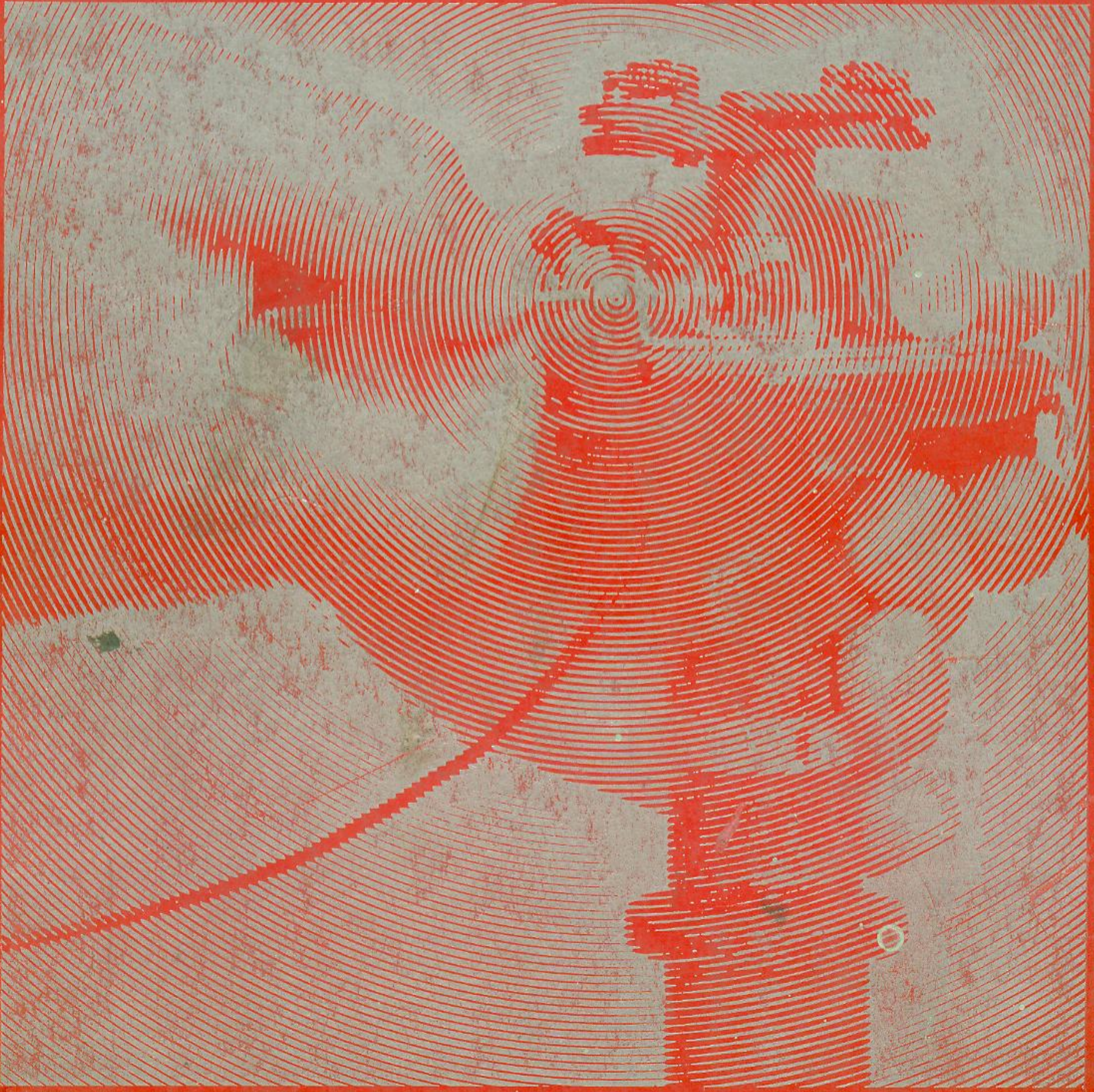
PONTIAC

GM

'72 Service Manual



1972
PONTIAC
SERVICE MANUAL

This manual applies to all 1972 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.

The arrangement of material in this manual is indicated by the table of contents at the right. Black tabs on the first page of each section register with this table to assist in readily locating information desired. A detailed table of contents appears at the beginning of each section and an alphabetic index is included at the back of the manual.

All information, illustrations and specifications contained in this literature 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 1972 Pontiac Models. In all cases, an equivalent may be used.

SERVICE DEPARTMENT

PONTIAC MOTOR DIVISION

GENERAL MOTORS CORPORATION

PONTIAC, MICHIGAN 48053

S-7204 August 1971 Litho in U.S.A.

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SECTION 0

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.

VEHICLE IDENTIFICATION PLATE

Serial number, assembly plant code, engine, exhaust, 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. 0-1.

NOTE: *The 1972 F Series V.I.N. plates will be sequenced in consecutive order starting with 500001 rather than 100001.*

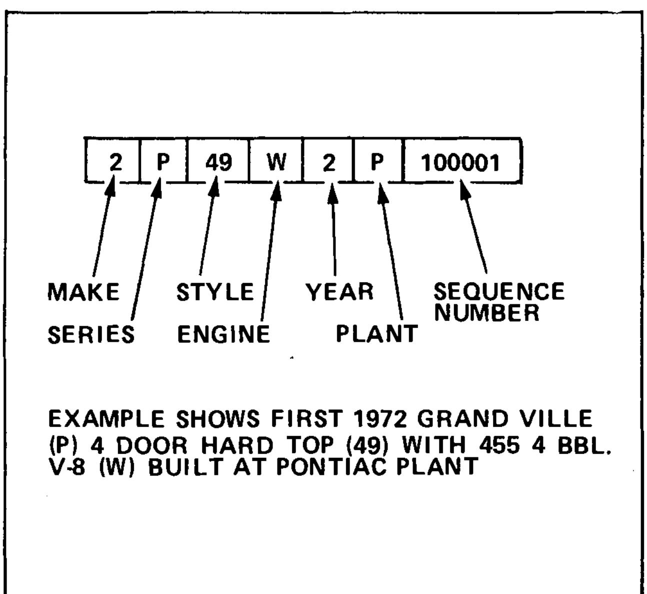


Fig. 0-1 Vehicle Identification Plate

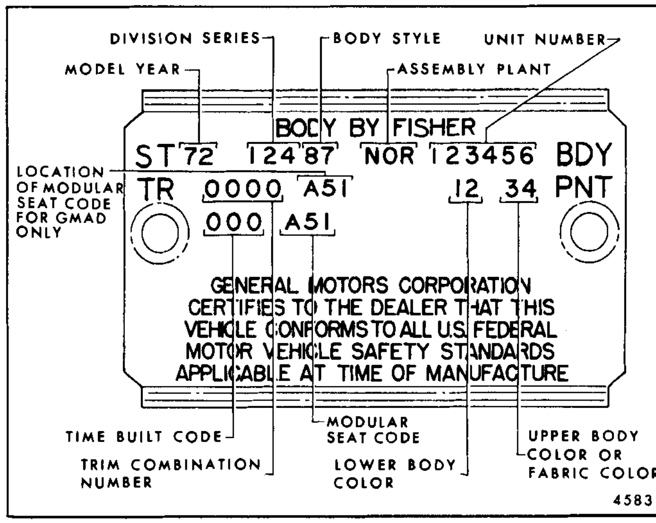


Fig. 0-2 Body Identification Plate

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. 0-2). This plate is attached to the left side of the cowl assembly just below the rear edge of the hood.

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" numbers. Fig. 0-3 shows both methods of identification.

The letter code in the vehicle identification number shows the plant where a given car was built (Fig. 0-4).

SERIES NAME	SERIES	MODEL	STYLE NO.	V. I. MODEL NO.
VENTURA II 21300	X	2 Door Sedan	21327	2Y27
	X	4 Door Sedan	21369	2Y69
FIREBIRD 22300	F	Firebird	22387	2S87
	F	Esprit	22487	2T87
	F	Formula	22687	2U87
	F	Trans Am	22887	2V87
LE MANS 23500	A	2 Door Sedan	23527	2D27
	A	2 Door Hardtop	23537	2D37
	A	4 Door Sedan	23569	2D69
	A	2 Seat Station Wagon	23536	2D36
	A	3 Seat Station Wagon	23546	2D46
	A	2 Door Convertible	23567	2D67
LUXURY LE MANS 24400	A	2 Door Hardtop	24437	2G37
	A	4 Door Hardtop	24439	2G39
CATALINA 25200	B	2 Door Hardtop	25257	2L57
	B	4 Door Hardtop	25239	2L39
	B	4 Door Sedan	25269	2L69
	B	2 Door Convertible	25267	2L67
	B	2 Seat Station Wagon	25235	2L35
	B	3 Seat Station Wagon	25245	2L45
CATALINA BROUGHAM 25800	B	2 Door Hardtop	25857	2M57
	B	4 Door Hardtop	25839	2M39
	B	4 Door Sedan	25869	2M69
BONNEVILLE 26200	B	2 Door Hardtop	26257	2N57
	B	4 Door Hardtop	26239	2N39
	B	4 Door Sedan	26269	2N69
	B	2 Seat Station Wagon	26235	2N35
	B	3 Seat Station Wagon	26245	2N45
	B	SWB Cowl	26240	2N40
	B	LWB Cowl	26290	2N90
GRAND VILLE 26800	B	2 Door Hardtop	26847	2P47
	B	4 Door Hardtop	26849	2P49
	B	2 Door Convertible	26867	2P67
GRAND PRIX 27600	G	Hardtop Coupe	27657	2K57

Fig. 0-3 Car Model Identification

PLANT	CODE	SERIES				
		A	B	F	G	X
Lakewood	A	X			X	
Southgate	C		X			
Doraville	D		X			
Framingham	G	X				
Van Nuys	L			X		X
Norwood	N			X		
Pontiac	P	X	X		X	
Kansas City, Kansas	X		X			
Fremont	Z	X				
St. Therese	2		X			
Willow Run	W					X

Fig. 0-4 Assembly Plants

ENGINE IDENTIFICATION

The engine letter code that appears on the vehicle identification plate in Fig. 0-1 represents engine information as shown in Fig. 0-5.

1972 ALL SERIES				
TYPE	DISPLACEMENT	CARBURETOR	EXHAUST	CODE
L6	250	1 BBL.	Single	D
V8	307	2 BBL.	Single	F
V8	350	2 BBL.	Single	M
V8	350	2 BBL.	Dual	N
V8	400	2 BBL.	Single	R
V8	400	2 BBL.	Dual	P
V8	400	4 BBL.	Single	S
V8	400	4 BBL.	Dual	T
V8	455	2 BBL.	Single	V
V8	455	2 BBL.	Dual	U
V8	455	4 BBL.	Single	W
V8	455	4 BBL.	Dual	Y
V8	455 H.O.	4 BBL.	Dual	X

Fig. 0-5 Vehicle Identification Plate Engine Code Chart

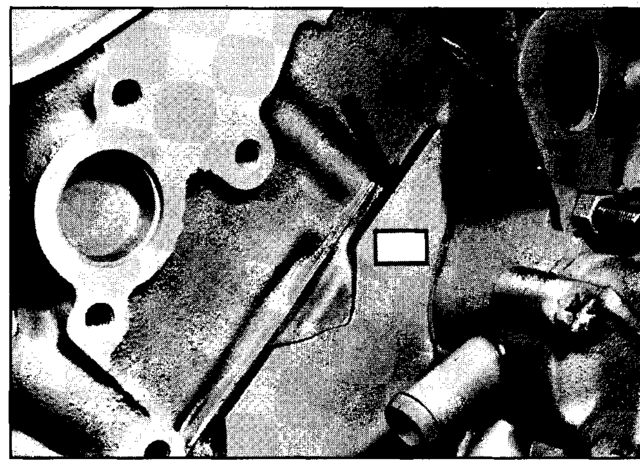


Fig. 0-6 8-Cylinder Engine Serial Number Location

8-CYL.

The 8-cyl. engine code is located beneath the production engine number on a machined pad on the right hand bank of the engine block (Fig. 0-6) and should be used whenever referring to a specific engine. For a complete listing of the various codes and engine options, refer to section 6 of this manual. See Sec. 6 for V.I. number derivative, which identifies the engine with the car.

6-CYL

The 6 cylinder engine code is stamped on the distributor mounting pad on the right side of the block (Fig. 0-7). See

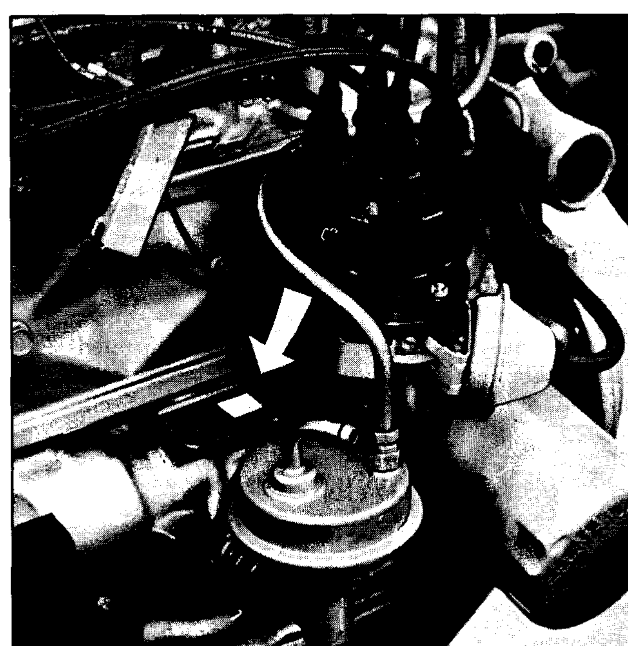


Fig. 0-7 6-Cylinder Engine Serial Number Location

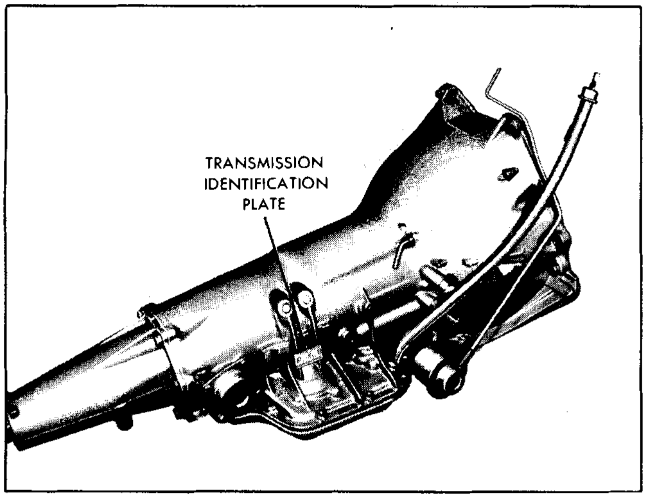


Fig. 0-8 Turbo Hydra-Matic (M-40) Serial Number Location

Sec. 6 for the V.I. number derivative, which identifies the engine with the car.

TRANSMISSION SERIAL NUMBER

TURBO HYDRA-MATIC (M-40)

The Turbo Hydra-Matic (M-40) transmission identification plate is located on the right side of the transmission case (Fig. 0-8). The serial number begins with the letter P meaning Pontiac, followed by the letter code A, B, C, etc., designating engine usage. The numerical code 72, following the two-letter code represents the model year. For more details and location of V.I. number derivative see Section 7E of this manual.

TURBO HYDRA-MATIC (M-38)

The Turbo Hydra-Matic (M-38) transmission identification number (Fig. 0-9) is located on the accumulator, at the right side of the transmission case. The serial number begins with the letter J, followed by the letter code A, B, C, etc., designating engine usage. The numerical code 72, following the two-letter code, represents the model year. For more details and location of V.I. number derivative see Section 7G of this manual.

TWO-SPEED AUTOMATIC

The transmission identification number is located (Fig. 0-10), on the right front of the transmission. For information and location of V.I. number derivative see Section 7F.

LIFTING AND TOWING

All Pontiac series and models may be lifted on the frame rails as shown in Section 2. They can also be lifted at front cross member, front lower control arms, or rear axle. When lifting on lower control arms, avoid contacting lower shock absorber brackets.

Under no circumstances should lift adapters be used on

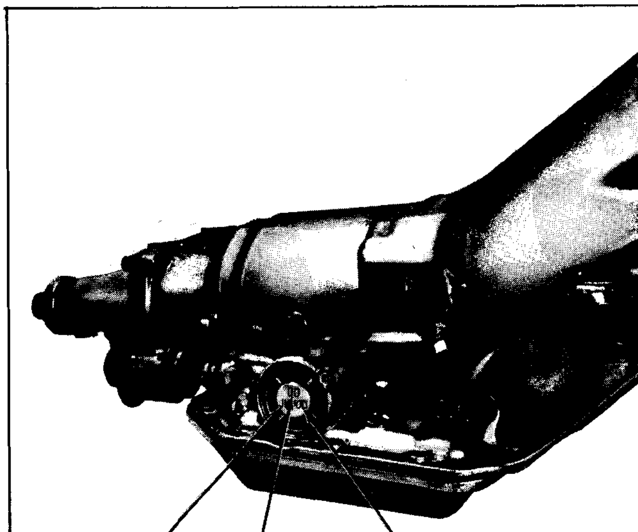


Fig. 0-9 Turbo Hydra-Matic (M-38) Serial Number Location

the bumpers, propeller shaft, transmission, rear axle or engine.

The propeller shaft and exhaust system are lower than the side rails. Lift adapters must provide adequate clearance height for these parts.

TOWING PRECAUTIONS

WARNING: TOWING A POWER STEERING-EQUIPPED CAR WITH ALL FOUR WHEELS ON THE GROUND REQUIRES EXTREME CAUTION. THERE IS NO POWER ASSIST WITH THE ENGINE OFF.

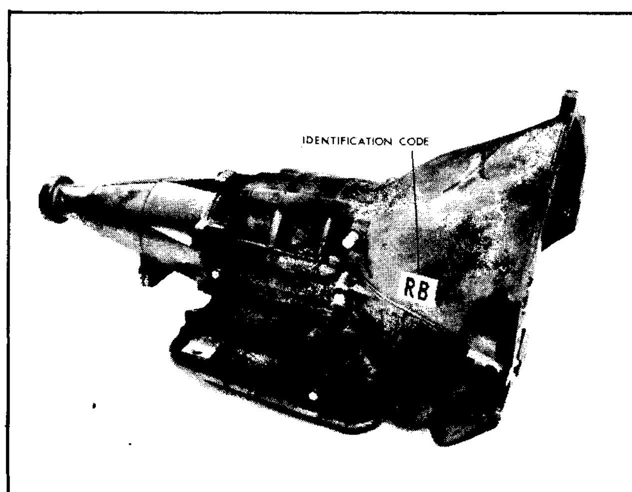


Fig. 0-10 Two Speed Automatic Transmission Serial Number

CAUTION: *If towing distance is more than 50 miles, tow from rear or disconnect propeller shaft. Do not exceed 30 m.p.h.*

Always place a rubber mat or other suitable material between the bumper and the tow chains or cables.

For front end lifting, place chains or cables around the ends of the frame side rails at both sides.

All models can be towed short distances without disconnecting the propeller shaft except in cases where the key is not available to unlock the steering column and transmission. In such a case, the propeller shaft must be disconnected and the car towed from the front. Where the transmission or propeller shaft has possibly been subject to failure or damage, the propeller shaft must be disconnected from the differential and wired to the tailpipe or car must be towed with rear wheels off the ground. If the propeller shaft is disconnected and the "U" joint bearing retaining strap is broken, wrap tape around the bearing caps to prevent loss. When towing with the rear wheels off the ground, the steering wheel must be centered and held in position by a steering wheel holding clamp or by tying it to the window division channel. Tire to ground clearance should not exceed 6 inches while towing the car.

IGNITION AND TRUNK LOCKS

REMOVE

1. Remove lock assembly from steering column. See Section 9.
2. Production Lock is not serviceable and should be discarded.

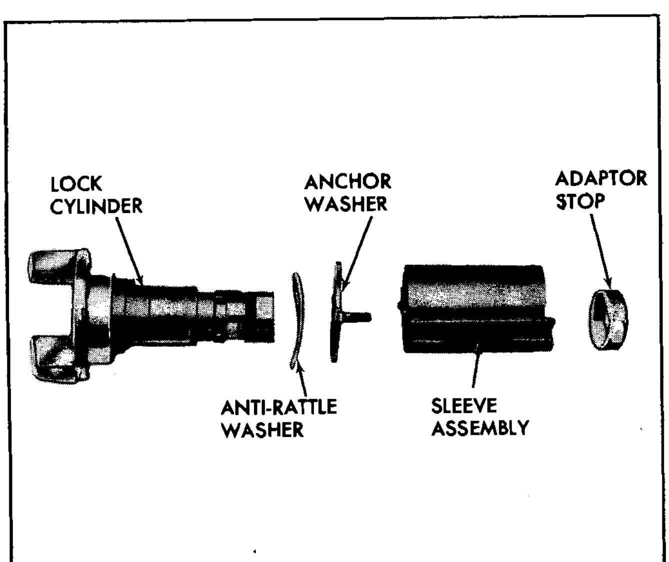


Fig. 0-11 Exploded View of Lock Cylinder

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. 0-11).

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. 0-12.

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 as shown in Fig. 0-13.

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

Two separate keys are used; type "C" (square) for ignition switch, door locks and tailgate and type "D" (oval) for the

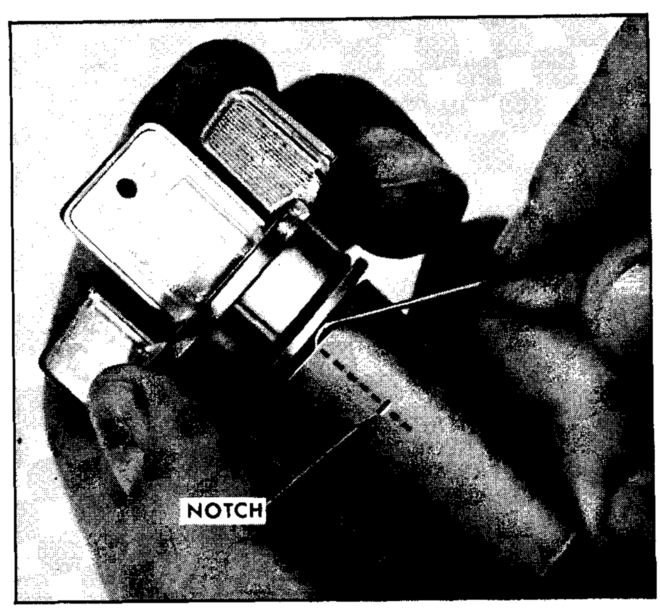


Fig. 0-12 Depressing Lock Cylinder Retaining Pin

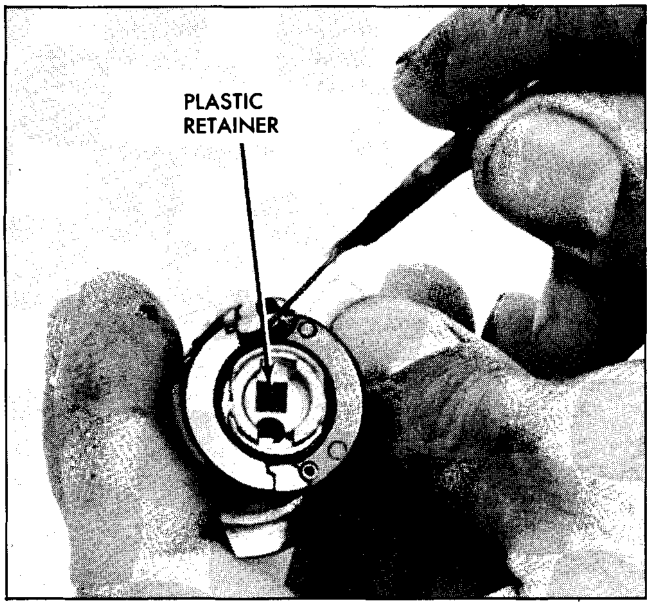


Fig. 0-13 Removing Lock From Cylinder

trunk and glove compartment. The keys will not be interchangeable with each other or with prior keys because of new keyway design.

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

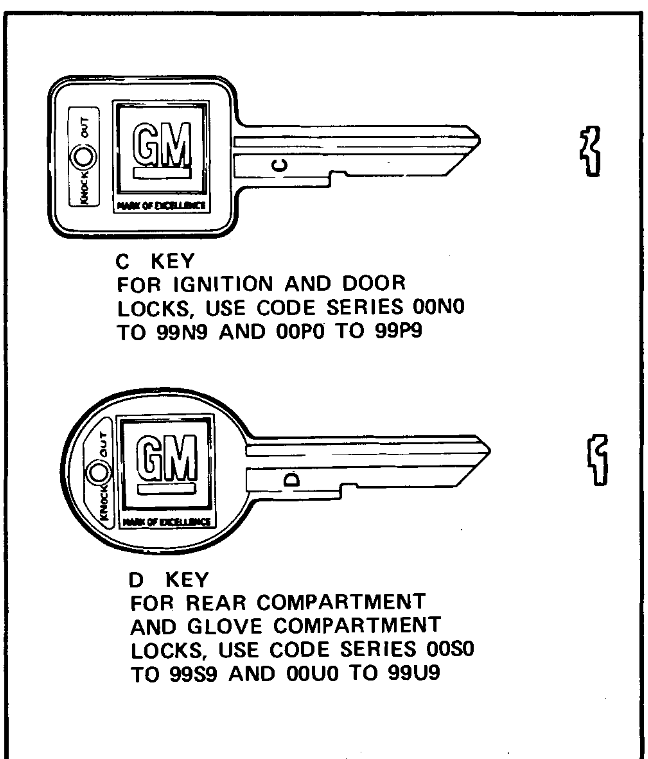


Fig. 0-14 Key Blanks

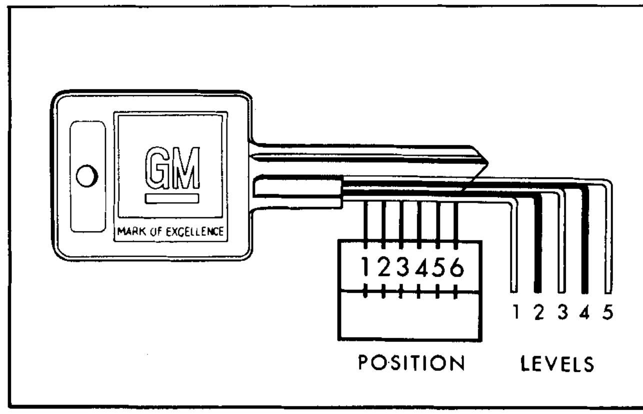


Fig. 0-15 Key Coding Diagram

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. 0-15, aligning the key with the outline as accurately as possible.

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.

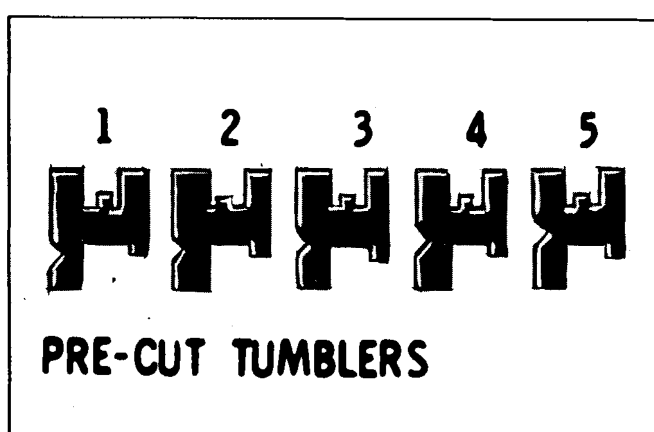


Fig. 0-16 Pre-Cut Tumblers

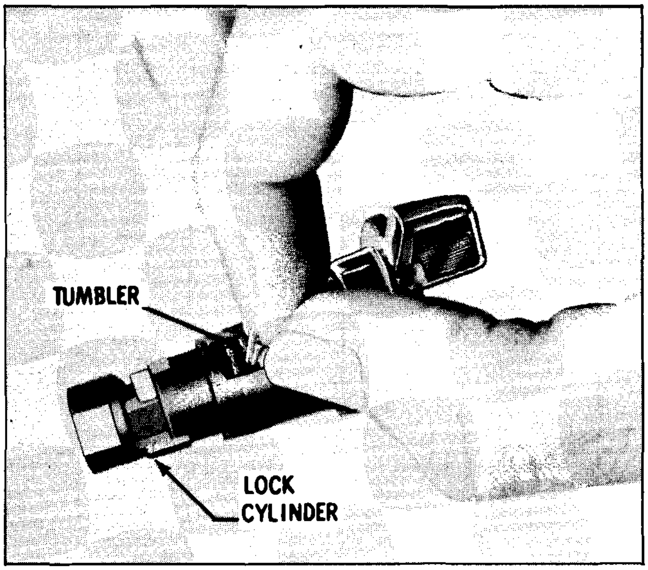


Fig. 0-17 Installing Tumblers

2. Insert spring in each round cavity of each tumbler lock between slots (Figs. 0-16 and 0-17).

   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 if correct tumblers have been installed.

5. Install spring retainer using vise. Stake as shown in Fig. 0-18.

INSTALL

1. With key inserted in lock part way, assemble wave washer and special lock washer over lock as shown in Fig. 0-11.

2. Align tang of washer over side of 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. 0-19.

6. Assemble lock and cylinder assembly into steering column. See Section 9.

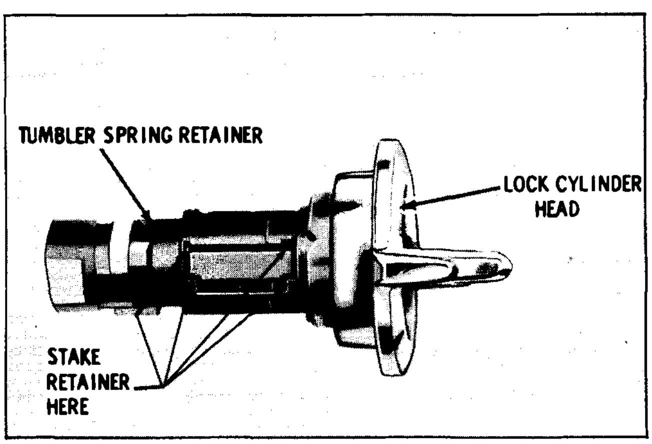


Fig. 0-18 Staking Tumbler Spring Retainer

S.A.E. NUT AND BOLT MARKINGS

Some various kinds of bolts used on Pontiac cars are illustrated in Fig. 0-20. Differences in strength of these bolts are indicated by their head markings.

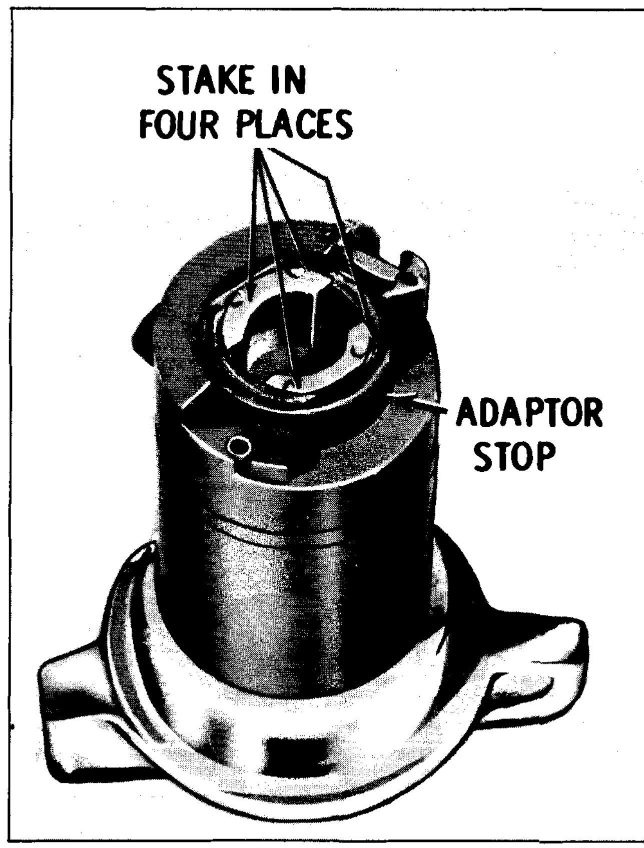


Fig. 0-19 Staking Adapter

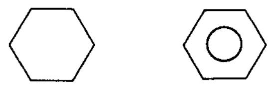
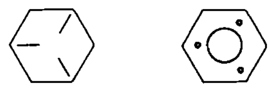
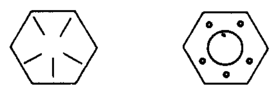
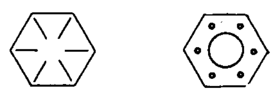
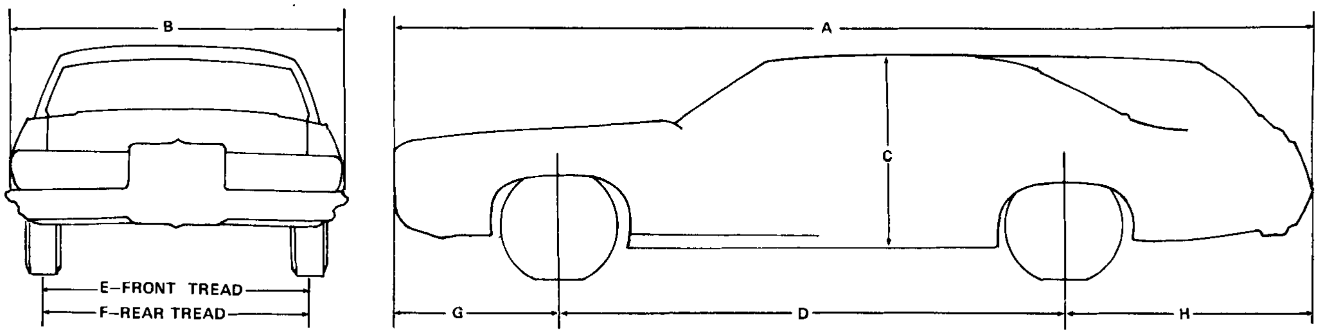
S.A.E. GRADE	MARKINGS	STRENGTH IN P.S.I.	
1 or 2		60,000	STANDARD STRENGTH
5		120,000	
7		133,000	
8		150,000	HIGH STRENGTH

Fig. 0-20 S.A.E. Nut and Bolt Markings



B & G SERIES
(ALL DIMENSIONS IN INCHES)

SERIES		252						258			262					268			276
STYLE	KEY	35	39	45	57	67	69	57	39	69	57	39	69	35	45	47	49	67	57
OVERALL LENGTH	A	228.0	22.4	228.0	222.4	222.4	222.4	222.4	222.4	222.4	226.2	226.2	226.2	228.0	228.0	226.2	226.2	226.2	212.9
WIDTH	B	79.5																	76.4
HEIGHT	C	54.2	53.6	54.2	53.4	53.7	54.3	53.4	53.6	54.3	53.4	53.6	54.3	54.2	54.2	54.2	54.2	53.7	52.0
WHEELBASE	D	127.0	123.5	127.0	123.5	123.5	123.5	123.5	123.5	123.5	126.0	126.0	126.0	127.0	127.0	126.0	126.0	126.0	118.0
TREAD–FRONT	E	64.0																	62.0
TREAD–REAR	F	64.0																	60.0

A & F SERIES
(ALL DIMENSIONS IN INCHES)

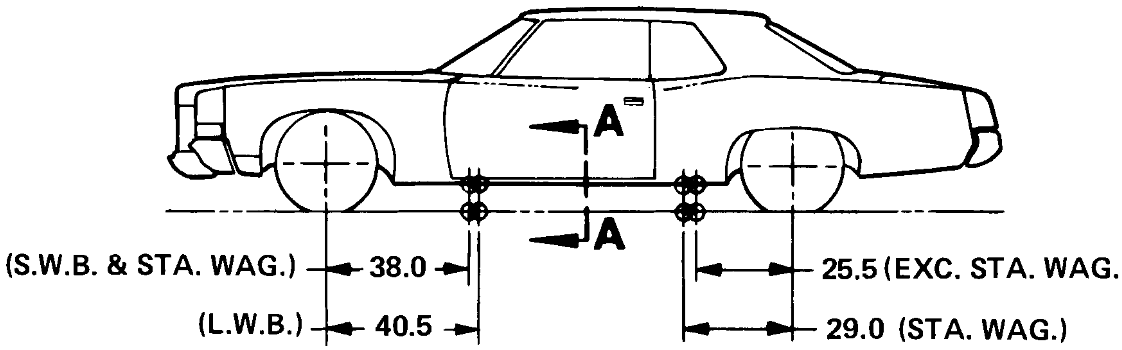
SERIES		223	235							244	
STYLE	KEY	87	27	37	69	36	46	39	67	37	39
*OVERALL LENGTH	A	191.6	202.8	202.8	206.8	210.9	210.9	206.8	202.8	202.8	210.9
WIDTH	B	73.4	76.7								
HEIGHT	C	50.4	52.0	52.0	52.6	54.5	54.5	52.6	52.3	52.0	52.6
WHEELBASE	D	108.0	112.0	112.0	116.0	116.0	116.0	116.0	112.0	112.0	116.0
TREAD–FRONT	E	61.3	61.0								
TREAD–REAR	F	60.0	60.0								

*On vehicles equipped with optional Endura front bumper add 0.5" to dimension A.

