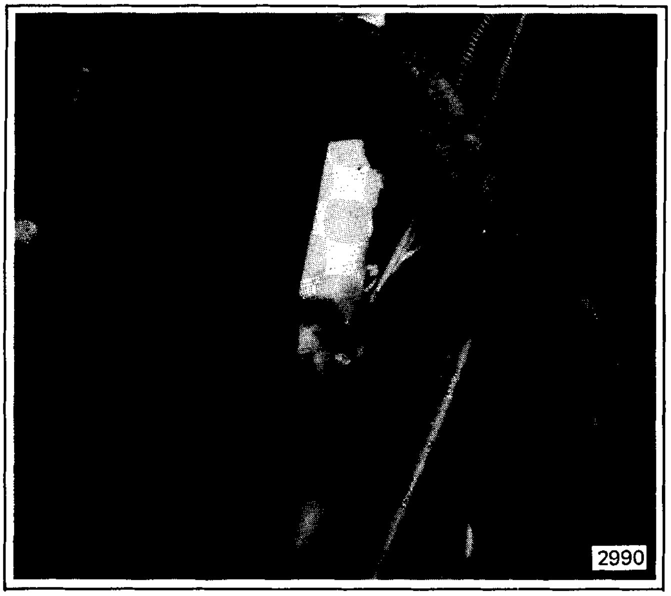


Fig. 6D-1 Diagnostic Connector Location

DIAGNOSIS

All of the tests listed below in conjunction with the diagnostic connector can be performed using a voltmeter. When a problem has been traced to a specific area (such as faulty starter, HEI unit, defective ignition switch, faulty generator, undercharged battery, etc.) further reference to Section 6D of the Service Manual may be required.

Some of the diagnostic connector terminal wires are spliced into the unit feed wire, instead of going directly to the connector on the unit. The connector at the unit should always be checked before starting a repair. The splice can be checked, if desired, by connecting a voltmeter to the connector at the unit. Voltage should be the same as at the terminal in the diagnostic connector. Refer to Fig. 6D-2 and 6D-3 for diagnostic procedures.

CRANKING PROBLEMS

Cranking tests are made with the engine at room or operating temperature. If the engine is extremely cold or hot, voltage readings will be lower than normal. This procedure assumes the engine does not have a defect which would result in poor cranking.

Turn the key to "Start" to determine which of the following symptoms apply.

1. Poor cranking, or solenoid clicks of chatters.
2. Soleniod makes no sound--no cranking.
3. Starter runs (spins), engine does not crank.
4. Starter keeps running with key "Off."

ANY CRANKING PROBLEM

Look for obvious problems, such as damaged battery, loose or corroded terminals or defective cables, and repair as necessary. If problem remains, check battery test indicator, or specific gravity as applicable.

Indicator Green or Specific Gravity 1.200 or more: Follow applicable procedure below with: automatic transmission in "Park"; manual transmission in "Neutral" and clutch depressed; ignition switch in "Start" position.

Indicator Dark or Specific Gravity below 1.200: Charge battery and recheck complaint. Check charging system for battery drain.

Indicator Light: Replace battery and recheck complaint.

Liquid Level Below Plates: Fill battery to proper level, charge the battery and recheck complaint.

POOR CRANKING, OR SOLENOID CLICKS OR CHATTERS

Ignition Switch in "Start."

1.	1 to G	9 volts or more	Move voltmeter from G to engine block, key in "Start." 9 volts or more – Faulty starter. Under 9 volts – Faulty ground, battery cable to engine block.
		Under 9 volts	Go to test 2.
2.	Bat + to Bat – at battery	9.6 volts or more	Go to test 3.
		Under 9.6 volts	Make battery load test. If OK, starter is faulty.
3.	Bat + at battery to term. #1	0.7 volt or more	Faulty positive cable, connections, or fusible link.
		Under 0.7 volt	Faulty ground cable or connection at battery.

SOLENOID MAKES NO SOUND – NO CRANKING

Ignition Switch in "Start."

1.	8 to G	7 volts or more	Starter is faulty.
		Under 7 volts	Go to test 2.
2.	1 to G	9 volts or more	Go to test 5.
		Under 9 volts	Go to test 3.
3.	Bat + to Bat – at battery	9.6 volts or more	Go to test 4.
		Under 9.6 volts	Make battery load test. If OK, starter is faulty.
4.	Bat + at battery to term. #1	0.7 volt or more	Faulty positive cable, connections, or fusible link.
		Under 0.7 volt	Faulty ground cable or connection at battery.
5.	9 to G	7 volts or more	Faulty purple wire from ignition switch to starter solenoid, or bulkhead connector.
		Under 7 volts	Go to test 6.
6.	2 to G	7 volts or more	Faulty ignition switch.
		Under 7 volts	Faulty battery lead to ignition switch.

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Fig. 6D-2 Diagnosis

STARTER RUNS (SPINS), ENGINE DOES NOT CRANK

Check flywheel gear teeth. If OK, starter is faulty.

STARTER KEEPS RUNNING WITH KEY "OFF"

Remove wire from "S" terminal of solenoid. If it keeps running, starter is faulty. If it stops, check for a short in the wiring harness or defective ignition switch.

IGNITION MISS OR WILL NOT START (CRANKS OK)

Make secondary available voltage check on two or more spark plug wires, using ST-125 spark gap or equivalent. HEI system should produce at least 25,000 volts (25KV) cranking or engine idling. If it does not, follow procedure below. If it does, check spark plugs, spark plug wires, and distributor cap.

If car will not start, make voltage checks below cranking. If it will start, make them running.

	VOLTS CRANKING	VOLTS IDLING	
1. 6 to G	7 or more	9.6 or more	Check HEI unit.
	Under 7	Under 9.6	Go to test 2.
2. 4 to G	7 or more	9.6 or more	Check the HEI unit. If OK, the wire from connector terminal #6 to HEI is grounded.
	Under 7	Under 9.6	Go to test 3.
3. 5 to G	7 or more	9.6 or more	Faulty lead or bulkhead connection from ignition switch to connector pin #4.
	Under 7	Under 9.6	Replace ignition switch.

GENERATOR WARNING LIGHT "ON" ENGINE RUNNING

Tighten or replace generator belt, if necessary.

Ignition switch "ON" engine stopped.

1. Light off Blown gauge fuse; determine cause.
   Light on With engine running, remove two wire connector from generator. If the light goes out, generator is faulty. If light stays on, wire from generator light to generator #1 terminal is grounded.

LOW BATTERY, BUT GENERATOR LIGHT INDICATES "NO PROBLEM"

1. Tighten or replace generator belt if necessary.
2. Charge battery.
3. Run engine at 1,500 to 2,000 RPM for one minute with lights on high beam, heater on high, radio and defogger blower on.

• 1 to G	Under 12.5 volts	Faulty generator.
	12.5 volts or more	Check for battery drain and driving habits. If no defect is found, make generator output check.

OVERCHARGING

1. Run engine at 1,500 to 2,000 RPM, no load, for one minute or until voltmeter reading exceeds 12.5 volts, whichever occurs first.

• 1 to G	15.5 volts or more	Faulty generator.
	Under 15.5 volts	Check for extended driving conditions in hot weather.

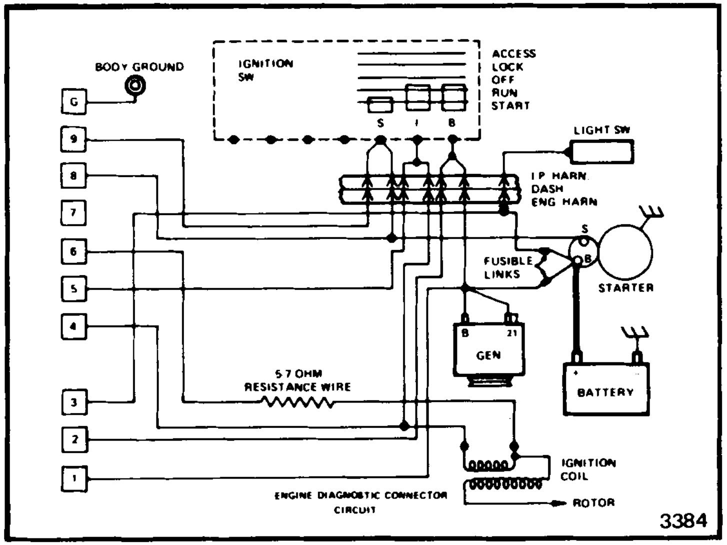

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Fig. 6D-3 Diagnosis

GENERAL ELECTRICAL SYSTEM DIAGNOSIS

On models without the diagnostic connector, the diagnosis in Figures 6D-4 and 6D-5 can be used to find electrical system faults. As with the Diagnostic Connector, once a fault has been traced to a particular component, refer to that component's section of the service manual.

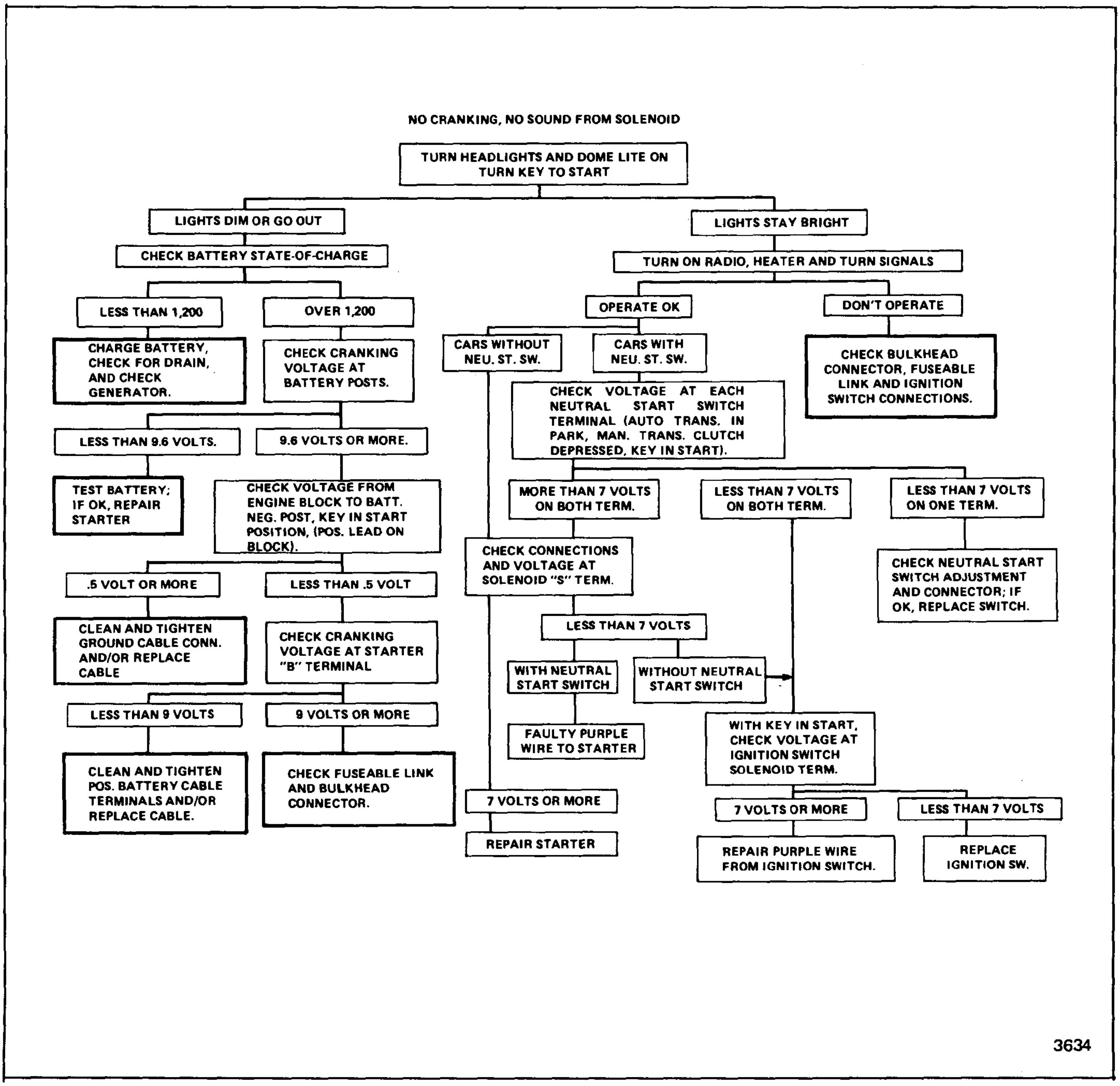
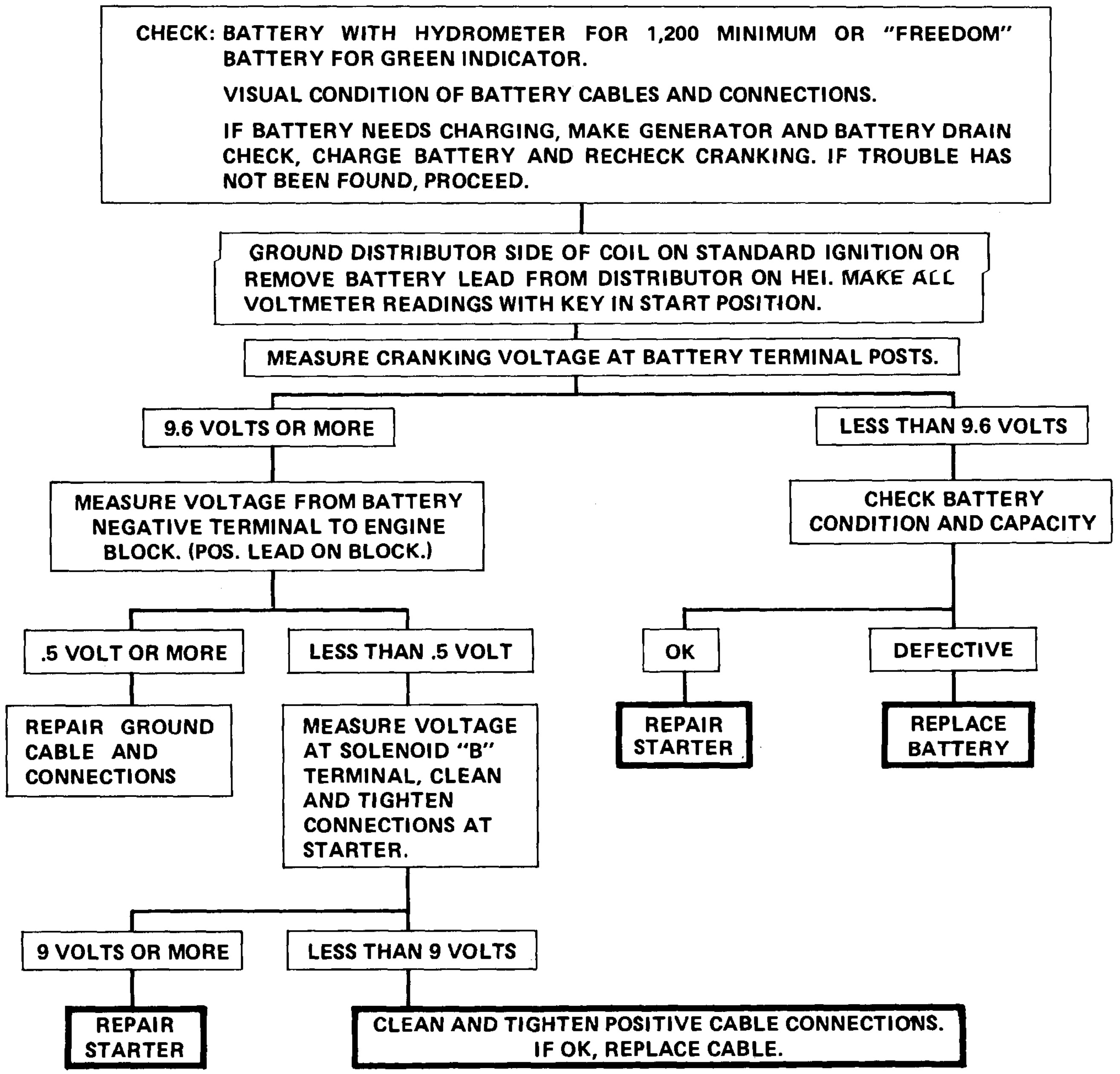


Fig. 6D-4 Electrical System Diagnosis

SLOW CRANKING, SOLENOID CLICKS OR CHATTERS



NOTE: THIS PROCEDURE IS DESIGNED FOR USE ON ENGINES AND BATTERIES AT ROOM OR NORMAL OPERATING TEMPERATURES. IT ALSO ASSUMES THERE ARE NO ENGINE DEFECTS WHICH WOULD CAUSE CRANKING PROBLEMS. TO USE IT UNDER OTHER CONDITIONS MIGHT RESULT IN MISDIAGNOSIS.

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Fig. 6D-5 Electrical System Diagnosis

BATTERY

GENERAL DESCRIPTION

Two types of batteries will be used for 1977 cars. The conventional battery (see Fig. 6D-6) has top flame arrestor filler caps, and must have water added at periodic intervals (see Section O). The sealed battery (see Fig. 6D-7) is a sealed unit, and cannot have water added. Both batteries share some common operating and construction characteristics.

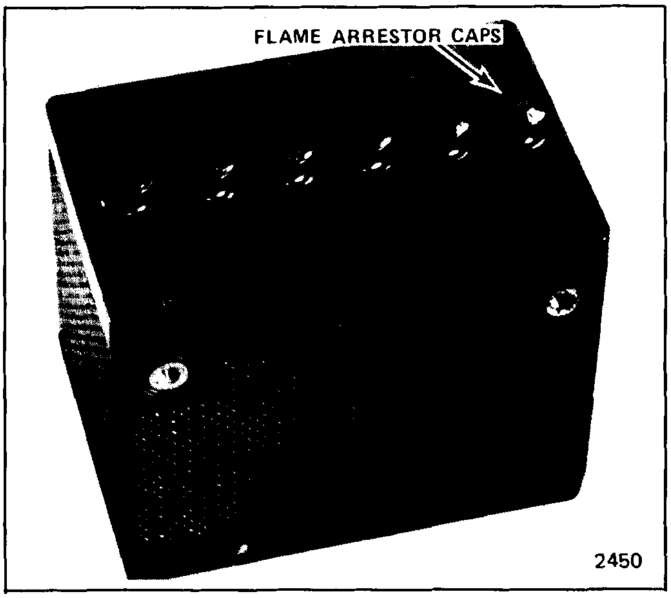

Fig. 6D-6 Conventional Battery

CONSTRUCTION

A battery is made up of a number of separate elements, each located in an individual cell in a hard plastic case. Each element consists of an assembly of positive plates and negative plates containing dissimilar active materials and kept apart by separators. The elements are immersed in an electrolyte composed of dilute sulfuric acid. Plate straps located on the top of each element connect all the positive plates and all the negative plates into groups. The elements are connected in series electrically by connectors that pass directly through the case partitions between cells. The battery top is a one-piece cover. The cell connectors, passing through the cell partitions, connect the elements along the shortest practical path.

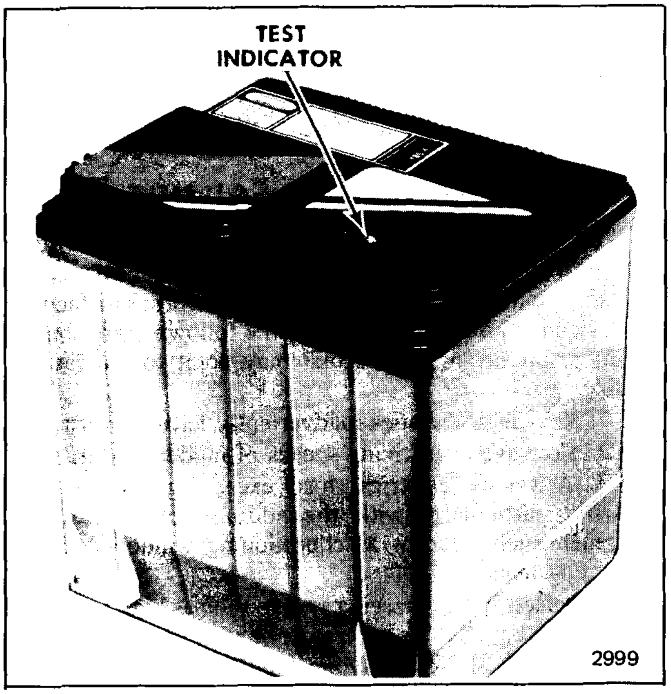

Fig. 6D-7 Sealed Battery

The terminals of this type battery, passing through the side of the case, are positioned out of the "wet" area surrounding the vent wells. Normal spillage, spewing, condensation, and road splash are not as likely to reach or remain on the vertical sides where the terminals are located. This greatly decreases the cause of terminal corrosion. Also, construction of the terminals is such that the mating cable connector seals the junction and provides a permanently tight and clean connection. Power robbing resistance in the form of corrosion is thereby eliminated at these connections. The connections require no maintenance except an occasional check for secure attachment.

The hard, smooth, one-piece cover greatly reduces the tendency for corrosion to form on the top of the battery. The cover is bonded to the case forming an air-tight seal between the cover and case.

OPERATION

Electrical energy is released by chemical reactions between the active materials in the two dissimilar plates and the electrolyte whenever the battery is being "discharged". As the cells discharge, chemical changes in the active materials in the plates gradually reduce the potential electrical energy available. "Recharging" the battery with a flow of direct current opposite to that during discharge reverses the chemical changes within the cells and restores them to their active condition and a state of full charge.

The battery has three major functions in the electrical system. First, it provides a source of energy for cranking the engine. Second, it acts as a voltage stabilizer for the electrical system. And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

GENERAL INFORMATION

COMMON CAUSES OF FAILURE

The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service.

If the battery tests good but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of trouble.

1. Vehicle accessories inadvertently left on overnight.
2. Slow average driving speeds of moderate duration.
3. A vehicle electrical load exceeding the generator capacity, particularly with the addition of after market equipment such as radios, air conditioning, window defoggers or light systems.
4. Defects in the charging system such as high resistance, slipping fan belt, faulty generator, or voltage regulator.
5. Battery abuse, including failure to keep the battery cable terminals clean and tight, loose battery hold-down, and failure to properly maintain electrolyte level in the conventional battery as outlined in Section O.
6. Mechanical defects in the electrical system, such as shorted or pinched wires.

ELECTROLYTE FREEZING

The freezing point of electrolyte depends on its specific gravity. Figure 6D-8 gives the freezing temperatures of electrolyte at various specific gravities.

VALUE OF SPECIFIC GRAVITY @ 30°F	FREEZING TEMP.		VALUE OF SPECIFIC GRAVITY @ 80°F	FREEZING TEMP.	
	°F	°C		°F	°C
1.100	18	– 8	1.220	–33	–36
1.120	13	–11	1.240	–50	–46
1.140	8	–13	1.260	–75	–59
1.160	1	–17	1.280	–92	–69
1.180	– 6	–21	1.300	–95	–71
1.200	–17	–27			

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Fig. 6D-8 Freezing Chart

Since freezing may ruin a battery, it should be protected against freezing by keeping it in a charged condition. Antifreeze should never be added to the battery to prevent it from freezing.

ELECTROLYTE LEVEL

Section O has information covering electrolyte level periodic service for the conventional battery. Two precautions should be followed with the conventional battery:

1. Never add electrolyte to the battery. Since only water evaporates in service, only water should be added.
2. Liquid level should never be allowed to drop below the level of the plates, as permanent damage to the battery may result.

CARRIER AND HOLD-DOWN

The battery carrier and hold-down should be clean and free from corrosion before installation.

The carrier should be in a sound mechanical condition so that it will support the battery securely and keep it level.

To prevent the battery from shaking in its carrier, the hold-down bolts should be tight. However, the bolts should not be tightened to the point where the battery case or cover will be placed under a severe strain. Torque hold down nut to 26 in. lbs.

CLEANING

The external condition of the battery should be checked periodically for damage such as cracked cover, case, or vent plugs or for the presence of dirt and corrosion. The battery should be kept clean in the area of the terminals. An accumulation of acid film and dirt may permit current to flow between the terminals, which will slowly discharge the battery. For best results when cleaning batteries, wash first with a soda solution to neutralize any acid present; then flush with clean water. Care must be taken to keep vent plugs tight (if so equipped) so that the neutralizing solution does not enter the cells.

RATINGS

A battery generally has two classifications of ratings: (1) a 20 hour reserve capacity rating at 80° F., and (2) a cold rating at 0° F. which indicates the cranking load capacity (see Specifications Section at end of 6D for specific battery ratings). The Ampere-Hour rating formerly found on batteries was based on the 20 hour rating, and is no longer used.

SEALED BATTERY

ADVANTAGES

The sealed battery (see Fig. 6D-7) is available on all car lines for 1977 (see Specifications Section at the end of 6D for specific applications). The battery grids are made up of a lead-calcium alloy rather than lead-antimony. This compound is less susceptible to gassing, overcharge and self-discharge, which gives this battery the following advantages:

1. No water addition for the life of the battery. This improvement makes the sealed battery possible.
2. Overcharge protection. If too much voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing, which causes liquid loss.

3. Reduced susceptibility to self-discharge as compared to a conventional battery. This is particularly important when a battery is left standing for long periods of time.

4. More power available in a lighter and smaller case.

TEST INDICATOR

The sealed battery includes a test indicator in the top of the battery. This indicator is to be used with accepted diagnostic procedures only. It is NOT to be used to determine if the battery is good or bad, or charged or discharged, except in conjunction with an acceptable diagnosis procedure. The indicator is a built-in hydrometer in one cell and provides visual information for battery testing.

It is important when observing the indicator that the battery be relatively level and have a clean indicator top to see the correct indication. A light may be required in some poorly-lit areas.

Under normal operation, two indications can be observed (see Figure 6D-9):

1. DARK; GREEN DOT VISIBLE

Any green appearance is interpreted as a "green dot" and the battery is ready for testing. On rare occasions following prolonged cranking, the green dot may still be visible. Should this occur, charge battery as described in "Charging Procedure" section.

2. DARK; GREEN DOT NOT VISIBLE

If there is a cranking complaint, the battery should be tested as described in the "Diagnosis" section.

Occasionally, a third condition may appear:

3. LIGHT

On rare occasions, the indicator will turn light (all clear). Normally, the battery is capable of further service; however, **if a cranking complaint has been reported** , replace the battery. DO NOT CHARGE, TEST OR JUMP-START.

DIAGNOSIS

The following procedure should be used for testing batteries:

1. VISUAL INSPECTION

Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious physical damage is noted, replace the battery. If not, proceed to step 2.

2. CHECK CHARGE OF BATTERY

Sealed Battery

a. DARK; GREEN DOT VISIBLE (Figure 6D-9)

If the indicator is dark and has a GREEN DOT in the center, the battery is ready for testing. Proceed to Step 3. On rare occasions, such as after prolonged cranking, the GREEN DOT may still be visible. Should this occur, charge battery as described in "Charging Procedure" section before testing.

b. DARK; GREEN DOT NOT VISIBLE

If the indicator is dark and the green dot is NOT visible, charge the battery as outlined under "Charging Procedure" section and proceed to Step 3.

c. LIGHT

On rare occasions the indicator will turn light (all clear) and the battery should NOT be tested. Replace the battery.

Conventional Battery (Hydrometer Test)

a. Check electrolyte level. If level is below the top of the plates in one or more cells, fill to split ring, and charge as necessary (see "Charging Procedure" section). Minimum charge should be 15 minutes at 15 to 25 ampere rate to allow the water and electrolyte to mix.

b. Check all cells using the hydrometer. One of two conditions will occur:

1) 50 or more points of variance between cells. Replace the battery.

2) Less than 50 points of variance.

a) Specific gravity 1.225 or higher (with compensation for temperature), proceed to Step 3. To compensate for temperature, subtract .004 for each 10°F. below 80°F. For example, at 60°F., a reading of 1.225 at 80°F. would read 1.217.

b) Specific gravity less than 1.225, charge as necessary. If the battery will not accept a charge, replace the battery.

3. LOAD TEST BATTERY

a. Remove surface charge by placing a 300 amp load across the terminals for 15 seconds.

NOTE: 1. If any smoking occurs on a conventional battery, replace battery.

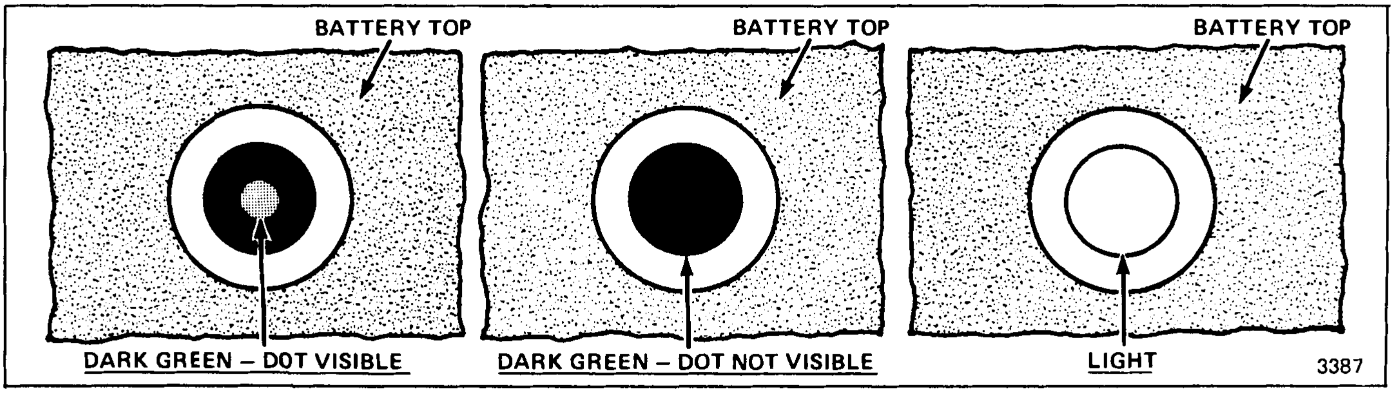

Fig. 6D-9 Test Indicator

2. Load testing may require use of battery side terminal adapter to insure good connections (see Fig. 6D-10).

b. Connect a voltmeter and a battery load tester across the terminals.

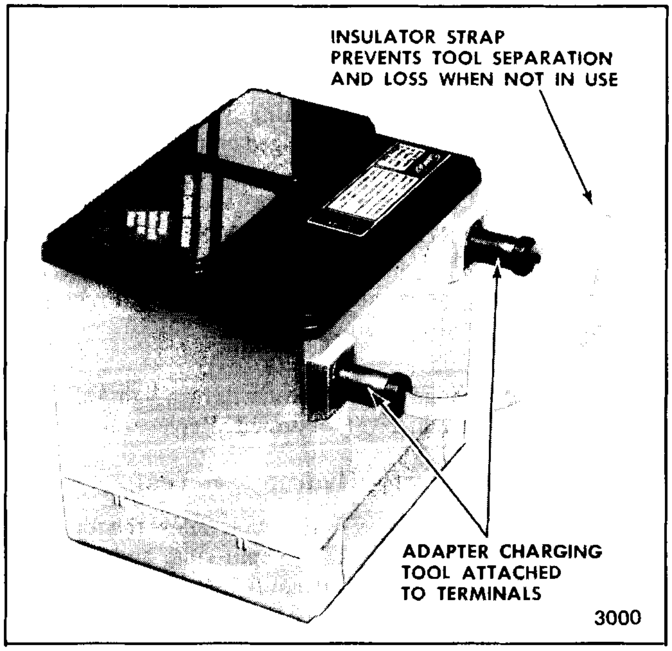

Fig. 6D-10 Side Terminal Battery Adapters

BATTERY	TEST LOAD
Y85-4, Y85A-4	130 AMPS
R85-5, R85A-5	170 AMPS
R87-5	210 AMPS
R89-5	230 AMPS
Y87P	130 AMPS
R87P	160 AMPS
R89SP	180 AMPS

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Fig. 6D-11 Load Test Values

c. Read voltage after 15 seconds with specified load applied (see Figure 6D-11), then disconnect load.

d. If voltage does not drop below the minimum listed in Fig. 6D-12, the battery is good and should be fully charged, cleaned, and returned to service.

e. If voltage drops below the minimum listed, replace the battery.

ON-CAR SERVICE

CHARGING PROCEDURES

When it is necessary to charge a battery, the following safety precautions must be followed:

1. If the electrolyte temperature is above 125°F. (52°C.), discontinue charging or reduce charging rate.

2. If violent gassing or spewing of electrolyte through the vent caps or holes occurs, discontinue charging or reduce charging rate.

MINIMUM VOLTAGE	TEMPERATURE	
	°F	°C
9.6	70	21
9.5	60	16
9.4	50	10
9.3	40	4
9.1	30	− 1
8.9	20	− 7
8.7	10	−12
8.5	0	−18

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Fig. 6D-12 Minimum Voltage Drop

3. Charging should also be stopped when 1) green dot is visible in sealed battery, 2) specific gravity no longer changes over a two hour period in conventional battery.

Charge the battery according to Figure 6D-13 below. The adapters shown in Fig. 6D-10 may be needed.

When the maximum time in Figure 6D-13 is reached for charging the sealed battery, charging should be stopped even if the green dot is not visible. It should be noted that these times are approximate and for reference only. Temperature of the battery, as well as age and condition of the battery, will affect the charging time. Also, most charging equipment will not charge at a constant amperage. The most satisfactory charging is accomplished at a slow charging rate. Whenever possible, the slow rate should be used.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

NOTE: Do not push or tow this vehicle to start. Damage to the emission system and/or to other parts of the vehicle may result.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow the procedure outlined below, being careful not to cause sparks:

WARNING: DEPARTURES FROM THESE CONDITIONS OR THE PROCEDURE BELOW COULD RESULT IN: (1) SERIOUS PERSONAL INJURY (PARTICULARLY TO EYES) OR PROPERTY DAMAGE FROM SUCH CAUSES AS BATTERY EXPLOSION, BATTERY ACID, OR ELECTRICAL BURNS; AND/OR (2) DAMAGE TO ELECTRONIC COMPONENTS OF EITHER VEHICLE.

Never expose battery to open flame or electric spark - batteries generate a gas which is flammable and explosive.

Remove rings, watches, and other jewelry. Wear approved eye protection.

Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces - fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the

BATTERY	SLOW CHARGING		FAST CHARGING			
	5 AMPS	10 AMPS	20 AMPS	30 AMPS	40 AMPS	50 AMPS
Y85-4, Y85A-4 R85-5, R85A-5, Y87P	10 HOURS	5 HOURS	2–1/2 HOURS	1–2/3 HOURS		
R87-5, R89-5, R87P, R89SP	15 HOURS	7–1/2 HOURS	3–3/4 HOURS	2–1/2 HOURS	2 HOURS	1–1/2 HOURS

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Fig. 6D-13 Battery Charging Rates

positive battery terminal (or metal in contact with it) and any other metal on the car, because a short circuit could occur. Batteries should always be kept out of the reach of children.

1. Set parking brake and place automatic transmission in "PARK" (neutral for manual transmission.) Turn off lights, heater, and other electrical loads.

2. Check the battery to insure that it is in proper condition to allow safe starting. If it is not, do not attempt jump starting.

a. If the battery is a sealed battery, check the test indicator. If it is light (all clear), replace the battery, and **do not attempt to jump start**.

b. If the battery has vent caps, check the water level. If the water level is below the proper level, add clear drinking water up to the split rings. If water is not available, remove the caps and place a cloth across the holes. After starting, dispose of the cloth and replace the caps.

3. Only 12 volt batteries can be used to start this engine.

4. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery. DO NOT PERMIT vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure.

5. Attach one end of the remaining negative cable to the negative terminal of the booster battery, and the other end to a solid engine ground (such as A/C compresser or generator mounting bracket) at least 12 inches from the battery of the vehicle being started (see Fig. 6D-14) (DO NOT CONNECT DIRECTLY TO THE NEGATIVE POST OF THE DEAD BATTERY).

6. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the car with the discharged battery.

7. Reverse these directions **exactly** when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started **first.**

Remove and Replace

When handling a battery, the following safety precautions should be observed:

1. Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.

2. Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantities of water and cleaned immediately.

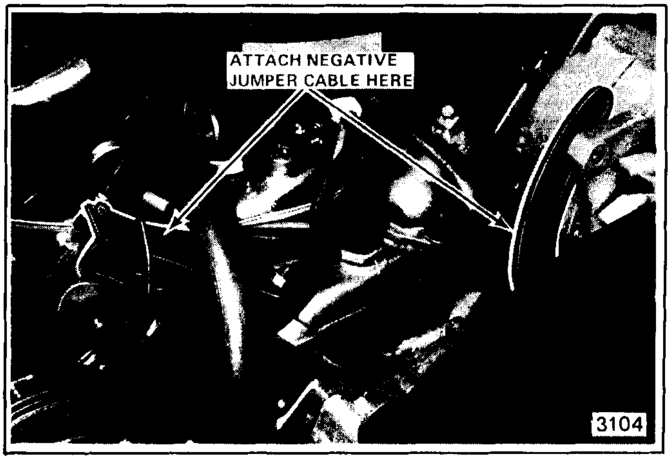
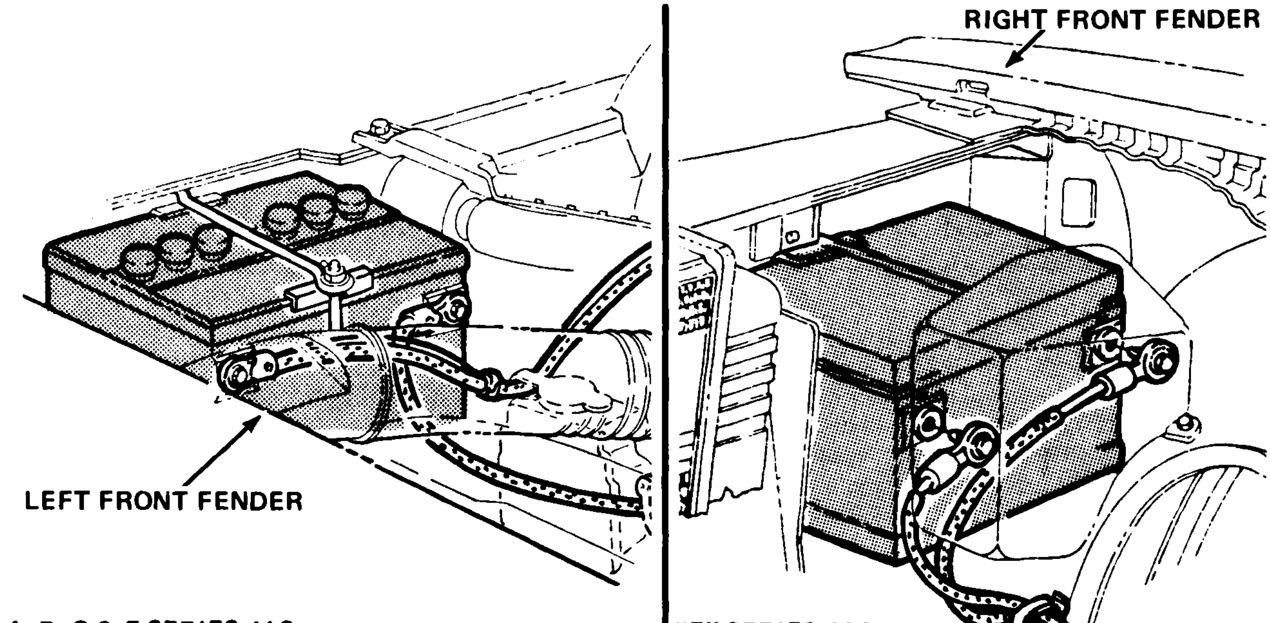


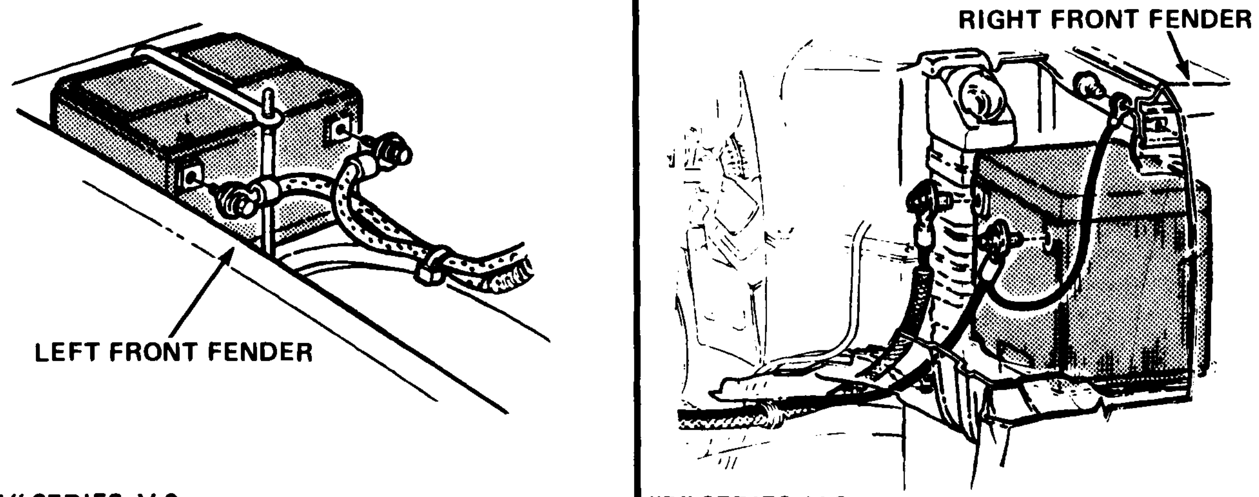
Fig. 6D-14 Negative Jumper Cable Connection

To remove or replace a battery, always disconnect the negative cable first then the positive cable. Remove as shown in Fig. 6D-15. Torque battery cables to 105 in.-lb.



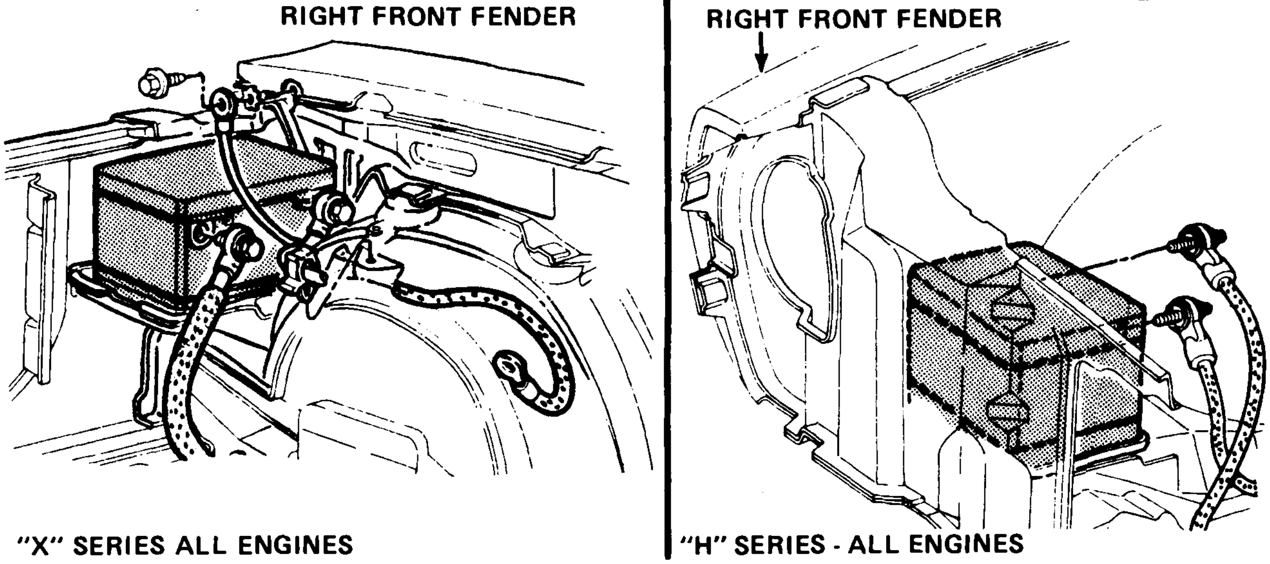
A, B, G & F SERIES V-8

"F" SERIES V-6



"A" SERIES V-6

"B" SERIES V-6



"X" SERIES ALL ENGINES

"H" SERIES - ALL ENGINES

Fig. 6D-15 Remove and Replace Battery

CHARGING SYSTEM

GENERAL DESCRIPTION

The basic charging system is the SI integral regulator charging system (Fig. 6D-16 and 6D-17). The components are connected electrically as shown in Fig. 6D-18.

Although several models are available with different outputs at idle and different maximum outputs, their basic operating principles are the same.

The Delcotron generator features a solid state regulator that is mounted inside the generator slip ring end frame. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The regulator voltage setting never needs adjusting, and no means for adjustment is provided.

The generator rotor bearings contain a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long periods of attention-free service.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator a.c. voltages to a d.c. voltage which appears at the generator output terminal. Generator field current is supplied through a diode trio which also is connected to the stator windings. A capacitor, or condenser, mounted in the end frame protects the rectifier bridge and diode trio from high voltages, and suppresses radio noise.

No periodic adjustments or maintenance of any kind are required on the entire generator assembly.

NOISY GENERATOR

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode, or defective stator.

DIAGNOSIS

A basic wiring diagram showing lead connections is shown in Figure 6D-20. To avoid damage to the electrical equipment, always observe the following precautions:

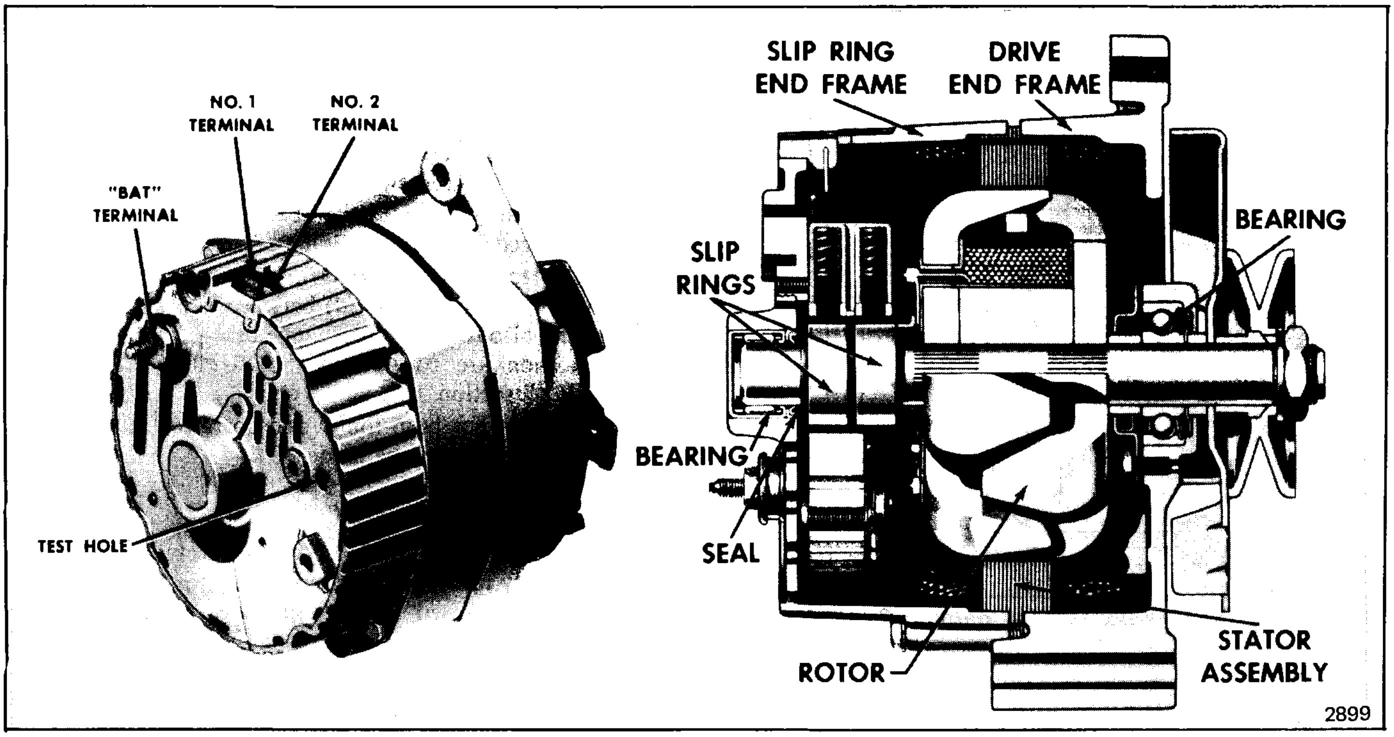


Fig. 6D-16 10-SI Generator

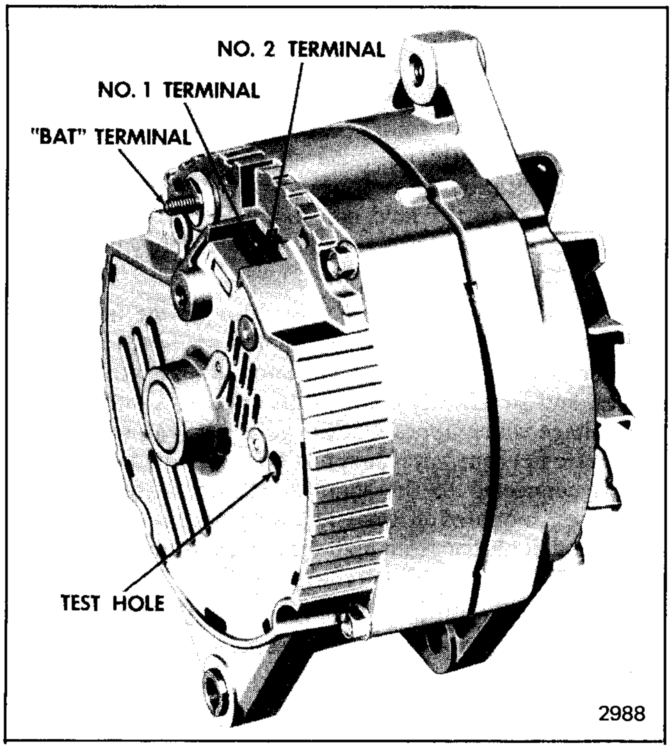


Fig. 6D-17 27-SI Generator

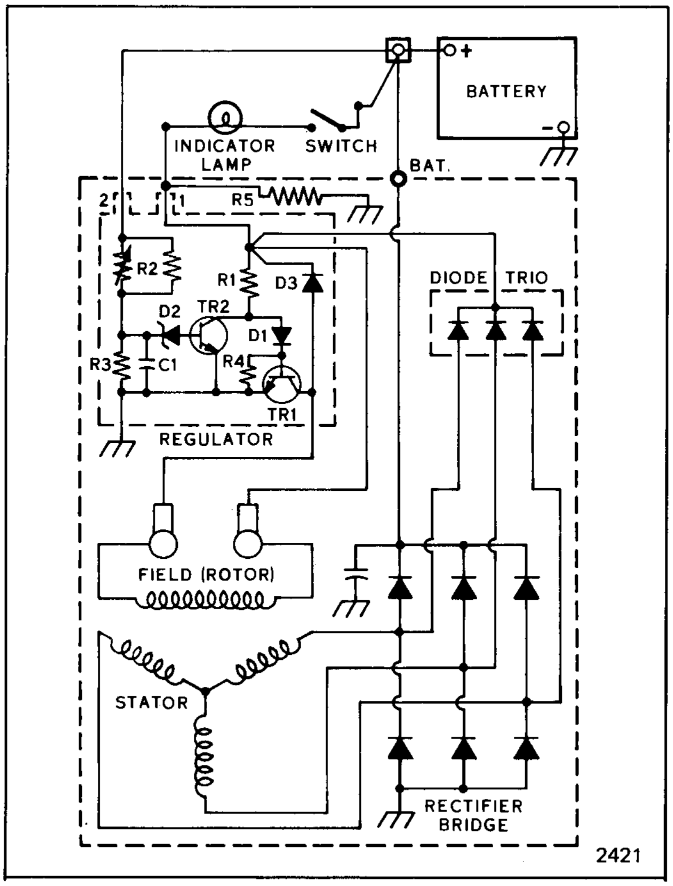


Fig. 6D-18 Regulator in Charging Circuit

- Do not polarize the generator.

- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed.

- NEVER operate the generator with the output terminal open-circuited.
- Make sure the generator and battery have the same ground polarity.
- When connecting a charger or a booster battery to the vehicle battery, connect negative to negative and positive to positive (see Charging Section).

NOTE: In some circuits (Rally Gage option), a voltmeter may be used instead of an indicator lamp. In this case, Section "A" pertaining to faulty indicator lamp operation should be omitted from the troubleshooting procedure.

Trouble in the charging system will show up as one or more of the following conditions:

A. Faulty indicator lamp operation.

B. An undercharged battery as evidenced by slow cranking and low specific gravity readings.

C. An overcharged battery as evidenced by excessive water usage.

A. Faulty Indicator Lamp Operation

Check the indicator lamp for normal operation as shown below.

If the indicator lamp operates normally, proceed to "Undercharged Battery" section. Otherwise, proceed to **one** of the following three **abnormal** conditions.

1. **Switch Off, Lamp On-** In this case, disconnect the two leads from the generator No. 1 and No. 2 terminals. If the lamp stays on, there is a short between these two leads. If the lamp goes out, replace the rectifier bridge as covered in the "GENERATOR REPAIR" section. This condition will cause an undercharged battery.

2. **Switch On, Lamp Off, Engine Stopped-** This condition can be caused by the defects listed in Part 1 above, or by an open in the circuit. To determine where an open exists, proceed as follows:

a. Check for a blown fuse, a burned out bulb, defective bulb socket, or an open in No. 1 lead circuit between generator and ignition switch.

b. If no defects have been found, proceed to "Undercharged Battery" section.

3. **Switch On, Lamp On, Engine Running** check for a blown fuse (where used) between indicator lamp and switch, and also in A/C circuit. The other possible causes of this condition are covered in the "UNDERCHARGED BATTERY" section.

If a defect has been found and corrected at this point, no further checks need be made.

B. Undercharged Battery

This condition, as evidenced by slow cranking and low specific gravity readings or sealed battery test indicator dark green, can be caused by one or more of the following conditions even though the indicator lamp may be operating normally. The following procedure also applies to circuits with a voltmeter.

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.

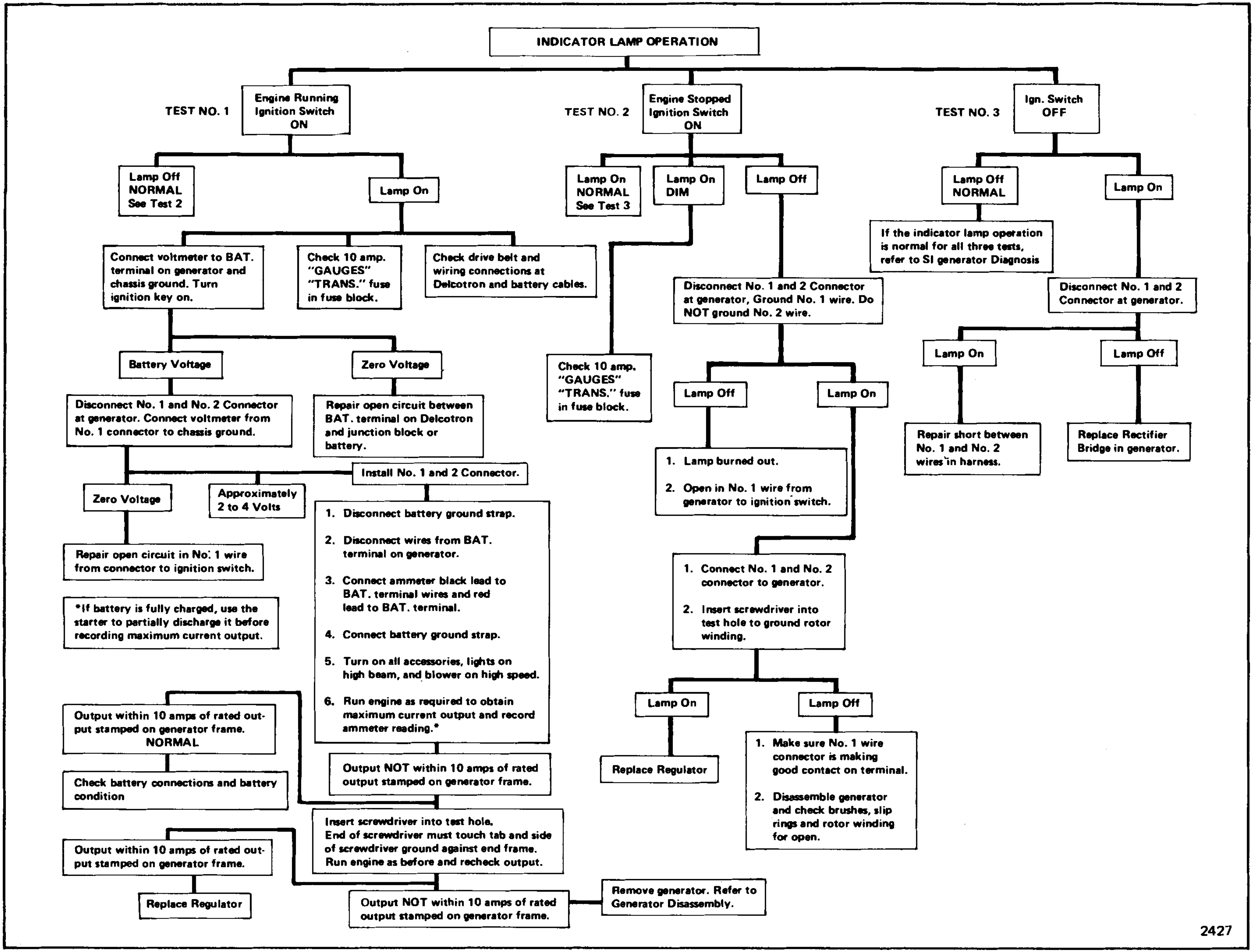


FIG. 6D-19 CHARGING SYSTEM DIAGNOSIS

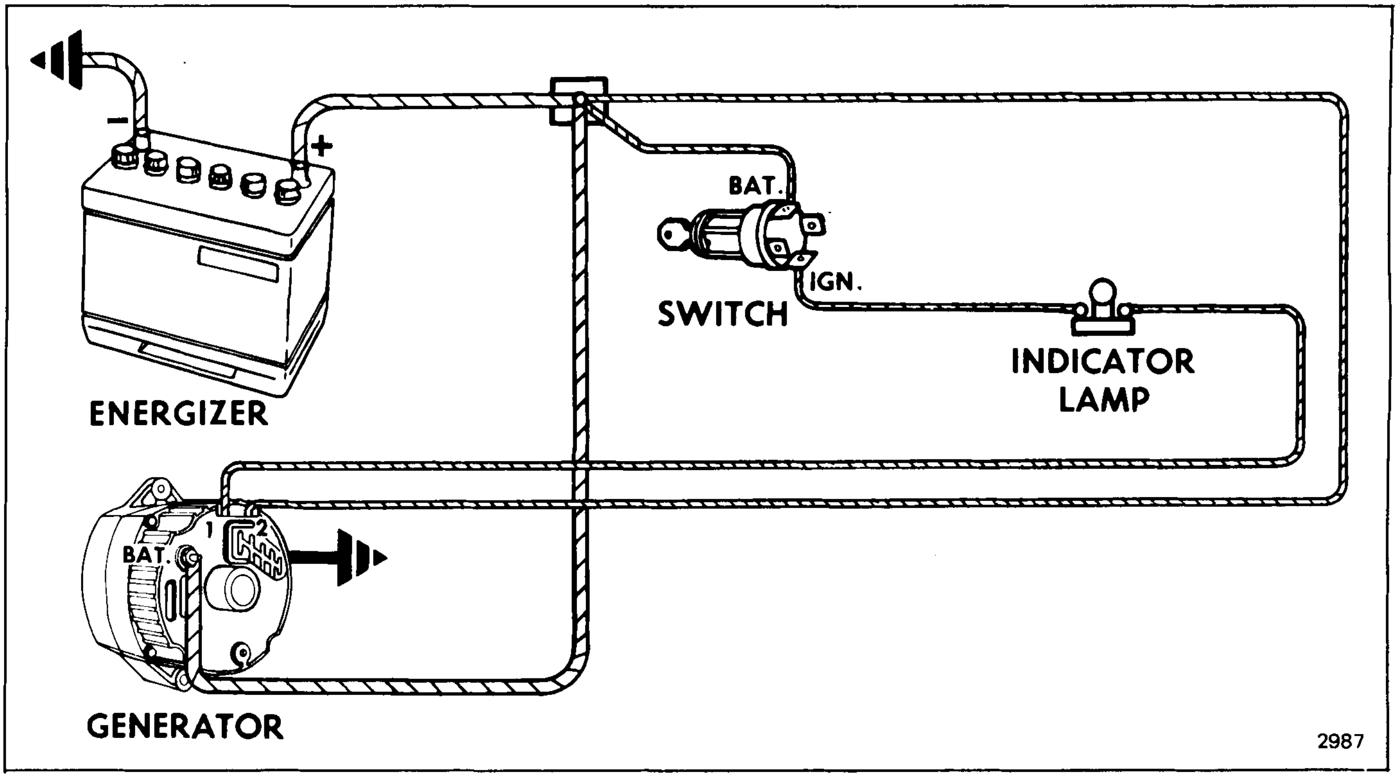


Fig. 6D-20 Charging Circuit - SI System

Switch	Engine	Lamp
OFF	STOPPED	OFF
ON	STOPPED	ON
ON	RUNNING	OFF

2. Check the drive belt for proper tension (see Section 6A).

3. If a battery defect is suspected, refer to Battery Section of Section 6D.

4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and firewall, and the cable clamps and battery posts.

5. With ignition switch on and all wiring harness leads connected (refer to Fig. 6D-16 and 6D-17), connect a voltmeter from:

a. generator "BAT" terminal to ground

b. generator No. 1 terminal to ground

c. generator No. 2 terminal to ground

A zero reading indicates an open between voltmeter connection and battery. Generators have a built-in feature which avoids overcharge and accessory damage by preventing the generator from turning on if there is an **open** in the wiring harness connected to the No. 2 generator terminal. Opens in the wiring harness connected between the No. 2 generator terminal and battery may be between the terminals, at the crimp between the harness wire and terminal, or in the wire.

6. If previous Steps 1 through 5 check satisfactorily, check generator as follows:

a. Disconnect battery ground cable.

b. Connect an ammeter in the circuit at the "BAT" terminal of the generator.

c. Reconnect battery ground cable.

d. Turn on radio, windshield wipers, lights high beam and blower motor high speed. Connect a carbon pile across the battery.

e. Operate engine at moderate speed as required, and adjust carbon pile as required, to obtain maximum current output.

f. If ampere output is within 10 amperes of rated output as stamped on generator frame, generator is not defective; recheck Steps 1 through 5.

g. If ampere output is not within 10 amperes of rated output, determine if test hole (Fig. 6D-21) is accessible. If accessible go to Step h. If not accessible go to step l.

h. Ground the field winding by inserting a screwdriver into the test hole (Fig. 6D-21).

CAUTION: *Tab is within 3/4 inch of casting surface. Do not force screwdriver deeper than one inch into end frame.*

i. Operate engine at moderate speed as required, and adjust carbon pile as required to obtain maximum current output.

j. If output is within 10 amperes of rated output, check field winding as covered in "GENERATOR REPAIR" section, and test regulator with an approved regulator tester.

k. If output is not within 10 amperes of rated output, check the field winding, diode trio, rectifier bridge, and stator as covered in "GENERATOR REPAIR" section.

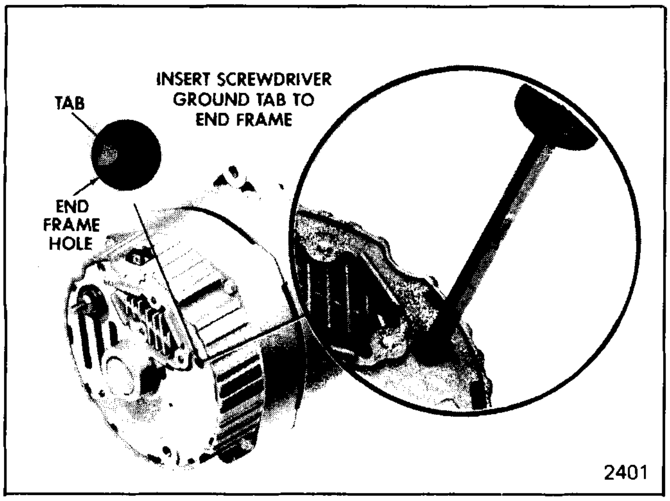


Fig. 6D-21 Generator Test Hole

1. If test hole is not accessible, disassemble generator and make tests listed in "OVERHAUL" section.

C. Overcharged Battery

1. To determine battery condition, refer to Battery Section of Section 6D.

2. Connect a voltmeter from generator No. 2 terminal to ground. If reading is zero, No. 2 lead circuit is open.

3. If battery and No. 2 lead circuit check good, but an obvious overcharge condition exists as evidenced by excessive battery water usage, proceed to "Disassembly" section of "GENERATOR OVERHAUL", and check field winding for grounds and shorts. If defective replace rotor, and test regulator with an approved regulator tester.

Generator Tester - Many testers are available to check the generator. They provide a quick on-car test, and can save time over conventional diagnostic methods. Consult manufacturer's instructions for usage.

ON-CAR SERVICE

The generator does not require periodic lubrication. The rotor shaft is mounted on ball bearings at the drive end and roller bearings at the slip ring end, and each contains a permanent grease supply. At periodic intervals, check mounting bolts for tightness and adjust belt tension.

CAUTION: *When adjusting belt tension, apply pressure at center of generator, never against either end frame (see Engine Cooling Section).*

Remove From Car

1. Disconnect negative battery terminal at battery.

CAUTION: *Failure to observe this step may result in an injury from hot battery lead at generator.*

2. Remove two terminal plug and battery leads on back of generator.

3. Loosen adjusting bolts (see Fig. 6D-22A through 6D-22S for generator mounting).

4. Remove generator drive belt.

5. Remove thru bolt which retains generator.

6. Remove generator from car.

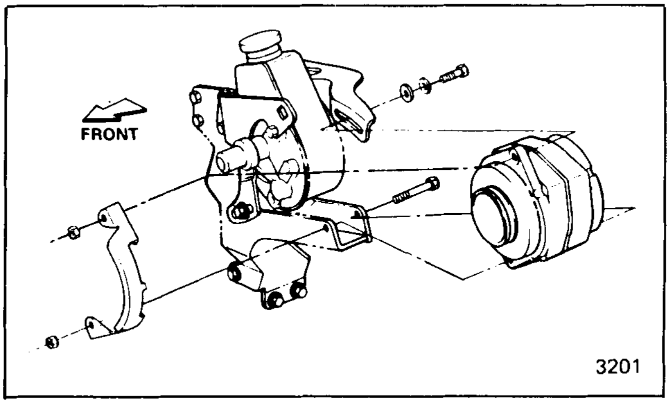


Fig. 6D-22A Generator Mounting: H Series With 151, A/C and Power Steering

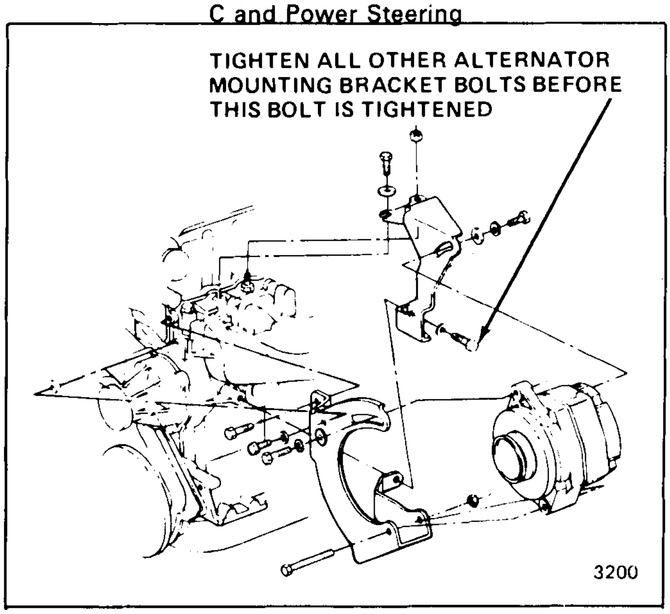


Fig. 6D-22B H and X Series With 151, A/C and Standard Steering

Install In Car

1. If removed from car, install generator to mounting bracket with bolts, washers and nuts. Do not tighten.

2. Install generator drive belt.

3. Tighten belt to the specified belt tension. See Engine Cooling Section for proper belt tensioning procedures.

4. Tighten bolts to 30 lb. ft., except bolt at sliding slots on brackets which is 20 lb. ft.

5. Install generator terminal plug and battery leads to generator.

6. Connect negative battery terminal.

CAUTION: *Take care not to reverse polarity.*

OVERHAUL

To repair the generator, observe the following procedure:

DISASSEMBLY

To disassemble the generator, take out the four thru-bolts, and separate the drive end frame and rotor assembly from the stator assembly by prying apart with a screwdriver at the stator slot. A scribe mark will help locate the parts in

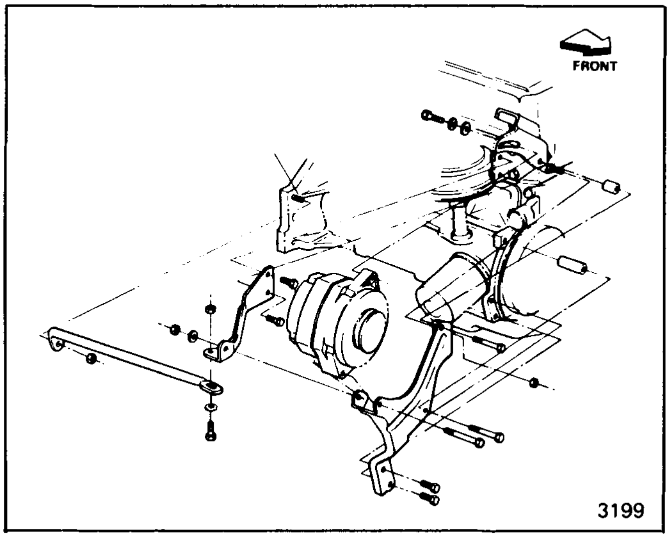


Fig. 6D-22C H and X Series With 151 and No A/C

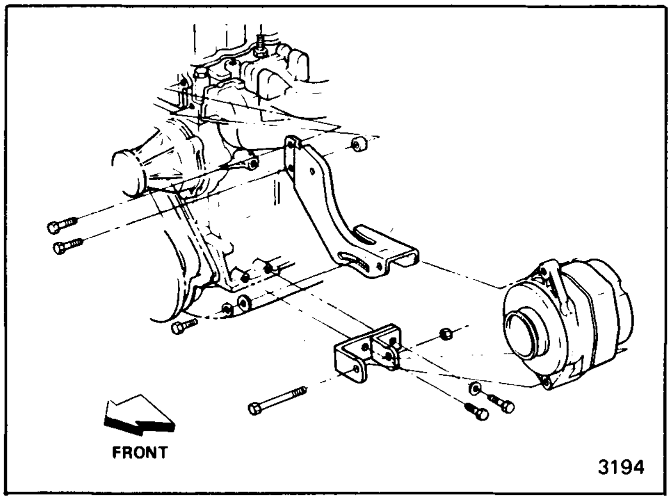


Fig. 6D-22D X Series With 151, A/C and Power Steering

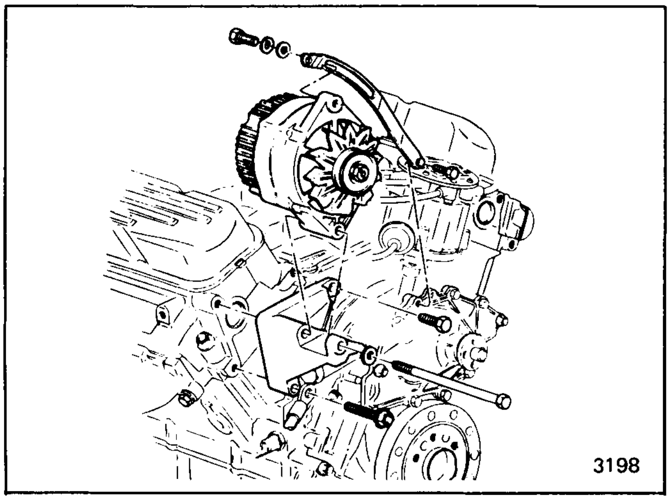


Fig. 6D-22E All Series With V6, No A/C

the same position during assembly (see Fig. 6D-23). After disassembly, place a piece of tape over the slip ring end frame bearing to prevent entry of dirt and other foreign material, and also place a piece of tape over the shaft on the slip ring end. If brushes are to be reused, clean with a soft dry cloth.

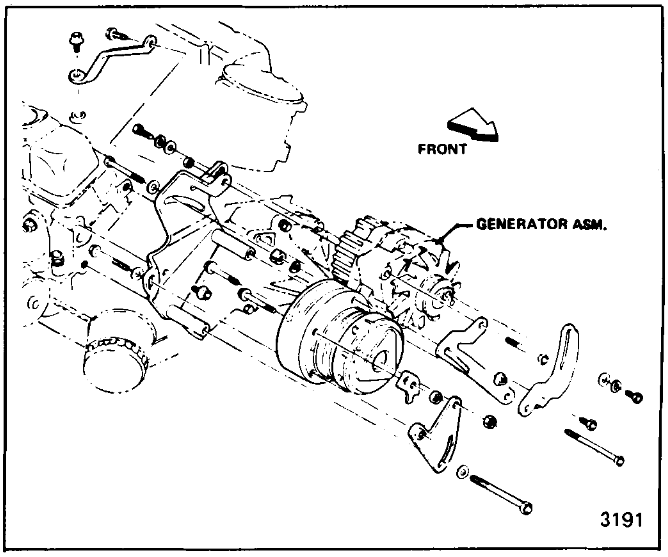


Fig. 6D-22F All Series With V6, A/C

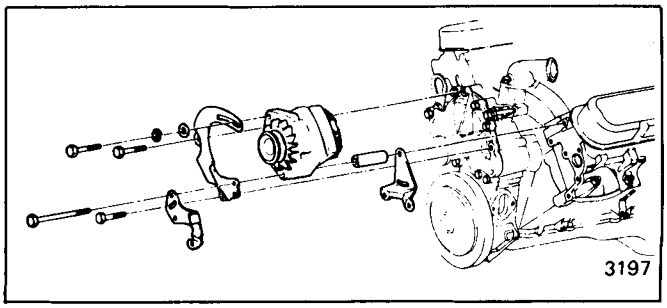


Fig. 6D-22G All Series With 301 V8

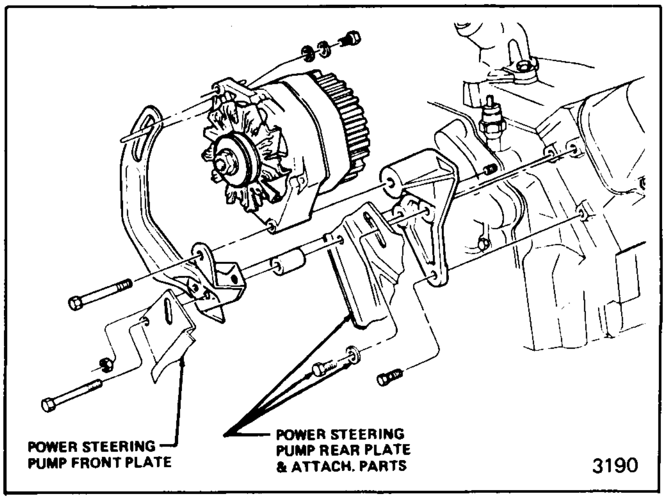


Fig. 6D-22H A, F and G Series With "R" and "K" V8's

CAUTION: *Use pressure sensitive tape and not friction tape which would leave a gummy deposit on the shaft.*

To remove the drive end frame from the rotor, place the rotor in a vise and tighten only enough to permit removal of the shaft nut.

CAUTION: *Avoid excessive tightening as this may cause distortion of the rotor. Remove the shaft nut, washer, pulley, fan, and the collar, and then separate the drive end frame from the rotor shaft.*

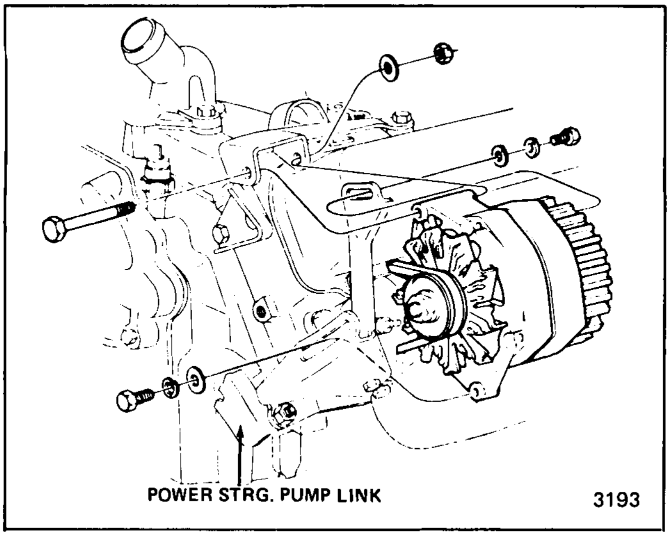


Fig. 6D-22J B and X Series With "R" and "K" V8's, A/C

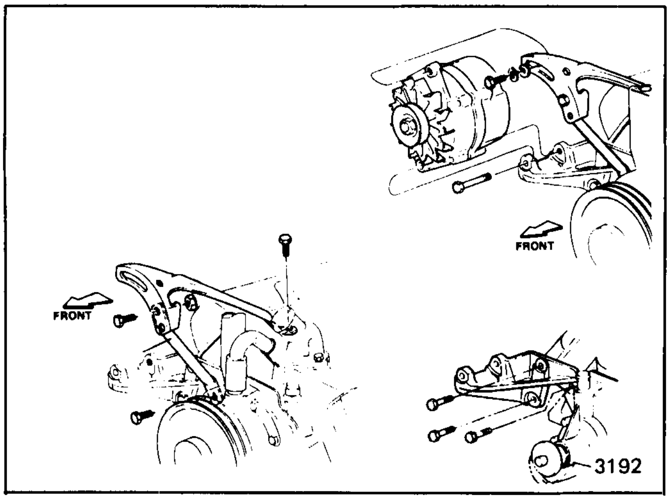


Fig. 6D-22K B and X Series with "R" and "K" V8's, No A/C

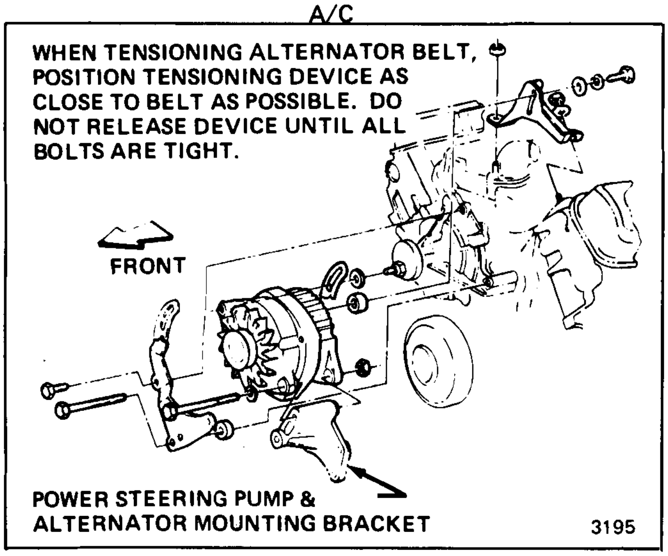


Fig. 6D-22L A, B, F and G Series With "P" and "Z" V8; 80 AMP Generator

ROTOR FIELD WINDING CHECKS

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open (Fig. 6D-24).

Connect test lamp or ohmmeter from one slip ring to shaft. If lamp lights, or if reading is low, the rotor winding is grounded.

The winding is checked for short circuits or excessive resistance by connecting a battery and ammeter in series with the edges of the two slip rings. The field current at 12 volts and 80°F should be between 4.0 - 4.5 amperes. As an alternate method, an ohmmeter can be used, and readings should be approximately 2.5 to 3.0 ohms. An ammeter reading above the specified value indicates shorted windings; a reading below the specified value indicates excessive resistance. If the resistance reading is below the specified value, the winding is shorted; if above the specified value the winding has excessive resistance.

Remember that the winding resistance and ammeter readings will vary slightly with winding temperature changes. If the rotor is not defective, but the generator fails to supply rated output, the defect is in the diode trio, rectifier bridge, stator, or regulator.

DIODE TRIO CHECK

The diode trio is identified in Figure 6D-25.

To check the diode trio, remove it from the end frame assembly by detaching the three nuts, the attaching screw, and removing the stator assembly. Note that the insulating washer on the screw is assembled over the top of the diode trio connector. Connect an ohmmeter having a 1 1/2 volt cell, and using the lowest range scale, to the single connector and to one of the three connectors (Fig. 6D-26). Observe the reading. Then reverse the ohmmeter leads to the same two connectors. If both readings are the same, replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors. Also, connect the ohmmeter to each pair of the three connectors (not illustrated). If any reading is zero, replace the diode trio.

NOTE: Figures 6D-25 and 6D-26 illustrate two diode trios differing in appearance. Either one of these diode trios may be used in these generators, and the two are completely interchangeable.

RECTIFIER BRIDGE CHECK

Note that the rectifier bridge has a grounded heat sink and an insluated heat sink connected to the output terminal. Also, note the insulating washer located between the insulated heat sink and end frame on 10-SI generators.

To check the rectifier bridge, connect the ohmmeter to the grounded heat sink and one of the three terminals (Fig. 6D-27). Then reverse the lead connections to the grounded heat sink and same terminal. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two terminals, and between the insulated heat sink and each of the three terminals. This makes a total of six checks, with two readings taken for each check.

The ohmmeter check of the rectifier bridge, and of the diode trio as previously covered, is a valid and accurate check. **Do not** replace either unit unless at least one pair of readings is the same.

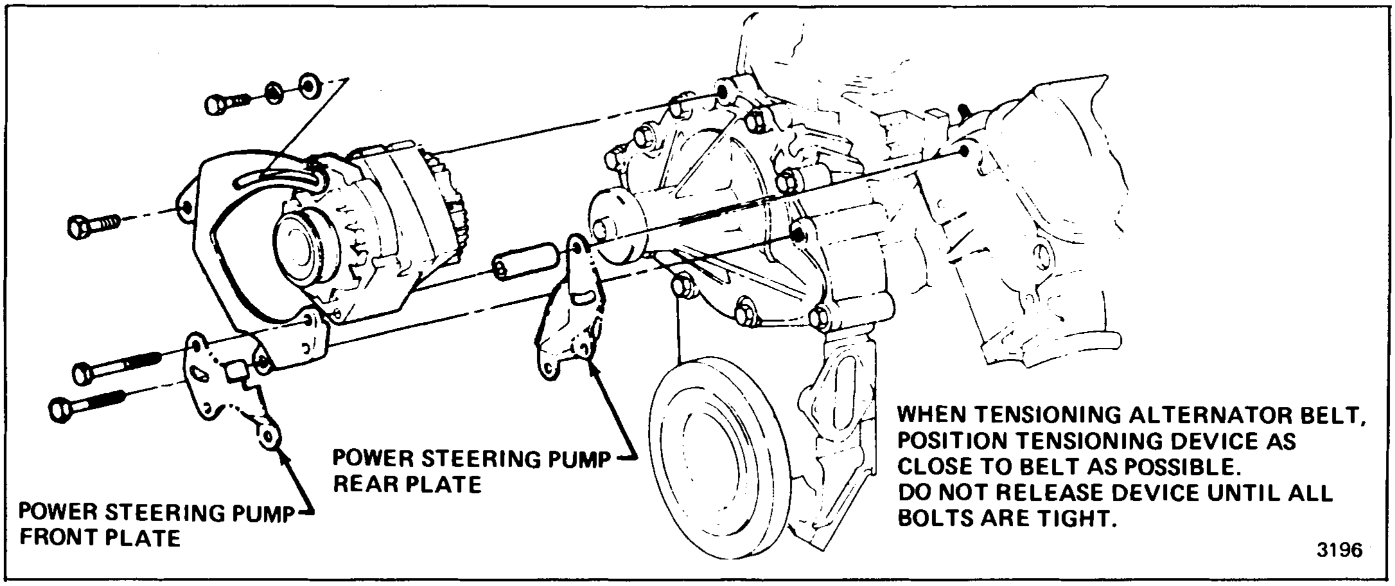


Fig. 6D-22M A, B, F and G Series With "P" and "Z" V8's, Except 80 AMP Generator

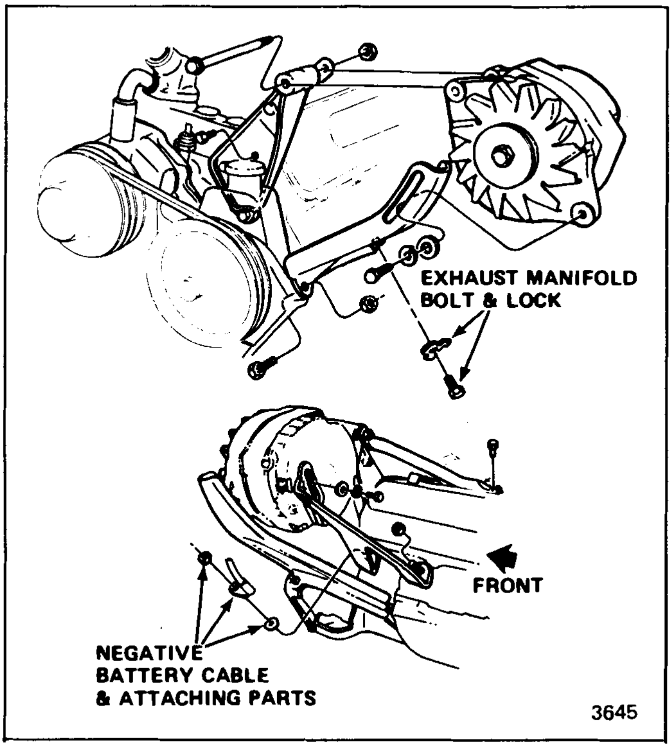


Fig. 6D-22N B Series With "R" and "K" V8's, 80 AMP Generator

CAUTION: *Do not use high voltage to check these units such as a 110 volt test lamp.*

To replace the rectifier bridge, remove the attaching screws, and disconnect the capacitor lead. Note the insulator between the insulated heat sink and end frame. Rectifier bridges may vary in appearance but are completely interchangeable in these generators.

STATOR CHECKS

The stator windings may be checked with a 110-volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light, or if the meter reading is high when successively connected between each pair of stator leads on 10-SI Series, the windings are open (Fig. 6D-28).

NOTE: Delta windings on 27-SI Series cannot be checked for opens.

A short circuit in the stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings or an open delta winding on 27-SI Series are indicated. Also, a shorted stator can cause the indicator lamp to be on with the engine at low speed. Check the regulator in next section before replacing stator.

BRUSH HOLDER AND REGULATOR REPLACEMENT

To determine if the regulator is defective, an approved regulator tester must be used.

After removing the three attaching nuts, the stator, and diode trio screw (Fig. 6D-27), the brush holder and regulator may be replaced by removing the two remaining screws. Note the two insulators located over the top of the brush clips in Figure 6D-25, and that these two screws have special insulating sleeves over the screw body above the threads. The third mounting screw may or may not have an insulating sleeve. If not, this screw must not be interchanged with either one of the other two screws, as a ground may result, causing no output or uncontrolled generator output. Regulators may vary in appearance but are completely interchangeable in these generators.

Using voltage regulator tester CTW-1170 (Fig. 6D-29), it is possible to check the voltage regulator both on the car and on the bench. It is also possible to use this tester for a continuity tester. Use the instructions on the tester cover for testing the regulator on the bench and use the following instructions for the on car test and the continuity test.

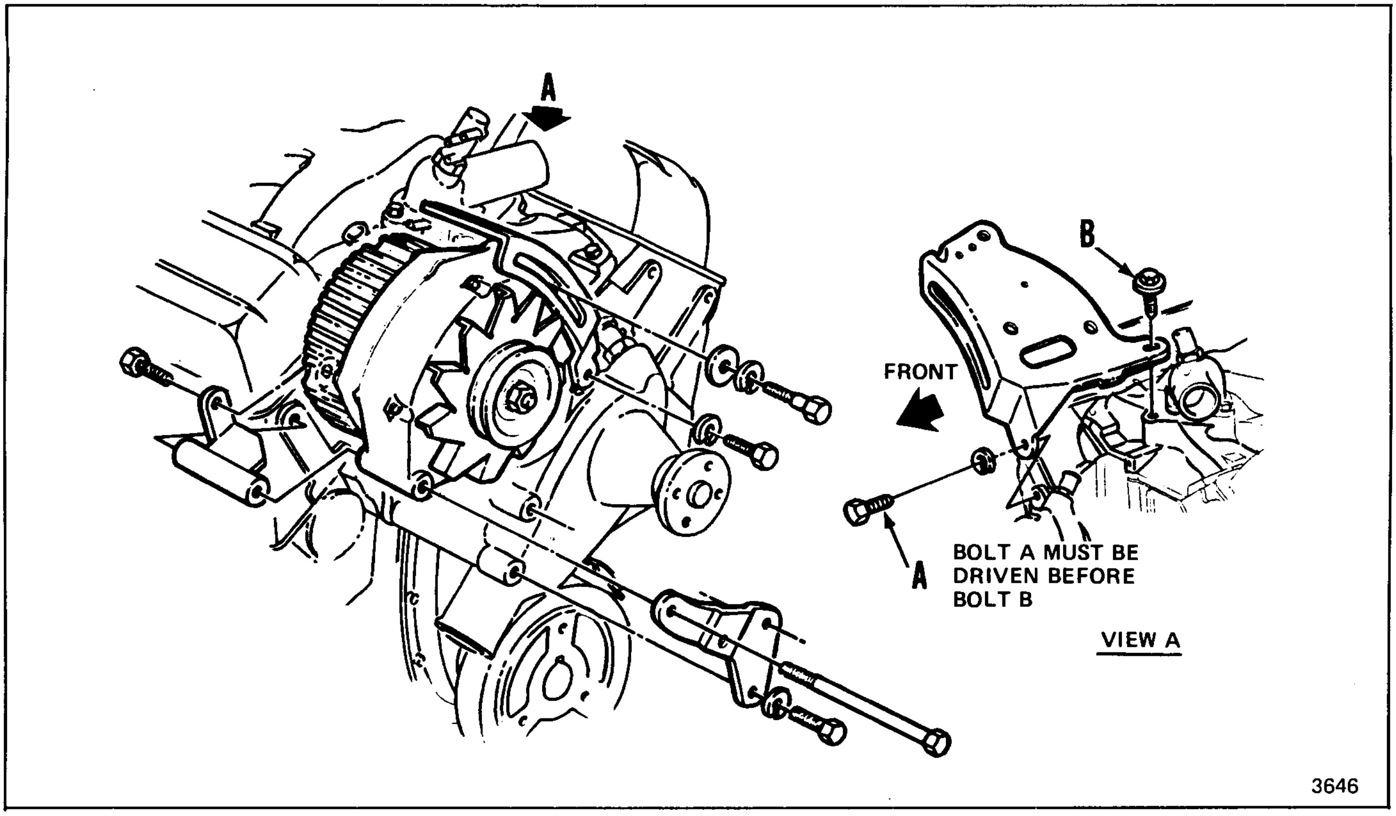


Fig. 6D-22P X Series With "U" and "L" V8's

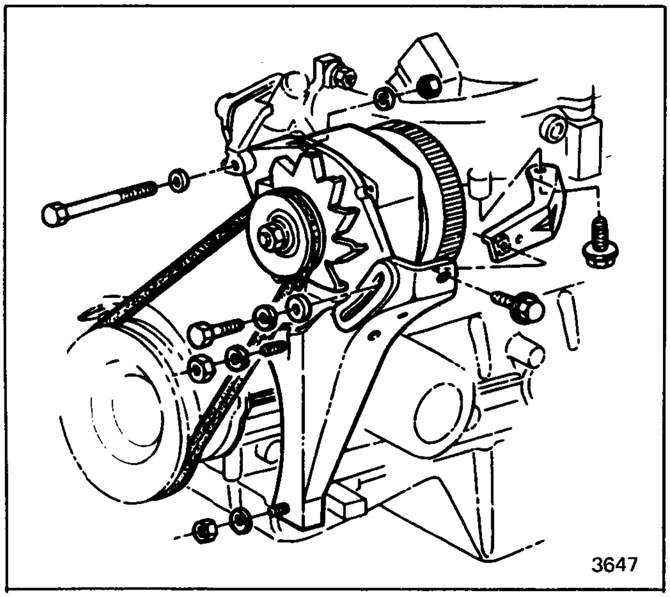


Fig. 6D-22Q H Series With 140 L-4, Standard Steering

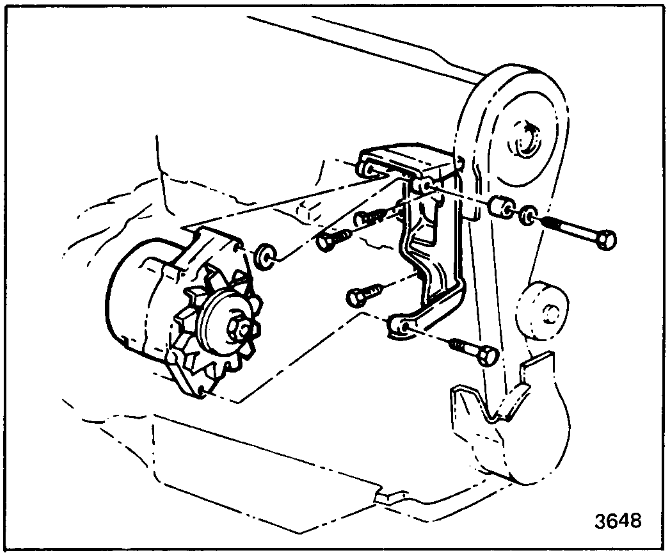


Fig. 6D-22R H Series With 140 L-4, Power Steering

On-Car Test

This on-car test procedure helps to quickly determine if a problem exists in the generator/regulator circuit. If you do not obtain the proper results in this test, the generator must be dismantled and the regulator removed for further testing.

1. Turn the Tester OFF.

2. Make sure a regulator is not installed in the Tester regulator holder.

3. Plug the on-car testing accessory cable into the accessory socket on the Tester front panel.

4. Disconnect the regulator connector from the generator. Then plug the on-car testing accessory cable in its place. Connect the ground lead (alligator clip) to the generator case.

5. Test the generator/regulator circuit using steps 2, 3, 4 and 15 of the instruction label located on the inside of the case cover. If you do not obtain the proper lamp and/or voltmeter indication, or if either or both lamps flicker on and off when you perform these steps, the regulator must be removed from the generator for further testing to determine whether the problem is in the generator or in the regulator.

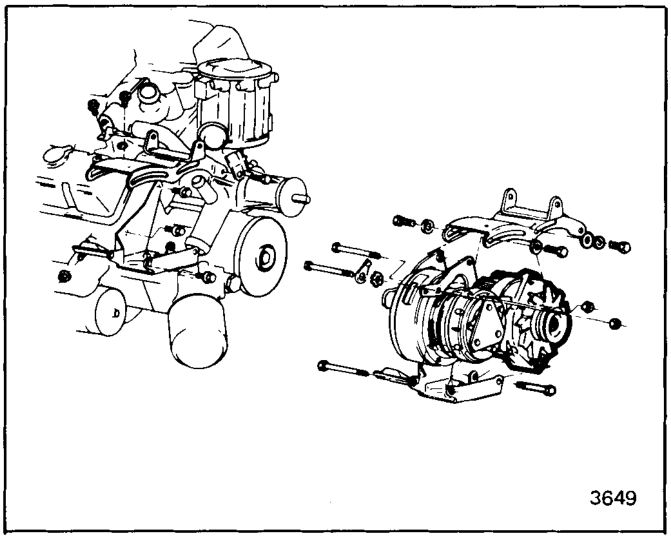


Fig. 6D-22S H Series With V6, A/C and A.I.R. Pump

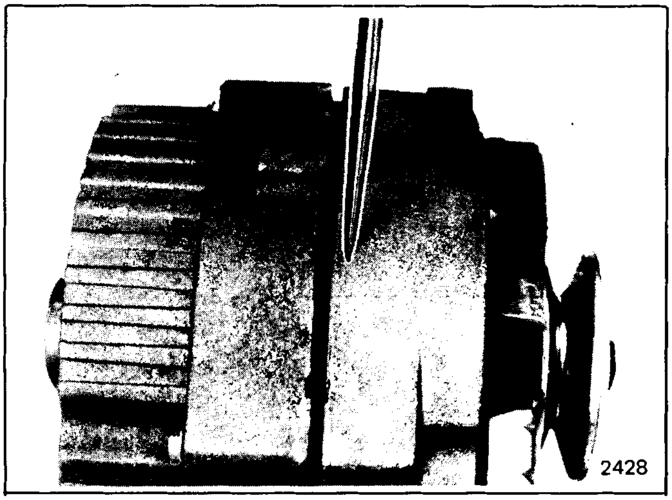


Fig. 6D-23 Marking End Frames

Continuity Test

The continuity test accessory cable is used in conjunction with the meter on the Tester. A high meter reading indicates an open circuit (no continuity) while a zero meter reading indicates continuity.

When you make a continuity test, keep the following points in mind:

1. Make sure a regulator is not installed in the holder.
2. The knob is turned clockwise only until it clicks.
3. All components must be isolated for testing.
4. Make sure voltage is not applied to the component being tested.

SLIP RING SERVICING

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor, and holding the polishing cloth against the slip rings until they are clean.

CAUTION: *The rotor must be rotated in order that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.*

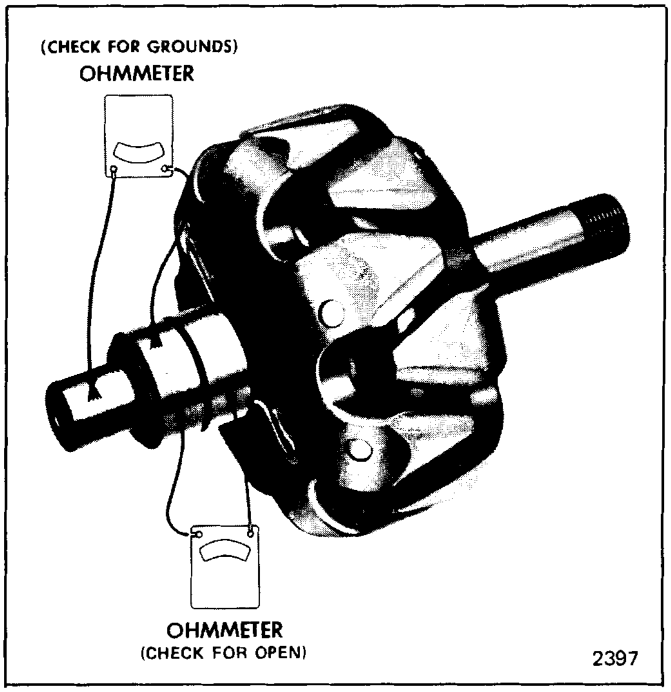


Fig. 6D-24 Checking Rotor

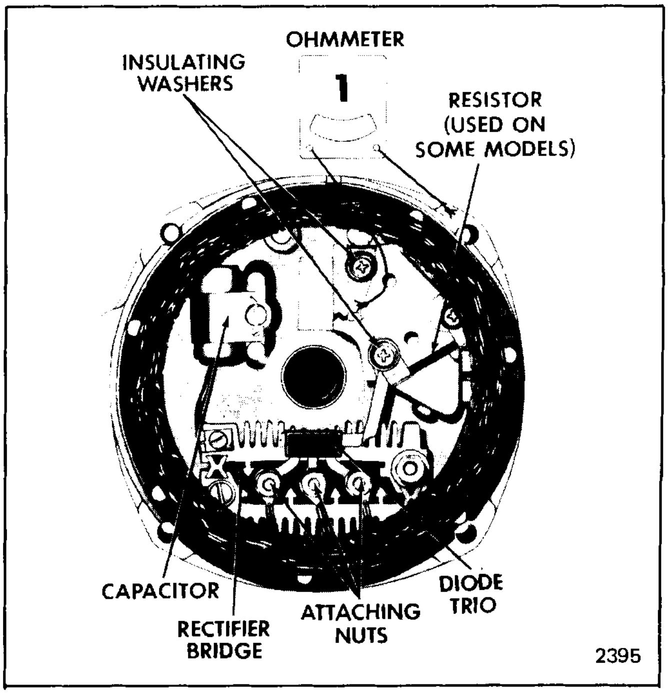


Fig. 6D-25 Slip Ring End Frame Assembly

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

BEARING REPLACEMENT AND LUBRICATION

The bearing in the drive end frame can be removed by detaching the retainer plate screws, and then pressing the bearing from the end frame. If the bearing is in satisfactory condition, it may be reused, and it should be filled one-quarter

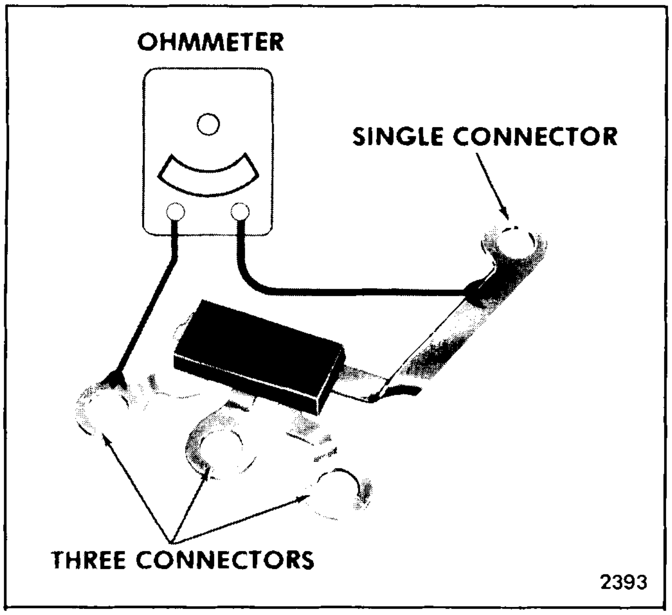


Fig. 6D-26 Checking Diode Trio

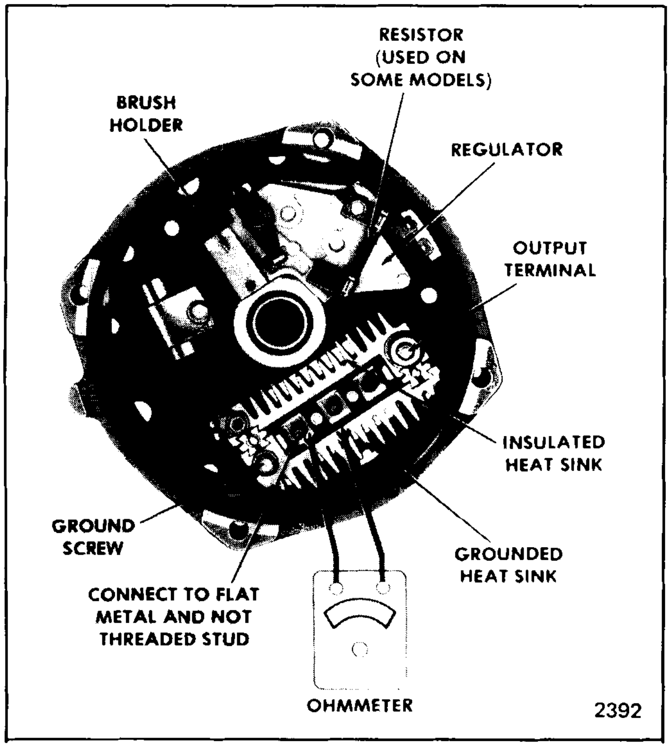


Fig. 6D-27 Checking Rectifier Bridge

full with lubricant part no. 1948791 before reassembly.

CAUTION: *Do not overfill, as this may cause the bearing to overheat, and use only 1948791 lubricant.*

To install a new bearing, press in with a tube or collar that just fits over the outer race, with the bearing and slinger assembled into the end frame as shown in Figure 6D-30. It is recommended that a new retainer plate be installed if the felt seal in the retainer plate is hardened or excessively worn. Fill the cavity between the retainer plate and bearing with 1948791 lubricant.

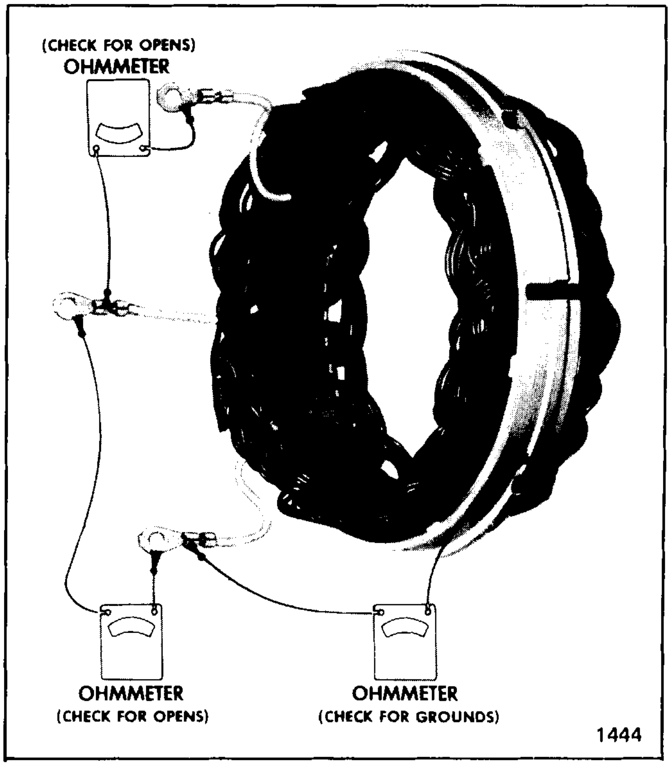


Fig. 6D-28 Checking Stator

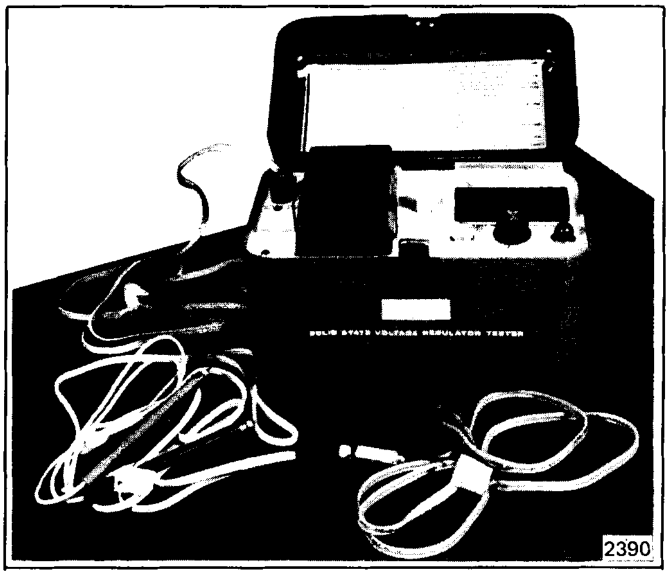


Fig. 6D-29 Voltage Regulator Tester CTW-1170

The bearing in the slip ring end frame should be replaced if its grease supply is exhausted. No attempt should be made to re-lubricate and reuse the bearing. To remove the bearing from the slip ring end frame, press out with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing towards the inside.

To install a new bearing, place a flat plate over the bearing and press in from the outside towards the inside of the frame until the bearing is flush with the outside of the end frame. Support the inside of the frame with a hollow cylinder to prevent breakage of the end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on the bearing.

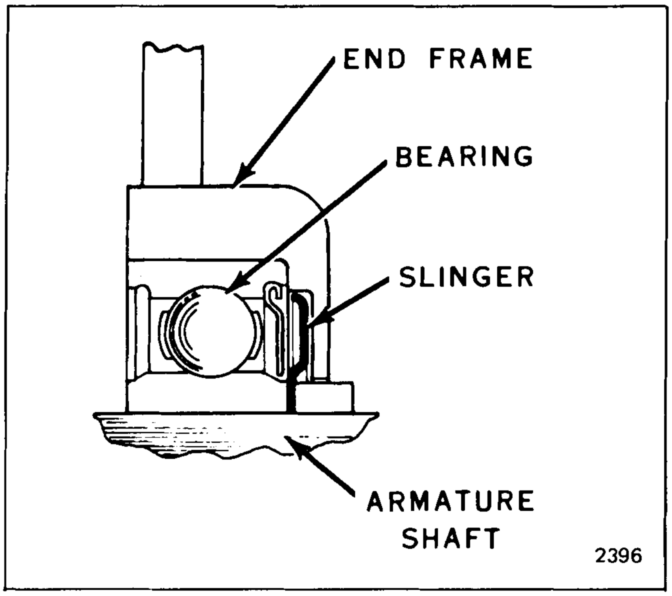


Fig. 6D-30 Drive End Frame Bearing Assembly

If the seal is separate from the bearing, it is recommended that a new seal be installed whenever the bearing is replaced. Press the seal in with the lip of the seal toward the rotor when assembled, that is, away from the bearing. Lightly coat the seal lip with oil to facilitate assembly of the shaft into the bearing.

REASSEMBLY

Reassembly is the reverse of disassembly. Remember when assembling the pulley to secure the rotor in a vise only light enough to permit tightening the shaft nut to 50 lb. ft. If excessive pressure is applied against the rotor, the assembly may become distorted. To install the slip ring end frame assembly to the rotor and drive end frame assembly, remove the tape over the bearing and shaft, and make sure the shaft is perfectly clean after removing the tape. Insert a pin through the holes to hold up the brushes. Carefully install the shaft into the slip ring end frame assembly to avoid damage to the seal. After tightening the thru-bolts remove the brush retaining pin to allow the brushes to fall down onto the slip rings.

IGNITION SYSTEM

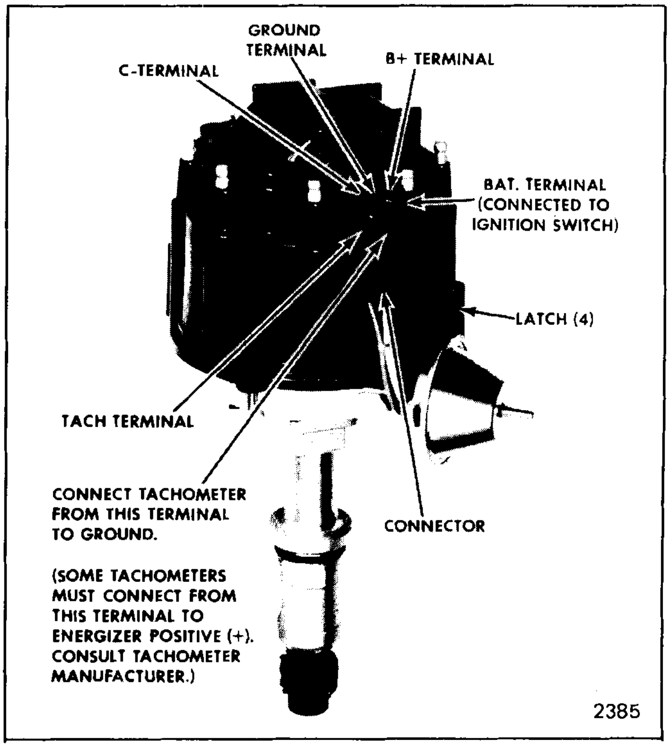
GENERAL DESCRIPTION

The ignition circuit consists of the battery, the distributor, the ignition switch, the spark plugs, and the primary and secondary wiring. Refer to the Battery portion of this section for battery information.

H.E.I. DISTRIBUTOR

The High Energy Ignition distributor used on all engines except the 140 L-40 (V.I. Code B) combines all ignition components in one unit (Fig. 6D-31 and 6D-32). The external electrical connections are the ignition switch feed wire, the tachometer pickup, and the four, six or eight spark plug leads. The 140 L-4 HEI distributor is identical to all other distributors except that the coil is externally mounted instead of being an integral coil inside the distributor assembly (Fig. 6D-33). The ignition switch feed connector to the distributor has full battery voltage when the ignition switch is in the "RUN" and "START" positions. There is NO RESISTOR WIRE FROM THE IGNITION SWITCH TO THE DISTRIBUTOR. The ignition coil is in the distributor cap (except 140 L-4) and connects through a resistance brush to the rotor. The High Energy Ignition System is basically identical in operation to conventional ignition except the module and pick-up coil replace the contact points.

The High Energy Ignition is a magnetic pulse triggered, transistor controlled, inductive discharge ignition system. The magnetic pick-up assembly located inside the distributor contains a permanent magnet, a pole piece with internal teeth, and a pick-up coil. When the teeth of the timer core rotating inside the pole piece line up with the teeth of the pole piece, an induced voltage in the pick-up coil signals the electronic module to trigger the coil primary circuit. The primary current decreases and a high voltage is induced in the ignition coil secondary winding which is directed through the rotor and secondary leads to fire the spark plugs. The capacitor in the distributor is for radio noise supression.



CONNECT TACHOMETER FROM THIS TERMINAL TO GROUND.

(SOME TACHOMETERS MUST CONNECT FROM THIS TERMINAL TO ENERGIZER POSITIVE (+). CONSULT TACHOMETER MANUFACTURER.)

Fig. 6D-31 H.E.I. Distributor Assembly

The magnetic pick-up assembly is mounted over the main bearing on the distributor housing, and is made to rotate by the vacuum control unit, thus providing vacuum advance. The timer core is made to rotate about the shaft by conventional advance weights, thus providing centrifugal advance.

The module automatically controls the dwell period, stretching it with increasing engine speed. The HEI system also features a longer spark duration, made possible by the higher amount of energy stored in the coil primary. This is desirable for firing lean mixtures.

IMPORTANT: When making compression checks, disconnect ignition switch connector (pink wire) from HEI system.

No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.

IGNITION TIMING

Timing specifications for each engine are listed in Section 6E. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type pick-up. **Do not pierce the plug lead.** Once the insulation of the spark plug cable has been broken, voltage will jump to the nearest ground, and the spark plug will not fire properly. The timing procedure remains the same as the conventional ignition system.

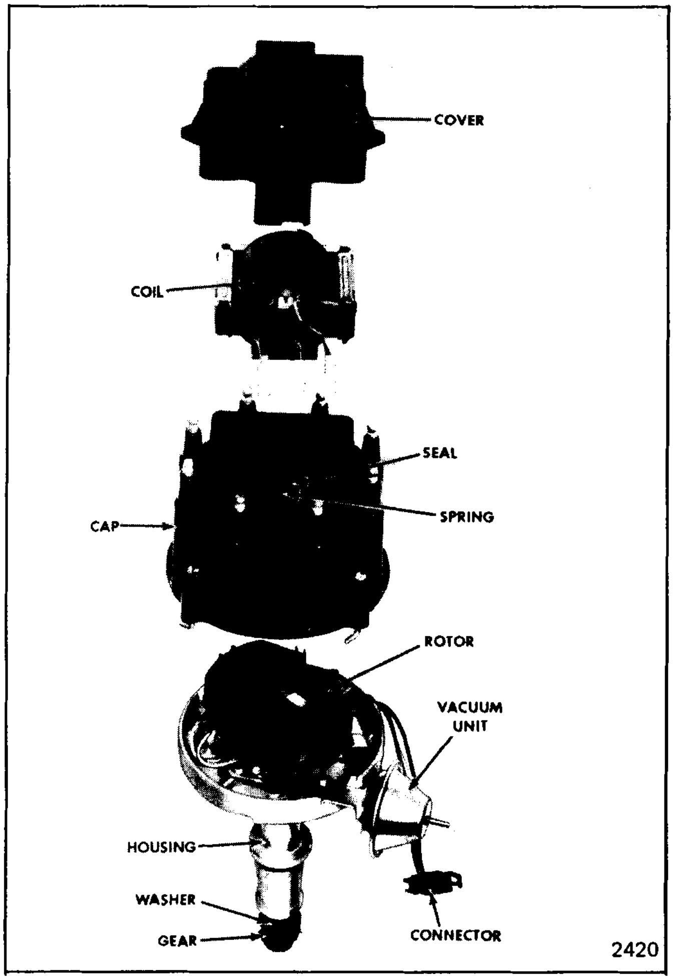


Fig. 6D-32 H.E.I. Distributor - Exploded View

Some 1977 engines will incorporate a magnetic timing probe hole for use with special electronic timing equipment. Figure 6D-34 shows a typical magnetic probe hole. Consult manufacturer's instructions for use of this equipment.

SECONDARY WIRING

The spark plug wiring used with the HEI system is a carbon impregnated cord conductor encased in an 8MM diameter silicone rubber jacket. The silicone wiring will withstand very high temperatures and also provides an excellent insulator for the higher voltage of the HEI system. The silicone spark plug boots form a tight seal on the plug and **the boot should be twisted 1/2 turn before removing.** Care should also be exercised when connecting a timing light or other pick-up equipment. Do not force contacts between the boot and wiring, or through the silicone jacket. Connections should be made in parallel using an adapter. DO NOT pull on the wire to remove. Pull on the boot, or use a tool designed for this purpose.

SPARK PLUGS

R44TSX, R45TSX, and R46TSX resistor type, tapered seat plugs with long reach are used in V8 engines except VI Code "R" and "K", and in the 151 L-4 (see Fig. 6D-35). The R43TS and R46TS plugs used in the 140 L-4 and 231 V6 engines are also a resistor type, tapered seat plug with long reach. R46TSX plugs may also be used in the 231 V6 engine. Replace with plug indicated on Emission Tune-up label.

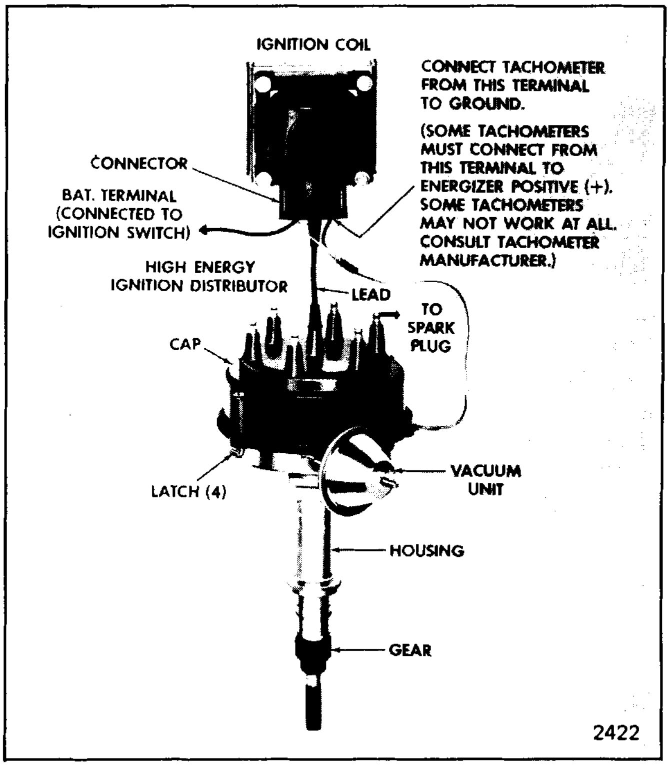


Fig. 6D-33 140 L-4 H.E.I. Distributor and Coil

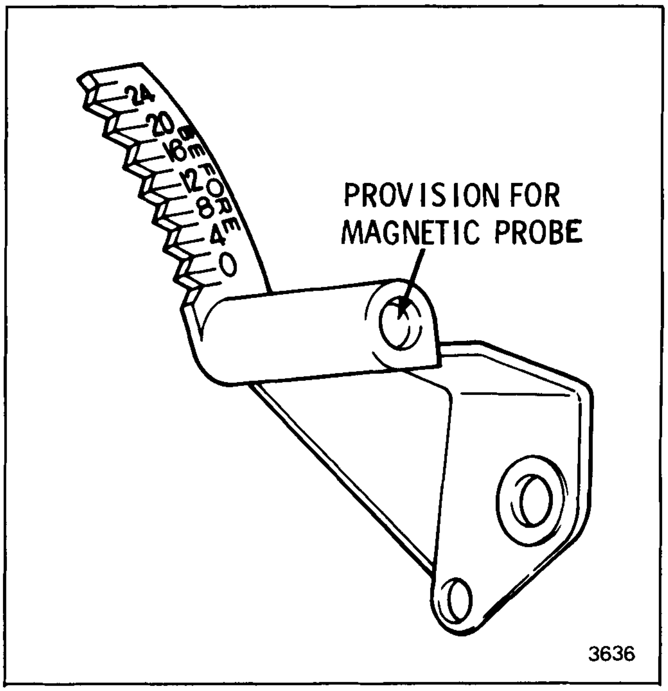


Fig. 6D-34 Magnetic Timing Probe Hole

The "R" and " K" VI code V8 engines use R46SZ resistor type spark plugs with a long reach but they are not tapered seat plugs.

See Engine Exhaust Emissions Section (6E) for spark plug application and gap sizes.

Normal or average service is assumed to be a mixture of idling, slow speed, and high speed operation with some of each making up the daily total driving. Occasional or intermittent high-speed driving is essential to good spark plug performance as it provides increased and sustained combustion heat that burns away any excess deposits of carbon or oxide that may have accumulated from frequent idling or continual stop-an-go or slow-speed driving. Spark plugs are protected by an insulating nipple made of special heat-resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent flash-over with resultant missing of engine, even though a film is allowed to accumulate on exposed portion of plug porcelains.

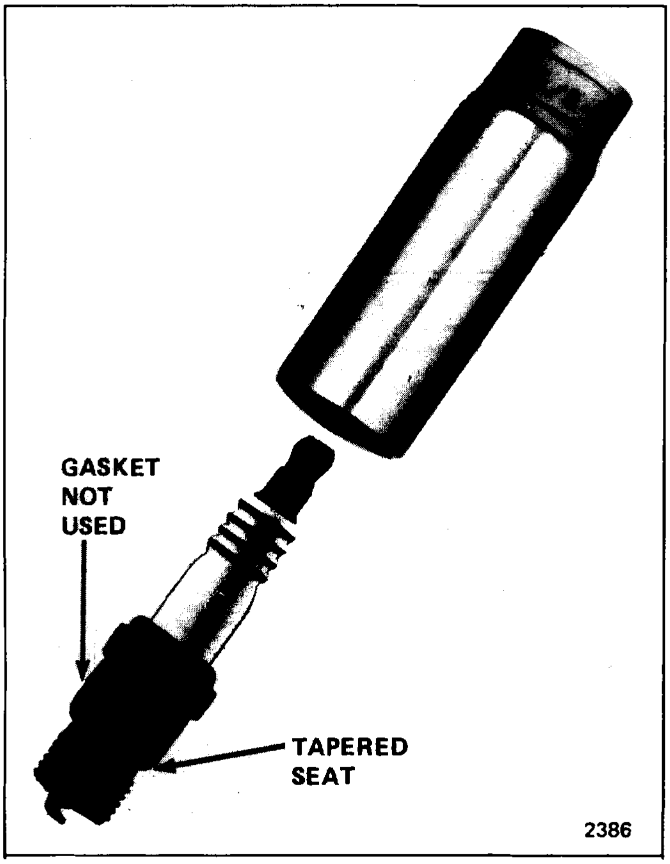


Fig. 6D-35 Spark Plug - Tapered Seat

NOTE: Do not mistake corona discharge for flash-over or a shorted insulator. Corona is a steady blue light appearing around insulator, just above the shell crimp. It is the visible evidence of high-tension field, and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

All spark plugs have a type number on the insulator which designates thread size as well as relative position of the plug in the Heat Range. Type numbers starting with 4 are 14 mm. thread size.

The last digit of the type number indicates the Heat Range position of the plug in the Heat Range System. Read these numbers as you would a thermometer; the higher the last digit, the hotter the plug will operate in engine; the lower the last digit the cooler the plug.

IGNITION SWITCH

The switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly.

For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEERING, Section 3B.

The ignition and starting switch is key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

The ignition switch used on all cars has five positions: Two "OFF" positions ("OFF" and "OFF-LOCKED"), "ACCESSORY", "RUN" and "START". "OFF" is the center position of the key-lock cylinder, and "OFF-LOCKED" is the next position to the left.

"ACCESSORY" is located one more detent to the left of "OFF-LOCKED". Turning the key to the right of the "OFF" position until spring pressure is felt will put the ignition switch in the "RUN" position, and when turned fully to the right against spring pressure, the swtich will be in the "START" position.

The connections to the ignition switch are shown in the Chassis Electrical Wiring Diagrams at the end of the manual. The charts included on the diagrams show how the switches are internally connected in each switch position. Fig. 6D-36 also shows how the switch is internally connected.

VACUUM ADVANCE SYSTEMS

All 1977 Pontiac engines are equipped with distributor vacuum spark advance. Vacuum advance provides smooth part throttle operation and good fuel economy. There are two types of vacuum advance: 1) ported vacuumn and 2) full manifold vacuum.

Ported vacuum advance systems have a timed port in the carburetor throttle body above the throttle plates. The timed port provides vacuum during open throttle operation only.

Full manifold vacuum advance systems use manifold vacuum from either a manifold vacuum from either a manifold vacuum port on the carburetor or a fitting in the intake manifold. Vacuum is provided whenever the engine is running.

The vacuum advance systems of various engines also include some of the following vacuum controls:

Thermal Vacuum Switches - TVS
Vacuum Delay Valves - VDV
Vacuum Modulator Valves - VMV
Vacuum Reducer Valves - VRV

How each of the above vacuum controls is used on each engine type is described below. Refer to Section 6E for proper installation of vacuum hoses. Fig 6D-37 shows the various switches, their connections, and their calibration valves.

L4-140 Engine

The L4-140 engine is equipped with a vacuum delay valve, VDV, to maintain vacuum advance during quick throttle openings when the engine coolant temperature is below approximately 115°F. This feature improves engine response during cold engine operation. The VDV is by-passed thru the distributor spark TVS when the engine coolant

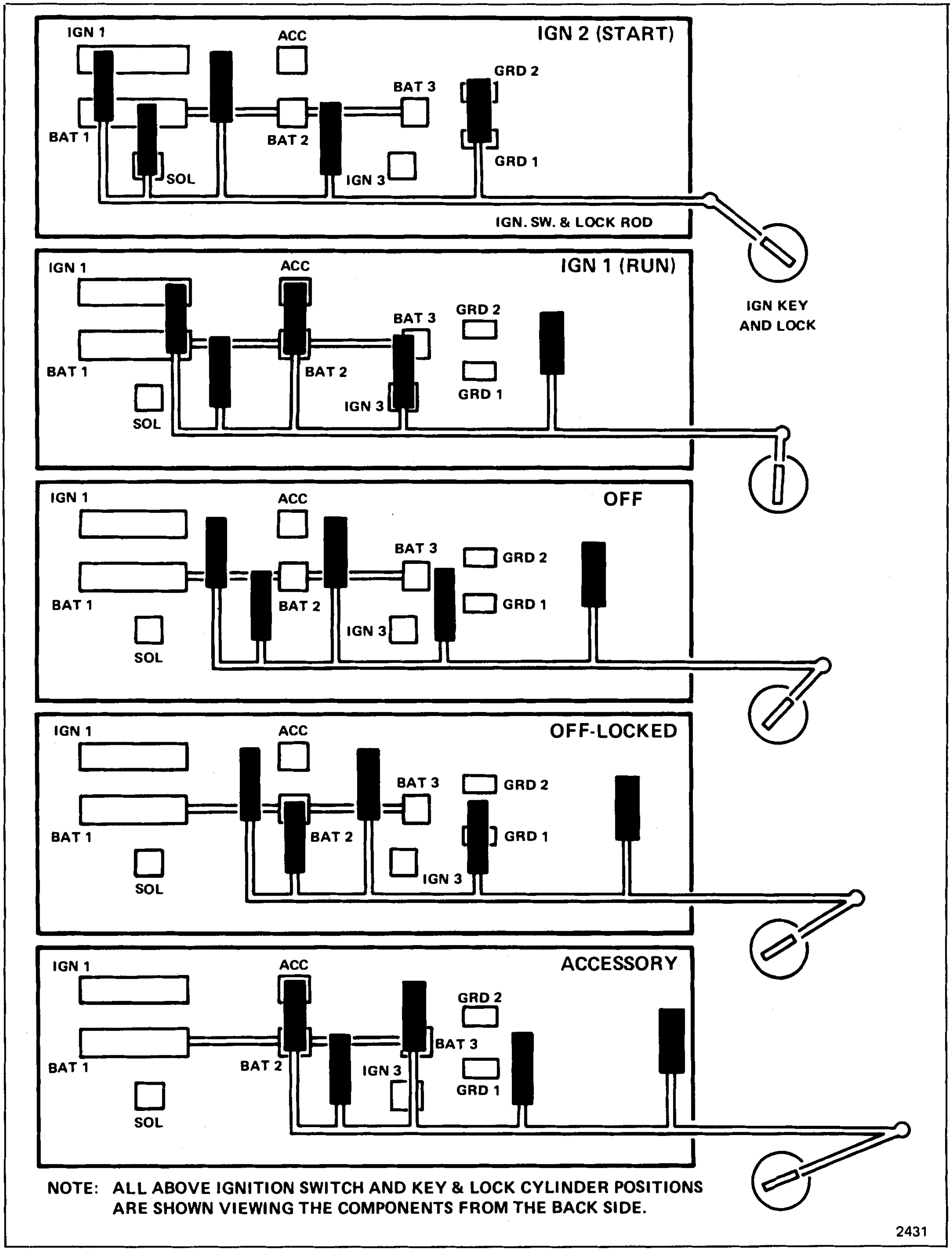


Fig. 6D-36 Ignition Switch

temperature is above approximately 115°F. and full manifold vacuum is applied to the distributor. The TVS also controls the secondary vacuum break on California and High Altitude Certified Vehicles and is called a SVB/BS-TVS. Service of the secondary vacuum break portion of the valve is in Section 6C.

L4-151 Engine

The L4-151 engine is equipped with a vacuum delay valve, VDV, to maintain vacuum advance during quick throttle openings when the engine coolant temperature is below approximately 120°F. This feature improves engine response during cold engine operation. The VDV is by-passed thru distributor spark TVS when the engine coolant temperature is above approximately 120°F. Above 120°F. coolant temperature full manifold vacuum is used for distributor spark except for L4-151 engine with air conditioning and automatic transmission, which uses ported vacuum.

V6-231 Engine

V6-231 Engines, except California, use full manifold vacuum for distributor spark with no vacuum controls. V6 231 California engines with automated transmissions use ported vacuum for distributor spark, with no vacuum controls. V6 231 California engines with manual transmission use ported vacuum with Transmission Controlled Spark, TCS. TCS applies vacuum to the distributor in 3rd gear on A, F and X Series and 4th and 5th gear on HM Series.

V8-301 Engine

V8-301 engines with manual transmission use ported vacuum for distributor spark. No vacuum controls are used.

V8-301 engines with automatic transmission without air conditioning use full manifold vacuum for distributor spark. No vacuum controls are used.

V8-301 engines with automatic transmission and air conditioning use a full time vacuum modulator valve, VMV, with a vacuum delay valve, VDV, to maintain vacuum advance during quick throttle openings when the engine coolant temperature is below approximately 120°F. This feature improves engine response during cold engine operation. The VDV is by-passed thru the distributor spark TVS when the engine coolant temperature is above approximately 120°F., and the distributor spark vacuum is regulated only by the VMV. The VMV limits the distributor spark vacuum to a calibrated value until ported vacuum applied to the control port of the VMV is greater than the calibration valve. When ported vacuum is greater than the calibration value, the distributor spark vacuum is equal to ported vacuum.

V8-350 and 400 Engine, VIN Code P & Z

V8-400 engines with manual transmission use port vacuum for distributor spark with a coolant overheat TVS which provides full manifold vacuum to the distributor when the engine coolant temperature is above approximately 225°F.

V8-350 and 400 engines, VIN Codes P & Z, with automatic transmission, are equipped with a spark retard delay orifice to maintain vacuum advance during quick throttle openings when the engine coolant temperature is below approximately 120°F. This feature improves engine response during cold engine operation. The spark retard delay orifice is by-passed thru the distributor spark TVS when the engine coolant temperature is above approximately 120°F. and full manifold vacuum is applied to the distributor.

V8-350 and 403 Engines, VIN Codes R & K

Low Altitude Certified Vehicles

Low altitude certified V8-350 and 403 engines, used in early production B cars only, use full manifold vacuum for distributor spark. The engines are equipped with a distributor spark vacuum reducer valve, DS-VRV, which reduces the vacuum applied to the distributor by 1.5 inches of mercury when engine coolant temperature is above approximately 220°F. The DS-VRV is by-passed by the distributor spark TVS when engine coolant temperature is below approximately 220°F.

California Certified Vehicles

California certified V8-350 and 403 engines use ported vacuum for distributor spark. The ported vacuum is controlled by an EGR/DS-TVS, DS-TVS, and a distributor spark VDV. The EGR/DS-TVS prevents any vacuum advance when the engine coolant temperature is below approximately 120°F. The DS-TVS applies full manifold vacuum to the distributor when the engine coolant temperature is above approximately 220°F., for engine overheat protection. The DS-VDV delays the application of vacuum to the distributor when throttle opening is reduced, such as after vehicle acceleration. The DS-VDV is unaffected by DS-TVS operation.

High Altitude Certified Vehicles

High altitude certified V8-350 and 403 engines use ported vacuum for distributor spark. The engine is equipped with a DS-TVS which applies full manifold vacuum to the distributor when the engine coolant temperature is above approximately 220°F., for engine overheat protection.

DIAGNOSIS

H.E.I. DISTRIBUTOR

Use Figure 6D-38 for H.E.I. Diagnosis. This diagnosis will cover both H.E.I. ignition systems, either internal or external coil.

SPARK PLUGS

Worn or dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are indicated in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear, may be due to carbon fouled plugs, excessive gap or broken insulator.

Fouled plugs may be indicated by checking for black carbon deposits. The black deposits are usually the result of slow-speed driving and short runs where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too cold will also result in carbon deposits.

Excessive gap wear, on plugs of low mileage, usually indicates the engine is operating at high speeds or loads that

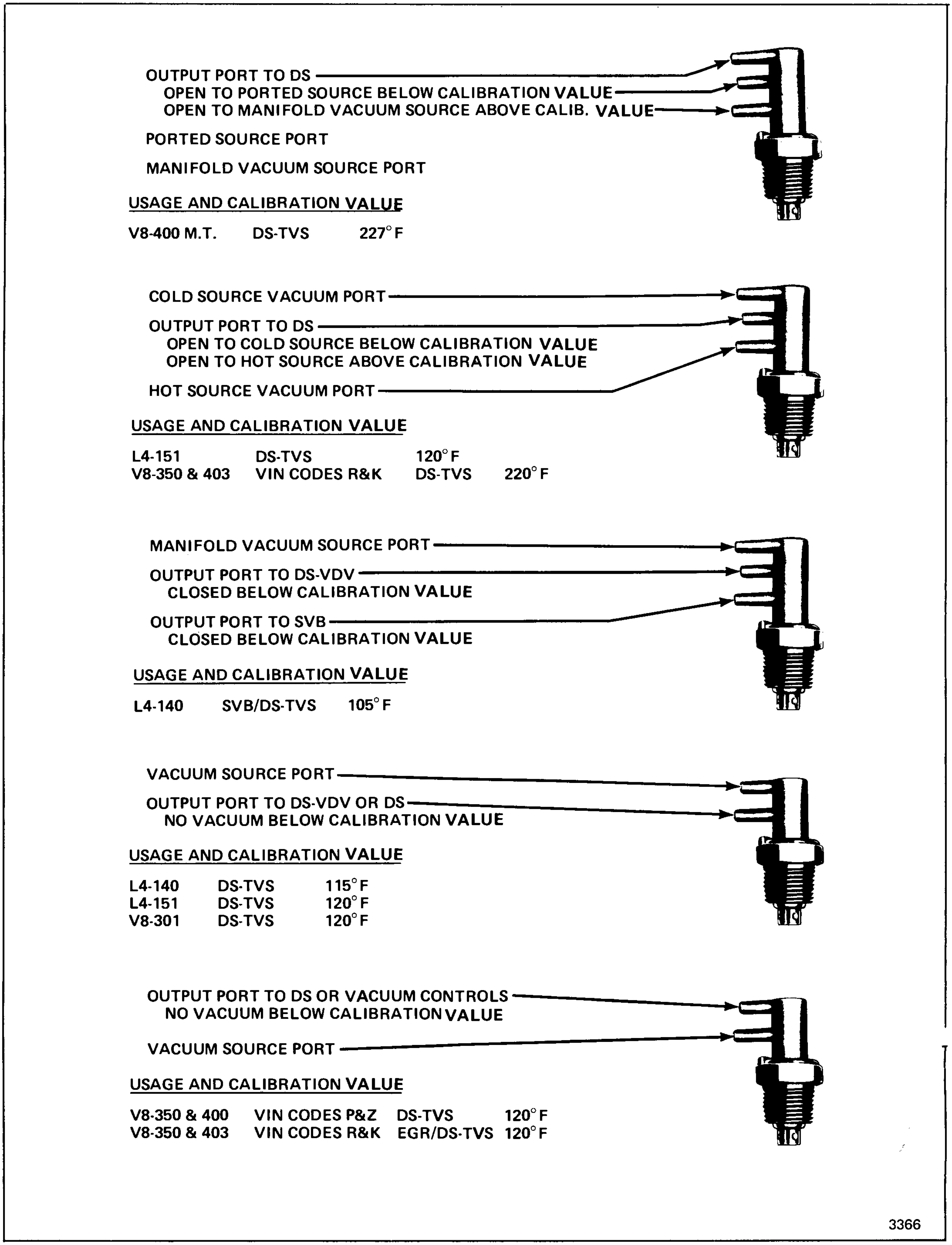
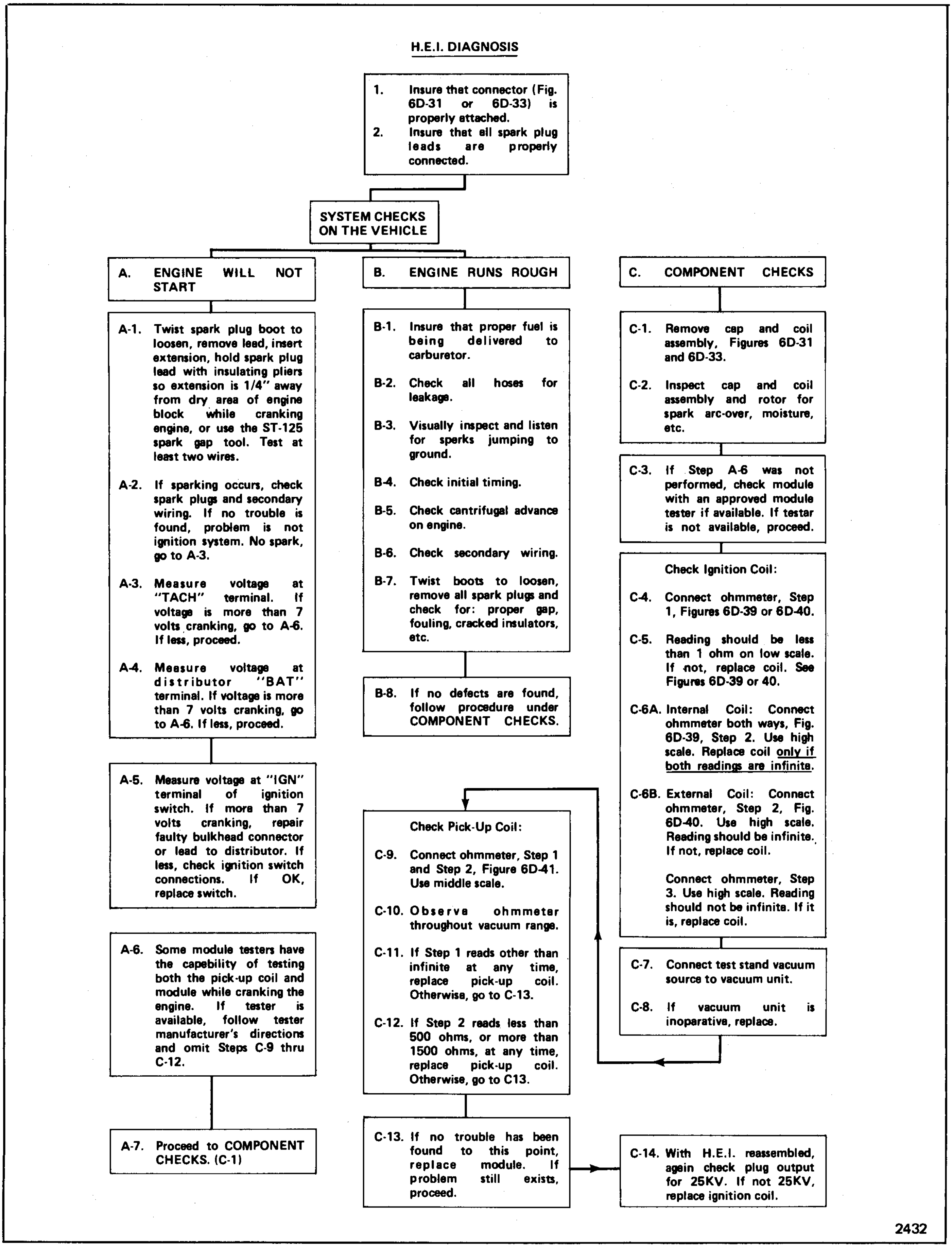


Fig. 6D-37 Distributor Spark Thermal Vacuum Switches



H.E.I. DIAGNOSIS

1. Insure that connector (Fig. 6D-31 or 6D-33) is properly attached.
2. Insure that all spark plug leads are properly connected.

SYSTEM CHECKS ON THE VEHICLE

A. ENGINE WILL NOT START

A-1. Twist spark plug boot to loosen, remove lead, insert extension, hold spark plug lead with insulating pliers so extension is 1/4" away from dry area of engine block while cranking engine, or use the ST-125 spark gap tool. Test at least two wires.

A-2. If sparking occurs, check spark plugs and secondary wiring. If no trouble is found, problem is not ignition system. No spark, go to A-3.

A-3. Measure voltage at "TACH" terminal. If voltage is more than 7 volts cranking, go to A-6. If less, proceed.

A-4. Measure voltage at distributor "BAT" terminal. If voltage is more than 7 volts cranking, go to A-6. If less, proceed.

A-5. Measure voltage at "IGN" terminal of ignition switch. If more than 7 volts cranking, repair faulty bulkhead connector or lead to distributor. If less, check ignition switch connections. If OK, replace switch.

A-6. Some module testers have the capability of testing both the pick-up coil and module while cranking the engine. If tester is available, follow tester manufacturer's directions and omit Steps C-9 thru C-12.

A-7. Proceed to COMPONENT CHECKS. (C-1)

B. ENGINE RUNS ROUGH

B-1. Insure that proper fuel is being delivered to carburetor.

B-2. Check all hoses for leakage.

B-3. Visually inspect and listen for sparks jumping to ground.

B-4. Check initial timing.

B-5. Check cantrifugal advance on engine.

B-6. Check secondary wiring.

B-7. Twist boots to loosen, remove all spark plugs and check for: proper gap, fouling, cracked insulators, etc.

B-8. If no defects are found, follow procedure under COMPONENT CHECKS.

C. COMPONENT CHECKS

C-1. Remove cap and coil assembly, Figures 6D-31 and 6D-33.

C-2. Inspect cap and coil assembly and rotor for spark arc-over, moisture, etc.

C-3. If Step A-6 was not performed, check module with an approved module tester if available. If testar is not available, proceed.

Check Ignition Coil:

C-4. Connect ohmmeter, Step 1, Figures 6D-39 or 6D-40.

C-5. Reading should be less than 1 ohm on low scale. If not, replace coil. See Figures 6D-39 or 40.

C-6A. Internal Coil: Connect ohmmeter both ways, Fig. 6D-39, Step 2. Use high scale. Replace coil only if both readings are infinite.

C-6B. External Coil: Connect ohmmeter, Step 2, Fig. 6D-40. Use high scale. Reading should be infinite. If not, replace coil.

Connect ohmmeter, Step 3. Use high scale. Reading should not be infinite. If it is, replace coil.

C-7. Connect test stand vacuum source to vacuum unit.

C-8. If vacuum unit is inoparative, replace.

Check Pick-Up Coil:

C-9. Connect ohmmeter, Step 1 and Step 2, Figure 6D-41. Use middle scale.

C-10. Observe ohmmeter throughout vacuum range.

C-11. If Step 1 reads other than infinite at any time, replace pick-up coil. Otherwise, go to C-13.

C-12. If Step 2 reads less than 500 ohms, or more than 1500 ohms, at any time, replace pick-up coil. Otherwise, go to C13.

C-13. If no trouble has been found to this point, replace module. If problem still exists, proceed.

C-14. With H.E.I. reassembled, again check plug output for 25KV. If not 25KV, replace ignition coil.

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Fig. 6D-38 H.E.I. Diagnosis

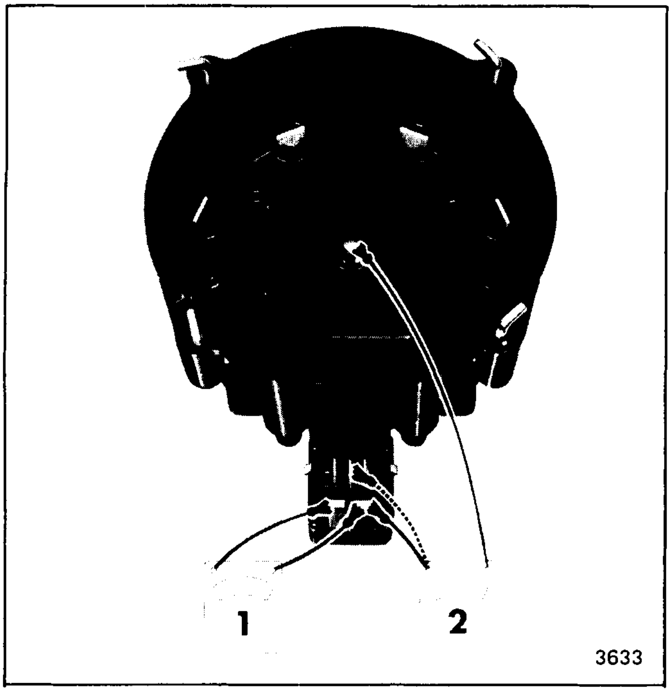

Fig. 6D-39 Checking Internal Coil

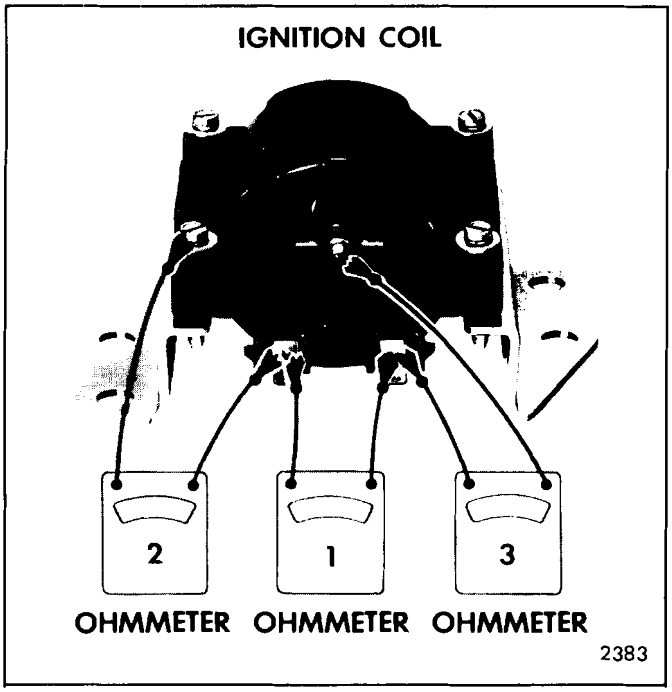

Fig. 6D-40 Checking External Coil

are consistently greater than normal or that a plug which is too hot is being used. In addition, electrode wear may be the result of plug overheating, caused by combustion gases leaking past the threads, due to insufficient torquing of the spark plug. Excessively lean carburetion will also result in excessive electrode wear.

Broken insulators are usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but will as soon as oil or moisture penetrates the fracture. The fracture is usually just below the crimped part of shell and may not be visible.

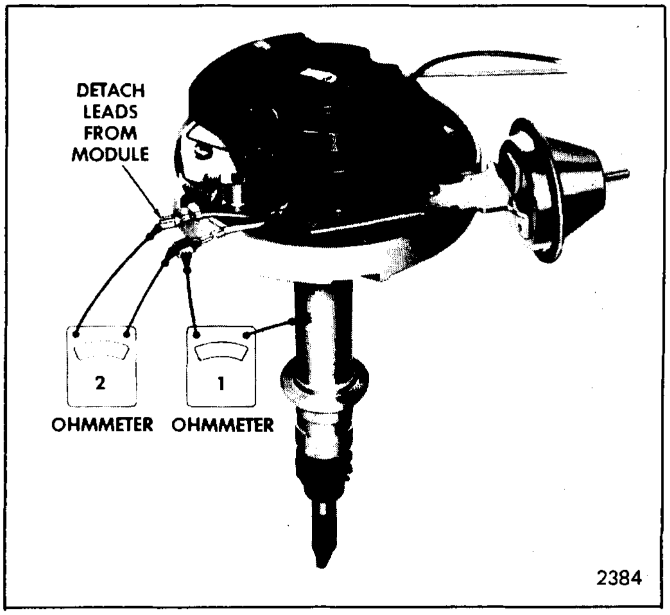

Fig. 6D-41 Checking Pick-Up Coil

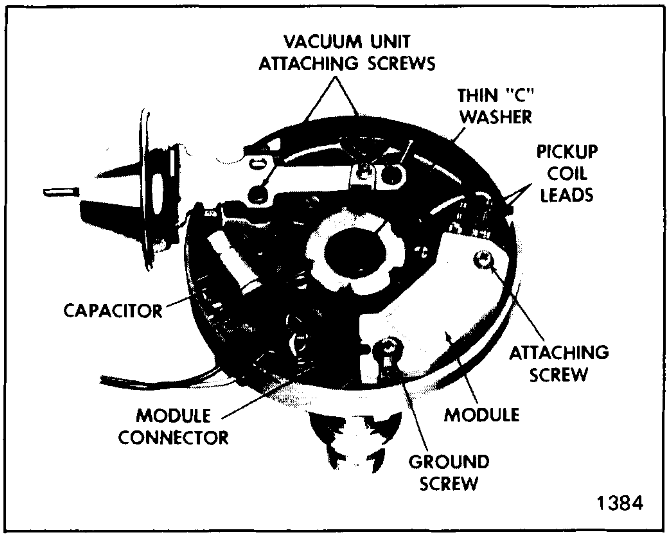

Fig. 6D-42 Distributor Base and Components

Broken lower insulators usually result from carelessness when regapping and generally are visible. In fairly rare instances, this type of break may result from the plug operating too "hot" such as encountered in sustained periods of high-speed operation or under extremely heavy loads. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced.

ON-CAR SERVICE

H.E.I. DISTRIBUTOR

Service Precautions

1. When making compression checks, disconnect the ignition switch feed wire at the distributor. When disconnecting this connector **do not** use a screwdriver or tool to release the locking tab as it may break.

2. No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.

3. The tachometer (TACH) terminal is next to the ignition switch (BAT) connector on the distributor cap.

CAUTION: *The tachometer terminal must NEVER be allowed to touch ground, as damage to the module and/or ignition coil can result.*

NOTE: Some service tachometers and electronic diagnostic equipment currently in use may NOT be compatible with the High Energy Ignition System. It is recommended that you consult your representative of such equipment as to the necessary updating of your equipment for compatibility with the HEI System.

4. There is no dwell adjustment as this is controlled by the module.

5. The centrifugal advance, and vacuum advance are similar to the conventional ignition.

6. The material used to construct the spark plug cables is very pliable and soft. This cable will withstand more heat and carry a higher voltage. Due to the more pliable cable, scuffing and cutting become easier. It is therefore extremely important that the spark plug cables be routed correctly to prevent chaffing or cutting. See Spark Plug Section of On-Car Service. Also when removing a spark plug wire from a spark plug, twist the boot on the spark plug and pull **on the boot** to remove the wire.

REMOVE AND REPLACE

Distributor

1.Disconnect ignition switch battery feed wire from distributor cap. (DO NOT use a screwdriver or tool to release the locking tab.)

2. Remove distributor cap by turning four latches counterclockwise.

NOTE: If necessary to remove secondary wires from cap, release wiring harness latches and remove wiring harness retainer. The spark plug wire numbers are indicated on the retainer.

3. Remove vacuum hose from vacuum advance unit.

4. Remove distributor clamp screw and hold-down clamp.

5. Note position of rotor, then pull distributor up until rotor just stops turning counterclockwise and again note position of rotor.

NOTE: To insure correct timing of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted in Step 5.

If the engine was accidentally cranked after the distributor was removed, the following procedure can be used for installing:

a. Remove No. 1 spark plug.

b. Place finger over No. 1 spark plug hole and crank engine slowly until compression is felt.

c. Align timing mark on pulley to "0" on engine timing indicator.

d. Turn rotor to point between No. 1 and No. 8 spark plug towers on distributor cap.

e. Install distributor and connect ignition feed wire.

f. Install distributor cap and spark plug wires.

g. Check engine timing.

Module (Refer to Fig. 6D-42)

It is not necessary to remove the distributor from car.

REMOVAL

1. Remove distributor cap and rotor.

2. Disconnect two pick-up leads from module. (Observe color code on leads as these cannot be interchanged.)

3. Remove two module attaching screws.

4. Remove module from distributor base and remove two wire connectors.

NOTE: Do not wipe grease from module or distributor base if same module is to be replaced. If a new module is to be installed, a package of silicone lubricant will be included with it. Spread the lubricant on the metal face of the module and on the distributor base where the module seats. This lubricant is important as it aids heat transfer for module cooling.

INSTALLATION

To install, reverse removal procedure.

Pick-Up Coil (Refer to Fig. 6D-42)

REMOVAL

1. Remove distributor from car. Mark distributor shaft and gear so that they may be reassembled in the same position (see Distributor Removal above).

2. Drive out the roll pin and remove gear.

3. Remove distributor cap.

4. Remove distributor shaft with rotor and advance weights.

5. Remove the thin "C" washer on top of pick-up coil assembly, remove pick-up coil leads from module, and remove the pick-up coil assembly. (Do not remove the three screws.)

INSTALLATION

To install reverse removal procedure noting alignment marks when installing gear.

Rotor (Refer to Fig. 6D-32)

The rotor is retained by two screws and is provided with a slot which fits over a square lug on the advance weight base, so that the rotor can be installed in only one position.

Vacuum Advance Unit (Refer to Fig. 6D-42)

REMOVAL

1. Remove distributor cap and rotor.

2. Remove module.

3. Remove two vacuum advance attaching screws.

4. Turn the pick-up coil clockwise and push the rod end of the vacuum advance down so that it will disengage and clear the pick-up coil plate.

INSTALLATION

To install, reverse removal procedure.

Integral Ignition Coil (Refer to Fig. 6D-32)

REMOVAL

1. Remove wiring connector from distributor cap by lifting two retaining tabs.

2. Remove three coil cover attaching screws, and lift off cover.

3. Remove four coil attaching screws and lift ignition coil and leads from cap.

4. Remove coil arc seal.

INSTALLATION

To install, reverse removal procedure.

Capacitor (Refer to Fig. 6D-42)

REMOVAL

1. Remove distributor cap and rotor.

2. Remove capacitor attaching screw, and unplug capacitor.

INSTALLATION

1. Plug in capacitor.

2. Install hold down screw making sure ground lead is under screw.

DISTRIBUTOR SPARK SWITCHES (REFER TO FIG. 6D-37)

Distributor spark vacuum hoses are to be checked for proper connection, cracking, abrasion or deterioration at regularly scheduled maintenance intervals. Refer to owner maintenance schedule in Section O for applicable intervals. Refer to Section 6E for vacuum hose schematics. The following procedures are to be followed when checking operation of vacuum advance system at regular maintenance intervals.

All L4-140 Engines

1. Allow engine to cool off to a temperature below 80°F. This may require not starting the engine for a period of 12 hours. If this is not possible, refer to off-car functional checks of individual components in this section.

2. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor spark vacuum unit and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seconds. If vacuum drops more than one inch, replace vacuum unit.

3. "TEE" a vacuum gage into the vacuum hose at the distributor spark vacuum unit.

4. Start engine and observe vacuum reading. Vacuum should be within one inch of manifold vacuum. If not, trace back along the vacuum hose from the vacuum unit to the vacuum source until the vacuum leak or plugged condition is located. Correct as necessary.

5. Start engine and allow vacuum reading to stabilize. Turn off the ignition and observe the vacuum gage.

Vacuum reading should not drop immediately, but should drop slowly (taking about 20 to 30 seconds to go from 15 to 5 inches).

6. If the vacuum drops too fast, the VDV is defective or there is a leak in the distributor vacuum advance unit. If the vacuum drops too slowly, the VDV is defective.

7. Allow engine to warm up until coolant temperature is above 115°F. Turn ignition off and observe vacuum reading. Vacuum should drop immediately. If vacuum does not drop immediately, either the vacuum hoses between the DS-TVS and VDV are plugged or the DS-TVS is defective; repair as required.

8. Disconnect vacuum hose at distributor and note decrease in idle RPM or retarding of igntion timing. If idle RPM and timing do not change, correct binding condition in vacuum unit by repair or replacement.

9. Re-connect vacuum hoses per vacuum hose schematics.

L4-151 Engine

1. Allow engine to cool off to a temperature below 80°F. This may require not starting the engine for a period of 12 hours. If this is not possible, refer to off-car functional checks of individual components in this section.

2. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor spark vacuum unit and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seconds. If vacuum drops more than one inch, replace vacuum unit.

3. "TEE" a vacuum gage into the vacuum hose at the distributor spark vacuum unit.

4. Start engine and observe vacuum reading. Vacuum should be within one inch of manifold vacuum. If not, trace back along the vacuum hose from the vacuum unit to the vacuum source until the vacuum leak or plugged condition is located. Correct as necessary.

5. Start engine and allow vacuum reading to stabilize. Turn off the ignition and observe the vacuum gage.

Vacuum reading should not drop immediately, but should drop slowly (taking about 7 seconds on automatic transmission vehicles or 3 seconds on manual transmission vehicles.

6. If the vacuum drops too fast, the VDV is defective or there is a leak in the distributor vacuum advance unit. If the vacuum drops too slowly, the VDV is defective.

7. Allow engine to warm up until coolant temperature is above 115°F. Turn igntion off and observe vacuum reading. Vacuum should drop immediately. If vacuum does not drop immediately, either the vacuum hoses between the DS-TVS and VDV are plugged or the DS-TVS is defective; repair as required.

8. Disconnect vacuum hose at distributor and note decrease in idle RPM or retarding of ignition timing. If idle RPM and timing do not change, correct binding condition in vacuum unit by repair or replacement.

9. Re-connect vacuum hoses per vacuum hose schematics.

V6-231 Engine Except California

1. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor spark vacuum unit and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seconds. If vacuum drops more than one inch,

replace vacuum unit. Reconnect vacuum hose at distributor and start engine.

2. Disconnect vacuum hose at distributor and note decrease in idle RPM or retarding of ignition timing. If idle RPM and timing do not change, correct binding condition in vacuum unit by repair or replacement.

3. Re-connect vacuum hoses per vacuum hose schematics.

California V6-231 Engine With Automatic Transmission

1. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor spark vacuum unit and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seconds. If vacuum drops more than one inch, replace vacuum unit. Re-connect vacuum hose at distributor.

2. "TEE" a vacuum gage into vacuum hose at distributor spark vacuum unit.

3. Start engine and allow engine to warm-up until carburetor is off fast idle.

4. Vacuum gage should read less than 1 inch of mercury. If vacuum is higher, check idle speed and reset as necessary.

5. With transmission in Neutral and engine running, open throttle and observe vacuum gage. Vacuum should increase as idle speed is increased. If vacuum does not increase, check for plugged or leaking hose or plugged carburetor port.

6. Re-connect vacuum hoses per vacuum hose schematics.

CALIFORNIA V6-231 ENGINE WITH MANUAL TRANSMISSION

1. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor spark vacuum unit and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seconds. Re-connect vacuum hose at distributor and start engine.

2. "TEE" a vacuum gage into the distributor vacuum advance hose at the distributor. Position the gage so it can be observed from the driver's seat. With transmission in Neutral, increase engine speed to about 1000 RPM.

3. At this point, note vacuum gage reading. It should be zero.

4. Shift 3 speed manual into 3rd gear or 4 speed manual into 4th gear or 5 speed manual into 4th gear or 5th gear.

5. Again note vacuum gage reading. There should be vacuum present at this time. If no vacuum is present, proceed with the following.

6. Connect a jumper with a test light (1893 bulb or smaller) between the two connector terminals of the TCS solenoid. Start engine and place 3 speed manual into 3rd gear, 4 speed manual into 4th gear, or 5 speed manual into 4th or 5th gear. The test light should be off.

7. If the test light is on, check for a grounded wire between solenoid connector and transmission. If wire is not grounded, replace transmission switch.

8. Shift transmission to neutral. Test light should come on. If test light does not come on, check for an open circuit. If circuit is not open, replace transmission switch.

9. If Steps 6 and 7 above check out correctly and there is still no vacuum present as required in Step 4 above, replace TCS solenoid.

V8-301 Engine With Automatic Transmission And Air Conditioning

1. Allow engine to cool off to a temperature below 80°F. This may require not starting the engine for a period of 12 hours. If this is not possible, refer to off-car functional checks of individual components in this section.

2. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor spark vacuum unit and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seconds. If vacuum drops more than one inch, replace vacuum unit.

3. "TEE" a vacuum gage into the vacuum hose at the distributor spark vacuum unit.

4. Start engine and observe vacuum gage. Vacuum should be 8.7±.5 inches of mercury. If vacuum is higher than 9.2 inches of mercury, replace VDV. If vacuum is less than 8.2 inches of mercury, trace back along the vacuum hoses from the vacuum unit to the vacuum source until the vacuum leak or plugged condition is located. Correct as necessary.

5. Start engine and allow vacuum reading to stabilize. Turn off the ignition and observe the vacuum gage.

Vacuum reading should not drop immediately, but should drop slowly (taking about 8 to 10 seconds to go from 15 to 5 inches).

6. If the vacuum drops too fast, the VDV is defective or there is a leak in the distributor vacuum advance unit. If the vacuum drops too slowly, the VDV is defective.

7. "Tee" a second vacuum gage into the hose between the "CARB" port and the front of the carburetor.

8. With the vehicle in "Park" with automatic or "Neutral" with manual transmission, gradually open the throttle and note that the "DIST" port gage will be reading the calibration value while the "CARB" port gage will gradually increase to the calibration value. Once both gages reach the calibration value, gages will be read the same as the throttle is opened (gages will peak at about 15 inches before dropping off). Replace valve if it does not conform.

9. Allow engine to warm up until coolant temperature is above 120°F.

10. Turn ignition off and observe "DIST" vacuum gage. Vacuum should drop immediately. If not, check for plugged vacuum hose or closed DS-TVS. Replace parts as necessary.

11. Disconnect vacuum hose at distributor and note decrease in idle RPM or retarding of ignition timing. If idle RPM and timing do not change, correct binding condition in vacuum unit by repair or replacement.

12. Re-connect vacuum hoses per vacuum hose schematics.

V8-400 Engine With Manual Transmission And High Altitude V8-350 & 403

1. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor spark vacuum unit and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seoncds. If vacuum drops more than one inch, replace vacuum unit.

2. With engine at normal operating temperature and slow idle, check for vacuum at hose to distributor. There should be less than 1 inch of mercury vacuum. If vacuum is present, check idle speed and reset as necessary. If vacuum is still present, verify engine coolant temperature is below 220°F. If coolant temperature is below 220°F., replace DS-TVS. If coolant temperature is above 220°F., determine cause for over-temperature operation and correct as necessary.

3. Open throttle slightly and observe an increase in vacuum at the distributor. If vacuum is not present at fast idle, check for plugged or leaking vacuum hoses or DS-TVS. Replace as necessary.

4. Re-connect vacuum hoses per vacuum hose schematics.

V8-350 & 400 Engines, VIN Codes P & Z, With Automatic Transmission

1. Allow engine to cool off to a temperature below 80°F. This may require not starting the eingie for a period of 12 hours. If this is not possible, refer to off-car functional checks of individual components in this section.

2. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor spark vacuum unit and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seconds. If vacuum drops more than one inch, replace vacuum unit.

3. "Tee" a vacuum gage into the vacuum hose at the distributor spark vacuum unit.

4. Start engine and observe vacuum reading. Vacuum should be within one inch of manifold vacuum. If not, trace back along the vacuum hose from the vacuum unit to the vacuum source until the vacuum leak or plugged condition is located. Correct as necessary.

5. Start engine and allow vacuum reading to stabilize. Turn off the ignition and observe the vacuum gage.

Vacuum reading should not drop immediately, but should drop slowly (taking about 2 to 5 seconds to go from 15 to 5 inches.

6. If the vacuum drops too fast, the VDV is defective or there is a leak in the distributor vacuum advance unit. If the vacuum drops too slowly, the VDV is defective.

7. Allow engine to warm up until coolant temperature is above 115°F. Turn ignition off and observe vacuum reading. Vacuum should drop immediately If vacuum does not drop immediately, either the vacuum hoses between the DS-TVS and VDV are plugged or the DS-TVS is defective; repair as required.

8. Disconnect vacuum hose at distributor and note decrease in idle RPM or retarding of ignition timing. If idle RPM and timing do not change, correct binding condition in vacuum unit by repair or replacement.

9. Re-connect vacuum hose per vacuum hose schematics.

Low Altitude V8-350 & 403 Engines, VIN Codes R & K

1. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seconds. If vacuum drops more than one inch, replace vacuum unit.

2. Start engine and note idle RPM. Re-connect vacuum hose at distributor and note increase in idle RPM or advancing of ignition timing. If idle RPM and timing do not change, verify vacuum is present at the distributor. If vacuum is present, correct binding condition in vacuum unit by repair or replacement. If no vacuum is present, trace along vacuum hoses inspecting for pinched or plugged hoses, plugged TVS, plugged VRV, or plugged carburetor port. Correct as necessary.

3. With engine running, remove vacuum hose from top port of DS-TVS. There should be a decrease in idle RPM and ignition timing. If there is no decrease in idle RPM and ignition timing, verify engine coolant temperature is below 220°F. If coolant temperature is above 220°F., determine cause of over temperature operation and correct as necessary. If coolant temperature is below 220°F., replace DS-TVS.

4. Measure vacuum level at port labeled "TVS" on DS-VRV and compare to manifold vacuum. Vacuum level should be approximately 1.5 inches less than manifold vacuum, if not disconnect vacuum hose from port labeled "V". If vacuum level at "TVS" port does not change, replace DS-VRV. If vacuum level changes, locate and correct plugged condition in vacuum hose between carburetor and "V" port or in carburetor port.

5. Re-connect vacuum hoses per vacuum hose schematics.

California V8-350 & 403 Engines, VIN Codes R & K

1. Allow engine to cool off to a temperature below 80°F. This may require not starting the engine for a period of 12 hours. If this is not possible, refer to off-car functional checks of individual components in this section.

2. Disconnect vacuum hose at distributor and connect a hand vacuum pump to the distributor spark vacuum unit and apply 15 inches of mercury vacuum. Observe vacuum reading for 20 seconds. If vacuum drops more than one inch, replace vacuum unit.

3. "Tee" a vacuum gage into the vacuum hose at the distributor spark vacuum unit.

4. Start engine, place carburetor on high step of fast idle cam, and observe vacuum gage. There should be no vacuum. If there is vacuum, verify engine coolant temperature is below 120°F., check for vacuum at bottom port of EGR/DS-TVS. If there is vacuum, replace the EGR/DS-TVS. There is no vacuum, replace the DS-TVS.

5. Allow engine to warm up until coolant temperature is above 120°F. Place carburetor on high step of fast idle cam. If vacuum gage reads less than 10" Hg., check for plugged carburetor port or plugged TVS. Turn off the igntion and observe the vacuum gage.

Vacuum reading should not drop immediately, but should drop slowly (taking about 20 to 30 seconds to go from 15 to 0 inches).

6. If the vacuum drops too fast, the VDV is defective or there is a leak in the distributor vacuum advance unit. If the vacuum drops too slowly, the VDV is defective.

7. Re-connect vacuum hoses per vacuum hose schematics.

OFF-CAR CHECK OF THERMAL VACUUM SWITCHES

Thermal vacuum valves open, close, or switch vacuum sources when the calibration temperature is reached. The following general checking procedures can be used for all thermal vacuum valves. Refer to the illustrations on the following pages for TVS identification, usage, and calibration temperatures.

1. Allow TVS to cool below calibration temperature.
2. Connect vacuum gage(s) to output port(s) of the TVV and apply vacuum signal to the source port(s) of the TVV.
3. Compare vacuum gage reading(s) to the correct reading(s) indicated in the TVS illustration.
4. Heat TVS to a temperature above the calibration temperature. Never apply a torch or open flame directly to the TVS.
5. Compare vacuum gage reading to the correct reading indicated in Fig. 6D-37.

IGNITION SWITCH

For removal and replacement procedures, refer to Steering Section 3B.

SPARK PLUG WIRES

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing, and pull on the **boot only** to remove the wire.

It is extremely important when replacing plug wires to route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground.

Refer to Figures 6D-43, 6D-44, 6D-45 and 6D-45A for proper spark plug wire routing.

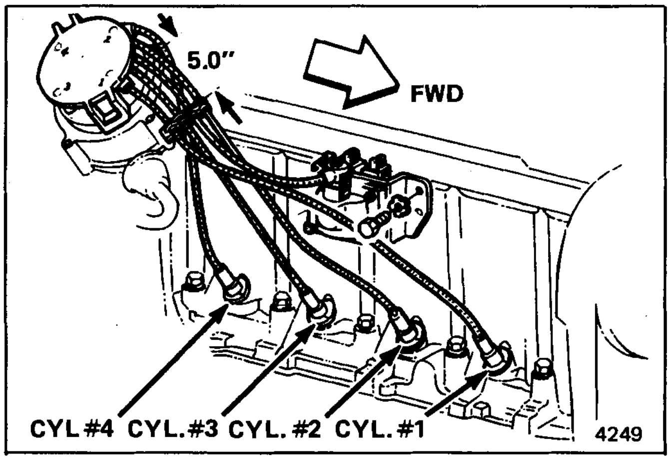

Fig. 6D-45A Spark Plug Wire Routing - 140 L-4

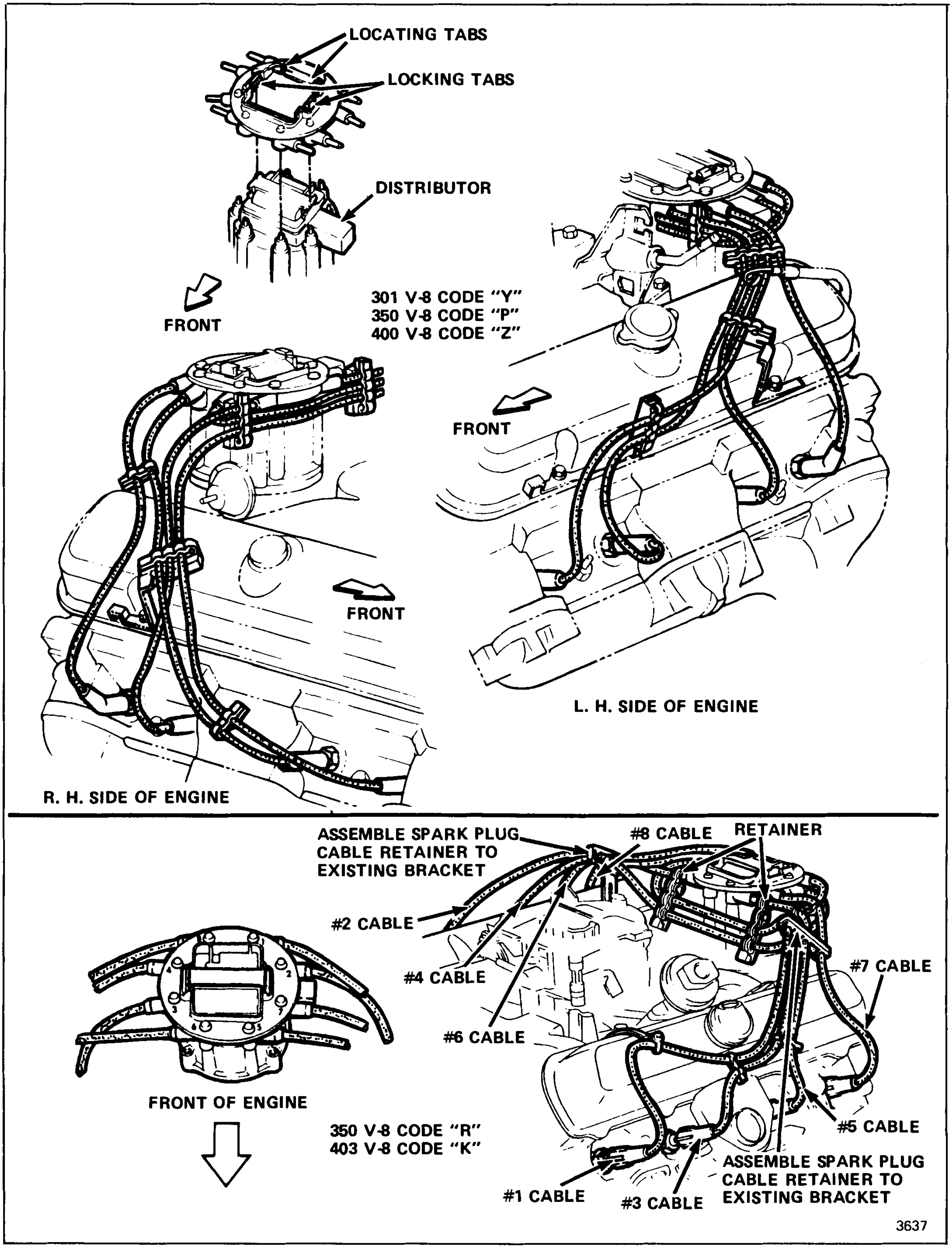

Fig. 6D-43 Spark Plug Wire Routing

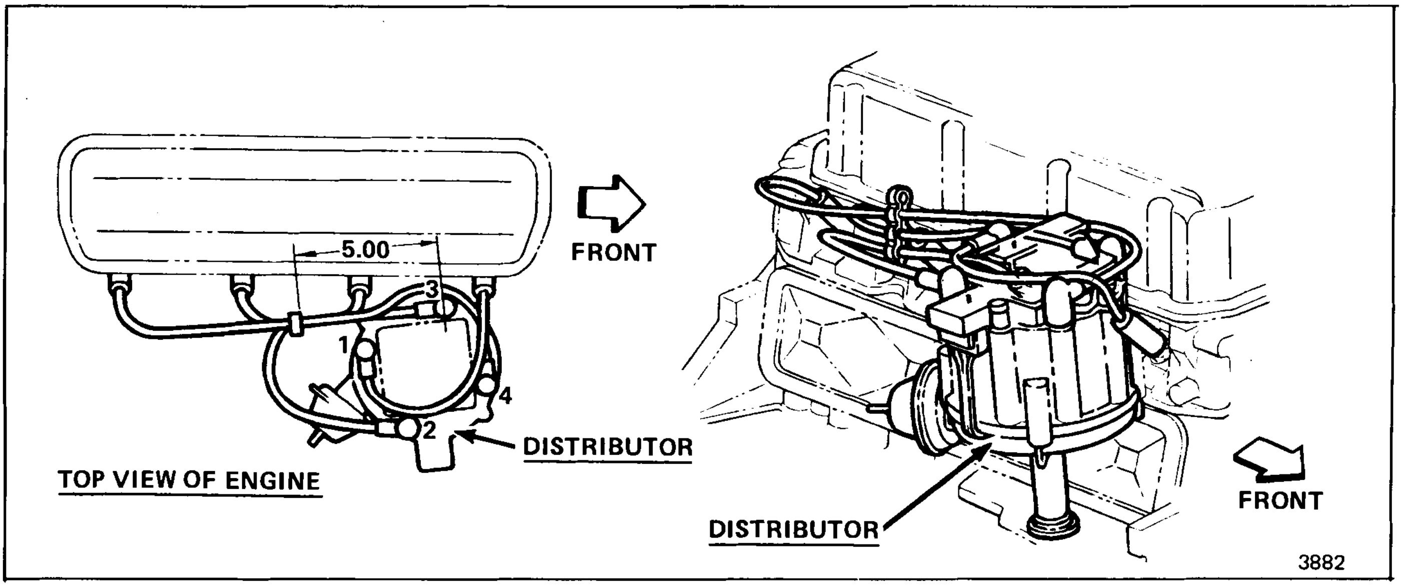

Fig. 6D-44 Spark Plug Wire Routing

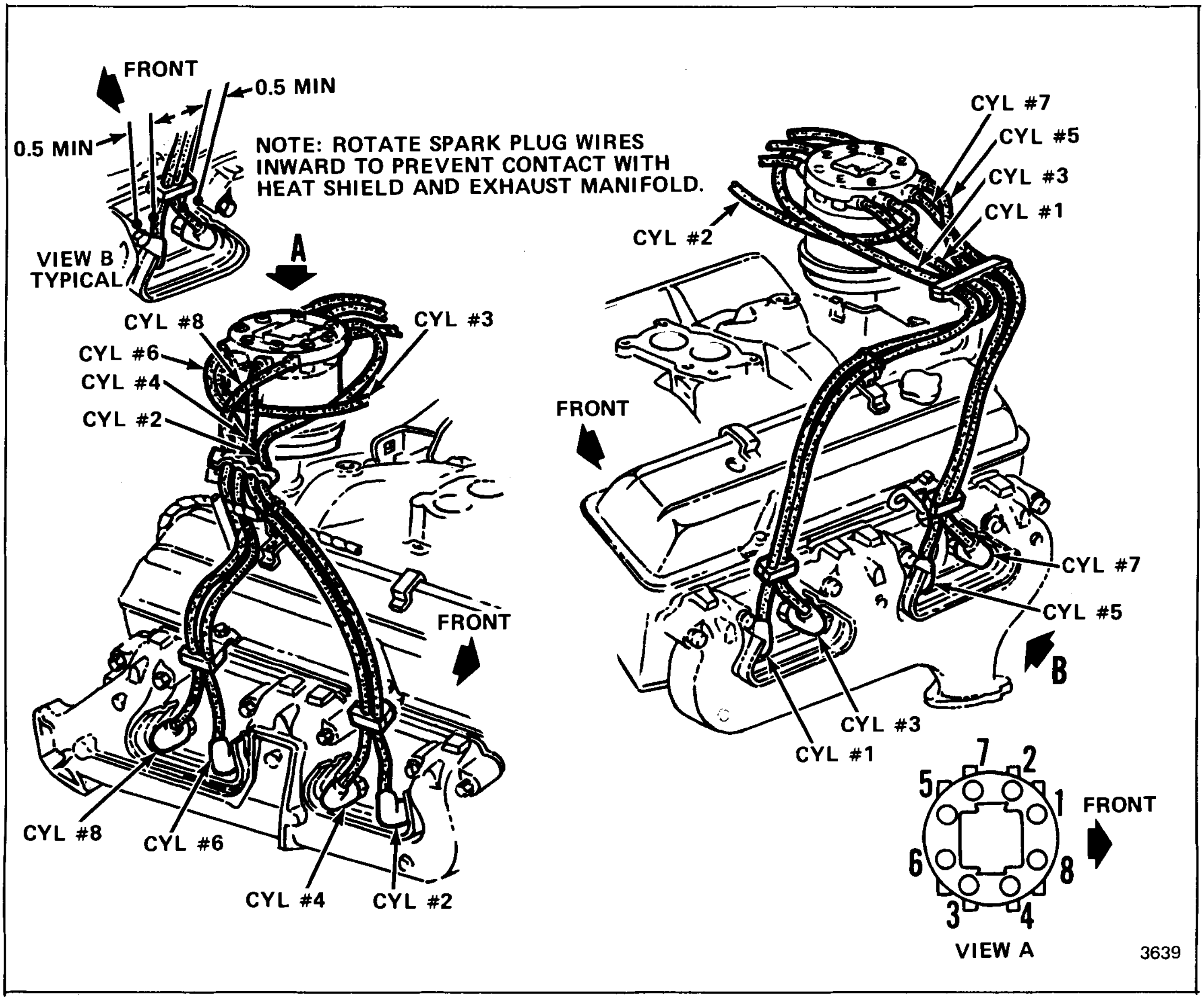

Fig. 6D-45 Spark Plug Wire Routing - VIN Code "U" and "L" V8's

CRANKING SYSTEM

GENERAL DESCRIPTION

CRANKING CIRCUIT

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically as shown in Figure 6D-46. Only the starting motor will be covered in this portion. Refer to Section 6D for information on the other components.

STARTING MOTOR

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing protecting them from exposure to dirt, icing conditions and splash. A typical motor is shown in Figure 6D-47.

In the basic circuit shown in Figure 6D-46, the solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear and the solenoid main contacts to close, and cranking takes place. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should be opened immediately when the engine starts.

DIAGNOSIS

Before removing any unit in a cranking circuit for repair, the following checks should be made:

Battery: To determine the condition of the battery, follow the testing procedure outlined in the Battery Section of 6D. Insure that the battery is fully charged.

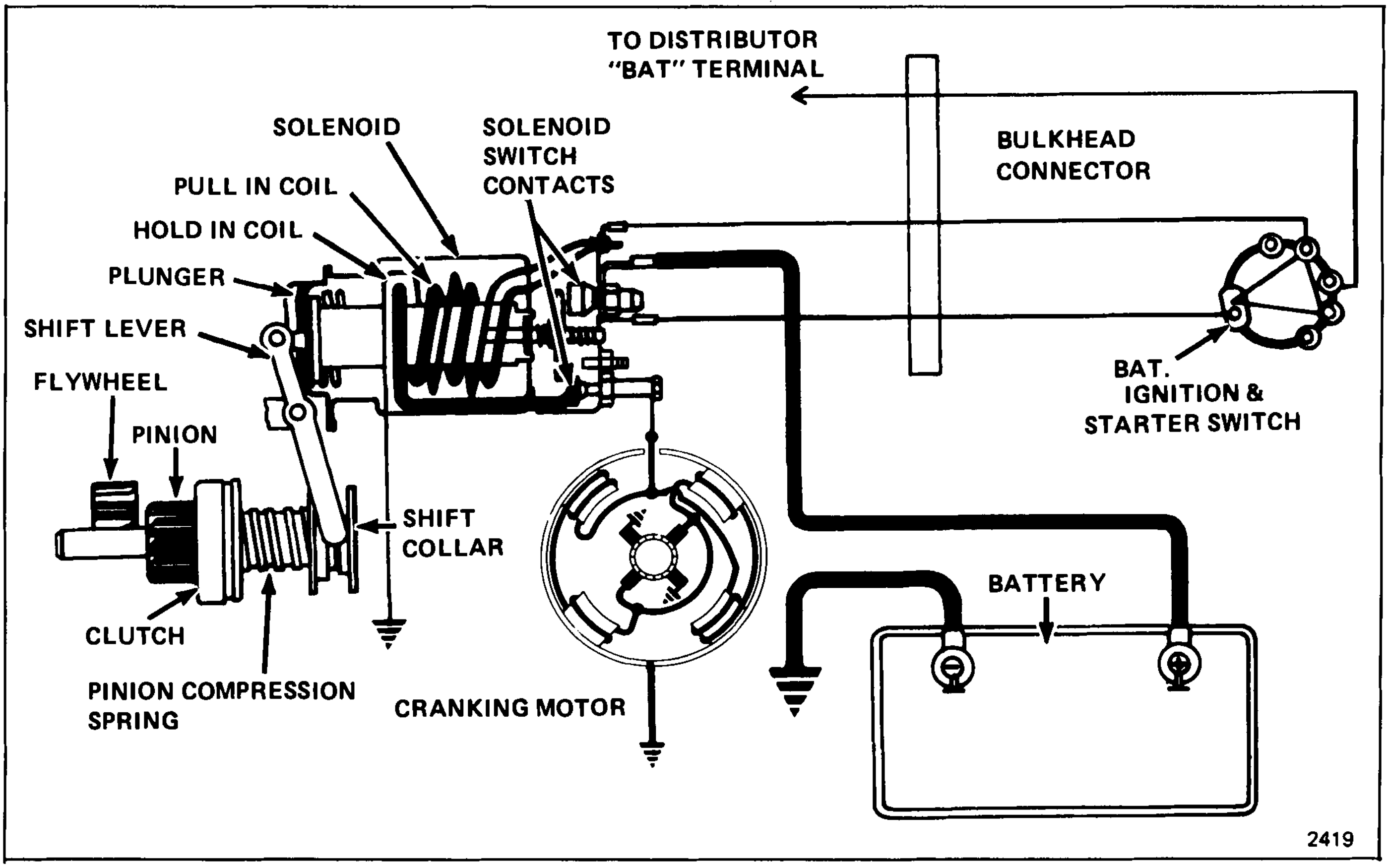

Fig. 6D-46 Cranking Circuit - All

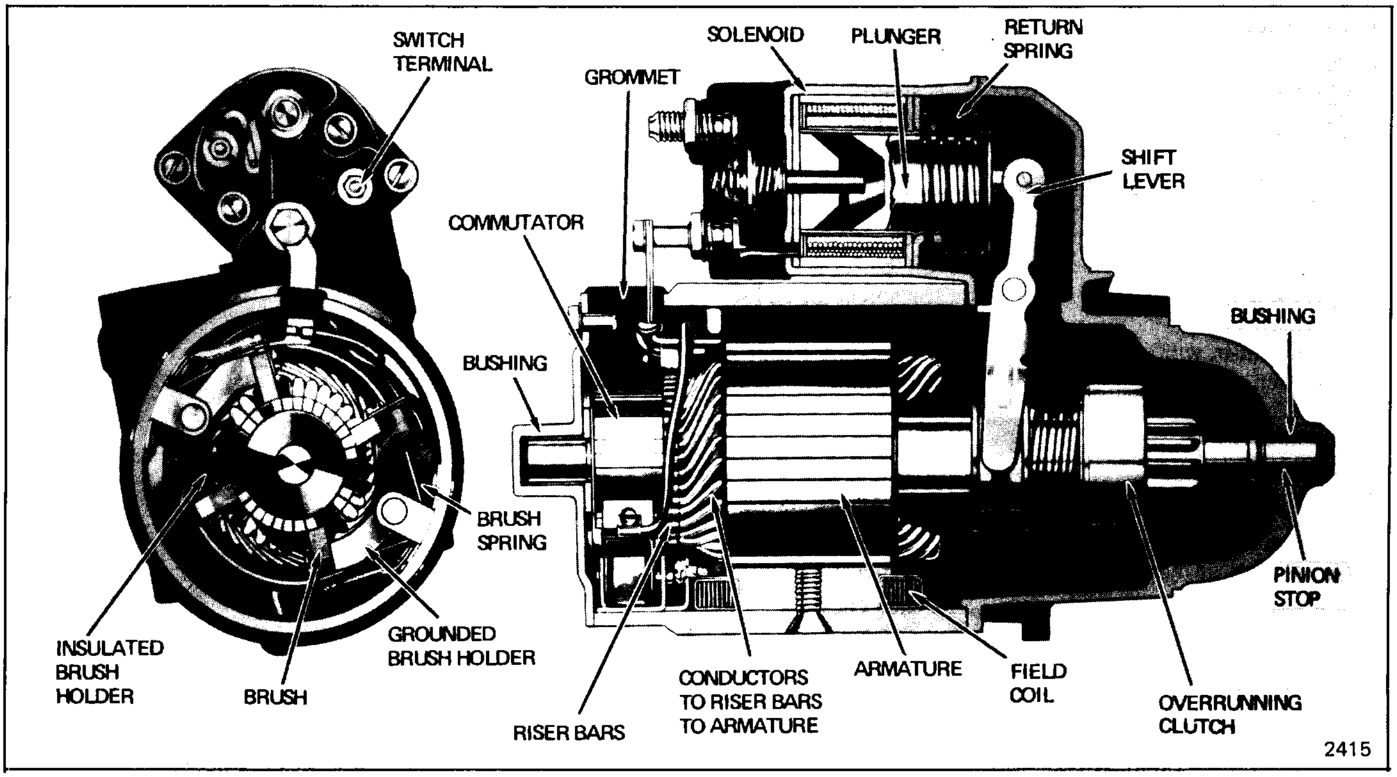

Fig. 6D-47 Cross Section of Starting Motor

Wiring: Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid, ignition switch, and battery, including all ground connections. Clean and tighten all connections as required.

Solenoid and Ignition Switch: Inspect all switches to determine their condition. Connect a jumper lead around any switch suspected of being defective. If the system functions properly using this method, repair or replace the bypassed switch.

Motor: If the battery, wiring and switches are in satisfactory condition, and the engine is known to be functioning properly, remove the motor and follow the test procedures outlined below.

Regardless of the construction, never operate the cranking motor more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will seriously damage the cranking motor.

A general diagnosis is covered in Figure 6D-3 and 6D-4. Once a problem has been traced to the starter, proceed to the test procedure below.

Test Procedure

With the cranking motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of rotation by prying the pinion with a screwdriver. Tight bearings, a bent armature shaft, or a loose pole shoe screw will cause the armature to not turn freely. If the armature does not turn freely the motor should be disassembled immediately. However, if the armature does rotate freely, the motor should be given a no-load test before disassembly.

No-Load Test (Fig. 6D-48)

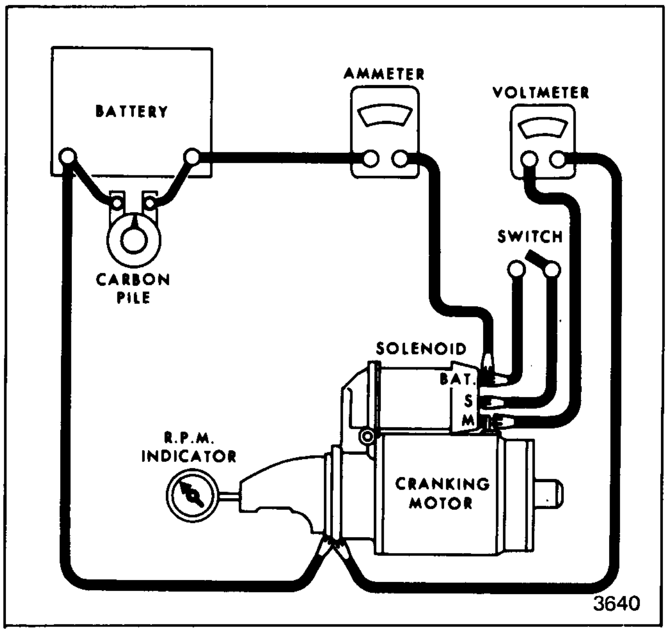

Fig. 6D-48 No-Load Test Hook-Up

Connect a voltmeter from the motor terminal to the motor frame, and use an RPM indicator to measure armature speed. Connect the motor and an ammeter in series with a fully charged battery of the specified voltage, and a switch in the open position from the solenoid battery terminal to the solenoid switch terminal. Close the switch and compare the RPM, current, and voltage readings with the specifications in Figure 6D-49. It is not necessary to obtain the exact voltage specified in the figure, as an accurate interpretation can be made by recognizing that if the voltage is slightly higher the RPM will be proportionately higher, with the current remaining essentially unchanged. However, if the exact voltage is desired, a carbon pile connected across the battery can be used to reduce the voltage to the specified value. If more than one 12-volt battery is used in series, connect the carbon pile across only one of the 12-volt batteries. If the specified current draw does not include the solenoid, deduct from the ammeter reading the specified current draw of the solenoid hold-in winding. Make disconnections only with the switch open. Interpret the test results as follows:

1. Rated current draw and no-load speed indicates normal condition of the cranking motor.

2. Low free speed and high current draw indicates:

a. Too much friction - tight, dirty, or worn bearings, bent armature shaft or loose pole shoes allowing armature to drag.

b. Shorted armature. This can be further checked on a growler after disassembly.

c. Grounded armature or fields. Check further after disassembly.

3. Failure to operate with high current draw indicates:

a. A direct ground in the terminal or fields.

b. "Frozen" bearings (this should have been determined by turning the armature by hand).

4. Failure to operate with no current draw indicates:

a. Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.

b. Open armature coils. Inspect the commutator for badly burned bars after disassembly.

c. Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

5. Low no-load speed and low current draw indicates:

a. High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under Number 4.

6. High free speed and high current draw usually indicate shorted fields. If shorted fields are suspected, replace the field coil assembly and check for improved performance. In some instances, the armature could also be shorted. Check on a growler.

MOTOR	VOLTS	AMPS		RPM	
		MIN.	MAX.	MIN.	MAX.
1108771	9	50	75	6,500	10,000
1108772	9	50	75	6,500	10,000
1109412	9	50	75	6,500	10,500
1108797	9	50	80	5,500	10,500
1108758	9	55	80	3,500	6,000
1108759	9	65	95	7,500	10,500
1108765	9	55	80	3,500	6,000
1108794	9	65	95	7,500	10,500
1109056	9	50	80	5,500	10,500
1108796	9	65	95	7,500	10,500

Fig. 6D-49 No Load Test Values 3641

ON-CAR SERVICE

No periodic lubrication of the starting motor or solenoid is required. The motor and brushes cannot be inspected without disassembling the unit, so no service is required on the motor or solenoid between overhaul periods.

REMOVE AND REPLACE

Starter

Use the following procedure to remove the starter:

1. Disconnect negative battery lead at battery.

2. Raise car (may not be necessary on "H" series with 140 L-4 engine).

3. Remove starter braces, shields, etc., that may be in the way.

4. Remove two starter motor to engine bolts, and allow starter to drop down.

5. Remove solenoid wires and battery cable and remove starter.

6. To replace, reverse the above procedure. Insure that any shims removed are replaced.

7. The 231 V6 engine in the "HM" series will require the following steps:

a. Removal (Manual Transmission)

1) Raise hood and disconnect the negative battery cable.

2) Raise vehicle on hoist.

3) Loosen engine crossmember. (Includes removal of six (6) crossmember bolts on passenger side, two (2) stabilizer shaft bolts on passenger side and loosening of four (4) crossmember bolts on driver's side.)

4) Remove two (2) starter attaching bolts.

5) Pull starter assembly forward and allow front of starter to drop down. Disconnect starter wiring and while pulling down on the engine crossmember to gain necessary clearance, remove the starter assembly.

6) To install, reverse removal procedure.

b. Removal (Automatic Transmission):

1) Raise hood and disconnect the negative battery cable.

2) Remove crossover pipe.

3) Remove flywheel inspection cover.

4) Remove two (2) starter attaching bolts.

5) Pull starter assembly forward and allow front of starter to drop down. Disconnect starter wiring and remove the starter assembly.

6) To install, reverse removal procedure.

Solenoid

Use the following procedure to remove the solenoid from the starter:

1. Disconnect field strap.
2. Remove solenoid to drive housing attaching screws, motor terminal bolt, and remove solenoid by twisting.
3. Replace by reversing above procedures.

OVERHAUL

The following procedure will be used to disassemble and reassemble the starter motor. Component checks are also included in this section.

Disassembly

If the motor does not perform in accordance with published specifications, it may need to be disassembled for further testing of the components. Normally the cranking motor should be disassembled only so far as is necessary to make repair or replacement of the defective parts. As a precaution, it is suggested that safety glasses be worn when disassembling or assembling the cranking motor. Following are general instructions for disassembling a typical overruning clutch drive cranking motor:

1. Disconnect the field coil connections from the solenoid motor terminal.
2. Remove the thru-bolts.
3. Remove the commutator end frame and field frame assembly.
4. Remove the armature assembly from the drive housing. On some models it will be necessary to remove the solenoid and shift lever assembly from the drive housing before removing the armature assembly.
5. Remove the thrust collar from the armature shaft.
6. Remove the pinion from the armature by sliding a metal cylinder onto the shaft; with a hammer striking the metal cylinder against the retainer, drive the retainer toward the armature core and off the snap ring (Fig. 6D-50).
7. Remove the snap ring from the groove in the armature shaft.
8. Roller type clutches are designed to be serviced as a complete unit, therefore do not disassemble. Replace if necessary.

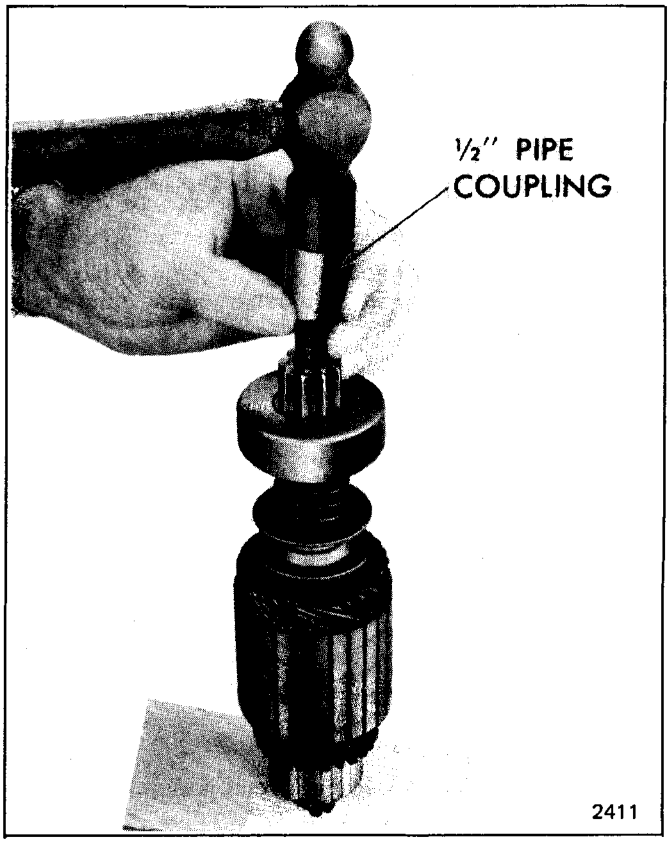

Fig. 6D-50 Removing Retainer From Snap Ring

Component Inspection

Brushes and Brush Holders- Inspect the brushes for wear. If they are worn excessively when compared with a new brush, they should be replaced. Make sure the brush holders are clean and the brushes are not binding in the holders. The full brush surface should ride on the commutator to give proper performance. Check by hand to insure that the brush springs are giving firm contact between the brushes and commutator. If the springs are distorted or discolored, they should be replaced.

Armature -Commutators should not have insulation undercut, and out-of-round commutators should **not** be turned in a lathe.

The armature should be checked for short circuits, opens, and grounds:

1. Short circuits are located by rotating the armature in a growler with a steel strip such as a hacksaw blade held on the armature. The steel strip will vibrate on the area of the short circuit. Shorts between bars are sometimes produced by brush dust or copper between the bars. Cleaning the dust out of the bars may eliminate these shorts.
2. Opens may be located by inspecting the points where the conductors are joined to the commutator for loose connections. Poor connections cause arcing and burning of the commutator. If the bars are not badly burned, leads originally soldered to the riser bars can be resoldered.
3. Grounds in the armature can be detected by the use of a test lamp. If the lamp lights when one test prod is placed on the commutator and the other test prod on the armature core or shaft, the armature is grounded. If the commutator

is worn, dirty, out of round, or has high insulation, the commutator should be turned down and undercut as previously described.

Field Coils- The field coils should be checked for grounds and opens using a test lamp. Typical circuits are shown in Figure 6D-51.

1. Grounds - Disconnect field coil ground connections. Connect one test prod to the field frame and the other to the field connector.

If the lamp lights, the field coils are grounded and must be repaired or replaced. This check cannot be made if the ground connection cannot be disconnected (See Fig. 6D-52).

2. Opens - Connect test lamp prods to ends of field coils. If lamp does not light, the field coils are open (see Fig. 6D-53).

If the field coils need to be removed for repair or replacement, a pole shoe spreader and pole shoe screwdriver should be used. Care should be exercised in replacing the field coils to prevent grounding or shorting them as they are tightened into place. Where the pole shoe has a long lip on the side, it should be assembled in the direction of armature rotation.

Solenoid- A basic solenoid circuit is shown in Figure 6D-46. Solenoids may differ in appearance, but can be checked electrically by connecting a battery of the specified voltage, a switch, and an ammeter to the two solenoid windings. With all leads disconnected from the solenoid, make test connections to the soleniod switch terminal and to ground, or to the second switch terminal, if present, to check the hold-in winding (Fig. 6D-54). Use the carbon pile across the battery to decrease the battery voltage to the value listed in the chart at the end of Section 6D, and compare the ammeter reading with the specifications. A high reading indicates a shorted or grounded hold-in winding, and a low reading excessive resistance. To check the pull-in winding, connect from the solenoid switch terminal and to the solenoid motor terminal.

NOTE: If needed to reduce the voltage to the specified value, connect the carbon pile between the battery and "M" terminal as shown in dashed lines instead of across the battery as shown in solid lines. If not needed, connect a jumper directly from the battery to the "M" terminal as shown in dashed lines.

CAUTION: *To prevent overheating, do not leave the pull-in winding energized more than 15 seconds. The current draw will decrease as the winding temperature increases. The purpose of the "R" terminal is to short out the ignition resistor during cranking, and thereby provide higher ignition coil output.*

Overrunning Clutch

1. Test overrunning clutch action. The pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked, or excessively worn. Replace assembly if necessary. Badly chipped pinion teeth may indicate chipped teeth on the ring gear. This should be checked under such conditions and replaced if necessary.

2. Check the overrunning clutch for slipping by leaving the clutch attached to the armature, wrap the armature with a shop towel and clamp the armature in a vice. Using a 15/16 12 point deep socket and torque wrench, put the socket on the clutch and turn counterclockwise. The clutch should not slip up to 50 ft. lb. (600 in. lb.) of torque. If it does, replace the clutch.

Reassembly

1. Place the clutch assembly on the armature shaft. To facilitate replacing the snap ring and retainer onto the armature:

a. Place the retainer on the armature shaft with the cupped surface facing the snap ring groove.

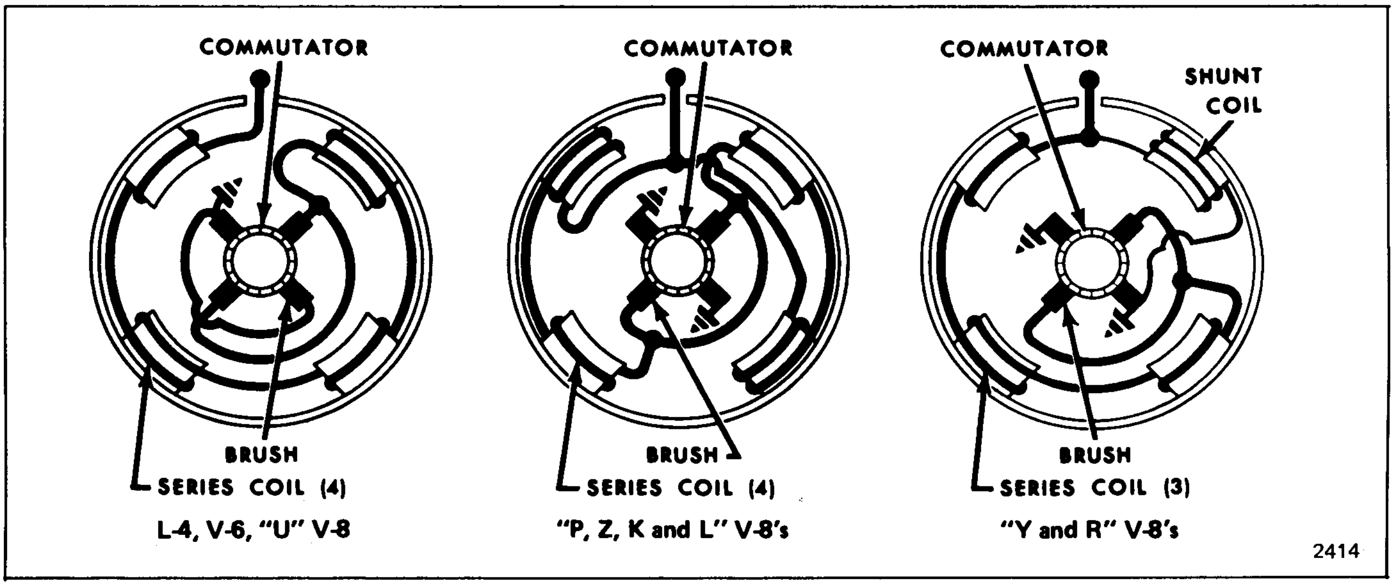

Fig. 6D-51 Starter Motor Circuits

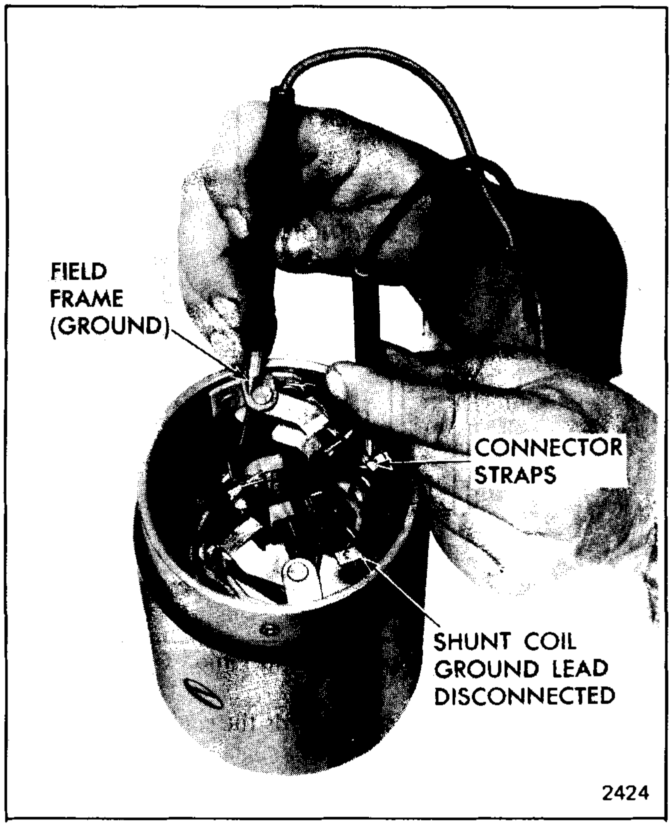

Fig. 6D-52 Testing Field Coils For Ground

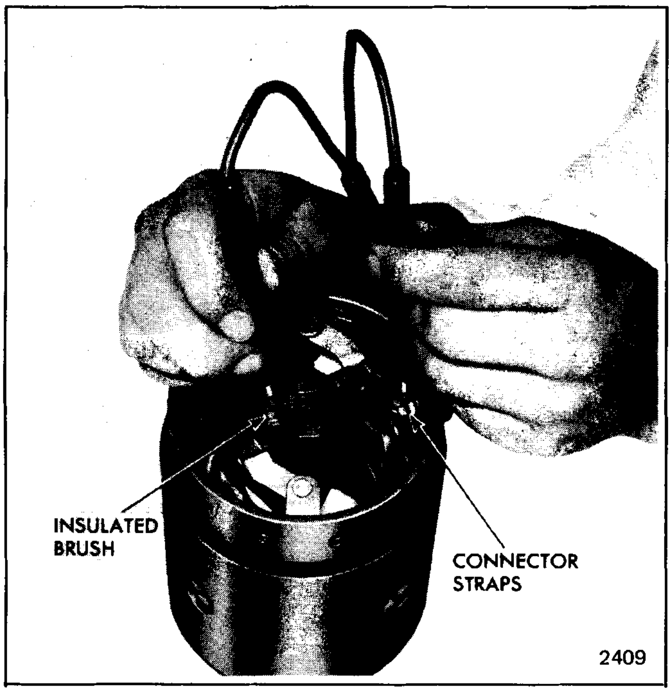

Fig. 6D-53 Testing Field Coils For Open

b. Place the snap ring on the end of the shaft. With a piece of wood on top, force the ring over the shaft with a light hammer blow (Fig. 6D-55), then slide the ring down into the groove.

c. To force the retainer over the snap ring, place a suitable washer over the shaft and squeeze retainer and washer together with pliers (Fig. 6D-56).

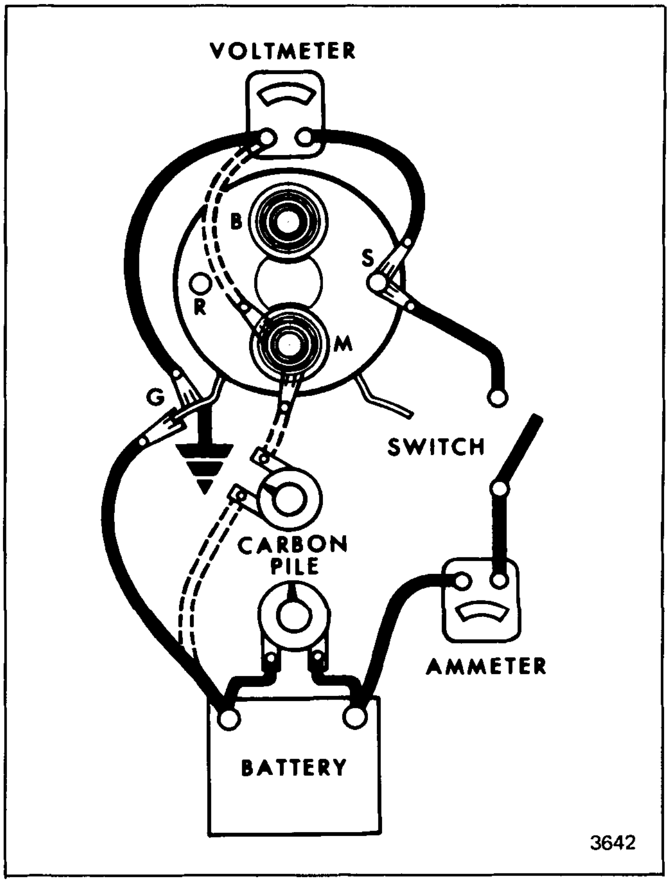

Fig. 6D-54 Connections For Checking Solenoid

d. Remove the washer.

e. Assemble collar over shaft.

2. Refer to the disassembly procedure and follow in reverse to complete the reassembly.

3. When the solenoid is reinstalled, apply sealing compound between field frame, flange, and solenoid junction.

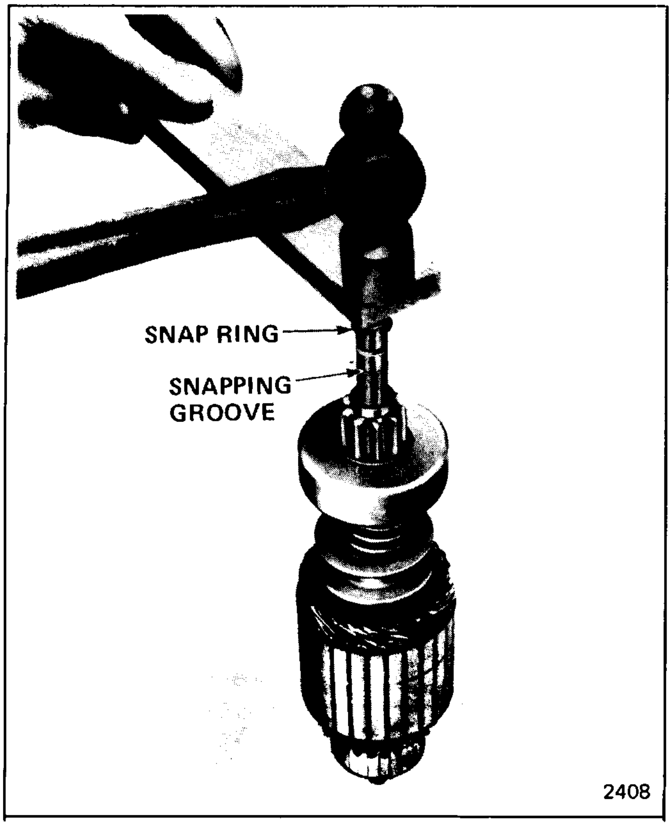

Fig. 6D-55 Forcing Snap Ring Over Shaft

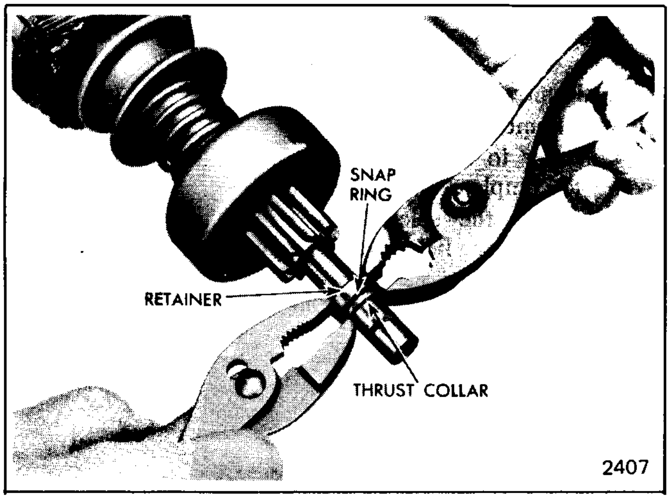

Fig. 6D-56 Forcing Retainer Over Snap Ring

Pinion Clearance

The pinion clearance cannot be adjusted but should be checked after reassembly of the motor to insure proper clearance. Improper clearance is an indication of worn parts.

To check pinion clearance, follow the steps listed below:

1. Disconnect the motor field coil connector from the solenoid motor terminal and INSULATE IT CAREFULLY.

2. Connect a battery from the solenoid switch terminal to the solenoid frame (Fig. 6D-57).

3. MOMENTARILY flash a jumper lead from the solenoid motor terminal to the solenoid frame. This will shift the pinion into cranking position and it will remain so until the battery is disconnected.

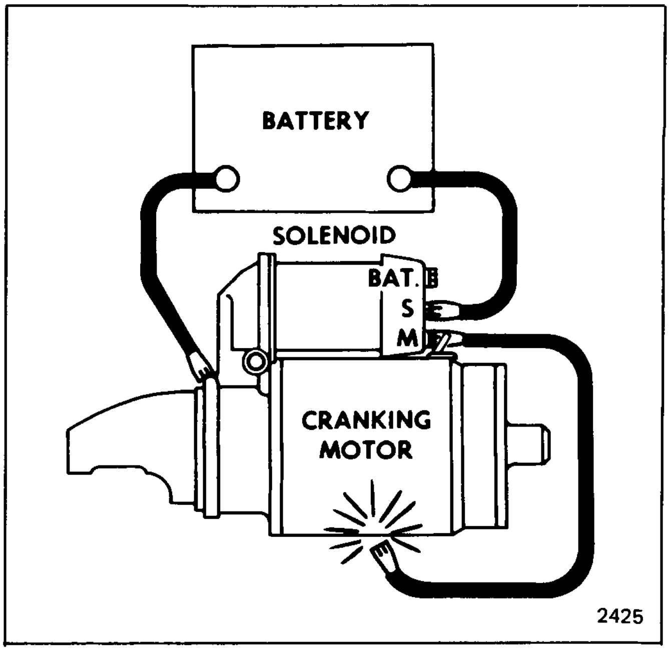

Fig. 6D-57 Circuit For Checking Pinion Clearance

4. Push the pinion back towards the commutator end to eliminate slack movement.

5. Measure the distance between pinion and pinion stop (Fig. 6D-58).

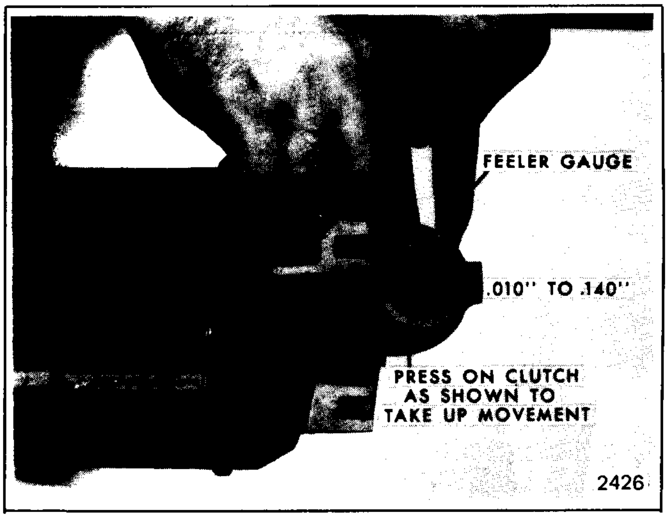

Fig. 6D-58 Checking Pinion Clearance

SPECIFICATIONS

CAR LINE		BATTERY	FREEDOM INDICATED BY "X"	COLD CRANK (AMPS)	RESERVE (MIN)	WATTS	REPLACEMENT BATTERY
H SERIES							
140 L-4	STD.	Y85-4	X	275	60	2500	85-5
	H.D.	R85-5	X	350	80	3200	85-5
VERT-I-PAK	STD.	Y85A-4	X	275	60	2500	85-5
(140 ONLY)	H.D.	R85A-5	X	350	80	3200	85-5
V-6, 151 L-4	STD.	R85-5	X	350	80	3200	85-5
V-6	H.D.	R87-5	X	430	100	3500	87-5
X SERIES							
151 L-4	STD.	R87P		350	80	3200	R87
	H.D.	R89-5	X	465	125	4000	89-5
A,B,F,X SERIES							
V-6 B	STD.	R85-5	X	350	80	3200	85-5
V-6 A,F,X	STD.	R87P		350	80	3200	R87
V-6 ALL	H.D.	R89-5	X	465	125	4000	89-5
A,F,G,X SERIES							
301,305,350,400	STD.	R87P		350	80	3200	R87
403	STD.	R89SP		430	100	3500	R89S
ALL V-8	H.D.	R89-5	X	465	125	4000	89-5
B SERIES							
301, 350, 400	STD.	R85-5	X	350	80	3200	85-5
403	STD.	R87-5	X	430	100	3500	87-5
ALL V-8	H.D.	R89-5	X	465	125	4000	89-5

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FIG. 6D-59 BATTERY APPLICATIONS AND SPECIFICATIONS

ENGINE	CAR LINE	STANDARD	ELEC. DEF.	A/C	ELEC. DEF. AND A/C	H.D.
140 L-4 (B)	H	37	55	55	63	—
151 L-4 (V)	H	37	55	55	63	—
	X	37	—	55	—	—
231 V-6 (C)	A	37	61	61	63	—
	B	42	61	61	63	—
	F,X	37	55	55	63	—
	H	37	55	55	55 CAL 63 OTHER	— —
301 V-8 (Y) 305 V-8 (U) "X" ONLY	A,G	37	61	61	63	—
	B	42	61	61	63	—
	F	37	55	55	63	—
	X	37	—	55	—	—
350 V-8 (P) 400 V-8 (Z)	A,G	37	61	61	63	80
	F	37	55	55	63	—
	B	42	61	61	63	—
350 V-8 (R) 403 V-8 (K)	A,G	42	61	61	63	—
	B	42	63	61	63	80
	F	37	55	55	63	—
	X (350)	37	—	55	—	—

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FIG. 6D-60 GENERATOR APPLICATIONS

ENGINE	CAR LINE	STARTER	NO. SHUNT WINDINGS	SPECIFICATIONS		
				SOLENOID	HOLD-IN WINDINGS AMPS @ 10V	PULL-WINDINGS AMPS @ 5V
140 L-4 (B)	H,HM	1108771 (MANUAL) 1108772 (AUTO)	0	1114356	14.5–16.5	13.0–15.5
151 L-4 (V)	H,HM,X	1109412	0	1114458	14.5–16.5	13.0–15.5
231 V-6 (C)	A,B,F,X,HM	1108797	0	1114458	14.5–16.5	13.0–15.5
301 V-8 (Y)	A,B,G,F,X	1108758	1	1114395	14.5–16.5	13.0–15.5
350 V-8 (P) 400 V-8 (Z)	A,B,G,F	1108759	0	1114396	14.5–16.5	13.0–15.5
350 V-8 (R)	A,B,G,F,X	1108765	1	1114395	14.5–16.5	13.0–15.5
403 V-8 (K)	A,B,G,F	1108794	0	1114458	14.5–16.5	13.0–15.5
305 V-8 (U)	X	1109056	0	1114399	17.0–23.0	16.0–18.0
350 V-8 (L)	X	1108796	0	1114468	17.0–23.0	16.0–18.0

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FIG. 6D-61 STARTER MOTOR APPLICATIONS AND SPECIFICATIONS

SECTION 6E

EMISSION CONTROL SYSTEMS

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The normal operation of the car engine results in the release of several compounds to the atmosphere. Federal Government and State of California legislation has placed limitations on the quantities of three compounds which can be emitted. The three controlled compounds are:

- Hydrocarbons - HC
- Carbon Monoxide - CO
- Oxides of Nitrogen-NOX

The Federal regulations for 1977 require that cars sold for initial licensing, or primary operation in designated high altitude counties be capable of meeting emission standards at such altitudes. In most cases, these regulations make it necessary to have specific engines and emission control systems for such cars.

The emission control systems for all engines include:

Carburetor Calibration

Distributor Calibration

Catalytic Converter

Early Fuel Evaporation (EFE) (Except on L4-140)

Exhaust Gas Recirculation (EGR)

Positive Crankcase Ventilation (PCV)

Choke Calibration

Thermostatic Air Cleaner (TAC)

Evaporative Emission Control (EEC)

The emission control system for some engines may use an additional emission control device called Air Injection Reaction (AIR).

GENERAL DESCRIPTION OF EMISSION CONTROL COMPONENTS

CARBURETOR CALIBRATION

While the carburetor's main function is to provide the engine with a combustible air/fuel mixture, the carburetor calibration is critical to maintaining proper emission levels. The carburetor's idle, off-idle, main metering, power enrichment, and accelerating pump systems are calibrated to provide the best possible combination of engine performance, fuel economy and exhaust emission control. Carburetor adjustments and service must be performed using the recommended procedures to insure engine exhaust emission levels remain within legislated limits. See Section 6C, Fuel System, for carburetor adjustment specifications and recommended service procedures.

DISTRIBUTOR CALIBRATION

The distributor is an integral part of the engine ignition system and the distributor calibration is an important part of exhaust emission control. The initial timing, centrifugal advance and vacuum advance are calibrated to provide the best engine performance and fuel economy at varying speeds and loads while remaining within exhaust emission limits. Distributor diagnostics and service procedures are in Section 6D, Engine Electrical.

CATALYTIC CONVERTER

The catalytic converter is an emission control device added to the exhaust system to reduce hydrocarbon and carbon monoxide pollutants from the exhaust gas stream. The converter contains material which is coated with a catalytic material containing platinum and palladium.

THE CATALYTIC CONVERTER REQUIRES THE USE OF UNLEADED FUEL ONLY.

Periodic maintenance of the exhaust system is not required; however, if the car is raised for other service, it is advisable to check the general condition of the underfloor catalytic converter, pipes and mufflers.

Refer to Section 6F, Exhaust System, for catalytic converter service procedures and diagnostics.

EARLY FUEL EVAPORATION SYSTEM (EFE)

The EFE system is used to provide a source of rapid heat to the engine induction system during cold driveaway. Rapid heating is desirable because it provides for quick fuel evaporation and more uniform fuel distribution to aid cold driveability. It also reduces the length of time carburetor choking is required making reduction in exhaust emission levels possible.

Two types of EFE are used on Pontiac vehicles. Some V8 engines use an orifice EFE system which consists of an orifice restriction in one leg of the exhaust crossover pipe. The restriction increases the flow of exhaust gases thru the exhaust crossover under the intake manifold. The orifice system is in effect whenever the engine is running. The other system uses a valve which increases the exhaust gas flow under the intake manifold during cold engine operation. The valve is vacuum operated and is controlled by a thermal vacuum switch (TVS) which passes vacuum to the valve when the coolant temperature is below the calibration value.

Diagnosis and service procedures of the EFE system are in this section.

EXHAUST GAS RECIRCULATION SYSTEM (EGR)

The Exhaust Gas Recirculation System is used on all engines. It meters exhaust gas into the induction system for recirculation through the combustion cycle to reduce oxides of nitrogen emissions. There are two types of EGR systems; ported and exhaust back pressure modulated. The ported system uses a timed vacuum port in the carburetor to regulate the amount of exhaust gas recirculation. The back pressure modulated system regulates the timed vacuum according to the exhaust back pressure level. The vacuum regulation is achieved by either a separate back pressure transducer sandwiched between the EGR valve and the manifold or by internal EGR valve design.

The EGR valve remains closed during periods of engine idle and deceleration to prevent rough idle from excessive exhaust gas dilution in the idle air/fuel mixtures.

Diagnosis and service procedures of the EGR system are in this section.

CLOSED POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)

All engines have a closed Positive Crankcase Ventilation System to provide more complete scavenging of crankcase vapors. See Figure 6E-2.

To maintain idle quality, a PCV valve is used which restricts the ventilation system flow whenever intake manifold vacuum is high. See Figure 6E-3.

Diagnosis and service procedures for the PCV system are in this section.

CHOKE CALIBRATION

The choke is an important part of exhaust emission control. The choke is calibrated to provide the best cold engine performance while remaining within exhaust emission limits. Variations in choke systems are described in Section 6C, Fuel System. Choke adjustment and service procedures are in Section 6C.

THERMOSTATIC AIR CLEANER (TAC)

The Thermostatic Air Cleaner (TAC) is on all engines. It uses a valve in the air cleaner inlet, controlled by either a vacuum motor or thermostatic coil, to mix pre-heated and non pre-heated air entering the air cleaner to maintain a controlled air temperature into the carburetor. The vacuum motor is modulated by a temperature sensor in the air cleaner. The pre-heating of the air cleaner inlet air allows leaner carburetor and choke calibrations resulting in lower emission levels, while maintaining good driveability. Some engines use a TAC check valve to hold the damper closed during low temperature, low manifold vacuum operating conditions. Diagnostics and service procedures for the thermostatic air cleaner are in this section.

AIR INJECTION REACTION SYSTEMS

An air injection reaction system is used on some engines to provide additional oxygen to continue the combustion process after the exhaust gases leave the combustion chamber. Two types of air injection reaction are used and are identified by the type of device used to inject the air. Some engines use an engine driven pump to provide pressurized air which is injected into the exhaust system. Systems using an engine driven pump, called AIR systems, may inject the air into either the exhaust port of the cylinder head, exhaust manifold, or the exhaust pipe. The AIR system operates at all times and will bypass air only for a short duration of time during deceleration and at high speeds. The diverter valve performs the bypass function, and the check valve protects the air pump from damage by preventing a back flow of exhaust gas.

AIR ON V6 CALIFORNIA AND HIGH ALTITUDE ENGINES

The AIR system used on V6 engines in 1977 uses several new devices for regulating the injection of air into the exhaust stream. The new components are:

1. Vacuum differential valve
2. Air bypass valve
3. Differential vacuum delay and separator valve

The purpose of the vacuum differential valve is to prevent backfiring in the exhaust system. Throttle closure at the beginning of a deceleration temporarily creates fuel air mixtures which are too rich to burn. These mixtures, when they reach the exhaust, become burnable when combined with injection air. The next firing of the engine ignites this

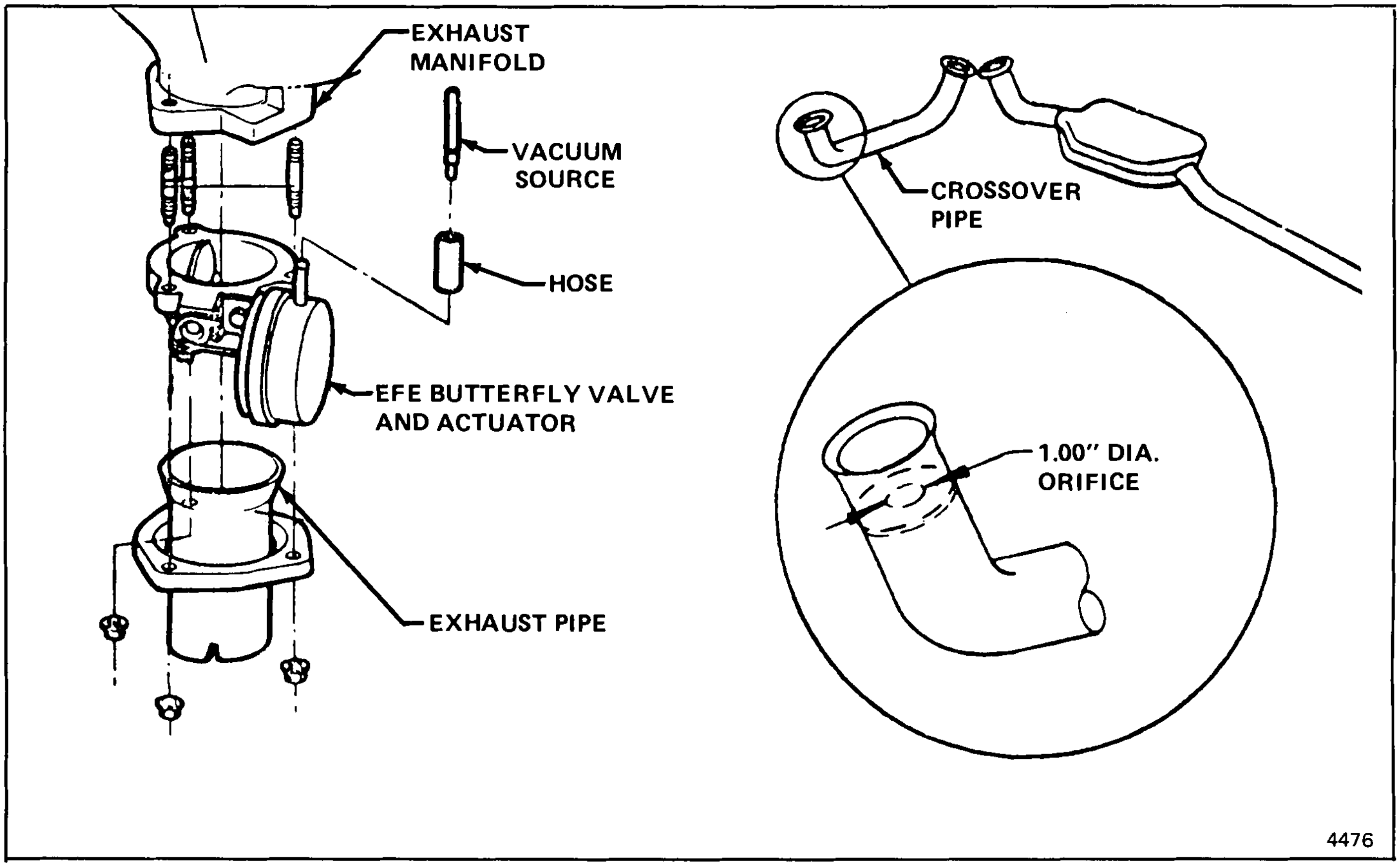


Fig. 6E-1 E.F.E. Systems

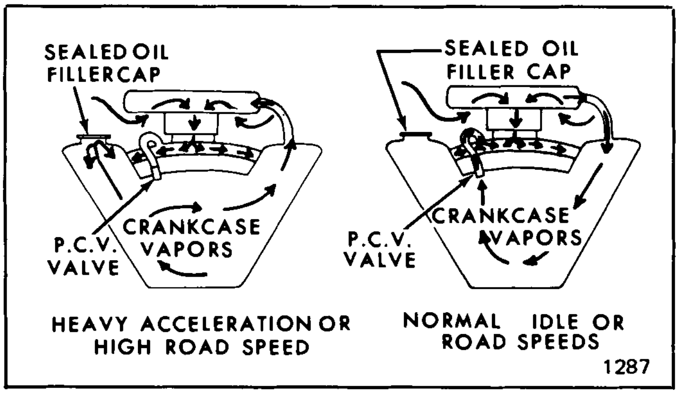


Fig. 6E-2 PCV System Flow

mixture causing an exhaust backfire. Momentary diverting of the injection air from the exhaust prevents the backfiring.

The AIR bypass valve allows the pump discharge air to bypass the injection system at high engine loads. Air bypass prevents excessively high exhaust system temperatures which could occur under certain extreme operating conditions. The valve also bypasses momentarily during deceleration to prevent backfiring. This function is controlled by the vacuum differential valve as described above.

The differential vacuum delay and separator valve delays the air bypassing function during heavy accelerations. This delay allows air to be injected during acceleration loads, but bypassed during susbtained high load operation where high exhaust temperatures can occur. Also incorporated in the valve is a fuel separator or collector. The collector is designed to prevent liquid fuel from migrating through the vacuum line to the vacuum operated components of the AIR system.

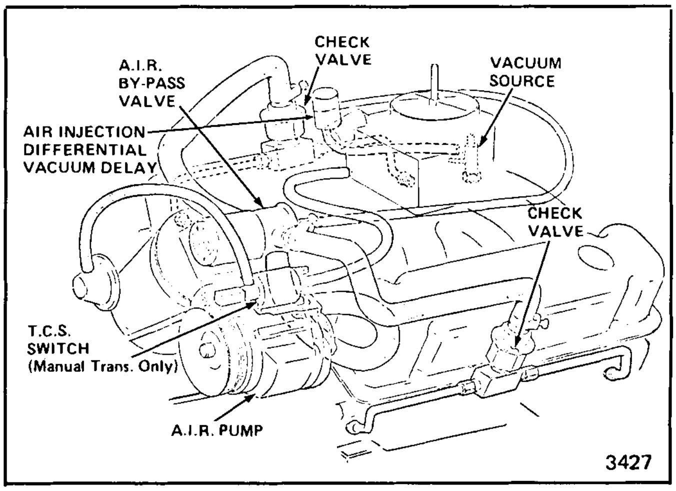


Fig. 6E-3 PCV Valve Cutaway View

PULSE AIR INJECTION REACTION - PAIR

Other engines use a system of air distribution pipes and check valves (called a pulse valve) which relies on the pulses of the engine's exhaust to siphon air into the exhaust system. This type of air injection reaction is called Pulse AIR. This system always injects the air into the exhaust port near the exhaust valve.

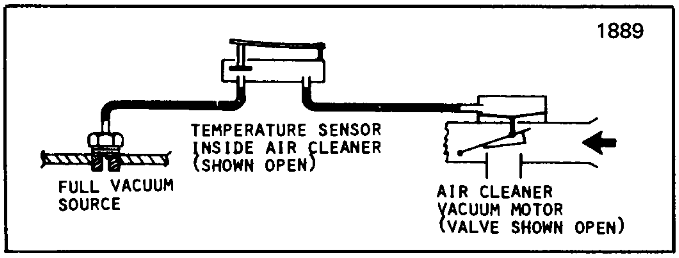


Fig. 6E-4 Thermostatic Air Cleaner

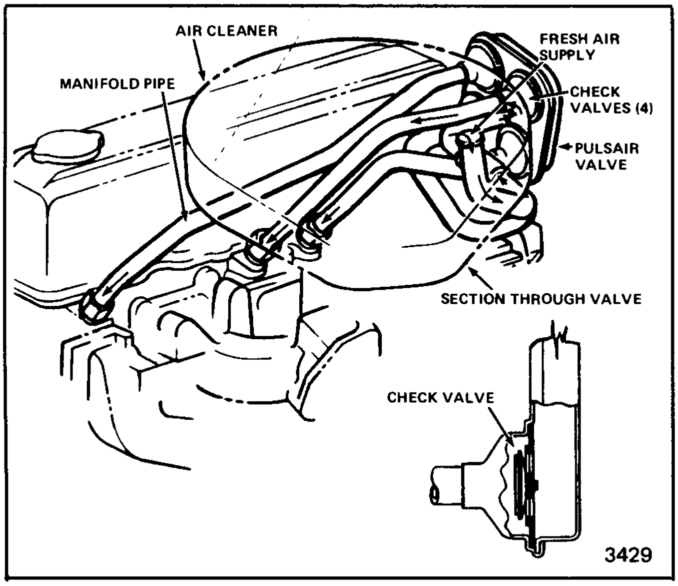


Fig. 6E-5 Pulse Air Injection Reaction Systems

Diagnosis and service procedures for air injection reaction systems are in this section.

VACUUM CONTROLS

Various types of vacuum controls are used in the emission control system to modify or control the operation of the various emission control components to optimize emission control effectiveness, while minimizing any negative effect on driveability. The types of vacuum control valves used are:

Thermal Vacuum Switches - TVS
Vacuum Delay Valves - VDV
Check Valves - CV
Vacuum Modulator Valves - VMV
Vacuum Reducer Valve - VRV

VACUUM HOSE SCHEMATICS

Refer to the vacuum hose schematics shown in Figures 6E-6 through 6E-24 for location and connection of the various vacuum control valves.

Diagnosis and service procedures for vacuum control valves are with the component being controlled. For example, vacuum advance control valves are in Section 6D with the distributor.

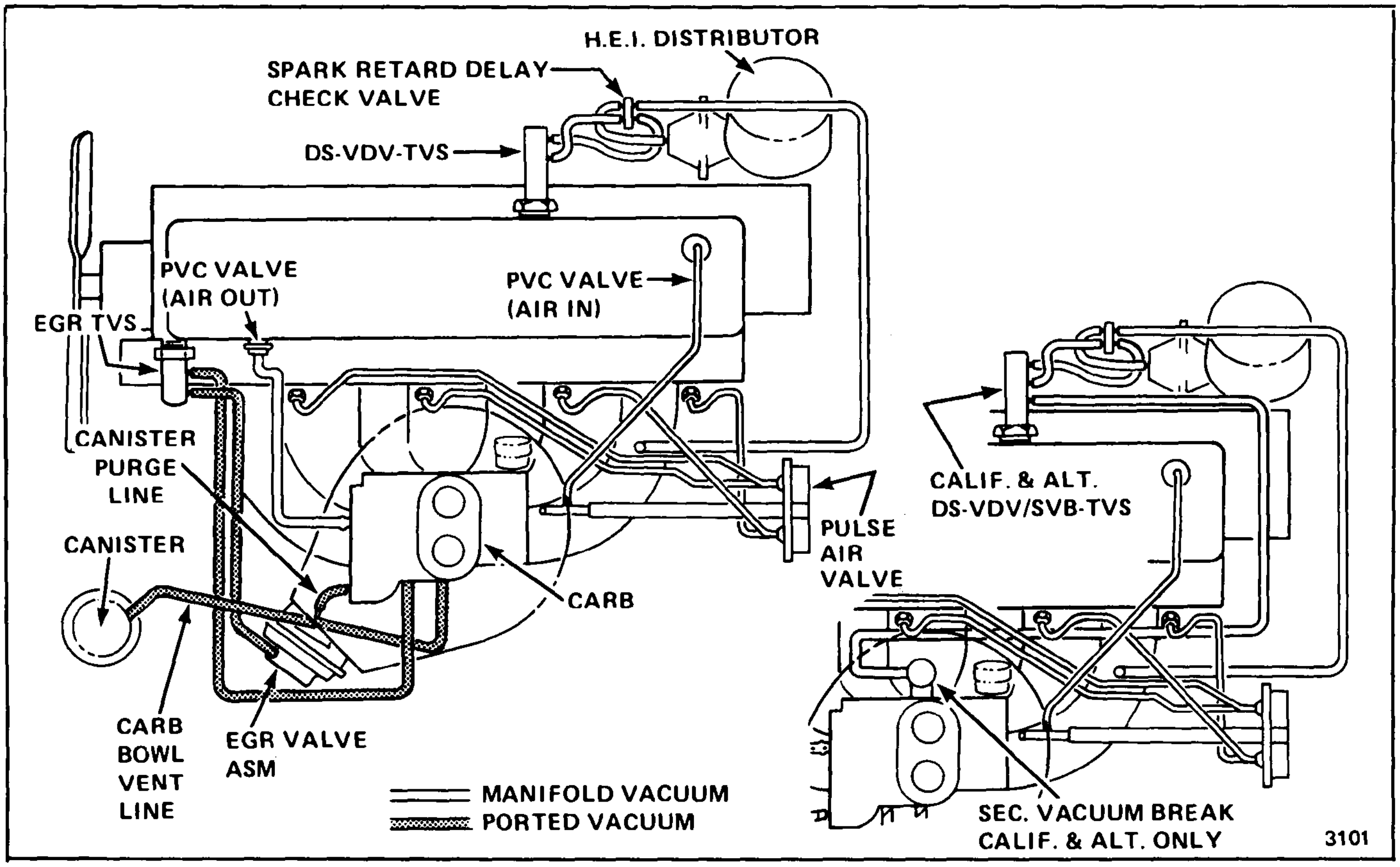


Fig. 6E-6 L-140 C.I.D. Nationwide

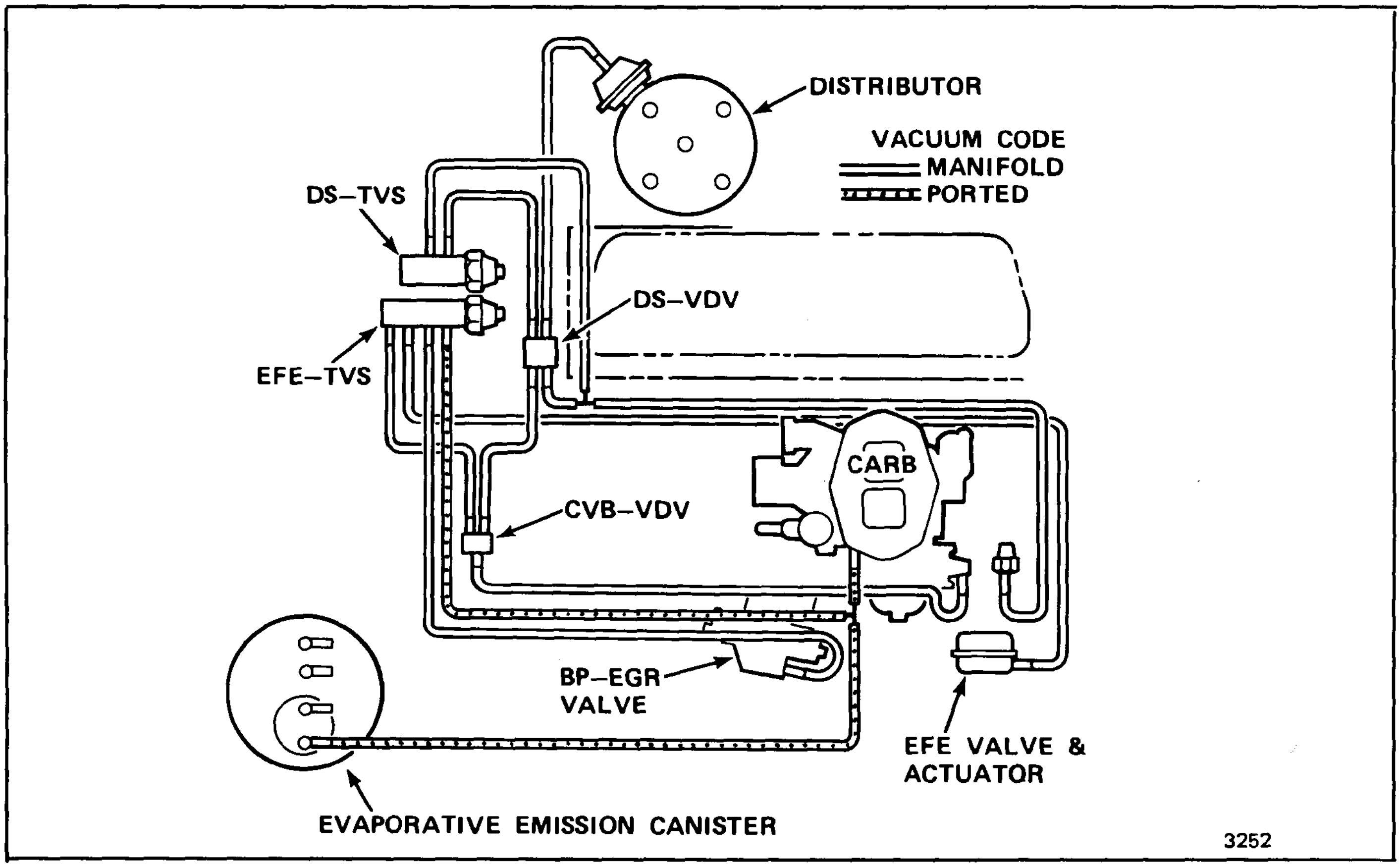


Fig. 6E-7 L4-151 C.I.D. California Automatic Transmission Without Air Conditioning

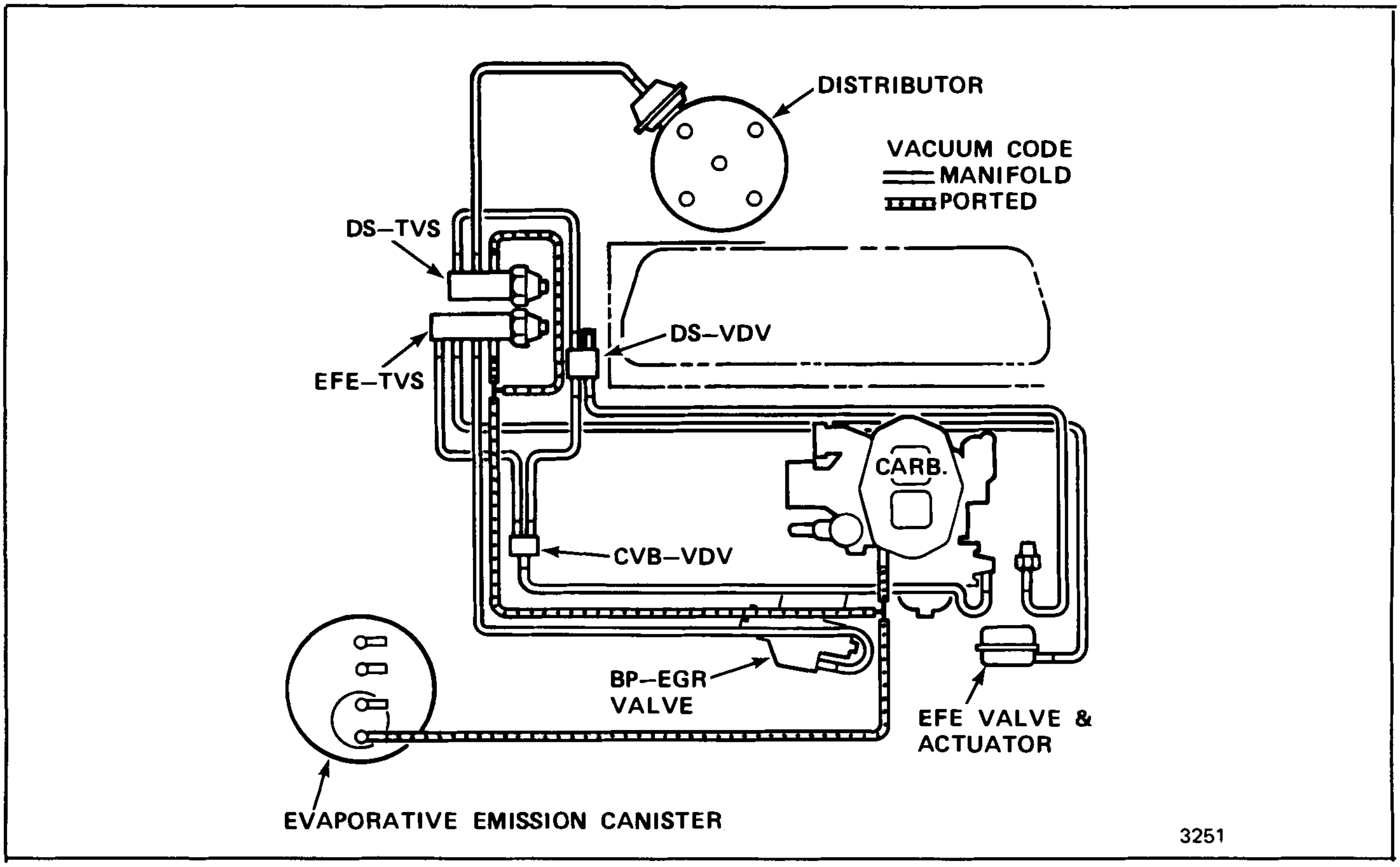


Fig. 6E-8 L4-151 C.I.D. California Automatic Transmission With Air Conditioning

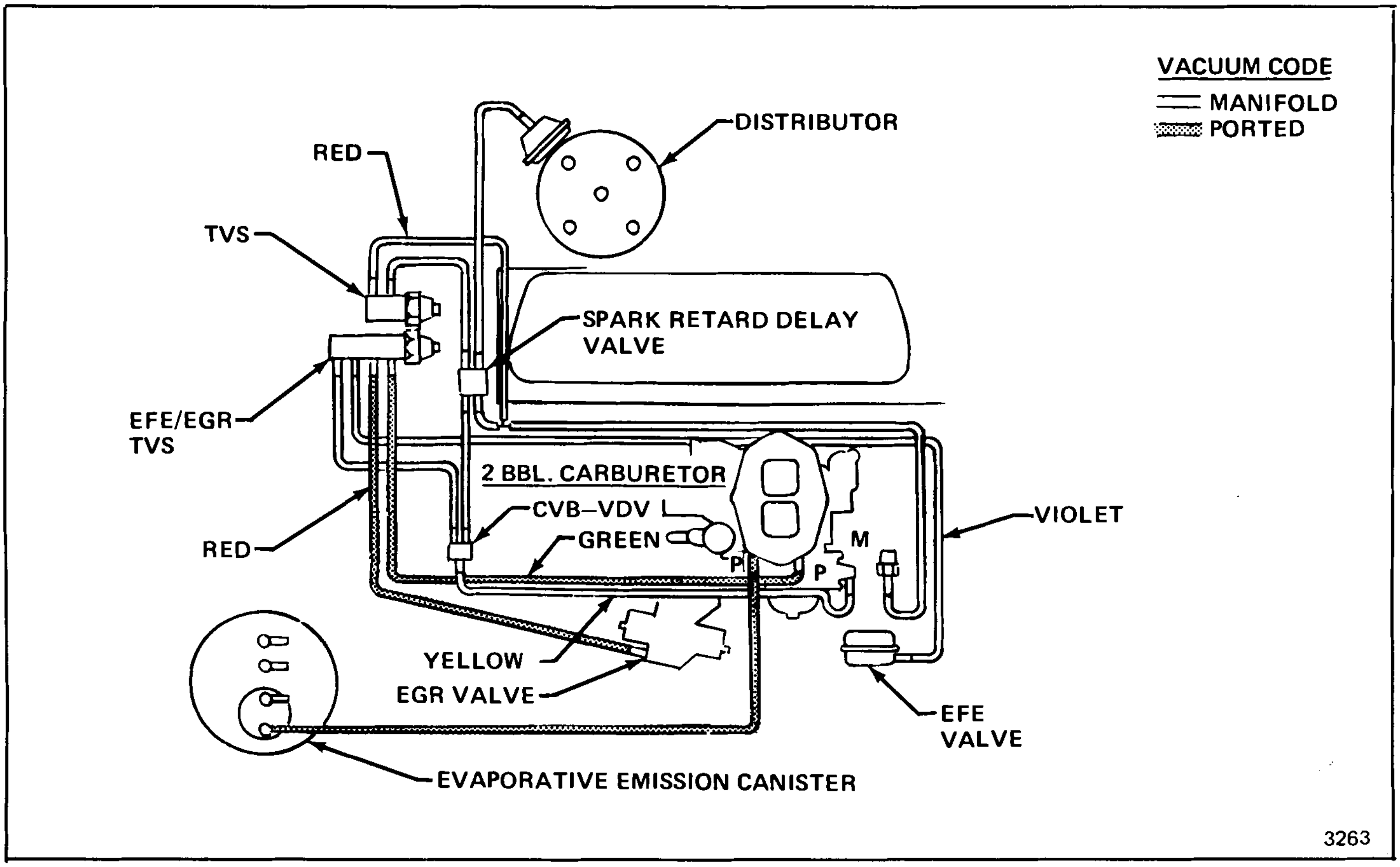


Fig. 6E-9 L4-151 C.I.D. Low Altitude Manual Transmission and Automatic Transmission Without Air Conditioning

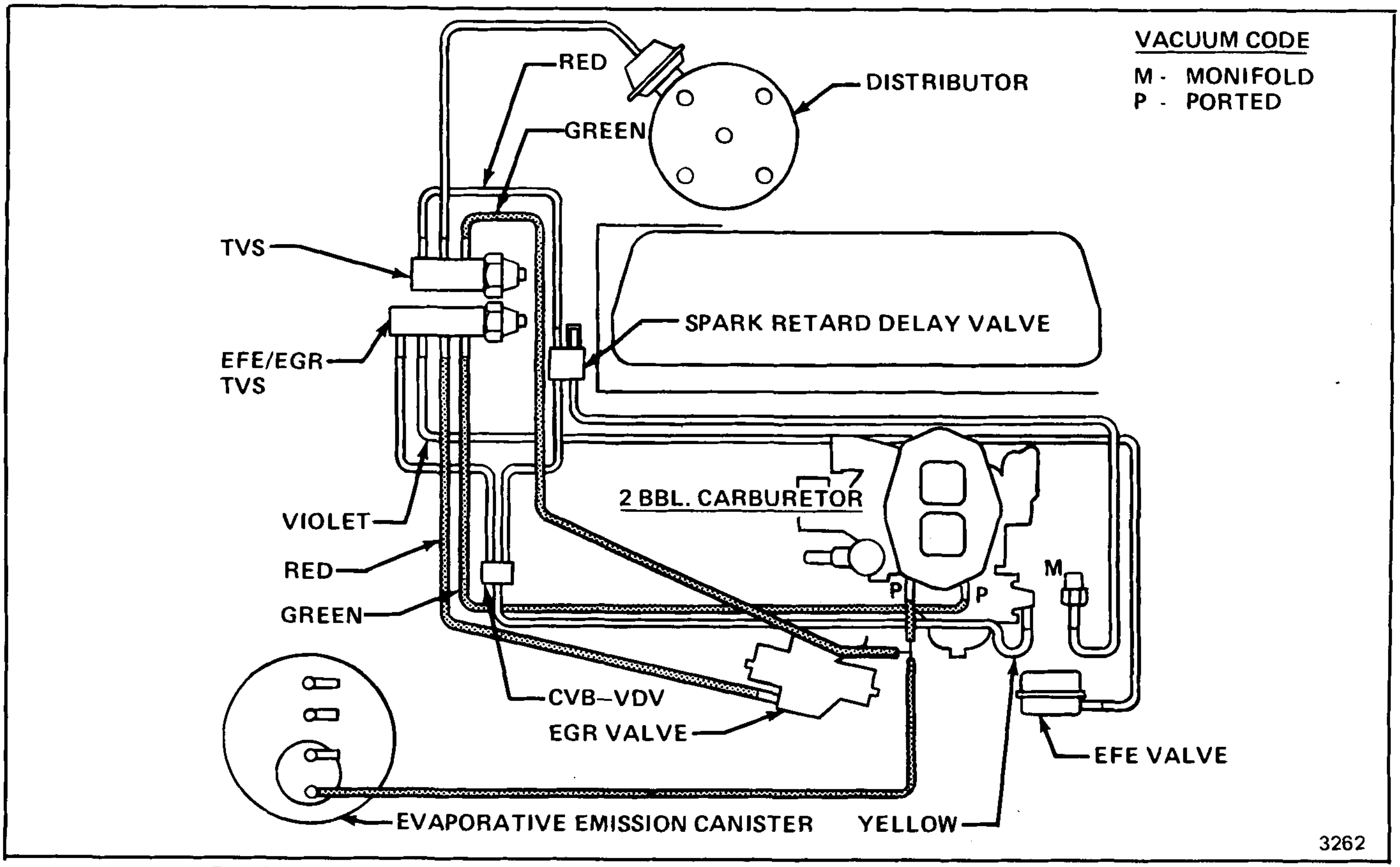


Fig. 6E-10 L4-151 C.I.D. Low Altitude Automatic Transmission With Air Conditioning

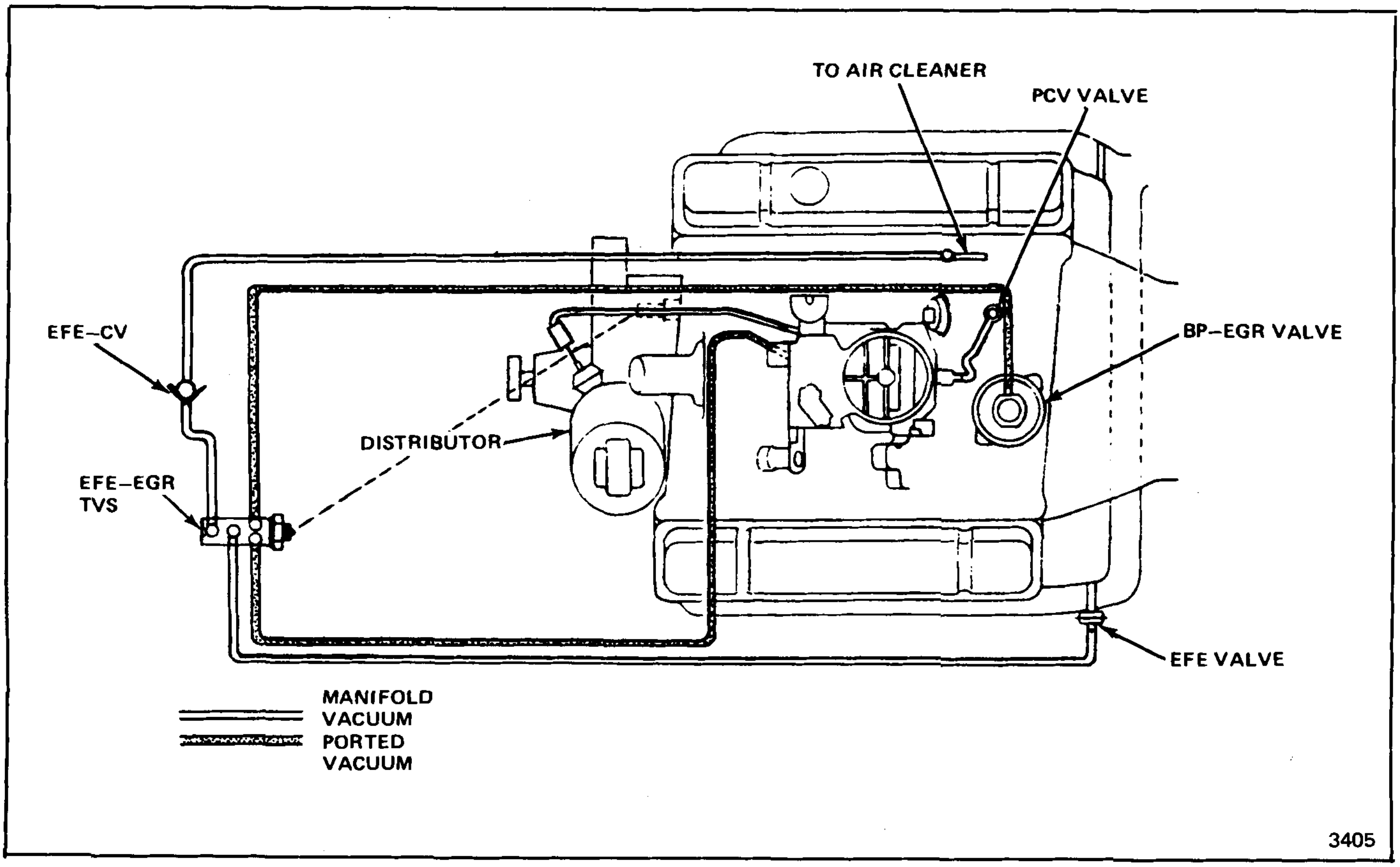


Fig. 6E-11 V6-231 C.I.D. Low Altitude

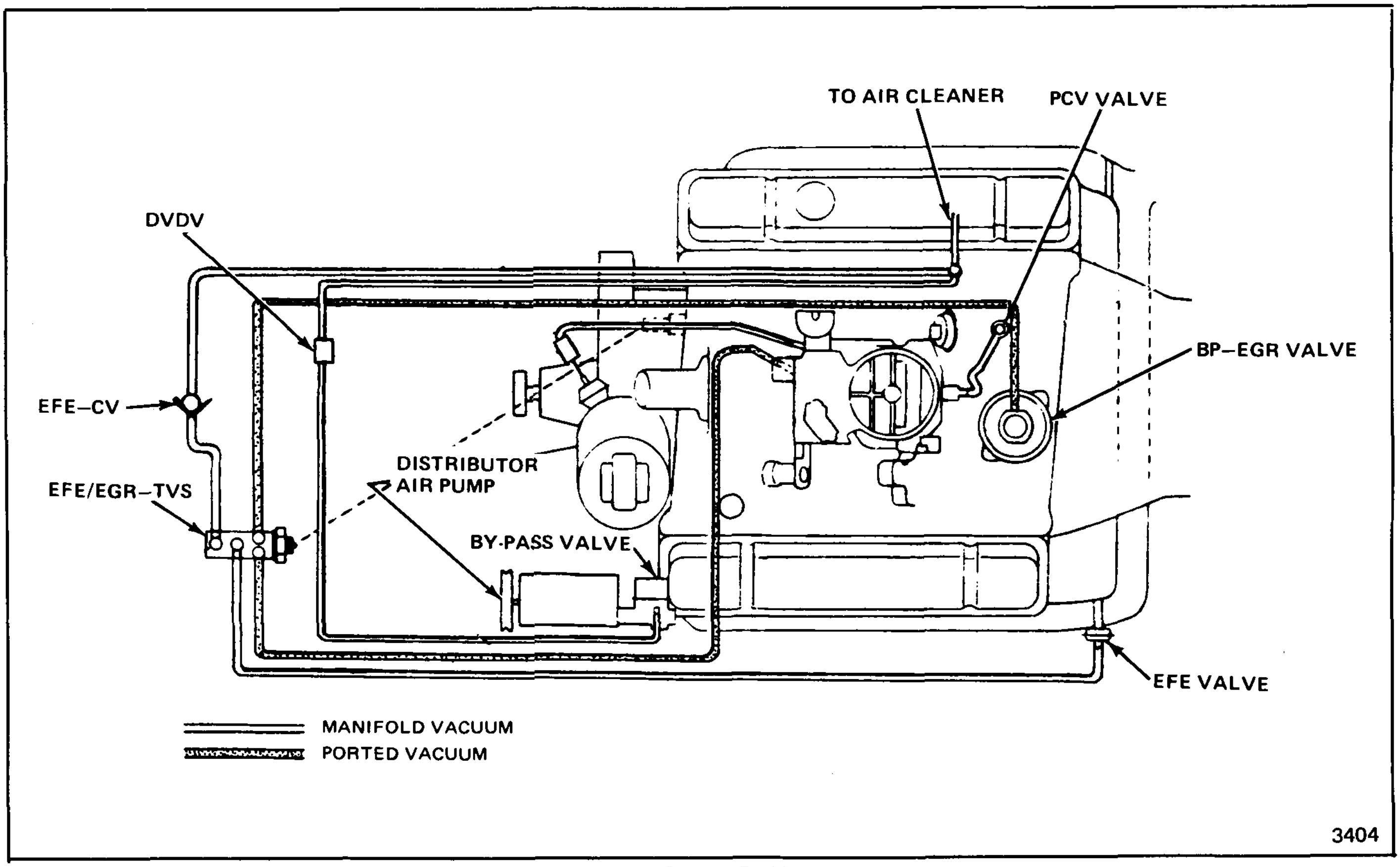


Fig. 6E-12 V6-231 C.I.D. High Altitude

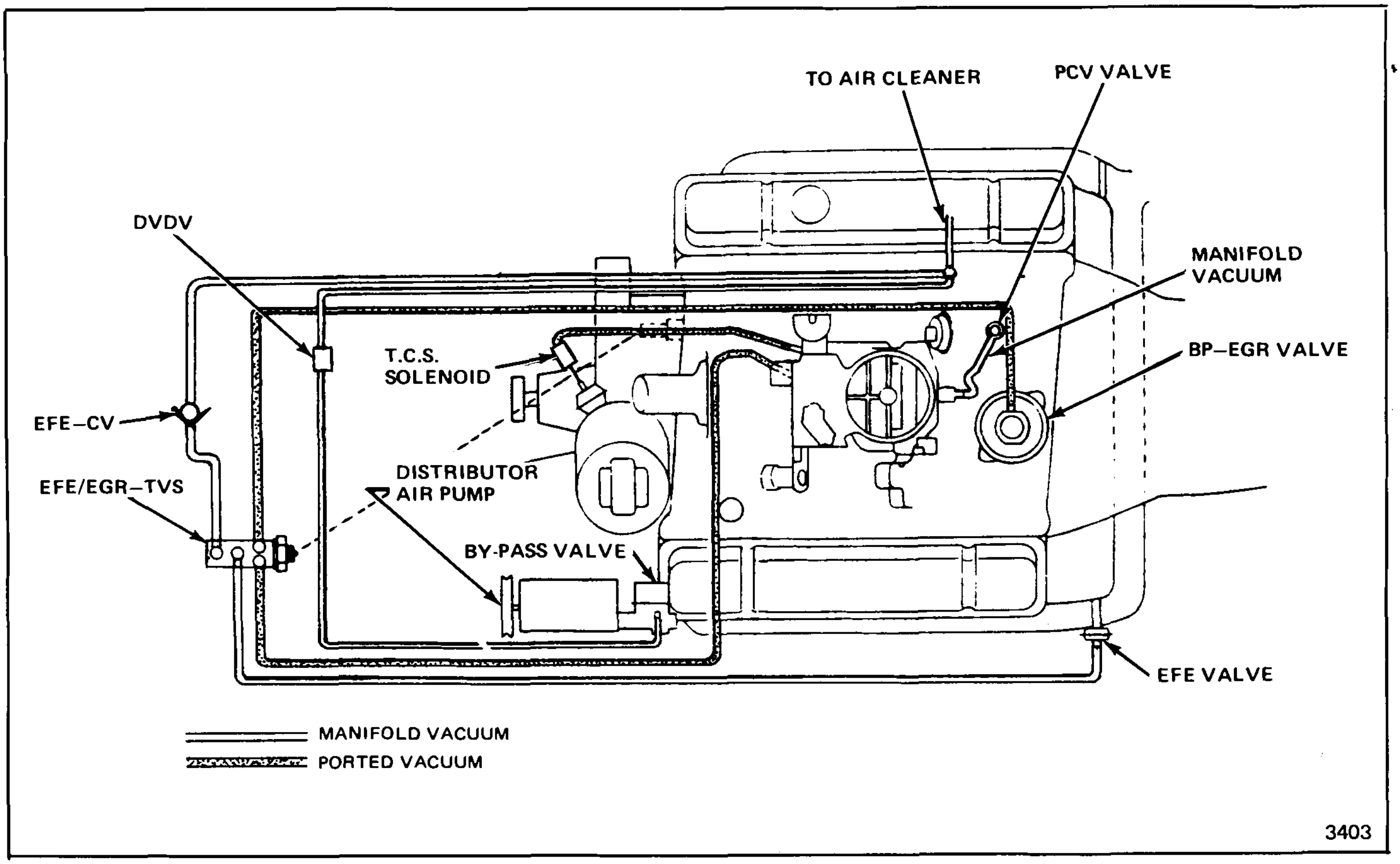


Fig. 6E-13 V6-231 C.I.D. California Manual Transmission

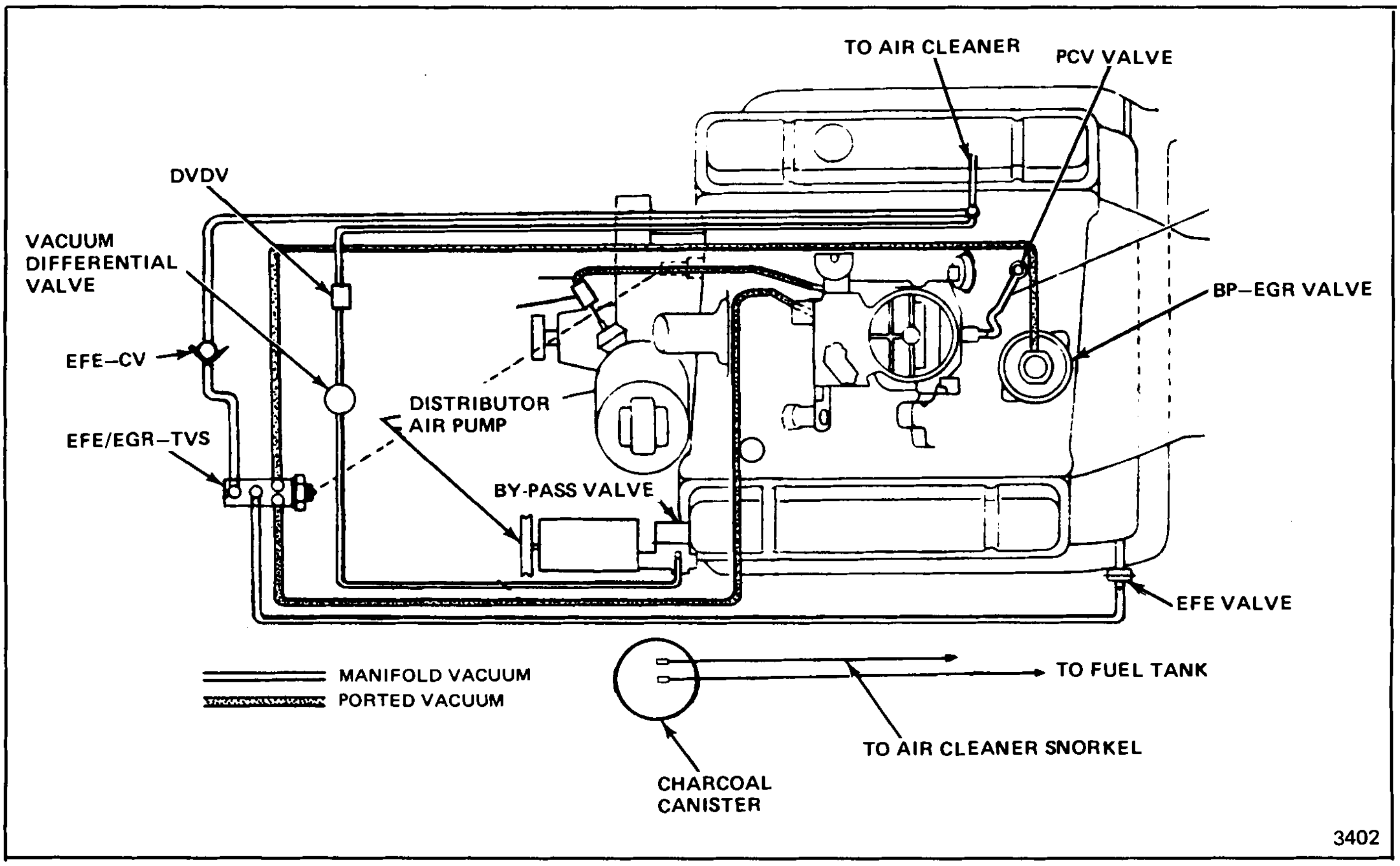


Fig. 6E-14 V6-231 C.I.D. California Automatic Transmission

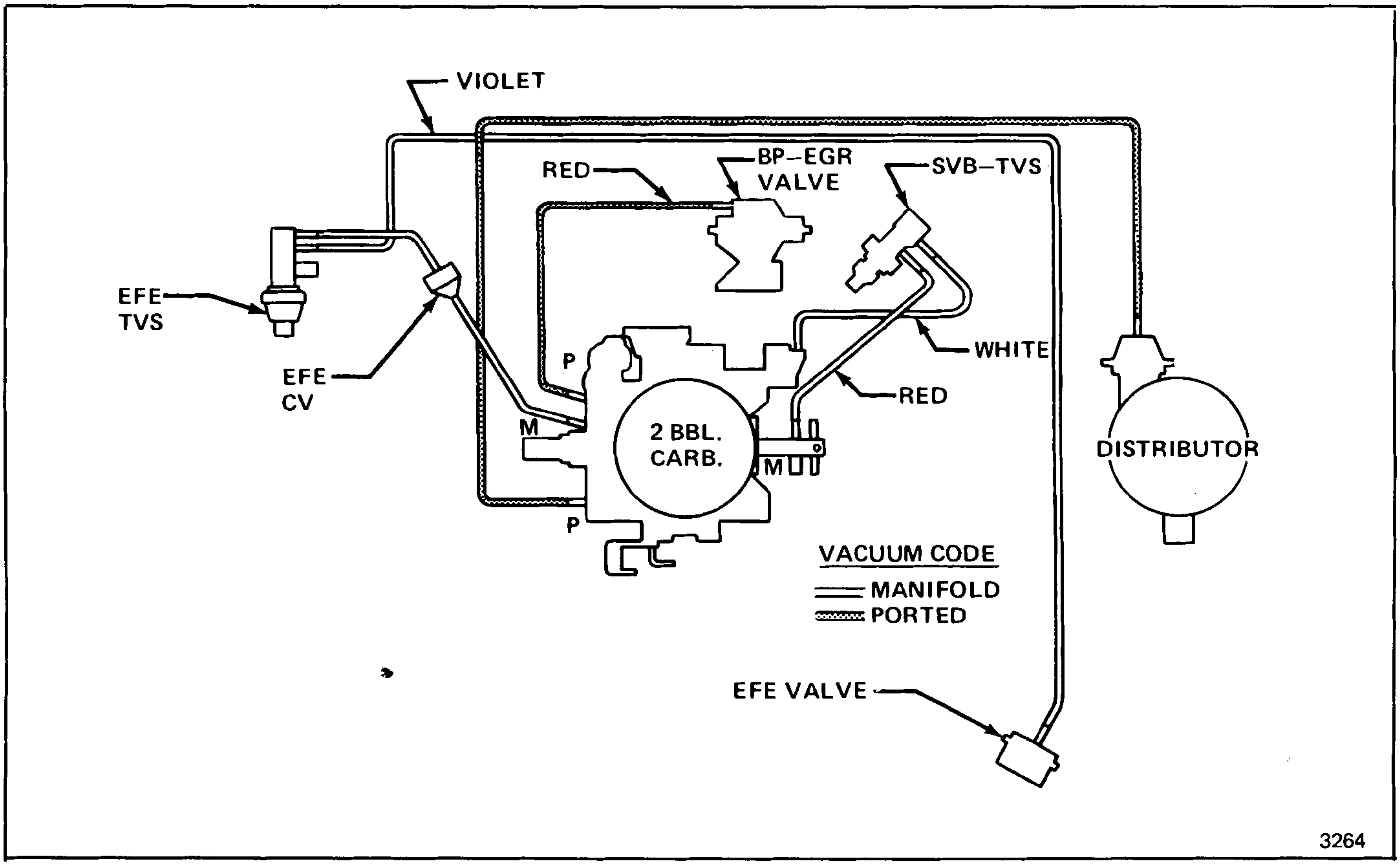


Fig. 6E-15 V8-301 C.I.D. Low Altitude Manual Transmission

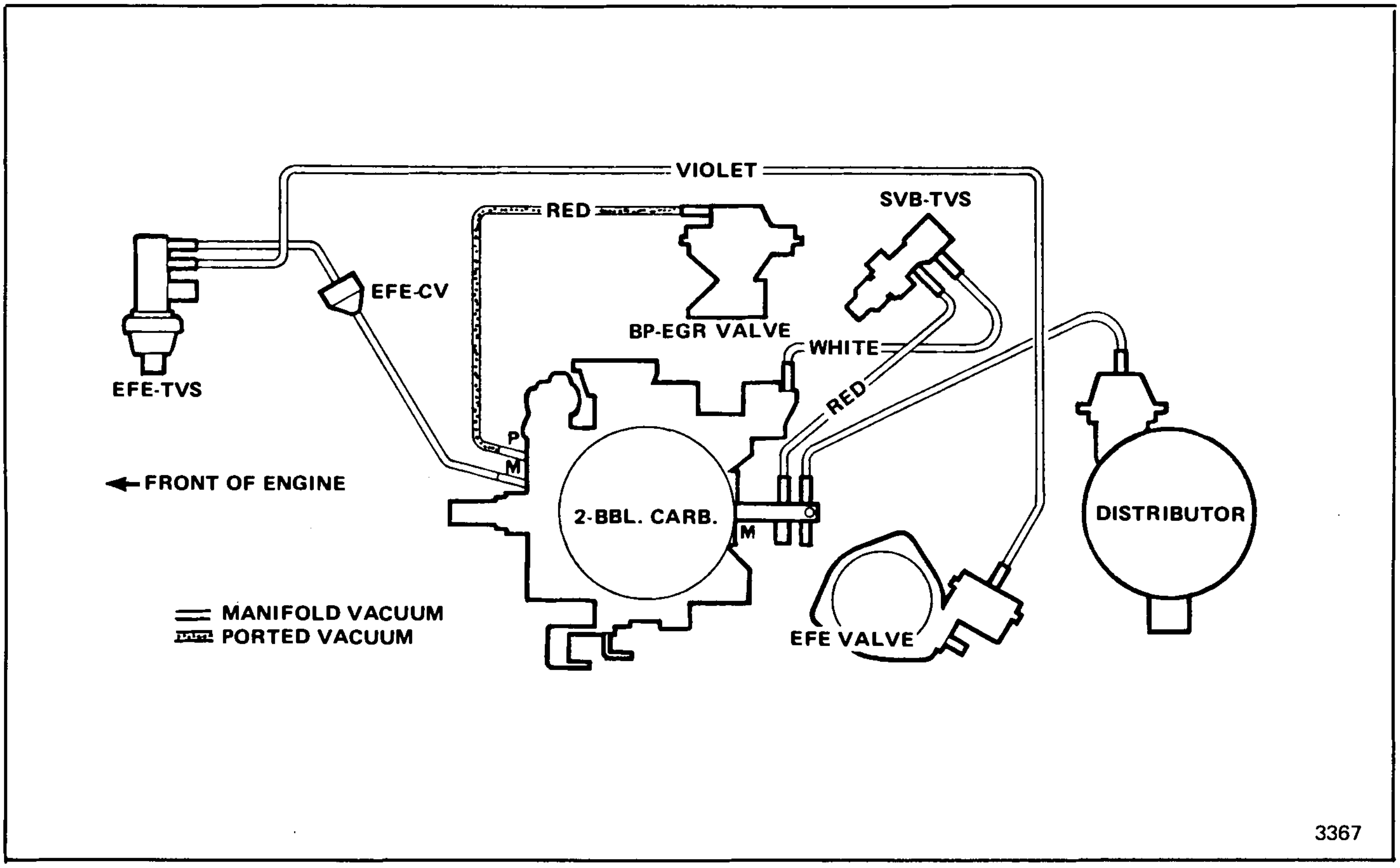


Fig. 6E-16 V8-301 C.I.D. Low Altitude Automatic Transmission Without Air Conditioning

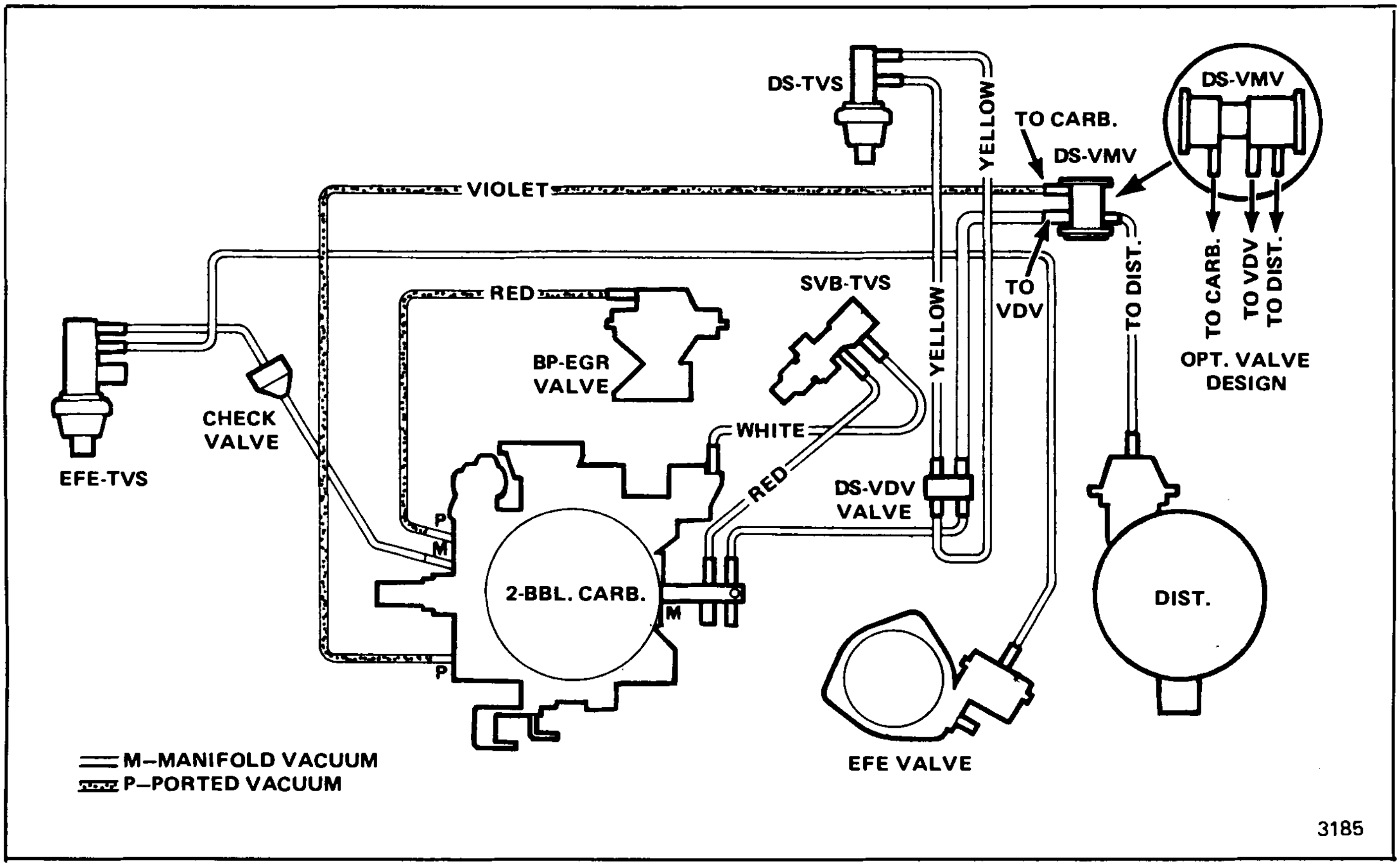


Fig. 6E-17 V8-301 C.I.D. Low Altitude Automatic Transmission With Air Conditioning

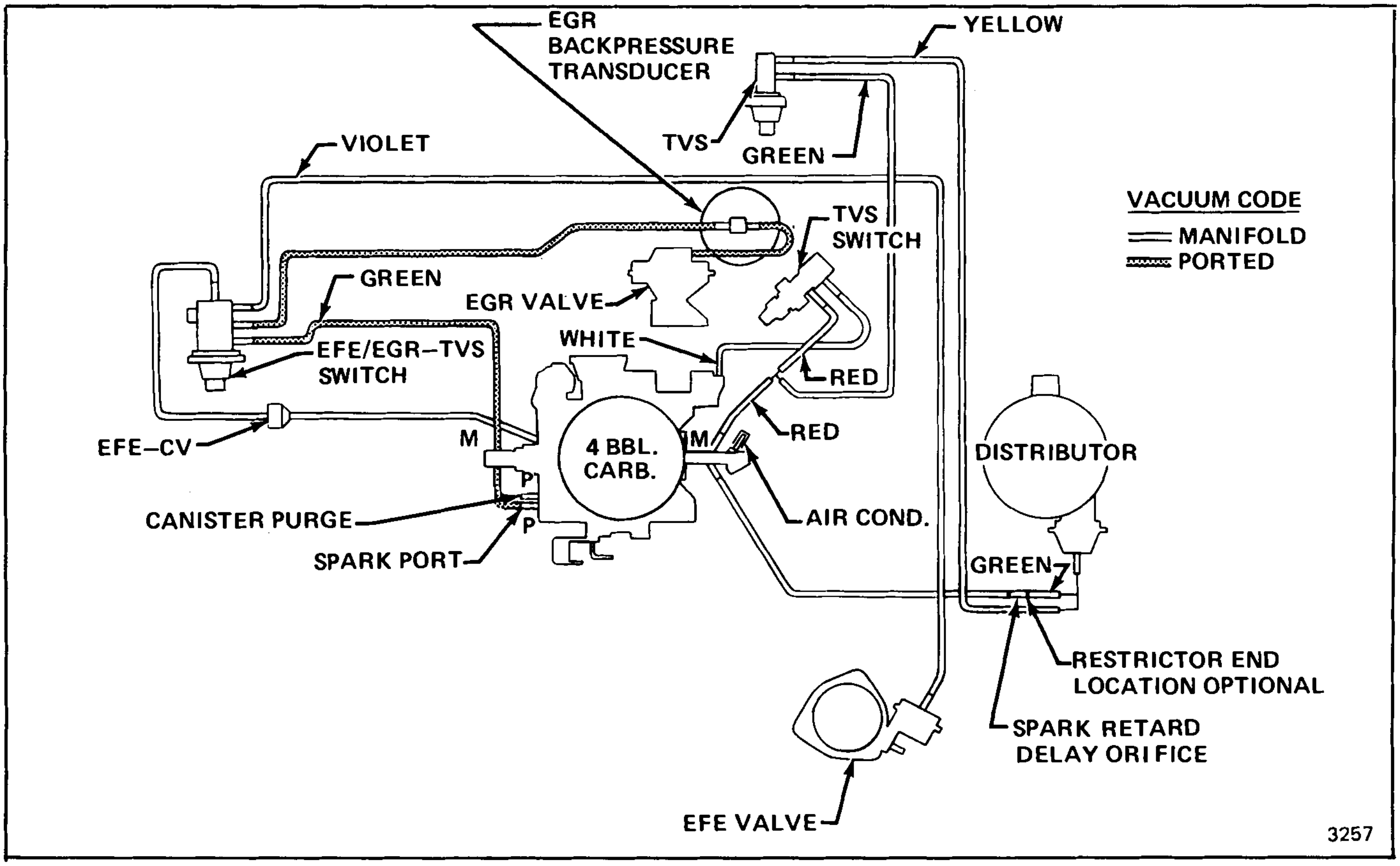


Fig. 6E-18 V8-350 and 400 C.I.D., VIN Codes P and Z, Low Altitude Automatic Transmission

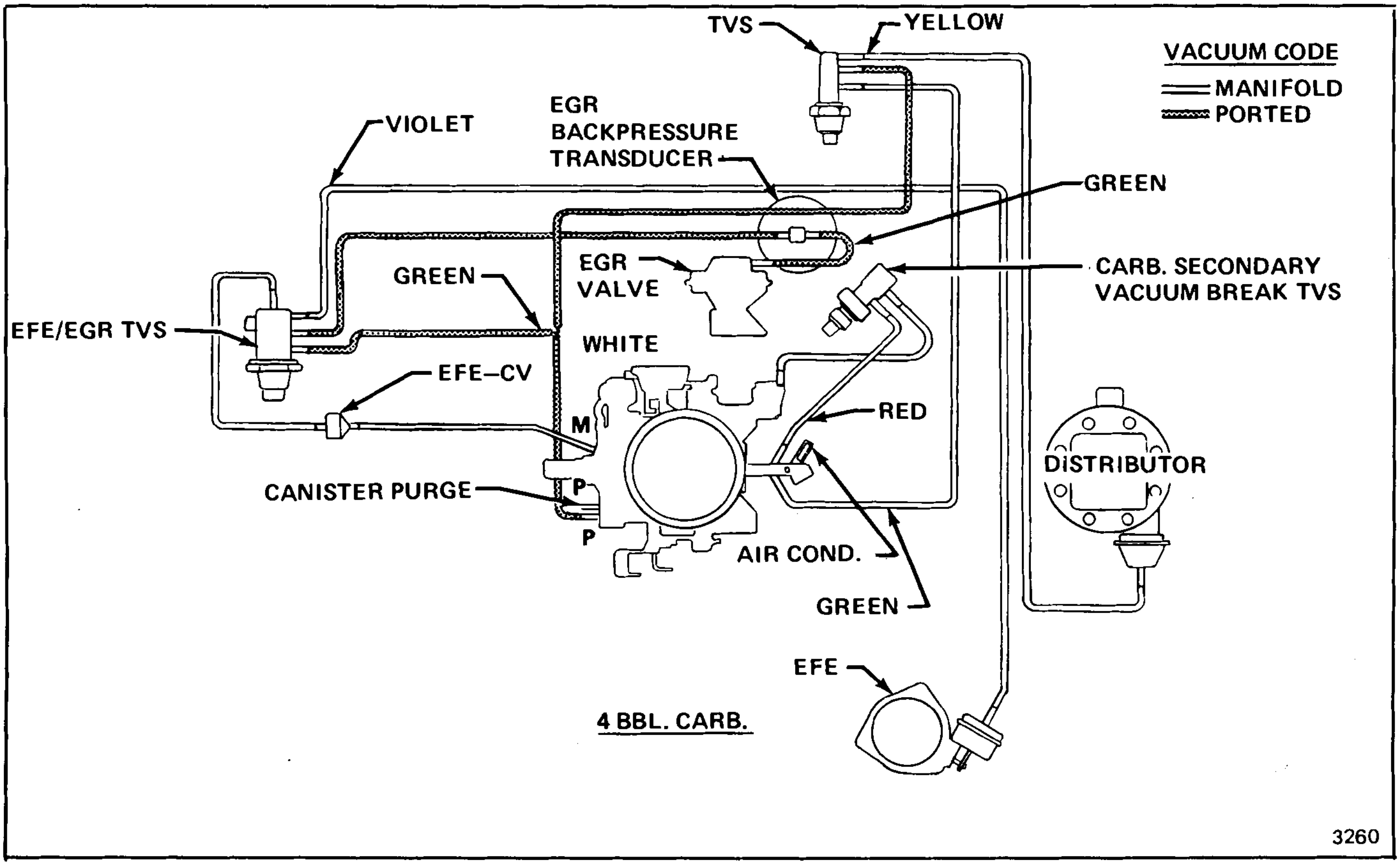


Fig. 6E-19 V8-400 C.I.D. Low Altitude Manual Transmission

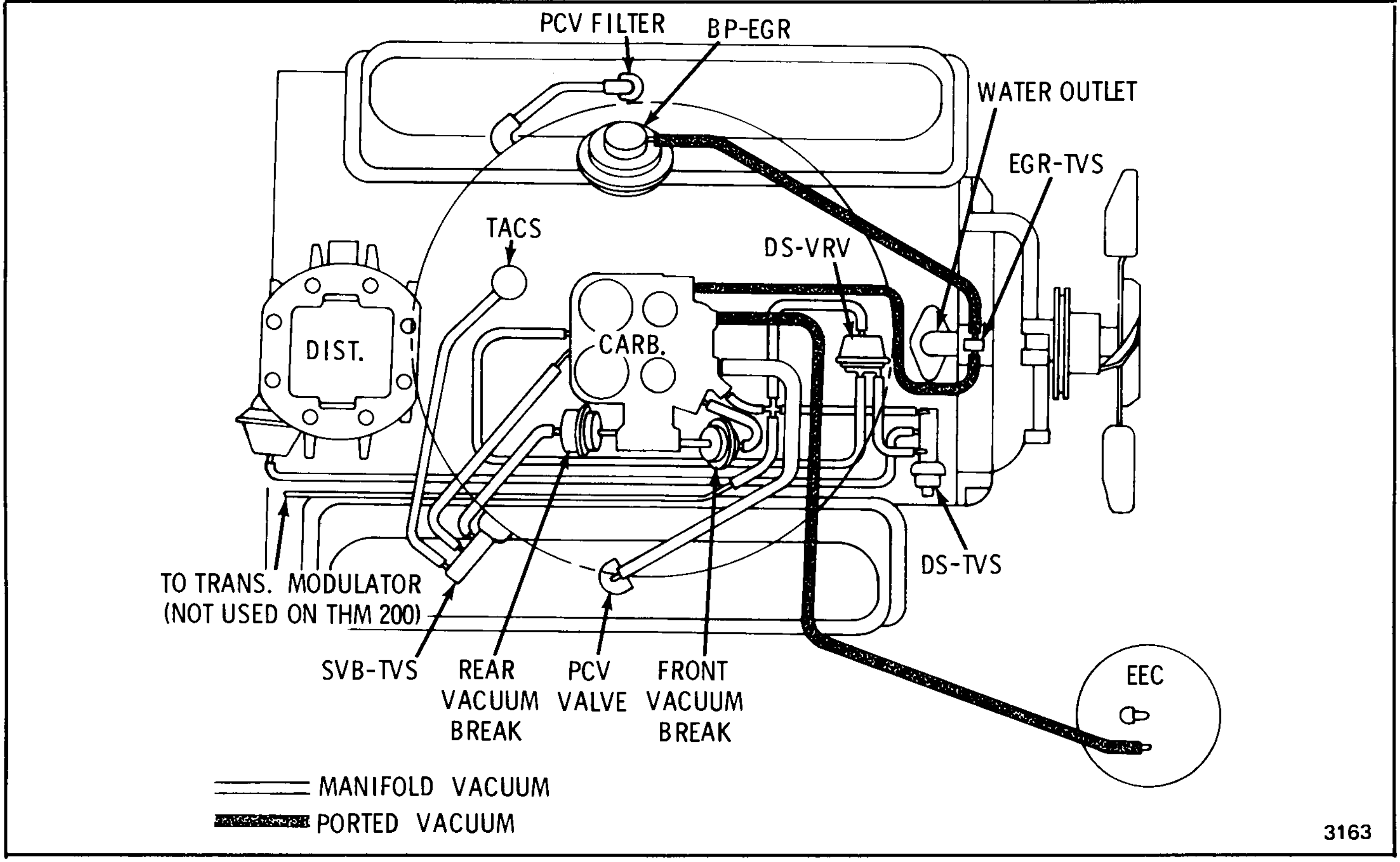


Fig. 6E-20 V8-350 and 403 C.I.D., VIN Codes R and K, Low Altitude

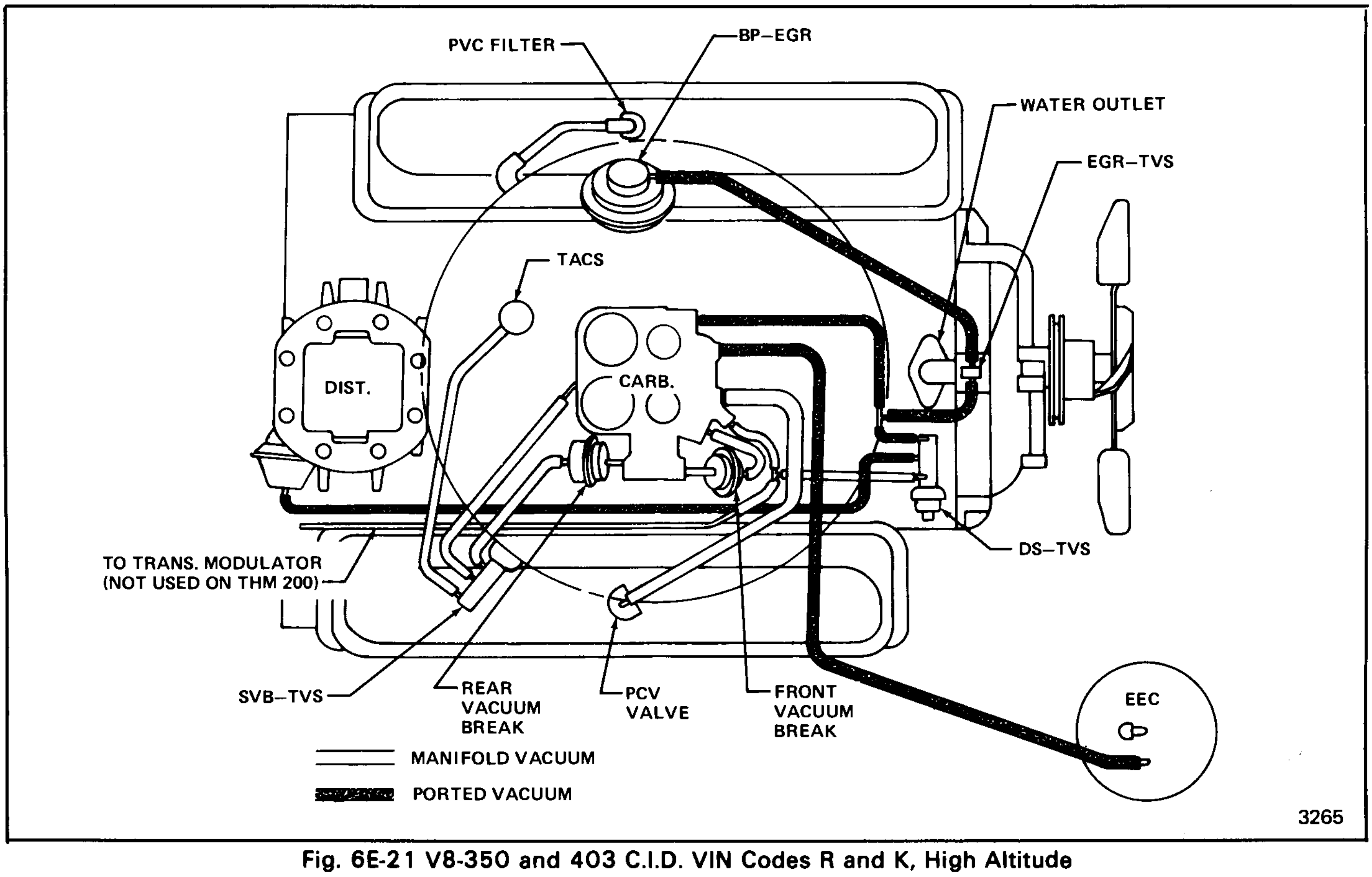


Fig. 6E-21 V8-350 and 403 C.I.D. VIN Codes R and K, High Altitude

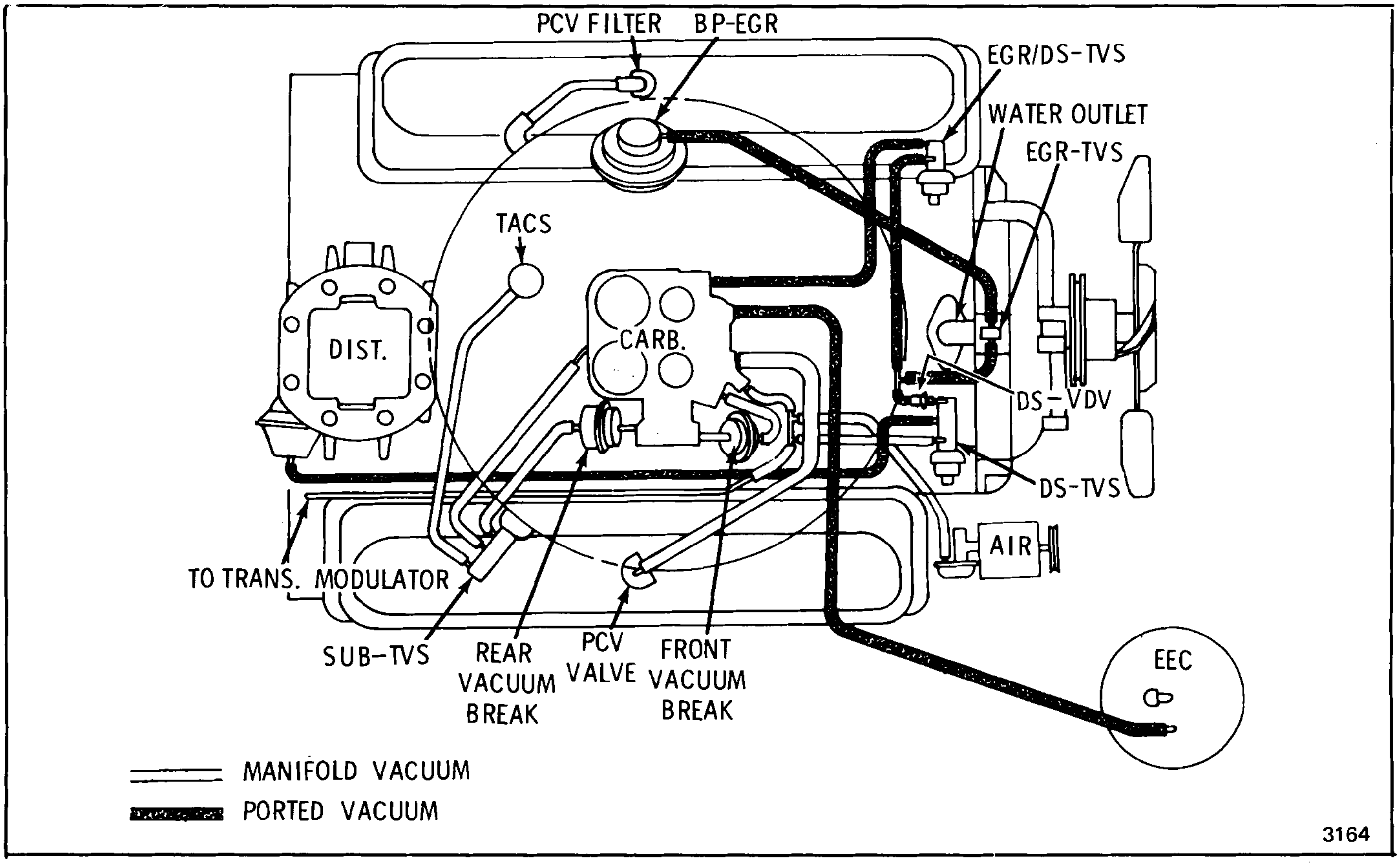


Fig. 6E-22 V8-350 and 403 C.I.D., VIN Codes R and K, California

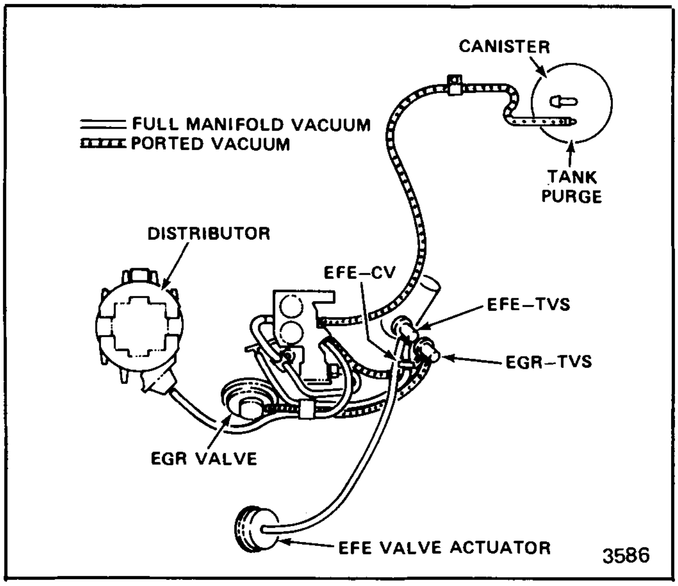


Fig. 6E-23 V8-305 C.I.D., VIN Code U

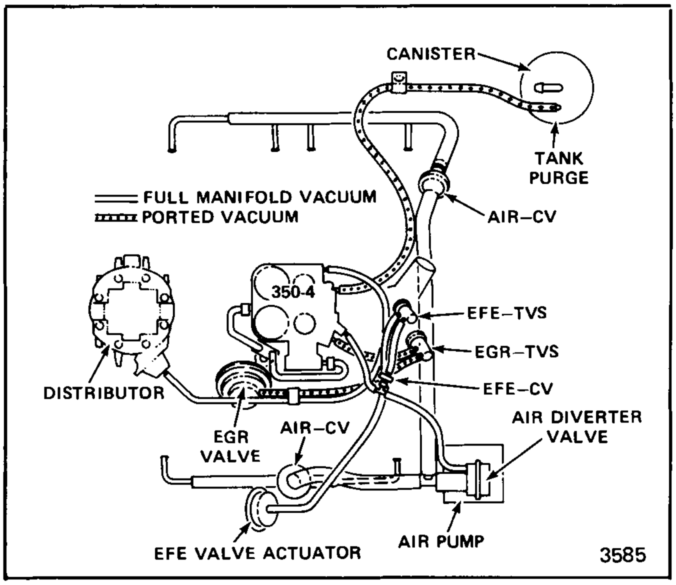


Fig. 6E-24 V8-350 C.I.D., VIN Code L

ON-CAR SERVICE

EARLY FUEL EVAPORATION SYSTEMS

ORIFICE EFE

The orifice EFE system does not require periodic service. If the orifice located in the exhaust crossover pipe becomes loose and rattles it can be re-welded into the pipe. If the orifice is cracked or broken making a weld repair impractical, it will be necessary to replace the exhaust crossover pipe.

VALVE CONTROLLED EFE

The operation of the EFE valve is to be checked at regular maintenance intervals (refer to Section 0 for maintenance interval information). Before performing the following EFE valve functional test, the vehicle should be allowed to cool down so that the engine temperature is below 40°C. (105°F.).

1. Locate EFE valve and note position of the actuator arm.

2. Observe EFE valve when engine is started.

Valve should close when engine is started cold. The actuator link will be pulled into the diaphragm housing.

3. If valve does not close, remove hose from EFE valve and apply an external vacuum source in excess of 8 inches. *Valve should close.*

a. If valve does not close, the valve could be seized. Lubricate with manifold heat valve lubricant, part number 1050422, or equivalent or replace as required.

b. If valve closes, the problem is not the EFE valve. Check for loose, kinked, pinched, plugged or cracked vacuum hoses and connections, and repair as required. Check function of EFE TVS. Then proceed with function test.

4. Warm up engine to normal operating temperature.

5. Observe EFE valve to see if it has opened. *Valve should open.*

6. If valve does not open, remove hose from EFE valve to see if it will open. *Valve should open.* If valve opens, there is no air bleed for the diaphragm, the TVS plunger is stuck in the cold mode or the engine is not reaching proper operating water temperature. Replace thermostat. Replace TVS.

EXHAUST GAS RECIRCULATION SYSTEMS

SYSTEM FUNCTIONAL TEST

1. Initial preparation.

a. Remove air cleaner so EGR valve diaphragm movement can be observed or felt.

NOTE: When air cleaner is removed, it is recommended that the choke secondary vacuum break TVV be unclipped and removed from the air cleaner body rather than removing hoses.

b. Plug air cleaner vacuum fitting.

c. Connect a tachometer.

NOTE: On engines with an EGR-TVS, there should be no EGR valve movement below the calibration temperature. If there is, replace TVS.

d. Warm up engine to operating temperature.

2. Open throttle part way and then release.

3. Observe the EGR diaphragm for movement.

The valve should open slightly when the throttle is opened and close when it is released.

4. Remove EGR hose from EGR valve and plug hose.

5. Place cam follower on second step of fast idle cam and *note speed.*

6. Attach a vacuum hose between air cleaner vacuum fitting and the EGR valve (or use an external source in excess of 11 inches) and *note speed change.* Speed should drop at least 200 rpm with A.T. or at least 150 rpm with M.T.

7. Summary.

a. A successful function test must meet the following:

- EGR diaphragm must move.
- Speed must drop when diaphragm moves.
- If system has a BPT, a separate check must be made on the BPT.

FUNCTIONAL TEST OF INDIVIDUAL EGR SYSTEM COMPONENT PARTS

1. Port type EGR VALVE (Valve can be left on or removed from the engine).

a. Depress the valve diaphragm.

b. With the diaphragm still depressed, plug the vacuum tube and release the diaphragm.

c. Observe diaphragm and/or pintle movement:

- Valve is satisfactory if it takes over 20 seconds for the pintle to seat or for the diaphragm to achieve full travel.
- Valve unsatisfactory and must be replaced if it takes less than 20 seconds for the pintle to seat or for diaphragm to achieve full travel.

2. BACK PRESSURE TRANSDUCER VALVE (Valve to be left on the engine).

a. Preparation

- Remove air cleaner and plug intake manifold air cleaner vacuum fitting.

NOTE: It is suggested that the choke secondary vacuum break TVV be unclipped and removed from the air cleaner body rather than removing hoses.

- Warm up engine to operating temperature.
- Connect a vacuum gage to carburetor side of BPT.

b. Place carburetor cam follower on high step of the fast idle cam with transmission in park.

c. Read and record the vacuum.

d. "Tee" a vacuum gage into hose between BPT and EGR valve. Vacuum should read between 1.8 and 3.2 inches.

- Replace BPT valve if not within specifications.
- Continue to next step with vacuum gage in same location.

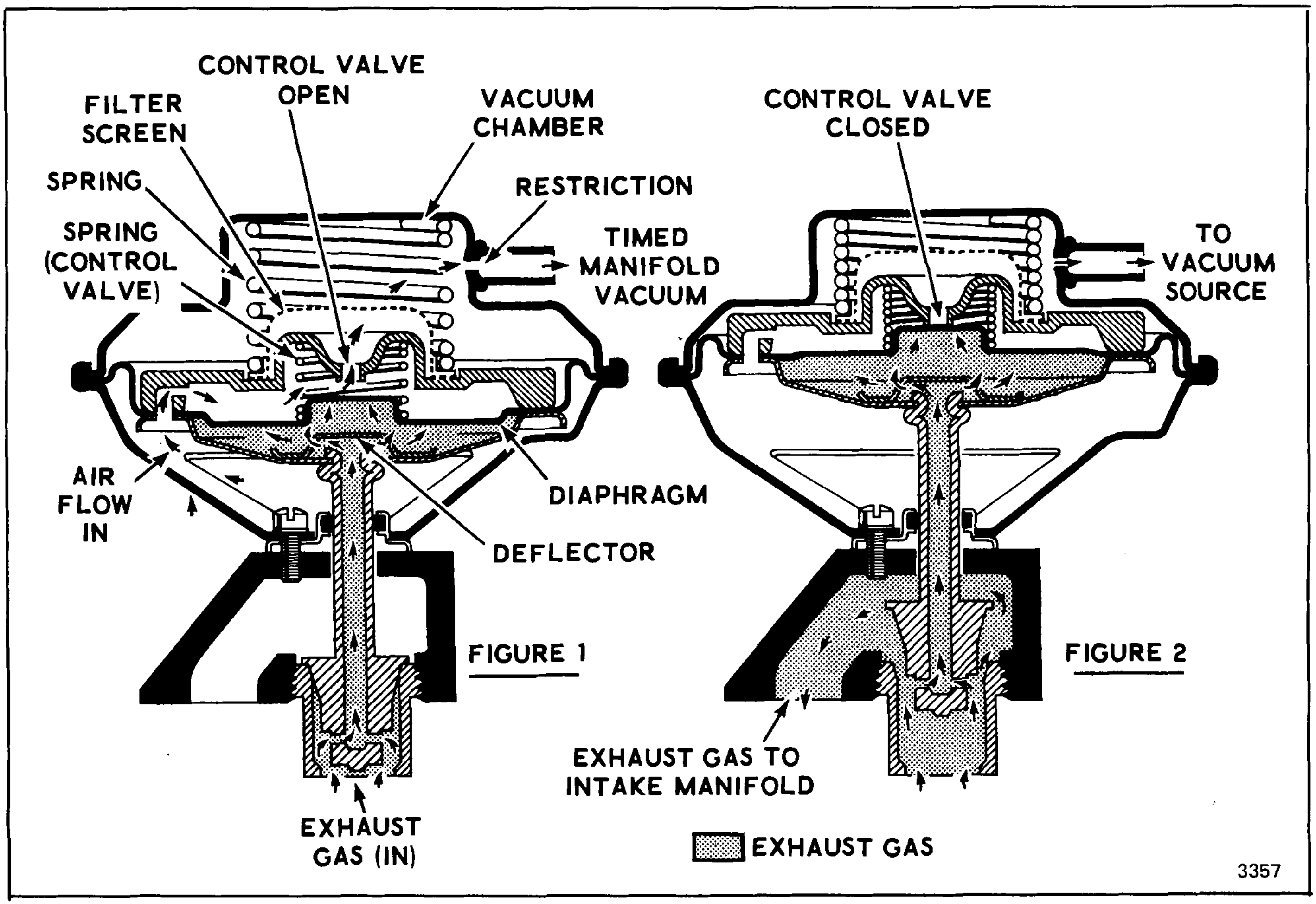


Fig. 6E-25 Port Type EGR Valve

e. Remove hose from EGR valve and plug hose. Read vacuum gage. This reading should be the same as or higher than the source reading taken in step 2C.

- Replace BPT valve if reading is not within 3 inches of source reading from step 2C.

3. EGR THERMAL VACUUM VALVE

a. Refer to Section 6D (vacuum controls) for checking temperature and procedures for the valve used on the engine being serviced.

EGR SYSTEM - INSPECTION AND CLEANING

The following procedure is to be used for the inspection and cleaning of the EGR valve and passages.

Inspection

1. Remove air cleaner.
2. Remove EGR valve from intake manifold.
3. Look for deposits on the valve pintle.
4. Depress the valve diaphragm and inspect for deposits around the valve seating area thru the valve outlet.
5. With the diaphragm still depressed, plug the vacuum tube then release the diaphragm. If the pintle has not closed in 20 seconds, the EGR valve is OK. If the pintle is closed within 20 seconds, the valve must be replaced.
6. The valve requires cleaning if deposits exist.

Cleaning

1. Hold the valve assembly in hand. Then, using a light snapping action with a plastic hammer, tap on the end of the round pintle to remove the exhaust despoits from the valve seat. Empty loose particles.
2. Clean the mounting surface of the EGR valve with a wire wheel or wire brush, and the pintle with a wire brush.
3. Depress the valve diaphragm and check the seating area for cleanliness by looking thru the valve outlet. If pintle or seat are not completely clean, repeat step 1.
4. Inspect the valve outlet for deposits. Remove any deposit build-up with a screwdriver or other suitable sharp tool.
5. Clean mounting surface with a wire wheel or wire brush.

NOTE: Do not use solvents for cleaning.

INTAKE MANIFOLD PASSAGES

1. Remove carburetor.
2. Remove the deposits from the EGR ports by hand turning a drill into the passage. Finish cleaning with a small screwdriver. Refer to Fig. 6E-26 for location of the EGR ports on various engine types.

CAUTION: *Do not use a power drill or file.*

3. Brush any small particles down the EGR port and blow compressed air through the port.

NOTE: Do not use solvents for cleaning.

POSITIVE CRANKCASE VENTILATION SYSTEM

FUNCTIONAL TEST OF PCV SYSTEM

1. Remove PCV valve from intake manifold or rocker arm cover.
2. Run the engine at idle.
3. Place your thumb over end of valve to check for vacuum. If there is no vacuum at valve, check for plugged hoses or valve.
4. Shut off the engine. Shake valve and listen for the rattle of check needle in valve. If valve does not rattle, replace valve.

THERMOSTATIC AIR CLEANER

VACUUM MOTOR CHECK

1. Check all hoses for proper hook-up. Check for kinked, plugged or damaged hoses.
2. With the engine "OFF", observe damper door position through snorkel opening. If position of snorkel makes observation difficult, use the aid of a mirror. At this point damper door should be in such a position that the heat stove passage is covered (snorkel passage open). See Fig. 6E-27. On V8-301 engines in cold temperatures the damper door may be closed due to the use of a vacuum check valve. Momentarily disconnect vacuum hose at TAC vacuum motor and observe damper position. If stove passage is not covered, check for binds in linkage.
3. Apply at least 7 in Hg. of vacuum to the diaphragm assembly through hose disconnected at sensor unit. Damper door should completely close snorkel passage when vacuum is applied. See Fig. 6E-28. If not, check to see if linkage is hooked up correctly and not binding and for a vacuum leak.
4. With vacuum applied, bend or clamp hose to trap vacuum in diaphragm assembly. Damper door should remain in position (closed snorkel passage), Fig. 6E-28 . If it does not, there is a vacuum leak in diaphragm assembly. Replace diaphragm assembly.

SENSOR CHECK (QUICK CHECK OF SYSTEM)

1. Start test with engine cold, air cleaner at a temperature below 77°F. (25°C.). If the engine has been in recent use, allow it to cool. (Removing the air cleaner from the engine and placing it on the bench will aid in quickly cooling the sensor.) On V8-301 engines, momentarily disconnect vacuum hose at TAC vacuum motor before proceeding with test.
2. Observe the damper door before starting the engine: it should be in the open snorkel position, Fig. 6E-27.
3. Start the engine and allow it to idle. Immediately after starting the engine, the damper door should be in the closed snorkel passage position, Fig. 6E-28.
4. As the engine warms up, the damper door should start to allow outside air and heated air to enter the carburetor inlet.

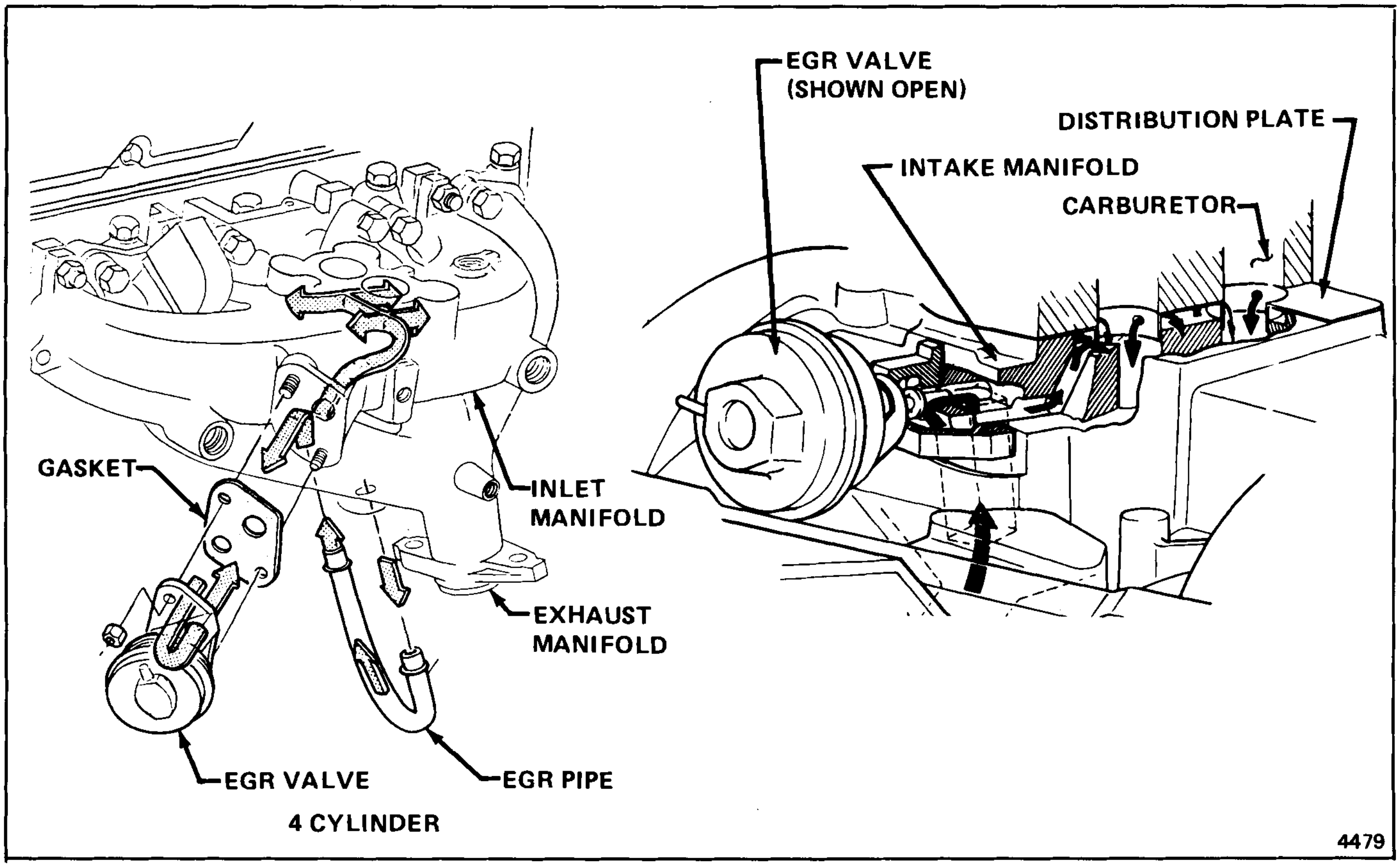


Fig. 6E-26 EGR Port Locations - Typical

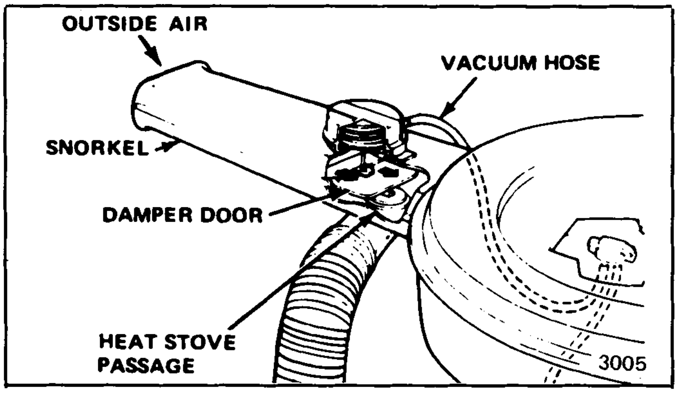


Fig. 6E-27 Snorkel Passage Open

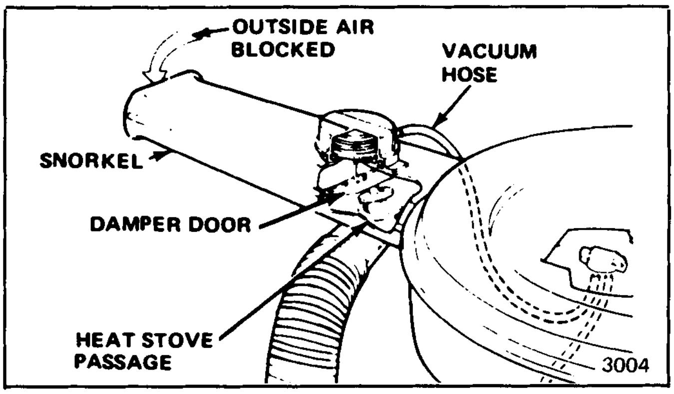


Fig. 6E-28 Snorkel Passage Closed

5. The system is operating normally as described above. If the air cleaner fails to operate as above, or if correct operation of the air cleaner is still in doubt, proceed to the thermometer check (of sensor).

THERMOMETER CHECK OF SENSOR

1. Start test with air cleaner temperature below 77°F. (25°C.). If engine has been run recently, remove air cleaner and place on bench (this will help quickly cool the air cleaner). Remove air cleaner cover and place Thermometer as close as possible to the sensor. Let air cleaner cool until thermometer reads below 79°F. (26°C.) about 5 to 10 minutes. Reinstall air cleaner on engine and continue to step 2 below.

2. Start and idle engine. Damper door should move to close the snorkel passage immediately if engine is cool enough. Fig. 6E-28. When damper door starts to open the snorkel passage (in a few minutes), remove air cleaner cover and read temperature gage. It must read 123°F., plus or minus 20° (40°C. ± 6°).

3. If the damper door does not start to open up the snorkel passage at temperature indicated, temperature sensor is malfunctioning and must be replaced.

VACUUM MOTOR

Removal (Fig. 6E-29)

1. Remove air cleaner.
2. Disconnect vacuum hose from motor.

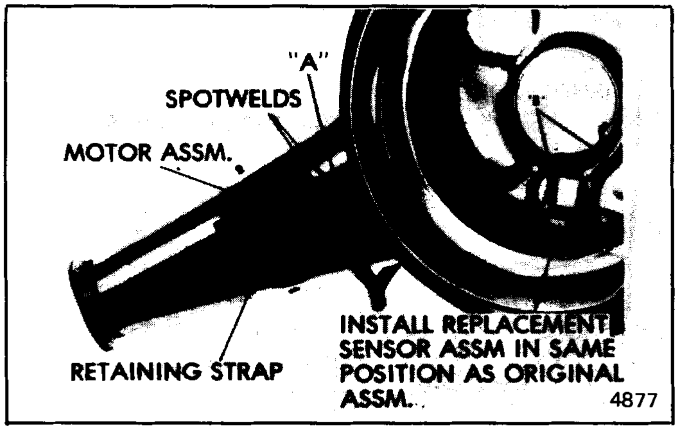


Fig. 6E-29 Removing TAC Vacuum Motor

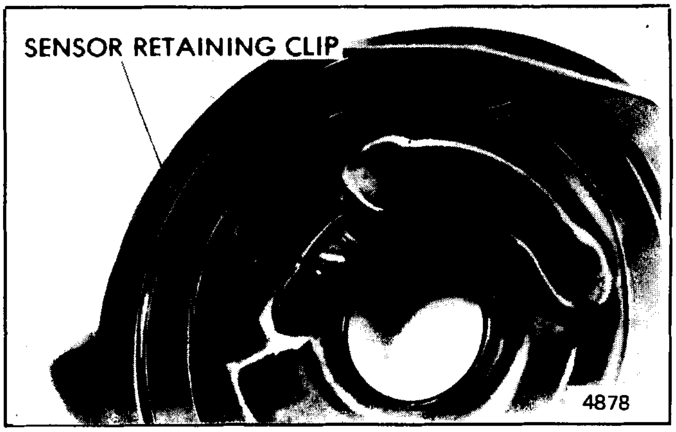


Fig. 6E-30 Removing TAC Sensor Retaining Clip

3. Drill out the two spot welds initially with a 1/16" hole, then enlarge as required to remove the retaining strap. Do not damage the snorkel tube.

4. Remove motor retaining strap.

5. Lift up motor, cocking it to one side to unhook the motor linkage at the control damper assembly.

Installation

1. Drill a 7/64" hole in snorkel tube at point "A" as shown in Fig. 6E-29.

2. Insert vacuum motor linkage into control damper assembly.

3. Use the motor retaining strap and sheet metal screw provided in the motor service package to secure the retaining strap and motor to the snorkel tube.

4. Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.

5. Connect vacuum hose to motor and install air cleaner.

SENSOR

Removal (Fig. 6E-30)

1. Remove air cleaner.

2. Detach hoses at sensor.

3. Pry up tabs on sensor retaining clip; remove clip and sensor from air cleaner. Note position of sensor for installation.

Installation

1. Install sensor and gasket assembly in original position.

2. Press retainer clip on hose connectors.

3. Connect vacuum hoses and install air cleaner on engine.

T.A.C. SYSTEM-140 AND 151 ENGINES

Functional Check

1. With engine cold, below 50°F. (10°C.), check the position of the snorkel valve. The cold air intake should be completely closed off.

2. Start the engine and allow to warm up. At approximately 50°F. (10°C.) the thermostatic coil will begin to open the cold air door and allow some cold air to enter the air cleaner.

3. Continue to warm engine, checking air cleaner inside temperature. The cold air door should gradually continue opening as temperature increases until full opening is obtained at approximately 110°F. (42°C.).

If system fails to operate in this manner, replace the snorkel assembly.

AIR INJECTION REACTION SYSTEMS

PULSE AIR SYSTEM SERVICE

Inspection

Inspect pulse air valve and hose for leaks and cracks and replace valve and/or hose as required.

Functional Test

1. Connect hand vacuum pump J23738 to the rubber hose of the pulse air valve.

2. Apply a vacuum greater than 15 inches of mercury and time vacuum loss from 15 inches to 5 inches of mercury.

3. If vacuum drops in less than two seconds, replace pulse air valve.

Remove

1. Remove air cleaner and disconnect rubber hose from pulse air valve.

2. Disconnect support bracket if present.

3. Loosen 4 attaching nuts and remove pulse air valve.

Replace

1. Apply light coat of oil to back of pulse air valve tubes, Fig. 6E-31.

2. Install replacement pulse air valve tightening attaching nuts to 10-13 lb.ft.

3. Connect support bracket if used.

4. Connect rubber hose to pulse air valve and install air cleaner.

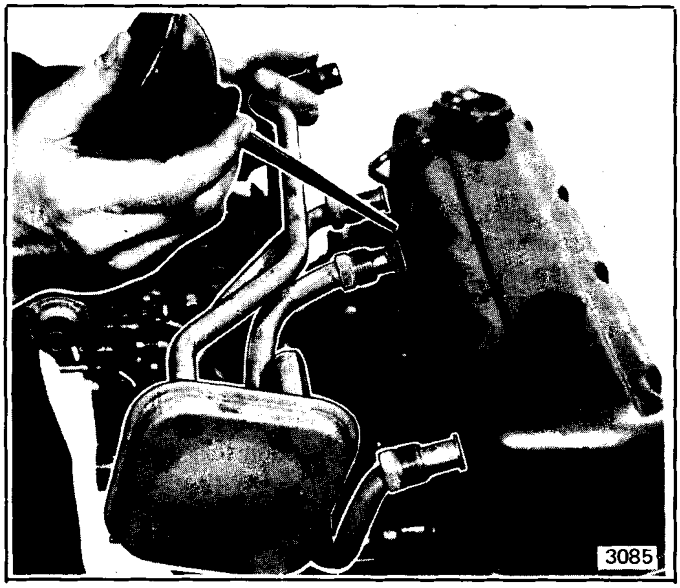


Fig. 6E-31 Pulse Air Valve Installation

A.I.R. SYSTEM SERVICE

Functional Test

1. Start engine and let idle in neutral or park.
2. Feel for presence of air exhausting out of the lower portion of diverter valve. There should be no air exhausting.
3. Seal off vacuum supply to the diverter valve by pinching the hose shut.
4. Keep hose pinched shut for at least one second.
5. Release hose.
6. There should be air exhausting out of the lower portion of the diverter valve. Air will exhaust for about four seconds. Replace diverter valve if air does not exhaust.

DRIVE BELT

Inspection

1. Inspect drive belt for wear, cracks or deterioration and replace if necessary.
2. Inspect belt tension and adjust if below 70 lbs. using a belt tension gage.

Adjustment

Loosen pump mounting bolt and pump adjustment bracket bolt. Move pump until belt is properly tensioned then tighten adjustment bracket bolt and mounting bolt. Use a belt tension gage to check adjustment (Fig. 6E-32).

CAUTION: *Do not pry on the pump housing. Distortion of the housing will result in extensive damage to the Air Injection Pump.*

Replace

1. Loosen pump mounting bolt and pump adjustment bracket bolt, then swing pump until drive belt may be removed.
2. Install a new drive belt and adjust as outlined above.

Fig. 6E-32 A.I.R. Belt Tensioning

PUMP PULLEY

Remove

1. Hold pump pulley from turning by compressing drive belt then loosen pump pulley bolts.
2. Remove drive belt as outlined above then remove pump pulley.

Install

1. Install pump pulley with retaining bolts hand tight. Install and adjust drive belt as outlined above.
2. Hold pump pulley from turning by compressing drive belt then torque pump pulley bolts to 24 lb. ft.
3. Recheck drive belt tension and adjust if required.

PUMP FILTER

Remove

1. Remove drive belt and pump pulley as previously outlined.
2. Insert needle nose and pull fan from hub (see Fig. 6E-33).

NOTE: Care should be taken to prevent fragments from entering the air intake hole. Do not insert a screwdriver between pump and filter. It is seldom possible to remove the filter without destroying it. Do not attempt to remove the metal hub.

Install

1. Install the new filter by drawing it on with the pulley and pulley bolts (Fig. 6E-34). Do not attempt to install a filter by hammering it on or pressing it on.
2. Draw the filter down evenly by alternately torquing the bolts. Make certain that the outer edge of the filter slips into the housing. The slight amount of interference with the housing bore is normal.

NOTE: The new filter may squeal upon initial operation until it's O.D. sealing lip has worn in.

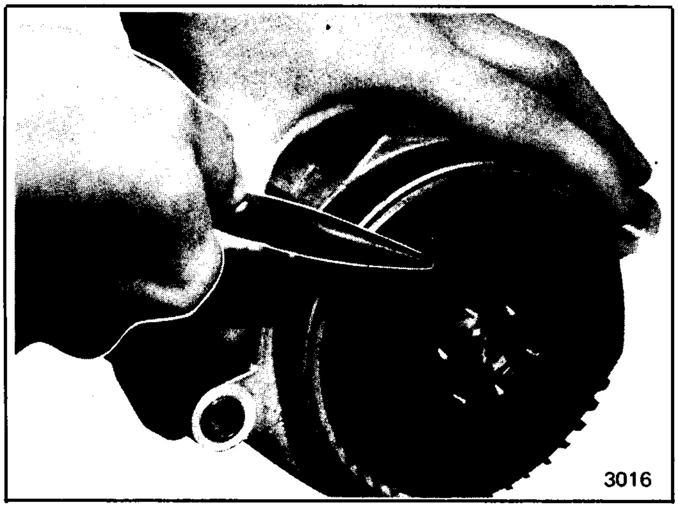


Fig. 6E-33 A.I.R. Filter Removal

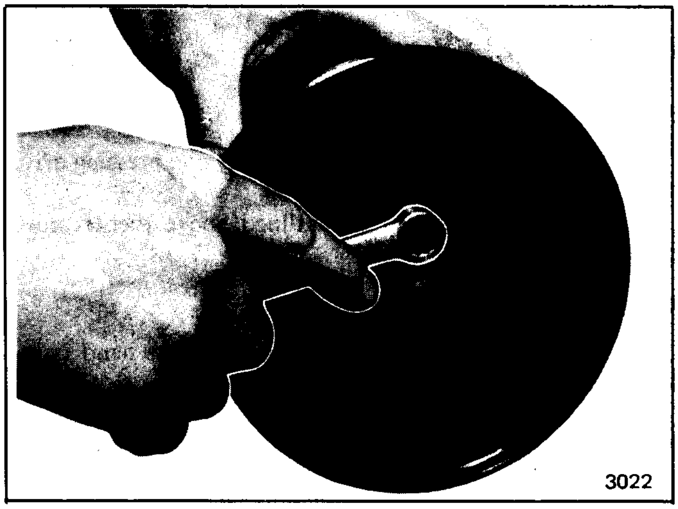


Fig. 6E-34 A.I.R. Filter Installation

A.I.R. HOSES AND TUBES

Inspection

1. Inspect all hoses for deterioration or holes.
2. Inspect all tubes for cracks or holes.
3. Check all hose and tube connections.
4. Make repairs or replace parts as needed.
5. Check all tube and hose routing. Interference may cause wear.
6. If leak is suspected on the pressure side of the system or any tubes and/or hoses have been disconnected on the pressure side, the connections should be checked for leaks with soapy water solution.
7. With the pump running, bubbles will form if a leak exists.

Remove

To replace any hose and/or tube, note routing then remove hose(s) and/or tube(s) as required.

Install

1. Install new hose(s) and/or tube(s), routing them as when removed.
2. Tighten all connections.

CHECK VALVE

Inspection

1. The check valve should be inspected whenever the hose is disconnected from the check valve or whenever check valve failure is suspected. (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure.)
2. Blow through the check valve (toward the cylinder head) then attempt to suck back through check valve. Flow should only be in one direction (toward the exhaust manifold) Replace valve which does not function this way.

Replace

Disconnect pump outlet hose at check valve. Remove check valve from pipe assembly, being careful not to bend or twist the assembly.

DIVERTER VALVE AND SILENCER ASSEMBLY

Inspection

1. Check condition and routing of all lines especially the signal line. All lines must be secure, without crimps and not leaking. Replace deteriorated lines.
2. Disconnect signal line at valve. A vacuum running.
3. Check diverter valve attaching screws for tightness. Screws should be torqued to 85 lb. in.
4. Defective valves should be replaced (see Functional Test).

Remove

1. Disconnect vacuum signal line. Disconnect valve outlet hose.
2. Remove diverter valve from pump or elbow.

Install

1. Install diverter valve to pump or elbow with new gasket. Torque valve attaching screws to 85 lb. in.
2. Install outlet and vacuum signal hoses and check system for leaks.

A.I.R. PUMP

Inspection

Accelerate engine to approximately 1500 rpm and observe air flow from hose(s). If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

1. Check for proper drive belt tension.
2. Check for a leaky pressure relief valve. Air may be heard leaking with the pump running.

NOTE: The A.I.R. System is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the Air Injection Reactor System, operate the engine with the pump drive belt removed. If excessive noise does not exist with the belt removed proceed as follows:

3. Check for a seized Air Injection Pump.
4. Check hoses, tubes and all connections for leaks and proper routing.

CAUTION: *Do not oil A.I.R. pump.*

5. Check diverter valve.
6. Check A.I.R. injection pump for proper mounting and bolt torque.
7. Repair irregularities in these components as necessary.
8. If no irregularities exist and the air injection pump noise is still excessive, replace pump.

Remove

1. Disconnect the hoses at the pump.
2. Remove pump pulley as outlined.
3. Remove pump mounting bolts and remove pump.

Install

1. Install pump with mounting bolts loose.
2. Install pump pulley as outlined.
3. Install and adjust belt as outlined.
4. Connect the hoses at the pump.
5. Tighten mounting bolts to 20-35 lb. ft.

ENGINE AND CODE	IGNITION TIMING BTDC DEGREES	SPARK PLUG TYPE & GAP	SOLENIOD SCREW (RPM)	SLOW IDLE CARBURETOR (RPM)	FAST IDLE (RPM)	CARBURETOR IDENTIFICATION	EMISSION CONTROL DEVICES	EGR VALVE MODEL	BACK PRESSURE TRANSDUCER	ENGINE FAMILY & EMISSION INFO. LABEL CODE	DISTRIBUTOR		VACUUM ADVANCE CRANKSHAFT DEGREES			MECHANICAL ADVANCE CRANKSHAFT DEGREES
											DIST. MODEL	VACUUM MODEL	START @ IN HG	FULL IN @ IN HG	MAXIMUM ADVANCE	
140 C.I.D. 2-BBL. L4 MANUAL TRANS. CBS,CBZ,CAY H SERIES LOW ALTITUDE	0° @ 700 RPM	R43TS .035	1250(N) (1)	700(N)	2500(N)	458103(1) 458105(2) 3NR	EGR,PCV,TAC EEC,OC,PAIR, EGR-TVS,DS-TVS DS-VDV	7044181	N.A.	710C2 AH	1110538	1973601	5 "	10"	24°	0° @ 850 RPM 8° @ 1200 RPM 17° @ 2000 RPM
140 C.I.D. 2-BBL. L4 AUTOMATIC TRANS. CBT H SERIES LOW ALTITUDE	2° @ 650 RPM	R43TS .035	850(D) (1)	650(D)	2500(N)	458102(1) 458104(2) 3NR	EGR,PCV,TAC EEC,OC,PAIR, EGR-TVS,DS-TVS DS-VDV	7044180	N.A.	710C2 AH	1110539	1973601	5 "	10"	24°	0° @ 850 RPM 13° @ 1400 RPM 32° @ 4400 RPM
140 C.I.D. 2-BBL. L4 MANUAL TRANS. CBK,CBY,CAZ H SERIES CALIFORNIA	2° ATDC @ 700 RPM	R43TS .035	1250(N) (1)	800(N)	2500(N)	458107(1) 458109(2) 3NR	EGR,PCV,TAC EEC,OC,PAIR EGR-TVS,DS-VDV SVB/DS-TVS	7044180	N.A.	710C2 AJ	1110538	1973601	5 "	10"	24°	0° @ 850 RPM 8° @ 1200 RPM 17° @ 2000 RPM
140 C.I.D. 2-BBL. L4 MANUAL TRANS. CAA, CAC H SERIES HIGH ALTITUDE	0° @ 700 RPM	R43TS .035	1250(N) (1)	800(N)	2500(N)	458107(1) 458109(2) 3NR	EGR,PCV,TAC EEC,OC,PAIR EGR-TVS,DS-VDV SVB/DS-TVS	7044181	N.A.	710C2 AK	1110538	1973601	5 "	10"	24°	0° @ 850 RPM 8° @ 1200 RPM 17° @ 2000 RPM
140 C.I.D. 2-BBL. L4 AUTOMATIC TRANS. CAB H SERIES HIGH ALTITUDE	2° @ 700 RPM	R43TS .035	850(D) (1)	700(D)	2500(N)	458110(1) 458112(2) 3NR	EGR,PCV,TAC EEC, OC, PAIR EGR-TVS, DS-VDV SVB/DS-TVS	7044180	N.A.	710C2 AK	1110539	1973601	5 "	10"	24°	0° @ 850 RPM 13° @ 1400 RPM 32° @ 4400 RPM
151 C.I.D. 2-BBL. L4 AUTOMATIC TRANS. YL,YM H SERIES LOW ALTITUDE	14° @ 650 RPM	R44TSX .060	850(D)(1) 650(D)(2)	650(D)(1) 500(D)(2)	2400(N)	527200(1) 527202(2) 4NR	EFE,EGR,OC CVB-VDV,DS-VDV EFE/EGR-TVS DS-TVS,TAC,PCV,EEC	7044379	N.A.	720X2U FL(1) FM(2)	1103229	1973591	3.5"	12"	20°	0° @ 1200 RPM 6° @ 1600 RPM 20° @ 4400 RPM
151 C.I.D. 2-BBL. L4 MANUAL TRANS. WF,WH X SERIES LOW ALTITUDE	14° @ 1000 RPM	R44TSX .060	1200(N)(1) 1000(N)(2)	500(N)	2200(N)	527201(1) 527203(2) 4NR	EFE,EGR,OC CVB-VDV,DS-VDV EFE/EGR-TVS DS-TVS,TAC,PCV,EEC	7044378	N.A.	720X2U FN(1) FP(2)	1103263	1973590	3.5"	9"	20°	0° @ 1200 RPM 20° @ 4400 RPM
151 C.I.D. 2-BBL. L4 AUTOMATIC TRANS. YR,YS X SERIES LOW ALTITUDE	14° @ 650 RPM	R44TSX .060	850(D)(1) 650(D)(2)	650(D)(1) 500(D)(2)	2400(N)	527200(1) 527202(2) 4NR	EFE,EGR,OC CVB-VDV,DS-VDV EFE/EGR-TVS DS-TVS,TAC,PCV,EEC	7044379	N.A.	720X2U FL(1) FM(2)	1103231	1973591	3.5"	12"	20°	0° @ 1200 RPM 20° @ 4400 RPM
151 C.I.D. 2-BBL. L4 MANUAL TRANS. WC,WD H SERIES LOW ALTITUDE	14° @ 1000 RPM	R44TSX .060	1200(N)(1) 1000(N)(2)	500(N)	2200(N)	527201(1) 527202(2) 4NR	EFE,EGR,OC CVB-VDV,DS-VDV EFE/EGR-TVS DS-TVS,TAC,PCV,EEC	7044378	N.A.	720X2U FN(1) FP(2)	1103230	1973590	3.5"	9"	20°	0° @ 1200 RPM 6° @ 1600 RPM 20° @ 4400 RPM
151 C.I.D. 2-BBL., A.T. ZJ,ZH H SERIES ZP, ZN HM SERIES CALIFORNIA	12° @ 650 RPM	R44TSX .060	850(D)(1) 650(D)(2)	650(D)(1) 500(D)(2)	2400(N)	527204(1) 527206(2) 4NR	EFE,BP-EGR,OC CVB-VDV,DS-VDV EFE/EGR-TVS,DS-TVS TAC,PCV,EEC,PAIR	7045137 ZJ,ZH ENG 7045165 ZP,ZN ENG	(3) (3)	720X2E FR(1) FS(2)	1103303	1973632	9 "	16"	20°	0° @ 1200 RPM 20° @ 4400 RPM
231 C.I.D. 2-BBL. V6 MANUAL TRANS. SA H SERIES SG A, F & X SERIES LOW ALTITUDE	12° @ 600 RPM	R46TS .040 R46TSX .060	800(N)	600(N)	N.A.	17057145	BP-EGR,EFE,PCV EEC,OC,EFE/EGR-TVS, EFE-CV,TAC	7044360 SA ENG 7044358 SG ENG	(3) (3)	740E2 BP,BH	1110677	1973605	4"	11"	24°	0° @ 1400 RPM 20° @ 3600 RPM
231 C.I.D. 2-BBL. V6 AUTOMATIC TRANS. SD, RE H SERIES SI,SJ,RG,RH A,F,B& X SERIES LOW ALTITUDE	12° @ 600 RPM	R46TS .040 R46TSX .060	670(D) B & X WITH A/C	600(D)	N.A.	17057148 (ALL) 17057182 17057146 (B & X 17057180 WITH A/C) 1NR	BP-EGR,EFE,PCV EEC,OC,EFE/EGR-TVS, EFE-CV-TAC	7044358 SD ENG 7044357 SI,SJ ENG	(3) (3)	740E2 BP, BH BS, BJ B & X WITH A/C	1110677	1973605	4"	11"	24°	0° @ 1400 RPM 20° @ 3600 RPM
231 C.I.D. 2-BBL. V6 MANUAL TRANS. SB H SERIES SU A, F, & X SERIES CALIFORNIA	12° @ 600 RPM	R46TS .040 R46TSX .060	800(N)	600(N)	N.A.	17057445 ENG. SU 17057447 ENG. SB 1NR	AIR,BP-EGR,EFE, PCV,EEC,TAC OC,EFE/EGR-TVS EFE-CV,TCS	7044479	(3)	740E2LU JC,BD	1110677	1973605	4"	11"	24°	0° @ 1400 RPM 20° @ 3600 RPM
231 C.I.D. 2-BBL. V6 AUTOMATIC SY H SERIES SK,SL A, F, B & X SERIES CALIFORNIA	12° @ 600 RPM	R46TS .040 R46TSX .060	670(D) B & X WITH A/C	600(D)	N.A.	17057448 (ALL) 17057446 (B & X WITH A/C) 1NR	AIR,BP-EGR,EFE, PCV,EEC,TAC, OC,EFE/EGR-TVS, EFE-CV	7044296 SY ENG 7044098 SK,SL ENG	(3) (3)	740E2LU JD, BA JC, BD B & X WITH A/C	1110686	1973606	7"	9"	8°	0° @ 1400 RPM 20° @ 3600 RPM
231 C.I.D. 2-BBL. V6 AUTOMATIC TRANS. SX H SERIES SM,SN A, F, B & X SERIES HIGH ALTITUDE	12° @ 600 RPM	R46TS .040 R46TSX .060	670(D) B & X WITH A/C	600(D)	N.A.	17057143 (ALL) 17057144 (B & X WITH A/C) 1NR	AIR,BP-EGR,EFE, PCV,EEC,TAC, OC,EFE/EGR-TVS EFE-CV	7045150 SX ENG 7044359 SM,SN ENG	(3) (3)	740E2LU JG, BE JE, JB B & X WITH A/C	1110677	1973605	4"	11"	24°	0° @ 1400 RPM 20° @ 3600 RPM
301 C.I.D. 2-BBL. AUTOMATIC TRANS. YW,YX B SERIES YH,YK A,F,X SERIES LOW ALTITUDE	12° @ 550 RPM	R46TSX .060	650(D) (1)	550(D)	1750(N)	17057172 2NR	EFE,BP-EGR,OC,TAC-TCV SVB-TVS,EFE-CV, EFE-TVS,TAC, (1)DS-VDV,(1)DS- TVS,(1)DS-VMV	7044177	(3)	720S2E FF (1) FH (2)	1103272	1982765	4 "	12"	25°	0° @ 825 RPM 10° @ 1800 RPM 21.5° @ 3430 RPM
301 C.I.D. 2-BBL. MANUAL TRANS. WB F, X SERIES LOW ALTITUDE	16° @ 750 RPM	R46TSX .060	850(N) (1)	750(N)	1750(N)	17057173 2NR	EFE,BP-EGR,OC SVB-TVS,EFE-TVS EFE-CV TAC TAC-TCV	7044372	(3)	720S2E FJ (1) FK (2)	1103273	1982765	4 "	12"	25°	0° @ 1000 RPM 17° @ 2600 RPM 19° @ 3600 RPM
305 C.I.D. 2-BBL. V8 AUTOMATIC TRANS. CPY F&X SERIES LOW ALTITUDE	8° @ 500 RPM	R45TS .045	650(D) (1)	500(D) N.A.	N.A.	17057110(1) 17057190(1) 17057108(2) 17057188(2) INDEX	EGR, OC, EFE EGR-TVS, EFE-CU, EFE-TVS EEC, PCV	17053034	N.A.	710Y2 AU	1103239	1973508	3.5"	9"	15°	0° @ 1200 RPM 15° @ 2700 RPM 20° @ 4200 RPM
305 C.I.D. 2-BBL. V8 AUTOMATIC TRANS. CEB F AND X SERIES	4° @ 500	R45TS .045	650(D) (1)	500(D) N.A.	N.A.	17057190(1) 17057188(2)	EGR, OC, EFE EGR-TVS, EFE-CU EFE-TVS, EEC, PCV	17053034	N.A.	710Y2 DM	1103244	1973602	4.5"	10"	20°	0° @ 1000 RPM 10° @ 1700 RPM 20° @ 3800 RPM
305 C.I.D. 2-BBL. V8 AUTOMATIC TRANS. CPR B SERIES	8° @ 500	R45TS .045	650 (D)	500(D)	N.A.	17057110(2) 17057190(2)	EGR, OC, EFE EGR-TVS, EFE-CU EFE-TVS, EEC, PCV	17053034	N.A.	710Y2 AU	1103239	1973508	3.5"	9"	15°	0° @ 1200 RPM 15° @ 2700 RPM 20° @ 4200 RPM
305 C.I.D. 2-BBL. V8 AUTOMATIC TRANS. CED B SERIES	4° @ 500	R45TS .045	650(D)	500(D)	N.A.	17057190(2)	EGR, OC, EFE EGR-TVS, EFE-CU EFE-TVS, EEC, PCV	17053034	N.A.	710Y2 DM	1103244	1973602	4.5"	10"	20°	0° @ 1000 RPM 10° @ 1700 RPM 20° @ 3800 RPM

ENGINE AND CODE	IGNITION TIMING BTDC DEGREES	SPARK PLUG TYPE & GAP	SOLENIOD SCREW (RPM)	SLOW IDLE CARBURETOR (RPM)	FAST IDLE (RPM)	CARBURETOR IDENTIFICATION	EMISSION CONTROL DEVICES	EGR VALVE MODEL	BACK PRESSURE TRANSDUCER	ENGINE FAMILY & EMISSION INFO. LABEL CODE	DISTRIBUTOR		VACUUM ADVANCE CRANKSHAFT DEGREES			MECHANICAL ADVANCE CRANKSHAFT DEGREES
											DIST. MODEL	VACUUM MODEL	START @ IN HG	FULL IN @ IN HG	MAXIMUM ADVANCE	
350 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. YA,YB A & G SERIES XB,XC B SERIES LOW ALTITUDE	16° @ 575 RPM	R45TSX .060	650(D) (1)	575(D)	1800(N)	17057262 1NR	EFE,EGR,OC SVB-TVS,EGR-TVS, DS-VDV,EFE-CV, EFE/DS-TVS,TAC, PCV,EEC,BPT	7048194	549426	720K4EH FD	1103276	1973607	5"	10"	20°	0° @ 800 RPM 4° @ 1000 RPM
350 C.I.D. 4-BBL. VB AUTOMATIC TRANS. Y9 F SERIES LOW ALTITUOE	16° @ 575 RPM	R45TSX .060	650(D) (1)	575(D)	1800(N)	17057262 1NR	EFE,EGR,OC SVB-TVS,EGR-TVS, DS-VDV,EFE,CV, EFE/DS,TVS, TAC,PCV,EEC,BPT	7047291	10000029	720K4EH FD	1103257	1973607	5"	10"	20°	0° @ 1200 RPM 4° @ 1400 RPM 17° @ 3600 RPM
350 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. QP,QQ B SERIES LOW ALTITUDE	20° @ 1100 RPM	R46SZ .060	650(D) (1)	550(D)	900(N)	17057255(2) 17057256(1) 2NR	BP-EGR,OC,SVB-TVS DS-TVS,DS-VRV, EGR-TVS,EEC,TAC PCV	7045315	(3)	730M4U OD, OF	1103259	1973597	6"	13"	24°	0° @ 1000 RPM 19° @ 4000 RPM
350 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. TN,TO A-WAG TK,TL A,G & B SERIES CALIFORNIA	20° @ 1100RPM	R46SZ .060	650(D) (1)	550(D)	1000(N)	17057550(2) 17057553(1) 2NR	BP-EGR,OC,SVB-TVS OS-TVS,EGR/DS-TVS EGR-TVS,AIR EEC,TAC,PCV	7044402 TK, TL ENG 7045061 TN, TO ENG	(3) (3) (3)	730M4AU OR,OS	1103266	1973603	5"	11"	16°	0° @ 1000 RPM 19° @ 4000 RPM
350 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. TS, TT F SERIES TX, TY X SERIES CALIFORNIA	18° @ 1100 RPM	R46SZ .060	650(D) (1)	550(D)	1000(N)	17057550(2) 17057553(1)	BP-EGR, OC, SVB-TVS, DS-TVS EGR/DS-TVS EGR-TVS,AIR EEC, TAC, PCV	7045060	(3)	730M4AU OZ	1103266	1973603	5"	11"	16°	0° @ 1000 RPM 19° @ 4000 RPM
350 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. CKR X SERIES CALIFORNIA	8° @ 500 RPM	R45TS .045	650(D) (1)	500(D)	1600(N)	17057504(1) 17057502(2) 2NL	AIR, BP-EGR, OC, EFE, EGR-TVS EFE-CV, EFE-TVS EEC, PCV	7044305	(3)	710J4S AZ	1103248	1973577	3.5"	7"	10°	0° @ 1200 RPM 15° @ 2700 RPM 20° @ 4200 RPM
350 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. CKM X SERIES HIGH ALTITUDE	8° @ 600 RPM	R45TS .045	650(D) (1)	600(D)	1600(N)	17057584(1) 17057582(2) 2NL	AIR,BP-EGR,OC, EFE, EGR-TVS EFE-CV, EFE-TVS EEC, PCV	7044307	(3)	710J4S CB	1103246	1973517	3.5"	11"	18°	0° @ 1200 RPM 12° @ 2000 RPM 22° @ 4200 RPM
350 C.I.D. 4-BBL. V8 AUTO. TRANS., Q2,Q3 A,B & G SERIES, Q6,Q7 B SERIES, Q8,Q9 X SERIES, Q4,Q5 F & X SERIES HIGH ALTITUDE	20° @ 1100 RPM	R46SZ .060	700(D) (1)	600(D)	1000(N)	17057258 2NR	BP-EGR,OC,SVB-TVS EGR/DS-TVS,EGR-TVS, EEC,TAC,PCV	7044396	(3)	730M4U OH, OJ	1103259	1973597	6"	13"	24°	0° @ 1000 RPM 19° @ 4000 RPM
400 C.I.D. 4-BBL. V8 MANUAL TRANS. WA F SERIES LOW ALTITUDE	18° @ 775 RPM	R45TSX .060	N.A.	775(N)	1800(N)	17057263 1NR	EFE,EGR,OC SVB-TVS,EGR-TVS DS-TVS,EFE-CV EFE/EGR-TVS TAC,PCV,EEC,BPT	7048194	549426	720K4EH FC	1103271	1973514	5"	11"	25°	0° @ 1000 RPM 8° @ 1400 RPM 20° @ 4400 RPM
400 C.I.D. 4-BBL. V8 AUTO. TRANS., XH,XJ,XO, XF B SERIES, YU,Y4 A & G SERIES, XA F SERIES LOW ALTITUDE	16° @ 575 RPM	R45TSX .060	650(D) (1)	575(D)	1800(N)	17057274 1NR	EFE,EGR,OC SVB-TVS,EGR-TVS DS-TVS,EFE-CV EFE/EGR-TVS TAC,PCV,EEC,BPT	7048194 XA, Y4 ENG 7045159 YU	10000029 XA ENG 549426 YU, Y4	720K4EH FA	1103269	1973607	5"	10"	20°	0° @ 1000 RPM 9° @ 2000 RPM 17° @ 4600 RPM
400 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. Y6 F SERIES LOW ALTITUOE	18° @ 600 RPM	R45TSX .060	700(D) (1)	600(D)	1800(N)	17057266 1NR	EFE,EGR,OC SVB-TVS,EGR-TVS DS-TVS,EFE-CV EFE/EGR-TVS TAC,PCV,EEC,BPT	7048194	10000029	720K4EH FB	1103271	1973514	5"	11"	25°	0° @ 1000 RPM 8° @ 1400 RPM 20° @ 4400 RPM
400 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. Y7 A-WAG, XK B SERIES LOW ALTITUDE	16° @ 575 RPM	R45TSX .060	650(D) (1)	575(D)	1800(N)	17057274 1NR	BP-EFE,EGR,OC SVB-TVS,EGR-TVS DS-TVS,EFE-CV EFE/EGR-TVS TAC,PCV,EEC,BPT	7048194	549425	720K4EH FA	1103278	1973607	5"	10"	20°	0° @ 1200 RPM 4° @ 1400 RPM 16° @ 4400 RPM
403 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. UA,UB B SERIES LOW ALTITUDE	22° @ 1100 RPM	R46SZ .060	650(D) (1)	550(D)	900(N)	17057255(2) 17057256(1) 2NR	BP-EGR,OC,SVB-TVS DS-TVS,DS-VRV EGR-TVS,EEC TAC,PCV	7044395	(3)	730M4U 730P4UY OK	1103260	1973597	6"	13"	24°	0° @ 1000 RPM 13° @ 3600 RPM
403 C.I.D. 4-BBL. V8 AUTOMATIC TRANS. VA,VB A,B,F & G SERIES VJ,VK A-WAG & B-WAG CALIFORNIA	20° @ 1100 RPM	R46SZ .060	650(D) (1)	550(D)	1000(N)	17057550(2) 17057553(1) 2NR	BP-EGR,OC,SVB-TVS OS-TVS,EGR/DS-TVS EGR-TVS,AIR EEC,TAC,PCV	7044097 VA,VB ENG 7044403 VJ, VK ENG	(3) (3)	730M4AU OT	1103264	1973603	5"	11"	16°	0° @ 1000 RPM 13° @ 3600 RPM
403 C.I.D. 4-BBL. V-8 AUTOMATIC TRANS. U2,U3 A,F,G & B SERIES HIGH ALTITUDE	20° @ 1100 RPM	R46SZ .060	650(D) (1)	600(D)	1000(N)	17057258 2NR	BP-EGR,OC,SVB-TVS EGR/DS-TVS,EGR TVS,EEC,TAC PCV	7044401 ALL EXC. A-WAG 7044398 A-WAG	(3) (3)	730M4U 730P4UY OL	1103260	1973597	6"	13"	24°	0° @ 1000 RPM 13° @ 3600 RPM

AIR = Air Injection Reaction
BP-EGR = Back Pressure Exhaust Gas Recirculation
BPT = Back Pressure Transducer
CVB-VDV = Choke Vacuum Break Vacuum Delay Valve
DS-TVS = Distributor Spark Thermal Vacuum Switch
DS-VDV = Distributor Spark Vacuum Delay Valve
DS-VMV = Distributor Spark Vacuum Modulator Valve
DS-VRV = Oistributor Spark Vacuum Reducer Valve
EEC = Evaporative Emission Control
EFE = Early Fuel Evaporation
EFE-CV = Early Fuel Evaporation Check Valve
EFE/DS-TVS = Secondary Vacuum Break/Distributor Spark Thermal Vacuum Switch
EGR/DS-TVS = Exhaust Gas Recirculation/Distributor Spark Thermal Vacuum Switch
EGR/EFE-TVS = Exhaust Gas Recirculation/Early Fuel Evaporation Thermal Vacuum Switch
EGR-TVS = Exhaust Gas Recirculation Thermal Vacuum Switch
OC = Oxidizing Catalyst
PAIR = Pulse Air Injection Reaction
PCV = Positive Crankcase Ventilation
SVB/DS-TVS = Secondary Vacuum Break/Distributor Spark Thermal Vacuum Switch
SVB-TVS = Thermal Vacuum Break Thermal Vacuum Switch
TAC = Thermostatic Air Cleaner
TAC-TCV = Thermostatic Air Cleaner Thermal Check Valve
TCS = Transmission Controlled Spark

(1) WITH AIR CONDITIONING
(2) WITHOUT AIR CONDITIONING
(3) INTEGRAL BACK PRESSURE EGR VALVE

SECTION 6F

EXHAUST SYSTEM

CAUTION: *Exhaust system components should have enough clearance from the underbody to avoid overheating and possible damage to the passenger compartment carpets. Minimum clearances are:*

B Series Pipes and Converter	26MM (1")
B Series Muffler	15MM (5/8")
A, F, X, H & G Series	5/8"

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

When inspecting or replacing exhaust system components make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor pan and possible damage to the passenger compartment insulation and trim materials.

Check complete exhaust system and nearby body areas and trunk lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the trunk or passenger compartment. Dust or water in the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately. To help insure continued integrity, the exhaust system pipe rearward of the muffler must be replaced whenever a new muffler is installed.

EXHAUST PIPE

The exhaust manifold to crossover pipe connections are of the ball type, thus eliminating the need for gaskets.

MUFFLER

All mufflers are a tri-flow design. Some muffler installations have a slot in the inlet and/or outlet pipe which indexes to a key (tab) welded on the exhaust and/or tail pipe to help maintain alignment.

RESONATOR

A resonator is used on some series exhaust systems. It allows the use of mufflers with less back pressure and provides for optimum tuning characteristics of the exhaust system.

HANGER

Two types of hangers are used to support the exhaust system. One type is a conventional rubber strap and the second type is a "rubber block". The rubber block type provides a rigid hanger along with a feature that continues to support the exhaust system in the event a rubber insulator block is broken.

The installation of exhaust system supports is very important as improperly installed supports can cause annoying vibrations which are difficult to diagnose.

CLAMP

Two methods are used for connecting exhaust system slip joints, (1) clamp and (2) weld. When servicing a welded connection it should be cut and the new connection clamped when installing replacement parts. Also, coat slip joints with exhaust system sealer before assembling (Fig. 6F-1).

CATALYTIC CONVERTER

The catalytic converter is an emission control device added to the exhaust system to reduce hydrocarbon and carbon monoxide pollutants from the exhaust gas stream. The converter contains beads which are coated with a catalytic material containing platinum and palladium.

THE CATALYTIC CONVERTER REQUIRES THE USE OF UNLEADED FUEL ONLY.

Periodic maintenance of the exhaust system is not required; however, if the car is raised for other service, it is advisable to check the general condition of the catalytic

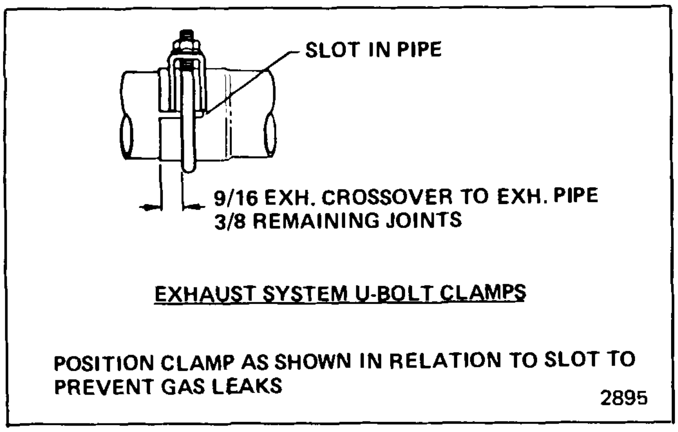


Fig. 6F-1 Installation of Exhaust System Clamp

converter, pipes and mufflers.

ON-CAR SERVICE

CATALYST

Removal

If necessary, the catalyst in the converter can be replaced on the car with Tool No. J-25077.

NOTE: Separate hoses should be attached to the aspirator and the vibrator with maximum available pressure. Minimum of 60 psi in each hose.

If the car has dual tailpipes, attach the aspirator to one pipe and place a plug in the other pipe.

1. Install aspirator, Fig. 6F-2.

Fig. 6F-2 Installation of Aspirator

2. Connect air supply line to aspirator to create a vacuum in the converter to hold beads in place when fill plug is removed.

3. Remove converter fill plug as follows:

a. Threaded plug - Remove with 3/4" hex wrench or Tool No. J-25077-3 (Fig. 6F-3).

Fig. 6F-3 Threaded Fill Plug Removal

b. Pressed plug - Drive a small chisel between the converter shell and the fill plug. Use care not to damage converter shell (Fig. 6F-4). Continue to deform fill plug until it can be removed with pliers (Fig. 6F-5).

Fig. 6F-4 Chisel Pressed Plug

NOTE: Do not pry fill plug from converter as damage to fill plug sealing surfaces could result.

4. Clamp on vibrator and catalyst container (Fig. 6F-6). Use adapter J-25077-6 if converter was built with pressed plug.

5. Disconnect air supply to aspirator and connect air supply to vibrator. Catalyst will now drain from the converter into the empty container.

6. When all the catalyst has been removed from the converter, disconnect air supply to vibrator and remove container from the converter.

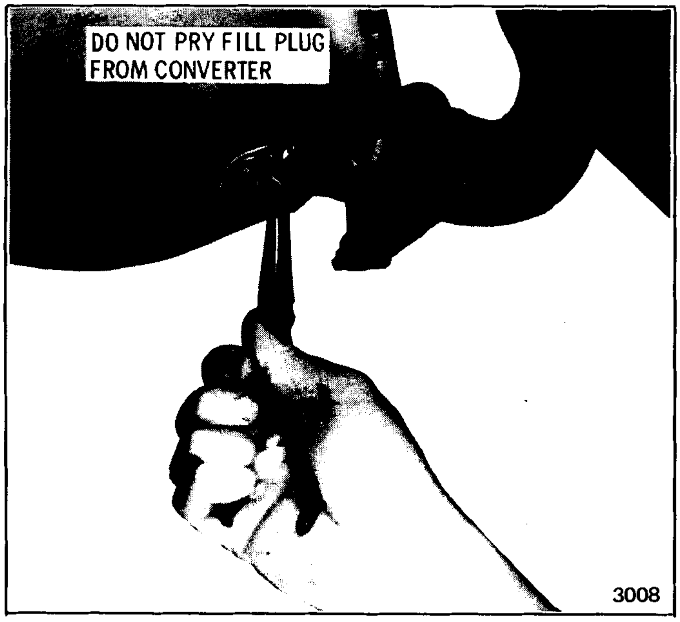


Fig. 6F-5 Deform & Remove Pressed Plug

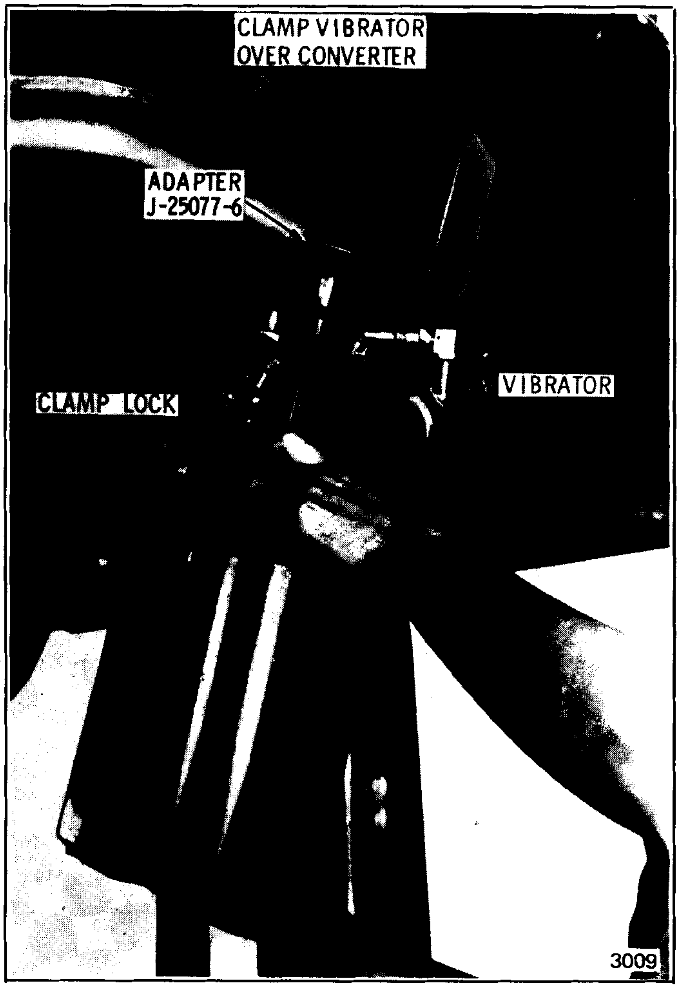


Fig. 6F-6 Vibrator and Catalyst Container

7. Discard used catalyst.

Replacement

1. Fill container with approved replacement catalyst.

2. Install fill tube extension to the fixture (Fig. 6F-7). Use adapter J-25077-6 if converter was built with pressed plug.