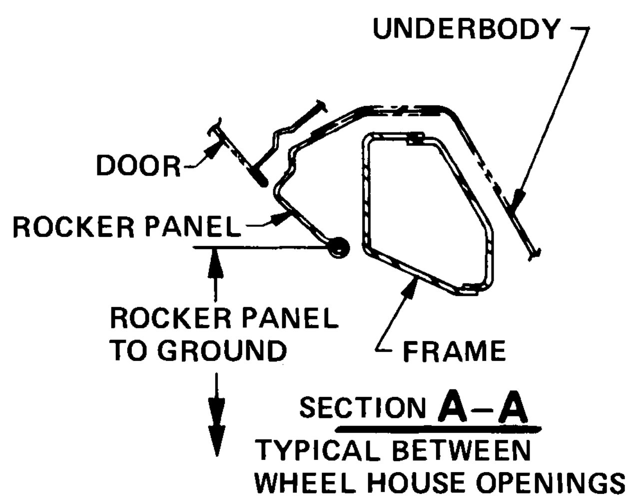
X SERIES
(ALL DIMENSIONS IN INCHES)

SERIES		213	
STYLE	KEY	27	69
OVERALL LENGTH	A	194.5	194.5
WIDTH	B	72.4	72.4
HEIGHT	C	52.5	53.9
WHEELBASE	D	111.0	111.0
TREAD–FRONT	E	59.0	59.0
TREAD–REAR	F	58.9	58.9

Fig. 0-21 Basic Dimensions

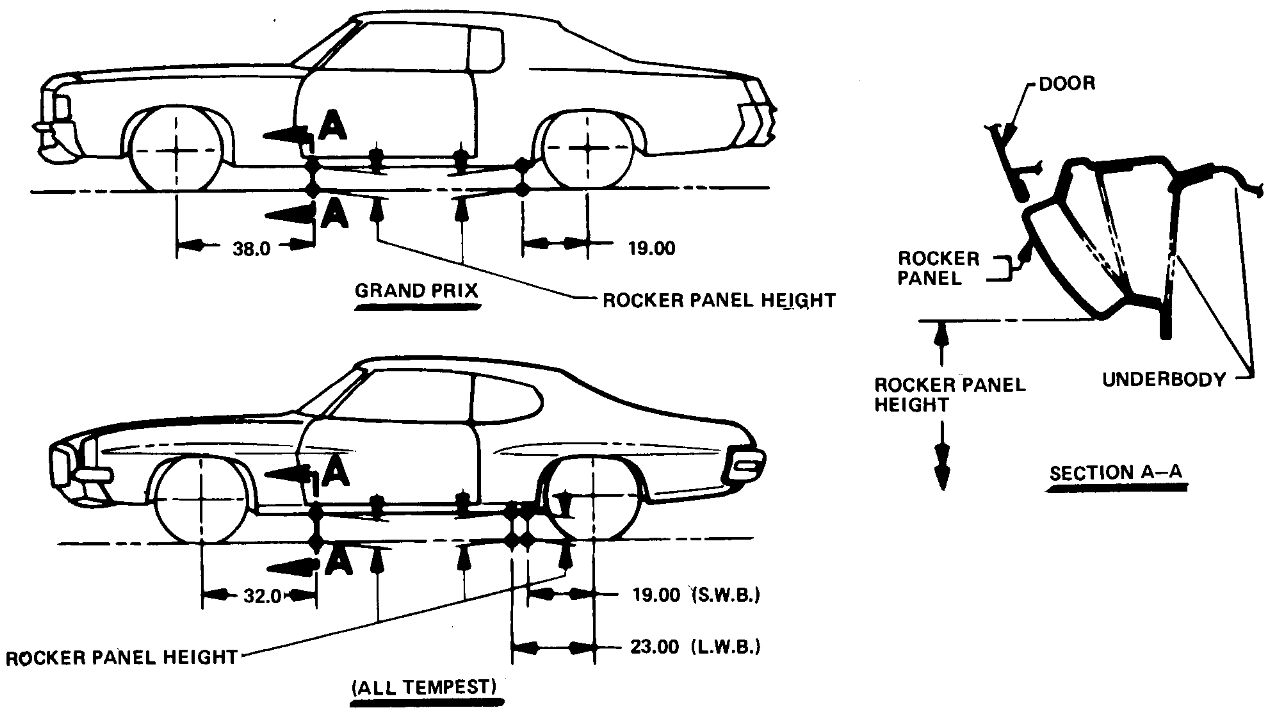


CURB ROCKER PANEL HEIGHT (NOMINAL)		MODEL
FRONT	REAR	
9.50	9.20	ALL EXC. STA. WAG. & H.D. SPRINGS
9.80	9.80	H.D. SPRINGS EXC. STA. WAG.
10.05	10.50	ALL STATION WAGONS



FOR REFERENCE ONLY–CURB LOAD CONDITION. (FULL FUEL TANK, SPECIFIED TIRE PRESSURE, STANDARD EQUIP. SPRINGS.)

Fig. 0-22 Rocker Panel Heights - B Series



CURB ROCKER PANEL HEIGHT (NOMINAL)		MODEL
FRONT	REAR	
9.50	9.10	3527, 3537, 3569 4437, 4467, 4439 (EXC. H.D. SPRINGS)
10.65	10.40	3536, 3546 (EXC. H.D. SPRINGS)
10.50	10.50	ALL H.D. SPRINGS EXC. 276 3536, 3546
9.25	9.00	276
10.65	10.65	3536, 3546 WITH H.D. SPRINGS

NOTE: TO CORRECT FOR ROCKER PANEL MOULDINGS' DEDUCT .03 FROM NOMINAL CURB ROCKER PANEL HEIGHT.

FOR REFERENCE ONLY. CURB CONDITIONS. (FULL FUEL TANK & SPECIFIED TIRE PRESSURE.)

Fig. 0-23 Rocker Panel Heights - A and G Series

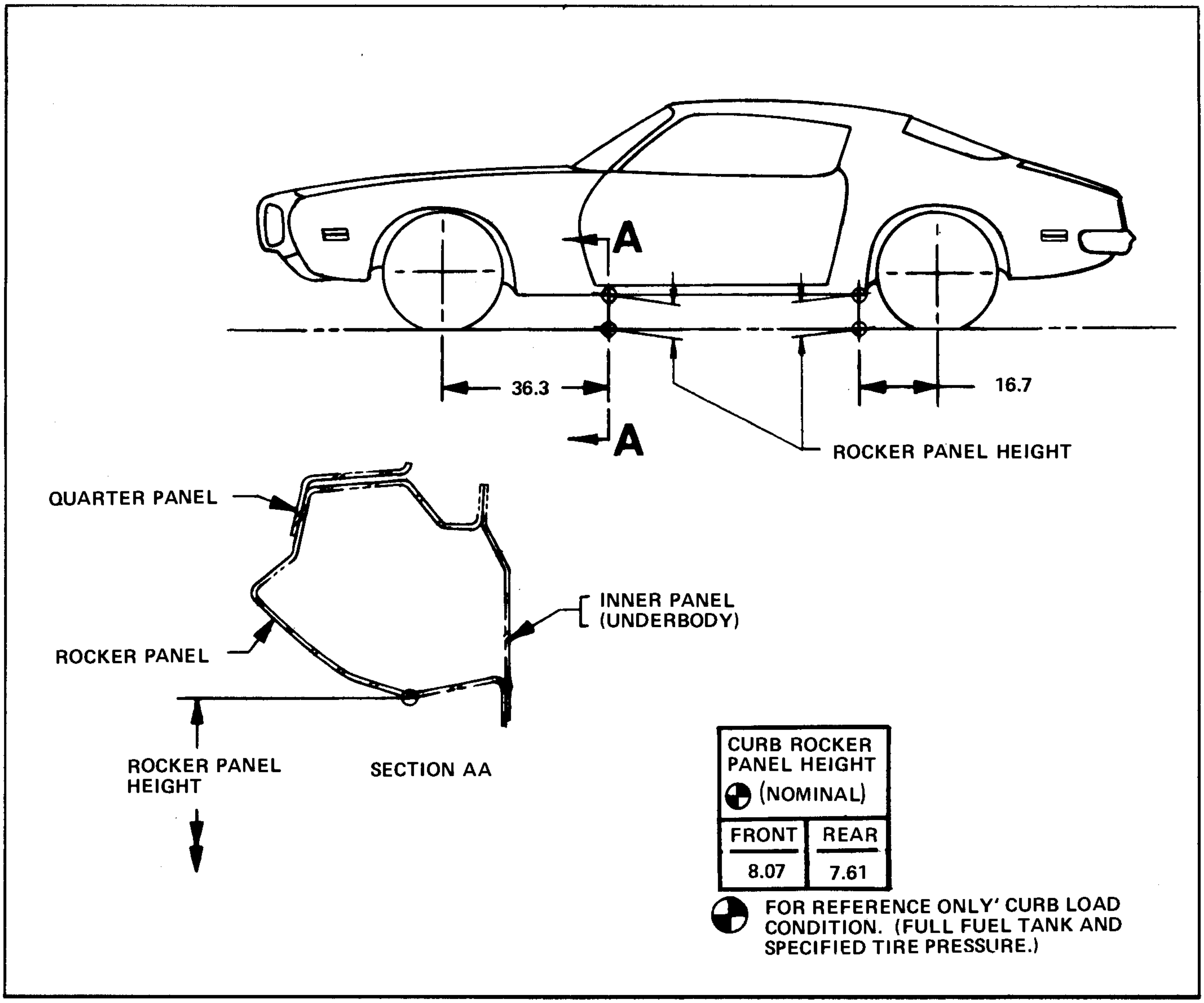


Fig. 0-24 Rocker Panel Heights - F Series

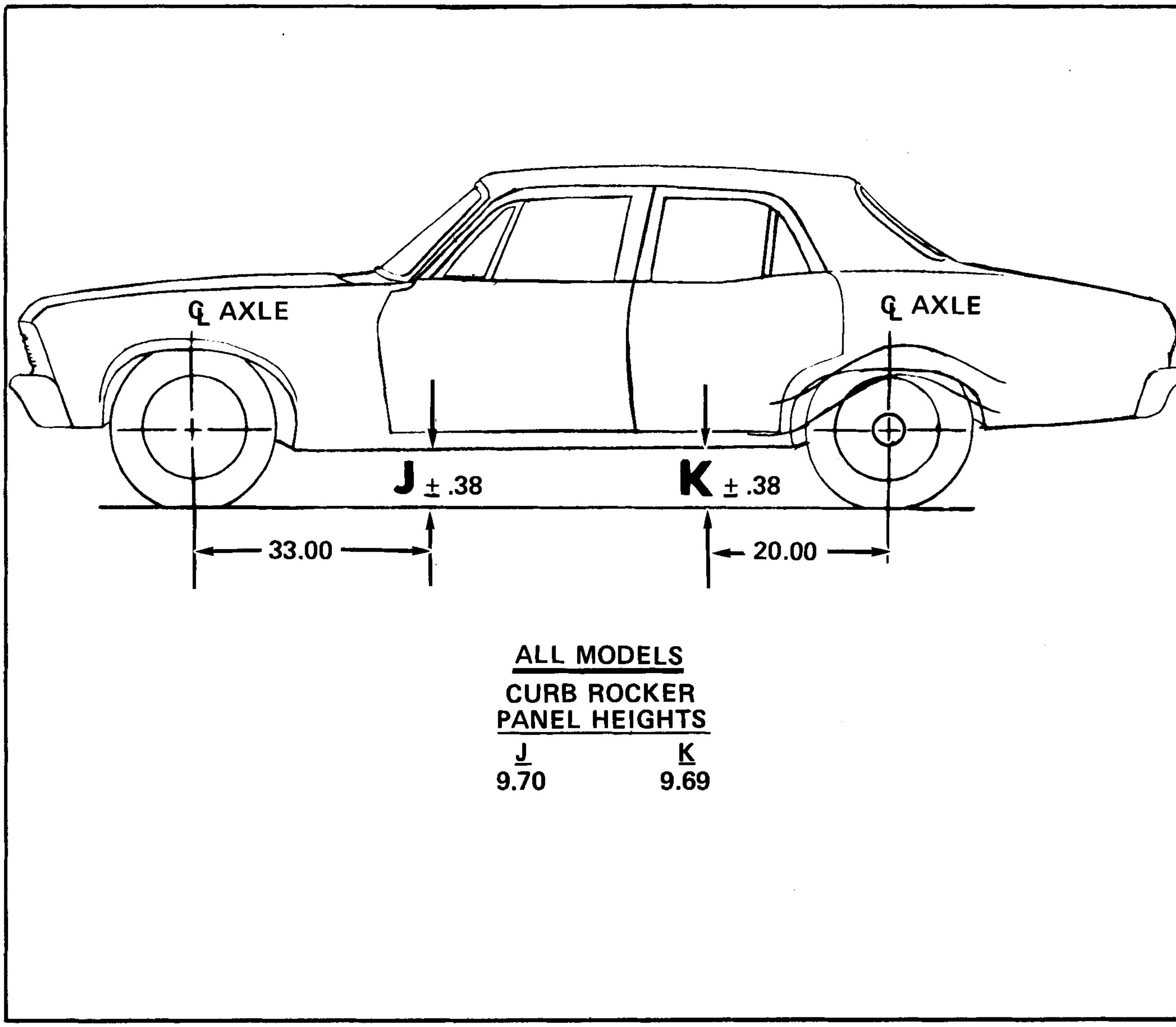


Fig. 0-25 Rocker Panel Heights - X Series

LUBRICATION

ITEMS REQUIRING LUBRICATION OR SERVICE AT 4 MONTHS OR 6,000 MILE INTERVALS, WHICHEVER OCCURS FIRST

ENGINE OIL

Change as outlined below.

Oil change interval should be lowered to two (2) months or 3,000 miles if the car is to be operated under adverse conditions such as extended idling, dusty conditions, when the engine is consistently not allowed to reach full operating temperature, or trailer pulling.

SAE 5W-20 oils are not recommended for sustained high-speed driving. SAE 30 oils may be used at temperatures above 40°F. All engines are equipped with specially engineered piston rings. These rings allow oil to flow freely on the cylinder walls during the break-in period. Therefore, oil consumption may be higher during the break-in period than it will be afterward. Oil which is labeled for service SE or MS and conforms to GM Standard 6041M should be used.

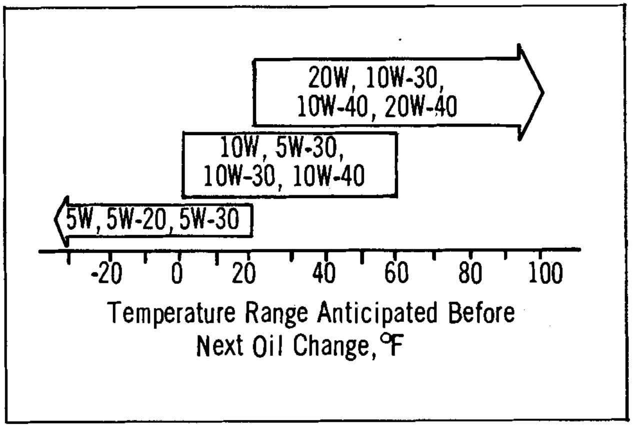


Fig. 0-26 Recommended Oils

OIL FILTER

Change at first oil change; every second oil change thereafter.

MANIFOLD HEAT CONTROL VALVE

Observe for freedom of movement. Lubricate with heat valve lubricant.

STATION WAGON TAILGATE HINGE AND LINKAGE

Engine oil at four months or 6,000 miles, more often if required.

CHASSIS LUBRICATION

Lubricate all normally greased suspension and steering linkage parts including ball joints and tie rod ends with chassis lubricant.

POWER STEERING SYSTEM AND PUMP RESERVOIR

Maintain lubricant level with GM power steering fluid, part 1050017 or equivalent. If this lubricant is not available, use DEXRON automatic transmission fluid or equivalent.

STANDARD DIFFERENTIAL

Check for leaks. Maintain lubricant level with SAE-80 or SAE-90, GL-5 multi-purpose gear lubricant. Change lubricant only when necessary to disassemble.

SAFE-T-TRACK DIFFERENTIAL

Check for leaks. Refill with part 1051022 lubricant or equivalent. Change lubricant only when necessary to disassemble.

MANUAL TRANSMISSION

Check for leaks. Maintain lubricant level with SAE-80 or SAE-90, GL-5 Multi-purpose gear lubricant. Change lubricant only when necessary to disassemble.

CLUTCH LINKAGE - MANUAL TRANSMISSION

Check lash and adjust as required. Lubricate with chassis grease at push rod to clutch fork joint and at cross shaft.

COLUMN SHIFT LINKAGE - MANUAL TRANSMISSION

Engine oil at all joints below steering column shift levers. Chassis grease at cross shaft bearing points.

FLOOR SHIFT LINKAGE - MANUAL TRANSMISSION

Chassis grease at all joints under body (lubricate shifter mechanism liberally).

BRAKE SYSTEM AND MASTER CYLINDER

Check system for adequate brake pedal reserve and for evidence of leaking. Check disc brake linings for wear. See Section 5, Lining Inspection. Use only recommended fluid such as Delco Supreme 11 or equivalent.

HOOD LATCH AND HOOD HINGES

Lubricate hood latch assembly as follows:

1. Wipe off any accumulation of dirt or contamination on latch parts.
2. Apply Lubriplate or equivalent to latch pilot bolts and latch locking plate.
3. Apply light engine oil to all pivot points in release mechanism as well as primary and secondary latch mechanisms.

4. Lubricate hood hinges with engine oil.
5. Make hood hinge and latch mechanism functional check to assure the assembly is working correctly.

AUTOMATIC TRANSMISSION SHIFT LINKAGE

Lubricate with engine oil at cross shaft pivot points. Console control cable must not be lubricated.

AIR CONDITIONING CONDENSER CORE

Clean off leaves and bugs and flush outside of condenser and radiator core to remove dirt.

CAUTION: *Do not use steam.*

ITEMS REQUIRING LUBRICATION OR SERVICE AT 12 MONTHS OR 12,000 MILE INTERVALS, WHICHEVER OCCURS FIRST

BRAKE SYSTEM - INSPECT ENTIRE SYSTEM (See Section 5)

AUTOMATIC TRANSMISSION

See below under items requiring service at 24 months or 24,000 miles.

CARBURETOR FUEL FILTER - INTEGRAL

Replace bronze filter or paper element; clean filter cavity.

AIR CLEANER ELEMENT (PAPER) - STANDARD ON ALL ENGINES

Replace.

EVAPORATIVE CONTROL SYSTEM

Replace filter at base of canister and inspect canister.

FRONT WHEEL BEARINGS

Lubricate with high melting-point, water-resistant grease, and only enough to thoroughly coat the rollers. Do not fill the wheel hub cavity. Wipe any grease off exposed surface of hub and seal.

ITEMS REQUIRING LUBRICATION OR SERVICE EVERY 24 MONTHS OR 24,000 MILES, WHICHEVER OCCURS FIRST

POSITIVE CRANKCASE VENTILATION

Check hose between valve cover and air cleaner, for clear passages; replace if clogged. Replace P.C.V. valve, and P.C.V. ventilation filter in air cleaner.

AUTOMATIC TRANSMISSION

Replace transmission fluid. Also replace oil filter in sump of Turbo Hydra-Matic. Refill with DEXRON automatic transmission fluid or equivalent. Under heavy-duty operating conditions or excessive stop-and-go driving, replace oil (and filter on Turbo Hydra-Matic) at 12,000 mile intervals.

THROTTLE LINKAGE

Lubricate carburetor throttle ball stud with chassis lubricant or equivalent. Do not lubricate remainder of throttle or carburetor linkage.

AIR CLEANER ELEMENT (PAPER) - STANDARD ON ALL ENGINES

Replace.

AIR CLEANER OPTIONAL-DUAL STAGE-HEAVY DUTY

Inner paper element - replace.

Outer polyurethane element: wash in solvent and re-oil with S.A.E. 30 engine oil. Wipe off excess oil.

COOLING SYSTEM

Drain, flush with water, and refill to specified level with special ethylene glycol type coolant, part number 1050027, 1050028, or equivalent.

ITEMS REQUIRING LUBRICATION OR SERVICE AT SPECIAL INTERVALS

TIRES

Rotate tires every 6,000 miles and rebalance tire and wheel assemblies on car as required.

PARKING BRAKE CABLES

Clean and lubricate during major brake service. Use light water-resistant grease.

BRAKE ASSEMBLIES

Clean and lubricate shoe pads, anchor pins, shoe hold-down spring pins (at contact area with backing plate) and adjusting screw at time of major brake service. Use only a high melting point lubricant and apply sparingly.

> **CAUTION:** *Grease must be kept off brake linings.*

MANUAL STEERING GEAR

Add lubricant as necessary. Change lubricant only when necessary to disassemble. Fill with water resistant EP grease to level of center side cover bolt hole.

BODY DOOR LOCKS AND STRIKERS

Stick-type lubricant - use sparingly as required.

DOOR HINGE HOLD-PINS

Light grease on friction surface. Use sparingly as required.

BODY DOOR HINGE PINS

Engine oil as required.

STATION WAGON FOLDING SEAT

Engine oil on pivots as required. Use sparingly.

FUEL DOOR HINGE

Engine oil on hinge pin and spring anchor points as required.

REAR COMPARTMENT LID HINGES

Engine oil as required.

CONVERTIBLE FRONT DOOR-TO-LOCK WEDGE PLATE

Stick-type lubricant, use sparingly as required.

WINDSHIELD WASHER SOLVENT

Use G.M. Optikleen, or equivalent and follow instructions on label to ensure proper operation of washer, and to prevent paint damage from excessively strong solutions.

BATTERY

Add distilled water as required. May require more frequent additions during high temperatures and/or extended trip operation. Clean terminals yearly and apply petroleum jelly to outside of terminals.

ITEMS NOT NORMALLY REQUIRING SERVICE

STARTING MOTOR

No lubrication required except on overhaul. When overhauling starting motor, add a few drops of engine oil to the bronze bushings in both end frame.

GENERATOR

The generator is designed and constructed to give long periods of trouble-free service with a limited amount of maintenance. The rotor is mounted on a ball bearing and a roller bearing. Both bearings have a grease supply which eliminates the need for periodic lubrication. The generator brushes are extra long and under normal operating conditions will provide extended service.

CONVERTIBLE HYDROELECTRIC PUMP MOTOR

The hydroelectric pump motor does not require periodic service.

CLUTCH RELEASE BEARING

The clutch release bearing requires no periodic lubrication. It is a ball bearing, lubricated and sealed for life.

SPEEDOMETER CABLE

Periodic lubrication is not required. When installing a new drive cable, apply a light coat of speedometer cable grease wiping off all excess along full length of the cable.

CAUTION: *Excessive amounts of lubricant can cause speedometer head failure. Lubricate new drive cables only.*

DRILL SIZES

Letter Sizes	Drill Diameter Inches	Wire Gage Sizes	Drill Diameter Inches	Wire Gage Sizes	Drill Diameter Inches	Wire Gage Sizes	Drill Diameter Inches
Z	0.413	1	0.2280	28	0.1405	55	0.0520
Y	0.404	2	0.2210	29	0.1360	56	0.0465
X	0.397	3	0.2130	30	0.1285	57	0.0430
W	0.386	4	0.2090	31	0.1200	58	0.0420
V	0.377	5	0.2055	32	0.1160	59	0.0410
U	0.368	6	0.2040	33	0.1130	60	0.0400
T	0.358	7	0.2010	34	0.1110	61	0.0390
S	0.348	8	0.1990	35	0.1100	62	0.0380
R	0.339	9	0.1960	36	0.1065	63	0.0370
Q	0.332	10	0.1935	37	0.1040	64	0.0360
P	0.323	11	0.1910	38	0.1015	65	0.0350
O	0.316	12	0.1890	39	0.0995	66	0.0330
N	0.302	13	0.1850	40	0.0980	67	0.0320
M	0.295	14	0.1820	41	0.0960	68	0.0310
L	0.290	15	0.1800	42	0.0935	69	0.0292
K	0.281	16	0.1770	43	0.0890	70	0.0280
J	0.277	17	0.1730	44	0.0860	71	0.0260
I	0.272	18	0.1695	45	0.0820	72	0.0250
H	0.266	19	0.1660	46	0.0810	73	0.0240
G	0.261	20	0.1610	47	0.0785	74	0.0225
F	0.257	21	0.1590	48	0.0760	75	0.0210
E	0.250	22	0.1570	49	0.0730	76	0.0200
D	0.246	23	0.1540	50	0.0700	77	0.0180
C	0.242	24	0.1520	51	0.0670	78	0.0160
B	0.238	25	0.1495	52	0.0635	79	0.0145
A	0.234	26	0.1470	53	0.0595	80	0.0135
		27	0.1440	54	0.0550		

U.S. AND IMPERIAL CAPACITIES (APPROXIMATE)

	F–SERIES		B–SERIES		G–SERIES		A–SERIES		X–SERIES	
	U.S. Gal.	Imp. Gal.	U.S. Gal.	Imp. Gal.	U.S. Gal.	Imp. Gal.	U.S. Gal.	Imp. Gal.	U.S. Gal.	Imp. Gal.
Fuel – All Exc. Sta. Wgn.	18.0	15.0	25.0	20.8	26.0	21.7	20.0	15.8	16.0	13.25
– Station Wagon	–	–	23.0	19.2	–	–	23.0	17.9	–	–
Cooling –	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.
6 Cyl. (w/o A/C)	12.4	10.3	–	–	–	–	12.4	10.3	12.5	10.5
6 Cyl. (with A/C)	–	–	–	–	–	–	13.4	11.2	–	–
8 Cyl. –V400 (w/o A/C)	18.6	15.5	18.6	15.5	18.6	15.5	18.6	15.5	15.5†	13.0†
–V400 (with A/C)	19.2	16.0	19.4	16.0	19.2	16.0	19.8	16.5	16.5†	13.8†
–V455 (w/o A/C)	18.0	15.0	18.0	15.0	18.0	15.0	18.0	15.0	–	–
–V455 (with A/C)	19.0	15.8	18.4	15.8	19.0	15.8	19.0	15.8	–	–
–V350 (w/o A/C)	19.5	16.25	–	–	–	–	20.2	16.8	19.5	16.2
–V350 (with A/C)	20.5	17.1	–	–	–	–	21.4	17.8	20.5	17.1
Engine Crankcase –	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.
6 Cyl. (with oil Filter Chg.)	5.0	4.2	–	–	–	–	5.0	4.2	5.0	4.25
6 Cyl. (w/o Oil Filter Chg.)	4.0	3.3	–	–	–	–	4.0	3.3	4.0	3.25
8 Cyl. (with Oil Filter Chg.)	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0	5.0†	4.25†
8 Cyl. (w/o Oil Filter Chg.)	5.0	4.2	5.0	4.2	5.0	4.2	5.0	4.2	4.0†	3.25†*
Transmission –	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.
3-Speed Manual (Dearborn)	–	–	–	–	–	–	–	–	–	–
3-Speed Manual (Saginaw)	3.5	2.9	–	–	–	–	3.5	2.9	3.5	3.0
3-Speed Manual (Muncie)	2.8	2.3	–	–	–	–	2.8	2.3	–	–
4-Speed Manual (Muncie)	2.5	2.1	–	–	–	–	2.5	2.1	–	–
2-Speed Automatic (M-35)										
Refill After Draining (Approx.)	3.0	2.5	–	–	–	–	3.0	2.5	3.0	2.5
Refill After Disassembly (Approx.)										
6 Cyl.	18.25	15.2	–	–	–	–	18.25	15.2	18.25	15.2
V-8	20.0	16.7	–	–	–	–	20.0	16.7	20.0	16.75
Turbo Hydra-Matic (M40) (Code PA, PB, Etc.)										
Refill After Draining (Approx.)	7.5	6.2	7.5	6.2	7.5	6.2	8.0	6.6	–	–
Refill After Disassembly (Approx.)	19.0	15.7	19.0	15.7	19.0	15.7	19.2	16.1	–	–
Turbo Hydra-Matic (M38) (Code JE, JF, & JU)										
Refill After Draining (Approx.)	8.0	6.7	–	–	–	–	8.0	6.7	5.0	4.2
Refill After Disassembly (Approx.)										
6 Cyl.	19.25	16.1	–	–	–	–	19.25	16.1	–	–
V-8	21.0	17.5	–	–	–	–	21.0	17.5	21.0	17.5
Differential –	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.
Standard or Safe-T-Track	–	–	4.25	3.5	3.0	2.5	3.0	2.5	3.75	3.1
"C" Axle (Standard or Safe-T-Track)	4.25	3.5	5.5	4.6	4.9	4.1	4.9	4.1	All	All
Brake Master Cylinder –	Fill to 1/4" from top using fluid meeting SAE 70R3 specifications.									

† 307 V-8

* X Series with 350 V-8 Oil Capacity is the same as A Series V-8 capacity

DECIMAL EQUIVALENTS

1/64	.015625	17/64	.265625	33/64	.515625	49/64	.765625
1/32	.03125	9/32	.28125	17/32	.53125	25/32	.78125
3/64	.046875	19/64	.296875	35/64	.546875	51/64	.796875
1/16	.0625	5/16	.3125	9/16	.5625	13/16	.8125
5/64	.078125	21/64	.328125	37/64	.578125	53/64	.828125
3/32	.09375	11/32	.34375	19/32	.59375	27/32	.84375
7/64	.109375	23/64	.359375	39/64	.609375	55/64	.859375
1/8	.125	3/8	.375	5/8	.625	7/8	.875
9/64	.140625	25/64	.390625	41/64	.640625	57/64	.890625
5/32	.15625	13/32	.40625	21/32	.65625	29/32	.90625
11/64	.171875	27/64	.421875	43/64	.671875	59/64	.921875
3/16	.1875	7/16	.4375	11/16	.6875	15/16	.9375
13/64	.203125	29/64	.453125	45/64	.703125	61/64	.953125
7/32	.21875	15/32	.46875	23/32	.71875	31/32	.96875
15/64	.234375	31/64	.484375	47/64	.734375	63/64	.984375
1/4	.25	1/2	.5	3/4	.75	1	1.

WEIGHTS AND MEASURES

LINEAR MEASURE

1/12 foot (ft.)	1 inch (in.)
12 inches	1 foot
3 feet	1 yard (1 yd.)

AREA MEASURE

1/144 square foot (sq. ft.)	1 square inch (sq. in.)
144 square inches	1 square foot
9 square feet	1 square yard (sq. yd.)

LIQUID MEASURE

1/16 pint (pt.)	1 ounce (oz.)
1 pint	16 ounces
2 pints	1 quart (qt.) 32 ounces
4 quarts	1 gallon (gal.)
31-1/2 gallons	1 barrel (bbl.)

DRY MEASURE

1/2 quart (qt.)	1 pint (pt.)
2 pints	1 quart (qt.)
8 quarts	1 peck (pk.)
4 pecks	1 bushel (bu.)
105 quarts	1 barrel

CUBIC MEASURE

1,728 cubic inches	1 cubic foot
27 cubic feet	1 cubic yard

COMMON WEIGHT

16 ounces	1 pound
100 pounds	1 hundred weight (cwt.)
2000 pounds	1 ton

COMMON U.S.A. EQUIVALENTS
LENGTH

1 inch	25.4001 millimeters
1 millimeter	0.03937 inches
1 foot	0.304801 meters
1 meter	3.28083 feet
1 yard	0.914402 meters
1 meter	1.093611 yards
1 mile	1.609347 kilometers
1 kilometer	0.621370 miles

LIQUID CAPACITY

1 quart	0.94633 liters
1 liter	1.05671 quarts
1 gallon	3.78533 liters
1 liter	0.26418 gallons

DRY CAPACITY

1 quart	1.1012 liters
1 liter	0.9081 quarts
1 peck	3.071 liters
1 liter	.32562 pecks

WEIGHTS AND MEASURES

SECTION 1

HEATING AND VENTILATION

CONTENTS OF THIS SECTION

DIAGNOSIS

HEATER SYSTEM WIRING SCHEMATICS - ALL

The heater system wiring schematic in Fig. 1-1 applies to B Series. The schematic in Fig. 1-2 applies to A, G and F Series. These schematics should be referred to for diagnosis of electrical problems in the heater system. The X Series heater wiring is part of the instrument panel wiring harness.

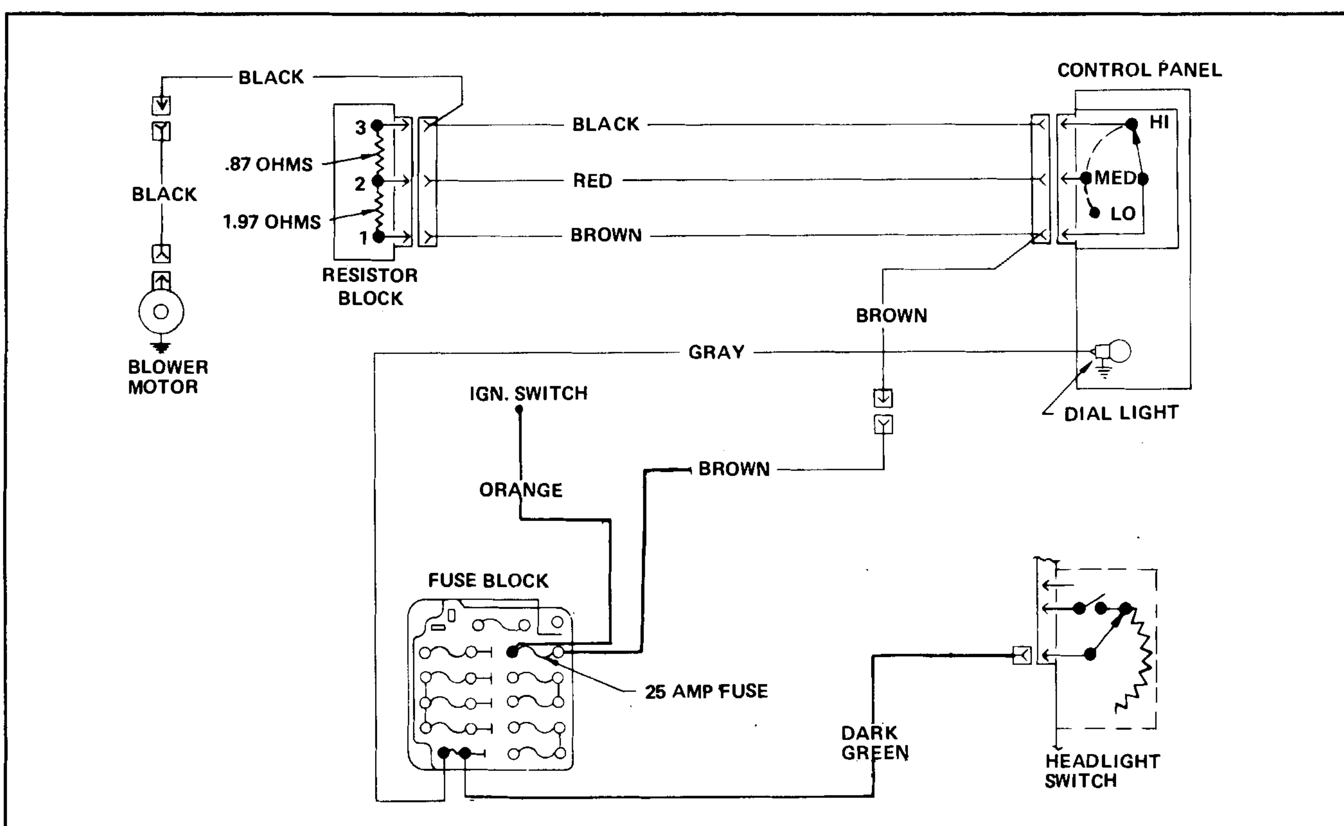


Fig. 1-1 Heater Wiring Schematic - B Series

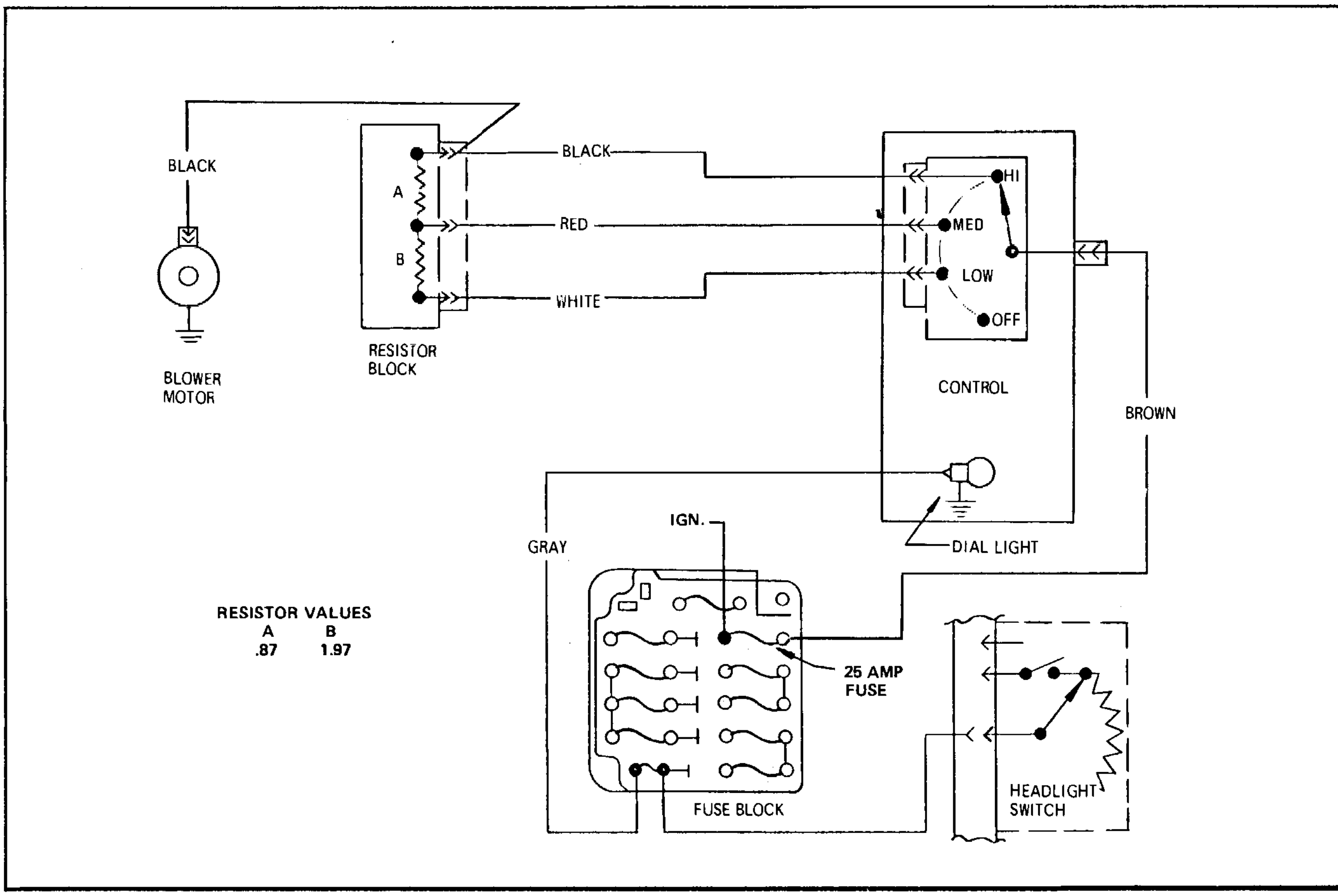


Fig. 1-2 Heater Wiring Schematic - A, G and F Series

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 cowl 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

	deadener felt 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 engine coolant level in radiator. correct and fill to proper level. Run engine to clear any air lock, then cap radiator.
Failure of engine cooling system to warm up.	Check engine thermostat and radiator cap, 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.	Adjust cable.
Air doors do not operate.	G Series - See VACUUM SYSTEM DOES NOT OPERATE AIR DOORS. B, A or X Series - Check installation and/or adjustment of air control cable. F Series - Check installation and/or adjustment of air-defrost control cable.

INADEQUATE REMOVAL OF FOG OR ICE

CAUSE	CORRECTION
Air door does not open. Defroster door does not open fully.	G Series - See VACUUM SYSTEM DOES NOT OPERATE AIR DOORS. Adjust operating linkage. Except G Series - Check cable operation.
Air door does not open.	Except G Series - Check installation and/or adjustment of air 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 outlets.
Dinged defroster outlets.	Reshape outlet flange with pliers. The outlet should have a uniform opening.
Blower motor not connected.	Connect wire. Check ground.
Inoperative blower motor (NOTE: B Series blower motor operates whenever ignition switch is ON).	Check heater fuse and wiring. Replace motor, if 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 control 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 switch.

Shorted or open blower resistor.	Check blower resistor in top of heater case (on blower and air inlet duct on B Series).

VACUUM SYSTEM DOES NOT OPERATE AIR DOORS - G SERIES

CAUSE	CORRECTION
Little or no vacuum at door diaphragm.	Check for vacuum leaks or obstruction.
Leak in vacuum system.	Check vacuum lines for leaks or obstructions. Check heater control panel vacuum switch. Replace if necessary.
Air door sticking.	Check for bind or obstruction at air door.
Air door does not operate.	Check for loose vacuum hose connection at diaphragm.
Defroster door does not operate.	Check for loose vacuum hose connection at diaphragm.

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".	Check engine coolant level in radiator.

GENERAL DESCRIPTION

Pontiac's heater and defroster system provides rapid warm-up and even distribution of warm air to all parts of the car. Air entering the system is taken through an opening at the rear of the hood, providing air with a minimum

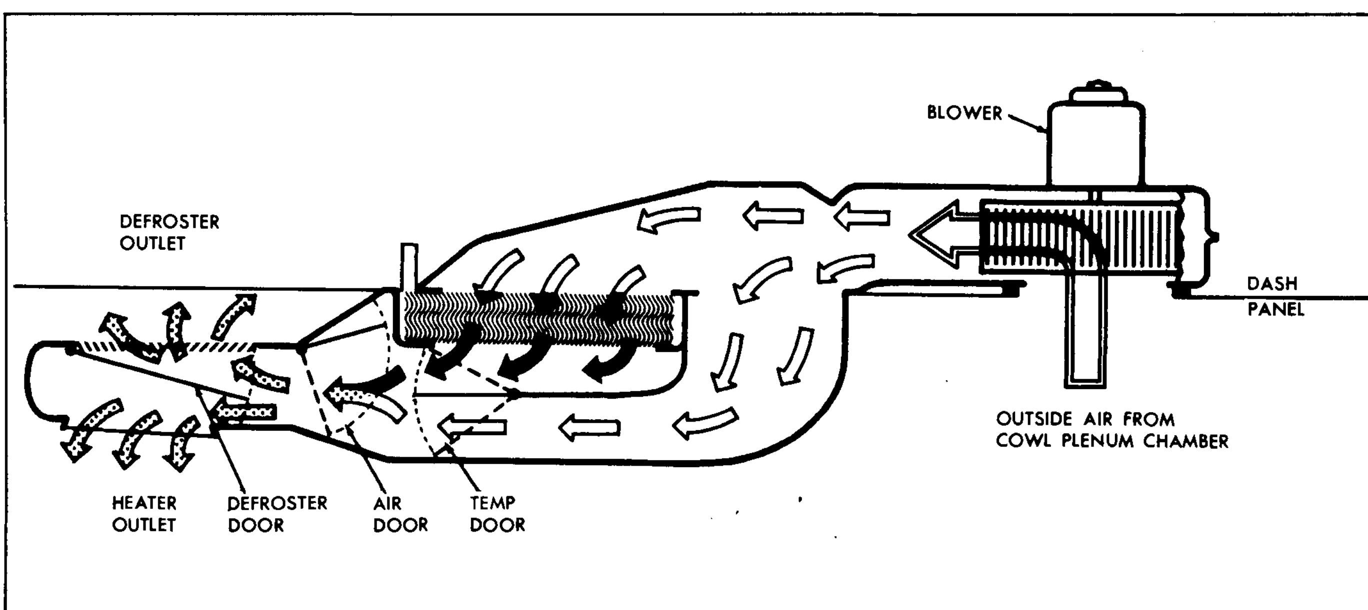


Fig. 1-3 Typical Heater Air Flow

of dust, foreign material and undesirable fumes. This air passes through the plenum chamber into the heater blower motor and air inlet duct.

The use of outside air provides constant and rapidly changing air inside the car, eliminating a smoke-filled interior to keep occupants comfortable.

The driver has fingertip control of the temperature of warmed air entering the car. When heated air is desired, the blower forces air taken from the blower and air inlet duct across the heater core and through an air distribution system to air outlets inside the passenger compartment (Fig. 1-3).

The design of the heater and defroster system, its doors (valves), and controls permits a method of obtaining two different levels of forced air flow for heating.

All heater systems are composed of the same basic components although they may differ slightly in design and capacity. Hot water is supplied to the heater core by the engine water pump through a heater hose. Air flow in the system is initiated in the plenum chamber where outside air is picked up by the blower motor and directed through the air inlet duct to the heater case. There, depending on the control panel setting, air is directed either through or around the heater core to the outlets. Here again, depending on control panel settings, air is directed primarily out the heater outlet to the front floor area or up through the defroster duct to the windshield area.

The doors which control air flow in the system are moved mechanically by either vacuum diaphragms or by cables. Three doors are utilized on all systems except F Series: a temperature door, an air door and (except F Series) a defroster door.

Should the system fail to satisfy, proper operation should be reviewed. This will determine whether the system is defective or being operated incorrectly.

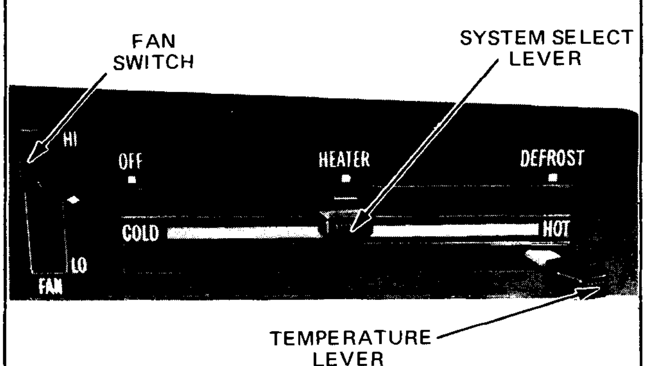
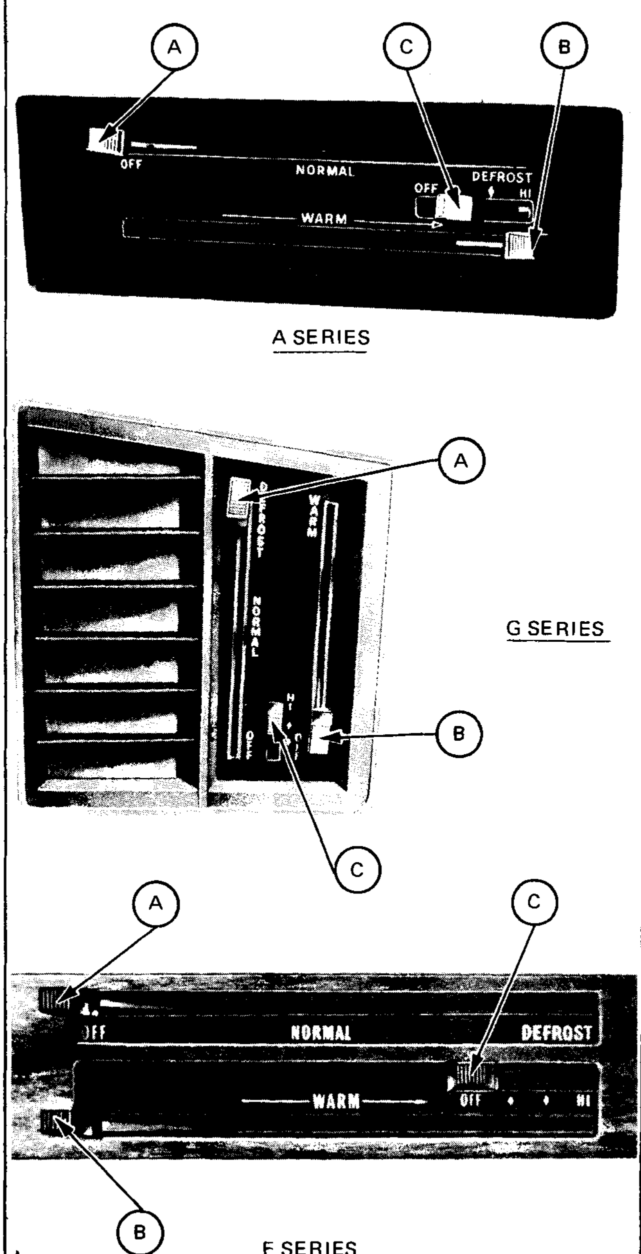


Fig. 1-4 B Series Heater Control Panel

AIR DISTRIBUTION

Heated air enters the interior of the car and is distributed by a center outlet under the heater duct which dispenses air over the front floor area and to the rear passenger compartment. On some models equipped with stereo tape or console, a different type duct is used which directs the air to each side of the console or stereo tape unit.



A—SYSTEM SELECTOR LEVER
B—TEMPERATURE LEVER
C—FAN SWITCH

Fig. 1-5 Heater Control Panels - A, G and F Series

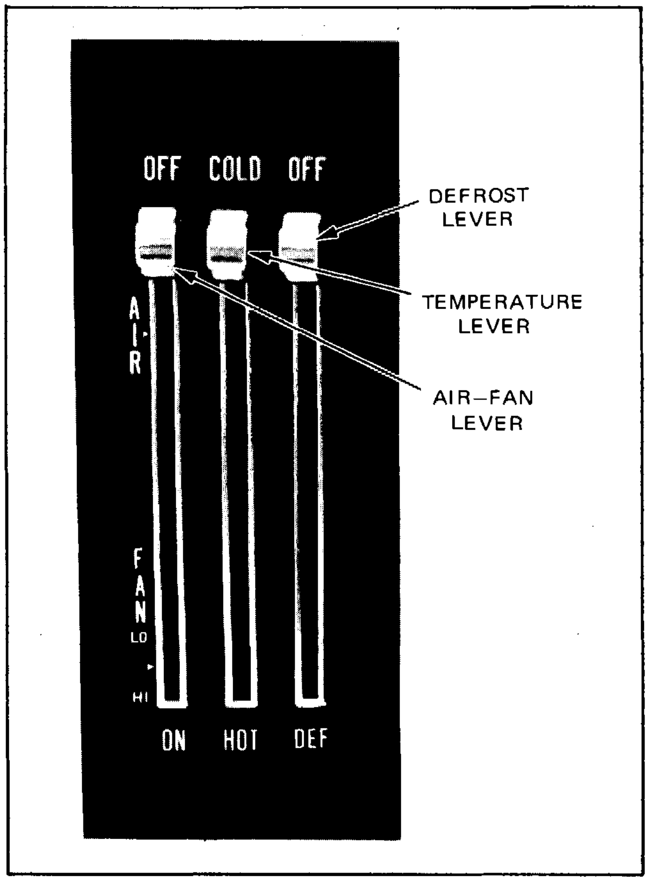


Fig. 1-6 X Series Heater Control Panel

Air is directed to the windshield through a duct (defroster nozzle) running upward from the heater case.

HEATER CONTROL PANEL

B, A and F Series heater controls (Figs. 1-4 and 1-5) are of the horizontal slide lever design. The levers transmit motion via bowden cables to the air, defrost and temperature doors. The G Series control (Fig. 1-5) utilizes vertical control levers; the temperature lever actuates a cable and the select lever a vacuum switch.

The X Series heater control (Fig. 1-6) is of the vertical slide lever design. Three levers trasmit motion via bowden cables to the air, defrost and temperature doors.

EXCEPT X SERIES

The system selector lever on the heater control panel controls air flow. The fan switch controls blower motor speed. With the system in the OFF position there is little or no air flow on A, F and G Series. On the B Series air flow is controlled by the blower speed switch and all air is distributed from the purge opening on the righthand side of the heater case. In the NORMAL or HEATER position approximately 20% of the air flow is directed through the defroster outlets, 80% through the heater outlets and the blower motor operation is governed by the fan switch.

NOTE: *On the B Series there is no OFF position on the fan switch.*

In the DEFROST position on the system selector lever, approximately 80% of air flow is directed through the defroster, 20% through heater outlets and the blower motor operates at speeds governed by the fan switch.

BLOWER CONTROL

Blower speed is controlled by the position of the fan switch on the control panel. On the B Series the blower speed range is LO-MED-HI with the blower motor operating whenever the ignition switch is in the RUN position, even if the heater control selector lever is in the OFF position. On all other models, the fan switch range includes OFF to shut the blower motor off.

AIR CONTROL

The inlet and distribution of air in the heater system are controlled by the system selector lever on the control panel. The selector lever positions an air door (all Series) and a defroster door (except F Series) by means of bowden cables (B, A and F Series) or a rotary vacuum valve and vacuum diaphragms (G Series).

AIR DOOR

The air door is closed on A, G, and F Series when the control panel selector lever is in OFF and air is prevented from entering the passenger compartment from the blower and air inlet duct. On the B Series, the air door closes but air is not prevented from entering the passenger compartment; all incoming air is directed out of the purge opening on the righthand side of the heater case.

When the system selector lever is moved to NORMAL (HEATER on B Series), the air door opens and air is allowed to pass into the heater case (the B Series purge opening no longer has air flow). On the F Series, the air door and defroster door are a single assembly and opening the air door (NORMAL) not only allows outside air to enter the heater case but also directs heater output air flow through the heater outlet duct with a slight flow of air from the defroster nozzles.

Moving the control panel selector lever to DEFROST will affect the position of the air door only on the F Series. On the F Series the air- defroster single door will move to direct the output air flow from the heater system out through the defroster nozzles with a slight air flow from the heater outlet duct.

DEFROSTER DOOR - EXCEPT F SERIES

The defroster door directs the output air flow from the heater system. In NORMAL (HEATER on B Series), the defroster door is positioned to distribute the majority of the heater system output air flow from the heater outlet duct with slight air flow from the defroster nozzles. In DEFROST, the output air flow is distributed just opposite, with the major portion of heater system output air flow directed toward the windshield.

X SERIES

AIR FAN LEVER

The air-fan lever has two functions; blower speed control and air inlet control. Moving the lever half way from OFF toward ON opens the air inlet door to allow outside air to enter the heater system. Further movement of the AIR-FAN lever actuates the blower motor at low speed. Medium and high blower speeds are achieved by further movement of the lever when more volume of air flow is desired.

DEFROST LEVER

The defrost lever controls the position of the defroster door in the heater case. In the OFF position almost all air flow is directed to the floor from the heater outlet at the bottom of the heater case (a small amount of air is distributed from the defroster outlets toward the windshield). In the DEFROST position the air distribution is reversed from that in the OFF position. Moving the lever to any desired point between OFF and DEFROST will divide air flow between the floor and windshield accordingly.

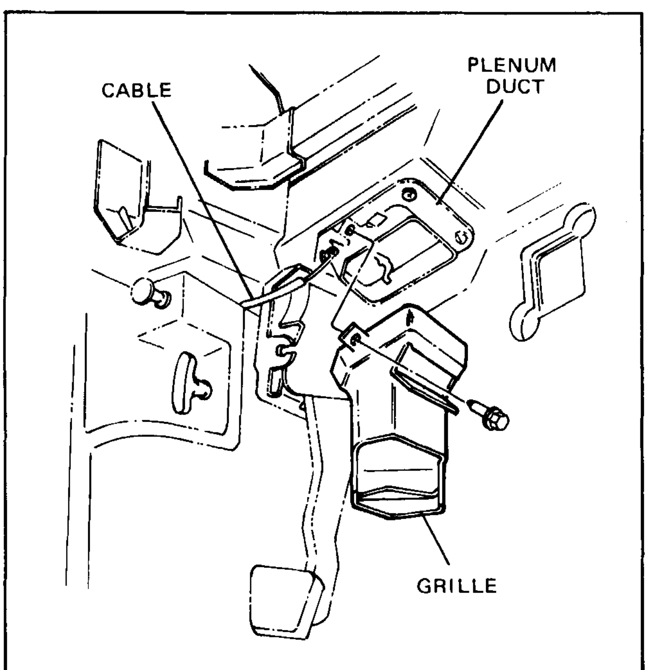


Fig. 1-7 B Series Lower Air Vent

TEMPERATURE CONTROL - ALL

The temperature lever on the control panel regulates output temperature of the heater by varying the position of the temperature door. With the temperature lever in WARM or HOT, all output air from the heater system is air which has passed through the heater core. Moving the temperature lever will introduce more air which has by-passed the heater core until the temperature lever reaches OFF or COLD and all output air flow is air which has by-passed the core. This air flow should be very close to outside air temperature.

VENTILATION

Two lower fresh air vents, one located in each kick pad (except B Series), are controlled by separate knobs located on each kick pad. (B Series lower fresh air vents are located just inboard of the kick pad on either side of the car, Fig. 1-7). Positioning the vent knobs between full forward and full out provides ventilation by allowing regulated amounts of outside air to enter the car through the vents. Operating the vent knob (pulling out or pushing in on knob) drives a cable which in turn positions a door inside the vent to regulate air intake.

B SERIES

In addition to the lower air vents, the B Series has two other sources of ventilation. When the heater system is OFF and the ignition switch is in RUN, the blower motor is operational and outside air is distributed from the purge opening on the righthand side of the heater case. This insures an uninterrupted supply of outside air to the interior of the passenger compartment whenever the ignition is ON. (When the heater system is ON, the outside air is supplied through the heater system.)

Ventilation is also available from two outlets at the center of the instrument panel, when desired. Regulation of air distribution from these outlets is controlled by a vent control panel (Fig. 1-8) on the lefthand side of the instrument panel.

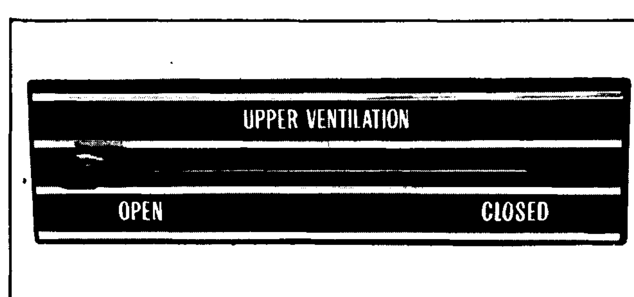


Fig. 1-8 Vent Control Panel - B Series

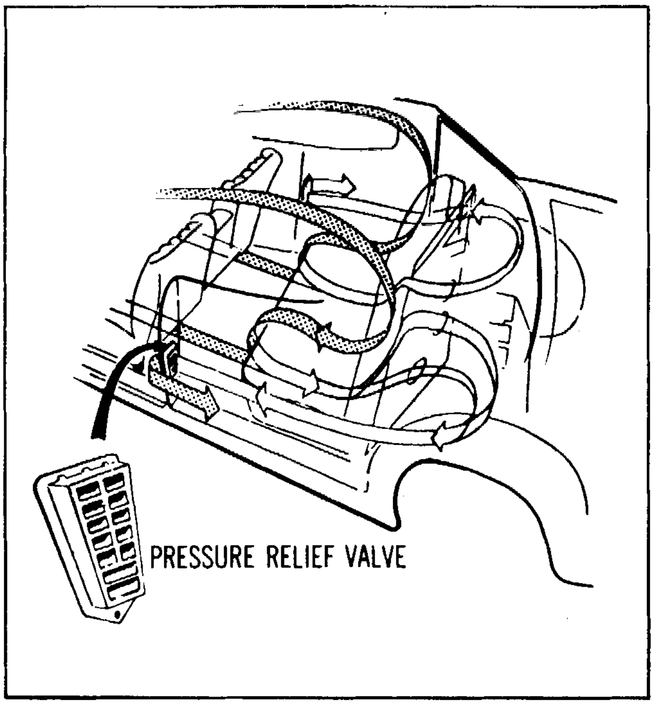


Fig. 1-9 Ventilation Air Flow - Typical

While outside air is distributed from either the heater system or the purge opening in the heater case at all times and is available from the lower vents and/or the upper center vents on the instrument panel, if desired, the air flow in the passenger compartment follows the same pattern. Inside air leaves the passenger compartment by passing under the rear seat into the trunk, then forward along the body sides to the lock pillars where the air escapes to the outside by means of pressure relief valves (Fig. 1-9).

A, G AND F SERIES

All G and F Series and A Series models without side vent pane windows are equipped with an upper ventilation system in addition to the lower vents previously described. Air outlets which may be individually controlled are built in at each end of the instrument panel. These outlets permit quiet circulation of air without the corresponding wind and road noise present with an open window.

Air through the upper vent system is controlled by a knob at each individual kick pad just above the knob which controls the lower vent.

Inside air leaves the passenger compartment by passing under the rear seat into the trunk, then forward along the body sides to the lock pillars where the air escapes to the outside by means of pressure relief valves (Fig. 1-9).

HEATER CONTROL FUNCTIONAL TEST - EXCEPT X SERIES

Functional tests are to be made with engine running and coolant warm.

1. Move system selector lever to OFF, set fan switch to HI position and move temperature lever to full WARM (HOT).

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

   B. Except B Series - Blower operates but little or no air flows from the heater or defroster outlets.

2. Move system selector lever to NORMAL (HEATER). Make sure lever is engaged in detent.

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

3. Move system selector lever to DEFROST.

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

4. Move temperature lever to OFF (COLD).

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

5. Move fan switch to OFF (LO on B Series), pausing at each detent.

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

   B. Except B Series - Blower speed and air flow decrease and stop at full OFF position.

6. B Series Only - Move selector lever of OFF.

   A. Blower continues to run at low speed but all air comes from purge opening on heater case.

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

SERVICE PROCEDURES

HEATER CABLE ADJUSTMENT

B SERIES

All Cable adjustments are to be made after cables have been securely connected except that wire loop at heater case end of cable is disconnected from heater case crank pin.

TEMPERATURE CABLE

1. Place control panel temperature lever at full HOT.
2. Rotate temperature door crank on heater case to the full heat position (crank full clockwise as viewed from above).
3. Adjust turnbuckle on temperature control cable (Fig. 1-10) until cable wire loop lines up with pin on temperature door crank.
4. Move temperature lever from full HOT to mid-travel and place cable wire loop on temperature door crank pin. Secure cable to pin with push-nut.

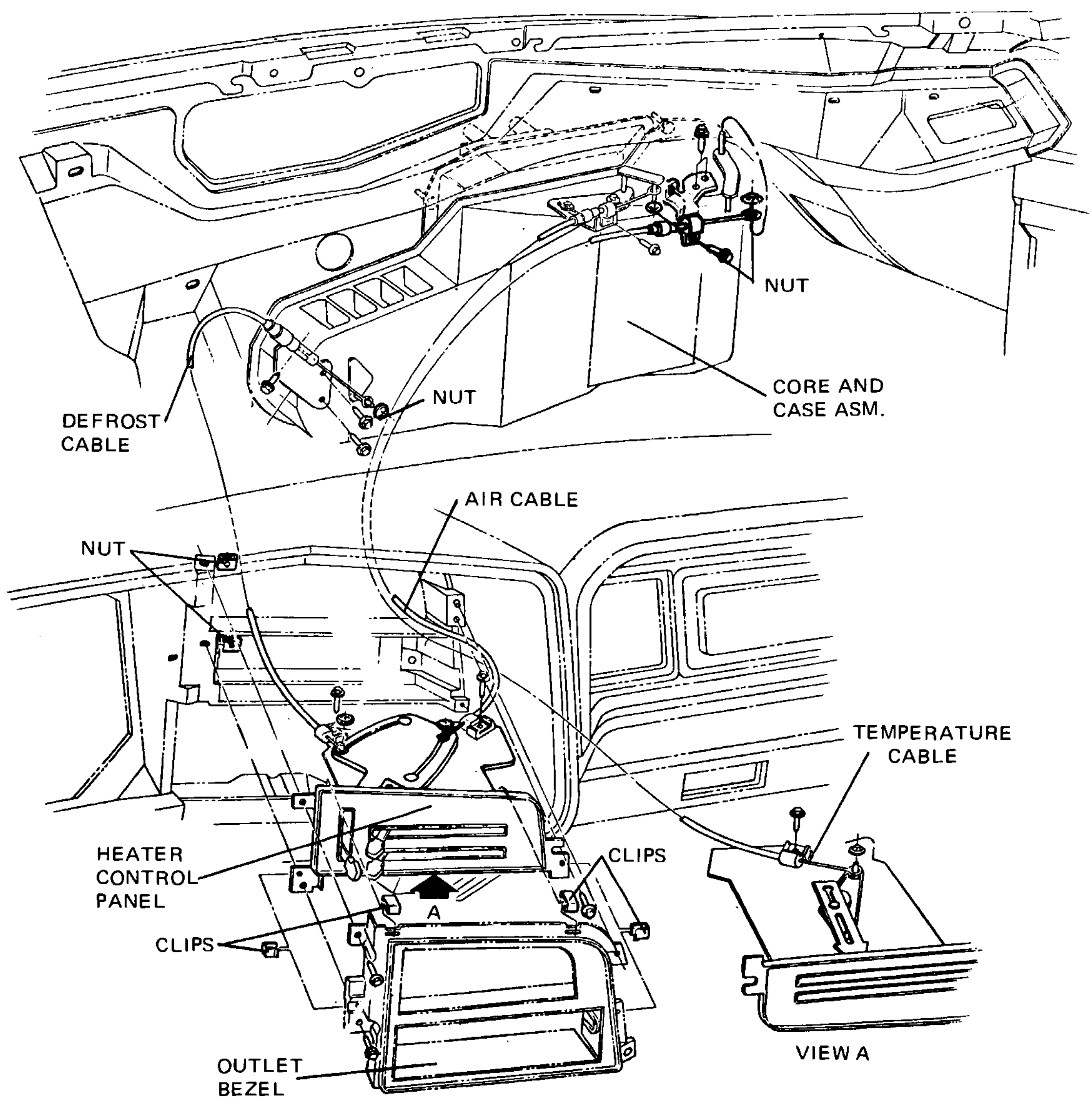


Fig. 1-10 B Series Heater Control Panel and Cables

5. Move lever back to full HOT. If temperature door cannot be heard hitting its seat, repeat adjustment procedure.

AIR CONTROL CABLE

1. Place control panel selector (air control) lever in HEATER.
2. Hold heater case air door in the heater position (crank rotated full clockwise as viewed from above) and adjust air control cable turnbuckle (Fig. 1A-10) until wire loop on cable lines up with pin on heater air door crank.
3. Place wire loop over crank pin and secure attachment with push-nut. Move control panel selector lever to OFF and back to HEATER position detent.
4. Start engine and set fan switch for HI blower speed. There should be no air flow out of purge opening at right hand side of heater case. If there is air leakage at the purge opening repeat adjustment procedure.

DEFROST CABLE

1. Place control panel selector lever in DEFROST.
2. Hold heater case defroster door crank in defrost position (crank rotated full clockwise as viewed from driver position) and adjust turnbuckle on defrost cable (Fig. 1-10) until wire loop on cable lines up with pin on defroster door crank arm.
3. Move control panel selector lever to HEATER, place cable loop on crank arm pin and secure cable attachment with push-nut.

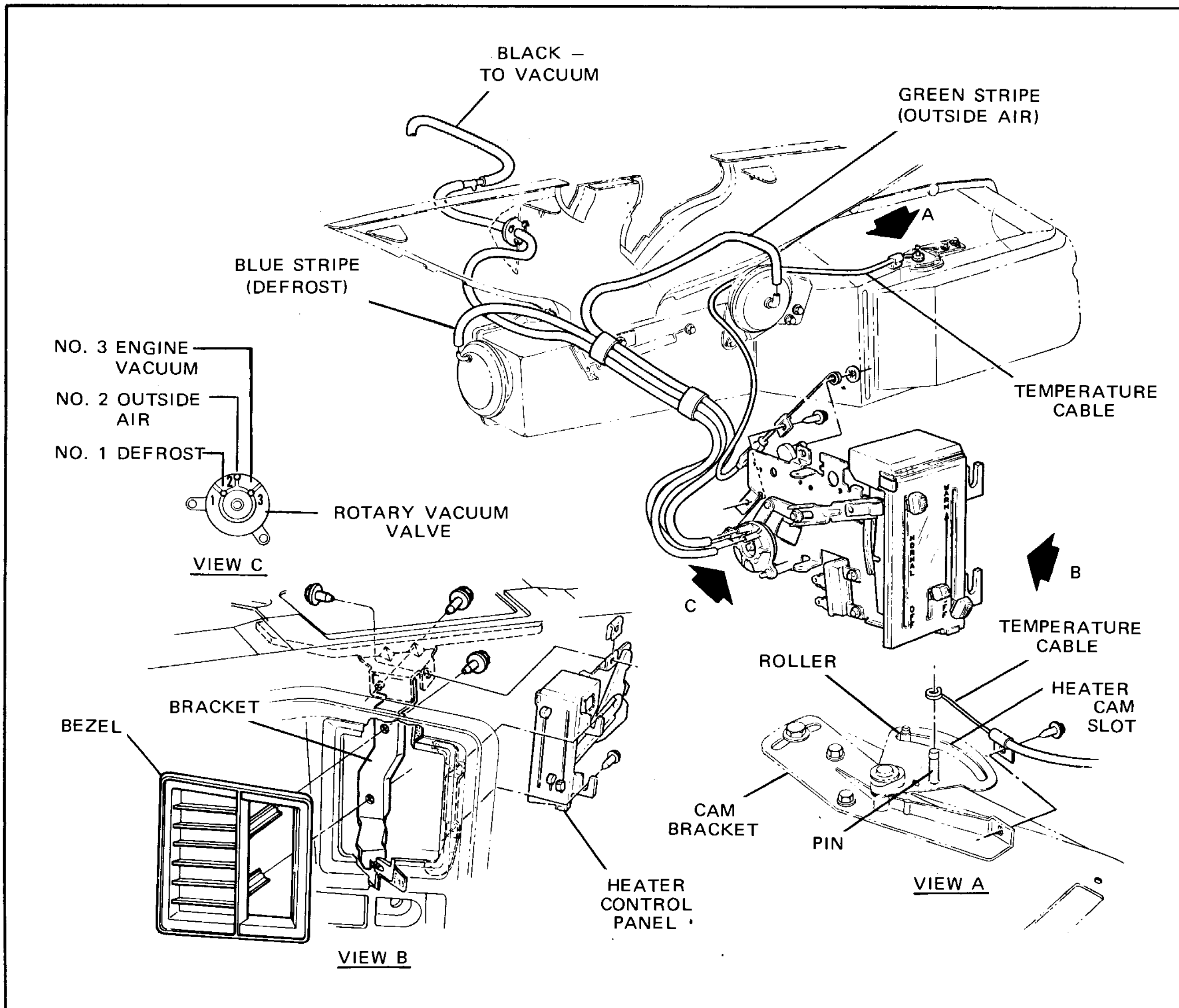


Fig. 1-11 G Series Control Cable and Vacuum Hose Routing

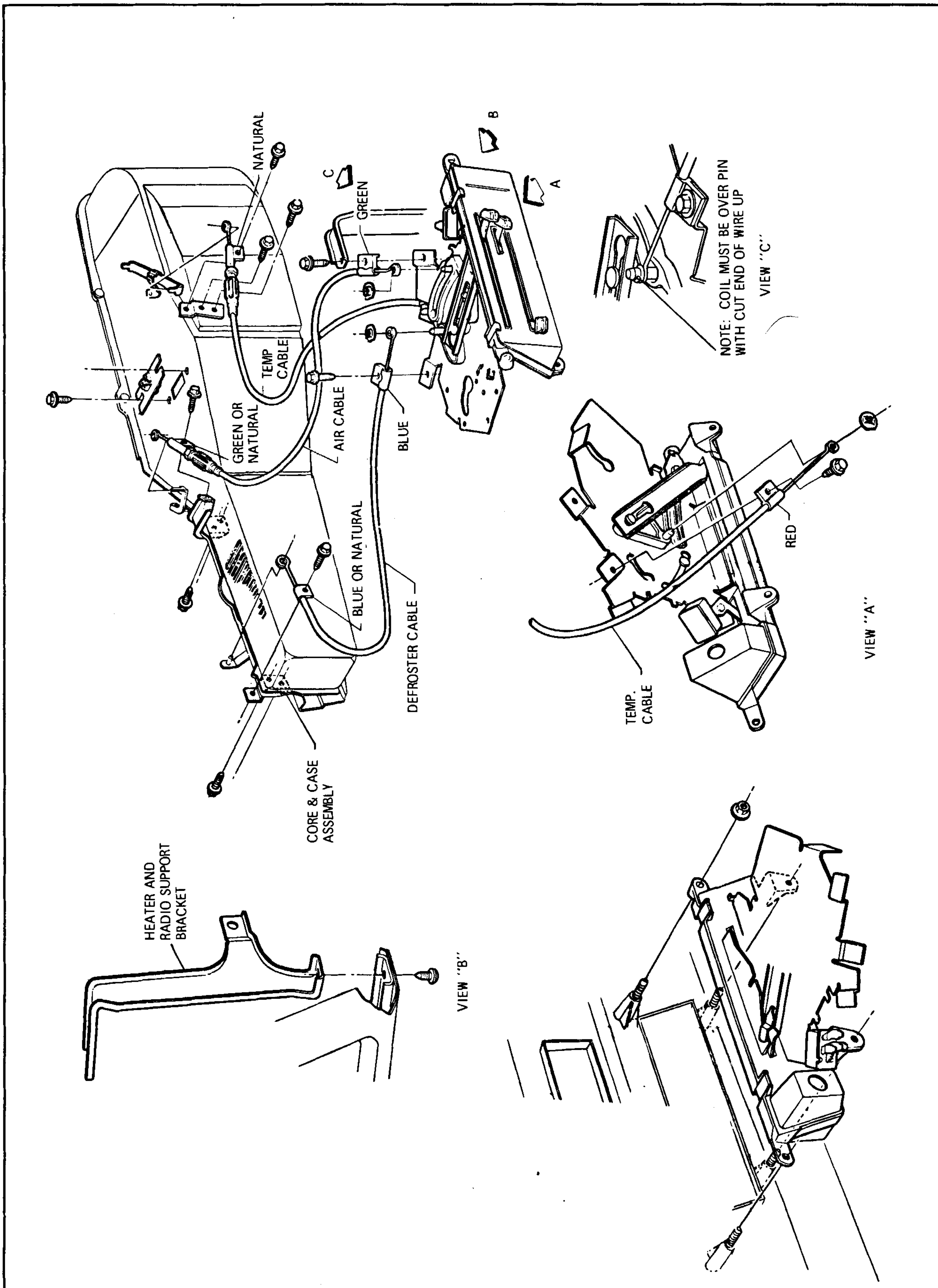


Fig. 1-12 A Series Heater Control Panel and Cables

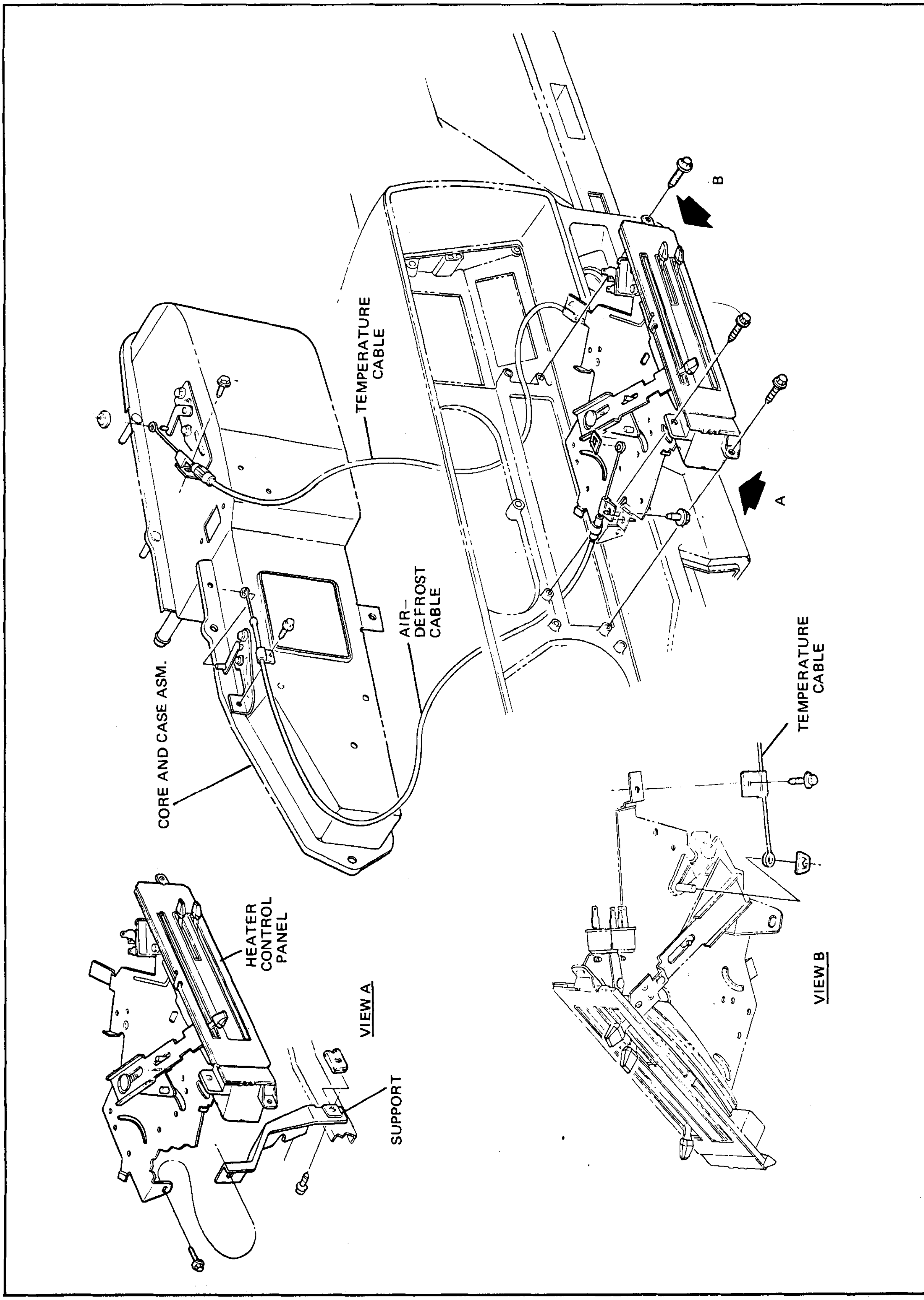


Fig. 1-13 F Series Heater Control Panel and Cables

G SERIES

TEMPERATURE CABLE

1. With cable securely connected at both ends, set temperature lever on control panel at full COLD (lever all the way down) and hold lever in this position.
2. Adjust cable turnbuckle (Fig. 1-11) until cam roller on heater case bottoms at end of heater cam slot.
3. Move temperature lever to full WARM (all the way up) and back to full COLD. Temperature lever should return to end of slot on control panel and cam roller should be against end of cam slot.
4. If temperature lever did not go full travel and/or cam roller did not come to rest at end of cam slot, repeat adjustment until cable functions properly.