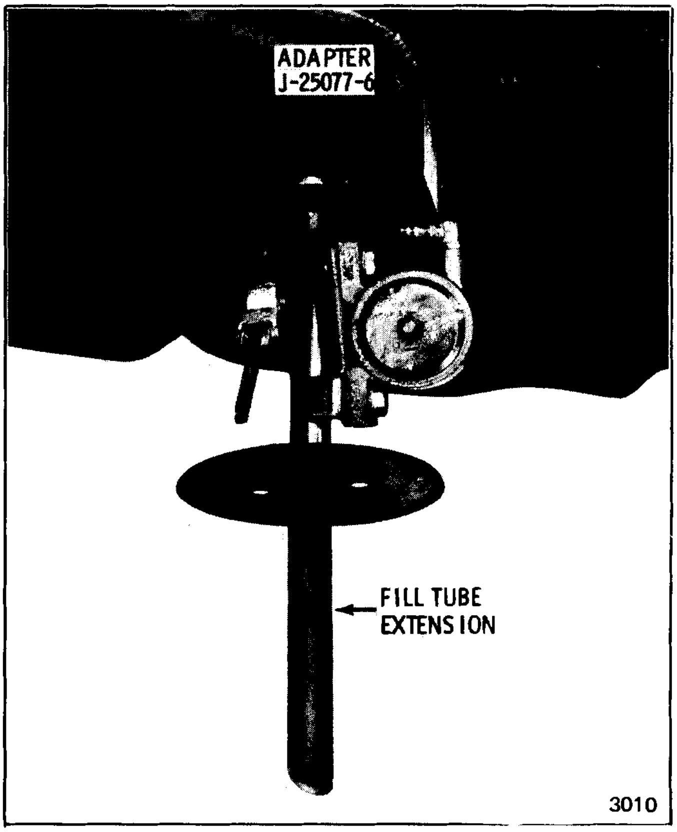


Fig. 6F-7 Fill Tube Extension

3. Connect air supply to aspirator and vibrator.

4. Attach catalyst container to the fixture (Fig. 6F-8).

5. After the catalyst stops flowing, disconnect air supply to the vibrator.

6. Remove vibrator and check that catalyst has filled converter flush with fill plug hole. Add catalyst if required.

7. Apply an anti-seize compound to the threaded fill plug; install and tighten to 60 ft. lbs.

If built with a pressed plug, install service fill plug (Fig. 6F-9) as follows: Install the bolt into the bridge and position the bridge into the converter opening. Move bolt and bridge back and forth to dislodge catalyst beads until bridge is positioned as shown in Fig. 6F-10.

8. Remove bolt from bridge then position the washer and fill plug, dished side out, over the bolt.

9. While holding the fill plug and washer against the bolt head (Fig. 6F-11), thread the bolt 4 or 5 turns into the bridge. Release the fill plug and the aspirator will pull the fill plug into position.

NOTE: If fill plug is allowed to seat against the converter before installing bolt, the threaded hole in the bridge will fill with beads and it will be very difficult to start the bolt.

10. After making sure fill plug is correctly seated tighten the bolt and torque to 28 ft. lbs. (Fig. 6F-12).

11. Disconnect air supply to aspirator and remove.

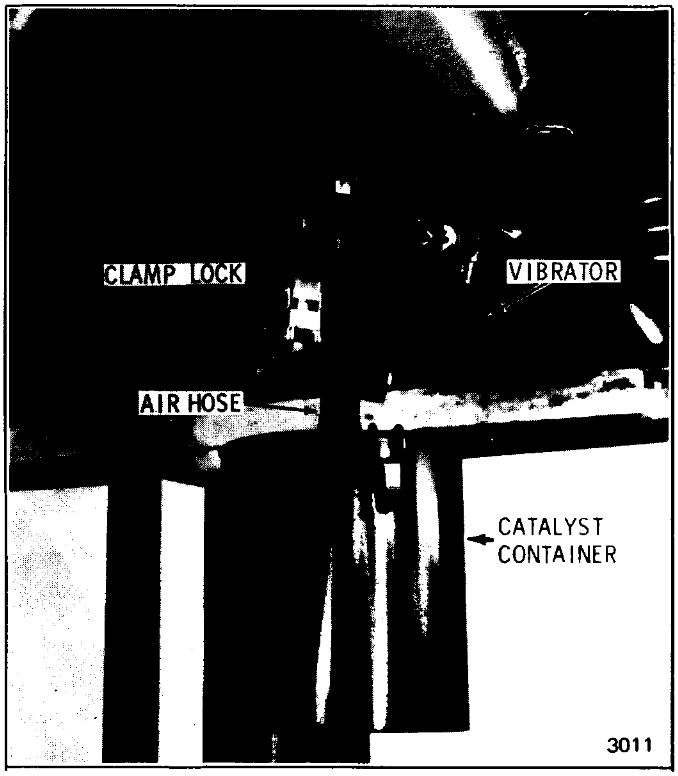


Fig. 6F-8 Catalyst Container

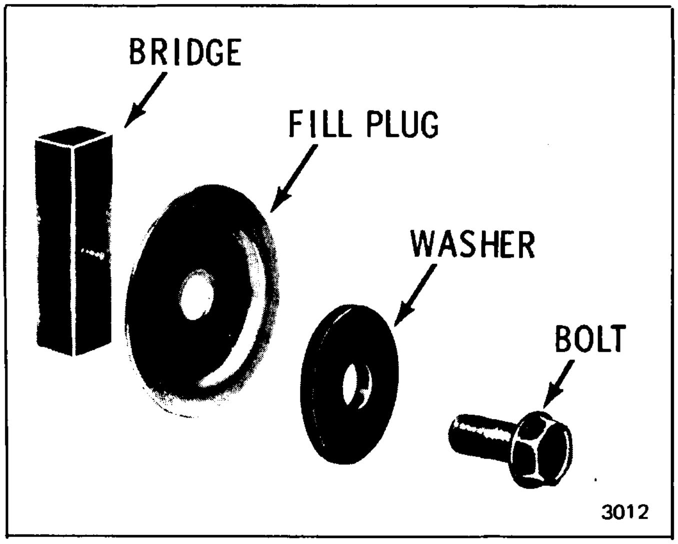


Fig. 6F-9 Service Fill Plug

12. Start car and check for leaks.

BOTTOM COVER

If, for any reason, the bottom cover of the converter is torn or damaged, it can be replaced with a repair kit.

Replacement

1. Remove bottom cover by cutting close to the bottom outside edge (Fig. 6F-13). Do not remove the fill plug. The depth of the cut must be very shallow to prevent damage to the inner shell of the converter.

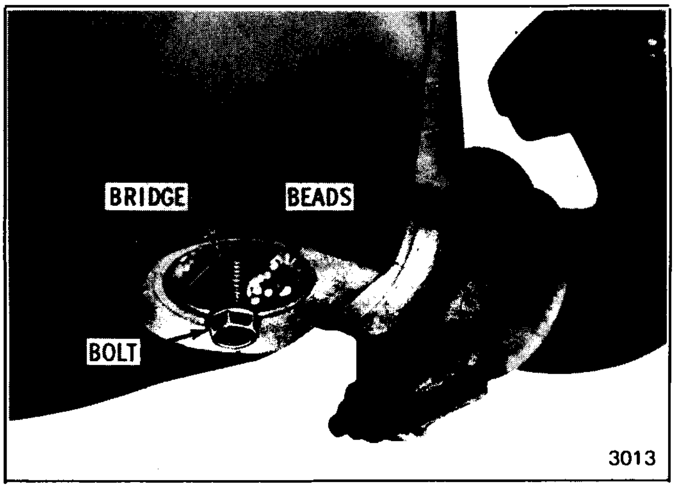


Fig. 6F-10 Bridge Positioning

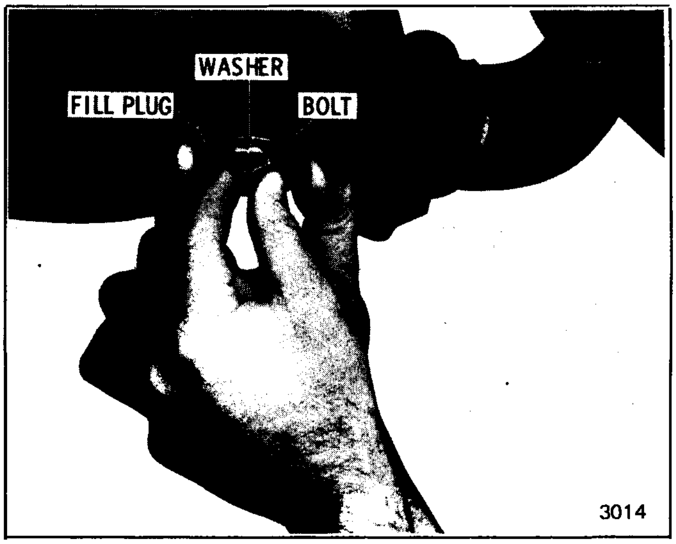


Fig. 6F-11 Service Fill Plug Installation

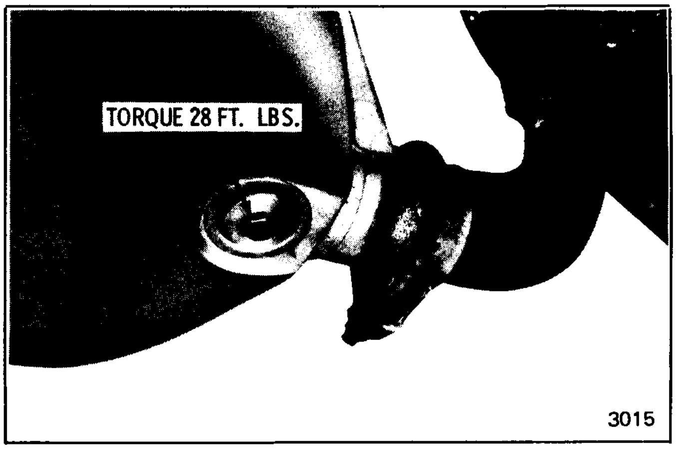


Fig. 6F-12 Torque Fill Plug

2. Remove insulation.

3. Inspect inner shell of the converter for damage. If there is damage in the inner shell, the converter assembly must be replaced.

4. Place new insulation in the replacement cover. Apply sealing compound, 8998245 or equivalent, all around the

Fig. 6F-13 Bottom Cover Removal

cover after the insulation is in position. Apply extra sealer at the front and rear opening for the pipes (Fig. 6F-14).

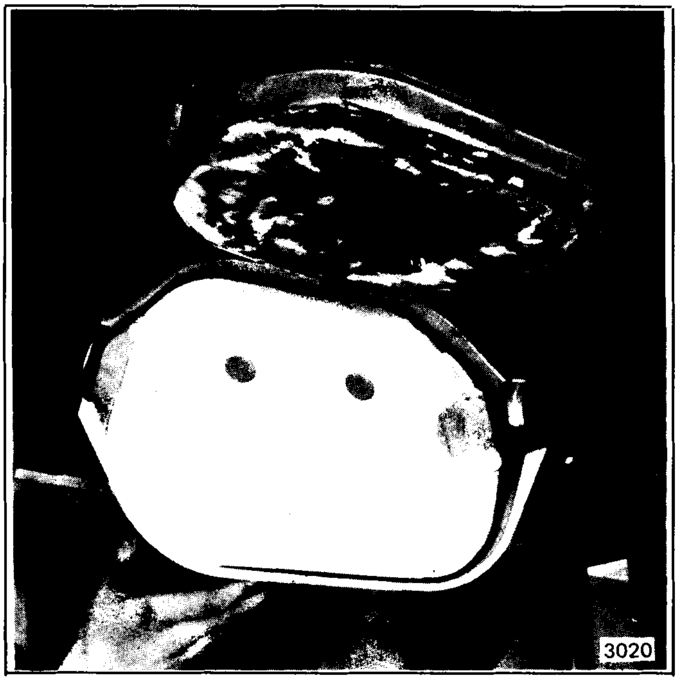


Fig. 6F-14 Bottom Cover Replacement

5. Install replacement cover on converter.
6. Install cover retaining channels on both sides of the converter (Fig. 6F-15).
7. Attach 2 clamps over retaining channels at each end of the converter (Fig. 6F-16).

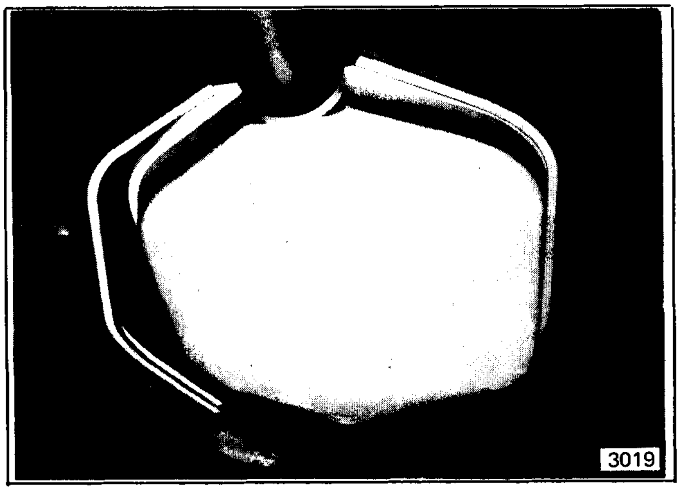


Fig. 6F-15 Retaining Channel Installation

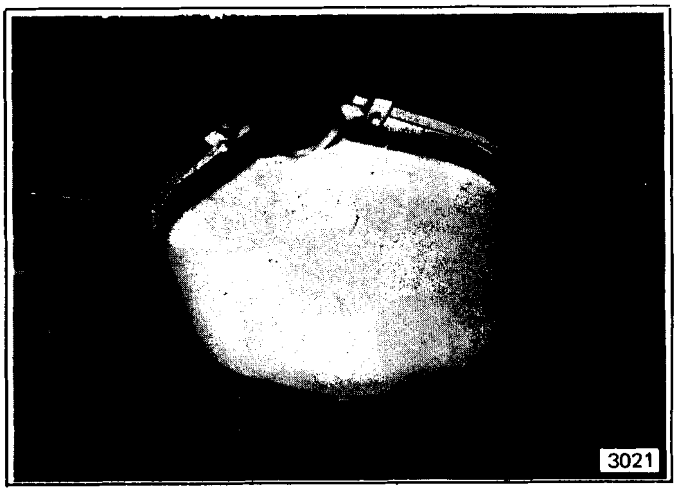


Fig. 6F-16 Replacement Bottom Cover Installed

SECTION 7A1

TURBO HYDRA-MATIC (200)

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The Turbo Hydra-Matic 200 transmission is a fully automatic unit consisting primarily of 3-element hydraulic torque converter and a compound planetary gear set. Three multiple-disc clutches, a roller clutch and a band provide the friction elements required to obtain the desired function of the compound planetary gear set.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The compound planetary gear set produces three forward speeds and reverse.

The 3-element torque converter consists of a pump or driving member, a turbine or driven member and a stator assembly. The stator is mounted on a one-way roller clutch which will allow the stator to turn clockwise but not counterclockwise.

The torque converter housing is filled with oil and is attached to the engine crankshaft by a flex plate and always rotates at engine speed. The converter pump is an integral part of the converter housing, therefore the pump blades, rotating at engine speed, set the oil within the converter into motion and direct it to the turbine, causing the turbine to rotate.

As the oil passes through the turbine, it is traveling in such a direction that if it were not re-directed by the stator it would hit the rear of the converter pump blades and impede its pumping action. So, at low turbine speeds, the oil is re-directed by the stator to the converter pump in such a manner that it actually assists the converter pump to deliver power or multiply engine torque.

As turbine speed increases, the direction of the oil leaving the turbine changes and flows against the rear side of the stator vanes in a clockwise direction. Since the stator is now impeding the smooth flow of oil, its roller clutch releases and it revolves freely on its shaft. Once the stator becomes inactive, there is no further multiplication of engine torque within the converter. At this point, the converter is merely acting as a fluid coupling as both the converter pump and turbine are being driven at approximately the same speed, or at one-to-one ratio.

A hydraulic system pressurized by a gear type pump provides the working pressure required to operate the friction elements and automatic controls.

The selector quadrant has six selector positions: P, R, N, D, L2(S) and L1(L).

P-PARK position positively locks the output shaft to the transmission case by means of a locking pawl to prevent the vehicle from rolling in either direction. The engine may be started in Park position.

R-REVERSE enables the car to be operated in a reverse direction.

N-NEUTRAL position enables the engine to be started and run without driving the vehicle.

D-DRIVE range is used for all normal driving conditions and maximum economy. Drive range has three gear ratios, from the starting ratio to direct drive. Detent downshifts are available by depressing the accelerator to the floor.

S-SUPER (or L2) range has the same starting ratio as Drive Range, but prevents the transmission from shifting above second gear, thus retaining second gear for acceleration or engine braking as desired. L2 or S Range can be selected at any car speed, and the transmission will shift to second gear and remain in second until the car speed or the throttle are changed to obtain first gear operation in the same manner as in D Range.

L-LOW (or L1) range can be selected at any car speed, and the transmission will shift to second gear and remain in second until the car is reduced to approximately 48 km/h (30 MPH) at which time the transmission will shift to first gear.

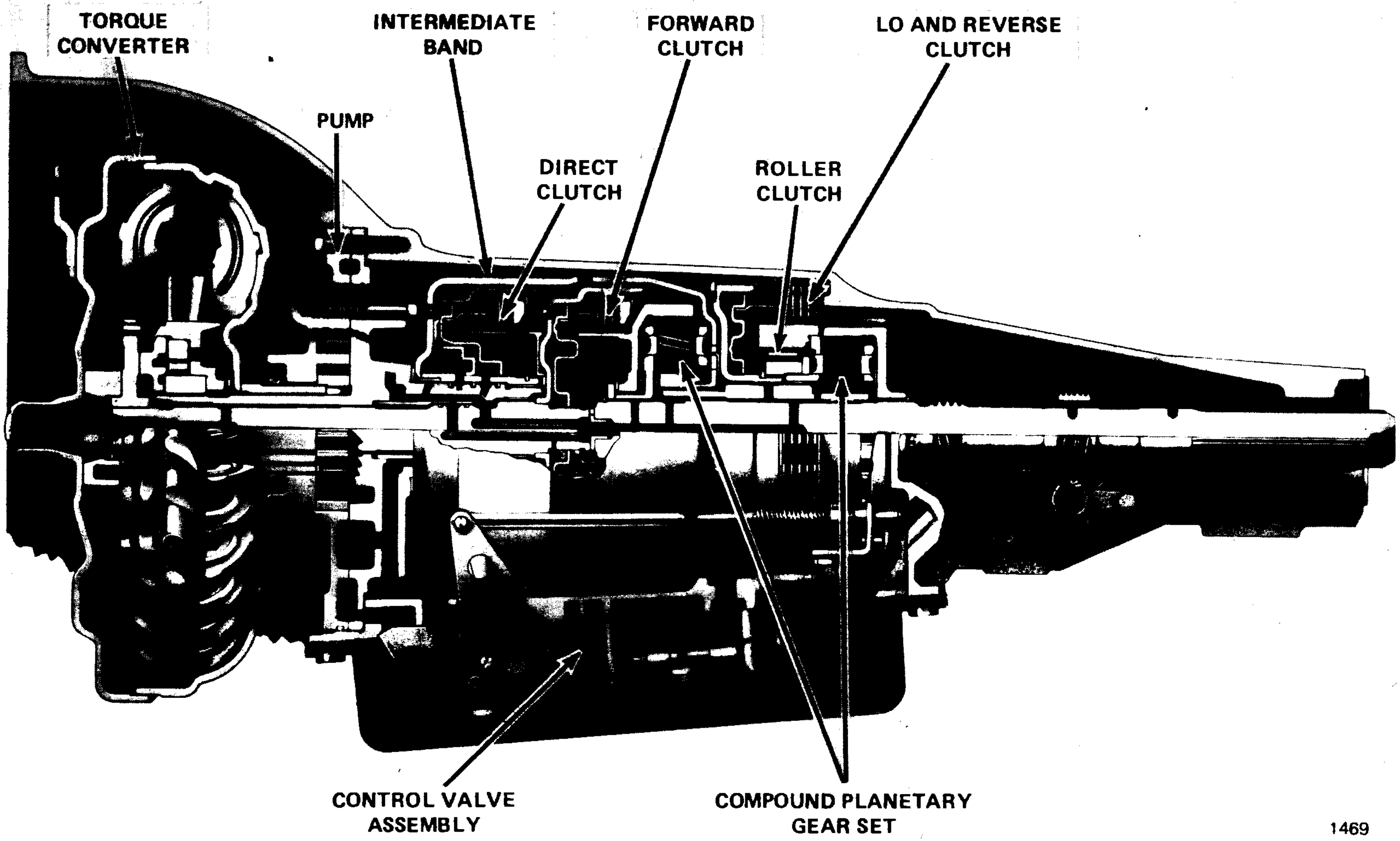


Fig. 7A1-1 Cut-Away View - THM 200 Transmission

DIAGNOSIS, MAINTENANCE AND ADJUSTMENTS

Approximately 2.8 litres (3 quarts) of fluid are required to refill transmission after the oil pan has been drained. The fluid capacity of the Turbo Hydra-Matic 200 transmission and converter assembly is approximately 6.2 litres (6.5 quarts) but correct level is determined by mark on the dipstick rather than by amount added. Use only DEXRON®-II D-number automatic transmission fluid or its equivalent.

NOTE: If the oil changes to a darker color at an early stage, from the usual red color and/or to a strong odor, this is normal even though it is usually associated with overheated transmission fluid. It is not a positive sign of required maintenance or transmission failure.

SEQUENCE FOR DIAGNOSIS

1. Check and correct oil level.
2. Check and adjust T.V. cable.
3. Check and correct manual linkage.
4. Install oil pressure gage.
5. Road test car.

a. Road test using all selective ranges noting when differences in operation or oil pressure occur.

b. Attempt to isolate the unit or circuit involved in the malfunction.

c. If engine performance indicates an engine tune up is required, this should be performed before road testing is completed or transmission correction attempted. Poor engine performance can result in rough shifting or other malfunctions.

MAINTENANCE

The fluid level should be checked at each oil change (see below). When adding or changing fluid, use DEXRON®-II D-number or equivalent automatic transmission fluid. Under normal driving conditions, change transmission fluid every 60,000 miles.

CHECKING AND ADDING FLUID

Transmission at Operating Temperature (Fig. 7A1-2)

The automatic transmission is designed to operate at the "FULL HOT" mark on the dip stick at normal operating temperature of 88° to 93°C. (190° to 200°F.) and should be checked under these conditions. The normal operating temperature is obtained only after at least 15 miles of highway type driving or the equivalent of city driving.

To determine proper level, preceed as follows:

1. Apply parking brake and block car wheels.

2. With the selector lever in the PARK position, start engine. DO NOT RACE ENGINE. Move selector lever through each range.

3. Immediately check fluid with the selector lever in PARK, engine running at SLOW IDLE and the car on a LEVEL surface. The fluid level on the dip stick should be at the "FULL HOT" mark.

4. If additional fluid is required, add sufficient fluid to bring to the "FULL HOT" mark on the dipstick.

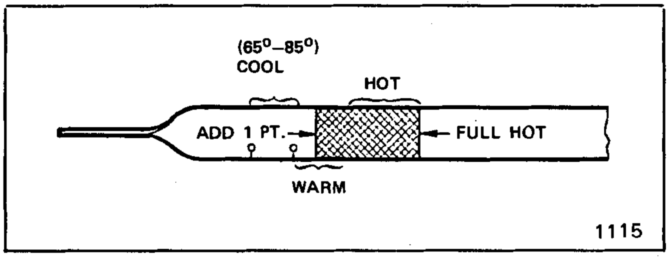


Fig. 7A1-2 Transmission Dipstick

Transmission at Room Temperature (Fig. 7A1-2)

Automatic transmissions are frequently overfilled because the fluid level is checked when the fluid is cold and the dipstick indicates fluid should be added. However, the low reading is normal since the level will rise as the fluid temperature increases. A level change of over 19 mm (3/4") will occur as fluid temperature rises from 16° to 82°C. (60° to 180°F.).

Overfilling can cause foaming and loss of fluid through the vent. Slippage and transmission failure can result.

Fluid level too low can cause slipping, particularly, when the transmission is cold or the car is on a hill.

Check the transmission fluid level with the engine running, the shift lever in park, and the car level.

NOTE: If the car has recently been operated for an extended period of high speed or in city traffic in hot weather or the car is being used to pull a trailer, an accurate fluid level cannot be determined until the fluid has cooled down-usually about 30 minutes after the car has been parked.)

Remove the dipstick and touch the transmission end of the dipstick cautiously to find out if the fluid is cool, warm or hot.

Wipe it clean and re-insert until cap seats. Remove dipstick and note reading:

1. If the fluid feels cool, about room temperature 18° to 29°C. (65° to 85°F.), the level should be between the two dimples below the "ADD" mark.

2. If it feels warm the level should be close to the "ADD" mark (either above or below).

3. If it feels hot (cannot be held comfortably) the level should be between the "ADD" and "FULL" marks.

FLUID DRAIN INTERVALS

The transmission operating temperature resulting from the type of driving conditions under which the car is used is the main consideration in establishing the proper frequency of transmission fluid changes.

Change the transmission fluid and service screen every 15,000 miles if the car is usually driven under one or more of the following conditions which are considered severe transmission service:

1. In heavy city traffic.

2. When the outside temperature regularly reaches 32° C. (90°F.).

3. In very hilly or mountainous areas.

4. Frequent trailer pulling.

5. Commercial use, such as taxi, police car, or delivery service.

If you do not use your car under any of these conditions, change the fluid and service screen every 60,000 miles.

NOTE: DO NOT OVERFILL. It takes only one pint to raise level from "ADD" to "FULL" with a hot transmission.)

CHECKING AND ADDING FLUID

(After Transmission Service)

If work has been performed on the transmission, add the following quantity of fluid, then check fluid as outlined above and below.

CHANGING FLUID

Pan Removal	2.8 litres (3 qts.)
Unit Repair	4.2 litres (4.5 qts.)

1. Raise car.

2. With drain pan placed under transmission oil pan, remove oil pan attaching bolts from front and side of pan.

3. Loosen rear pan attaching bolts approximately four (4) turns.

4. Carefully pry transmission oil pan loose with screwdriver, allowing fluid to drain.

5. Remove remaining bolts and remove oil pan and gasket. Discard gasket.

6. Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.

7. Remove two (2) screen-too-valve body bolts, screen and gasket. Discard gasket.

8. Thoroughly clean screen assembly in solvent and dry thoroughly with clean compressed air.

9. Install new gasket on screen and two (2) bolts. Tighten bolt to 13 to 17 N·m (9 to 12 ft. lbs.)

10. Install new gasket on oil pan and install oil pan. Tighten attaching bolt and washer assemblies to 14.0-18.0 N·m (10-13 ft. lbs.).

11. Lower car, add approximately 2.8 litres (3 quarts) of DEXRON® IID-number automatic transmission fluid or its equivalent through filler tube.

12. With selector lever in PARK position, apply hand brake, start engine and let idle (carburetor off fast idle stip). DO NOT RACE ENGINE.

13. Measure selector lever through each range and, with selector lever in PARK range, check fluid level.

14. Add additional fluid to bring level between the dimples on the dipstick.

ADDING FLUID TO FILL DRY TRANSMISSION AND CONVERTER

In cases of transmission overhaul, when a complete fill is required, including converter, proceed as follows:

1. Add 4.2 litres (4.5 quarts) of transmission fluid through filler tube.

2. With manual control lever in park (P) position, start engine and place on cold idle cam. DO NOT RACE ENGINE. Move manual control lever through each range.

3. Immediately check fluid level with selector lever in park (P), engine running and vehicle on LEVEL surface and add additional fluid to bring level to a point between the two dimples on the dipstick. Do not overfill.

FLUID LEVEL AND CAPACITY

The transmission dipstick is located in a filler tube at right rear of the engine. To bring fluid level from ADD mark to FULL mark requires one pint of fluid. Fluid level should be checked at every engine oil change.

Fluid level should be to FULL mark with transmission fluid at normal operating temperature 93° C. (200°F.). With warm fluid room temperature 21°C. (70°F.) level will be between 1 the two dimples on the dipstick. The normal operating temperature is obtained only after at least 15 miles of highway type driving or equivalent of city driving.

DIAGNOSIS

OIL LEAKS

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

When an oil leak is found the following procedure will assist in locating the leak.

1. Clean the area with solvent to remove all traces of oil.

2. Remove the flywheel lower cover, if leak is suspected at rear of engine or front of the transmission.

3. Spray suspected leak areas with a pressurized foot powder.

4. Start engine and run at high idle.

5. Repair any leaks which are detected and recheck as necessary. Reinstall previously removed parts.

The use of a "black light" to identify the oil at the source of the leak is also helpful. Comparing the oil from the leak to that on the engine or transmission dipstick (when viewed by black light) will determine the source of the leak.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission "oil filler tube to case leak" will sometimes appear as a leak at the rear of the transmission. In determining the source of an oil leak, it is most helpful to keep the engine running.

A "black light" testing unit such as J 6640 may be obtained from service tool suppliers.

6. Degrease underside of transmission.

7. Road test to get unit at operating temperature 82°C. (180°F.).

8. Inspect for leak with engine running.

9. With engine off, check for oil leaks due to the raised oil level caused by drain back.

POSSIBLE POINTS OF OIL LEAK

1. Transmission Oil Pan Leak:

a. Attaching bolts not correctly torqued.

b. Improperly installed or damaged pan gasket.

c. Oil pan gasket mounting face not flat.

2. Case Leak:

a. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine "loading" one side of "O" ring.

b. T.V. cable "O" ring seal missing, damaged or improperly installed.

c. Rear seal assembly damaged or improperly installed.

d. Governor cover and "O" rings damaged or missing.

e. Speedometer driven gear "O" ring damaged.

f. Manual shaft lip seal damaged or improperly installed.

g. Line pressure tap plug.

h. Vent pipe.

i. Porous casting.

j. Intermediate servo "O" ring damaged.

3. Leak at Front of Transmission:

a. Front pump seal leaks.

- Seal lip cut. Check converter hub for nicks, etc.
- Bushing moved forward and damaged.
- Garter spring missing from seal.

b. Front pump attaching bolts loose or bolt seals damaged or missing.

c. Front pump housing "O" ring damaged or cut.

d. Converter leak in weld area.

e. Porous casting (pump or case).

4. Oil comes out Vent Pipe:

a. Transmission over-filled.

b. Water in oil

c. Foreign matter between pump and case or between pump cover and body.

d. Case porous, front pump cover mounting face shy of stock near breather.

e. Pump to case gasket mispositioned.

f. Incorrect dipstick.

g. Pump shy of stock on mounting faces, porous casting, breather hole plugged in pump cover.

CASE POROSITY REPAIR

External leaks caused by case porosity have successfully been repaired with the transmission in the car by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 90°C. (200°F.).

2. Raise car on a hoist or jack stand, engine running and locate source of oil leak, Check for leak in all operating positions. A mirror may be helpful in finding leaks.

3. Shut engine off and thoroughly clean area to be repaired with a cleaning solvent and air dry.

4. Using instructions of the manufacturer, mix a sufficient amount of epoxy, No. 1360016 or equivalent, to make repair. Observe cautions of manufacturer in handling.

5. While the transmission case is still HOT apply the epoxy to the area to be repaired. A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement. Make certain the area to be repaired is fully covered.

6. Allow cement to cure for three hours before starting engine.

7. Road test and check for leaks.

CONVERTER STATOR OPERATION DIAGNOSIS

The torque converter stator assembly and its related roller clutch can possibly have one of two different type malfunctions.

1. The stator assembly freewheels in both directions.

2. The stator assembly remains locked up at all times.

Stator Assembly Freewheels

If the stator roller clutch becomes ineffective, the stator assembly freewheels at all times in both directions. With this condition, the car will tend to have poor acceleration from a standstill. At speeds above 48 to 56 km (30-35 mph), the car may act normal. If poor acceleration problems are noted, it should first be determined that the exhaust system is not blocked, the engine is in good tune and the transmission is in first (1st) gear when starting out.

If the engine will freely accelerate to high rpm in Neutral (N), it can be assumed that the engine and exhaust system are normal.

Stator Assembly Remains Locked Up

If the stator assembly remains locked up at all times, the engine rpm and car speed will tend to be limited or restricted at high speeds. The car performance when accelerating from a standstill will be normal. Engine overheating may be noted. Visual examination of the converter may reveal a blue color from the overheating that will result.

Under conditions above, if the converter has been removed from the transmission, the stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely in the clockwise direction, but not turn or be very difficult to turn in the counterclockwise direction.

NOTE: Do not use such items as the pump cover or stator shaft to turn the race as the results may be misleading.

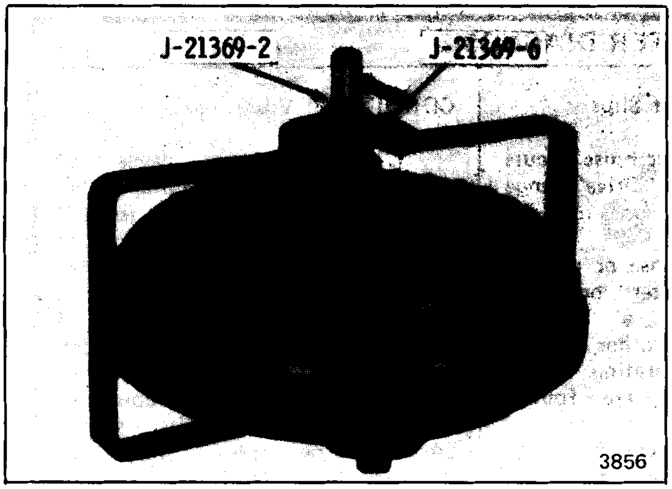
Checking Converter

1. Check converter for leaks as follows:

a. Install J 21369-2 and J 21369-6 and tighten hex nut on J 21369-2 (Fig. 7A1-3).

b. Fill converter with air; 551 kilopascals (80 psi).

c. Submerge in water and check for leaks.



7A1-3 Installing Tool J 21369

d. Bleed pressurized air from J 21369-2 before removing tools from converter, then remove tools.

2. Check converter hub surfaces for signs of scoring or wear.

3. Check converter and clearance as follows:

a. Fully release collet end of tool J 25020.

b. Install collet end of tool J 25020 in to converter hub until it bottoms; then tighten cap nut to 6.7 N·m (5 lb. ft.) (Fig. 7A1-4).

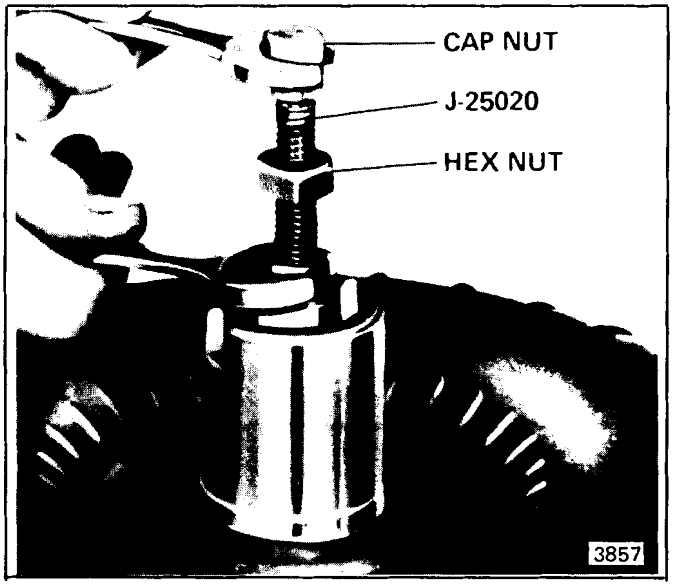


Fig. 7A1-4 Installing Tool J 25020

c. Install tool J 21371-3 and tighten hex nut to 4.0 N·m (3 lb. ft.) (Fig. 7A1-5).

d. Install dial indicator and set it at zero while its plunger rests on the cap nut of tool J 25020 (Fig. 7A1-5).

e. Loosen hex nut while holding cap nut stationary. With hex nut loose and holding tool J 21371-3 firmly against the converter hub, the reading obtained on the dian indicator will be the converter end clearance. End should be less than 0-1.27 mm (0-.050"). If the end clearance is greater, the converter must be replaced (Fig. 7A1-5).

NOTE: See additional Converter Diagnosis, Fig. 7A1-6.

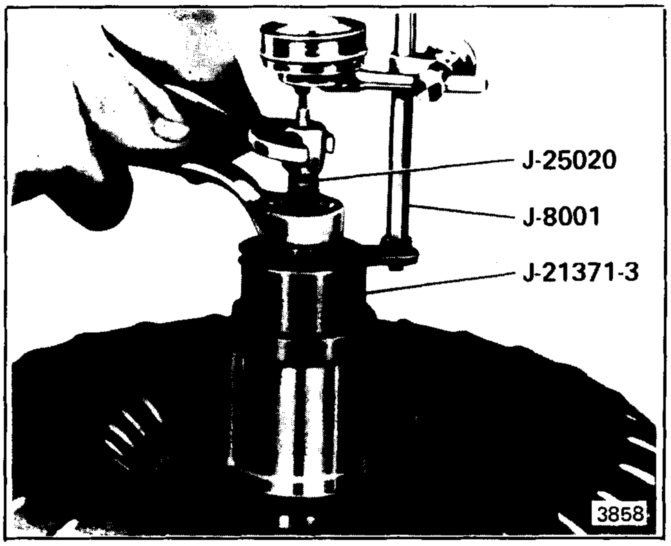


Fig. 7A1-5 Installing Tool J 21371-3

4. With the transmission in cradle or portable jack, install the converter assembly into the pump assembly, making sure that the converter hub drive slots are fully engaged with the pump drive gear tangs and the converter installed fully towards the rear of the transmission.

NOTE: The converter will be properly installed if the distance is 25.4mm (1.00") minimum between the engine mounting face of the case and the front face of the converter cover drive lugs.

5. Retain converter with J 21366 (Fig. 7A1-7).

OIL PRESSURE CHECKS (FIG. 7A1-8)

1. Connect an oil pressure gage to the line pressure tap.
2. Connect a tachometer to the engine.

TORQUE CONVERTER DIAGNOSIS

CONDITION: Contaminated Oil

1. If oil in the converter is discolored but does not contain metal particles, the converter is not damaged internally and need not be replaced. Remove as much of the discolored oil as possible by draining through the hub.
2. If oil in the converter contains metal particles, the converter is damaged internally and must be replaced. The oil may have an "aluminum paint" appearance.
3. If the cause of the transmission failure was due to engine coolant (cooler leak) contamination, the converter must be replaced.
4. If the pump gears or cover show signs of damage or are broken, the converter will contain metal particles and must be replaced.

(NOTE: After failure that generates sludge, metal particles or converter replacement, it is recommended that the transmission be properly cleaned and the cooler lines be flushed. Refer to the Cooler and Cooler Lines Flushing Procedure.)

CONDITION: Stripped Converter Bolt Holes

1. Inspect for cause, such as damaged bolt threads. To repair stripped bolt holes, use heli-coils or equivalent.

CONDITION: Noisy or Slips

(NOTE: Most converter noise occurs under light throttle in "Drive" range with brakes applied.)

1. Check for loose or missing flywheel to converter bolts, a cracked flywheel, a broken converter pilot, or other engine parts that may be vibrating. If any of these conditions are found, correct as required.
2. Inspect the converter for damage to the roller bearing, thrust races and roller clutch. The thrust roller bearing and thrust races can be checked by viewing them when looking into the converter neck or feeling through the opening to make sure they are not cracked, broken or mispositioned.

The stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely in the clockwise direction, but not turn or be very difficult to turn in the counterclockwise direction.

(NOTE: Do not use such items as the pump cover or stator shaft to turn the race as the results may be misleading.)

The converter must be replaced if the roller bearing, thrust races or roller clutch are damaged.

3. Inspect for excessive end play. (Refer to Procedure) Replace the converter if turbine end play clearance exceeds .050".

CONDITION: Vibration

1. Isolate the cause of vibration by disconnecting other engine driven parts one at a time. If the converter is determined to be the cause of vibration, check for loss of balance weights and replace converter if weights are missing. If weights are not missing, re-index converter 120 degrees at a time to cancel out engine and converter unbalance conditions. Washers may be used on the converter to flywheel bolts to isolate area of unbalance.

CONDITION: Leaks

1. Inspect converter hub surface for roughness, scoring or wear that could damage seal or bushing. If roughness can be felt with a fingernail, front seal could be damaged. Repair the converter hub with crocus cloth if possible and replace the front seal.
2. Inspect the inside of the bell housing. If covered with oil, a converter leak is indicated and the converter should be leak tested. (Refer to Procedure) Replace the converter is leaks are found.

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Fig. 7A1-6 Torque Converter Diagnosis Chart

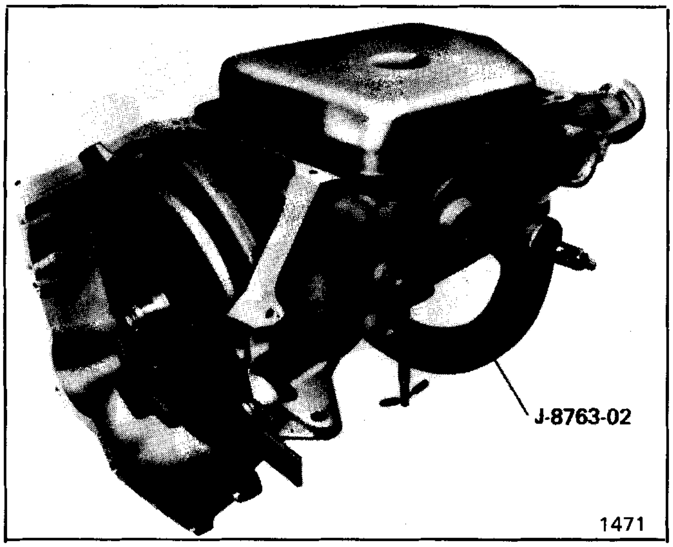
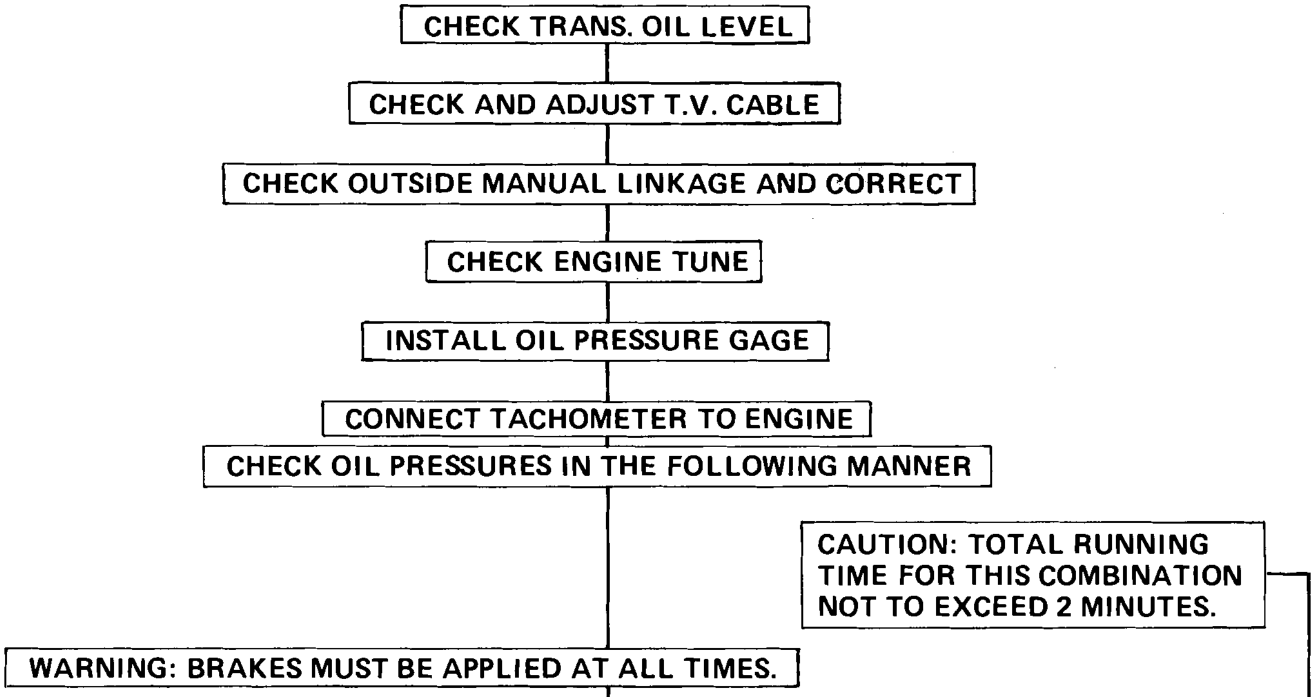


Fig. 7A1-7 Retaining Converter With Tool J 21366



RANGE	RECORD OIL PRESSURES	NORMAL OIL PRESSURES		
		kPa	MODEL	P.S.I.
PARK AT 1000 RPM		240-345	CU	35-50
		275-380	CN,CZ	40-55
		310-415	BR,CX	45-60
		345-450	BL,BU,OW,OZ	50-65
		415-515	BH,BZ,CD,CE,CR,CY,OS,PZ,PY	60-75
REVERSE AT 1000 RPM		690-795	CU	100-115
		760-860	CN,CZ	110-125
		895-1000	PY	130-145
		1000-1105	BR,BU,CX,OW,OZ	145-160
		1035-1140	BL,BZ,CD,OS	150-165
		1105-1205	BH	160-175
		1205-1345	CE,CR,CY,PZ	175-195
NEUTRAL AT 1000 RPM		240-345	CU	35-50
		310-415	CN,CZ	45-60
		345-450	BR,CX	50-65
		380-485	BL,BU,OW,OZ	55-70
		450-550	BH,BZ,CD,CE,CR,CY,OS,PZ,PY	65-80
DRIVE AT 1200 RPM		275-380	CU	40-55
		345-450	CN,CZ	50-65
		380-485	BR,BU,CX,OW,OZ	55-70
		450-550	BL,BZ,CY,OS,PZ	65-80
		485-585	BH,CD,CE,CR,PY	70-85
INT. AT 1000 RPM		515-620	CN,CU,CZ	75-90
		620-725	BR,CX	90-105
		725-825	PY	105-120
		930-1070	BL,BU,CE,CR,CY,OW,OZ,PZ	135-155
		1000-1105	BH,BZ,CD,OS	145-160
LO AT 1000 RPM		SAME AS INTERMEDIATE		

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Fig. 7A1-8 Oil Pressure Chart

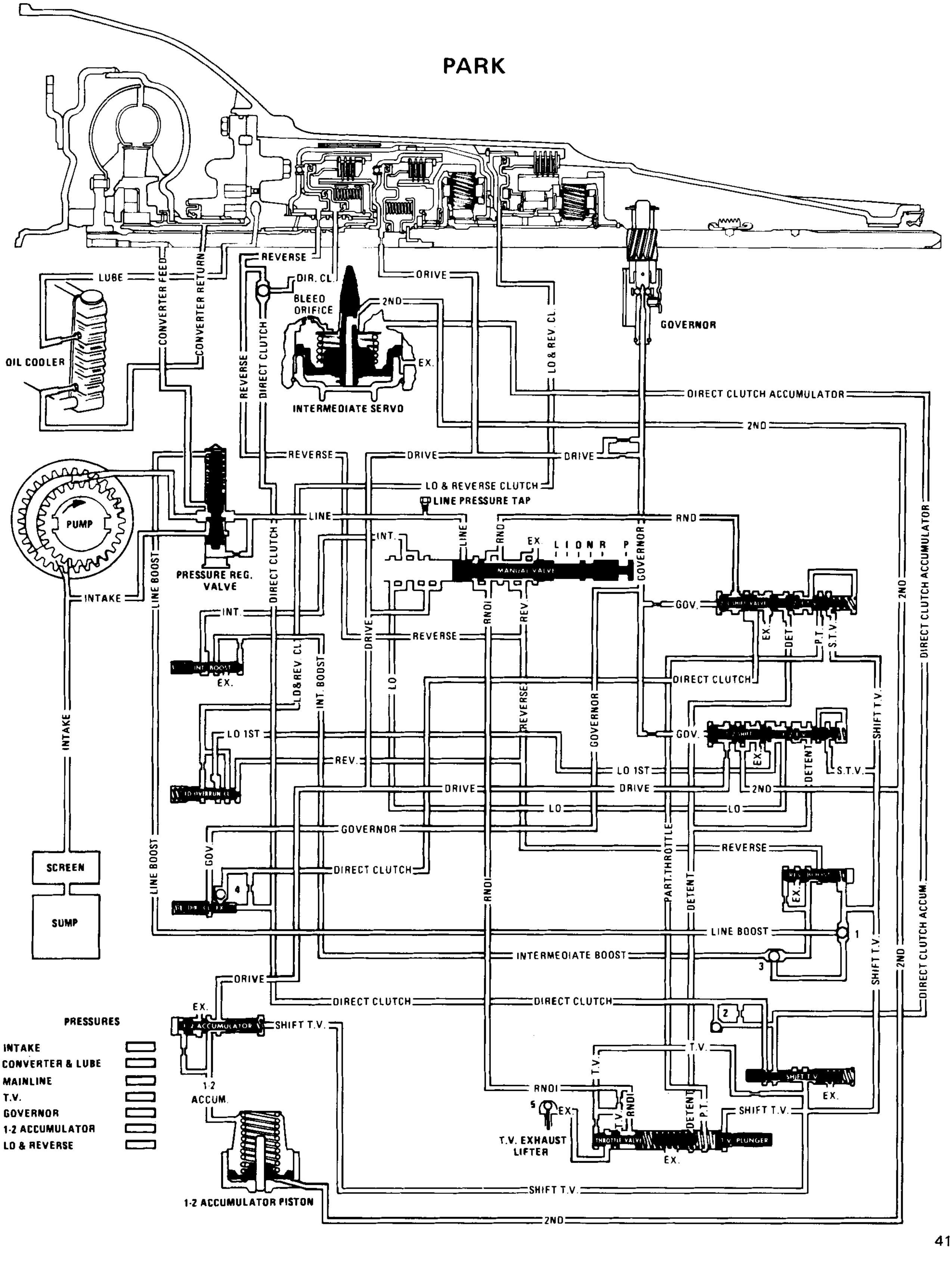

Fig. 7A1-8A Oil Flow Chart

HYDRA-MATIC (200) DIAGNOSIS CHART

TRANSMISSION PROBLEMS AND RELATED CAUSES

PROBLEM	POSSIBLE CAUSE	POSSIBLE CONDITION
NO DRIVE IN DRIVE RANGE (Check Oil Pressure)	A. Low Oil Level	1. Incorrect level. 2. External leaks.
	B. Manual Linkage	1. Maladjusted.
	C. Low or No Oil Pressure	1. Pump - pressure regulator valve stuck with chips or burrs 2. Pump drive or driven gear damaged or broken. 3. Cup plugs missing from pump cover. 4. Plugged or restricted oil screen. 5. Oil screen gasket off location. 6. Case-porosity in intake bore
	D. Control Valve Asm.	1. Manual valve disconnected from inside detent lever pin. 2. Control valve assembly gasket mis-positioned.
	E. Forward Clutch	1. Forward clutch does not apply - piston cracked seals missing, damaged; clutch plates burned; snap ring out of groove. 2. Forward clutch oil seal rings missing or damaged on turbine shaft; leak in feed circuits; pump to case gasket mis-positioned or damaged. 3. Clutch housing check ball stuck or missing. 4. Cup plug leaking or missing in the rear of the turbine shaft in the clutch apply passage. 5. Wrong forward clutch apply ring or wrong number of clutch plates. 6. Feed orifice plugged in turbine shaft. 7. Turbine shaft not welded to housing. 8. Feed passage in turbine shaft intersecting lube passage.

	F. Roller Clutch Asm.	1. Springs missing in the roller clutch. 2. Rollers gaulled, or missing.
	F. Converter	1. Turbine hub broken loose from turbine.
HIGH OR LOW OIL PRESSURES (See Fig. 7A1-8)	A. Throttle Valve Asm.	1. Misadjusted, binding, unhooked, or broken. 2. Wrong throttle lever to cable link. 3. Wrong T.V. cable.
	B. Manual Valve	1. Not connected to inside detent lever pin.
	C. Throttle Lever and Bracket Asm.	1. Binding, unhooked or mispositioned.
	D. T.V. Exhaust Valve Lifter Rod (Causes High Line Pressure)	1. Bent or binding.
	E. Pressure Regulator Valve & Spring	1. Valve binding. 2. Wrong spring-(Check pressure regulator bore plug leaking.
	F. Control Valve Asm.	1. Throttle valve or throttle valve plunger binding. 2. Shift T.V. valve binding. 3. Intermediate boost valve binding -- pressures will be incorrect in Intermediate and Low ranges only. 4. Reverse boost valve binding-- pressures will be incorrect in Reverse range only.
	G. Valve Body Spacer Plate	1. "Intermediate Boost" orifice plugged in spacer plate. 2. "Reverse Boost" orifice plugged in the spacer plate.
	H. Pump Assembly	1. Low oil pressure 2. Damaged gears and damaged pump gear pocket. 3. Cup plugs missing. 4. Mis-matched pump cover/ pump body. 5. Oil pressure control orifice in pump cover plugged, causing high line pressure.
	I. Forward Clutch Asm.	1. Cup plug missing from turbine shaft.

1-2 AND 2-3 SHIFTS-FULL THROTTLE ONLY	A. Throttle Valve Cable	1. Binding, unhooked or or broken. 2. Misadjusted. 3. Wrong T.V. cable.
	B. Throttle lever and Bracket Assembly	1. Binding or unhooked. 2. Wrong throttle lever to cable link.
	C. T.V. exhaust valve lifter rod (high line pressure)	1. Binding, mispositioned or unhooked. NOTE: Allowing #5 ball to seat causes full T.V. pressure regardless of throttle valve position.
	D. Control Valve Asm.	1. Control valve assembly gaskets or spacer plate, leaking, damaged, incorrectly installed. 2. Throttle valve and throttle valve plunger binding.
	E. Case Assembly	1. Porosity
FIRST SPEED ONLY, NO 1-2 UPSHIFT	A. Throttle valve cable	1. Misadjusted 2. Binding, disconnected or broken. 3. Wrong T.V. cable.
	B. Governor and Governor Cover	1. Governor assembly missing. 2. Governor balls missing in governor assembly. 3. Inner governor cover rubber "O" ring seal missing or leaking. (NOTE: If the outer governor cover "O" ring seal leaks, an external leak will be present along with no upshifts.) 4. Governor shaft seal worn, missing or damaged. 5. Governor driven gear stripped. 6. Governor weights binding on pin. 7. Distorted or mis-aligned governor spring(s). 8. Governor cover shaft worn or damaged. 9. Governor weight tangs must seat check balls when weights are extended completely outward.

	C. Intermediate Servo Assembly	1. Servo to cover oil seal ring missing or damaged. 2. Porosity in servo cover or piston. 3. Wrong intermediate band apply pin. (Refer to Chassis Service Manual for proper pin selection.) 4. Incorrect usage of cover and piston.
	D. Throttle lever and Bracket Assembly	1. Binding or unhooked. 2. Wrong throttle lever to cable link.
	E. Control Valve Asm.	1. 1-2 shift valve or 1-2 throttle valve stuck in downshift position. 2. Wrong spacer plate gaskets or in wrong position.
	F. Valve body spacer	1. Plugged "Governor to Valve Body" orifice in spacer plate -- feeds governor oil to shift valves. 2. Plugged "Drive to Governor" orifice in spacer plate.
	G. Case	1. Porosity in case channels or undrilled 2nd speed feed holes. 2. Excessive leakage between case bore and intermediate band apply pin. 3. Intermediate band anchor pin missing or unhooked from band. 4. Broken or missing band.
FIRST AND SECOND SPEEDS ONLY, NO 2-3 SHIFT	A. Throttle valve cable	1. Misadjusted. 2. Binding, disconnected or broken. 3. Wrong T.V. cable.
	B. Governor assembly & governor cover	1. Governor shaft oil seal missing, damaged or worn. 2. Check balls missing. 3. Governor cover seal damaged.
	C. Intermediate servo asm. (Direct clutch accumulator oil passages).	1. Servo to case oil seal ring broken or missing on intermediate servo piston. 2. Exhaust hole in case between servo piston seal rings, plugged or undrilled. 3. Orifice plug missing from case in the intermediate servo bore area.

	D. Throttle lever & bracket assembly	1. Binding or unhooked. 2. Wrong throttle lever to cable link.
	E. Control valve asm., & spacer plate	1. 2-3 shift valve or 2-3 throttle valve stuck in the downshift position. 2. "Direct Clutch Feed" orifice in spacer plate plugged. 3. Valve body spacer plate or gaskets, leaking, damaged, or incorrectly installed. 4. Wrong spacer plate to valve body gaskets.
	F. Case	1. Porosity in case channels. 2. Orifice cup plug in intermediate servo bore area in case missing.
	G. Pump Assembly	1. Channels in pump plugged or leaking. 2. Check ball missing or mislocated. 3. Pump to case gasket off location. 4. Rear oil seal ring on pump cover leaking, or missing. 5. Cup plug missing.
	H. Direct Clutch	1. Oil seals missing or damaged on piston. 2. Direct clutch piston or housing cracked. 3. Direct clutch plates damaged or missing. 4. Direct clutch backing plate snap ring out of groove. 5. Wrong piston apply ring. 6. Check ball in housing and/or piston missing or damaged. 7. Direct clutch release spring guide mislocated, preventing check ball in the piston from seating, causing plates to burn.
DRIVE IN NEUTRAL	A. Manual Linkage	1. Misadjusted or disconnected.
	B. Forward Clutch	1. Clutch does not release. Exhaust check ball sticking. Plates burned together.
	C. Pump	1. Cross leakage in pump passages.

	D. Case	1. Cross leakage to forward clutch passages.
NO DRIVE IN REVERSE OR SLIPS IN REVERSE. (REFER TO OIL PRESSURE CHECKS.)	A. Throttle valve cable.	1. Binding or misadjusted.
	B. Manual linkage	1. Misadjusted
	C. Pump assembly	1. Pressure regulator valve binding or stuck with chips. 2. Check ball missing or mislocated. 3. Pump to case gasket mislocated or damaged. 4. Direct clutch feed holes leaking, cross feeding or not drilled. 5. Cup plugs missing. 6. Oil rings damaged or missing.
	D. Control Valve asm.	1. Throttle valve binding. 2. Shift T.V. valve binding. 3. Reverse boost valve binding. 4. Lo overrun clutch valve binding. (Line presure readings will be normal.)
	E. Valve body spacer plate and gaskets	1. Orifices plugged. 2. Control valve assembly gaskets in reverse order.
	F. Case Assembly	1. Lo and reverse clutch housing-to-case seal or cup plug missing, damaged or no feed hole in cup plug. Also, seal may not be seated against the housing. 2. Porosity in case passages - direct clutch feed.
	G. Direct clutch asm.	1. Piston or housing cracked. 2. Piston seals cut or missing. 3. Check ball in housing and/or piston stuck, leaking or missing. 4. Plates burned. 5. Incorrect piston. 6. Clutch release spring guide mis-located, preventing check ball in the piston from seating, causing plates to burn.
	H. Lo & Reverse clutch assembly	1. Piston - cracked, broken or missing seals. Clutch plates burned. 2. Wrong selective spacer ring.

SLIPS ON 1-2 SHIFT	A. Low Oil Level	1. Oil will aerate. Correct oil level.
	B. Throttle valve cable	1. Not adjusted properly.
	C. Intermediate servo piston & cover asm.	1. Incorrect usage of piston and cover. 2. Wrong band apply pin. (Refer to Chassis Service manual for selection procedure.) 3. Porosity in piston. 4. Seals damaged or missing. 5. Excessive leakage between band apply pin and case.
	D. Control valve asm.	1. Throttle valve binding. 2. Shift T.V. valve binding. 3. 1-2 accumulator valve sticking, causing low 1-2 accumulator pressure.
	E. 1-2 accumulator piston and spring	1. Piston seal cut or missing. 2. Leak between piston and pin in control valve assembly. 3. Spring broken or missing.
	F. Case	1. Porosity in 2nd clutch passages.
	G. Pump Assembly	1. Forward clutch feed hole in the pump cover sleeve does not line up with "Drive" oil in the pump cover casting.
	H. Intermediate Band	1. Worn or burned.
	I. Forward Clutch Asm.	1. Forward clutch feed passage intersects with lube passage in the turbine shaft.
ROUGH 1-2 SHIFT	A. Throttle Valve Cable	1. Not adjusted properly. 2. Binding. 3. Wrong or damaged cable.
	B. Intermediate Servo Assembly	1. Wrong band apply pin. (See Chassis Service manual for correct selection.) 2. Servo piston to case oil seal ring damaged or missing.
	C. Control Valve Asm.	1. T.V. plunger binding. 2. Throttle valve binding. 3. Shift T.V. valve binding. 4. 1-2 accumulator valve binding.

	D. 1-2 Accumulator Piston & Spring	1. Oil ring damaged. 2. Piston stuck 3. Broken or missing spring. 4. Bore damaged.
SLIPS 2-3 SHIFT	A. Oil Level Low	1. Correct oil level.
	B. Throttle Valve Cable	1. Not adjusted properly. 2. Binding.
	C. Intermediate Servo Assembly	1. Servo to case oil seal ring damaged.
	D. Control Valve Asm.	1. Throttle valve binding.
	E. Spacer Plate & Gaskets	1. Direct clutch orifice partially blocked in spacer plate. 2. Gaskets mispositioned or damaged.
	F. Case Assembly	1. Porosity in direct clutch feed channels in case. 2. Orifice cup plug missing from case in the intermediate servo bore area.
	G. Pump Assembly	1. Pump to case gasket mispositioned or damaged. 2. Pump channels cross feeding, leaking or restricted. 3. Pump cover oil seal rings damaged or missing. 4. Pump cover sleeve loose.
	H. Direct Clutch Asm.	1. Direct clutch piston or housing cracked. 2. Piston seals cut or missing. 3. Direct clutch plates burned. 4. Check ball in housing and/or piston damaged or missing.
ROUGH 2-3 SHIFT	A. Throttle Valve Cable	1. Not adjusted properly. 2. Binding. 3. Wrong or damaged cable.
	B. Intermediate Servo Assembly	1. Exhaust hole undrilled or plugged between intermediate servo piston seals, not allowing intermediate servo piston to complete its stroke.
	C. Control Valve Asm.	1. T.V. plunger binding. 2. Throttle valve binding. 3. Shift T.V. valve binding.

		4. Direct clutch check ball #4 missing or missing or mis-located.
NO ENGINE BRAKING IN INTERMEDIATE RANGE, 2nd GEAR (CHECK OIL PRESSURES)	A. Intermediate Servo Assembly	1. Small oil seal on piston cut or missing.
	B. Control Valve Asm.	1. Intermediate - reve. check ball #3 mislocating or missing. 2. Shift T.V. check ball #1 mis-located or missing. 3. Intermediate boost valve binding.
	C. Intermediate Band	1. Not located on band anchor pin. 2. Broken or burned.
NO ENGINE BRAKING IN LOW RANGE, 1st GEAR (CHECK OIL PRESSURES)	A. Control Valve Asm.	1. Low overrun clutch valve binding.
	B. Lo and reverse Clutch Assembly	NOTE: (No reverse should also be a complaint with any of the (3) following conditions). 1. Piston seals broken or missing. 2. Porosity in piston or housing. 3. Clutch housing snap ring out of case.
	C. Case	1. Lo and reverse clutch housing-to-case seal or cup plug missing, damaged or no feed hole in cup plug. Also, seal may not be seated against the housing.
NO PART THROTTLE OR DETENT DOWNSHIFTS (CHECK OIL PRESSURES)	A. Throttle Valve Cable	1. Improperly adjusted. 2. Wrong or damaged cable.
	B. Throttle Lever and Bracket Assembly	1. Wrong throttle lever to cable link.
	C. Control Valve Asm.	1. Passages not open in 2-3 T.V. bushing. 2. Throttle valve bushing passages not open. 3. Shift T.V. valve binding. 4. Throttle valve binding.
	D. Control Valve Asm.	1. Mispositioned, damaged or

	E. Valve Body Spacer Plate	1. Hole plugged or undrilled.
LOW OR HIGH SHIFT POINTS (CHECK OIL PRESSURES)	A. Throttle Valve Cable	1. Binding, disconnected or misadjusted. 2. Wrong or damaged cable.
	B. Throttle Lever and Bracket Assembly	1. Binding, unhooked or loose at mounting valve body bolt. 2. Not positioned at the throttle valve plunger bushing pin. 3. Wrong throttle lever to cable link.
	C. Governor Shaft to Cover Seal Ring	1. Broken or missing.
	D. Governor Cover "O" Ring The oute	1. Broken or missing. NOTE: r ring will leak externally and the inner ring internally.
	E. Pump Assembly	1. Pressure regulator valve binding or stuck.
	F. Control Valve Asm.	1. T.V. exhaust valve lifter binding, unhooked or missing. 2. 1-2 or 2-3 valves sticky. 3. Throttle valve plunger binding. 4. Throttle valve binding. 5. Shift T.V. valve binding. 6. T.V. shift check ball #1 missing or mis-located.
	G. Valve Body Spacer Plate or Gaskets.	1. Damaged or wrong gaskets.
	H. Case	1. Porosity
WON'T HOLD IN PARK	A. Manual Linkage	1. Misadjusted
	B. Manual Detent Roller and Spring Assembly	1. Bolt loose that holds roller assembly to control valve assembly. 2. Pin or roller damaged or mispositioned or missing.
	C. Inside Detent Lever and Pin Assembly	1. Nut loose. 2. Hole in lever worn or damaged.
	D. Parking Lock Components	1. Park pawl binding in case. 2. Actuator rod or plunger damaged. 3. Parking pawl broken.

		4. Parking bracket, loose or damaged.
TRANSMISSION NOISY	A. Pump Noise	1. Oil level setting low. 2. Cavitation due to plugged screen, porosity in intake circuit, water in oil. 3. Pump gears - damaged.
	B. Gear Noise	1. Transmission grounded to body. 2. Roller bearings worn or damaged.
THUMPING OR CLUNKING SOUND AT 1-5 MPH - DRIVE OR INTERMEDIATE RANGE	A. Governor Assembly	1. Governor Spring(s) damaged, mispositioned or tilted.

CLUTCH PLATE DIAGNOSIS

Composition-Faced Clutch Plates -

1. Dry plates and inspect for:

a. pitting and flaking.

b. wear.

c. glazing.

d. cracking.

e. charring.

f. chips or metal particles imbedded in lining.

If composition clutch plate shows any of the above conditions, replacement is required.

NOTE: Do not diagnose composition-faced clutch plates by color.

Steel Clutch Plates -

Wipe plates dry and check for heat discoloration. If the surface is smooth and an even color smeer is indicated, the plate should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plate must be replaced.

Clutch Release Spring -

Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would require replacement of the springs.

CAUSES OF BURNED CLUTCH PLATES

1. Direct Clutch:

a. Check ball in the direct clutch piston damaged, stuck or missing.

b. Check ball in clutch housing damaged, stuck or missing.

c. Clutch piston damaged; seals damaged, missing or rolled over.

d. Low line pressure.

e. Pump cover oil seal rings cut, missing or undersized; oversize ring groove.

f. Deformed piston retainer and spring assemlby.

g. Mis-assembled clutch pack.

h. Case valve body face not flat or porosity between channels.

i. Valve body face not flat, porosity between channels or damaged bores.

j. Pump pressure regulator valve stuck.

k. Pump check ball missing or mis-located.

l. Intermediate servo seals damaged.

2. Forward Clutch:

a. Check Ball in clutch housing damaged, stuck or missing.

b. Clutch piston damaged, seals damaged or missing.

c. Low line pressure.

d. Turbine shaft oil seal rings cut, missing, broken or undersize; ring groove oversize; feed hole blocked partially, interconnected or cup plug missing.

e. Deformed piston retainer and spring assembly.

f. Mis-assembled clutch pack.

g. Case valve body face not flat or porosity between channels.

h. Valve body face not flat, porosity between channels or damaged bores.

i. Pump pressure regulator valve stuck.

3. Lo & Reverse Clutch:

a. Clutch piston damaged; seals damaged or missing.

b. Low line pressure.

c. Lo - reverse clutch housing to case cup plug and seal damaged, missing or mis-assembled.

d. Mis-assembled clutch pack.

e. Case valve body face not flat or porosity between channels.

f. Valve body face not flat, porosity between channels or damaged bores.

g. Pump pressure regulator valve stuck or check ball missing.

NOTE: Burned clutch plates can be caused by incorrect usage of clutch plates. Also, engine coolant in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.

ENGINE COOLANT IN TRANSMISSION

If the transmission oil cooler, located in the radiator assembly, has developed a leak allowing engine coolant to enter the transmission, use the following procedure:

1. Remove transmission from car.
2. Disassemble transmission and replace all rubber type seals (the coolant will attack the seal material causing leakage).
3. Replace the composition-faced clutch plate assemblies (the facing material may become separated from the steel center portion).
4. Replace the nylon washers, speedometer gears and governor gear (the nylon can swell and become damaged).
5. Replace the converter assembly. All the contaminated oil cannot be poured out of the converter.
6. Throughly clean and rebuild transmission, using new gaskets and oil filter.
7. Flush the cooler lines after the transmission cooler has been properly repaired or replaced.

ON CAR SERVICE

The following parts can be serviced with the transmission in the car. For part removal and installation procedures not listed in this section, refer to the disassembly and reassembly sections.

1. Governor Cover and Seals; Governor Assembly.
2. Intermediate Servo Cover and Seal; Intermediate Servo Piston Assembly.
3. Oil Pan; Oil Screen Assembly (Refer to Changing Fluid as outlined previously).
4. Pressure Regulator parts.
5. Control Valve Assembly; Spacer Plate; Gaskets; Manual Detent Roller and Spring Assembly; Throttle Lever and Bracket Assembly; Manual Valve; Check Balls; 1-2 Accumulator Valve and Spring; Intermediate Band Anchor Pin; Lo and Reverse Clutch Cup Plug and Seal.
6. Inside Detent Lever and Parking Brake Actuator Rod; Manual Shaft; Manual Shaft to Case Seal; Parking Pawl; Parking Bracket.
7. Rear Seal.
8. Vent Assembly.
9. Cooler Fittings
10. T.V. Cable
11. Oil Filler Pipe and "O" Rign Seal.
12. Speedometer Driven Gear Assembly.

GOVERNOR

Removal

1. Before raising the car, disconnect the negative battery cable and remove the air cleaner.
2. Raise car on hoist and remove the exhaust to converter bolts. Let the catalytic converter and exhaust pipe hang down.
3. Place jack stand under transmission for support and remove rear transmission support bolts.
4. Remove the drive shaft as outlined in Section 4A.
5. Let transmission drop down until sufficient clearance is obtained to remove the governor.
6. Remove the governor retainer ring and cover. Discard the two seal rings.
7. Remove governor assembly from case.
8. For inspection of the governor, refer to the overhaul portion of this ection.

Installation

To install, reverse removal procedure.

CAUTION: *Do not use any type of hammer to install governor assembly and cover into case. Damage to case, governor or cover could result.*

INTERMEDIATE SERVO ASSEMBLY

Removal and Installation

1. Before raising the car, disconnect the negative battery cable and release the parking brake.
2. Raise car on hoist.
3. Place jack stand under transmission for support and remove rear transmission support.
4. Let transmission drop down slightly and position a 50 mm (2") block on the right side of the transmission.
5. With transmission positioned to the left of the car, remove the intermediate servo cover retaining ring.
6. Remove intermediate servo cover and discard seal ring, seal ring may be located in case.
7. Remove intermediate servo piston and band apply pin assembly.
8. Refer to Overhaul operations for inspection procedure.

To install, reverse removal procedure.

PRESSURE REGULATOR VALVE

Removal

1. Referring to draining procedures, drain transmission fluid from oil pan.
2. Remove oil pan and screen. Discard gasket.
3. Pushing on pressure regulator valve bore plug, compress pressure regulator spring with small screwdriver or Tool J 24684 as shown in Fig. 7A1-9.
4. Remove retaining ring, withdraw screwdriver or tool slowly to release spring tension.
5. Remove pressure regulator bore plug, valve, spring and guide. Refer to overhaul portion of this section for the inspection procedure.

Installation

1. Install pressure regulator spring first, guide and then valve, stem end out and bore plug hole side out.
2. Pushing with screwdriver or Tool J 24684 as shown in Fig. 7A1-9 push bore plug past retaining ring groove by compressing pressure regulator valve spring.

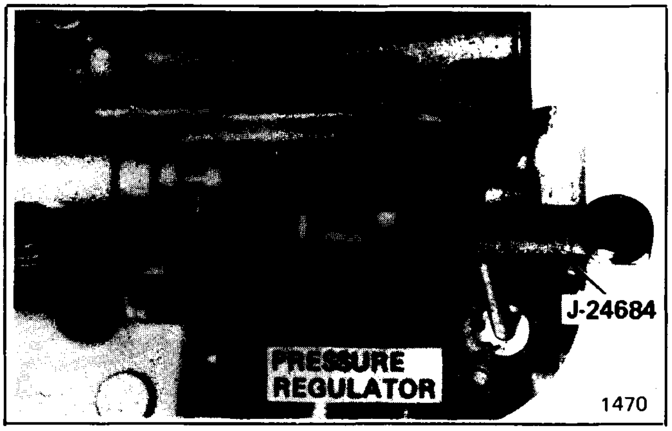

Fig. 7A1-9 Removing Pressure Regulator Valve

3. Install retaining ring.
4. Refer to Refill Section for correct fluid level.

CONTROL VALVE ASSEMBLY

Removal

1. Referring to draining procedures, drain transmission fluid from oil pan.
2. Remove oil pan and screen. Discard gasket.
3. Remove screw and washer securing cable to transmission and disconnect T.V. cable.
4. Remove throttle lever and bracket assembly. Do not bend throttle lever link.
5. Remove manual detent roller and spring assembly.
6. Holding manual valve with fingers, remove valve assembly spacer plate and gaskets together to prevent dropping of four (4) check balls located in control valve body and fifth (5th) check ball located on spacer plate.

NOTE: After removing control valve assembly, the intermediate band anchor pin and reverse clutch cup plug may come out.

7. Lay control valve assembly down with spacer plate side up and remove fifth check ball off spacer plate.
8. Refer to overhaul operations for inspection procedure.

Installation

Installation of control valve assembly is the reverse of removal. Torque all valve body bolts to 13.0 to 17.0 N·m (9-12 ft. lbs.).

CAUTION: *Intermediate band anchor pin must locate on intermediate band or damage to transmission will result.*

Refer to Refilling of Transmission portion of this section for correct fluid level.

REAR HOUSING OIL SEAL

Removal

1. Remove propeller shaft.
2. Pry out lip oil seal with screwdriver or small chisel.

Installation

1. Coat outer casing of new lip oil seal with a nonhardening sealer and drive it into place with Installer J 21426.
2. Install propeller shaft and adjust fluid level.

OIL COOLER PIPES

(Figs. 7A1-10 & 11)

If replacement of transmission steel tubing cooler lines is required, use only double wrapped and brazed steel tubing meeting GM Specification 123M or equivalent. Under no condition use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory fatigue durability to withstand normal car vibrations.

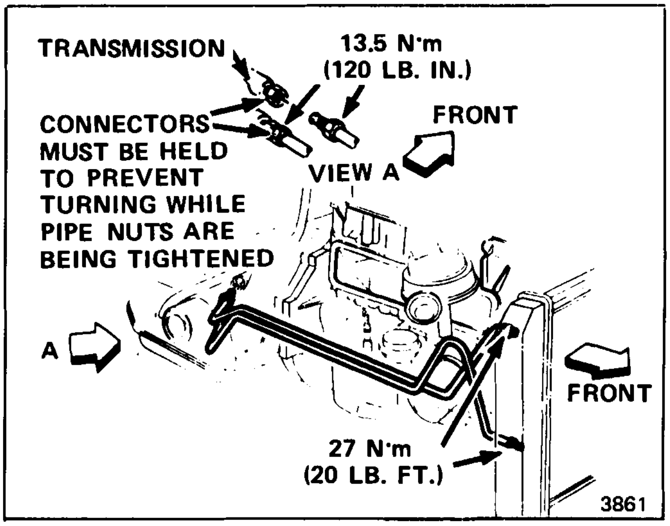

Fig. 7A1-10 Oil Cooler Lines (Typical) - L-4 Shown

Steel tubing should be flared using the double flare method.

T.V. CABLE

(Figs. 7A1-12, 13 and 14)

Removal

1. Remove air cleaner.
2. Push up on bottom of "Snap Lock" and release lock and T.V. cable.
3. Compress locking tabs and disconnect "Snap Lock" assembly from bracket.
4. Disconnect cable from carburetor lever.
5. Remove clamp around filler tube, remove screw and washer securing cable to transmission and disconnect T.V. cable.

Installation

1. Install new seal on T.V. cable. Lubricate seal with transmission fluid.
2. Connect transmission end of T.V. cable and secure to transmission case with bolt and washer tightened to 10 N·m (8 ft. lbs.).

3. Route cable in front of filler tube and clamp to filler tube at the filler tube bracket.

4. Pass cable through bracket and engage locking tube of “Snap Lock” on bracket.

5. Connect cable to carburetor lever.

6. Install air cleaner.

Adjustment

1. Disengage ”Snap Lock“ (Cable should be free to slide thru ”Snap Lock“).

2. With cable installed in support and attached to transmission and carburetor lever, move carburetor lever to wide open throttle position.

3. Push ”Snap Lock“ flush and return carburetor lever to closed position.

SPEEDOMETER DRIVEN GEAR

Removal and Installation

1. Disconnect speedometer cable.

2. Remove retainer bolt, retainer, speedometer driven gear and ”O“ ring seal.

To install, reverse removal procedure, using new ”O“ ring seal (if required) and adjust fluid level.

CHECKING TRANSMISSION MOUNT

Raise car on a hoist. Push up and pull down on transmission tailshaft while observing transmission mount. If rubber separates from metal plate of mount or if tailshaft moves up but not down (mount bottomed out) replace mount. If there is relative movement between a metal plate of mount and its attaching point, tighten screws or nuts attaching mount to transmission or crossmember.

COLUMN SHIFT CONTROLS

(Fig. 7A1-15)

Adjust

1. Looses screw on adjusting swivel clamp.

2. Position steering column shift lever in NEUTRAL gate notch.

3. Set transmission selection lever in NEUTRAL detent.

NOTE: Obtain NEUTRAL detent by moving selection lever counterclockwise to its stop, then clockwise three detents to NEUTRAL.

4. Tighten screw on adjusting swivel clamp to 27 N·m (20 lb. ft.).

CONSOLE SHIFT CONTROLS

(Figs. 7A1-16 and 17)

Adjust

1. Loosen nut from pin at selection lever.

2. Position shift on assembly in NEUTRAL position.

3. Place transmission selector lever in NEUTRAL detent.

4. Tighten nut on pin at selector lever to 27 N·m (20 lb. ft.).

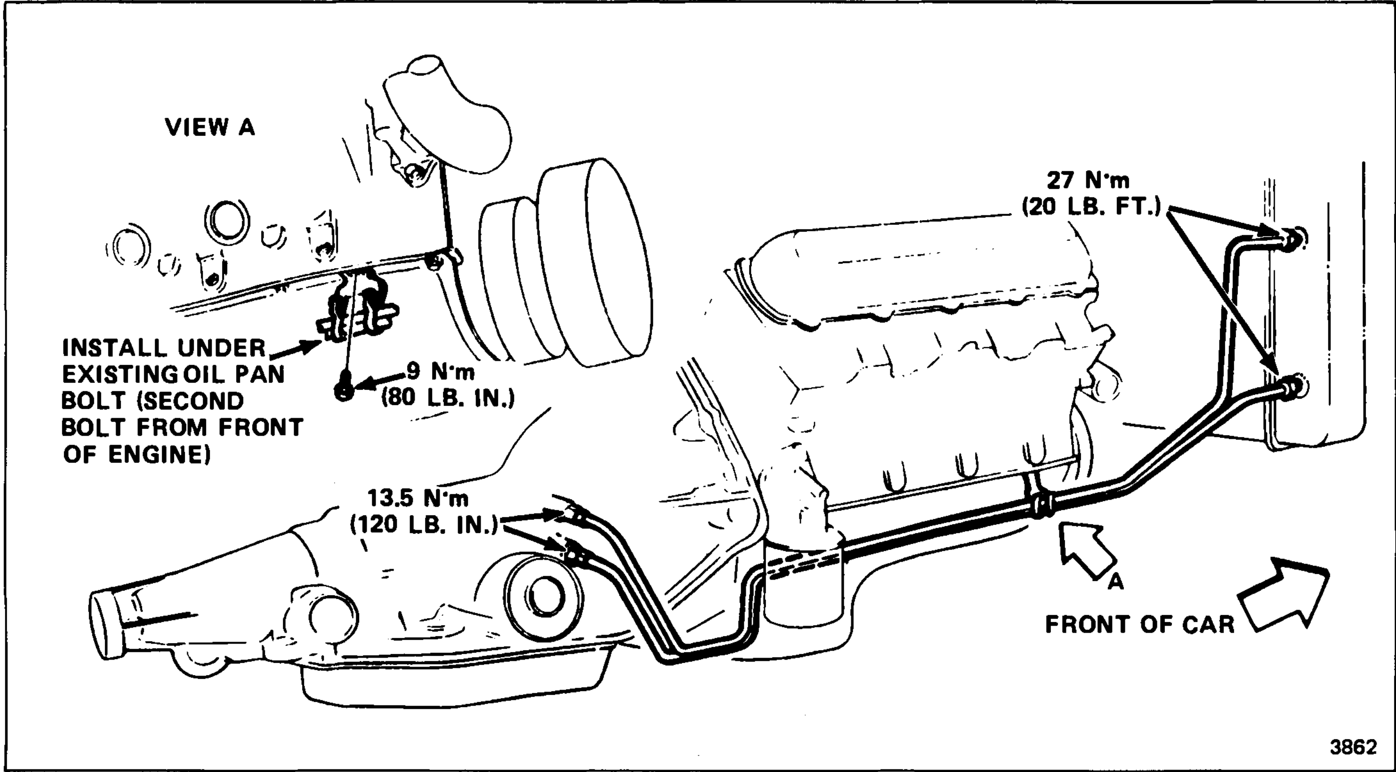

Fig. 7A1-11 Oil Cooler Lines (Typical) - V8 Shown

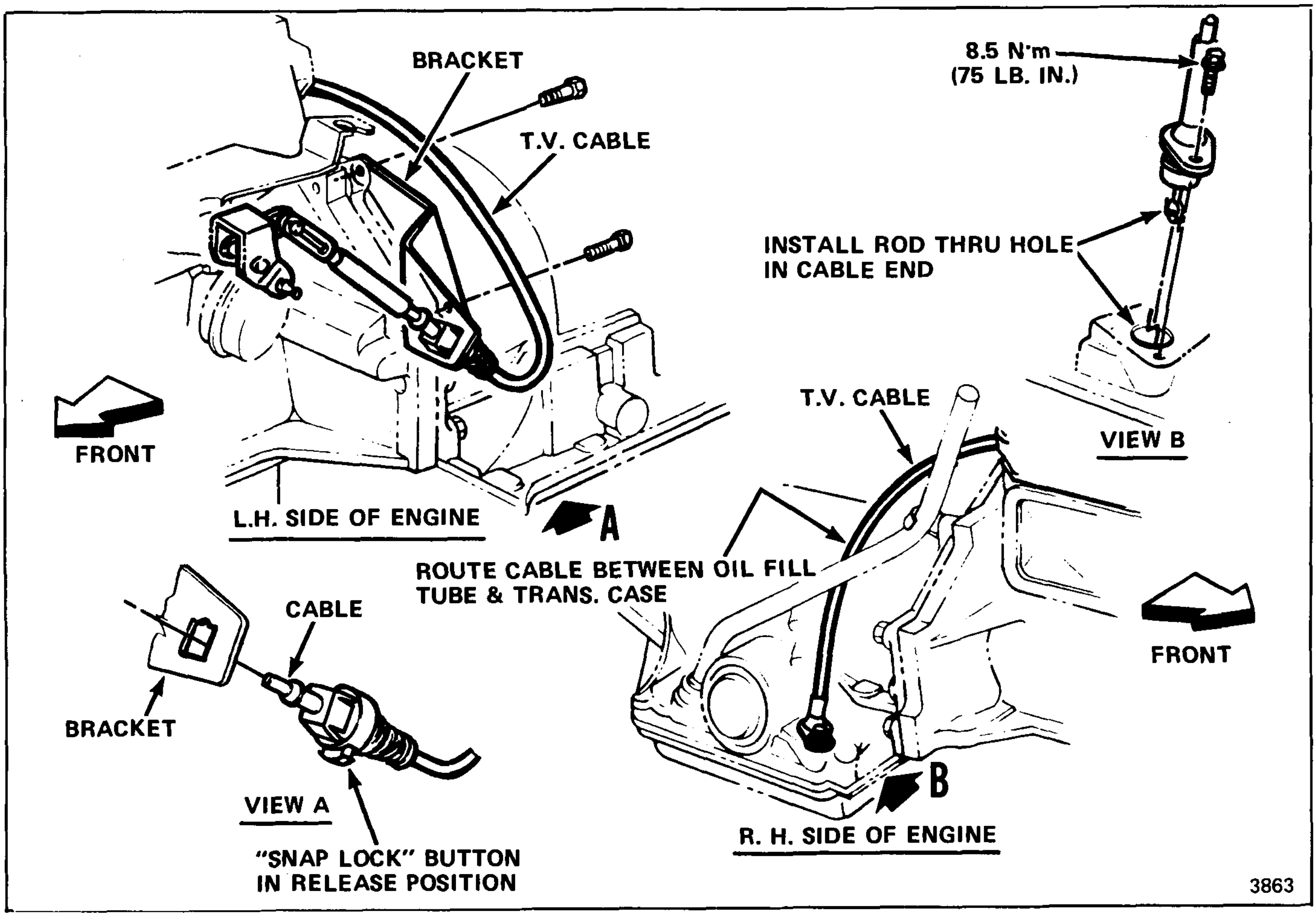

Fig. 7A1-12 T.V. Cable Routing - L-4 Shown

GENERAL SERVICE PRECAUTIONS

When servicing the transmission, it is recommended that upon disassembly of a unit, all parts should be cleaned and inspected as outlined under CLEANING AND INSPECTION. The unit should be reassembled before disassembly of other units to avoid confusion and interchanging of parts.

1. Before disassembly of the unit, thoroughly clean the exterior.

2. Disassembly and reassembly of the unit and tie subassemblies must be made on a clean work bench. As in reparing any hydraulically operated unit, cleanliness is of the utmost importance; therefore, the bench, tools, and parts must be kept clean at all times.

3. Before installing cap screws into aluminum parts, ALWAYS DIP SCREWS INTO OIL to prevent cap screws from galling the aluminum threads and also to prevent the screw for seizing.

4. Always use a torque wrench when installing cap screws into aluminum parts to prevent the possibility of stripping the threads.

5. If tapped, threads in aluminum parts are stripped or damaged, the part can be made serviceable by the use of Heli-Coils or equivalent.

6. Seal protecting tools must be used when assembling the units to prevent damage to the seals. The slightest flaw in the sealing surface of the seal can cause an oil leak.

7. The aluminum castings and the valve parts are very susceptible to nicks, burrs, etc., and care should be exercised when handling them.

8. The internal snap rings should be expanded and the external snap rings compressed if they are to be reused. This will insure proper seating when installed.

9. Replace all "O" rings, gaskets and oil seals that are removed.

NOTE: Teflon oil seal rings should not be removed unless damaged.

10. During assembly of each unit, all internal parts must be lubricated with oil.

PARTS CLEANING AND INSPECTION

After complete disassembly of a unit, all metal parts should be washed in a clean solvent and dried with compressed air. All oil passages should be blown out and checked to make sure that they are not obstructed. Small passages should be checked with tag wire. All parts should be inspected to determine which parts are to be replaced.

The various inspections of parts are as follows:

1. Inspect linkage and pivot points for excessive wear.

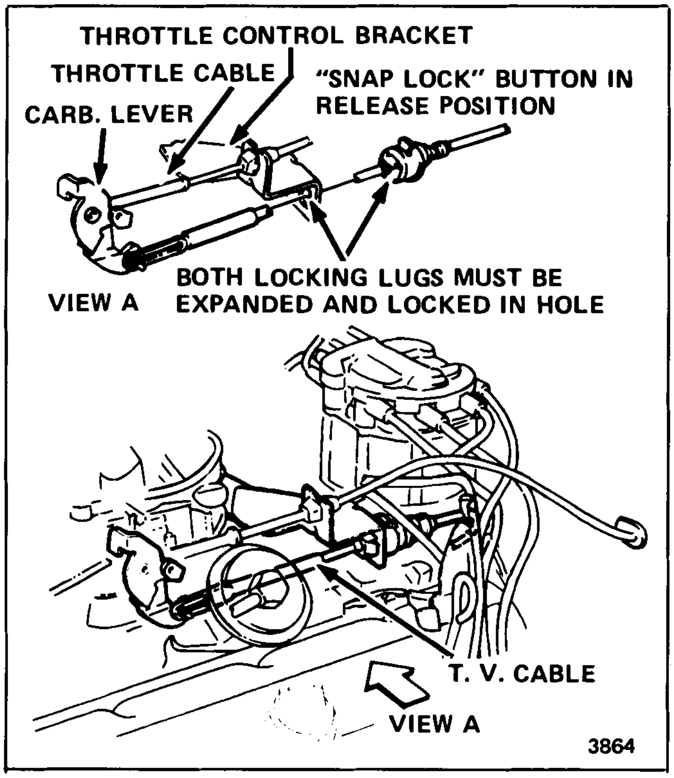

Fig. 7A1-13 T.V. Cable Routing at Engine - V8 Shown

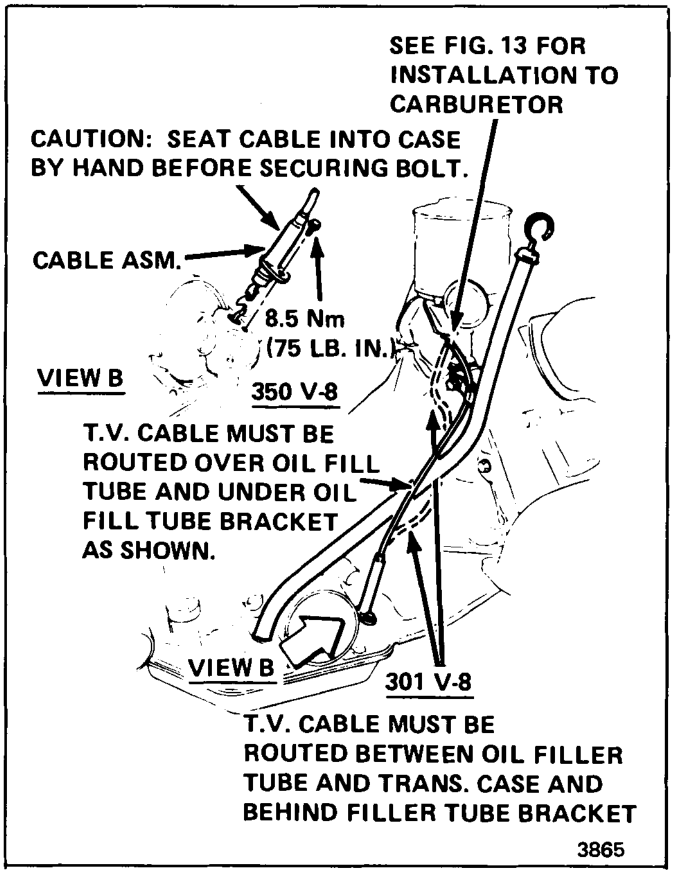

Fig. 7A1-14 T.V. Cable Routing At Transmission - V8 Shown

WARNING: IF A MANUAL LINKAGE ADJUSTMENT IS MADE, THE ASSOCIATED NEUTRAL START SWITCH SHOULD BE ADJUSTED. IF NECESSARY, THE NEUTRAL START SWITCH SHOULD BE ADJUSTED SO THAT THE ENGINE WILL START IN "PARK" AND "NEUTRAL" POSITIONS ONLY. WITH THE SELECTOR LEVER IN THE "PARK" POSITION, THE PARKING PAWL SHOULD FREELY ENGAGE AND PREVENT THE CAR FROM ROLLING.

2. Bearing and thrust surfaces of all parts should be checked for excessive wear and scoring.
3. Check for broken seal rings, damaged ring lands and damaged threads.
4. Inspect seals and "O" rings.
5. Mating surfaces of castings and end plates should be checked for burrs and irregularities may be removed by lapping the surface with crocus cloth. The crocus cloth should be laid on a flat surface, such as a piece of plate glass.
6. Castings should be checked for cracks and sand holes.

MANUAL LINKAGE

Manual linkage adjustment and the associated neutral start switch are important from a safety standpoint.

The neutral start switch should be adjusted so that the engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage and prevent the car from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

If the linkage is not adjusted properly, an internal leak could occur at the manual valve which could cause a clutch and/or band failure.

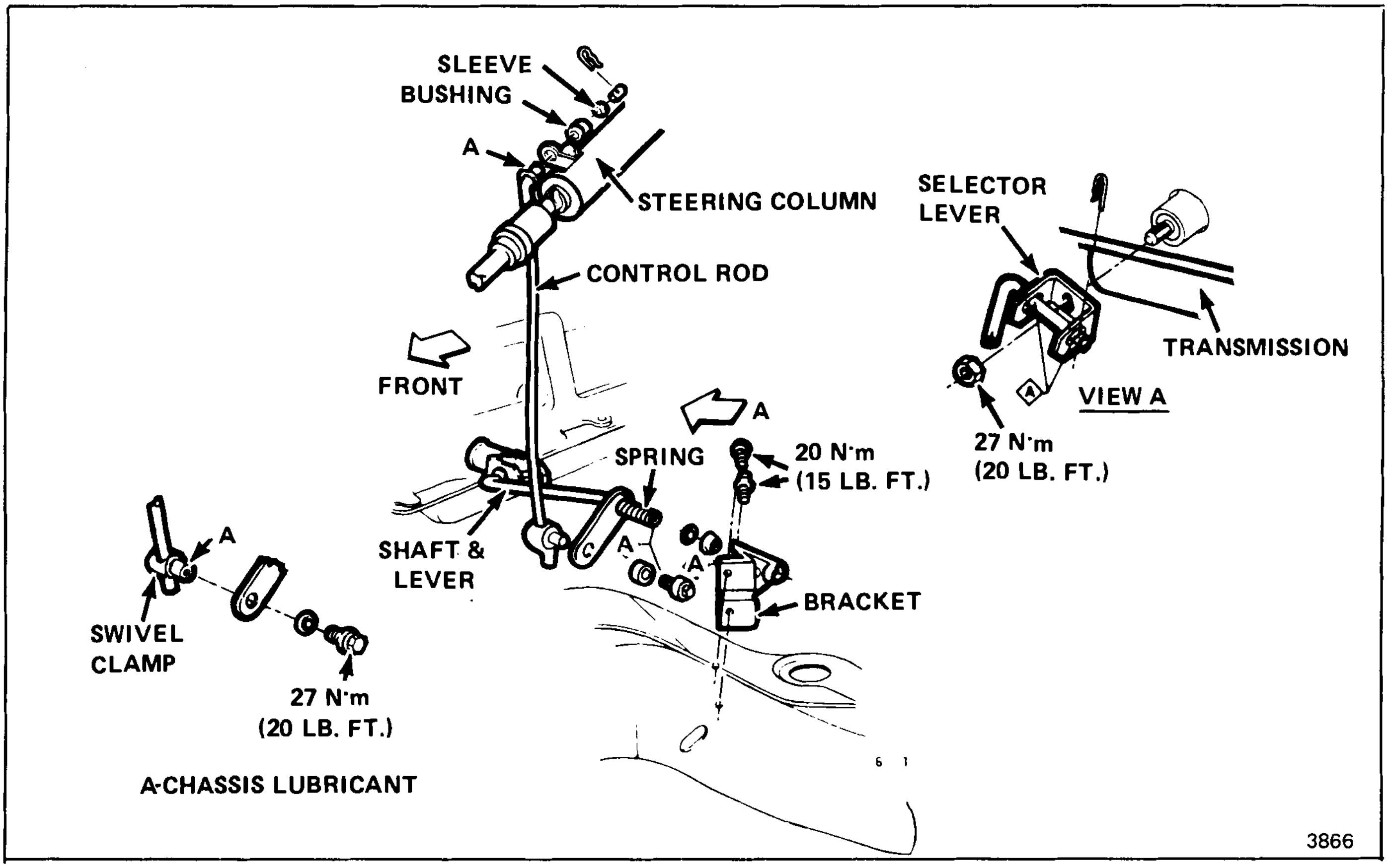

Fig. 7A1-15 Column Shift Controls - "B" Series Shown

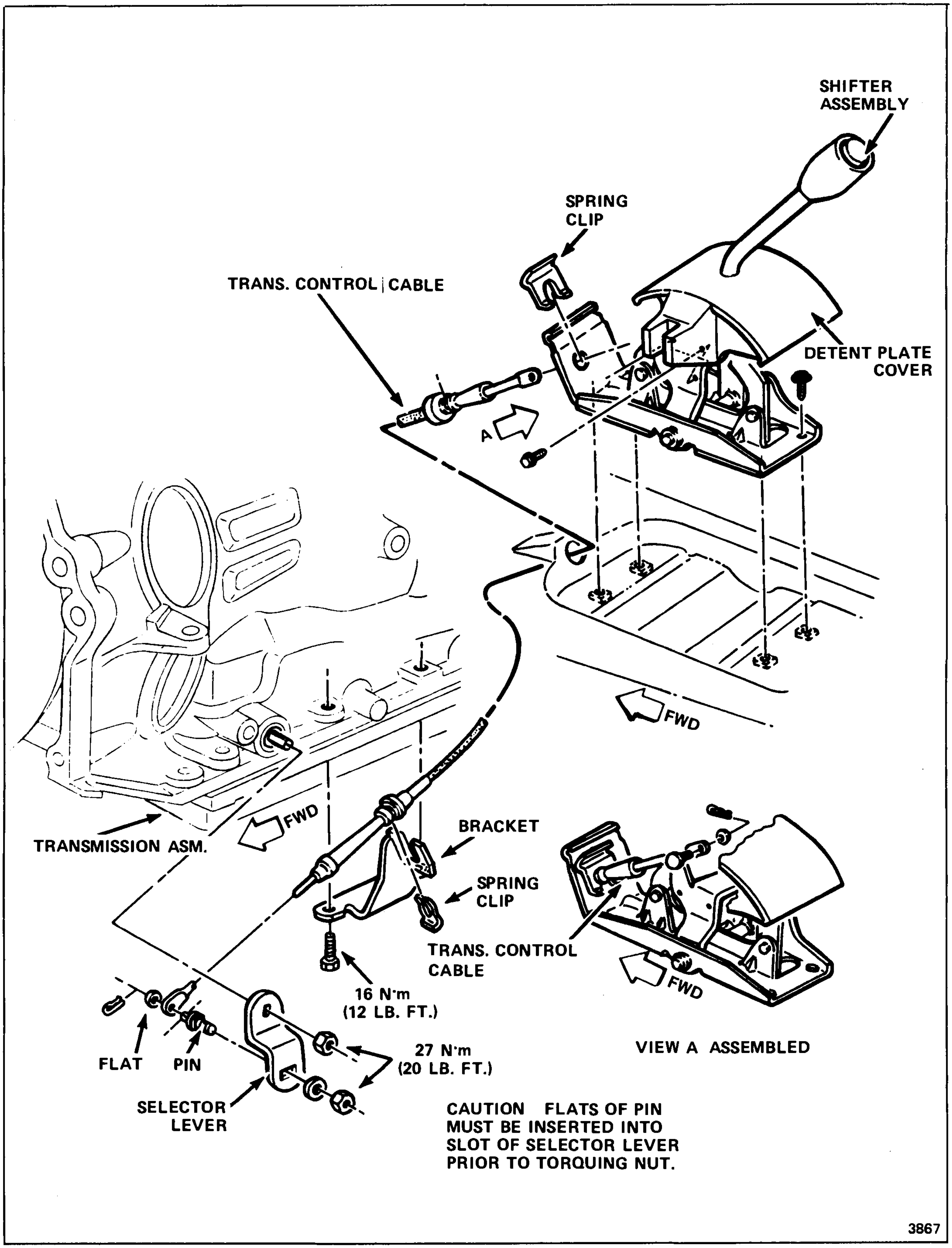

Fig. 7A1-16 Console Shift Controls - "H" Series Shown

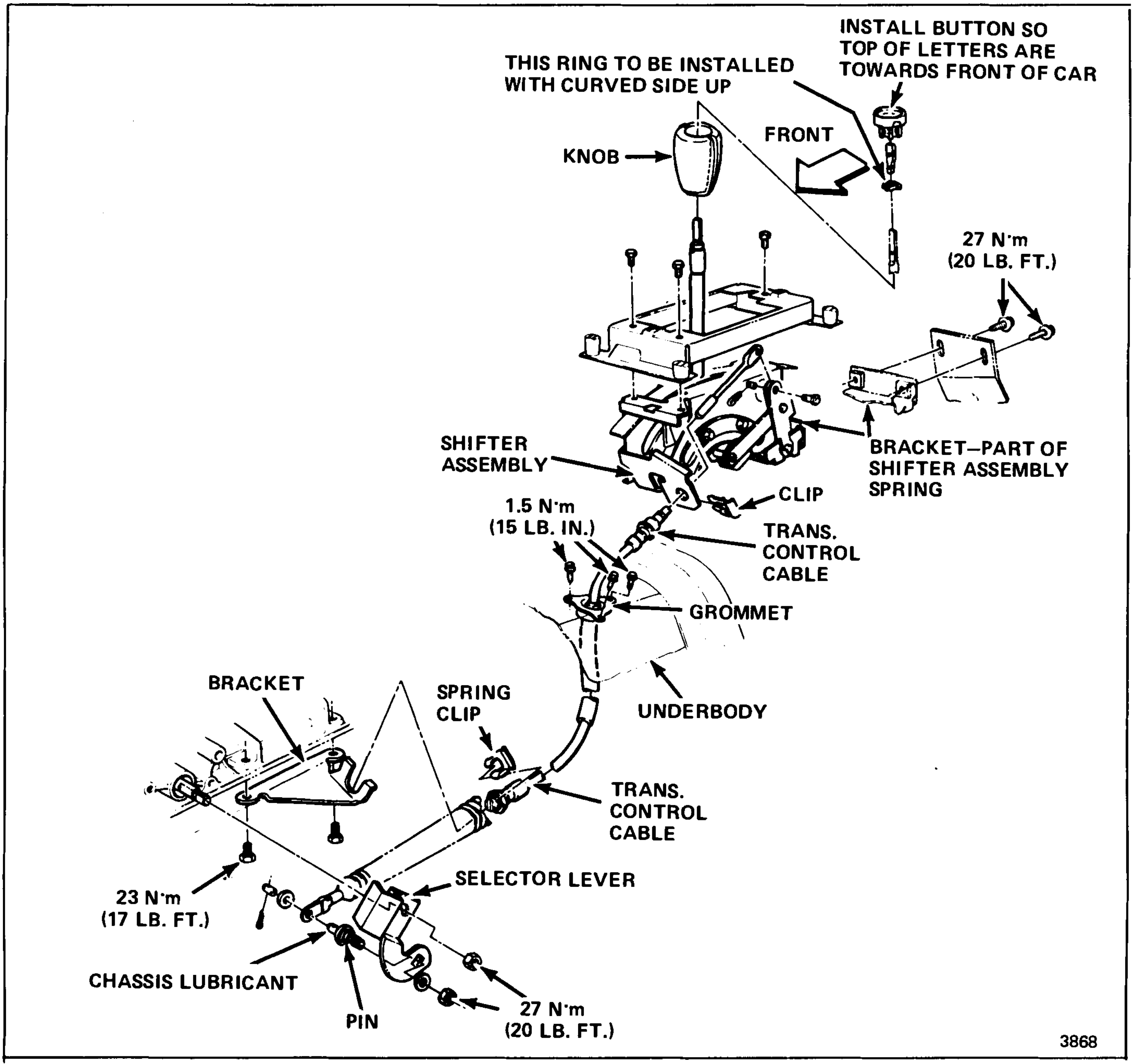

Fig. 7A1-17 Console Shift Controls - "X" Series Shown

UNIT REPAIR

TRANSMISSION

Removal

1. Inside engine compartment, disengage "Snap Lock" (Figs. 7A1-12 or 13) T.V. cable.

2. Remove transmission oil level dipstick, upper bolt retaining filler tube to engine (Fig. 7A1-14) and remove tube from transmission case.

3. Hoist car.

4. Remove retaining bolt for T.V. cable (Figs. 7A1-12 or 14). Remove T.V. cable from link. Plug hole.

5. Disconnect transmission cooler lines at transmission (Figs. 7A1-10 or 11).

6. Remove catalytic converter support bracket.

7. Remove flywheel cover pan and three bolts holding the converter to the flywheel. Support engine.

NOTE: Mark flywheel and converter for reassembly in the same manner.

8. Disconnect speedometer cable.

9. Remove cotter pin and manual shift linkage from selector lever (Fig. 7A1-15). If console equipped, remove spring clip and T.V. cable from bracket at transmission (Figs. 7A1-16 or 17).

10. Remove propeller shaft.

11. Remove transmission support to transmission mount bolts and transmission support to frame bolts.

12. Raise transmission with a jack and remove support.

13. Lower transmission slightly and remove transmission to engine bolts.

14. Lower transmission being careful not to damage cooler lines, T.V. cable and shift linkage.

15. If transmission is to be moved, install converter holding Tool J 21366.

Installation

1. Place transmission on locating pilots. Install downshift cable into clip on transmission. insert oil filler tube and bolt tube in place. Install transmission to engine bolts and torque to 54 N·m (40 lb. ft.).

NOTE: Rotate converter to permit coupling of flywheel and converter in the original position by aligning the marks made before removal.

2. Install transmission support and torque support to frame nuts to 34 N·m (25 lb. ft.). Torque support to transmission mount bolts to 61 N·m (45 lb. ft.). Remove engine support bar.

NOTE: Make sure parking brake cable is above the support.

3. Install shift linkage.

4. Install 3 converter to flywheel bolts and torque to 41 N·m (30 lb. ft.). Install transmission flywheel cover pan.

5. Install T.V. cable to link. Install cable housing into transmission case and torque retaining bolt to 10 N·m (8 lb. ft.).

6. Reconnect catalytic converter support bracket at transmission. Torque nuts to 47 N·m (35 lb. ft.) at transmission and U-bolt.

NOTE: This transmission is easily identified by the word METRIC stamped on the bottom pan.

NOTE: To hold the torque converter from falling during transmission removal, secure converter by drilling hole in J 21366 tool on the 90mm (3-1/2") step side to line up with converter lug bolt hole and retain with bolt. (Fig. 7A1-18)

TRANSMISSION DISASSEMBLY

Removal of Converter

1. With transmission in cradle of portable jack, remove J 21366 and then converter assembly by pulling straight out.

2. Installing Holding Fixture, J 8763-02 on transmission and place into Holding Fixture, J 3289-20, with manual shaft facing bench and oil pan side up (Fig. 7A1-18).

CAUTION: *Do not over torque fixture holding screw.*

NOTE: Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the transmission should be thoroughly cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During inspection and re-assembly, all parts should be thoroughly cleaned with cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts.

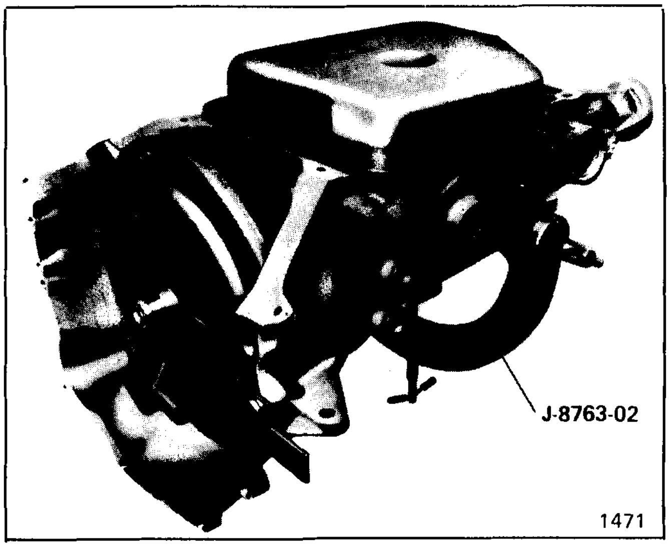

Fig. 7A1-18 Transmission in Holding Fixture

CAUTION: *Do not use solvents on neoprene seals, composition-faced clutch plates or thrust washers.*

TEFLON SEALS

If any teflon seal rings are damaged (distorted, cut, scored, etc.), or do not rotate freely in their groove, and replacement is necessary, do the following:

1. Remove and discard old angle cut seal rings; full circle rings must be cut off.

2. Inspect seal ring groove for burrs or damage.

3.When installing angle cut seal rings, do not overstretch. Make sure cut ends are in same relation as cut. (Fig. 7A1-19) Also, make sure rings are seated in the grooves to prevent damage to the rings during resasembly of mating part over rings. Retain with petrolatum.

4. New angle cut or full circle teflon seal rings may appear to be distorted after being installed. Once exposed to normal transmission oil temperatures, the new seal rings will return to their normal shape and fit freely in their bores.

5. The teflon seal rings allow for a free fit in their bores after operation. The free fit of the rings in their bores does not indicate leakage during operation.

SNAP RINGS

Do not over expand snap rings when removing or installing.

THRUST WASHER SURFACES

The thrust washers and thrust bearings will polish the surface they protect. This is not to be considered a damaged part because of this condition.

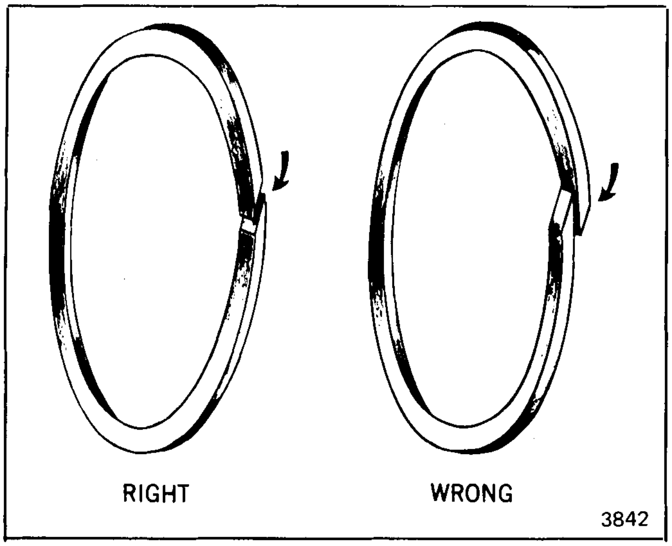

Fig. 7A1-19 Teflon Oil Seal Rings

EXTERNAL PARTS

Removal

1. Remove oil pan and discard gasket.
2. Remove oil screen and discard gasket (Fig. 7A1-20).

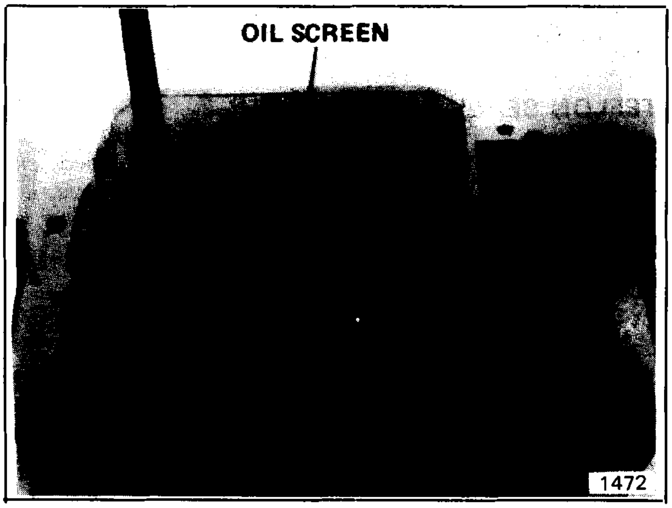

Fig. 7A1-20 Removing Oil Screen

CAUTION: *The two oil screen attaching bolts are about 10mm (3/8") longer than the control valve assembly attaching bolts, and they are not interchangeable.*

3. Control Valve Assembly:

a. Remove throttle lever and bracket assembly (Fig. 7A1-21). Do not bend throttle lever link.

NOTE: T.V. exhaust valve lifter and spring may separate from throttle lever and bracket assembly.

b. Remove manual detent roller and spring assembly (Fig. 7A1-22).

c. Remove remaining control valve assembly attaching bolts.

CAUTION: *Do not drop manual valve.*

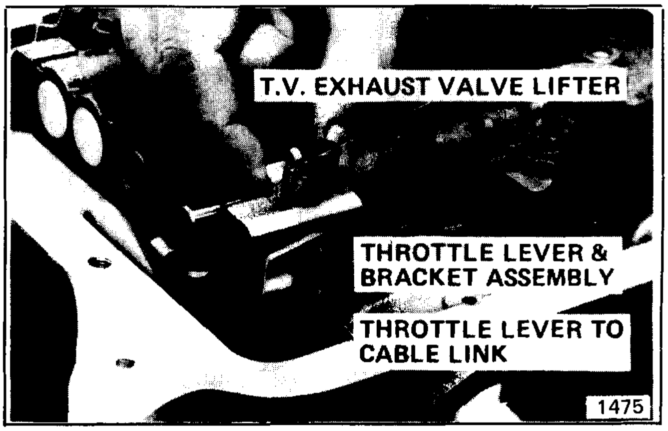

Fig. 7A1-21 Removing Throttle Lever and Bracket

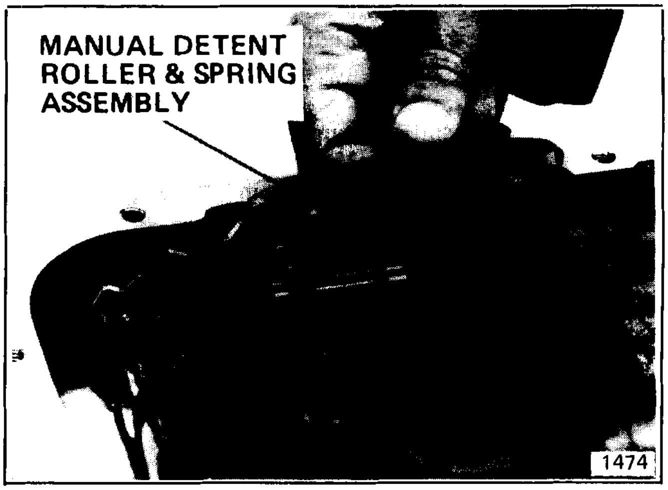

Fig. 7A1-22 Removing Manual Detent Roller & Spring Assembly

d. Holding manual valve with finger, remove control valve assembly, spacer plate, and gaskets together, to prevent the dropping of 4 check balls, located in the control valve assembly (Fig. 7A1-23).

e. Lay control valve assembly down with spacer plate side up and discard gaskets.

4. Remove 1-2 accumulator spring (Fig. 7A1-24).
5. Remove 5th check ball located in case (Fig. 7A1-25).
6. Governor Assembly:

a. Using small screwdriver, remove governor cover retaining ring (Fig. 7A1-26).

b. Using pliers, remove governor cover and discard 2 seal rings; seal rings may be located in case (Fig. 7A1-27).

NOTE: Governor assembly may come out with cover.

CAUTION: *Do not use any type of pliers to remove governor assembly.*

c. Remove governor assembly and governor to case washer from case. It may be necessary to rotate output shaft counterclockwise whole removing the governor.

7. Intermediate Servo Assembly:

a. Using small screwdriver, remove intermediate servo cover retaining ring (Fig. 7A1-28).

b. Using pliers, remove intermediate servo cover and discard seal rings; cover seal ring may be located in case (Fig. 7A1-29).

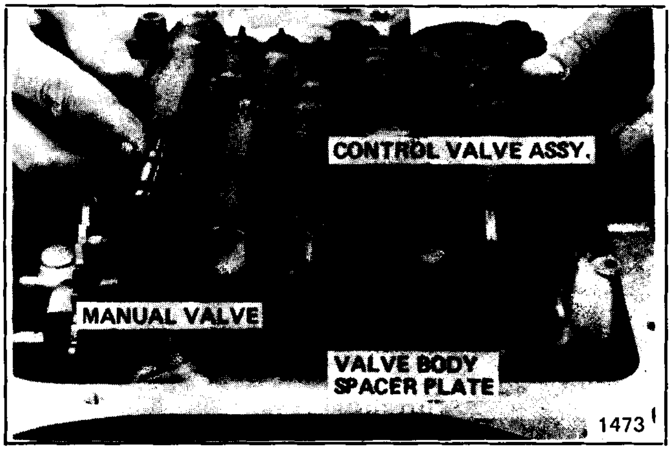

Fig. 7A1-23 Removing Control Valve Assembly From Case

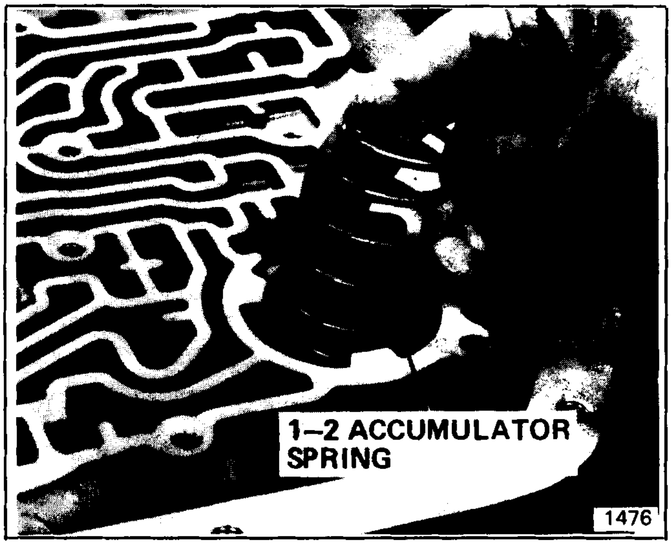

Fig. 7A1-24 Removing 1-2 Accumulator Spring

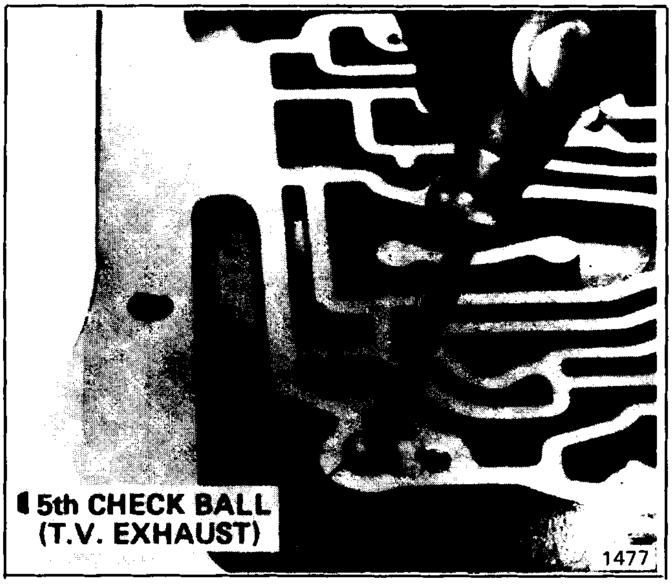

Fig. 7A1-25 Removing 5th Check Ball

c. Remove intermediate servo piston and band apply (Fig. 7A1-30).

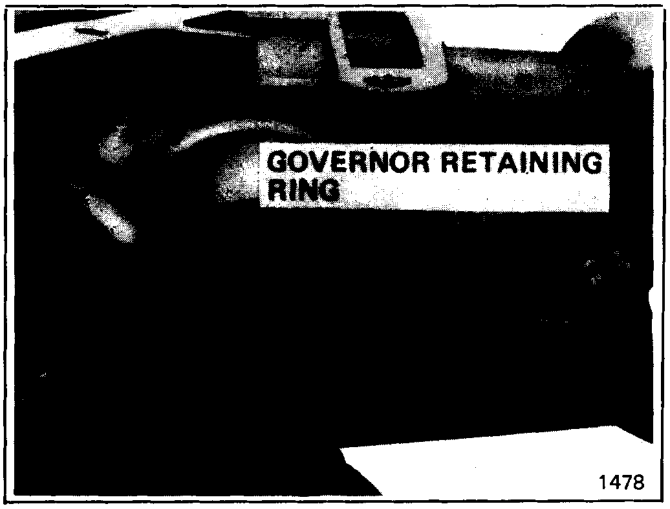

Fig. 7A1-26 Removing Governor Cover Retaining Ring

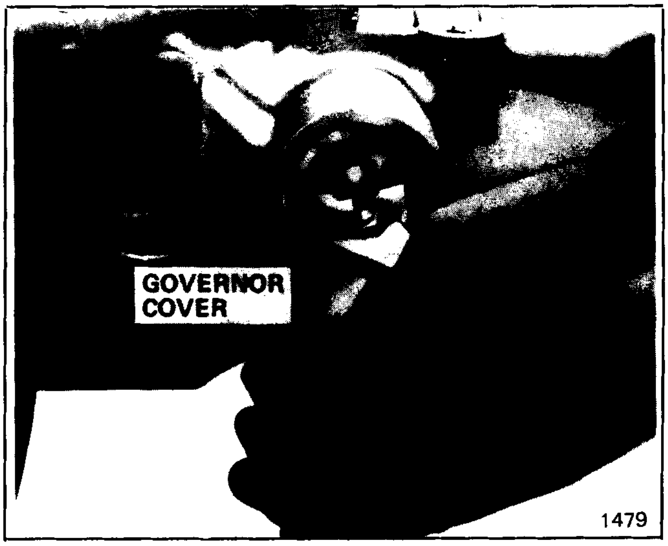

Fig. 7A1-27 Removing Governor Cover

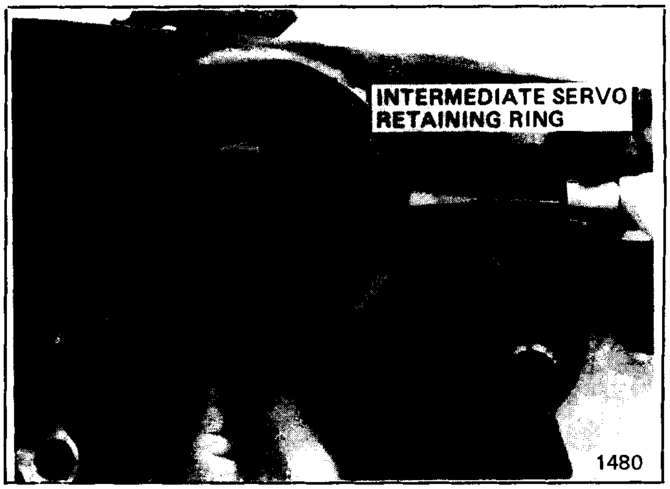

Fig. 7A1-28 Removing Intermediate Servo Retaining Ring

NOTE: If intermediate servo cover and seal assembly can not be removed easily, place shop towels and hand over cover and case. Apply air pressure into the direct clutch assumulator port, (Figs. 7A1-31 and 32).

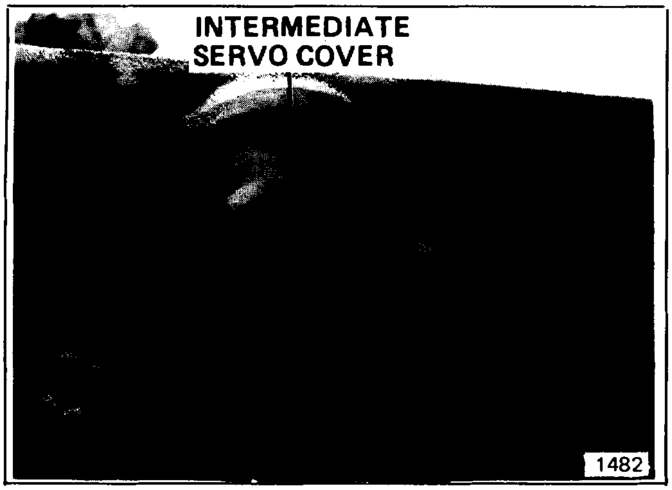

Fig. 7A1-29 Removing Servo Cover and Seal

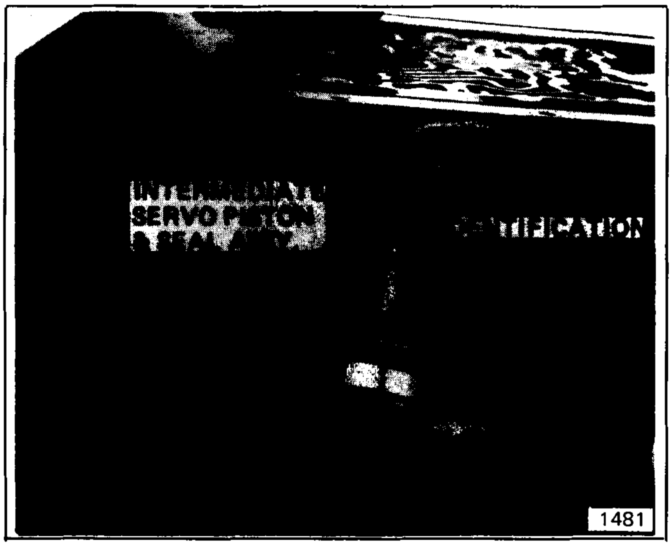

Fig. 7A1-30 Removing Intermediate Servo

8. Check for proper intermediate band apply pin as follows:

a. Install J 25014-2 in intermediate servo bore and retain with intermediate servo cover retaining ring, aligning ring with gap at case slot (Fig. 7A1-33).

b. Install pin J 25014-1 into J 25014-2.

CAUTION: *Make sure the tapered pin end is properly located against the band apply lug. Also, make sure the band anchor pin is properly located in the case and band anchor lug.*

c. Install dial indicator J 8001 and position dial indicator point on top of J 25014-2 zero post and set dial indicator to zero.

NOTE: Seat J 25014-2 squarely against the servo retaining snap ring.

d. Align stepped side of pin J 25014-1 with torquing arm of J 25014-2. Arm must stop against step of pin J 25014-1.

NOTE: If band selection pin does not register between the high and low limits, look for possible problem with the intermediate band, direct clutch or case.

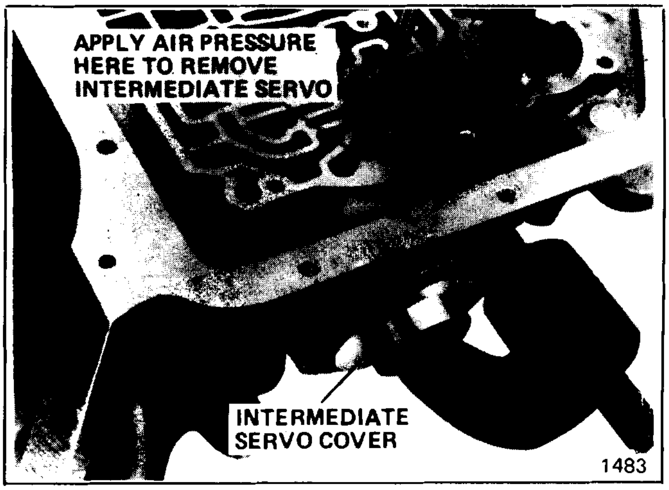

Fig. 7A1-31 Direct Clutch Accumulator Port

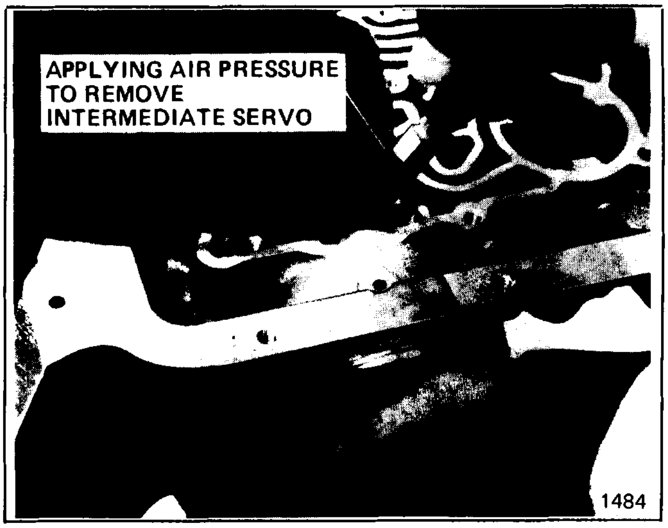

Fig. 7A1-32 Apply Air Pressure to Remove Intermediate Servo

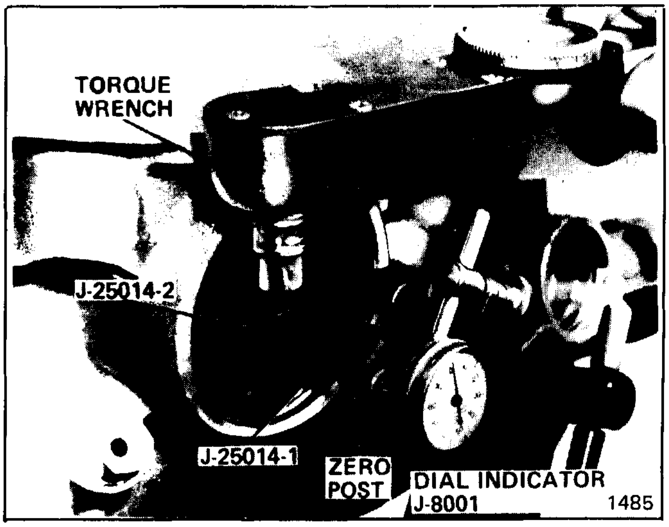

Fig. 7A1-33 Intermediate Band Apply Pin Tools

e. Apply 12 N·m (100 lbs. in.) of torque to hex nut on side of gage. Slide dial indicator over pin J 25014-1 (Fig. 7A1-34). Read dial indicator and see Fig. 7A1-35 below for proper size.

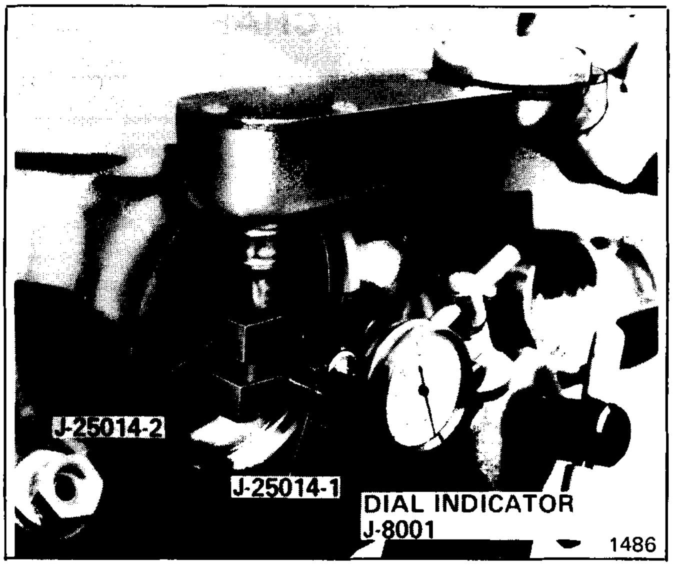

Fig. 7A1-34 Checking for Proper Intermediate Band Apply Pin

NOTE: Dial indicator travel is reversed, making the indicator readings backwards. On an indicator that ranges from 0-100, a 5mm (.020") travel will read 2mm (.080"), a 1.5mm (.060") travel will read 1mm (.040"). The identification ring is located on the band end of the pin.

f. Remove tools J 25014-2 and J 25014-1.

DIAL INDICATOR TRAVEL	APPLY PIN I.D.
.0mm– .72mm (.0" –.029")	1 RING
.72mm–1.44mm (.029"–.057")	2 RINGS
1.44mm–2.16mm (.057"–.086")	3 RINGS
2.16mm–2.88mm (.086"–.114")	WIDE BAND

3875

Fig. 7A1-35 Intermediate Band Apply Pin Selector Chart

FRONT UNIT PARTS

Removal

1. Check front unit end play as follows:

a. Install J 25013-1 sleeve on output shaft first; then bolt J 25013-5 on end of case (Fig. 7A1-36).

b. Turn transmission to vertical position, pump side up.

c. Remove pump to case bolt and washer and install 278mm (11") long bolt and locking nut as shown (Fig. 7A1-37)

d. Push turbine shaft downward.

e. Install J 25022 on J 24773 tool and secure on end of turbine shaft.

f. Mount dial indicator and clamp assembly on bolt, positioning indicator point against cap nut of J 24773.

g. Move output shaft upward by turning the adjusting screw on J 25013-5 unit the white or scribed line on sleeve J 25013-1 begins to disappear (Fig. 7A1-36), the set dial indicator to zero.

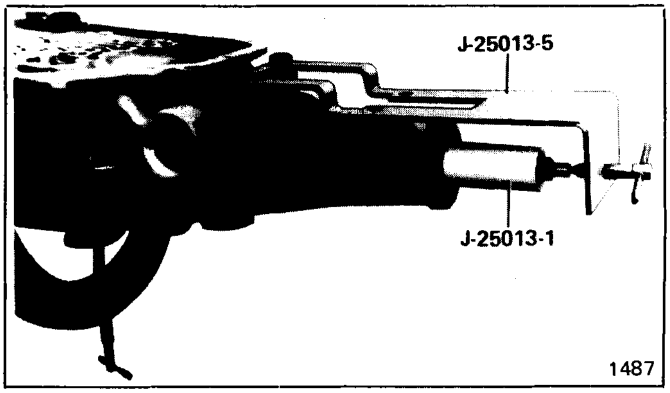

Fig. 7A1-36 Installing Tools On Rear End of Case

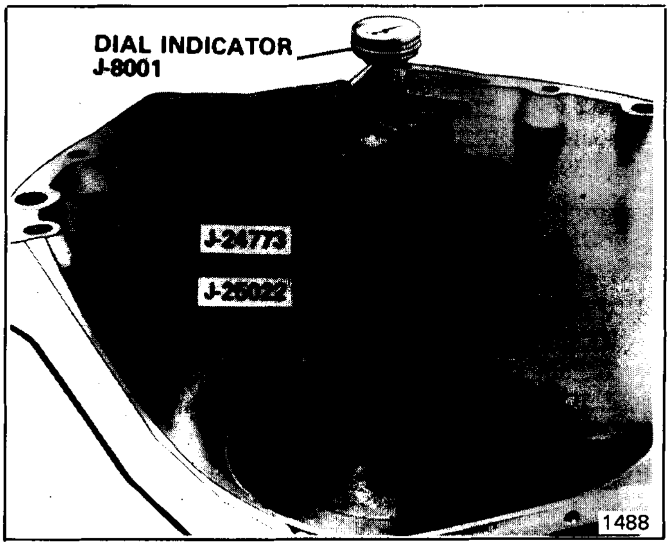

Fig. 7A1-37 Checking Front Unit End Play

h. Pull J 24773 on turbine shaft upward and read end play (Fig. 7A1-37). Front unit end play should be 0.56mm-1.30mm (.022"-.051").

NOTE: Selective washer controlling this end play is located between the output shaft and turbine shaft. If more or less washer thickness is required to bring end play within specifications, select proper washer from the following chart.

FRONT UNIT END PLAY WASHER THICKNESS CHART

THICKNESS	IDENTIFICATION
	Number and/or Color
1.66-1.77mm (0.065"-0.070")	1 --
1.79-1.90mm (0.070"-0.075")	2 --
1.92-2.03mm (0.076"-0.080")	3 Black
2.05-2.16mm (0.081"-0.085")	4 Light Green
2.18-2.29mm (0.086"-0.090")	5 Scarlet
2.31-2.42mm (0.091"-0.095")	6 Purple
2.44-2.55mm (0.096"-0.100")	7 Cocola Brown
2.57-2.68mm (0.101"-0.106")	8 Orange
2.70-2.81mm (0.106"-0.111")	9 Yellow
2.83-2.94mm (0.111"00.116")	10 Light Blue
2.96-3.07mm (0.117"-0.121")	11 --
3.09-3.20mm (0.122"-0.126")	12 --
3.22-3.33mm (0.127"-0.131")	13 Pink
3.35-3.46mm (0.132"-0.136")	14 Green
3.48-3.59mm (0.137"-0.141")	15 Gray

i. Remove dial indicator, clamp assembly, J 24773 and J 25022.

j. Do not remove J 25013-5 or J 25013-1 (Fig. 7A1-36).

2. Pump:

a. If necessary, remove pump oil seal and discard (Fig. 7A1-38).

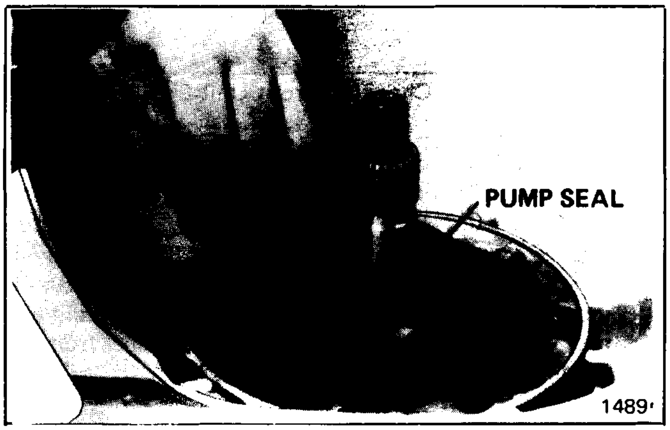

Fig. 7A1-38 Removing Pump Seal

b. Remove remaining pump to case bolts and washers; discard washers.

c. Using J 24773 tool, remove pump assembly, pump to case gasket (Fig. 7A1-39).

3. Forward and Direct Clutch:

a. Grasp turbine shaft and remove direct and forward clutch assemblies (Fig. 7A1-40).

b. Lift direct clutch assembly off of forward clutch assembly.

NOTE: The direct-to-forward clutch thrust washer may stick to the end of the direct clutch housing when it is removed from the forward clutch housing.

4. Remove intermediate band assembly (Fig. 7A1-41).

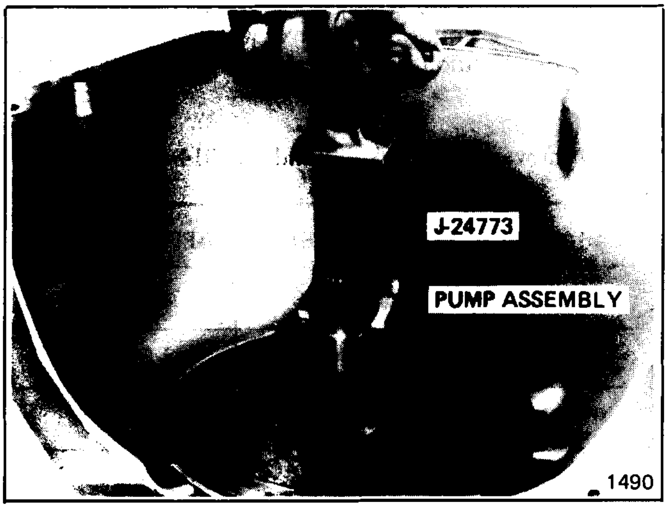

Fig. 7A1-39 Removing Pump Assembly

5. Remove band anchor pin (Fig. 7A1-42).

FRONT GEAR PARTS

Removal

1. Remove output shaft to turbine shaft front selective washer (Fig. 7A1-43).

NOTE: This washer may be stuck to the end of the turbine shaft.

2. Check Rear Unit end play as follows:

a. Loosen J 25013-5 adjusting screw on output shaft and push output shaft downward (Fig. 7A1-44).

b. Install gage clamp on case as shown (Fig. 7A1-45).

c. Install dial indicator J 8001 and plunger extension J 7057. Position extension against end of output shaft and set dial indicator to zero.

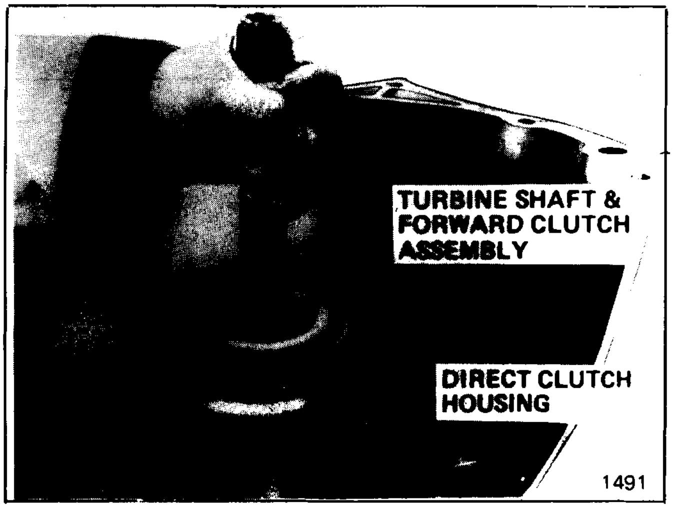

Fig. 7A1-40 Removing Forward and Direct Clutch Assemblies

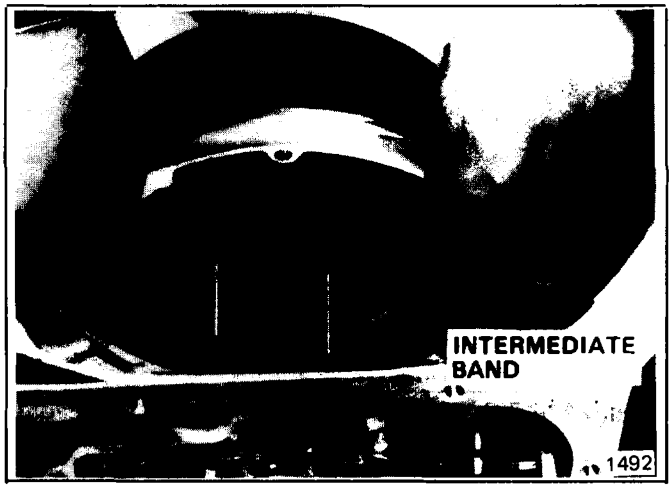

Fig. 7A1-41 Removing Intermediate Band Assembly

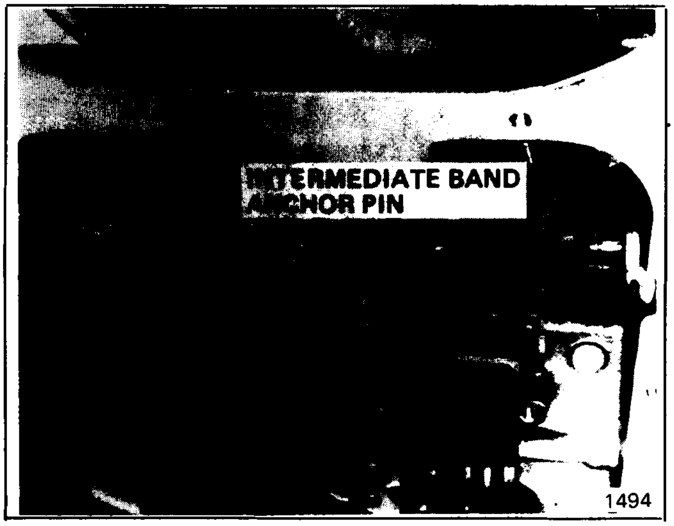

Fig. 7A1-42 Removing Intermediate Band Anchor Pin

d. Move output shaft upward by turning adjusting screw on J 25013-5 until the white or scribed line on sleeve J 25013 begins to disappear; then read end play should be 0.10-0.64mm (.004"-.025").)

Fig. 7A1-43 Location of Front Selective Washer

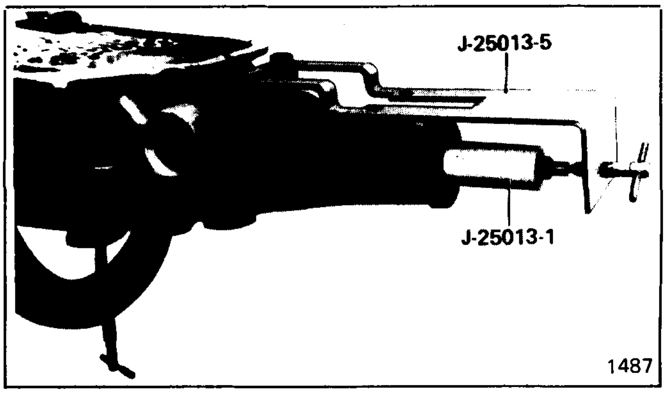

Fig. 7A1-44 Installing Tools on Rear End of Case

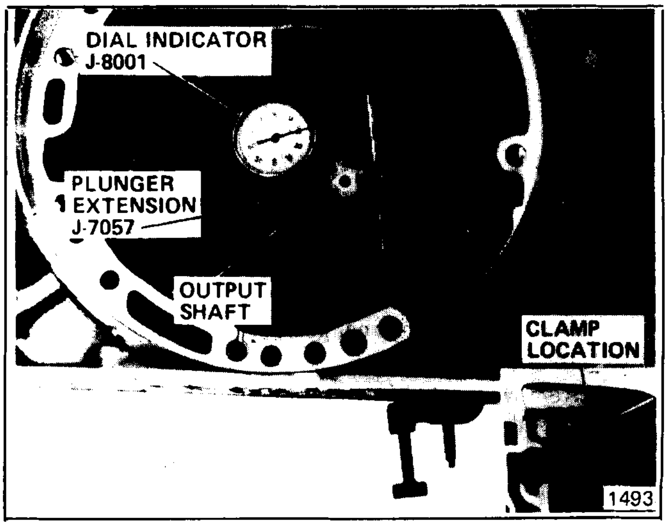

Fig. 7A1-45 Checking Rear Unit End Play

NOTE: Selective washer controlling this end play is located between the front internal gear thrust washer and output shaft snap ring. If more or less washer thickness is required to bring end play within specifications, select proper washer from the following chart:

REAR UNIT END PLAY WASHER THICKNESS CHART

THICKNESS	IDENTIFICATION
	Number and/or Color
2.90-3.01mm (0.114"-0.119")	1 Orange
3.08-3.19mm (0.121"-0.126")	2 White
3.26-3.37mm (0.128"-0.133")	3 Yellow
3.44-3.55mm (0.135"-0.14")	4 Blue
3.62-3.37mm (0.143"-0.147")	5 Red
3.80-3.91mm (0.150"-0.154")	6 Brown
3.98-4.09MM (0.157"-0.161")	7 Green
4.16-4.27mm (0.164"-0.168")	8 Black
4.34-4.45mm (0.171"-0.175")	9 Purple

e. Remove dial indicator and clamp assembly. Do not remove J 25013 tools (Fig. 7A1-44).

NOTE: It may be necessary to tighten J 25013 adjusting screw on output shaft to remove snap ring.

3. Using snap ring pliers, remove output shaft to selective washer snap ring (Fig. 7A1-46).

4. Front Internal Gear:

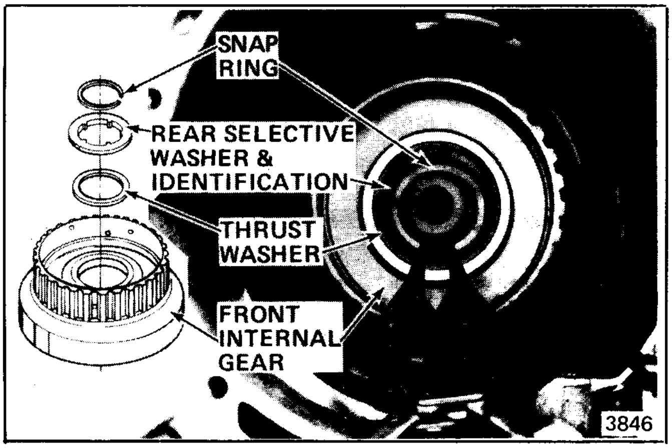

Fig. 7A1-46 Removing Output Shaft to Selective Washer Snap Ring

a. Remove front internal gear, rear selective washer and tanged thrust washer.

b. Remove rear selective washer and thrust washer from front internal gear.

5. Remove front carrier assembly and the front internal gear to front carrier roller bearing assembly (Fig. 7A1-47).

NOTE: Models CN, CU and CZ use a front carrier with 2 pinions. All other models use 4 pinions.

NOTE: The front sun gear to front carrier thrust bearing assembly may come out as the front carrier to removed.

6. Remove front sun gear and front sun gear to front carrier roller thrust bearing assembly (Fig. 7A1-48).

NOTE: This thrust bearing requires only one thrust race.

7. Input drum and rear sun gear assembly:

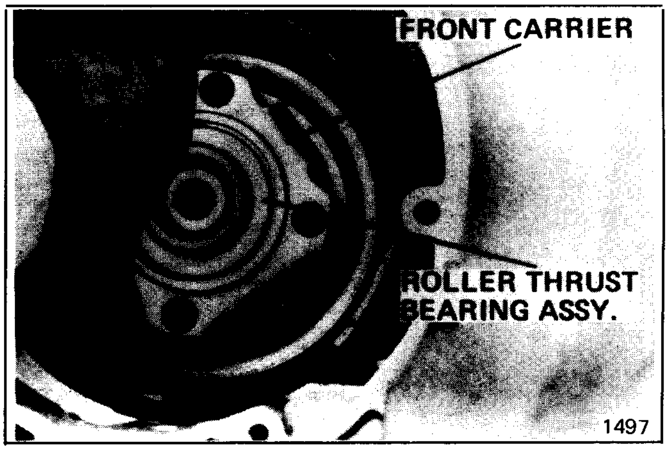

Fig. 7A1-47 Removing Front Carrier and Roller Bearing Assembly

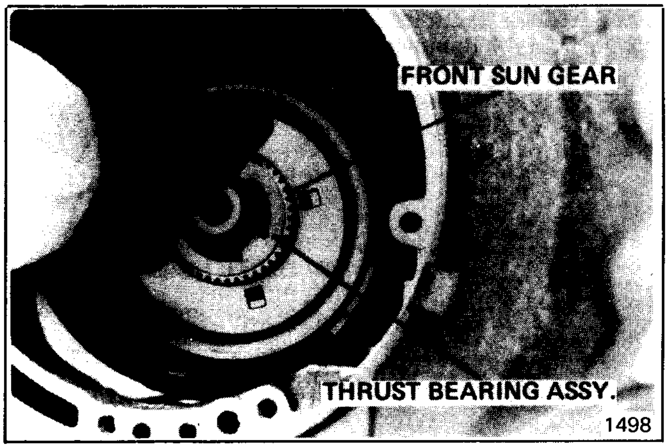

Fig. 7A1-48 Removing Thrust Bearing Assembly and Front Sun Gear

a. Remove input drum and rear sun gear (Fig. 7A1-49).

b. Remove the 4 tanged input drum to reverse clutch housing thrust washer from rear of input drum or from reverse clutch housing.

8. Low and Reverse clutch housing assembly:

CAUTION: *If low and reverse clutch housing assembly has to be removed, the low and reverse clutch piston travel must be checked.*

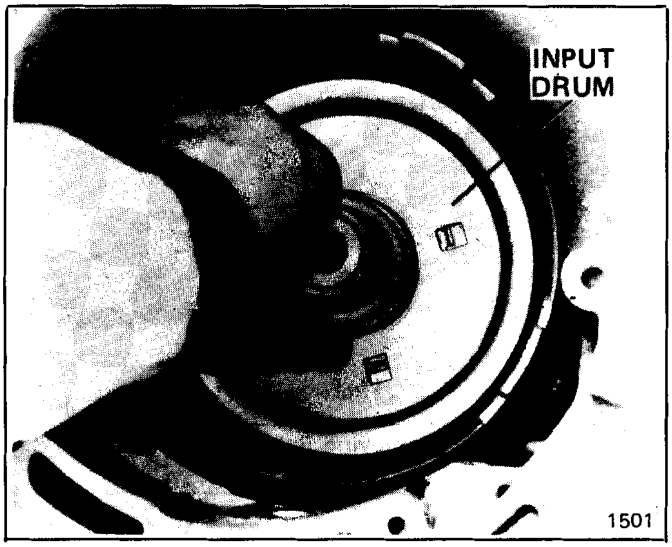

Fig. 7A1-49 Removing Input Drum and Rear Sun Gear

a. Using a No. 14 sheet metal screw, remove housing to case cut plug and seal by turning screw 2 or 3 turns and pulling straight out. Discard cup plug and seal (Fig. 7A1-50).

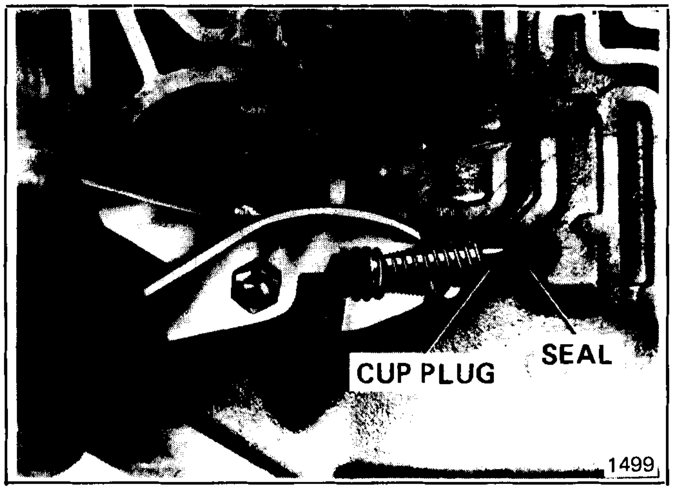

Fig. 7A1-50 Removing Cup Plug and Seal

NOTE: If cup plug will not remove, grind approximately 20mm (3/4") from end of 6.3mm (No. 4) easy out to remove cup plug. Then use No. 14 sheet metal screw to remove seal.

b. Remove low and reverse clutch housing to case beveled snap ring (Fig. 7A1-51).

NOTE: The flat side of the ring should have been against the low and reverse clutch housing with beveled side up.

c. Using J 25013, remove low and reverse clutch housing assembly by moving J 25012 back and forth (Fig. 7A1-52).

d. Remove low and reverse clutch housing to case spacer ring (Fig. 7A1-53).

REAR GEAR PARTS

Removal

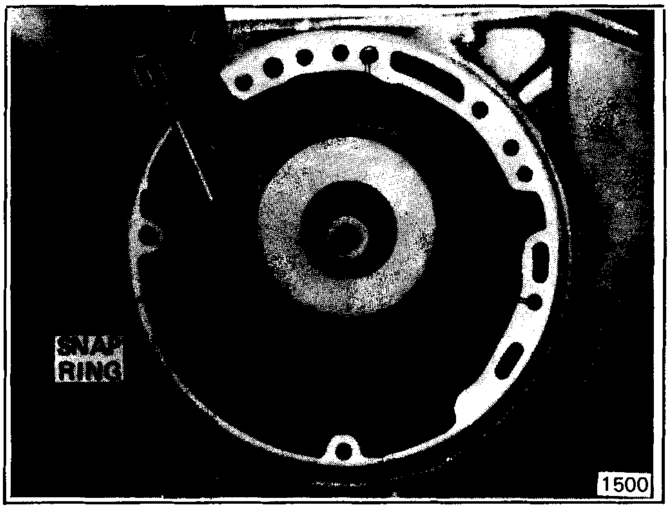

Fig. 7A1-51 Removing Low and Reverse Housing to Case Snap Ring

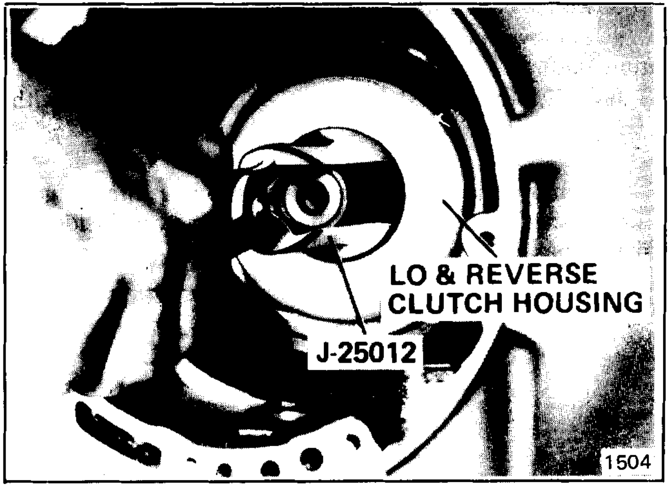

Fig. 7A1-52 Removing Low and Reverse Clutch Housing

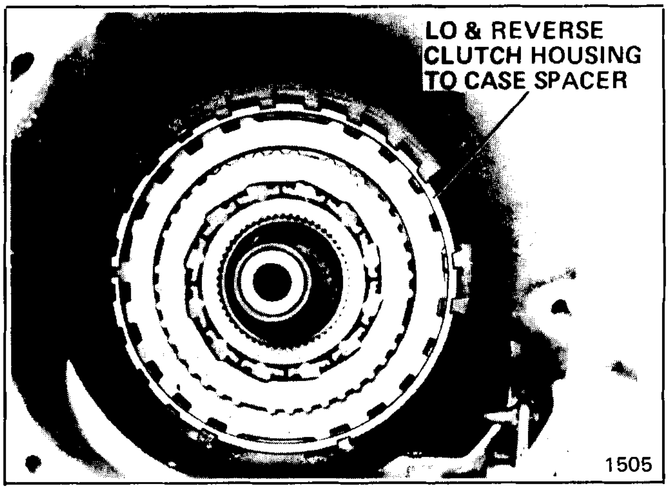

Fig. 7A1-53 Proper Location of Low and Reverse Housing to Case Spacer Ring

NOTE: Make sure governor has been removed at this time.

1. Grasp output shaft and lift out remainder of rear unit parts and lay down in a horizontal position (Fig. 7A1-54).

2. Remove low and reverse clutch selective spacer.

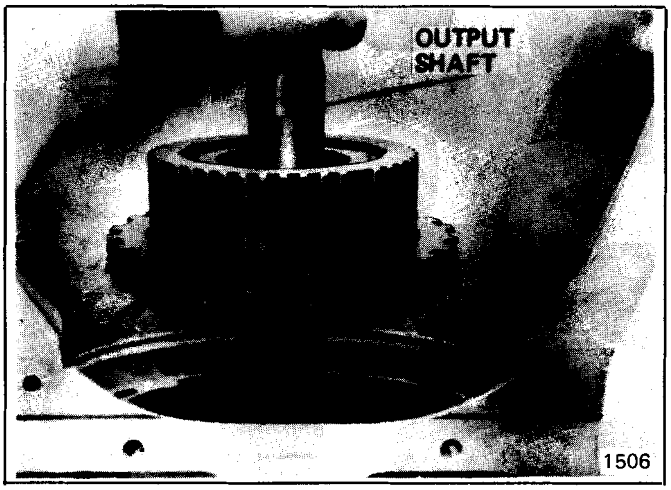

Fig. 7A1-54 Removing Rear Unit Parts

3. Roller clutch and rear carrier:

a. Remove roller clutch and rear carrier assembly from output shaft.

NOTE: Models CN, CU and CZ use a rear carrier with 2 pinions. All other models use 4 pinions.

b. Remove the 4 tanged rear carrier to rear internal gear thrust washer from the end of the rear carrier, or inside the rear internal gear (Fig. 7A1-55).

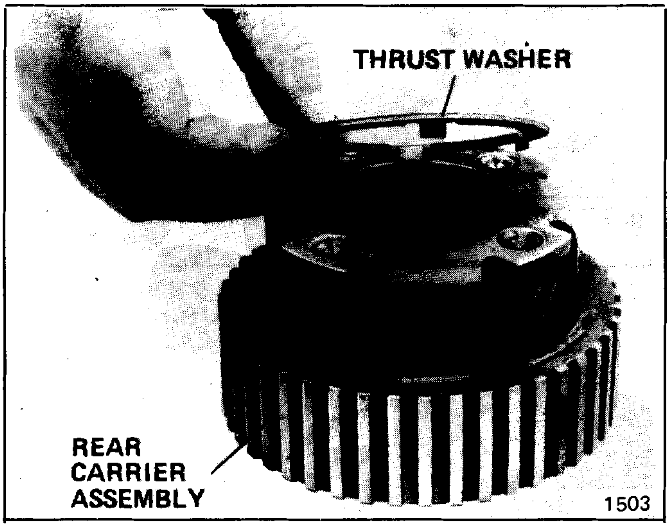

Fig. 7A1-55 Removing Thrust Washer

4. Remove low and reverse clutch plates from output shaft.

5. Rear internal gear:

a. Remove rear internal gear to rear sun gear roller thrust bearing assembly from rear internal gear.

b. Remove rear internal gear from output shaft (Fig. 7A1-56).

6. Turn transmission to horizontal position and remove J 25013-5 and J 25013-1 tools from case. Turn transmission to vertical position with rear end up.

7. If necessary, remove real oil seal (Fig. 7A1-57).

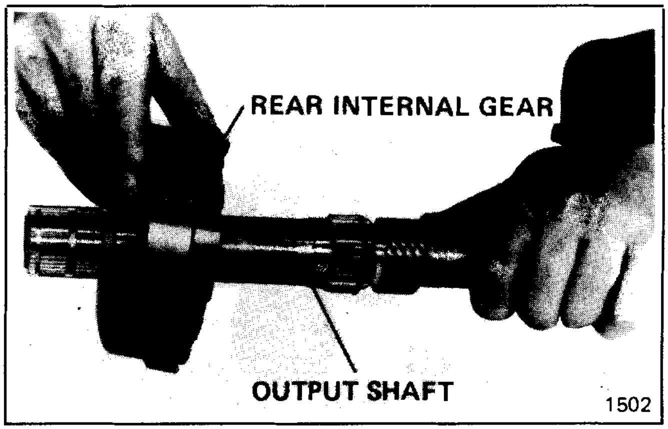

Fig. 7A1-56 Removing Rear Internal Gear

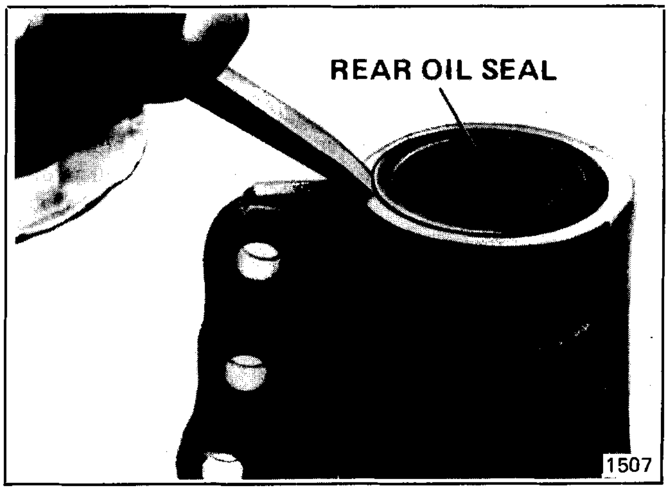

Fig. 7A1-57 Removing Rear Oil Seal

MANUAL SHAFT AND PARKING PAWL PARTS

(Fig. 7A1-58)

Removal

1. Turn transmission to horizontal position, oil pan side up.

2. If necessary, remove manual shaft and parking linkage as follows:

a. Remove hex nut which holds inside detent lever to manual shaft (Fig. 7A1-59).

b. Remove parking brake actuator rod and inside detent lever assembly.

c. Remove manual shaft retaining pin from case and slide manual shaft out (Fig. 7A1-60).

d. Inspect manual shaft to case seal for damage.

If necessary, pry out manual shaft seal using screwdriver (Fig. 7A1-61).

e. Remove parking brake bracket (Fig. 7A1-62).

f. Remove parking brake pawl shaft retaining pin (Fig. 7A1-63).

g. Using 6.3mm (No. 4) easy out, remove parking brake pawl cup plug and discard (Fig. 7A1-64).

NOTE: Grind approximately 20mm (3/4") from end of 6.3mm (No. 4) easy out to remove cup plug.

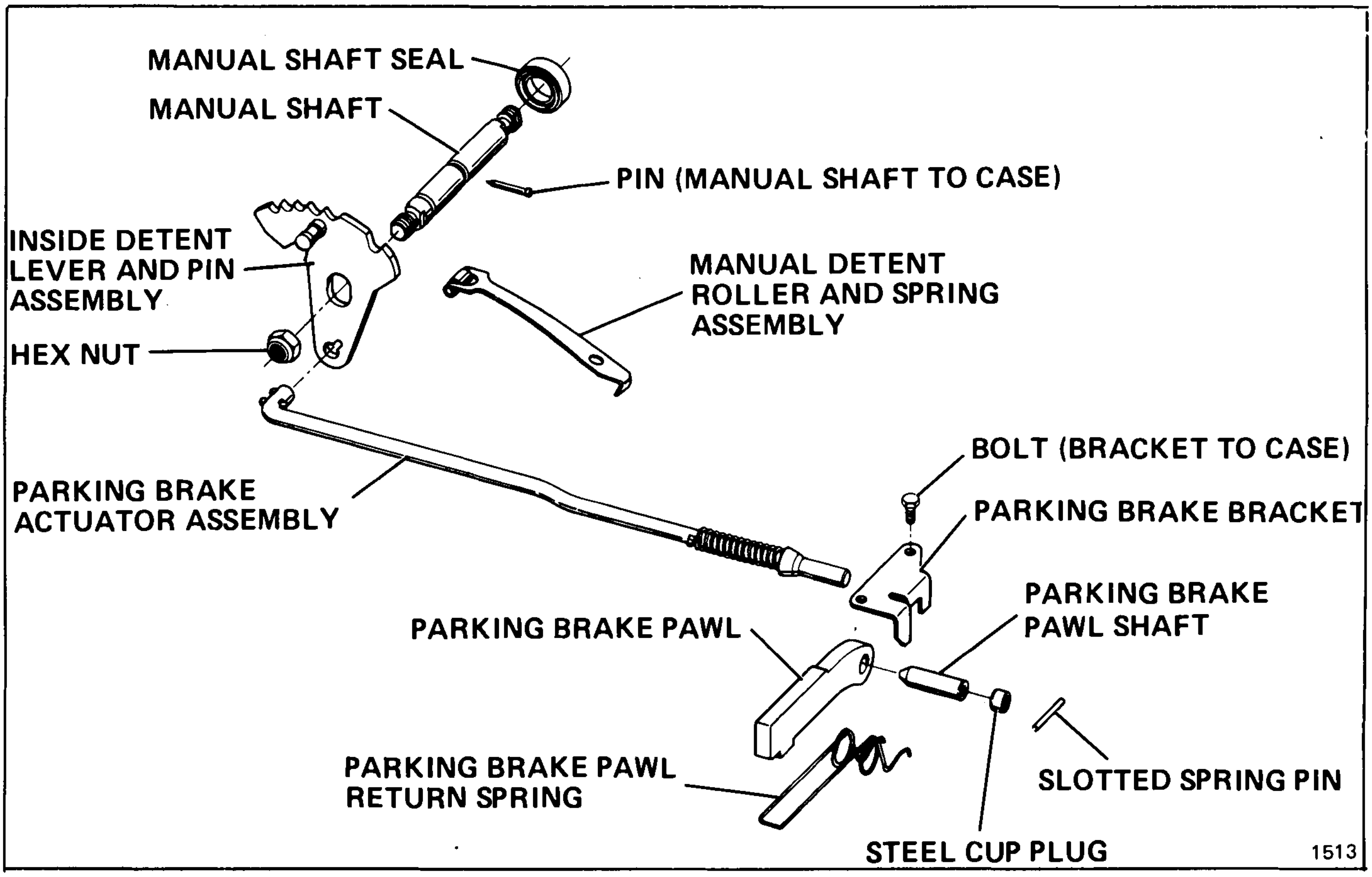

Fig. 7A1-58 Manual Shaft and Parking Shaft Parts

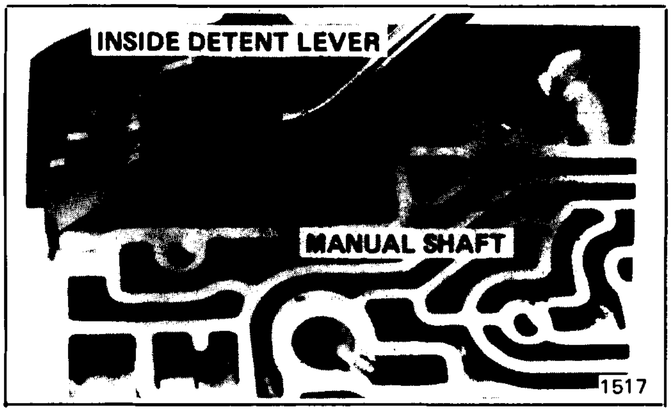

Fig. 7A1-59 Removing Manual Shaft Nut

h. Using sheet metal screw or 4mm (No. 3) easy out, remove parking brake pawl shaft (Fig. 7A1-65).

i. Remove parking pawl and return spring.

INSPECTION OF CASE ASSEMBLY

(Figs. 7A1-66 and 67)

NOTE: Models CN, CU and CZ case has a tapped hole with a hex head plug or a pressure switch in it near the intermediate servo bore. Do remove the switch or plug unless replacement is required.

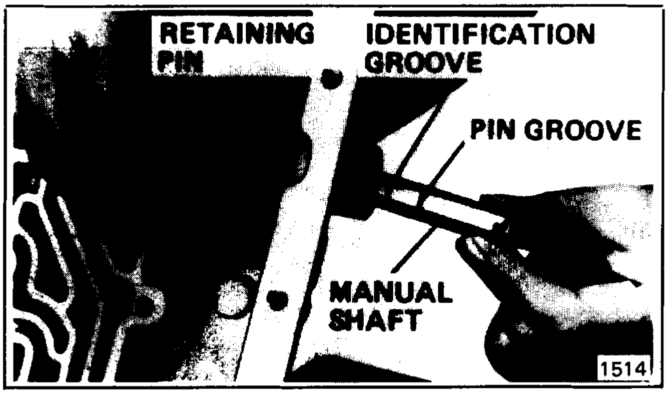

Fig. 7A1-60 Removing Manual Shaft From Case

1. Inspect case assembly for damage, cracks, porosity or interconnected oil passages. If case is porous, refer to porosity repair.

2. Inspect orifice plug in the intermediate servo bore. If the plug requires replacement, place the new plug, orifice end first into plug hole in case. Drive plug flush to slightly below top of plug hole.

3. Inspect the exhaust vents for being opened.

4. Inspect reverse clutch lugs, governor bore, intermediate servo bore, speedometer bore and snap ring grooves for damage.

5. Inspect reverse clutch seal and intermediate band anchor pin bores for damage.

6. Inspect vent assembly in case for damage. Do not remove unless replacement is required.

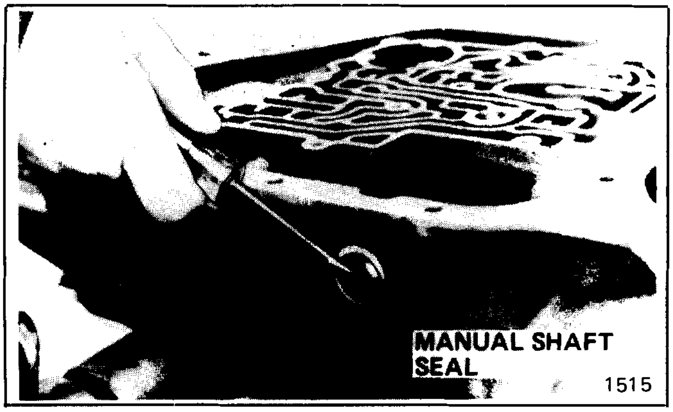

Fig. 7A1-61 Removing Manual Shaft Seal From Case

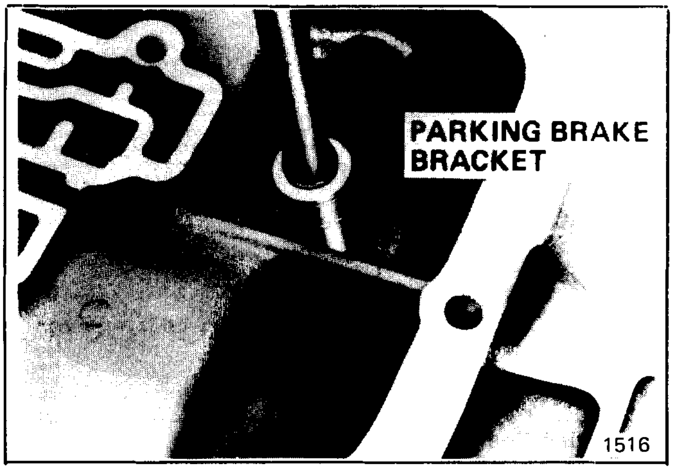

Fig. 7A1-62 Removing Parking Brake Bracket Bolt

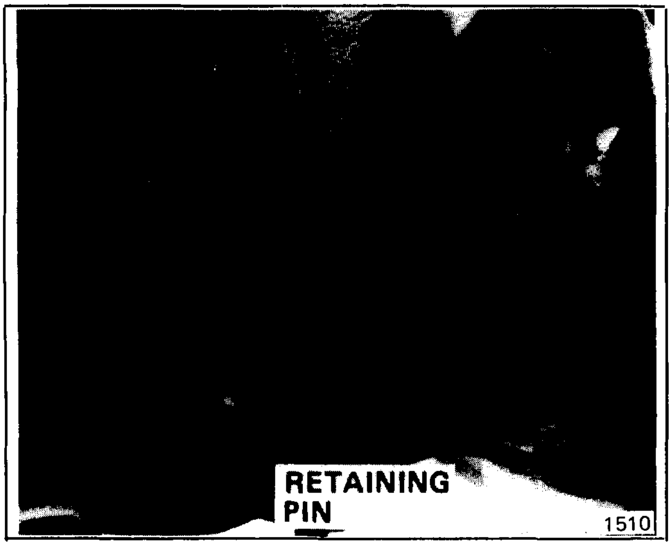

Fig. 7A1-63 Removing Parking Brake Pawl Shaft Pin

7. Inspect for damaged or stripped bolt holes. If any threaded holes require heli-coils or equivalent, install these to renew the threads.

8. Move transmission to vertical position, rear end up.

9. Inspect cooler line connectors for damage. Do not remove unless replacing.

10. Inspect case bushing for damage or scoring.

11. If removed, install a new oil seal, using J 21426 (Fig. 7A1-68).

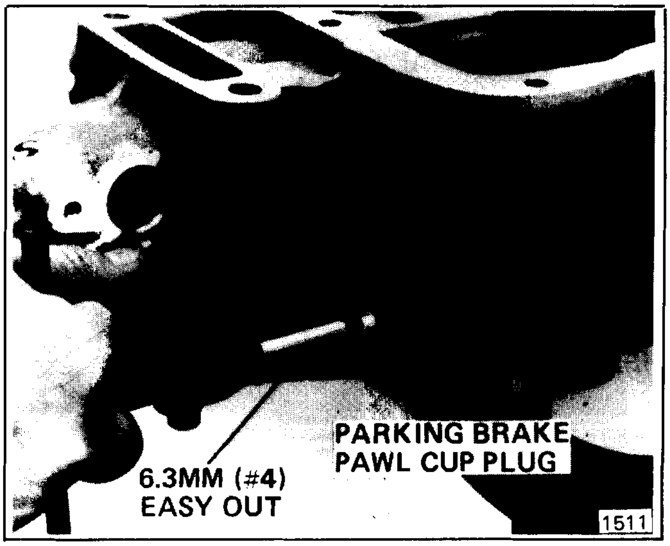

Fig. 7A1-64 Removing Parking Brake Pawl Shaft Cup Plug from Case

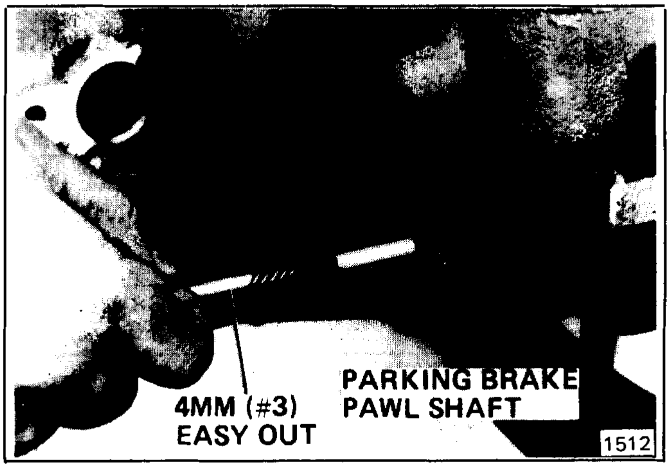

Fig. 7A1-65 Remove Parking Brake Pawl Shaft From Case

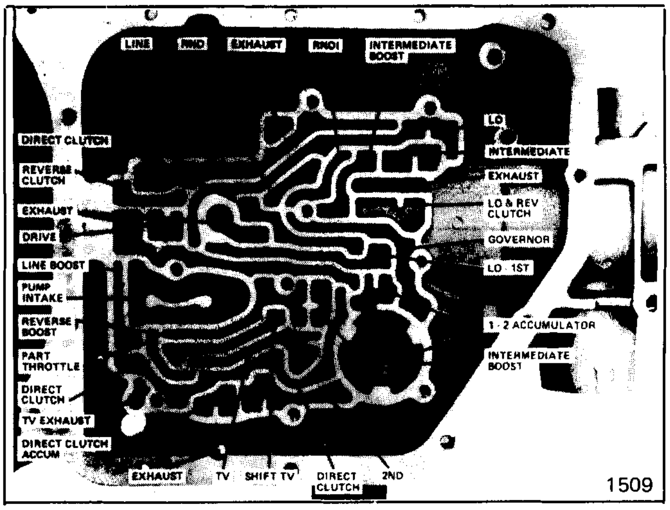

Fig. 7A1-66 Oil Passages-Bottom of Case

12. If vent was removed, apply Loctite primer "T", or equivalent, to the outside diameter of the vent that locates in the case and Loctite 35, or equivalent, to the vent hole in the case. Install vent, using a rubber or plastic hammer.

13. If removed, install new cooler line washer(s) and connector(s); torque to 20.0-27.0 N·m (15-20 ft. lbs.).

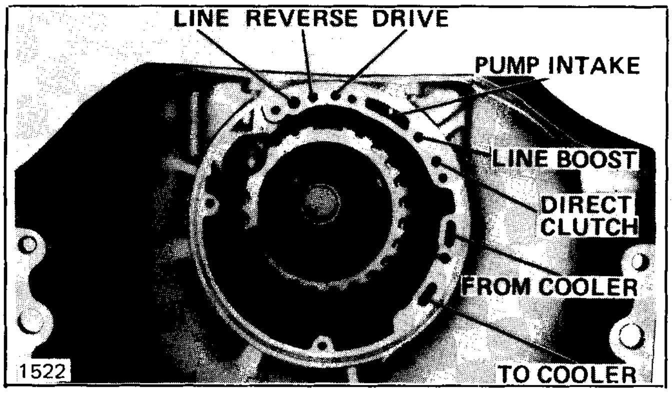

Fig. 7A1-67 Oil Passages-Front of Case

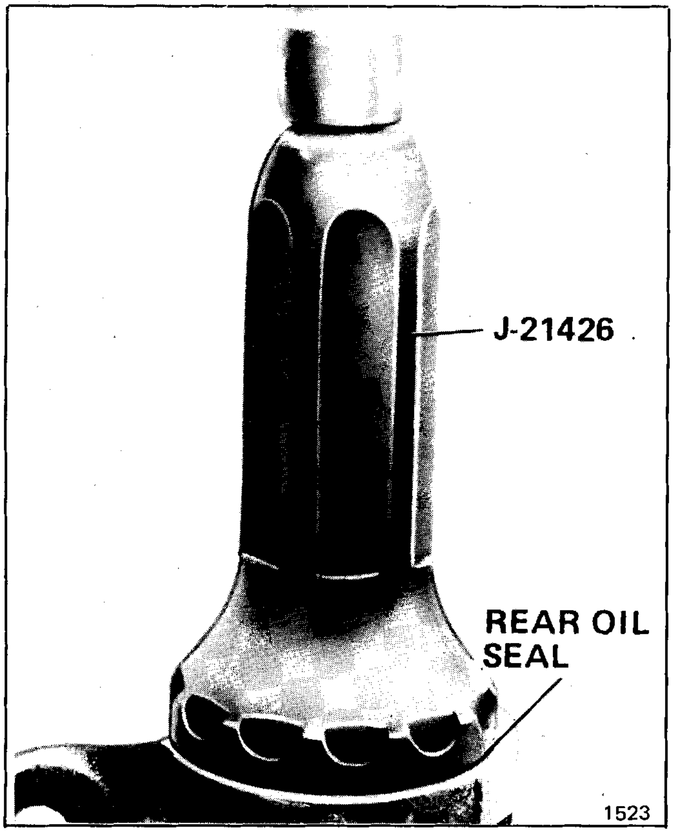

Fig. 7A1-68 Installing Rear Oil Seal

MANUAL SHAFT AND PARKING PAWL PARTS

(Fig. 7A1-69)

Inspection

1. Align actuator rod tangs with hole in inside detent lever and separate.

2. Inspect parking brake actuator rod for damage or broken retainer lugs.

3. Inspect parking brake actuator spring for damage.

5. Inspect parking pawl for cracks or damage.

6. Inspect parking pawl return spring for deformed end or coils.

7. Inspect parking pawl shaft for damage.

8. Inspect parking brake bracket for cracks or wear.

9. Inspect inside detent lever for cracks or loose pin.

10. Inspect manual shaft for damaged threads and the flats for raised edges. File down any raised edges.

Reassembly

1. Turn transmission to horizontal position, oil pan side up.

2. If removed, install new manual shaft seal, with lip facing inward into transmission case, using a 13mm (9/16") socket to seat seal (Fig. 7A1-70).

3. Install parking pawl and return spring with tooth toward inside of case and parking pawl return spring under pawl tooth with spring ends toward inside of case (Fig. 7A1-71). Make sure spring ends locate against case pad.

4. Align parking pawl and return spring with case shaft bore.

5. Install parking pawl shaft, tapered end first.

6. Using 10mm (3/8") rod, install new parking pawl shaft cup plug, open end out, past retaining pin hole (Fig. 7A1-72).

7. Install parking pawl shaft retaining pin.

8. While holding the parking pawl toward center of transmission, install parking brake bracket. Torque bolts to 20.0-27.0 N·m (15-20 lb. ft.).

9. Install parking brake actuator rod into inside detent lever on pin side, locating lever between actuator rod tangs.

10. Install parking brake actuator rod and inside detent lever with detent lever pin toward center of transmission and actuator plunger between parking pawl and parking brake bracket (Fig. 7A1-73).

> **CAUTION:** *File any burrs or raised edges off the manual shaft that could damage the seal during installation of the shaft.*

11. Install manual shaft, small identification ring groove first, through case. Install manual shaft (Fig. 7A1-74).

12. Aligning inside detent lever with flats on manual shaft, install inside detent lever on shaft.

13. Install hex nut on manual shaft and torque to 27.0-34.0 N·m (20-25 lb. ft.).

REAR GEAR PARTS

Output Shaft (Fig. 7A1-75)

> **NOTE:** The service output shaft has one speedometer drive gear retaining clip hole at the front speedometer gear location which is about 6.3 mm (1/4") diameter and opposite this hole is another clip hole which is about 4.0 mm (5/32"). The shaft also has the same size holes at the rear speedometer gear location (Fig. 7A1-76).

1. Inspect journals and snap ring grooves for wear or damage.

2. Inspect lubrication passages for being plugged or damaged.

3. Inspect splines for damage.

4. Inspect governor drive gear for rough or damaged teeth.

5. Inspect speedometer drive gear for rough or damaged teeth and also the clip for damage.

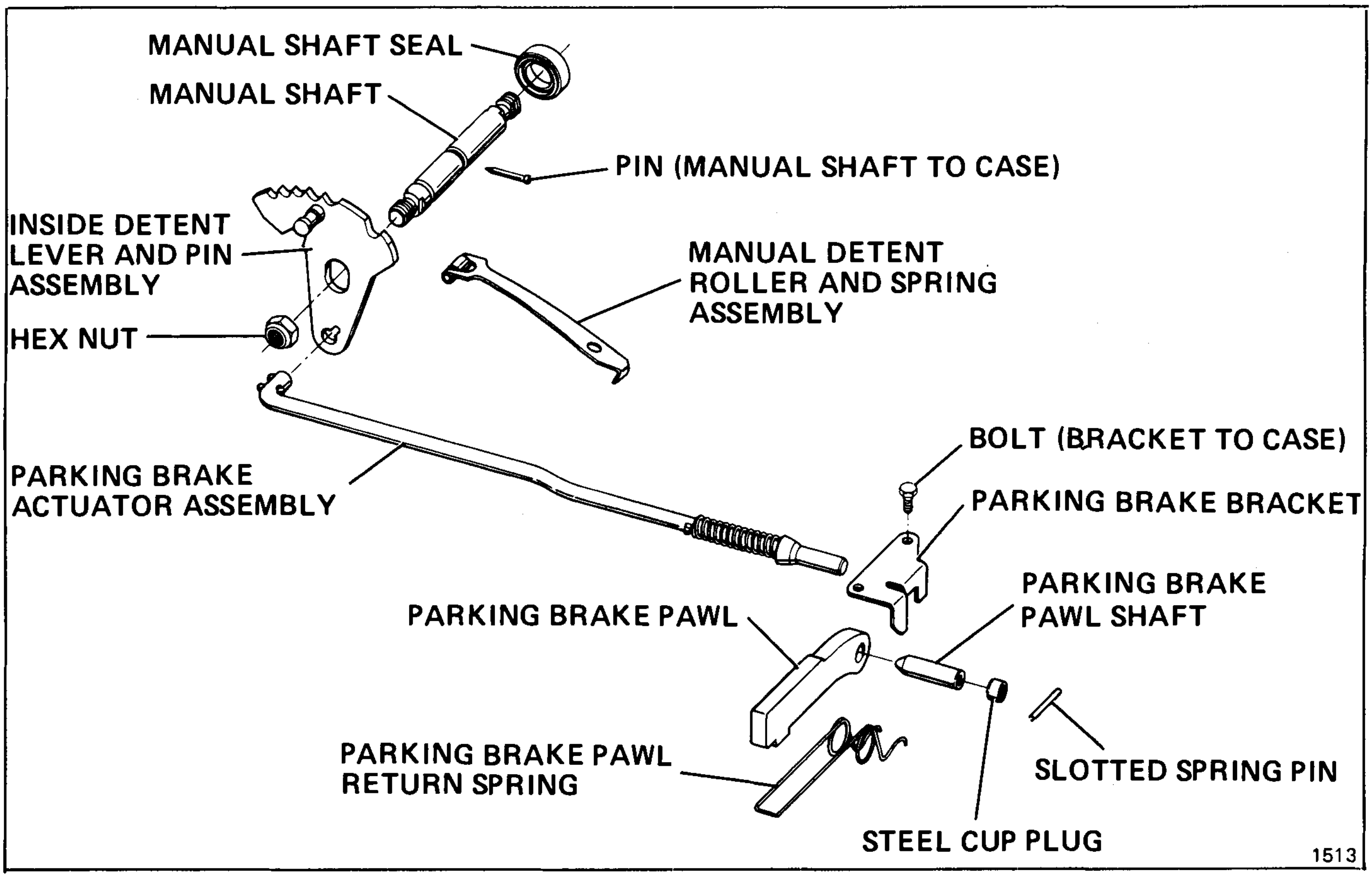

Fig. 7A1-69 Manual Shaft and Parking Shaft Parts

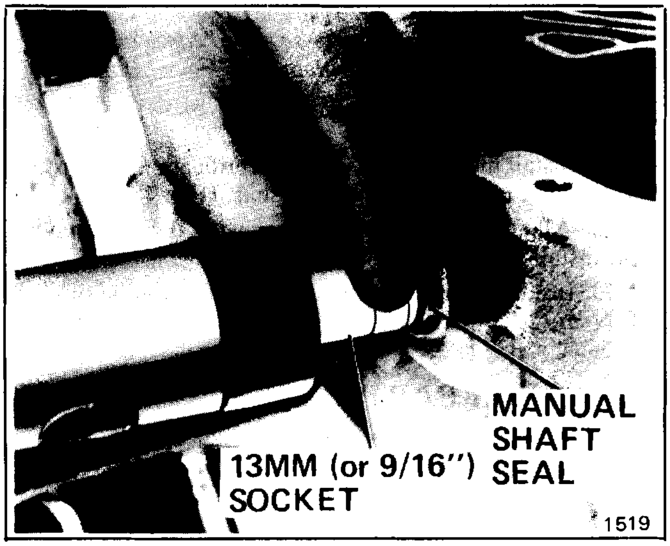

Fig. 7A1-70 Installing Manual Shaft Seal Into Case

6. If necessary to replace speedometer drive gear, proceed as follows:

a. Depress speedometer drive gear clip.

b. Remove gear and clip,tapping gear lightly with plastic hammer.

NOTE: Make sure speedometer drive gear is located so speedometer driven gear will mesh with it.

c. Place speedometer drive gear clip with the tanged end in the correct hole in the output shaft (Fig. 7A1-76).

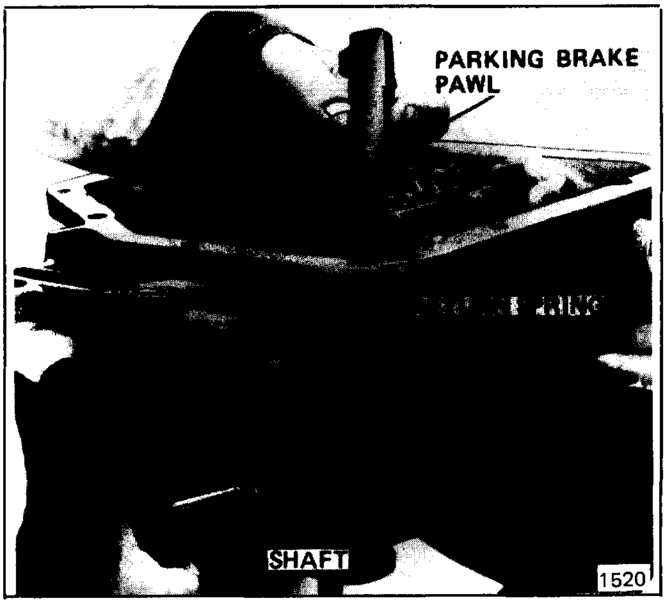

Fig. 7A1-71 Installing Parking Brake Pawl

d. Align the slot of the speedometer drive gear with the clip and install the gear.

7. If necessary, remove rear internal gear to output shaft snap ring. If damaged, replace with a new snap ring (Fig. 7A1-75).

Rear Internal Gear

1. Inspect rear internal gear, splines, teeth and bearing surface for wear, cracks or damage.

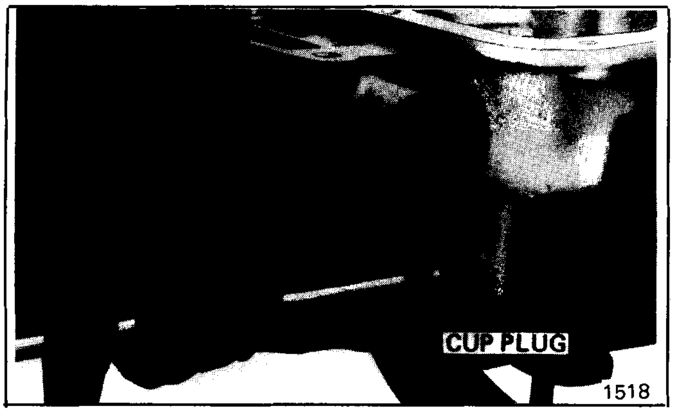

Fig. 7A1-72 Installing Parking Brake Pawl Cup Plug

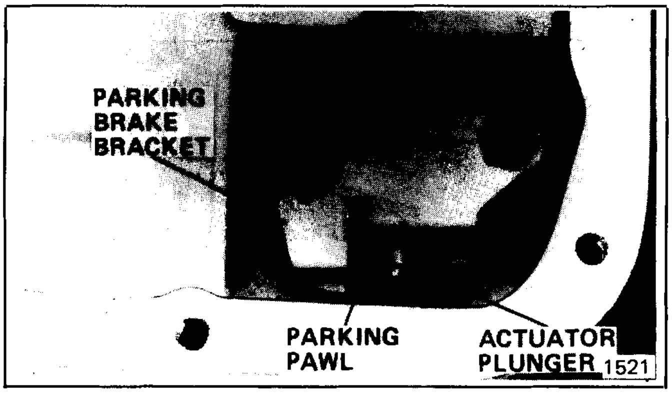

Fig. 7A1-73 Installing Parking Brake Actuator Assembly

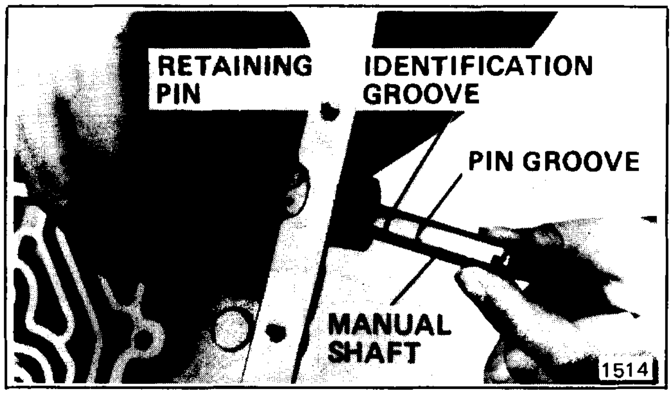

Fig. 7A1-74 Installing Manual Shaft Into Case

2. Inspect parking pawl lugs for cracks or damage.

3. Install rear internal gear, hub end first, on output shaft, as shown in Fig. 7A1-77.

4. Thoroughly clean, air dry and inspect closely, the rear internal gear to rear sun gear roller thrust bearing assembly for pitted or rough conditions.

5. Install rear internal gear to rear sun gear roller thrust bearing assembly by placing the small diameter race over the output shaft (Fig. 7A1-78).

Roller Clutch and Rear Carrier Assembly

NOTE: Models CN, CU and CZ use a rear carrier with 2 pinions. All other models use 4 pinions.

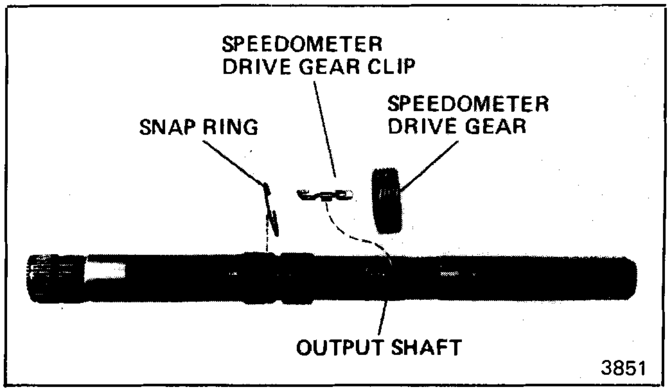

Fig. 7A1-75 Output Shaft

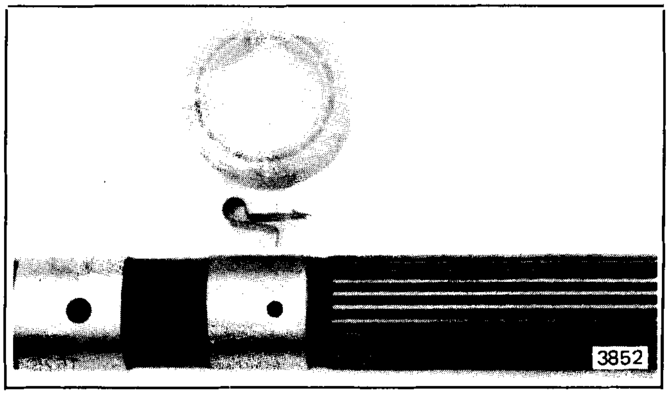

Fig. 7A1-76 Speedometer Drive Gear Locations

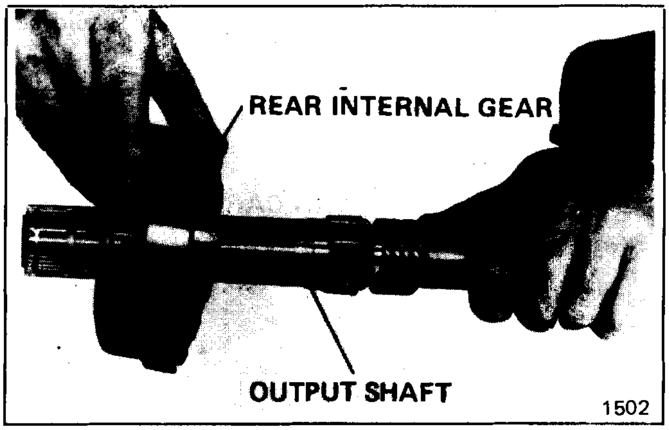

Fig. 7A1-77 Installing Rear Internal Gear

Inspection

1. Remove roller clutch race. Inspect race and spline for scoring or wear (Fig. 7A1-79).

2. Remove roller clutch assembly and inspect roller bearings, cage and springs for damage or wear.

3. Remove and inspect rear carrier rear carrier to roller clutch thrust washer for signs of scoring or excessive wear.

4. Inspect 4 tanged rear carrier to rear internal gear thrust washer for being scored or distorted tangs.

5. Inspect rear carrier for damage.

6. Inspect roller clutch cam ramps for damage.

7. Inspect bushing for damage or scoring.

8. Inspect planet pinions for damage, rough bearings or tilt.

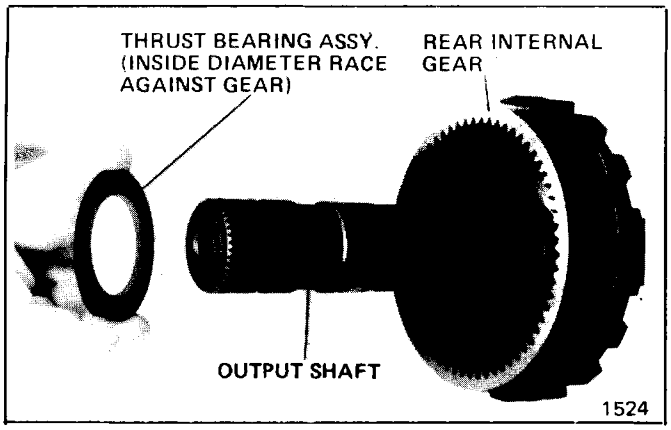

Fig. 7A1-78 Installing Thrust Bearing Assembly

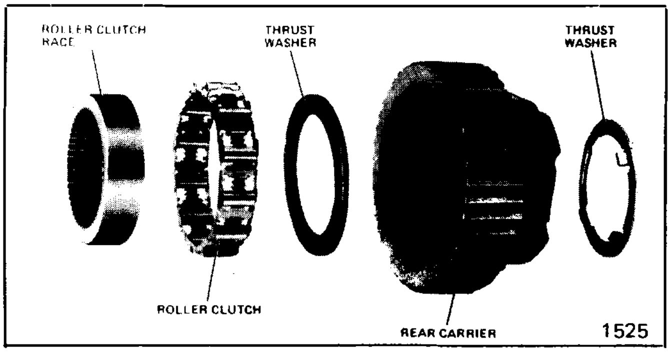

Fig. 7A1-79 Roller Clutch and Rear Carrier - Exploded View

9. Check pinion end play. Pinion end play should be 0.24-0.69mm (0.009"-0.027") (Fig. 7A1-80).

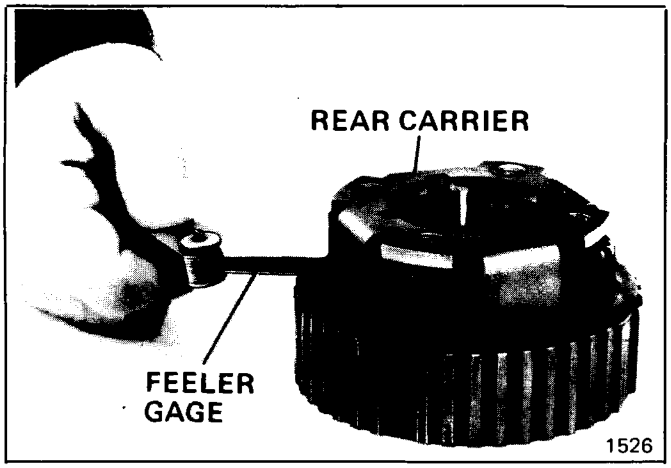

Fig. 7A1-80 Checking Rear Carrier Pinion End Play

Reassembly

1. Install roller clutch to rear carrier thrust washer (Fig. 7A1-81).

2. Install rollers that may have come out of roller clutch cage, by compressing the energizing spring with forefinger and inserting roller from outer edge (Fig. 7A1-82).

3. Install roller clutch assembly into roller clutch cam (Fig. 7A1-83).

4. Install roller clutch race, spline side out and rotate clutch race counterclockwise into position (Fig. 7A1-84).

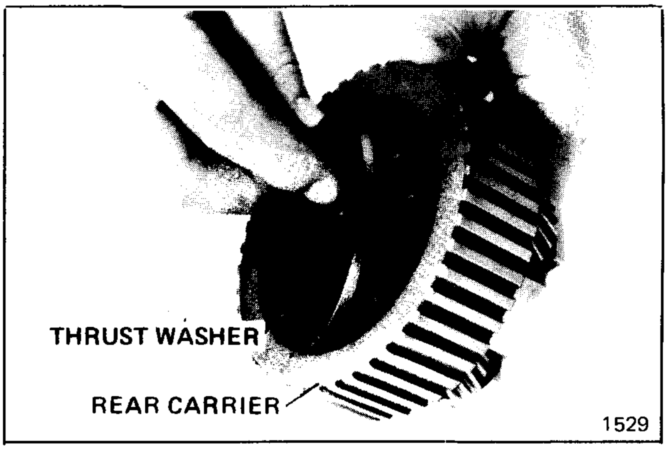

Fig. 7A1-81 Installing Thrust Washer Into Rear Carrier

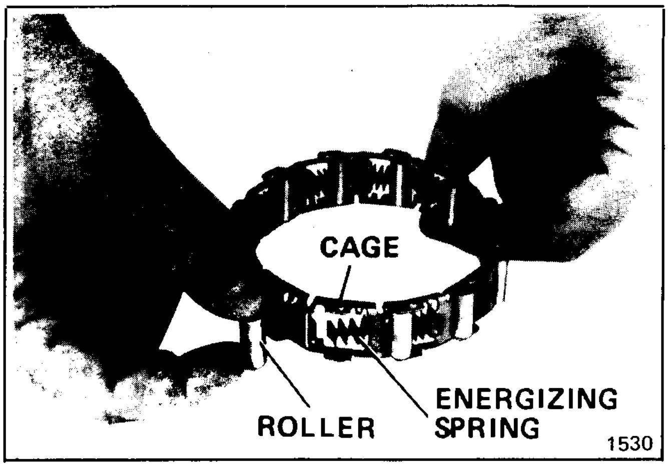

Fig. 7A1-82 Installing Roller Into Cage

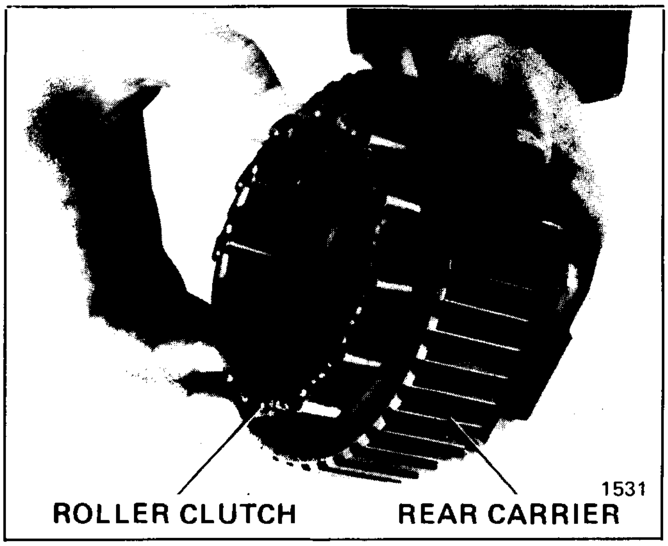

Fig. 7A1-83 Installing Roller Clutch Into Rear Carrier

5. Install 4 tanged rear carrier to rear internal gear thrust washer. Align tangs into slots of rear carrier and retain with petrolatum (Fig. 7A1-85).

6. Install roller clutch and rear carrier assembly into rear internal gear (Fig. 7A1-86).

7. Install J 25013-1, open end first, into rear end of case. Bolt J 25013-5 on end of case (Fig. 7A1-87).

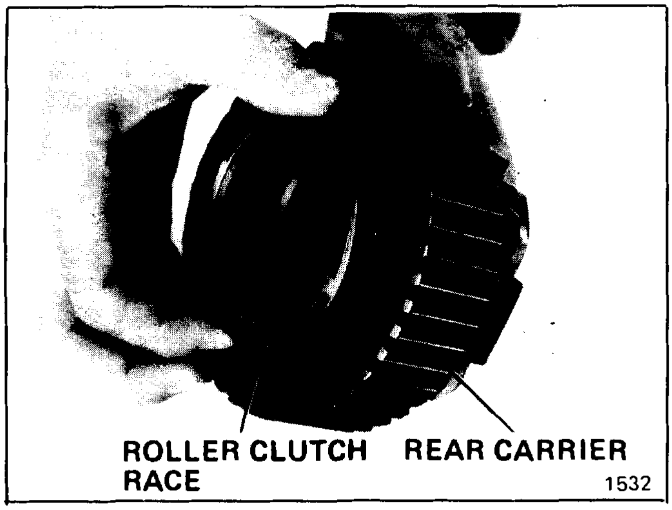

Fig. 7A1-84 Installing Roller Clutch Race

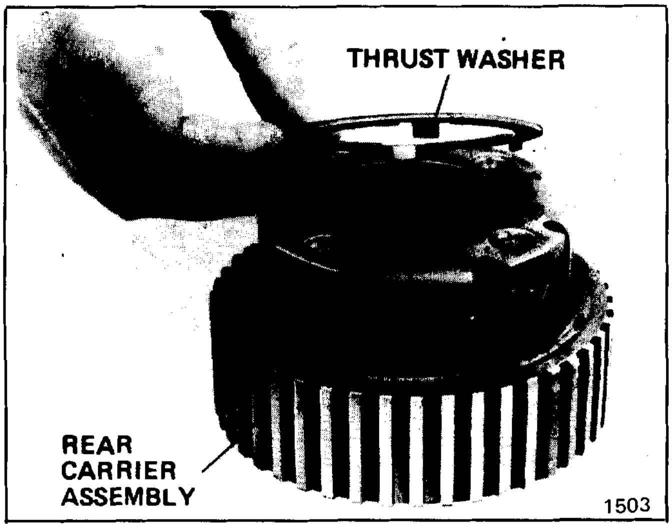

Fig. 7A1-85 Installing Thrust Washer

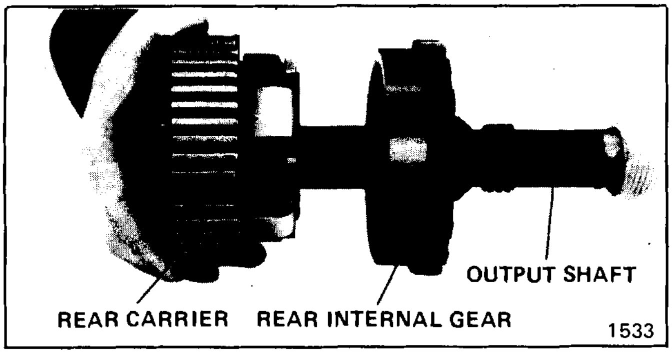

Fig. 7A1-86 Installing Rear Carrier Into Rear Internal Gear

8. Turn case to vertical position, pump end up.
9. Install rear unti parts into case and into J 25013-1 sleeve (Fig. 7A1-88), indexing rear internal gear parking pawl lugs to pass by parking pawl tooth.
10. Using J 25013-5 adjusting screw (Fig. 7A1-87) and looking through parking pawl case slot, adjust the height of the rear internal gear parking pawl lugs to align flush with the parking pawl tooth.

NOTE: Make sure speedometer drive gear is visible through speedometer gear bore. If drive gear is not visible, it may be located on wrong journal of shaft.

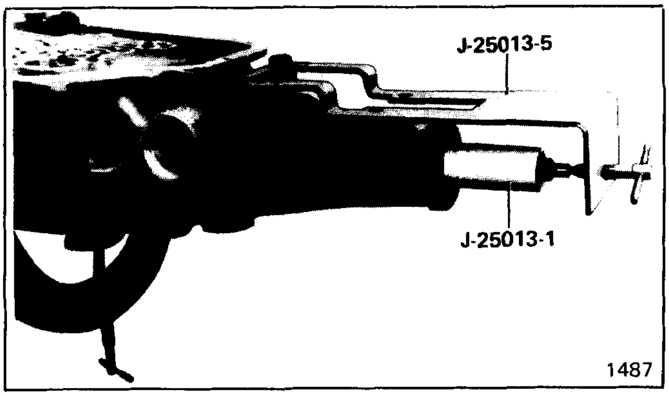

Fig. 7A1-87 Installing Tools On Rear End of Case

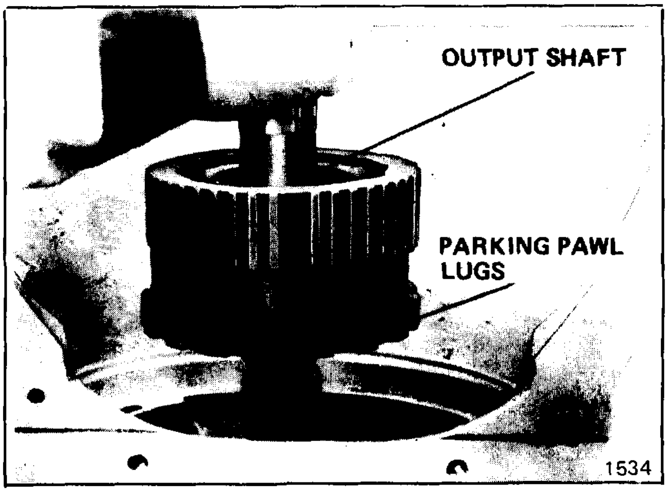

Fig. 7A1-88 Installing Rear Unit Parts

LOW AND REVERSE CLUTCH

Inspection

CAUTION: *If low and reverse clutch housing has been removed, the low and reverse clutch piston travel must be checked.*

Inspect low and reverse clutch composition-faced and steel clutch plates for signs of wear or burning.

Low and Reverse Clutch Housing Assembly (Fig. 7A1-89).

Disassembly

1. Compress low and reverse clutch spring retainer, remove snap ring and retainer and inspect for damage or distortion (Fig. 7A1-90).
2. Remove waved spring (Fig. 7A1-91).
3. Remove low and reverse clutch piston.
4. Remove outer and inner piston seals (Figs. 7A1-92 and 93).
5. Remove clutch apply ring.

Inspection

1. Inspect low and reverse clutch housing for damage or plugged feed hole.
2. Inspect low and reverse clutch housing bushing for damage or scoring.

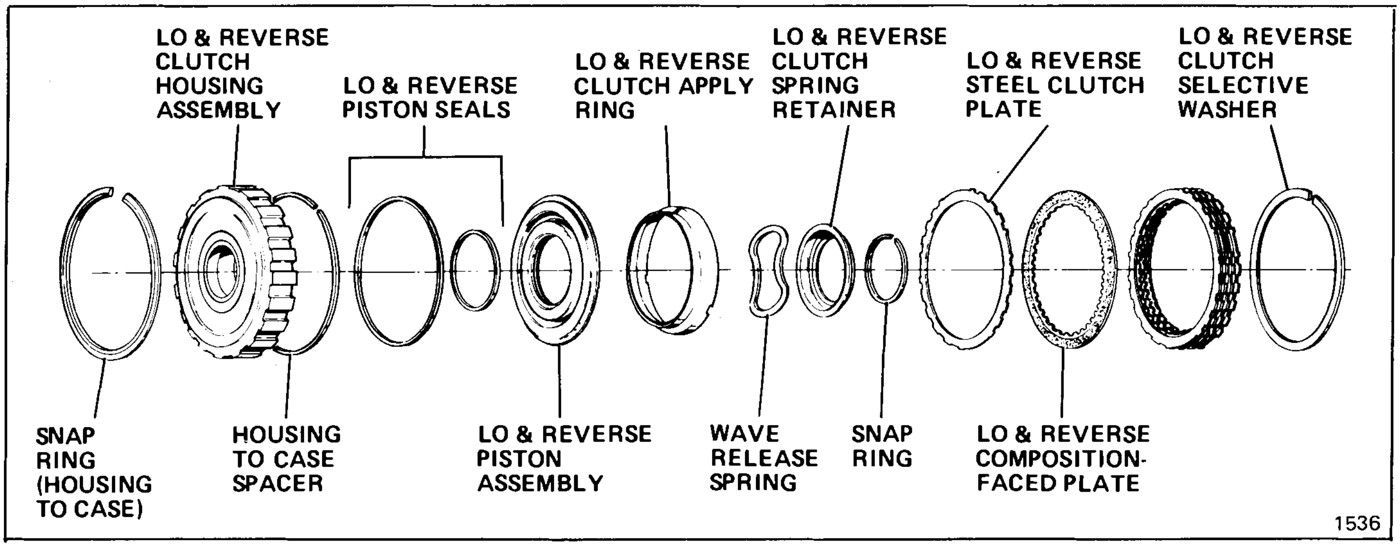

Fig. 7A1-89 Low and Reverse Clutch Housing - Exploded View

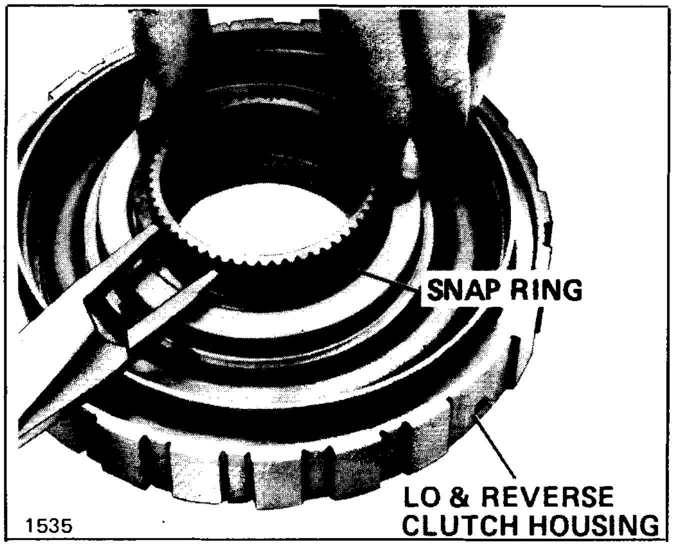

Fig. 7A1-90 Removing Low and Reverse Clutch Spring Retaining Snap Ring

Fig. 7A1-91 Removing Wave Release Spring

3. Inspect low and reverse clutch splines and snap ring groove for damage or burrs. Remove any burrs on splines or snap ring groove.

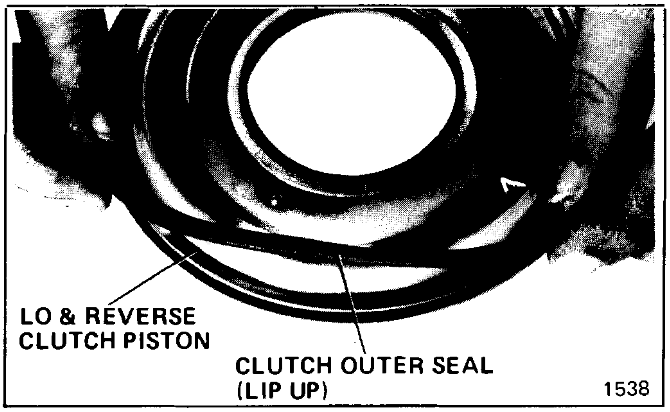

Fig. 7A1-92 Removing or Installing Clutch Outer Seal

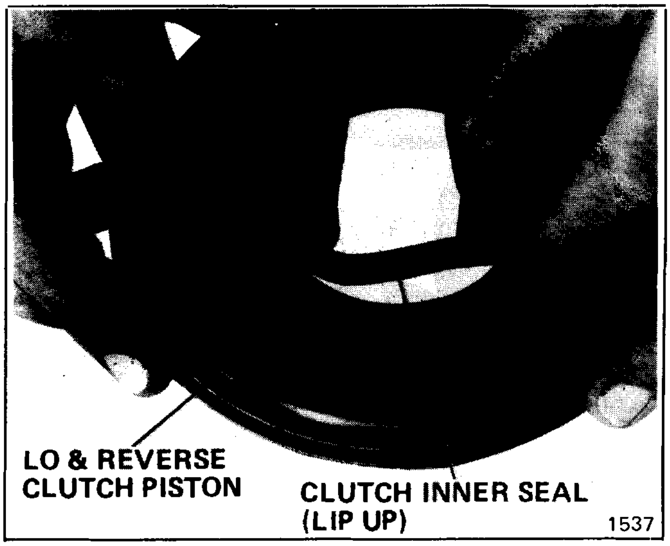

Fig. 7A1-93 Removing or Installing Clutch Inner Seal

4. Inspect low and reverse clutch piston and clutch apply ring assembly for distortion, cracks or damage.

NOTE: The apply ring is identified by a number located on the ring. The ring usage and identification are as follows: Models CE, CD, CK, CO, CR, CY, OS and PZ are identified by number 7. Models BH, BL, BU, BZ, OW and OZ are identified by number 8. Models BR, CN, CU, CX, CZ and PY are identified by number 9.

5. INspect low and reverse clutch spring retainer for damage.

6. Inspect waved spring for damage.

7. Inspect low and reverse clutch housing to case spacer ring for damage.

Reassembly

1. Install clutch apply ring on low and reverse clutch piston.

2. Install new outer and inner seals on piston with lips facing away from clutch apply ring side (Figs. 7A1-92 and 93).

3. Install seal protector J 25011.

NOTE: Apply transmission fluid to all clutch seals before reassembly.

CAUTION: *Flat screwdriver surface area must be smooth to prevent damaging outer seal.*

4. Using flat edged small screwdriver, install low and reverse clutch piston, while rotating and pushing down into place (Fig. 7A1-94).

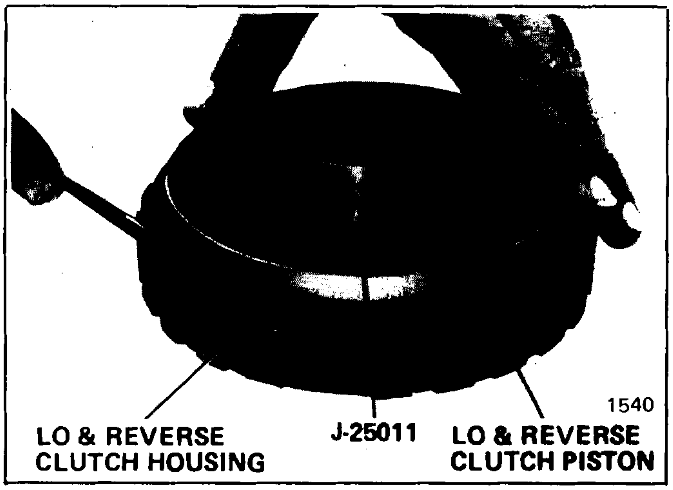

Fig. 7A1-94 Installing Low and Reverse Clutch Piston

5. Remove seal protector J 25011.

6. Install waved release spring (Fig. 7A1-95).

7. Install retainer, cupped faced down (Fig. 7A1-96).

8. Comress retainer and install snap ring.

9. Check low and reverse clutch piston travel as follows:

a. Center the low and reverse clutch housing and piston assembly on J 25023-1 plate (Fig. 7A1-97).

b. Center steel and composition clutch plates on clutch apply ring, then place J 25023-2 with gage pin toward housing.

c. Install spring J 25023-7 over bolt of J 25023-1.

d. Using nut and washer, compress spring J 25023-7 until washer bottoms against shoulder on J 25023-1.

e. Using feeler gage determine distance between gage pin on J 25023-2 and top edge of housing. See Selective Spacer chart (Fig. 7A1-98A) to determine proper selective washer.

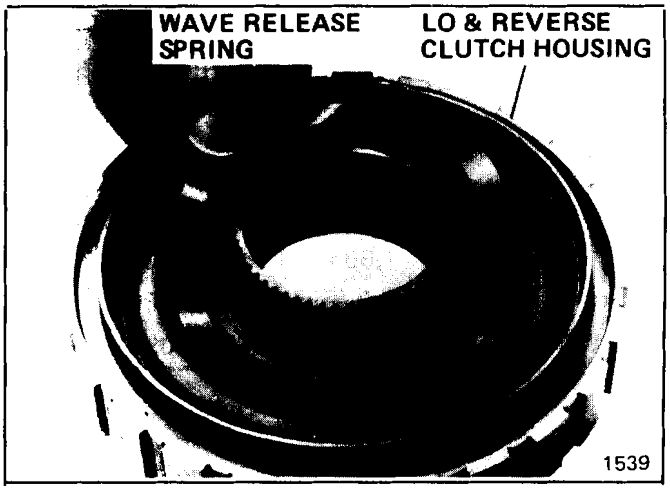

Fig. 7A1-95 Installing Wave Release Spring

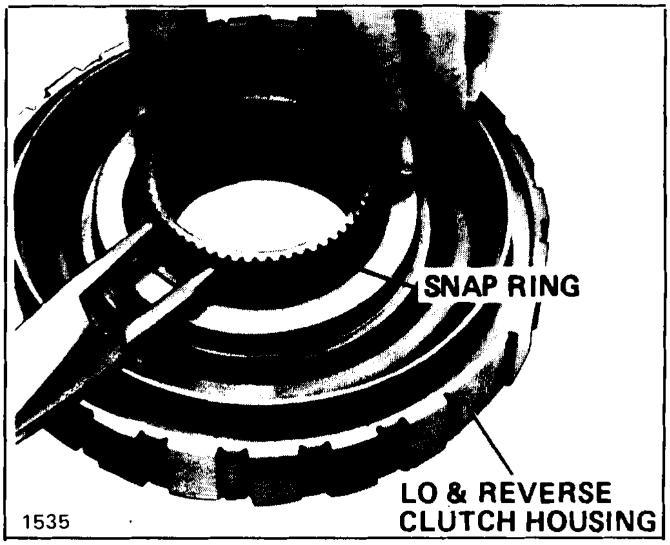

Fig. 7A1-96 Installing Clutch Retaining Snap Ring

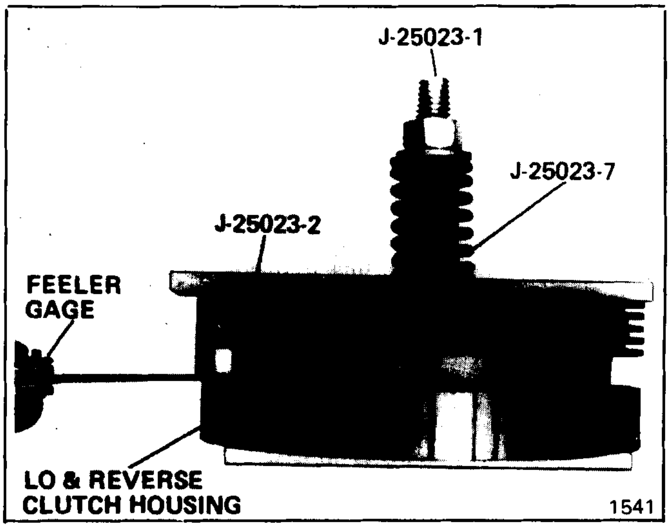

Fig. 7A1-97 Checking For Correct Selective Spacer

NOTE: The low and reverse clutch selective spacer identification number is also the last number of the part number. It may be necessary to measure the thickness of the selective spacer for positive identification.

FEELER STOCK THICKNESS	SPACER NUMBER	SPACER THICKNESS
.04mm– .40mm (.001"–.016")	6	3.85mm–3.75mm (.152"–.148")
.40mm– .80mm (.016"–.032")	5	3.45mm–3.35mm (.136"–.132")
.80mm–1.20mm (.032"–.048")	4	3.05mm–2.95mm (.120"–.116")
1.20mm–1.60mm (.048"–.064")	3	2.65mm–2.55mm (.104"–.100")
1.60mm–2.0 mm (.064"–.080")	2	2.25mm–2.15mm (.089"–.085")
2.00mm–2.40mm (.080"–.096")	1	1.85mm–1.75mm (.073"–.069")

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Fig. 7A1-98A Low and Reverse Clutch Selective Spacer Chart

f. Remove J 25023 (Fig. 7A1-97).

g. Install proper low and reverse clutch selective spacer in the case (Fig. 7A1-99).

Fig. 7A1-99 Installing Selective Spacer

Installation

1. Oil and install the low and reverse clutch plates into the case, starting with a flat steel and alternating composition-faced and flat steel clutch plates (see Clutch Plate and Apply Ring Usage chart, Fig. 7A1-98B).

2. Install low and reverse clutch housing to case spacer ring in case (Fig. 7A1-100).

3. Install low and reverse clutch housing assembly aligning reverse clutch housing feed hole to reverse clutch case feed passage, using J 25012 (Fig. 7A1-101). If the low and reverse clutch housing does not seat past the case snap ring groove, proceed as follows:

a. Remove tool J 25012.

b. Using rear sun gear and input drum as a tool, install input drum and rear sun gear in case.

c. Rotate rear sun gear back and forth, tapping lightly with input drum, to align roller clutch race and low and reverse clutch hub splines (Fig. 7A1-102).

d. Remove tool (input drum and rear sun gear).

NOTE: It may be necessary to loosen adjusting screw on J 25013-5 on output shaft to install snap ring.

e. Repeat the above steps if low and reverse clutch housing is not fully seated past case snap ring groove.

4. Install low and reverse clutch housing to case snap ring, flat side against housing (beveled side up), and position snap ring gap on opposite side of parking brake rod.

FRONT GEAR PARTS

Rear Sun Gear and Input Drum (Fig. 7A1-103)

Inspection

1. Inspect rear sun gear for cracks, splits, damage spline, worn gear or hournals and plugged lubrication holes.

2. Inspect rear sun gear bushing for damage or scoring.

3. If necessary, remove input drum to rear sun gear snap ring and remove sun gear from input drum.

4. Inspect input drum for damage.

5. Inspect 4 tanged input drum to low and reverse clutch housing thrust washer for scoring or distorted tangs.

6. If damaged, replace rear sun gear to input drum snap ring.

Reassembly

1. Install rear sun gear into input drum, spline side first, and retain with snap ring.

2. Install 4 tanged thrust washer on input drum over sun gear end; align tangs into input drum and retain with petrolatum (Fig. 7A1-104).

3. Install rear sun gear and input drum assembly (Fig. 7A1-102).

Front Sun Gear

1. Inspect front sun gear splines and teeth for damage or wear.

2. Inspect machined face for pitting, scoring or damage.

3. Install front sun gear face with the identification mark (a drill spot or groove) against input drum to rear sun gear snap ring (Figs. 7A1-105 and 106).

4. Thoroughly clean, air dry and inspect front sun gear to front carrier thrust race and thrust bearing for pitted or rough conditions.

5. Install front sun gear to front carrier thrust bearing and race assembly with roller thrust bearing against the front sun gear (Fig. 7A1-107).

NOTE: This thrust bearing requires only 1 thrust race.

MODELS	DIRECT CLUTCH					FORWARD CLUTCH							LO & REV. CLUTCH			
	FLAT STEEL PLATE		COMP. FACED PLATE	APPLY RING		WAVED PLATE		FLAT STEEL PLATE		COMP. FACED PLATE	APPLY RING		FLAT STEEL	COMP. FACED PLATE	APPLY RING	
	NO.	THICKNESS	NO.	• I.D.	WIDTH	NO.	THICKNESS	NO.	THICKNESS	NO.	• I.D.	WIDTH	NO.	NO.	• I.D.	WIDTH
CU,CN,CZ PY	4	2.324mm (.091")	4	1	16.99mm (.669")	1	1.585mm (.062")	2	1.969mm (.077")	3	0	17.50mm (.689")	5	4–GROOVED	9	22.33mm (.879")
BR,CX	3	2.324mm (.091")	3	2	21.44mm (.844")	1	1.585mm (.062")	2	1.969mm (.077")	3	0	17.50mm (.689")	5	4–GROOVED	9	22.33mm (.879")
BH,BL,BU BZ,OW,OZ	4	2.324mm (.091")	4	1	16.99mm (.669")	1	1.585mm (.062")	3	1.969mm (.077")	4	8	13.51mm (.532")	6	5–NON-GROOVED	8	18.19mm (.716")
CD,CE,CK, CO,CR,CY, OS,PZ	5	2.324mm (.091")	5	9	12.50mm (.492")	1	1.585mm (.062")	3	1.969mm (.077")	4	8	13.51mm (.532")	7	6–NON-GROOVED	7	14.05mm (.553")

NOTE: The direct and forward clutch flat steel clutch plates and the forward clutch waves steel plate should be identified by their thickness.

The direct and forward production installed composition-faced clutch plates must not be interchanged. For service, direct and forward clutch use the same composition-faced plates.

All lo and reverse clutch composition-faced plates are serviced with the grooved composition-faced plates.

*Measure the width of the clutch apply ring for positive identification.

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Fig. 7A1-98B Clutch Plate and Apply Ring Usage Chart

Fig. 7A1-100 Installing Case Spacer Ring

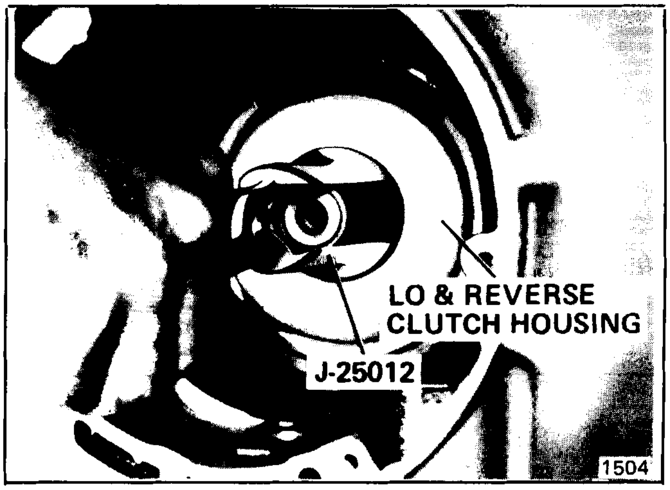

Fig. 7A1-101 Installing Low and Reverse Clutch Housing

Front Carrier Assembly

NOTE: Models CN, CU and CZ use a front carrier with 2 pinions. All other models use 4 pinions.

Inspection

1. Inspect front carrier for damage.
2. Inspect pinions for damage, rough bearings or tilt.
3. Check pinion end play. Pinion end play should be 0.24mm-0.69mm (0.009"-0.027") (Fig. 7A1-108).
4. Thoroughly clean, air dry and inspect closely, front carrier to front internal gear roller thrust bearing assembly for pitted or rough conditions.

Reassembly

1. Install front carrier to front internal gear roller thrust bearing assembly by placing the smaller diameter race against carrier (Fig. 7A1-109). Retain with petrolatum.
2. Install front carrier and thrust bearing assembly (Fig. 7A1-110).

Front Internal Gear and Thrust Washer

1. Inspect forward clutch hub for worn splines and for lubrication holes.
2. Inspect internal gear for cracks or damage.
3. Inspect gear teeth for excessive wear or damage.
4. Inspect bushing for damage or scoring.
5. Inspect thrust washer, front internal gear to selective washer for scoring or damage.
6. Install thrust washer on front internal gear and retain with petrolatum. (Fig. 7A1-111)
7. Install front internal gear and thrust washer.

Rear Selective Thrust Washer (Fig. 7A1-111)

1. Inspect selective washer for scoring or damage.

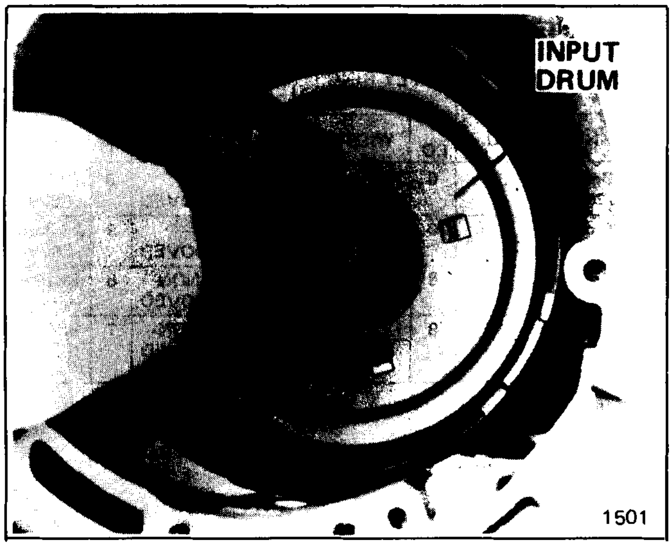

Fig. 7A1-102 Installing Input Drum and Rear Sun Gear

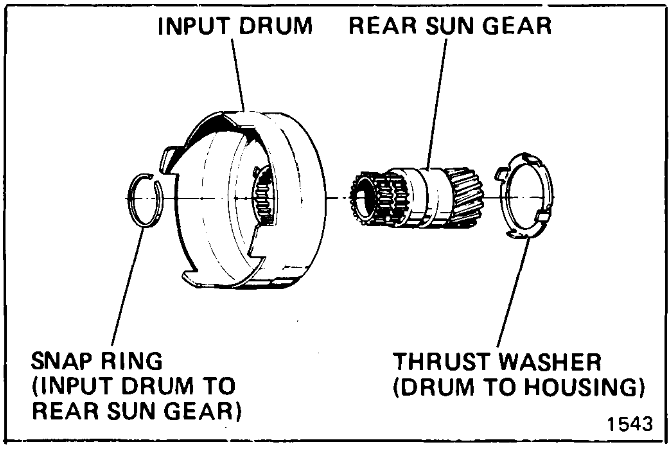

Fig. 7A1-103 Rear Sun Gear and Input Drum

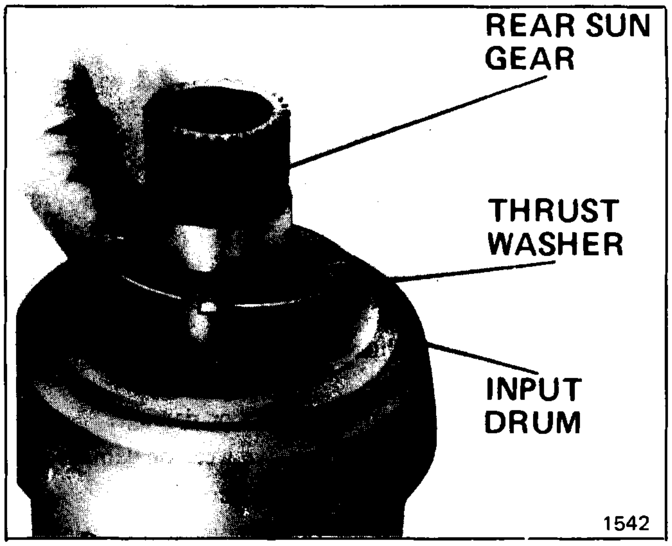

Fig. 7A1-104 Installing Thrust Washer

CAUTION: *The rear selective thrust washer must be installed with the identification number toward the front of the transmission.*

2. Install rear selective washer.

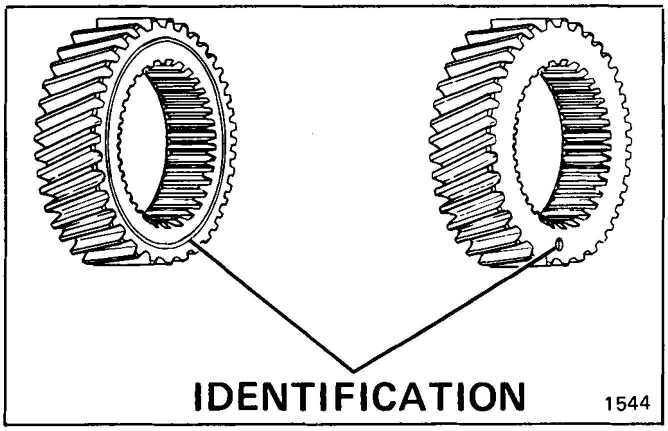

Fig. 7A1-105 Front Sun Gear Identification

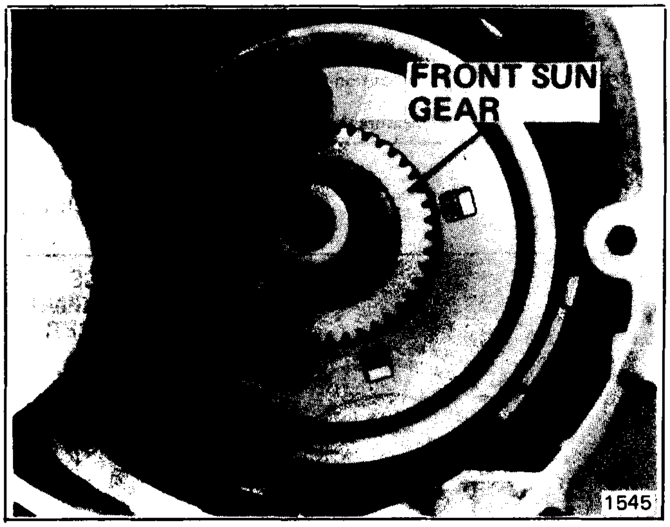

Fig. 7A1-106 Installing Front Sun Gear

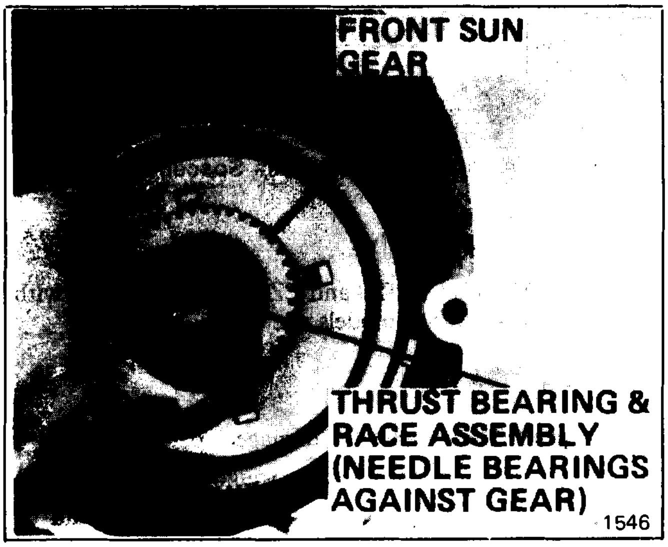

Fig. 7A1-107 Installing Thrust Bearing and Race Assembly

3. Inspect output shaft to selective thrust washer snap ring for damage or distortion.

NOTE: It may be necessary to move output shaft upward by turning the adjusting screw on J 25013-5 to install output shaft to selective washer snap ring.

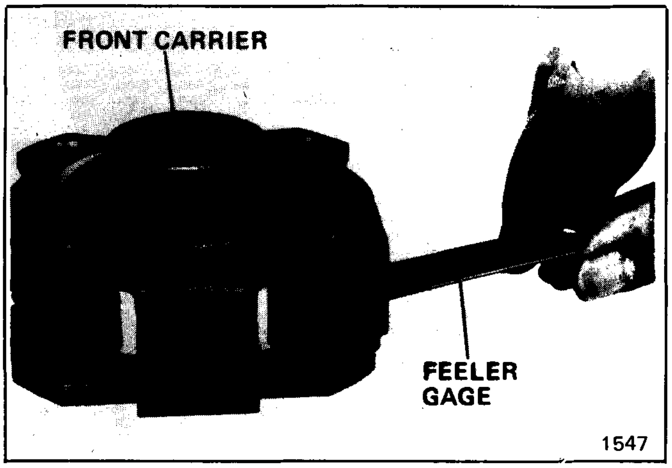

Fig. 7A1-108 Checking Pinion End Play

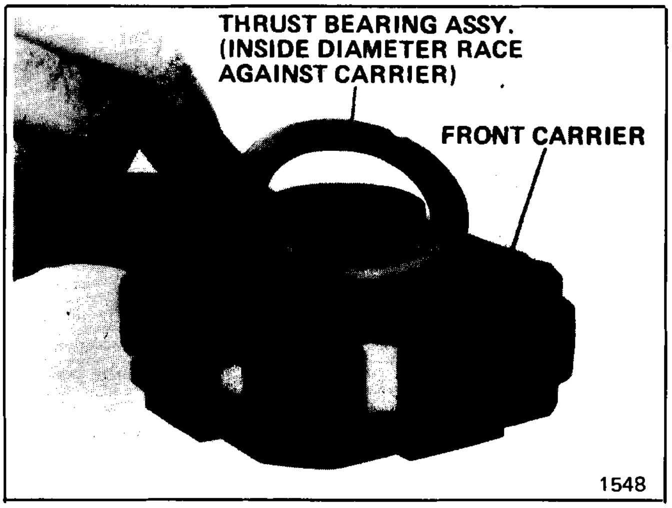

Fig. 7A1-109 Installing Thrust Bearing Assembly

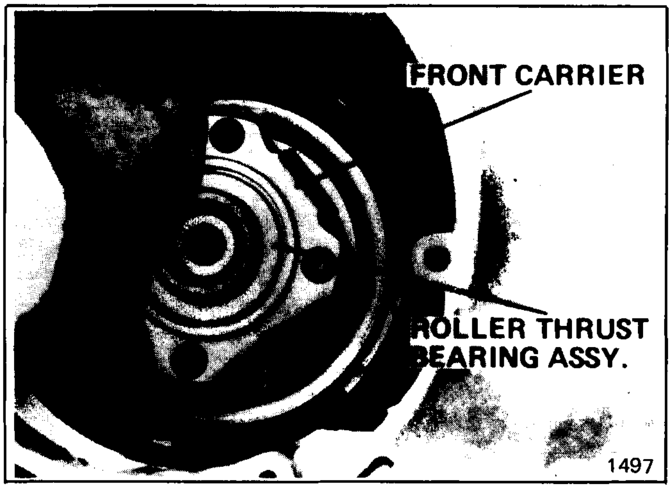

Fig. 7A1-110 Installing Front Carrier

4. Install snap ring on output shaft (Fig. 7A1-111).

CAUTION: *Make sure snap ring is fully seated in output shaft groove.*

Check Rear Unit End Play

1. Loosen J 25013-5 adjusting screw on output shaft and push output shaft downward (Fig. 7A1-112).

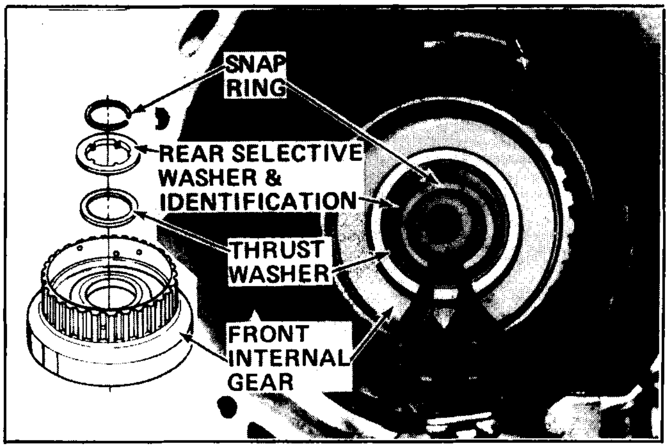

Fig. 7A1-111 Installing Output Shaft to Selective Washer Snap Ring

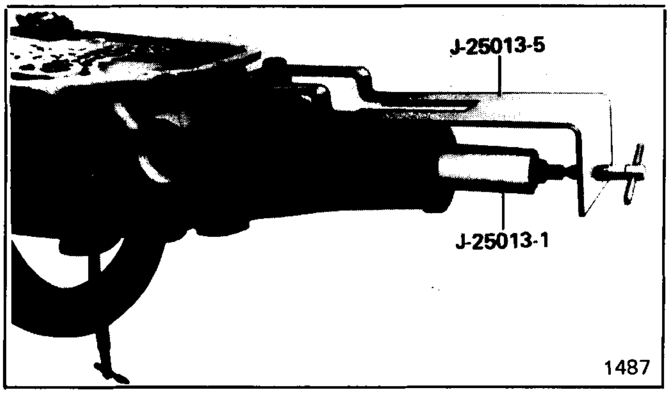

Fig. 7A1-112 Installing Tools On Rear End of Case

CAUTION: *Do not install clamp assembly on any machined case surfaces.*

2. Install gage clamp on case as shown in Fig. 7A1-113.

3. Install dial indicator J 8001 and plunger extension J 7057. Position extension against end of output shaft. Set dial indicator to zero.

4. Move output shaft upward by turning the adjusting screw on J 25013-5 until the white or scribed line on sleeve J 25013-1 begins to disappear and read end play. Rear unit end play should be 0.10-0.64mm (.004"-.025").

NOTE: Selective washer controlling this end play is located between the front internal gear thrust washer and output shaft snap ring. If more or less washer thickness is required to bring end play within specifications, select proper washer from the THICKNESS CHART:)

5. Remove dial indicator amd clamp assembly (Fig. 7A1-113).

6. Loosen J 25013-5 adjusting screw on output shaft.

7. Inspect output shaft to turbine shaft front selective thrust washer for damage or scoring.

8. Install output shaft to turbine shaft front selective thrust washer, locating in ouptput shaft and retain with petrolatum (Fig. 7A1-114).

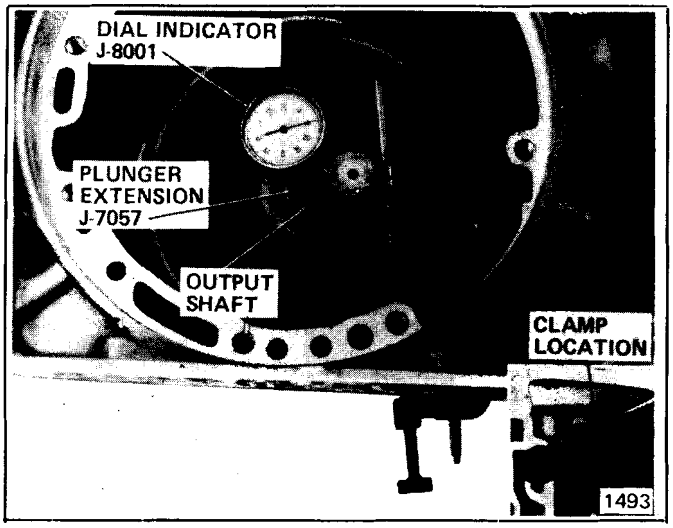

Fig. 7A1-113 Checking Rear Unit End Play

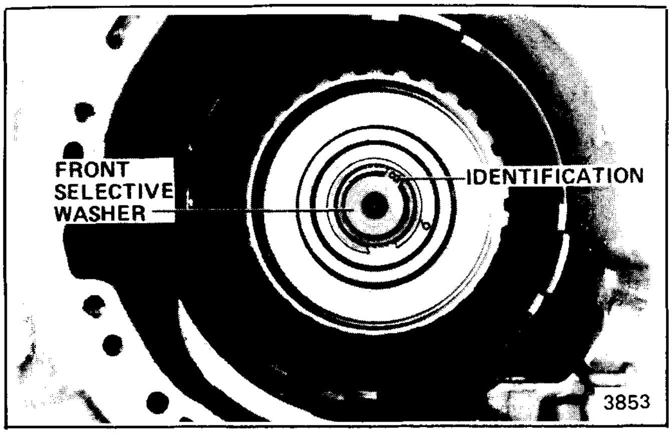

Fig. 7A1-114 Location of Front Selective Washer

REAR UNIT END PLAY WASHER THICKNESS CHART

THICKNESS	IDENTIFICATION
	Number and/or Color
2.90-3.01mm (0.114"-0.119")	1 Orange
3.08-3.19mm (0.121"-0.126")	2 White
3.26-3.37mm (0.128"-0.133")	3 Yellow
3.44-3.55mm (0.135"-0.140")	4 Blue
3.62-3.73mm (0.143"-0.147")	5 Red
3.80-3.91mm (0.150"-0.154")	6 Brown
3.98-4.09mm (0.157"-0.161")	7 Green
4.16-4.27mm (0.164"-0.168")	8 Black
4.34-4.45mm (0.171"-0.175")	9 Purple

FRONT UNIT PARTS

Direct Clutch Housing Assembly (Fig. 7A1-115)

1. Remove snap ring. (Fig. 7A1-7-116)

2. Remove the clutch backing plate from the direct clutch housing.

3. Remove the clutch plates from the direct clutch housing and keep them separated from the forward clutch plates (See Clutch Plate Usage Chart, Fig. 7A1-98B).

4. Inspect composition-faced plates and steel clutch plates for wear or burning.

5. Inspect clutch backing plate for scoring or other damage.

6. Using J 23327, compress retainer and spring assembly (Fig. 7A1-117), remove snap ring and inspect for damage or distortion.

7. Remove J 23327.

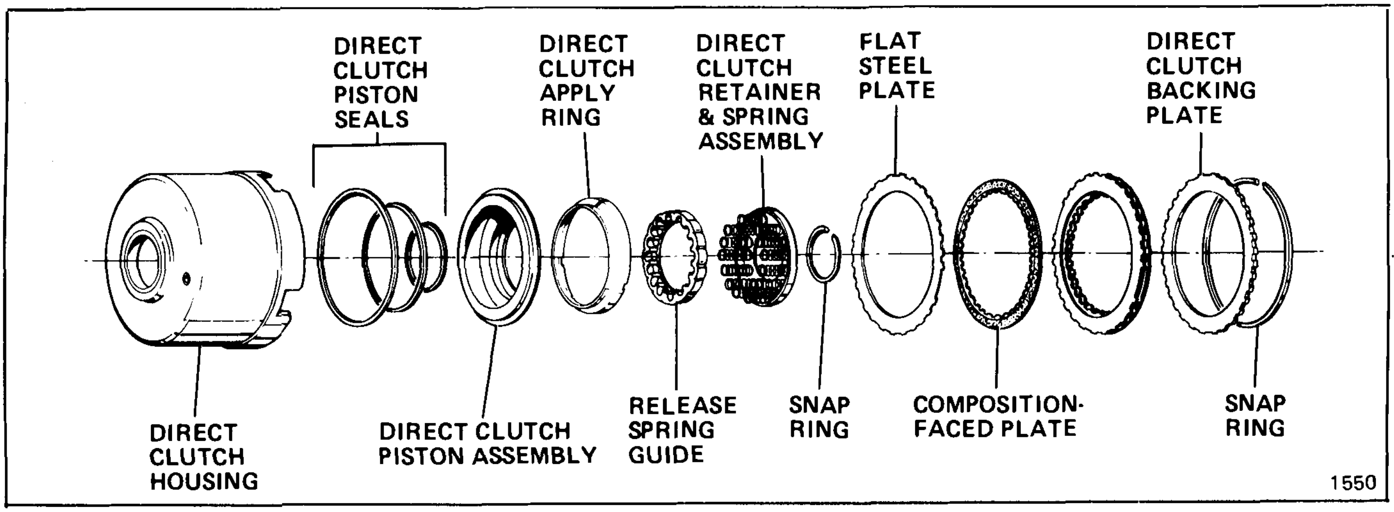

Fig. 7A1-115 Direct Clutch Assembly - Exploded View

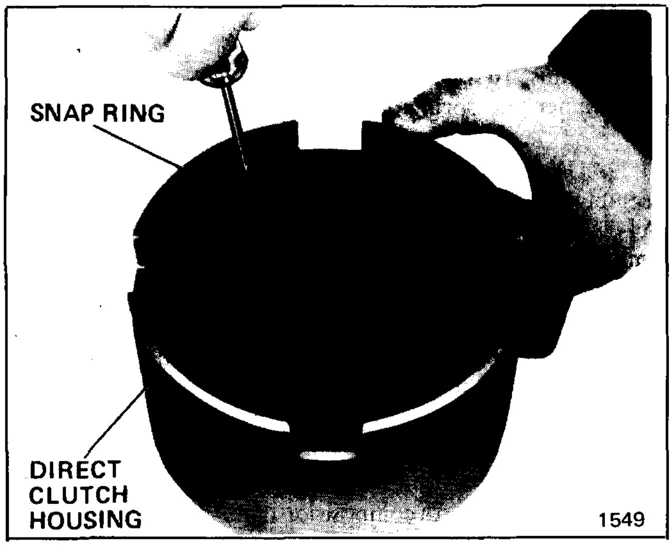

Fig. 7A1-116 Removing Direct Clutch Housing Snap Ring

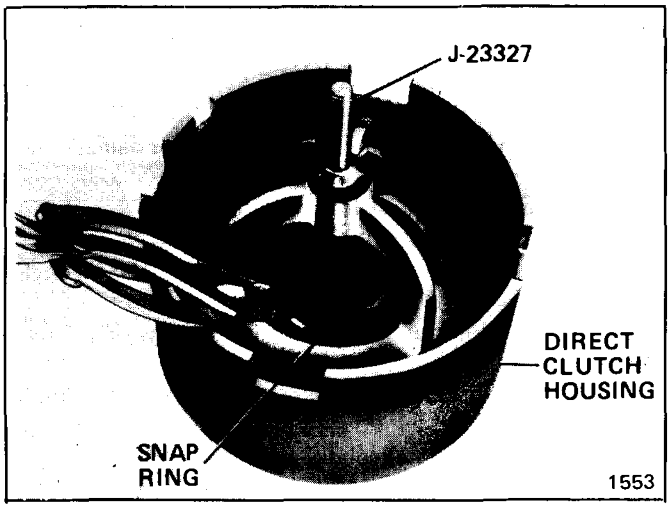

Fig. 7A1-117 Removing Direct Clutch Inner Snap Ring

8. Remove retainer and spring (Fig. 7A1-116).

9. Inspect release spring retainer for being collapsed.

10. Inspect release springs for being collapsed.

11. Remove release spring guide and inspect for damage.

12. Remove direct clutch piston.

13. Remove outer and inner seals from direct clutch piston and discard (Figs. 7A1-118 and 119).

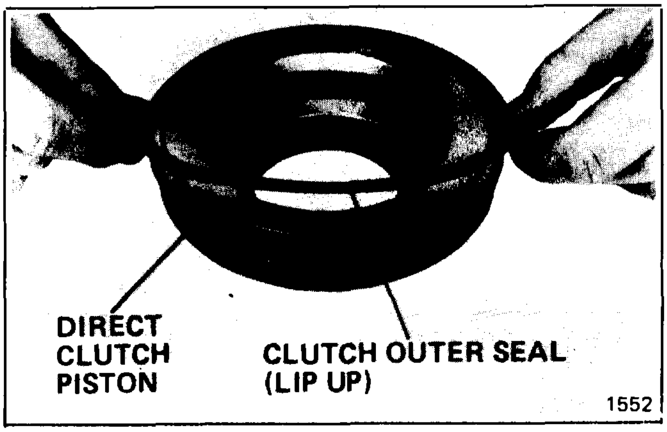

Fig. 7A1-118 Removing or Installing Direct Clutch Piston Outer Seal

14. Do not remove the clutch apply ring from the piston unless the piston or apply ring requires replacement.

NOTE: The apply ring is identified by a number on the ring. The ring usage and identification are as follows:

Models BH, BL, BU, BZ, CN, CU, CZ, OW, OZ and PY identified by number 1. Models BR and CX identified by number 2. Models CD, CE, CK, CO, CR, CY, OS and PZ identified by number 9.

15. Inspect direct clutch piston assembly for distortion, cracks, damage and check ball for free operation.

16. Remove center seal from direct clutch housing and discard (Fig. 7A1-120).

17. Inspect direct clutch housing for cracks, wear and open oil passages.

18. Check for free operation of check ball.

19. Inspect direct clutch housing snap ring grooves for damage.

20. Inspect direct clutch bushings for damage or scoring.

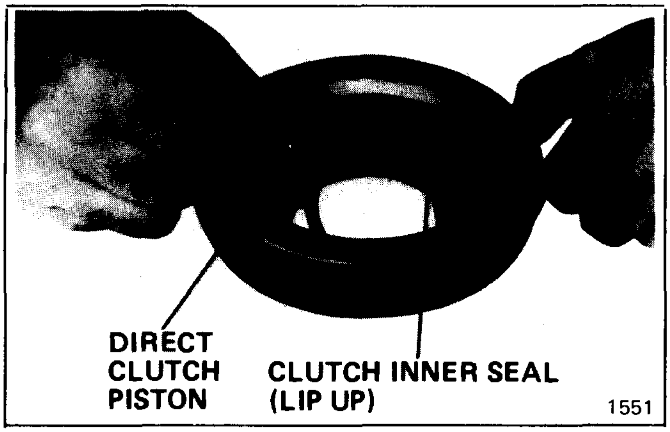

Fig. 7A1-119 Removing and Installing Direct Clutch Piston Inner Seal

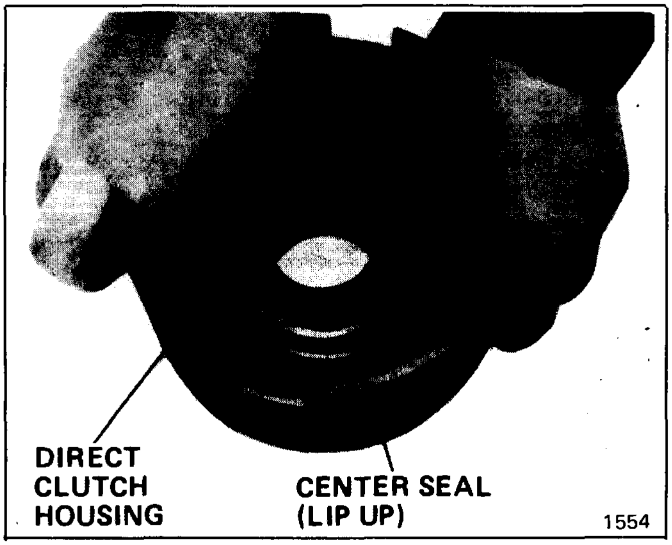

Fig. 7A1-120 Direct Clutch Housing Center Seal

Reassembly

1. Install clutch apply ring on piston.

2. Install new inner and outer seals on piston with lips facing away from clutch apply ring side (Figs. 7A1-118 and 119).

3. Install new center seal on direct clutch housing with lip facing up (Fig. 7A1-120).

4. Install seal protector J 25010 over center seal (Fig. 7A1-121).

CAUTION: *Use extreme care when installing direct clutch piston past larger direct clutch snap ring groove. Groove could cut outer seal on piston.*

5. Oil seals and install direct clutch piston.

NOTE: To make piston easier to install, insert tool between seal and housing; rotate tool around the housing to compress the lip of the seal, while pushing down slightly on the piston (See Tool Fig. 7A1-122).

6. Remove seal protection J 25010.

7. Install release spring guide with the omitted rib of guide over the check ball in the piston (Fig. 7A1-123).

8. Install retainer and spring assembly.

CAUTION: *Retainer could locate in snap ring groove and forcing retainer to compress springs, could damage retainer plate when installing.*

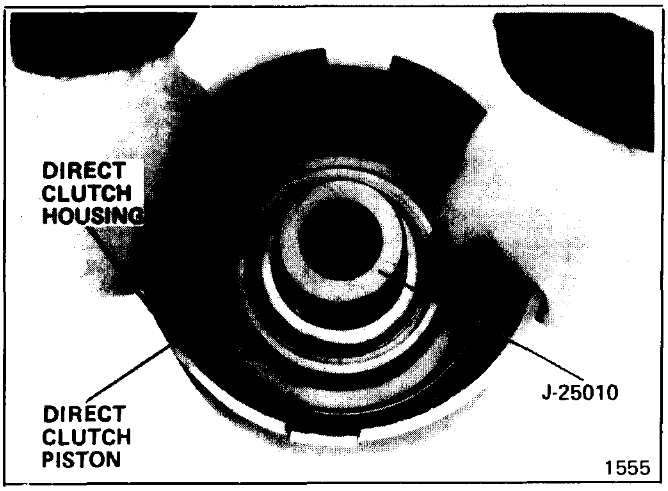

Fig. 7A1-121 Installing Direct Clutch Piston

NOTE: Models BR, CN, CU, CX, CZ and PY use a direct clutch retainer and spring assembly which contains 16 release springs. All other models use a retainer and spring assembly with 10 release springs.

9. Using J 23327 tool, compress retainer and spring assembly past the snap ring groove. Install the snap ring (Fig. 7A1-124). An arbor press and J 23327 can be used to compress the retainer and spring assembly.

10. Remove J 23327.

11. Oil and install direct clutch plates into direct clutch housing, starting with a flat steel and alternating composition-faced and flat steel clutch plates (Fig. 7A1-125 and see Fig. 7A1-98B for proper clutch plate usage).

12. Install backing plate, chamfered side up.

13. Install snap ring (Fig. 7A1-126).

NOTE: Make sure composition clutch plates turn freely.

14. Set direct clutch assembly aside.

Forward Clutch Housing Assembly (Fig. 7A1-127)

Inspection

1. Inspect telfon oil seals on turbine shaft for damage and free fit in grooves. Do not remove unless replacing.

2. Remove and inspect forward clutch to direct clutch thrust washer for damage (Fig. 7A1-128).

3. Place forward clutch down with turbine shaft through hole in work bench.

4. Remove snap ring and inspect for damage (Fig. 7A1-129).

5. Remove backing plate from the forward clutch housing.

6. Remove the clutch plates from the forward clutch housing and keep them separated from the direct clutch plates. (See Clutch Plate Usage Chart, Fig. 7A1-98B).

7. Inspect composition-faced and steel clutch plates for signs of wear or burning.

8. Inspect backing plate for scratches or damage.

9. Using tools J 25024 and J 23327-1, compress retainer and spring assembly and remove snap ring (Fig. 7A1-130). An arbor press and tools J 25018 and J 23327-1 can be used to compress the retainer and spring assembly.

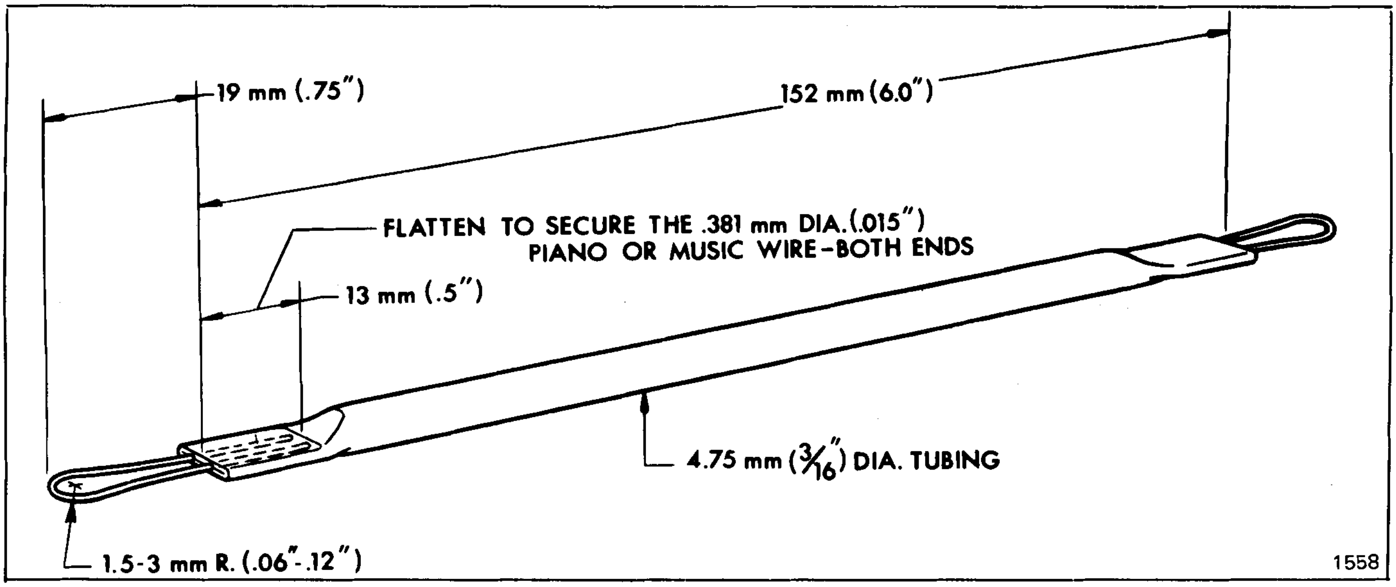

Fig. 7A1-122 Piston Installing Tool

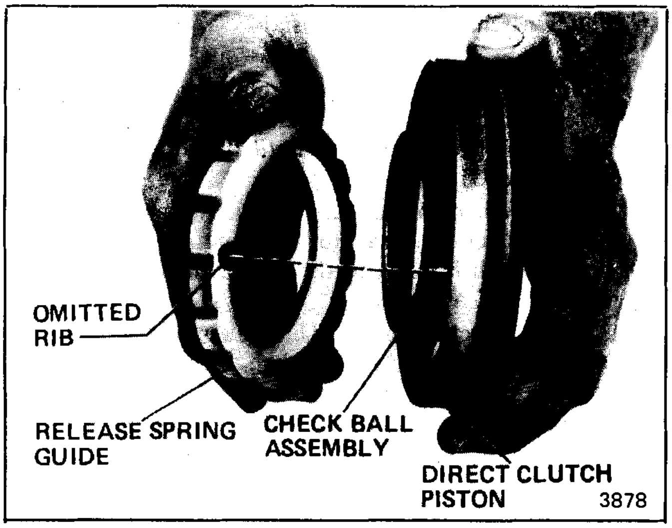

Fig. 7A1-123 Installing Spring Guide to Direct Clutch Piston

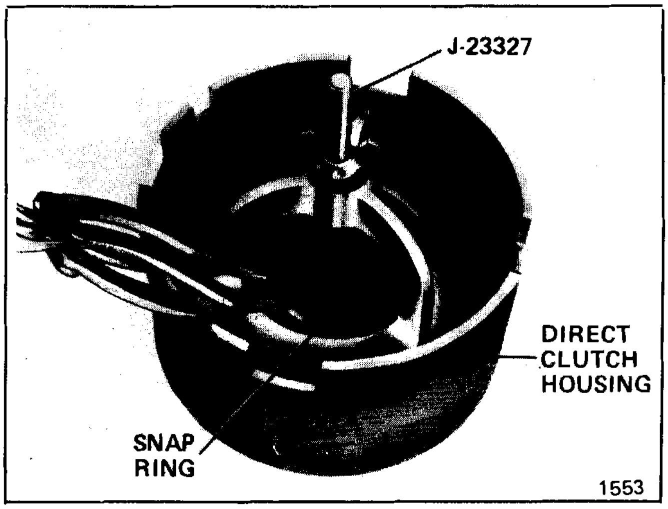

Fig. 7A1-124 Installing Direct Clutch Retainer Snap Ring

10. Remove J 23327-1 and J 25018.

11. Remove reatiner and spring assembly from housing.

12. Inspect release spring retainer for distortion.

13. Inspect release springs for being collapsed.

14. Remove forward clutch piston.

15. Remove forward clutch outer and inner piston seals and discard (Figs. 7A1-131 and 132).

16. Do not remove the clutch apply ring from the piston unless the piston or apply ring requires replacement.

17. Inspect the forward clutch piston and clutch apply ring assembly for cracks or damage.

NOTE: The apply ring is identified by a number located on the apply ring. Models BR, CN, CU, CX, CZ and PY identified by number 0. Models BH, BL, BU, BZ, CD, CE, CK, CO, CR, CY, OS, OW, OZ and PZ identified by number 8.

18. Inspect forward clutch housing for cracks, opened oil passeges or other damage (Fig. 7A1-133).

19. Check for free operation of check ball.

20. Inspect forward clutch housing snap ring groove for damage or burrs.

21. Inspect turbine shaft for open oil passages on both ends of shaft and journals for damage.

22. Inspect cup plug for damage If cup plug is damaged or missing, proceed as follows:

a. Use 4mm (No. 3) easy out (grind to fit) and remove cup plug.

b. Install new cup plug to 1.00mm (.039") below surface.

Reassembly

1. Install clutch apply ring on piston.

2. Install new outer and inner seals on piston with lips facing away from clutch apply ring side (Figs. 7A1-131 and 132).

CAUTION: *Use extreme care when installing forward clutch piston past large forward clutch snap ring groove, Groove could cut outer seal on piston.*

3. Lubricate seals and install forward clutch piston (Fig. 7A1-134).

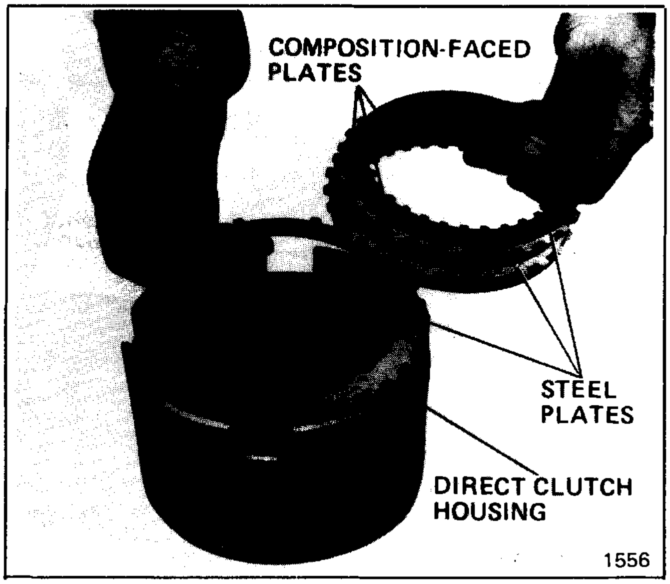

Fig. 7A1-125 Installing Direct Clutch Plates Into Direct Clutch Housing

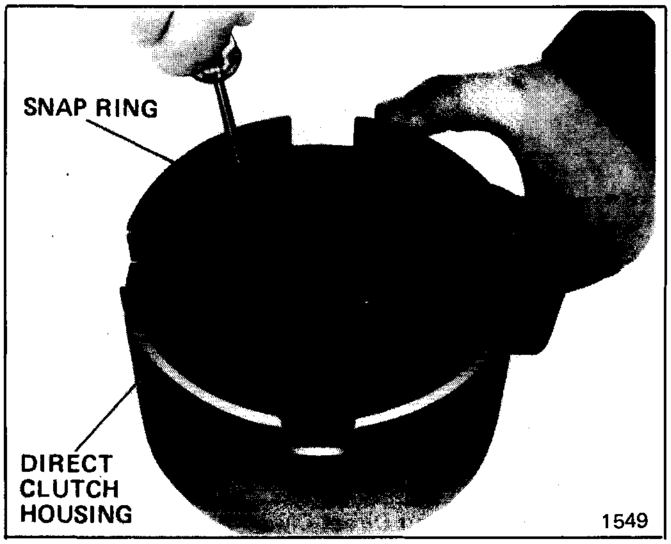

Fig. 7A1-126 Installing Direct Clutch Housing Outer Snap Ring

NOTE: To make piston easier to install, insert tool between the inner seal and shaft; rotate tool around the shaft to compress the lip of the seal, while pushing down slightly on the piston. Use the same procedure between the outer seal and the housing. Refer to Figures 7A1-134 and 122.

4. Install retainer and spring assembly.

CAUTION: *Retainer could locate in snap ring groove and forcing retainer to compress springs, could damage reatiner plate.*

5. Using J 23327-01, J 25024 and J 25018 adaptor, compress retainer past snap ring groove, (Fig. 7A1-135) and install snap ring. An arbor press may also be used with J 23327-1 and J 25018 to compress retainer and spring assembly.

6. Remove J 23327-1, J 25024 and J 25018.

7. Oil and install the forward clutch plates into the forward clutch housing, starting with the waved steel plate and alternating composition-faced and flat steel clutch plates (see Fig. 7A1-136 and Clutch Plate Usage Chart, Fig. 7A1-98B).

8. Install backing plate, chamfered side up.

9. Install snap ring (Fig. 7A1-137).

NOTE: Make sure compostion clutch plates turn freely.

10. Install forward to direct clutch thrust washer and retain with petrolatum (Fig. 7A1-138)

11. If removed, install new turbine shaft seal rings, making sure cut ends are assembled in the same relationship as cut and rings are seated in their groove (see Fig. 7A1-139 for correct way to position cut ends). Retain rings in place with petrolatum.

Forward and Direct Clutch

Installation

1. Position direct clutch assembly, clutch plate end up, over hole in bench.

NOTE: Align direct clutch composition-faced clutch plate teeth one above the other to make the forward clutch assembly easier to install.

2. Install forward clutch assembly turbine, shaft first, into direct clutch. Hold direct clutch housing and rotate forward clutch back and forth until the forward clutch is seated (Fig. 7A1-140).

NOTE: When the forward clutch is seated, it will be approximately 19.05mm (3/4") from the tang end of the direct clutch housing to the end of the forward clutch drum, Fig. 7A1-141).

3. Grasp direct and forward clutch assemblies to prevent their separation and position on behch, with the turbine shaft up.

4. Install J 25021 as shown in Fig. 7A1-142.

5. Install direct and forward clutch assemblies into case, using J 25021, and rotate into position (Fig. 7A1-142).

NOTE: The direct clutch housing will be approximately 33.34mm (1-5/16") from the pump face in case when correctly seated. See Fig. 7A1-143.

6. Remove J 25021.

Intermediate Band Assembly

1. Inspect band for burning, flaking or damage.

2. Install intermediate band, locating band apply lug and anchor pin lug in case slots (Fig. 7A1-144).

PUMP ASSEMBLY

(Fig. 7A1-145)

Inspection

1. Remove pump to case seal ring and inspect groove for damage.

2. Place pump over hole in bench with pump cover side up.

3. Remove pump to direct clutch thrust washer and inspect for damage or wear (Fig. 7A1-146).

4. Inspect 3 teflon oil ring seals for damage and free fit in grooves. Do not remove unless replacing.

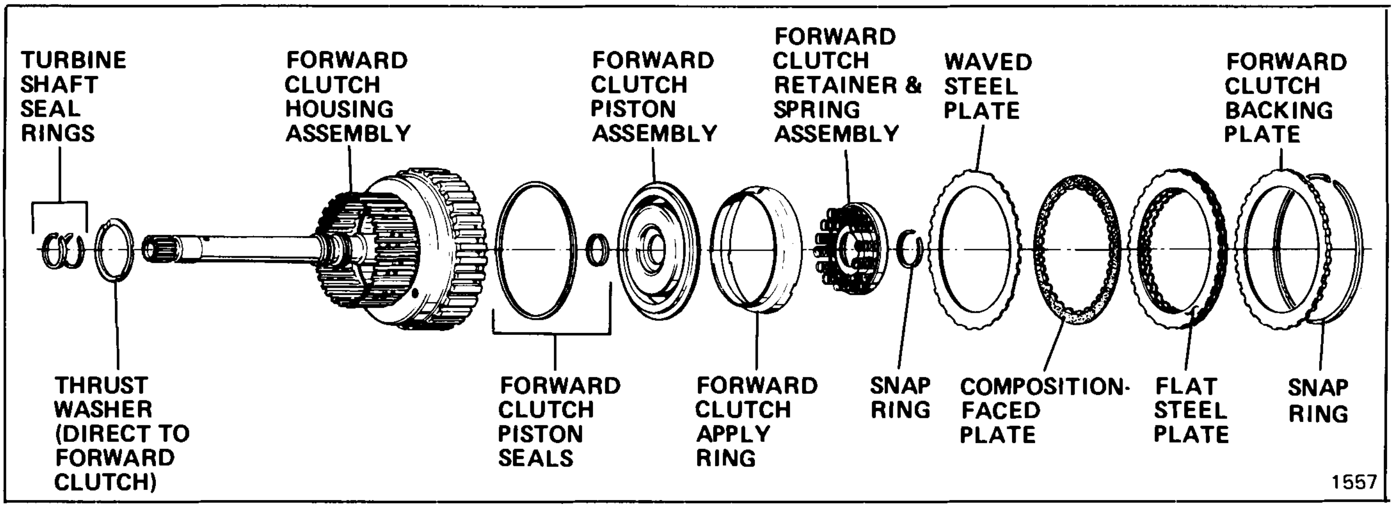

Fig. 7A1-127 Forward Clutch Assembly-Exploded View

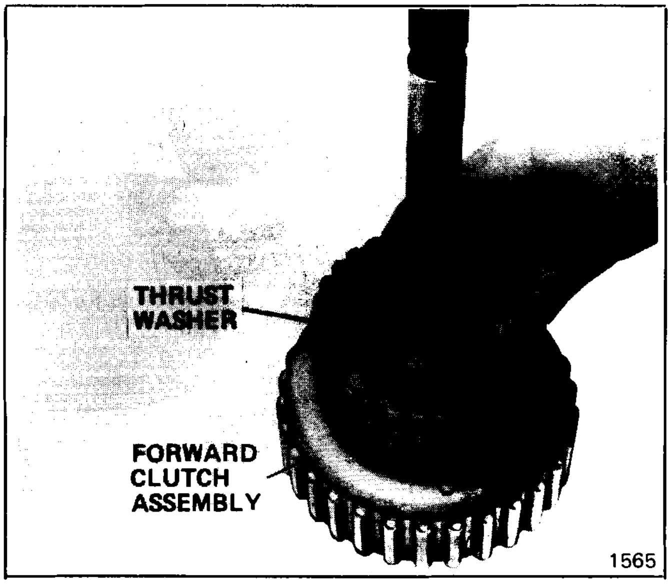

Fig. 7A1-128 Removing Forward Clutch to Direct Clutch Thrust Washer

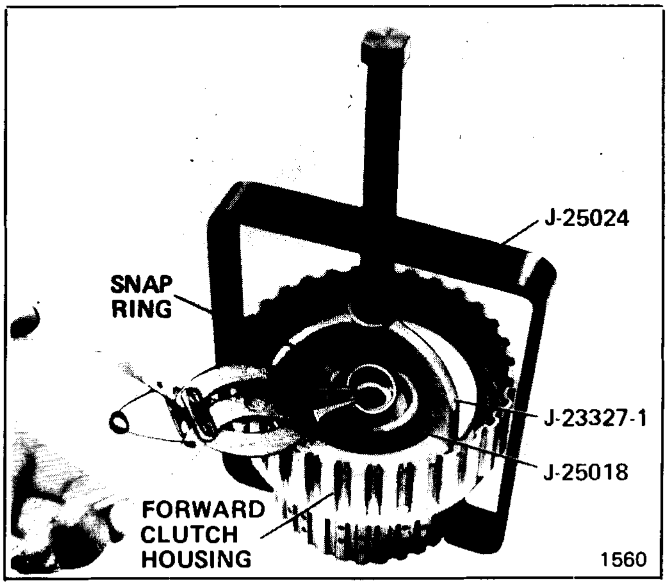

Fig. 7A1-130 Removing Forward Clutch Release Spring Snap Ring

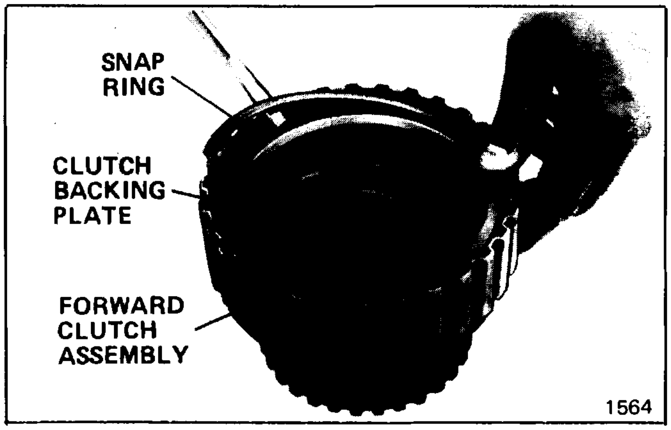

Fig. 7A1-129 Removing Snap Ring From Forward Clutch Housing

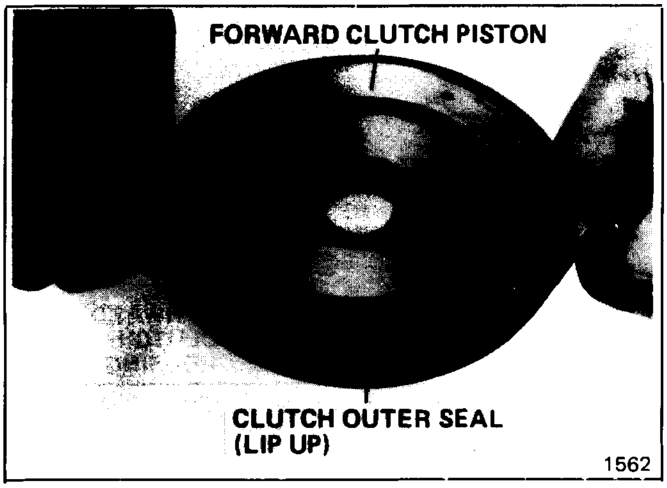

Fig. 7A1-131 Removing Or Installing Piston Outer Seal

PRESSURE REGULATOR

Inspection

1. To prevent the pump from turning while removing the pressure regulator valve, place a bolt or screwdriver through a hole in the pump and bench (Fig. 7A1-147).

2. Using small screwdriver, push on bore plug, compressing pressure regulator spring; and using snap ring pliers, remove retaining ring (Fig. 7A1-147).

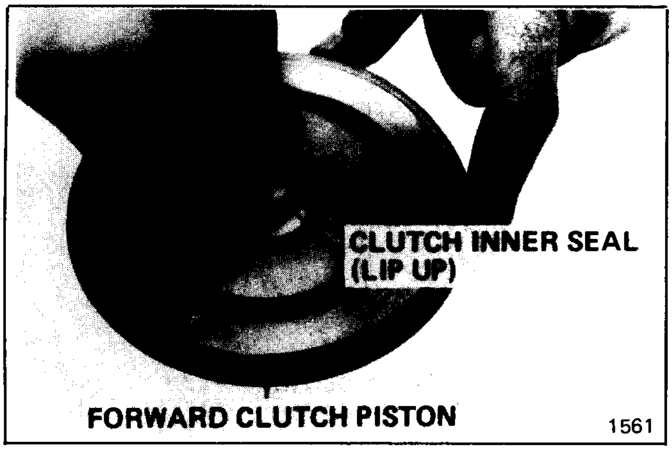

Fig. 7A1-132 Removing or Installing Piston Inner Seal

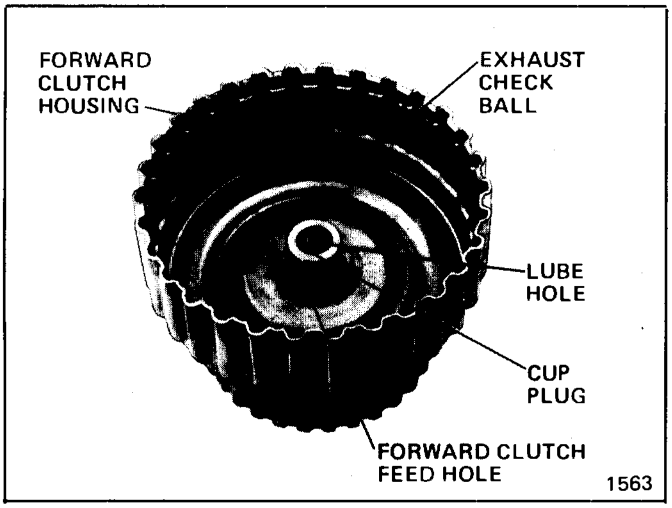

Fig. 7A1-133 Forward Clutch Housing

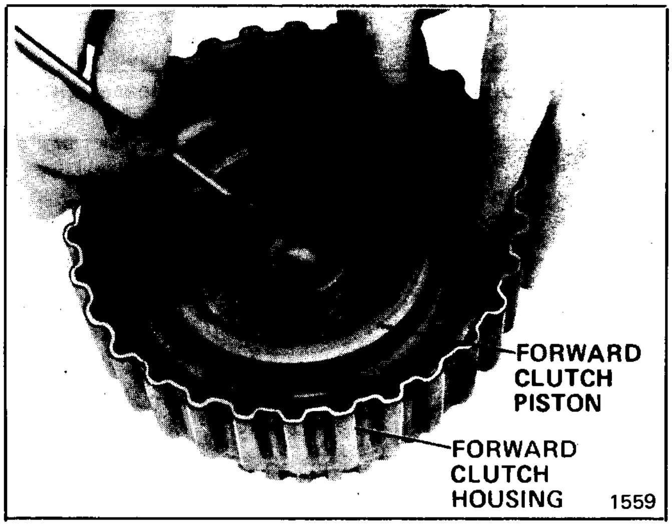

Fig. 7A1-134 Installing Forward Clutch Piston

3. Release valve spring tension slowly and remove valve train.

4. Inspect pressure regulator valve for nicks or damage.

5. Inspect spring and guide for damage or distortion.

6. Inspect pressure regulator valve for free operation in bore.

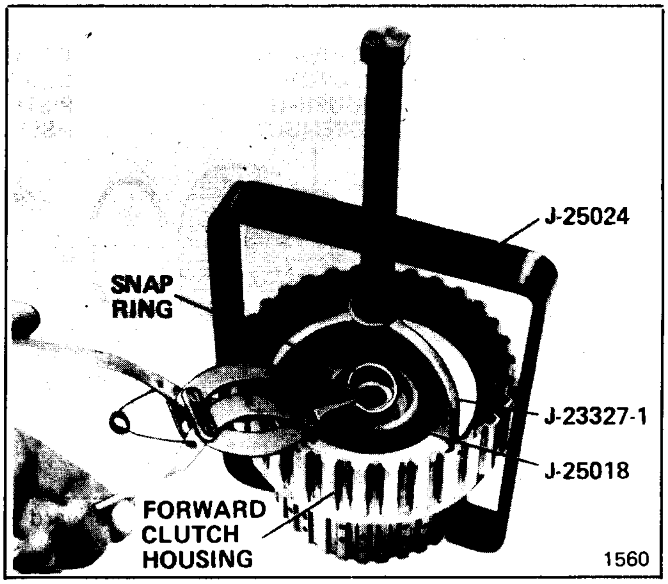

Fig. 7A1-135 Installing Forward Clutch Release Spring Snap Ring

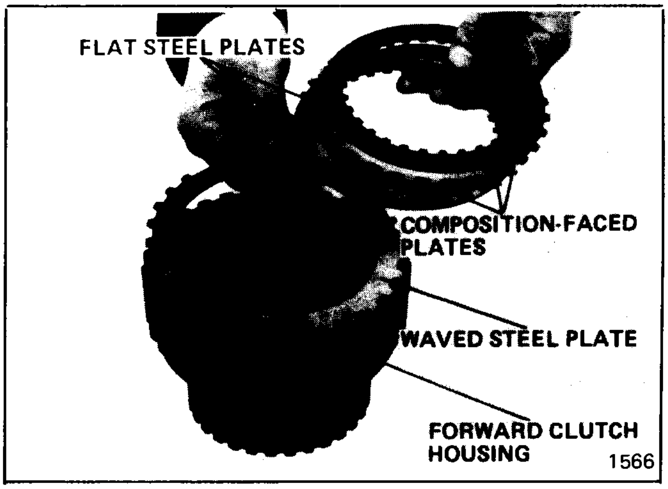

Fig. 7A1-136 Installing Forward Clutch Plates Into Forward Clutch Housing

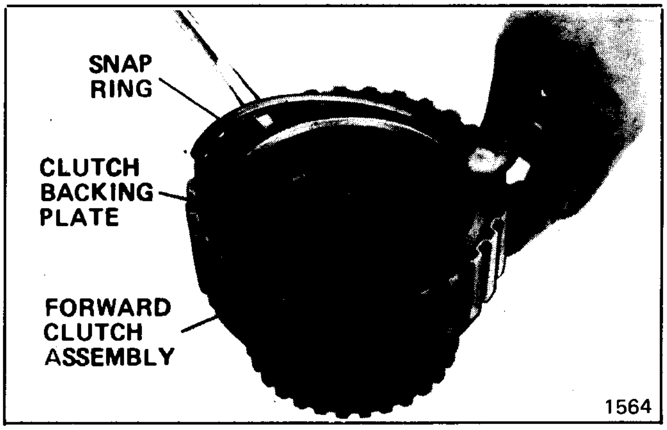

Fig. 7A1-137 Install Forward Clutch Housing Outer Snap Ring

CAUTION: *Do not drop the check ball that is in the pump, as the pump body and pump cover are separated.*

7. Remove pump cover to pump body attaching bolts and spearate pump cover from pump body.

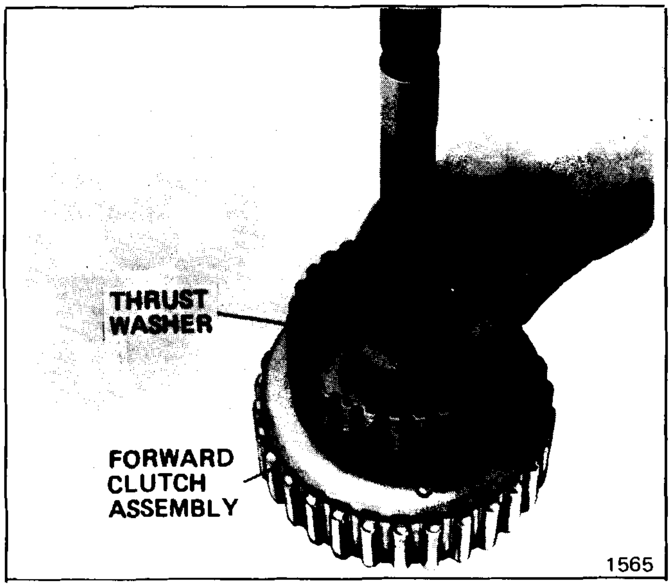

Fig. 7A1-138 Installing Forward Clutch to Direct Clutch Thrust Washer

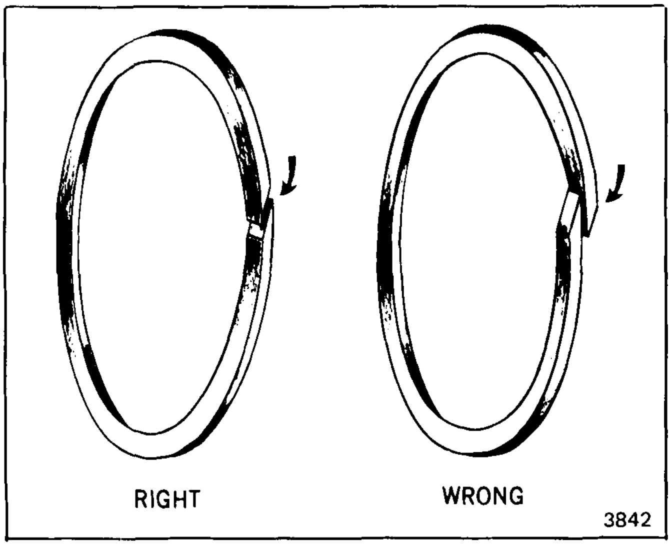

Fig. 7A1-139 Teflon Oil Seal Rings

PUMP BODY

Inspection

1. Remove the check ball (7.14mm (.281")) from the pump body or pump cover and keep it separated from the five check balls (6.35mm (.250")) used in the case and control valve assembly.

2. Mark pump drive and driven gears with pencil or piece of copper for reassembly in same position and remove from pump body (Fig. 7A1-148).

3. Inspect drive and driven gears for scoring, galing or damage.

NOTE: Driven gear identification marks should have been against the pump body gear pocket (See Fig. 7A1-149 for identification). The drive gear has 1 identification mark on each drive tang (Fig. 7A1-148). This side should be facing away from the pump body gear pocket.

4. Inspect drive and driven gear pocket and crescent for scoring or damage (Fig. 7A1-150).

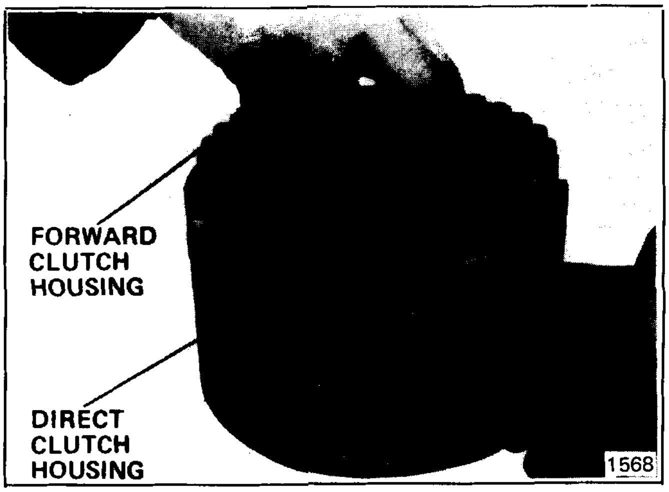

Fig. 7A1-140 Installing Forward Clutch Into Direct Clutch Housing

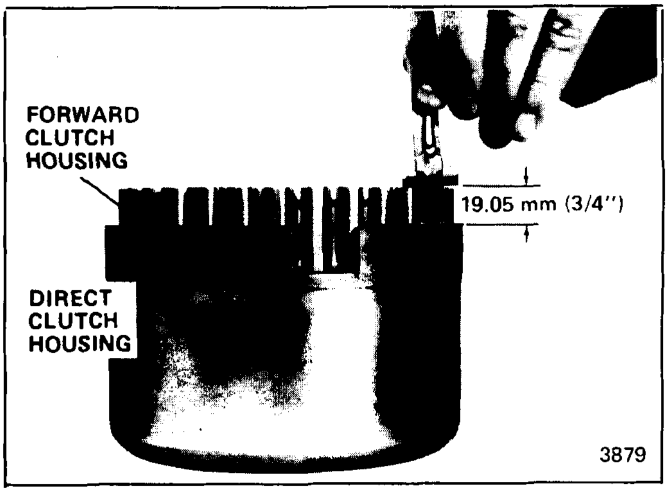

Fig. 7A1-141 Properly Seated Forward Clutch Within Direct Clutch Housing

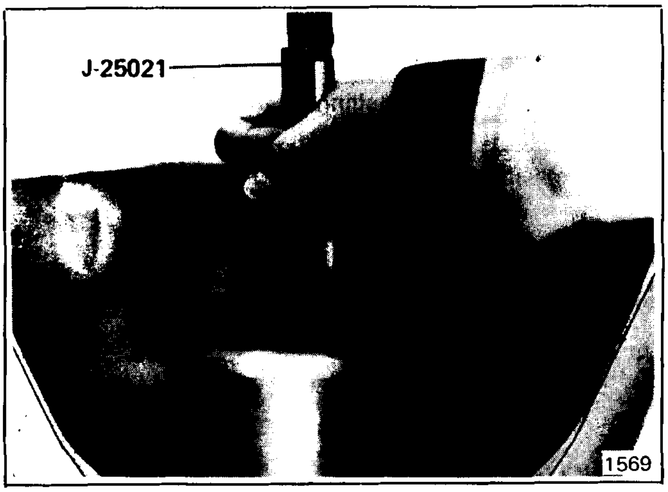

Fig. 7A1-142 J 25021 Installed On Direct and Forward Clutch Assemblies

5. Inspect pump body face for nicks and overall flatness.
6. Inspect for open oil passages.
7. Inspect for damaged bolt hole threads.
8. Inspect for open drainback hole.
9. Inspect bushing for scores or nicks

10. If removed, coat outside of seal body with non-hardening sealing compound; support pump body oil seal side up, and using J 25016, install new pump body oil seal (Fig.

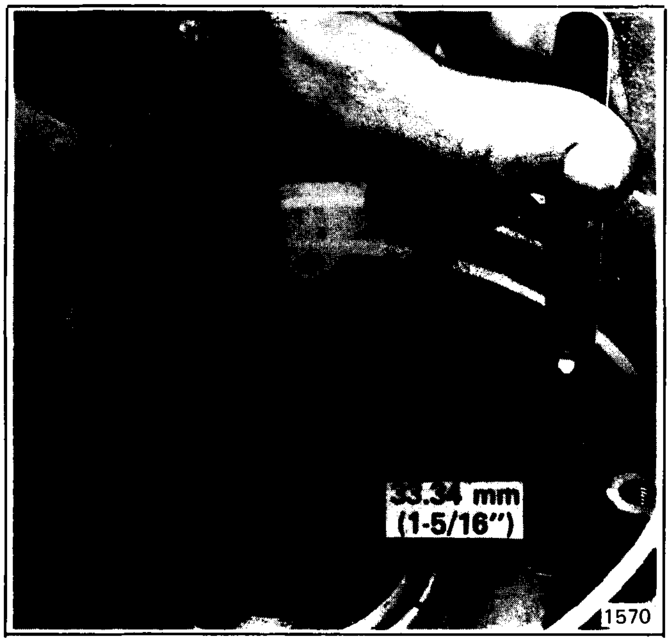

Fig. 7A1-143 Properly Seated Direct Clutch Housing Within Case

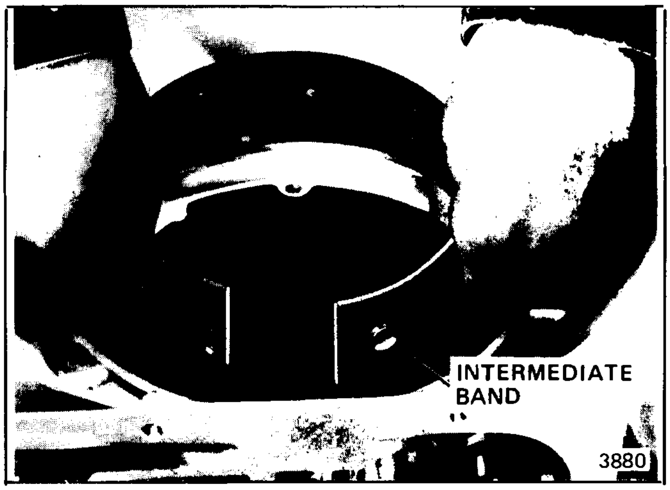

Fig. 7A1-144 Installing Intermediate Band

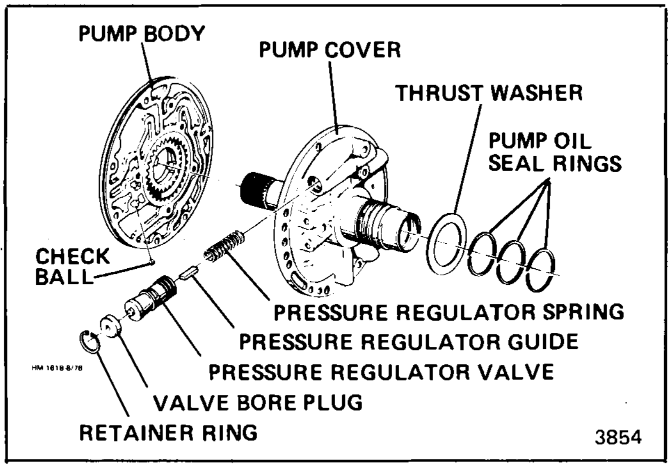

Fig. 7A1-145 Pump Assembly-Exploded View

7A1-151).

11. Install pump driven gear with identification mark down against gear pocket of pump body (Fig. 7A1-152). See Fig. 7A1-149 for identification.)

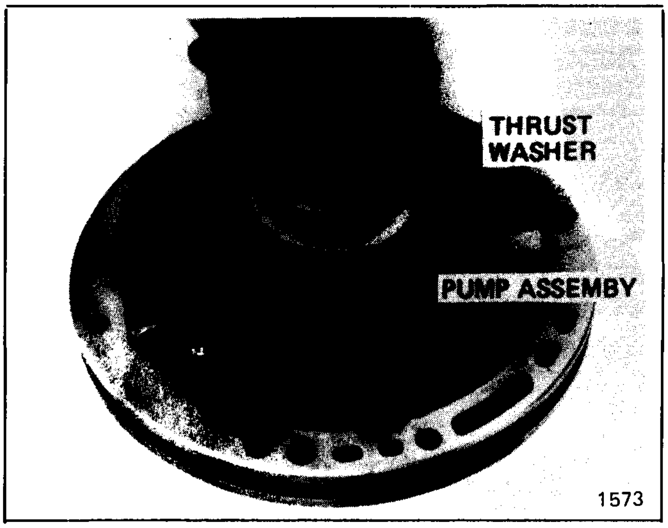

Fig. 7A1-146 Removing Thrust Washer From Pump

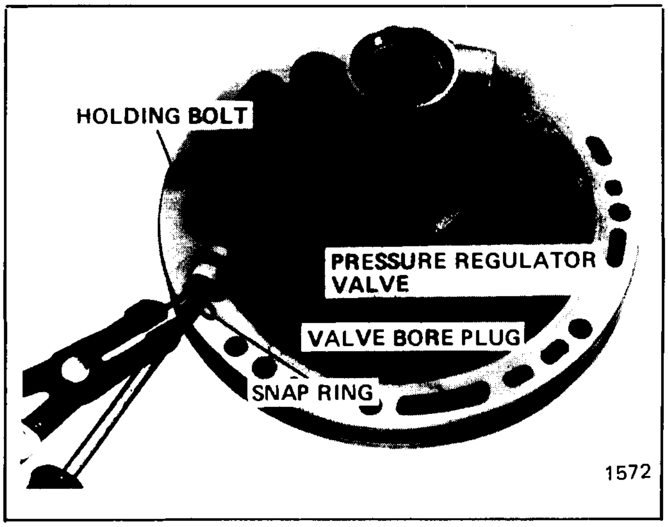

Fig. 7A1-147 Removing Pressure Regulator Valve Retaining Ring

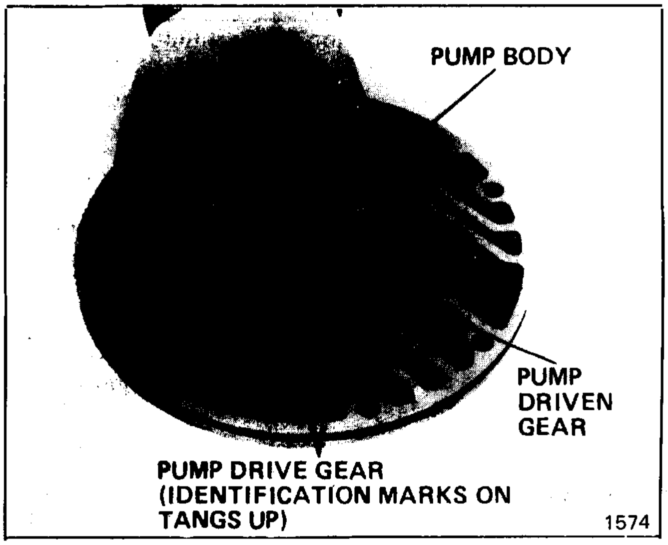

Fig. 7A1-148 Removing Pump Drive Gear

12. Install drive gear with identification marks on drive tangs up (Fig. 7A1-148).

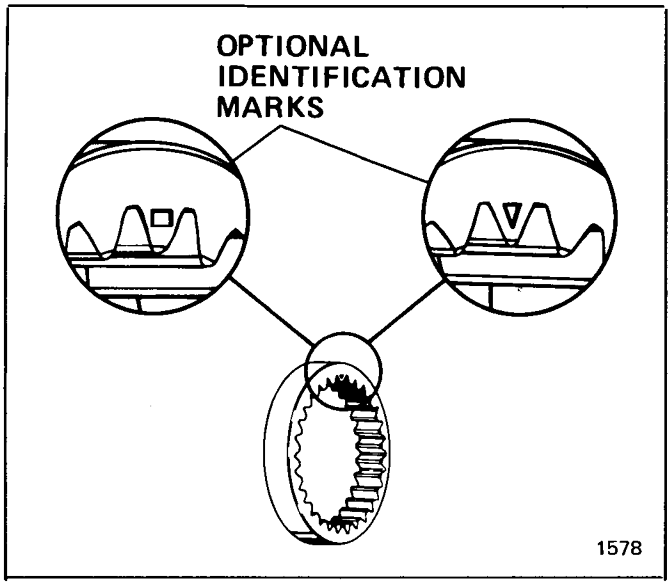

Fig. 7A1-149 Pump Driven Gear Identification

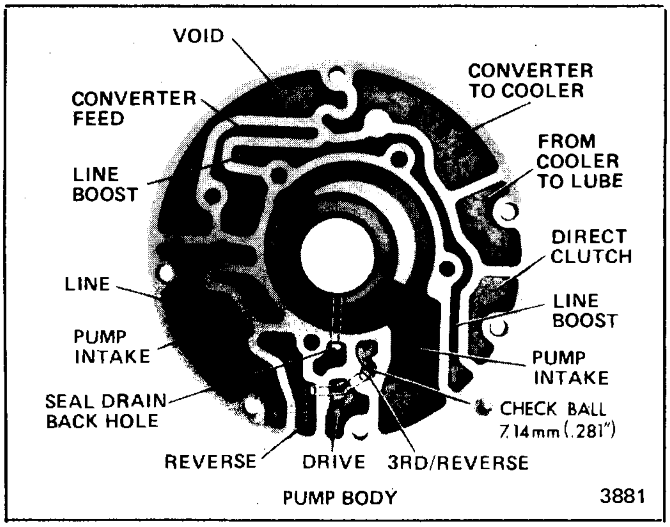

Fig. 7A1-150 Pump Body Face

13. Pump body face to gear face clearance should be 0.020-0.055mm (.007"-.0021") (Fig. 7A1-153).

14. Place the check ball into the check ball pocket in the pump body and retain it with petrolatum (see Fig. 7A1-145 for ball location).

PUMP COVER

Inspection

1. Inspect for open oil passages (Figs. 7A1-154 and 155).

2. Inspect seven (7) cup plugs. If a plug is missing, drive a new cup plug to .79mm (1/32") below top of hole, using a 7.14mm (9/32") below top of hole, using a 7.14mm (9/32") diameter rod on the tow smaller plugs and a 7.92mm (5/16") diameter rod on the four larger plugs. Stake top hole two places, directly opposite each other, to retain plug.

3. Inspect pump cover face for nicks and overall flatness.

4. Inspect for chips in pressure regulator bore.

5. Inspect stator shaft for damaged splines or damaged bushings.

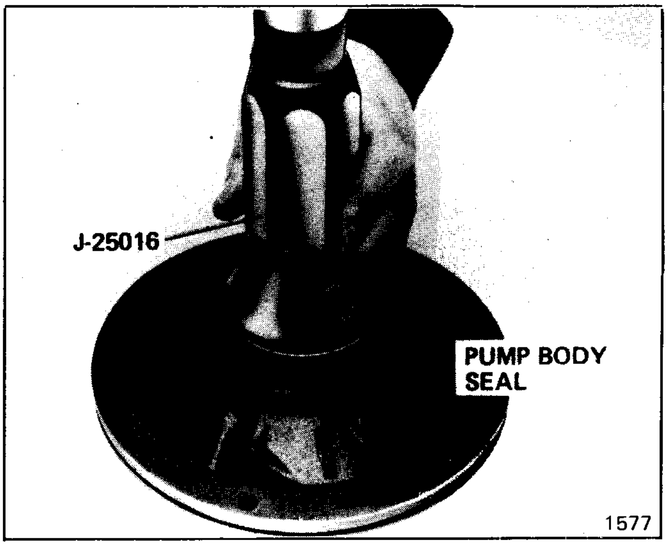

Fig. 7A1-151 Installing Pump Body Oil Seal

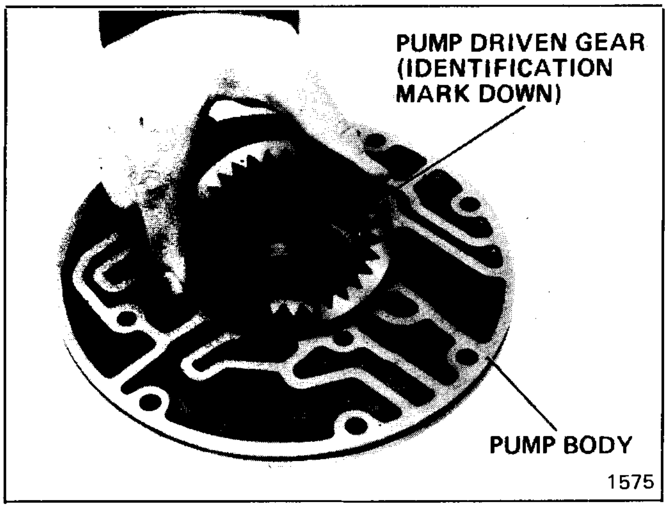

Fig. 7A1-152 Installing Pump Driven Gear

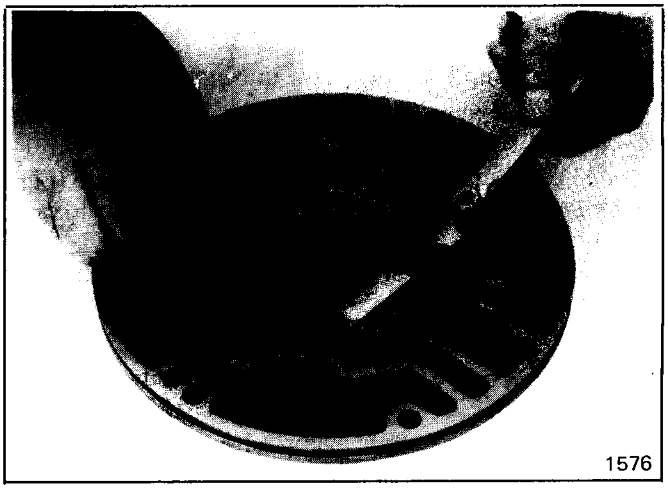

Fig. 7A1-153 Checking Pump Body-to-Gear Face Clearance

6. Inspect orifice plug. If the plug requires replacement, place new plug, orifice end first, into plug hole from the rough casting side. Drive the plug flush to .25mm (.010") below top of hole rough casting side. Stake the tip of the hole two places to retain the plug.

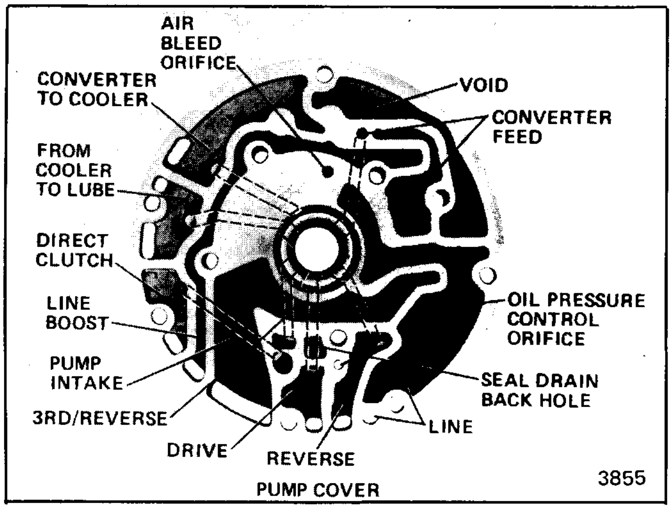

Fig. 7A1-154 Pump Cover Face

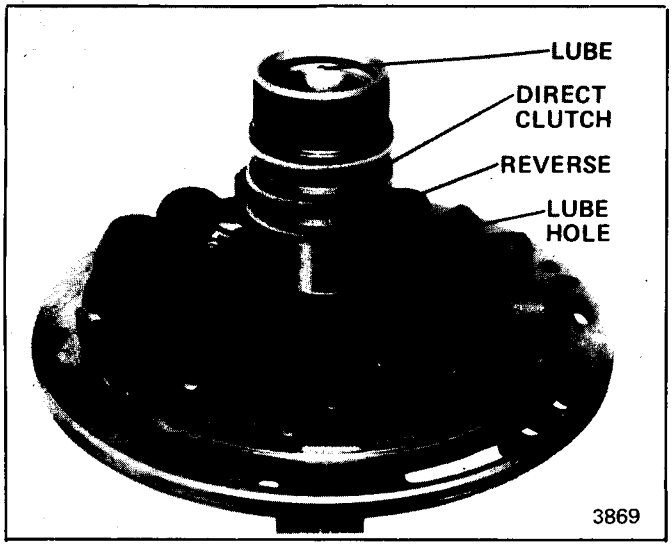

Fig. 7A1-155 Pump Cover Oil Passages

Reassembly

1. Place pump body over hole in bench.
2. Assemble pump cover to pump body with attaching bolts, finger tight.
3. Align pump cover and pump body using J 25015 (Fig. 7A1-156) and place bolt or screwdriver through pump to case bolt hole and bench.
4. Torque pump cover attaching bolts to 20.0-27.0 N·m (15-20 lb. ft.).
5. Remove J 25015.
6. Install pressure regulator spring guide, valve stem end out, and bore plug, hole side out (Fig. 7A1-157).
7. Compress pressure regulator valve spring by pushing on bore plug with small screwdriver and install retaining ring (Fig. 7A1-158).
8. If removed, install 3 new oil seal rings, make sure cut ends are assembled in the same relationship as cut (Fig. 7A1-159). Also, make sure rings are seated in the grooves to prevent damage to the rings during reassembly of mating part over rings. Retain with petrolatum.
9. Install pump to case seal ring, chamfered side out, making sure the ring is not twisted.

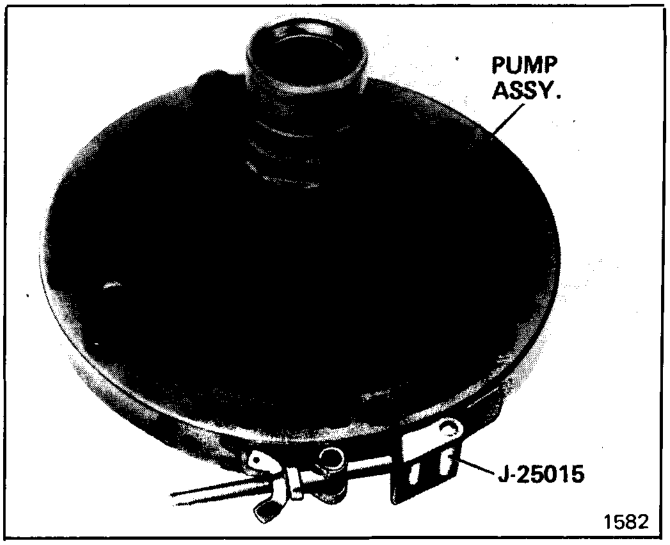

Fig. 7A1-156 Aligning Pump Cover to Pump Body

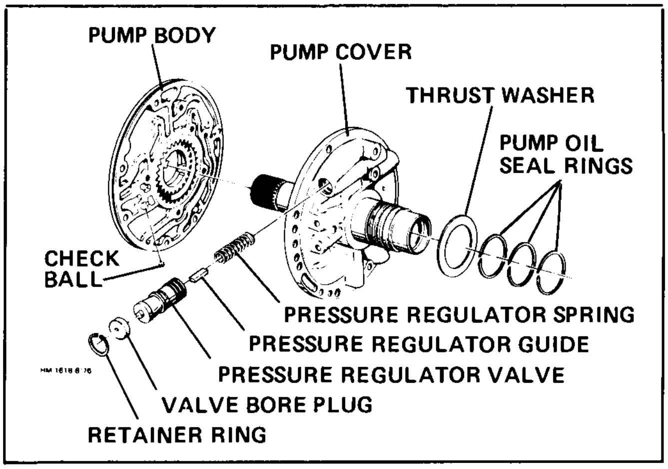

Fig. 7A1-157 Pump Assembly-Exploded View

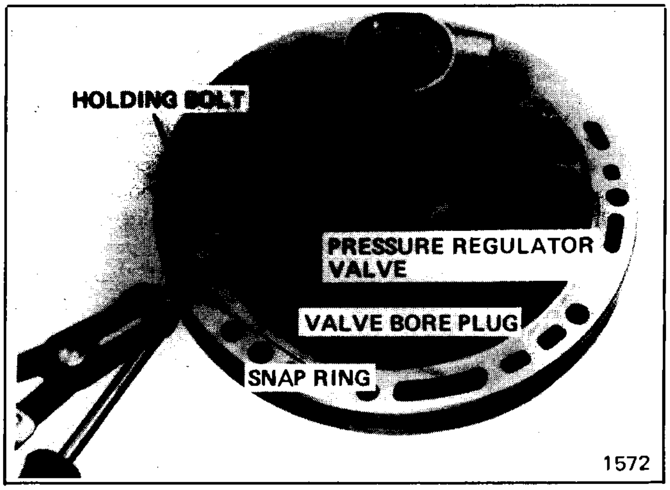

Fig. 7A1-158 Installing Pressure Regulator Valve Retaining Ring

10. Install pump to direct clutch thrust washer and retain with petrolatum (Fig. 7A1-160).
11. Remove bolt or screwdriver (Fig. 7A1-158).
12. Install new pump to case gasket on pump and retain with petrolatum.

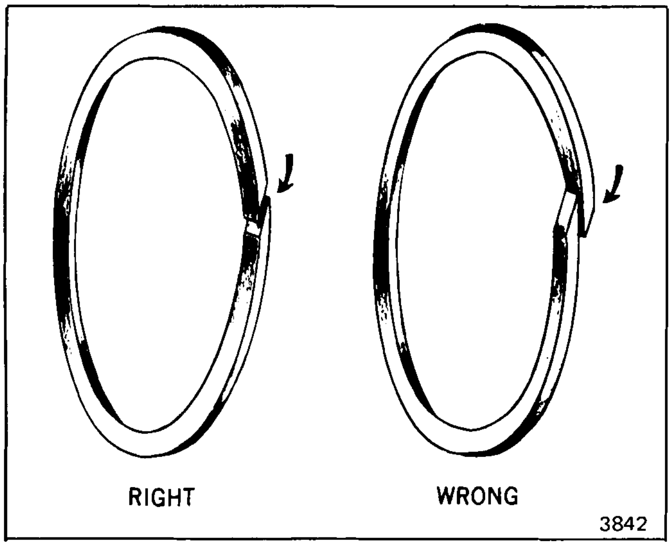

Fig. 7A1-159 Teflon Oil Seal Rings

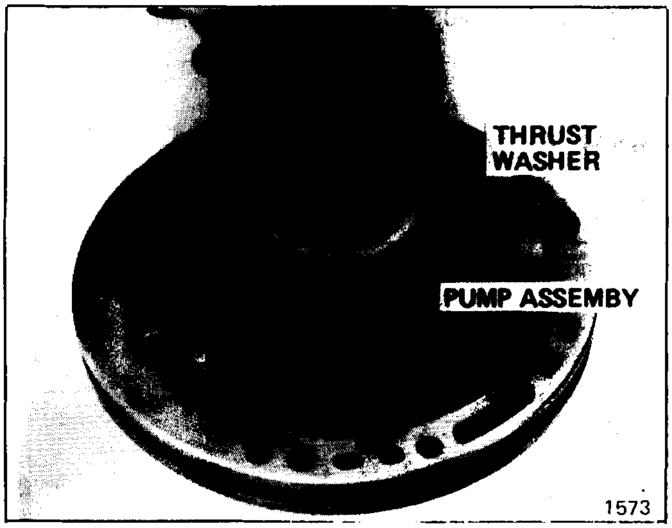

Fig. 7A1-160 Installing Thrust Washer on Pump

13. Install 2 pump to case guide pins in case as shown in Fig. 7A1-161.

NOTE: Before installing pump, make sure intermediate band anchor pin lug is aligned with band anchor pin in hole in case.

14. Install pump assembly and finger start pump to case bolts and new washers, except one bolt hole which will be used to make the front unit end play check.

NOTE: If turbine shaft cannot be rotated as pump is being pulled into place,the forward or direct clutch housings have not been installed properly to index with all the clutch plates. This condition must be corrected before pump is pulled fully into place.

15. Replace 2 alignment pins with 2 bolts and new washers.

16. Torque pump to case bolts to 20.0-27.0 N·m (15-20 lb. ft.)

NOTE: Make sure turbine shaft rotates freely.

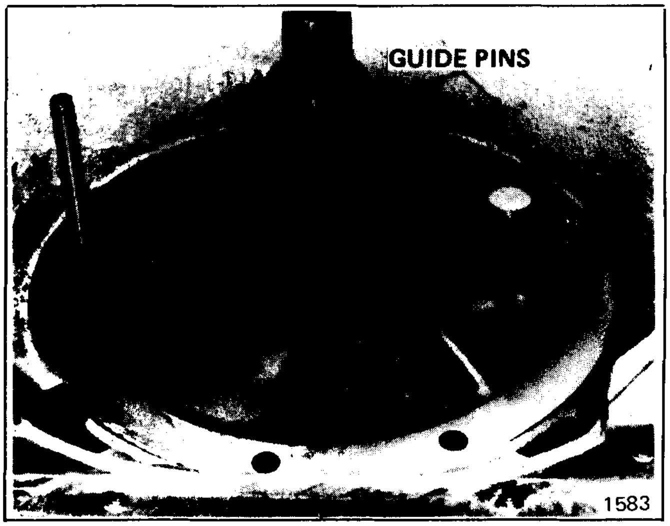

Fig. 7A1-161 Guide Pins Installed Thru Pump to Case

Check Front Unit End Play (Fig. 7A1-162)

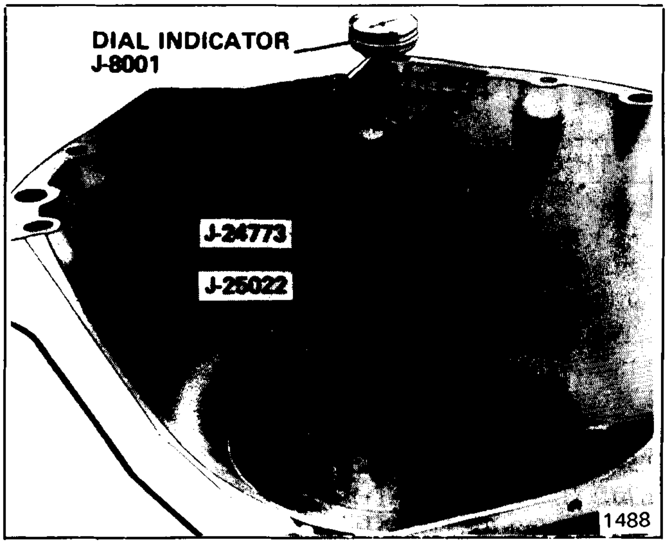

Fig. 7A1-162 Checking Front Unit End Play

1. Install 278mm (11") bolt and locking nut as shown in Fig. 7A1-162.

2. Push turbine shaft downward.

3. Install J 25022 on J 24773 tool and locate on end of turbine shaft.

4. Mount dial indicator on bolt and position indicator point against cap nut of J 24773.

5. Move output shaft forward by turning the adjusting screw on J 25013-5 until the white or scribed line on sleeve J 25013-1 begins to disappear, then set dial indicator to zero.

6. Pull turbine shaft upward and read end play. Front unit end play should be 0.056mm-1.30mm (.022"-.051").

NOTE: Selective washer controlling this end play is located between the output shaft and turbine shaft. If more or less washer thickness is required to bring end play within specifications, select proper washer from FRONT UNIT END PLAY WASHER THICKNESS CHART.

7. Remove front unit end play checking tools.

8. Install remaining pump to case bolt and new washer, torquing bolt to 20.0-27.0 N·m (15-20 lb. ft.).

9. Remove J 25013-5 and J 25013-1 from rear end of transmission (Fig. 7A1-163).

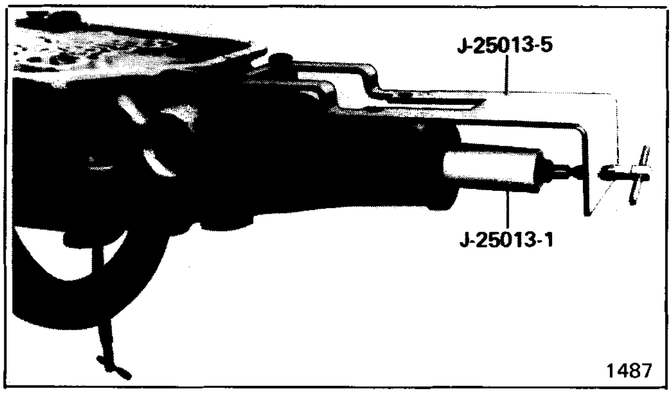

Fig. 7A1-163 Output Shaft Support and Sleeve Tools

10. Turn transmission to horizontal position, oil pan side up.

EXTERNAL PARTS

Governor Assembly

Inspection

1. Inspect governor cover for damage, scored or worn bore or plugged oil passage.
2. Wash in cleaning solvent and blow out oil passage.
3. Inspect governor driven gear for nicks or damage.
4. Inspect governor shaft seal ring for cuts, damage and free fit in groove.
5. Inspect for free operation of governor weights.
6. Inspect for damaged, mispoisitioned or tilted springs.

NOTE: Governor in models BZ, CD, CK, CO, OS, PY and PZ use 2 springs. Other models use 1 spring.

7. Inspect for presence of 2 check balls.
8. Inspect shaft for damage.
9. Inspect governor washer for damage.
10. If damaged, cut seal ring of governor shaft.

FRONT UNIT END PLAY WASHER THICKNESS CHART

THICKNESS	IDENTIFICATION
	Number and/or Color
1.66-1.77mm (0.065"-0.070")	1 --
1.79-1.90mm (0.070"-0.075")	2 --
1.92-2.03mm (0.076"-0.080")	3 Black
2.05-2.16mm (0.081"-0.085")	4 Light Green
2.18-2.29mm (0.086"-0.090")	5 Scarlet
2.31-2.42mm (0.091"-0.095")	6 Purple
2.44-2.55mm (0.096"-0.100")	7 Cocoa Brown
2.57-2.68mm (0.101"-0.106")	8 Orange
2.70-2.81mm (0.106"-0.111")	9 Yellow
2.83-2.94mm (0.111"-0.116")	10 Light Blue
2.96-3.07mm (0.117"-0.121")	11 --
3.09-3.20mm (0.122"-0.126")	12 --
3.22-3.33mm (0.127"-0.131")	13 Pink
3.35-3.46mm (0.132"-0.136")	14 Green
3.48-3.59mm (0.137"-0.141")	15 Gray

CAUTION: *Do not damage seal ring when removing seal.*

Installation

1. If removed, install new seal ring on shaft and place seal ring end into governor cover to size seal; lubricate with petrolatum.

2. Lubricate with petrolatum and install 2 new seal rings on governor cover.

CAUTION: *The governor cover seal rings must be well lubricated with petrolatum to prevent damage or cutting of the rings. Also, make sure 2 check balls are in the governor before installation.*

3. Install governor assembly, seal ring end first, into cover.

CAUTION: *Do not use any type of hammer to install governor assembly and cover into case. Damage to case, governor or cover could result.*

4. Install governor and cover assembly, aligning governor shaft with shaft hole in case (Fig. 7A1-164) Rotate governor and cover assembly and output shaft slightly. The governor cover fits tight in the bore the last 1.5mm (1/16").

NOTE: Governor shaft is not aligned with case hole, if retaining ring cannot be installed.

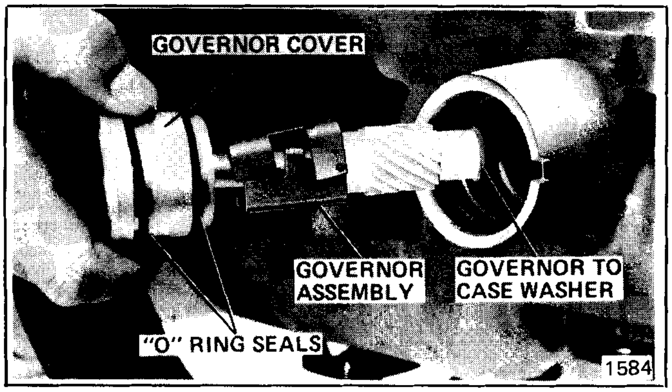

Fig. 7A1-164 Installing Governor and Cover Assembly

5. Install governor retaining ring. Align ring gap with an end showing in case slot.

Intermediate Band Anchor Pin

1. Inspect anchor pin for damage.

2. Install anchor pin, stem end first, making sure stem locates in hole of intermediate band lug (Fig. 7A1-165).

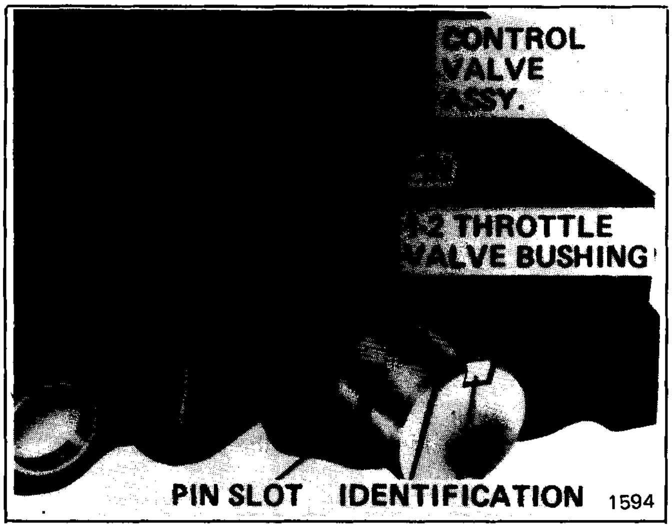

Fig. 7A1-165 Installing Intermediate Band Anchor Pin

Intermediate Servo Piston Assembly (Fig. 7A1-166)

Inspection

> **NOTE:** Some production transmissions will be built with two oil seal rings on the band apply pin. All service band apply pins will have two oil seal rings.

1. Inspect pin for damage and fit in case bore.

2. Inspect inner and outer piston seal rings for damage and free fit in ring grooves. Do not remove unless replacing.

3. Inspect spring.

4. Inspect intermediate servo cover and piston assembly for proper combination and usage (Fig. 7A1-167).

5. Check for proper intermediate band apply pin as follows:

a. Install J 25014-2 in intermediate servo bore and retain with intermediate servo cover ring, aligning ring with gap at case slot (Fig. 7A1-168).

b. Install pin J 25014-1 into J 25014-2.

> **CAUTION:** *Make sure the tapered pin and is properly located against the band apply lug. Also, make sure the band anchor pin is properly located in the case and band anchor lug.*

c. Install dial indicator J 8001 and position dial indicator point on top of J 25014-2 zero post and set dial indicator to zero.

d. Align stepped side of pin J 25014-1 with torquing arm of J 25014-2. Arm must stop against step of pin J 25014-1.

> **NOTE:** If band selection pin does not register between the high and low limits, look for possible problem with the intermediate band, direct clutch or case.

> **NOTE:** Make sure J 25014-2 gage plate is pulled backwards and seated squarely against the retaining ring.

e. Apply 12 N·m (100 in. lbs.) of torque to hex nut on side of gage. Slide dial indicator over gage pin J 25014-1. Rear dial indicator and see chart below for proper size.

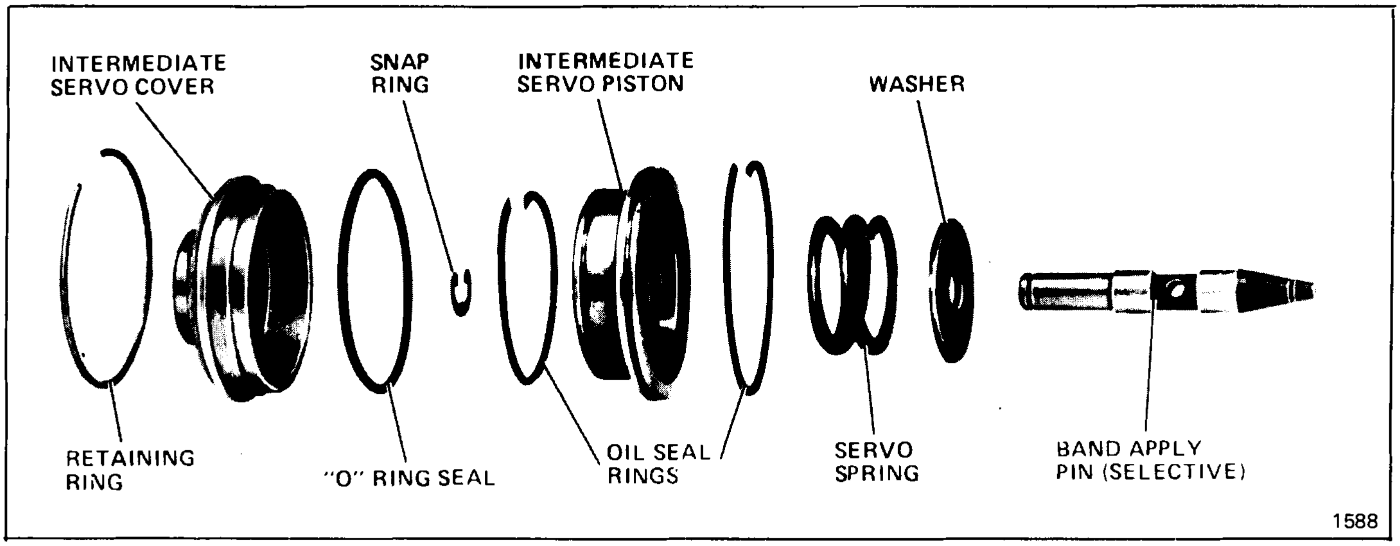

Fig. 7A1-166 Intermediate Servo Piston-Exploded View

MODEL	COVER	PISTON
	IDENTIFIED BY CAST PART NO. ON COVER	IDENTIFIED BY CAST PART NO. ON PISTON
BR+,BU CN,CU,CX+ CZ,PZ,PY	8628696	8630131
BH,BL,BZ OS*** PZ***	*8630085	**8630083
CE,CR	8628134	8628112
CD,CY OS***,OW,OZ PZ*** BR+,CX+	8628133	8628111

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NOTE: *Intermediate servo cover, 8630085, at start of production will be identified by the part number 8628696 cast on the cover with the letter "A" stamped on it.

**Intermediate servo piston, 8630083, at start of production will be identified by the part number 8628111 cast on the piston with the letter "A" stamped on it.

***OS and PZ models prior to transmission serial number 77-OS-31859 and 77-PZ-13419, used 8628133 cover and 8628111 piston. Beginning with transmission serial numbers 77-OS-31859 and 77-PZ-13419, these models use 8630085 cover and 8630083 piston.

+BR and CX models prior to transmission serial numbers 77-BR-1840 and 77-CX-2350 used 8628133 cover and 8628111 piston. Beginning with transmission serial numbers 77-BR-1840 and 77-CX-2350, these models use 8628696 cover and 8630131 piston.

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Fig. 7A1-167 Intermediate Servo Cover and Piston Usage Chart

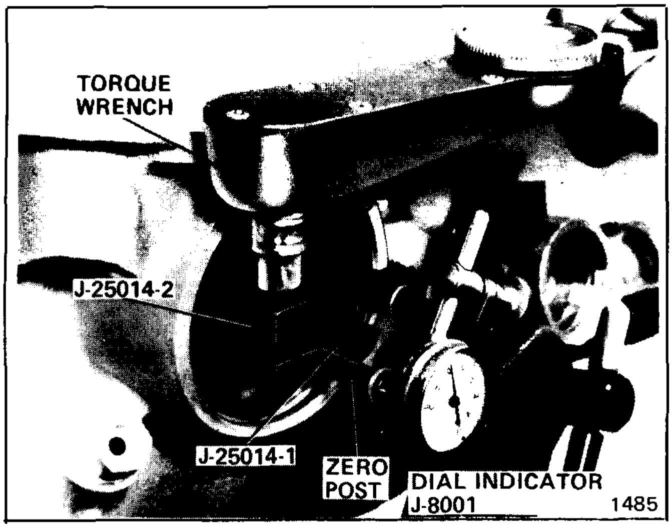

Fig. 7A1-168 Intermediate Band Apply Pin Tools

INTERMEDIATE BAND APPLY PIN CHART

DIAL INDICATOR TRAVEL	IDENTIFICATION
0.00mm-0.72mm (0.00"-0.29")	1 Ring
0.72mm-1.44mm (0.29"-0.57")	2 Rings
1.44mm-2.16mm (0.57"-0.86")	3 Rings
2.16mm-2.88mm (0.86"-1.14")	Wide Band

NOTE: Dial indicator travel is reversed, making the indicator readings backwards. On an tor that ranges from 0-100, a .5mm (.020") travel will read 2mm (.080"), a 1.5mm (.060") travel will read 1mm (.040"). The identification ring is located on the band end of the pin.

f. Remove retaining ring and band apply pin tools. If new apply pin or replacement of piston is required, proceed as follows:

Disassembly

1. Using J 22269-01, compress intermediate servo piston spring (Fig. 7A1-169).
2. Using small flat edge screwdriver, remove intermediate pin to piston snap ring.
3. Remove J 22269-01 and separate band apply pin, spring and washer from intermediate servo piston.

Reassembly

1. Install washer on snap ring end of band apply pin (Fig. 7A1-166).
2. Install servo spring on washer.
3. Install band apply pin, spring end first, through intermediate servo piston.
4. Using J 22269-01, compress intermediate servo piston spring (Fig. 7A1-169).
5. Using small pliers, install band apply pin to piston snap ring. Remove J 22269-01.
6. If removed, install new intermediate servo piston, inner and outer seal rings. Make sure cut ends are assembled in the same relationship as cut (Fig. 7A1-170). Make sure rings are seated in the grooves to prevent damage to the rings. Retain with petrolatum.

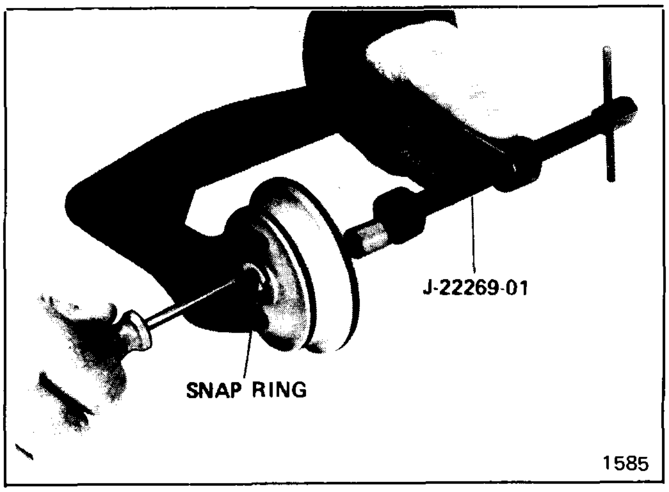

Fig. 7A1-169 Compressing Intermediate Servo Piston

7. Lubricate with petrolatum and install new seal ring on intermediate servo cover.

CAUTION: *The intermediate servo cover seal rings must be well lubricated with petrolatum to prevent damage or cutting of ring.*

8. Install intermediate servo piston assembly into intermediate servo cover (Fig. 7A1-171).

9. Install intermediate servo assembly into case, tapping lightly with non-metal or plastic hammer if necessary (Fig. 7A1-172).

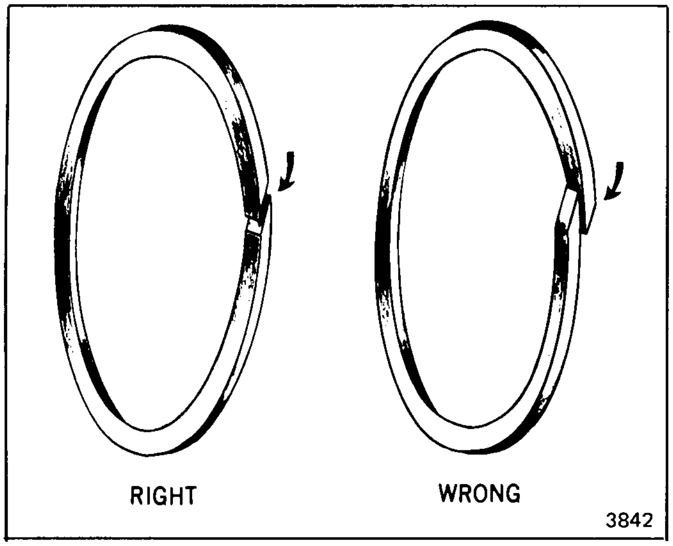

Fig. 7A1-170 Teflon Oil Seal Rings

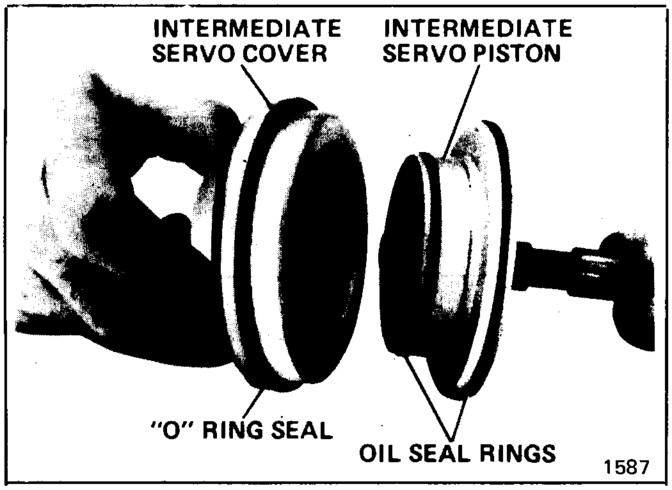

Fig. 7A1-171 Installing Intermediate Servo Piston Into Cover

CAUTION: *Make sure the tapered end of the band apply pin is properly located against the band apply lug.*

10. Install servo retaining ring. Align ring gap with an end showing in case slot.

Low and Reverse Clutch Housing to Case Cup Plug and Seal (Fig. 7A1-173).

1. Install new seal, making sure it seats against.
2. Place cup plug, with smaller hole end first, into hole in case. Using a 10mm (3/8") diameter by 150mm (6") metal rod and hammer,drive plug until it seats against the seal.

Control Valve Assembly

Disassembly (Fig. 7A1-174)

NOTE: As each valve train is removed, place individual valve train in the order that it is removed and in a separate location, relative to its position in the valve body. None of the valves, bushings or springs are interchangeable; some coiled pins are interchangeable.

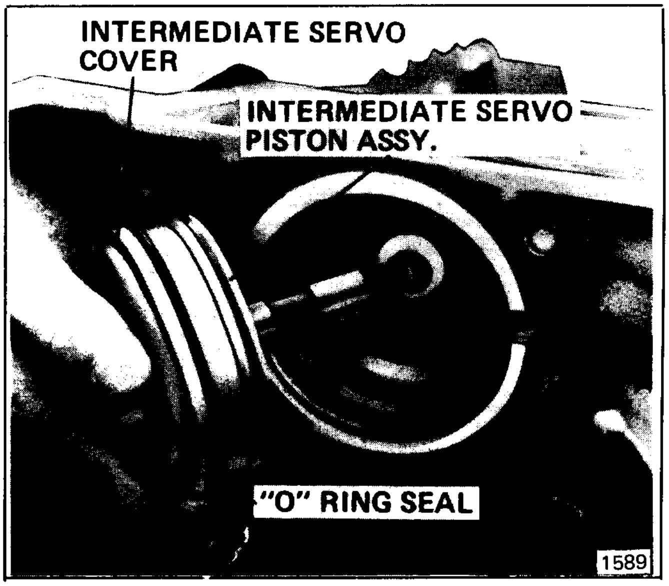

Fig. 7A1-172 Installing Servo Assembly into Case

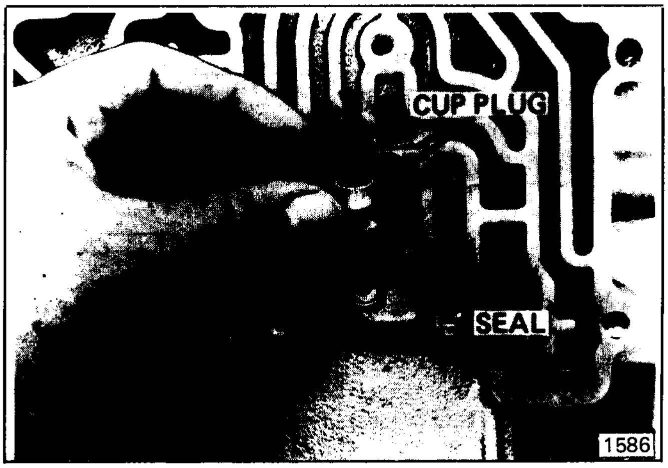

Fig. 7A1-173 Installing Cup Plug and Seal Into Case

Remove all coiled pins by pushing through from the rough cast surface side of the control valve assembly, except the 2 pins which retain the throttle valve and throttle valve plunger.

1. Remove the 4 check balls.
2. Position control valve assembly as shown in Fig. 7A1-174.
3. Remove 1-2 accumulator piston.
4. Remove manual valve from upper bore.

CAUTION: *Some of the coiled pins in the control valve assembly have pressure against them. Therefore, hold a shop towel over the bore while removing the pin, to prevent possibly losing a bore plug, spring, etc.*

5. Remove coiled pin from the upper right bore. Remove 2-3 throttle valve bushing, 2-3 throttle valve spring, 2-3 throttle valve and 2-3 shift valve.

NOTE: The 2-3 throttle valve spring and 2-3 throttle valve may be inside the 2-3 throttle valve bushing.

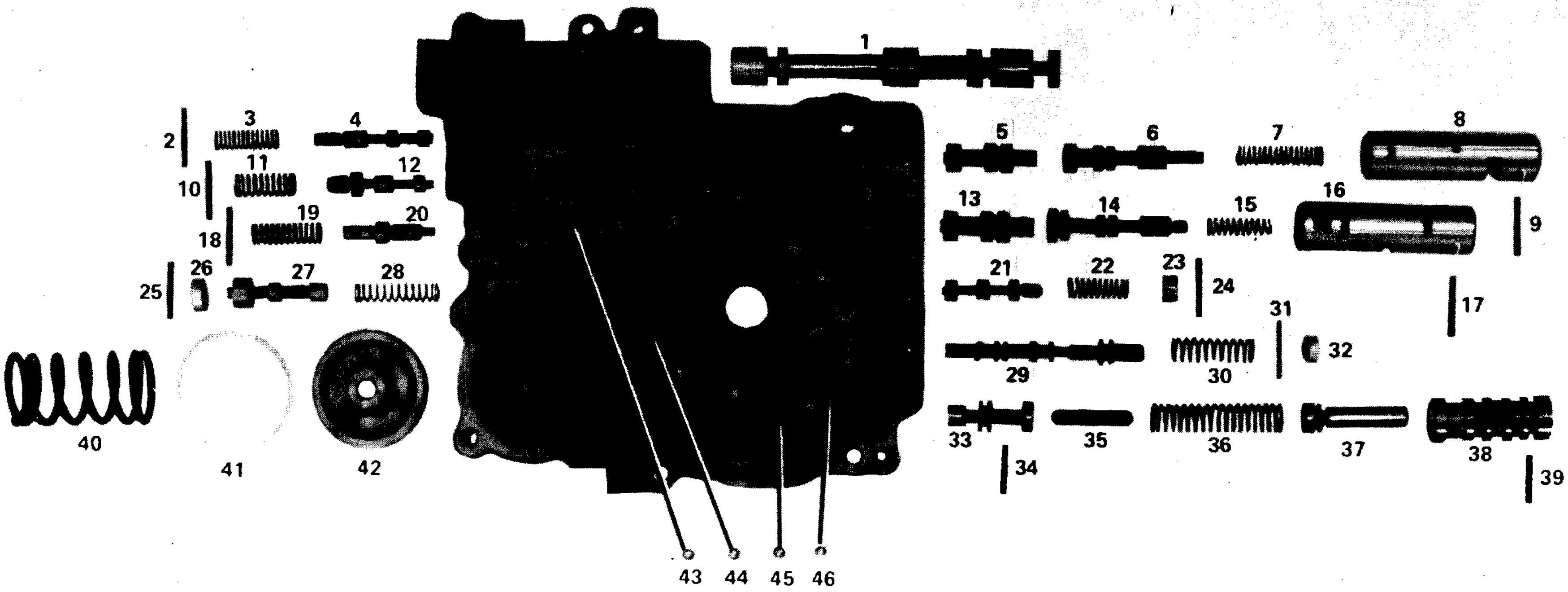

Fig. 7A1-174 Control Valve Assembly-Exploded View

1. MANUAL VALVE
2. RETAINING COILED PIN
3. INTERMEDIATE BOOST SPRING
4. INTERMEDIATE BOOST VALVE
5. 2-3 SHIFT VALVE
6. 2-3 THROTTLE VALVE
7. 2-3 THROTTLE VALVE SPRING
8. 2-3 THROTTLE VALVE BUSHING
9. RETAINING COILED PIN
10. RETAINING COILED PIN
11. LO OVERRUN CLUTCH SPRING
12. LO OVERRUN CLUTCH VALVE
13. 1-2 SHIFT VALVE
14. 1-2 THROTTLE VALVE
15. 1-2 THROTTLE VALVE SPRING
16. 1-2 THROTTLE VALVE BUSHING
17. RETAINING COILED PIN
18. RETAINING COILED PIN
19. DIRECT CLUTCH EXHAUST SPRING
20. DIRECT CLUTCH EXHAUST VALVE
21. REVERSE BOOST VALVE
22. REVERSE BOOST SPRING
23. REVERSE BOOST BORE PLUG
24. RETAINING COILED PIN
25. RETAINING COILED PIN
26. 1-2 ACCUMULATOR BORE PLUG
27. 1-2 ACCUMULATOR VALVE
28. 1-2 ACCUMULATOR VALVE SPRING
29. SHIFT T.V. VALVE
30. SHIFT T.V. SPRING
31. RETAINING COILED PIN
32. SHIFT T.V. BORE PLUG
33. THROTTLE VALVE
34. RETAINING COILED PIN
35. DETENT PIN
    (Note: Models CD, CE And CH
    Do Not Use A Detent Pin)
36. THROTTLE VALVE SPRING
37. THROTTLE VALVE PLUNGER
38. THROTTLE VALVE PLUNGER BUSHING
39. RETAINING COILED PIN
40. 1-2 ACCUMULATOR SPRING
41. 1-2 ACCUMULATOR PISTON SEAL
42. 1-2 ACCUMULATOR PISTON
43. CHECK BALL #4
44. CHECK BALL #3
45. CHECK BALL #2
46. CHECK BALL #1
    (Note: 5th Check Ball
    Is In The Case)

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6. From next bore down, remove coiled pin. Remove 1-2 throttle valve bushing, 1-2 throttle valve spring, 1-2 throttle valve and 1-2 shift valve.

NOTE: The 1-2 throttle valve spring and the 1-2 throttle valve may be inside the 1-2 throttle valve bushing.

7. From next bore down, remove coiled pin and bore plug. Remove reverse boost spring and reverse boost valve.

8. Check the operation of the shift T.V. valve in the next bore down, by moving the valve against the spring. If it is necessary to remove the valve, proceed as follows:

a. Remove coiled pin and place valve body on shop towel with rough casting surface up.

b. Using needle nose pliers, compress the shift T.V. spring by pushing on the shift T.V. valve; hold valve with small screwdriver (Fig. 7A1-175).

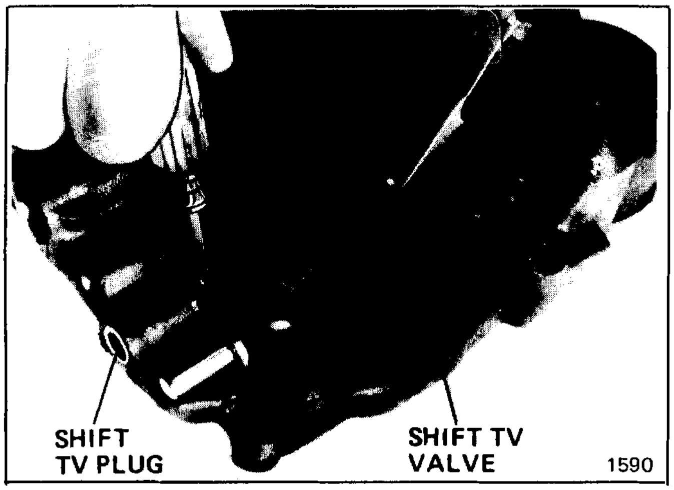


Fig. 7A1-175 Compressing Shift T.V. Spring

c. Place 6.3mm (1/4") rod, 9.5mm (3/8") long, against the end of the shift T.V. valve.

d. Prying on end of the rod with a large screwdriver, remove small screwdriver and remove shift T.V. bore plug, shift T.V. spring and shift T.V. valve (Fig. 7A1-176).

e. Discard shift T.V. plug and remove 6.3mm (1/4") rod from shift T.V. bore.

9. From next bore down, remove outer coiled pin. Remove the throttle valve plunger and bushing, throttle valve spring and detent pin. Using a 1.5,, (1/16") allen wrench with ground sides to fit inside the pin, remove the inner coiled pin (Fig. 7A1-177). Remove the throttle valve.

NOTE: The detent pin is used only on BR, CN, CU, CX and CZ models. All other models do not use a detent pin.

10. From upper left bore, remove coiled pin, intermediate boost spring and intermediate boost valve.

11. From next bore down, remove coiled pin, low overrun clutch spring and low overrun clutch valve.

12. From next bore down, remove coiled pin, direct clutch exhaust spring and direct clutch exhaust valve.

13. From next bore down, remove coiled pin, 1-2 accumulator bore plug, 1-2 accumulator valve and 1-2 accumulator valve spring.

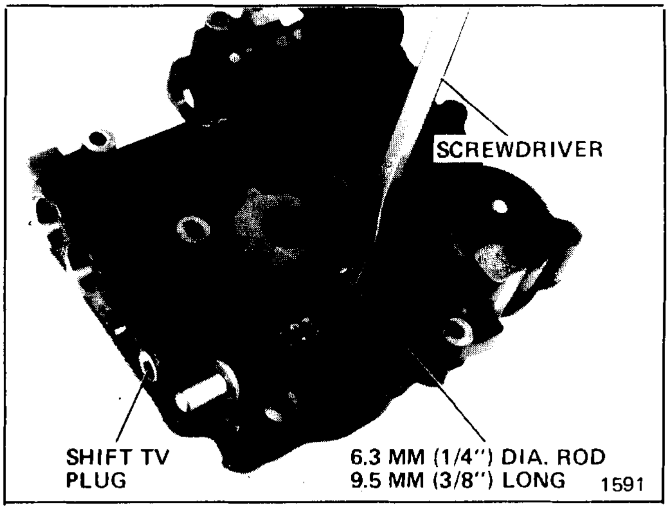


Fig. 7A1-176 Removing Shift T.V. Bore Plug

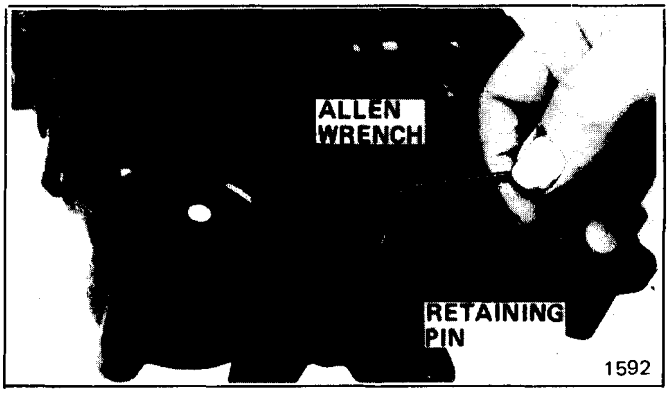


Fig. 7A1-177 Removing Inner Coiled Pin

Inspection

1. Wash control valve body, valves, springs and other parts in clean solvent and air dry.
2. Inspect 1-2 accumulator piston for damage.
3. Inspect 1-2 accumulator piston seal for damage and free fitting groove. Do not remove seal unless replacing.
4. Inspect valve for scoring, cracks and free movement in their bores.
5. Inspect bushings for cracks or scored bores.
6. Inspect valve body for cracks, damage or scored bores.
7. Inspect springs for distortion or collapsed coils.
8. Inspect bore plugs for damage.

Reassembly (Fig. 7A1-174)

NOTE: Install all coiled pins from machined face side except the coil pin retaining the throttle valve bushing, plunger, spring and detent pin. Install this coil pin from rough casting side. Coiled pins do not fit flush on rough casting face.

1. Position control valve body as shown in Fig. 7A1-174.

2. Install into lower left bore,1-2 accumulator valve spring and 1-2 accumulator valve, smaller stem end out. Install bore plug, hole out, and coiled pin.

3. In next bore up, install direct clutch exhaust valve, longer stem end out, direct clutch exhaust spring and coiled pin.

4. In next bore up, install low overrun clutch valve, longer stem end out, low overrun clutch spring and coiled pin.

5. In next bore up, install intermediate boost valve, longer stem end out, intermediate boost spring and coiled pin.

6. In lower right bore, install throttle valve, smaller outside diameter land first, making sure valve is seated at the bottom of the bore. Install inner coiled pin between the lands of the valve (Fig. 7A1-177). Install the detent pin into the shift T.V. spring and install these 2 parts into the bore. Install the throttle valve plunger, stem end first, into the throttle valve plunger bushing and install these 2 parts into the bore, valve end first. Install outer coiled pin from rough cast surface side, aligning pin with slot in bushing.

> **NOTE:** The detent pin is used only on BR, CN, CU, CX and CZ models. All other models do not use a detent pin.

7. In next bore up, if removed, install shift T.V. valve, larger outside diameter stem end out, shift T.V. spring and coiled pin. Then, using plastic hammer, install new shift T.V. plug flush with rough casting surface.

8. In next bore up, install reverse boost valve, stem end out, reverse boost spring, reverse bore plug, hole side out and coiled pin.

9. In next bore up, install 1-2 shift valve, longer stem end out, making sure valve is seated at the bottom of the bore. Install 1-2 throttle valve spring into the 1-2 throttle valve bushing and 1-2 throttle valve, stem end first, into the bushing. Install these 3 parts, valve end first, into the bore, aligning bushing so the coiled pin can be installed in the pin slot. (See Fig. 7A1-178 for pin slot and identification of 1-2 throttle valve bushing.)

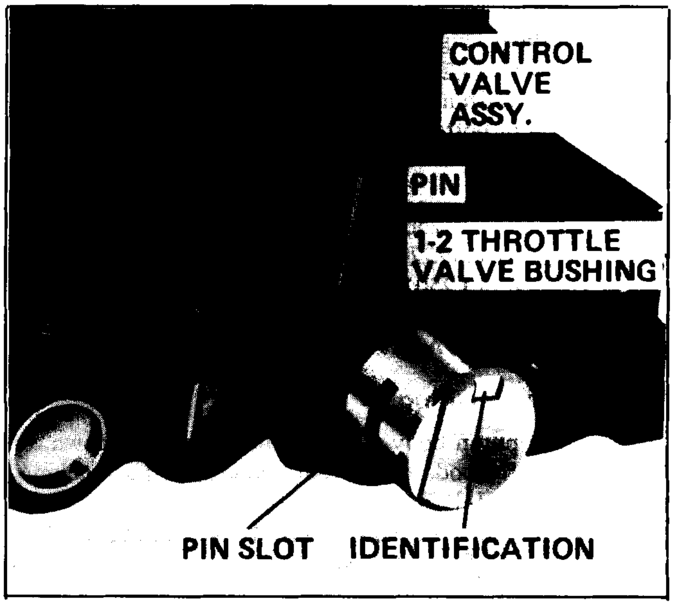


Fig. 7A1-178 Installing 1-2 Throttle Valve Bushing

10. In next bore up, install 2-3 shift valve, longer stem end out, making sure valve is seated at the bottom of the bore. Install 2-3 throttle valve spring into the 2-3 throttle valve bushing and 2-3 throttle valve, stem end first, into the bushing. Install these 3 parts, valved end first, into the bore, aligning bushing so coiled pin can be installed in the pin slot (Fig. 7A1-179).

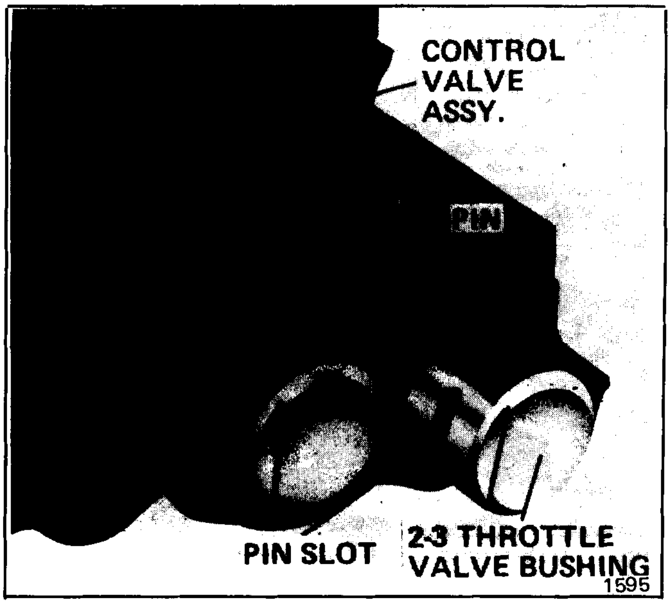


Fig. 7A1-179 Installing 2-3 Throttle Valve Bushing

11. Install manual valve with the inside detent lever pin groove to the right.

12. If removed, install new seal ring on 1-2 accumulator piston.

13. Oil and install 1-2 accumulator piston, spring pocket side out, into 1-2 accumulator piston bore of valve body.

CONTROL VALVE ASSEMBLY

Installation

1. Inspect 1-2 accumulator spring for damage.

2. Install 1-2 accumulator spring into case (Fig. 7A1-180).

3. Inspect control valve assembly and spacer plate for damage (Fig. 7A1-181).

> **NOTE:** The size of the 5 check balls used in the case and control valve assembly is 6.35mm (.250"). The size of the check ball used in the pump is 7.14mm (.281"). Do not interchange.

4. Install 5th check ball in case as shown (Fig. 7A1-182).

5. Install 2 guide pins as shown in Fig. 7A1-185.

6. Install 4 check balls into ball seat pockets in control valve assembly and retain with petrolatum (see Fig. 7A1-183 for check ball location).

7. Place the control valve assembly to spacer plate gasket marked "VB" on the control valve assembly.

8. Place the valve body spacer plate on the gasket marked "VB".

9. Place the spacer plate to case gasket marked "C" on the spacer plate (Fig. 7A1-184).

10. Insert 2 control valve assembly to case attaching bolts through the control valve assembly, gaskets and spacer plate; and install these parts, aligning the manual valve with the detent lever pin (Fig. 7A1-185).

> **NOTE:** Make sure check balls, 1-2 accumulator piston and manual valve do not fall out.

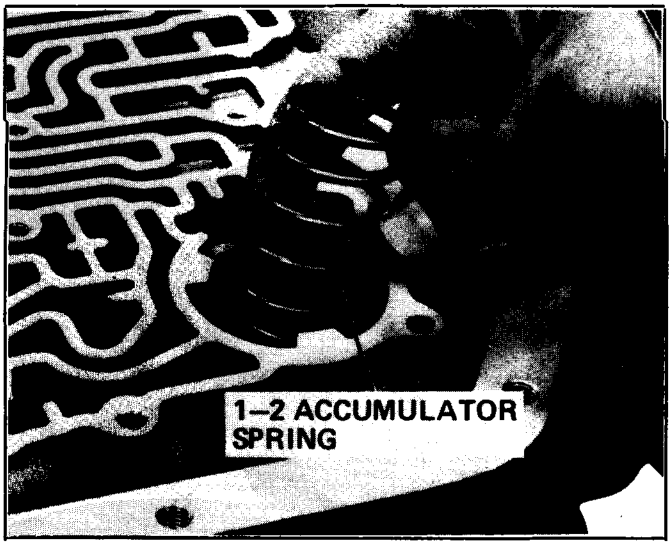


Fig. 7A1-180 Installing 1-2 Accumulator Spring In Case

11. Start control valve assembly to case attaching bolts, except the throttle lever and bracket assembly and the oil screen attaching bolts.

CAUTION: *The (2) oil screen attaching bolts are about 10mm (3/8") longer than the control valve assembly attaching bolts, and they are not interchangeable.*

12. Inspect inside manual detent roller and spring assembly for damage.
13. Remove guide pins and replace with bolts and inside manual detent roller and spring assembly, locating the tang in the control valve assembly and the roller on the inside detent lever (Fig. 7A1-186).
14. Throttle lever and bracket assembly:
   a. Inspect throttle lever and bracket assembly for damage (Fig. 7A1-187).
   b. If removed, install spring on top of lifter then lifter spring first insto throttle bracket.
   c. Install link on throttle lever, making sure link is hooked as shown.
   d. Install throttle lever and bracket assembly, location slot in bracket with coiled pin, aligning lifter through valve body hole and link through T.V. linkage case bore. Retain with bolt (Fig. 7A1-188).
15. Torque all control valve assembly to case attaching bolts to 13.0-17.0 N·m (9-12 lb. ft.).

Oil Screen

1. Thoroughly clean, air dry and inspect oil screen assembly.
2. Install new oil screen gasket on screen and retain with petrolatum.
3. Install oil screen assembly and attaching bolts (Fig. 7A1-189). Torque bolts to 13.0-17.0 N·m (9-12 lb. ft.).

Oil Pan

1. Clean and inspect oil pan for damage.
2. Install new oil pan to case gasket on case.
3. Install oil pan and retaining bolts. Torque bolts to 14.0-18.0 N·m (10-13 lb. ft.).

Speedometer Driven Gear (Fig. 7A1-190)

Inspection

1. Remove speedometer driven gear from housing and inspect gear for damage.
2. Inspect housing for damage and "O" ring for damage or cuts.
3. If damaged, remove and discard "O" ring.

Reassembly

1. If removed, install new "O" ring on housing.
2. Install speedometer driven gear into housing.
3. Install speedometer driven gear assembly into case.
4. Install speedometer retainer and attaching bolt, aligning slot in speedometer driven gear housing with retainer. Torque bolt to 8.0-14.0 N·m (6-10 lb. ft.).
5. Place transmission in cradle or transmission jack. Remove holding fixture, J 8763-02 from transmission.

BUSHING SERVICE

During disassembly and inspection of the transmission, if a bushing is galled, scored or excessively worn, the bushing may be replaced, using the following proceudre:

The replacement bushings used for field service are of high quality with close tolerances to fit and do not require boring or reaming after installation.

Pump Cover Bushing

Front Bushing:

a. Using tool J 24036 with Slide Hammer, J 7004-1, remove bushing (Fig. 7A1-191).

b. Using tool J 25019-2 with Driver Handle J 8092, drive or press new bushing, part no. 8628915 or equivalent, into place until tool bottoms (Fig. 7A1-192).

Rear Bushing:

a. Using tool J 25019-14 with Slide Hammer J 7004-1, remove bushing (Fig. 7A1-193).

b. Using tool J 25019-6 with Driver Handle J 8092, drive or press new bushings, part no. 8628916, or equivalent until tool bottoms (Fig. 7A1-194).

Pump Body Bushing

a. Place pump body with the machined face down, on two blocks of wood, to prevent damaging the machined surface (Fig. 7A1-195).

b. Using tool J 25019-4 with Drive Handle J 8092, remove bushing (Fig. 7A1-195).

c. Using tool J 25019-12 with Driver Handle J 8092, drive or press new bushing, part number 8628913, or equivalent into place until tool bottoms (Fig. 7A1-196).

Front Bushing

a. Using tool J 25019-16 with Slide Hammer J 7004-1, remove bushing (Fig. 7A1-197).

b. Place bushing, chamfered inside diameter end first, over tool J 25019-9. Using tool J 25019-9 with Driver Handle J 8092, drive or press new bushing, part number 8628918, or equivalent into place until tool bottoms (Fig. 7A1-198).