A SERIES

All cable adjustments are to be made after cables have been securely connected at both ends and routed smoothly and free of sharp kinks or bends.

TEMPERATURE CABLE

1. Hold lever on top of heater case in full cold position (full left or clockwise when viewed from above).
2. Adjust cable turnbuckle (Fig. 1-12) so that the temperature control lever will drop into the detent for the full OFF position.

AIR CONTROL CABLE

1. Place air control lever in OFF position.

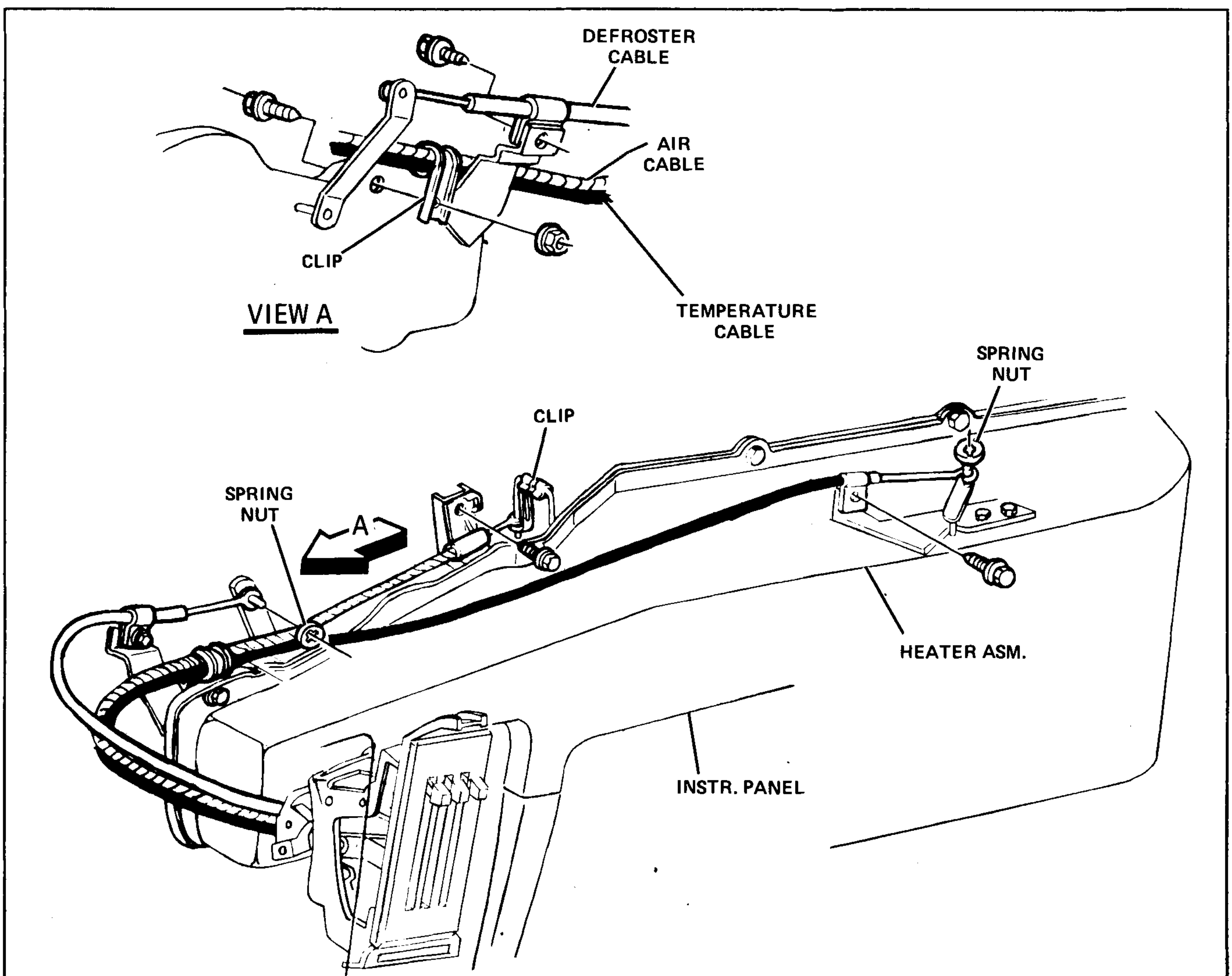


Fig. 1-14 Heater Cable Routing - X Series

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

3. While holding air control door in this position, adjust turnbuckle (Fig. 1-12) 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 and must remain in detent when lever is moved full travel.

DEFROST CABLE

The defrost cable is not adjustable.

F SERIES

Cable adjustments are to be made with cables routed smoothly (free of sharp kinks or bends) and securely connected at both ends.

TEMPERATURE CABLE

1. Place heater control temperature lever at full cold (full left).

2. Adjust temperature cable turnbuckle, Fig. 1-13, until temperature door is felt to seat in housing (heater case).

3. Move temperature lever full right and back to full left. Door should be heard hitting its seat.

4. If door did not seat or if lever did not go full travel, repeat steps 2 and 3 until cable is properly adjusted.

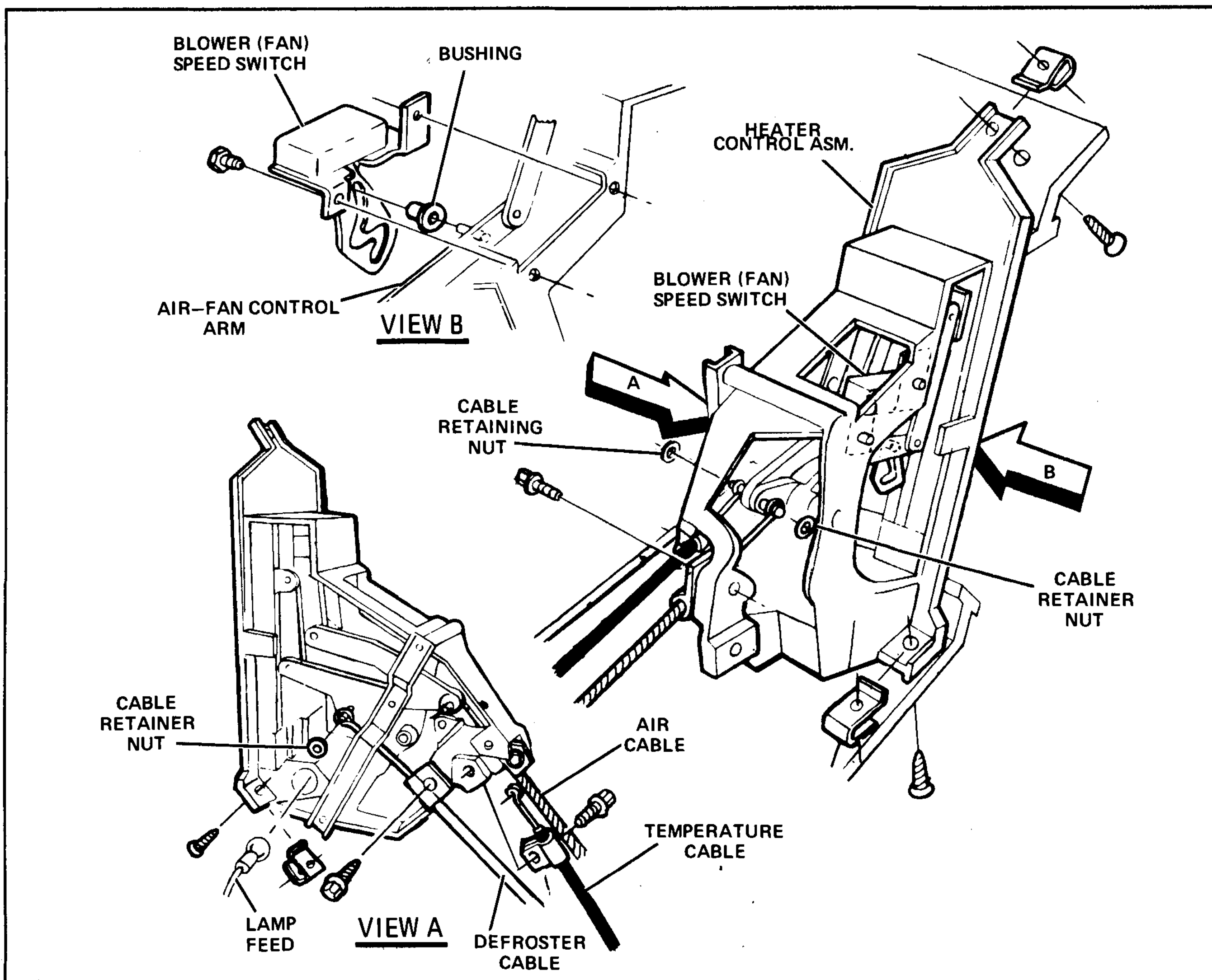


Fig. 1-15 Heater Control Panel - X Series

AIR-DEFROST CABLE

1. Place air control lever in the OFF position.
2. While holding control lever in the OFF position, adjust cable turnbuckle (Fig. 1-13) until door seats and air control lever is forced to start to move.
3. Move lever to DEFROST position then back to OFF. Door should be heard hitting its seat.
4. If door does not seat or if lever is more than 1/8" away from end of slot, repeat steps 2 and 3 until cable is properly adjusted.

X SERIES

ALL CABLES

Unlike other Pontiac models, the X Series heater cables do not have adjustable turnbuckles. Cable adjustment on the X Series is in the positioning of the cable attaching bracket at the heater case. Refer to Figs. 1-14 and 1-15 for cable routing and attachment.

1. Connect cable at heater control.
2. Set control lever to the closed (full up) position.
3. Move corresponding heater case door to the off (full closed) position.
4. Attach cable wire to heater case door lever and tighten cable attaching bracket screws.
5. Check for proper cable operation.

HEATER CABLE REPLACEMENT

ALL CABLES - B SERIES

1. Perform steps 1 thru 5 of heater control panel replacement procedure.
2. Remove retaining screw and nut at control panel and remove cable.
3. To replace, reverse removal procedure. Check cable operation and adjust if necessary.

TEMPERATURE CABLE - A, G and F SERIES

1. On F Series, remove glove compartment and door.
2. Remove retaining screw and disconnect cable from top of heater case.
3. On A and F Series, remove radio.
4. Remove nut retaining cable wire to pin on control panel.
5. Remove screw retaining cable to control and remove cable.
6. To replace cable, reverse removal procedure. Route cable smoothly, check operation and adjust if necessary. See Figs. 1-11, 1-12 and 1-13 for G, A and F Series respectively.

AIR CONTROL CABLE - A SERIES

1. Remove radio.
2. Remove retaining screw and disconnect cable from heater case.
3. Remove nut and screw retaining cable to control panel and remove cable.
4. To replace cable, reverse removal procedure. Route cable smoothly, check operation and adjust if necessary, see Fig. 1-12.

DEFROST CABLE - A SERIES

1. Remove radio.
2. Remove retaining screw and disconnect cable from heater case.
3. Remove nut and screw retaining cable to control panel and remove cable.
4. To replace, reverse removal procedure, see Fig. 1-12.

AIR-DEFROST CABLE - F SERIES

1. Remove retaining nut and screw and disconnect cable from heater case (Fig. 1-13).
2. Remove lower instrument panel trim (at steering column).
3. Remove upper instrument panel trim (at cluster).
4. Remove rally (fuel, volts) cluster if equipped with rally gages.

5. Remove screw and nut retaining cable at control panel and remove cable.

6. To replace, reverse removal procedure. Route cable smoothly, check operation and adjust if necessary.

ALL CABLES - X SERIES

1. Remove radio.

2. If replacing defrost cable, remove ash tray and bracket for access to cable attachment at control.

3. Remove retaining screw and nut and disconnect cable at heater case (Fig. 1-14).

4. If replacing temperature cable, remove screw and clip used to route cable along heater case.

5. Remove retaining screw and nut and disconnect cable at control (Fig. 1-15).

6. Remove cable.

7. To replace, reverse removal procedure, check adjustment when connecting cable at heater case.

HEATER CONTROL PANEL

REMOVE AND REPLACE - B SERIES

1. Disconnect battery.

2. Remove center ash tray. Remove lower instrument panel (I.P.) trimplate (4 screws).

3. Remove radio knobs and bezels and upper I.P. trimplate (5 screws).

4. Disconnect all three heater control cables at heater case.

5. Remove 3 screws and position heater control panel and outlet bezel away from I.P. opening. Disconnect lamp socket and fan switch connector and remove control and outlet bezel as an assembly with heater cables attached.

6. Separate control panel from outlet bezel. (These parts are connected by 4 clips, Fig. 1-10.)

7. Disconnect all 3 heater control cables at the control.

8. To replace, reverse the removal procedure. When routing heater control cables take care to avoid kinks or bends; check cable operation and adjust cables if necessary.

REMOVE AND REPLACE - A SERIES

1. Disconnect battery.

2. Remove radio.

3. Disconnect heater control cables at heater case.

4. Disconnect lamp and wire connectors from control panel (Fig. 1-12).

5. Remove (4) control panel attaching nuts and screw holding heater control and radio support bracket to the lower instrument panel reinforcement.

6. Remove control panel and transfer support bracket.

7. To replace reverse removal procedure, check cable operation and adjust if necessary.

REMOVE AND REPLACE - G SERIES

1. Disconnect battery.

2. Remove radio.

3. Disconnect electrical and vacuum connections at control panel (Fig. 1-11).

4. Remove rear attaching screw.

5. Loosen (2) screws securing control panel to instrument panel (panel mounting tabs are slotted).

6. Remove control panel and disconnect lamp.

7. To replace reverse removal procedure, check operation and adjust temperature cable if necessary.

REMOVE AND REPLACE - F SERIES

1. Disconnect battery.

2. Remove lower instrument panel trim (at steering column).

3. Remove upper instrument panel trim plate (at cluster).

4. Remove rally gages (fuel, volts) if equipped with rally gages.

5. Remove (3) control retaining screws (Fig. 1-13).

6. Remove screw at support bracket.

7. Remove radio.
8. Disconnect temperature cable and air-defrost cable at control panel.
9. Disconnect all electrical connections at control and remove control panel.
10. To replace, reverse removal procedure. Adjust cables if necessary.

REMOVE AND REPLACE - X SERIES

1. Disconnect battery.
2. Remove radio.
3. Remove (3) heater control to instrument panel attaching screws and lower heater control assembly from instrument panel.
4. Disconnect heater control cables from control panel.
5. Disconnect electrical connectors and remove control panel (Fig. 1-15).
6. To replace, reverse removal procedure.

BLOWER SPEED (FAN) SWITCH

REMOVE AND REPLACE - B SERIES

1. Remove heater control panel and outlet bezel from

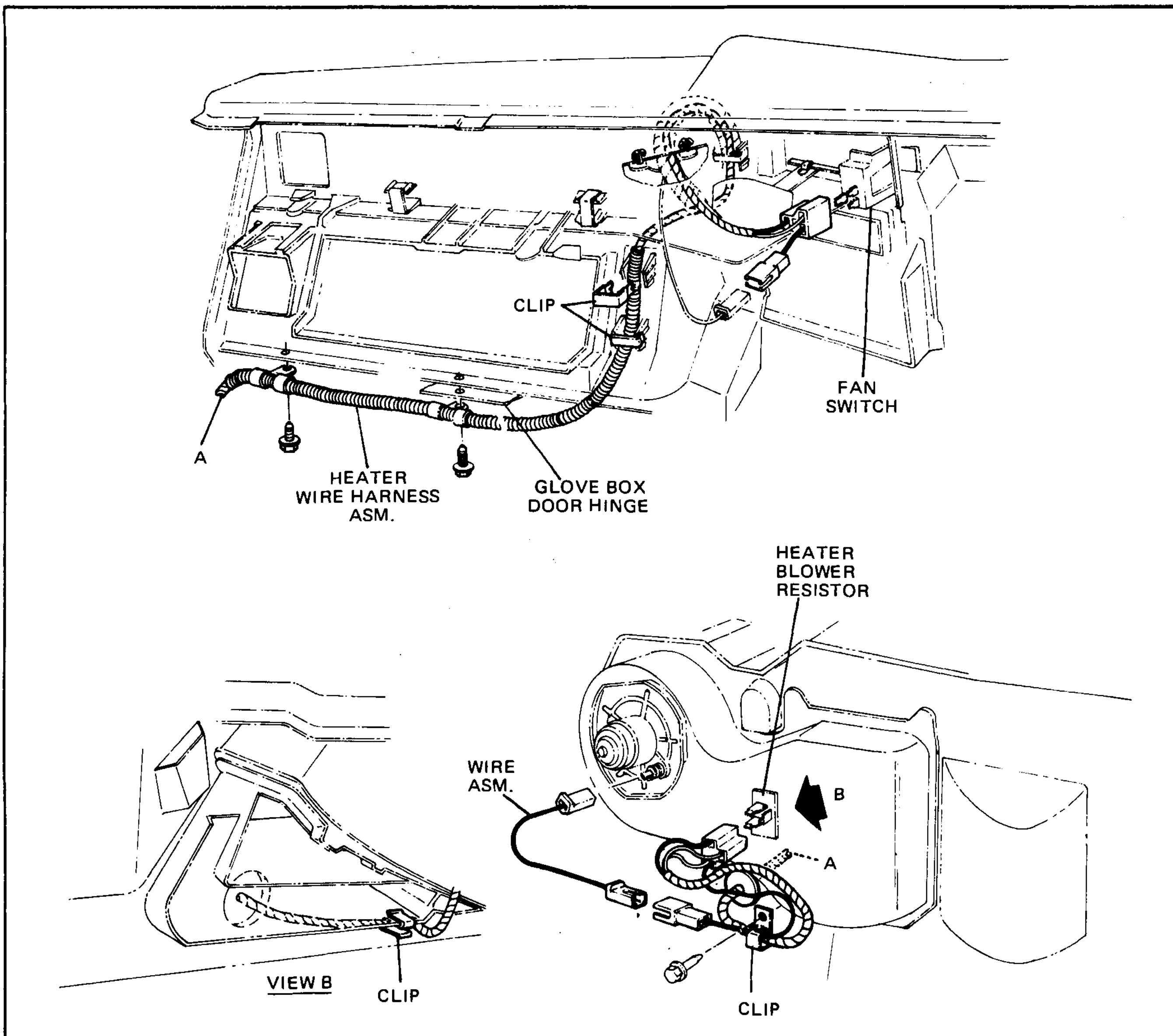


Fig. 1-16 B Series Heater Wire Harness Routing

instrument panel as an assembly (steps 1 thru 5 of Heater Control Panel - Remove and Replace).

2. Remove switch knob. Remove (2) switch retaining screws and remove switch.

3. To replace, reverse removal procedure.

REMOVE AND REPLACE - A AND G SERIES

1. Disconnect battery.
2. Remove radio.
3. Remove heater control panel.
4. Remove plastic knob from switch lever.
5. Remove switch retaining screws and remove switch.
6. To replace, reverse removal procedure.

REMOVE AND REPLACE - F SERIES

1. Perform steps 1 through 4 of procedure for heater control replacement.
2. Remove switch knob (Fig. 1-13).
3. Disconnect electrical connector.
4. Remove (2) switch retaining screws and remove switch through rally gage opening.
5. To replace, reverse removal procedure.

REMOVE AND REPLACE - X SERIES

1. Disconnect battery.
2. Remove radio.
3. Remove heater control to instrument panel attaching screws and lower heater control from instrument panel.
4. Disconnect electrical connector from switch.
5. Remove switch retaining screws and remove switch (Fig. 1-15).
6. To replace, reverse removal procedure.

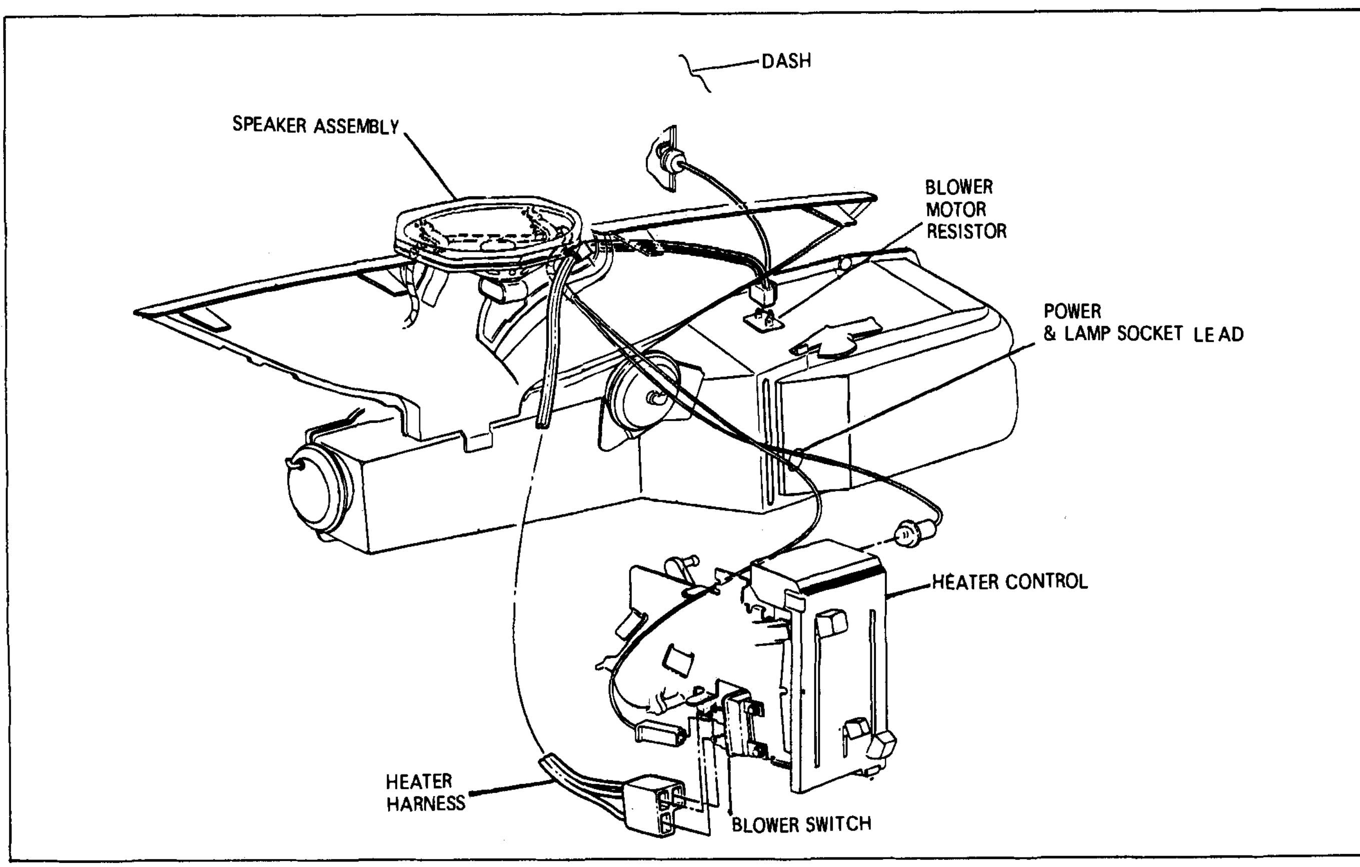


Fig. 1-17 G Series Heater Wire Harness Routing

HEATER BLOWER MOTOR RESISTOR

REMOVE AND REPLACE - ALL

1. Remove glove compartment and door (on F and X Series only).
2. Remove resistor wire connector (B Series - on air inlet assembly underhood, except B Series - on top of heater case).
3. Remove resistor (2 screws).
4. Replace by reversing removal procedure.
5. Check operation.

HEATER WIRE HARNESS

The X Series heater and defroster system does not utilize a separate heater wire harness. For servicing electrical wiring refer to Section 12 of this manual.

REMOVE AND REPLACE - EXCEPT X SERIES

1. Disconnect battery.
2. Disconnect wire connector at blower motor (and connector at blower resistor on B Series), remove dash grommet and feed wire harness through dash opening into passenger compartment.

   For installation drawing, see Fig. 1-16 (B Series), Fig. 1-17 (G Series), Fig. 1-18 (A Series) and Fig. 1-19 (F Series).
3. Remove lower instrument panel trim at steering column (B and F Series only).
4. Remove upper instrument panel trim plate at cluster (B and F Series only).
5. Disconnect blower switch and power feed connectors at control panel. On B Series it will be necessary to disconnect the heater control cables, remove 3 screws and position control panel out from I.P. opening to disconnect connectors.

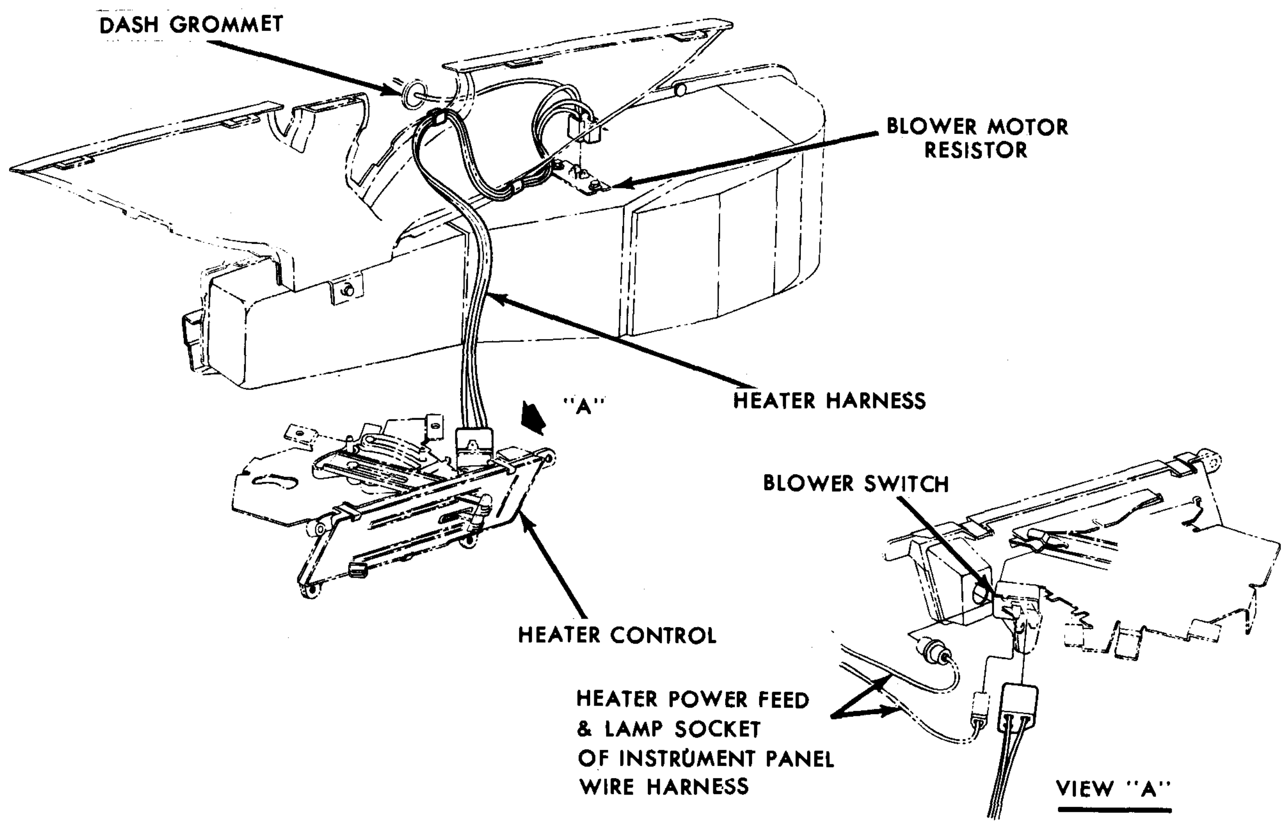


Fig. 1-18 A Series Heater Wire Harness Routing

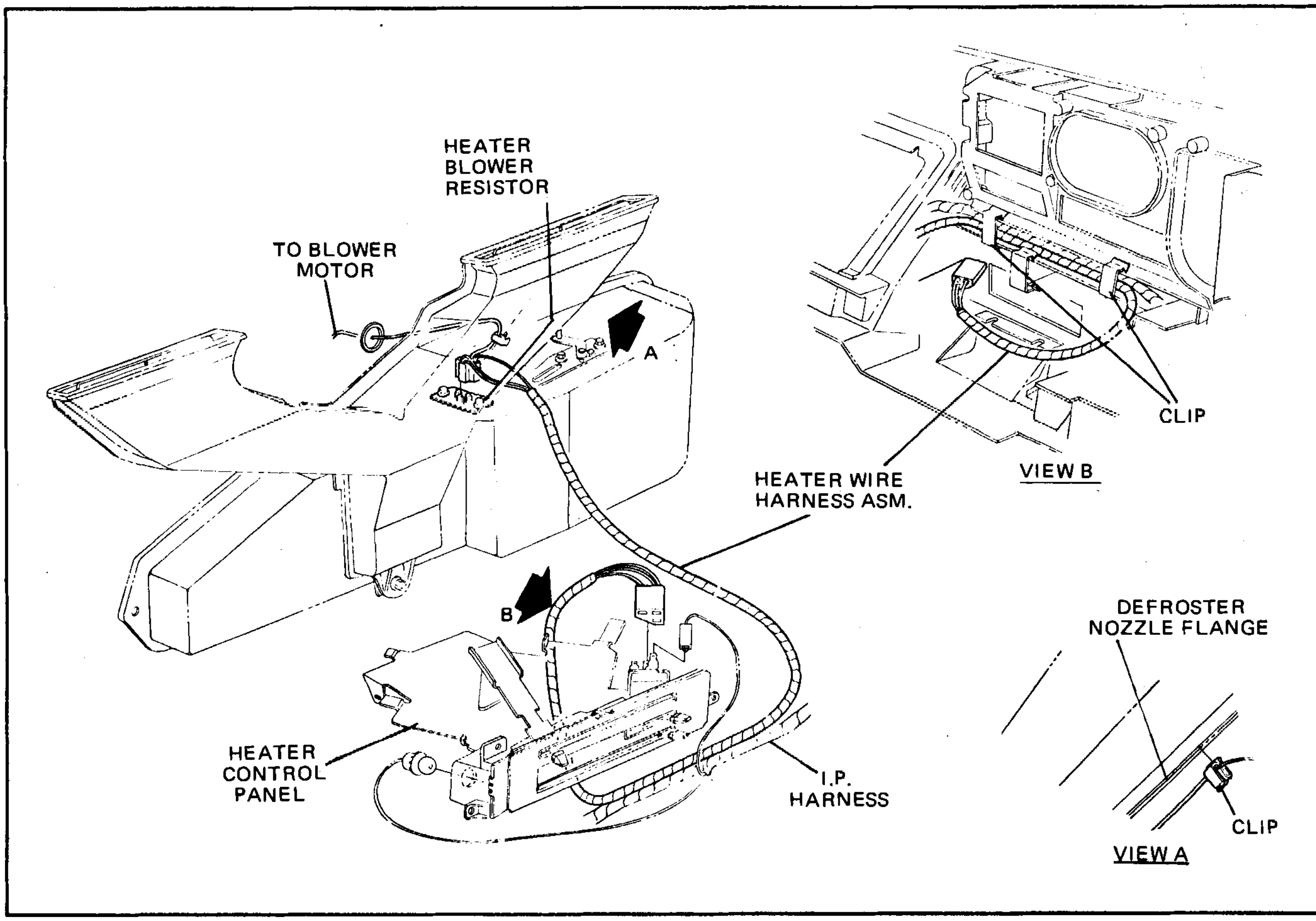


Fig. 1-19 F Series Heater Wire Harness Routing

6. Disconnect resistor connector (except B Series).
7. Remove glove box (B Series only), remove 2 harness retaining screws (B Series only), pull harness from wire clips and remove harness.
8. To replace, reverse removal procedure.
9. Check operation. Make sure dash grommet is in place and resealed.

DEFROSTER NOZZLE (DUCT)

REMOVE AND REPLACE - B SERIES (WITHOUT A/C)

1. Disconnect battery.
2. Remove center ash tray and remove lower instrument panel trim plate (4 screws).
3. Remove radio knobs and bezels. Remove upper I.P. trim plate (5 screws) and remove radio.
4. Remove plastic filler panel on top of I.P. at base of windshield.
5. Remove windshield garnish mouldings at both ends of instrument panel.
6. Remove 4 bolts retaining I.P. pad extension to cowl.
7. Remove center I.P. brace (2 bolts), disconnect shift quadrant cable, remove 2 nuts and lower steering column.
8. Disconnect heater control cables at heater case.
9. Remove 3 retaining screws and position heater control panel and outlet bezel away from I.P. opening. Remove upper vent duct retaining screw.
10. Remove lower I.P. bolts (at extreme ends of I.P. asm.).
11. Place rags or fender pad on steering column, disconnect speedometer cable, tilt I.P. pad toward rear of car and allow pad to rest on steering column.
12. Remove upper vent duct screw at cowl and remove duct.