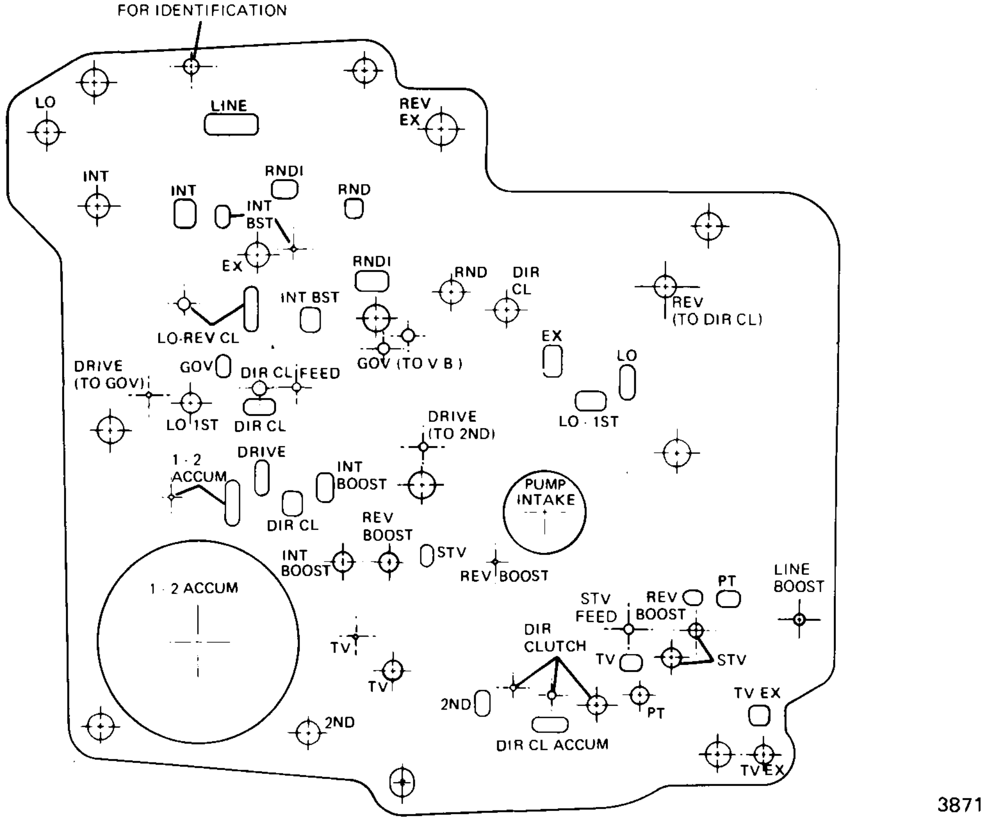


Fig. 7A1-181 Valve Body Spacer Plate

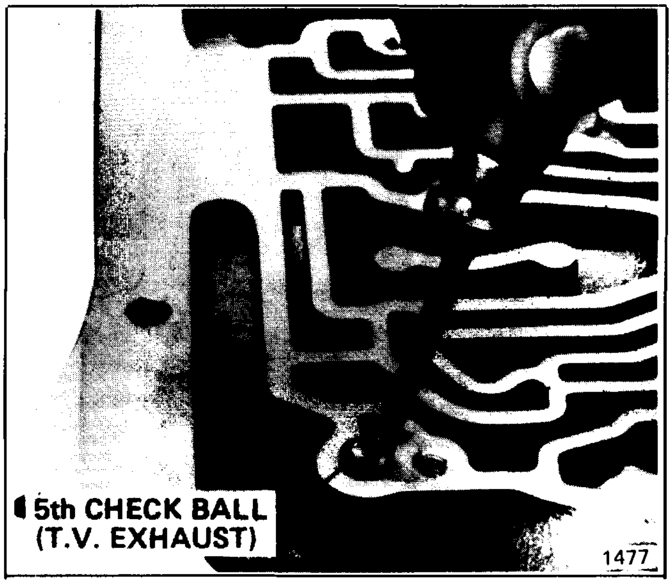


Fig. 7A1-182 Installing 5th Check Ball In Case

Rear Bushing

a. Place direct clutch housing with the thrust washer face down on a block of wood to prevent damaging the thrust washer surface (Fig. 7A1-199).

b. Using tool J 25019-4 with Driver Handle J 8092, remove bushing (Fig. 7A1-199).

c. Using tool J 25019-6 with Driver Handle J 8092, drive or press new bushing, part number 8628917, or equivalent into place until tool bottoms (Fig. 7A1-200).

Front Internal Gear Bushing

a. Using tool J 25019-3 with Driver Handle J 8092, remove bushing (Fig. 7A1-201).

b. Using tool J 25019-9 with Driver Handle J 8092, drive or press new bushing, part number 8628925, or equivalent into place until tool bottoms (Fig. 7A1-202).

Rear Sun Gear

a. Using tool J 25019-14 with Slide Hammer J 7004-1, remove bushing (Fig. 7A1-203).

b. Place rear sun gear with gear side down on block of wood to prevent damaging the gear (Fig. 7A1-204).

c. Use tool J 25019-2 with Driver Handle J 8092, drive or press new bushing, part number 8628928, or equivalent into place until tool bottoms (Fig. 7A1-204).

Lo and Reverse Clutch Housing Bushing

a. Using tool J 25019-16 with Slide Hammer J 7004-1, remove bushing (Fig. 7A1-205).

b. Place lo and reverse clutch housing with splined hub between two blocks of wood to prevent damaging the splines (Fig. 7A1-206).

c. Using tool J 25019-8 with Driver Handle J 8091, drive or press new bushing, part number 8628929, or equivalent into place until tool bottoms (Fig. 7A1-206).

Rear Carrier Bushing

a. Using tool J 25019-16 with Slide Hammer J 7004-1, remove bushing (Fig. 7A1-207).

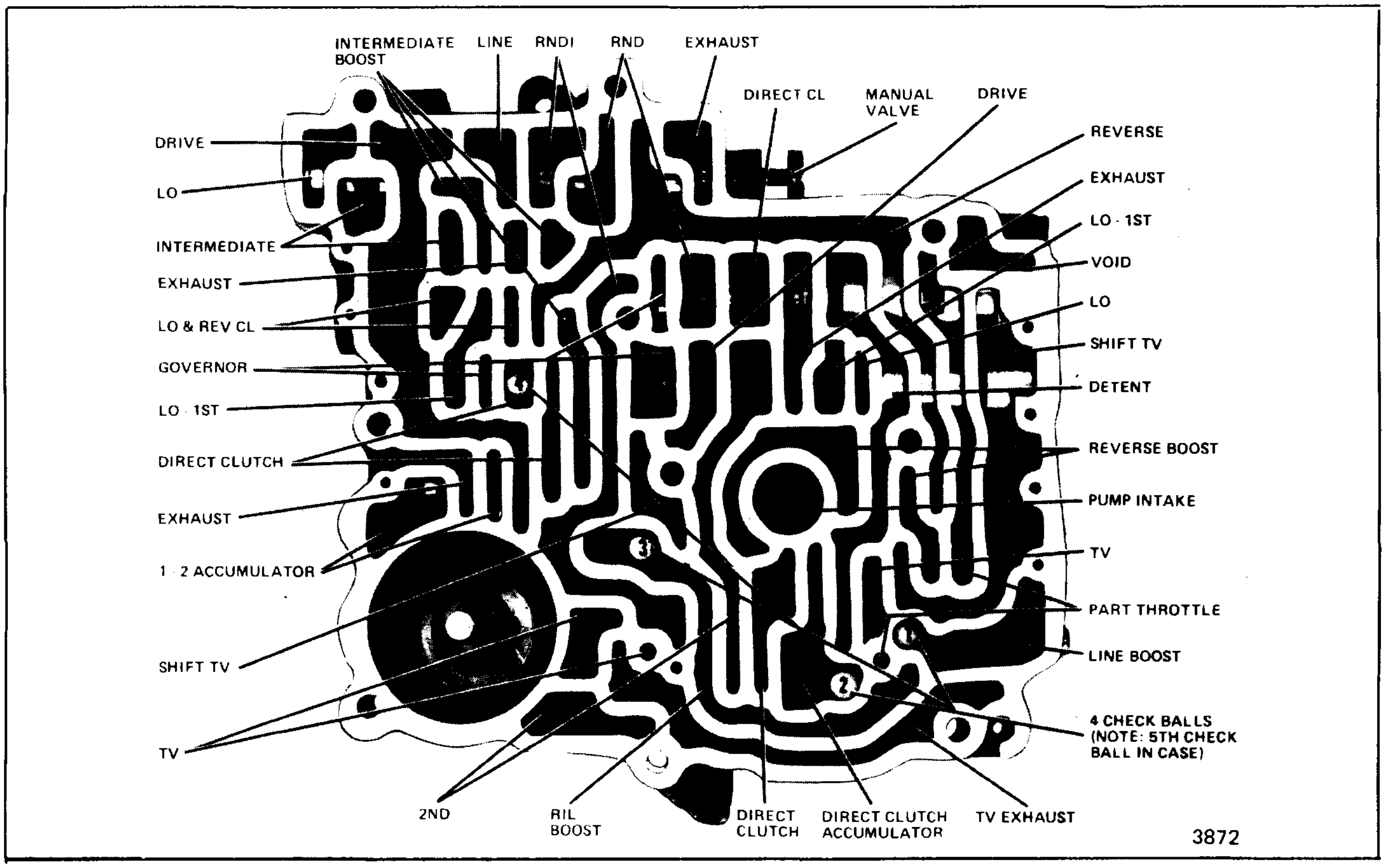


Fig. 7A1-183 Control Valve Assembly-Case Face

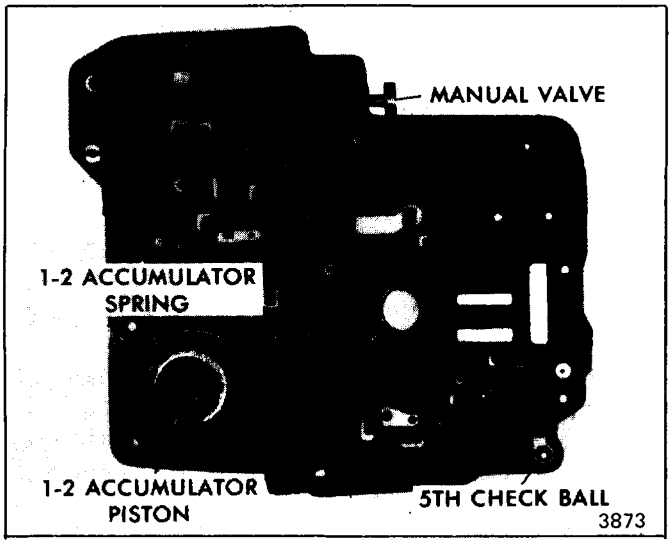


Fig. 7A1-184 Control Valve Spacer Plate To Case Gasket

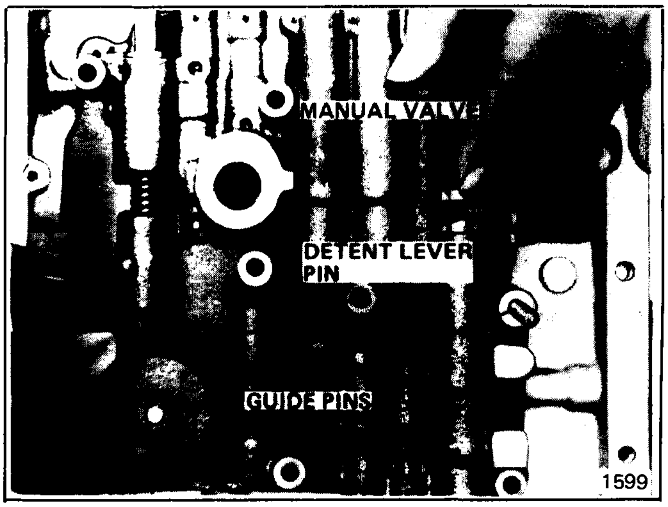


Fig. 7A1-185 Installing Control Valve Assembly Using Guide Pins

b. Using tool J 25019-7 with Driver Handle J 8092, driver or press new bushing, part number 8628947, or equivalent into place until tool bottoms (Fig. 7A1-208).

Case Bushing

a. Using tool J 21424-9 with driver Handle J 8092, remove bushing (Fig. 7A1-209).

b. Using tool J 21424-9 with Driver Handle J 8092, drive or press new bushing, part number 6261109; or equivalent to a distance of approximately 17.3mm (or 11/16") between rear end of the bushing and rear end of the case (Fig. 7A1-209).

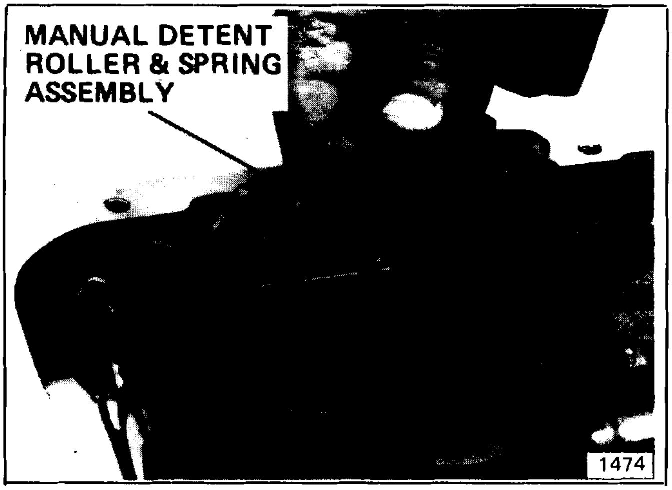


Fig. 7A1-186 Installing Manual Detent Roller and Spring Assembly

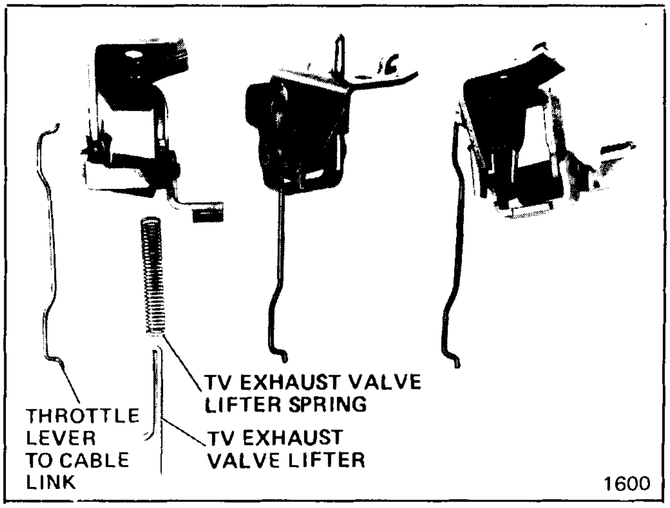


Fig. 7A1-187 Throttle Lever and Bracket Assembly

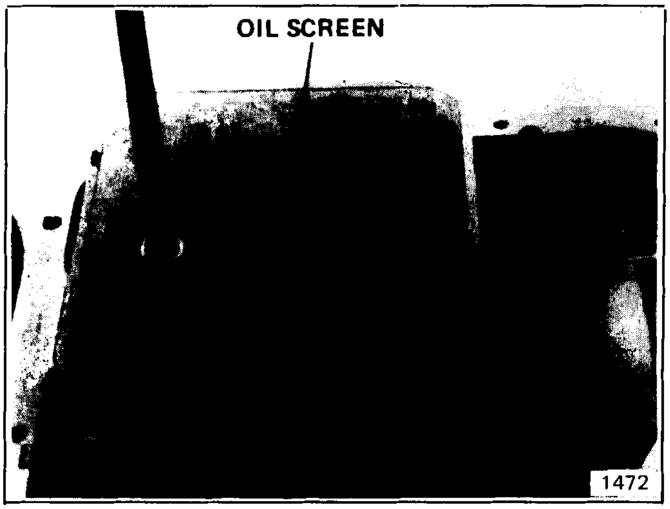


Fig. 7A1-189 Installing Oil Screen

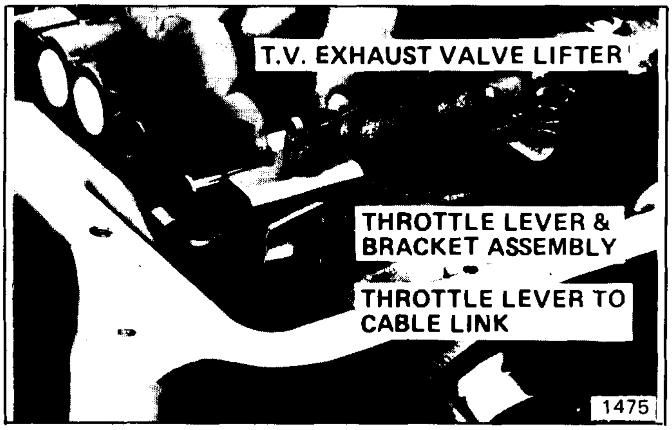


Fig. 7A1-188 Install Throttle Lever and Bracket Assembly

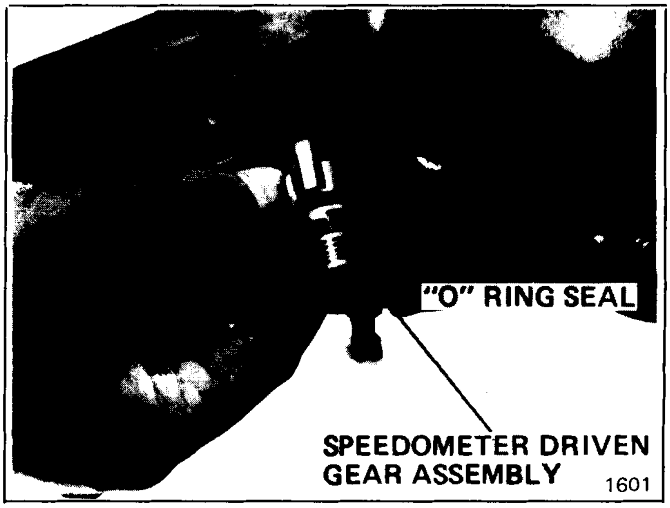


Fig. 7A1-190 Removing or Installing Speedometer Driven Gear - Typical

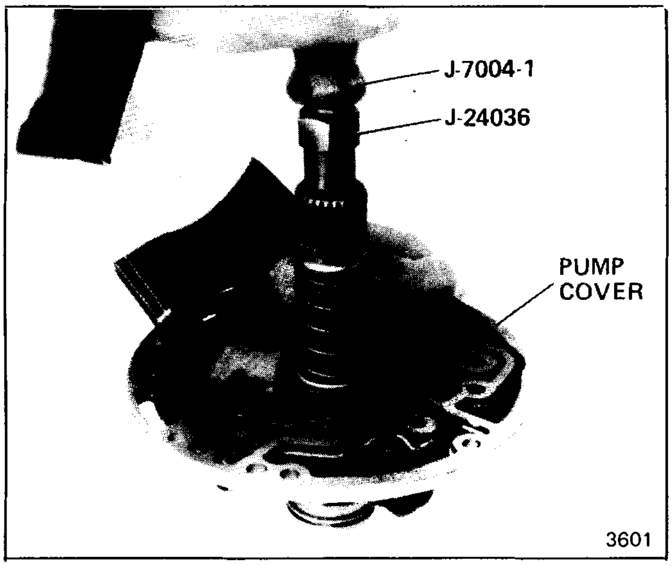


Fig. 7A1-191 Removing Pump Cover Bushing - Front

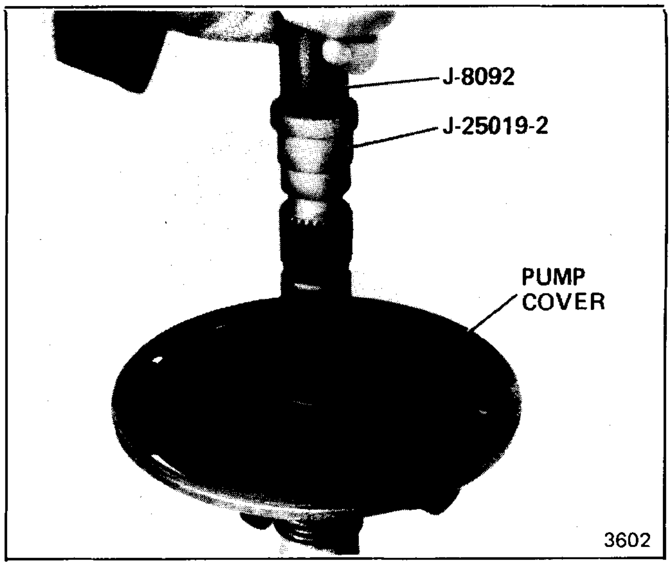


Fig. 7A1-192 Installing Pump Cover Bushing - Front

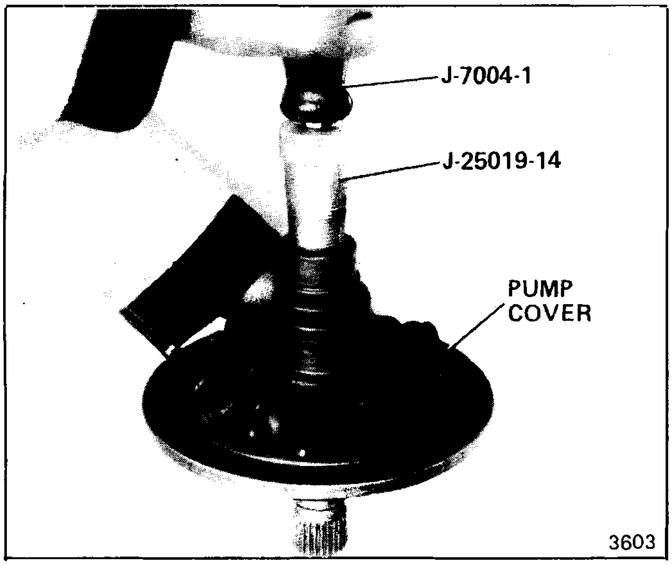


Fig. 7A1-193 Removing Pump Cover Bushing - Rear

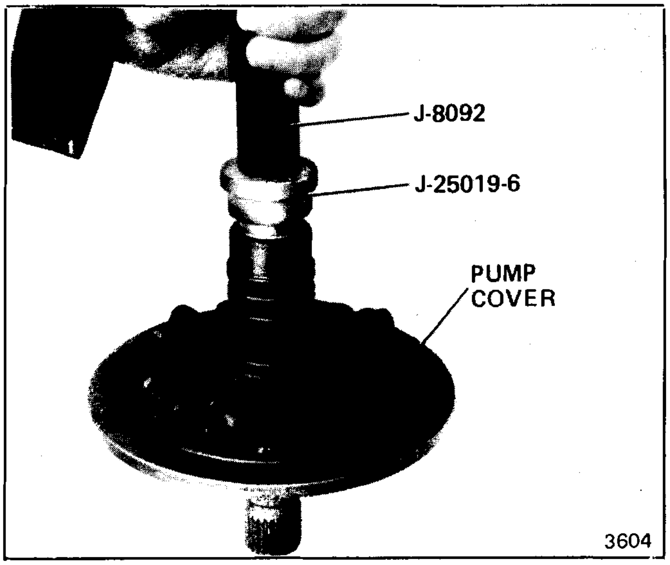


Fig. 7A1-194 Installing Pump Cover Bushing - Rear

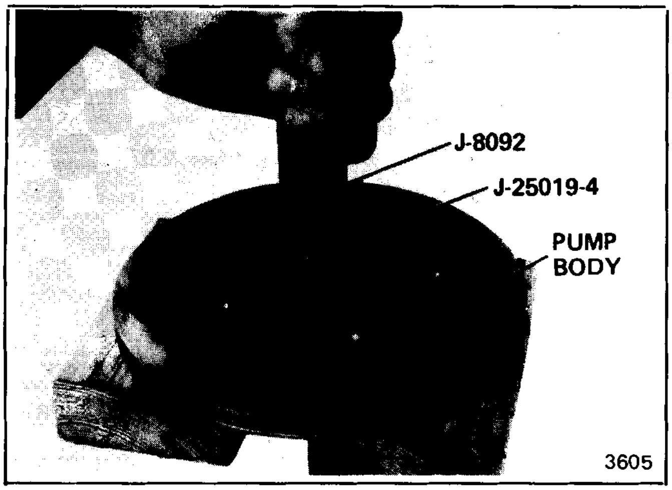


Fig. 7A1-195 Removing Pump Body Bushing

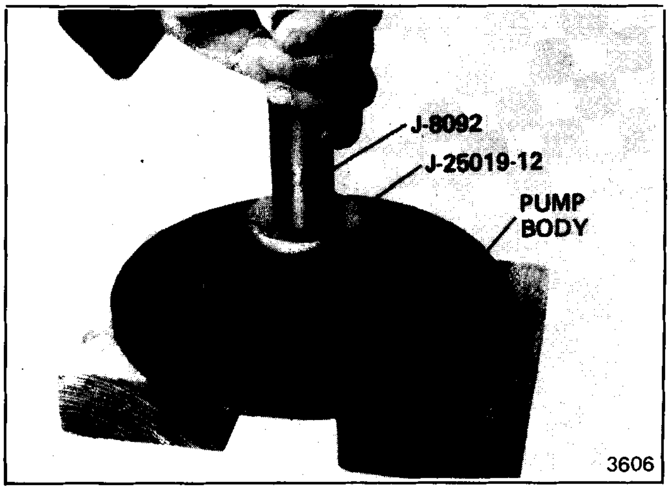


Fig. 7A1-196 Installing Pump Body Bushing

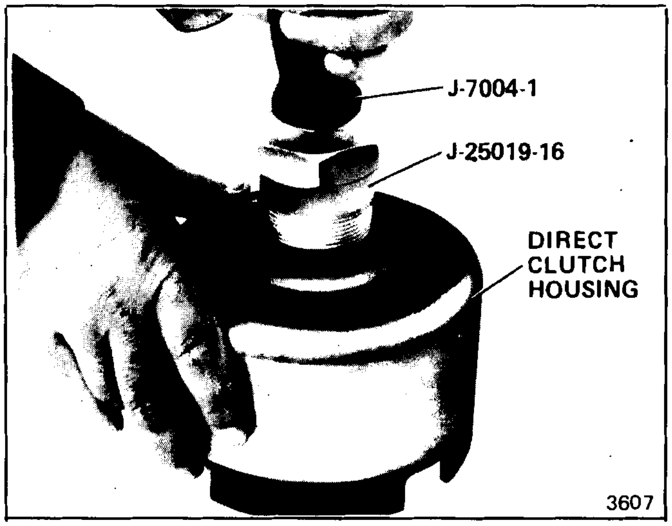


Fig. 7A1-197 Removing Direct Clutch Housing Bushing - Front

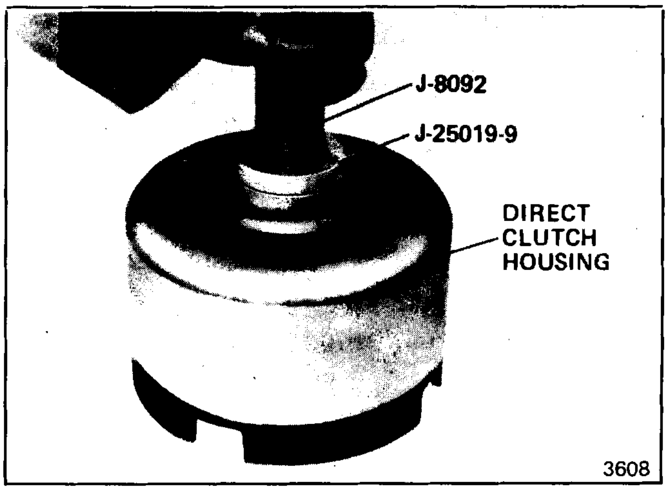


Fig. 7A1-198 Installing Direct Clutch Housing Bushing - Front

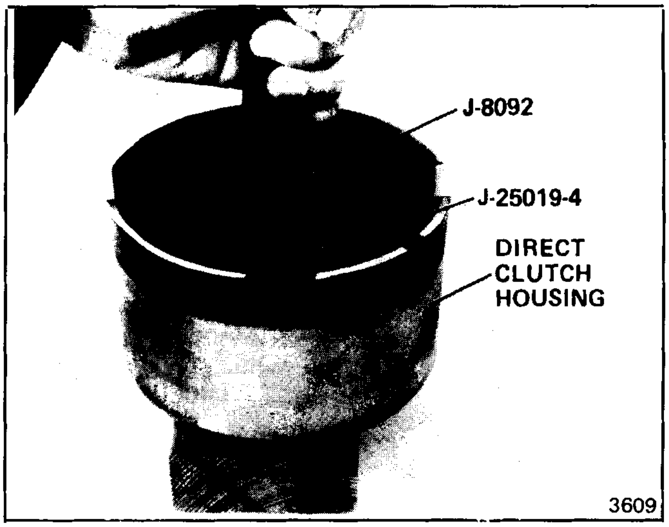


Fig. 7A1-199 Removing Direct Clutch Housing Bushing - Rear

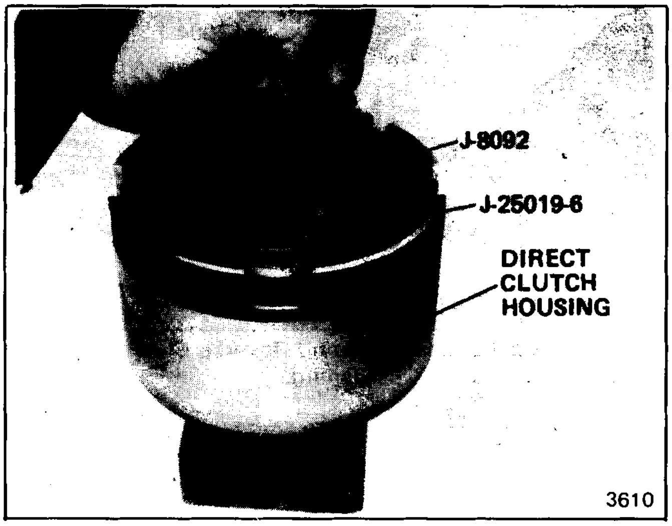


Fig. 7A1-200 Installing Direct Clutch Housing Bushing - Rear

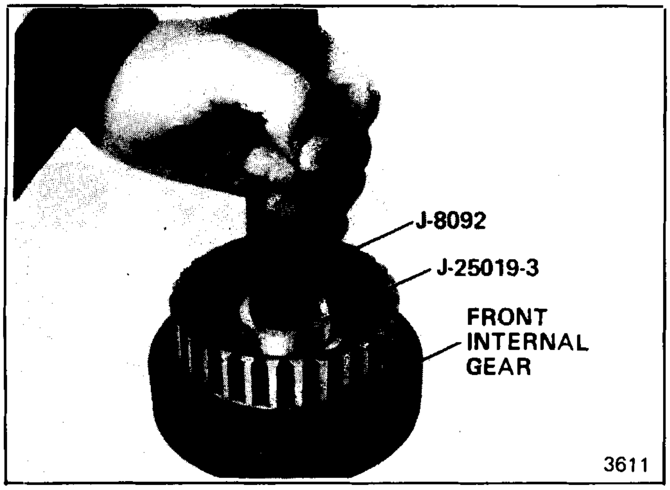


Fig. 7A1-201 Removing Front Internal Gear Bushing

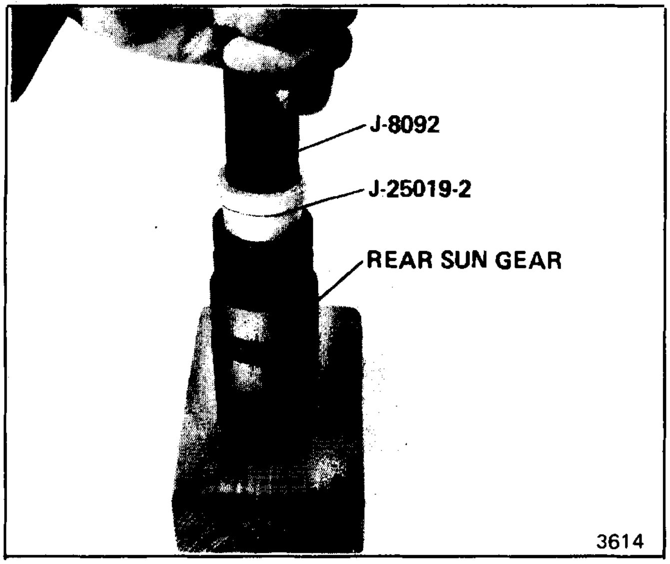
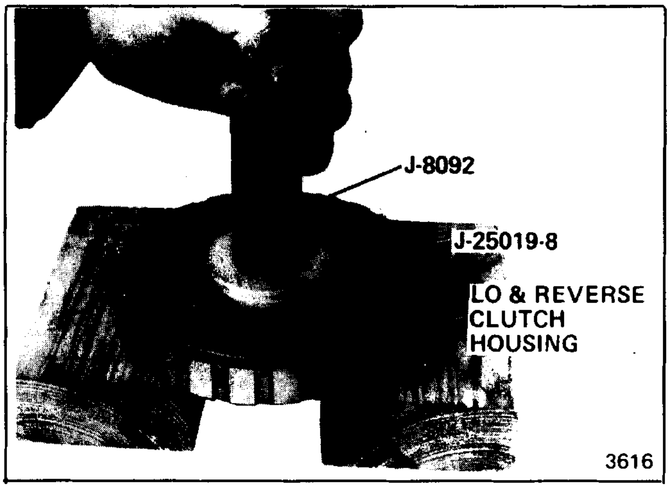


Fig. 7A1-204 Installing Rear Sun Gear Bushing



Fig, 7A1-206 Installing Lo and Reverse Clutch Housing Bushing

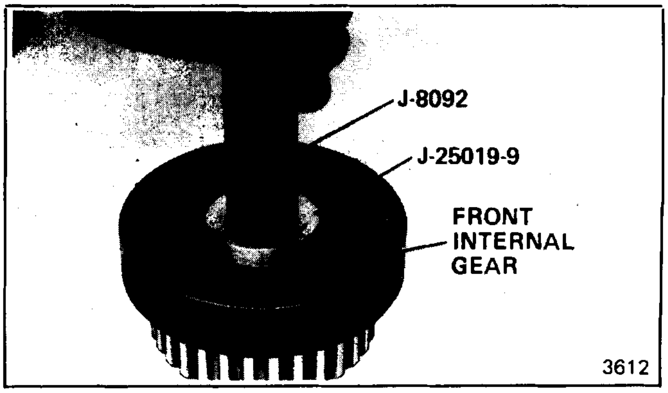


Fig. 7A1-202 Installing Front Internal Gear Bushing

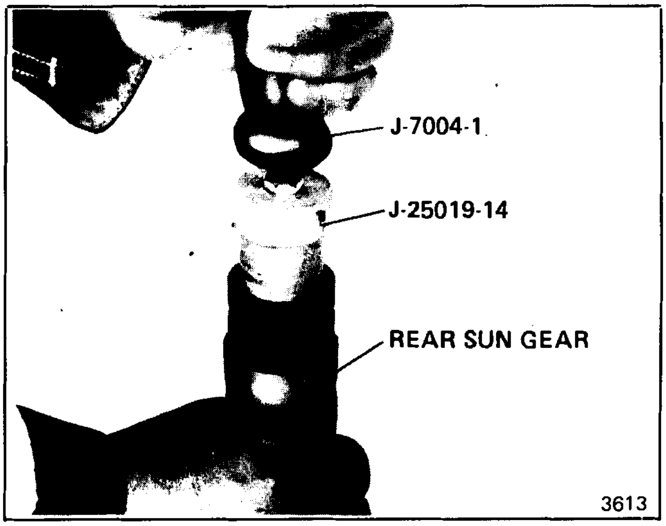


Fig. 7A1-203 Removing Rear Sun Gear Bushing

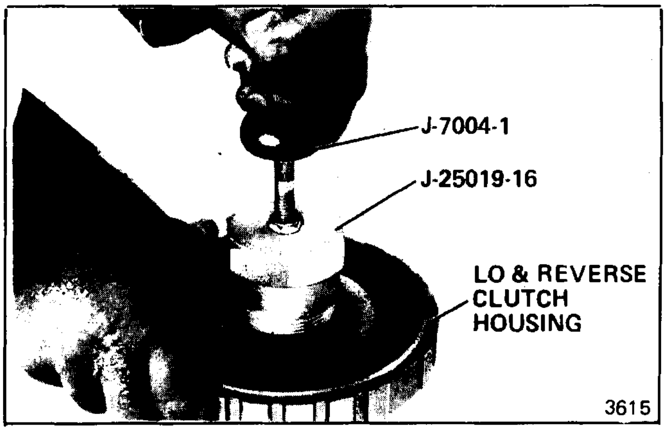


Fig. 7A1-205 Removing Lo and Reverse Clutch Housing Bushing

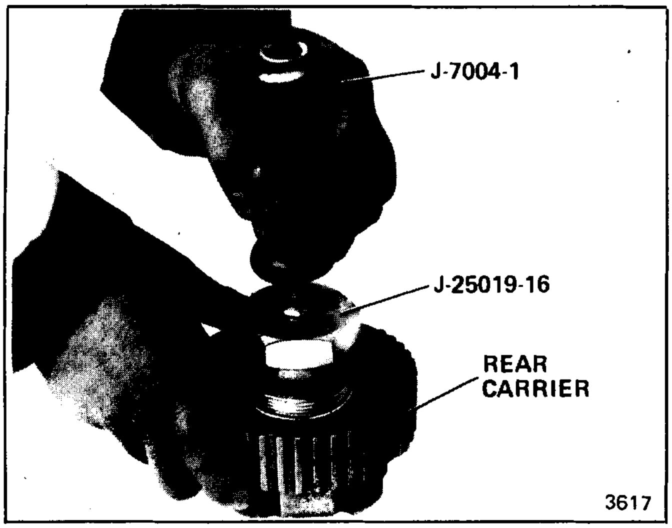


Fig. 7A1-207 Removing Rear Carrier Bushing

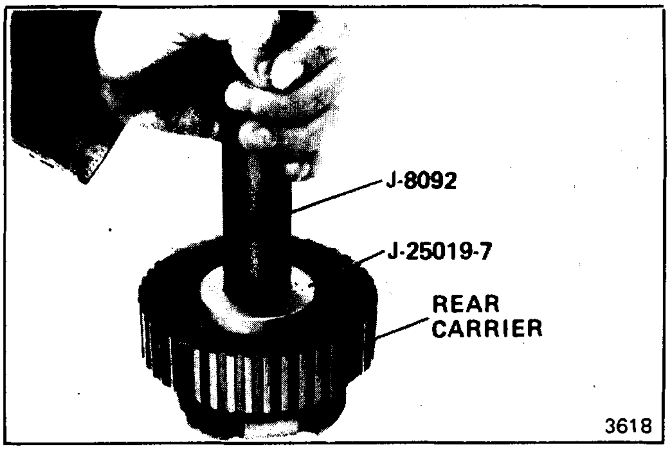


Fig. 7A1-208 Installing Rear Carrier Bushing

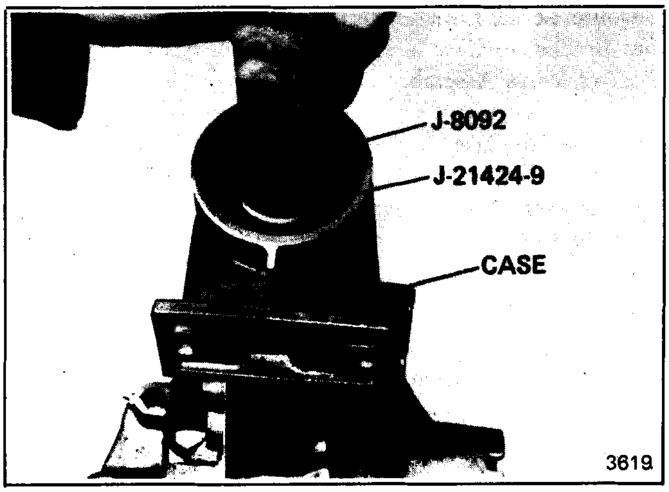


Fig. 7A1-209 Removing or Installing Case Bushing

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

An identifying code is found on the serial number plate of the turbo hydra-matic 200 transmission. This plate is located on the right side of the transmission case.

The serial numbers on these plates are all preceded by the year (77) and one of the following code letters - BH, BL, BU, BZ, CE, OS, PY or PZ. The application of each code is:

BH-231 cu. in., 2 bbl. engine, except California (HM Series)

BL-231 cu. in., 2 bbl. engine, California only (X Series)

BU - 231 cu. in., 2 bbl engine, California only (HM Series)

BZ - 231 cu. in., 2 bbl engine, except California (X Series)

CE - 305 cu. in., 2 bbl. engine except California (X Series)

OS - 350 cu. in. (Eng. code R), 4 bbl. engine (B Series)

PY - 151 cu. in., 2 bbl. engine (H and HM Series) and except California (X Series)

PZ - 301 cu. in., 2 bbl. engine, except California (B Series)

On all Turbo Hydra-matic 200 transmissions, the vehicle serial number is stamped:

1. On a pad located just above the bottom pan face on the left hand side of the transmission below the parking pawl area - or
2. On a pad above the parking pawl area - or
3. On the lower right hand side of the case bell housing.

DESCRIPTION OF USAGE	QUANTITY	SIZE	TORQUE
Pump Body to Pump Cover	5	M8 x 1.25 x 45	20.0-27.0 N·m (15-20 lb. ft.)
Pump Assembly to Case	6	M8 x 1.25 x 35	20.0-27.0 N·m (15-20 lb. ft.)
Parking Brake Bracket to Case	2	M8 x 1.25 x 20	20.0-27.0 N·m (15-20 lb. ft.)
Transmission Oil Pan to Case	11	M8 x 1.25 x 16	14.0-18.0 N·m (10-13 lb. ft.)
Manual Shaft to Inside Detent Lever	1	M10 x 1.5	27.0-34.0 N·m (20-25 flb. ft.)
Cooler Connector - Brass s	2	1/4-18 NPSF	20.0-27.0 N·m (15-20 lb. ft.)
Line Pressure Take-Off	1	1/8-27 NPTF	7.0-14.0 N·m (5-10 lb. ft.)
Throttle Lever, Link and Bracket to Case	1	M6.3 x 1.0 x 45	13.0-17.0 N·m (9-12 lb. ft.)
Control Valve Assembly Case	7	M6.3 x 1.0 x 45	13.0-17.0 N·m (9-12 lb. ft.)
Oil Screen to Case	2	M6.3 x 1.0 x 45	13.0-17.0 N·m (9-12 lb. ft.)
Speedometer Driven Gear Retainer to Case	1	M6.3 x 1.0 x 16	8.0-14.0 N·m (6-10 lb. ft.)

NOTE: All critical torque specifications are listed in each section, where appropriate.

TOOL NUMBER	NAME	QUANTITY
J 24473	Oil Pump Puller and Front End Play Checking Fixture	2
J 25022	Front End Play Gage Adapter	2
J 25016	Oil Pump Sealer Installer	1
J 25023	Low and Reverse Clutch	1
J 25015	Oil Pump Body and Cover Alignment Band	1
J 25010	Direct Clutch Seal Protector	1
J 25011	Low and Reverse Clutch Seal Protector	1
J 25012	Low and Reverse Clutch Housing Installer	2
J 25014	Intermediate Band Apply Pin Gage	1
J 23327-1	Forward Clutch Spring Compressor	1
J 25018	Forward Clutch Compressor Adapter Plate	1
J 25020	Converter End Play Checking Fixture	1
J 25021	Turbine Shaft and Direct Clutch Installer	1
J 25013	Output Shaft Support and Sleeve	4
J 23327	Direct Clutch Compressor	1
J 21369	Converter Leak Test Fixture	1
J 21426	Rear Seal Installer	1

J 21426	Rear Seal Installer	1
J 8001	Dial Indicator Set	1
J 7057	Plunger Extension	1
J 8763-02	Transmission Holding Fixture	1
J 3289-20	Transmission Holding Fixture Base	1
J 21366	Converter Holding Tool	1
J 22269-01	Servo Piston Spring Compressor	1
J 25024	Forward Clutch Spring Compressor	1

SECTION 7A2

TURBO HYDRA-MATIC 250 TRANSMISSION

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The Turbo Hydra-Matic 250 transmission (Fig. 7A2-1) is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and two planetary gear sets. Three multiple-disc clutches, one roller clutch and an adjustable intermediate band provide friction elements required to obtain desired function of two planetary gear sets.

The 3-element torque converter consists of a pump, turbine and a stator assembly. Stator is mounted on a one way roller clutch which will allow stator to turn clockwise, but not counterclockwise. References to clockwise and counterclockwise are determined by looking toward rear of vehicle.

Torque converter is of welded construction and is serviced as a complete assembly. The unit is filled with hydraulic fluid and is attached to the engine crankshaft by a flywheel, thus always rotates at engine speed. Converter pump is an integral part of converter housing, therefore, pump blades, rotating at engine speed, set fluid within the converter into motion and direct it to turbine, causing turbine to rotate.

As fluid passes throughout turbine it is traveling in such a direction that, if it were not redirected by stator, it would hit the rear of the converter pump blades and impede its pumping action. So, at low turbine speeds, fluid is redirected by stator to converter pump in such a manner that it actually assists converter pump to deliver power, or multiply engine torque.

As turbine speed increases, the direction of fluid leaving turbine changes and flows against rear side of stator vanes in a clockwise direction. Since stator is now impeding the smooth flow of fluid, its roller clutch releases and it revolves freely on its shaft. Once stator becomes inactive, there is no further multiplication of engine torque within converter.

At this point, converter is merely acting as a fluid coupling as both converter pump and turbine are being driven at approximately the same speed.

A hydraulic system pressurized by a gear type pump provides working pressure required to operate friction elements and automatic controls.

External control connections to transmission are:

- Manual Linkage - To select desired operating range.
- Engine Vacuum - To operate vacuum modulator.
- Cable Control - To operate detent valve.

A vacuum modulator is used to automatically sense any change in torque input to transmission. Vacuum modulator transmits this signal to pressure regulator, which controls line pressure, so that all torque requirements of transmission are met and smooth shifts are obtained at all throttle openings.

Detent valve is activated at a cable that is connected to accelerator lever assembly. When throttle is half open, the valve is actuated causing throttle downshift at speeds below approximately 40 mph. When the throttle is fully open, the detent valve is actuated causing transmission to downshift from 3-1 at speeds below approximately 35 mph and 3-2 below approximately 65 mph.

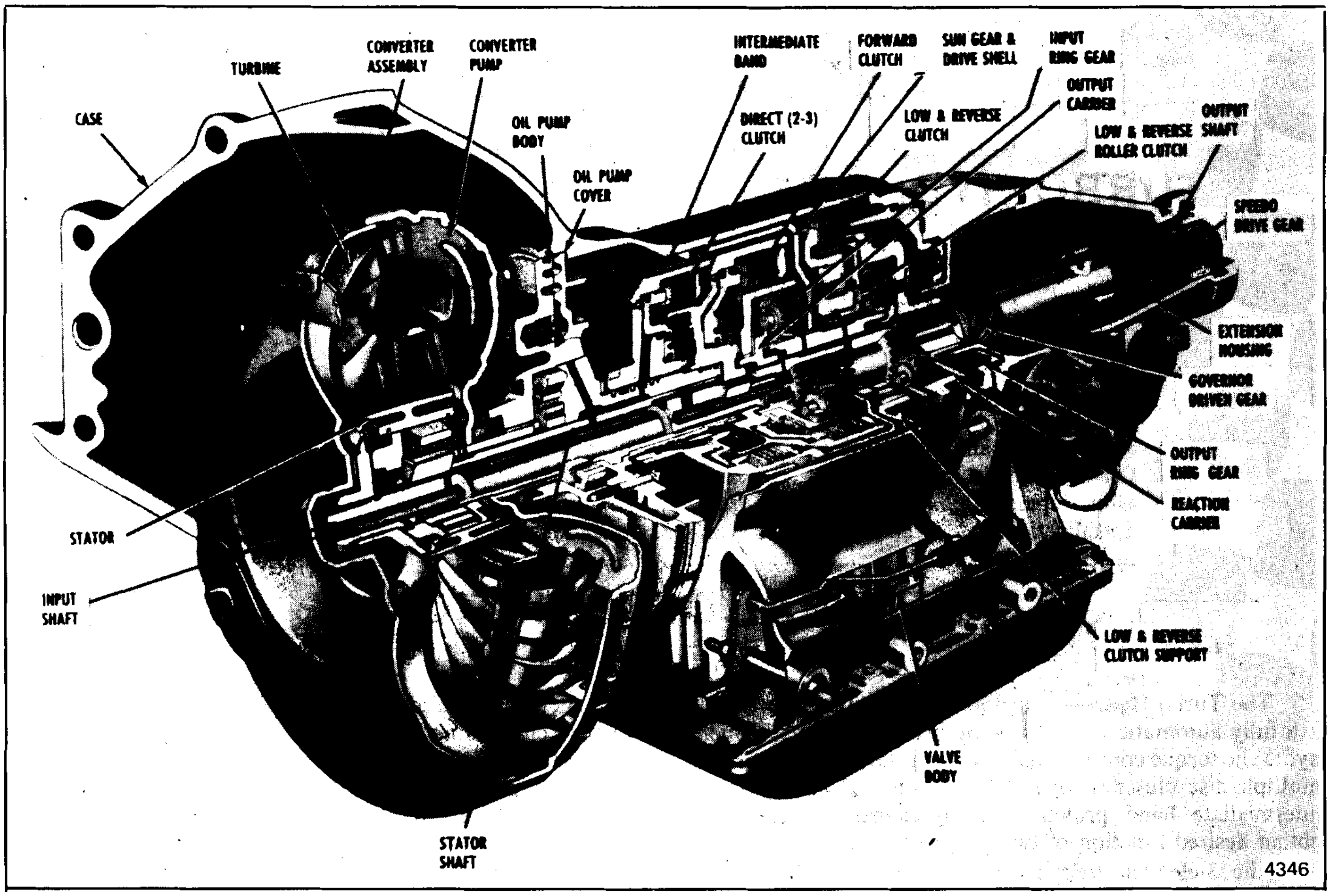


Fig. 7A2-1 Turbo Hydra-Matic 250 Transmission - Sectional View

DIAGNOSIS

SEQUENCE FOR DIAGNOSIS

1. Check and correct fluid level.
2. Check detent downshift cable adjustment.
3. Check and correct vacuum line and fittings.
4. Check and correct manual linkage.
5. Road test vehicle:

a. Install oil pressure gage.

b. Road test using all selective ranges, noting when discrepancies in operation or oil pressure occur.

c. Attempt to isolate the unit or circuit involved in the malfunction.

d. If engine performances indicates an engine tune-up is required, this should be performed before testing is completed or transmission correction attempted. Poor engine performance can result in rough shifting or other malfunctions.

FLUID CHECKING PROCEDURES

Refer to "Maintenance and Adjustments" section for fluid checking procedures.

FLUID LEAK DIAGNOSIS

Determining Source of Fluid Leak

Before attempting to correct a fluid leak, the acutal source of leak must be determined. In many cases, source of leak can be deceiving due to "wind flow" around engine and transmission.

The suspected area should be wiped clean of all fluid before inspecting for source of leak.

The use of a "Black Light" to locate point at which fluid is leaking is helpful. Comparing fluid from leak to that on engine or transmission dipstick, when viewed by black light, will determine source of leak - engine or transmission.

Fluid leaks around engine and transmission are generally carried toward rear of vehicle by air stream. For example, a transmission oil filler tube to case leak will sometimes appear as a leak at rear of transmission. In determining source of a leak, proceed as follows:

1. Degrease underside of transmission.
2. Road test to get unit at operating temperature.
3. Inspect for leak with engine running.
4. With engine off, check for fluid leaks due to raised fluid level caused by drain back.

Possible Points of Fluid Leak

1. Transmission Oil Pan Leak:

a. Attaching bolts not correctly torqued.

b. Improperly installed or damaged pan gasket.

c. Oil pan gasket mounting face not flat.

2. Extension Housing:

a. Attaching bolts not correctly torqued.

b. Rear seal assembly damaged or improperly installed.

c. Square seal, extension to case, damaged or improperly installed.

d. Governor cover not tight, gasket damaged or leak between case face and gasket.

e. Speedometer gear "O" ring damaged.

f. Manual shaft seal damaged or improperly installed.

g. Line pressure tag plug loose.

h. Vent pipe (refer to item 5).

i. Porous casting.

4. Leak at Front of Transmission:

a. Front pump seal leaks

1. Seal lip cut. Check governor hub, etc.

2. Bushing moved and damaged. Fluid return hole plugged.

3. No fluid return hole.

b. Front pump attaching bolts loose or bolt washer type seals damaged or missing.

c. Front pump housing "O" ring damaged or cut.

d. Converter leak in weld area.

e. Porous casting (pump).

5. Fluid Comes Out Vent Pipe:

a. Transmission over-filled.

b. Water in fluid.

c. Foreign material between pump and case or between pump cover and body.

d. Case - porous near converter bosses. Front pump cover or housing oil channels shy or stock near breather.

e. Pump to case gasket mis-positioned.

FLUID PRESSURE CHECK

While vehicle is stationary (parking brake on), engine speed set to 1200 rpm, transmission oil pressure gage attached to line pressure tap (Fig. 7A2-2) and vacuum modulator tube disconnected, transmission line pressure should read 120 psi in Drive, 120 psi in L1 or L2 and 245 psi in Reverse.

While vehicle is stationary (parking brake on), engine speed set to maintain 16 inches hg absolute mainfold pressure, transmission oil pressure gage attached, and vacuum modulator tube connected, the transmission line should read: 55 psi - Drive, 82 psi - L1-L2, 88 psi - Rev. (Fig. 7A2-3).

CASE POROSITY REPAIR

External fluid leaks caused by case porosity can be successfully repaired with the transmission in the vehicle by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 180 degrees F.

2. Raise vehicle on a hoist or jack stand, engine running, and locate source of fluid leak. Check for fluid leaks in Low, Drive and Reverse.

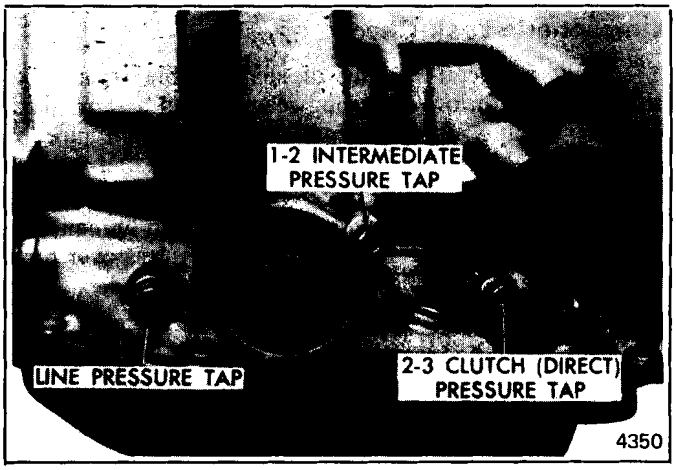


Fig. 7A2-2 Pressure Tap Location

3. Shut engine off and thoroughly clean area to be repaired with a suitable cleaning solvent and a brush - air dry.

A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement.

4. Using instructions of the manufacturer, mix a sufficient amount of epoxy to make the repair. Make certain the area to be repaired is fully covered.

5. Allow cement to cure for .3 hours before starting engine.

6. Road test and check for leaks.

APPROXIMATE ALTITUDE OF CHECK (FT. ABOVE SEA LEVEL)	ABSOLUTE MANIFOLD PRESSURE (" HG.)	DRIVE NEUTRAL PARK	L1 OR L2	REVERSE
0	16	55.0	81.9	88.4
2000	16	66.9	88.8	107.5
4000	16	81.9	97.6	131.5
6000	16	95.6	105.6	153.6
8000	16	107.9	112.8	173.4

4348

Fig. 7A2-3 Oil Pressure Check-Vacuum Modulator Connected

VACUUM MODULATOR DIAGNOSIS

A defective vacuum modulator can cause one or more of the following complaints:

1. Harsh upshifts and downshifts.
2. Delayed upshifts.
3. Soft upshifts and downshifts.
4. Slips in low, drive and reverse.
5. Transmission overheating.
6. Engine burning transmission fluid.

If any one of the above complaints are encountered, the modulator must be checked.

Vacuum Diaphragm Leak Check

Insert a pipe cleaner into vacuum connector pipe as far as possible and check for the presence of transmission fluid. If fluid is found, replace modulator.

Gasoline or water vapor may settle in vacuum side of the modulator. If this is found without presence of fluid, modulator is serviceable and should not be changed.

Atmospheric Leak Check

Apply a liberal coating of soap bubble solution to crimped upper to lower housing seam. Using a short piece of rubber tubing, apply air pressure to vacuum pipe by blowing into tube and observe for leak bubbles. If bubbles appear, replace modulator.

NOTE: Do not use any method other than human lung power for applying air pressure as pressures over 6 psi may damage modulator.

Spring Comparison Check

Using J 24466, or a comparison gage as shown in Fig. 7A2-4, compare the load on a known good modulator with assembly in question:

a. Install modulator that is known to be good on either end of the gage.

b. Install modulator in question on opposite end of the gage.

c. Holding modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches line in center of gage. The gap between opposite modulator sleeve end and gage line should then be 1/16 inch or less. If distance is greater than this amount, the modulator in question should be replaced.

Sleeve Alignment Check

Roll main body of modulator on a flat surface and observe the sleeve for concentricity to cam. If sleeve is concentric and plunger is free, modulator is acceptable.

Once modulator assembly passes all of the above tests, it is an acceptable part and should be re-used.

TRANSMISSION CLUTCH PLATES DIAGNOSIS

1. Lined Drive Plates-

a. Dry plates with compressed air and inspect lined surface for:

1. Pitting and flaking.
2. Wear.
3. Glazing.
4. Cracking.
5. Charring
6. Chips or metal particles imbedded in lining. If a line drive plate exhibits any of the above conditions, replacement is required. Do not diagnose drive plates by color.

2. Steel Driven Plates-

Wipe plates dry and check for heat discoloration. If surface is smooth and an even color smear is indicated, plate should be reused. If severe heat spot discoloration or surface scuffing is indicated, plate must be replaced.

3. Clutch Release Springs-

Evidence of extreme heat or burning in area of clutch may have caused springs to take a heat set and would justify replacement of springs.

CAUSES OF BURNED CLUTCH PLATES OR BURNED BAND

1. FORWARD CLUTCH

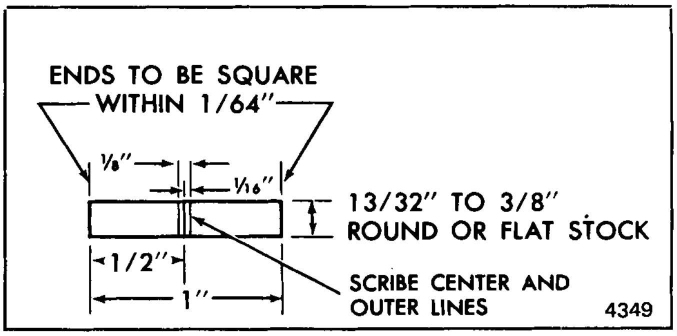


Fig. 7A2-4 Spring Comparison Gage

a. Check ball in clutch housing damaged, stuck or missing.

b. Clutch piston cracked, seals damaged or missing.

c. Low line pressure.

d. Pump cover oil seal rings missing, broken or undersize; ring groove oversize.

e. Case valve body face not flat; porosity between channels.

2. INTERMEDIATE BAND

a. Intermediate servo piston seals damaged or missing.

b. Low line pressure.

c. Case valve body face not flat; porosity between channels.

3. DIRECT CLUTCH

a. Restricted orifice in vacuum line to modulator (poor vacuum response).

b. Check ball in direct clutch piston damaged, stuck or missing.

c. Defective modulator spring.

d. Clutch piston seals damaged or missing.

e. Case valve body face not flat; porosity between channels.

f. Clutch installed backwards.

NOTE: Burned clutch plates can be caused by incorrect usage of clutch plates. Also engine coolant in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.

GOVERNOR PRESSURE CHECK

1. Install Pressure Gage, at line pressure tap location (Fig. 7A2-2).

2. Disconnect vacuum line to modulator.

3. With vehicle on hoist (rear wheels off ground), foot off brake, in Drive, check line pressure at 1000 RPM.

4. Slowly increase engine RPM to 3000 RPM and determine if a line pressure drop occurs (7 PSI or more).

5. If no pressure drop occurs:

a. Inspect Governor-

1. Stuck valve.
2. Free Weights.
3. Restricted orifice in governor valve.

b. Governor Feed System-

1. Check screen in control valve assembly.
2. Check for restrictions in feed line.

3. Scored governor bore.

MANUAL LINKAGE

Manual linkage adjustment and associated neutral start switch are important from a safety standpoint. The neutral start switch should be adjusted so that engine will start in Park and Neutral positions only.

With selector lever in Park position, parking pawl should freely engage and prevent vehicle from rolling. The pointer on indicator quadrant should line up properly with range indicators in all ranges.

ROAD TEST

Drive Range

Position selector lever in DRIVE RANGE and accelerate vehicle from 0 MPH. A 1-2 and 2-3 shift should occur at all throttle openings (shift points will vary with throttle opening). As vehicle decreases in speed to 0 MPH, the 3-2 and 2-1 shifts should occur.

Low L2 Range

Position selector lever in L2 RANGE and accelerate vehicle from 0 MPH. A 1-2 shift should occur at all throttle openings (No. 2-3 shoft can be obtained in this range). The 1-2 shift point will vary with throttle opening. As vehicle decreases in speed to 0 MPH, a 2-1 shift should occur.

The 1-2 shift in INTERMEDIATE (L2) RANGE is somewhat firmer than in DRIVE RANGE. This is normal.

Low L1 Range

Position selector lever in L1 RANGE and accelerate vehicle from 0 MPH. No upshift should occur in this range.

2nd Gear - Overrun Braking (L2 Range)

Position selector lever in DRIVE RANGE, and with vehicle speed at approximately 35 MPH, move selector lever to L2 RANGE. Transmission should downshift to 2nd. An increase in engine RPM and an engine braking effect should be noticed. Line pressure should change from approximately 55 PSI to approximately 125 PSI in 2nd.

1st Gear - Overrun Braking (L1 Range)

Position selector lever in L2 RANGE at approximately 30 to 50 MPH, with throttle closed, move selector lever to L1. A 2-1 downshift should occur in speed range of approximately 45 to 30 MPH, depending on axle ratio and valve body calibration. The 2-1 downshift at closed throttle will be accompanied by increased engine RPM and an engine braking effect should be noticed. Line pressure should be approximately 80 PSI. Stop vehicle.

Reverse Range

Position selector lever in REVERSE RANGE and check for reverse operation.

TROUBLE DIAGNOSIS

Refer to Diagnosis Chart (Fig. 7A2-5) to determine a possible cause of a transmission problem.

Additional diagnosis of a malfunction is as follows:

No Drive in Drive Range

(Install pressure gage)

- Low Fluid Level - correct level and check for external leaks or defective vacuum modulator (leaking diaphragm will evacuate fluid from unit).
- Manual Linkage - misadjusted, correct alignment to manual lever shift quadrant is essential.
- Low Fluid Pressure - refer to LOW LINE PRESSURE below.
- Forward Clutch:

a. Forward clutch does not apply, piston cracked - see BURNED CLUTCH PLATES below.

b. Pump feed circuit-to-forward clutch oil seal rings missing or broken on pump cover; leak in feed circuits; pump-to-case gasket mispositioned or damaged; clutch drum ball check stuck or missing.

- Low and Reverse Roller Clutch Assembly - broken spring, damaged cage or installed backwards.

High or Low Fluid Pressure

(Refer to FLUID PRESSURE CHECK)

High Line Pressure

- Vacuum Leak:

a. Vacuum line disconnected.

b. Leak in line from engine to modulator.

c. Improper engine vacuum.

d. Leak in vacuum-operated accessory (hoses, vacuum advance, etc.).

- Modulator:

a. Stuck modulator valve.

b. Water in modulator.

c. Damaged, not operating properly.

- Detent System - detent valve or cable stuck in detent position.
- Valve Body:

a. Pressure regulator and/or boost valve stuck.

b. Boost valve sleeve broken or defective.

c. Incorrect pressure regulator valve spring.

Low Line Pressure

- Low transmission fluid level.
- Defective vacuum modulator assembly.
- Strainer Assembly:

a. Blocked or restricted.

b. Gasket omitted or damaged.

- Oil Pump:

a. Gear clearance, damaged, worn, gear installed backwards.

b. Pump-to-case gasket mispositioned.

c. Defective pump body and/or cover.

- Valve Body:

a. Pressure regulator or boost valve stuck.

b. Pressure regulator valve spring too weak.

- Internal Circuit Leaks:

CAR ROAD TEST

LEGEND
X–PROBLEM AREA VS. CAUSE
*–@"O" VACUUM ONLY
O–BALLS/#2/3/4 ONLY
L–LOCKED
S–STUCK

PROBLEM	LOW FLUID LEVEL/WATER IN FLUID	VACUUM LEAK	MODULATOR &/OR VALVE	STRAINER &/OR GASKET	GOVERNOR-VALVE/SCREEN	VALVE BODY-GASKET/PLATE	PRES. REG. &/OR BOOST VALVE	BALL (#1) SHY	1-2 SHIFT VALVE	2-3 SHIFT VALVE	MANUAL LOW CONT'L. VALVE	DETENT VALVE & LINKAGE	DETENT REG. VALVE	2-3 ACCUMULATOR	MANUAL VALVE/LINKAGE	POROSITY/CROSS LEAK	PUMP-GEARS	CLUTCH SEAL RINGS	POROUS/CROSS LEAK	GASKET SCREEN-PRESSURE	CASE-POROUS/X LEAK	1-2 ACCUMULATOR	INTERMED. SERVO	FORWARD CLUTCH ASS'Y	DIRECT CLUTCH ASS'Y	INTERMED. BAND ASS'Y	L & REV. CL. ASS'Y	L. & R. ROLLER CL. ASS'Y	PARK PAWL/LINKAGE	CONVERTER ASS'Y	GEAR SET & BEARINGS
ALL RANGES-SLIPS	X		X	X		X	X	X							X	X	X	X	X	X	X	X									
DRIVE-SLIPS-NO 1ST GEAR	X		X	X		X	X	X							X	X	X	X	X	X	X	X	X	X				X			
LINE PRESSURE-ALL LOW	X		*	X	X	X	X	*							X	X	X	X	X	X	X	X	X								
LINE PRESSURE-ALL HIGH		X	X		X		X					X				X					X										
1-2 INTERM. PRES. HIGH		X	X				X									X					X										
1-2 INTERM. PRES. LOW	X			X		X	X	X	X					X		X	X	X	X		X	X	X			X					
2-3 DIRECT CL. PRES. HIGH		X					X									X					X										
2-3 DIRECT CL. PRES. LOW	X			X		X	X			X						X	X	X	X		X				X						
NO 1-2 UPSHIFT		X			X	X	X		X							X		X	X		X	X				X					
1-2 U.S. EARLY/LATE		X			X	X		X	X							X					X										
1-2 UPSHIFT @ W.O.T. ONLY		X							X			X				X					X										
SLIPS-1-2 UPSHIFT	X		X			X	X	X	X					X		X	X	X	X		X	X	X			X					
ROUGH-1-2 UPSHIFT		X	X				X									X			X		X	X									
NO 2-3 UPSHIFT						X				X						X		X	X		X				X						
2-3 U.S.-EARLY/LATE		X	X		X	X		X		X		X				X					X										
SLIPS-2-3 UPSHIFT	X		X			X	X	X		X						X	X	X	X		X				X						
ROUGH-2-3 UPSHIFT		X	X				X			X				X		X					X										
NO WOT. 1-2 UPSHIFT													X			X			X												
NO-PART TH. DOWN SHIFT										X		X																			
NO-FULL TH. DOWN SHIFT												X																			
2-3 UPSHIFT-W.O.T. ONLY		X										X																			
HARSH-DOWN SHIFT								O																							
L1 RANGE-NO ENG. BRAKING							X		X		X				X	X		X			X			X			X				
L2 RANGE-NO ENG. BRAKING							X								X	X		X					X	X							
NEUTRAL-DRIVES IN NEUTRAL																								X							
REVERSE-NO REVERSE							X	X							X	X		X	X	X	X			L	X		X				
SLIPS IN REVERSE	X		X	X		X	X	X	X						X	X		X	X	X	X				X		X				
PARK-NO PARK-RATCHETS																													X		
NOISY-ALL RANGES	X			X		X											X			X										X	X
1-2 2-3 SHIFT NOISY	X																								X	X					X
REV. & D. L1 & L2 NOISY																														X	
SPEWS FLUID OUT BREATHER	X			X															X												
HUNTS BETWEEN 2 & 3 AND 3 & 2												S																			

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Fig. 7A2-5 Diagnosis Chart

a. Forward clutch leak (pressure low in Drive range, pressure normal in Neutral and Reverse) -

1. Check pump oil seal rings.

2. Check forward clutch seals.

b. Direct clutch leak (pressure low in Reverse, pressure normal in other ranges) -

1. Check direct clutch outer seal.

2. Check 1-2 accumulator piston and ring for damage or missing.

- Case Assembly - check ball missing from cored passages in case face.

1-2 Shift - Full Throttle Only

- Detent Valve - sticking or linkage misadjusted.
- Vacuum Leak - vacuum line or fittings leaking.
- Control Valve Assembly:

a. Valve body gaskets - leaking, damaged or incorrectly installed.

b. Detent valve train stuck.

c. 1-2 valve stuck closed (in downshifted position).

- Case Assembly - refer to case porosity repair above.

First Speed Only - No 1-2 Shift

- Detent (downshift) cable - binding.
- Governor Assembly:

a. Governor valve sticking.

b. Driven gear loose, damaged or worn (check for pin in case and length of pin showing; also, check output shaft drive gear for nicks or rough finish if driven gear shows damage).

- Control Valve Assembly:

a. Valve body gaskets - leaking, damaged or incorrectly installed.

b. Governor feed channels blocked.

c. 1-2 shift valve train stuck closed (in downshifted position).

- Intermediate Band:

a. Servo piston seals - missing, improperly installed or broken.

b. Band improperly adjusted - screw loose.

c. Servo apply rod broken.

- Case:

a. Porosity between channels.

b. Governor feed channel blocked; governor bore scored or worn, allowing cross pressure leak.

First and Second Speeds Only - No 2-3 Shift

- Control Valve Assembly:

a. Valve body gaskets - leaking, damaged or incorrectly installed.

b. 2-3 shift valve train stuck closed (in downshifted position).

- Direct Clutch:

a. Pump hub - direct clutch oil seal rings - broken or missing.

b. Clutch piston seals - missing, improperly assembled or cut.

c. Clutch plates burned (see BURNED CLUTCH PLATES above).

No First Speed - Starts in Second Speed

(Locks up in L1 Range)

- Intermediate Band:

a. Band adjustment too tight.

b. 1-2 shift valve stuck in upshift position.

Drive in Neutral

- Manual Linkage - misadjusted (correct alignment in manual lever shaft quadrant is essential).
- Internal Linkage - manual valve disconnected or end broken.
- Oil Pump - line pressure leaking into forward clutch apply passage.
- Forward Clutch - incorrect clutch plate usage or burned clutches (see BURNED CLUTCH PLATES above).

No Motion in Reverse or Slips in Reverse

(Install pressure gage)

- Low Fluid Level - add fluid.
- Manual Linkage - misadjusted (correct alignment in manual lever shift quadrant is essential).
- Low Oil Pressure - refer to Low Line Pressure above.
- Control Valve Assembly:

a. Valve body gaskets - leaking, damaged or incorrectly installed.

b. 2-3 shift valve train stuck open (in upshifted position).

- Intermediate Servo - piston or pin stuck so intermediate band is applied.
- Low and Reverse Clutch - piston outer seal damaged or missing.
- Direct Clutch:

a. Outer seal damaged or missing.

b. Clutch plates burned (see BURNED CLUTCH PLATES above).

- Forward Clutch - clutch does not release (will cause DRIVE in NEUTRAL).

Slips in All Ranges or Slips on Start

(Install pressure gage)

- Low Fluid Level - add fluid.
- Low Fluid Pressure - refer to Low Line Pressure above.
- Forward Clutch:

a. Clutch plates burned (see BURNED CLUTCH PLATES above).

b. Pump cover oil seal rings broken or worn.

- Case - cross leaks or porosity.

Slipping 1-2 Shift

(Install pressure gage)

- Low Fluid Level - add fluid.
- Low Fluid Pressure - refer to Low Line Pressure above.
- 1-2 Accumulator - oil ring damaged, missing or case bore damaged.
- Pump-to-Case Gasket - mispositioned or damaged.
- Intermediate Band:

a. Improper band adjustment.

b. Piston seals damaged or missing.

c. Intermediate Band burned (see BURNED INTERMEDIATE BAND above).

- Case - porosity between channels.

Slipping 2-3 Shift

(Install pressure gage)

- Low Fluid Level - add fluid.
- Low Oil Pressure - refer to Low Line Pressure above.
- Direct Clutch:

a. Piston seals leak, damaged or missing.

b. Clutch plates burned (see BURNED CLUTCH PLATES above).

c. Inspect for proper number and type of clutch plates.

- Case - refer to case porosity repair.

Rough 1-2 Shift

(Install pressure gage)

- High Fluid Pressure - refer to High Line Pressure above.
- 1-2 Accumulator:

a. Oil rings damaged.

b. Piston stuck.

c. Broken or improper spring.

d. Bore damaged.

- Case:

a. Check for correct number and location of check balls.

b. Porosity between channels.

- Intermediate Band:

a. Improper adjustment.

b. Improper or broken servo spring.

Rough 2-3 Shift

(Install pressure gage)

- High Fluid Pressure - refer to High Line Pressure above
- 2-3 Accumulator:

a. Oil ring damaged.

b. Piston stuck.

c. Broken or missing spring.

d. Piston bore damaged.

No Engine Braking in L2 Range

(Install pressure gage)

- Low Fluid Pressure - pressure regulator and/or boost valve stuck.
- Intermediate Servo:

a. Servo oil rings or bores leaking or damaged.

b. Servo piston stuck or cocked.

- Intermediate Band - intermediate band broken or burned (look for cause), not engaged on servo pin or improper adjustment.

No Engine Braking on L1 Range

(Install pressure gage)

- Low Fluid Pressure - pressure regulator and/or boost valves stuck.
- Manual Low Control Valve Assembly - stuck.
- Low and Reverse Clutch - piston inner seal damaged or missing.

No Part Throttle Downshift

(Install pressure gage)

- Fluid Pressure - vacuum modulator assembly, modulator valve or pressure regulator valve train (other malfunctions may also be noticed).
- Detent Valve and Linkage - sticks, disconnected or broken.
- 2-3 shift valve - stuck.

No Detent (Wide Open Throttle) Downshift

- Detent cable or retainer not adjusted properly.
- Detent cable disconnected at transmission or throttle linkage.
- Valve Body:

a. Detent valve sticks.

b. Detent regulator valve sticks.

c. Incorrect spacer plate or gasket.

High or Low Shift Points

(Install pressure gage)

- Fluid Pressure:

a. Engine Vacuum - check at transmission end of modulator pipe.

b. Check vacuum line connections at engine and transmission.

c. Vacuum modulator assembly and valve and pressure regulator valve train.

- Governor:

a. Valve sticking.

b. Feed holes restricted or leaking.

- Detent Valve and Linkage - stuck open (will cause high shift points).
- Control Valve Assembly:

a. 1-2 shift valve train sticking.

b. 2-3 shift valve train sticking.

- Case - refer to case porosity repair.

Won't Hold in Park

- Manual Linkage - misadjusted (correct alignment in manual lever shift quadrant is essential).
- Internal Linkage:

a. Inner lever and actuating rod assembly - defective or improperly installed.

b. Parking pawl - broken or inoperative.

c. Parking lock bracket loose, burred or rough edges or incorrectly installed.

d. Parking pawl disengaging spring missing, broken or incorrectly hooked.

TRANSMISSION NOISY

CAUTION: *Before checking transmission, make certain that noise is not coming from water pump, generator, power steering, etc. These components can be isolated by removing proper belt and running engine not more than two minutes at one time.*

Park, Neutral and All Driving Ranges

- Pump Cavitation:

a. Low fluid level.
b. Plugged or restricted strainer.
c. Strainer-to-valve body gasket damaged.
d. Porosity in valve body intake area.
e. Water in fluid.
f. Porosity or voids at transmission case (pump face) intake port.
g. Pump-to-case gasket off location.

- Pump Assembly:

a. Gears damaged.
b. Driving gear assembled backwards.
c. Crescent interference.
d. Oil seal rings damaged or worn.

- Converter:

a. Loose flexplate-to-converter bolts.
b. Converter damage.
c. Water in fluid (causes whine).

First, Second and/or Reverse Gear

Planetary Gear Set:

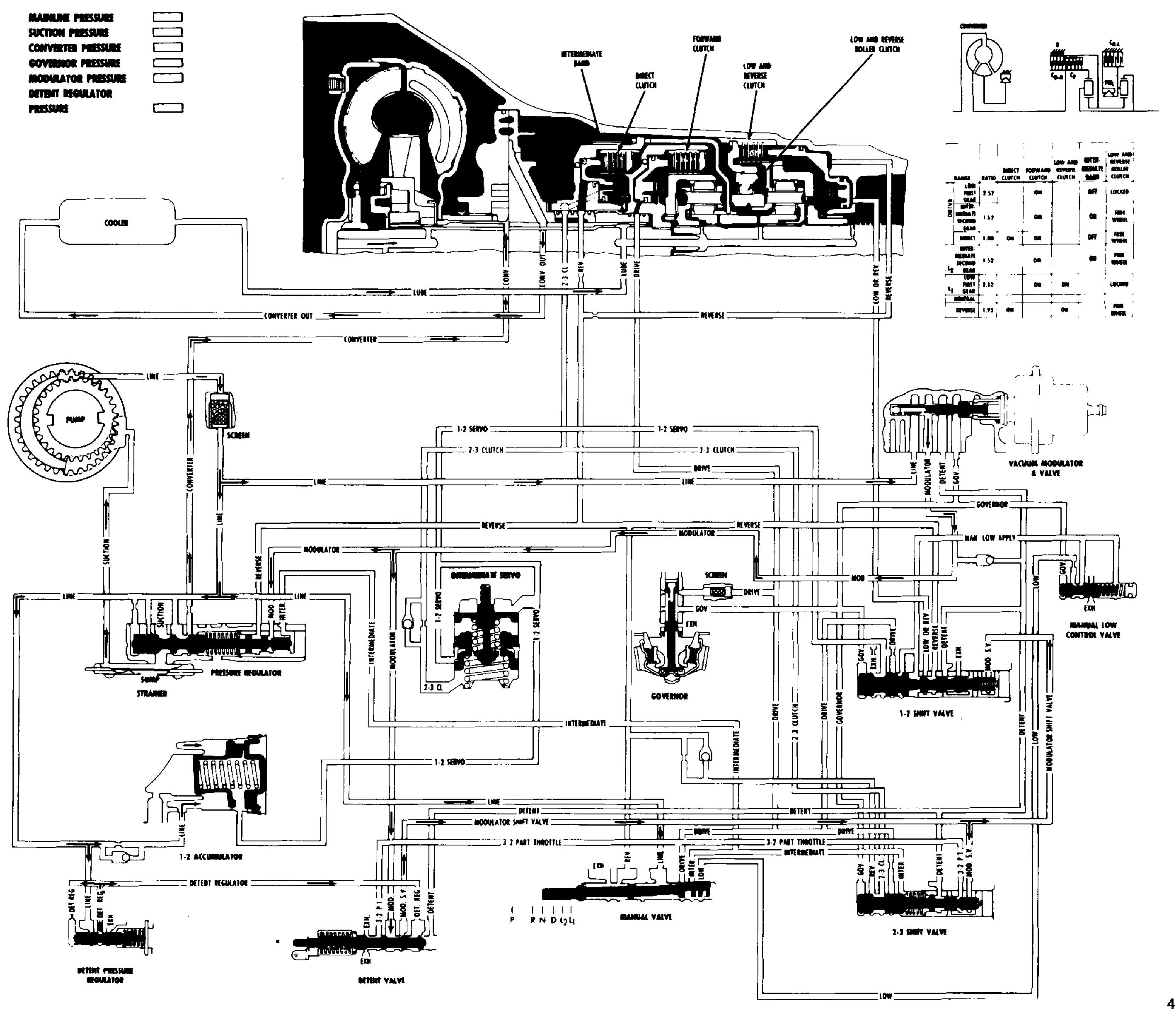
- Gears or thrust bearings damaged.
- Input or output ring gear damaged.

During Acceleration - Any Gear

- Transmission grounded to underbody.
- Motor mounts loose or broken.

Squeal at Low Vehicle Speed

Speedometer driven gear shaft seal - requires lubrication or replacement.



RANGE		RATIO	DIRECT CLUTCH	FORWARD CLUTCH	LOW AND REVERSE CLUTCH	INTER-MEDIATE BAND	LOW AND REVERSE ROLLER CLUTCH
DRIVE	LOW FIRST GEAR	2.52		ON		OFF	LOCKED
	INTERMEDIATE SECOND GEAR	1.52		ON		ON	FREE WHEEL
	DIRECT	1.00	ON	ON		OFF	FREE WHEEL
L2	INTERMEDIATE SECOND GEAR	1.52		ON		ON	FREE WHEEL
L1	LOW FIRST GEAR	2.52		ON	ON		LOCKED
NEUTRAL							
REVERSE		1.93	ON		ON		FREE WHEEL

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Fig. 7A2-6 Circuit Schematic - Typical (Drive Range, Third Gear Shown)

MAINTENANCE AND ADJUSTMENTS

TRANSMISSION FLUID

Fluid Level and Capacity

Fluid level indicator is located in filler tube at right rear of the engine. To bring fluid level from ADD mark to FULL mark requires one pint of fluid. Fluid level should be checked at every engine oil change.

Fluid level should be to FULL mark with transmission fluid at normal operating temperature (200°F). With warm fluid (room temperature 70°F), level will be 1/4-inch below ADD mark on dipstick. The normal operating temperature is obtained only after at least 15 miles of highway-type driving or equivalent of city driving.

Approximately 8 pints of fluid are required to refill transmission after oil pan has been drained. The fluid capacity of the Turbo Hydra-Matic 250 transmission and converter assembly is approximately 21-1/2 pints, but correct level is determined by mark on the dipstick rather than by amount added. Use only DEXRON II automatic transmission fluid or its equivalent.

NOTE: An early stage to a darker color from the usual red color and/or a strong odor that is usually associated with overheated transmission fluid is normal and is not a positive sign or required maintenance or transmission failure.

Checking Procedure and Adding Fluid

To determine proper fluid level at normal operating temperature, proceed as follows:

1. Position vehicle on a level surface, place selector lever in park (P), apply parking brake and have engine running at normal idle.

2. Remove fluid level indicator, wipe it clean and reinstall fully until cap seats.

3. Remove indicator and reading of fluid level should be at full "FULL" mark.

4. If additional fluid is required, add DEXRON® II D-number automatic transmission fluid or its equivalent to "FULL" mark on indicator.

If vehicle cannot be driven sufficiently to bring the transmission to operating temperature and it becomes necessary to check fluid level, transmission may be checked at room temperature (70 degrees F) as follows:

1. Position selector lever in park (P), apply parking brake and start engine. DO NOT RACE ENGINE. Move selector lever through each range.

2. Immediately check fluid level with selector lever in Park, engine running and vehicle on LEVEL surface. Fluid level on indicator should be 1/4-inch below the "ADD" mark.

3. If additional fluid is required, add enough fluid to bring level to 1/4-inch below "ADD" mark on dipstick. If transmission fluid level is correctly established at 70°F, it will appear at "FULL" mark on dipstick when transmission reaches its normal operating temperature of 200° F.

CAUTION: *DO NOT OVERFILL, as foaming and loss of fluid through vent pipe might occur as fluid heats up.*

If fluid is too low, especially when cold, complete loss of drive may result which can result in transmission failure.

Draining and Refilling Transmission

Oil pan should be drained and screen cleaned every 60,000 miles and fresh fluid added to obtain proper level on indicator. For vehicle subjected to heavy city traffic during hot weather, or in commercial use, when engine is regularly idled, for prolonged periods or when vehicle is used for towing, oil pan should be drained and screen cleaned every 15,000 miles. Drain fluid immediately after operation before it has had an opportunity to cool.

WARNING: TRANSMISSION FLUID TEMPERATURE CAN EXCEED 350°F.

1. Raise vehicle and support transmission with suitable jack at the transmission vibration damper.

2. Remove transmission crossmember support.

3. With fluid receptacle placed under transmission oil pan, remove oil pan attaching bolts from front and side of pan.

4. Loosen rear pan attaching bolts approximately four (4) turns.

5. Carefully pry transmission oil pan loose with screwdriver, allowing fluid to drain.

6. Remove remaining screws and remove oil pan and gasket. Discard gasket.

7. Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.

8. Remove two (2) strainer-to-valve body screws, strainer and gasket. Discard gasket.

9. Thoroughly clean strainer assembly in solvent and dry thoroughly with clean compressed air.

10. Install new strainer-to-valve body gasket, strainer and two (2) screws.

11. Install new gasket on oil pan and install oil pan. Tighten its thirteen (13) attaching bolt and washer assemblies to 12 lb. ft.

12. Lower vehicle add approximately 5 pints U.S. measure (4 pints Imperial measure) of DEXRON II automatic transmission fluid or its equivalent through the filler tube.

13. With selector lever in PARK position, apply parking brake, start engine and let idle (carburetor off fast idle step). DO NOT RACE ENGINE.

14. Measure selector lever through each range and, with selector lever in PARK range, check fluid level.

15. Add additional fluid to bring level to 1/4-inch below "ADD" mark on the dipstick.

CAUTION: *Do not overfill. Foaming will result if overfilled.*

Adding Fluid to Fill Dry Transmission and Converter Assembly

In cases of transmission overhaul when a complete fill is required, including converter (approximately 20 pints), proceed as follows:

1. Add 8 pints of transmission fluid through filler tube.
2. With manual control lever in park (P) position, start engine and place on cold idle cam. DO NOT RACE ENGINE. Move manual control lever through each range.
3. Immediately check fluid level with selector lever in park (P), engine running and vehicle on LEVEL surface and add additional fluid to bring level to 1/4-inch below "ADD" mark on the dipstick. Do not overfill.

INTERMEDIATE BAND ADJUSTMENT

Intermediate band adjustment should be performed every 60,000 miles with transmission fluid change or sooner, as necessary, if operating performance indicates intermediate band slippage.

1. Position selector lever in neutral (N) and raise vehicle.
2. Using Special Tool J-24367 in position over adjusting screw and locknut on right side of transmission, loosen locknut 1/2 turn and hold tool in this position.
3. With a torque wrench attached to special tool, tighten adjusting screw to 30 inch pounds and back-off 3 complete turns. Use mark on special tool as indicator.
4. With torque wrench held in position on special tool, tighten locknut 15 lb. ft.

CHECKING TRANSMISSION MOUNT

Raise vehicle on a hoist. Push up and pull down on transmission tailshaft while observing transmission mount. If rubber separates from metal plate of mount or if tailshaft moves up but not down (mount bottomed out) replace mount. If there is relative movement between a metal plate of mount and its attaching point, tighten screws or nuts attaching mount to transmission or crossmember.

Shift Control Cable Adjustment (Fig. 7A2-7)

1. Place control shifter assembly "A" in neutral position.
2. Loosen nut "B" and washer from pin "C" at the selector lever "D" (View A).
3. Make sure selector lever "D" is in NEUTRAL position.

   NOTE: NEUTRAL can be obtained by moving selector lever "D" counter clockwise to L1 detent, then move clockwise through three (3) detent positions to NEUTRAL.

4. Then, with control shifter assembly "A" in NEUTRAL, tighten nut "B" to 20 lb. ft. torque.
5. Readjust neutral start switch if necessary to provide the correct relationship to the transmission detent positions. See Section 8.

   CAUTION: *Any inaccuracies in the above adjustments may result in premature failure of transmission due to operation without controls in full detent. Such operation results in reduced fluid pressure and in turn partial engagement of affected clutches. Partial engagement of clutches with sufficient pressure to cause apparent normal operation of vehicle will result in failure of clutches or other internal parts after only a few miles of operation.*

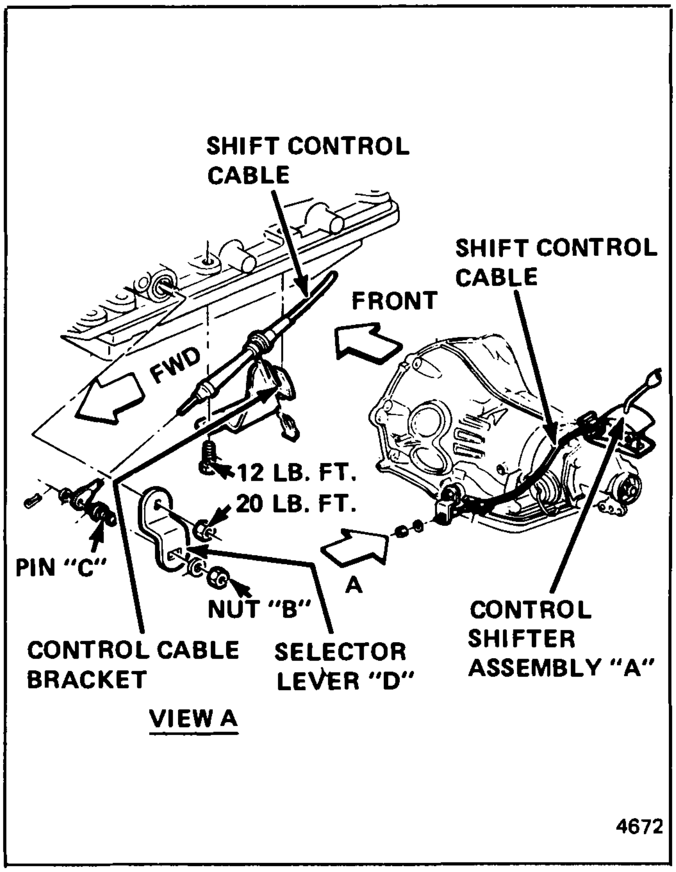


Fig. 7A2-7 Shift Control Cable

Detent Control Cable Adjustment (Fig. 7A2-8)

1. Disengage "snap lock" on detent control cable by pushing up on bottom of "snap lock" to release the detent control (View A).
2. Position carburetor lever to wide open throttle (W.O.T.) position (View C) and push "snap lock" downward until its top is flush with rest of cable.

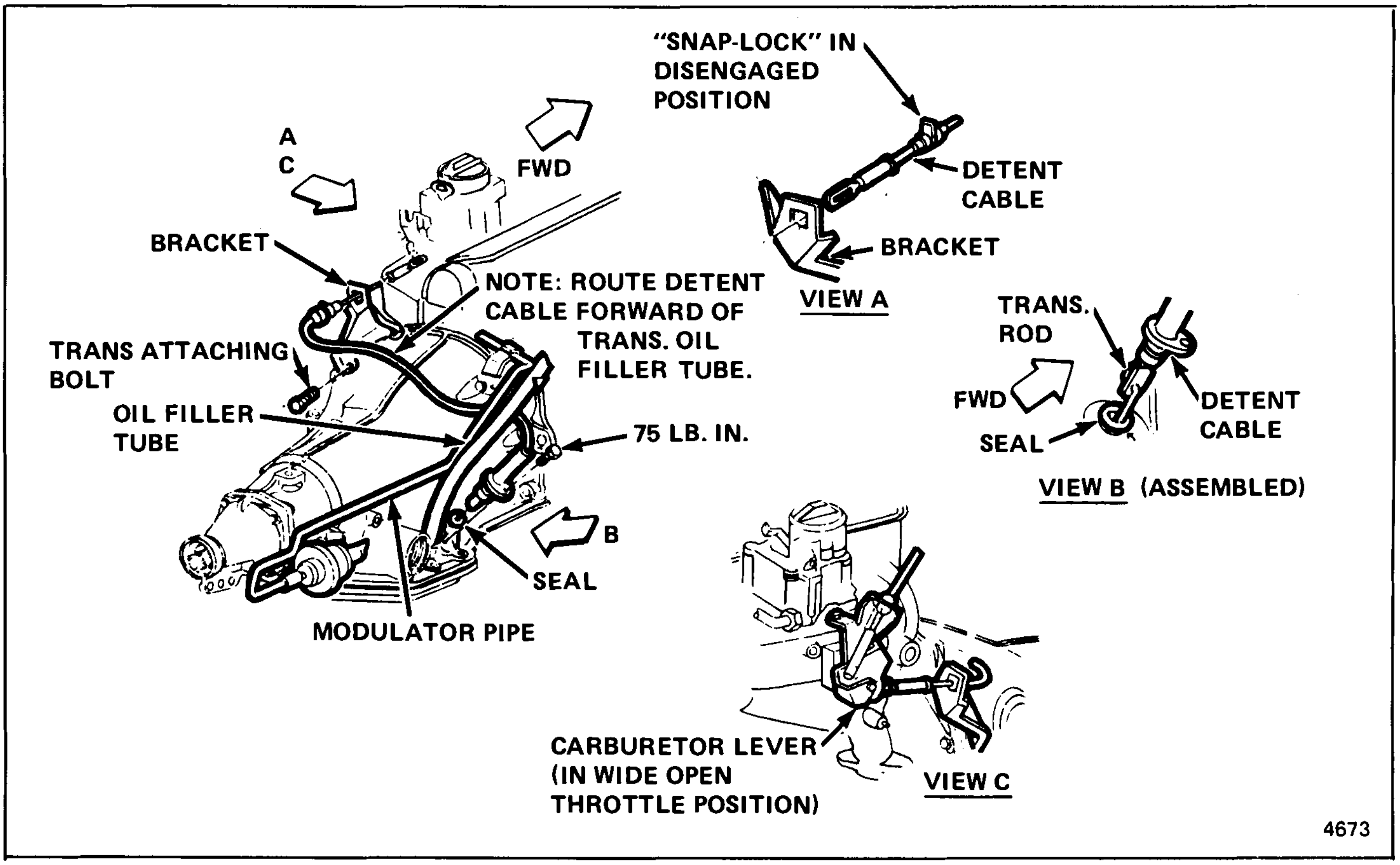


Fig. 7A2-8 Detent Control Cable

ON-CAR SERVICE

CONTROL SHIFTER ASSEMBLY

Removal

1. Lower vehicle and remove two (2) cover mounting screws and remove console cover assembly (Fig. 7A2-9).

2. Disconnect electrical connector to combination neutral start and back-up lamp switch and disconnect quadrant lamp.

3. Disconnect end of shift control cable from shifter assembly by removing clevis pin and yoke spring from control cable (Fig. 7A2-10).

4. Remove four (4) control shifter assembly-to-floor mounting screws and remove control shifter assembly.

Installation

Reverse removal procedure steps 1 thru 4. Thoroughly coat pointer inner shaft and guide slot with lub-lithium soap or equivalent. When installing console cover, insert pointer into "finger" or detent cover prior to attachment of cover. Install cover mounting screws and torque to 18 lb. in.

VACUUM MODULATOR AND MODULATOR

VALVE ASSEMBLY

Removal

1. Disconnect vacuum hose from vacuum modulator stem and remove vacuum modulator attaching screw and retainer.

2. Remove modulator assembly and its o-ring seal from case.

3. Remove modulator valve from case.

Installation

Installation of modulator and modulator valve is the reverse of REMOVAL. Install a new O-ring seal torque attaching screw to 130 lb. in. and adjust fluid level.

DETENT CONTROL CABLE (FIG. 7A2-8)

Remove

1. Remove air cleaner.

2. Push up on bottom of snap-lock and release lock and detent cable.

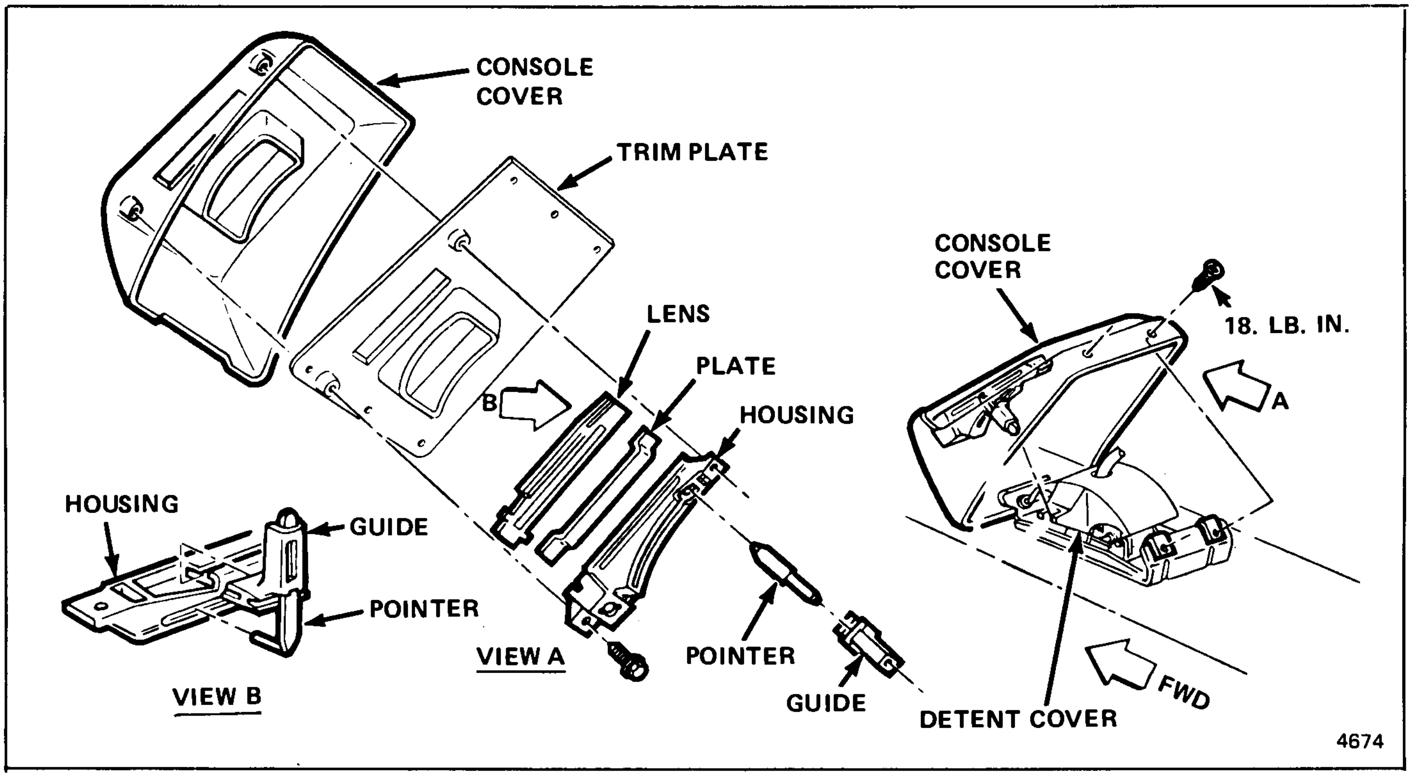


FIG. 7A2-9 CONSOLE COVER

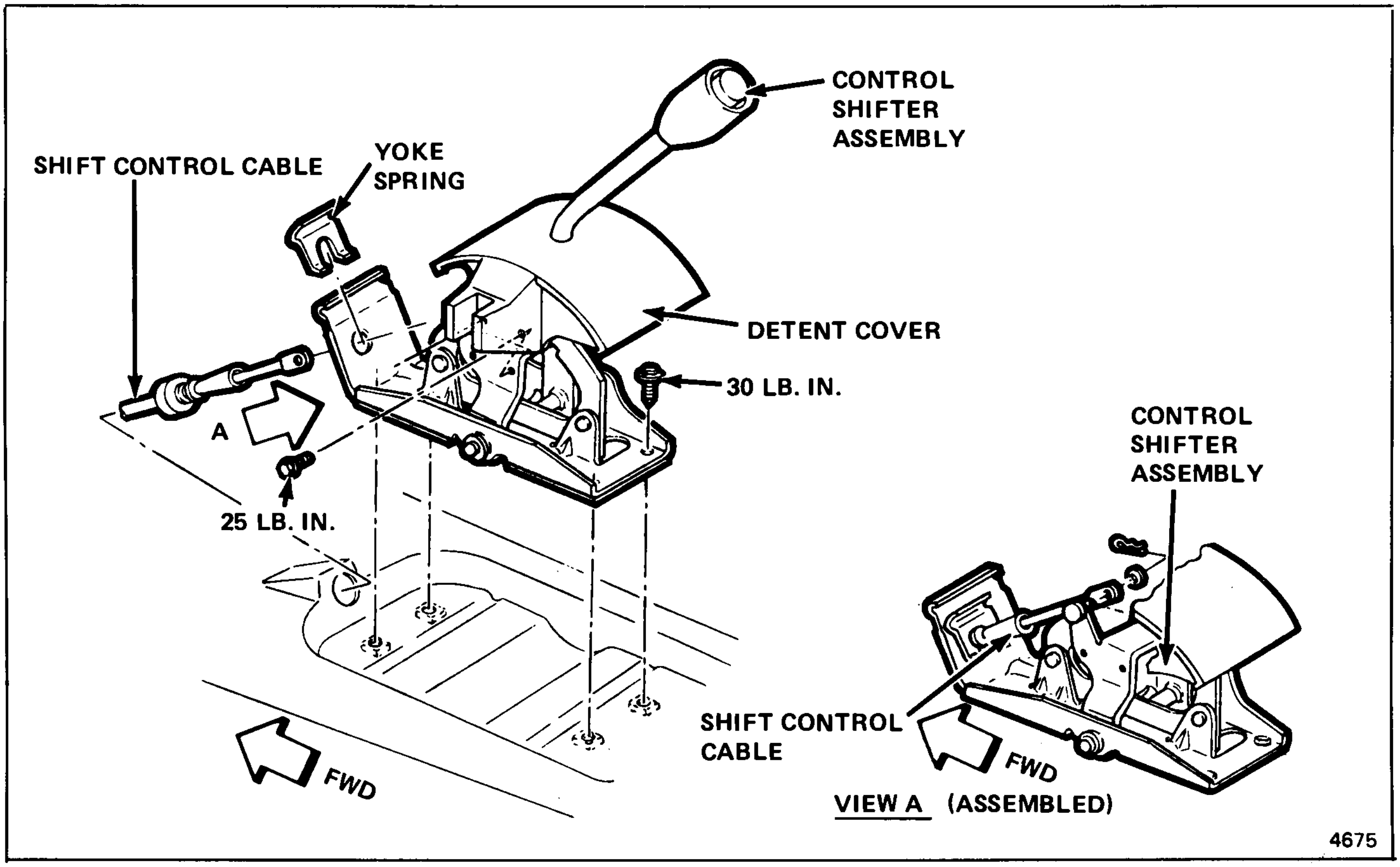


FIG. 7A2-10 CONTROL SHIFTER ASSEMBLY

3. Compress locking tabs and disconnect snap-lock assembly from bracket.

4. Disconnect cable from carburetor lever.

5. Remove clamp around filler tube, remove screw and washer securing cable to transmission and disconnect detent cable.

Install

1. Install new seal on transmission end of detent cable. Lubricant seal with transmission fluid.

2. Connect transmission end of detent cable to transmission rod and secure to transmission case with screw and washer, tighten to 75 lb. in.

3. Route cable in front of filler tube and install clamp around filler tube, modulator pipe and detent cable. Locate clamp approximately 2 inches above filler tube bracket.

4. Pass cable through bracket and engage locking tube of snap-lock on bracket.

5. Connect cable to carburetor lever.

6. Install air cleaner.

Adjust

With snap-lock disengaged, position carburetor to wide open throttle (W.O.T.) position and push snap-lock downward until top is flush with rest of cable.

GOVERNOR

Remove

1. Raise vehicle and disconnect speedometer cable at transmission.

2. Remove governor cover retainer and governor cover.

NOTE: Be careful not to damage cover and "O" ring seal.

3. Remove governor. Inspect weights and valve for freeness.

Install

1. Install governor.

2. Install governor cover, using a brass drift around outside flange of cover.

NOTE: Do not distort cover on installation. Be sure "O" ring seal is not cut or damaged.

3. Install retainer to cover.

4. Connect speedometer cable, lower vehicle and check transmission fluid level.

SPEEDOMETER DRIVEN GEAR

Removal

1. Disconnect speedometer cable.

2. Remove reatiner bolt, retainer, speedometer driven gear and O-ring seal.

Installation

Installation of speedometer driven gear-speed control switch assembly is the reverse of REMOVAL. Install new O-ring seal (if required) and adjust fluid level.

SPEEDOMETER DRIVE GEAR

Removal

1. Raise vehicle and support transmission with suitable transmission on jack.

2. Remove propeller shaft.

3. Disconnect speedometer cable.

4. Disconnect transmission rear mount from frame crossmember.

5. Remove two bolts at each end of frame crossmember and remove crossmember.

6. Remove extension housing.

7. Install Special Tools, J 21427-01 and J 8105, on output shaft and remove speedometer drive gear. Remove retaining clip.

Installation

1. Place speedometer drive gear retaining clip into hole in output shaft.

2. Align slot in speedometer drive gear with retaining clip and install.

3. Install extension housing and tighten attaching bolts to 25 lb. ft.

4. Connect speedometer cable.

5. Install crossmember to frame and transmission.

6. Install propeller shaft.

7. Remove transmission jack and lower vehicle.

EXTENSION HOUSING OIL SEAL

Removal

1. Remove propeller shaft.

2. Pry out lip oil seal with screwdriver or small chisel.

Installation

1. Coat outer casing or new lip oil seal with a nonhardening sealer and drive it into place with Installer J 21426.

2. Install propeller shaft and adjust fluid level.

1-2 ACCUMULATOR

Remove

1. Remove two transmission oil pan bolts below the 1-2 accumulator cover. Install J 23069 in place of bolts removed.

2. Press in on cover, remove retaining ring and remove cover "O" ring seal, spring and 1-2 accumulator.

Install

1. Install 1-2 accumulator piston.

NOTE: Rotating piston slightly when installing will help to get rings started in bore.

2. Position spring, "O" ring seal and cover in place.

3. Press in cover with J 23069, install retaining ring, remove tool and install oil pan bolts, torquing to 130 lb. in.

VALVE BODY ASSEMBLY

Removal

1. Referring to draining procedures, drain transmission fluid from oil pan.

2. Remove oil pan and strainer. Discard gaskets.

3. Remove detent spring and roller assembly from valve body and remove valve body-to-case bolts.

4. Remove valve body assembly while disconnecting manual control valve link from range selector inner lever and removing detent control valve link from the detent actuating lever.

5. Remove manual valve and link assembly from valve body assembly.

Installation

Installation of valve body assemlby is the reverse of REMOVAL. Install new gaskets to strainer and oil pan and adjust fluid level.

MANUAL SHAFT, RANGE SELECTOR INNER LEVER AND PARKING LINKAGE

Removal

1. Referring to draining procedures, drain transmission fluid from oil pan.

2. Remove oil pan, strainer and valve body assembly. Discard gaskets.

3. Remove manual shaft-to-case reatiner and unthread jam nut holding range selector inner lever to manual shaft.

4. Remove jam nut and removal manual shaft from range selector inner lever and case.

NOTE: Do not remove manual shaft lip oil seal unless replacement is required.

5. Remove parking pawl actuating rod and range selector inner lever from case.

6. Remove bolts and parking lock bracket.

7. Remove parking pawl disengaging spring and, if necessary to replace park pawl or shaft, clean up bore in case and remove parking pawl shaft retaining plug, park pawl shaft and pawl.

Installation

Installation of parking linkage, selector lever and manual shaft is the reverse of REMOVAL. Install new plug (if required), new lip oil seal (if required) and new gaskets. Adjust fluid level.

UNIT REPAIR

REMOVE TRANSMISSION

1. Before raising vehicle, disconnect negative battery cable, detent downshift cable at carburetor and release parking brake.

2. Raise vehicle on hoist.

3. Remove propeller shaft.

4. Disconnect speedometer cable, detent downshift cable and modulator vacuum line at transmission.

5. Disconnect shift control linkage.

6. Support transmission with suitable transmission jack.

7. Disconnect transmission rear mount from frame crossmember.

8. Remove two bolts at each end of frame crossmember. Remove crossmember.

9. Remove converter under pan.

10. Remove converter to flywheel bolts.

11. Lower transmission until jack is barely supporting it.

12. Remove transmission to engine mounting bolts and remove oil filler tube at transmission.

13. Raise transmission to its normal position, support engine with jack and slide transmission rearward from the engine and lower it away from vehicle.

CAUTION: *Use suitable converter holding tool when lowering transmission or keep rear of transmission lower than front so as not to lose converter.*

REMOVAL OF CONVERTER AND VACUUM MODULATOR

1. Install Holding Fixture J 8763-01 on transmission and place into Holding Tool base J 3289-14 with converter facing up (Fig. 7A2-11).

NOTE: Cleanliness is an important factor in the overhaul of transmission. Before attempting any disassembly operation, exterior of case should be thoroughly cleaned and prevent the possibility of dirt entering the transmission internal mechanism. During disassembly, all parts should be thoroughly cleaned in cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts.

CAUTION: *Do not use solvents which should damage rubber seals or clutch facings.*

2. With transmission in holding fixture, remove torque converter assembly.

3. Remove vacuum modulator assembly attaching bolt and retainer.

4. Remove vacuum modulator, "O" ring seal, and modulator valve from case (Fig. 7A2-12). Discard "O" ring.

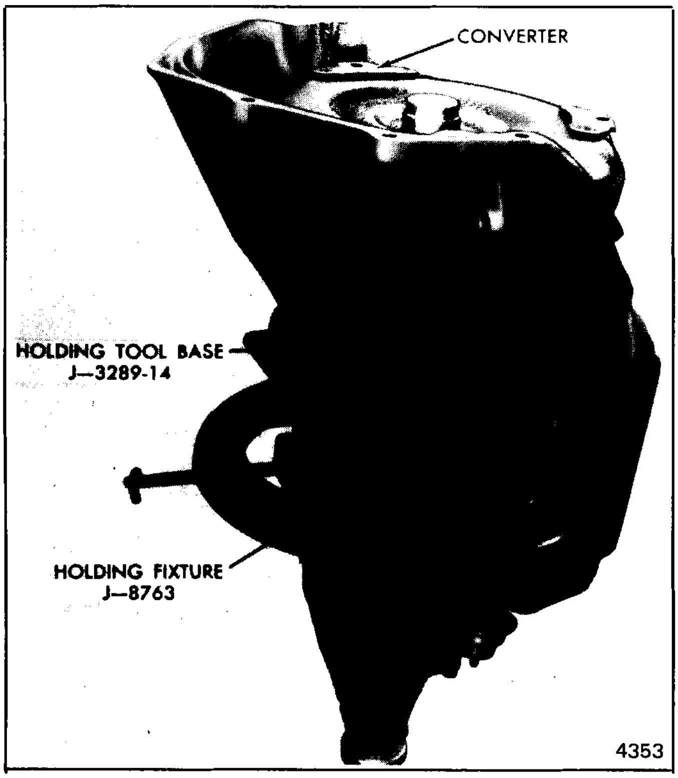


Fig. 7A2-11 Transmission In Holding Fixture

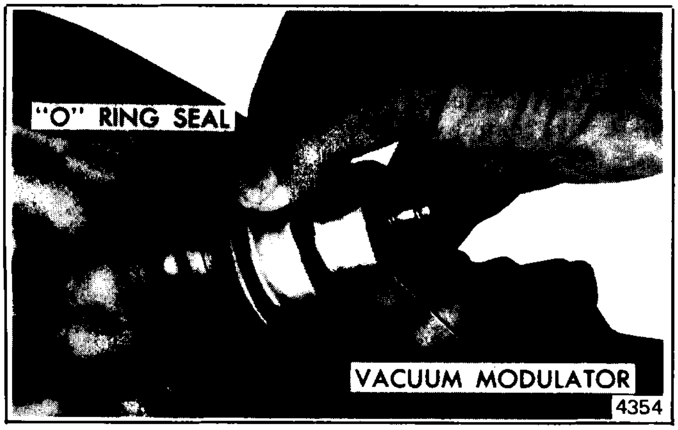


Fig. 7A2-12 Removing Vacuum Modulator

REMOVAL OF EXTENSION, SPEEDOMETER DRIVEN GEAR, GOVERNOR, OIL PAN AND SCREEN

1. Remove four extension to case attaching bolts.

2. Remove extension from case and remove square cut "O" ring seal from extension housing.

3. Remove extension housing lip seal, using screw driver (Fig. 7A2-13).

4. Install speedometer drive gear remover Tool J 21427-01 and J 9539 bolts with J 8105, or suitable puller, on output shaft and remove speedometer drive gear. Remove retaining clip.

5. Remove governor cover retainer with a screw driver.

6. Using a screwdriver and hammer, gently tap along governor cover lip (Fig. 7A2-14), remove governor cover and "O" ring seal (Fig. 7A2-15). Discard seal.

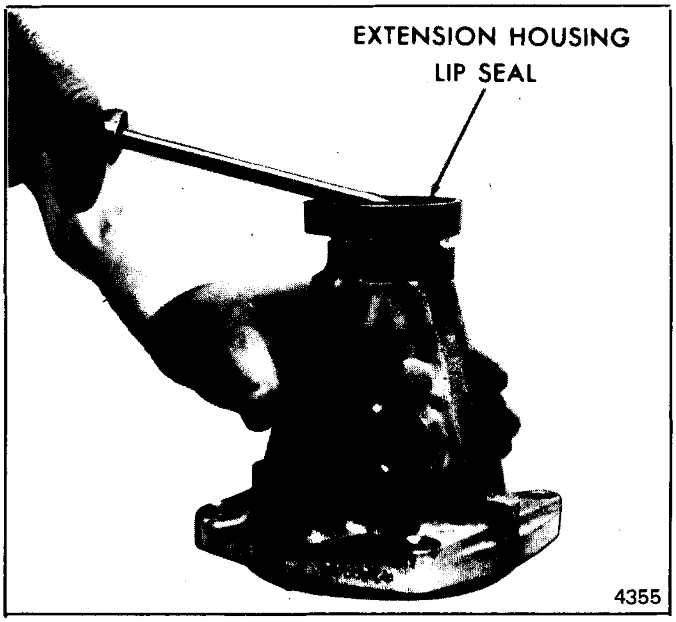


Fig. 7A2-13 Removing Extension Housing Lip Seal

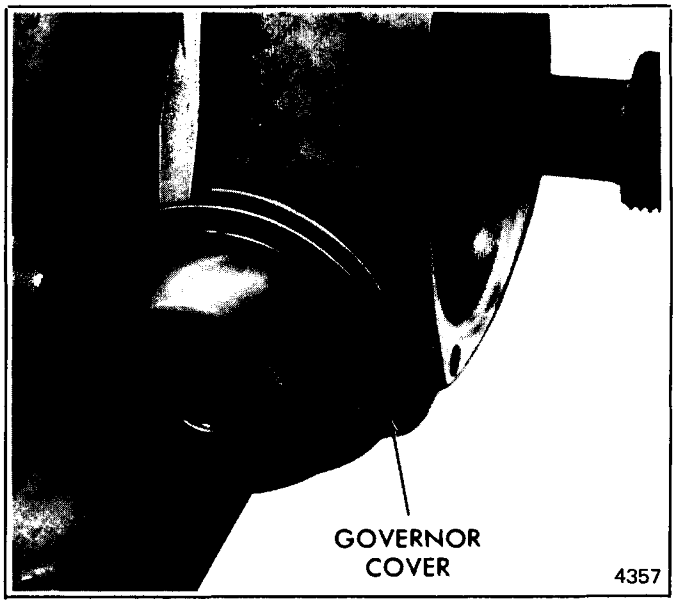


Fig. 7A2-14 Removing Governor Cover

CAUTION: *Do not attempt to pry screwdriver between case and governor cover as this could cause damage to case.*

7. Withdraw governor assembly from case (Fig. 7A2-16) and check governor bore and governor sleeve for scoring.

8. Remove oil pan attaching screws (Fig. 7A2-17), oil pan and gasket. Discard gasket.

9. Remove oil pump suction screen (strainer) to valve body attaching screws (Fig. 7A2-18).

10. Remove oil pump screen (strainer) and gasket from valve body.

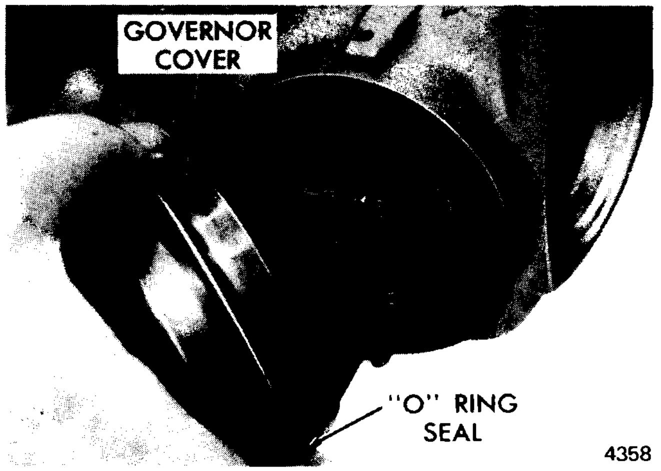


Fig. 7A2-15 Governor Cover and "O" Ring Seal

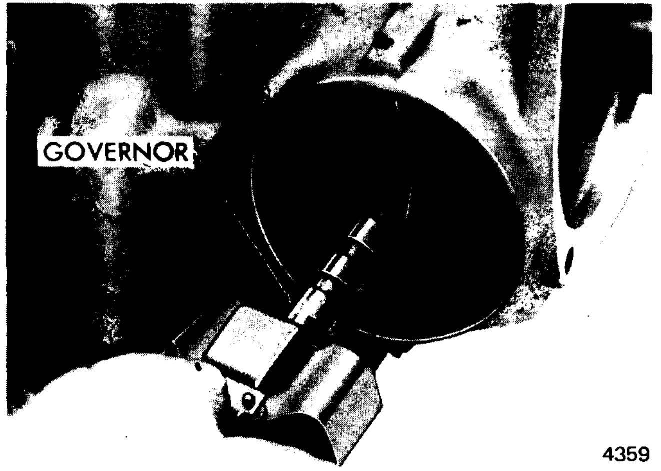


Fig. 7A2-16 Removing Governor

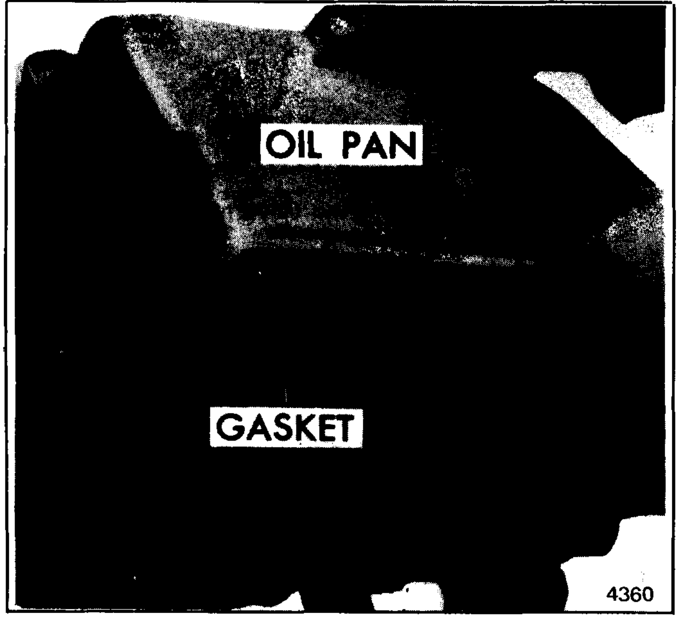


Fig. 7A2-17 Removing Transmission Oil Pan

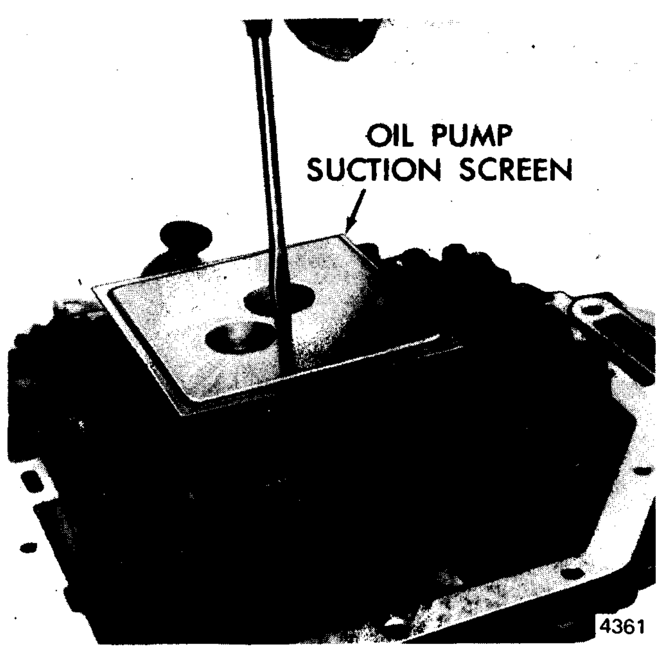


Fig. 7A2-18 Removing Oil Pump Suction Screen (Strainer)

REMOVAL OF VALVE BODY AND LINKAGE

1. Remove detent roller and spring assembly from valve body (Fig. 7A2-19). Remove valve body to case attaching bolts.

2. Remove actuator pin from detent actuator valve lever and remove control wire (Fig. 7A2-20).

3. Remove manual control valve link from range selector inner lever and remove valve body (Fig. 7A2-20).

4. Remove intermediate servo return spring, transfer support plate bolts and remove transfer support plate (Fig. 7A2-21).

5. Remove upper valve gasket, valve body transfer plate and lower valve gasket (Fig. 7A2-22).

6. Remove (4) check balls from correct passages in case face (Fig. 7A2-23).

7. Remove oil pump pressure screen from oil pump pressure hole in case (Fig. 7A2-24).

8. Remove governor feed screen from governor feed hole (drive oil) in case (Fig. 7A2-25).

9. Remove manual shaft to case retainer with screwdriver (Fig. 7A2-26).

10. Loosen nut holding range selector lever to manual shaft (Fig. 7A2-27). Pull on manual shaft and remove nut and manual shaft.

11. Remove range selector lever parking pawl actuator rod from case. Disassemble inner lever from parking pawl actuator rod (Fig. 7A2-28).

12. Remove manual shaft to case lip seal if replacement is required (Fig. 7A2-29).

13. Remove attaching special bolts and parking lock, lock bracket (Fig. 7A2-30).

14. Remove parking pawl disengaging spring (Fig. 7A2-31).

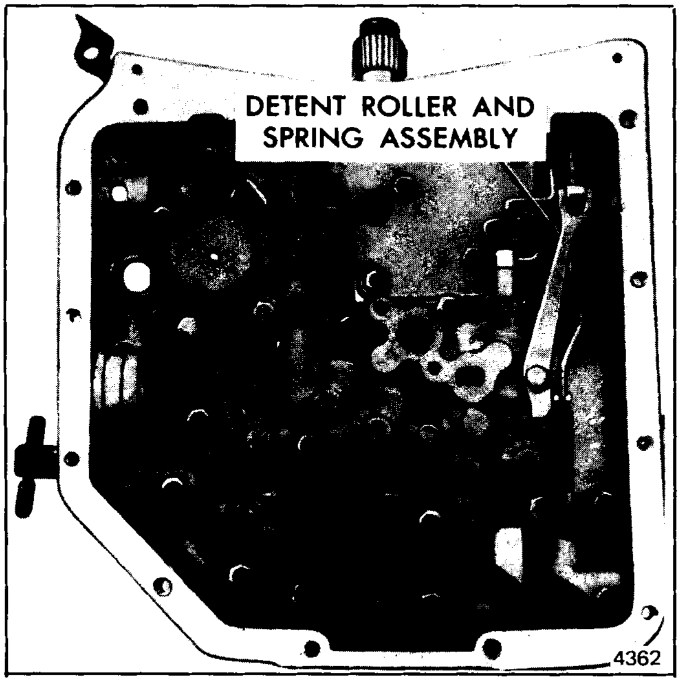


Fig. 7A2-19 Detent Roller and Spring Assembly

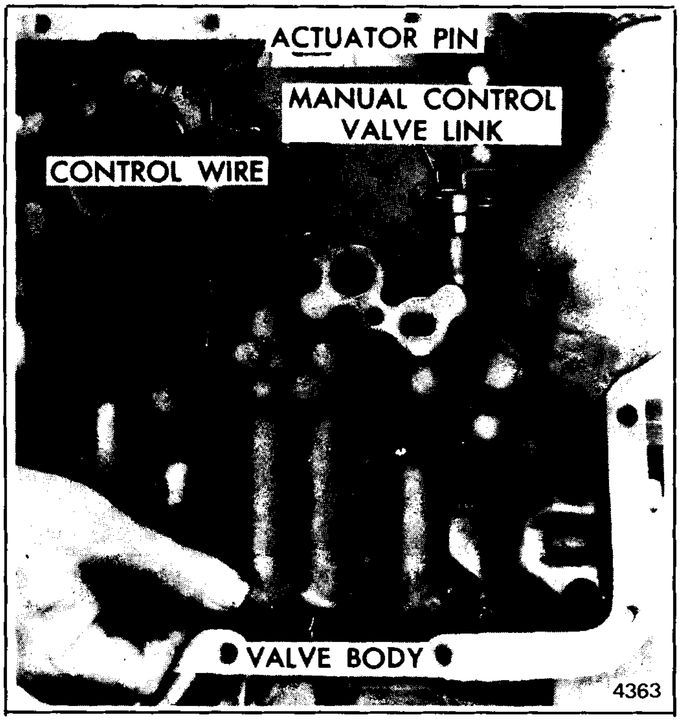


Fig. 7A2-20 Manual Control Valve Link, Valve Body, Detent Actuator Pin and Control Wire

15. Remove parking pawl shaft retaining plug, park pawl shaft and parking pawl if replacement is required (Fig. 7A2-32).

NOTE: The parking pawl shaft retaining clip may be removed by using a bolt extractor.

REMOVAL OF OIL PUMP AND INTERNAL CASE COMPONENTS

1. Remove eight (8) pump attaching bolts with washer type seals (Fig. 7A2-33).

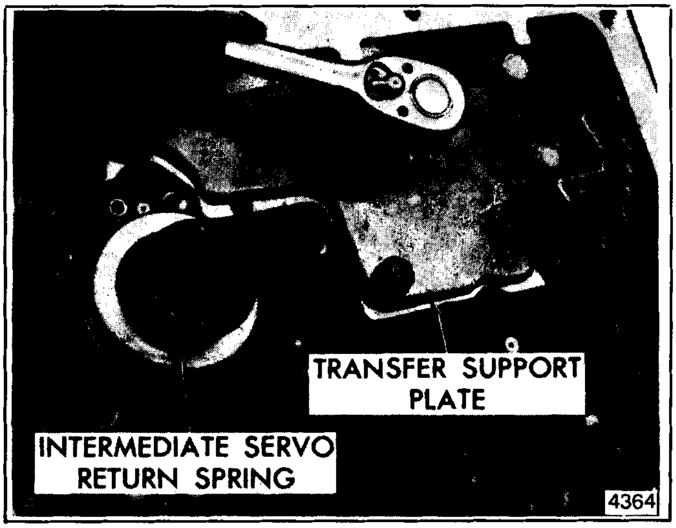


Fig. 7A2-21 Removing Transfer Support Plate and Intermediate Servo Return Spring

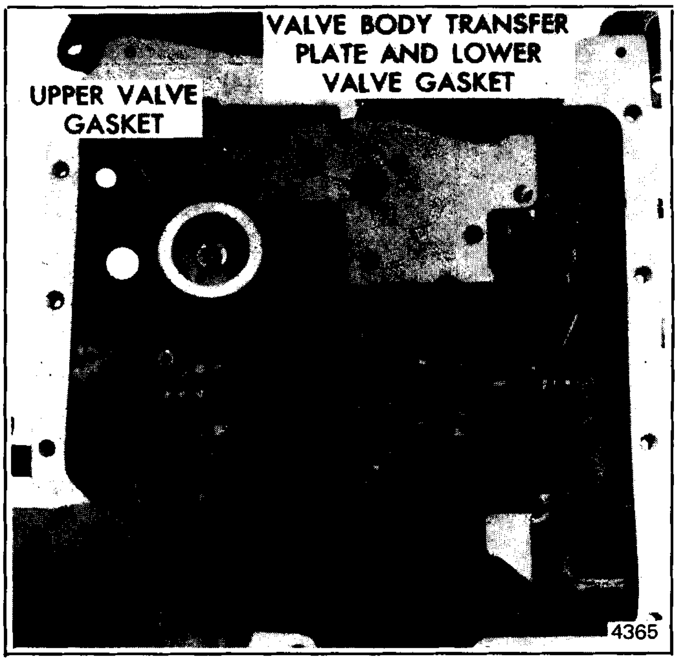


Fig. 7A2-22 Removing Valve Body Transfer Plate and Gasket

2. Install two (2) threaded slide hammers J 7004 into threaded holes in pump body and remove pump assembly from case (Fig. 7A2-34). Discard pump gasket.

3. Loosen nut and intermediate band anchor bolt (Fig. 7A2-35).

4. Remove intermediate band (Fig. 7A2-36).

5. Remove intermediate servo (Fig. 7A2-37) and disassembly as shown in Fig. 7A2-38.

6. Remove direct and forward clutch assemblies from case (Fig. 7A2-39). Refer to proper section for disassembly and reassembly of the direct and forward clutches.

7. Remove input ring gear front thrust washer (Fig. 7A2-40).

NOTE: Washer has 3 tangs.

8. Remove output carrier to output shaft snap ring (Fig. 7A2-41).

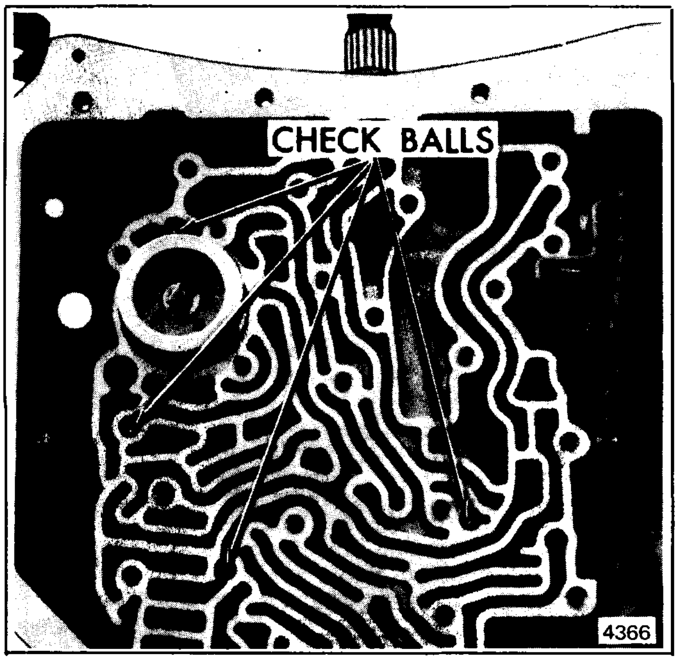


Fig. 7A2-23 Check Ball Four (4) Locations

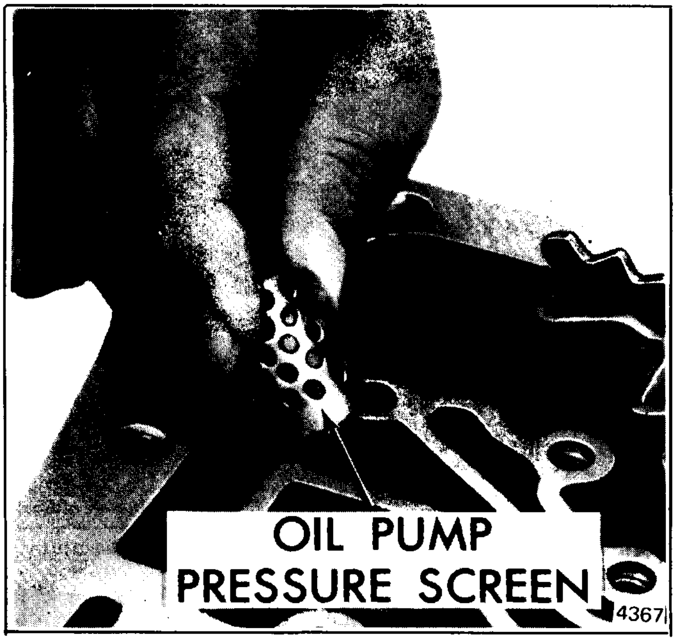


Fig. 7A2-24 Removing Oil Pump Pressure Screen

9. Remove input ring gear (Fig. 7A2-42).

10. Remove input ring gear rear (output carrier) thrust washer (Fig. 7A2-43).

11. Remove output carrier assembly (Fig. 7A2-44).

12. Remove sun gear drive shell assembly (Fig. 7A2-45).

13. Remove low and reverse roller clutch support to case retaining ring (Fig. 7A2-46).

14. Remove low and reverse clutch support and race assembly and anti-clunk spring.

15. Remove low and reverse clutch pack (Fig. 7A2-47).

16. Remove reaction carrier assembly from output ring gear and shaft assembly (Fig. 7A2-48).

17. Remove output ring gear and shaft assembly from case (Fig. 7A2-49).

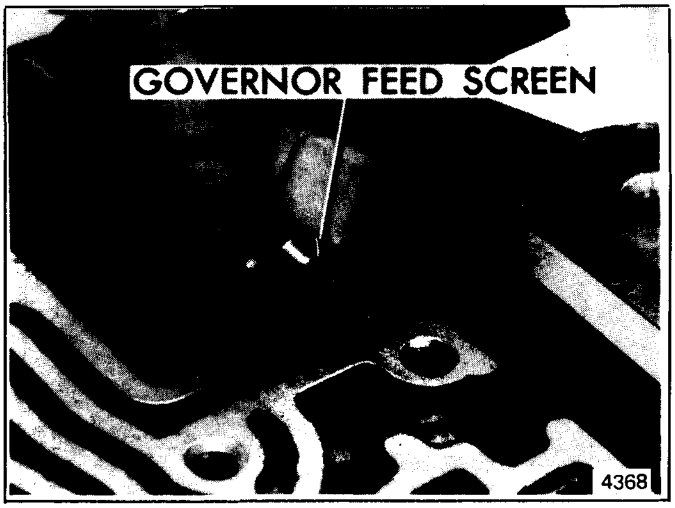


Fig. 7A2-25 Removing Governor Feed Screen

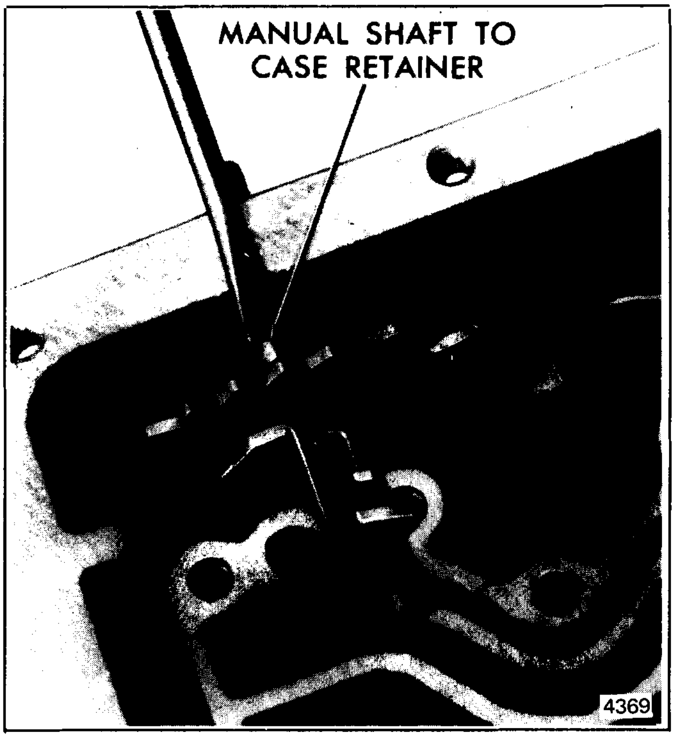


Fig. 7A2-26 Removing Manual Shaft to Case Retainer

18. Remove reaction carrier to output ring gear tanged (front) thrust washer (Fig. 7A2-50).

19. Remove output ring gear to case needle bearing assembly (Fig. 7A2-51).

20. Compress low and reverse clutch piston spring retainer using tool J 23327 and remove piston retaining ring and spring retainer (Fig. 7A2-52).

21. Remove seventeen (17) piston springs from piston (Fig. 7A2-53).

22. Remove low and reverse clutch piston assembly by applying compressed air in passage (Fig. 7A2-54).

23. Remove low and reverse clutch piston outer seal (Fig. 7A2-55).

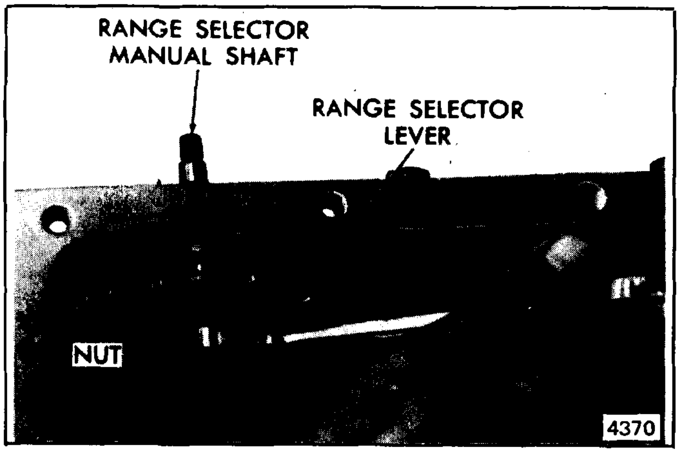


Fig. 7A2-27 Loosening Nut Holding Selector Lever to Manual Shaft

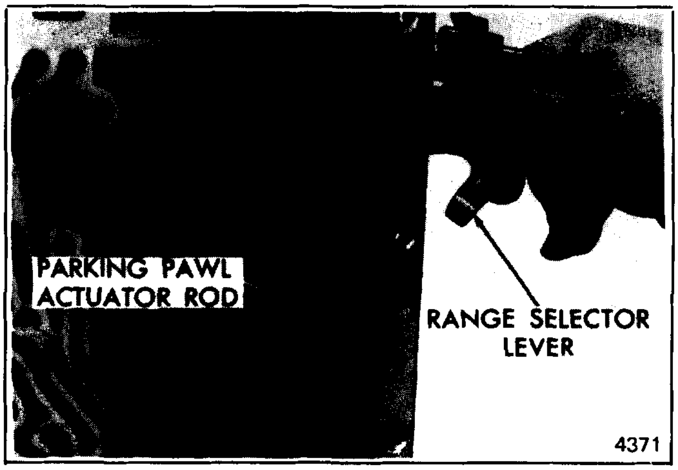


Fig. 7A2-28 Removing Selector Lever and Actuator Rod

24. Remove low and reverse clutch piston center and inner seal (Fig. 7A2-56).
25. Install tool J 23069 to compress 1-2 accumulator piston cover and remove retaining ring (Fig. 7A2-57).
26. Remove 1-2 accumulator piston cover. Remove "O" ring seal from case (Fig. 7A2-58).
27. Remove 1-2 accumulator piston spring.
28. Remove 1-2 accumulator piston assembly.

Also remove inner and outer hook type oil seal rings from piston, if required.

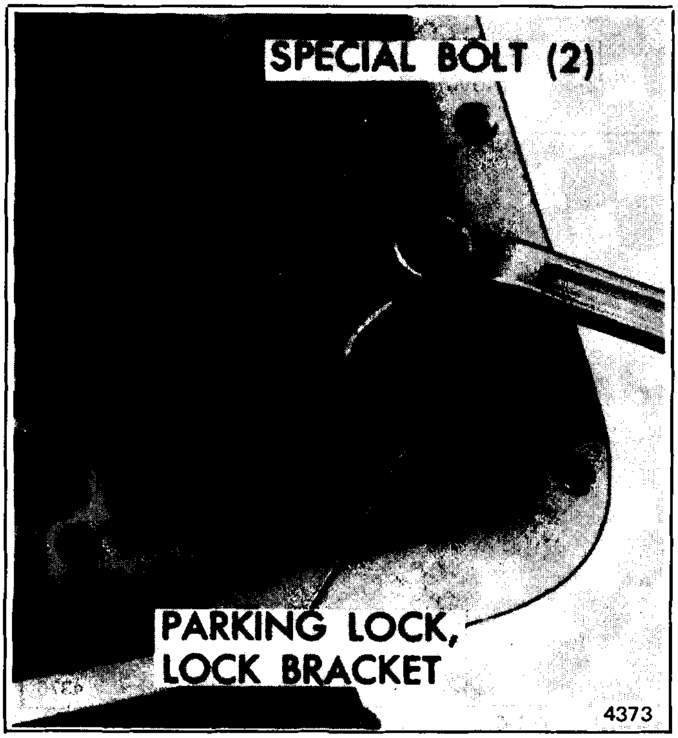


Fig. 7A2-30 Removing Parking Lock, Lock Bracket

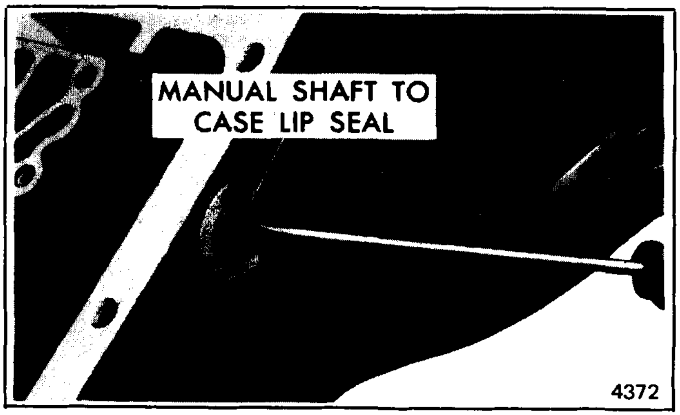


Fig. 7A2-29 Removing Manual Shaft to Case Lip Seal

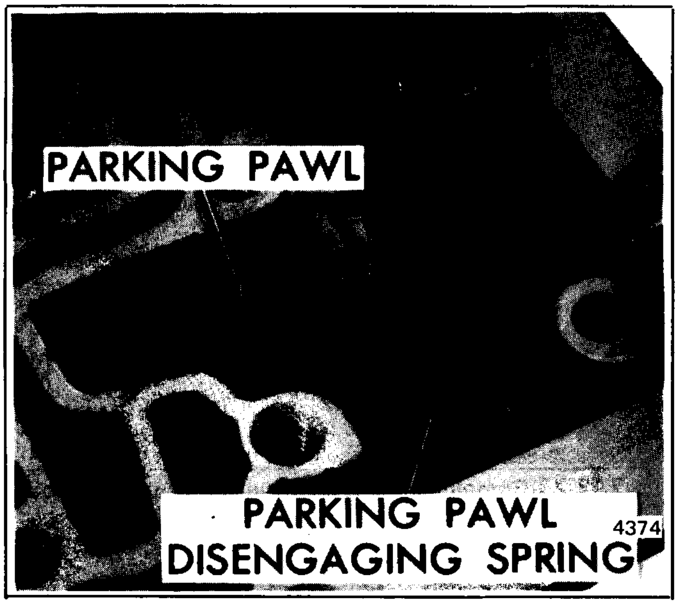


Fig. 7A2-31 Removing Parking Pawl Disengaging Spring

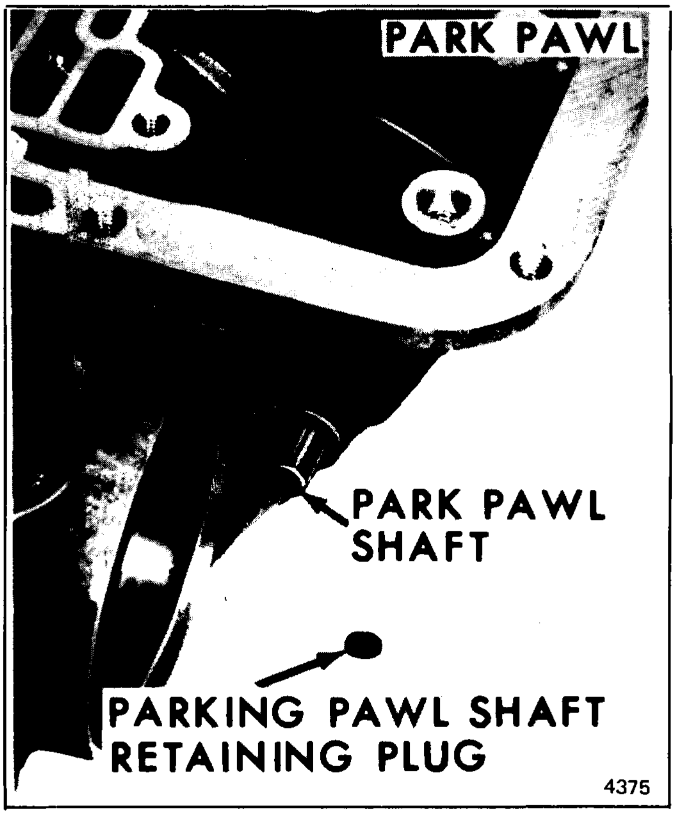


Fig. 7A2-32 Parking Pawl Shaft Retaining Plug, Park Pawl Shaft and Park Pawl

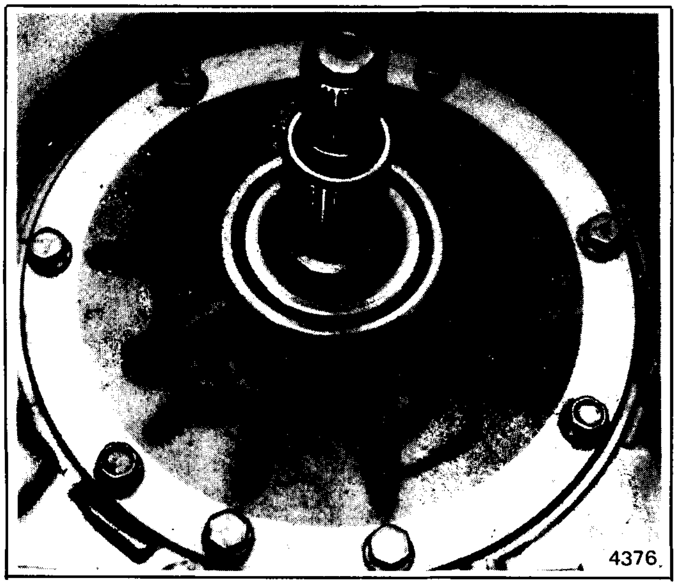


Fig. 7A2-33 Oil Pump Attaching Bolts

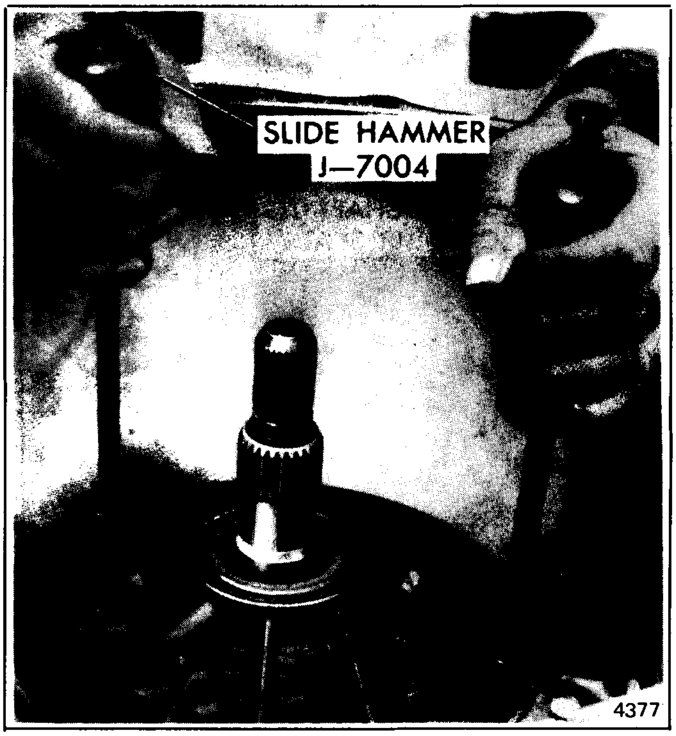


Fig. 7A2-34 Removing Oil Pump From Case

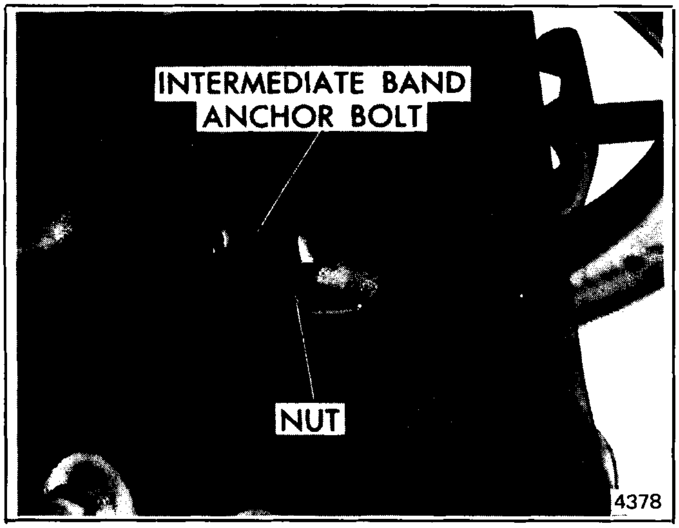


Fig. 7A2-35 Intermediate Band Anchor Bolt and Nut

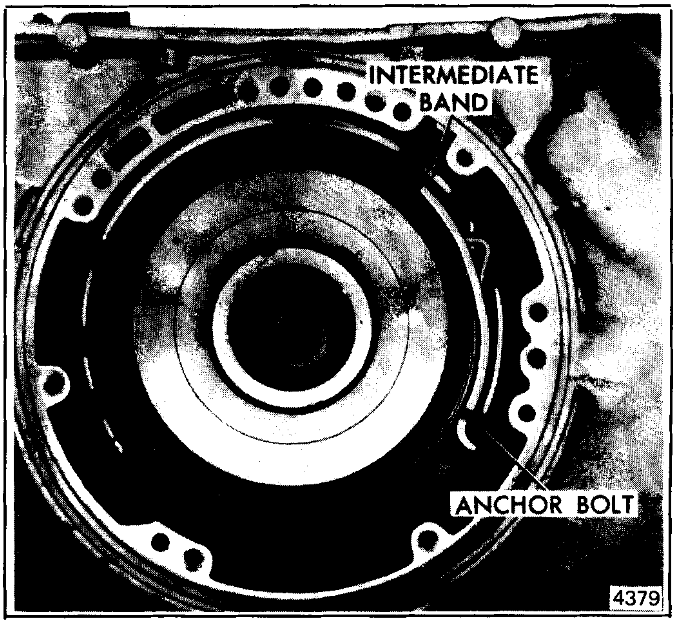


Fig. 7A2-36 Intermediate Band

Fig. 7A2-37 Removing Intermediate Servo

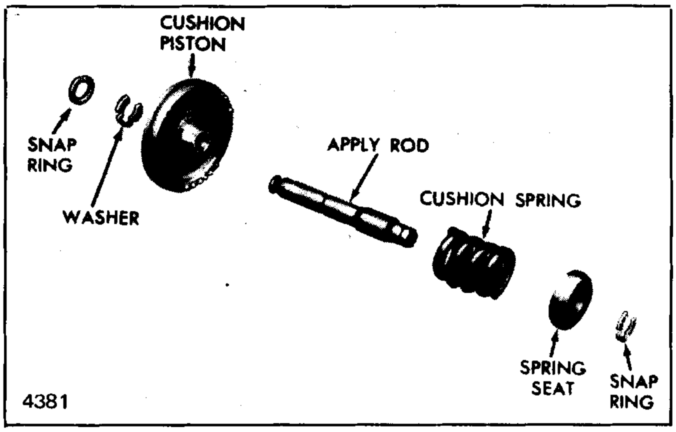


Fig. 7A2-38 Intermediate Servo

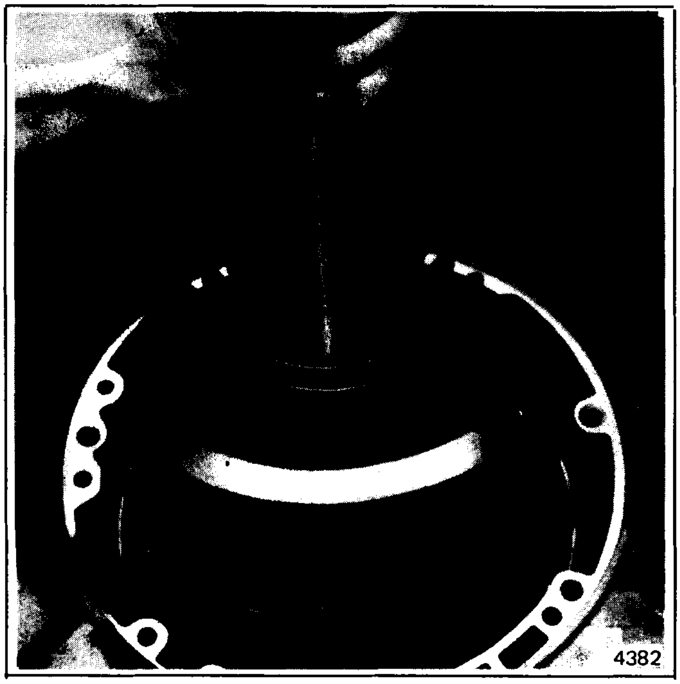


Fig. 7A2-39 Removing Direct and Forward Clutch Assemblies

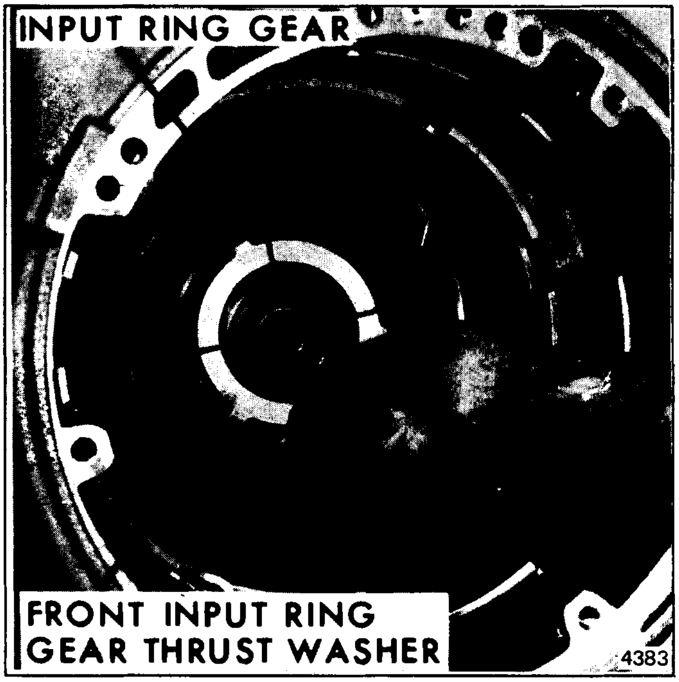


Fig. 7A2-40 Removing Input Ring Gear Front Thrust Washer

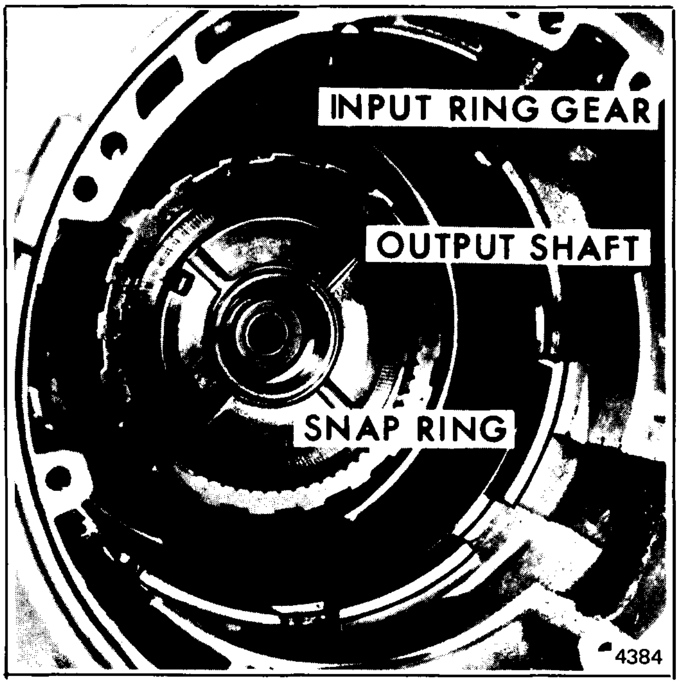


Fig. 7A2-41 Removing Output Carrier to Output Shaft Snap Ring

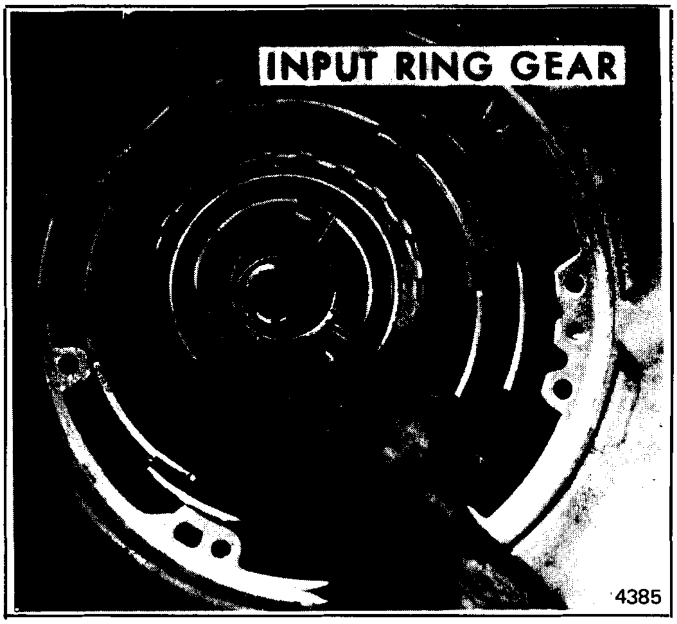


Fig. 7A2-42 Removing Input Ring Gear

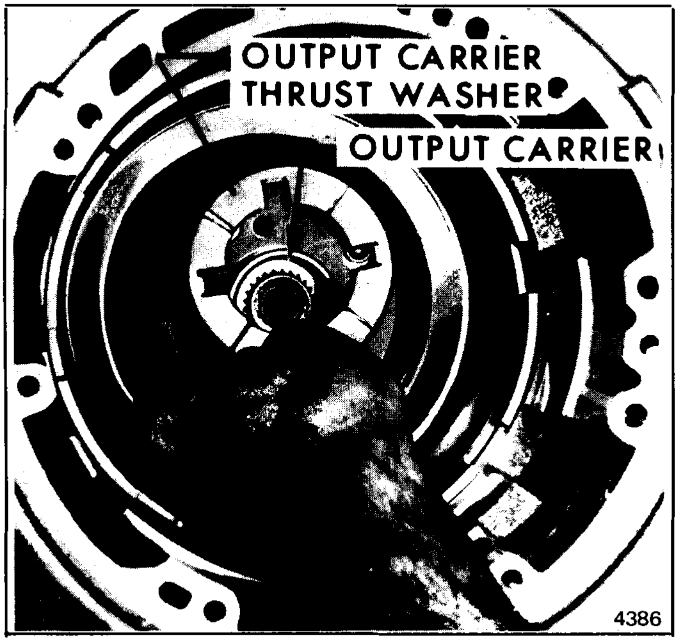


Fig. 7A2-43 Removing Input Ring Gear Rear Thrust Washer

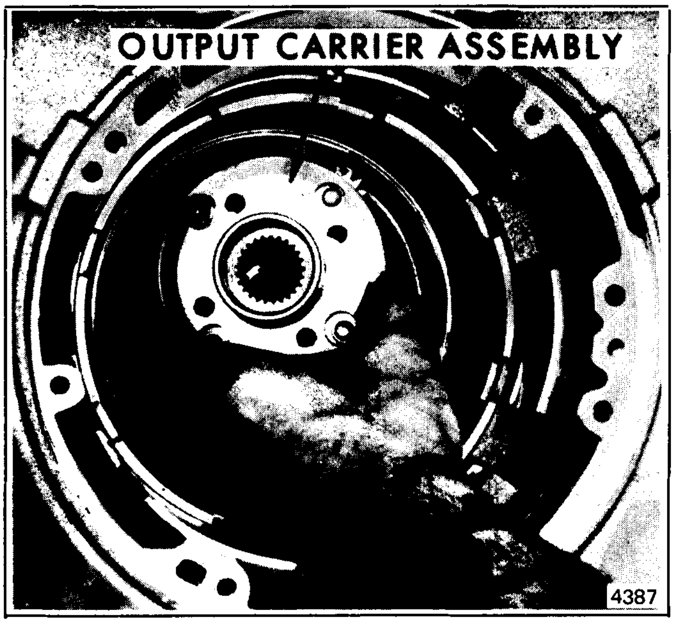


Fig. 7A2-44 Removing Output Carrier Assembly

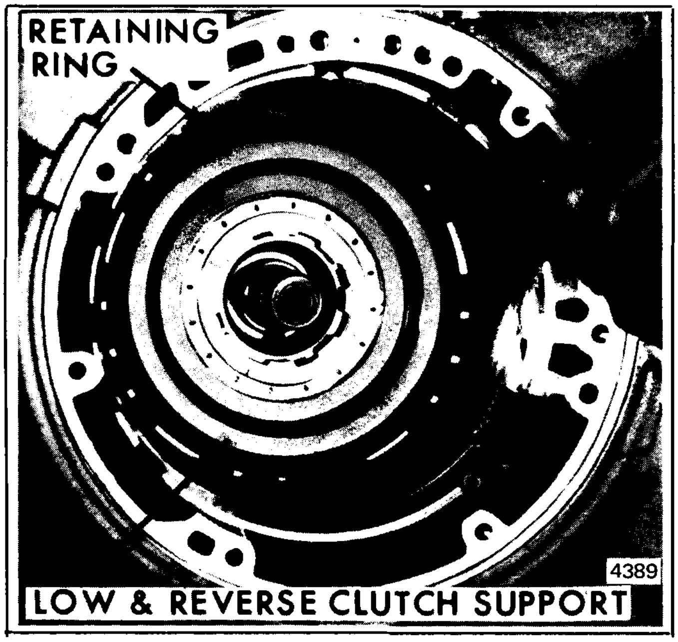


Fig. 7A2-46 Removing Low and Reverse Clutch Support Retaining Ring

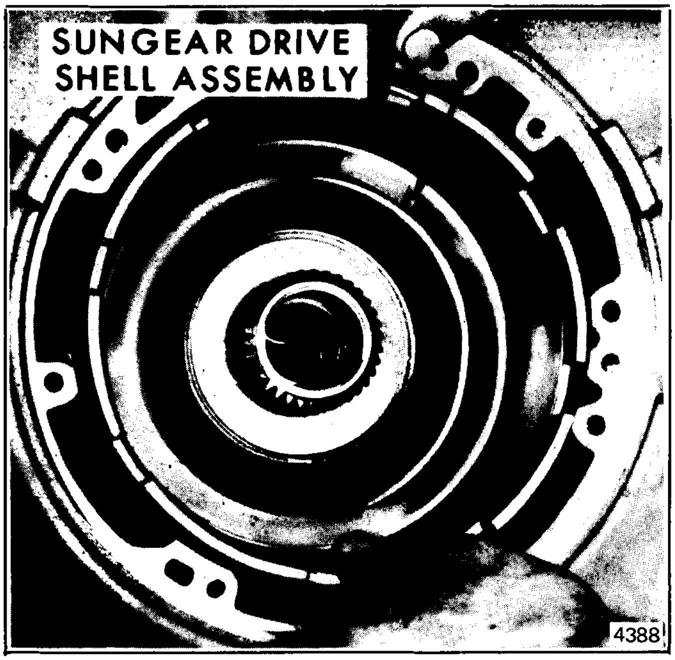


Fig. 7A2-45 Removing Sun Gear Drive Shell

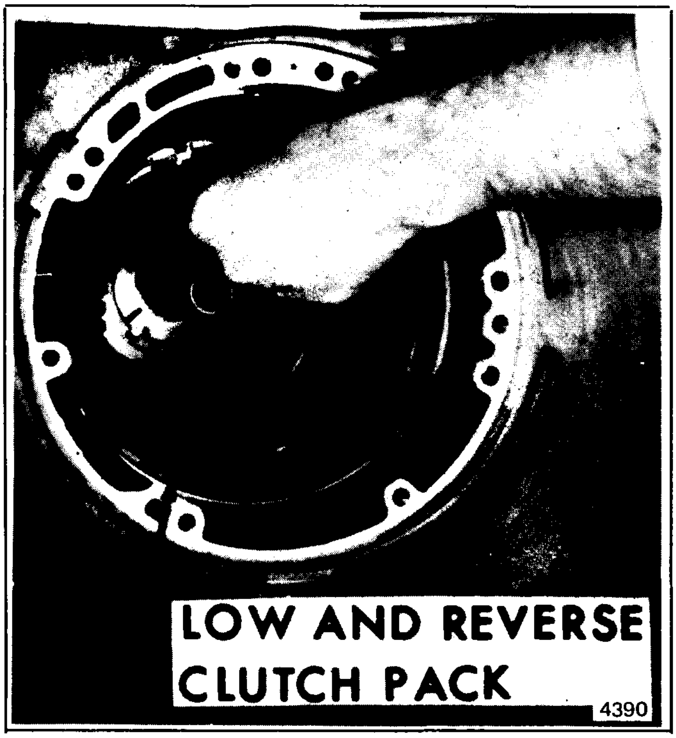


Fig. 7A2-47 Removing Low and Reverse Clutch Pack

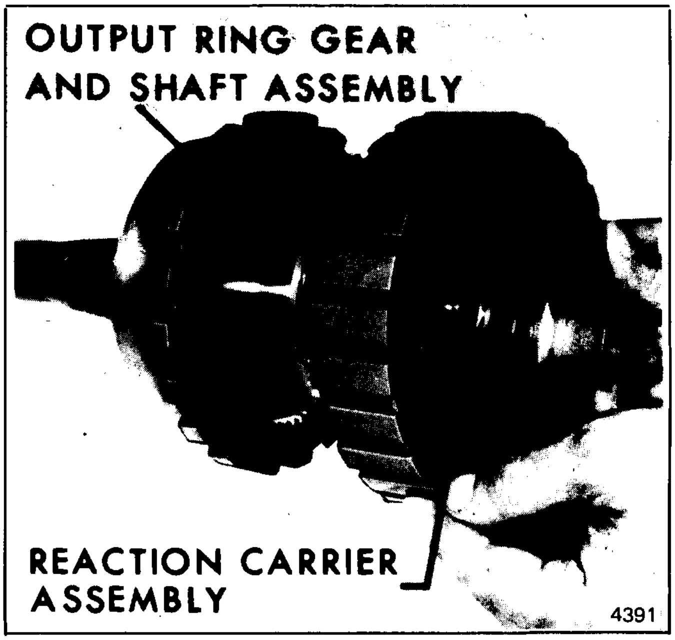


Fig. 7A2-48 Removing Reaction Carrier Assembly

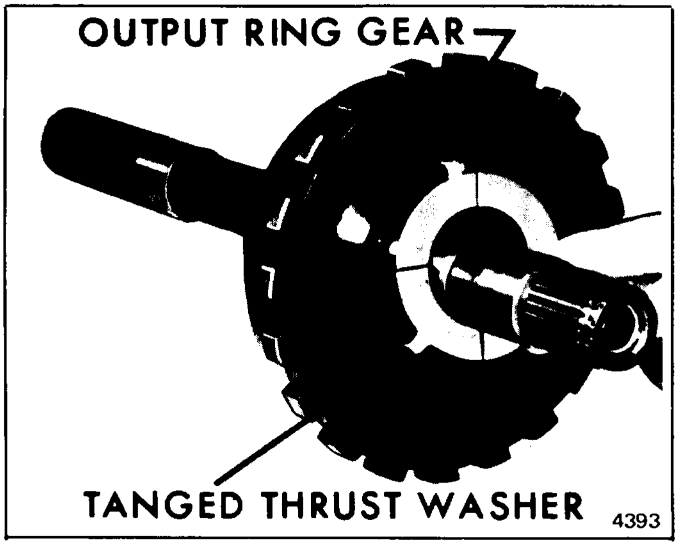


Fig. 7A2-50 Removing Output Ring Gear Tanged Thrust Washer

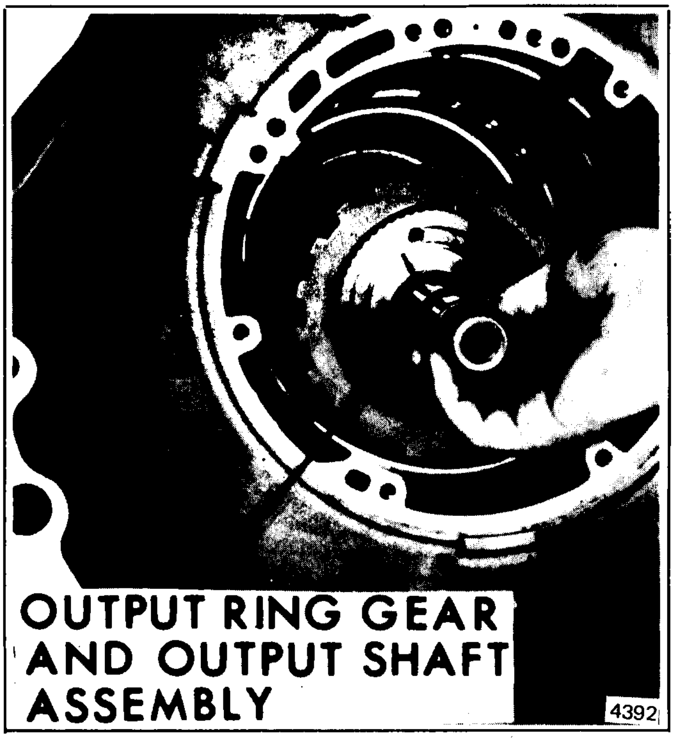


Fig. 7A2-49 Removing Output Ring Gear and Shaft Assembly

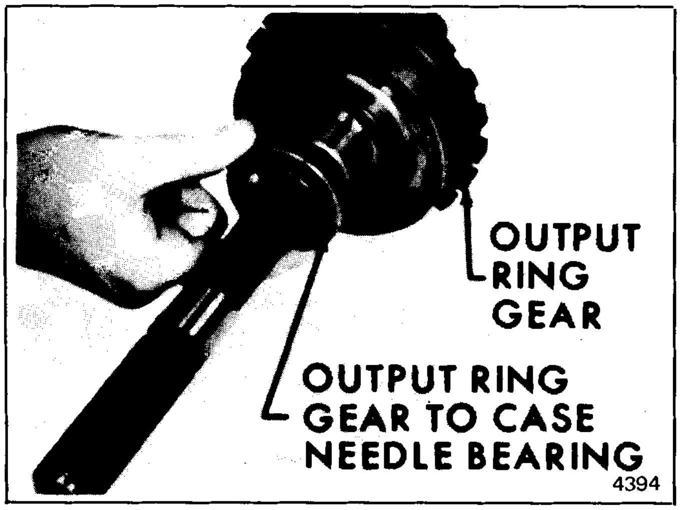


Fig. 7A2-51 Removing Output Ring Gear to Case Needle Bearing Assembly

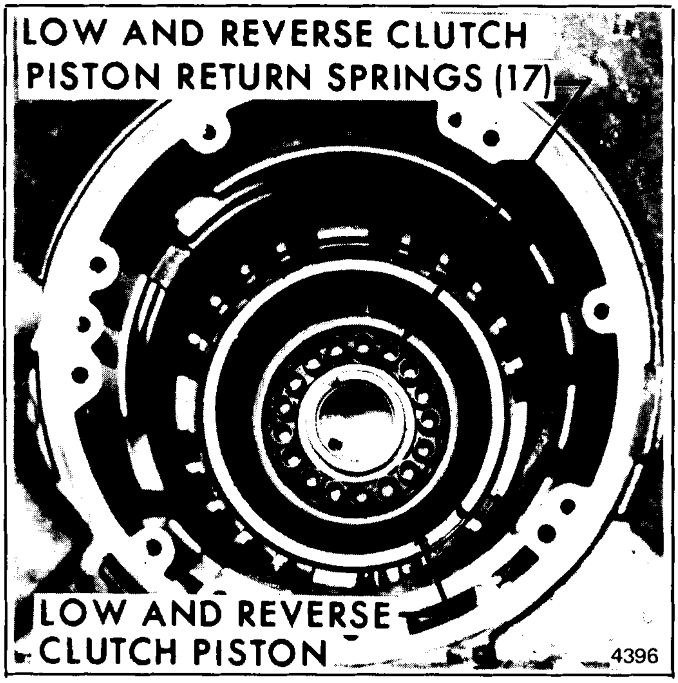


Fig. 7A2-53 Low and Reverse Clutch Piston Springs and Piston

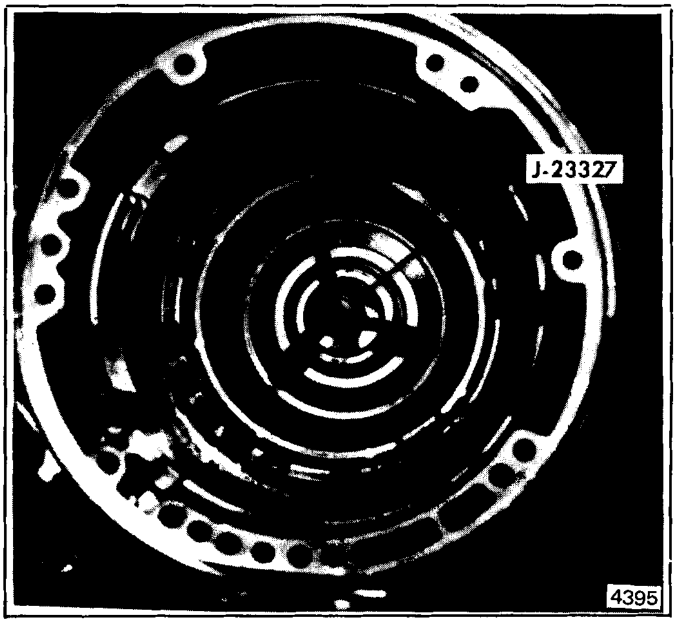


Fig. 7A2-52 Compressing Low and Reverse Clutch Piston Spring Retainer

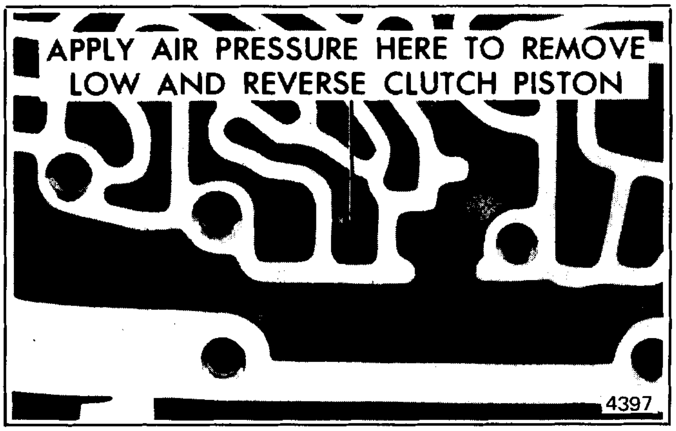


Fig. 7A2-54 Removing Low and Reverse Clutch Piston

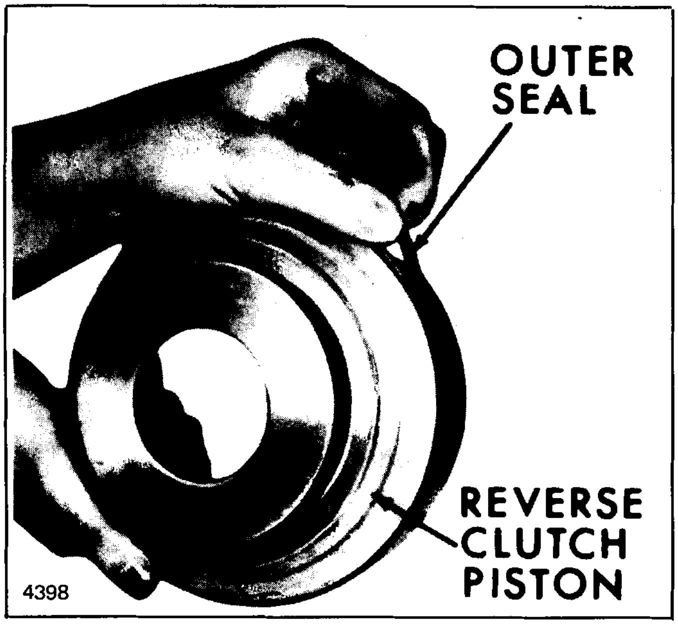


Fig. 7A2-55 Removing Low and Reverse Clutch Piston Outer Seal

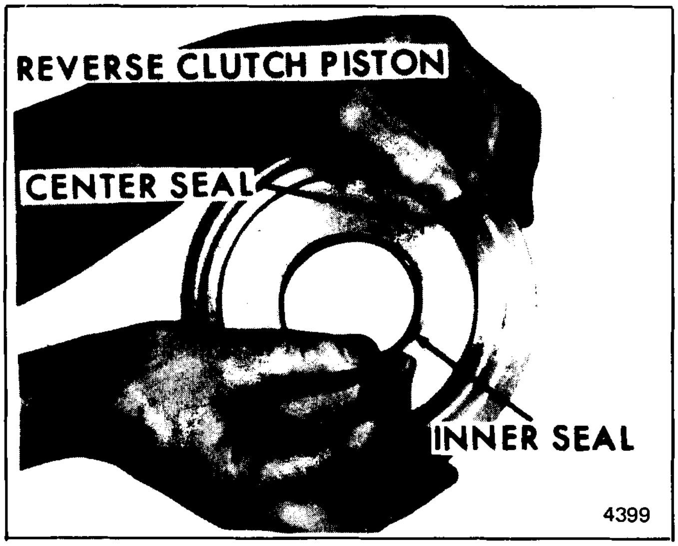


Fig. 7A2-56 Removing Low and Reverse Clutch Piston Center and Inner Seal

VALVE BODY (FIG. 7A2-59)

Disassembly

1. Position valve body assembly with cored face up and direct clutch accumulator piston pocket positioned.

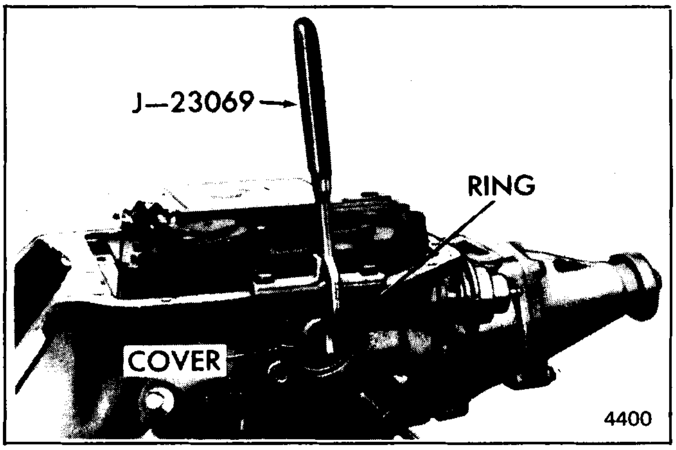


Fig. 7A2-57 Compressing 1-2 Accumulator Piston Cover

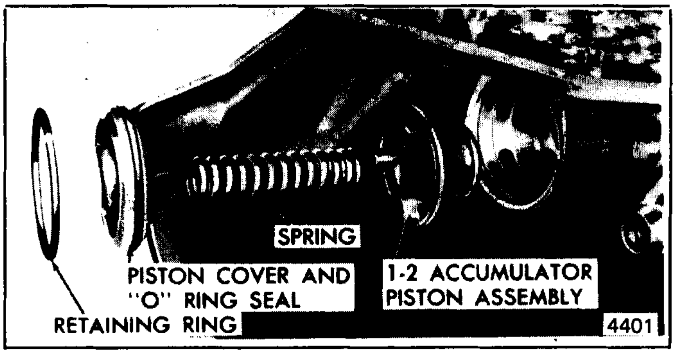


Fig. 7A2-58 1-2 Accumulator Assembly - Exploded View

2. Remove manual valve from lower left hand bore.

3. From lower right hand bore, remove pressure regulator valve train retaining pin, boost valve sleeve, intermediate boost valve, reverse and modulator boost valve, pressure regulator valve spring and pressure regulator valve.

4. From next bore, remove 2-3 shift valve train retaining pin, control valve sleeve, control valve spring, 2-3 shift control valve, shift valve spring and 2-3 shift valve.

5. From next bore, remove the 1-2 shift valve train retaining pin, control valve sleeve, control valve spring, 1-2 shift control valve and 1-2 shift valve.

6. From next bore, remove retaining pin, plug, manual low control valve spring and manual low control valve.

7. From next bore, remove retaining pin, detent regulator valve spring, spring seat and detent regulator valve.

8. From bore on opposite side, remove detent actuating lever bracket bolt, bracket, stop, spring retainer, seat, outer spring, inner spring, washer and detent valve.

Inspection

1. Inspect all valves for scoring, cracks and free movement in their respective bores.

2. Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face.

3. Check all springs for distortion or collapsed coils.

Reassembly

1. Install detent valve, washer, outer spring, inner spring, spring seat, and spring retainer. Install detent valve stop and detent valve actuating bracket. Torque retaining bolt to 52 lb. in.

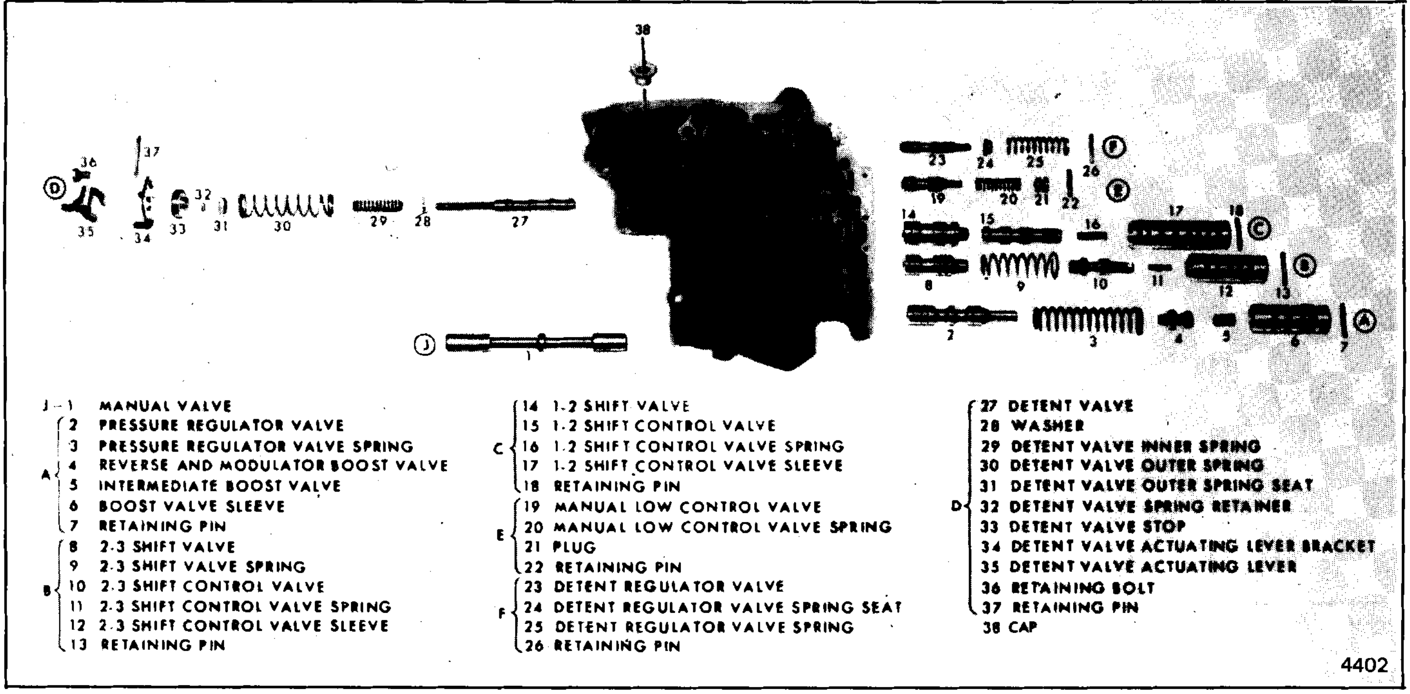


Fig. 7A2-59 Valve Body - Exploded View

2. In lower right hand bore, install pressure regulator valve, spring, reverse and modulator boost valve, intermediate boost valve, boost valve sleeve and retaining pin.

3. In next bore up, install 2-3 shift valve, shift valve spring, 2-3 shift control valve, spring, sleeve and retaining pin.

4. In next bore up, install 1-2 shift valve, 1-2 shift control valve, control valve spring, control valve sleeve and retaining pin.

5. In the next bore up, install manual low control valve, spring, plug and retaining pin.

6. In top right hand bore, install detent regulator valve, spring seat, spring and retaining pin.

OIL PUMP (FIG. 7A2-60)

Disassembly

1. Place pump cover and starter shaft assembly through hole in bench.

2. Remove pump cover to body attaching bolts (Fig. 7A2-61).

3. Remove two (2) forward clutch to pump hub hook-type oil seal rings and three (3) direct clutch to pump hook-hub type oil rings (Fig. 7A2-62).

4. Remove pump cover to direct clutch drum housing selective thrust washer.

5. Remove pump cover and stator shaft assembly from pump body (Fig. 7A2-63).

6. Mark drive and driven gears for reassembly in same position and remove gears from pump body.

7. Remove pump outside diameter to case (square cut) "O" ring seal. Discard seal.

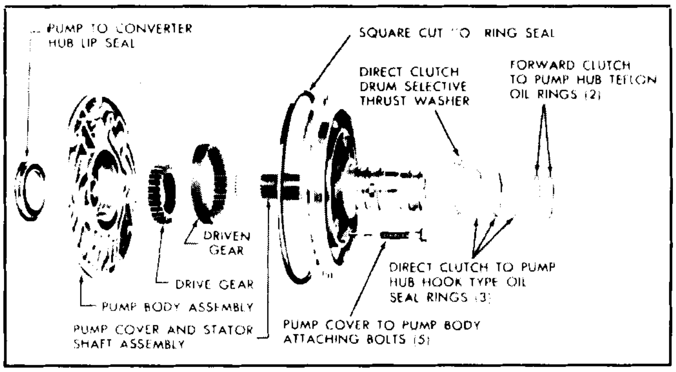


FIG. 7A2-60 OIL PUMP ASSEMBLY - EXPLODED VIEW

Inspection

1. Wash all parts in cleaning solvent and blow out all oil passages. DO NOT USE RAGS TO DRY PARTS.

CAUTION: *Some solvents may be harmful to rubber seals.*

2. Inspect pump gears for nicks or damage.

3. Inspect body and cover faces for nicks or scoring. Inspect cover hub O.D. for nicks or burrs which might damage clutch drum bushing journal.

4. Inspect body bushing for galling or scoring. Check clearance between body bushing and converter pump hub. Maximum clearance is .005". If bushing is damaged, oil pump body should be replaced.

5. Inspect converter housing hub O.D. for nicks or burrs which might damage pump seal or bushing. Repair or replace as necessary.

6. If hub lip seal is damaged or is leaking (and pump body is otherwise suitable for reuse), replace seal.

7. With parts clean and dry, place pump gears in pump body and check pump body face to gear face clearance.

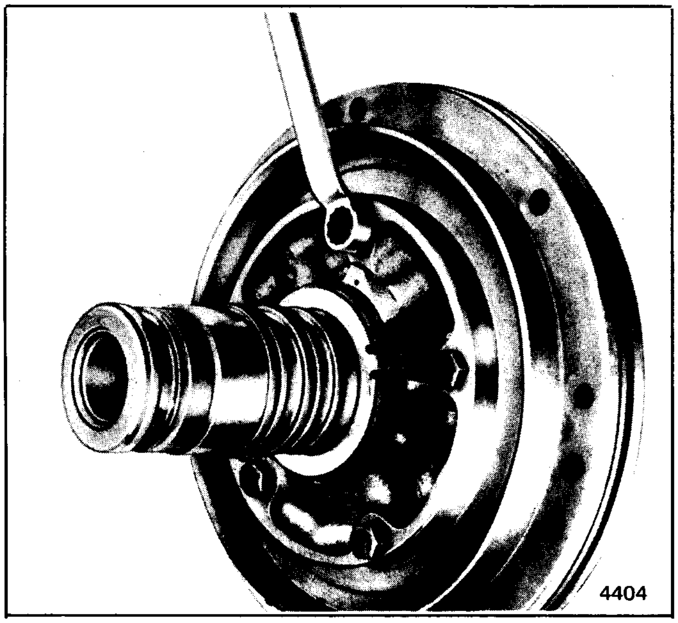


Fig. 7A2-61 Removing Pump Cover to Body Attaching Bolts

Fig. 7A2-62 Pump Hub Oil Seal Rings

Clearance should be .0005"-.0015" (Fig. 7A2-64).

Reassembly

1. Replace hub lip seal if defective in the following manner:

a. Place pump body on wood blocks and pry out defective seal (Fig. 7A2-65).

b. Coat outer diameter of new seal with a non-hardening sealer and install, using seal installer J 21359 to seat fully in counterbore (Fig. 7A2-66).

2. Install pump drive and driven griven gears into pump body with alignment marks up.

3. Install direct clutch drum selective thrust washer over pump cover delivery sleeve.

4. Install three (3) direct clutch to pump hub hook-type oil seal rings. Install two (2) forward clutch to pump hub hook-type oil seal rings.

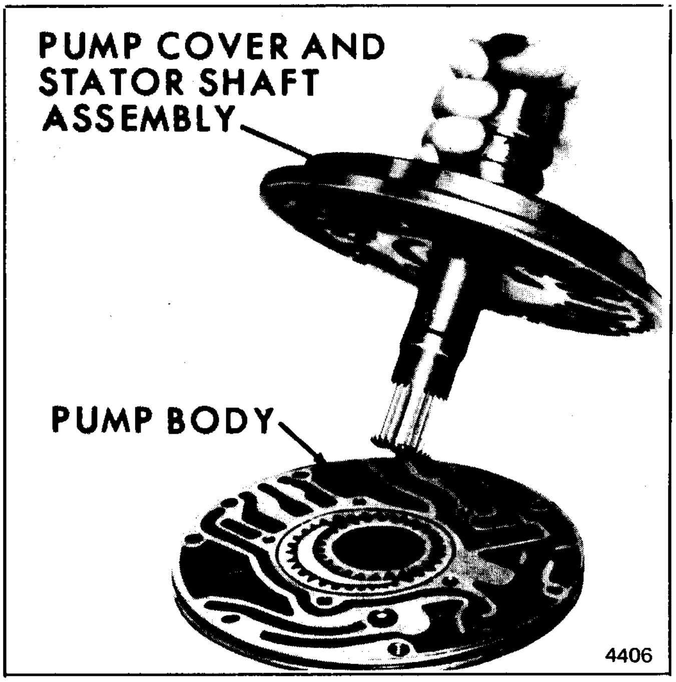


Fig. 7A2-63 Removing Pump Cover From Pump Body

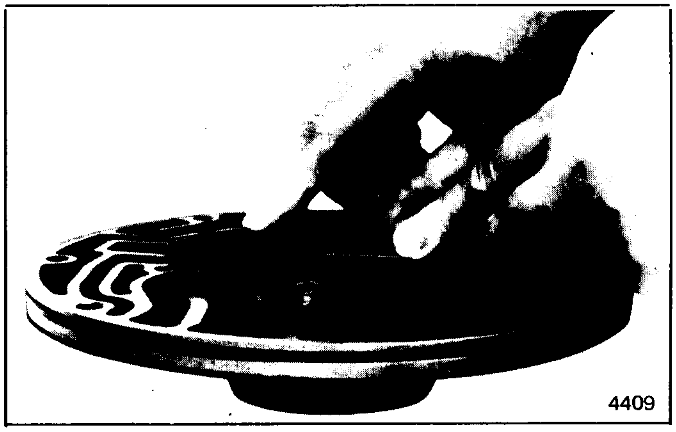


Fig. 7A2-64 Checking Pump Body Face to Gear Face Clearance

CAUTION: *Check pump cover and body oil passages to make sure they are not restricted (Figs. 7A2-68 and 7A2-69).*

5. Install pump outside diameter to case (square cut) "O" ring seal.

6. Align pump body to cover and install five (5) attaching bolts. Tighten bolts to 18 lb. ft.

DIRECT CLUTCH (FIG. 7A2-70)

Disassembly

1. Remove direct clutch pressure plate to clutch drum retaining ring and pressure plate (Fig. 7A2-71).

2. Remove three lined drive plates and three steel driven plates (Fig. 7A2-72).

3. Using Compressor Tool J 23327-1, remove direct clutch piston return spring seat retaining ring, spring seat and seventeen (17) clutch return coil springs (Fig. 7A2-73).

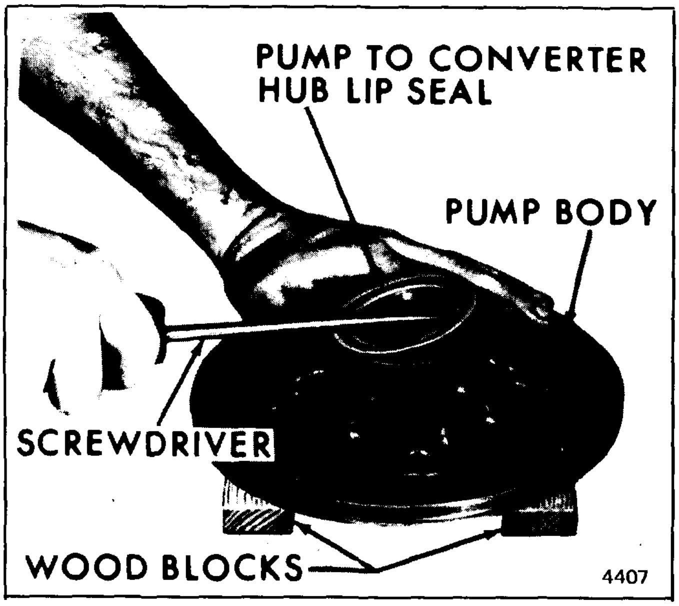


Fig. 7A2-65 Removing Oil Pump Hub Lip Seal

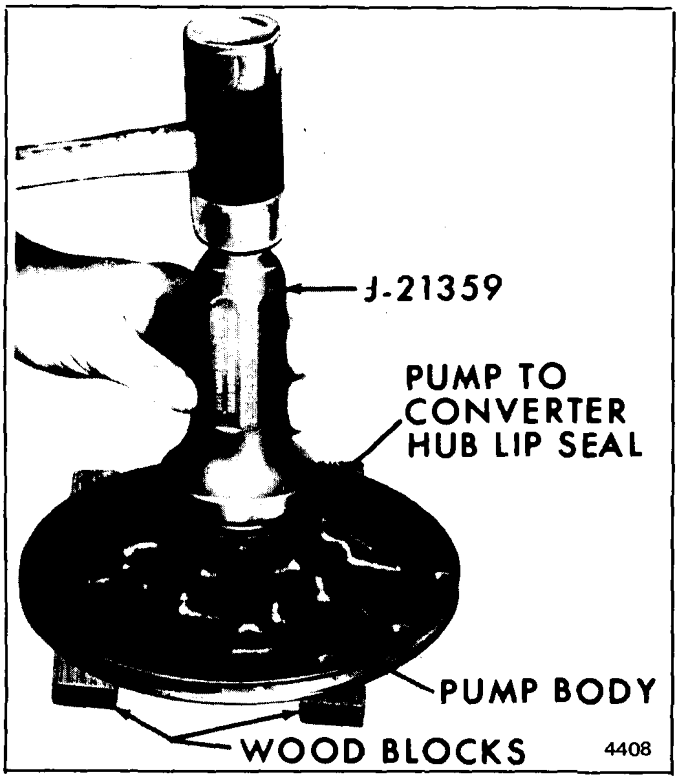


Fig. 7A2-66 Installing Oil Pump Hub Lip Seal

4. Remove direct clutch piston assembly.

5. Remove direct clutch piston outer seal and inner seal (Fig. 7A2-74).

6. Remove direct clutch piston center seal on drum (Fig. 7A2-75).

Inspection

1. Inspect drive and driven clutch plates for signs of burning, scoring or wear.

2. Inspect seventeen (17) springs for collapsed coils or signs of distortion.

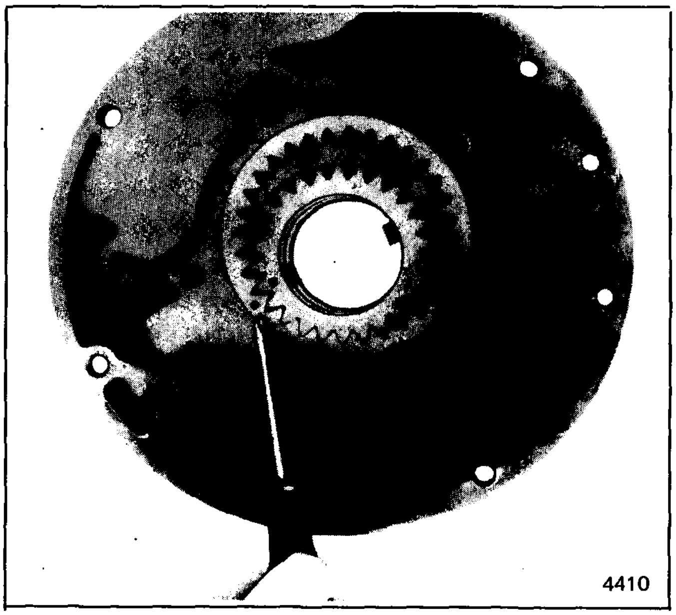


Fig. 7A2-67 Installing Pump Drive and Driven Gears

3. Inspect piston for cracks.

4. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check.

Reassembly

1. Install new direct clutch piston outer seal and inner seal.

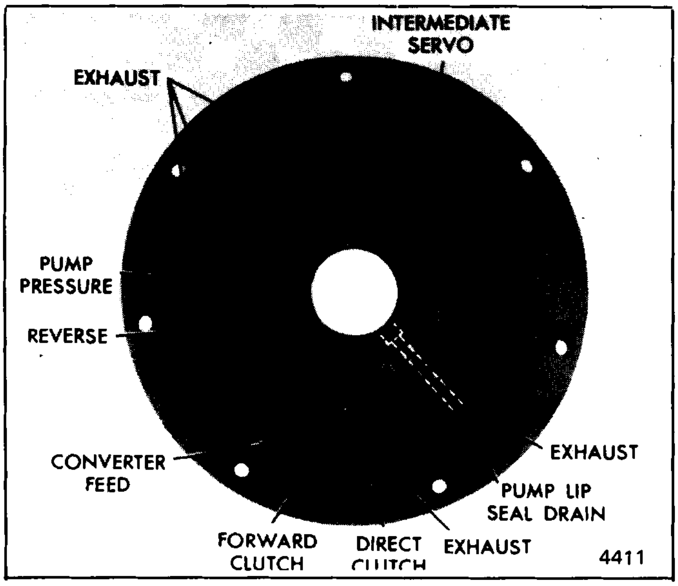


Fig. 7A2-68 Pump Body Oil Passages

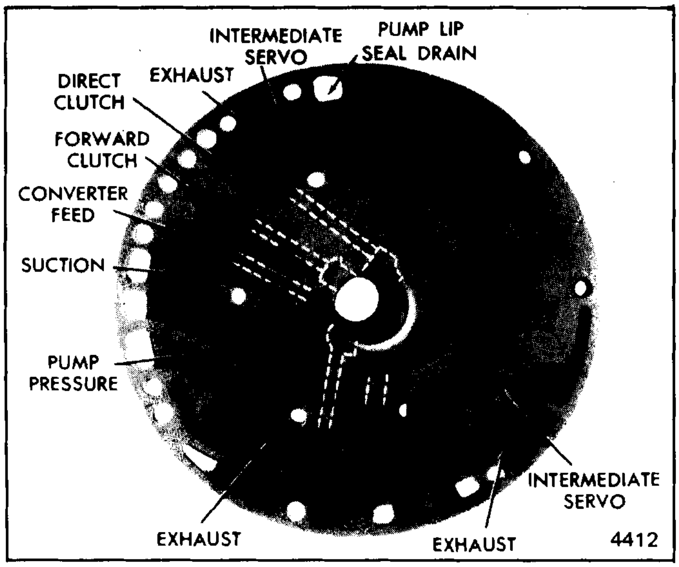


Fig. 7A2-69 Pump Cover Oil Passages

2. Install new direct clutch piston center seal on drum with lip facing upward.

3. Install direct clutch piston into housing with aid of a feeler gage or a piece of .020" piano wire crimped into copper tubing (Fig. 7A2-76).

4. Install seventeen (17) clutch return coil springs.

5. Install piston return spring seat and retaining ring. Compress spring seat with Tool J 23327 and engage retaining ring (Fig. 7A2-73).

6. Lubricate with transmission fluid and install face plates and steel separator plates, alternating steel and faced plates.

7. Install direct clutch pressure plate and retaining ring.

FORWARD CLUTCH (FIG. 7A2-77)

Disassembly

1. Remove direct clutch drum to forward clutch housing needle roller bearing (Fig. 7A2-78).

2. Remove forward clutch retaining ring and pressure plate (Fig. 7A2-79).

3. Remove four face plates, four steel separator plates and cushion spring (Fig. 7A2-80).

4. Using Tool J 23327-1, compress retainer and remove forward clutch drum to piston return seat retaining ring (Fig. 7A2-81).

5. Remove piston return seat and twenty-one (21) clutch return coil springs.

6. Remove forward clutch piston assembly.

7. Remove the forward clutch inner and outer piston seals (Fig. 7A2-82).

Inspection

1. Inspect drive and driven clutch plates for signs of burning, scoring or wear.

2. Inspect twenty one (21) springs for collapsed coils or signs of distortion.

3. Inspect piston for cracks.

4. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check exhaust (Fig. 7A2-83).

5. Inspect output shaft:

a. Inspect for open lubrication passages at each end.

b. Inspect splines for damage.

c. Inspect ground bushing journals for damage.

d. Inspect shaft for cracks or distortion.

NOTE: Input shaft and clutch housing are serviced separately.

Reassembly

1. Install new forward clutch inner piston seal and outer piston seal.

2. Install the forward clutch piston assembly (with the aid of a feeler gage or piece of .020" piano wire crimped into copper tubing (Fig. 7A2-84).

3. Install twenty-one (21) clutch return coil springs.

4. Install piston return seat. Compress return seat and install retaining ring, using Tool J 23327 as shown on Fig. 7A2-81.

5. Lubricate with transmission fluid and install cushion spring, face plates and steel separator plates, starting with the cushion spring and alternating steel and faced.

6. Using chart on Fig. 7A2-86 to select correct pressure plate (dimension C) to be used on assembly, measure distance from the top of clutch pack to the top of clutch drum (dimension A). Measure distance from the lower edge of the notch on the inner surface of the drum to the top of the drum (dimension B). Subtract B from A to get dimension C. Install selected pressure plate (indicated by dimension C) and retaining ring into forward clutch drum.

SUN GEAR AND SUN GEAR DRIVE SHELL (FIG. 7A2-86)

Disassembly

1. Remove sun gear to sun gear drive shell rear retaining ring (Fig. 7A2-87). Discard retaining ring.

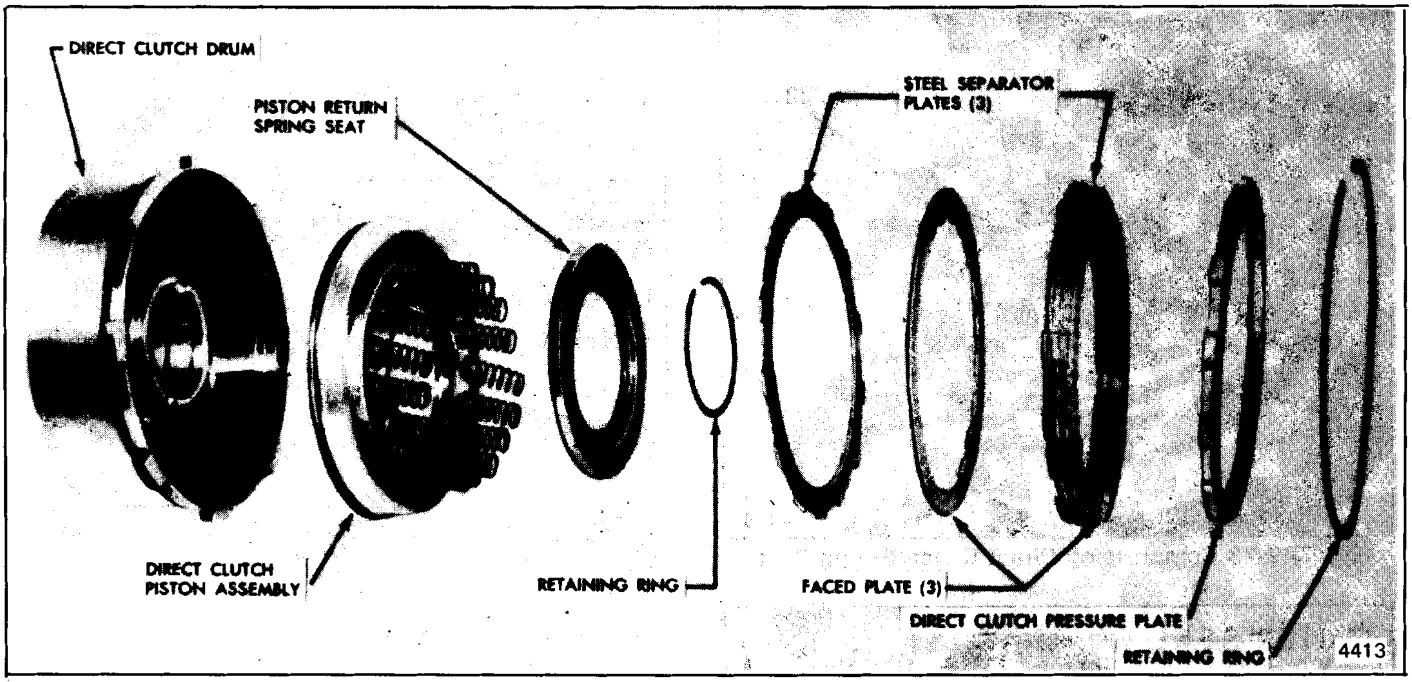


FIG. 7A2-70 DIRECT CLUTCH ASSEMBLY - EXPLODED VIEW

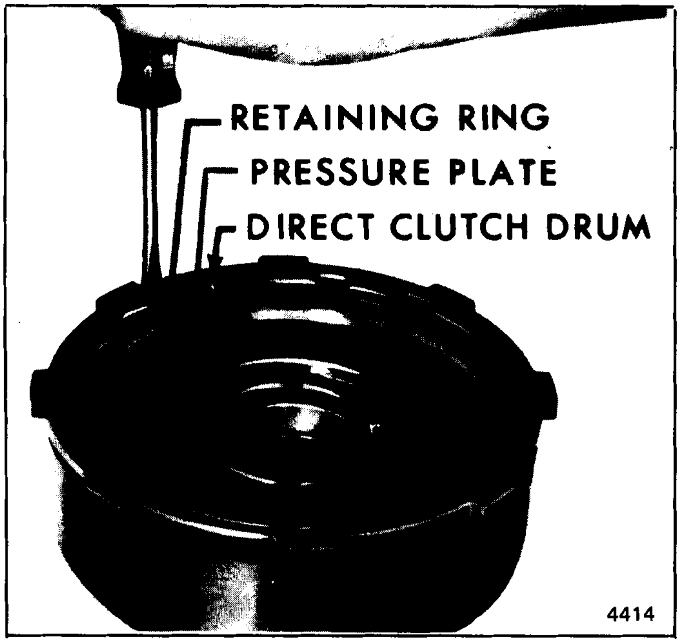


Fig. 7A2-71 Removing Direct Clutch Pressure Plate

2. Remove sun gear to drive shell flat rear steel thrust washer (Fig. 7A2-88).

3. Remove sun gear assembly from drive shell.

4. Remove sun gear to drive shell front retaining ring (Fig. 7A2-89). Discard retaining ring.

5. If bushing is to be replaced, refer to Bushing Replacement Replacement Section.

Inspection

Check gear and sun gear shell for damage or wear.

Reassembly

1. Install new sun gear to drive shell front retaining ring.

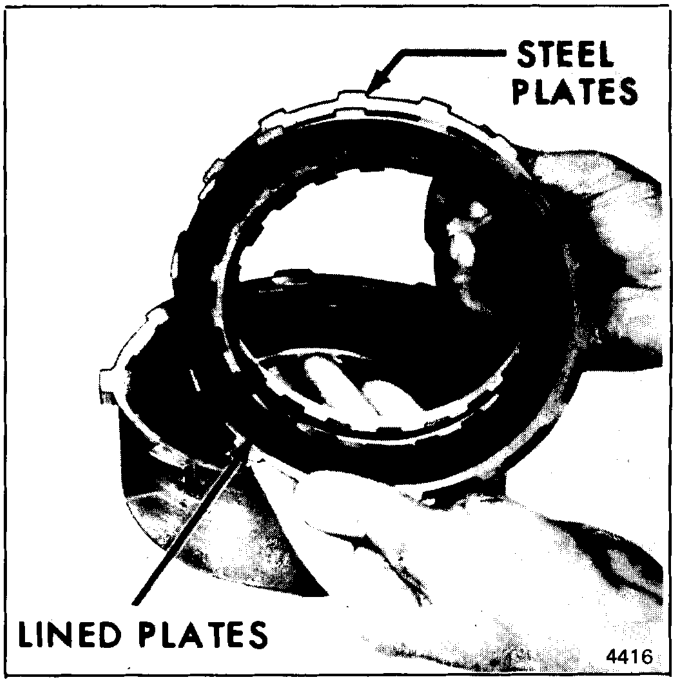


Fig. 7A2-72 Removing Lined and Steel Clutch Plates

2. Install sun gear assembly into drive shell.

3. Install sun gear to drive shell rear flat steel rear thrust washer.

4. Install new sung ear to sun gear drive shell rear retaining ring.

NOTE: Do not stress front and rear retaining rings at installation.

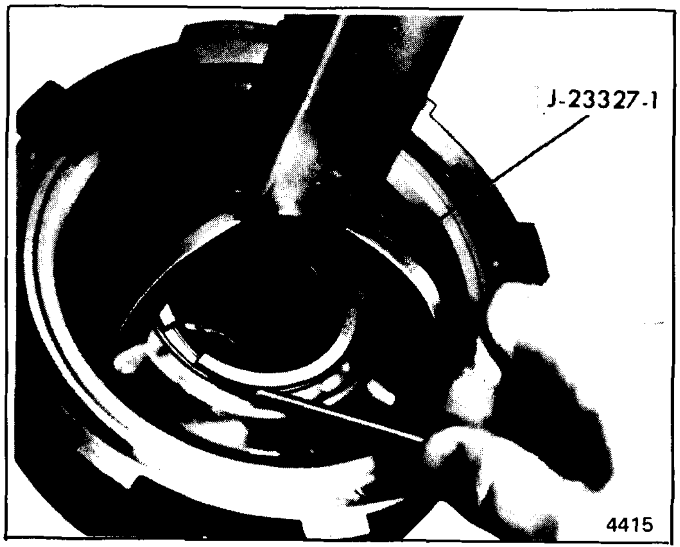


Fig. 7A2-73 Compressing Direct Clutch Spring Seat

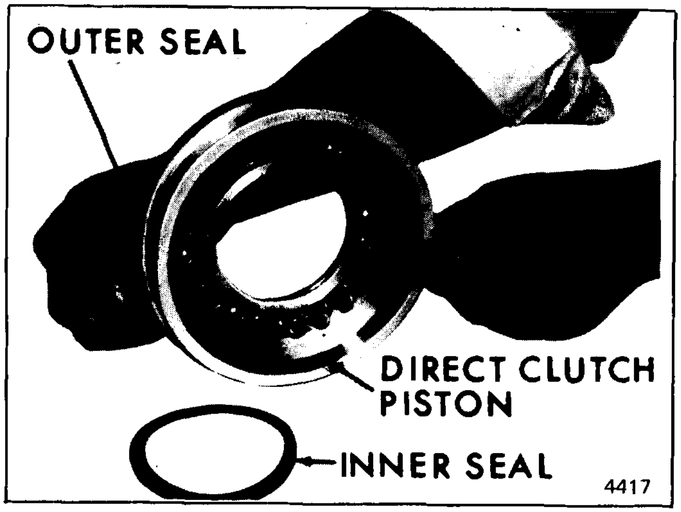


Fig. 7A2-74 Removing Direct Clutch Outer and Inner Seals

LOW AND REVERSE CLUTCH SUPPORT (FIG. 7A2-90)

Disassembly

1. Remove low and reverse clutch to sun gear shell thrust washer.
2. Remove low and reverse overrun clutch inner race from support (Fig. 7A2-91).
3. Remove low and reverse roller clutch retaining ring (Fig. 7A2-92).
4. Remove low and reverse roller clutch assembly from clutch support (Fig. 7A2-93).

Inspection

1. Inspect roller clutch support and inner race for scratches and indentations.
2. Inspect rollers for wear and roller springs for distortion.

Reassembly

1. Install low and reverse roller clutch assembly to inner race with oil holes toward rear of transmission.

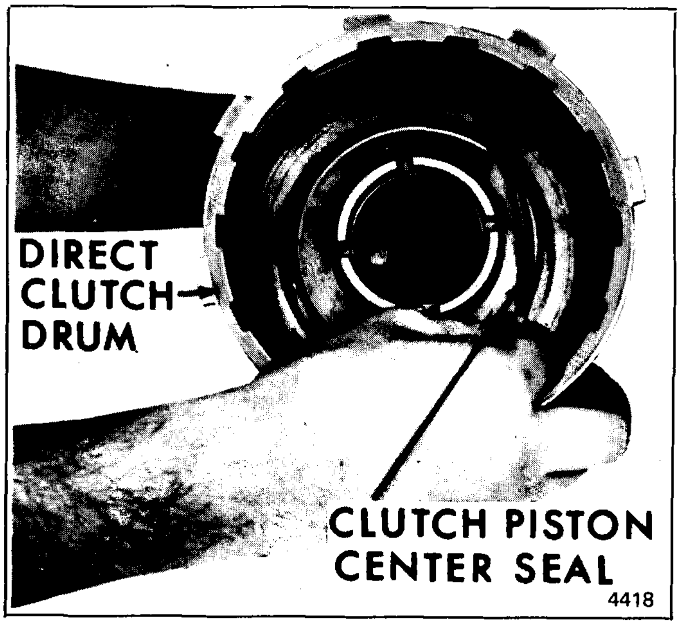


Fig. 7A2-75 Removing Direct Clutch Piston Center Seal

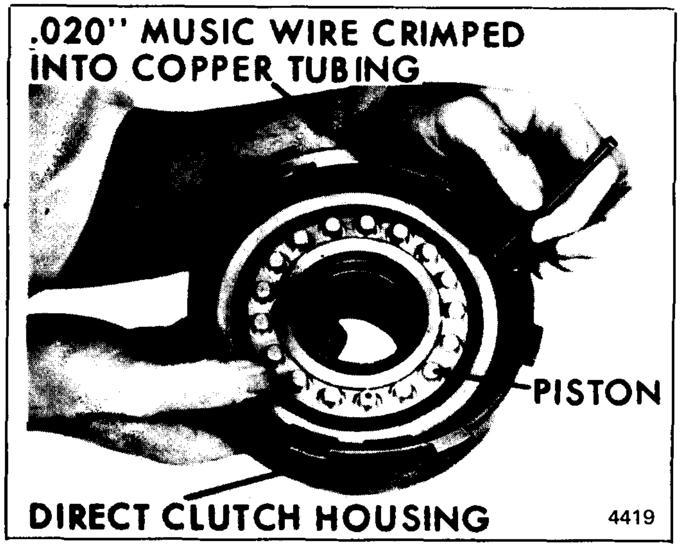


Fig. 7A2-76 Installing Direct Clutch Piston

2. Install low and reverse clutch support.
3. Install low and reverse clutch to cam retaining ring.

NOTE: Low and reverse overrun clutch inner race should free wheel in the clockwise direction only.

GOVERNOR ASSEMBLY (FIG. 7A2-94)

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including driven gear, is serviced as a complete assembly. The driven gear can also be serviced separately.

It is necessary to disassemble governor assembly in order to replace driven gear. Disassembly may also be necessary due to improper operation. In such cases, proceed as follows:

Disassembly

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights and springs. Governor weights are interchangeable from side to

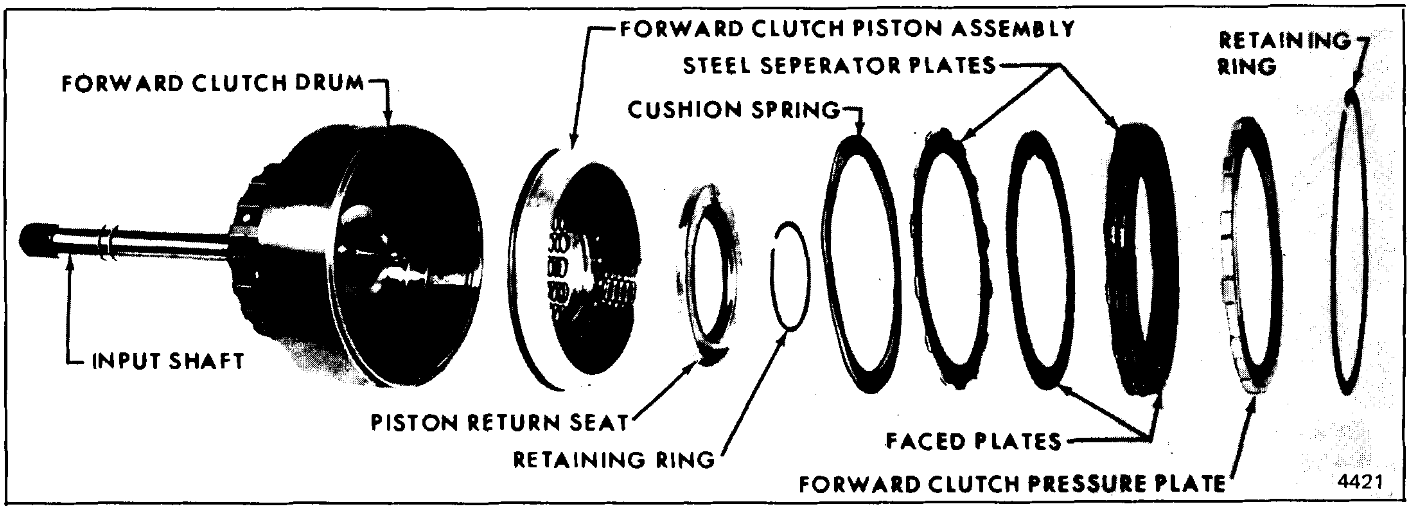


FIG. 7A2-77 FORWARD CLUTCH ASSEMBLY - EXPLODED VIEW

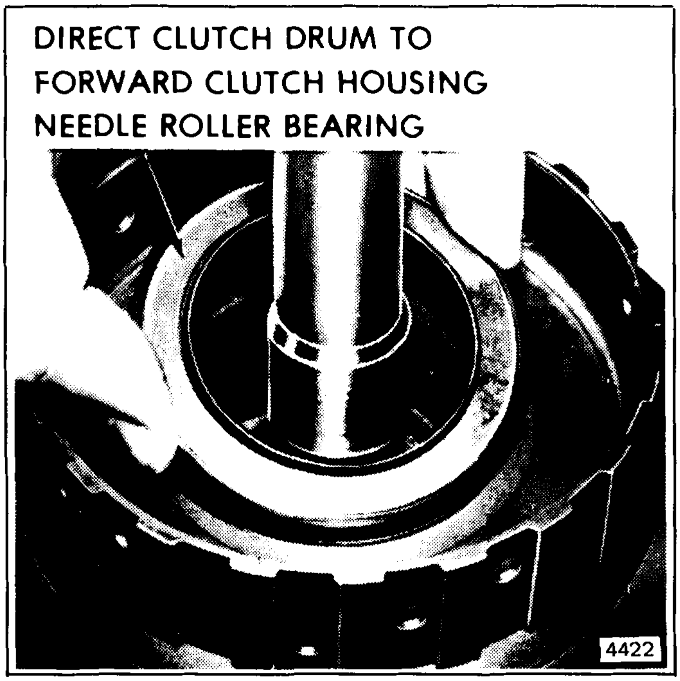


Fig. 7A2-78 Direct Clutch Drum to Forward Clutch Housing Needle Roller Bearing

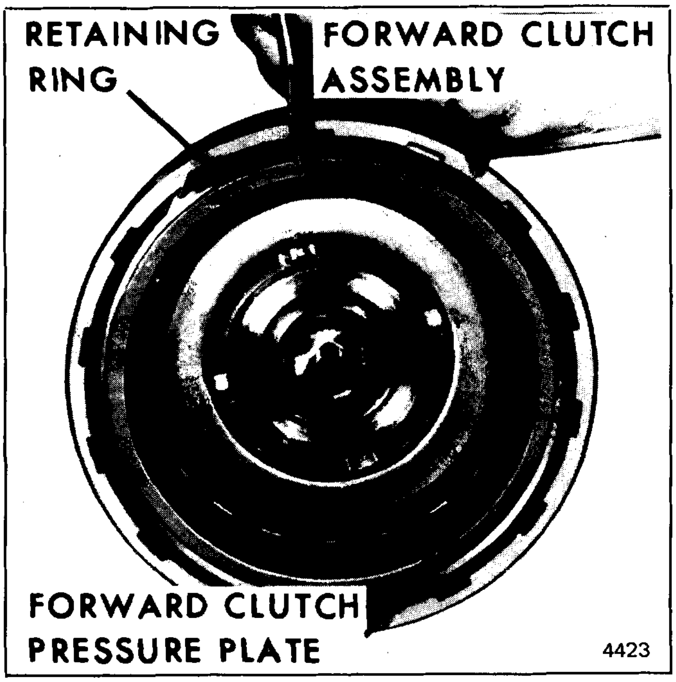


Fig. 7A2-79 Removing Forward Clutch Retaining Ring and Pressure Plate

side and need not be identified.

2. Remove governor valve from governor sleeve. Be careful not to damage valve.

3. Perform following inspections and replace governor driven gear, if necessary.

Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.

2. Inspect governor sleeve for nicks, burrs, scoring or galling.

3. Check governor sleeve for free operation in bore of transmission case.

4. Inspect governor valve for nicks, burrs, scoring or galling.

5. Check governor valve for free operation in bore of governor sleeve.

6. Inspect governor driven gear for nicks, burrs or damage.

7. Check governor driven gear for looseness on governor sleeve.

8. Inspect governor weight springs for distortion or damage.

9. Check governor weights for free operation in their retainers.

10. Check valve opening at entry and exhaust (.020 inch minimum).

GOVERNOR DRIVEN GEAR REPLACEMENT

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer

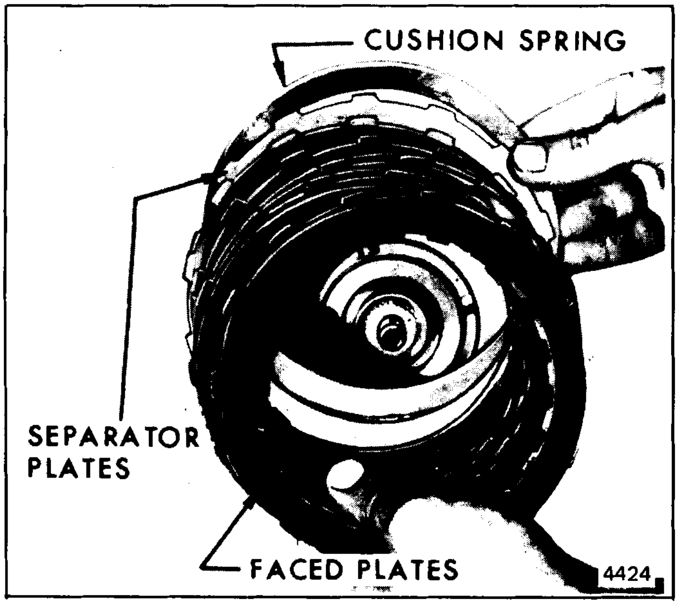


Fig. 7A2-80 Removing Forward Clutch Pack

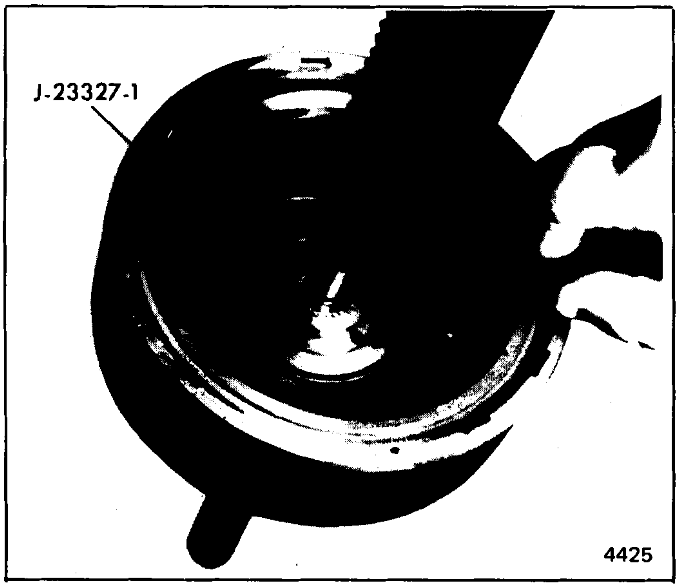


Fig. 7A2-81 Compressing Forward Clutch Spring Return Seat

split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin, using small punch.

2. Support governor on 3/16 inch plates installed in exhaust slots of governor sleeve, place in arbor press and, with a long punch, press gear out of sleeve.

3. Carefully clean governor sleeve of chips that remain from original gear installation.

4. Support governor on 3/16" plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.

5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard (1/8 inch) drill.

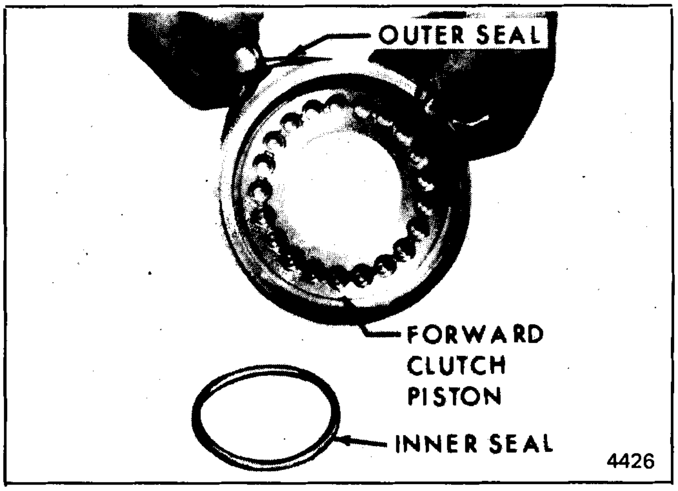


Fig. 7A2-82 Removing Forward Clutch Piston Inner & Outer Seals

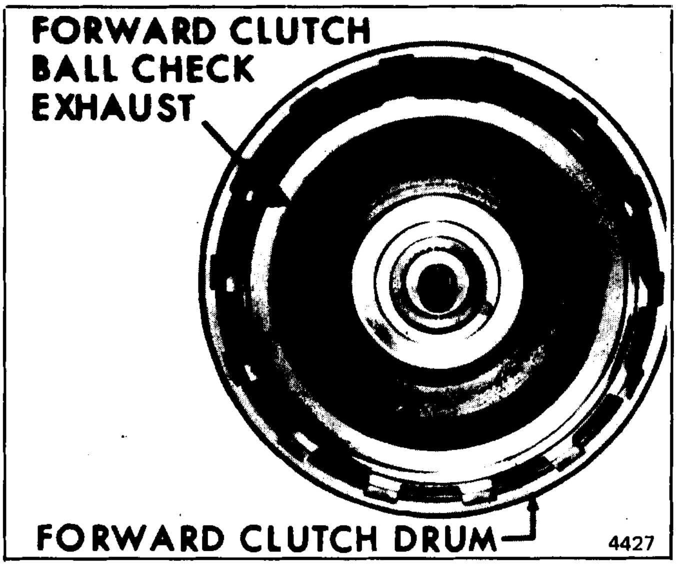


Fig. 7A2-83 Forward Clutch Ball Check Exhaust

6. Install split retaining pin.

7. Wash governor assembly thoroughly to remove any chips that may have collected.

Reassembly

1. Install governor valve in bore of sleeve, large land end first.

2. Install governor weights and springs and thrust cap on governor sleeve.

3. Align pin holes in thrust cap, governor weight assemblies and governor sleeve and install new pins. Crimp both ends of pins to prevent them from falling out.

4. Check governor weight assemblies for free operation on pins.

5. Check governor valve for free movement in governor sleeve.

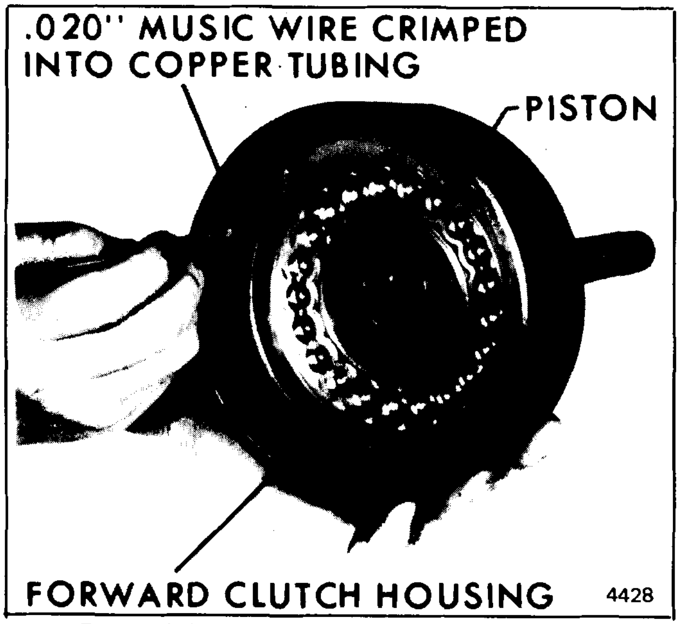
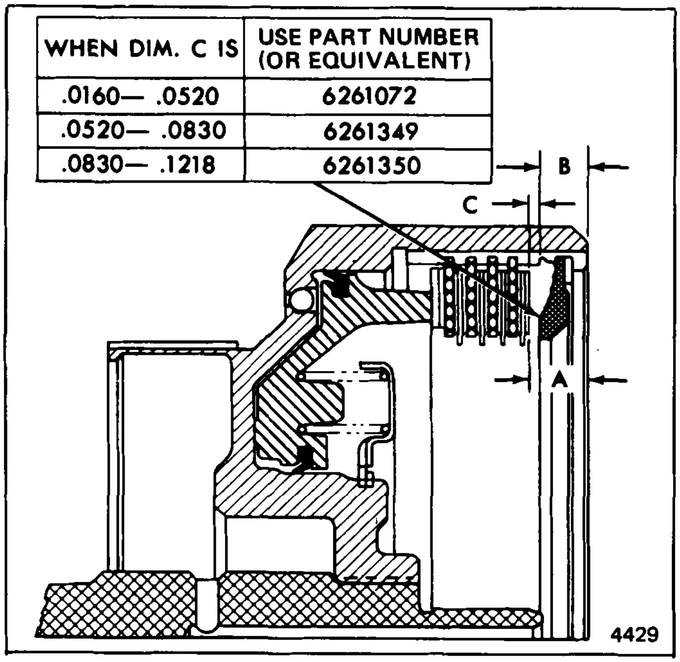


Fig. 7A2-84 Installing Forward Clutch Piston



WHEN DIM. C IS	USE PART NUMBER (OR EQUIVALENT)
.0160— .0520	6261072
.0520— .0830	6261349
.0830— .1218	6261350

Fig. 7A2-85 Determining Correct Forward Clutch Pressure Plate

BUSHING REPLACEMENT

EXTENSION HOUSING BUSHING

Removal

Collapse bushing with a screw driver (Fig. 7A2-95).

Installation

Using Tool J 21424-9 and Drive Handle J 8092, install extension housing bushing flush to .010 below seal counter bore surface (Fig. 7A2-96).

OUTPUT SHAFT BUSHING

Removal

With output shaft properly supported, remove bushing using Remover J 9434-01 and Slide Hammer J 7004 (Fig. 7A2-97).

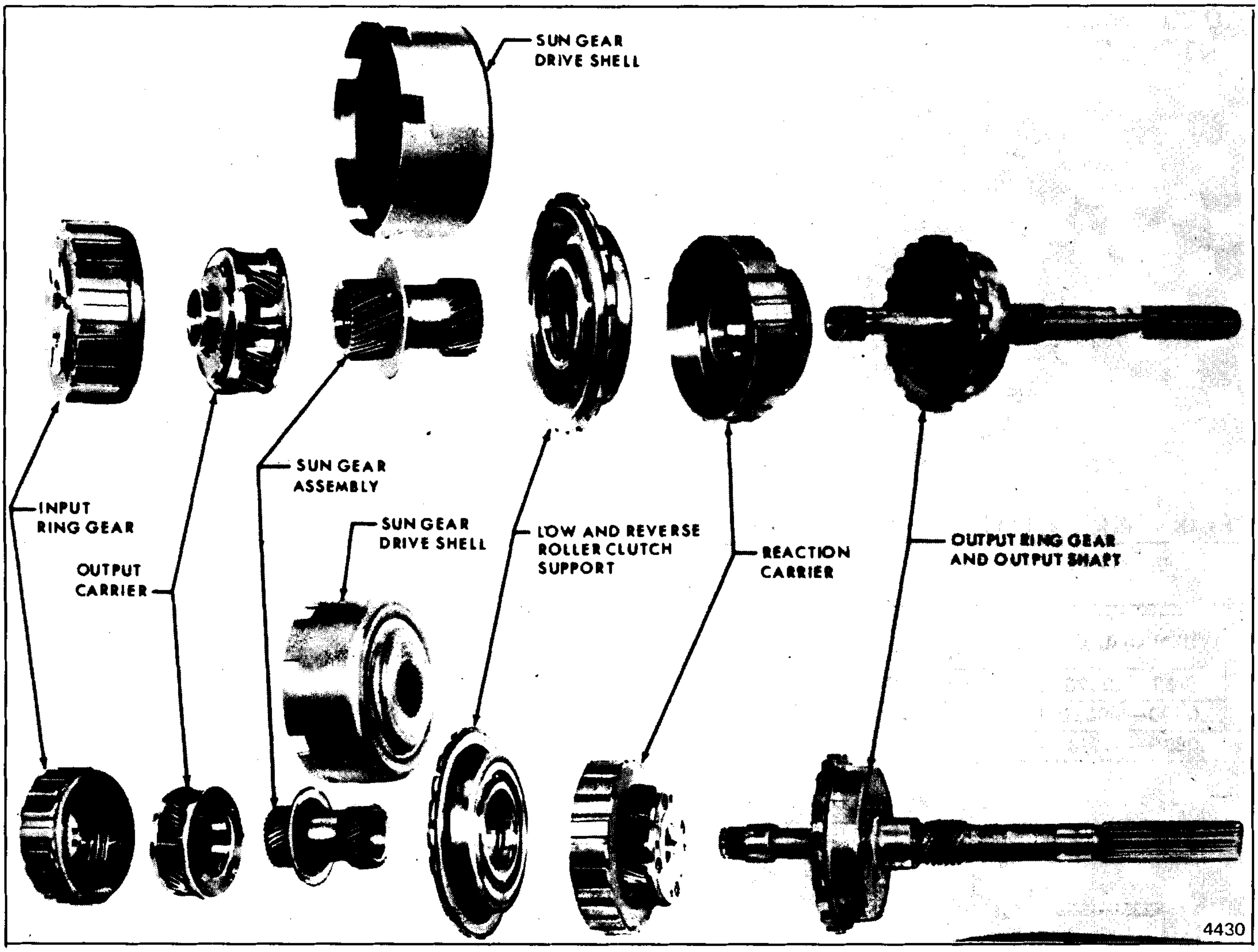


FIG. 7A2-86 PLANETARY GEAR TRAIN - EXPLODED VIEW

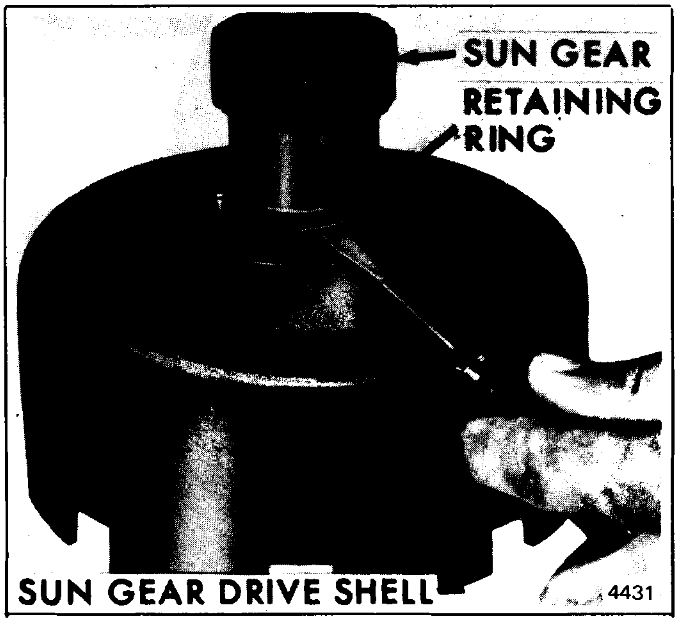


Fig. 7A2-87 Removing Sun Gear Drive Shell Rear Retaining Ring

Fig. 7A2-88 Removing Sun Gear to Drive Shell Rear Thrust Washer

Fig. 7A2-89 Removing Sun Gear to Drive Shell Front Retaining Ring

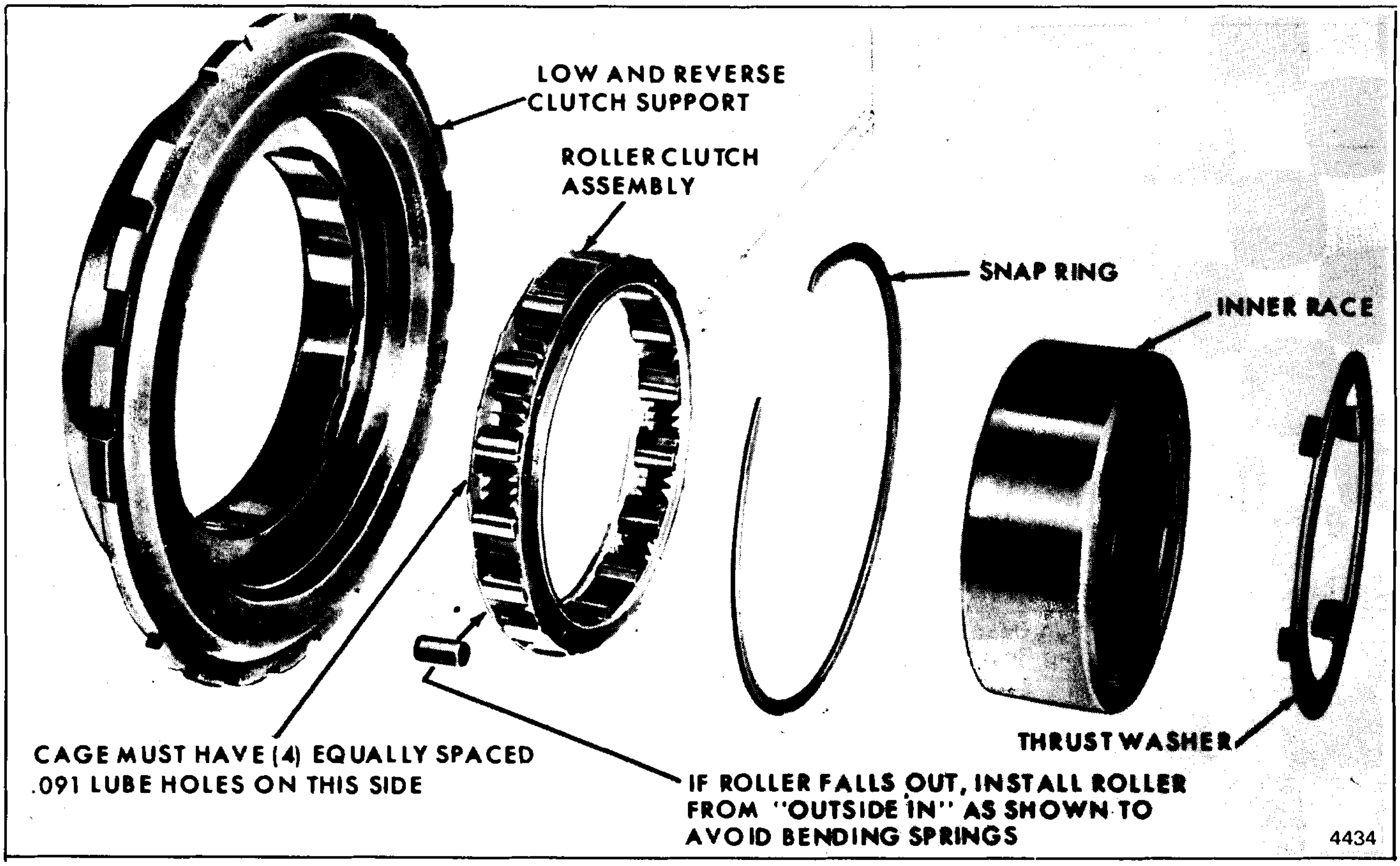


FIG. 7A2-90 LOW AND REVERSE CLUTCH ASSEMBLY - EXPLODED VIEW

Fig. 7A2-91 Removing Overrun Clutch Inner Race

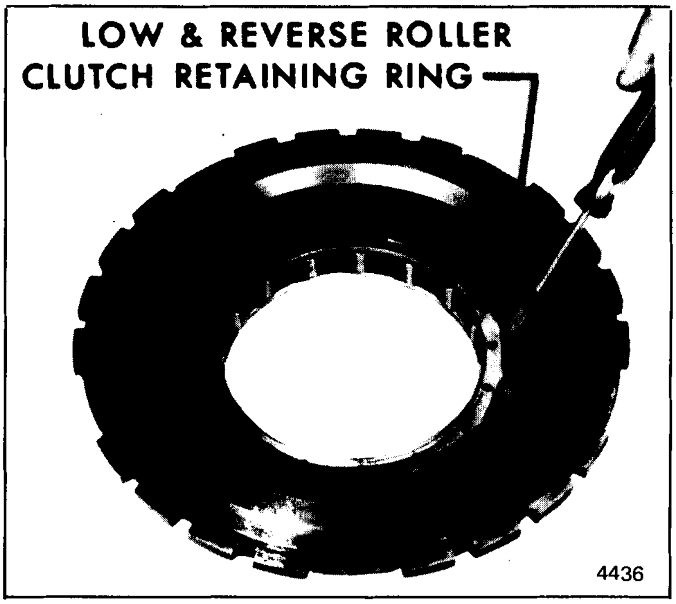


Fig. 7A2-92 Removing Roller Clutch Retaining Ring

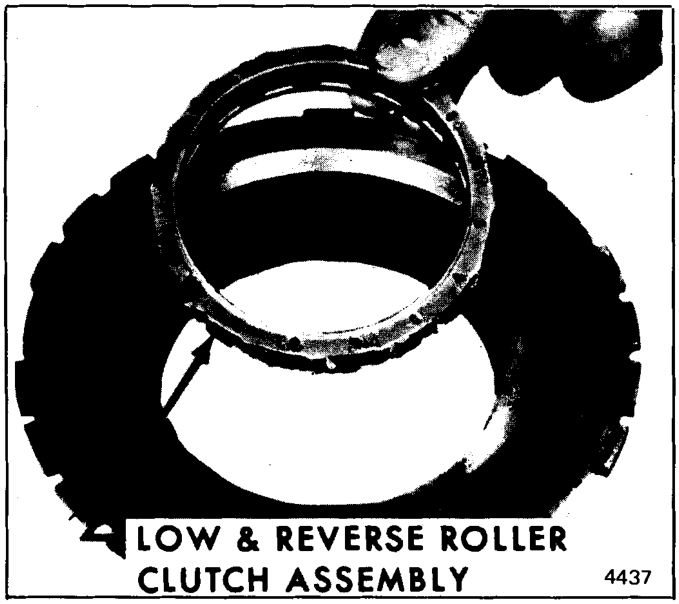


Fig. 7A2-93 Removing Roller Clutch Assembly

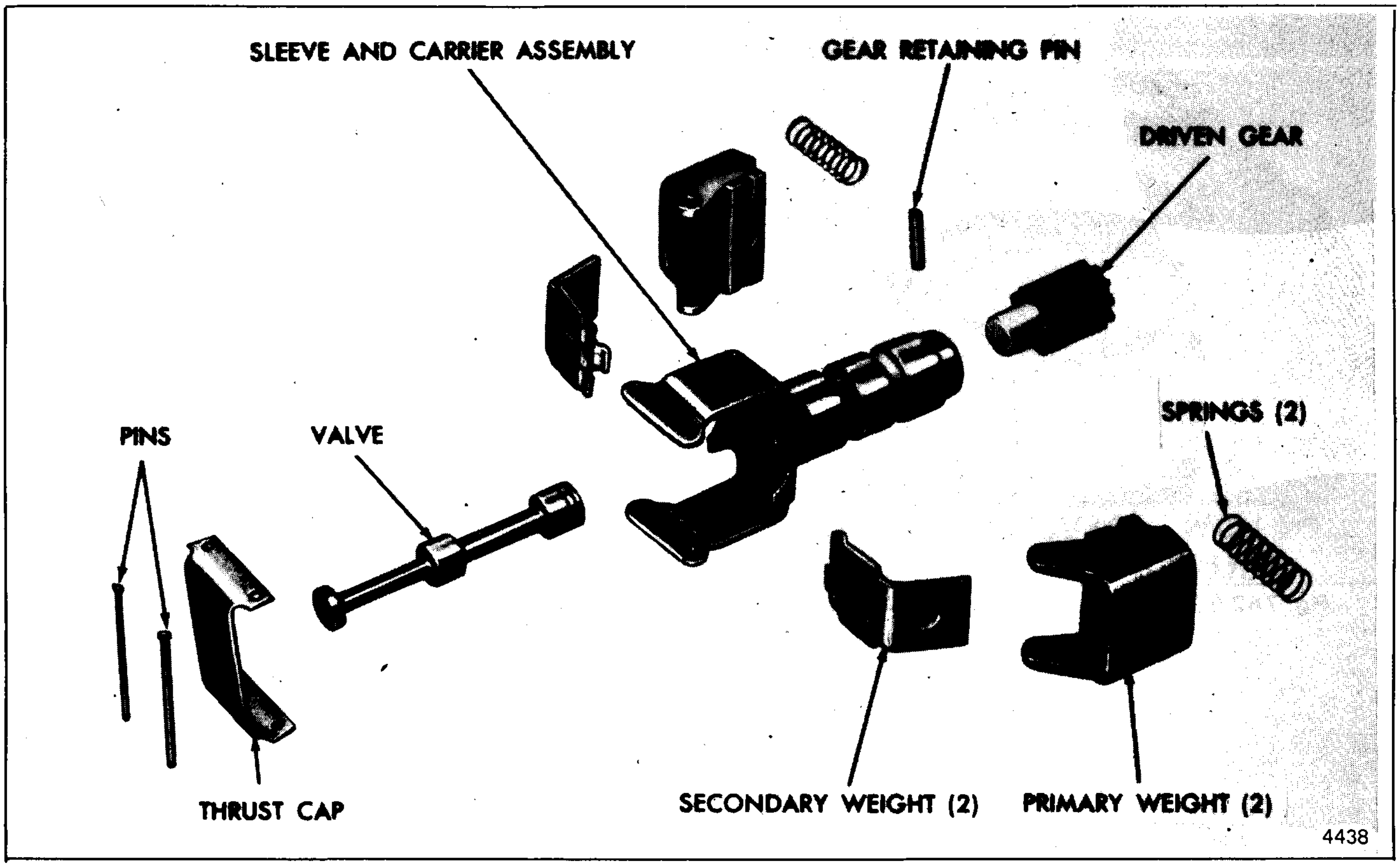


Fig. 7A2-94 Governor Assembly - Exploded View

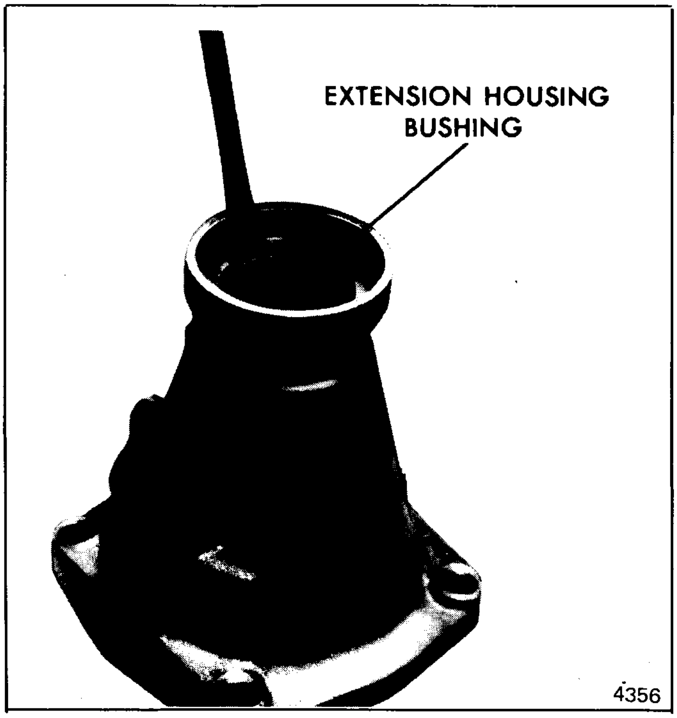


Fig. 7A2-95 Removing Extension Housing Bushing

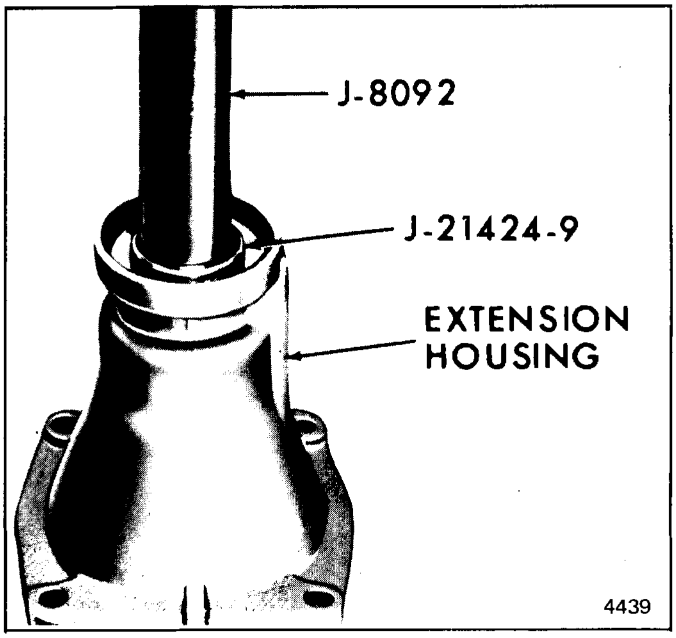


Fig. 7A2-96 Installing Extension Housing Bushing

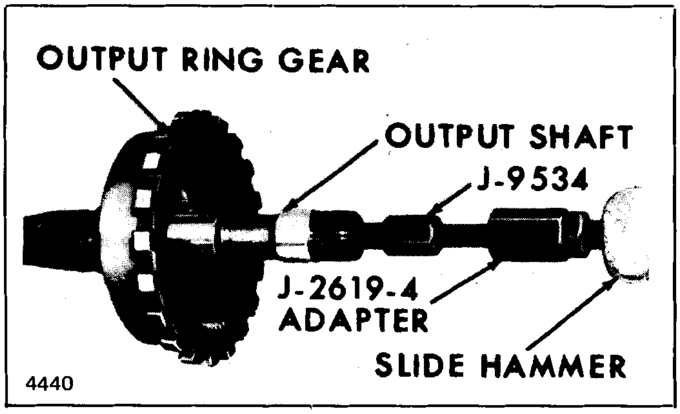


Fig. 7A2-97 Removing Output Shaft Bushing

Installation

Using Tool J 23062-1 and Drive Handle J 8092, install output shaft bushing.

CASE BUSHING

Removal

With case properly supported, drive out bushing from rear of case using Tool J 23062-1 and Drive Handle J 8092.

Installation

Using Tool J 23062-1 and Drive Handle J 8092 with Extension J 21465-13, install case bushing from interior of case to 3/16" from front surface with split in the bushing located at governor pilot upper bore wall area.

STATOR SHAFT FRONT BUSHING

Removal

With stator shaft properly supported, remove front bushing using Tool J 21465-16 with Slide Hammer J 2619-01 and Adapter J 2619-4 (Fig. 7A2-98).

Installation

Using Tool J 21424-7 and Drive Handle J 8092, install front stator shaft bushing to .250" from front face (Fig. 7A2-99).

STATOR SHAFT REAR BUSHING

Removal

With stator shaft properly supported, remove front bushing (Fig. 7A2-98). Place Tool J 21424-7 and Drive Handle J 8092 with Extension J 21465-13 through front of the stator shaft and drive out rear (2) bushings.

Installation

Using Tool J 23062-2 and Extension J 21465-13, install inner rear bushing to approximately 1-5/32" below front face and outer rear bushing 3/32" below front face (Fig. 7A2-101). Install new front bushing (Fig. 7A2-100).

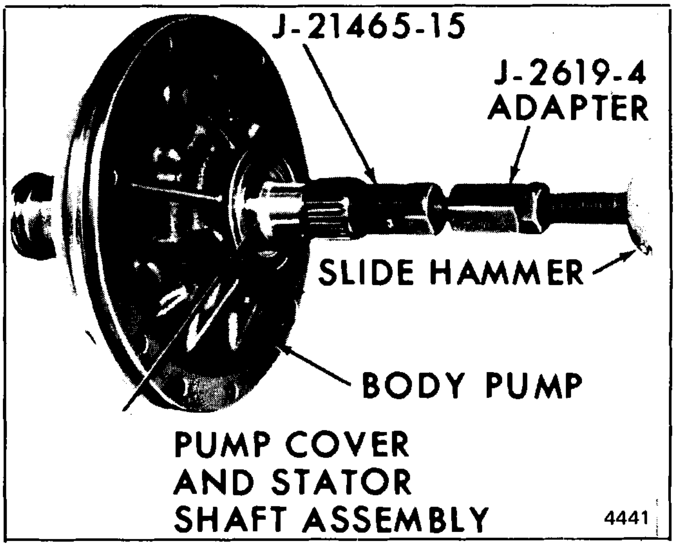


Fig. 7A2-98 Removing Stator Shaft Front Bushing

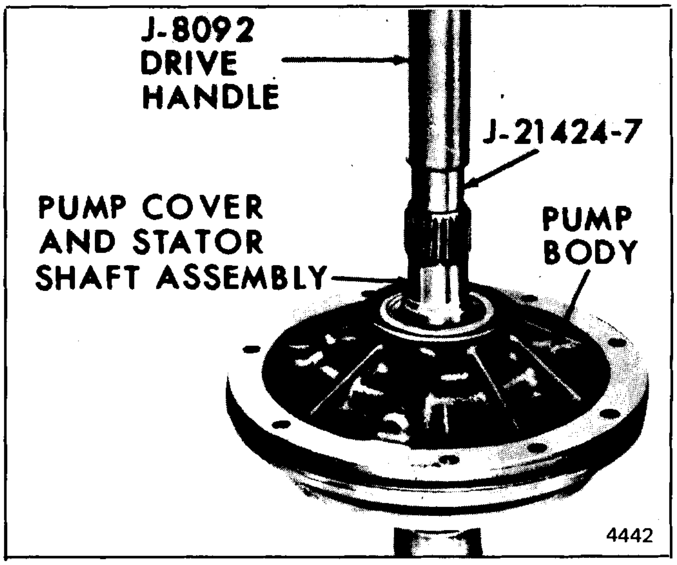


Fig. 7A2-99 Installing Stator Shaft Front Bushing

INPUT RING GEAR SUPPORT BUSHING

Removal

With input ring gear support properly supported, remove bushing using Tool J 23062-5 and Drive Handle J 8092.

Installation

Using Tool J 23062-5 and Drive Handle J 8092, install input ring gear bushing to approximately 1/16" below rear face inside gear end (Fig. 7A2-101).

SUN GEAR BUSHING

Removal

With sun gear properly supported, remove two (2) sun gear bushings using Tool J 23062-3 and Drive Handle J 8092 with Extention J 21465-13.

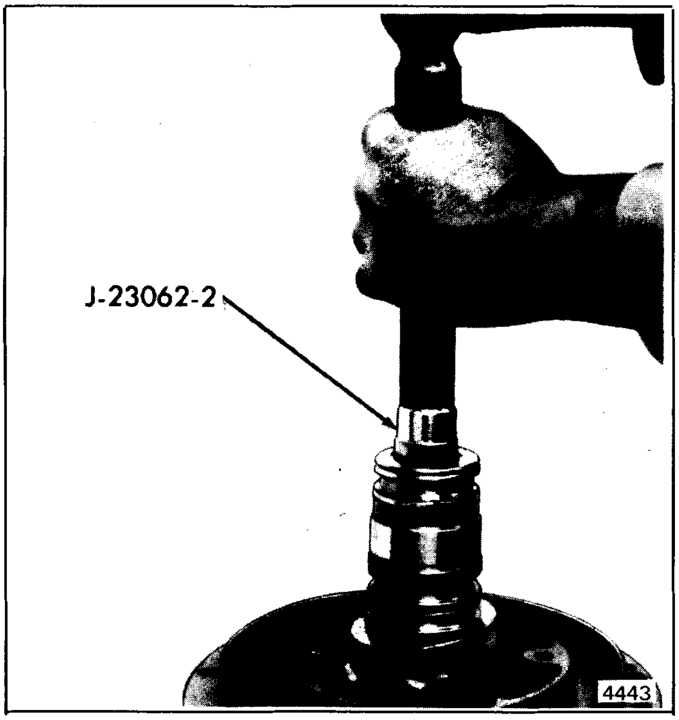


Fig. 7A2-100 Installing Inner and Outer Stator Shaft Rear Bushings

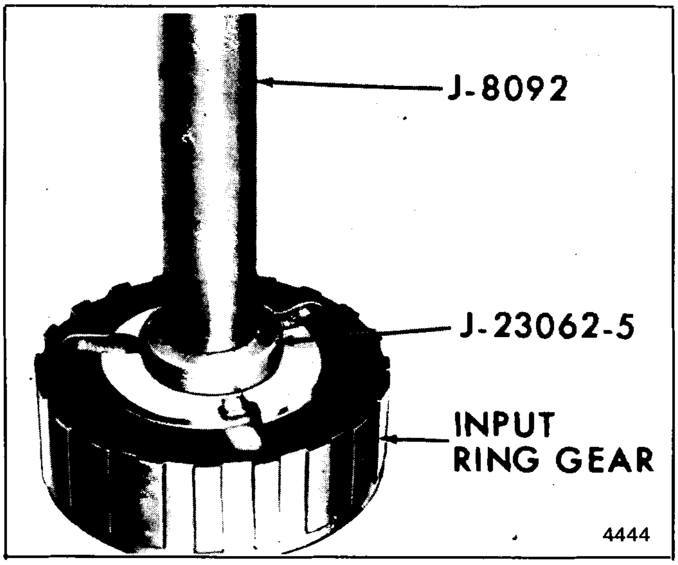


Fig. 7A2-101 Installing Input Ring Gear Support Bushing

Installation

Using Tool J 23062-3 and Drive Handle J 8092, install sun gear bushings to .010" below surface at either end (Fig. 7A2-102).

REACTION CARRIER BUSHING

Removal

With reaction carrier properly supported, remove bushing using Tool J 23062-3 and Drive Handle J 8092.

Installation

Using Tool J 23062-3 and Drive Handle J 8092, install

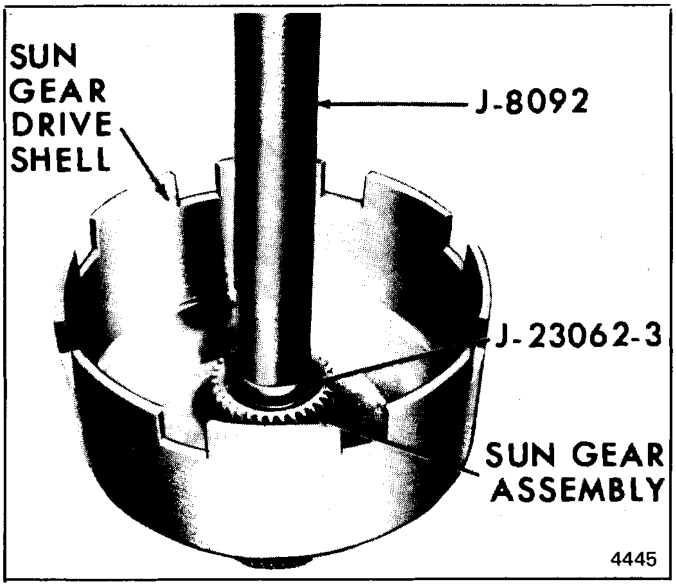


Fig. 7A2-102 Installing Sun Gear Bushings

DIRECT CLUTCH BUSHING

Removal

With direct clutch drum properly supported, remove bushing (Fig. 7A2-103).

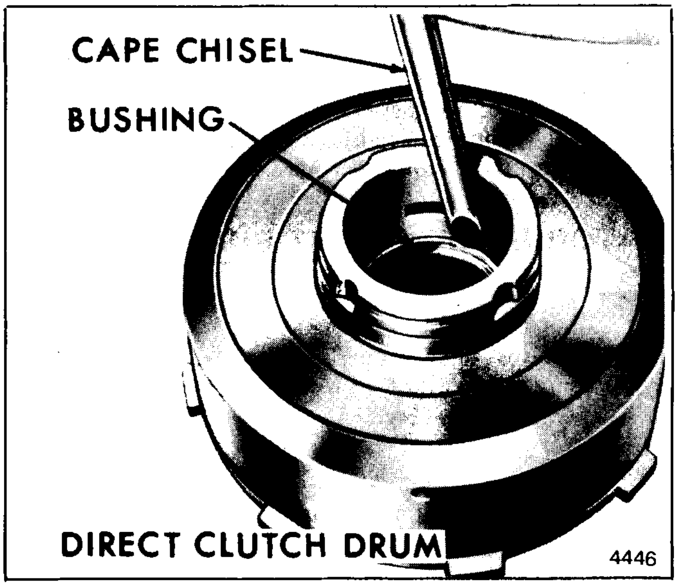


Fig. 7A2-103 Removing Direct Clutch Drum Bushing

Installation

Using Tool J 23329 and Drive Handle J 8092, install direct clutch bushing (Fig. 7A2-104).

TRANSMISSION REASSEMBLY

When servicing transmission, use only transmission fluid or petroleum jelly as lubricants to retain bearings or races during assembly. Lubricate all bearings, seal rings and clutch

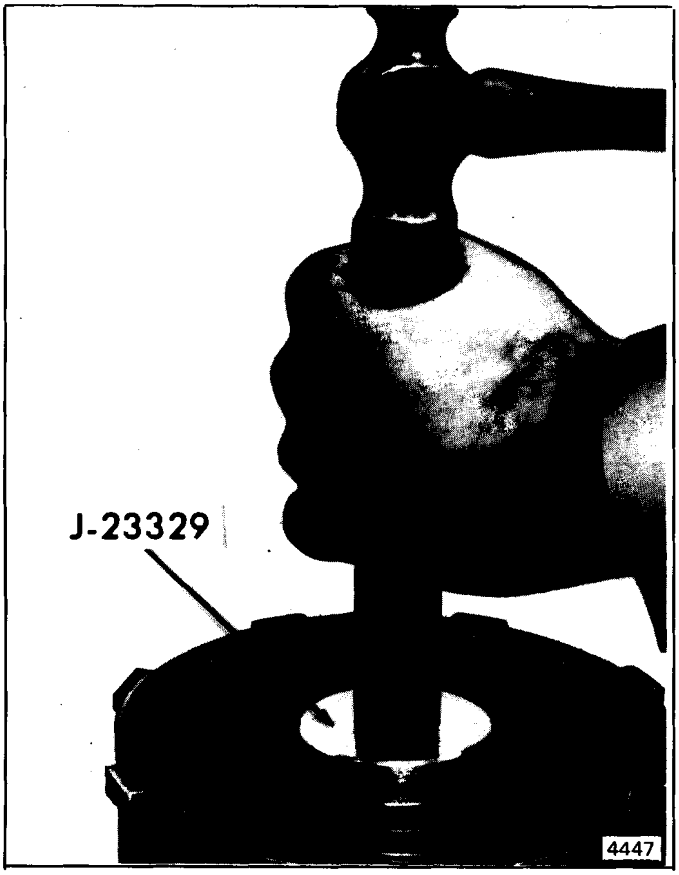


Fig. 7A2-104 Installing Direct Clutch Drum Bushing

TRANSMISSION INTERNAL COMPONENTS

1. Install low and reverse clutch piston assembly with notch in piston installed adjacent to parking pawl.
2. Install seventeen (17) piston return (coil) springs.
3. Install spring retainer and retaining ring. Using Tool J 23327, compress return seat so spring retainer retaining ring may be installed. Install output ring gear rear thrust bearing in case.
4. Install output ring gear on output shaft.
5. Install reaction carrier to output ring gear front thrust washer (3 tangs) into output ring gear support.
6. Install output shaft assembly into case.
7. Install reaction carrier assembly into output ring gear and shaft assembly.
8. Lubricate and install low and reverse clutch steel reaction plates and face plates, starting with a steel plate and alternating with face plates. Install low and reverse clutch support retainer spring (anti-clunk) spring.

NOTE: Notch in steel separator plates should be placed toward bottom of case.

9. Install low and reverse clutch support assembly with position of notch with low and reverse clutch support retainer (anti-clunk) spring as shown on Fig. 7A2-105.

IMPORTANT: Make certain the splines on inner race of the roller clutch align with splines on reaction carrier.

10. Install low and reverse roller clutch inner race to sun gear shell thrust washer.

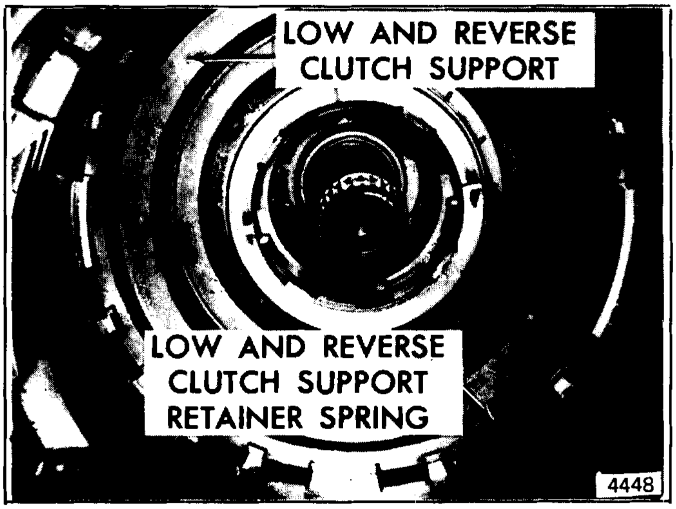


Fig. 7A2-105 Installing Low and Reverse Clutch Support Assembly

Fig. 7A2-106 Pump Cover to Direct Clutch Selective Thrust Washer

11. Install low and reverse clutch support to case snap ring with anti-clunk spring between gap.
12. Install rear thrust washer and sun gear drive shell assembly.
13. Install output carrier assembly.
14. Install input ring gear rear thrust washer.
15. Install input ring gear.
16. Install input ring gear to output shaft snap ring.

CAUTION: *Do not over-stress snap ring.*

17. Install input gear front thrust washer.
18. Install direct clutch assembly and special thrust washer to forward clutch assembly.
19. Install direct and forward clutch assemblies into case.

CAUTION: *Make certain forward clutch face plates are positioned over input ring gear and the tangs on direct clutch housing are installed into slots on the sun gear drive shaft.*

20. Install intermediate servo.

21. Install intermediate band. Make sure band ends are properly located on adjusting screw and servo rod ends. Turn adjusting screw into case until end of screw has picked up slot in band lug.

22. Check for proper thickness of selective fit thrust washer between oil pump cover and direct clutch assembly, proceed as follows:

a. Install selective fit thrust washer (Fig. 7A2-106) oil pump gasket and, using guide studs from J 3387 set, install oil pump. Install two pump to case bolts.

b. Position transmission so that output shaft points down. Install dial indicator as shown in Fig. 7A2-107. Zero indicator.

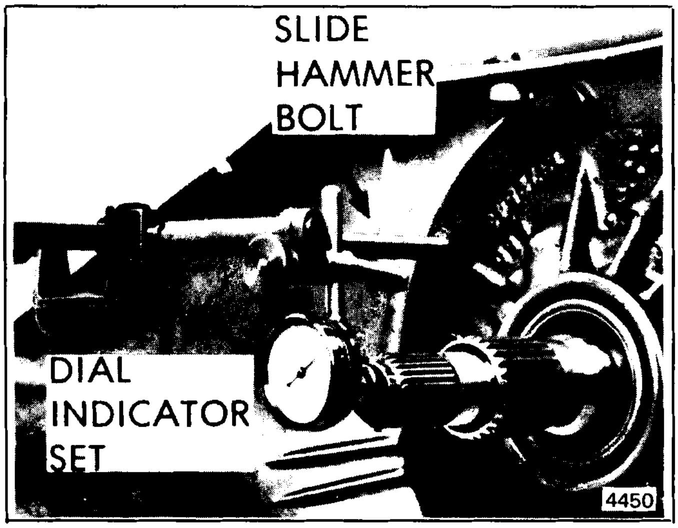


Fig. 7A2-107 Checking End Play for Proper Selective Thrust Washer

c. Lift up on transmission output shaft and observe total indicator movement.

d. Indicator should read .032" to .064". If reading is within limits, proper selective washer is being used. If reading is not within limits, it will be necessary to remove pump and change to a thicker or thinner selective thrust washer, as required, to obtain the specified clearance. Repeat the above checking procedure.

NOTE: Selective fit thrust washers are available in thicknesses of .065"-.067", .082"-.084" and .099"-.101".

23. Install new pump assembly to case gasket.

24. Install new pump assembly square cut oil seal ring.

25. Install guide pins into case.

26. Install pump assembly into case. Install attaching bolts with new washer type seals.

IMPORTANT: If input shaft cannot be rotated as the pump is being pulled into place, direct and forward clutch housings have not been properly installed to index faced plates with their respective parts. This condition must be corrected before pump is pulled into place.

27. After pump assembly is completely installed, adjust intermediate band. Tighten adjusting screw to 30 inch-pounds and then back-off 3 complete turns. While holding screw in position, tighten locknut to 15 lb. ft.

SPEEDOMETER DRIVE GEAR AND EXTENSION

1. Place speedometer drive gear retaining clip into hole in output shaft.

2. Heat a new speedometer drive gear, using heat lamp or suitable heat method.

3. Align slot in speedometer drive gear with retaining clip and install.

4. Install extension housing to case square cut "O" ring seal.

5. Attach extension housing to case using attaching bolts. Torque to 25 lb. ft.

6. If necessary, install a new extension housing oil seal, using Seal Installer J 5154 or J 21426 (Fig. 7A2-108).

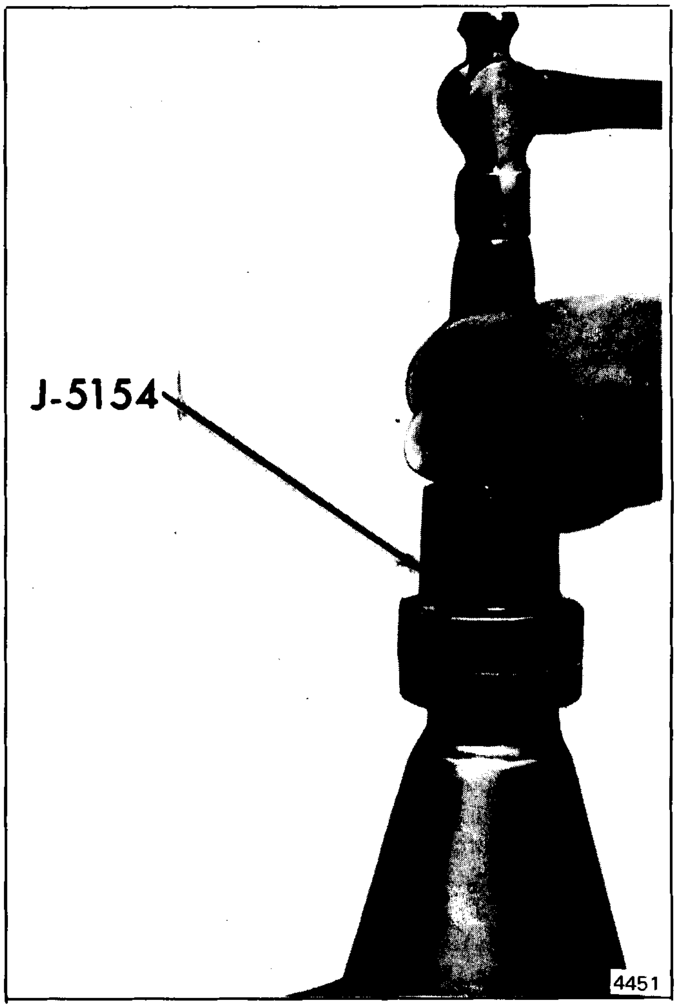


Fig. 7A2-108 Installing Extension Housing Oil Seal

MANUAL LINKAGE

1. If necessary, install a new manual shaft to case lip seal using 3/4" diameter rod to seat seal in case.

2. Install parking pawl, tooth toward the inside of case, into case.

3. Install parking pawl shaft into case and through parking pawl.

4. Install parking pawl shaft retainer plug. Drive into case, using a 3/8" diameter rod, until retainer plug is .130"-.170" below face of case. Then stake in three places.

5. Install parking pawl disengaging spring, square end hooked on pawl.

6. Install park lock bracket, using 2 special bolts (GM 300M, 6 marks on head), and torque bolts to 29 lb. ft. (Fig. 7A2-109).

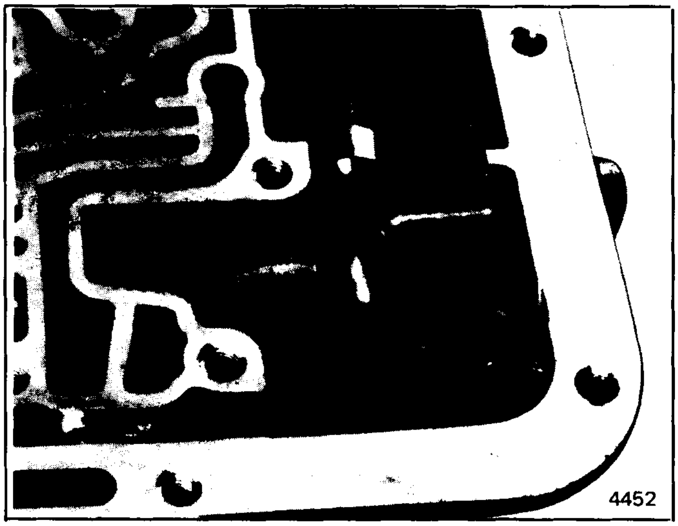


Fig. 7A2-109 Park Lock Bracket Special Bolt Identification

7. Install range selector inner lever to parking pawl actuator rod.

8. Install actuating rod under the park lock bracket and parking pawl.

9. Install manual shaft through case and range selector inner lever.

10. Install retaining nut on manual shaft. Torque to 30 lb. ft. (Fig. 7A2-110).

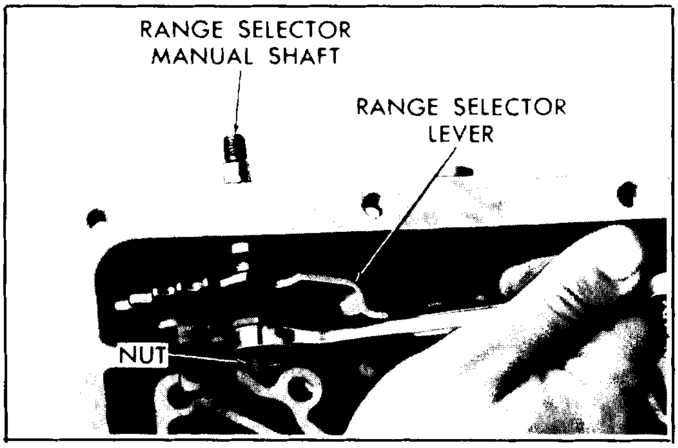


Fig. 7A2-110 Tightening Nut On Manual Shaft

11. Install manual shaft to case retainer (Fig. 7A2-111).

VALVE BODY, OIL PAN AND GASKET

1. Install oil pump pressure screen and governor feed screen.

2. Install four (4) check balls into proper transmission case pockets (Fig. 7A2-112).

3. Install valve body transfer plate and lower valve gasket.

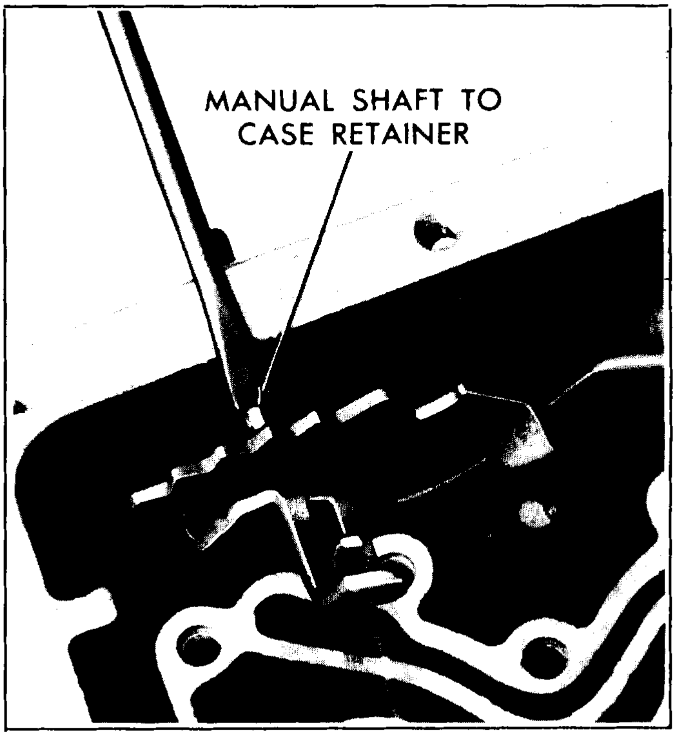


Fig. 7A2-111 Installing Manual Shaft To Case Retainer

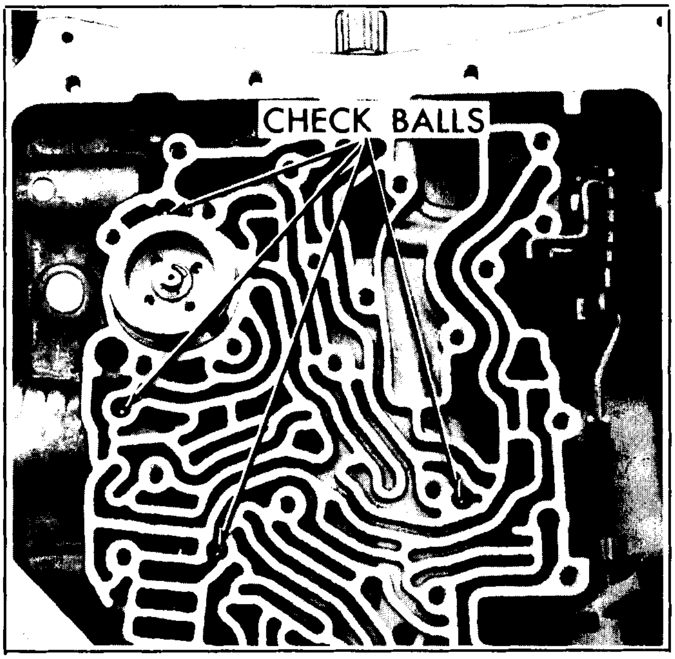


Fig. 7A2-112 Location of Four (4) Check Balls

4. Install upper valve gasket.

5. Install intermediate servo return spring.

6. Install valve body. Connect manual control valve link to range selector inner lever. Torque bolts in random sequence to 130 lb. in.

7. Install transfer support plate, torque bolts to 130 lb. in.

8. Connect detent control valve wire to detent valve actuating lever, then attach lever to valve body.

9. Install detent roller and spring assembly to valve body (Fig. 7A2-113).

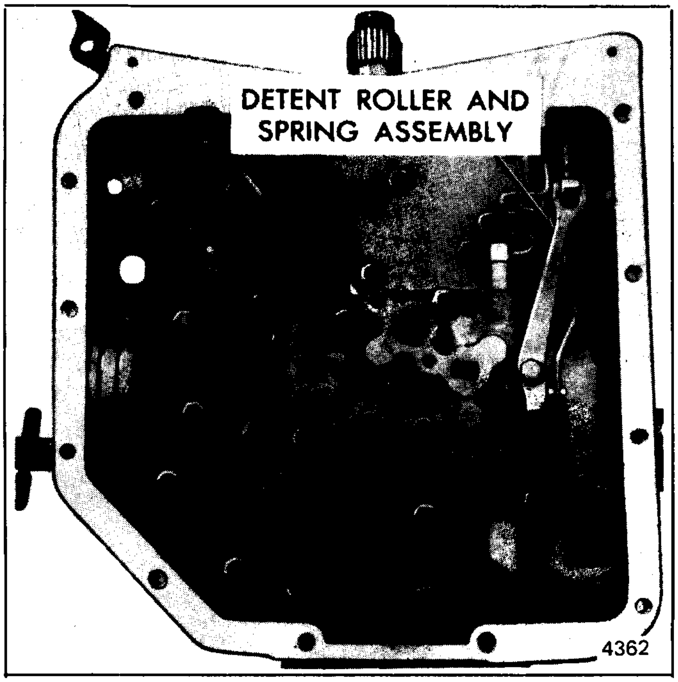


Fig. 7A2-113 Detent Roller and Spring Assembly

10. Align lube holes in suction screen with those in valve body and install screen gasket and screen.

NOTE: Be sure lube holes in screen match up with those in valve body.

11. Install oil pan, using a new gasket. Tighten bolts to 130 lb. in. in succession until bolts maintain torque specification.

NOTE: If a new oil pan is being installed, transfer production code number from right side of oil pan to new pan.

GOVERNOR AND VACUUM MODULATOR

1. Install governor assembly, cover and "O" ring seal and retainer wire (Fig. 7A2-114).
2. Install vacuum modulator valve.
3. Install vacuum modulator and retainer clip. Torque bolts to 130 lb. in.

NOTE: Position retainer with tangs pointing toward modulator.

1-2 ACCUMULATOR (FIG. 7A2-115)

1. Install 1-2 accumulator piston assembly.
2. Install accumulator spring.
3. Install new "O" ring seal in groove in case before installing cover.
4. Install 1-2 accumulator cover compress cover and install retaining ring.

INSTALL TRANSMISSION

Then installation of transmission is the reverse of remove transmission with the following added steps:

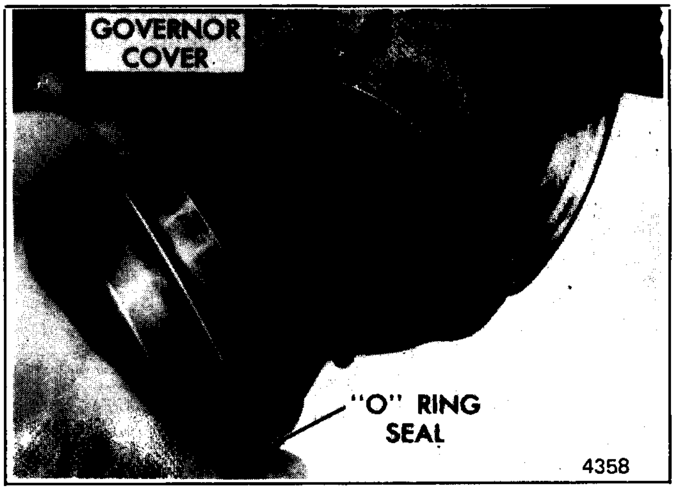


Fig. 7A2-114 Governor Cover and "O" Ring Seal

FIG. 7A2-115 1-2 ACCUMULATOR ASSEMBLY

Before installing flex plate to coverter bolts, make certain that the attaching lugs on converter are flush with flex plate and converter rotates freely by hand in this position. Then, hand start all three bolts and tighten finger tight before torquing to specification. This will insure proper converter alignment.

NOTE: After installation of transmission, lower and remove vehicle from hoist. Check linkage for proper adjustment.

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

A production day and shift built number, transmission and model year are stamped on the governor cover, which is located on the middle rear left side of the transmission case. The application of each transmission model is as follows:

AP - 140 cu. in., 2 bbl. engine,except California (H Series)

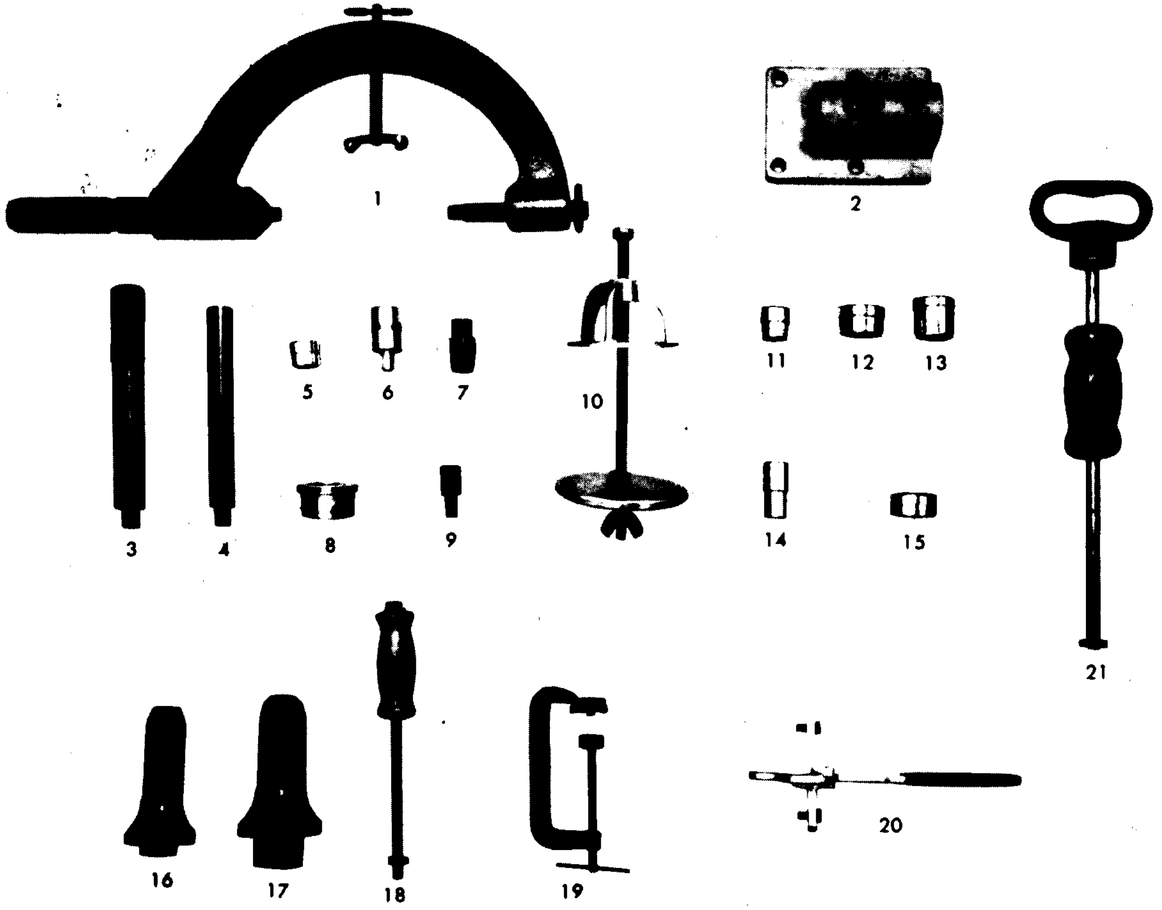
AO - 140 cu. in., 2 bbl. engine (H Series)

In addition, the vehicle identification number is stamped on the lower left side of the case, next to the manual shaft.

Whenever the governor cover is replaced, it will be necessary to stamp this information (on original cover) onto the new cover. All Transmission parts returned to Pontiac Motor Division, and any communication concerning same, must be identified by transmission identification and vehicle identification numbers.

TORQUE

Pump Cover to Pump Body	18 lb. ft.
Pump Assembly to Case	20 lb. ft.
Valve Body and Support Plate	130 lb. in.
Parking Lock Bracket	29 lb. ft.
Oil Suction Screen	40 lb. in.
Oil Pan to Case	130 lb. in.
Extension to Case	25 lb. ft.
Modulator Retainer to Case	130 lb. in.
Inner Selector Lever to Shaft	25 lb. ft.
Detent Valve Actuating Bracket	52 lb. in.
Converter to Flywheel Bolts	35 lb. ft.
Under Pan to Transmission Case	110 lb. in.
Transmission Case to Engine	35 lb. ft.
Control Lever	25 lb. in.
Manual Shaft to Lever	30 lb. ft.
Control Rod to Swivel	120 lb. in.
Intermediate Band Adjustment	15 lb. ft.



1.	J-8763-02	Transmission Holding Fixture (Used with J-3289-20 Base)
2.	J-3289-20	Transmission Holding Fixture Base
3.	J-8092	Driver Handle (Threaded type)
4.	J-21465-13	Driver Handle Extension (Used with J-8092)
5.	J-23062-3	Sun Gear and Reaction Carrier Bushing
6.	J-23062-7	Output Shaft Bushing Installer
7.	J-21465-15	Stator Shaft Front Bushing Remover (Used with J-8092)
8.	J-23329	Direct Clutch Bushing Installer
9.	J-9534-01	Output Shaft Bushing Remover
10.	J-23327	Clutch Spring Compressor
11.	J-23062-2	Stator Shaft Rear Bushing Installer (Both Rear)
12.	J-23062-1	Case Bushing Remover and Installer
13.	J-21424-9	Extension Housing Bushing Remover and Installer (Used with J-8092)
14.	J-21424-7	Stator Shaft Front Bushing Installer (Used with J-8092)
15.	J-23062-5	Input Ring Gear Bushing Remover and Installer
16.	J-5154 or J-21426	Extension Housing Oil Seal Installer
17.	J-21359	Pump Oil Seal Installer
18.	J-7004	Slide Hammers (Pair) For Pump Body removal (3/8" x 16 tread)
19.	J-22269-01	Direct Clutch Accumulator Piston Remover and Installer (THM 350 only)
20.	J-23069	Intermediate Accumulator Cover Remover and Installer
21.	J-2619-01	Slide Hammer (5/8" x 18 with 1/2" x 13 Adapter)

Not Illustrated

J-21369	Converter Pressure Check Fixture
J-8001	Dial Indicator Set (.001" Increments, .001" Travel)
J-21427-1	Speedo Gear Remover
J-9539	Slide Hammer Bolts (3/8" - 16 Threads)
J-8105	Speedo Gear Remover Puller
J-5586	Snap Ring Pliers
J-24367	Transmission Band Adjuster
J-24675	Accumulator Piston Adapter (Used with J-22269-01)

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Fig. 7A2-116 Special Tools

SECTION 7A3

TURBO HYDRA-MATIC 350 TRANSMISSION

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The Turbo Hydra-matic 350 transmission, see Fig. 7A3-1, is a fully automatic unit consisting primarily of 3-element hydraulic torque converter and two planetary gear sets. Four multiple-disc clutches, two roller clutches and an intermediate overrun band provide the friction elements required to obtain the desired function of the two planetary gear sets.

A hydraulic system pressurized by a gear type pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to the transmission are:

1. Manual Linkage - To select the desired operating range.
2. Engine Vacuum - To operate the vacuum modulator.
3. Cable Control - To operate the detent valve.

The following shift points are approximate and vary depending on rear axle ratio.

In Drive-range at minimum throttle, the 1st shift will occur at 9-14 mph and the 2nd shift at 15-20 mph. At maximum throttle, the 1st shift will occur at 40-55 mph and the 2nd shift at 65-70 mph.

The detent valve is activated by a cable that is connected to the carburetor linkage. When the throttle is half open, the valve is actuated causing throttle downshifts at speeds below 50 mph. When the throttle is fully open, the detent valve is actuated causing the transmission to downshift. The maximum throttle 3-1 downshift will occur at approximately 8 to 12 mph below the maximum throttle 1-2 upshift point. The maximum throttle 3-2 downshift will occur at approximately 4 to 8 mph below the maximum throttle 2-3 upshift point.

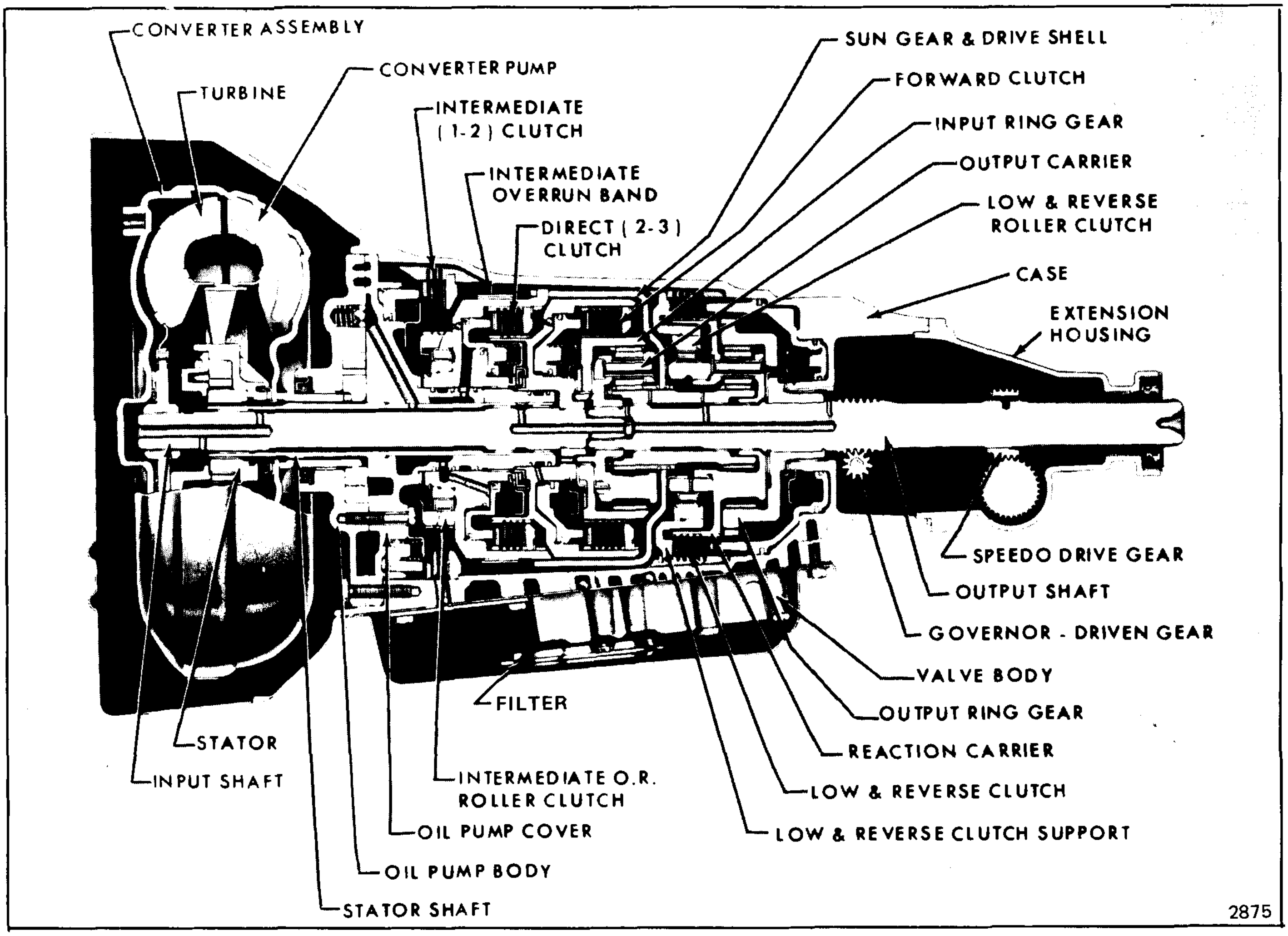


Fig. 7A3-1 THM 350 Transmission - Cross Section

DIAGNOSIS

SEQUENCE FOR TURBO HYDRA-MATIC 350 TRANSMISSION DIAGNOSIS

1. Check and correct oil level.
2. Check detent cable adjustment.
3. Check and correct vacuum line and fittings.
4. Check and correct manual linkage.
5. Road test car.

a. Install oil pressure gage.

b. Road test using all selective ranges, noting when discrepancies in operation or oil pressure occur. See Fig. 7A3-2.

c. Attempt to isolate the unit or circuit involved in the malfunction.

d. If engine performances indicate an engine tune-up is required, this should be performed before road testing is completed or transmission correction attempted. Poor engine performance can result in rough shifting or other malfunctions.

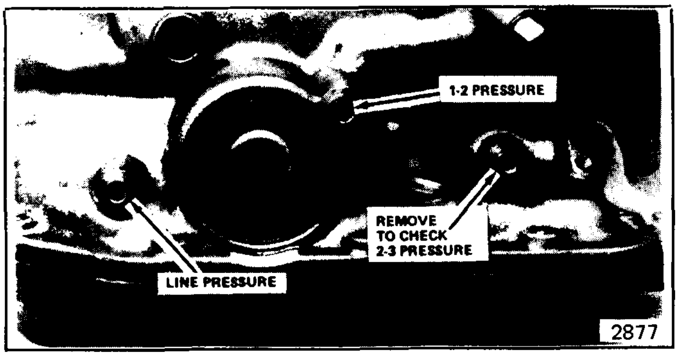


Fig. 7A3-2 Taps for Oil Pressure Checks

TURBO HYDRA-MATIC 350 TRANSMISSION OIL CHECKING PROCEDURES

Before diagnosis of any transmission complaint is attempted, there must be understanding of oil checking procedure and what appearance the oil should have. Many times a transmission malfunction can be traced to low oil level or improper reading of dipstick. Due to the transmission fluid that is now being used in may appear to be darkened and have a stronger odor. This is normal, and not a positive sign of required maintenance or transmission failure.

Also when the dipstick is removed, it should be noted whether the oil is devoid of air bubbles or not. Oil with air bubbles gives an indication of an air leak in the suction lines, which can cause erratic operation and slippage. Water in the oil imparts a milky, pink cast to the oil and can cause spewing.

EXTERNAL OIL LEAKS

Determining Source of Oil Leak

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to "wind flow" around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a "Black Light" to locate the point at which the oil is leaking is helpful. Comparing the oil from the leak to that on the engine or transmission dipstick, when viewed by black light, will determine the source of the leak - engine or transmission.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by air stream. For example, a transmission oil filler tube to case leak will sometimes appear as a leak at the rear of the transmission. In determining the source of a leak, proceed as follows:

1. Degrease underside of transmission.
2. Road test to get unit at operating temperature.
3. Inspect for leak with engine running.
4. With engine off, check for oil leaks due to the raised oil level caused by drain back.

Possible Points of Oil Leaks

1. Transmission Oil Pan Leak

a. Attaching bolts not correctly torqued.

b. Improperly installed or damaged pan gasket.

c. Oil pan gasket mounting face not flat.

2. Extension Housing

a. Attaching bolts not correctly torqued.

b. Rear seal damaged or improperly installed.

c. Square seal, extension to case, damaged or improperly installed.

3. Case Leak

a. Filler pipe "O" ring seal damaged or missing, misposition of filler pipe bracket to engine.

b. Modulator assembly "O" ring seal damaged or improperly installed.

c. Governor cover not tight, gasket damaged or leak between case face and gasket.

d. Speedometer gear "O" ring damaged.

e. Manual shaft seal damaged or improperly installed.

f. Line pressure gap plug loose.

4. Leak at Front of Transmission

a. Oil pump seal leaks.

(1) Seal lip cut. Check converter hub, etc.

(2) Bushing moved and damaged. Oil return hole plugged.

(3) No oil return hole.

b. Oil pump attaching bolts loose or bolt washer type seals damaged or missing.

c. Oil pump housing "O" ring damaged or cut.

d. Converter leak in weld area.

e. Porous casting (pump).

5. Oil Comes Out Vent Pipe

a. Transmission over-filled.

b. Water in oil.

c. Foreign material between pump and case or between pump cover and body.

d. Case - porous near converter bosses. Front pump cover or housing oil channels shy or stock near breather.

e. Pump to case gasket mis-positioned.

CONVERTER STATOR OPERATION DIAGNOSIS

1. The stator assembly freewheels in both directions.

If the stator roller clutch becomes ineffective, the stator assembly freewheels at all times in both directions. With this condition, the vehicle will tend to have poor acceleration from a standstill. At speeds above 30-35 mph, the vehicle may act normal. If poor acceleration problems are noted, it should first be determined that the exhaust system is not blocked, the engine is in good tune and the transmission is in first (1st) gear when starting out.

If the engine will freely accelerate to high rpm in Neutral (N), it can be assumed that the engine and exhaust system are normal. Driving the vehicle in Reverse (R) and checking for poor performance will help determine if the stator is freewheeling at all times.

2. The stator assembly remains locked up at all times.

If the stator assembly remains locked up at all times, the engine rpm and vehicle speed will tend to be limited or restricted at high speeds. The vehicle performance when accelerating from a standstill will be normal. Engine overheating may be noted. Visual examination of the converter may reveal a blue color from the overheating that will result.

Under both conditions 1 or 2, if the converter has been removed from the transmission, the stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely in the clockwise direction, but not turn or be very difficult to turn in the counterclockwise direction.

NOTE: Do not use such items as the pump cover stator shaft to turn the race as the results may be misleading.

VACUUM MODULATOR DIAGNOSIS PROCEDURE

A failed vacuum modulator can cause one or more of the following complaints:

1. Harsh upshifts and downshifts.
2. Delayed upshifts.

3. Soft upshifts and downshifts.
4. Slips in low, drive and reverse.
5. Transmission overheating.
6. Engine burning transmission oil.

If any one of the above complaints are encountered, the modulator must be checked.

The vacuum modulator has three areas to be checked. If any one of the three (3) areas fail to pass the prescribed checks, the modulator must be replaced.

1. Load Comparison Check

To check load proceed as follows:

a. Insert one end of the comparison gage J 24466 into the suspected modulator sleeve. Insert the opposite end of the gage into a known, good modulator of the same part number as the suspected modulator. This part number of the modulator assembly is located on the vacuum end of the modulator.

b. Holding the modulators in a horizontal position, see Fig. 7A3-3, bring them slowly together under pressure. The modulator in question, if bad, will reach the center line of the comparison gage before the known good modulator lines up with the outer gage line.

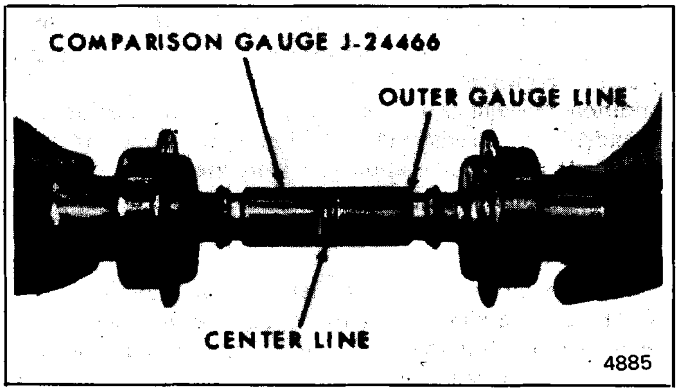


Fig. 7A3-3 Modulator Load Comparison Check

If the modulator in question is good, both modulator assemblies will be within the outer gage lines as the assemblies are slowly brought together.

2. Vacuum Diaphragm Leak Check

Turn modulator so vacuum line stem points downward. If the transmission oil comes out the vacuum diaphragm is bad.

Gasoline and/or water vapor may settle in the vacuum side of the modulator. If this is found WITHOUT the presence of oil, the modulator MUST NOT BE CHANGED.

Check solution that comes out of the modulator for evidence of lubricity. If the solution does not have the feel of oiliness it can be assumed the solution is a mixture of gas and/or water. The only way transmission oil can be on the vacuum side of the modulator is by a leak in the vacuum diaphragm.

If oil is found, the modulator must be replaced. If oil is not found in the vacuum side of the modulator but the transmission oil level is continually low, and no external leaks are found, there is a possibility that a pin hole leak exists.

3. Inspection for External Damage -

a. Check for dents or cracks in modulator.

b. Check modulator valve sleeve alignment. Roll modulator on a flat surface to determine if the sleeve is concentric to the modulator can. If the sleeve is bent, runout will be visible, and modulator must be replaced.

If the modulator passes the above checks, the following items should also be checked as a possible cause of the problem:

1. Check freeness of modulator valve in transmission case.

2. Check the vacuum line from the manifold to modulator for holes, cracks or dents. Check the rubber hose connections at the modulator and at the intake manifold for leaks.

CAUSES OF IMPROPER VACUUM AT MODULATOR

1. Engine -
a. Tune up.
b. Loose vacuum fittings.
c. Vacuum operated accessory leak (hoses, vacuum advance, etc.).
d. Engine exhaust system restricted.
2. Vacuum line to modulator -
a. Leak
b. Loose fitting
c. Restricted orifice or incorrect orifice size.
d. Carbon build-up at modulator vacuum fitting.
e. Pinched line.
f. Grease in pipe (no or delayed upshift-cold).

TURBO HYDRA-MATIC 350 TROUBLE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
No drive in drive range - (install pressure gage).	1. Low oil level.	1. Correct level - check for external leaks or vacuum modulator (leaking diaphragm will evacuate oil from unit).
	2. Manual linkage adjustment	2. See Page 7A3-14.
	3. Low oil pressure.	3a. Filter assembly-blocked. b. Pump assembly-pressure regulator, pump drive gear, tangs damaged by converter. c. Case-porosity in intake bore.
	4. Control valve assy.	4. Manual valve disconnected from inner lever.
	5. Forward clutch.	5a. Forward clutch does not apply - piston cracked; seals missing, damaged; clutch plates burned. b. Pump feed circuit to forward clutch oil seal rings missing or broken on pump cover; leak in feed circuits; pump to case gasket mispositioned or damaged. c. Clutch drum ball check stuck or missing.
	6. Roller clutch assy.	6. Broken spring or damaged cage.
Oil pressure high or low	1. High oil pressure	1a. Vacuum line or fittings leaking. b. Vacuum modulator. c. Modulator valve. d. Pressure regulator. e. Oil pump.
	2. Low oil pressure	2a. Vacuum line or fittings obstructed. b. Vacuum modulator. c. Modulator valve. d. Pressure regulator. e. Governor. f. Oil pump.
1-2 shift - full throttle only	1. Detent valve	1. Sticking or linkage misadjusted.
	2. Vacuum leak	2. Vacuum line or fittings leaking.
	3. Control valve assy.	3a. Valve body gaskets - leaking, damaged, incorrectly installed. b. Detent valve train stuck. c. 1-2 valve stuck.
	4. Case assembly	4. Porosity.

First speed only - no 1-2 shift	1. Governor assembly.	1a. Governor valve sticking. b. Driven gear loose, damaged or worn (check for pin in case and length of pin showing); also, check output shaft drive gear for nicks or rough finish if driven gear shows damage.
	2. Control valve assy.	2a. 1-2 shift valve train stuck closed. b. Governor feed channels blocked. c. Valve body gaskets - leaking, damaged, incorrectly installed.
	3. Case	3a. Porosity between channels. b. Governor feed channel blocked. Governor bore scored or worn, allowing cross pressure leak.
	4. Intermediate clutch	4a. Clutch piston seals-missing, improperly assembled, cut. b. Intermediate roller clutch broken spring or damaged cage.
First and second speeds only; no 2-3 shift	1. Control valve assy.	1a. 2-3 shift train stuck. b. Valve body gaskets - leaking, damaged, incorrectly installed.
	2. Direct clutch	2a. Pump hub - direct clutch oil seal rings - broken, missing. b. Clutch piston seals - missing improperly assembled, cut, piston, ball check stuck or missing.
Drive in Neutral	1. Manual linkage	1. Misadjusted.
	2. Forward clutch	2. Clutch does not release - (this condition will also cause No Reverse).

No motion in Reverse or slips in Reverse - (install pressure gage).	1. Low oil level.	1. Add oil.
	2. Manual linkage.	2. Misadjusted.
	3. Oil pressure.	3a. Modulator valve stuck. b. Modulator and reverse boost valve stuck. c. Pump hub - direct clutch oil seal rings broken, missing. d. Direct clutch piston seal cut or missing. e. Low and reverse clutch piston seal cut or missing. f. No. 1 check ball missing.
	4. Control valve assy.	4a. Valve body gaskets - leaking, damaged, incorrectly installed (other malfunctions may also be indicated). b. 2-3 valve train stuck in up-shifted position. This will also cause 1-3 upshift in drive range. c. 1-2 valve train stuck in upshifted position.
	5. Intermediate servo	5. Piston or pin stuck so intermediate overrun band is applied.
	6. Low and reverse clutch	6. Piston out or seal damaged or missing.
	7. Direct clutch	7a. Outer seal damaged or missing. b. Clutch plates burned-may be caused by stuck ball check in piston.
	8. Forward clutch	8. Clutch does not release (will also cause Drive in Neutral).
Slips in all ranges, slips on take-off - (install pressure gage)	1. Oil level low.	1. Add oil.
	2. Oil pressure.	2a. Vacuum modulator inoperative. b. Vacuum modulator valve sticking. c. Filter assy - plugged or leaks.
	3. Case	3a. Pressure regulator valve stuck. b. Pump to case gasket damaged or incorrectly installed.
	4. Forward clutch	4. Cross leaks, porosity. a. If burned, look for cause. b. Oil seal rings on pump cover broken or worn.

Slips 1-2 shift - (install pressure gage).	1. Oil level low.	1. Add oil.
	2. Oil pressure.	2a. Vacuum modulator assembly inoperative. b. Modulator valve sticking. c. Pump pressure regulator valve.
	3. 2-3 accumulator.	3. Oil ring damaged or missing.
	4. 1-2 accumulator	4. Oil ring missing or damaged, case bore damaged.
	5. Pump to case gasket.	5. Mispositioned.
	6. Case	6. Porosity between channels.
	7. Intermediate clutch.	7. Piston seals missing or damaged; clutch plates burned.
Rough 1-2 shift - (install pressure gage)	1. Oil pressure.	1a. Vacuum modulator - check for loose fittings, restrictions in line. b. Modulator valve stuck. c. Valve body - regulator or boost valve stuck. d. Pump to case gasket - off location or damaged.
	2. Case	2. Porosity between channels.
	3. 1-2 accumulator assembly.	3a. Oil rings damaged. b. Piston stuck. c. Broken or missing spring. d. Bore damaged. e. Check accumulator feed hole in valve body plate.
Slips 2-3 shift - (install pressure gage)	1. Oil level low.	1. Add oil.
	2. Oil pressure low.	2a. Modulator assembly. b. Modulator valve. c. Pump pressure regulator valve or boost valve pump to case gasket off location.
	3. Case	3. Porosity.
	4. Direct clutch.	4. Piston seals leaking, or ball check leak.
Rough 2-3 shift - (install pressure gage).	1. Oil pressure high.	1a. Vacuum leak. b. Modulator valve sticking. c. Valve body - pressure regulator or boost valve inoperative.
	2. 2-3 accumulator assembly.	2a. 2-3 accumulator spring missing, broken. b. Accumulator piston stuck.

No engine braking - L2 - 2nd gear	1. Intermediate servo and 2-3 accumulator	1a. Servo or accumulator oil rings or bores leaking. b. Servo piston stuck.
	2. Intermediate overrun band.	2. Intermediate overrun band broken, burned (check for cause).
	3. Oil pressure low.	3. Pressure regulator and/or boost valve stuck.
No engine L1 - 1st gear	1. Manual low control	1. Stuck valve assembly.
	2. Oil pressure low.	2. Pressure regulator and/or boost valve stuck.
	3. Low and reverse clutch.	3. Piston inner seal damaged or missing.
No part throttle downshift (install pressure gage)	1. Oil pressure.	1. Vacuum modulator assembly, modulator valve, pressure regulator valve train (other malfunctions may also be noticed).
	2. Detent valve and linkage.	2. Sticks or disconnected or broken.
	3. 2-3 shift valve.	3. Stuck.
No detent downshifts	1. Control valve assy	1. 2-3 valve stuck.
	2. Detent valve and linkage.	2. Sticks or disconnected or broken.
Low or high shift points (install pressure gage)	1. Oil pressure.	1a. Engine vacuum - check at transmission end of the modulator pipe. b. Vacuum modulator assembly vacuum line connections at engine and transmission, modulator valve, pressure regulator valve train.
	2. Governor	2a. Valve sticking. b. Feed holes restricted or leaking, pipes damaged or mispositioned. c. Feed line plugged.
	3. Detent valve and linkage.	3. Stuck open (will cause late shifts).
	4. Control valve assy.	4a. 2-3 valve train sticking. b. 1-2 shift valve train sticking.
	5. Case	5. Porosity.
Won't hold in Park	1. Manual linkage.	1. Misadjusted.
	2. Internal linkage.	2a. Parking brake lever and actuator assembly. Check for chamfer on actuator rod sleeve. b. Parking pawl broken or inoperative.

Locks up in manual low (usually hot only).	1. Converter pressure leaking into direct clutch thru stator shaft. 2. Direct clutch.	1. Check stator shaft index. 2a. Direct clutch bore undersize or piston oversize. b. Direct clutch feed hole shy small chamber.
Second gear start or slips second	1. Intermediate clutch gear only.	1. Wrong number of clutch plates or wrong piston.
Locks up in reverse (usually hot only)	1. Forward clutch. 2. Direct clutch.	1. Bore undersize or piston oversize. 2. Direct clutch feeding forward clutch thru stator shaft (check stator shaft index).
Locks in reverse from park to reverse only.	1. Parking pawl.	1. Parking pawl staying in due to a burr on leading edge.
Cold morning reverse no drive till engine warms up.	1. Pressure regulator bore or sleeve tight.	1. Remove and repair.
Shifts cold but not warm.	1. Governor assembly.	1. Nylon gear roll pin shy.
No drive - but has manual low.	1. Low reverse roller clutch.	1. Low reverse roller clutch installed backwards.
No 1-2 shift - makes 1-3 shift and 3-1 shift, but has all shifts manually.	1. Intermediate roller clutch.	1. Intermediate roller clutch not locking.
Governor nylon gear stripped 360°.	1. Case pin. 2. Output shaft.	1. Governor case pin missing. 2. Output shaft rough or worn.
Governor gear stripped one side.	1. Governor sizing in bore.	1. Repair or replace as necessary.
Slow reverse (cold only)	1. Low oil level.	1. Adjust oil level.
Harsh 1-2 shift.	1. 1-2 accumulator.	1a. Piston or spring. b. Accumulator feed hole in valve body plate.

Slow reverse (hot only)	1. Valve body. 2. Shift selector lever	1. Leaking valve body support plate. 2a. Bent or S-hook hole off location. b. S-hook bent. c. Detent roller spring hole off location. d. Manual valve S-hook hole off location.

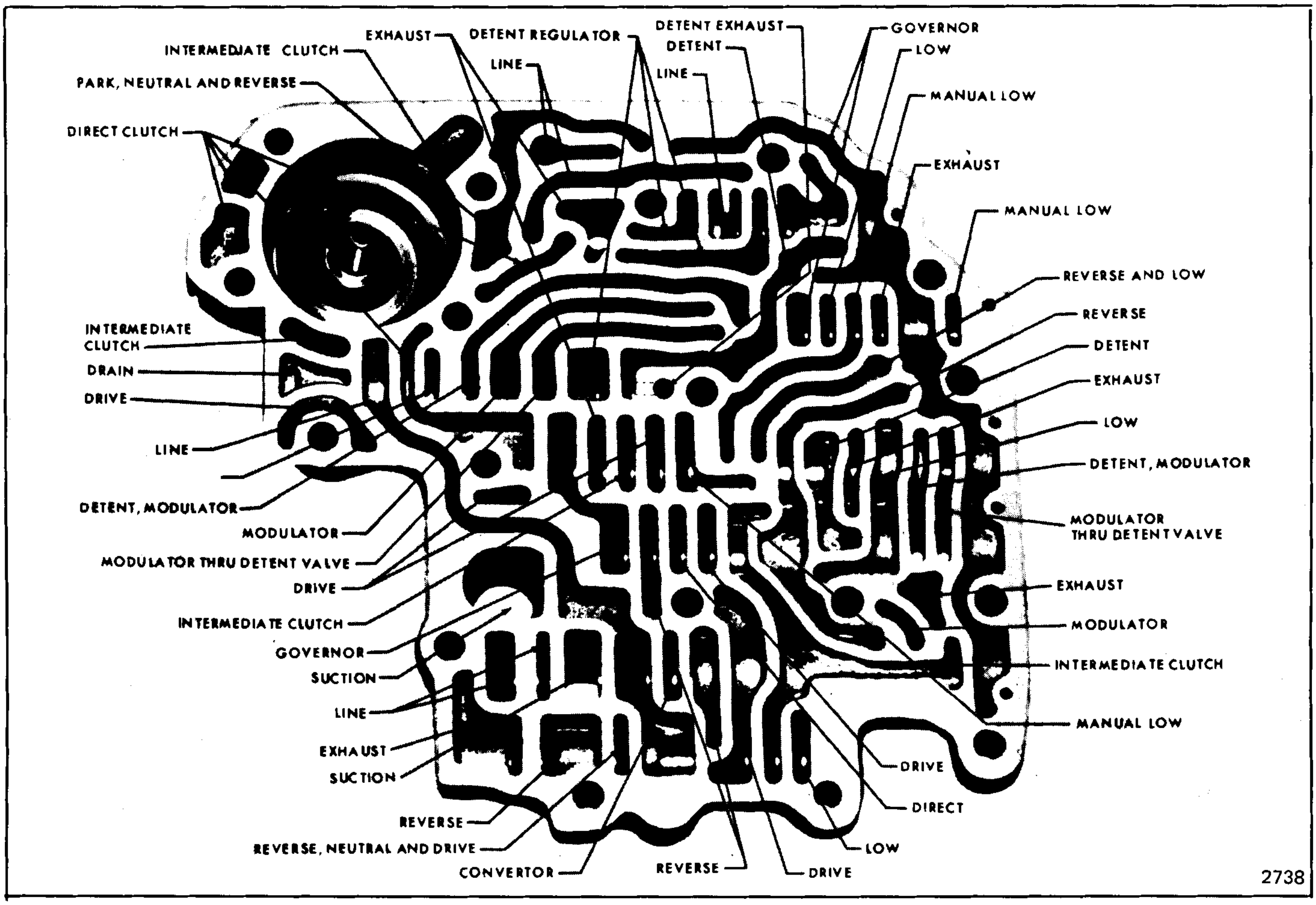


Fig. 7A3-4 Valve Body - Oil Passages

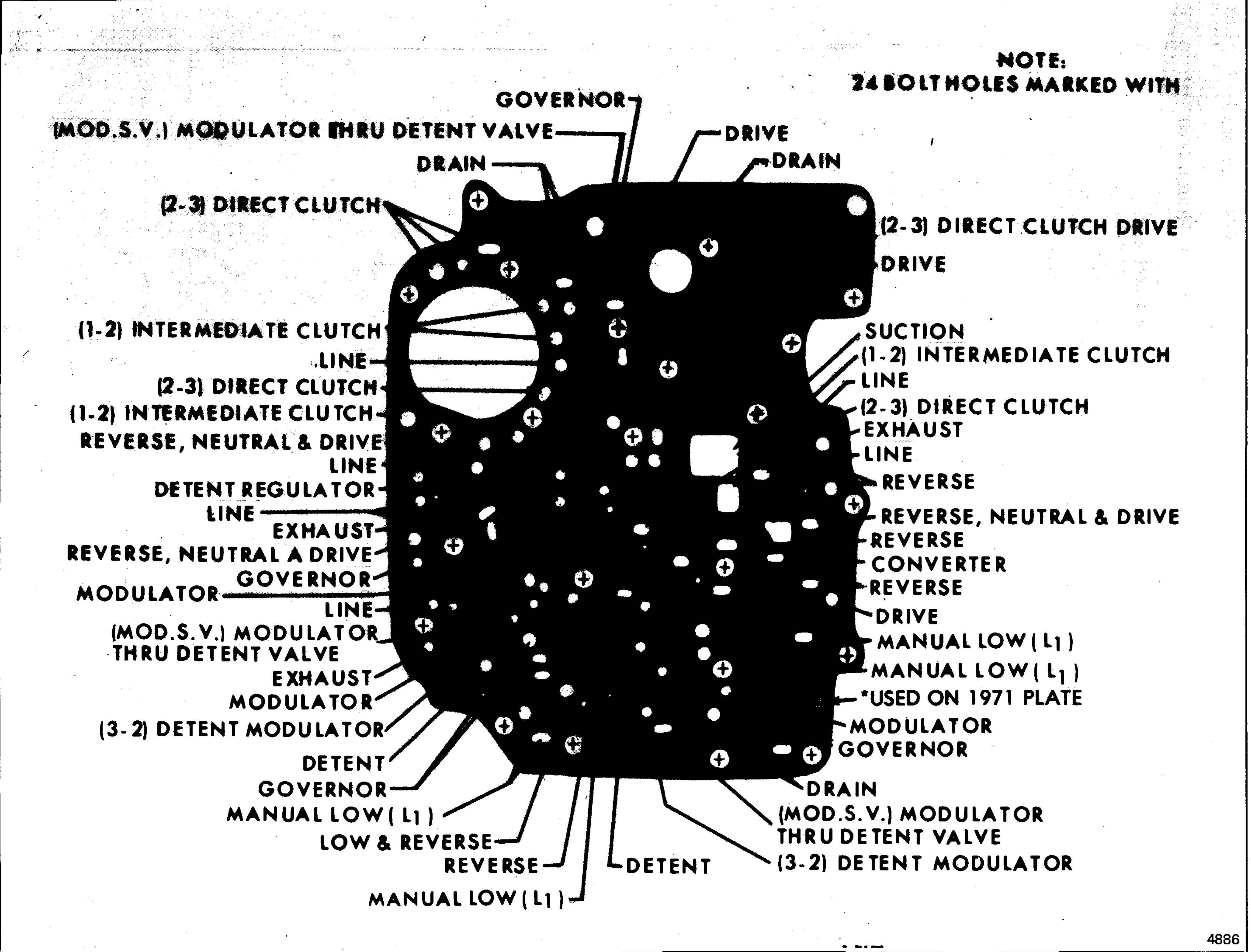


Fig. 7A3-5 Valve Body-Spacer Plate (Typical)

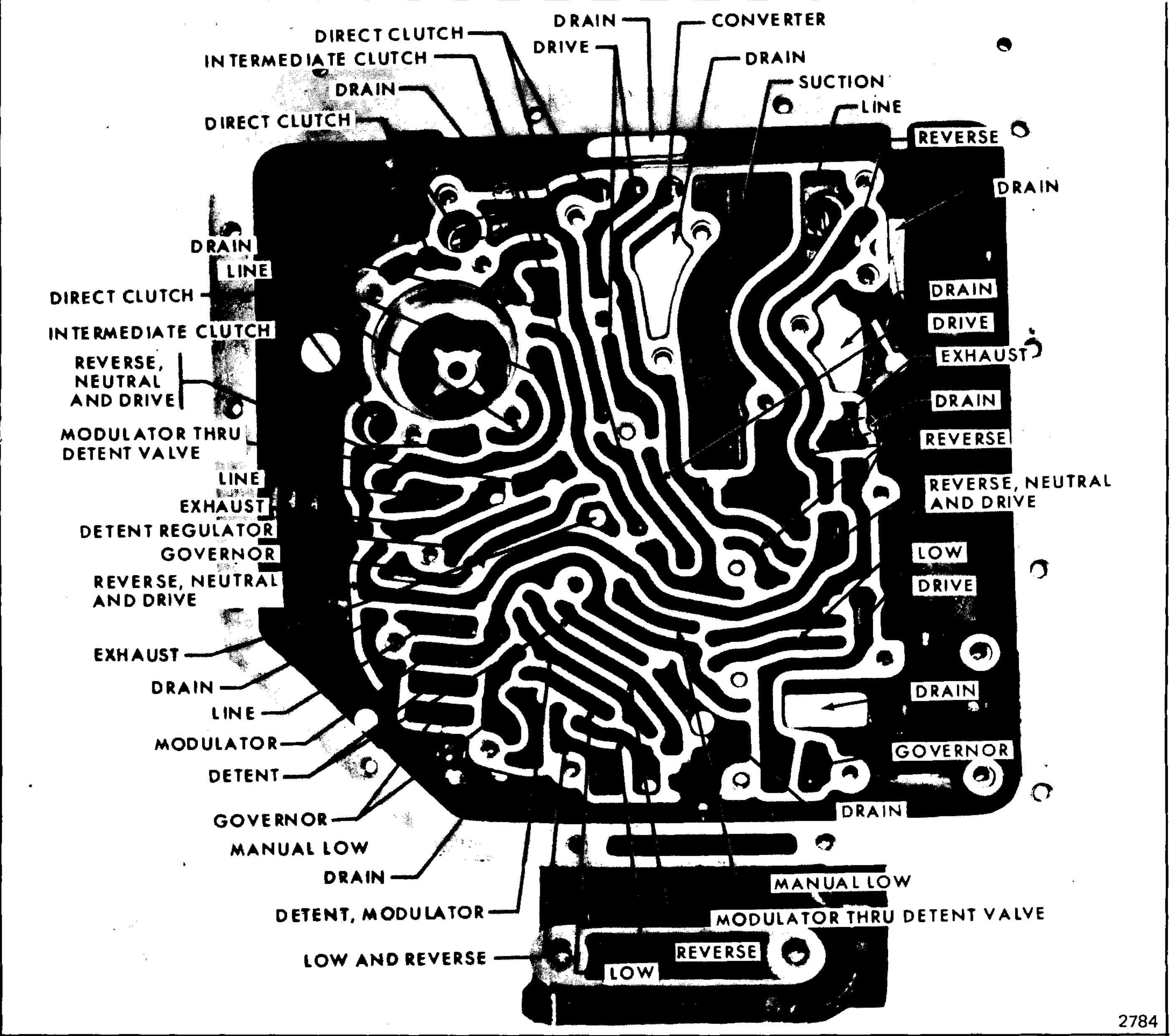


Fig. 7A3-6 Case Oil Channels - Bottom View

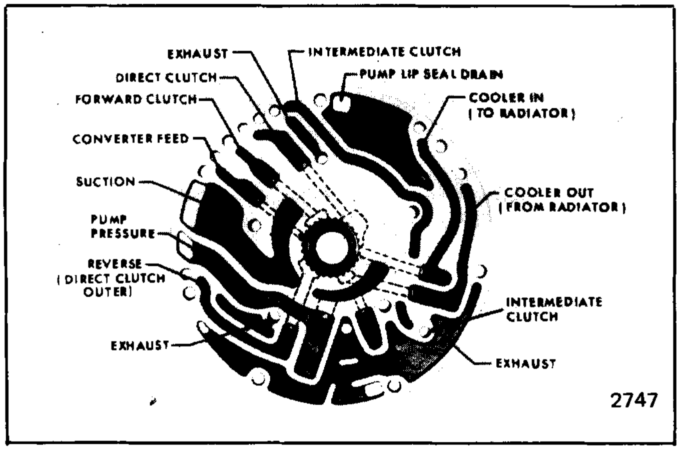


Fig. 7A3-7 Pump Cover and Stator Shaft Face - Oil Channels

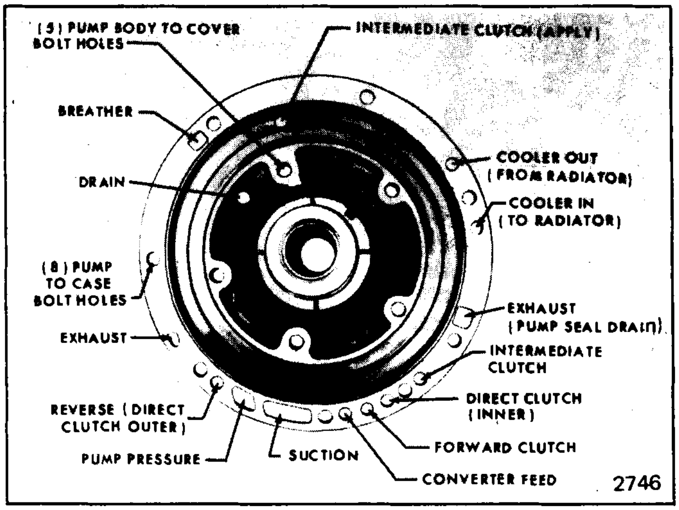


Fig. 7A3-9 Pump Cover Rear Face - Oil Channels

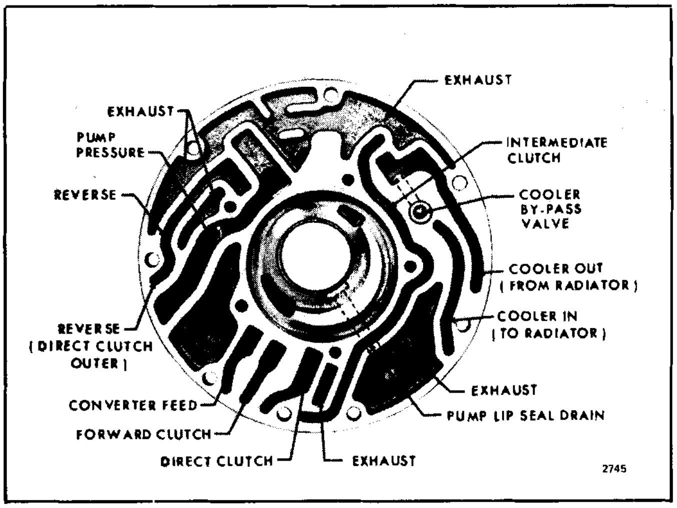


Fig. 7A3-8 Pump Body Front Face - Oil Channels

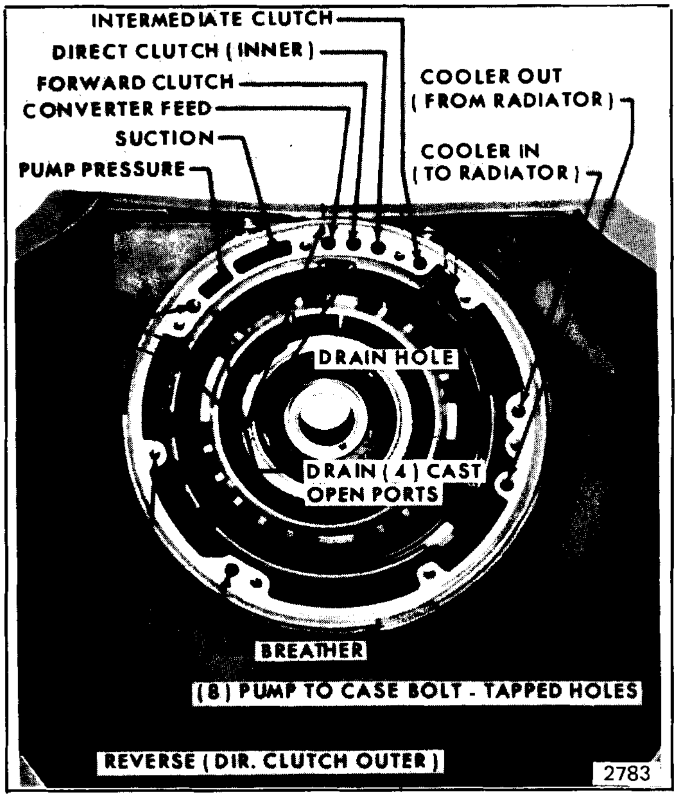


Fig. 7A3-10 Case Oil Channels - Front View

MAINTENANCE AND ADJUSTMENTS

ADJUST COLUMN SHIFT CONTROLS

1. Loosen screw on adjusting swivel clamp (Fig. 7A3-11).

2. Set transmission range selector lever in PARK detent. Obtain PARK by rotating selector lever clockwise.

3. Set upper gearshift lever in PARK position.

4. Tighten screw on adjusting swivel clamp to 20 lb. ft.

ADJUST CONSOLE SHIFT CONTROLS

1. Disconnect shift cable from transmission range selector lever by removing nut from pin (Fig. 7A3-12).

2. Adjust back drive linkage by following procedures under Column Shift Controls above.

3. After adjusting column controls, unlock ignition and rotate transmission range selector lever counterclockwise two detent positions.

4. Set console gearshift lever in NEUTRAL range and move it forward against its stop in neutral.

5. Assemble shift cable and pin to transmission range selector lever, allowing cable to position pin in slot of lever and then install and tighten nut to 20 lb. ft. torque.

ADJUST NEUTRALIZER SWITCH

Refer to Chassis Electrical Section.

ADJUST DOWNSHIFT (DETENT) CONTROL CABLE

The downshift cable is adjusted under the hood at the carburetor in the following manner (Fig. 7A3-13):

1. With engine off and throttle valves closed (carburetor off fast idle), position the "snap lock" button in its unlocked position.

2. Rotate and hold the carburetor over against the wide open throttle stop.

3. Push "snap lock" into its locked position and release the carburetor lever.

REPLACING DOWNSHIFT (DETENT) CONTROL CABLE

When replacing the downshift (detent) cable, it should first be disconnected from the carburetor lever. This will provide slack in the cable so that it may easily disconnect at its transmission end (Fig. 7A3-13, View C).

CAUTION: *When removing or installing downshift cable, do not rock the plastic fitting as it is being removed from, or inserted into, the transmission case. This plastic fitting can be broken through its O-ring groove if mishandled. It should be removed by pulling straight out of the case and installed by pushing straight into the transmission case.*

FLUID RECOMMENDATIONS

Automatic transmissions are frequently overfilled because the fluid level is checked when the fluid is cold and the dipstick indicates fluid should be added. However, the low reading is normal since the level will rise as the fluid temperature increases. A level change of over 3/4 inch will occur as fluid temperature rises from 60° to 180°F. (16° to 82°C.).

Overfilling can cause foaming and loss of fluid through the vent. Slippage and transmission failure can result.

Fluid level too low can cause slipping, particularly when the transmission is cold or the car is on a hill.

Check the transmission fluid level with the engine running, the shift lever in Park, and the car level.

NOTE: If the vehicle has recently been operated for an extended period at high speed or in city traffic in hot weather or the vehicle is being used to pull a trailer, an accurate fluid level cannot be determined until the fluid has cooled down, usually about 30 minutes after the vehicle has been parked.

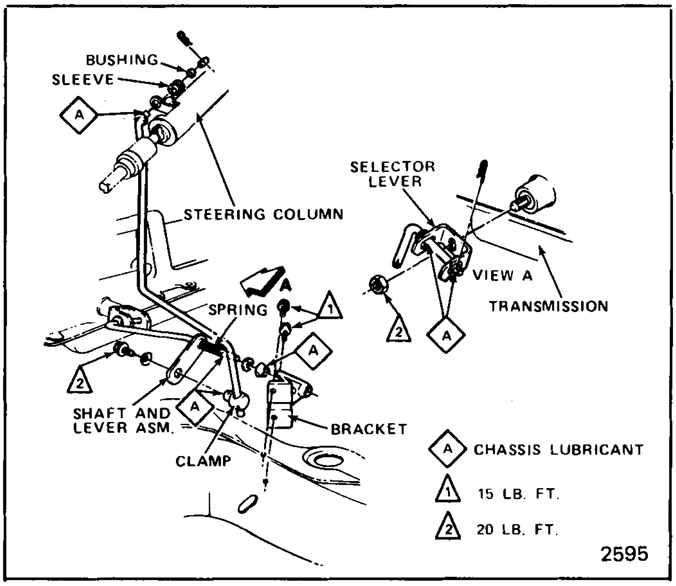


Fig. 7A3-11 Column Shift Controls (Typical)

Remove the dipstick and touch the transmission end of the dipstick cautiously to find out if the fluid is cool, warm or hot.

Wipe it clean and re-insert until cap seats. Remove dipstick and note reading.

- If the fluid feels cool, about room temperature 65° to 85°F. or (18° to 29°C.), the level should be between the two dimples below the "ADD" mark.
- If it feels warm the level should be close to the "ADD" mark (either above or below).
- If it feels hot (cannot be held comfortably) the level should be between the "ADD" and "FULL" marks. See Fig. 7A3-14.

Fluid Drain Intervals

The transmission operating temperature resulting from the type of driving conditions under which your vehicle is used is the main consideration in establishing the proper frequency of transmission fluid changes.

Change the transmission fluid and filter every 15,000 miles if the vehicle is usually driven under one or more of the following conditions which are considered severe transmission service:

- In heavy city traffic.
- Where the outside temperature regularly reaches 90°F. (32°C.).
- In very hilly or mountainous areas.
- Frequent trailer pulling.
- Commercial use, such as taxi, police car or delivery service.

If you do not use your vehicle under any of these conditions, change the fluid and filter every 60,000 miles.

TURBO HYDRA-MATIC 350 TOWING INSTRUCTIONS

If a car equipped with Turbo Hydra-matic 350 transmission must be towed, the following precautions must be observed:

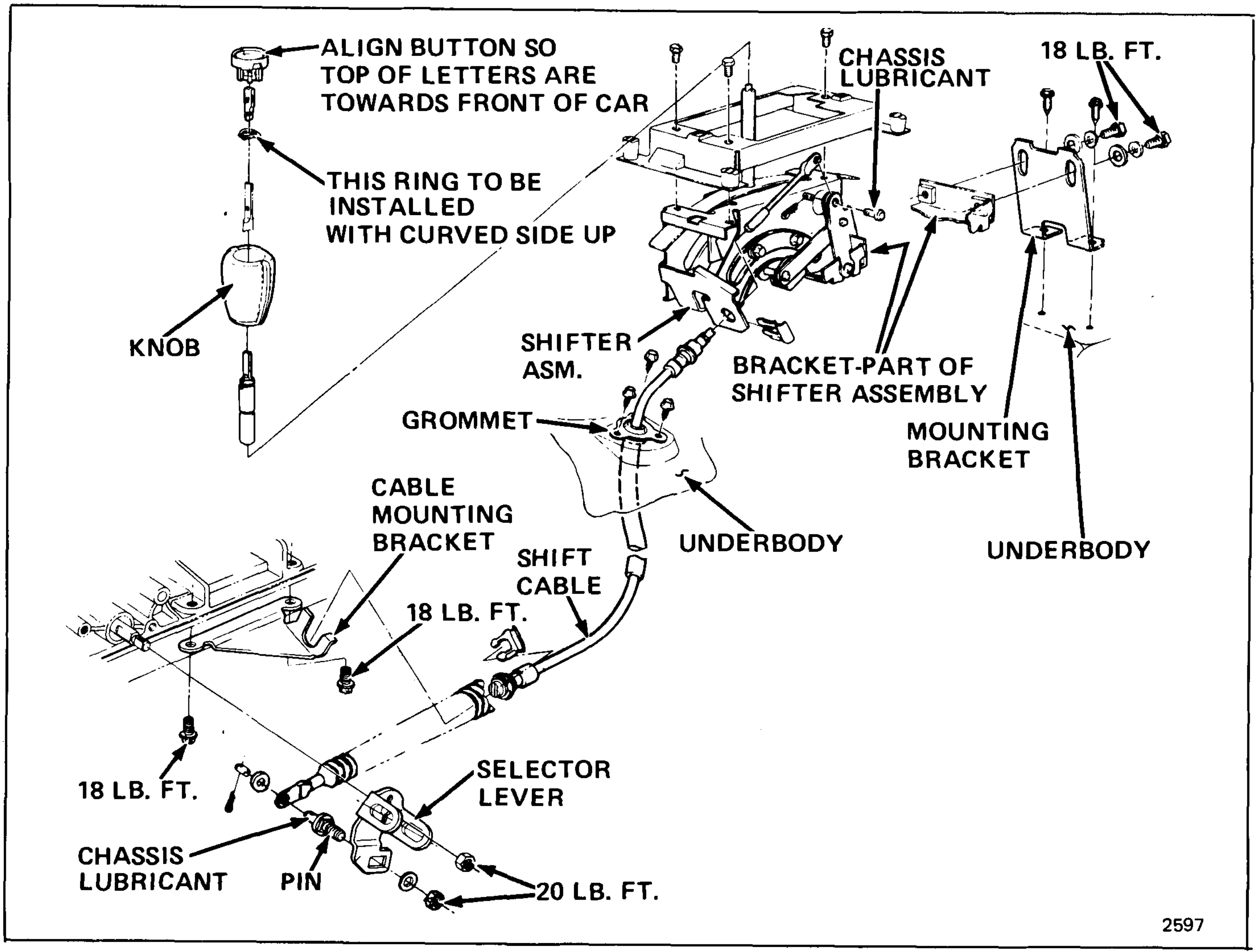


Fig. 7A3-12 Console Shift Controls (Typical)

The car may be towed safely on its rear wheels with shift lever in neutral position at speeds of 35 miles per hour or less under most conditions.

However, the drive shaft must be disconnected or the car towed on its front wheels if tow speeds in excess of 35 mph are necessary.

Car must be towed for extended distances (over 50 miles) or if transmission is not operating properly.

If car is towed on its front wheels, the steering wheel should be secured to keep the front wheels in a straight-ahead position.

ROCKING CAR

If it becomes necessary to rock the car to free it from sand, mud or snow, move the selector lever from D to R in a repeat pattern while simultaneously applying moderate pressure to the accelerator. Do not race engine. Avoid spinning wheels when trying to free the car.

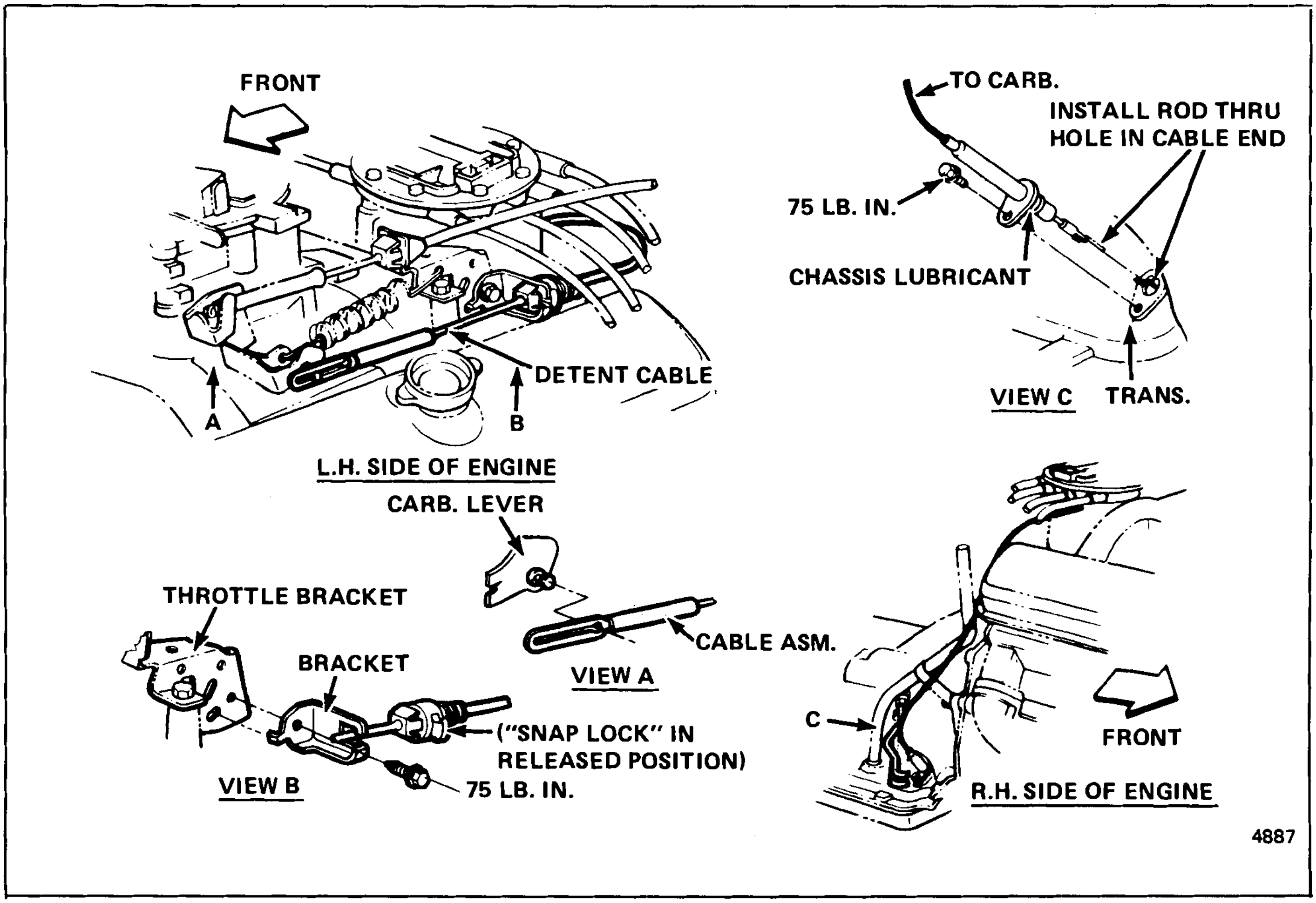


Fig. 7A3-13 Downshift (Detent) Control Cable (Typical)

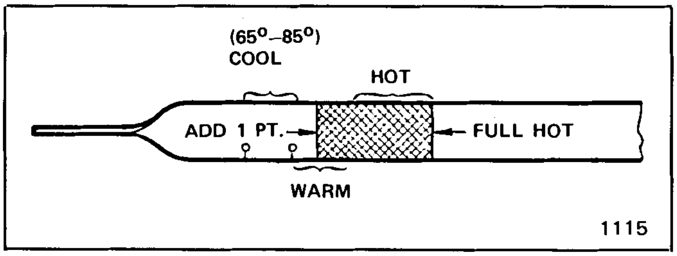


Fig. 7A3-14 Transmission Dipstick

ON-CAR SERVICE

REMOVAL OF SPEEDOMETER DRIVE GEAR AND GOVERNOR

Removal and Installation of Speedometer Drive Gear

Removal

1. Remove propeller shift and extension housing.
2. Depress retaining clip and remove drive gear from output shaft (Fig. 7A3-15).

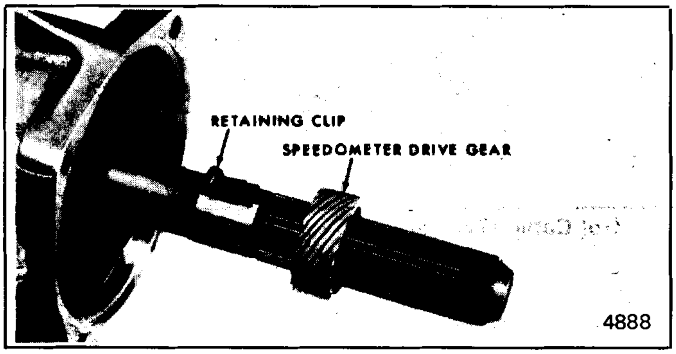


Fig. 7A3-15 Speedometer Drive Gear and Clip

Installation

1. Align slot in speedometer drive gear with retaining clip and install (Fig. 7A3-16).

Removal of Governor

1. Remove governor cover and "O" ring seal from case. Aid removal of cover with screwdriver. Use extreme care not to damage cover. If cover is damaged it must be replaced.
2. Remove "O" ring seal from governor cover and replace. See Fig. 7A3-17.
3. Withdraw governor assembly from case (Fig. 7A3-18).

Check governor bore and governor sleeve for scoring.

The governor should be replaced only if the O.D. surface of the sleeve is scored, the carrier is loose on the sleeve, or the valve is sticking in the sleeve, after a thorough cleaning has been attempted.

Refer to Section 7A4 (400 THM) for governor overhaul procedures.

Draining Oil Pan and Replacing Filter Assembly

With transmission in the car:

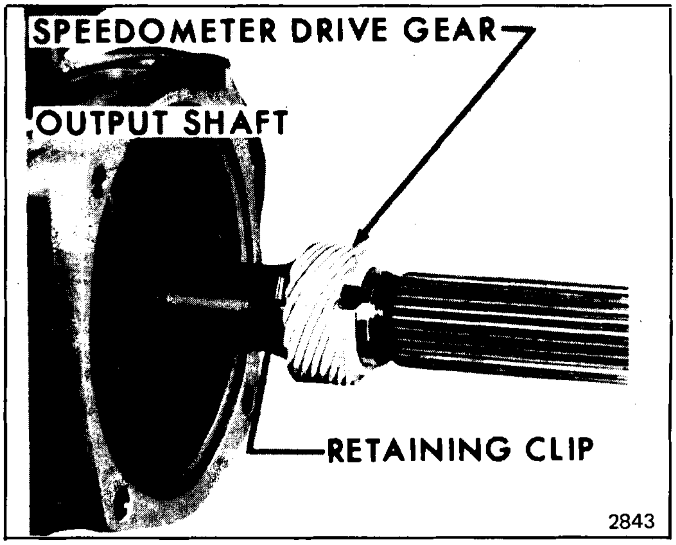


Fig. 7A3-16 Drive Gear Installed

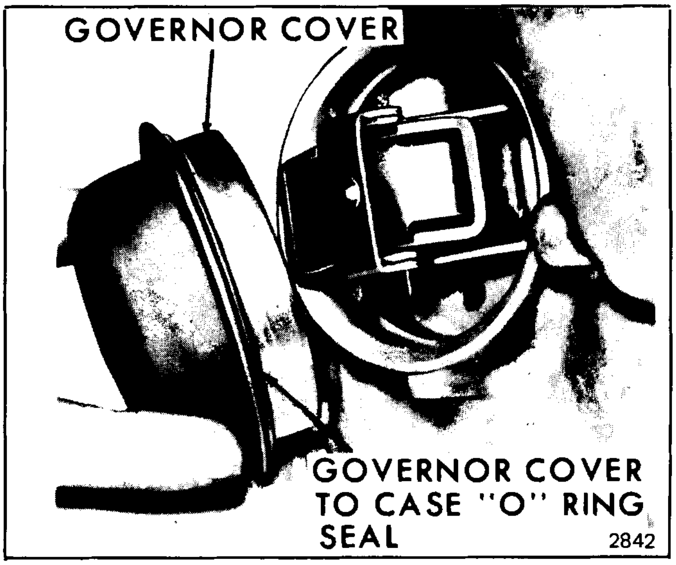


Fig. 7A3-17 Removing Governor Cover

1. Raise car on hoist or place on jack stands, and provide container to collect draining fluid. Care should be taken if transmission is hot.

2. Remove oil pan and gasket. Discard gasket.

3. Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.

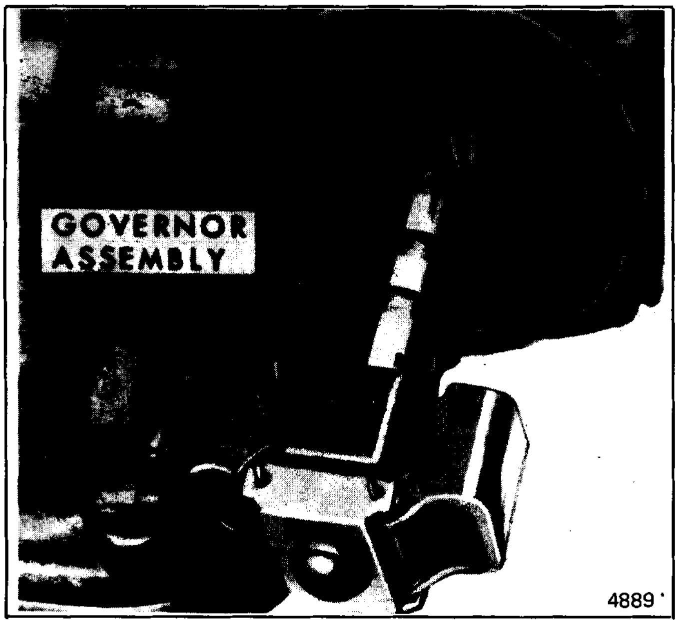


Fig. 7A3-18 Removing Governor Assembly

4. Remove filter assembly and gasket.

5. Install new oil filter to valve body gasket on filter. Install new filter assembly.

6. Install new gasket on oil pan and install pan. Tighten attaching bolts to 13 lb. ft.

7. Lower car and add 3 pints of transmission fluid through filler tube.

8. With manual control lever in Park position, start engine. DO NOT RACE ENGINE. Move manual control lever through each range.

9. Immediately check fluid level with selector lever in Park, engine running, and vehicle on LEVEL surface.

10. Add additional fluid to bring level between the two small dimples located below the "ADD" mark on the dipstick. Do not overfill.

REMOVAL OF OIL PAN, OIL FILTER AND VALVE BODY

Removal of Oil Pan

1. Remove (13) oil pan attaching screw and washer assemblies, oil pan and gasket.

Removal of Oil Filter

1. Remove two (2) filter assembly to valve body attaching screws (Fig. 7A3-19).

2. Remove filter and gasket from valve body (Fig. 7A3-20).

Removal of Valve Body

1. Remove detent roller and spring assembly from valve body. Remove valve body to case attaching bolts (Fig. 7A3-21).

2. Remove valve body from case while carefully guiding manual valve link from range selector inner lever. Remove detent control valve link from detent actuating lever.

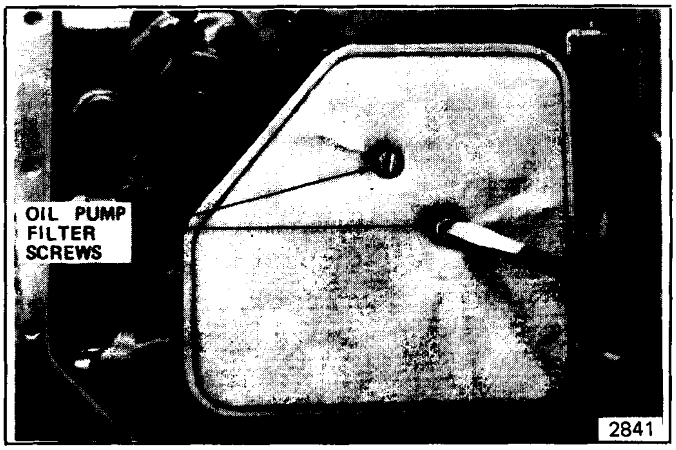


Fig. 7A3-19 Removing Filter Attaching Screws

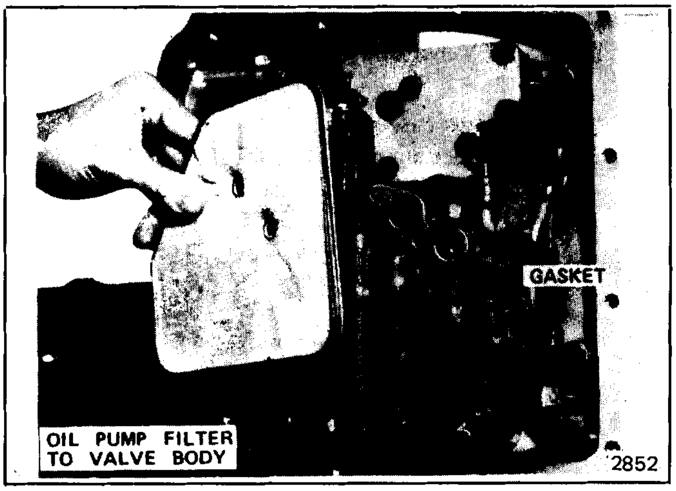


Fig. 7A3-20 Removing Filter and Gasket

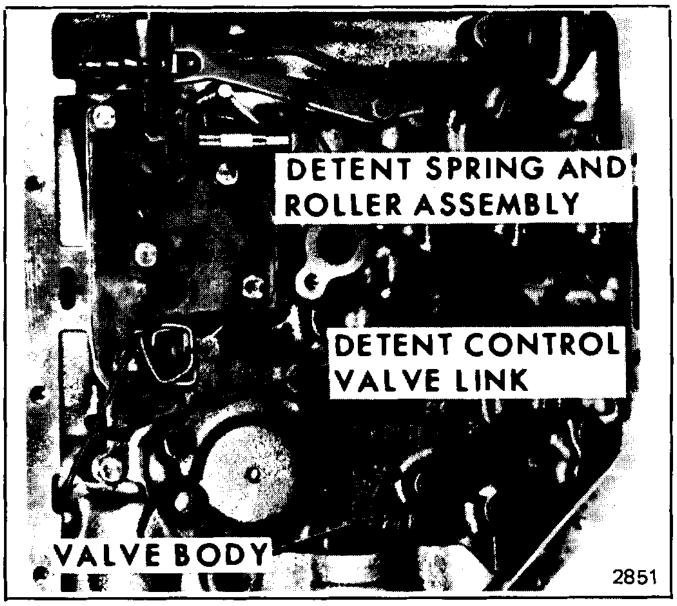


Fig. 7A3-21 Valve Body Assembly

3. Remove valve body to spacer plate gasket (Fig. 7A3-22).

The spacer plate to valve body will have a new gasket with a yellow ink stripe. The yellow ink stripe is necessary for identification purposes. The gasket is now almost identical

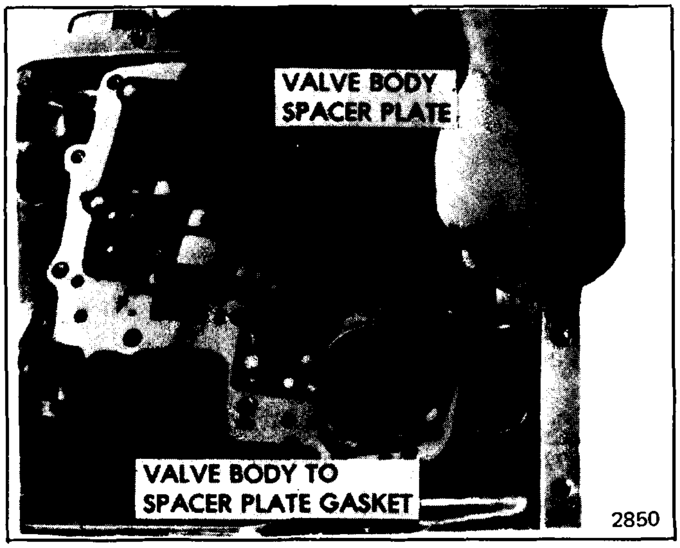


Fig. 7A3-22 Valve Body to Spacer Plate Gasket

to the spacer plate to case gasket.

4. Remove spacer support plate (Fig. 7A3-23).

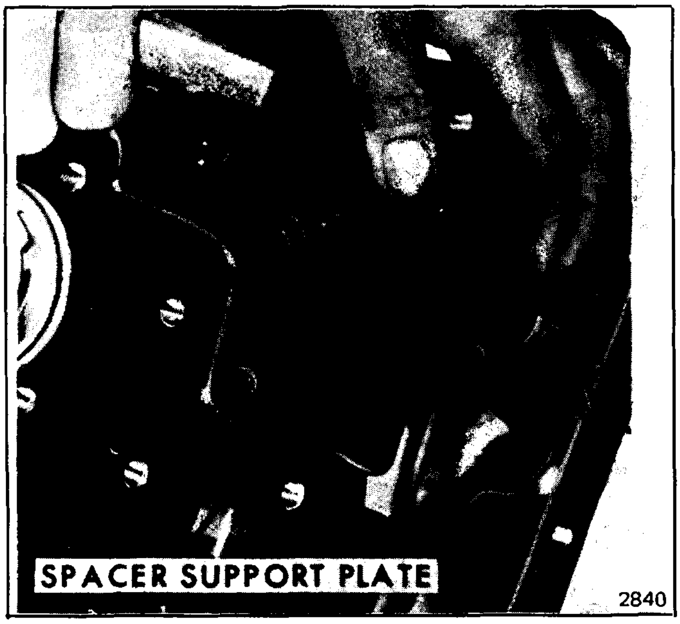


Fig. 7A3-23 Removing Support Plate

5. Remove valve body spacer plate and valve body spacer plate to case gasket (Fig. 7A3-24). Be sure to note position of the four (4) plastic check balls so they are assembled correctly (Fig. 7A3-25).

CASE POROSITY REPAIR

Turbo Hydra-matic 350 transmission external oil leaks caused by case porosity can be successfully repaired with the transmission in the car by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 190°F. (85°C.).

2. Raise car on hoist or jack stand, engine running, and locate source of oil leak. Check for oil leaks in Low, Drive and Reverse.

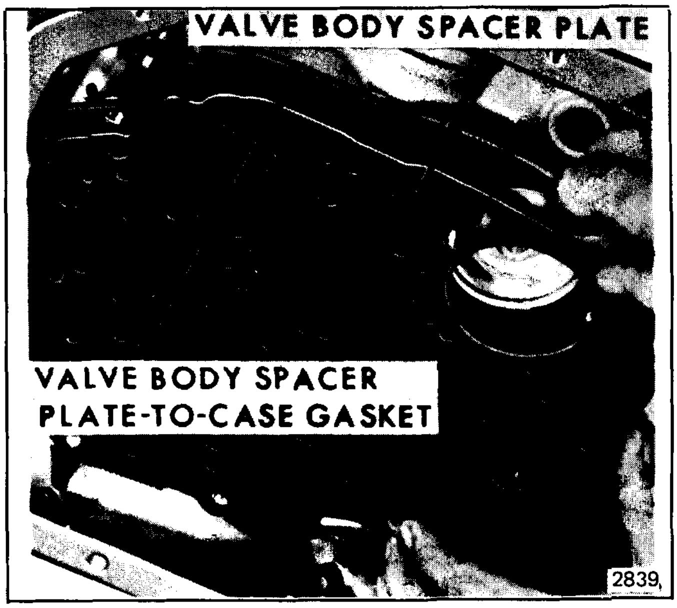


Fig. 7A3-24 Removing Spacer Plate and Gasket

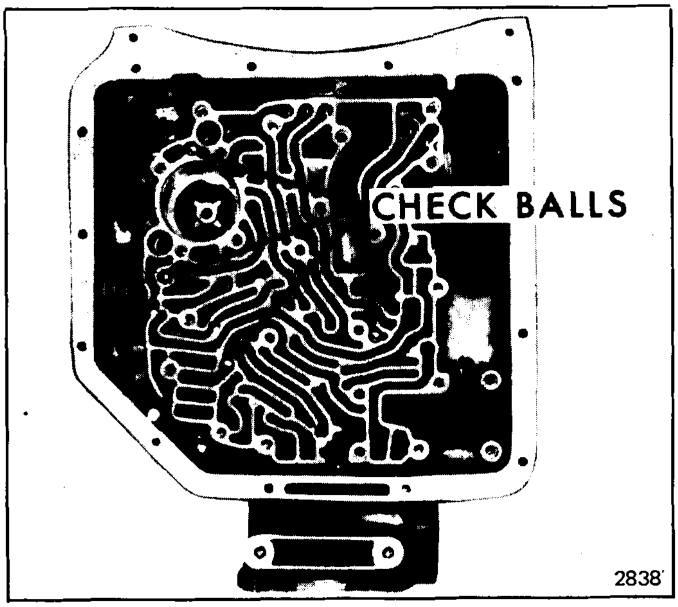


Fig. 7A3-25 Location of Check Balls

3. Shut engine off and thoroughly clean area to be repaired with a suitable cleaning solvent and a brush - air dry.

A clean, dry soldering acid brush can be used to clean the area and also to apply the cement.

4. Using instructions of the manufacturer, mix a sufficient amount of epoxy (or equivalent) to make the repair. Make certain the area to be repaired is fully covered.

5. Allow cement to cure for 3 hours before starting engine.

6. Road test and check for leaks.

UNIT REPAIR

TRANSMISSION ASSEMBLY - REMOVAL AND INSTALLATION

Removal

1. Disconnect detent cable.

NOTE: H Series-remove mounting bracket.

2. Raise car on hoist.
3. H Series only-remove exhaust crossover pipe.
4. Remove flywheel inspection cover.
5. Remove flywheel to converter bolts and mark for reassembly in same position.
6. A and B Series-remove catalytic converter and bracket. X and H Series-remove bracket only.
7. Remove propeller shaft and mark for reassembly in same position. H Series-also disconnect torque arm and mount from transmission extension housing.
8. Remove rear transmission mounting pad bolts.
9. Using a transmission jack, raise transmission and remove crossmember support and mount.
10. Lower transmission, leaving jack still holding full support of transmission at lowest position.
11. Disconnect shift linkage and speedo cable.
12. Disconnect vacuum modulator line, detent cable and cooler lines.
13. Remove transmission to engine block mounting bolts and filler pipe.
14. Move transmission rearward and lower away from car, using Tool J 21366 to hold converter in place (Fig. 7A3-26).

Installation

The installation of the transmission is the reverse of removal except for the following reminder steps:

1. Torque transmission to engine block mounting bolt to 35 lb. ft.
2. Install propeller shaft in original position.
3. Connect converter and flywheel in original position and torque bolts to 30 lb. ft.
4. Lower car and, if transmission was disassembled, add 6 pints of transmission fluid (10 pints if converter was replaced) through the filler tube.
5. With the manual control lever in park position, start engine, DO NOT RACE ENGINE, apply emergency brake and move selector lever through each range.
6. With selector lever in park, engine running, check fluid level.
7. Add additional fluid to bring level between the two small dimples located below the add mark on the dipstick. This is the correct reading at room temperature, approximately 65° to 85°F. (18° to 29°C.).

PRELIMINARY INSTRUCTIONS

1. Before starting disassembly of the transmission, it should be thoroughly cleaned externally to avoid getting dirt inside.

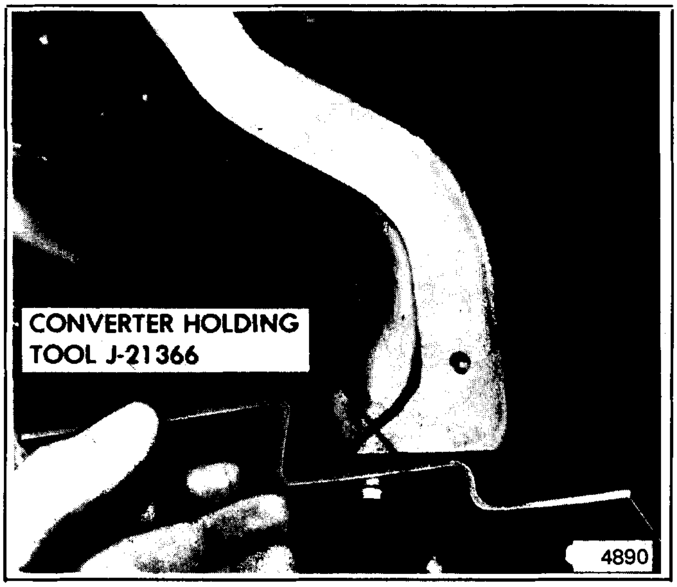


Fig. 7A3-26 Converter Holding Tool

2. Place transmission on a CLEAN work bench and use CLEAN tools during disassembly. Provide clean storage space for parts and units removed from transmission.
3. The transmission contains parts which are ground and highly polished, therefore, parts should be kept separated to avoid nicking and burring surfaces.
4. When disassembling transmission, carefully inspect all gaskets at times of removal. The imprint of parts on both sides of an oil gasket will show whether a good seal was obtained. A poor imprint indicates a possible source of oil leakage due to gasket condition, looseness of bolts or uneven surfaces of parts.
5. None of the parts require forcing when disassembling or assembling transmission. Use a rawhide or plastic mallet to separate tight fitting cases - do not use a hard hammer.

REMOVAL OF CONVERTER HOLDING TOOL J 21366, CONVERTER AND VACUUM MODULATOR

Removal of Converter

1. Assemble transmission in Fixture J 8763. Do not overtighten (Fig. 7A3-27).
2. Remove Converter Holding Tool J 21366.
3. With transmission in Holding Fixture J 8763, remove torque converter assembly (Fig. 7A3-28).

Removal of Vacuum Modulator

1. Remove modulator assembly attaching bolt and retainer. (Fig. 7A3-29).
2. Remove vacuum modulator assembly "O" ring seal and modulator valve from case (Fig. 7A3-30).

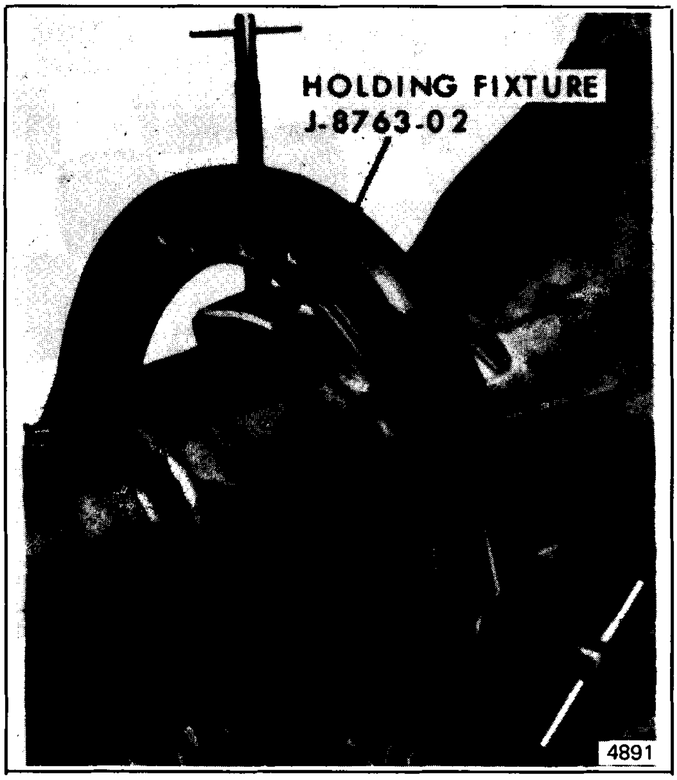


Fig. 7A3-27 Transmisison In Holding Fixture

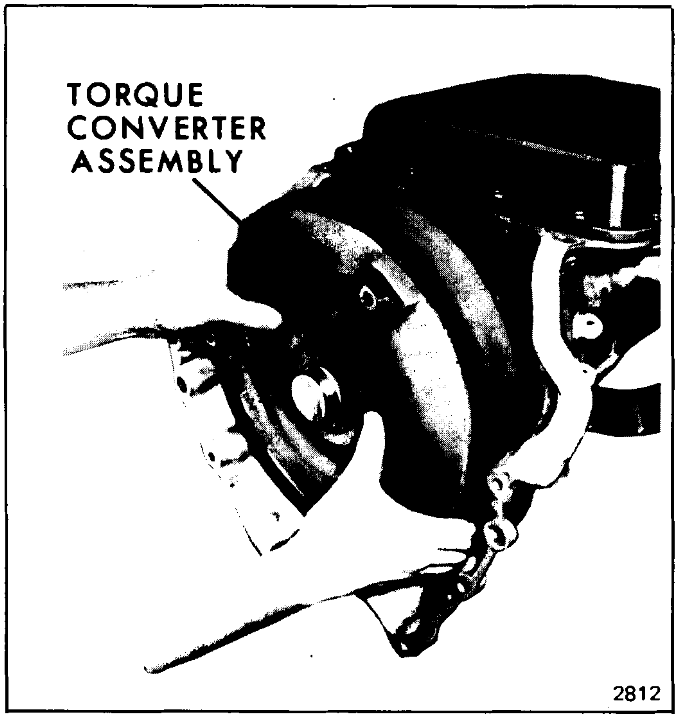


Fig. 7A3-28 Removing Torque Converter

REMOVAL OF EXTENSION HOUSING, LIP SEAL AND BUSHING

Removal of Extension Housing

1. Remove bolt retainer and speedometer driven gear from side of extension housing and remove four (4) extension housing to case attaching bolts. See Fig. 7A3-31.

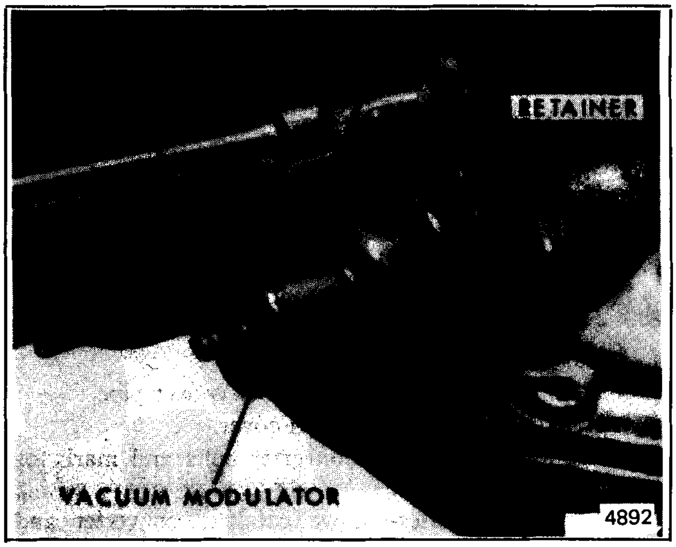


Fig. 7A3-29 Removing Modulator Attaching Bolt

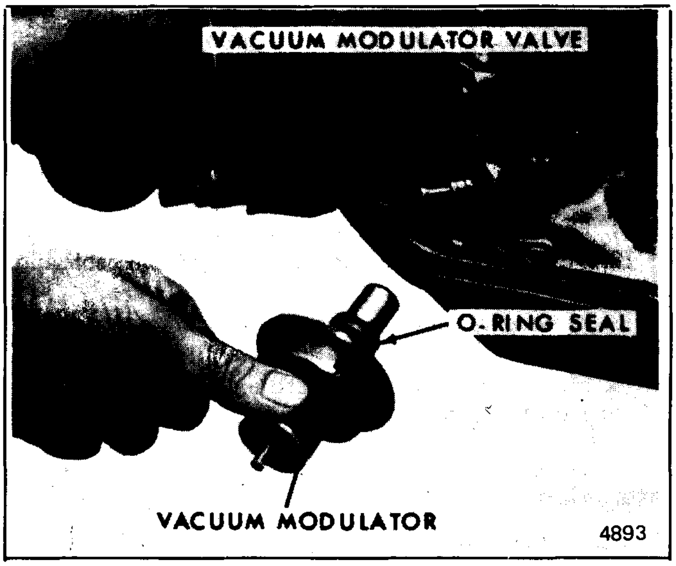


Fig. 7A3-30 Removing Modulator, Valve and O-ring Seal

Removal of Extension Housing Seal

1. Remove extension housing to case oil seal (Fig. 7A3-32).

Removal of Extension Housing Lip Seal

1. Remove extension housing lip seal using screwdriver (Fig. 7A3-33).

Removal of Extension Housing Bushing

1. Remove extension housing bushing using screwdriver to collapse bushing (Fig. 7A3-34).

INSTALL EXTENSION HOUSING BUSHING AND LIP SEAL

Installation of Extension Housing Bushing

1. Install extension housing bushing using Drive Handle J 8092 and Bushing Tool J 21424-1 (Fig. 7A3-35).

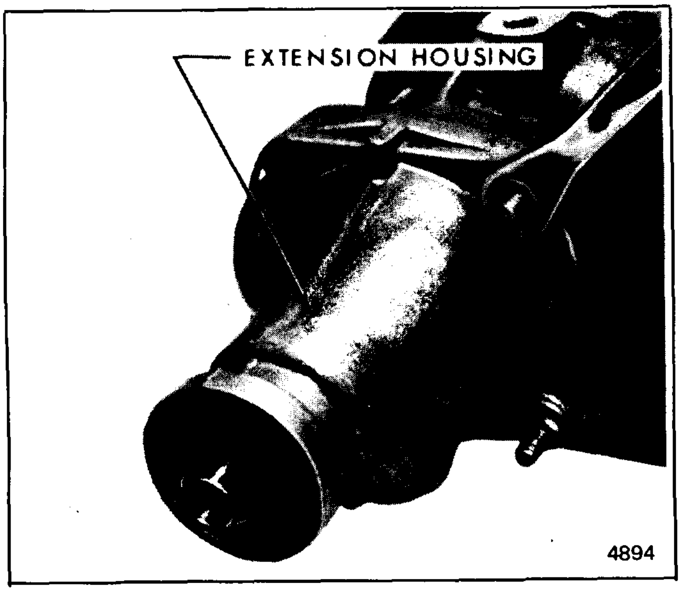


Fig. 7A3-31 Removing Extension to Case Bolts

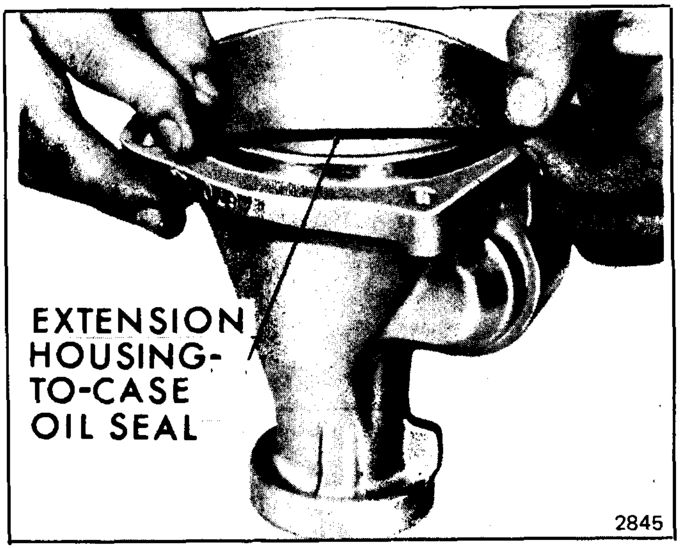


Fig. 7A3-32 Removing Extension Housing Oil Seal

Installation of Extension Housing Lip Seal

1. Install extension housing lip seal using Installer J 21426 (Fig. 7A3-36).

REMOVAL OF OIL PUMP SCREEN, GOVERNOR, SCREENS AND CHECK BALLS

Remove oil pan, oil filter and valve body as described in On-Car Service.

Removal of Pressure Screen

1. Remove oil pump pressure screen from oil pump pressure hole in case and clean (Fig. 7A3-37).
2. Remove governor screens from case and clean (Fig. 7A3-38).

Removal of Check Balls

1. Remove four check balls from case face (Fig. 7A3-25).

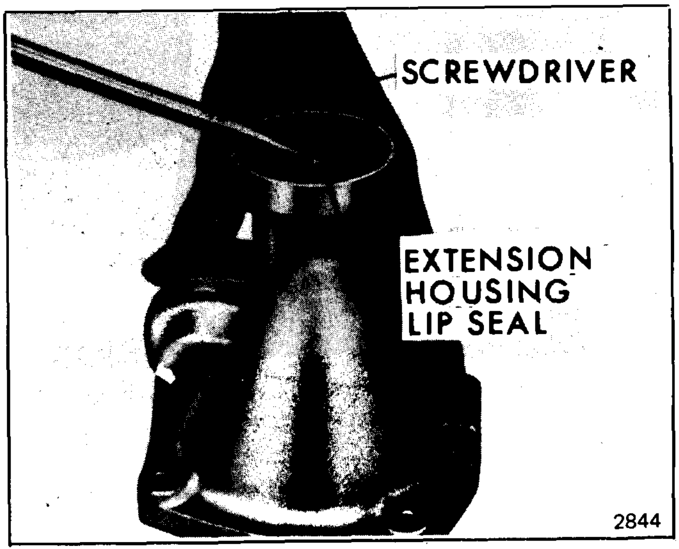


Fig. 7A3-33 Removing Lip Oil Seal

Fig. 7A3-34 Collapsing Extension Housing Bushing

REMOVAL OF MANUAL SHAFT, INNER LEVER, PARKING PAWL, AND INTERMEDIATE SERVO PISTON

Removal of Range Selector Inner Lever

1. Remove manual control valve link retainer from range selector inner lever.
2. Remove manual shaft to case retainer with screwdriver (Fig. 7A3-39).
3. Remove jam nut holding range selector inner lever to manual shaft.
4. Remove manual shaft from case. Remove range selector inner lever and parking pawl actuating rod.
5. Remove manual shaft to case lip seal, if necessary (Fig. 7A3-40).

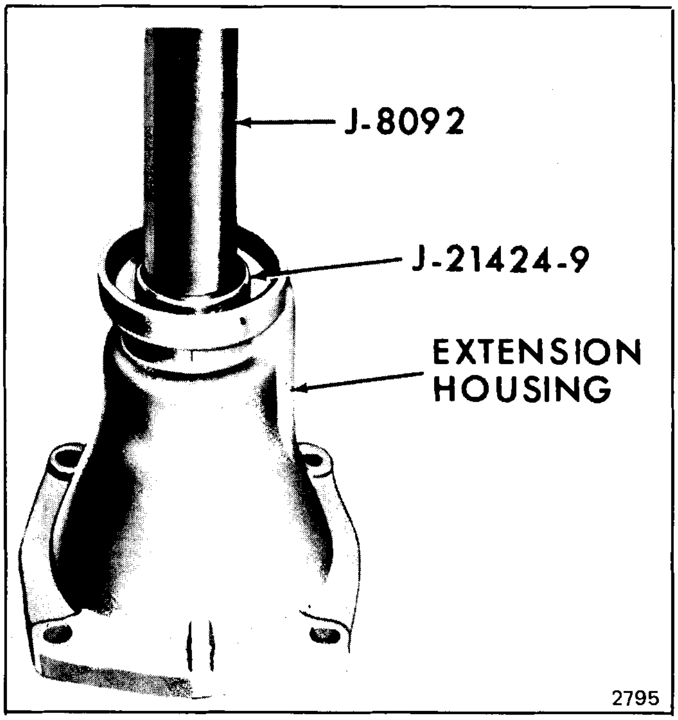


Fig. 7A3-35 Installing Extension Housing Bushing

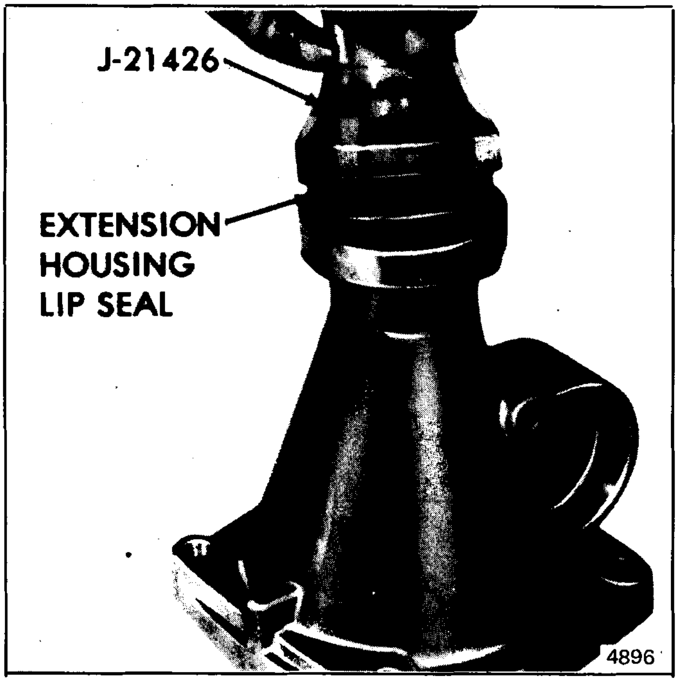


Fig. 7A3-36 Installing Lip Oil Seal

6. Remove park lock bracket (Fig. 7A3-41).

7. Remove parking pawl shaft retaining plug stake marks.

8. Using #4 easy out, remove parking pawl shaft retaining plug.

9. Remove retaining plug, parking pawl shaft, parking pawl and disengaging spring (Fig. 7A3-42).

Removal of Intermediate Servo Piston

1. Remove intermediate servo piston, washer, spring seat and apply pin (Fig. 7A3-43).

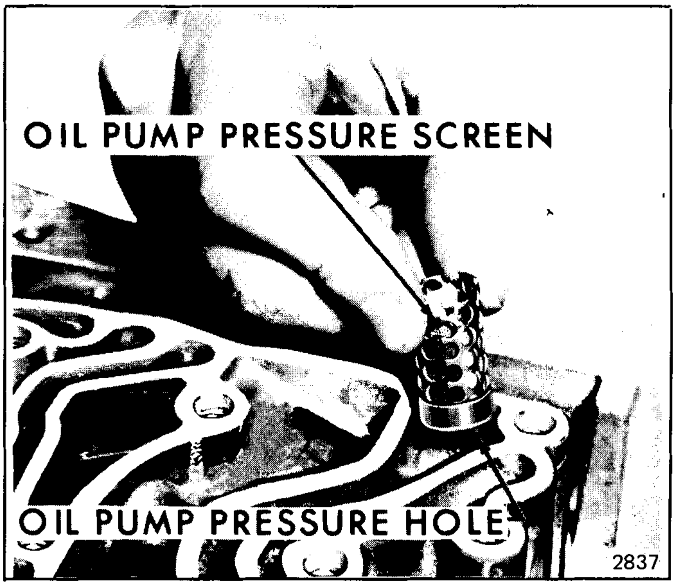


Fig. 7A3-37 Removing Pump Pressure Screen

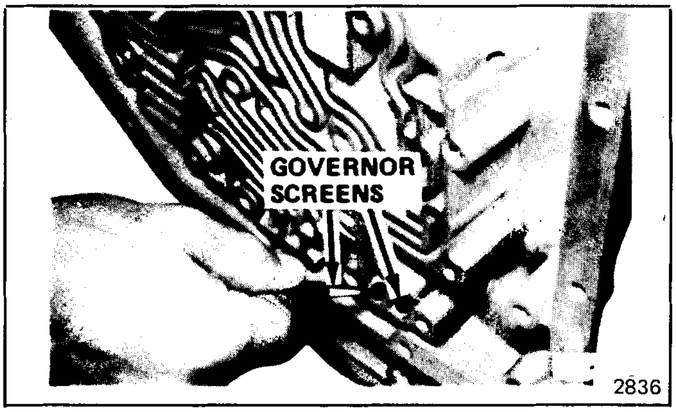


Fig. 7A3-38 Cleaning Governor Screen

2. If the piston seal needs replacing, the piston assembly will have to be replaced. This is due to a plastic grooved piston that is not serviceable (Piston and Seal are one assembly).

REMOVAL OF PUMP ASSEMBLY, CUSHION SPRING, INTERMEDIATE CLUTCH PLATES AND OVERRUN BRAKE BAND

Removal of Oil Pump Assembly

1. Remove eight (8) pump attaching bolts with washer type seals. Discard washer type seals.

2. Install two (2) threaded slide hammers J 7004 into threaded holes in pump body. Tighten jam nuts and remove pump assembly from case (Fig. 7A3-44).

3. Remove pump assembly to case gasket and discard.

Removal of Intermediate Clutch Cushion Spring, Intermediate Clutch Plates and Intermediate Overrun Brake Band

1. Remove intermediate clutch cushion spring.

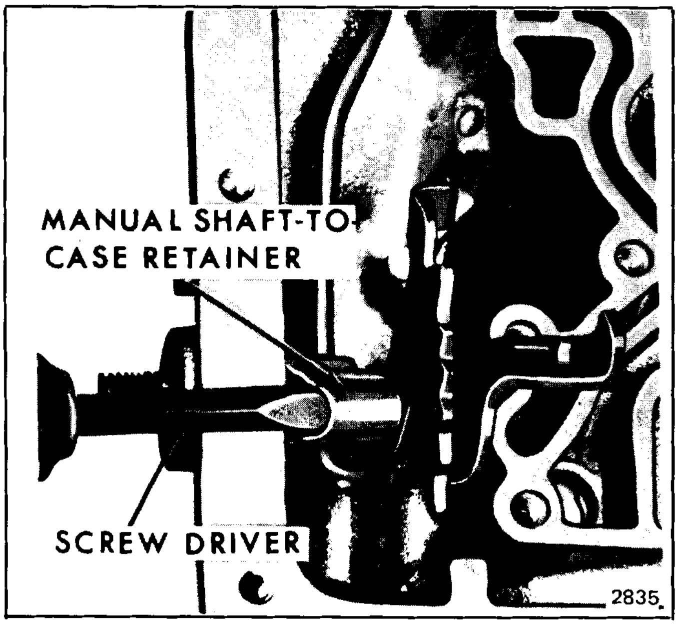


Fig. 7A3-39 Removing Manual Shaft Retainer

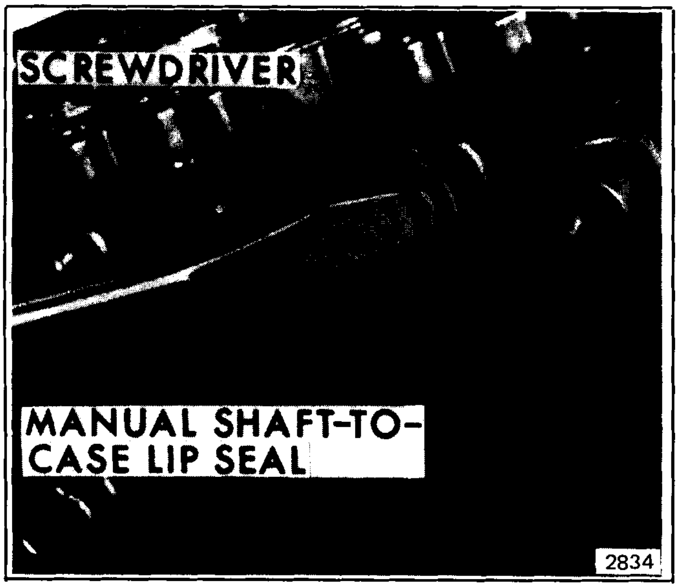


Fig. 7A3-40 Removing Manual Shaft Oil Seal

2. Remove three (3) or two (2) intermediate clutch faced plates and three (3) or two (2) steel separator plates (Fig. 7A3-45).

3. Inspect condition of the lined and steel plates. **Do not diagnose a lined drive plate by color.**

A. Dry lined plates with compressed air and inspect the lined surfaces for:

1. Pitting and flaking
2. Wear
3. Glazing
4. Cracking
5. Charring
6. Chips or metal particles imbedded in lining

If a lined drive plate exhibits any of the above conditions, replacement is required.

B. Wipe steel plates dry and check for heat discoloration.

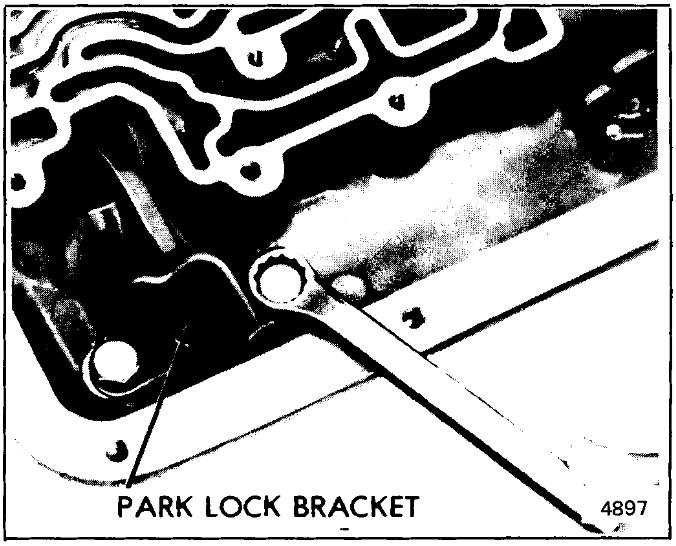


Fig. 7A3-41 Removing Park Lock Bracket

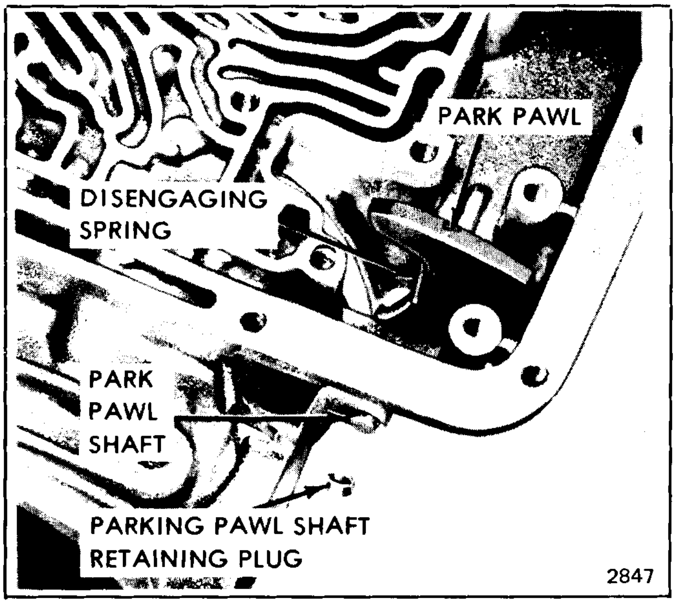


Fig. 7A3-42 Parking Pawl Assembly

If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plates must be replaced.

4. Remove intermediate clutch pressure plate.

5. Remove intermediate overrun brake band (Fig. 7A3-46).

REMOVAL OF DIRECT AND FORWARD CLUTCH ASSEMBLIES, INPUT RING GEAR AND OUTPUT CARRIER

Removal of Direct and Forward Clutch Assemblies

1. Remove direct and forward clutch assemblies from case (Fig. 7A3-47).

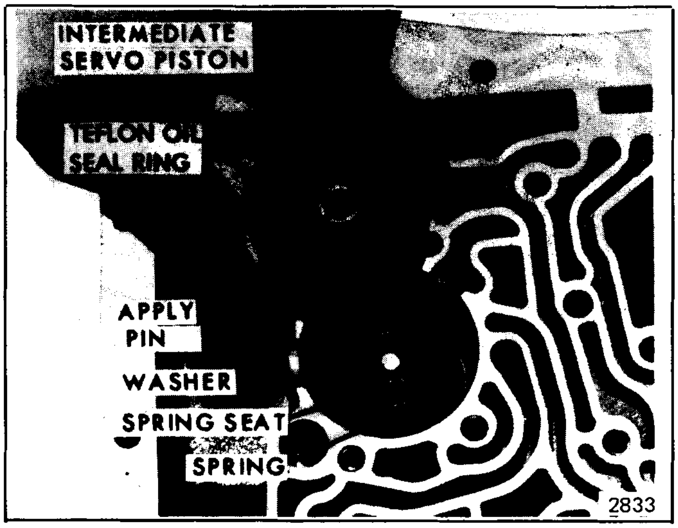


Fig. 7A3-43 Intermediate Servo Piston Assembly

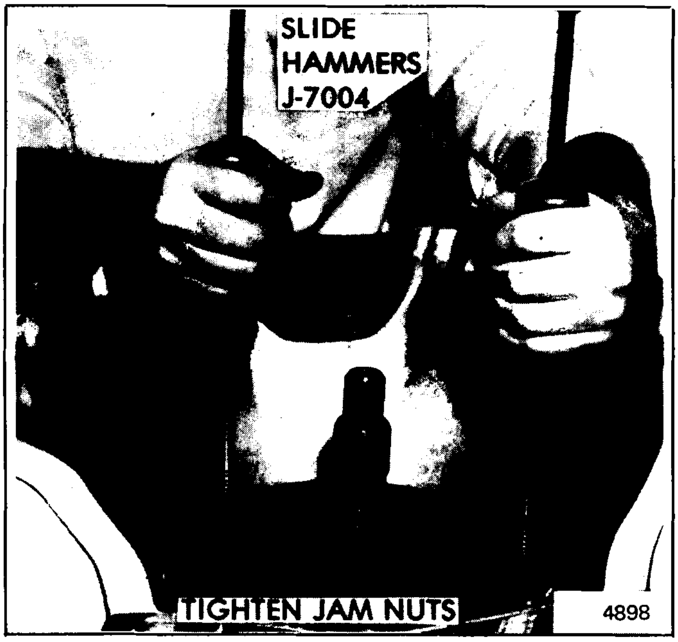


Fig. 7A3-44 Removing Pump From Case

Removal or Input Ring Gear

1. Remove forward clutch housing to input ring gear front thrust washer. Inspect for excessive wear or scoring.

2. Remove input ring gear (Fig. 7A3-48).

Removal of Output Carrier Assembly

1. Remove input ring gear to output carrier needle thrust bearing.

2. Remove output carrier to output shaft snap ring and discard (Fig. 7A3-49).

3. Remove output carrier assembly.

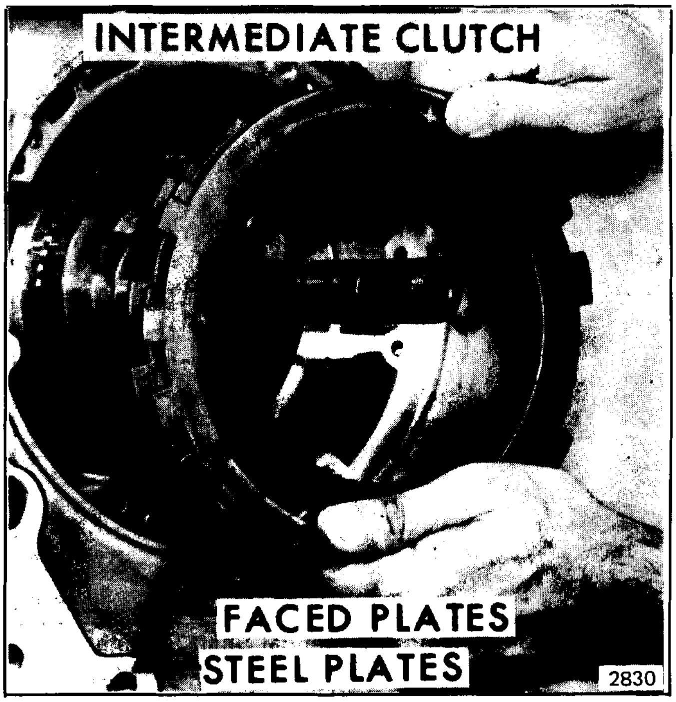


Fig. 7A3-45 Removing Intermediate Clutch Plates

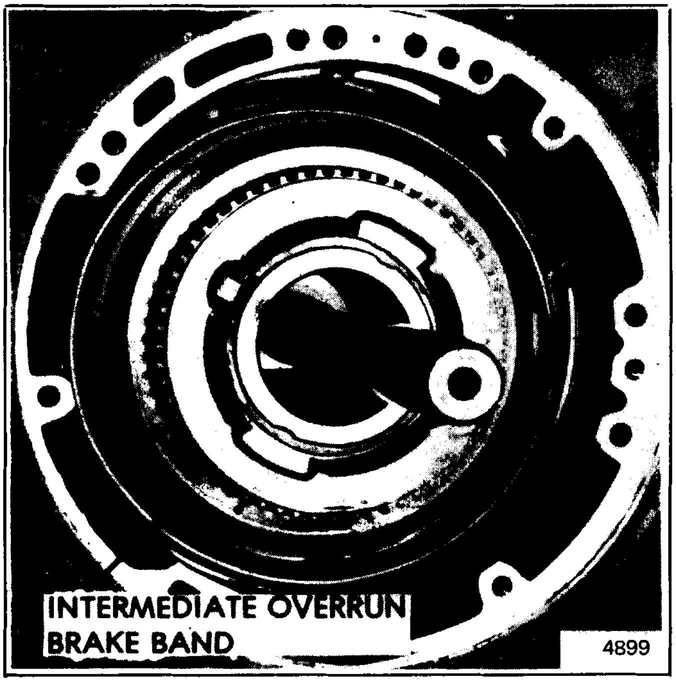


Fig. 7A3-46 Intermediate Overrun Brake Band

REMOVAL OF SUN GEAR DRIVE SHELL, LOW AND REVERSE CLUTCH SUPPORT ASSEMBLY, LOW AND REVERSE CLUTCH PLATES AND REACTION CARRIER

Removal of Sun Gear Drive Shell Assembly

1. Remove sun gear drive shell assembly (Fig. 7A3-50).

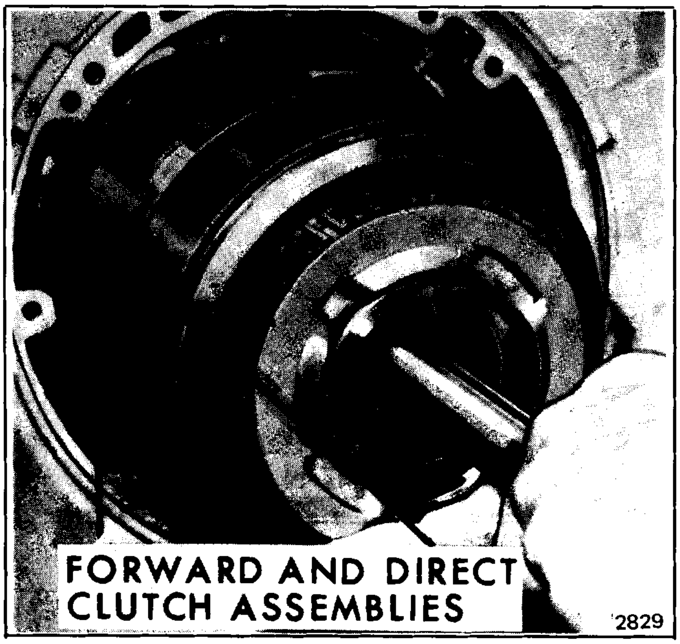


Fig. 7A3-47 Removing Clutch Assemblies

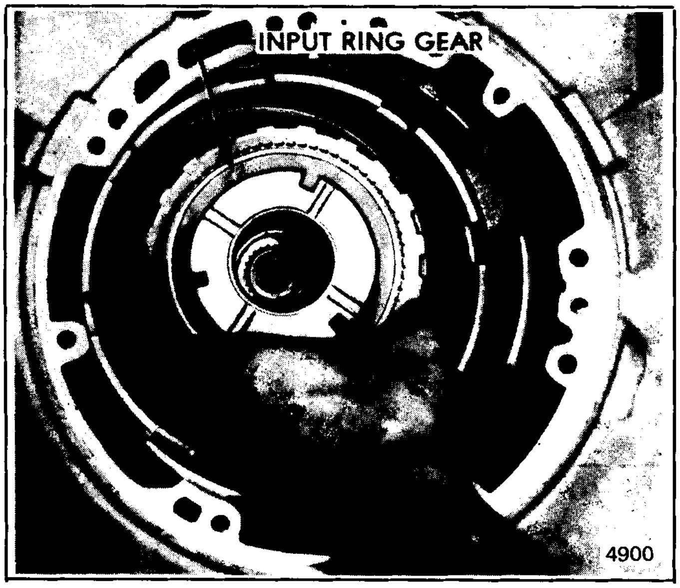


Fig. 7A3-48 Removing Input Ring Gear

Removal of Low and Reverse Clutch Support Assembly

1. Remove low and reverse roller clutch support to case retaining ring (Fig. 7A3-51).

2. Grasp output shaft and pull up until low and reverse roller clutch and support assembly clear low and reverse clutch support retainer spring and remove support assembly.

3. Remove low and reverse clutch support retainer spring (Fig. 7A3-51).

Removal and Reverse Clutch Plates

1. Remove five (5) or four (4) low and reverse clutch faced plates and five (5) or four (4) steel separator plates (Fig. 7A3-52).

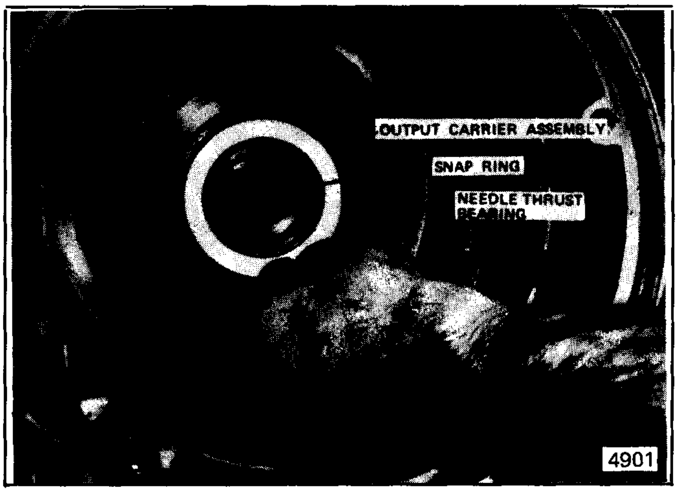


Fig. 7A3-49 Removing Output Carrier Snap Ring

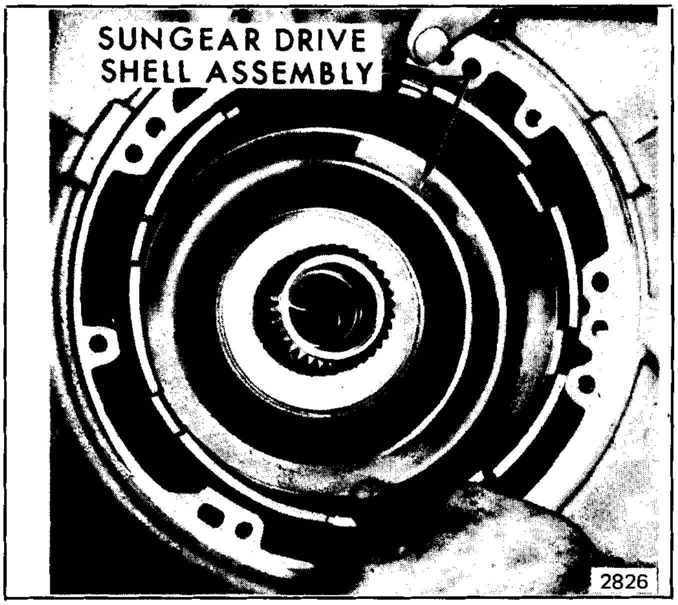


Fig. 7A3-50 Removing Drive Shell

Removal of Reaction Carrier Assembly

1. Remove reaction carrier assembly from output ring gear and shaft assembly (Fig. 7A3-53).

REMOVAL OF OUTPUT RING GEAR AND SHAFT ASSEMBLY AND OUTPUT RING GEAR TO CASE NEEDLE BEARING ASSEMBLY

Removal of Output Ring Gear and Shaft Assembly

1. Remove output ring gear and shaft assembly from case (Fig. 7A3-54).

2. Remove reaction carrier to output ring gear needle thrust bearing.

3. Remove output ring gear to output shaft snap ring and discard. Remove output ring gear from output shaft (Fig. 7A3-55).

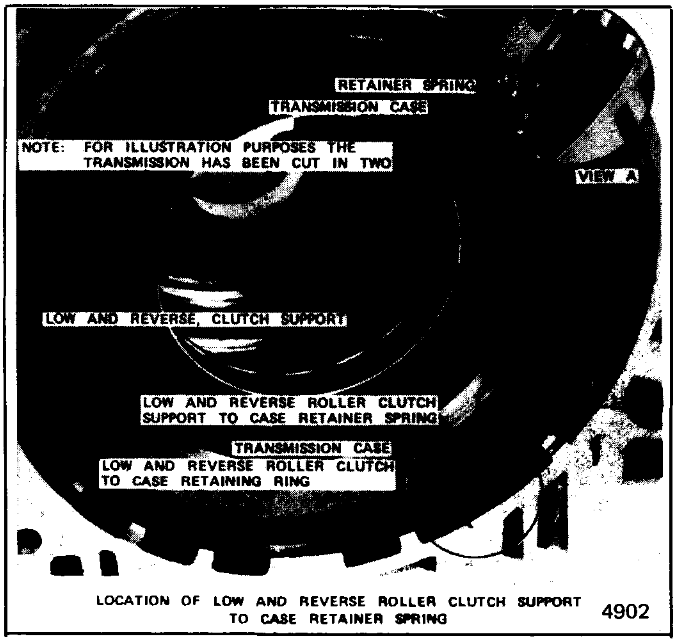


Fig. 7A3-51 Location of Retainer Spring and Ring

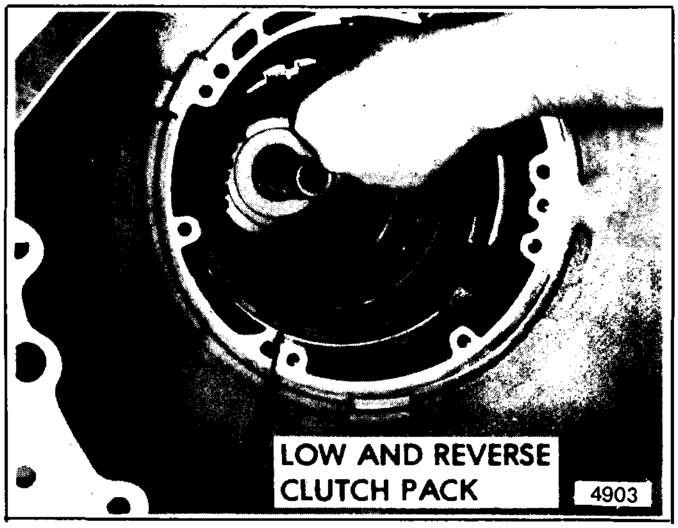


Fig. 7A3-52 Removing Low and Reverse Clutch Plates

4. Remove output ring gear to case needle bearing (Fig. 7A3-56).

REMOVAL OF LOW AND REVERSE CLUTCH PISTON AND CASE BUSHING

Removal of Low and Reverse Clutch Piston

1. Using Tool J 21420-1, compress low and reverse clutch piston spring retainer and remove piston retaining ring and spring retainer with springs (Fign 7A3-57).

2. Remove low and reverse clutch piston assembly. Aid removal with the use of compressed air in passage shown (Fig. 7A3-58).

Removal of Low and Reverse Clutch Piston Seals

1. Remove low and reverse clutch piston outer seal.

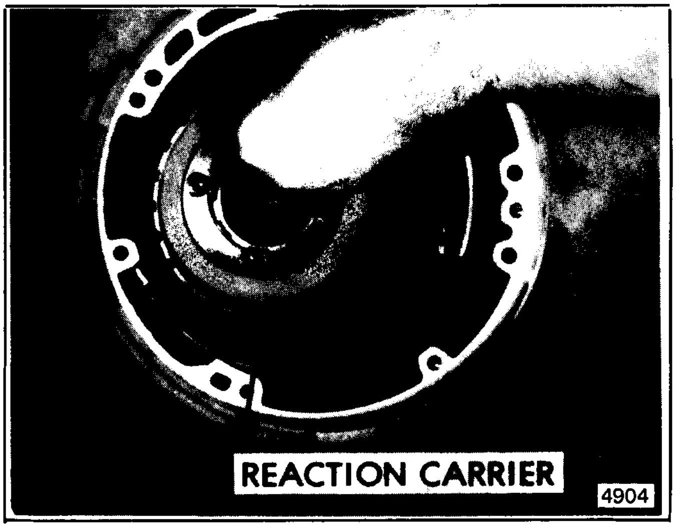


Fig. 7A3-53 Removing Reaction Carrier

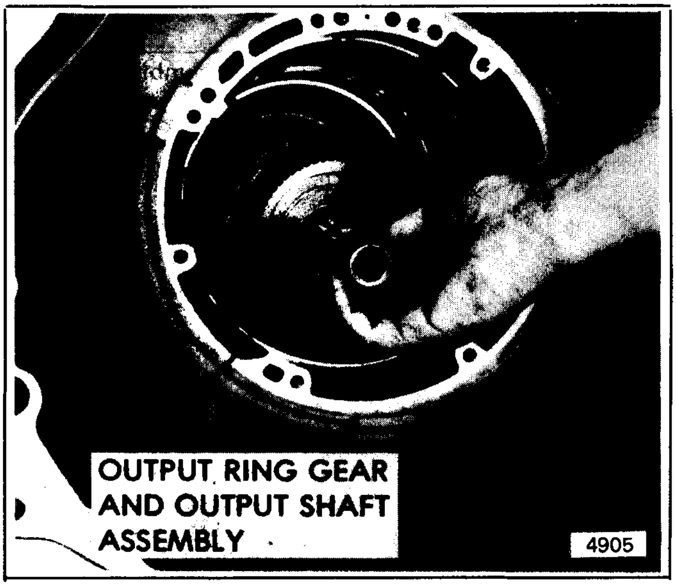


Fig. 7A3-54 Removing Output Ring Gear and Shaft Assembly

2. Remove low and reverse clutch piston center and inner seal (Fig. 7A3-59).

REMOVAL AND INSTALLATION OF INTERMEDIATE CLUTCH 1-2 ACCUMULATOR

Removal and installation of intermediate clutch 1-2 accumulator can be done without removal of transmission from car.

Removal of Intermediate Clutch 1-2 Accumulator Piston

1. Install Tool J 23069 to compress intermediate clutch 1-2 accumulator cover and remove retaining ring (Fig. 7A3-60).

2. Remove intermediate clutch 1-2 accumulator piston cover and "O" ring seal from case (Fig. 7A3-61).

3. Remove intermediate clutch 1-2 accumulator piston spring.

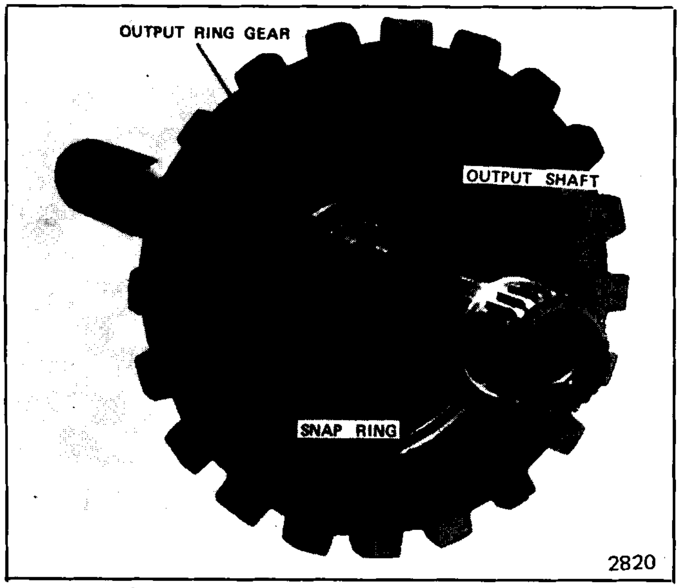


Fig. 7A3-55 Output Ring Gear and Shaft Assembly

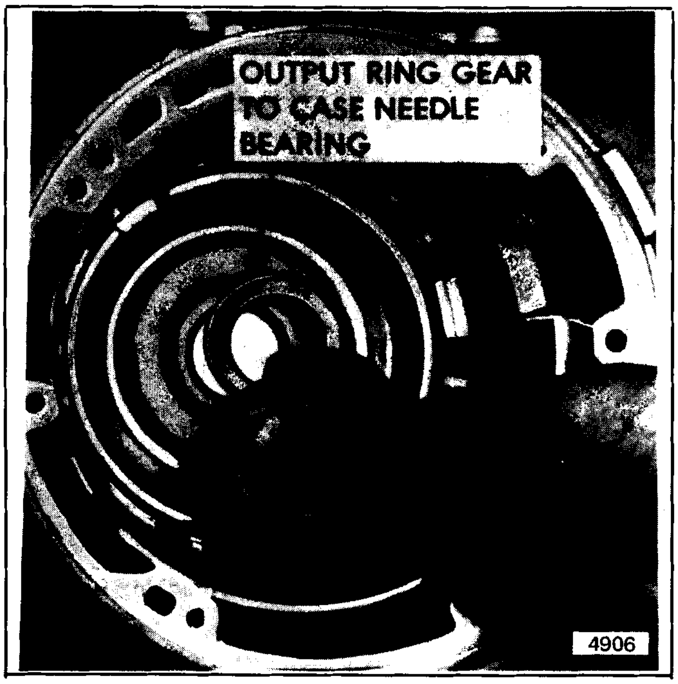


Fig. 7A3-56 Removing Needle Bearing

4. Remove intermediate clutch 1-2 accumulator piston assembly. **Inspect the inner and outer teflon oil seal rings for wearing or scoring. DO NOT REMOVE THESE TWO RINGS UNLESS THEY ARE DAMAGED.** If replacement of one or the other of the two rings is necessary, the piston assembly will have to be replaced. See Fig. 7A3-61 (Piston and Seal are one assembly).

Installation of Intermediate Clutch 1-2 Accumulator Piston

1. Install intermediate clutch 1-2 accumulator piston assembly (Fig. 7A3-61).

2. Install intermediate clutch 1-2 accumulator piston spring.

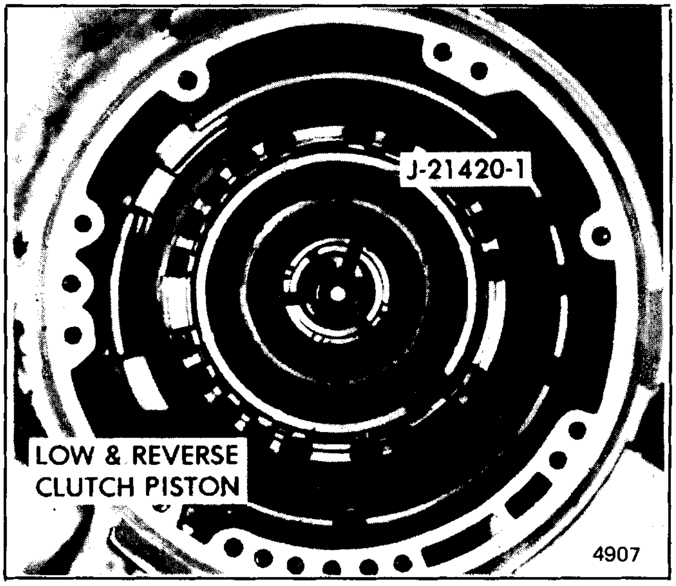


Fig. 7A3-57 Compressing Low and Reverse Clutch Piston

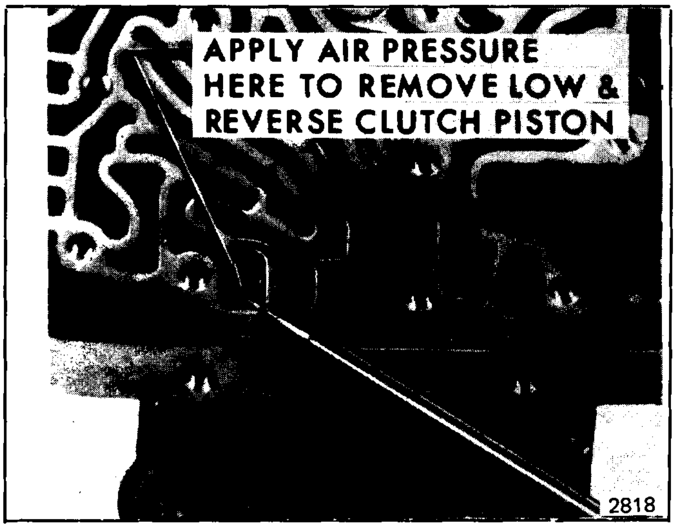


Fig. 7A3-58 Using Air to Remove Piston

3. Place "O" ring seal on intermediate clutch 1-2 accumulator piston cover and install cover into case.

4. Install J 23069 tool and compress intermediate clutch 1-2 accumulator cover and install retaining ring (Fig. 7A3-60).

DISASSEMBLY AND REASSEMBLY OF OIL PUMP

Disassembly of Oil Pump Assembly

1. Place assembly through hole in bench. Remove five (5) pump cover to body attaching bolts (Fig. 7A3-62).

2. Remove intermediate clutch return spring seat retainer with springs and the intermediate clutch piston assembly (Fig. 7A3-63).

3. Remove intermediate clutch piston inner and outer seals (Fig. 7A3-64).

4. Remove three (3) direct clutch to pump hub hook type oil rings. Remove pump cover to direct clutch drum needle thrust bearing. Inspect the two (2) forward clutch to pump

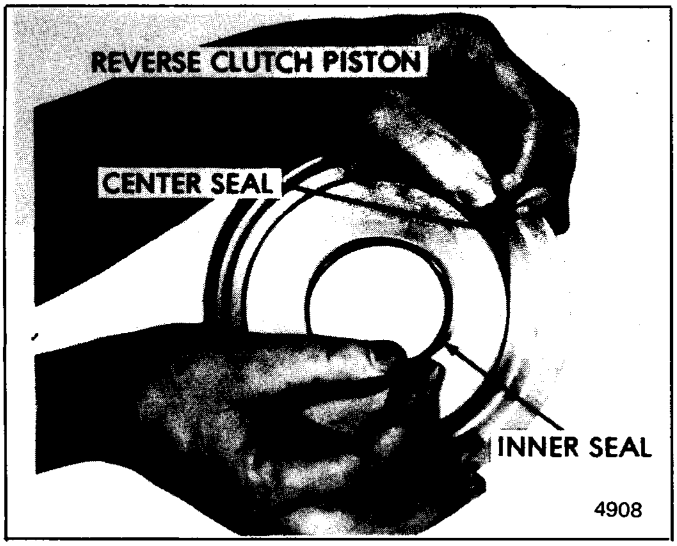


Fig. 7A3-59 Removing Low and Reverse Clutch Piston Seals

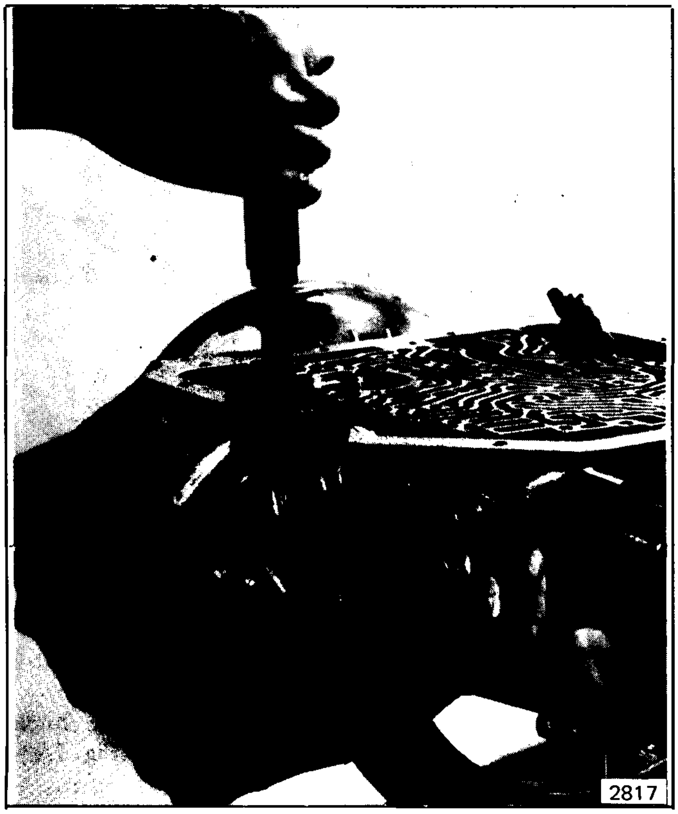


Fig. 7A3-60 Compressing 1-2 Accumulator Piston Cover

hub teflon oil seal rings, but do not remove them unless they are damaged. If replacement is necessary, use two metal hook type service replacement rings (Fig. 7A3-63).

5. Remove pump cover and stator shaft assembly from pump body (Fig. 7A3-65).

6. Remove pump drive gear and driven gear from pump body. Inspect pump gears and cover for wear or scoring (Fig. 7A3-66).

The pump body assembly should be replaced only if the drive and/or driven gears are broken or galled, pump body galled, uneven machined surfaces, pump body to case seal ring groove damaged or the pump seal drain back hole is un-drilled.

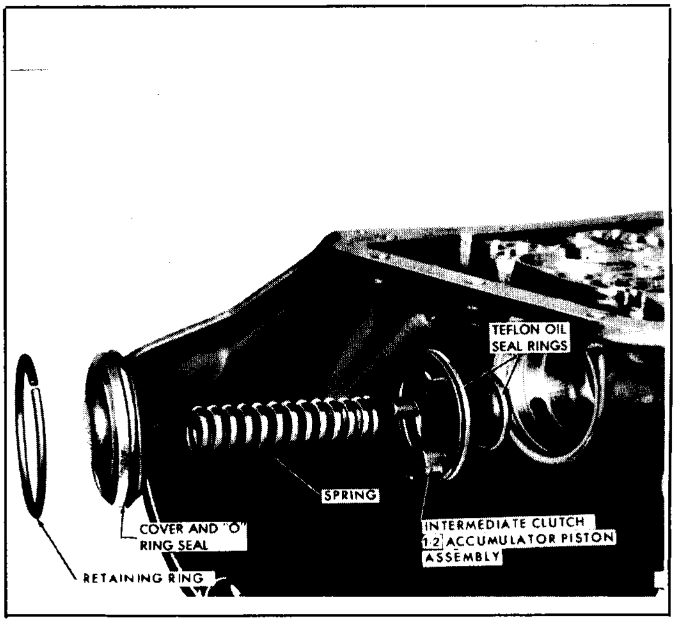


Fig. 7A3-61 Intermediate Clutch 1-2 Accumulator Piston Assembly

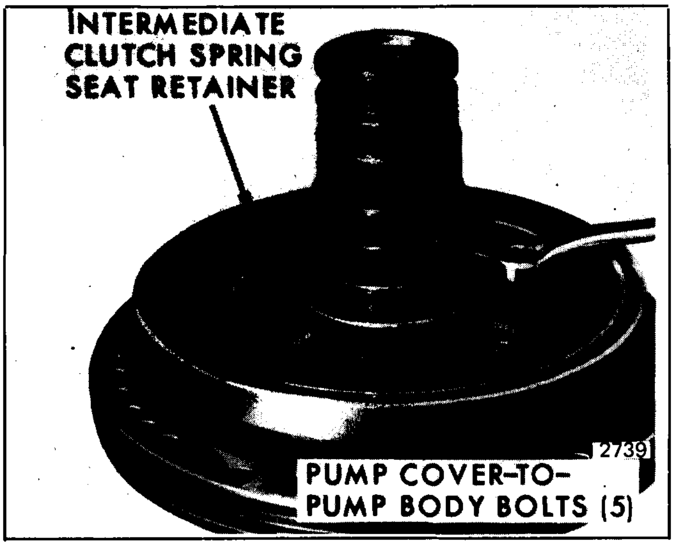


Fig. 7A3-62 Removing Pump Cover Attaching Bolts

7. Filler cooler by-pass passage with grease and insert Tool J 23071 or J 23134 and force by-pass valve seat, check ball and spring from pump body (Fig. 7A3-67).

8. Remove pump outside diameter to case square cut "O" ring seal and discard (Fig. 7A3-68).

9. Remove pump body to converter hub lip seal, if necessary and discard (Fig. 7A3-69).

10. Place pump on wood blocks so surface finish is not damaged and install pump to converter hub lip seal, using Seal Driver J 21359. Make certain lip seal is not torn or nicked.

Reassembly of Oil Pump Assembly

1. Install pump drive gear and driven gear. Drive gear has off-set tangs, assemble with tang face up to prevent damage to converter (Fig. 7A3-66).

2. Install cooler by-pass spring, check ball and seat. Using Tool J 23112, press seat into bore until top of seat is flush with face of pump body (Fig. 7A3-70).

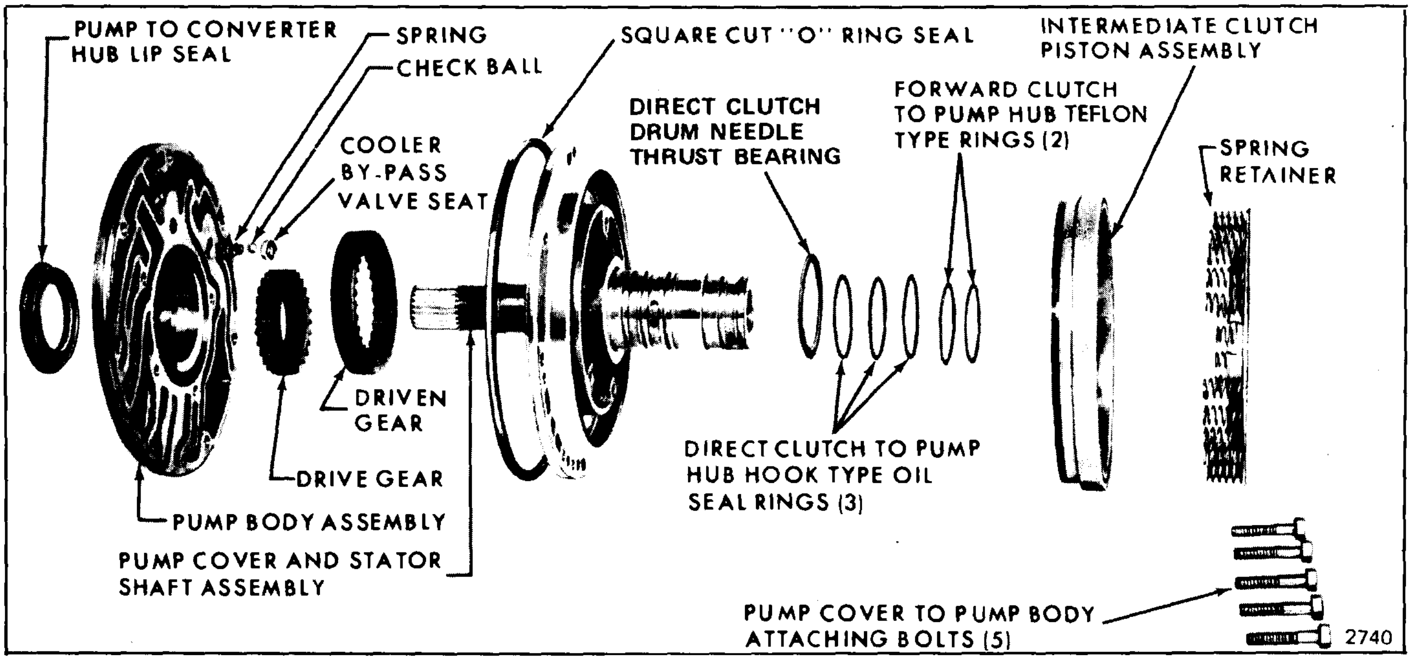


Fig. 7A3-63 Oil Pump Assembly - Exploded View

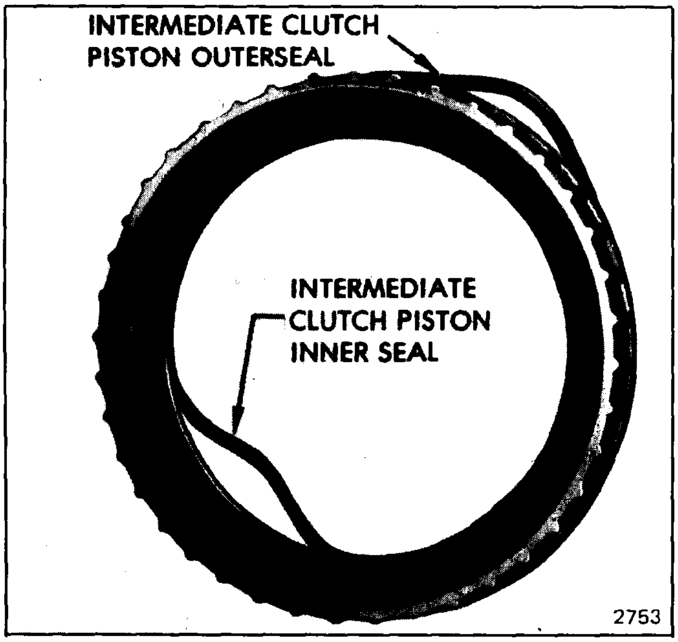


Fig. 7A3-64 Intermediate Clutch Piston Seals

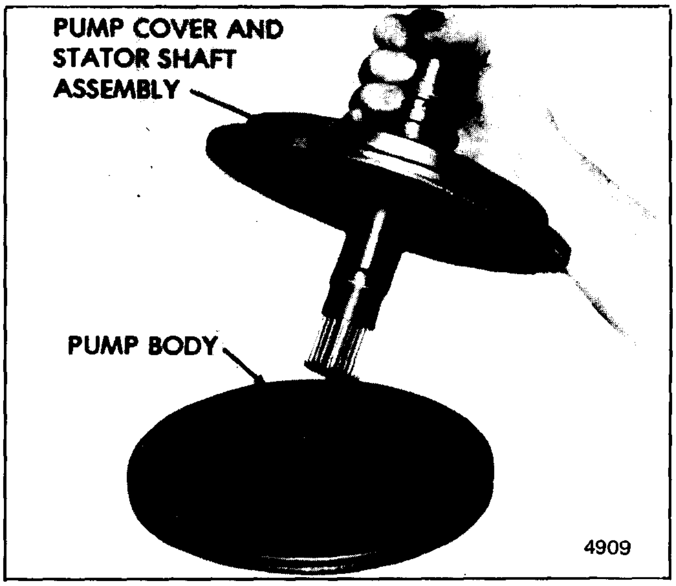


Fig. 7A3-65 Removing Pump Cover From Body

3. Assemble pump cover to pump body (Fig. 7A3-65).

4. Install intermediate clutch piston inner seal and outer seal (Fig. 7A3-64).

5. Install intermediate clutch piston assembly into pump cover with the aid of a piece of .020" music wire crimped into copper tubing.

6. Install spring retainer and install five (5) attaching bolts, finger tight (Fig. 7A3-63).

7. Place pump aligning strap J 21368 over pump body and cover and tighten.

8. Tighten attaching bolts. Torque to 18 lb. ft.

9. Install pump outside diameter to case (square cut) "O" ring seal (Fig. 7A3-68). Use new square cut "O" ring seal.

10. Install three (3) direct clutch to pump hub hook-type oil seal rings. Inspect two (2) forward clutch to pump hub teflon oil seal rings. For service, if rings require replacement use hook-type cast iron rings (Fig. 7A3-63).

11. Check three (3) pump cover hub lube holes. Make certain they are not restricted (Fig. 7A3-71).

DISASSEMBLY AND REASSEMBLY OF DIRECT CLUTCH

NOTE: Refer to specifications in rear of this section to determine the required amount of lined and steel clutch plates to use with specific transmission model and engine combination. When replacing piston assembly, specific part number must be used.

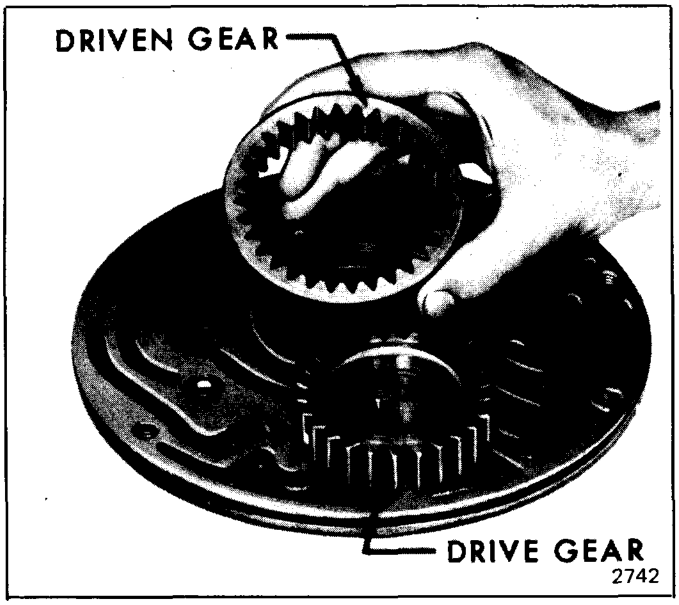


Fig. 7A3-66 Removing Drive and Driven Gears

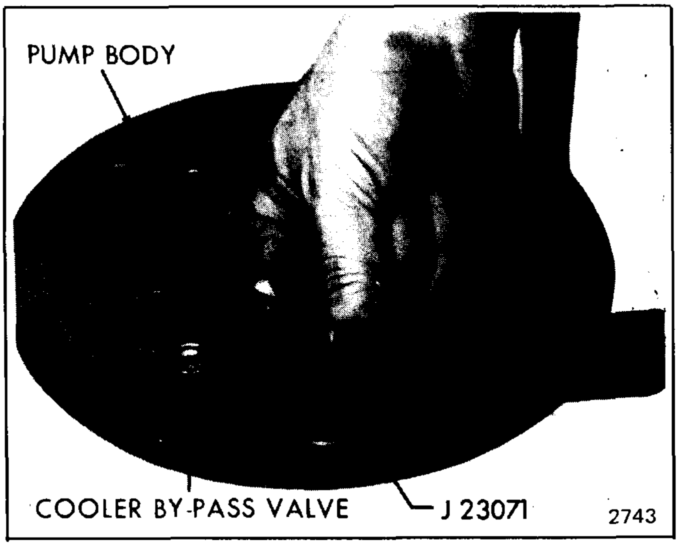


Fig. 7A3-67 Removing By-Pass Valve Seat

Disassembly of Direct Clutch

1. Remove intermediate overrun clutch from retainer ring and retainer (Fig. 7A3-72).
2. Remove intermediate clutch overrun outer race (Fig. 7A3-73).

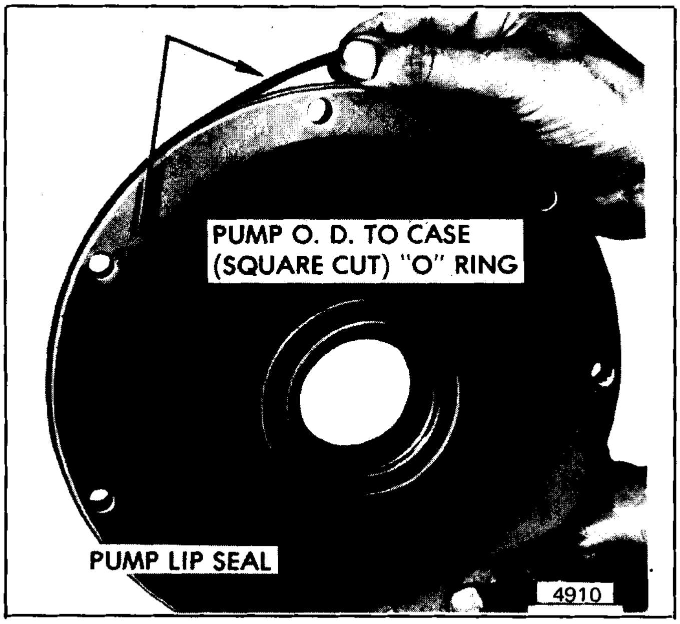


Fig. 7A3-68 Pump to Case O-Ring Seal

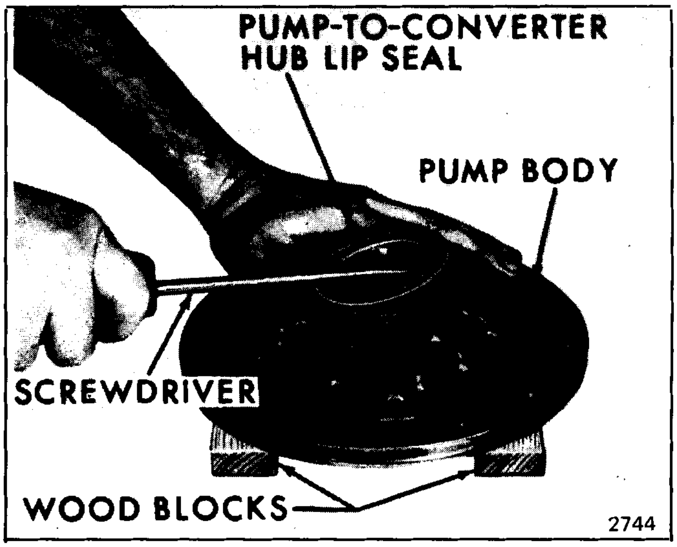


Fig. 7A3-69 Removing Pump Body Lip Oil Seal

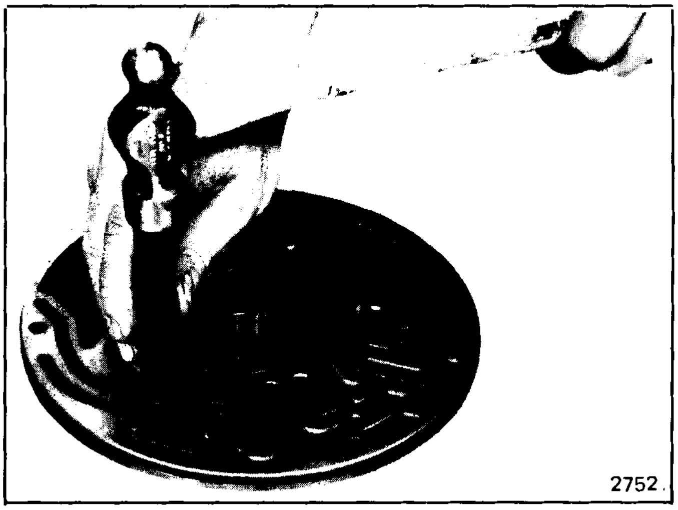


Fig. 7A3-70 Installing By-Pass Valve Seat

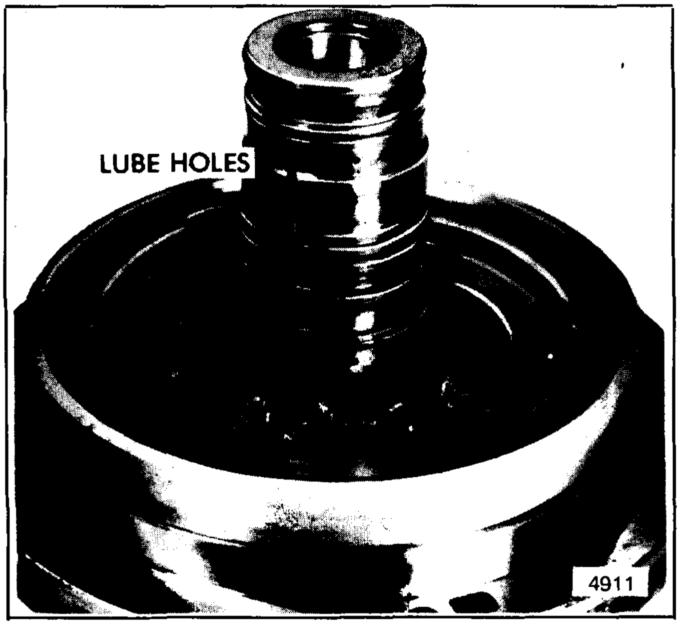


Fig. 7A3-71 Location of Pump Cover Hub Lube Holes

3. Remove intermediate overrun roller clutch assembly (Fig. 7A3-74).

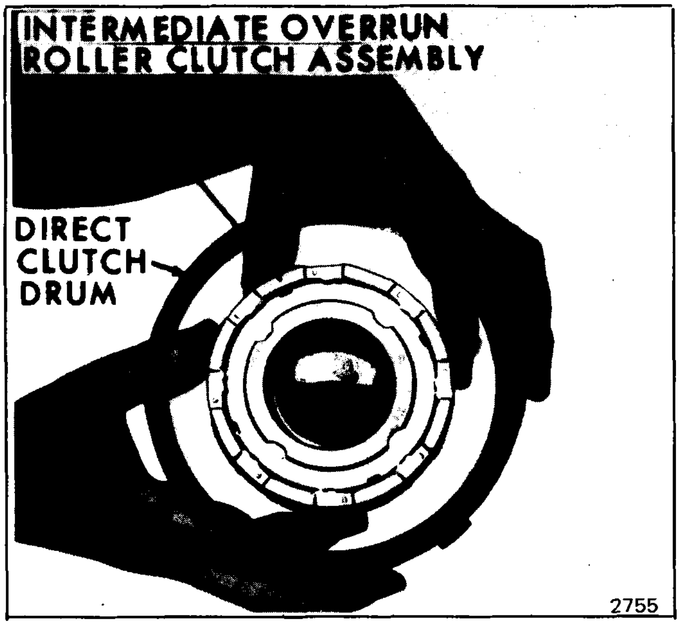


Fig. 7A3-74 Removing Roller Clutch

4. Remove direct clutch drum to forward clutch housing needle roller bearing (Fig. 7A3-75).

5. Remove direct clutch pressure plate to clutch drum retaining ring and pressure plate (Fig. 7A3-76).

6. Remove lined and steel plates from direct clutch housing (Fig. 7A3-77).

7. Inspect condition of lined and steel plates. **Do not diagnose a lined drive plate by color.**

A. Dry lined plates with compressed air and inspect the lined surfaces for:

1. Pitting and flaking.
2. Wear.

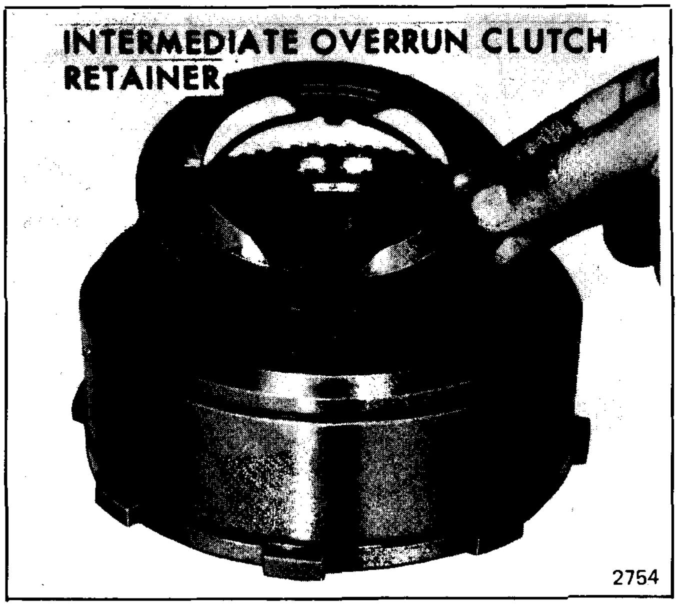


Fig. 7A3-72 Removing Clutch Retainer

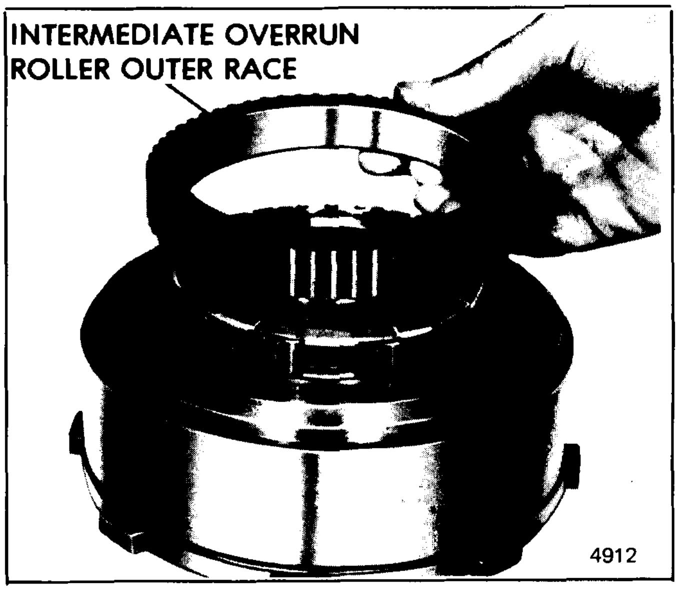


Fig. 7A3-73 Removing Overrun Outer Race

3. Glazing.
4. Cracking.
5. Charring.
6. Chips or metal particles imbedded in lining.

If a lined drive plate exhibits any of the above conditions, replacement is required.

B. Wipe steel plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plates must be replaced.

8. Remove direct clutch piston return spring seat retaining ring and spring seat by using Tools J 2590-3, J 2590-5 and snap ring pliers (Fig. 7A3-78).

9. Remove spring retainer, springs and piston (Fig. 7A3-79).

10. Inspect the return springs. Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would justify replacement of

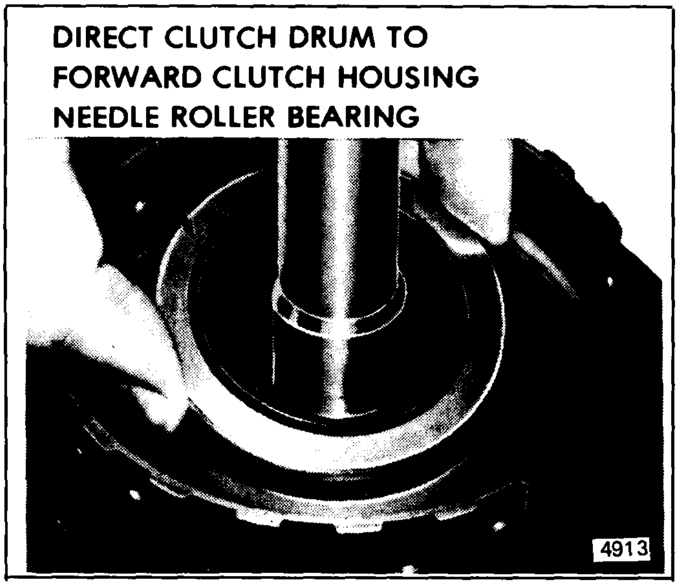


Fig. 7A3-75 Removing Needle Roller Bearing

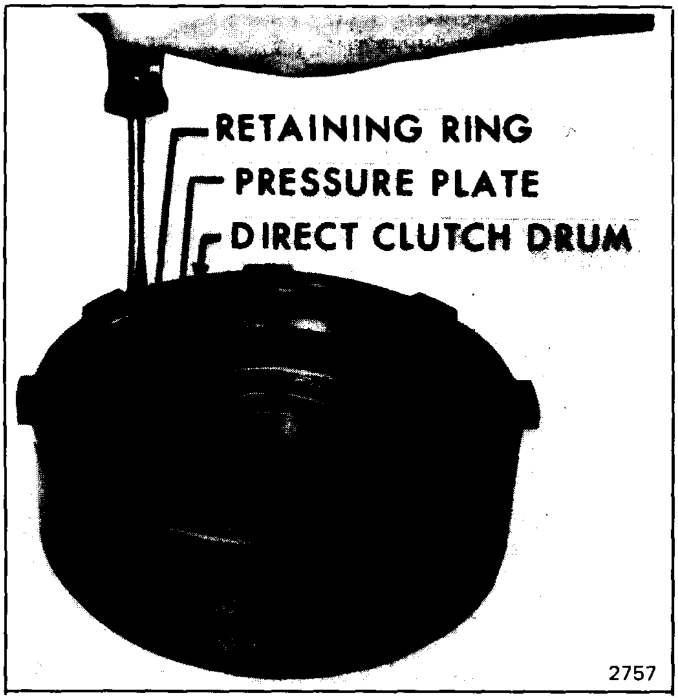


Fig. 7A3-76 Removing or Installing Retaining Ring

the springs.

11. Remove direct clutch piston inner and outer seals (Fig. 7A3-80).

12. Remove direct clutch piston center seal (Fig. 7A3-81).

Reassembly of Direct Clutch

1. Install direct clutch piston outer seal and inner seal (Fig. 7A3-80).

2. Install direct clutch piston center seal (Fig. 7A3-81).

3. Install the direct clutch piston into housing with the aid of a piece of .020" music wire crimped into copper tubing (Fig. 7A3-82).

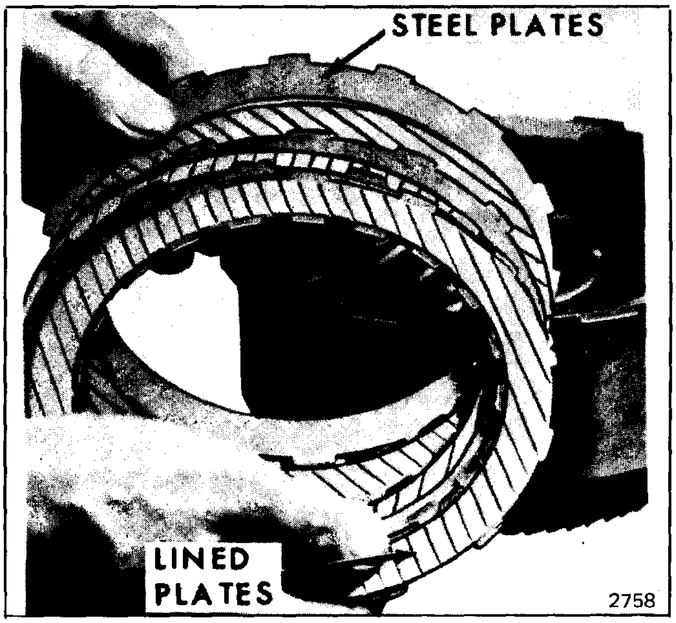


Fig. 7A3-77 Direct Clutch Plates

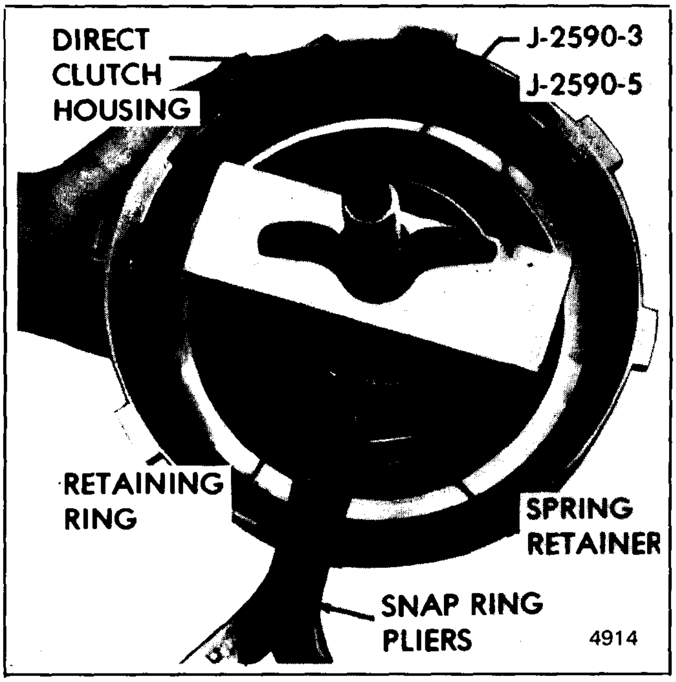


Fig. 7A3-78 Compressing Spring Retainer

4. Install spring retainer and springs. Compress spring retainer and install retaining ring, using Tools J 2590-3 and J 2590-5

5. Lubricate with transmission fluid and install faced plates and steel separator plates starting with a steel plate and alternating steel and faced (Fig. 7A3-83).

6. Install direct clutch pressure plate and retaining ring.

7. Install intermediate overrun roller clutch assembly (Fig. 7A3-84).

Roller clutch assembly must be assembled with four (4) holes up (toward front of transmission).

8. Install intermediate clutch overrun outer race.

When the intermediate overrun clutch outer race is installed, it should free wheel in the counterclockwise

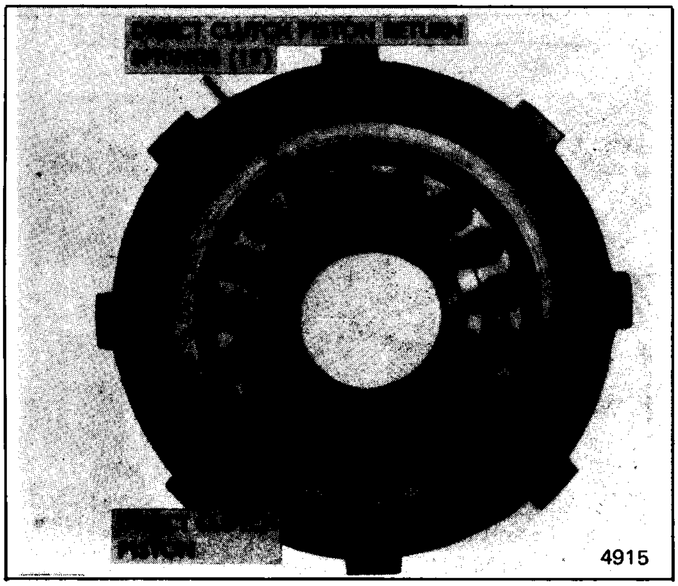


Fig. 7A3-79 Direct Clutch Piston and Return Springs

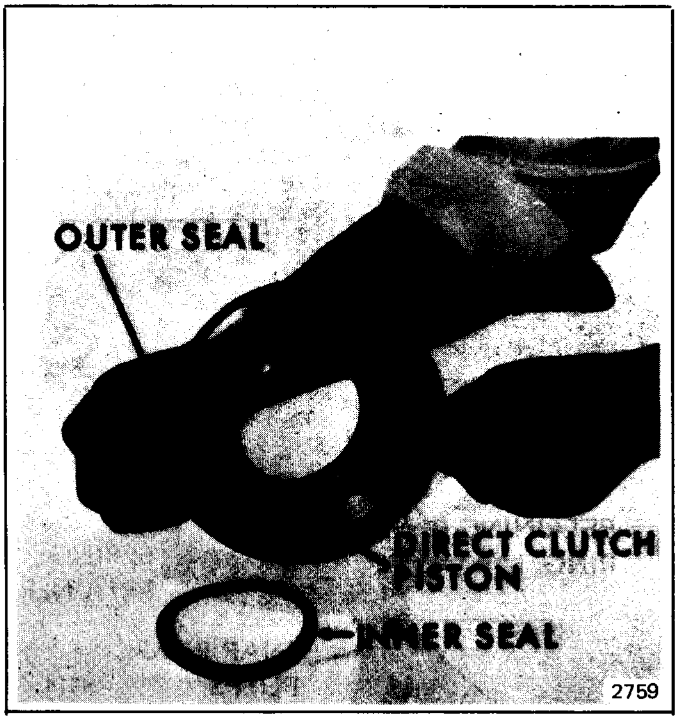


Fig. 7A3-80 Direct Clutch Piston Inner and Outer Seals

direction only.

9. Install intermediate overrun clutch retainer, and retaining ring.

DISASSEMBLY AND REASSEMBLY OF FORWARD CLUTCH ASSEMBLY

NOTE: Refer to specifications in rear of this section to determine the required amount of lined and steel clutch plates to use with specific transmission model and engine combination. When replacing piston assembly, specific part number must be used.

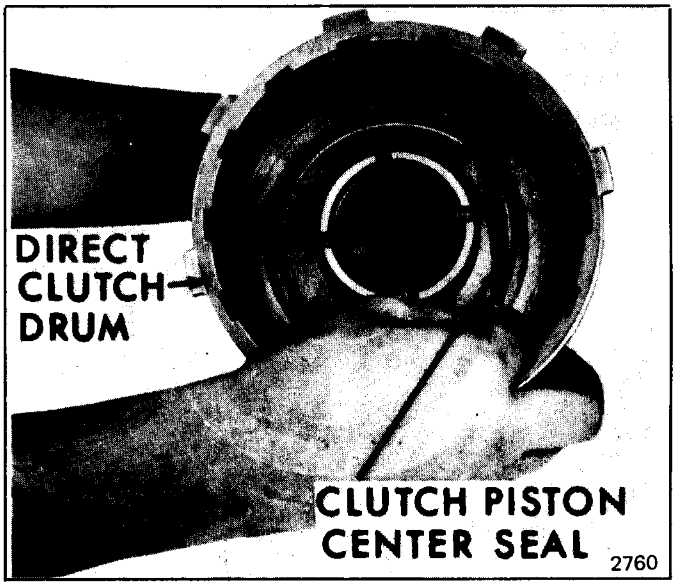


Fig. 7A3-81 Direct Clutch Piston Center Seal

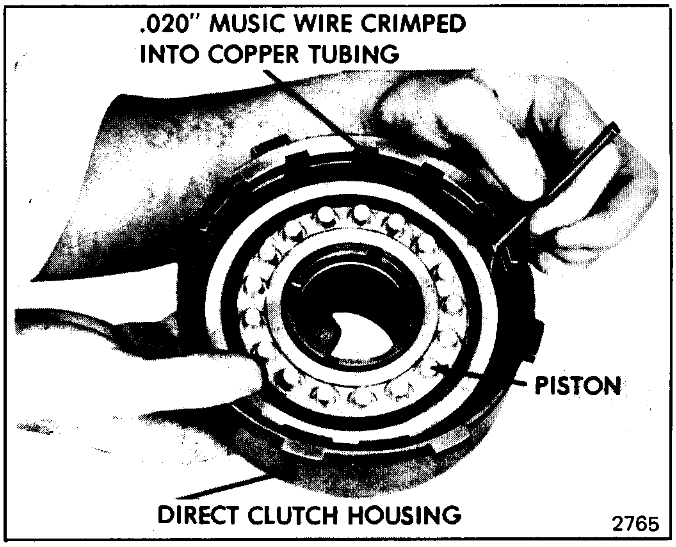


Fig. 7A3-82 Installing Direct Clutch Piston

Disassembly of Forward Clutch

1. Remove forward clutch drum to pressure plate retaining ring. Remove forward clutch pressure plate (Fig. 7A3-85).

2. Remove forward clutch housing faced plates, steel plates and cushion spring (Fig. 7A3-86).

3. Inspect condition of lined and steel plates. **Do not diagnose a lined drive plate by color.**

A. Dry lined plates with compressed air and inspect the lined surfaces for:

1. Pitting and flaking.
2. Wear.
3. Glazing.
4. Cracking.
5. Charring.
6. Chips or metal particles imbedded in lining.

If a lined drive plate exhibits any of the above conditions, replacement is required.

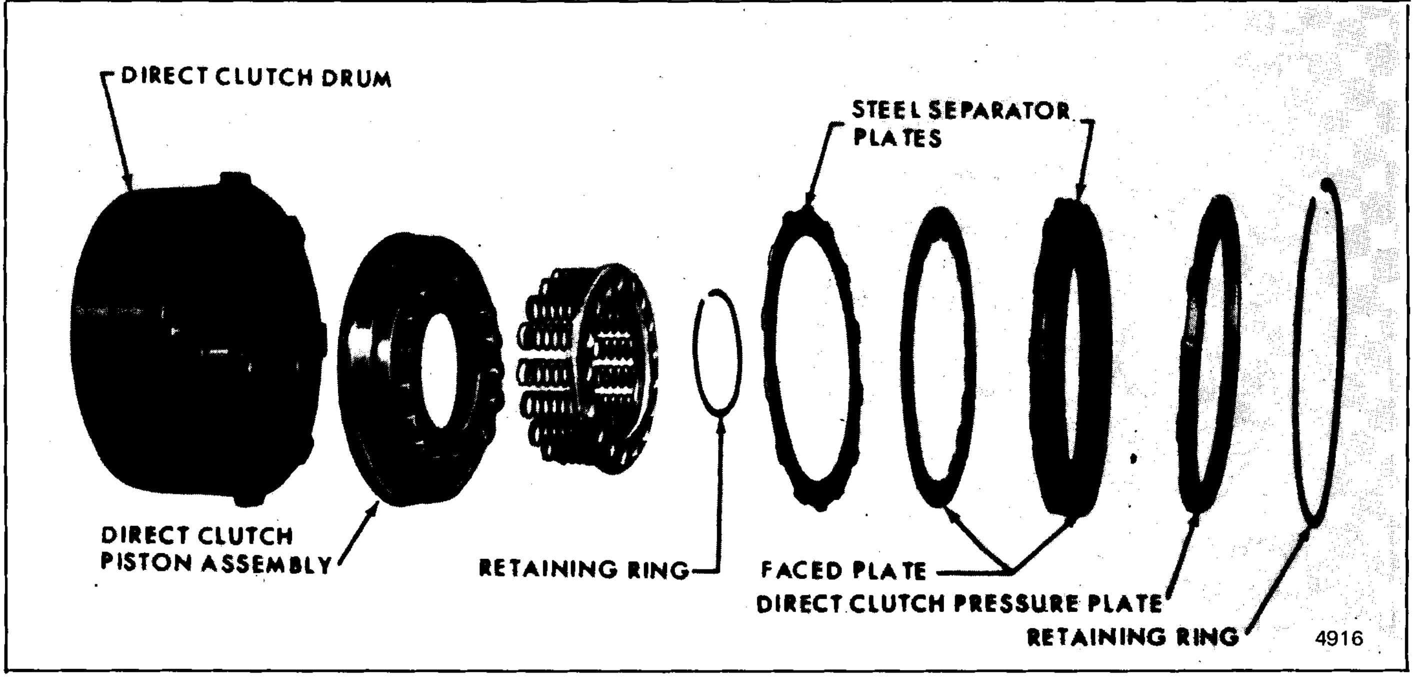


Fig. 7A3-83 Direct Clutch Assembly - Exploded View

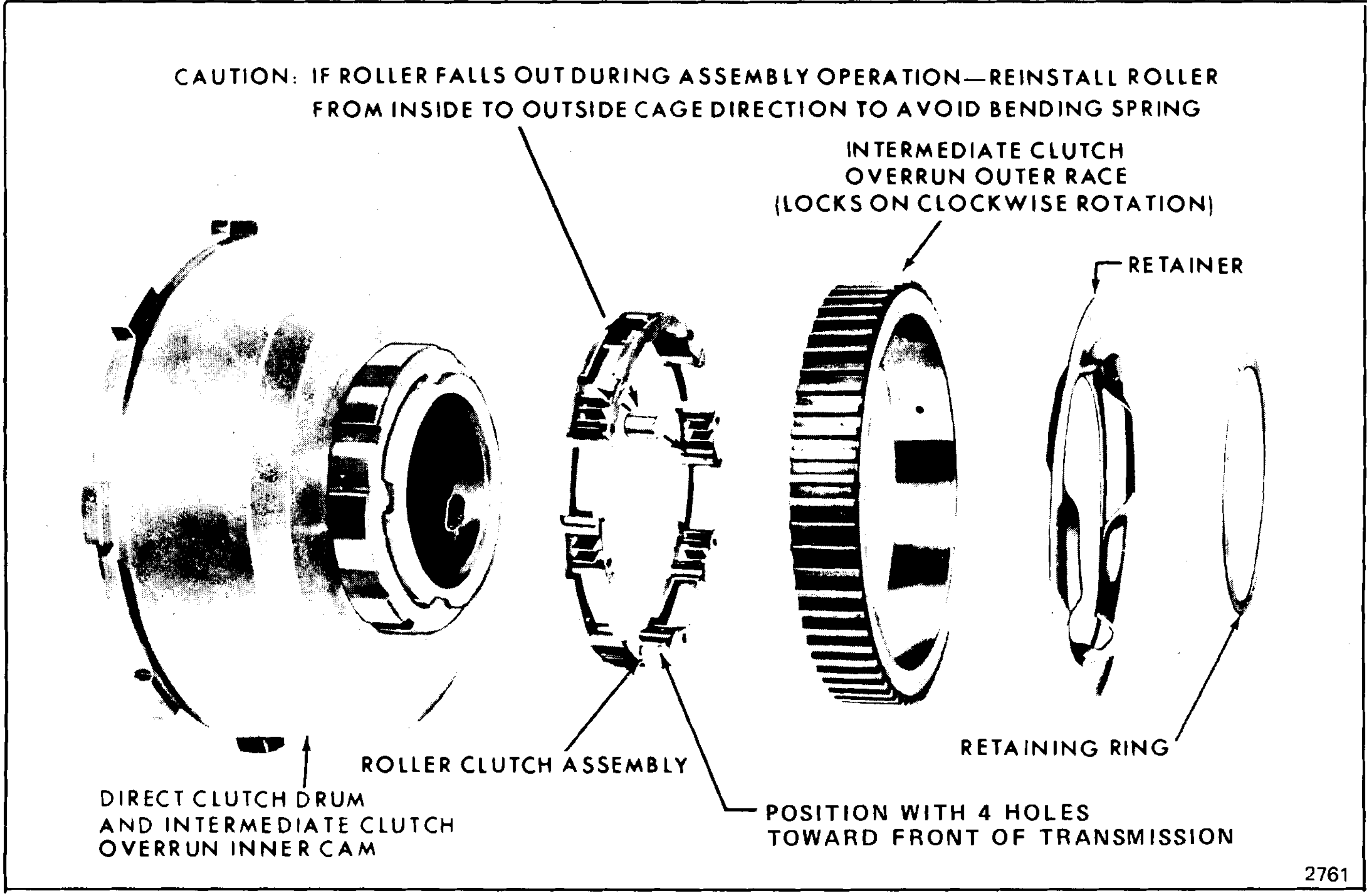


Fig. 7A3-84 Intermediate Overrun Clutch - Exploded View

B. Wipe steel plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plates must be replaced.

4. Remove spring retainer and springs by compressing with a ram press.

5. Inspect the return springs. Evidence of extreme heat or burning in the area of the clutch may have caused the

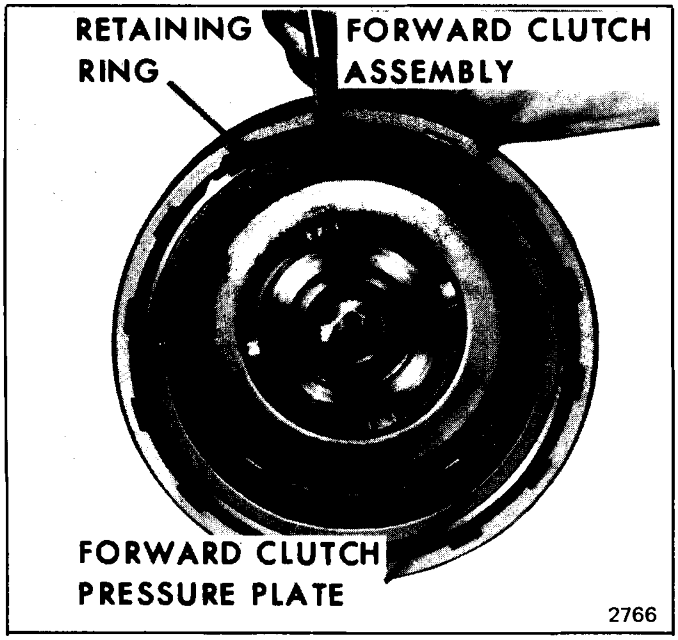


Fig. 7A3-85 Removing Retainer Ring

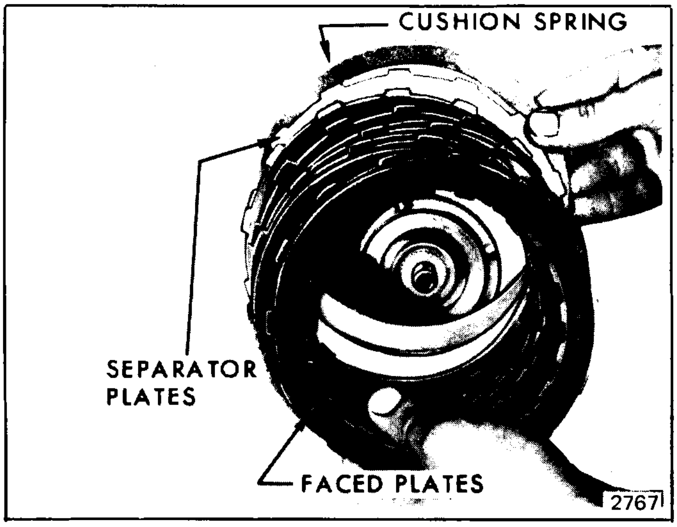


Fig. 7A3-86 Forward Clutch Plates

springs to take a heat set and would justify replacement of the springs.

6. Remove forward clutch piston assembly (Fig. 7A3-87).

7. Remove forward clutch piston inner and outer seals (Fig. 7A3-88).

8. Make certain forward clutch ball check exhaust is free of dirt, etc. (Fig. 7A3-89).

9. If the input shaft is scored it may be replaced using the following procedure:

a. Using wood blocks for support, press input shaft out of forward clutch housing.

b. Taking care support forward clutch housing on rear thrust washer surface and press input shaft into housing until it is properly seated.

c. Runout at rear thrust washer surface should be no more than .005.

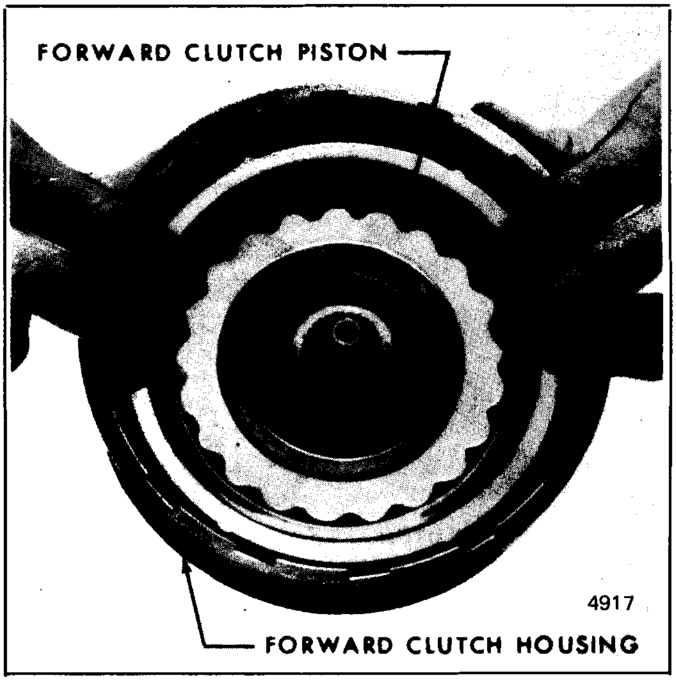


Fig. 7A3-87 Removing Forward Clutch Piston

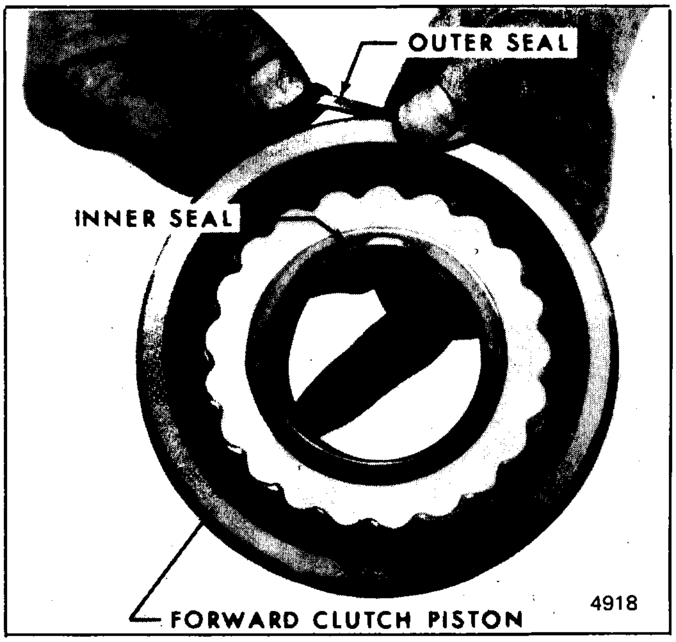


Fig. 7A3-88 Forward Clutch Piston Inner and Outer Seals

Reassembly of Forward Clutch Assembly

1. Install the forward clutch inner piston seal and outer piston seal. See Fig. 7A3-88.

2. Install the forward clutch piston assembly using a thin feeler gage (Fig. 7A3-91).

3. Install spring retainer and springs. Compress spring retainer with an arbor press or ram press.

4. Lubricate with transmission fluid and install cushion spring, faced plates and steel separator plates, starting with the cushion spring and alternating steel and faced (Fig. 7A3-86).

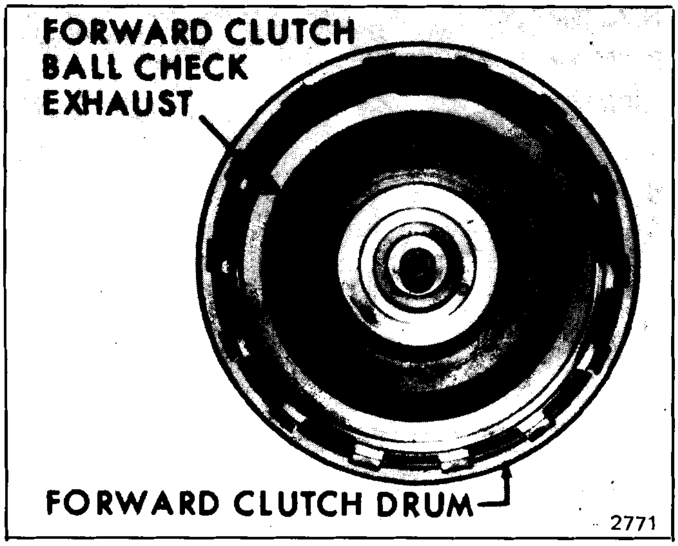


Fig. 7A3-89 Location of Ball Check Exhaust

5. Install forward clutch pressure plate and retaining ring. Using a feeler gage check clearance between forward clutch pressure plate and faced plate (Fig. 7A3-92).

The specifications for this transmission call for a clearance of no less than .011" and no greater than .082". There are three pressure plates available which are identified by tangs adjacent to the source identification mark (Fig. 7A3-93). These three pressure plates have different thicknesses.

If the clearance between the forward clutch pressure plate and the faced plate checks out to be less than .011", a thinner pressure plate should be used to give a clearance between .011" and .082". If the clearance checks out to be greater than .082", a thicker pressure plate should be used to give a clearance between .011" and .082". If the clearance checks out to be between .011" and .082", no change of pressure plate is necessary.

DISASSEMBLY AND REASSEMBLY OF SUN GEAR TO DRIVE SHELL

Disassembly of Sun Gear to Drive Shell

1. Remove sun gear to sun gear drive shell rear retaining ring (Fig. 7A3-94).
2. Remove sun gear to drive shell flat rear thrust washer (Fig. 7A3-95).
3. Remove front retaining ring from sun gear (Fig. 7A3-96).

Reassembly of Sun Gear to Drive Shell

1. Install sun gear to drive shell front retaining ring and install gear into drive shell (Fig. 7A3-96). Use a new ring and do not overstress when installing.
2. Install sun gear to drive shell flat thrust washer (Fig. 7A3-95).
3. Install sun gear to sun gear drive shell rear retaining ring (Fig. 7A3-94). Use a new ring and do not overstress when installing.

DISASSEMBLY AND REASSEMBLY OF LOW AND REVERSE ROLLER CLUTCH ASSEMBLY

Disassembly of Low and Reverse Roller Clutch Assembly (Fig. 7A3-97)

1. Remove low and reverse clutch to sun gear shell thrust washer.
2. Remove low and reverse overrun clutch inner race.
3. Remove low and reverse roller clutch retaining ring.
4. Remove low and reverse roller clutch assembly and visually inspect the rollers for wearing and scoring and check for any springs that may be collapsed.

Reassembly of Low and Reverse Roller Clutch Assembly

1. Install low and reverse roller clutch assembly to inner race (Fig. 7A3-98). The inner race should free wheel in the clockwise direction only.
2. Install low and reverse overrun roller clutch assembly and inner race into the low and reverse clutch support (Fig. 7A3-99). Assemble with four (4) holes down or to rear of transmission
3. Install low and reverse clutch to cam retaining ring (Fig. 7A3-100).
4. Install low and reverse clutch to sun gear drive shell thrust washer (Fig. 7A3-97).

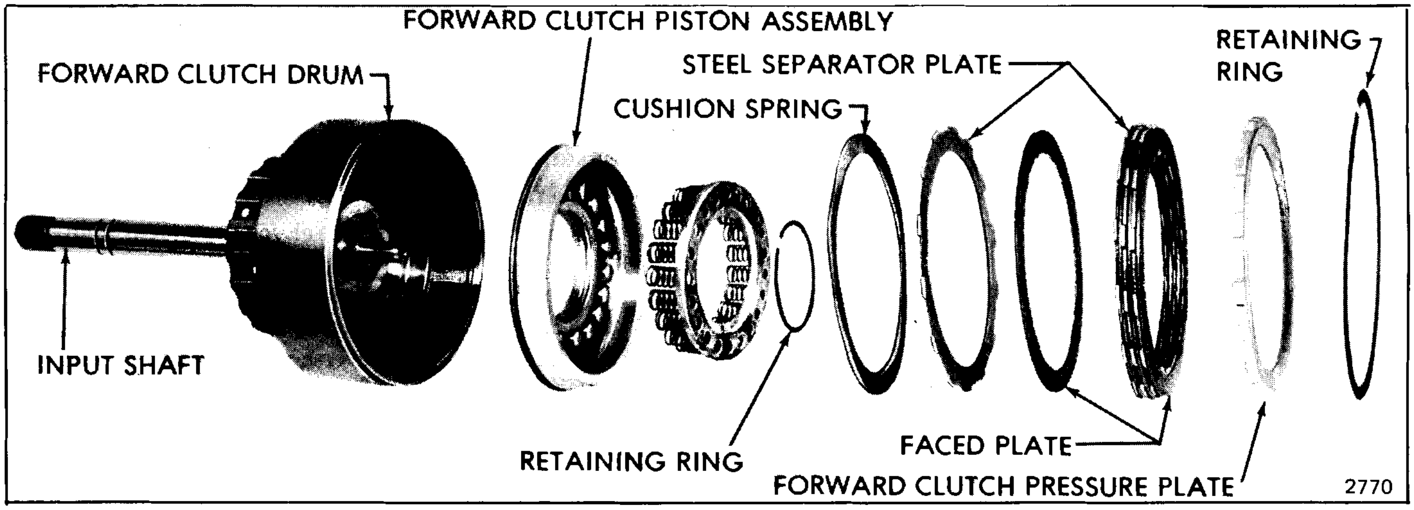


Fig. 7A3-90 Forward Clutch Assembly - Exploded View

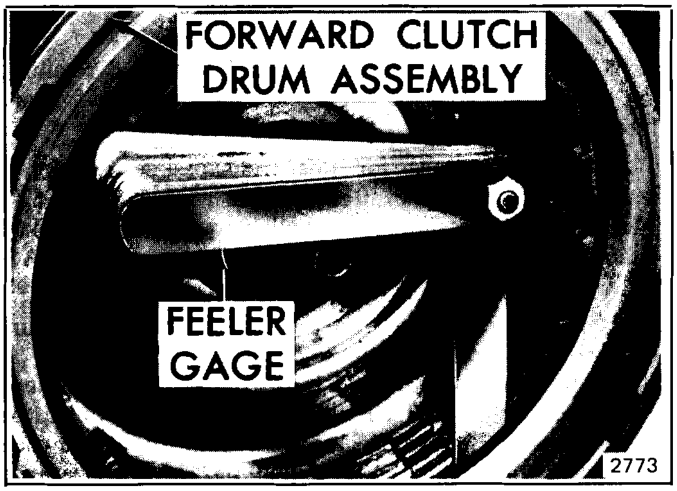


Fig. 7A3-92 Checking Plate Clearance

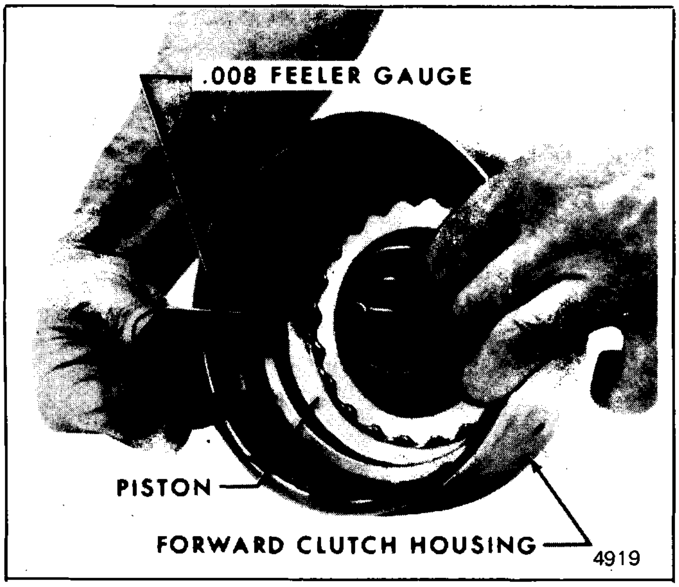


Fig. 7A3-91 Installing Forward Clutch Piston

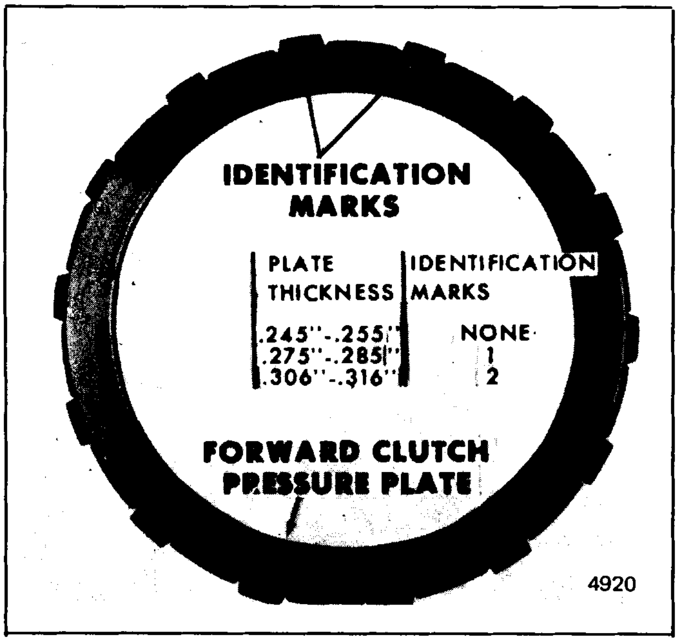


PLATE THICKNESS	IDENTIFICATION MARKS
.245"-.255"	NONE
.275"-.285"	1
.306"-.316"	2

Fig. 7A3-93 Pressure Plate Identification

Fig. 7A3-96 Removing or Installing Front Retaining Ring

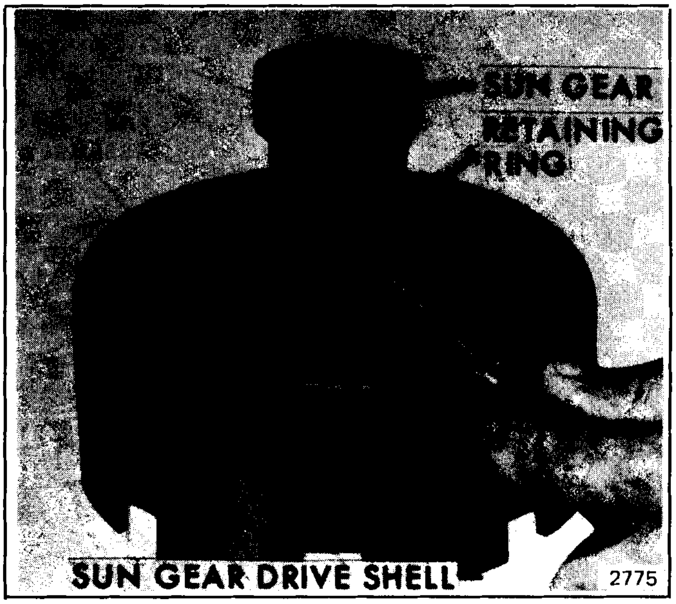


Fig. 7A3-94 Removing or Installing Rear Retaining Ring

Fig. 7A3-95 Removing or Installing Rear Thrust Washer

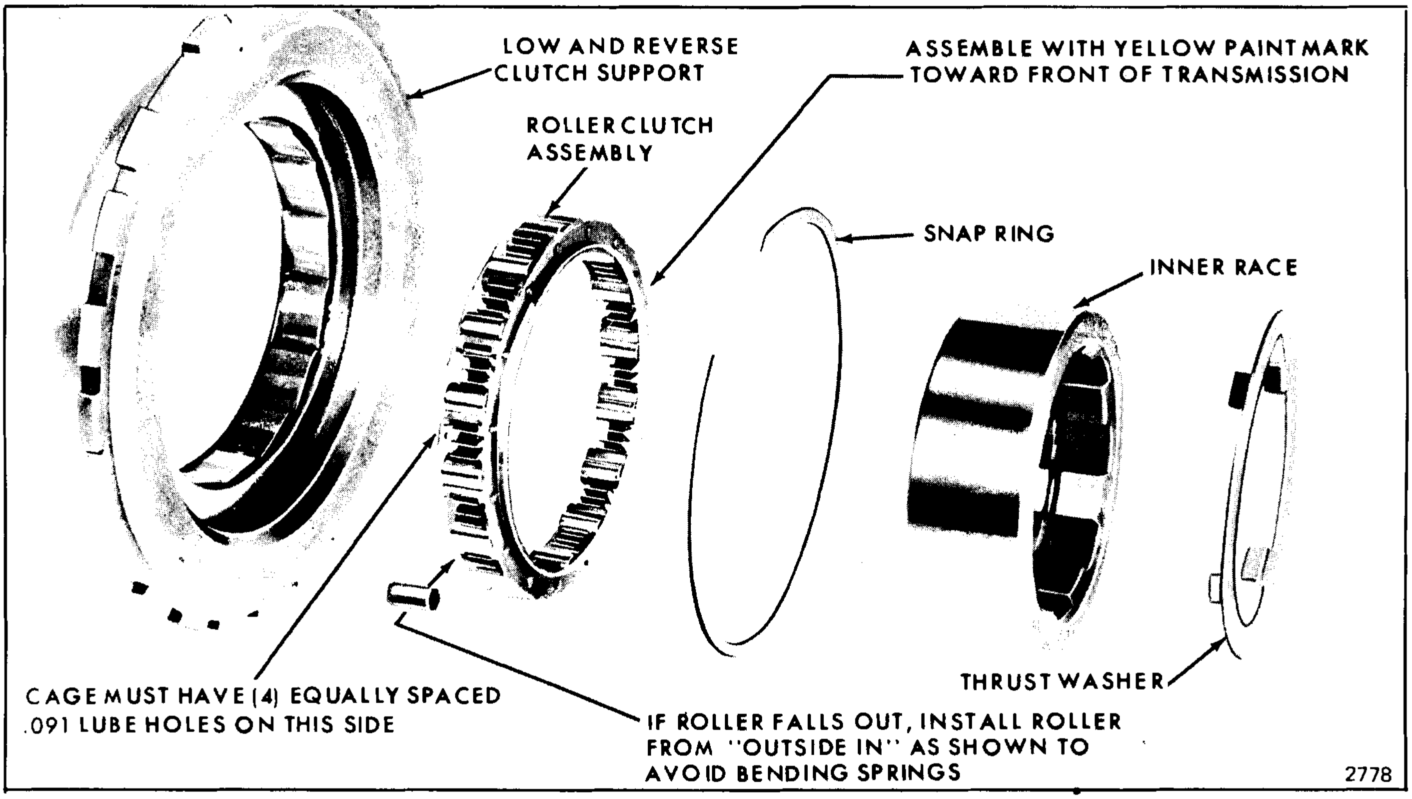


Fig. 7A3-97 Low and Reverse Clutch Support and Overrun Roller Clutch Assembly

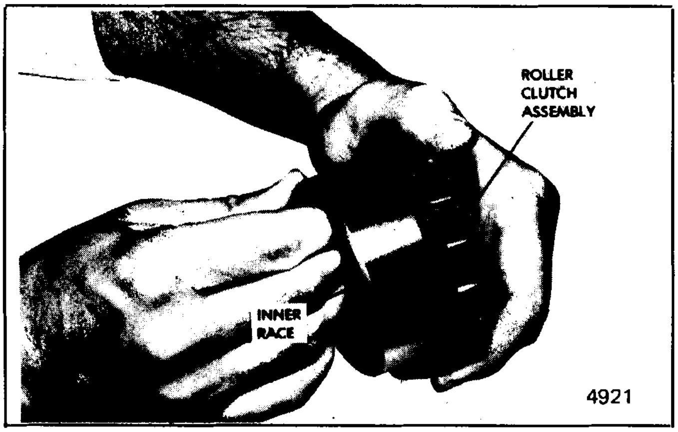


Fig. 7A3-98 Installing Race Into Roller Clutch

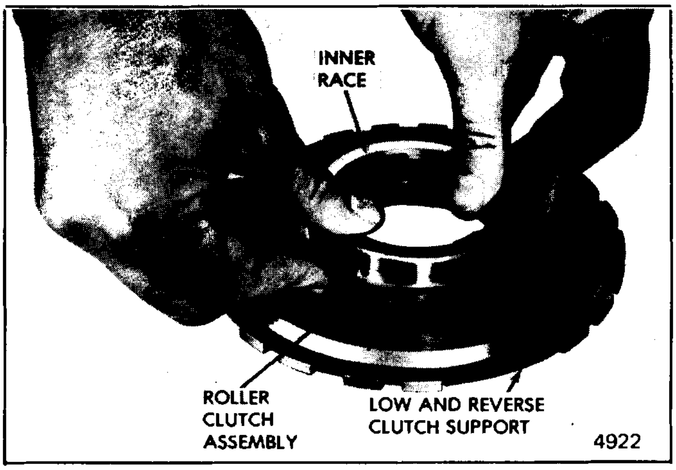


Fig. 7A3-99 Installing Roller Clutch Into Clutch Support

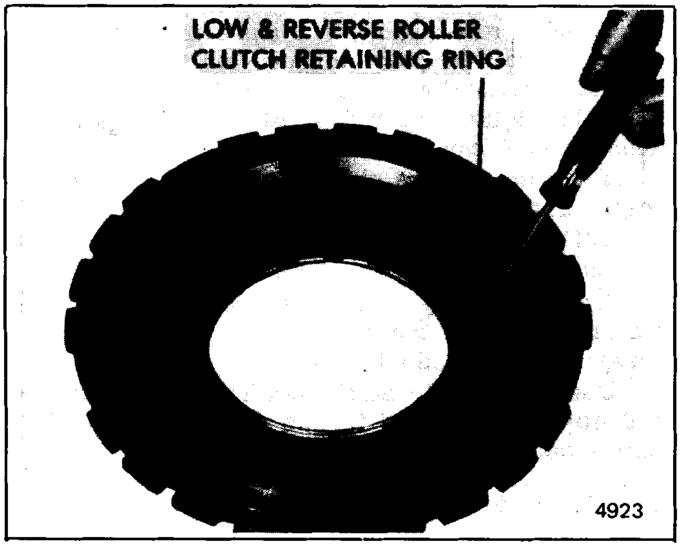


Fig. 7A3-100 Installing Clutch Retaining Ring

VALVE BODY DISASSEMBLY, INSPECTION AND REASSEMBLY

Disassembly of Valve Body (Fig. 7A3-101)

Transmission need not be removed from car to perform the following operations:

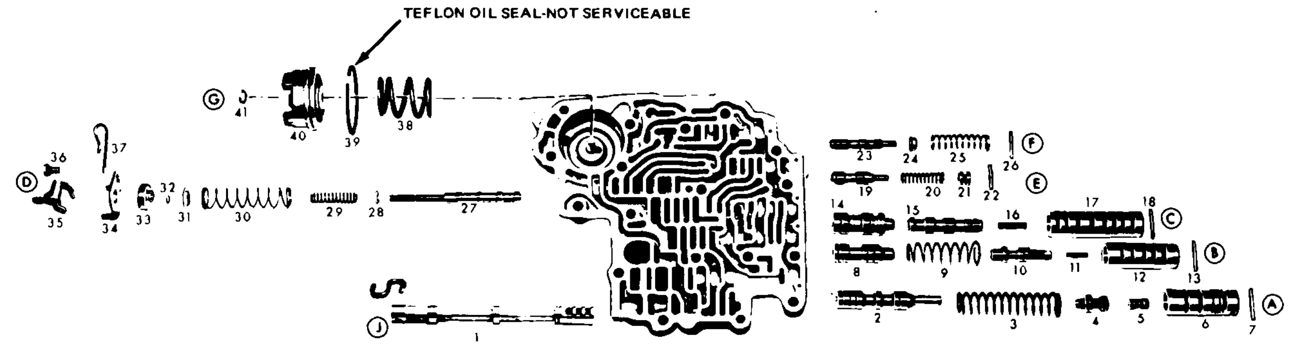
1. Position valve body assembly with cored face up.

2. Remove manual valve from lower left hand bore (J).

3. From lower right hand bore (A), remove the pressure regulator valve train retaining pin, boost valve sleeve, intermediate boost valve, reverse and modulator boost valve, pressure regulator valve spring and the pressure regulator valve.

4. From the next bore (B), remove the 2-3 shift valve train retaining pin, sleeve, control valve spring, 2-3 shift control valve, shift valve spring and the 2-3 shift valve.

5. From the next bore (C), remove the 1-2 shift valve train retaining pin, sleeve, shift control valve spring, 1-2 shift control valve and the 1-2 shift valve.



J	1	MANUAL VALVE AND LINK ASSEMBLY
A	2	PRESSURE REGULATOR VALVE
	3	PRESSURE REGULATOR VALVE SPRING
	4	REVERSE AND MODULATOR BOOST VALVE
	5	INTERMEDIATE BOOST VALVE
	6	BOOST VALVE SLEEVE
	7	RETAINING PIN
B	8	2-3 SHIFT VALVE
	9	2-3 SHIFT VALVE SPRING
	10	2-3 SHIFT CONTROL VALVE
	11	2-3 SHIFT CONTROL VALVE SPRING
	12	2-3 SHIFT CONTROL VALVE SLEEVE
	13	RETAINING PIN
C	14	1-2 SHIFT VALVE
	15	1-2 SHIFT CONTROL VALVE
	16	1-2 SHIFT CONTROL VALVE SPRING
	17	1-2 SHIFT CONTROL VALVE SLEEVE
	18	RETAINING PIN
E	19	MANUAL LOW CONTROL VALVE
	20	MANUAL LOW CONTROL VALVE SPRING
	21	PLUG
	22	RETAINING PIN
F	23	DETENT REGULATOR VALVE
	24	DETENT REGULATOR VALVE SPRING SEAT
	25	DETENT REGULATOR VALVE SPRING
	26	RETAINING PIN
D	27	DETENT VALVE
	28	WASHER
	29	DETENT VALVE INNER SPRING
	30	DETENT VALVE OUTER SPRING
	31	DETENT VALVE OUTER SPRING SEAT
	32	DETENT VALVE SPRING RETAINER
	33	DETENT VALVE STOP
	34	DETENT VALVE ACTUATING LEVER BRACKET
	35	DETENT VALVE ACTUATING LEVER
	36	RETAINING BOLT
	37	RETAINING PIN
G	38	DIRECT CLUTCH ACCUMULATOR SPRING
	39	OIL SEAL RING
	40	DIRECT CLUTCH ACCUMULATOR PISTON
	41	RETAINER RING

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Fig. 7A3-101 Valve Body Assembly - Exploded View

6. From the next bore (E), remove retaining pin, plug, manual low control valve spring and the manual low control valve.

7. From the next bore (F), remove the retaining pin, spring, seat and the detent regulator valve.

8. Install Tool J 22269 on direct clutch 2-3 accumulator piston and remove retaining "E" ring (G).

9. Remove direct clutch 2-3 accumulator piston and spring (G). If the teflon piston seal needs replacing the piston assembly will have to be replaced (Piston and Seal are an assembly).

10. From the next bore down (D), remove the detent actuating lever bracket bolt, bracket, actuating lever and retaining pin, stop, spring retainer, seat, outer spring, inner spring, washer and the detent valve. Use care when handling valve body assembly as valve body sleeve retaining pins may fall out.

Valve Body Inspection

1. Inspect all valves for scoring, cracks and free movement in their respective bores.

2. Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face.

3. Check all springs for distortion or collapsed coils.

Reassembly of Valve Body

1. Install direct clutch 2-3 accumulator piston spring and piston into valve body.

2. Install special tool J 22269 and J 24675 (installs piston evenly) on direct clutch 2-3 accumulator piston and compress spring and piston and secure with retaining ring. Align piston and oil seal ring when entering bore (G).

3. Install the detent valve, washer, outer spring, inner spring, spring seat and spring retainer. Install detent valve stop and detent valve actuating bracket. Torque bolt to 52 lb. in. Assemble detent actuating lever with retaintermidiate boost valve, boost valve sleeve and retaining pin (D).

4. Install the pressure regulator valve, spring, reverse and modulator boost valve, intermediate boost valve, boost valve sleeve and retaining pin (A).

5. In the next bore up, install 2-3 shift valve, shift valve spring, 2-3 shift control valve, shift control valve spring, shift control valve sleeve and retaining pin (B).

6. In the next bore up, install the 1-2 shift valve, 1-2 shift control valve, control valve spring, control valve sleeve and retaining pin (C).

7. In the next bore up, install the manual low control valve, spring, plug and retaining pin (E).

8. In the top right hand bore, install the detent regulator valve, spring seat, spring and retaining pin (F).

REASSEMBLY OF TRANSMISSION

General Instructions

1. Before starting to assemble the transmission, make certain that all parts are **absolutely clean** . Keep hands and tools clean to avoid getting dirt into assembly. If work is stopped before assembly is completed, cover all openings with clean cloths.

2. When reassembling, it is important that all thrust washer surfaces be given an intial lubrication. Bushings should be lubricated with transmission fluid. Thrust washers should be lubricated on both surfaces with petroleum jelly (unmedicated) before installation.

3. **Do not take a chance on used gaskets and seals - use new ones to avoid oil leaks.**

4. Use care to avoid making nicks or burrs on parts, particularly on surfaces where gaskets are used.

5. It is extremely important to tighten all parts evenly and in proper sequence, to avoid distortion of parts and leakage at gaskets and other joints.

Use a reliable torque wrench to tighten all bolts and nuts to specified torque and in the specified sequence.

Installation of Low and Reverse Clutch Piston

1. Install low and reverse clutch piston outer seal (Fig. 7A3-102).

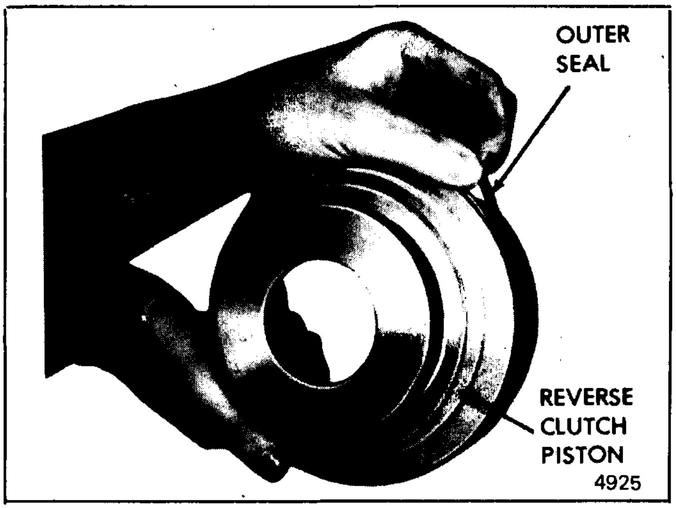

Fig. 7A3-102 Installing Low and Reverse Clutch Piston Outer Seal

2. Install low and reverse clutch piston center and inner seal (Fig. 7A3-103).

3. Install low and reverse clutch piston assembly with notch in piston installed adjacent to parking pawl (Fig. 7A3-104).

4. Position piston return seat and springs. Place snap ring on return seat so that ring may be easily installed when seat is compressed with Tool J 21420.

5. Using tool J 21420-1, compress return seat so spring retainer retaining ring may be installed with snap ring pliers (Fig. 7A3-105).

NOTE: As spring retainer is compressed, make certain inner edge of retainer does not hang up on snap ring groove.

Installing Output Shaft and Reaction Carrier

1. Install output ring gear to output shaft and output ring gear to output shaft ring (Fig. 7A3-106).

DO NOT OVERSTRESS SNAP RING ON ASSEMBLY. ALWAYS USE NEW RING ON REASSEMBLY.

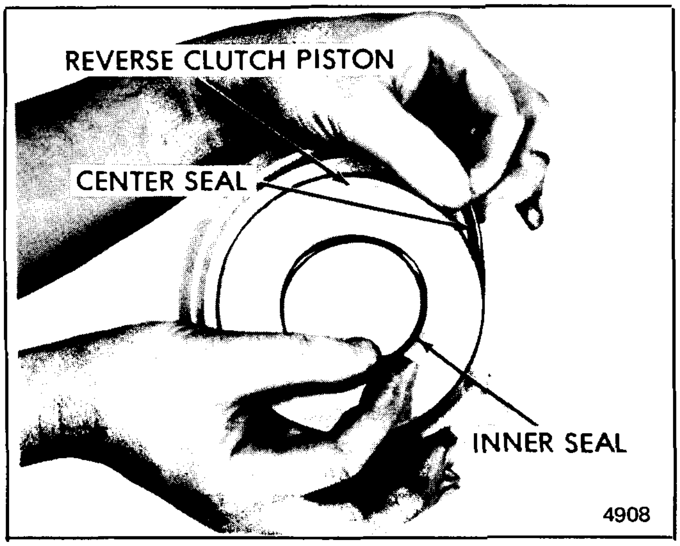

Fig. 7A3-103 Installing Piston Center and Inner Seals

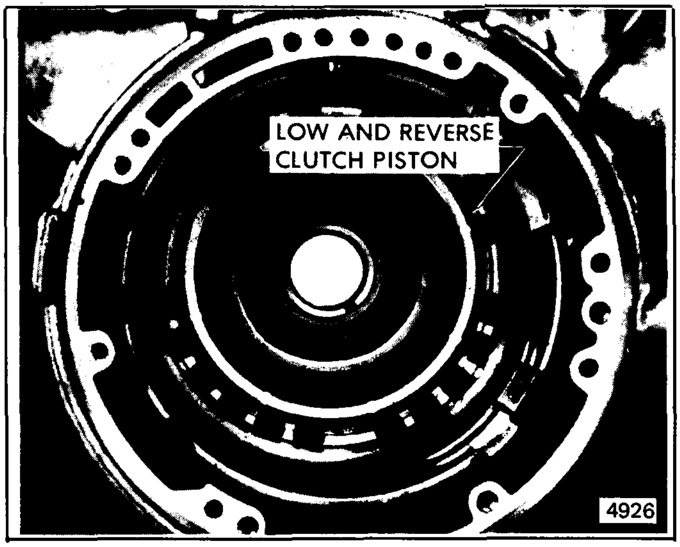

Fig. 7A3-104 Installing Low and Reverse Clutch Piston

2. Install reaction carrier to output ring gear needle thrust bearing, with lip side face up (Fig. 7A3-107).

3. Install output ring gear to case needle bearing assembly (Fig. 7A3-108). Lip on inner race of bearing MUST point toward rear of transmission.

4. Install reaction carrier assembly into output ring gear and shaft assembly (Fig. 7A3-109).

5. Install output shaft and reaction carrier assembly into case.

Installing Low and Reverse Clutch Plates

NOTE: Refer to specifications in rear of this section to determine the required amount of lined and steel clutch plates to use with specific transmission model and engine combination. When replacing piston assembly, specific part number must be used.

1. Oil and install low reverse clutch steel separator plates and faced plates, starting with a steel plate and alternating with faced plates (Fig. 7A3-110).

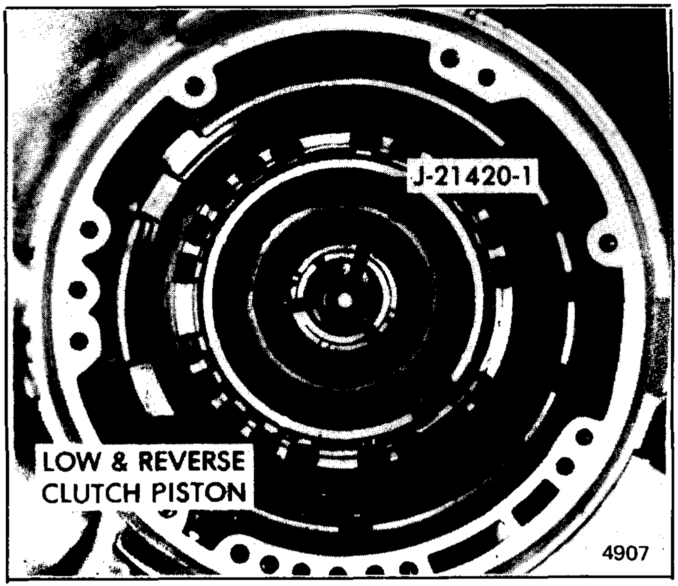

Fig. 7A3-105 Compressing Low and Reverse Clutch Piston

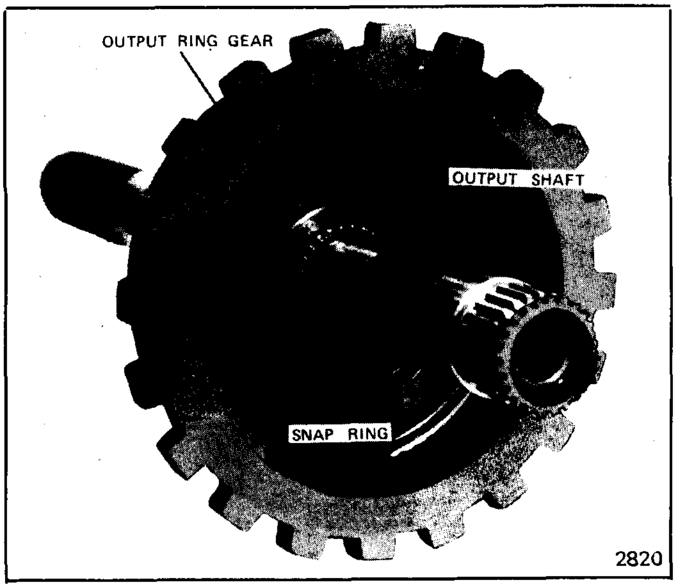

Fig. 7A3-106 Output Ring Gear and Shaft Assembly

2. Install low and reverse clutch support retainer spring (Fig. 7A3-111).

3. Install low and reverse clutch support assembly pushing firmly until support assembly is seated past top of low and reverse clutch support retainer spring so retaining ring can be installed (Fig. 7A3-112).

Make certain the splines on inner race of the roller clutch align with splines on reaction carrier.

4. Install low and reverse clutch support to case retaining ring (Fig. 7A3-111).

Installing Sun Gear Drive Shell Assembly

1. Install low and reverse clutch support inner race to sun gear drive shell thrust washer and install sun gear drive shell assembly (Fig. 7A3-113).

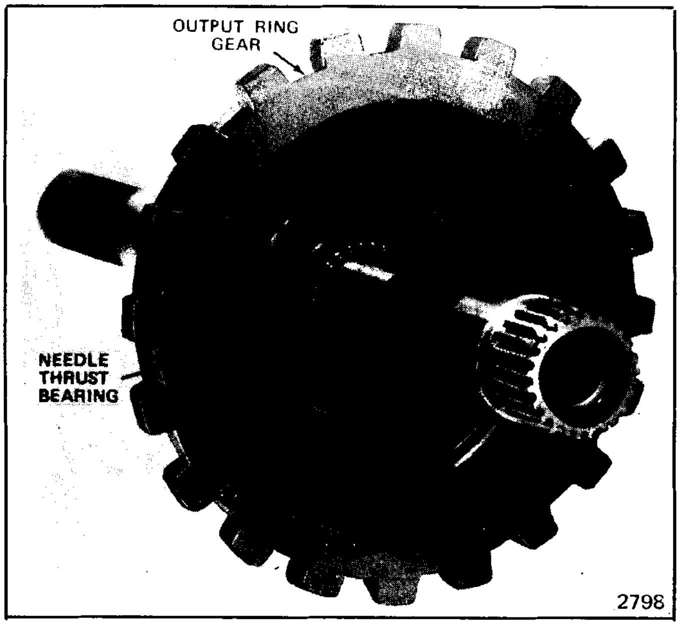

Fig. 7A3-107 Installing Needle Thrust Bearing

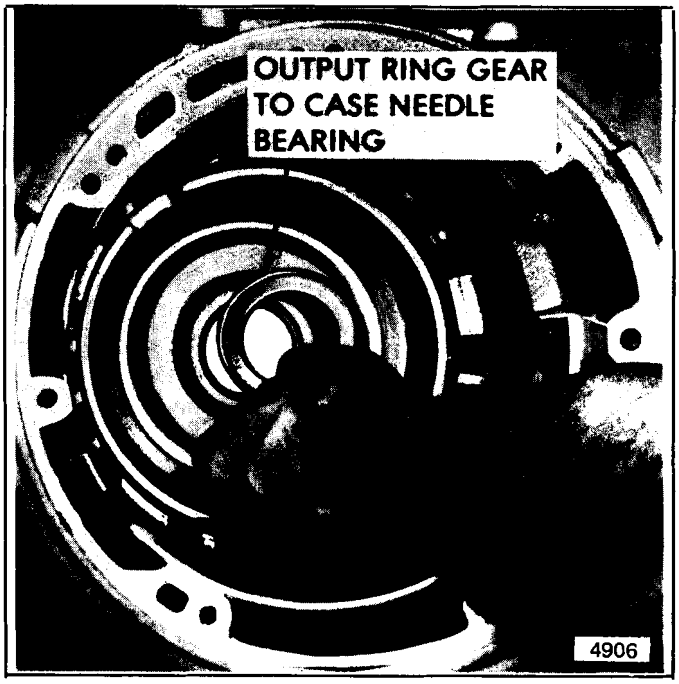

Fig. 7A3-108 Ring Gear to Case Needle Bearing

Installing Output Carrier Assembly

1. Install output carrier assembly (Fig. 7A3-114).

2. Install input ring gear to output carrier needle thrust bearing lip side face down.

3. Install output carrier to output shaft snap ring.

Use new snap ring and do not overstress on installing. USE PROPER SNAP RING PLIERS.

Installing Input Ring Gear

1. Install input ring gear (Fig. 7A3-115).

2. Install forward clutch housing to input ring gear front thrust washer (Fig. 7A3-115). Washer has three (3) tangs.

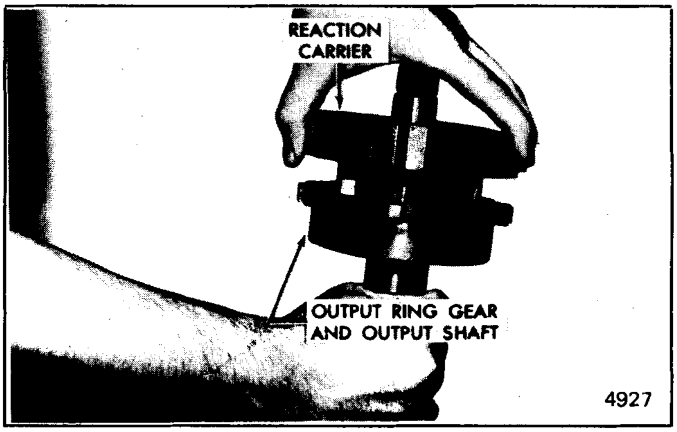

Fig. 7A3-109 Installing Reaction Carrier Into Output Ring Gear

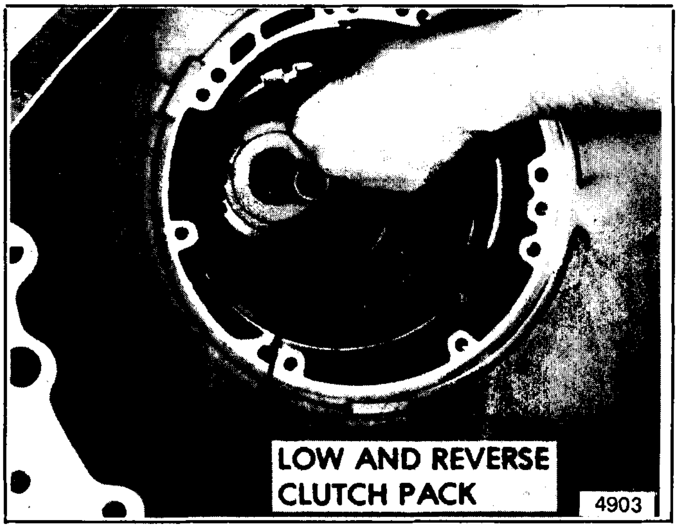

Fig. 7A3-110 Installing Low and Reverse Clutch Plates

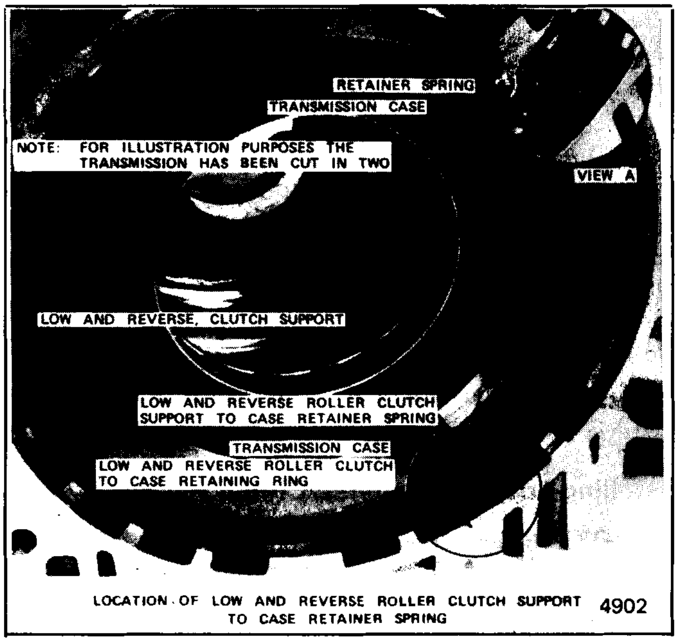

Fig. 7A3-111 Installing Clutch Support Retainer Ring

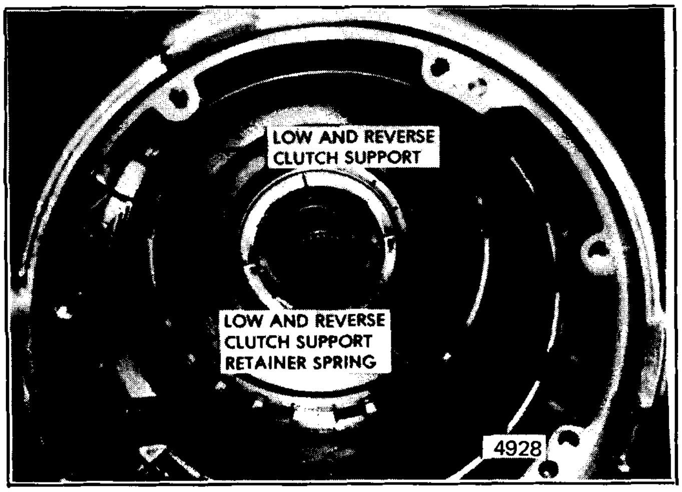

Fig. 7A3-112 Seating Low and Reverse Clutch Support in Case

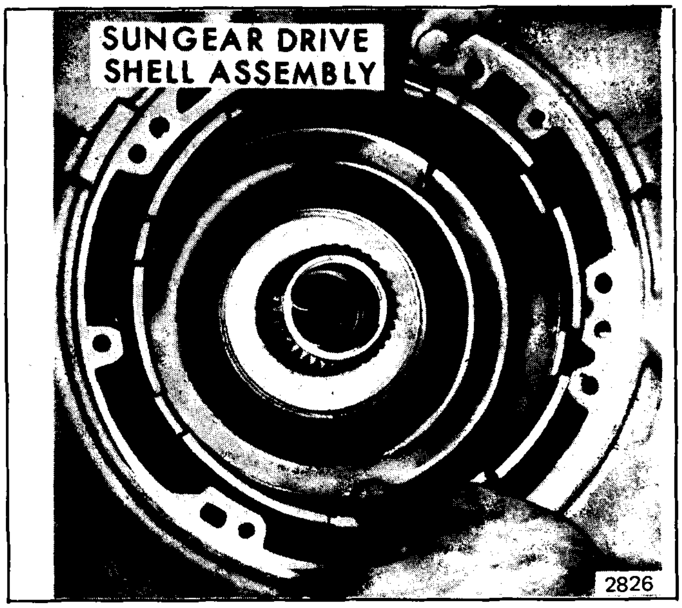

Fig. 7A3-113 Installing Drive Shell

Installing Direct and Forward Clutch Assemblies

1. Install direct clutch drum to forward clutch housing needle roller bearing (Fig. 7A3-116).

2. Install direct clutch assembly to forward clutch assembly. Install assemblies into case, making certain forward clutch faced plates are positioned over input ring gear and the tangs on direct clutch housing are installed into slots on the sun gear drive shell (Fig. 7A3-117).

Installing Intermediate Clutch Overrun Brake Band

1. Install intermediate clutch overrun brake band (Fig. 7A3-118).

Installing Intermediate Clutch Pressure Plate, Clutch Plates and Cushion Spring

NOTE: Refer to specifications in rear of this section to determine the required amount of lined and steel clutch plates to use with specific transmission model and engine. When replacing piston assembly, specific part number must be used.

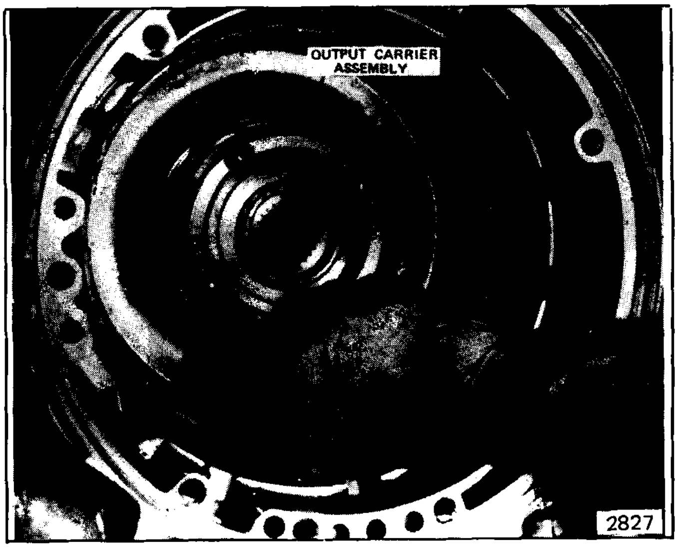

Fig. 7A3-114 Installing Output Carrier Assembly

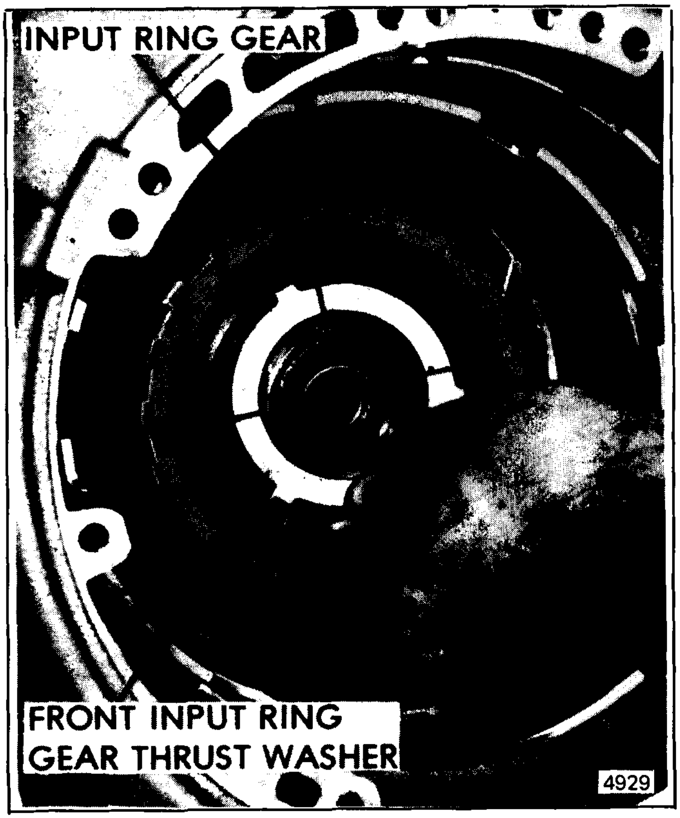

Fig. 7A3-115 Installing Input Ring Gear

1. Install intermediate clutch pressure plate (Fig. 7A3-119).

2. Oil and install lined and steel intermediate clutch plates, starting with a lined plate and alternating steel and lined (Fig. 7A3-120).

3. Install intermediate clutch cushion spring (Fig. 7A3-121).

Installing Oil Pump Assembly

1. Install original amount of .017 shims and needle thrust bearing, lip side face down, on pump cover hub. Before installation, apply petroleum jelly to both sides of shim and

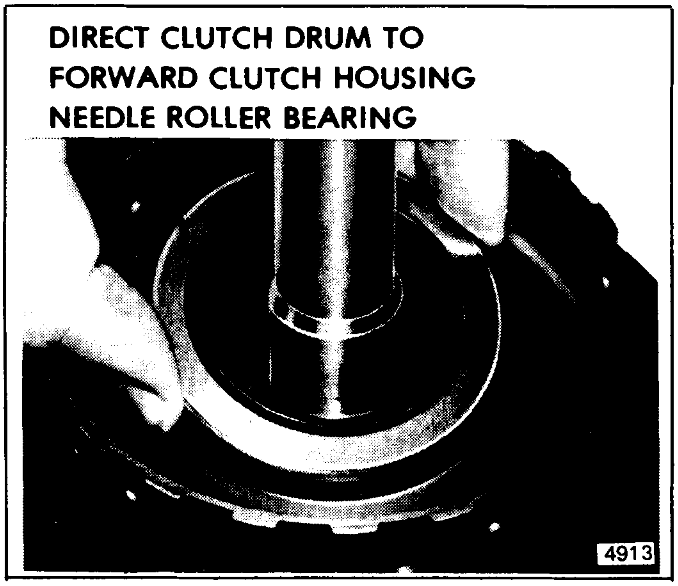

Fig. 7A3-116 Installing Needle Roller Bearing

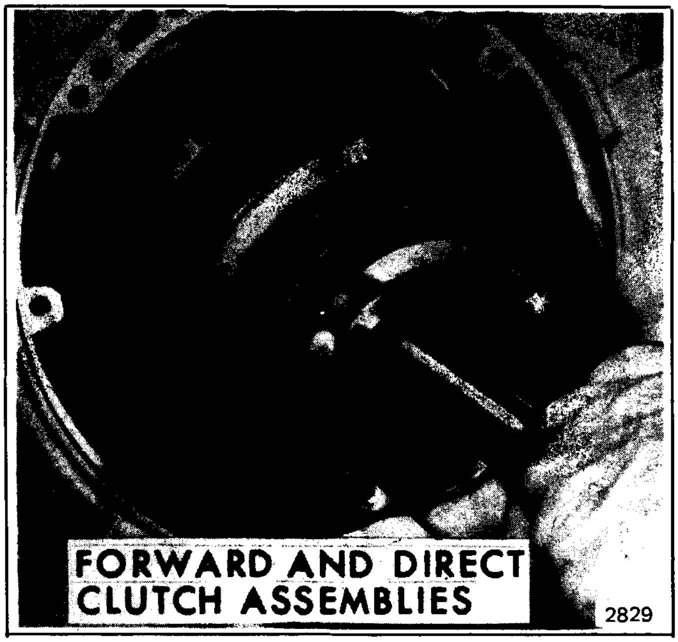

Fig. 7A3-117 Installing Clutch Assemblies

bearing (Fig. 7A3-122).

2. Install new pump assembly to case gasket. Before installing pump, lubricate case bore.

3. Install guide pins into case. Install pump assembly into case, remove guide pins and install pump to case bolts. Using new washer type seals, tighten alternately to 20 lb. ft. torque (Fig. 7A3-123).

4. If input shaft cannot be rotated as the pump is being pulled into place, the direct and forward clutch housings have not been properly installed to index the faced plates with their respective parts. This condition must be corrected before the pump is pulled into place.

5. To check direct clutch to oil pump clearance, attach slide hammer bolt to threaded hole in oil pump. With flat of hand on end of input shaft, move shaft rearward. Install Dial Indicator Set J 8001 on rod and "O" dial indicator on end of input shaft. Push on end of output shaft to move shaft forward. The reading obtained should be between .010 and .044 (Fig. 7A3-124). If the reading is incorrect, remove pump assembly and install zero, one or two .017 shims to obtain correct reading (Fig. 7A3-122).

Fig. 7A3-118 Intermediate Overrun Brake Band

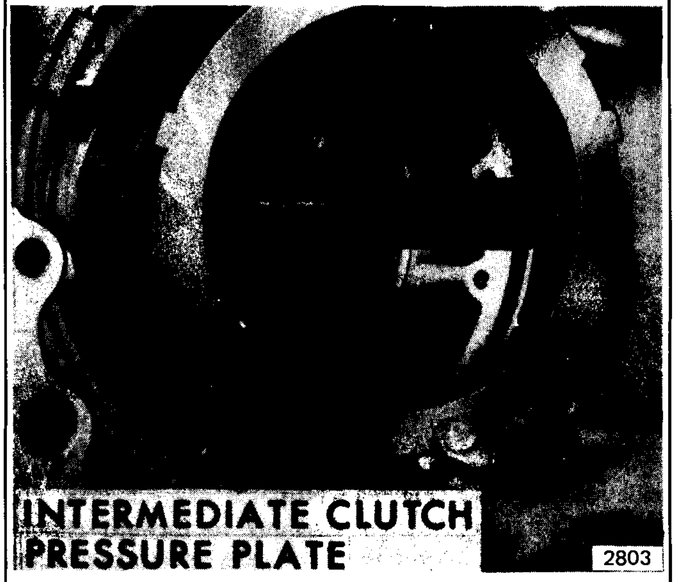

Fig. 7A3-119 Installing Clutch Pressure Plate

Installing Speedometer Drive Gear

1. Place speedometer drive gear retaining clip into hole in output shaft.

2. Align slot in speedometer drive gear with retaining clip and install (Fig. 7A3-125).

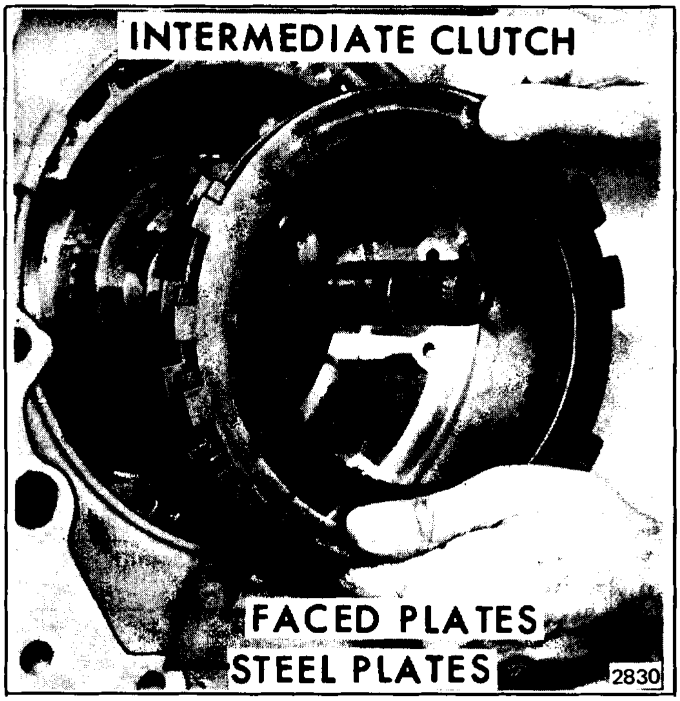

Fig. 7A3-120 Installing Intermediate Clutch Plates

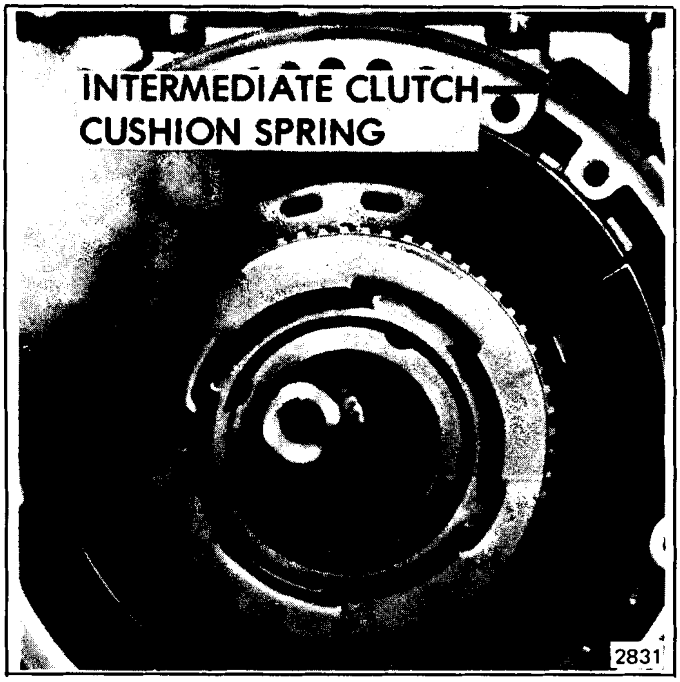

Fig. 7A3-121 Installing Clutch Cushion Spring

Installing Extension Housing

1. Install extension housing to case square cut "O" ring seal (Fig. 7A3-126).

NOTE: Extension has studs for the catalytic converter support on the right side.

3. Install speedometer driven gear, retainer and bolt. Torque bolt to 12 lb. ft.

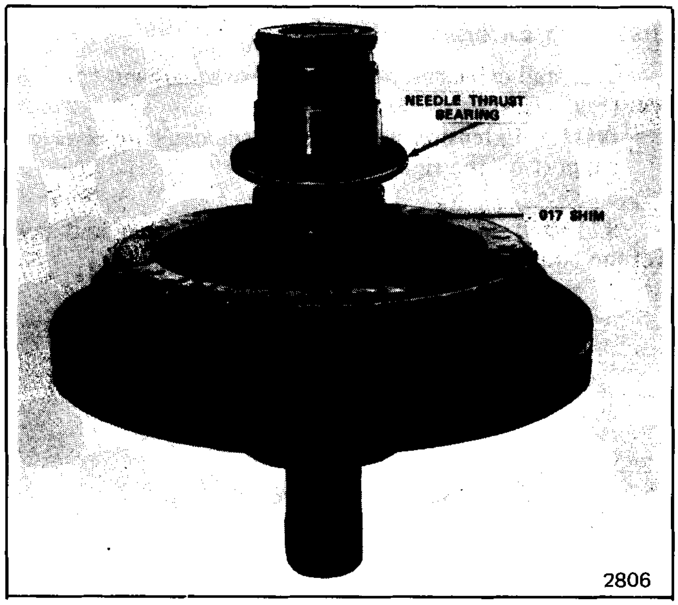

Fig. 7A3-122 Installing Shim and Thrust Bearing on Pump Hub

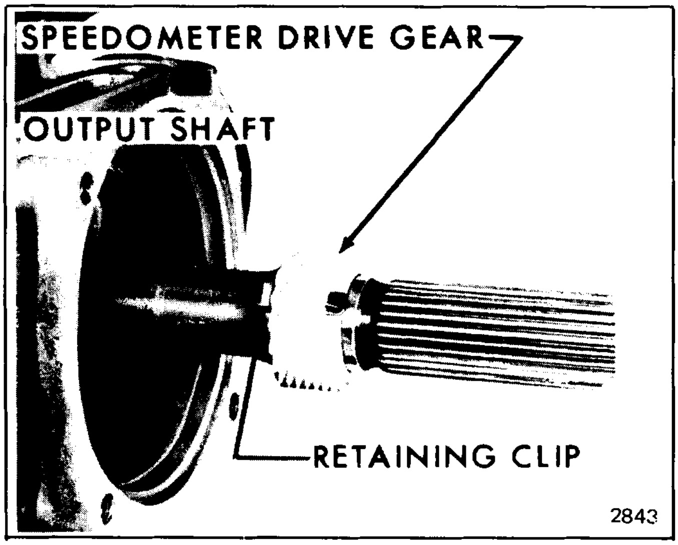

Fig. 7A3-125 Installing Speedometer Drive Gear

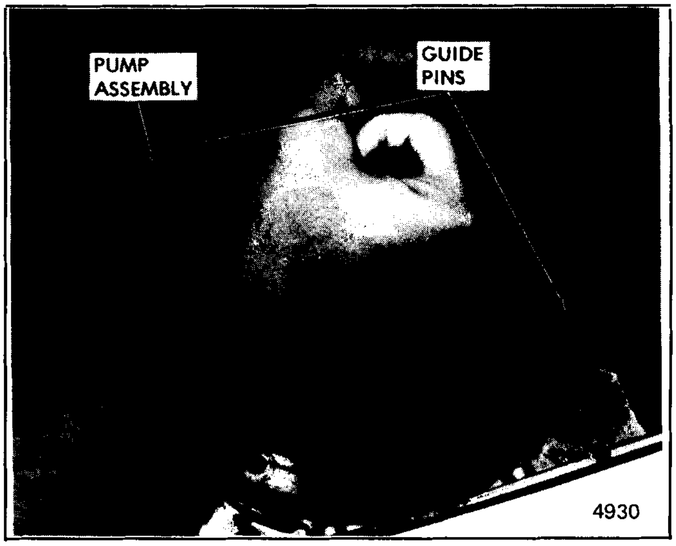

Fig. 7A3-123 Installing Pump Assembly

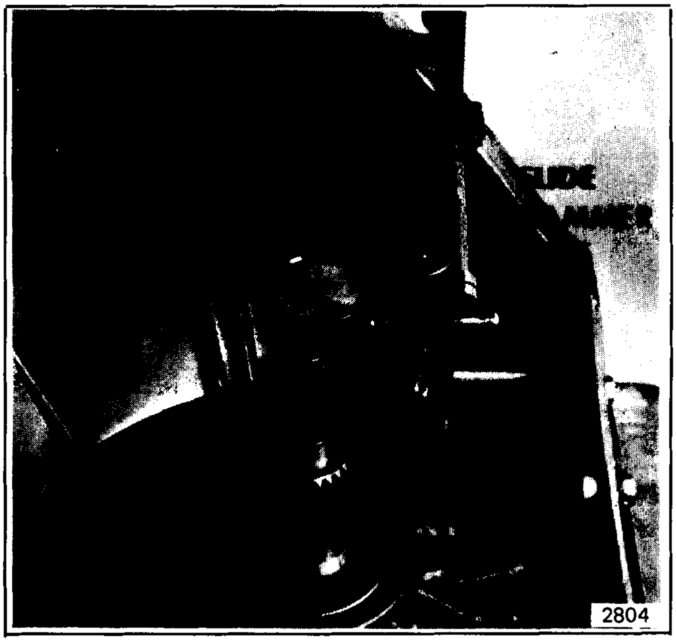

Fig. 7A3-124 Checking Direct Clutch to Pump Clearance

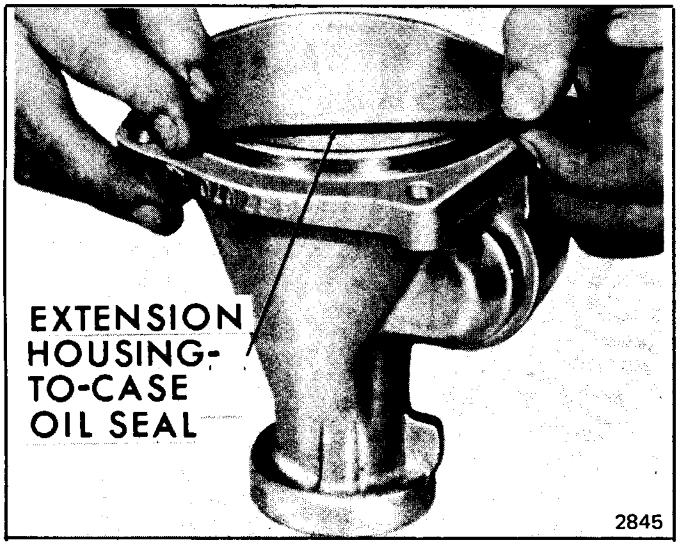

Fig. 7A3-126 Installing Square Cut O-Ring Seal

Installing Parking Pawl and Actuating Rod

1. Install parking pawl, tooth toward the inside of case (Fig. 7A3-127).

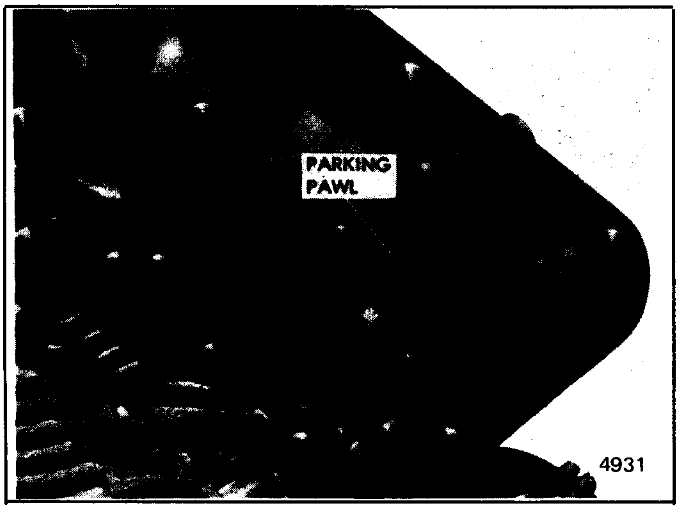

Fig. 7A3-127 Installing Parking Pawl

2. Install parking pawl shaft into case through disengaging spring. Install disengaging spring on parking pawl and slide shaft through parking pawl (Fig. 7A3-128).

3. Install parking pawl shaft retainer plug. Drive into case using a 3/8" diameter rod, until retainer plug is flush to .010" below face of case. Stake plug in three (3) places to retain plug in case (Fig. 7A3-129).

4. Install park lock bracket and torque bolts to 29 lb. ft. (Fig. 7A3-130).

5. Install actuating rod under the park lock bracket and parking pawl (Fig. 7A3-131).

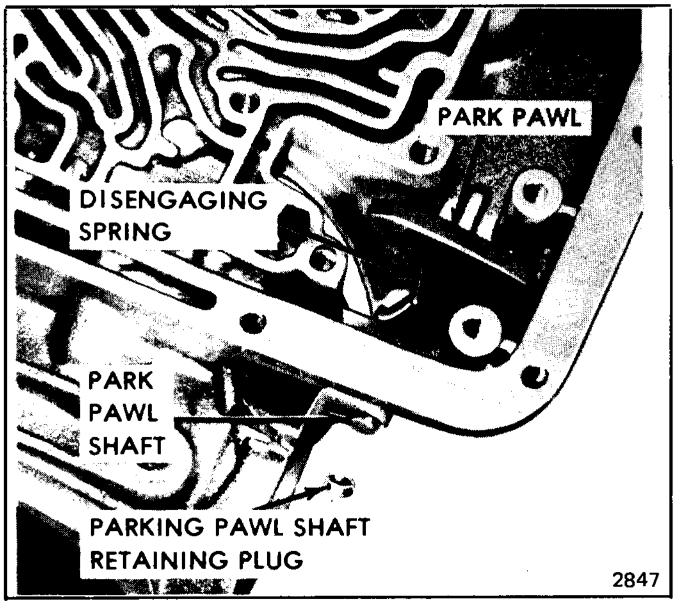

Fig. 7A3-128 Parking Pawl Assembly

Installing Manual Shaft and Range Selector Inner Lever

1. If a new manual shaft to case lip seal is necessary, use a 7/8" diameter rod and seat flush with case (Fig. 7A3-132).

2. Install manual shaft through case and range selector inner lever.

3. Install retaining jam nut on manual shaft. Torque jam nut to 30 lb. ft. See Fig. 7A3-133. Install manual shaft to case retainer.

Installing Intermediate Servo Piston, Check Balls, Oil Pump Pressure Screen and Governor Feed Screens

1. Install intermediate servo piston, apply pin, spring seat (Fig. 7A3-134).

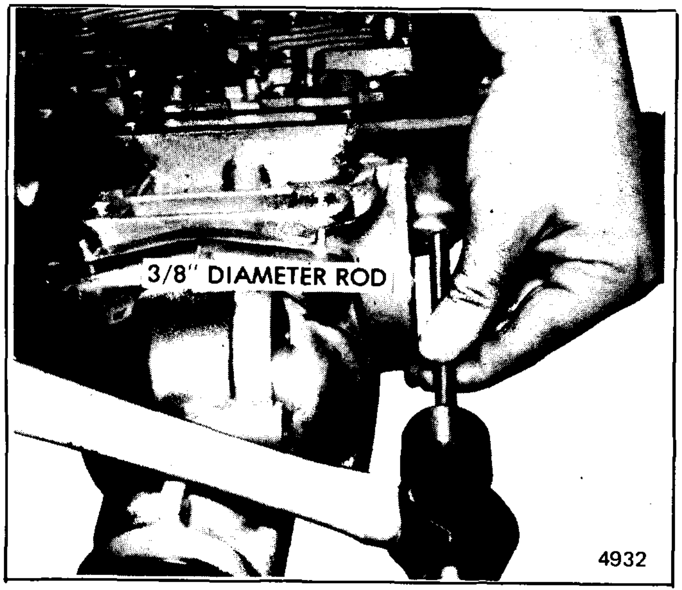

Fig. 7A3-129 Installing Retainer Plug

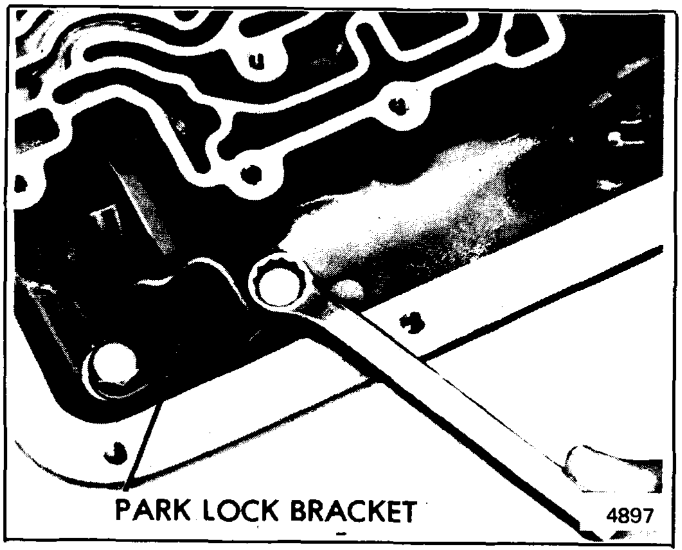

Fig. 7A3-130 Installing Park Lock Bracket

2. Install four (4) check balls into correct transmission case pockets (Fig. 7A3-135).

If number one (1) check ball is omitted or incorrectly placed, transmission failure will result due to minimum line pressure.

If transmission is still in car, place check balls in proper position in spacer plate and gasket and carefully raise into position.

3. Install oil pump pressure screen in the oil pump pressure hole in case. Ring end of screen must be installed toward case face (Fig. 7A3-136).

Clean before installing.

4. Install governor screens in the case (Fig. 7A3-137).

Clean before installing.

Installing Valve Body, Detent Roller and Spring Assembly and Filter

1. Install valve body spacer plate to case gasket and valve body spacer plate (Fig. 7A3-138).

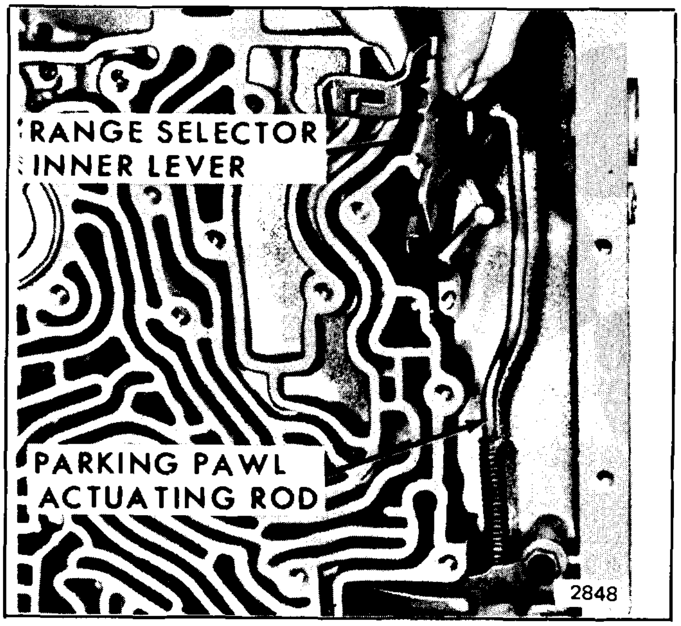

Fig. 7A3-131 Installing Actuator Rod

Fig. 7A3-132 Installing Shaft Lip Seal

2. Install valve body to spacer plate gasket. This gasket has a yellow ink stripe for identification purposes.

3. Install spacer support plate. Torque bolts to 13 lb. ft. See Fig. 7A3-139.

4. Connect detent control valve wire to detent valve actuating lever (Fig. 7A3-140).

5. Install valve body. Connect manual control valve link to range selector inner lever. Torque bolts in random sequence to 13 lb. ft. leaving bolt loose for detent roller and spring assembly (Fig. 7A3-141).

When handling valve body assembly, do not touch sleeves as retainer pins will fall into transmission.

6. Install detent roller and spring assembly to valve body (Fig. 7A3-142).

7. Install filter assembly gasket and filter (Fig. 7A3-143). Install filter and gasket exactly as shown. Always replace filter when foreign material is found to be present.

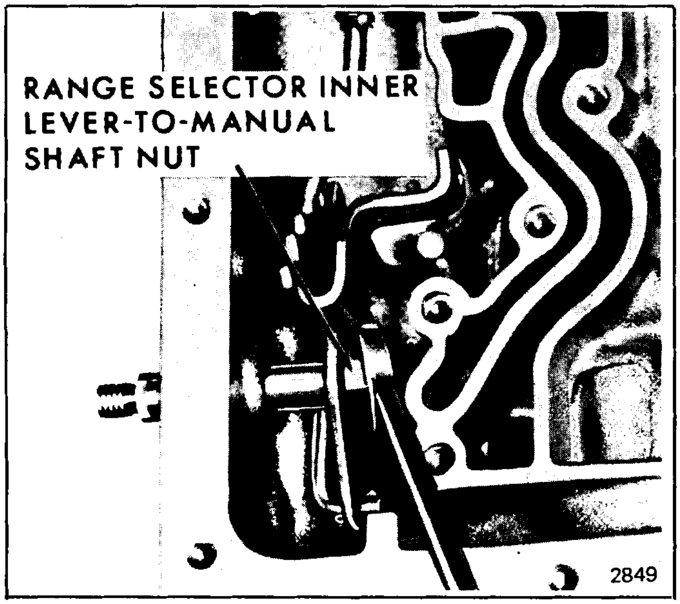

Fig. 7A3-133 Installing Jam Nut

Installing Oil Pan, Governor and Modulator Valve

1. Install new bottom pan gasket and bottom pan (Fig. 7A3-144).

2. Install governor assembly, cover and seal and retainer wire (Fig. 7A3-145). Use extreme care not to damage cover. If cover is damaged it must be replaced.

3. Install vacuum modulator valve and modulator (Fig. 7A3-146). Lubricate "O" ring seal to prevent damage, install retaining clip and torque bolt to 12 lb. ft.

CONVERTER CHECKING PROCEDURE

Converter Replacement

A converter should be replaced only if one of the following conditions exist:

1. The front oil pump cover or body are badly scored. This results in having cast iron grindings entering the converter and the oil circuit.

2. "Aluminized" oil in the converter. This comes as a result of internal converter failure.

3. End play in the converter exceeds .050".

4. External leaks.

5. A scored or damaged hub which could cause front seal failure or front pump bushing failure.

6. A broken, damaged or bad fitting converter crankshaft pilot.

7. The converter has an unbalance which results in a vibration that cannot be corrected.

A converter should **not** be replaced for any of the following conditions:

1. The oil has an odor, is discolored and there is no evidence of metal particles.

2. The oil cooler was defective, allowing engine coolant to enter the transmission.

3. A small amount of wear appears on the hub where the oil pump drive gear locates. A certain amount of such wear is normal for both the hub and oil pump gear.

4. The threads in one or more of the three converter bolt holes are damaged. Correct such conditions with the use of a Heli-coil or its equivalent.

Check Converter For Leaks as Follows:

1. Install tool J 21369 and tighten (Fig. 7A3-147).
2. Fill converter with air, 80 psi.
3. Submerge in water and check for leaks.
4. Bleed air pressure and remove tool.

Check Converter End Clearance as Follows:

1. Install tool J 21371-2 and tighten cap nut (Fig. 7A3-148).

2. Install tool J 21371-3 and tighten hex nut (Fig. 7A3-149).

3. Install dial indicator set at zero.

4. Loosen hex nut while holding cap nut stationary (Fig. 7A3-150). When nut is fully loosened, the reading obtained on the dial indicator will be converter end clearance. If clearance is .050" or over and the oil has the appearance of having been mixed with aluminumpaint, replace the converter.

When replacing the converter refer to the part number as each THM 350 model uses a specific converter.

Install Converter (Fig. 7A3-151)

1. Install converter, making sure that the converter hub engages the drive keys inside the pump gear. If they don't engage, a low mileage pump failure will occur.

2. Make sure that the converter hasn't bound up the pump gear inside the transmission.

3. Check the converter to be sure that it turns freely and is able to move forward to meet the flywheel.

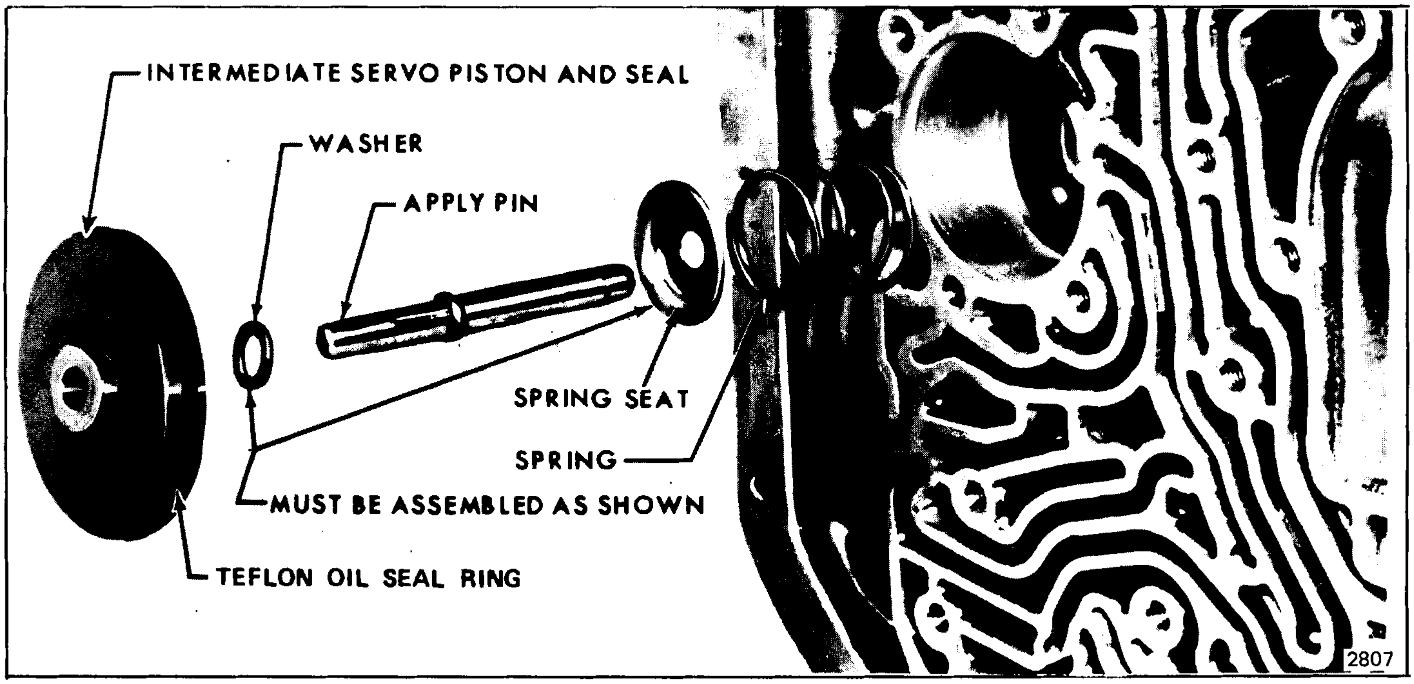

Fig. 7A3-134 Intermediate Servo Assembly - Exploded View

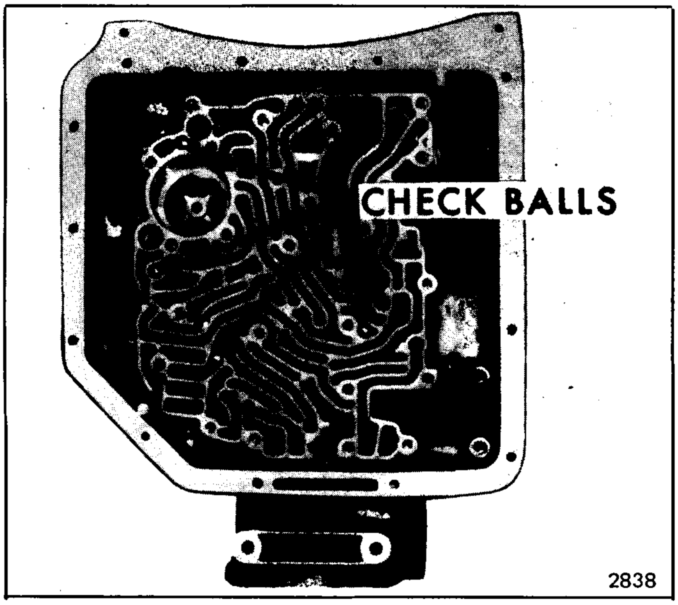

Fig. 7A3-135 Location of Check Balls

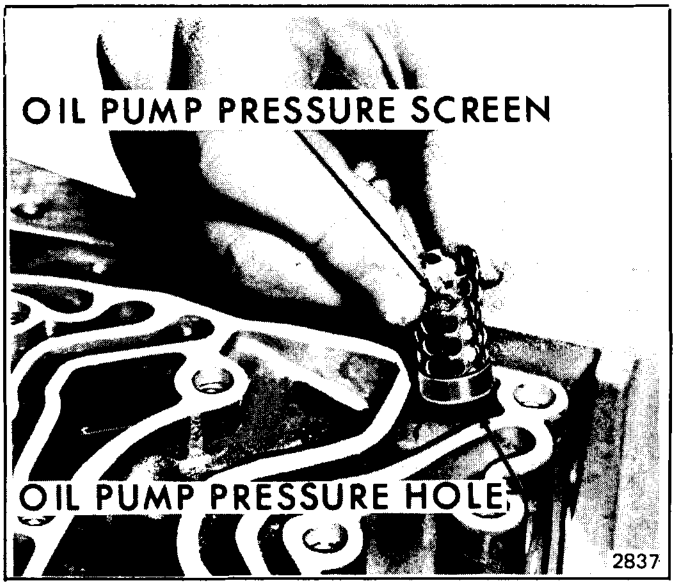

Fig. 7A3-136 Installing Pump Pressure Screen

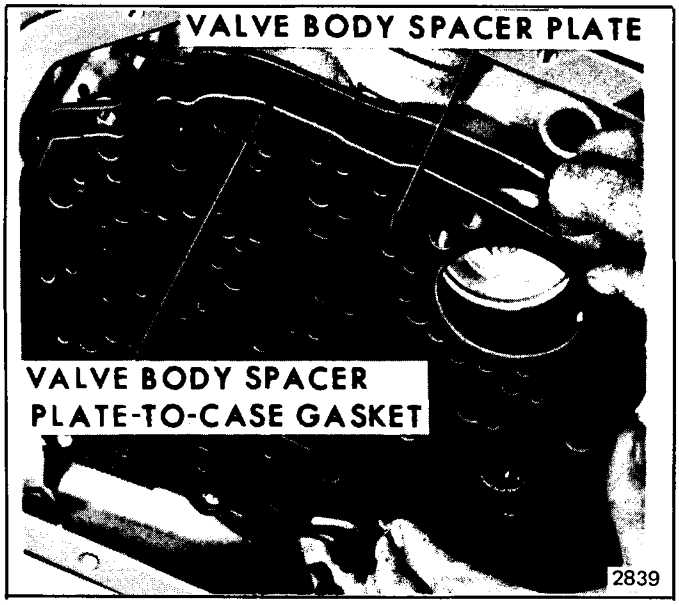

Fig. 7A3-138 Installing Spacer Plate and Gasket

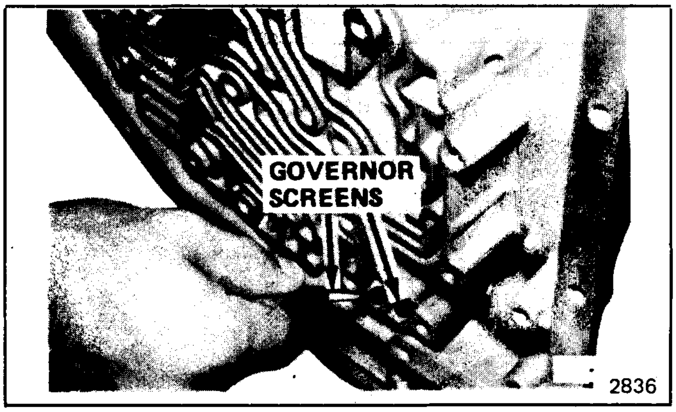

Fig. 7A3-137 Installing Governor Screens

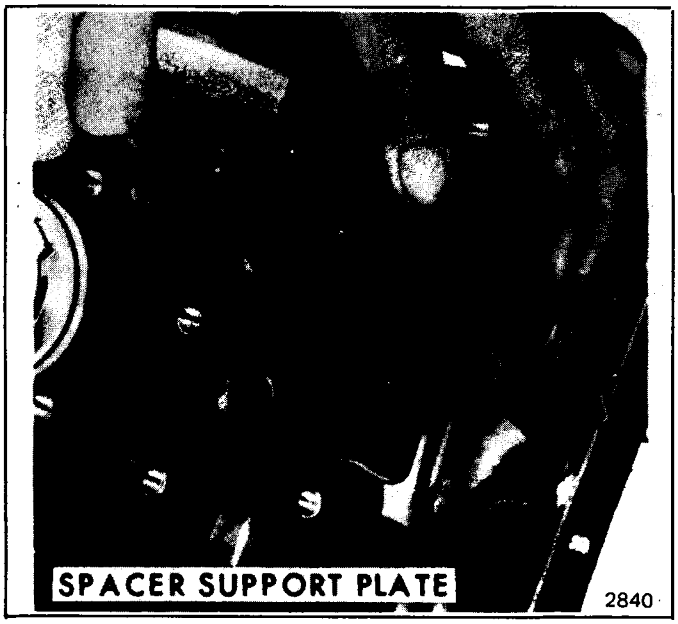

Fig. 7A3-139 Installing Support Plate

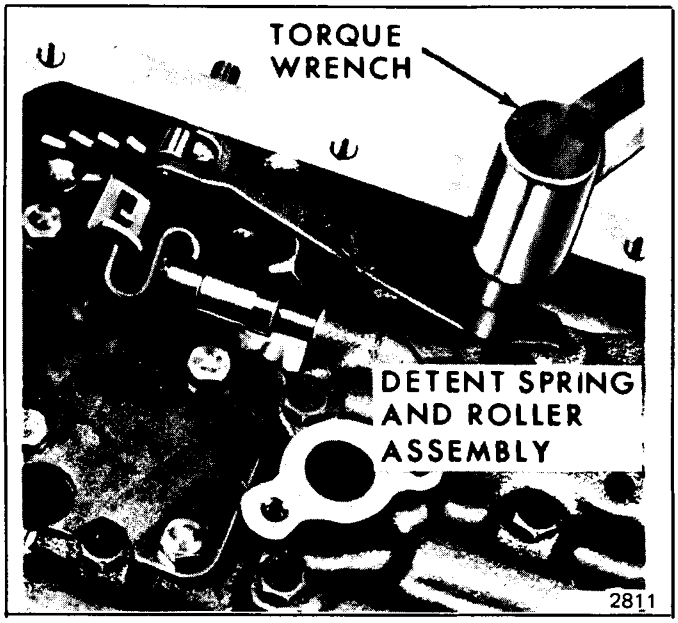

Fig. 7A3-142 Installing Detent Spring and Roller

Fig. 7A3-144 Installing Gasket and Oil Pan

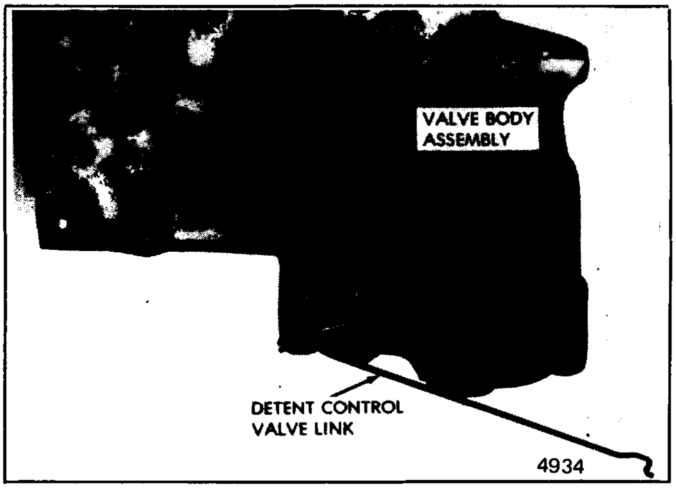

Fig. 7A3-140 Connecting Detent Control Valve Wire

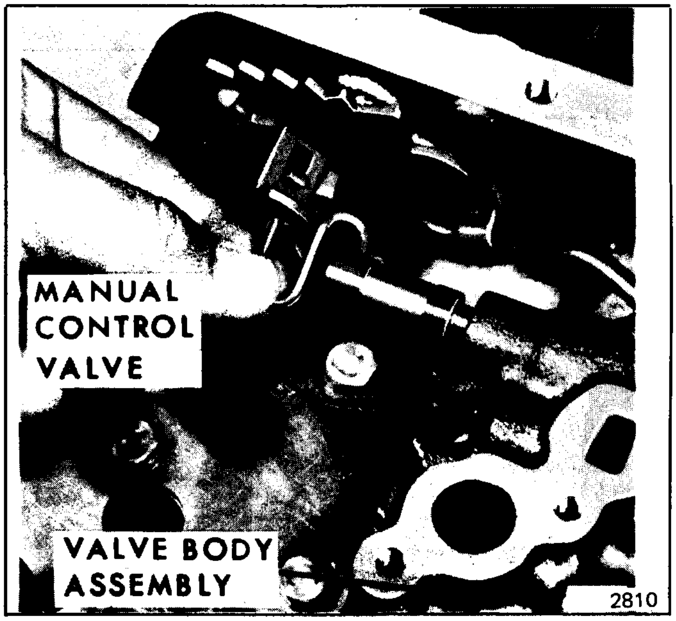

Fig. 7A3-141 Connecting Manual Control Valve Link

Fig. 7A3-143 Intalling Filter and Gasket

Fig. 7A3-145 Governor, Cover and Seal

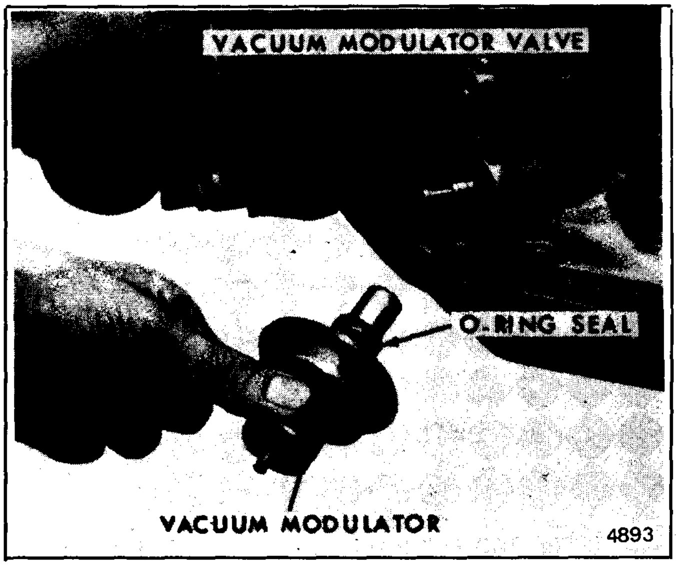

Fig. 7A3-146 Installing Modulator Valve and Modulator

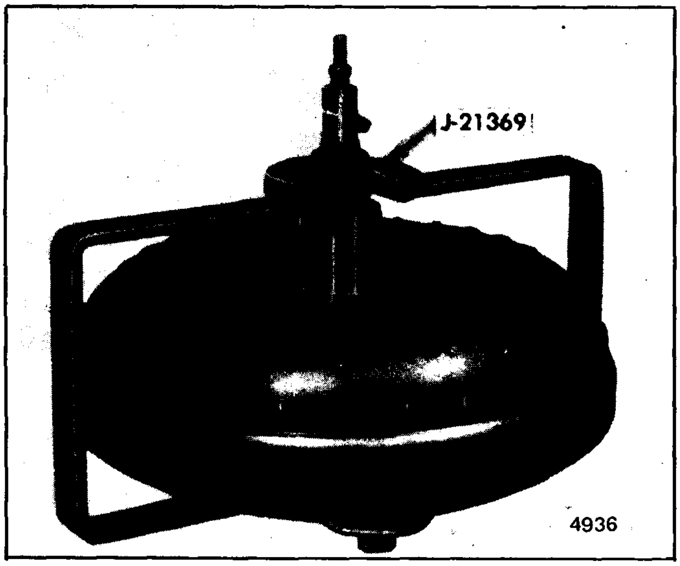

Fig. 7A3-147 Air Checking Converter

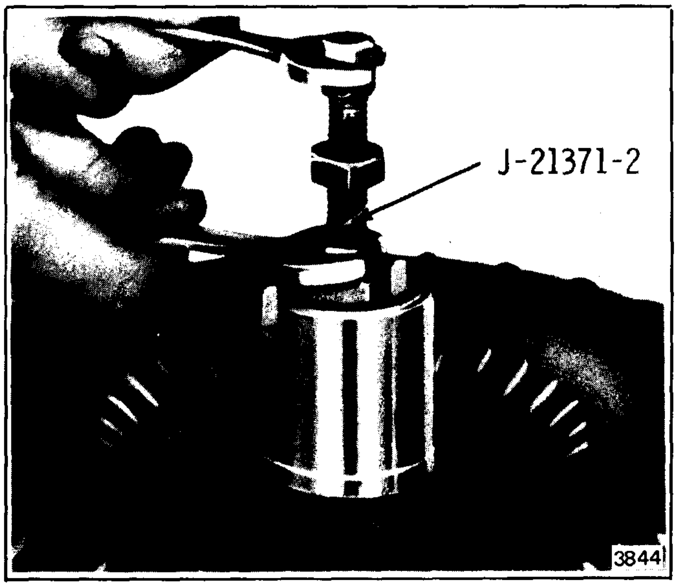

Fig. 7A3-148 Installing Tool J 21371-2

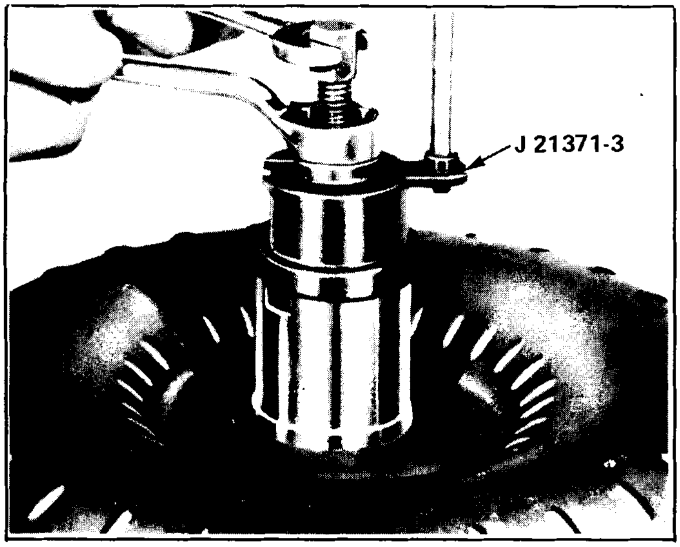

Fig. 7A3-149 Installing Tool J 21371-3

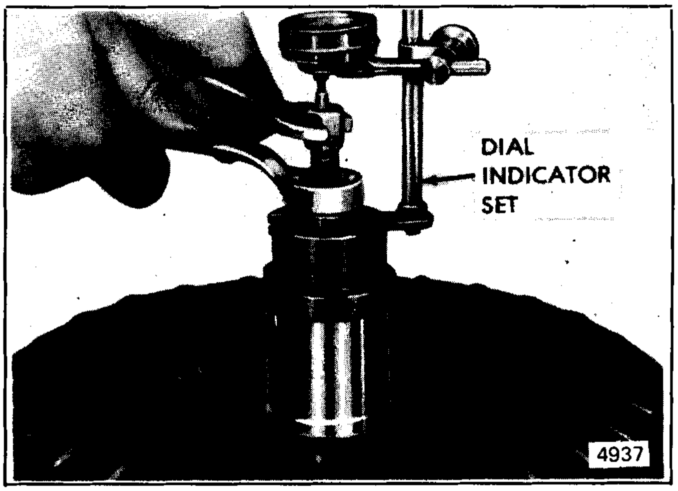

Fig. 7A3-150 Checking Converter End Play

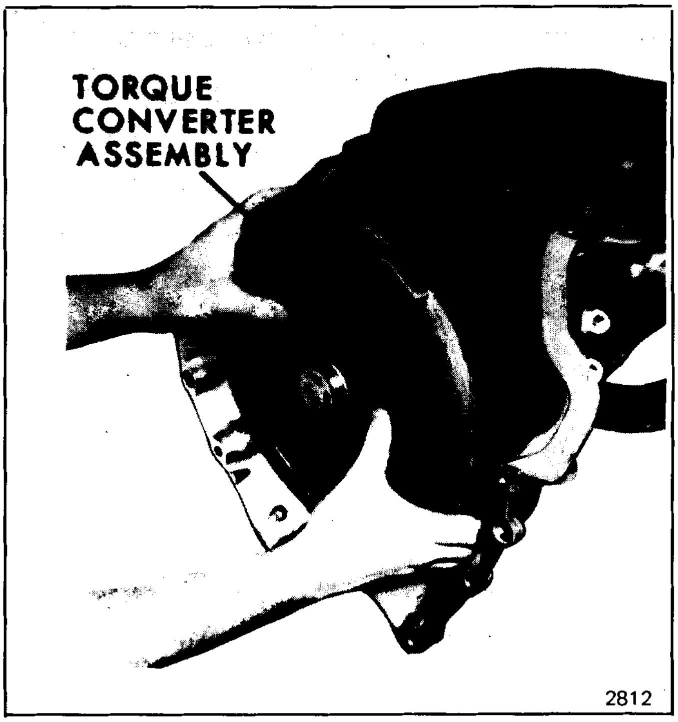

Fig. 7A3-151 Installing Converter

SPECIFICATIONS

TRANSMISSION IDENTIFICATION NUMBER

A production day and shift built number, transmission model and model year are stamped on the governor cover (Fig. 7A3-152). Since the production day built number and model number furnishes the key to construction and interchangeability of parts in each transmission, they should be used when selecting replacement parts as listed in the master parts list. The model number and day built number should also be furnished on product reports, warranty document forms and all correspondence with factory concerning a particular transmission.

The vehicle identification number is stamped on the lower left side of the case, next to the manual shaft. The application of each transmission model is as follows (Fig. 7A3-153):

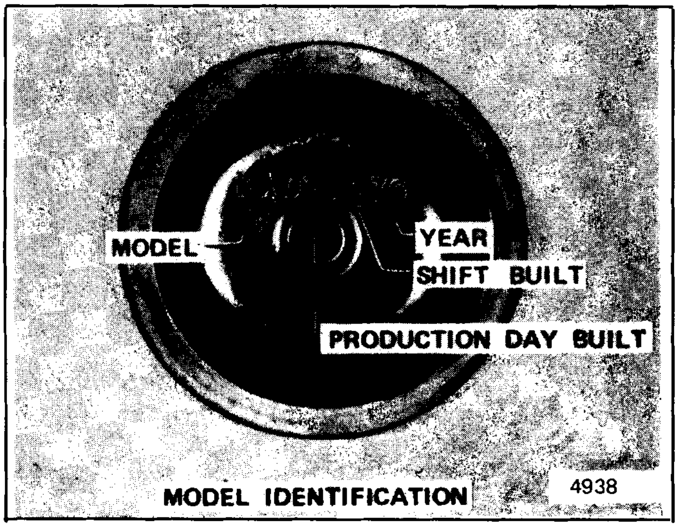

Fig. 7A3-152 Transmission Identification Number

TIGHTENING SPECIFICATIONS FOR METRIC EXTERNAL FASTENERS

1. Transmission mount to transmission--M-10-1.5 thread size torqued to 48 N·m (35 lb. ft.).

2. Speedometer sleeve retainer on extension housing--M-6.3-1.0 thread size torqued to 17 N·m (150 lb. in.).

3. Detent cable to case--M-6.3-1.0 thread size torqued to 8.5 N·m (75 lb. in.).

4. Nut on end of selector lever shaft--M-10-1.5 thread size torqued to 27 N·m (20 lb. ft.).

TRANS. MODEL		ENGINE USAGE					VEHICLE SERIES
	231	301	305	350	400	403	
KE	X						A & B
KJ FED.			X				F & X
KK FED.	X						X
KT	X						F
KX				X			X
LA						X	B
LC CAL.				X			B & X
LD CAL.				X			A & G
LE CAL.				X			A & E
LJ						X	B
LK				X			B
LM CAL.						X	A & G
LP CAL.						X	A & G
MA FED.				X			F
MC	X						F
MD	X						A & B
ME FED.				X			A & B
MG FED.					X		F
MH						X	B
MJ CAL.				X			F
MK FED.					X		F
ML CAL.				X			B
MM FED.		X					A & B
MP FED.					X		B
MR FED.		X					F
MS FED.					X		A & B
MT FED.					X		F
MW FED.		X					A
MX FED.		X					F & X
MZ CAL.						X	F

	CLUTCH PLATE USAGE			
	INTERMEDIATE CLUTCH	DIRECT CLUTCH	FORWARD CLUTCH	LOW/REVERSE CLUTCH
ALL V-6 ENGINES	2 STEEL 2 FACED	3 STEEL 3 FACED	4 STEEL 4 FACED	4 STEEL 4 FACED
ALL V-8 ENGINES	3 STEEL 3 FACED	4 STEEL 4 FACED	5 STEEL 5 FACED	5 STEEL 5 FACED

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Fig. 7A3-153 Transmission Model and Clutch Plate Usage

TIGHTENING SPECIFICATIONS

LOCATION	THREAD SIZE	TORQUE LBS. FT.
Oil Pan to Transmission Case	5/16 - 18	13
Pump Assembly to Transmission Case	5/16 - 18	20
Vacuum Modulator Retainer Case	5/16 - 18	12
Valve Body Assembly to Case	5/16 - 18	13
Oil Channel Support Plate to Case	5/16 - 18	13
Pump Body to Pump Cover	5/16 - 18	15
Parking Lock Bracket to Case	5/16 - 18	29
Extension Housing to Case	3/8 - 16	35
Inside Shift Nut	3/8 - 16	30
External Test Plugs to Case	1/8 - 27	8

SECTION 7A4

TURBO HYDRA-MATIC 400 AUTOMATIC TRANSMISSION

CONTENTS OF THIS SECTION

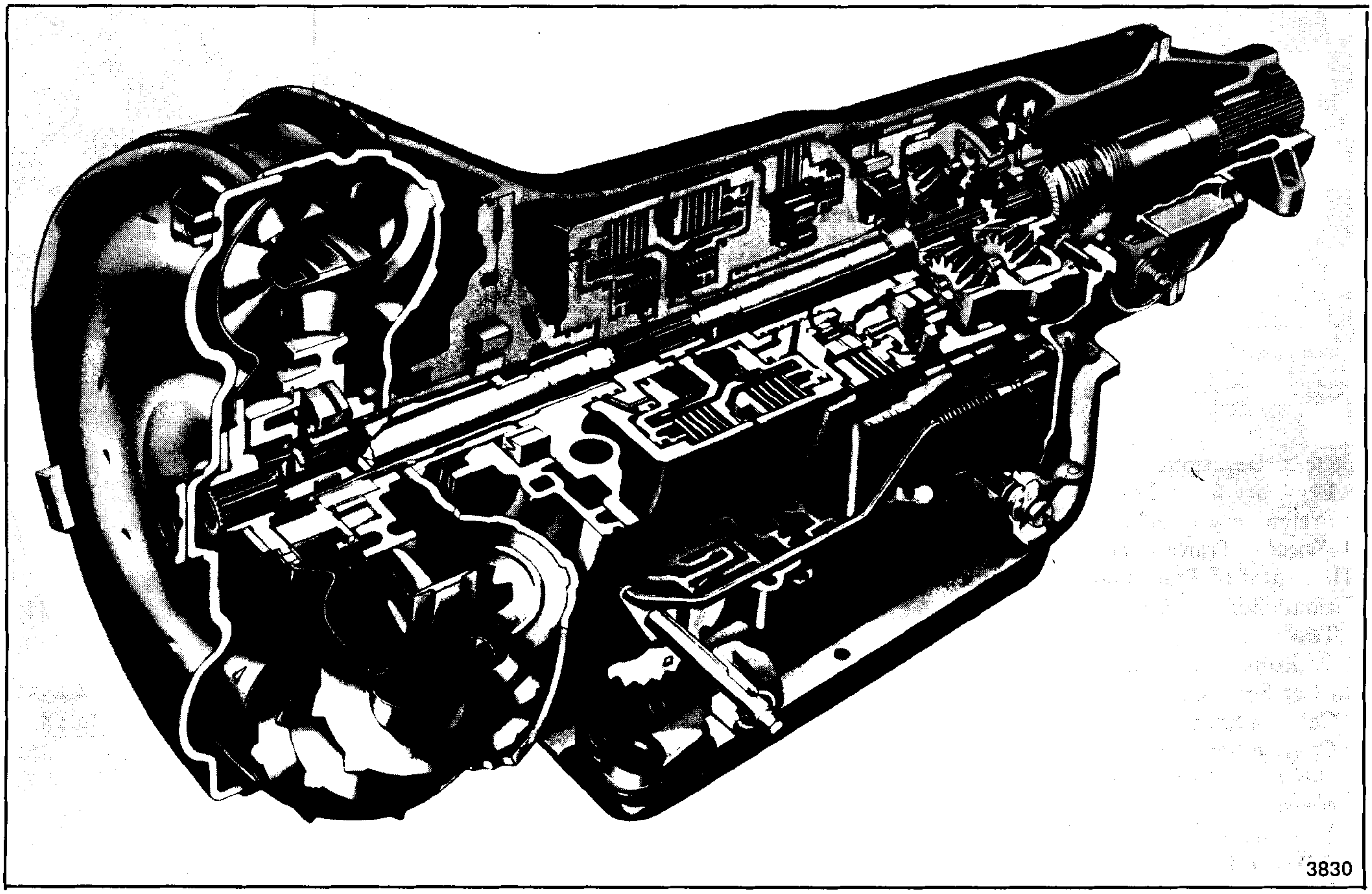


Fig. 7A4-1 400 Transmission - Cross Section

GENERAL DESCRIPTION

The Turbo Hydra-Matic transmission is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and a compound planetary gear set (Fig. 7A4-1). Three multiple-disc clutches, two roller clutches and two bands provide the friction elements required to obtain the desired function of the compound planetary gear set.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The compound planetary gear set produces three forward speeds and reverse (Fig. 7A4-2).

The 3-element torque converter consists of a pump or driving member, a turbine or driven member and a stator assembly. The stator is mounted on a one-way roller clutch which will allow the stator to turn clockwise but not counter-clockwise when viewed from the front (Fig. 7A4-3).

The torque converter housing is filled with oil and is attached to the engine crankshaft by a flex plate, thus always rotates at engine speed. The converter pump is an integral part of the converter housing, therefore the pump blades, rotating at engine speed, set the oil within the converter into motion and direct it to the turbine, causing the turbine to rotate.

As the oil passes through the turbine, it is traveling in such a direction that if it were not re-directed by the stator it would hit the rear of the converter pump blades and impede its pumping action. So, at low turbine speeds, the oil redirected by the stator to the converter pump in such a manner that it actuallly assists the converter pump to deliver power or multiply engine torque.

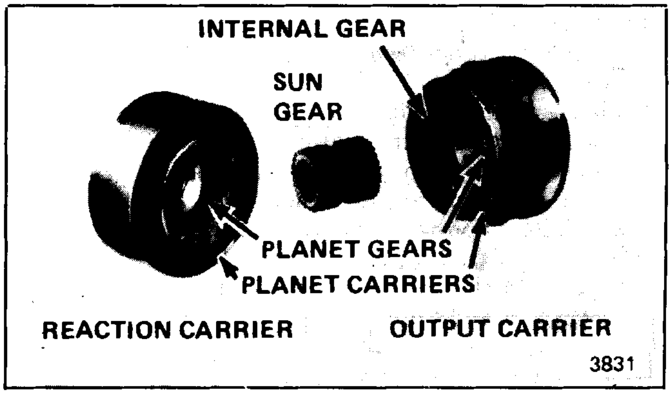


Fig. 7A4-2 Compound Planetary Gear Set

As turbine speed increases, the direction of the oil leaving the turbine changes and flows against the rear side of the stator vanes in a clockwise direction. Since the stator is now impeding the smooth flow of oil, its roller clutch releases and it revolves freely on its shaft. Once the stator becomes inactive, there is no further multiplication of engine torque within the converter. At this point, the converter is merely acting as a fluid coupling as both the converter pump

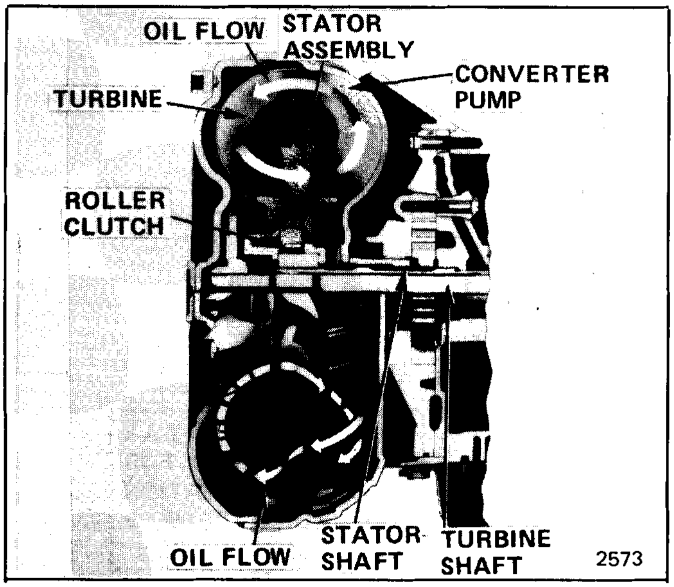


Fig. 7A4-3 Converter Operation

and turbine are being driven at approximately the same speed - or at one-to-one ratio.

A hydraulic system, pressurized by a gear-type pump, provides the working pressure required to operate the friction elements and automatic controls. External control connections to transmission are:

Manual Linkage - To select the desired operating range.

Engine Vacuum - To operate a vacuum modulator unit.

12 Volt Electrical Signal - To operate an electrical detent solenoid and TCS switch.

Approximate gear or torque ratios of the transmission are as follows:

First - 2.5 gear ratio X 2.00 converter stall ratio	5:1
*Second - 1.5 gear ratio	1.5:1
*Third	1:1
Reverse - 2:1 gear ratio X 2.00 converter stall ratio	4:1

*Second and third are also multiplied.

A vacuum modulator is used to automatically sense any change in the torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator for line pressure control, to the 1-2 accumulator valve and to the shift valves so that all torque requirements and shift speed requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

The detent solenoid is activated by an electric switch on the firewall. When the throttle is fully opened, the switch is closed, activating the detent solenoid and causing the transmission to downshift at speeds below approximately 70 mph.

PLANETARY GEAR TRAIN

A planetary gear train (Fig. 7A4-2) consists of three members:

1. A sun gear.
2. A planet carrier with four planet pinion gears.
3. An internal gear.

The sun gear is surrounded by and meshes with the planet pinion gears, which rotate freely on pins attached to a common support called the planet carrier. An internal gear surrounds the assembly and meshes with the planet pinion gears.

DIAGNOSIS

I. PRELIMINARY CHECKING PROCEDURE

IF LINE PRESSURES ARE INITIALLY HIGH:

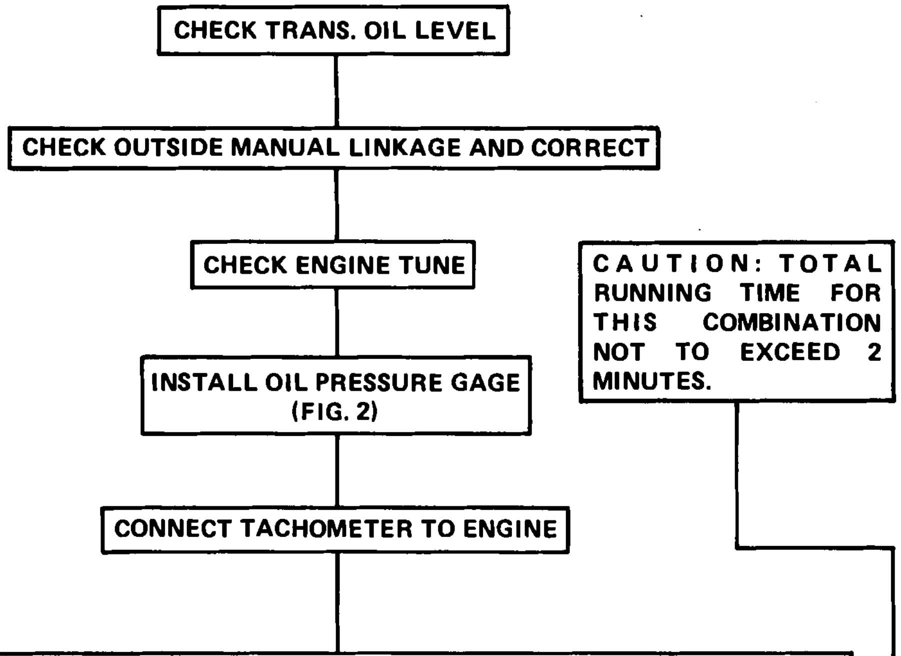
Engines With EGR Valves

On some engines with Exhaust Gas Recirculation (EGR), the throttle is open enough in "Drive" range 1000 rpm to cause the EGR valve to open. When the EGR valve opens, exhaust gas enters the intake manifold which lowers intake manifold vacuum. When intake manifold vacuum is lowered, the transmission line oil pressure raises accordingly, and may go above the upper specification limit. For this reason, if high line pressures are obtained, proceed as follows:

1. Disconnect the EGR vacuum line at the EGR valve and plug the vacuum line.

2. Recheck line pressures as indicated on the Preliminary Checking Procedure Chart (Fig. 7A4-4).

3. If high line pressures are still obtained, continue below.



CHECK OIL PRESSURES IN FOLLOWING MANNER

	RANGE	OIL PRESSURE	NORMAL P.S.I.
1	NEUTRAL—BRAKES APPLIED ENGINE AT 1000 RPM		55 to 70
2	DRIVE IDLE SET ENGINE IDLE TO SPECIFICATIONS		60 TO 85
3	DRIVE—BRAKES APPLIED ENGINE AT 1000 RPM		60 TO 90
4	SUPER OR LO—BRAKES APPLIED ENGINE AT 1000 RPM		135 TO 160
5	REVERSE—BRAKES APPLIED ENGINE AT 1000 RPM		95 TO 150
6	DRIVE—BRAKES APPLIED ENGINE AT 1000 RPM DOWNSHIFT SWITCH ACTIVATED		90 TO 110
7	GOVERNOR CHECK—SEE "CONTROL VALVE—GOVERNOR LINE PRESSURE CHECK"		DROP OF 10 P.S.I. OR MORE
8	DRIVE—30 MHP—CLOSED THROTTLE ON ROAD, OR ON HOIST*		55 TO 70

- VEHICLE ON HOIST, DRIVING WHEELS OFF GROUND, SELECTOR IN DRIVE, BRAKES RELEASED; RAISE ENGINE TO 3000 RPM, CLOSE THROTTLE AND READ PRESSURE BETWEEN 2000 AND 1200 RPM.

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FIG. 7A4-4 PRELIMINARY CHECKING PROCEDURE CHART

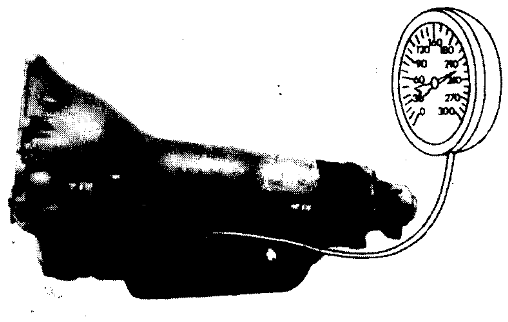
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FIG. 7A4-5 OIL PRESSURE GAGE INSTALLED

Engines Without EGR Valve Or If High Line Pressures Were Obtained With The EGR Vacuum Line Plugged

If high line pressures are experienced on vehicles without EGR or with EGR line plugged, it may be that the engine is not producing enough vacuum to lower transmission line pressure within specifications. The newer engines with emission controls characteristically have lower engine vacuum than older past model engines. To obtain line pressures suitable for evaluation, it is recommended that vacuum be applied to the modulator, using an external vacuum source such as Kent-Moore J 23738 hand operated vacuum device or its equivalent. The unit allows definite amounts of vacuum to be applied to the modeulator so that consistent line pressures may be obtained for evaluation as follows:

1. Disconnect the vacuum hose to the modulator at the modulator and plug the vacuum hose.

2. Attach the hand operated vacuum device as shown in Fig. 7A4-6 and apply 20" of vacuum.

3. Recheck line pressures according to the Preliminary Checking Procedure Chart (Fig. 7A4-4).

4. If line pressures are still high, proceed to the specific diagnosis chart that applies to the malfunction encountered.

5. If line pressures are normal with external vacuum applied, check engine vacuum and vacuum systems for leaks (See "CAUSES OF IMPROPER VACUUM AT MODULATOR").

USING THE HAND OPERATED VACUUM DEVICE (Fig. 7A4-6)

When using the hand operated vacuum device to provide a consistent vacuum for line pressure checks and/or when checking a modulator, apply 20" of vacuum. The vacuum should not bleed down any for at least 30 seconds. If a bleed down occurs, a vacuum leak is indicated.

NOTE: Before using this vacuum device each time, check it for leaks. Hold a finger firmly against the end of the hose and apply 20" of vacuum. Vacuum must not drop any for at least 30 seconds. Also, make sure the hose that fits over the modulator pipe is very tight.

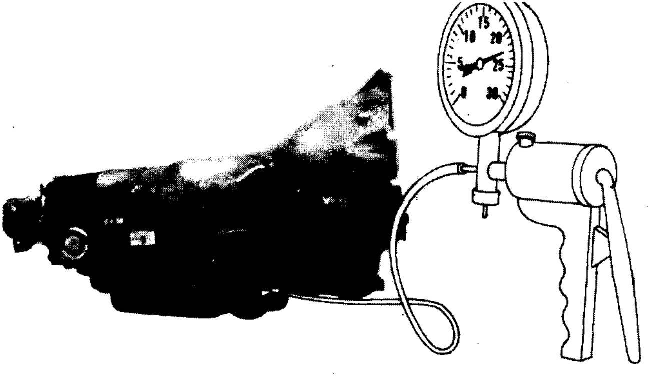
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Fig. 7A4-6 Vacuum Device Installed

CHECKING TRANSMISSION OIL LEVEL

1. ENGINE RUNNING.
2. VEHICLE ON LEVEL SURFACE.
3. BRAKES APPLIED.
4. MOVE LEVER THROUGH ALL RANGES.
5. PLACE TRANSMISSION IN "PARK".
6. CHECK OIL LEVEL.
7. IF OIL IS LOW, CHECK FOR POSSIBLE CAUSES — REFER TO "CAUSES OF OIL LEAKS".

The oil level should be between the "ADD" and "FULL HOT" marks at normal operating temperature (180-200°F). This temperature is obtained after at least 15 miles of expressway driving or equivalent city driving. Also, at normal operating temperature, the oil will heat the gage end of the dip stick to a degree where the average person can not grasp it firmly with his bare hand without discomfort.

With the oil at room temperature (approx. 70°F), the oil level should be between the two dimples located below the "ADD" mark. If the oil level is correctly established at room temperature, (70°F.), it should be at the "FULL HOT" mark on the dip stick when the transmission reaches normal operating temperature (180-200°F).

MAINTAIN OIL LEVEL BETWEEN THE "ADD" AND "FULL HOT" MARKS AT NORMAL OPERATING TEMPERATURE.

CAUTION: *DO NOT OVERFILL TRANSMISSION, AS THIS WILL CAUSE FOAMING AND LOSS OF OIL THROUGH THE VENT PIPE.*

MANUAL LINKAGE ADJUSTMENT

The transmission manual linkage must be adjusted so that the pointer on the indicator quadrant and linkage detents or stops correspond with the transmission inside detent lever detents. If the linkage is not adjusted properly, an internal leak could occur at the manual valve which could cause a clutch and/or front band to slip. Refer to the Manual Linkage Adjustment Procedure.

NOTE: IF A MANUAL LINKAGE ADJUSTMENT IS MADE, THE ASSOCIATED NEUTRAL SAFETY SWITCH SHOULD BE ADJUSTED, IF NECESSARY. THE NEUTRAL SAFETY SWITCH SHOULD BE ADJUSTED SO THAT THE ENGINE WILL START IN "PARK" AND "NEUTRAL"

POSITIONS ONLY. WITH THE SELECTOR LEVER IN THE "PARK" POSITION, THE PARKING PAWL SHOULD FREELY ENGAGE AND PREVENT THE VEHICLE FROM ROLLING.

ROAD TEST IF NECESSARY

Check All Shifts In The Following Manner:

DRIVE RANGE

Position selector lever in DRIVE RANGE and accelerate the vehicle from 0 MPH. A 1-2 and 2-3 shift should occur at all throttle openings [the shift points will vary with the throttle opening]. As the vehicle decreases in speed to 0 MPH, the 3-2 and 2-1 shifts should occur.

SUPER RANGE

Position the selector lever in SUPER RANGE and accelerate the vehicle from 0 MPH. A 1-2 shift should occur at all throttle openings [no 2-3 shift can be obtained in this range]. The 1-2 shift point will vary with throttle opening. As the vehicle decreases in speed to 0 MPH, a 2-1 shift should occur.

NOTE: The 1-2 shift in SUPER RANGE is somewhat firmer than in DRIVE RANGE. This is normal.

LO RANGE

Position the selector lever in LO RANGE and accelerate the vehicle form 0 MPH. No upshift should occur in this range, except possibly in some vehicles which have a high numerical axle ratio and/or engine rpm.

2nd GEAR - OVERRUN BRAKING

Position the selector lever in DRIVE RANGE and, with the vehicle speed at approximately 35 MPH with closed or 0 throttle, move the selector lever to SUPER RANGE. The transmission should downshift to 2nd. An increase in engine rpm and an engine braking effect should be noticed. Line pressure should change from approximately 90 PSI to approximately 150 PSI in 2nd gear.

1ST GEAR - OVERRUN BRAKING

Position the selector lever in SUPER RANGE at approximately 30 to 40 MPH. With throttle closed, move the selector lever to LO RANGE. A 2-1 downshift should occur in the speed range of approximately 40 to 20 MPH, depending on axle ratio and valve body calibration. The 2-1 downshift at closed throttle will be accompanied by increased engine rpm and an engine braking effect should be noticed. Line pressure should be approximately 150 PSI. Stop vehicle.

REVERSE RANGE

Position the selector lever in REVERSE RANGE and check for reverse operation.

II. SPECIFIC TRANSMISSION MALFUNCTIONS

See Charts A through F.

III. CAUSES OF TRANSMISSION MALFUNCTIONS

IMPROPER VACUUM AT MODULATOR

1. ENGINE

A. TUNE UP.

B. LOOSE FITTING.

C. VACUUM OPERATED ACCESSORY LEAK (HOSES, VACUUM ADVANCE, ETC).

D. ENGINE EXHAUST SYSTEM RESTRICTED.

E. EXHAUST GAS RECIRCULATION (EGR) VALVE.

2. VACUUM LINE TO MODULATOR

A. LEAK.

B. LOOSE FITTING.

C. RESTRICTED ORIFICE OR INCORRECT ORIFICE SIZE.

D. CARBON BUILD UP AT MOD. VAC. FITTING.

E. PINCHED LINE.

F. GREASE IN PIPE (NO OR DELAYED UPSHIFT-COLD).

CONTROL VALVE ASSEMBLY - GOVERNOR LINE PRESSURE CHECK

1. INSTALL LINE PRESSURE GAGE.

2. INSTALL TACHOMETER.

3. DISCONNECT VACUUM LINE TO MODULATOR.

4. WITH VEHICLE ON HOIST (DRIVING WHEELS OFF GROUND), FOOT OFF BRAKE, IN DRIVE, CHECK LINE PRESSURE AT 1000 rpm.

5. SLOWLY INCREASE ENGINE rpm TO 3000 rpm AND DETERMINE IF A LINE PRESSURE DROP OCCURS (10 PSI OR MORE).

6. IF PRESSURE DROP OF 10 PSI OR MORE OCCURS, DISASSEMBLE, CLEAN AND INSPECT CONTROL VALVE ASSEMBLY.

7. IF PRESSURE DROP IS LESS THAN 10 PSI:

A. INSPECT GOVERNOR

1. STUCK VALVE.

2. WEIGHT FREENESS.

3. RESTRICTED ORIFICE IN GOVERNOR VALVE.

4. CHECK GOVERNOR VALVE ENTRY AND EXHAUST (.020" min.).

B. GOVERNOR FEED SYSTEM

1. CHECK SCREEN IN CONTROL VALVE ASSEMBLY OR CASE.

2. CHECK FOR RESTRICTIONS IN GOVERNOR PIPE.

3. CHECK FOR FIT OF GOVERNOR PIPES IN CASE HOLES.

LOW LINE PRESSURE

1. LOW TRANSMISSION OIL LEVEL.

2. MODULATOR ASSEMBLY - PERFORM A BELLOWS COMPARISON CHECK (SEE "INSPECTION OF MODULATOR AND VALVE").

TRANSMISSION MALFUNCTION RELATED TO OIL PRESSURE
(PRESSURES OBTAINED FROM THE "PRELIMINARY CHECKING PROCEDURE CHART")

MALFUNCTION	NEUTRAL BRAKES APPLIED 1000 RPM	DRIVE IDLE	DRIVE BRAKES APPLIED 1000 RPM	SUPER OR LO BRAKES APPLIED 1000 RPM	REVERSE BRAKES APPLIED 1000 RPM	DRIVE–BRAKES APPLIED 1000 RPM DOWNSHIFT SWITCH ACTIVATED	PRESSURE DROP OCCURS WHILE ENGINE RPM INCREASES FROM 1000 TO 3000 RPM WHEELS FREE TO MOVE*	DRIVE 30 MPH CLOSED THROTTLE	POSSIBLE CAUSE OF MALFUNCTION
	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE	OIL PRESSURE		OIL PRESSURE	
NO 1-2 UPSHIFT AND/OR DELAYED UPSHIFT	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	10 PSI DROP OR MORE	NORMAL	MALFUNCTION IN CONTROL VALVE ASSY.
	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	LESS THAN 10 PSI DROP	NORMAL	MALFUNCTION IN GOVERNOR OR GOVERNOR FEED SYSTEM
	NORMAL	HIGH	HIGH	NORMAL	NORMAL	NORMAL	DROP	HIGH	MALFUNCTION IN DETENT SYSTEM
	HIGH	HIGH	HIGH	NORMAL	HIGH	---	---	---	MALFUNCTION IN MODULATOR OR VACUUM FEED SYSTEM TO MODULATOR
SLIPPING–REVERSE	NORMAL	NORMAL	NORMAL	NORMAL	LOW	NORMAL	DROP	NORMAL	OIL LEAK IN FEED SYSTEM TO THE DIRECT CLUTCH
SLIPPING–1ST GEAR	NORMAL	LOW TO NORMAL	LOW TO NORMAL	LOW TO NORMAL	NORMAL	LOW TO NORMAL	---	LOW TO NORMAL	OIL LEAK IN FEED SYSTEM TO THE FORWARD CLUTCH
NO DETENT DOWNSHIFTS	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	LOW	NORMAL	NORMAL	MALFUNCTION IN DETENT SYSTEM

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*DRIVE RANGE, VACUUM LINE DISCONNECTED FROM MODULATOR.

NOTE: A DASH (–) IN THE ABOVE CHART MEANS THAT THE OIL PRESSURE READING HAS NO MEANING UNDER THE TEST CONDITION.

Fig. 7A4-7 Preliminary Diagnosis Chart

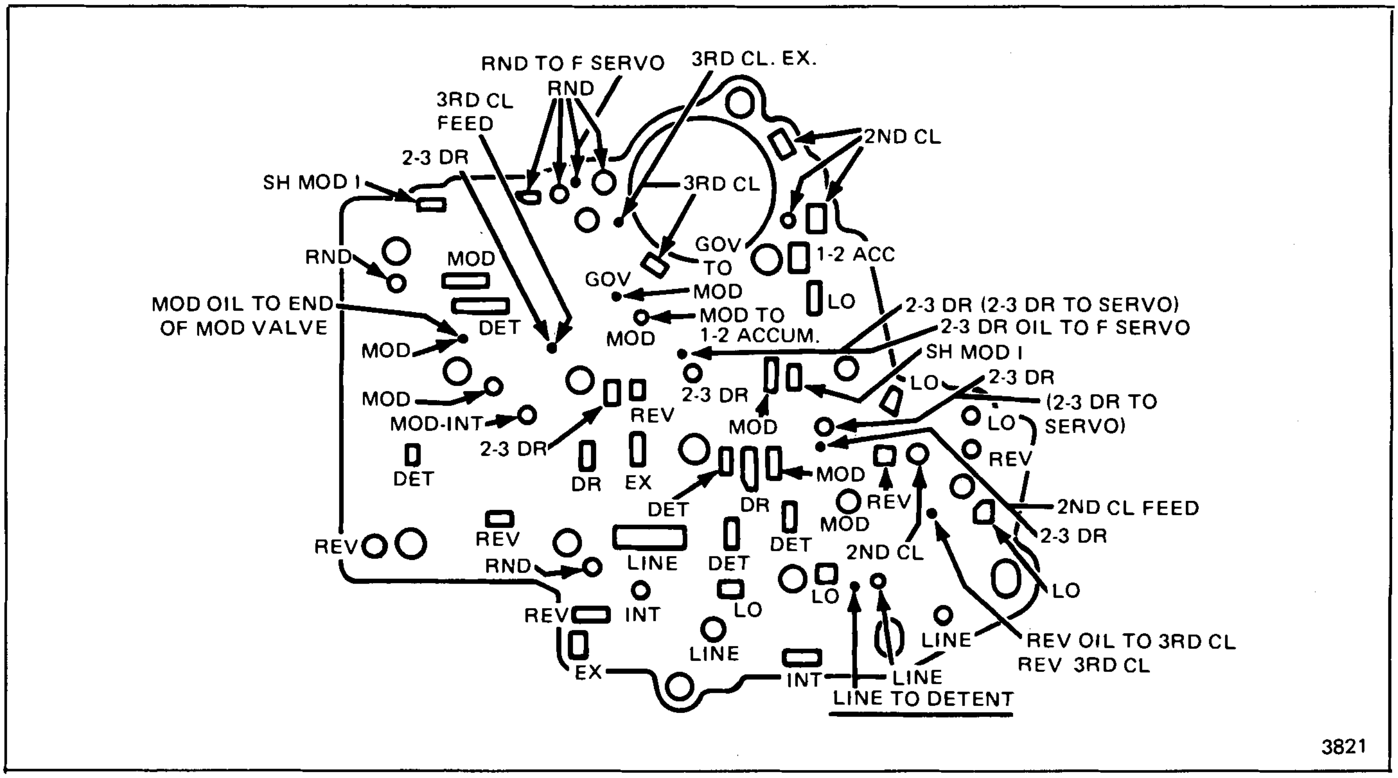


Fig. 7A4-8 Spacer-Control Valve Assy. (Typical)

3. FILTER

A. BLOCKED OR RESTRICTED.

B. "O" RING ON INTAKE PIPE AND/OR GROMMET OMITTED OR DAMAGED.

C. SPLIT OR LEAKING INTAKE PIPE.

D. WRONG FILTER ASSEMBLY.

4. PUMP

A. PRESSURE REGULATOR OR BOOST VALVE STUCK.

B. GEAR CLEARANCE, DAMAGED, WORN (PUMP WILL BECOME DAMAGED IF DRIVE GEAR IS INSTALLED BACKWARDS OR IF CONVERTER PILOT DOES NOT ENTER CRANKSHAFT FREELY).

C. PUMP TO CASE GASKET MISPOSITIONED.

D. PUMP BODY AND/OR COVER MACHINING ERROR OR SCORING OF PUMP GEAR POCKET.

E. MISMATCH PUMP COVER/PUMP BODY TYPES.

5. INTERNAL CIRCUIT LEAKS

A. FORWARD CLUTCH LEAK (PRESSURE NORMAL IN NEUTRAL AND REVERSE-PRESSURE LOW IN DRIVE):

1. CHECK PUMP RINGS FOR DAMAGE.

2. CHECK FORWARD CLUTCH SEALS FOR DAMAGE.

3. CHECK TURBINE SHAFT JOURNALS FOR DISTRESS.

4. CHECK STATOR SHAFT BUSHINGS FOR DAMAGE.

B. DIRECT CLUTCH LEAK (PRESSURE NORMAL IN NEUTRAL, LOW, SUPER AND DRIVE-PRESSURE LOW IN REVERSE):

1. CHECK CENTER SUPPORT OIL SEAL RINGS FOR DAMAGE.

2. CHECK DIRECT CLUTCH OUTER SEAL FOR DAMAGE.

3. CHECK REAR SERVO AND FRONT ACCUM. PISTONS AND RINGS FOR DAMAGE OR MISSING.

6. CASE ASSEMBLY

A. POROSITY IN INTAKE BORE AREA.

B. CHECK CASE FOR INTERMEDIATE CLUTCH PLUG LEAK OR BLOWN OUT (SEE FIG. 7A4-131).

C. LOW LINE PRESSURE IN REVERSE OR IF LO-REVERSE CHECK BALL MISPOSITIONED OR MISSING (THIS WILL CAUSE NO REVERSE AND NO OVERRUN BRAKING IN LO RANGE).

THERE IS NOT APPROVED WAY FOR CHECKING OR CLEANING THE FILTER. IF THE FILTER IS SUSPECTED OF BEING PLUGGED OR RESTRICTED, IT MUST BE REPLACED.

HIGH LINE PRESSURE

1. VACUUM LEAK

A. FULL LEAK, VACUUM LINE DISCONNECTED.

B. PARTIAL LEAK IN LINE FROM ENGINE TO MODULATOR.

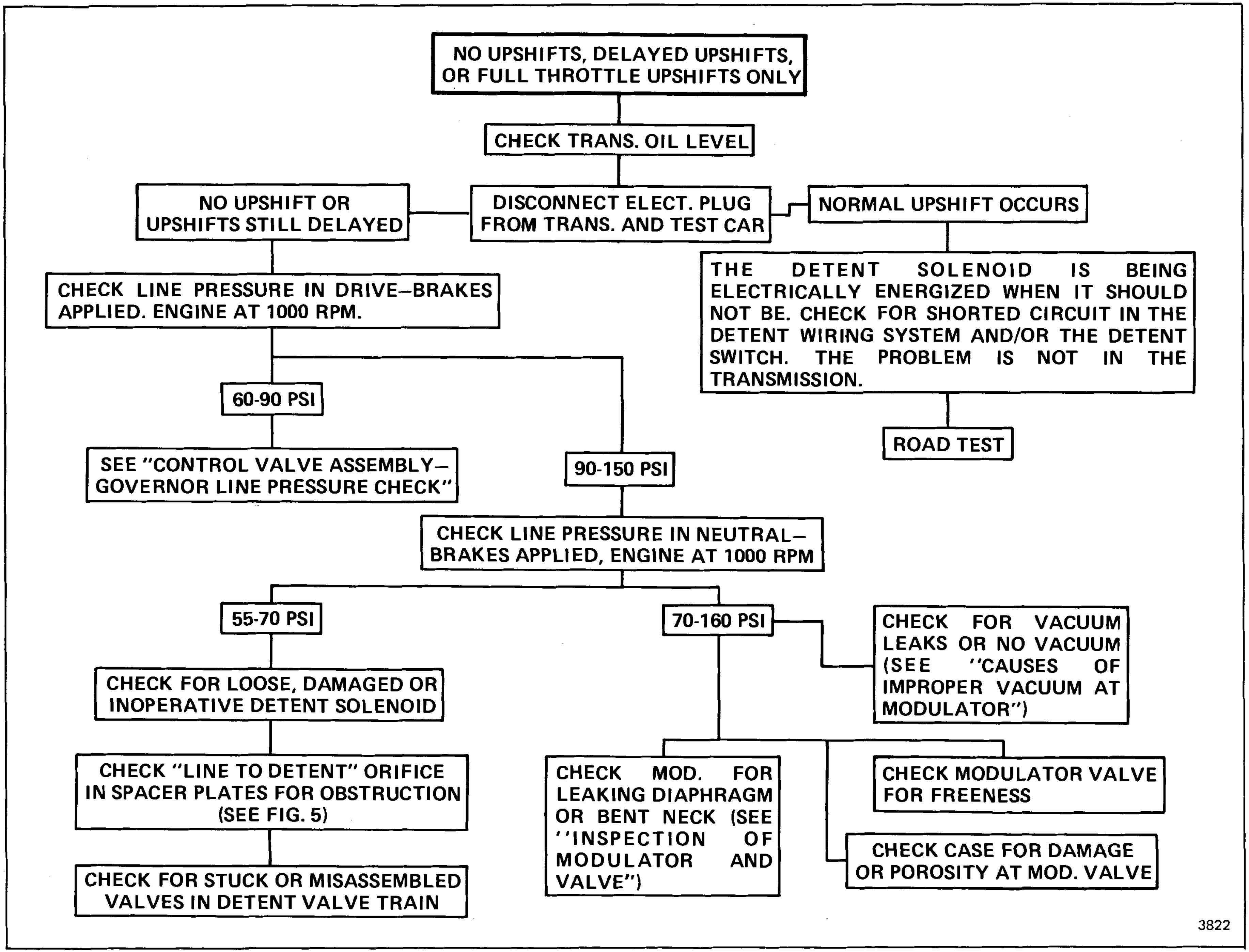
C. IMPROPER ENGINE VACUUM.

D. VACUUM OPERATED ACCESSORY LEAK (HOSES, VACUUM ADVANCE, ETC.).

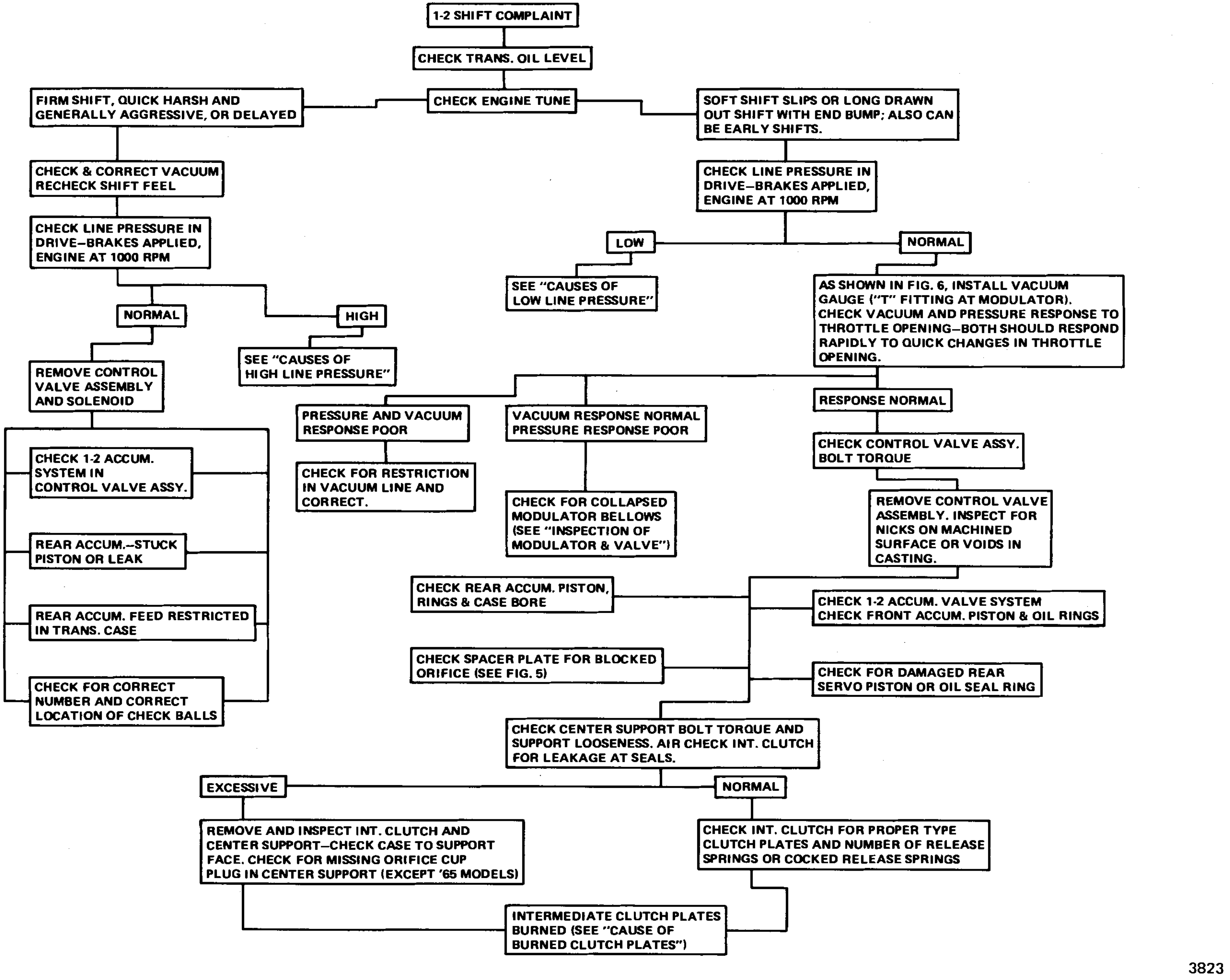
2. DAMAGED MODULATOR

A. STUCK VALVE.

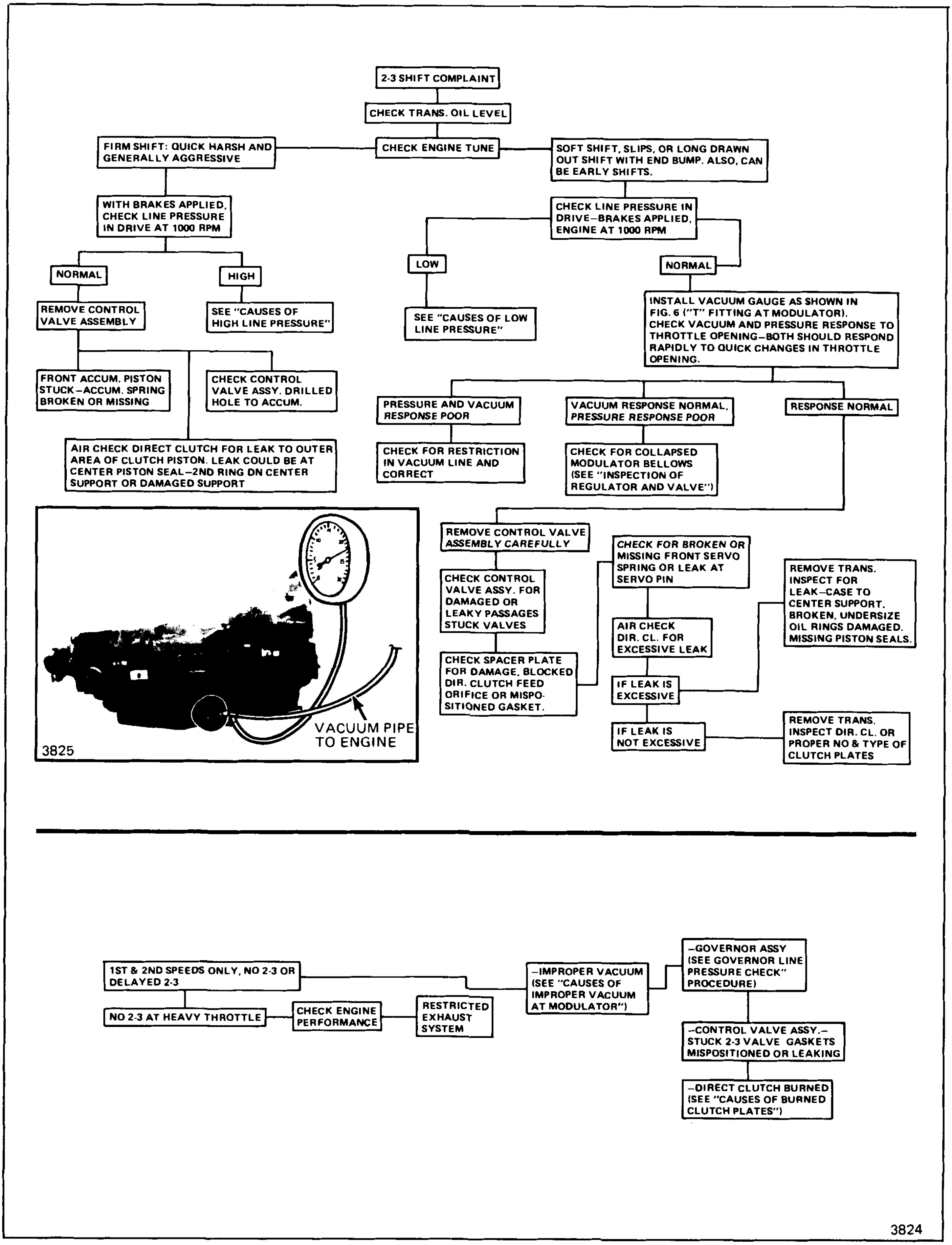
B. WATER IN MODULATOR.



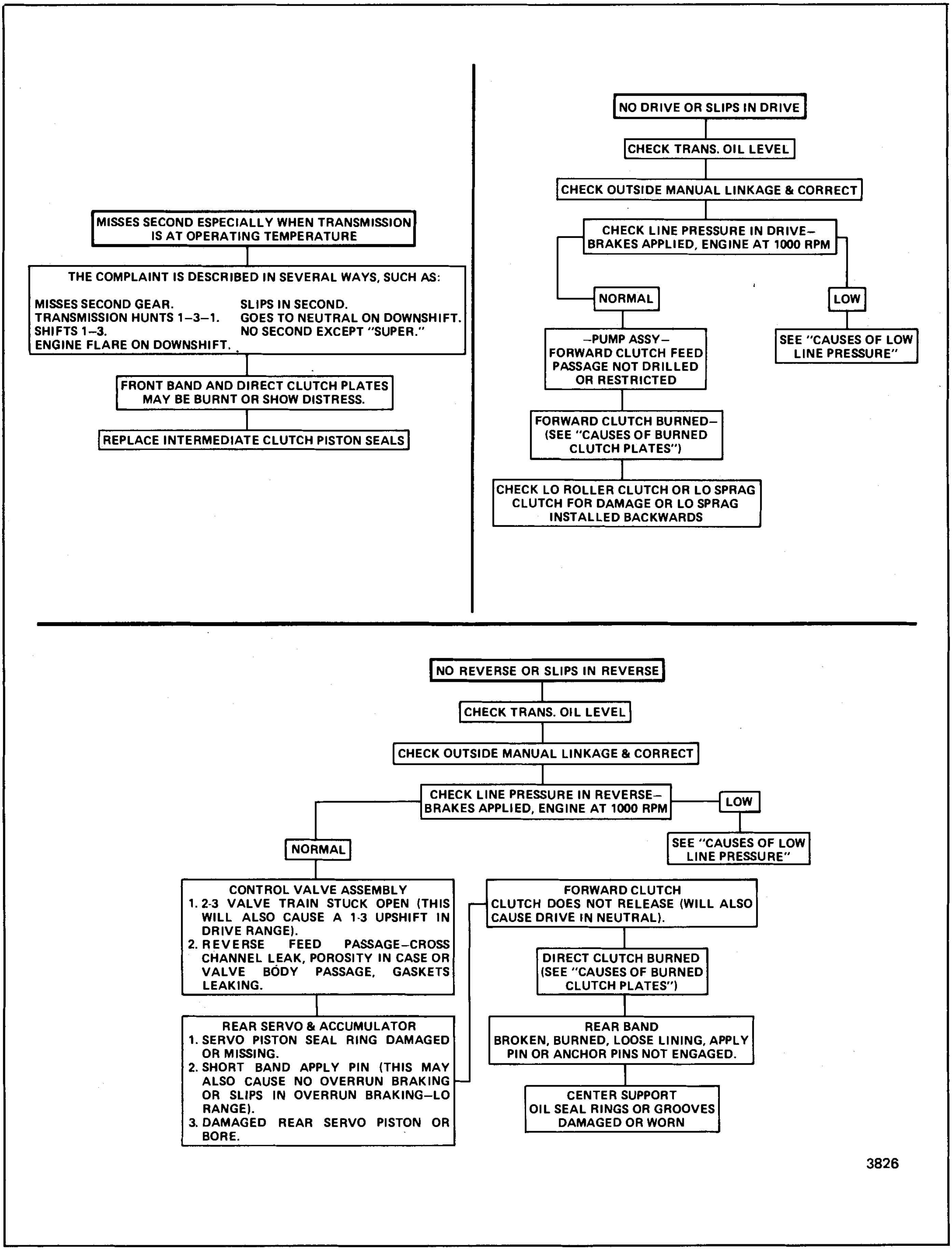
Diagnosis Chart A



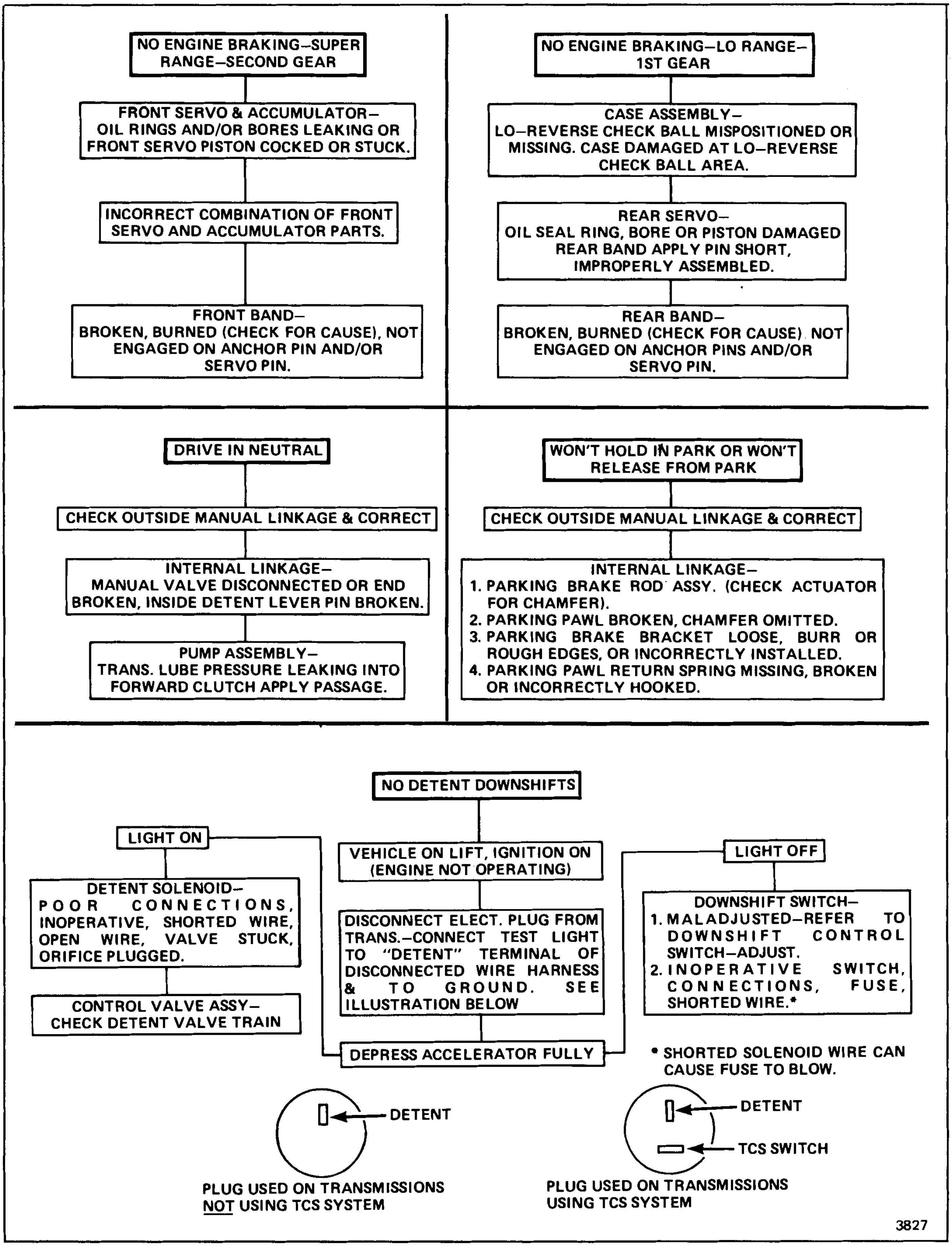
Diagnosis Chart B



Diagnosis Chart C



Diagnosis Chart D



NO ENGINE BRAKING–SUPER RANGE–SECOND GEAR

FRONT SERVO & ACCUMULATOR–
OIL RINGS AND/OR BORES LEAKING OR FRONT SERVO PISTON COCKED OR STUCK.

INCORRECT COMBINATION OF FRONT SERVO AND ACCUMULATOR PARTS.

FRONT BAND–
BROKEN, BURNED (CHECK FOR CAUSE), NOT ENGAGED ON ANCHOR PIN AND/OR SERVO PIN.

NO ENGINE BRAKING–LO RANGE–1ST GEAR

CASE ASSEMBLY–
LO–REVERSE CHECK BALL MISPOSITIONED OR MISSING. CASE DAMAGED AT LO–REVERSE CHECK BALL AREA.

REAR SERVO–
OIL SEAL RING, BORE OR PISTON DAMAGED REAR BAND APPLY PIN SHORT, IMPROPERLY ASSEMBLED.

REAR BAND–
BROKEN, BURNED (CHECK FOR CAUSE) NOT ENGAGED ON ANCHOR PINS AND/OR SERVO PIN.

DRIVE IN NEUTRAL

CHECK OUTSIDE MANUAL LINKAGE & CORRECT

INTERNAL LINKAGE–
MANUAL VALVE DISCONNECTED OR END BROKEN, INSIDE DETENT LEVER PIN BROKEN.

PUMP ASSEMBLY–
TRANS. LUBE PRESSURE LEAKING INTO FORWARD CLUTCH APPLY PASSAGE.

WON'T HOLD IN PARK OR WON'T RELEASE FROM PARK

CHECK OUTSIDE MANUAL LINKAGE & CORRECT

INTERNAL LINKAGE–
1. PARKING BRAKE ROD ASSY. (CHECK ACTUATOR FOR CHAMFER).
2. PARKING PAWL BROKEN, CHAMFER OMITTED.
3. PARKING BRAKE BRACKET LOOSE, BURR OR ROUGH EDGES, OR INCORRECTLY INSTALLED.
4. PARKING PAWL RETURN SPRING MISSING, BROKEN OR INCORRECTLY HOOKED.

NO DETENT DOWNSHIFTS

VEHICLE ON LIFT, IGNITION ON (ENGINE NOT OPERATING)

DISCONNECT ELECT. PLUG FROM TRANS.–CONNECT TEST LIGHT TO "DETENT" TERMINAL OF DISCONNECTED WIRE HARNESS & TO GROUND. SEE ILLUSTRATION BELOW

DEPRESS ACCELERATOR FULLY

LIGHT ON

DETENT SOLENOID–
POOR CONNECTIONS, INOPERATIVE, SHORTED WIRE, OPEN WIRE, VALVE STUCK, ORIFICE PLUGGED.

CONTROL VALVE ASSY–
CHECK DETENT VALVE TRAIN

LIGHT OFF

DOWNSHIFT SWITCH–
1. MALADJUSTED–REFER TO DOWNSHIFT CONTROL SWITCH–ADJUST.
2. INOPERATIVE SWITCH, CONNECTIONS, FUSE, SHORTED WIRE.*

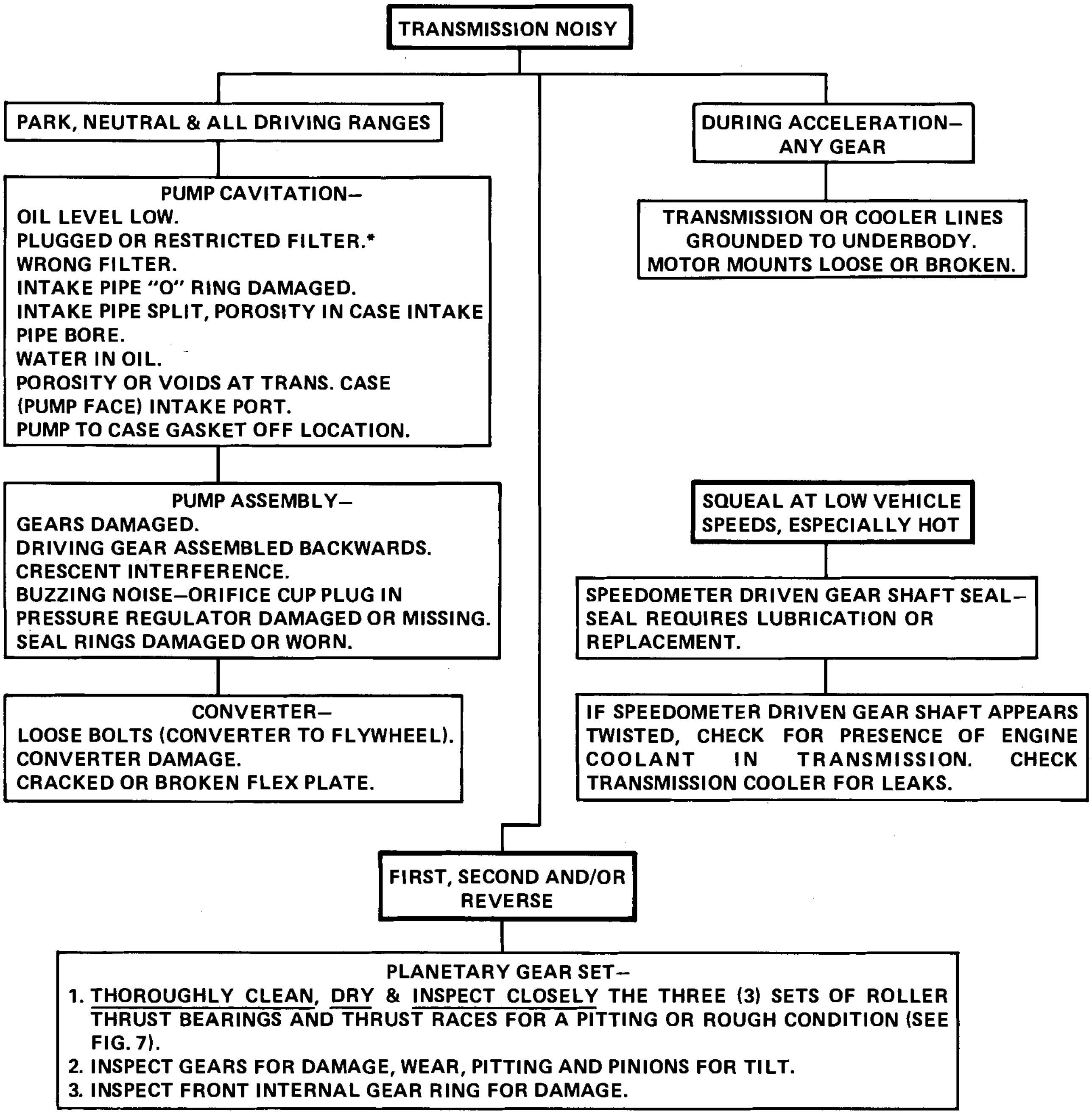
* SHORTED SOLENOID WIRE CAN CAUSE FUSE TO BLOW.

PLUG USED ON TRANSMISSIONS NOT USING TCS SYSTEM

PLUG USED ON TRANSMISSIONS USING TCS SYSTEM

Diagnosis Chart E

CAUTION: BEFORE CHECKING TRANSMISSION FOR WHAT IS BELIEVED TO BE "TRANS. NOISE," MAKE CERTAIN THE NOISE IS NOT FROM THE WATER PUMP, ALTERNATOR, AIR CONDITIONER, POWER STEERING, ETC. THESE COMPONENTS CAN BE ISOLATED BY REMOVING THE PROPER BELT AND RUNNING THE ENGINE NOT MORE THAN TWO MINUTES AT ONE TIME.



TRANSMISSION NOISY

PARK, NEUTRAL & ALL DRIVING RANGES

PUMP CAVITATION–
OIL LEVEL LOW.
PLUGGED OR RESTRICTED FILTER.*
WRONG FILTER.
INTAKE PIPE "O" RING DAMAGED.
INTAKE PIPE SPLIT, POROSITY IN CASE INTAKE PIPE BORE.
WATER IN OIL.
POROSITY OR VOIDS AT TRANS. CASE (PUMP FACE) INTAKE PORT.
PUMP TO CASE GASKET OFF LOCATION.

PUMP ASSEMBLY–
GEARS DAMAGED.
DRIVING GEAR ASSEMBLED BACKWARDS.
CRESCENT INTERFERENCE.
BUZZING NOISE–ORIFICE CUP PLUG IN PRESSURE REGULATOR DAMAGED OR MISSING.
SEAL RINGS DAMAGED OR WORN.

CONVERTER–
LOOSE BOLTS (CONVERTER TO FLYWHEEL).
CONVERTER DAMAGE.
CRACKED OR BROKEN FLEX PLATE.

DURING ACCELERATION– ANY GEAR

TRANSMISSION OR COOLER LINES GROUNDED TO UNDERBODY.
MOTOR MOUNTS LOOSE OR BROKEN.

SQUEAL AT LOW VEHICLE SPEEDS, ESPECIALLY HOT

SPEEDOMETER DRIVEN GEAR SHAFT SEAL– SEAL REQUIRES LUBRICATION OR REPLACEMENT.

IF SPEEDOMETER DRIVEN GEAR SHAFT APPEARS TWISTED, CHECK FOR PRESENCE OF ENGINE COOLANT IN TRANSMISSION. CHECK TRANSMISSION COOLER FOR LEAKS.

FIRST, SECOND AND/OR REVERSE

PLANETARY GEAR SET–
1. THOROUGHLY CLEAN, DRY & INSPECT CLOSELY THE THREE (3) SETS OF ROLLER THRUST BEARINGS AND THRUST RACES FOR A PITTING OR ROUGH CONDITION (SEE FIG. 7).
2. INSPECT GEARS FOR DAMAGE, WEAR, PITTING AND PINIONS FOR TILT.
3. INSPECT FRONT INTERNAL GEAR RING FOR DAMAGE.

• THERE IS NO APPROVED WAY OF CHECKING OR CLEANING THE FILTER. IF THE FILTER IS SUSPECTED OF BEING PLUGGED OR RESTRICTED, IT MUST BE REPLACED.

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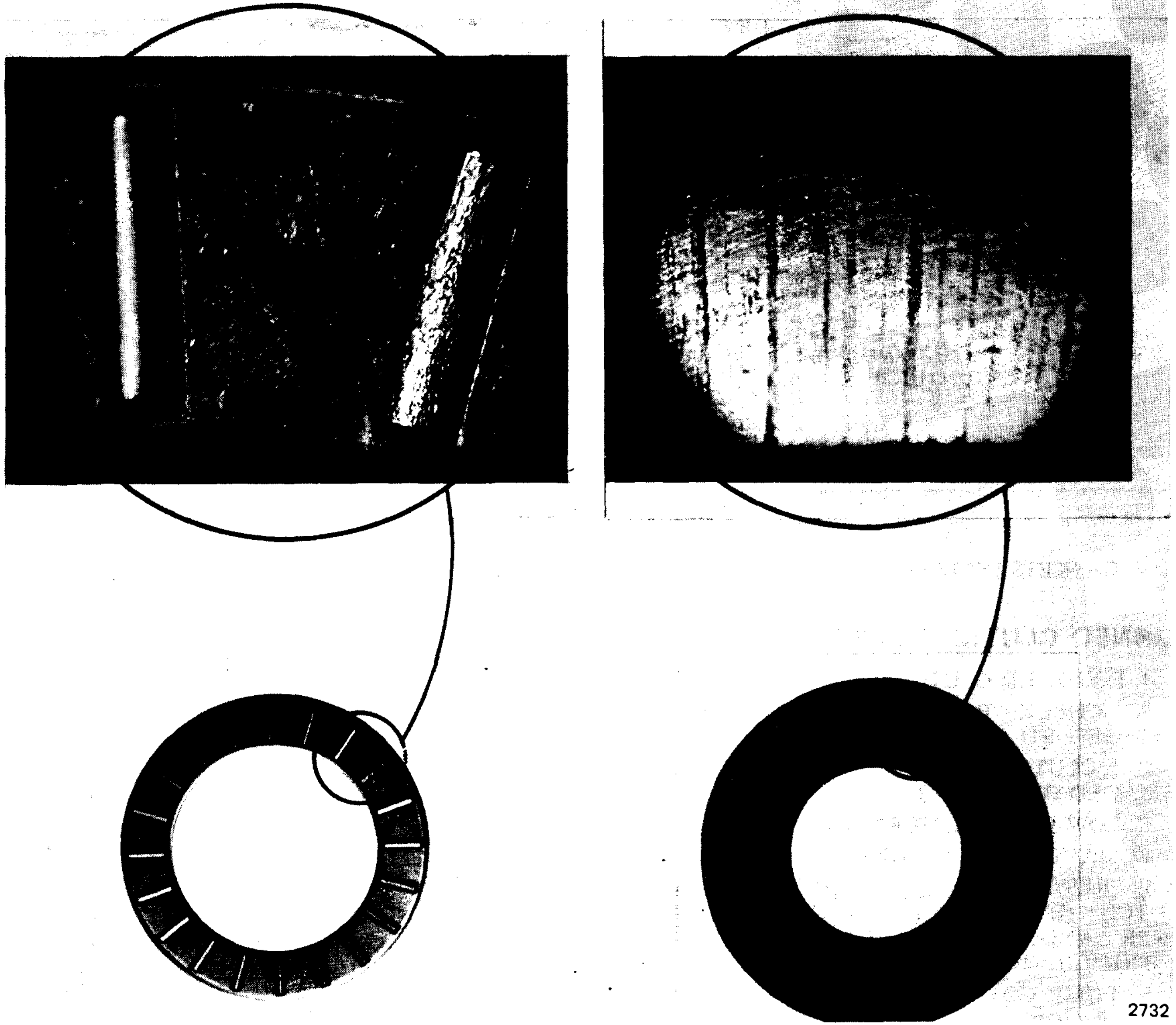
Diagnosis Chart F



NOTE: IF PITTING OR ROUGHNESS, AS SHOWN IN THE ILLUSTRATIONS BELOW, IS APPARENT ON ANY THRUST BEARING ROLLER OR THRUST RACE, THEY MUST BE REPLACED.

Fig. 7A4-10 Roller Thrust Bearing and Race

C. NOT OPERATING PROPERLY.

3. DETENT SYSTEM

A. DETENT SWITCH ACTUATED (PLUNGER STUCK) OR SHORTED.

B. DETENT WIRING SHORTED.

C. DETENT SOLENOID STUCK OPEN.

D. DETENT FEED ORIFICE IN SPACER PLATE BLOCKED (SEE FIG. 7A4-8).

E. DETENT SOLENOID LOOSE.

F. DETENT VALVE BORE PLUG DAMAGED.

G. DETENT REG. VALVE PIN SHORT.

4. PUMP

A. PRESSURE REG. AND/OR BOOST VALVE STUCK.

B. PUMP CASTING POROUS OR IMPROPERLY MACHINED.

C. PRESSURE BOOST VALVE INSTALLED BACKWARDS OR IMPROPERLY MACHINED.

D. ALUMINUM BORE PLUG HAS HOLE OR IMPROPERLY MACHINED.

E. PRESSURE BOOST BUSHING BROKEN OR IMPROPERLY MACHINED.

F. WRONG TYPE PRESSURE REGULATOR VALVE.

5. CONTROL VALVE ASSEMBLY.

A. CONTROL VALVE ASSY. TO SPACER GASKET OFF LOCATION.

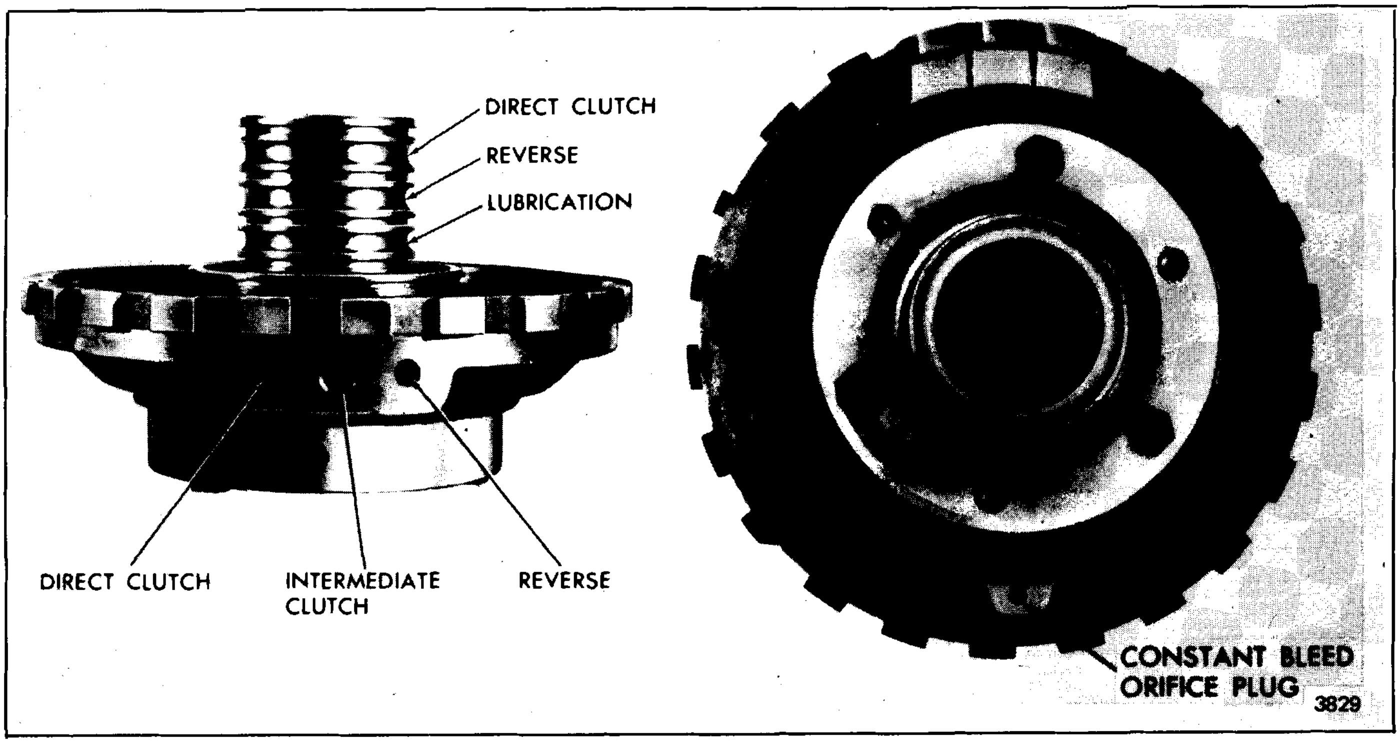


Fig. 7A4-11 Center Support

B. GASKETS INSTALLED IN REVERSE ORDER.

BURNED CLUTCH PLATES

1. FORWARD CLUTCH

A. CHECK BALL IN CLUTCH HOUSING DAMAGED, STUCK OR MISSING.

B. CLUTCH PISTON CRACKED, SEALS DAMAGED OR MISSING.

C. LOW LINE PRESSURE.

D. MANUAL VALVE MISPOSITIONED.

E. RESTRICTED OIL FEED TO FORWARD CLUTCH (EXAMPLES: CLUTCH HOUSING TO INNER AND OUTER AREAS NOT DRILLED, RESTRICTED OR POROSITY IN PUMP).

F. PUMP COVER OIL SEAL RINGS MISSING, BROKEN OR UNDERSIZE: RING GROOVE OVERSIZE.

G. CASE VALVE BODY FACE NOT FLAT OR POROSITY BETWEEN CHANNELS.

H. MANUAL VALVE BENT AND CENTER LAND NOT GROUND PROPERLY.

2. INTERMEDIATE CLUTCH

A. CONSTANT BLEED ORIFICE IN CENTER SUPPORT MISSING (Fig. 7A4-11).

B. REAR ACCUMULATOR PISTON OIL RING, DAMAGED OR MISSING.

C. 1-2 ACCUMULATOR VALVE STUCK IN CONTROL VALVE ASSEMBLY.

D. INTERMEDIATE CLUTCH PISTON SEALS DAMAGED OR MISSING.

E. CENTER SUPPORT BOLT LOOSE.

F. LOW LINE PRESSURE.

G. INTERMEDIATE CLUTCH PLUG IN CASE MISSING

H. CASE VALVE BODY FACE NOT FLAT OR POROSITY BETWEEN CHANNELS.

I. MANUAL VALVE BENT AND CENTER LAND NOT GROUND PROPERLY.

3. DIRECT CLUTCH

A. RESTRICTED ORIFICE IN VACUUM LINE TO MODULATOR (POOR VACUUM RESPONSE).

B. CHECK BALL IN DIRECT CLUTCH PISTON OR DIRECT CLUTCH HOUSING DAMAGED, STUCK OR MISSING.

C. LEAKING MODULATOR BELLOWS.

D. CENTER SUPPORT BOLT LOOSE (BOLT MAY BE TIGHT IN SUPPORT BUT NOT HOLDING SUPPORT TIGHT TO CASE).

E. CENTER SUPPORT OIL RINGS OR GROOVES DAMAGED OR MISSING.

F. CLUTCH PISTON SEALS DAMAGED OR MISSING.

G. FRONT AND REAR SERVO PISTONS AND SEALS DAMAGED.

H. MANUAL VALVE BENT AND CENTER LAND NOT CLEANED UP.

I. CASE VALVE BODY FACE NOT FLAT OR POROSITY BETWEEN CHANNELS.

J. INTERMEDIATE ROLLER CLUTCH INSTALLED BACKWARDS.

K. 3-2 VALVE, 3-2 SPRING OR 3-2 SPACER PIN INSTALLED IN THE WRONG SEQUENCE IN 3-2 VALVE BORE.

L. INCORRECT COMBINATION OF FRONT SERVO AND ACCUMULATOR PARTS.

M. REPLACE INTERMEDIATE CLUTCH PISTON SEALS.

NOTE: IF DIRECT CLUTCH PLATES AND FRONT BAND ARE BURNED, CHECK MANUAL LINKAGE FOR CORRECT ADJUSTMENT. BURNED CLUTCH PLATES CAN BE CAUSED BY INCORRECT USAGE OF CLUTCH PLATES. ALSO, ANTI-FREEZE IN TRANSMISSION FLUID CAN CAUSE SEVERE DAMAGE, SUCH AS LARGE PIECES OF COMPOSITION CLUTCH PLATE MATERIAL PEELING OFF.

OIL LEAKS

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to wind flow around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a black light to identify the oil at the source of leak is also helpful. Comparing the oil from the leak to that on the engine or transmission dipstick (when viewed by black light) will determine the source of the leak.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission oil filler tube-to-case leak will sometimes appear as a leak at the rear of the transmission. In determining the source of an oil leak, it is most helpful to keep the engine running.

1. TRANSMISSION OIL PAN LEAKS

A. ATTACHING BOLTS NOT CORRECTLY TORQUED.

B. IMPROPERLY INSTALLED OR DAMAGED PAN GASKET.

C. OIL PAN GASKET MOUNTING FACE NOT FLAT.

2. CASE EXTENSION LEAK

A. ATTACHING BOLTS NOT CORRECTLY TORQUED.

B. IF THE REAR SEAL IS SUSPECTED:

- CHECK SEAL FOR DAMAGE OR IMPROPERLY INSTALLED.
- CHECK SLIP YOKE FOR DAMAGE.

C. EXTENSION-TO-CASE GASKET OR SEAL DAMAGED OR IMPROPERLY INSTALLED.

3. CASE LEAK

A. FILLER PIPE "O" RING SEAL DAMAGED OR MISSING: MISPOSITION OF FILLER PIPE BRACKET TO ENGINE "LOADING" ONE SIDE OF THE "O" RING. FILL PIPE CRACKED, OR MALFORMED "O" RING GROOVE.

B. MODULATOR ASSEMBLY "O" RING SEAL - DAMAGED OR IMPROPERLY INSTALLED.

C. ELECTRICAL CONNECTOR "O" RING SEAL DAMAGED OR IMPROPERLY INSTALLED.

D. GOVERNOR COVER, GASKET AND BOLTS - DAMAGED, LOOSE: CASE FACE DAMAGED OR POROSITY.

E. LEAK AT SPEEDOMETER DRIVEN GEAR HOUSING OR SEAL. LEAK AT SPEEDO HOLE PLUG.

F. MANUAL SHAFT SEAL - DAMAGED, IMPROPERLY INSTALLED.

G. LINE PRESSURE TAP PLUG - STRIPPED, SHY SEALER COMPOUND.

H. VENT PIPE (REFER TO ITEM 5).

I. POROUS CASE OR CRACKED AT PRESSURE PLUG BOSS.

4. FRONT END LEAK

A. FRONT SEAL - DAMAGED (CHECK CONVERTER NECK FOR NICKS, ETC., ALSO FOR PUMP BUSHING MOVED FORWARD), GARTER SPRING MISSING.

B. PUMP ATTACHING BOLTS LOOSE: SEAL WASHERS DAMAGED.

C. CONVERTER LEAK AT WELDS.

D. LARGE "O" RING PUMP SEAL DAMAGED - ALSO CHECK CASE BORE.

E. POROUS CASTING (PUMP OR CASE).

F. PUMP DRAINBACK HOLE NOT OPEN (SEE FIG. 7A4-83 FOR LOCATION OF SEAL DRAIN BACK HOLE).

5. OIL COMES OUT VENT PIPE

A. TRANSMISSION OVER-FILLED.

B. WATER IN OIL.

C. FILTER "O" RING DAMAGED OR IMPROPERLY ASSEMBLED, CAUSING OIL TO FOAM.

D. FOREIGN MATERIAL BETWEEN PUMP AND CASE OR BETWEEN PUMP COVER AND BODY.

E. CASE - POROUS, PUMP FACE IMPROPERLY MACHINED.

F. PUMP - SHY OF STOCK, POROUS.

G. PUMP TO CASE GASKET MISPOSITIONED.

H. PUMP BREATHER HOLE BLOCKED OR MISSING (SEE FIG. 7A4-84 FOR LOCATION OF BREATHER HOLE).

I. HOLE IN INTAKE PIPE.

J. CHECK BALL IN FORWARD CLUTCH HOUSING STUCK OPEN OR MISSING.

K. INSPECT TURBINE SHAFT BUSHING JOURNALS AND STATOR SHAFT BUSHINGS FOR SCORING OR OTHER DISTRESS.

6. OIL COOLER LINES

A. CONNECTIONS AT RADIATOR LOOSE OR STRIPPED.

B. CONNECTIONS AT CASE LOOSE OR STRIPPED.

7. MODULATOR ASSY.

A. VACUUM DIAPHRAGM LEAKING.

CASE POROSITY REPAIR

Turbo Hydra-Matic transmission leaks caused by CASE POROSITY (not cracks) may be repaired with the transmission in the car by using epoxy cement and following this recommended procedure:

1. Road test car to bring transmission fluid to operating temperature, approximately 180°F.

2. Raise car on hoist or jack stand, engine running with rear wheels free to turn and locate source of oil leak. Check for leaks with transmission in "LOW", "SUPER", "DRIVE", and "REVERSE" ranges.

NOTE: Use of a mirror is helpful in locating leaks.

3. Shut engine off and thoroughly clean area to be repaired with cleaning solvent and a brush, then air dry.

NOTE: A clean, dry soldering acid brush may be used to clean the area and also to apply the epoxy cement.

4. Following the instructions of the manufacturer, mix a sufficient amount of epoxy cement, 3M-SCOTCH WELD-2216 (preferred), Part No. 1360016, Grp. No. 0.423 (alternate) or equivalent to make the repair.

NOTE: Observe manufacturer's cautions in handling.

5. While transmission case is still hot, apply epoxy cement to the area to be repaired. Be sure the area to be repaired is completely covered.

6. If 3M-SCOTCH WELD-2216 epoxy is used, allow ONE (1) hour to cure before starting engine. If 1360016 epoxy is used, allow THREE (3) hours to cure before starting engine.

7. Road test car to bring transmission fluid to operating temperature of 180°F and re-check transmission for leaks.

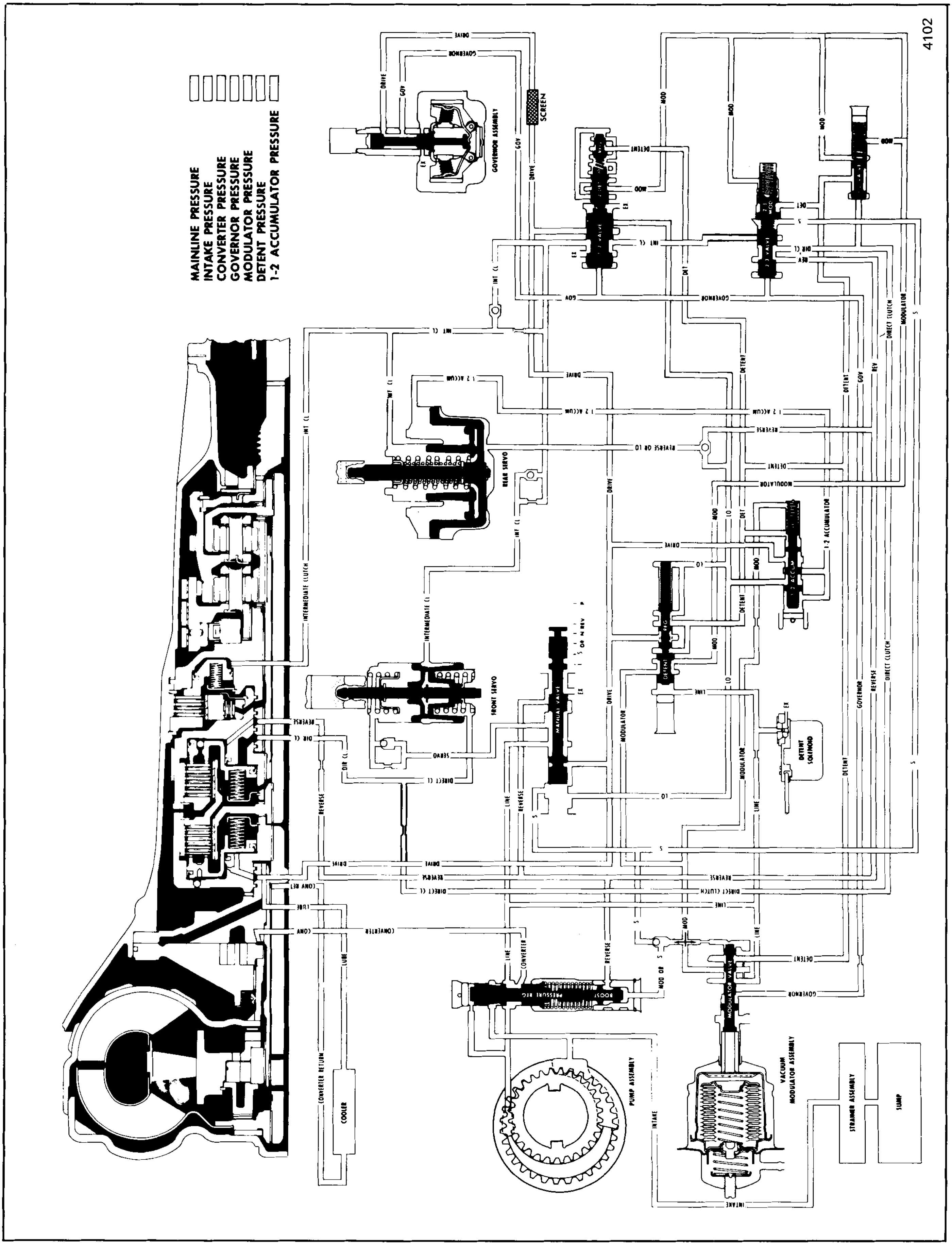


Chart G - Oil Flow Chart

PERIODIC SERVICE RECOMMENDATIONS

TOWING

If the transmission, drive line or axle do not have a malfunction, the vehicle may be towed in neutral at speeds up to 45 mph. The distance should not exceed 50 miles.

For higher speeds or extended distances, it is recommended that the propeller shaft be disconnected or the rear wheels be off the ground.

TRANSMISSION FLUID

Transmission fluid level should be checked (with transmission hot) every time engine oil level is checked or every 7500 miles when engine oil is changed.

CAUTION: *Since the Turbo Hydra-Matic 400 transmission is very sensitive to oil level, special precautions should be taken when checking the oil level, to ensure against an overfill (see Checking Procedure).*

Transmission fluid and filter assembly should be changed every 24 months or 30,000 miles, whichever occurs first. Refill with DEXRON or equivalent automatic transmission fluid. Under heavy-duty operating conditions or excessive stop-and-go driving, replace the fluid and filter assembly at 15,000 mile intervals.

ON CAR SERVICE

COLUMN SHIFT CONTROLS

Adjust (Fig. 7A4-12)

1. Loosen screw on adjusting swivel clamp.
2. Set transmission range selector lever in PARK detent.

NOTE: Obtain PARK position by rotating transmission range selector lever clockwise.

3. Set upper gearshift lever in PARK position and lock ignition.
4. Push up on gear shift control rod to take up clearance in steering column lock mechanism and tighten screw on adjusting swivel clamp to 20 lb. ft.

CONSOLE SHIFT CONTROLS

Adjust (Figs. 7A4-13 and 14)

1. Disconnect shift cable from transmission selector lever by removing nut from pin.
2. Adjust back drive linkage by following the procedures under COLUMN SHIFT CONTROLS.
3. After adjusting column controls, unlock ignition and rotate transmission range selector lever counterclockwise two detent positions.
4. Set Console gearshift lever in NEUTRAL range and move it forward against its stop in NEUTRAL.
5. Assemble shift cable and pin to transmission range selector lever, allowing cable to position pin in slot of lever and then install and tighten nut to 20 lb. ft. torque.

DOWNSHIFT CONTROL SWITCH

Adjust

The downshift switch is adjusted from **inside** the driver's compartment in the following manner:

CAUTION: *If equipped with accessory floor mats, adjust with mats in place.*

1. With engine off, depress the downshift switch plunger fully in the direction of arrow as shown (see Section 6D).
2. Then, fully depress the accelerator pedal to properly "set" the downshift control switch.

NEUTRALIZER SWITCH

Adjust

Refer to Section 6D.

TRANSMISSION FLUID

FLUID LEVEL

The fluid level indicator is located in the filler pipe at the right rear of the engine. To bring the fluid level from the ADD mark to the FULL mark requires ONE PINT■

Fluid level should be to the FULL HOT mark with transmission at normal operating temperature 180-200°F. (80-92°C.). With fluid at room temperature 65° to 85°F. (20-30°C.), the level should be between the two dimples located below the "ADD" mark.

NOTE: In checking the oil, insert the dipstick in the filter tube with the markings up (toward center of car).

Checking Procedure

To determine proper fluid level, proceed as follows:

CAUTION: *The "FULL HOT" mark on the dipstick is an indication of transmission fluid at normal operating temperature of 180-200°F. (80-92°C.). This temperature is only obtained after at least 15 miles of highway driving or equivalent of city driving.*

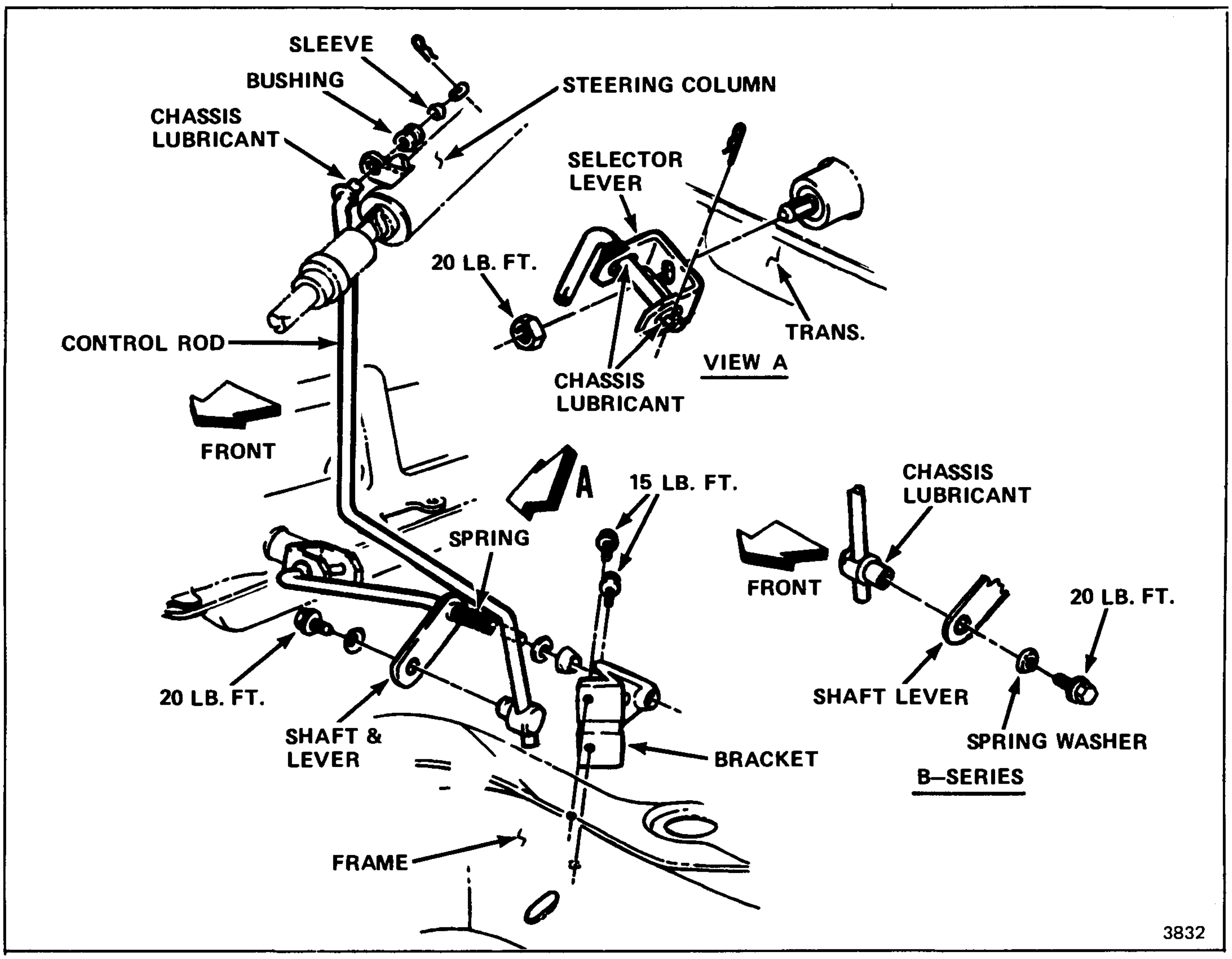


Fig. 7A4-12 Column Shift Controls

1. With manual control lever in Park position, start engine. DO NOT RACE ENGINE. Move manual control lever through each range.

2. Immediately check fluid level with selector lever in Park, engine running and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be at the "FULL HOT" mark.

3. If additional fluid is required, add enough fluid to bring level to the "FULL HOT" mark on the dipstick.

If vehicle is not driven 15 expressway miles, or its equivalent, and it becomes necessary to check fluid level, the transmission fluid must be at room temperature 65-85°F. (20-30°C.). With fluid at room temperature, follow steps 1, 2 and 3 below:

1. With manual control lever in Park position, start engine. Fast idle engine for 1 minute to circulate fluid throughout transmission and move manual control lever through each range. DO NOT RACE ENGINE.

2. Immediately check fluid level with selector lever in Park, engine running and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be between the two dimples located below the "ADD" mark.

NOTE: If transmission fluid level is correctly established at room temperature, it will appear at the "FULL HOT" mark on the dipstick when the transmission reaches normal operating temperature 180-200°F. (80-92°C.).

3. If additional fluid is required, add fluid so that level is between the two dimples located below the "ADD" mark on the dipstick.

CAUTION: *Do Not Overfill, as foaming and loss of fluid through the vent pipe might occur as fluid heats up. If fluid is too low, expecially when cold, complete loss of drive may result which can cause a transmission problem.*

IMPORTANT: When adding fluid, use only DEXRON II®-D number or equivalent automatic transmission fluid. The difference in oil level between "ADD" and "FULL HOT" is one pint.

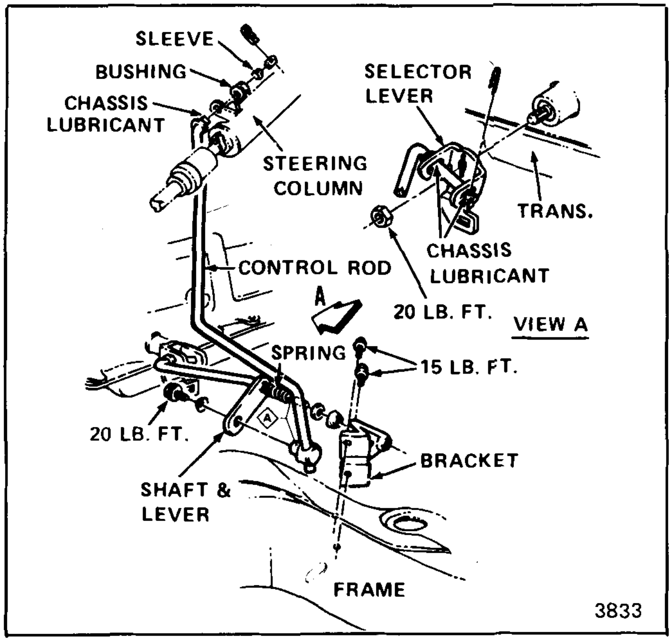


Fig. 7A4-13 Steering Column Lock Controls (Typical)

FLUID CAPACITY

Approximately 7 1/2 pints of fluid are required to refill transmission after oil pan has been drained. When unit has been disassembled and rebuilt, approximately 19 pints will be required to refill. Use only DEXRON II®-D number automatic transmission fluid or equivalent.

DRAINING AND REFILLING TRANSMISSION

Drain oil immediately after operation before it has had an opportunity to cool.

To drain oil, proceed as follows:

1. Remove bottom pan attaching screws, pan and gasket. Discard gasket.
2. Remove oil filter retainer bolt, oil filter assembly, O-ring seal from intake pipe and discard the filter and O-ring seal.
3. Install new O-ring seal on intake pipe and install new filter on pipe assembly.
4. With O-ring seal on intake pipe, install pipe and filter assembly, attaching filter to the control valve assembly with its retainer bolt, torquing to 10 lb. ft.
5. Thoroughly clean bottom pan.
6. Affix new gasket to bottom pan with petrolatum.
7. Install bottom pan with attaching screws and torque to 12 lb. ft.
8. Pour approximately 7 1/2 pints of fluid into the transmission (if the valve body has also been removed, use 9 1/2 pints). After a complete overhaul, approximately 19 pints are required. Be sure container, spout or funnel is clean.
9. Start engine and let idle (carburetor off fast idle step). Place selector lever in Park position and apply hand brake.
10. With transmission hot (approximately 180-200°F [80-92°C.]), add fluid, add fluid to bring level to "FULL HOT" mark on indicator.

With transmission at room temperature 65-85°F. (20-30°C.), add fluid to bring level between the two dimples located below the "ADD" mark.

CAUTION: *Do not overfill. Foaming will result.*

COOLER AND COOLER LINE

FLUSHING PROCEDURE

IMPORTANT: After any failure that generates sludge, metallic particles or converter replacement, it is recommended that the transmission be properly cleaned and that the cooler and cooler lines be flushed.

1. Disconnect both cooler lines at the transmission.
2. Place a hose over the end of one cooler line and place the other end of this hose into an empty container.
3. Using an oil suction gun, flush clean transmission fluid through the other cooler line until clean fluid comes out of the hose into the container.

PRESSURE REGULATOR VALVE

Remove

1. Remove bottom pan and filter. Discard pan gasket.
2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using snap ring pliers and tool as shown in Fig. 7A4-15.
3. Remove regulator boost valve bushing and valve.
4. Remove pressure regulator spring.
5. Remove regulator valve, spring retainer and spacer(s) if present.

Install

Installation of the pressure regulator valve is the reverse of the removal. Affix new gasket to bottom pan and adjust oil level.

Units Or Parts That Can Be Readily Removed From Transmission Are:

Oil pan and gasket, extension housing, gasket and/or seal, governor, vacuum modulator and modulator valve, rear seal, oil cooler lines, speedometer driven gear and speedometer drive gear.

Units Or Parts That Can Be Removed After Oil pan Removal Are:

Filter assembly and "O" ring, manual detent lever, shaft and/or seal, park lock actuator, parking pawl and/or shaft and cup plug, electrical connection (in case), rear servo, detent solenoid, control valve assembly and/or spacer plate and/or governor screen assembly, pressure switch assembly, front servo and control valve check balls.

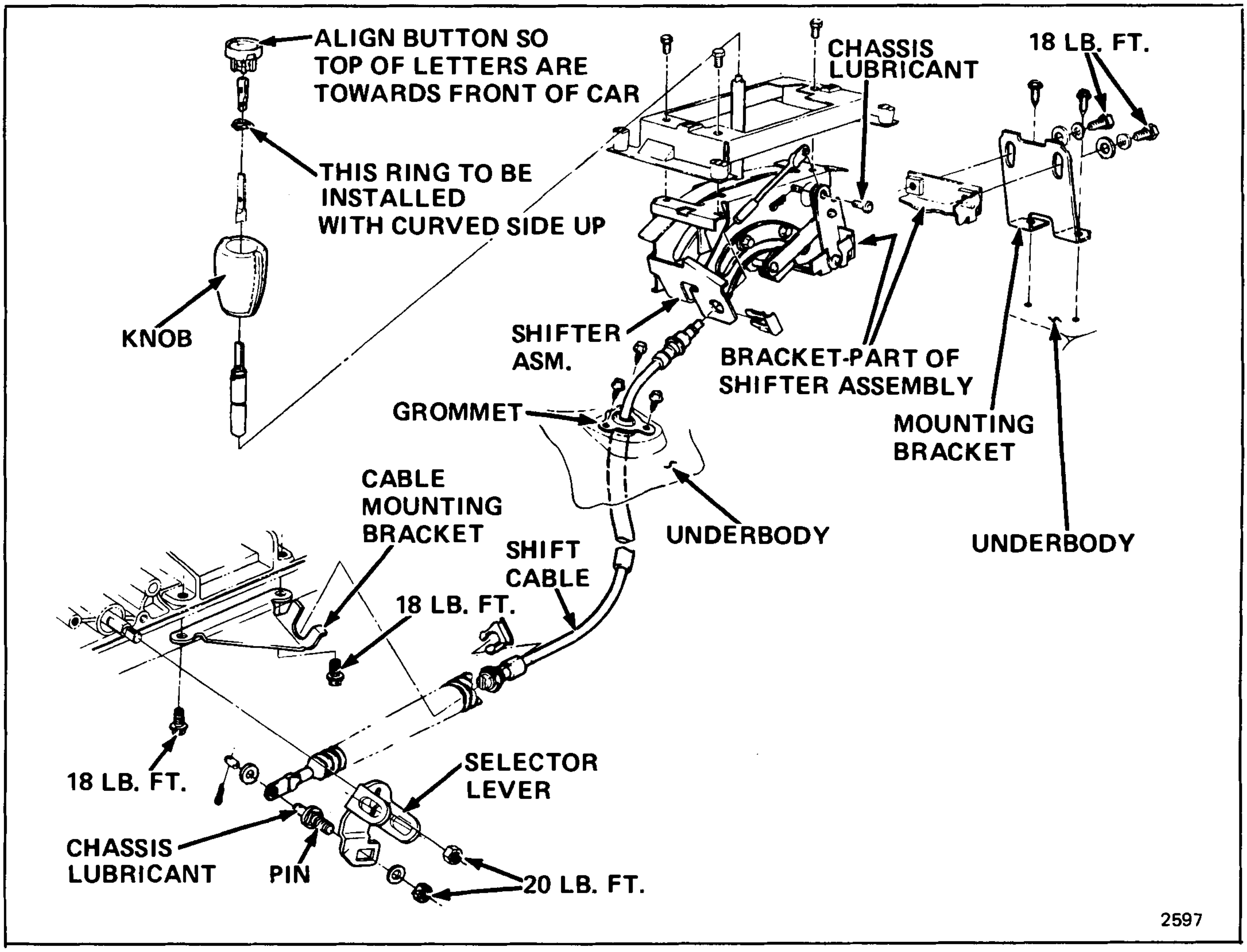


Fig. 7A4-14 Console Shift Controls (Typical)

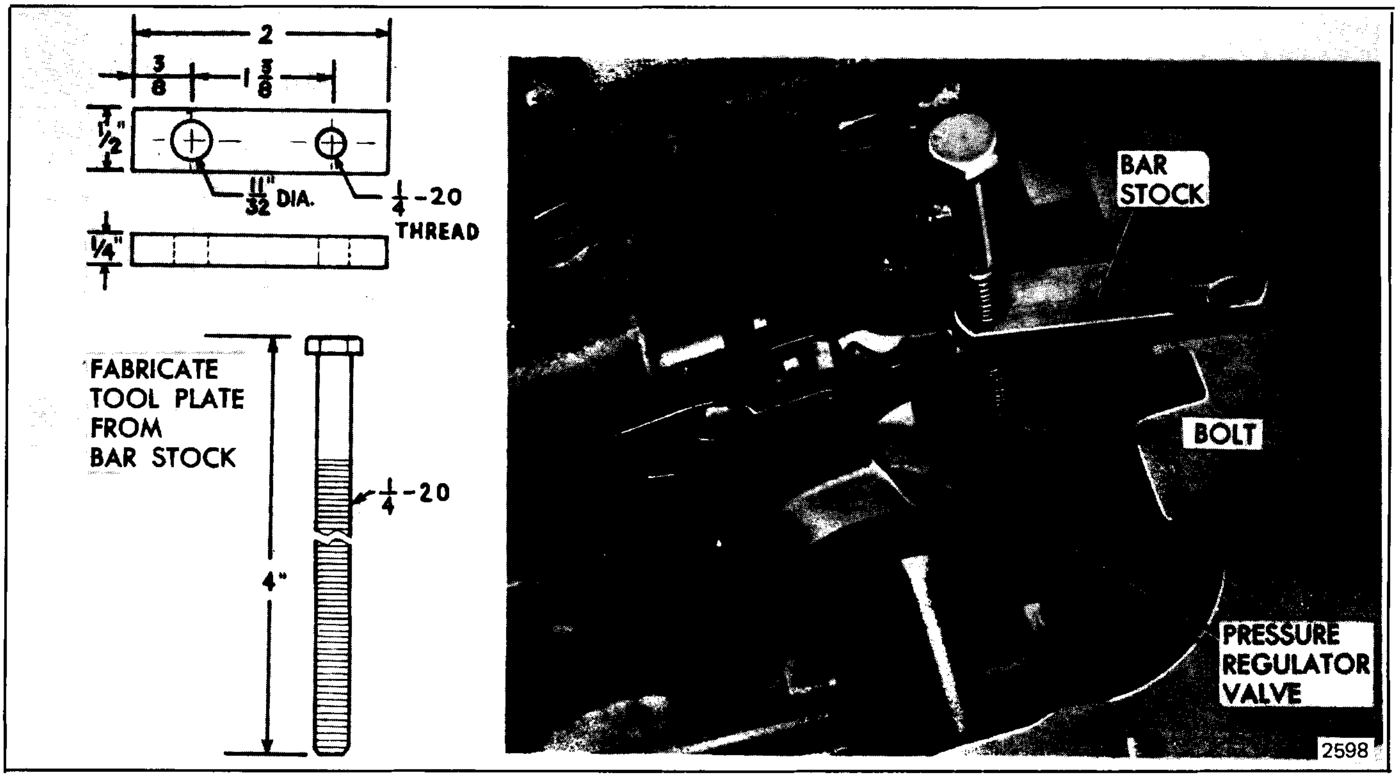


Fig. 7A4-15 Removing Pressure Regulator Valve

UNIT REPAIR

TRANSMISSION

REMOVE AND INSTALL

Before raising the car, disconnect the battery and release the parking brake.

1. Remove propeller shaft.
2. Disconnect speedometer cable, electrical lead-to-case connector, vacuum line at modulator, redundant ground cable from transmission case and oil cooler pipes.
3. Disconnect shift control linkage.
4. Support transmission with jack.
5. Disconnect rear mount from transmission and frame crossmember.
6. Remove two bolts at each end of frame crossmember and remove crossmember.
7. Remove converter dust shield and mark flywheel and converter for reassembly in same position.
8. Remove flywheel plate-to-converter bolts.
9. Loosen exhaust pipe-to-manifold bolts approximately 1/4" and lower transmission until jack is barely supporting it.
10. Remove transmission-to-engine mounting bolts.
11. Raise transmission to its normal position, slide rearward from engine and lower it away from car.

CAUTION: *When lowering transmission, keep rear of transmission lower than front so as not to lose converter, or retain converter by using Clamp J 21366.*

12. The installation of the transmission is the reverse of the removal.

CONVERTER AND MODULATOR

1. With transmission in cradle on portable jack, remove Clamp J 21366 and remove converter assembly by pulling straight out.

NOTE: Converter contains a large amount of oil.

2. Install Fixture J 8763 on transmission so that modulator will be located on side of holding fixture nearest bench (Fig. 7A4-16).

NOTE: Do not over-torque holding screw. This will bind center support.

3. Install fixture and transmission into Base J 3289-20 with bottom pan facing up.
4. Remove modulator attaching screw and retainer (Fig. 7A4-17).
5. Remove modulator assembly and O-ring seal from case.
6. Discard O-ring seal and remove modulator valve from transmission case.

GOVERNOR, SPEEDOMETER DRIVEN GEAR, PAN, FILTER AND INTAKE PIPE

1. Remove attaching screws, governor cover and gasket. Discard gasket (Fig. 7A4-18).

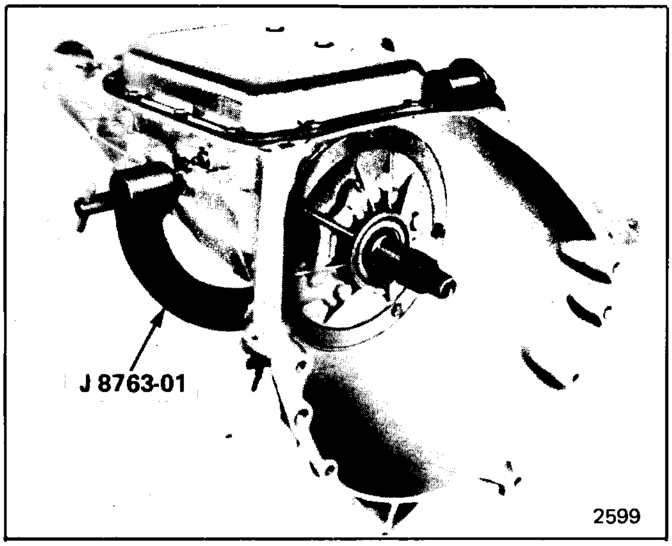


Fig. 7A4-16 Transmission in Holding Fixture

Fig. 7A4-17 Removing Modulator Retainer

2. Withdraw governor assembly from case.

3. Remove speedometer driven gear attaching screw and retainer.

4. Withdraw speedometer driven gear assembly from case.

5. Remove bottom pan attaching screws, bottom pan and bottom pan gasket. Discard gasket.

6. Remove the filter retainer bolt (Fig. 7A4-19).

7. Remove the filter and intake pipe assembly and discard filter (Fig. 7A4-20).

8. Remove intake pipe-to-case O-ring seal from intake pipe or case and discard.

CONTROL VALVE, GOVERNOR SCREEN, ELECTRICAL CONNECTOR, GOVERNOR PIPES, DETENT SPRING ASSEMBLIES

1. Remove control valve body attaching screws and detent roller spring assembly.

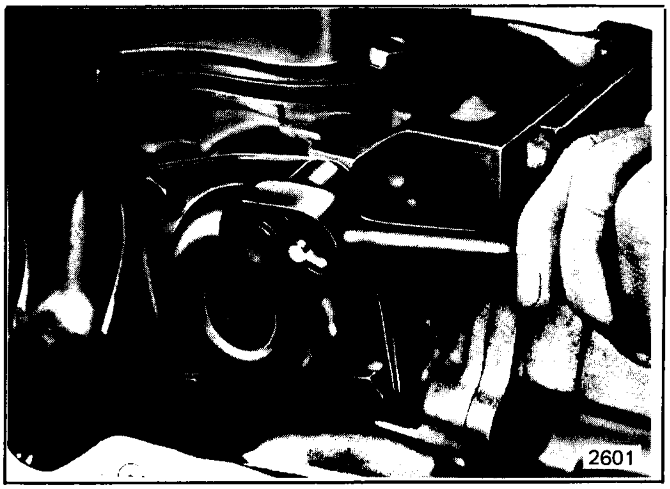


Fig. 7A4-18 Removing Governor Cover Attaching Screws

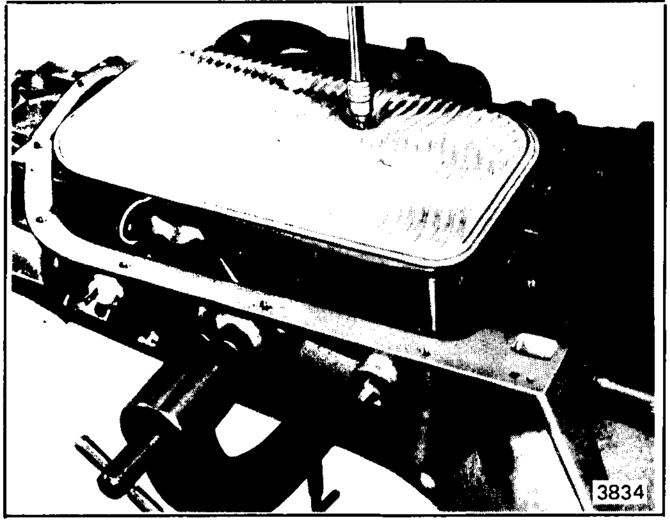


Fig. 7A4-19 Removing Filter Retainer Bolt

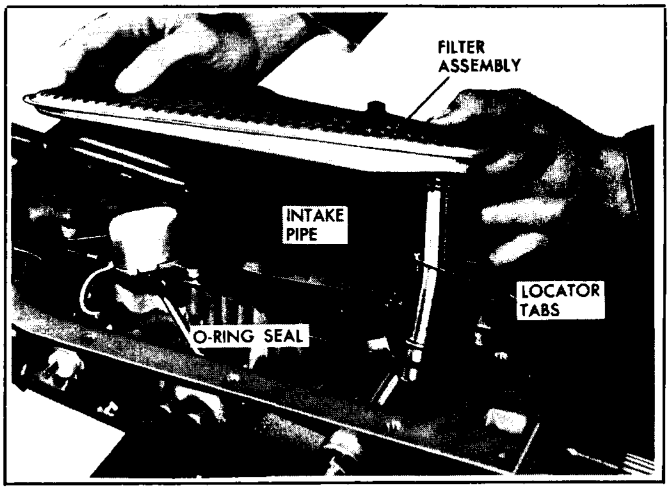


Fig. 7A4-20 Removing Filter and Intake Pipe Assembly

NOTE: Do not remove solenoid attaching screws.

CAUTION: *If transmission is in vehicle, the front servo parts may drop out as the control valve is removed.*

2. Remove control valve body assembly and governor pipes (Fig. 7A4-21).

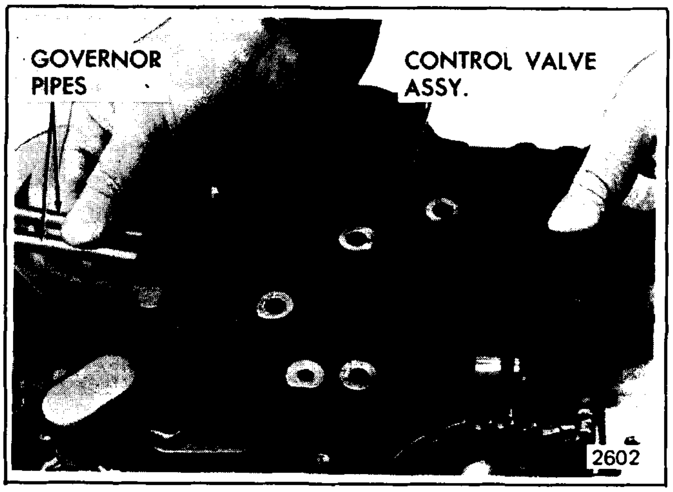


Fig. 7A4-21 Removing Control Valve Assembly

3. Remove the governor screen assembly from the governor feed pipe hole in the case or from the end of the governor feed pipe (Fig. 7A4-22).

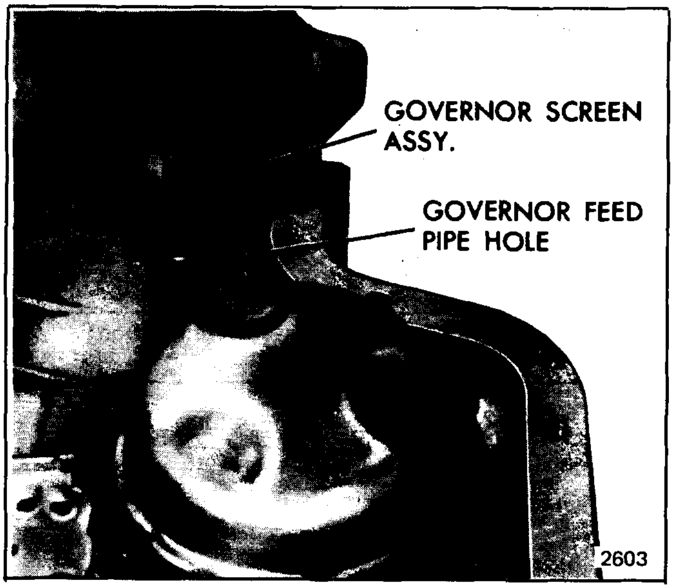


Fig. 7A6-22 Removing Governor Screen Assembly

4. Disconnect solenoid wire and lead wire from electrical connector.

5. Remove governor pipes from control valve assembly.

6. Remove valve body-to-spacer gasket.

REAR SERVO, VALVE BODY SPACER, GASKET AND FRONT SERVO

1. Remove rear servo cover attaching screws, servo cover and gasket. Discard gasket.

2. Remove rear servo from case (Fig. 7A4-23).

3. Remove rear servo accumulator spring.

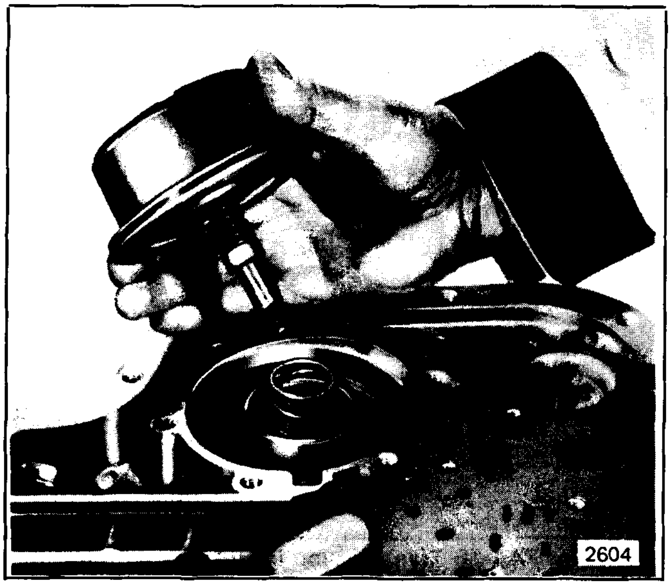


Fig. 7A4-23 Removing Rear Servo

4. Make band apply pin selection check to determine possible cause of malfunction (Fig. 7A4-24):

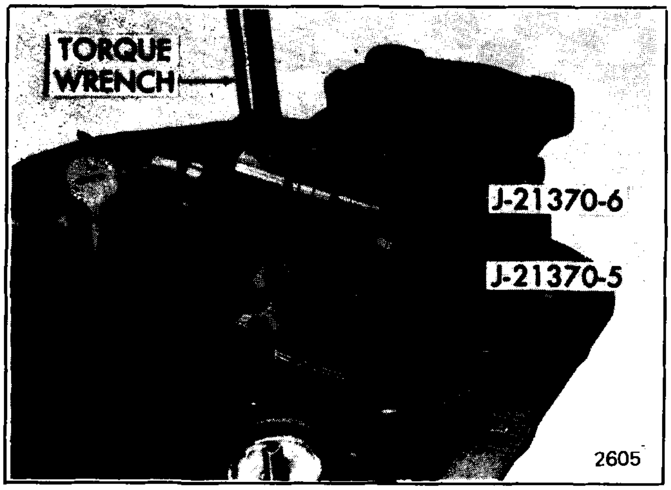


Fig. 7A4-24 Checking for Correct Rear Band Pin

a. Attach Pin J 21370-5 and Fixture J 21370-6 to transmission case with attaching screws.

b. Apply 25 ft. lb. torque and select proper pin to be used during assembly of transmission.

c. There are three selective pins, identified as follows: (1) If both steps of Pin J 21370-5 are below the gage surface, the long pin, identified by 3 rings, should be used. (2) If the gage surface is between the steps, the medium pin, identified by 2 rings, should be used. (3) If both steps are above the gage surface, the short pin, identified by 1 ring, should be used.

NOTE: Identification rings are located on band lug end of the pin. Selecting the proper pin is equivalent of adjusting the band.

CAUTION: *If transmission is in vehicle, be careful when detent solenoid is removed as it prevents the spacer plate, gasket and check balls from dropping down.*

5. Remove solenoid wire, attaching screws, solenoid assembly and gasket (Fig. 7A4-25).

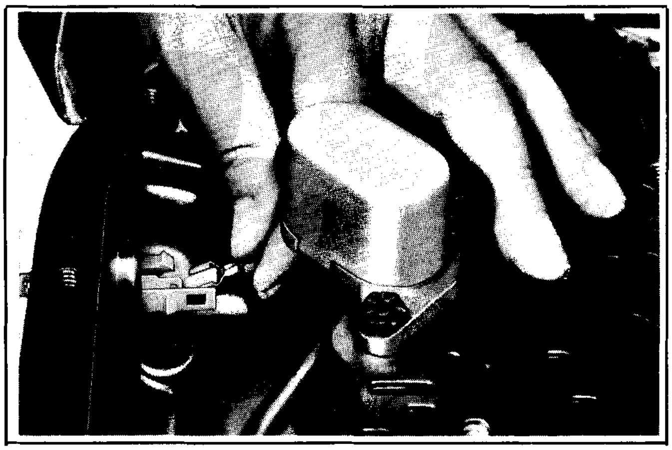


Fig. 7A4-25 Removing Detent Solenoid

6. Withdraw electrical connector and O-ring seal (Fig. 7A4-26).

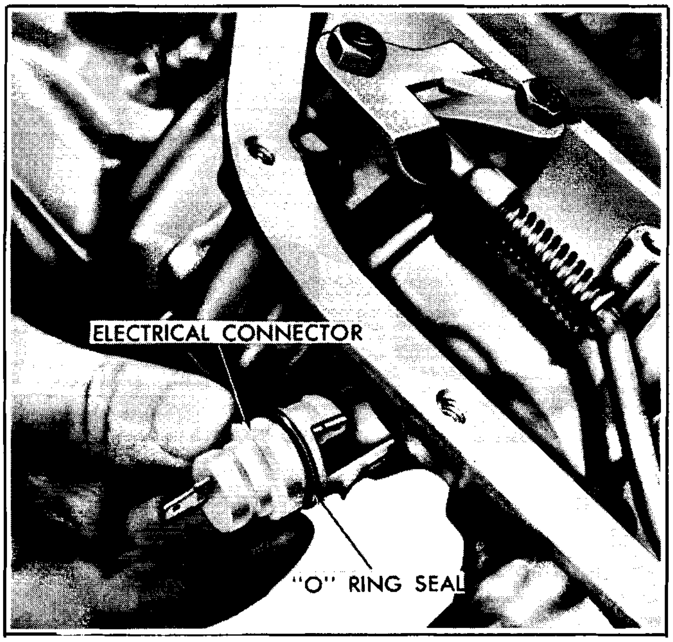


Fig. 7A4-26 Removing Electrical Connector and O-Ring Seal

7. Remove control valve assembly spacer plate and gasket.

8. Remove six (6) check balls from cored passages in transmission case (Fig. 7A4-27).

NOTE: Mark location of balls for aid in reassembly.

9. Remove front servo piston, retainer ring, pin, spring retainer and spring from transmission case (Fig. 7A4-28).

REAR OIL SEAL AND CASE EXTENSION

1. If necessary to replace, pry rear oil seal from case extension (Fig. 7A4-29).

2. Remove case extension-to-case attaching bolts and/or studs.

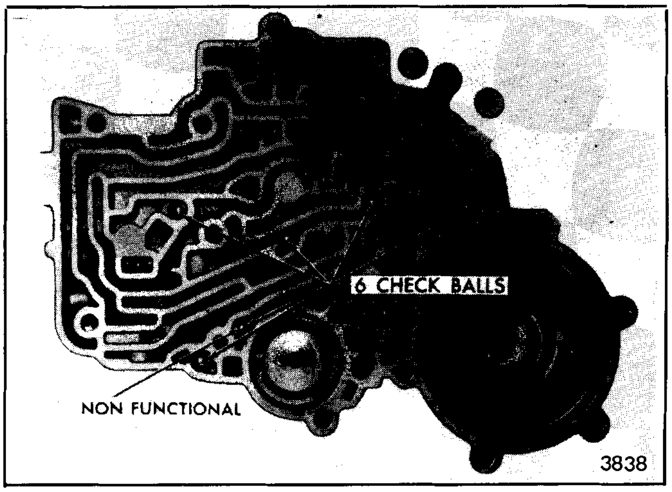


Fig. 7A4-27 Location of Check Balls

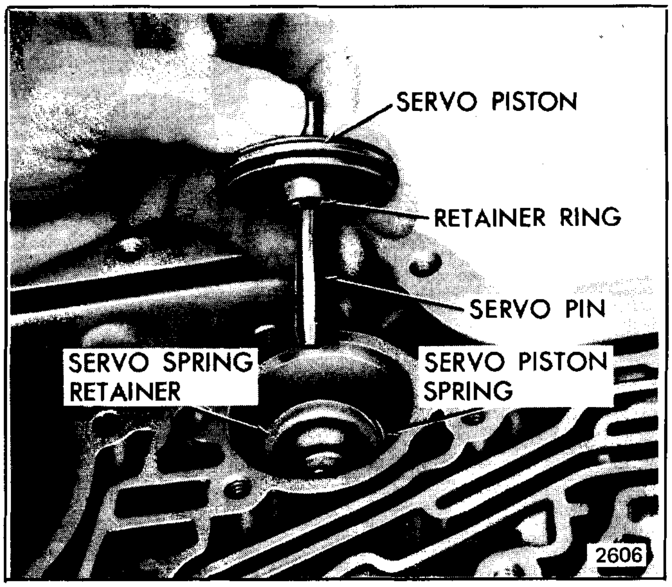


Fig. 7A4-28 Removing Front Servo

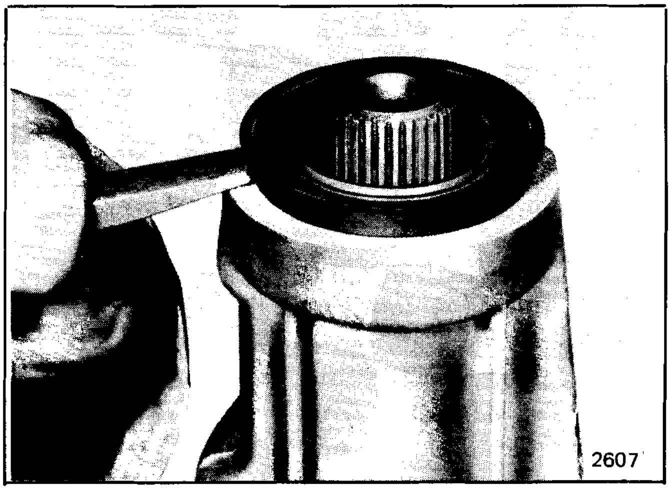


Fig. 7A4-29 Removing Rear Oil Seal

3. Remove case extension and case extension-to-case gasket (Fig. 7A4-30).

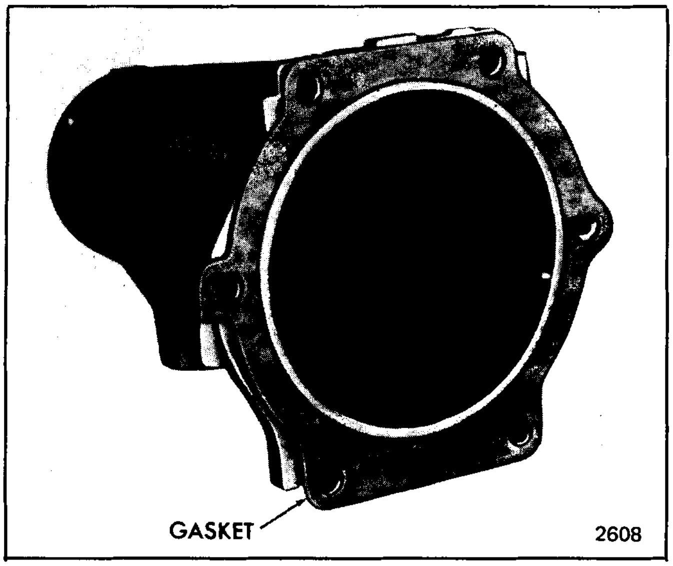


Fig. 7A4-30 Case Extension and Gasket

FRONT END PLAY CHECKING PROCEDURE

1. Remove one front pump attaching bolt and bolt seal.

2. Install a 5/16"-18 threaded slide hammer bolt or Bolt J 21904-1 into bolt hole (see Fig. 7A4-31 for location).

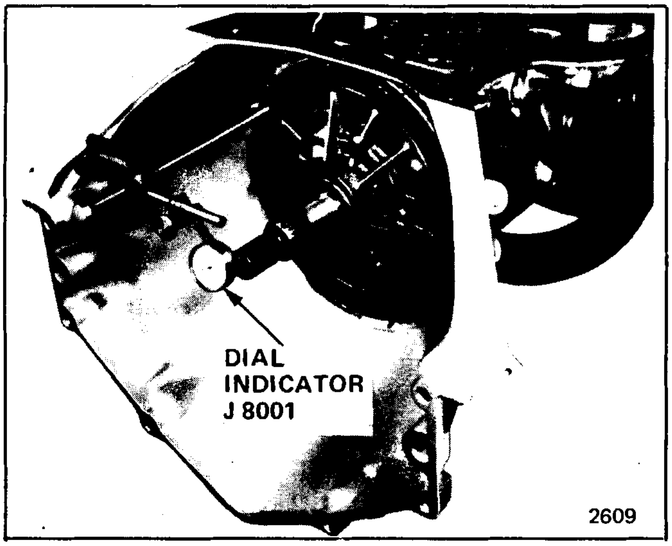


Fig. 7A4-31 Checking Front End Play

3. Mount Indicator J 8001 on rod and index indicator to register with end of turbine shaft.

4. Push turbine shaft rearward.

5. Push output shaft forward.

6. Set dial indicator to Zero.

7. Pull turbine shaft forward.

8. Read resulting travel (or end play). Should be .003"-.024".

9. Selective washer controlling this end play is the washer located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the following chart:

Thickness	Color
.060-.064"	Yellow
.071-.075"	Blue
.082-.086"	Red
.093-.097"	Brown
.104-.108"	Green
.115-.119"	Black
.126-.130"	Purple

NOTE: An oil soaked washer may tend to discolor, so it will be necessary to measure washer for its actual thickness.

OIL PUMP

1. If necessary to replace, pry front seal from pump (Fig. 7A4-32).

Fig. 7A4-32 Removing Front Seal

2. Remove pump attaching bolts.

3. Install 3/8"-16 threaded Adapters J 6125-2 into bolt holes in pump body, attach Hammers J 6125-1 and remove pump assembly from case (See Fig. 7A4-33 for location of threaded holes).

4. Remove and discard pump-to-case seal ring and gasket.

5. Remove forward clutch assembly and turbine shaft from transmission (Fig. 7A4-34).

6. Remove forward clutch hub to direct clutch housing thrust washer if it did not come out with forward clutch housing.

7. Remove direct clutch assembly (Fig. 7A4-35).

8. If necessary, remove manual linkage as follows:

a. Unthread jam nut holding detent lever to manual shaft.

b. Remove manual shaft retaining pin from case (Fig. 7A4-36).

c. Remove manual shaft and jam nut from case (Fig. 7A4-37).

CAUTION: *Do not lose jam nut as it becomes free from manual shaft.*

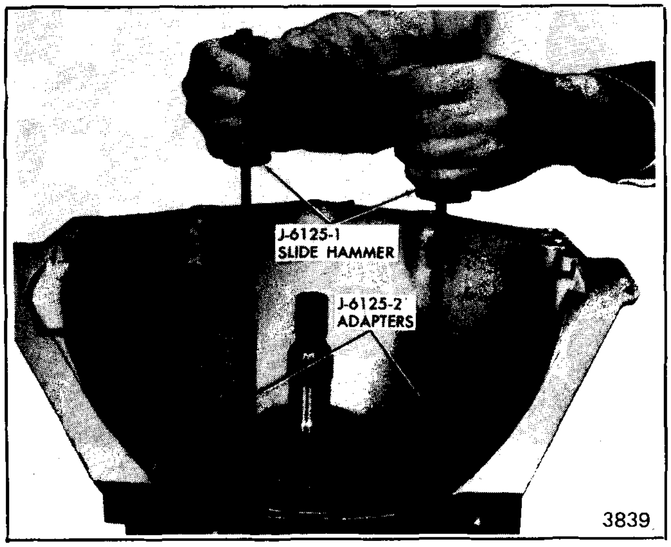


Fig. 7A4-33 Removing Pump Assembly

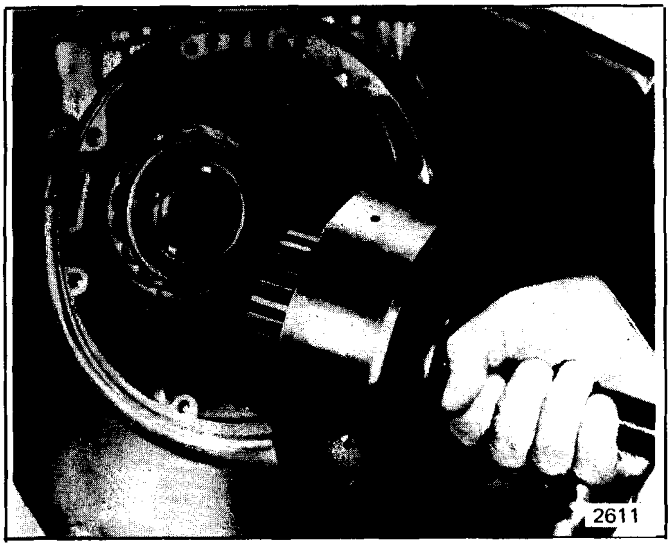


Fig. 7A4-34 Removing Turbine Shaft and Forward Clutch

d. Remove parking actuator rod and detent lever assembly.

e. Remove attaching screws and parking bracket (Fig. 7A4-38).

f. Remove parking pawl return spring (Fig. 7A4-39).

NOTE: The following steps are to be completed only if one or more of the parts involved require replacement:

g. Remove parking pawl shaft retaining spring (Fig. 7A4-40).

h. Remove parking pawl shaft cup plug by inserting a screwdriver between the parking pawl shaft and the transmission case rib (Fig. 7A4-41).

i. Remove parking pawl shaft and parking pawl (Fig. 7A4-42).

9. Remove front band (Fig. 7A4-43).

10. Remove sun gear shaft (Fig. 7A4-44).

11. Check end play as follows:

a. Install Bolt J 21904 into an extension housing attaching bolt hole.

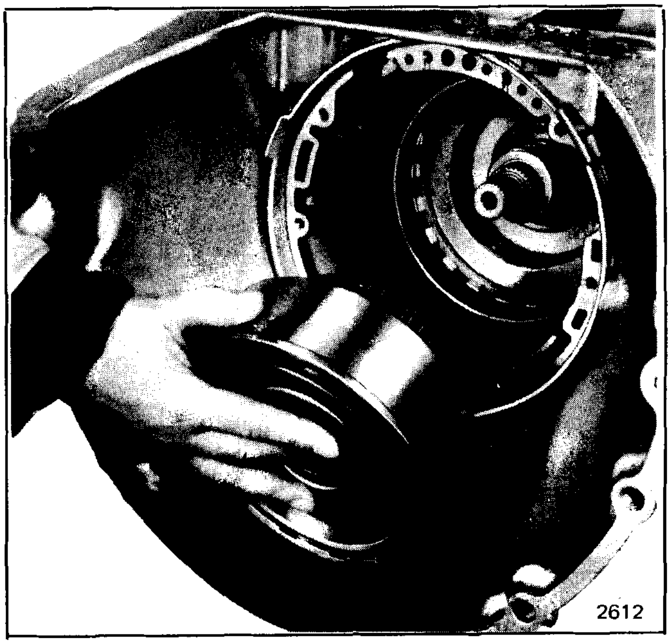


Fig. 7A4-35 Removing Direct Clutch Assembly

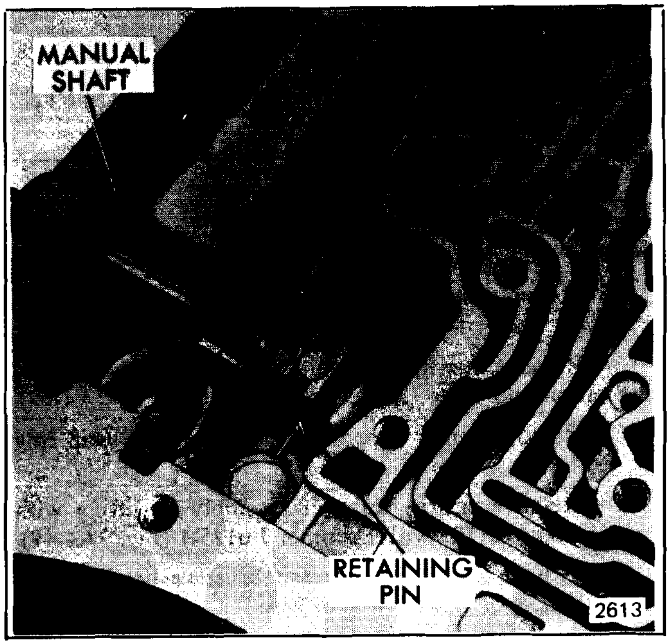


Fig. 7A4-36 Location of Manual Shaft Retaining Pin

b. Mount Indicator J 8001 on rod and index with end of output shaft (Fig. 7A4-45).

c. Move output shaft in and out to read end play. End play should be from .007" to .019". Selective washer controlling this end play is a steel washer having 3 lugs. It is located between a thrust washer and the rear face of transmission case.

d. If a different washer thickness is required to bring end play within specification, it can be selected from the following chart:

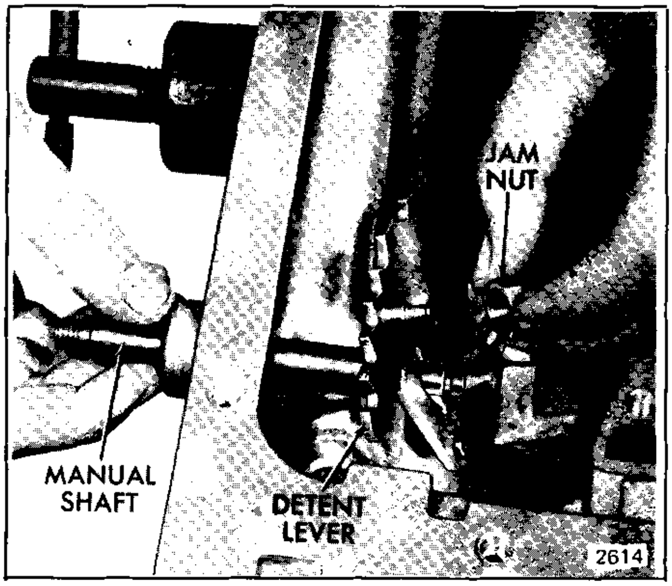


Fig. 7A4-37 Removing Jam Nut and Manual Shaft

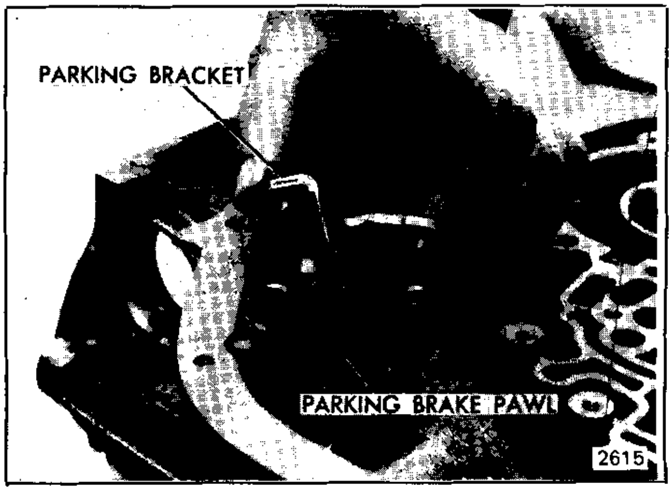


Fig. 7A4-38 Removing Parking Bracket

THICKNESS	NOTCHES	AND/OR NUMBER
.074-.078	None	1
.082-.086	1 Tab Side	2
.090-.094	2 Tab Side	3
.098-.102	1 Tab O.D.	4
.106-.110	2 Tabs O.D.	5
.114-.118	3 Tabs O.D.	6

12. Remove center support-to-case bolt, using a 3/8" 12 point thin wall deep socket (Fig. 7A4-46).

13. Remove intermediate clutch backing plate-to-case snap ring.

14. Remove intermediate clutch backing plate, three (3) composition and three (3) steel clutch plates (Fig. 7A4-47).

15. Remove center support-to-case retaining snap ring (Fig. 7A4-48).

16. Remove entire gear unit assembly by lifting with Holding Tool J 21795 with Hammer J 6125-1 (Fig. 7A4-49).

17. Remove output shaft-to-case thrust washer from rear of output shaft or from inside of case.

18. Place gear unit assembly, with output shaft facing down, in hole in work bench or in Holding Fixture J 6116 and Adapter J 21364.

19. Remove rear unit selective washer from transmission case (Fig. 7A4-50).

20. Remove support-to-case spacer from inside of case (Fig. 7A4-51).

21. Remove rear band assembly (Fig. 7A4-52).

DISASSEMBLY OF GEAR UNIT

1. Remove center support assembly (Fig. 7A4-53).

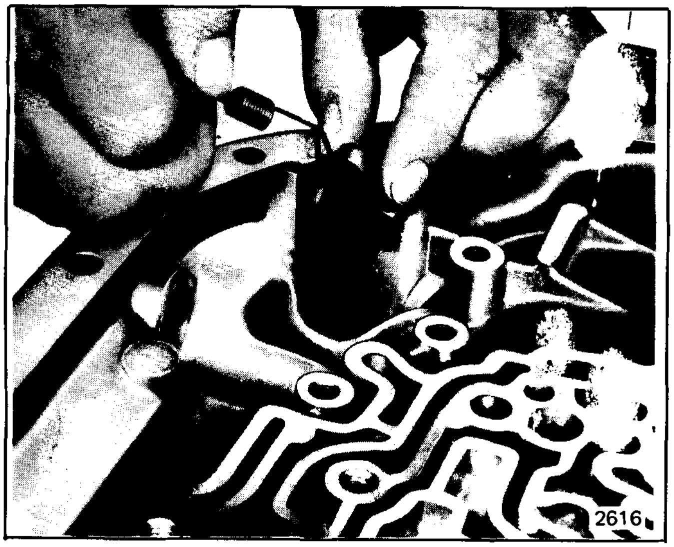


Fig. 7A4-39 Removing Parking Pawl Return Spring

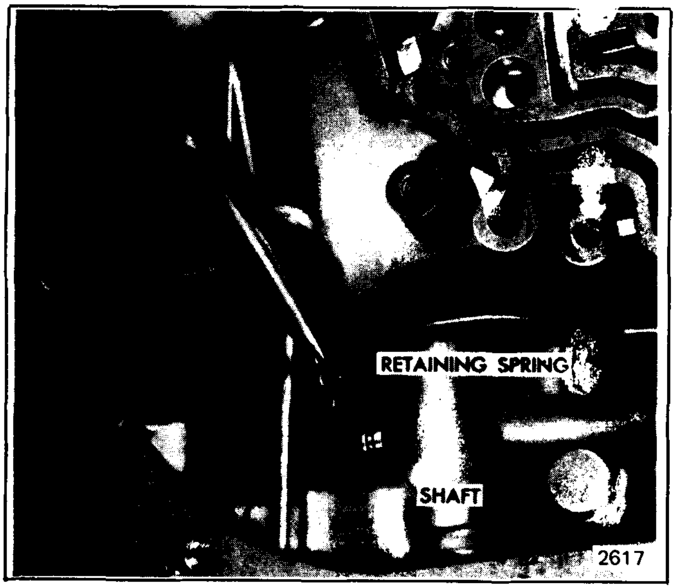


Fig. 7A4-40 Removing Retaining Spring From Parking Pawl Shaft

2. Remove center support-to-reaction carrier thrust washer (Fig. 7A4-54).

3. Remove center support-to-sun gear races and thrust bearing.

NOTE: One race may have been removed with center support.

4. Remove reaction carrier and roller clutch assembly (Fig. 7A4-55).

5. Remove front internal gear ring from output carrier assembly.

6. Remove sun gear (Fig. 7A4-56).

7. Remove reaction carrier-to-output carrier thrust washer.

8. Turn carrier assembly over.

9. Remove output shaft-to-output carrier snap ring (Fig. 7A4-57).

10. Remove output shaft.

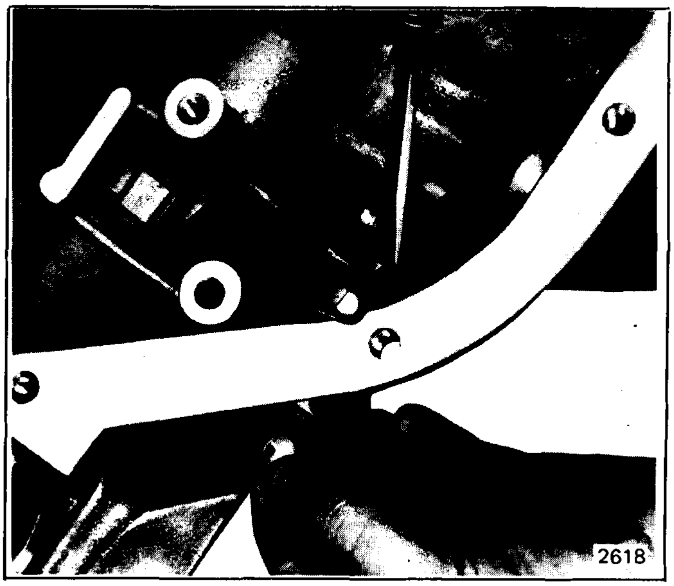


Fig. 7A4-41 Removing Cup Plug From Case

Fig. 7A4-42 Removing Parking Pawl and Shaft

11. If removal and installation or replacement of the speedometer drive gear is necessary, proceed as follows:

TRANSMISSIONS WITH NYLON SPEEDOMETER DRIVE GEAR

a. Depress retaining clip and slide gear off the output shaft (Fig. 7A4-58).

b. To install, place retaining clip (square end toward flange of shaft) into hole in output shaft (Fig. 7A4-59). Align slot in speedometer drive gear with retaining clip and install gear.

NOTE: The nylon speedometer drive gear is installed at the factory only. All service replacement speedometer drive gears are steel. When replacing the nylon speedometer drive gear with a steel gear, discard the retaining clip and proceed as indicated in step "d" below.

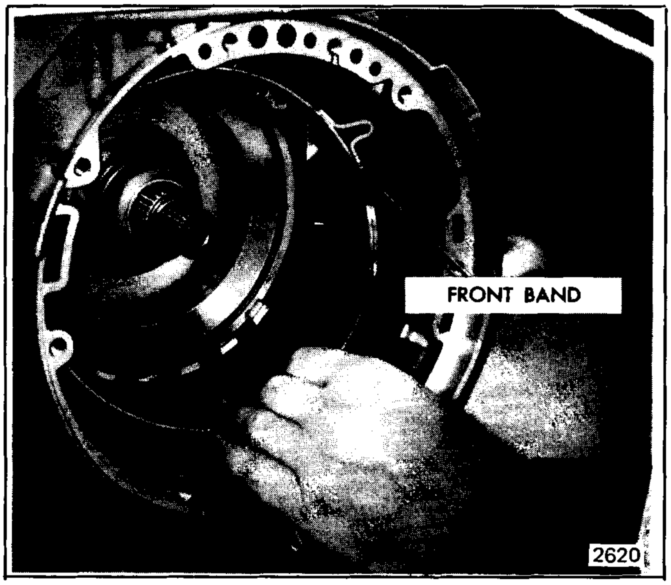


Fig. 7A4-43 Removing Front Band

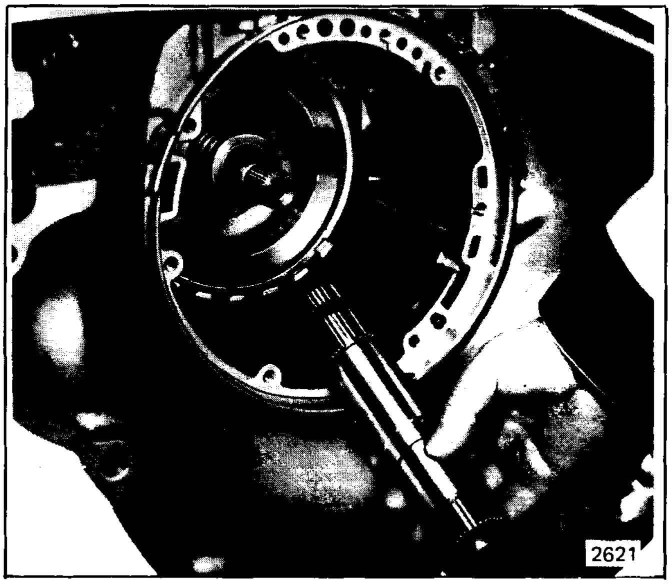


Fig. 7A4-44 Removing Sun Gear Shaft

TRANSMISSIONS WITH STEEL SPEEDOMETER DRIVE GEAR

c. Installing Removers J 21427 and J 8433 and Bolt J 21904 on the output shaft, remove the speedometer drive gear (Fig. 7A4-60).

d. Install a new steel speedometer drive gear and drive to location approximately 5 21/32" from end of output shaft to rear face of gear, using Spacer J 21028 (cup side up) and Installer J 6133 (Fig. 7A4-61).

12. Remove output shaft-to-rear internal gear thrust bearing and two (2) races.

13. Remove rear internal gear and mainshaft (Fig. 7A4-62).

NOTE: Do not drop bearings.

14. Remove rear internal gear-to-sun gear thrust bearing and two (2) races.

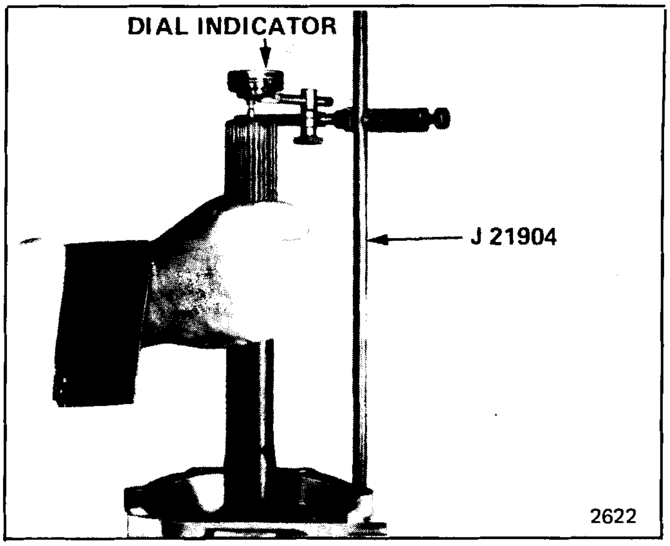


Fig. 7A4-45 Checking Rear End Play

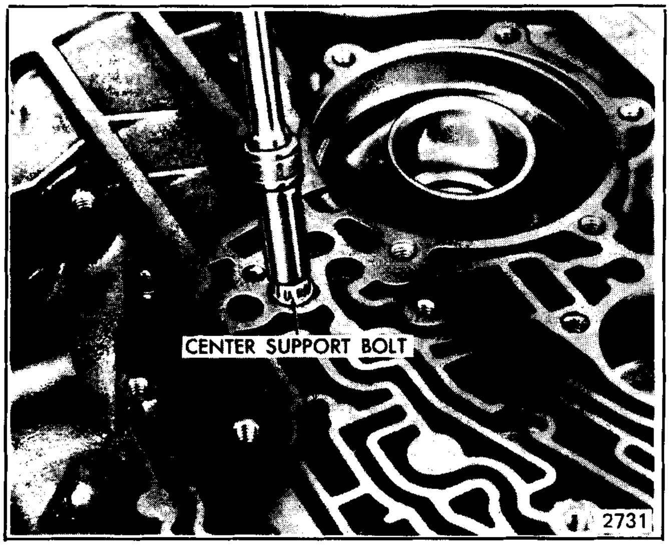


Fig. 7A4-46 Removing Center Support Bolt

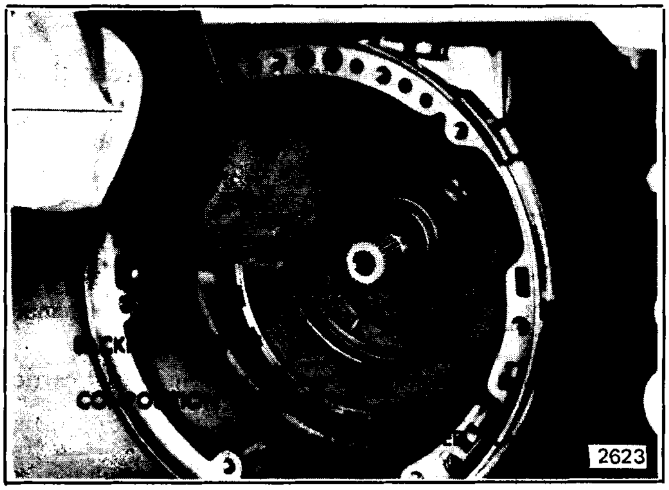


Fig. 7A4-47 Removing Intermediate Clutch Pack

15. Remove rear internal gear-to-mainshaft snap ring to remove mainshaft.

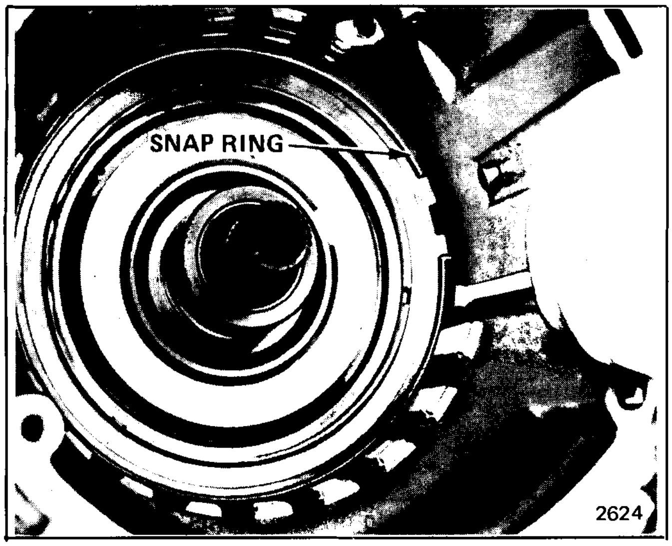


Fig. 7A4-48 Removing Support-to-Case Snap Ring

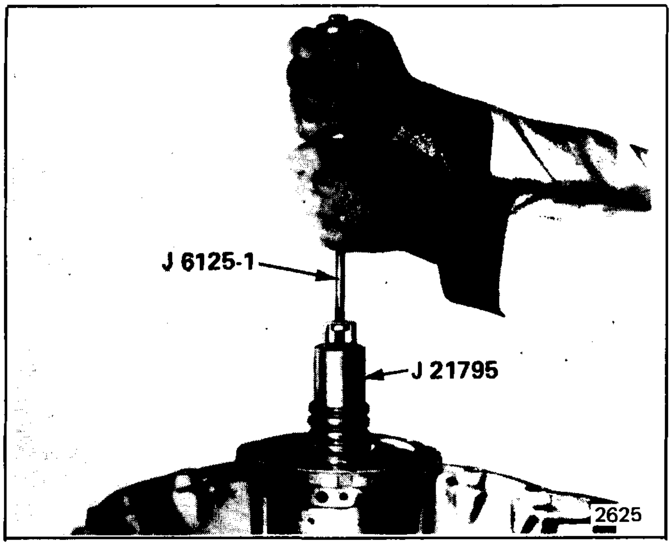


Fig. 7A4-49 Removing Entire Gear Unit Assembly

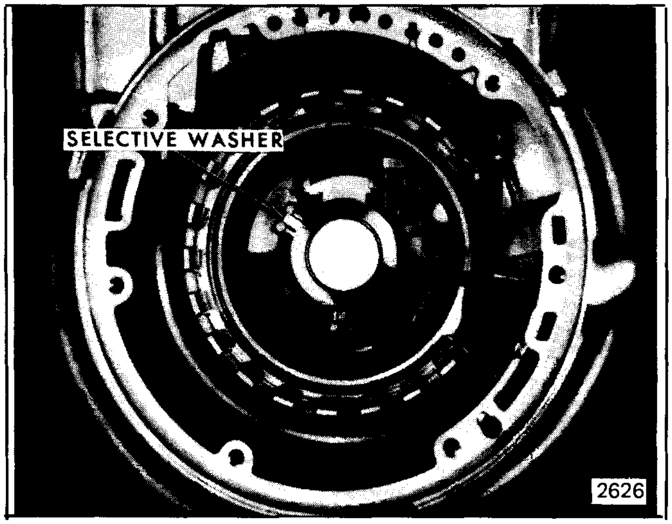


Fig. 7A4-50 Location of Rear Unit Selective Washer

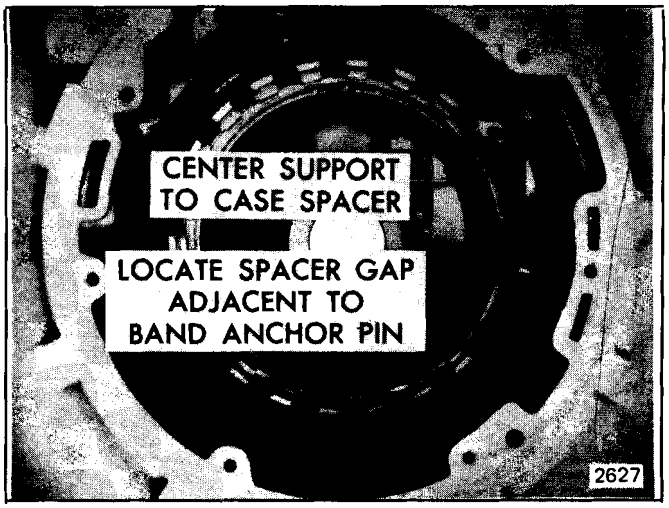


Fig. 7A4-51 Location of Support-to-Case Spacer

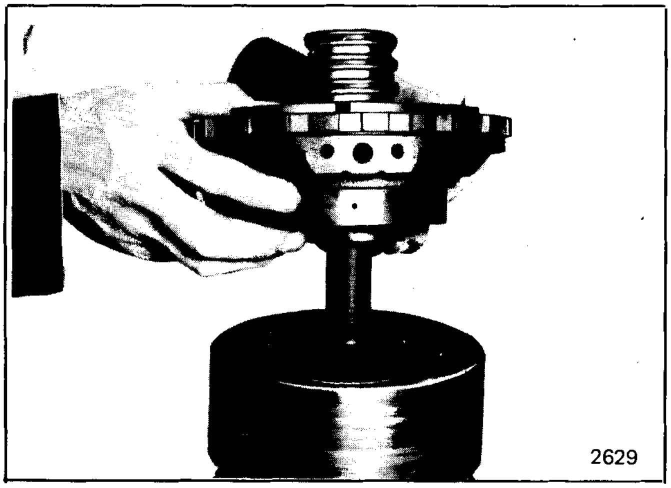


Fig. 7A4-53 Removing Center Support Assembly

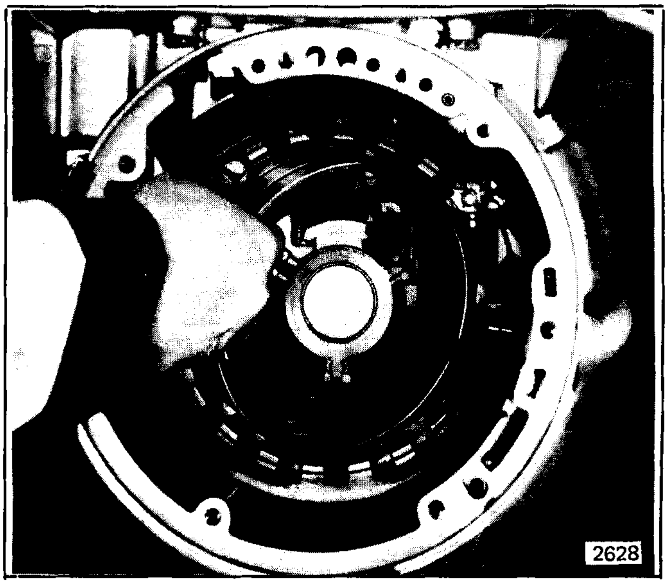


Fig. 7A4-52 Removing Rear Band

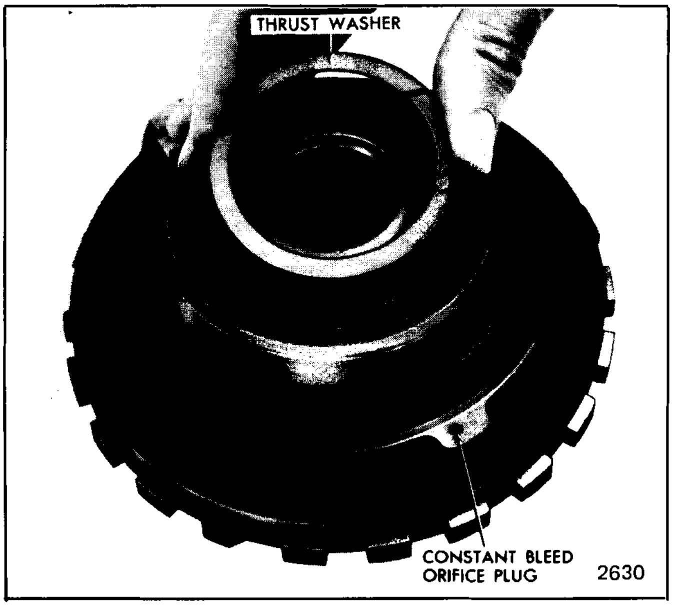


Fig. 7A4-54 Removing Center Support Thrust Washer

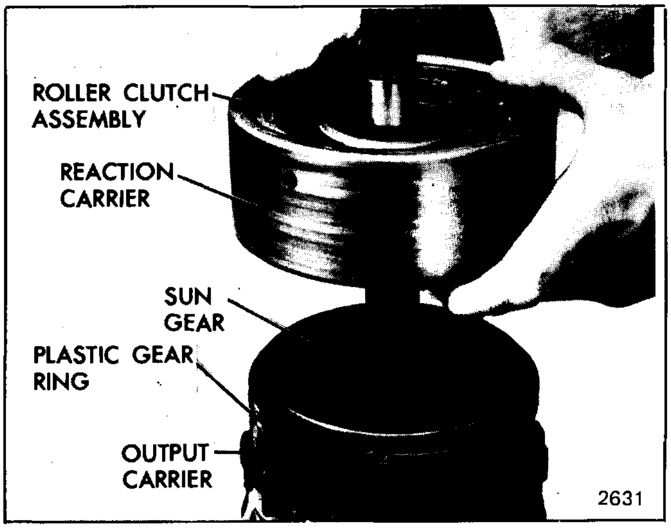


Fig. 7A4-55 Removing Reaction Carrier Assembly

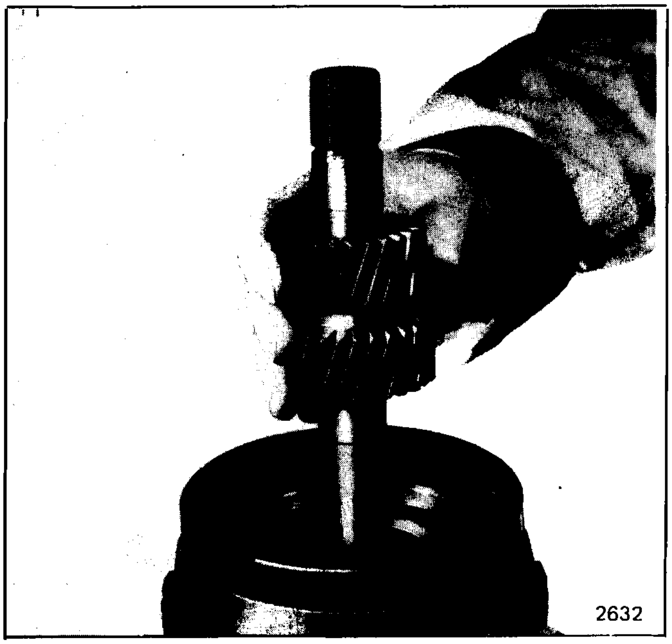


Fig. 7A4-56 Removing Sun Gear

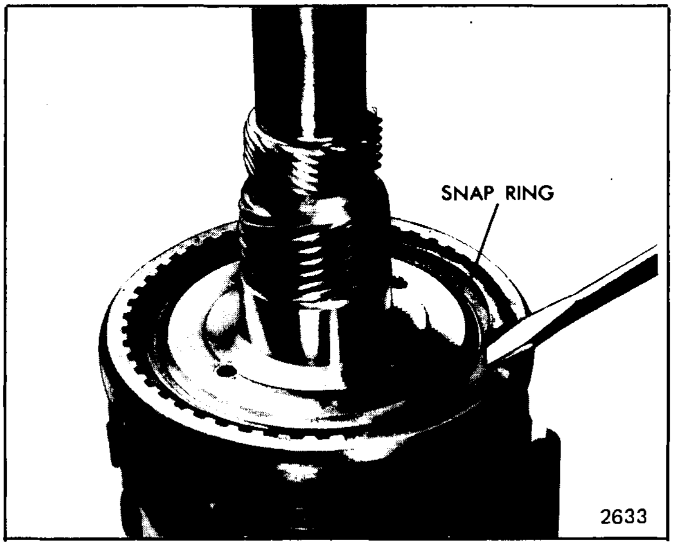


Fig. 7A4-57 Disengaging Snap Ring From OUtput Carrier

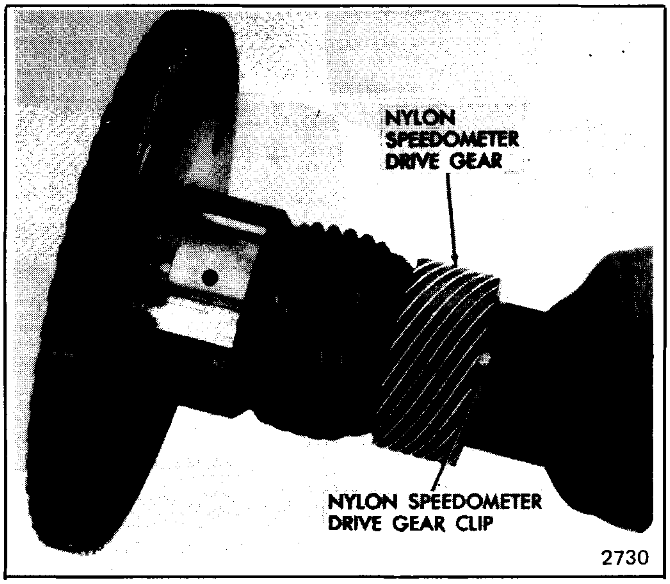


Fig. 7A4-58 Depressing Retaining Clip

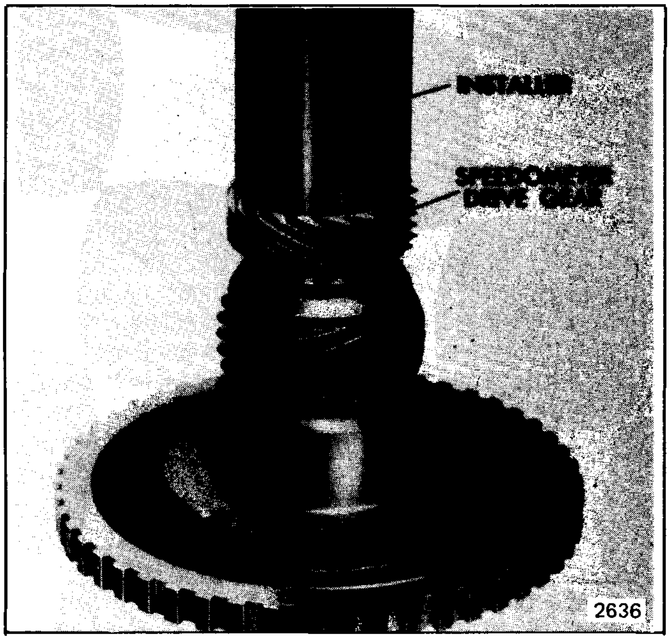


Fig. 7A4-61 Installing Steel Speedometer Drive Gear

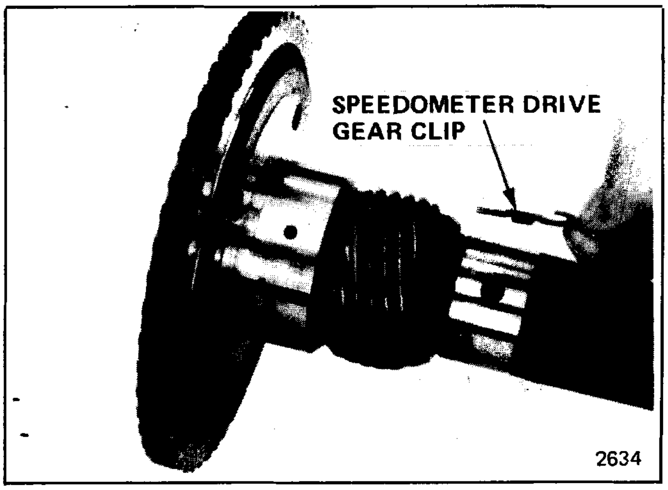


Fig. 7A4-59 Installing Reatining Clip

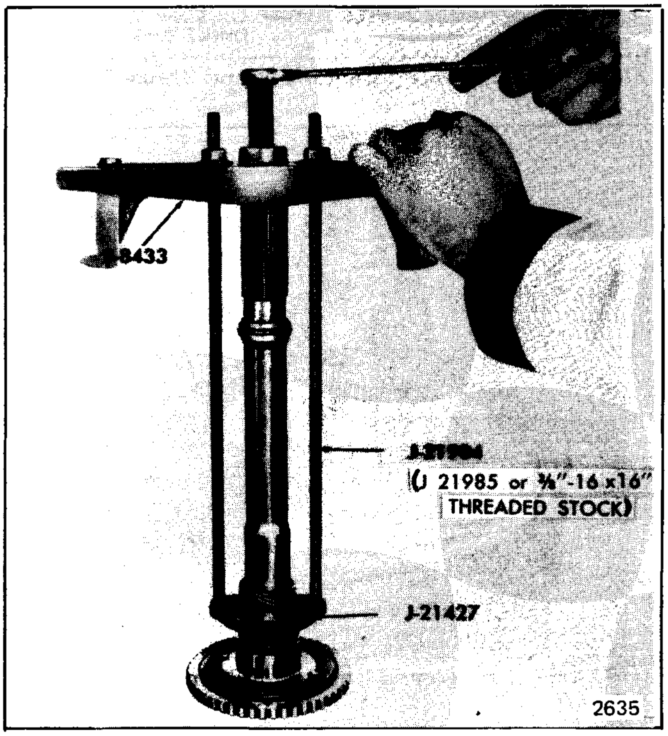


Fig. 7A4-60 Removing Steel Speedometer Drive Gear

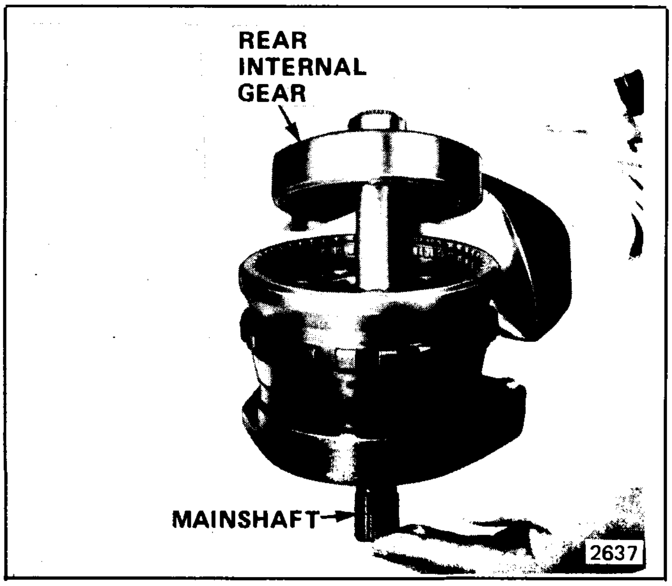


Fig. 7A4-62 Removing Rear Internal Gear - Mainshaft

OVERHAUL OF MAJOR UNITS

GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

It is necessary to disassemble governor assembly in order to replace driven gear. Disassembly may also be necessary due to foreign material causing improper operation. In such cases, proceed as follows:

Disassemble Governor

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights and springs. Governor weights are interchangeable from side to side and need not be identified (Fig. 7A4-63).
2. Remove governor valve from governor sleeve. Be careful not to damage valve or sleeve.
3. Perform the following inspections and replace governor driven gear, if necessary.