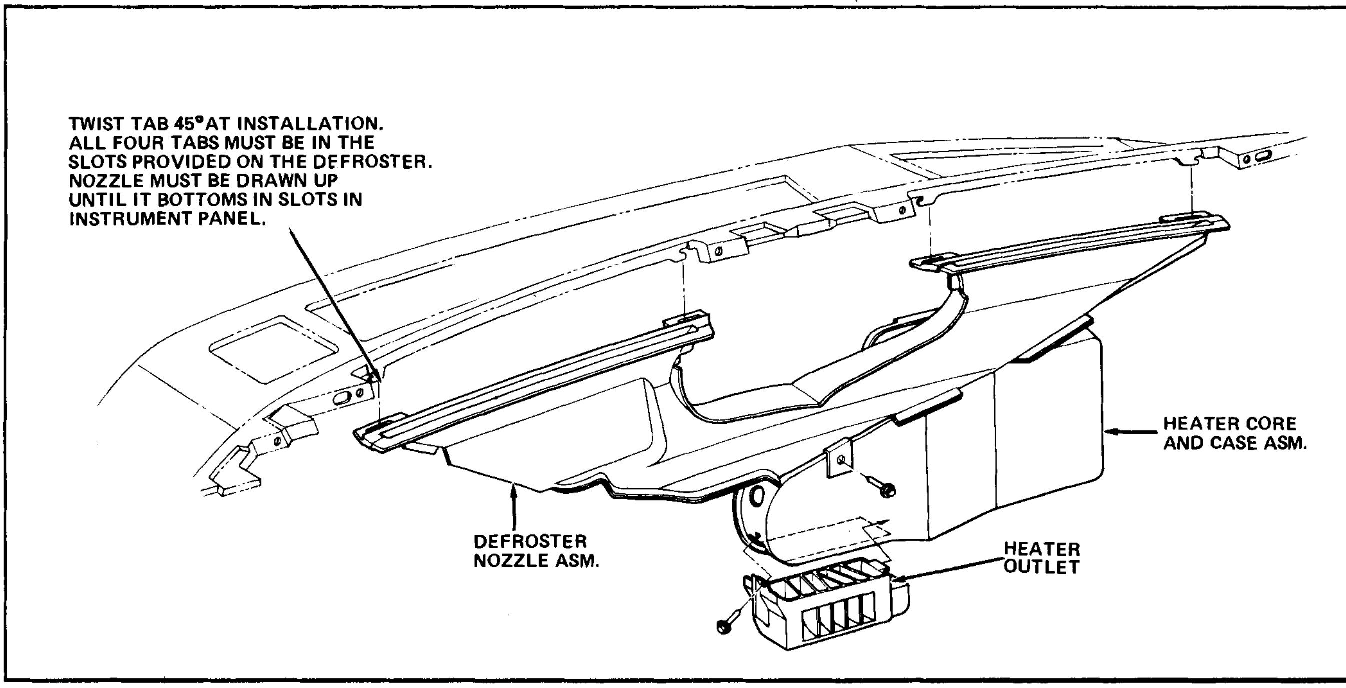


Fig. 1-20 B Series Heater Duct Installation

13. Remove defroster nozzle to heater case screw. Straighten defroster nozzle retaining tabs (Fig. 1-20) and remove defroster nozzle.
14. To replace, reverse removal procedure. Refer to Fig. 1-20 for defroster nozzle attachment. Check cable adjustment after assembly and adjust cables if necessary.

REMOVE AND REPLACE - B SERIES (WITH A/C)

1. Perform steps 1 thru 7 of procedure for defroster nozzle replacement on non-air conditioned models.
2. Disconnect temperature cable at heater case.
3. Remove glove box and cold air duct.
4. Remove lower I.P. bolts (at extreme ends of I.P. asm.).
5. Place rags or fender pad on steering column, disconnect speedometer cable, tilt I.P. pad toward rear of car and allow pad to rest on steering column.
6. Remove defroster nozzle screw at heater case. Straighten nozzle retaining tabs (Fig. 1-20) and remove nozzle.
7. To replace, reverse removal procedure. Check temperature cable operation and adjust cable if necessary.

REMOVE AND REPLACE - A AND G SERIES

1. Disconnect battery.
2. Disconnect heater cables at heater case.
3. Remove defroster duct retaining screw at heater case.
4. Lower steering column from instrument panel.
5. Remove instrument panel pad attaching nuts and bolts and position pad out onto steering column (For instrument panel pad procedure see Section 12 of Service Manual).
6. On A Series, bend (4) defroster duct retaining tabs and remove duct. On G Series, remove (4) defroster duct retaining screws from instrument panel pad and remove duct.
7. To replace reverse removal procedure, check heater cable operation and adjust if necessary. For installation, see Figs. 1-21 (G Series) and 1-22 (A Series).

REMOVE AND REPLACE - F SERIES (WITHOUT AIR CONDITIONING)

1. Disconnect battery.
2. Remove lower (at steering column) and upper (at cluster) instrument panel trim.

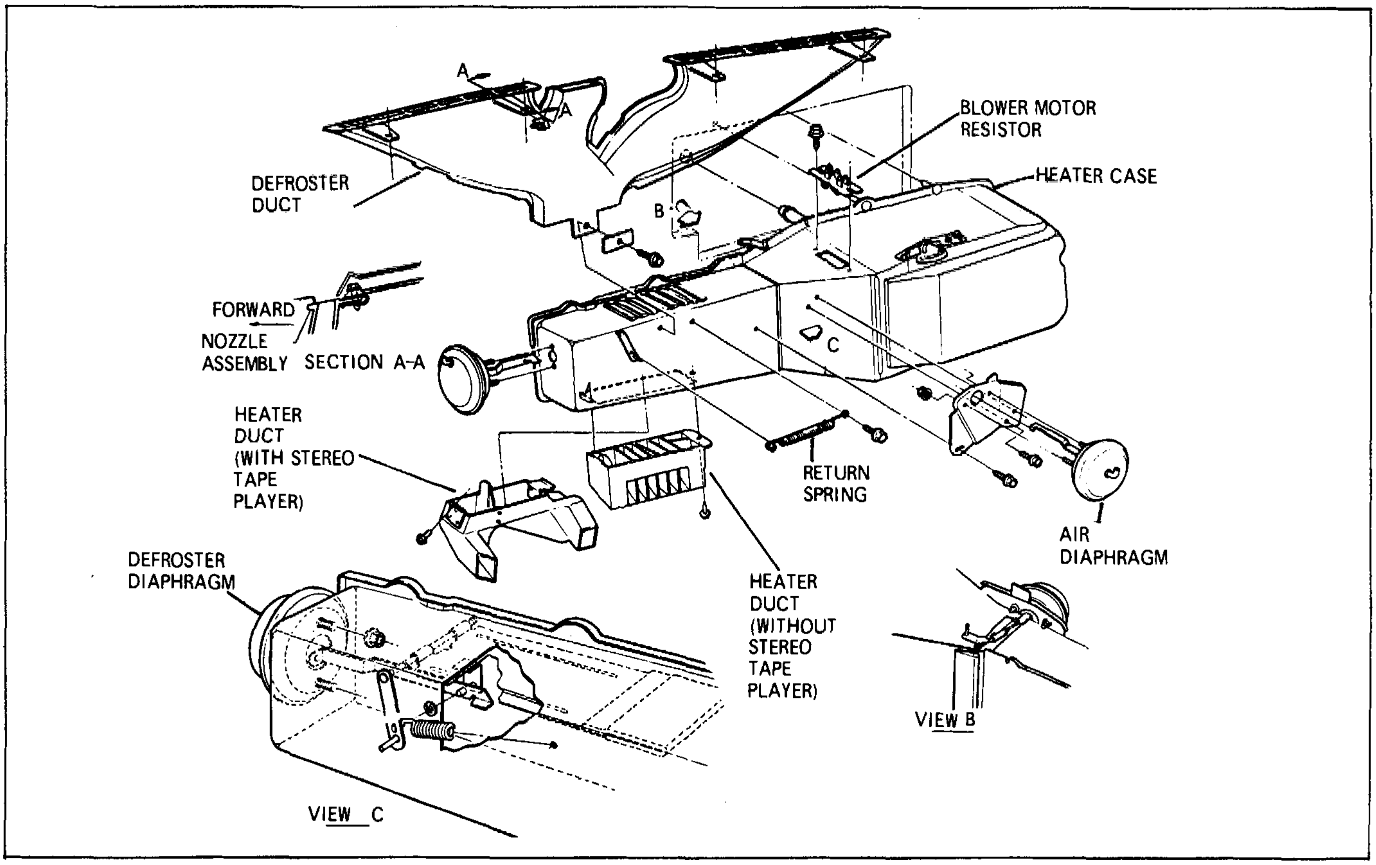


Fig. 1-21 G Series Vacuum Diaphragm and Duct Installation

3. Remove rally gage cluster (fuel, volts) if equipped with rally gages.
4. Remove glove compartment and door.
5. Disconnect air-defrost cable at heater case and position out of way.
6. Remove lower defroster duct screw at heater case.
7. Remove duct retaining nut at each defroster outlet and remove duct through bottom of instrument panel (Fig. 1-23).
8. To replace, reverse removal procedure. Check cable operation and adjust if necessary.

REMOVE AND REPLACE - F SERIES (WITH AIR CONDITIONING)

1. Disconnect battery.
2. Remove lower instrument panel trim and upper trim plate (at cluster).
3. Remove lower left hand A/C duct.
4. Remove steering column support bracket.
5. Remove (4) steering column nuts and lower column.
6. Remove glove compartment and door.
7. Remove right hand lower A/C duct (cold air duct).
8. Remove defroster duct attaching screw at heater case.
9. Remove windshield side garnish moldings.
10. Disconnect emergency brake release cable.
11. Remove (2) lower I.P. bolts at extreme corners of I.P. and remove console to I.P. bolts (if applicable).
12. Remove (3) upper I.P. screws at cluster and (3) nuts from I.P. pad studs above glove box opening.
13. Lift I.P. pad and tip out toward rear of car.
14. Remove duct retaining nut at each defroster outlet (Fig. 1-23) and remove duct from top of instrument panel.
15. To replace, reverse removal procedure.

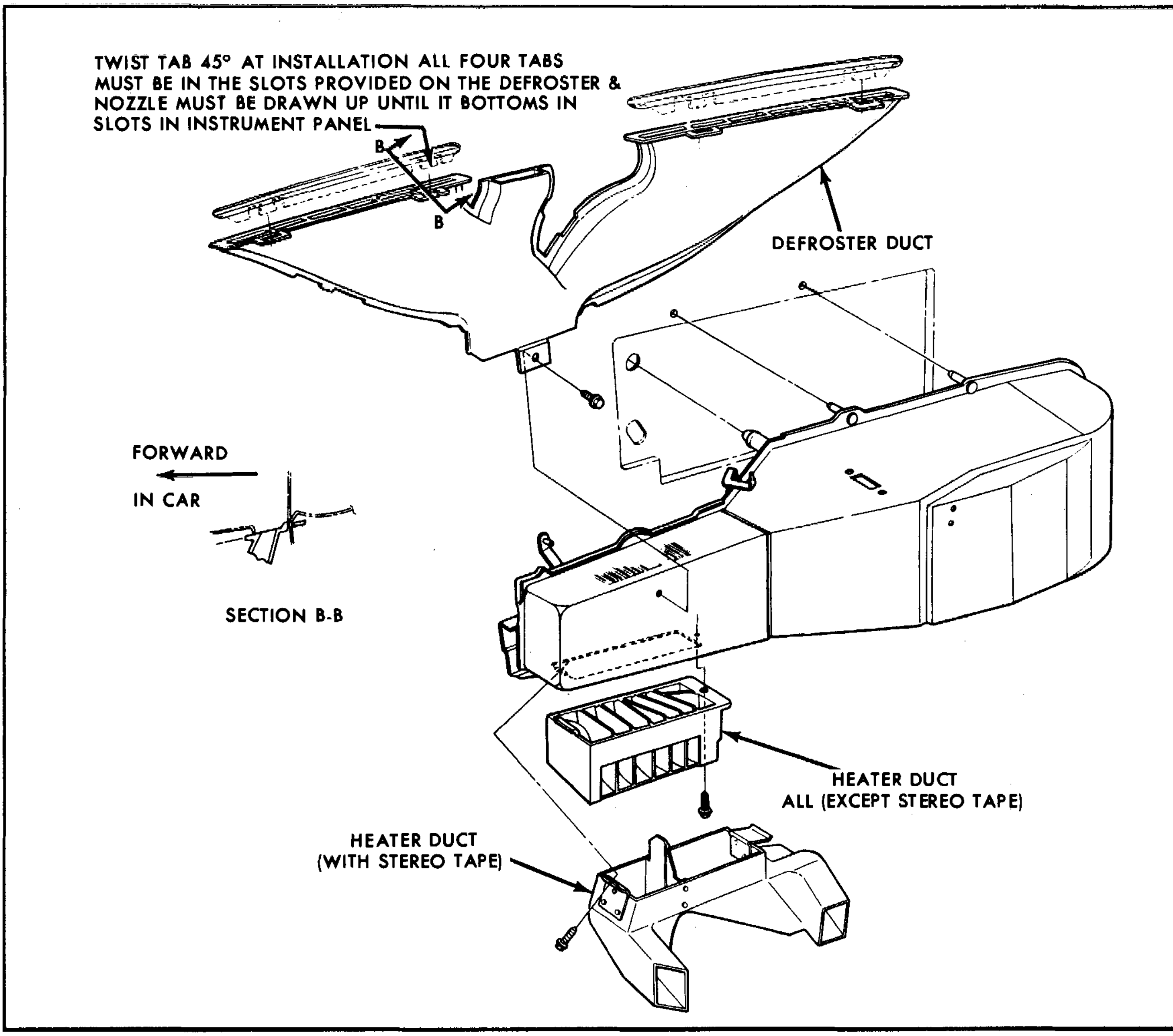


Fig. 1-22 A Series Heater Duct Installation

REMOVE AND REPLACE - X SERIES

1. Remove heater core and case assembly from car (steps 1 through 8 of heater core replacement procedure).
2. Remove (2) upper defroster nozzle attaching screws.
3. Remove lower attaching screw and washer and remove defroster nozzle (Fig. 1-24).
4. Replace defroster nozzle and (3) attaching screws.
5. Replace heater core and case assembly (steps 12 through 16 of heater core replacement procedure).

HEATER OUTLET DUCT

REMOVE AND REPLACE - ALL

1. Remove screw(s) retaining outlet to heater case and remove duct.
2. To replace, reverse removal procedure.

DEFROSTER DIAPHRAGM

REMOVE AND REPLACE - G SERIES

1. Disconnect vacuum hose from diaphragm (Fig. 1-21).

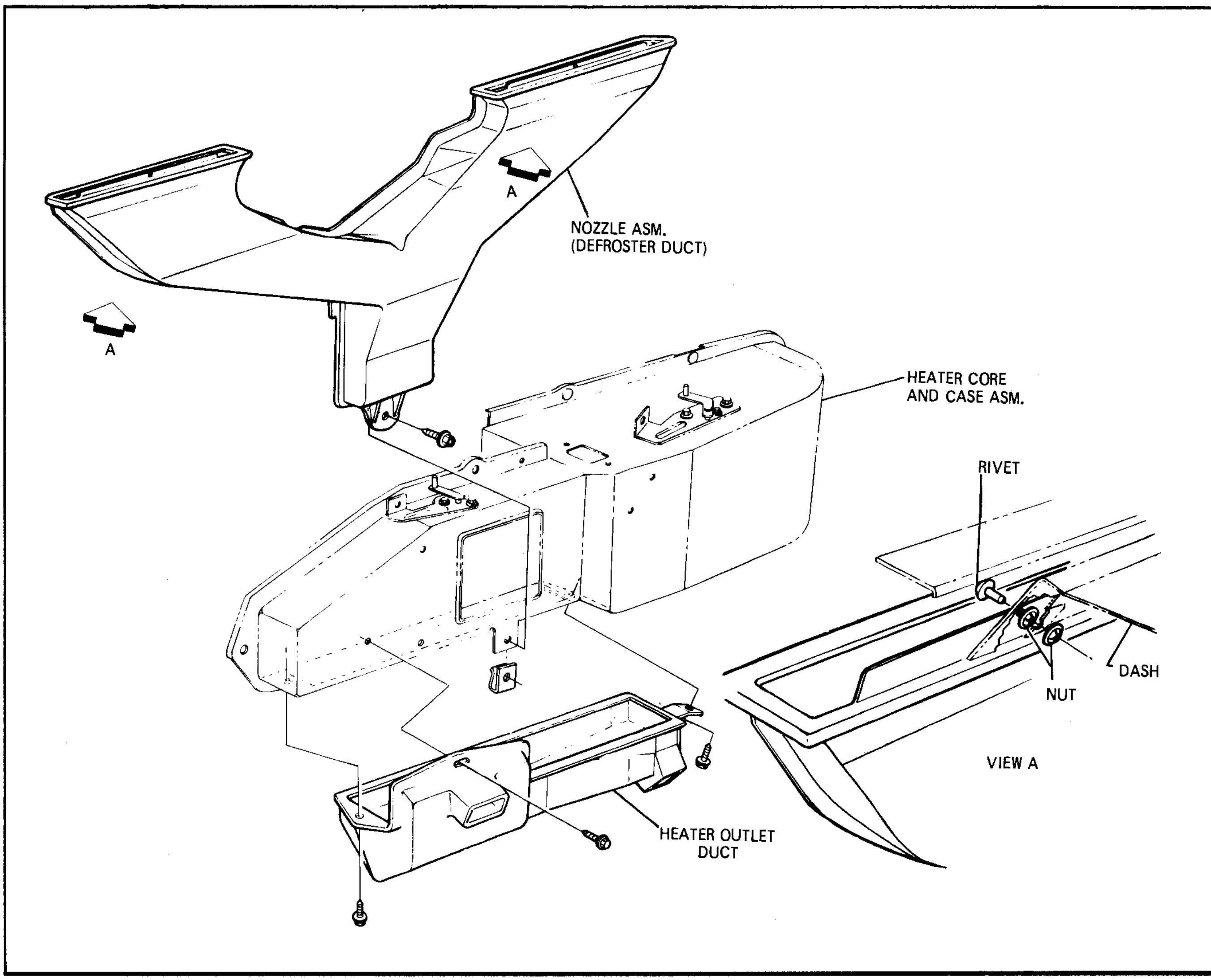


Fig. 1-23 F Series Heater Duct Installation

2. Remove heater outlet.
3. Remove diaphragm retaining nuts from below.
4. Remove nut retaining actuating lever to pin and remove diaphragm.
5. To replace, reverse removal procedure.

AIR DIAPHRAGM

REMOVE AND REPLACE - G SERIES

1. Disconnect vacuum hose from diaphragm (Fig. 1-21).
2. Remove diaphragm retaining screws and spring.
3. Remove diaphragm.
4. To replace, reverse removal procedure.

VACUUM HARNESS

REMOVE AND REPLACE - G SERIES

1. Disconnect vacuum source hose in engine compartment, remove dash grommet and feed hose through dash opening into car.
2. Disconnect vacuum hoses from defroster and air diaphragms on heater case.
3. Disconnect hoses from rotary vacuum valve on control panel and remove harness (Fig. 1-11).

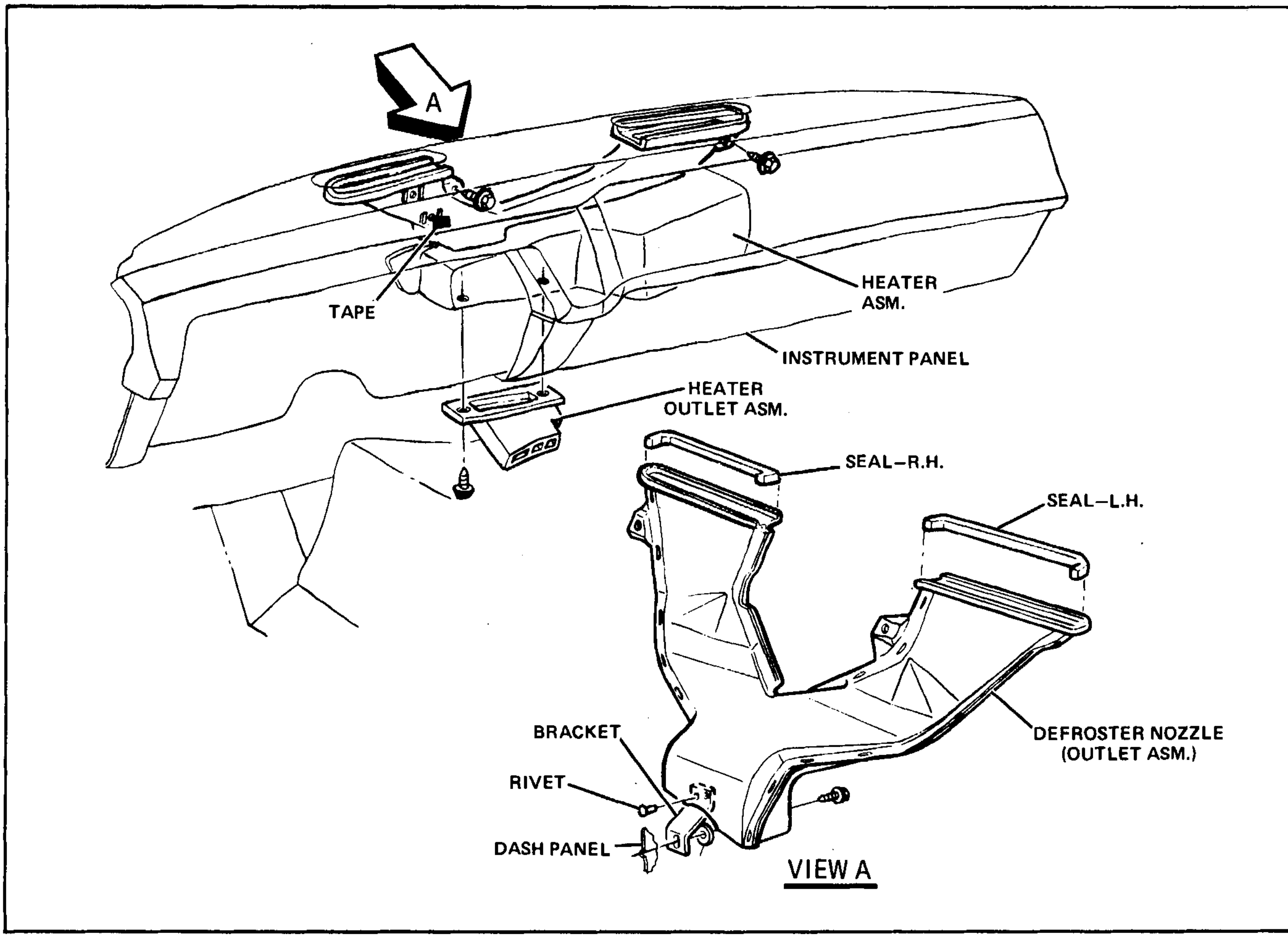


Fig. 1-24 X Series Heater Duct Installation

4. To replace, reverse removal procedure. Make sure dash grommet is in place and resealed.

HEATER BLOWER MOTOR AND/OR IMPELLER

REMOVE AND REPLACE - EXCEPT G AND X SERIES

1. Raise car and remove right hand front wheel.
2. Cut access hole approximately 3/4 of the way along outline stamped in right hand fender skirt with pneumatic chisel or equivalent and bend cut portion of skirt outward for access to blower motor area.
3. Disconnect blower feed wire.
4. Remove blower motor and transfer impeller.
5. To install, reverse procedure for removal. Bend cut portion of fender skirt back to its original position and retain cut-out with sheet metal screws. Seal cut-out area with undercoating or body joint and seam sealer.

The cut-out panel can be retained using a 2" by 3" piece of scrap metal and four sheet metal screws. Fasten piece of scrap metal with 2 screws into fender skirt and 2 screws into cut-out panel.

Another method of retaining the cut-out panel is to install 3 sheet metal screws with large washers (approximately 1 1/2") equally spaced around cut line with center screw and washer into cut-out panel and the other two screws in the fender skirt itself so that washers over-lap cut line.

For installation of blower motor, impeller and inlet duct, see Figs. 1-25 (B Series) and 1-26 (Except B Series).

REMOVE AND REPLACE - G SERIES

1. Disconnect blower motor feed wire.
2. Remove blower motor or duct retaining screws as required (see Fig. 1-26).

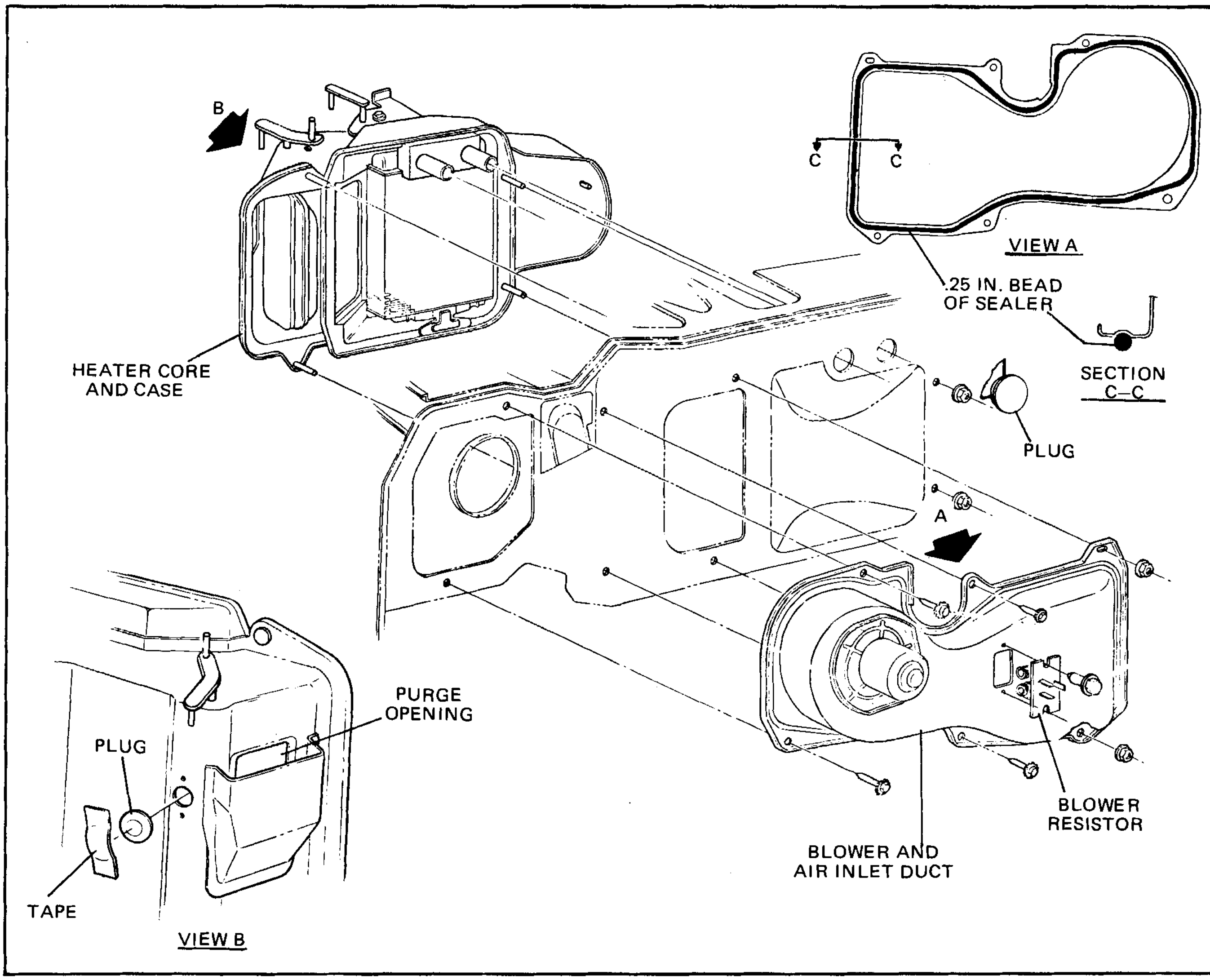


Fig. 1-25 B Series Blower Motor and Air Inlet Duct Installation

3. Remove motor or duct.

4. To replace reverse removal procedure using care to reseal duct. NOTE: Impeller is accessible with either duct or motor removed.

REMOVE AND REPLACE - X SERIES

1. Disconnect battery.

2. Raise car on hoist.

3. Remove all fender skirt attaching bolts except those attaching skirt to radiator support.

4. Pull out then down on skirt and place wooden block between skirt and fender to allow clearance for blower motor removal.

5. Disconnect blower motor electrical connections.

6. Remove attaching screws and remove blower motor. Pry motor flange gently if sealer acts as an adhesive.

7. Remove blower impeller retaining nut and separate motor from impeller.

8. To replace, reverse removal procedure.

BLOWER AND AIR INLET CASE

REMOVE AND REPLACE - X SERIES

1. Remove blower motor and impeller assembly (steps 1 through 6 of blower motor removal procedure).

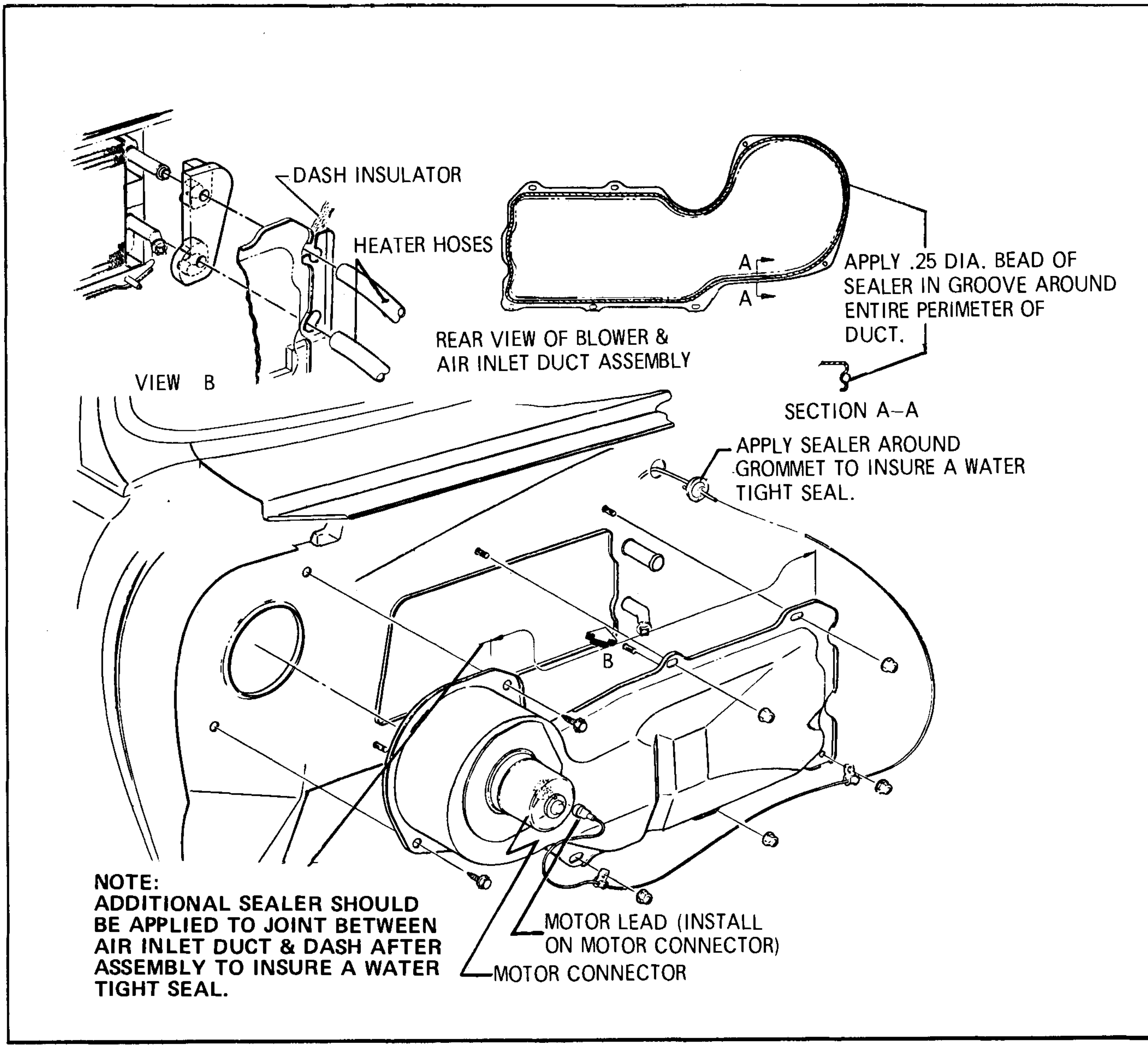


Fig. 1-26 Blower Motor and Air Inlet Duct Installation - Except B Series

2. Remove (2) air inlet case attaching screws through opening between fender and skirt.

3. Remove (5) air inlet case attaching nuts and remove case.

4. To replace, reverse removal procedure. Reseal air inlet case when replacing. See Fig. 1-26 for installation.

HEATER WATER HOSES

REMOVE AND REPLACE

1. Drain radiator.

2. Loosen hose clamps and remove hose.

3. When replacing hose refer to Figs. 1-27 (B Series), 1-28 (A and G Series), 1-29 (F Series) and 1-30 and 1-30A (X Series) for proper hose routing and connections. Attach hoses, tighten clamps and refill radiator.

HEATER CORE

REMOVE AND REPLACE - EXCEPT X SERIES

1. Drain radiator.

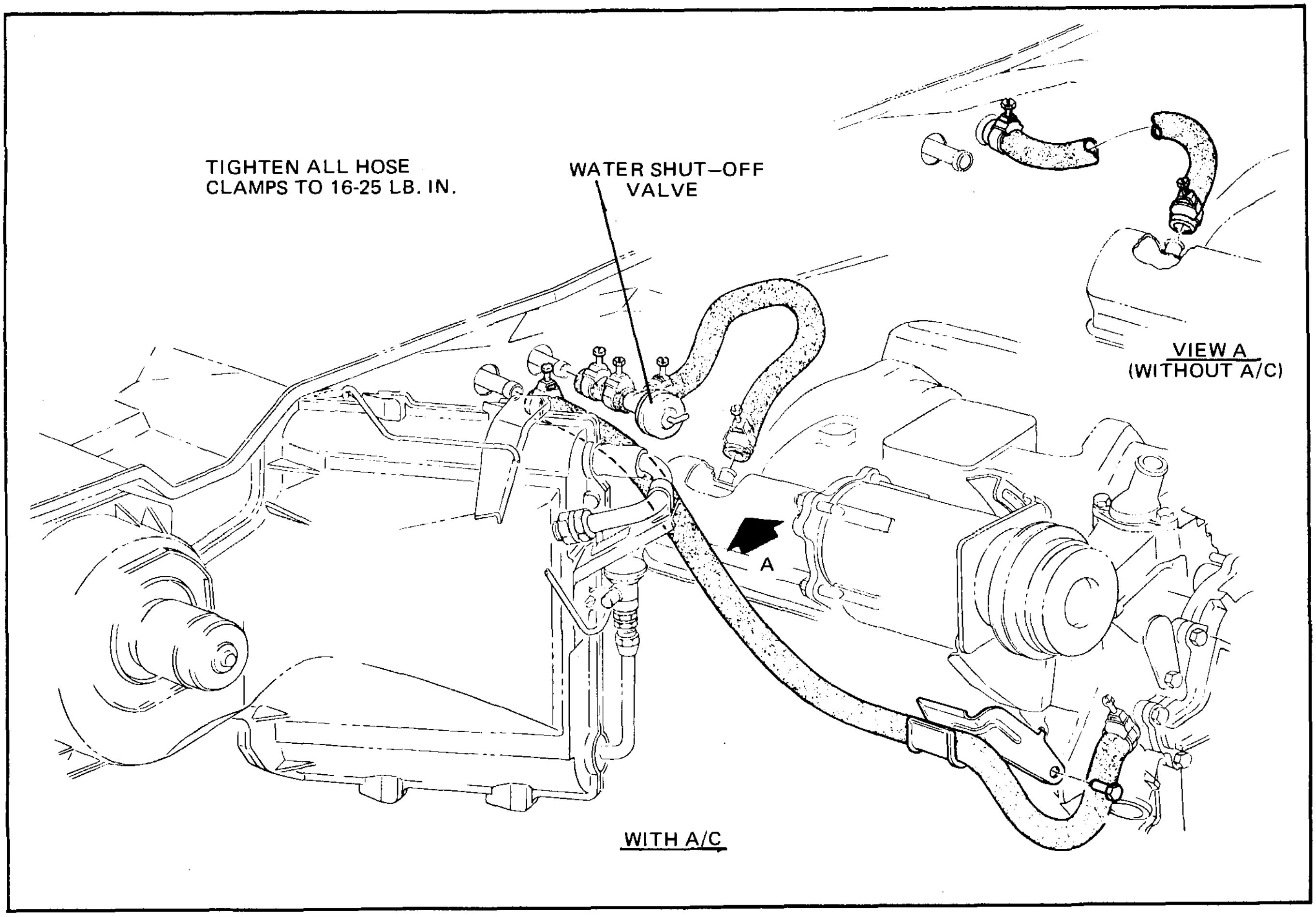


Fig. 1-27 Heater Hose Routing - B Series

2. Disconnect heater hoses at their connections beside the air inlet assembly.

3. Remove retaining nuts from core case studs on the engine side of the dash.

4. Inside vehicle, remove glove compartment and door (F Series only) and heater outlet from heater case (F Series only).

5. Remove defroster duct retaining screw from heater case and pull the entire heater assembly from the firewall.

6. Disconnect heater control cables and all electrical connectors from the heater assembly and remove assembly. On G Series, disconnect vacuum hoses.

7. Remove the core tube seal and core assembly retaining strips and remove core.

8. Install the replacement core. Be sure the core to case sealer is intact before installing core. Use new sealer if necessary.

9. Install core retaining strips and core tube seal.

10. Within the vehicle, insert the studs on heater through the holes in cowl and blower and air inlet assembly. Install the case to firewall mounting nuts (on engine side). It may be necessary to first insert coolant tubes through the dash followed by the studs.

11. Connect heater control cables and electrical connectors. Check cable operation and adjust if necessary.

12. Connect heater hoses, being careful to install them in their proper locations.

13. Refill radiator.

For heater core and case installation refer to Figs. 1-25 (B Series), 1-21 (G Series), 1-22 (A Series) and 1-32 (F Series).