Inspect Governor

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor weight springs for distortion or damage.
9. Check governor weights for free operation in their retainers.
10. Sleeve must be tight in carrier.

GOVERNOR DRIVEN GEAR

Replace

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin, using small punch (Fig. 7A4-64).
2. Support governor on 7/64" plates installed in exhaust slots of governor sleeve, place in arbor press and, with long punch, press gear out of sleeve.
3. Carefully clean governor sleeve of chips that remain from original gear installation.
4. Support governor on 7/64" plates installed in exhaust slots of sleeve, position new gear in sleeve and, with suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.
5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90° from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard 1/8" drill.
6. Install retaining pin.
7. Wash governor assembly thoroughly to remove any chips that may have collected.

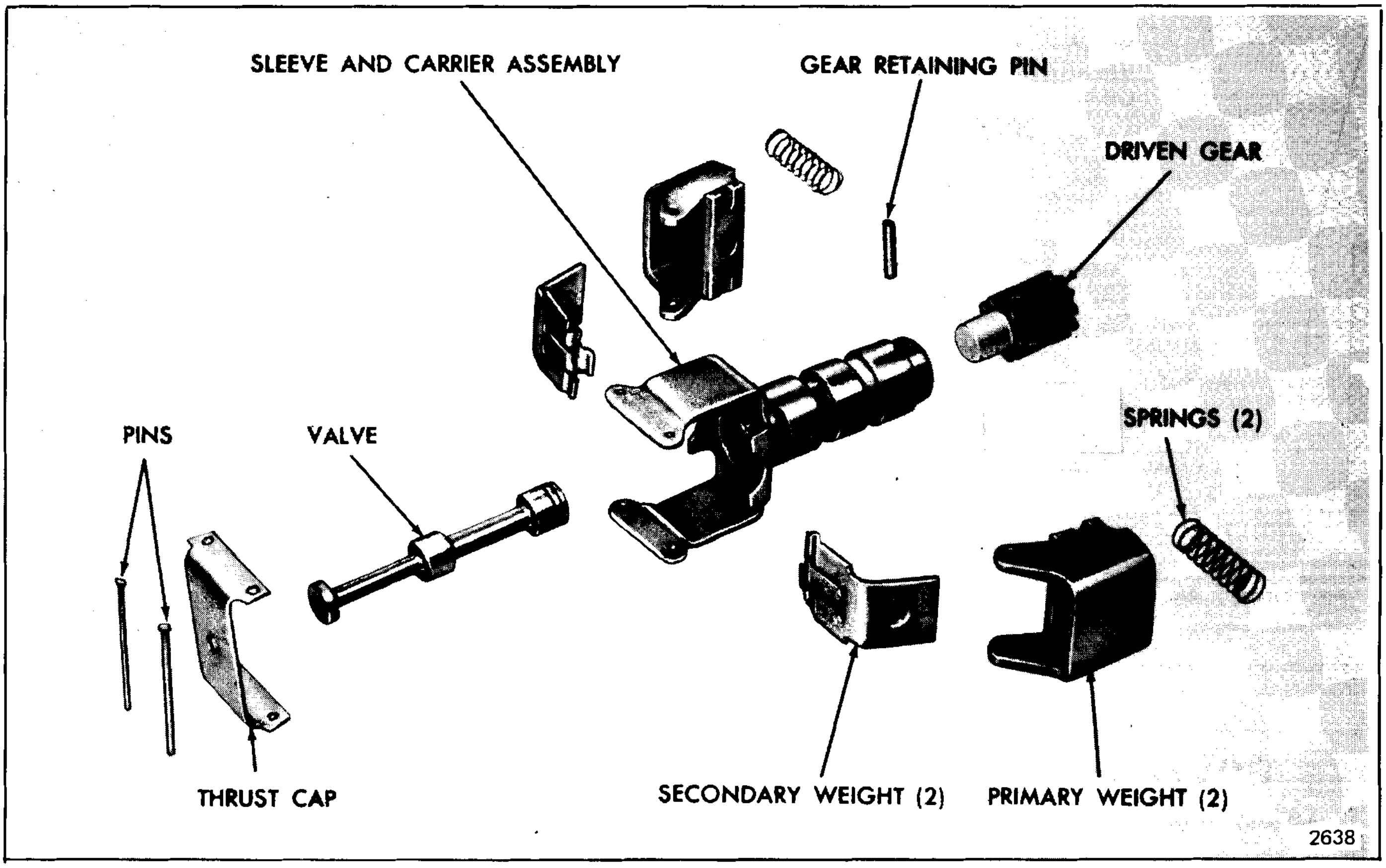


Fig. 7A4-63 Governor Assembly - Exploded View

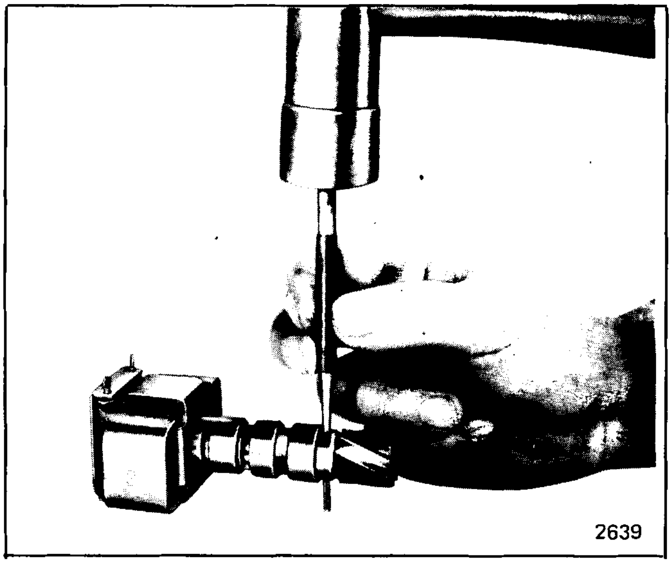


Fig. 7A4-64 Driving Pin From Governor

Assemble Governor

1. Install governor valve in bore of governor sleeve.

2. Install governor weights and springs and thrust cap on governor sleeve.

3. Align pin holes in thrust cap, governor weight assemblies and governor sleeve and install new pins. Crimp both ends of pins to prevent them from falling out.

4. Check governor weight assemblies for free operation on pins and governor valve for free movement in governor sleeve.

5. Check for valve opening at entry (feed) and exhaust ports of governor as follows:

a. Check valve opening at entry (feed) port with a feeler gage as shown with governor weights extended completely outward (Fig. 7A4-65).

b. Check valve opening at exhaust port with a feeler gage as shown by holding the governor weights completely inward (Fig. 7A4-66).

c. If less than .020" minimum opening is found, governor assembly must be replaced.

INSPECT FRONT SERVO

1. Inspect servo pin for damage (Fig. 7A4-67).

2. Inspect servo piston and oil seal ring for damage. Do not remove the teflon oil seal ring from the servo piston unless the ring requires replacement. For service, the oil seal ring will be aluminum.

3. Check fit of servo pin in piston.

REAR SERVO

DISASSEMBLE

1. Remove rear accumulator piston from rear servo piston (Fig. 7A4-68).

2. Remove E-ring, retaining rear servo piston to band apply pin (Fig. 7A4-69).

3. Remove rear servo piston and seal from band apply (servo) pin (Fig. 7A4-70).

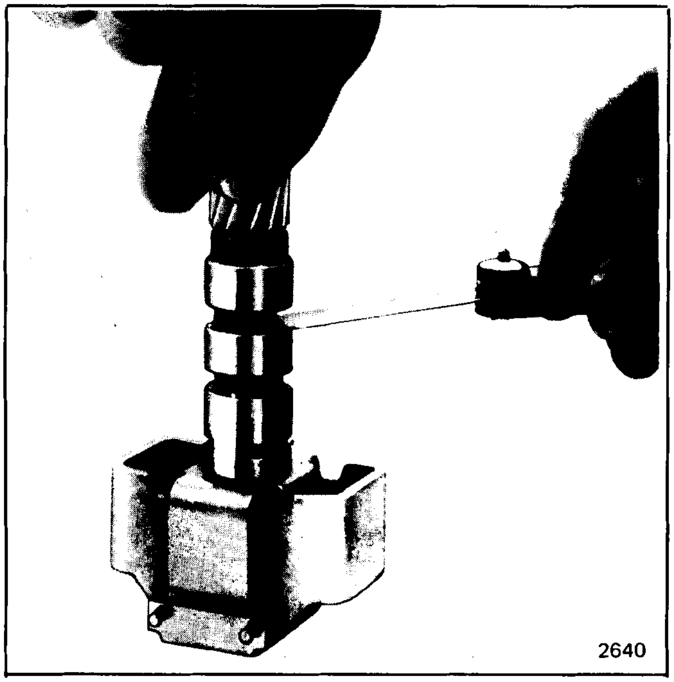


Fig. 7A4-65 Checking Feed Port

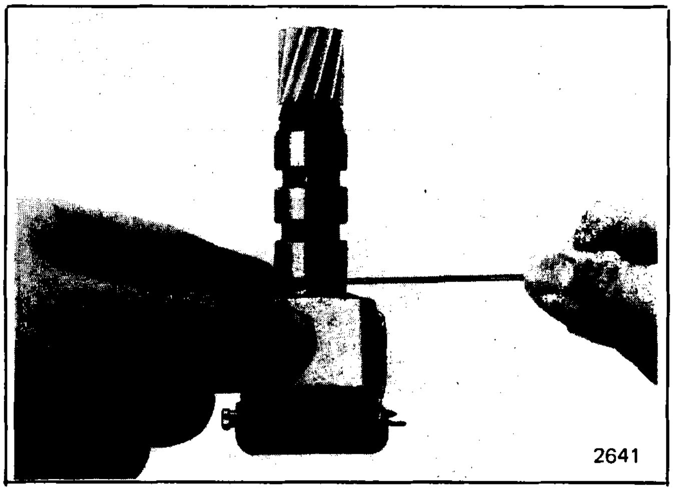


Fig. 7A4-66 Checking Exhaust Port

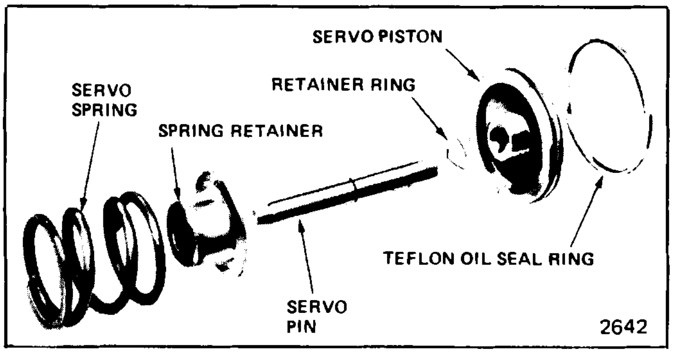


FIG. 7A4-67 FRONT SERVO - EXPLODED VIEW

4. Remove washer, spring and retainer.

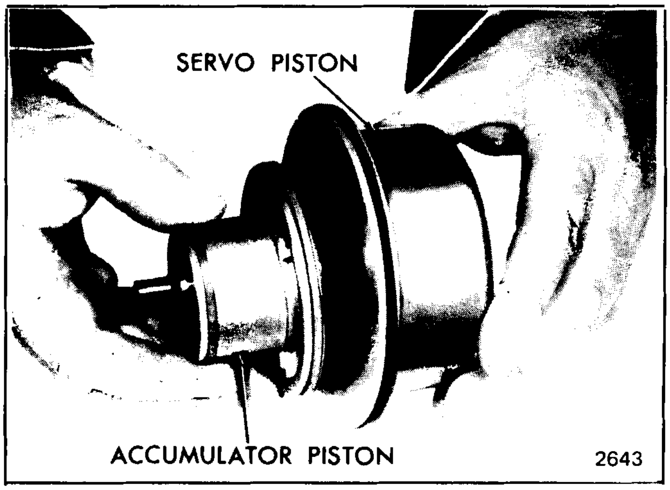


Fig. 7A4-68 Removing Accumulator Piston From Servo

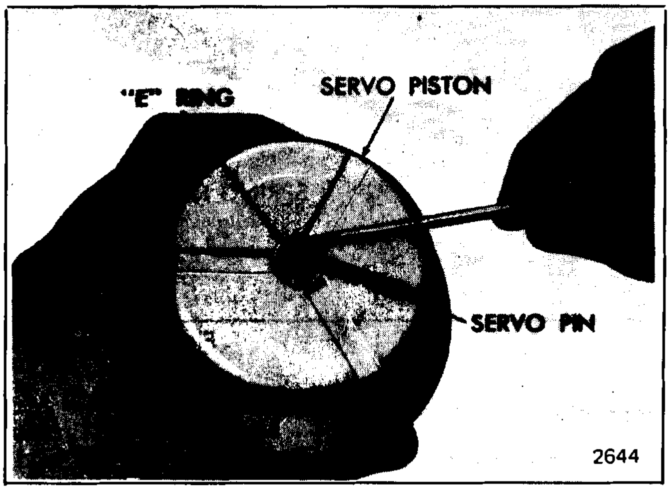


Fig. 7A4-69 Removing E-Ring From Servo Pin

REAR SERVO

INSPECT

1. Inspect the freeness of accumulator rings in piston groove.
2. Inspect the fit of band apply (servo) pin in servo piston.
3. Inspect the band apply (servo) pin for scores or cracks.
4. Inspect accumulator and servo pistons for cracks or porosity.

NOTE: Refer to Fig. 7A4-70. Do not remove the teflon oil seal rings from the accummulator piston unless they require replacement.

If the teflon inner (small diameter) oil seal ring requires replacement, use the aluminum oil seal ring, Group No. 4.242, Part No. 8623671 or equivalent. The large diameter ring groove in the accummulator piston is machined shallower in order to accept the teflon outer (large diameter) oil seal ring. If this ring requires replacement, use only the teflon oil seal ring, Group No. 4.242, Part No. 8627153 or equivalent.

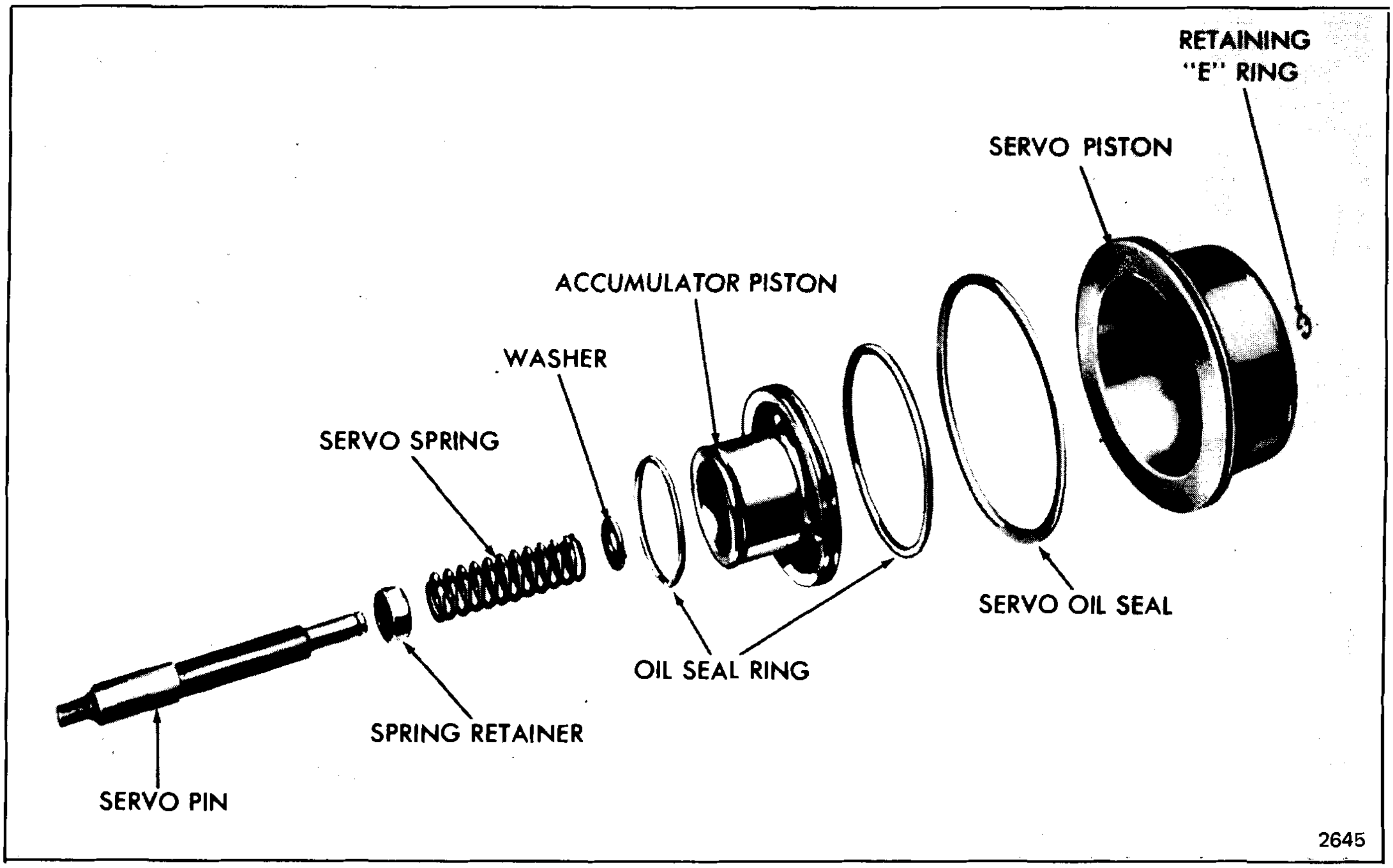


Fig. 7A4-70 Rear Servo - Exploded View

Assemble Rear Servo

1. Install spring retainer, spring and washer on band apply pin.
2. Install band apply (servo) pin, retainer, spring and washer into bore of servo piston and secure with E-ring.
3. Install oil seal on servo piston, if removed.
4. Install outer and inner oil rings on accumulator piston, if removed, and assemble into bore of servo piston.

CONTROL VALVE ASSEMBLY

Disassemble

1. Position control valve assembly with cored face up and accumulator pocket toward operator.
2. Remove manual valve from upper bore.
3. Install Compressor J 21885 on accumulator piston valve, remove retaining ring (Fig. 7A4-71) and remove front accumulator piston and spring (Fig. 7A4-72).
4. From the top right hand bore, remove retaining pin, 1-2 modulator bushing, 1-2 regulator valve, 1-2 regulator spring, 1-2 detent valve and 1-2 shift valve (Fig. 7A4-73).
5. From next bore down, remove retaining pin, 2-3 primary spring, modulator valve bushing, 2-3 modulator valve, 2-3 secondary spring and 2-3 shift valve.
6. From next bore down, remove retaining pin, bore plug, 3-2 valve spring, spacer and 3-2 valve.
7. At other end of assembly, top bore, remove retaining pin and bore plug, detent valve, detent regulator valve, spring and spacer.

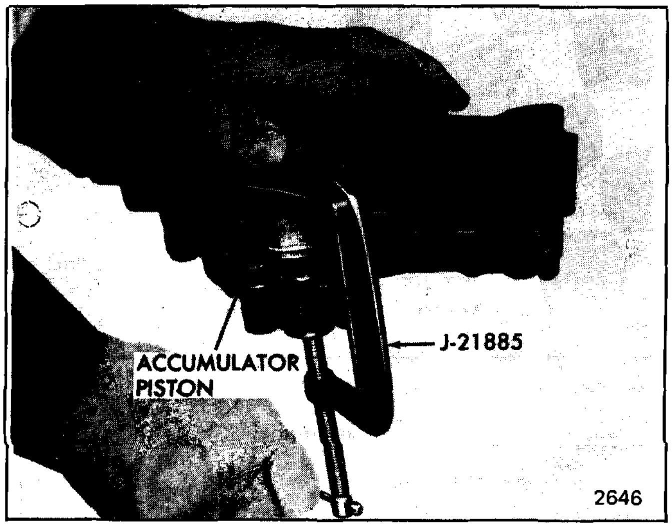


Fig. 7A4-71 Compressing Accumulator Piston and Spring

8. From next bore down, on models PB, PC and PD remove the grooved retaining pin, bore plug, 1-2 accumulator valve and the 1-2 accumulator primary spring.

On model OC, remove the grooved retaining pin, bore plug and the 1-2 accumulator valve.

On models PA and OB, remove the grooved retaining pin, bore plug, 1-2 accumulator secondary spring and the 1-2 accumulator valve.

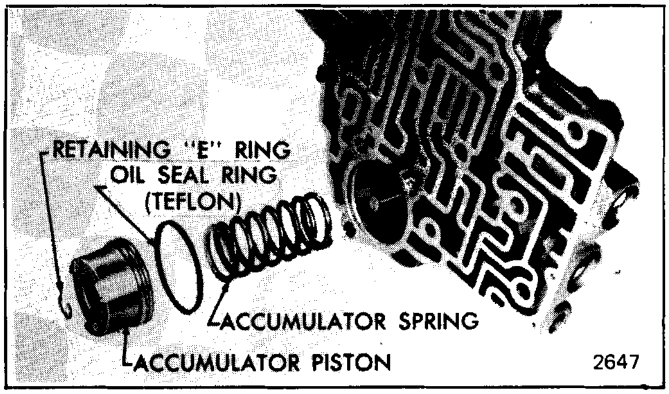


Fig. 7A4-72 Front Accumulator Piston - Exploded View

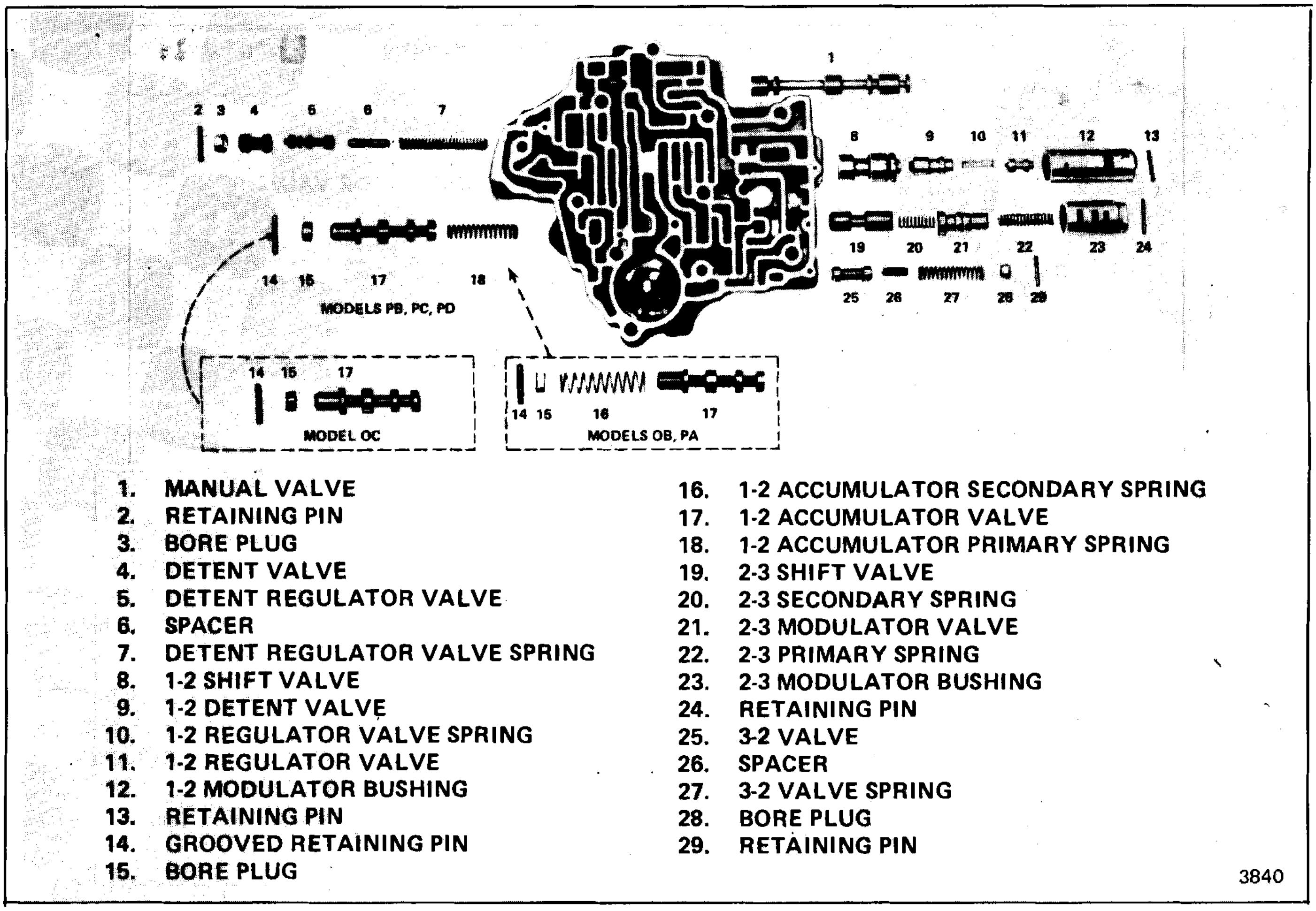


Fig. 7A4-73 Control Valve Assembly - Exploded View

INSPECT CONTROL VALVE ASSEMBLY

NOTE: See Fig. 7A4-72. Do not remove the teflon oil seal ring from the front accumulator piston unless the oil seal ring requires replacement. For service, the replacement oil seal ring will be cast iron.

1. Inspect all valves for scoring, cracking and free movement in their respective bore.
2. Inspect bushing for cracks, scratches or distortion.
3. Inspect body for cracks or scored bores.
4. Check all springs for distortion or collapsed coils.
5. Inspect front accumulator piston and oil seal ring for damage.

ASSEMBLE CONTROL VALVE ASSEMBLY

1. Install front accumulator spring and piston into valve body, install Compressor J 21885, compress spring and piston and secure with retaining E-ring (Fig. 7A4-71).
2. In lower left bore, install the 1-2 accumulator primary spring (not used on PA, OB or OC models) and the 1-2 accumulator valve (stem end out). Install the 1-2 accumulator secondary spring (used on PA and OB models only), the bore

plug (hole out) and install the grooved retaining pin from cast surface side of the valve body, with the grooves entering the pin hole last. Tap pin with hammer until flush with cast surface.

NOTE: The OC model uses no 1-2 accumulator springs.

3. In next bore up, install detent spring and spacer, compress spring and secure with small screwdriver (Fig. 7A4-74), install detent regulator valve, wide land first, and install detent valve, narrow land first. Install bore plug (hole out), depress spring by pressing in on plug, install retaining pin and remove screwdriver.

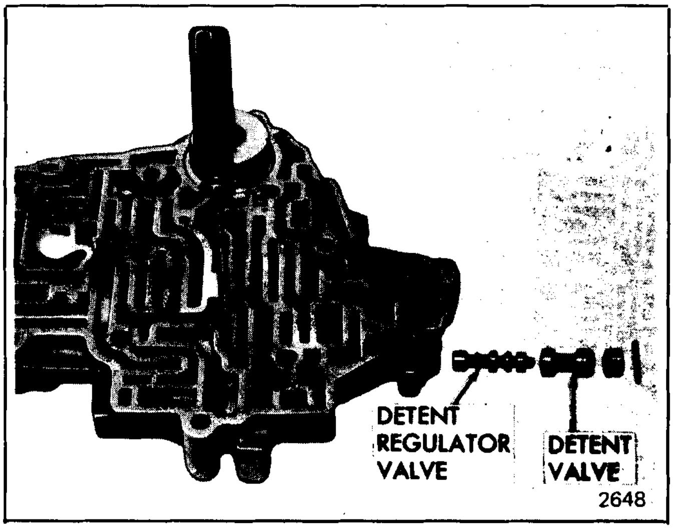


Fig. 7A4-74 Installing Detent Regulator Valve and Detent Valve

4. In lower right hand bore, install 3-2 valve, 3-2 valve spring, spacer, bore plug (hole out) and retaining pin.

5. In next bore up, install 2-3 shift valve, open end out and install 2-3 secondary spring into its open end. Install 2-3 modulator valve into its bushing, install both parts into valve body bore and install 2-3 primary spring and its retaining pin.

6. In next bore up, install 1-2 valve, stem end out, install the 1-2 regulator valve, larger stem first, spring and the 1-2 detent valve, hole end first, into the 1-2 modulator bushing, aligning the spring into the bore of the detent valve and install this assembly into the valve body bore. Compress bushing against the spring and install the retaining pin.

7. Install manual valve with detent pin groove to the right.

OIL PUMP

Disassemble

1. Place oil pump assembly in hole in bench or Fixture J 6116 and Adapter J 21364.

2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using snap ring pliers (Fig. 7A4-75).

3. Remove regulator boost valve bushing and valve.

4. Remove pressure regulator spring.

5. Remove spring retainer, spacer(s) if present and regulator valve (Fig. 7A4-76).

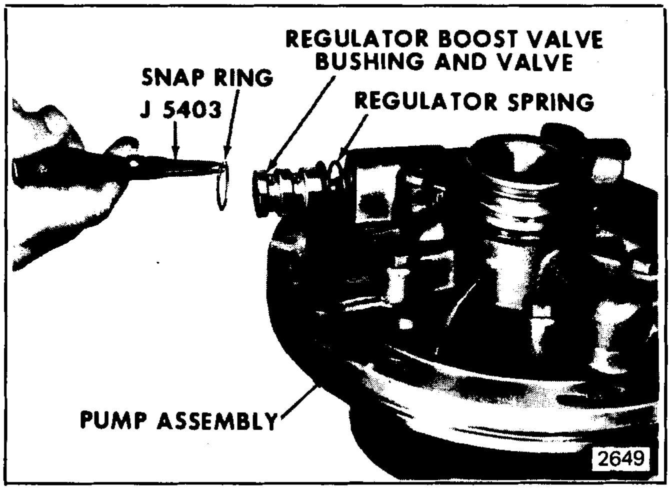


Fig. 7A4-75 Removing Snap Ring Front Boost Valve Bushing

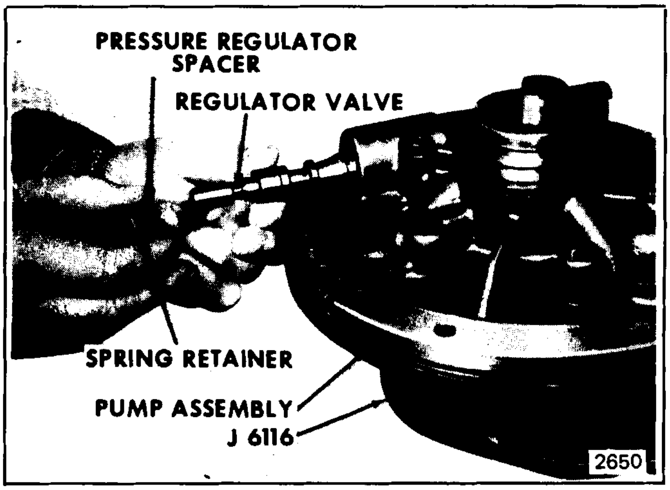


Fig. 7A4-76 Removing Pressure Regulator Valve

6. Remove pump cover-to-body attaching bolts and remove cover from pump body.

7. Remove retaining pin and bore plug from pressure regulator bore (Fig. 7A4-77).

8. Check condition of oil seal rings and remove from pump cover if necessary (Fig. 7A4-78).

9. Remove pump-to-forward clutch housing selective washer.

10. Mark drive and driven gears for reassembly in same position and remove gears from pump body (Fig. 7A4-79).

Inspect Oil Pump

NOTE: A solid type pressure regulator valve must only be used in a pump cover with a squared off pressure regulator boss (Fig. 7A4-80). A pressure regulator valve with oil holes and orifice cup plug may be used to service either type pump cover.

1. Inspect drive gear, driven gear, gear pocket and crescent for scoring, galling or other damage.

2. Place pump gears in pump and check pump body face-to-gear face clearance, should be .0008"-.0035" (Fig. 7A4-82).

3. Check face of pump body for scores or nicks.

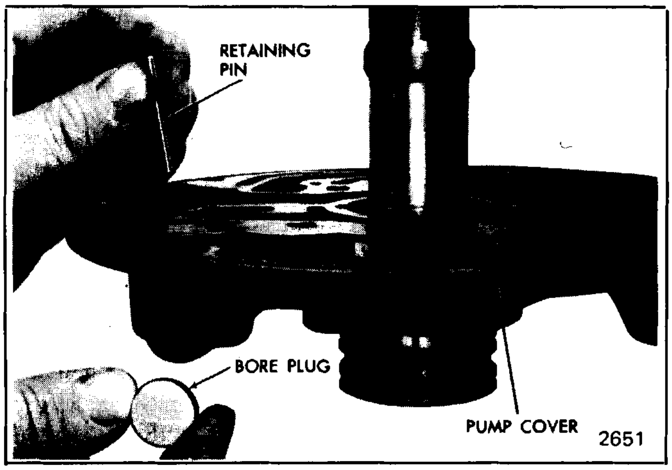


Fig. 7A4-77 Removing Retaining Pin and Bore Plug

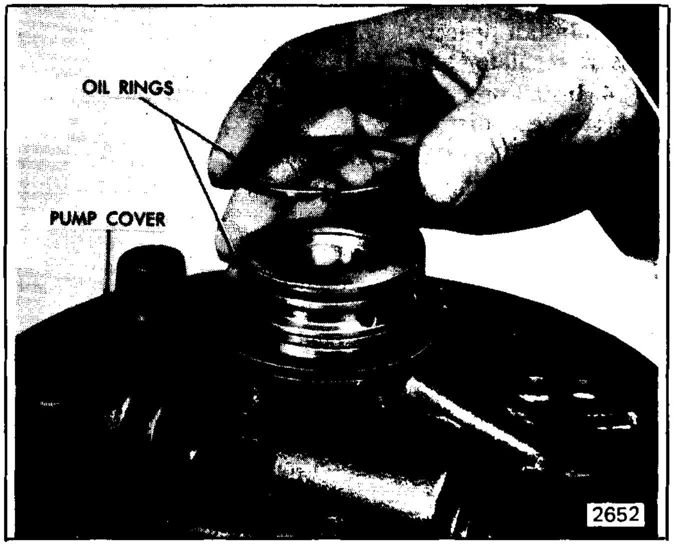


Fig. 7A4-78 Removing Oil Seal Rings From Pump Cover

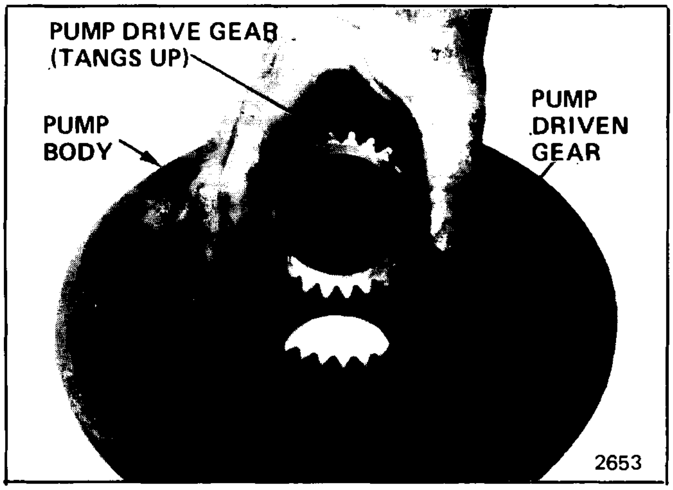


Fig. 7A4-79 Removing or Installing Pump Gears

4. Check oil passages in pump body (Fig. 7A4-83).

5. Check for damaged cover bolt attaching threads.

6. Check for overall flatness of pump body face.

7. Check bushing for scores or nicks. If replacement is necessary, proceed as follows:

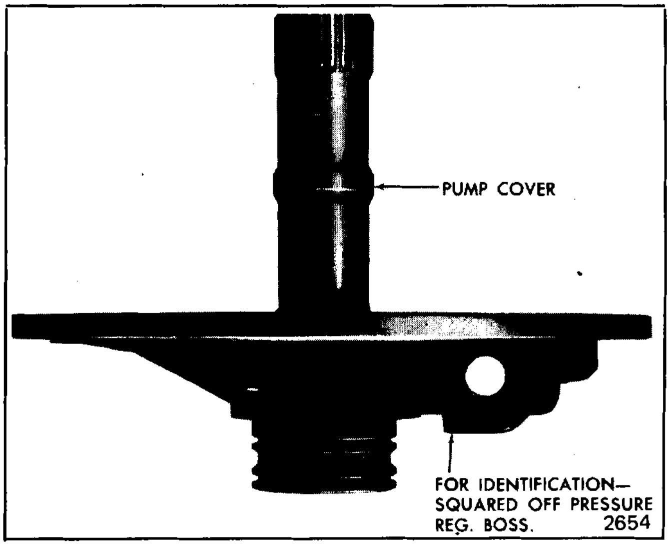


Fig. 7A4-80 Pump Cover With Squared Off Boss

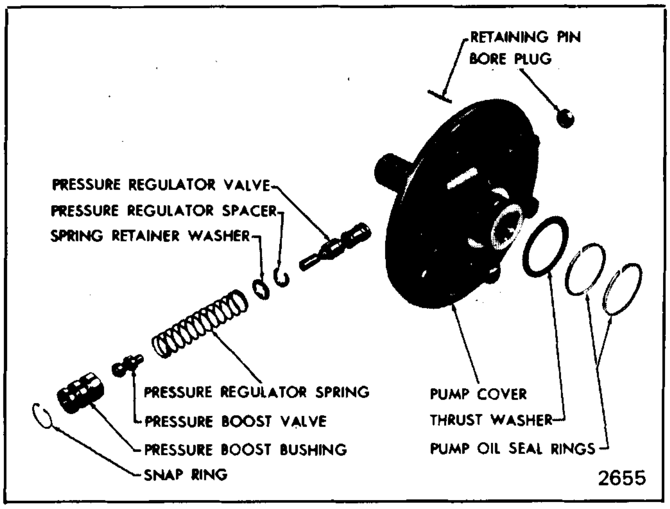


Fig. 7A4-81 Pump Cover - Exploded View

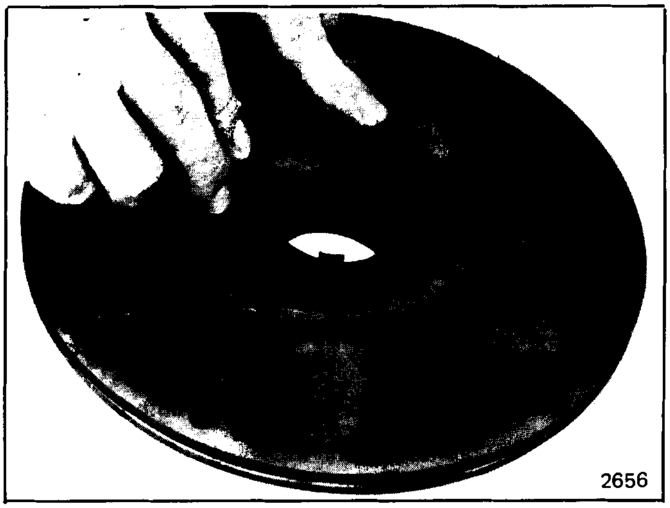


Fig. 7A4-82 Checking Body Face-to-Gear Face Clearance

a. Using Remover J 21465-17 with Handle J 8092, remove bushing.

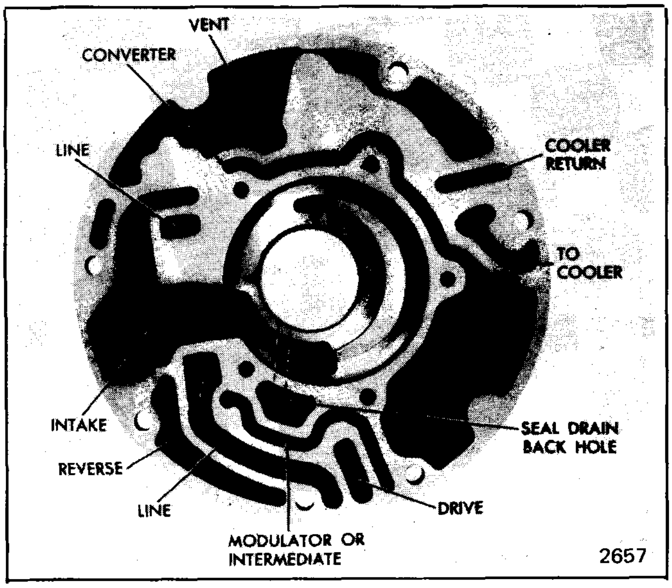


Fig. 7A4-83 Pump Body-oil Passages

b. From gear pocket side of pump and, using Installer J 21465-17 with Handle J 8092, install new bushing flush to .010" below gear pocket face.

8. Inspect pump attaching bolt seals for damage, replace if necessary.

9. Inspect pump cover face for overall flatness.

10. Check for scores or chips in pressure regulator bore.

11. Check that all passages are open and not interconnected in pump cover (Fig. 7A4-84).

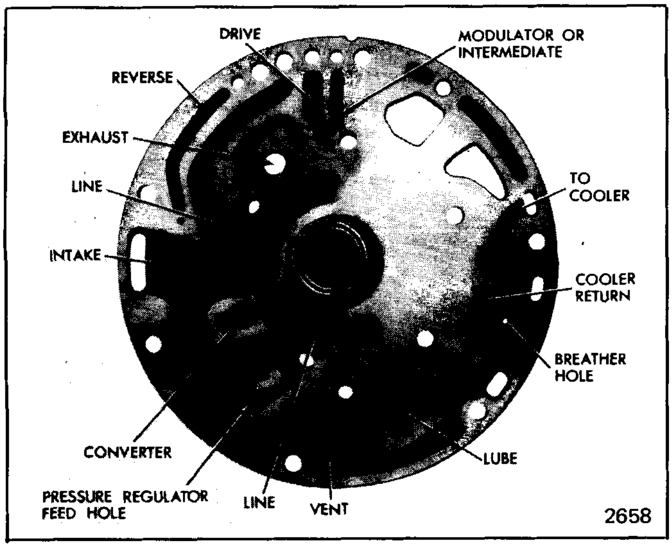


Fig. 7A4-84 Pump Cover-Oil Passages

12. Check for scoring and damage at pump gear face.

13. Inspect stator shaft for damaged splines or scored bushings. If replacement of bushings is necessary, proceed as follows:

a. Thread Remover J 21465-15 into stator shaft bushing. Thread Hammer J 2619 into remover. Clamp Slide Hammer handle into vise. Grasp stator shaft and remove.

b. Using Installer J 21465-3 (front) or J 21465-2 (rear) with Handle J 8092, press or drive bushing until tool bottoms.

14. Inspect oil ring grooves for damage or wear.

15. Inspect selective washer thrust face for wear or damage.

16. Inspect pressure regulator valve and boost valve for free operation.

17. Inspect pump cover for open 1/8" diameter breather hole (Fig. 7A4-84).

Assemble Oil Pump

1. Install drive and driven pump gears into pump body with alignment marks up (Fig. 7A4-79).

NOTE: Some pump driven gears have a rectangular or triangular identification mark on one tooth. If the gear does, it must be installed with the identification mark down. Install pump drive gear with drive tangs up.

2. Protect stator shaft and install pump in vise.

3. Install spacer(s) if used, retainer and spring into pressure regulator bore.

4. Install pressure regulator valve from opposite end of bore, stem end first.

5. Install boost valve into bushing, stem end out, and install both parts into pump cover by compressing bushing against spring.

6. Install retaining snap ring.

7. Install pressure regulator valve bore plug and retaining pin into opposite end of bore.

8. Install previously selected front unit selective thrust washer over pump cover delivery sleeve.

9. Install oil seal rings on pump cover sleeve if removed (Fig. 7A4-78).

NOTE: When installing teflon oil seal rings, make sure slit ends are assembled in same relation as cut (Fig. 7A4-86). Also, make sure oil seal rings are seated in ring grooves to prevent damage to rings during re-assembly of mating parts over rings. Retain with petrolatum.

10. Assembly pump cover to pump body with attaching bolts.

NOTE: Leave bolts one turn loose at this time.

11. Place Strap J 21368 over pump body and cover and tighten tool (Fig. 7A4-87).

12. Tighten pump cover bolts (18 lb. ft. torque).

13. Install and align pump-to-case gasket.

14. Install pump-to-case O-ring seal.

FORWARD CLUTCH

Disassemble

1. Place forward clutch and turbine shaft in hole in bench or Fixture J 6116 and remove forward clutch housing-to-direct clutch hub snap ring (Fig. 7A4-89).

2. Remove direct clutch hub.

3. Remove forward clutch hub and thrust washers (Fig. 7A4-90).

4. (Models PC, PD and OC) - Remove five (5) composition-faced, four (4) thin (.0775") flat steel and one (1) waved steel clutch plates from the forward clutch housing.

(Models PA, PB and OB) - Remove four (4) composition-faced, three (3) thin (.0775") flat steel and one

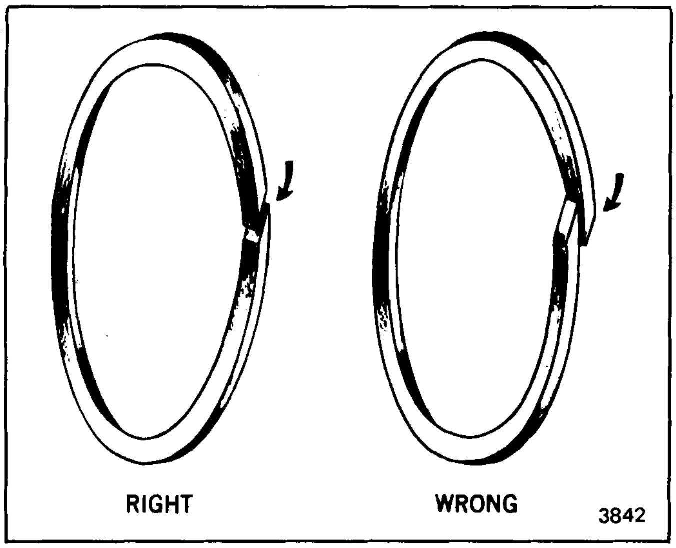


Fig. 7A4-86 Installation of Teflon Rings

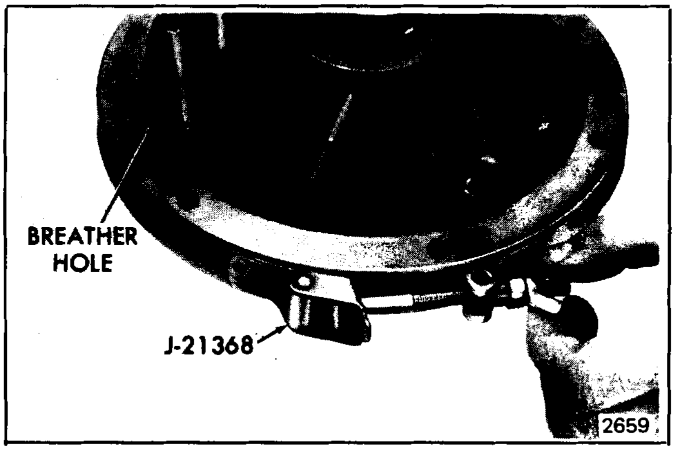


Fig. 7A4-87 Aligning Pump Cover to Pump Body

(1) waved steel clutch plates from the forward clutch housing.

5. Place forward clutch and turbine shaft in arbor press and press out turbine shaft (Fig. 7A4-91).

NOTE: If removal of turbine shaft from clutch housing is not necessary, the forward clutch piston and release springs may still be removed by using Compressor J 23327-1 in an arbor press to compress the spring retainer and remove its snap ring.

6. Using Compressor J 4670 with Adapters J 6129 and J 8765, compress spring retainer and remove snap ring (Fig. 7A4-92).

7. Remove snap ring, spring retainer and sixteen (16) clutch release springs.

CAUTION: *Keep clutch release springs separate from direct clutch piston release springs.*

8. Remove forward clutch piston.

NOTE: The production built transmissions now use a direct clutch without a check ball. The forward and direct clutch pistons look almost the same. Make sure the forward clutch piston is identified during disassembly so it will be reassembled into the forward clutch housing.

NOTE: The production built forward clutch piston will be aluminum or stamped steel.

9. Remove inner and outer clutch piston seals from clutch piston (Fig. 7A4-93).

10. Remove center piston seal from forward clutch housing (Fig. 7A4-94).

INSPECT FORWARD CLUTCH

1. Inspect composition and steel clutch plates for signs of burning, scoring or wear.

2. Inspect sixteen (16) springs for collapsed coils or signs of distortion.

3. Inspect clutch hubs for worn splines, proper lubrication holes and thrust faces.

4. Inspect piston for cracks.

5. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check.

6. Inspect turbine shaft:

a. Check for open lubrication passages at each end.

b. Check splines for damage.

c. Check ground bushing journals for damage.

d. Check shaft for cracks or distortion.

Assemble Forward Clutch

NOTE: Apply automatic transmission oil to all seals and clutch plates before re-assembly.

1. Place new inner and outer oil seals on forward clutch piston, lips face away from spring pockets (Fig. 7A4-93).

2. Place a new center seal on clutch housing, lip faces up (Fig. 7A4-94).

3. Place Protector J 21362 over clutch hub and install Protector J 21409 into clutch drum and install piston, rotating piston on drum until seated (Fig. 7A4-95).

4. Install sixteen (16) clutch release springs into pockets in piston.

5. Place spring retainer and snap ring on springs.

6. Compress springs, using Compressors J 4670, J 6129 and Ring J 8765 and install snap ring (Fig. 7A4-92).

7. Install turbine shaft in forward clutch housing, using arbor press.

8. Install forward clutch hub washers on forward clutch hub, making sure bronze washer is installed on side of hub facing forward clutch housing. Retain with petrolatum.

9. Place forward clutch hub into forward clutch housing (Fig. 7A4-90).

10. (Models PC, PD and OC) - Oil and install five (5) composition-faced, four (4) thin (.0775") flat steel and one (1) waved plate (Plate with "U" notch), starting with waved plate and alternating composition-faced and flat steel clutch plates (Fig. 7A4-7E-96).

(Models PA, PB and OB) - Oil and install four (4) composition-faced, three (3) thin (.0775") flat steel and one (1) waved plate (Plate with "U" notch), starting with waved plate and alternating composition-faced and flat steel clutch plates (Fig. 7A4-7E-96).

NOTE: Radially grooved composition clutch plates are installed at the factory only. All service composition plates have the smooth surface configuration.

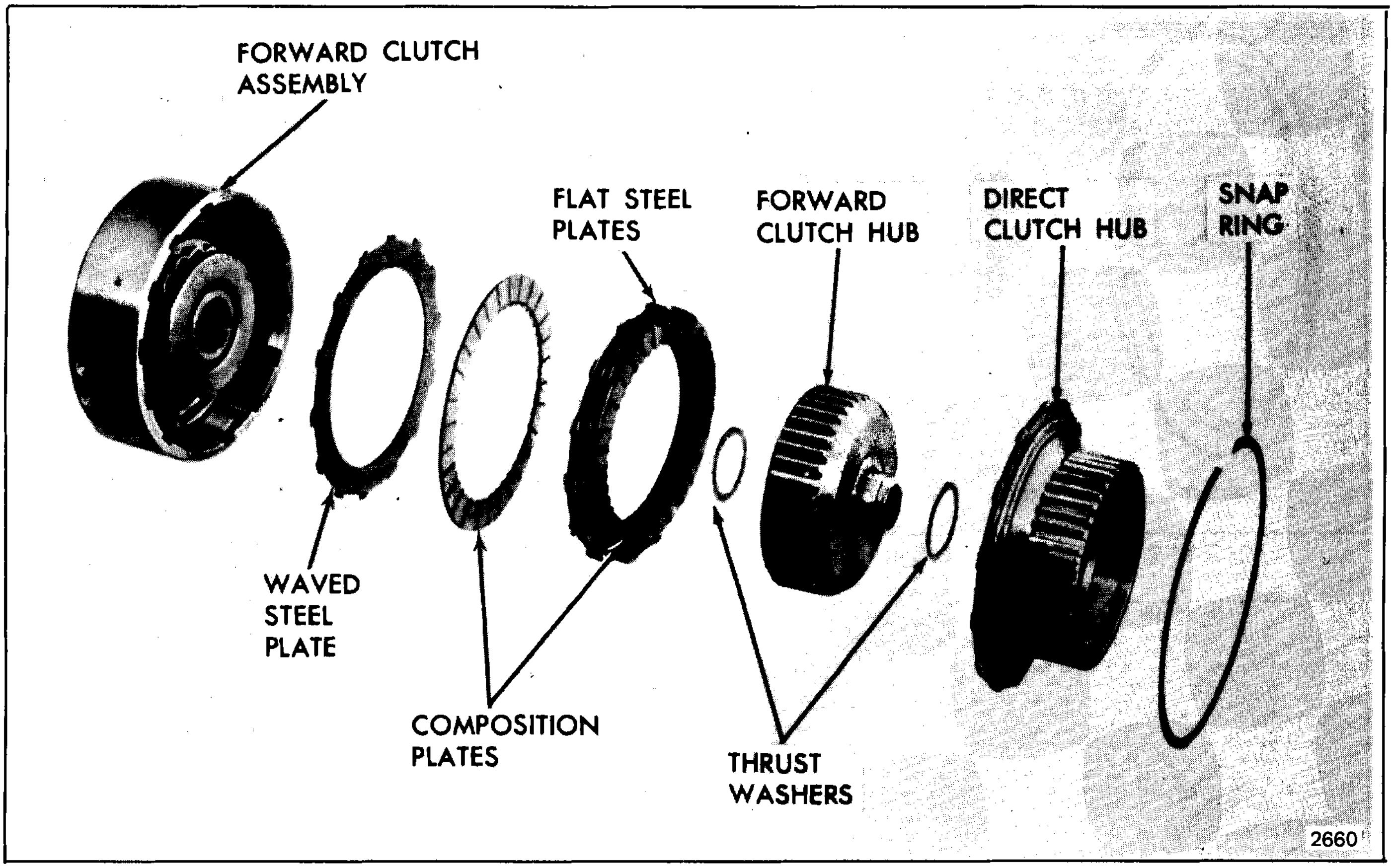


Fig. 7A4-88 Forward Clutch Assembly - Exploded View

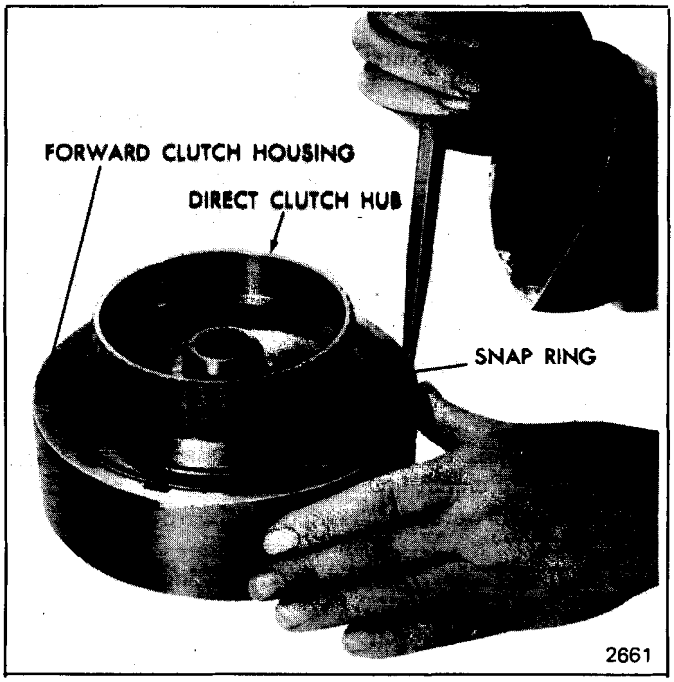


Fig. 7A4-89 Removing or Installing Clutch Hub Retaining Snap Ring

CAUTION: *Do not confuse the flat steel plate (plate with "V" notch) with the waved steel clutch plate (plate with "U" notch).*

11. Install direct clutch hub and retaining snap ring (Fig. 7A4-89).

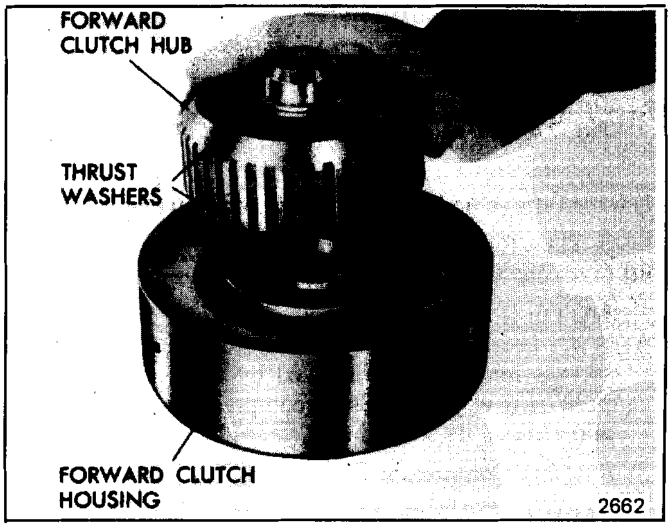


Fig. 7A4-90 Removing or Installing Forward Clutch Hub

12. Place forward clutch housing on pump delivery sleeve and air check clutch operation (Fig. 7A4-97).

DIRECT CLUTCH AND INTERMEDIATE ROLLER

Disassemble

1. Remove intermediate clutch retainer snap ring and retainer (Fig. 7A4-98).

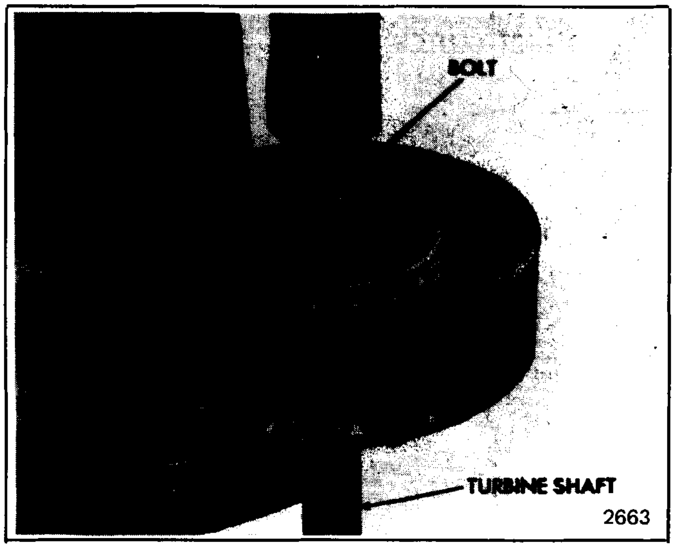


Fig. 7A4-91 Pressing Turbine Shaft From Clutch Housing

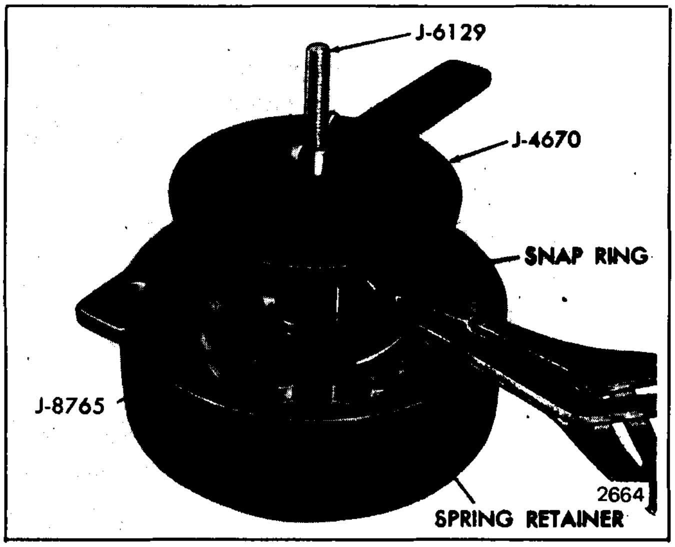


Fig. 7A4-92 Removing or Installing Spring Retainer Shap Ring

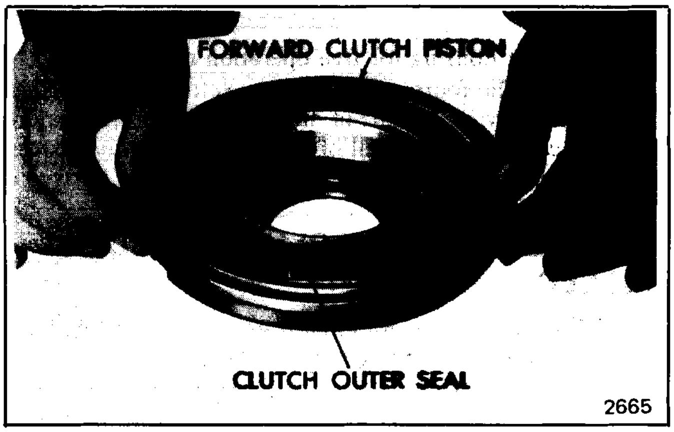


Fig. 7A4-93 Removing or Installing Clutch Piston Seals

2. Remove clutch outer race and roller assembly.

3. Turn unit over and remove backing plate-to-direct clutch housing snap ring (Fig. 7A4-99).

4. Remove the direct clutch backing plate.

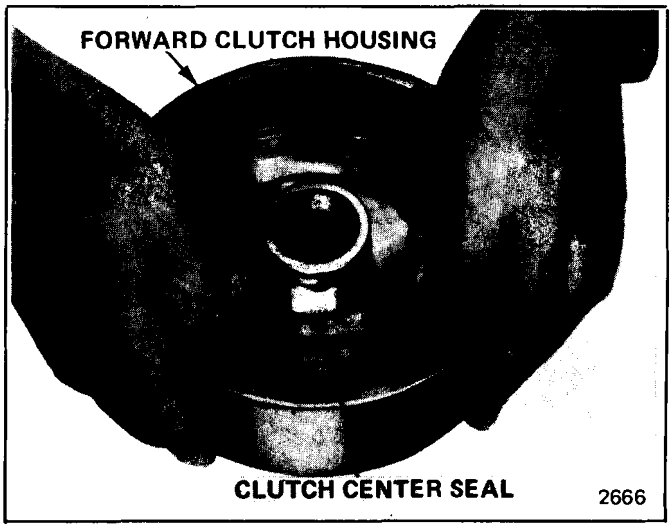


Fig. 7A4-94 Removing or Installing Clutch Housing Center Seal

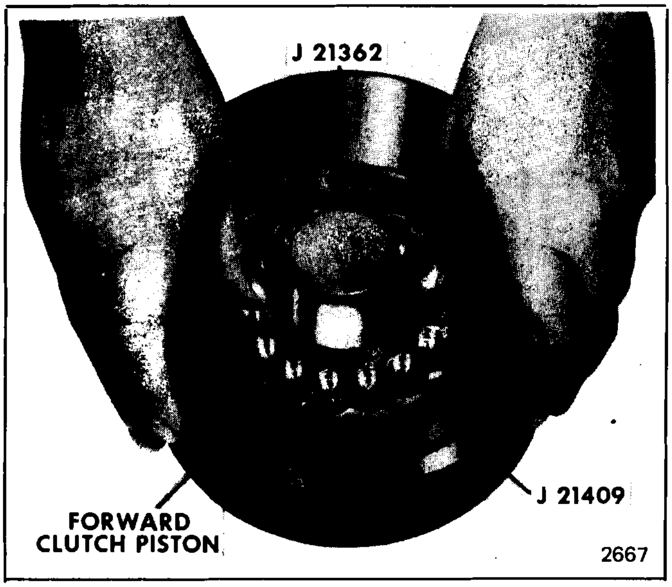


Fig. 7A4-95 Installing Forward Clutch Piston

5. (Models PC, PD and OC) - Remove five (5) composition-faced and five (5) flat steel clutch plates from the direct clutch housing (Fig. 7A4-100).

(Models PA, PB and OB) - Remove four (4) composition-faced and four (4) flat steel clutch plates from the direct clutch housing (Fig. 7A4-100).

6. Using Compressors J 4670, J 6129 and Ring J 8766, compress spring retainer and remove snap ring (Fig. 7A4-101).

7. Remove retainer and fourteen (14) piston release springs.

CAUTION: *Keep piston release springs separate from forward clutch release springs.*

8. Remove direct clutch piston (Fig. 7A4-102).

NOTE: The production built transmissions use a direct clutch piston without a check ball. The forward and direct clutch pistons look almost the same. Make sure the direct clutch piston is identified during disassembly so it will be re-assembled into the direct clutch housing. The service replacement direct clutch piston contains a

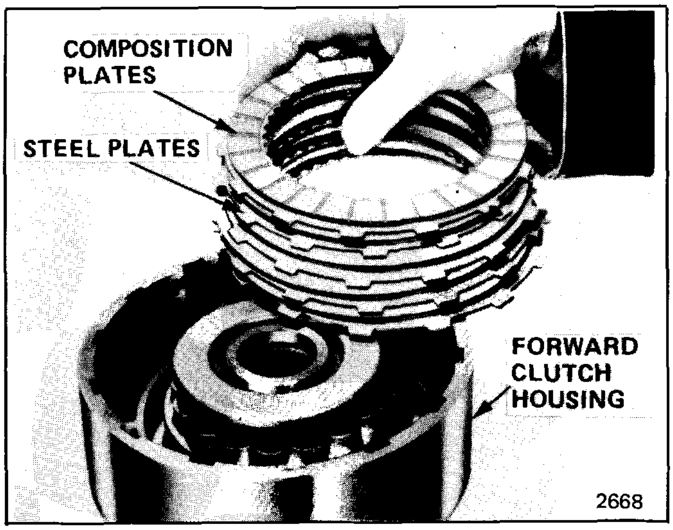


Fig. 7A4-96 Installing Forward Clutch Pack

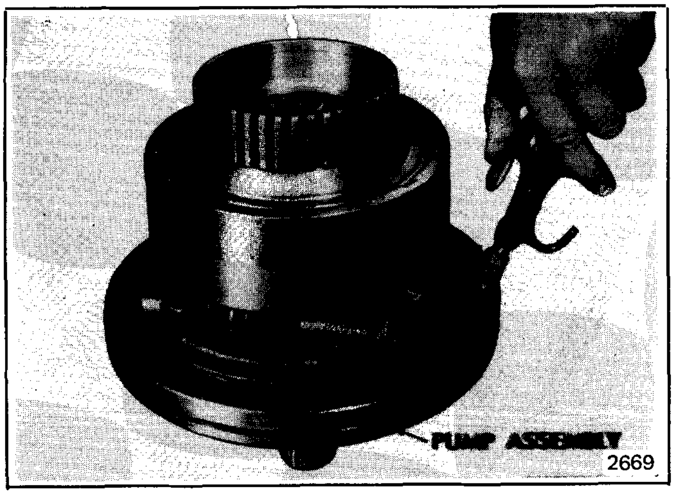


Fig. 7A4-97 Air Checking Forward Clutch

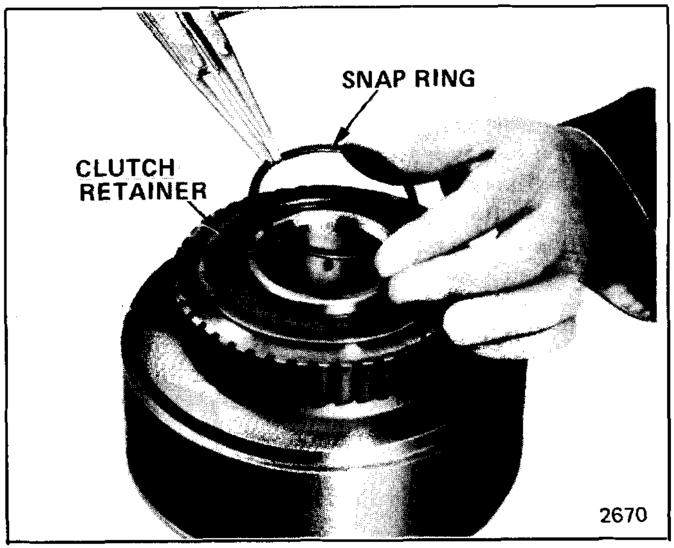


Fig. 7A4-98 Removing or Installing Clutch Retainer Snap Ring

check ball.

NOTE: The production built direct clutch piston will be aluminum or stamped steel.

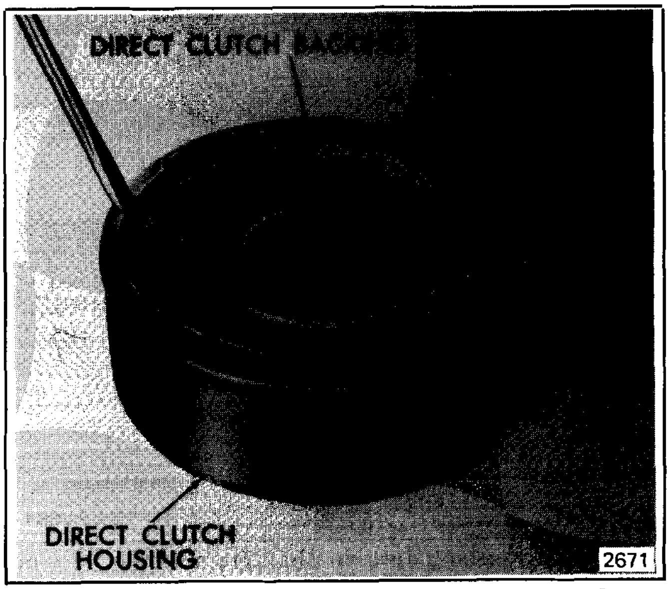


Fig. 7A4-99 Removing or Installing Backing Plate Snap Ring

9. Remove outer seal from piston.
10. Remove inner seal from piston.
11. Remove center piston seal from direct clutch housing.

INSPECT DIRECT CLUTCH AND ROLLER

1. Inspect roller assembly for popped or loose rollers.
2. Inspect inner cam and outer race for scratches or wear.
3. Inspect clutch housing for cracks, wear, proper opening of oil passages or wear on clutch plate drive lugs.
4. Inspect composition faced and steel clutch plates for sign of wear or burning.
5. Inspect backing plate for scratches or other damage.
6. Inspect clutch piston for cracks.
7. Inspect springs for collapsed coils or signs of distortion.
8. Inspect housing for free operation of check ball.

NOTE: The fourteen (14) direct clutch release springs are not serviced. If one of more of these springs require replacement, discard all of them and install the sixteen (16) service direct clutch springs.

ASSEMBLE DIRECT CLUTCH AND ROLLER

1. Install a new inner clutch piston seal on piston, with lip facing away from spring pockets (Fig. 7A4-104).

NOTE: Apply Hydra-Matic oil to all seals.

2. Install a new outer clutch piston seal with lip facing away from spring pockets (Fig. 7A4-105).

CAUTION: *Production built transmissions use a direct clutch housing with a check ball (Fig. 7A4-106). If the housing requires replacement and the replacement housing does not contain a check ball, replace the direct clutch piston with the service piston which has a check ball. EITHER THE DIRECT CLUTCH HOUSING AND/OR THE*

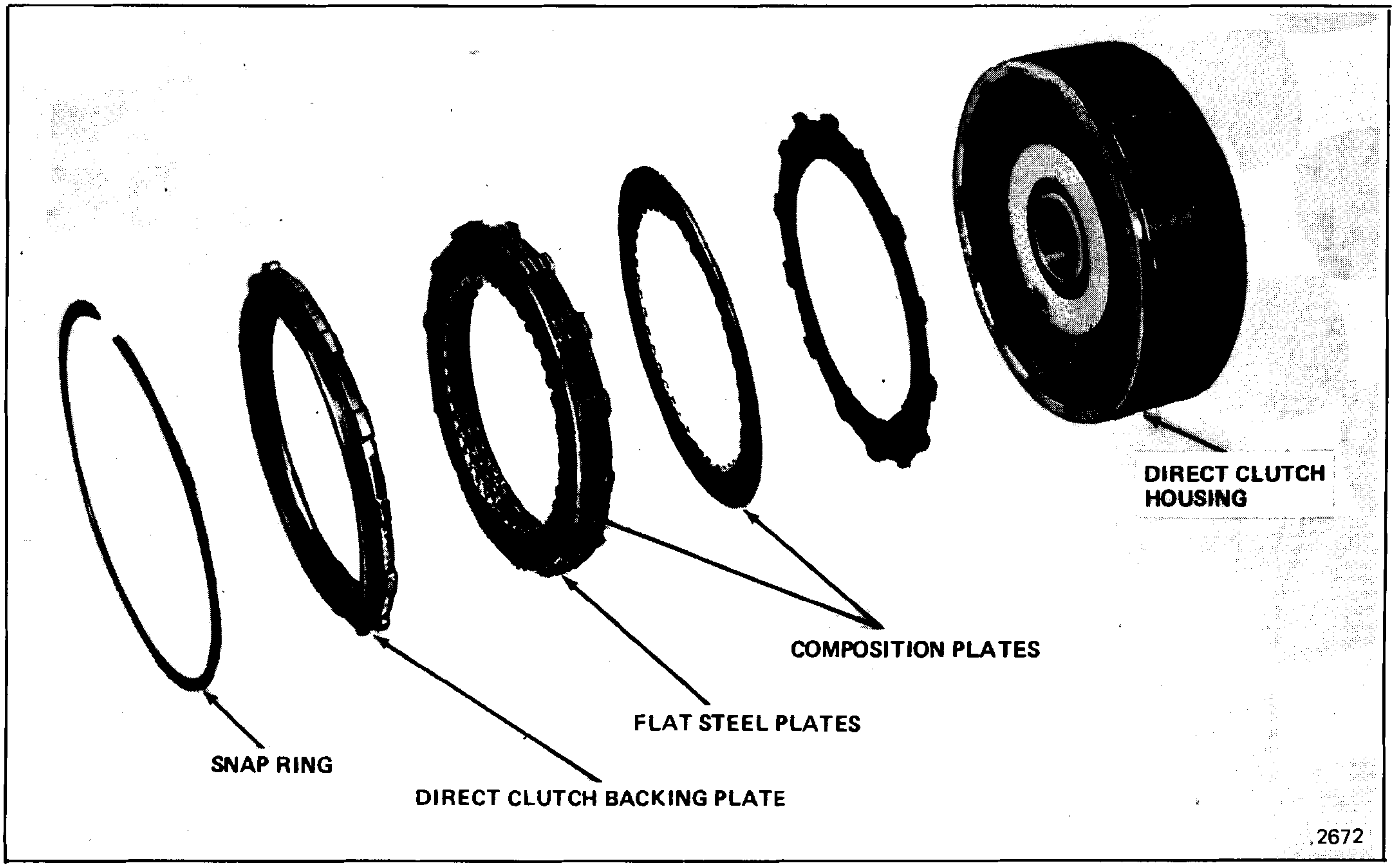


Fig. 7A4-100 Direct Clutch Pack - Exploded View

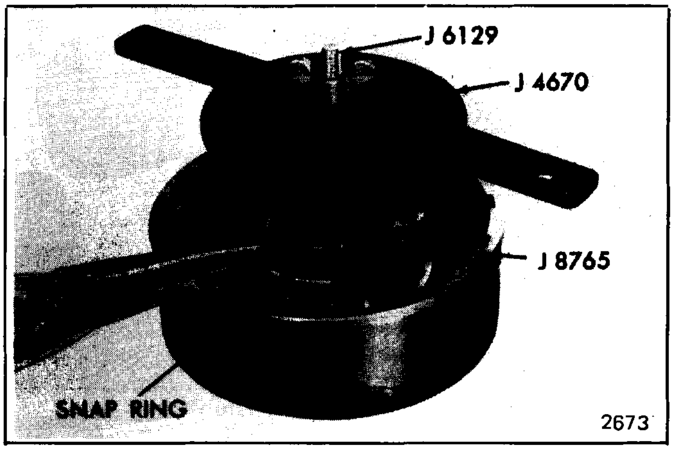


Fig. 7A4-101 Removing or Installing Clutch Piston Snap Ring

PISTON MUST CONTAIN A CHECK BALL(S).

3. Install a new clutch center seal on hub of direct clutch housing with lip of seal facing up (Fig. 7A4-107).

4. Place seal protectors, J 21362 Inner and J 21409 Outer, over hub and clutch housing and install clutch piston with a rotating motion (Fig. 7A4-108).

5. Install fourteen (14) clutch release springs into spring pockets in clutch piston, leaving two pockets diametrically opposite with no springs.

NOTE: The fourteen (14) direct clutch release springs are not serviced. If one or more of these springs require replacement, discard all of them and install the sixteen (16) service direct clutch springs.

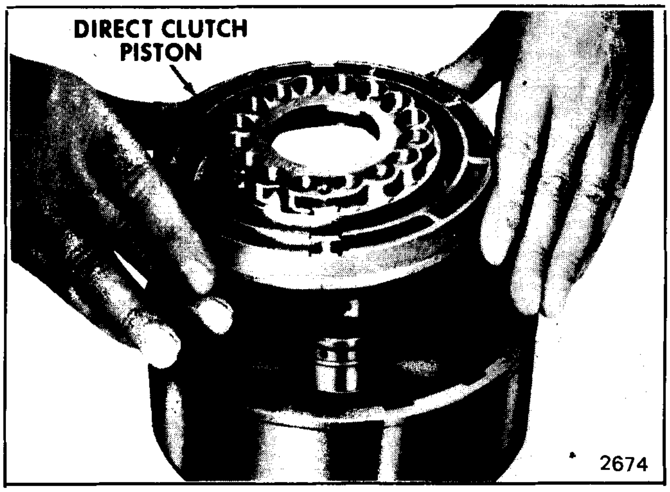


Fig. 7A4-102 Removing Direct Clutch Piston

6. Place spring retainer and snap ring on retainer.

7. Using Compressors J 4670, J 6129 and Ring J 8765, install snap ring (Fig. 7A4-101).

8. Install direct clutch plates into direct clutch housing as follows:

a. (Models PC, PD and OC) - Oil and install five (5) composition-faced and five (5) flat steel clutch plates, starting with a flat steel and alternating composition-faced and flat steel clutch plates.

b. (Models PA, PB and OB) - Oil and install four (4) composition-faced and four (4) flat steel clutch plates, starting with a flat steel and alternating composition-faced

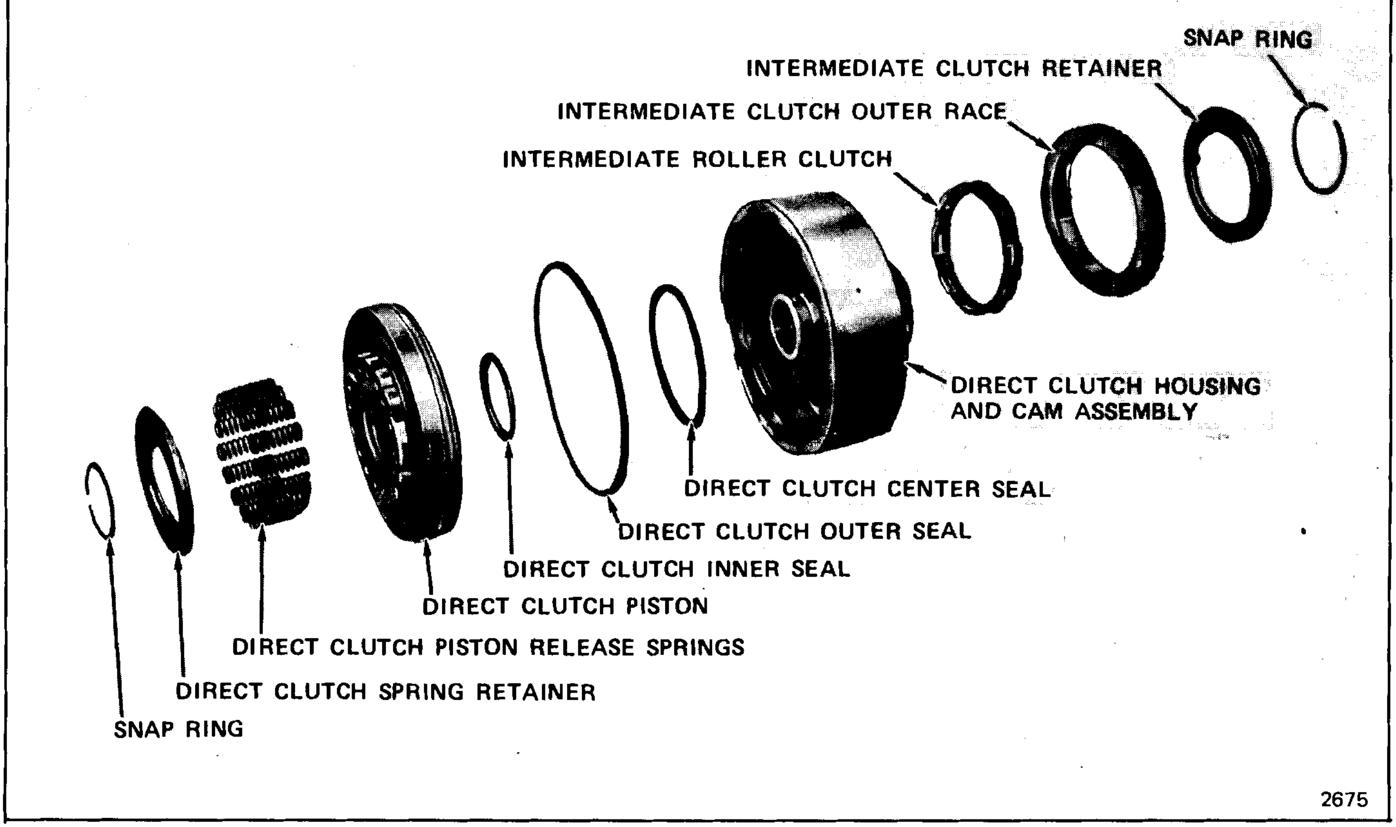


FIG. 7A4-103 DIRECT CLUTCH AND INTERMEDIATE ROLLER ASSEMBLY - EXPLODED VIEW

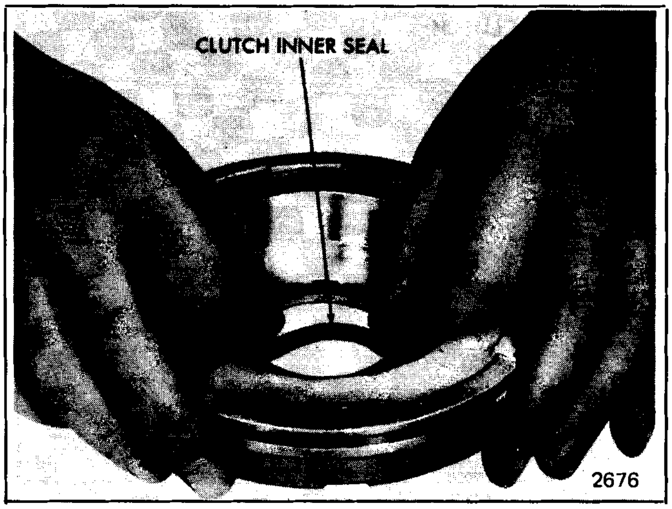


Fig. 7A4-104 Installing Clutch Piston Inner Seal

and flat steel clutch plates.

NOTE: All the direct clutch flat steel clutch plates are the thick (.0915") type.

CAUTION: *Do not use radial groove composition plates here.*

9. Install direct clutch backing plate.

10. Install backing plate snap ring (Fig. 7A4-100).

11. Install rollers that may have come out of the roller cage by compressing the energizing spring with forefinger and inserting the roller from the outer side.

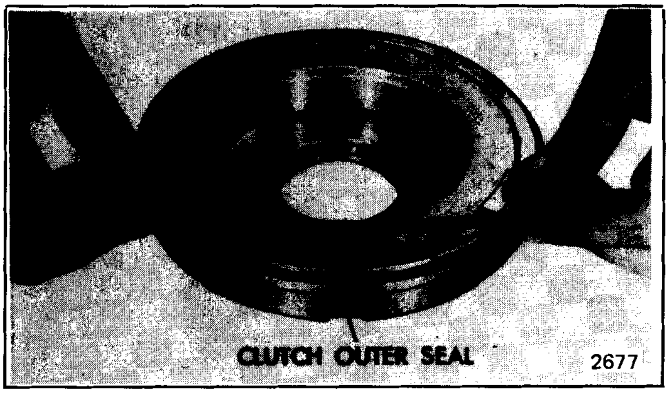


Fig. 7A4-105 Installing Clutch Piston Outer Seal

12. Turn unit over and install the roller clutch assembly onto the intermediate clutch inner cam (Fig. 7A4-109).

13. Install the intermediate clutch outer race with clockwise turning motion (Fig. 7A4-110).

14. Install clutch retainer and snap ring (Fig. 7A4-111).

15. Place direct clutch assembly over center support and air check operation of direct clutch (Fig. 7A4-112).

NOTE: If air is applied through reverse passage (right oil feed hole), it will escape from direct clutch passage (left oil feed hole). This is considered normal. Applying air through direct clutch passage (left oil feed hole) will activate piston and move direct clutch piston.

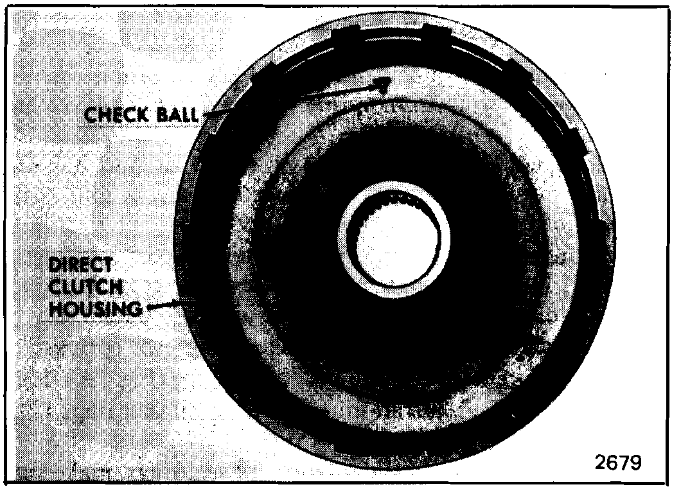


Fig. 7A4-106 Direct Clutch Housing

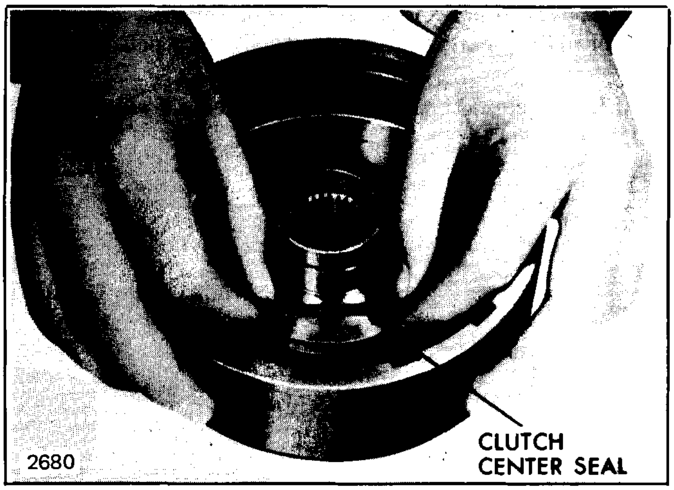


Fig. 7A4-107 Installing Direct Clutch Center Seal

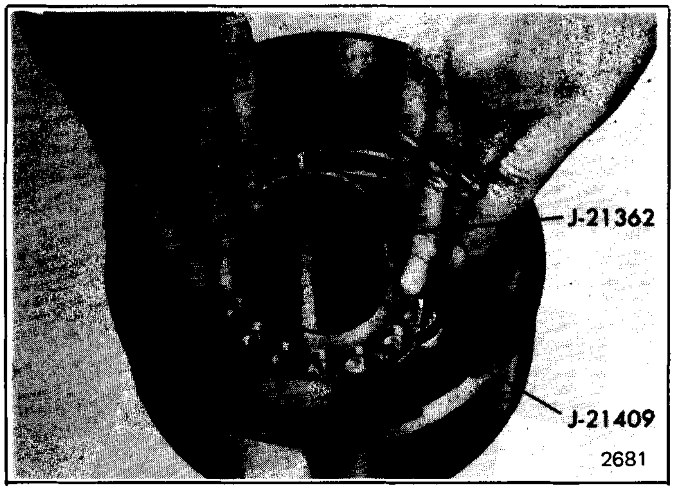


Fig. 7A4-108 Installing Direct Clutch Piston

CENTER SUPPORT

Disassemble (Fig. 7A4-113)

1. Check condition of the four oil seal rings and remove from the center support if necessary.

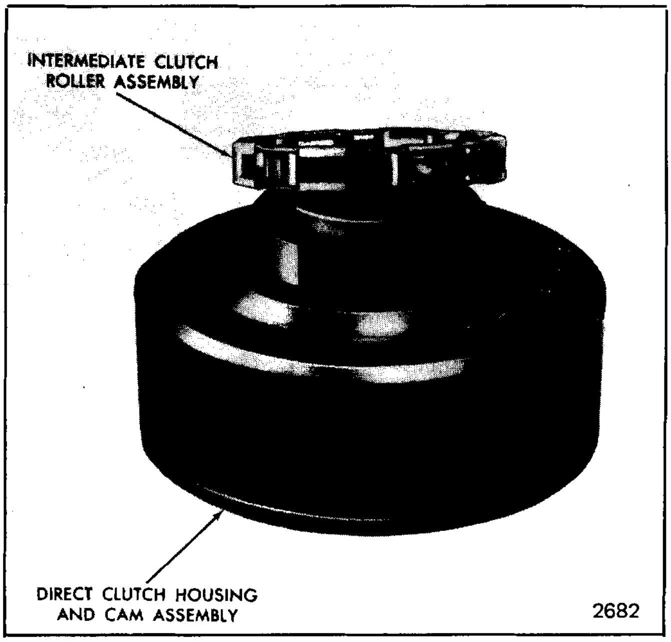


Fig. 7A4-109 Installing Intermediate Roller Assembly

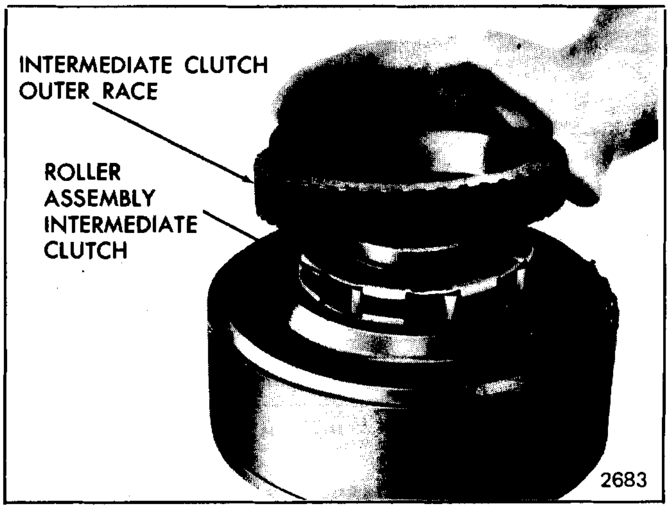


Fig. 7A4-110 Installing Outer Race

2. Using your fingers, compress spring retainer and remove snap ring (Fig. 7A4-114).

3. Remove spring retainer and three (3) clutch release springs.

4. Remove clutch release spring guide (Fig. 7A4-115).

5. Remove intermediate clutch piston (Fig. 7A4-116).

6. Remove inner and outer piston seal.

NOTE: Do not remove three (3) screws retaining roller clutch inner race to center support.

Inspect Center Support

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open.

NOTE: Be sure constant bleed plug orifice (approx. .020 dia.) is open (Fig. 7A4-54).

2. Inspect bushing for scoring, wear or galling. If replacement is necessary, proceed as follows:

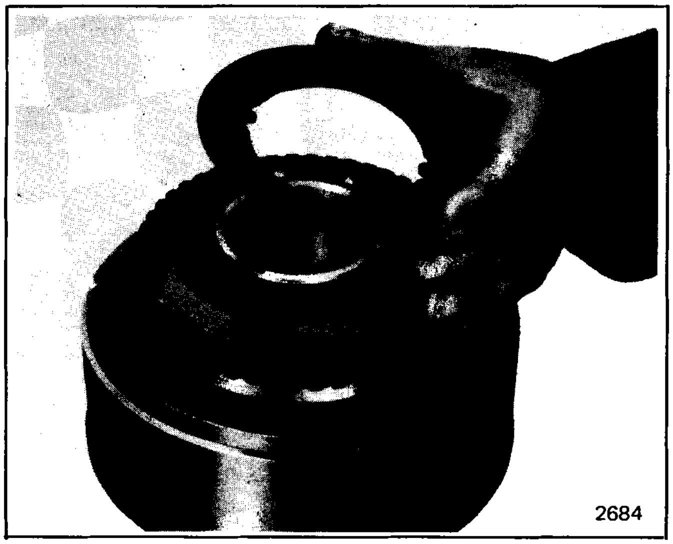


Fig. 7A4-111 Installing Clutch Retainer

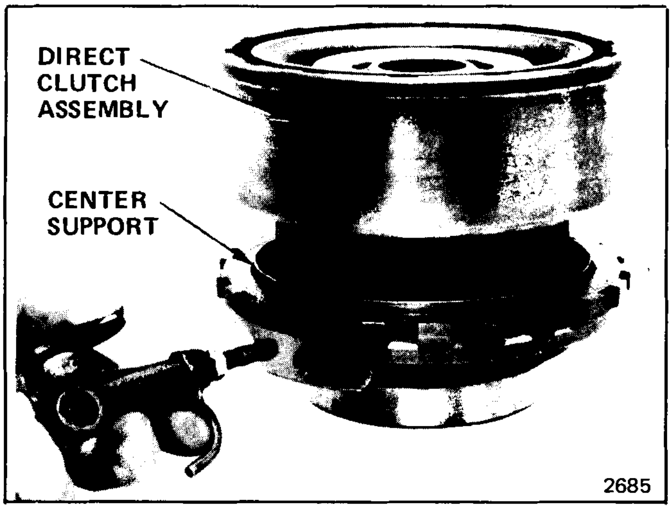


Fig. 7A4-112 Air Checking Direct Clutch

a. Using Remover J 21465-6 with Handle J 8092, remove bushing.

b. From front side of center support, align the elongated slot in bushing with the drilled hole in the oil delivery sleeve closest to piston.

c. Using Tool J 21465-6 and Handle J 8092, drive bushing squarely into the bore until bushing is flush to .010" below top of oil delivery sleeve.

3. Check oil seal rings and ring grooves in the center support tower for damage.

4. Air check oil passages to be sure they are not interconnected.

5. Inspect piston sealing surfaces for scratches.

6. Inspect piston seal grooves for nicks or other damage.

7. Inspect piston for cracks or porosity.

8. Inspect release springs for distortion.

9. Inspect support-to-case spacer for burrs or raised edges. If present, remove with a stone or fine sand paper.

Assemble Center Support

1. Install new inner and outer seals on piston with lip of seal facing away from spring pocket (Figs. 7A4-117 and 118).

2. Install Protector J 21363 on center support hub and install piston, indexing spring pockets of piston into cored areas of center support (Fig. 7A4-119).

3. Install spring guide into center support and install three (3) release springs into holes of spring guide. Space equally during assembly (Fig. 7A4-120).

4. Place spring retainer and snap ring over springs.

5. Compress springs and install snap ring (Fig. 7A4-114).

6. If removed, install four (4) teflon oil seal rings (Fig. 7A4-113).

NOTE: When installing teflon oil seal rings, make sure slit ends are assembled in same relation as cut (Fig. 7A4-86). Also, make sure oil seal rings are seated in ring grooves to prevent damage to rings during re-assembly of mating parts over rings. Retain with petrolatum.

7. Air check operation of intermediate clutch piston (Fig. 7A4-121).

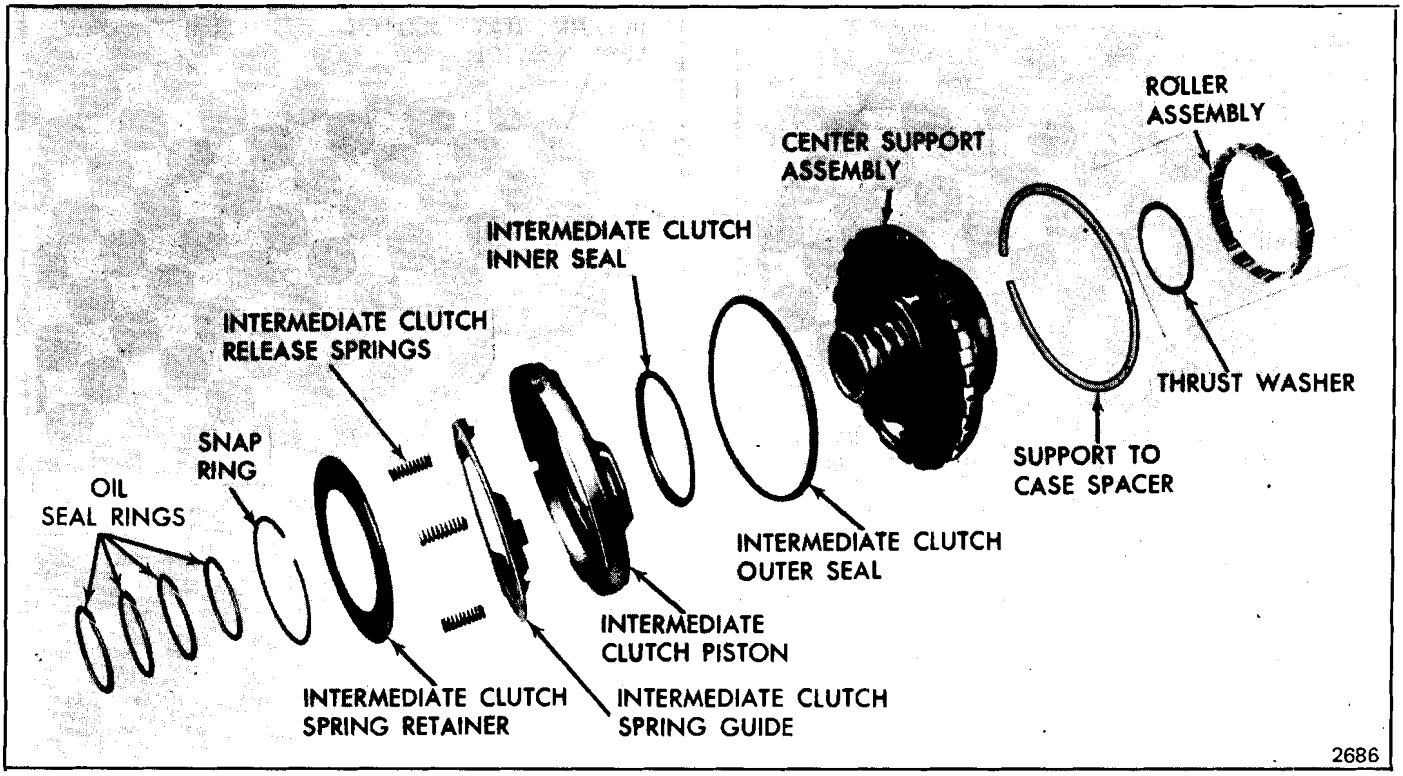


Fig. 7A4-113 Center Support Assembly - Exploded View

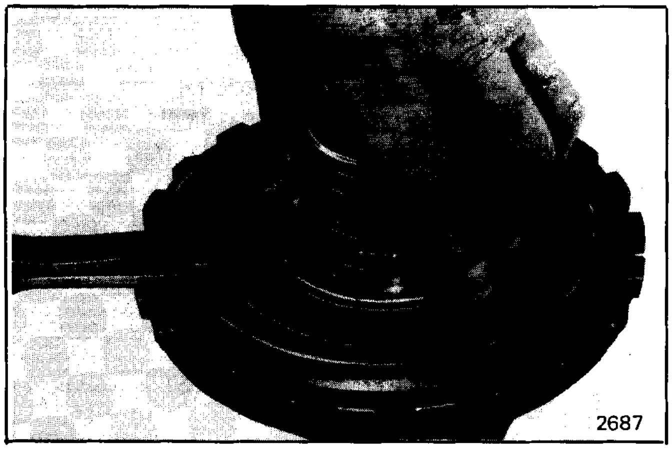


Fig. 7A4-114 Compressing Spring Retainer

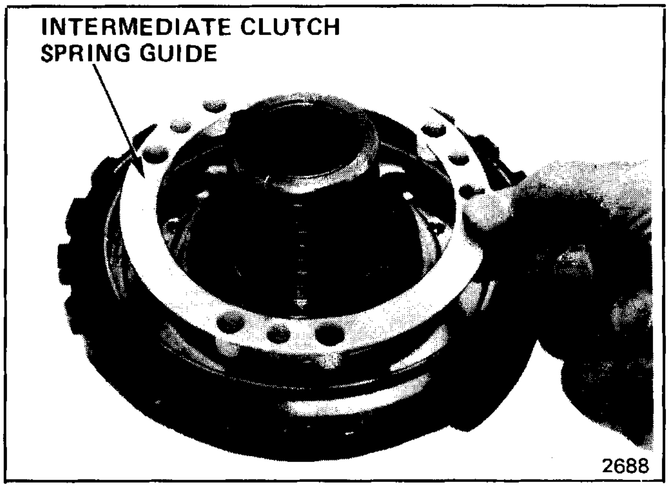


Fig. 7A4-115 Removing Clutch Spring Guide

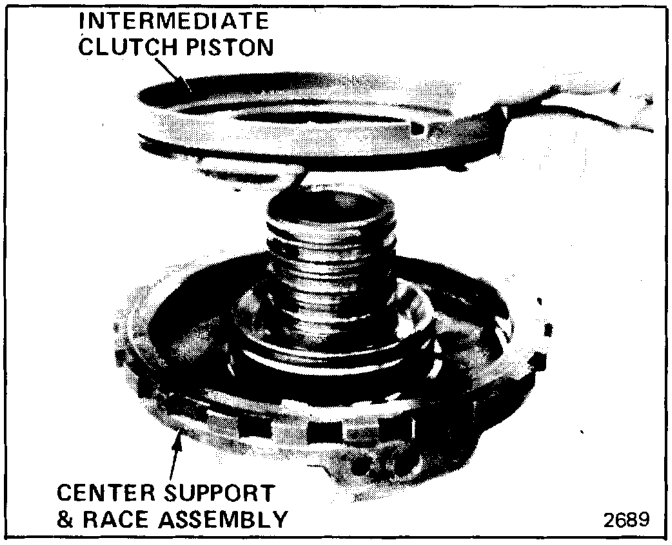


Fig. 7A4-116 Removing Intermediate Clutch Piston

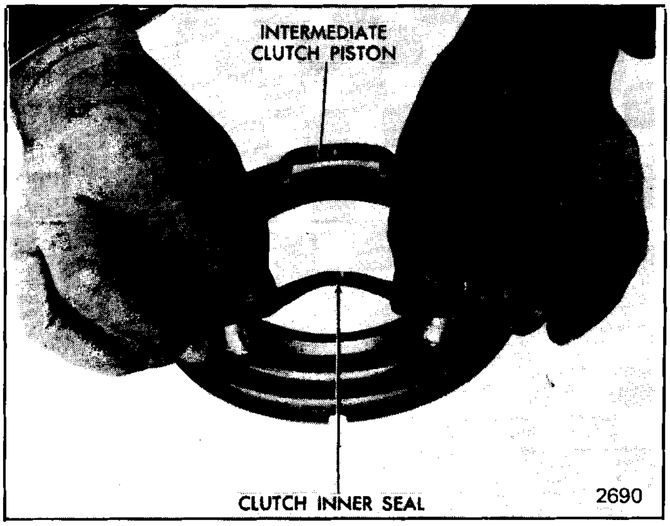


Fig. 7A4-117 Installing Clutch Piston Inner Seal

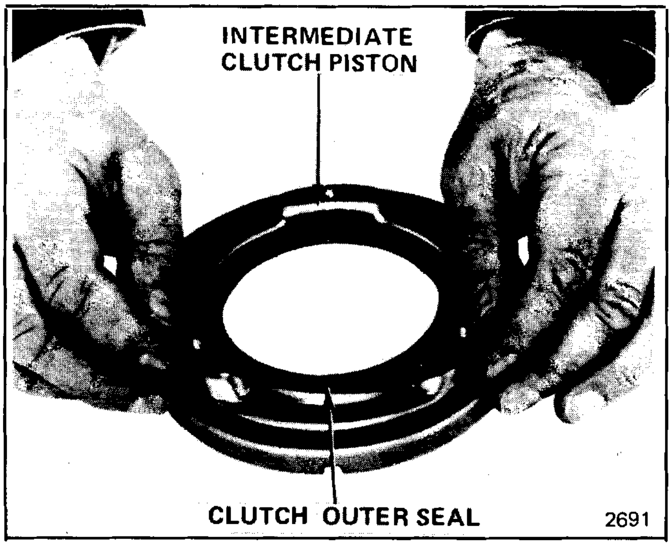


Fig. 7A4-118 Installing Clutch Piston Outer Seal

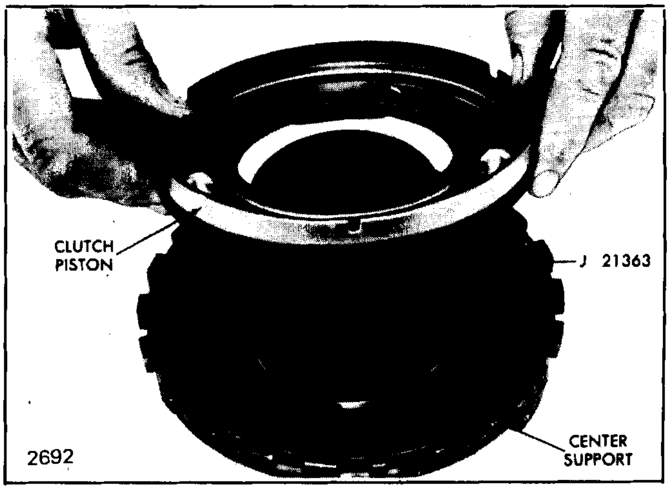


Fig. 7A4-119 Installing Intermediate Clutch Piston

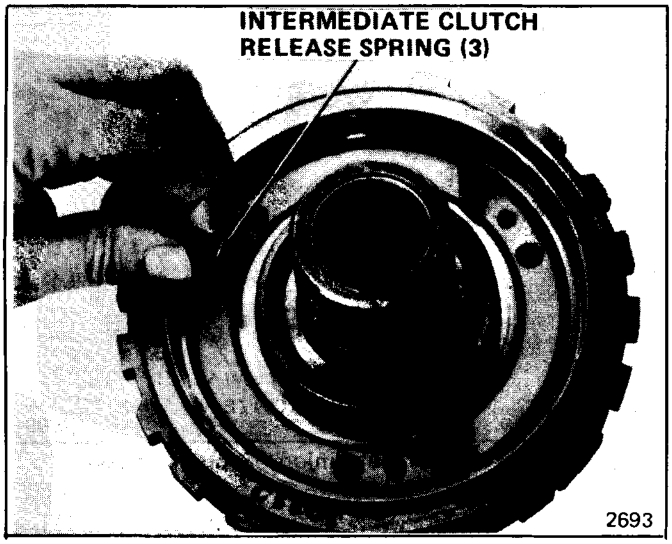


Fig. 7A4-120 Installing Clutch Release Springs

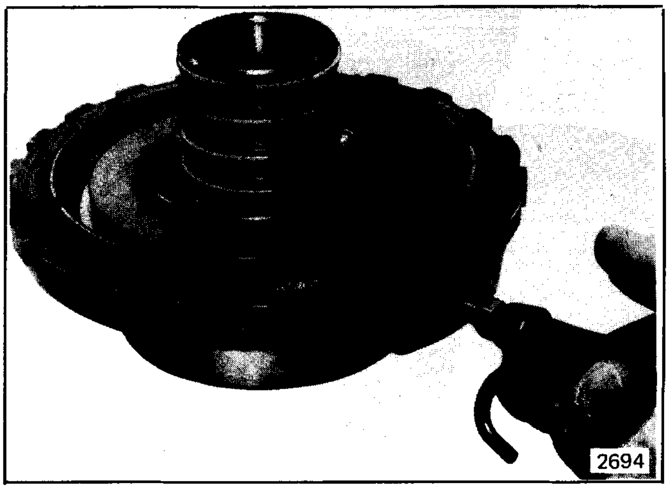


Fig. 7A4-121 Air Checking Intermediate Clutch Piston

INSPECTION OF MAJOR UNITS

REACTION CARRIER, ROLLER CLUTCH AND OUTPUT CARRIER ASSEMBLY

1. Inspect band surface on reaction carrier for signs of burning or scoring.
2. Inspect roller clutch outer race for scoring or wear.
3. Inspect thrust washer surfaces for signs of scoring or wear.
4. Inspect bushing for damage. If bushing is damaged, reaction carrier must be replaced.
5. Inspect reaction carrier pinions for damage, rough bearings or excessive tilt.
6. Check reaction carrier pinion end play. Should be .009"-.024" (Fig. 7A4-122).
7. Inspect roller clutch for damaged members.
8. Inspect roller clutch cage for damage.
9. If the reaction carrier has a spacer ring in an undercut at the bottom of the roller cam ramps, inspect it for damage (Fig. 7A4-123).

   NOTE: The reaction carrier with the undercut and spacer ring is used optionally and interchangeably with the reaction carrier which does not have an undercut and spacer ring.
10. Inspect front internal gear (output carrier) for damaged teeth.
11. Inspect output carrier pinions for damage, rough bearings or excessive tilt.
12. Check output carrier pinion end play. Should be .009"-.024" (Fig. 7A4-124).
13. Inspect parking pawl lugs for cracks or damage.
14. Inspect output locating splines for damage.
15. Inspect front internal gear ring for flaking.

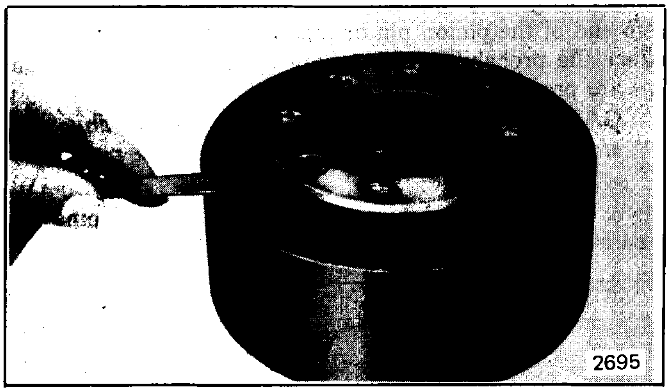


Fig. 7A4-122 Checking Reaction Carrier Pinion End Play

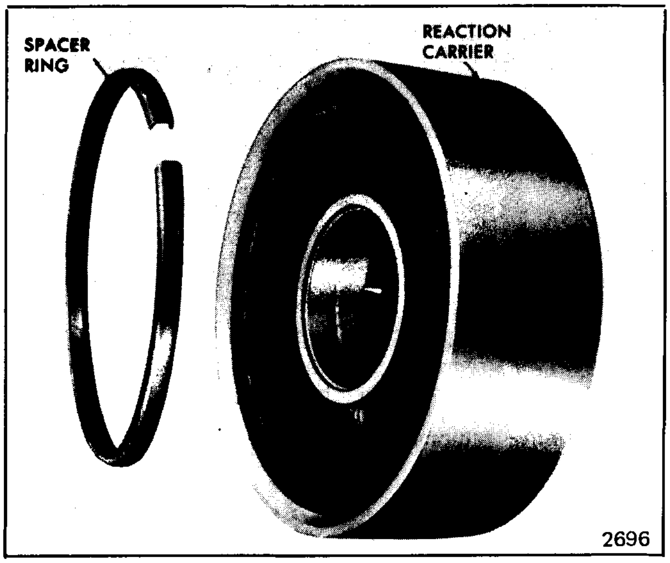


Fig. 7A4-123 Spacer Ring - Reaction Carrier

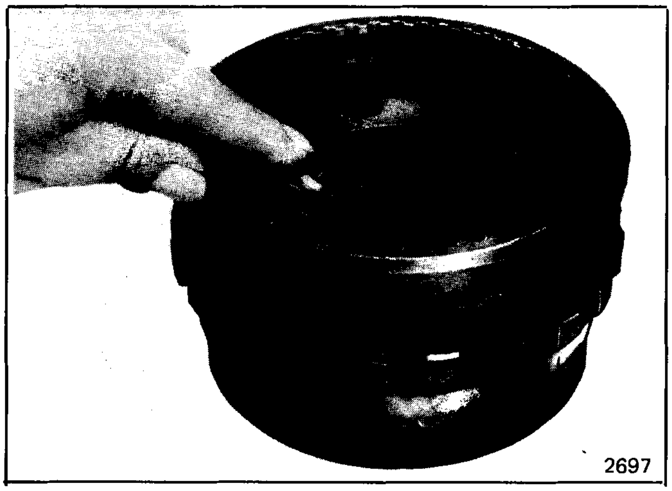


Fig. 7A4-124 Checking Output Carrier Pinion End Play

PINION REPLACEMENT PROCEDURE

1. Support carrier assembly on its front face.

2. Using a 1/2" diameter drill, eliminate the stake marks from end of the pinion pin or pins to be replaced. This will reduce the probability of cracking the carrier when pinion pins are pressed out.

CAUTION: *Do not allow drill to remove any stock from the carrier as this will weaken the part.*

3. Using a tapered punch, drive or press pinion pins out of carrier (Fig. 7A4-125).

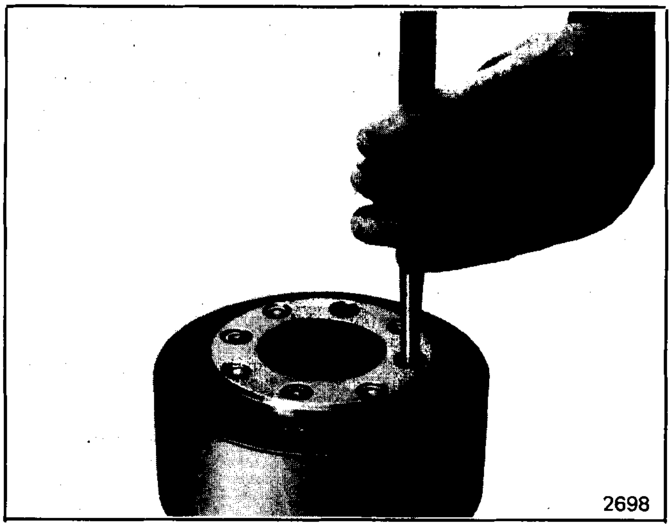


Fig. 7A4-125 Driving Pinion Pin From Carrier (Reaction Carrier Shown)

4. Remove pinions, thrust washers and roller needle bearings.

5. Inspect pinion pocket thrust faces for burrs and remove if present.

6. Install eighteen (18) needle bearings into each pinion, using petrolatum to hold bearings in place. Use pinion pin as guide (Fig. 7A4-126).

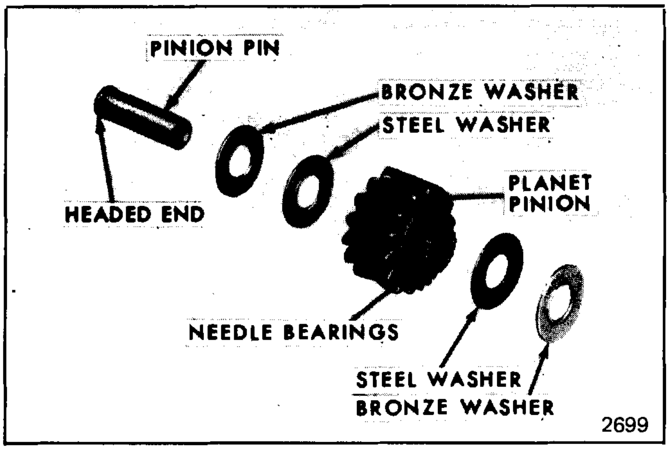


Fig. 7A4-126 Planet Pinion - Exploded View

7. Place a bronze and steel washer on each side of pinion so steel washer is against the pinion and hold them in place with petrolatum.

8. Place pinion assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.

9. Drive a new pinion pin into place while rotating its pinion from front, being sure that headed end is flush or below face of carrier (Fig. 7A4-127).

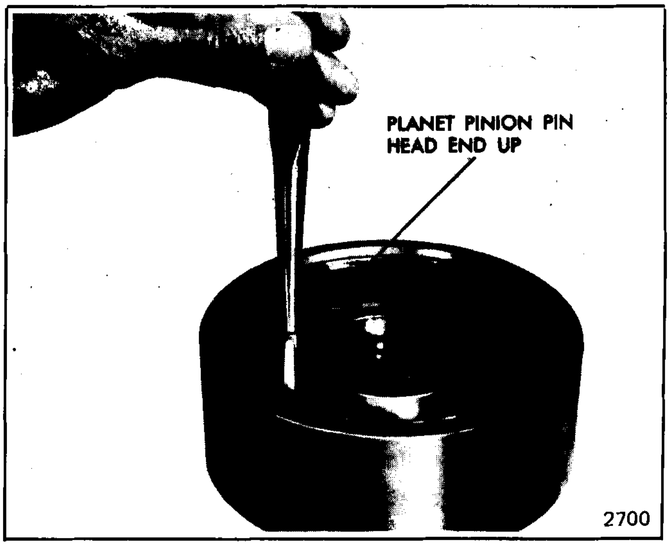


Fig. 7A4-127 Driving Pinion Pin Into Carrier (Reaction Carrier Shown)

10. Place a large punch in a bench vise to be used as an anvil while staking opposite end of pinion pin in three places.

NOTE: Both ends of pinion pins must lie below face of carrier or interference may occur.

OUTPUT SHAFT

1. Inspect bushing for wear or galling. If replacement is necessary, proceed as follows:

a. Thread Remover J 21465-16 into bushing and, using Hammer J 2619 and Adapter J 2619-4, remove bushing.

b. Using Installer J 21465-1 with Handle J 8092, install bushing into place until tool bottoms.

2. Inspect bearing and thrust washer surfaces for damage.

3. Inspect governor drive gear for rough or damaged teeth.

4. Inspect splines for damage.

5. Inspect lubrication passage.

6. Inspect drive lugs for damage.

REAR INTERNAL GEAR

1. Inspect gear teeth for damage or wear.
2. Inspect splines for damage.
3. Inspect gear for cracks.

SUN GEAR

1. Inspect gear teeth for damage or wear.
2. Inspect splines for damage.
3. Be sure oil lubrication hole is open.

SUN GEAR SHAFT

1. Inspect shaft for cracks or splits.

2. Inspect splines for damage.

3. Inspect bushings for scoring or galling. If necessary to replace, proceed as follows:

A. SUN GEAR SHAFT BUSHING, FRONT -

Remove:

With sun gear shaft properly supported, thread Remover J 21465-14 into bushing and, using Hammer J 2619 and Adaptor J 2619-4, remove bushing.

Replace:

Using Installer J 21465-5 with Handle J 8092, press or drive replacement bushing into place until tool bottoms.

B. SUN GEAR SHAFT BUSHING, REAR -

Remove:

With sun gear shaft properly supported, and using Remover J 21465-15 with Hammer J 2619, remove bushing.

Replace:

Using Installer J 21465-5 with Handle J 8092, press or drive replacement bushing into place until tool bottoms.

4. Inspect ground bushing journals for damage.

5. Be sure oil lubrication hole is open.

MAINSHAFT

1. Inspect shaft for cracks or distortion.

2. Inspect splines for damage.

3. Inspect ground bushing journals for damage.

4. Inspect snap ring groove for damage.

5. Inspect mainshaft to make sure that oil lubrication holes are open.

NOTE: If mainshaft is being replaced, remove the orificed cup plug from the service mainshaft if it contains one. This can be done by using a 1/4" diameter by 12" long rod.

FRONT AND REAR BANDS

1. Inspect lining for cracks, flaking, burning or looseness.
2. Inspect bands for cracks or distortion.
3. Inspect end for damage at anchor lugs or apply lugs.

CASE EXTENSION

1. Inspect bushing for excessive wear or damage. If replacement is necessary, proceed as follows:

a. Install Remover J 21465-17 and remove bushing.

b. Using Installer J 21465-17 with Handle J 8092, install new bushing flush to .010" below oil seal counterbore.

c. Stake bushing in place, using Staking Tool J 21465-10 in diamond area of bushing lube groove.

2. Inspect gasket mounting face for damage.

3. Inspect housing for cracks or porosity.

4. Be sure rear seal drain-back port is not obstructed.

MODULATOR AND VALVE

1. Inspect modulator assembly for any signs of bending or distortion (Fig. 7A4-128).

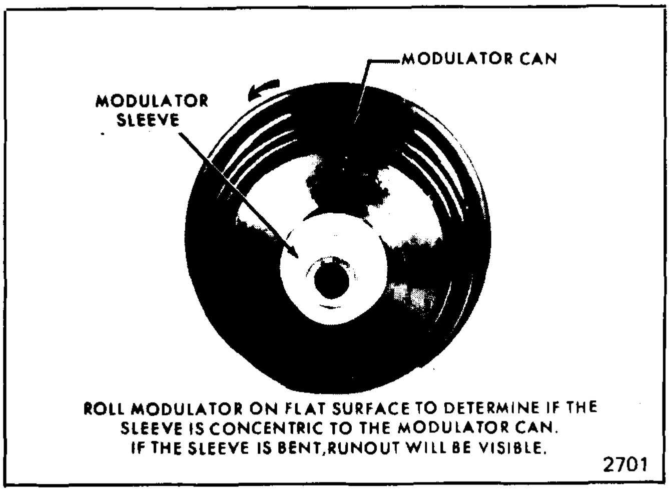


Fig. 7A4-128 Checking Concentricity of Sleeve

a. Roll main body of modulator on a flat surface and observe the sleeve for concentricity to the body.

b. If sleeve is concentric and the modulator valve is free within the sleeve,the modulator is acceptable.

2. Inspect O-ring seal seat for damage.

3. Check for vacuum diaphragm leakage as follows (Fig. 7A4-129):

a. Insert a pipe cleaner into vacuum connector pipe as far as possible and check for presence of transmission fluid.

b. If transmission fluid is found on pipe cleaner, replace the modulator.

NOTE: Gasoline or water vapor may settle in vacuum side of diaphragm. If this is found without presence of transmission fluid, modulator should not be changed.

4. Make a bellows comparison check by using the Modulator Bellows Checking Gage J 24466 and compare the load of a known good modulator of the same part number with the modulator in question, as follows:

a. Install known good modulator into one end of the gage.

b. Insert modulator in question into the opposite end of the gage and then press the two modulators together.

c. A non-conforming modulator bellows will be indicated if there is no color showing in the center groove of the gage. If the bellows of the suspected modulator is good, then there will be a color band appear in the center groove of the gage.

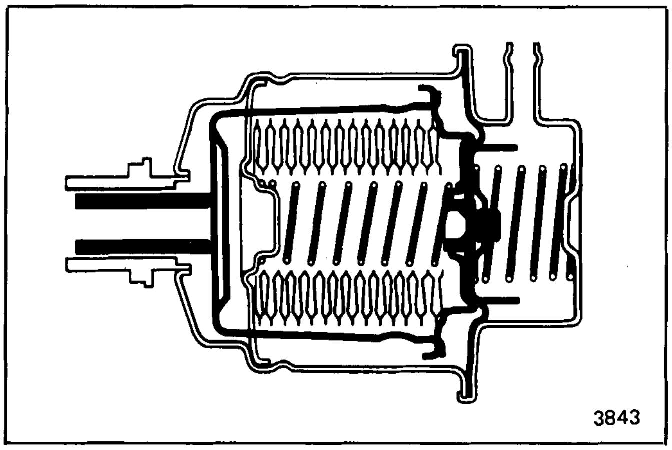


Fig. 7A4-129 Vacuum Modulator - Cross Section

5. Inspect modulator valve for nicks or damage.
6. Check freeness of valve operation in case bore.

Once the modulator assembly passes all of the above tests, it is an acceptable part and should be re-used.

MANUAL AND PARKING LINKAGE

1. Inspect parking actuator rod for cracks or broken spring retainer lugs (Fig. 7A4-130).

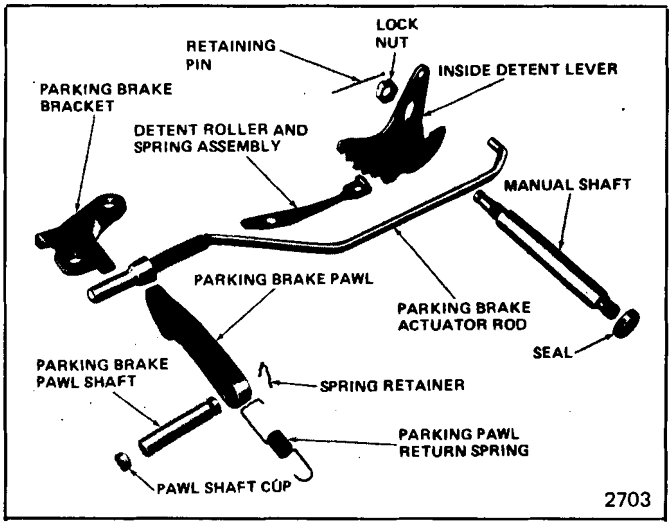


Fig. 7A4-130 Manual and Parking Linkage - Exploded View

2. Inspect actuator spring for damage.
3. Inspect actuator for free fit on actuator rod.
4. Inspect parking pawl for cracks or wear, if removed.
5. Inspect manual shaft for damaged threads or loose lever.
6. Inspect inside detent lever for cracks or a loose pin.
7. Inspect parking pawl shaft for damaged retainer groove, if removed.
8. Inspect parking pawl return spring for deformed coils or ends.
9. Inspect parking bracket for cracks or wear.
10. Inspect detent roller and spring assembly.

CASE ASSEMBLY

1. Inspect case for cracks, porosity or inter-connected passages (Figs. 7A4-131 and 132).

CAUTION: *If the case assembly requires replacement, make sure that the center support-to-case spacer is removed from the old case and reinstalled in the new case.*

NOTE: If the case assembly requires replacement, remove the nameplate from the old case and reinstall it onto the new case, using the truss head nameplate attaching screw that is serviced with the case.

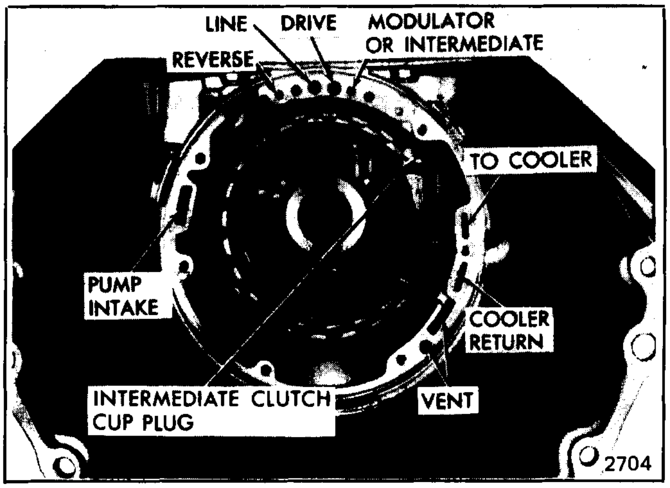


Fig. 7A4-131 Case Passages - Front View

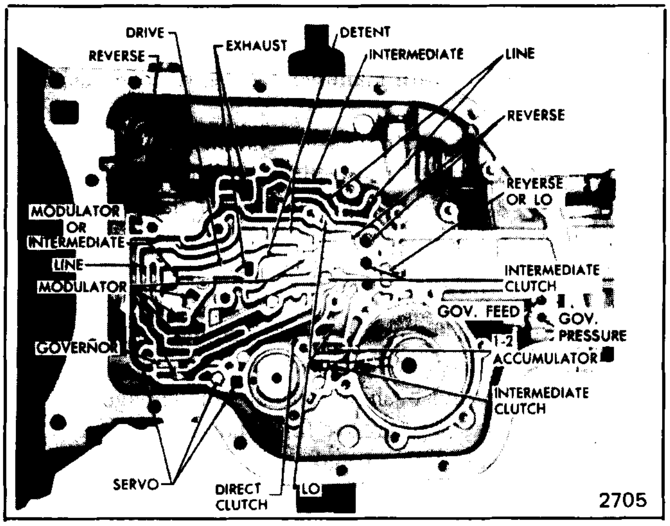


Fig. 7A4-132 Case Passages - Bottom View

2. Check for good retention of band anchor pins.

3. Inspect all threaded holes for thread damage.

4. Inspect intermediate clutch plate lugs for damage or brinneling.

5. Inspect internal case snap ring grooves for damage. If grooves are broken, it is caused by either incorrectly installed snap rings and/or spacer or by high oil pressure causing excessive forces (the usual cause of high pressure is found in the pressure regulator valve system).

6. Inspect governor assembly bore for scratches or scoring.

7. Inspect modulator valve bore for scoring or damage.

8. Inspect for missing or loose intermediate clutch cup plug (see Fig. 7A4-131 for location). If necessary to install a cup plug, proceed as follows:

a. Place transmission case in holding fixture and position with its front end facing up.

b. Make sure that the intermediate clutch cup plug hole is free of dirt, chips, etc.

c. Place intermediate clutch cup plug (Group 4.103, Part No. 8611710 or equivalent) into its passageway in the case, open end of the plug out.

d. Drive plug until flush or slightly below top of hole, using a 3/8" diameter by 10" long rod.

CAUTION: *Make certain that rod used is large enough in diameter to locate on the lip edge of the plug, not the bottom of the plug.*

9. Inspect case bushing. If necessary to replace, proceed as follows:

a. Remove - with case properly supported and using Remover J 21465-8 with Handle J 8092, remove bushing.

b. Replace - Use Installer J 21465-8, Ring J 21465-9, Handle J 8092 and Extension J 21465-13. With its lube passage facing front of case, drive the bushing into case until it is .040"-.055" above the selective thrust washer face. Stake bushing with Staking Tool J 21465-10, with stake marks in the lube grooves.

CONVERTER ASSEMBLY

1. Inspect inside of bell housing. If covered with oil, a converter leak is indicated and converter should be leak tested as follows:

a. Drain oil out of converter.

b. Install Fixture J 21369 and tighten.

c. Fill converter with 80 psi of air (Fig. 7A4-133).

d. Submerge in water and check for leaks.

2. Check converter hub surfaces for signs of roughness, scoring or wear that could damage the oil pump front seal. If roughness can be felt with a fingernail, seal could be damaged.

3. Check converter for loss of balance weight or a broken converter-to- crankshaft pilot. If balance weight is off or pilot is broken, replace the converter.

4. Check converter end play as follows:

a. Fully release collet end of Fixture J 21371-2 by turning its cap nut clockwise.

b. Install collet end of Fixture J 21371-2 into converter hub until it bottoms, then tighten its cap nut to 5 lb. ft. (Fig. 7A4-134).

c. Install Fixture J 21371-3 and tighten the hex nut to 3 lb. ft. (Fig. 7A4-135).

d. Install Indicator J 8001 and set it for "zero" while its plunger rests on the cap nut of Fixture J 21371-2.

e. Loosen hex nut while holding cap nut stationary, allowing converter internal assembly to lower, until dial indicator shows that internal assembly has bottomed (Fig. 7A4-136).

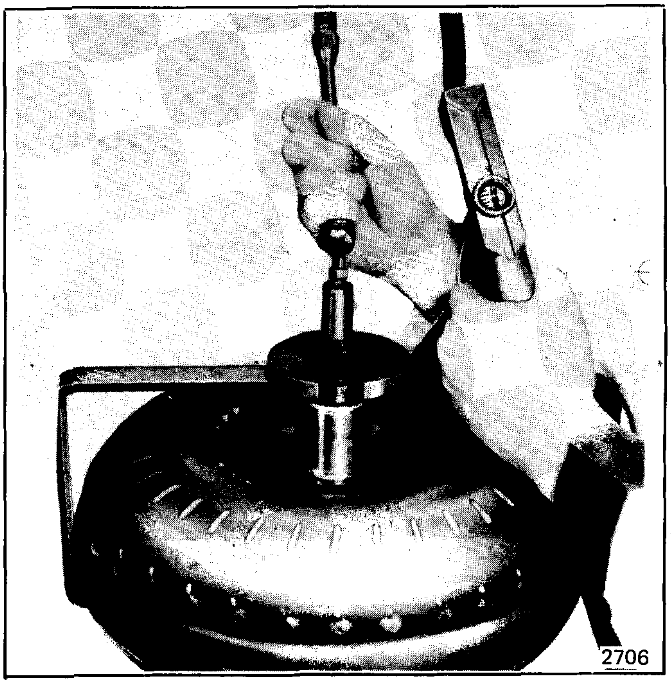


Fig. 7A4-133 Pressurizing Converter

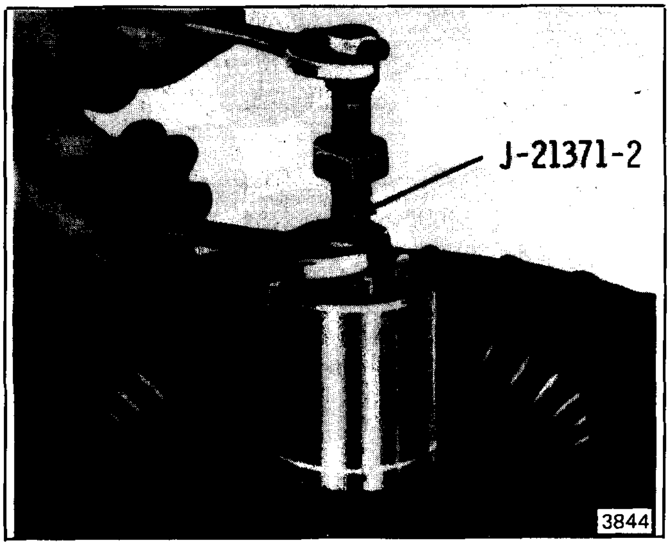


Fig. 7A4-134 Installing Fixture J-21371-2

f. The reading obtained on dial indicator represents converter end clearance. If clearance is less than .050", the converter is acceptable. If clearance is .050" or more, replace the converter.

5. If fluid in the converter has the appearance of having been mixed with "aluminum paint", converter is damaged internally and must be replaced.

6. Do not change the converter if non-conformity in some other part of the transmission has resulted in the converter containing dark, discolored fluid. The full flow filter is designed to remove all harmful residue from non-conforming parts, other than converter and/or pump non-conformities before the oil is pumped into the converter.

7. Check the converter internally for damage to its roller bearings, thrust races and the roller clutch (Fig. 7A4-137):

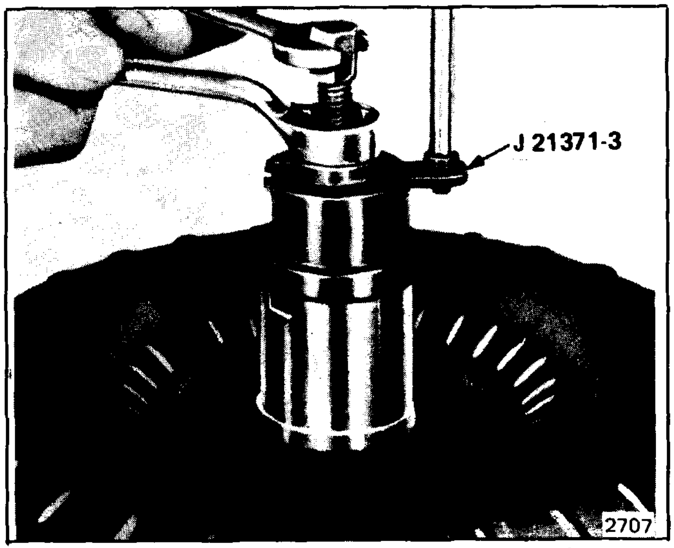


Fig. 7A4-135 Installing Fixture J-21371-3

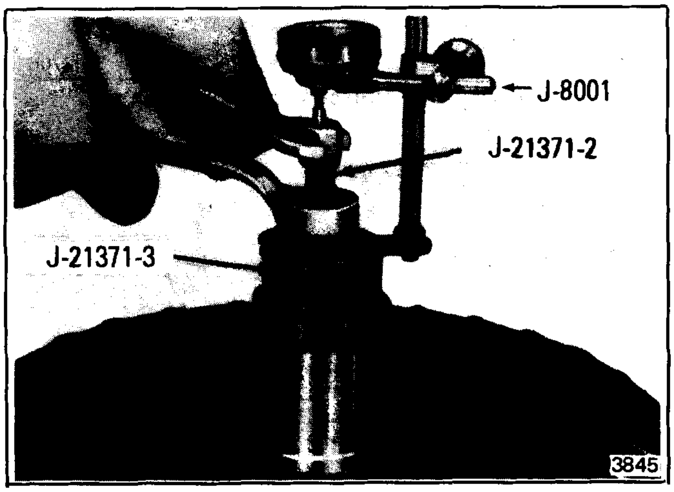


Fig. 7A4-136 Checking Converter End Play

a. The thrust roller bearings and thrust races can be checked by viewing them when looking into the converter neck or feeling through the opening to make sure they are not cracked, broken or mispositioned.

b. The stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and turn the race in both directions. The inner race should turn fairly freely in a clockwise direction and not turn or be very difficult to turn in the counterclockwise direction.

CAUTION: *Do not use items such as a pump cover or stator shaft to turn the inner race as the results may be misleading.*

8. Check for stripped converter bolt holes. If found stripped, inspect for cause (such as damaged bolt threads), heli-coil the damaged bolt holes and install new bolt(s).

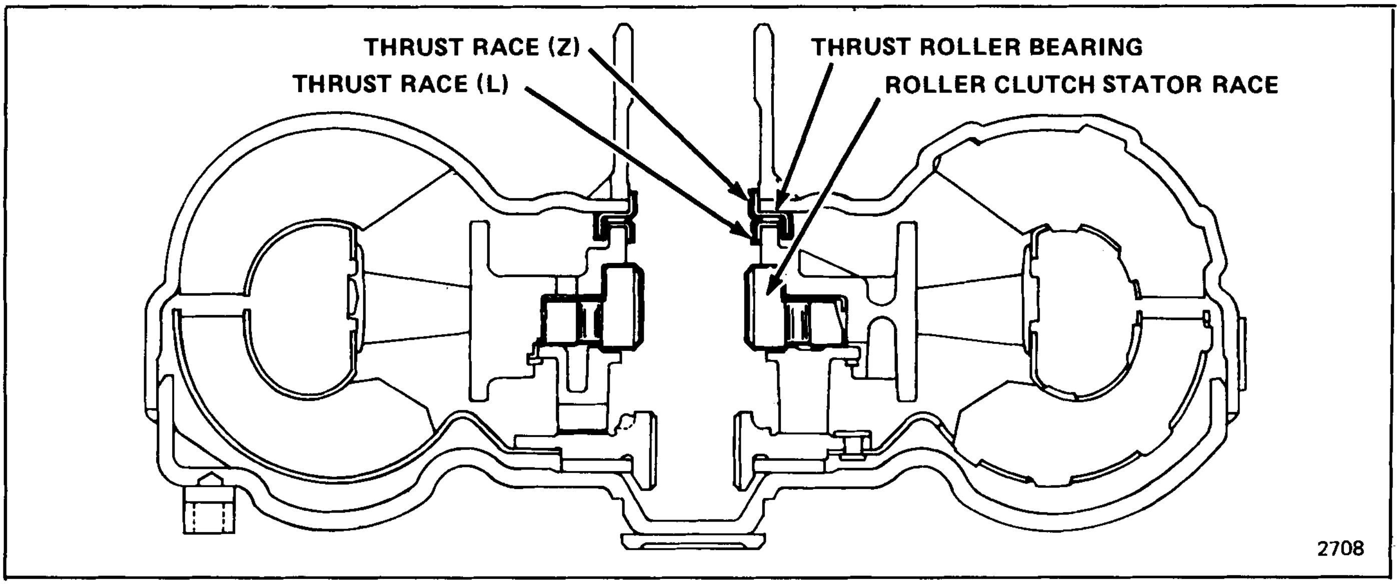


Fig. 7A4-137 Converter Assembly - Cross Section

REASSEMBLY AND INSTALLATION OF TRANSMISSION

REAR UNIT

(Fig. 7A4-138)

1. Install rear internal gear on end of main shaft.

2. Install internal gear retaining snap ring (Fig. 7A4-139).

3. Install sun gear-to-internal gear thrust races and bearings against inner face of rear internal gear, as follows, and retain with petrolatum:

a. Place large race against internal gear, with flange facing forward or up (Fig. 7A4-140).

b. Place thrust bearing against race.

c. Place small race against bearing, with inner flange facing into bearing or down.

4. Install output carrier over mainshaft so that pinions mesh with rear internal gear.

5. Place above portion of build-up through hole in bench so that mainshaft hangs downward.

6. Install rear internal gear-to-output shaft thrust races and bearings as follows and retain with petrolatum (Fig. 7A4-141):

a. Place small diameter race against internal gear, with center flange facing up.

b. Place bearing on race.

c. Place second race on bearing, with outer flange cupped over bearing.

7. Install output shaft into output carrier (Fig. 7A4-142).

8. Install output shaft-to-output carrier snap ring.

9. Turn assembly over and support so that output shaft hangs downward.

10. Install reaction carrier-to-output carrier non-metal or metal thrust washer, with tabs facing down in pockets and retain with petrolatum.

NOTE: The production built transmissions use a non-metal washer here. However, the service replacement washer is made of metal.

11. Install sun gear, splines with chamfer down.

12. Install composition gear ring over output carrier (Fig. 7A4-143).

13. Install reaction carrier (Fig. 7A4-144).

NOTE: When a new output carrier and/or reaction carrier is being installed and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the service gear ring.

14. Install sun gear shaft with long splined end down.

15. Install center support-to-sun gear thrust races and bearings, retaining with petrolatum, as follows:

a. Install large race, center flange up over sun gear shaft.

b. Install thrust bearing against race.

c. Install second race, center flange up (Fig. 7A4-145).

16. Install rollers that may have come out of the roller cage by compressing the energizing spring with forefinger and inserting roller from the outer side (Fig. 7A4-146).

17. Install roller clutch into reaction carrier outer race (Fig. 7A4-147).

18. Install center support-to-reaction carrier thrust washer into recess in center support. Retain with petrolatum (Fig. 7A4-148).

19. Install center support into reaction carrier and roller clutch assembly (Fig. 7A4-149).

NOTE: With reaction carrier held, center support should only turn counterclockwise.

20. Install Holding Tool J 21795 on gear unit to hold units in place.

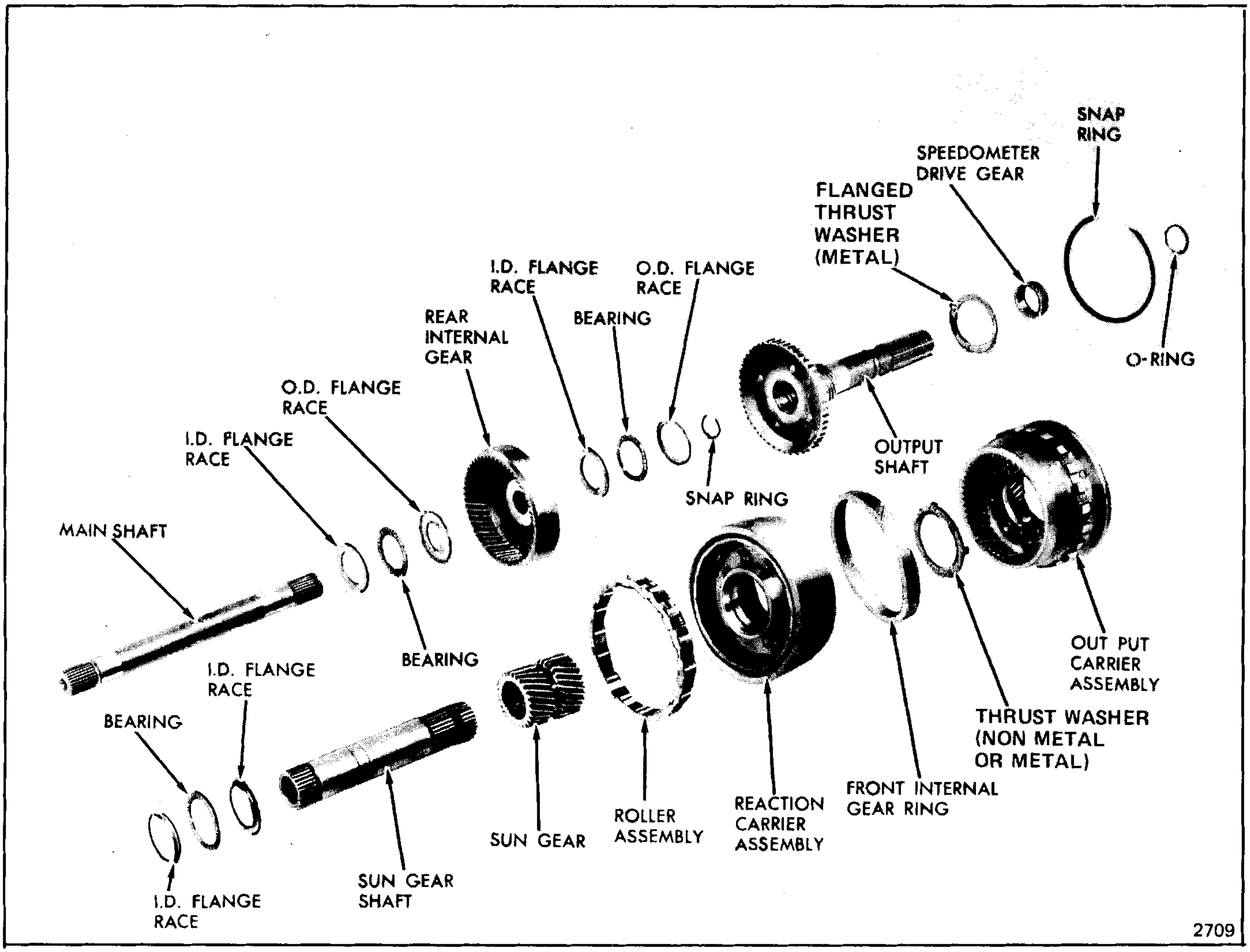


Fig. 7A4-138 Rear Unit - Exploded View

21. Install output shaft-to-case thrust washer (metal) tabs in pockets and retain with petrolatum (Fig. 7A4-150).

CAUTION: *This must be a metal washer.*

ASSEMBLY OF UNITS INTO TRANSMISSION CASE

NOTE: The first 3 steps can be omitted if the parts involved were not removed on disassembly.

1. Install parking pawl, tooth toward inside of case, and parking pawl shaft (Fig. 7A4-151).

2. Install parking pawl shaft retaining spring (Fig. 7A4-152).

3. Install new cup plug, using a 3/8" dia. rod, and drive into transmission case until parking pawl shaft bottoms on case rib (Fig. 7A4-153).

4. Install parking pawl return spring, square end hooked on pawl and other end on case (Fig. 7A4-154).

5. Install parking brake bracket guides over parking pawl, using two attaching bolts. Torque to 18 lb. ft.

6. Install rear band so that two lugs index with two anchor pins. Check to make sure band is seated on lugs (Fig. 7A4-155).

7. Install the support-to-case spacer against the shoulder at the bottom of case splines, with the ring gap adjacent to the band anchor pin (Fig. 7A4-156).

CAUTION: *Do not confuse this spacer (.040" thick and both sides flat) with either the center support-to-case snap ring (one side is beveled) or the intermediate clutch backing plate-to-case snap ring (.093" thick and both sides flat).*

8. Install proper rear selective washer (proper washer determined by previous end play check) into slots provided inside rear of transmission case.

NOTE: Dip washer in transmission oil before installation.

9. Install complete gear unit assembly into case, using Holding Tool J 21795 (Fig. 7A4-157) and making certain center support bolt hole is properly aligned with hole in case.

10. Install center support-to-case retaining snap ring, with its bevel side up and locating gap adjacent to band anchor pin. Make certain ring is properly seated in case (Fig. 7A4-158).

IMPORTANT: When properly installed, flat side of ring is against the center support.

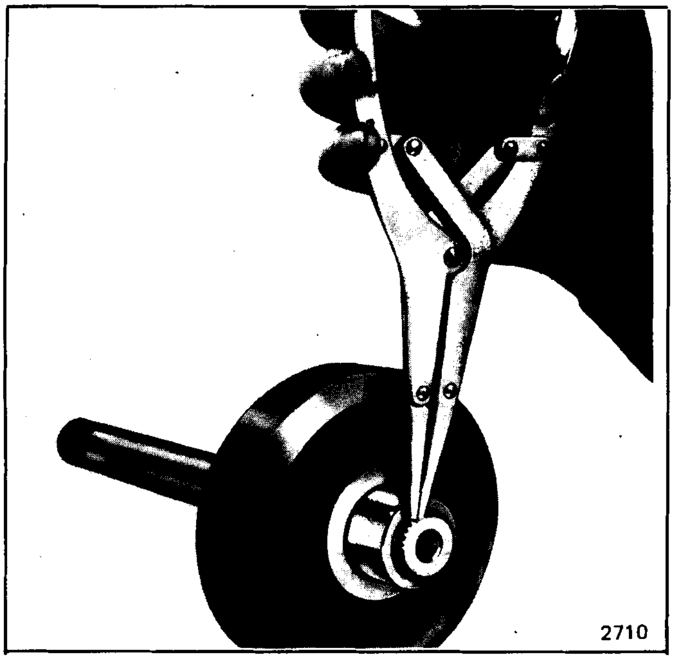


Fig. 7A4-139 Installing Mainshaft Snap Ring

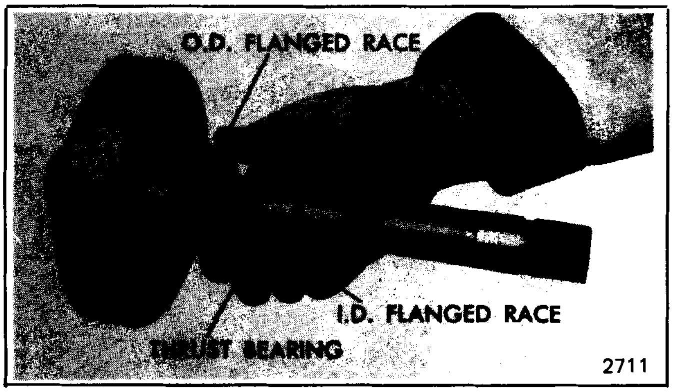


Fig. 7A4-140 Installing Bearing and Races

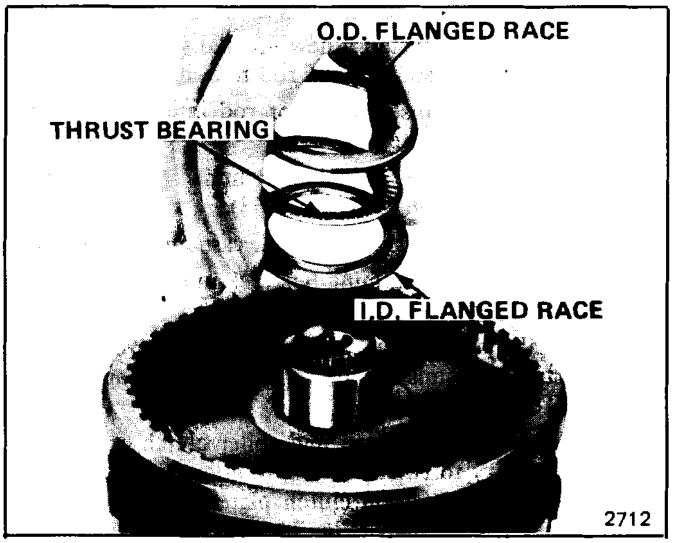


Fig. 7A4-141 Installing Bearing and Races on Rear Internal Gear

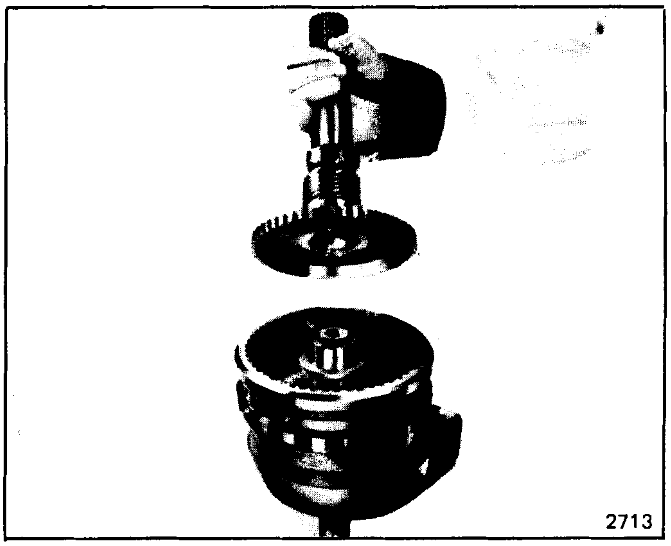


Fig. 7A4-142 Installing Output Shaft

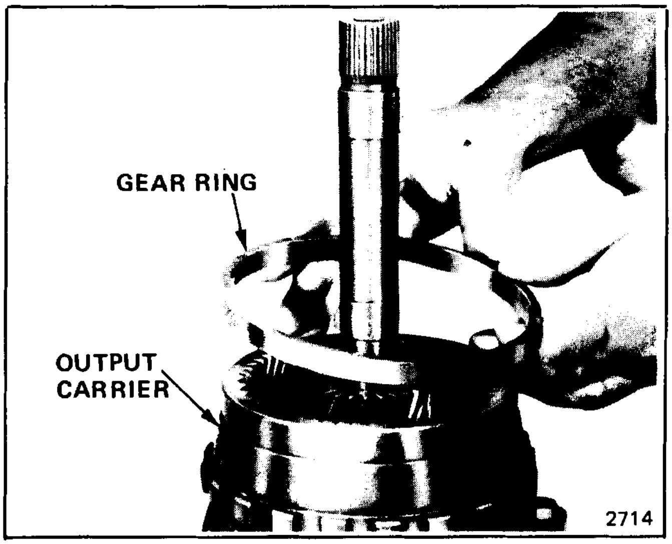


Fig. 7A4-143 Installing Gear Ring to Output Carrier

11. Install the case to center support bolt by placing Locating Tool J 23093 into case direct clutch passage, with handle of tool pointing to right as viewed from front of transmission and parallel to the bell housing mounting face (Fig. 7A4-159).

12. Apply pressure downward on tool handle, which will tend to rotate the center support counterclockwise as viewed from front of transmission. While holding center support firmly counterclockwise against the case splines, torque the case-to-center support bolt to 20-25 ft. lbs., using a 3/8" 12-point thin wall deep socket.

CAUTION: *When using the locating tool, use care not to raise burrs on the case valve body mounting face.*

13. Lubricate with transmission oil two (2) flat and one (1) waved steel plates and three (3) composition intermediate clutch plates and install, starting with waved steel plate and alternating composition and steel plates (Fig. 7A4-160).

14. Install intermediate clutch backing plate, ridge up.

15. Install backing plate-to-case snap ring, locating gap opposite the band anchor pin.

Fig. 7A4-144 Installing Reaction Carrier

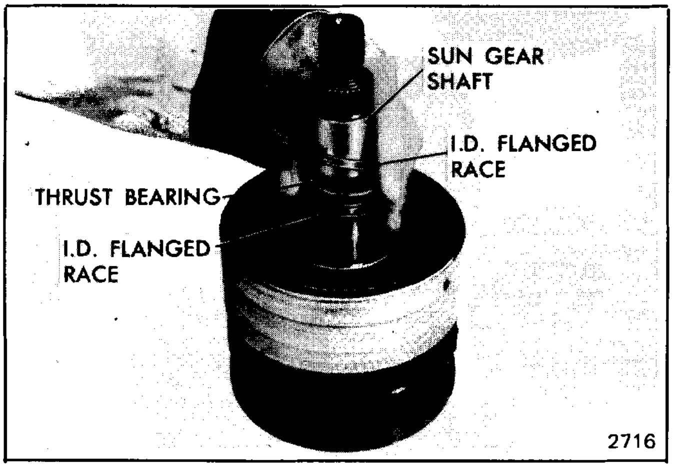


Fig. 7A4-145 Installing Bearing and Races on Sun Gear Shaft

NOTE: Both sides of this snap ring are flat and ring is .093" thick.

16. Check rear end play as follows:

a. Install Bolt J 21904 with 3/8" adapter into an extension housing attaching bolt hole (Fig. 7A4-161).

b. Mount Indicator J 8001 on rod and index with end of output shaft.

c. Move output shaft in and out to read end play. End play should be from .007"-.019". The selective washer controlling this end play is a steel washer having 3 lugs and is located between thrust washer and rear face of transmission case.

If a different washer thickness is required to bring end play within specifications, it can be selected from the chart under REAR END PLAY CHECKING PROCEDURE.

17. Install front band with anchor hole placed over band anchor pin and apply lug facing servo hole (Fig. 7A4-162).

18. Install manual linkage as follows:

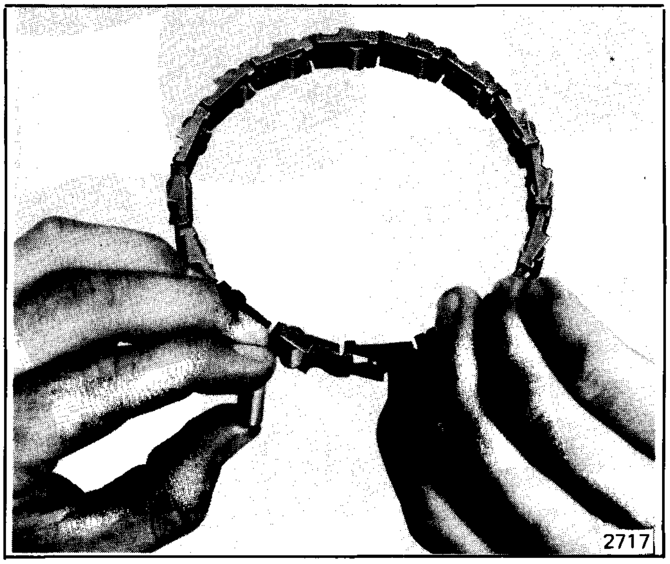


Fig. 7A4-146 Installing Roller Into Roller Clutch

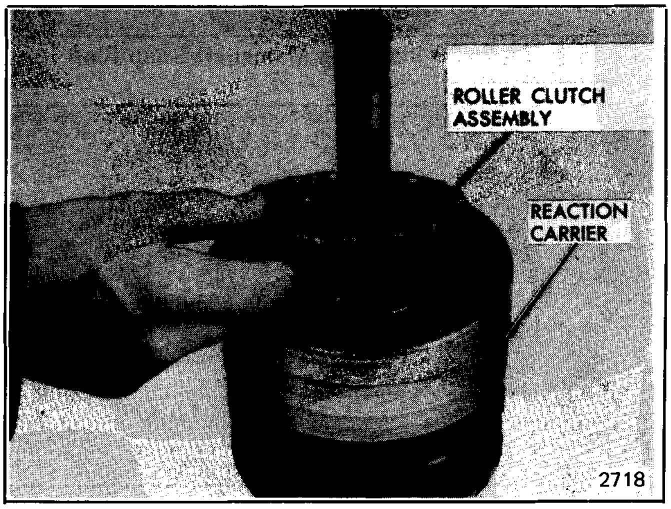


Fig. 7A4-147 Installing Roller Clutch Assembly

a. If necessary, install a new manual shaft seal into the transmission case, using a 3/4" rod to seat the seal.

b. If removed, insert actuator rod into manual detent lever from side opposite pin.

c. Install actuator rod plunger under parking bracket and over parking pawl (Fig. 7A4-163).

d. Install manual shaft through case and detent lever.

e. Install detent retaining hex lock nut on manual shaft and tighten to 20 lb. ft. (Fig. 7A4-164).

f. Install retaining pin, indexing with groove in manual shaft. Rotate transmission to vertical position and remove Holding Tool J 21795.

19. Install direct clutch and roller clutch assembly. It will be necessary to twist housing to allow sprag outer race to index with composition clutch plates. Housing hub will bottom on sun gear shaft (Fig. 7A4-165).

NOTE: Removal of direct clutch composition and steel plates may be helpful.

20. Install forward clutch hub-to-direct clutch housing thrust washer on forward clutch hub, if not already installed. Retain with petrolatum.

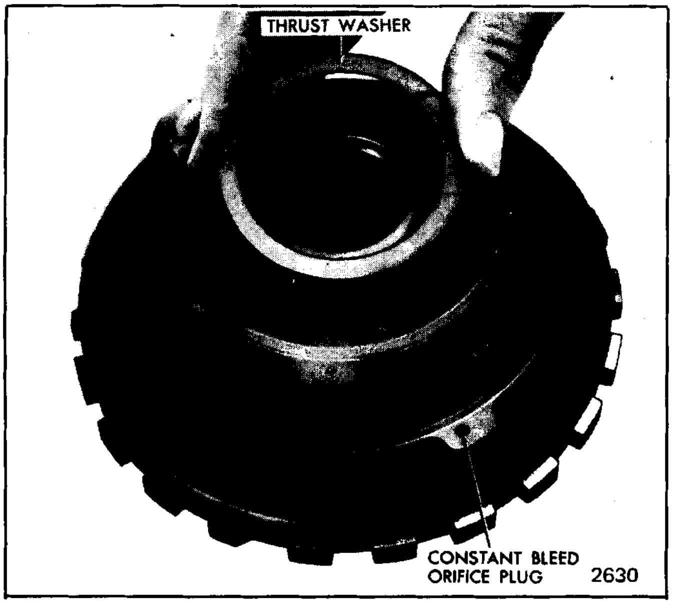


Fig. 7A4-148 Installing Center Support Thrust Washer

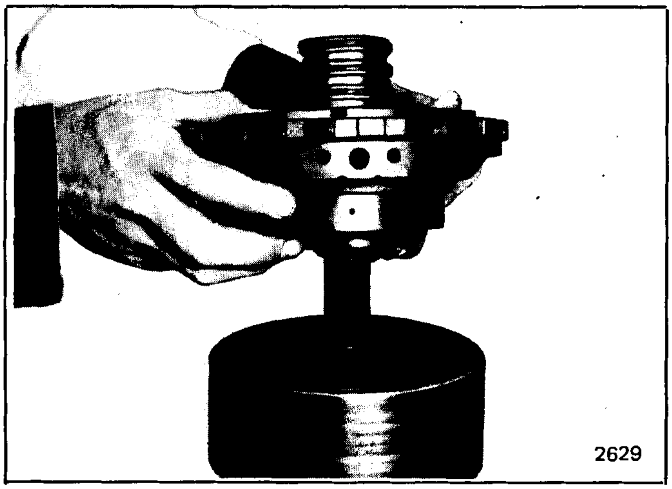


Fig. 7A4-149 Installing Center Support Assembly

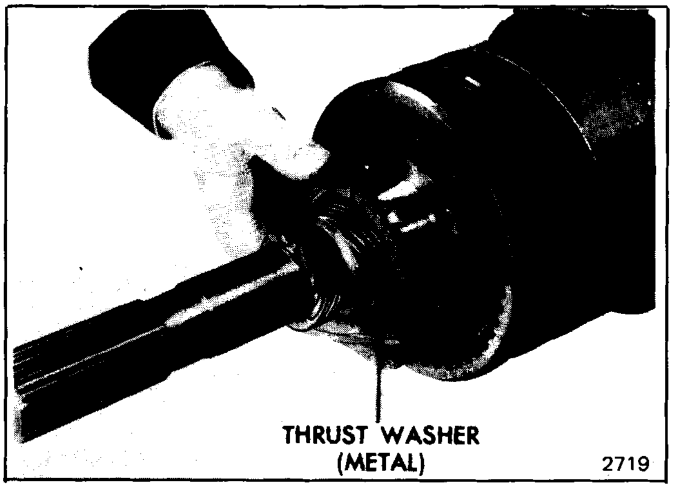


Fig. 7A4-150 Installing Output-to-Case Thrust Washer

Fig. 7A4-151 Installing Parking Pawl and Shaft

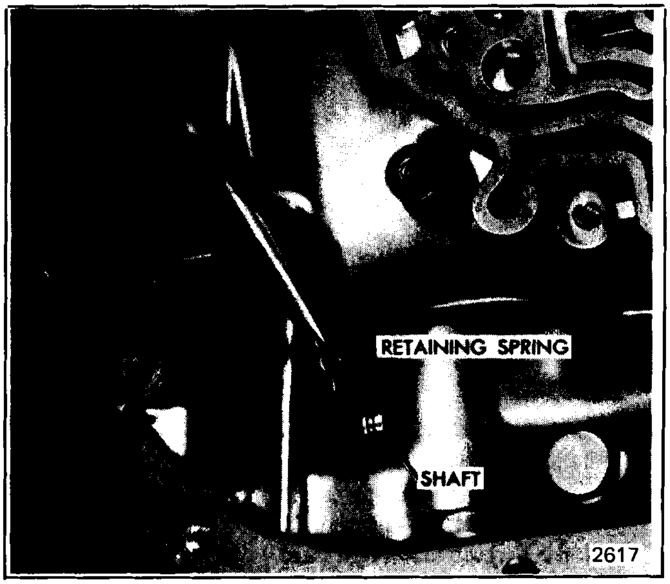


Fig. 7A4-152 Installing Retaining Spring Onto Pawl Shaft

21. Install forward clutch and turbine shaft, indexing direct clutch hub so end of mainshaft will bottom on end of forward clutch hub. When forward clutch is seated, it will be 1 1/4" from pump face in case (Fig. 7A4-166).

22. Install gasket and front pump.

23. Install all but one pump attaching bolt and seal. Torque to 18 lb. ft.

NOTE: If turbine shaft can not be rotated as pump is being pulled into place, forward or direct clutch housing has not been properly installed to index with all clutch plates. This condition must be corrected before pump is pulled fully into place.

24. If necessary to install a new front seal, use a non-hardening sealer on outside of seal body and using Installer J 21359, drive seal in place (Fig. 7A4-167).

25. Check front unit end play as follows (Fig. 7A4-168):

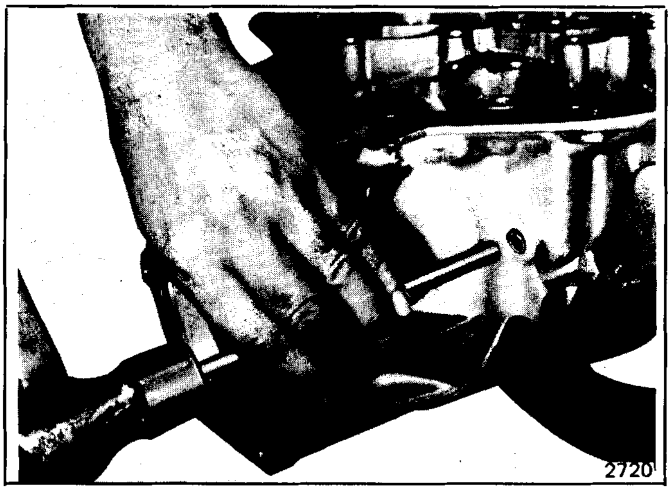


Fig. 7A4-153 Driving Cup Plug Into Case

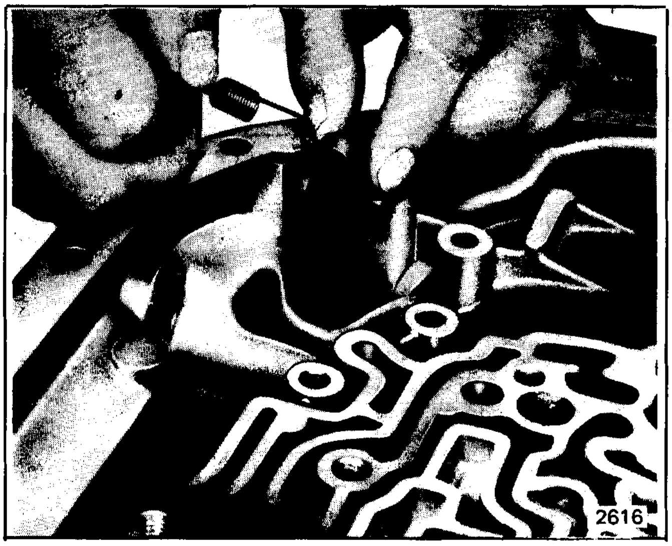


Fig. 7A4-154 Installing Parking Pawl Return Spring

a. Install a 5/16"-18 threaded slide hammer bolt or Bolt J 21904 into bolt hole in pump.

b. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.

c. Push turbine shaft rearward.

d. Push output shaft forward.

e. Set dial indicator to zero.

f. Pull turbine shaft forward.

Read resulting travel or end play - should be .003" to .024". Selective washer controlling this end play washer located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the chart below:

THICKNESS	COLOR
.060-.064"	Yellow
.071-.075"	Blue
.082-.086"	Red
.093-.097"	Brown
.104-.108"	Green
.115-.119"	Black
.126-.130"	Purple

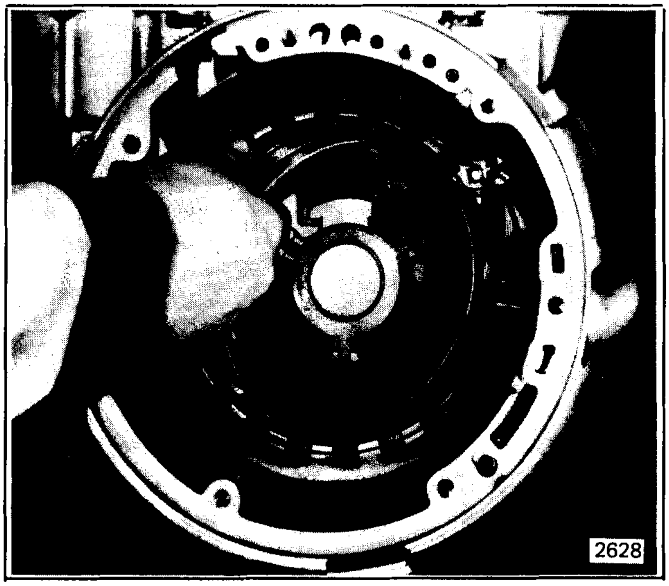
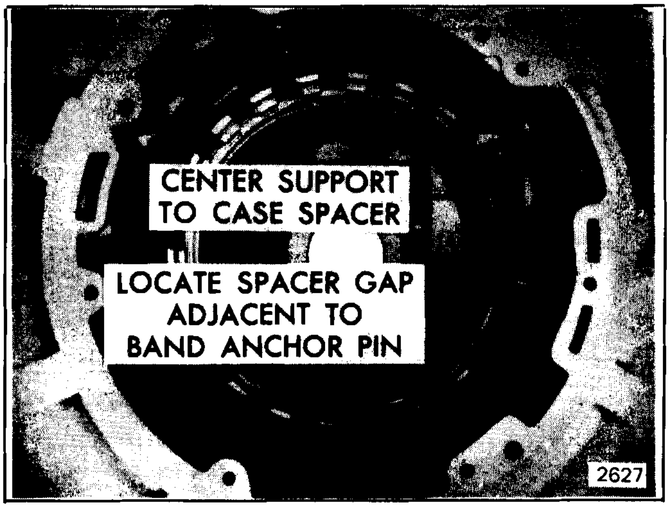


Fig. 7A4-155 Installing Rear Band


CENTER SUPPORT TO CASE SPACER

LOCATE SPACER GAP ADJACENT TO BAND ANCHOR PIN

Fig. 7A4-156 Proper Location of Support-to-Case Spacer

NOTE: An oil soaked washer may tend to discolor. It will be necessary to measure washer for its actual thickness.

26. Install remaining front pump attaching bolt and seal. Torque 18 lb. ft.

INSTALL CASE EXTENSION ASSEMBLY

1. Install case extension-to-case gasket on extension.

2. Attach case extension to case, using attaching bolts and/or studs. Torque to 22 lb. ft.

NOTE: All models use two (2) studs at 3 o'clock and 5 o'clock positions (when viewed from rear of case and transmission in vehicle). These studs are for installation of the catalytic converter.

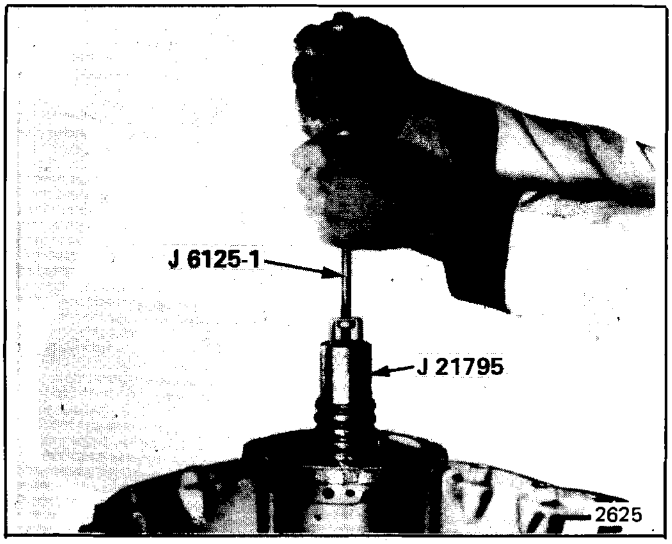


Fig. 7A4-157 Installing Complete Gear Unit

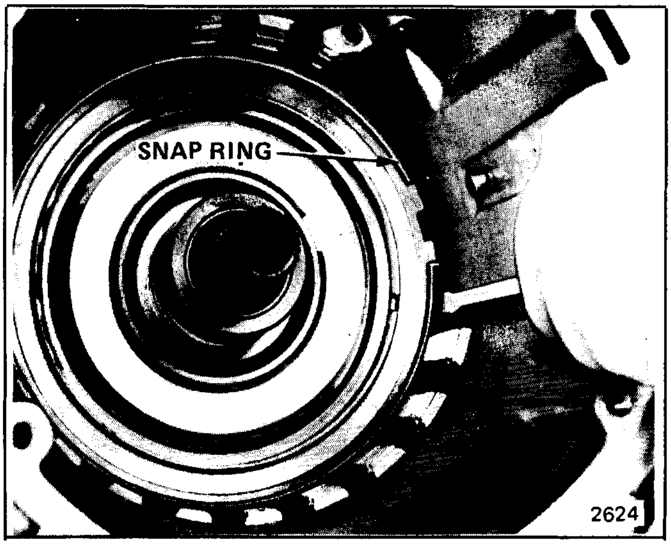


Fig. 7A4-158 Installing Support-to-Case Snap Ring

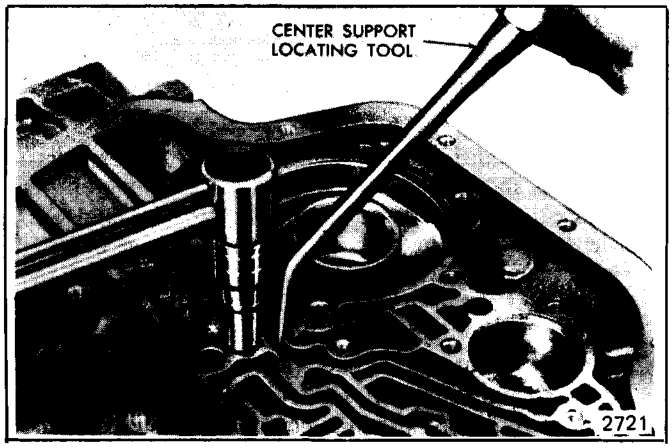


Fig. 7A4-159 Installing Center Support Bolt

3. If necessary to install a new rear seal, use non-hardening sealer on outside of seal body and, using Installer J 21359, drive seal into place (Fig. 7A4-169).

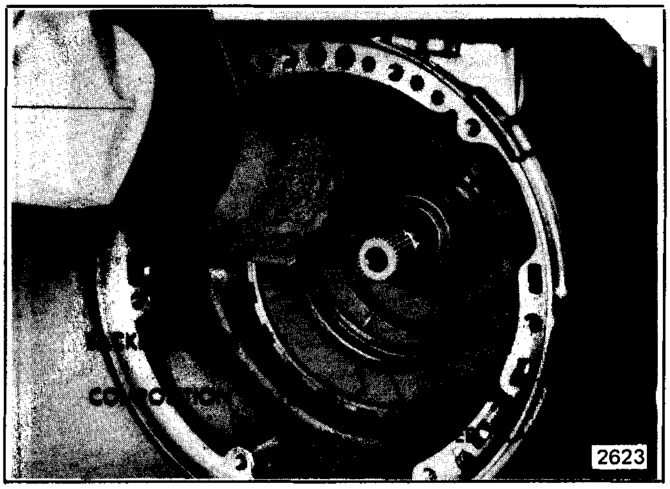


Fig. 7A4-160 Installing Intermiediate Clutch Pack

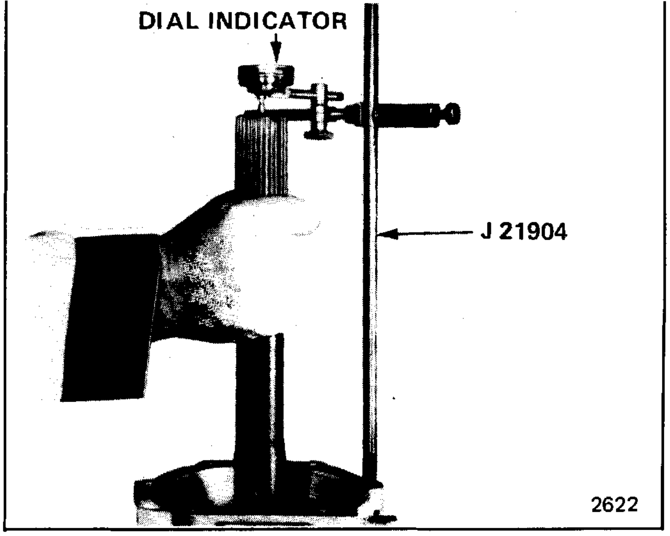


Fig. 7A4-161 Checking Rear End Play

CHECK BALLS, CONTROL VALVE SPACER PLATE AND GASKET, DETENT SOLENOID, FRONT SERVO ASSEMBLY AND ELECTRICAL CONNECTOR

Install

1. Install two guide pins (control valve assembly attaching bolts with their heads cut off) into the transmission case valve body face.

2. Install five (5) check balls into ball seat pockets in the transmission case valve body face (Fig. 7A4-170).

NOTE: If transmission is in car, install check balls into ball seat pockets on the spacer plate (Fig. 7A4-171).

3. Install control valve spacer plate-to-case gasket (gasket with the extension for the detent solenoid and identified with "C" near front servo location).

4. Install control valve spacer plate (Fig. 7A4-172).

5. Install detent solenoid gasket and solenoid, with connector facing the outer edge of the case (Fig. 7A4-173).

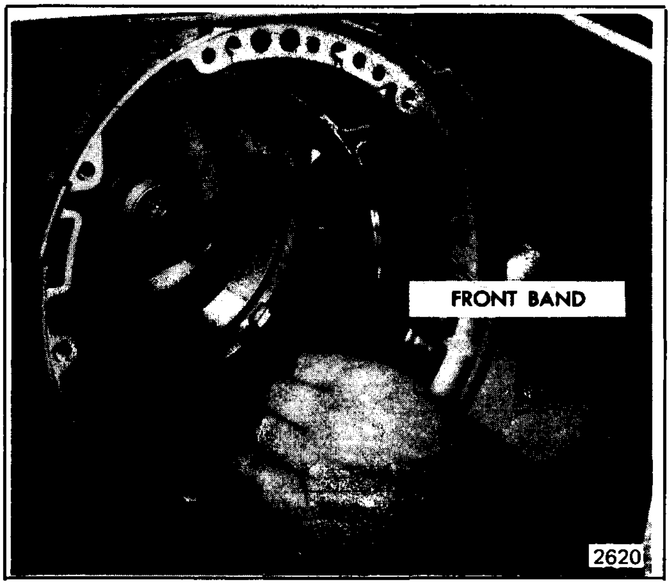


Fig. 7A4-162 Installing Front Band

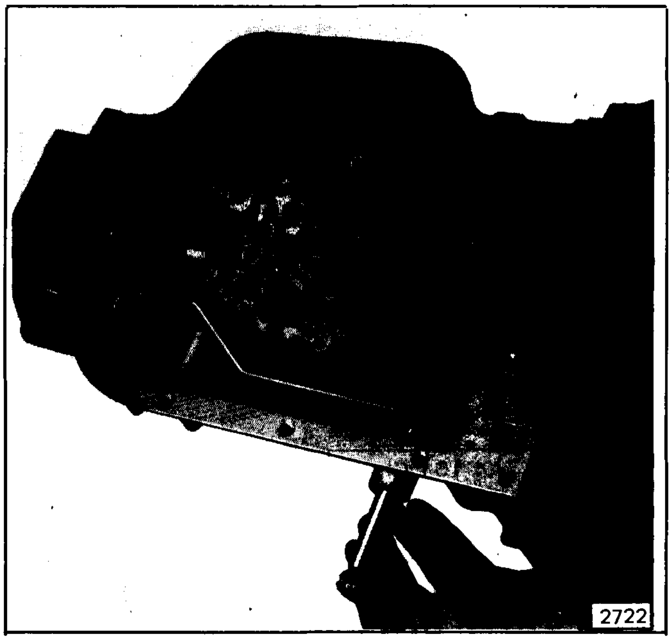


Fig. 7A4-163 Positioning Actuator Rod Plunger

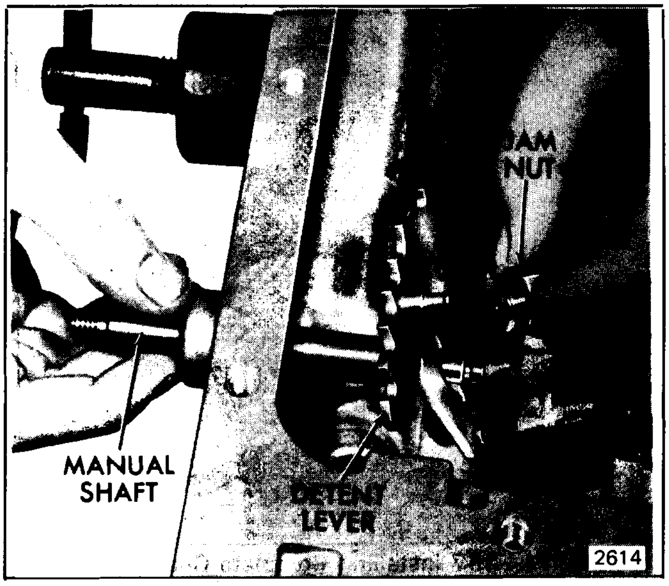


Fig. 7A4-164 Installing Jam Nut Onto Manual Shaft

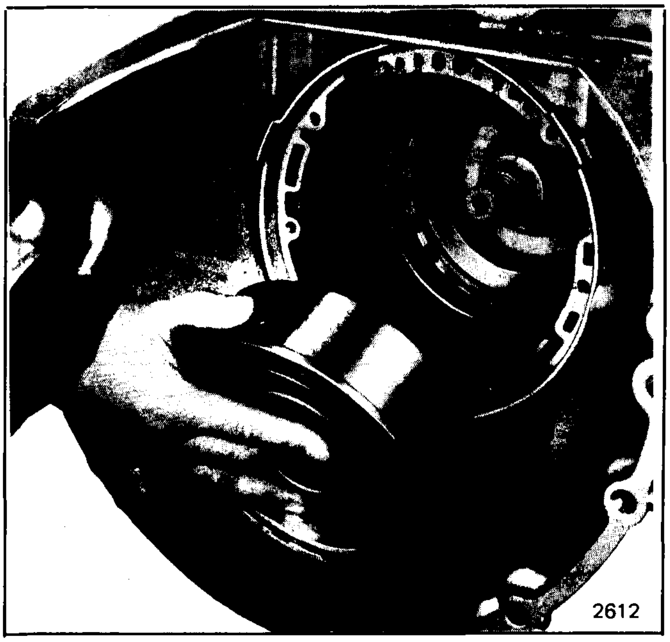


Fig. 7A4-165 Installing Direct Clutch Assembly

NOTE: Do not tighten bolts at this time.

6. Install front servo spring and spring retainer into transmission case.

7. Install retainer ring in front servo pin groove and install pin into the case so that tapered end contacts the front band. Make certain that retainer ring is installed in servo pin groove.

8. Install seal ring on servo piston, if removed, and install on servo pin with flat side of piston positioned toward bottom pan (Fig. 7A4-174).

The teflon ring allows the front servo piston to slide very freely in the case. This free fit of the ring in the bore is a normal characteristic and does not indicate leakage during operation. The teflon ring should be replaced only if it shows damage or if evidence of leakage during operation exists.

NOTE: If transmission is in car, assemble the front servo group as shown in Figure 91 and install this group of parts into the front servo bore in the case and hold. Slip a length of straight, smooth, clean feeler gage or shim stock (about .020") between the spacer plate and the front servo piston to temporarily retain the front servo group in its bore as shown in Fig. 7A4-175.

9. Install O-ring seal on electrical connector.

10. Lubricate and install electrical connector with lock tabs facing into case, positioning locator tab in notch on side of case (Fig. 7A4-176) and connect detent wire to electrical connector (Fig. 7A4-177).

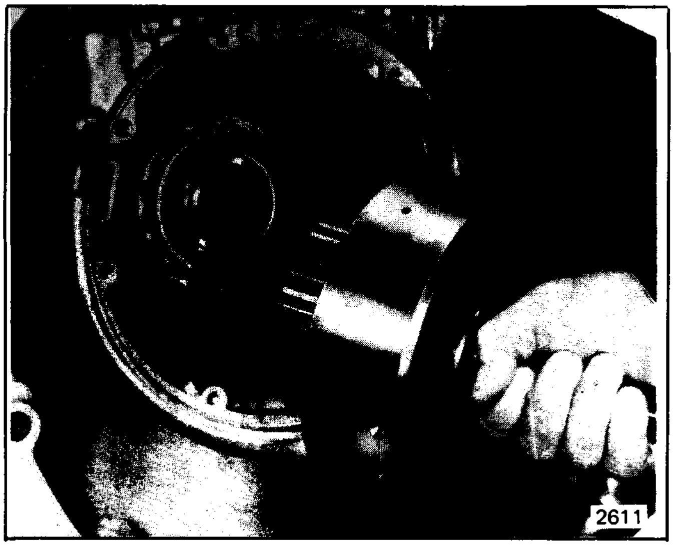


Fig. 7A4-166 Installing Forward Clutch Assembly

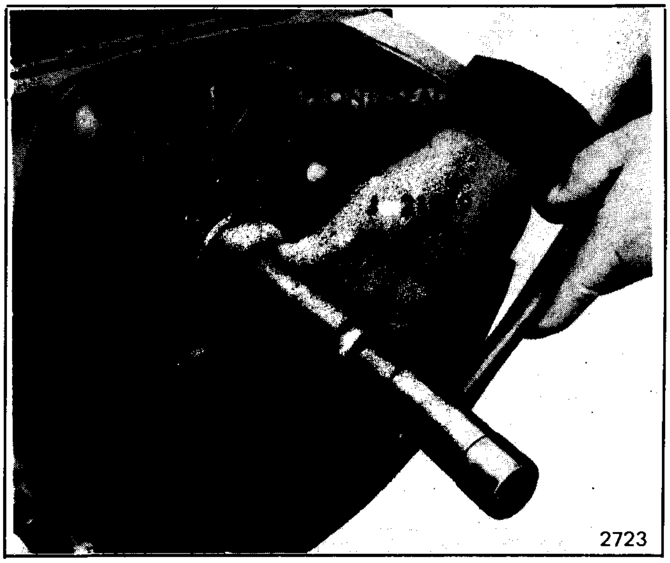


Fig. 7A4-167 Installing Front Seal

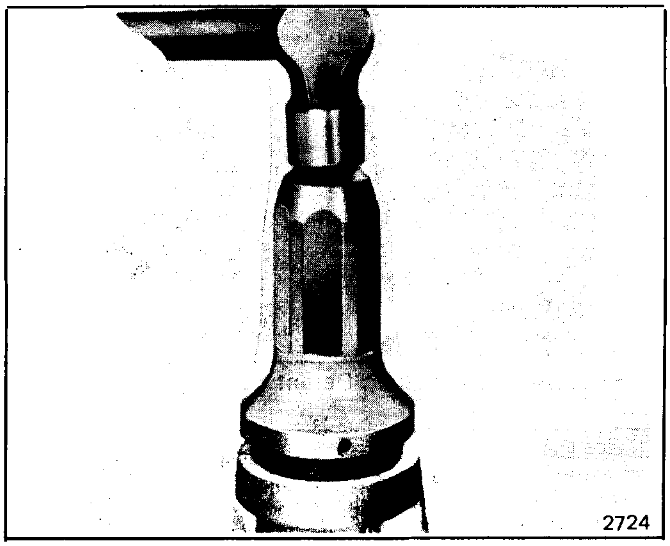


Fig. 7A4-169 Installing Rear Oil Seal

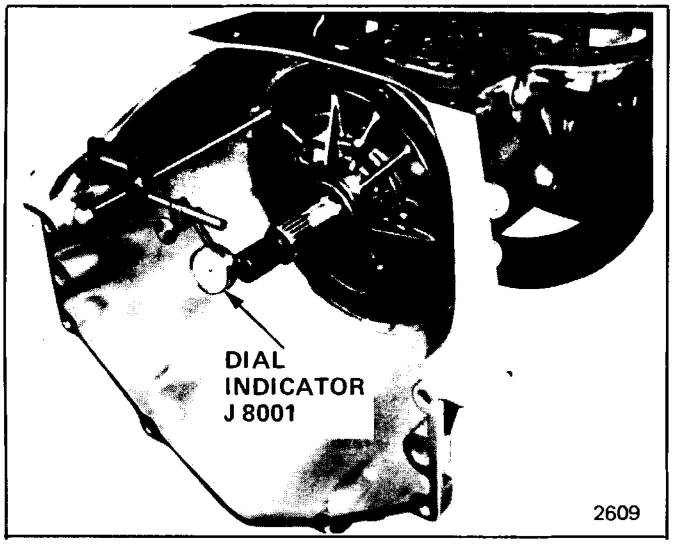


Fig. 7A4-168 Checking Front End Play

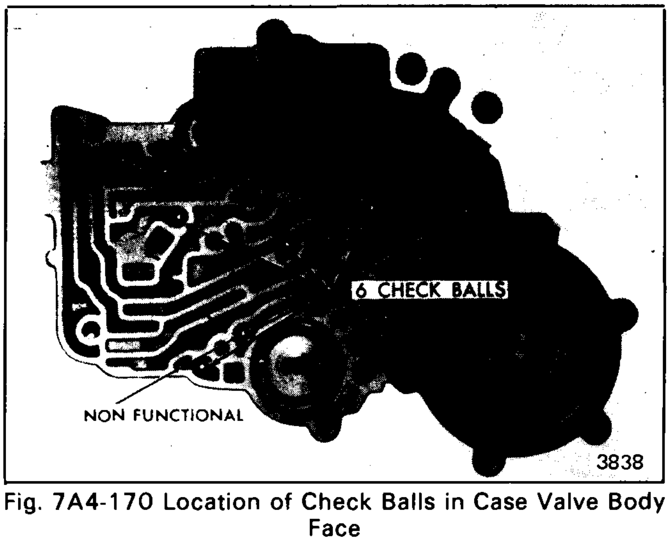


Fig. 7A4-170 Location of Check Balls in Case Valve Body Face

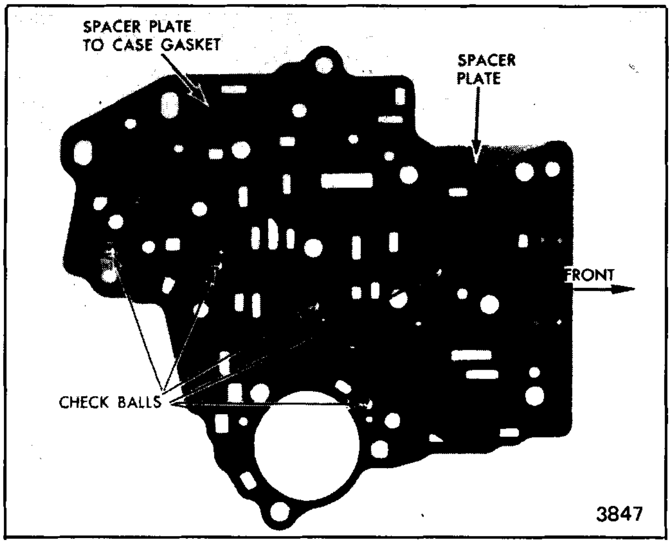


Fig. 7A4-171 Location of Check Balls in Spacer Plate

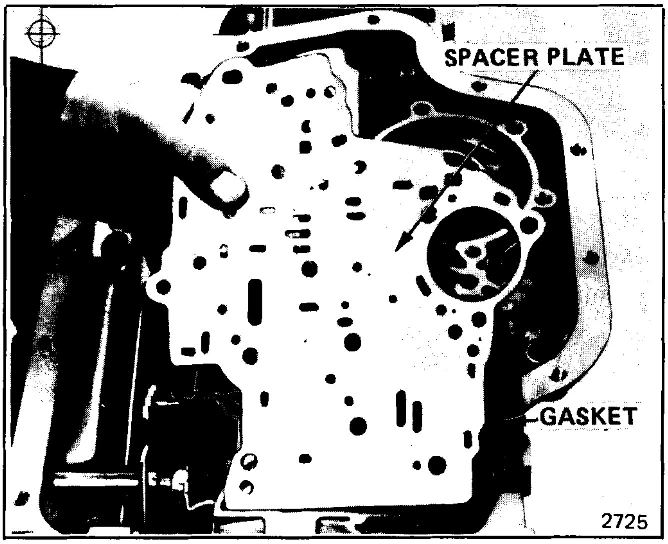


Fig. 7A4-172 Installing Gasket and Spacer Plate

Fig. 7A4-173 Installing Detent Solenoid and Gasket

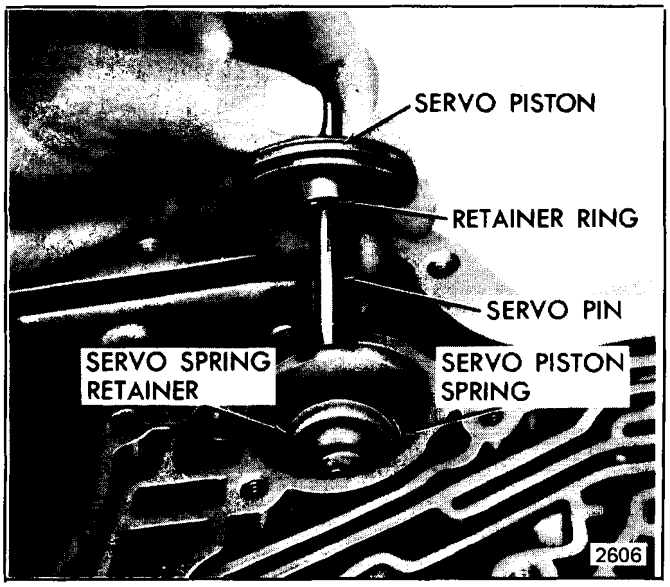


Fig. 7A4-174 Installing Front Servo Assembly

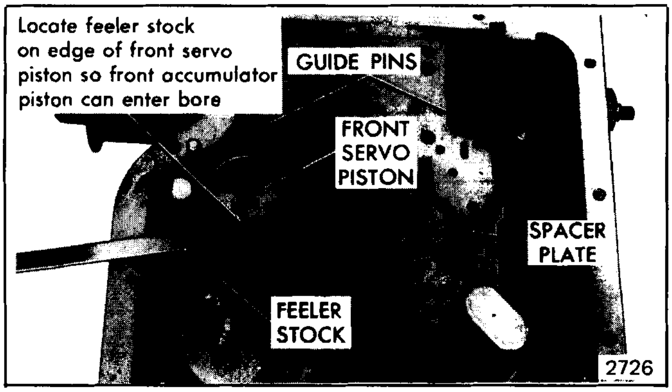


Fig. 7A4-175 Retaining Front Servo Group in Case Bore

Fig. 7A4-176 Installing Electrical Connector

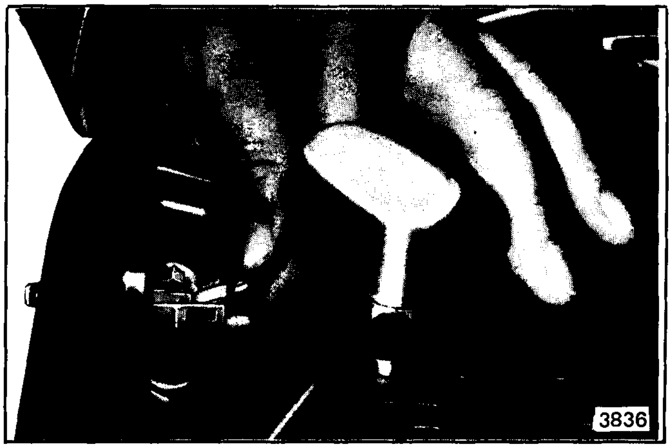


Fig. 7A4-177 Connecting Leads to Connector

REAR SERVO ASSEMBLY

Install

1. Before installing rear servo, check band apply (Servo) pin, using Pin and Fixture J 21370-5 and 6 as follows (Fig. 7A4-178):

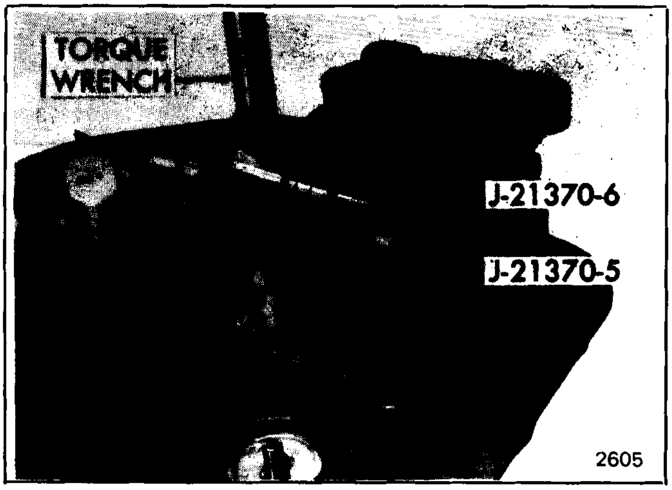


Fig. 7A4-178 Checking For Proper Band Apply Pin

a. Attach Pin J 21370-6 and Fixture J 21370-5 to transmission case (lever pivot pin to rear), with rear servo cover attaching screws.

NOTE: Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 ft. lbs. and recheck pin to make certain it does not bind.

b. Apply 25 lb. ft. torque and select proper band apply (servo) pin to be used from scale on tool.

c. Remove tool and make note of proper pin to be used during assembly of transmission.

There are three selective pins identified as follows:

(1) If both steps are below the gage surface, the long pin, identified by 3 rings, should be used. (2) If the gage surface is between the steps, the medium pin, identified by 2 rings, should be used. (3) If both steps are above the gage surface, the short pin, identified by 1 ring, should be used.

Identification ring is located on band lug end of servo pin. If it is found that a new pin is required, install it in rear servo (see REAR SERVO - DISASSEMBLY AND ASSEMBLY).

2. Install rear accumulator spring into case (Fig. 7A4-179).

3. Lubricate and install rear servo assembly into case (Fig. 7A4-180).

4. Install rear servo gasket and cover (Fig. 7A4-181).

5. Install attaching screws. Torque bolts to 18 lb. ft.

CONTROL VALVE ASSEMBLY, GOVERNOR PIPES AND GOVERNOR SCREEN ASSEMBLY

Install

1. Install governor pipes into control valve assembly. Governor pipes are interchangeable.

2. Install governor screen assembly, open end first, into the governor feed pipe hole in the case (hole nearest center of transmission - Fig. 7A4-182).

NOTE: If transmission is in car, before installing the control valve assembly and governor pipes as outlined in Step 3 below, insert the governor screen (closed end

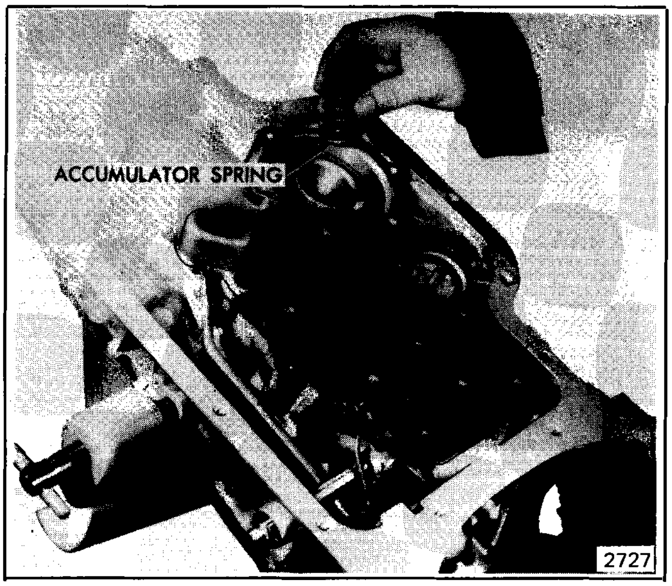


Fig. 7A4-179 Installing Rear Accumulator Spring

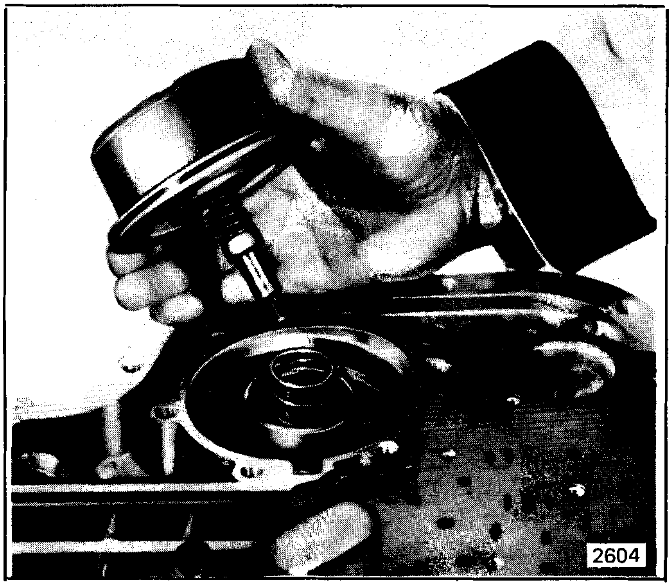


Fig. 7A4-180 Installing Rear Servo Piston

first) into the governor feed pipe. This pipe locates in the governor feed pipe hole in case nearest center of transmission.

3. Install valve body-to-spacer gasket (identified with "VB" near front servo location), control valve assembly and governor pipes on transmission while carefully aligning the governor feed pipe over the governor screen (Fig. 7A4-183). Make certain that gasket and spacer do not become mispositioned.

NOTE: Be sure that manual valve is indexed properly with pin on detent lever and that governor pipes are properly seated in case holes.

4. Start control valve assembly attaching bolts.

NOTE: If transmission is in car, remove shim stock (or feeler gage) from between spacer plate and front servo piston before tightening any control valve bolts.

Fig. 7A4-181 Installing Rear Servo Cover

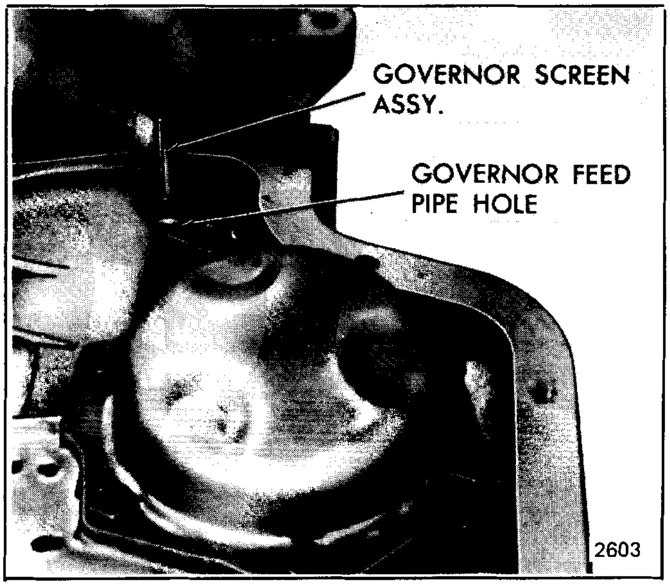


Fig. 7A4-182 Installing Governor Screen Assembly

5. Remove guide pins, install detent roller and spring assembly, remaining attaching bolts and torque all attaching bolts to 8 lb. ft. (Fig. 7A4-184).

FILTER AND INTAKE PIPE

Install

1. Install case-to-intake pipe O-ring seal on intake pipe, assemble new filter to intake pipe and install filter and intake pipe assembly to case and control valve assembly (Fig. 7A4-185).

NOTE: Intake pipe is stamped with "filter" and "case" near ends of the pipe. Assemble "filter" end of pipe into the filter.

2. Attach filter to the control valve assembly with the retainer bolt (Fig. 7A4-186).

NOTE: After any major repair, the filter must be replaced and oil cooler and cooler lines must be flushed.

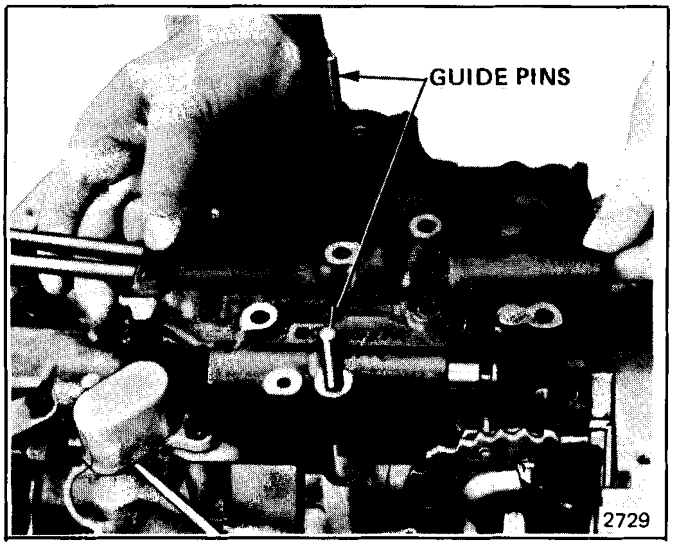


Fig. 7A4-183 Installing Control Valve Assembly

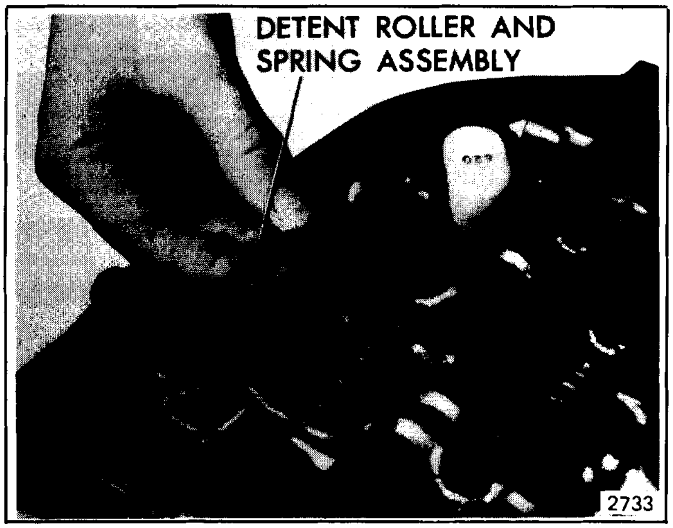


Fig. 7A4-184 Installing Detent Roller and Spring Assembly

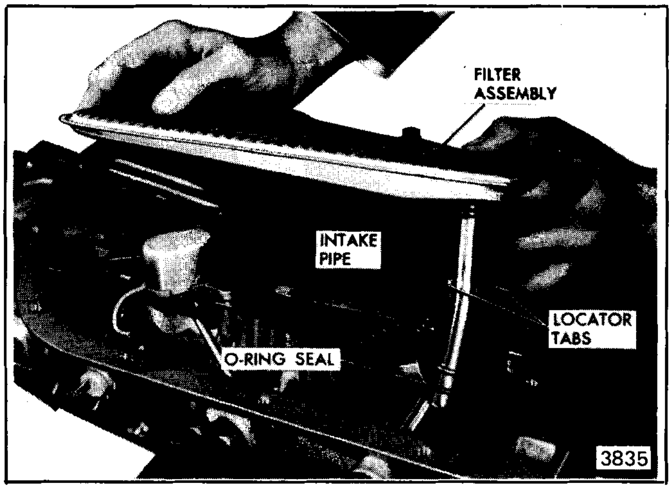


Fig. 7A4-185 Installing Filter Assembly

3. Install new bottom pan gasket and bottom pan with attaching screws. Torque to 12 lb. ft.

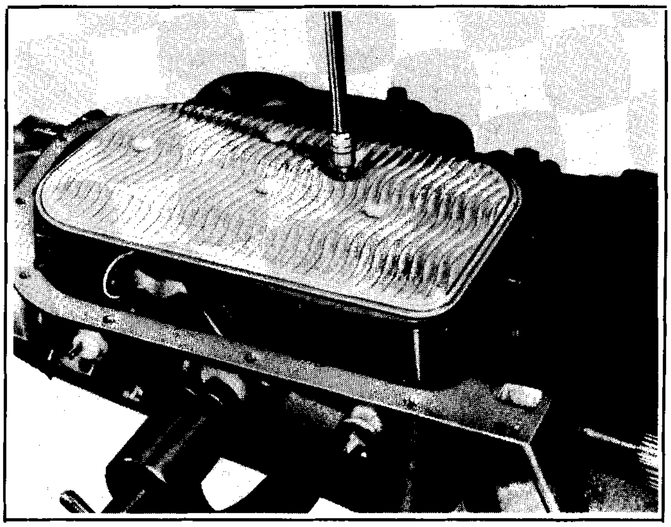


Fig. 7A4-186 Installing Filter Retainer Bolt

MODULATOR VALVE AND VACUUM MODULATOR

Install

1. Install modulator valve into case, stem end out.
2. Install O-ring seal on vacuum modulator.
3. Install vacuum modulator into case (Fig. 7A4-187).

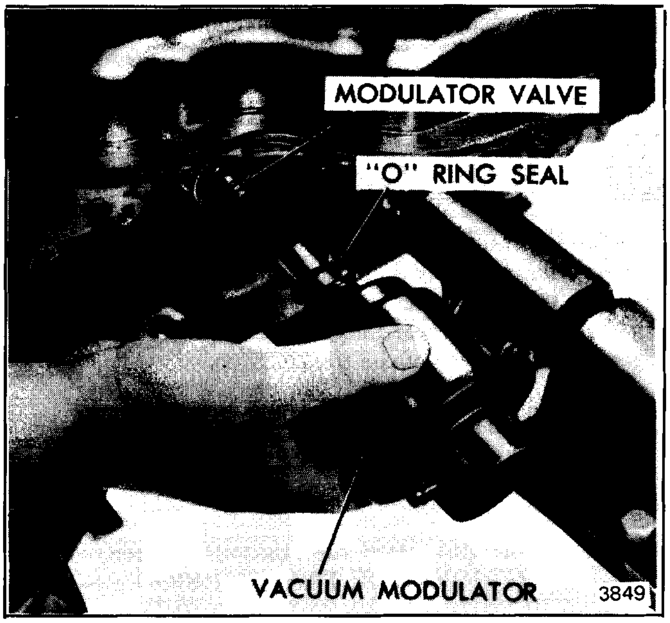


Fig. 7A4-187 Installing Vacuum Modulator

4. Install modulator retainer and attaching bolt. Torque bolt to 18 lb. ft.

GOVERNOR

Install

1. Install governor into case (Fig. 7A4-188).
2. Attach governor cover and new gasket with four (4) attaching bolts. Torque bolts to 18 lb. ft.

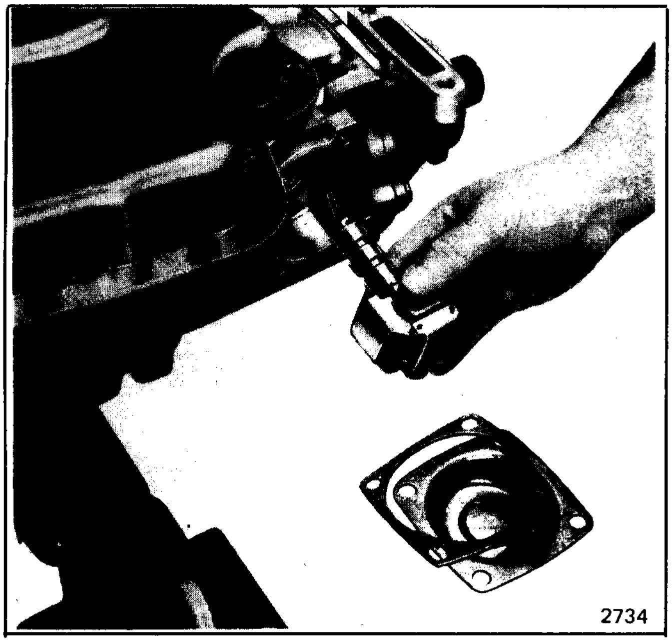


Fig. 7A4-188 Installing Governor

SPEEDOMETER DRIVEN GEAR

Install

1. Install speedometer driven gear into case extension.
2. Install speedometer driven gear retainer and attaching bolt.

CONVERTER ASSEMBLY

Install

With the transmission in cradle or portable jack, install the converter assembly into the pump assembly, making certain that the converter hub drive slots are fully engaged with the pump drive gear tangs and the converter installed fully towards the rear of the transmission.

TRANSMISSION ASSEMBLY

Install

Reverse the procedure for transmission removal as stated under REMOVAL OF TRANSMISSION.

MANUAL LINKAGE

Adjust

Manual linkage adjustment and the associated neutral safety switch are important from a safety stand point. The neutral safety switch should be adjusted so that the engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage and prevent the vehicle from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

REFILLING TRANSMISSION

Follow the procedure as outlined under DRAINING AND REFILLING TRANSMISSION.

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

An identifying code is found on the serial number plate of the Turbo Hydra-Matic 400 transmission. This plate is located on the right side of the transmission case, just forward of the governor.

The serial numbers on these plates are all preceded by either code letters PA, PB, PC, PD, OB or OC. The application of each transmission code is as follows:

PA -301 cu. in. 2 Bbl. engine, except California (G Series).

PB -350 cu. in., 4 Bbl. engine, except California (G Series).

PC -400 cu. in., 4 Bbl. engine, except California (A and G Series).

PD -400 cu. in. 4 Bbl. engine with Police option (A Series).

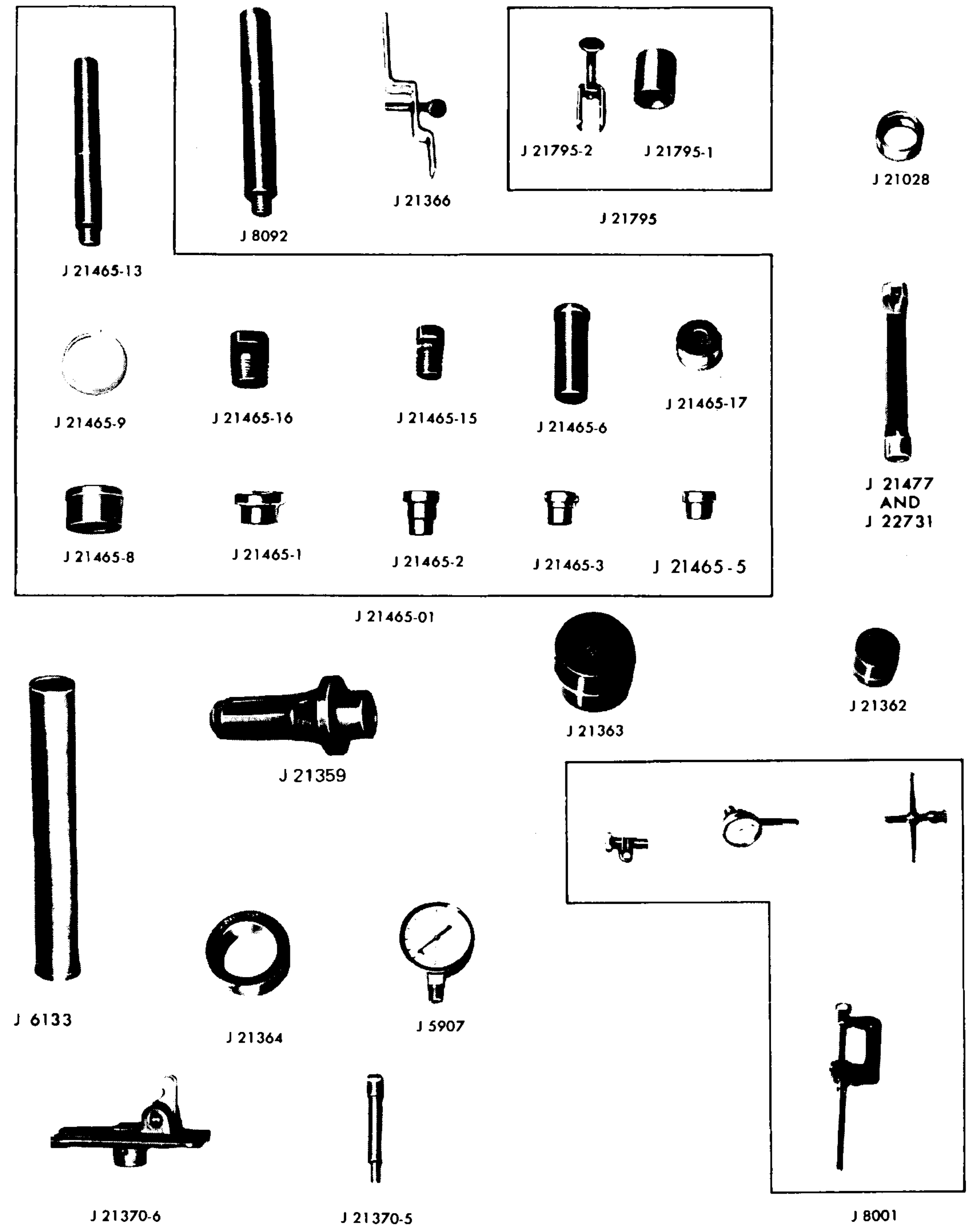
OB -350 cu. in., 4 Bbl. engine, California only (A Series).

OC -403 cu. in., 4 Bbl. engine, California only (A Series).

It is very important that any communications concerning the Turbo Hydra-Matic 400 transmission always contains the complete transmission serial number and the vehicle identification number. All transmission parts returned to Pontiac Motor Division **must** be tagged with the transmission serial number.

TORQUE

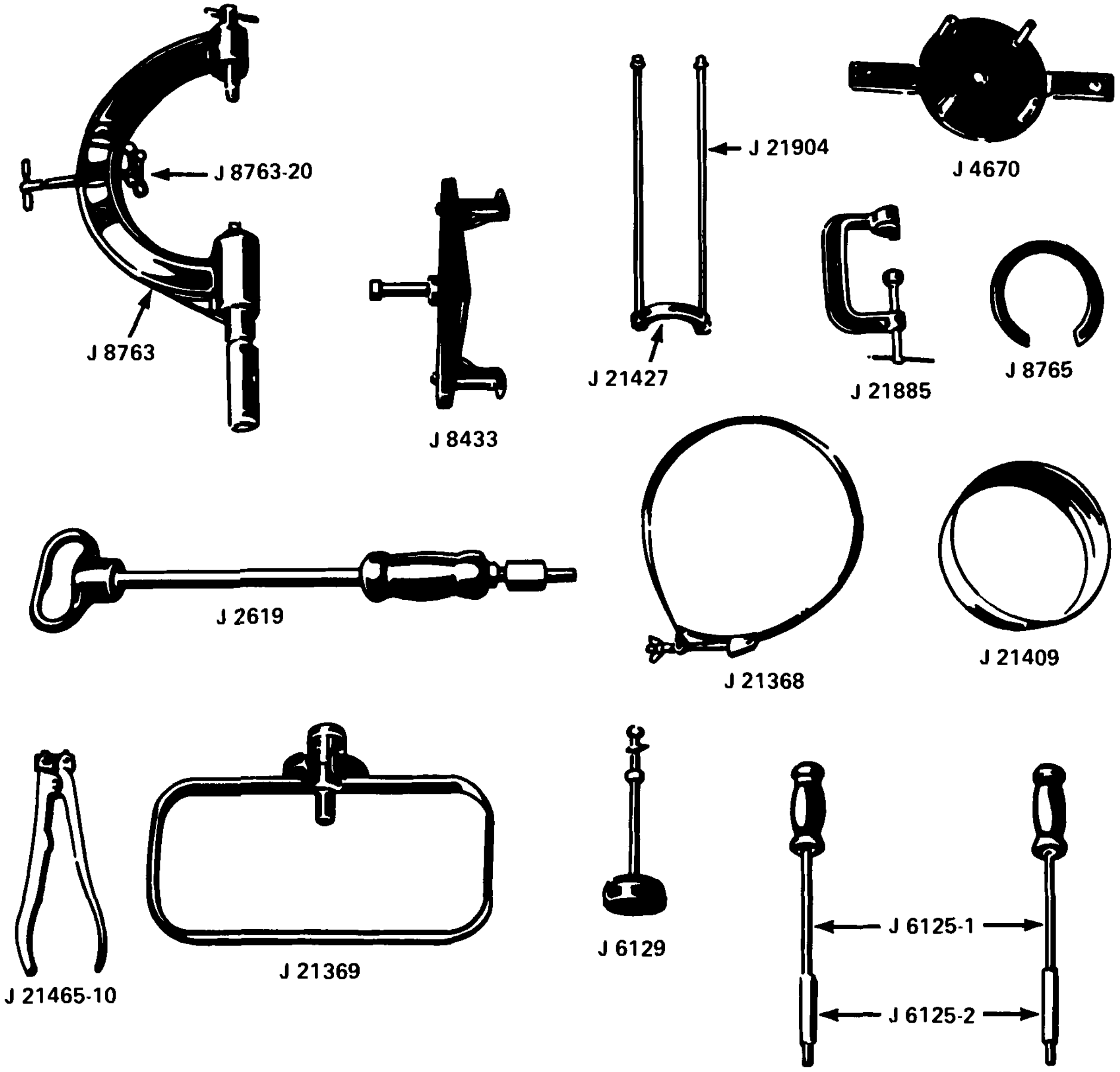
	LB. FT.
Flywheel Plate-to-Converter Bolts	30
Pump Cover Bolts	18
Parking Pawl Bracket Bolts	18
Center Support Bolt	22
Pump-to-Case Attaching Bolts	18
Extension-to-Case Attaching Bolts	22
Rear Servo Cover Bolts	18
Detent Solenoid Bolts	8
Control Valve Body Bolts	8
Bottom Pan Attaching Screws	12
Modulator Retainer Bolt	18
Governor Cover Bolts	18
Manual Lever-to-Manual Shaft Nut	20
Linkage Swivel Clamp Screw	20
Transmission-to-Engine Mounting Bolts	40
Rear Mount-to-Transmission Bolts (2)	40
Rear Mount-to-Crossmember Bolt	40
Frame-to-Crossmember Bolts (4)	35
Oil Cooler Line	28
Filter Retainer Bolt	10



J 5907	Pressure Gauge
J 6116	Clutch Unit Holding Fixture (Not Shown)
J 6133	Speedo Gear Installer
J 8001	Dial Indicator Set
J 8092	Driver Handle
J 21028	Speedo Gear Installer Spacer
J 21359	Oil Seal Installer
J 21362	Seal Protector, Inner-Forward and Direct Clutch
J 21363	Seal Protector, Inner-Intermediate Clutch
J 21364	Rear Unit Holding Fixture Adapter
J 21366	Converter Holding Clamp
J 21370-5	Rear Band Apply Pin
J 21370-6	Rear Band Apply Fixture
J 21465-01	Bushing Tool Set
J 21477	Cooler Pipe Wrench
J 21795	Gear Unit Assembly Holding Tool
J 22731	Cooler Pipe Wrench
J 23093	Center Support Locating Tool (Not Shown

2735

Fig. 7A4-189 Special Tools



J 2619	Slide Hammer
J 3289-20	Holding Fixture Base (Not Shown)
J 4670	Clutch Spring Compressor
J 6125-1	Slide Hammers
J 6125-2	Slide Hammer Adapters
J 6129	Clutch Spring Compressor
J 8400-1	Chisel (Not Shown)
J 8433	Speedo Gear Remover
J 8763-02	Holding Fixture
J 8763-20	Holding Fixture Adapter
J 8765	Compressor Adapter Ring
J 21368	Pump Body and Cover Alignment Strap
J 21369	Converter Leak Test Fixture
J 21371-2&-1	End Play Checking Fixture (Not Shown)
J 21409	Seal Protector, Outer - Forward Clutch
J 21424-9	Case Extension Bushing Installer - PD Model Only (Not Shown)
J 21427	Speedo Gear Remover
J 21465-10	Staking Tool
J 21885	Accumulator Piston Compressor
J 21904	Speedo Gear Remover Bolts

3850

Fig. 7A4-190 Special Tools

SECTION 7B

MANUAL TRANSMISSIONS

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

3-SPEED 76MM LT. DUTY MUNCIE TRANSMISSION

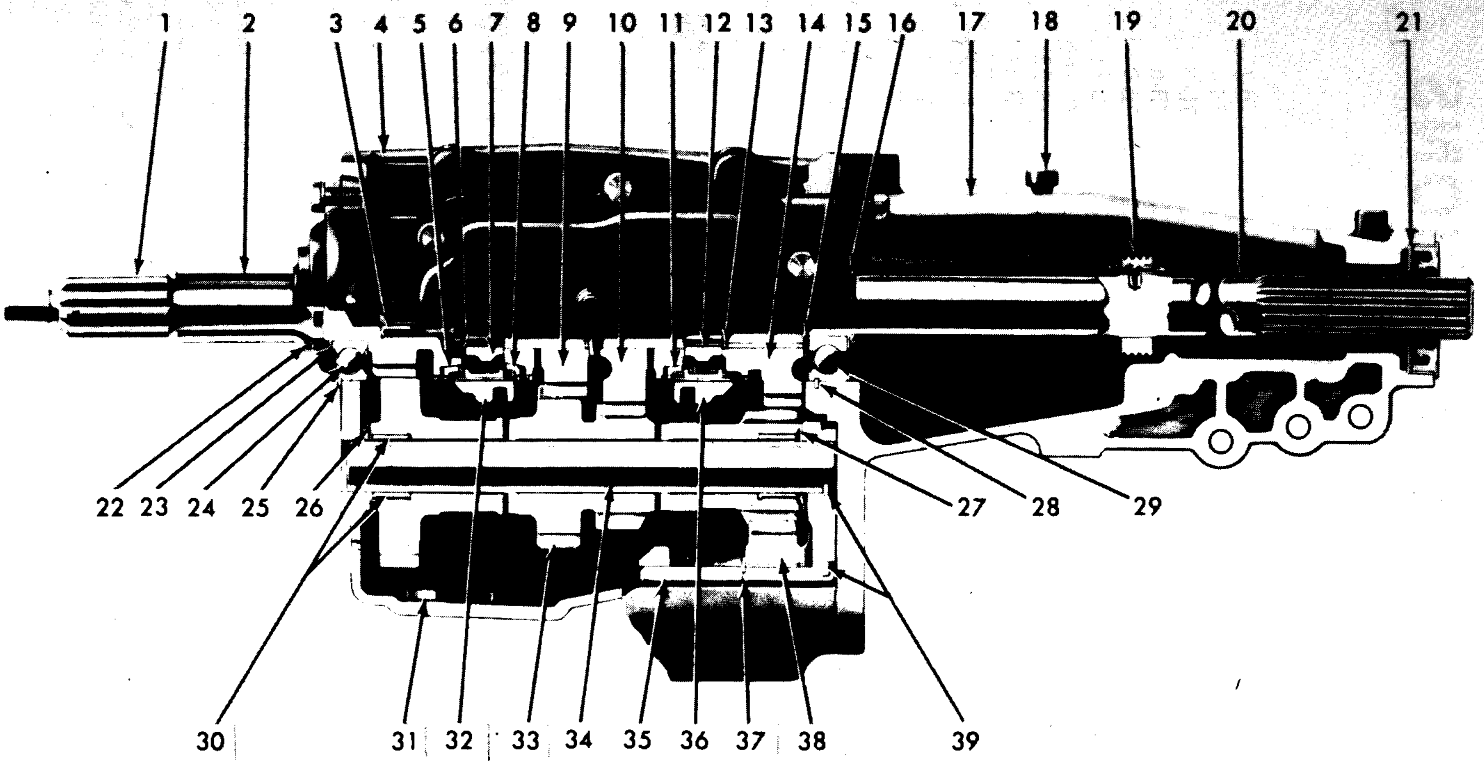
AND

4-SPEED 76MM LT. DUTY MUNCIE TRANSMISSION

These transmissions are representative of a synchronized, constant-mesh design. Fundamental components of these units are the case, which houses the gears and shaft; the control cover, which houses the shifter mechanism; and the various shafts and gears. The input shaft has an integral main drive gear and rotates with the clutch driven plate; that is, the shaft rotates all the time the clutch is engaged and the engine is running. The input shaft is supported in the case by a ball bearing and at the front end by an oil impregnated bushing mounted in the engine crankshaft. The drive gear is in constant mesh with the countershaft drive gear. Since all gears in the countershaft cluster are integral to the shaft, they also rotate at the time the clutch is engaged. The countergear is carried on roller bearings at both ends and thrust is absorbed by thrust washers located between the countergear and thrust bosses in the case. An anti-lash plate assembly at the front face of the countergear provides a constant spring tension between the countergear and the main drive gear to reduce torsional vibrations. The transmission mainshaft is held in line with the input shaft by a pilot bearing at its front end, which allows it to rotate or come to rest independently of the input shaft. Its carried at the rear by a ball bearing mounted in the front face of the extension housing.

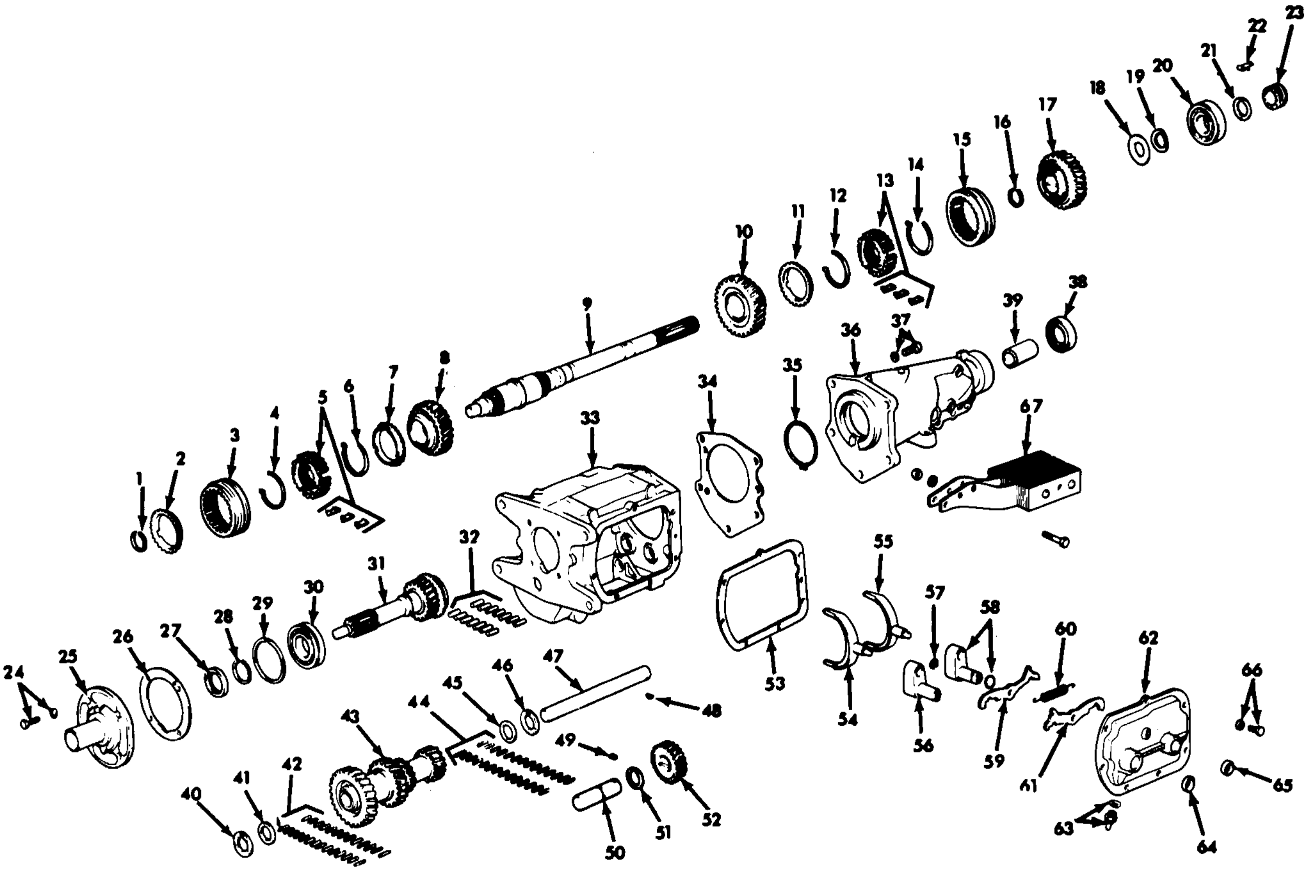
Helical gears are incorporated throughout, (except reverse gear on the four speed 76mm unit which uses a spur gear design.) The mainshaft gears are free to rotate independently on the mainshaft and are in constant mesh with the countershaft gears. The reverse idler gear is carried on a bushing finish bored in place and thrust is taken on the thrust bosses of the case.

The transmissions are fully synchronized in all forward speeds; however, reverse gear is not. The synchronizer assemblies consist of a hub, sleeve, two key springs and three synchronizer keys. The synchronizer hubs are splined to the mainshaft and retained by snap rings. These assemblies permit gears to be selected without clashing, by synchronizing the speeds of mating parts before they engage.



1. Clutch Gear
2. Bearing Retainer
3. Pilot Bearings
4. Case
5. 3rd Speed Blocker Ring
6. 2-3 Synch. Snap Ring
7. 2-3 Synch. Hub
8. 2nd Speed Blocker Ring
9. 2nd Speed Gear
10. 1st Speed Gear
11. 1st Speed Blocker Ring
12. 1st Speed Synch. Hub
13. 1st Speed Synch. Snap Ring
14. Reverse Gear
15. Reverse Gear Thrust and Spring Washers
16. Snap Ring-Bearing to Mainshaft
17. Extension
18. Vent
19. Speedometer Drive Gear and Clip
20. Mainshaft
21. Rear Oil Seal
22. Retainer Oil Seal
23. Snap Ring-Bearing to Gear
24. Clutch Gear Bearing
25. Snap Ring-Bearing to Case
26. Thrust Washer-Front
27. Thrust Washer-Rear
28. Snap Ring-Bearing to Extension
29. Rear Bearing
30. Countergear Roller Bearings
31. Magnet
32. 2-3 Synch. Sleeve
33. Countergear
34. Counter Shaft
35. Reverse Idler Shaft
36. 1st Speed Synch. Sleeve
37. "E" Ring
38. Reverse Idler Gear
39. Woodruff Keys

Fig. 7B-1 3-Speed 76mm Transmission - Cross Section



1. Snap Ring
2. Synchronizer Ring
3. 2-3 Synchronizer Sleeve
4. Synchronizer Key Spring
5. Synchronizer Hub and Keys
6. Synchronizer Key Spring
7. Synchronizer Ring
8. Second Gear
9. Main Shaft
10. First Gear
11. Synchronizer Ring
12. Synchronizer Key Spring
13. Synchronizer Hub and Keys
14. Synchronizer Key Spring
15. 1-2 Synchronizer Sleeve
16. Snap Ring
17. Reverse Gear
18. Thrust Washer
19. Waved Washer
20. Rear Bearing
21. Snap Ring
22. Speedometer Gear Clip
23. Speedometer Drive Gear
24. Bearing Retainer Bolts and Washers (4)
25. Front Bearing Retainer
26. Bearing Retainer Gasket
27. Bearing Retainer Oil Seal
28. Snap Ring
29. Bearing Snap Ring
30. Front Bearing
31. Drive Gear
32. Pilot Bearings
33. Case
34. Extension to Case Gasket
35. Rear Bearing to Extension Retaining Ring
36. Rear Extension
37. Extension to Case Retaining Bolts and Washers
38. Rear Extension Bushing
39. Rear Seal
40. Thrust Washer
41. Spacer
42. Countergear Shaft Bearings
43. Countergear
44. Countergear Shaft Bearings
45. Spacer
46. Thrust Washer
47. Countergear Shaft
48. Countergear Shaft Key
49. Idler Shaft Key
50. Reverse Idler Shaft
51. Snap Ring
52. Reverse Idler Gear
53. Side Cover Gasket
54. 2-3 Shift Fork
55. 1-Rev Shift Fork
56. 2-3 Shifter Shaft
57. Retaining "E" Ring
58. 1-Rev Shifter Shaft with "O" Ring
59. 2-3 Detent Cam
60. Detent Cam Spring
61. 1-Rev Detent Cam
62. Shift Cover
63. TCS Switch and Gasket
64. Shifter Shaft Seal
65. Shifter Shaft Seal
66. Shift Cover Bolts and Washers
67. Damper Assembly

5013

Fig. 7B-2 3-Speed 76mm Transmission - Exploded View

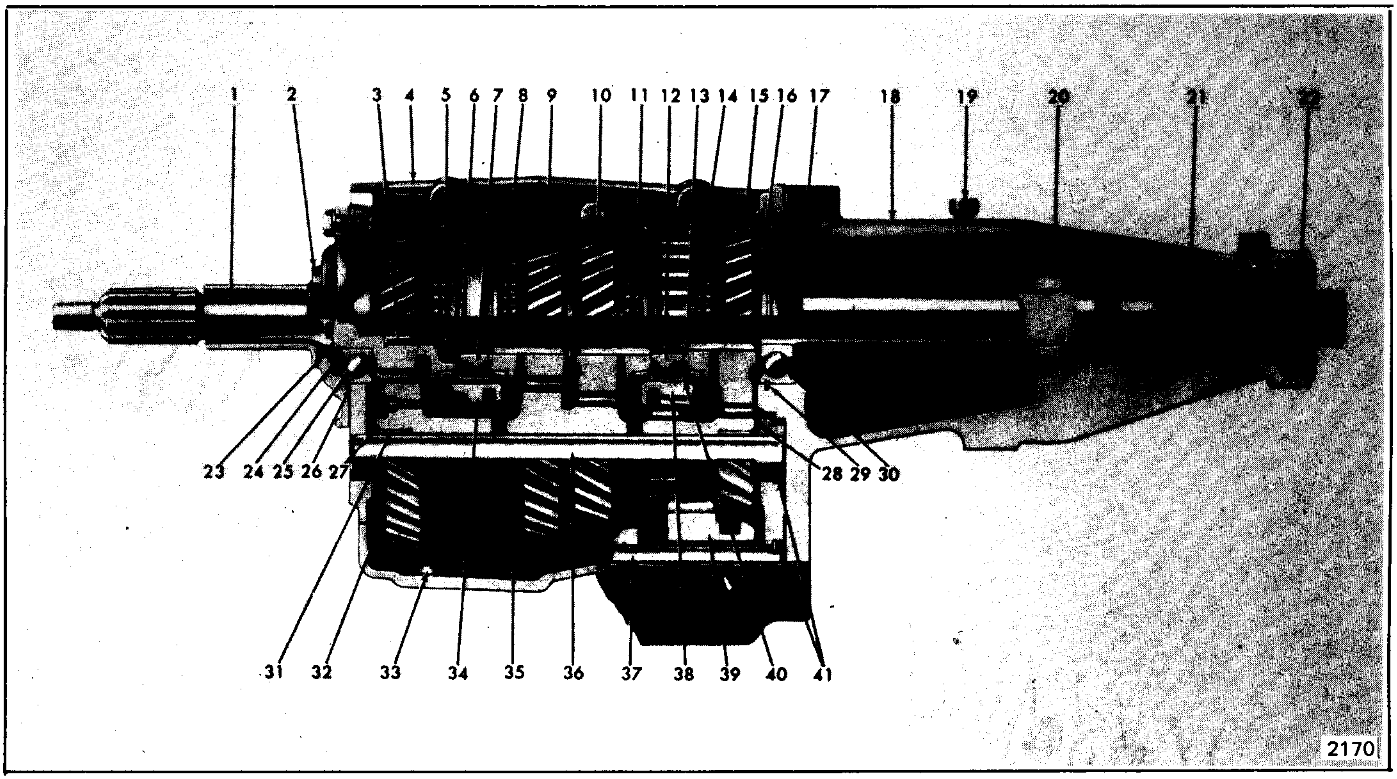
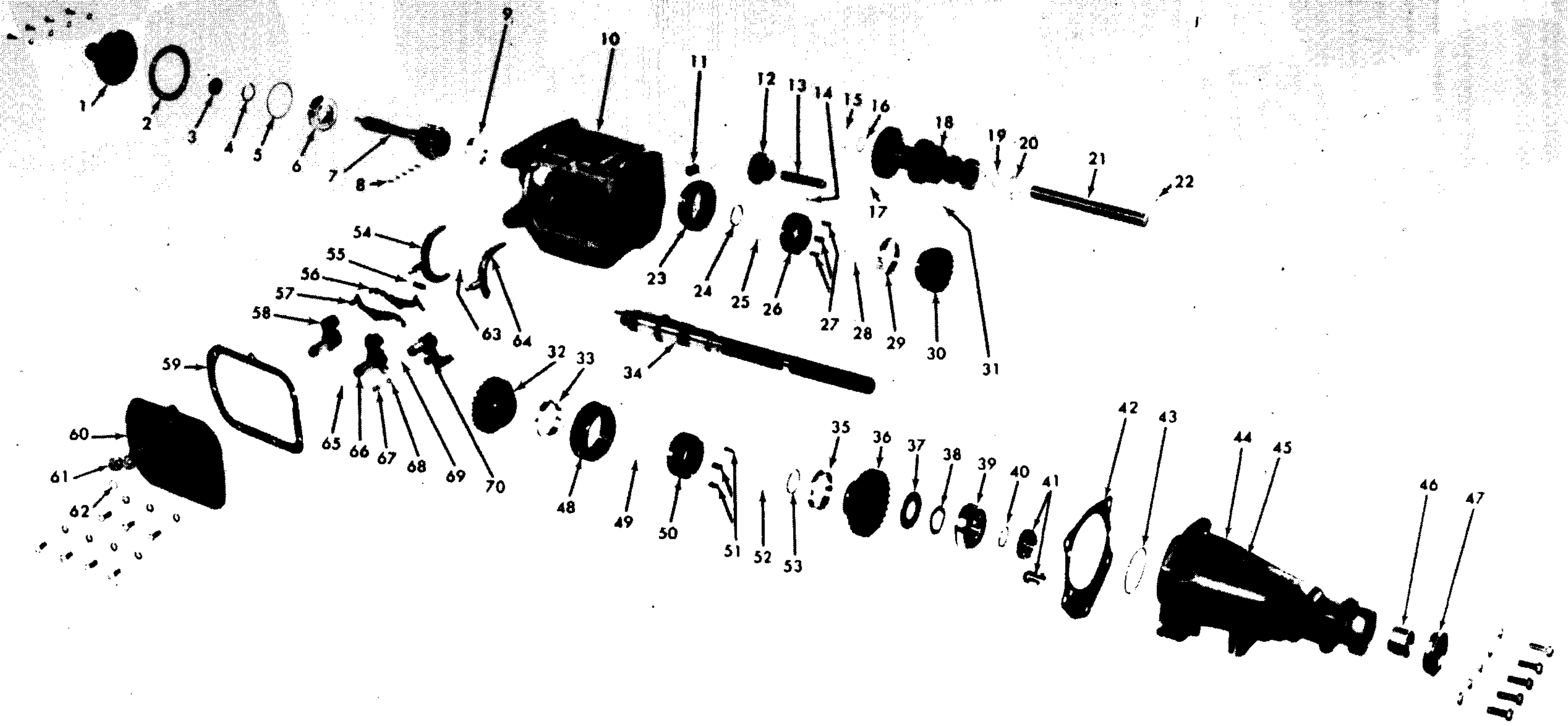


Fig. 7B-3 4-Speed 76mm Transmission - Cross Section



1. Bearing Retainer
2. Gasket-Retainer to Case
3. Oil Seal
4. Snap Ring-Bearing to Shaft
5. Snap Ring-Bearing to Case
6. Drive Gear Bearing
7. Drive Gear
8. Mainshaft Pilot Bearings
9. 4th Speed Blocker Ring
10. Case
11. Filler Plug
12. Reverse Idler Gear
13. Reverse Idler Shaft
14. Woodruff Key
15. Thrust Washer-Front Gear
16. Needle Retainer Washer
17. Needle Bearings
18. Countergear
19. Needle Retainer Washer
20. Thrust Washer-Rear Gear
21. Countershaft
22. Woodruff Key
23. Synchronizer Sleeve
24. Snap Ring-Hub to Shaft
25. Key Retainer
26. 3-4 Synchronizer Hub
27. Clutch Keys
28. Key Retainer
29. 3rd Speed Blocker Ring
30. 3rd Speed Gear
31. Needle Bearings
32. Second Speed Gear
33. 2nd Speed Blocker Ring
34. Mainshaft
35. 1st Speed Blocker Ring
36. First Speed Gear
37. Thrust Washer
38. Wave Washer
39. Rear Bearing
40. Snap Ring-Bearing to Shaft
41. Speedo Drive Gear and Clip
42. Gasket-Extension to Case
43. Snap Ring-Extension to Rear Bearing
44. Extension
45. Vent
46. Bushing
47. Oil Seal
48. 1-2 Synchronizer Sleeve and Reverse Gear
49. Key Retainer
50. 1-2 Synchronizer Hub
51. Clutch Keys
52. Key Retainer
53. Snap Ring-Hub to Shaft
54. 3-4 Shift Fork
55. Detent Spring
56. 3-4 Detent Cam
57. 1-2 Detent Cam
58. 3-4 Shifter Shaft
59. Gasket-Cover to Case
60. Cover
61. TCS Switch and Gasket
62. Lipseal
63. Detent Cam Retainer
64. 1-2 Shift Fork
65. "O" Ring
66. 1-2 Shift Shaft
67. Spring
68. Ball
69. "O" Ring
70. Reverse Shifter Shaft and Fork

5014

Fig. 7B-4 4-Speed 76mm Transmission - Exploded View

4-SPEED 82MM BORG-WARNER TRANSMISSION

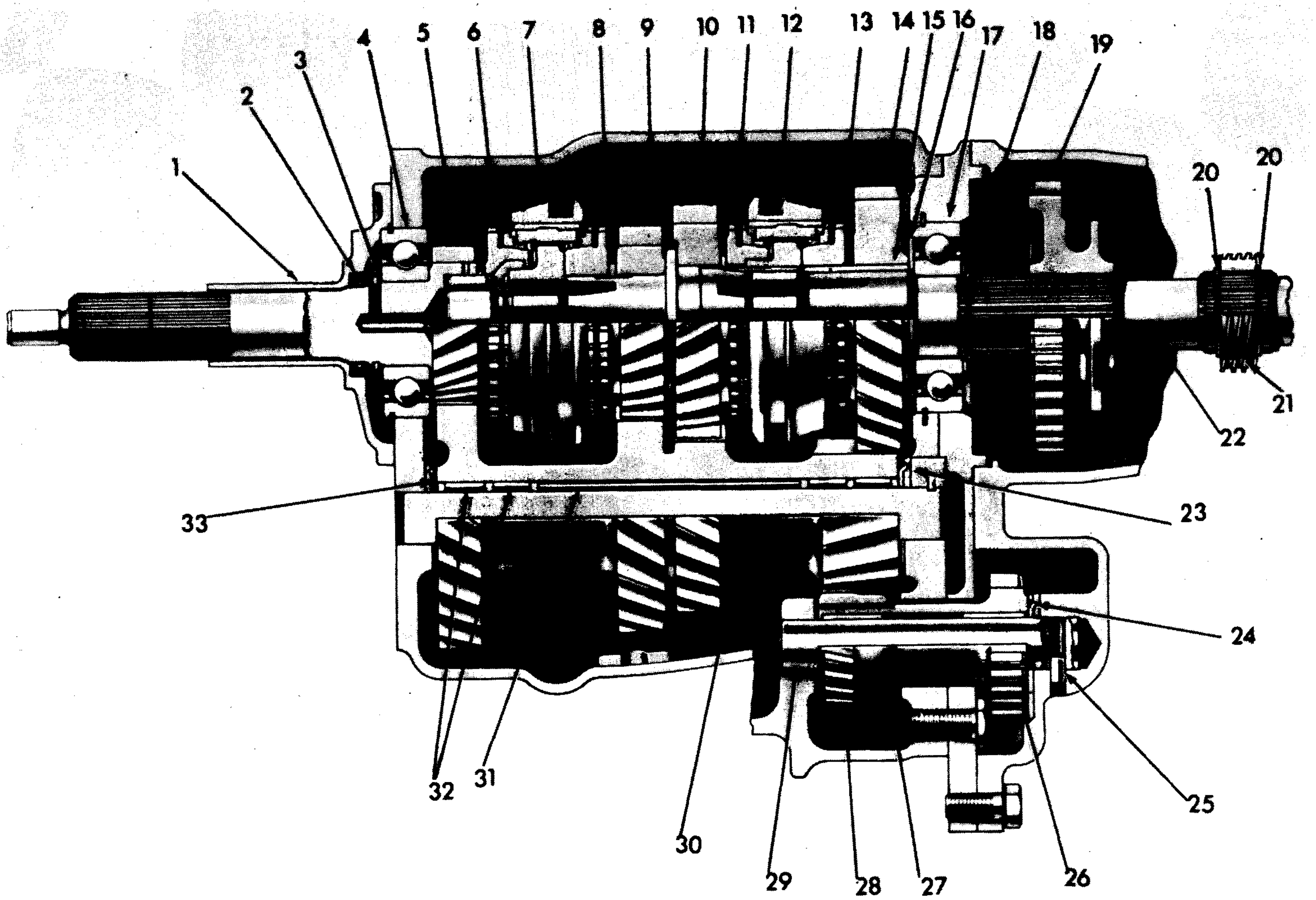
The four-speed Borg-Warner manual transmission is an optional, heavy-duty, floor shift, four-speed manual transmission used on the 400 cu. in. engine, "F" Series.

This four-speed transmission (Fig. 7B-5) consists of two basic sections: the transmission case and the case extension. The transmission case contains the four forward speed gear assemblies and their synchronizing mechanism; the case extension contains the reverse gear assembly.

Gearshifting is manual through a floor-type gearshift lever, which activates shift control rods connected to the transmission cover shifter levers for first through fourth gears and to the reverse lever located in the rear extension. The shifter lever to the rear of the transmission cover controls the 1st and 2nd speed gears, while the lever to the front controls the 3rd and 4th speed gears.

All four forward gears are provided with synchronizing clutches which can be engaged while the car is in motion. Gear ratios of 2.43 (first), 1.61 (second), 1.23 (third), 1.00 (fourth) and 2.35 (reverse) provide excellent ratio matching with minimum loss of engine speed at the shift points. Reverse gear is not synchronized; therefore, vehicle should be brought to a complete stop before engaging reverse gear.

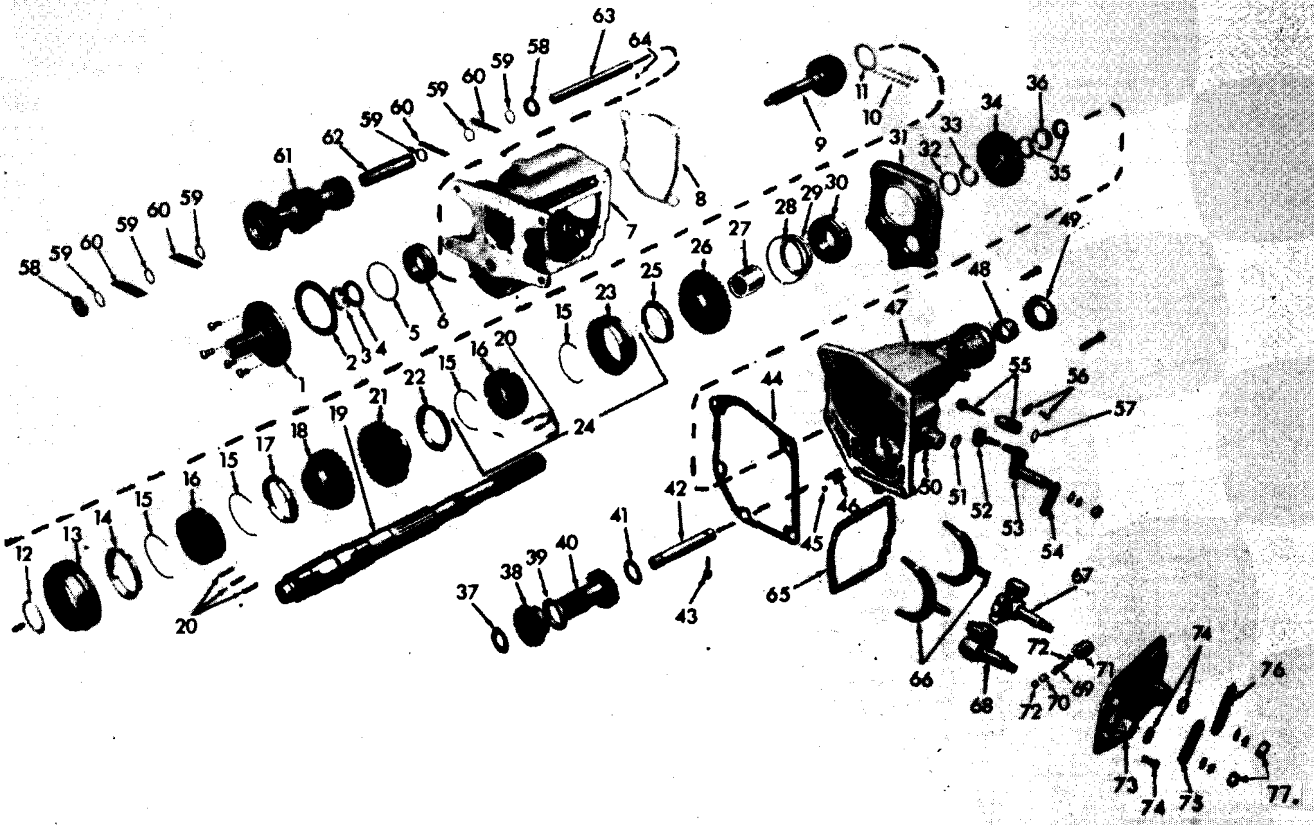
The transmission may be used as an aid in decelerating by downshifting in sequence without double clutching or gear clashing, due to all forward speeds being synchronized.



1	Clutch Gear Bearing Retainer
2	Retainer Lip Seal
3	Snap Ring and Washer
4	Clutch Gear Bearing
5	Clutch Gear
6	4th Speed Synchronizer Ring
7	3rd & 4th Speed Clutch Assy.
8	3rd Speed Synchronizer Ring
9	3rd Speed Gear
10	2nd Speed Gear
11	2nd Speed Synchronizer Ring
12	1st & 2nd Speed Clutch Assy.
13	1st Speed Synochronizer Ring
14	1st Speed Gear
15	1st Speed Gear Bushing
16	Spacer
17	Rear Main Bearing
18	Snap Ring and Washer
19	Reverse Gear
20	Snap Rings
21	Speedometer Gear
22	Mainshaft
23	Thrust Washer
24	Thrust Washer
25	Idler Shaft Roll Pin
26	Rear Idler Gear
27	Spacer
28	Front Idler Gear
29	Reverse Idler Shaft
30	Countergear
31	Countergear Sleeve
32	Countergear Bearing Rollers
33	Thrust Washers

5015

Fig. 7B-5 4-Speed 82mm Transmission - Cross Section



1. Bearing Retainer
2. Gasket
3. Selective Fit Snap Ring
4. Spacer Washer
5. Bearing Snap Ring
6. Main Drive Gear Bearing
7. Transmission Case
8. Rear Bearing Retainer Gasket
9. Main Drive Gear
10. Bearing Rollers (16)
11. Washer
12. Snap Ring
13. Third and Fourth Speed Clutch Sliding Sleeve
14. Fourth Speed Gear Synchronizing Ring
15. Clutch Key Spring
16. Clutch Hub
17. Third Speed Gear Synchronizing Ring
18. Third Speed Gear
19. Mainshaft
20. Clutch Keys (3)
21. Second Speed Gear
22. Second Speed Gear Synchronizing Ring
23. First and Second Speed Clutch Sliding Sleeve
24. First and Second Speed Clutch Assembly
25. First Speed Gear Synchronizing Ring
26. First Speed Gear
27. First Speed Gear Sleeve
28. Rear Bearing Snap Ring
29. Thrust Washer
30. Rear Bearing
31. Rear Bearing Retainer
32. Washer
33. Selective Fit Snap Ring
34. Reverse Gear
35. Snap Ring
36. Speedometer Drive Gear
37. Reverse Idler Front Thrust Washer (Flat)
38. Reverse Idler Gear (Front)
39. Snap Ring
40. Reverse Idler Gear (Rear)
41. Thrust Washer (Tanged)
42. Reverse Idler Shaft
43. Reverse Idler Shaft Lock Pin and Welch Plug
44. Rear Bearing Retainer To Case Extension Gasket
45. Reverse Shifter Shaft Detent Ball
46. Reverse Shifter Shaft Ball Detent Spring
47. Case Extension
48. Extension Bushing
49. Rear Oil Seal
50. Reverse Shifter Shaft Lock Pin
51. Reverse Shifter Shaft Lip Seal
52. Reverse Shift Fork
53. Reverse Shifter Shaft and Detent Plate
54. Reverse Shifter Lever
55. Speedometer Driven Gear and Fitting
56. Retainer and Bolt
57. "O" Ring Seal
58. Washer (Tanged)
59. Spacer (.050")
60. Bearing Rollers (28)
61. Countergear
62. Countergear Roller Spacer
63. Countershaft
64. Countershaft Woodruff Key
65. Gasket
66. Forward Speed Shift Forks
67. First and Second Speed Gear Shifter Shaft and Detent Plate
68. Third and Fourth Speed Gear Shifter Shaft and Detent Plate
69. Poppet Spring
70. Interlock Pin
71. Interlock Sleeve
72. Detent Balls
73. Transmission Side Cover
74. Lip Seals
75. Third and Fourth Speed Shifter Lever
76. First and Second Speed Shifter Lever
77. Lever Attaching Nuts

2192

Fig. 7B-6 4-Speed 82mm Transmission - Exploded View

5-SPEED 77MM BORG-WARNER TRANSMISSION

GENERAL DESCRIPTION

The five-speed Borg-Warner manual transmission is a floor shift transmission and is fully synchronized in all forward gears. Fifth gear is an overdrive, which means that the transmission output shaft turns faster than the input shaft.

The transmission has a single shift rail with the shifting mechanism totally enclosed within the transmission. With this design, the shift mechanism is unaffected by dirt, water and corrosion.

All gears are in constant mesh with the counter gear, including reverse (through the reverse idler gear). When shifting gears, the selected gear is locked to the output shaft through the synchronizer clutch hub.

Overdrive (fifth gear) is obtained by a gear on the output shaft and one of the gears on the counter gear inside the transmission, instead of a bolt-on overdrive as used with some other transmissions.

Automatic transmission fluid is used for lubrication. The capacity of the transmission is 3.5 U.S. pints (56 fluid ounces). When checking the fluid level, remove the fill plug from the right side of the transmission case. Add automatic transmission fluid to bring the level to the bottom of the fill hole.

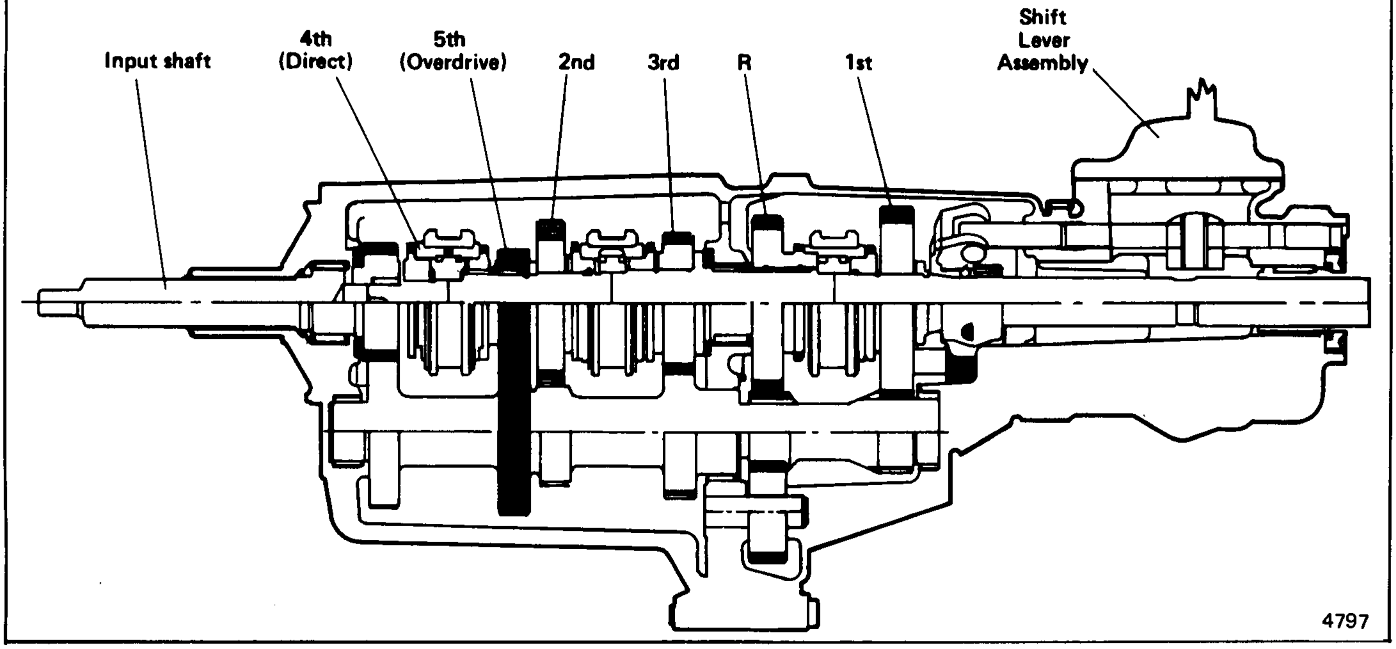


Fig. 7B-7 5-Speed 77mm Transmission - Cross Section

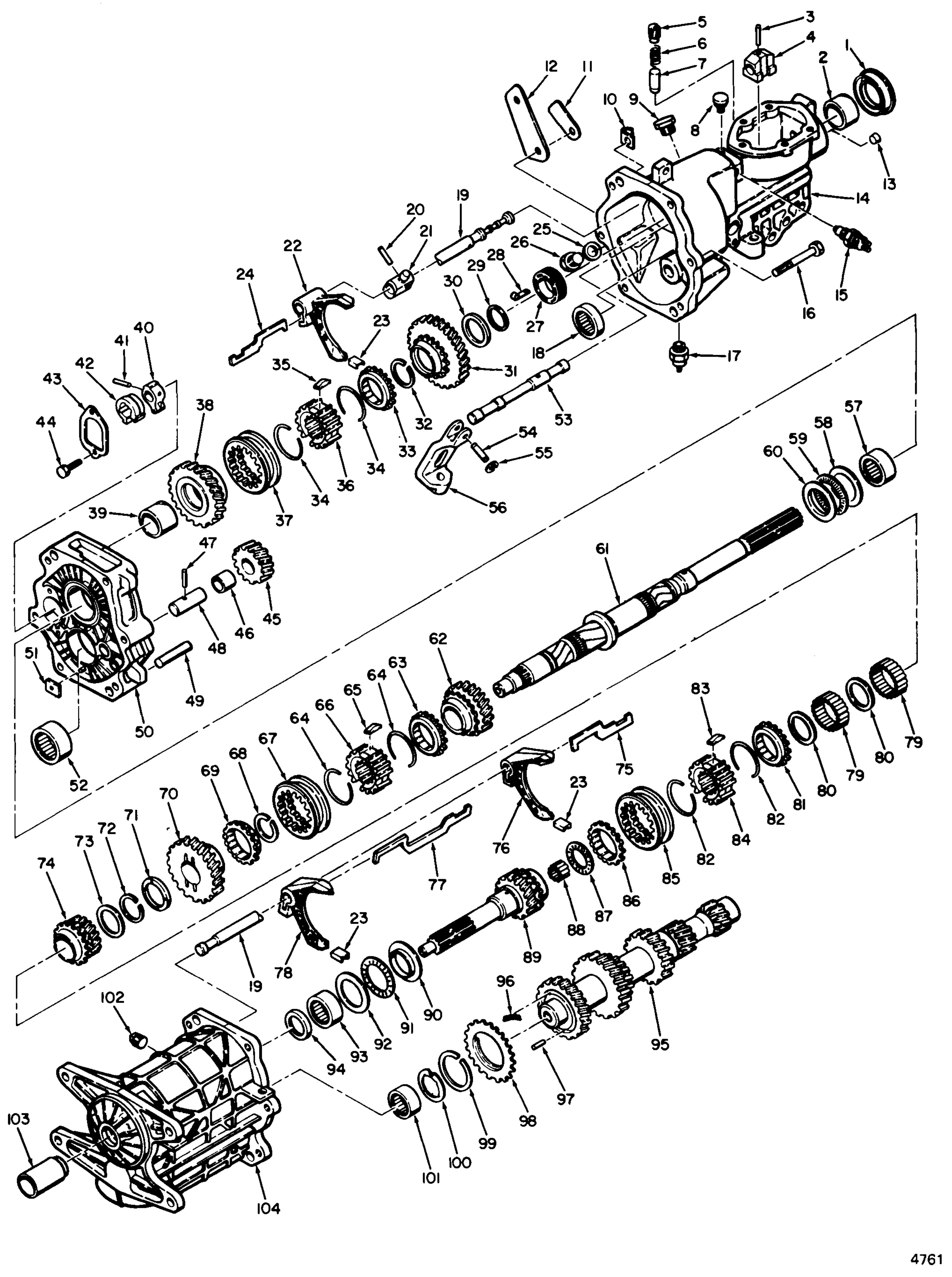


Fig. 7B-8 5-Speed 77mm Transmission - Exploded View

INDEX NO.		DESCRIPTION	INDEX NO.		DESCRIPTION
1		OIL SEAL	57		NEEDLE BEARING
2		BUSHING	58		THRUST WASHER
3		PIN	59		NEEDLE THRUST BEARING
4		SHIFTER HEAD	60		NEEDLE THRUST RACE
5		THREADED PLUG	61		OUTPUT SHAFT
6		POPPET SPRING	62		3RD SPEED GEAR
7		MESH LOCK PLUNGER	63		BLOCKING RING
8		BREATHER	64		SYNCHRONIZER SPRING
9		SELECTOR LEVER PIVOT	65		SYNCHRONIZER SHIFT PLATE
10		WIRING HARNESS CLIP	66		CLUTCH HUB
11		NAME PLATE	67		CLUTCH SLEEVE
12		BACK-UP LIGHT BRACKET	68		SNAP RING
13		CUP PLUG	69		SYNCHRONIZER BLOCKING RING
14		EXTENSION HOUSING	70		2ND SPEED GEAR
15		SWITCH	71		THRUST WASHER
16		3/8-16 x 3-1/4 HEX HEAD BOLT	72		SNAP RING
17		SWITCH	73		SPACER
18		NEEDLE BEARING	74		5TH SPEED GEAR
19		SHIFT RAIL	75		2ND & 3RD SHIFT LINK
20		SPRING PIN	76		2ND & 3RD SHIFT FORK
21		RAIL SELECTOR	77		4TH & 5TH SHIFT LINK
22		FIRST & REVERSE SHIFT FORK	78		4TH & 5TH SHIFT FORK
23		SHIFT FORK PAD	79		NEEDLE ROLLERS
24		FIRST & REVERSE SHIFT LINK	80		SPACER
25		GASKET	81		SYNCHRONIZER BLOCKING RING
26		9/16-18 PLUG	82		SYNCHRONIZER SPRING
27		SPEEDOMETER GEAR	83		SHIFT PLATE
28		SPEEDOMETER GEAR RETAINER	84		CLUTCH HUB
29		SNAP RING	85		CLUTCH SLEEVE
30		THRUST WASHER	86		SYNCHRONIZER BLOCKING RING
31		1ST SPEED GEAR	87		NEEDLE THRUST BEARING
32		SNAP RING	88		NEEDLE ROLLERS
33		BLOCKING RING	89		INPUT DRIVE GEAR
34		SYNCHRONIZER SPRING	90		NEEDLE THRUST PLATE
35		SHIFT PLATE	91		NEEDLE THRUST BEARING
36		CLUTCH HUB	92		THRUST WASHER
37		CLUTCH SLEEVE	93		NEEDLE BEARING
38		REVERSE GEAR & BUSHING ASSEMBLY	94		OIL SEAL
39		BUSHING	95		CLUSTER GEAR
40		SELECTOR ARM	96		SPRING
41		SPRING PIN	97		SPRING PIN
42		INTERLOCK PAWL	98		GEAR DAMPER
43		SELECTOR ARM RETAINING SCREW	99		SNAP RING
44		1/4-20 x 3/4 HEX HEAD SELF TAPPING SCREW	100		THRUST WASHER
45		REVERSE IDLER GEAR & BUSHING	101		NEEDLE BEARING
46		BUSHING	102		1/2 INCH PIPE PLUG
47		SPRING PIN	103		TRANSMISSION CASE SLEEVE
48		REVERSE IDLER SHAFT	104		TRANSMISSION CASE
49		DOWEL PIN			
50		CENTER SUPPORT			
51		MAGNET			
52		NEEDLE BEARING			
53		SHIFT RAIL			
54		PIN			
55		RETAINING CLIP			
56		SELECTOR LEVER			

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Fig. 7B-8A 5-Speed 77mm Transmission - Exploded View - Index

DIAGNOSIS

Before attempting to repair the clutch, transmission or related linkages for any reason other than an obvious failure, the problem and probable cause should be identified. A large percentage of clutch and manual transmission problems are manifested by shifting difficulties such as high shift effort, gear clash and grinding or transmission blockout. When any of these problems occur, a careful analysis of these difficulties should be accomplished and the following checks and adjustments performed in the presented sequence before removing the clutch or transmission for repairs:

A. Clutch Free Pedal Travel

1. The clutch free pedal travel adjustment should be made as outlined in the Clutch and Transmission sections of the Pontiac Service Manual for the specific vehicle insvolved.

2. Check clutch linkage for lost motion caused by loose or worn swivels, deflection of mounting brackets or damaged cordon shaft.

B. Clutch Spin Down Time

1. Run the engine at a normal idle with transmission in neutral and clutch engaged.

2. Disengage the clutch, wait nine seconds and shift the transmission to reverse. No grinding noise should be heard. A grinding noise indicates incorrect clutch adjustment, lost motion clutch misalignment or internal problems such as failed dampers, facings, cushion springs, diaphragm spring fingers, pressure plate drive straps, etc.

SHIFT LINKAGE ADJUSTMENT

A. Column Shift Control

1. Remove the shift control rods from the column levers.

2. Check shift effort at the shift control lever knob (effort should not exceed 2 lbs. with transmission linkage removed).

3. If binding is felt, refer to the adjustment procedure for the steering column lower bearing for Manual Transmission Column Shift as described in the Steering Section of the Pontiac Service Manual.

4. Lubricate all rod and swivel connectors and recheck shift effort after installation.

5. If shift linkage is free from binding, the column levers should be checked for end play. A .005" feeler gage should fit between the levers and control lever.

6. Connect control rods and check steering column control levers for alignment. In neutral, the column control lever tangs should line up with the slot in the main control lever.

B. Floor Shift Control

1. The cross-over from first-second to the third-fourth position on four-speed transmissions and from reverse-first to the second-third position on three-speed transmissions should be smooth without any offset or step.

2. All swivels, rods and mountings should be checked for lost motion and repaired or replaced as necessary. Transmission control levers should be checked for wear and repaired or replaced as necessary.

TRANSMISSION SHIFT EFFORT

A. Transmission Shift Effort Checking Procedures

1. Remove the shift rods at the transmission and align the sleeve, blocker ring and gear by shifting into the offending gear and then back into neutral.

2. Check the torque required to shift into gear with an pound inch torque wrench on the shift lever attaching bolt. If more than the specified torque (see below) is required, the transmission shift lever should be checked for rust or dirt binding the lever.

3. Clean levers, lubricate and recheck the torque value.

NOTE: If, at this point in the procedure, it is found that high shift effort or gear clashing still exists, an anti-chatter lubricant (positraction additive) should be used. The lubricant is available in a 4 oz. plastic bottle and can be squirted into the transmission through the filler plug.

SHIFT EFFORT	3-SPEED 76mm	4-SPEED 76mm	4-SPEED 82mm
LB. IN.	50	80	92

5016

Fig. 7B-9 Shift Effort - Pound Inches

B. Transmission Internal Problems Related to Shift Effort

When the above procedures have been checked and the problem still exists, the transmission will have to be removed and disassembled for further diagnosis. There are three basic types of transmission internal problems reflected by shifting effort.

1. Hard Shifting - The effort to shift is excessive, but the gears engage. The lever moves with excessive effort throughout the entire travel range. If the static shift effort is high (clutch depressed, engine not running), the synchronizer sleeve and hubs should be checked for a tight fit. With the three synchronizer keys removed, the sleeve should be loose on the hub. If the hub and sleeve are not a loose fit, replace the synchronizer assembly.

2. Blockout - The lever moves freely until the synchronizer is engaged. Synchronization should be heard to take place, but the gear will not engage. When it does engage, a double bump is generally felt in the lever.

The synchronized blocker ring can be damaged by excessive force on gear cones that are finished improperly. The blocker ring material may stick to the synchronizer gear cone, causing it to be a yellowish brass color, in streaks, which results in hard shifts when present. The gear cone should be a bright silver color. Polish the gear cone with 400 grit paper to a bright silver when this condition is present. The blocker rings should be replaced if the thread is damaged or worn.

3. Clash - Gear clash is a typical sound which occurs when the sleeve and gear chamfers contact each other in the unsynchronized state. The characteristics of clash are a grating or loud buzzing sound from the transmission. The shift lever load will be lower, but a vibration should be felt. The noise (clash) can be for a short instant or long enough to keep the gear from being engaged. This condition should not be confused with hard shifting or reported as such. Hard shifting and clash are directly opposite conditions. When the clash is slight, the load will build up on the shift lever and then fall off rapidly followed by the grating sound.

If the transmission has been clashing, the sleeve ends should be examined for chipping and burrs. If the sleeves are damaged, the synchronizer assemblies and blocker rings should be replaced. Synchronizer sleeve ends should have an angular surface. The surfaces should be even from side to side and the radii indicated should be very small. Any chipping will require synchronizer replacement.

Check the synchronizer load. When the keys are installed, the spring ends on one side of the hub should be hooked in one key and the spring on the opposite side of the synchronizer should not be hooked on the same key. A definite load should be felt when the sleeve is moved on the hubs with the keys and springs in proper position.

MANUAL TRANSMISSION DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
Slips Out of High Gear	a. Transmission loose on clutch housing	a. Tighten mounting bolts
	b. Shift rods interfere with engine mounts or clutch throw-out lever	b. Replace or bend levers and rods to eliminate interference
	c. Shift linkage does not work freely; binds	c. Adjust and free up shift linkage
	d. Damaged mainshaft pilot bearing	d. Replace pilot bearing
	e. Main drive gear retainer broken or loose	e. Tighten or replace main drive gear
	f. Dirt between transmission case and clutch housing	f. Clean mating surfaces
	g. Misalignment of transmission	g. Refer to TRANSMISSION ALIGNMENT
	h. Stiff shift lever seal	h. Replace seal
	i. Pilot bearing loose in crankshaft	i. See Section 6 for bearing fits
	j. Worn or improperly adjusted linkage	j. Adjust or replace linkage as required
Noisy in All Gears	a. Insufficient lubricant	a. Fill to correct level
	b. Worn countergear bearings	b. Replace countergear bearings and shaft
	c. Worn or damaged main drive gear and countergear	c. Replace worn or damaged gears
	d. Damaged main drive gear or main shaft bearings	d. Replace damaged bearings or main drive gear
	e. Worn or damaged countergear antilash plate	e. Replace countergear
	f. Shift lever boot damaged (5-Speed 77mm Trans.)	f. Replace shift lever boot.
Noisy in High Gear	a. Damaged main drive gear bearing	a. Replace damaged bearing
	b. Damaged mainshaft bearing	b. Replace damaged bearing
	c. Damaged high speed gear synchronizer	c. Replace synchronizer
	d. Damaged fifth speed gear or countergear (5-Speed 77mm Trans.)	d. Replace damaged parts.
Noisy in Neutral with Engine Running	a. Damaged main drive gear bearing	a. Replace damaged bearing
	b. Damaged or loose mainshaft pilot bearing	b. Replace pilot bearings.
	c. Worn or damaged countergear antilash (damper) plate	c. Replace countergear or damper (5-Speed 77mm Trans.)

	d. Worn countergear bearings e. Idle speed too low	d. Replace countergear bearings and shaft e. Adjust idle speed
Noisy in All Reduction Gears	a. Insufficient lubricant b. Worn or damaged main drive gear or countergear	a. Fill to correct level b. Replace faulty or damaged gears
Noisy in First Only (5-Speed 77mm Trans.)	a. Damaged first speed or countergear b. Needle bearing rubbing first speed gear	a. Replace damaged gears b. Replace as necessary
Noisy in Second Only	a. Damaged or worn second-speed constant mesh gears b. Worn or damaged countergear rear bearings c. Damaged or worn second-speed synchronizer	a. Replace damaged gears b. Replace countergear bearings and shaft c. Replace synchronizer
Noisy in Third Only	a. Damaged or worn third-speed constant mesh gears b. Worn or damaged countergear bearings c. Damaged damper gear (5-Speed 77mm Trans.)	a. Replace damaged gears b. Replace damaged countergear bearings and shaft c. Replace damper gear
Noisy in Reverse Only	a. Worn or damaged reverse idler gear or idler bushing b. Worn or damaged reverse gear on mainshaft c. Damaged or worn reverse countergear d. Damaged shift mechanism	a. Replace reverse idler gear assembly b. Replace reverse gear c. Replace countergear assembly d. Inspect linkage and adjust or replace damaged parts
High Pitched Whine* (5-Speed 77mm Trans.)	a. Damaged needle thrust bearing	a. Replace as necessary
Excessive Backlash in all Reduction Gears	a. Worn countergear bearings b. Excessive end play in countergear	a. Replace bearings b. Replace countergear thrust washers
Main Drive Gear Bearing Retainer Burned or Scored by Input Shaft	a. Loose or damaged mainshaft pilot bearing b. Misalignment of transmission	a. Replace bearing. See Section 6 for bearing fit b. Align transmission
Leaks Lubricant	a. Excessive amount of lubricant in transmission b. Loose or broken main drive gear bearing retainer	a. Drain to correct level b. Tighten or replace retainer

*Usually noticeable in all forward gears under drive condition–not noticeable under coast load.

	c. Main drive gear bearing gasket damaged	c. Replace gasket
	d. Side cover loose or gasket damaged	d. Tighten cover or replace gasket
	e. Rear bearing retainer oil seal leaks	e. Replace seal
	f. Countershaft loose in case	f. Replace case
	g. Shift lever seals leak	g. Replace seal
	h. Center support loose, leaks	h. Tighten bolts or replace sealer

SHIFTING DIFFICULTY DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
High Shift Effort-Column Shift (Effort exceeds 2 ft. lbs. at lever knob with transmission linkage disconnected.)	Binding of column levers	Adjust column mechanism per Section 9, Steering. Clean and lubricate all rod and swivel connections.
	Lever end play exceeds .005 in.	Adjust levers
	Misalignment of column control levers.	Adjust levers
High Shift Effort-Floor Shift (3-Speed and 4-Speed Transmissions)	Improper linkage adjustment	Adjust linkage
	Lost motion due to damaged or worn swivels, rods, grommets or mountings.	Repair or replace defective components.
	Loose lever attaching bolts.	Tighten bolts and check levers for correct fit on shifter shafts.
	Binding	Clean and adjust linkage
	Stiff shift lever boot	Replace boot
High Shift Effort - Floor Shift	Shift cover improperly positioned.	Loosen and align-should have side travel in all gears.
(5-Speed 77mm Trans.)	Synchronizers improperly assembled or damaged.	Repair as necessary - spring tang must not touch I.D. of synchronizer hub.
	Shift handle binds	Repair as necessary
	Blocker ring does not release .	Replace ring
	No side travel freedom in 1st & 5th.	Replace shift handle
	Shift handle interfers with top of shifter head.	Add one extra gasket
	Shift rail bent	Replace shift rail

	Hydraulic lock at rear of lower shift rail.	Replace with notched rail
	Synchronizer break away load too high.	Replace synchronizer springs
	Ball on rail selector too large.	Replace rail selector end
	Rail selector installed backwards.	Re-install correctly
Gear Clash and Binding	Improper linkage adjustment.	Adjust shift linkage
Lost Motion	Loose or worn swivels and grommets. Deflection of Mounting Brackets. Loose shift levers. Damaged Cordon Shaft	Replace defective parts
Jumps out of gear (5-Speed 77mm Trans.)	Boot improperly installed on shift handle.	Push boot down to proper position.
	Weak poppet spring	Replace
	Shift fork pads worn	Replace pads and shift fork
	Synchronizer hub loose on shaft.	Replace as necessary
	Too much input gear end play.	Install proper thrust plates & needle on input & output shafts.
	Clutch teeth on speed gear or synchronizer sleeve damaged.	Replace as necessary
	Clutch housing out of alignment.	Align as necessary

MAINTENANCE AND ADJUSTMENTS

CHECKING TRANSMISSION MOUNTS

Raise the car on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottomed out), replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

LINKAGE ADJUSTMENT

Column Mounted Shift-A & X Series (Fig. 7B-10)

1. Place column shift lever in the "Reverse" position and ignition switch in the "LOCK" position.
2. Raise vehicle on hoist.
3. Loosen shift control rod swivel lock nuts. Pull down slightly on 1st/Reverse control rod attached to column lever to remove any slack in column mechanism and then tighten lock nut at transmission lever.
4. Unlock ignition switch and shift column lever to the "Neutral" position. Position column lower levers in "Neutral" position, align gage holes in levers and insert 3/16" gage pin.

NOTE: Alignment holes are on the lower side of the levers.

5. Support rod and swivel to prevent movement of the assembly and tighten 2nd/3rd shift control rod lock nut.
6. Remove alignment tool from column lower levers and check shift operation. Then place the column shift lever in "Reverse" and check the interlock control.

NOTE: With shift lever in "Reverse" the ignition key must move freely to "Lock" position. It must not be possible to obtain "Lock" position in "Neutral" or any other gears than "Reverse".

7. Lower and remove vehicle from hoist.

Floor Mounted Shift-F & X Series (Figs. 7B-11 through 7B-14)

1. Place ignition switch in "OFF" position. Raise vehicle on hoist.

2. Loosen locknuts at swivels on the shift rods. Rods should pass freely through swivels.

3. Set shift levers into neutral at the transmission.

4. Move shift control lever in the neutral detent position, align control assembly levers and insert 3/16" locating gage into lever alignment slot.

5. Tighten locknuts at shift rod swivels and remove locating gage. Discard gage.

6. Shift transmission control lever into reverse and place ignition switch in "LOCK" position. Loosen locknut at back drive control rod swivel, then pull down slightly on rod to remove any slack in the column mechanism and tighten clevis jam nut.

7. Check interlock control. The ignition key should move freely to and from the "LOCK" position. Readjust back drive control rod, if necessary.

8. Check transmission shift operation. Readjust shift controls, if necessary. Lower and remove vehicle from hoist.

Floor Mounted Shift-H Series (Fig. 7B-15)

1. Turn ignition switch to the "OFF" position and raise vehicle on hoist.

2. Loosen lock nuts at swivels on the shift rods. Rods should pass freely through the swivels.

3. Set transmission shift levers in neutral.

4. Set shift control lever in neutral position. Align control levers and install 3/16" gage pin into levers and bracket.

5. Tighten 1st-2nd shift rod nut against swivel. Torque to 120 lb. in.

6. Tighten 3rd-4th shift rod nut against swivel. Torque to 120 lb. in.

7. Tighten reverse shift control rod nut. Torque to 120 lb. in.

8. Remove gage pin from control lever assembly and check operation of control lever. Readjust as required.

9. Lower and remove vehicle from hoist.

FLOOR MOUNTED SHIFT BACK DRIVE CONTROLS

(Figs. 7B-12 and 7B-14)

1. Shift transmission into "Reverse" position and place ignition switch in the "LOCK" position.

2. Raise vehicle on hoist.

3. Loosen back drive control rod swivel lock nut and pull down on the rod slightly to remove any slack in the column mechanism, then tighten the clevis jam nut.

4. Check interlock control. Ignition switch should move freely through the "LOCK" position. If binding, leave control LOCKED and readjust rod at bell crank.

5. Lower and remove vehicle from hoist.

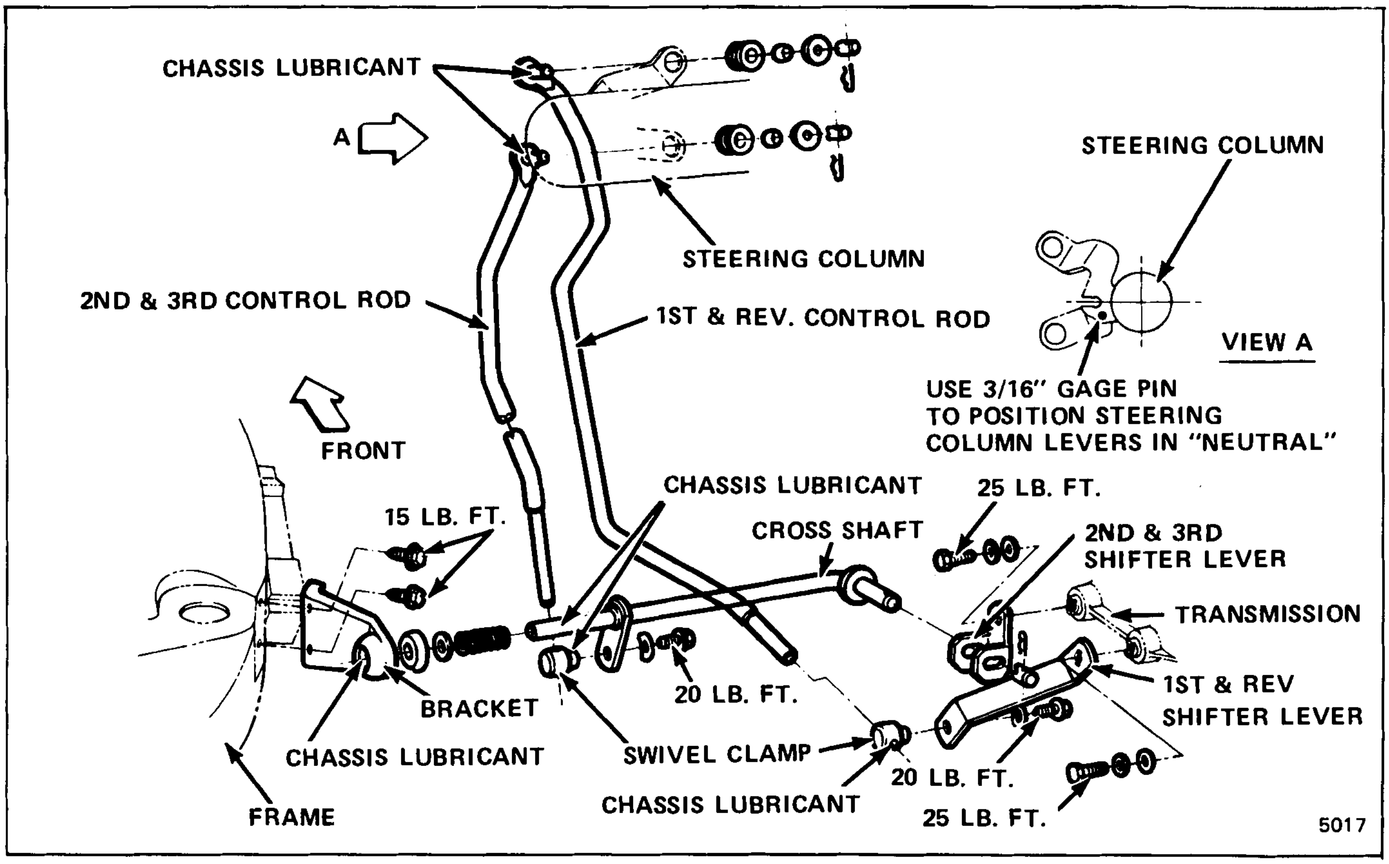


Fig. 7B-10 Column Shift Linkage (Typical)

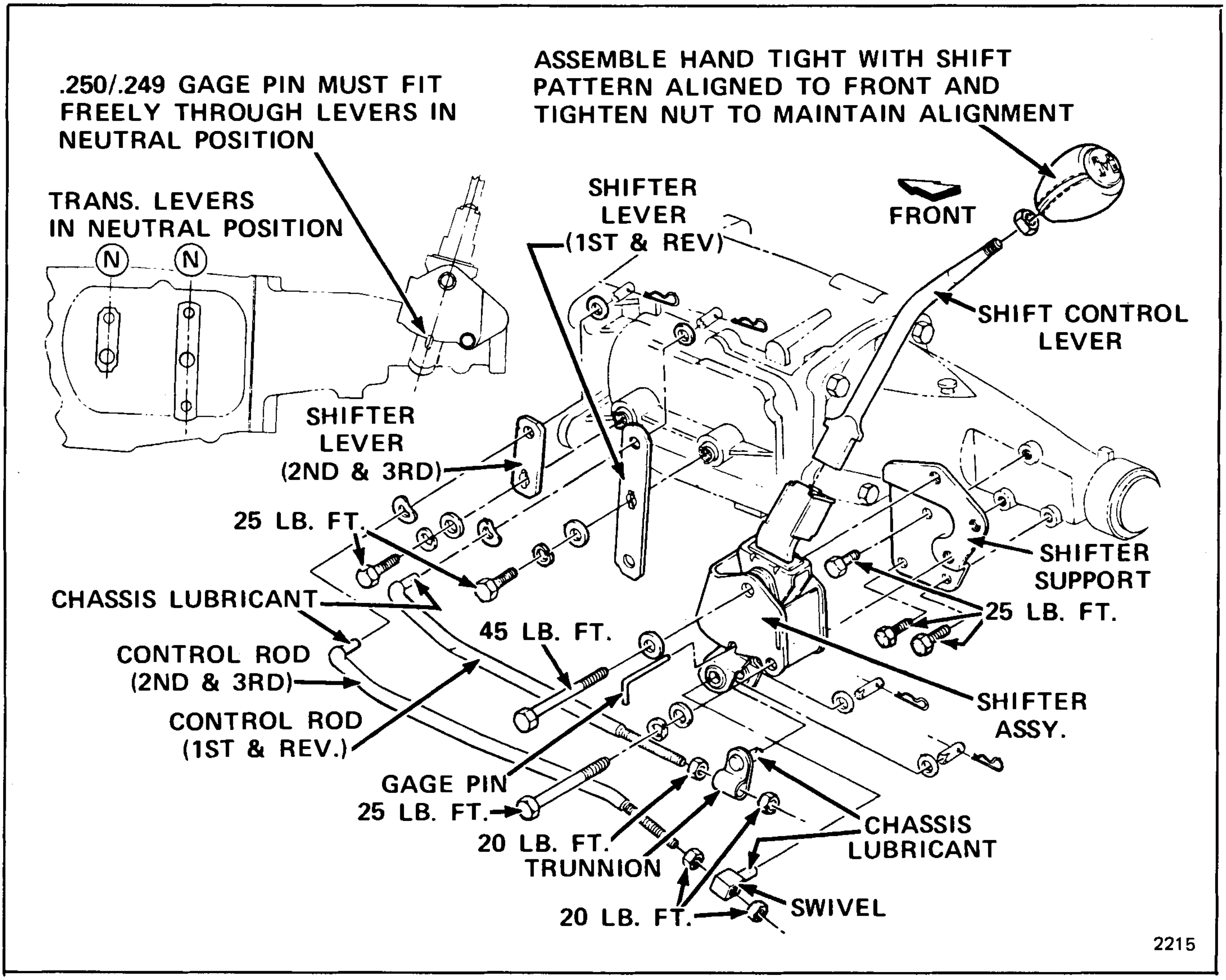


Fig. 7B-11 3-Speed Floor Shift Controls (Typical)

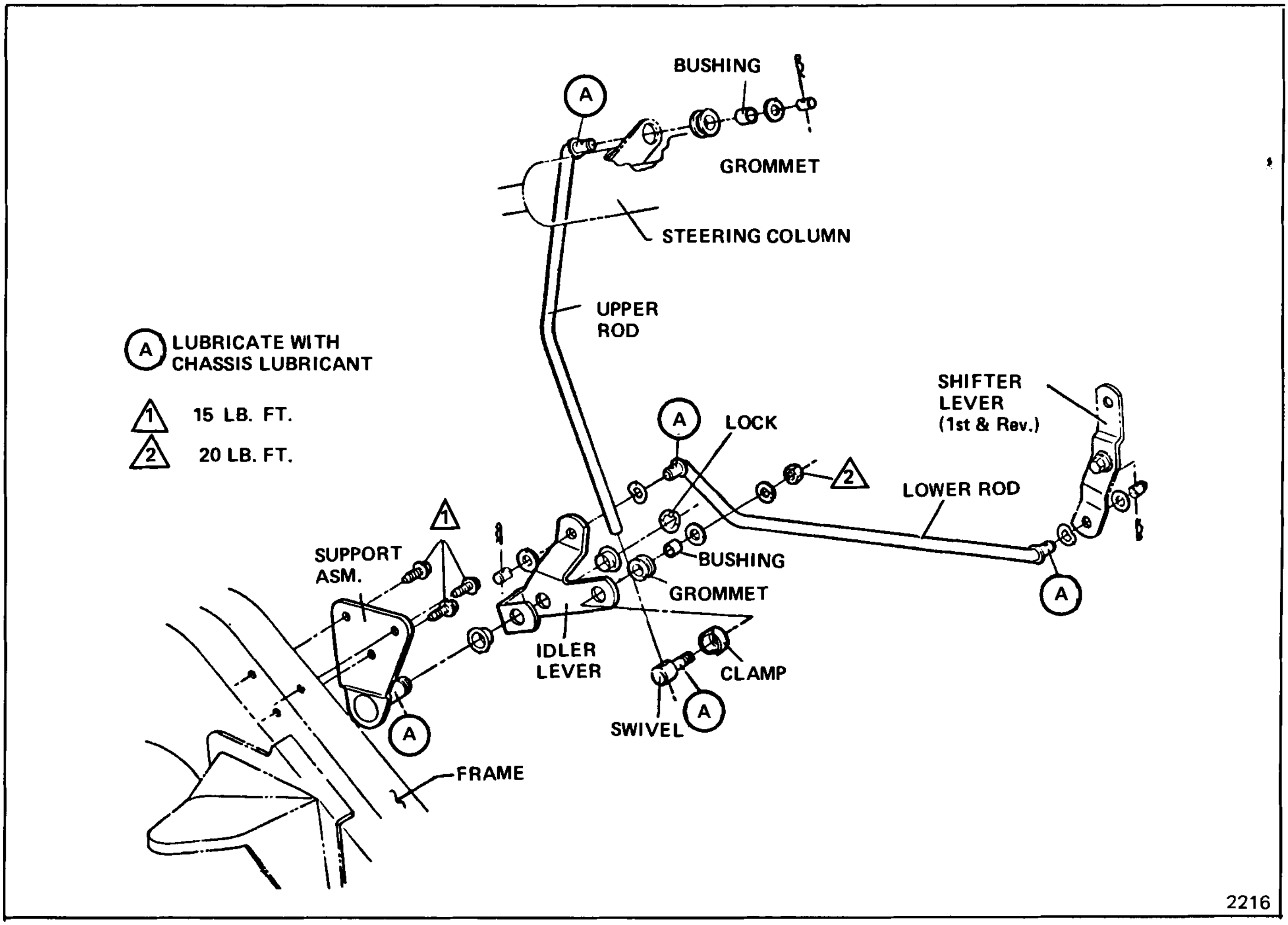
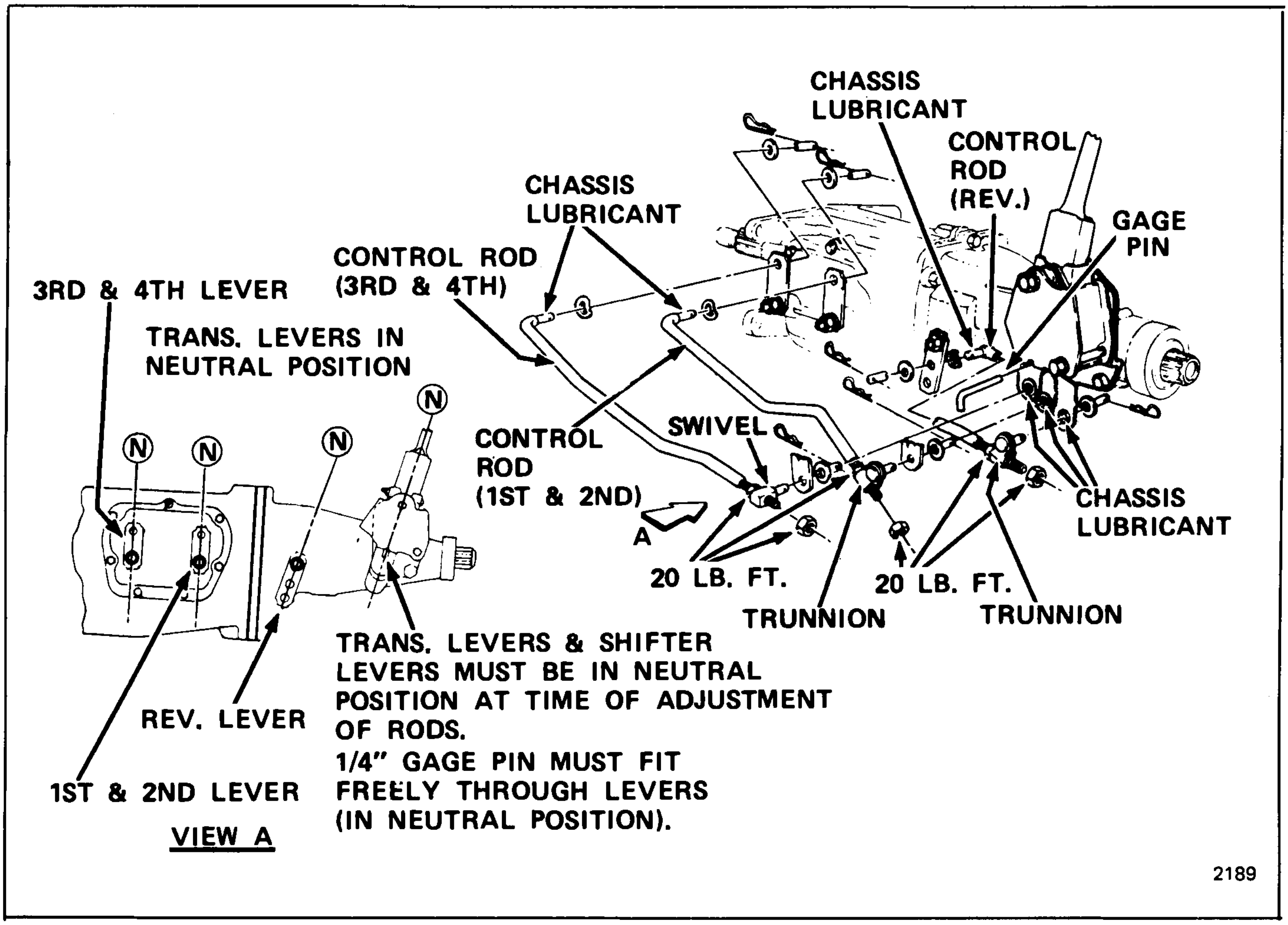


Fig. 7B-12 3-Speed Floor Shift Back Drive Controls (Typical)



TRANS. LEVERS & SHIFTER LEVERS MUST BE IN NEUTRAL POSITION AT TIME OF ADJUSTMENT OF RODS.

1/4" GAGE PIN MUST FIT FREELY THROUGH LEVERS (IN NEUTRAL POSITION).

Fig. 7B-13 4-Speed Floor Shift Controls (Typical)

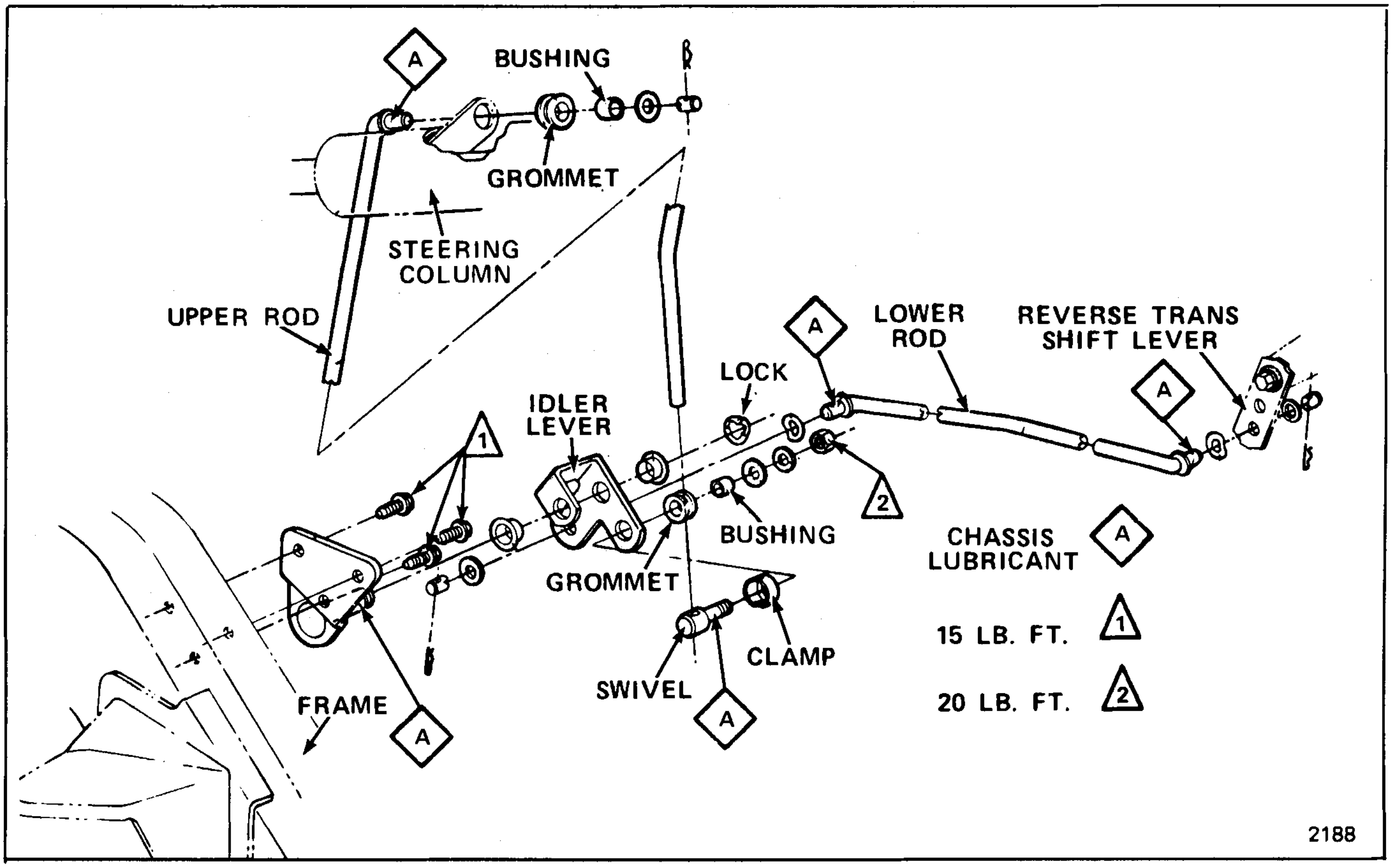


Fig. 7B-14 4-Speed Floor Shift Back Drive Controls (Typical)

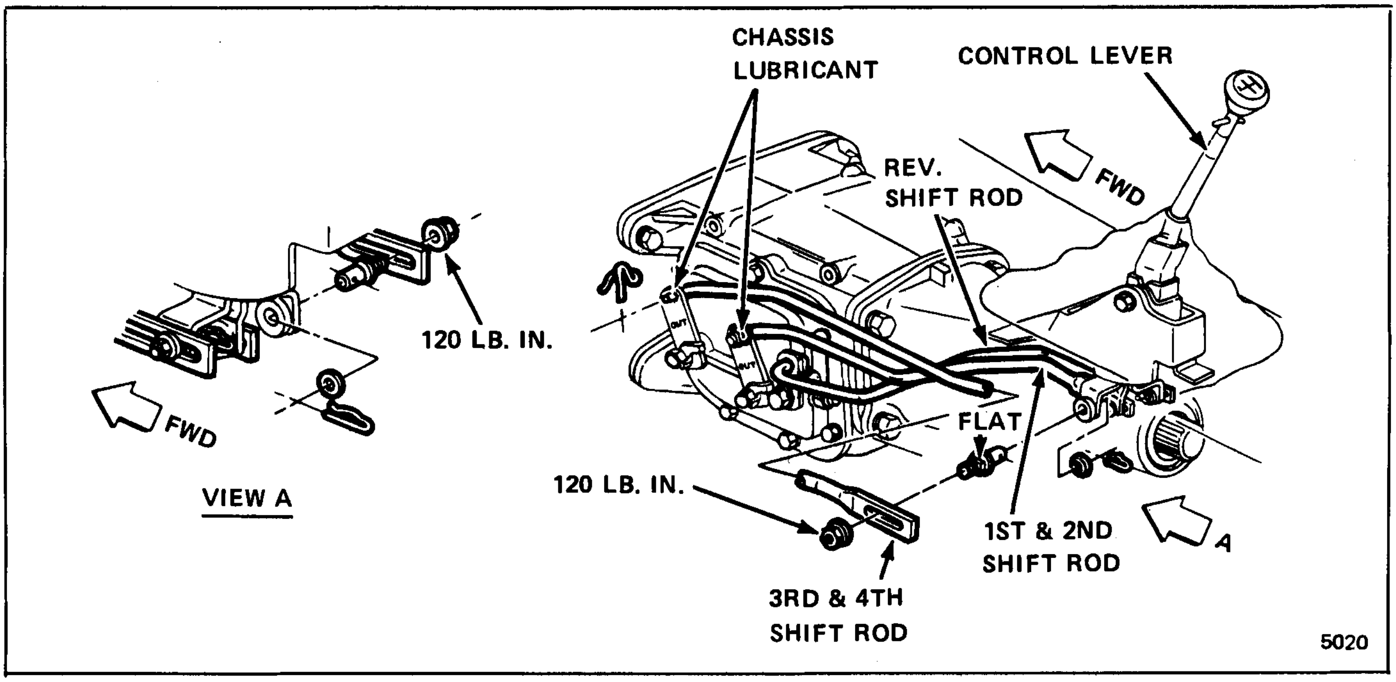


Fig. 7B-15 4-Speed Floor Shift Controls - H Series

"ON-CAR" SERVICE

3-SPEED 76MM LT. DUTY MUNCIE TRANSMISSION

REAR EXTENSION OIL SEAL - R & R

Before raising vehicle, disconnect battery and release parking brake.

1. Raise vehicle on hoist and remove propeller shaft as outlined in Section 4A.
2. Remove oil seal by prying out with screwdriver.
3. Wash counterbore with cleaning solvent and inspect for damage.
4. Inspect propeller shaft yoke for nicks, burrs or scratches which could cut new seal or cause seal to leak or damage bushing.
5. Coat new seal with sealing compound and start new seal in opening.
6. Place Collar J 6403-2 onto Installer J 6403-1 and over end of mainshaft (Fig. 7B-16).

NOTE: Flat side of J 6403-2 must be toward rear of J 6403-1.

7. Tap end of tool with soft hammer to seat oil seal and re-install propeller shaft.

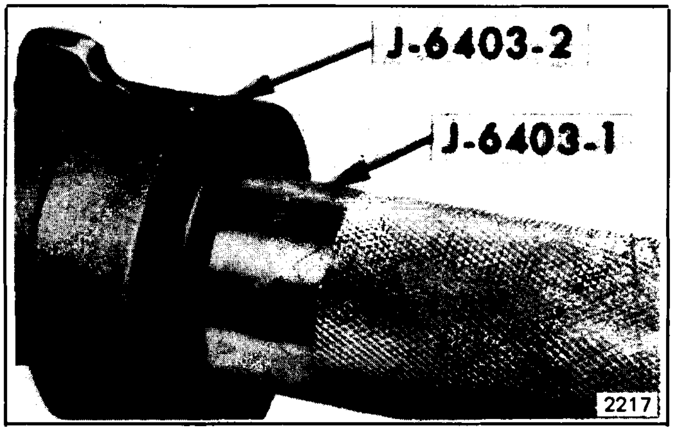


Fig. 7B-16 Installing Rear Extension Oil Seal

REAR EXTENSION BUSHING - R & R

Before raising vehicle, disconnect battery and release parking brake.

1. Raise vehicle on hoist and remove propeller shaft as outlined in Section 4A.
2. Inspect Remover J 4830-02 over mainshaft and tighten screw.
3. Attach Slide Hammer J 2619 (Fig. 7B-17) and, using hammer, pull bushing and oil seal from rear extension.
4. Start new bushing into rear extension and, using Installer J 64031-1 and a soft hammer, tap bushing into place (Fig. 7B-18).
5. Install new oil seal, using Installer J 6403-1 and Collar J 6403-2 (Fig. 7B-16), tapping end of installer with soft hammer to seat oil seal.
6. Re-install propeller shaft.

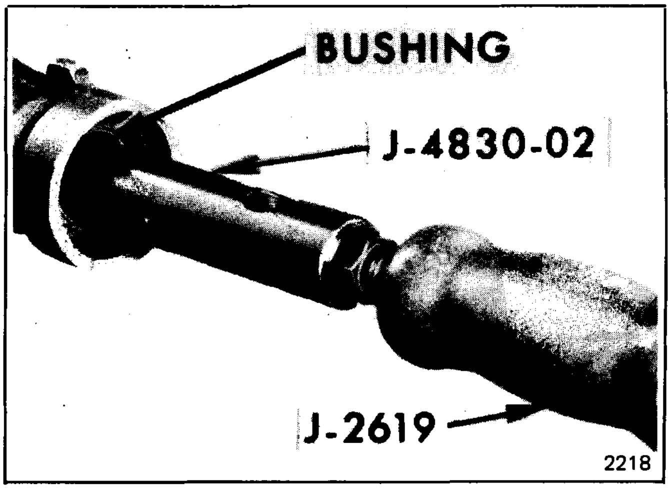


Fig. 7B-17 Removing Rear Extension Bushing

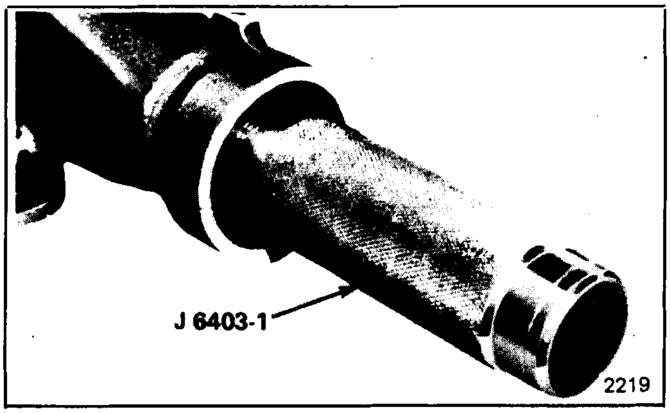


Fig. 7B-18 Installing Rear Extension Bushing

CASE COVER - R & R

Before raising vehicle, disconnect battery and release parking brake.

1. After shifting transmission into neutral, raise vehicle on hoist.
2. Loosen case cover bolts and allow transmission fluid to drain.
3. Disconnect control rods from shifter levers, remove bolts and case cover from transmission case.
4. Disassemble cover by removing outer shifter levers, detent cam spring, shift forks, shifter shafts, detent cam retainer ring and detent cams (Fig. 7B-19).
5. Inspect all parts and seals and replace if necessary.
6. Install shifter shaft seals, detent cams, detent cam retainer ring, shifter shafts, shift forks and detent cam spring.

NOTE: Detent cams, shifter shafts and shift forks are interchangeable.

7. Install new gasket and attach case cover to transmission case.

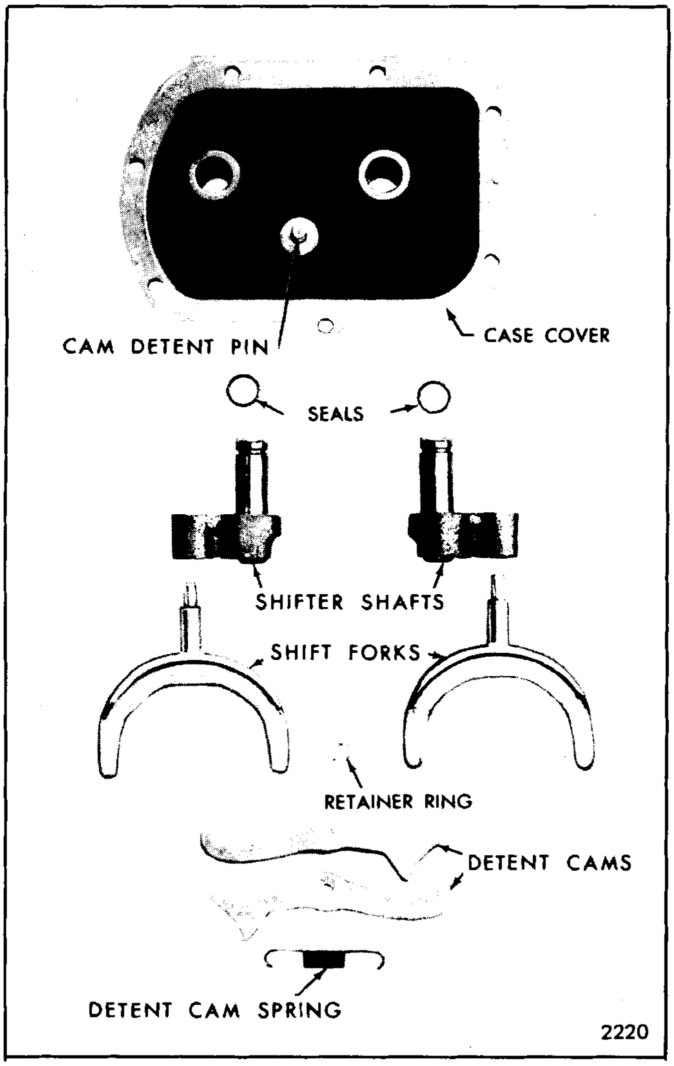


Fig. 7B-19 Transmission Case Cover - Exploded View

8. Connect control rods to shifter levers and to shifter shafts.

9 Refill transmission to proper level, check transmission operation and adjust linkage as required.

SPEEDOMETER DRIVEN GEAR - R & R

1. Raise vehicle on hoist.
2. Disconnect speedometer cable, remove lock plate-to-extension bolt and lock washer and remove lock plate.
3. Insert screwdriver on lock plate slot in fitting and pry fitting, gear and shaft from rear extension. Pry "O" ring seal from groove in fitting.
4. Inspect parts and replace as necessary.
5. Install new "O" ring seal in groove in fitting. Coat "O" ring and driven gear shaft with transmission lubricant and insert shaft into fitting.
6. Hold assembly so that slot in fitting is toward lock plate boss on rear extension and install assembly into extension. Push fitting into extension until lock plate can be inserted in groove and attached to extension.
7. Lower and remove vehicle from hoist.

4-SPEED 76MM LT. DUTY MUNCIE TRANSMISSION

REAR EXTENSION OIL SEAL - R & R

Before raising vehicle, disconnect battery and release parking brake.

1. Raise vehicle on hoist and remove propeller shaft as outlined in Section 4A.
2. Pry out oil seal with screwdriver.
3. Wash counterbore and inspect for damage.
4. Coat new seal with sealing compound and press seal carefully into place in rear extension, using Installer J 5154 or J 21426.
5. Reinstall propeller shaft and lower vehicle from hoist.

REAR EXTENSION BUSHING - R & R

Refer to procedure under 3-SPEED LT. DUTY MUNCIE TRANSMISSION.

CASE COVER - R & R

Before raising vehicle on hoist, disconnect battery and release parking brake.

1. Raise vehicle on hoist and disconnect control rods from shifter levers. Disconnect back-up lamp at cover.
2. Shift transmission into neutral and remove bolts and case cover from transmission case, allowing transmission fluid to drain.
3. Remove outer shifter levers and both shift forks from shifter shaft assemblies. Remove all three (3) shifter shaft assemblies from case cover. Remove reverse shifter shaft detent ball and spring (Fig. 7B-20).

NOTE: The 3rd-4th shifter shaft lip seal in the case cover and "O" ring seal on 1st-2nd shifter shaft may now be replaced if required because of damage.

4. Remove detent cam spring and pivot retainer "C" ring. Mark to identify for reassembly, then remove both detent cams.

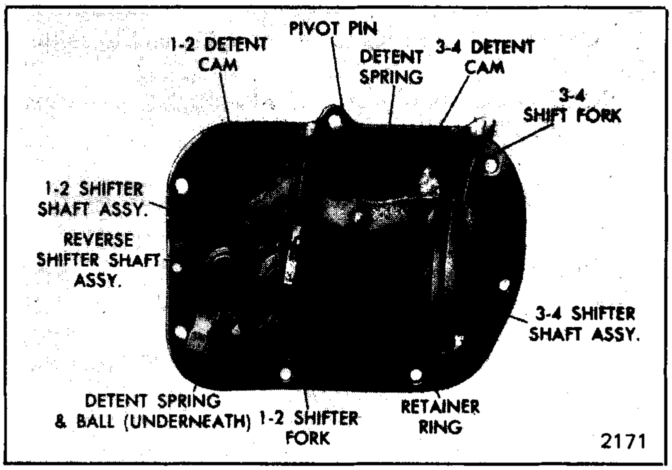


Fig. 7B-20 Transmission Case Cover Assembly

5. Inspect and replace damaged parts.

6. With detent spring tang projecting up over 3rd-4th shifter shaft cover opening, install 1st-2nd detent cam onto cam pivot pin. With detent spring tang projecting up over 1st-2nd shifter shaft cover hole, install 3rd-4th detent cam.

NOTE: 1st-2nd detent cam has .090" greater contour on inside detent notch.

7. Install detent cam retaining "C" ring to pivot pin and hook detent spring into detent cam notches.

8. Install 1st-2nd and 3rd-4th shifter shafts into case cover, being careful not to damage seals. Install both shift forks to shifter shafts, lifting up on detent cams to allow forks to fully seat.

9. Install reverse detent ball and spring to case cover, then install reverse shifter shaft assembly to case cover.

10. Install outer shifter levers, flat washers, lock washers and bolts to case cover. Position shifter levers into neutral detent (center) position and position cover gasket on case.

11. Carefully position case cover assembly into place, making sure that shift forks are aligned to respective sliding sleeves.

12. Install case cover attaching bolts and tighten evenly to 22 lb. ft. torque. Connect control rods to shifter levers at case cover.

13. Remove filler plug and add lubricant as necessary to level of filler plug hole. Lower and remove vehicle from hoist. Check transmission operation and adjust linkage as required.

SPEEDOMETER DRIVEN GEAR - R & R

Refer to procedure under 3-SPEED LT. DUTY MUNCIE TRANSMISSION

SHIFT CONTROL ASSEMBLY - R & R

("H" Series Only)

1. Remove control lever knob, lock nut, spring and reverse release handle.

2. Remove boot retainer, boot and insulator.

3. Pull back edge of carpeting and remove control assembly attaching bolts.

4. Raise vehicle on hoist. Remove retaining pins and disconnect control rods from shift control levers. Remove 3-4 swivel from lever.

5. Disconnect speedometer cable and back-up lamp switch from transmission.

6. Push 1st-2nd and reverse control rods up to floor pan. Move shift control assembly rearward and to left until it clears rear extension, then tip rear of shift control assembly downward and remove shift control assembly from vehicle.

7. To install, position shift control assembly with lower seal in floor pan opening and install bolts attaching shift control assembly to floor pan.

8. Install insulator, upper seal and retainer, reverse release handle and spring.

9. Install lock nut and lever knob.

10. Install 3-4 swivel and connect control rods to shift control levers.

11. Connect speedometer cable and back-up light switch to transmission.

12. Check and adjust shift linkage as required, lower and remove vehicle from hoist.

SHIFT CONTROL ASSEMBLY - REPAIR

(Fig. 7B-21)

1. Remove shift lever shaft retainer and shaft from control lever housing. Then, remove shift control lever assembly from control lever housing.

2. Note position of spacers in relation to shift levers and remove spacers and shift levers from control lever housing.

3. Remove spring bracket and spring from shift control lever assembly.

4. Remove retainer and control lever pivot pin from shift control lever assembly and separate control lever bracket from shift control lever.

5. Clean and inspect all components. Replace all worn, cracked or broken parts as necessary.

NOTE: If necessary to remove reverse lever adjusting screw, grind or chisel off the weld and remove screw from control lever bracket.

6. If adjusting screw were removed, position shift control lever into control lever bracket and install pivot pin and retainer. Install reverse lever adjusting screw but do not weld at this time.

NOTE: Lubricate all levers and spacers with water repellant-type of lubricant such as lubriplate or equivalent.

7. Install shift levers and spacers in control lever housing.

8. Install spring bracket and spring in control lever bracket and shift control lever assembly into control lever housing, making sure lever engages shift levers.

9. Install shift lever shaft and retainer.

10. If removed, adjust reverse lever adjusting screw as follows:

a. Position shift control lever in 1st-2nd shift lever and touching interlock plate spacer between 1st-2nd and reverse shift levers.

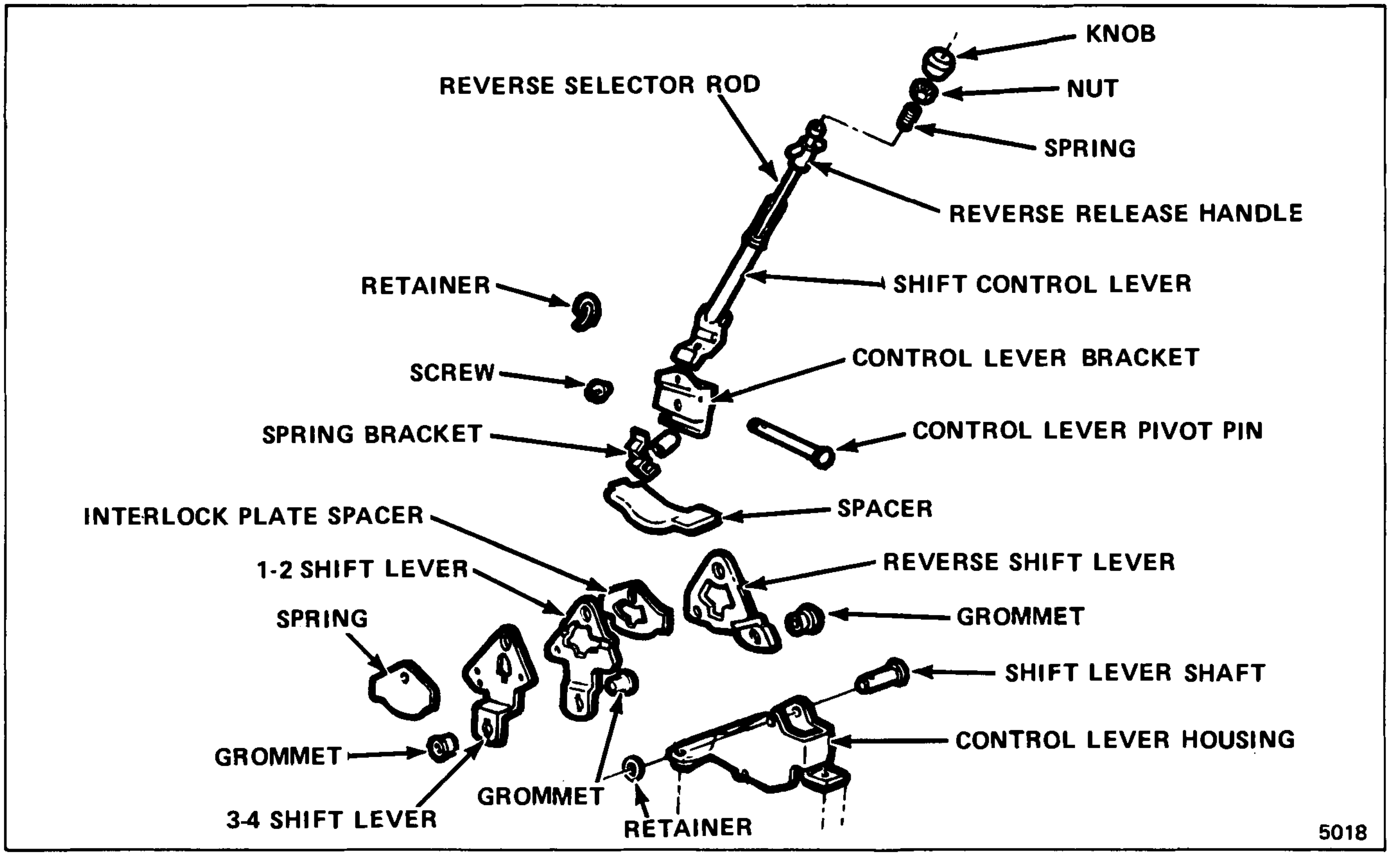


Fig. 7B-21 Shift Control Assembly - Exploded View ("H" Series Only)

b. Hold reverse selector rod against the adjusting screw, tightening screw to eliminate any contact of the control finger as it travels across neutral gate of interlock plate spacer.

c. Weld screw securely in place.

4-SPEED 82MM BORG-WARNER TRANSMISSION

REAR EXTENSION OIL SEAL - R & R

Before raising vehicle, disconnect battery and release parking brake.

1. Raise vehicle on hoist and remove propeller shaft as outlined in Section 4A.
2. Use punch, or other suitable tool, to loosen oil seal from extension, remove and discard.
3. Wash counterbore with cleaning solvent and inspect for damage.
4. Inspect propeller shaft yoke for nicks, burrs or scratches which could cut new seal, cause seal to leak or damage bushing.
5. Coat new seal with sealing compound and press straight into bore of extension with Installer J 21359.

CAUTION: *Do not excessively force seal against seat in extension.*

6. Reinstall propeller shaft.

CASE COVER - R & R

Before raising vehicle, disconnect battery and release parking brake.

1. Raise vehicle on hoist and disconnect control rods from shifter levers.
2. Shift transmission into second speed by moving 1st-2nd shifter lever into forward detent position.
3. Loosen case cover bolts and allow transmission to drain.
4. Remove case cover from transmission and remove both shift forks from shifter shafts.
5. Remove shifter lever nuts, lockwashers and flat washers from case cover assembly. Then, pull shifter levers from shifter shafts.
6. Slowly push shifter shafts into case cover, allowing detent balls (2) to fall free and then remove both shifter shafts (Fig. 7B-22). Note that 3rd-4th shifter shaft has a detent cavity on its shaft.
7. Remove interlock sleeve, poppet spring and lock pin. If found to be leaking, pry out shifter shaft lip seals (2) from case cover and discard them.
8. Inspect all parts and seals and replace as required.
9. If removed, install new lip seals into shifter shaft openings in case cover.
10. Insert 3rd-4th shifter shaft (contains detent cavity on its shaft) into forward bore of cover, place it in neutral and then install detent ball, interlock sleeve and poppet spring with its lock pin in position.

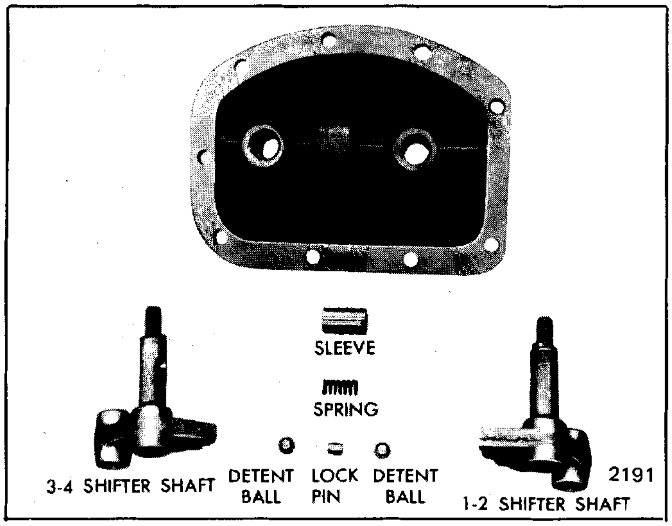


Fig. 7B-22 Transmission Case Cover - Exploded View

11. Insert other detent ball into other end of interlock sleeve and, while depressing ball, insert 1st-2nd shifter shaft into cover and place it in second gear position.

12. Install shift forks, position new gasket on case (do not coat with grease) and carefully position case cover assembly into place, making sure shift forks are aligned with their respective synchronizer sleeves.

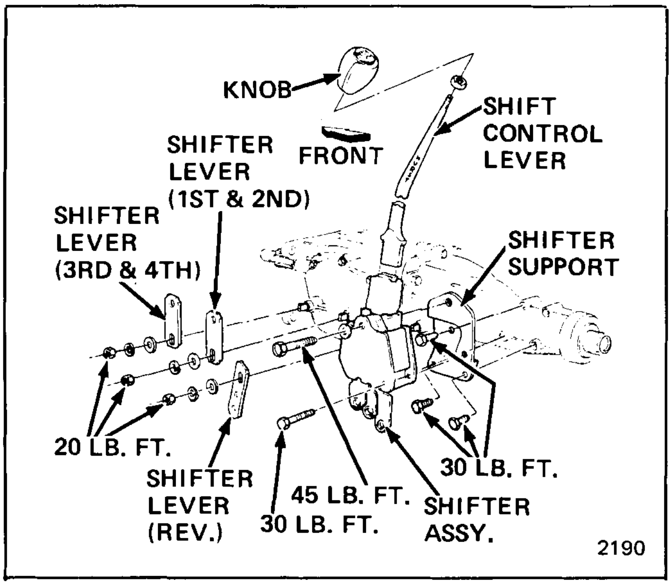


Fig. 7B-23 Floor Shift Levers

13. Install case cover attaching bolts evenly to 18 lb. ft. torque.

14. Install shifter levers, flat washers, lock washers and nuts on shifter shafts. Torque nuts to 20 lb. ft.

15. Connect control rods to shifter levers, refill transmission to proper level, check transmission operation and adjust linkage as required.

SPEEDOMETER DRIVEN GEAR

Refer to procedure under 3-SPEED LT. DUTY MUNCIE TRANSMISSION.

SHIFT CONTROL LEVER - R & R

(Fig. 7B-23)

1. Release shift control lever by inserting a thin rule or a piece of .015"-.020" shim stock into socket along side base of shift control lever on driver's side.

2. Insert rule or stock to depth of at least one inch to unlock its bayonet retainer and lift control lever and tool up out of shift socket.

3. Install shift control lever by inserting into shift socket. Bayonet retainer will lock control lever automatically into proper position.

UNIT REPAIR

3-SPEED 76MM LT. DUTY MUNCIE TRANSMISSION

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REMOVAL OF TRANSMISSION

Before raising vehicle, disconnect battery and release parking brake.

1. Raise vehicle on hoist and drain lubricant from transmission.

2. Scribe a mark on companion flange yoke and propeller shaft yoke to assure proper reassembly and remove propeller shaft.

3. Disconnect speedometer cable and TCS/back-up light connector.

4. On column shift controlled vehicles, disconnect transmission shifter levers from transmission shifter shafts (Fig. 7B-10).

On floor shift controlled vehicles, in addition it will be necessary to remove shifter assembly-to-shifter support bolts and remove shifter assembly from transmission (Fig. 7B-11). If shifter assembly replacement is not required, it may be left hanging from its floor seal while transmission is being removed.

5. Remove crossmember-to-transmission mount bolts, catalytic converter-to-transmission bracket and remove crossmember-to-frame bolts.

6. Raise transmission to take weight off support and remove crossmember from vehicle.

7. Remove upper transmission-to-clutch housing bolts and install aligning Guide Pins J 1126 (or 1/2"-13 x 2" threaded headless bolts).

NOTE: Aligning guide pins or studs must be used to support transmission in order to prevent distortion of the clutch driven plate hub while removing transmission.

8. Slide transmission straight back on guide pins until main drive gear splines are free of clutch driven plate and remove from vehicle.

DISASSEMBLY OF TRANSMISSION

1. Remove case cover attaching screws and remove case cover assembly and shift forks.

2. Remove drive gear bearing retainer and gasket.

3. Remove drive gear bearing to gear stem snap ring, then remove drive gear bearing by pulling outward on gear until a screw driver of other suitable tool can be inserted between bearing large snap ring and case to complete removal (Fig. 7B-24). The drive gear bearing is a slip fit on the gear and into the case bore (this provides clearance for removal of drive gear and mainshaft assembly).

4. Remove speedometer driven gear from extension.

5. Remove extension to case attaching bolts.

6. Remove the reverse idler shaft "E" ring.

7. Remove drive gear, mainshaft and extension assembly together through the rear case opening. Remove clutch drive gear, needle bearings (14) and synchronizer ring from mainshaft assembly.

8. Using snap ring pliers, expand the snap ring in the extension, which retains the mainshaft rear bearing (Fig. 7B-25), and remove the extension.

9. Using J 22246 at the front of the countershaft, drive the shaft and its woodruff key out the rear of the case. Tool J 22246 will now hold the roller bearings in position within the countergear bore. Remove the gear, bearings and thrust washers from case.

10. Remove loading tool, bearings and spacers from countergear.

11. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and woodruff key through the rear of the case (Fig. 7B-26).

DISASSEMBLY OF MAINSHAFT

(Fig. 7B-27)

1. Using snap ring pliers, remove the 2nd and 3rd speed sliding clutch hub snap ring from mainshaft and remove clutch assembly, 2nd speed blocker ring and 2nd speed gear from front of mainshaft.

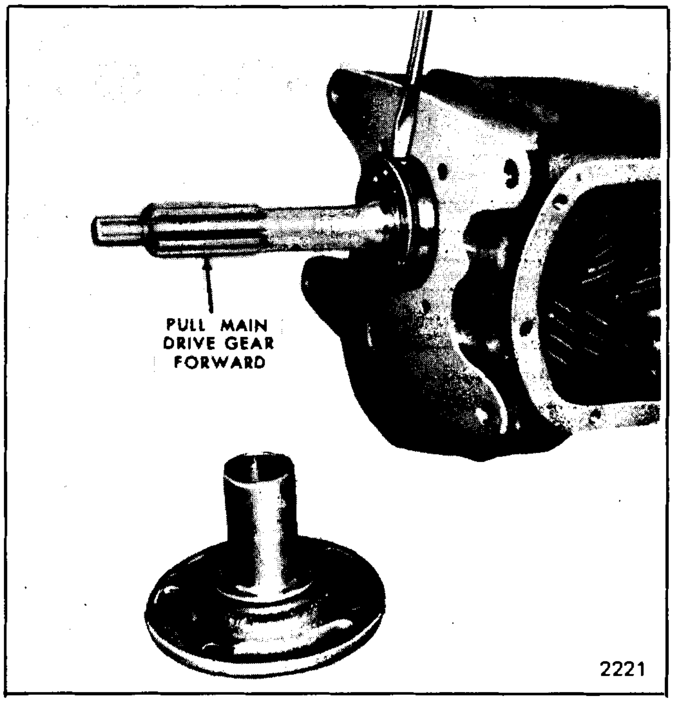

Fig. 7B-24 Removing Drive Gear Bearing

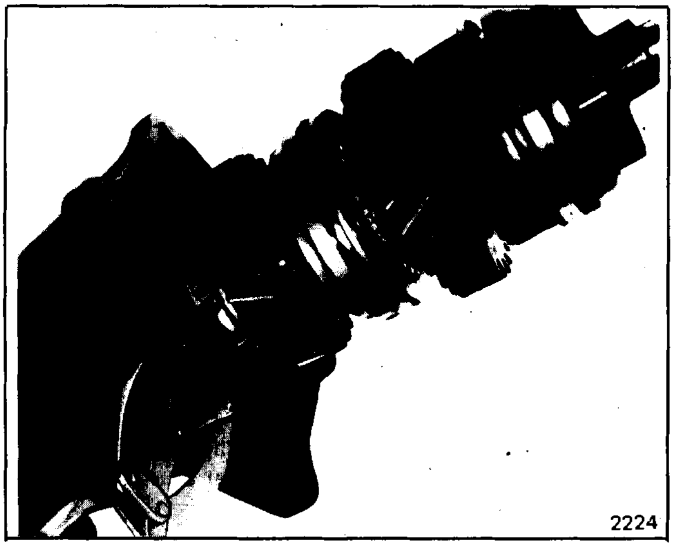

Fig. 7B-25 Extension Rear Bearing Snap Ring

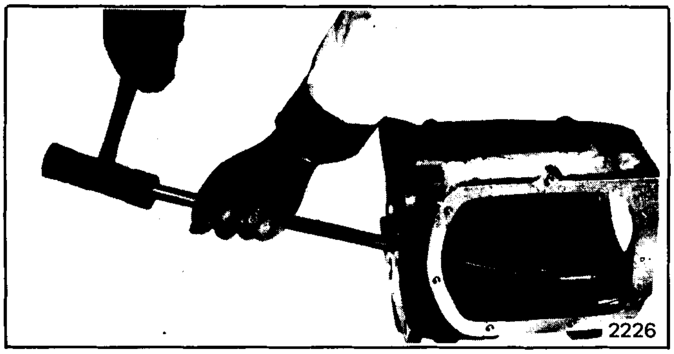

Fig. 7B-26 Removing Reverse Idler Shaft

2. Depress speedometer retaining clip and slide gear from mainshaft.

3. Remove rear bearing snap ring from mainshaft groove.

4. Support reverse gear with press plates and press on rear of mainshaft to remove reverse gear, thrust washer, spring washer, rear bearing and snap ring from rear of mainshaft.

5. Remove the 1st and Reverse sliding clutch hub snap ring from the mainshaft and remove the clutch assembly, 1st speed blocker ring and 1st speed gear from rear of the mainshaft.

NOTE: Under certain tolerance conditions, it may be necessary to press the synchronizer hub and gear from the shaft.

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.

2. Check the front and rear faces for burrs and, if present, dress them off with a fine mill file.

3. Check bearing bores in case and, if damaged, replace case.

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.

2. Blow out bearings with compressed air.

CAUTION: *Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings will damage the race and balls.*

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

Bearing Rollers

All clutch gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect counter shaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.

2. Inspect reverse gear bushing and, if worn or damaged, replace the entire gear.

NOTE: Reverse gear bushing is not serviced separately.

3. Check both clutch sleeves to see that they slide freely on their hubs.

Reverse Idler Gear Bushing

The bushing, used in the idler gear, is pressed into the gear and finished bored in place. This insures the positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

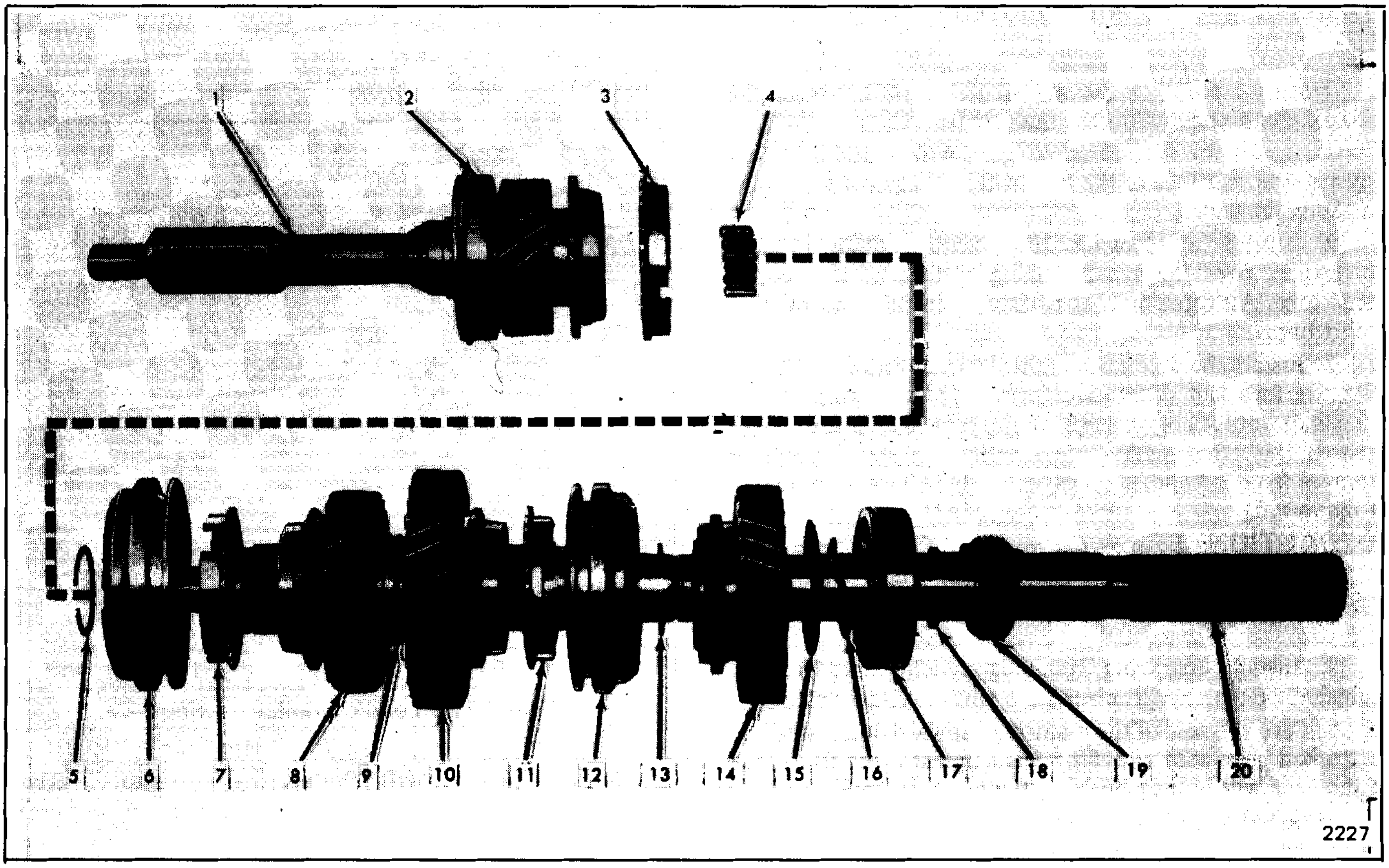

Fig. 7B-27 Mainshaft Assembly - Exploded View

Countergear Anti-Lash Plate

Inspect the plate teeth for wear or other damage. The plate and two damper springs are retained to the countergear by three rivets. Disassembly is not recommended.

REPAIRS

CLUTCH KEYS AND SPRINGS

Replacement

NOTE: The clutch hubs and sliding sleeves are selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. Mark hub and sleeve so they can be matched upon reassembly.
2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.
3. Place the three keys and two springs in position (one on each side of hub), so all three keys are engaged by both springs (Fig. 7B-28). The tanged end of each synchronizer spring should be installed into different key cavities on either side. Slide the sleeve onto the hub aligning the marks made before disassembly.

NOTE: A groove around the outside of the synchronizer hub identifies the end that must be opposite the fork slot in the sleeve when assembled. This groove indicates the end of the hub with a .07" greater recess depth.

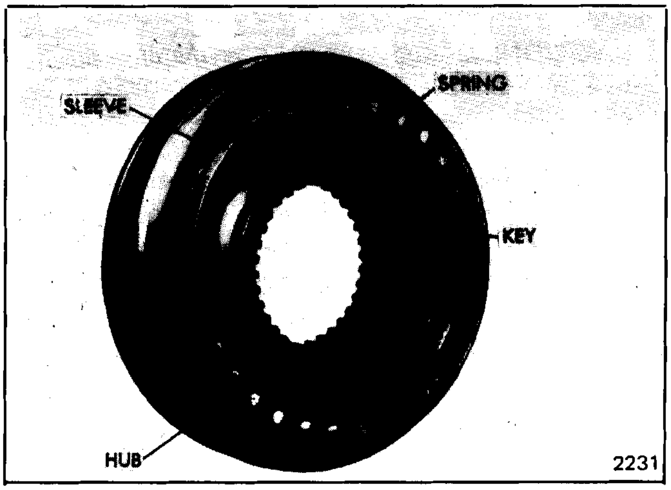

Fig. 7B-28 Synchronizer Assembly

EXTENSION OIL SEAL OR BUSHING

If bushing in rear of extension requires replacement, remove seal and use Tool J 5778 to drive bushing into extension housing. Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal, using Tool J 5154 or J 21426.

CLUTCH BEARING RETAINER OIL SEAL

If the lip seal in the retainer needs replacement, pry the old seal out and replace with a new seal, using Installer J 23096, or similar tool, until seal seats in its bore.

ASSEMBLY OF MAINSHAFT (FIG. 7B-27)

Turn the front of the mainshaft upward. Install the following components on the mainshaft:

1. Install the second speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.
2. Install a blocking ring, with clutching teeth downward, over the synchronizing surface of the second speed gear. All three blocker rings used in this transmission are identical.
3. Install the second and third synchronizer assembly with the fork slot downward; press it onto splines on the mainshaft until it bottoms out. Both synchronizer assemblies used in this transmission are identical (if sleeve becomes removed from 2-3 hub, notches on hub O.D. face forward end of mainshaft).

CAUTION: *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.*

4. Install snap ring retaining synchronizer hub to mainshaft. Both snychronizer snap rings are identical.
5. Turn the rear of the mainshaft upward and install the first speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.
6. Install a blocker ring with clutching teeth downward over synchronizing surface of the first speed gear.
7. Install the first and reverse synchronizer assembly with fork slot downward; push it onto splines on the mainshaft.

CAUTION: *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.*

8. Install synchronizer hub to mainshaft snap ring.
9. Install reverse gear with clutching teeth downward.
10. Install reverse gear thrust washer (steel).
11. Install reverse gear spring washer.
12. Install rear ball bearing with snap ring slot downward; press onto mainshaft.
13. Install rear bearing to mainshaft snap ring.
14. Install speedometer drive gear and retaining clip.

ASSEMBLY OF TRANSMISSION

1. Using Tool J 22246, load a row of roller bearings (27) and a bearing thrust washer at each end of the countergear. Use heavy grease to hold them in place (Fig. 7B-29).
2. Place countergear assembly through case rear opening along with a tanged thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case.

CAUTION: *Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.*

3. Install reverse idler gear and shaft with its woodruff key from the rear of case. Do not install idler shaft "E" ring yet.
4. Using snap ring pliers, expand the snap ring in the extension and assemble extension over rear of mainshaft and onto rear bearing. Seat snap ring in rear bearing groove.

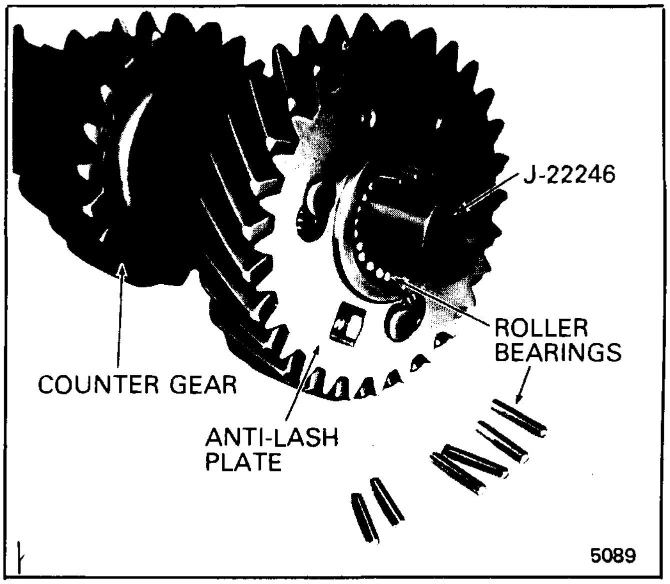

Fig. 7B-29 Loading Roller Bearings

5. Load the mainshaft pilot bearings (14) into the drive gear cavity and assemble the 3rd speed blocker ring onto the drive gear clutching surface with its teeth toward the gear.
6. Pilot the drive gear, pilot bearings and 3rd speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.

CAUTION: *Be sure the notches in the blocker ring align with the keys in the 2-3 synchronizer assembly.*

7. Place extension to case gasket at rear of case, holding in place with grease, and, from the rear of case, assemble the drive gear, mainshaft and extension to case as an assembly.

CAUTION: *Be sure the drive gear engages the countergear anti-lash plate.*

8. Install extension to case retaining bolts. Torque to 45 lb. ft.
9. Install front bearing outer snap ring to bearing and position bearing over stem of drive gear and into front case bore.
10. Install snap ring to drive gear stem and install drive gear bearing retainer and gasket to case, torquing bolts to 10 lb. ft.

NOTE: The retainer oil return hole should be at the bottom.

11. Install reverse idler gear retainer "E" ring to shaft.
12. Shift synchronizer sleeves to neutral positions and install cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves.
13. Tighten all bolts evenly to 10 lb. ft. to avoid case cover distortion.
14. Rotate drive gear shaft and shift transmission to free rotation in all gears.

15. Install speedometer driven gear in rear extension.

Installation of Transmission

1. Place transmission on guide pins and rotate transmission as necessary to start main drive gear splines into clutch driven plate. Slide transmission forward.

NOTE: Make certain that main drive gear shaft is aligned with pilot bearing in crankshaft and that clutch release bearing is properly installed.

2. Install two (2) lower transmission-to-clutch housing bolts. Remove guide pins and install two (2) upper bolts. Torque bolts evenly to 55 lb. ft.

3. Slide crossmember forward and install four (4) bolts. Torque to 25 lb. ft.

4. Lower engine-transmission and install crossmember-to-transmission mount bolts and catalytic converter-to-transmission bracket bolts. Tighten all bolts to specified torque.

5. Connect linkage and adjust as described under MAINTENANCE AND ADJUSTMENTS.

On floor shift controlled vehicles, install shifter assembly to shifter support and secure with two (2) shifter assembly-to-support bolts. Torque upper bolt to 45 lb. ft. and lower bolt to 25 lb. ft.

6. Connect speedometer cable and TCS/back-up light connector.

7. Install propeller shaft and re-fill transmission with lubricant.

8. Lower vehicle and, after vehicle is road tested, recheck lubricant level and add as required.

4-SPEED 76MM LT. DUTY MUNCIE TRANSMISSION

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Removal of Transmission

Before raising vehicle, disconnect battery and release parking brake.

1. Raise vehicle on hoist and drain lubricant from transmission.

2. Scribe a mark on companion flange yoke and propeller shaft yoke to assure proper reassembly and remove propeller shaft.

3. Disconnect speedometer cable and TCS/back-up light connector.

4. Disconnect transmission control rod and lower assemblies from the shifter shafts. Tie rods up out of work area.

5. Remove crossmember-to-transmission mount bolts, catalytic converter-to-transmission bracket and remove crossmember-to-frame bolts.

6. Raise transmission to take weight off support and remove crossmember from vehicle.

7. Remove upper transmission-to-clutch housing bolts and install aligning Guide Pins J 1126 (or 1/2"-13 x 2" threaded headless bolts).

NOTE: Aligning guide pins or studs must be used to support transmission in order to prevent distortion of the clutch driven plate hub while removing transmission.

8. Slide transmission straight back on guide pins until main drive gear splines are free of clutch driven plate and remove from vehicle.

DISASSEMBLY OF TRANSMISSION

1. Remove case cover attaching bolts and case cover assembly.

2. Remove drive gear bearing retainer.

3. Remove drive gear bearing to gear stem snap ring, then remove drive gear bearing by pulling outward on gear until a screwdriver or other suitable tool can be inserted between bearing, large snap ring and case to complete removal (Fig. 7B-30). The drive gear bearing is a slip fit on the gear and into the case bore. This provides clearance between case bore and shaft for removal of drive gear and mainshaft assembly.

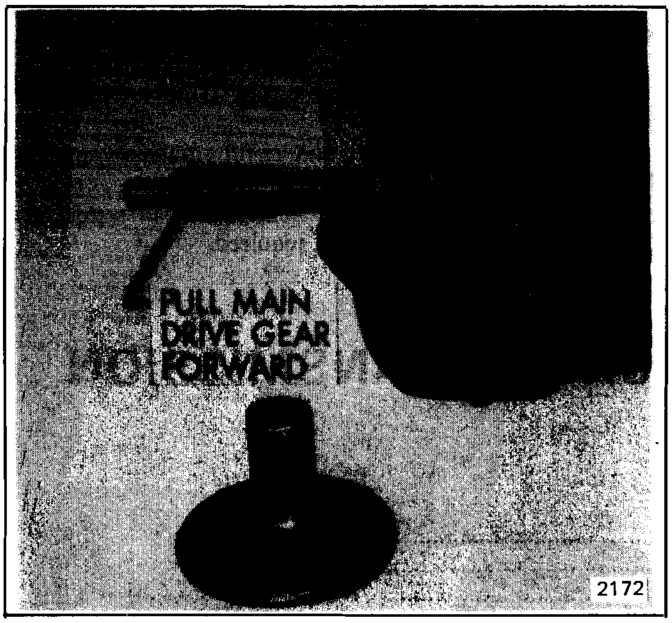


Fig. 7B-30 Removing Drive Gear Bearing

4. Remove extension to case attaching bolts.

5. Remove drive gear, mainshaft and extension assembly together through the rear case opening (Fig. 7B-31). Remove drive gear and bearings from mainshaft.

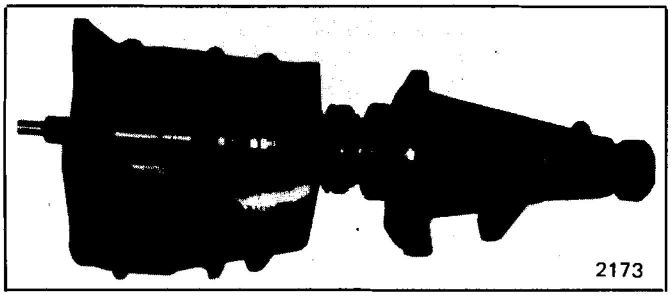


Fig. 7B-31 Removing Mainshaft Assembly from Case

6. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (Fig. 7B-32) and remove the extension.

7. Using J 22246 at the front of the countershaft, drive the shaft and its woodruff key out the rear of the case. Tool J 22246 will now hold the roller bearings in position within the countergear bore. Remove the gear and thrust washers from case (Fig. 7B-33).

8. Remove reverse idler gear stop ring. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and woodruff key through the rear of the case (Fig. 7B-34).

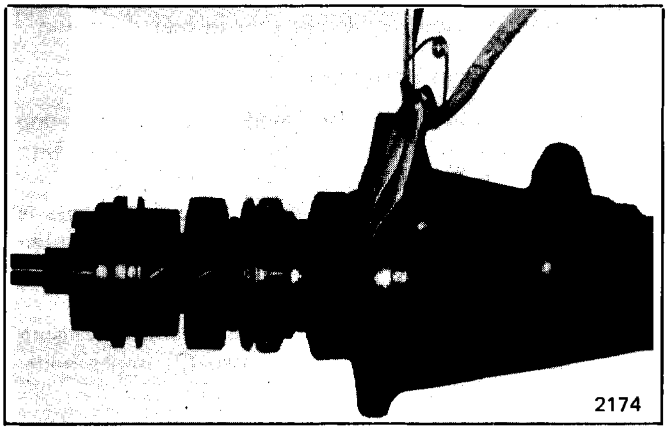


Fig. 7B-32 Expanding Rear Bearing Snap Ring

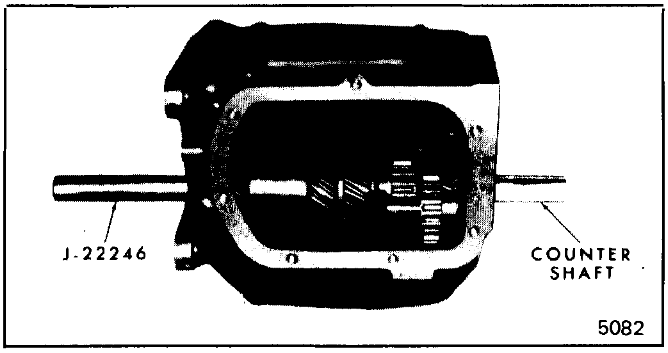


Fig. 7B-33 Removing Countershaft

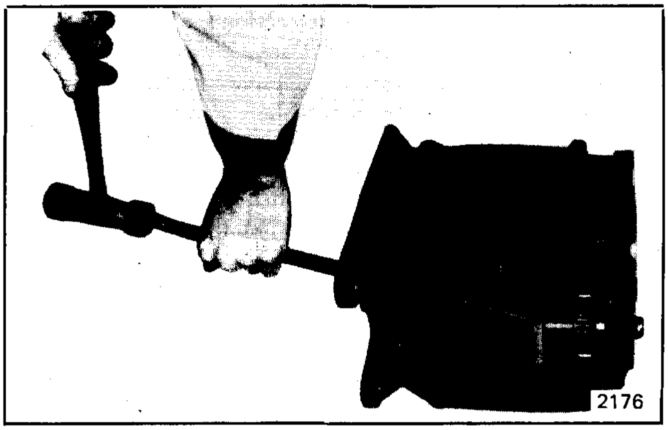


Fig. 7B-34 Removing Reverse Idler Shaft

DISASSEMBLY OF MAINSHAFT

1. Using snap ring pliers, remove the 3rd and 4th speed sliding clutch hub snap ring from mainshaft and remove clutch assembly, third gear blocker ring and third speed gear from front of mainshaft (Fig. 7B-35).

2. Depress speedometer retaining clip and slide gear from mainshaft.

3. Remove rear bearing snap ring from mainshaft groove (Fig. 7B-36).

4. Support first gear with press plates and press on rear of mainshaft to remove first gear, thrust washer, spring washer and rear bearing from rear of mainshaft (Fig. 7B-37).

5. Remove the 1st and second sliding clutch hub snap ring from the mainshaft (Fig. 7B-38) and remove the clutch assembly, 2nd speed blocker ring and second speed gear from

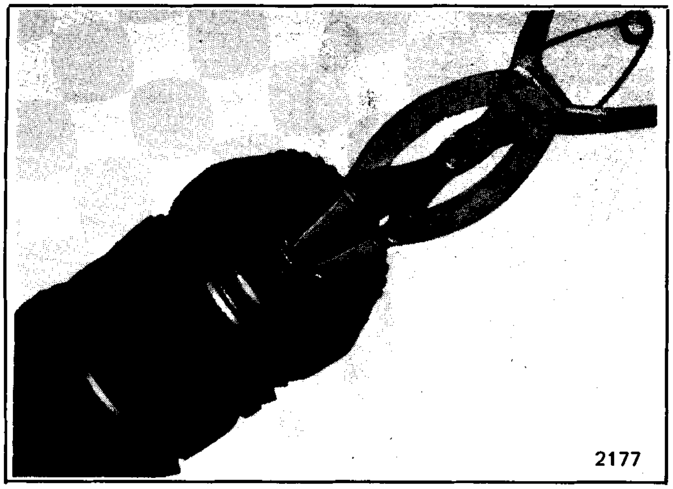


Fig. 7B-35 Removing Third and Fourth Synchronizer Snap Ring

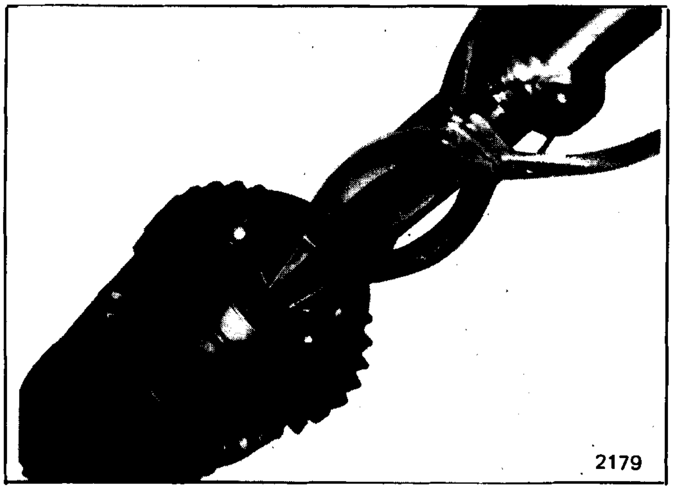


Fig. 7B-36 Removing Rear Bearing Snap Ring

the rear of the mainshaft.

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.

2. Check the front and rear faces for burrs and, if present, dress them off with a fine mill file.

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.

2. Blow out bearings with compressed air.

CAUTION: *Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings will damage the race and balls.*

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

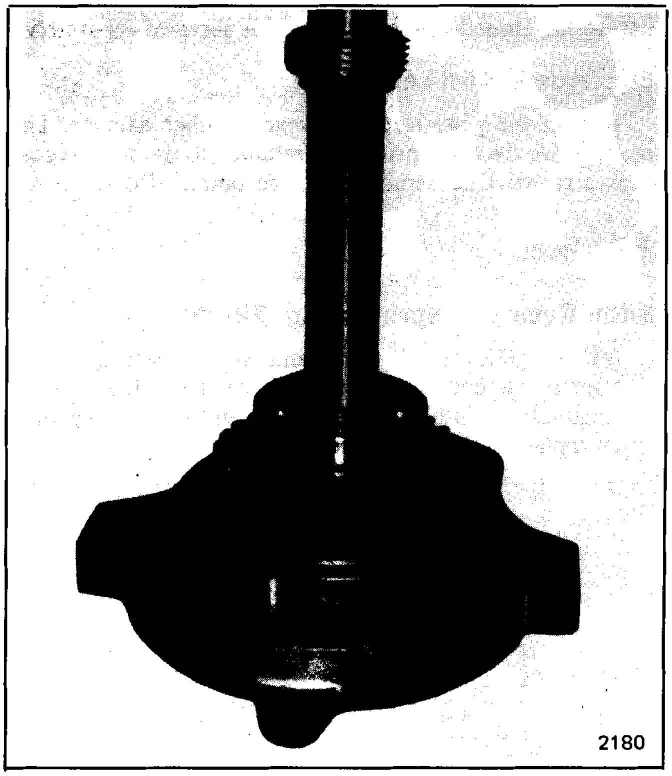
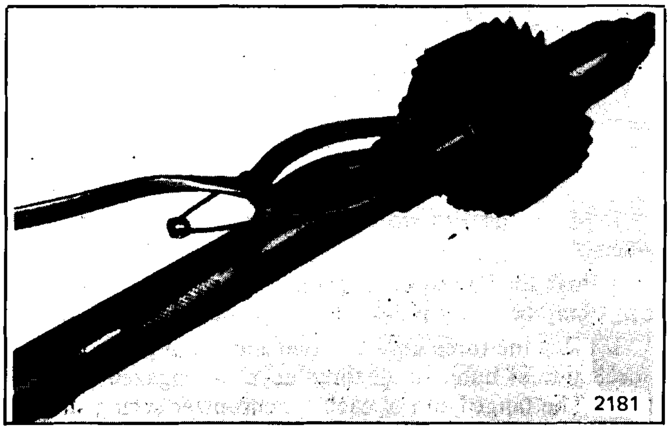


Fig. 7B-37 Removing Rear Bearing and First Speed Gear



Removing Fig. 7B-38 Removing First and Second Synchronizer Snap Ring

Bearing Rollers

All clutch gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.

2. Check both clutch sleeves to see that they slide freely on their hubs.

Reverse Idler Gear Bushings

The bushing used in the idler gear is pressed into the gear and finish bored in place. This insures the positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

Countergear Anti-Lash Plate

Inspect the plate teeth for wear or other damage. The plate and two damper springs are retained to the countergear by three rivets. Disassembly is not recommended.

REPAIRS

Clutch Keys and Springs (Fig. 7B-39)

NOTE: The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

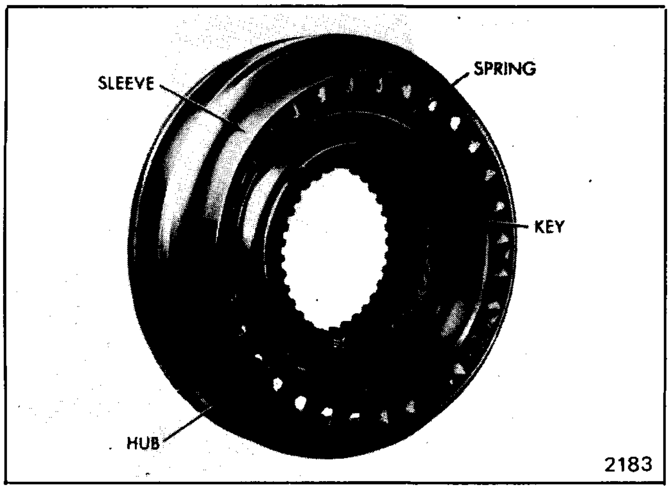


Fig. 7B-39 Synchronizer Assembly

1. Mark hub and sleeve so they can be matched upon reassembly.

2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.

3. Place the three keys and two springs in position (one on each side of hub), so all three keys are engaged by both springs. The tanged end of each synchronizer spring should be installed into different key cavaties on either side. Slide the sleeve onto the hub, aligning the marks made before disassembly.

NOTE: A groove around the outside of the synchronizer hub identifies the end that must be opposite the fork slot in the sleeve when assembled. This groove indicates the end of the hub with a greater recess depth.

Extension Oil Seal or Bushing

If bushing in rear of extension requires replacement, remove seal and use Tool J 5778 to drive bushing into extension housing (Fig. 7B-40). Using the same tool, drive new bushing in from the rear. Coat I.D. of bushing and seal with transmission lubricant, then install new oil seal using Tool J 5154 (Fig. 7B-41).

Clutch Gear Bearing Retainer Oil Seal

If the lip seal in the retainer needs replacement, pry the oil seal out (Fig. 7B-42) and replace with a new seal, using Tool J 23096 until seal seats in its bore (Fig. 7B-43).

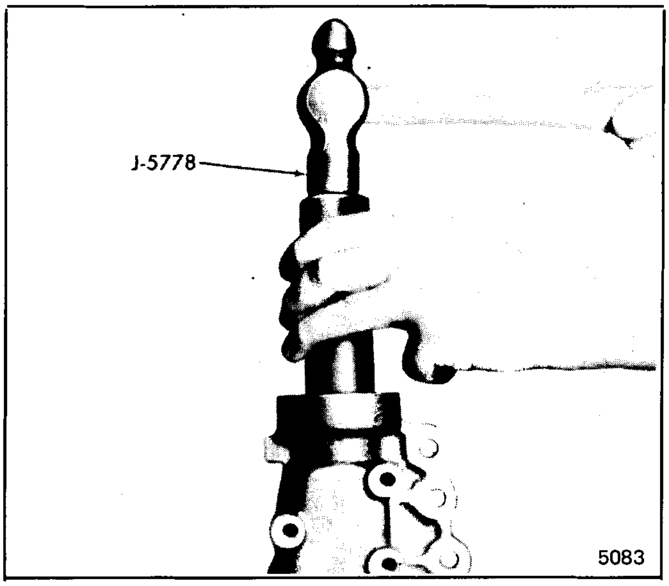


Fig. 7B-40 Removing Extension Bushing

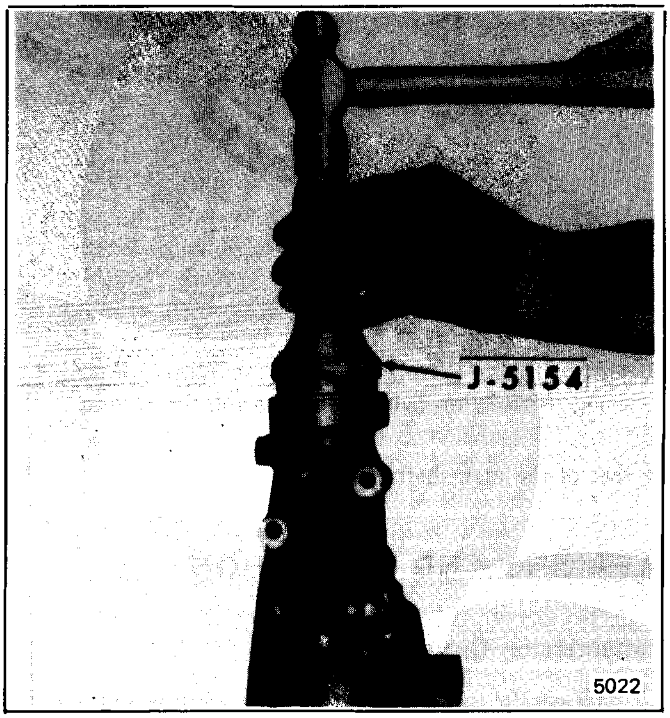


Fig. 7B-41 Installing Extension Oil Seal

NOTE: Lip of seal must face rear of bearing retainer.

ASSEMBLY OF MAINSHAFT (FIG. 7B-44).

Turn the front of the mainshaft upward. Install the following components on the mainshaft:

1. Install the third speed gear with clutching teeth upward; the rear face of the gear will butt against the flange on the mainshaft.

2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the third speed gear.

NOTE: All four blocker rings used in this transmission are identical.

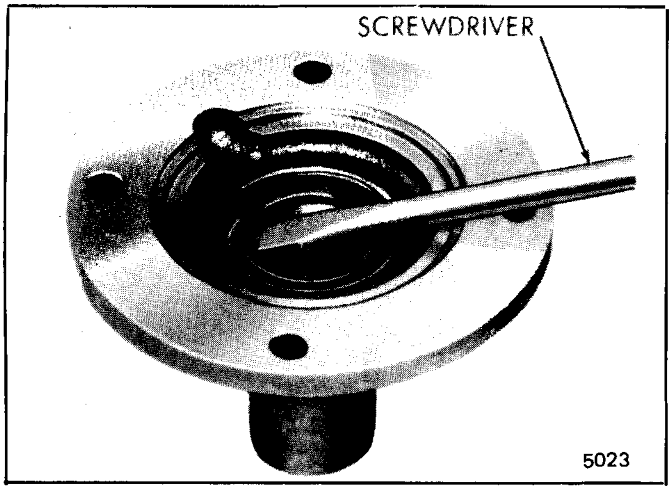


Fig. 7B-42 Removing Bearing Retainer Oil Seal

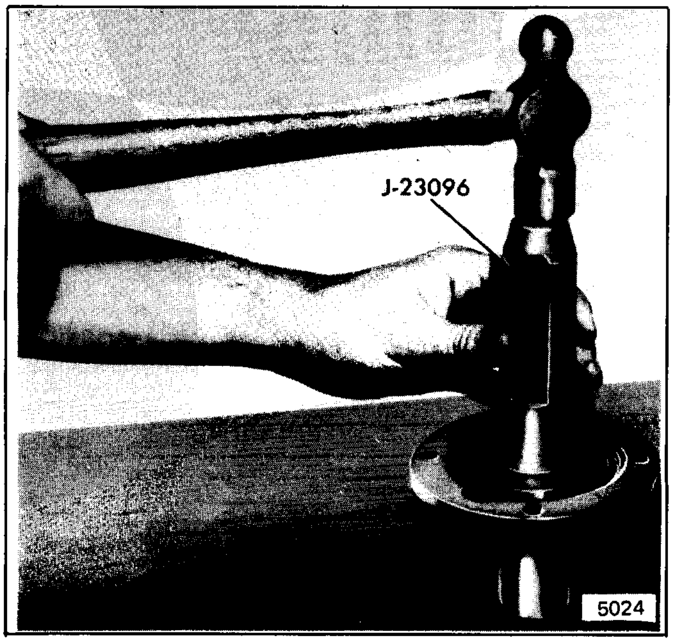


Fig. 7B-43 Installing Bearing Retainer Oil Seal

3. Install the 3rd and 4th synchronizer assembly with the fork slot downward; push assembly onto splines on the mainshaft until it bottoms out against flange.

CAUTION: *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.*

4. Install synchronizer hub to mainshaft snap ring. Both synchronizer snap rings are identical.

Turn the rear of the mainshaft upward. Install the following components on the mainshaft:

5. Install the second speed gear with clutching teeth upward; the front face of the gear will butt against the flange on the mainshaft.

6. Install a blocker ring with clutching teeth downward over synchronizing surface of the second speed gear.

7. Install the first and second synchronizer assembly with fork slot downward.

CAUTION: *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.*

8. Install synchronizer hub to mainshaft snap ring (Fig. 7B-38).

9. Install a blocker ring with notches downward so they align with the keys of the 1-2 synchronizer assembly.

10. Install first gear with clutching teeth downward.

11. Install first gear thrust washer (steel).

12. Install first gear spring washer.

13. Install rear ball bearing with snap ring slot downward; reverse and press onto mainshaft (Fig. 7B-45).

14. Install rear bearing to mainshaft snap ring (Fig. 7B-36).

15. Install speedometer drive gear and clip.

ASSEMBLY OF TRANSMISSION

1. Using Tool J 22246, load a row of roller bearings (27) and a bearing thrust washer at each end of the countergear. Use heavy grease to hold them in place (Fig. 7B-46).

2. Place countergear assembly through case rear opening along with a tanged thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case.

CAUTION: *Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.*

3. Install reverse idler gear and shaft with its woodruff key from the rear of case.

4. Using snap ring pliers, expand the snap ring in the extension and assembly extension over rear of mainshaft and onto rear bearing (Fig. 7B-32). Seat snap ring in rear bearing groove.

5. Load the mainshaft pilot bearings (14) into the drive gear cavity and assemble the 4th speed blocker ring onto the drive gear clutching surface with its clutching teeth toward the gear (Fig. 7B-47).

6. Pilot the drive gear, pilot bearings and 4th speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.

CAUTION: *Be sure the notches in the blocker ring align with the keys in the 3-4 synchronizer assembly.*

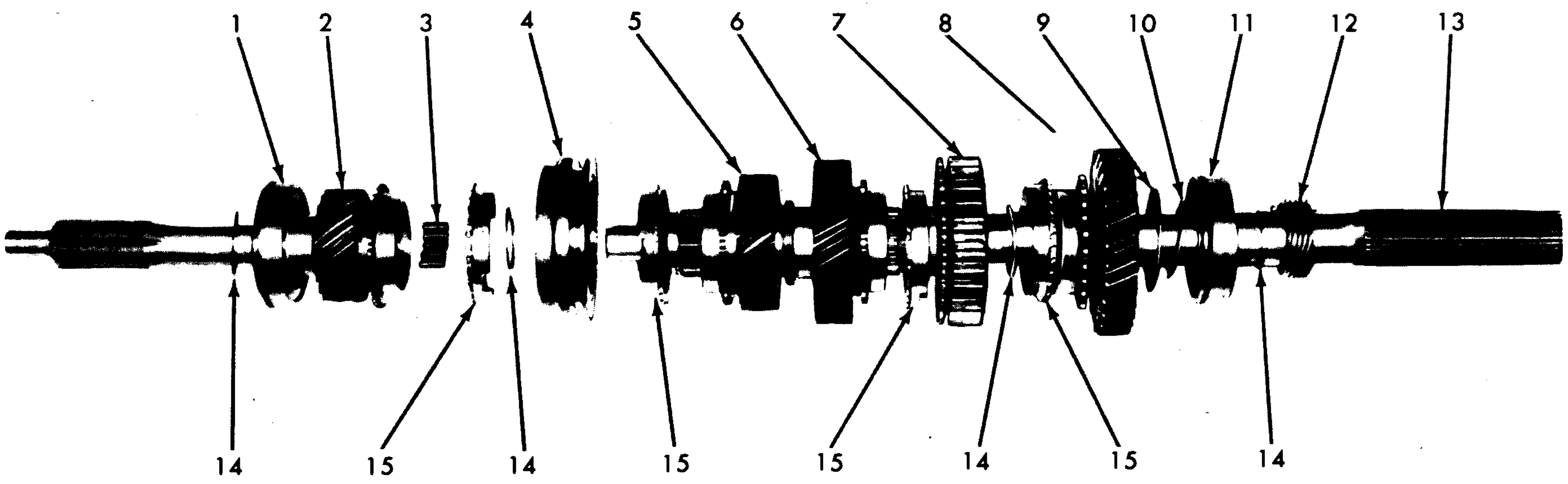
7. Place extension to case gasket at rear of case holding in place with grease and, from the rear of the case, assemble the clutch gear, mainshaft and extension to case as an assembly.

8. Install extension to case retaining bolts, using seal cement on bottom bolt only. Torque bolts to 45 lb. ft.

9. Install front bearing outer snap ring to bearing and position bearing over stem of drive gear and into front case bore.

10. Install snap ring to drive gear stem and drive bearing retainer and gasket to case, torquing bolts to 22 lb. ft.

NOTE: The retainer oil return hole should be at the bottom.



1. Drive Gear Bearing
2. Drive Gear
3. Mainshaft Pilot Bearings
4. 3-4 Synchronizer Assembly
5. Third Speed Gear
6. Second Speed Gear
7. 1-2 Synchronizer and Reverse Gear Assembly
8. First Speed Gear
9. Thrust Washer
10. Spring Washer
11. Rear Bearing
12. Speedo Drive Gear
13. Mainshaft
14. Snap Ring
15. Synchronizing "Blocker" Ring

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FIG. 7B-44 MAINSHAFT ASSEMBLY - EXPLODED VIEW

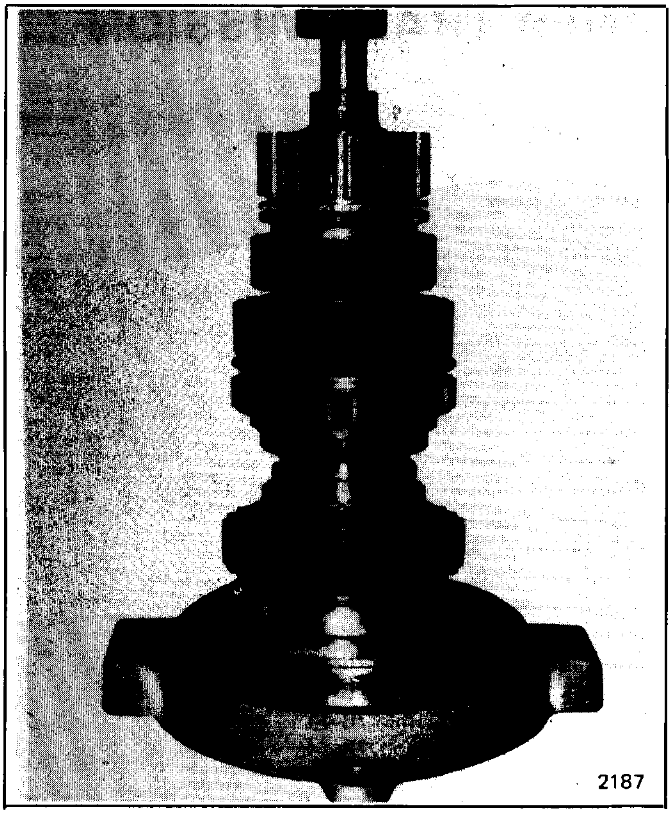

FIG. 7B-45 INSTALLING REAR BEARING

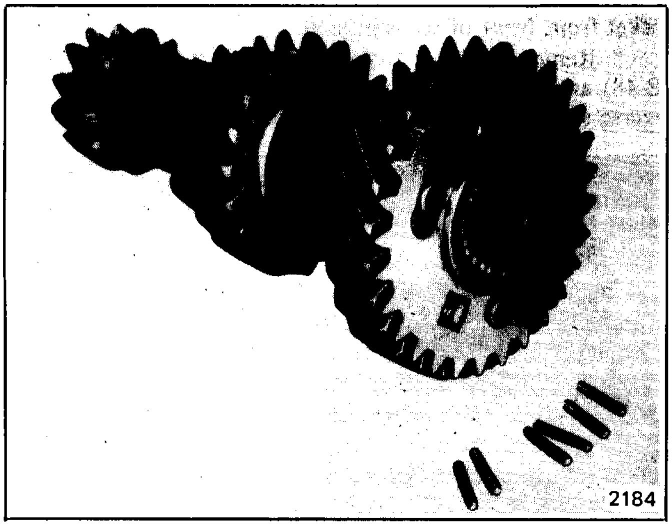

Fig. 7B-46 Loading Roller Bearings

11. Shift synchronizer sleeves to neutral positions and install case cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves. Torque all bolts evenly to 22 lb. ft.

INSTALLATION OF TRANSMISSION

1. Place transmission on guide pins and rotate transmission as necessary to start main drive gear splines into clutch driven plate. Slide transmission forward.

> **NOTE:** Make certain that main drive gear shaft is aligned with pilot bearing in crankshaft and that clutch release bearing is properly installed.

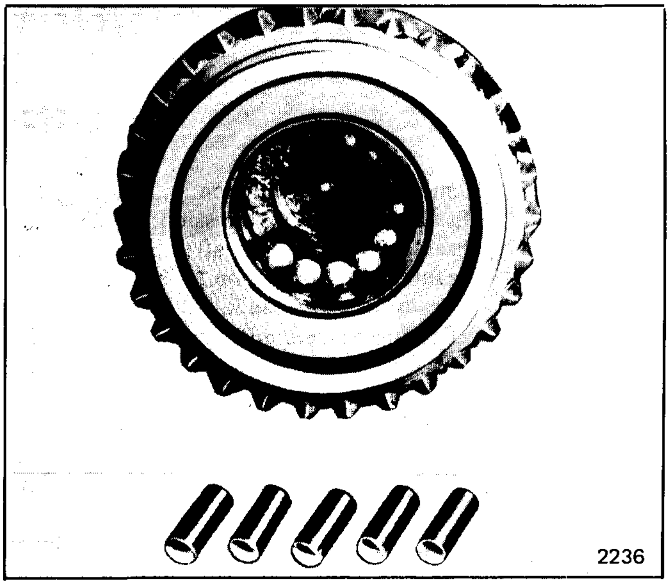

Fig. 7B-47 Loading Mainshaft Pilot Bearings

2. Install two (2) lower transmission-to-clutch housing bolts. Remove guide pins and install two (2) upper bolts. Torque bolts evenly to 55 lb. ft.

3. Slide crossmember forward and install four(4) bolts. Torque to 25 lb. ft.

4. Lower engine-transmission and install crossmember-to-transmission mount bolts and catalytic converter-to-transmission bracket bolts. Tighten all bolts to specified torque.

5. Install shifter assembly to shifter support and secure with two (2) shifter assembly-to-support bolts. Torque upper bolt to 45 lb. ft. and lower bolt to 25 lb.ft.

Connect linkage and adjust as described under MAINTENANCE AND ADJUSTMENTS.

6. Connect speedometer cable and TCS/back-up light connector.

7. Install propeller shaft and re-fill transmission with lubricant.

8. Lower vehicle and, after vehicle is road tested, re-check lubricant level and add as required.

4-SPEED 82MM BORG-WARNER TRANSMISSION

INDEX

REMOVAL OF TRANSMISSION

Before raising vehicle, disconnect battery and release parking brake.

1. Raise vehicle on hoist and drain lubricant from transmission.

2. Scribe a mark on companion flange yoke and propeller shaft yoke to assure proper reassembly and remove propeller shaft.

3. Disconnect speedometer cable and TCS/back-up light connector.

4. Disconnect transmission control rod and lower assemblies from the shifter shafts. Tie rods up out of work area.

5. Remove crossmember-to-transmission mount bolts, catalytic converter-to-transmission bracket and remove crossmember-to-frame bolts.

6. Raise transmission to take weight off support and remove crossmember from vehicle.

7. Remove upper transmission-to-clutch housing bolts and install aligning Guide Pins J 1126 (or 1/2"-13 x 2" threaded headless bolts).

NOTE: Aligning guide pins or studs must be used to support transmission in order to prevent distortion of the clutch driven plate hub while removing transmission.

8. Slide transmission straight back on guide pins until main drive gear splines are free of clutch driven plate and remove from vehicle.

DISASSEMBLY OF TRANSMISSION

1. Thoroughly clean the exterior of the transmission assembly.

2. Shift transmission into second gear, remove drain plug from lower right of case and drain lubricant from transmission.

3. Remove case cover attaching bolts, cover assembly and gasket. Remove both shift forks.

4. Remove drive gear bearing retainer bolts, retainer and gasket from front of transmission.

5. Remove lock pin from reverse shifter lever boss (Fig. 7B-48) and pull shifter shaft partially out to disengage the reverse shifter fork from the reverse gear.

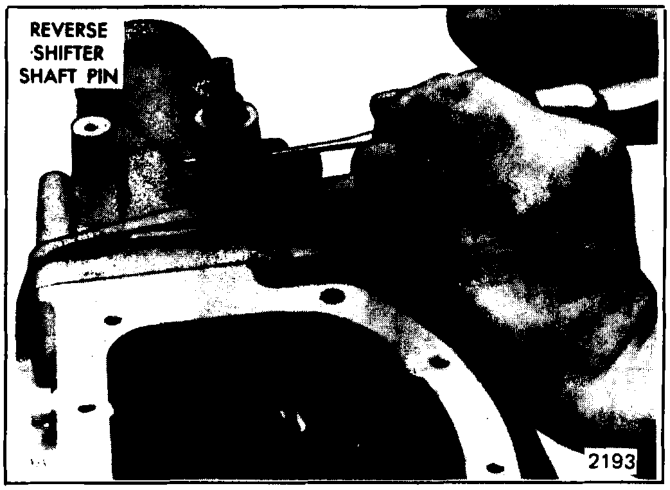

Fig. 7B-48 Removing Reverse Shifter Shaft Lock Pin

6. Remove rear extension attaching bolts, tap extension rearward with a soft hammer to start removal. Slide extension rearward until reverse idler shaft is clear of reverse idler gears. Then rotate extension to the left to free shift fork from collar of reverse gear and remove the case extension. Remove and discard gasket.

7. Remove speedometer gear outer snap ring (Fig. 7B-49). Tap or slide speedometer gear from mainshaft, then remove second snap ring.

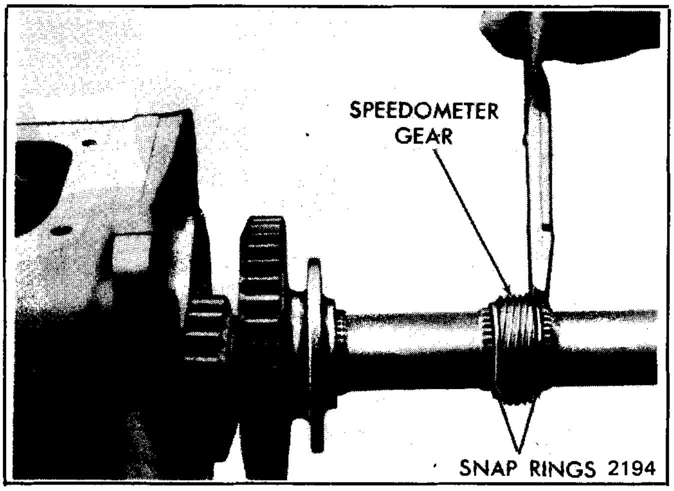

Fig. 7B-49 Speedometer Gear and Snap Rings

8. Slide the reverse gear from the mainshaft (Fig. 7B-50) and slide the rear portion of the reverse idler gear from the transmission case.

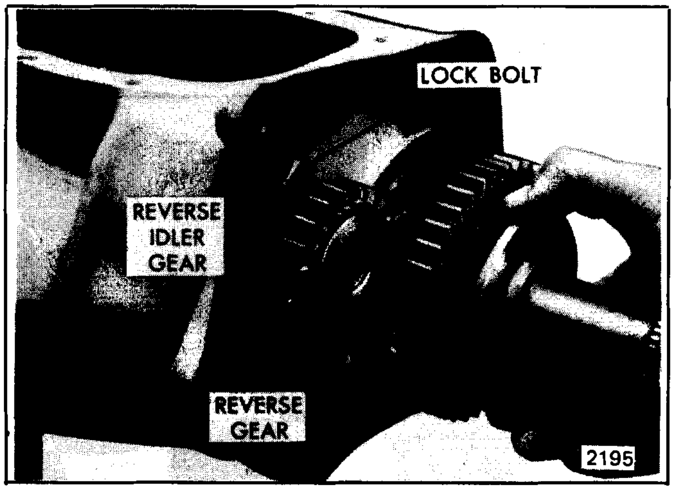

Fig. 7B-50 Removing Reverse Gear

9. Remove front bearing retainer bolts, gasket and front bearing retainer from case.

10. Remove front bearing snap ring selective fit snap ring and spacer washer.

11. Using Tools J 8433-1 and J 22912, remove front main drive gear bearing from transmission case (Fig. 7B-51).

12. Remove the rear retainer lock bolt.

13. Shift first-second and third-fourth clutch sliding sleeves forward to permit adequate clearance for mainshaft removal. Remove mainshaft and rear bearing retainer assembly from the transmission case.

14. Remove front reverse idler gear and thrust washer from case.

NOTE: Gear teeth face toward front of transmission.

15. Using Loader J 24658, drive countergear shaft out of countergear (Fig. 7B-52) and remove countergear and tanged thrust washers from case. Check bottom of case for pilot bearings or other loose components.

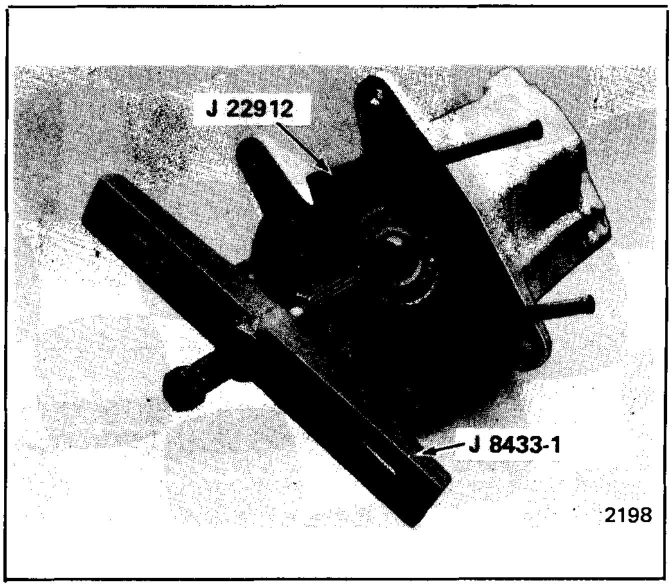

Fig. 7B-51 Removing Main Drive Gear Bearing

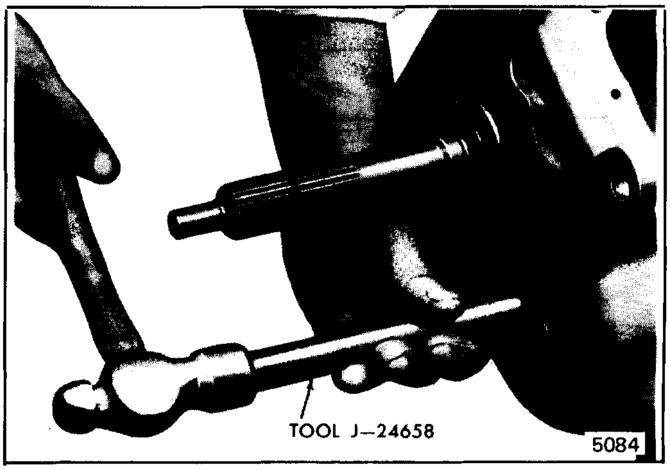

Fig. 7B-52 Removing Countergear Shaft

DISASSEMBLY OF MAINSHAFT

(Fig. 7B-53)

1. Using snap ring pliers, remove 3-4 clutch assembly retaining ring at front of mainshaft (Fig. 7B-54). Slide washer, synchronizer and clutch assembly, synchronizer ring and 3rd speed gear from mainshaft.

2. Spread rear bearing retainer snap ring (Fig. 7B-55) and slide retainer from mainshaft.

3. Remove rear bearing-to-mainshaft snap ring (Fig. 7B-56).

4. Support mainshaft under 2nd gear and press mainshaft from rear bearing, 1st gear and sleeve, 1-2 clutch and synchronizer assembly and the second gear (Fig. 7B-57).

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.

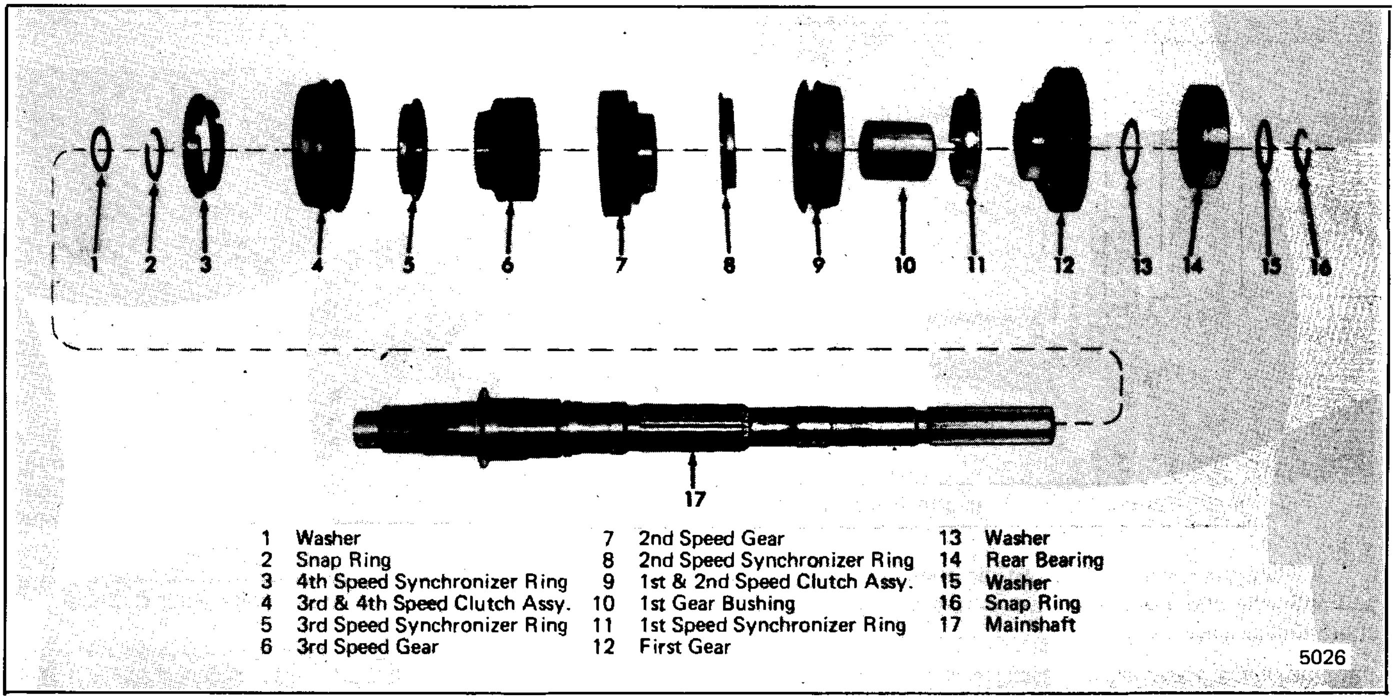

Fig. 7B-53 Mainshaft Assembly - Exploded View

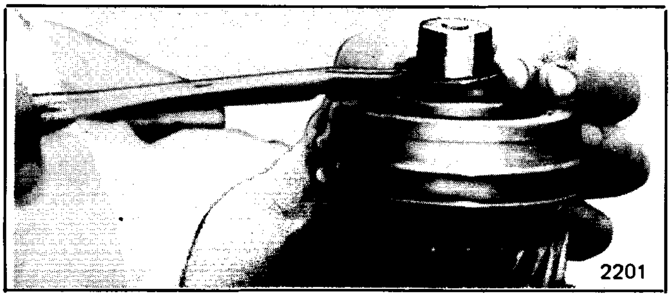

Fig. 7B-54 Removing 3-4 Clutch Assembly Retainer Ring

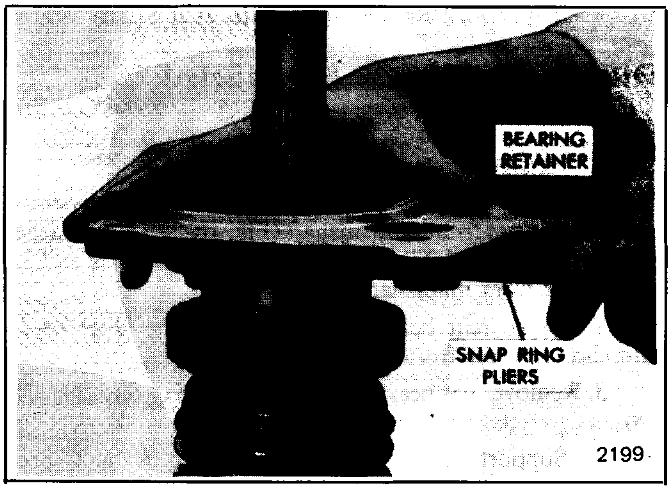

Fig. 7B-55 Removing Rear Bearing Retainer

2. Check the front and rear faces for burrs and, if present, dress them off with a fine mill file.

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

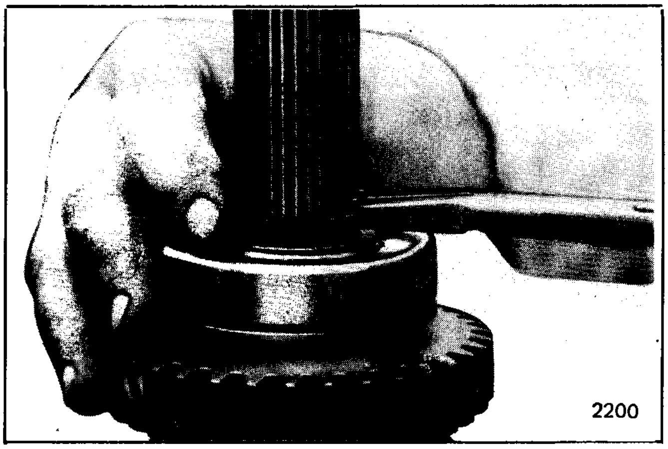

Fig. 7B-56 Removing Rear Bearing Snap Ring

Roller Bearings and Spacers

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft and reverse idler shaft at the same time, replace if necessary. Replace all worn spacers.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.

2. Inspect reverse gear bushing and, if worn or damaged, replace the entire gear (reverse gear bushing is not serviced separately).

3. Check both clutch sleeves to see that they slide freely on their hubs.

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a clean solvent.

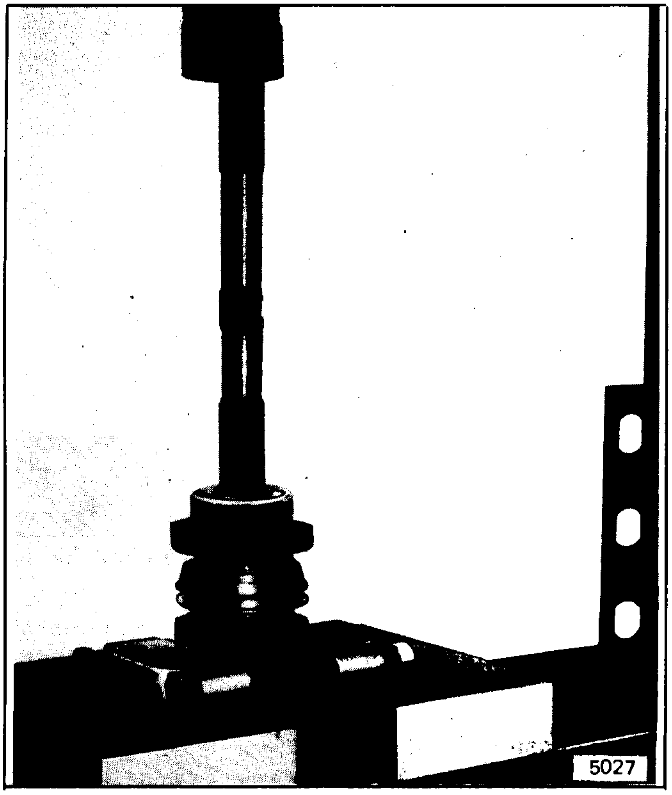

Fig. 7B-57 Pressing Rear Bearing From Mainshaft

2. Blow out bearings with compressed air.

CAUTION: *Do not allow the bearings to spin. Turn them slowly by hand. Spinning bearings will damage the race and balls.*

REPAIRS

Synchronizer Keys and Springs Replacement (Fig. 7B-58)

The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. If relation of hub and sleeve are not already marked, mark for assembly purposes.

2. Push the hub from the sliding sleeve; the keys will fall free and the springs may be easily removed.

3. Place the two springs in position (one on each side of hub), so all three keys are engaged by both springs.

4. Place the keys in position and, while holding them in place, slide the sleeve onto the hub, aligning the marks made before disassembly.

Extension Oil Seal and/or Bushing Replacement

1. Pry seal from rear of extension.

2. Remove bushing, using Tool J 21465-17 with Handle J 8092. Drive bushing into extension housing (Fig. 7B-59).

3. Using a new bushing and Tool J 21465-17 with Handle J 8092, press bushing into extension from rear of extension.

4. Coat I.D. of bushing and seal with transmission lubricant. Install new seal, using Tool J 21359 (Fig. 7B-60).

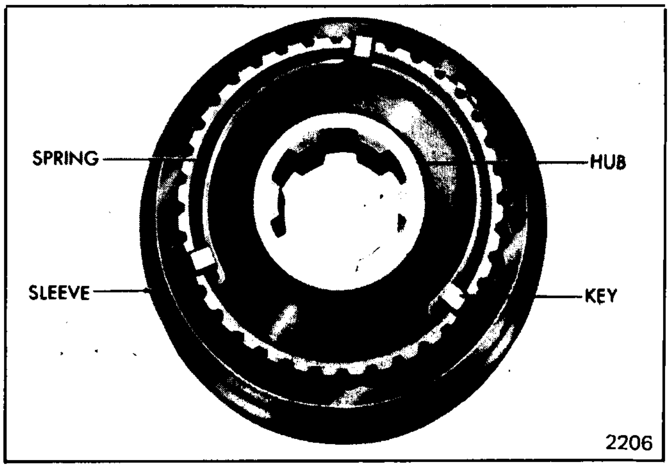

Fig. 7B-58 Synchronizer Assembly

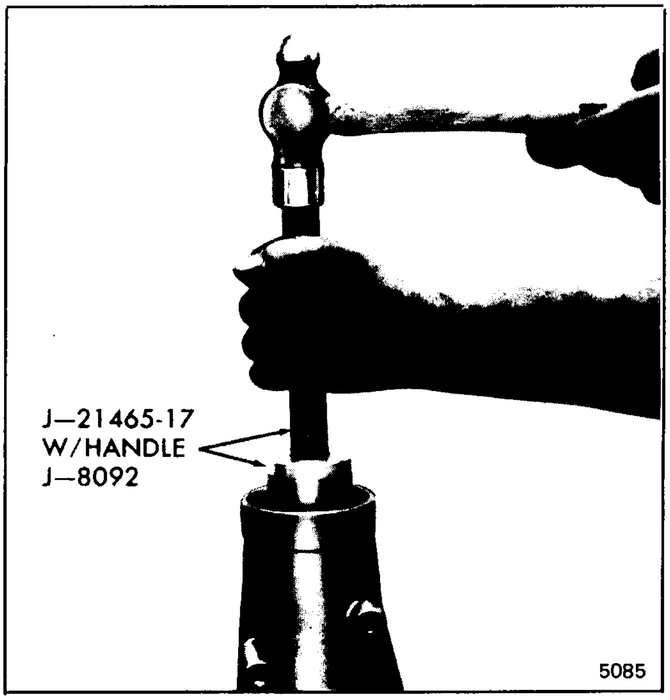

Fig. 7B-59 Removing Extension Bushing

Drive Gear Bearing Retainer Oil Seal Replacement

1. Pry out old seal.

2. Using a new seal, install new seal into retainer, using Tool J 21359 until it bottoms in bore (Fig. 7B-61). Lubricate I.D. of seal with transmission lubricant.

Reverse Shifter Shaft and/or Seal Replacement

1. With extension removed from transmission, the reverse shifter shaft lock pin will already be removed (see Step 5 under Transmission Disassembly).

2. Remove shift fork.

3. Carefully drive shifter shaft into extension, allowing ball detent to drop into case. Remove shaft and ball detent spring. Remove "O" ring seal from shaft.

4. Place ball detent spring into detent spring hole and start reverse shifter shaft into hole in boss.

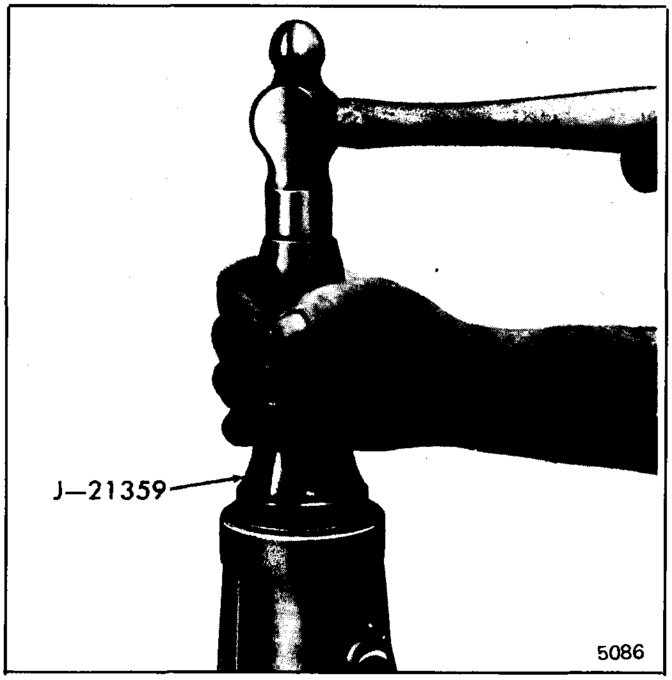

Fig. 7B-60 Installing Extension Oil Seal

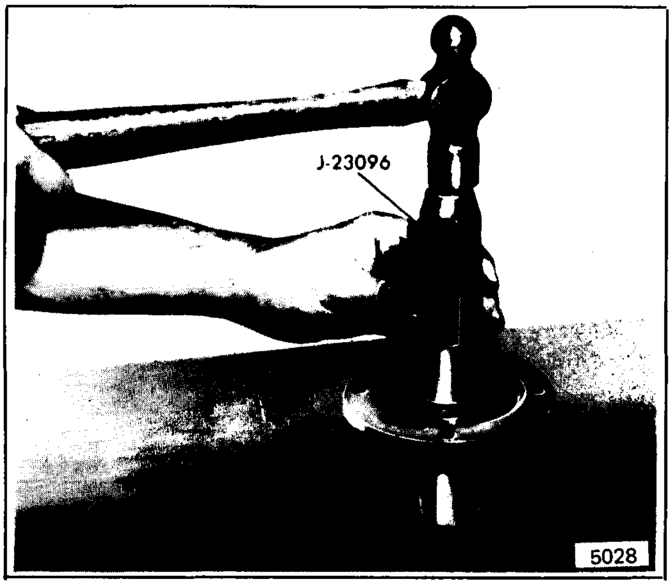

Fig. 7B-61 Installing Drive Gear Bearing Retainer Seal

5. Place detent ball on spring and, while holding ball down, push the shifter shaft into place and turn until the ball drops into place in detent on the shaft detent plate.

6. Install "O" ring seal on shaft.

7. Install shift fork.

NOTE: Do not drive the shifter shaft lock pin into place until the extension has been installed on the transmission case.

Reverse Idler Shaft Replacement

1. Place a small punch into hole in extension's reverse idler shaft boss and drive the welch plug and pin into the shaft (Fig. 7B-62), until the shaft can be pulled from rear extension.

2. Insert new idler shaft into extension until hole in shaft lines up with hole in boss.

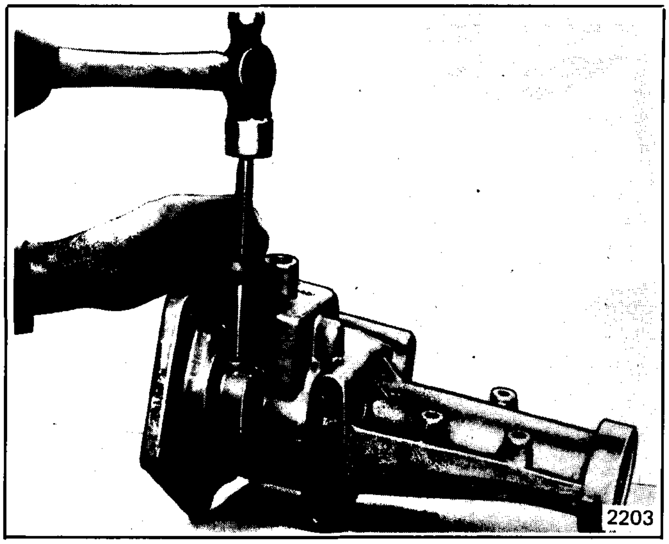

Fig. 7B-62 Removing Reverse Idler Shaft Roll Pin

3. Insert roll pin in boss opening and drive the pin into the extension until the shaft is securely locked in place. Install new welch plug, with sealer, in boss opening.

Transmission Case Cover

Although service of the case cover is covered here, the transmission does not have to be removed to perform these operations. To remove the cover on-the-vehicle, simply drain the transmission, disconnect the 1st/2nd cross shaft and 3rd/4th linkage and remove the attaching bolts and case cover from transmission.

1. Remove the outer shifter lever nuts and lockwasher and pull levers from shafts.

2. Carefully push the shifter shafts into cover, allowing the detent balls to fall free, then remove both shifter shafts.

3. Remove interlock sleeve, interlock pin and poppet spring.

4. Replace necessary parts (Fig. 7B-63) and assembly by reversing Steps 1-3.

ASSEMBLY OF COUNTERGEAR

1. Install roller spacer in countergear (if removed).

2. Using heavy grease to retain rollers, install spacer, rollers, spacer, rollers and spacer in either end of countergear. Repeat in other end of countergear (Fig. 7B-64).

3. Insert a dummy shaft, or Loader J 24658, into countergear.

CHECKING COUNTERGEAR END PLAY

1. Rest the transmission case on its side, with the case cover opening toward the assembler. Put countergear tanged thrust washers in place, retaining them with heavy grease, making sure the tangs are resting in the notches of the case.

2. Set countergear in place in bottom of transmission case, making sure that tanged thrust washers are not knocked out of place.

3. Position the transmission case, resting on its front face.

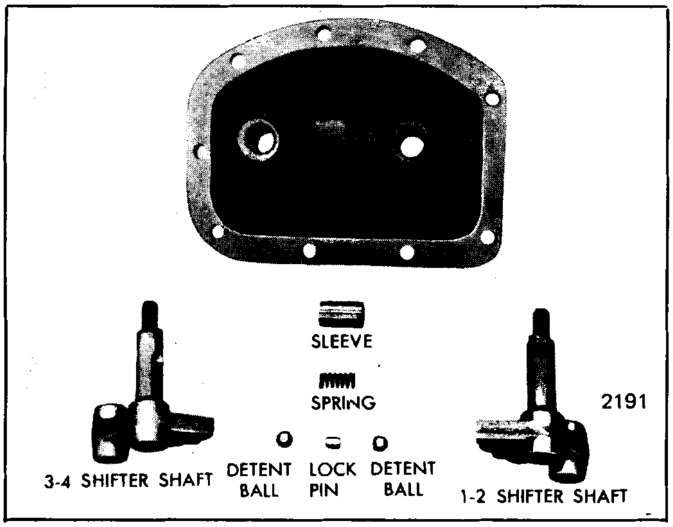

Fig. 7B-63 Case Cover - Exploded View

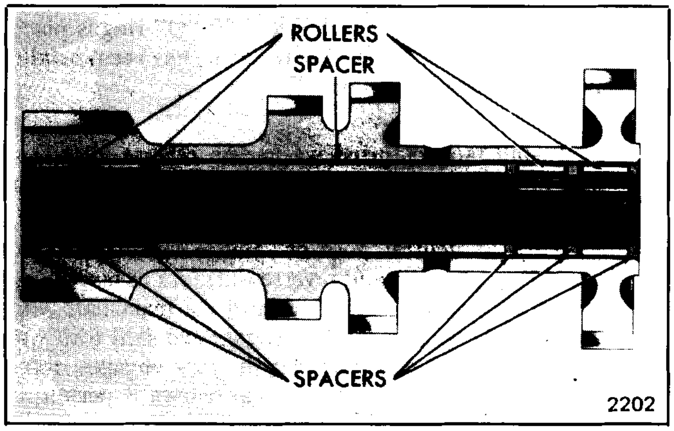

Fig. 7B-64 Countergear - Cross Section

4. Lubricate and insert countergear (pushing Loader J 24658 out front of case) until woodruff key slot is in its relative installed position (do not install key).

5. Attach a dial indicator (as shown in Fig. 7B-65) and check end play of the countergear. If end play is greater than .025", new thrust washers must be installed.

ASSEMBLY OF MAINSHAFT

1. From rear of mainshaft, assemble the 2nd speed gear (with hub of gear toward rear of shaft).

2. Install 1st-2nd synchronizer clutch assembly (sliding clutch sleeve taper toward rear, hub to front) on the mainshaft, together with a synchronizer ring on both sides of the cultch assemblies.

3. Position the 1st gear sleeve on the shaft and press the sleeve onto the mainshaft until the 2nd gear, clutch assembly and sleeve bottom against the shoulder of the mainshaft (Fig. 7B-66).

4. Install 1st speed gear (with hub toward front) and, supporting inner race, press the rear bearing onto the mainshaft with the snap ring groove toward front of the transmission (Fig. 7B-67).

5. Install spacer and new correct selective fit (thickest that will assemble) snap ring in mainshaft behind rear bearing.

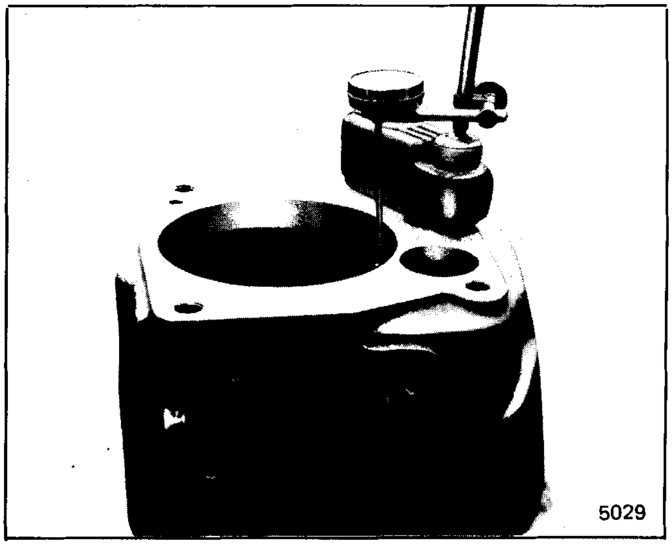

Fig. 7B-65 Checking Countergear End Play

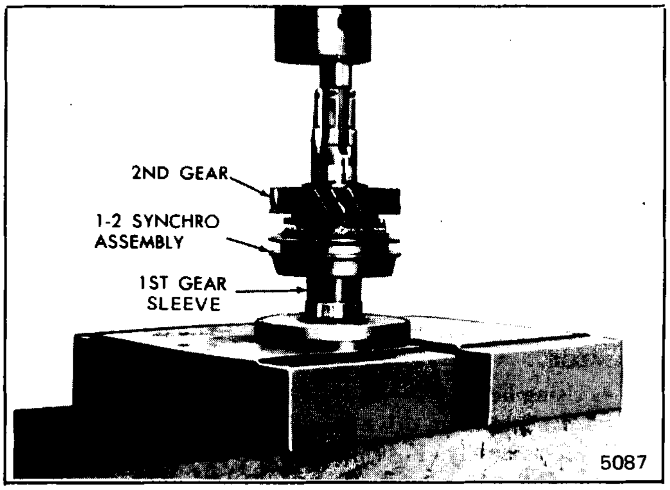

Fig. 7B-66 Installing 1st Gear Sleeve

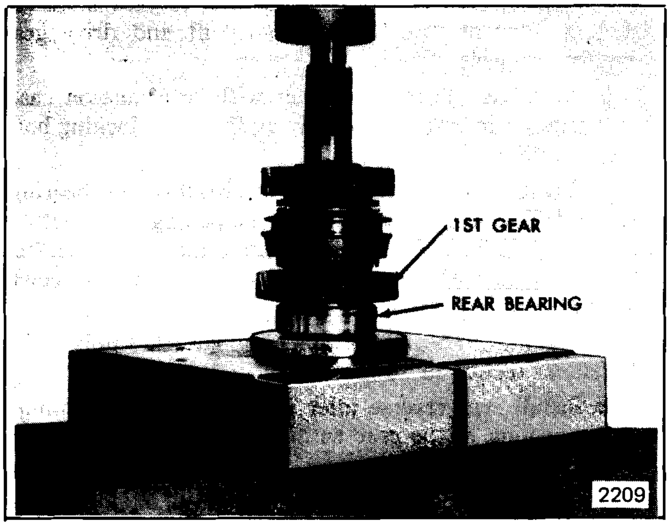

Fig. 7B-67 Installing Rear Bearing

6. Install the 3rd speed gear (hub to front of transmission) and the 3rd speed gear synchronizing ring (notches to front of transmission).

7. Install the 3rd and 4th speed gear clutch assembly (hub and sliding sleeve) with taper toward the front, making sure that the keys in the hub correspond to the notches in the 3rd speed gear synchronizing ring.

8. Install new selective fit snap ring (thickest that will install) in the groove in mainshaft in front of the 3rd and 4th speed clutch assembly.

9. Install the rear bearing retainer over end of mainshaft. Spread the snap ring to drop around the rear bearing. Release snap ring when it aligns with groove in rear bearing.

10. Install the reverse gear (shift collar to rear).

11. Install a snap ring, the speedometer drive gear and a second snap ring, onto the mainshaft.

ASSEMBLY OF TRANSMISSION

1. Place the transmission case on its side, with the case cover opening toward the assembler. Position the countergear tanged washers in place, using heavy grease to retain them.

NOTE: Be sure the tangs are in the notches of the thrust face.

2. Install the countergear in the case, aligning the bore of the countergear with the case opening. With the thrust washers in place, slide the loading tool to the front of the case and install the countergear shaft from the rear of the case. Install the woodruff key and tap shaft into gear until shaft is flush with rear face of transmission case.

3. Install front reverse idler gear (teeth forward) and thrust washer in case. Use heavy grease to hold thrust washer in position.

4. Using heavy grease, install sixteen (16) roller bearings and washer into main drive gear. Mate main drive gear with mainshaft assembly. Position 3rd-4th clutch sliding sleeve forward. This will provide clearance for installation as well as hold the assembly together.

5. Position new rear bearing retainer to case extension gasket on rear of case. Install mainshaft and drive gear assembly into case.

6. Align rear bearing retainer with transmission case. Install retainer to case locating pin and retainer locking bolt. Torque to 25 lb. ft.

7. Place bearing snap ring on front main bearing. Position front main bearing to case opening and, with a hollow shaft or Tool J 5680, tap bearing into case (Fig. 7B-68). Install spacer washer and selective fit snap ring to secure main drive bearing.

8. Install front bearing retainer and gasket. Apply sealer to bolts and torque to 18 lb. ft.

9. Install rear reverse idler gear, engaging the splines with the portion of the gear within the case.

10. Place new rear bearing retainer to case extension gasket into position on rear face of bearing retainer. Slide reverse gear on shaft. Install speedometer gear and two selective fit snap rings.

11. Install idler shaft into extension until hole in shaft lines up with hole in boss. Insert reverse idler shaft lock pin in boss opening and drive the pin into the extension until the shaft is securely locked in place. Install new welch plug, with sealer, in boss opening.

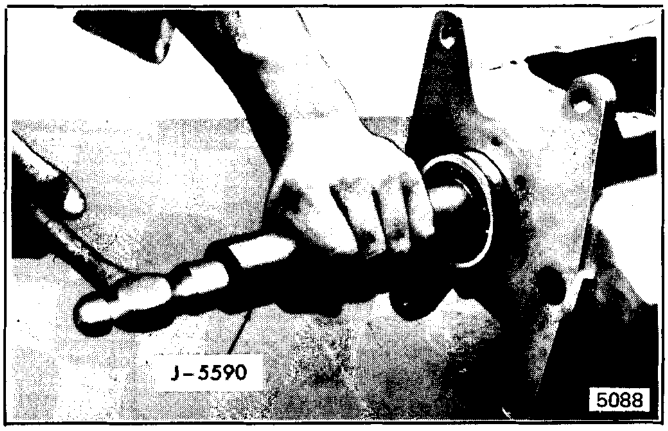

Fig. 7B-68 Installing Front Main Bearing

12. Install reverse shifter shaft and detent plate into extension. Locate reverse shift fork in reverse shifter shaft. Use heavy grease to hold reverse shift fork in position.

NOTE: Be sure reverse shifter shaft "O" ring is placed on reverse shifter shaft after the shaft has been installed in the extension housing.

13. Install tanged thrust washer on reverse idler shaft with tang of washer in notch of idler thrust face of extension.

14. Place the 1st-2nd speed and 3rd-4th speed clutch sliding sleeve in neutral position. Pull reverse shift shaft partially out of extension and reverse shift fork as far forward in as possible. Start the extension onto the mainshaft while pushing in on the shifter shaft to engage the shift fork with the reverse gear shift collar. When the fork engages, rotate the shifter shaft to move the reverse gear rearward, permitting the extension to mate against the transmission case.

15. Install reverse shifter shaft lock pin.

16. Install rear extension housing-to-case bolts (long bolts). Install rear extension to rear bearing retainer bolts (short bolts). Torque long bolts to 40 lb. ft. and short bolts to 25 lb. ft.

NOTE: It is essential that sealer be used on the extension bolt as indicated in Fig. 7B-69.

17. Position 1st-2nd speed clutch sliding sleeve into 2nd gear and 3rd-4th speed clutch sliding sleeve into neutral. Position forward shift forks in sliding sleeves.

18. Position 1st-2nd speed gear shifter shaft and detent plate into 2nd gear position and, using a sealer, install cover gasket and case cover assembly to transmission. Torque bolts evenly to 18 lb. ft.

INSTALLATION OF TRANSMISSION

1. Place transmission on guide pins and rotate transmission as necessary to start main drive gear splines into clutch driven plate. Slide transmission forward.

NOTE: Make certain that main drive gear shaft is aligned with pilot bearing in crankshaft and that clutch release bearing is properly installed.

2. Install two (2) lower transmission-to-clutch housing bolts. Remove guide pins and install two (2) upper bolts. Torque bolts evenly to 55 lb. ft.

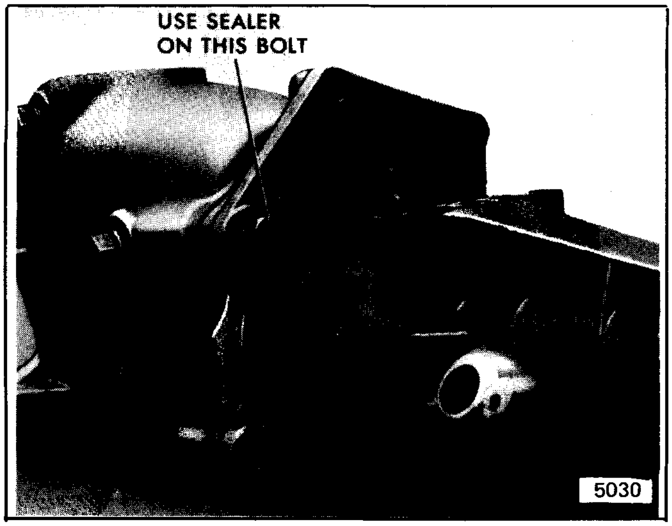

Fig. 7B-69 Extension Bolt To Be Sealed

3. Slide crossmember forward and install 33bolts. Torque to 25 lb. ft.

4. Lower engine-transmission and install crossmember-to-transmission mount bolts and catalytic converter-to-transmission bracket bolts. Tighten all bolts to specified torque.

5. Install shifter assembly to shifter support and secure with two (2) shifter assembly-to-support bolts. Torque upper bolt to 45 lb. ft. and lower bolt to 30 lb. ft.

6. Connect speedometer cable and TCS/back-up light connector.

7. Connect linkage and adjust as described under MAINTENANCE AND ADJUSTMENTS.

8. Install propeller shaft and re-fill transmission with lubricant.

9. Lower vehicle and, after vehicle is road tested, re-check lubricant level and add as required.

5-SPEED 77MM BORG-WARNER TRANSMISSION

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NOTE: A retaining compound such as Loctite #601, or equivalent, must be applied to the bearing bore I.D. for all bearing installations to the case, center support and extension housing. The respective surfaces must be degreased and cleaned to insure that the compound will bond.

REMOVAL OF TRANSMISSION

Before raising vehicle, disconnect battery and release parking brake.

1. From inside vehicle, remove screws that hold chrome bezel ring to tunnel and remove bezel by slipping over boot and shift lever.

2. With transmission shift lever in "Neutral", hold boot out of way, remove four (4) bolts securing lever assembly to transmission and remove shift lever assembly.

3. Raise vehicle on hoist, scribe a mark on companion flange yoke and and propeller shaft to assure proper reassembly and remove shaft from vehicle.

4. Remove nut from front torque arm, two (2) catalytic converter support bracket bolts, three (3) damper attaching bolts and, finally, damper if vehicle is so equipped.

5. Remove two (2) bolts holding transmission mount to support and raise transmission to take weight off support. Remove two (2) long end bolts and remove transmission support.

6. Disconnect speedometer cable and TCS/back-up light connector.

7. Remove upper transmission-to-clutch housing bolts and install aligning Guide Pins J 1126 (or 1/2"-13 x 2" threaded headless bolts).

NOTE: Aligning guide pins or studs must be used to support transmission in order to prevent distortion of the clutch driven plate hub while removing transmission.

8. Slide transmission straight back on guide pins until main drive gear splines are free of clutch driven plate and remove from vehicle.

DISASSEMBLY OF TRANSMISSION

1. Remove plug, poppet spring and mesh lock plunger from extension housing (Fig. 7B-70). Use a magnet to remove plunger.

2. Remove selector lever pivot from extension housing (Fig. 7B-71).

3. Drive roll pin from shifter head and shift rail (Fig. 7B-72). Roll pin may be left in position if linkage were not to be disassembled.

4. Remove six (6) bolts that retain transmission case and extension housing to center support.

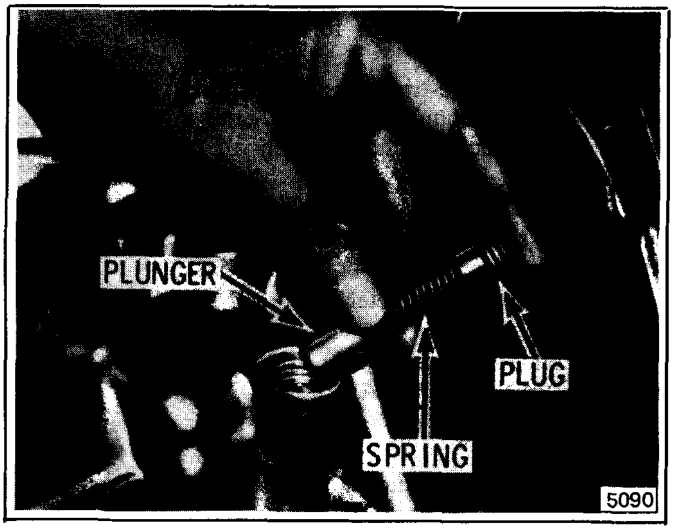


Fig. 7B-70 Removing Plug, Poppet Spring and Plunger

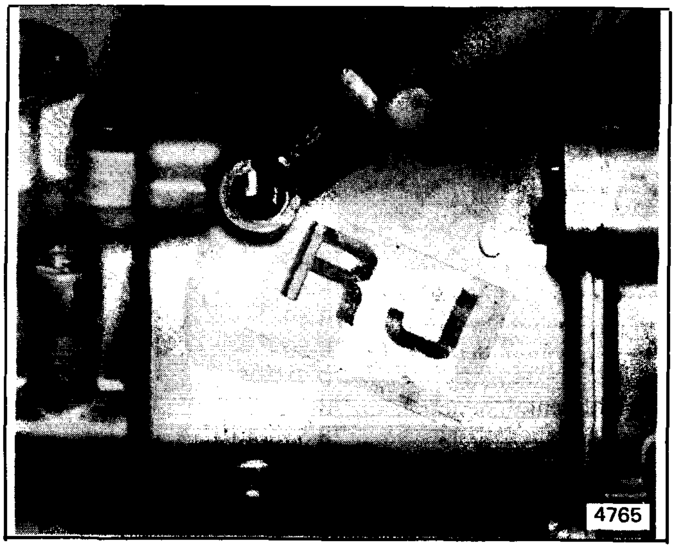


Fig. 7B-71 Removing Selector Lever Pivot

5. Slide transmission case forward and remove needle thrust bearing and race from input shaft or case.

NOTE: Some models may also contain a lipped thrust washer.

6. Remove extension housing by sliding it rearward. The shifter head, shift rail and selector lever are not fastened to housing and should not be permitted to drop out. Remove from extension housing.

The selector lever may be removed from shift rail by removing retaining clip and pin.

NOTE: The needle rollers are not always retained in needle case. Catch loose needles if they fall out during disassembly so they can be replaced in mating race during assembly.

7. Remove rail selector pin and remove rail selector (Fig. 7B-73).

8. Remove snap ring behind speedometer gear, then remove gear and ball from output shaft.

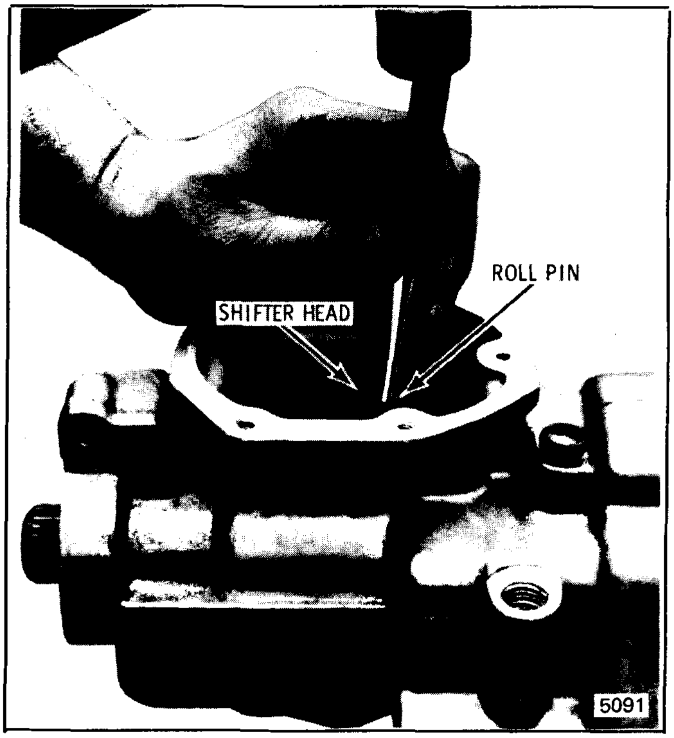


Fig. 7B-72 Removing Shifter Head Roll Pin

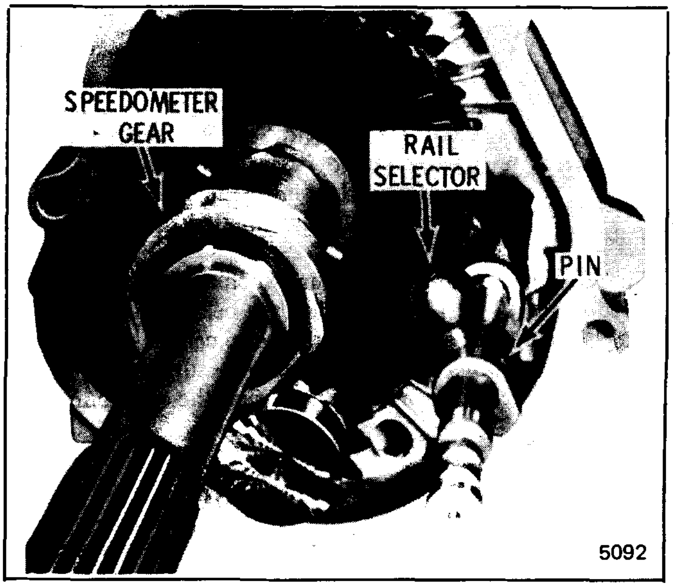


Fig. 7B-73 Removing Pin and Rail Selector

9. Remove snap ring, thrust washer, first speed gear and blocker ring from output shaft (Fig. 7B-75).

NOTE: All snap rings are not the same. Be sure the correct snap ring is installed into the correct groove when reassembling (see Fig. 7B-74).

10. Remove snap ring from behind synchronizer hub (Fig. 7B-76).

11. Turn shift rail to position interlock pawl to the inboard position to permit removal of first and reverse shift link.

12. Slide first and reverse synchronizer, shift fork, shift link and shift rail rearward from transmission (Fig. 7B-77).

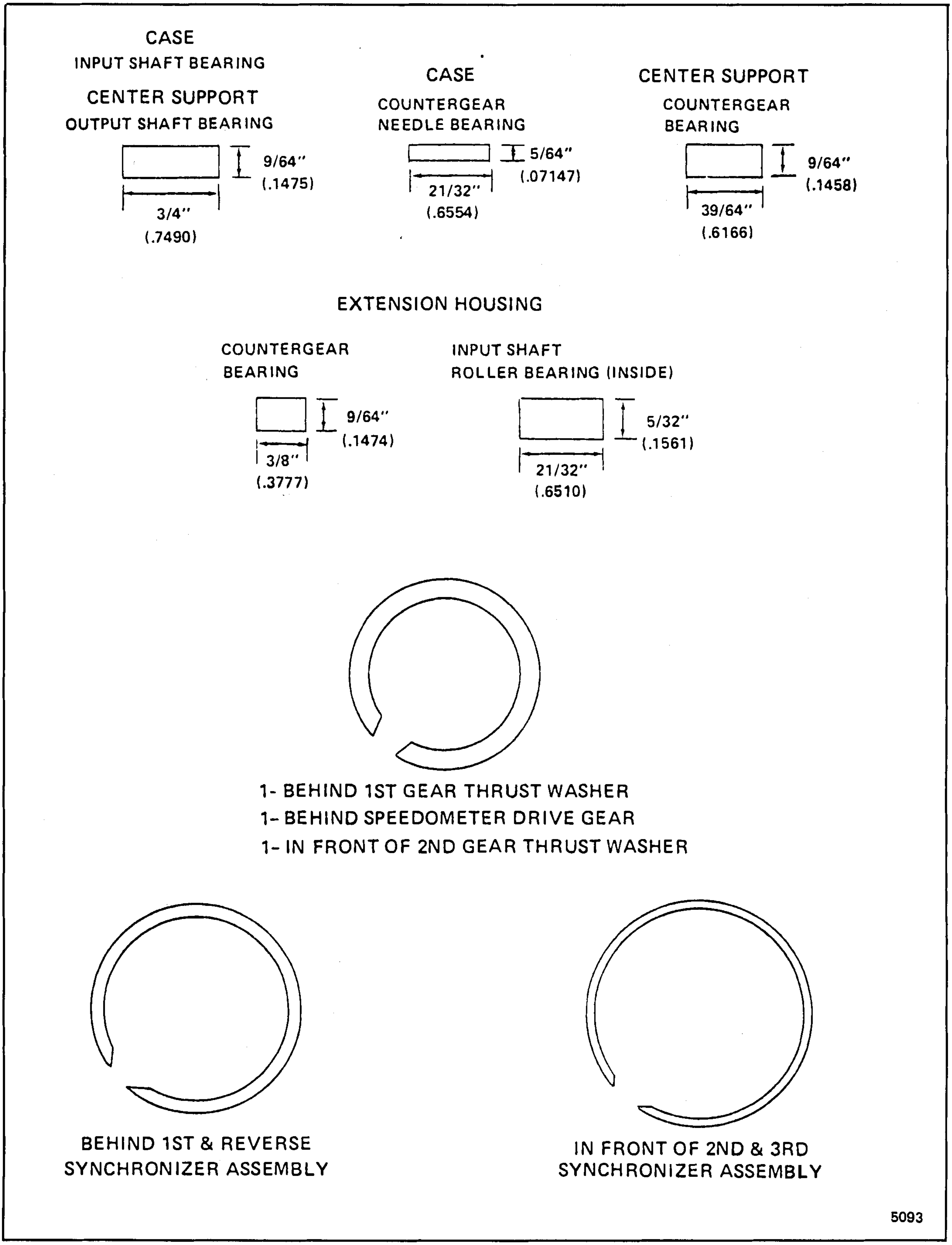


Fig. 7B-74 Snap Ring and Needle Bearing Identification

NOTE: Mark synchronizer hub and sleeve to permit reassemblying parts in same relative position to insure correct sliding fit and backlash.

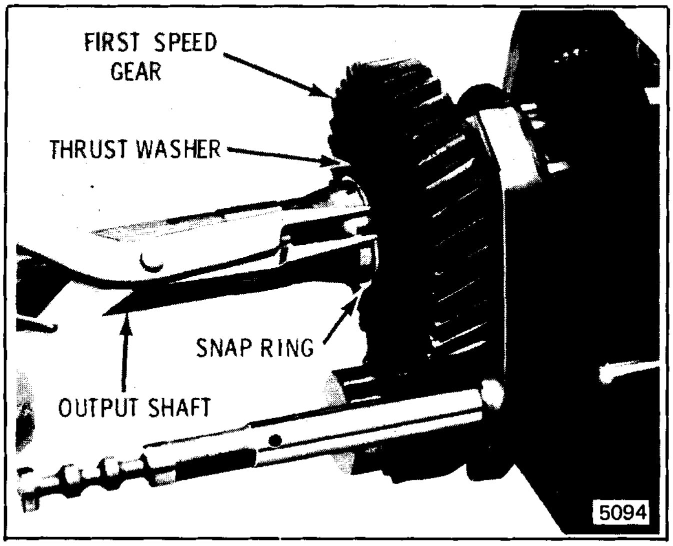


Fig. 7B-75 Removing First Speed Gear Snap Ring

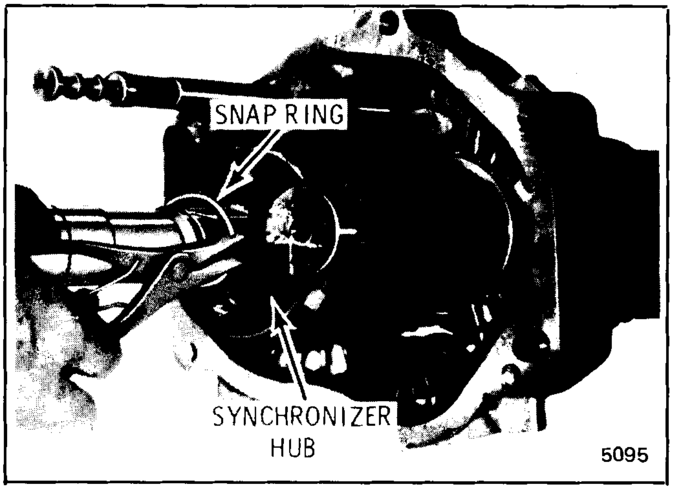


Fig. 7B-76 Removing Synchronizer Hub Snap Ring

13. Remove reverse idler gear from idler shaft and slide reverse gear rearward from output shaft (Fig. 7B-78).

14. Position interlock pawl to the center position to permit the second and third speed shift link and shift fork to be removed (Fig. 7B-79).

15. Lift link from shift fork and slide link out. Remove shift fork.

16. Position interlock pawl to the outboard position to permit the fourth and fifth shift link and shift fork to be removed (Fig. 7B-80).

17. Lift link from shift fork and slide link out. Remove shift fork.

18. Remove center support from output shaft and countergear (Fig. 7B-81).

NOTE: Needles could drop out of center support needle bearing.

19. Remove needle thrust bearing and race from output shaft or center support (Fig. 7B-82).

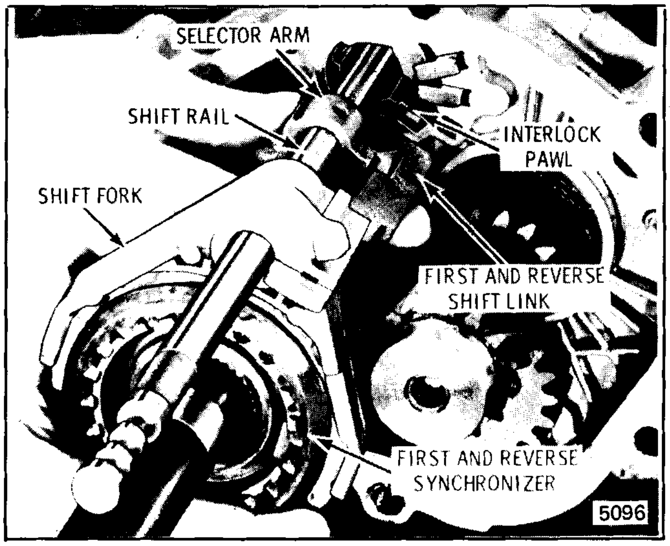


Fig. 7B-77 Removing First and Reverse Synchronizer, Shift Fork, Rail and Link

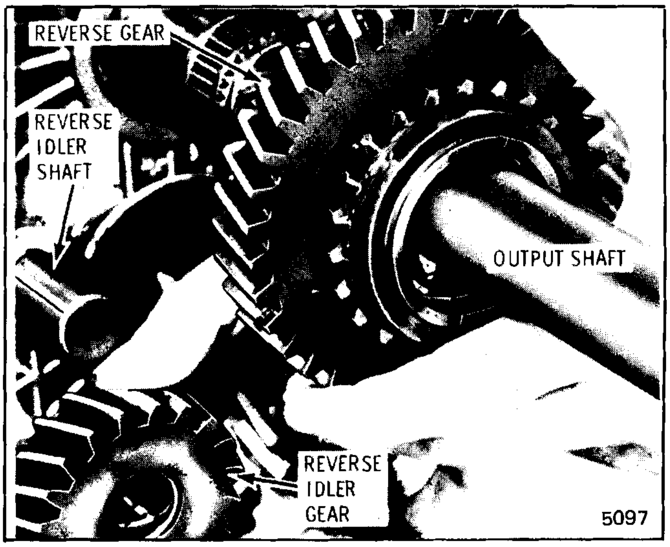


Fig. 7B-78 Removing Reverse Idler and Reverse Gears

Fig. 7B-79 Removing Second and Third Shift Link and Fork

NOTE: Some models may also contain a lipped thrust race.

20. Remove countergear from gears on output shaft.

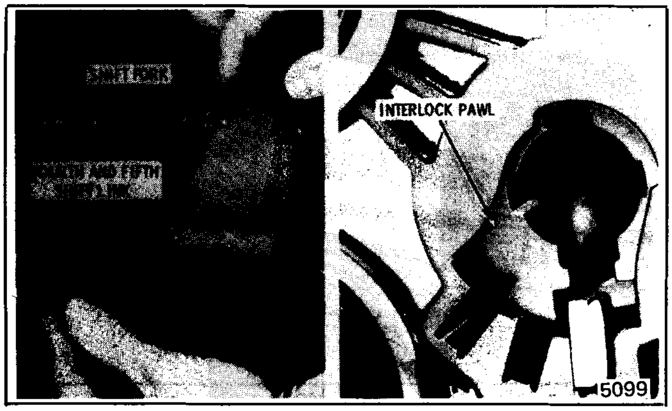


Fig. 7B-80 Removing Fourth and Fifth Shift Link and Fork

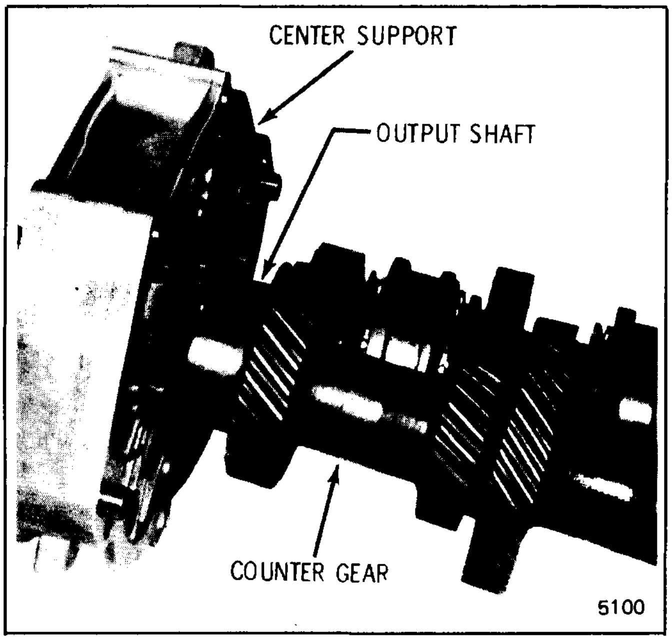


Fig. 7B-81 Removing Center Support

21. Remove input shaft from output shaft (Fig. 7B-83).

NOTE: Needle rollers could drop out of input shaft.

22. Remove needle thrust bearing from end of input shaft or synchronizer hub.

23. Remove the fourth and fifth gear synchronizer assembly and blocker rings from output shaft (Fig. 7B-84).

24. Remove fifth speed gear. Spacers and needle rollers may drop out (Fig. 7B-85).

NOTE: When correct number of needle rollers are installed, one needle space should remain unused in each row.

25. Remove snap ring and thrust washer from output shaft and remove second gear and blocker ring (Fig. 7B-86).

26. Remove snap ring; then, remove second and third gear synchronizer assembly and blocker ring from output shaft (Fig. 7B-87).

27. Remove third speed gear (Fig. 7B-88).

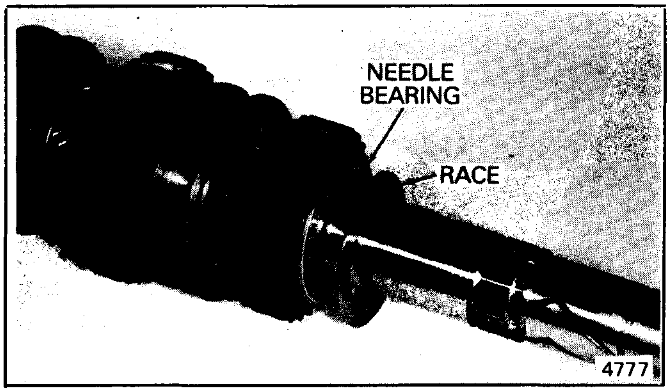


Fig. 7B-82 Removing Needle Thrust Bearing and Race

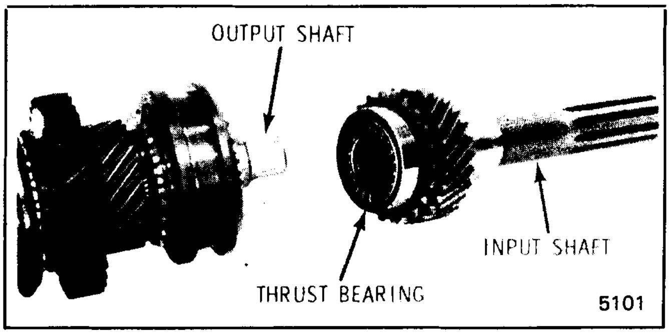


Fig. 7B-83 Removing Input Shaft from Output Shaft

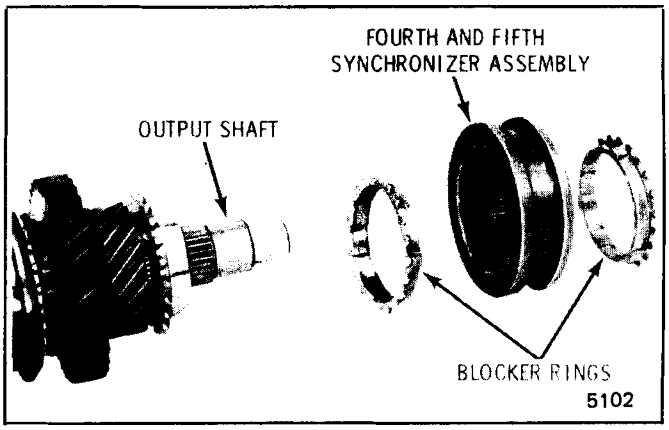


Fig. 7B-84 Removing Fourth and Fifth Gear Synchronizer Assembly

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission case thoroughly inside and outside with cleaning solvent; then inspect for cracks.

2. Check the front and rear faces for burrs and, if present, dress them off with a fine mill file.

3. Check bearing bores in case and, if damaged, replace case.

Needle Bearings

All needle bearings in center support, case and extension housing should be inspected and replaced if they are worn or damaged.

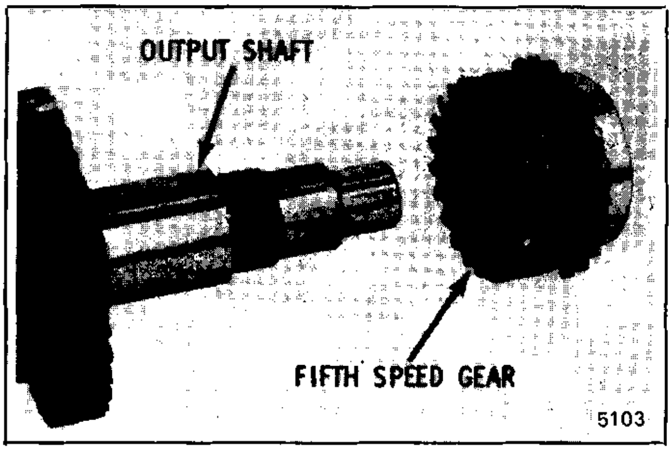


Fig. 7B-85 Removing Fifth Speed Gear

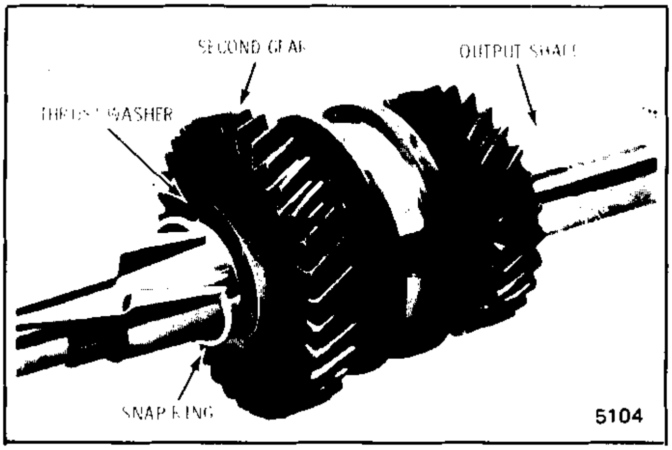


Fig. 7B-86 Removing Second Speed Gear

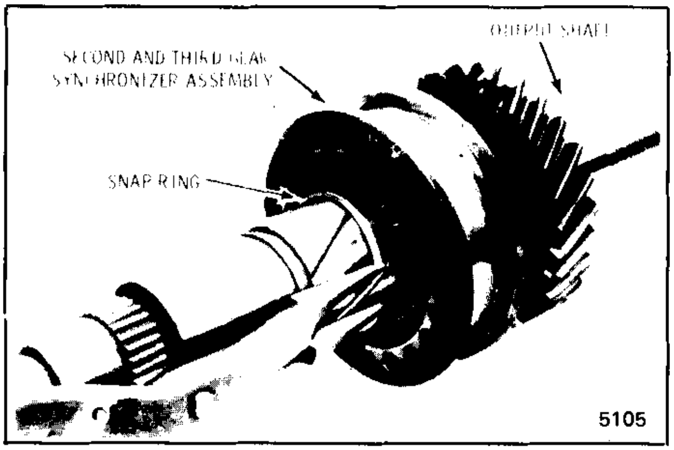


Fig. 7B-87 Removing Second and Third Gear Synchronizer Assembly

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.

2. Check all three synchronizer clutch sleeves to see that they slide freely on their hubs.

Replacing Synchronizer Keys and Springs (Fig. 7B-89)

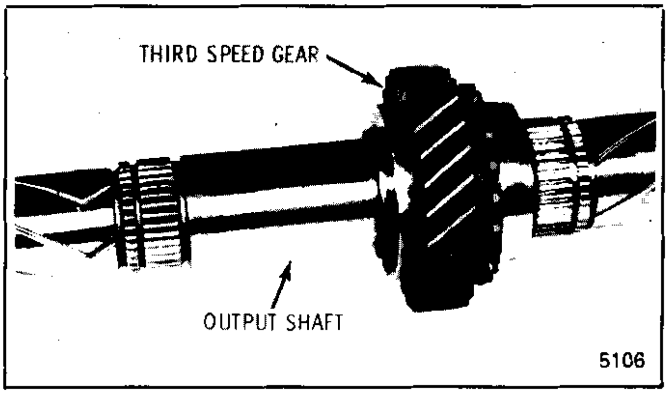


Fig. 7B-88 Removing Third Speed Gear

NOTE: The clutch hubs and sliding sleeves are a selected assembly and should be kept together as an assembly, but the keys and two springs may be replaced if worn or broken.

1. Mark hub and sleeve so they can be matched upon reassembly.
2. Push hub from sliding sleeve and remove the keys and springs.
3. Place one spring on each side of hub so springs overlap slots in hub and opening in springs are not opposite each other.
4. Place shift keys in slots of hub with radius side out and springs in grooves of keys.
5. Install sliding sleeve onto hub, aligning the marks made before disassembly. Depress keys for ease of installation.

REPLACEMENT OF CASE BEARINGS AND SEAL

Removal and Installation of Input Shaft Needle Bearing

1. Install Tool J 26225 beneath needle bearing and expand tool until a firm grip is obtained.
2. Use Slide Hammer J 6125 and remove bearing from case (Fig. 7B-90).
3. See NOTE at beginning of this section. Then, using Tools J 26222-1 and J 26222-2 with Driver Handle J 8092, drive needle bearing into case until tool seats on case (Fig. 7B-91).

Removal and Installation of Countergear Needle Bearing

1. Install Tool J 26225 beneath needle bearing and expand tool until a firm grip is obtained.
2. Use Slide Hammer J 6125 and remove bearing from case (Fig. 7B-92).
3. See NOTE at beginning of this section. Then, using Tool J 26223 with Drive Handle J 8092, drive needle bearing into case until tool seats on case (Fig. 7B-93).

Removal and Installation of Seal

1. Remove input shaft needle bearing from case, using Tool J 26225 with Slide Hammer J 6125.

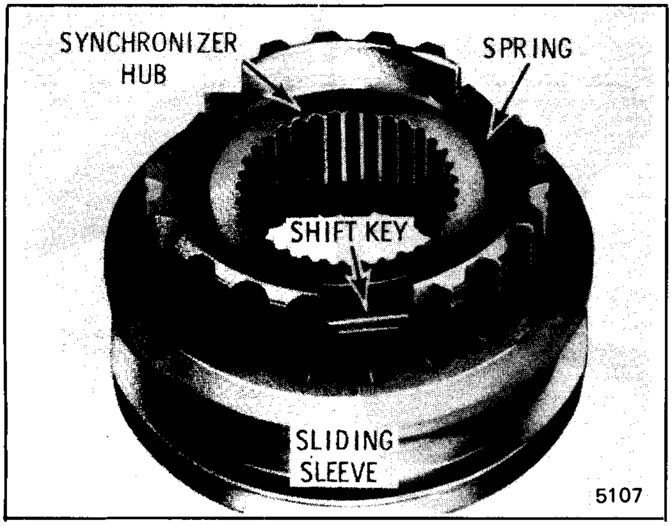


Fig. 7B-89 Synchronizer Assembly (Typical)

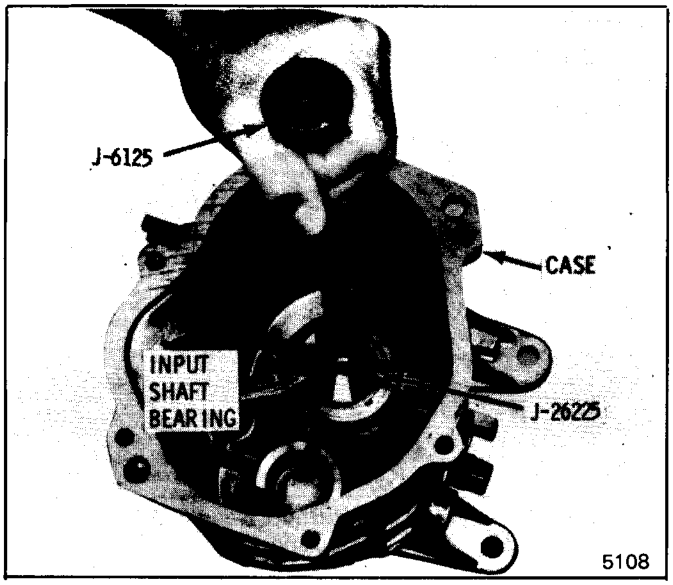


Fig. 7B-90 Removing Input Shaft Needle Bearing from Case

2. Insert Tool J 26243 through front of case and work pointed end of tool behind seal and drive seal out of case (Fig. 7B-94).

3. Install new seal on Tool J 26224 with lip and spring against tool and drive seal into case until tool seats on case (Fig. 7B-95).

4. Using Tool J 26223 with Driver Handle J 8092, drive needle bearing back into case.

REPLACEMENT OF CENTER SUPPORT BEARINGS

Removal and Installation of Output Shaft Needle Bearing

1. Support center support on two wood blocks.

2. Using Tool J 22407 (Pitman Shaft Bearing Installer-variable ratio) with Driver Handle J 8092, drive needle bearing out of center support (Fig. 7B-96).

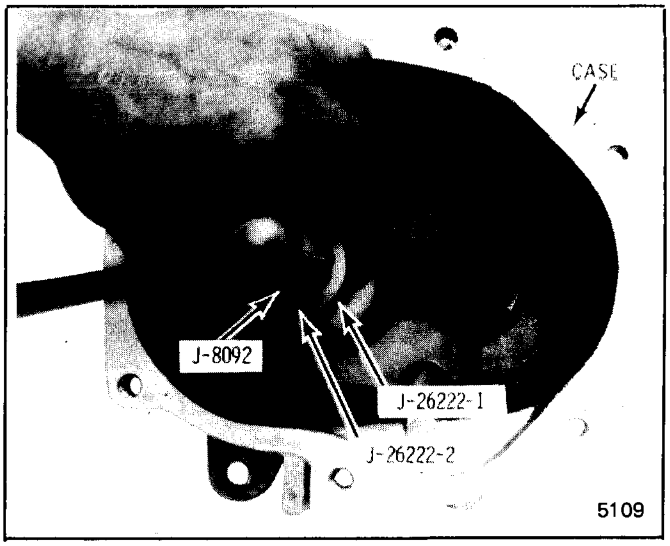


Fig. 7B-91 Installing Input Shaft Needle Bearing Into Case

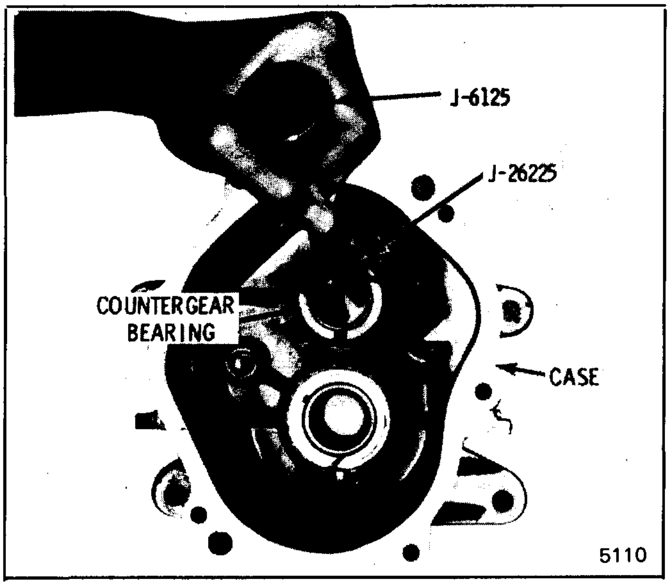


Fig. 7B-92 Removing Countergear Needle Bearing from Case

NOTE: Drive needle bearing out from front to rear of center support.

3. See NOTE at beginning of this section. Then, using Tool J 26222-1 and -3 with Driver Handle J 8092, drive needle bearing from front to rear of center support until tool seats on center support (Fig. 7B-97).

Removal and Installation of Countergear Needle Bearing

1. Support center support on two wood blocks.

2. Remove retaining plate and interlock pawl.

3. Using Tool J 26222-1 with Driver Handle J 8092, drive needle bearing out of center support (Fig. 7B-98).

4. See NOTE at beginning of this section. Then, using Tool J 26223 with Driver Handle J 8092, drive needle bearing until tool seats on center support (Fig. 7B-99).

5. Install interlock pawl and retaining plate. Torque screws to 10 lb. ft.

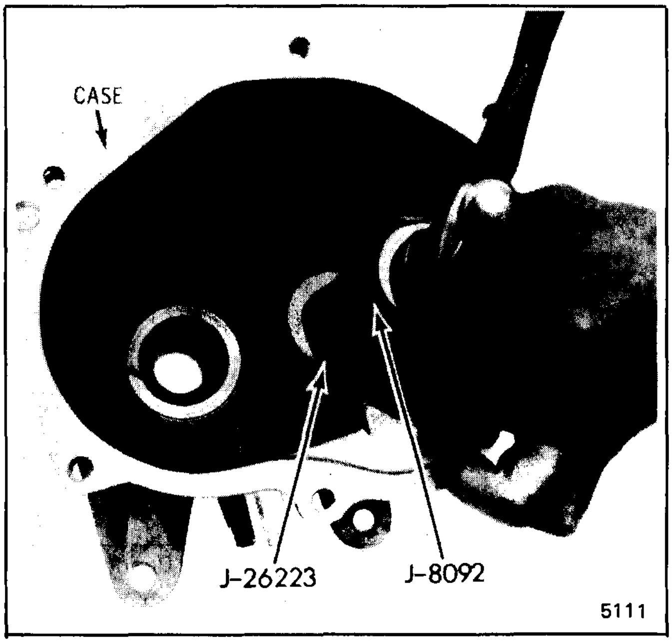


Fig. 7B-93 Installing Countergear Needle Bearing Into Case

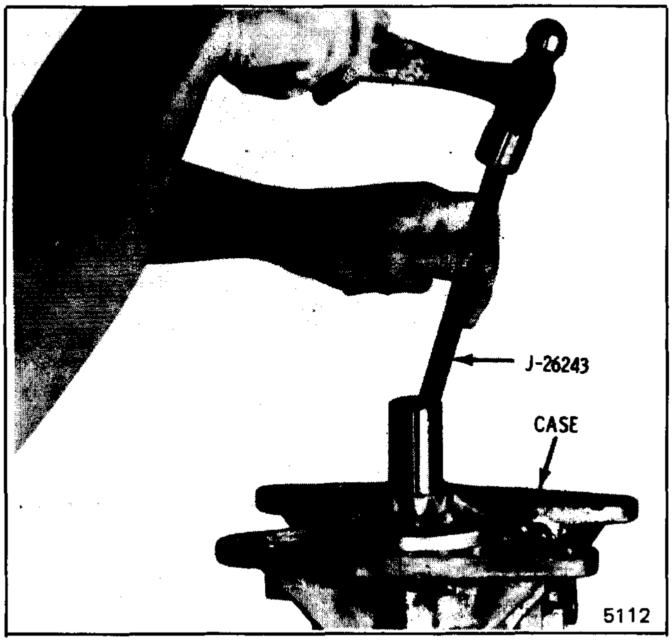


Fig. 7B-94 Driving Seal from Case

REPLACEMENT OF EXTENSION HOUSING BEARING, BUSHING AND SEAL

Removal and Installation of Countergear Needle Bearing

1. Install Tool J 26225 beneath needle bearing and expand tool until a firm grip is obtained.

2. Use Slide Hammer J 6125 and remove bearing (Fig. 7B-100).

3. See NOTE at beginning of this section. Then, using Tool J 26222-1 with Driver Handle J 8092, drive needle bearing until tool seats on extension housing (Fig. 7B-101).

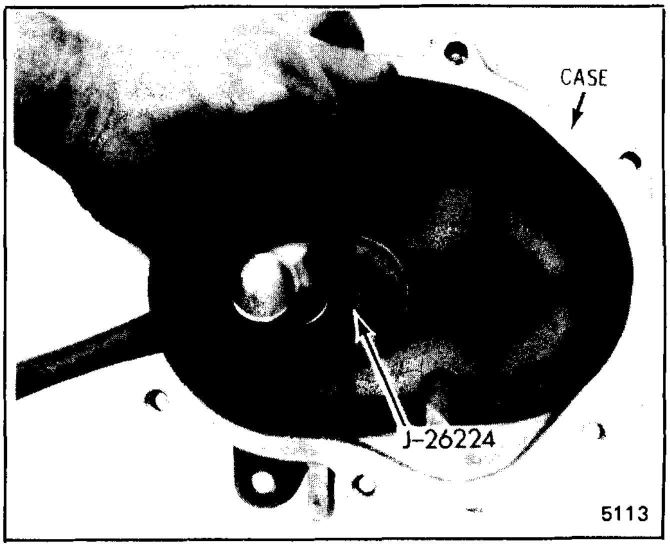


Fig. 7B-95 Installing Seal into Case

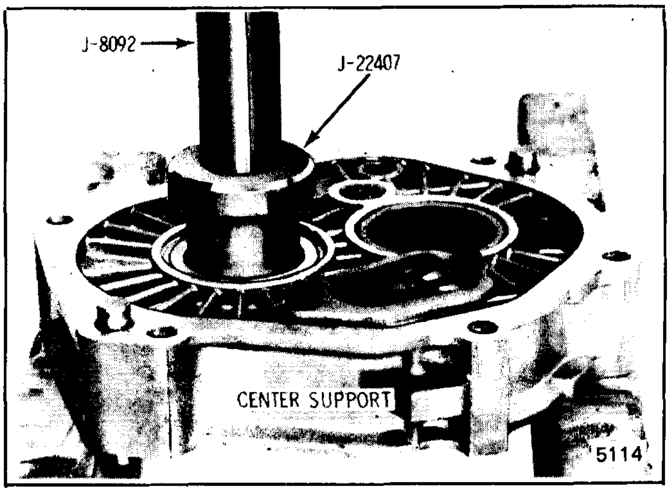


Fig. 7B-96 Removing Output Shaft Needle Bearing from Center Support

Removal and Installation of Oil Seal

1. Pry oil seal from extension housing (Fig. 7B-102).

2. For installation, prelubricate between sealing lips and coat new seal O.D. with Permatex or equivalent.

3. Using Tool J 21426 or J 5154, tap seal until it seats on extension housing (Fig. 7B-103).

Removal and Installation of Bushing (Fig. 7B-104)

1. Remove oil seal.

2. Observe depth location of bushing in bore of extension housing.

3. Using Tool J 5778 or J 21424-9 with Driver Handle J 8092, drive bushing out from rear of extension housing.

4. Drive new bushing in from rear of extension housing to same depth, using Tool J 5778 or J 21424-9 with Driver Handle J 8092.

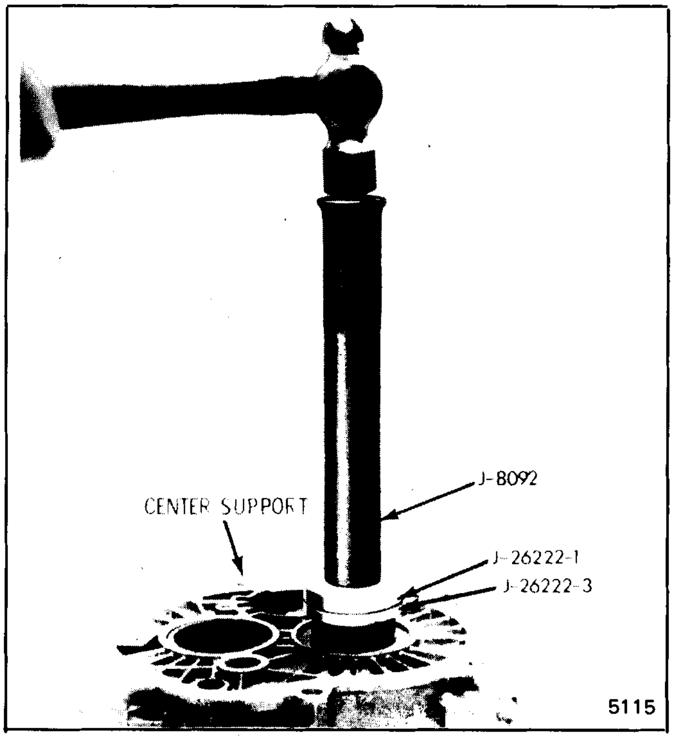


Fig. 7B-97 Installing Output Shaft Needle Bearing into Center Support

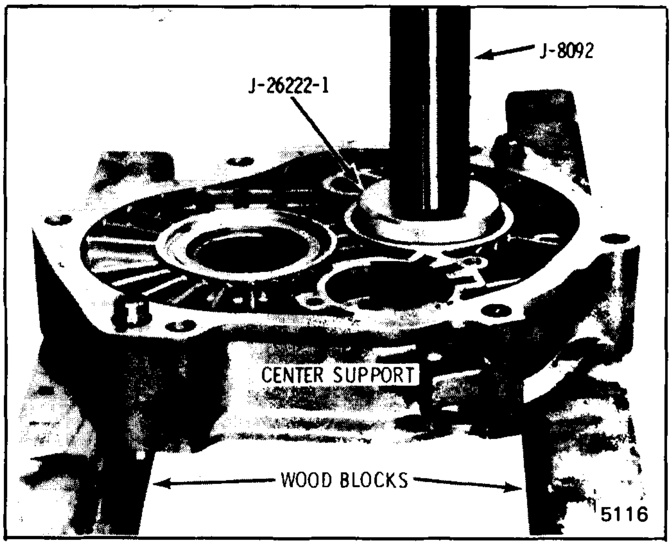


Fig. 7B-98 Removing Countergear Needle Bearing from Center Support

ASSEMBLY AND INSTALLATION OF TRANSMISSION

1. Assemble the third speed gear over output shaft, with coned end toward front and against shaft shoulder (Fig. 7B-105).

NOTE: Although synchronizer assemblies are similar, the hub splines differ. Hub and sleeve are selective fit to obtain a free sliding fit with .002" maximum backlash. Keep mated parts together to insure correct sliding fit and backlash.

2. Assembly blocker rings with slots aligned with shift keys of second and third gear synchronizer assembly.

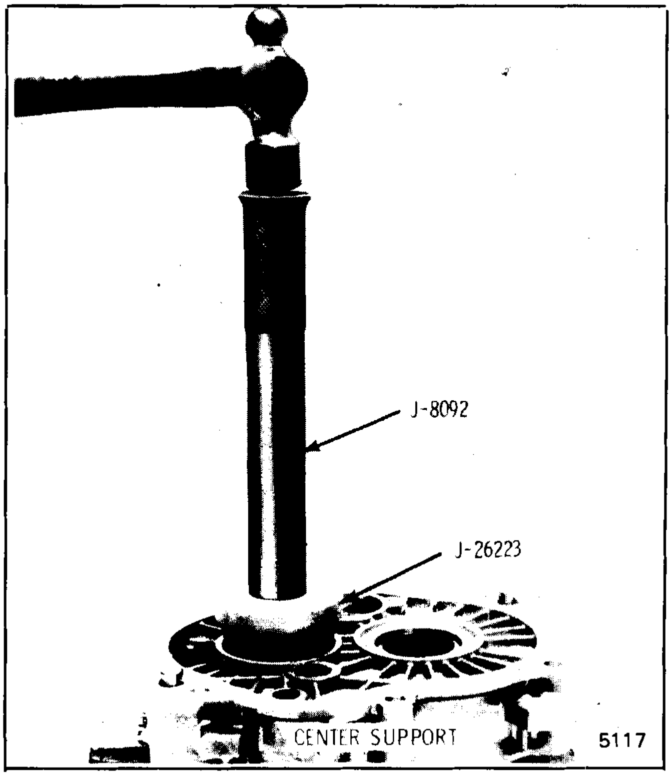


Fig. 7B-99 Installing Countergear Needle Bearing into Center Support

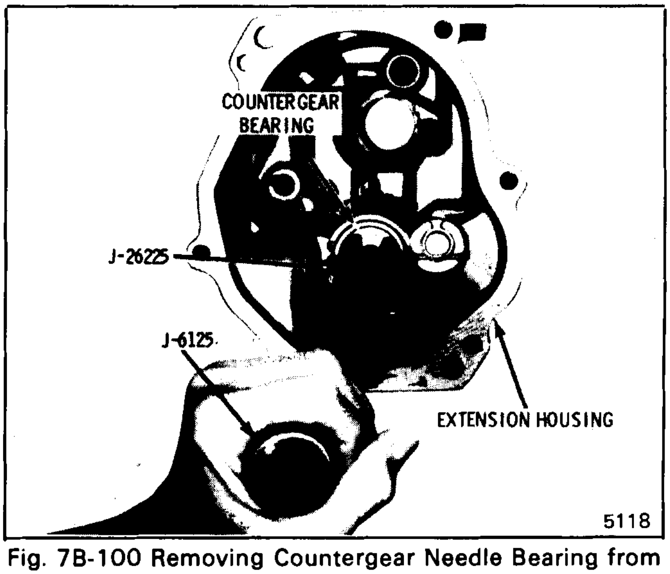


Fig. 7B-100 Removing Countergear Needle Bearing from Extension Housing

3. Install synchronizer and blocker rings, with chamfer on sleeve toward front of shaft, and position on face of third speed gear.

4. Install snap ring in shaft groove ahead of synchronizer hub (Fig. 7B-106).

5. Install the second speed gear, coned end in, against blocker ring.

6. Install thrust washer on face of second speed gear and install snap ring in shaft groove in front of thrust washer (Fig. 7B-107).

7. Install two rows of 46 needle rollers inside of the fifth speed gear, with a spacer in between and on each end of needle rollers. Retain with petroleum jelly as they are installed (Fig. 7B-108). Note that one needle space in each

Fig. 7B-101 Installing Countergear Needle Bearing into Extension Housing

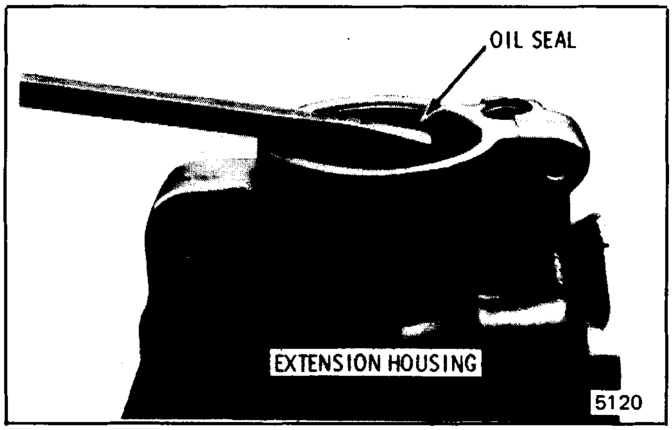


Fig. 7B-102 Removing Oil Seal From Extension Housing

row should remain unused.

CAUTION: *Be sure to use the correct needle rollers; other needles used in this transmission are similar in length but have a slightly different diameter.*

8. Carefully install fifth speed gear on output shaft with coned end toward front of shaft (Fig. 7B-109).

NOTE: Be sure needle rollers and spacers do not drop out.

9. Assemble the blocker rings with slots aligned to shift keys on the fourth and fifth synchronizer gear assembly (Fig. 7B-110).

10. Install on output shaft with chamfered edge of sleeve toward front of transmission.

11. Install needle thrust bearing on end of the fourth and fifth synchronizer assembly (Fig. 7B-111).

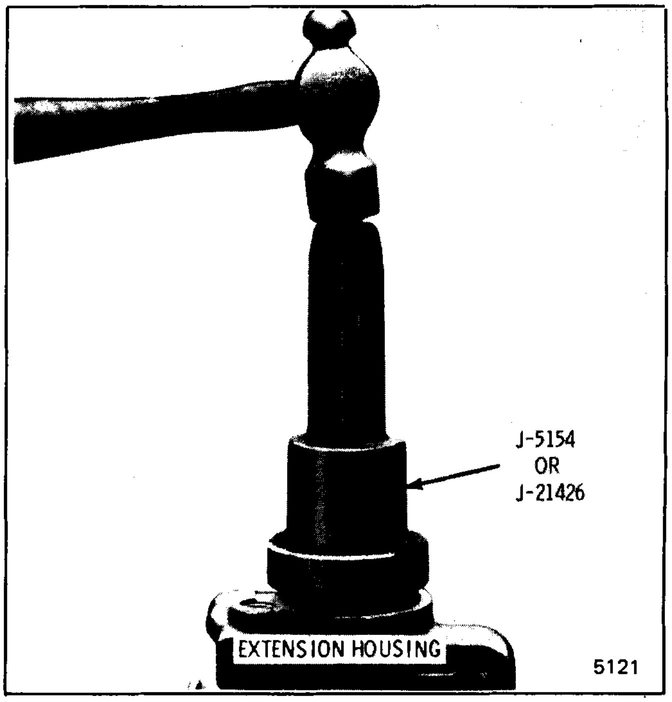


Fig. 7B-103 Installing Oil Seal into Extension Housing

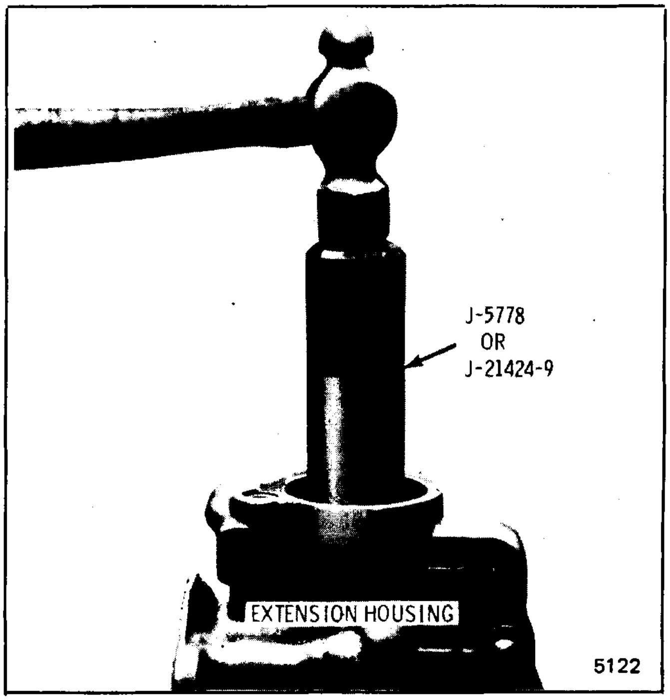


Fig. 7B-104 Removing or Installing Bushing in Extension Housing

12. Assembly 19 needle rollers into second step of input shaft bore and retain with petroleum jelly (Fig. 7B-112).

13. Carefully install input shaft, with needle rollers, over end of output shaft.

NOTE: Be sure needle rollers do not drop out.

14. Install a needle thrust bearing and race over output shaft against shaft shoulder (Fig. 7B-113).

NOTE: Some models may also contain a lipped thrust washer.

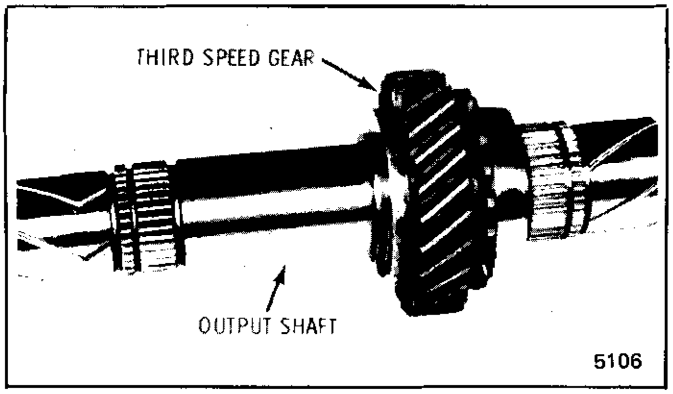


Fig. 7B-105 Installing Third Speed Gear

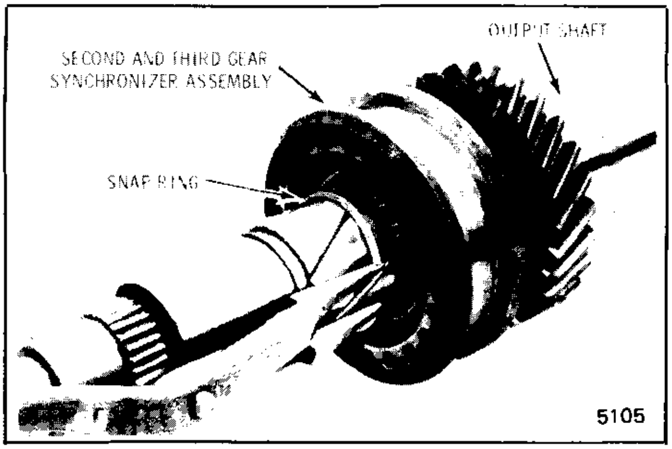


Fig. 7B-106 Installing Second and Third Gear Synchronizer Assembly

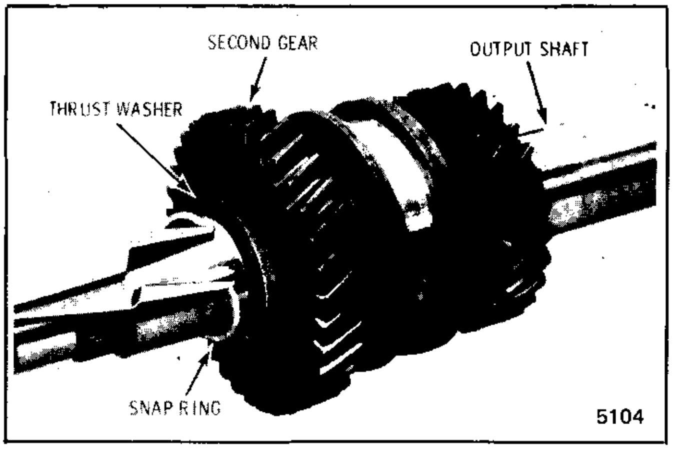


Fig. 7B-107 Installing Second Speed Gear

15. Be sure needles in needle bearing are retained in center support with petroleum jelly.

16. Mesh countergear teeth with teeth of input shaft gear, assembled to output shaft.

17. Install center support over output shaft and countergear (Fig. 7B-114).

NOTE: Be sure needles do not fall out of center support.

18. Install the reverse gear and bushing assembly over output shaft and against center support.

19. Install reverse idler gear and bushing assembly over reverse idler shaft to mesh with reverse gear (Fig. 7B-115).

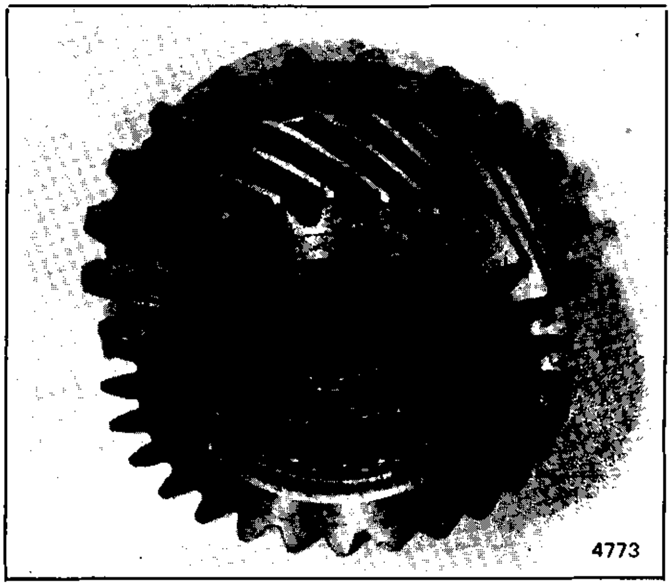


Fig. 7B-108 Installing Fifth Speed Gear Needle Rollers

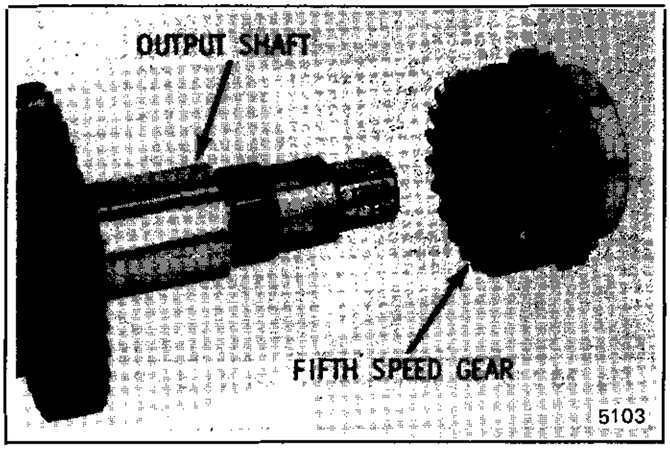


Fig. 7B-109 Installing Fifth Speed Gear

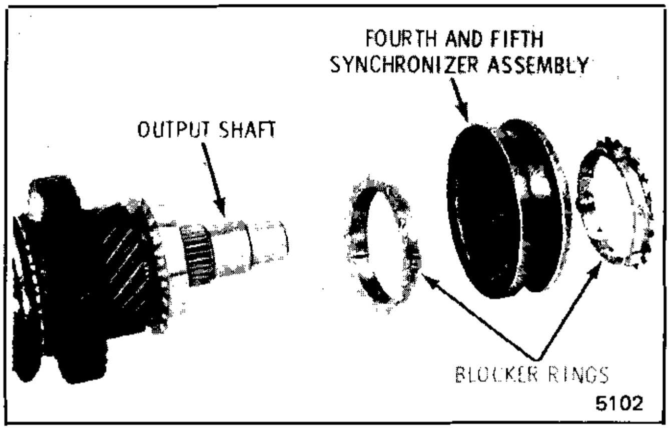


Fig. 7B-110 Installing Fourth and Fifth Gear Synchronizer Assembly

20. Assemble the fourth and fifth shift fork on the fourth and fifth synchronizer sliding sleeve. Locate interlock pawl to permit shift link to be installed through outboard slot of center support.

NOTE: The shift forks can be identified in Fig. 7B-116 by the different angles of the holes in each fork. Replace worn or damaged shift pads on all shift forks if

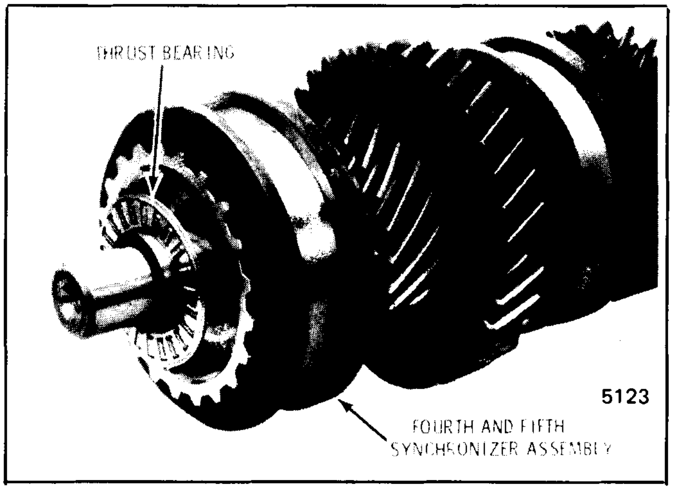


Fig. 7B-111 Installing Input Shaft Needle Thrust Bearing

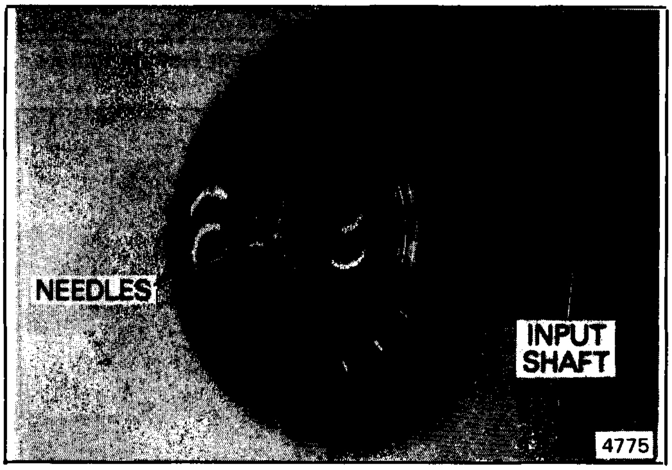


Fig. 7B-112 Installing Input Shaft Needle Rollers

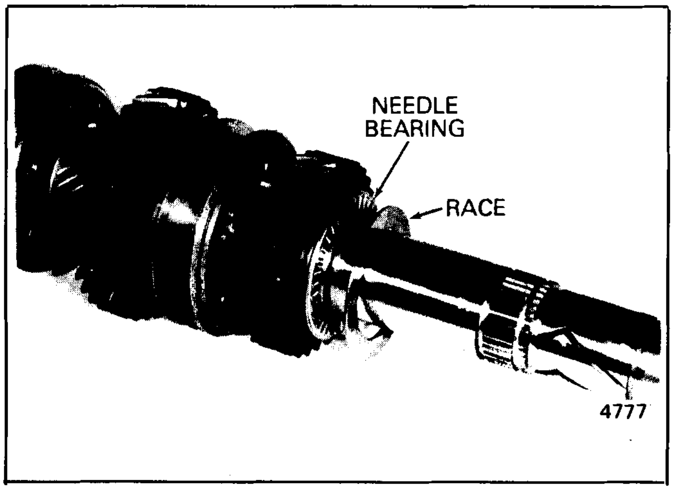


Fig. 7B-113 Installing Needle Thrust Bearing and Race to Output Shaft

necessary.

21. Install fourth and fifth shift link through slot and engage in shift fork.

22. Assemble the second and third shift fork on second and third sliding sleeve. Locate interlock pawl to permit shift link to be installed through center slot in center support.

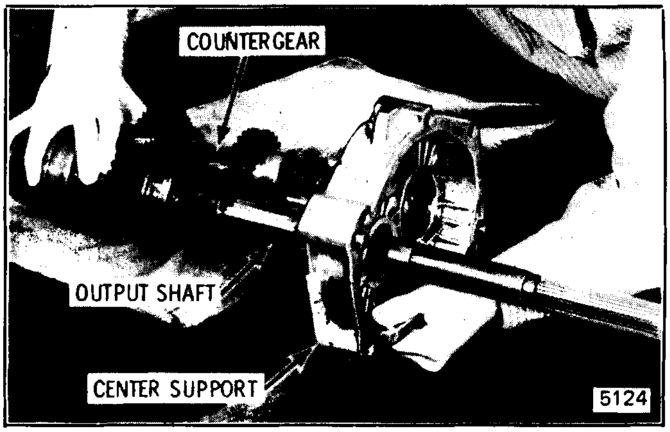


Fig. 7B-114 Installing Output Shaft, Mainshaft and Countergear into Center Support

23. Install second and third shift link through slot and engage in shift fork.

24. Locate interock pawl to permit first and reverse shift link to be installed in inboard slot of center support.

25. Install first and reverse shift link into shift fork.

26. If the selector arm was removed during disassembly, install the selector arm over shift rail, aligning hole in selector arm with the hole near middle of rail. Drive roll pin into arm and rail.

27. Install shift rail through shift fork from front to rear with poppet notches located to rear of transmission (Fig. 7B-117).

28. Engage shift fork with first and reverse synchronizer sleeve and install these parts by sliding synchronizer hub over output shaft, with chamfered edge of sleeve towards front (Fig. 7B-118).

29. Guide shift rail through interlock pawl, second and third shift fork and fourth and fifth shift fork. Be sure selector arm is aligned with notch in shift link.

30. Install snap ring in shaft groove (Fig. 7B-119).

31. Install blocker ring and first speed gear over output shaft, behind first and reverse synchronizer assembly. Align notches on blocker ring with notches in synchronizer hub.

32. Install thrust washer and snap ring behind first speed gear (Fig. 7B-120).

33. Install speedometer gear retainer in hole in output shaft with retainer loop forward. Slide speedometer gear over output shaft and retain until retainer snaps up to lock gear.

34. Slide rail selector, with hole in selector, onto shift rail with its ball facing inboard and retain with roll pin (Fig. 7B-121).

35. Install selector lever and shift rail into hole provided in extension housing. Install shifter head on rail, as rail becomes exposed in housing opening. Do not install roll pin at this time (Fig. 7B-122).

CAUTION: *Be sure to use the correct needle bearing. Other bearings in this transmission are similar in length but have a different diameter.*

36. Apply a continuous 1/32" bead of RTV (Room Temperature Vulcanizing) sealer to transmission case and extension housing. Be sure needle rollers in extension housing are retained with petroleum jelly.

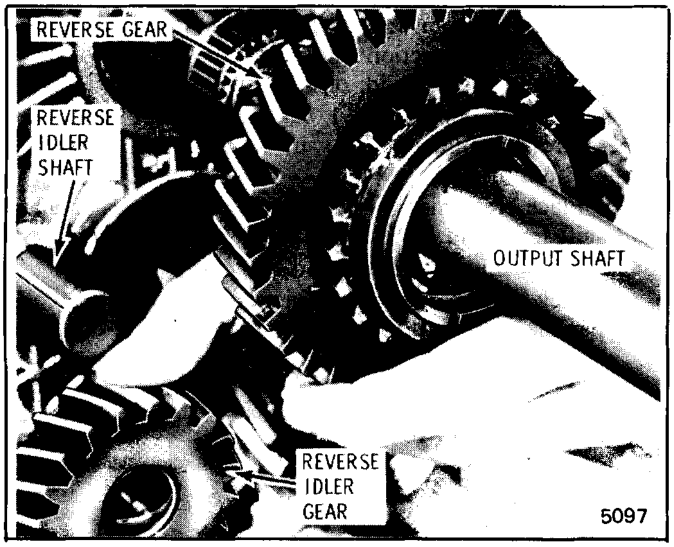


Fig. 7B-115 Installing Reverse and Reverse Idler Gears

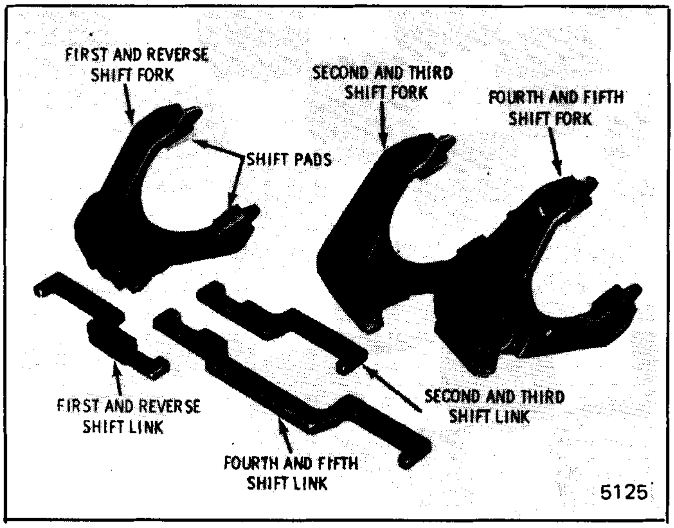


Fig. 7B-116 Shift Forks and Links

37. Install extension housing over output shaft, while guiding selector lever to engage rail selector (Fig. 7B-123).

38. Install lipped needle thrust race (if used) with lip toward front, needle thrust bearing and flat race over input shaft (Fig. 7B-124).

39. Install case to front side of center support and retain with six (6) hex head bolts. Torque to 35 lb. ft.

NOTE: If a binding condition exists when installing case, check to be sure that a fifth speed gear spacer for needle rollers did not fall down between fifth speed gear and synchronizer.

40. Drive roll pin into shifter head and shift rail (Fig. 7B-125).

NOTE: Coat plug threads with sealer number 1052080, Loctite number 92 or equivalent.

41. Install mesh lock plunger, poppet spring and threaded plug (Fig. 7B-126). Torque to 10 lb. ft.

NOTE: Coat pivot threads with sealer number 1052080, Loctite number 92 or equivalent.

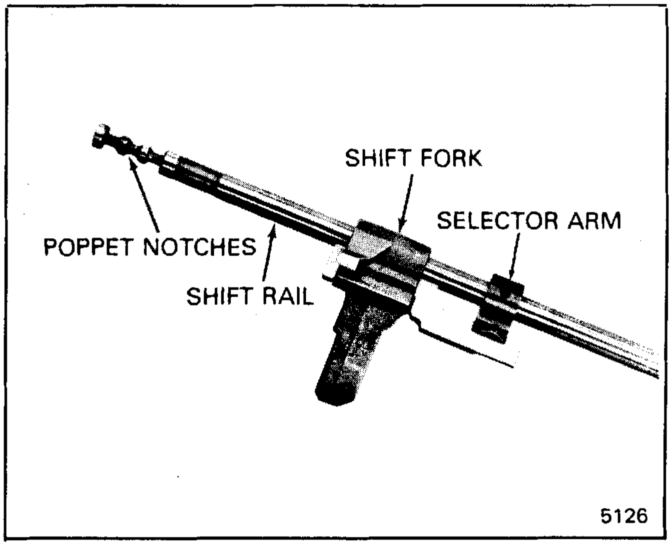


Fig. 7B-117 Installing First and Reverse Shift Fork to Shift Rail

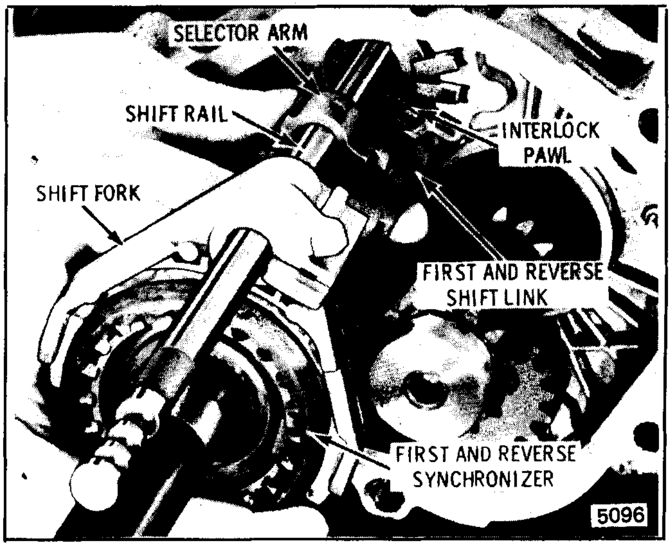


Fig. 7B-118 Installing First and Reverse Shift Fork and Rail

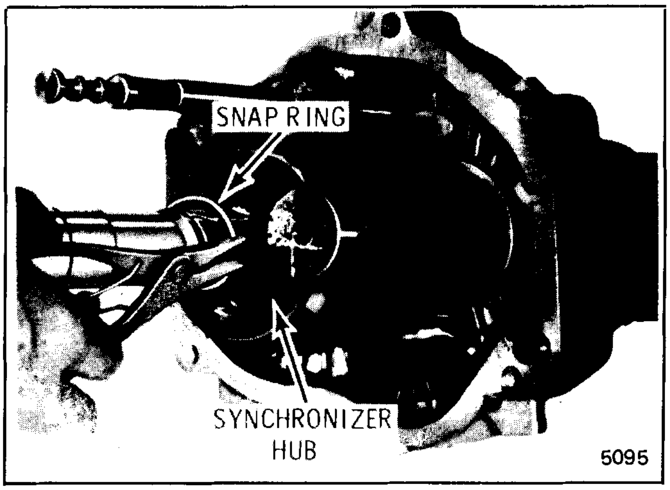


Fig. 7B-119 Installing Synchronizer Hub Snap Ring

42. Line hole in selector lever with hole in extension housing and install selector lever pivot (Fig. 7B-127). Torque to 60 lb. ft.

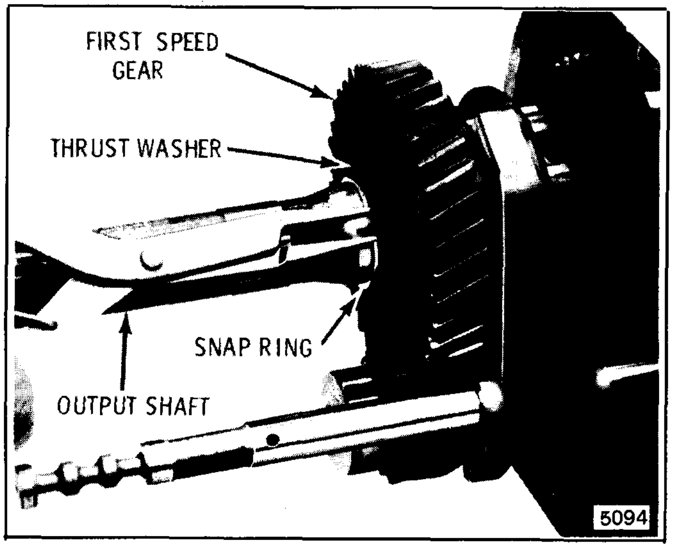


Fig. 7B-120 Installing First Speed Gear, Thrust Washer and Snap Ring

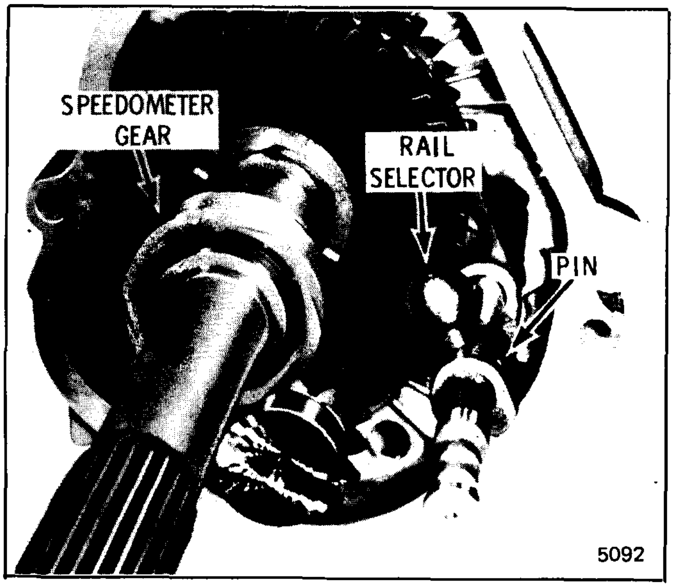


Fig. 7B-121 Installing Speedometer Gear and Rail Selector

43. Install the transmission in reverse of the procedure at the front of this section and fill with DEXRON-II® automatic transmission fluid, or equivalent.

44. Apply a continuous 1/32" bead of RTV (Room Temperature Vulcanizing) sealer, inboard of bolt pattern, to extension housing.

45. Place transmission and shift lever in neutral and install shift lever and cover (Fig. 7B-128).

46. Install four (4) screws and torque to 80 lb. in.

47. Tuck in the carpeting and install the boot around the shifter per the removal procedure.

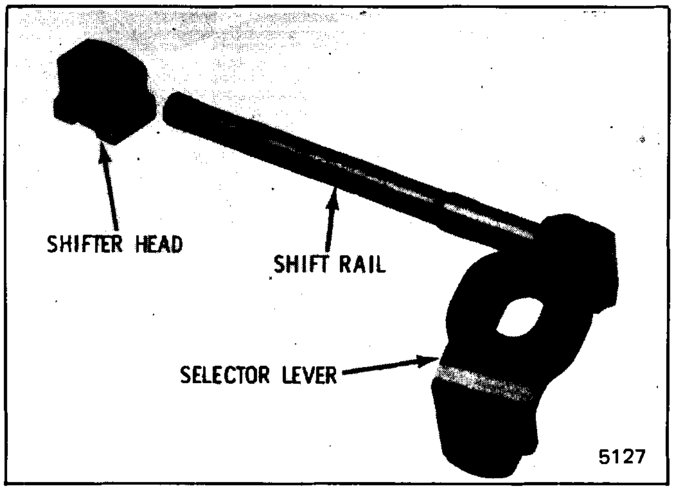


Fig. 7B-122 Installing Selector Lever, Shift Rail and Shifter Head

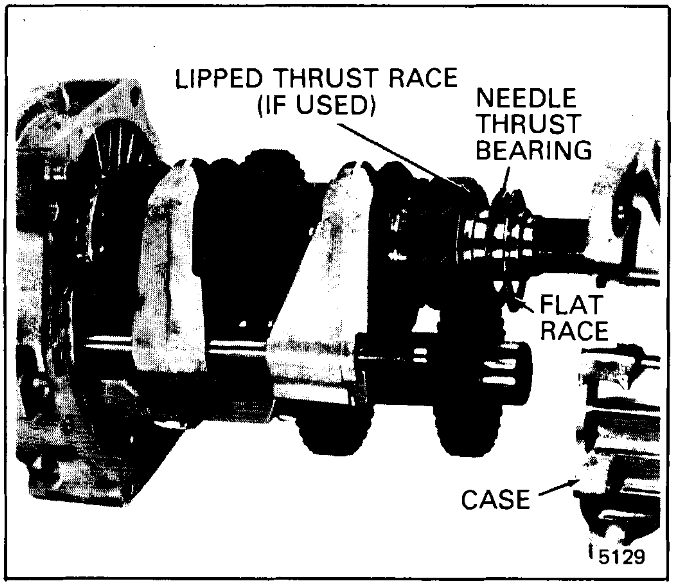


Fig. 7B-124 Installing Input Shaft Needle Thrust Bearing and Race(s)

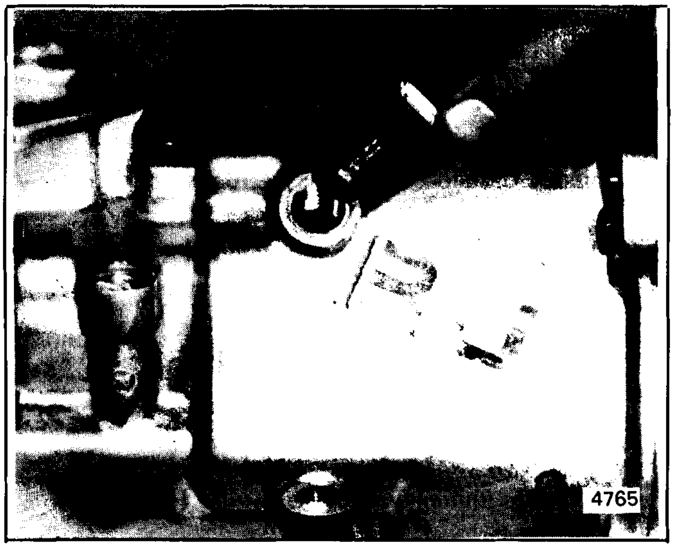


Fig. 7B-127 Installing Selector Lever Pivot

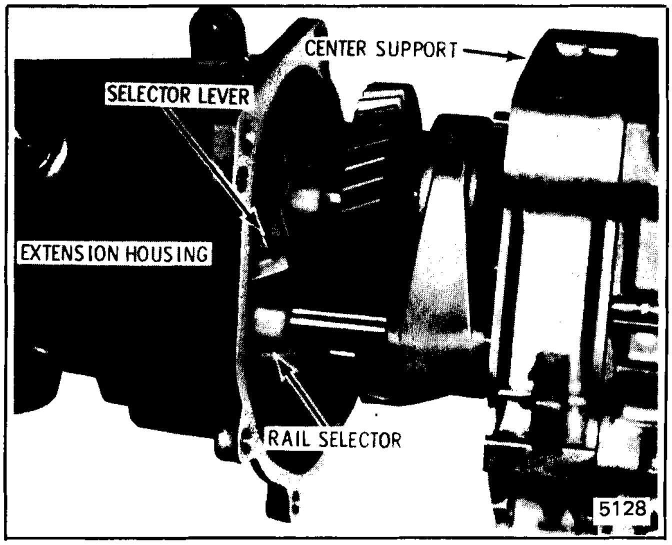


Fig. 7B-123 Installing Extension Housing

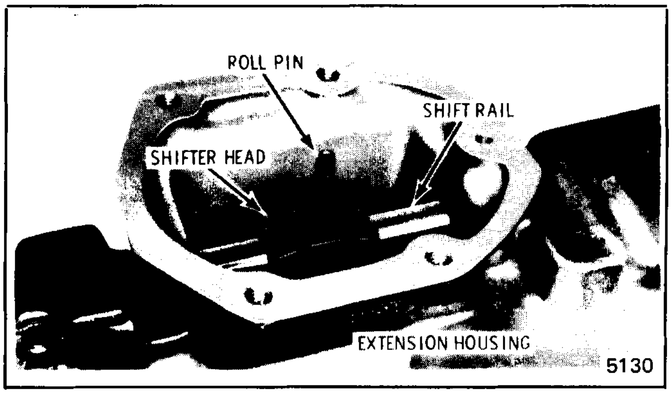


Fig. 7B-125 Installing Shifter Head Roll Pin

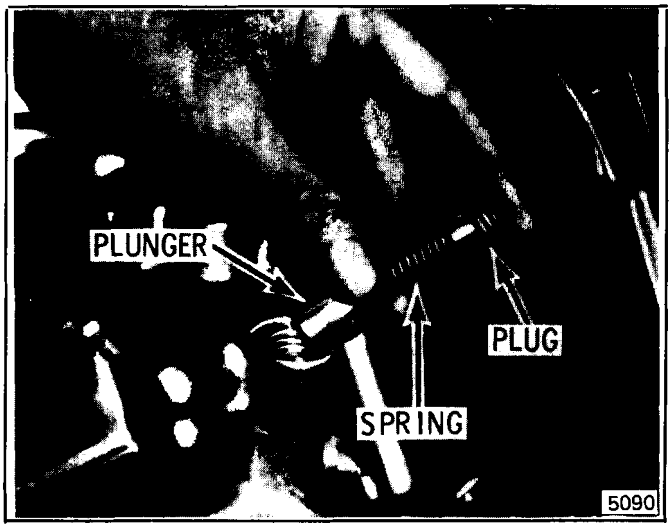


Fig. 7B-126 Installing Plunger, Poppet Spring and Plunger

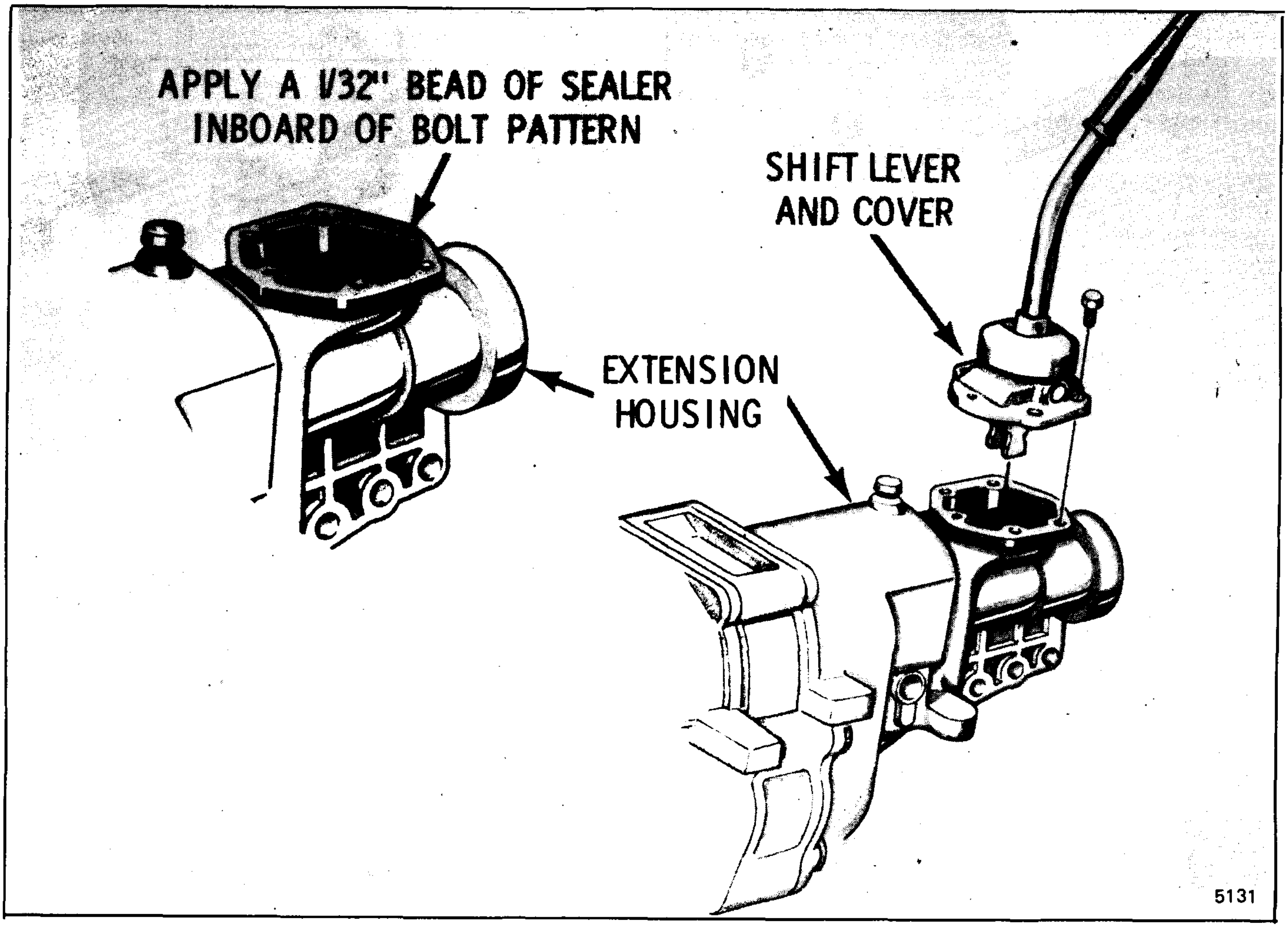


Fig. 7B-128 Installing Shift Lever and Cover

SPECIFICATIONS

3-SPEED 76MM LT. DUTY MUNCIE TRANSMISSION

TRANSMISSION IDENTIFICATION

An identifying code "ZH" is marked in yellow paint on all 3-speed manual transmissions. This code is two inches high and is found on the right side of the transmission case.

This "ZH" transmission is used on A, F and X Series vehicles equipped with the 231 cu. in. V6 engine.

GEAR RATIOS

First Speed Gear	3.11 to 1
Second Speed Gear	1.84 to 1
Third Speed Gear	1.00 to 1
Reverse Gear	3.22 to 1

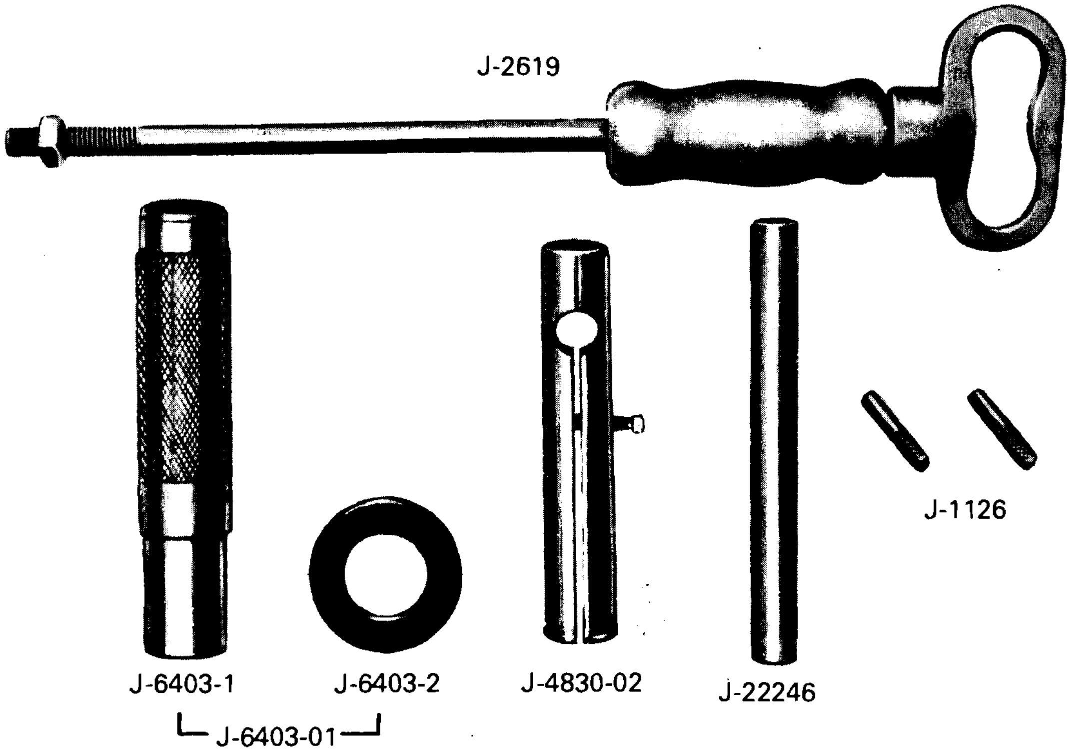
LUBRICANT

Use SAE 90 multi-purpose gear lubricant.

Capacity	3.5 U.S. Pints (56 fluid ounces)

TORQUE

Transmission Case-to-Clutch Housing Bolts	55 lb. ft.
Extension Housing-to-Case Bolts	45 lb. ft.
Drive Gear Bearing Retainer Bolts	10 lb. ft.
Case Cover-to-Case Bolts	10 lb. ft.
Lubricant Filler Plug	15 lb. ft.
Shifter Support-to-Extension Bolts	25 lb. ft.
Shifter Lever-to-Shifter Shaft Bolts	25 lb. ft.
Shifter Assembly-to-Support (Upper) Bolt	45 lb. ft.
Shifter Assembly-to-Support (Lower) Bolt	25 lb. ft.
Frame-to-Crossmember Bolts	25 lb. ft.



J-1126	Transmission Guide Pins	J-22246	Countershaft Alignment Tool
J-2619	Slide Hammer	J-5154	Installer (Not Shown)
J-4830-02	Extension Bushing and Oil Seal Remover	J-5778	Remover and Installer (Not Shown)
J-6403-01	Extension Bushing and Oil Seal Installer	J-21426	Installer (Not Shown)
		J-23096	Installer (Not Shown)

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Fig. 7B-129 Special Tools - 3 and 4 Speed 76mm Muncie Transmissions

4-SPEED 76MM LT. DUTY MUNCIE TRANSMISSION

TRANSMISSION IDENTIFICATION

Code	Series
RY	"H" with 231 V6 Engine (California Only)
SS	"X" with 301 V8 Engine (Except California)
ST	"F" with 301 V8 Engine (Except California)
ZN	"H" with 140 L-4 Engine
ZR	"H" with 151 L-4 Engine (Except California)
ZS	"H" with 231 V6 Engine (Except California)

GEAR RATIOS

	SS and ST	RY, ZN and ZS	ZR
First Speed Gear	2.85 to 1	3.11 to 1	3.50 to 1
Second Speed Gear	2.02 to 1	2.20 to 1	2.43 to 1
Third Speed Gear	1.35 to 1	1.47 to 1	1.66 to 1
Fourth Speed Gear	1.00 to 1	1.00 to 1	1.00 to 1
Reverse Gear	2.85 to 1	3.11 to 1	3.50 to 1

LUBRICANT

Use SAE 90 multi-purpose gear lubricant

Capacity............................... 3.5 U.S. Pints (56 fluid ounces)

TORQUE

Transmission Case-to-Clutch Housing Bolts	55 lb. ft.
Extension Housing-to-Case Bolts	45 lb. ft.
Drive Gear Bearing Retainer Bolts	22 lb. ft.
Case Cover-to-Case Bolts	22 lb. ft.
Lubricant Filler Plug	15 lb. ft.
Shifter Support-to-Extension Bolts	25 lb. ft.
Shifter Assembly-to-Support (Upper) Bolt	45 lb. ft.
Shifter Assembly-to-Support (Lower) Bolt	25 lb. ft.
Frame-to-Crossmember Bolts	25. lb. ft.

SPECIAL TOOLS Refer to Fig. 7B-129

4-SPEED 82MM BORG WARNER TRANSMISSION

TRANSMISSION IDENTIFICATION

An identifying code "ZT" is stamped on rear side of side cover case face. This "ZT" transmission is used only on the F Series equipped with the 400 cu. in. V8 engine.

GEAR RATIOS

First Speed Gear	2.43 to 1
Second Speed Gear	1.61 to 1
Third Speed Gear	1.23 to 1
Fourth Speed Gear	1.00 to 1
Reverse Gear	2.35 to 1

LUBRICANT

Use SAE 90 multi-purpose gear lubricant

Capacity .... 2.44 U.S. Pints (39 fluid ounces)

TORQUE

Transmission Case-to-Clutch Housing Bolts	55 lb. ft.
Rear Bearing Retainer Locking Bolt	25 lb. ft.
Drive Gear Bearing Retainer Bolts	18 lb. ft.
Case Cover-to-Case Bolts	18 lb. ft.
Extension Housing-to-Case (Long) Bolts	40 lb. ft.
Extension Housing-to-Retainer (Short) Bolts	25 lb. ft.
Shifter Support-to-Extension Bolts	30 lb. ft.
Shifter Assembly-to-Support (Upper) Bolts	45 lb. ft.
Shifter Assembly-to-Support (Lower) Bolt	30 lb. ft.
Lubricant Filler Plug	30 lb. ft.
Frame-to-Crossmember Bolts	25 lb. ft.

SPECIAL TOOLS

J 1126	Guide Pins
J 5590	Installer
J 8092	Driver Handle
J 8433-1	Puller
J 21359	Installer
J 21465-17	Remover & Installer
J 22912	Remover
J 24658	Loader

5-SPEED 77MM BORG WARNER TRANSMISSION

TRANSMISSION IDENTIFICATION

Code	Series
RJ	"H" with 140 L-4 Engine (California Only) "H" and "X" with 151 L-4 Engines (Except California)
RM	"H" with 231 V6 Engine (California Only)
RN	"H" with 231 V6 Engine (Except California)

GEAR RATIOS

First Speed Gear	3.40 to 1
Second Speed Gear	2.08 to 1
Third Speed Gear	1.39 to 1
Fourth Speed Gear	1.00 to 1
Fifth Speed Gear	0.80 to 1
Reverse Gear	3.36 to 1

LUBRICANT

Use ATF or DEXRON II® fluid only.

Capacity .... 3.5 U.S. Pints (56 fluid ounces)

TORQUE

Transmission Case-to-Clutch Housing Bolts	55 lb. ft.
Case and Extension Housing-to-Center Support Bolts	35 lb. ft.
Selector Lever Pivot	60 lb. ft.
Mesh Lock Plunger Spring Plug	10 lb. ft.
Interlock Pawl Retainer Plate Bolts	10 lb. ft.
Speedometer Driven Gear Retainer Bolt	4 lb. ft.
Shifter Lever Cover-to-Extension Bolts	80 lb. in.

SPECIAL TOOLS

J 1126	Guide Pins
J 5154	Installer
J 5778	Installer & Remover
J 6125 (J 2619-01)	Slide Hammer
J 8092	Driver Handle
J 21424-9	Installer & Remover
J 21426	Installer
J 22407	Installer
J 26222-1	Installer & Remover
J 26222-2 & -3	Installers
J 26223	Installer
J 26224	Installer
J 26225	Remover
J 26243	Remover

SECTION 7C

CLUTCH

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The principal parts of a clutch are: the driving members, attached to the engine and turning with it; the driven members, attached to the transmission and turning with it; the operating members which include the spring or springs and the linkage required to apply and release the pressure which holds the driving and driven members in contact with each other. Figure 7C-1 shows a clutch cutaway so that operating members can be seen.

DRIVING MEMBERS

The driving members of a clutch usually consist of two nodular iron plates or flat surfaces machined and ground to a smooth finish. Nodular iron is desirable because it contains enough graphite to provide some lubrication when the driving member is slipping during engagement. One of these surfaces is usually the rear face of the engine flywheel, and the other is a comparatively heavy flat ring with one side machined and surface. This part is known as the pressure plate. It is fitted into a steel cover, which also contains some of the operating members, and is bolted to the flywheel.

DRIVEN MEMBERS

The driven member is a disc with a splined hub which is free to slide lengthwise along the splines of the clutch shaft, but which drives the shaft through these same splines. Grooves on both sides of the clutch driven plate lining prevent sticking of the plate to the flywheel and pressure plate due to vacuum between the members on disengaging. The clutch driven plate is usually made of spring steel in the shape of a single flat disc consisting of a number of flat segments. Suitable frictional facings are attached to each side of the plate by means of brass rivents. These facings must be heat resistant since friction produces heat. The most commonly used facings are made of cotton and asbestos fibers woven or molded together and impregnated with resins or similar binding agents. Very often, copper wires are woven or pressed into material to give it additional strength.

In order to make clutch engagement as smooth as possible and eliminate chatter, the steel segments attached to the splined hub are slightly waved, which also causes the facings to make gradual contact as the waved springs flatten out.

The driven member of the clutch (Fig. 7C-2) is usually provided with a flexible center to absorb the torsional vibration of the crankshaft which would be transmitted to the power train unless it were eliminated. The flexible center usually takes the form of steel compression springs placed between the hub and the steel plate. The springs permit the disc to rotate slightly with relation to its hub until, under extreme conditions, the springs are fully compress and relative motion stops. Then the disc can rotate slightly backward as the springs decompress. This slight backward and forward rotation permitted by the springs allows the clutch shaft to rotate at a more uniform rate than the crankshaft, thereby eliminating some of the torsional vibration from the crankshaft and preventing the vibration from being carried back through the transmission.

OPERATING MEMBERS

The driving and driven members are held in contact by spring pressure. This pressure is exerted by a one-piece conical or diaphragm spring (Fig. 7C-3). The throwout bearing moves forward against the spring fingers forcing the diaphragm spring to pivot around the inner pivot ring, dishing the fingers toward the flywheel. The outer circumference of the spring now lifts the pressure plate away from the driven disc, through a series of retracting springs placed around the outer circumference of the pressure plate.

NOTE: Two variations of the diaphragm spring design are the flat finger type and the bent finger type. The integral release fingers in the bent finger design are bent back to gain a centrifugal boost to aid quick re-engagement at high engine speeds. This design is used primarily with high performance V8 engines and passenger car heavy duty clutch assemblies.

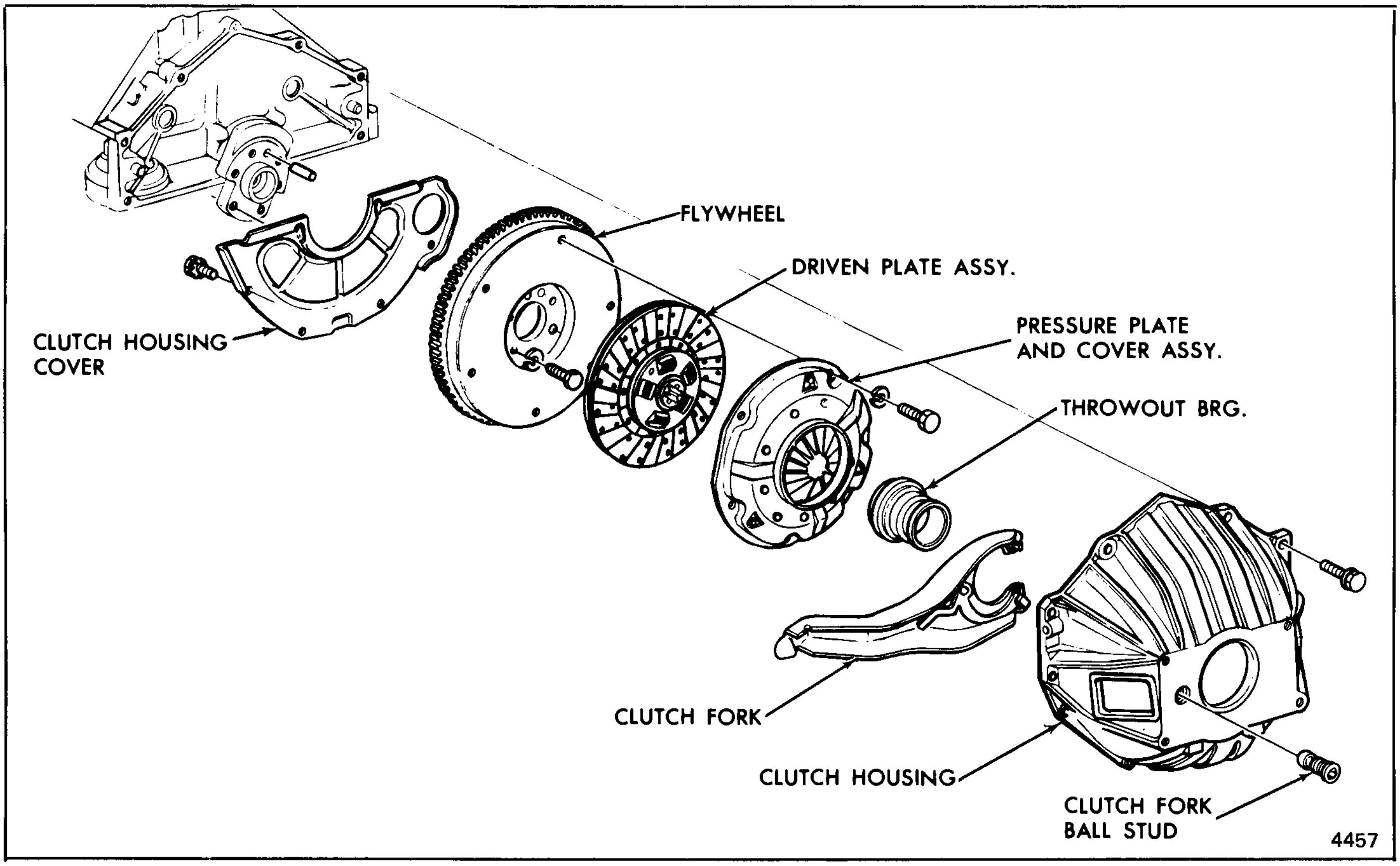


Fig. 7C-1 Exploded View of Clutch

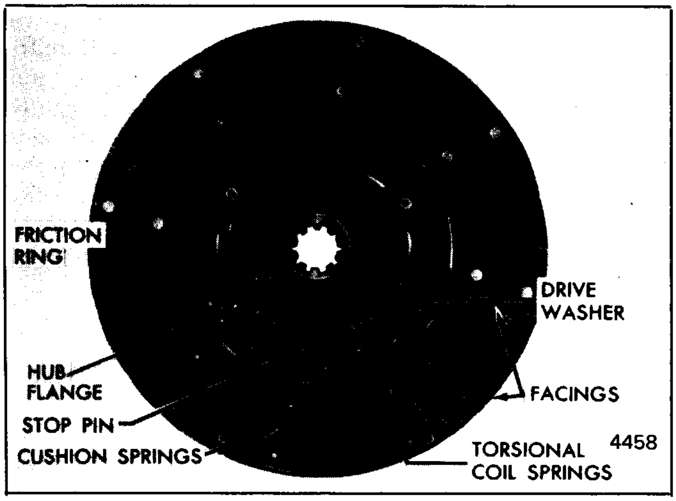


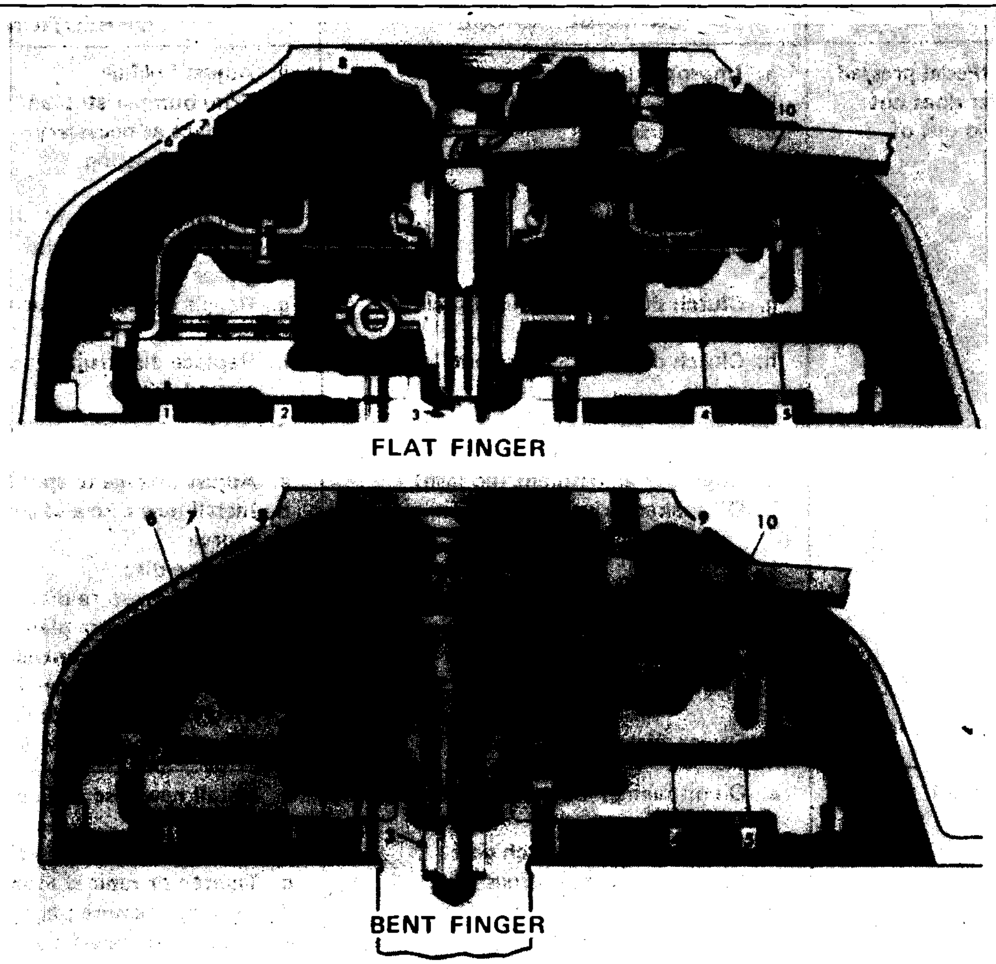
Fig. 7C-2 Clutch Driven Plate Assembly

The clutch release (or throw-out) bearing is a ball-thrust bearing contained in the clutch housing, mounted on a sleeve attached to the front of the transmission case. The release bearing (Fig. 7C-1) is connected through linkage to the clutch, and is moved by the release fork to engage the release levers and move the pressure plate to the rear, thus separating the clutch driving members from the driven member when the clutch pedal is depressed by the driver. A return spring preloads clutch linkage, removing looseness due to wear keeping the bearing clear of the spring fingers. The clutch free pedal travel, therefore, will increase with linkage wear and the free travel felt at the clutch pedal is throw-out bearing lash.

NOTE: The clutch release bearing used with the bent finger design is of shorter length than the release bearing used with the flat finger design clutch. Do not interchange the two bearings. The longer bearing, if used with the bent finger spring clutch, will cause inability to obtain proper free pedal travel resulting in slippage and rapid wear.

CLUTCH OPERATION

In diaphragm spring type clutches, a diaphragm is positioned between the cover and the pressure plate so that the diaphragm spring is nearly flat when the clutch is in the engaged position. The action of this type of spring is similar to that of the bottom of an ordinary oil can. The pressure of the outer rim of the spring on the pressure plate increases until it reaches the flat position and decreases as this position is passed. The outer rim of the diaphragm is secured to the pressure plate and is pivoted on rings approximately 1 inch in from the outer edge so that the application of the pressure at the inner section will cause the outer rim to move away from the flywheel and draw the pressure plate away from the clutch disc, releasing or disengaging the clutch. When the pressure is released from the inner section, the oil can action of the diaphragm causes the inner section to move out and the movement of the outer rim forces the pressure plate against the clutch disc, thus engaging the clutch.



1. FLYWHEEL
2. DOWEL-HOLE
3. PILOT BUSHING
4. DRIVEN DISC
5. PRESSURE PLATE
6. DIAPHRAGM SPRING
7. COVER
8. THROWOUT BEARING
9. FORK
10. RETRACTING SPRING

Fig. 7C-3 Diaghragm Spring Clutch - Cross Section

DIAGNOSIS

Before attempting to repair the clutch, transmission or related linkages for any reason other than an obvious failure, the problem and probable cause should be identified. A large percentage of clutch and manual transmission problems are manifested by shifting difficulties such as high shift effort, gear clash and grinding or transmission blockout. When any of these problems occur, a careful analysis of these difficulties should be accomplished and the following checks and adjustments performed in the presented sequence before removing the clutch or transmission for repairs.

CLUTCH ADJUSTMENT

A. Clutch Free Pedal Travel

1. The clutch free pedal travel adjustment should be made as outlined in "Maintenance and Adjustments."

2. Check clutch linkage for lost motion caused by loose or worn swivels, deflection of mounting brackets or damaged cordon shaft.

B. Clutch Spin Down Time

1. Run the engine a normal idle with transmission in neutral and clutch engaged.

2. Disengage the clutch, wait nine seconds and shift the transmission to reverse. No grinding noise should be heard. A grinding noise indicates incorrect clutch adjustment, lost motion, clutch misalignment or internal problems such as failed dampers, facings, cushion springs, diaphragm spring fingers, pressure plate drive straps, etc.

MAINTENANCE AND ADJUSTMENTS

LINKAGE INSPECTION

A, F or X Series

There are several things which affect good clutch operations. Therefore, it is necessary, before performing any major clutch operations, to make preliminary inspections to

CONDITION	PROBABLE CAUSE	CORRECTION
Fails to Release (Pedal pressed to floor-shift lever does not move freely in and out of reverse gear	a. Improper linkage adjustment	a. Adjust linkage
	b. Improper pedal travel	b. Trim bumper stop and adjust linkage
	c. Loose linkage	c. Replace as necessary
	d. Faulty pilot bearing	d. Replace bearing
	e. Faulty driven disc	e. Replace disc
	f. Fork off ball stud	f. Install properly and* lubricate fingers at release bearing with wheel bearing grease
	g. Clutch disc hub binding on clutch gear spline	g. Repair or replace clutch gear and/or disc
	h. Clutch disc warped or bent	h. Replace disc (run-out should not exceed .020")
		*Very lightly lubricate fingers
Slipping	a. Improper adjustment (no lash)	a. Adjust linkage to spec.
	b. Oil soaked driven disc	b. Install new disc and correct leak at its source
	c. Worn facing or facing torn from disc	c. Replace disc
	d. Warped pressure plate or flywheel	d. Replace pressure plate or flywheel
	e. Weak diaphragm spring	e. Replace pressure plate (be sure lash is checked before replacing plate)
	f. Driven plate not seated in	f. Make 30 to 40 normal starts CAUTION: Do Not Overheat
	g. Driven plate overheated	g. Allow to cool – check lash
Grabbing (Chattering)	a. Oil on facing. Burned or glazed facings	a. Install new disc and correct leak
	b. Worn splines on clutch gear	b. Replace transmission clutch gear
	c. Loose engine mountings	c. Tighten or replace mountings
	d. Warped pressure plate or flywheel	d. Replace pressure plate or flywheel
	e. Burned or smeared resin on flywheel or pressure plate	e. Sand off if superficial, replace burned or heat checked parts
Rattling-Transmission Click	a. Weak retracting springs	a. Replace pressure plate
	b. Clutch fork loose on ball stud or in bearing groove	b. Check ball stud and retaining
	c. Oil in driven plate damper	c. Replace driven disc
	d. Driven plate damper spring failure	d. Replace driven disc
Clutch Release Bearing Noise With Clutch Fully Engaged	a. Improper adjustment. No lash.	a. Adjust linkage
	b. Release bearing binding on transmission bearing retainer	b. Clean, relubricate, check for burrs, nicks, etc.
	c. Insufficient tension between clutch fork spring and ball stud	c. Replace fork
	d. Fork improperly installed	d. Install properly
	e. Weak linkage return spring	e. Replace spring
Noisy	a. Worn release bearing	a. Replace bearing
	b. Fork off ball stud (heavy clicking)	b. Install properly and lubricate fork fingers at bearing
	c. Pilot bearing loose in crankshaft	c. See Section 6 for bearing fits
Pedal Stays on Floor When Disengaged	a. Bind in linkage or release bearing	a. Lubricate and free up linkage and release bearing
	b. Springs weak in pressure plate	b. Replace pressure plate
	c. Springs being over traveled	c. Adjust linkage to get proper lash, be sure proper pedal stop (bumper) is installed
Hard Pedal Effort	a. Bind in linkage	a. Lubricate and free up linkage
	b. Driven plate worn	b. Replace driven plate

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Fig. 7C-4 Clutch Trouble Diagnosis Chart determine whether trouble is actually in the clutch.

Check the clutch linkage to be sure the clutch releases fully as follows:

1. With engine running and brake on, hold the clutch pedal approximately 1/2" from floor mat and move shift lever between first and reverse several times. If this can be done smoothly, the clutch is fully releasing. If shift is not smooth, clutch is not fully releasing and adjustment is necessary.

2. Check clutch pedal bushings for sticking or excessive wear.

3. Check fork for proper installation on ball stud. Lack of lubrication on fork can cause fork to be pulled off the ball.

4. Check for bent, cracked or damaged cross shaft levers or support bracket.

5. Loose or damaged engine mounts may allow the engine to shift its position causing a bind on clutch linkage at the cross shaft. Check to be sure there is some clearance between cross shaft and both mount brackets.

6. Check clutch release bearing and clearance between spring fingers and front bearing retainer on the transmission. If no clearance exists, fork may be improperly installed on ball or clutch disc may be worn out.

CLUTCH PEDAL FREE TRAVEL

A, F or X Series (Fig. 7C-5)

There is one linkage adjustment (clutch fork push rod or pedal push rod) to compensate for all normal clutch wear.

1. Disconnect return spring at clutch fork.

2. Rotate clutch lever and shaft assembly until clutch pedal is firmly against rubber bumper on dash brace.

3. Push outer end of clutch fork rearward until clutch release bearing lightly contacts pressure plate fingers.

4. Install push rod in gage hole and increase length until all lash is removed from system.

5. Remove swivel or rod from gage hole and insert into lower hole on lever. Install retainer and tighten lock nut being careful not to change rod length.

6. Reinstall return spring and check pedal free travel. Pedal travel should be 3/4" to 1 5/16" for A Series or 7/8" to 1 7/16" for F and X Series.

H Series (Fig. 7C-6, View A)

Adjustment for normal clutch wear is accomplished by turning the clutch fork ball stud counterclockwise to give .90 ± .25 lash at clutch pedal.

1. Remove ball stud cap and loosen lock nut on ball stud end located to the right of the transmission on the clutch housing.

2. Adjust ball stud to obtain .90" ± .25" free travel at the clutch pedal.

3. Tighten lock nut to 25 lb. ft., being careful not to change adjustment, and install ball stud cap.

4. Check operation of clutch.

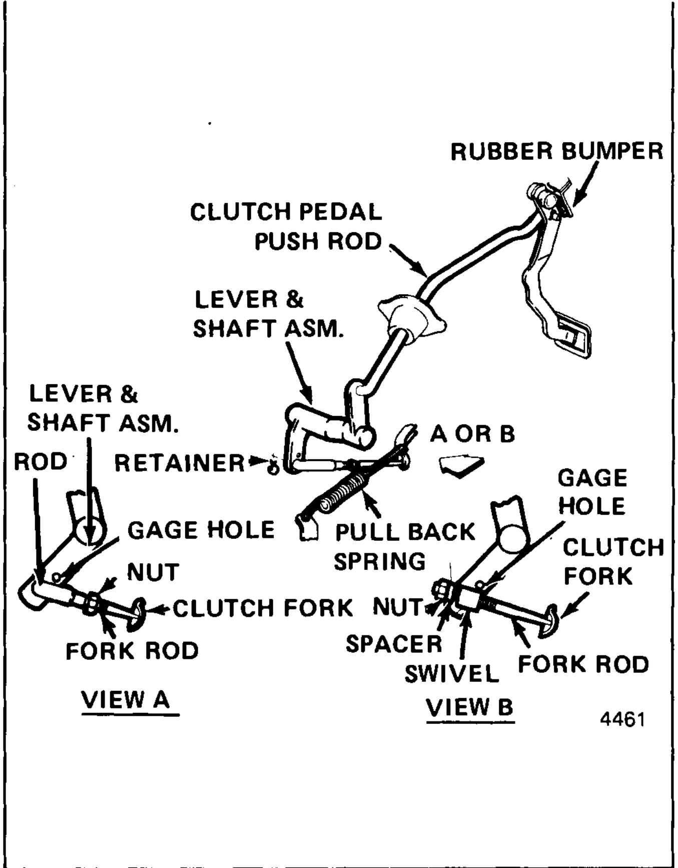


Fig. 7C-5 Clutch Pedal Free Travel (A, F or X Series)

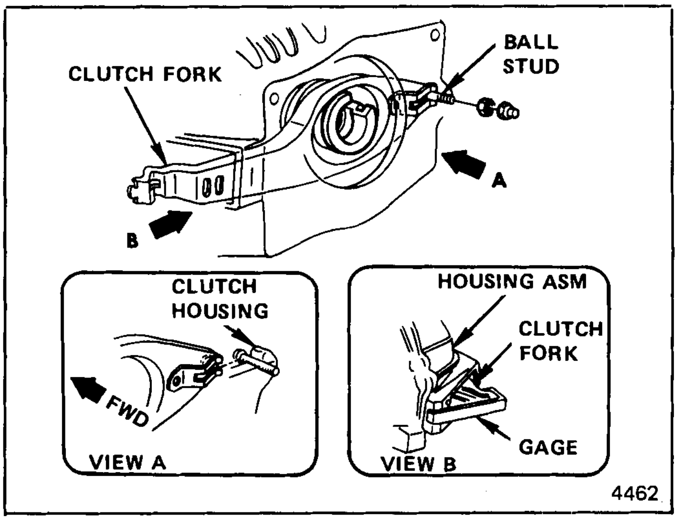


Fig. 7C-6 Clutch Pedal Free Travel and Adjustment (H Series)

CLUTCH MECHANISM ADJUSTMENT (H SERIES)

Initial adjustment after clutch and/or cable replacement is accomplished at two points, at the ball stud and at the lower end of the cable, as described in the following procedure:

Initial Ball Stud Adjustment

1. Prior to attachment of cable, place gage J 23644 so flat end is against front face of the clutch housing and the hooked end is located at point of cable attachment on fork (Fig. 7C-6, View B).

2. Turn ball stud inward by hand until clutch release bearing makes contact with clutch spring fingers.

3. Install lock nut and tighten to 25 lb. ft., being careful not to change ball stud adjustment.

4. Install ball stud cap.

5. Remove gage by pulling outward at housing end.

Clutch Cable Attachment & Adjustment (Lower End)

1. Place cable thru hole in clutch fork.
2. Pull cable until clutch pedal is firmly against rubber bumper.
3. Push clutch fork forward until throw out bearing contacts clutch spring fingers.
4. Screw pin on cable until it bottoms out on fork.
5. Turn 1/4 additional revolution clockwise and drop pin down into groove in fork.
6. Attach return spring. This procedure will produce .90" ± .25" lash at clutch pedal.
7. Install clutch fork cover. Tighten retaining screws to 80 lb. in.

Post-Adjustment Check

The clutch pedal should have free travel (measured at clutch pedal pad) before the throwout bearing engages the clutch diaphragm spring levers. Lash is required to prevent clutch slippage which would occur if the bearing was held against the fingers or to prevent the bearing from running continually until failure. A clutch that has been slipping prior to free play adjustment may still slip right after the new adjustment due to previous heat damage. Give the clutch time to cool at least 12 hours to normal temperatures. Any slippage should then be evaluated as follows:

1. Drive in high gear at 20-25 MPH.
2. Depress clutch pedal to the floor and rev engine to 2500-3500 rpm.
3. Engage clutch quickly (snap foot off pedal) and press accelerator to full throttle.

Engine speed should drop noticeably, then accelerate with vehicle. If clutch is bad, the engine speed will increase.

NOTE: Do not repeat more than once or clutch will overheat.

ON CAR SERVICE

CLUTCH PEDAL REPLACEMENT

A, F or X Series

1. Disconnect clutch pedal return spring.
2. Disconnect clutch pedal push rod at pedal arm.
3. Disconnect and remove neutral start switch.
4. A-Series only: Remove pivot shaft retaining nut from left side of pedal pivot shaft. Remove pedal arm and bushings from pivot shaft (Fig. 7C-7).

F-Series only: Remove pivot shaft retaining nut and slide pivot shaft to the left until it clears the pedal support. Insert dummy shaft in support to hold brake components in place while removing pivot shaft. Remove pivot shaft, pedal arm and bushings from vehicle (Fig. 7C-8).

X-Series only: Remove pivot shaft retaining clip from right side of pivot shaft. Slide pivot shaft and pedal arm from support housing and remove from vehicle. Insert dummy shaft into support housing to hold brake components in place while sliding pivot shaft out (Fig. 7C-9).

5. Clean and inspect all components. Replace as necessary. Do not clean nylon bushings with a cleaning agent, simply wipe with a clean cloth. Relubricate all bushings and moving parts.
6. Reinstall bushings, pivot shaft and pedal arms in support housing.
7. Install pivot shaft retainer or lock nut.
8. Position neutral start switch on mounting post and pedal arm. Install retaining nut and connect switch wiring.
9. Connect clutch push rod to pedal arm.
10. Connect clutch pedal return spring and check clutch pedal free travel. Adjust clutch neutral start as required.

CLUTCH CROSS SHAFT

A, F or X Series (Figs. 7C-10 and 7C-11)

Removal

1. Remove linkage return and lower linkage springs and disconnect clutch pedal and fork push rods from respective cross shaft levers.
2. Loosen outboard ball stud nut and slide stud out of bracket slot.
3. Move cross shaft outboard, and as required to clear inboard ball stud, then lift out to remove from vehicle.

Repairs

The cross shaft has nylon ball stud seats which should be inspected for wear or damage. Also check condition of engine bracket ball stud assembly and special antirattle "O" ring. Figures show component parts of cross shaft. Replace parts as necessary based on wear or damage. Lubricate ball studs and seats with graphite grease before reassembly.

Installation

1. Reverse removal procedure to install.
2. Adjust clutch linkage as previously outlined.

CLUTCH CABLE REPLACEMENT

H Series (Fig. 7C-12)

1. Remove clutch fork cover at side of housing.
2. Disconnect return spring and clutch cable at clutch shift fork.
3. Remove clip and pin retaining cable to pedal arm.
4. Disconnect cable at fender skirt reinforcement.
5. Disconnect bolt holding cable to body reinforcement pull through body reinforcement.
6. Push new cable through body reinforcement and secure cable end to pedal arm with pin, washer and clip.

NOTE: Lubricate retaining pin with graphite type grease.

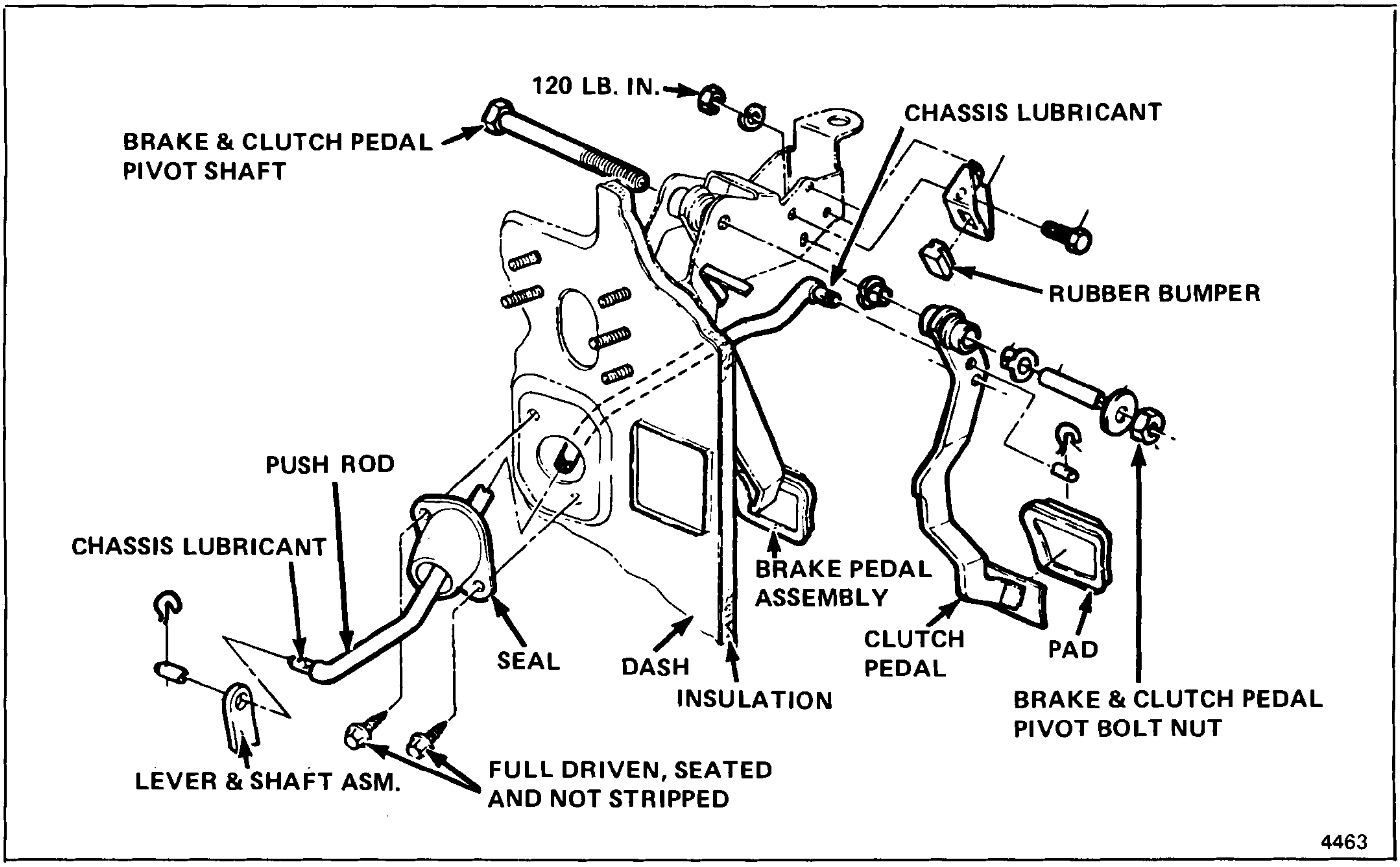


Fig. 7C-7 Clutch Pedal Linkage (A Series)

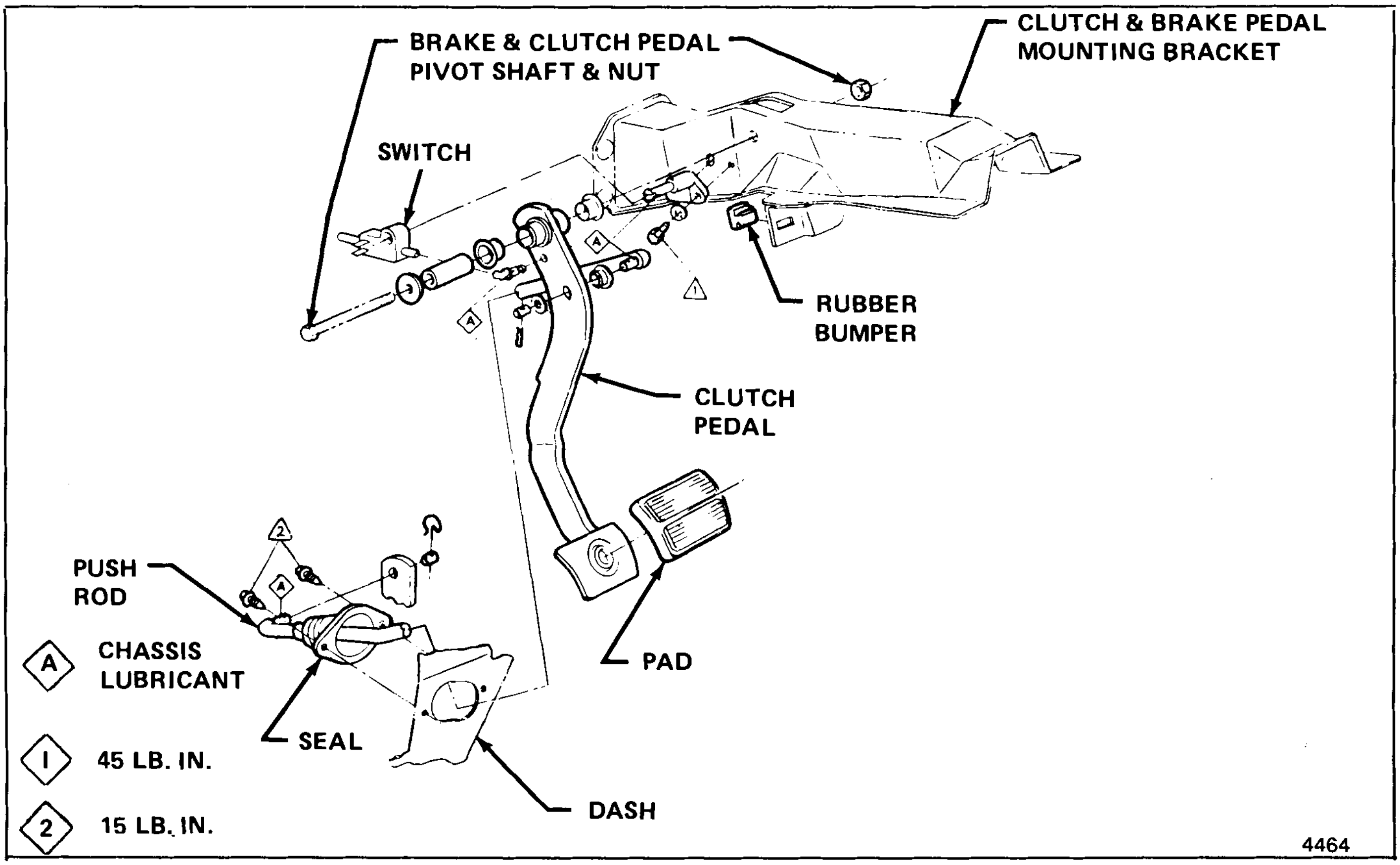


Fig. 7C-8 Clutch Pedal Linkage (F Series)

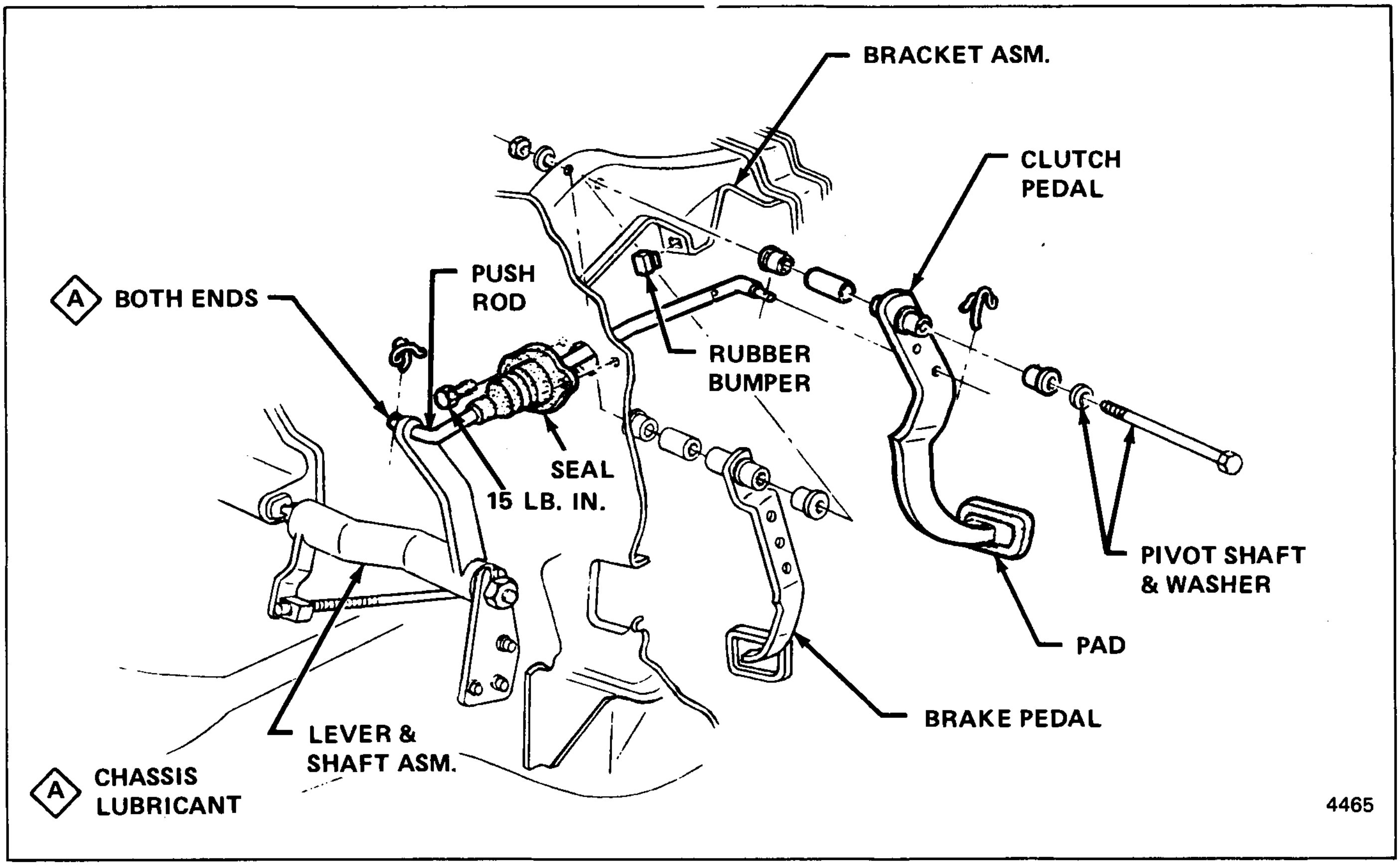


Fig. 7C-9 Clutch Pedal Linkage (X Series)

7. Route cable over fender skirt reinforcement and down to the clutch fork lever.

8. Secure cable to fender skirt reinforcement.

9. Re-set clutch fork ball stud adjustment as stated in "Maintenance and Adjustments."

10. Install cable end in fork lever and install screw pin.

11. Push clutch fork forward until clutch release bearing contacts clutch spring fingers and tighten screw pin on cable until it bottoms on fork. Turn 1/4 additional revolution clockwise and drop pin in groove in fork.

12. Attach return spring.

13. Re-check clutch pedal free travel as stated in "Maintenance and Adjustments."

14. Install clutch fork cover and tighten retaining screw to specifications.

UNIT REPAIR

CLUTCH ASSEMBLY REPLACEMENT

Removal

1. Raise vehicle on hoist.

2. Remove transmission as outlined in transmission section.

3. A, F or X Series - Disconnect clutch fork push rod and spring.

H Series - Remove clutch fork cover. Then disconnect clutch return spring and control cable from clutch fork.

4. Remove flywheel housing lower cover.

5. Remove flywheel housing from engine.

6. A, F or X Series - Slide clutch fork from ball stud and remove fork from dust boot. Install Tool J 5824 to support the clutch assembly during removal.

H Series - To remove release bearing from clutch fork, slide lever off ball stud against spring action. If necessary to replace ball stud, remove cap, lock nut and stud from housing.

7. If assembly marks on clutch assembly and flywheel are not distinguishable, remark with paint or centerpunch for indexing purposes during installation.

8. Loosen clutch cover to flywheel attaching bolts one turn at a time until spring pressure is released, to avoid bending clutch cover flange.

9. Support the pressure plate and cover assembly then remove the bolts and clutch assembly from vehicle.

CAUTION: *Do not disassemble the clutch cover, spring and pressure plate for repair. If defective, replace complete assembly.*

Inspection

1. Examine friction surfaces of flywheel and pressure plate for scoring, roughness, or severe overheating. Slight roughness may be smoothed with fine emery cloth, but if surface is deeply scored or grooved, component should be replaced.

2. Inspect clutch driven plate for condition of facings or facing wear to rivets, loose rivets, broken or very loose torsional springs. If oil is found on the driven plate facings,

examine the transmission drain back hole, pilot bushing, engine rear main bearing, transmission input shaft seal, and other local points for oil leakage.

3. Check fit of driven plate hub on transmission input shaft gear for an easy sliding fit.

4. Inspect clutch release bearing for scoring or excessive wear on front contact face. Check for roughness and free fit on clutch drive gear bearing retainer.

5. Inspect clutch fork ball socket and fingers for wear and ball retaining spring for damage. Spring should hold fork tightly to ball stud.

Installation

1. Index alignment marks on clutch assembly and flywheel. Place driven plate on pressure plate with long end of splined end facing forward, damper springs inside pressure plate and insert a used or dummy transmission drive gear shaft (or Tool J 5824) through the cover and driven plate.

2. Position the complete assembly against the flywheel and insert the dummy shaft or tool into the pilot bearing in the crankshaft.

3. Index the alignment marks and install clutch cover to flywheel bolts finger tight.

CAUTION: *Tighten all bolts evenly and gradually until tight to avoid possible clutch distortion. Torque bolts to specifications and remove alignment tool.*

4. Lubricate the recess on inside of release bearing collar and fork groove with a light coat of graphite grease (Fig. 7C-13).

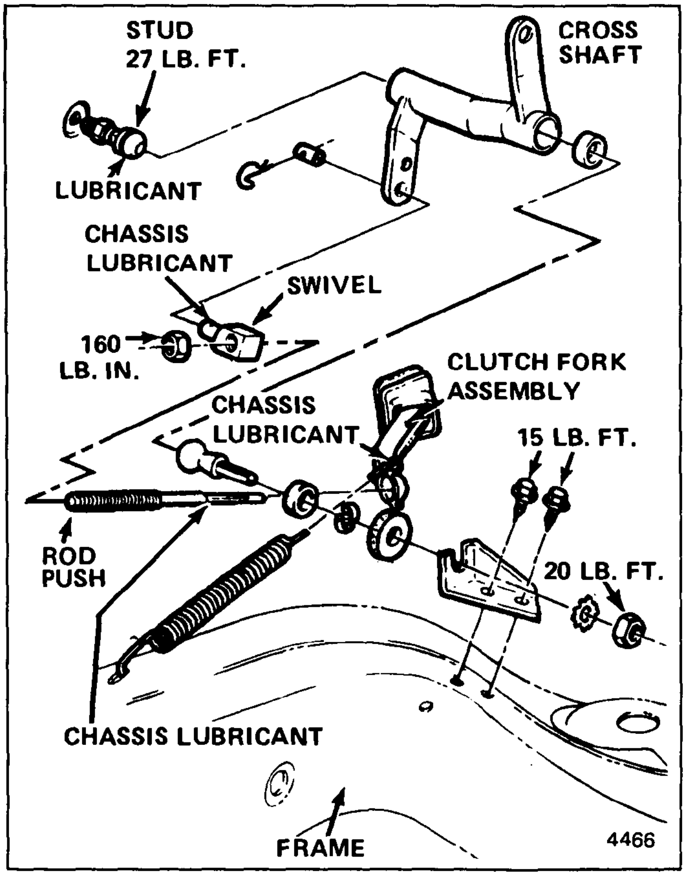


Fig. 7C-10 Cross Shaft Controls (A Series)

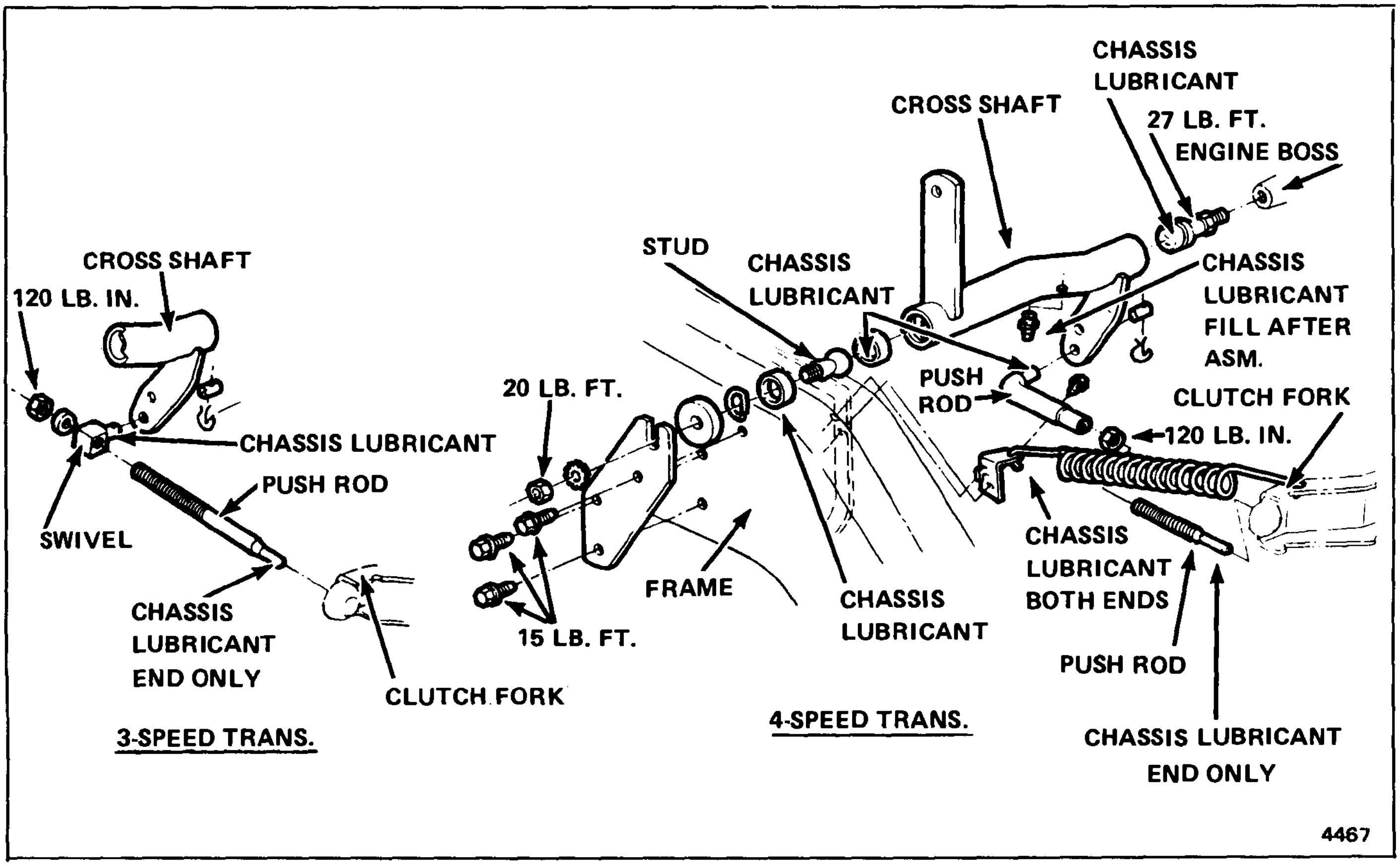


Fig. 7C-11 Cross Shaft Controls (Typical - F or X Series)

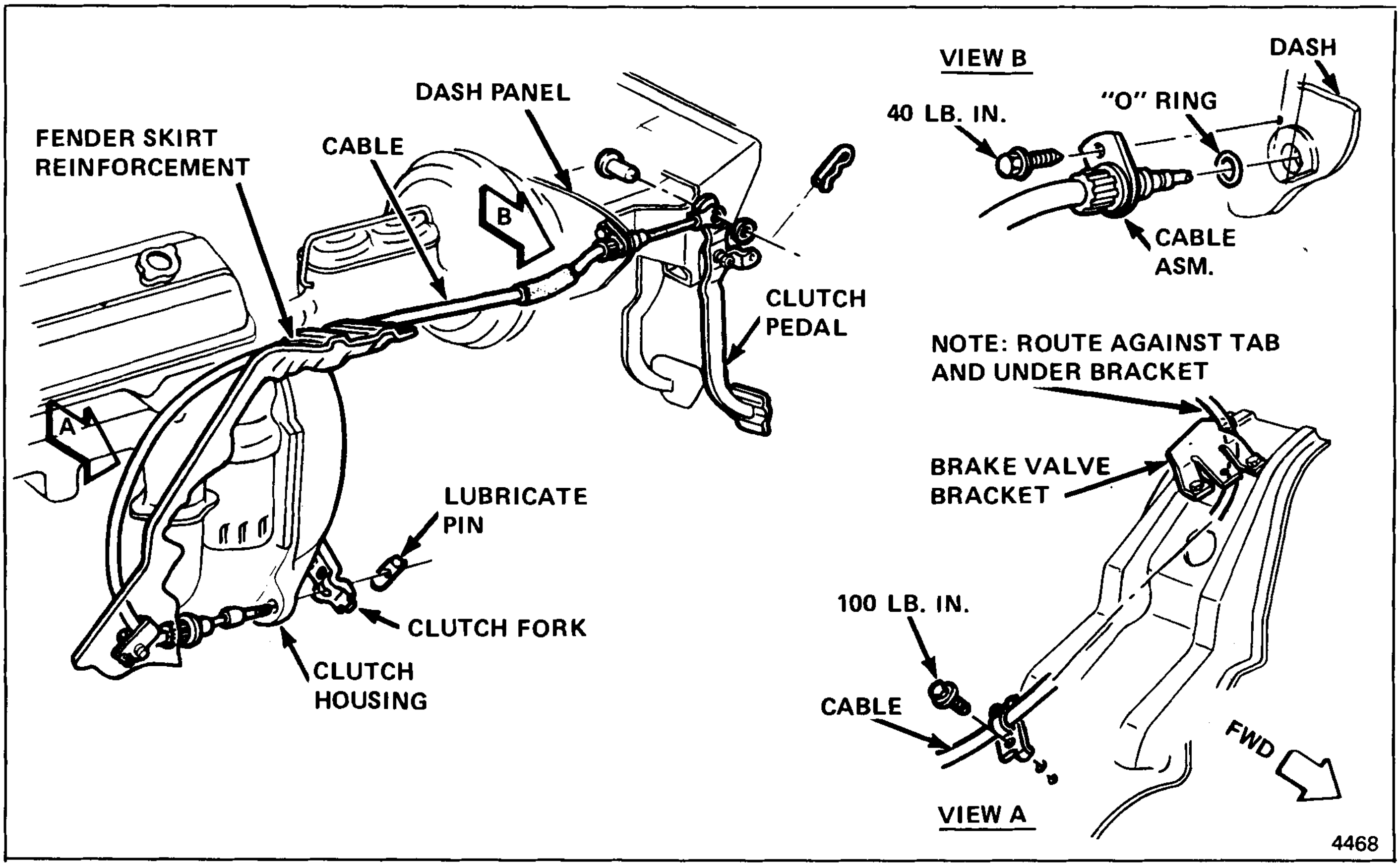


Fig. 7C-12 Clutch Cable Routing (Typical - H Series)

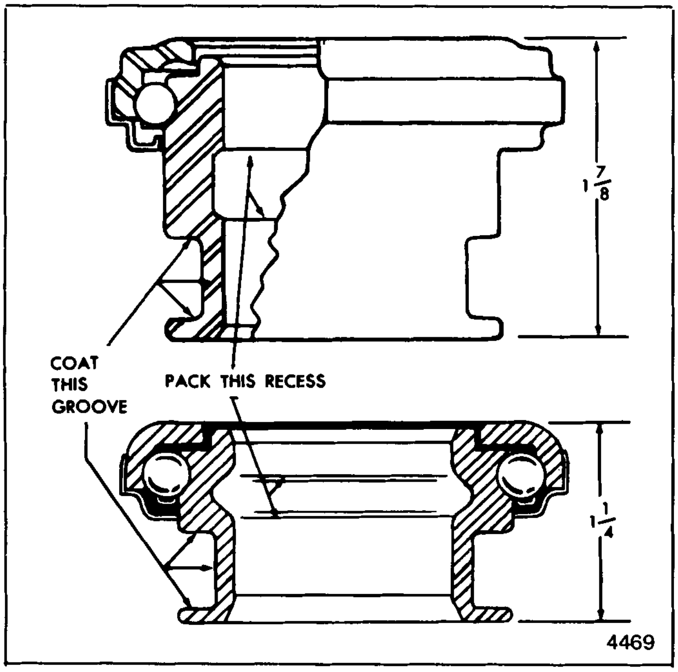


Fig. 7C-13 Release Bearing Lubrication

5. Install clutch release bearing and fork assembly in housing with fork spring hooked under ball stud.

6. Position clutch housing to engine and torque attaching bolts to specifications.

7. Install transmission as outlined in transmission section.

8. A, F or X Series - Connect fork push rod and spring. Lubricate spring and push rod ends.

H Series - Re-adjust ball stud position with Gage J 23644 and adjust clutch linkage as outlined in "Maintenance and Adjustment" Section.

9. Install transmission shift levers to transmission and adjust shift linkage as outlined in transmission section.

10. Lower vehicle and remove from hoist. Check operation of transmission and clutch. Adjust as required.

SINGLE PLATE DIAPHRAGM CLUTCH

Disassembly (Fig. 7C-14)

NOTE: When disassembling, mark edge of pressure plate and cover. These marks must be aligned in assembly to maintain balance.

1. Remove three drive-strap to pressure plate bolts and retracting springs, and remove pressure plate from clutch cover.

2. The clutch diaphragm spring and two pivot rings are riveted to the clutch cover. Spring, rings and cover should be inspected for excessive wear or damage and, if there is a defect, it is necessary to replace the complete cover assembly.

Inspection

1. Check drive straps for looseness at the clutch cover and evidence of looseness at pressure plate bolt holes.

2. Wash all parts, except driven disc and throwout bearing, in cleaning solvent.

NOTE: The clutch release bearing is permanently packed with lubricant and should not be soaked in cleaning solvent as this will dissolve the lubricant.

3. Inspect pressure plate and flywheel for scores on the contact surfaces. Use a straight-edge and check for flatness of contact surfaces.

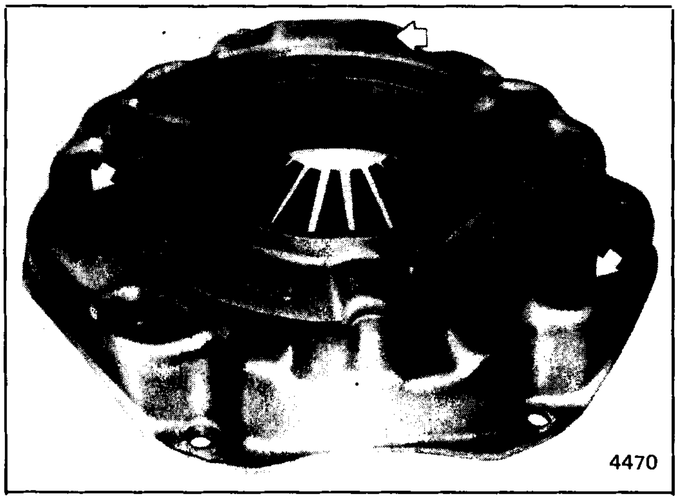


Fig. 7C-14 Retracting Spring Location (Typical)

4. Check release bearing for roughness and free fit on the sleeve of the transmission clutch gear bearing retainer. Replace retainer if rough.

5. Inspect clutch disc for worn, loose or oil soaked facings, broken springs, loose rivets, etc. Replace if necessary.

6. Examine splines in hub and make sure they slide freely on splines of transmission clutch shaft. If splines are worn, the clutch disc or clutch gear should be replaced as necessary.

7. Inspect clutch fork ball socket and fingers for wear and ball retaining spring for damage. Spring should hold fork tightly to ball stud.

NOTE: Ball spring on fork may be bent in toward fork if necessary.

8. Inspect ball stud for wear. Replace if scored.

9. Check run-out of transmission pilot hole in clutch housing by removing a flywheel bolt and installing a dial indicator. The run-out should not exceed .015".

10. Lubricate ball stud before reassembly.

Assembly

1. Install the pressure plate in the cover assembly, lining up the punch marks on the edge of the pressure plate with the punch marks on the edge of the cover.

2. Install pressure plate retracting springs and drivestrap to pressure plate bolts and lock washers and tighten to 11 ft. lbs. torque. The clutch is now ready to be installed.

PILOT BEARING REPLACEMENT

The clutch pilot bearing is an oil impregnated type bearing pressed into the crankshaft. This bearing requires attention when the clutch is removed from the vehicle, at which time it should be cleaned and inspected for excessive wear or damage and should be replaced if necessary.

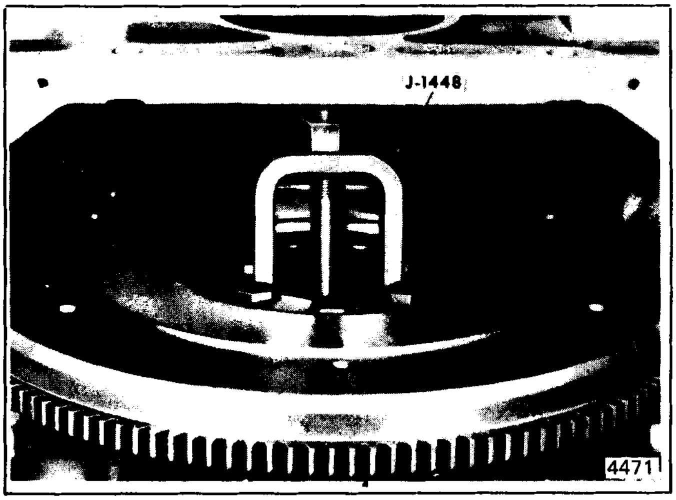
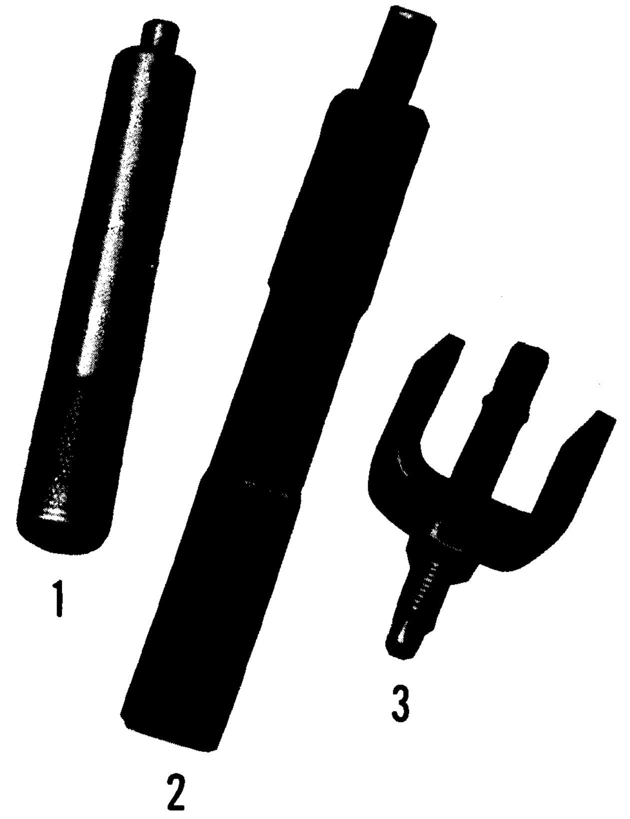


Fig. 7C-15 Clutch Pilot Bearing Removal

To remove, install Tool J 1448 and remove bearing from crankshaft (Fig. 7C-15). In replacing this bearing, use Tool J 1522. Place bearing on pilot of tool with radius in bore of bearing next to shoulder on tool and drive into crankshaft. Lubricate with several drops of machine oil.



1. J 1522 PILOT BEARING DRIVER
2. J 5824 OR J 23720 CLUTCH PILOT TOOL
3. J 1448 PILOT BEARING PULLER

Fig. 7C-16 Special Tools

SECTION 8

CHASSIS ELECTRICAL

NOTE: All LeMans Series using the Grand Prix style instrument panel will be referred to as AG Series.

CONTENTS OF THIS SECTION

Wiring Harnesses

Instrument Panel

Horn

Lamps

Seat Belt Warning System

WIRING HARNESSES

Complete wiring diagrams for all car lines are shown at the rear of this section. The diagrams and car lines are:

Fig. 8-1 B Series
Fig. 8-2 A Series (See Note Above)
Fig. 8-3 G & AG Series (See Note Above)
Fig. 8-4 F Series
Fig. 8-5 X Series
Fig. 8-6 H Series
Fig. 8-7 HM Series

The diagrams show the engine, passenger compartment, and rear end wire harness routing and connections. Physical locations for much of the wiring is shown in the On-Car Service portion of this section. Body harness details are shown in the Body Service Manual. Accessory wiring circuits are shown in Section 9.

The wiring harness for F Series shows two standard instrument cluster printed circuits. The carryover 1976 cluster will be used approximately the first half of the year, and the standard "A"series cluster will replace the 1976 "F"cluster after that time. The wiring diagram reflects the new cluster wiring; therefore, in tracing a circuit to the old cluster follow the circuit to the cluster connector, then note the number of that connector on the new printed circuit (for example, #39). Then find that number connector on the old printed circuit and complete the circuit tracing. When the new cluster is incorporated in production, circuit tracing will be done normally. The rally gage cluster is not affected.

ENGINE WIRE HARNESS (FIGS. 8-8 THROUGH 8-12)

ON-CAR SERVICE

1. Disconnect battery.
2. Hoist car and disconnect wires underneath car, such as starter solenoid, transmission connections, etc.
3. Lower car, remove bolt holding front end and engine harness to bulkhead connector. Separate harness.
4. Disconnect wires on engine. It may be necessary on some models to remove the air cleaner, washer bottle, or other parts to gain access to connections.
5. Remove engine harness.
6. To replace, reverse removal procedure.
7. Make electrical check to insure proper operation.

FRONT END WIRE HARNESS (FIG. 8-12 THROUGH 8-17)

On-Car Service

1. Disconnect negative battery cable.
2. Remove bolt holding front end and engine harness to bulkhead connector. Separate harnesses.
3. Disconnect wires to wiper motor and brake switch.
4. Remove harness from fender skirt clips.
5. Disconnect park and signal lamp sockets from lamp assembly.
6. Disconnect RH and LH headlamp sockets.
7. Disconnect horn wires and 2 ground screws, 1 on each side.
8. Remove harness from front end clips by reaching up from under bumper and remove harness from car.
9. To replace, reverse removal procedure.
10. Make electrical check to insure proper operation of wipers, lights, and horns, turn signals, etc.

BATTERY CABLES (FIGS. 8-18 THROUGH 8-25)

On-Car Service

1. Disconnect negative battery cable at battery first whenever replacing either cable.
2. To replace positive cable, hoist the car to gain access to solenoid connections. Grease connections at solenoid when reinstalling to prevent corrosion.

REDUNDANT GROUND

In addition to the ground strap connecting the engine to the firewall, a redundant ground cable is used on A, G and F series to provide an added electrical ground path. See Figure 8-26.

FUSIBLE LINK

Added protection is provided in all battery feed circuits and other selected circuits by a fusible link. This link is a short piece of copper wire approximately 4" long inserted in series with the circuit and acts as a fuse. The link is four or more gages smaller in size than the circuit wire it is protecting and will burn out without damage to the circuit in case of current overload. The chassis electrical wiring diagrams at the end of this section show the locations and colors of these fusible links.

On-Car Service

1. Disconnect battery.
2. Locate burned out link. This may require use of the chassis wiring diagrams at the end of the manual.
3. Strip away all melted harness insulation.
4. Cut burned link ends from circuit wire.
5. Strip circuit wire back approximately 1/2" to allow soldering of new link.
6. Using fusible link 4 gages smaller than protected circuit (approximately 10" long), solder new link into circuit.

   CAUTION: *Use only resin core solder. Under no circumstances should an acid solder be used nor should link be connected in any other manner except by soldering.*

7. Tape soldered ends securely using suitable electrical tape.
8. After taping wire, tape harness leaving an exposed loop of wire approximately 5" in length.
9. Reconnect battery.

FUSE BLOCK AND BULKHEAD CONNECTOR

The fuse block (Figs. 8-27, 28 and 29) is located on the inner firewall at the left side just above the front edge of floor mat on the A, B, F, X, H and HM Series and under the lower trim plate on the G, AG and other A Series models using the G type instrument panel. The B Series uses a new fuse block for miniturized fuses (see Fig. 8-29), designed for increased circuit protection and greater reliability. Various convenience connectors, which snap lock on to the fuse block sides, add to the serviceability of this unit.

A new miniaturized fuse has been developed in conjunction with the new fuse block. This compact fuse, with blade terminal design, allows finger tip removal and replacement. Fuses of different ratings are interchangeable, but amperage values are molded in bold, color coded, easy to read numbers on the fuse body. Be sure that only fuses of proper ratings are used for replacement. See Figure 8-30.

A suspected blown fuse can easily be pulled out and examined. The clear plastic body gives full view of the element to blade construction for visual checking for defects. In addition, blade terminal tips are exposed in the fuse body,

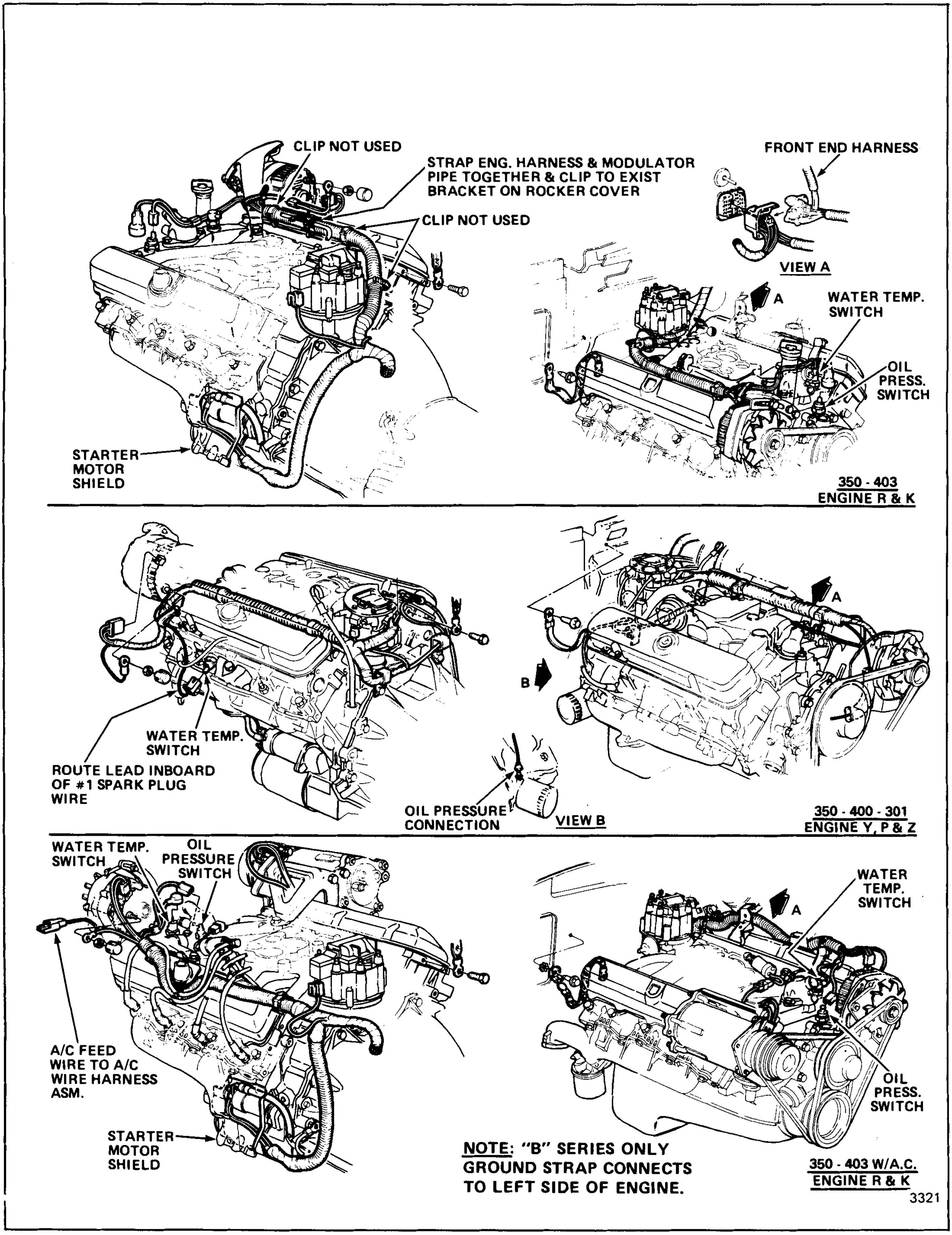


Fig. 8-8 Engine Wire Harness Installation, All Series, V-8

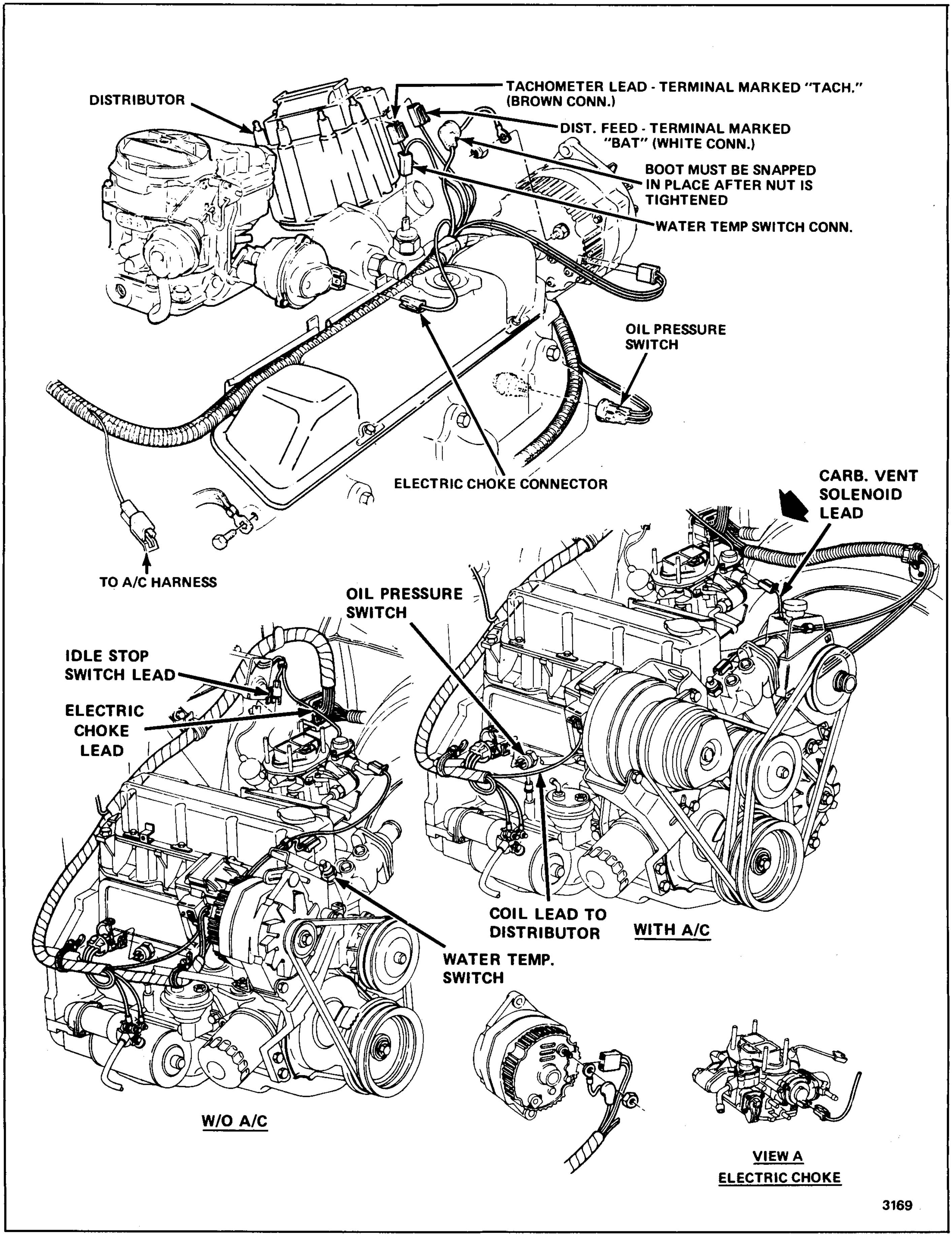


Fig. 8-9 Engine Wire Harness Installation, V-6 and 151 L-4, All Series

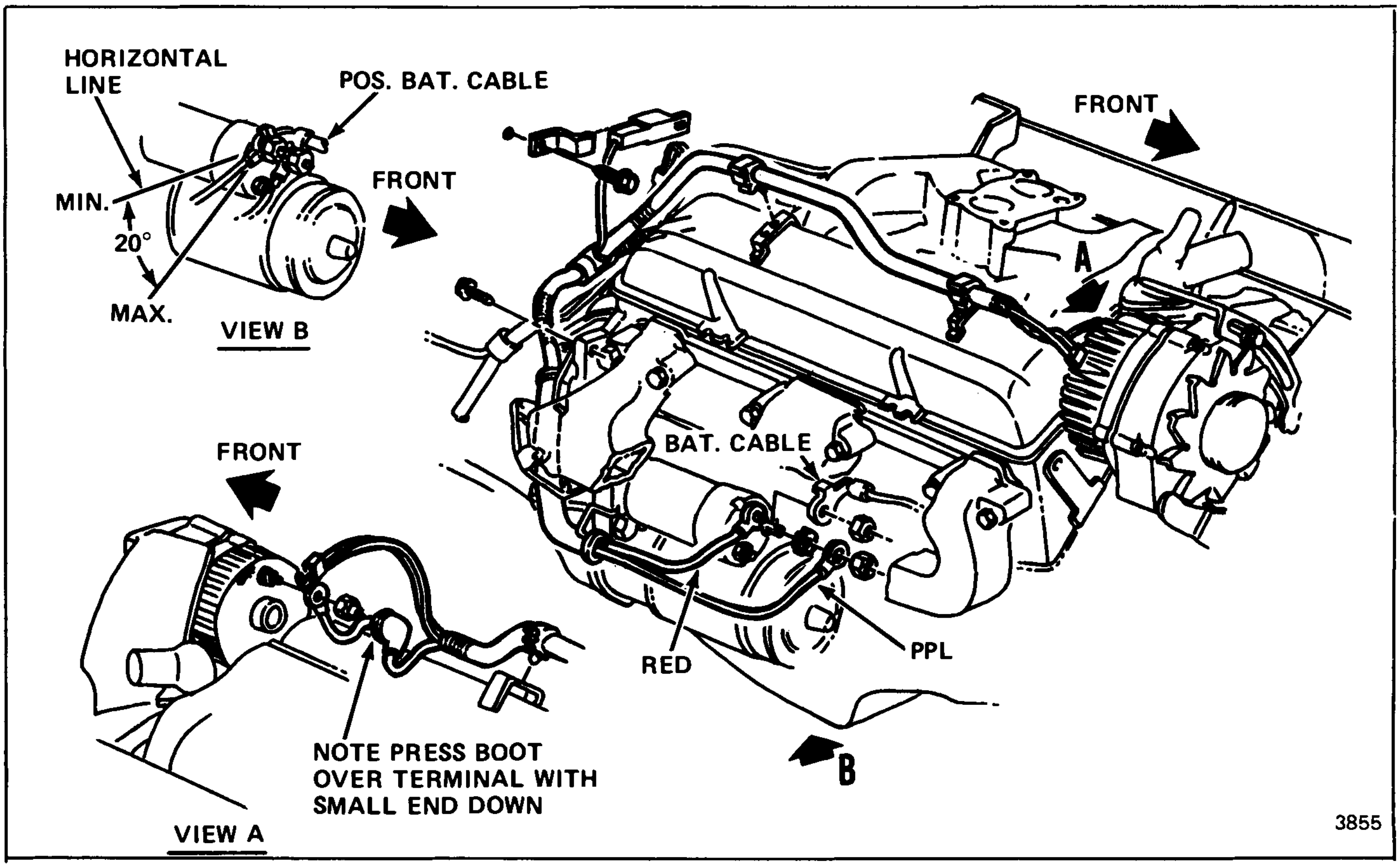


Fig. 8-10 Engine Wire Harness Installation, V.I.N. Code "U"and "L"V-8's, X Series

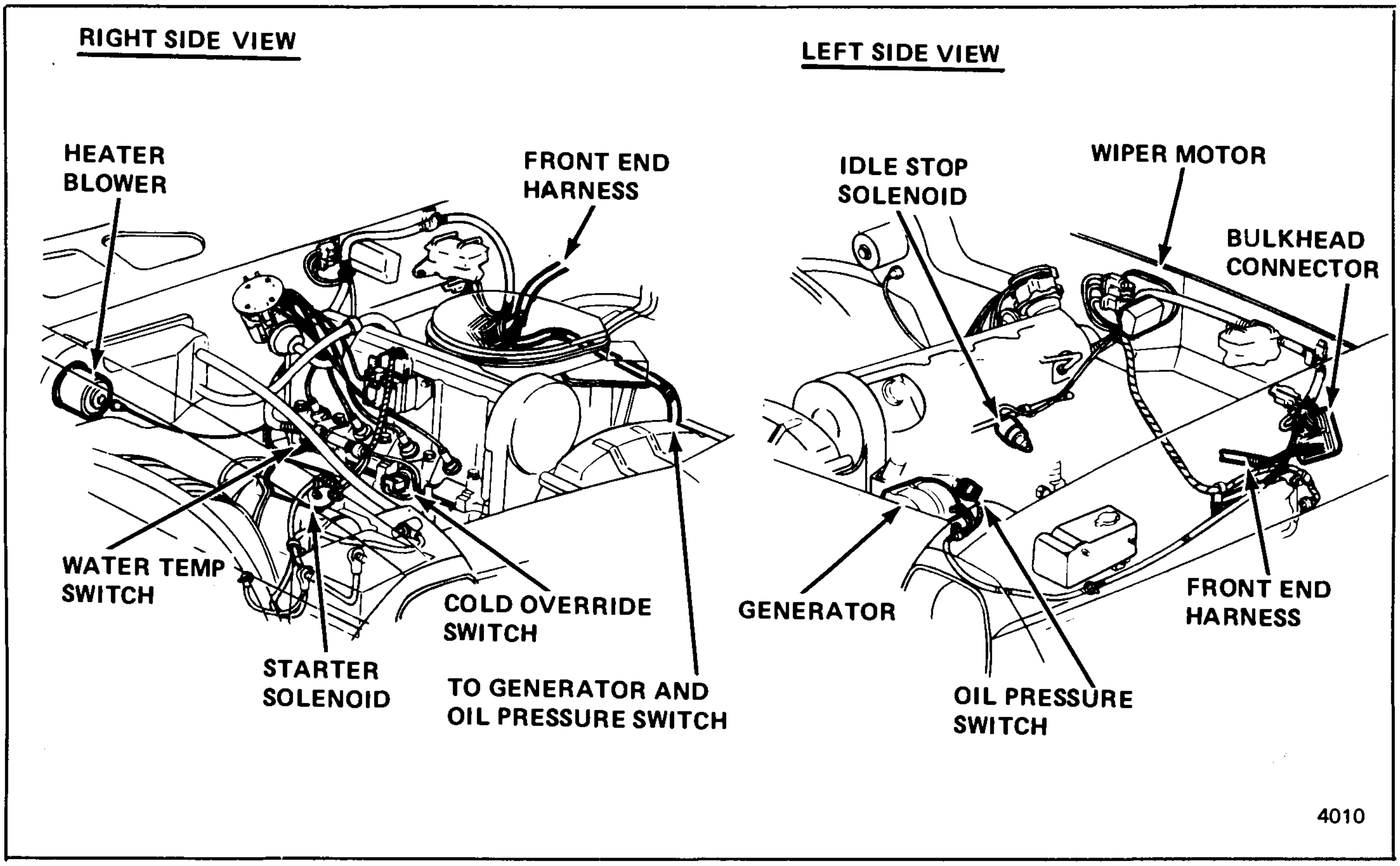


Fig. 8-11 Engine Wire Harness Installation, H and HM Series 140 L-4

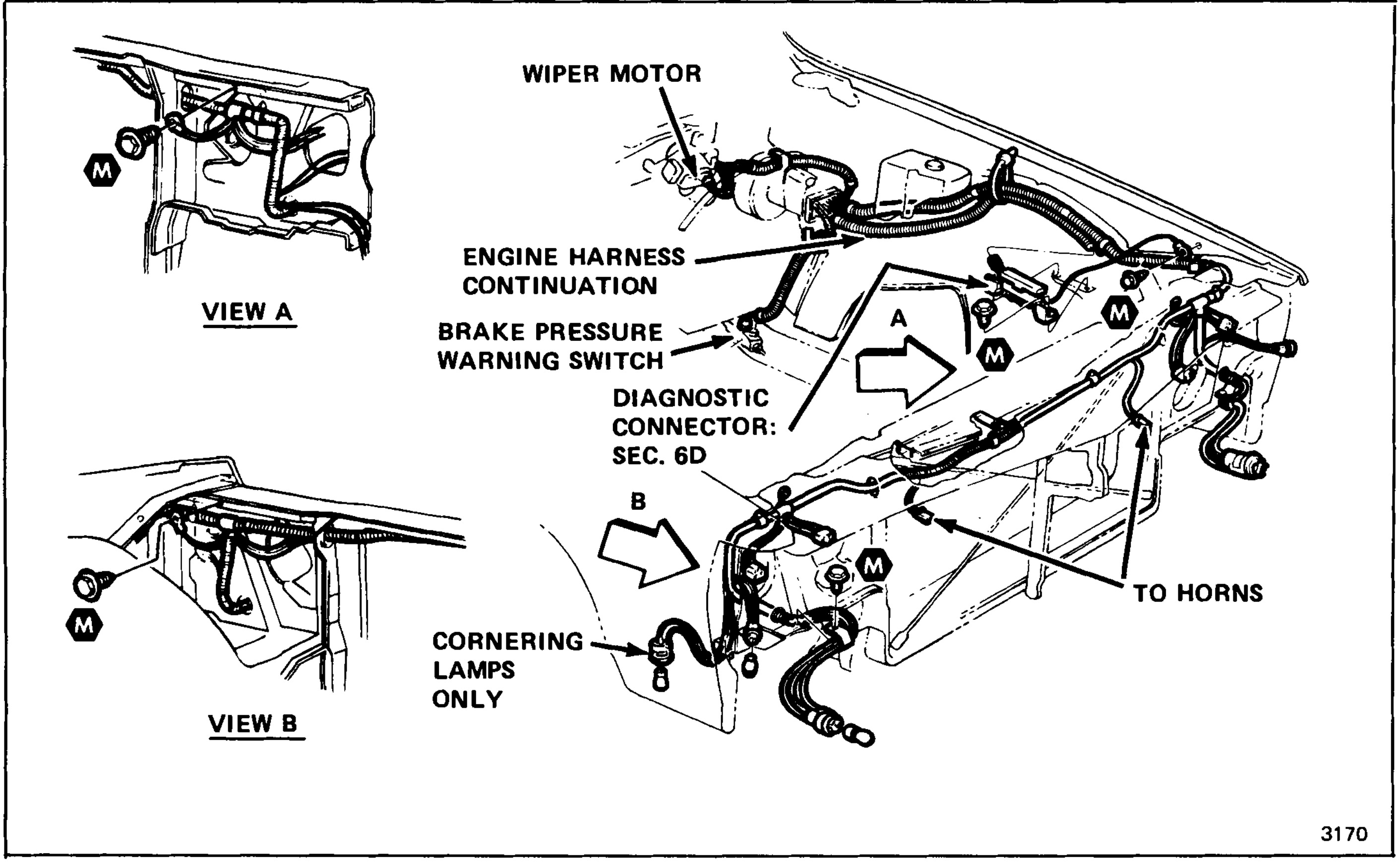


Fig. 8-12 Front End Wire Harness Installation, B Series

allowing for continuity checking if desired.

The front end and engine harnesses are firmly attached to the bulkhead connector, which is connected to the front of the fuse block by a center bolt. This makes for easy disconnection allowing quick diagnosis of electrical problems. A circuit passing through a given terminal may be identified by using the embossed letters on the bulkhead connector (see Figures 8-31, 32 and 33).

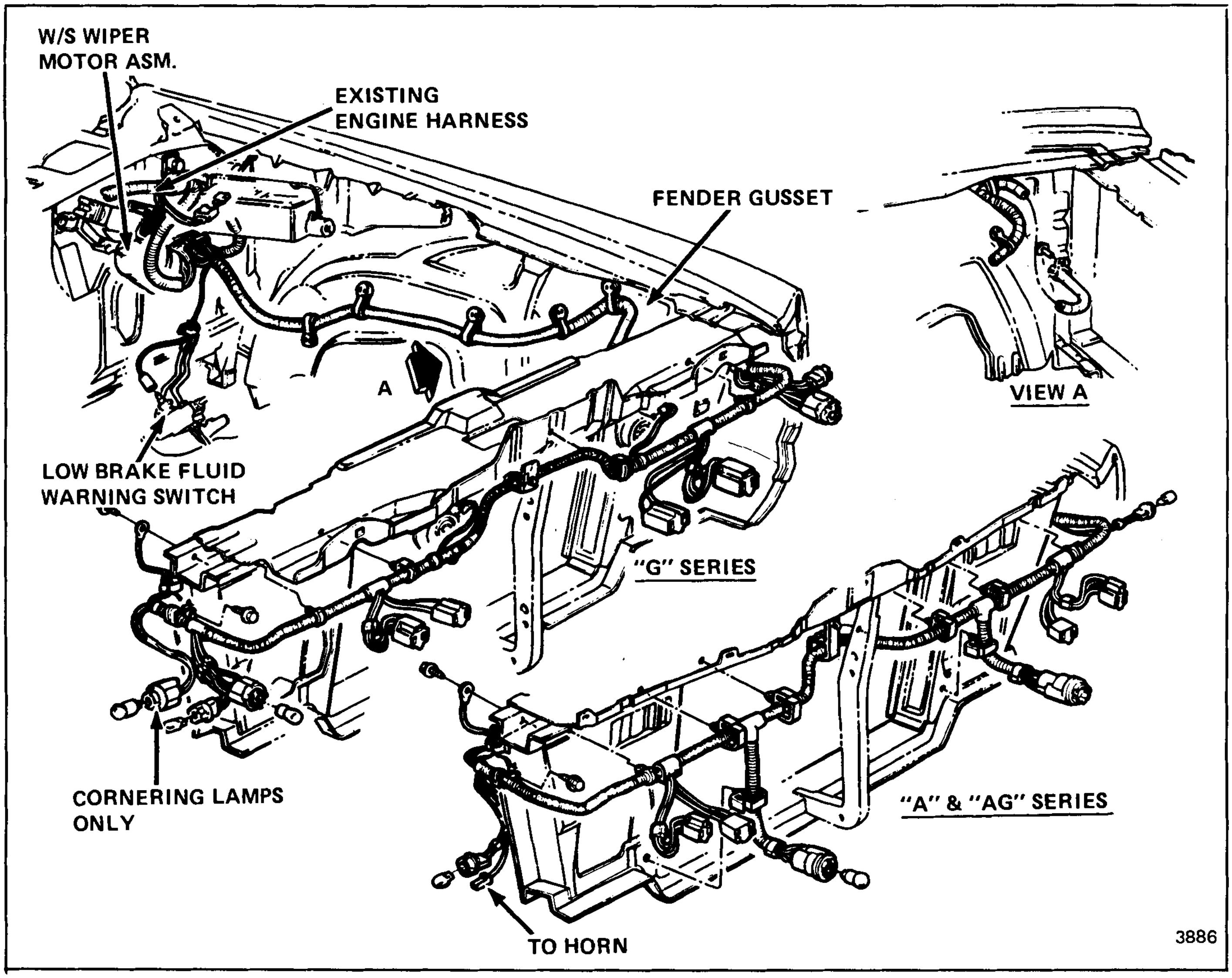


Fig. 8-13 Front End Wire Harness Installation, A and G Series

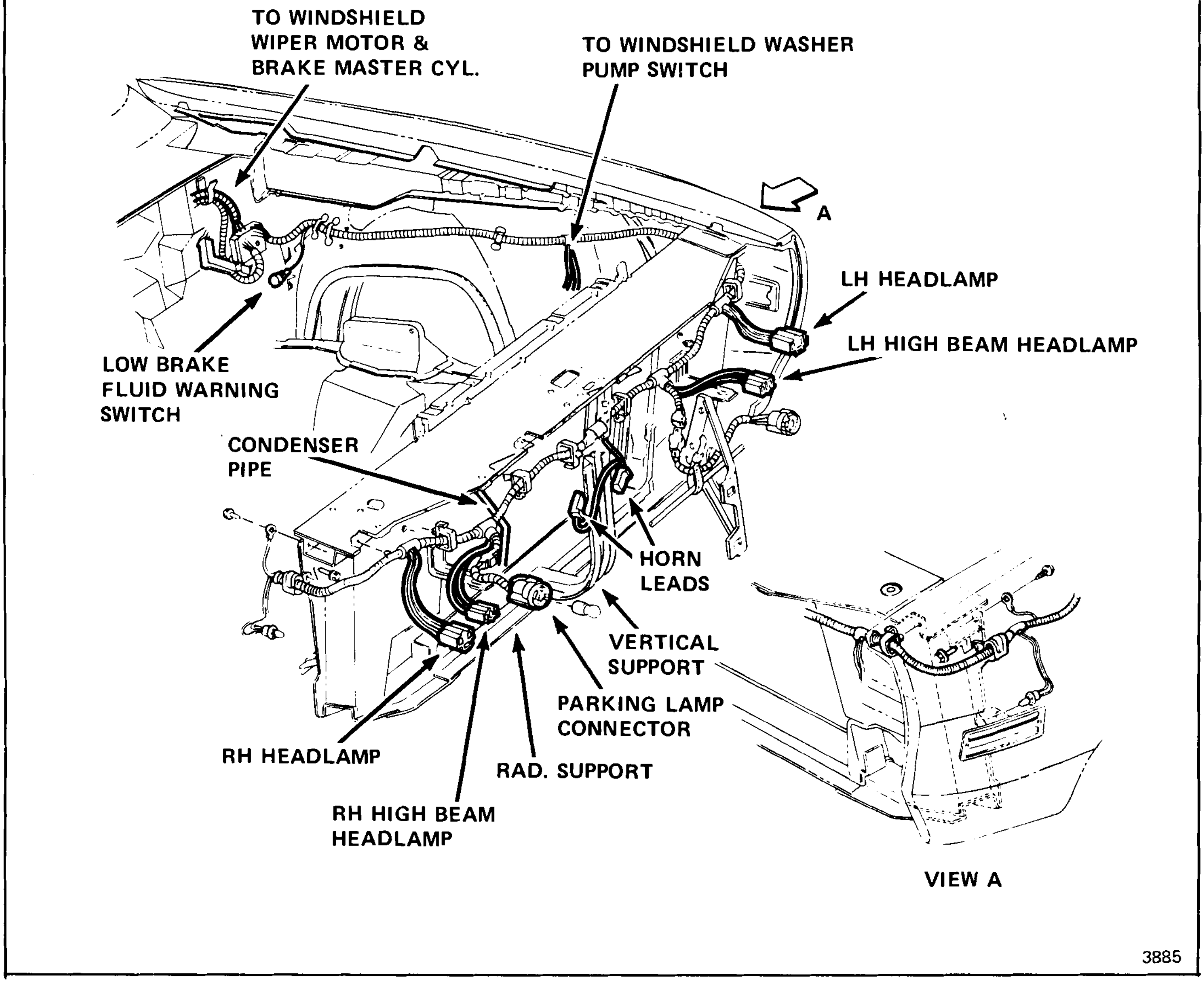


Fig. 8-14 Front End Wire Harness Installation, F Series

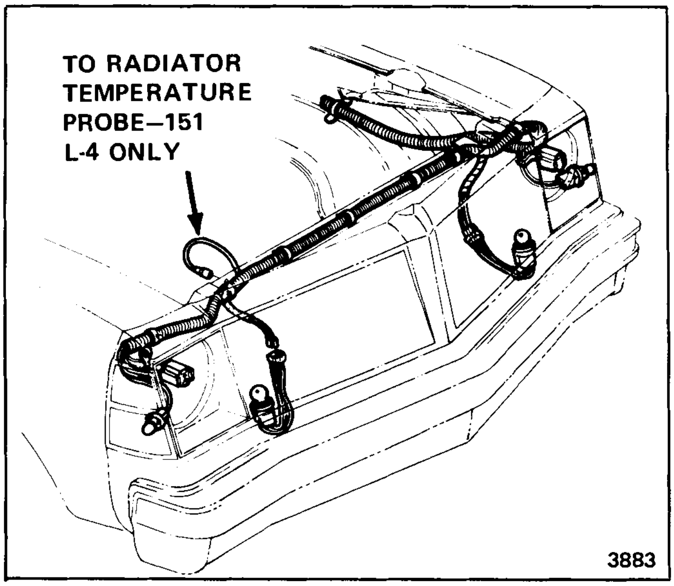


Fig. 8-15 Front End Wire Harness Installation, X Series

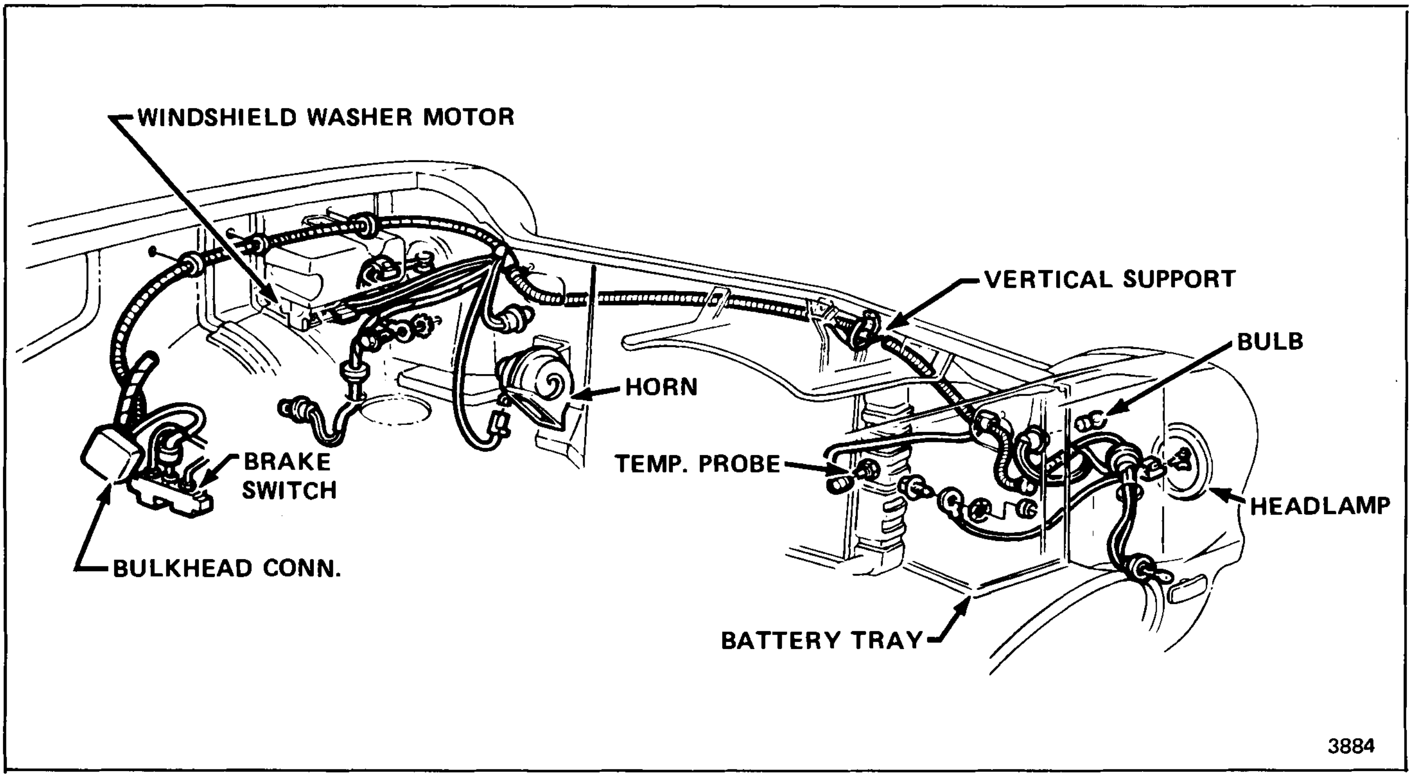


Fig. 8-16 Front End Wire Harness Installation, H Series

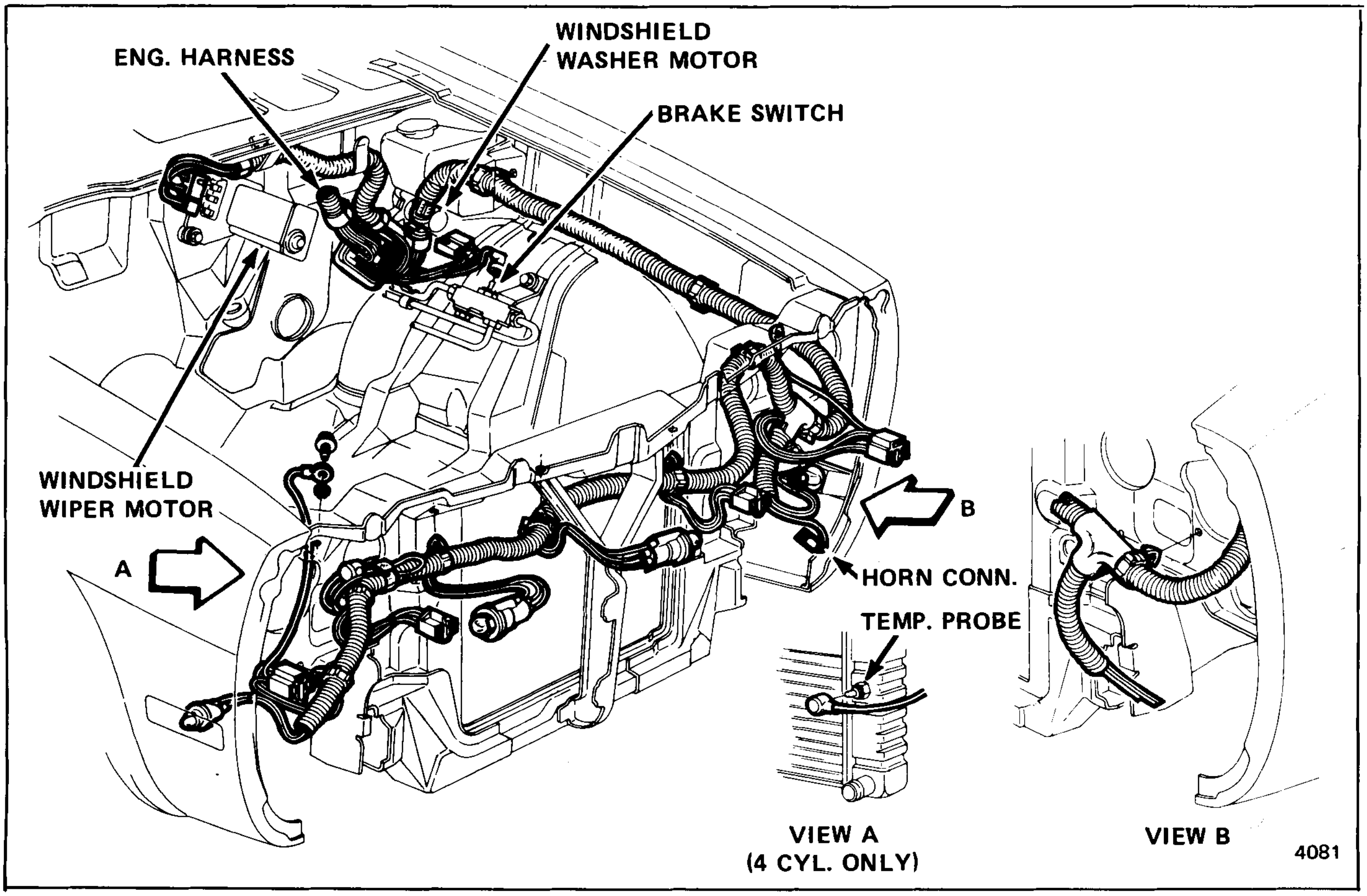


Fig. 8-17 Front End Wire Harness Installation, HM Series

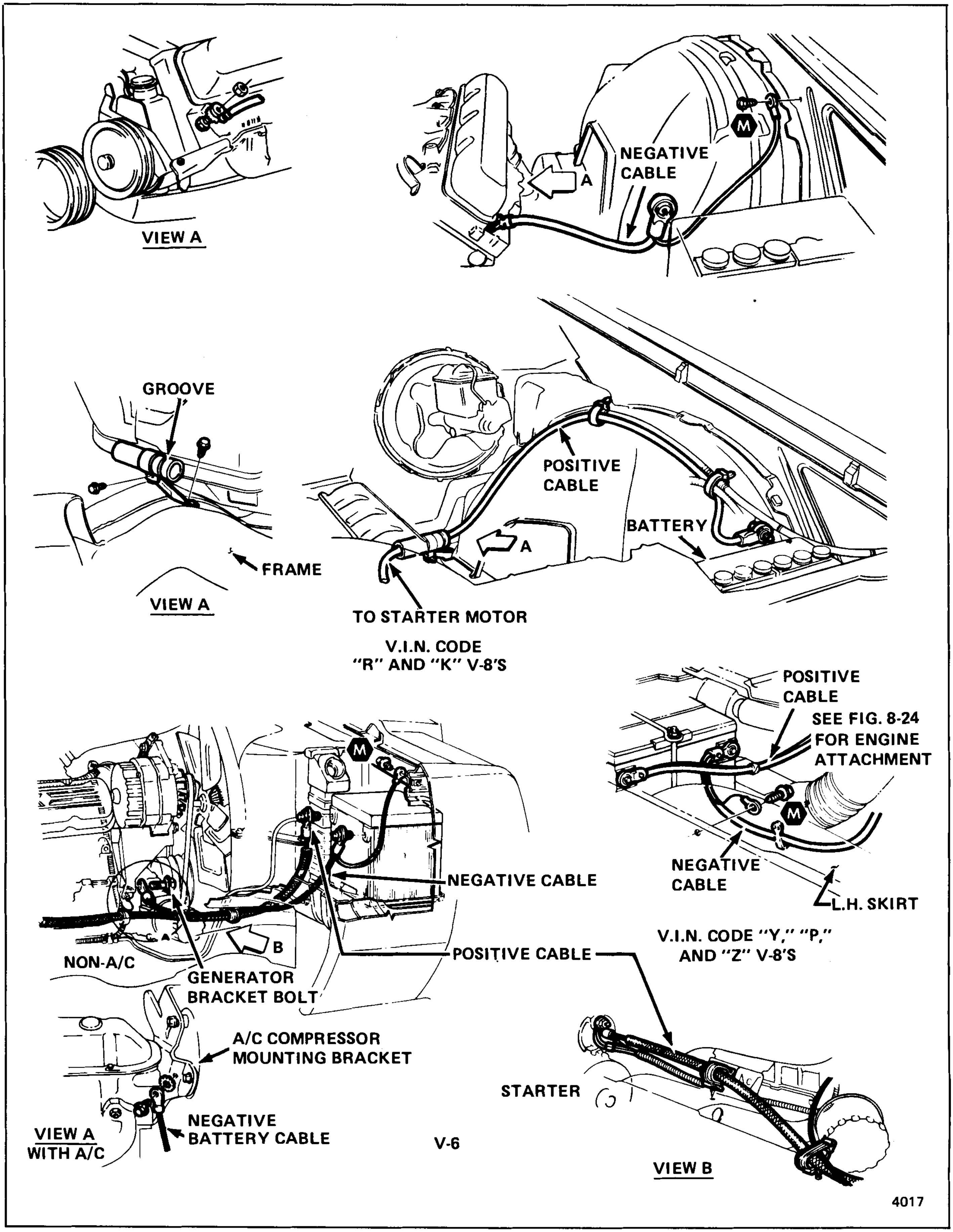


Fig. 8-18 Battery Cable Routing, B Series

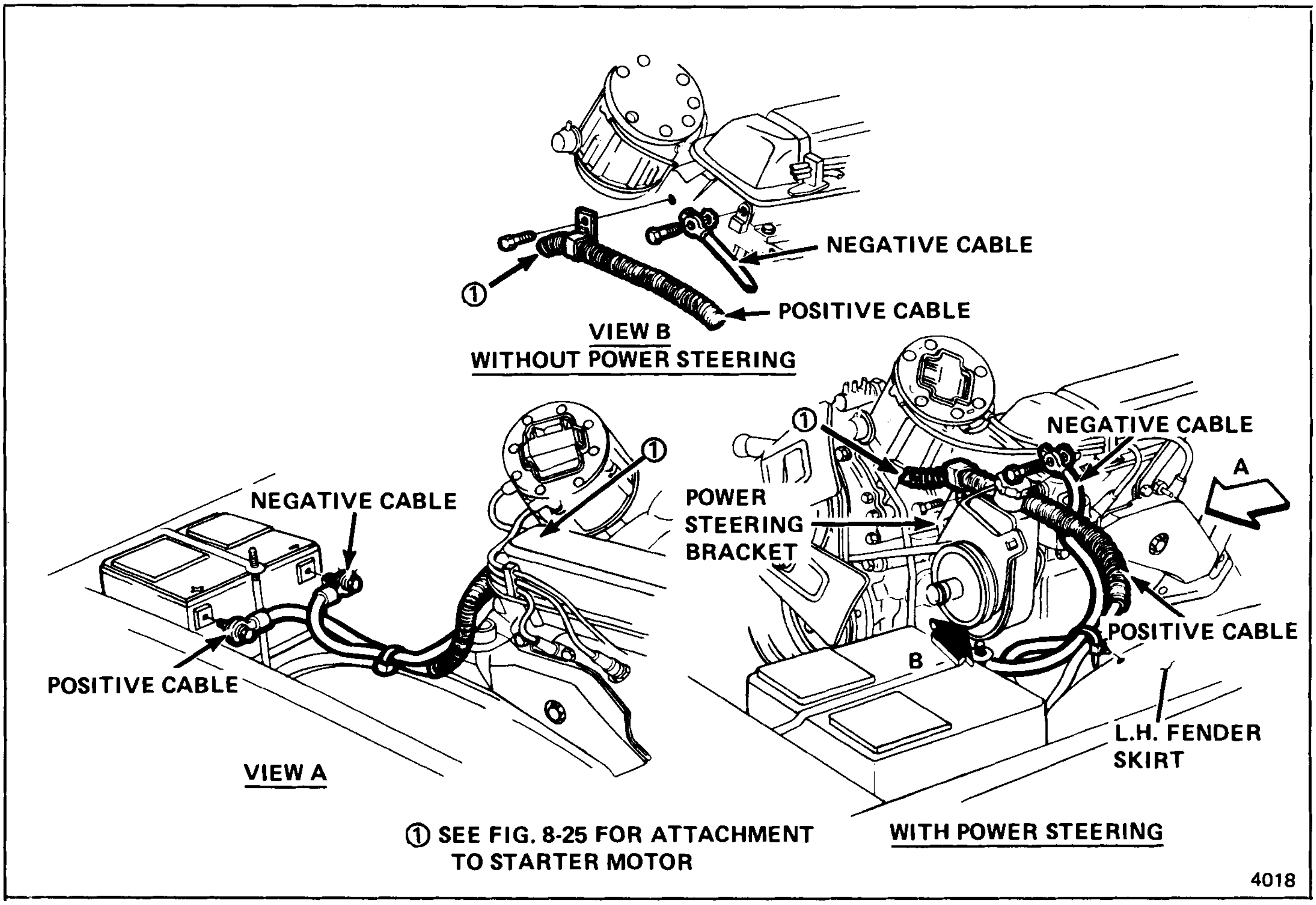


Fig. 8-19 Battery Cable Routing, A Series V-6

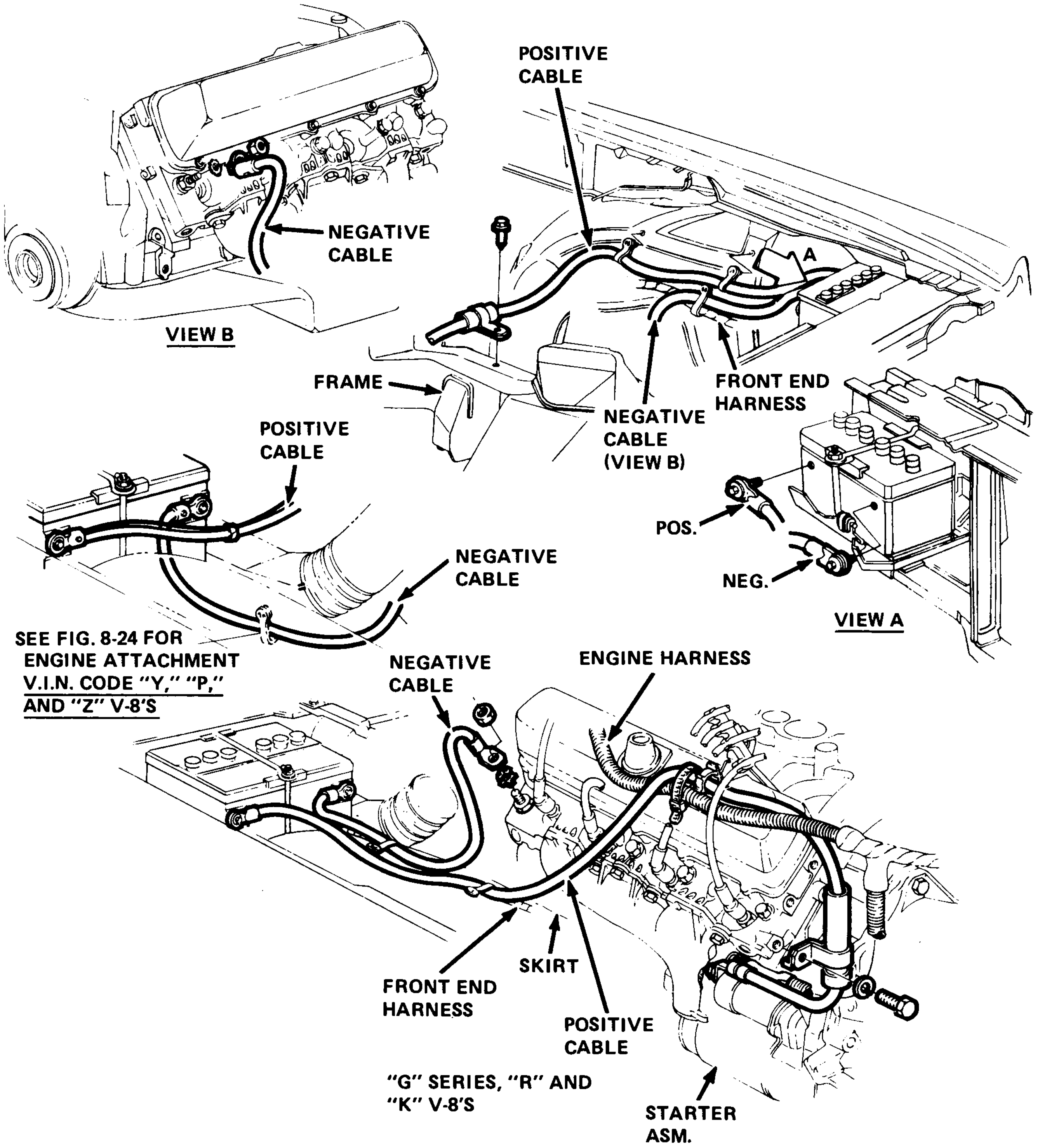


Fig. 8-20 Battery Cable Routing, A and G Series V-8

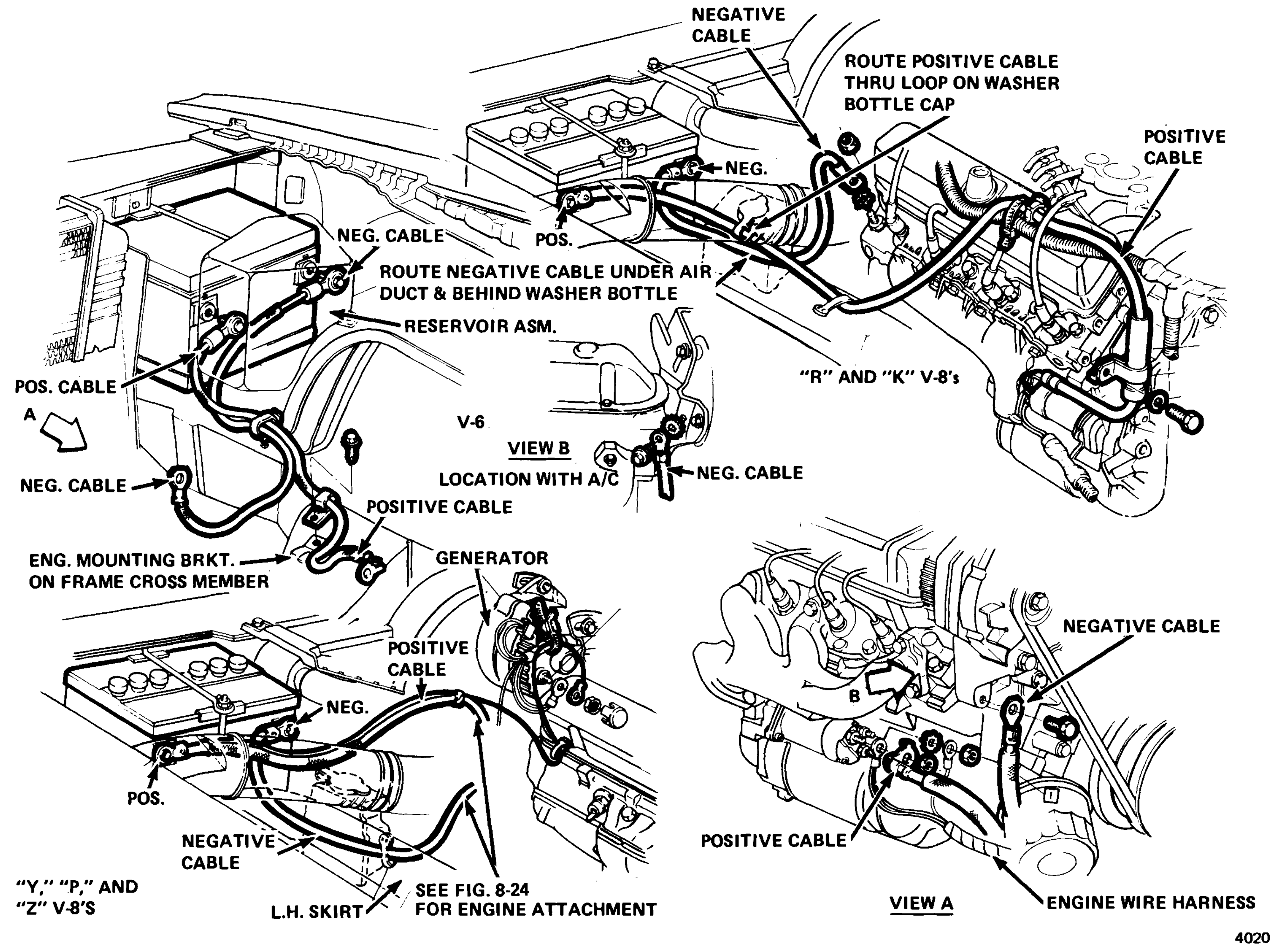


Fig. 8-21 Battery Cable Routing, F Series

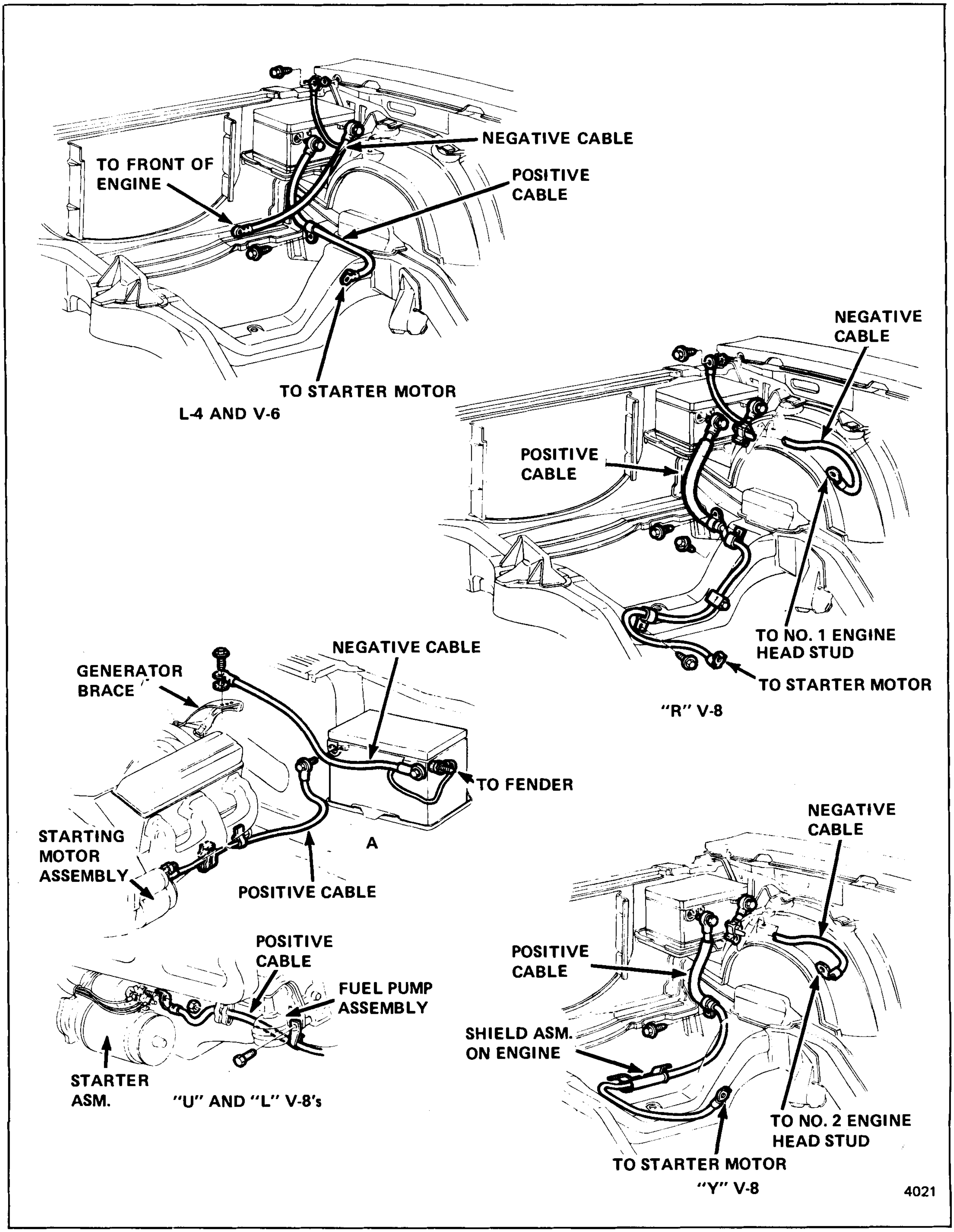


Fig. 8-22 Battery Cable Routing, X Series

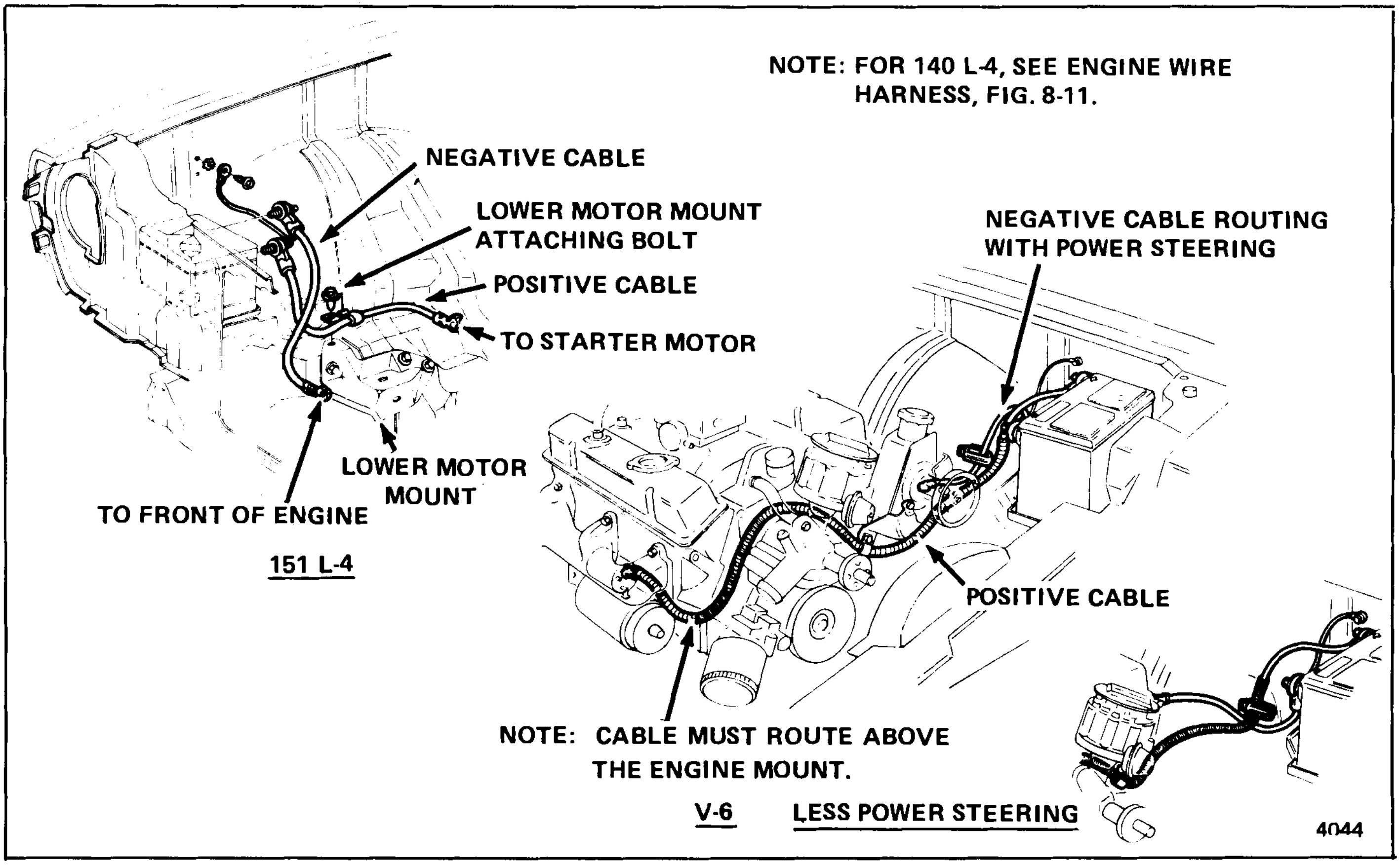


Fig. 8-23 Battery Cable Routing, H and HM Series

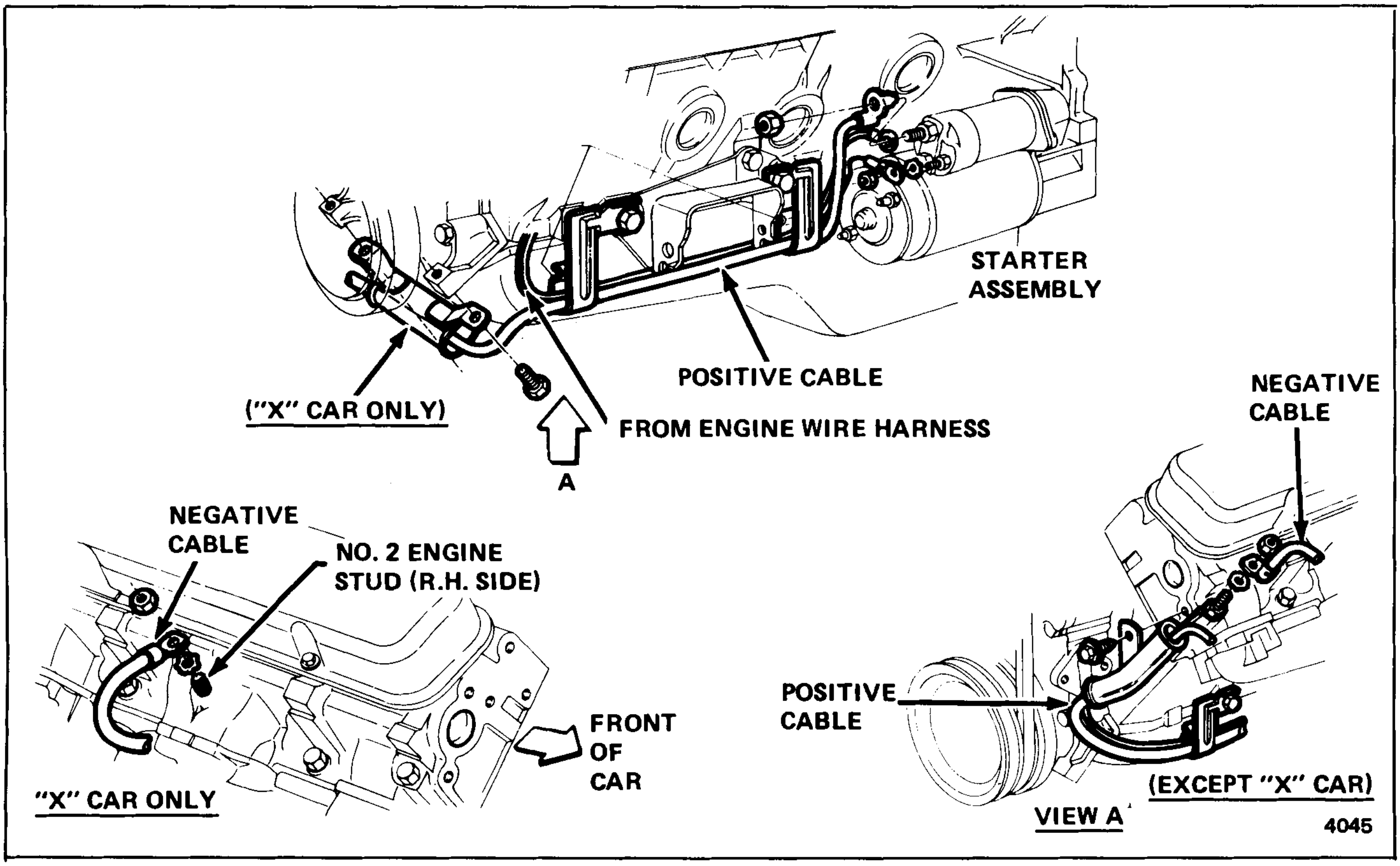


Fig. 8-24 Battery Cable to Engine Attachment - VIN Code Y, P and Z V-8's

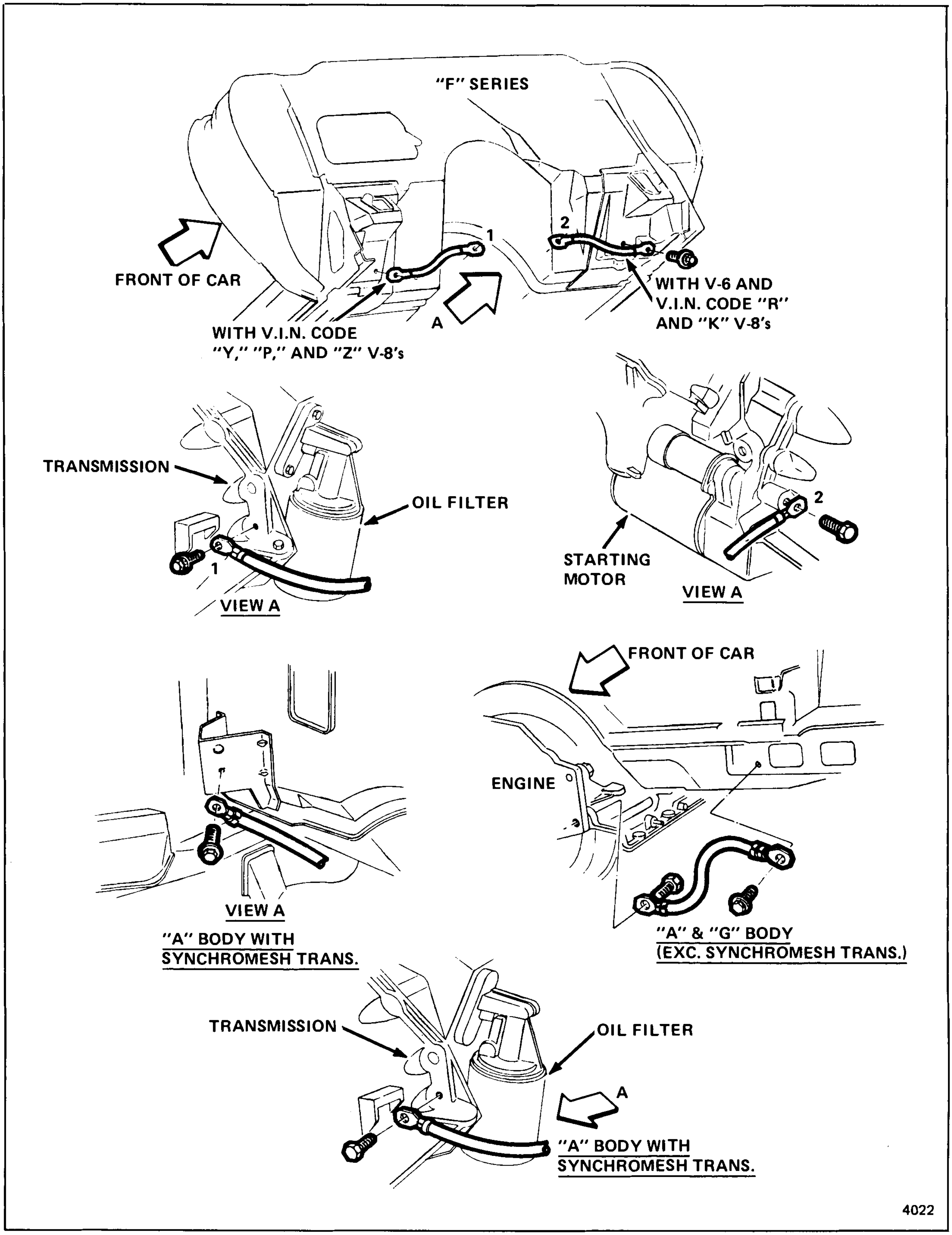


Fig. 8-26 Redundant Ground Cables

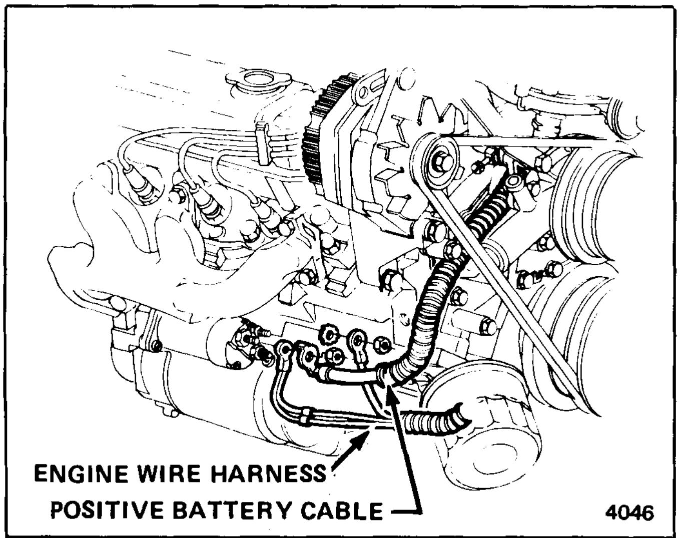
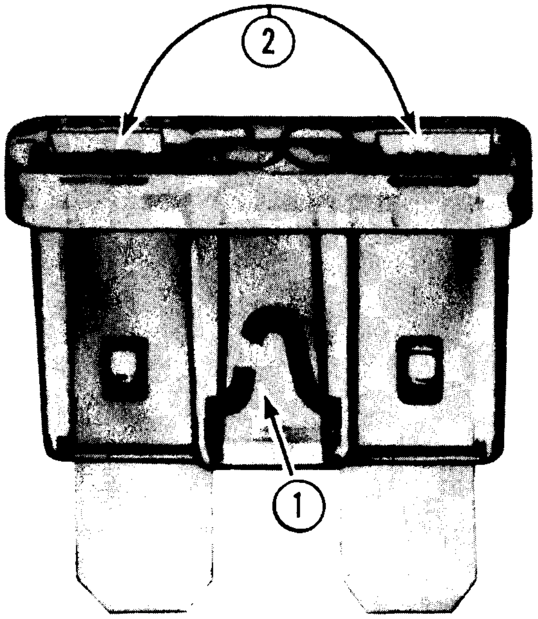


Fig. 8-25 Battery Cable to Engine Attachment - V-6 Positive Cable



TO TEST FOR BLOWN MINI-FUSE:

① PULL FUSE OUT AND CHECK VISUALLY.
② USE A TEST LIGHT TO CHECK FOR CONTINUITY AS SHOWN.

MINI-FUSE COLOR CODES

RATING	COLOR
5 AMP	TAN
10 AMP	RED
20 AMP	YELLOW
25 AMP	WHITE

3309

Fig. 8-30 Miniaturized Fuse

DIR. SIGN. BACK-UP
(20 AMP.)
BACK-UP LIGHTS
DIRECTIONAL SIGNALS
TAILGATE LOCK RELEASE (A,G)
NOT USED (X)

HAZARD FLASHER

PWR. ACCESSORY
CIRCUIT BREAKER

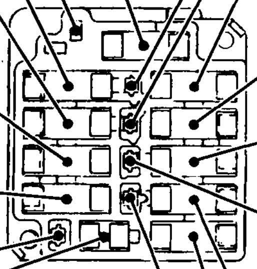
POWER WINDOWS (A,F)
POWER SEATS (A)
ELEC. DOOR LOCKS (A,F)
ELECTRIC SUN ROOF (A)
SEE BULKHEAD COVER (G)
HEATER REAR GLASS (A,F)
NOT USED (X)

CLK-LTR-CTSY
(20 AMP.)
CLOCK POWER
CIGAR LIGHTER
COURTESY LIGHTS
DECK LID RELEASE (A,G,F)
GLOVE BOX LIGHT
TRUNK LAMP (X)
DOME LAMP (X)
VANITY LIGHT (A,G)

TAIL LIGHTS
(20 AMP.)
TAIL LIGHTS
PARK LIGHTS
CORNERING LIGHTS (G)
SIDE MARKER LIGHTS
LICENSE LAMP
DIGITAL AM/FM RECEIVER (G)

STOP – HAZARD
(20 AMP.)
STOP LIGHTS
HAZARD LIGHTS
DOME LIGHT (A,F,G)
TRUNK LIGHT (A,F,G)

NOT USED



INST. LIGHTS
(4 AMP.)
INST. PANEL ILLUM. LIGHTS
ASH TRAY ILLUM. LIGHTS
CLOCK LIGHT
AUTO-TRANS. SHIFT IND. LIGHT
RADIO DIAL LIGHT
CIGAR LIGHTER ILLUM. LIGHT
HEATER OR AIR CONDITION CONTROL LIGHT
TACHOMETER LIGHT (CLUSTER MOUNTED) (A,F,G)
FUEL ECONOMY VACUUM GAUGE (A,F,G)
W/S WIPER SWITCH LIGHT (X)

POWER CONN. FOR –
SEE BULKHEAD COVER (G)
NOT USED (A,F)
REAR WINDOW DEFOG (BLOWER)
IN LINE FUSE (3 AMP.) (X)

WIPER
(25 AMP.)
W/S WIPER
W/S WASHER
PULSE WIPER

NOTE: A/C BLOWER MOTOR IS FUSIBLE LINK PROTECTED IN ENGINE HARNESS (X). A/C HIGH BLOWER MOTOR IS FUSIBLE LINK PROTECTED IN ENGINE HARNESS (A,F,G). POWER WINDOWS AND/OR POWER DOOR LOCKS ARE FUSIBLE LINK AND CIRCUIT BREAKER PROTECTED IN THE ENGINE COMPARTMENT (X).

POWER CONN. FOR –
POWER WINDOWS (A,F)
POWER SEATS (A)
ELEC. DOOR LOCKS (A,F)
SEE BULKHEAD COVER (G)
ELECTRIC SUN ROOF (A)
HEATER REAR GLASS
RELAY (ACT. COIL) (A,F)
NOT USED (X)

POWER CONNECTOR FOR –
RADIO SUPPRESSION CAPACITOR (A,F)
SEE BULKHEAD COVER (G)
ELECTRIC CLOCK (X)
VANITY LIGHT (A)
PULSE WIPER FEED (A)

GAUGES – TRANS. (A,F,G) — HTR. – AIR COND. (X)
(10 AMP.) (25 AMP.)
OIL PRESS. GAUGE
TEMP. GAUGE
FUEL GAUGE
LOW BRAKE TELLTALE
SEAT BELT WARNING TELLTALE
SEAT BELT WARNING BUZZER & TIMER
(ACTUATING COIL)
SEE BULKHEAD COVER (G)
HEATED REAR GLASS
(ACT. COIL FEED) (A,F)
DIGITAL AM/FM CLOCK
RECEIVER (G)

HTR. OR A/C BLOWER MOTOR

DIR. SIG. – BACK-UP (X)
(20 AMP.)
BACK-UP LIGHTS
DIRECTIONAL SIGNALS

HEATER – AIR COND. (A,F,G) — GAUGES – TRANS. (X)
(25 AMP.) (10 AMP.)
HEATER BLOWER MOTOR
AIR COND. BLOWER MOTOR
(LO—M1—M2 SPEEDS)
TAILGATE AJAR WARNING LAMP (A)

OIL PRESSURE GAUGE
TEMP. GAUGE
FUEL GAUGE
LOW BRAKE TELLTALE
SEAT BELT WARNING TELLTALE
SEAT BELT WARNING BUZZER
SEAT BELT BUZZER–TIMER
(ACTUATING COIL)

(FOLLOWING ITEMS CONTROLLED BY THIS FUSE BUT CONNECTED TO ACC. POWER CONNECTOR ABOVE FUSE BLOCK)
REAR WINDOW DEFOG. (BLO) (A,B,F)
TAILGATE AJAR (A)

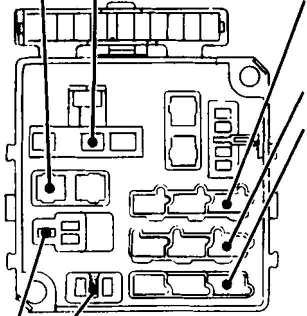
POWER CONN. FOR –
WINDOW CONTROL RELAY
(ACTUATING COIL)
CRUISE CONTROL IN LINE (4 AMP.) (A,F)
TACH. IN LINE (1 AMP. FUSE) (A,F)
ELECTRIC SUN ROOF
RELAY (ACTUATING COIL) (A)
RADIO SUPPRESSION CAPACITOR (X)
SEE BULKHEAD COVER (G)

CONTROLLED BY
HEATER FUSE (A,G)
CRUISE CONTROL (X)

RADIO
(10 AMP.)
RADIO
TAPE PLAYER (A,F,G)

POWER ACCESSORY
CIRCUIT BREAKER
POWER WINDOWS
POWER SEATS
ELECTRIC DOOR LOCKS
ELECTRIC SUN ROOF

SEAT BELT WARNING
BUZZER & TIMER



POWER CONN. FOR –
POWER WINDOWS
POWER SEATS
ELEC. DOOR LOCKS
ELECTRIC SUN ROOF
HEATED RR. GLASS RELAY (ACT. COIL)

RADIO SUPPRESSION CAPACITOR
PULSE WIPER FEED

POWER CONN. FOR –
BUZZER RELAY
(ACTUATING COIL)
WINDOW CONTROL
RELAY (ACTUATING COIL)
ELECTRIC SUN ROOF RELAY
(ACTUATING COIL)
CRUISE CONTROL IN LINE
(4 AMP. FUSE)
TACH. IN LINE (1 AMP. FUSE)
TAILGATE AJAR WARNING LAMP

BULKHEAD COVER CONN.
GRAND PRIX &
GRAND LeMANS

HEATED REAR GLASS

DOOR CTSY./WARNING LAMP

CAR DESIGNATIONS
A – LeMANS
B – PONTIAC
F – FIREBIRD
G – GRAND PRIX & GRAND LeMANS

3314

Fig. 8-27 Fuse Block Identification - All Series Except H, HM and B

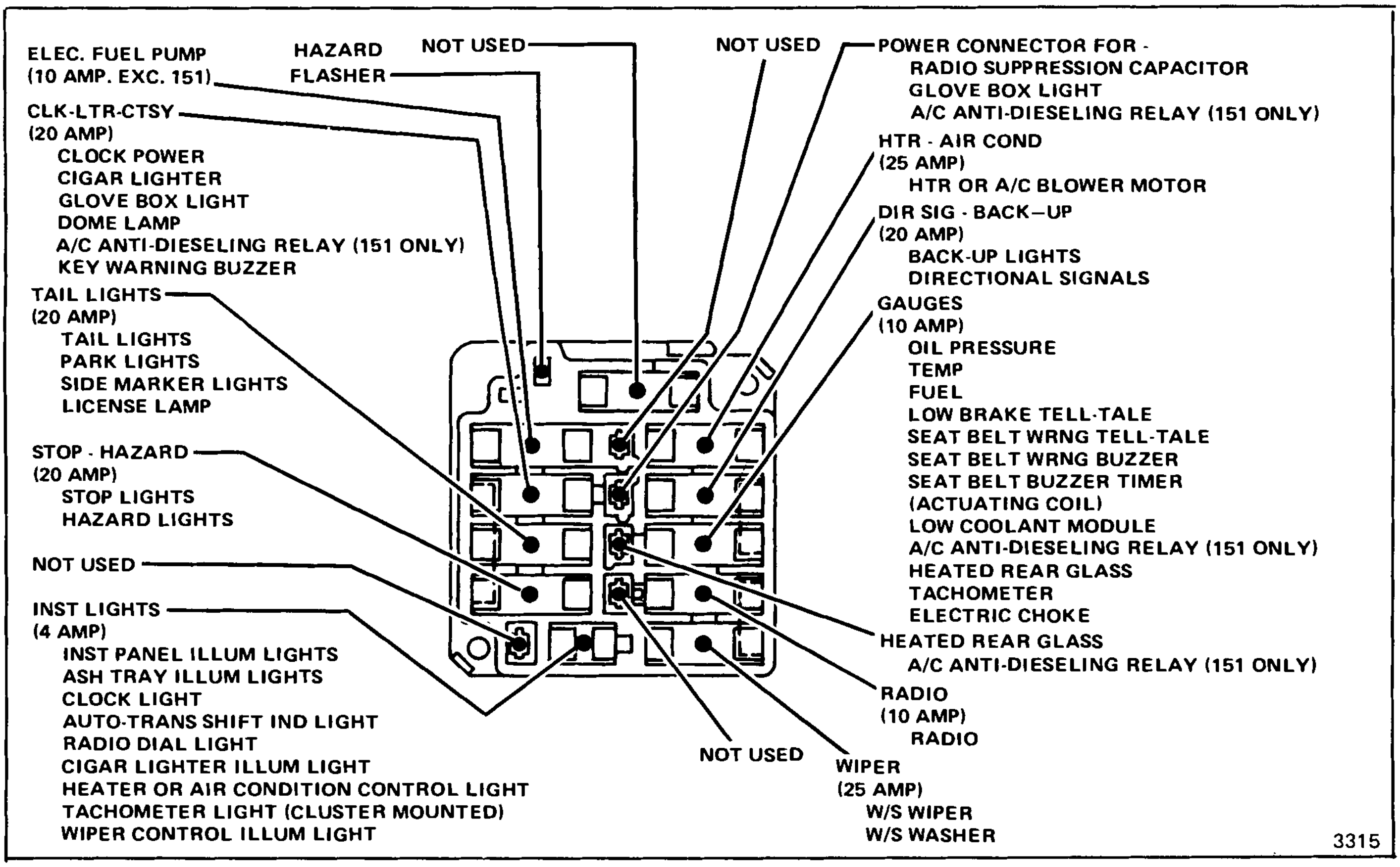
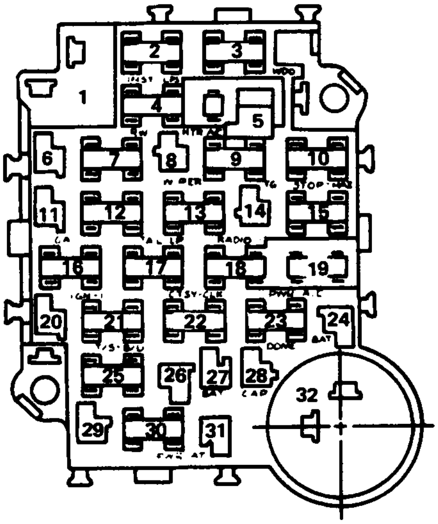


Fig. 8-28 Fuse Block Identification - H and HM Series



1 - HAZARD FLASHER

2 - INST. LIGHTS
(5 AMP.)
INST. PANEL ILLUM. LIGHTS
ASH TRAY ILLUM. LIGHT
CLOCK LIGHT
AUTO. TRANS. SHIFT
IND. LIGHT
RADIO DIAL LIGHT
CIGAR LIGHTER ILLUM.
HEATER OR AIR COND.
CONTROL LIGHT
FUEL ECONOMY VACUUM
GAUGE LIGHT

3 - NOT USED

4 - NOT USED

5 - PWR. ACSRY. - CIRCUIT BREAKER
(30 AMP.)
POWER WINDOWS
POWER R R. WINDOW (STA. WAGON)

6 - 11 - 20 -
IGN. NO. 1 POWER CONN. FOR –
(GAUGE FUSE)
HEATED R R. GLASS RELAY
(ACTUATING COIL)
CRUISE CONTROL

7 - NOT USED

8 - HTD. R R. GLASS TIMER

9 - HEATER - AIR COND.
(25 AMP.)
HEATER BLOWER MOTOR
AIR COND. BLOWER MOTOR

10 - NOT USED

11 - SEE ITEM NO. 6

12 - NOT USED

13 - WIPER
(25 AMP.)
W/S WIPER
W/S WASHER

14 - TAILGATE AJAR LP.

15 - STOP - HAZARD
(20 AMP.)
STOP LIGHTS
HAZARD LIGHTS
TRUNK LIGHT
KEY WARNING BUZZER

16 - GAUGES
(10 AMP.)
OIL PRES. GAUGE
TEMP. GAUGE
FUEL GAUGE
LOW BRAKE TELL-TALE
SEAT BELT WARNING TELL-TALE
SEAT BELT WARNING BUZZER
(ACTUATING COIL FEED)
SEAT BELT BUZZER TIMER
(ACTUATING COIL)
PULSE WIPER ENGAGEMENT
SW. FEED
DIGITAL AM/FM CLOCK RECEIVER

17 - TAILLIGHTS
(20 AMP.)
TAIL LIGHTS
PARK LIGHTS
CORNERING LIGHTS
SIDE MARKER LIGHTS
LICENSE LAMP
DIGITAL AM/FM CLOCK RECEIVER

18 - RADIO
(10 AMP)
RADIO
TAPE PLAYER
IDLE STOP SOLENOID

19 - CIRCUIT BREAKER
(30 AMP.)
POWER CONNECTION FOR
ITEM NO. 24

20 - SEE ITEM NO. 6

21 - DIR. - SIGN. - BACK-UP
(20 AMP.)
BACK-UP LIGHTS
DIRECTIONAL SIGNALS

22 - CLOCK-LTR. - CTSY.
(20 AMP.)
CLOCK POWER
CIGAR LIGHTER
CTSY. LIGHTS
DECK LID RELEASE
GLOVE BOX LAMP
PULSE WIPER FEED
POWER ANTENNA
TO HORNS

23 - DOME LAMP
(20 AMP.)
DOME LAMP
RADIO SUPPRESSION CAPACITOR

24 - POWER CONN. FOR –
HEATED R.R. GLASS TIMER
ELECTRIC DOOR LOCKS
SEAT BACK LOCKS
POWER SEATS
VANITY LIGHT
ELECTRIC SLIDING SUNROOF

25 - NOT USED

26 - NOT USED

27 - 31 -
POWER CONN. FOR
(CLK-LTR-CTSY FUSE)
PULSE WIPER
POWER ANTENNA

28 - POWER CONN. FOR –
(DOME LAMP FUSE)
RADIO SUPPRESSION CAPACITOR

29 - NOT USED

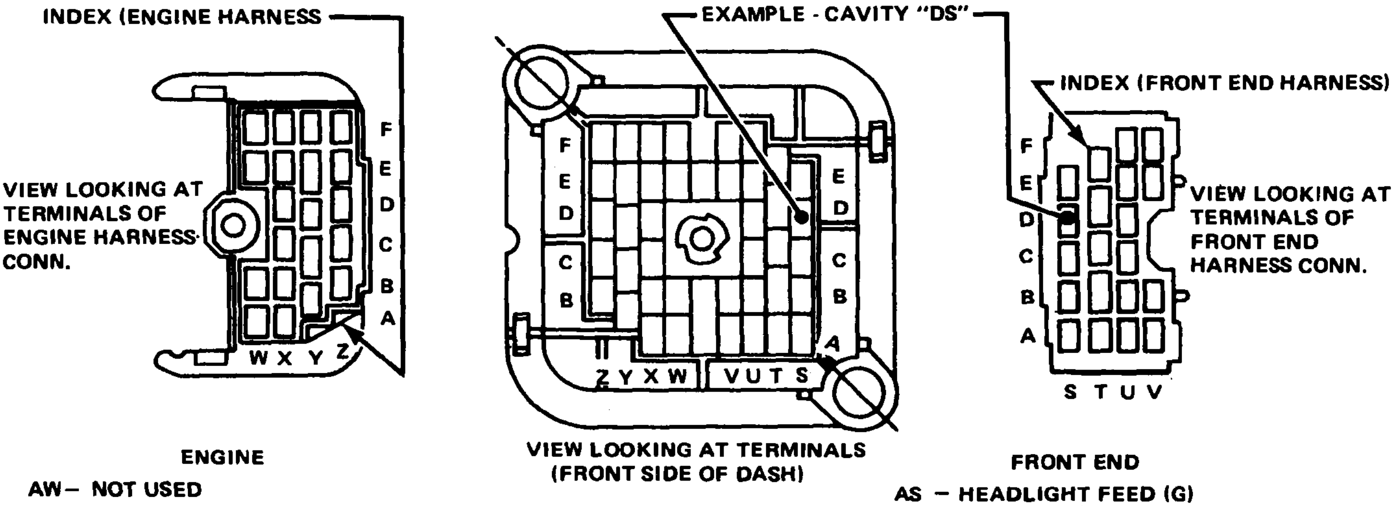
30 - NOT USED

31 - SEE ITEM NO. 27

32 - DIRECTIONAL SIGNAL
FLASHER

3316

Fig. 8-29 Fuse Block Identification - B Series



ENGINE

AW – NOT USED
AX – NOT USED
BW – NOT USED
BX – ELECTRIC CHOKE FEED
BY – NOT USED
BZ – NOT USED
CX – TO ALTERNATOR
CY – BATTERY FEED INTO CAR (ALSO SEE FZ)
CZ – NOT USED
DX – TO TEMP SWITCH
DY – STARTER SOLENOID PULL-IN COIL
DZ – NOT USED
EW – ELECTRICAL DOWNSHIFT SWITCH (V-8'S, V.I.N. CODE Y, P, AND Z, ON GRAND PRIX ONLY)
EX – TO OIL PRESSURE SWITCH
EY – TO PLUS (+) TERMINAL ON HIGH ENERGY IGNITION (H.E.I.)
EZ – NOT USED
FW – NOT USED
FX – NOT USED
FY – NOT USED
FZ – BATTERY FEED TO HEADLIGHT SW (A. F. & G) NOT USED (X)

CAR DESIGNATIONS

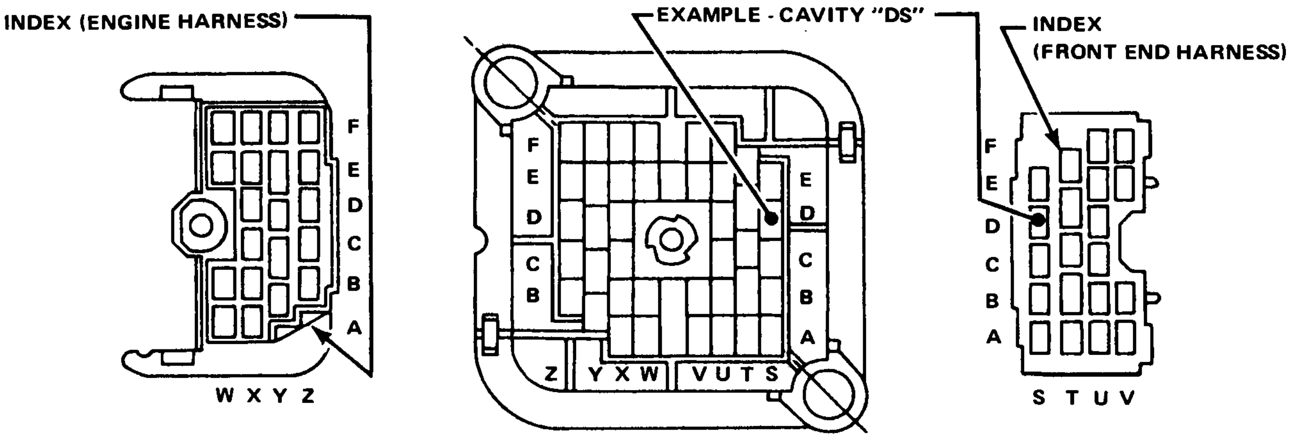
A – LEMANS
F – FIREBIRD
G – GRAND PRIX & GRAND LEMANS
X – VENTURA

FRONT END

AS – HEADLIGHT FEED (G) NOT USED (A. F & X)
AT – NOT USED
AU – TO HIGH BEAM HEADLIGHTS (A, F & X) HIGH BEAM TO DIMMER SW. (G)
AV – NOT USED
BS – TO HORN
BT – NOT USED
BU – TO LOW BEAM HEADLIGHTS (A, F & X) LOW BEAM TO DIMMER SWITCH (G)
BV – TO LOW BRAKE FLUID SW.
CS – NOT USED
CT – TO LH & RH PARK/MARKER LPS.
CU – TO LH FRONT DIR. & SIDE MARKER LP.
DS – NOT USED
DT – NOT USED
DU – TO RH FRONT DIR. & SIDE MARKER LP.
ES – TO WINDSHIELD WIPER FEED
ET – TO WINDSHIELD WASHER
EU – TO WINDSHIELD WIPER - (LOW)
EV – TO LH CORNERING LP. (G - GRAND PRIX ONLY) NOT USED (A. F & X)
FU – TO WINDSHIELD WIPER - (HIGH)
FV – TO RH CORNERING LAMP (G - GRAND PRIX ONLY) NOT USED (A. F & X)

3317

Fig. 8-31 Bulkhead Connector - All Series Except H, HM and B



VIEW LOOKING AT TERMINALS OF ENGINE HARNESS

VIEW LOOKING AT TERMINALS (FRONT SIDE OF DASH)

VIEW LOOKING AT TERMINALS OF FRONT END HARNESS

ENGINE

AW – TO WINDSHIELD WIPER (LOW)
AX – TO WINDSHIELD WIPER FEED
BW – NOT USED
BX – BLOWER MOTOR FEED
BY – TO WINDSHIELD WIPER (HI)
BZ – TO TACHOMETER
CX – TO ALTERNATOR
CY – BATTERY FEED INTO CAR
CZ – NOT USED
DX – TO TEMPERATURE SENDER
DY – STARTER SOL. PULL-IN COIL. OIL PRESSURE SW.
DZ – OIL PRESSURE SW. TO ELECTRIC CHOKE
EW – TO TEMPERATURE SW. NOT USED (LD7 WITH GAUGES)
EX – NOT USED
EY – TO COIL - ELECTRIC CHOKE FEED
EZ – NOT USED
FW – B/UP LP. SW. TO BODY CONN. (MANUAL TRANS.) NOT USED - (AUTO TRANS.)
FX – B/UP LP. SW. FEED (MANUAL TRANS.) NOT USED - (AUTO TRANS.)
FY – (IDLE STOP SOLENOID) NOT USED - (AUTO. TRANS.)
FZ – NOT USED

CAR DESIGNATIONS

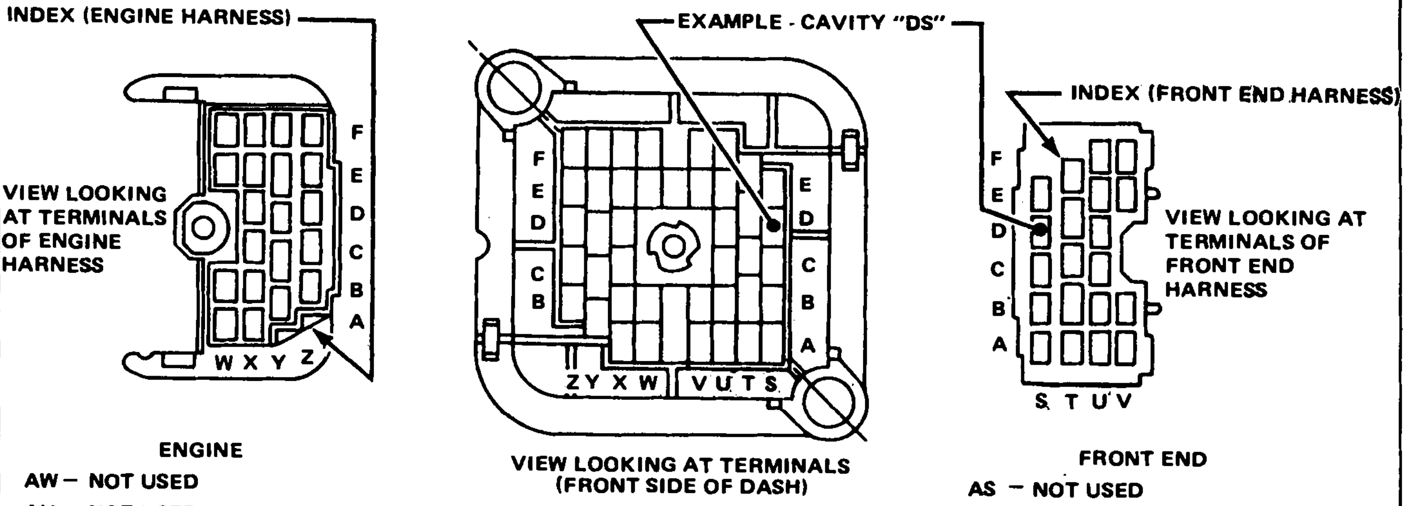
HC – ASTRE
HM – SUNBIRD

FRONT END

AS – NOT USED
AT – NOT USED
AU – TO LH HI-LOW BEAM HEADLAMP (HI) (HM) TO LH HEADLAMP (HI) (HC)
AV – NOT USED
BS – TO HORNS
BT – NOT USED
BU – TO RH HI-LOW BEAM HEADLAMP (LO) (HM) TO RH HEADLAMP (LO) (HC)
BV – TO LOW BRAKE FLUID SW
CS – NOT USED
CT – TO LH & RH PARK. MARKER LPS.
CU – TO LH FRONT DIR. & SIDE MARKER LP.
DS – NOT USED
DT – NOT USED
DU – TO RH FRONT DIR. & SIDE MARKER LP
ES – TO WINDSHIELD WASHER FEED
ET – TO WINDSHIELD WASHER SW.
EU – NOT USED
EV – NOT USED
FU – NOT USED
FV – TO LOW COOLANT WARNING SW.

3318

Fig. 8-32 Bulkhead Connector - H and HM Series



ENGINE

AW – NOT USED
AX – NOT USED
BW – NOT USED
BX – FEED FOR ELECTRIC CHOKE - V-6 NOT USED ON V-8
BY – NOT USED
BZ – NOT USED
CX – TO GENERATOR
CY – BATTERY FEED INTO CAR (ALSO SEE FZ)
CZ – DIAGNOSTICS - BATTERY FEED TO IGN. SWITCH
DX – TO TEMP SWITCH
DY – STARTER SOLENOID PULL-IN COIL
DZ – DIAGNOSTICS TO IGN. SWITCH FOR CRANKING CIRCUIT
EW – NOT USED
EX – TO OIL PRESSURE SWITCH
EY – TO PLUS TERMINAL (+) ON HIGH ENERGY IGNITION (H.E.I.)
EZ – DIAGNOSTICS - TO IGN. SWITCH BATTERY FEED
FW – NOT USED
FX – NOT USED
FY – NOT USED
FZ – BATTERY FEED TO HEADLIGHT SWITCH

FRONT END

AS – NOT USED
AT – NOT USED
AU – TO HIGH BEAM HEADLIGHTS
AV – NOT USED
BS – TO HORNS
BT – NOT USED
BU – TO LOW BEAM HEADLIGHTS
BV – TO BRAKE PRESSURE SWITCH
CS – NOT USED
CT – TO LH & RH PARK/MARKER LPS.
CU – TO LH FRONT DIRECTIONAL & SIDE MARKER LP.
DS – NOT USED
DT – NOT USED
DU – TO RH FRONT DIRECTIONAL & SIDE MARKER LP.
ES – TO WINDSHIELD WIPER FEED
ET – TO WINDSHIELD WASHER
EU – TO WINDSHIELD WIPER - (LOW)
EV – TO LH CORNERING LP.
FU – TO WINDSHIELD WIPER - (HI)
FV – TO RH CORNERING LP.

3319

Fig. 8-33 Bulkhead Connector - B Series

INSTRUMENT PANEL

INSTRUMENT PANEL PAD, CLUSTER, AND ATTACHING PARTS

Refer to Fig. 8-34 through 8-50 for applicable models. Replacement procedures are given below.

INSTRUMENT PANEL PAD/ CARRIER ASSEMBLY

ON-CAR SERVICE

A, G and F Series (Figs. 8-37, 40 and 43).

1. Disconnect battery and remove lower air conditioning ducts if equipped.

2. Remove ash tray and lower and upper instrument panel trimplates.

3. Remove glove box and W/S garnish moldings, if necessary.

4. Remove instrument panel upper cover on A and G Series.

5. Disconnect and separate fuse block (bulkhead cover on G and AG Series) at firewall.

6. Disconnect dimmer switch, parking brake switch, stop lamp switch, body harness, ignition switch and air conditioning harness.

7. Disconnect vacuum harness and temperature control cable at control panel. Disconnect radio wires and antenna lead-in.

8. Remove screw securing steering column toe cover plate halves to dash panel and loosen clamping screws. Lower steering column and disconnect speedometer cable and steering column wires (ignition, neutral start, turn signal and back-up lamp switches).

9. On console equipped G and AG Series, remove the radio trim plate and remove the three screws attaching the I.P. to the console.

10. Remove instrument panel attaching bolts and the center instrument panel support brace. Place shop towel on steering column, place IP on column and disconnect miscellaneous connectors.

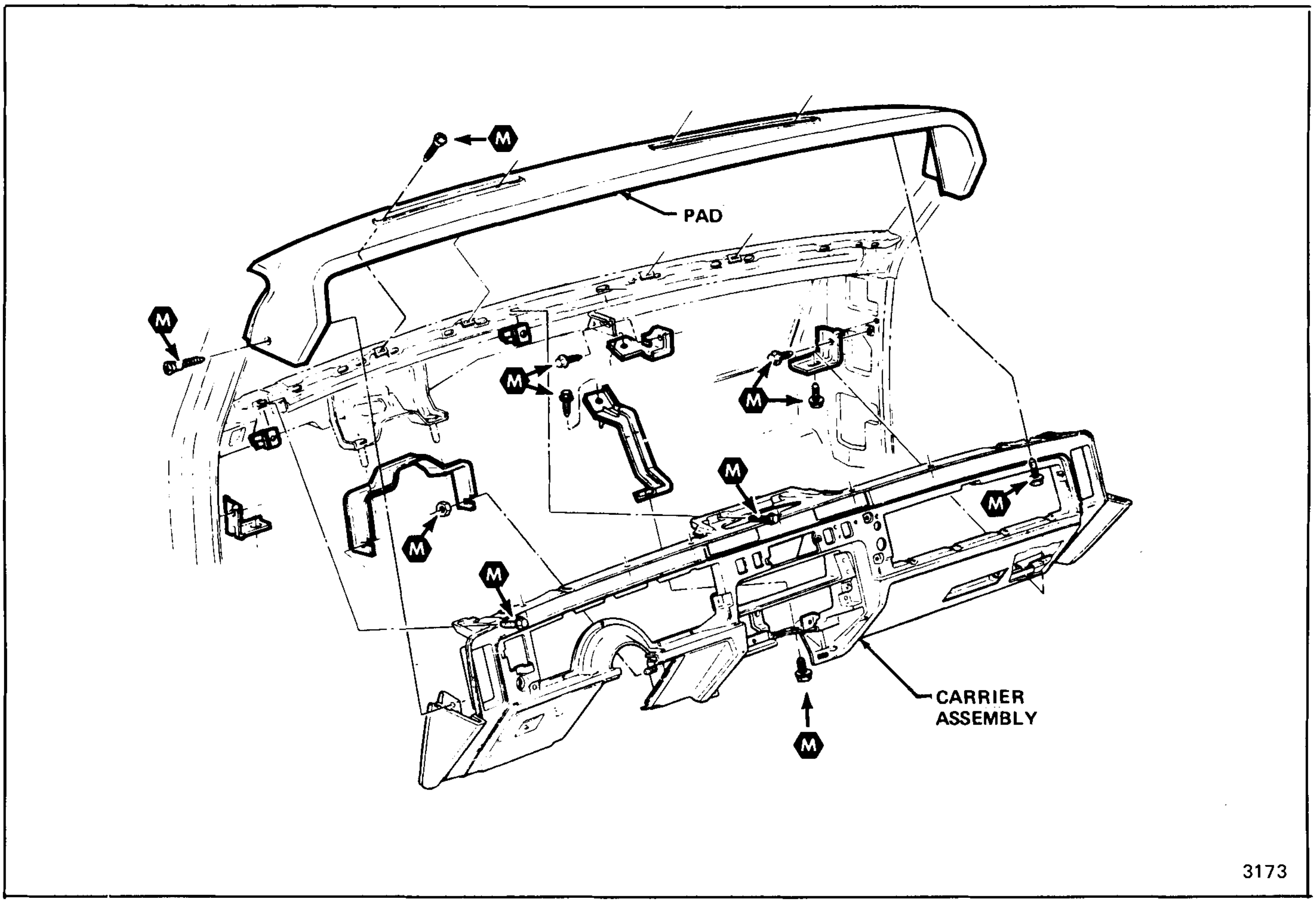


Fig. 8-34 B Series Instrument Panel Pad and Carrier Assembly

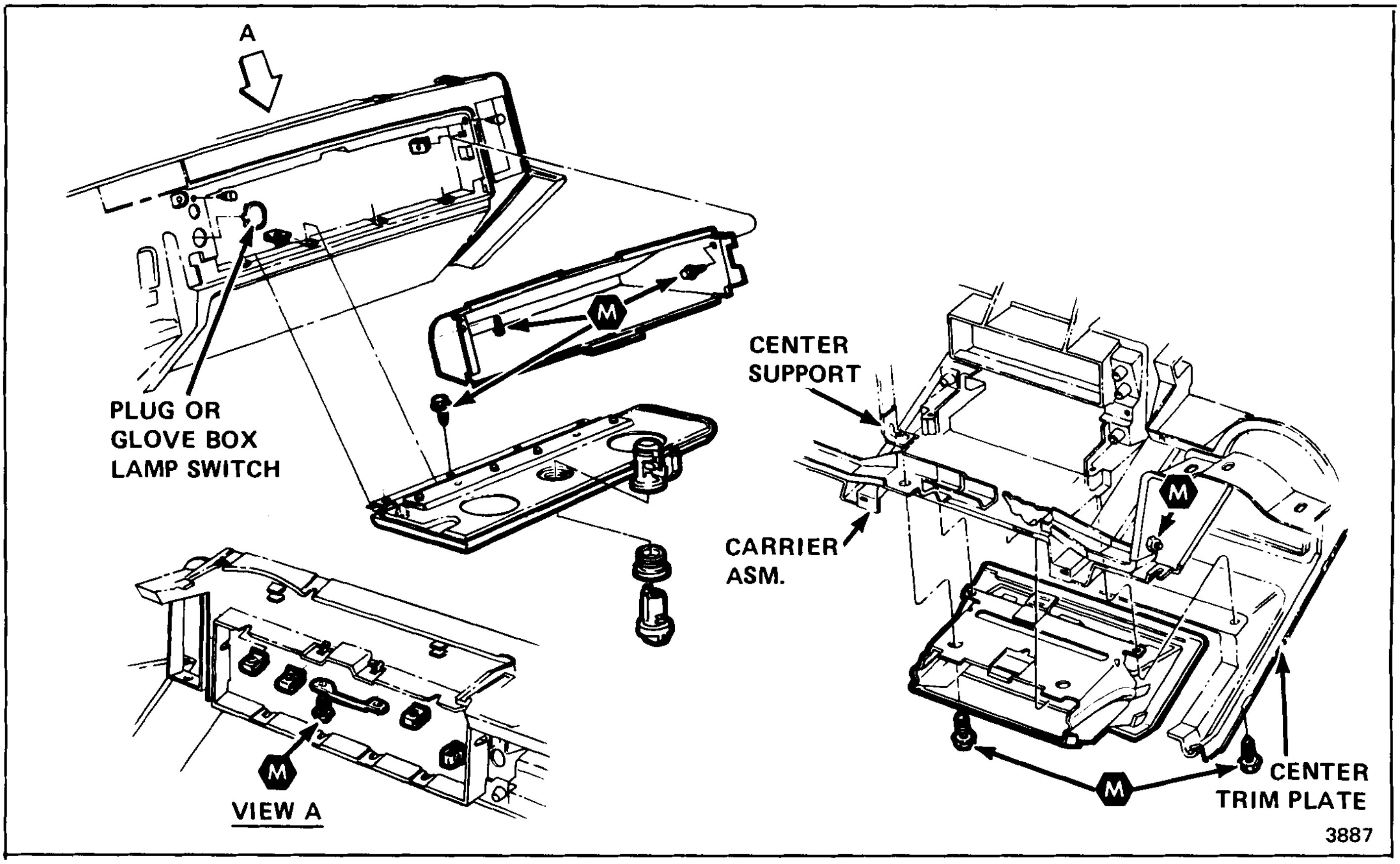


Fig. 8-35 B Series Instrument Panel Attaching Parts

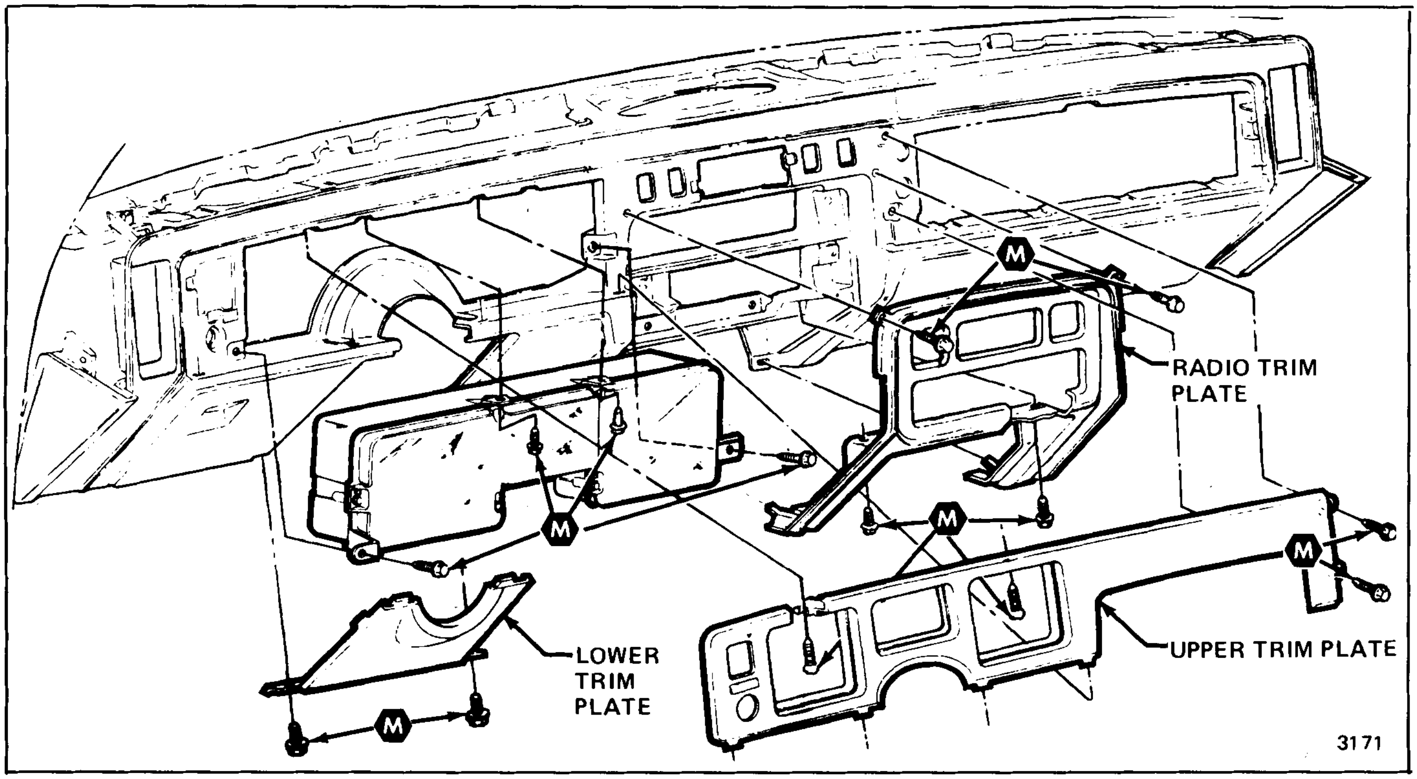


Fig. 8-36 B Series Instrument Cluster and Trim Plates

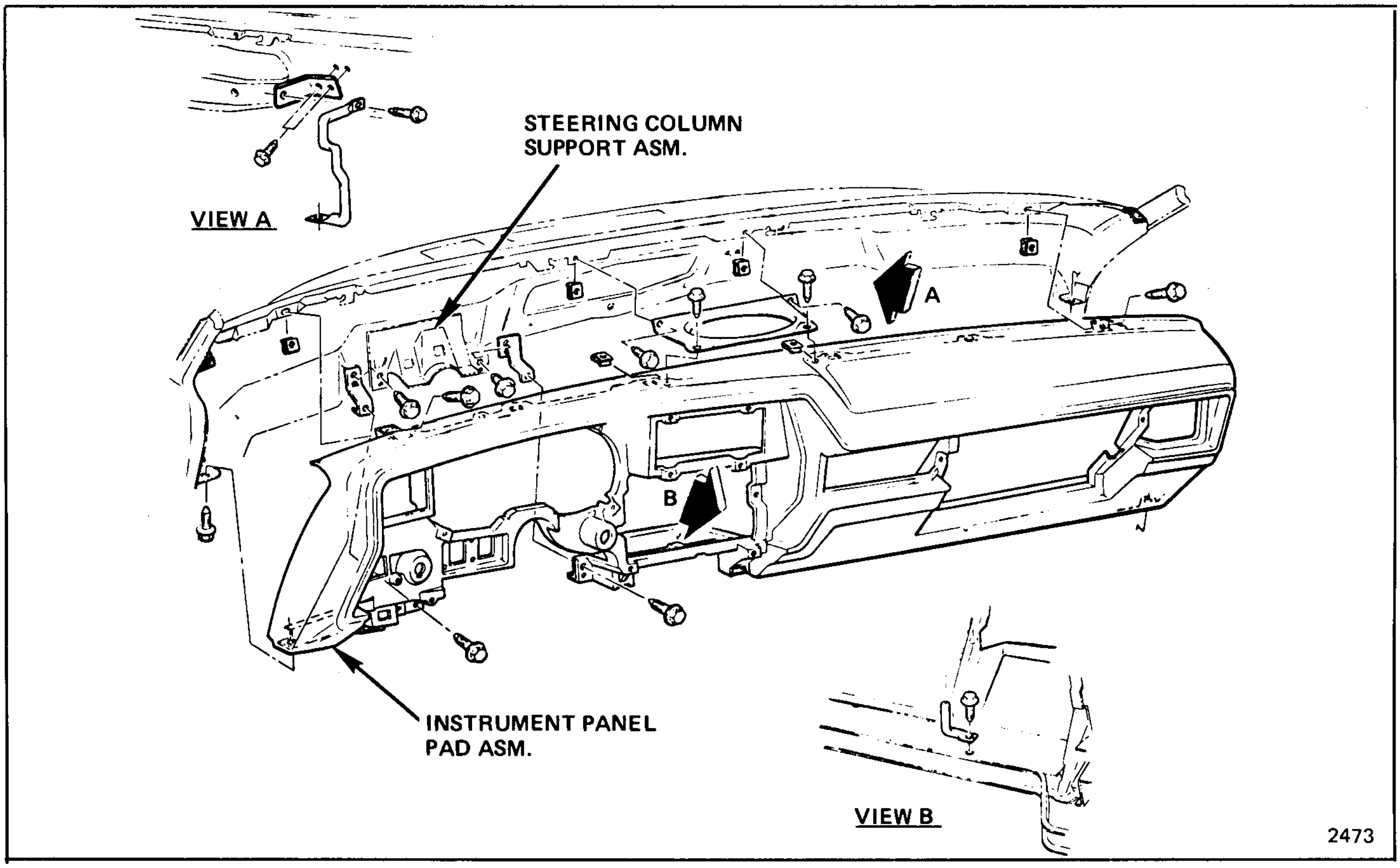


Fig. 8-37 A Series Instrument Panel Pad

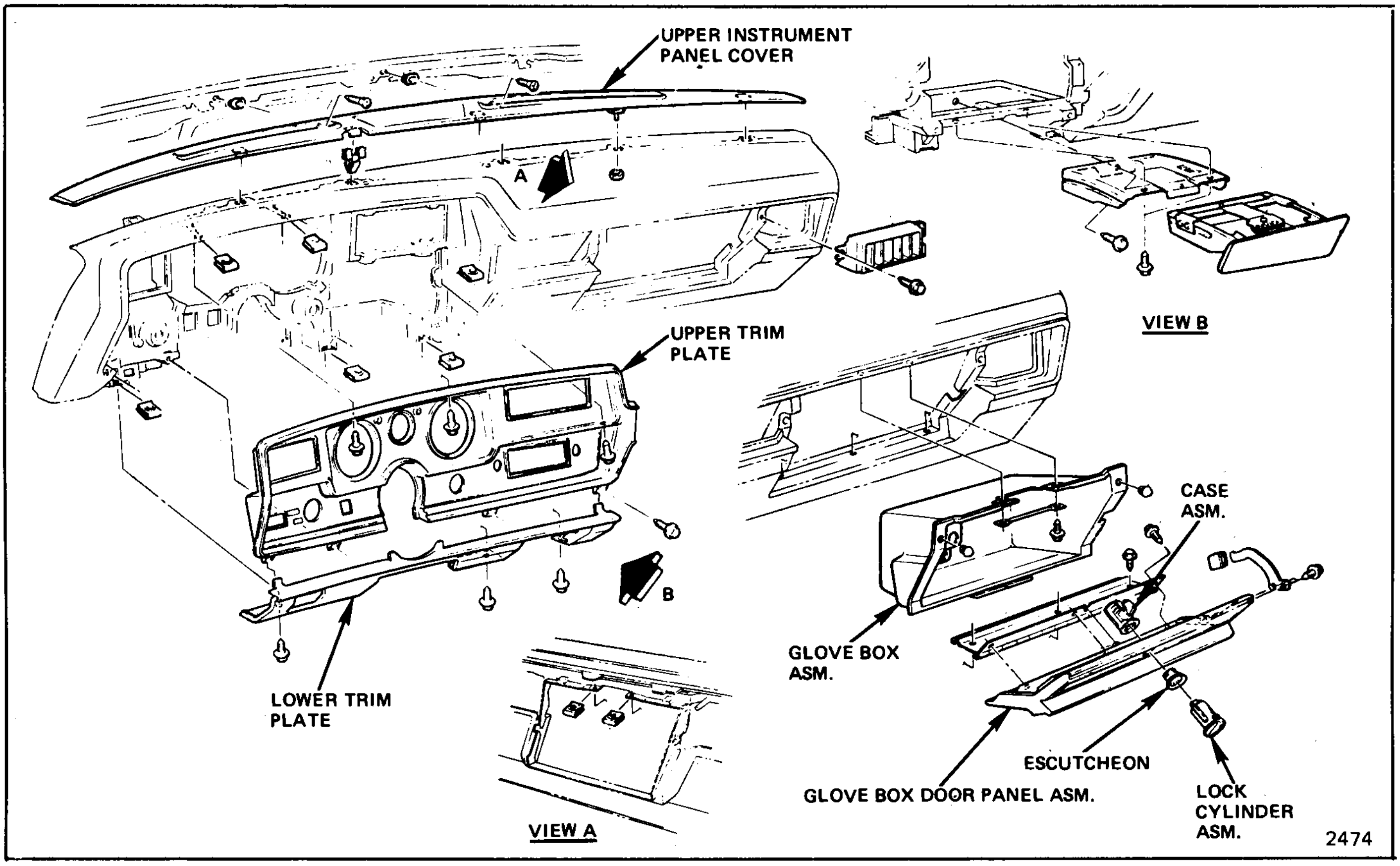


Fig. 8-38 A Series Instrument Panel Attaching Parts

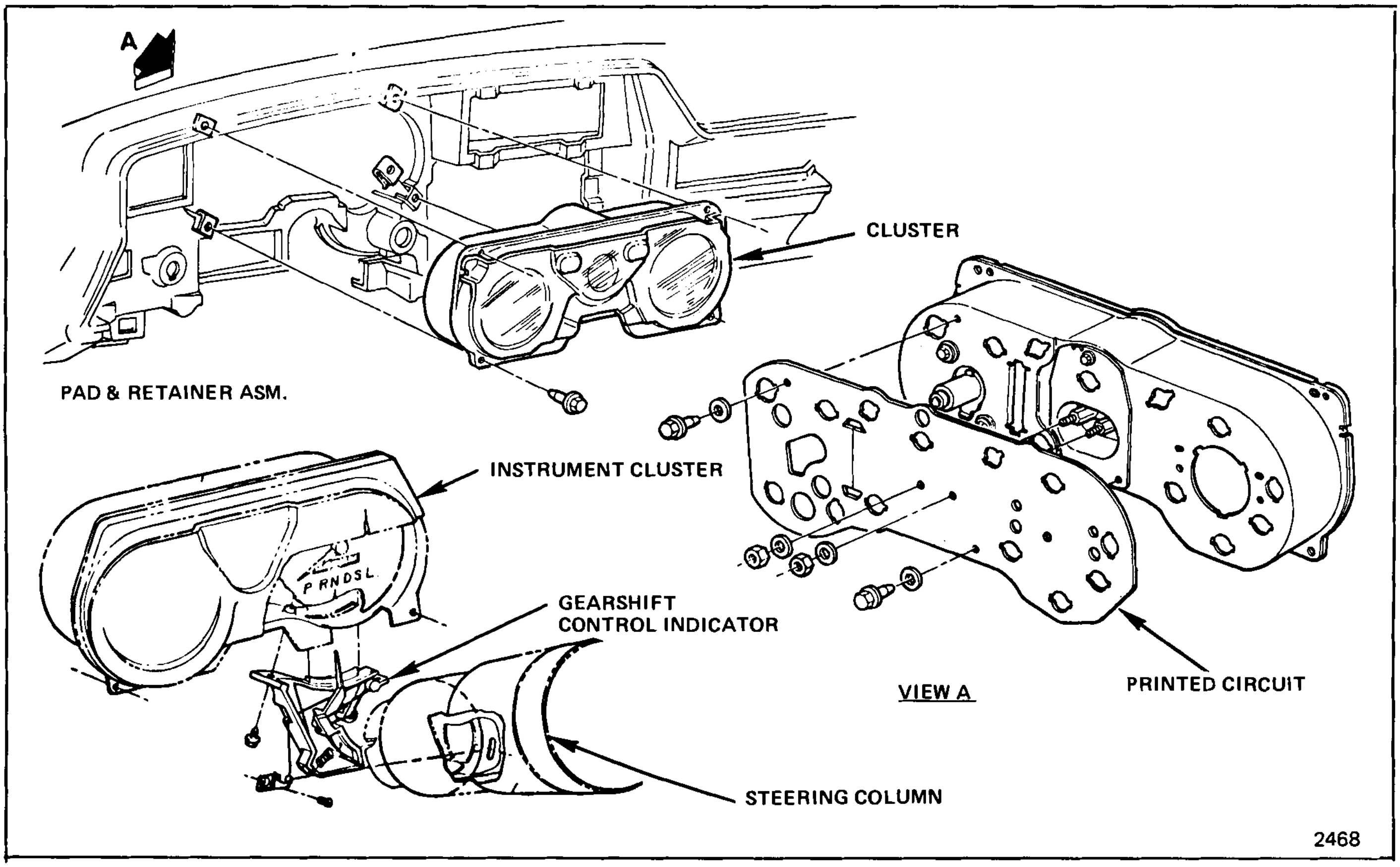


Fig. 8-39 A Series Instrument Cluster

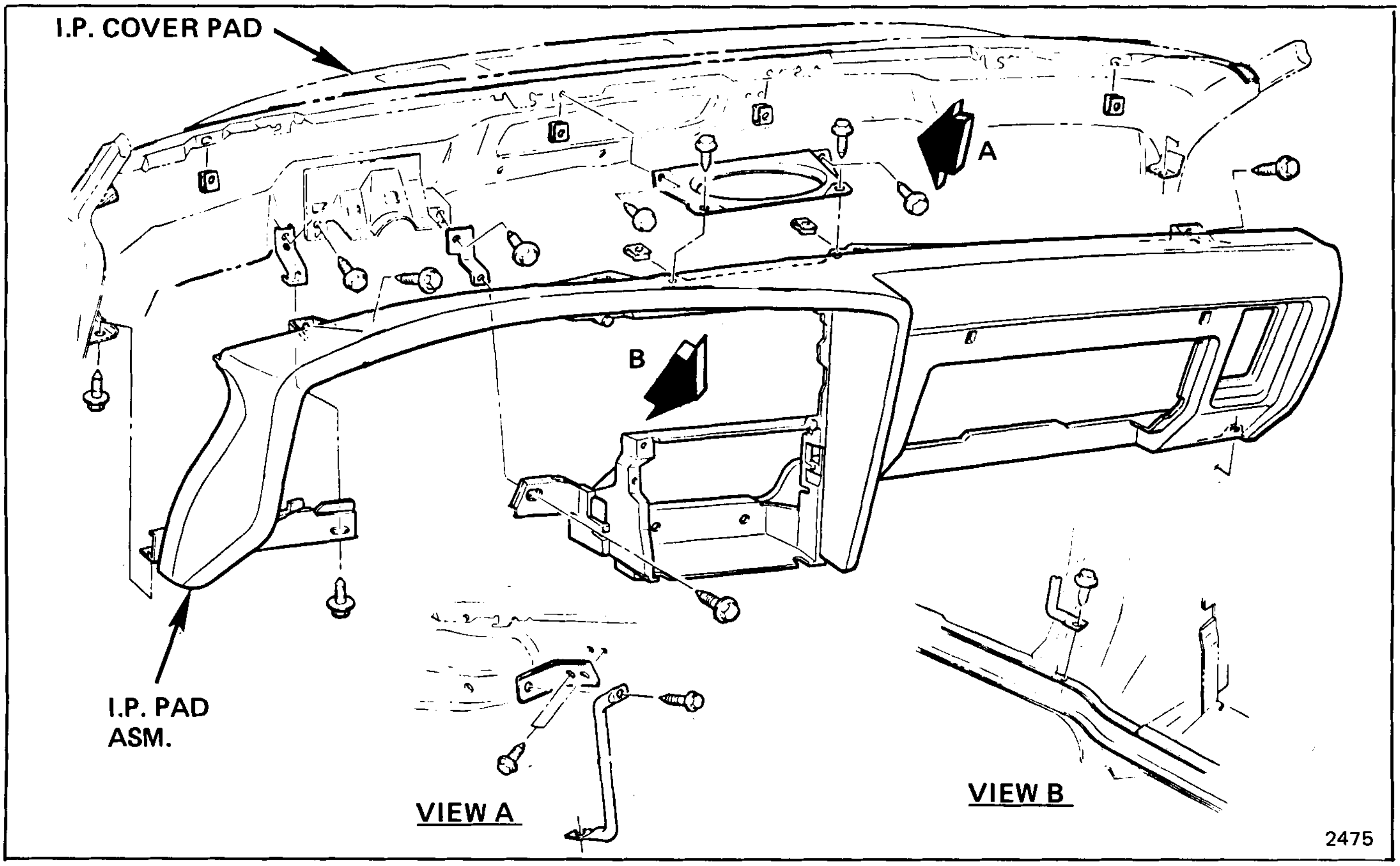


Fig. 8-40 G and AG Series Instrument Panel Pad

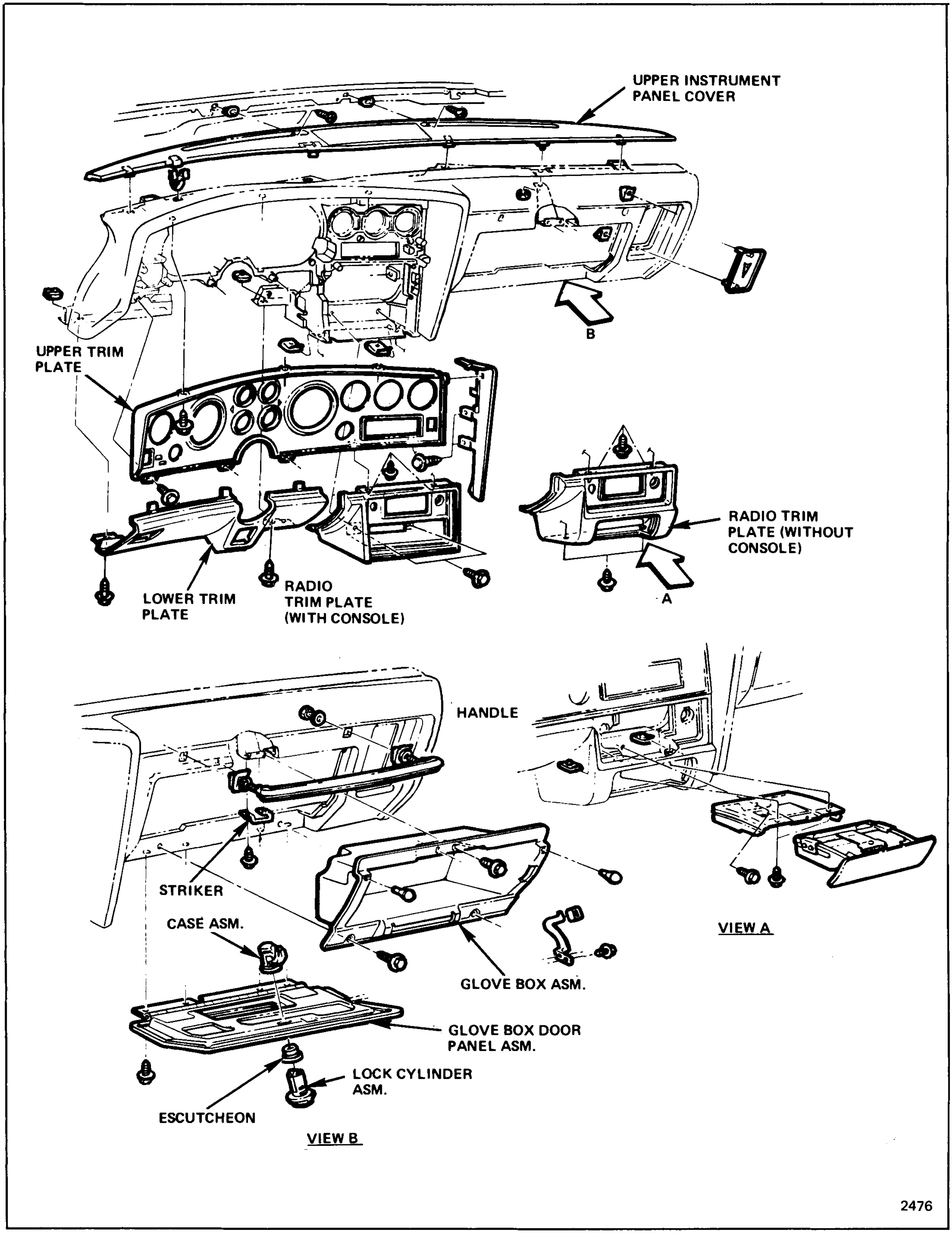


Fig. 8-41 G and AG Series Instrument Panel Attaching Parts

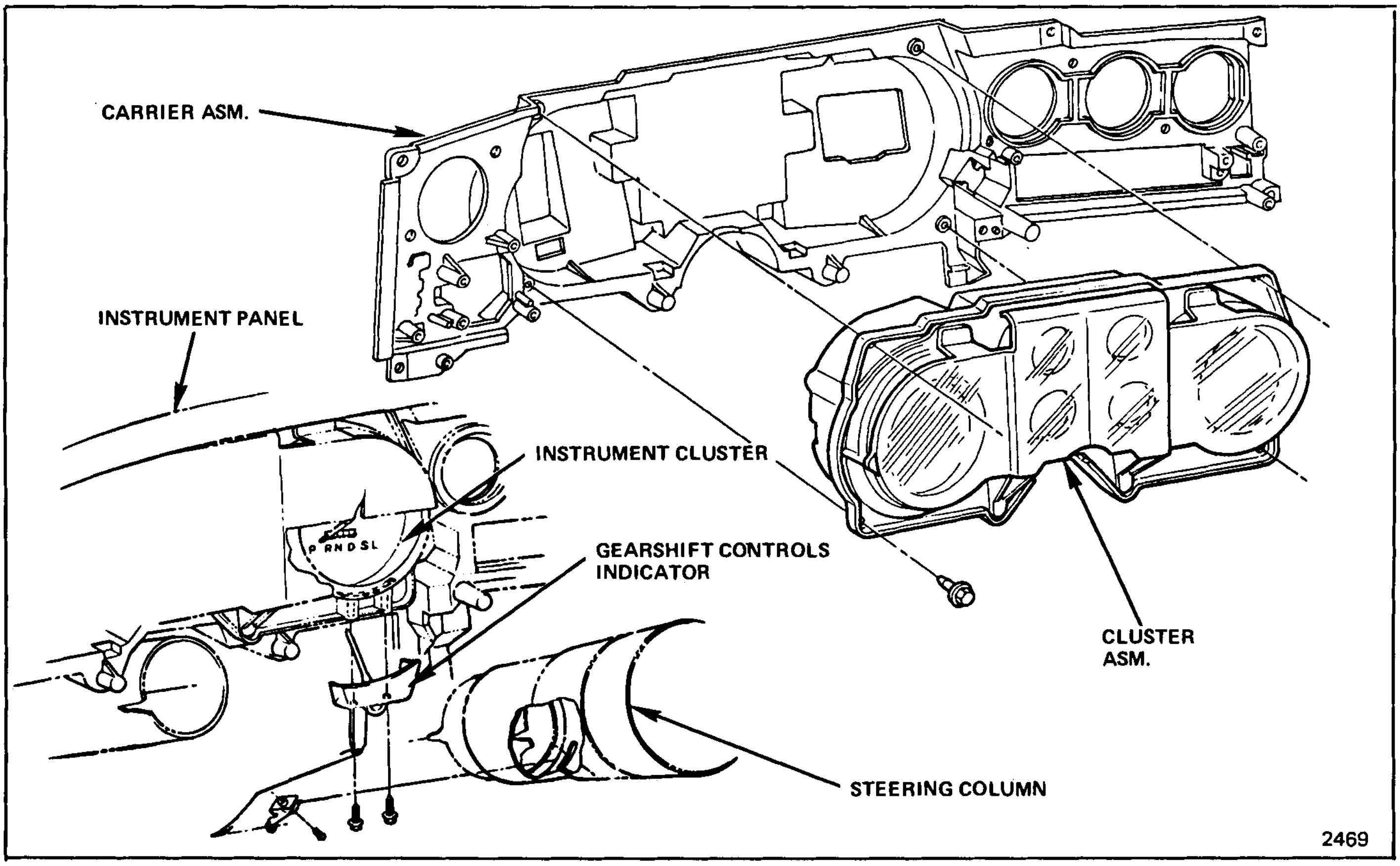


Fig. 8-42 G and AG Series Instrument Cluster

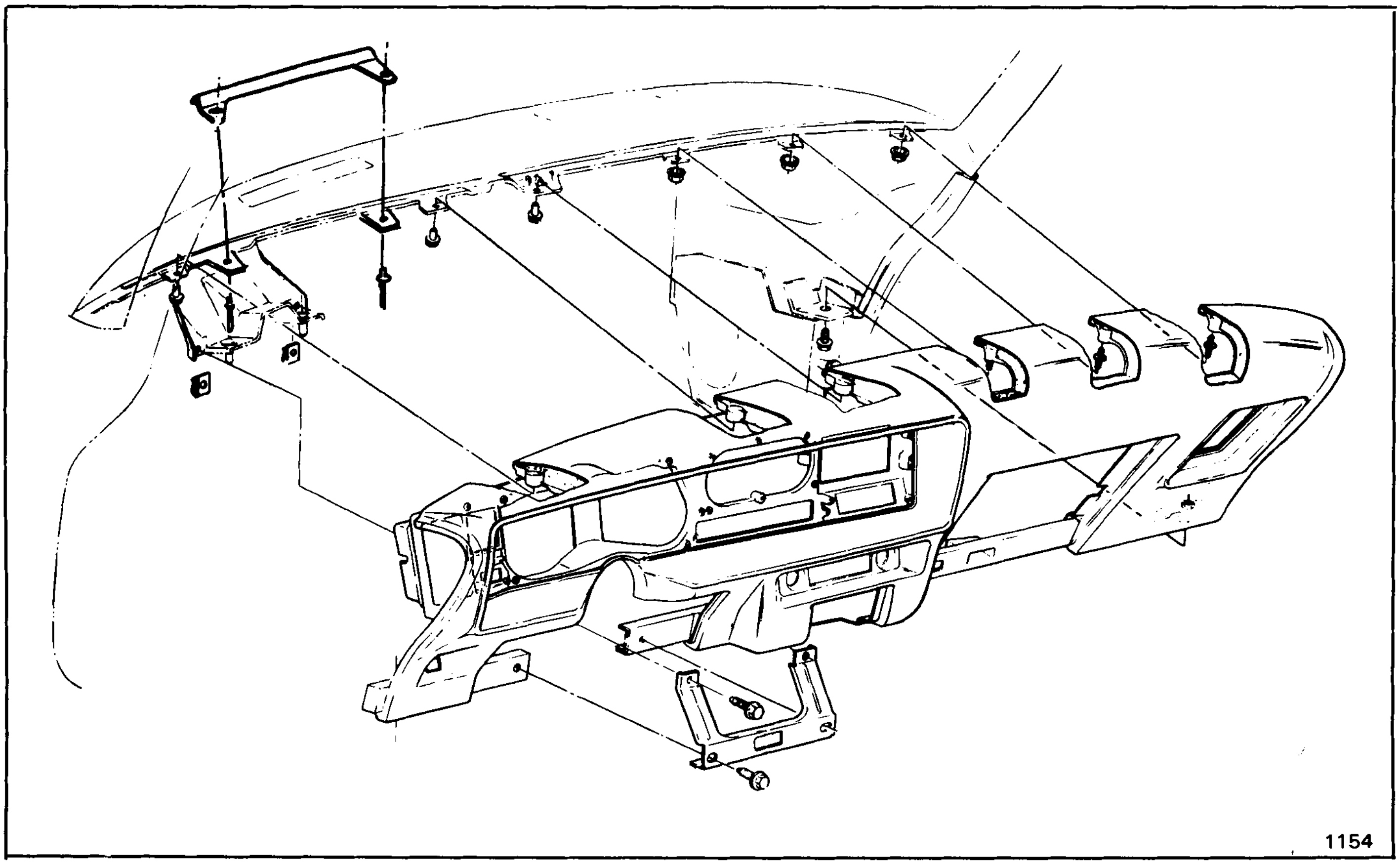


Fig. 8-43 F Series Instrument Panel Pad

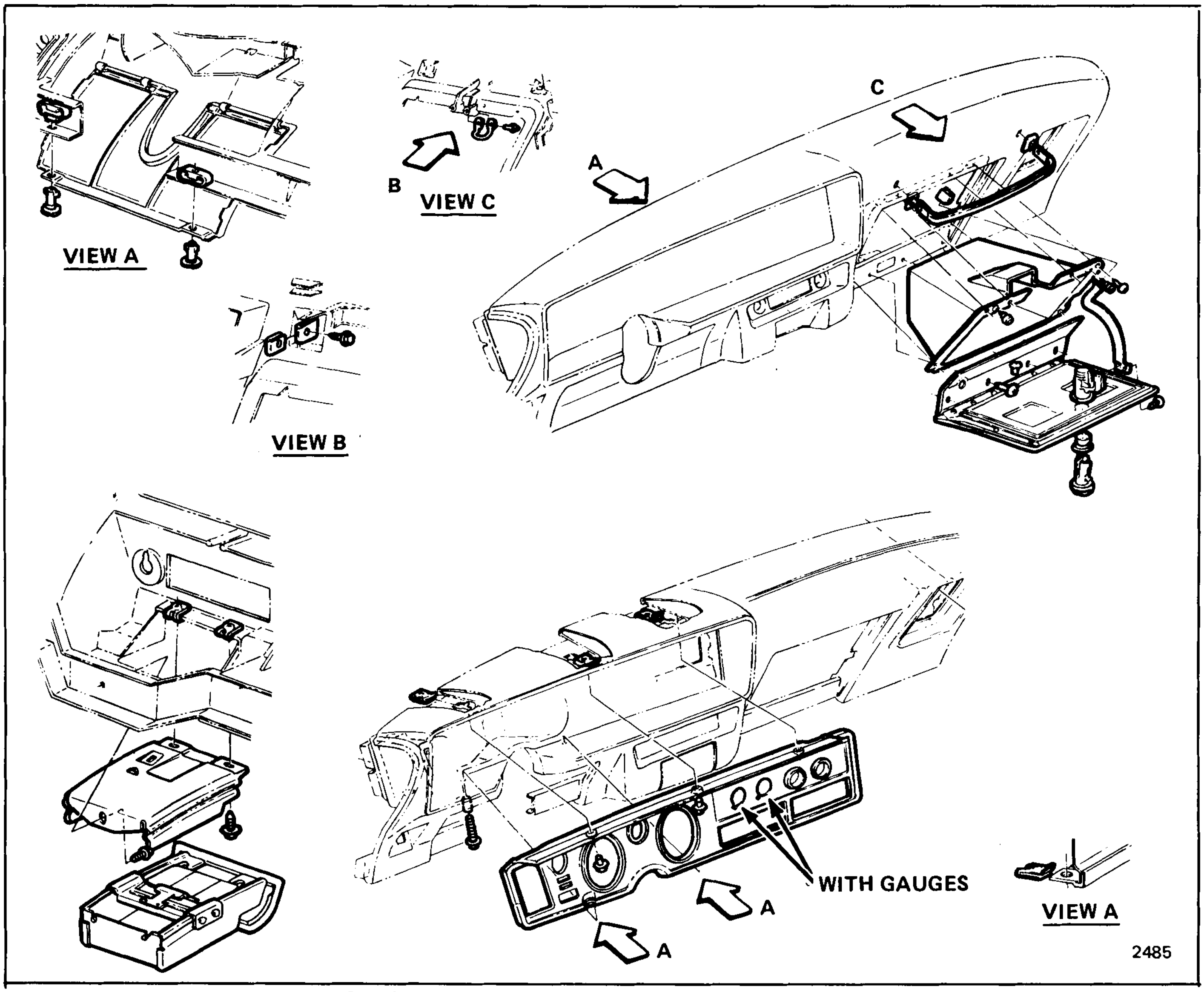


Fig. 8-44 F Series Instrument Panel Attaching Parts

11. Remove complete assembly from car and transfer remaining parts while at bench. Transfer of parts at bench includes radio, cluster, instrument panel harness, air conditioning duct extensions and air outlet nozzles, control panel, all switches and miscellaneous trim and retaining parts.

12. To replace instrument panel, reverse removal procedure.

B Series (Fig. 8-34)

1. The I.P. pad can be replaced by removing 7 screws at the bottom, 4 in the top vents and 2 at the sides.

2. To remove the instrument panel carrier assembly, the following procedure can be used:

a. Remove I.P. pad, as in 1 above.

b. Disconnect negative battery cable.

c. Remove instrument cluster.

d. Remove "hush"panel (A/C only, one on each side).

e. Remove radio.

f. Remove glovebox and door.

g. Remove lower and middle A/C ducts, if equipped.

h. Remove two steering column nuts and allow column to drop. Protect the column with shop cloths or tape.

i. Loosen carrier (4 screws at top, 5 nuts at bottom).

j. Disconnect parking brake cable at parking brake.

k. Disconnect wiring harness from back of carrier. Remove the remaining A/C ducts at this time.

l. Remove carrier assembly from car.

m. At a workbench, transfer remaining parts to the new carrier.

n. To reinstall, reverse above procedure.

X Series (Fig. 8-46)

1. Disconnect battery and remove glove box.

2. Remove lower A/C duct if so equipped.

3. Loosen IP carrier and pull forward. It will not be necessary to remove the radio, disconnect the wiring, or remove the heater controls. It will be necessary to remove the radio knobs, bezels, and nuts and the upper IP carrier screws.