REMOVE AND REPLACE - X SERIES

1. Disconnect battery.

2. Drain radiator.

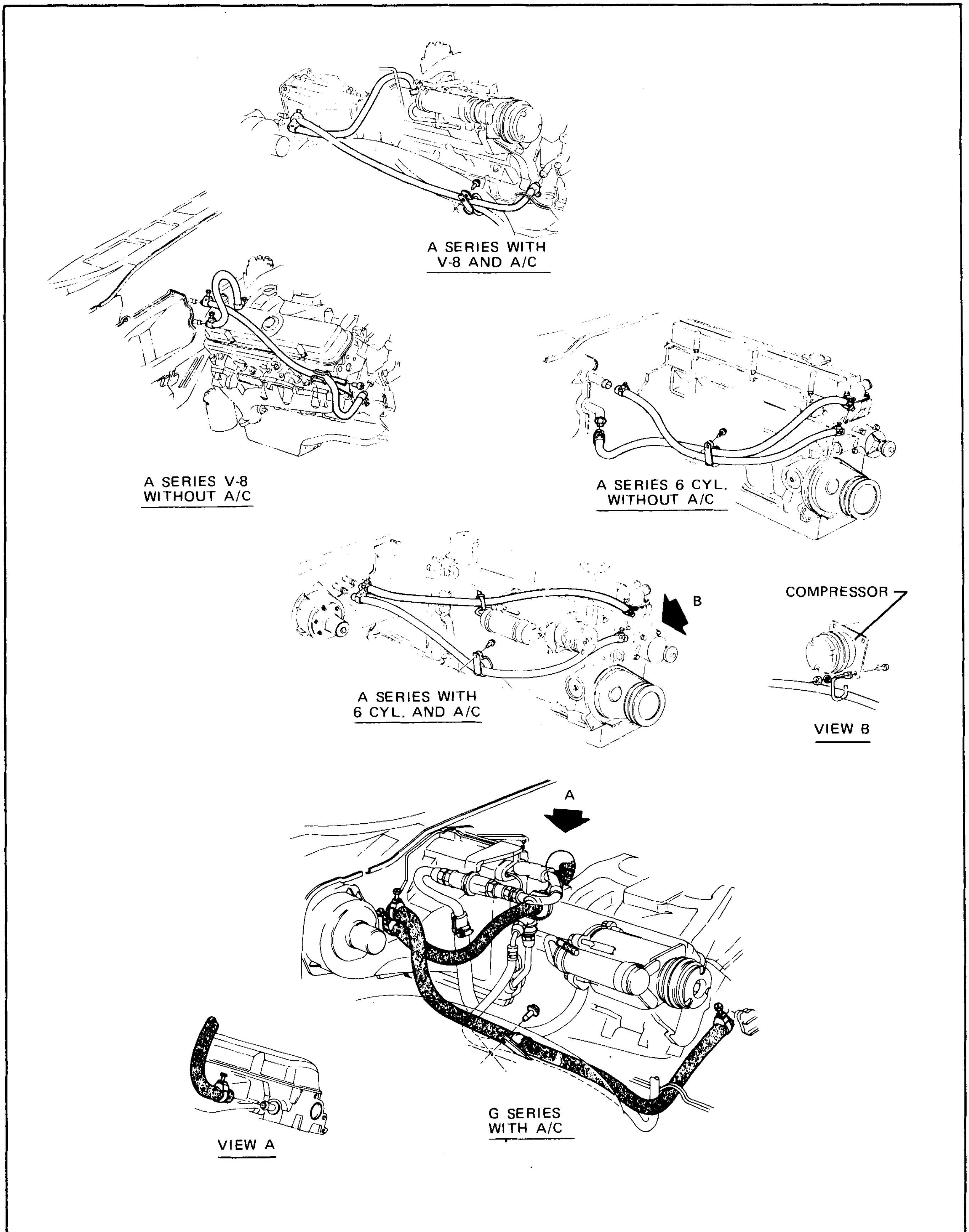


Fig. 1-28 Heater Hose Routing - A and G Series

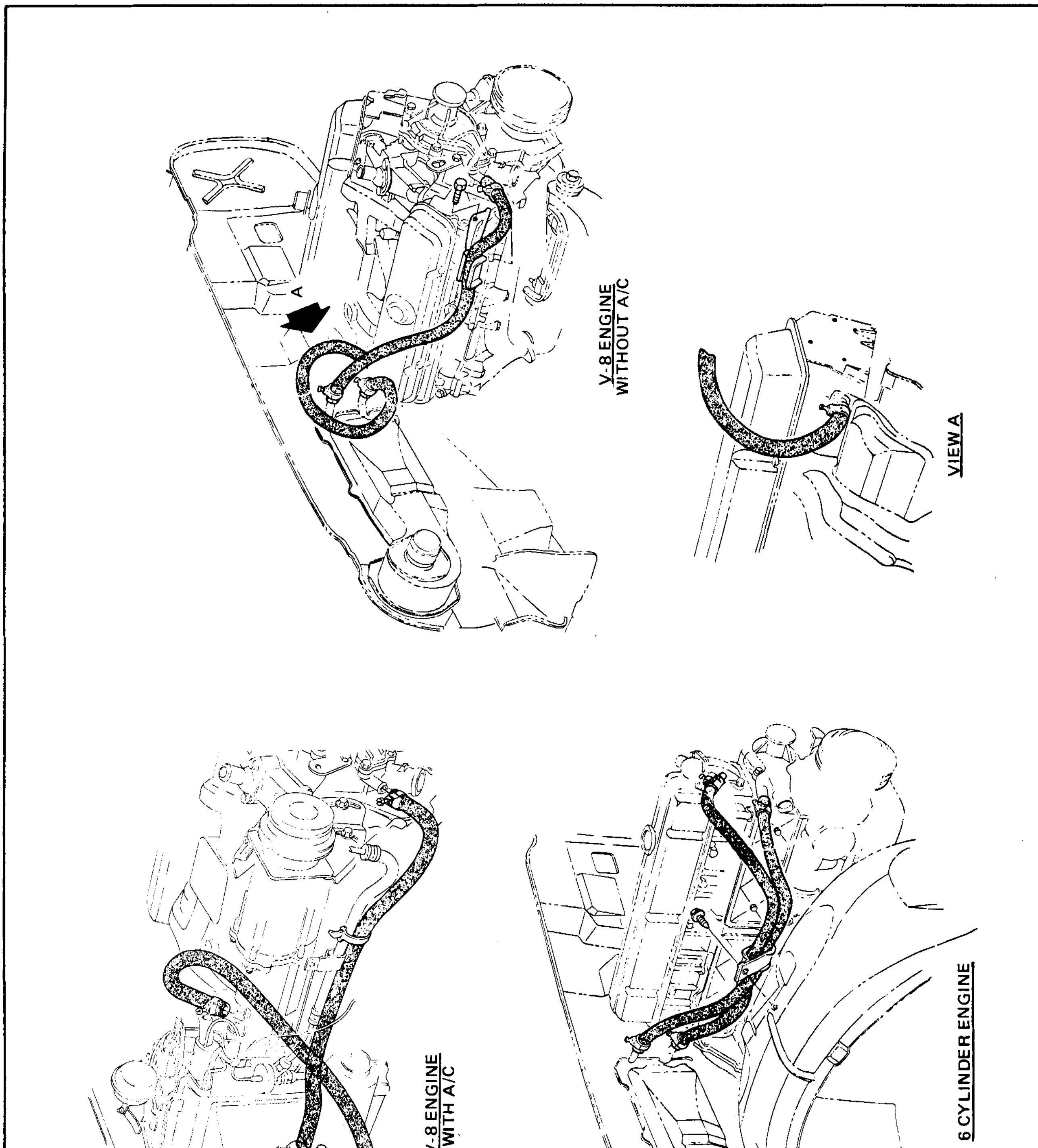


Fig. 1-29 Heater Hose Routing - F Series

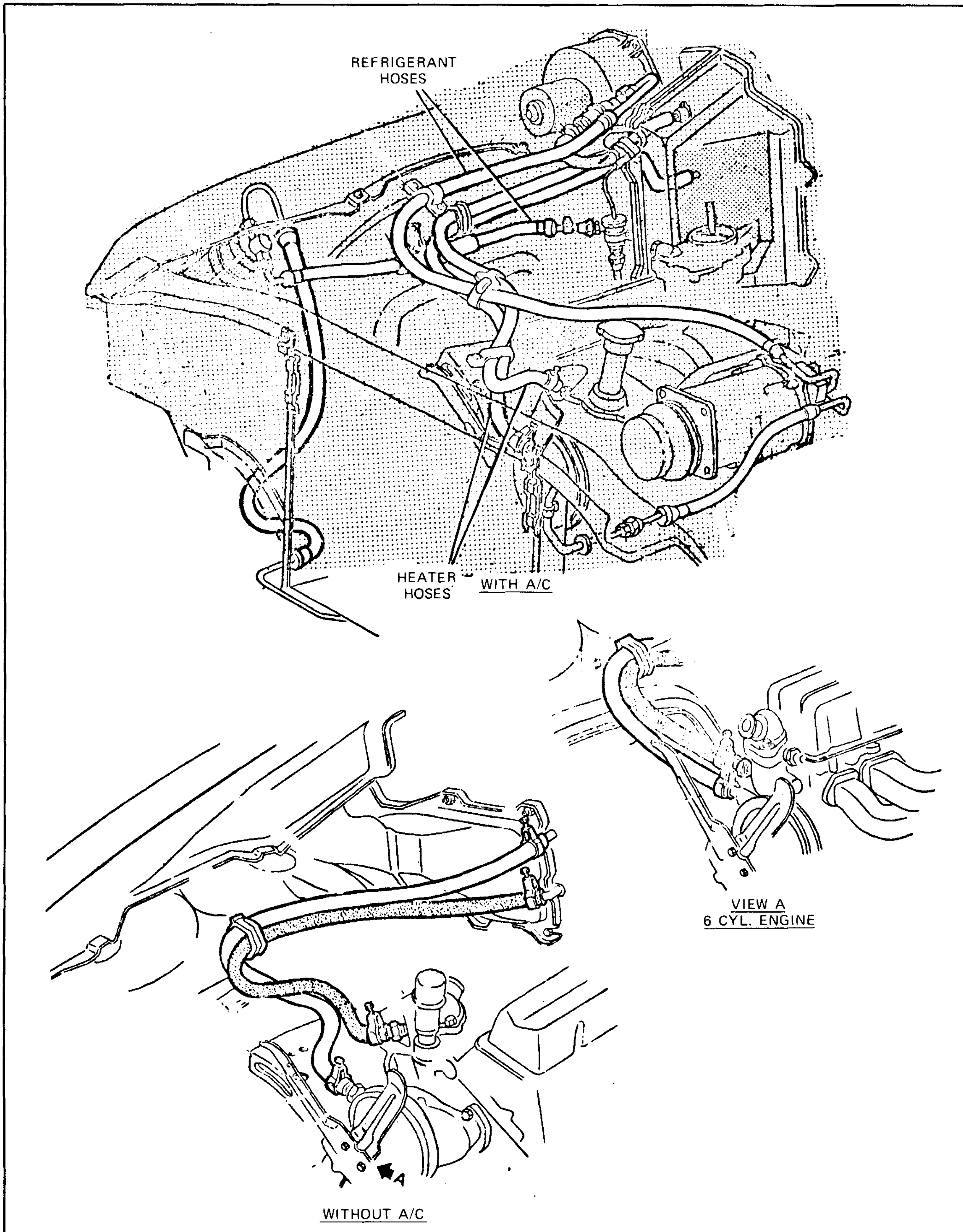


Fig. 1-30 Heater Hose Routing - X Series (307 Engine)

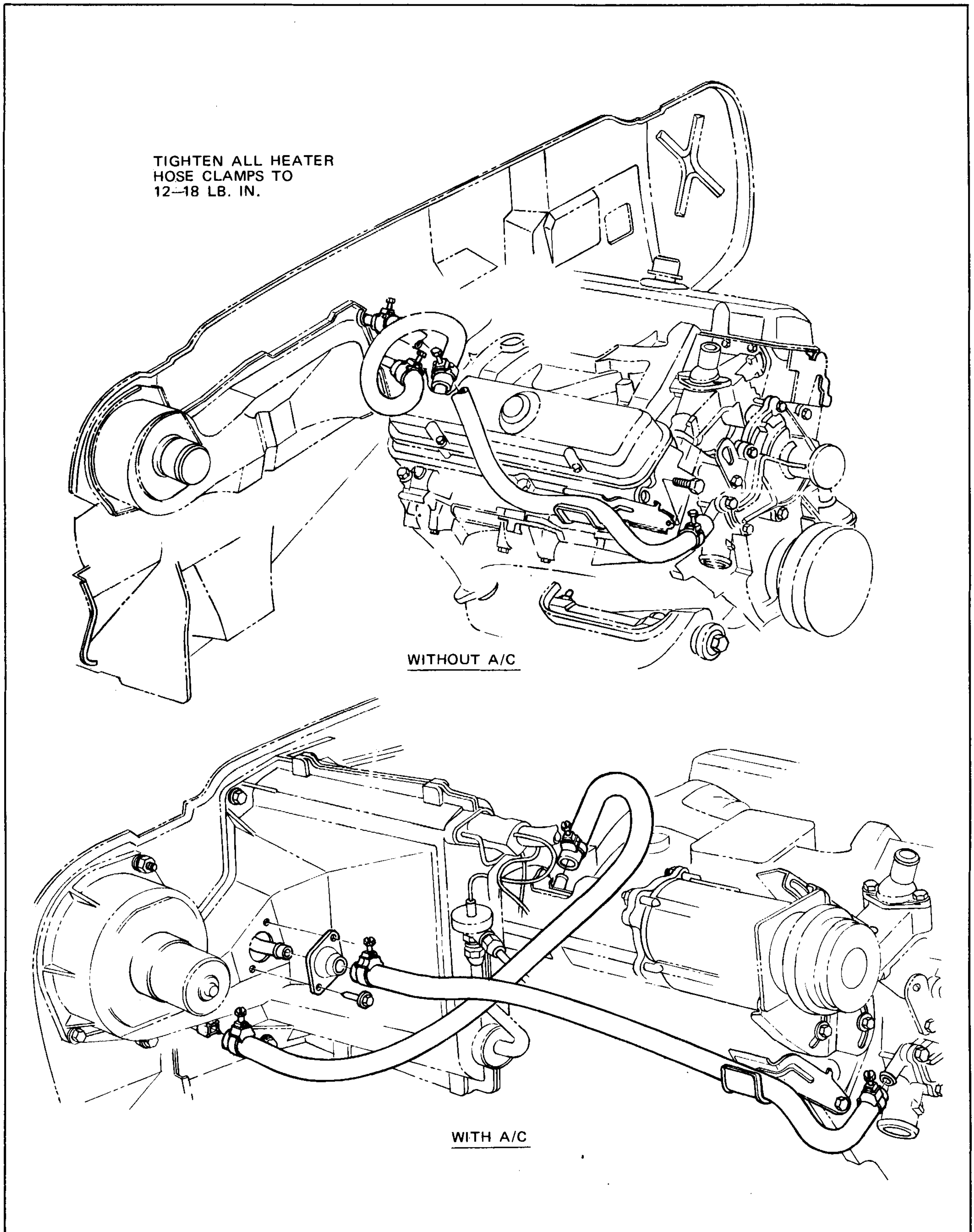


Fig. 1-30A Heater Hose Routing - X Series (350 Engine)

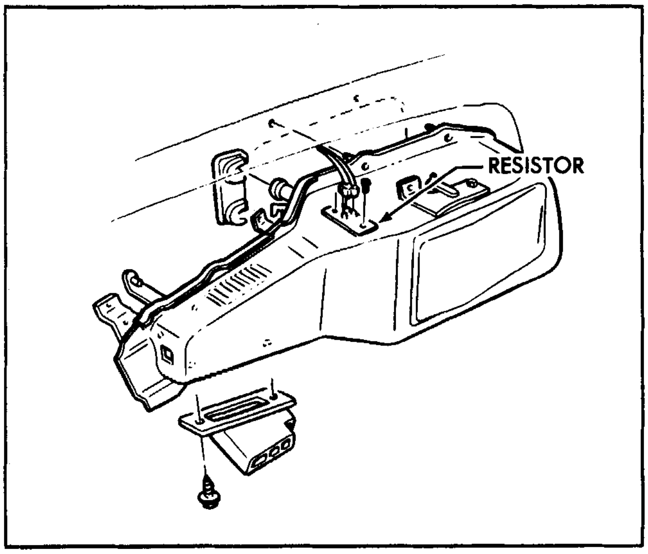


Fig. 1-31 Heater Core and Case - X Series

3. Disconnect heater hoses at core connections (Fig. 1-30) and plug core tubes to prevent spilling coolant when removing core and case assembly.

4. Remove retaining nuts from core case studs on the engine side of the dash.

5. Inside vehicle, remove glove compartment and door.

6. From inside vehicle, drill out lower right hand heater case stud with 1/4" drill.

7. Pull the entire heater core and case assembly (Fig. 1-31) from the firewall.

8. Disconnect heater cables and blower resistor connector from heater case and remove core and case assembly from car.

9. Remove the core tube seal and core assembly retaining strips and remove core.

10. Install replacement core. Be sure the core to case sealer is intact before installing core. Use new sealer if necessary.

11. Install core retaining strips and core tube seal.

12. Replace drilled out heater case stud with new screw and stamped (pall) nut.

13. Inside car, insert heater case studs through holes in cowl and blower and air inlet assembly. Install case to firewall mounting nuts. (NOTE: It may be necessary to first insert coolant tubes through the dash followed by the studs.)

14. Connect heater cables and resistor connector. Check cable operation and adjust if necessary.

15. Connect heater hoses, being careful to install them in their proper locations.

16. Refill radiator and connect battery.

HEATER CASE

REMOVE AND REPLACE - EXCEPT X SERIES

1. Perform steps 1 through 7 of heater core replacement procedure.

2. Transfer parts to new heater case: temperature door cam, heater outlet, cable brackets, blower resistor and (on G Series) defroster and air diaphragms.

3. Install heater core. Be sure the core to case sealer is intact before installing core. Use new sealer if necessary.

4. Perform steps 9 through 13 of heater core replacement procedure.

For installation refer to Figs. 1-25 (B Series), 1-21 (G Series), 1-22 (A Series) and 1-32 (F Series).

REMOVE AND REPLACE - X SERIES

1. Perform steps 1 through 9 of heater core replacement procedure.

2. Transfer parts to new heater case: cable brackets, heater outlet and blower resistor.

3. Install heater core. Be sure core to case sealer is intact before installing core. Use new sealer if necessary.

4. Perform steps 11 through 16 of heater core replacement procedure.

LOWER VENT DOOR

REMOVE AND REPLACE - B SERIES

1. Remove vent cable retainer and disconnect cable from door.

2. Remove retaining screw(s) and release vent grille (Fig. 1-7) from plenum duct.

3. Slide vent door to one side to release pivot shaft and remove door.

4. To replace, reverse removal procedure.

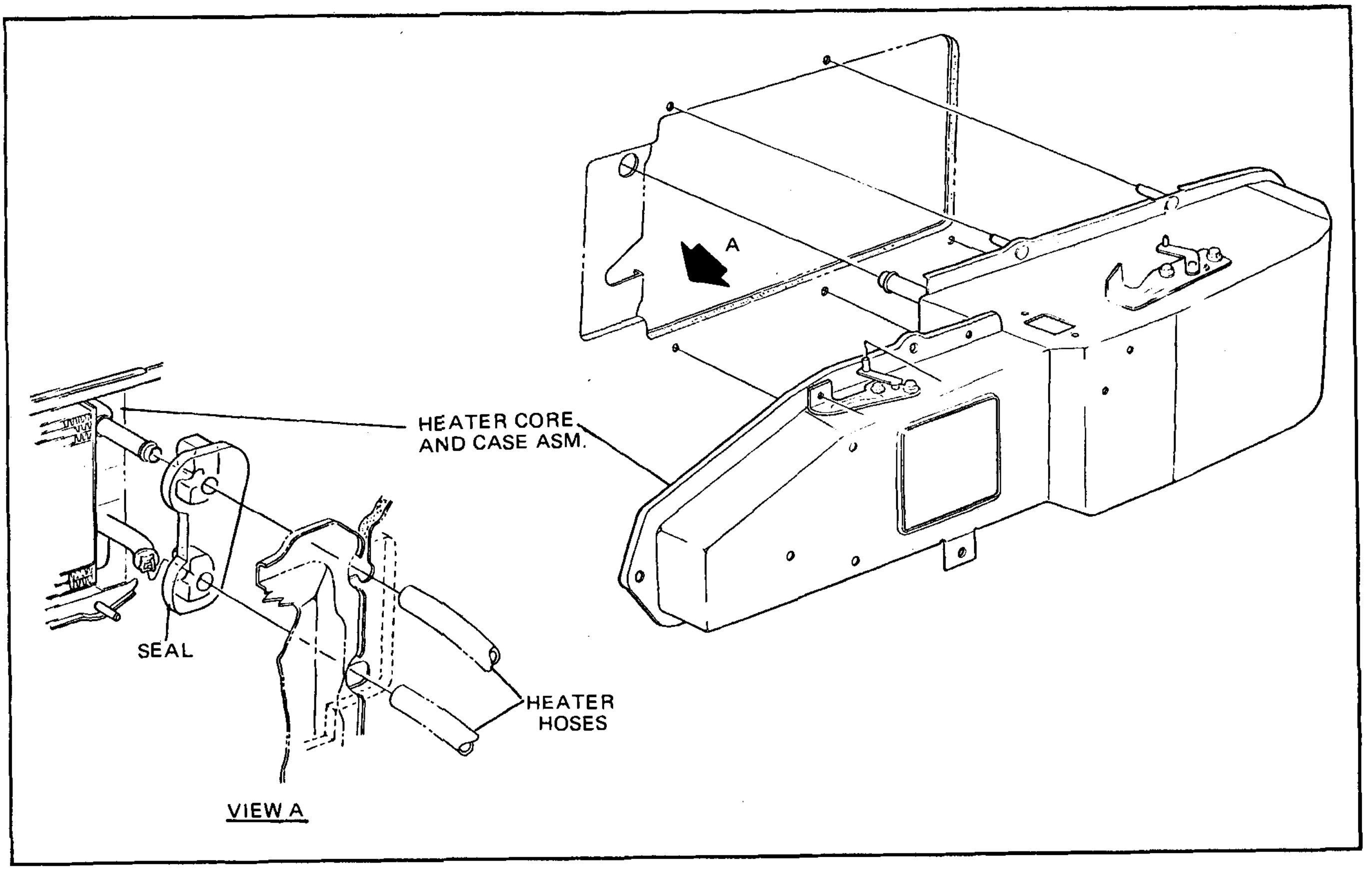


Fig. 1-32 Heater Core and Case - F Series

REMOVE AND REPLACE - G AND A SERIES

RIGHT SIDE:

1. Remove air outlet grille (grille is pressed fit and can be removed by prying edge and pulling grille out).
2. Disconnect vent cable from ventilator door.
3. Pull down on ventilator door upper pivot pin and pull top of door outward to remove door.
4. To replace position lower pivot pin in locating hole, pull down on upper pivot pin and position pivot pin in upper locating hole.
5. Connect vent cable to door and replace air outlet grille.

LEFT SIDE:

1. Remove screw securing park brake bracket to lower instrument panel reinforcement and position bracket toward right side of car for access to left hand kick pad.
2. Perform steps 1 through 5 of right hand ventilator door procedure.
3. Return park brake bracket to proper position and replace screw.

REMOVE AND REPLACE - F AND X SERIES

1. Remove parking brake ratchet assembly (left hand side only).
2. Remove forward door sill plate screw.
3. Remove (5) kick pad screws.
4. On F Series only, disconnect upper ventilation cable at upper vent door and remove kick pad.
5. Disconnect cable and remove ventilator door from kick pad.
6. To replace, reverse removal procedure.

LOWER VENT CABLE

REMOVE AND REPLACE - B SERIES

1. Remove cable retaining nut and disconnect cable from vent door.
2. Remove kick pad screw and tip kick pad out for access to cable attachment.

3. Remove cable retainer clip and remove cable. On left hand side, remove the cable from additional routing clip.

4. To replace, reverse removal procedure.

REMOVE AND REPLACE - G AND A SERIES

1. On left side only, remove park brake bracket mounting screw at instrument panel.

2. Remove kick pad air outlet grille.

3. Disconnect cable at ventilator door.

4. Loosen door sill plate to gain access to rear edge of kick pad.

5. On models with upper ventilation disconnect upper vent cable.

6. Remove kick pad screws and position outward to gain access to vent cable retainer clips.

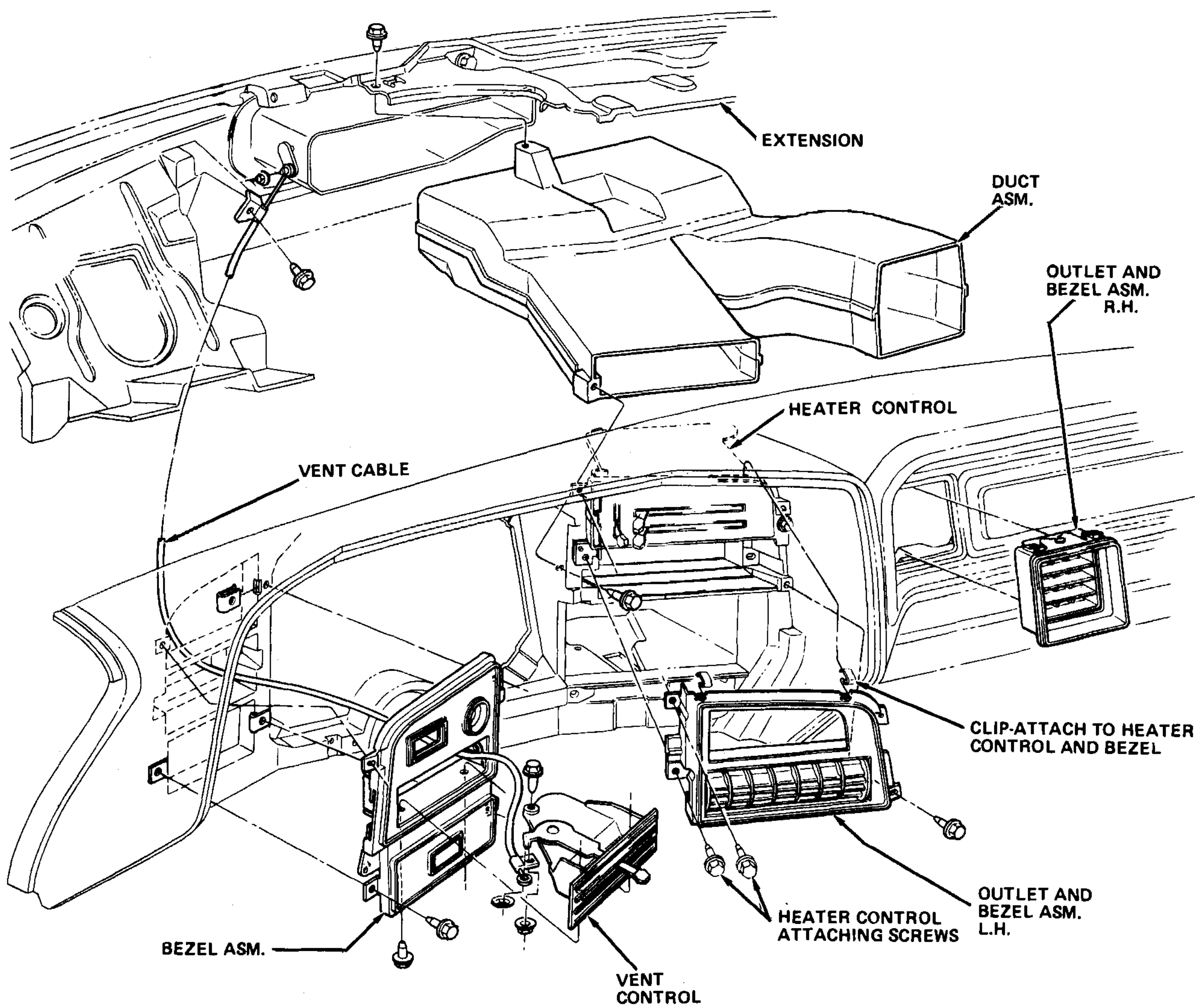


Fig. 1-33 B Series Upper (Center) Ventilation Duct and Controls

7. Remove retainer clip and cable.

8. To replace, reverse removal procedure.

   For installation of lower ventilation parts, see Section 5 of body manual.

REMOVE AND REPLACE - F AND X SERIES

1. Perform steps 1 through 4 of ventilator door procedure.

2. Disconnect cable from ventilator door and remove cable.

3. To replace, reverse removal procedure.

UPPER VENTILATION

For installation of upper ventilation instrument panel attaching parts see Figs. 1-33 (B Series), 1-34 (A and G Series) and 1-35 (F Series).

UPPER VENT DOOR (VALVE)

REMOVE AND REPLACE - B SERIES

1. Remove defroster nozzle following procedure published in this section.

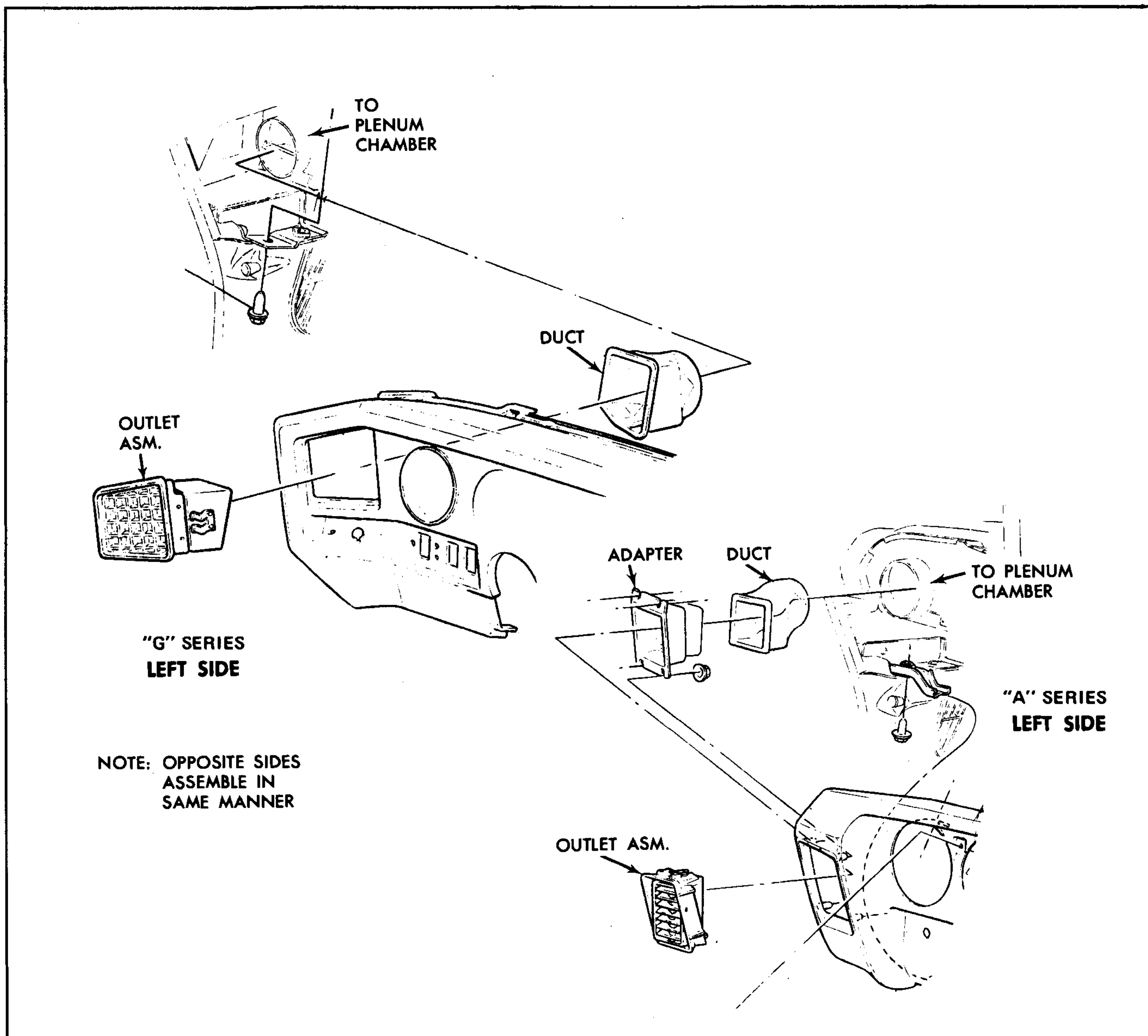


Fig. 1-34 A and G Series Upper Level Ventilation Ducts and Outlets

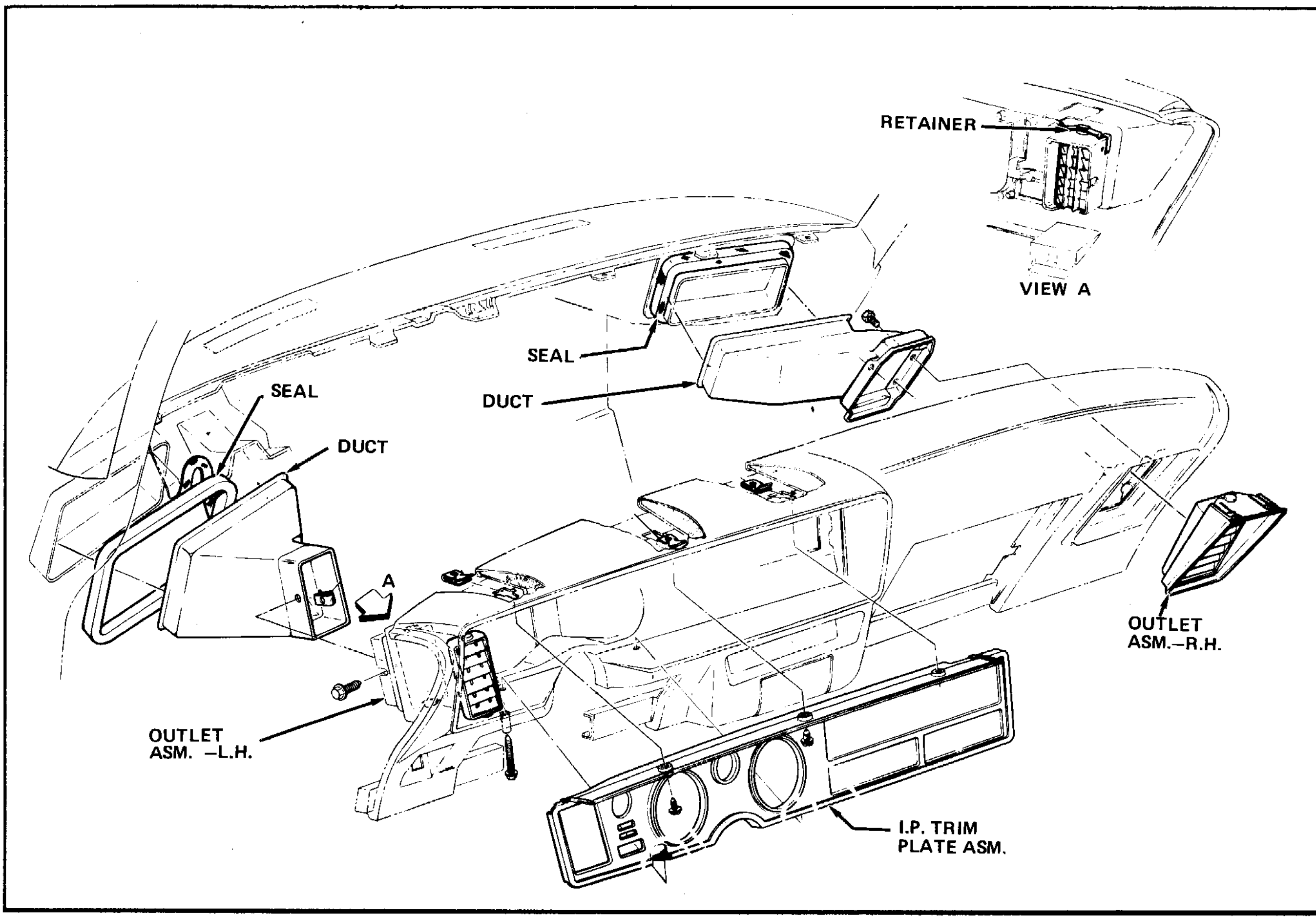


Fig. 1-35 F Series Upper Ventilation Ducts and Outlets

2. Remove upper vent cable retaining screw and nut at cowl and disconnect cable.

3. Remove vent door at cowl opening. For installation details, consult body manual.

4. To replace, reverse removal procedure.

REMOVE AND REPLACE - F SERIES

RIGHT SIDE

1. Perform steps 2 through 4 of kick pad ventilator door replacement procedure.

2. Remove glove compartment and door.

3. Remove right hand upper vent nozzle, adapter and duct (Fig. 1-35).

4. Remove (5) vent door mount screws and remove door assembly.

5. To replace, reverse removal procedure.

LEFT SIDE

1. Perform steps 1 through 4 of kick pad ventilator door replacement procedure.

2. Remove left hand upper vent duct screw and remove duct (Fig. 1-35).

3. Remove (5) door assembly mounting screws and remove door assembly.

4. To replace, reverse removal procedure.

UPPER VENT CABLE

REMOVE AND REPLACE - B SERIES

1. Remove defroster nozzle according to procedure stated previously in this section.

2. Remove retaining screw and nut and disconnect cable at vent control panel (Fig. 1-33).

3. Remove retaining screw and nut and disconnect cable at cowl. Remove cable.
4. To replace, reverse removal procedure.

REMOVE AND REPLACE - A AND G SERIES

For removal and replacement of upper vent cables, follow procedure for kick pad vent cables.