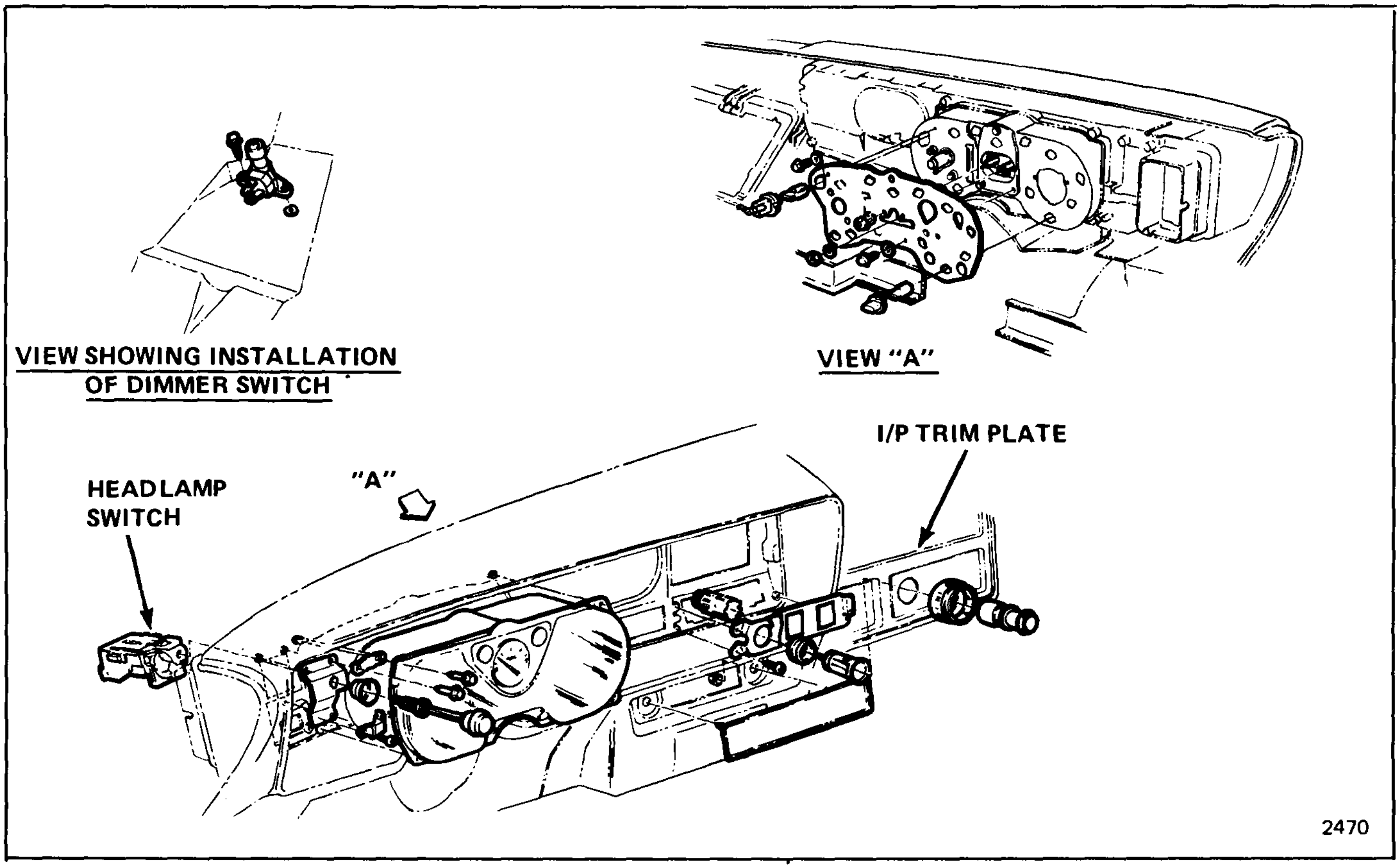


Fig. 8-45 F Series Instrument Cluster

4. Remove the center A/C duct.

5. Remove the instrument panel pad, attached with 2 nuts at the top, 3 nuts from the back, and 2 at the sides.

6. To replace, reverse removal procedure.

HM Series (Fig. 8-50)

NOTE: Instrument panel pad can be removed without removing instrument cluster bezel.

1. Remove 11 screws from around edge of pad.

2. On A/C equipped vehicles, disconnect left duct.

3. Use a pry action in raising pad so that clips at rear of pad are allowed to disengage. Then remove pad.

4. To replace instrument panel pad, align clips at rear of pad with holes in instrument panel and rap top of pad with palm of hand. Then secure with 11 screws around edge of pad.

H Series (Fig. 8-48)

1. Remove clock stem set knob.

2. Remove instrument cluster bezel (9 screws on standard cluster, 6 screws on GT cluster).

3. Remove one screw at left lower edge of pad, three (3) screws along lower right side of pad.

4. Sharply rap lower right edge of pad upward with palms of hands to disengage three retaining clips at top right of pad.

5. To replace instrument panel pad align three right side upper clips with holes in instrument panel and rap right side of panel pad with palm of hand.

6. Attach four screws to lower edge of instrument panel pad.

7. Install cluster bezel, then install clock stem set knob.

INSTRUMENT PANEL (SPEEDO) CLUSTER

NOTE: On all series except X, individual instruments can be replaced without removing the entire cluster. Refer to Speedometer and Fuel Gage Replacement Procedures.

A, B, G and F Series (Figs. 8-36, 39, 42 and 46)

1. Disconnect battery and remove lower and upper IP trimplates.

2. Remove automatic transmission shift indicator cable (except console).

3. Loosen 2 steering column nuts and lower steering column approximately 1/2 inch (F series only).

4. Remove cluster retaining screws, disconnect speedo cable and printed circuit connector (not required on G and AG Series), and remove cluster.

5. To replace, reverse removal procedure.

X Series (Fig. 8-46)

1. Disconnect battery and remove "hush"panel if present.

2. Remove three (3) screws retaining heater or A/C control panel to IP carrier.

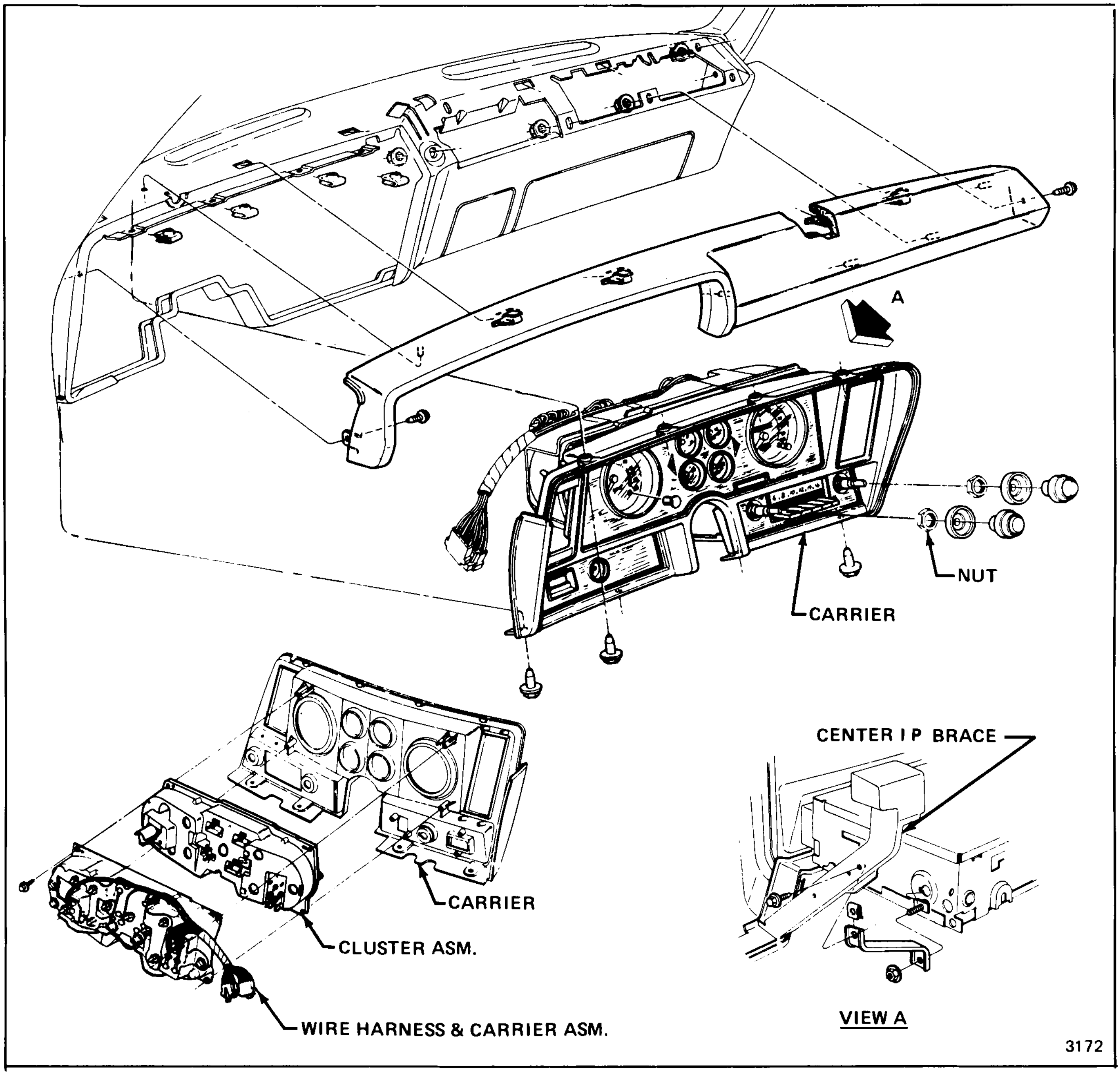


Fig. 8-46 X Series Instrument Panel Pad and Cluster Assembly

3. Remove radio control knobs, bezels and nuts, and remove radio.

4. Remove screws at top and bottom of carrier securing it to the IP pad and cowl brackets.

5. Disconnect shift indicator cable at shift bowl (if automatic transmission), remove two (2) steering column to IP nuts.

6. Lower steering column from IP and protect with shop towel or tape.

7. Disconnect speedometer cable from under dash.

8. Tilt carrier and cluster assembly forward, disconnect printed circuit and cluster ground connectors, and all remaining wiring.

9. Place carrier assembly on bench. Remove wire harness and carrier assembly (4 screws) and set aside. Remove cluster.

10. To replace, reverse removal procedure.

H and HM Series (Figs. 8-48 and 50)

All instruments and gages can be replaced from front of cluster in the normal manner after removing bezel and lens as shown. If entire cluster carrier assembly must be replaced, refer to Figures 8-48 and 8-50.

PRINTED CIRCUIT

All models except H are equipped with printed circuits which supply current to most instrument panel lights and instruments. These circuits are made of copper foil which are

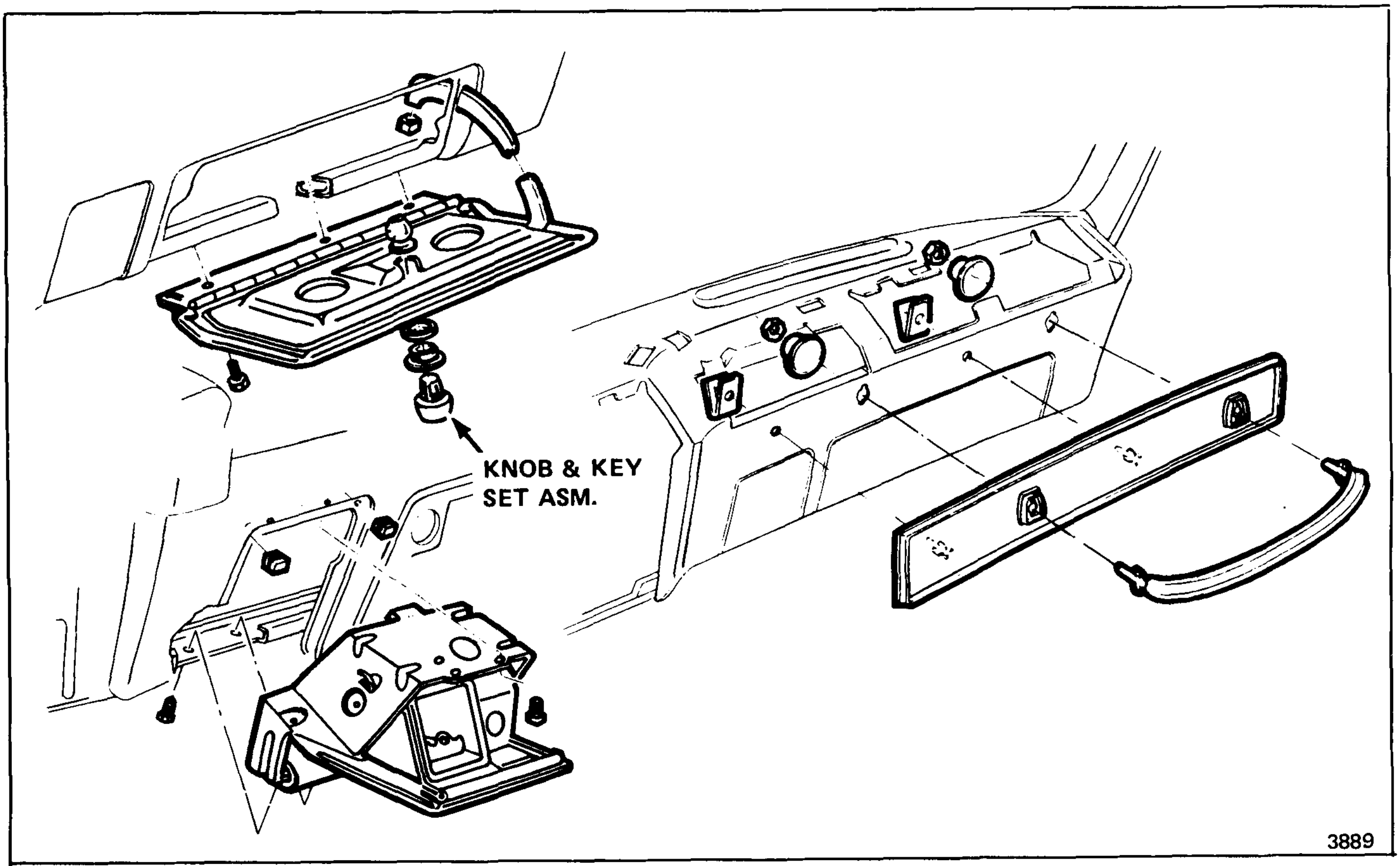


Fig. 8-47 X Series Instrument Panel Attaching Parts

die cut and bonded to a polyester base film (usually mylar). The printed circuit is supplied electrical power by a connector containing several wires as shown in the instrument panel wiring harness installation instructions. The connector also helps retain the printed circuit to the speedo cluster. The rest of the circuit is retained by screws and snap-in bulbs. The G, AG, X and HM Series printed circuits are attached to the I.P. Carrier Assembly and not to the speedo cluster as the A, B and F Series. Printed circuit diagrams are shown in Figures 8-48 through 8-59.

INSTRUMENT PANEL WIRE HARNESS

A Series (Fig. 8-60)

1. Disconnect battery.
2. Remove upper and lower trim plates, cluster, radio, heater controls and glove box.
3. Remove screw securing steering column toe cover plate halves to dash panel and loosen clamping screws. Lower steering column, disconnect ignition switch, neutral start switch, brake switch and turn signal connector.
4. Disconnect bulkhead connector and fuse block from under dash.
5. Disconnect all harness connectors.
6. Remove wire harness clips retaining wire harness.
7. Remove wire harness.
8. To replace, reverse removal procedure.

F Series (Fig. 8-61)

1. Disconnect battery.
2. Remove IP Pad as previously described for A Series.
3. With IP Pad on the bench, disconnect remaining connectors.
4. Remove wire harness from IP Pad.
5. To replace, reverse removal procedure.

G and AG Series (Figs. 8-62)

1. Disconnect battery and junction block.
2. Remove speedo cluster as previously described.
3. Remove switches - headlamp, w/s wiper, etc.
4. Remove lower A/C duct.
5. Disconnect bulkhead connector and attaching wires.
6. Disconnect wires to switches on steering column.
7. Remove radio and heater or A/C control.
8. Remove I.P. carrier attaching screws and remove carrier with I.P. harness attached.
9. To replace, reverse removal procedure.

B Series (Fig. 8-64)

1. Disconnect negative battery cable.
2. Referring to the I.P. pad and assembly carrier replacement procedure, loosen the carrier assembly and pull forward. It will not be necessary to remove the glovebox or the glovebox door.
3. From the back of the carrier assembly, remove all electrical connections. Disconnect all clips and screws retaining harness to the carrier. Remove all A/C ducts if

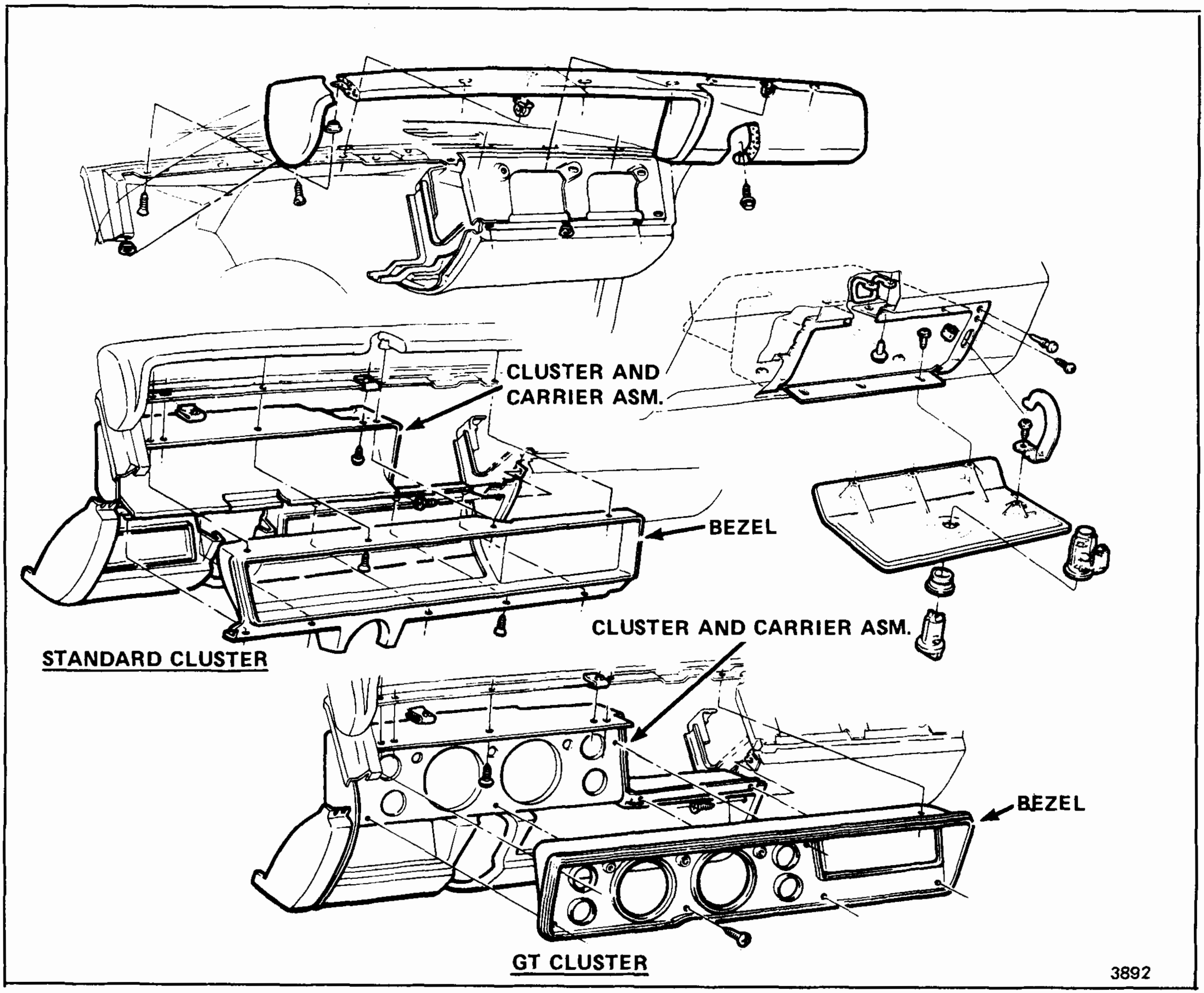


Fig. 8-48 H Series Instrument Panel Pad and Cluster

equipped.

4. Disconnect leads to the brake switch, back-up light switch, turn signal connector, dimmer switch and parking brake.

5. Remove bulkhead connector at engine side and remove fuseblock and bulkhead connector from the firewall. Remove harness from car.

6. Transfer all bulbs, fuses, flashers, relays, etc., to new harness.

7. To reinstall, reverse the above procedure.

X Series (Fig. 8-65)

1. Disconnect battery, remove bulkhead connector bolt, remove glove box.

2. On A/C equipped cars, remove upper A/C extension and lower A/C outlet at center of IP.

3. Remove ash tray, disconnect cigar lighter and glove box lamp connectors.

4. Remove radio (includes remove knobs, bezels, nuts and disconnect antenna lead-in and connectors).

5. Disconnect the following connectors: heater or A/C control, clock, printed circuit (at main connectors), turn signal and neutral start switch, turn signal flasher, headlamp and wiper switch, stop lamp switch, dimmer and park brake switch, body harness.

6. Disconnect center ground wire at radio side brace, left side ground wires above left kick pad, and cluster ground wire.

7. Loosen two (2) column to IP nuts, lower column part way and disconnect ignition switch connectors.

8. Remove two (2) fuse block screws, route all wires to left side of car and remove harness from car.

9. To replace, reverse removal procedure.

H and HM Series (Figs. 8-66 through 69)

1. Disconnect battery.

2. Remove "hush"panel.

3. Separate fuse block from bulkhead connector.

4. Disconnect dimmer switch, clutch switch and body connector.

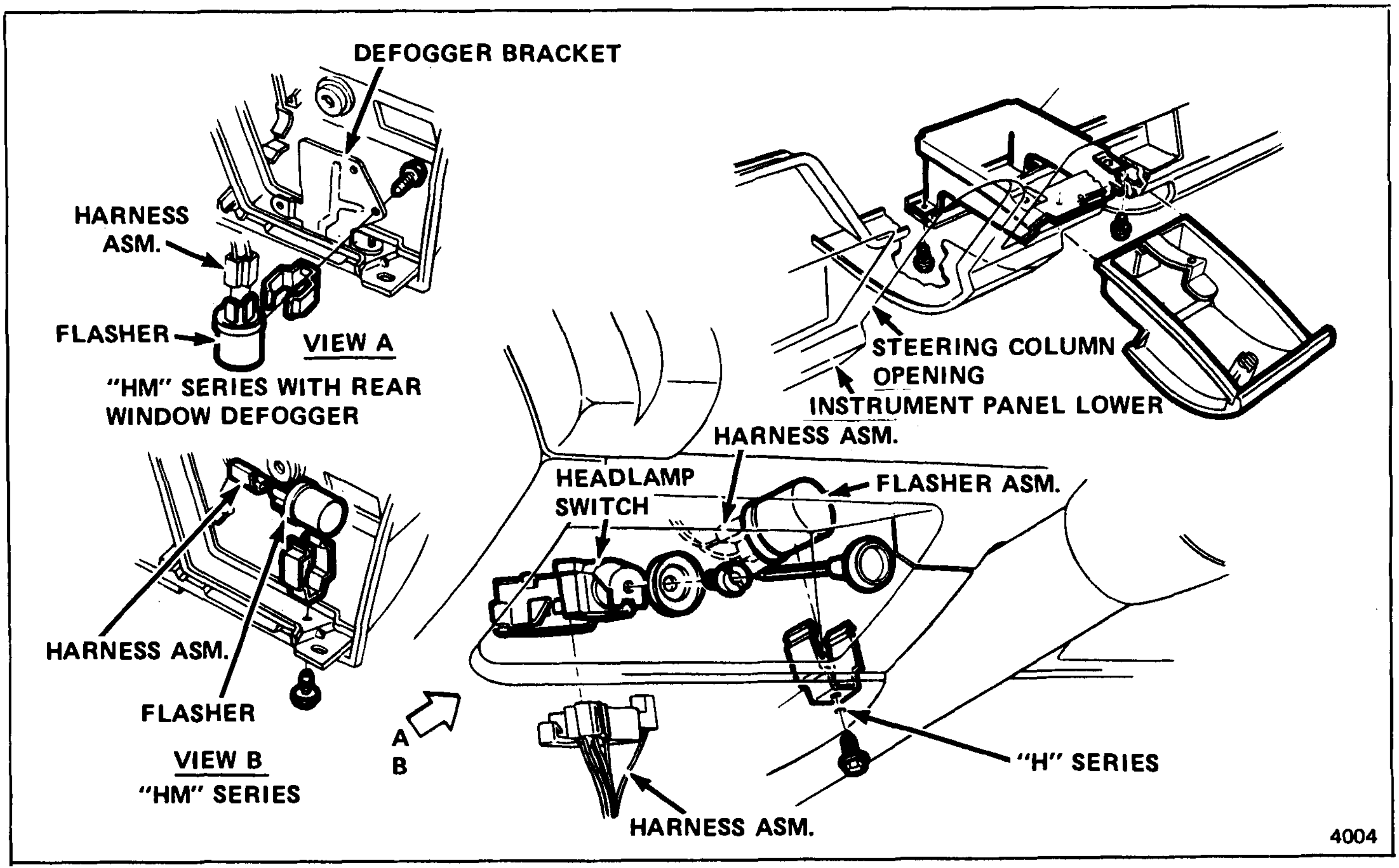


Fig. 8-49 H and HM Series Instrument Panel Attaching Parts

5. Remove instrument panel pad.
6. Lower steering column.
7. Remove the I.P. cluster carrier and tilt the carrier rearward.
8. Disconnect the printed circuit connector on HM and individual connectors on H, windshield wiper, headlamp, steering column, radio, brake switch and other miscellaneous connectors.
9. Remove instrument panel harness from car.
10. To replace, reverse removal procedure.

"HUSH"PANEL

Many 1977 Pontiacs with air conditioning will be equipped with a "hush"panel designed to substantially reduce the interior noise level. It may be necessary to remove this panel for some under dash service procedures. Fuses can be reached without removing the panel on most series. Refer to Figs. 8-70 through 8-76 for instructions for each car line. Proper installation is essential to avoid interferring with moving parts and to maintain adequate toe clearance.

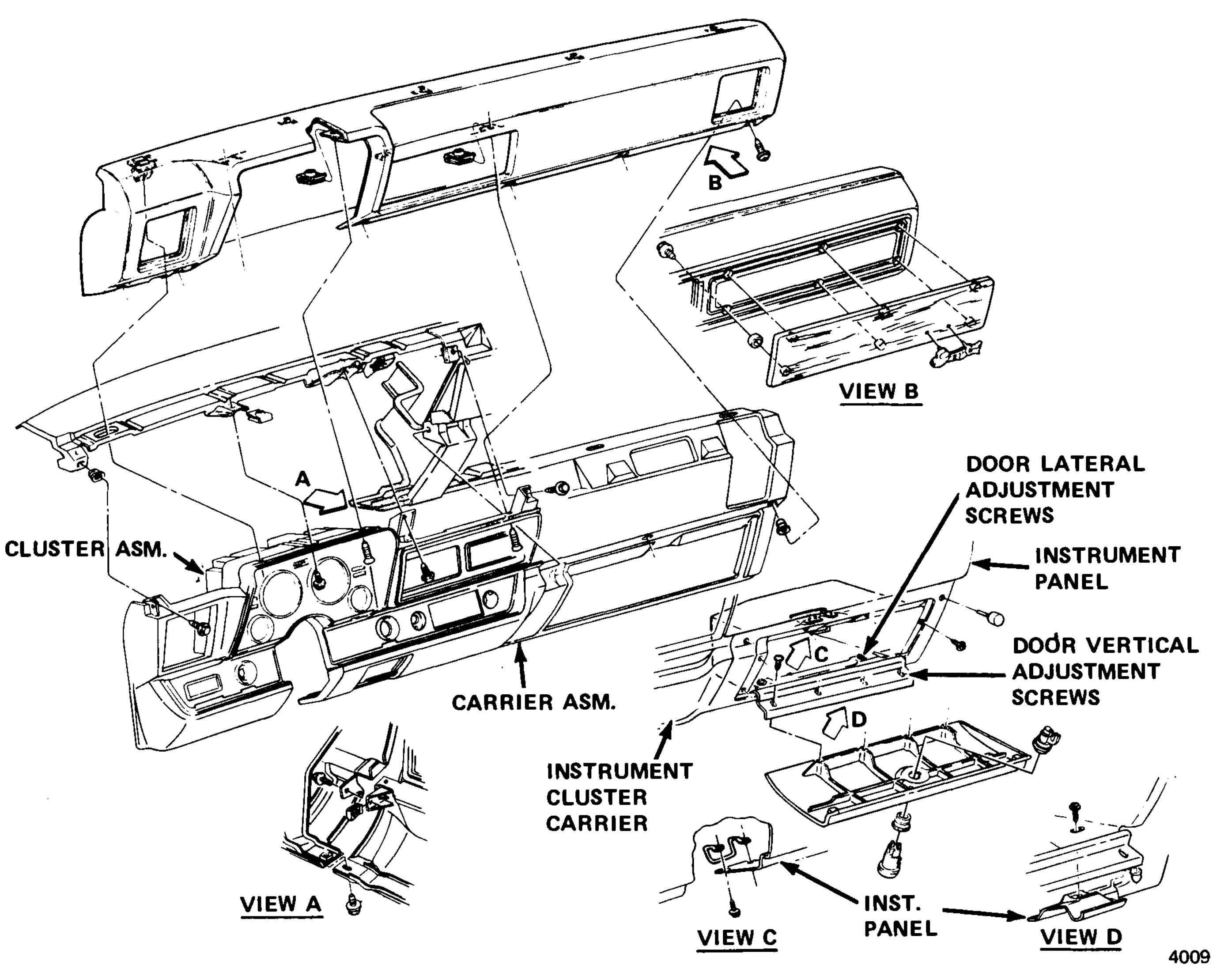
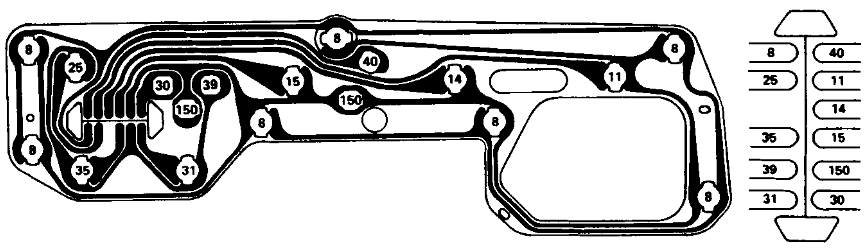


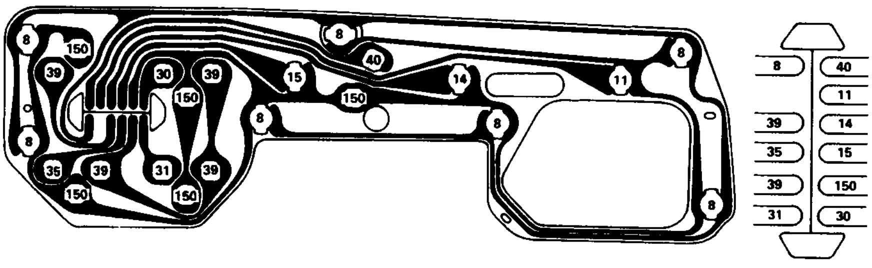
Fig. 8-50 HM Series Instrument Panel Pad and Cluster



LEGEND OF CONNECTOR PADS

8 – ILLUMINATION
11 – HIGH BEAM INDICATOR
14 – LEFT TURN SIGNAL INDICATOR
15 – RIGHT TURN SIGNAL INDICATOR
25 – GENERATOR TELLTALE
30 – FUEL GAGE SENDER
31 – OIL PRESSURE TELLTALE
35 – TEMPERATURE TELLTALE
39 – IGNITION
40 – CLOCK
150 – GROUND

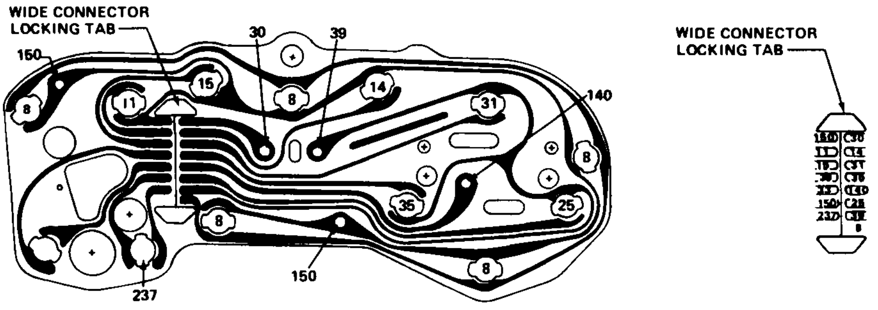
Fig. 8-51 B Series Printed Circuit Without Rally Gages



LEGEND OF CONNECTOR PADS

8 – ILLUMINATION
11 – HIGH BEAM INDICATOR
14 – LEFT TURN SIGNAL INDICATOR
15 – RIGHT TURN SIGNAL INDICATOR
30 – FUEL GA SENDER
31 – OIL GA SENDER
35 – TEMP GA SENDER
39 – IGNITION
40 – CLOCK
150 – GROUND

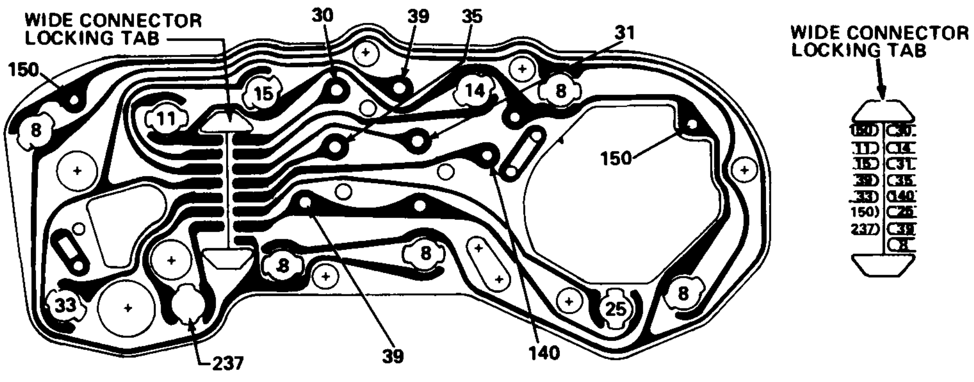
Fig. 8-52 B Series Printed Circuit With Rally Gages



LEGEND OF CONNECTOR PADS

8 – ILLUMINATION
11 – HIGH BEAM INDICATOR
14 – LEFT TURN SIGNAL INDICATOR
15 – RIGHT TURN SIGNAL INDICATOR
25 – GENERATOR TELLTALE
30 – FUEL GA. SENDER
31 – OIL TELLTALE
33 – BRK WARNING INDICATOR
35 – TEMP TELLTALE
39 – IGNITION
140 – CLOCK
150 – GROUND
150 – SEAT BELT TELLTALE GROUND
237 – IGNITION FOR SEAT BELT WARNING TELLTALE

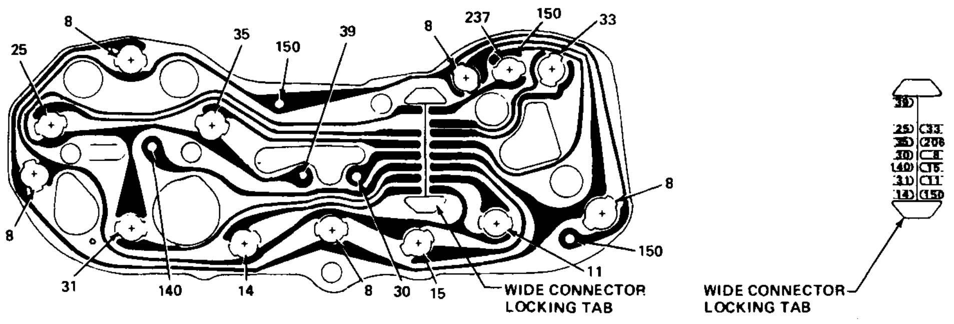
Fig. 8-53 A and F Series (Late Cluster) Printed Circuit Without Rally Gages



LEGEND OF CONNECTOR PADS

8 – ILLUMINATION
11 – HIGH BEAM INDICATOR
14 – LEFT TURN SIGNAL INDICATOR
15 – RIGHT TURN SIGNAL INDICATOR
25 – GENERATOR TELLTALE
30 – FUEL GA. SENDER
31 – OIL GA. SENDER
33 – BRK. WARNING INDICATOR
35 – TEMP GA. SENDER
39 – IGNITION
140 – CLOCK
150 – GROUND
150 – SEAT BELT TELLTALE GROUND
237 – IGN. FOR SEAT BELT TELLTALE

Fig. 8-54 A Series Printed Circuit With Rally Gages

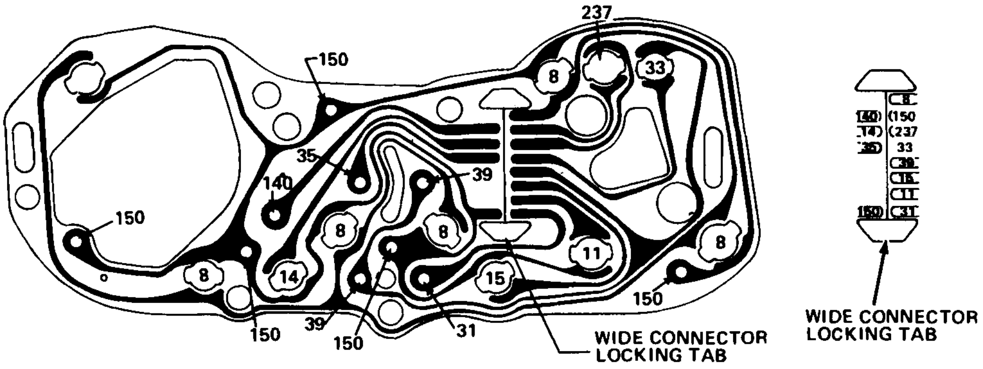


LEGEND OF CONNECTOR PADS

8 – ILLUMINATION
11 – HIGH BEAM INDICATOR
14 – LEFT TURN SIGNAL INDICATOR
15 – RIGHT TURN SIGNAL INDICATOR
25 – GENERATOR TELLTALE
30 – FUEL GA SENDER
31 – OIL TELLTALE
33 – BRK WARNING INDICATOR
35 – TEMP TELLTALE
39 – IGNITION
140 – CLOCK
150 – GROUND
150 – SEAT BELT TELLTALE GROUND
237 – IGNITION FOR SEAT BELT TELLTALE

2454

Fig. 8-55 F Series Printed Circuit Without Rally Gages, Early Cluster

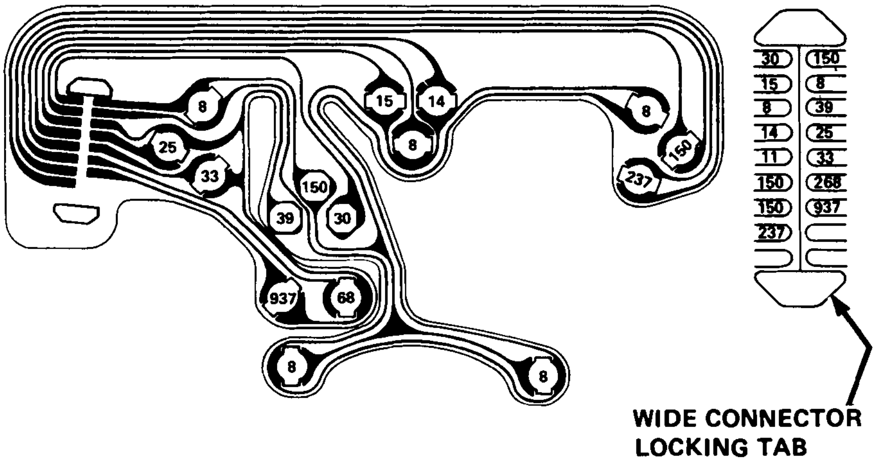


LEGEND OF CONNECTOR PADS

8 – ILLUMINATION
11 – HIGH BEAM INDICATOR
14 – LEFT TURN SIGNAL INDICATOR
15 – RIGHT TURN SIGNAL INDICATOR
31 – OIL GA. SENDER
33 – BRK. WARNING INDICATOR
35 – TEMP. GA. SENDER
39 – IGNITION
140 – CLOCK
150 – GROUND
150 – SEAT BELT TELLTALE GROUND
237 – IGNITION FOR SEAT BELT TELLTALE

2455

Fig. 8-56 F Series Printed Circuit With Rally Gages

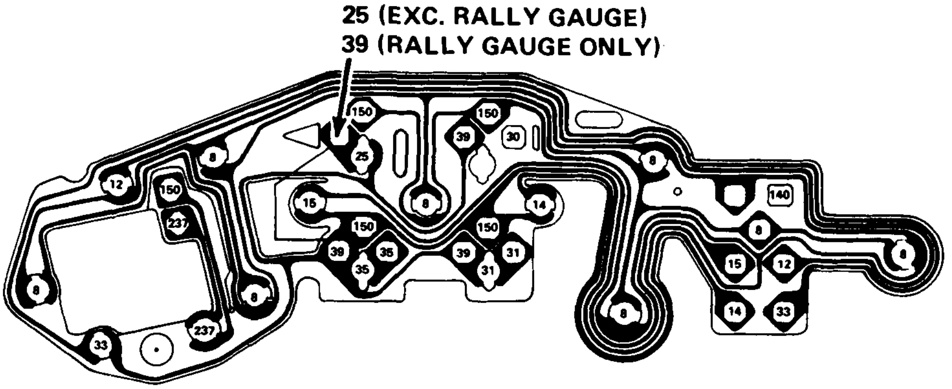


LEGEND OF CONNECTOR PADS

150 – GROUND
8 – ILLUMINATION
39 – IGNITION–B +
25 – IGNITION FOR GENERATOR
33 – BRAKE–SENDER
68 – ADD–COOLANT
937 – TEMP/PRESS
237 – FASTEN BELTS
150 – FASTEN BELTS GROUND
150 – GROUND
11 – HI–BEAM
14 – LEFT TURN SENDER
8 – ILLUMINATION
15 – RIGHT TURN SENDER
30 – FUEL–SENDER

4039

Fig. 8-58 HM Series Printed Circuit Without Rally Gages



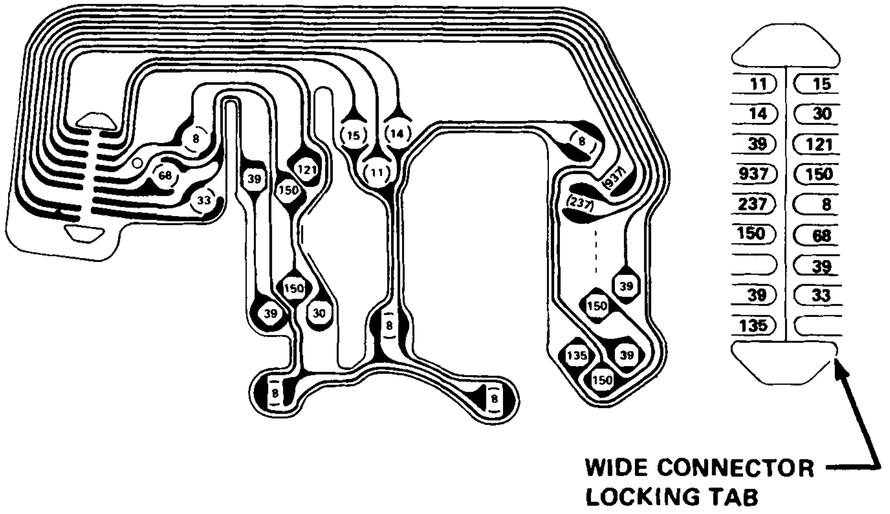
LEGEND OF CLUSTER CIRCUITS

8 – ILLUMINATION
12 – HIGH BEAM INDICATOR
14 – LEFT TURN SIGNAL INDICATOR
15 – RIGHT TURN SIGNAL INDICATOR
25 – VOLTAGE GAUGE OR TELLTALE
30 – FUEL GAUGE OR TELLTALE
31 – OIL GAUGE OR TELLTALE
33 – BRAKE WARNING INDICATOR
35 – TEMP. GAUGE OR TELLTALE
39 – IGNITION (BAT.)
140 – CLOCK
150 – GROUND
237 – IGNITION FOR SEAT BELT TELLTALE
150 – SEAT BELT TELLTALE GROUND
* – TAILGATE AJAR (AG WAGON ONLY)
** – LO-COOLANT WARNING LAMP (151 X ONLY)

NOTE: WITH RALLY GAUGES, NO BULBS ARE INSTALLED IN SPOTS 25, 31 AND 35.

2456

Fig. 8-57 G, AG and X Series Printed Circuit



LEGEND OF CONNECTOR PADS

15 – RIGHT TURN SENDER
30 – FUEL–SENDER
121 – COIL–TACH
150 – GROUND
8 – ILLUMINATION
68 – ADD–COOLANT
39 – IGNITION–B +
33 – BRAKE
135 – TEMP–SENDER
39 – IGN. (VOLTMETER)
150 – FASTEN BELTS GROUND
237 – FASTEN BELTS
937 – TEMP/PRESS
39 – IGNITION–B +
14 – LEFT TURN–SENDER
11 – HI–BEAM

4040

Fig. 8-59 HM Series Printed Circuit With Rally Gages

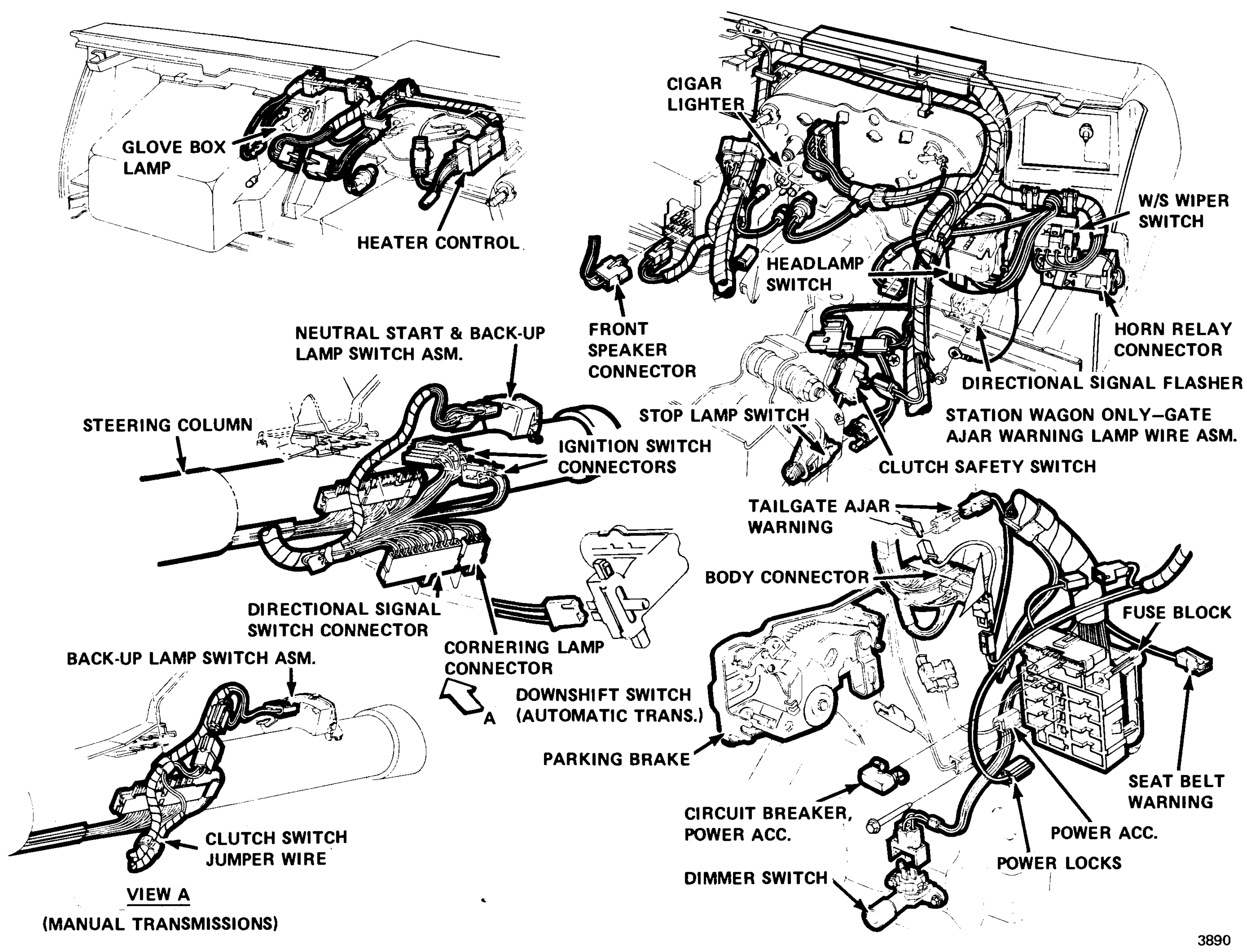


Fig. 8-60 A Series Instrument Panel Wire Harness

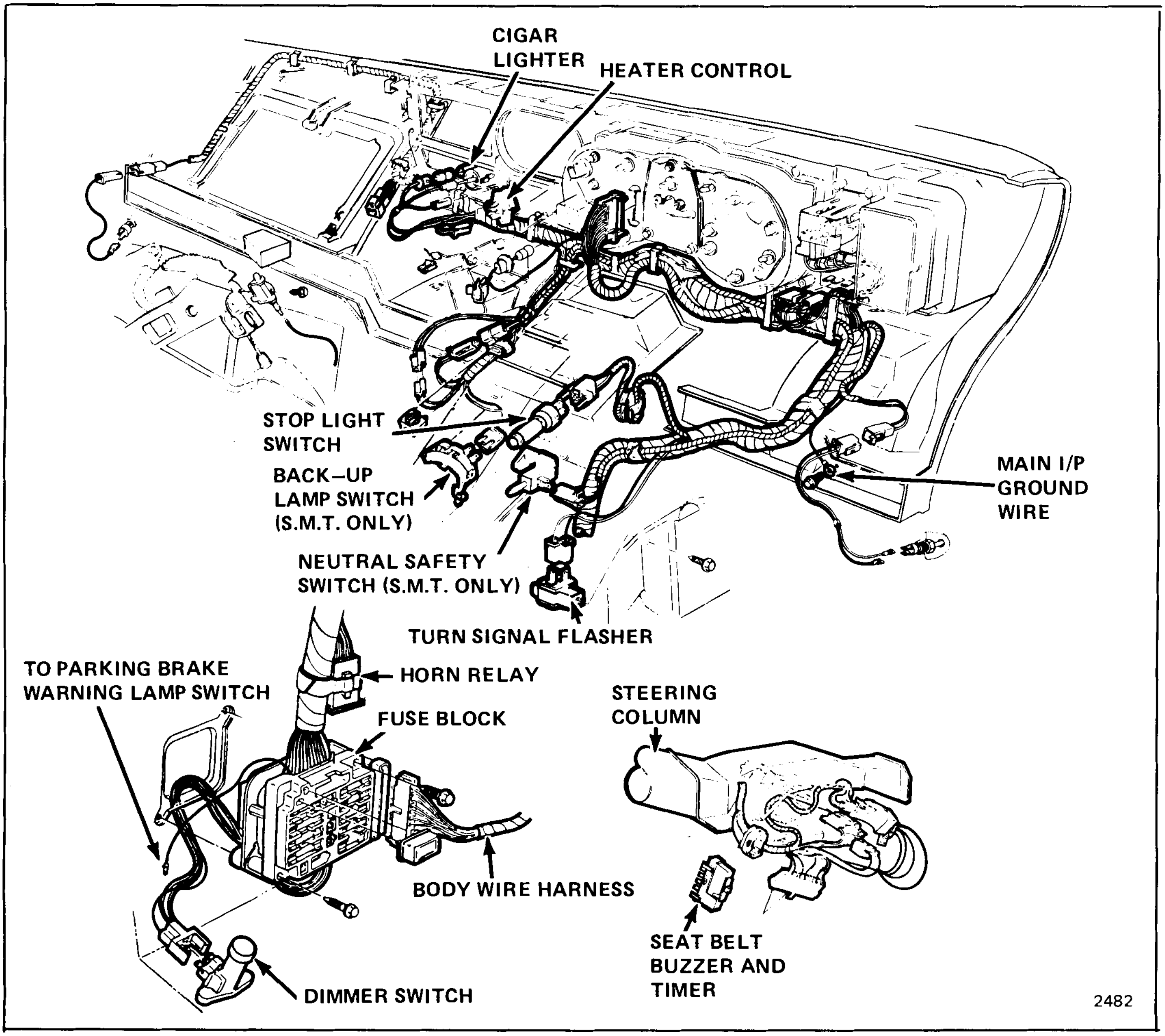


Fig. 8-61 F Series Instrument Panel Wire Harness

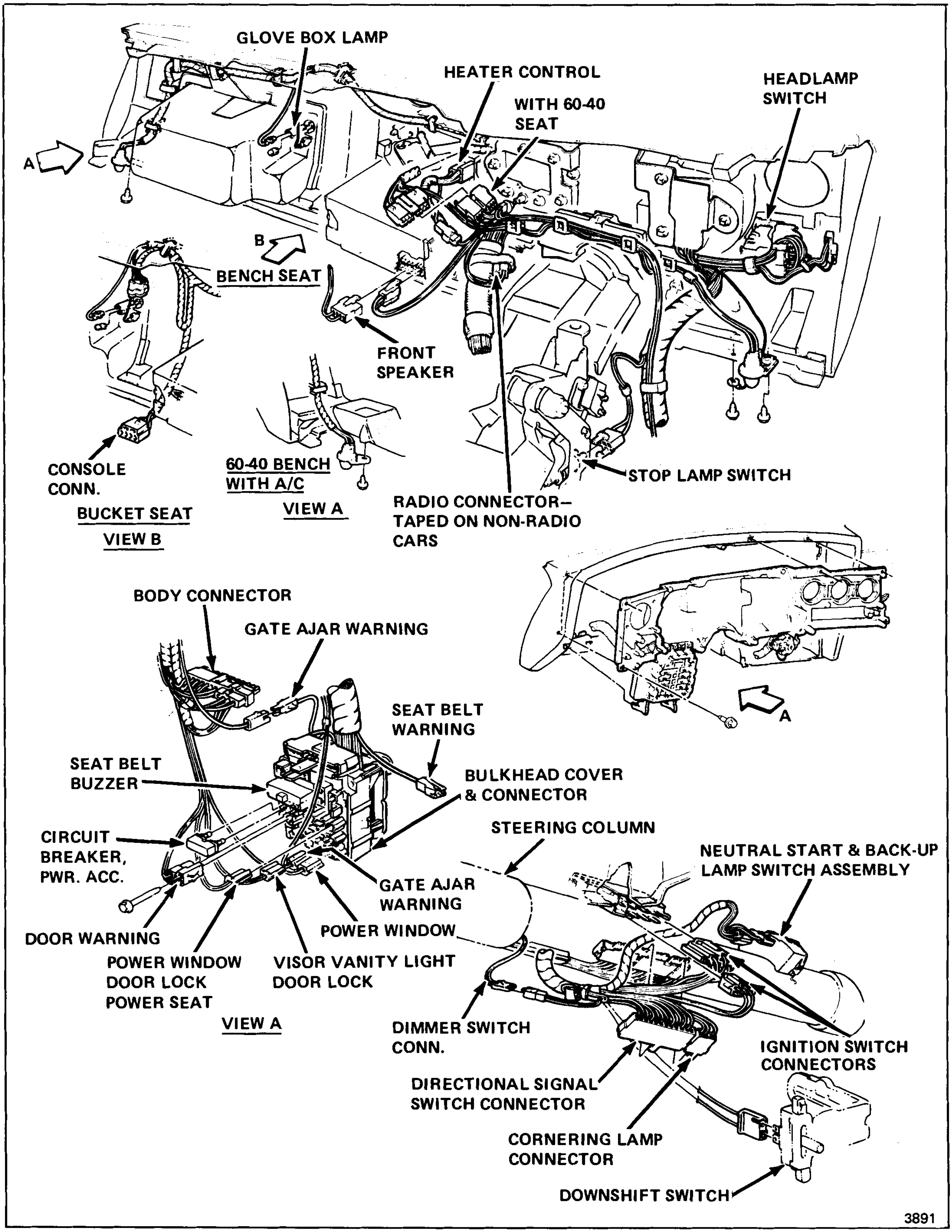


Fig. 12-62 G and AG Series Instrument Panel Wire Harness

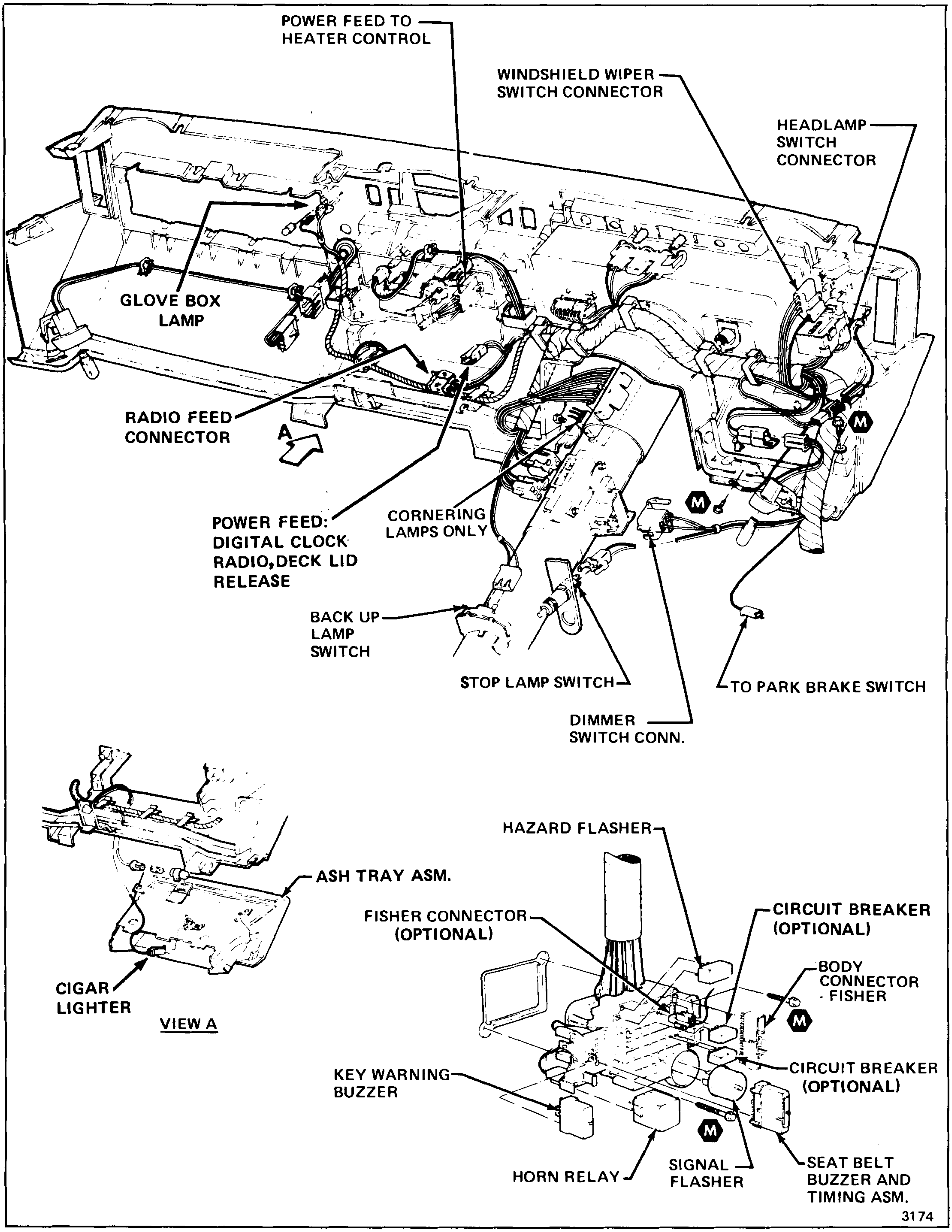


Fig. 8-64 B Series Instrument Panel Wire Harness

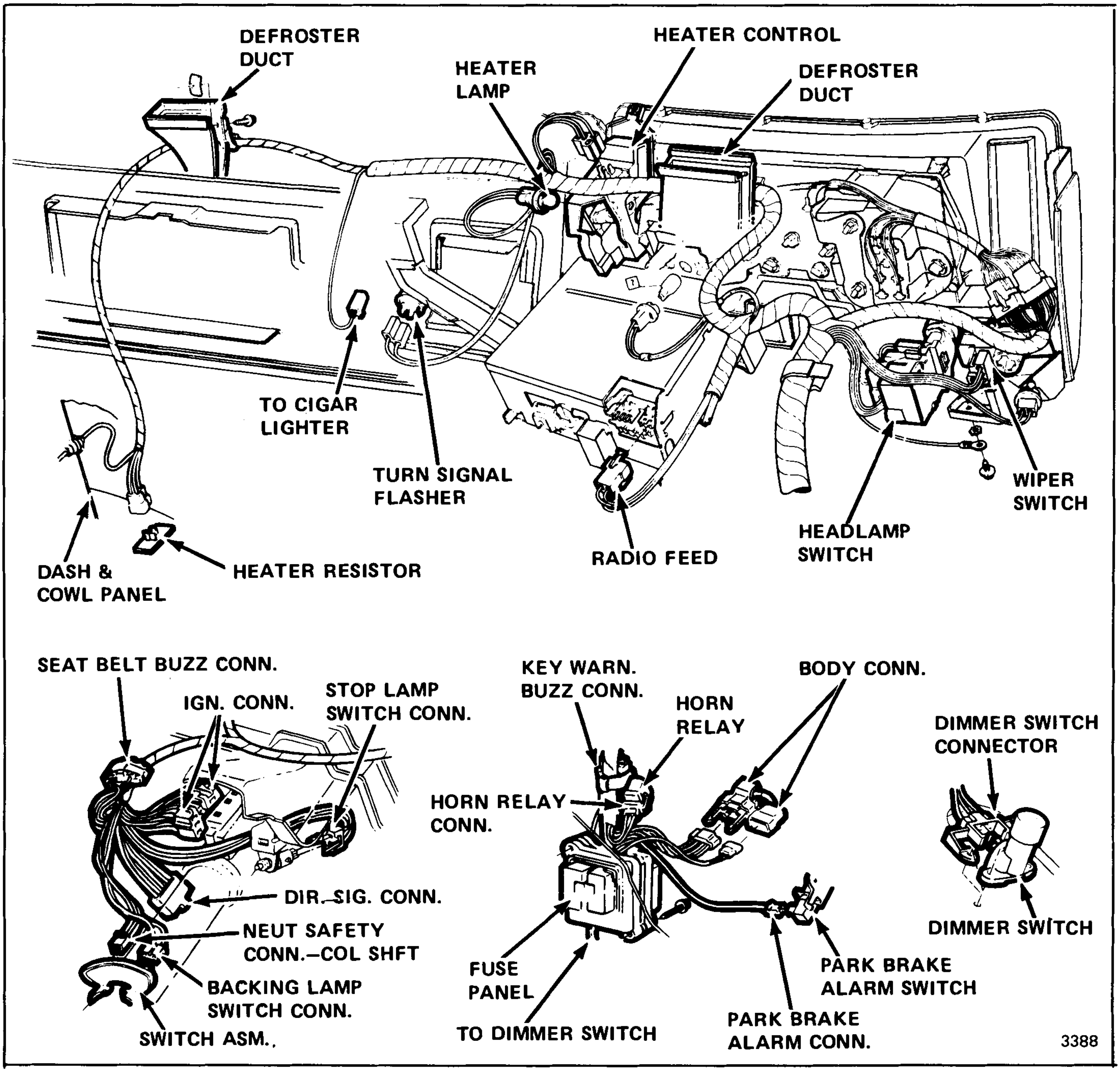


Fig. 8-65 X Series Instrument Panel Wire Harness

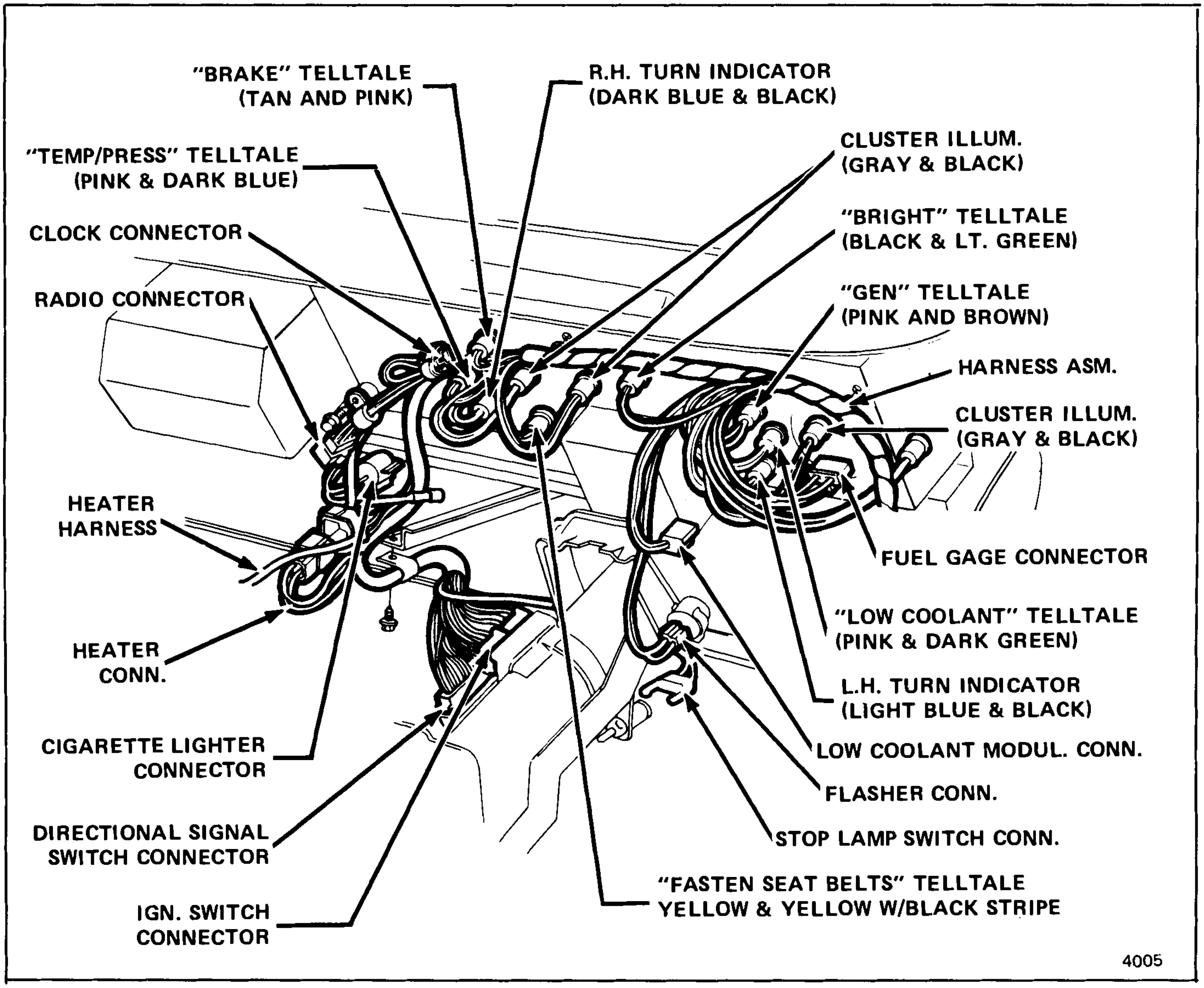


Fig. 8-66 H Series Instrument Panel Wire Harness - Standard Cluster

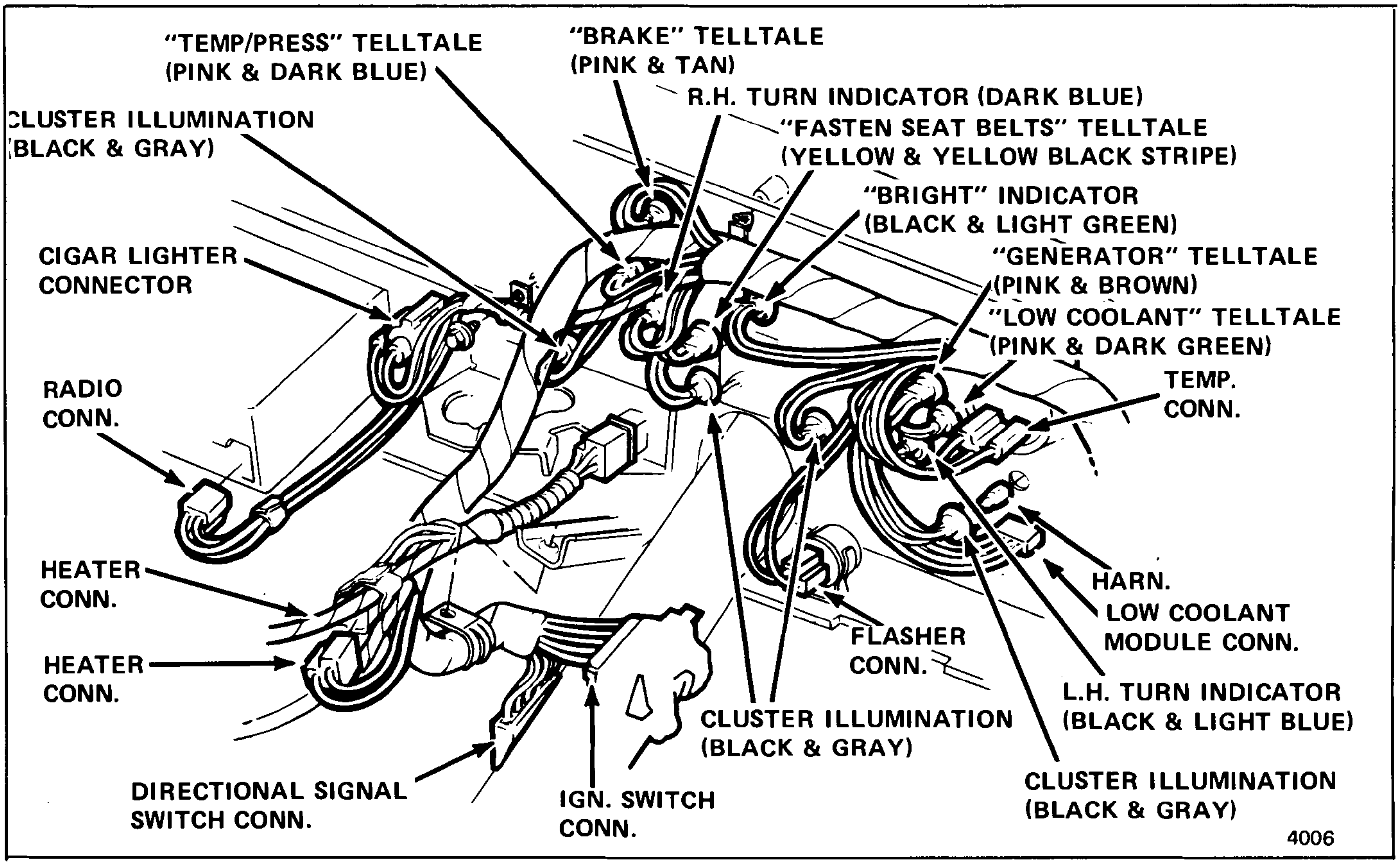


Fig. 8-67 H Series Instrument Panel Wire Harness - GT Cluster

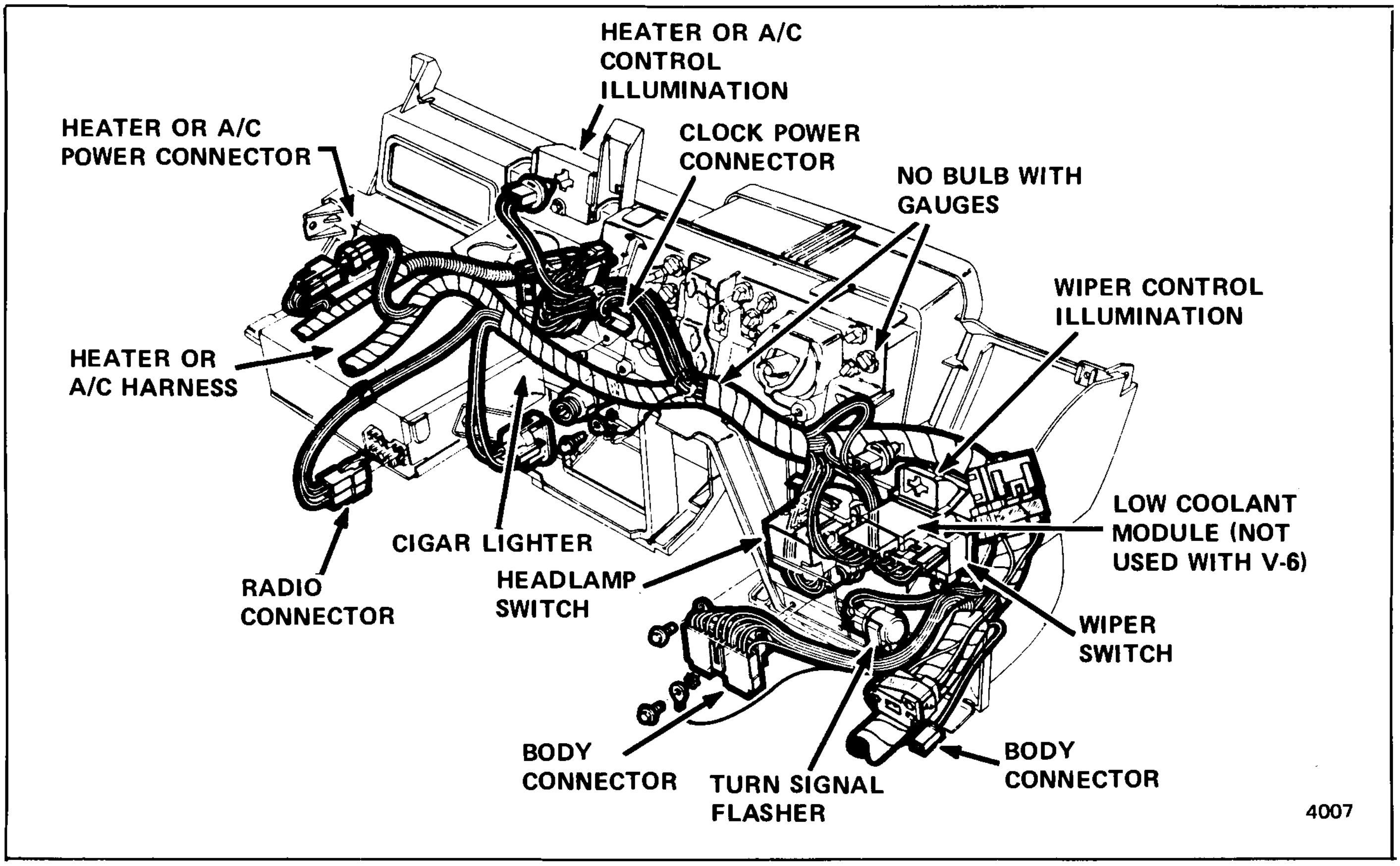


Fig. 8-68 HM Series Instrument Panel Wire Harness

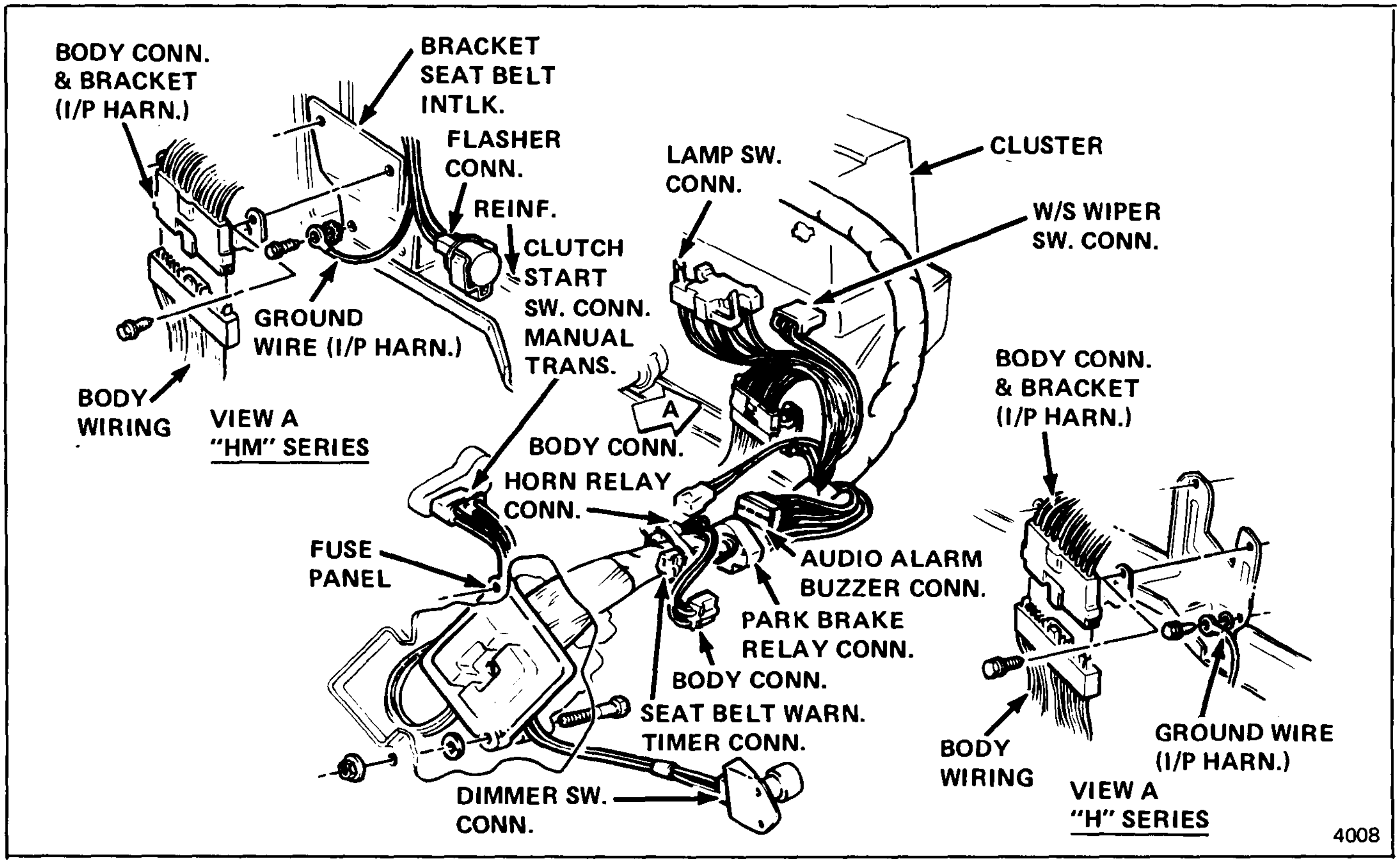


Fig. 8-69 H and HM Series - Steering Column and Fuse Panel

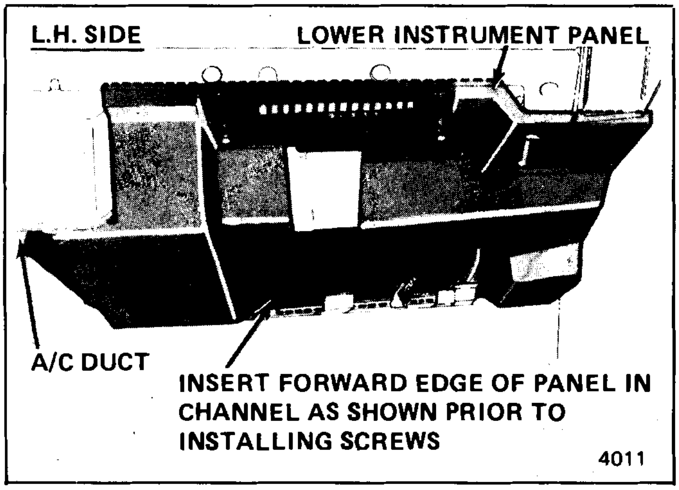


Fig. 8-70 "Hush"Panel, B Series, L.H.

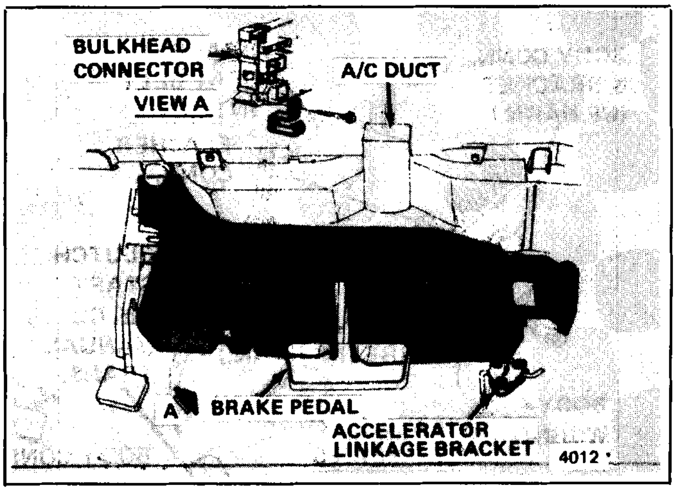


Fig. 8-71 "Hush"Panel, G Series

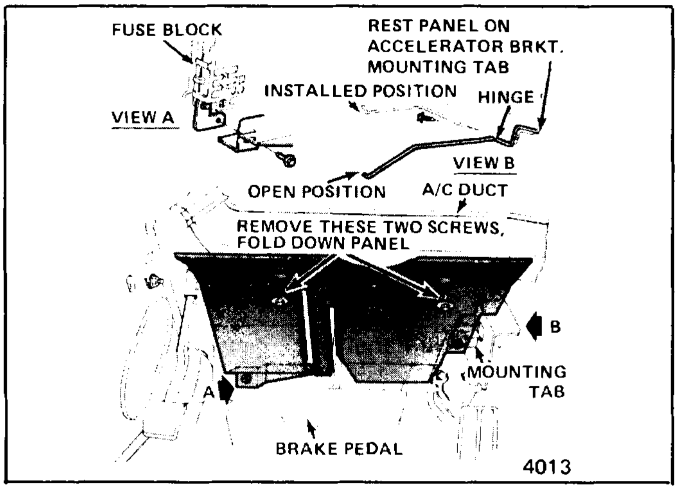


Fig. 8-72 "Hush"Panel, F Series

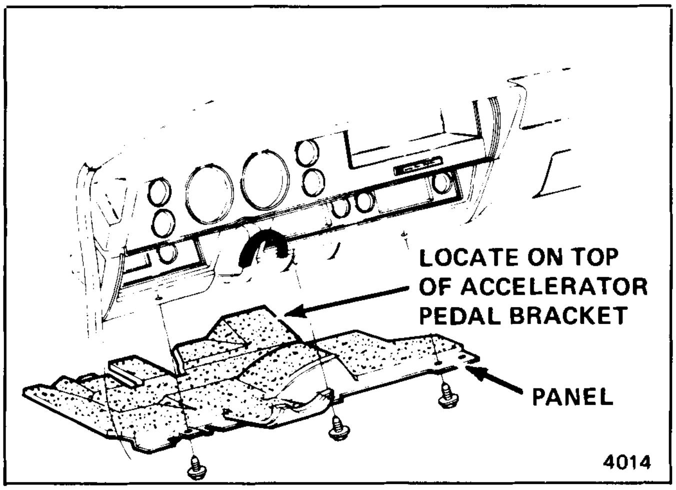


Fig. 8-73 "Hush"Panel, H Series

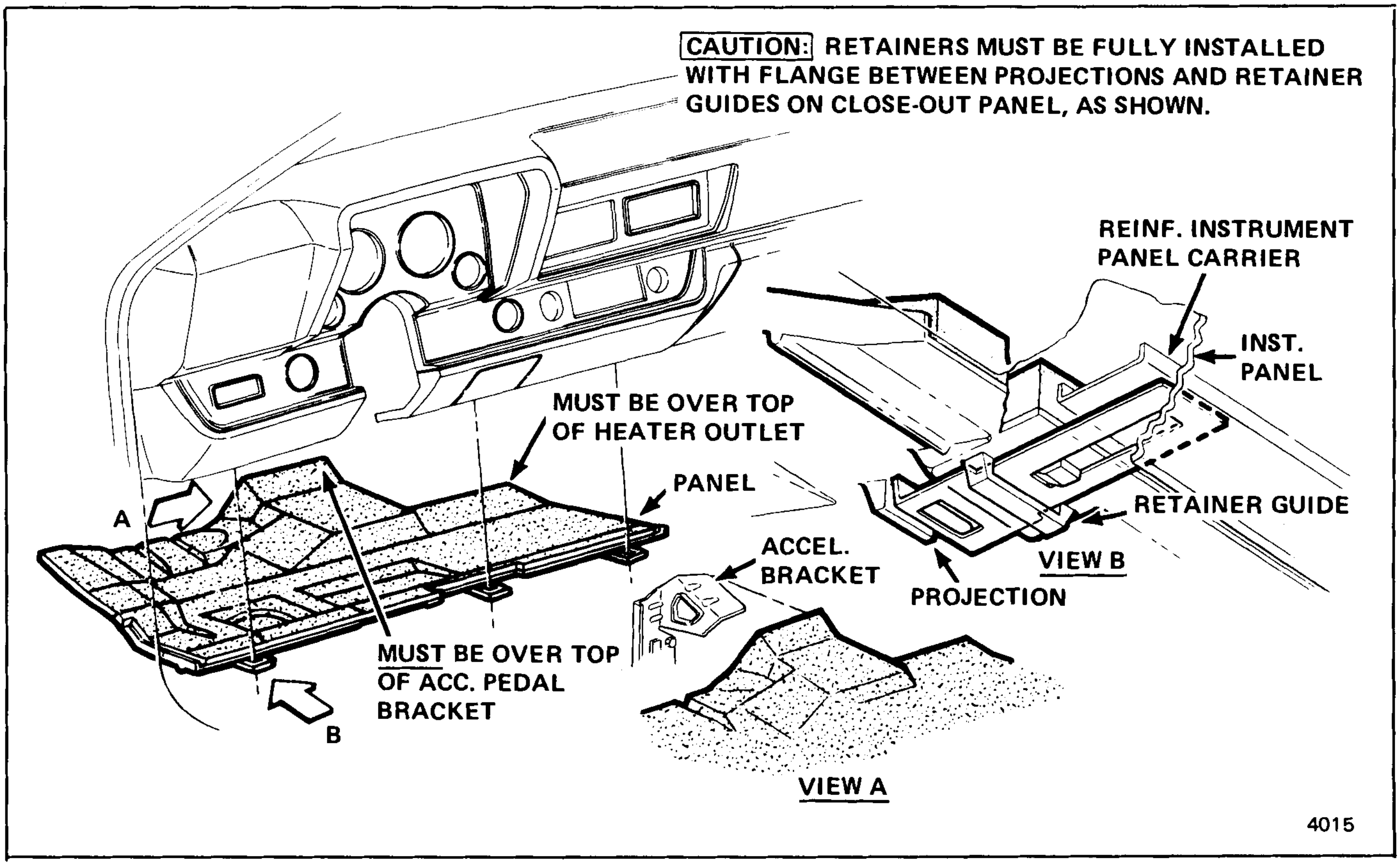


Fig. 8-74 "Hush"Panel, HM Series

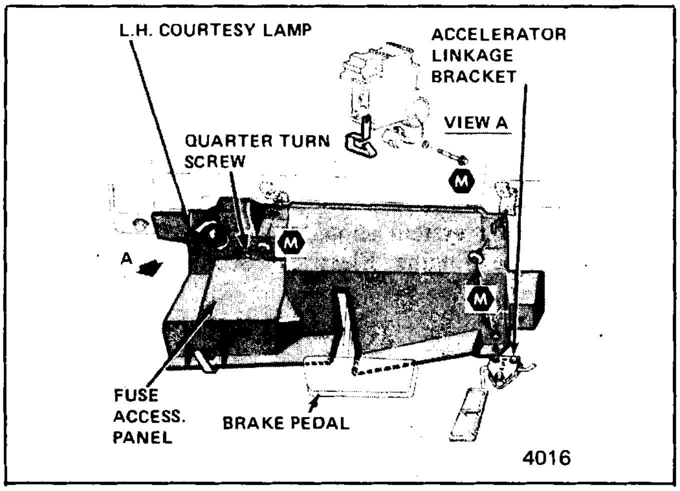


Fig. 8-75 "Hush"Panel, B Series, R.H.

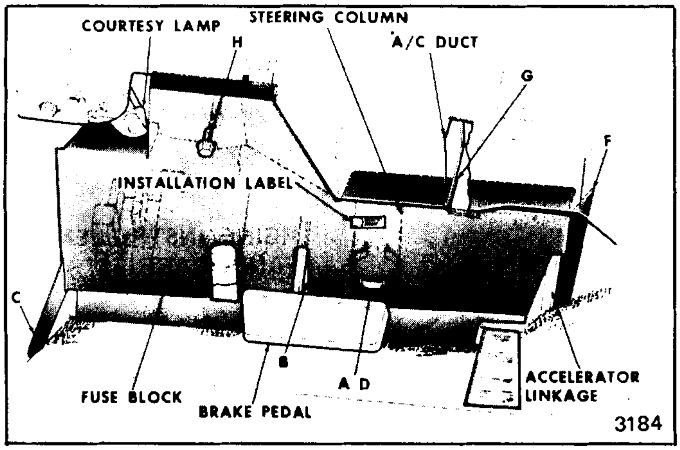


Fig. 8-76 "Hush"Panel, Early B Series, LH

INSTRUMENTS

GENERAL DESCRIPTION

Instruments consist of fuel gage, temperature indicator lamp, generator lamp, oil pressure indicator lamp, and speedometer. See Section 9 for optional Rally Gages. Service on instruments can be obtained through authorized branches. However, knowledge of instrument circuit checks will help in determining if operating difficulties lie in instrument itself or its allied circuit.

Instruments have been designed for easy removal by elimination of separate ground straps. With the grounding provisions intergrated with the instrument panel wiring, the instruments can be removed after removing a separate trim plate (except X Series).

FUEL GAGE

An electrical fuel gage is used on all series, consisting of an instrument panel gage and a fuel tank pick-up. The fuel gage indicates the quantity of fuel in tank only when ignition switch is turned to "on"or "accessory"positions.

When ignition is turned to "off"or "start"positions, the pointer may come to rest at any position. The letters "E"and "F"on fuel gage are used to point out direction of indicator travel only.

Gage readings are made from five markings on gage face. The left-hand line indicates empty, the centerline half-full and the right line full.

TEMPERATURE INDICATOR LAMP

The engine temperature indicator lamp is controlled by a thermal switch which senses engine coolant temperatures.

When the ignition switch is turned to "start"position, a test circuit is closed to indicate whether the red lamp is functioning properly.

NOTE: In H and HM Series, temperature and oil pressure lamps are combined. Operation of this system is covered in Section 6C, Carburetion and Fuel Systems, and the wiring diagram is shown in Fig. 8-76A.

If the cooling system does not hold pressure due to pressure cap being left loose, or accident such as puncture of radiator, rupture or disconnection of a hose, or use of low boiling point anti-freeze, the calibration temperature of red lamp heat indicator may not be reached, in spite of boiling.

NOTE: Low boiling coolants such as water will not operate lamp.

GENERATOR LAMP

The red generator indicator lamp, located in the instrument cluster, should light when the ignition switch is turned on and engine is not running. If not, either the bulb is burned out or generator has an open circuit.

When the generator voltage output becomes greater than the battery voltage, the red lamp should go out. This does not, however, indicate whether the battery is being charged or regulator is functioning properly.

The charging system should be checked if trouble is experienced. See Engine Electrical Section, 6D, of the manual.

ENGINE OIL PRESSURE INDICATOR LAMP

The engine oil pressure indicator lamp is controlled by a pressure-operated switch located on the oil filter support, or on the side of the block. When engine is running, the lamp operates only when oil pressure is not satisfactory. This lamp should come on when ignition is turned ON and engine is not running.

The oil pressure switch breaks contact at 4 ± 2 psi on increasing pressure and makes contact at 4 ± 2 psi on decreasing pressure (except V6, which is 3 ± 2 psi).

H and HM Series use an electric fuel pump with 140 L-4 and 231 V-6 engines. Power for the pump is fed through the oil pressure switch, and the pump will not operate unless sufficient pressure is present at the oil pressure switch. For further information on this system, see Section 6C, and Fig. 8-76A.

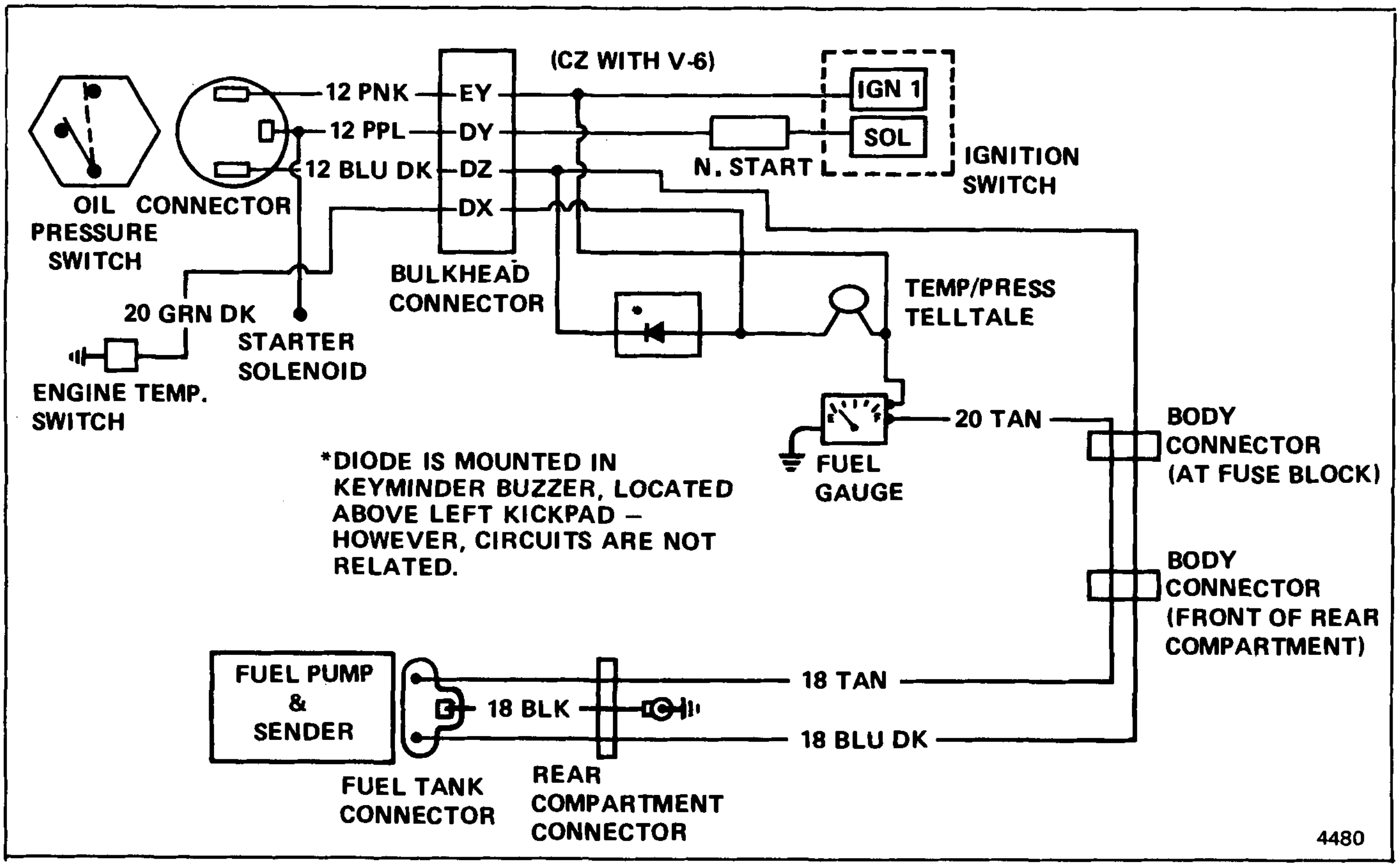


Fig. 8-76A Temp/Press Warning Lamp Circuit

SPEEDOMETER

The speedometer incorporates a speed indicating mechanism and an odometer to record total mileage. A flexible cable, which enters the speedometer driven gear in the transmission on one end and the speedometer head at the other, rotates both mechanisms whenever the transmission main shaft, propeller shaft and wheels rotate. For cruise control equipped cars, there are two cables: one from the transmission to the cruise control regulator, and the other from the regulator to the speedometer head.

The odometer is driven by a series of gears from a worm gear cut on the magnet shaft. The odometer discs are so geared that as any one disc finishes a complete revolution, the next disc to left is turned one-tenth of a revolution.

COOLANT LEVEL INDICATOR

All H, HM and X Series with L-4 engines are equipped with a low coolant level indicator. The system is comprised of an instrument panel warning lamp, module and coolant lever sensor located in the right hand radiator core tank. Wiring is incorporated in the Front End and Instrument Panel Harness assemblies.

DIAGNOSIS

Speedometer

CONDITION	CORRECTION
Noisy speedometer cable.	Remove cable and shorten if necessary. Insure that housing is routed properly. Replace housing if kinked.
Pointer and odometer inoperative.	Replace broken cable.
Inaccurate reading.	Check tire size. Check for correct speedometer driven gear.
Kinked cable.	Replace cable. Re-route casing so that bends have no less than 6" radius (unless pre-formed).
Defective speedometer head.	Replace or have repaired at authorized service station.
Casing connector loose on speedometer case.	Tighten connector.

Oil Pressure Indicator

CAUSE	CORRECTION
Oil light stays on with engine running (if electrical failure).	Check sender unit for improper ground. Check connection at bulkhead connector. Check for short from printed circuit to bulkhead. Check for ground between switch and bulkhead connector. Check engine oil pressure.
Lamp does not come on during crank.	Check bulb. Check for blown fuse. Check for open in above circuits. Check for open at printed circuit connector. Check break in printed circuit.

Temperature Warning Lamp

CONDITION	CORRECTION
Temperature warning lamp stays on (if electrical failure).	Check sender for abnormal ground. Check for short between bulkhead and sender. Check for short from bulkhead to printed circuit. Check printed circuit.
Temperature warning lamp inoperative during crank	Check bulb. Check fuse. Check for open in circuit.

GENERATOR INDICATOR LAMP

See Engine Electrical Section, 6D.

LOW COOLANT LEVEL INDICATOR

INDICATOR LAMP WILL NOT ILLUMINATE

1. Turn ignition switch to **CRANK** position. If lamp illuminates, system is **OK** . If lamp still does not illuminate, go to step 2.

2. Turn ignition switch to **ON** position and disconnect electrical lead at coolant level sensor on radiator. If lamp illuminates, replace sensor. If lamp fails to illuminate, connect electrical lead and go to step 3.

3. Check indicator lamp. If lamp is defective, replace. If lamp is **OK** , go to step 4.

4. Check for an open circuit between sensor and module, then from module to indicator. If an open circuit is found, repair. If no open circuit is found, replace module.

INDICATOR LAMP REAMINS ON AT ALL TIMES

1. Turn ignition switch to **ON** position and check coolant level. Add coolant if necessary. If indicator lamp remains illuminated, go to step 2.

2. Disconnect electrical lead at coolant level sensor on radiator. Use a jumper wire and ground electrical connector.

If lamp does not illuminate, replace sensor. If lamp remains illuminated, connect electrical lead and go to step 3.

3. Check for short circuit from sensor to module. If a short is found, repair. If no short is found, replace module.

INDICATOR LAMP FLICKERS ON AND OFF

If a problem of a flickering low-coolant light is encountered, it may be necessary to remove trapped air from the radiator. To remove the air, perform the following steps.

1. With engine cold, remove the radiator cap.
2. Start engine and let run until it reaches normal operating temperature (approximately 5 to 10 minutes).

CAUTION: *When running the engine for longer than 5 minutes, make certain that the choke is open and fast idle speed is reduced to a normal idle speed.*

3. Fill the radiator with coolant until it is completely full and install the radiator cap.

FUEL GAGE

Use the following procedure to diagnose an inoperative fuel gage:

1. Locate fuel gage sender wire (tan) in rear compartment. With igntion "off", disconnect the wire. The gage should read past "FULL" with ignition"on".
2. Use a jumper wire to short the connector to ground. The gage should now read past "EMPTY".
3. If Steps 1 and 2 are OK, the trouble is in the fuel tank sending unit, or the wiring connector at the tank.
4. If Steps 1 and 2 are not OK, remove the gage as shown in On-Car Service and reconnect the wire in the rear compartment. Then check the gage terminal connectors in the instrument cluster. The three signals with ignition "on" should be 12 volts, ground, and a signal. Use an ohmmeter to check the signal. It should read somewhere between 0 and 90 ohms. If all three signals are OK, replace the gage. If not, repair the wiring problem between the rear compartment connector and the gage.
5. A variable resistance load may also be used in Steps 1 and 2. A load of 0 ohms should read "EMPTY", and 90 ohms should read "FULL".

ON-CAR SERVICE

SPEEDOMETER

On all series except X, the speedometer can be removed as follows:

1. Remove upper trimplate.
2. Remove cluster lens (will require removal of knob for clock or trip odometer).
3. Remove shift indicator pointer if necessary.
4. Remove speedometer head. It is NOT necessary to disconnect the speedometer cable.
5. Replace by reversing above procedure.

To replace the X Series speedometer, the cluster must be removed, as described in Speedo Cluster Replacement.

The speedometer can be repaired at authorized repair stations.

WARNING LAMPS

B, A, F and G Series - The lamps should be replaced by removing the cluster and removing the socket on the back of the cluster. On G and AG Series, removing the cluster will provide access to the bulbs, which are mounted on the back of the carrier assembly.

X Series - The bulbs can be replaced by loosening the carrier assembly and pulling forward to gain access to the rear of the assembly, and removing the lamp socket.

H and HM Series - Indicator lamps can be replaced by removing the upper trimplate, removing the cluster lens, removing necessary instruments and/or coverplates, and replacing the bulb.

FUEL GAGE

The fuel gage is replaced in the same manner as the speedometer.

LOW-COOLANT INDICATOR LAMP

The lamp is replaced as shown for other indicator lamps. The module replacement is shown in the I.P. Wire Harness illustrations.

SPEEDOMETER CABLE

Speedometer cable connection at speedometer cluster is of quick disconnect design. Fig. 8-77 shows detail. Fig. 8-78 shows attachment at transmission.

Remove and Replace

1. Remove lower A/C duct if equipped on A and G Series or lower IP trimplates (except X Series).
2. Disconnect speedometer cable casing from speedometer head (Fig. 8-77).
3. Slide old cable out from upper end of casing or, if broken, from both ends of casing.
4. Take short piece of speedometer cable with a tip to fit speedometer and insert it in speedometer socket. Spin short cable between fingers in direction that higher speed is indicated on speedometer dial and note if there is any tendency to bind. If binding is noted, there is trouble inside

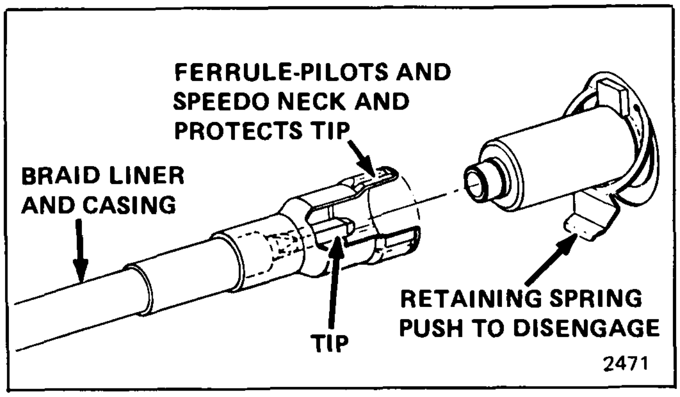


Fig. 8-77 Speedometer Cable Attachment at Cluster

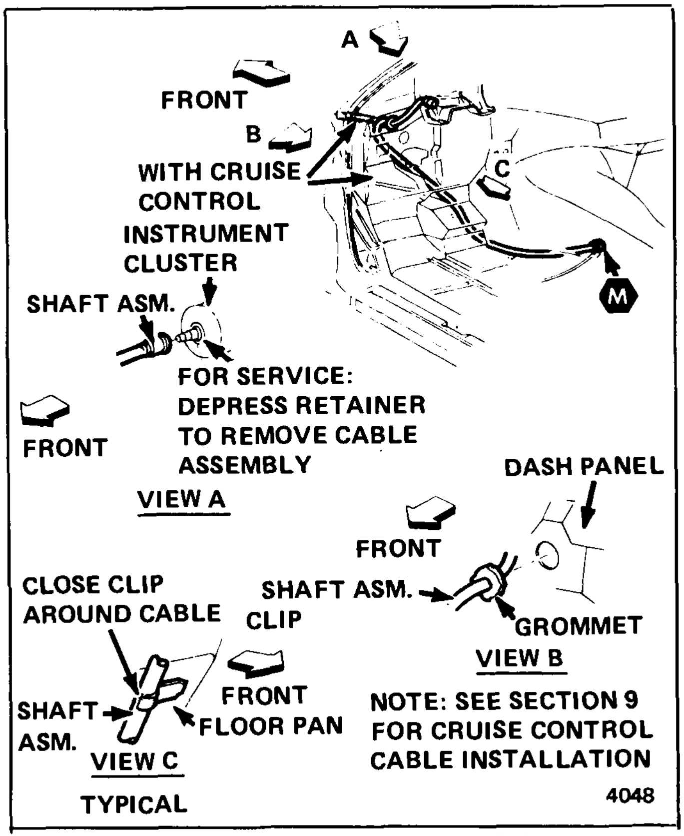


Fig. 8-80 Speedo Cable Routing - B Series

head and speedometer should be repaired.

5. Inspect cable casing, especially at transmission end, for sharp bends and breaks. If breaks are noted, replace casing.

6. To insure quiet operation, assemble cable in following manner:

a. Wipe cable clean, using lint-free cloth. Flush bore of casing with oleum spirits or suitable solvent solution and blow dry with air under pressure.

b. Place an approved speedometer cable lubricant in palm of hand.

c. Feed cable through lubricant in hand and into casing until lubricant has been applied to lower two-thirds of cable. Do not over-lubricate and do not apply lubricant to upper third of cable, since operation of cable assures adequate lubrication of upper third and at same time prevents lubricant from seeping into speedometer head.

7. Seat upper cable tip in speedometer and snap retainer on casing.

Speedo Cable and Case Replacement

When it is necessary to replace the speedometer cable and case, proper routing must be followed, as shown in Figures 8-79 through 8-83. Always insure that bend radius does not exceed 6 inches, unless the cable has a pre-formed radius. Also, insure that the cable is not positioned near exhaust pipes, or is not routed where it could be pinched or chaffed by moving parts.

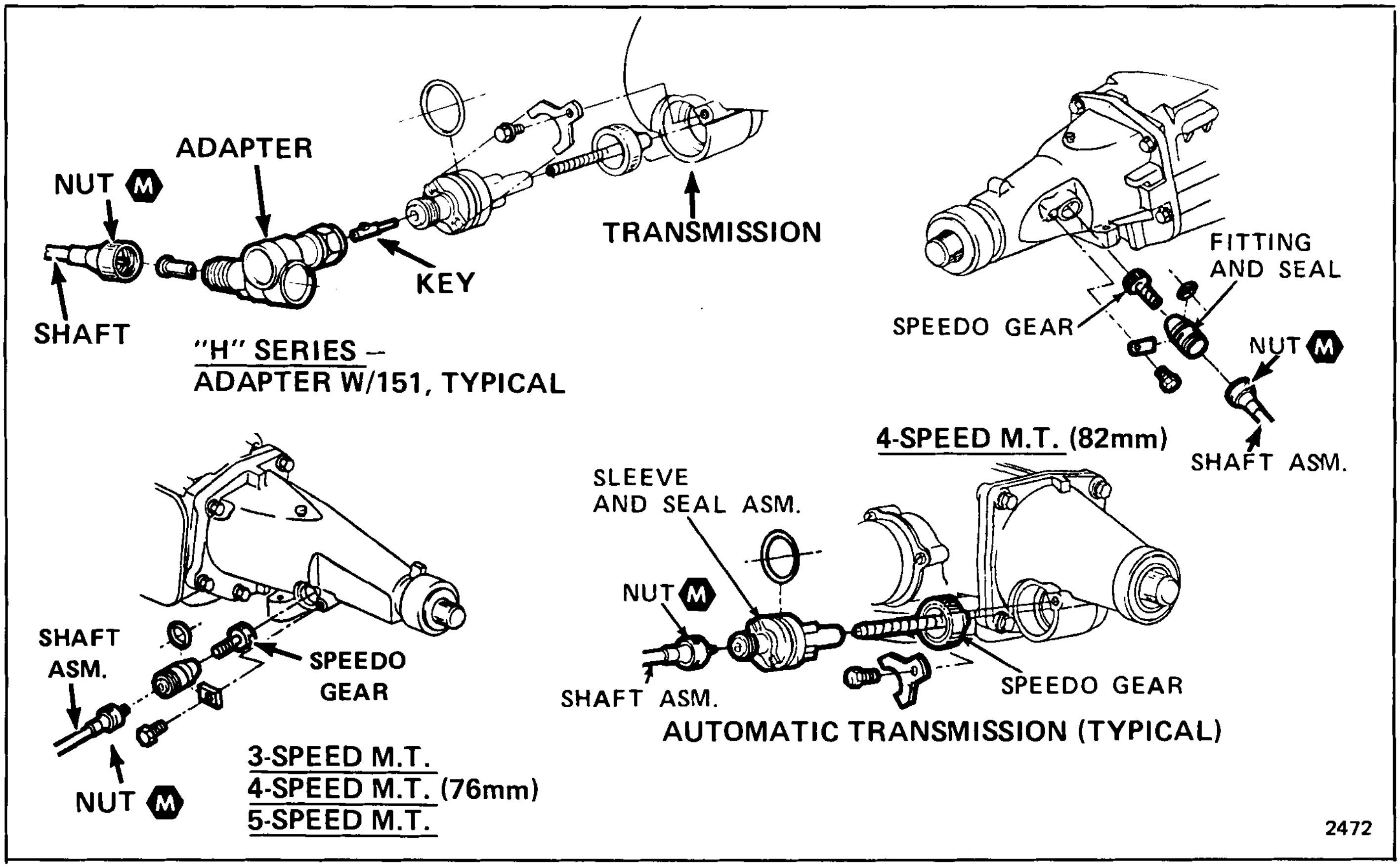


Fig. 8-78 Speedometer Cable Attachment at Transmission

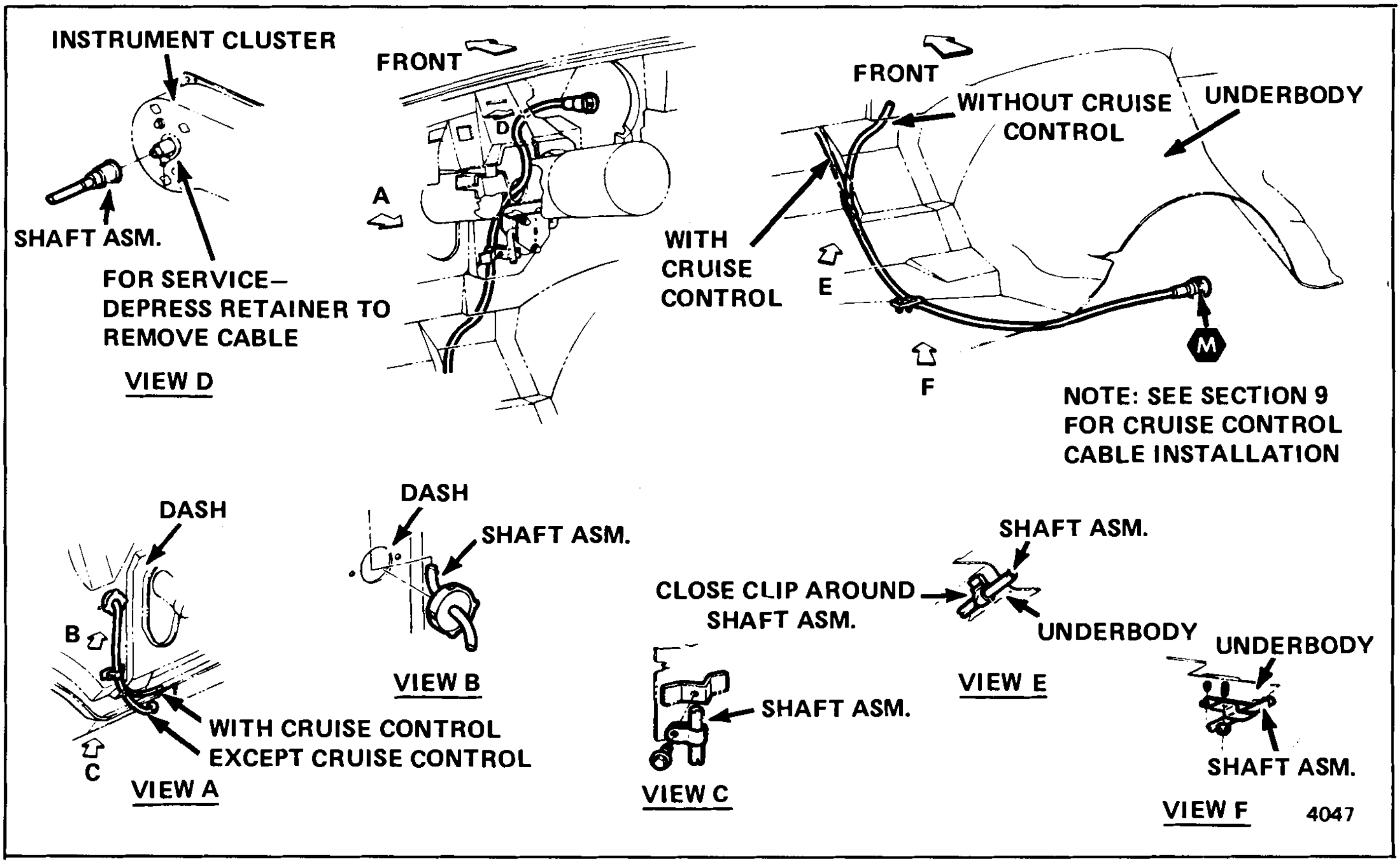


Fig. 8-79 Speedo Cable Routing - A and G Series

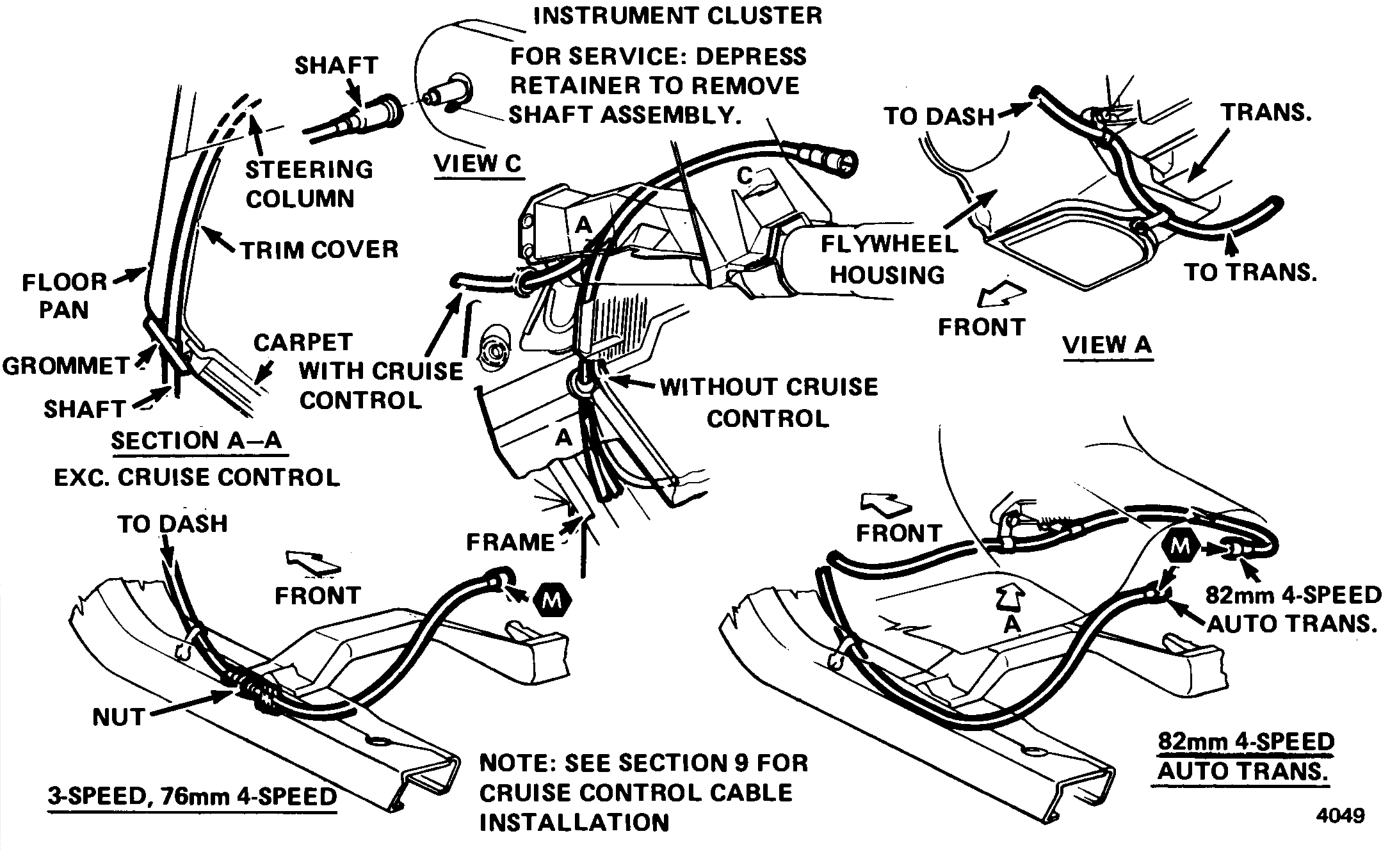


Fig. 8-81 Speedo Cable Routing - F Series

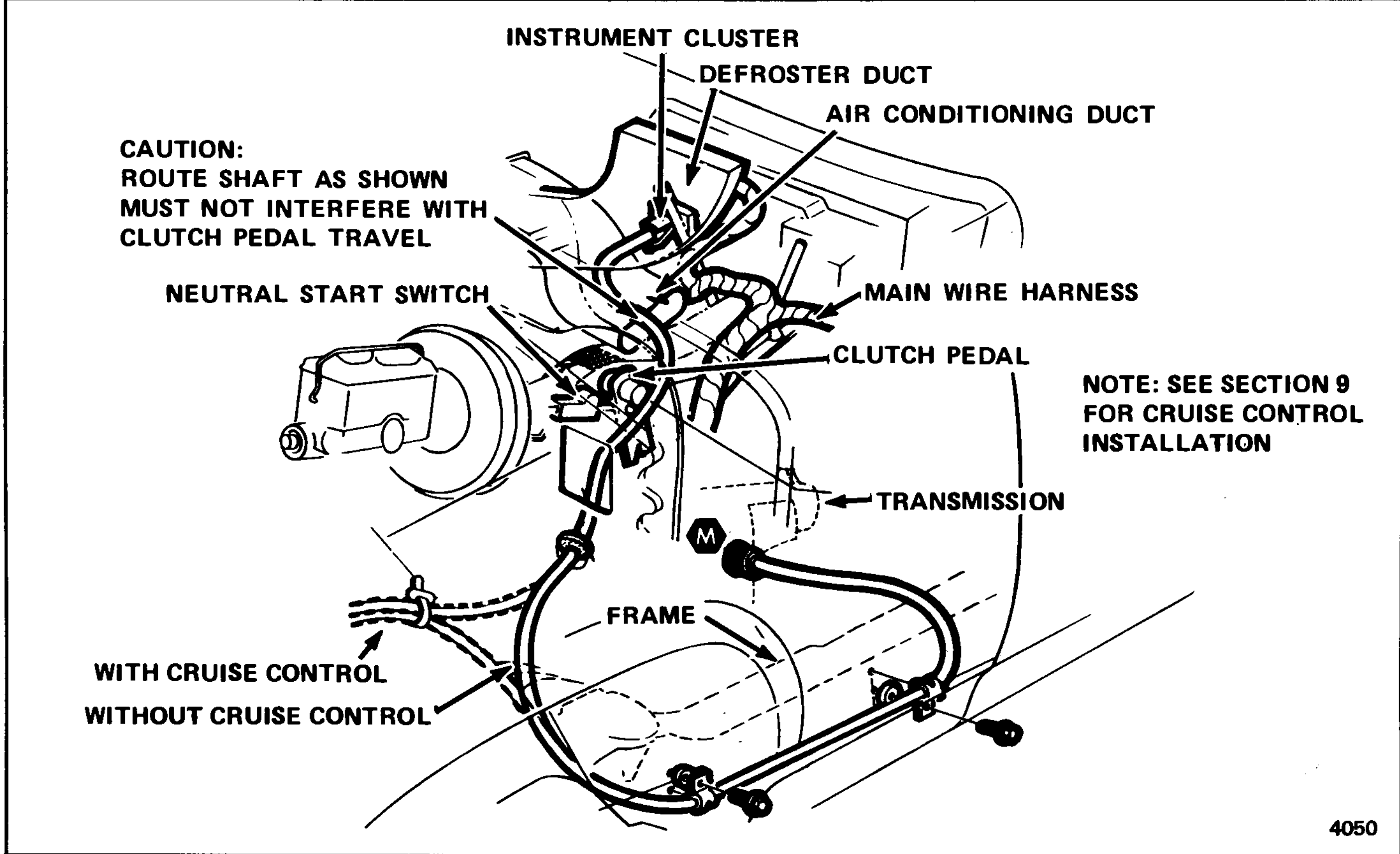


Fig. 8-82 Speedo Cable Routing - X Series

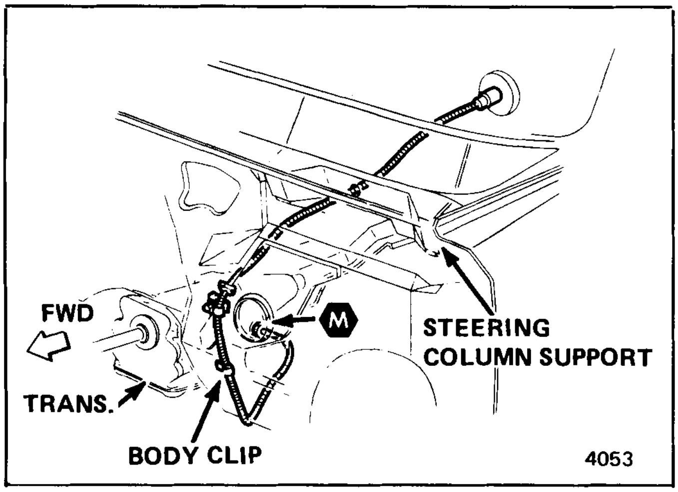


Fig. 8-83 Speedo Cable Routing - H and HM Series

HORN

A single horn is standard on some series, while dual horns are standard on some series and optional on others.

Each horn utilizes a solenoid-actuated diaphragm to develop a resonating air column in horn projector. See Fig. 8-84 for horn mounting.

A relay is inserted in the horn circuit because of high current required to operate horns. The relay reduces length of heavy gage wire required and provides a more direct connection between horns and battery. Consequently, higher voltage is available at the horns and better performance is obtained by eliminating voltage drop which otherwise would be in the horn button wiring circuit. See Fig. 8-85 for horn relay mounting.

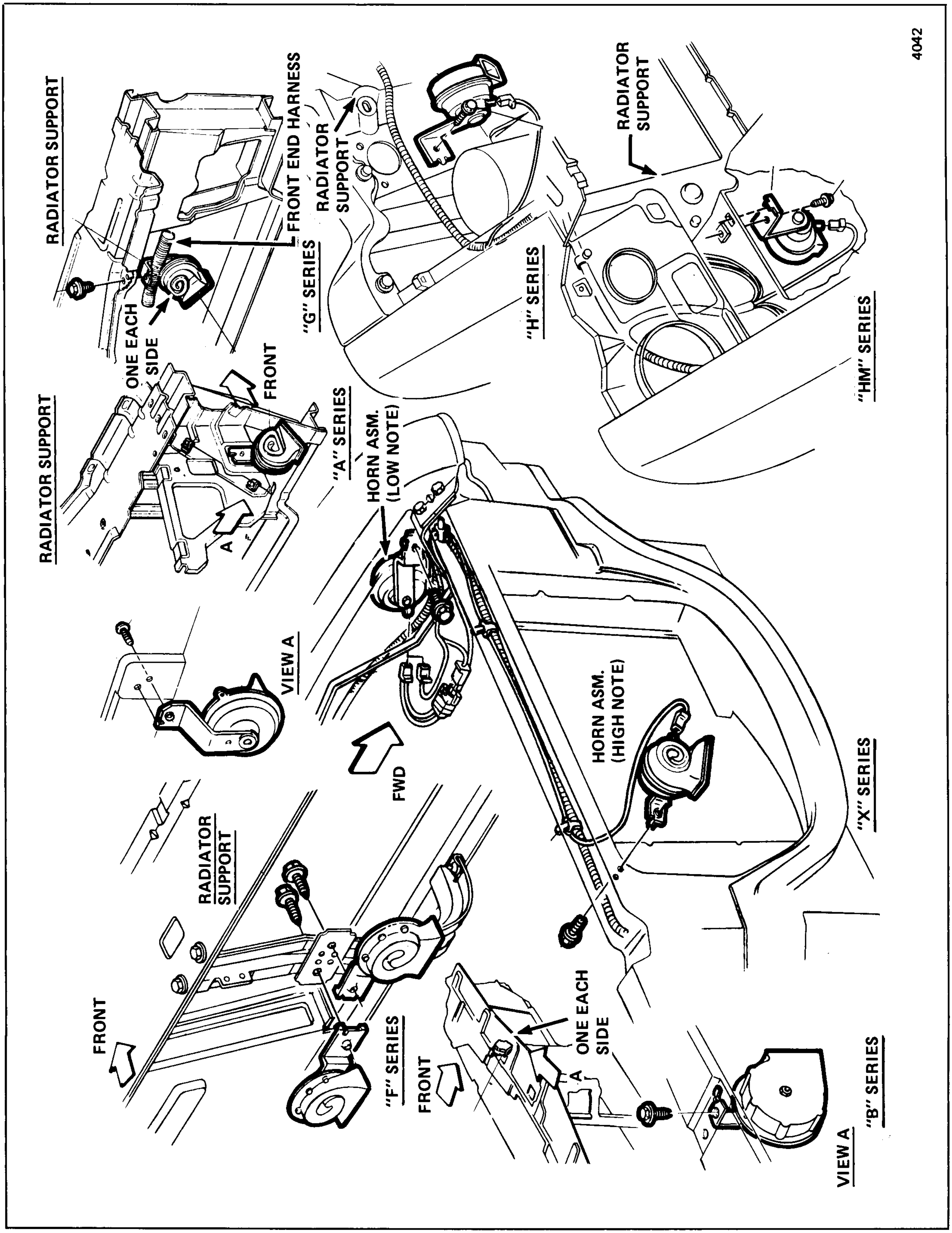


Fig. 8-84 Horn Mounting

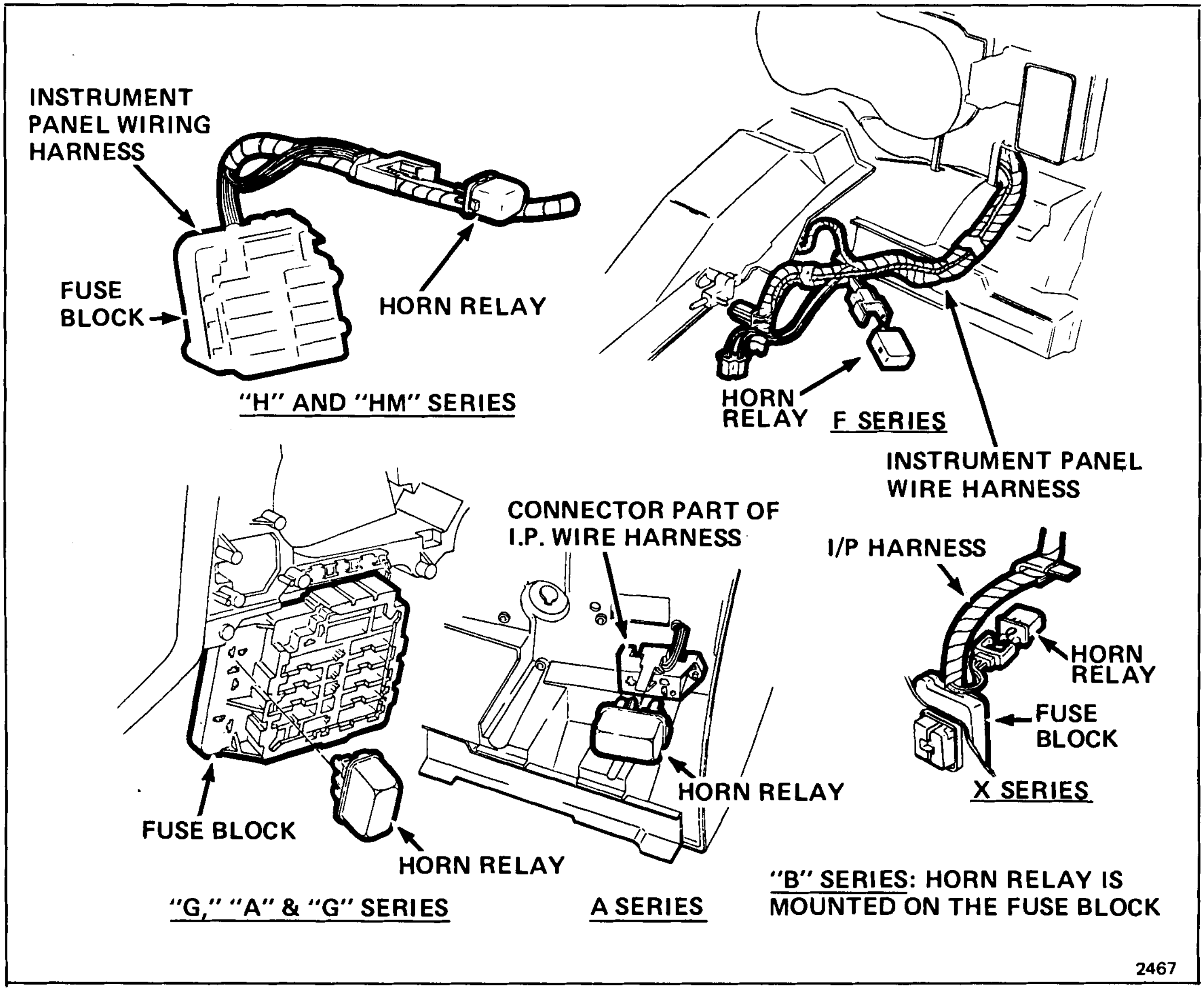


Fig. 8-85 Horn Relay Mounting

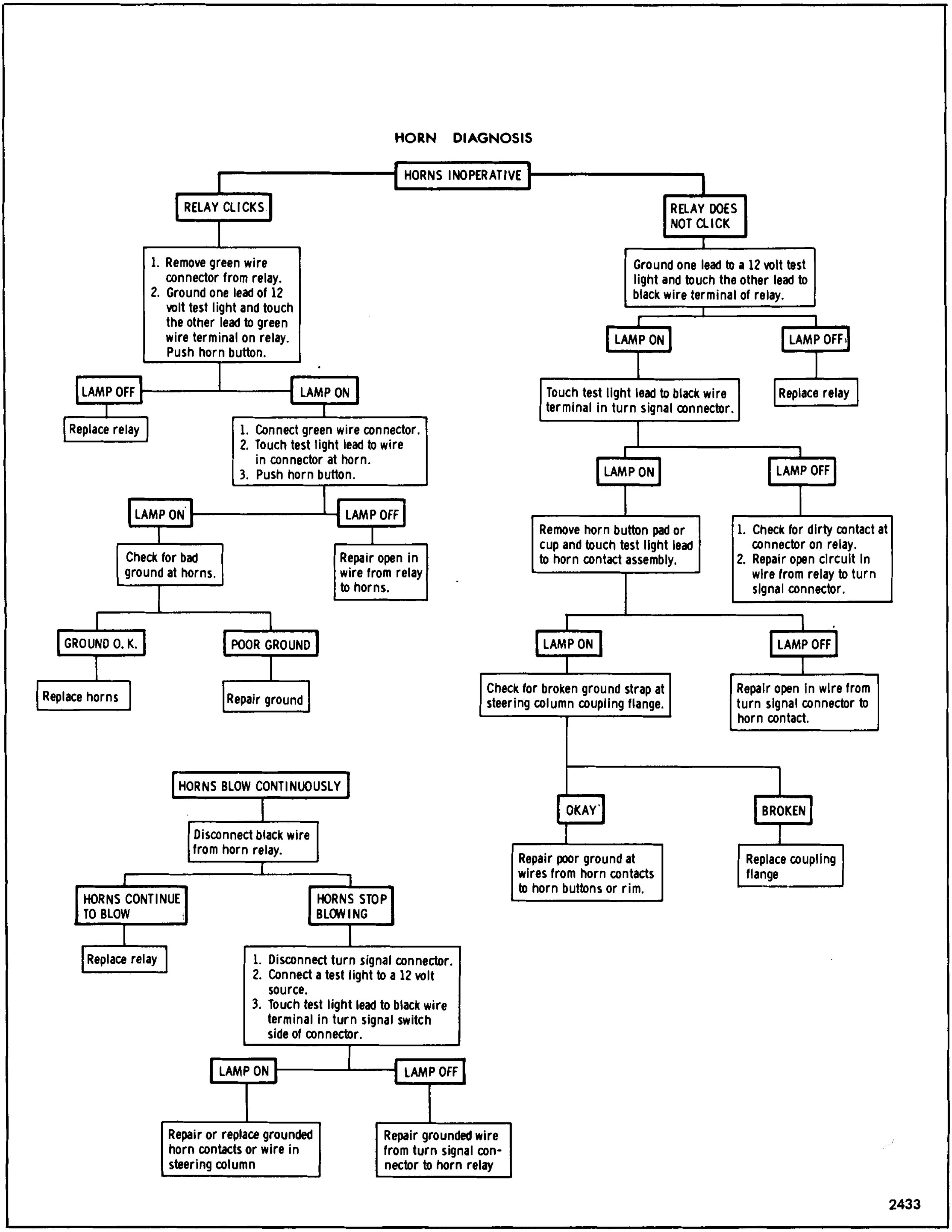


Fig. 8-86 Horn Diagnosis

LAMPS AND LIGHTING

GENERAL DESCRIPTION

IMPORTANT: When replacing any lamp socket, it is necessary to carefully check the parts catalogs for correct model application. If incorrect sockets are used for replacement, the bulb filament will be in the wrong location with respect to the lens and/or reflector. As a result, the lamp may fail to meet the required lighting standards. See Figure 8-87 for bulb usage.

The headlamp system consists of two dual headlamp units (one on X and H Series) mounted in a horizontal arrangement on each side of car. In this installation the outside lamp is a dual filament sealed beam unit. All models which use dual headlamps also use rectangular headlamps. The inside unit contains a single filament and is used as the primary source of light for the high beam.

Lighting is controlled by two switches. The first is the instrument panel main lighting switch, which has two"on" positions or notches, the first for parking, side marker, tail and license lamps, and the second or full out position for the headlamps, parking, side marker, tail and license lamps. Rotating the lighting switch knob operates a rheostat for dimming the instrument panel lamps; with the rheostat in the extreme counterclockwise position the instrument panel lights are completely off and the dome light is turned on. Second, the high beam switch (foot operated on A, F, X, H and HM Series and column operated on G, AG and B Series) determines if the headlamp high (bright) beam or low (dim) beam is on when the main lighting switch is pulled out. A blue indicator lamp on the instrument panel glows when the headlamp high beam is on.

Parking lamps use a two filament bulb. One filament is for the directional signal and the other is for the parking lamp.

Side marker lamps adjacent to the front parking lamp and in the rear quarter panel are single filament lamps. The rear lamps show red and the front amber.

Headlamps are of sealed beam construction so that light source, reflector, lens, and lens gasket are all assembled in one sealed unit. When the filament burns out or lens is cracked or broken, the entire unit is readily replaceable with a new unit.

The filaments used in the twelve volt headlamps are very fagile, therefore, the headlamp units must be handled carefully.

The headlamps must be properly aimed in order to obtain maximum road illumination and safety that has been built into the headlamp lighting equipment. The headlamps must be checked for proper aim whenever a sealed beam unit is replaced and after any adjustment or repairs of front end sheet metal assembly.

When checking headlamp aim, car must be at normal weight, that is, with gas, oil, water and spare tire. Tires must be uniformly inflated to specified pressure (see tire placard on glove box door or left front door). If car regularly carries an unusually heavy load in rear compartment or trailer, these loads should be on car when headlamps are checked. Some states have special requirements for headlamp aiming adjustment and these requirements should be known and observed.

Headlamp aiming equipment (J 25300 or equivalent) is commercially available. Follow manufacturer's recommendations for use of this equipment.

Illumination for the following components is transmitted by a system called "fiber optics"lighting. This lighting system consists of flexible plastic feeders, composed of thin plastic fibers enclosed in black plastic tubing, which transmit the light. The components are: "A" Series - Ash tray, console gearshift indicator, headlamp switch and windshield wiper switch. "AG"and "G"Series - A/C control, heater control, cigar lighter, headlamp switch and windshield wiper switch. "F"Series - Ash tray.

The taillamp bulb is a double filament bulb which acts as stop, tail and turn signal lamp. The bulb can be removed by removing the taillamp lens on station wagon series or removing bulb and socket from inside trunk on sedans and coupes.

BACK-UP LAMPS (FIG. 8-88 AND 8-89)

Back-up lamps are standard equipment on all models. On A, G, F, and X Series with automatic transmission, the back-up lamp switch is incorporated in the neutral start switch located on the steering column. B Series back-up lamp switch is mounted on the steering column, but does not have an electric neutral start switch. H and HM Series have the switch mounted on the transmission console. Manual transmissions with floor shift have the switch located on the transmission. Moving the shift lever to reverse position closes the switch and completes the electrical circuit anytime the ignition is in the "ON"or "ACC"position.

TRAFFIC HAZARD FLASHER

The traffic hazard flasher has been integrated into the steering column with a control button located on the direction signal switch housing. Pushing the button causes both the right and left hand direction signals to blink simultaneously.

The switch may be disengaged by turning the steering wheel sharply or by pulling out the button on the steering column. Unlike the direction signal flasher, the traffic hazard flasher is the variable load type and will operate regardless of the number of bulbs that are burned out. The flasher assembly is located on the fuse block.

DIRECTIONAL SIGNAL

The directional signal circuit consists of the switch, flasher, two lamps in instrument cluster, stop light filaments in rear lamp (except HM which uses separate lamps), and turn signal filaments in parking lamps and front side marker lamps.

The electrical switch, mounted in the directional signal housing, is actuated by a lever running to the inside of the housing. The directional signal switch has a double detent in each direction. By holding the direction signal lever in the first detent position the flasher will indicate a lane change. Upon releasing the lever after changing lanes, the direction

COMMON BULBS	
BACK-UP	1156
FRONT SIDE MARKER	194
REAR TAIL & STOP	1157
AMMETER TELLTALE	194
BRAKE WARNING	194
CLUSTER & SPEEDO ILLUMINATION	194
DIRECTION SIGNAL INDICATOR	194
HEADLAMP "HI" BEAM INDICATOR	194
I.P. COMPARTMENT	1891
OIL PRESSURE TELLTALE	194
SEAT BELT WARNING	194
TEMPERATURE TELLTALE	194

NOTES:
(A) PART OF LAMP ASSEMBLY—NO BULB REQUIRED.
(B) USES CLUSTER ILLUMINATION.
(C) PART OF SWITCH ASSEMBLY.
(D) FIBER OPTIC.

LAMP	"B"	"A"	"AG"	"G"	"F"	"X"	"H"	"HM"
CORNERING	1156	——	——	1295	——	——	——	——
REAR SIDE MARKER (EXC. WAGON)	168	194	194	194	194	194	194	194
(WAGON)	(A)	194	194	——	——	——	194	——
HEADLAMP (OUTER)	4652	4652	4652	4652	4652	TYPE 2	TYPE 2	4652
(INNER)	4651	4651	4651	4651	4651	——	——	4651
LICENSE (EXC. WAGON)	168	194	194	194	194	194	194	194
(WAGON)	194	194	194	——	——	——	194	——
PARK & DIRECTION SIGNAL	1157NA	1157NA	1157NA	1157NA	1157NA	1157NA	1157NA	1157
REAR SIGNAL	1157	1157	1157	1157	1157	1157	1157	1156
A/C CONTROL	1895	1895	(D)	(D)	1895	194	INDIRECT	194
ASH TRAY ILLUM. (I.P.)	1445	(D)	(D)	(D)	(D)	(D)	(B)	——
(CONSOLE)	——	558	558	558	——	558	——	——
AUTO. TRANS. SHIFT IND. (DASH)	(B)	(B)	(B)	(B)	——	(B)	——	——
(CONSOLE)	——	(D)	(D)	(D)	1445	——	194	194
CIGAR LIGHTER ILLUMINATION	1445	1445	(D)	(D)	1445	(D)	——	——
CLOCK (IN CLUSTER)	(B)	1895	(B)	1895	(B)	(B)	(B)	(B)
(BELOW RADIO)	——	——	1895	1895	——	——	——	——
(DIGITAL)	1895	——	——	——	——	——	——	——
COURTESY (I.P.)	906	89	89	89	89	631	——	——
(DOOR/WARNING)	562	——	——	562	——	——	——	——
(CONSOLE)	——	——	89	89	——	——	——	——
(QUARTER UPPER)	——	——	——	562	——	——	——	——
(WAGON REAR)	562	562	562	——	——	——	——	——
DOME	561	561	561	561	211	561	561	561
FUEL ECONOMY VACUUM GAGE	(B)	(B)	(B)	(B)	(B)	——	——	——
FUEL GAGE & VOLTMETER ILLUM.	——	——	——	——	1895	——	——	——
FIBER OPTIC SUPPLY	——	158	192	192	——	——	——	——
HEADLAMP/WIPER SW. ILLUM.	73	(D)	(D)	(D)	(B)	(D)	(B)	194
HEATED BACKLIGHT "ON" IND.	(C)	(C)	(C)	(C)	(C)	——	168	168
HEATER CONTROL	1895	1895	(D)	(D)	1895	194	INDIRECT	194
LOW COOLANT TELLTALE	——	——	——	——	——	——	194	194
LUGGAGE COMPARTMENT	1003	1003	1003	1003	1003	1003	——	——
RADIO: ILLUM. (AM)	1893	1893	1893	1893	1895	1893	1816	1816
(AM/FM)	216	1893	1893	1893	1895	——	1816	1816
(AM/FM STEREO)	216	564	564	564	216	216	1816	1816
(INTEGRAL TAPE)	——	566	566	566	——	——	——	——
STEREO IND. (RADIO/TAPE)	DRAKE 66	DRAKE 66	DRAKE 66	DRAKE 66	——	——	——	——
(RADIO ONLY)	——	——	9343731	9343731	DRAKE 66	DRAKE 66	——	DRAKE 66
READING LAMP	1004	1004	1004	1004	——	——	——	——
TACHOMETER (IN CLUSTER)	——	(B)	(B)	(B)	(B)	——	(B)	(B)
TAILGATE AJAR WARNING	194	1895	194	——	——	——	——	——
VISOR VANITY MIRROR ILLUM.	74	74	74	74	——	——	——	——

4041

Fig. 8-87 Bulb Usage

signal lever automatically returns to the off position and cancels the lane change signal. Normal operation of the direction signals is achieved by passing the lever through this intermediate detent to the normal stop position. After a turn is completed, the return of the steering wheel to straight ahead position automatically turns off signal lamps.

When the system is operating correctly, the frequency of turn signal is about 60-120 flashes per minute. If either a front or rear signal bulb burns out, the reduced current in the circuit will cause the I.P. signal lamp on that side of car to burn steadily when the system is activated.

The flasher is a sealed unit and is non-adjustable. If flasher is inoperative, it must be replaced.

NOTE: Do not use a "heavy-duty" variable load flasher such as hazard flasher, since it will not indicate bulb outage.

The flasher makes an audible signal when it is properly positioned. This audible signal serves as an additional warning when signal is operating.

COLUMN MOUNTED DIMMER SWITCH

The headlamp dimmer switch on G, and AG Series is located on the outside of the steering column at the base of the turn signal lever. B Series switch is located on the column below the instrument panel, and is actuated by a rod from

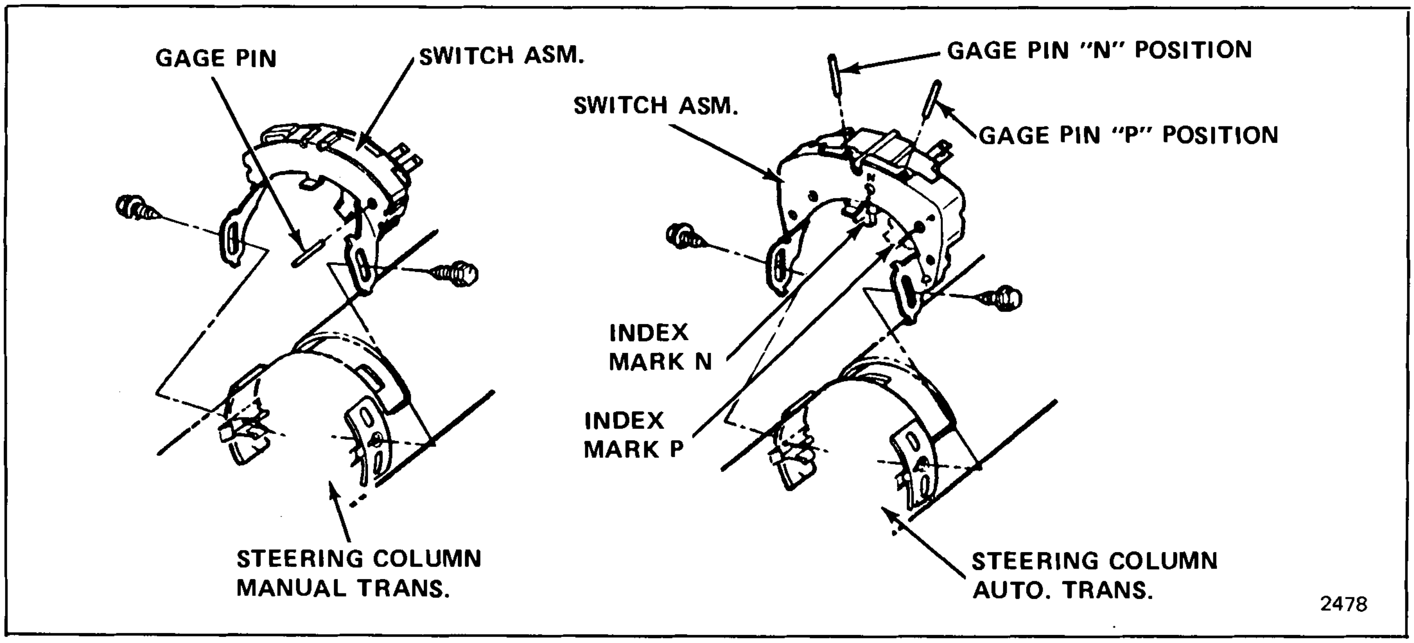


Fig. 8-88 Neutral Start and Back-up Lamp Switch

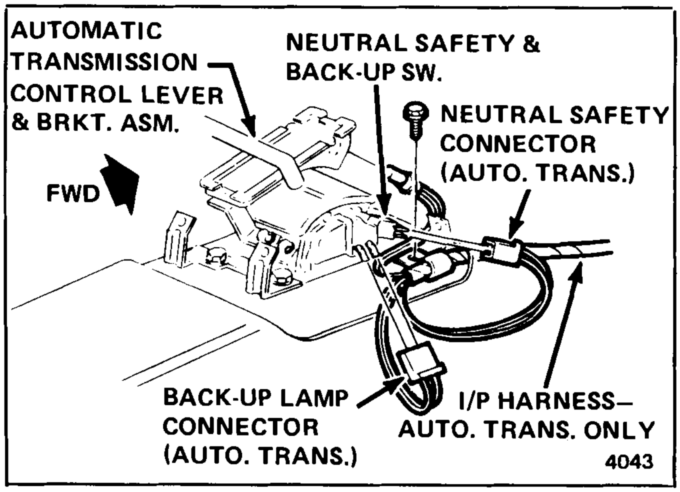


Fig. 8-89 Neutral Start and Back-up Lamp Switch

the turn signal lever.

The turn signal lever pivots to actuate the dimmer switch. The switch is activated when the outer end of the lever is pulled toward the driver. As with the conventional foot operated switch, when the switch is activated by a single movement of the lever the high beams come on. When the switch is activated again the lights will switch to low beam. See the Steering Section for further details.

CORNERING LAMPS

Cornering lamps, optional equipment on B and G Series only, are single filament lamps which illuminate when the turn signal is engaged and the headlamp switch is on. The cornering lamp will not blink and turns off when the turn signal cancels. Current is available to the cornering lamps via the front end harness and is fused through the fuse block.

SIDE MARKER LAMPS

These lamps are standard equipment on all cars. The lamps become functional with the headlamp switch and are designed to illuminate the side of the vehicle. The front side marker lamps flash with the turn signals in operation while the rear side marker lamps are illuminated only by the headlamp switch. The circuit is fused with the tail, cornering and park lamps.

DIAGNOSIS

Troubles in the lighting circuits are caused by loose connections, open or shorted wiring, burned out bulbs, failed switches, inadequate ground, or blown fuses. In each, trouble diagnosis requires following through the circuits until the source of difficulty is found. To aid in making an orderly check, refer to the wiring diagrams shown at the end of Section 8.

TURN SIGNAL SYSTEM

When a complaint is made involving the turn signal system, it must first be determined whether the problem is mechanical or electrical. If mechanical, the switch, column casting, or cancel cam may be the cause, and one or more of these should be repaired or replaced. If electrical, it must be determined whether the switch or the chassis wiring is in need of repair or replacement.

The wiring diagram, found at the end of this section, should be used to trouble shoot the chassis and body wiring.

The nature of the customer complaint will generally point to the problem area. Should it refer to the operation of the turn signal lever, not cancelling from a turn, or not returning from lane change, it is possible that the switch is mounted loosely or off center.

Should lamps not light or flash or if one part of the system itself is out, the problem would appear to be electrical and could be caused by faulty chassis wiring, a partially inoperative turn signal switch, burned out lamps, flashers or fuses.

ELECTRICAL CHECK

The most common turn signal system problems are generally electrical and may easily be fixed by the replacement of fuses, lamps, or flashers.

First make these checks and replace any non-operative components.

1. Check fuses. Replace if blown. If new fuse blows, replace flasher in system. (There are two (2) flashers in the signal switch system. The hazard warning flasher and turn signal flasher are located on the fuse block on the G, AG and B Series, while the turn signal flasher is up under the instrument panel adjacent to the column on the A, F, X, H and HM Series).

2. Check for secure connection at the chassis switch connector. This is the turn signal on the column. Secure if loose. Check all individual wire terminals for proper seating in the connector bodies. Terminals should be locked in place.

3. Depress hazard warning button and check all lights in signal switch system. Replace any which do not work. If **all** lamps light when hazard warning is depressed, but flashing does not occur, replace hazard warning flasher located on fuse block.

4. If **all** directional lamps on the indicated side light when lane change or turn indicator is acutated, but no flashing occurs, replace the turn signal flasher.

The above four steps will, in most cases, cure the common signal switch system troubles. If the system is still not operating correctly, determine whether the chassis wiring or the signal switch itself is at fault.

To check the electrical function of the switch in the vehicle, refer to the Steering Section.

HEADLIGHT

One Headlight Inoperative or Intermittent

CAUSE	CORRECTION
Loose connection.	Secure connections to sealed beam including ground. (Black Wire).
Defective sealed beam.	Replace.

One or More Headlights are Dim

CAUSE	CORRECTION
Open ground connection at headlight.	Repair black wire connection between sealed beam and body ground.
Black ground wire mislocated in headlight connector (sealed beam).	Relocate as shown in Headlamp Circuit.

One or More Headlights—Short Life

CAUSE	CORRECTION
Voltage regulator defective.	Check and replace if necessary.

All Headlights Inoperative or Intermittent

CAUSE	CORRECTION
Loose connection.	Check and secure connections at dimmer switch and light switch.
Defective dimmer switch.	Check voltage at dimmer switch with test bulb. If bulb lights only at light blue wire terminal, replace dimmer switch (does not apply to G and AG Series, which uses ground side switching.
Open wiring - light switch to battery.	Check voltage at light blue wire with test bulb. If bulb lights at light switch light blue wire terminal, but not at dimmer switch, repair open wire.
Open wiring - light switch to battery.	Check voltage at light switch red wire terminal with test bulb. If bulb fails to light, repair open red wire circuit to battery

	(possible open fusible link).
Circuit shorted to ground.	If, after a few minutes operation, headlights flicker on and off and/or a thumping noise can be heard from the light switch (circuit breaker opening and closing), repair short to ground in circuit between light switch and headlights. After repairing short, check for headlight flickering after one minute operation. If flickering occurs, the circuit breaker has been damaged and light switch must be replaced.
Defective light switch.	Check voltage at light switch red and blue wire terminals with test bulb. If bulb lights at red wire terminal but not at light blue, replace light switch.

High or Low Beam Will Not Light or Intermittent

CAUSE	CORRECTION
Open connection or defective dimmer switch.	Check voltage at dimmer switch headlight terminals with test light. If bulb lights at headlight terminals, repair open wiring between dimmer switch and headlights. If bulb will not light at one of the dimmer switch headlight terminals, replace dimmer switch.
Circuit short	Follow diagnosis shown above under "All Headlights Inoperative or Intermittent".

CORNERING LAMPS

One Lamp Inoperative

CAUSE	CORRECTION
Loose Connection.	Secure connector near lamp.
Bulb out.	Replace burned out bulb.
Open ground connection.	If bulb is known good and test bulb lights at connector near lamp, repair open ground connection.
Open wiring.	If test bulb lights on both sides of steering column connector, repair open wiring between connector and lamps. If not, check for open connection in connector.
Defective directional signal switch.	If test bulb lights at brown wire terminals of steering column connector but not at gray (left turn) or black/white (right turn) terminal, replace directional signal switch.

Both Lamps Inoperative

CAUSE	CORRECTION
Taillamp fuse blown.	If taillamps do not light, replace taillamp fuse. if blown. If new fuse blows, repair short to ground between fuse and lamps.
Loose connection.	Secure connectors at light switch and steering column.

Open wiring.	If taillamps light, check voltage at steering column connector brown wire. If test bulb lights on lamp side of connector only, repair terminal. If taillamps do not light, check for open wiring between light switch and battery.
Defective directional signal switch.	If taillamps light, and test bulb lights on both sides of steering column connector, replace directional signal switch.
Defective light switch.	If taillamps do not light and test bulb lights at light switch terminal #5 but not at #4, replace light switch.

TURN SIGNAL AND HAZARD WARNING LAMPS

Turn Signal Inoperative—One Side

CAUSE	CORRECTION
Bulb out (flasher cannot be heard).	Turn on hazard warning system. If one or more lamps do not operate, check for defective bulb.
Open wiring or ground connection.	Turn on hazard warning system. If one or more lamps do not operate, check for defective bulb.
Open wiring or ground connection.	Turn on hazard warning system. If one or more bulbs do not operate, use 12 volt test lamp to check voltage at lamp socket. If test bulb lights, repair open ground connection. If not, repair open wiring between bulb socket and turn signal switch.
Improper bulb or defective turn signal switch.	Turn on hazard warning system. If all front and rear lamps operate, check for improper bulb (1034 instead of 1157). If bulbs are OK, replace defective turn signal switch.
Short to ground (flasher can be heard, but no lamps operate).	Locate and repair short to ground by disconnecting front and rear circuits separately.

Turn Signals Inoperative—Both Sides

CAUSE	CORRECTION
Open fuse (turn signal).	Turn on hazard warning system. If all lamps operate, replace turn signal fuse if blown. If new fuse blows, repair short to ground between fuse and lamps.
Defective flasher (located behind instrument panel near steering column).	If turn signal fuse is OK, and hazard warning system will operate lamps, replace defective turn signal flasher (behind instrument panel near steering column or in fuse block).
Loose Connection.	Secure steering column connector. If test bulb lights only on one side of purple wire terminals in connector, clean or tighten connector contacts.

Open wiring or defective turn signal	If test bulb lights when connected to both sides of purple wire connection in steering column connector, replace defective turn signal switch. If test bulb does not light on either side of the connector, repair open circuit between fuse and connector.

Hazard Warning Lamps Inoperative

CAUSE	CORRECTION
Open fuse (stop-hazard).	Switch on turn signals. If lamps operate, replace stop-hazard fuse if blown. If new fuse blows, repair short to ground. (Could possibly be in stop light circuit.)
Defective flasher (located on fuse panel).	If stop-hazard fuse is OK, switch on turns signals If lamps operate, replace defective hazard flasher on fuse panel.
Open wiring or defective turn signal switch.	With 12 volt test bulb, check voltage at brown wire in turn signal steering column connector. If test bulb does not light on either side of connector, repair open circuit between flasher and connector. If test bulb lights only on feed side of connector, clean connector contacts. If test bulb lights on both sides of connector, replace defective turn signal switch assembly.

SIDE MARKER LAMPS

One Lamp Inoperative

CAUSE	CORRECTION
Directional signal bulb out(front lamp).	Turn on directional signal. If signal bulb does not light, replace bulb. (Bulb filament provides ground path for marker lamp bulb through light blue or dark blue/white wires.)
Side marker bulb out.	Replace burned out bulb.
Loose connection or open wiring.	Check voltage at bulb socket brown wire terminal with test bulb. If bulb lights, repair open ground circuit. If bulb does not light, repair open brown wire circuit.

Front or Rear Lamps Inoperative

CAUSE	CORRECTION
Loose connection or open ground connection.	If associated tail or park lamps do not operate, secure all connectors in brown wire circuit. If park and taillamps operate, repair open ground connections.
Multiple bulbs out.	Replace burned out bulbs.

All Lamps Inoperative

CAUSE	CORRECTION
Fuse blown.	If park and taillamps do not operate, replace tail fuse if blown. If new fuse blows, check for short to ground between fuse panel and lamps.
Loose connection.	Secure connector to light switch.
Open wiring.	Check voltage at tail fuse with test bulb. If bulb lights, repair open wiring between fuse and light switch. If not, repair open wiring between fuse and battery. (Possible open fusible link.)
Defective light switch.	If test bulb lights at light switch terminal #5 but not at terminal #4, replace light switch.

TAIL, PARK OR LICENSE LAMPS

One Side Inoperative

CAUSE	CORRECTION
Bulb out.	Replace.
Open ground connection at bulb socket or ground wire terminal.	Jumper bulb base socket connection to ground. If lamp lights, repair open ground circuit.

Both Sides Inoperative

CAUSE	CORRECTION
Tail lamp fuse blown.	Replace fuse. If new fuse blows, repair short to ground in brown wire circuit between fuse panel through light switch to lamps.
Loose connection.	Secure connector at light switch.
Open wiring.	If test bulb does not light on either side of fuse, repair open circuit between fuse panel and battery. (Possible open fusible link.) If test bulb lights at light switch brown wire terminal #5, repair open wiring between light switch and lamps.
Multiple bulb burnout.	If test bulb lights at lamp socket brown wire terminal replace bulbs.
Defective light switch.	If test bulb lights at light switch terminal #4 (brown/white) but not at terminal #5 (brown), replace defective light switch.

BACK-UP LAMPS

One Lamp Inoperative or Intermittent

CAUSE	CORRECTION
Open ground connection.	Repair bulb ground circuit.
Loose connection.	Tighten connectors.
Bulb out.	Replace bulb.

Both Lamps Inoperative or Intermittent

CAUSE	CORRECTION
Fuse blown.	Replace fuse. If new fuse blows, repair short to ground in circuit from fuse through neutral-safety switch to back-up lamps.
Loose connection or open circuit.	Secure all connectors. If OK, check continuity by voltage checking circuit from fuse to lamps with test bulb. If test bulb does not light on either side of fuse, check open circuit from battery to fuse.
Neutral-safety swtich misadjusted (open when shift lever is in reverse position).	Adjust
Defective neutral-safety swtich.	With ignition on, check voltage at terminals with switch in back-up position. If bulb lights at pink wire terminal but not at output terminal, replace ignition switch.
Defective Ignition Switch	If test bulb lights at ignition switch battery terminal but not at output terminal, replace ignition switch.

Lamps Will Not Turn Off

CAUSE	CORRECTION
Neutral-safety switch misadjusted (closed when shift lever is not in reverse position).	Adjust.

STOP LAMPS

One Bulb Inoperative

CAUSE	CORRECTION
Bulb out.	Replace bulb.

One Side Inoperative

CAUSE	CORRECTION
Loose connection, open wiring or defective bulbs.	Turn on directional signal. If lamp does not operate, check bulbs. If bulbs are OK, secure all connections. If lamp still does not operate, check for open wiring with a test bulb.
Defective directional signal switch or cancelling cam.	If lamp will operate by turning on directional signal, the switch is not centering properly during cancelling operation.

	Replace defective cancelling cam or direction signal switch.

All Inoperative

CAUSE	CORRECTION
Stop-hazard fuse blown.	Replace. If new fuse blows, repair short to ground in circuit between fuse and lamps.
Stop-switch misadjusted or defective.	With test bulb check voltage with brake pedal depressed at white wire terminal in steering column connector. If bulb does not light, check stop switch for proper adjustment. If adjustment is OK, replace stop switch.

Will Not Turn Off

CAUSE	CORRECTION
Stop switch misadjusted or defective.	Readjust properly. If switch still malfunctions, replace.

ON-CAR SERVICE

REMOVE AND REPLACE

Headlamps - The headlamp assembly can be replaced from the front of the vehicle by removing trim rings or bezels, releasing retaining spring, twisting assembly to remove, and disconnecting wiring harness connector. Refer to Section 2C, Chassis Sheet Metal, for further details. Headlamps should be aimed after replacement.

To replace only the headlamp bulb, remove outer trim ring or bezel, then remove the outer retaining ring around the bulb. Pull the bulb out and disconnect the wiring. Connect the wiring to the new bulb, replace in the housing, replace the retaining ring insuring that the bulb seats properly in the housing, and replace the outer bezel.

All Other Front Bulbs - Bulbs at the front of the car can normally be replaced from beneath the car. Some bulbs may require removal of the outer lens to replace. Remove the socket from the bulb housing by twisting. Then replace the bulb, and reinstall the socket. Check the system for proper operation. Refer to Section 2C for lamp housing removal and replacement.

Rear Bulbs - Information on rear bulbs and housings is contained in the Body Service Manual. All bulbs except B Series and A Series Station Wagon can be reached inside the rear compartment. B Series and A Series Wagon can be replaced from beneath the rear bumper.

SEAT BELT WARNING SYSTEM

GENERAL DESCRIPTION

The seat belt warning system on all 1977 cars is the "8-SECOND-ON"system.

This system will activate a warning light and buzzer for approximately 8 seconds when the ignition key is turned to the "ON"position if the driver's seat belt is not buckled. NOTE: Rapid cycling of the system will result in a decrease in the time period.

The light and buzzer with timer sequence of operation is as follows:

1. "DRIVER'S BELT UNFASTENED" Turn ignition switch "ON"- light and buzzer both come on for approximately 8 seconds, then go off and stay off. If belt buckle is fastened prior to 8 second turn-off time, buzzer will go off and light stays on for balance of 8 second delay time.

2. "DRIVER'S BELT FASTENED". Turn ignition switch "ON"- light comes on; buzzer does not. At end of approximately 8 seconds, light goes off and stays off. If buckle is unfastened prior to 8 second turn-off time, buzzer and light both stay on for balance of 8 second delay time.

NOTE: Light always comes on for full 8 second time, while the buzzer is controlled by the driver's seat belt buckle switch on B, H and HM Series, and by the retractor switch on all others. Light is controlled only by ignition switch and timer.

DIAGNOSIS

See Figure 8-90 for the seat belt system diagnosis.

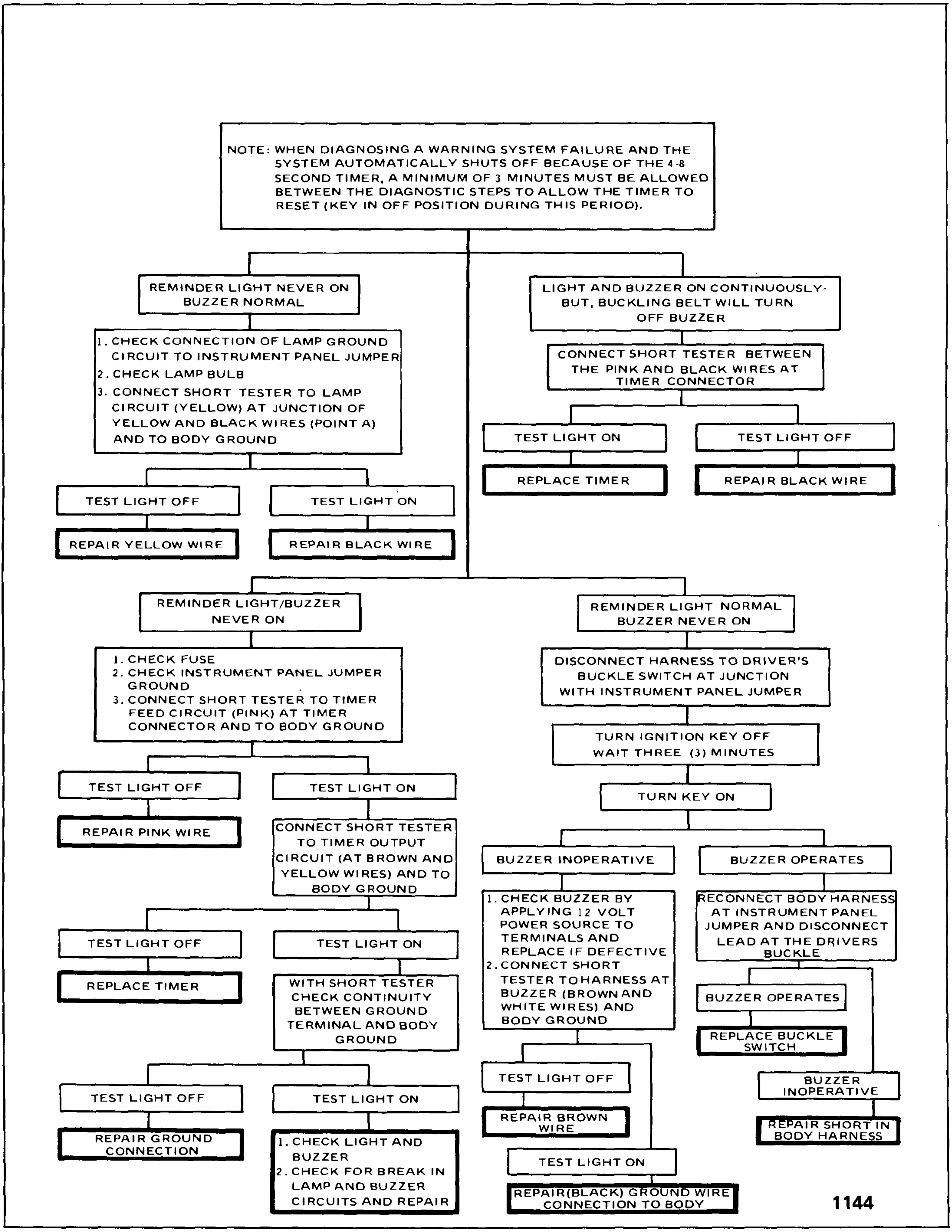


Fig. 8-90 Seat Belt Diagnosis

WINDSHIELD WASHER AND WIPER SYSTEM

The windshield wiper motor and all connecting linkage is covered in the Body Service Manual.

Controlled cycle wiper systems are covered in the Accessory Section.

Two types of washer systems are used. The first, a demand type, sprays fluid on the windshield while the washer switch is depressed, and stops when the switch is released. This system is used on H, HM, F and X Series. The second type, used on A, G and B Series, will operate for a predetermined number of pulses when the washer button is depressed.

Refer to the Instrument Panel illustrations for replacement of the wiper/washer switch.

Any time washer nozzles must be replaced, insure that the spray pattern falls within the area shown in Figure 8-91.

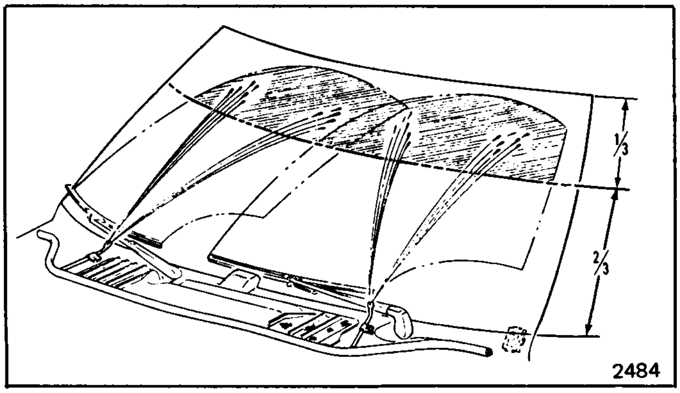


Fig. 8-91 Windshield Washer Target Area

Circuit Name	Circuit Color	Circuit Number
FEED CIRCUITS - GENERAL		
Feed, Battery - Unfused	Red	2
Feed, Battery - Fused	Orange	40 (1)
	Orange	140 (1)
	Orange	240 (1)
	Orange	340 (1)
Feed, Ign. Sw. "On" Controlled - Unfused	Pink	3
Feed, Ign. Sw. "On" Controlled - Fused	Pink-Black	39 (1)
	Pink-Black	139 (1)
	Pink-Black	239 (1)
Feed, Ign. Sw. Accsy. Controlled - Unfused	Brown	4
Feed, Ign. Sw. Accsy. Controlled - Fused	Brown-White	41 (1)
	Brown-White	141 (1)
	Brown-White	241 (1)
Feed, Battery - Circuit Breaker Protected	Orange-Black	60
Feed, Relay Controlled - Circuit Breaker Protected	Red-White	70
Feed, Cutout Sw. Controlled - Circuit Breaker Protected	Pink-Black	90
STARTER AMMETER AND IGNITION		
"Hot" Circuit - Ignition (or Master Switch) On - Unfused	Pink	3
Primary Ignition Voltage - Dropping Resistor .38 ohm./ft.	White-Purple & Orange	3
Primary Ignition Voltage - Dropping Resistor .30 ohm./ft.	White-Red & Black	3
Neutral Safety Switch Feed	Purple	5
Starter Solenoid Feed		
Primary Ignition Resistance Bypass		
Ammeter - Generator	Purple	6
Ammeter - Battery	Yellow	7
	Black	105
FORWARD LAMPS	Black-White	106
Side Marker Lamps		
Dimmer Switch Feed		
Headlamp, High Beam	Brown	9
Headlamp, Low Beam	Light Blue	10
Front Parking Lamps	Light Green	11
L. H. Indicator and Front Direction Light	Tan	12
	Purple	13
R. H. Indicator and Front Direction Light	Light Blue	14
Fog or Drive Lamp	Dark Blue	15
R. H. Cornering Lamp		
L. H. Cornering Lamp	Purple	34
	Black	58
INSTRUMENT PANEL	Gray	57
L. H. Indicator and Front Direction Light		
R. H. Indicator and Front Direction Light	Light Blue	14
Direction Signal Switch, Feed from Flasher	Dark Blue	15
	Purple	16

Circuit Name	Circuit Color	Circuit Number
INSTRUMENT PANEL (Continued)		
Direction Signal Switch, Feed from Stop Switch	White	17
Flasher, Fused Feed	Dark Blue	38
Instrument and Panel Lights, (Fused No. 44 Circuit)	Gray	8
Instrument and Panel Lights, Feed (Usually Light Switch to Fuse)	Dark Green	44
Radio Feed	Yellow	43
Rear Seat Speaker Feed from Radio Single or Rt., Stereo	Dark Blue	46
Map Light	Yellow	32
Warning Light - Brake Alarm	Tan	33
Back-Up Switch or Parking Brake Alarm Feed	Dark Green	75
Over-Speed Warning Light	Dark Blue	107
Horn Switch	Black	28
REAR LAMPS		
Tail and License Lamp	Brown	9
Stop and Direction Lamp, or Direction Lamp Only - Rear L. H.	Yellow	18
Stop and Direction Lamp, or Direction Lamp Only - Rear R. H.	Dark Green	19
Stop Lamp (Trailer)	Red	20
Marker and Clearance Lamps (Trailers - ICC Requirement)	Black	45
Auxiliary Circuit (Trailer)	Dark Blue	47
Back-Up Lamp	Light Green	24
GENERATOR AND REGULATOR		
Generator or Generator Armature to Voltage Regulator "A" (Includes Generator Telltale Circuit) or Regulator to Ignition Switch (Truck)	Brown	25
Field Circuit (F) (Gen./Reg.)	Dark Blue	26
Generator (Alternator) to Regulator	White	119
Generator (Alternator) External Resistance	Color depends on Resistance	130
2 ohms per foot	Brown-White	
1 ohm per foot	Black-Pink	
SI Alternator Regulator Sensing Circuit	White	102
SENDING UNITS		
Tachometer to Coil	Brown	121
Fuel Gauge to Tank Unit	Tan	30
Oil Pressure - Engine	Dark Blue	31
Telltale Temp. Gauge (Hot), or Std. Temp. - Readable Gauge	Dark Green	35
Telltale Circuit - Temp. Gauge (Cold)	Light Green	36
Telltale Temperature Gauge (Hot)	Dark Green-White	112 (2)
WINDSHIELD WIPERS		
Windshield Wiper - Low	Black	91
Windshield Wiper - High	Light Blue	92
Windshield Wiper Motor - Feed	Yellow	93
Windshield Washer Switch to Windshield Washer	Dark Blue	94

(1) Use feed circuit numbers in the order listed, depending on the number of circuits used at any one time.

(2) When No. 35 circuit does not apply (normally on vehicles with both telltale light and standard temperature gauge.)

(3) Use ground circuit numbers in the order as listed, depending on the number of circuits used at any one time.

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Fig. 8-92 Electrical Wire Codes By Category

Circuit Name	Circuit Color	Circuit Number
HEATER, AIR CONDITIONING, VENTILATING SYSTEMS		
Blower Switch - Feed	Brown	50
Blower Feed - Low	Yellow	51
Blower Feed - High	Orange	52
Blower-Switch Control - Low and Feed	Tan	63
Compressor to Air Conditioning Switch	Dark Green	59
Blower Motor to Relay	Purple	65
Blower Switch Medium to Blower Resistor	Light Blue	72
Resistor Output to Blower Relay	Dark Blue	101
Defogger - High or Single Speed	Purple	192
Defogger - Low Speed - .38 ohm/ft.	White-Purple & Orange	193
In-Car Sensor to Control	Light Green	198
Amplifier to Transducer	Tan	56
MISCELLANEOUS FEED CIRCUITS		
Neutral Safety Switch Feed, or Neutral Safety Switch to Relay (Truck) or Relay to Ignition Switch (Truck)	Purple	5
Starter Solenoid Feed	Purple	6
Horn Feed	Dark Green	29
Traffic Hazard Switch, Feed from Flasher	Brown	27
Feed - Key Warning Buzzer	Pink-Black	80
TRANSMISSION UNITS		
Kick-Down on Automatic Transmission	Orange	55
ELECTRICALLY POWERED ACCESSORIES		
Window Control - L. F. - Up	Dark Blue	164
Window Control - L. F. - Down	Brown	165
Window Control - L. R. - Up	Dark Green	168
Window Control - L. R. - Down	Purple	169
Window Control - R.F. - Up	Dark Blue-White	166
Window Control - R. F. - Down	Tan	167
Window Control - R.R. - Up	Light Green	170
Window Control - R. R. - Down	Purple-White	171
Vent Control - L. F. - Open	Yellow	173
Vent Control - L. F. - Close	Light Green	172
Vent Control - L. R. - Open	Tan	185
Vent Control - L. R. - Close	Gray	186
Vent Control - R. F. - Open	Yellow-Black	175
Vent Control - R. F. - Close	Light Green	174
Vent Control - R. R. - Open	Tan-Black	187
Vent Control - R. R. - Close	Gray-Black	188
Tailgate or Center Partition Window - Up	Light Blue	183
Tailgate or Center Partition Window - Down	Tan-White	184

Circuit Name	Circuit Color	Circuit Number
ELECTRICALLY POWERED ACCESSORIES (Continued)		
Power Seat - Fore	Dark Green	176
Power Seat - Aft	Yellow	177
Power Seat - 4-W - Fore and Down	Dark Green	189
Power Seat -- 4-W - Aft and Up	Yellow	190
Power Seat - 4-W - Solenoid - Up and Down	Light Green	191
Power Seat - Solenoid - Fore and Aft	Light Blue	181
Power Seat - 6-W - Fore and Aft	Dark Green	178
Power Seat - 6-W - Aft and Down	Yellow	182
Power Seat - 6-W - Solenoid - Frt. - Up and Down	Light Green	180
Power Seat - 6-W - Solenoid - Rear - Up and Down	Tan	179
Power Antenna - Up	Black	161
Power Antenna - Down	White	160
GROUND CIRCUITS		
Ground Circuit - Direct	Black	150 (3)
Ground Circuit - Direct	Black	151 (3)
Ground Circuit - Direct	Black	152 (3)
Ground Circuit - Direct	Black	153 (3)
Ground Circuit - Direct	Black	154 (3)
Ground Circuit - Direct	Black	155 (3)
Ground Circuit - Switch Controlled - Body Interior Lamps - such as Dome, Courtesy, Map, Warning, etc.	White White-Black White-Dark Green	156 (3) 157 (3) 158 (3)
Ground - Key Warning Buzzer	Black-Purple	159
RADIO SPEAKERS		
Rear Seat Speaker - Feed from Radio Left Stereo	Brown	199
Front Speaker - Feed from Radio - Single or Right Stereo	Light Green	200
Front Speaker - Feed from Radio - Left Stereo	Tan	201

(1) Use feed circuit numbers in the order listed, depending on the number of circuits used at any one time.

(2) When No. 35 circuit does not apply (normally on vehicles with both telltale light and standard temperature gauge.)

(3) Use ground circuit numbers in the order as listed, depending on the number of circuits used at any one time.

Fig. 8-93 Electrical Wire Codes By Category

Circuit Number	Circuit Color	Circuit Name
2	Red	Feed, Battery - Unfused
3	Pink	Feed, Ign. Sw. "On" Controlled - Unfused
3	White-Purple & Orange	Primary Ignition Voltage - Dropping Resistor .38 ohm./ft.
3	White-Red & Black	Primary Ignition Voltage - Dropping Resistor .30 ohm./ft.
4	Brown	Feed, Ign. Sw. Accsy. Controlled - Unfused
5	Purple	Neutral Safety Switch Feed or Neutral Safety Switch to Relay (Truck) or Relay to Ignition Switch (Truck) (Auto. Trans.)
6	Purple	Starter Solenoid Feed
7	Yellow	Primary Ignition Resistance Bypass
8	Gray	Instrument and Panel Lights, (Fused No. 44 Circuit)
9	Brown	Tail and License Lamp, Forward Side Marker Lamps
		Tail, Clearance and Marker Lamps (Trailers)
10	Light Blue	Dimmer Switch Feed
11	Light Green	Headlamp, High Beam
12	Tan	Headlamp, Low Beam
13	Purple	Front Parking Lamps
14	Light Blue	L. H. Indicator and Front Direction Light
15	Dark Blue	R. H. Indicator and Front Direction Light
16	Purple	Direction Signal Switch, Feed from Flasher
17	White	Direction Signal Switch, Feed from Stop Switch
18	Yellow	Stop and Direction Lamp, or Direction Lamp Only - Rear L. H.
19	Dark Green	Stop and Direction Lamp, or Direction Lamp Only - Rear R. H.
20	Red	Stop Lamp (Trailer)
22	White	Ground - Direct (Trailer Wiring)
24	Light Green	Back-Up Lamp
25	Brown	Generator or Generator Armature to Voltage Regulator "A" (Includes Generator Telltale Circuit) or Regulator to Ignition Switch (Truck)
26	Dark Blue	Field Circuit (F) (Gen./Reg.)
27	Brown	Traffic Hazard Switch, Feed from Flasher
28	Black	Horn Switch
29	Dark Green	Horn Feed
30	Tan	Fuel Gauge to Tank Unit
31	Dark Blue	Oil Pressure - Engine
32	Yellow	Map Light
33	Tan	Warning Light - Brake Alarm
34	Purple	Fog or Drive Lamp
35	Dark Green	Telltale Temp. Gauge (Hot), or Std. Temp. - Readable Gauge
36	Light Green	Telltale Circuit - Temp. Gauge (Cold)
38	Dark Blue	Flasher, Fused Feed
39	Pink-Black	Feed, Ign. Sw. "On" Controlled - Fused
40	Orange	Feed, Battery - Fused
41	Brown-White	Feed, Ign. Sw. Accsy. Controlled - Fused
43	Yellow	Radio Feed
44	Dark Green	Instrument and Panel Lights, Feed (Usually Light Switch to Fuse)
45	Black	Marker and Clearance Lamps (Trailers - ICC Requirement)
46	Dark Blue	Rear Seat Speaker Feed from Radio Single or Rt., Stereo
47	Dark Blue	Auxiliary Circuits (Trailer)
48	Dark Green	Amplifier Conn. to Light Watch Switch
49	Gray	Mod. Assembly to Control
50	Brown	Blower Switch - Feed
51	Yellow	Blower Feed - Low
52	Orange	Blower Feed - High
53	Light Green	Anti-Wheel Lock Valve Release Solenoid to Control Box
54	Dark Green	Anti-Wheel Lock Control to Shield
55	Orange	Kick-Down on Over-Drive or Automatic Transmission
56	Tan	Amplifier to Transducer
57	Gray	L. H. Cornering Lamp
58	Black	R. H. Cornering Lamp
59	Dark Green	Compressor to Air Conditioning Switch
60	Orange-Black	Feed, Battery - Circuit Breaker Protected
63	Tan	Blower-Switch Control - Low and Feed
65	Purple	Blower Motor to Relay
70	Red-White	Feed, Relay Controlled - Circuit Breaker Protected
72	Light Blue	Blower Switch Medium to Blower Resistor
75	Dark Green	Back-Up Switch or Parking Brake Alarm Feed
80	Pink-Black	Feed - Key Warning Buzzer
90	Pink-Black	Feed, Cutout Sw. Controlled - Circuit Breaker Protected
91	Black	Windshield Wiper - Low
92	Light Blue	Windshield Wiper - High
93	Yellow	Windshield Wiper Motor - Feed
94	Dark Blue	Windshield Washer Switch to Windshield Washer
101	Dark Blue	Resistor Output to Blower Relay
102	White	SI Alternator Regulator Sensing Circuit
105	Black	Ammeter - Generator
106	Black-White	Ammeter - Battery
107	Dark Blue	Over-Speed Warning Light

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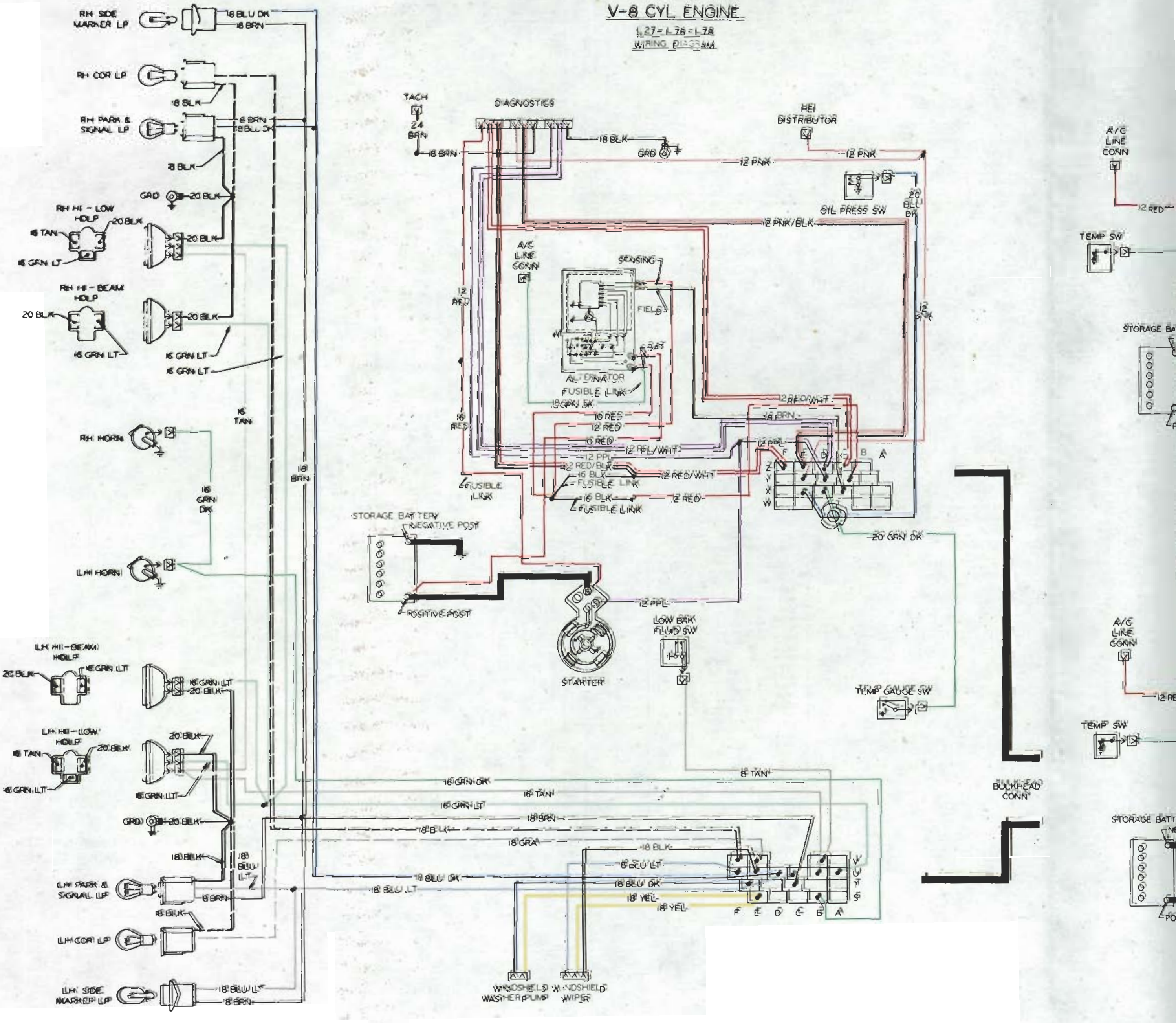
Fig. 8-94 Electrical Wire Codes By Circuit Number

Circuit Number	Circuit Color	Circuit Name
111	Black	Buzzer to Low Air Pressure or Vacuum Switch
*112	Dark Green-White	Telltale Temperature Gauge (Hot)
119	White	Generator (Alternator) to Regulator
120	Black	Power Trans. - Relay to Thermo Switch (Truck)
121	Brown	Tachometer to Coil
124	Black	Switch on Shift Lever to Adapter, or to Motor on Rear Axle (Low), or to Adaptor (Low) (Truck)
125	Light Green	Switch to Diff. Lock-Out Valve (Truck)
126	Brown	Diesel Ignition - Buzzer to No. 4 "L" on Voltage Regulator (Truck)
127	Dark Green	Two-Speed Axle - Switch on Shift Lever to Motor on Rear Axle (High) (Truck)
130	Color depends on Resistance	Generator (Alternator) External Resistance
	Brown-White	2 ohms per foot
	Black-Pink	1 ohm per foot
131	Brown	Low Vacuum to Air Pressure Warning Light to Switch (Truck)
139	Pink-Black	Feed, Ign. Sw. "On" Controlled - Fused
140	Orange	Feed, Battery - Fused
141	Brown-White	Feed Ign. Sw. Accsy. Controlled - Fused
150	Black	Ground Circuit - Direct
151	Black	Ground Circuit - Direct
152	Black	Ground Circuit - Direct
153	Black	Ground Circuit - Direct
154	Black	Ground Circuit - Direct
155	Black	Ground Circuit - Direct
156	White	Ground Circuit - Switch Controlled - Body Interior Lamps - such as Dome, Courtesy, Map, Warning, etc.
157	White-Black	
158	White-Dark Green	
159	Black-Purple	Ground - Key Warning Buzzer
160	White	Power Antenna - Down
161	Black	Power Antenna - Up
162	Gray	Power Top - Up
163	Purple	Power Top - Down
164	Dark Blue	Window Control - L. F. - Up
165	Brown	Window Control - L. F. - Down
166	Dark Blue-White	Window Control - R.F. - Up
167	Tan	Window Control - R. F. - Down
168	Dark Green	Window Control - L. R. - Up
169	Purple	Window Control - L. R. - Down
170	Light Green	Window Control - R.R. - Up
171	Purple-White	Window Control - R. R. - Down
172	Light Green	Vent Control - L. F. - Close
173	Yellow	Vent Control - L. F. - Open
174	Light Green	Vent Control - R. F. - Close
175	Yellow-Black	Vent Control - R. F. - Open
176	Dark Green	Power Seat - Fore
177	Yellow	Power Seat - Aft
178	Dark Green	Power Seat - 6-W - Fore and Aft
179	Tan	Power Seat - 6-W - Solenoid - Rear - Up and Down
180	Light Green	Power Seat - 6-W - Solenoid - Frt. - Up and Down
181	Light Blue	Power Seat - Solenoid - Fore and Aft
182	Yellow	Power Seat - 6-W - Aft and Down
183	Light Blue	Tailgate or Center Partition Window - Up
184	Tan-White	Tailgate or Center Partition Window - Down
185	Tan	Vent Control - L. R. - Open
186	Gray	Vent Control - L. R. - Close
187	Tan-Black	Vent Control - R. R. - Open
188	Gray-Black	Vent Control - R. R. - Close
189	Dark Green	Power Seat - 4-W - Fore and Down
190	Yellow	Power Seat -- 4-W - Aft and Up
191	Light Green	Power Seat - 4-W - Solenoid - Up and Down
192	Purple	Defogger - High or Single Speed
193	White-Purple & Orange	Defogger - Low Speed - .38 ohm/ft.
194	Red	R. H. Wheel Pick-Up to Electronic Control
195	White	R. H. Wheel Pick-Up to Electronic Control
196	Light Blue	L. H. Wheel Pick-Up to Electronic Control
197	Black	L. H. Wheel Pick-Up to Electronic Control
198	Light Green	In-Car Sensor to Control
199	Brown	Rear Seat Speaker - Feed from Radio Left Stereo
200	Light Green	Front Speaker - Feed from Radio - Single or Right Stereo
201	Tan	Front Speaker - Feed from Radio - Left Stereo
239	Pink-Black	Feed, Ign. Sw. "On" Controlled - Fused
240	Orange	Feed, Battery - Fused
241	Brown-White	Feed Ign. Sw. Accsy. Controlled - Fused
340	Orange	Feed, Battery - Fused

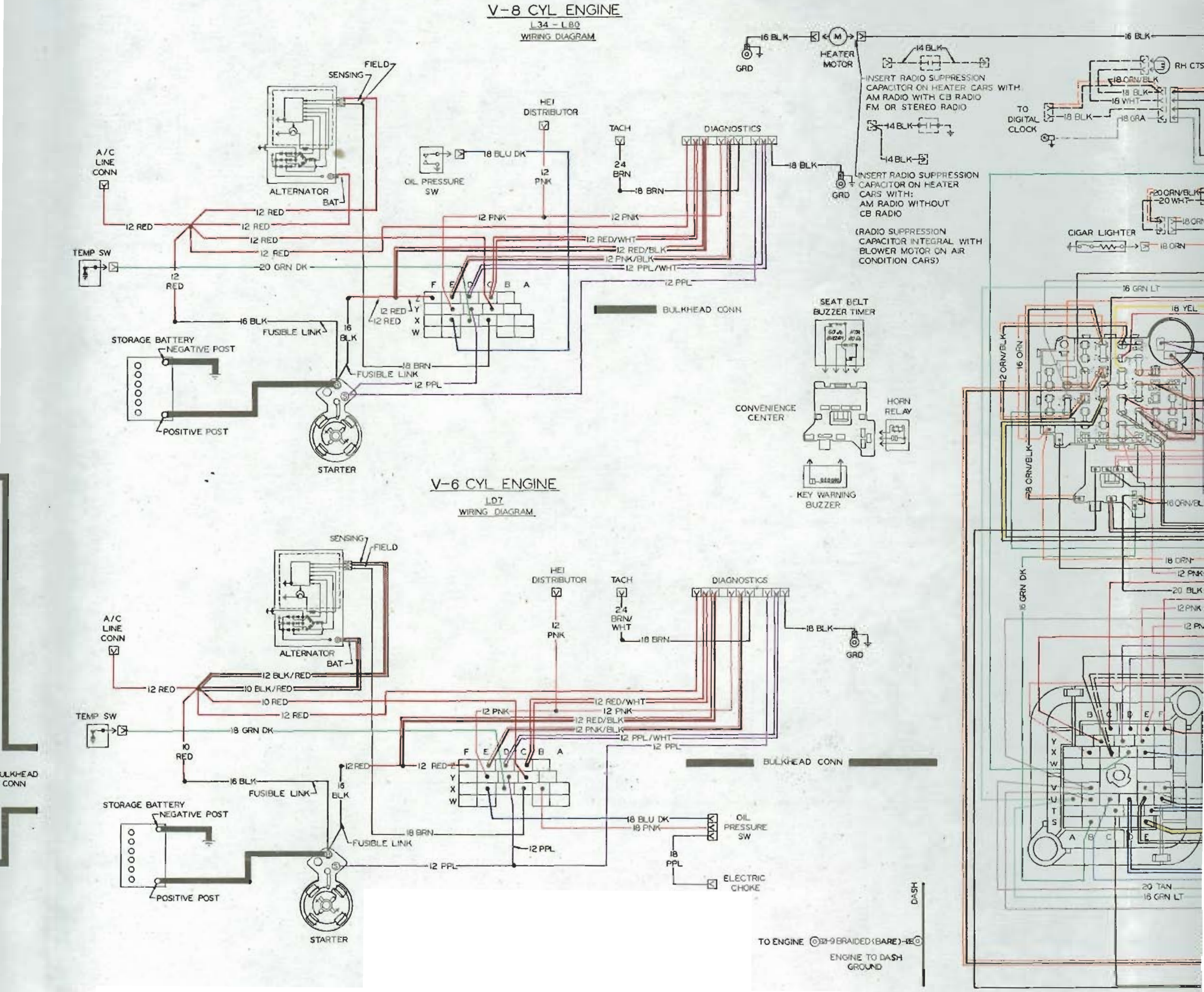
NOTE: Use ground circuit numbers in the order as listed, depending on the number of circuits used at any one time.

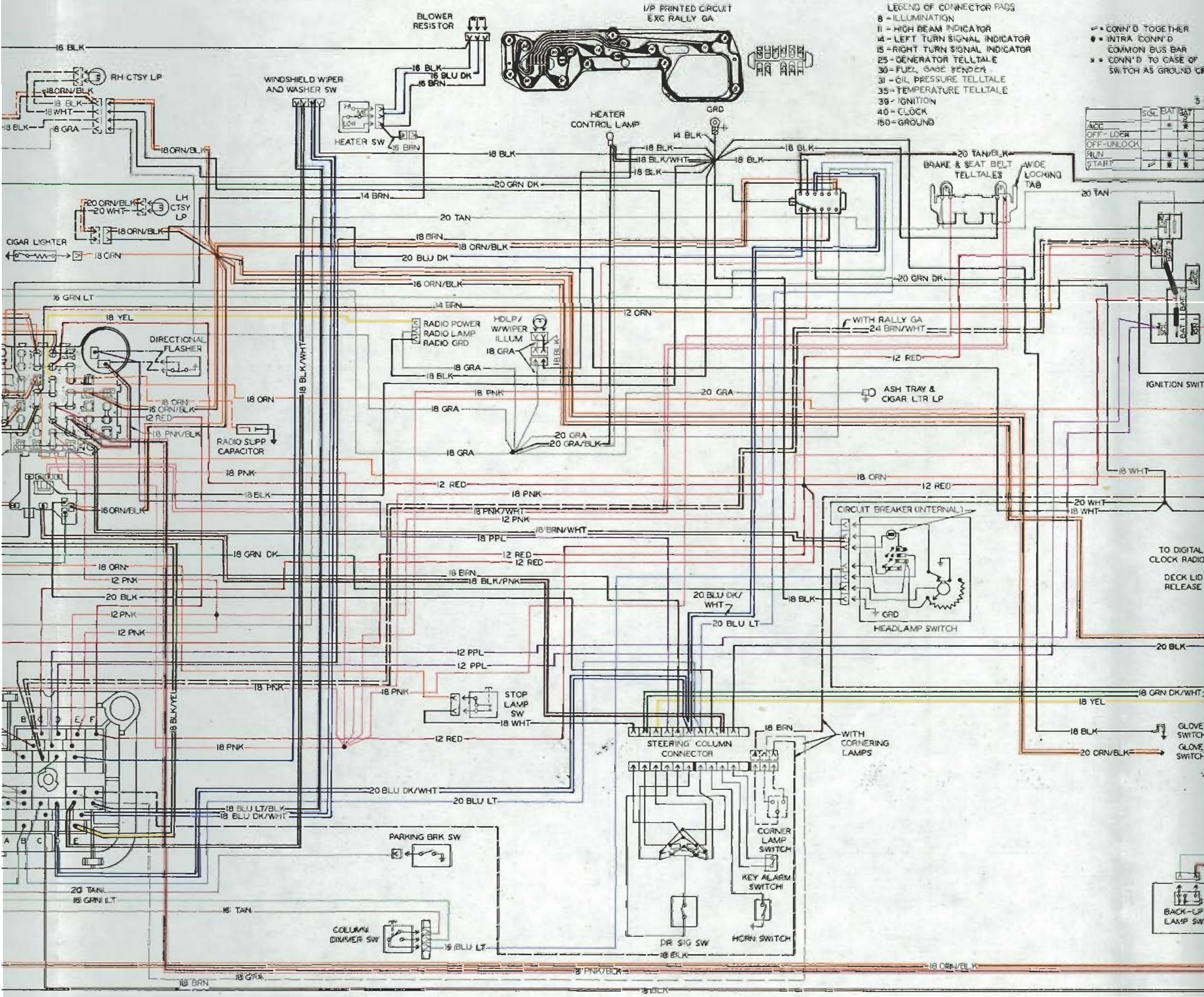
* When No. 35 circuit does not apply (normally on Vehicles with both Telltale Light and Standard Temperature Gauge.)

Fig. 8-95 Electrical Wire Codes By Circuit Number



1977 PONTIAC BLACK


V-8 CYL ENGINE
L34 - L80
WIRING DIAGRAM
FIELD
SENSING
ALTERNATOR
BAT
A/C LINE CONN
12 RED
12 RED
12 RED
12 RED
12 RED
TEMP SW
20 GRN DK
12 RED
16 BLK
FUSIBLE LINK
16 BLK
STORAGE BATTERY
NEGATIVE POST
POSITIVE POST
STARTER
FUSIBLE LINK
18 BRN
12 PPL
HEI DISTRIBUTOR
OIL PRESSURE SW
18 BLU DK
12 PNK
12 PNK
12 PNK
TACH
24 BRN
18 BRN
DIAGNOSTICS
18 BLK
12 RED/WHT
12 RED/BLK
12 PNK/BLK
12 PPL/WHT
12 PPL
F E D C B A
Z Y X W
12 RED
12 RED
BULKHEAD CONN
16 BLK
HEATER MOTOR
GRD
14 BLK
INSERT RADIO SUPPRESSION CAPACITOR ON HEATER CARS WITH AM RADIO WITH CB RADIO FM OR STEREO RADIO
14 BLK
14 BLK
18 BLK
GRD
INSERT RADIO SUPPRESSION CAPACITOR ON HEATER CARS WITH: AM RADIO WITHOUT CB RADIO
(RADIO SUPPRESSION CAPACITOR INTEGRAL WITH BLOWER MOTOR ON AIR CONDITION CARS)
16 BLK
RH CTS
18 ORN/BLK
18 BLK
18 WHT
TO DIGITAL CLOCK
18 BLK
18 GRA
20 ORN/BLK
20 WHT
18 ORN
CIGAR LIGHTER
18 ORN
16 GRN LT
18 YEL
SEAT BELT BUZZER TIMER
CONVENIENCE CENTER
HORN RELAY
KEY WARNING BUZZER
12 ORN/BLK
16 ORN
18 ORN/BLK
18 ORN/BLK
18 ORN
12 PNK
20 BLK
12 PNK
12 PNK
16 GRN DK
V-6 CYL ENGINE
LD7
WIRING DIAGRAM
SENSING
FIELD
ALTERNATOR
BAT
A/C LINE CONN
12 RED
12 BLK/RED
10 BLK/RED
10 RED
12 RED
TEMP SW
18 GRN DK
10 RED
16 BLK
FUSIBLE LINK
16 BLK
STORAGE BATTERY
NEGATIVE POST
POSITIVE POST
STARTER
FUSIBLE LINK
18 BRN
12 PPL
12 PPL
HEI DISTRIBUTOR
12 PNK
TACH
24 BRN/WHT
18 BRN
DIAGNOSTICS
18 BLK
GRD
12 RED/WHT
12 PNK
12 PNK
12 RED/BLK
12 PNK/BLK
12 PPL/WHT
12 PPL
12 RED
12 RED
F E D C B A
Z Y X W
BULKHEAD CONN
18 BLU DK
18 PNK
OIL PRESSURE SW
18 PPL
ELECTRIC CHOKE
DASH
TO ENGINE
19-9 BRAIDED (BARE)
ENGINE TO DASH GROUND
B C D E F
Y X W V U T S
A B C E
20 TAN
16 GRN LT
BULKHEAD CONN


BLOWER RESISTOR
I/P PRINTED CIRCUIT EXC RALLY GA
LEGEND OF CONNECTOR PADS
8 - ILLUMINATION
11 - HIGH BEAM INDICATOR
14 - LEFT TURN SIGNAL INDICATOR
15 - RIGHT TURN SIGNAL INDICATOR
25 - GENERATOR TELLTALE
30 - FUEL GAGE SENDER
31 - OIL PRESSURE TELLTALE
35 - TEMPERATURE TELLTALE
39 - IGNITION
40 - CLOCK
150 - GROUND
= CONN'D TOGETHER
= INTRA CONN'D COMMON BUS BAR
= CONN'D TO CASE OF SWITCH AS GROUND CI
SOL
BAT 1
BAT 2
ACC
OFF-LOCK
OFF-UNLOCK
RUN
START
16 BLK
RH CTSY LP
18 ORN/BLK
18 BLK
18 WHT
18 BLK
18 GRA
WINDSHIELD WIPER AND WASHER SW
16 BLK
16 BLU DK
16 BRN
HEATER SW
16 BRN
GRD
14 BLK
HEATER CONTROL LAMP
18 BLK
18 BLK/WHT
18 BLK
18 BLK
18 BLK
20 TAN/BLK
BRAKE & SEAT BELT TELLTALES
WIDE LOCKING TAB
20 TAN
20 GRN DK
14 BRN
20 ORN/BLK
20 WHT
LH CTSY LP
18 ORN/BLK
20 TAN
CIGAR LIGHTER
18 ORN
18 BRN
18 ORN/BLK
20 BLU DK
16 ORN/BLK
20 GRN DK
16 GRN LT
18 YEL
24 BRN
12 ORN
DIRECTIONAL FLASHER
RADIO POWER
RADIO LAMP
RADIO GRD
HDLP/W/WIPER ILLUM
18 GRA
18 BLK
WITH RALLY GA
24 BRN/WHT
12 RED
18 GRA
18 BLK
18 ORN
16 ORN/BLK
12 RED
18 PNK/BLK
18 BLK/WHT
18 PNK
20 GRA
ASH TRAY & CIGAR LTR LP
IGNITION SWIT
18 GRA
RADIO SUPP CAPACITOR
20 GRA
20 GRA/BLK
18 GRA
18 PNK
18 WHT
12 RED
18 ORN
12 RED
18 BLK
18 PNK
16 ORN/BLK
18 PNK/WHT
12 PNK
18 BRN/WHT
18 PPL
CIRCUIT BREAKER (INTERNAL)
20 WHT
18 WHT
TO DIGITAL CLOCK RADIO
DECK LID RELEASE
18 GRN DK
12 RED
12 RED
18 ORN
12 PNK
18 BRN
18 BLK/PNK
20 BLK
12 PNK
12 PNK
20 BLU DK/WHT
20 BLU LT
18 BLK
GRD
HEADLAMP SWITCH
20 BLK
12 PPL
12 PPL
18 PNK
18 PNK
18 BLK/YEL
STOP LAMP SW
18 WHT
18 GRN DK/WHT
18 YEL
18 PNK
12 RED
STEERING COLUMN CONNECTOR
18 BRN
WITH CORNERING LAMPS
18 BLK
GLOVE SWITCH
20 ORN/BLK
GLOVE SWITCH
20 BLU DK/WHT
20 BLU LT
18 BLU LT/BLK
18 BLU DK/WHT
PARKING BRK SW
CORNER LAMP SWITCH
KEY ALARM SWITCH
20 TAN
16 GRN LT
16 TAN
COLUMN DIMMER SW
16 BLU LT
DIR SIG SW
HORN SWITCH
18 BLK
BACK-UP LAMP SW
18 PNK/BLK
18 ORN/BLK
18 BRN
18 GRA
18 BLK
A
B
C
E
F

✓ - CONN'D TOGETHER
✱ - INTRA CONN'D COMMON BUS BAR
× - CONN'D TO CASE OF SWITCH AS GROUND CIRC

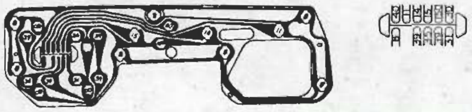
5 PIN CONN

	SOL	BAT 1	BAT 2		IGN 1	ACC
ACC		✱	✱			✓
OFF - LOCK						
OFF-UNLOCK						
RUN		✱	✱		✓	✓
START	✓	✱	✱		✓	

4 PIN CONN

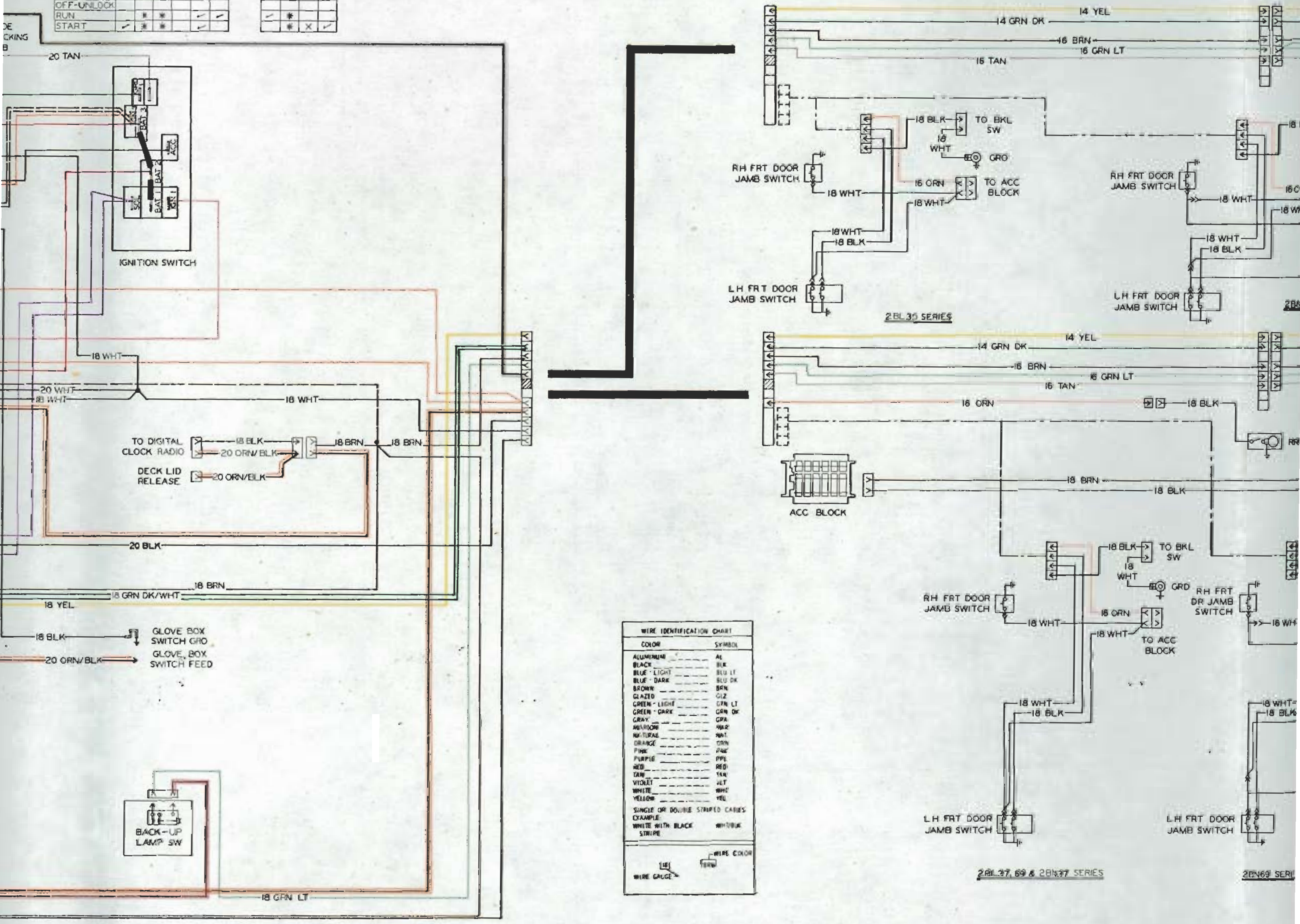
IGN 3	BAT 3	GRD 1	GRD 2
	✱		
✓	✱		
	✱	X	✓

I/P PRINTED CIRCUIT
RALLY GA



LEGEND OF CONNECTOR PADS

8 - ILLUMINATION
11 - HIGH BEAM INDICATOR
14 - LEFT TURN SIGNAL INDICATOR
15 - RIGHT TURN SIGNAL INDICATOR
30 - FUEL GA SENDER
31 - OIL GA SENDER
35 - TEMP GA SENDER
39 - IGNITION
40 - CLOCK
150 - GROUND

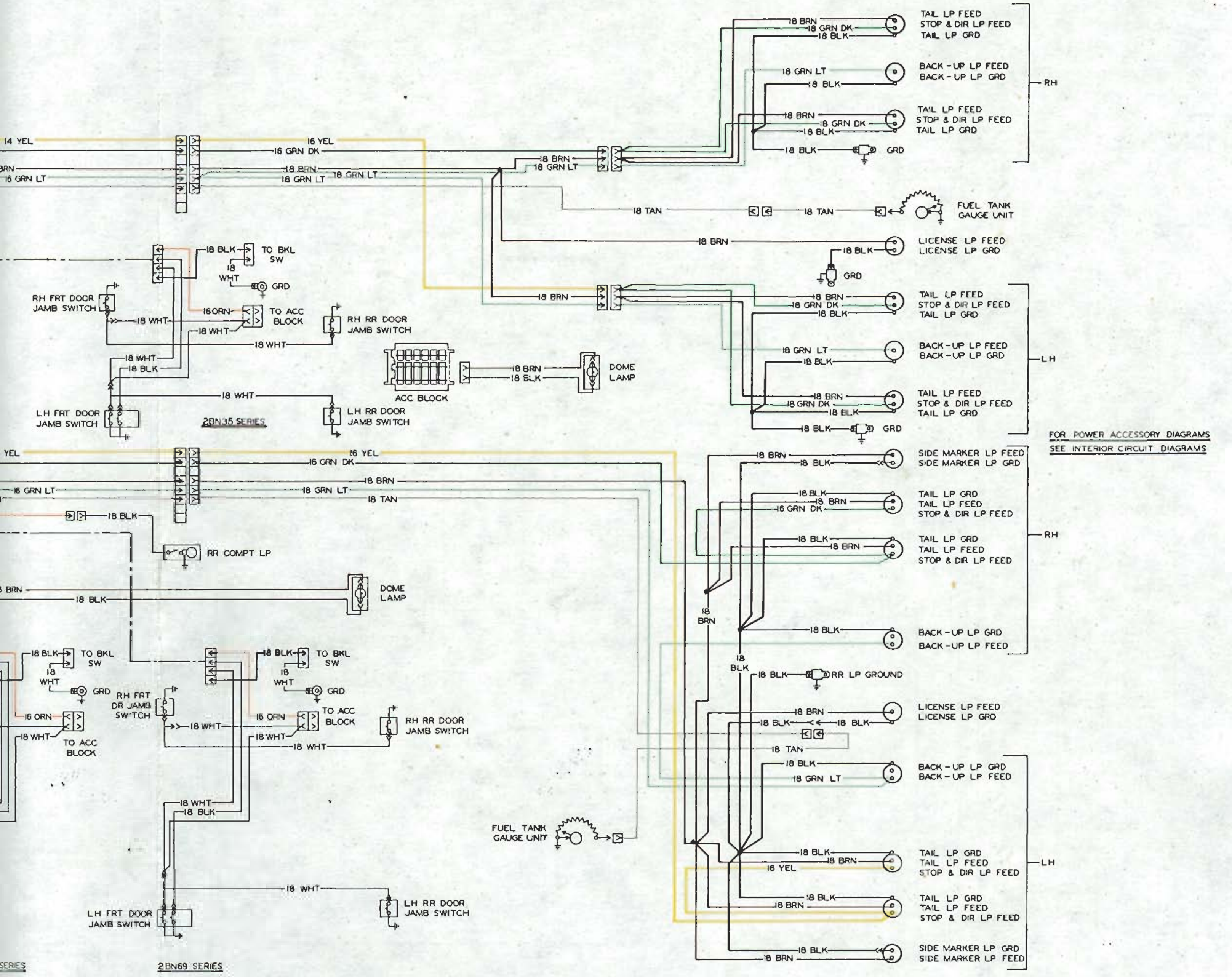


WIRE IDENTIFICATION CHART

COLOR	SYMBOL
ALUMINUM	AL
BLACK	BLK
BLUE - LIGHT	BLU LT
BLUE - DARK	BLU DK
BROWN	BRN
GLAZED	GLZ
GREEN - LIGHT	GRN LT
GREEN - DARK	GRN DK
GRAY	GRA
MAROON	MAR
NATURAL	NAT
ORANGE	ORN
PINK	PNK
PURPLE	PPL
RED	RED
TAN	TAN
VIOLET	VLT
WHITE	WHT
YELLOW	YEL

SINGLE OR DOUBLE STRIPED CABLES
EXAMPLE
WHITE WITH BLACK STRIPE — WHT/BLK

18 — WIRE GAUGE
BRN — WIRE COLOR



FOR POWER ACCESSORY DIAGRAMS SEE INTERIOR CIRCUIT DIAGRAMS

FIG. 8-1 B SERIES WIRING DIAGRAM

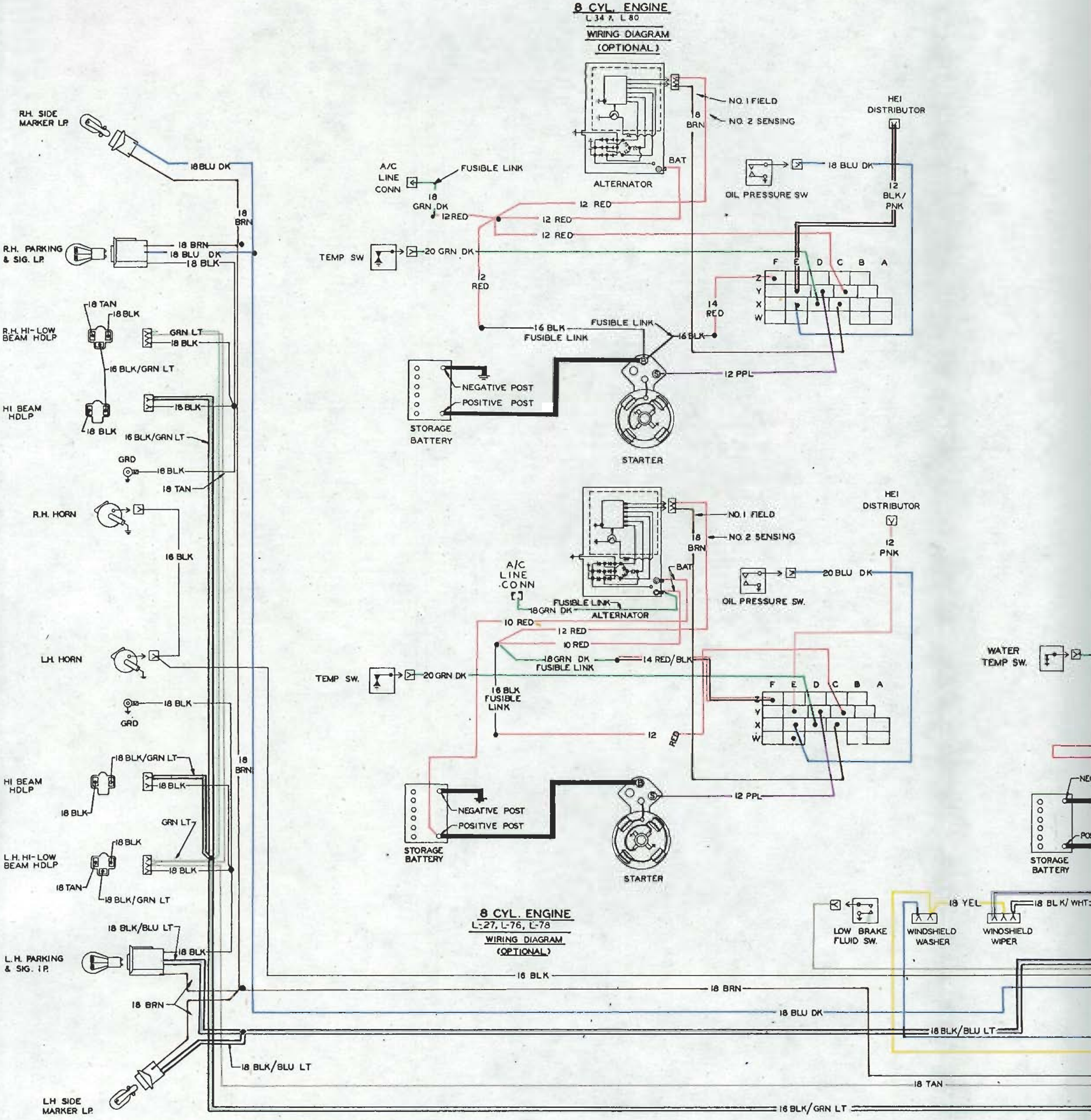
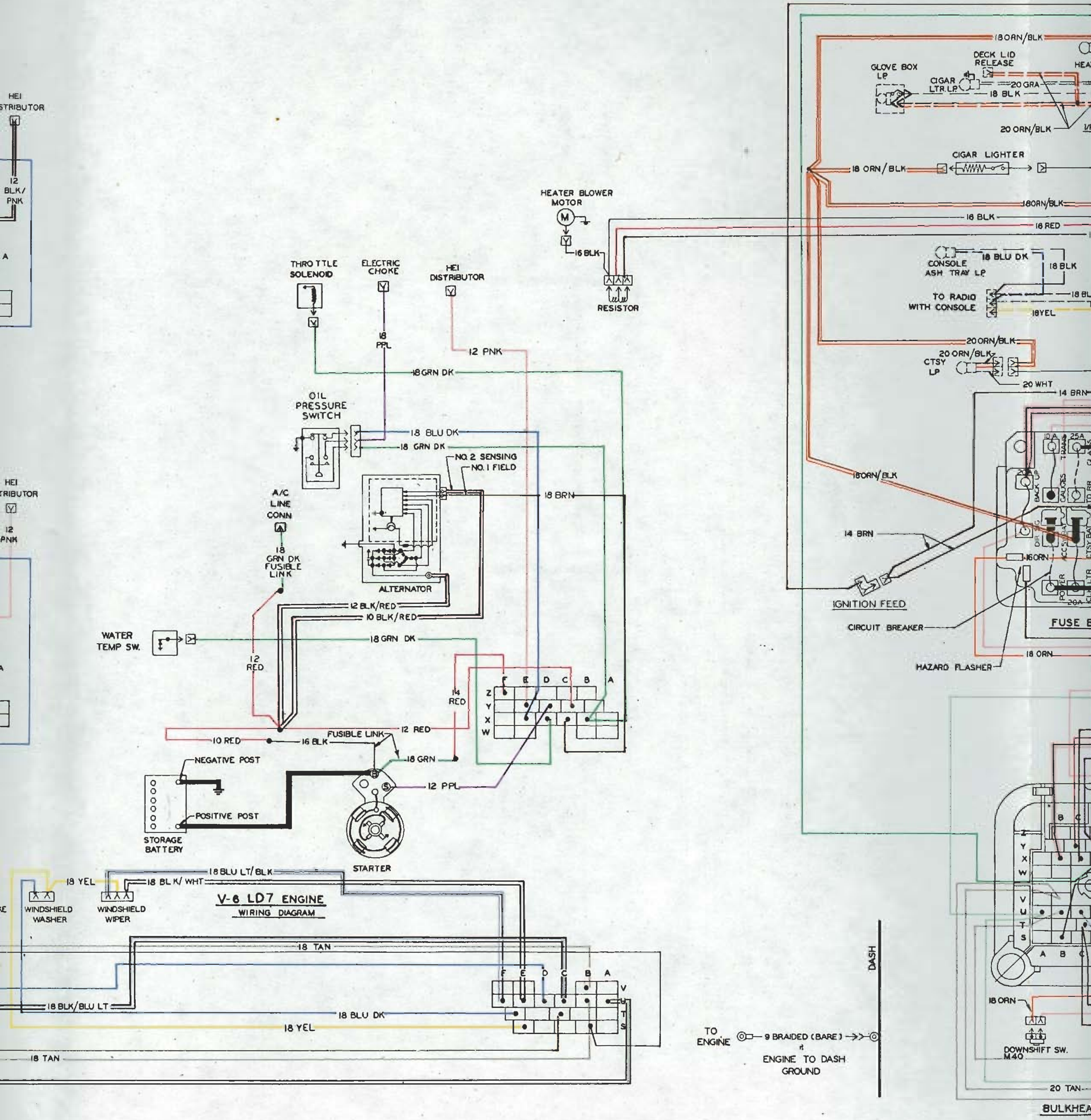
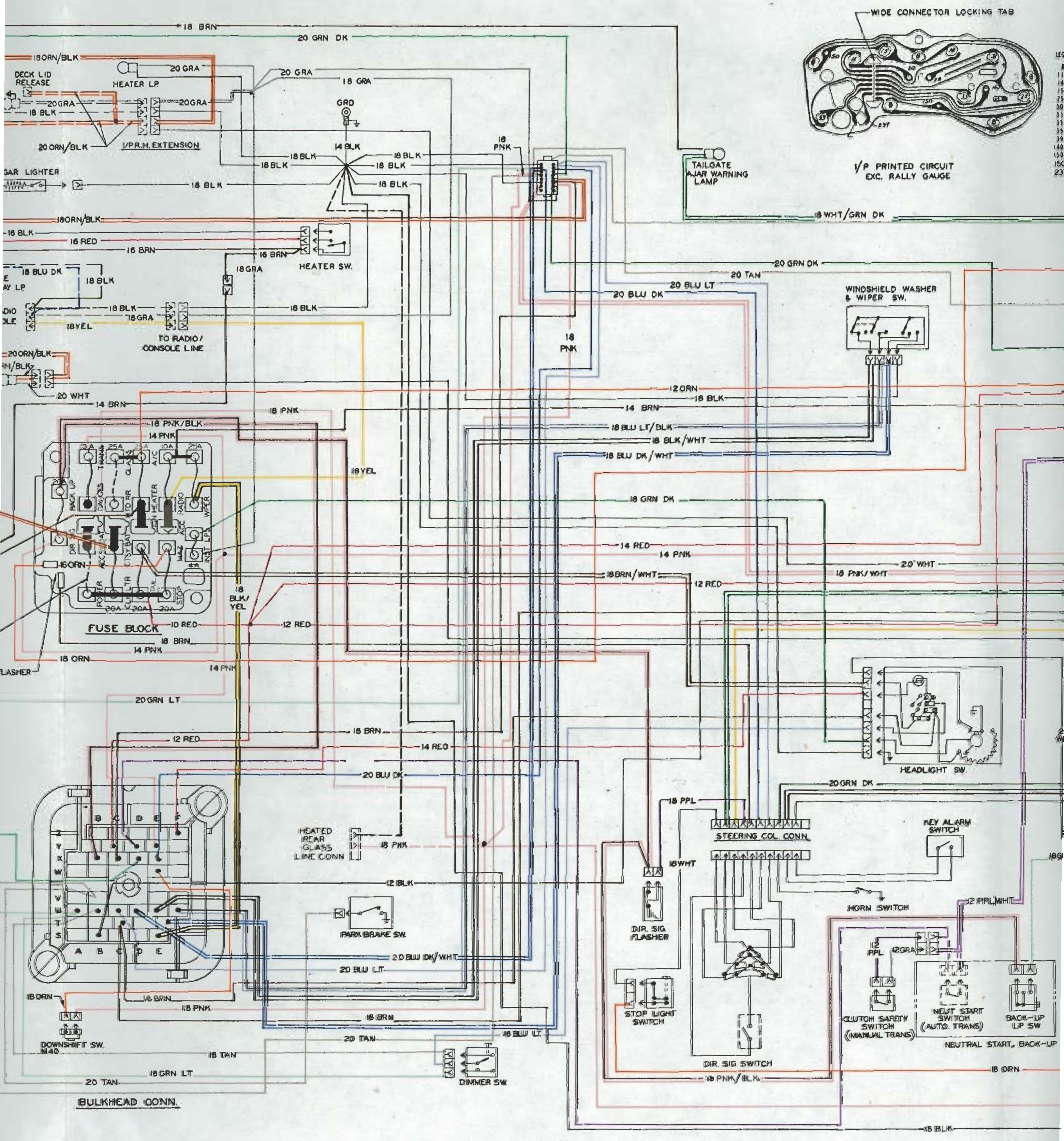
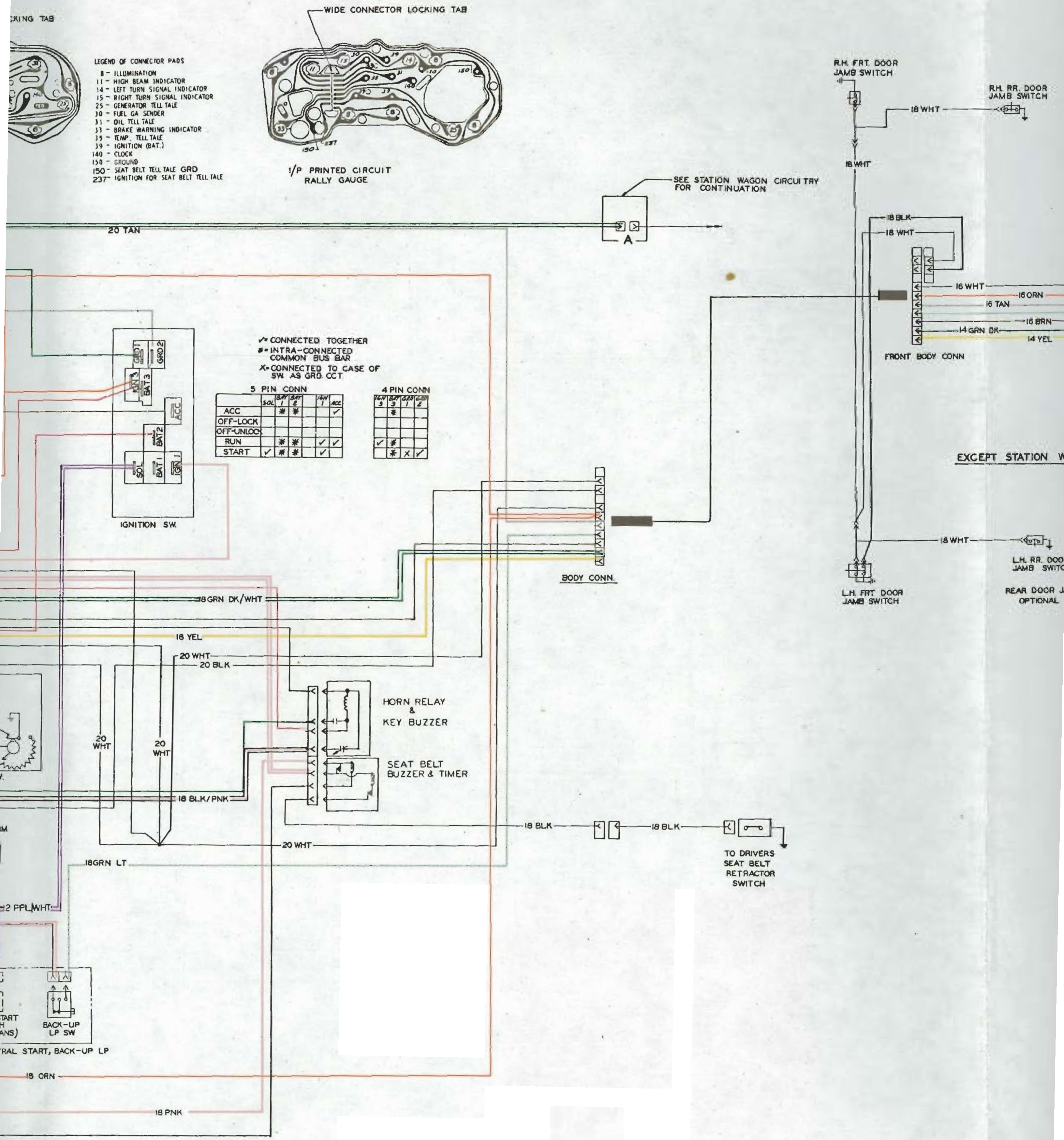


FIG. 8-2 A SERIES WIRING DIAGRAM


V-6 LD7 ENGINE
WIRING DIAGRAM
HEI DISTRIBUTOR
12 BLK/PNK
A
HEI DISTRIBUTOR
12 PNK
THROTTLE SOLENOID
ELECTRIC CHOKE
HEI DISTRIBUTOR
HEATER BLOWER MOTOR
16 BLK
RESISTOR
18 PPL
12 PNK
18 GRN DK
OIL PRESSURE SWITCH
18 BLU DK
18 GRN DK
NO. 2 SENSING
NO. 1 FIELD
18 BRN
A/C LINE CONN
18 GRN DK FUSIBLE LINK
ALTERNATOR
12 BLK/RED
10 BLK/RED
WATER TEMP SW.
18 GRN DK
12 RED
14 RED
F E D C B A
Z Y X W
12 RED
10 RED
16 BLK
FUSIBLE LINK
18 GRN
NEGATIVE POST
POSITIVE POST
STORAGE BATTERY
12 PPL
STARTER
18 BLU LT/BLK
18 YEL
18 BLK/WHT
WINDSHIELD WASHER
WINDSHIELD WIPER
18 TAN
18 BLK/BLU LT
18 BLU DK
18 YEL
F E D C B A
V U T S
18 TAN
TO ENGINE
9 BRAIDED (BARE)
ENGINE TO DASH GROUND
DASH
18 ORN/BLK
GLOVE BOX LP.
DECK LID RELEASE
CIGAR LTR. LP.
20 GRA
18 BLK
20 ORN/BLK
CIGAR LIGHTER
18 ORN/BLK
18 ORN/BLK
18 BLK
18 RED
CONSOLE ASH TRAY LP.
18 BLU DK
18 BLK
TO RADIO WITH CONSOLE
18 YEL
20 ORN/BLK
20 ORN/BLK
CTSY LP
20 WHT
14 BRN
10A
25A
20A
BACK UP
GAUGES
TRANS
14 BRN
18 ORN/BLK
16 ORN
ACCS
CTSY BAT
POWER
20A
IGNITION FEED
CIRCUIT BREAKER
HAZARD FLASHER
18 ORN
FUSE B
B C
Z Y X W
V U T S
A B C
18 ORN
DOWNSHIFT SW. M40
20 TAN
BULKHEA


WIDE CONNECTOR LOCKING TAB
I/P PRINTED CIRCUIT
EXC. RALLY GAUGE
18 BRN
20 GRN DK
18ORN/BLK
DECK LID RELEASE
HEATER LP.
20 GRA
20GRA
20GRA
18 BLK
20 ORN/BLK
I/P R.H. EXTENSION
20 GRA
18 GRA
GRD
14 BLK
18 BLK
18 BLK
18 BLK
18 BLK
18 BLK
18 PNK
GAR LIGHTER
18 BLK
TAILGATE AJAR WARNING LAMP
18 WHT/GRN DK
18ORN/BLK
16 BLK
16 RED
16 BRN
16 BRN
HEATER SW.
18 BLU DK
18 BLK
18GRA
18 BLK
18GRA
18 BLK
18YEL
TO RADIO/ CONSOLE LINE
20ORN/BLK
20 WHT
14 BRN
20 GRN DK
20 TAN
20 BLU LT
20 BLU DK
18 PNK
WINDSHIELD WASHER & WIPER SW.
12 ORN
18 BLK
14 BRN
18 PNK
18 PNK/BLK
14 PNK
18 BLU LT/BLK
18 BLK/WHT
18 BLU DK/WHT
10A
25A
20A
10A
25A
TRANS
GLV.
A/C
20A
BACK UP
GAUGES
I/P FR
HEATER
RADIO
WIPER
DIR SIG
ACCS
CTSY BAT
ACC
INST LPS
16ORN
POWER
LTR
TAIL
STOP
6A
20A
20A
20A
18YEL
18 GRN DK
14 RED
14 PNK
20 WHT
18 PNK/WHT
18BRN/WHT
12 RED
18 BLK/YEL
FUSE BLOCK
10 RED
12 RED
18 BRN
14 PNK
18 ORN
FLASHER
14 PNK
20GRN LT
12 RED
18 BRN
14 RED
20 BLU DK
HEADLIGHT SW.
20 GRN DK
18 PPL
B
C
D
E
F
Z
Y
X
W
V
U
T
S
A
B
C
D
E
HEATED REAR GLASS LINE CONN
18 PNK
STEERING COL. CONN.
KEY ALARM SWITCH
18WHT
12 BLK
DIR. SIG. FLASHER
HORN SWITCH
12 PPL/WHT
PARK BRAKE SW.
12 PPL
12GRA
20 BLU DK/WHT
20 BLU LT
18ORN
18 BRN
18 PNK
STOP LIGHT SWITCH
CLUTCH SAFETY SWITCH (MANUAL TRANS)
NEUT START SWITCH (AUTO. TRANS)
BACK-UP LP SW
DOWNSHIFT SW. M40
18 BRN
20 TAN
18 BLU LT
18 TAN
NEUTRAL START, BACK-UP
18GRN LT
DIR. SIG SWITCH
18 ORN
20 TAN
DIMMER SW.
18 PNK/BLK
BULKHEAD CONN.
18 BLK



LEGEND OF CONNECTOR PADS
8 - ILLUMINATION
11 - HIGH BEAM INDICATOR
14 - LEFT TURN SIGNAL INDICATOR
15 - RIGHT TURN SIGNAL INDICATOR
25 - GENERATOR TELL TALE
30 - FUEL GA SENDER
31 - OIL TELL TALE
33 - BRAKE WARNING INDICATOR
35 - TEMP. TELL TALE
39 - IGNITION (BAT.)
140 - CLOCK
150 - GROUND
150 - SEAT BELT TELL TALE GRD
237 - IGNITION FOR SEAT BELT TELL TALE

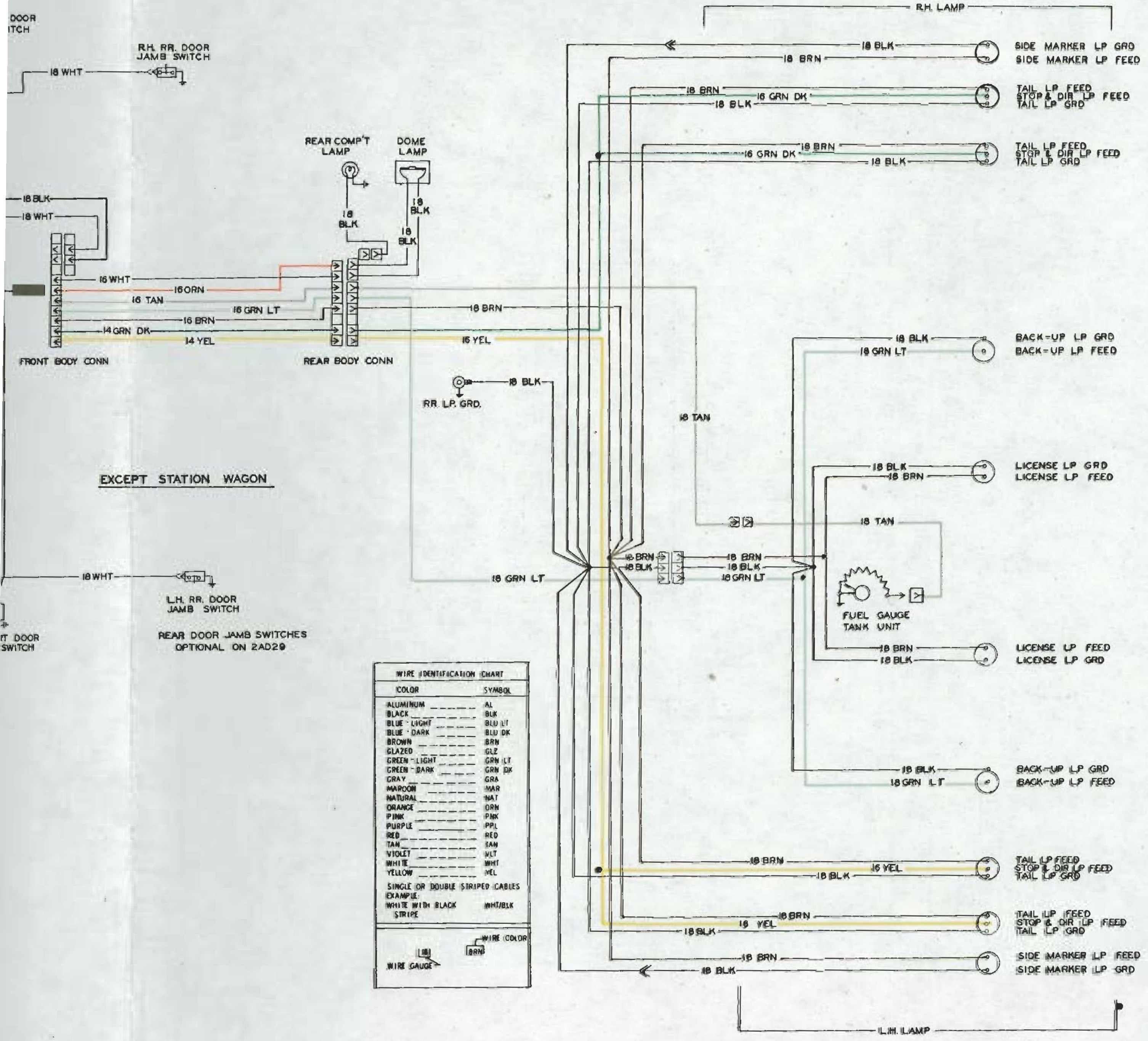
✓= CONNECTED TOGETHER
#= INTRA-CONNECTED COMMON BUS BAR
X= CONNECTED TO CASE OF SW. AS GRD. CCT.

5 PIN CONN

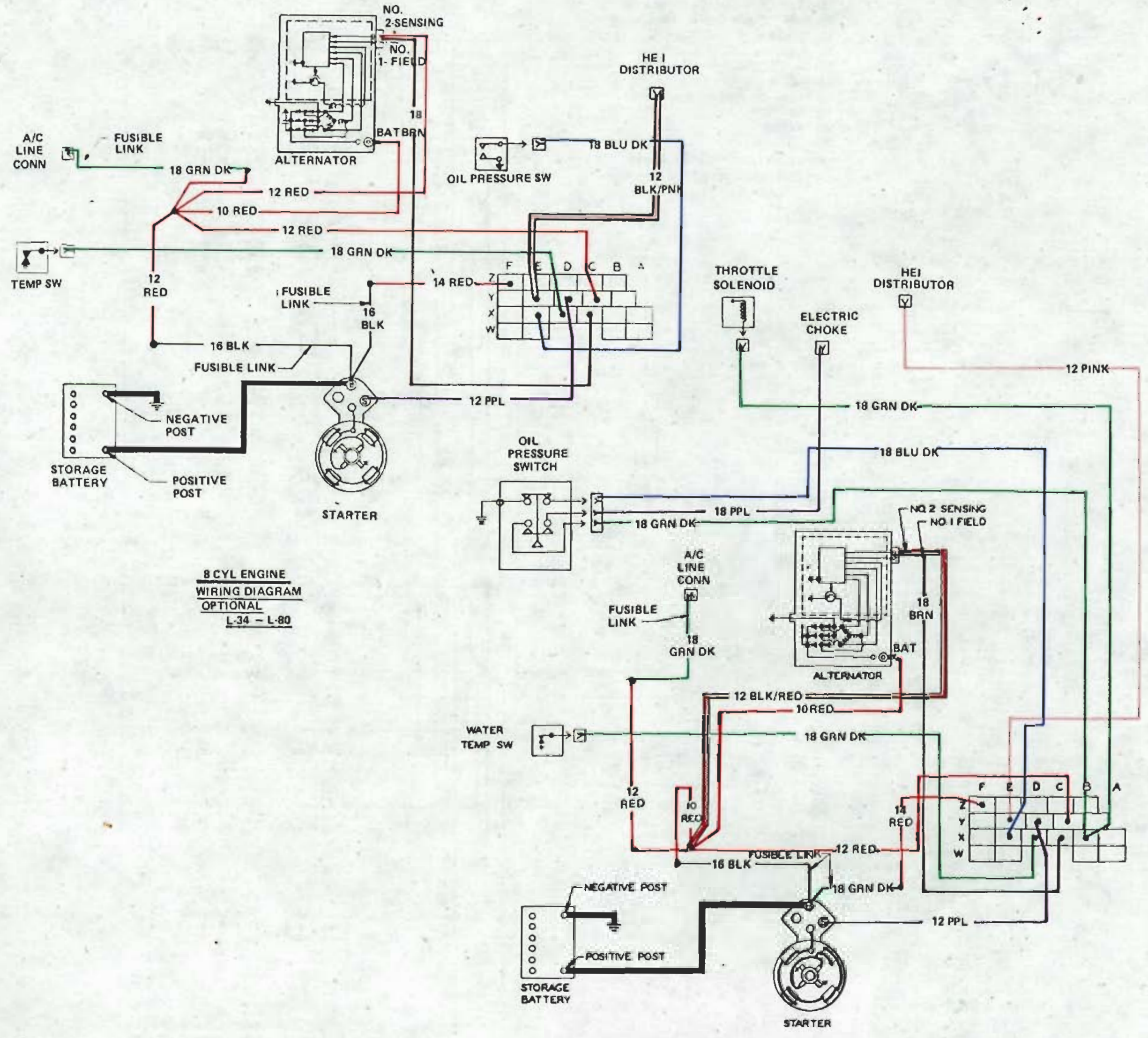
	SOL	BAT 1	BAT 2		IGN 1	ACC
ACC		#	#			✓
OFF-LOCK						
OFF-UNLOCK						
RUN		#	#		✓	✓
START	✓	#	#		✓	

4 PIN CONN

IGN 3	BAT 3	GRD 1	GRD 2
	#		
✓	#		
	#	X	✓

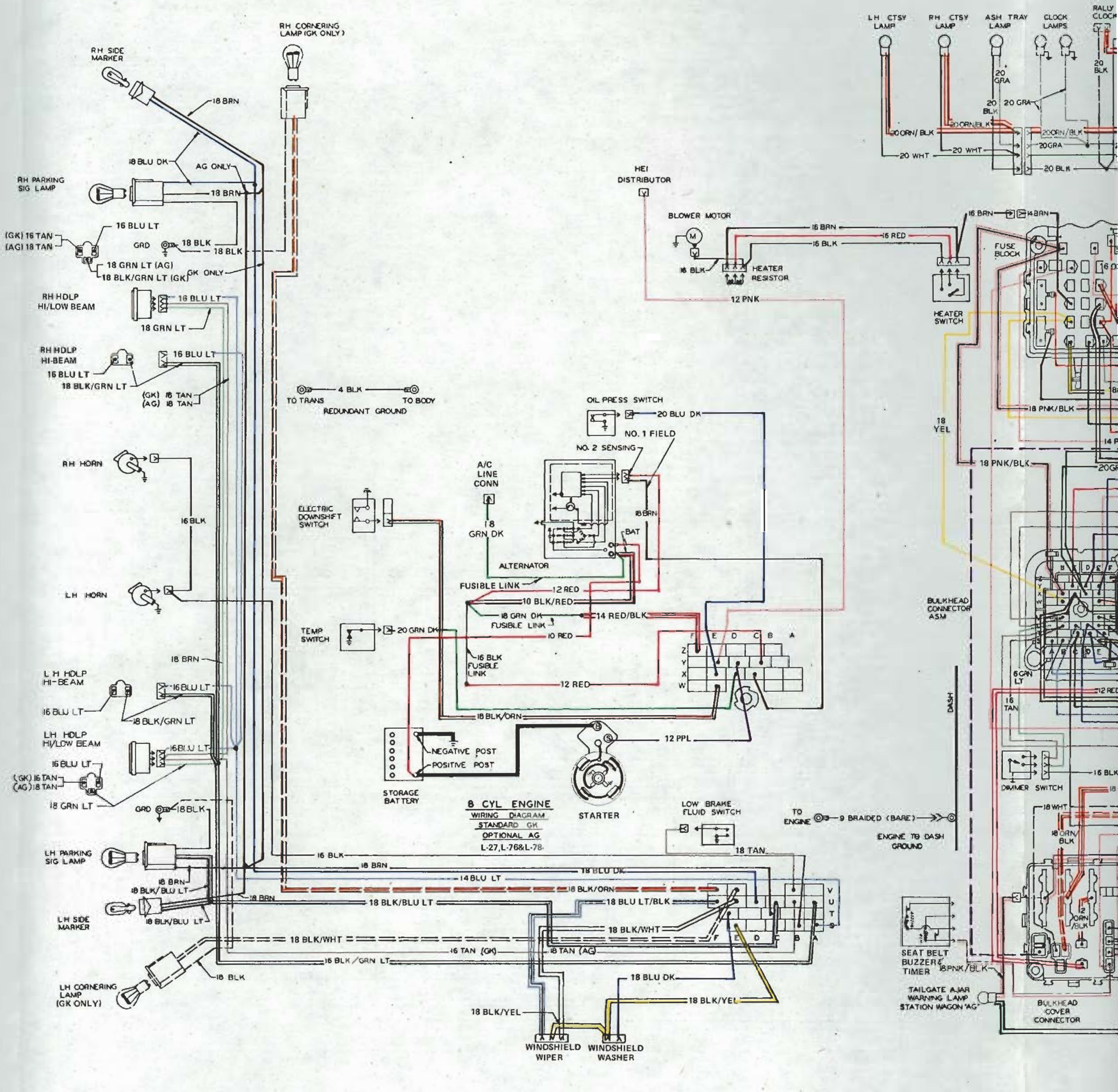


WIRE IDENTIFICATION CHART	
COLOR	SYMBOL
ALUMINUM	AL
BLACK	BLK
BLUE - LIGHT	BLU LT
BLUE - DARK	BLU DK
BROWN	BRN
GLAZED	GLZ
GREEN - LIGHT	GRN LT
GREEN - DARK	GRN DK
GRAY	GRA
MAROON	MAR
NATURAL	NAT
ORANGE	ORN
PINK	PNK
PURPLE	PPL
RED	RED
TAN	TAN
VIOLET	VLT
WHITE	WHT
YELLOW	YEL
SINGLE OR DOUBLE STRIPED CABLES EXAMPLE:	
WHITE WITH BLACK STRIPE	WHT/BLK

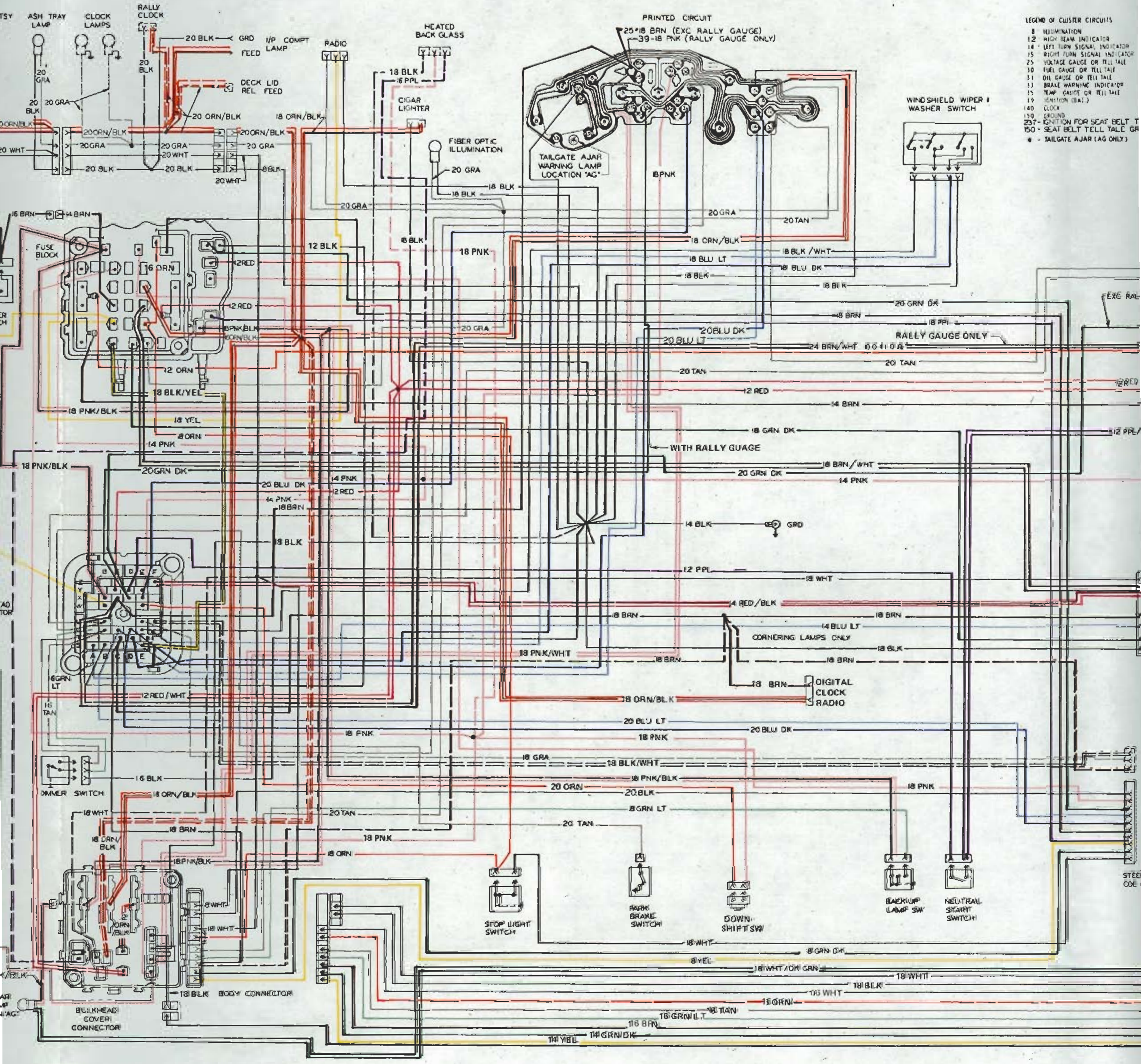


8 CYL ENGINE
WIRING DIAGRAM
OPTIONAL
L-34 – L-80

V-6 CYL ENGINE
WIRING DIAGRAM
STANDARD AG
NOT AVAILABLE GK
LD 7



8 CYL ENGINE
WIRING DIAGRAM
STANDARD GK
OPTIONAL AG
L-27, L-76 & L-78



TSY
ASH TRAY LAMP
CLOCK LAMPS
RALLY CLOCK
20 BLK
GRD
FEED
I/P COMPT LAMP
RADIO
HEATED BACK GLASS
DECK LID REL FEED
20 GRA
20 BLK
20 ORN/BLK
20 WHT
20 GRA
18 BLK
16 PPL
CIGAR LIGHTER
FIBER OPTIC ILLUMINATION
18 ORN/BLK
PRINTED CIRCUIT
25-18 BRN (EXC RALLY GAUGE)
39-18 PNK (RALLY GAUGE ONLY)
TAILGATE AJAR WARNING LAMP LOCATION "AG"
18 PNK
WINDSHIELD WIPER & WASHER SWITCH
LEGEND OF CLUSTER CIRCUITS
8 ILLUMINATION
12 HIGH BEAM INDICATOR
14 LEFT TURN SIGNAL INDICATOR
15 RIGHT TURN SIGNAL INDICATOR
25 VOLTAGE GAUGE OR TELL TALE
30 FUEL GAUGE OR TELL TALE
31 OIL GAUGE OR TELL TALE
33 BRAKE WARNING INDICATOR
35 TEMP GAUGE OR TELL TALE
39 IGNITION (BAT.)
140 CLOCK
150 GROUND
237- IGNITION FOR SEAT BELT T
150 - SEAT BELT TELL TALE GR
● - TAILGATE AJAR (AG ONLY)
16 BRN
14 BRN
FUSE BLOCK
16 ORN
12 RED
12 BLK
18 PNK
20 GRA
18 BLK
20 TAN
18 ORN/BLK
18 BLK/WHT
18 BLU LT
18 BLU DK
20 GRN DK
18 BRN
18 PPL
EXC RAL
RALLY GAUGE ONLY
20 BLU DK
20 BLU LT
24 BRN/WHT
20 TAN
12 RED
18 PNK/BLK
18 ORN/BLK
12 ORN
18 BLK/YEL
18 PNK/BLK
18 YEL
18 ORN
14 PNK
14 BRN
18 GRN DK
12 PPL
WITH RALLY GUAGE
18 PNK/BLK
20 GRN DK
20 BLU DK
14 PNK
12 RED
14 PNK
18 BRN
18 BRN/WHT
20 GRN DK
14 PNK
18 BLK
14 BLK
GRD
12 PPL
18 WHT
14 RED/BLK
18 BRN
18 BRN
14 BLU LT
CORNERING LAMPS ONLY
18 BLK
18 PNK/WHT
18 BRN
18 BRN
18 BRN
DIGITAL CLOCK RADIO
HEAD ECTOR
16 GRN LT
16 TAN
12 RED/WHT
18 ORN/BLK
20 BLU LT
20 BLU DK
18 PNK
18 PNK
18 GRA
18 BLK/WHT
18 PNK/BLK
16 BLK
DIMMER SWITCH
18 ORN/BLK
18 WHT
20 ORN
20 BLK
18 PNK
18 GRN LT
20 TAN
18 ORN/BLK
18 BRN
20 TAN
18 PNK
18 PNK/BLK
18 ORN
STOP LIGHT SWITCH
PARK BRAKE SWITCH
DOWN SHIFT SW
BACKUP LAMP SW
NEUTRAL START SWITCH
STEE COL
18 WHT
18 WHT
18 BLK
BODY CONNECTOR
BULKHEAD COVER CONNECTOR
18 WHT
18 GRN DK
18 YEL
18 WHT/DK GRN
18 WHT
18 BLK
18 WHT
18 ORN
18 TAN
16 GRN LT
16 BRN
14 GRN DK
14 YEL

LEGEND OF CLUSTER CIRCUITS

- 8 ILLUMINATION
- 12 HIGH BEAM INDICATOR
- 14 LEFT TURN SIGNAL INDICATOR
- 15 RIGHT TURN SIGNAL INDICATOR
- 25 VOLTAGE GAUGE OR TELL TALE
- 30 FUEL GAUGE OR TELL TALE
- 31 OIL GAUGE OR TELL TALE
- 33 BRAKE WARNING INDICATOR
- 35 TEMP GAUGE OR TELL TALE
- 39 IGNITION (BAT.)
- 140 CLOCK
- 150 GROUND
- 237 - IGNITION FOR SEAT BELT TELL TALE
- 150 - SEAT BELT TELL TALE GRD
- ✱ - TAILGATE AJAR (AG ONLY)

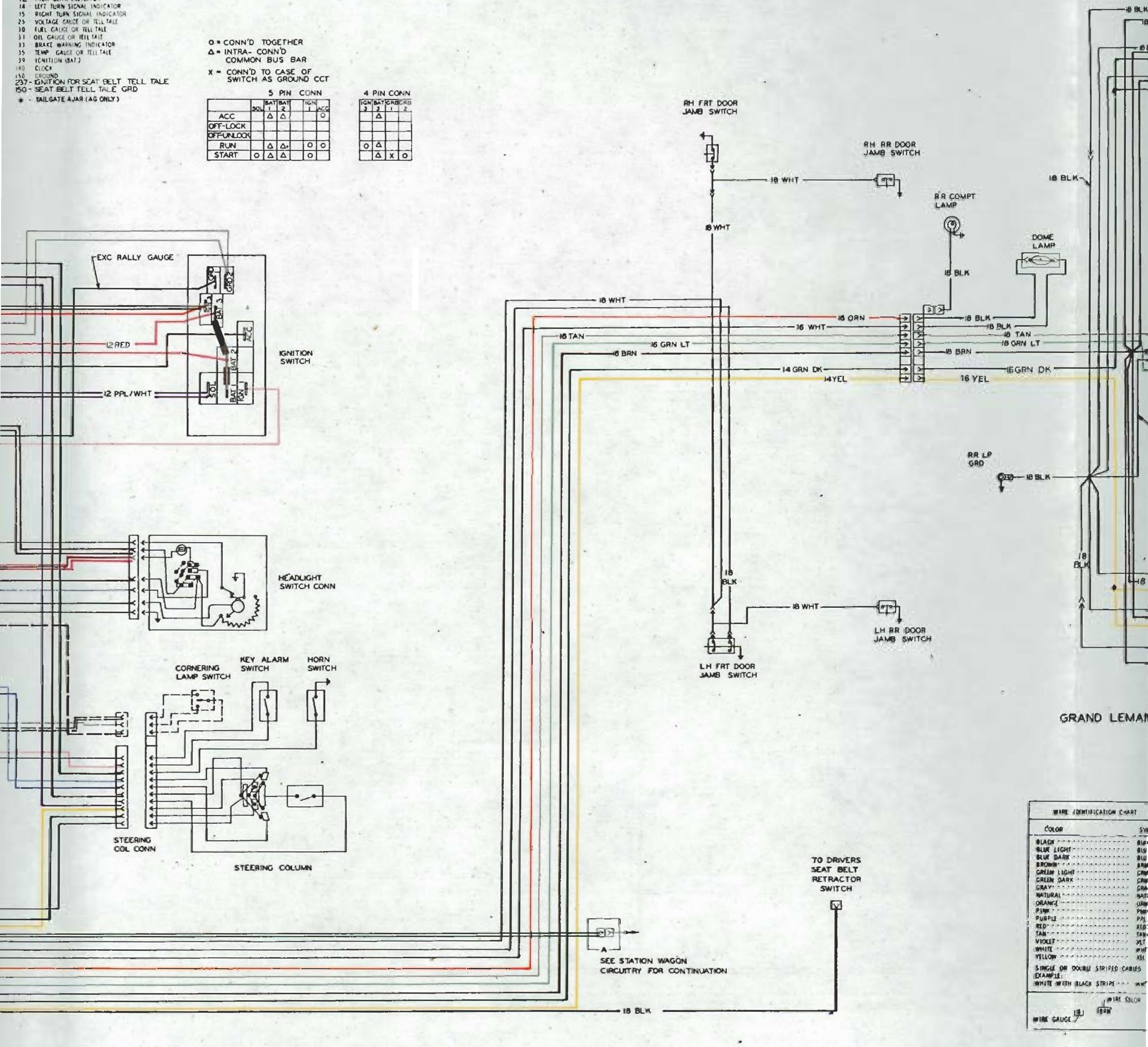
O = CONN'D TOGETHER
Δ = INTRA- CONN'D COMMON BUS BAR
X = CONN'D TO CASE OF SWITCH AS GROUND CCT

5 PIN CONN

	SOL	BAT 1	BAT 2		IGN 1	ACC
ACC		Δ	Δ			O
OFF-LOCK						
OFF-UNLOCK						
RUN		Δ	Δ		O	O
START	O	Δ	Δ		O	

4 PIN CONN

IGN 3	BAT 3	GRD 1	GRD 2
	Δ		
O	Δ		
	Δ	X	O

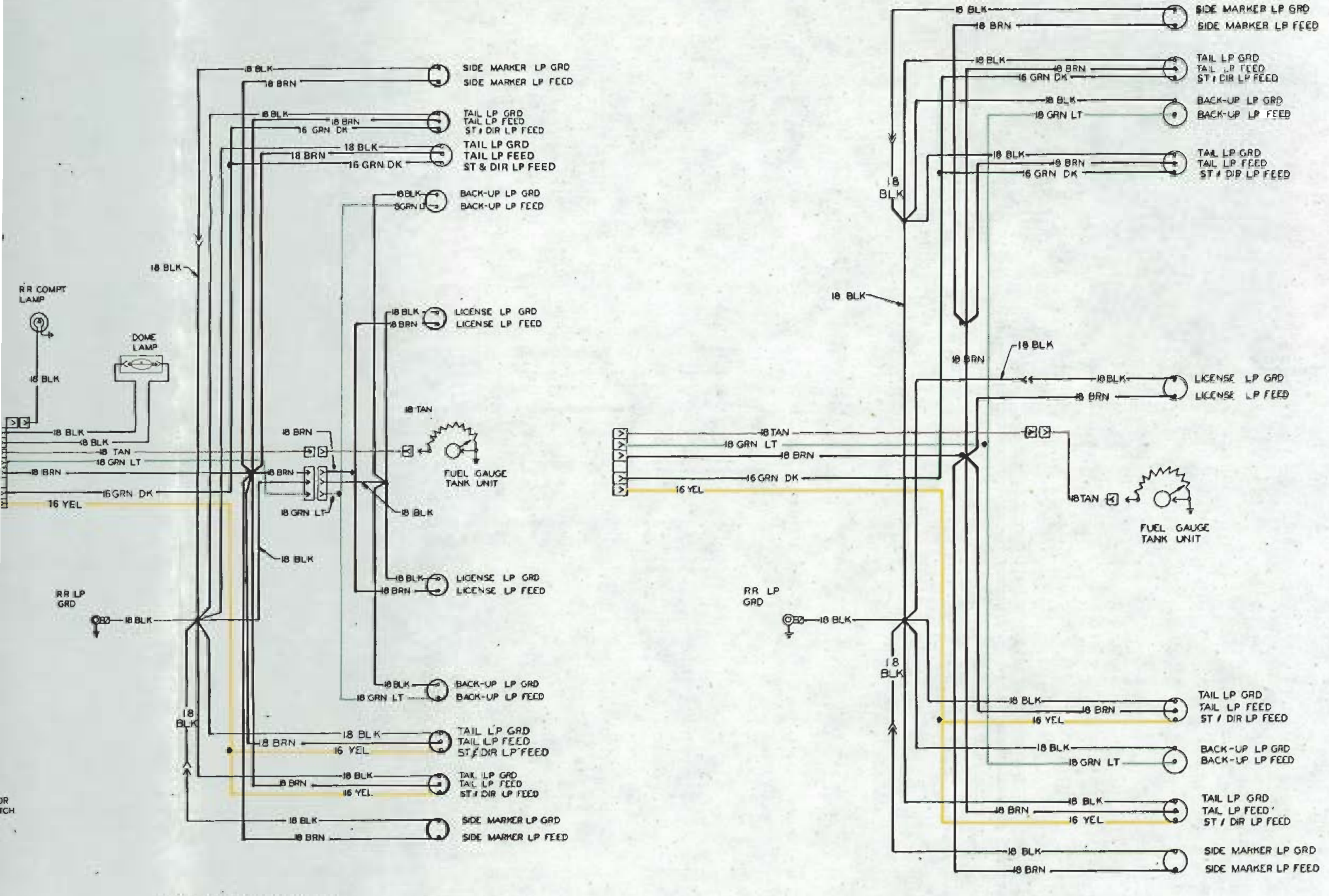


WIRE IDENTIFICATION CHART

COLOR	SY
BLACK	BLK
BLUE LIGHT	BLU
BLUE DARK	BLU
BROWN	BRN
GREEN LIGHT	GRN
GREEN DARK	GRN
GRAY	GRA
NATURAL	NAT
ORANGE	ORN
PINK	PNK
PURPLE	PPL
RED	RED
TAN	TAN
VIOLET	VLT
WHITE	WHT
YELLOW	YEL

SINGLE OR DOUBLE STRIPED CABLES
EXAMPLE:
WHITE WITH BLACK STRIPE WHT

WIRE COLOR
18
BRN
WIRE GAUGE



GRAND LEMANS (AG)

GRAND PRIX (GK)

WIRE IDENTIFICATION CHART

COLOR	SYMBOL
BLACK	BLK
BLUE LIGHT	BLU LT
BLUE DARK	BLU DK
BROWN	BRN
GREEN LIGHT	GRN LT
GREEN DARK	GRN DK
GRAY	GRA
NATURAL	NAT
ORANGE	ORN
PINK	PNK
PURPLE	PPL
RED	RED
TAN	TAN
VIOLET	VLT
WHITE	WHT
YELLOW	YEL

SINGLE OR DOUBLE STRIPED CABLES
EXAMPLE:
WHITE WITH BLACK STRIPE - - - WHT/BLK

WIRE COLOR
18 BRN
WIRE GAUGE

FIG. 8-3 G & AG SERIES WIRING DIAGRAM

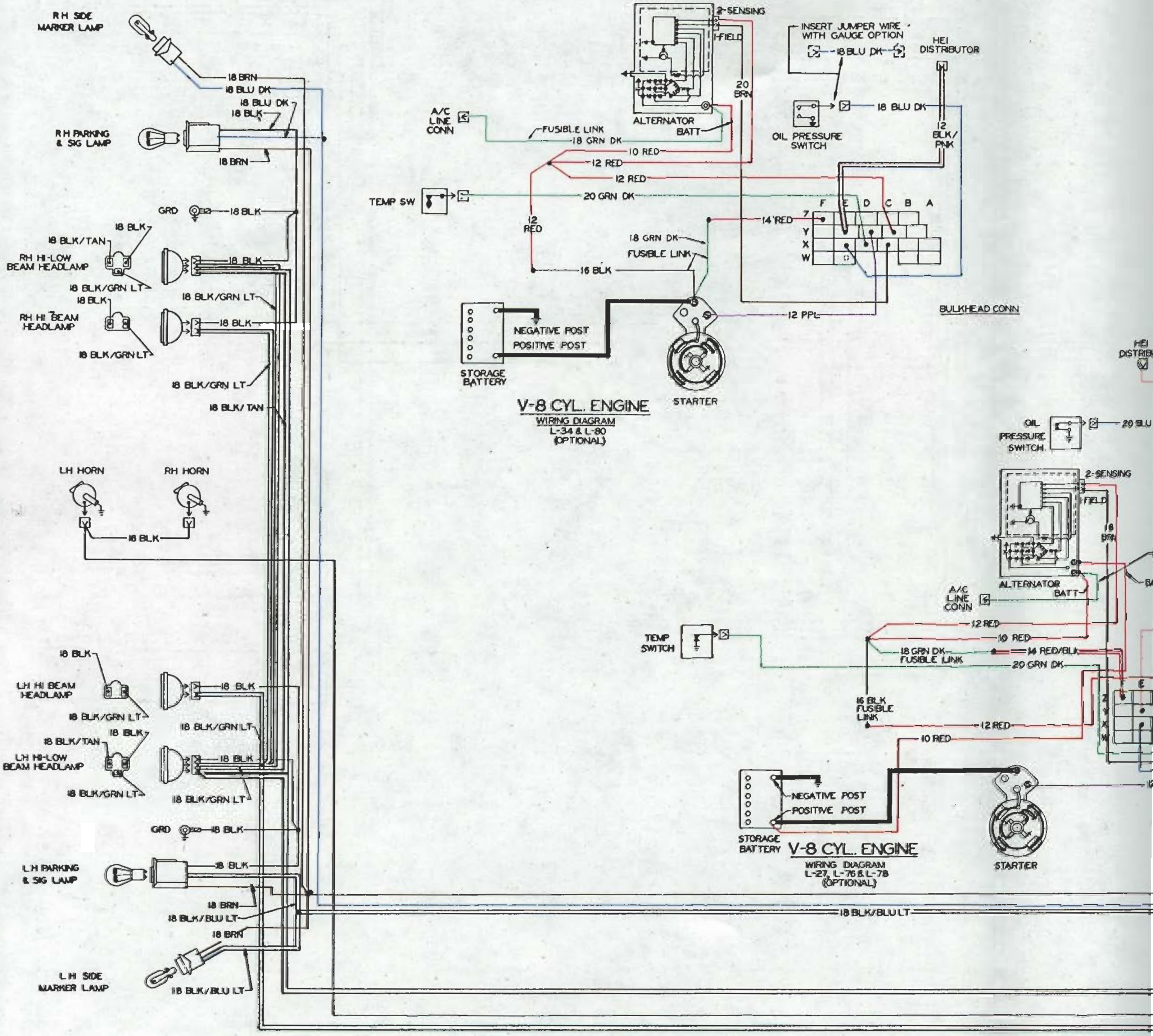
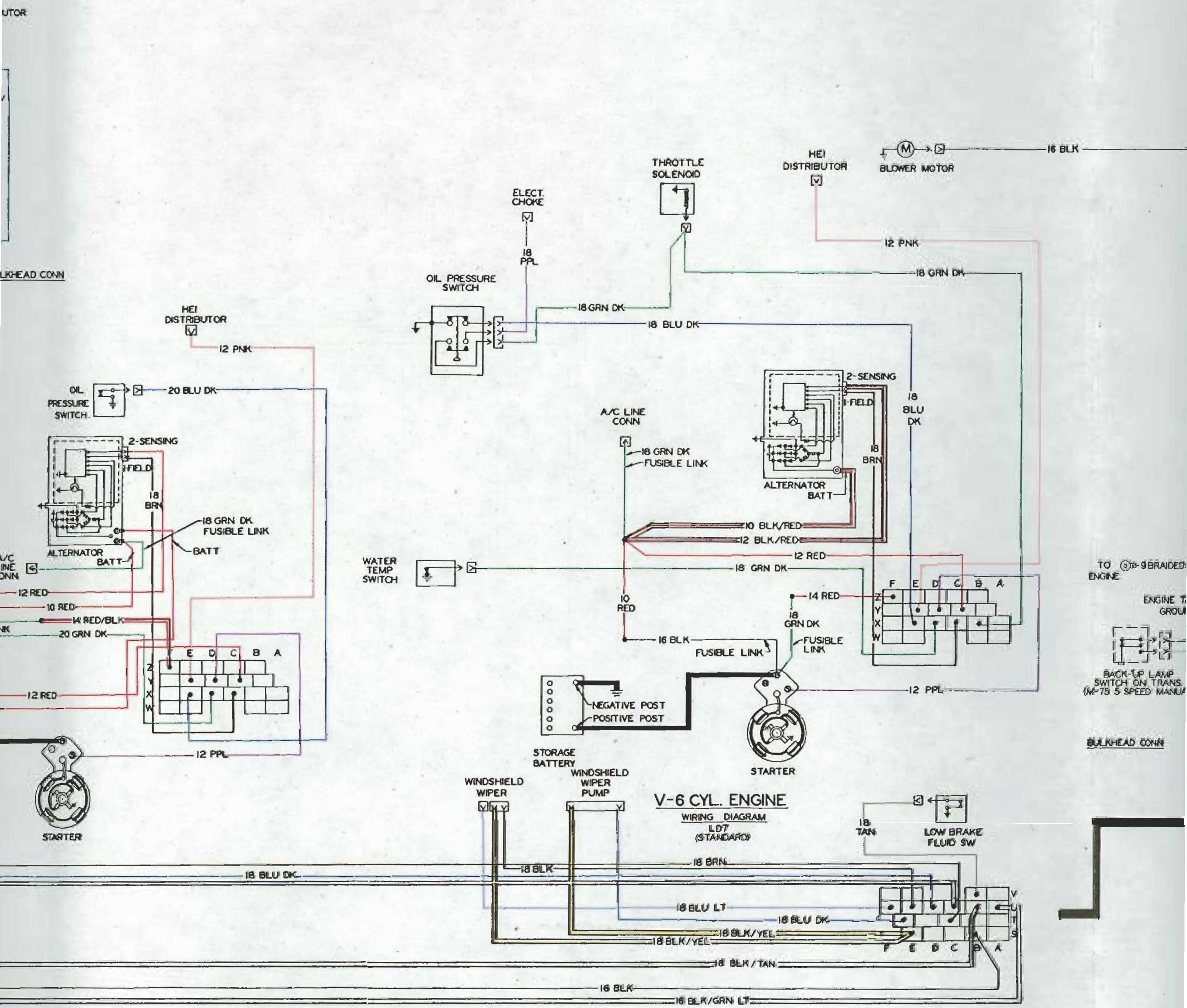
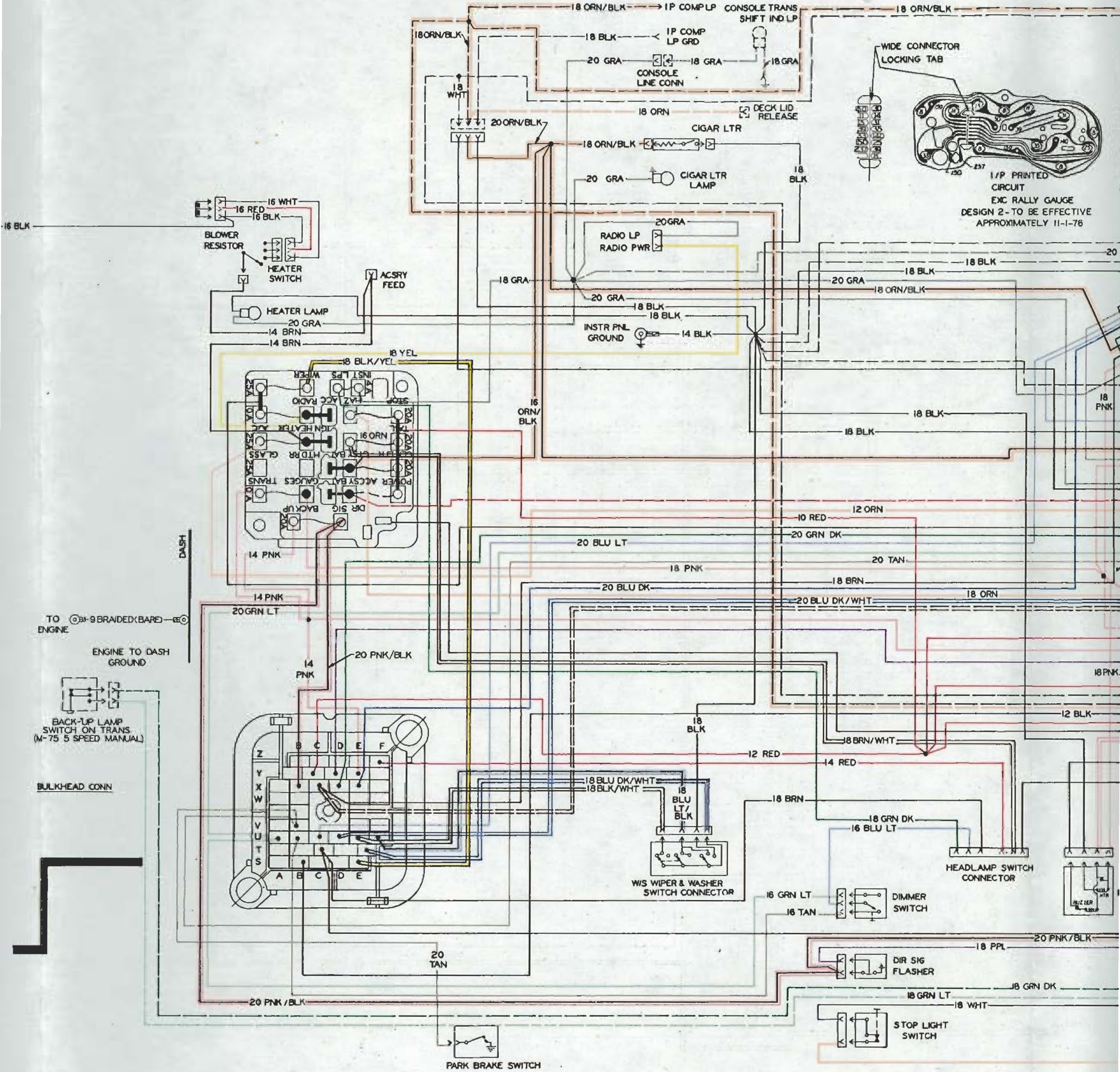


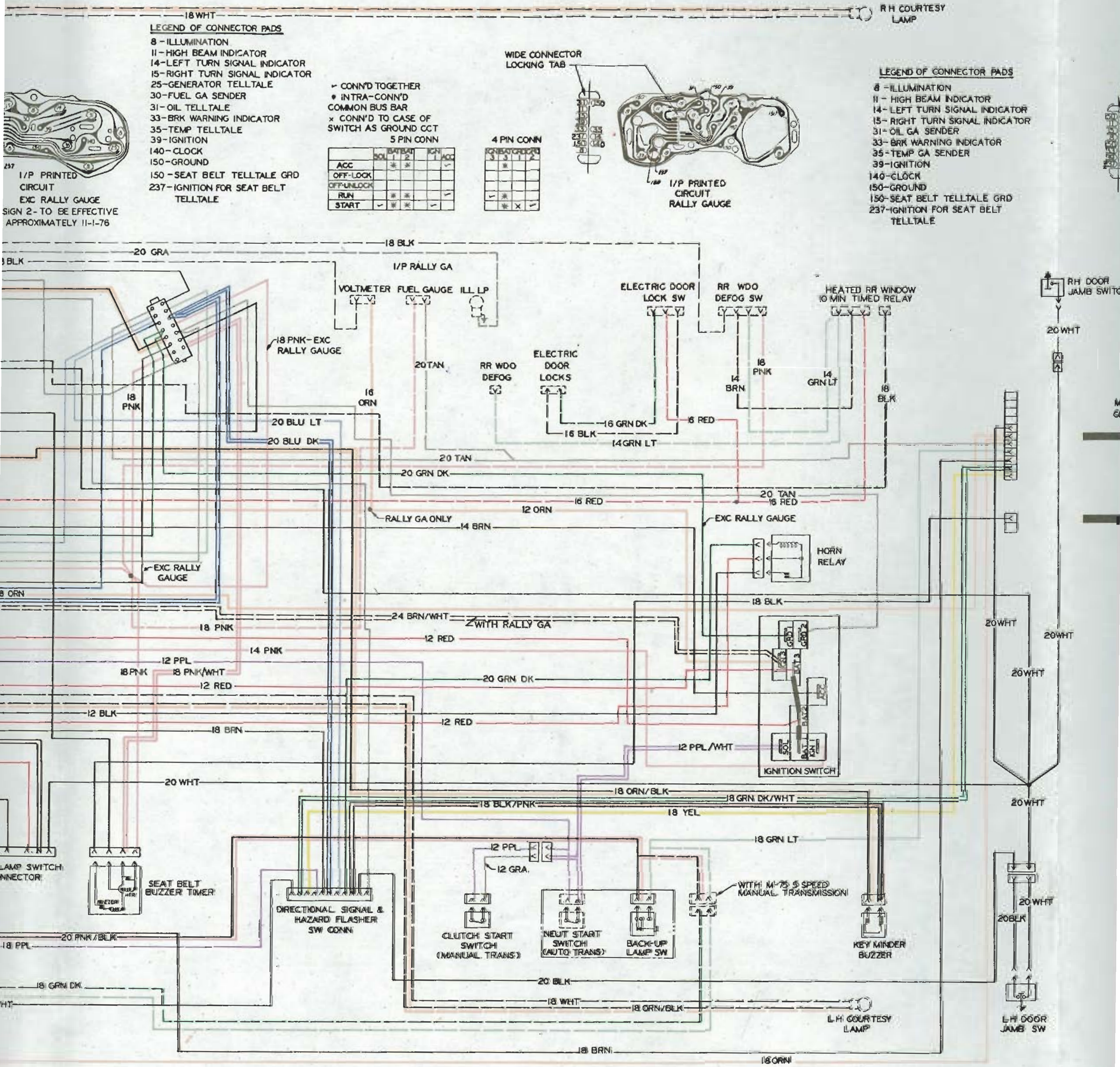
FIG. 8-4 F SERIES WIRING DIAGRAM



V-6 CYL. ENGINE

WIRING DIAGRAM
LD7
(STANDARD)


18 ORN/BLK
IP COMP LP
CONSOLE TRANS SHIFT IND LP
18 ORN/BLK
18ORN/BLK
18 BLK
IP COMP LP GRD
20 GRA
18 GRA
CONSOLE LINE CONN
18 GRA
18 WHT
18 ORN
DECK LID RELEASE
20 ORN/BLK
CIGAR LTR
18 ORN/BLK
18 BLK
20 GRA
CIGAR LTR LAMP
WIDE CONNECTOR LOCKING TAB
I/P PRINTED CIRCUIT
EXC RALLY GAUGE
DESIGN 2 - TO BE EFFECTIVE APPROXIMATELY 11-1-76
16 BLK
16 WHT
16 RED
16 BLK
BLOWER RESISTOR
HEATER SWITCH
20GRA
RADIO LP
RADIO PWR
ACSRY FEED
18 GRA
20 GRA
18 BLK
18 BLK
18 BLK
18 GRA
18 ORN/BLK
20
HEATER LAMP
20 GRA
14 BRN
14 BRN
INSTR PNL GROUND
14 BLK
18 YEL
18 BLK/YEL
WIPER
INST LPS
RADIO
ACC
HAZ
STOP
IGN
HEATER
A/C
TAIL
16 ORN
GLASS
RR HTD
BAT
CTSY
DR
TRANS
GAUGES
BAT
ACCSY
POWER
BACK UP
DIR SIG
20A
16 ORN/BLK
18 PNK
18 BLK
18 BLK
12 ORN
10 RED
20 GRN DK
20 BLU LT
DASH
14 PNK
18 PNK
20 TAN
18 BRN
20 BLU DK
18 ORN
20 BLU DK/WHT
14 PNK
20GRN LT
TO ENGINE
3 1/2-9 BRAIDED (BARE)
ENGINE TO DASH GROUND
14 PNK
20 PNK/BLK
18PNK
BACK-UP LAMP SWITCH ON TRANS (M-75 5 SPEED MANUAL)
BULKHEAD CONN
12 BLK
18 BLK
B C D E F
Z Y X W V U T S
A B C D E
12 RED
18 BRN/WHT
14 RED
18 BLU DK/WHT
18 BLK/WHT
18 BLU LT/ BLK
18 BRN
18 GRN DK
16 BLU LT
W/S WIPER & WASHER SWITCH CONNECTOR
HEADLAMP SWITCH CONNECTOR
BUZZER
16 GRN LT
16 TAN
DIMMER SWITCH
20 PNK/BLK
18 PPL
20 TAN
DIR SIG FLASHER
18 GRN DK
20 PNK/BLK
18 GRN LT
18 WHT
STOP LIGHT SWITCH
PARK BRAKE SWITCH



LEGEND OF CONNECTOR PADS
8 - ILLUMINATION
11 - HIGH BEAM INDICATOR
14 - LEFT TURN SIGNAL INDICATOR
15 - RIGHT TURN SIGNAL INDICATOR
25 - GENERATOR TELLTALE
30 - FUEL GA SENDER
31 - OIL TELLTALE
33 - BRK WARNING INDICATOR
35 - TEMP TELLTALE
39 - IGNITION
140 - CLOCK
150 - GROUND
150 - SEAT BELT TELLTALE GRD
237 - IGNITION FOR SEAT BELT TELLTALE

I/P PRINTED CIRCUIT EXC RALLY GAUGE
SIGN 2 - TO BE EFFECTIVE APPROXIMATELY 11-1-76

⌐ CONN'D TOGETHER
• INTRA-CONN'D COMMON BUS BAR
× CONN'D TO CASE OF SWITCH AS GROUND CCT

5 PIN CONN

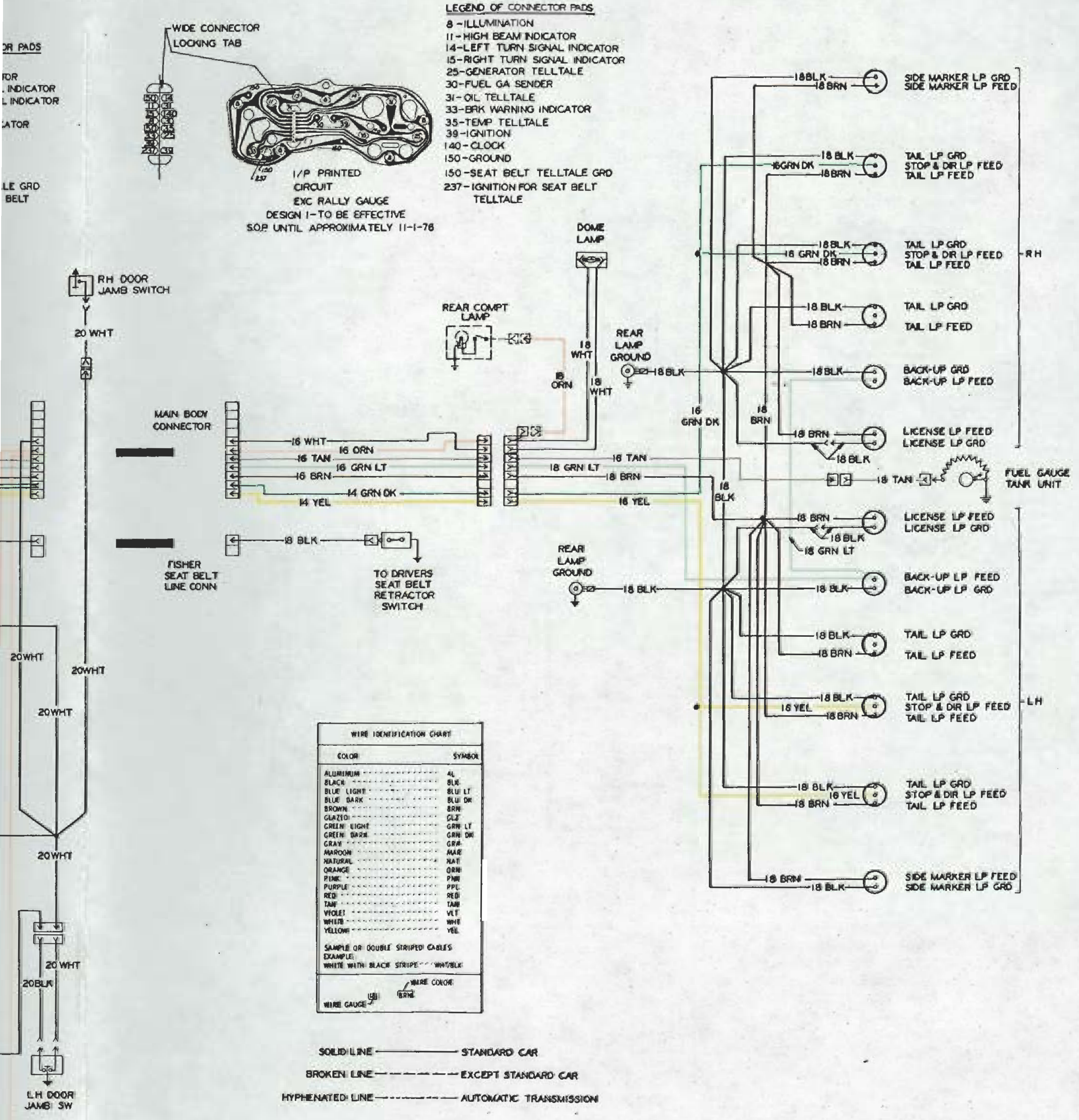
	SOL	BAT 1	BAT 2		IGN 1	ACC
ACC		*	*			⌐
OFF-LOCK						
OFF-UNLOCK						
RUN		*	*			⌐
START	⌐	*	*		⌐	

4 PIN CONN

IGN 3	BAT 3	GRD 1	GRD 2
	*		
⌐	*		
	*	×	⌐

WIDE CONNECTOR LOCKING TAB
I/P PRINTED CIRCUIT RALLY GAUGE

LEGEND OF CONNECTOR PADS
8 - ILLUMINATION
11 - HIGH BEAM INDICATOR
14 - LEFT TURN SIGNAL INDICATOR
15 - RIGHT TURN SIGNAL INDICATOR
31 - OIL GA SENDER
33 - BRK WARNING INDICATOR
35 - TEMP GA SENDER
39 - IGNITION
140 - CLOCK
150 - GROUND
150 - SEAT BELT TELLTALE GRD
237 - IGNITION FOR SEAT BELT TELLTALE



I/P PRINTED
CIRCUIT
EXC RALLY GAUGE
DESIGN I-TO BE EFFECTIVE
S.O.P. UNTIL APPROXIMATELY 11-1-76

LEGEND OF CONNECTOR PADS

8 - ILLUMINATION
11 - HIGH BEAM INDICATOR
14 - LEFT TURN SIGNAL INDICATOR
15 - RIGHT TURN SIGNAL INDICATOR
25 - GENERATOR TELLTALE
30 - FUEL GA SENDER
31 - OIL TELLTALE
33 - BRK WARNING INDICATOR
35 - TEMP TELLTALE
39 - IGNITION
140 - CLOCK
150 - GROUND
150 - SEAT BELT TELLTALE GRD
237 - IGNITION FOR SEAT BELT TELLTALE

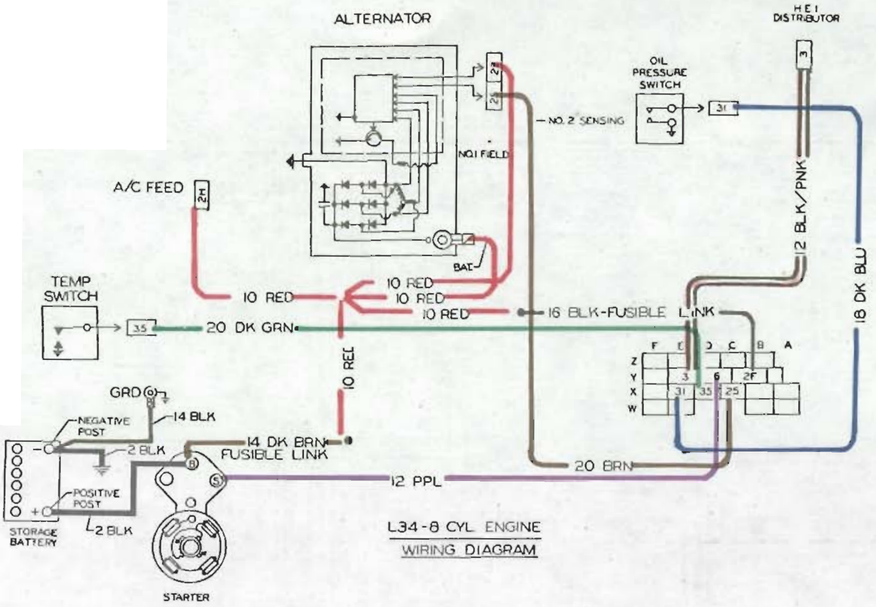
WIRE IDENTIFICATION CHART

COLOR	SYMBOL
ALUMINUM	AL
BLACK	BLK
BLUE LIGHT	BLU LT
BLUE DARK	BLU DK
BROWN	BRN
GLAZED	GLZ
GREEN LIGHT	GRN LT
GREEN DARK	GRN DK
GRAY	GRA
MAROON	MAR
NATURAL	NAT
ORANGE	ORN
PINK	PNK
PURPLE	PPL
RED	RED
TAN	TAN
VIOLET	VLT
WHITE	WHT
YELLOW	YEL

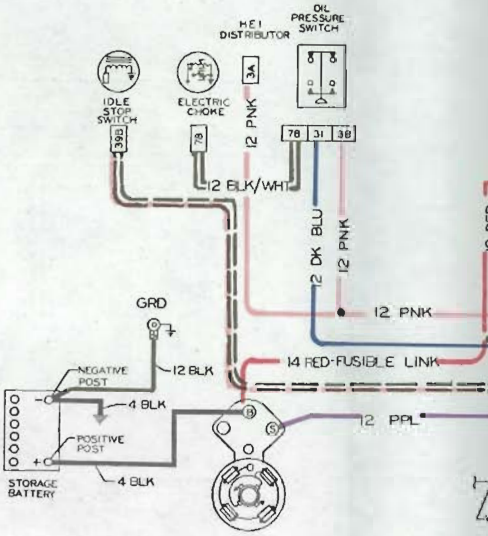
SAMPLE OR DOUBLE STRIPED CABLES
EXAMPLE:
WHITE WITH BLACK STRIPE - - - WHT/BLK

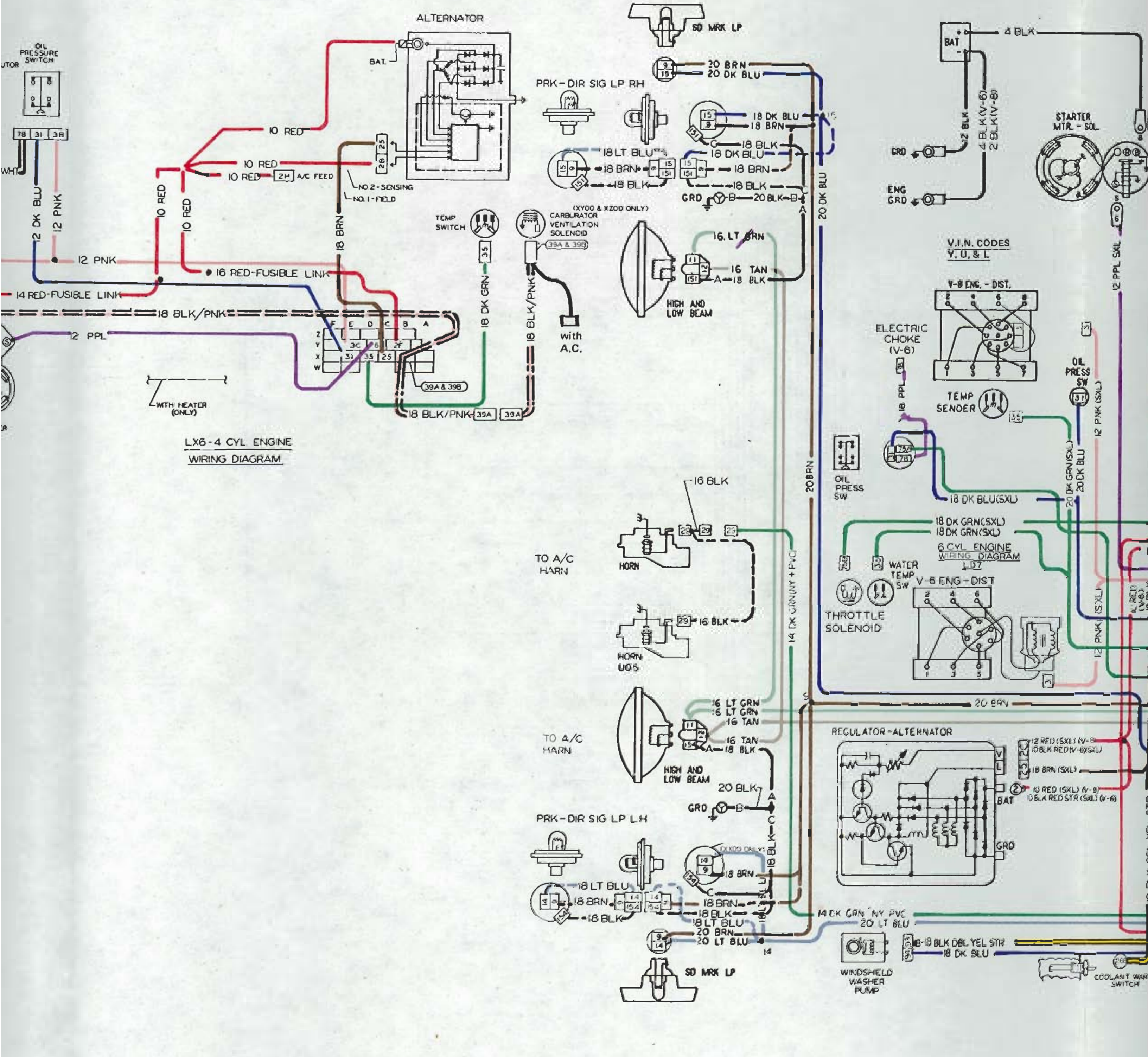
WIRE COLOR
18 BRN
WIRE GAUGE

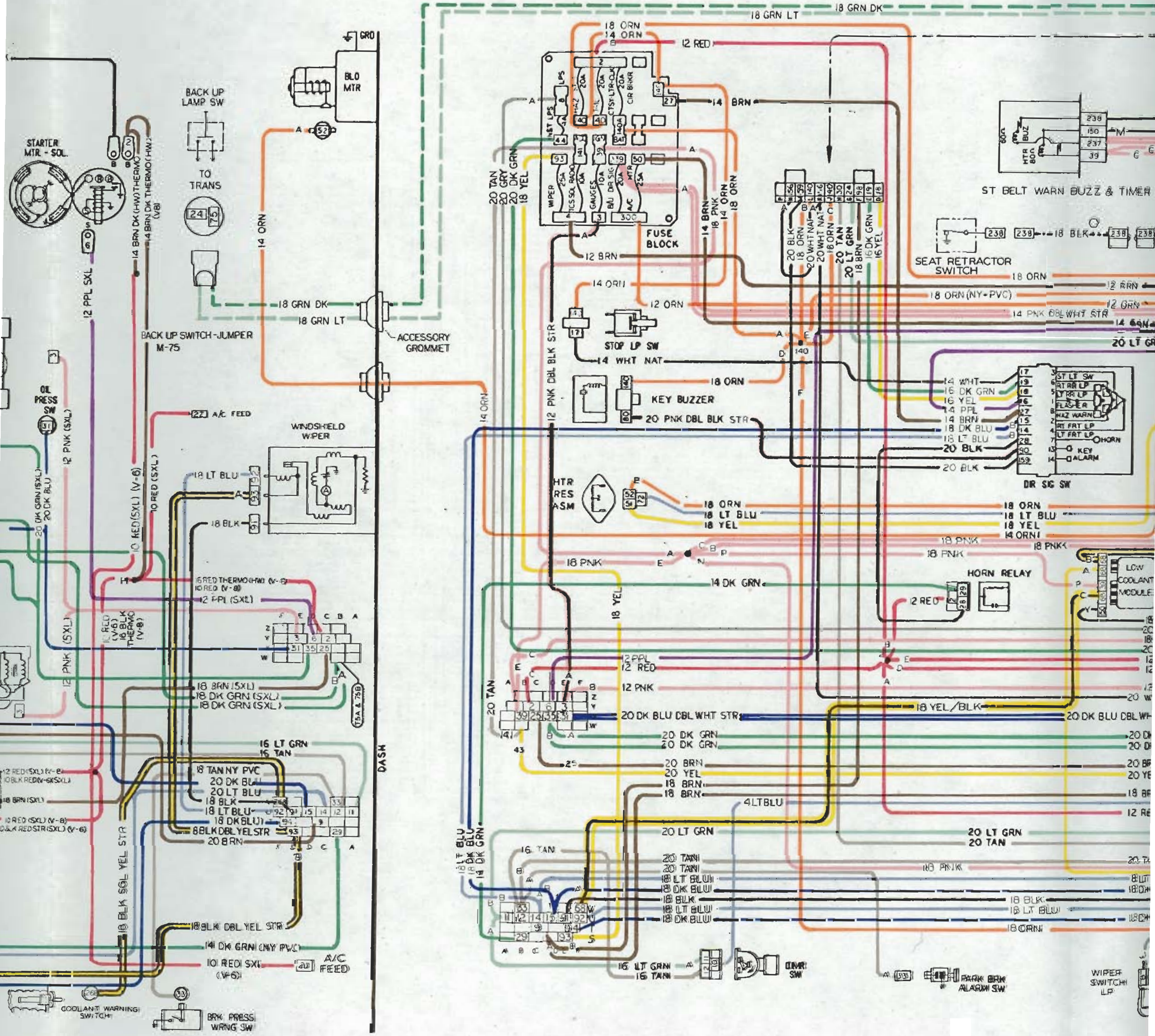
SOLID LINE ——————— STANDARD CAR
BROKEN LINE — — — — — EXCEPT STANDARD CAR
HYPHENATED LINE -·-·-·-·- AUTOMATIC TRANSMISSION

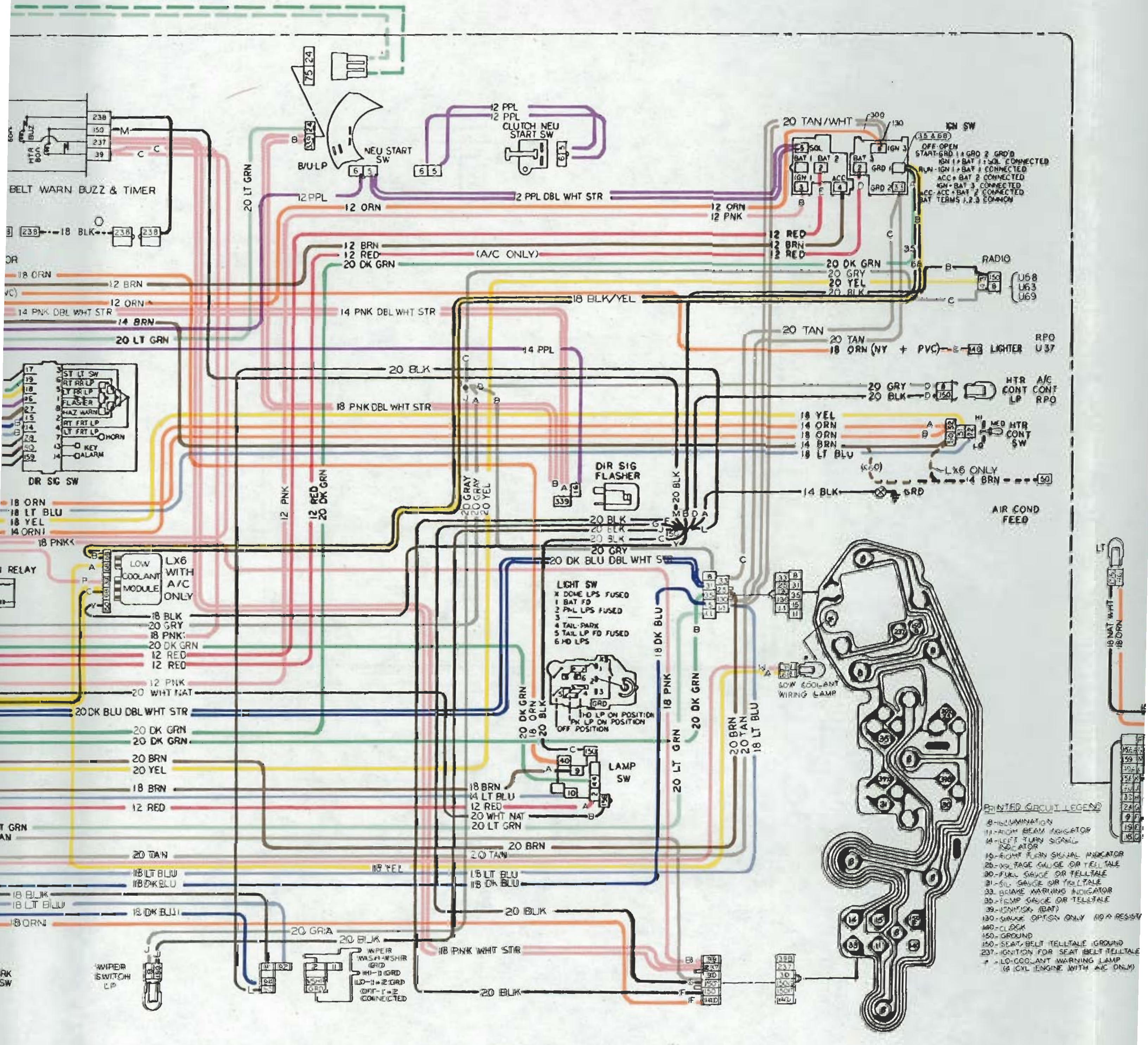


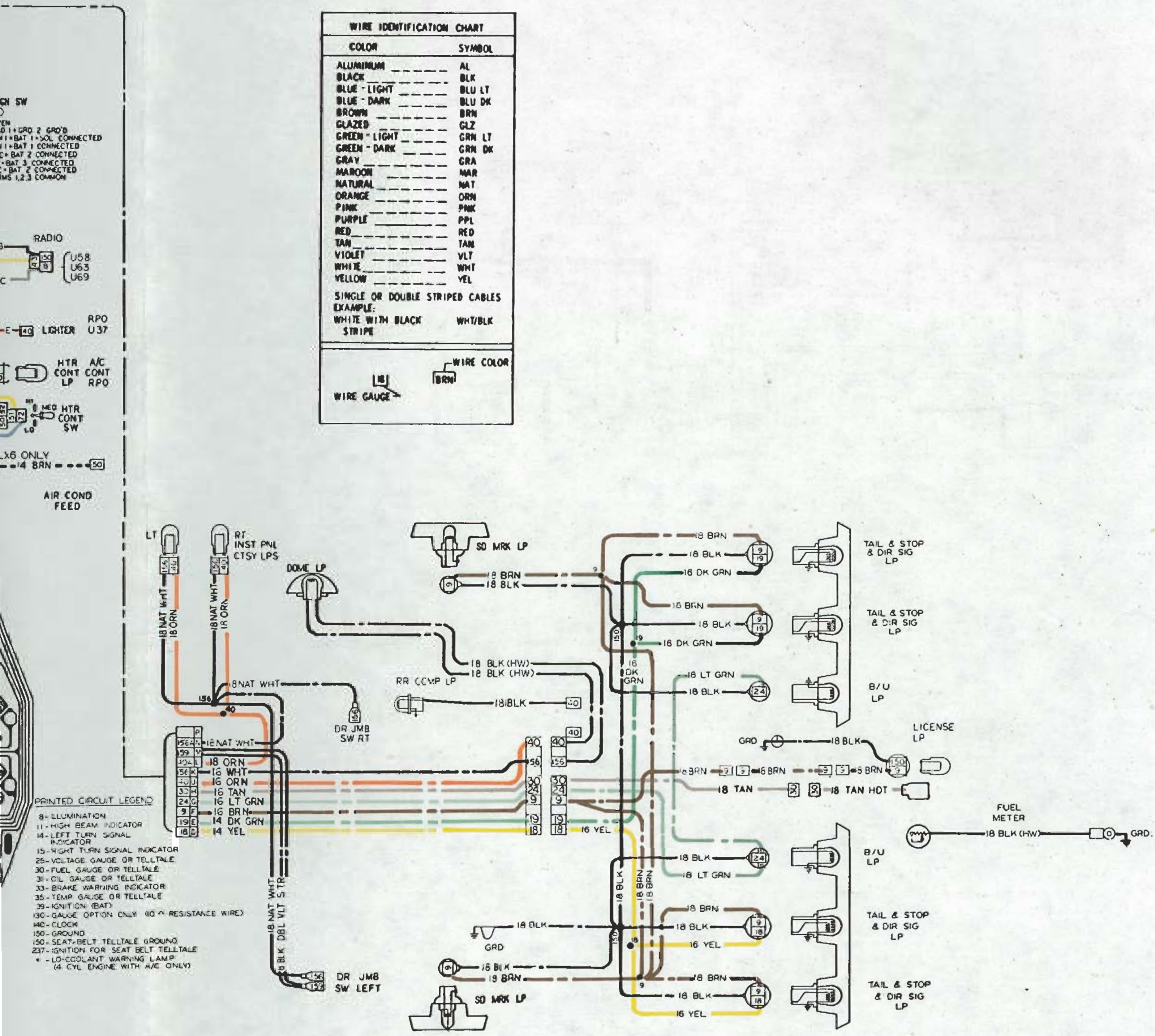
L34-8 CYL. ENGINE
WIRING DIAGRAM




OIL PRESSURE SWITCH
UTOR
78
31
3B
WHT
12 DK BLU
12 PNK
12 PNK
14 RED-FUSIBLE LINK
18 BLK/PNK
12 PPL
ALTERNATOR
BAT.
10 RED
10 RED
10 RED
2H
A/C FEED
10 RED
10 RED
25
28
NO 2 - SENSING
NO. 1 - FIELD
18 BRN
16 RED-FUSIBLE LINK
F E D C B A
Z
Y
X
W
3C
6
2F
31
35
25
39A & 39B
WITH HEATER (ONLY)
18 BLK/PNK
39A
39A
TEMP SWITCH
35
18 DK GRN
(XY00 & XZ00 ONLY)
CARBURATOR VENTILATION SOLENOID
39A & 39B
18 BLK/PNK
with A.C.
LX6 - 4 CYL ENGINE WIRING DIAGRAM
SD MRK LP
9
15
20 BRN
20 DK BLU
PRK - DIR SIG LP RH
15
9
151
18 DK BLU
18 BRN
C
18 BLK
18 LT BLU
18 DK BLU
18 BRN
18 BRN
18 BLK
18 BLK
GRD
B
20 BLK
B
C
A
20 DK BLU
16. LT GRN
11
12
151
16 TAN
A
18 BLK
HIGH AND LOW BEAM
20 BRN
16 BLK
29
29
23
HORN
TO A/C HARN
29
16 BLK
HORN U05
14 DK GRN(NY + PVC)
16 LT GRN
16 LT GRN
16 TAN
16 TAN
A
18 BLK
TO A/C HARN
HIGH AND LOW BEAM
20 BLK
A
GRD
B
C
18 BLK
PRK - DIR SIG LP LH
(XX00 ONLY)
14
9
154
18 BRN
C
18 LT BLU
18 BRN
18 BLK
14
154
14
154
18 BRN
18 BLK
18 LT BLU
18 LT BLU
20 BRN
20 LT BLU
9
14
14
SD MRK LP
S
BAT
4 BLK
12 BLK
4 BLK (V-6)
2 BLK (V-8)
GRD
ENG GRD
STARTER MTR. - SOL.
S
6
12 PPL SXL
V.I.N. CODES Y, U, & L
V-8 ENG. - DIST.
2 4 6 8
1 3 5 7
ELECTRIC CHOKE (V-6)
18 PPL
TEMP SENDER
35
OIL PRESS SW
31
3
12 PNK (SXL)
75A
78
OIL PRESS SW
18 DK BLU(SXL)
20 DK GRN(SXL)
20 DK BLU
18 DK GRN(SXL)
18 DK GRN(SXL)
6 CYL ENGINE WIRING DIAGRAM LD7
75B
35
WATER TEMP SW
V-6 ENG - DIST
2 4 6
1 3 5
THROTTLE SOLENOID
3
12 PNK (SXL)
10 RED (V-6)
20 BRN
REGULATOR - ALTERNATOR
V
L
12 RED (SXL) (V-8)
10 BLK RED (V-6)(SXL)
18 BRN (SXL)
2
BAT
10 RED (SXL) (V-8)
10 BLK RED STR (SXL) (V-6)
GRD
14 DK GRN NY PVC
20 LT BLU
WINDSHIELD WASHER PUMP
18 BLK DBL YEL STR
18 DK BLU
COOLANT WAR SWITCH


18 GRN DK
18 GRN LT
GRD
BLO MTR
BACK UP LAMP SW
TO TRANS
STARTER MTR.-SOL.
14 BRN DK (HW) THERMO (HW)
14 BRN DK THERMO (V8)
12 PPL SXL
14 ORN
18 GRN DK
18 GRN LT
ACCESSORY GROMMET
BACK UP SWITCH-JUMPER M-75
OIL PRESS SW
12 PNK (SXL)
20 DK GRN (SXL)
20 DK BLU
10 RED (SXL) (V-6)
10 RED (SXL)
A/C FEED
WINDSHIELD WIPER
18 LT BLU
18 BLK
16 RED THERMO (HW) (V-6)
10 RED (V-8)
12 PPL (SXL)
10 RED (V-6) 16 BLK THERMO (V-8)
12 PNK (SXL)
18 BRN (SXL)
18 DK GRN (SXL)
18 DK GRN (SXL)
7.5A & 7.5B
16 LT GRN
16 TAN
18 TAN NY PVC
20 DK BLU
20 LT BLU
18 BLK
18 LT BLU
18 DK BLU
18 BLK DBL YEL STR
20 BRN
12 RED (SXL) (V-8)
10 BLK RED (V-6) (SXL)
18 BRN (SXL)
10 RED (SXL) (V-8)
10 BLK RED STR (SXL) (V-6)
18 BLK SGL YEL STR
18 BLK DBL YEL STR
14 DK GRN (NY PVC)
10 RED SXL (V-6)
A/C FEED
COOLANT WARNING SWITCH
BRK PRESS WRNG SW
DASH
12 RED
18 ORN
14 ORN
14 BRN
FUSE BLOCK
WIPER 25A
ICS SOL RADIO 10A
GAUGES 10A
BU DIR SIG 10A
HTR A/C 25A
HAZ ST 20A
CTSY LTR-CLK 20A
CIR BRKR
20 TAN
20 GRY
20 DK GRN
18 YEL
14 BRN
18 PNK
14 ORN
12 BRN
14 ORN
12 ORN
STOP LP SW
14 WHT NAT
18 ORN
KEY BUZZER
20 PNK DBL BLK STR
12 PNK DBL BLK STR
14 ORN
HTR RES ASM
18 ORN
18 LT BLU
18 YEL
18 PNK
14 DK GRN
18 YEL
12 PPL
12 RED
12 PNK
20 TAN
20 DK BLU DBL WHT STR
20 DK GRN
20 DK GRN
20 BRN
20 YEL
18 BRN
18 BRN
4 LT BLU
20 LT GRN
18 LT BLU
18 DK BLU
14 DK GRN
16 TAN
20 TAN
20 TAN
18 LT BLU
18 DK BLU
18 BLK
18 LT BLU
18 DK BLU
16 LT GRN
16 TAN
DIMR SW
20 BLK
18 ORN
20 WHT NAT
20 WHT NAT
18 ORN
20 TAN
20 LT GRN
18 BRN
16 DK GRN
16 YEL
140
ST BELT WARN BUZZ & TIMER
SEAT RETRACTOR SWITCH
18 BLK
18 ORN
18 ORN (NY-PVC)
12 BRN
12 GRN
14 PNK DBL WHT STR
14 GRN
20 LT GRN
14 WHT
16 DK GRN
16 YEL
14 PPL
14 BRN
18 DK BLU
18 LT BLU
20 BLK
20 BLK
ST LT SW
RT RR LP
LT RR LP
FLASHER
HAZ WARN
RT FRT LP
LT FRT LP
HORN
KEY ALARM
DR SIG SW
18 ORN
18 LT BLU
18 YEL
14 ORN
18 PNK
18 PNK
18 PNK
HORN RELAY
12 RED
LOW COOLANT MODULE
18 YEL/BLK
20 DK BLU DBL WH
20 LT GRN
20 TAN
18 PNK
18 BLK
18 LT BLU
18 ORN
PARK BRK ALARM SW
WIPER SWITCH LP


BELT WARN BUZZ & TIMER
B/U LP
NEU START SW
12 PPL
12 PPL
CLUTCH NEU START SW
12 PPL DBL WHT STR
12 ORN
12 PNK
20 TAN/WHT
300
130
IGN SW
35 & 68
OFF-OPEN
START-GRD 1 + GRD 2 GRD'D
IGN 1 + BAT 1 + SOL CONNECTED
RUN-IGN 1 + BAT 1 CONNECTED
ACC + BAT 2 CONNECTED
IGN + BAT 3 CONNECTED
ACC-ACC + BAT 2 CONNECTED
BAT TERMS 1,2,3 COMMON
SOL
BAT 1
BAT 2
BAT 3
IGN 1
IGN 3
ACC
GRD 1
GRD 2
12 RED
12 BRN
12 RED
12 BRN
12 RED
20 DK GRN
(A/C ONLY)
20 DK GRN
20 GRY
20 YEL
20 BLK
RADIO
U58
U63
U69
18 ORN
12 BRN
12 ORN
14 PNK DBL WHT STR
14 BRN
20 LT GRN
20 LT GRN
18 BLK/YEL
14 PPL
20 TAN
20 TAN
18 ORN (NY + PVC)
LIGHTER
RPO U37
20 BLK
20 GRY
20 BLK
HTR CONT LP
A/C CONT RPO
18 PNK DBL WHT STR
18 YEL
14 ORN
18 ORN
14 BRN
18 LT BLU
HTR CONT SW
HI
MED
LO
LX6 ONLY
14 BRN
14 BLK
GRD
AIR COND FEED
DIR SIG FLASHER
DIR SIG SW
ST LT SW
RT RR LP
LT RR LP
FLASHER
HAZ WARN
RT FRT LP
LT FRT LP
HORN
KEY ALARM
18 ORN
18 LT BLU
18 YEL
14 ORN
18 PNK
RELAY
LOW COOLANT MODULE
LX6 WITH A/C ONLY
18 BLK
20 GRY
18 PNK
20 DK GRN
12 RED
12 RED
12 PNK
20 WHT NAT
20 DK BLU DBL WHT STR
20 DK GRN
20 DK GRN
20 BRN
20 YEL
18 BRN
12 RED
20 TAN
18 LT BLU
18 DK BLU
18 BLK
18 LT BLU
18 DK BLU
18 ORN
18 YEL
12 PNK
12 RED
20 DK GRN
20 GRAY
20 GRAY
20 YEL
20 BLK
20 BLK
20 BLK
20 BLK
20 GRY
20 DK BLU DBL WHT STR
LIGHT SW
X DOME LPS FUSED
1 BAT FD
2 PNL LPS FUSED
3 —
4 TAIL-PARK
5 TAIL LP FD FUSED
6 HD LPS
GRD
HD LP ON POSITION
PK LP ON POSITION
OFF POSITION
20 DK GRN
18 ORN
20 BLK
18 DK BLU
18 PNK
20 DK GRN
20 LT GRN
20 BRN
20 TAN
18 LT BLU
LAMP SW
18 BRN
14 LT BLU
12 RED
20 WHT NAT
20 LT GRN
20 BRN
20 TAN
18 LT BLU
18 DK BLU
20 BLK
20 GRA
20 BLK
18 PNK WHT STR
20 BLK
LOW COOLANT WARNING LAMP
WIPER SWITCH LP
WIPER
WASH-WSHR
GRD
HI-1 GRD
LO-1 + 2 GRD
OFF-1 + 2 CONNECTED
LT
18 NAT WHT
18 ORN
PRINTED CIRCUIT LEGEND
8-ILLUMINATION
11-HIGH BEAM INDICATOR
14-LEFT TURN SIGNAL INDICATOR
15-RIGHT TURN SIGNAL INDICATOR
25-VOLTAGE GAUGE OR TELLTALE
30-FUEL GAUGE OR TELLTALE
31-OIL GAUGE OR TELLTALE
33-BRAKE WARNING INDICATOR
35-TEMP GAUGE OR TELLTALE
39-IGNITION (BAT)
130-GAUGE OPTION ONLY (10 Ω RESIST
140-CLOCK
150-GROUND
150-SEAT BELT TELLTALE GROUND
237-IGNITION FOR SEAT BELT TELLTALE
* -LO-COOLANT WARNING LAMP (4 CYL ENGINE WITH A/C ONLY)



WIRE IDENTIFICATION CHART

COLOR	SYMBOL
ALUMINUM	AL
BLACK	BLK
BLUE - LIGHT	BLU LT
BLUE - DARK	BLU DK
BROWN	BRN
GLAZED	GLZ
GREEN - LIGHT	GRN LT
GREEN - DARK	GRN DK
GRAY	GRA
MAROON	MAR
NATURAL	NAT
ORANGE	ORN
PINK	PNK
PURPLE	PPL
RED	RED
TAN	TAN
VIOLET	VLT
WHITE	WHT
YELLOW	YEL

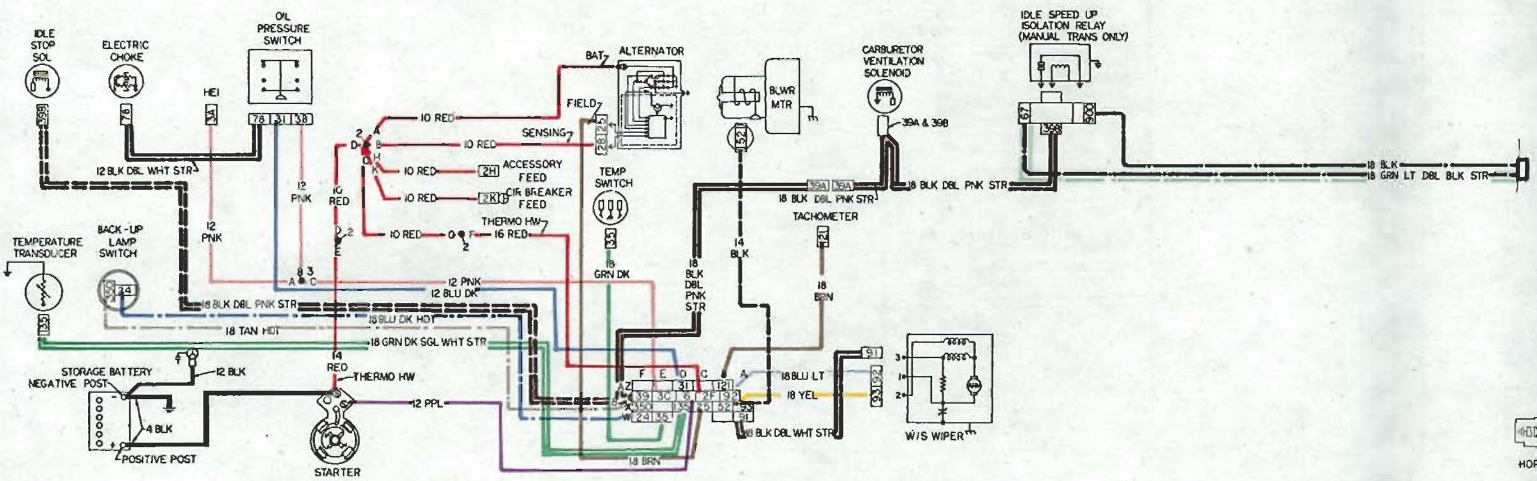
SINGLE OR DOUBLE STRIPED CABLES EXAMPLE:

WHITE WITH BLACK STRIPE — WHT/BLK

PRINTED CIRCUIT LEGEND

8- ILLUMINATION
11- HIGH BEAM INDICATOR
14- LEFT TURN SIGNAL INDICATOR
15- RIGHT TURN SIGNAL INDICATOR
25- VOLTAGE GAUGE OR TELLTALE
30- FUEL GAUGE OR TELLTALE
31- OIL GAUGE OR TELLTALE
33- BRAKE WARNING INDICATOR
35- TEMP GAUGE OR TELLTALE
39- IGNITION (BAT)
130- GAUGE OPTION ONLY (10 Ω RESISTANCE WIRE)
140- CLOCK
150- GROUND
150- SEAT-BELT TELLTALE GROUND
237- IGNITION FOR SEAT BELT TELLTALE
* - LO-COOLANT WARNING LAMP (4 CYL ENGINE WITH A/C ONLY)

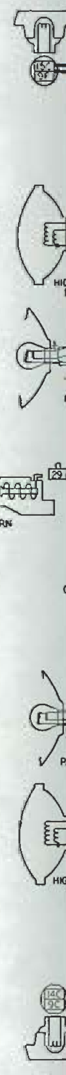
FIG. 8-5 X SERIES WIRING DIAGRAM

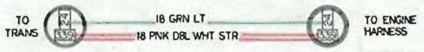


4-CYL ENGINE
LX6
WIRING DIAGRAM

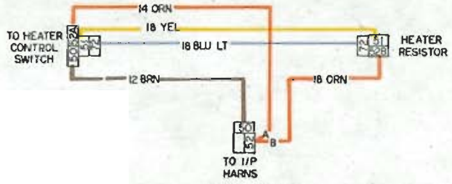
WITH MANUAL TRANS ONLY

WITH HEATER ONLY



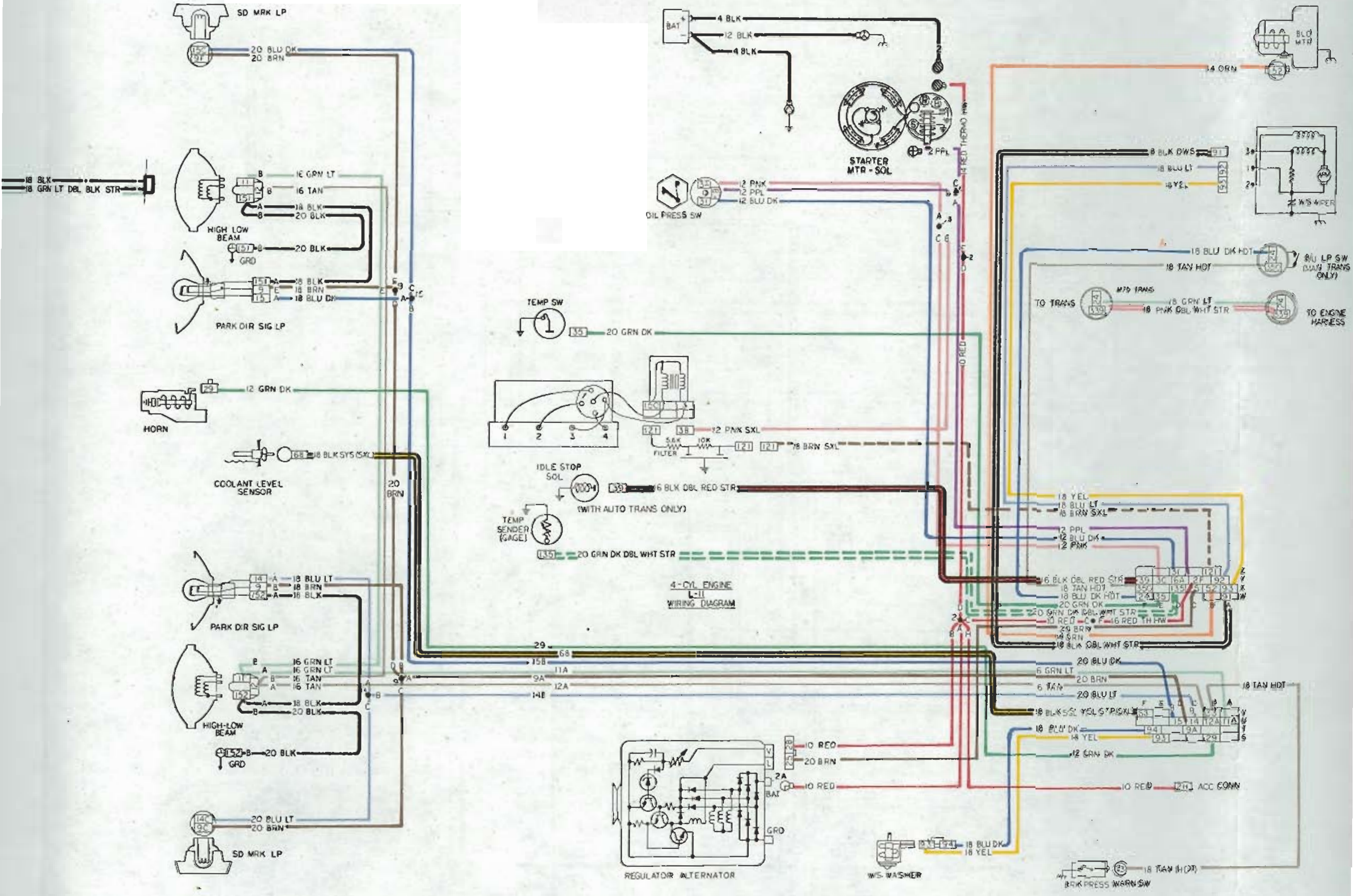


M75 - JUMPER

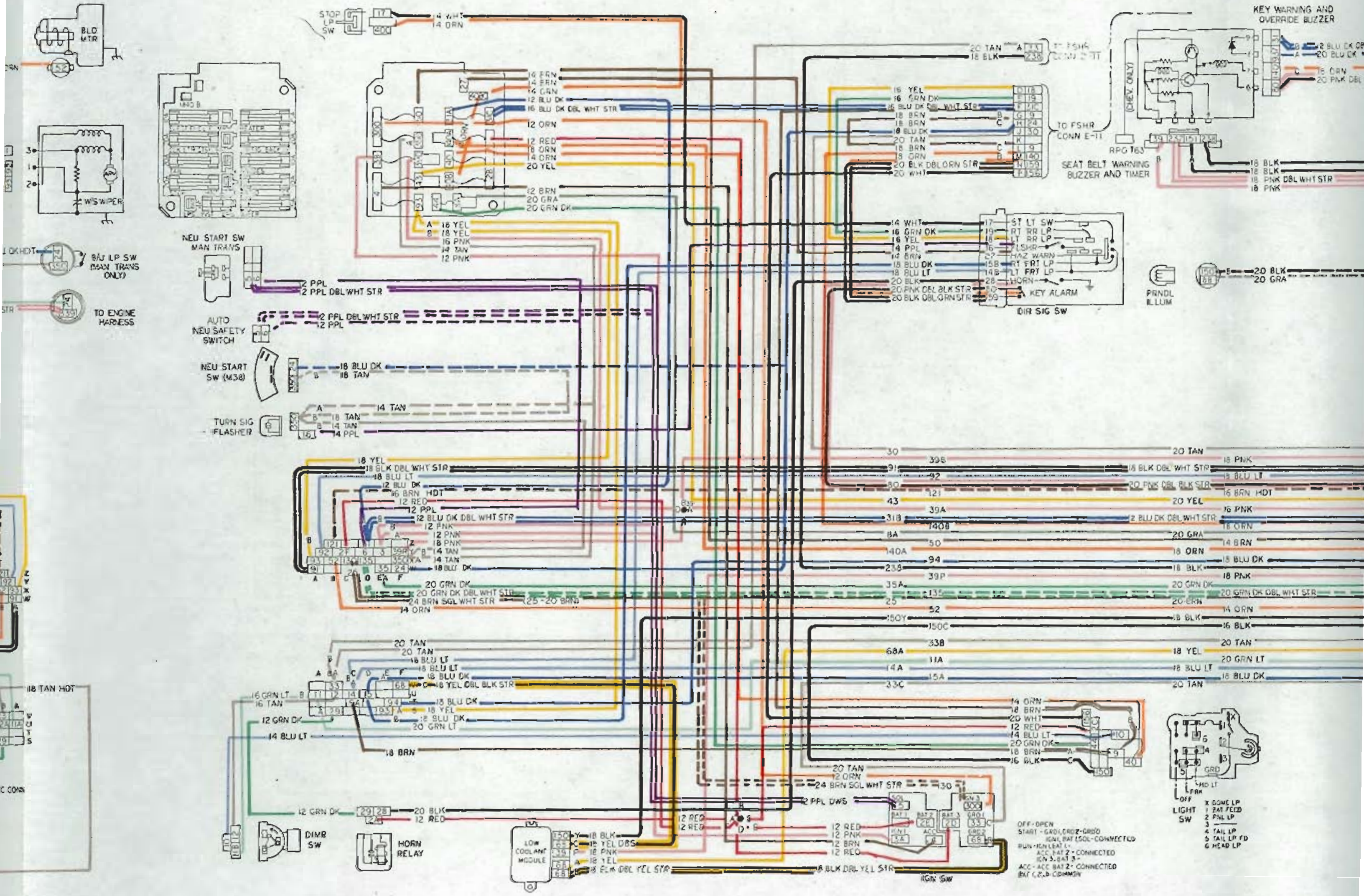


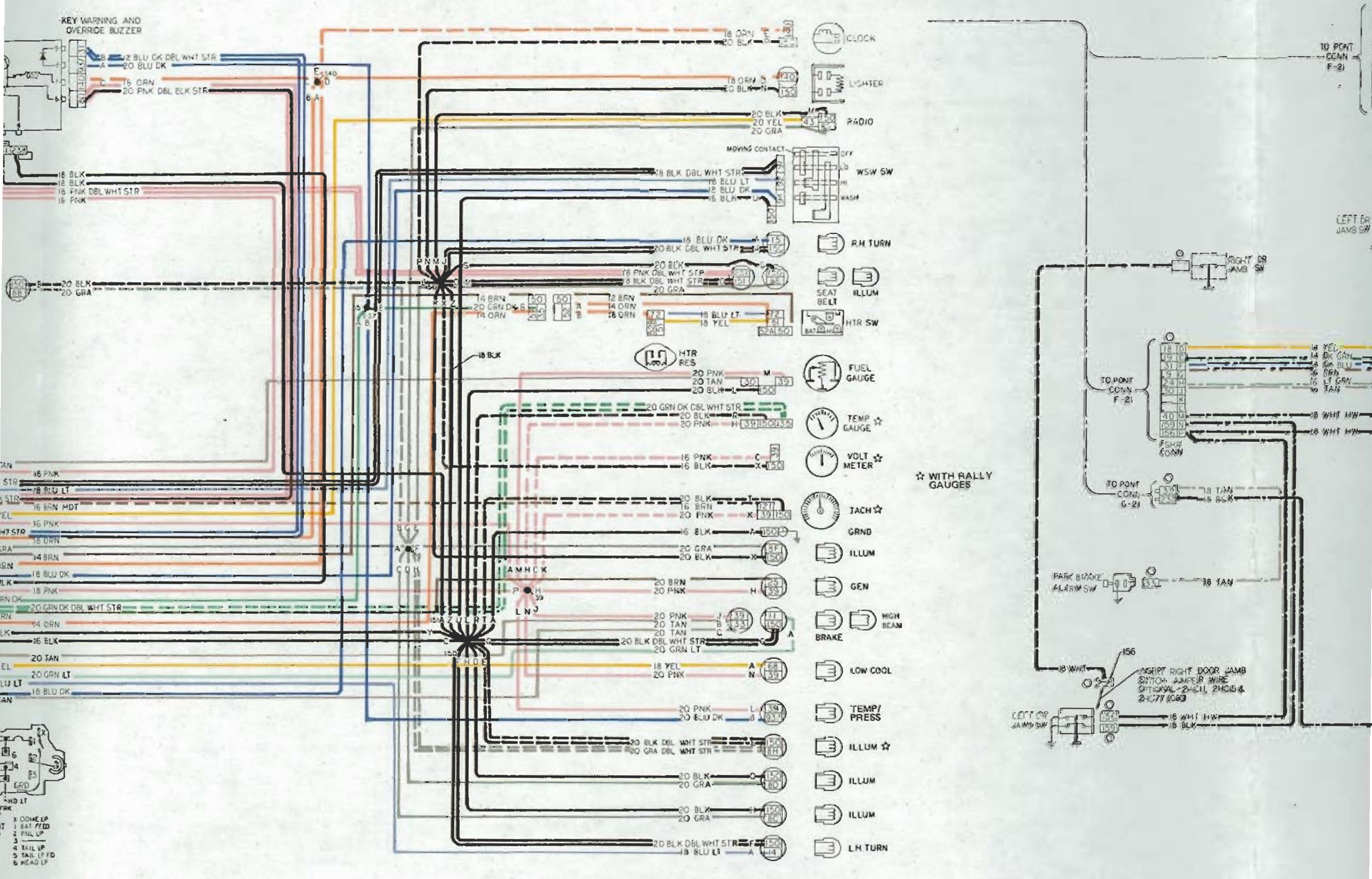
HEATER WIRING

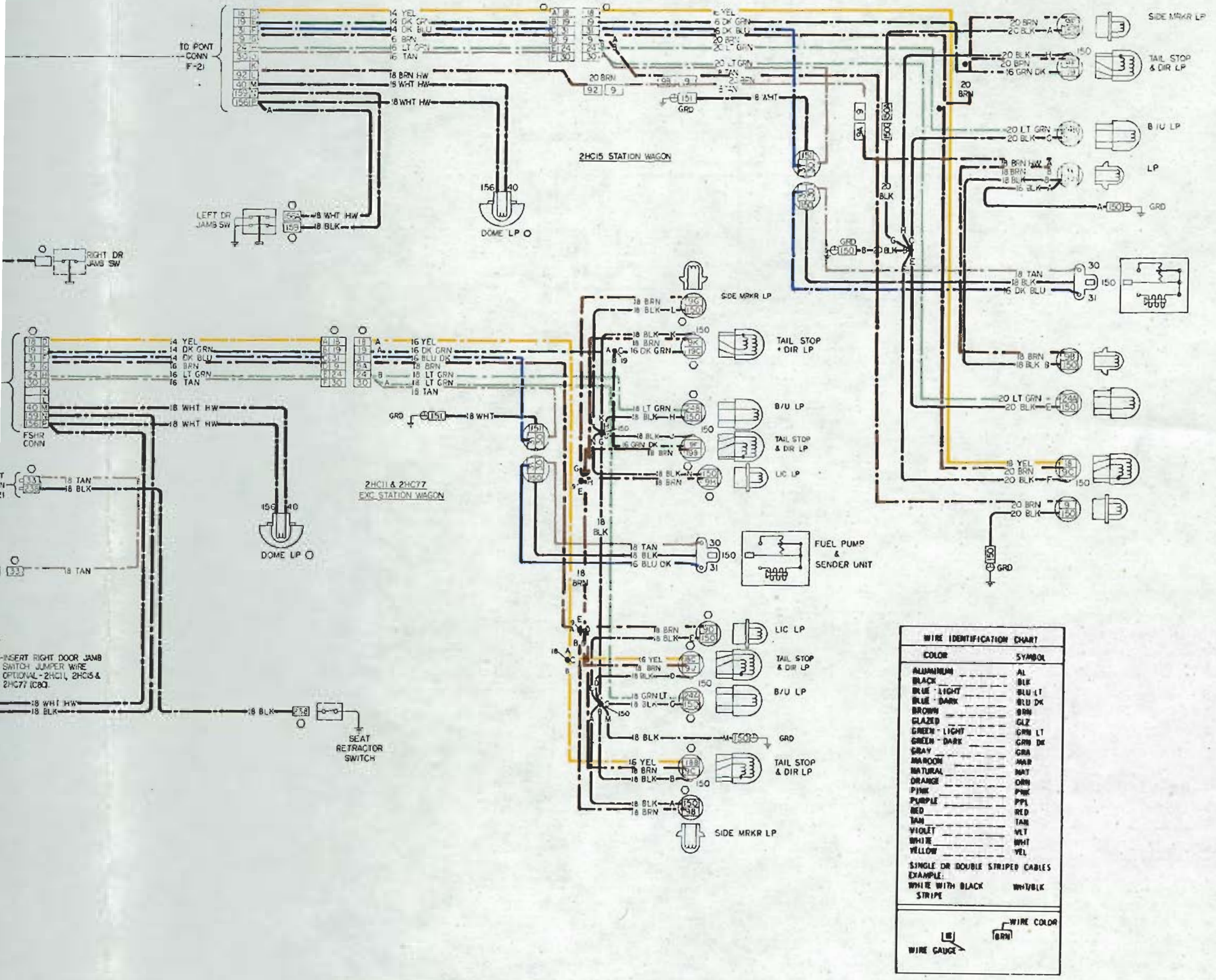
FIG. 8-6 H SERIES WIRING DIAGRAM



4-CYL ENGINE
L-11
WIRING DIAGRAM


BLO MTR
W/S WIPER
B/U LP SW (MAN TRANS ONLY)
TO ENGINE HARNESS
STOP LP SW
14 WHT
14 ORN
NEU START SW MAN TRANS
2 PPL
2 PPL DBL WHT STR
AUTO NEU SAFETY SWITCH
NEU START SW (M38)
18 BLU DK
18 TAN
TURN SIG FLASHER
14 TAN
14 PPL
14 BRN
14 GRN
16 BLU DK
16 BLU DK DBL WHT STR
12 ORN
12 RED
8 ORN
14 ORN
20 YEL
12 BRN
20 GRA
20 GRN DK
16 YEL
16 PNK
12 PNK
20 TAN
18 BLK
TO FSHR CONN E-11
SEAT BELT WARNING BUZZER AND TIMER
RPO T63
KEY WARNING AND OVERRIDE BUZZER
(CHEV. ONLY)
ST LT SW
RT RR LP
LT RR LP
HAZ WARN
RT FRT LP
LT FRT LP
HORN
KEY ALARM
DIR SIG SW
PRNDL ILLUM
20 BLK
20 GRA
18 PNK DBL WHT STR
18 PNK
18 BLU LT
16 BRN HDT
20 YEL
16 PNK
16 ORN
14 BRN
18 ORN
18 BLK
16 BLU DK
20 GRN DK
20 GRN DK DBL WHT STR
20 BRN
14 ORN
16 BLK
20 GRN LT
18 YEL
18 TAN HOT
16 GRN LT
16 TAN
12 GRN DK
14 BLU LT
18 BRN
18 YEL DBL BLK STR
24 BRN SGL WHT STR
DIMR SW
HORN RELAY
LOW COOLANT MODULE
18 BLK DBL YEL STR
IGN SW
2 PPL DWS
LIGHT SW
OFF - OPEN
START - GRD1, GRD2 - GRD0
RUN - IGN, BAT 1
ACC - ACC BAT 2 - CONNECTED

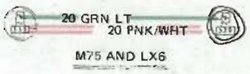

KEY WARNING AND OVERRIDE BUZZER
12 BLU DK DBL WHT STR
20 BLU DK
15 ORN
20 PNK DBL BLK STR
18 BLK
12 BLK
18 PNK DBL WHT STR
18 PNK
20 BLK
20 GRA
18 ORN
20 BLK
CLOCK
18 ORN
20 BLK
LIGHTER
20 BLK
20 YEL
20 GRA
RADIO
MOVING CONTACT
OFF
LO
HI
WASH
18 BLK DBL WHT STR
18 BLU LT
12 BLU DK
16 BLK
WSW SW
18 BLU DK
20 BLK DBL WHT STR
R.H. TURN
20 BLK
18 PNK DBL WHT STR
18 BLK DBL WHT STR
20 GRA
SEAT BELT
ILLUM
14 BRN
20 GRN DK
14 ORN
12 BRN
14 ORN
18 ORN
18 BLU LT
18 YEL
HTR SW
BAT
18 BLK
HTR RES
20 PNK
20 TAN
20 BLK
FUEL GAUGE
20 GRN DK DBL WHT STR
20 BLK
20 PNK
TEMP GAUGE ☆
16 PNK
16 BLK
VOLT METER ☆
☆ WITH RALLY GAUGES
20 BLK
16 BRN
20 PNK
TACH ☆
16 BLK
GRND
20 GRA
20 BLK
ILLUM
20 BRN
20 PNK
GEN
20 PNK
20 TAN
20 TAN
20 BLK DBL WHT STR
20 GRN LT
BRAKE
HIGH BEAM
18 YEL
20 PNK
LOW COOL
20 PNK
20 BLU DK
TEMP/ PRESS
20 BLK DBL WHT STR
20 GRA DBL WHT STR
ILLUM ☆
20 BLK
20 GRA
ILLUM
20 BLK
20 GRA
ILLUM
20 BLK DBL WHT STR
18 BLU LT
LH TURN
16 PNK
18 BLU LT
16 BRN HDT
16 PNK
18 ORN
14 BRN
18 BLU DK
18 PNK
20 GRN DK DBL WHT STR
14 ORN
16 BLK
20 TAN
20 GRN LT
18 BLU DK
GRD
HD LT
X DOME LP
1 BAT FEED
2 PNL LP
3
4 TAIL LP
5 TAIL LP FD
6 HEAD LP
TO PONT CONN F-21
LEFT DR JAMB SW
RIGHT DR JAMB SW
TO PONT CONN F-21
14 YEL
14 DK GRN
14 DK BLU
16 BRN
16 LT GRN
16 TAN
18 WHT HW
18 WHT HW
FSHR CONN
TO PONT CONN G-21
18 TAN
18 BLK
PARK BRAKE ALARM SW
18 TAN
18 WHT
156
INSERT RIGHT DOOR JAMB SWITCH JUMPER WIRE OPTIONAL-2HC11, 2HC15 & 2HC77 (C60)
LEFT DR JAMB SW
18 WHT HW
18 BLK



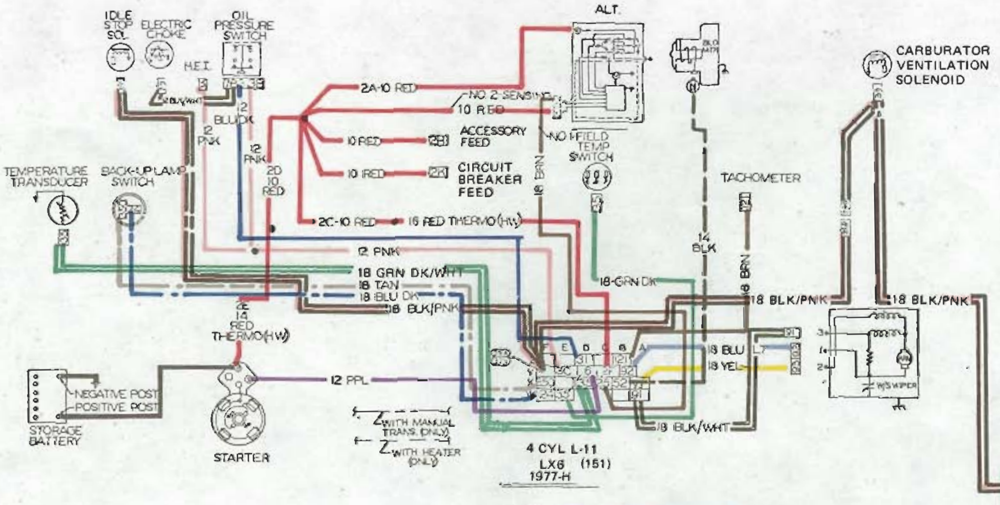
WIRE IDENTIFICATION CHART	
COLOR	SYMBOL
ALUMINUM	AL
BLACK	BLK
BLUE - LIGHT	BLU LT
BLUE - DARK	BLU DK
BROWN	BRN
GLAZED	GLZ
GREEN - LIGHT	GRN LT
GREEN - DARK	GRN DK
GRAY	GRA
MAROON	MAR
NATURAL	NAT
ORANGE	ORN
PINK	PNK
PURPLE	PPL
RED	RED
TAN	TAN
VIOLET	VLT
WHITE	WHT
YELLOW	YEL

SINGLE OR DOUBLE STRIPED CABLES EXAMPLE:

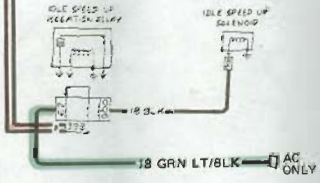
WHITE WITH BLACK STRIPE WHT/BLK



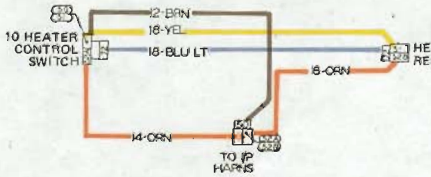
M75 AND LX6



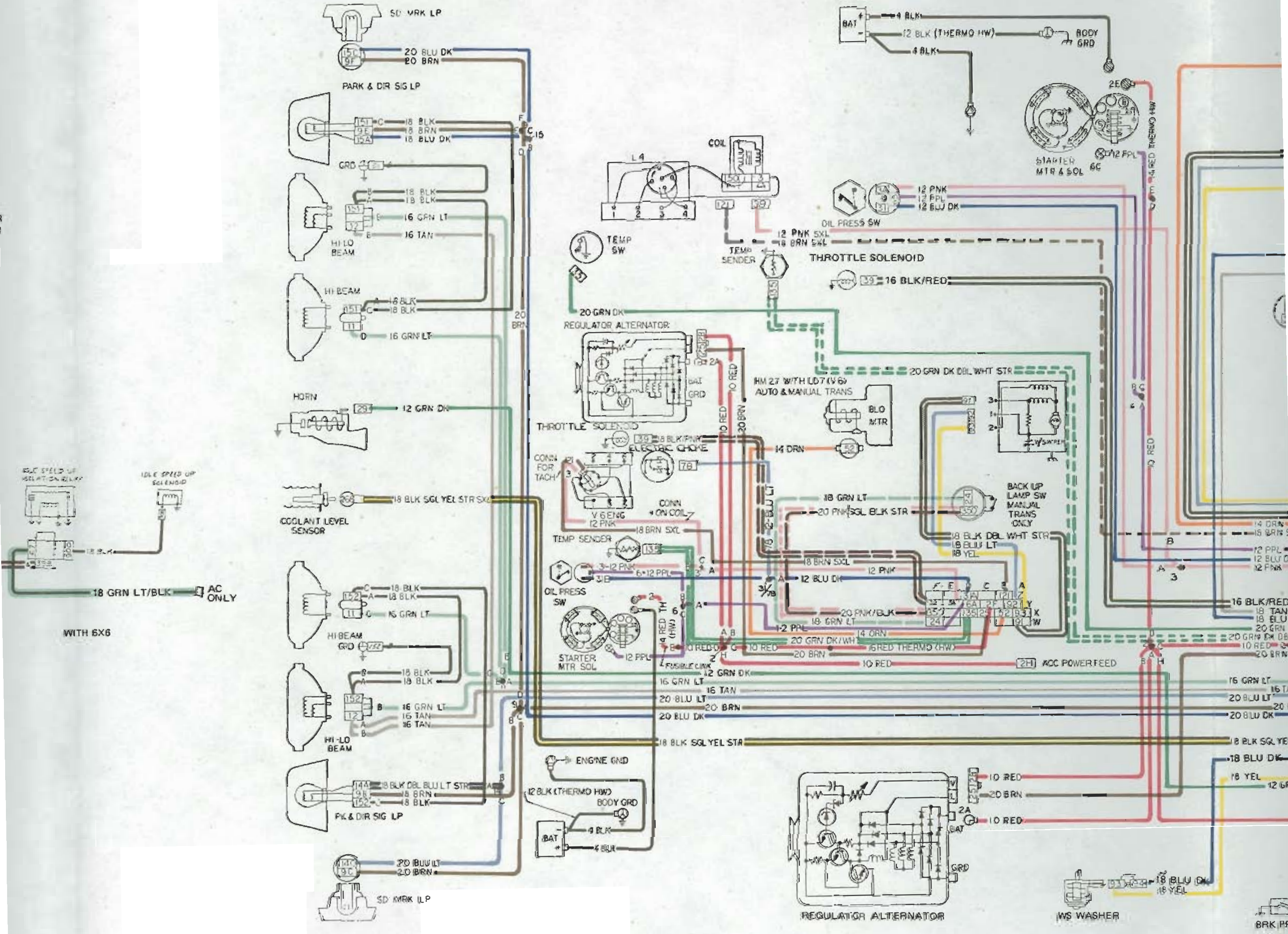
4 CYL L-11
LX6 (151)
1977-H

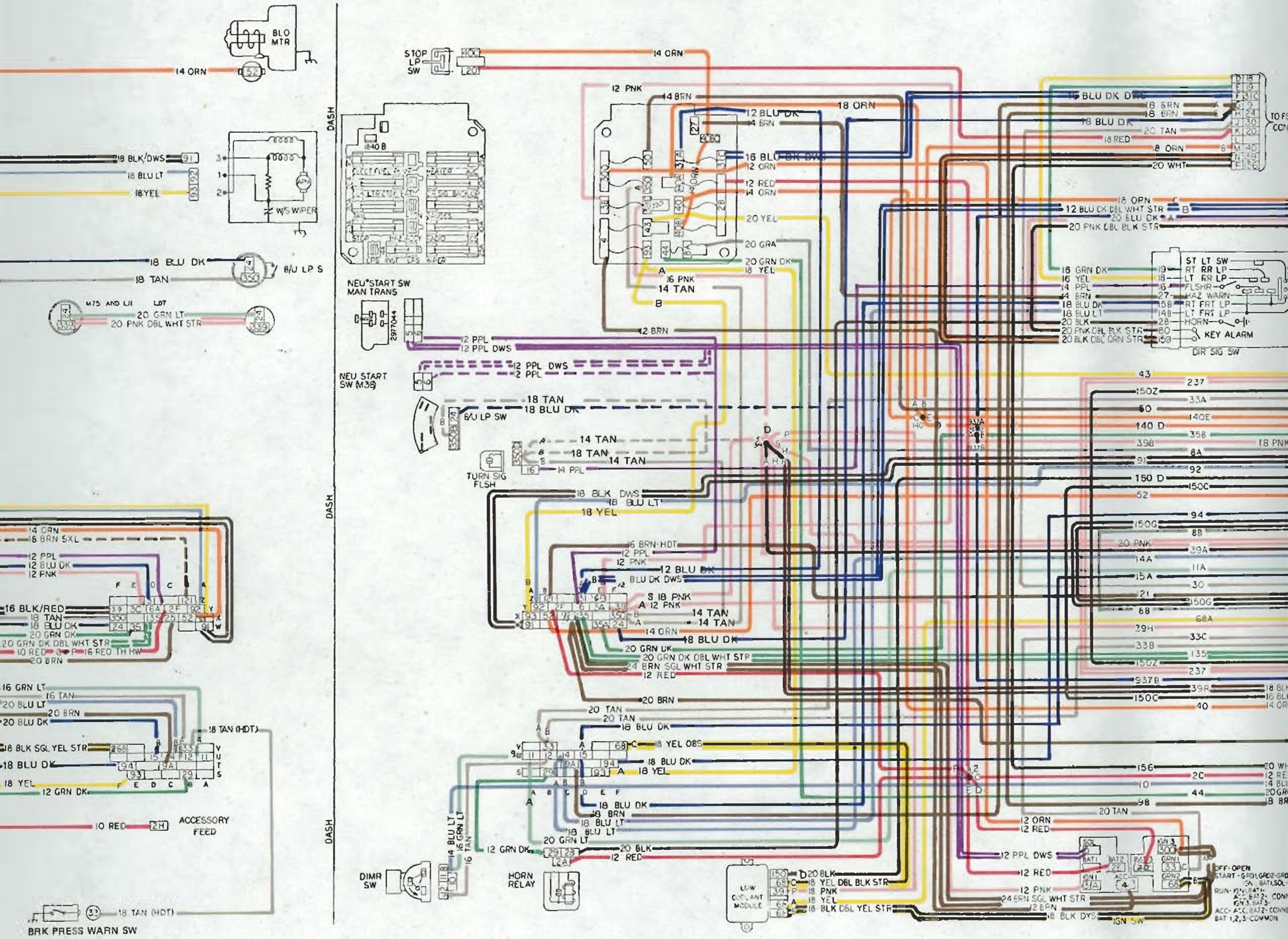


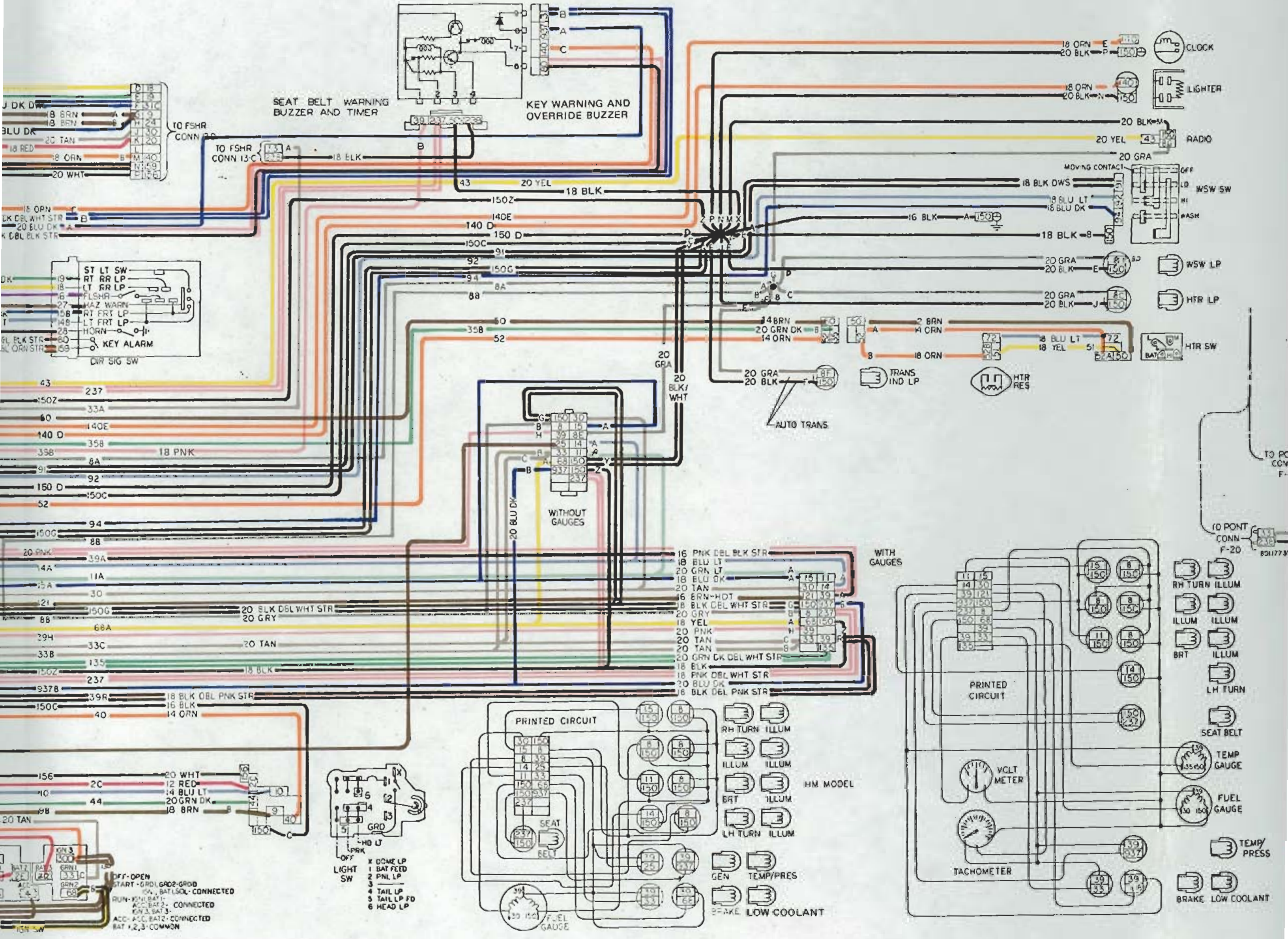
WITH 6X6

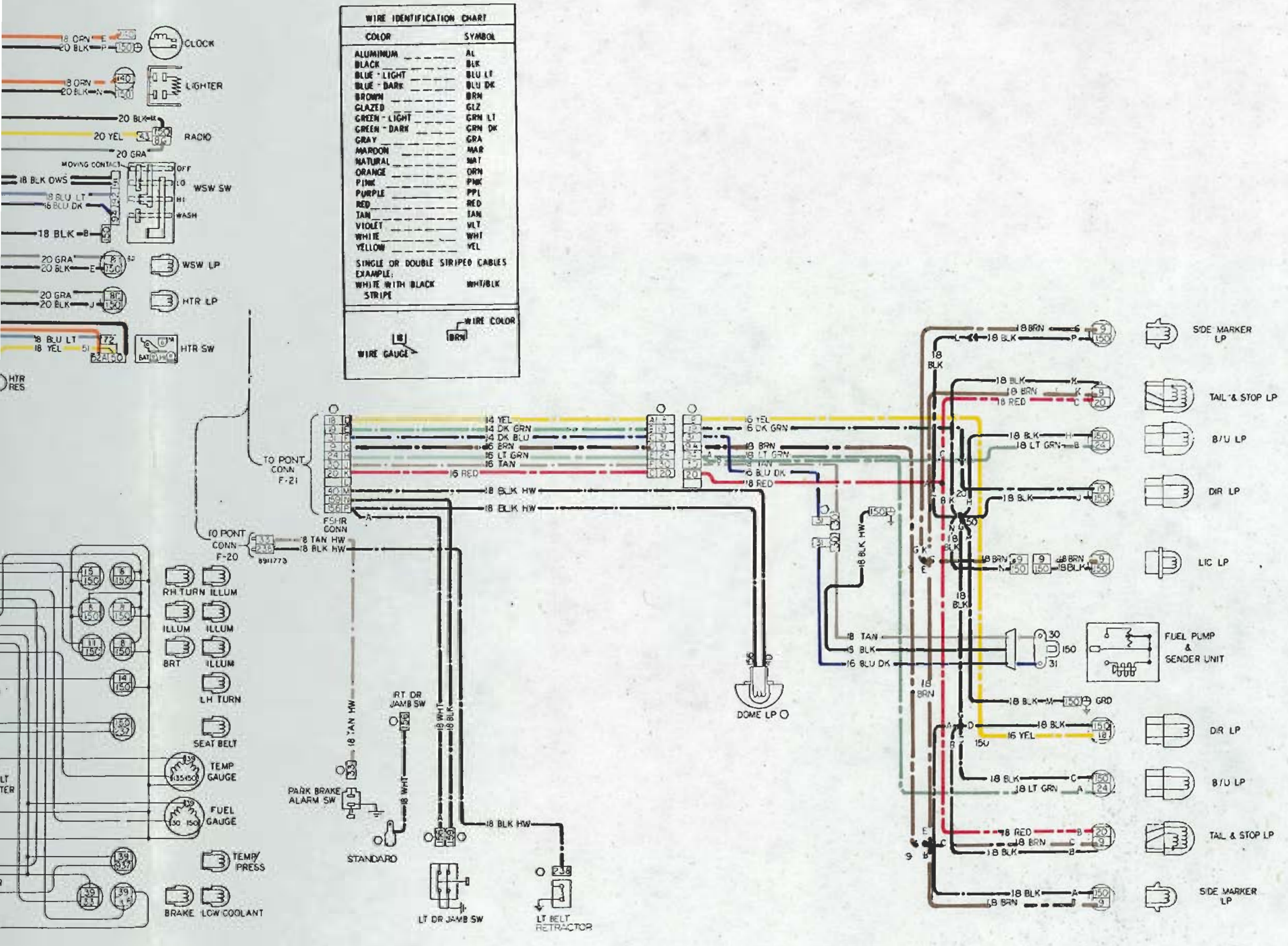


HEATER WIRING


SD MRK LP
20 BLU DK
20 BRN
PARK & DIR SIG LP
18 BLK
18 BRN
18 BLU DK
15
GRD
16 GRN LT
16 TAN
HI LO BEAM
HI BEAM
20 BRN
HORN
12 GRN DK
COOLANT LEVEL SENSOR
18 BLK SGL YEL STR SXL
IDLE SPEED UP ISOLATION RELAY
IDLE SPEED UP SOLENOID
18 GRN LT/BLK
AC ONLY
WITH 6X6
HI-LO BEAM
PK & DIR SIG LP
18 BLK DBL BLU LT STR
20 BLU LT
20 BRN
L4
COIL
TEMP SW
TEMP SENDER
12 PNK SXL
18 BRN SXL
THROTTLE SOLENOID
16 BLK/RED
20 GRN DK
REGULATOR ALTERNATOR
BAT
GRD
10 RED
20 BRN
OIL PRESS SW
12 PNK
12 PPL
12 BLU DK
STARTER MTR & SOL
12 PPL
14 RED THERMO HW
12 BLK (THERMO HW)
BODY GRD
4 BLK
HM 27 WITH LD7 (V6) AUTO & MANUAL TRANS
BLO MTR
20 GRN DK DBL WHT STR
ELECTRIC CHOKE
18 BLK/PNK
14 DRN
CONN FOR TACH
V6 ENG
CONN TO COIL
18 BRN SXL
BACK UP LAMP SW MANUAL TRANS ONLY
18 GRN LT
20 PNK SGL BLK STR
18 BLK DBL WHT STR
18 BLU LT
18 YEL
12 BLU DK
20 PNK/BLK
18 GRN LT
12 PPL
20 GRN DK/WH
14 ORN
16 RED THERMO (HW)
10 RED
20 BRN
FUSIBLE LINK
ACC POWER FEED
12 GRN DK
16 GRN LT
16 TAN
20 BLU LT
20 BRN
20 BLU DK
18 BLK SGL YEL STR
ENGINE GND
12 BLK (THERMO HW)
BODY GRD
4 BLK
BAT
16 BLK/RED
18 TAN
18 BLU
20 GRN
20 GRN DK DB
14 DRN
18 BRN
18 BLU DK
18 YEL
12 GR
10 RED
20 BRN
2A
REGULATOR ALTERNATOR
WS WASHER
18 BLU DK
18 YEL
BRK PS


BLO MTR
14 ORN
18 BLK/DWS
18 BLU LT
18 YEL
W/S WIPER
18 BLU DK
18 TAN
B/U LP S
M75 AND LII
LDT
20 GRN LT
20 PNK DBL WHT STR
DASH
STOP LP SW
14 ORN
12 PNK
14 BRN
12 BLU DK
18 ORN
16 BLU DK DWS
12 ORN
12 RED
14 ORN
20 YEL
20 GRA
20 GRN DK
18 YEL
16 PNK
14 TAN
12 BRN
NEU START SW MAN TRANS
12 PPL
12 PPL DWS
NEU START SW (M38)
2 PPL
18 TAN
18 BLU DK
B/U LP SW
14 TAN
18 TAN
14 PPL
TURN SIG FLSH
18 BLK DWS
18 BLU LT
18 YEL
16 BRN HDT
12 BLU DK
BLU DK DWS
18 PNK
14 ORN
18 BLU DK
20 GRN DK
20 GRN DK DBL WHT STP
24 BRN SGL WHT STR
12 RED
20 BRN
20 TAN
18 YEL OBS
18 BRN
20 GRN LT
20 BLK
HORN RELAY
DIMR SW
14 BLU LT
16 GRN LT
16 TAN
12 GRN DK
LOW COOLANT MODULE
18 YEL DBL BLK STR
18 PNK
18 YEL
18 BLK DBL YEL STR
16 BLU DK DWS
18 BRN
18 BLU DK
18 RED
20 TAN
18 ORN
20 WHT
TO FS
12 BLU DK DBL WHT STR
20 BLU DK
20 PNK DBL BLK STR
18 GRN DK
16 YEL
14 PPL
14 BRN
18 BLU DK
18 BLU LT
20 BLK
20 PNK DBL BLK STR
20 BLK DBL ORN STR
ST LT SW
RT RR LP
LT RR LP
FLSHR
HAZ WARN
RT FRT LP
LT FRT LP
HORN
KEY ALARM
DIR SIG SW
12 ORN
12 PPL DWS
12 RED
12 PNK
24 BRN SGL WHT STR
12 BRN
18 BLK DYS
IGN SW
OFF-OPEN
14 ORN
18 BRN SXL
12 PPL
12 BLU DK
12 PNK
16 BLK/RED
18 TAN
18 BLU DK
20 GRN DK
20 GRN DK DBL WHT STR
10 RED
16 RED TH HW
20 BRN
16 GRN LT
16 TAN
20 BLU LT
20 BRN
20 BLU DK
18 TAN (HDT)
18 BLK SGL YEL STR
18 BLU DK
18 YEL
12 GRN DK
10 RED
ACCESSORY FEED
18 TAN (HDT)
BRK PRESS WARN SW


SEAT BELT WARNING BUZZER AND TIMER
KEY WARNING AND OVERRIDE BUZZER
TO FSHR CONN 13-C
TO FSHR CONN 13-C
CLOCK
LIGHTER
RADIO
WSW SW
MOVING CONTACT
OFF
LO
HI
WASH
WSW LP
HTR LP
HTR SW
HTR RES
TRANS IND LP
AUTO TRANS
ST LT SW
RT RR LP
LT RR LP
FLSHR
HAZ WARN
RT FRT LP
LT FRT LP
HORN
KEY ALARM
DIR SIG SW
WITHOUT GAUGES
WITH GAUGES
18 PNK
20 BLU DK
20 GRA
20 BLK/WHT
18 ORN
20 BLK
20 YEL
18 BLK
16 BLK
18 BLK DWS
18 BLU LT
18 BLU DK
20 GRA
20 BLK
14 BRN
20 GRN DK
14 ORN
2 BRN
14 ORN
18 BLU LT
18 YEL
8 ORN
16 PNK DBL BLK STR
18 BLU LT
20 GRN LT
18 BLU DK
20 TAN
16 BRN-HDT
18 BLK DBL WHT STR
20 GRY
18 YEL
20 PNK
20 TAN
20 TAN
20 GRN DK DBL WHT STR
18 BLK
18 PNK DBL WHT STR
18 BLK DBL PNK STR
20 BLK DBL WHT STR
20 GRY
20 TAN
18 BLK
18 BLK DBL PNK STR
16 BLK
14 ORN
20 WHT
12 RED
14 BLU LT
20 GRN DK
18 BRN
20 TAN
PRINTED CIRCUIT
RH TURN
ILLUM
BRT
LH TURN
SEAT BELT
FUEL GAUGE
GEN
TEMP/PRES
BRAKE
LOW COOLANT
HM MODEL
VOLT METER
TACHOMETER
TEMP GAUGE
FUEL GAUGE
TEMP/PRESS
10 PONT CONN F-20
LIGHT SW
OFF
PRK
HD LT
GRD
X DOME LP
1 BAT FEED
2 PNL LP
3
4 TAIL LP
5 TAIL LP FD
6 HEAD LP
OFF-OPEN
START-GRD1,GRD2-GRD
IGN SW
RUN-IGN,BAT1-ACC,BAT2-CONNECTED
ACC-ACC,BAT2-CONNECTED
BAT 1,2,3-COMMON



WIRE IDENTIFICATION CHART	
COLOR	SYMBOL
ALUMINUM	AL
BLACK	BLK
BLUE - LIGHT	BLU LT
BLUE - DARK	BLU DK
BROWN	BRN
GLAZED	GLZ
GREEN - LIGHT	GRN LT
GREEN - DARK	GRN DK
GRAY	GRA
MAROON	MAR
NATURAL	NAT
ORANGE	ORN
PINK	PNK
PURPLE	PPL
RED	RED
TAN	TAN
VIOLET	VLT
WHITE	WHT
YELLOW	YEL
SINGLE OR DOUBLE STRIPED CABLES EXAMPLE: WHITE WITH BLACK STRIPE	WHT/BLK

WIRE GAUGE — 18
WIRE COLOR — BRN

FIG. 8-7 HM SERIES WIRING DIAGRAM

SECTION 9

ACCESSORIES

CONTENTS OF THIS SECTION

Cruise Control Systems

Radio

Power Antenna

Rally Gage, Tachometer and Clock

Miscellaneous Accessories

Accessory Wiring Diagrams

CRUISE CONTROL SYSTEMS

Two cruise control systems are used on 1977 Pontiacs. The first is the system used on A and G Series and on B Series with V.I.N. code "P" and "Z" V8 engines. It will be referred to as Cruise Control. The second system, referred to as Cruise Master, is used on F and X Series, and on all remaining engines on B Series.