REMOVE AND REPLACE - F SERIES

1. Perform steps 1 through 4 of kick pad ventilator door replacement procedure.
2. Remove cable from kick pad.
3. To replace, reverse removal procedure.

UPPER VENT CONTROL PANEL

REMOVE AND REPLACE - B SERIES

1. Remove center ash tray and remove lower I.P. trim plate (4 screws).
2. Remove radio knobs and bezels. Remove upper I.P. trim plate (5 screws).
3. Remove headlamp and wiper switch bezel from I.P. opening (4 screws) for access to vent control panel.
4. Remove retaining screw and nut and disconnect upper vent cable at control panel.
5. Remove 2 vent control panel retaining screws (Fig. 1-33) and remove control panel.
6. To replace, reverse removal procedure.

UPPER VENT DUCT

REMOVE AND REPLACE - B SERIES

To replace the upper (center) vent duct (Fig. 1-33), perform steps 1 thru 12 of procedure for defroster nozzle replacement on B Series without air conditioning. To replace, reverse removal procedure.

SECTION 1A
CUSTOM AIR CONDITIONING

CONTENTS OF THIS SECTION

DIAGNOSIS

LEAK DETECTORS

LEAK DETECTOR J 6084

Leak detector J 6084 (Fig. 1A-1) is a gas-operated, torch-type leak detector using a replaceable cylinder.

ASSEMBLING J 6084

1. Remove dust cap from cylinder.
2. Close valve knob on detector unit.
3. Thread detector unit onto top of fuel cylinder, finger tight.
4. Attach search hose to detector unit.

LIGHTING J 6084

1. Open control valve until slight hiss of gas is heard, then light gas at opening in chimney.

> **WARNING: Do not use lighted detector in any area where combustible or explosive gases, dust or vapors may be present.**

2. Adjust flame until the desired volume is obtained. A pale blue flame approximately 3/8" above the reaction plate is best for detecting leaks (the reaction plate will be heated to a cherry red).

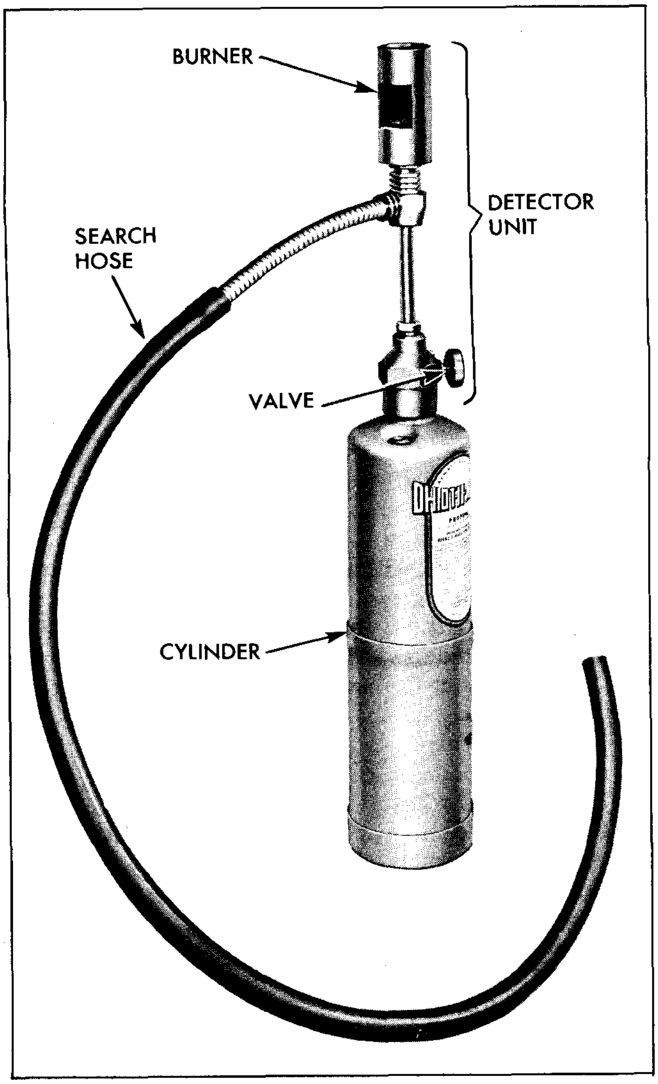


Fig. 1A-1 J 6084 Leak Detector

CORRECTION FOR YELLOW FLAME

If the flame is yellow, insufficient air is being aspirated or the reaction plate is dirty. Insufficient air may be caused by:

1. Obstructed or partially collapsed suction tube.
2. Dirt or foreign substance in burner tube.
3. Dirty or partially clogged orifice.

Blowing air through the suction tube and back through the detector will usually clear dirt or foreign matter. If a yellow flame is caused by a dirty reaction plate, allow the flame to burn for several minutes. This will usually burn the plate clean. If an oxide film appears on the reaction plate from continued use, it will reduce the sensitivity of the detector. This may be remedied by removing the plate and scraping the surface gently with a knife.

TO CLEAN ORIFICE

1. Never attempt to clean orifice by passing anything through the hole.
2. Unscrew burner assembly from burner tube by applying wrench to hexagon part located immediately below search hose connection. Turn to left. This will expose orifice block which is inserted into the end of the tube.
3. Remove orifice block from tube.
4. Reverse orifice block and replace against burner tube; screw burner head onto burner tube (hand tight), then open valve quickly, admitting several short blasts.
5. To reassemble: unscrew burner head, insert orifice block into burner tube, and screw burner head onto burner tube with a wrench to form a gas-tight joint.

CHECKING FOR REFRIGERANT LEAKS

After the leak detector flame is adjusted, check for refrigerant leaks in an area having a minimum amount of air flow in the following manner:

Explore for leaks by moving the end of the search hose around all connections and points where a leak may be. Check around the bottom of connections, since refrigerant is heavier than air and will, therefore, be more apparent at the bottom of fittings.

The color of the flame will turn to a yellow-green when a small leak is detected. Large leaks will be indicated by a change in color to brilliant blue or purple. When the suction hose is moved away from the leak, the flame will clear to an almost colorless pale blue again.

WARNING: Do not breathe the fumes and black smoke that are produced by a large leak. They are poisonous. Any time an open flame is used near a car there is a certain amount of danger. Although the torch flame is small and well protected, it is recommended that a fire extinguisher be close at hand for any emergency that might arise.

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 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.

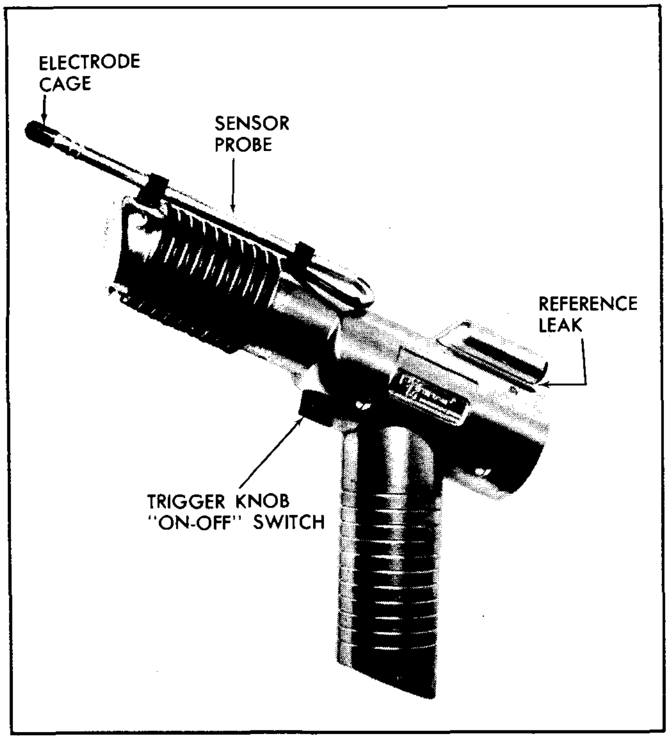


Fig. 1A-2 J 23400 Electronic Leak Detector

For confined areas, such as sections of the evaporator and condenser, the torch-type and electronic leak detectors are more practical for determining leaks.

ELECTRONIC LEAK DETECTOR - J 23400

An electronic leak detector, J 23400 (Fig. 1A-2), is available for detecting refrigerant leaks. The J 23400 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

The P.O.A. valve is pre-set at the factory to maintain correct evaporator core pressure. If a malfunction in the refrigerant system is suspected due to the P.O.A. valve or below normal evaporator core pressures, check the following:

1. Restrictions in evaporator core, hoses, tubes, etc.
2. Refrigerant leaks.
3. Compressor clutch slippage.
4. Improper drive belt tension.
5. Capillary tube broken or not tight to evaporator tube.
6. Expansion valve inoperative.
7. P.O.A. valve bleed line valve stuck open.
8. P.O.A. valve stuck.

PRELIMINARY CHECKS

1. Check compressor belt for proper tension.
2. Check all refrigeration lines for leaks, kinks, or other restrictions.
3. Check all air hoses for leaks or restrictions. Air restriction may indicate a plugged (or partially plugged) evaporator core.
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 engine and operate at 2000 rpm with system in A/C mode, temperature control lever set for maximum cooling and blower speed on HI. After at least five minutes of engine operation, check for bubbling at the sight glass (above 70°F ambient). If the system is low on refrigerant (bubbling at sight glass), add refrigerant until sight glass on receiver-dehydrator just shows clear and add an additional one-half pound of refrigerant.
6. Decrease blower speed and observe decreases in air flow.

TROUBLE DIAGNOSIS

When diagnosing problems in the electrical and vacuum systems of the air conditioning system, consult Figs. 1A-3 thru 1A-6 for electrical wiring schematics and Figs. 1A-7 thru 1A-13 for vacuum circuit diagrams.

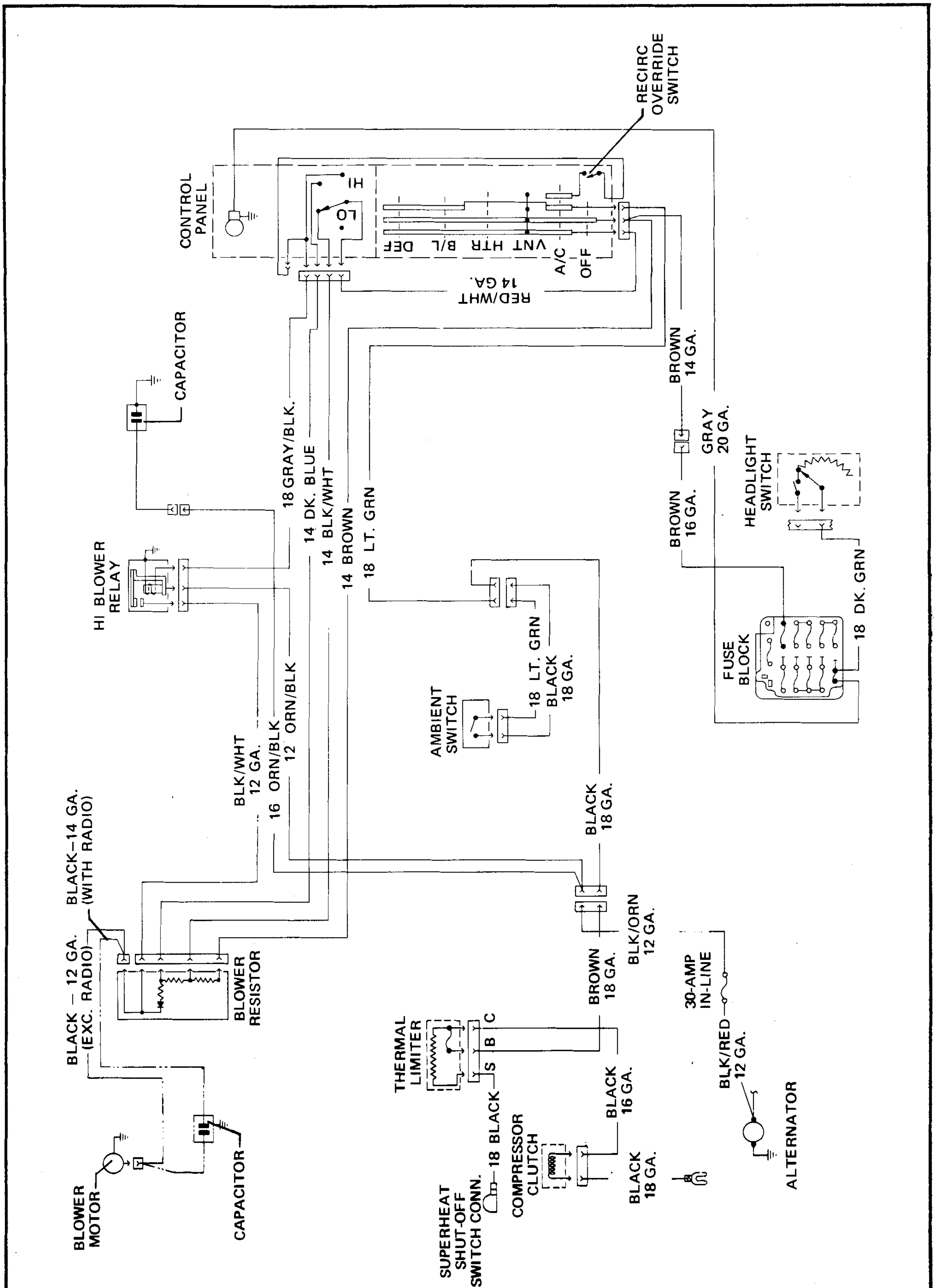


Fig. 1A-3 A/C Wiring Schematic - B Series

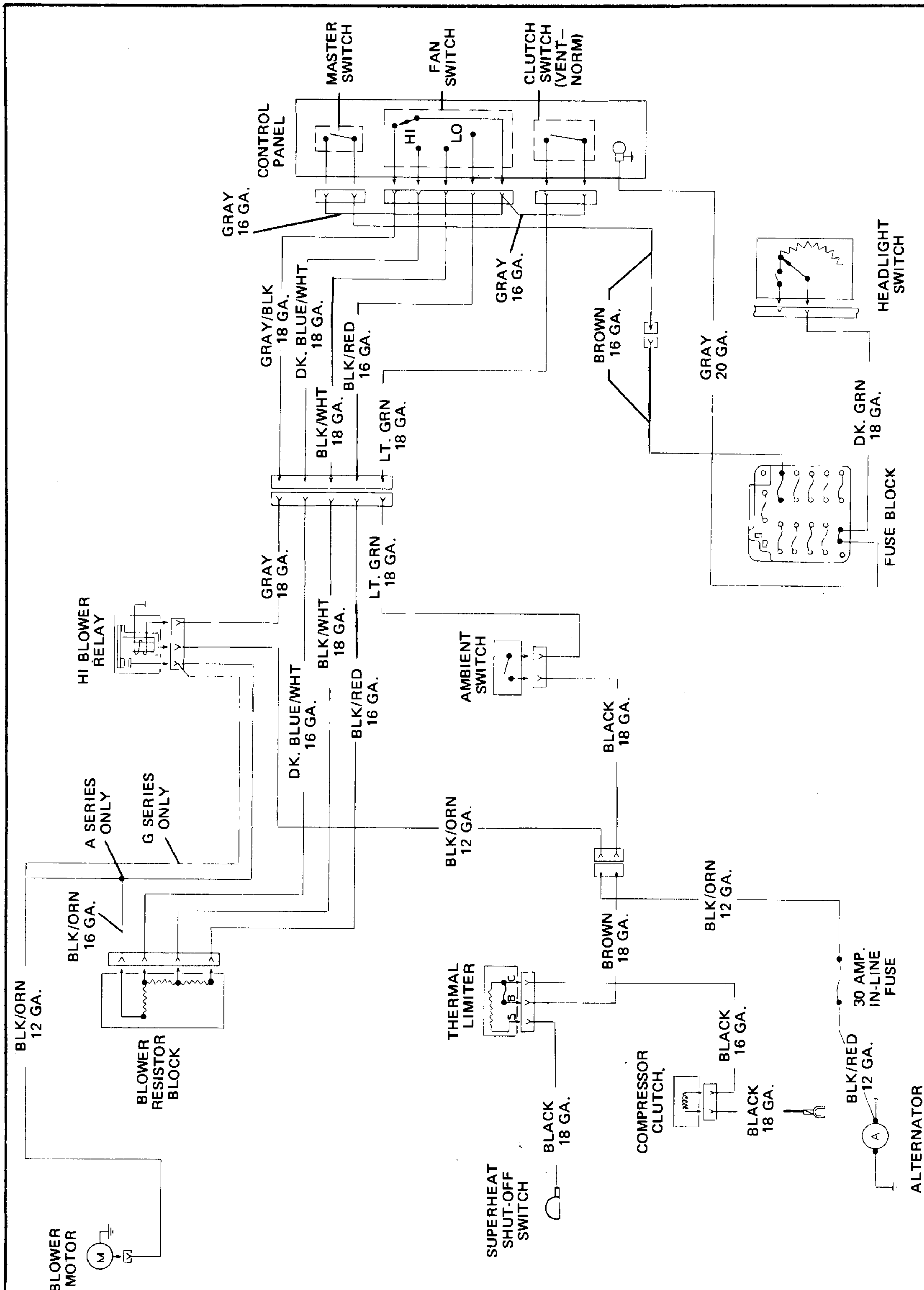


Fig. 1A-4 A/C Wiring Schematic - A and G Series

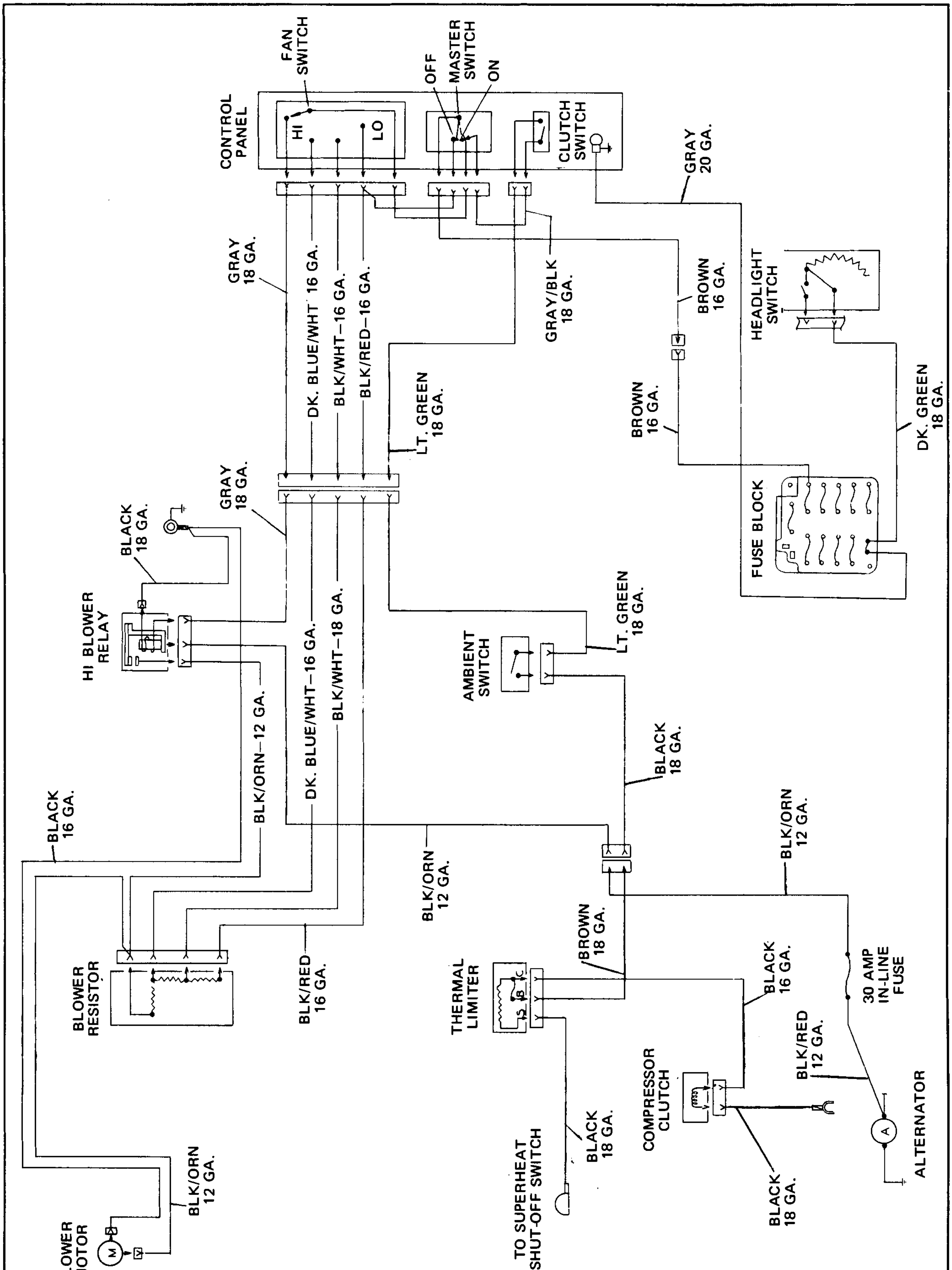


Fig. 1A-5 A/C Wiring Schematic - F Series

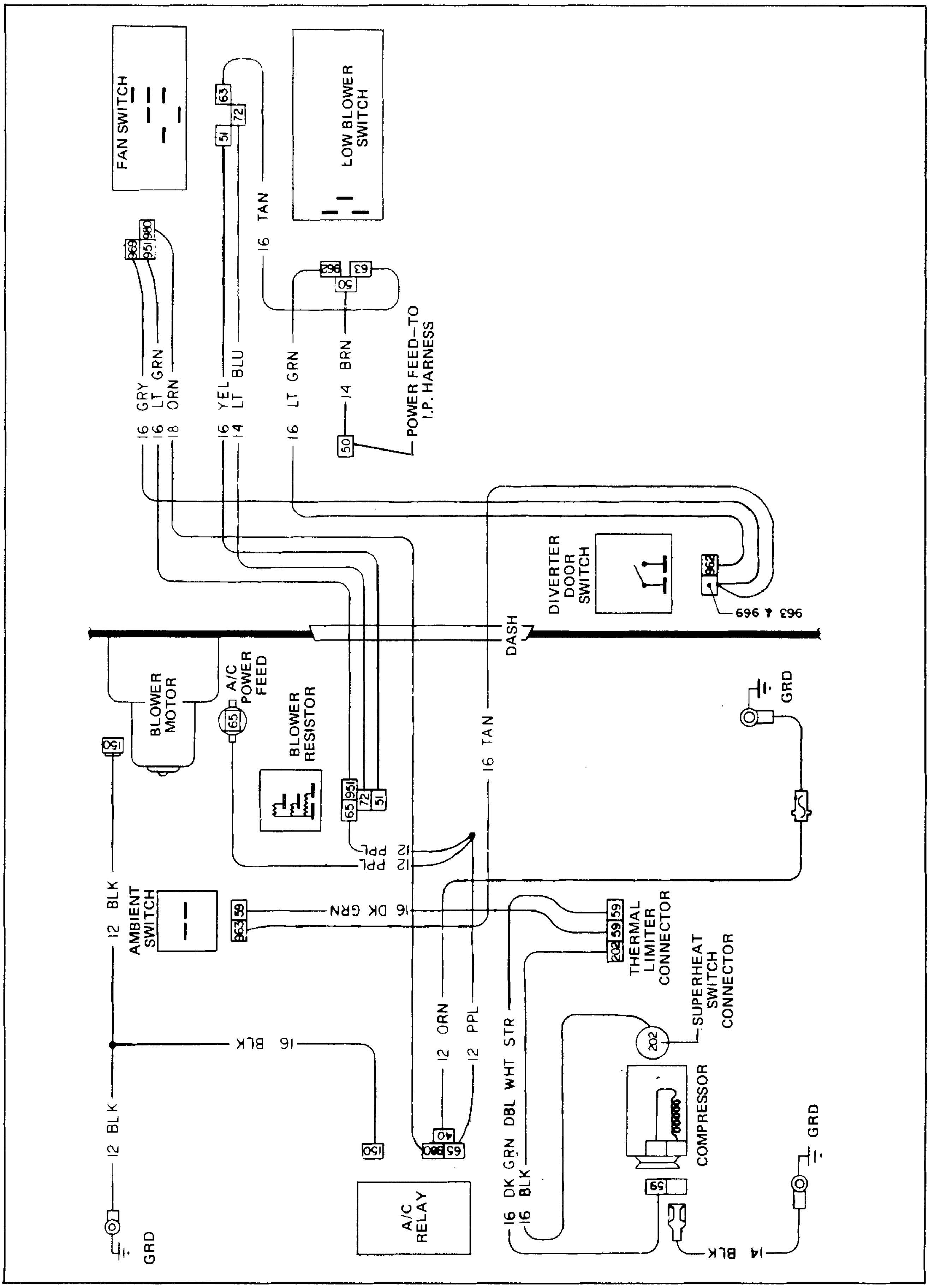
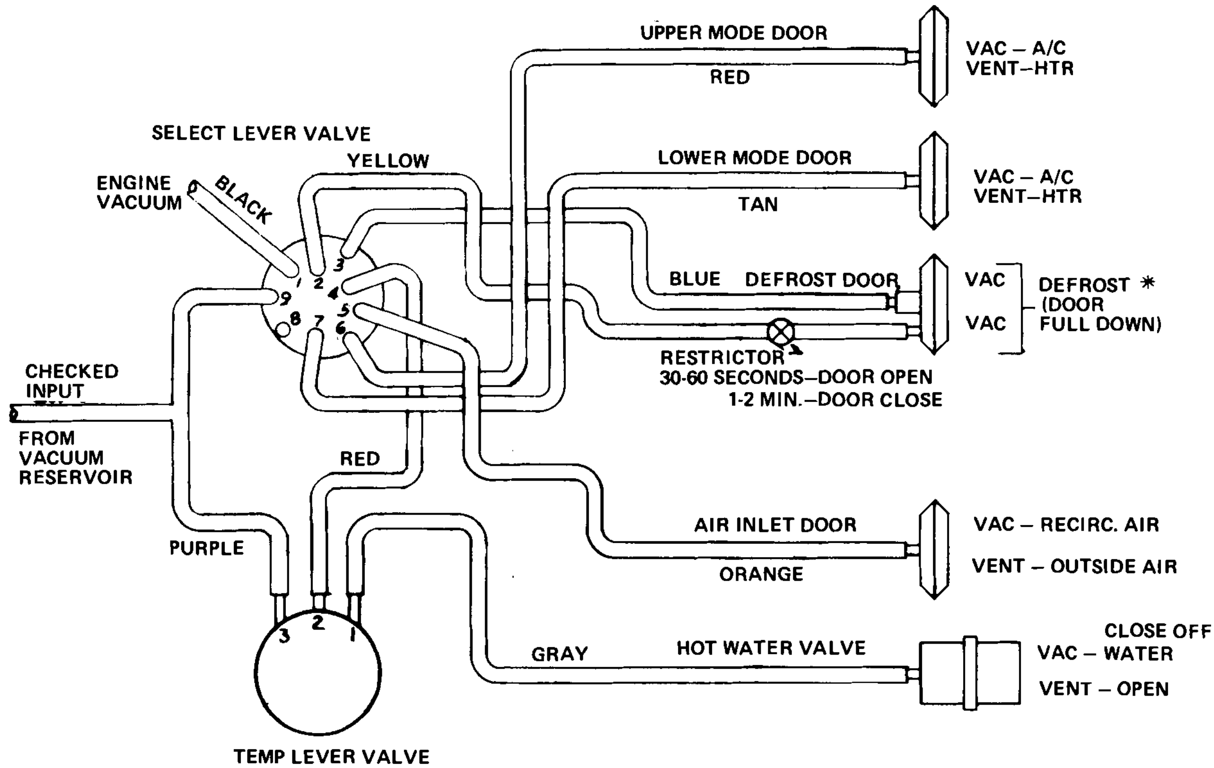


Fig. 1A-6 A/C Wiring Schematic - X Series



TEMP LEVER VALVE & SWITCH					
PORT NO.	PORT CONN	TEMP LEVER POSITION COLD			HOT
1	H.W.V.	VAC	VAC	VENT →	
2	R.A. O'RIDE	VAC	VENT	VENT →	
3	INPUT (CHECKED)	VAC	VAC	VAC →	
RECIRC O'RIDE SWITCH		CLOSED	OPEN		

*DEFROST DOOR
VENT / VAC — BLEED (DOOR PARTIAL DOWN)
VENT / VENT — (DOOR CLOSED)

SELECT LEVER VALVE							
PORT NO.	PORT CONN	OFF	A/C	LEVER POSITION VENT	HEATER	BI LEVEL	DEFROST
1	INPUT (UNCHECKED)	SEAL	SEAL	SEAL	CONN 2	CONN 2	CONN 2
2	BLEED	VENT	VENT	VENT	CONN 1	CONN 1	CONN 1
3	DEFROST	VENT	VENT	VENT	VENT	VENT	CONN 9
4	R.A. O'RIDE	SEAL	CONN 5	SEAL	SEAL	SEAL	SEAL
5	O.A.–R.A.	VENT	CONN 4	VENT	VENT	VENT	VENT
6	MODE–UPPER	VENT	CONN 7,9	VENT	VENT	VENT	VENT
7	MODE–LOWER	VENT	CONN 6,9	CONN 9	VENT	CONN 9	VENT
8	NO CONNECTION						
9	INPUT (CHECK)	SEAL	CONN 6,7	CONN 7	SEALED	CONN 7	CONN 3

Fig. 1A-7 A/C Vacuum Schematic - B Series

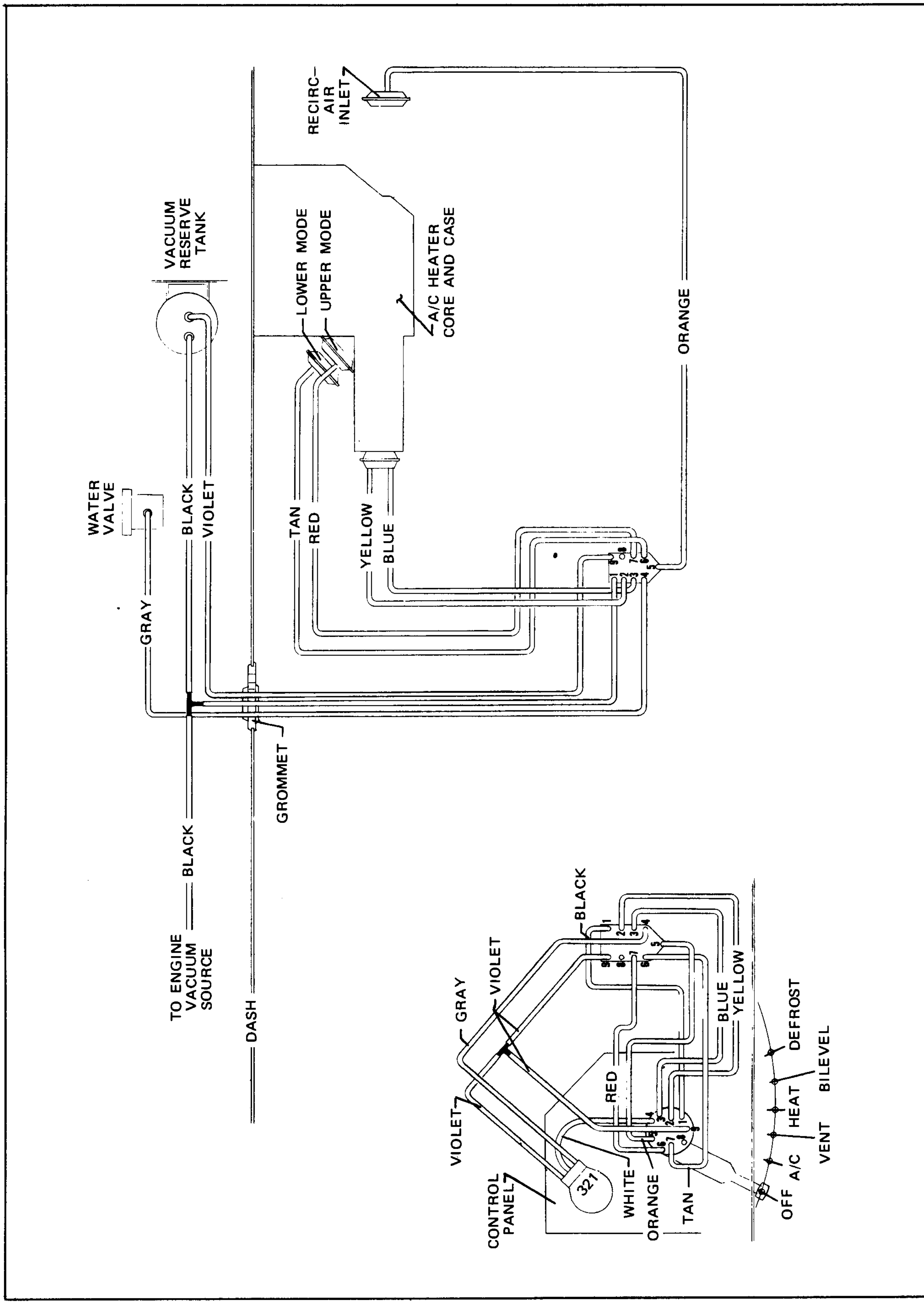


Fig. 1A-8 A/C Vacuum Hose Diagram - B Series

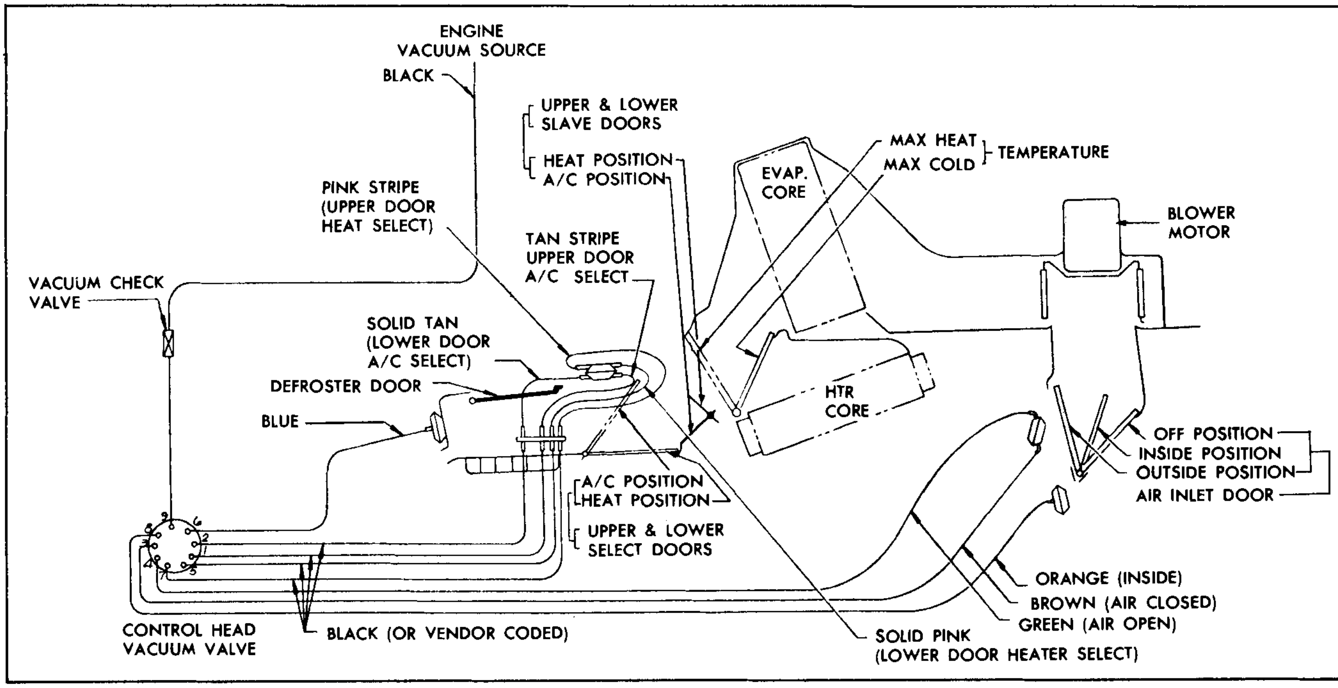


Fig. 1A-9 A/C Vacuum Schematic - G Series

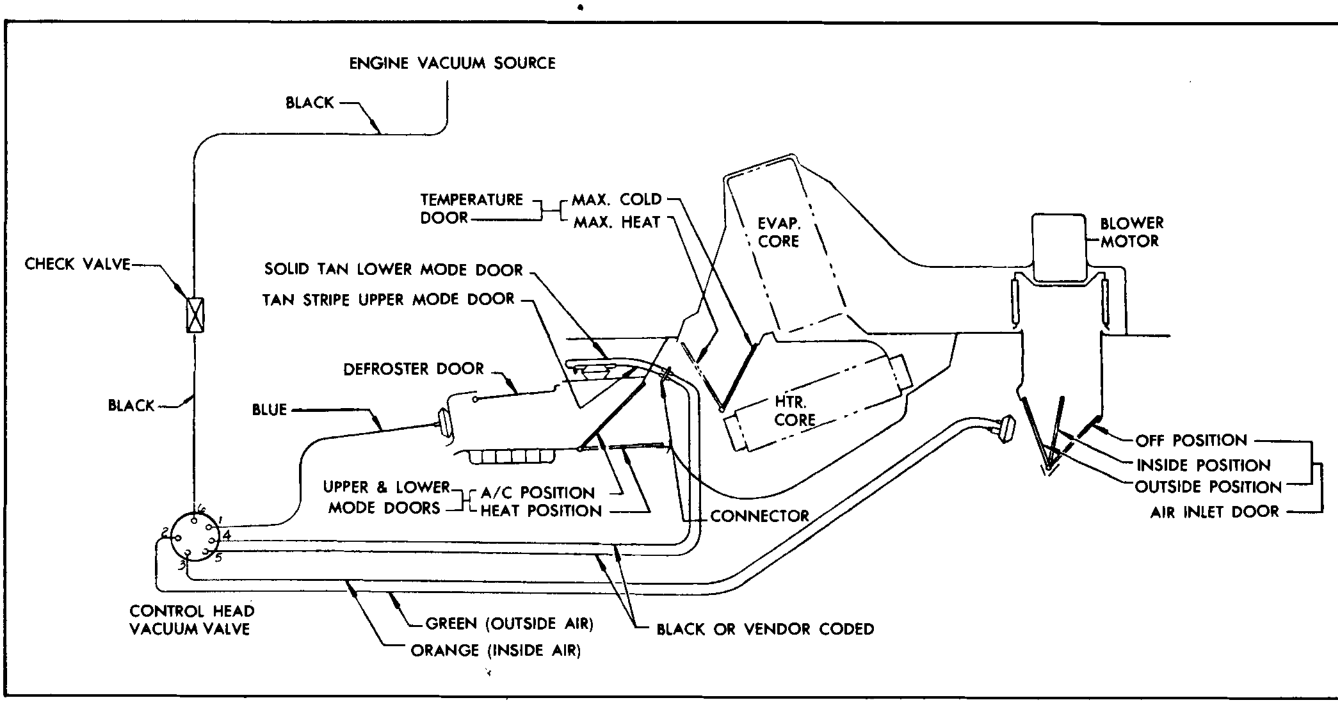


Fig. 1A-10 A/C Vacuum Schematic - A Series

OPERATIONAL TEST

The purpose of performing an operational test (Fig. 1A-14) is to prove that the air conditioning electrical, air, vacuum and refrigeration systems are operating properly and efficiently. Results of the test are as follows:

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. A clear (no bubbles) sight glass would indicate a properly charged refrigeration system.