CRUISE CONTROL

GENERAL DESCRIPTION

Cruise Control is an easy-to-use, driver-operated speed control system. It may be either factory or dealer installed on most engines in A, G and B Series models, as noted above.

ENGAGEMENT

Maintain desired speed and depress engagement button (located in the end of the turn signal lever), then release button slowly. The cruise system immediately takes over throttle position control and within engine limitation maintains this speed regardless of changes in terrain. (The lowest speed at which the system can be engaged is 30 mph).

DISENGAGEMENT

The system automatically disengages whenever the brake is depressed. To re-engage, again maintain the desired speed and push the engagement button.

SPEED ADJUSTMENT

Upward - Accelerate to and maintain any desired speed above 30 mph, depress engagement button fully, then release slowly.

Downward - Release control by pushing in the engagement button. When car decelerates to the newly desired speed, release the engagement button slowly.

OVERRIDE

The accelerator pedal may be depressed at any time to override the cruise system. Release of the accelerator pedal will return the car to previous cruise speed.

MAJOR COMPONENTS

The major components of the cruise control system are:

- pushbutton engaging switch
- regulator assembly
- vacuum servo
- release switches (electric and vacuum)

REGULATOR ASSEMBLY

The regulator (Fig. 9-1) controls the amount of engine vacuum going to the servo. An electrical impulse from the engaging switch vents engine vacuum to the atmosphere, the size of the opening being varied by a governor. The governor is driven by a cable from the transmission with a transfer gear driving the speedometer cable in a 1:1 ratio.

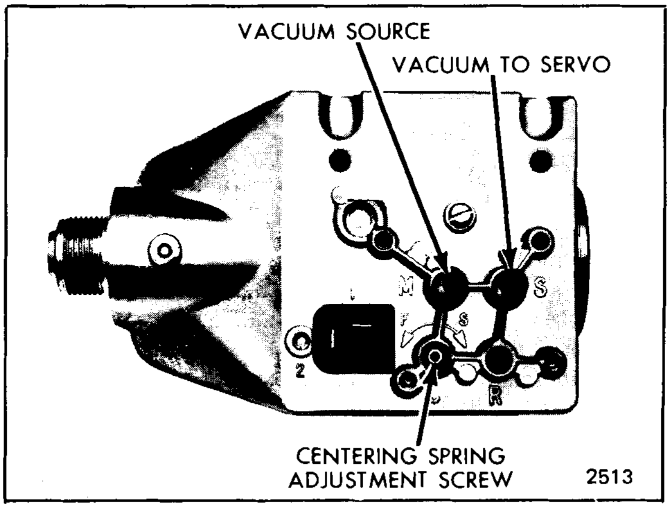


Fig. 9-1 Cruise Control Regulator Assembly

VACUUM SERVO

The vacuum servo is located on the left hand fender skirt, on the front of the engine, or on the front of the cowl on F Series. It is connected by a cable to the throttle lever and varies throttle opening in relation to vacuum supplied by the regulator.

DIAGNOSIS

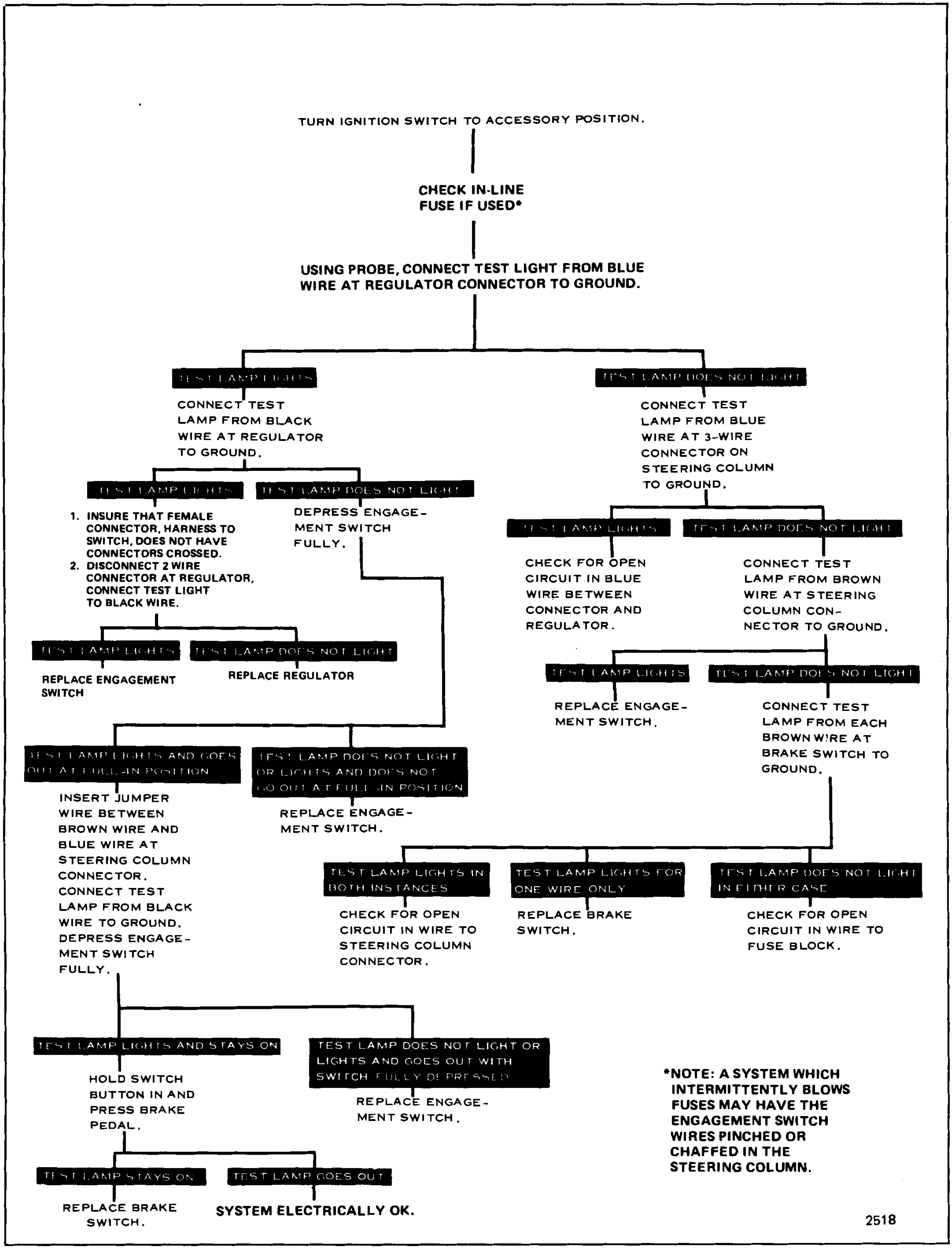
All electrical and vacuum connections and other obvious items, such as cruise control brake release switch adjustment, are to be checked and corrected prior to any type of testing. The electrical wiring schematic is shown in Fig. 9-3.

VACUUM CHECKS

The vacuum servo is a sealed unit; therefore, a leaky or defective bellows requires replacement of the assembly. Utilize engine vacuum to test for leakage as follows:

1. Disconnect vacuum servo cable from accelerator linkage and hose from regulator assembly. Connect engine vacuum directly to vacuum servo.
2. Note position of vacuum servo diaphragm.
3. Start engine. The bellows should pull in.
4. Clamp off engine vacuum supply and check for leakage.

The vacuum brake release switch and all vacuum connection hoses can be checked in a similar manner by utilizing a vacuum source.



***NOTE: A SYSTEM WHICH INTERMITTENTLY BLOWS FUSES MAY HAVE THE ENGAGEMENT SWITCH WIRES PINCHED OR CHAFFED IN THE STEERING COLUMN.**

Fig. 9-2 Cruise Control Diagnosis

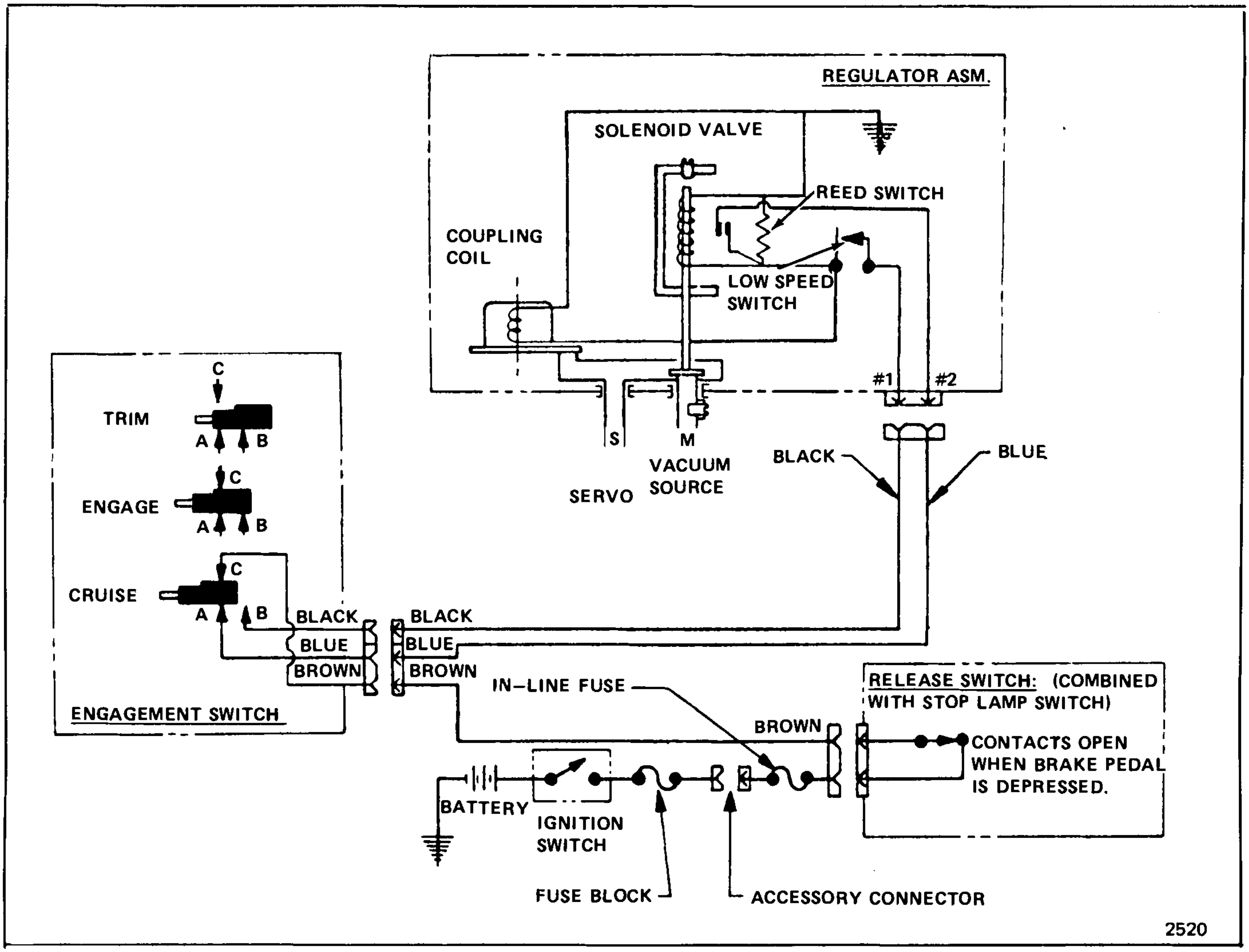


Fig. 9-3 Cruise Control Wiring Schematic

CRUISE CONTROL DOES NOT ENGAGE

CAUSE	CORRECTION
Fuse blown.	Replace fuse, determine cause from Fig. 9-2.
Brake switch out of adjustment.	Adjust brake switch.
No current to terminal No. 2.	Repair wire harness.
Engaging switch inoperative.	Replace engaging switch.
Faulty regulator.	Replace regulator.

CRUISE CONTROL DOES NOT DISENGAGE WHEN BRAKE IS APPLIED

CAUSE	CORRECTION
Improper brake release switch adjustment.	Adjust brake release switch.
Defective brake release switch.	Replace brake release switch.
Faulty regulator.	Replace regulator.

CRUISE CONTROL RE-ENGAGES WHEN BRAKE IS RELEASED

CAUSE	CORRECTION
Faulty engaging switch.	Replace engaging switch.
Terminal No. 1 grounded.	Replace or repair wire harness.

CARBURETOR DOES NOT RETURN TO NORMAL IDLE

CAUSE	CORRECTION
Faulty Cruise Control linkage cable.	Replace cable.
Improper accelerator linkage adjustment.	Adjust accelerator linkage.
Weak or disconnected throttle return spring.	Connect or replace spring.

PULSATING ACCELERATOR PEDAL

CAUSE	CORRECTION
Speedometer cable or drive cable kinked.	Replace cables if necessary.

CRUISE CONTROL DOES NOT CONTROL AT SELECTED SPEED

CAUSE	CORRECTION
Faulty vacuum servo or vacuum hose.	Replace vacuum servo or vacuum hose.
Faulty regulator.	Replace regulator.

CRUISE CONTROL CONTROLS SPEED 3 OR MORE MPH ABOVE SELECTED SPEED

CAUSE	CORRECTION
Improper centering spring adjustment.	Adjust centering spring (C) (Fig. 9-4)

CRUISE CONTROL CONTROLS SPEED 1 OR MORE MPH BELOW SELECTED SPEED

CAUSE	CORRECTION
Improper centering spring adjustment.	Adjust centering spring (C) (Fig. 9-4).

ON-CAR SERVICE

The regulator assembly cannot be overhauled. It should be replaced. Proper diagnosis procedures, as listed above in Fig. 9-1, should prevent unnecessary replacement of the regulator. Refer to Figs. 9-5 through 9-7 for regulator and vacuum servo mounting. Engagement switch wire routing through the steering column is shown in Figs. 9-8 and 9-9, and underdash wiring is shown in Fig. 9-10. Vacuum hose schematics are shown in Figs. 9-21 and 9-22, and show the proper connections of the hoses. They do not show the physical routings. Removal and replacement of the engagement switch is covered in the steering section of this manual.

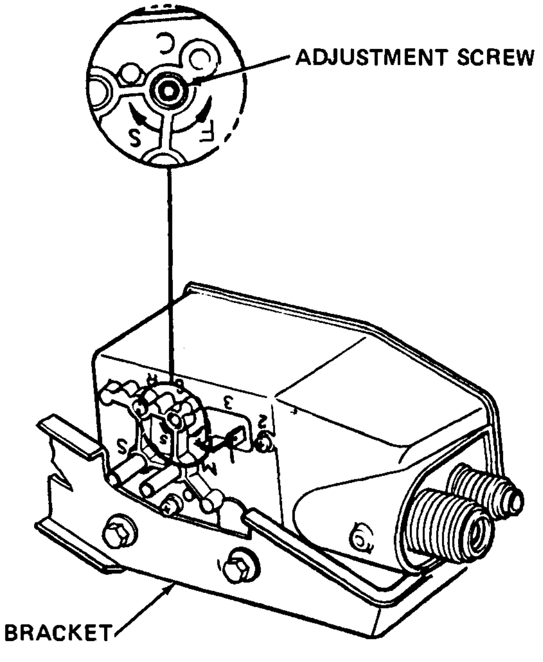
<u>CRUISE CONTROL TEST PROCEDURE</u>

ROAD TEST AS FOLLOWS:

1. ON A LEVEL ROAD, DRIVE AT A STEADY SPEED OF 55 M.P.H.
2. PUSH AND RELEASE ENGAGE BUTTON. RELEASE ACCELERATOR PEDAL AFTER A 2 - 3 SEC. DELAY. CRUISE CONTROL SHOULD ENGAGE AND CRUISE AT 55 M.P.H. $^{+2}_{-0}$ M.P.H.
3. PUSH AND HOLD ENGAGE BUTTON AT FULL TRAVEL. CRUISE CONTROL MUST RELEASE THROTTLE, ALLOWING CAR TO DECELERATE.

   RELEASE BUTTON SLOWLY. CRUISE CONTROL SHOULD RE–ENGAGE.
4. SLOWLY DEPRESS BRAKE PEDAL. CRUISE CONTROL MUST RELEASE THROTTLE PRIOR TO BRAKE ENGAGEMENT.

IN THE EVENT THAT THE LIMIT IN STEP 2 IS EXCEEDED, AN ALLEN WRENCH ADJUSTMENT IS PROVIDED ON THE REGULATOR ASSEMBLY (SEE ILLUSTRATION). THIS ADJUSTMENT SCREW IS MARKED "C" AND IS LOCATED NEXT TO THE ELECTRICAL TERMINALS WITH "F" (FAST) AND "S" (SLOW) ARROWS INDICATING CLOCKWISE ROTATION TO BRING CRUISE SPEED DOWN TO ENGAGE SPEED AND COUNTERCLOCKWISE ROTATION TO BRING CRUISE SPEED UP TO ENGAGE SPEED. THE REQUIRED ADJUSTMENT WILL USUALLY BE 1/8 OF A TURN OR LESS.



<u>REGULATOR ASSEMBLY</u> 2519

Fig. 9-4 Cruise Control Regulator Test Procedure

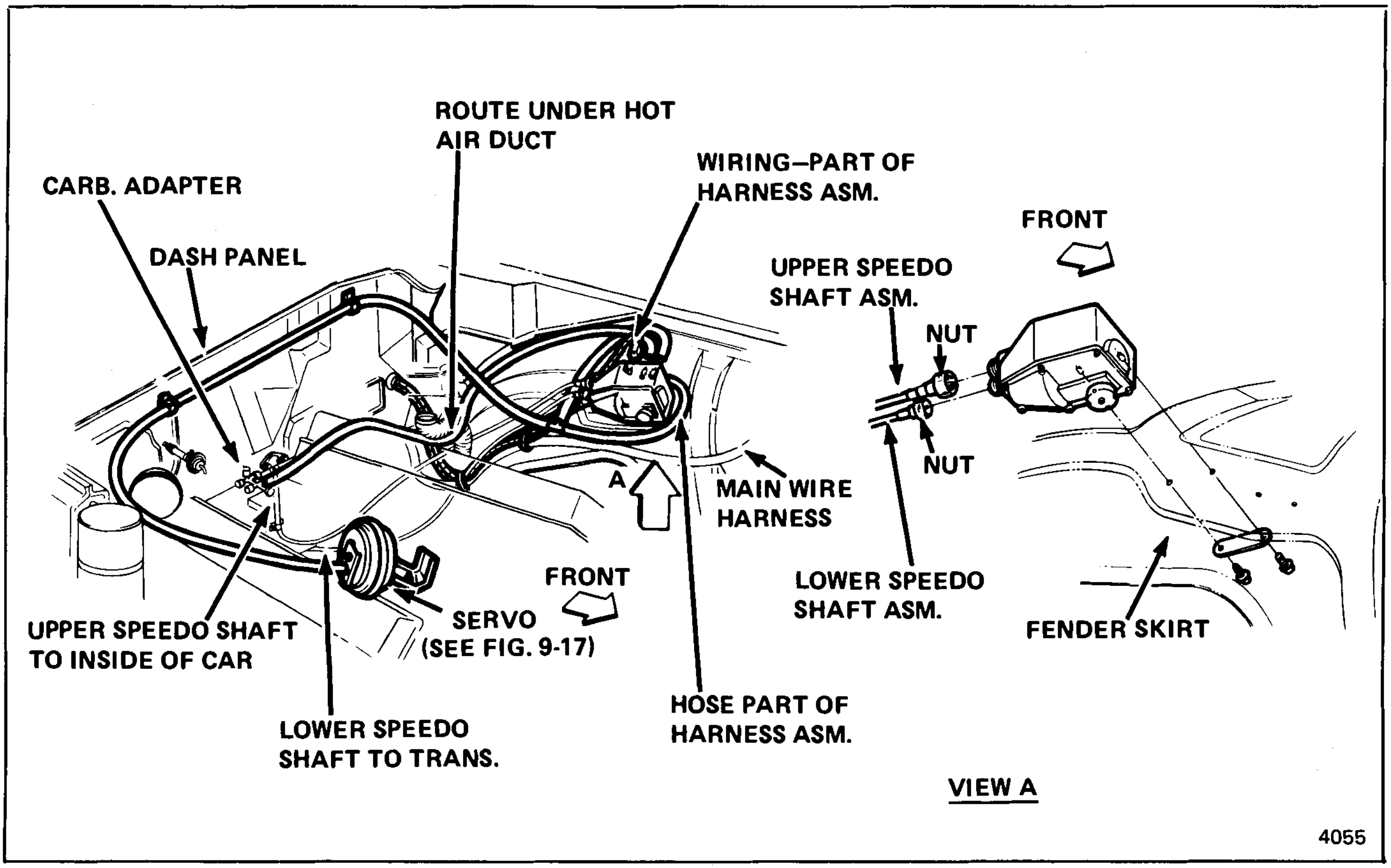


Fig. 9-5 Cruise Control Regulator Mounting - "Y" V8, A and G Series

CRUISE MASTER

GENERAL DESCRIPTION

The Cruise Master system is used on F, X and some B Series models. It operates in the same manner as the cruise control system, and the only difference in the two systems is the regulator. However, diagnosis of the two systems is somewhat different.

DIAGNOSIS

ELECTRICAL SYSTEM

1. Check fuse and connecter.
2. Check electric brake switch as follows:

a. Unplug connecter at swtich.

b. Connect ohmmeter across cruise master contacts on brake switch. The ohmmeter must indicate no continuity when the pedal is depressed and continuity when pedal is released. The cruise release brake switch (electric) is adjusted as is the standard stop light brake switch.

c. Replace electric brake switch if needed.

ENGAGEMENT SWITCH TEST

Check engagement switch and connecting wiring as follows; Unplug engagement switch connecter (brown, blue, black) at electrical wiring harness connecter then perform the following tests (Fig. 9-11):

Test #1-Connect ohmmeter between terminal #1 (brown wire) and terminal #2 (blue wire). Continuity shall be maintained until switch is depressed all the way in.

Test #2-Connect ohmmeter between terminals #1 (brown wire) and terminal #3 (black wire). No continuity shall be shown; however, when the button is partially depressed, continuity shall be indicated. When the button is pressed all the way down, no continuity shall be shown.

Test #3-Connect ohmmeter between terminal #2 (blue wire) and terminal #3 (black wire). Button released, no continuity; however, when the button is depressed partially and fully, continuity shall be shown.

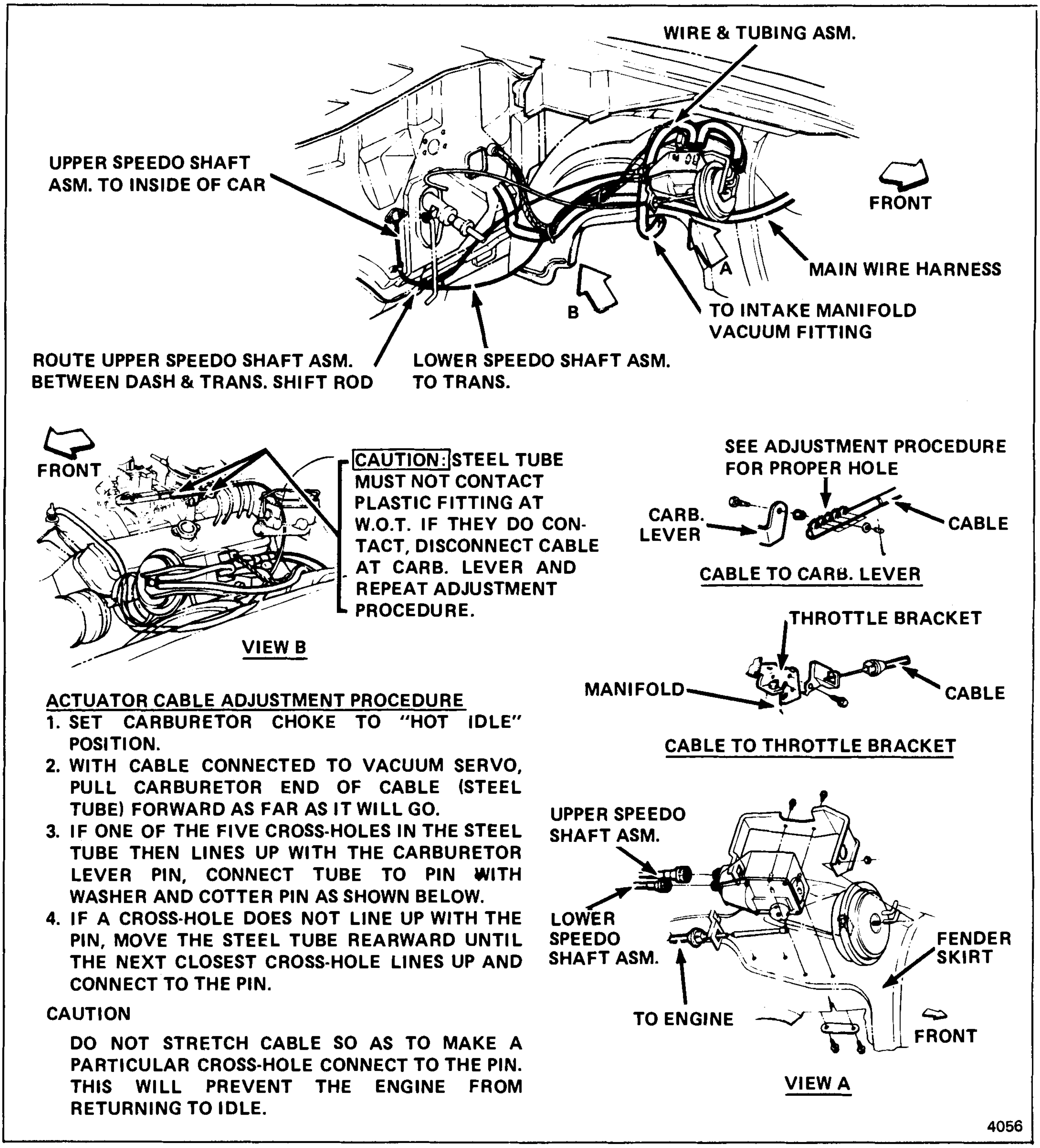
HARNESS TEST (SEE FIG. 9-11)

1. Disconnect engage switch wire harness connecter from the main harness connecter.

2. Connect ohmmeter between point C (brown/white strip wire in main wire harness) and ground. Make sure the regulator is well grounded to the chassis. The ohmmeter should read between 42 and 49 ohms. If a resistance either above or below the value indicated is shown, then disconnect the connecter from the regulator and measure the resistance of the brown/white stripe wire from point C to D. It should measure 40 ohms ±2 ohms.

3. If a resistance either above or below the value indicated is shown, the main wiring harness should be replaced.

NOTE: When disconnecting or reconnecting the main wiring harness connecter from the regulator, care should be exercised so as not to damage the blade connecters



ACTUATOR CABLE ADJUSTMENT PROCEDURE

1. SET CARBURETOR CHOKE TO "HOT IDLE" POSITION.
2. WITH CABLE CONNECTED TO VACUUM SERVO, PULL CARBURETOR END OF CABLE (STEEL TUBE) FORWARD AS FAR AS IT WILL GO.
3. IF ONE OF THE FIVE CROSS-HOLES IN THE STEEL TUBE THEN LINES UP WITH THE CARBURETOR LEVER PIN, CONNECT TUBE TO PIN WITH WASHER AND COTTER PIN AS SHOWN BELOW.
4. IF A CROSS-HOLE DOES NOT LINE UP WITH THE PIN, MOVE THE STEEL TUBE REARWARD UNTIL THE NEXT CLOSEST CROSS-HOLE LINES UP AND CONNECT TO THE PIN.

CAUTION

DO NOT STRETCH CABLE SO AS TO MAKE A PARTICULAR CROSS-HOLE CONNECT TO THE PIN. THIS WILL PREVENT THE ENGINE FROM RETURNING TO IDLE.

Fig. 9-6 Cruise Control Regulator and Servo Mounting-"P" and "Z" v-8's, A, B and G Series

or the wiring harness. The connecter may be removed by prying carefully with a small screwdriver. Be sure not to short the terminals together.

4. Measuring the solenoid coil circuit resistance between point E (Hold Terminal) and ground, the ideal resistance should be between 5 and 6 ohms. A higher reading indicates excessive resistance in the coil circuit. Either extremity indicates replacement of the regulator assembly. The main harness wiring from point F to G (white wire) should also be checked for continuity.

SERVO AND VACUUM SYSTEM TEST

To determine the condition of the diaphragm, remove hose from the servo unit and apply 14 inches of vacuum to the tube opening and hold in for one minute. The vacuum

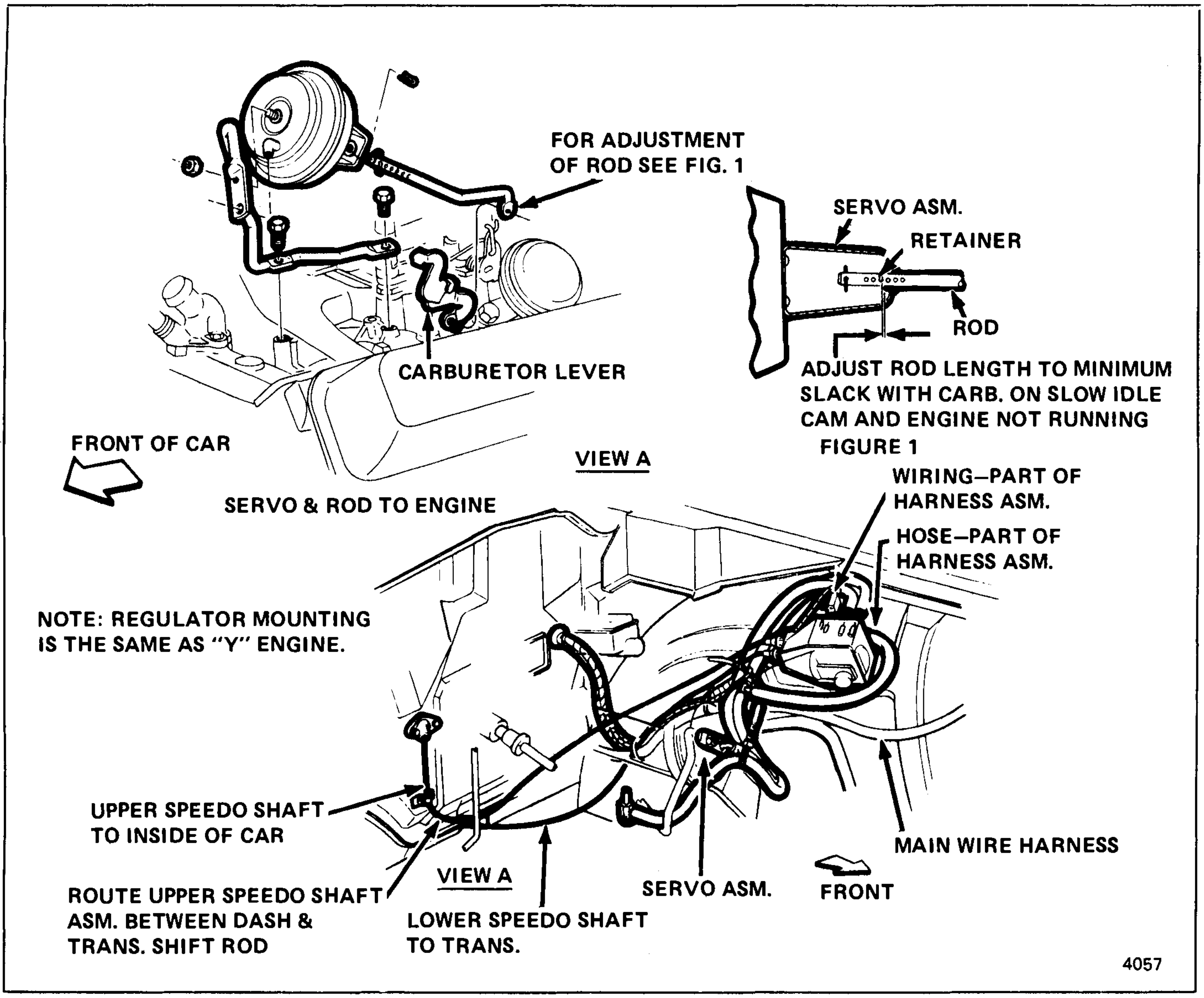


Fig. 9-7 Cruise Control Regulator & Servo Mounting - "R" and "K" V8's, A and G Series

shall not leak down more than 5 inches of vacuum in one minute. If leakage is detected, replace the servo. To utilize engine as a vacuum source, proceed as follows:

1. Disconnect servo cable at carburetor and vacuum hose from the servo, then connect engine vacuum directly to the servo fitting.
2. Note position of servo diaphragm.
3. Start engine--the diaphragm should pull in.
4. Clamp off engine vacuum supply line and check for leakage.

The cruise release brake valve (vacuum) and connecting hoses can likewise be checked using a vacuum pump.

For further diagnosis refer to Figs. 9-12 and 9-13.

ON-CAR SERVICE

The components of the Cruise Master system are designed to be replaced if they become inoperative. The regulator is calibrated in such a manner during manufacturing that overhaul operations are impractical. However, one adjustment may be made to the regulator to correct speed drop or increase at the time of engagement.

REGULATOR

One regulator adjustment is possible - Engagement Cruising Speed Zeroing (to remove any difference between engagement and cruising speed). No regulator adjustment should be made, however, until the servo cable adjustment has been checked and vacuum hoses are checked for leaks, kinks, or other restrictions.

If the car cruises at a speed a few mph above or below the engagement speed, this error can be corrected with a simple adjustment of the orifice tube in the regulator (Fig. 9-14).

CAUTION: *Never remove orifice tube from casing. It cannot be reinstalled once it has been removed.*

1. To check cruise speed error, engage Cruise Master at 55 mph.
2. If car cruises **below** engagement speed, screw the orifice tube **outward.**

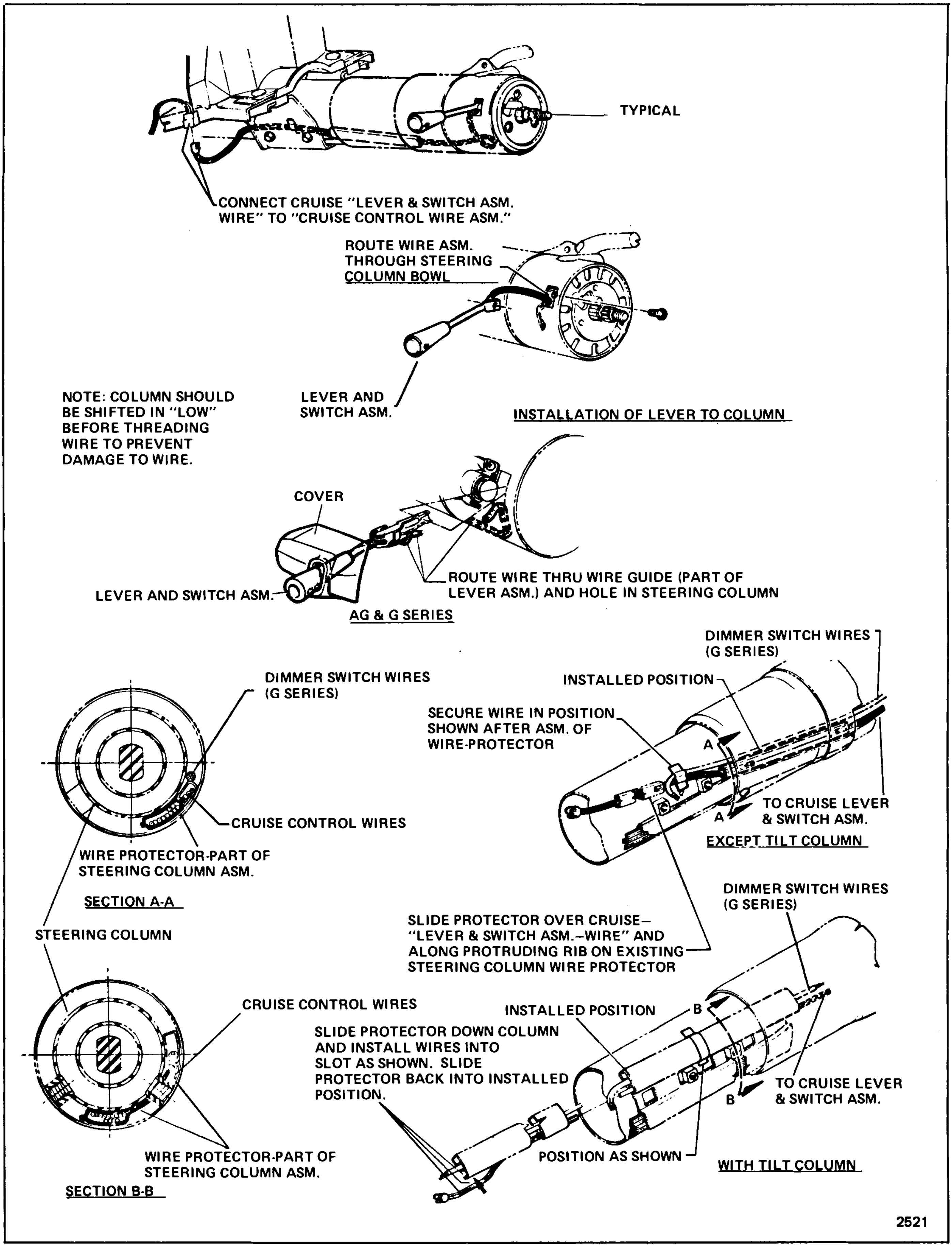


Fig. 9-8 Cruise Control Engagement Switch Wiring-All Series Except B

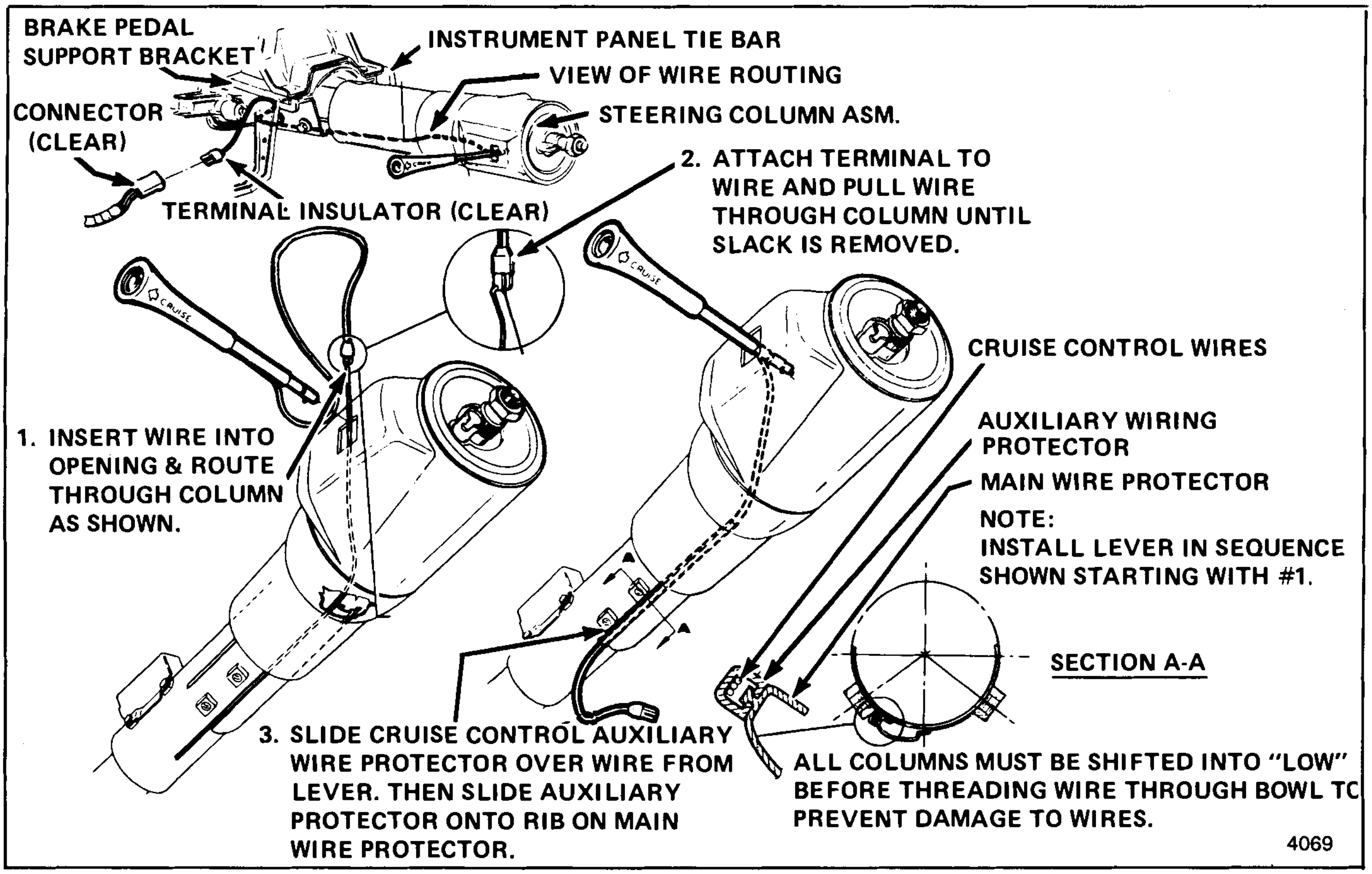


Fig. 9-9 Cruise Control Engagement Switch Wiring-B Series

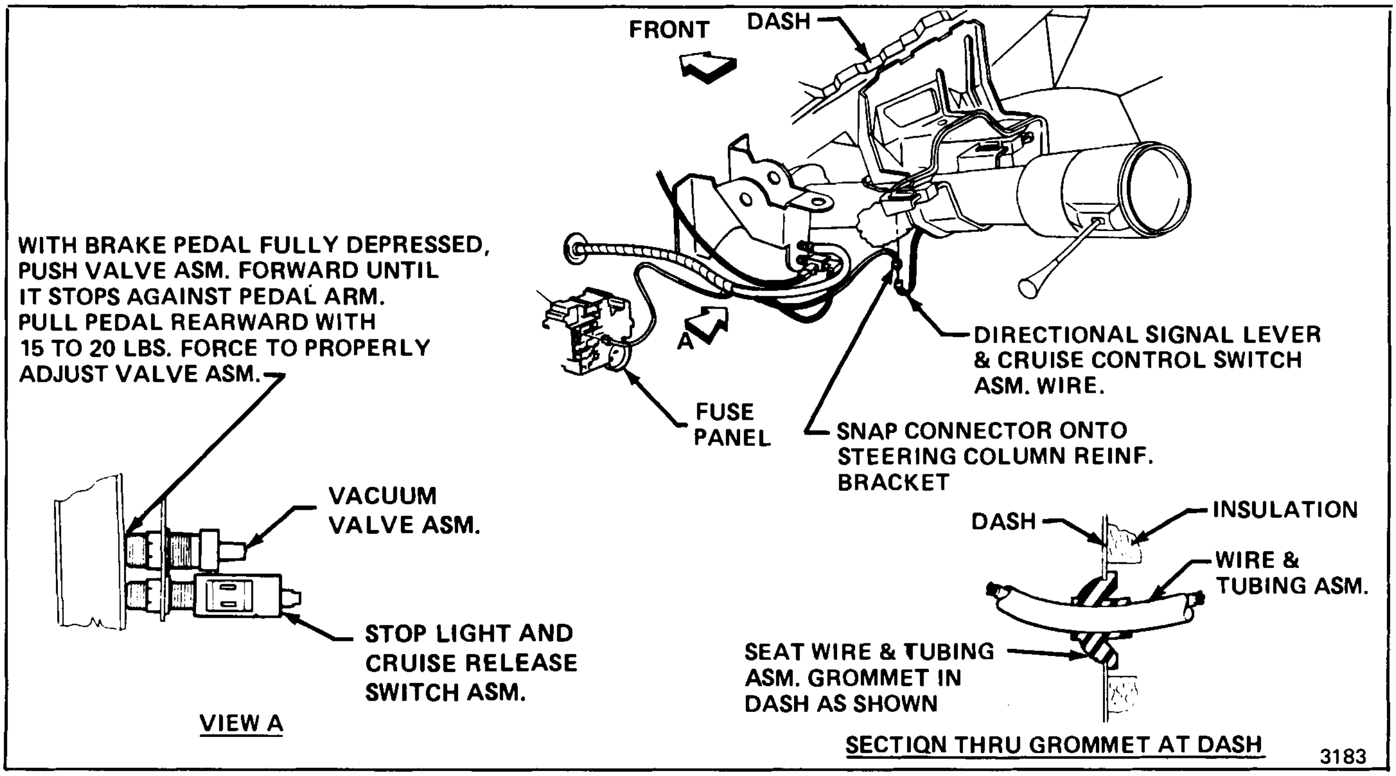


Fig. 9-10 Cruise Control Under-Dash Wiring-Typical

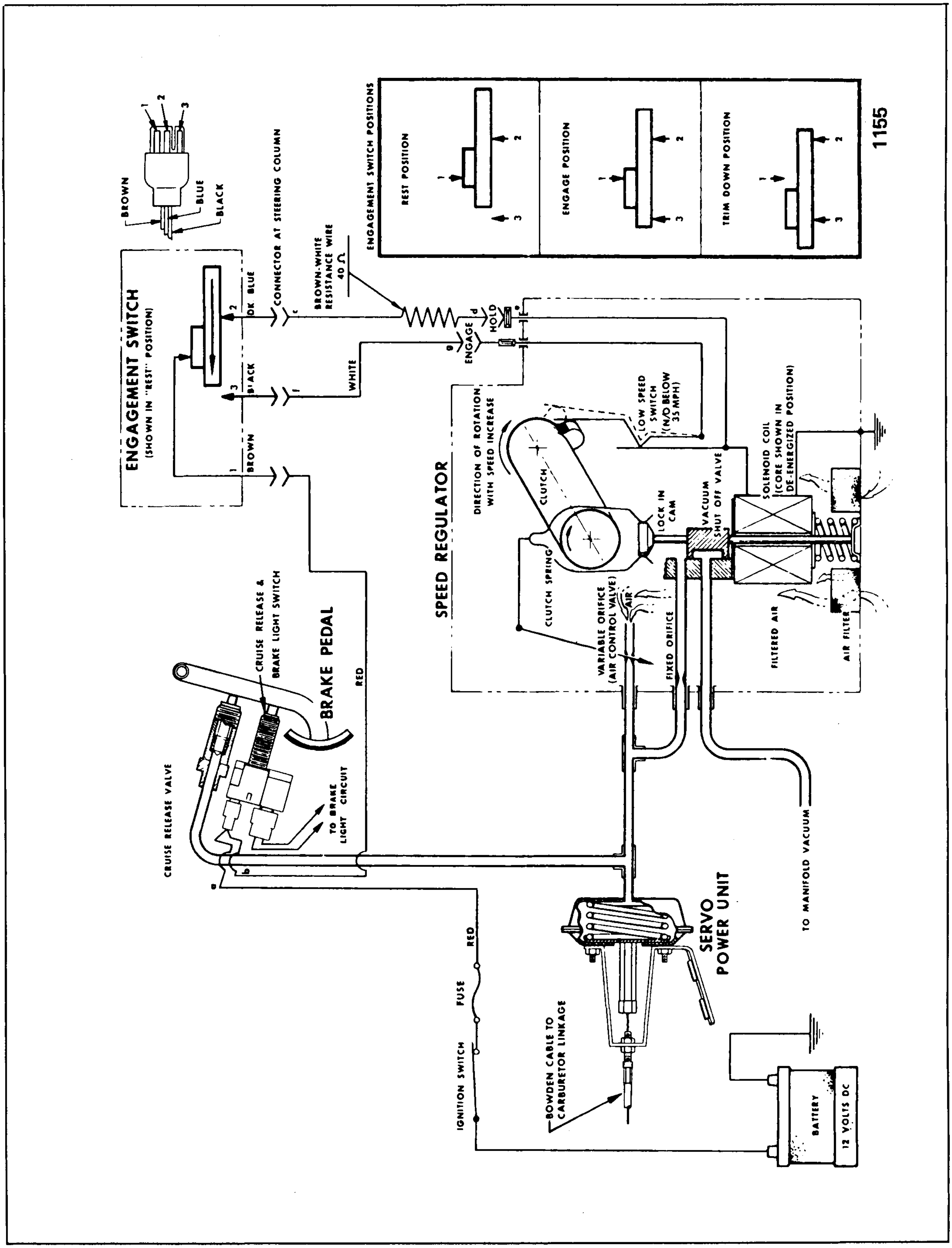
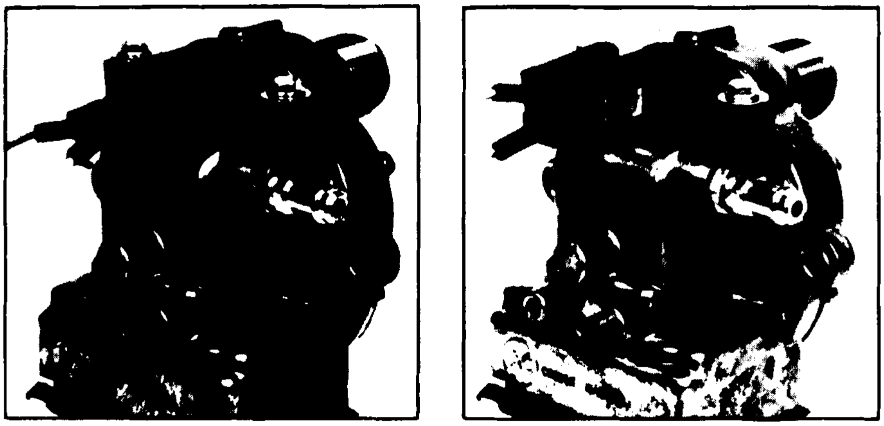


Fig. 9-11 Cruise Master Wiring Schematic

CRUISE MASTER TROUBLESHOOTING

CHECK I FOR SYSTEMS WITH ERRATIC CRUISE PERFORMANCE

CHECK II FOR INOPERATIVE SYSTEMS MAKE ALL TESTS WITH TRANSMISSION SELECTOR IN "PARK" & PARKING BRAKE ON EXCEPT WHERE INDICATED OTHERWISE. RECONNECT ANY DISCONNECTED HOSES AND/OR ELECTRICAL CONNECTORS IN PROPER MANNER AT THE COMPLETION OF TEST.



CHECK I

1. CHECK SERVO CABLE ADJUSTMENT - MUST HAVE MINIMUM AMOUNT OF LOST MOTION SEE SERVICE ADJUSTMENT PROCEDURE.
2. CHECK FOR PINCHED, KINKED, PLUGGED, OR DAMAGED VACUUM HOSES. ALSO CHECK VACUUM FITTINGS.
3. CHECK SPEEDOMETER CABLE ROUTING. IT MUST NOT BE KINKED OR HAVE TOO SHARP A TURNING RADIUS (NOT LESS THAN 6" RADIUS). CHECK DRIVE CABLE FOR DISTORTED OR BENT TIPS. FERRULES MUST BE SNUG.
4. CHECK FOR A BINDING THROTTLE LINKAGE CONDITION.
5. CHECK ADJUSTMENT OF BRAKE RELEASE SWITCH & VACUUM RELEASE VALVE. (SEE SERVICE & ADJUSTMENTS)
6. CHECK FOR PROPER OPERATING PROCEDURE OF THE ENGAGE SWITCH
7. IF STEPS 1 THROUGH 6 DO NOT SOLVE THE PROBLEM PROCEED WITH CHECK II.

SPECIAL NOTE PERTAINING TO ENGAGEMENT-CRUISING SPEED ZEROING.

IF THE CAR CRUISES BELOW ENGAGEMENT SPEED, SCREW THE ORIFICE TUBE OUTWARD. IF THE CAR CRUISES ABOVE THE ENGAGEMENT SPEED, SCREW THE ORIFICE TUBE INWARD. EACH 1/4 TURN WILL CHANGE THE CAR SPEED APPROXIMATELY ONE MPH. ENGAGEMENT ACCURACY TESTING TO BE DONE AT 60 MPH. SNUG UP LOCK NUT AFTER EACH ADJUSTMENT.

CAUTION: DO NOT REMOVE ORIFICE TUBE FROM CASTING.

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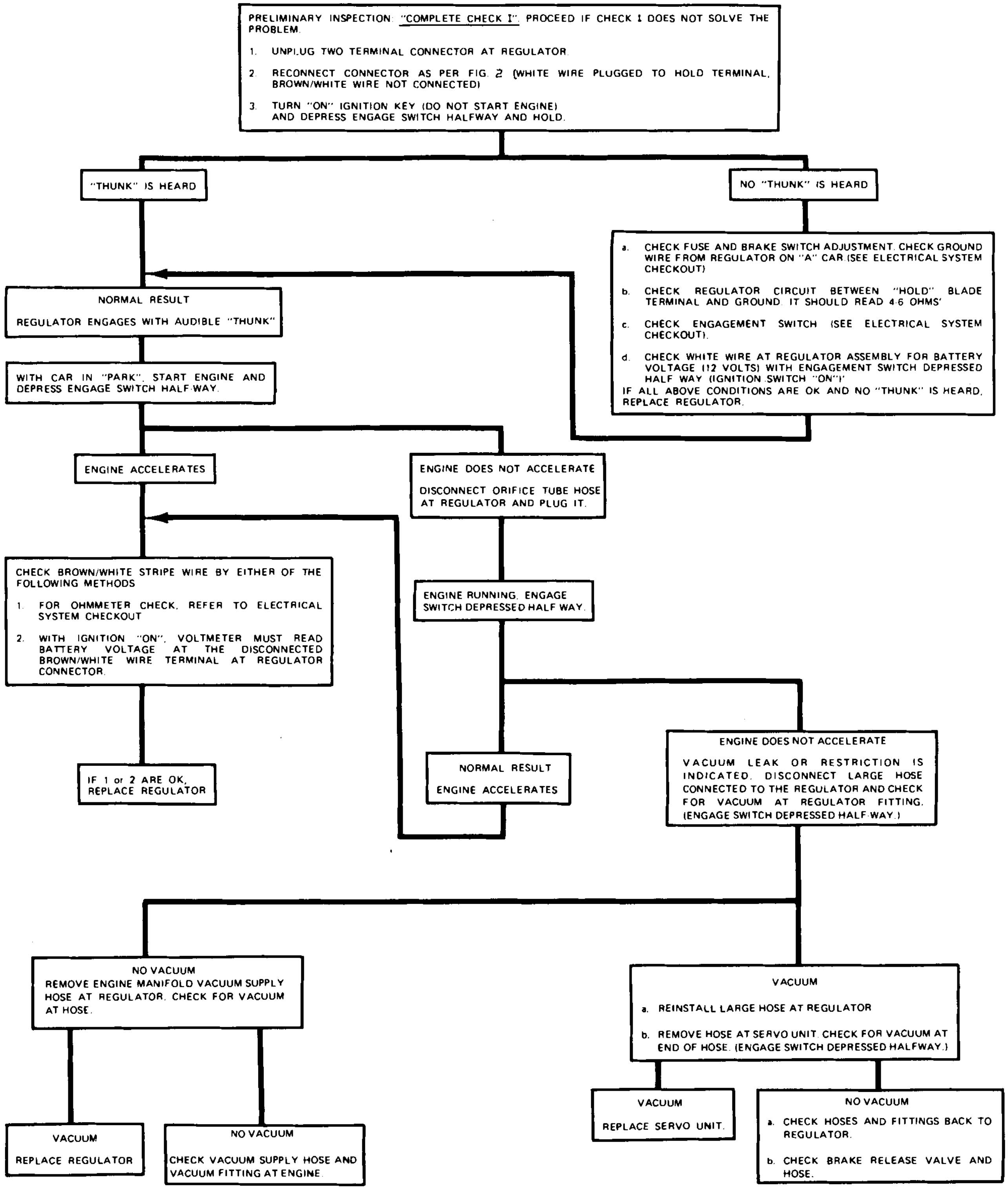
Fig. 9-12 Cruise Master Diagnosis Chart 1



PRELIMINARY INSPECTION: "COMPLETE CHECK I". PROCEED IF CHECK I DOES NOT SOLVE THE PROBLEM.

1. UNPLUG TWO TERMINAL CONNECTOR AT REGULATOR.
2. RECONNECT CONNECTOR AS PER FIG. 2 (WHITE WIRE PLUGGED TO HOLD TERMINAL, BROWN/WHITE WIRE NOT CONNECTED)
3. TURN "ON" IGNITION KEY (DO NOT START ENGINE) AND DEPRESS ENGAGE SWITCH HALFWAY AND HOLD.

"THUNK" IS HEARD

NO "THUNK" IS HEARD

a. CHECK FUSE AND BRAKE SWITCH ADJUSTMENT. CHECK GROUND WIRE FROM REGULATOR ON "A" CAR (SEE ELECTRICAL SYSTEM CHECKOUT)

b. CHECK REGULATOR CIRCUIT BETWEEN "HOLD" BLADE TERMINAL AND GROUND. IT SHOULD READ 4-6 OHMS'

c. CHECK ENGAGEMENT SWITCH (SEE ELECTRICAL SYSTEM CHECKOUT).

d. CHECK WHITE WIRE AT REGULATOR ASSEMBLY FOR BATTERY VOLTAGE (12 VOLTS) WITH ENGAGEMENT SWITCH DEPRESSED HALF WAY (IGNITION SWITCH "ON")'

IF ALL ABOVE CONDITIONS ARE OK AND NO "THUNK" IS HEARD, REPLACE REGULATOR.

NORMAL RESULT

REGULATOR ENGAGES WITH AUDIBLE "THUNK"

WITH CAR IN "PARK", START ENGINE AND DEPRESS ENGAGE SWITCH HALF WAY.

ENGINE ACCELERATES

ENGINE DOES NOT ACCELERATE

DISCONNECT ORIFICE TUBE HOSE AT REGULATOR AND PLUG IT.

CHECK BROWN/WHITE STRIPE WIRE BY EITHER OF THE FOLLOWING METHODS

1. FOR OHMMETER CHECK, REFER TO ELECTRICAL SYSTEM CHECKOUT
2. WITH IGNITION "ON", VOLTMETER MUST READ BATTERY VOLTAGE AT THE DISCONNECTED BROWN/WHITE WIRE TERMINAL AT REGULATOR CONNECTOR.

ENGINE RUNNING, ENGAGE SWITCH DEPRESSED HALF WAY.

IF 1 or 2 ARE OK, REPLACE REGULATOR

NORMAL RESULT

ENGINE ACCELERATES

ENGINE DOES NOT ACCELERATE

VACUUM LEAK OR RESTRICTION IS INDICATED. DISCONNECT LARGE HOSE CONNECTED TO THE REGULATOR AND CHECK FOR VACUUM AT REGULATOR FITTING. (ENGAGE SWITCH DEPRESSED HALF WAY.)

NO VACUUM

REMOVE ENGINE MANIFOLD VACUUM SUPPLY HOSE AT REGULATOR. CHECK FOR VACUUM AT HOSE.

VACUUM

a. REINSTALL LARGE HOSE AT REGULATOR

b. REMOVE HOSE AT SERVO UNIT. CHECK FOR VACUUM AT END OF HOSE. (ENGAGE SWITCH DEPRESSED HALFWAY.)

VACUUM

REPLACE SERVO UNIT.

NO VACUUM

a. CHECK HOSES AND FITTINGS BACK TO REGULATOR.

b. CHECK BRAKE RELEASE VALVE AND HOSE.

VACUUM

REPLACE REGULATOR

NO VACUUM

CHECK VACUUM SUPPLY HOSE AND VACUUM FITTING AT ENGINE.

Fig. 9-13 Cruise Master Diagnosis Chart 2

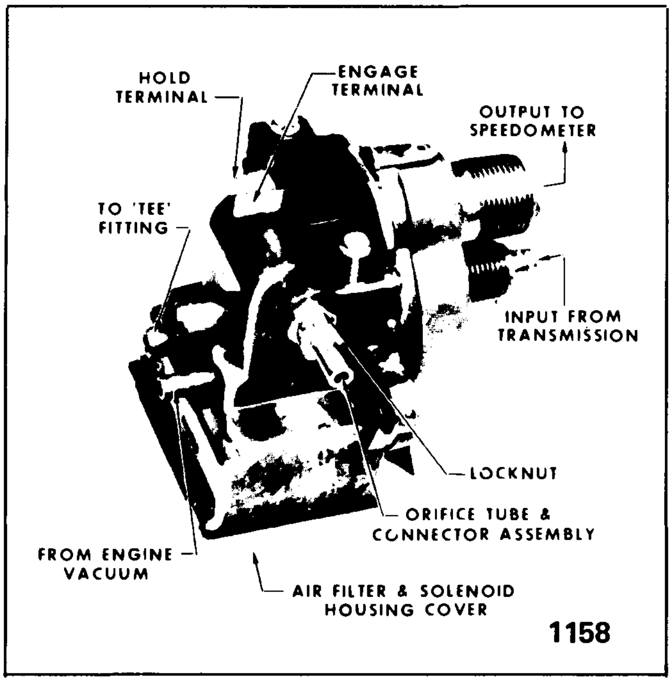


Fig. 9-14 Cruise Master Regulator

3. If car cruises **above** engagement speed, screw the orifice tube **inward.**

NOTE: Each 1/4 turn of the orifice tube will change cruise speed approximately one mph. Snug-up lock nut after each adjustment.

If a regulator is found to be defective and not simply out of adjustment, it must be replaced. During replacement, check the hoses which connect to the regulator and replace any which are cracked or deteriorated.

SERVO UNIT

Before adjusting the servo cable, make sure the carburetor is set at its lowest idle throttle position by manually setting the fast idle cam at its lowest step with the ignition switch "OFF". Adjust the cable so there is as little lost motion at the servo as possible. Servo cable adjustment procedures are shown on the mounting illustrations.

If the servo unit is found to be defective, replacement is required. Note the condition of the hoses and replace any which are cracked or deteriorated.

BRAKE RELEASE SWITCHES (FIG. 9-10)

Electric

The Cruise Master brake release switch electrical contacts must be switched open when the brake pedal is depressed .38" to .64", measured at the brake pedal.

An inoperative switch must be replaced. Switch replacement procedure is identical to standard brake lamp switch replacement.

Vacuum

The vacuum valve plunger must clear the pedal arm when the arm is moved 5/16 inch, measured at the switch.

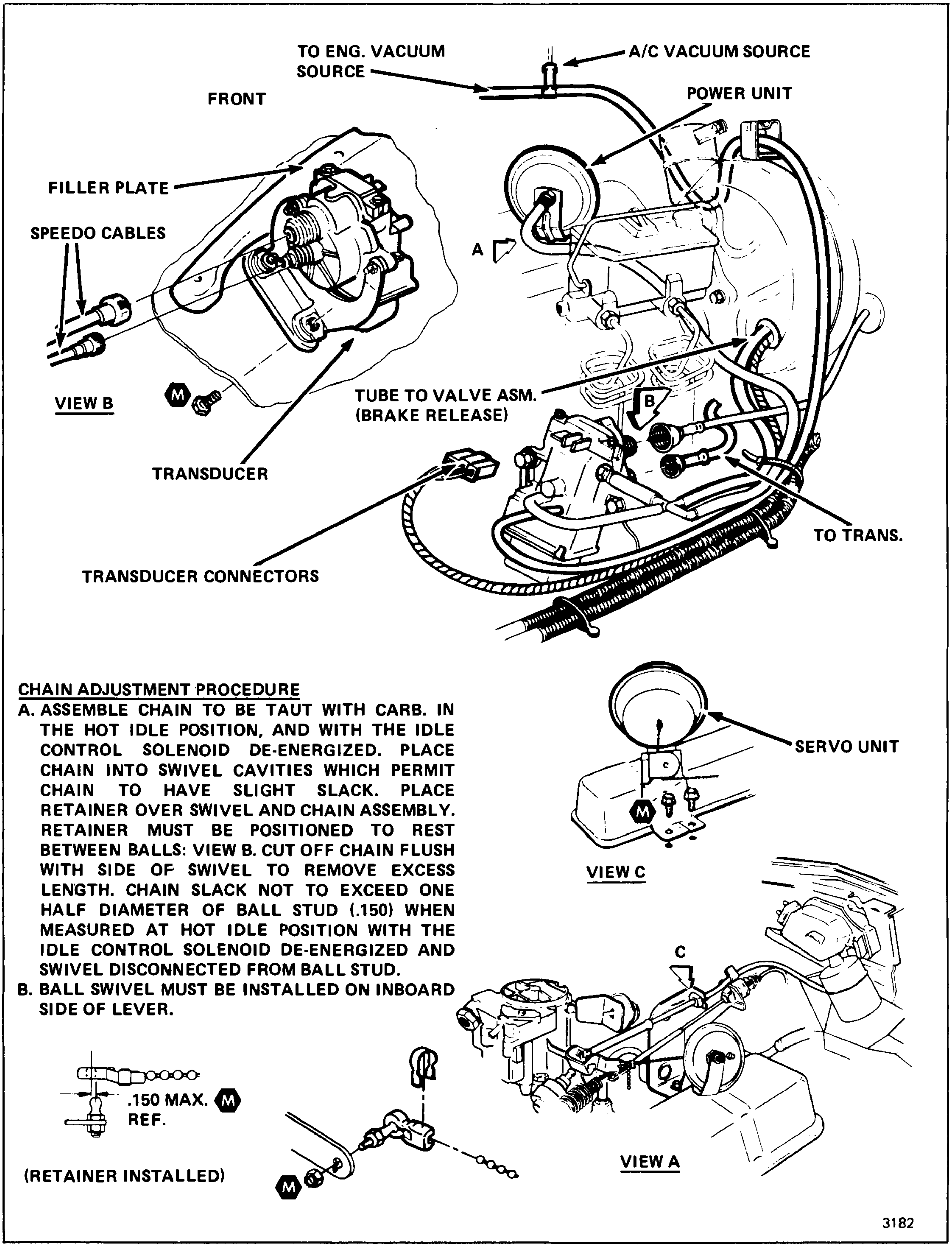
An inoperative (sticking, plugged or leaking) vacuum valve must be replaced. Vacuum valve replacement is similar to brake switch replacement. Be certain that the hose to the valve is connected firmly and is not cracked or deteriorated.

COLUMN MOUNTED ENGAGEMENT SWITCH

The engagement switch is serviced only by replacement of the turn signal lever assembly. Replacement procedures are in the steering section, and wire routing is shown in Figs. 9-8 and 9-9.

Remove and Replace

Regulator and Servo mounting are shown in Figs. 9-15 through 9-20. Vacuum schematics are shown in Figs. 9-21 and 9-22. These do not show physical routings, but rather proper vacuum connections.



CHAIN ADJUSTMENT PROCEDURE

A. ASSEMBLE CHAIN TO BE TAUT WITH CARB. IN THE HOT IDLE POSITION, AND WITH THE IDLE CONTROL SOLENOID DE-ENERGIZED. PLACE CHAIN INTO SWIVEL CAVITIES WHICH PERMIT CHAIN TO HAVE SLIGHT SLACK. PLACE RETAINER OVER SWIVEL AND CHAIN ASSEMBLY. RETAINER MUST BE POSITIONED TO REST BETWEEN BALLS: VIEW B. CUT OFF CHAIN FLUSH WITH SIDE OF SWIVEL TO REMOVE EXCESS LENGTH. CHAIN SLACK NOT TO EXCEED ONE HALF DIAMETER OF BALL STUD (.150) WHEN MEASURED AT HOT IDLE POSITION WITH THE IDLE CONTROL SOLENOID DE-ENERGIZED AND SWIVEL DISCONNECTED FROM BALL STUD.

B. BALL SWIVEL MUST BE INSTALLED ON INBOARD SIDE OF LEVER.

Fig. 9-15 Cruise Master Regulator & Servo Mounting-V6, B & X Series, Typical

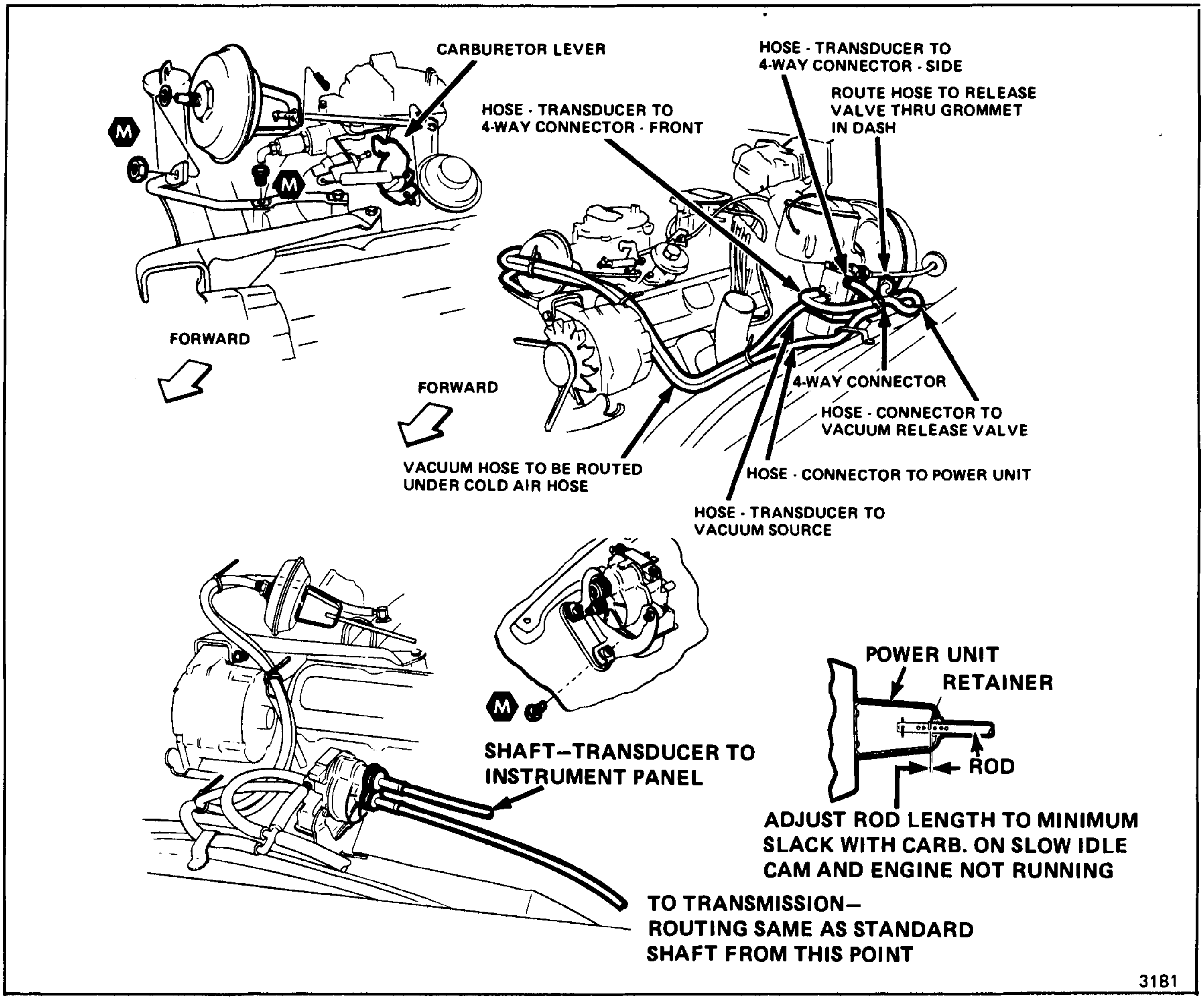
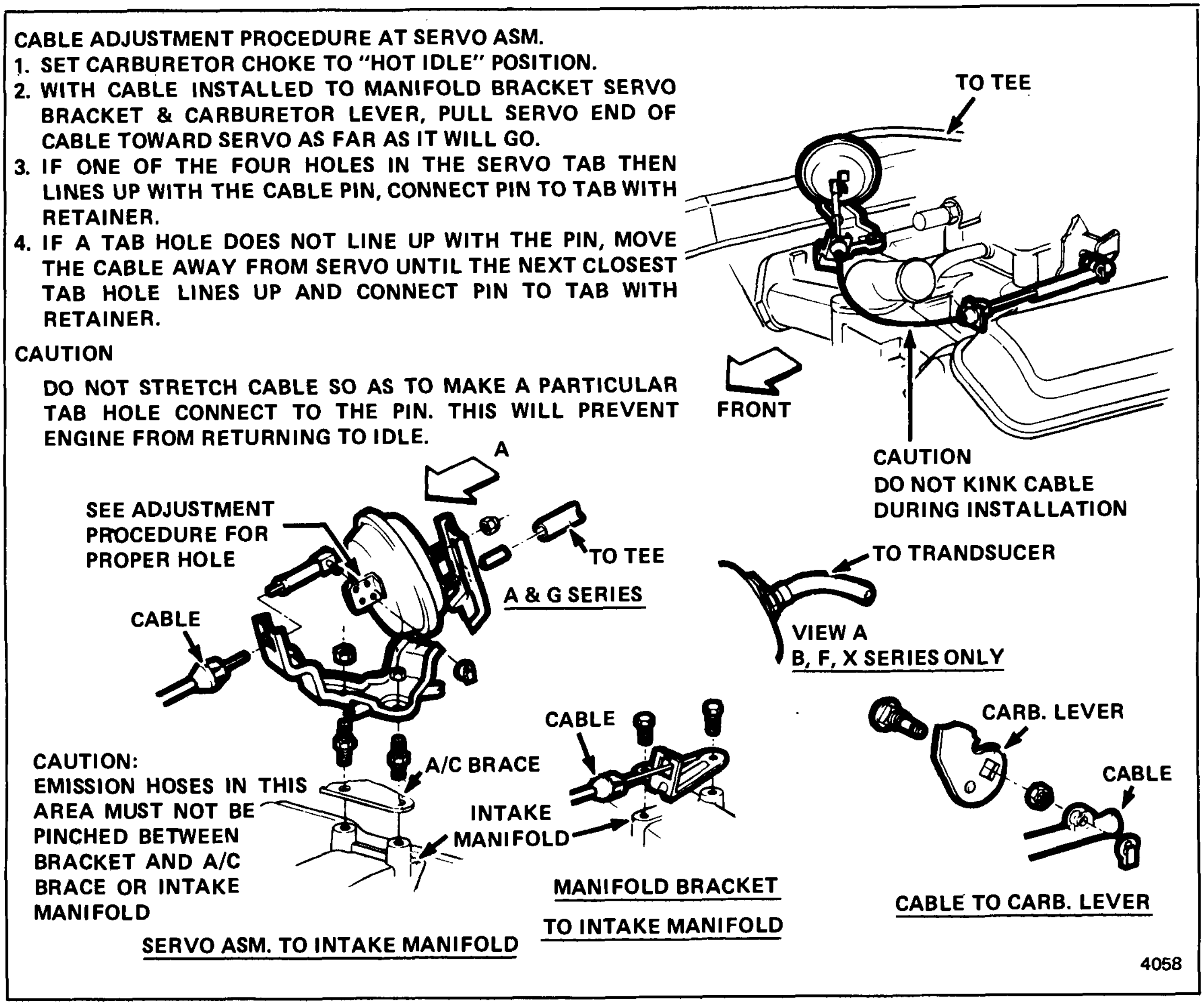


Fig. 9-16 Cruise Master Regulator & Servo Mounting-"R" & "K" V8, B Series



CABLE ADJUSTMENT PROCEDURE AT SERVO ASM.

1. SET CARBURETOR CHOKE TO "HOT IDLE" POSITION.
2. WITH CABLE INSTALLED TO MANIFOLD BRACKET SERVO BRACKET & CARBURETOR LEVER, PULL SERVO END OF CABLE TOWARD SERVO AS FAR AS IT WILL GO.
3. IF ONE OF THE FOUR HOLES IN THE SERVO TAB THEN LINES UP WITH THE CABLE PIN, CONNECT PIN TO TAB WITH RETAINER.
4. IF A TAB HOLE DOES NOT LINE UP WITH THE PIN, MOVE THE CABLE AWAY FROM SERVO UNTIL THE NEXT CLOSEST TAB HOLE LINES UP AND CONNECT PIN TO TAB WITH RETAINER.

CAUTION

DO NOT STRETCH CABLE SO AS TO MAKE A PARTICULAR TAB HOLE CONNECT TO THE PIN. THIS WILL PREVENT ENGINE FROM RETURNING TO IDLE.

CAUTION
DO NOT KINK CABLE DURING INSTALLATION

CAUTION:
EMISSION HOSES IN THIS AREA MUST NOT BE PINCHED BETWEEN BRACKET AND A/C BRACE OR INTAKE MANIFOLD

Fig. 9-17 Cruise Master Servo Mounting on Engine-"Y" V8, All Series

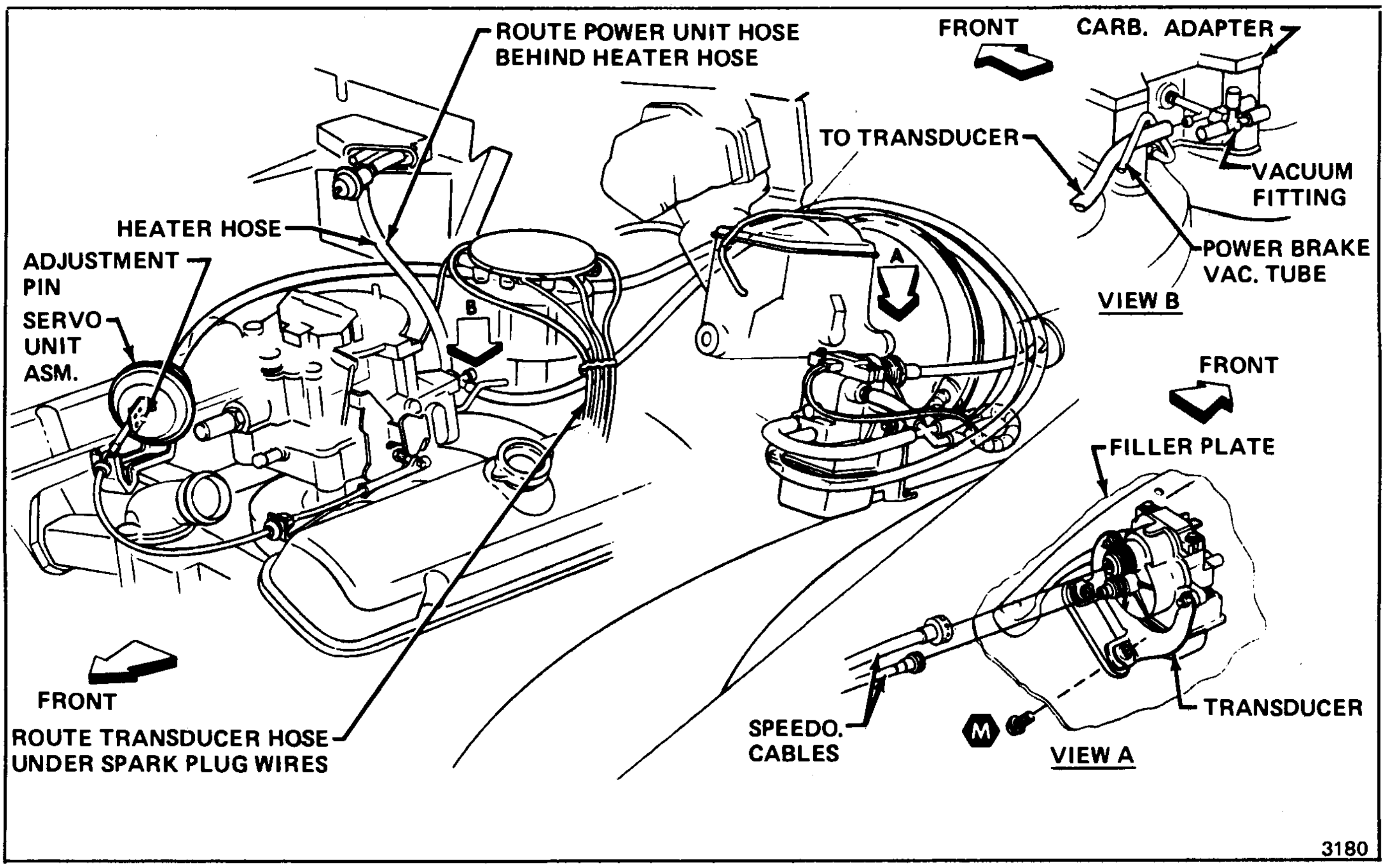
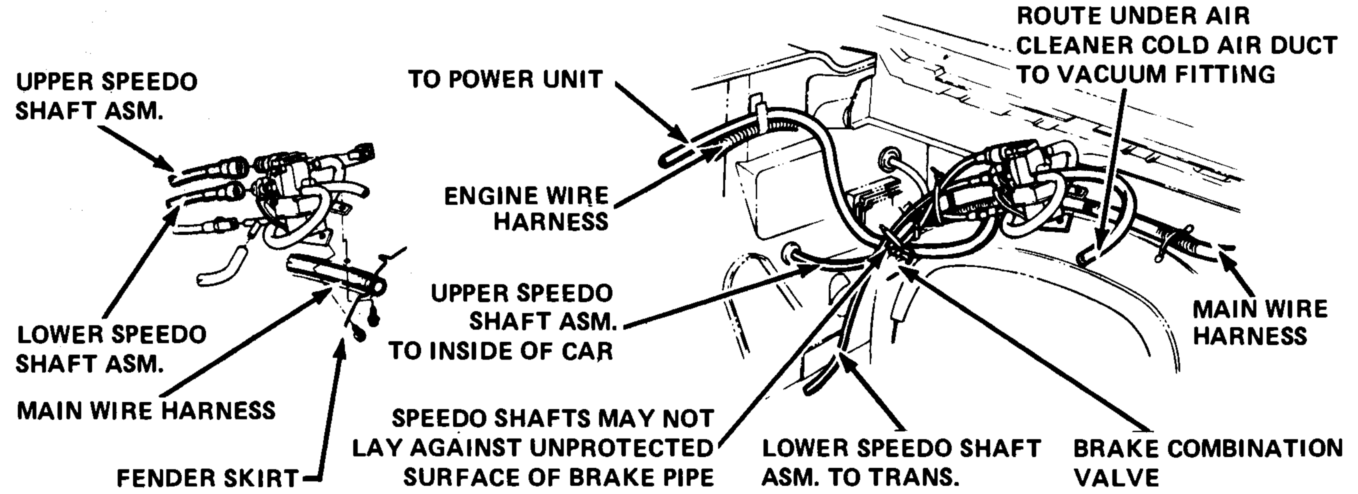


Fig. 9-19 Cruise Master Regulator Mounting-"Y" V8, B & X Series

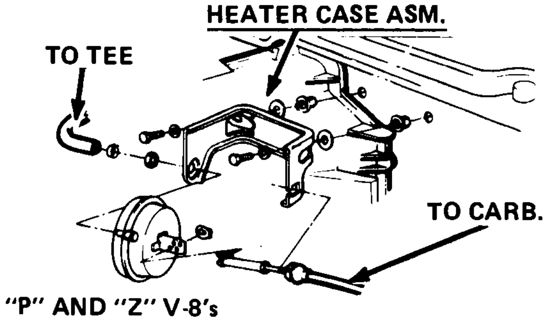


CABLE ADJUSTMENT AT POWER UNIT.

1. SET CARBURETOR CHOKE TO "HOT IDLE" POSITION.
2. WITH CABLE INSTALLED TO THROTTLE BRACKET AND CARBURETOR LEVER, PULL POWER UNIT END OF CABLE TOWARD POWER UNIT AS FAR AS IT WILL GO.
3. IF ONE OF THE FOUR HOLES IN THE POWER UNIT TAB THEN LINES UP WITH THE CABLE PIN, CONNECT PIN TO TAB WITH RETAINER.
4. IF A TAB HOLE DOES NOT LINE UP WITH THE PIN, MOVE THE CABLE AWAY FROM POWER UNIT UNTIL THE NEXT CLOSEST TAB HOLE LINES UP AND CONNECT PIN TO TAB WITH RETAINER.

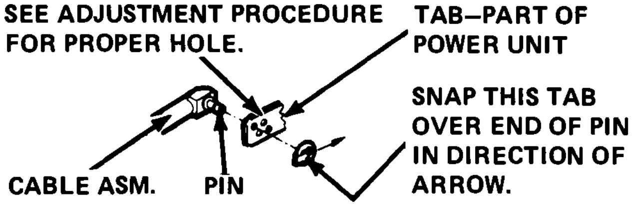
CAUTION

DO NOT STRETCH CABLE SO AS TO MAKE A PARTICULAR TAB HOLE CONNECT TO THE PIN. THIS WILL PREVENT ENGINE FROM RETURNING TO IDLE.



"P" AND "Z" V-8's

NOTE: FOR "Y" V-8 SERVO SEE FIG. 9-17



INSTALLATION OF RETAINER

4059

Fig. 9-18 Cruise Master Regulator & Servo Mounting-"Y", "P" and "Z", F Series

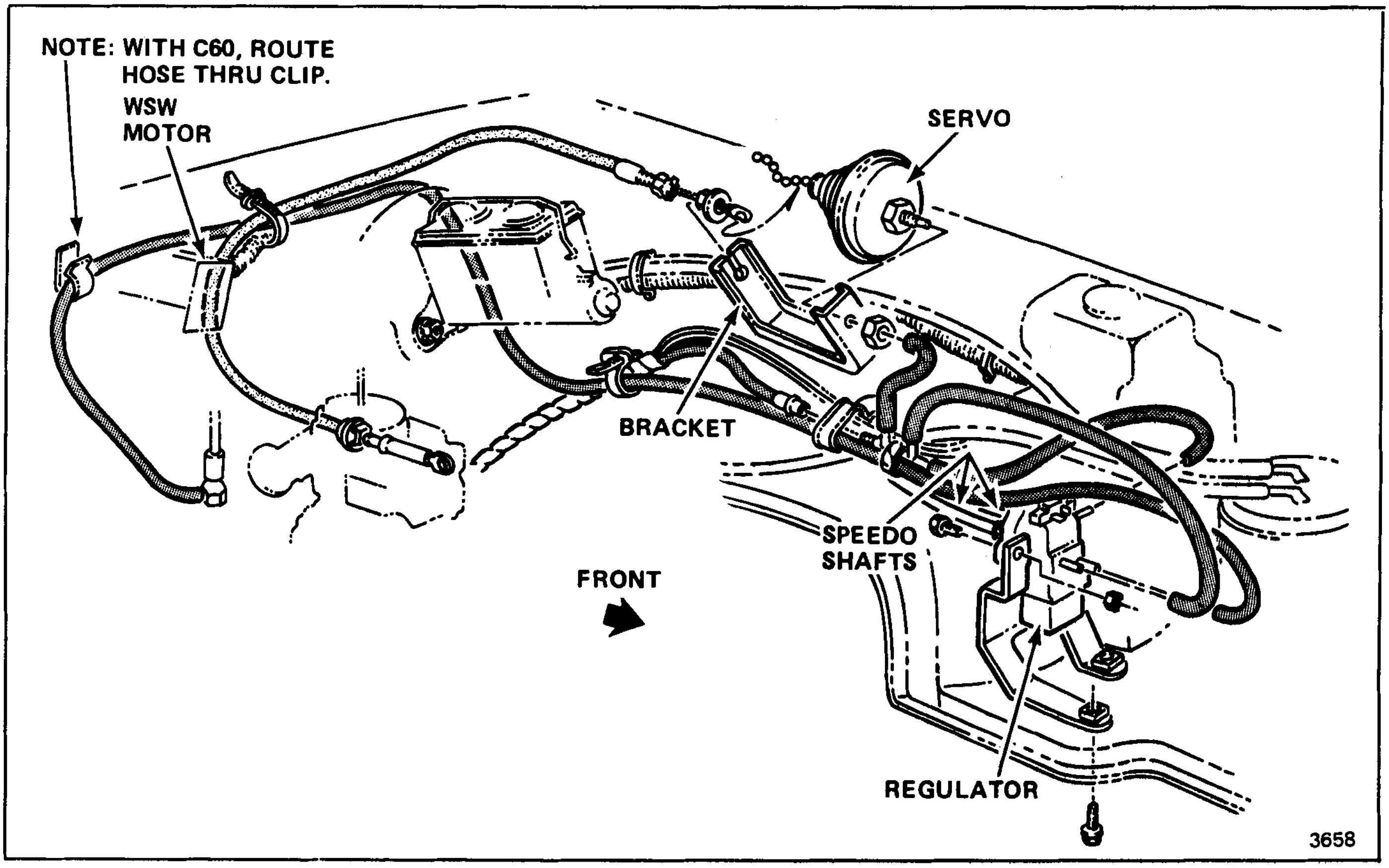
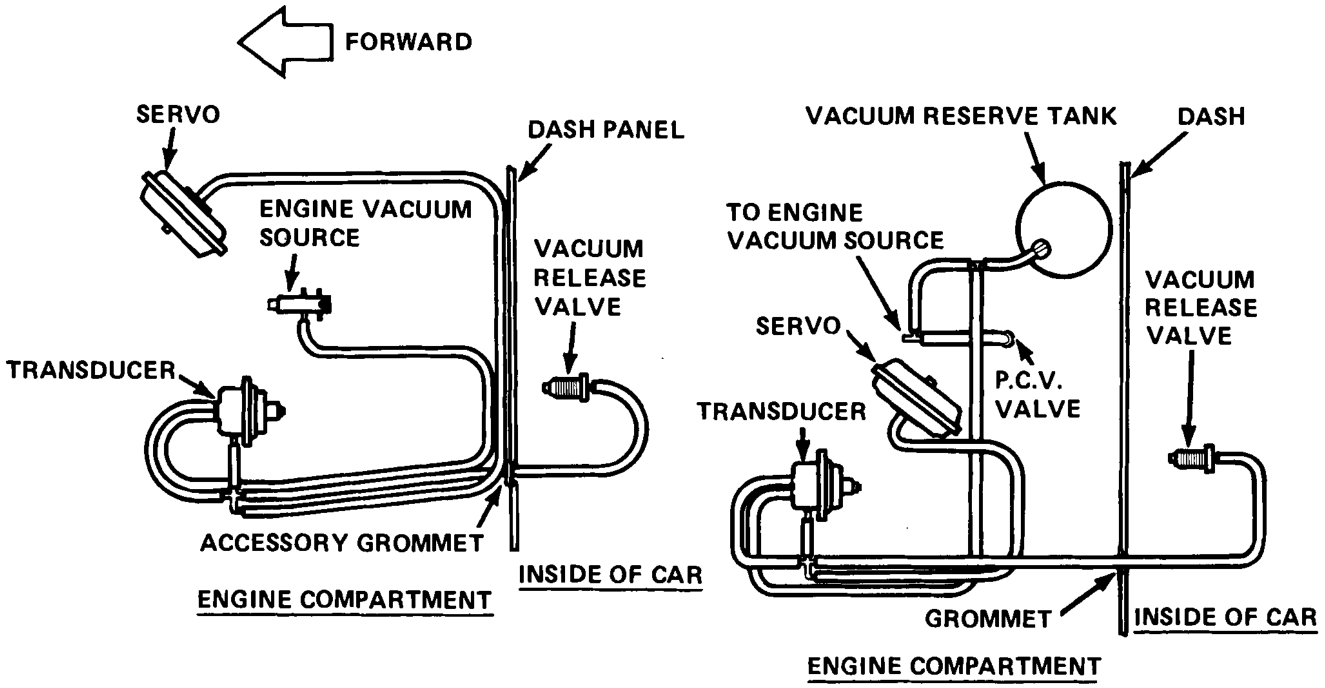
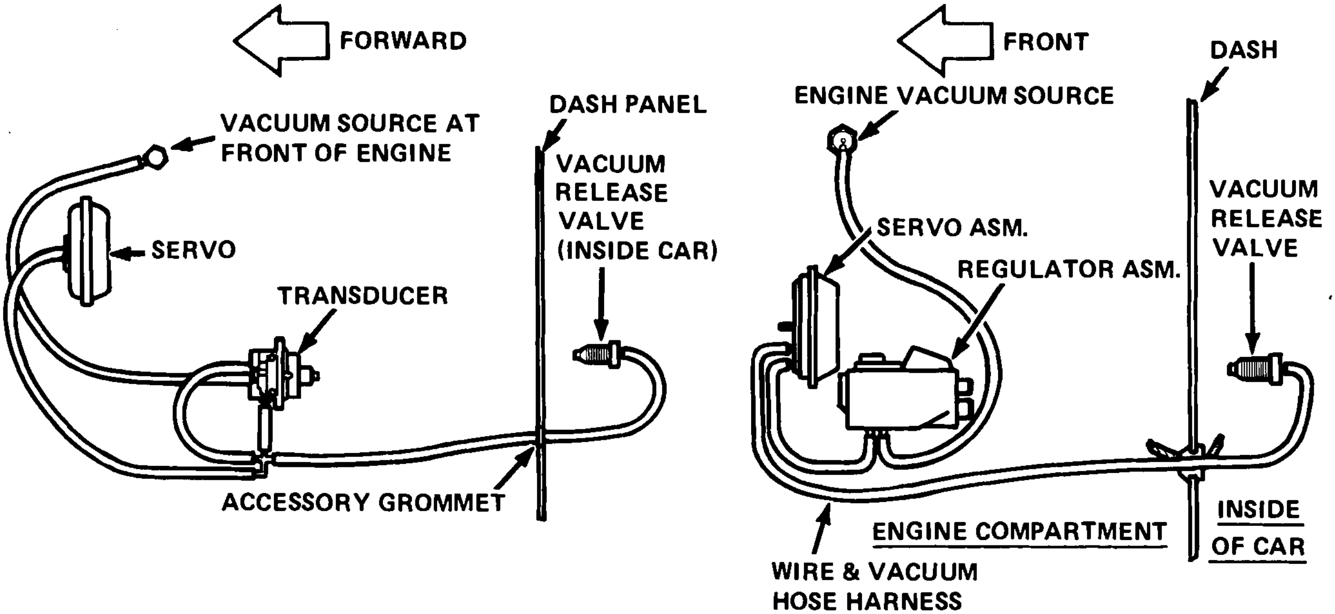


Fig. 9-20 Cruise Master Regulator & Servo Mounting-"U" &"L" V8, X Series



"Y" ENGINE, B & X SERIES

V-6, B & X SERIES

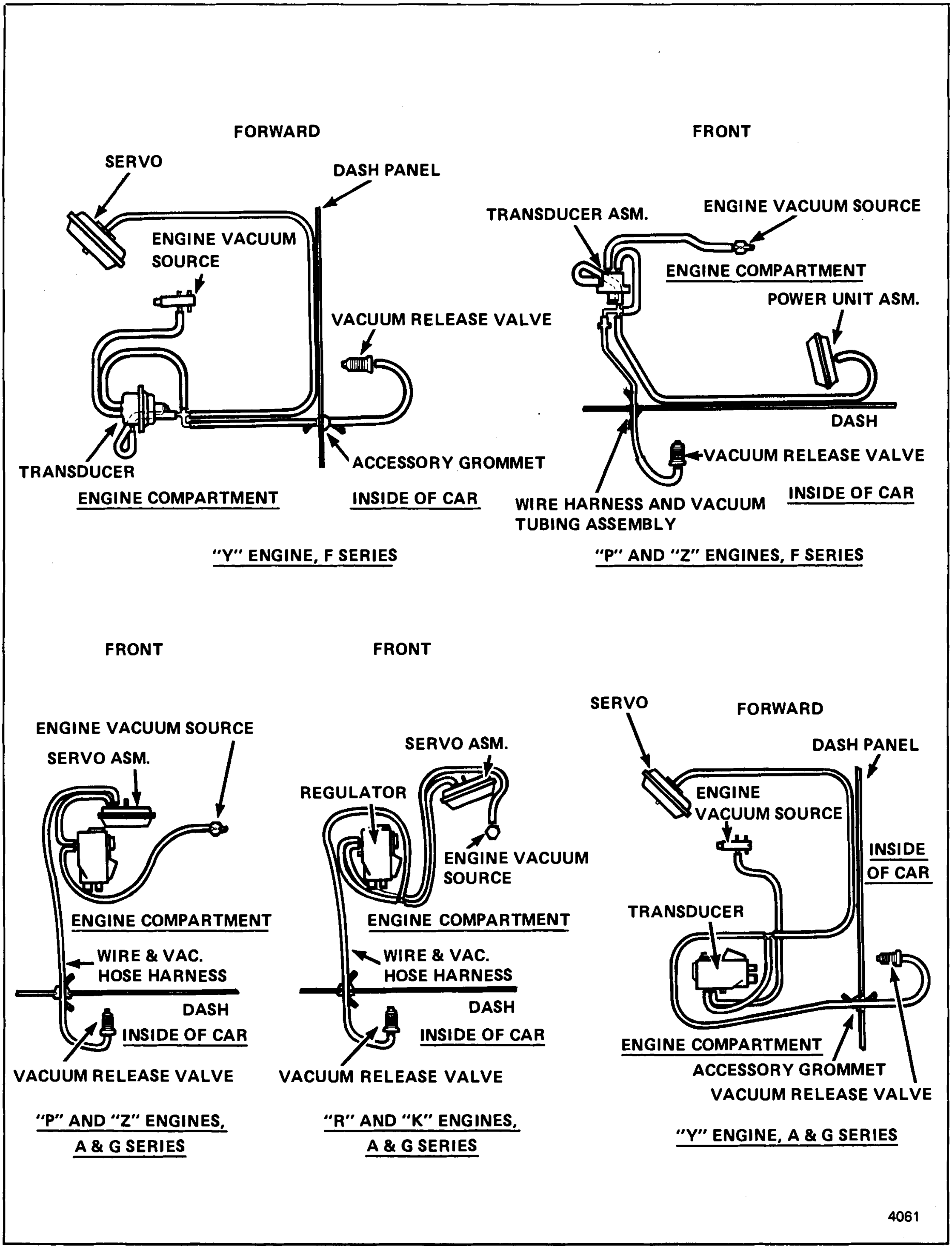


"R" AND "K" ENGINES, B SERIES

"P" AND "Z" ENGINES, B SERIES

4060

Fig. 9-21 Cruise Control System Vacuum Schematics



"Y" ENGINE, F SERIES

"P" AND "Z" ENGINES, F SERIES

"P" AND "Z" ENGINES, A & G SERIES

"R" AND "K" ENGINES, A & G SERIES

"Y" ENGINE, A & G SERIES

Fig. 9-22 Cruise Control System Vacuum Schematics

RADIO

GENERAL DESCRIPTION

Eight types of radios are avilable: AM Pushbutton, AM Stereo/Tape, AM/FM, AM/FM Stereo, AM/FM Stereo/Tape, AM/FM Stereo with Digital read out, AM/FM Stereo with integral CB, and bracket mounted CB. See Fig. 9-23 for series application.

AM

The outer left knob operates the on-off switch and volume control, and the inner left knob operates the tone control. The right hand outer knob controls manual tuning.

To set a pre-selected station, first find the desired station using the manual tuning knob. Pull a push button all the way out, and then push in. That station can subsequently be selected by pushing the button. On AM-FM radios, either five or ten stations may be selected. See Fig. 9-23.

On AM or AM/FM radios equipped with an optional rear seat speaker, a variable type control located behind the manual tuning knob adjusts the relative volume of the front and rear speakers simultaneously. As the control is turned clockwise, the volume of the rear speaker increases and the volume of the front speaker decreases. As the control is turned counterclockwise, the volume of the rear speaker diminishes and the volume of the front speaker increases. After the desired relative speaker volume is obtained, both speakers total volume can be regulated by the volume control knob.

On cars equipped with stereo radios or stereo tape player, the inner right knob controls the relative volume from the individual channel speakers. This control should be adjusted for the most pleasing stereo separation between the front and rear speakers.

AM/FM MONAURAL

This radio is identical to the AM radio as far as the operation of the on-off and volume control, tone control, manual turning control, and push buttons are concerned. The FM automatic frequency control circuit automatically keeps the receiver on frequency.

AVAILABILITY					
RADIO/TAPE	A & G	B	F	H	X
AM	X	X	X	X	X
AM-FM	X	X	X	X	X
AM-FM STEREO	X	X	X	X	X
AM/TAPE	X	X		X	
AM-FM STEREO/TAPE	X	X		X	
DIGITAL	X (AG & G)	X			
AM-FM/STEREO 23 CH. CB	X (AG & G)	X			
HANG ON 23 CH. CB	X	X	X		X
CONSOLE MOUNTED TAPE			X		
OTHER INFORMATION					
	A	B	F	H	X
10 STATION (5 AM, 5 FM) TUNER	ON AM-FM TAPE & DIGITAL CLOCK RADIO	X		X	X
AM-FM BAND SWITCH LOC.	ABOVE DIAL	BELOW DIAL	NO. 1 BUTTON (AM) NO. 5 BUTTON (FM)	BELOW DIAL	BELOW DIAL
NUMBER OF STEREO SPEAKERS	3 1 FRONT 2 REAR ON SAME CH.	4 2 FRONT 2 REAR X-FIRE	2 1 FRONT 1 REAR	2 1 FRONT 1 REAR	2 1 FRONT 1 REAR

4344

Fig. 9-23 Radio Availability

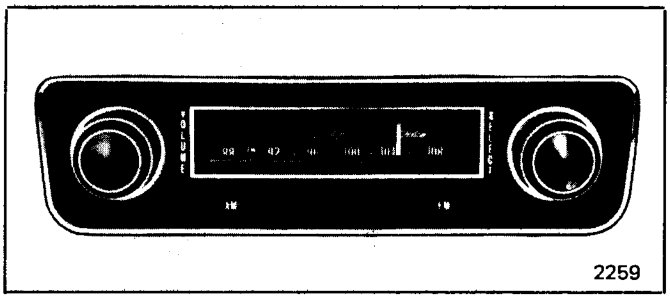

2259

Fig. 9-25 AM-FM Radio

AM/FM STEREO

The STEREO indicator lights up when tuned to stereo signals. The B Series has four speakers; right rear and left front on one channel, left rear and right front on the other channel. The A and G Series have three speakers, and the F, X & H have 2 speakers. Improper wire connections to speakers (out of phase) will reduce sound quality. For best stereo reception, set tone control to center detent position, adjust fader control so that sound is balanced for greatest stereo effect.

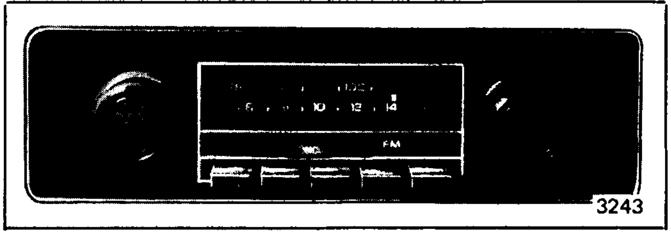

3243

Fig. 9-26 AM-FM Stereo Radio

AM OR AM-FM STEREO/TAPE PLAYER

With the AM radio/tape player or the AM/FM stereo radio and eight-track tape player, the owner may make his own selection of prerecorded music. To operate in the tape player mode, turn the radio on and fully insert a tape cartridge into the opening covered by the face of the receiver dial. The dial face will swing into the receiver when the tape cartridge is inserted. This automatically removes power from the radio and switches control of the speakers to the tape player.

To change tape programs, momentarily depress the volume control knob. Each time the volume control knob is depressed, the tape cartridge will change to the next recorded program. To eject the tape cartridge from the engaged position, depress the left pushbutton on A and G Series. On B and H Series, simply grasp the tape and gently pull out. The cartridge may be left in the pulled out position without damage to the tape. With the tape cartridge out, power is automatically returned to the radio along with control of the speakers. To fully remove tape cartridge, pull gently out of the radio face.

F Series uses a console mounted tape player separate from the radio (see Fig. 9-27). It has a separate program button and separate volume and stereo separation controls.

Tape cartridges should be handled carefully and should be kept clean. A cartridge should never be left inserted fully in the player when it is turned off. This may cause permanent damage to the tape player.

Silicone spray lubricants are specifically **not** recommended for switch plunger or tape head lubrication.

Tape players should be cleaned regularly. Refer to owners manual.

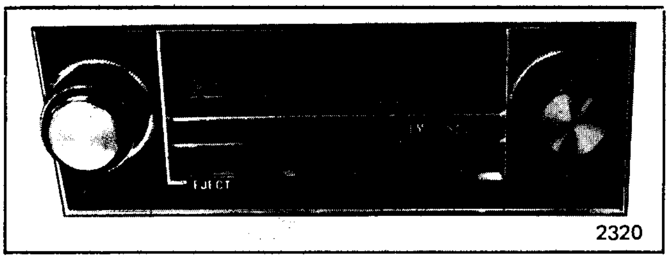

2320

Fig. 9-27 AM-FM Stereo/Tape Player

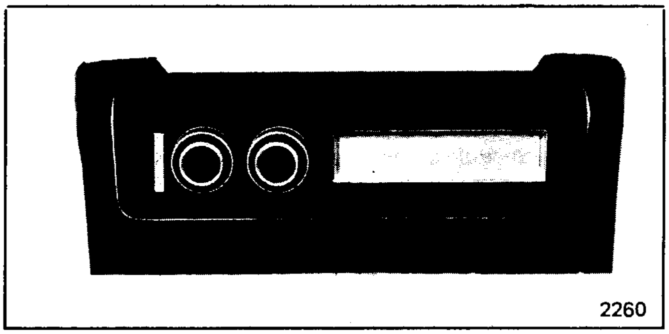

2260

Fig. 9-28 Console Tape Player - F Series

DIGITAL DISPLAY RADIO

This system provides illuminated digital display of the selected radio station frequency, calendar date, time of day, and elapsed time.

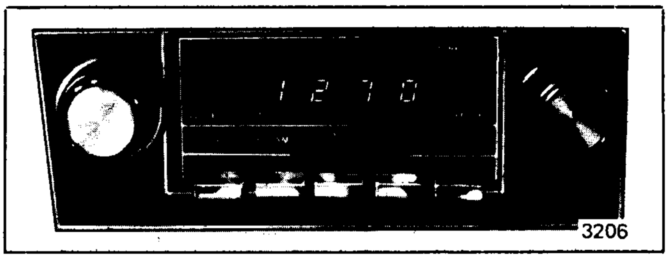

3206

Fig. 9-29 Digital Display Radio

When the headlights of the car are off, the L.E.D. panel will display bright, legible numerical digits. The light intensity of the display panel is varied with the light dimmer switch when the headlights are on.

The digital display radio will normally display the time of day with the ignition on. The other functions can be displayed by pressing the appropriate buttons. These functions will remain displayed for approximately a three to five second interval after which the time of day will automatically reappear.

The time of day is numerically displayed in hours and minutes separated by a colon flashing at one second intervals (or steady, depending on build date of radio). An AM-FM indicator light is provided at the left end of the display panel.

Selected station frequency is digitally displayed in 10 KHZ steps on the AM radio band and 0.2 MHZ steps on the FM radio band. The radio and ignition switches must be on for the frequency to be displayed. The selected radio frequency is displayed for approximately a three to five second interval when the radio is activated through either the ignition or radio switches, when the station frequency is manually or pushbutton selected, or when the volume control knob is depressed.

The elapsed time indicator allows you to record and store up to 19 hours and 59 minutes of travel time while the car is in operation. New timing intervals are begun when the button marked "reset" is depressed. This clears all stored time and simultaneously restarts timing for the next interval. Display of the elapsed time can be obtained whenever desired by pushing the "E time" button. Stored time will be displayed in hours and minutes separated by a steady lit colon. The timer records only when the ignition switch is in the ACCESSORY or ON positions. Accumulated time is retained when the ignition is in the OFF position.

Depressing the button marked "Date" will display the month and day of the year separated by a steadily lit colon. The system is programmed for the correct number of days per calendar month and with the exception of February 29, in leap year, will automatically operate as a perpetual calendar. The display will appear only when the ignition switch is in either the ON or ACCESSORY positions.

Two recessed setup buttons are provided to be used for setting the correct time or date; one at the right and one at the left end of the digital display panel marked "HOUR" and "MIN" respectively. A small non-breakable blunt object may be used during the setup procedure (see Fig. 9-30). Do not use a lead pencil or other object that might break and jam the setup buttons. The buttons should be depressed and held until the proper digit appears.

Radio stations frequently provide the exact time of the day by referencing: "At the sound of the tone the exact time is ...". You can set your digital radio to the minute by simultaneously depressing the hour and minute buttons when the tone is heard and then setting the display to correspond to the time provided.

CB RADIO

Two types of Civilian Band radios are available in 1977 Pontiacs (see Fig. 9-23). The first is a two-piece combination in-dash AM/FM Stereo radio and 23 or 40 channel CB transceiver with a common audio system and a common display and control panel. The CB radio chassis is located in a remote box, mounted inside the instrument panel, connected by a cable to the main radio chassis. A common audio speaker system is used for both the entertainment radio and the CB unit. The displays and controls for the combination unit are all mounted on the radio escutcheon (see Fig. 9-31).

The outer left knob operates the on-off switch and volume control for both the CB and entertainment radio. The right knob, pushbuttons, and slide bar pertain to the entertainment unit as usual.

The squelch circuit permits quiet standby operation while awaiting a call from another station. Adjust the control on a quiet channel by turning it slowly clockwise until the background noise disappears. The receiver will resume operation automatically when a station comes on the air. If the control is turned further clockwise, weaker stations will be squelched and only strong stations will be heard.

The lever in the upper right corner is the mode switch. This places the unit in either the radio, override, or CB position. When the unit is placed in the override position, the entertainment radio can be interrupted by a CB signal of a predetermined strength, set by the squelch adjustment. When the CB message is completed, the unit will automatically turn back to the entertainment radio. If the squelch is turned too far counterclockwise, nothing will be received from the entertainment radio.

The CB channel selector is located to the left of the dial face. This switch controls both the transmitter and receiver frequency, and may be set to any of the 23 or 40 authorized CB channels. The channel that has been selected will be shown on the LED channel read-out which is placed in the upper left corner when radio is in CB or override mode.

The transceiver is designed to operate with any standard CB antenna. The transmitter should not be operated unless the antenna is connected. Do not connect the CB radio with the regular car entertainment radio antenna, as it may cause damage to the CB radio.

CAUTION: *There is no internal over-voltage protection for the CB unit. It should be switched off when jump starting the car to avoid damage to any of the electronic circuits.*

A second type CB radio is the bracket mounted unit, which is mounted below the dash or on the transmission hump (see Fig. 9-32). It is available on A, B, F, X and G models except station wagons. It has its own integral speaker and separate controls. It can be operated with the ignition on, and is independent of the other car radios. The squelch control operates as above.

CB ANTENNA

The antenna used with all CB radios is trunk lid mounted. The cable is routed alongside the rear speaker wiring, and plugs into the back of the bracket mounted unit, or into the right side of the remote box of the integral unit. The CB radio should never be operated unless the antenna is connected.

Whenever a CB radio is removed for any reason, and particularly when a CB antenna is removed, the standing wave ratio should be checked (see Fig. 9-33). This is important, as too high a ratio will impair performance, and if extremely high, may damage the radio

DIAGNOSIS

ALL RADIOS

Because radio problems are most often repaired at authorized warranty repair stations, the tendency is to remove the set when a problem is reported, without any preliminary diagnosis. This results in a large number of radios showing up as "NO TROUBLE FOUND" units when received by the warranty repair stations. Many times when this is the case, the trouble usually could have been corrected without removal of the radio.

The inconvenience of driving without a radio while the set is being serviced at a warranty repair station can frequently be avoided if the following quick checks are used to eliminate external radio system problems before removing

SETUP PROCEDURE

TO RESET:	DEPRESS:			DEPRESS AND HOLD UNTIL PROPER DIGIT APPEARS
	DATE	HOUR	MIN.	
HOUR		*		ADVANCES AM/PM INDICATOR – @12 CHECK AM/PM
AM/PM		*		AUTOMATICALLY ADVANCES @12
MINUTE			*	
MONTH	* 1ST	* 2ND		PUSH AND HOLD IN SEQUENCE SHOWN
DAY	• 1ST		• 2ND	PUSH AND HOLD IN SEQUENCE SHOWN
FEB. 29	* 1ST	* 2ND	• 2ND	PUSH DATE BUTTON AND THEN IMMEDIATELY DEPRESS THE HOUR AND MIN. BUTTON SIMULTANEOUSLY

NOTE: ALWAYS WAIT UNTIL THE TIME OF DAY IS DISPLAYED BEFORE SETTING UP ANY FUNCTION.

4345

Fig. 9-30 Digital Display Set-Up

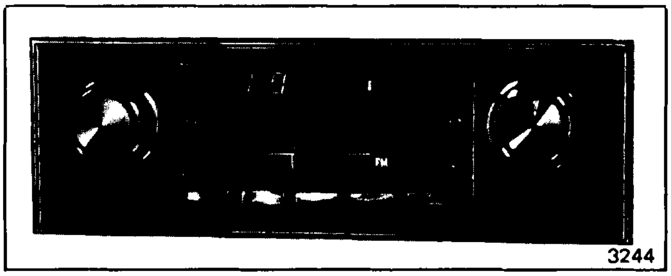

3244

Fig. 9-31 AM-FM Stereo with Integral CB

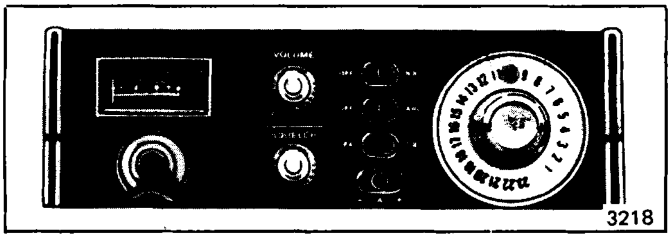

3218

Fig. 9-32 Bracket Mounted CB Radio

the radio for repair:

1. Turn ignition to the accessory position and turn radio on.

2. On AM/FM radios (with or without stereo), if the radio is dead on FM but the AM plays normally, the radio should be removed for repair. (The reverse of this condition does not necessarily call for radio removal.)

3. On combination radio/tape units, if the radio operates properly but the tape player does not, the unit should be removed for repair. (The reverse of this condition does not necessarily call for radio/tape removal.)

4. For more detailed diagnosis, see Figs. 9-34 through 9-37.

Always determine the exact nature of the radio problem as an aid to diagnosis. Knowing whether the condition is intermittent or constant, whether it occurs with engine off or running, and whether it occurs with car stationary or moving will help to pinpoint the problem.

CB UNITS

A number of common problems can prevent good transmission and reception on your CB. Always make certain that you have checked the "obvious" before going into further diagnosis procedures. Listed below are typical problem areas that should be checked:

1. Check for blown fuses (one in fuse block and one in-line) and power cord connection.

2. Check that antenna is securely mounted to chassis and that connecter is snug.

CAUTION: *Never operate transmit section of CB radio without an antenna connected. Also check that SWR is below 2 to 1 (see Fig. 9-33).*

3. Check that squelch level is low enough to receive signal properly.

4. Check that volume control is turned up.

5. Check that CB-PA switch (if used) is in CB position.

WINDSHIELD RADIO ANTENNA

All radios except those with optional power antenna are equipped with a windshield radio antenna. The windshield is installed and the antenna lead-in is provided under the instrument panel. For installation details, see body manual.

Following are a few of the advantages of this design:

1. The antenna cannot be broken off by accident, automatic car washes or by malicious destruction.

2. Any antenna windnoise problem is eliminated.

3. Vastly improves overall appearance of car.

4. Noticeably improves FM reception. The top segment of each antenna conductive element is mounted horizontally and measures 31 inches, resulting in good FM reception.

CHECKING STANDING WAVE RATIO

NOTE: The SWR checking procedure requires that the transmitter be operated, and FCC regulations governing C.B. radio operation apply. It would appear that three options are available:

- Have this test performed by a technician who holds a C.B. radio operator's license.
- Acquire a dealership C.B. Radio Operator's license to allow technicians to use such license during business hours.
- Ask the vehicle owner or operator possessing a Permanent C.B. Radio license to properly operate the transmitter during the test.

Your attention is also called to the fact that C.B. radio adjustments or repairs within the transmitter unit itself may only be performed by people holding an FCC Engineer's License, Class 1 or Class 2. Adjustments or repairs referred to in this SWR procedure are limited to the antenna itself or the antenna lead-in and connections.

NOTE: When adjusting SWR, the car must be at least 20 feet away from any building.

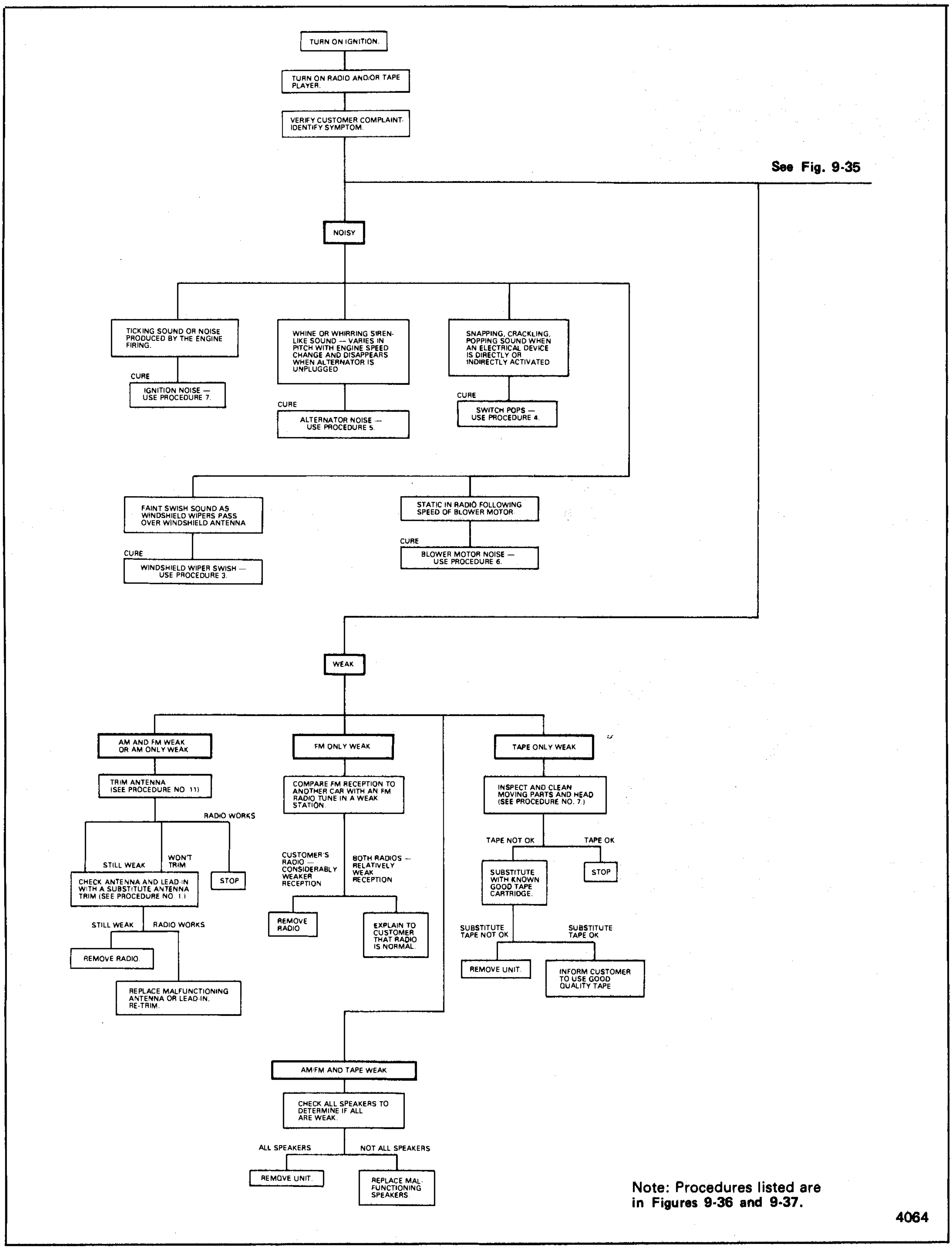
1. Make certain that the ignition and the C.B. radio are turned off.
2. Disconnect the C.B. antenna from the C.B. radio.
3. Connect one end of the antenna jumper from the SWR meter to the C.B. radio antenna socket.
4. Connect the other end of the antenna jumper from the SWR meter to the "Transmitter" socket on the SWR meter.
5. Connect the C.B. antenna to the "Antenna" socket on the SWR meter.
6. Turn ignition and C.B. radio on and turn to channel 12 for 23 channel sets. Channel 20 for 40 channel sets.
7. Follow the SWR meter manufacturer's instructions on proper method of measuring SWR.
8. Now, key the microphone and read the SWR. If the SWR is 2.0 to 1 or lower, the antenna is properly adjusted. If the SWR is higher than 2.0, adjust the length of the antenna. A reading of 1.5 to 1 or lower is desirable.
9. Turn the radio and ignition off, remove the SWR meter and reconnect the antenna to the radio.

CAUTION: Keying the microphone with the antenna disconnected may damage the radio.

SWR meters are available from local electronics supply outlets from $15.00 and up.

4479

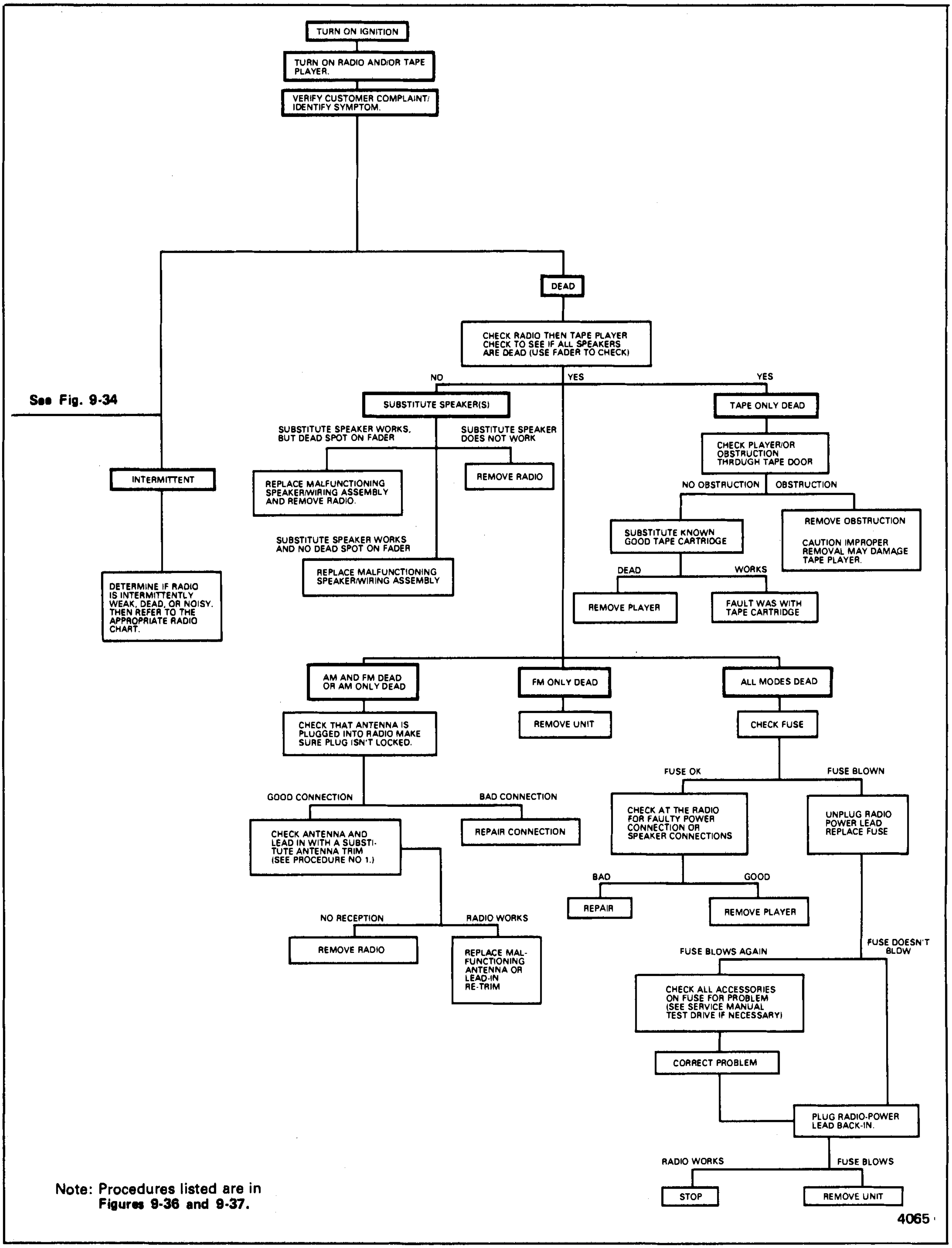
Fig. 9-33 Adjusting Standing Wave Ratio



Note: Procedures listed are in Figures 9-36 and 9-37.

4064

Fig. 9-34 Radio Diagnosis



Note: Procedures listed are in **Figures 9-36 and 9-37.**

Fig. 9-35 Radio Diagnosis

PROCEDURE NO. ① ANTENNA TRIMMER ADJUSTMENT

THE ANTENNA TRIMMER ADJUSTMENT MATCHES THE ANTENNA COIL IN THE RADIO TO THE CAR ANTENNA. ONLY AM RADIOS, OR THE AM PART OF AM/FM RADIOS, NEED THIS ADJUSTMENT.

1. TUNE THE RADIO TO A WEAK AM STATION NEAR 1400 KHz. TURN THE VOLUME ALL THE WAY UP. YOU SHOULD BARELY HEAR THE STATION. (FENDER MOUNTED ANTENNAS SHOULD BE EXTENDED TO 31 INCHES.)
2. REMOVE THE RIGHT INNER AND OUTER KNOBS.
3. SOME RADIOS HAVE A FADER CONTROL FOR A REAR SPEAKER. REMOVE THE FADER BY PULLING OUT. PUT A SHORT PIECE OF JUMPER WIRE FROM THE CENTER HOLE TO THE BOTTOM HOLE NEXT TO THE TUNING SHAFT (FIGURE a). THE JUMPER WIRE CONNECTS THE FRONT SPEAKER TO THE RADIO.

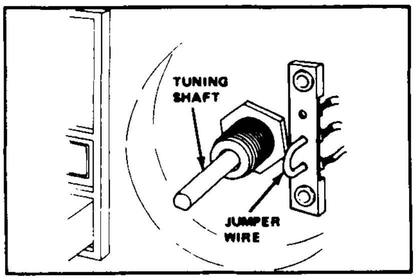


Figure a. Connecting the radio to the front speaker.

4. USE A SMALL SCREWDRIVER TO ADJUST THE TRIMMER SCREW (FIGURE b). ADJUST THE SCREW FOR THE LOUDEST VOLUME.

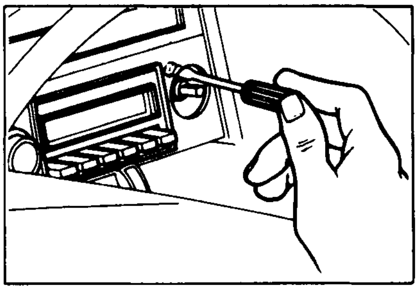


Figure b. Adjusting trimmer screw.

5. REMOVE THE JUMPER, IF USED, AND REINSTALL THE CONTROL KNOBS.

PROCEDURE NO. ② CLEANING PARTS OF TAPE PLAYER

THERE ARE TWO PARTS THAT YOU CLEAN ON A TAPE PLAYER: THE HEAD AND THE CAPSTAN. SINCE YOU CAN REACH THEM THROUGH THE TAPE DOOR, YOU CAN LEAVE THE TAPE PLAYER IN THE CAR.

TO CLEAN THE HEAD AND CAPSTAN, USE A COTTON SWAB DIPPED IN ORDINARY RUBBING ALCOHOL. WIPE THE HEAD AND CAPSTAN AS SHOWN IN FIGURE c.

MOST STORES THAT SELL TAPE CARTRIDGES CARRY SPECIAL TAPE HEAD CLEANING TAPES. BE SURE TO FOLLOW THE INSTRUCTIONS ON THE CLEANING TAPE CARTRIDGE TO AVOID DAMAGING THE TAPE PLAYER.

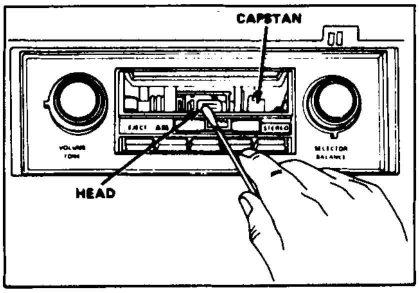


Figure c. Clean tape player head and capstan with a cotton swab.

PROCEDURE NO. ③ WINDSHIELD WIPER SWISH

1. TURN ON WINDSHIELD WIPERS.
2. IF SWISH NOISE IS PRESENT, ADD A MIXTURE OF TWO PARTS GM WINDSHIELD SOLUTION (OR EQUIVALENT), TWO PARTS WATER, AND ONE PART LIQUID DETERGENT TO THE WINDSHIELD WASHER RESERVOIR. PRESS WASH BUTTON.
3. IF SOLUTION DOES NOT SOLVE SWISH, REPLACE ARM WITH ANTI-STATIC TYPE.

PROCEDURE NO. ④ SWITCH POPS

1. ACTIVATE THE FOLLOWING ELECTRICAL DEVICES TO ISOLATE THOSE CAUSING THE NOISE.
   a. BRAKE LIGHTS
   b. TURN SIGNALS
   c. CIGARETTE LIGHTER
   d. HEADLIGHTS
   e. HORN RELAY
   f. IGNITION KEY
   g. SEAT BELT BUZZER
   h. EMERGENCY FLASHER
   i. ELECTRIC WINDOWS
   j. OTHER
2. CONNECT A .5MFD CAPACITOR FROM THE HOT SIDE OF THE SWITCH TO GROUND.
3. IF THE NOISE IS RADIATED FROM THE INSTRUMENT PANEL, SHIELD THE ANTENNA FROM THE SWITCH BY USING A METAL SCREEN UNDER THE DASH (SEE PROCEDURE NO. 7).

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Fig. 9-36 Radio Noise Suppression

PROCEDURE NO. 5 ALTERNATOR WHINE

1. CONNECT A .5MFD TEST CAPACITOR TO BATTERY TERMINAL OF ALTERNATOR (FIGURE d).

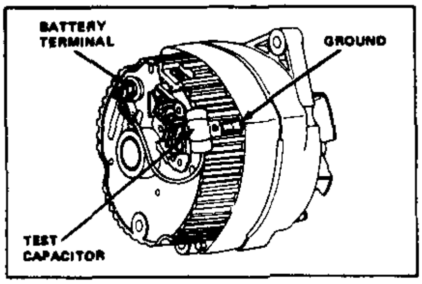

Figure D. Test capacitor connected to battery terminal of alternator.

2. REMOVE ANTENNA LEAD-IN FROM RADIO.
3. FOR COMBINATION RADIO/TAPE PLAYERS, INSERT A TAPE UPSIDE DOWN TO TURN THE SET ON WITHOUT SOUND.
4. LISTEN FOR A WHINE WHICH INCREASES AND DECREASES WITH ENGINE RPM.
5. IF WHINE PERSISTS, ADD A .5MFD CAPACITOR TO BATTERY TERMINAL (SEE FIGURE e).

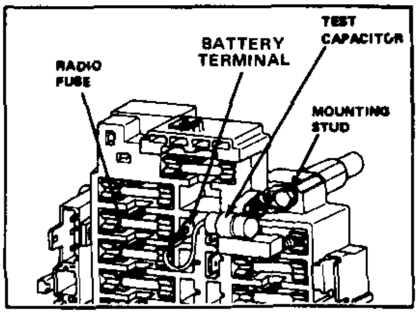

Figure E. Typical test capacitor connection to fuse block battery terminal for radio fuse.

6. IF WHINE PERSISTS, FOLLOW PROCEDURE NUMBER 6.

PROCEDURE NO. 6 CONNECTING FILTER PACKAGE TO RADIO POWER LINE

1. DISCONNECT RADIO FEED WIRES FROM BACK OF RADIO.
2. CONNECT FILTER PACKAGE (P/N 1223480) TO A RADIO (FIGURE f). CONNECT THE GROUND LEAD TO A RADIO CASE SCREW.
3. CONNECT RADIO FEED WIRES TO OTHER END OF FILTER PACKAGE.

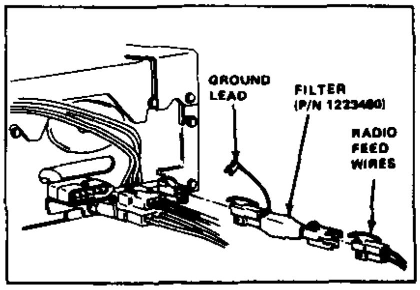

Figure F. Connecting filter package to radio.

PROCEDURE NO. 7 SCREENING THE DASH

1. CUT OUT A 36 INCH BY 12 INCH PIECE OF SCREEN. ATTACH A CLIP LEAD TO EACH END OF THE SCREEN.
2. MAKE SURE THE ANTENNA IS PLUGGED IN. START THE ENGINE, AND TURN ON THE RADIO.
3. LAY THE PIECE OF SCREEN ON TOP OF THE DASH (FIGURE g). ATTACH THE CLIP LEADS FROM THE SCREEN TO THE CAR CHASSIS (BARE METAL) TO ACHIEVE A GOOD GROUND.
4. IF THE NOISE REDUCES OR DISAPPEARS, THE CAUSE IS UNDER THE DASH. THE SCREEN ACTS AS A SHIELD TO REMOVE NOISE.

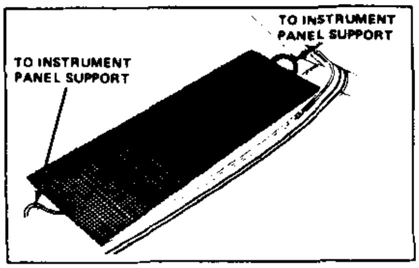

Figure G. Screen in position on dash.

PROCEDURE NO. 8 BLOWER MOTOR

1. INSTALL COAX CAPACITOR AS SHOWN IN FIGURE h.

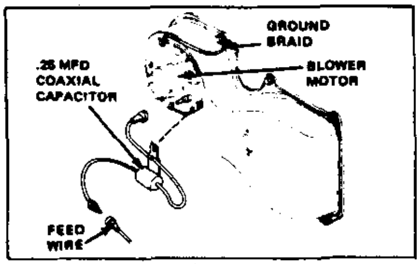

Figure H. Coaxial capacitor connections.

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Fig. 9-37 Radio Noise Suppression

5. AM reception is restricted to a shorter range, thus, eliminating unwanted distant station interference in the evening hours - AM signals are transmitted and received vertically and the verticle portion of the conductive element serves as the AM reception antenna. It is comparable to an external antenna extended to a height of approximately 18".

6. The antenna does not deteriorate with age.

TESTING: The antenna can easily be checked using tester J 23520 and following procedure in Fig. 9-38.

ON-CAR SERVICE

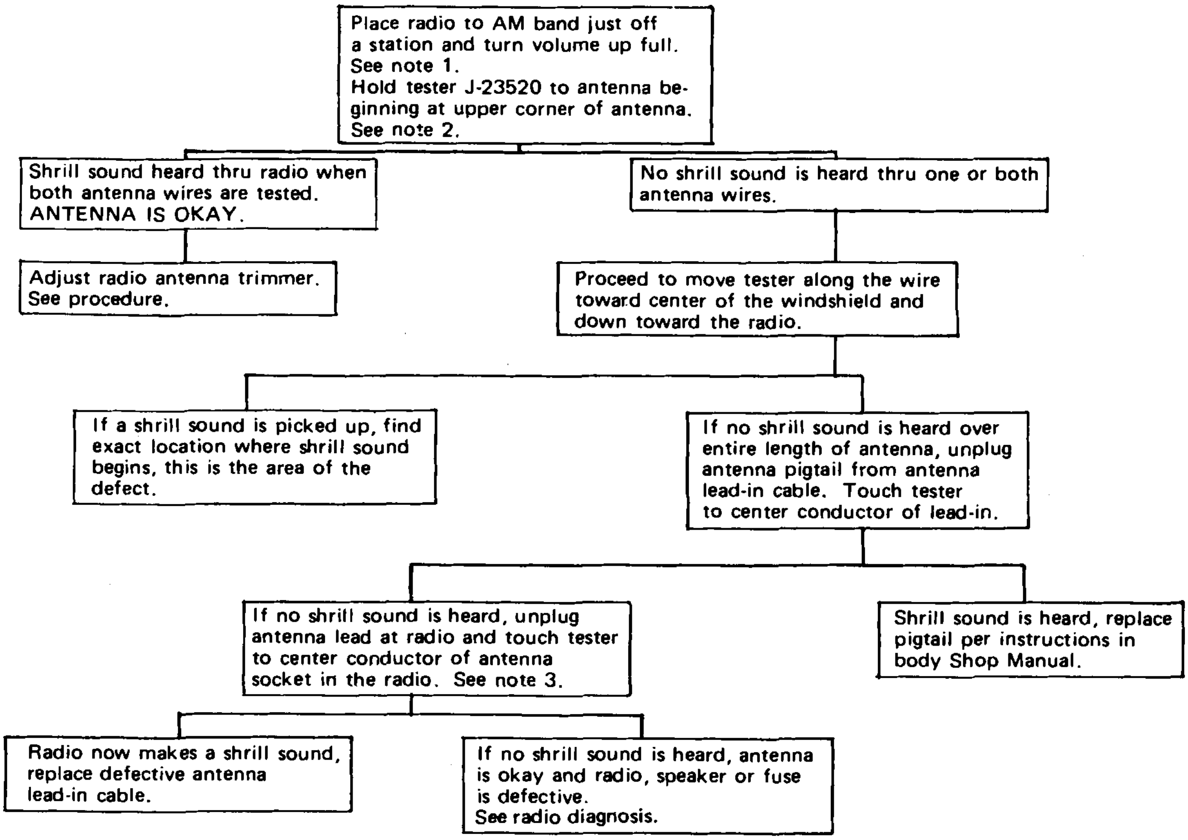
MINOR ADJUSTMENTS

Antenna Trimmer Adjustment

NOTE: If antenna is not trimmed, the set will have weak and fading AM reception. Antenna trimming should always be performed after any radio or antenna repair work, or antenna replacement is completed.

1. Turn radio switch on, and set band selector to AM.
2. Use manual antenna switch and extend mast to full up position when a car is equipped with power antenna.
3. Tune in a weak station at approximately 1400 Kilohertz on the AM band and turn volume control to maximum.
4. Adjust antenna trimmer, located behind right control knob ring, for maximum volume. Access to antenna trimmer is gained by removing right control knob, spring and control ring. Use a standard 1.8" long screwdriver to adjust the screw.

NOTE: If during adjustment, the station becomes strong so that a change in volume cannot be heard with further screw rotating, tune to a weaker station and continue the adjustment.



Place radio to AM band just off a station and turn volume up full. See note 1. Hold tester J-23520 to antenna beginning at upper corner of antenna. See note 2.

Shrill sound heard thru radio when both antenna wires are tested. ANTENNA IS OKAY.

Adjust radio antenna trimmer. See procedure.

No shrill sound is heard thru one or both antenna wires.

Proceed to move tester along the wire toward center of the windshield and down toward the radio.

If a shrill sound is picked up, find exact location where shrill sound begins, this is the area of the defect.

If no shrill sound is heard over entire length of antenna, unplug antenna pigtail from antenna lead-in cable. Touch tester to center conductor of lead-in.

If no shrill sound is heard, unplug antenna lead at radio and touch tester to center conductor of antenna socket in the radio. See note 3.

Shrill sound is heard, replace pigtail per instructions in body Shop Manual.

Radio now makes a shrill sound, replace defective antenna lead-in cable.

If no shrill sound is heard, antenna is okay and radio, speaker or fuse is defective. See radio diagnosis.

Note 1. AM & FM radio must be tuned to the AM band.

Note 2. The shield band must be on the tester at all times to direct the signals only to the area desired.

Note 3. It may be necessary to remove the cold air duct to provide access to antenna socket.

Note 4. Check tester on a known good car to make sure it is operating properly and that the battery is not weak or dead.

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Fig. 9-38 Windshield Antenna Diagnosis

The antenna trimmer adjustment should be made after a set has been removed from car and worked on by a radio repair man. Trimming the antenna is especially important with the all-transistor radio as this will directly affect sensitivity and selectivity. Complaints of station AM mixing on AM all-transistor radios can be eliminated by this adjustment.

Balance Adjustment

(AM/FM Stereo Models, B Series Only)

If the sound appears to be louder on one side of the car than the other, an adjustment to the audio balance may be made.

> **NOTE:** On some stereo programming, it is normal for one side to be louder than the other for a short time. This is done purposely for stereo effect. The only positive method to tell if the balance control needs adjustment is to tune in a non-stereo program and make a critical evaluation, in which the owner may assist.

If the adjustment is needed proceed as follows:

1. Turn radio on. Switch to AM band.
2. Remove left knob, spring and control ring to gain access to stereo balance screw.
3. With fader control turned clockwise, insert screwdriver into balance screw.
4. Rotate balance control adjustment clockwise or counterclockwise until the sound in the left and right speakers appear to have equal volume.
5. Install left control ring, spring and knob.

STEREO TAPE PLAYER

The only required maintenance on tape players is periodic cleaning of the tape player head. This service should be performed approximately every 100 hours of operation. The head cleaning is done by swabbing the head (unit still installed in car) with a cotton swab that has been dipped in rubbing alcohol.

No lubricants should be used since they will cause the player to operate improperly, especially at extreme temperature.

Do not bring any magnetized tools near the tape head. If the head becomes magnetized, every cartirdge played in the player will be degraded.

A test tape cartridge is available for diagnosing problems in tape players. The "Stereo 8" test tape cartridge is part J 22683. (Test tape cartridges should always be stored in a container to keep the tape clean.)

Remove and Replace - Except CB Radios

A Series (Fig. 9-39 and 9-40)

1. Disconnect battery.
2. Remove radio knobs and bezels.
3. Remove I.P. lower trimplate.
4. Remove I.P. upper trimplate.
5. Remove (2) radio front retaining screws.
6. Remove radio from I.P. opening, disconnecting electrical connections and antenna lead-in while radio is on the way out.
7. If radio is to be replaced with another unit, remove bushing from rear of radio and install on replacement radio.
8. To replace, reverse removal procedure.

AG and G Series (Figs. 9-39 and 9-40)

1. Disconnect battery.
2. Remove radio knobs and bezels and retaining hex nut from the righthand radio tuning shaft.
3. Remove (4) retaining screws and remove radio trimplate.
4. Remove (1) front radio retaining screw and (1) radio mounting bracket retaining screw (below radio).
5. Remove radio and bracket as an assembly; disconnect electrical connections and antenna lead-in while radio is on the way out.
6. Remove radio support bracket nut and remove bracket.
7. To replace, reverse removal procedure.

B Series (Fig. 9-41)

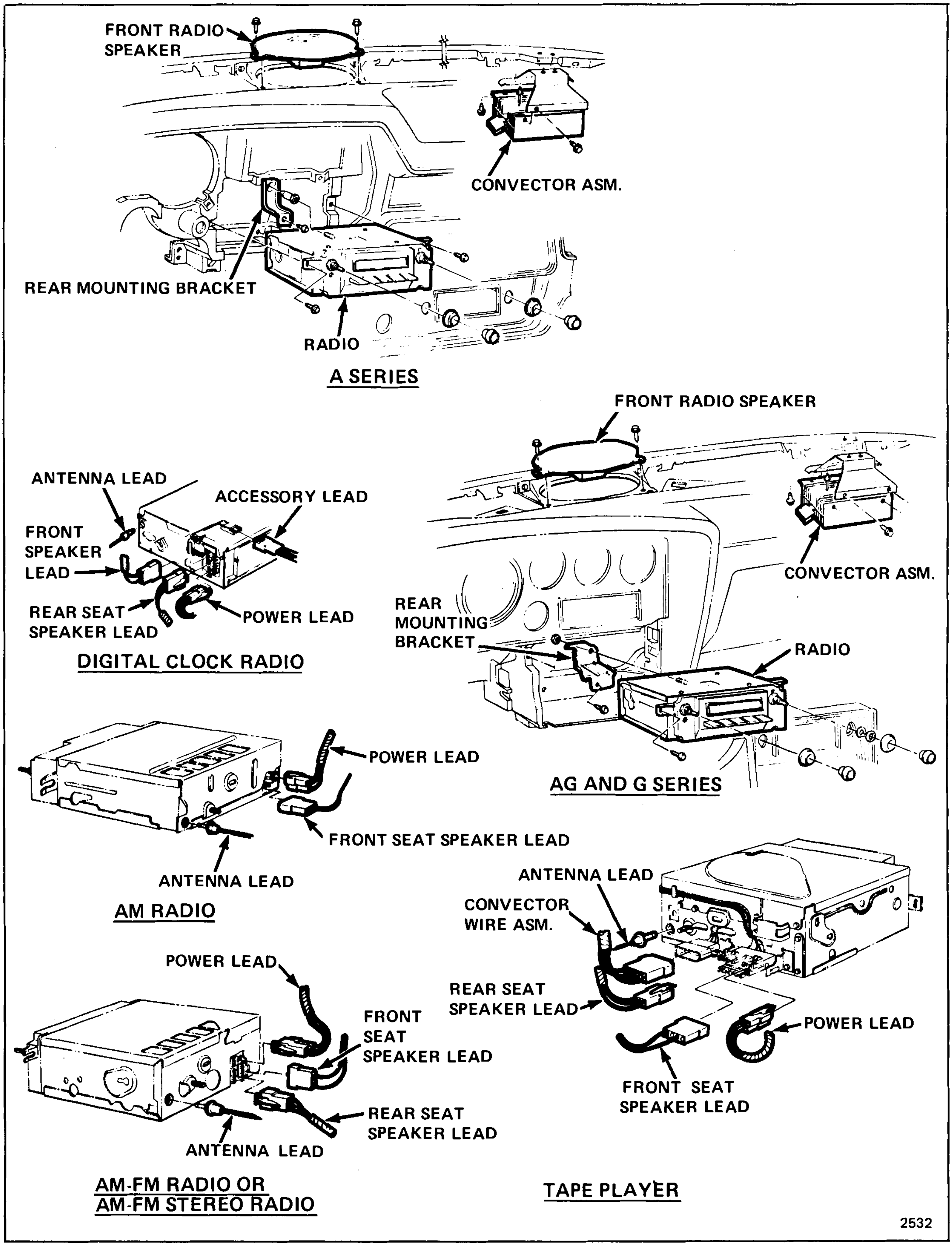
1. Disconnect battery.
2. Remove upper trimplate.
3. Remove radio trimplate by removing 2 top screws, removing ash tray assembly, disconnecting lighter, and removing (2) small screws and large screw retaining ash tray bracket.
4. Remove (2) screws securing radio.
5. Remove raido from I.P. opening, disconnecting electrical connections and antenna lead-in while radio is on the way out.
6. Remove bezel nuts to remove front radio trimplate if a new radio is being installed.
7. To replace, reverse above procedure.

F Series (Fig. 9-42 and 9-43)

1. Disconnect battery.
2. Remove glove box and right lower A/C duct (on A/C equipped cars only). For Stereo Radio, also remove center A/C duct.
3. Remove radio knobs, nuts and lower trimplate.
4. Disconnect antenna lead-in and radio connecters.
5. Remove radio bracket and radio from passenger side of I.P., thru glove box opening.
6. To replace, reverse removal procedure.

X, H and HM Series (Figs. 9-44 through 9-47)

1. Disconnect battery ground cable.
2. Remove "Hush" panel if present.
3. Remove radio control knobs and bezels.
4. Remove control shaft nuts and washers.
5. Disconnect antenna lead at rear of radio receiver.
6. Remove screws securing radio receiver to instrument panel reinforcement.
7. Lower radio receiver with mounts still attached from instrument panel and disconnect speaker and electrical connecters.



A SERIES

DIGITAL CLOCK RADIO

AG AND G SERIES

AM RADIO

AM-FM RADIO OR
AM-FM STEREO RADIO

TAPE PLAYER

Fig. 9-39 Radio Installation - A and G Series

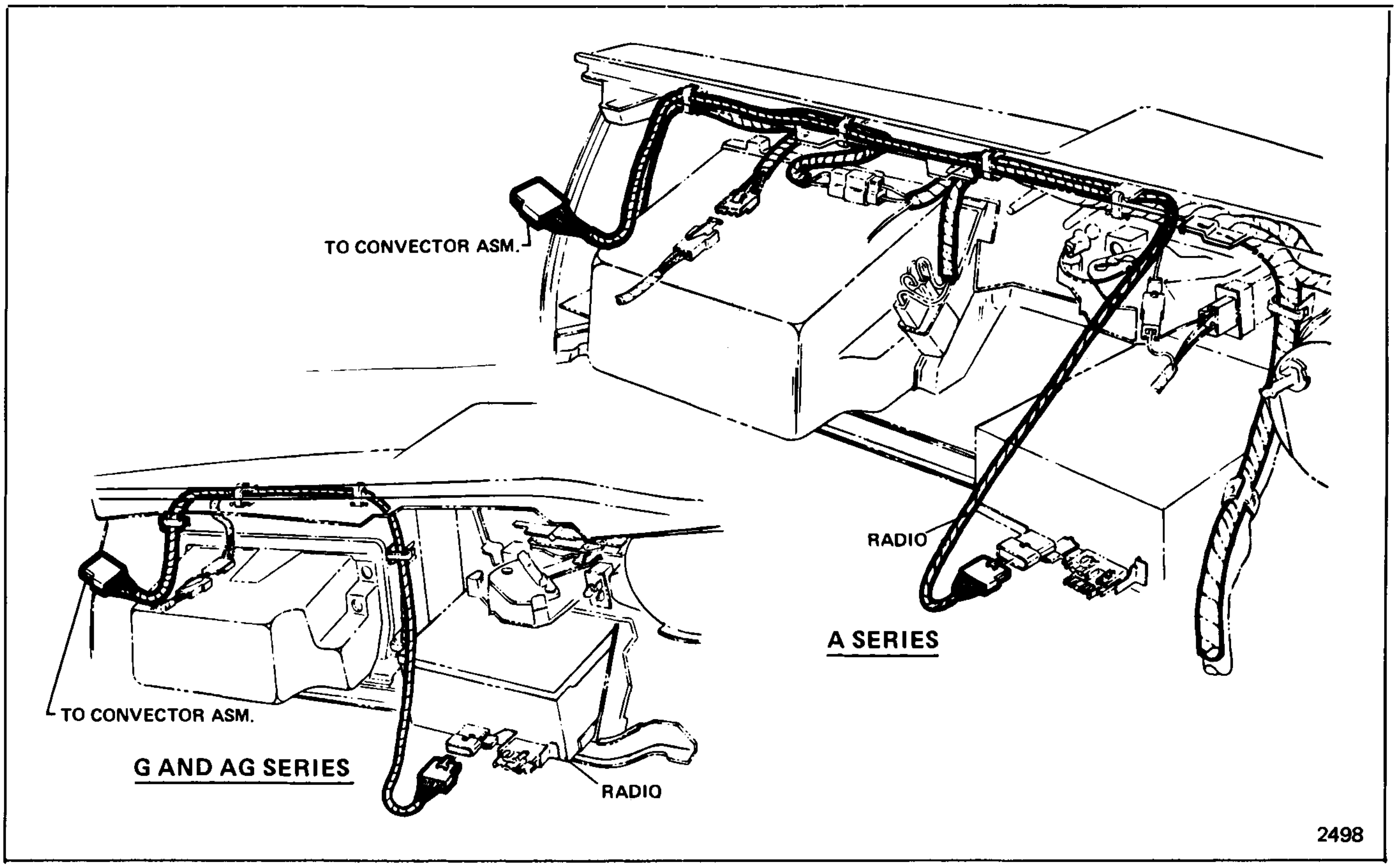


Fig. 9-40 Tape Player Convector Wiring - A and G Series

8. Remove mounting brackets, if present, and install mounts on replacement receiver. Make sure that J nuts are positioned in place on mounts.

9. Install replacement radio receiver in reverse order of removal.

STEREO LIGHT

All Series

1. Remove radio as outlined above.
2. Remove tape and/or cover from top of radio for access to dial light.
3. Remove light from socket.
4. To replace, reverse removal procedure.

RADIO DIAL LIGHT

The following radios may have radio dial lights replaced by pressing the dial plate down to gain access to the bulb; B, H, HM and X Series radios except integral tape player.

A and G Series with integral tape players allow access to the dial light bulb through the tape door.

Radio dial lights can be replaced by removing the radio as previously described on B, H, HM and X Series with integral tape player, on A and G Series without tape player, and on all F Series.

RADIO SUPPRESSION EQUIPMENT

When installing a new radio, or when noise is a problem, insure that radio suppression equipment is present. See Fig. 9-48 for typical equipment.

ANTENNA LEAD-IN

1. Disconnect lead-in at radio.
2. Connect a length of wire to lead-in connecter to aid in pulling new lead-in into place.
3. Remove lower windshield trim moldings at rear of hood.
4. Disconnect windshield rubber connecter from antenna lead-in connecter at cowl.
5. Remove the two attaching screws from the connecter for the antenna lead-in to cowl.
6. Pull lead-in out until wire attached in step 2 is accessible. Disconnect wire from lead-in.

To Replace

1. Wrap pull-in wire around new antenna lead-in and start feeding lead-in through cowl.
2. Apply silicone base sealer to cowl where lead-in attached to cowl.
3. Pull lead-in into place and install attaching screws.
4. Connect windshield rubber connecter to antenna lead-in.
5. Install lower windshield trim molding.
6. Remove pull-in wire from antenna lead-in connecter and plug lead-in into radio.

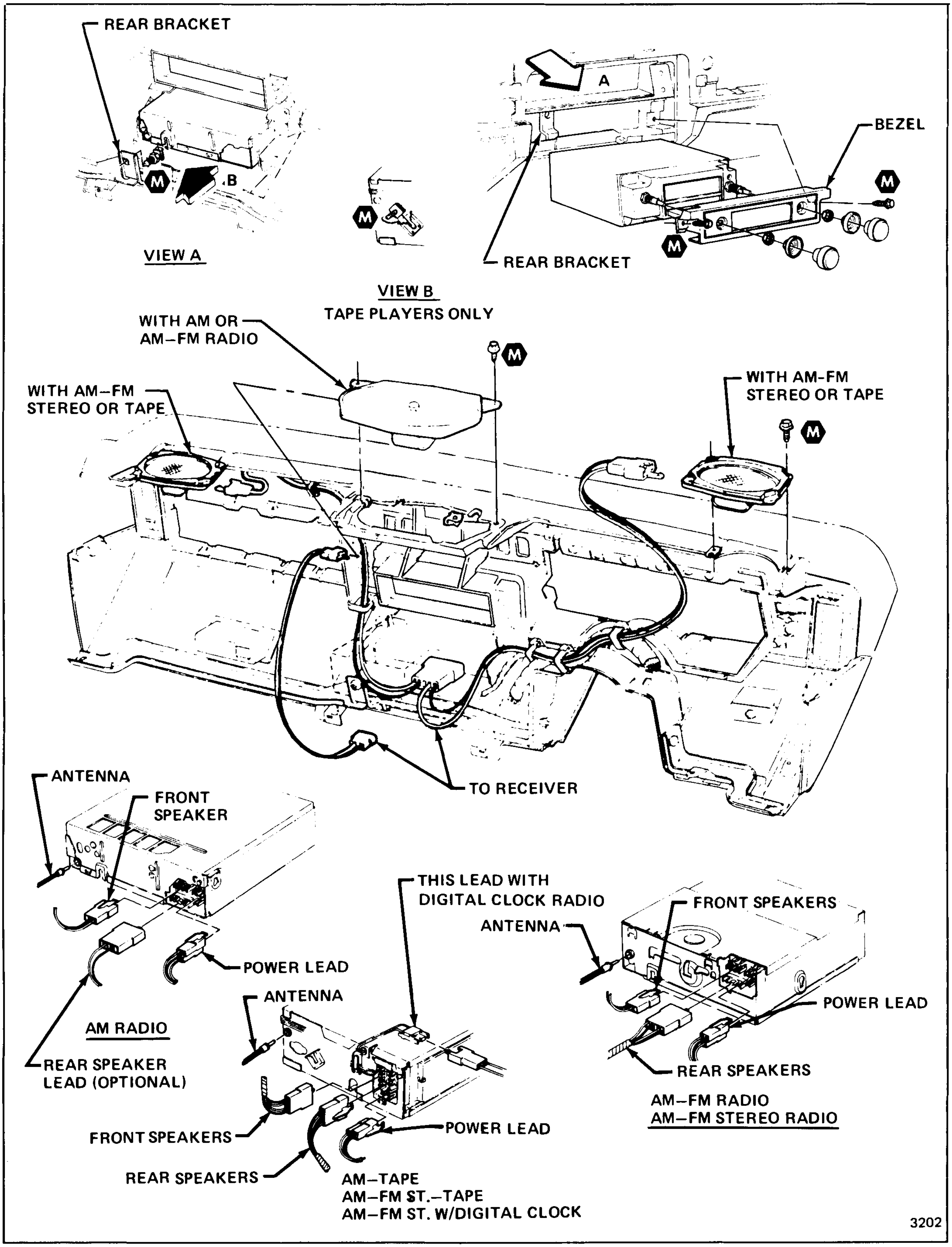


Fig. 9-41 Radio Installation - B Series

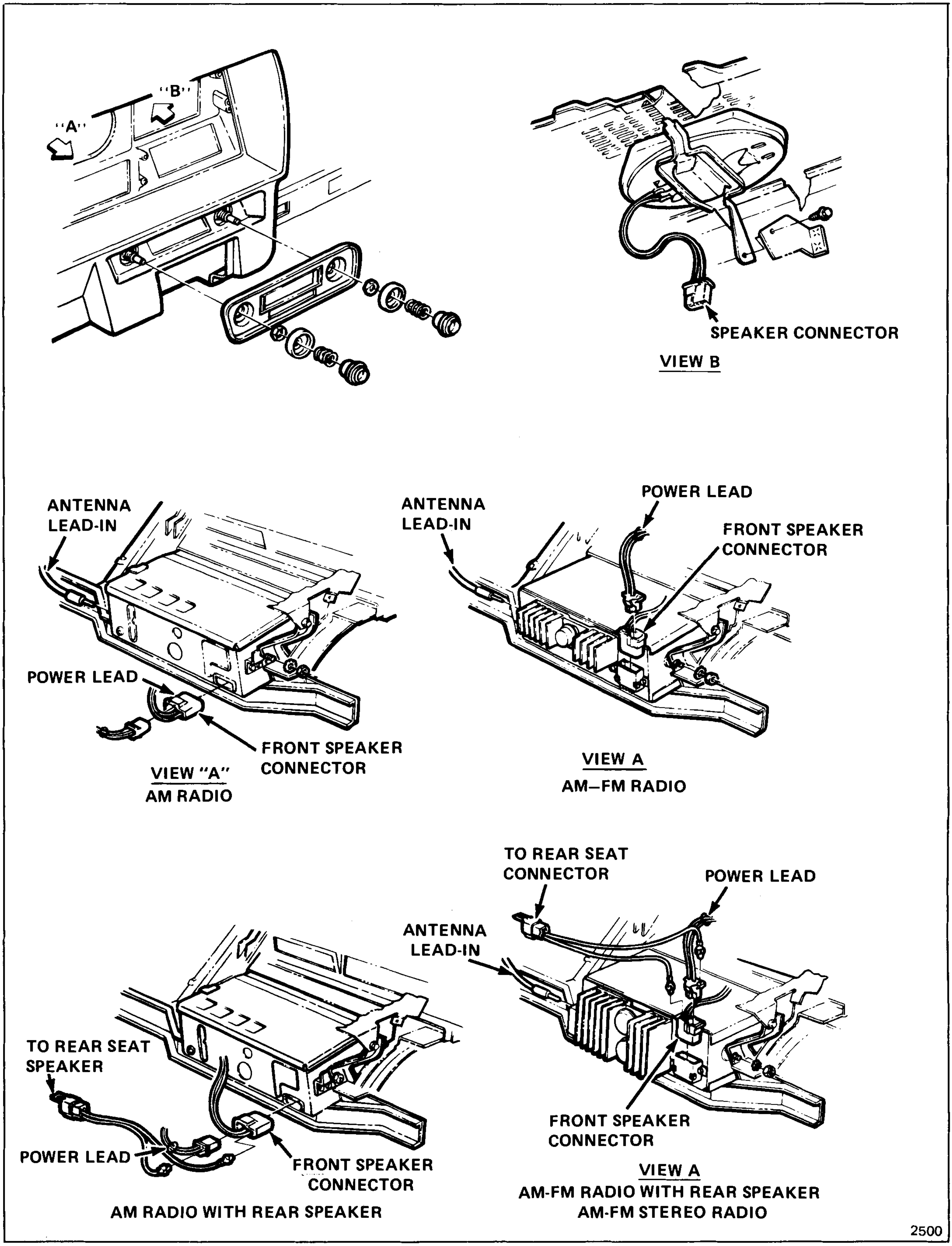


Fig. 9-42 Radio Installation - F Series

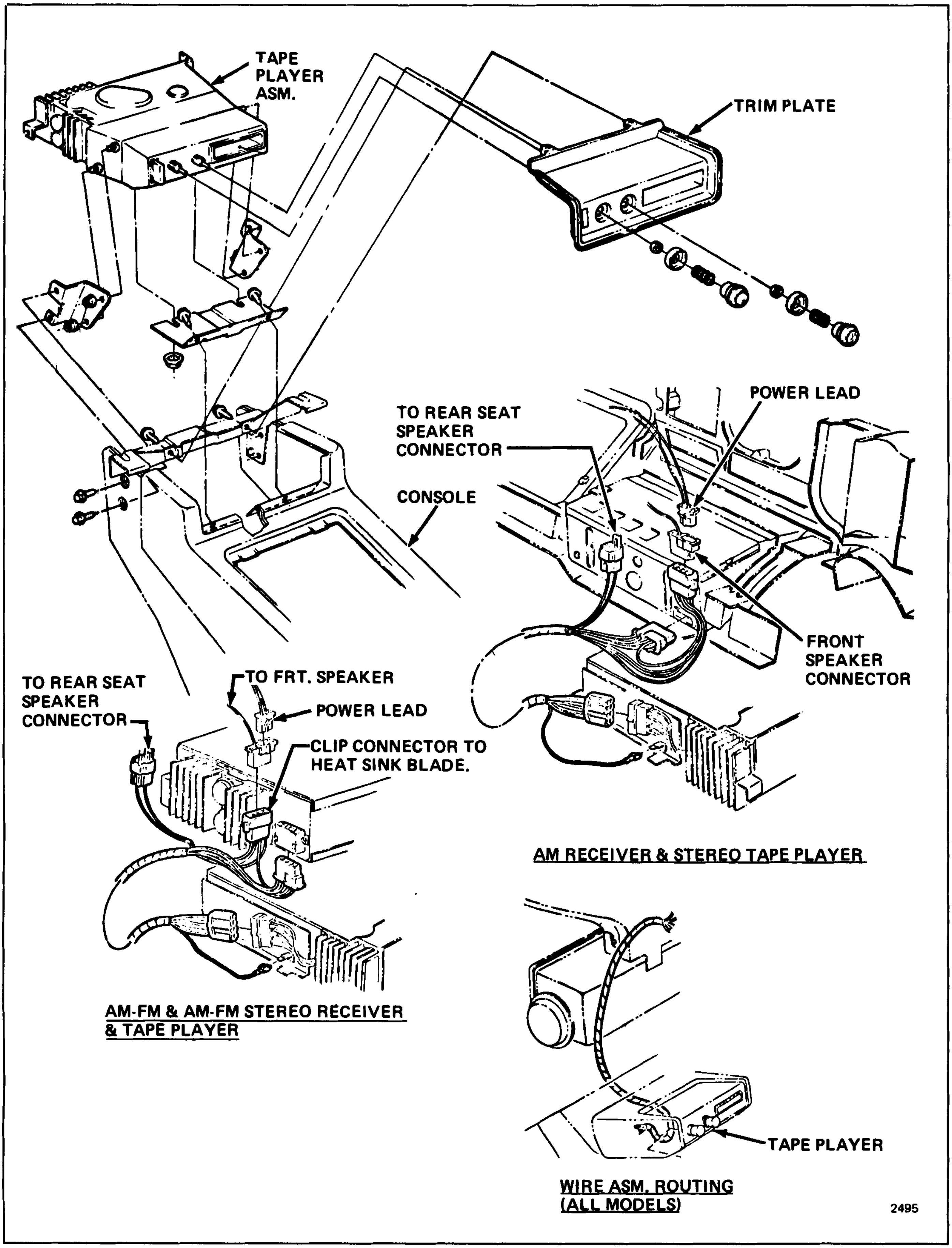


Fig. 9-43 Stereo Tape Installation - F Series

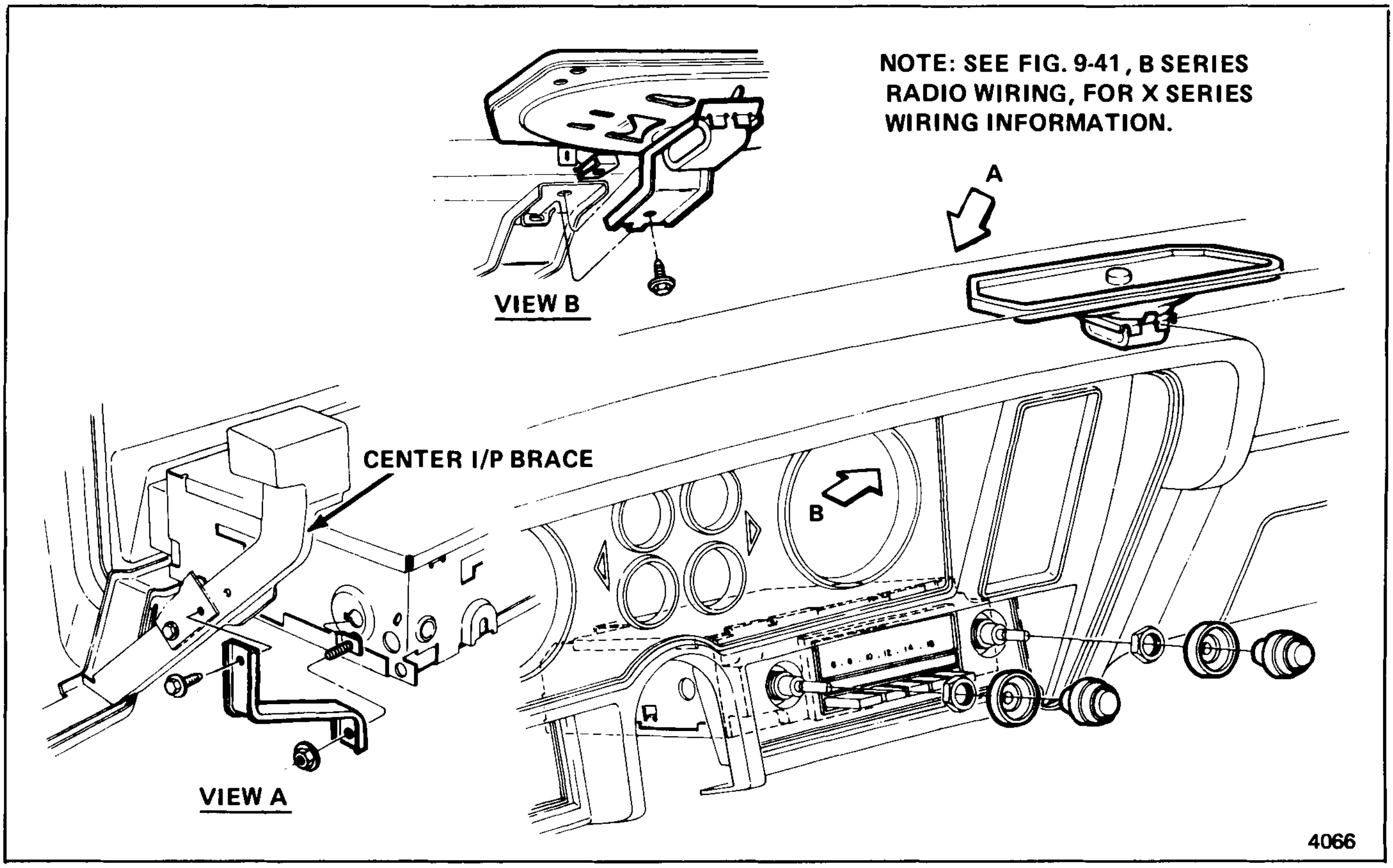


Fig. 9-44 Radio Installation - X Series

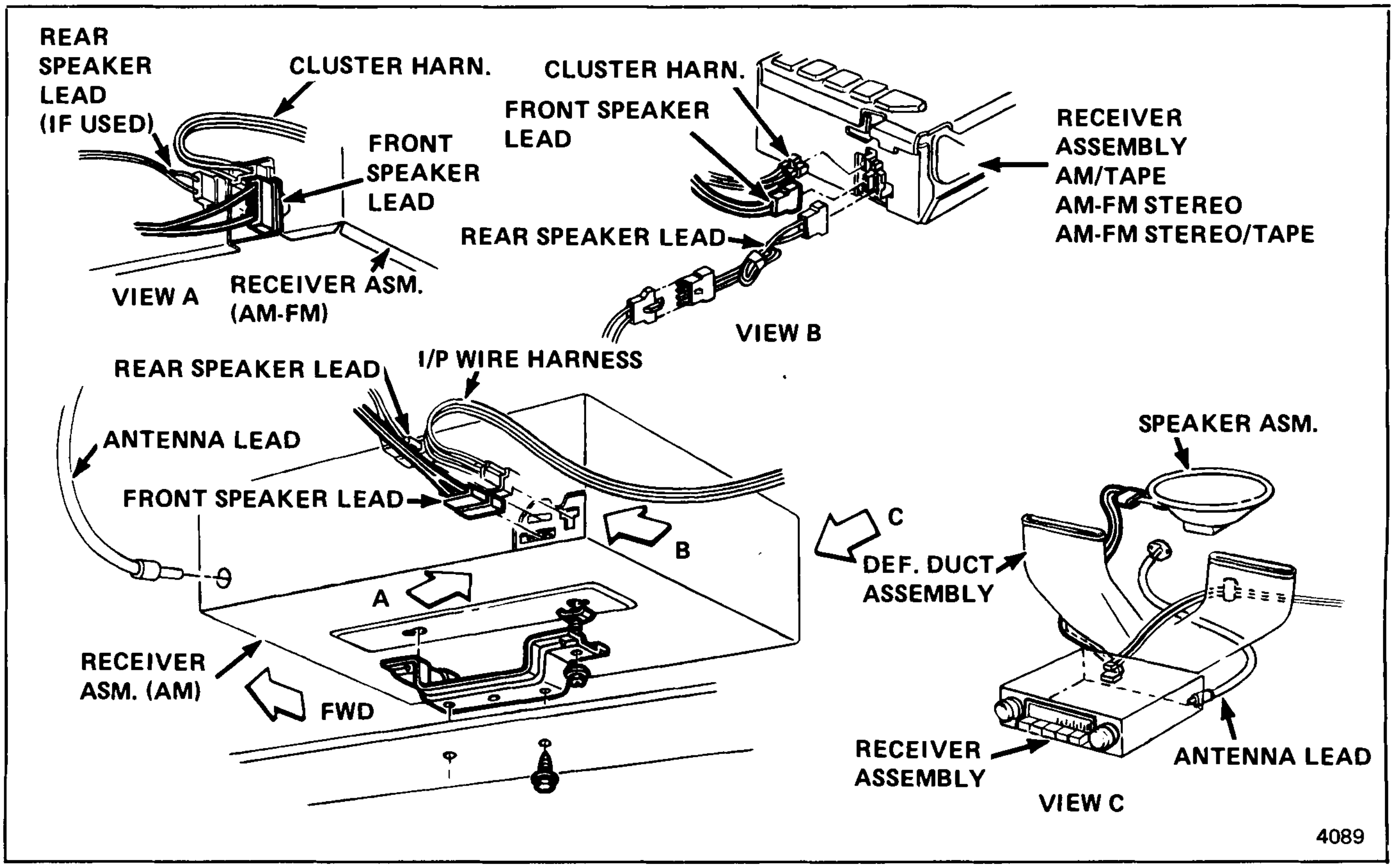


Fig. 9-45 Radio Installation - H Series

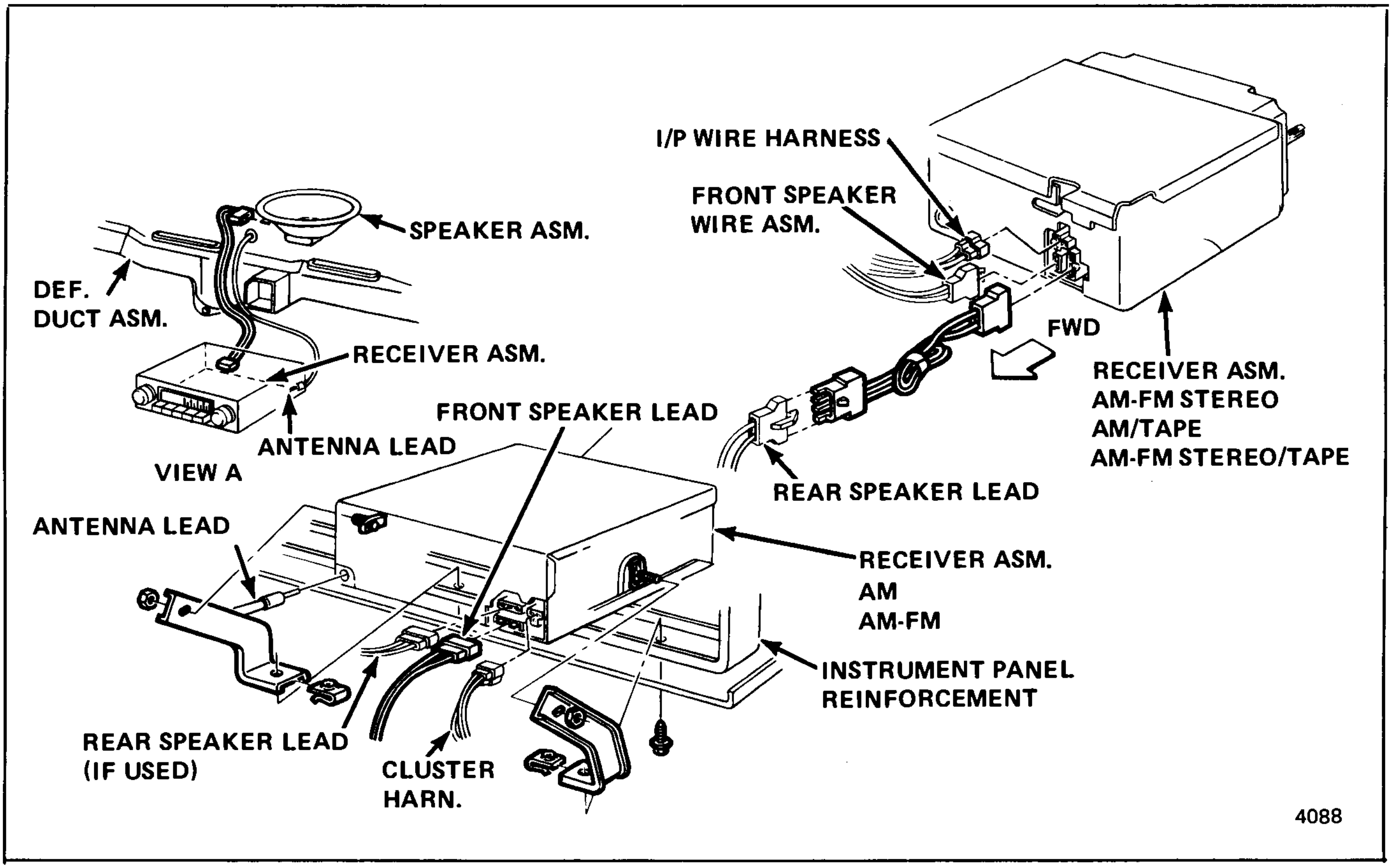


Fig. 9-46 Radio Installation - HM Series

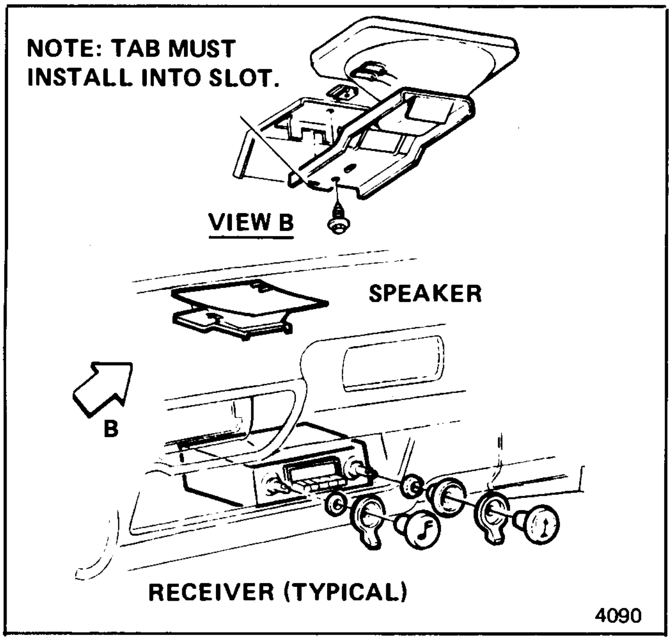


Fig. 9-47 Front Speaker Installation - H & HM Series

REMOVE AND REPLACE - CB RADIO

CB radio installation is shown in Figs. 9-50 through 9-53. Refer to General Description for information on CB Antenna installation.

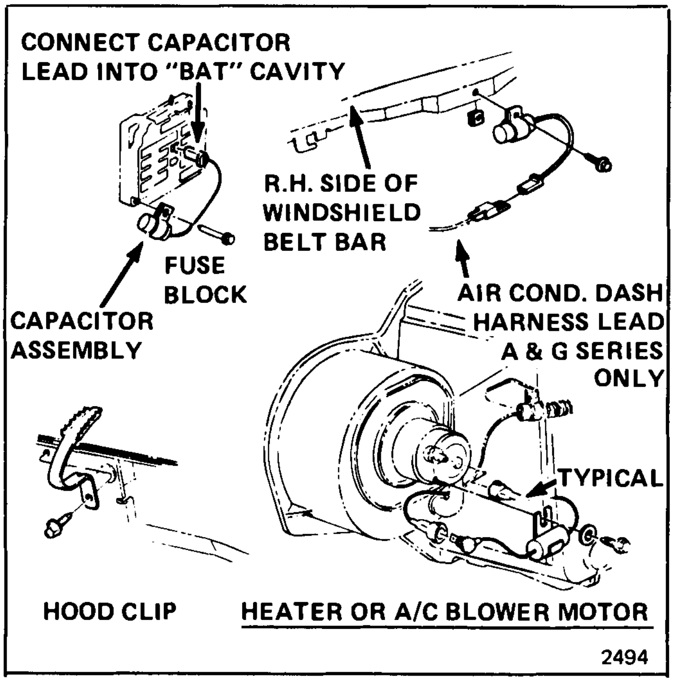


Fig. 9-48 Radio Suppression Equipment - Typical

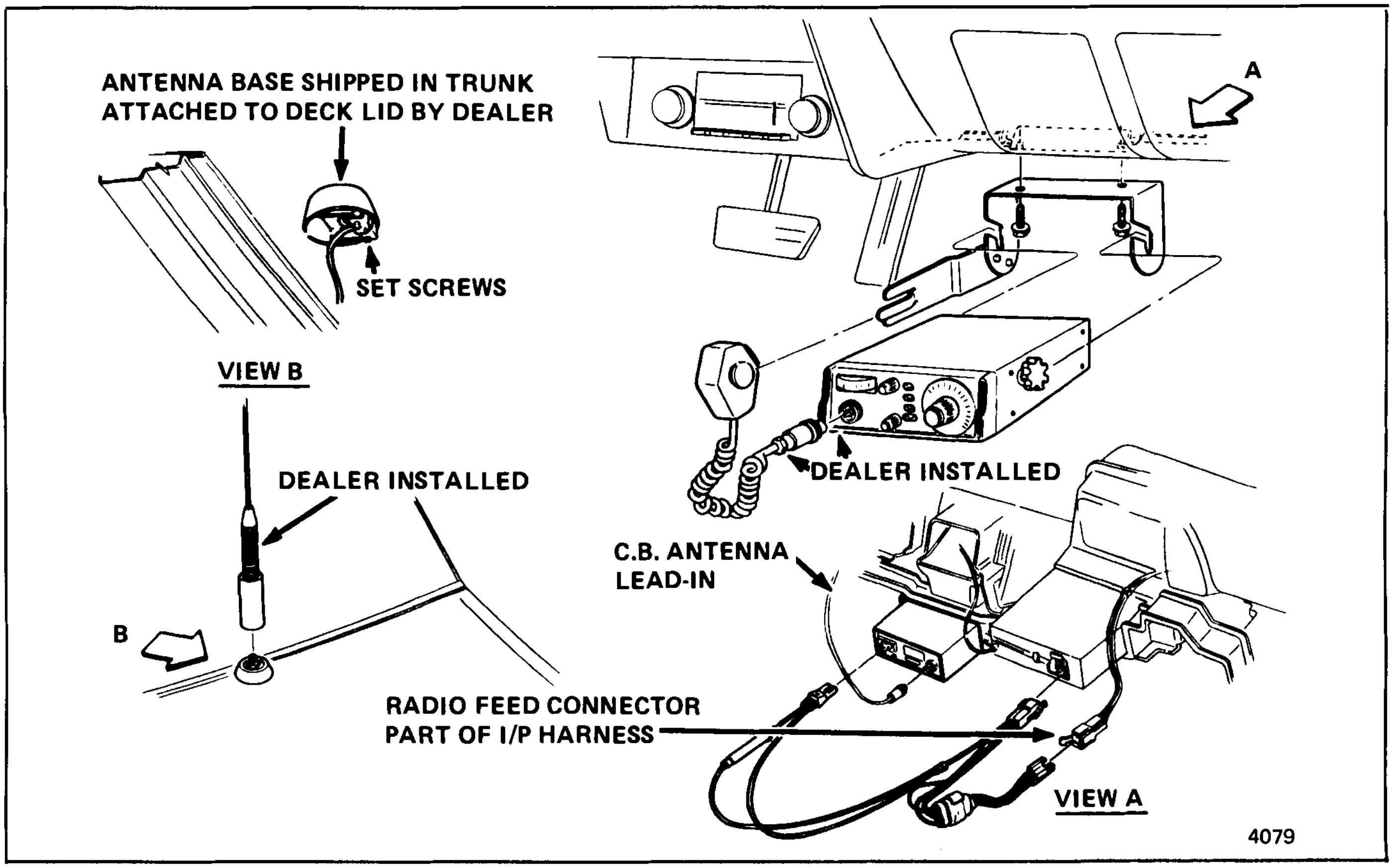


Fig. 9-52 Bracket Mounted CB Installation, X Series, and CB Antenna Mounting

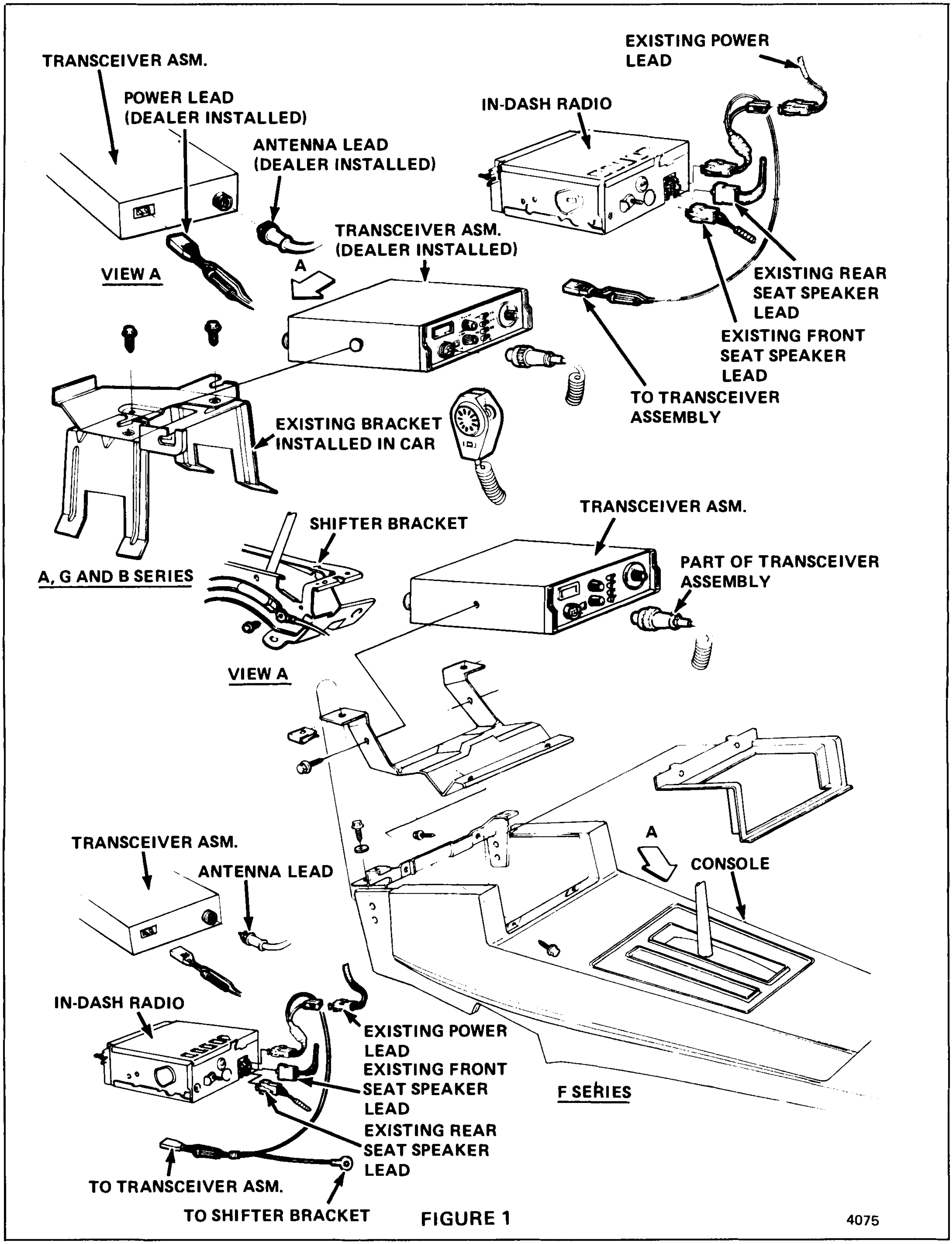


Fig. 9-50 Bracket Mounted CB Installation - A, B, F & G Series

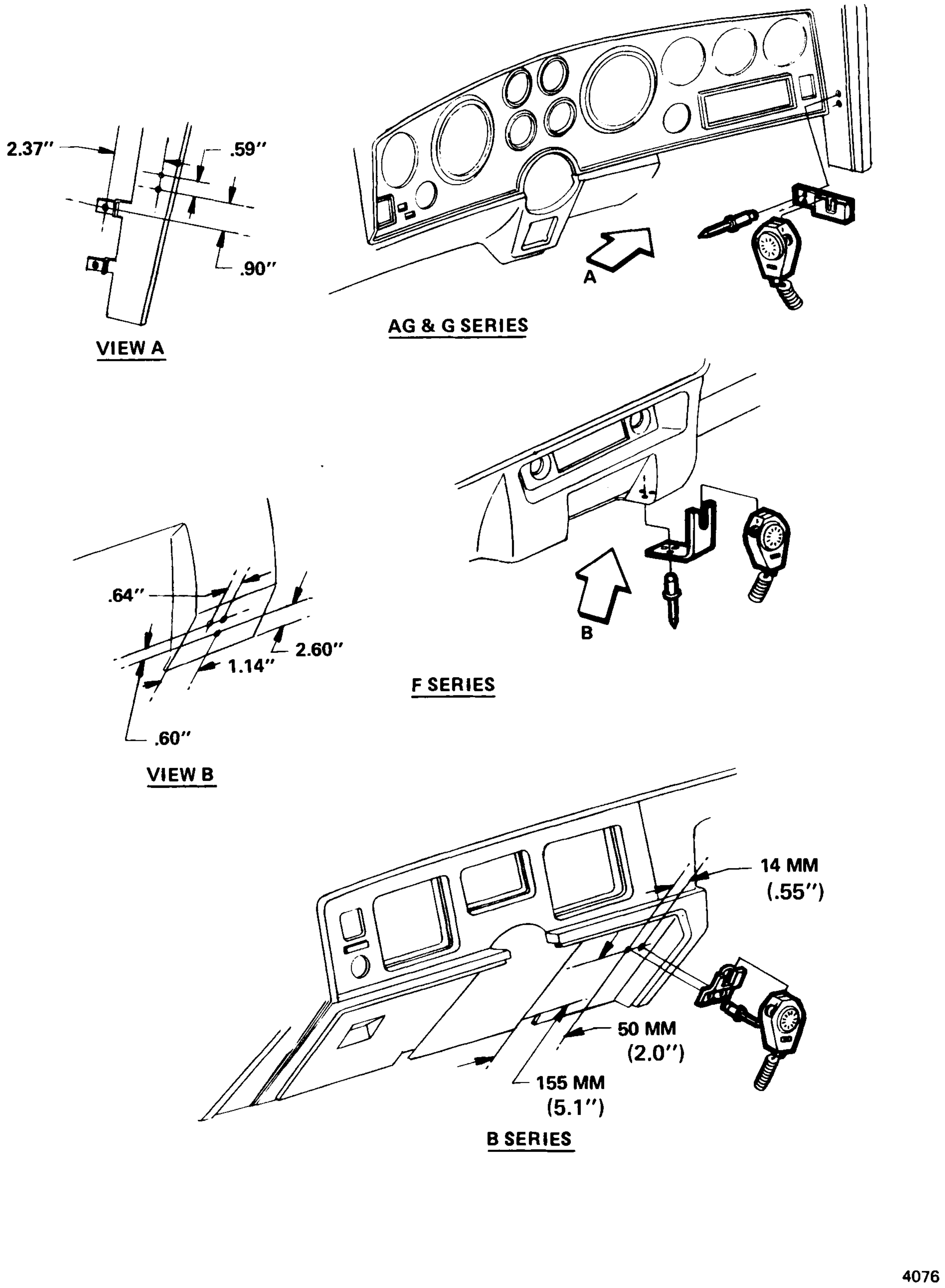


Fig. 9-51 Microphone Mounting - B, F, G & AG Series

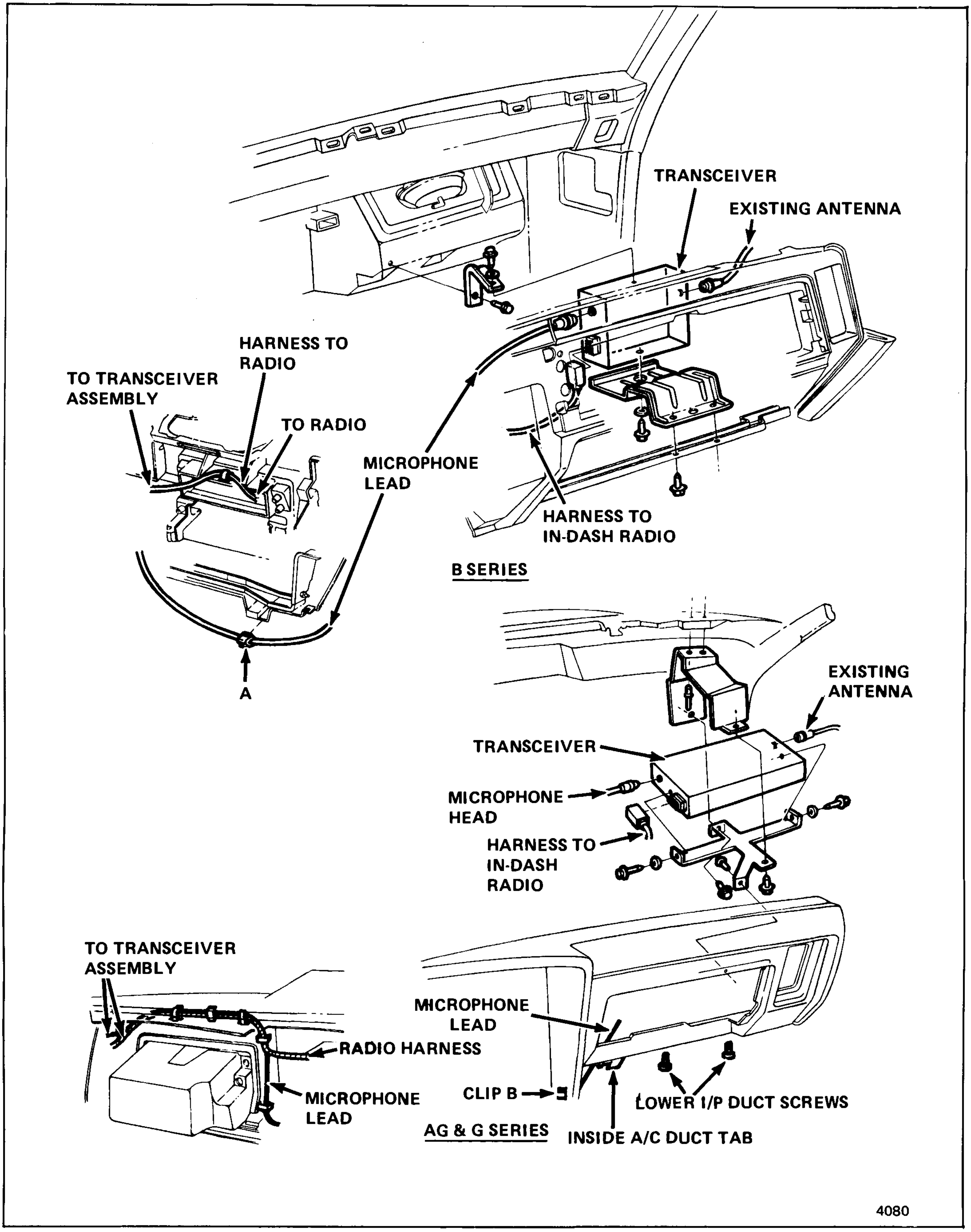


Fig. 9-53 Integral CB Installation, B, G & AG Series

POWER ANTENNA

GENERAL DESCRIPTION

A new telescoping rod type power antenna unit is available on all B Series. It consists of a 12V reversible permanent magnet motor, drive gear unit and a mast and support tube assembly (see Fig. 9-54). A plastic drive cable attached to the mast extends or retracts the mast when the motor operates the drive unit.

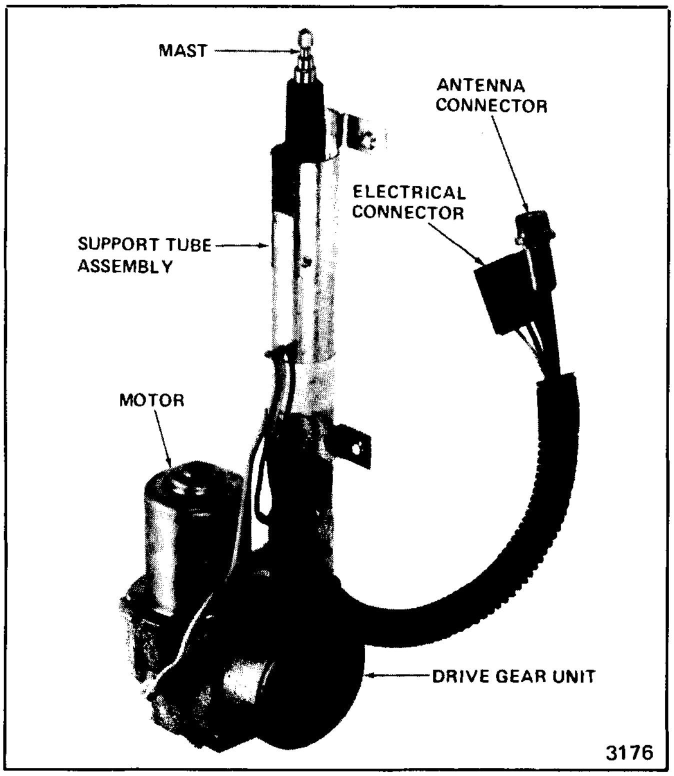


Fig. 9-54 Power Antenna Assembly

This system will operate only when the antenna dash switch is actuated. The mast can be stopped in any position during up or down travel by releasing the dash control switch. Refer to Fig. 9-55 for the electrical wiring circuit.

The drive gear unit used on this system consists of a drive gear and pulley assembly and a spool for storing the excess nylon drive cable when the mast is in the retracted position.

When the motor circuit is completed by the dash switch, the motor armature worm shaft rotates a gear and pulley. The pulley then extends or retracts the nylon cable depending on the direction of motor rotation.

The gear is coupled to the drive pulley by a torque limiting clutch that permits continued gear rotation when the mast reaches the limit of travel. To avoid damage to the antenna assembly, the switch should be released as soon as the antenna mast reaches the limit of travel.

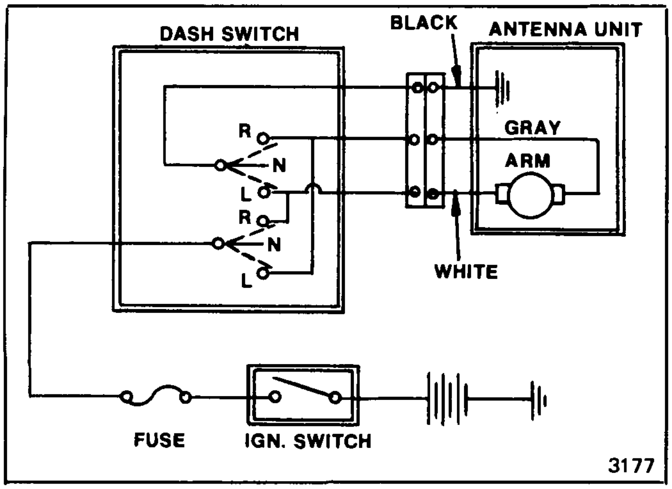


Fig. 9-55 Antenna Wiring Diagram

DIAGNOSIS

PROBLEM-ANTENNA INOPERATIVE (MOTOR DOESN'T RUN)

PROCEDURE	RESULTS
STEP 1 Check antenna fuse	FUSE BLOWN Go to Step 2 FUSE OK Go to Step 4
STEP 2 Replace fuse and recheck antenna operation.	ANTENNA RUNS OK End of test ANTENNA INOPERATIVE: Recheck antenna fuse: Blown - Go to Step 3 OK - Go to Step 4
STEP 3 Disconnect wiring at antenna unit; replace fuse and actuate antenna dash switch up and down, then recheck fuse.	FUSE BLOWS AGAIN: Locate and repair shorted or grounded condition in car wiring. FUSE OK: Reconnect wiring to antenna and recheck operation. If fuse blows again, replace antenna assembly.

STEP 4

1) Connect jumper wire from antenna black wire terminal to ground (see Fig. 9-56).

2) Turn ignition switch on and check antenna operation.
CAUTION: Carefully check connections to ant wires when preparing to extend or retract antenna during diagnosis or overhaul procedu Improper connections can damage antenna circ

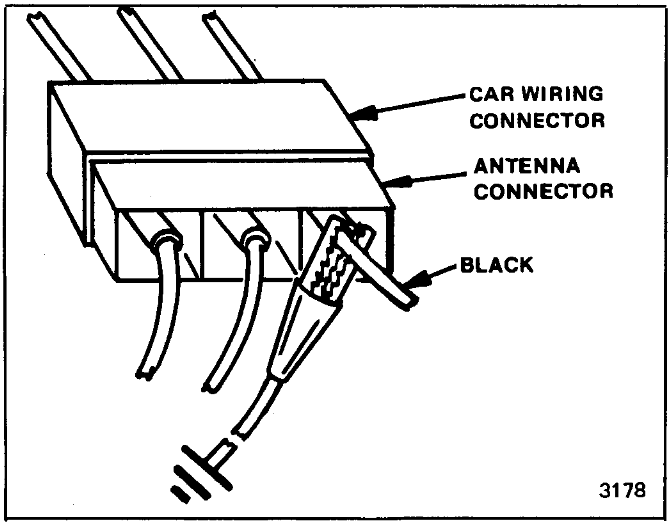


Fig. 9-56 Step 4

ANTENNA RUNS OK
Black wire ground connection at antenna support tube loose or wire is broken.
ANTENNA DOESN't RUN
Go to Step 5

STEP 5

Disconnect wiring from antenna unit and try operating antenna independently of car wirin and dash switch as follows (See Fig. 9-57):
Connections to Extend Antenna Mast:
B-source to gray wire terminal; white to ground
Connections to Retract Antenna Mast:
Reverse the above connections.

ANTENNA RUNS OK
Locate and repair open condition in car wiring. If no open condition exists, replace dash switch.
ANTENNA DOESN'T RUN
Replace antenna unit.

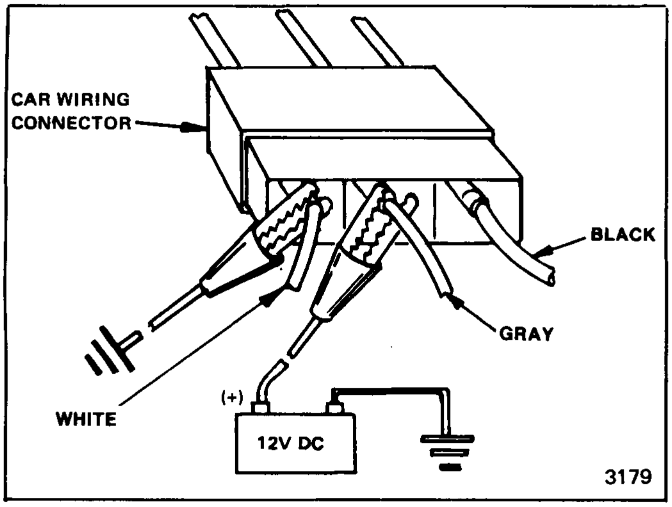


Fig. 9-57 Step 5

PROBLEM-ANTENNA DOESN'T MOVE UP AND DOWN FULL TRAVEL

OR

ANTENNA MOTOR RUNS BUT ANTENNA DOESN'T MOVE

PROCEDURE	RESULT
STEP 1	
1) Remove antenna unit from vehicle (see Fig. 9-58) 2) Disassemble mast and support tube assembly from motor-gear box assembly (refer to Overhaul Procedure).	ANTENNA DOES NOT EXTEND AND/OR RETRACT Replace mast and support tube assembly.
3) Check that drive cable is attached to the mast; next, manually extend and retract the mast sections and note whether they move freely.	ANTENNA SECTIONS EXTEND AND RETRACT EASILY. If drive cable does not appear to be worn or damaged replace complete antenna assembly.

NOTE: If antenna has been extended for a length of time and will not retract try cleaning the mast before ding further.

ON-CAR SERVICE

REMOVE AND REPLACE (FIG. 9-58 AND 9-59)

1. Remove outer bezel and top attaching screw, and disconnect wires and antenna lead-in.

2. Remove bolts at bottom of fender and fender skirt to allow fender to be moved outward.

3. Remove nut on inside of fender skirt which attaches to bottom of power antenna assembly. Allow antenna to drop down. Attaching a cord to the tip of the antenna will help with reassembly.

4. To reinstall the new antenna unit, attach the cord to the tip of the antenna mast, and draw into position. Install attaching nut and screw. Reattach fender.

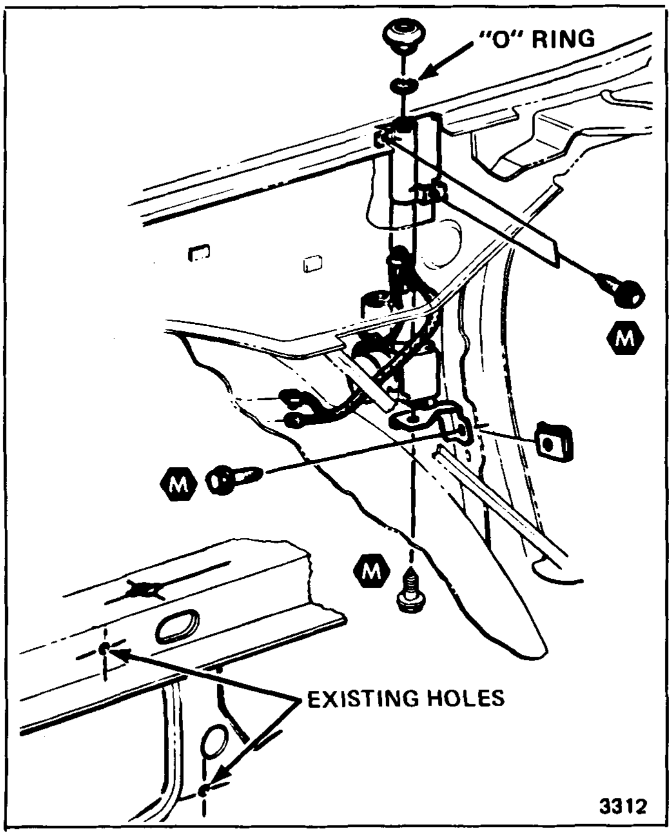


Fig. 9-58 Power Antenna Mounting

OVERHAUL PROCEDURE

MAST AND SUPPORT TUBE

Removal

1. Scribe a reference mark on both the mast support tube and casting to insure correct installation of replacement part.

2. Remove tape that attaches motor leads to support tube. Remove flexible shielding. Save shielding for reassembly.

3. Remove the two (2) screws that attach support tube to gear box and separate the tube from the gear box.

4. Clamp the gear box in a vise.

CAUTION: *Do not clamp gearbox too tight or possible damage to unit may result.*

5. Connect power source (12V) to antenna wires to extend mast and/or run the drive cable out of the gear box. Refer to Fig. 9-60.

NOTE: If mast fails to extend and/or drive cable does not move out of gear box, manually assist mast or cable while motor is running.

Assembly

1a. Refer to Fig. 9-61 and start cable in the gear housing with cable looped in the direction shown.

b. Push cable into housing until it bottoms, then apply pressure to force an additional 3/4 inch of cable into the gear box. This will engage the cable with the drive pulley.

2. Connect power source (12V) to antenna wires to run cable into the gear box. Refer to Fig. 9-60.

3. Using the scribe marks made in step 1 under Removal, assemble the support tube on the gear box in the same position as the original and install the two (2) retaining screws.

4. Re-attach leads to support tube with tape and reinstall flexible shield as required.

5. Re-install antenna unit in vehicle and recheck operation.

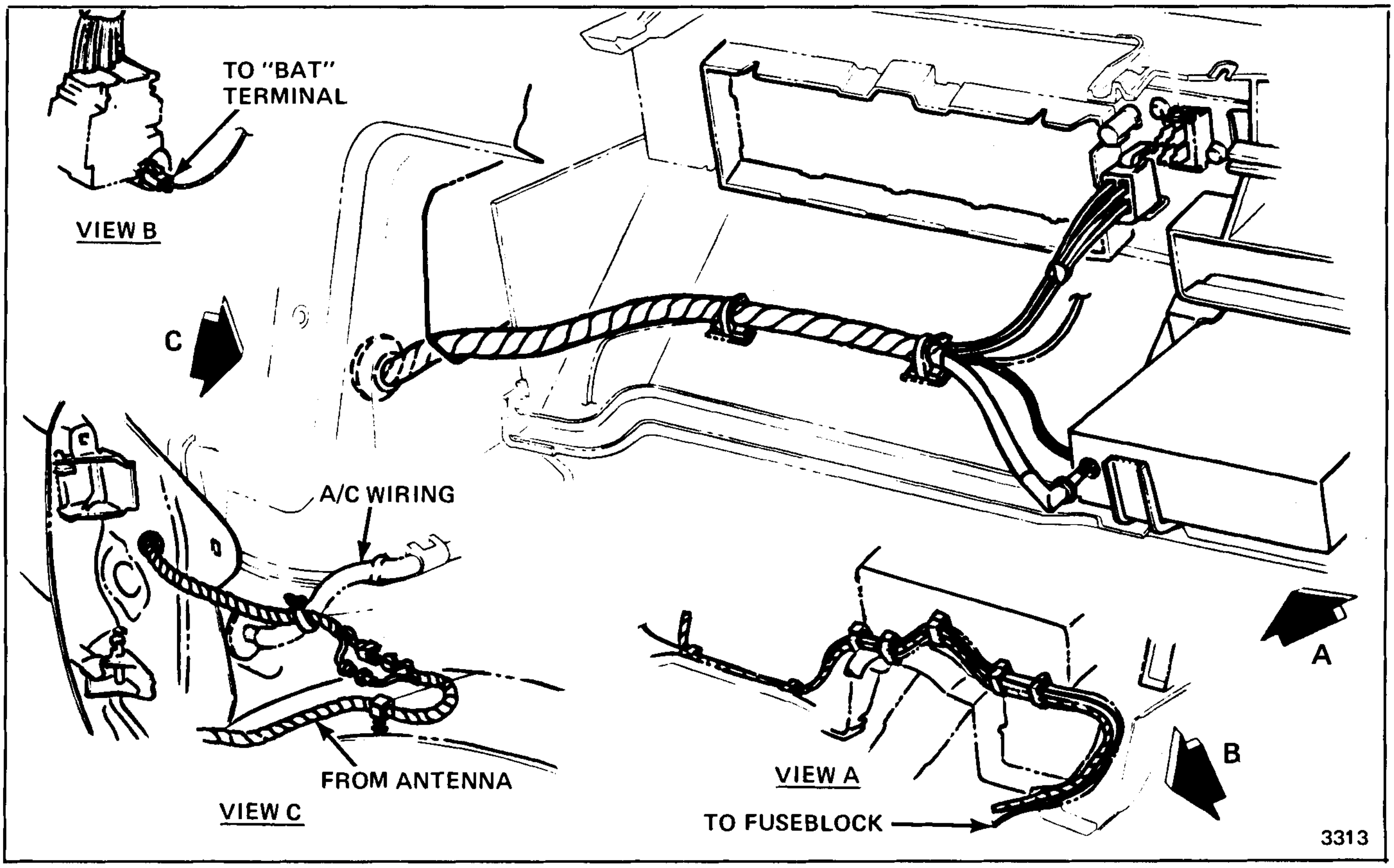


Fig. 9-59 Power Antenna Wiring

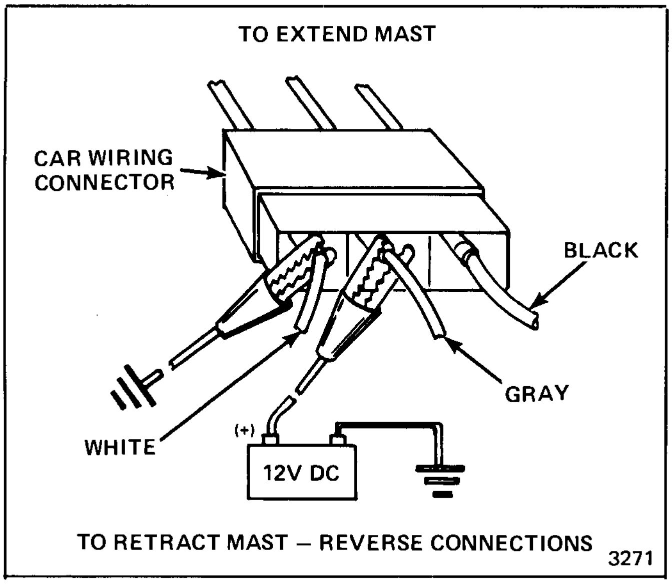


Fig. 9-60 Extending Mast

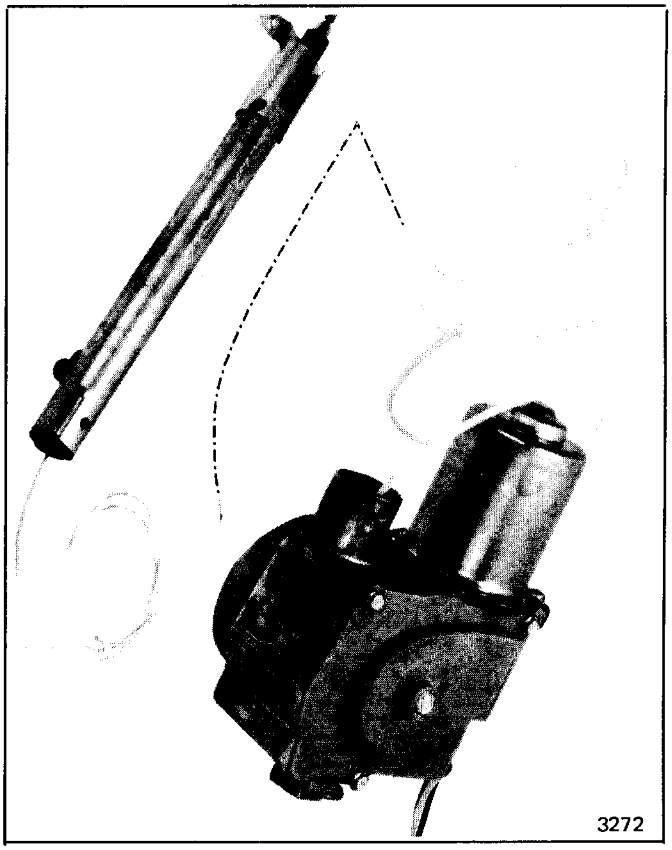


Fig. 9-61 Starting Mast Cable

RALLY GAUGE, TACHOMETER AND CLOCK

GENERAL DESCRIPTION

RALLY GAUGES (FIG. 9-62)

The rally gage option, available on all series, consists of an engine water temperature gage, an oil pressure gage (except H and HM), and a voltmeter (except A Series).

These gages are incorporated into the instrument cluster and replace the standard warning lamps. The water temperature and oil pressure gages are electrically operated from sending units mounted in the cylinder head and oil filter base respectively. The voltmeter registers regulated voltage which provides an indication of the charging systems ability to keep the battery charged. Continuous readings in either the high or low voltage red bands can indicate improper voltage regulation, broken or slipping alternator belt, shorted alternator diode or defective battery. Readings in the yellow band are normal with the engine idling or for short periods after long engine cranking. However, continuous readings in the yellow can indicate faulty operation.

FUEL ECONOMY INDICATOR (FIG. 9-63)

The fuel economy indicator is available on the A, B, F, G and X Series and mounts in the speedometer cluster in the clock location.

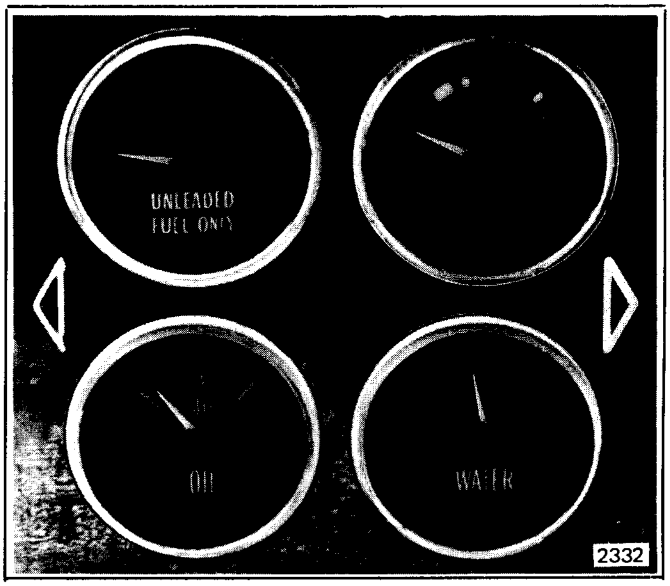


Fig. 9-62 Rally Gages

The fuel economy indicator operates from engine vacuum. When the accelerator pedal is depressed rapidly, the vacuum in the engine decreases and the needle on the fuel economy indicator registers low vacuum or "Power" on the face of the indicator. When the accelerator is operated slowly and smoothly the engine vacuum remains high and the needle indicates high vacuum or "Economy" on the face of the indicator.

When accelerating or decelerating, the needle will fluctuate rapidly and should not be diagnosed as a problem.

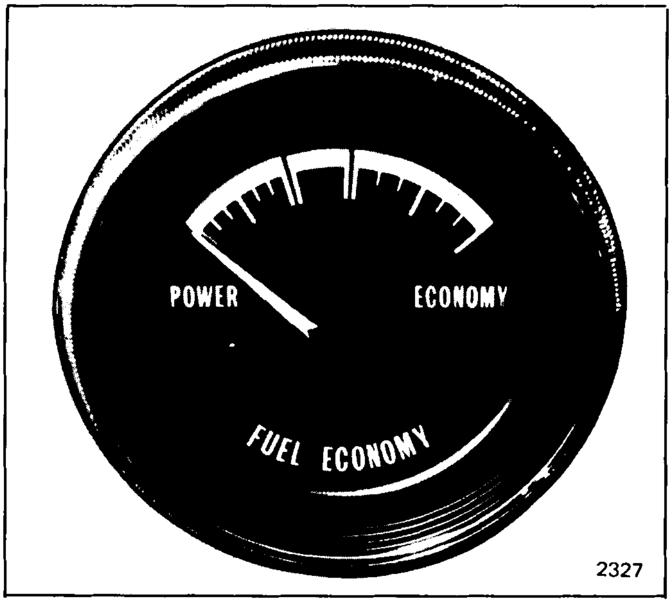


Fig. 9-63 Fuel Economy Indicator

TACHOMETER

The tachometer indicates speed of the engine in revolutions per minute. The engine can safely be operated up to a maximum RPM as indicated by the start of the red bar. Engine operation causing tachometer readings in the red area can lead to serious engine damage.

Due to its dual-coil design, the tachometer may not return to zero when the ignition is turned off. This is a normal condition and should not be diagnosed as a problem in the tachometer.

The tachometer is available as a dash mounted unit on all series except B.

CLOCK

The electric clock, available on all series, operates on direct current from the car battery and must not be compared too closely for accuracy to a home electric clock operating on alternating current. The cycles per second of alternating current used in the home are controlled and periodically corrected at the power house, thereby eliminating accumulation of errors.

With the direct current system, no such control is possible; therefore, automobile electric clocks will accumulate errors day by day the same as handwound, spring-operated clocks.

The electric clock provides automatic regulation of the rate when the position of the hands is changed manually. Moving the hands forward or backward adjusts the length of the hair spring to make the clock run faster or slower. The amount of change in rate depends upon the amount the hands are changed. Maximum rate change is approximately 20 seconds per day and is obtained when the hands are moved five minutes. If the clock is reset less than five minutes the change in rate is proportionally less than 20 seconds.

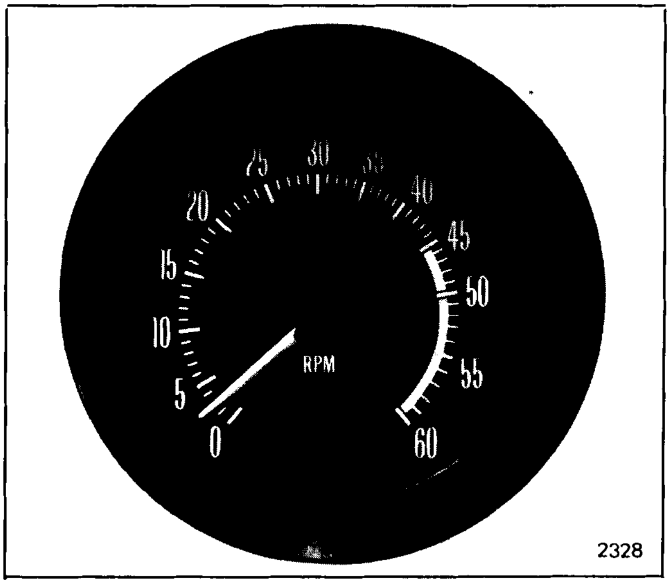


Fig. 9-64 Tachometer

When setting the clock to correct for errors in time, pull reset stem out, move hands counterclockwise to correct time if clock is running fast, or move hands clockwise to correct time if clock is running slow, then allow reset stem to return to its normal position. This will automatically adjust the rate of clock.

Owners should be advised to set the clock to the correct time once a week at regular intervals to insure maximum accuracy.

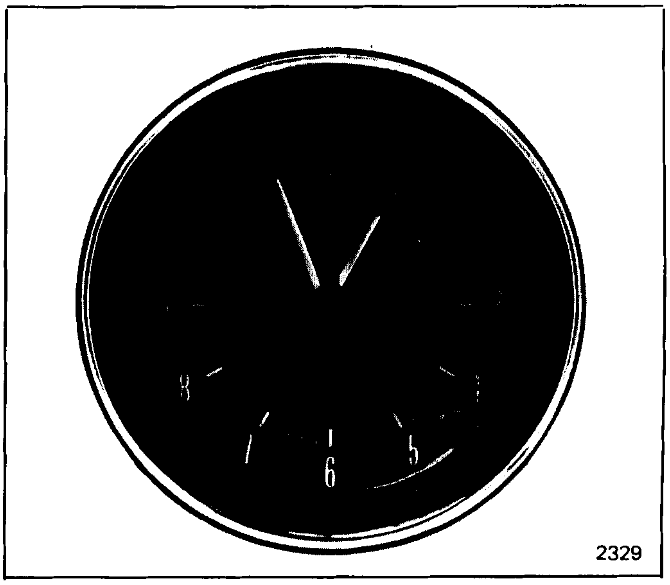


Fig. 9-65 Clock

Digital Clock

The digital clock is available on the B Series and is quartz crystal controlled. To reset the time, push in and rotate the thumb wheel to the desired time.

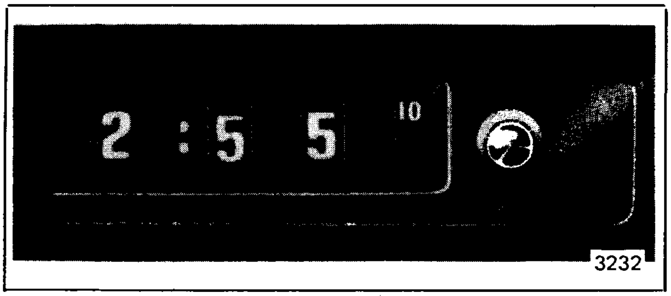


Fig. 9-66 Digital Clock

TRIP ODOMETER (FIG. 9-67)

The trip odometer used on A, G and X Series is reset by pulling the knob out and turning until all zeroes appear.

A new style trip odometer is available on the B Series. It can be reset by twice fully depressing the pushbutton located on the right side of the speedometer cluster. The first depression shows all zeroes, and the second locks them in position. Both depressions must be done to avoid possible half cycling of the trip odometer. A slow, steady push should be used to avoid damage to the internal mechanism.

On both styles, do not reset the odometer with the vehicle in motion. Damage to the odometer may occur.

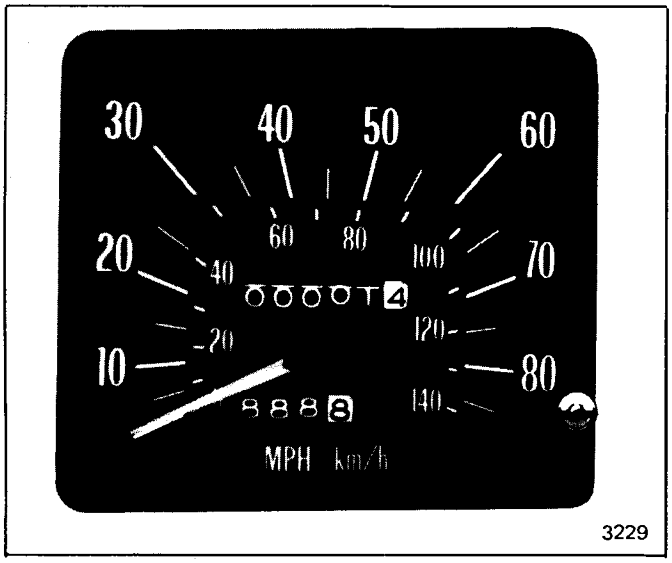


Fig. 9-67 Trip Odometer

DIAGNOSIS

NOTE: Always check the fuse first before proceding with diagnosis.

TACHOMETER

1. Insure that the in line fuse is not blown.

2. With ignition off, on H and HM Series, remove the tachometer from the cluster to gain access to the connecters. On G, A, F and X, disconnect the connecter from the back of the instrument panel. Turn ignition on and check for 12 volts at the ignition input connecter (pink) and no voltage at ground (black). Connect a test light to the brown wire which connects to the "TACH" terminal of the distributor. With the engine idling, a test light should light with approximately the same intensity as a 12 volt signal. As the engine speed increases, the test light intensity should decrease.

3. If proper signals are present at the connecter, replace the gage. If not, the problem is in the wiring to the gage.

OIL PRESSURE GAGE

1. Disconnect the wire at the sending unit on the engine. With igntion on, gage should register past 80 psi.

2. With ignition on, use a jumper wire to short the connecter to ground. Gage should now read below 0.

3. If gage reads properly in steps 1 and 2, replace the sending unit. If it does not, the trouble is either in the gage or the wiring to the gage.

4. Noticeably improves FM reception. should be ground, ignition voltage, and signal. The signal input should be checked with an ohmmeter, and should indicate continuity (0 ohms) with the connecter at the sender shorted to ground, and no continuity (infinite resistance) with the connecter at the sender disconnected. If these checks are ok, replace the gage. If not, repair the problem in the wiring.

5. The gage may also be checked by substituting a resistence source for the sender. The gage should read approximately 0 psi at 1 ohm and 80 psi at 88 ohms.

VOLTMETER

1. Remove the gage as shown in On-Car Service.

2. With ignition on, terminal connecters to the gage should indicate electrical system voltage and ground. If they do, replace the gage. If they do not, repair the problem in the wiring.

WATER TEMPERATURE GAGE

1. Disconnect the wire at the temperature sender on the block. With ignition on, gage should read below 100°F.

2. Use a jumper wire to short the wire to ground. With ignition on, gage should deflect full scale, well past 260°F.

3. If the gage reads properly in steps 1 and 2, replace the sender. If it does not, the problem is either in the gage or the wiring.

4. Remove the gage as shown in On-Car Service. With ignition on, the terminal connecters should read ground, electrical system voltage and signal. Check for continuity as shown for oil pressure gage. If these check ok, replace the gage. If not, repair the wiring problem.

5. The gage may also be checked by substituting a resistence source for the sender. The gage should read 100°F. at 350 ohms, 220°F. at 68 ohms, and 260°F. at 46 ohms.

CLOCK

1. Remove the clock as shown in On-Car Service, or disconnect wiring to it.

2. With igntion **off**, clock should receive battery voltage at one terminal and ground at the other. If it does not, replace the clock.

FUEL ECONOMY GAGE

ON-CAR SERVICE

All rally gages, tachometers, fuel economy gages, and clocks are replaced as listed below.

A AND G SERIES

To replace the rally gages, remove the upper trimplate, remove the cluster lens, and remove the gage cluster from the front (see Section 8).

To replace the tachometer (which also houses a clock), the fuel economy gage (which also houses a clock), or the clock by itself, remove the upper trimplate, remove the cluster assembly, and remove the gage from the rear of the cluster. Refer to Section 8 for instrument panel cluster removal. Fig. 9-68 shows the tachometer installation, and Fig. 9-69 shows clock installation. Fig 9-70 shows fuel economy gage hose routing.

B SERIES

All gages in the B Series are replaced by removing the upper trimplate, removing the cluster lens, and removing the gage from the front (see Section 8). Fig 9-71 shows the digital clock removal (which requires only trimplate removal), and Fig. 9-72 shows fuel economy gage hose routing.

F SERIES

Replacements procedures are the same as A and G Series above. Fig. 9-73 shows the rally gage and tachometer installation.

X SERIES

Replacement of any gage in X Series requires removal of the instrument cluster as described in Section 8. Since no front trimplate is used, no gages can be removed from the front. Fig. 9-74 shows the tachometer wiring.

H AND HM SERIES

All gages except the clock can be replaced from the front by removing the trimpate, removing the cluster lens, and removing the gage from the front (see Section 8). No fuel economy gage is available.

The clock can be removed from beneath the instrument panel by removing the "hush" panel, removing the "set" knob and screws, and removing the clock from the back of the panel (see Fig. 9-75).

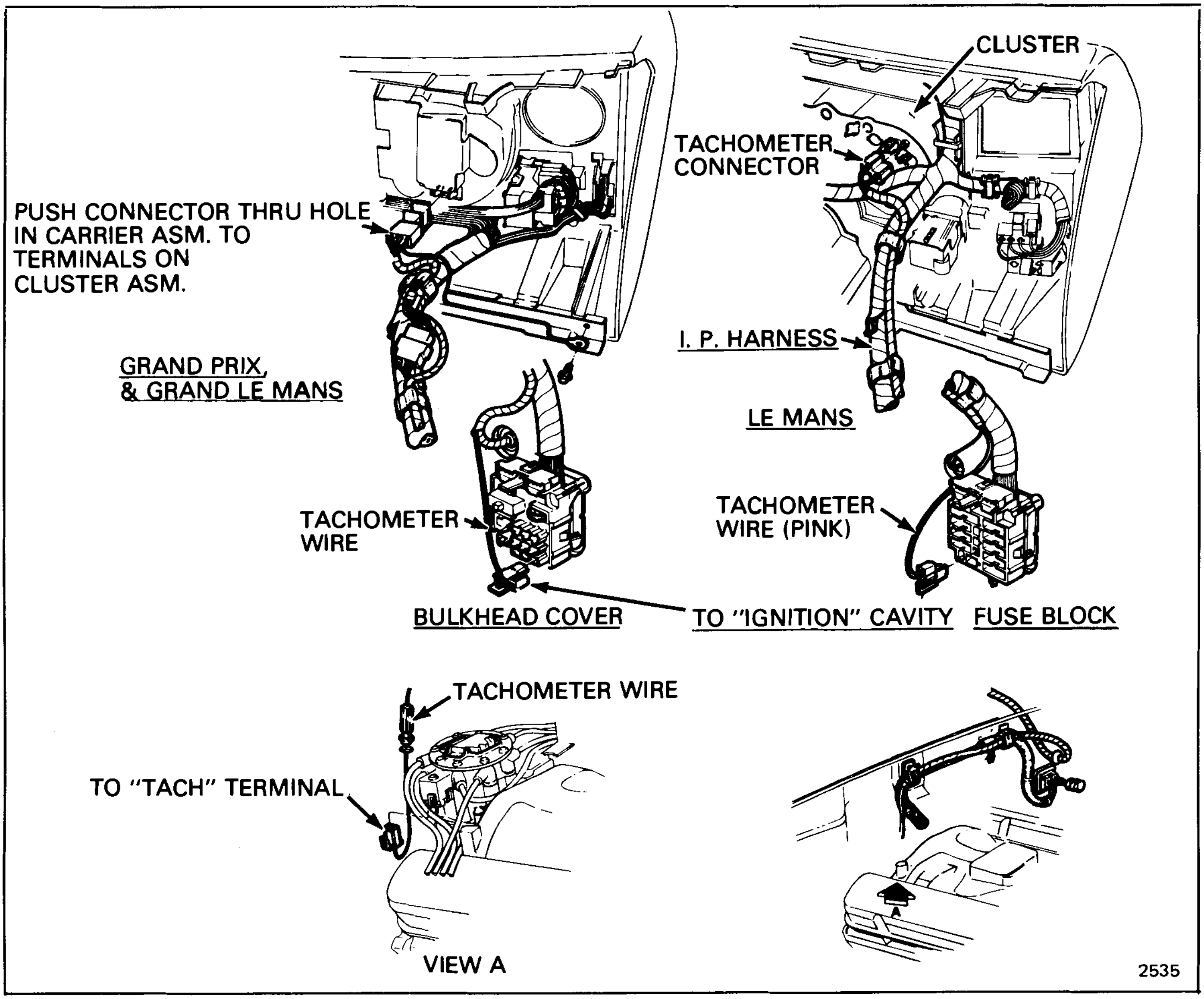


Fig. 9-68 Tach Installation - A and G Series

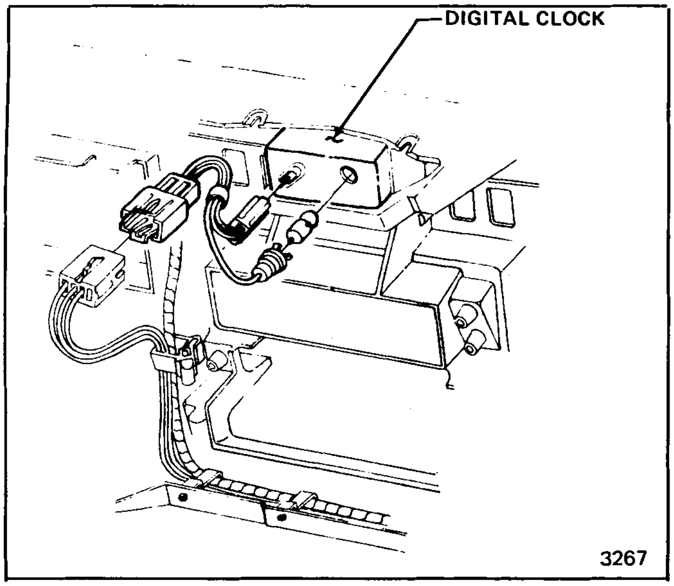


Fig. 9-71 Digital Clock - B Series

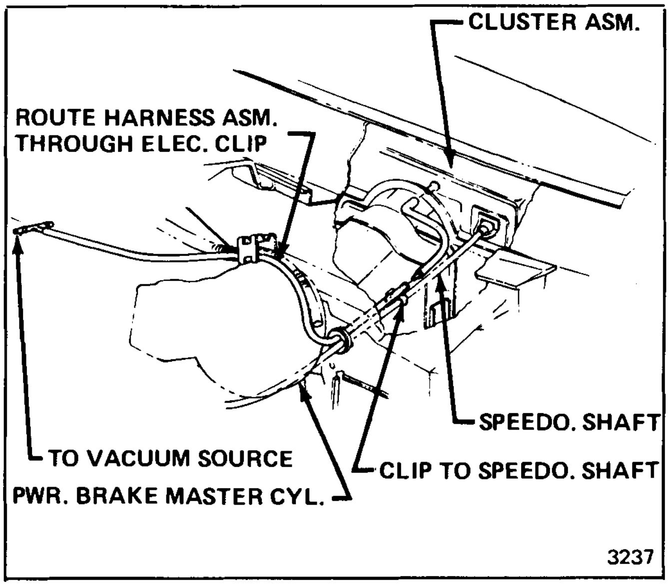


Fig. 9-72 Fuel Economy Gage Hose Routing - B Series

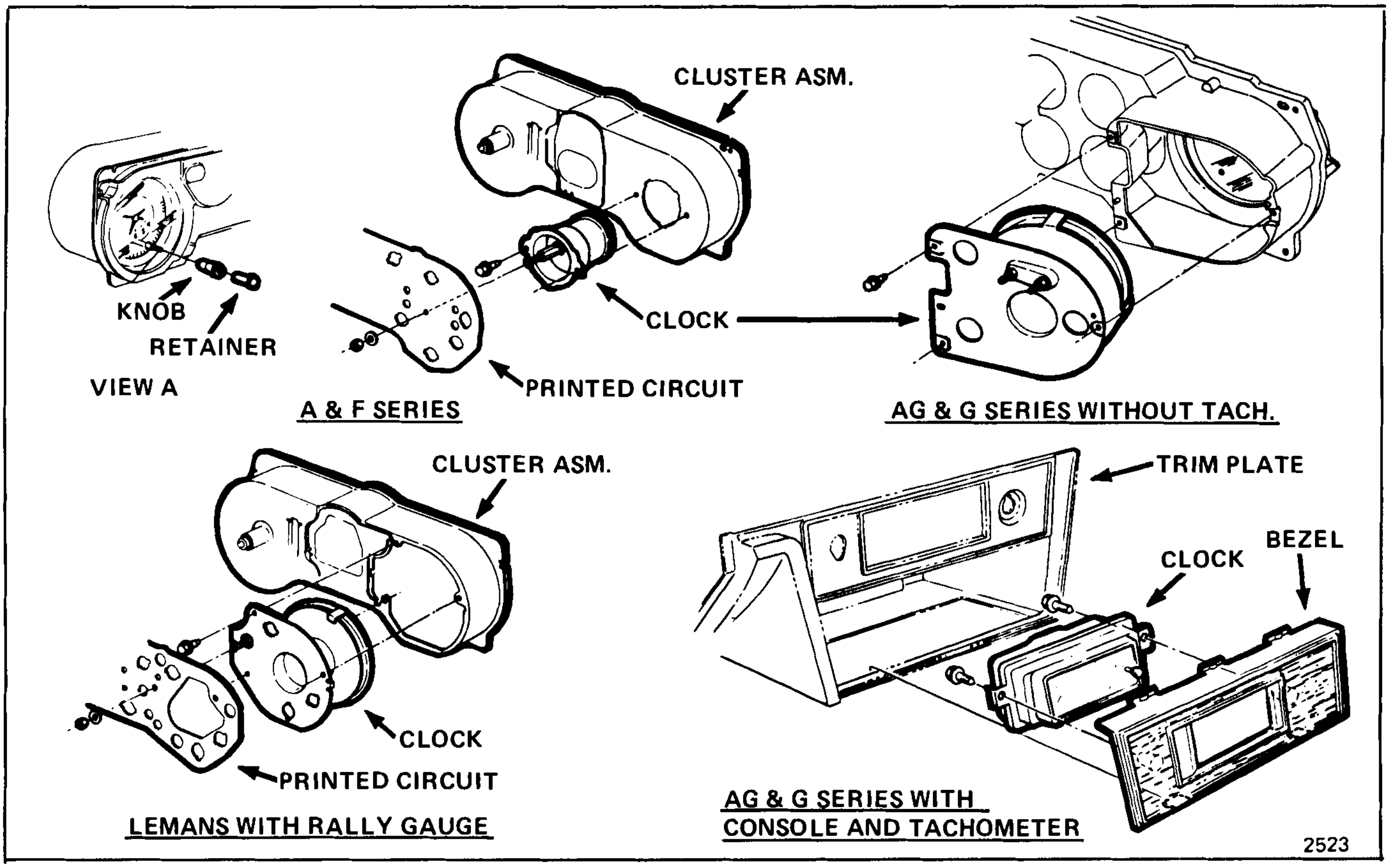


Fig. 9-69 Clock Installation - A, G, F and X Series

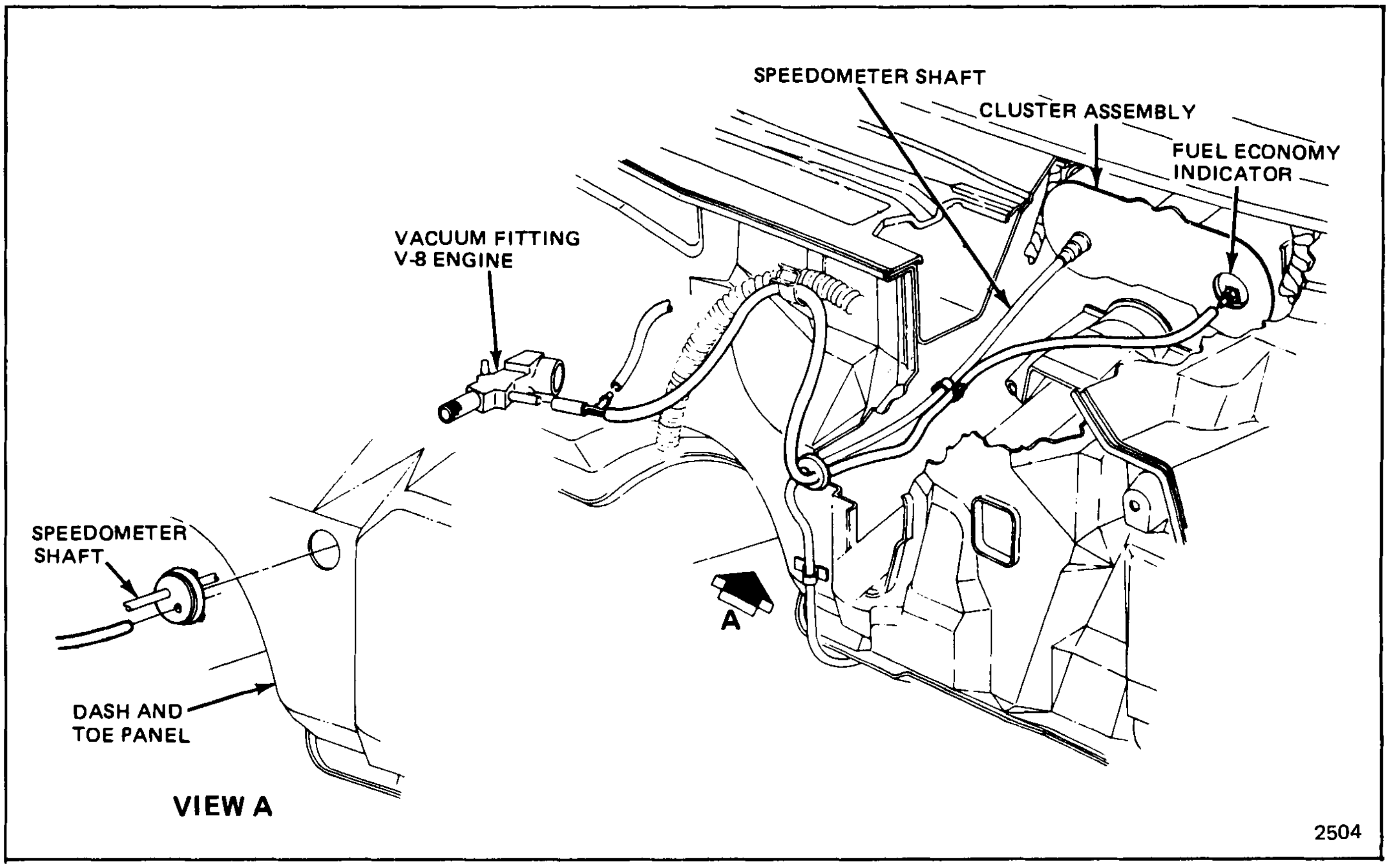


Fig. 9-70 Fuel Economy Gage Hose Routing

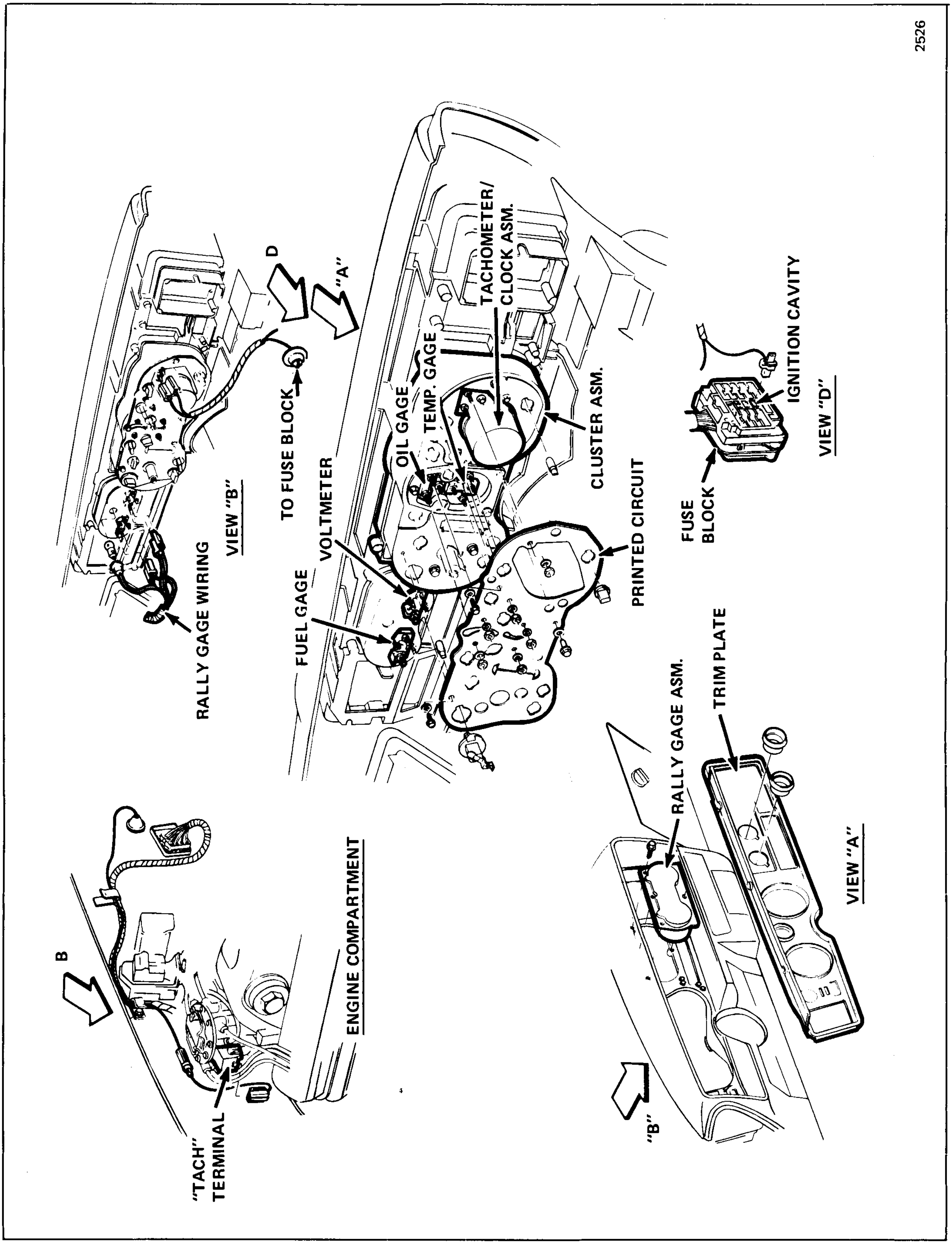


Fig. 9-73 Rally Gage and Tach Installation - F Series

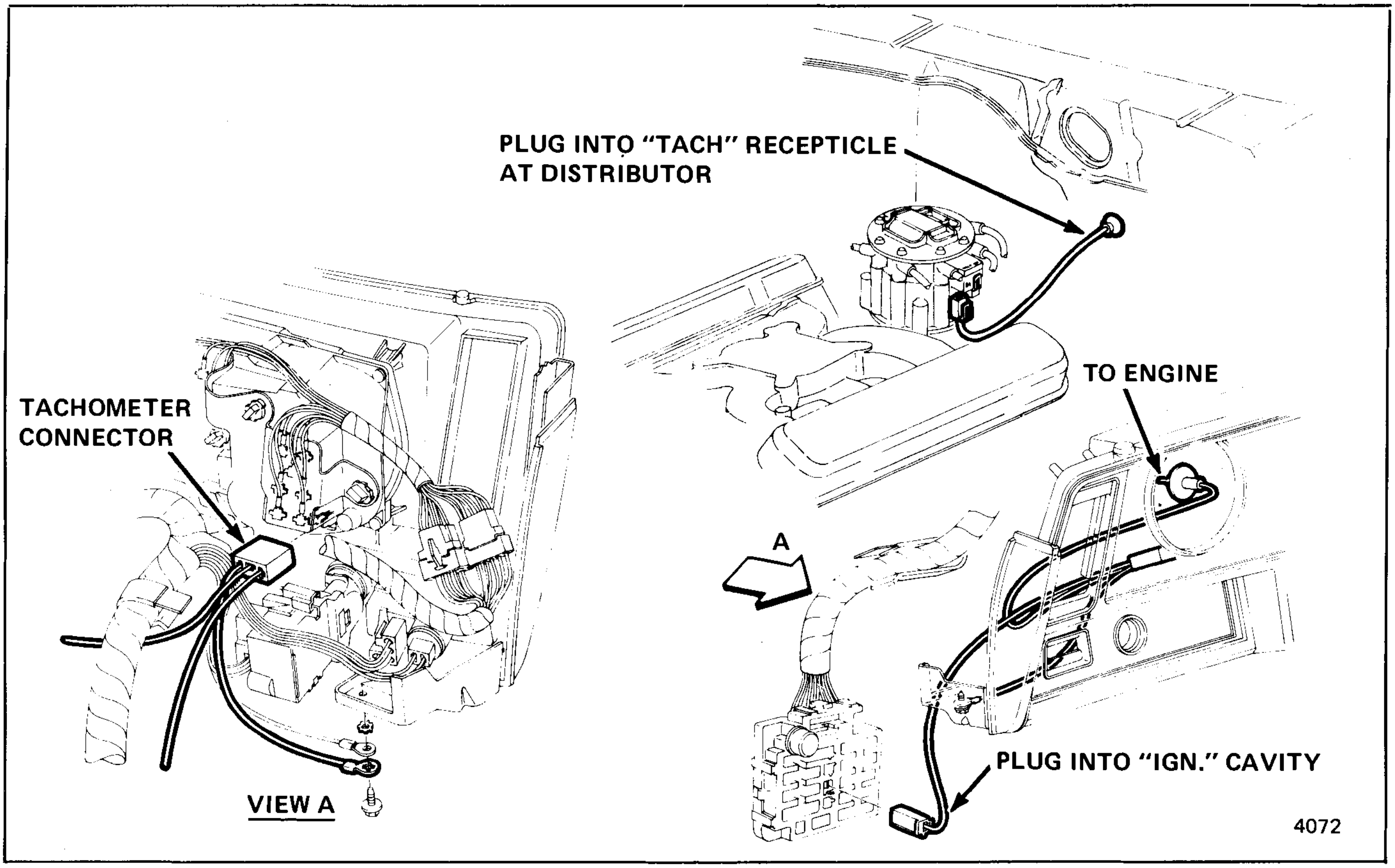


Fig. 9-74 Tach Wiring - X Series

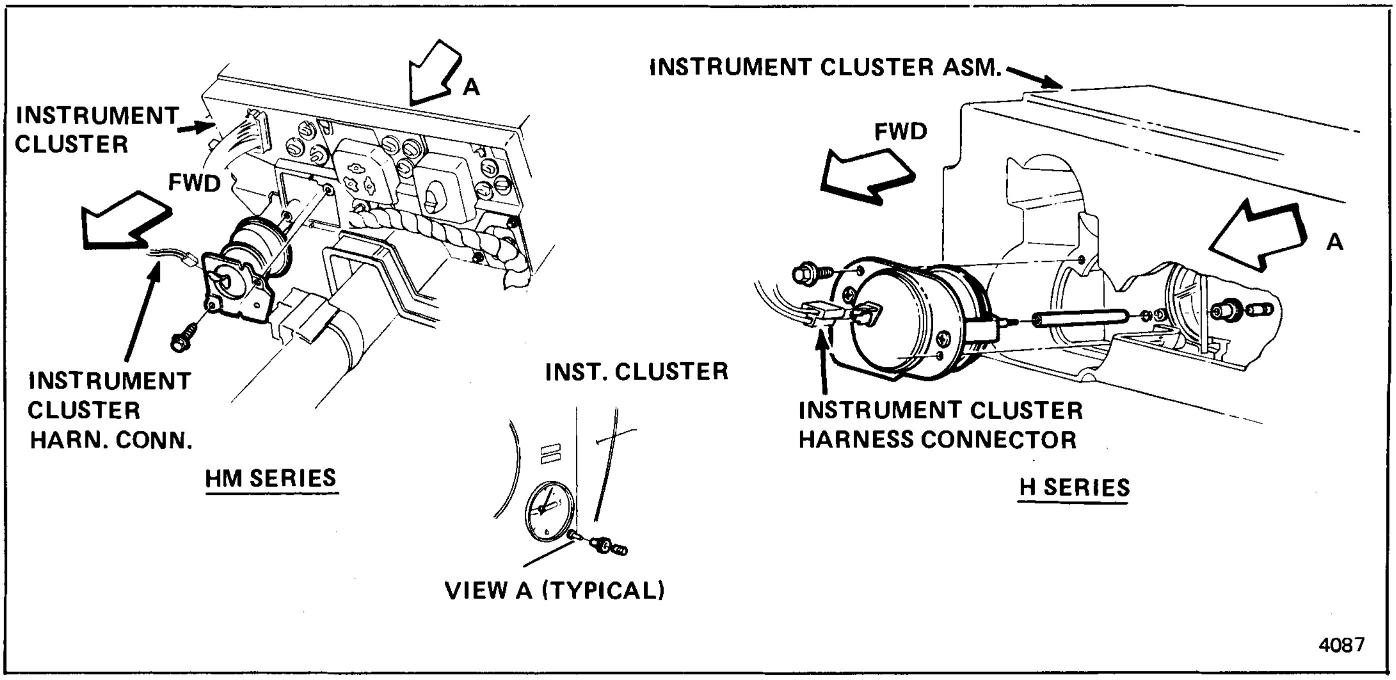


Fig. 9-75 Clock Installation - H and HM Series

MISCELLANEOUS ACCESSORIES

CONSOLE

A center console is available on all series except B, along with bucket seats. A break or puncture in the padded portion of the console can often be repaired. Various manufacturers offer kits for vinyl repair. Follow their instructions for use of their products.

On-Car Service

Refer to Figures 9-76 through 9-80 for replacement procedures.

ENGINE BLOCK HEATER

Optional engine block heaters are available on many Pontiac engines. They are rated at 600 watts, and should be operated from a 110 volt A.C. power supply. Mounting instructions are covered in Figures 9-81 through 9-83. It is important to install the heater element in the correct direction, as shown below, to avoid having the element contact the side of the block.

REAR WINDOW DEFOGGER

Electric Defogger

The electric defogger system, used on all series except X, incorporates an electrical grid fused to the inside surface of the rear glass to which current is applied to warm and defog the glass. A control switch on the insturment panel activates the system and allows current flow through the rear window grid for approximately 10-15 minutes. A timer in the control assembly, which is also activated when the switch is depressed, automatically shuts off the system. The system can be turned off at any time by momentarily pushing the control switch to the "OFF" position. The system, designed to operate only when the engine is running, may be reactivated whenever the engine has been turned off and re-started.

The rear window grid, powered from a buss bar at the left side of the glass, is of a silver ceramic compound. Care should be exercised when cleaning the inside rear glass so as not to scratch or remove any of the grid material. Damage to the grid could cause an open circuit. A monitor lamp in the control switch housing indicates power being fed to the rear window grids so the operator can determine when the system is operating.

To check for proper operation of the rear window grid, start the engine and actuate the system by depressing the control switch to the "ON" position mementarily. Contact one probe of a test lamp to one of the left side rear window garnish molding screws. With the other test lamp probe tip removed (so as not to damage the grid), contact the bare wire to the grid adjacent to the garnish molding. The test lamp should glow at full brilliance. Contact the same grid line midway across the window. The lamp should glow at half brilliance. Repeat the procedure for each grid line. If an open circuit exists in a grid line between the left side and the center, the test lamp will not glow. If there is an open circuit between the center and the right side, the test lamp will glow more brilliantly at the center than if the line were unbroken.

Rear window grid repairs may be made by following the procedure published in the electrical section of the Body Service Manual. Figures 9-84 through 9-88 show switch mounting and wiring.

Blower Defogger

X Series uses a blower type defogger. The control switch is located to the right of the headlamp switch, and allows either "HI" or "LOW" speeds to be selected.

TRAILER WIRING HARNESS

Two wire harness options are avialable for trailer hauling; one has five wires and the other has seven.

The five-wire harness consists of:

1. Auxiliary wire - 14 ga. dark blue.
2. Righthand stop and directional signal lamp wire - 16 ga. dark green.
3. Lefthand stop and directional signal lamp wire - 16 ga. yellow.
4. Taillamp wire - 16 ga. brown.
5. Ground wire - 14 ga. white.

The seven-wire harness consists of:

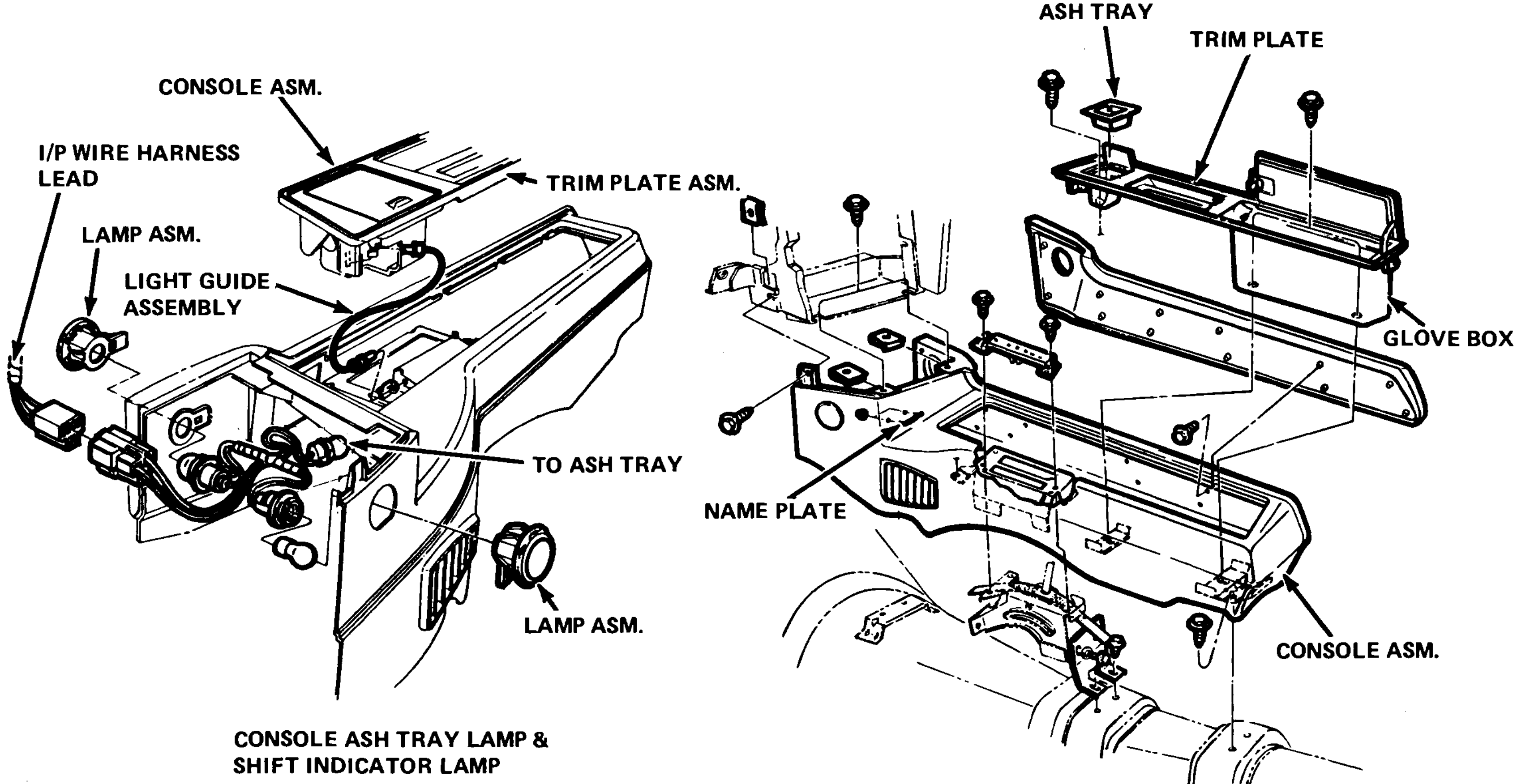
1. Righthand stop and directional signal lamp wire - 16 ga. dark green.
2. Lefthand stop and directional signal lamp wire - 16 ga. yellow.
3. Taillamp wire - 18 ga. brown.
4. Back-up lamp wire - 18 ga. light green.
5. Ground wire - 14 ga. white.
6. Trailer brake wire (routes to front of car) - 12 ga. dark blue.
7. Trailer battery charging wire (routes to front of car) - 10 ga. red.

CONTROLLED CYCLE WIPER SYSTEMS

Controlled cycle wipers allow the wiper blades to pause between wiping strokes for a period of up to 12 seconds. On B, G and A Series (Fig. 9-89 and 9-90), the length of the cycle is controlled by the wiper speed lever, which is a slider bar. On X, H and HM Series (Fig. 8-91 and 92), the length of the cycle is controlled by a separate rotary knob. Diagnosis and repair of these systems is covered in the Body Service Manual.

RIGHT HAND REMOTE CONTROL REAR VIEW MIRROR

A right hand remote control mirror is available on B, G, A and X Series. A dash mounted control allows the mirror to be adjusted from the driver's seat. The repair and mounting of the mirror assembly is covered on the Body Service Manual. Figures 9-93 through 9-95 show the control mounting and cable routing.



CONSOLE ASH TRAY LAMP & SHIFT INDICATOR LAMP

AUTOMATIC TRANSMISSION

Fig. 9-76 Console Installation - G and AG Series

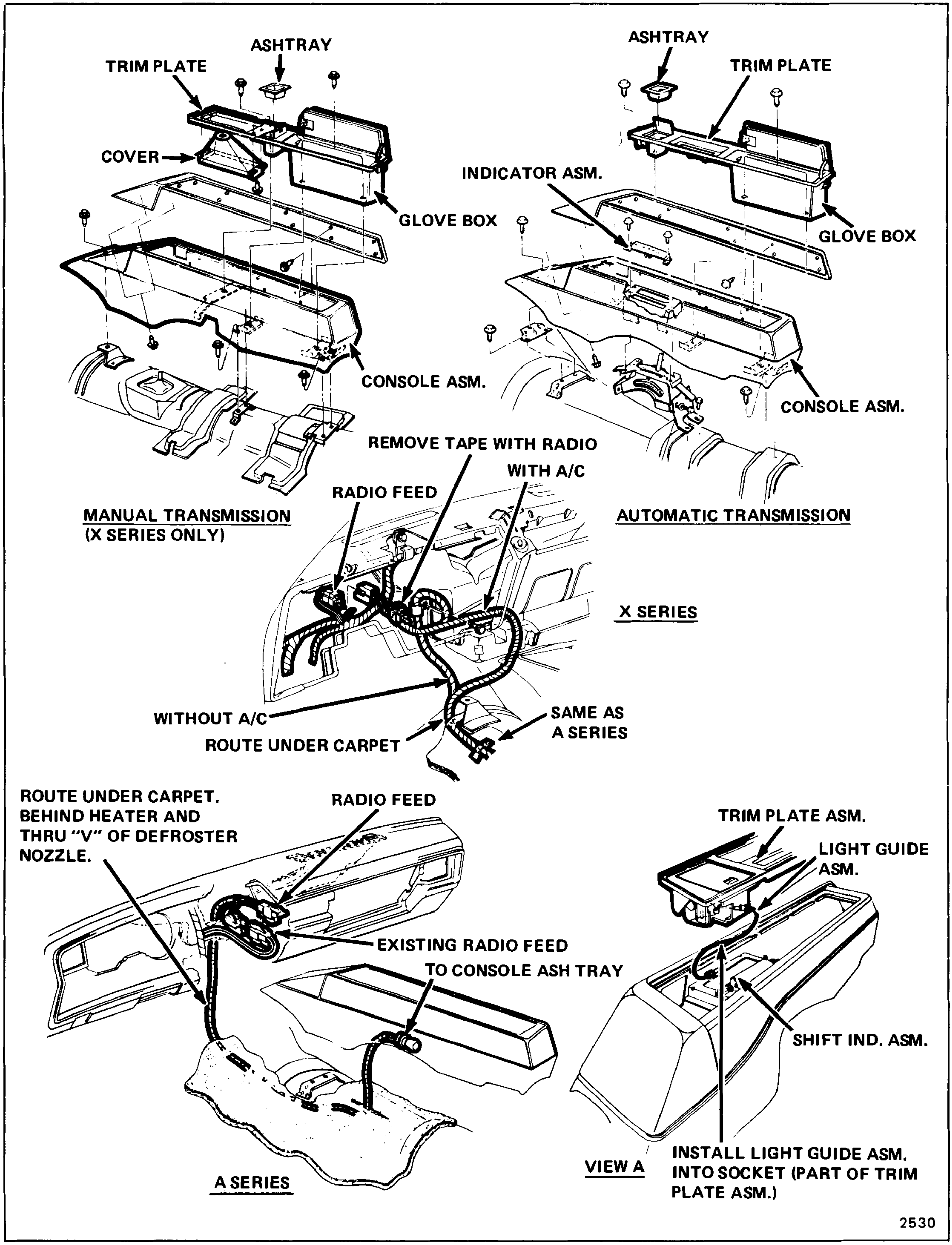
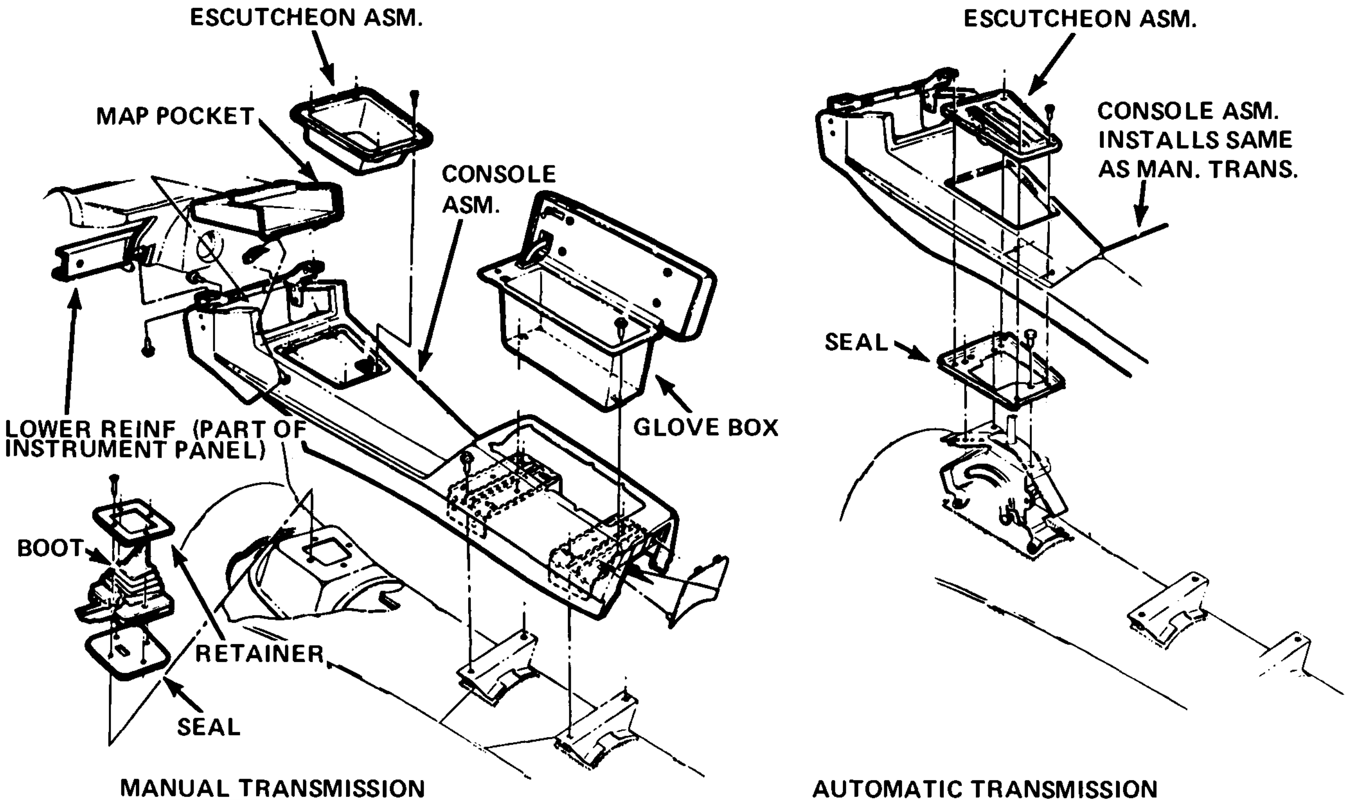
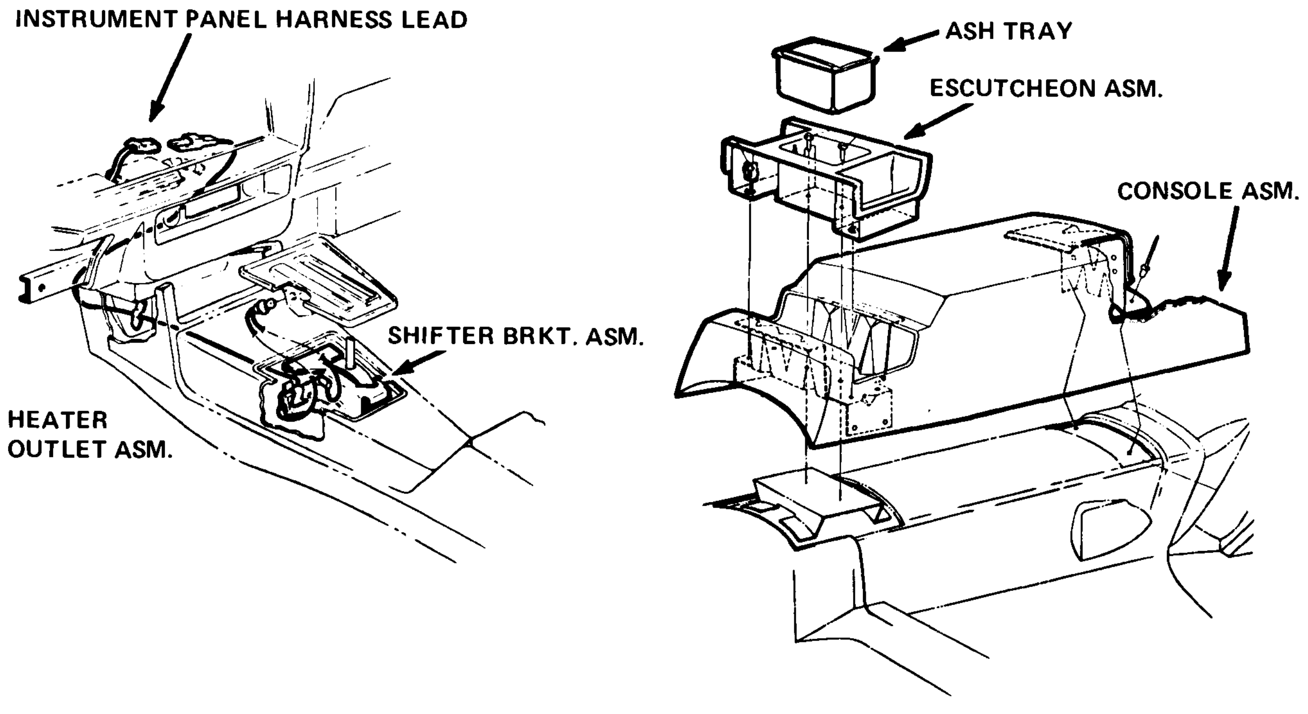


Fig. 9-77 Console Installation - A and X Series



MANUAL TRANSMISSION

AUTOMATIC TRANSMISSION



WIRING HARNESS- AUTO. TRANS. ONLY

REAR SEAT CONSOLE

2531

Fig. 9-78 Console Installation - F Series

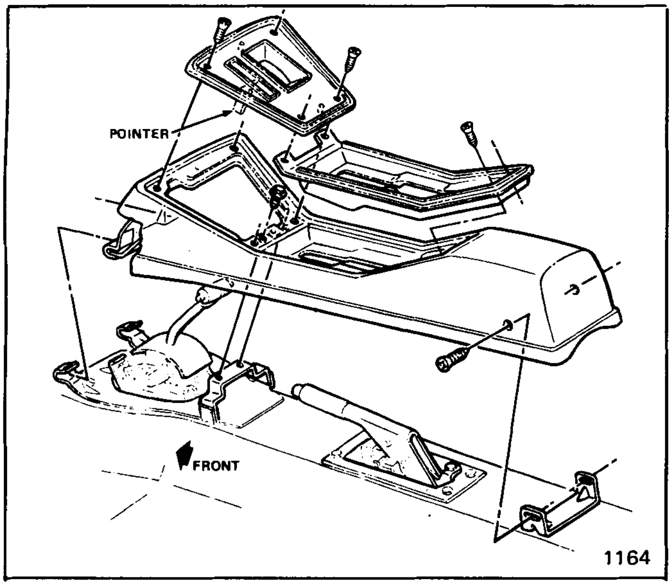


Fig. 9-79 Console Installation - H and HM Series

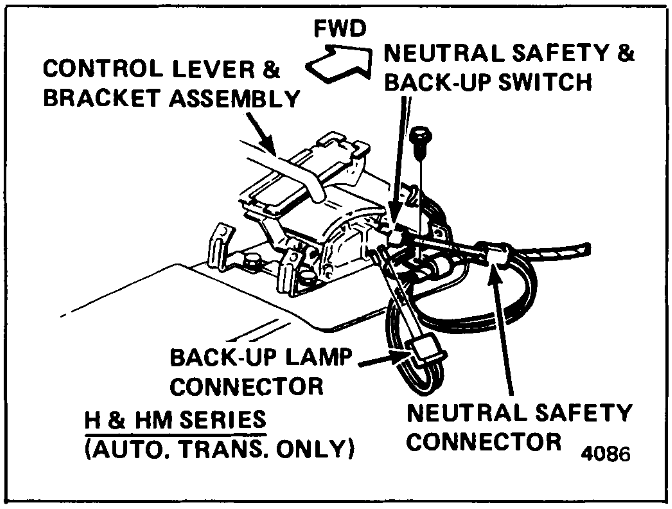


Fig. 9-80 Console Wiring - H and HM Series

LUGGAGE COMPARTMENT LAMP (FIGURE 9-96)

A luggage compartment lamp is availabe on must series. The lamp is wired to a battery circuit, and operates with a mercury switch any time the deck lid is opened. The lamp should not illuminate until the lid is opened 6 to 8 inches.

DECK LID RELEASE

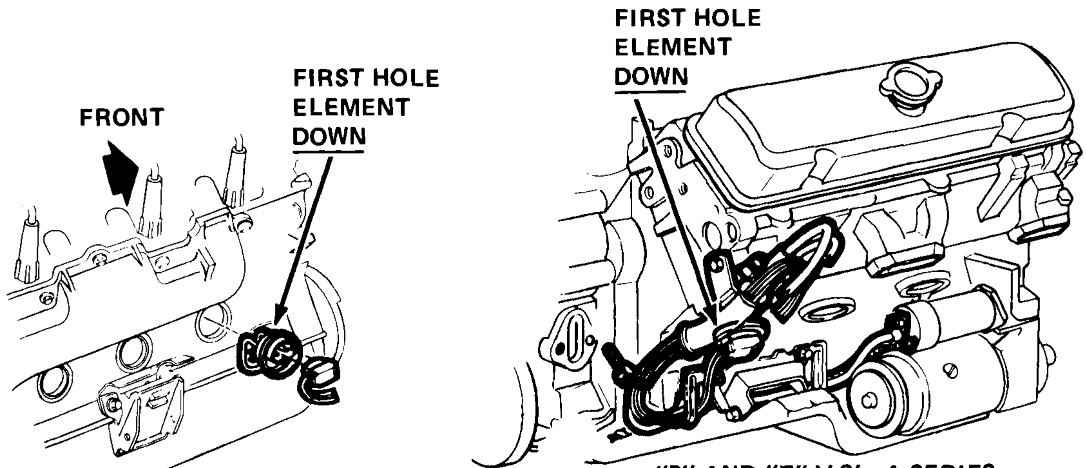
An electric deck lid release is available on A, G, B and F Series. The switch is wired to a battery circuit, and can be used regardless of ignition switch position. The switch is located inside the glove box door. Installation is shown in Figures 9-97 and 9-98.

DASH MOUNTED ACCESSORY SWITCHES

Installation and wiring for various dash mounted accessory switches is shown in Figures 9-99 through 9-102.

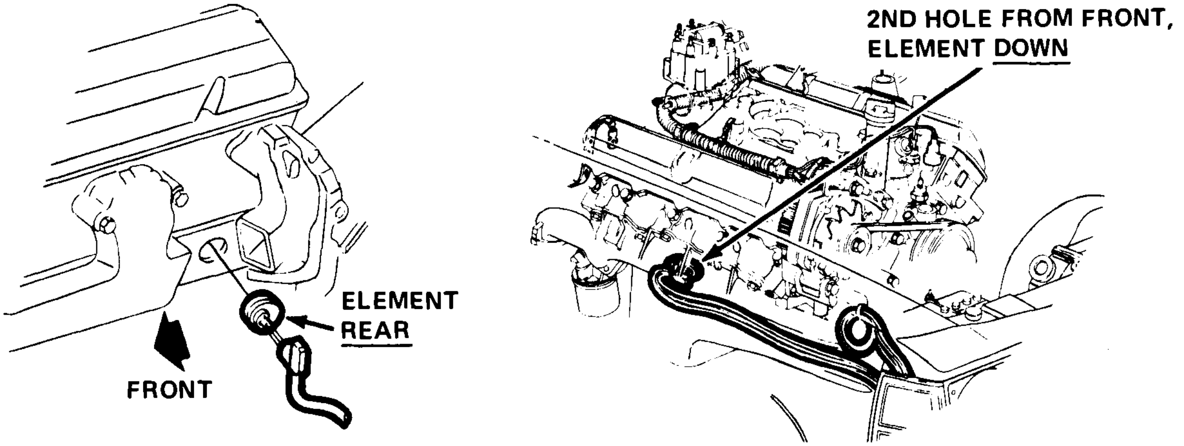
ROOF RACK INSTALLATION

Refer to Fig. 9-103 for roof rack installation for B Series Station Wagon.



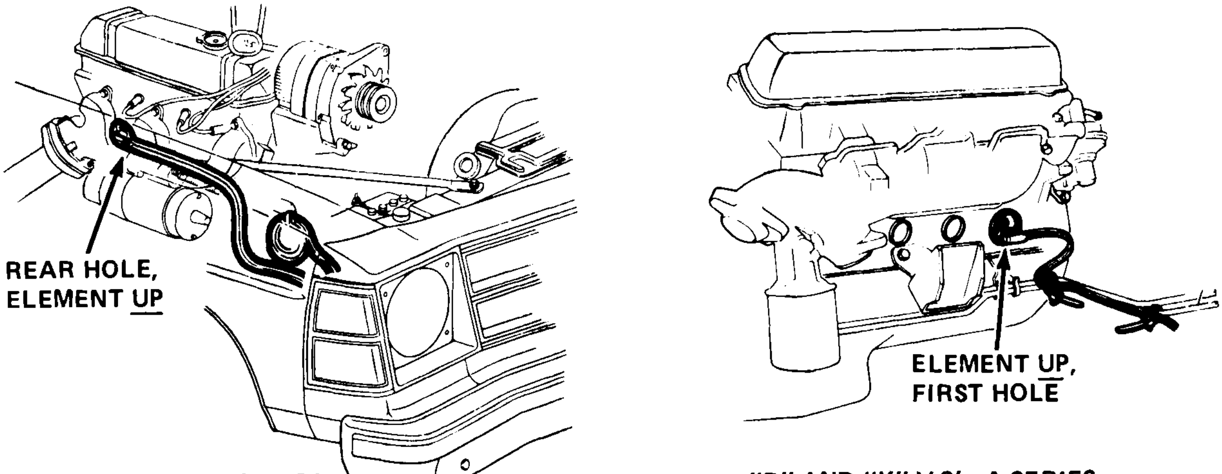
"R" AND "K" V-8's, B SERIES

"P" AND "Z" V-8's, A SERIES



"U" AND "L" V-8's, X SERIES

"R" AND "K" V-8's, F & X SERIES



V-6, ALL SERIES

"R" AND "K" V-8's, A SERIES

4054

Fig. 9-81 Engine Block Heater

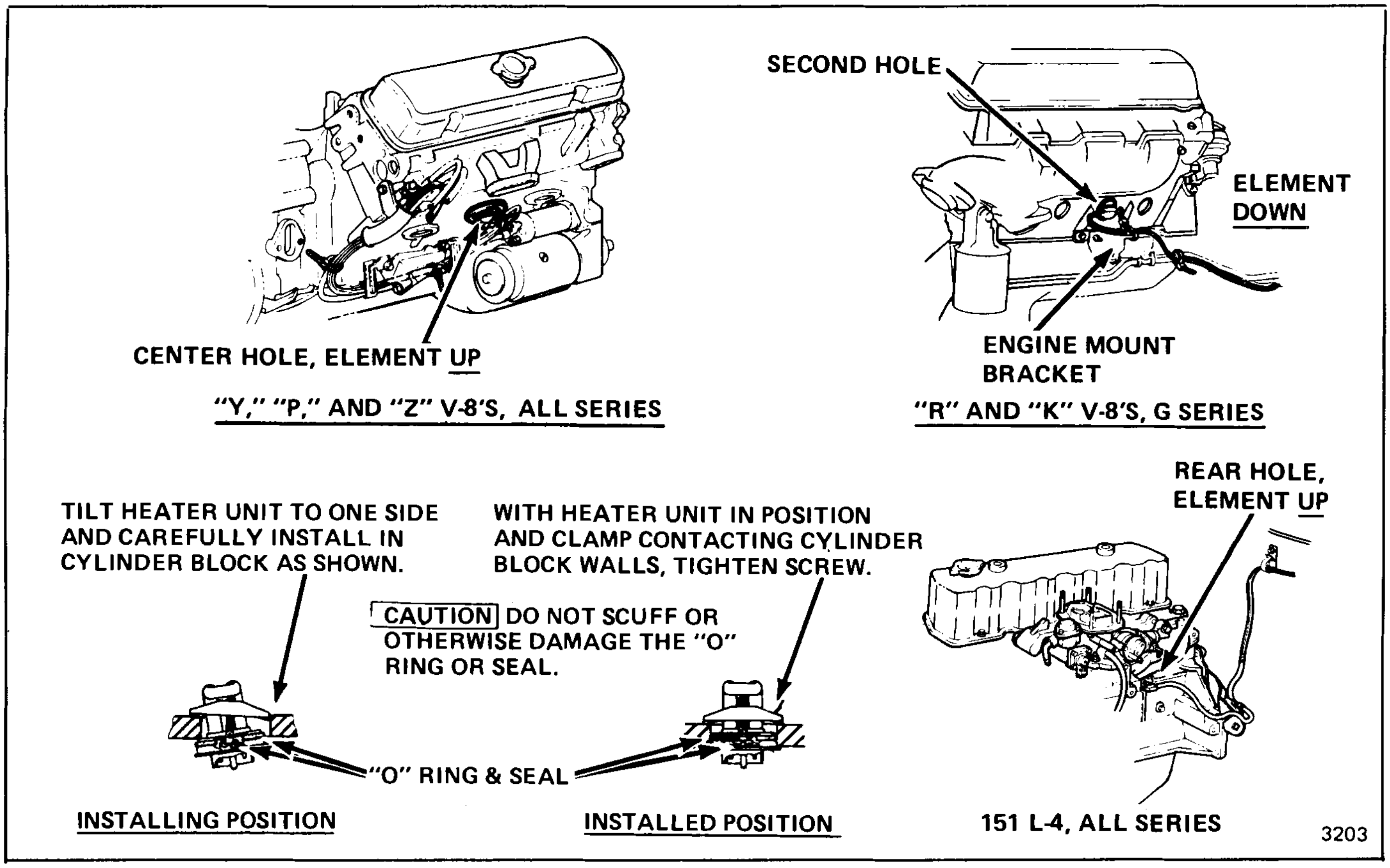


Fig. 9-82 Engine Block Heater

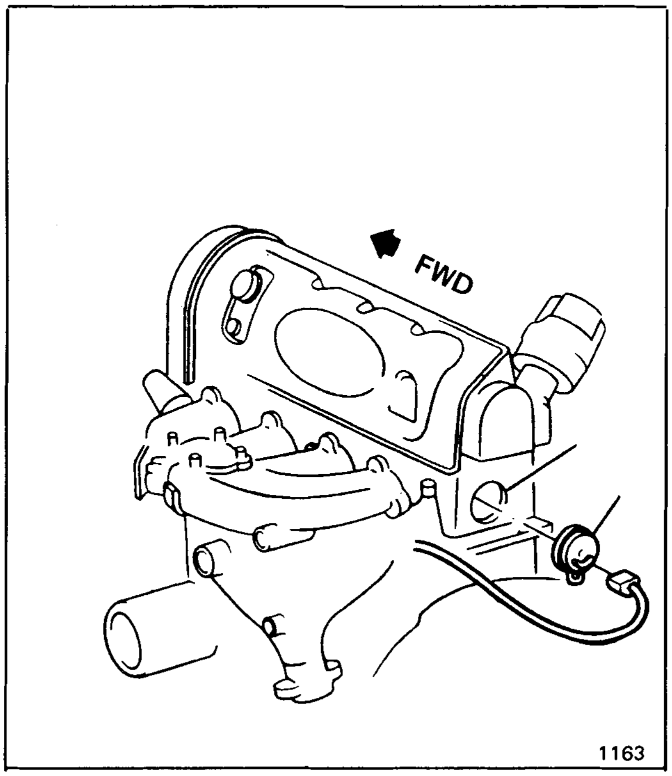


Fig. 9-83 Engine Block Heater - 140 L-4

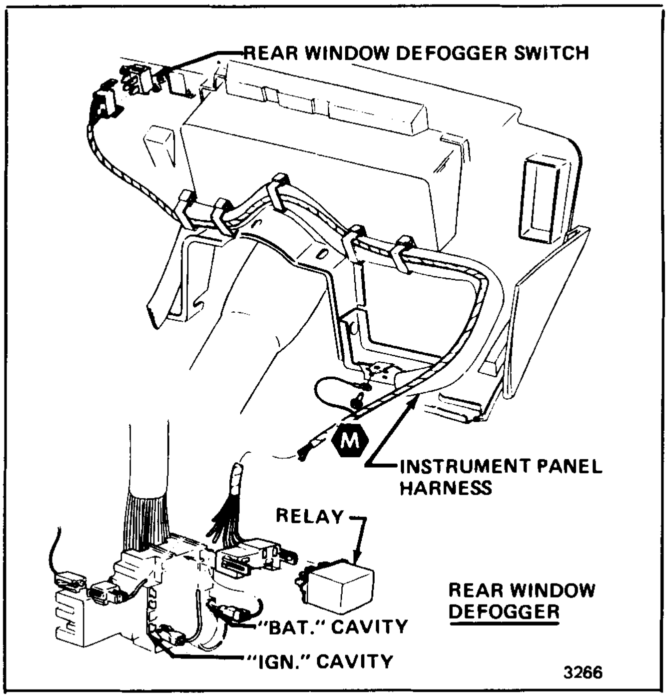


Fig. 9-84 Rear Window Defogger - B Series

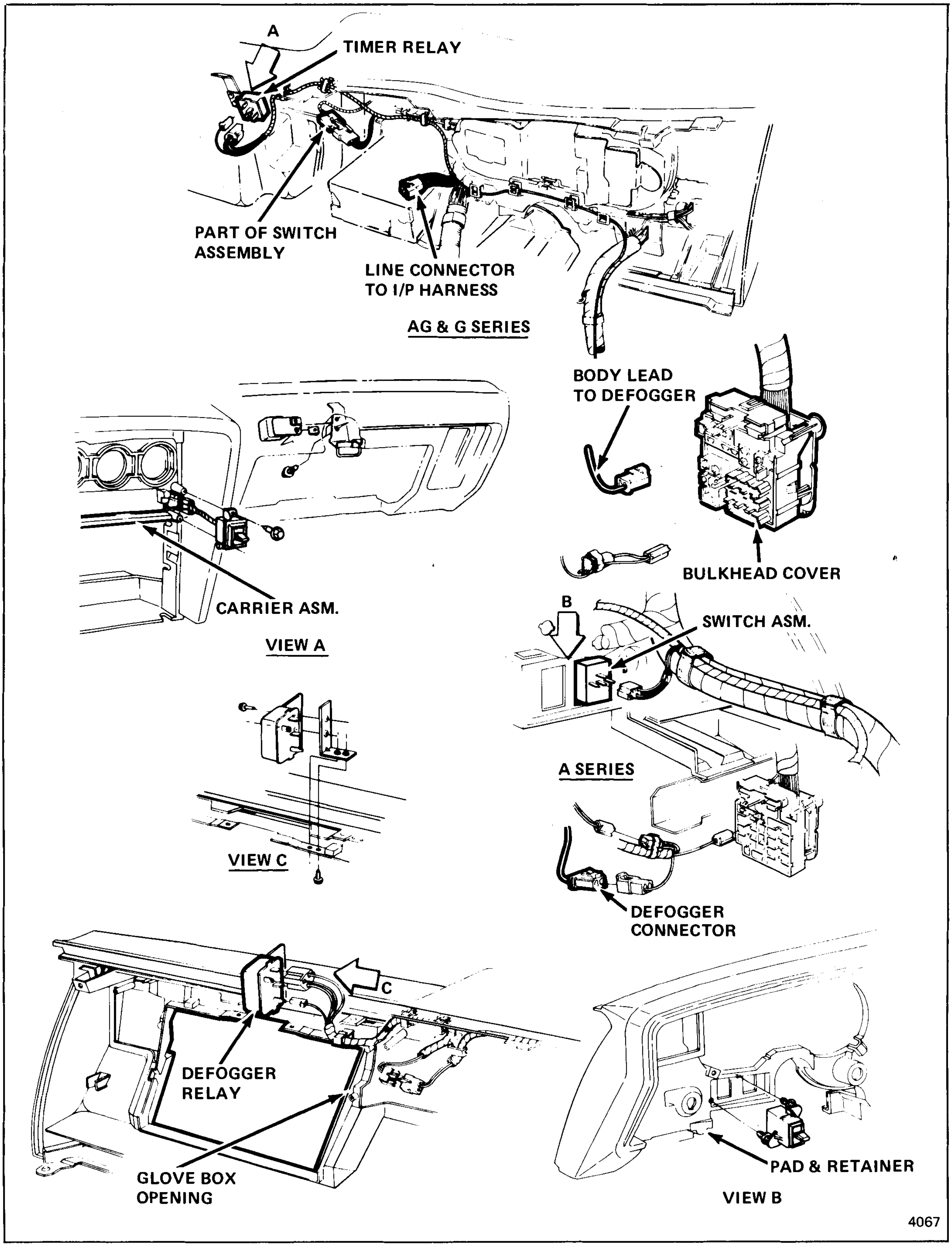


Fig. 9-85 Rear Window Defogger - A and G Series

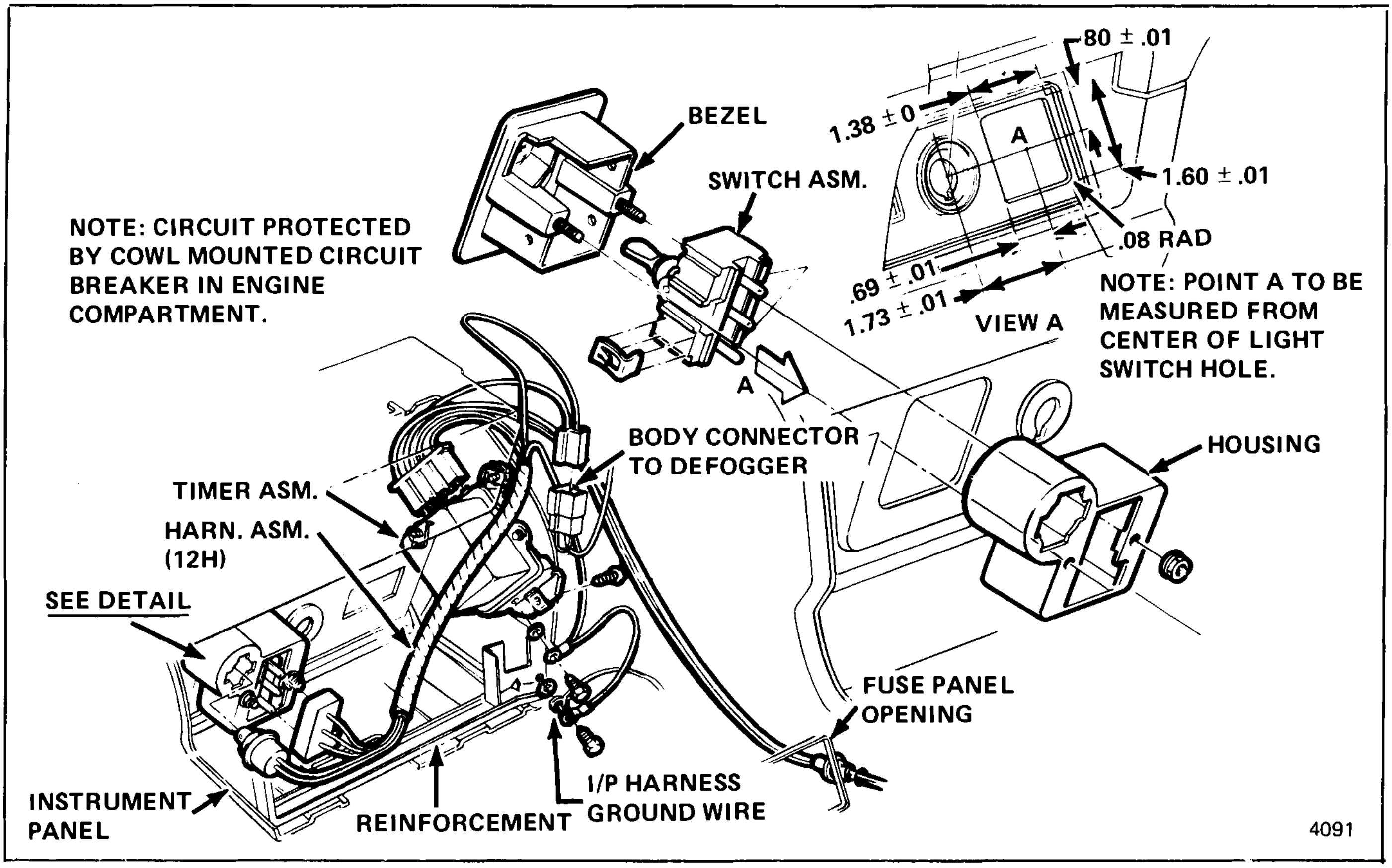


Fig. 9-87 Rear Window Defogger - H Series

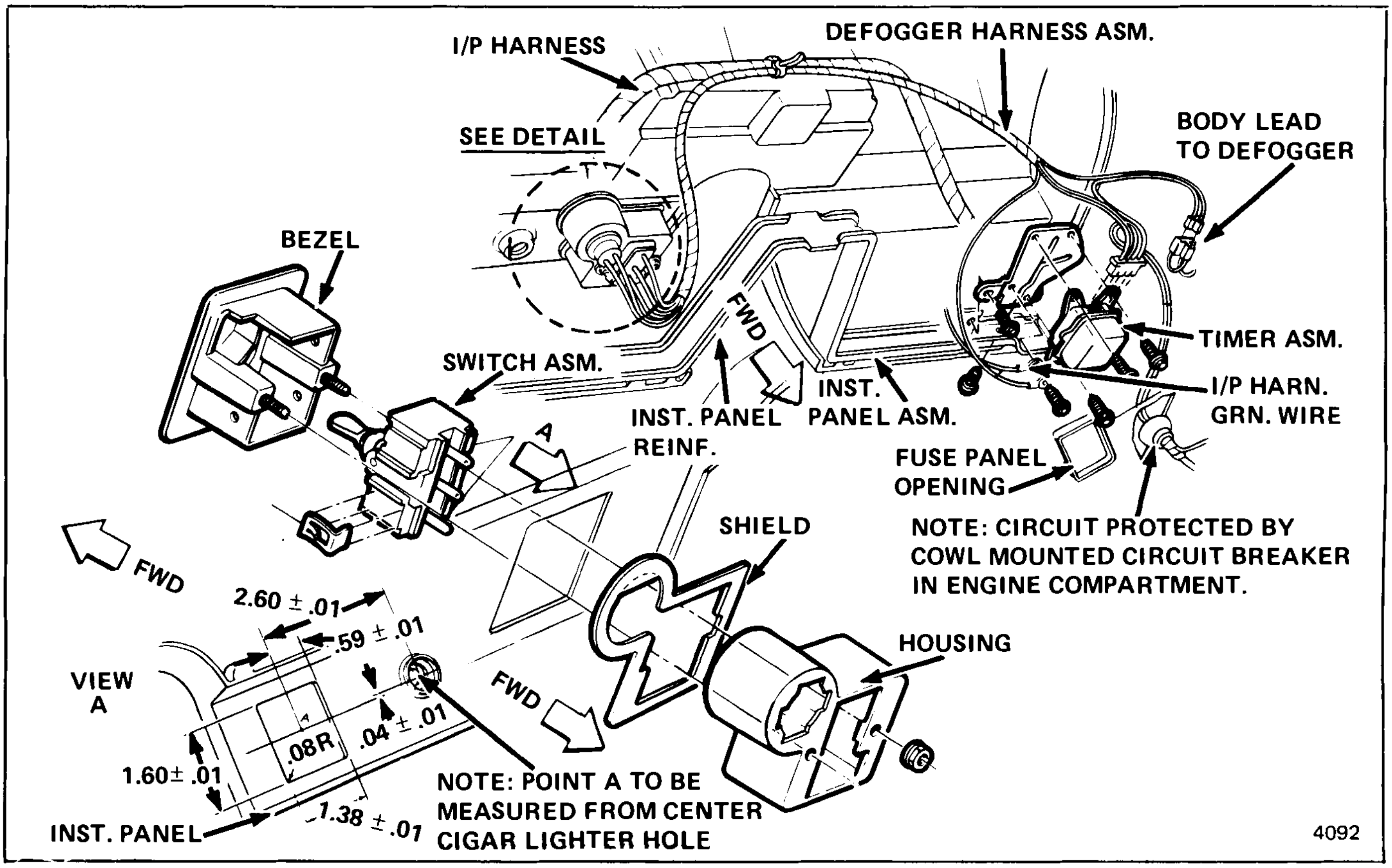


Fig. 9-88 Rear Window Defogger - HM Series

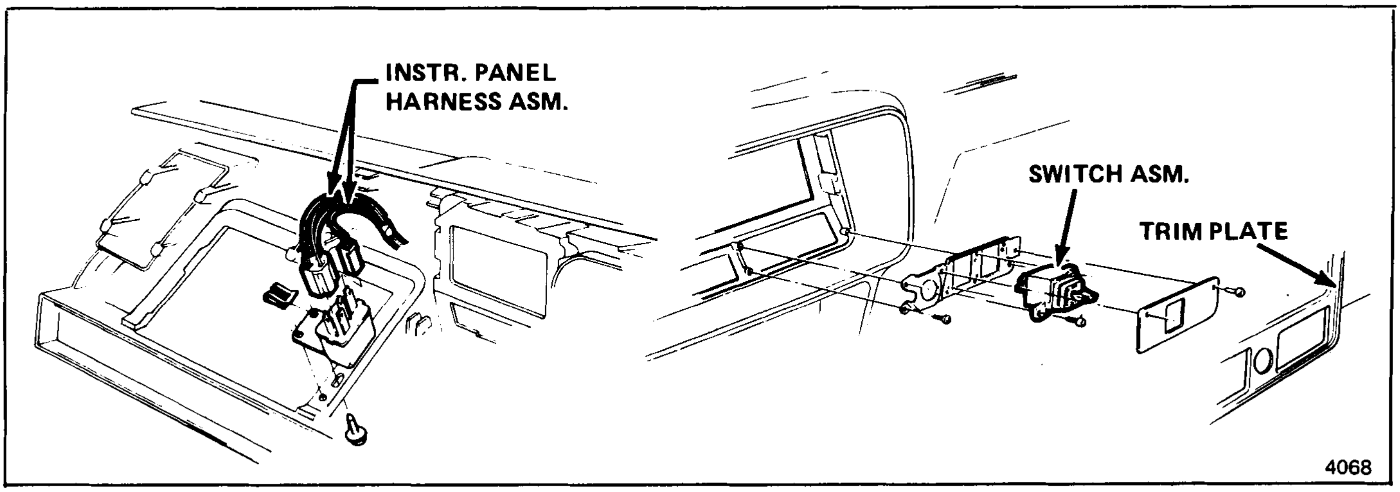


Fig. 9-86 Rear Window Defogger - F Series

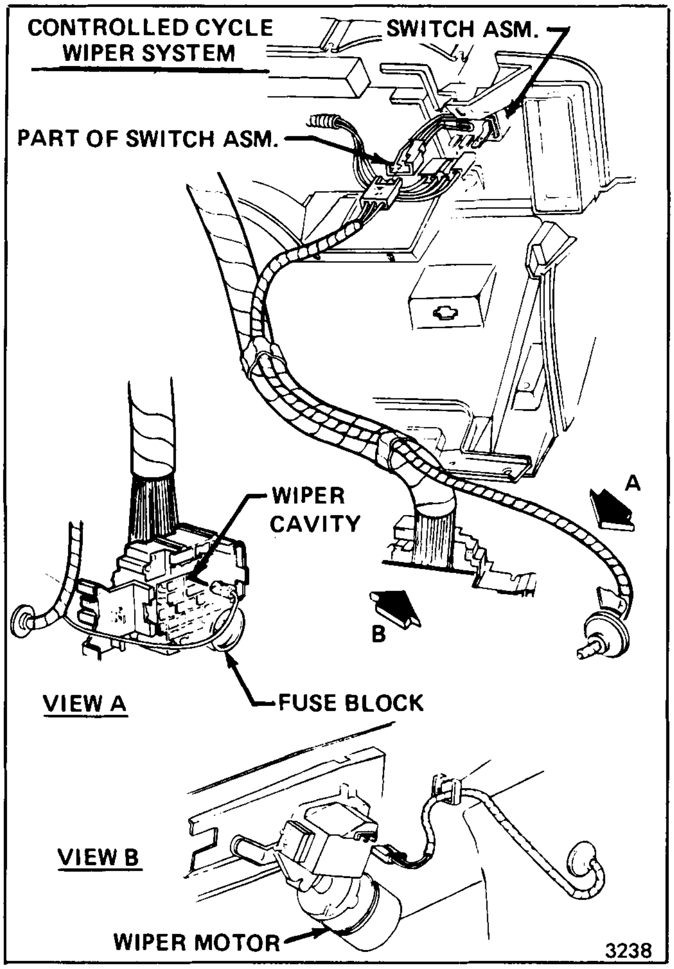


Fig. 9-89 Controlled Cycle Wiper - B Series

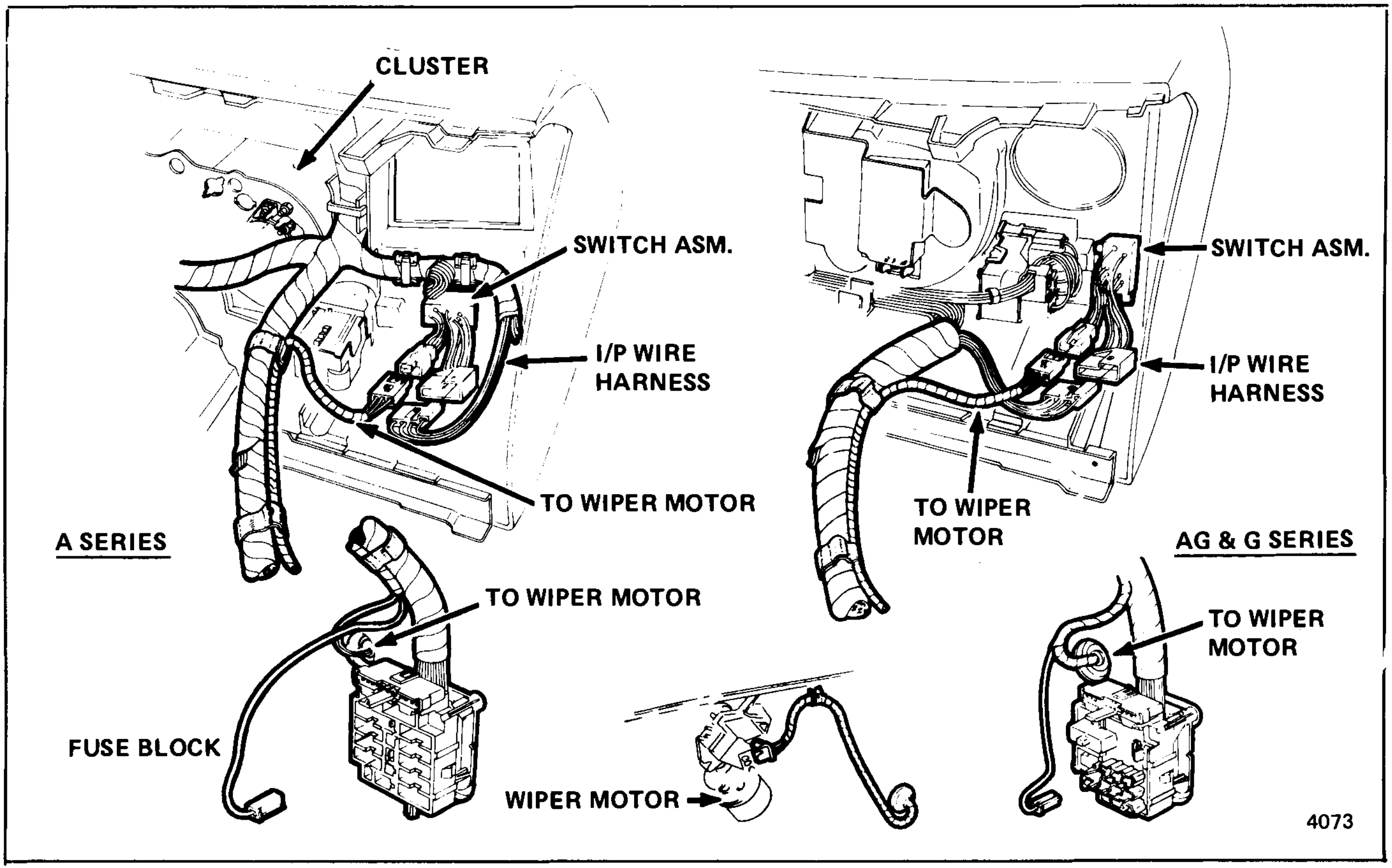


Fig. 9-90 Controlled Cycle Wiper - A and G Series

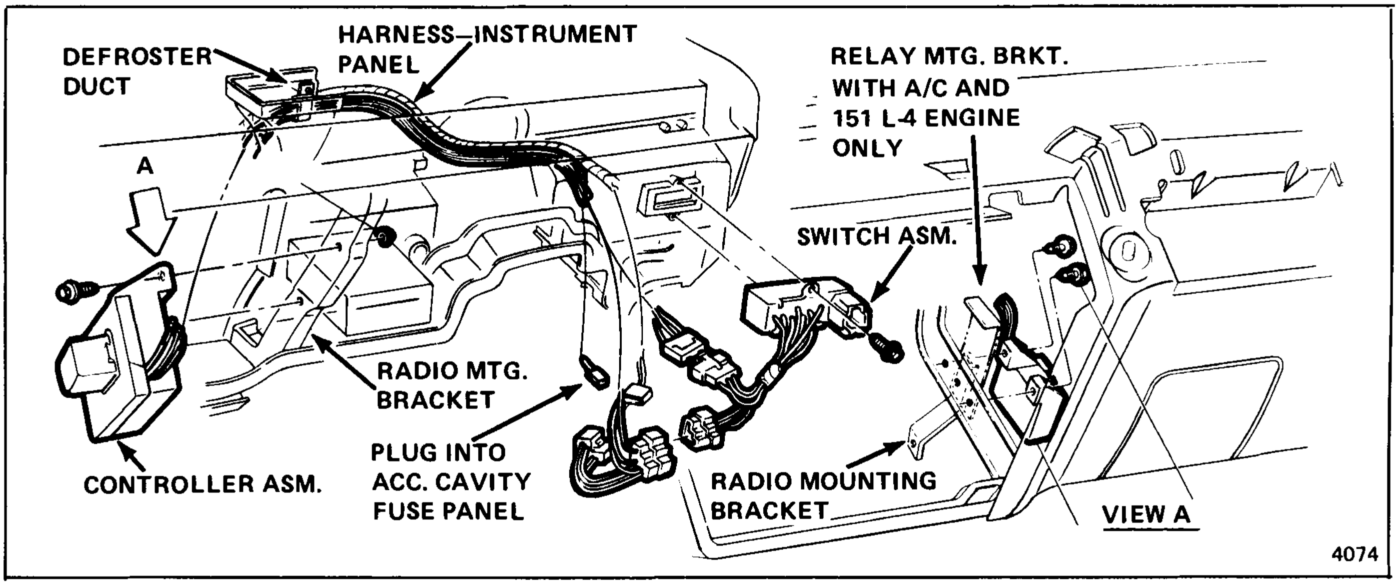


Fig. 9-91 Controlled Cycle Wiper - X Series

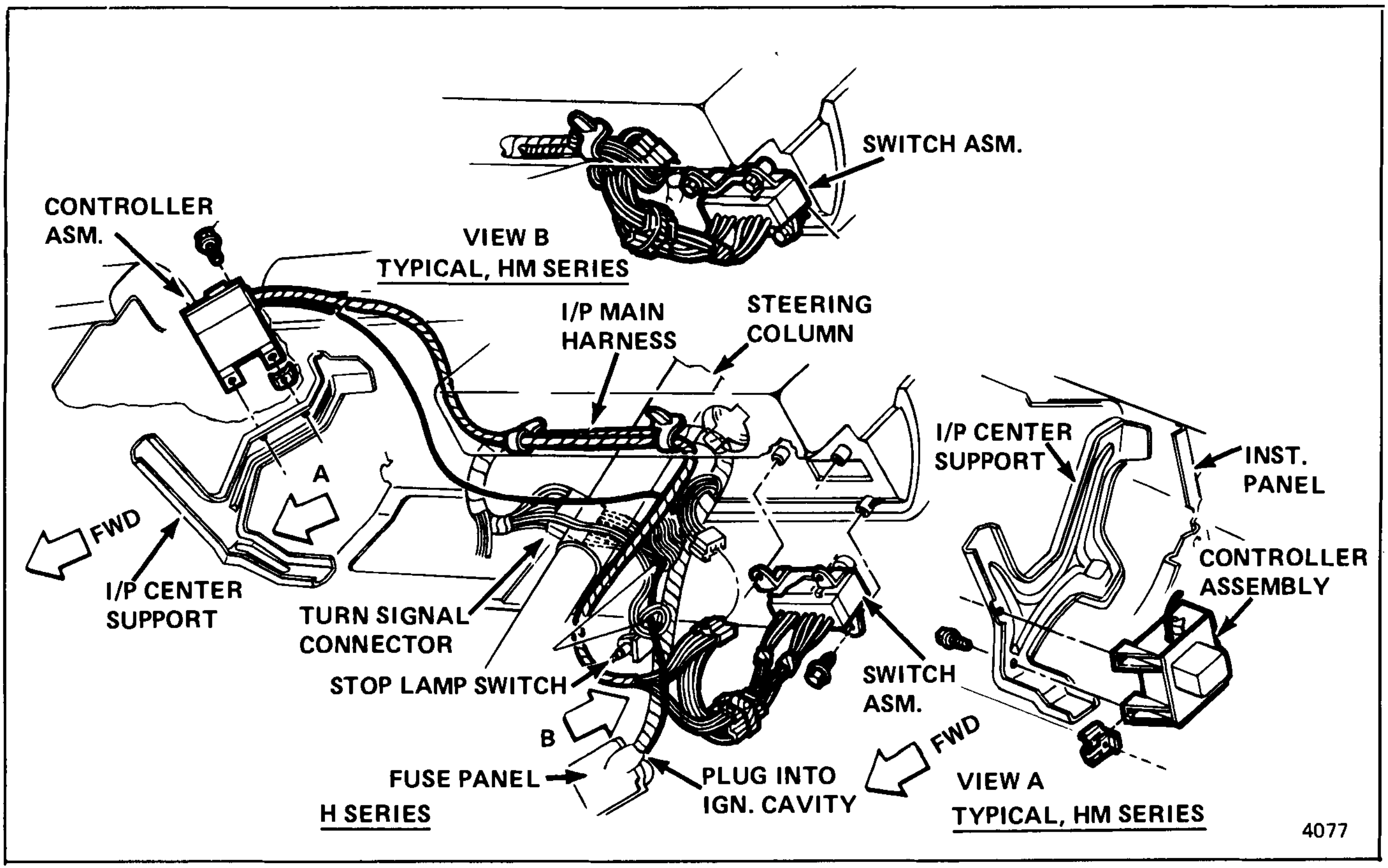


Fig. 9-92 Controlled Cycle Wiper - H and HM Series

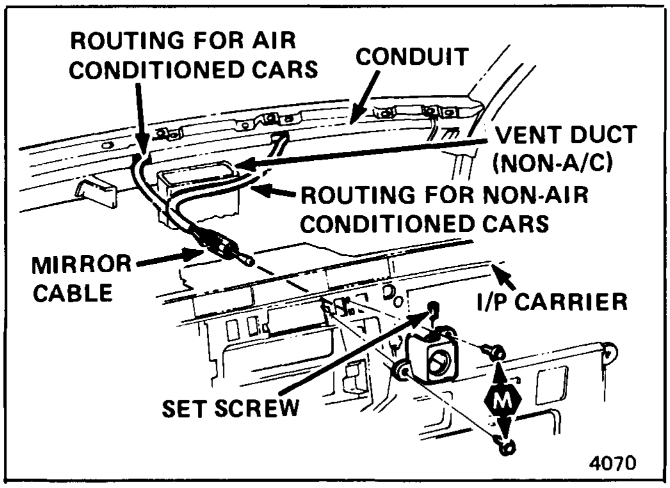


Fig. 9-93 R.H. Rear View Mirror - B Series

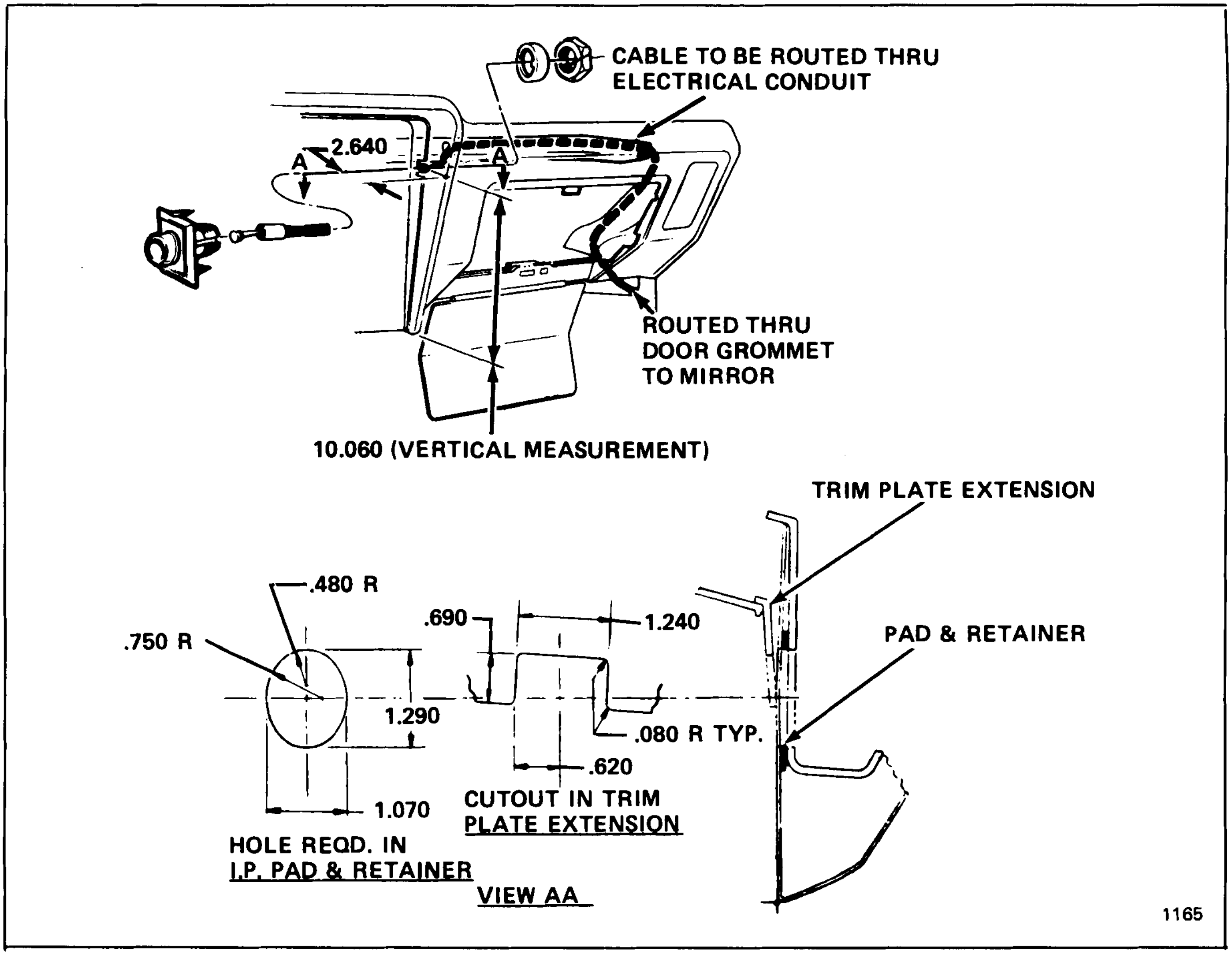


Fig. 9-94 R.H. Rear View Mirror - G Series

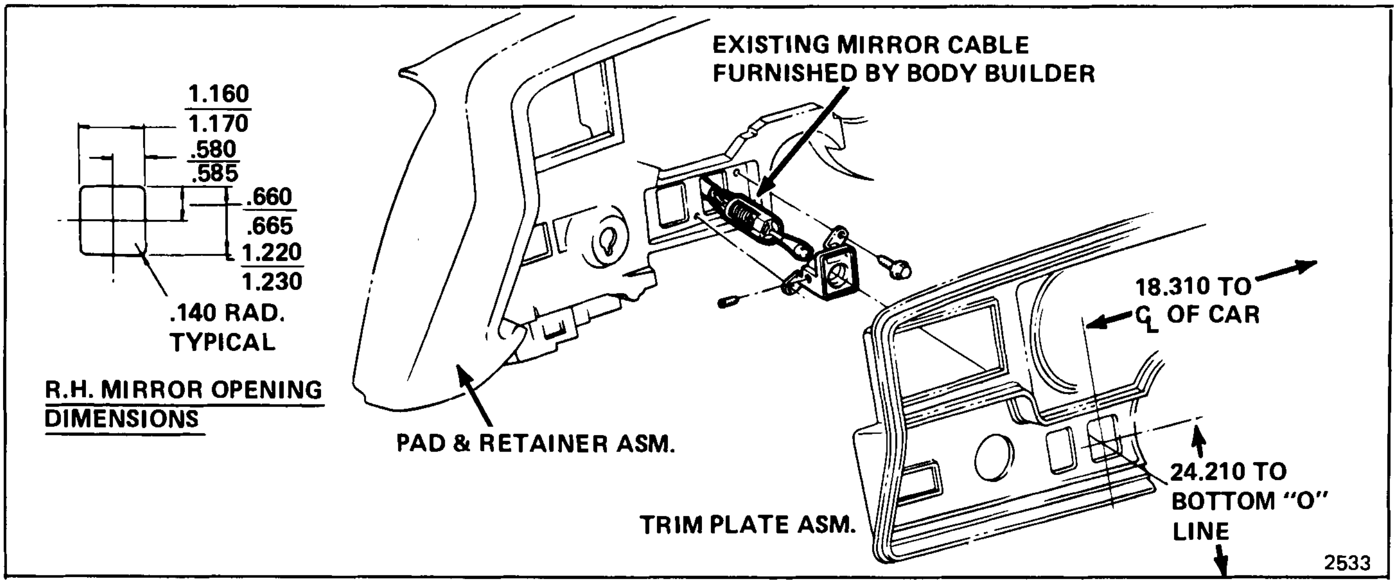


Fig. 9-95 R.H. Rear View Mirror - A Series

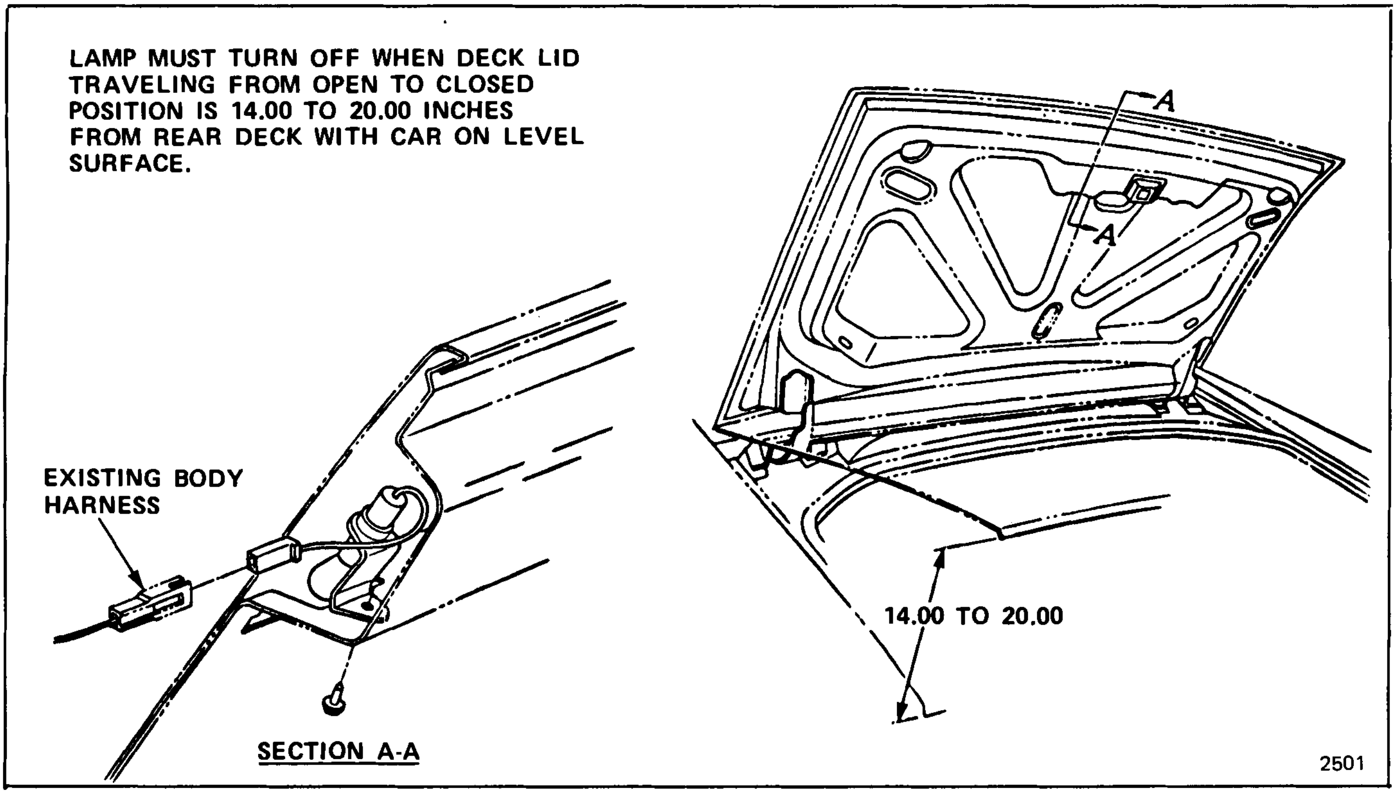


Fig. 9-96 Luggage Compartment Lamp - Typical

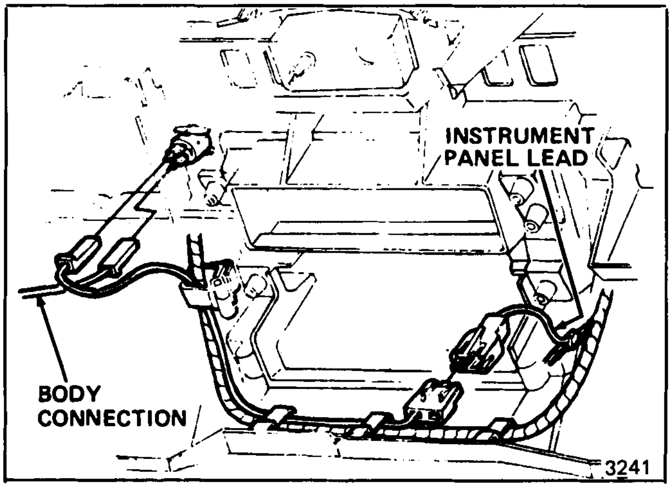


Fig. 9-97 Deck Lid Release - B Series

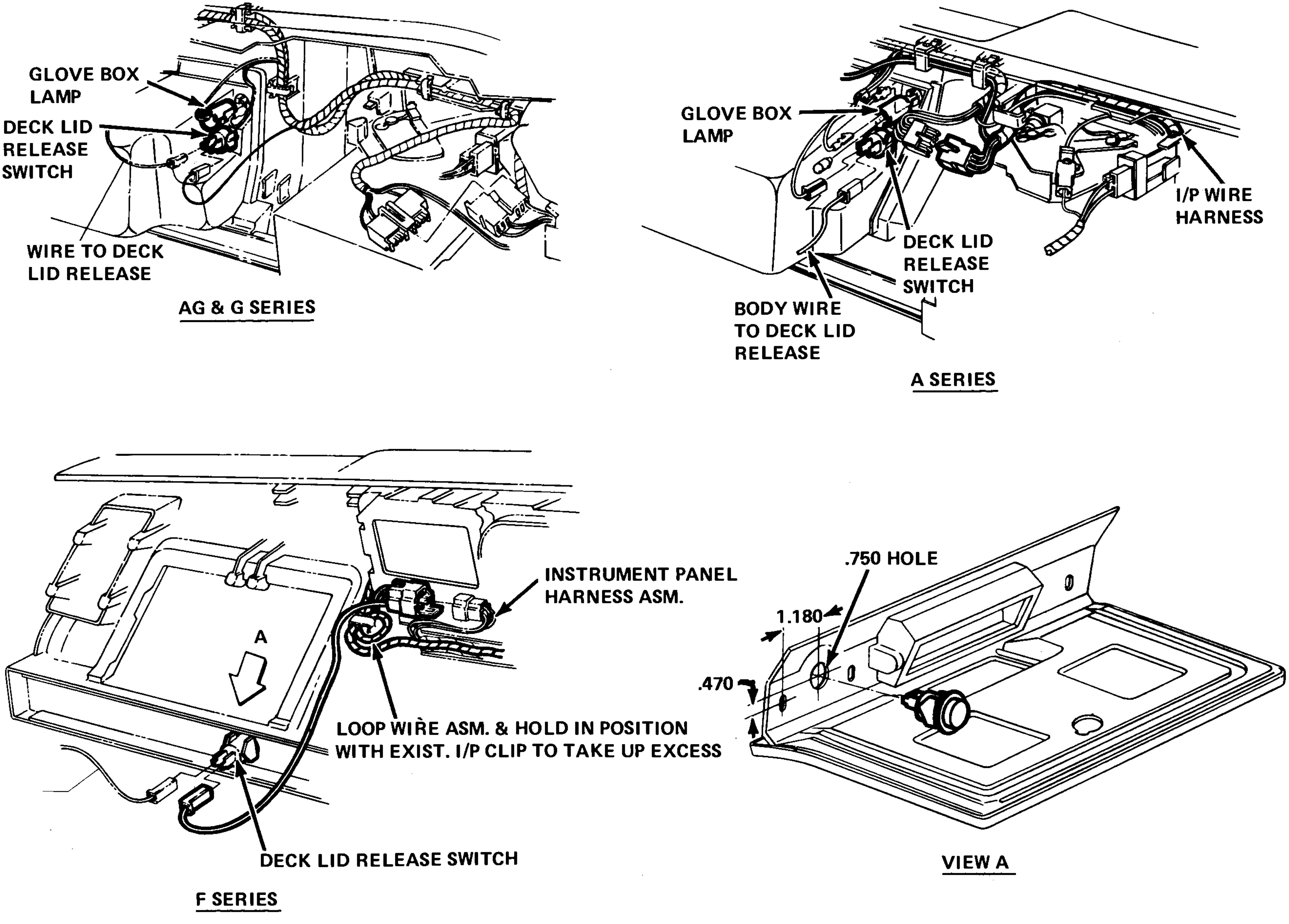
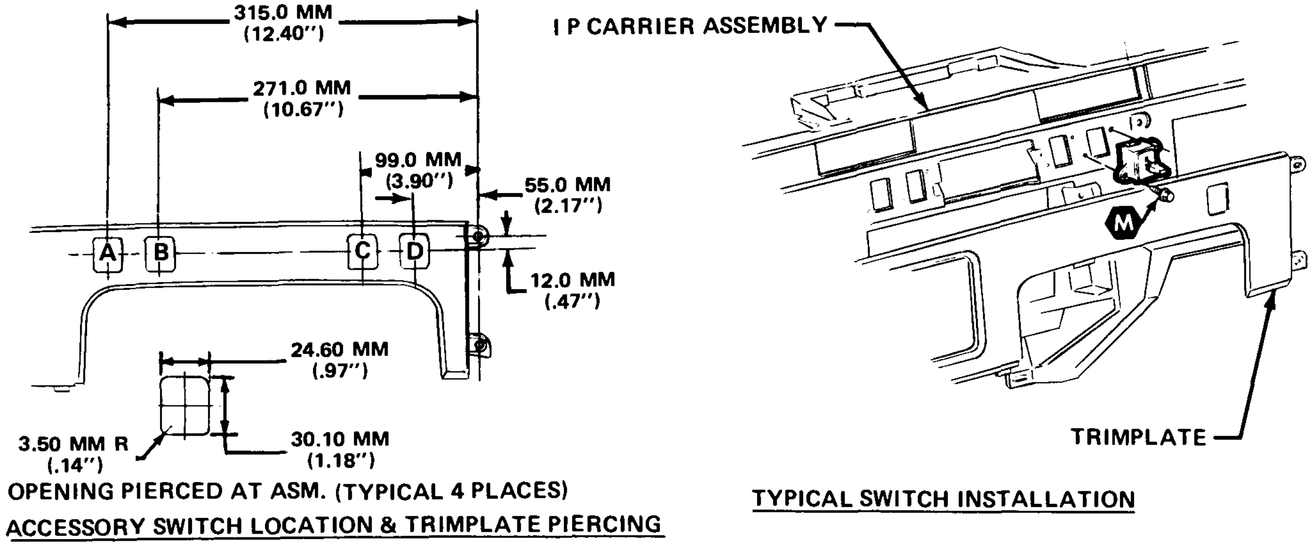


Fig. 9-98 Deck Lid Release - A, G and F Series



USE THE FOLLOWING GENERAL GUIDELINES FOR LOCATING SWITCHES:

1 SWITCH: MOUNT AT B

2 SWITCHES: MOUNT AT B AND C

3 SWITCHES: MOUNT AT A, B, AND C

4 SWITCHES: ALL FOUR LOCATIONS

NOTE: REMOTE MIRROR IS ALWAYS MOUNTED AT C.

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Fig. 9-99 Accessory Switch Mounting - B Series

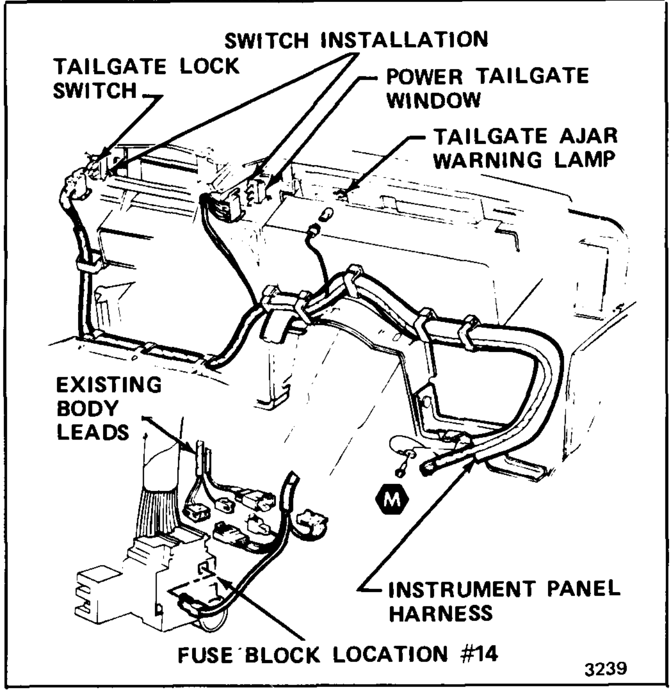


Fig. 9-100 Accessory Wiring - B Series

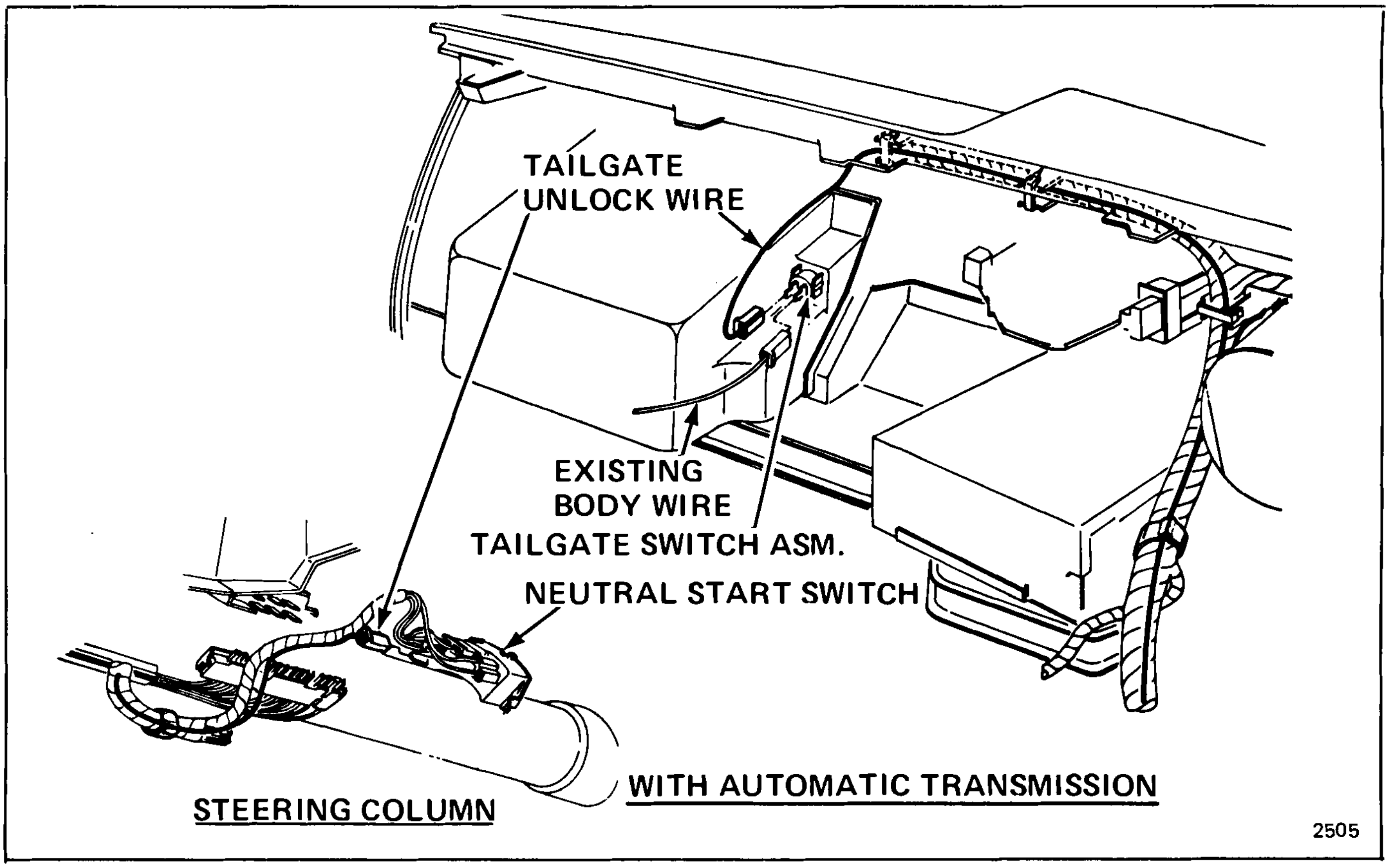


Fig. 9-101 Tailgate Release - A Series Wagon

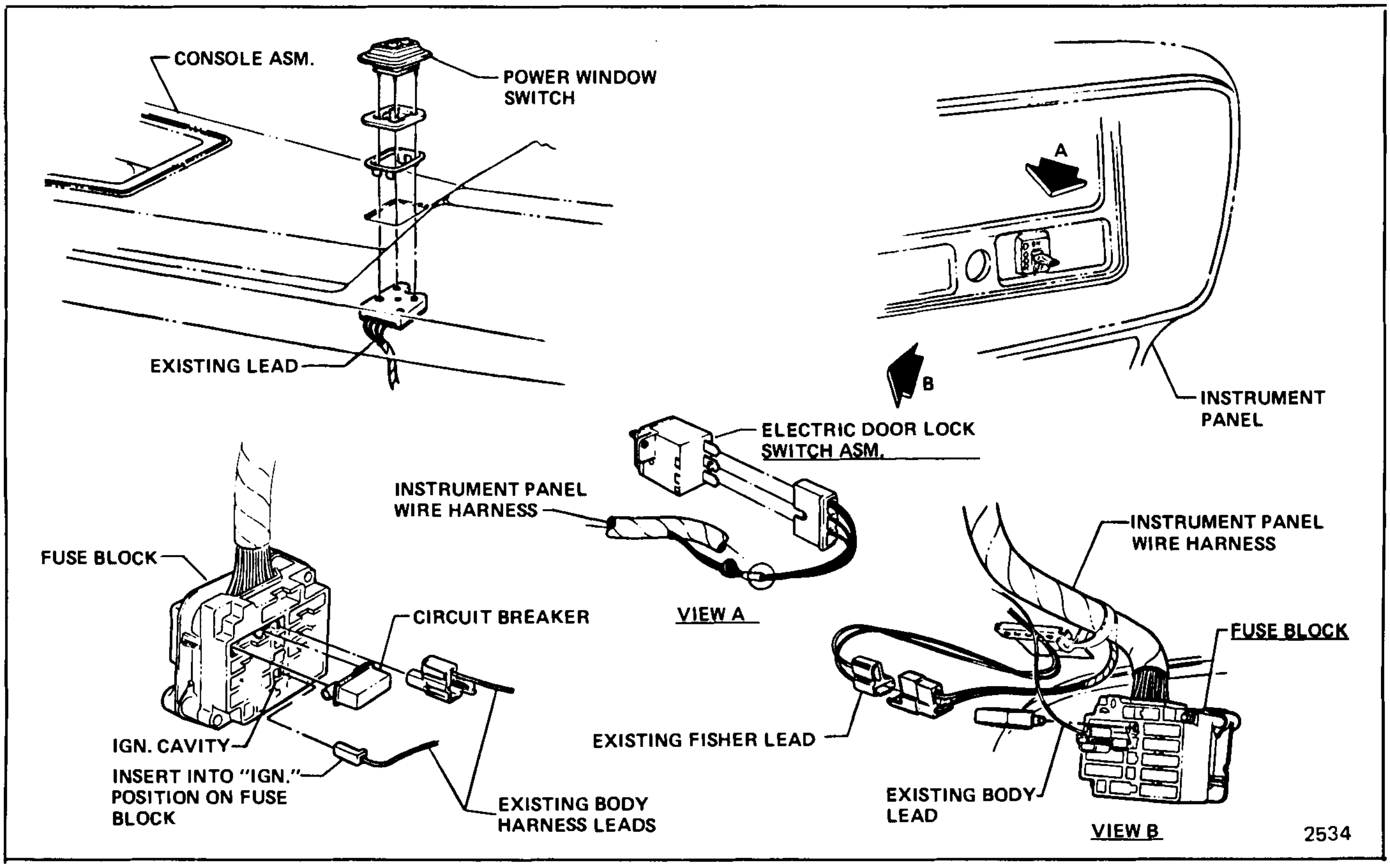
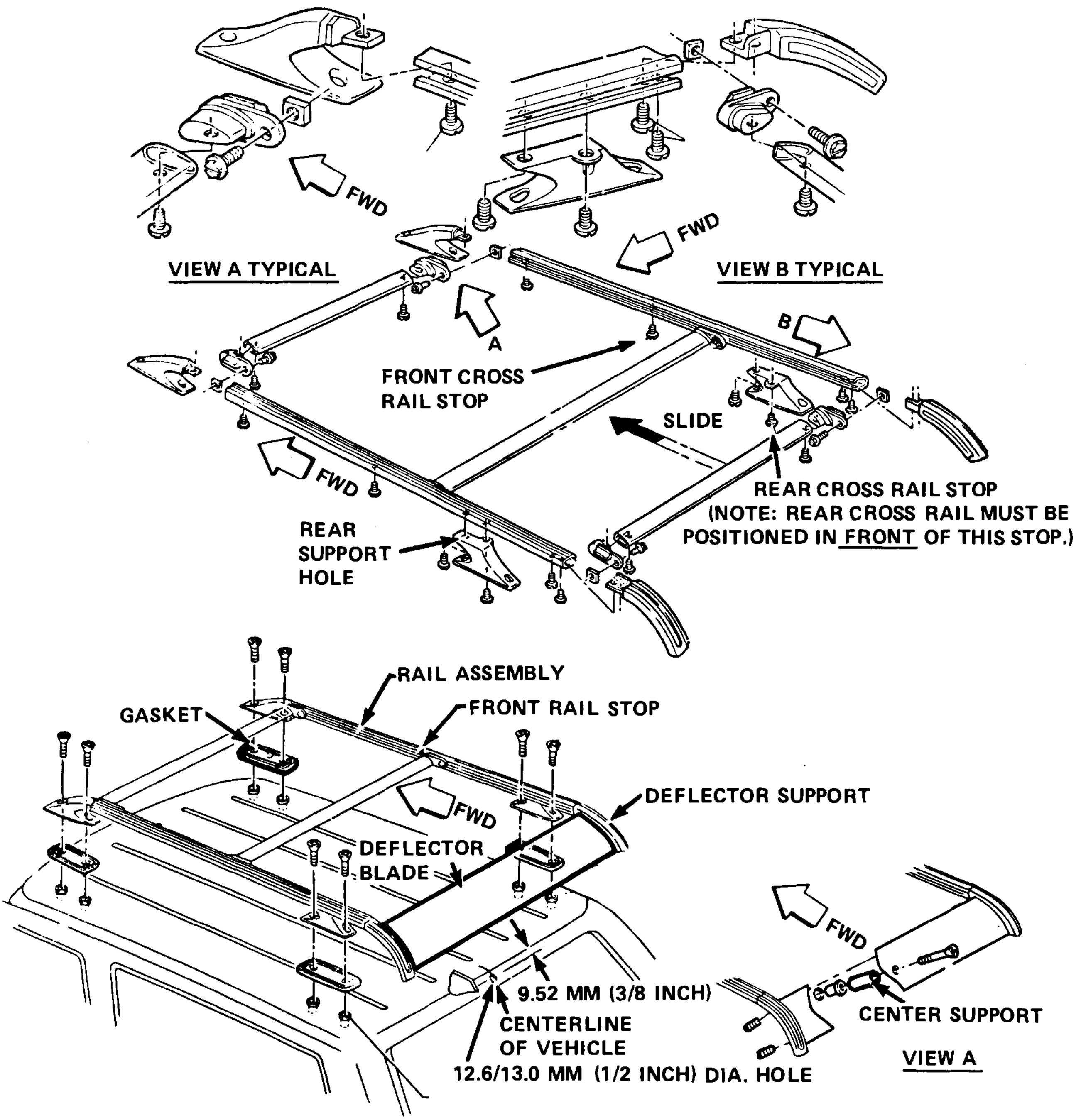


Fig. 9-102 Accessory Switch Mounting - F Series



GENERAL INSTRUCTION NOTES

1. INSTALL GASKETS AND RAIL ASSEMBLY TO ROOF WITH EXISTING SCREWS.
2. LOCATE HOLE FOR CENTER SUPPORT AS SHOWN. CAUTION: DO NOT DRILL HOLE AT THIS STAGE.
3. INSERT DEFLECTOR BLADE INTO DEFLECTOR SUPPORTS BY APPLYING SIDE PRESSURE ON SIDE RAILS AND DEFLECTOR SUPPORTS.
4. CHECK CENTER SUPPORT ALIGNMENT WITH HOLE IN DEFLECTOR BLADE AND HOLE MARKED ON ROOF. ADJUST HOLE ACROSS CAR IF REQUIRED TO PROVIDE GOOD ALIGNMENT. REMOVE DEFLECTOR BLADE AND DRILL HOLE. SEE CAUTION NOTE.

NOTE: REMOVE SCREWS AND FLAT WASHERS FROM EXISTING SPECIAL NUTS AND RETAIN SCREWS FOR INSTALLATION OF SUPPORT BRACKETS TO ROOF, DISCARD WASHERS.

CAUTION: USE DRILL STOP TO PREVENT DRILL FROM EXTENDING MORE THAN 9 MM (.35 IN.) THROUGH ROOF PANEL AND DAMAGING HEADLINER.

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Fig. 9-103 Roof Rack Installation - B Series

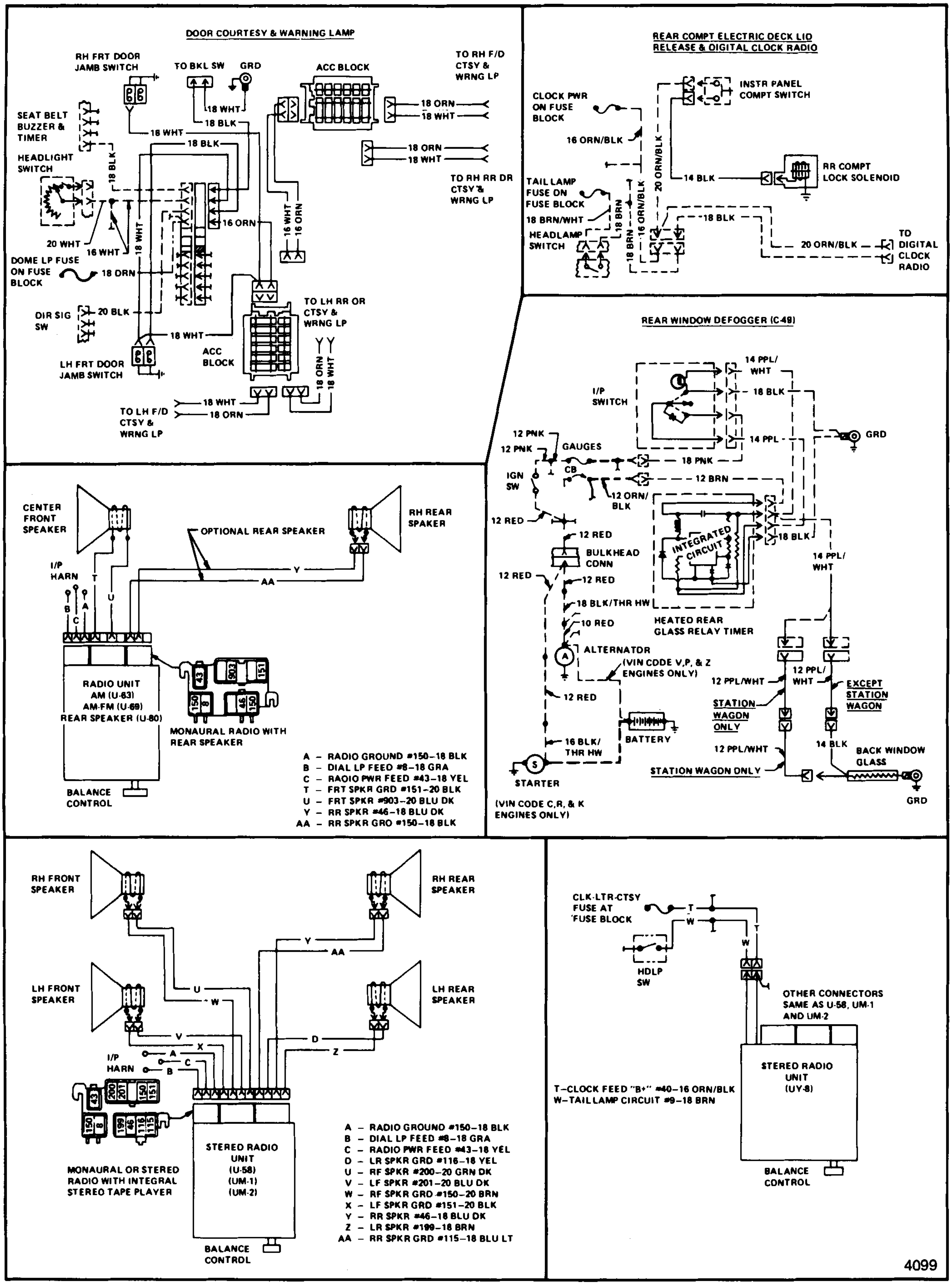


Fig. 9-104 Accessory Wiring Diagram - B Series

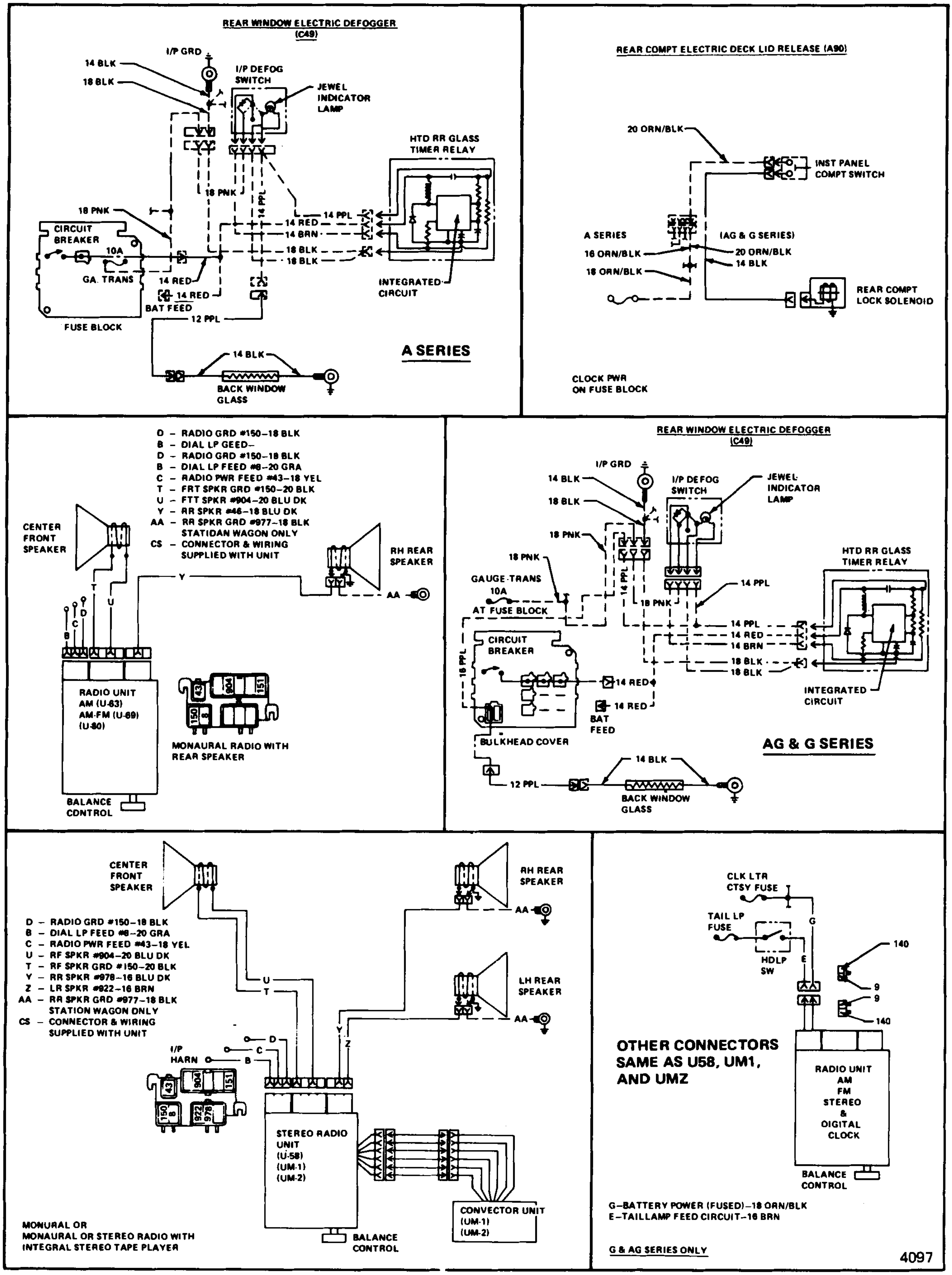
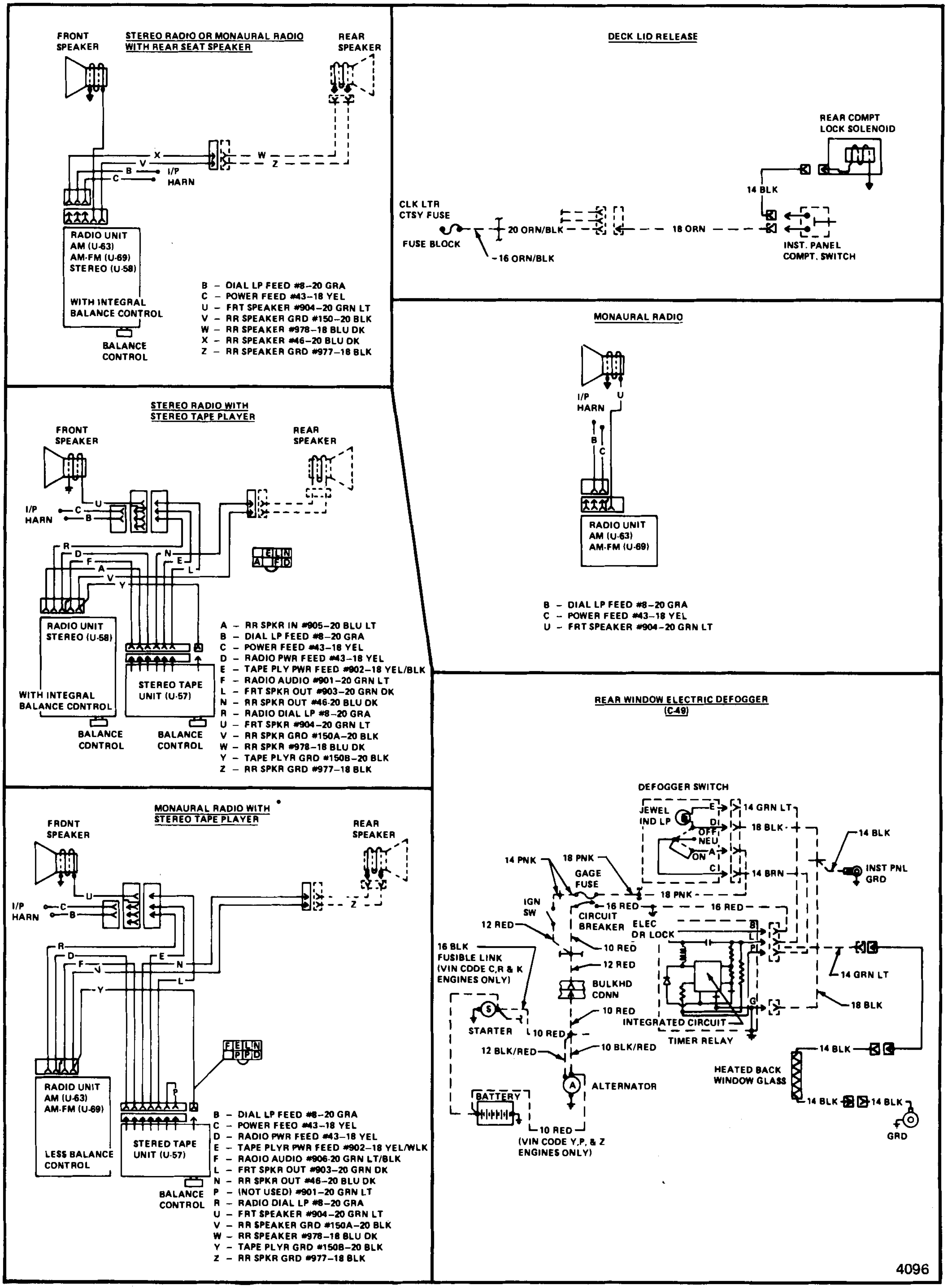


Fig. 9-105 Accessory Wiring Diagram - A and G Series



STEREO RADIO OR MONAURAL RADIO WITH REAR SEAT SPEAKER

B – DIAL LP FEED #8–20 GRA
C – POWER FEED #43–18 YEL
U – FRT SPEAKER #904–20 GRN LT
V – RR SPEAKER GRD #150–20 BLK
W – RR SPEAKER #978–18 BLU DK
X – RR SPEAKER #46–20 BLU DK
Z – RR SPEAKER GRD #977–18 BLK

DECK LID RELEASE

MONAURAL RADIO

B – DIAL LP FEED #8–20 GRA
C – POWER FEED #43–18 YEL
U – FRT SPEAKER #904–20 GRN LT

STEREO RADIO WITH STEREO TAPE PLAYER

A – RR SPKR IN #905–20 BLU LT
B – DIAL LP FEED #8–20 GRA
C – POWER FEED #43–18 YEL
D – RADIO PWR FEED #43–18 YEL
E – TAPE PLY PWR FEED #902–18 YEL/BLK
F – RADIO AUDIO #901–20 GRN LT
L – FRT SPKR OUT #903–20 GRN DK
N – RR SPKR OUT #46-20 BLU DK
R – RADIO DIAL LP #8–20 GRA
U – FRT SPKR #904–20 GRN LT
V – RR SPKR GRD #150A–20 BLK
W – RR SPKR #978–18 BLU DK
Y – TAPE PLYR GRD #150B–20 BLK
Z – RR SPKR GRD #977–18 BLK

REAR WINDOW ELECTRIC DEFOGGER (C-49)

MONAURAL RADIO WITH STEREO TAPE PLAYER

B – DIAL LP FEED #8–20 GRA
C – POWER FEED #43–18 YEL
D – RADIO PWR FEED #43–18 YEL
E – TAPE PLYR PWR FEED #902–18 YEL/WLK
F – RADIO AUDIO #906-20 GRN LT/BLK
L – FRT SPKR OUT #903–20 GRN DK
N – RR SPKR OUT #46–20 BLU DK
P – (NOT USED) #901–20 GRN LT
R – RADIO DIAL LP #8–20 GRA
U – FRT SPEAKER #904–20 GRN LT
V – RR SPEAKER GRD #150A–20 BLK
W – RR SPEAKER #978–18 BLU DK
Y – TAPE PLYR GRD #150B–20 BLK
Z – RR SPKR GRD #977–18 BLK

Fig. 9-106 Accessory Wiring Diagram - F Series

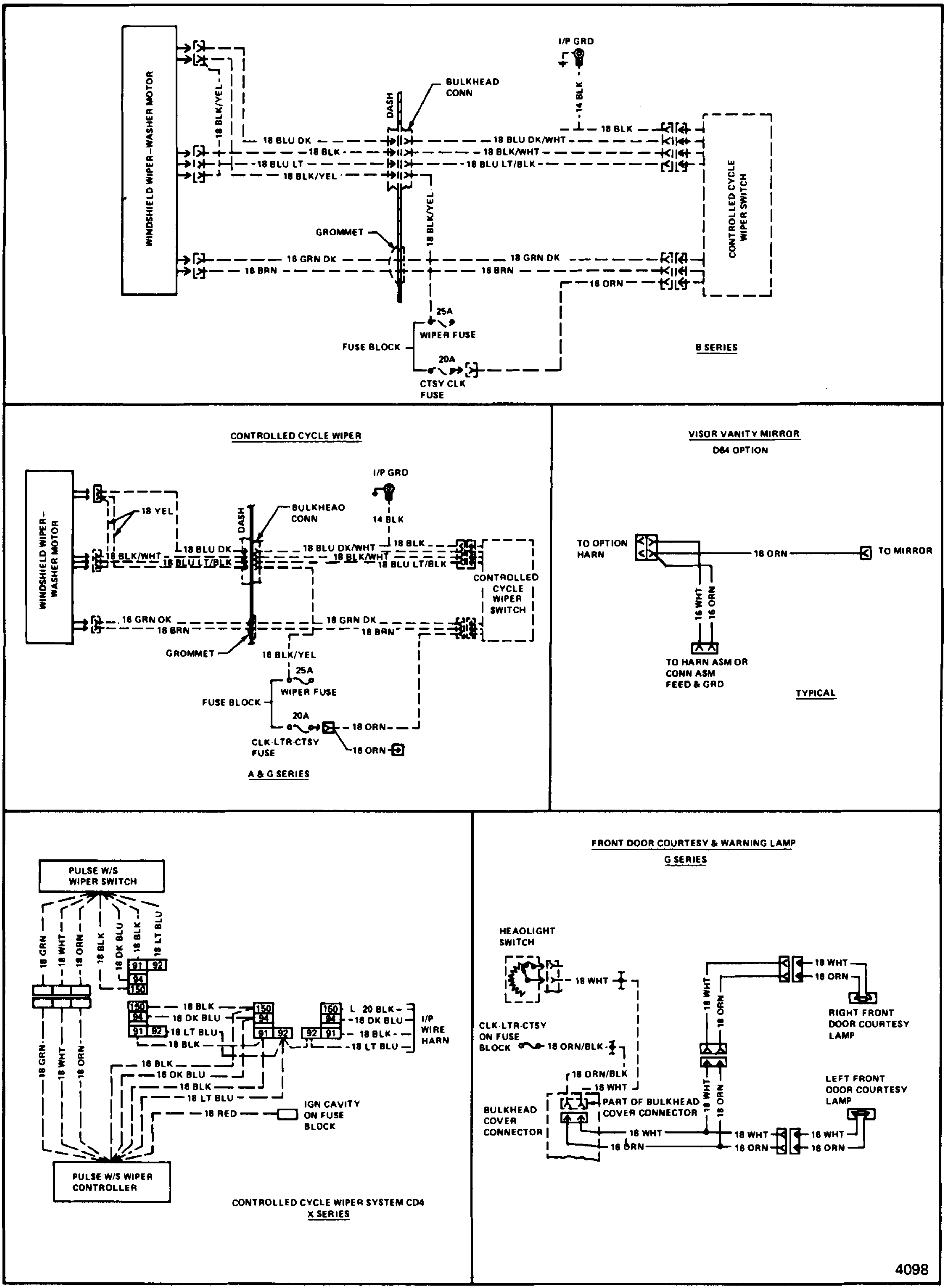


Fig. 9-107 Accessory Wiring Diagram - Miscellaneous

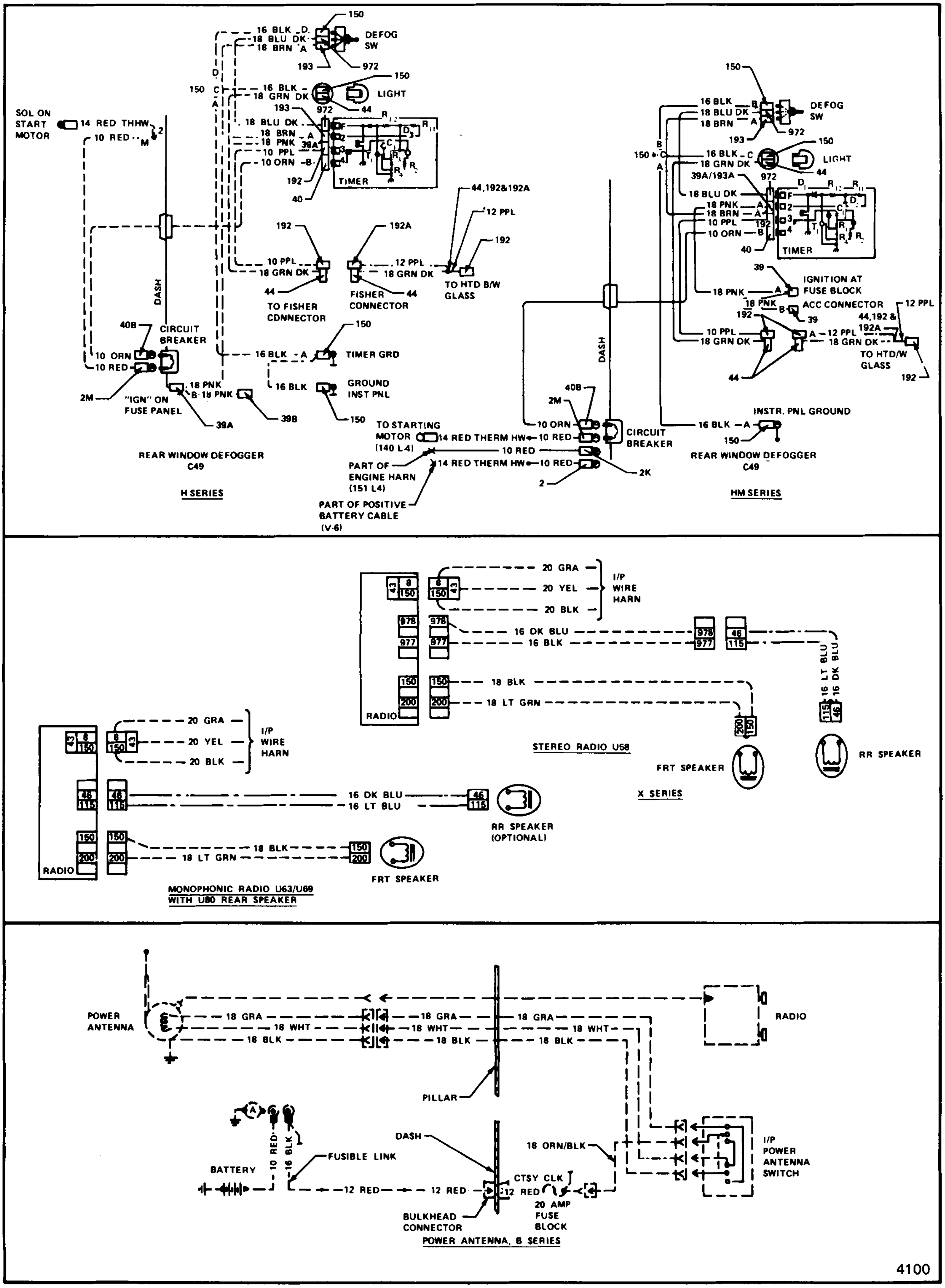


Fig. 9-108 Accessory Wiring Diagram - Miscellaneous

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