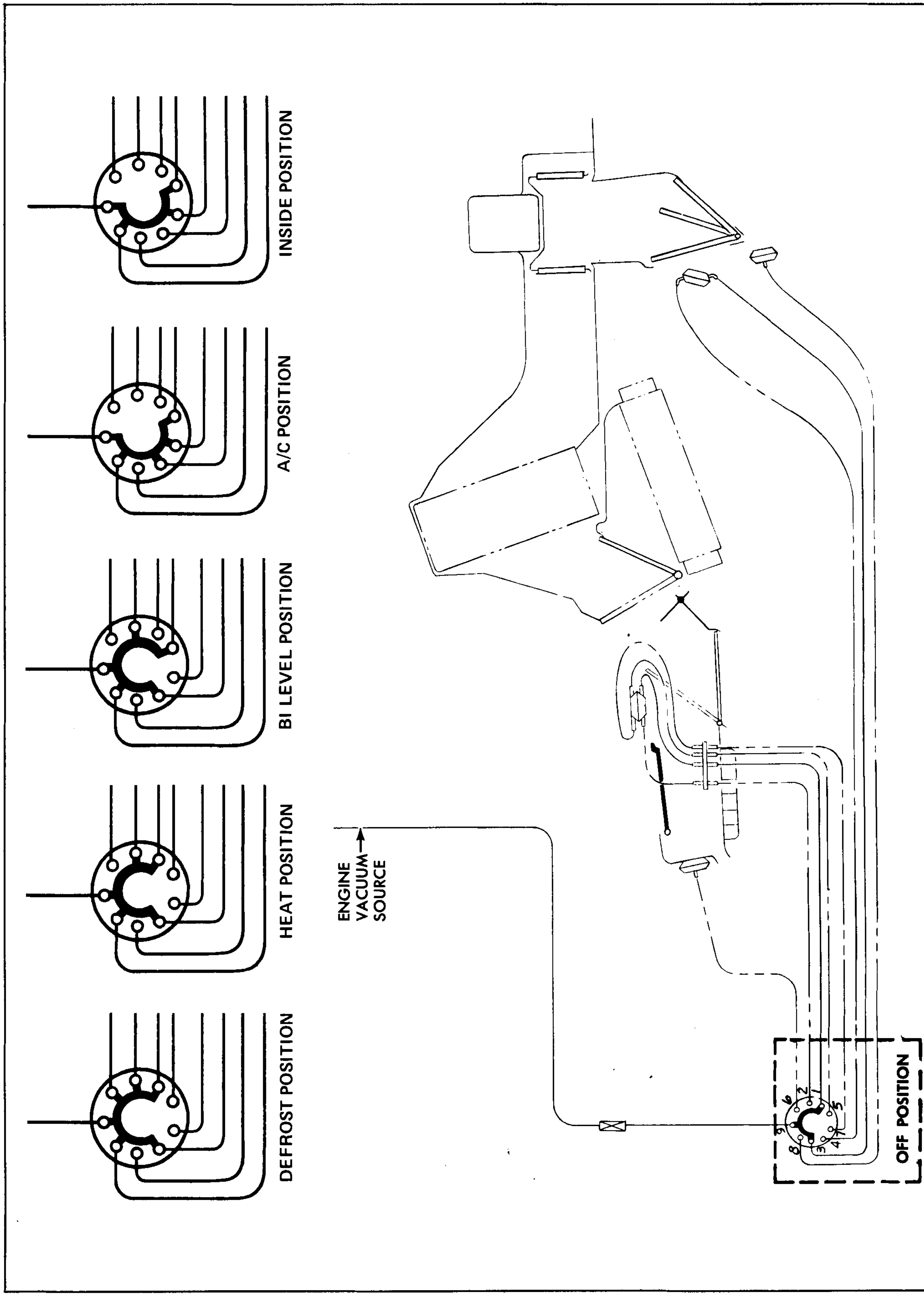


Fig. 1A-11 G Series Vacuum Valve Positions

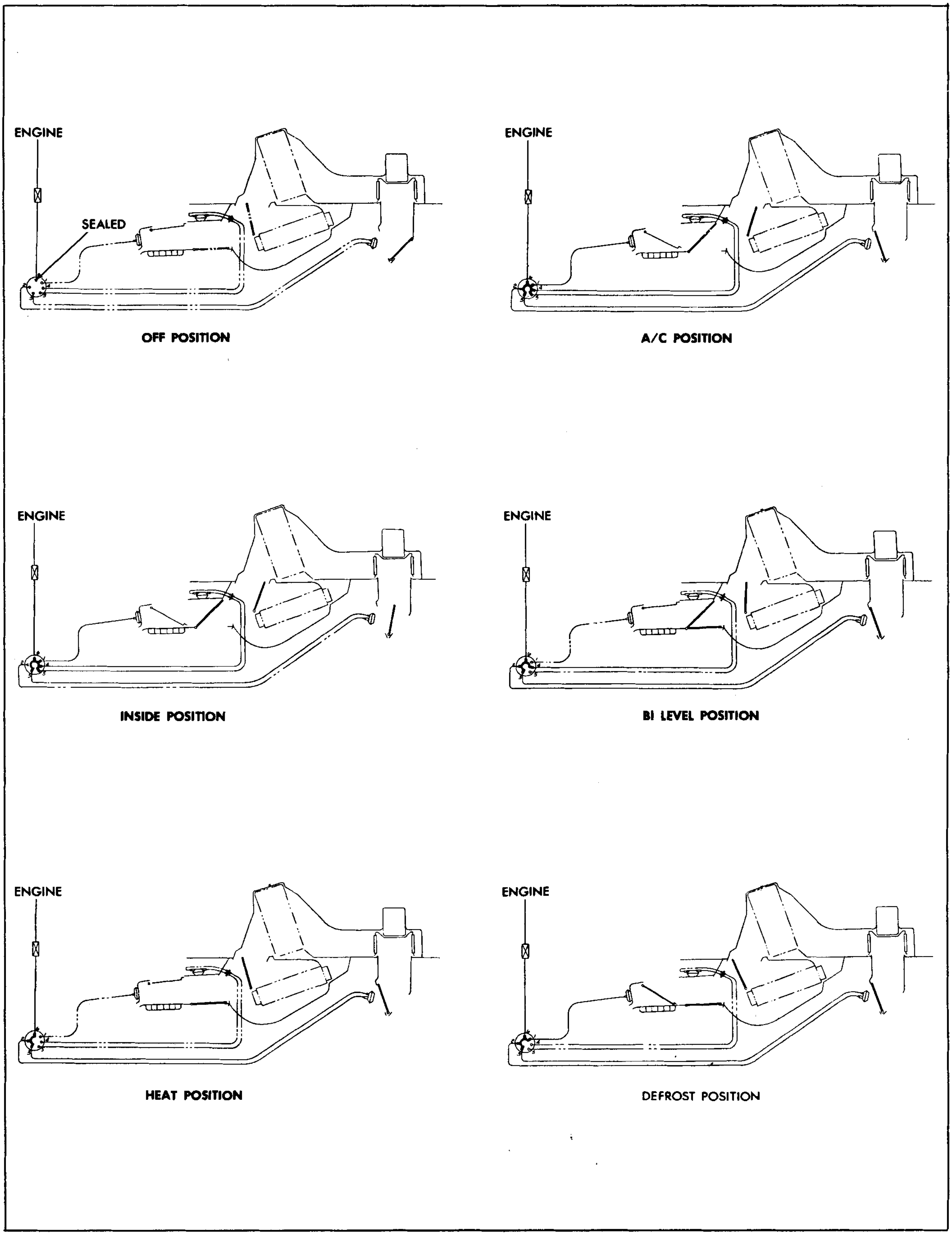


Fig. 1A-12 A Series Vacuum Valve Positions

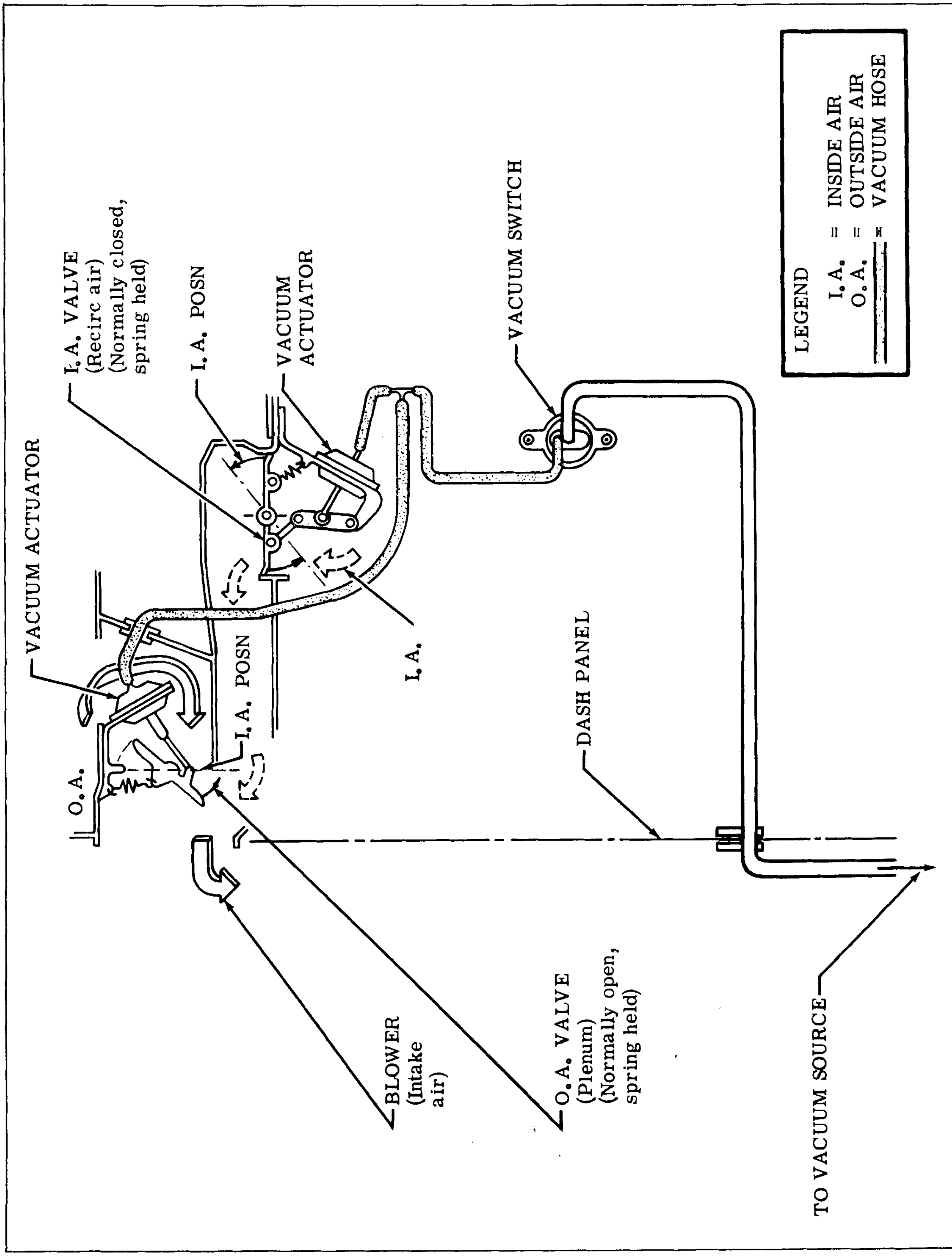


Fig. 1A-13 A/C Vacuum Schematic - X Series

OPERATIONAL TEST CHART

TEST CONDITIONS:

Hood .... Raised
Front Doors .... Open
A/C Control Panel

Select Lever .... A/C Mode

Blower Speed Switch .... HI

Temperature Lever .... Full Cold

Nozzles and Air Outlets .... Open
Engine Speed .... 2000 RPM

TEST READINGS:

Ambient Air in Degrees F. (In Auxiliary Fan Air Blast Ahead of Condenser)	70°		80°		90°		100°		110°	
Air Quality	Arid	Humid	Arid	Humid	Arid	Humid	Arid	Humid	Arid	Humid
*Average Compressor Head Pressure in PSI	163 to 187	193 to 217	193 to 217	223 to 247	223 to 247	263 to 287	258 to 282	313 to 337	298 to 322	373 to 397
Average P.O.A. Valve Pressure **PSI AT SEA LEVEL	27.5 to 29.5	28.5 to 30.5	28 to 30	29 to 31	28 to 30	30 to 32	28 to 30	33 to 35	28.5 to 30.5	37.5 to 39.5
Center Outlet Temperature in Degrees F.	38° to 42°	41° to 45°	39° to 43°	43° to 47°	40° to 44°	47° to 51°	41° to 45°	52° to 56°	43° to 47°	59° to 63°

*NOTE: These pressures are for engine with engine fan clutch engaged. With fan clutch disengaged, pressures generally are 25-35 psi higher than shown here.

**NOTE: Interior pressure of the P.O.A. valve is isolated from exterior atmospheric pressure. As a result, the controlling element (vacuum bellows) of the P.O.A. valve is able to operate independently of the effect of atmospheric pressure. However, any gauge used to check the P.O.A. valve pressure will not be free from the effect of atmospheric pressure. This altitude effect on the gauge must be taken into account when interpreting a reading. As the altitude increases and atmospheric pressure goes down, the pressure reading on the gauge will go up.

The increase noted in the above readings will be approximately .5 psi per 1,000 feet above sea level. For example at 90°F. in an arid climate at 2,000 feet above sea level, P.O.A. valve pressures would be 29 to 31 psi.

Fig. 1A-14 A/C Operational Test Chart

3. Proper evaporator pressure, as controlled by the P.O.A. valve would provide proper freeze protection for the evaporator.

Check and correct all air and refrigerant leaks in the air conditioning system as well as operation of the air doors.

Check for proper compressor oil level during the repair of refrigerant leaks, before conducting an operational test.

INSUFFICIENT HEATING

CONDITION AND CAUSE	CORRECTION
Heater outlet temperature too low.	Check for proper engine thermostat. Check blower operation. Inspect TEMP lever and cable for proper operation. Check heater hoses for function. On B Series check water control valve as follows: 1. Start engine and allow to warm up. 2. Set temperature control to full heat. 3. Feel hose from water valve to determine if water is flowing to heater core. If water is not flowing, inspect water control valve and vacuum supply line. (Water should flow - no vacuum.)

A/C REFRIGERANT SYSTEM DIAGNOSIS

When trouble shooting the refrigerant system, see Fig. 1A-15 , A/C Diagnostic Chart.

COMPRESSOR DISCHARGE PRESSURE TOO HIGH

CONDITION AND CAUSE	CORRECTION
Engine overheated.	See Engine Section.
Overcharge of refrigerant or air in system. (Note: Always disconnect thermal limiter before depressurizing system.)	Systems with excess discharge pressures should be slowly depressurized at the receiver inlet connection, observing behavior of high pressure gauge indicator. 1. Rapid discharge pressure drop indicates air (with possibility of moisture) in system. When pressure drop levels but still indicates in excess of specifications, slowly bleed system until bubbles appear in sight glass and stop. Add refrigerant until bubbles clear, then add one-half pound refrigerant. Recheck operational pressures. If pressure still remains above specifications and suction pressure is slightly above normal, a restriction exists in high pressure side of system. 2. Slow discharge pressure drop indicates excessive refrigerant. If pressures drop to specifications and sight glass remains clear, stop depressurizing and recheck operational pressures. If pressures are satisfactory, depressurize until bubbles appear in sight glass, stop depressurizing, then add 1/2 pound refrigerant. Recheck operational pressures. 3. If discharge pressure remains high after depressurizing system, continue depressurizing until bubbles appear in sight glass.

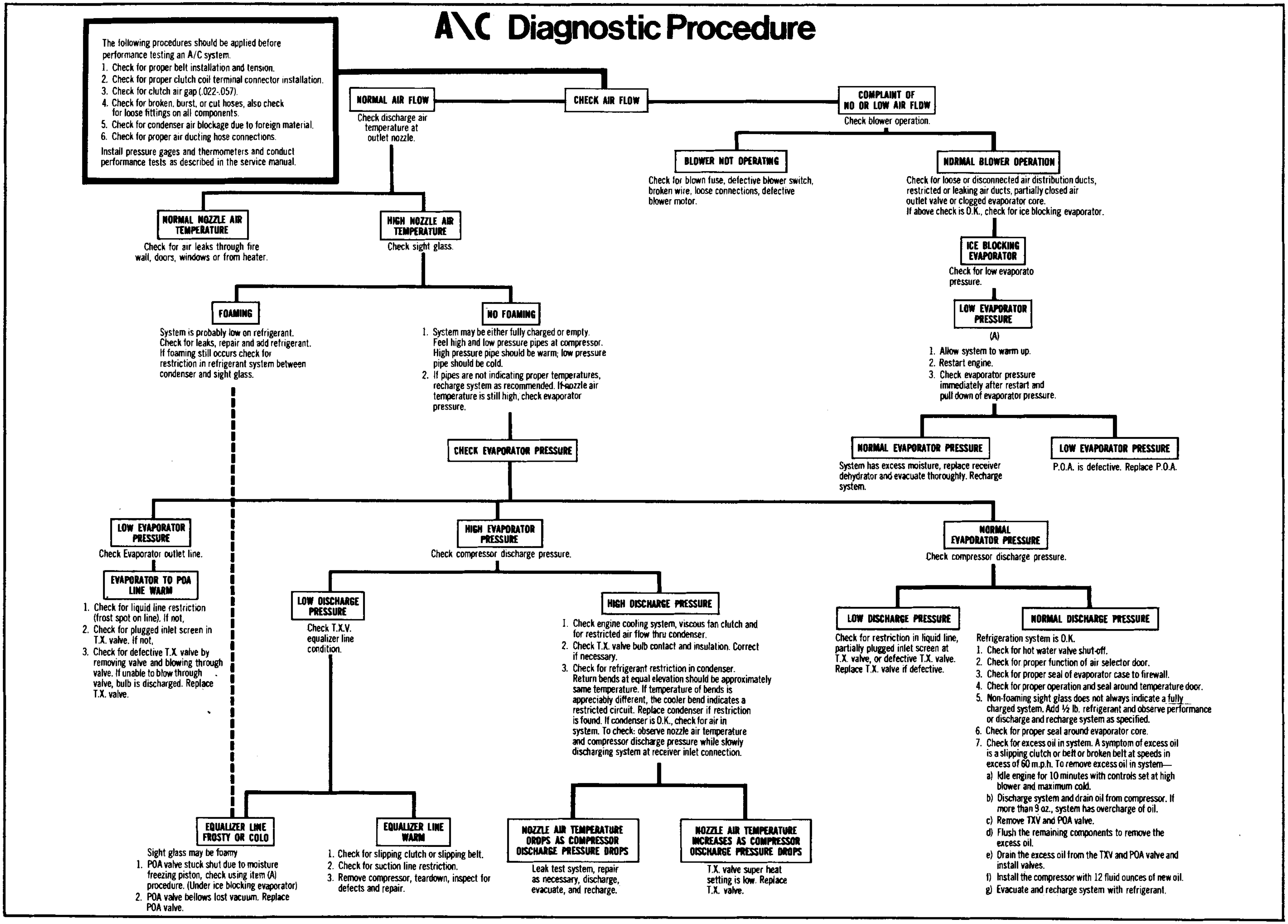


Fig. 1A-15 A/C Diagnostic Chart

	The system will have high pressure control more frequently under this condition. Also see P.O.A. VALVE INLET PRESSURE TOO HIGH
Overcharge of refrigerant or air in system. (Note: Disconnect thermal limiter before discharging the system.)	Install gauge set and bleed off refrigerant from P.O.A. valve suction side and compressor discharge side for 20 seconds. After 20 seconds close valves and recheck pressures. Repeat until discharge pressure is normal. Check sight glass. If bubbles appear, it indicates that air was in system. Charge as follows: 2000 engine rpm, A/C mode, Hi blower and maximum cooling. Add refrigerant until sight glass clears, then add one-half pound additional.
Restriction in condenser, receiver-dehydrator or any high pressure line.	Remove parts, inspect and clean or replace.
Condenser air flow blocked.	Clean condenser.
P.O.A. Valve Inlet Pressure too high.	See P.O.A. Valve Inlet Pressure Too High.

COMPRESSOR DISCHARGE PRESSURE TOO LOW

CONDITION AND CAUSE	CORRECTION
Insufficient refrigerant.	Check sight glass for presence of bubbles or foam. If bubbles or foam are noted, charge as follows: 2000 engine rpm, A/C mode, Hi blower and maximum cooling. Add refrigerant until sight glass clears; add an additional 1/2 pound. (It is not unusual for bubbling to occur on minimum cooling and LO blower in mild weather even with fully charged system.)
Defective Compressor.	See Service Procedures-Compressor Assembly.
Plug in refrigerant System.	1. Disconnect fitting assembly and hoses from compressor; disconnect receiver-dehydrator inlet and outlet tube. Seal the compressor ports and receiver fittings. 2. Check ends of lines for slipping plugs or torn-off spare pieces of plugs left in at assembly. 3. Blow dry nitrogen, refrigerant or dry air through lines to determine if lines or condenser are plugged. **CAUTION:** *Bleed air hose of all moisture.* 4. If plug in the system has not been found, disconnect P.O.A. valve from evaporator. 5. Blow thru expansion valve and evaporator, to check for plugged evaporator.
P.O.A. Valve inlet pressure too low.	See P.O.A. Valve Inlet Pressure Too Low.

P.O.A. VALVE INLET PRESSURE TOO HIGH

CONDITION AND CAUSE	CORRECTION
P.O.A. Valve stuck open.	Remove valve and inspect. **CAUTION:** *Use only prescribed valve.*
Expansion valve capillary tube to evaporator tube.	Remove insulation. Inspect for clearance between tube and bulb. If gap exists, move bulb to establish contact, reclamp and reinsulate.
Expansion valve inoperative.	Remove expansion valve and inspect screen for foreign objects. If present, it is possible seat is being held open. Install new expansion valve; if condition is corrected, discard valve removed.

P.O.A. VALVE INLET PRESSURE TOO LOW

CONDITION AND CAUSE	CORRECTION
P.O.A. Valve stuck open.	Shut off engine. If inlet pressure does not rise, valve is stuck open. (Also indicated by less than 3 to 4 psi pressure differential between suction pressure and P.O.A. valve inlet pressure.)
Expansion valve capillary tube broken, inlet screen plugged or valve otherwise fails.	Remove expansion valve and inspect. Install new expansion valve; if condition is corrected, discard the valve removed.
Restriction in system hoses or tubes.	Inspect and replace restricted hose or kinked tube.

NOZZLE OUTLET TEMPERATURE TOO WARM

CONDITION AND CAUSE	CORRECTION
Poor seal--evaporator core to evaporator inlet case or evaporator to heater case.	Correct sealing.
Defective or missing evaporator drain hose.	Replace.
Air ducts not properly connected.	Inspect air ducts.
Vacuum control hoses not connected properly.	Check connections.
Insufficient refrigerant.	See Compressor Discharge Pressure Too Low.
P.O.A. Valve faulty.	See P.O.A. Valve Inlet Pressure Too High.
Expansion valve faulty.	See P.O.A. Valve Inlet Pressure Too High.

NOZZLE OUTLET TEMPERATURE TOO COLD

CONDITION AND CAUSE	CORRECTION
P.O.A. valve faulty.	See P.O.A. Valve Inlet Pressure Too Low.

LOW REFRIGERANT PROTECTION SYSTEM

The design of the low refrigerant protection system (Fig. 1A-16) is such that the fusible portion of the thermal limiter will open under low refrigerant conditions. This in turn opens the electrical circuit to the compressor clutch.

When replacing thermal limiter, check new part for electrical continuity (0 ohms) between terminals B and C and for a resistance of 8.4 ohms to 10.4 ohms between terminals C and S. If either reading is not obtained, the limiter is defective and should be discarded.

BLOWN THERMAL LIMITER

CAUSE	CORRECTION
Low refrigerant charge or totally discharged system.	Inspect for leaks, repair, evacuate and recharge system and then replace thermal limiter.
Inoperative expansion valve (see A/C Diagnosis Chart, Fig. 1A-15).	Replace expansion valve according to normal procedures and then replace the thermal limiter.
Thermal limiter installed in improper location where temperatures exceed 260°F.	Install new thermal limiter in proper location.

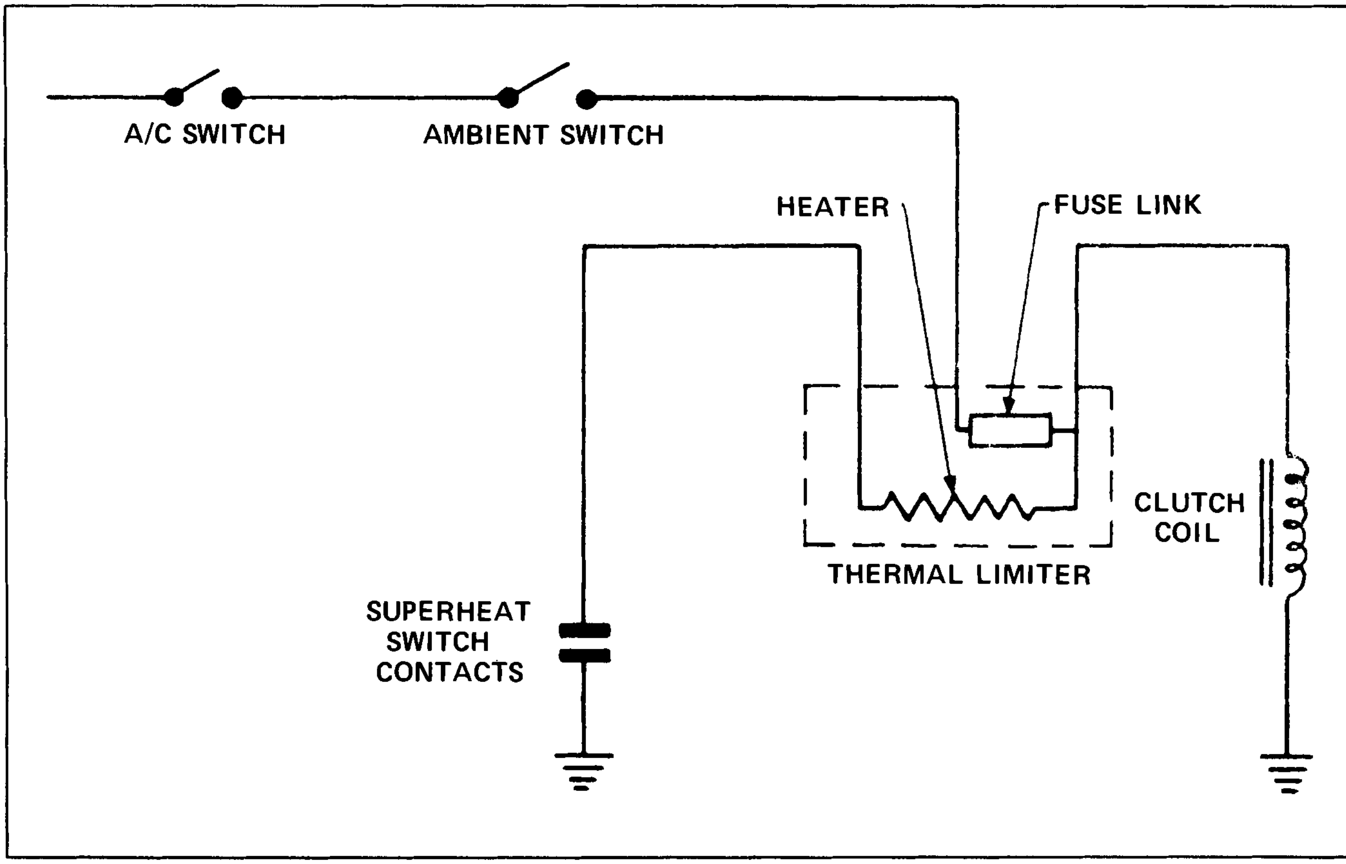


Fig. 1A-16 Schematic - Low Refrigerant Protection System

Thermal limiter blown during charging of refrigerant system.	Disconnect thermal limiter and place jumper between terminals B and C of connector plug during charging. Replace thermal limiter.
Faulty superheat shut-off switch. (See Superheat Shut-Off Switch Check.)	Replace superheat switch according to procedure, recharge system and replace thermal limiter.

SUPERHEAT SHUT-OFF SWITCH CHECK

On Car:

1. Disconnect electrical connector at superheat switch in rear head of compressor.

2. Check for electrical continuity from switch terminal to ground. An open circuit should be read between switch terminal and ground.

Off Car:

With superheat shut-off switch removed, the switch contacts (terminal to housing) should be open at atmospheric pressure and temperatures below 100°F. With switch in hot bath (150°F. or above), switch contacts should close.

If switch contacts are not open and closed as described in preceding paragraph, the switch is defective and must be replaced.

PRINCIPLES OF REFRIGERATION

In order to better understand the operation of Pontiac's Air Conditioning System, the following principles are presented. These principles are basic to the operation of any refrigeration system and are stated informally as follows:

Heat is a form of energy which always seeks a region of lesser energy. For example, an ice cube (little heat energy) absorbs heat from a substance like hot water (high heat energy). As heat is added to a substance, a change in temperature is usually noted. This same heat may serve to change the state of a substance as well as its temperature. For example, when water reaches a temperature of 212°F. additional heat will not change the temperature of the water but will change its state from liquid to vapor. This same reasoning applies when heat is dissipated. As water vapor cools and reaches its condensation point, heat can be dissipated with no change in temperature. Once the change in state has occurred, however, additional changes in heat will change temperature.

Pressure also has an important effect on heat and temperature. For example, the vaporization or boiling point of water can be raised above 212°F. by increasing the pressure on the water. An engine cooling system accomplishes this by use of a pressurized system which raises the boiling point well above 212°F.

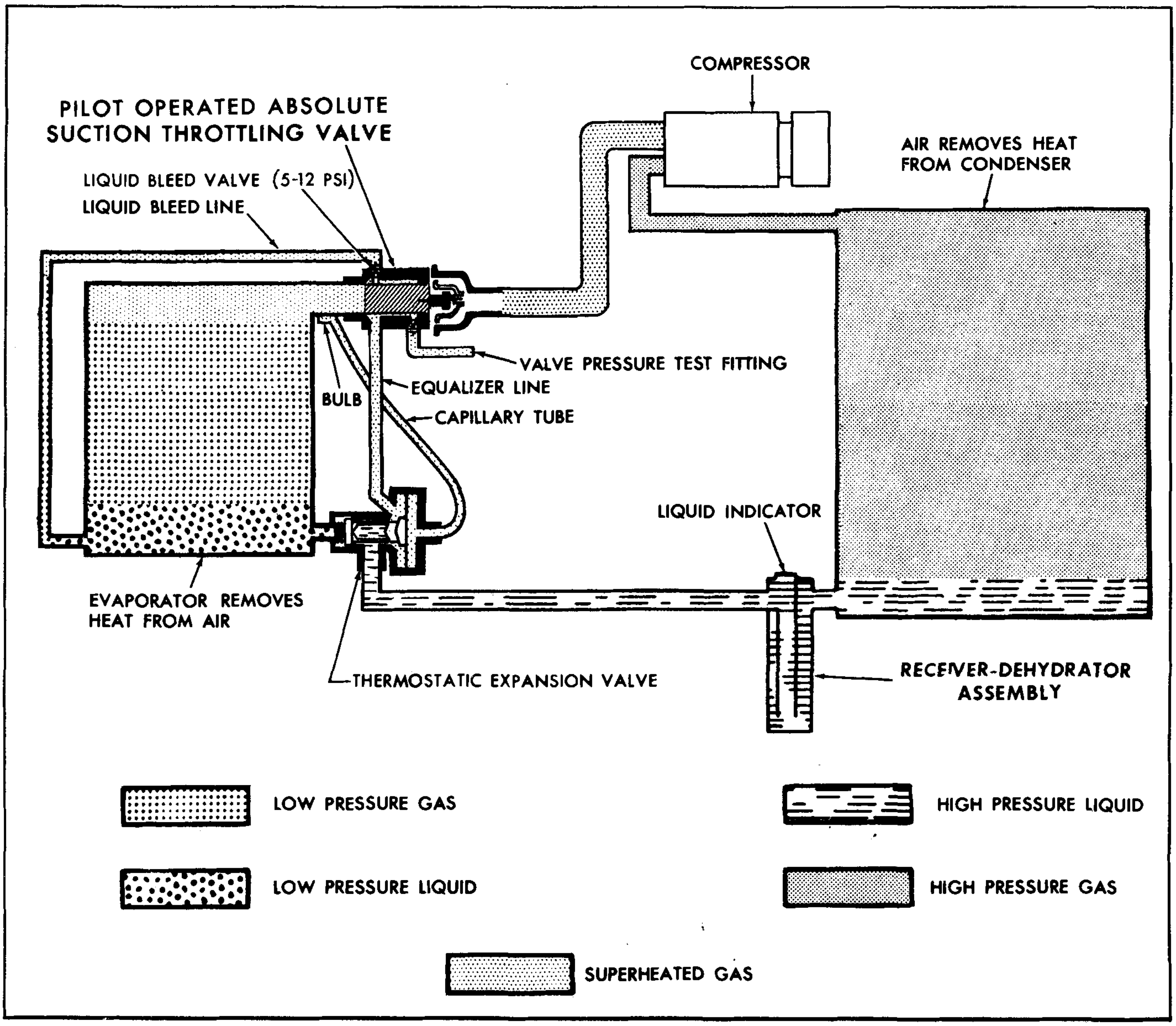


Fig. 1A-17 Refrigeration Circuit

Similarly, the characteristics of a gas can be altered by pressure. If a gas is heated additionally after complete vaporization without changing pressure, this gas is said to be superheated. For instance, in the evaporator the refrigerant absorbs heat and boils at a constant temperature and pressure until it has been completely vaporized. It then continues to absorb heat from the warm air passing over the evaporator without any increase in pressure. The refrigerant is then superheated.

Another important concept deals with compression of a substance. When the pressure of a substance is increased (compression), the temperature is also increased. In the air conditioning system, this pressure and temperature increase takes place in the compressor. The refrigerant, the substance used in the system, leaves the compressor at a high temperature and a high pressure.

Using the principles described above, a brief description of Pontiac's air conditioning system follows:

OPERATION

Pontiac's refrigeration system (Fig. 1A-17) is composed of six basic parts. They are the compressor, condenser, receiver, expansion valve, evaporator and P.O.A. (Pilot Operated Absolute) valve. The integrated operation of these basic parts is presented in the following section.

Cool refrigerant gas is drawn into the compressor from the evaporator and pumped from the compressor to the condenser under high pressure (Fig. 1A-17). This high pressure gas being pumped to the condenser will have a high temperature as a result of being subjected to compression. As it passes through the condenser, the high pressure, high temperature gas rejects its heat to the outside air as the air passes over the metal surfaces of the condenser. This cooling of the gas causes it to condense into liquid refrigerant and drop to the bottom of the condenser. Fig. 1A-18 shows just how pressure and temperature effect refrigerant.

The liquid refrigerant, still under high pressure, then passes from the bottom of the condenser into the receiver-dehydrator assembly. The receiver portion of this assembly acts as a reservoir for the liquid refrigerant.

Liquid refrigerant from the receiver-dehydrator assembly flows (under pressure) to the expansion valve.

The expansion valve meters the high pessure liquid refrigerant flow into the evaporator. Since the pressure in the evaporator is relatively low, the refrigerant immediately begins to boil. As the refrigerant passes through the evaporator, it continues to boil, drawing heat from the surface of the evaporator core, warmed by the air passing over the surfaces of the evaporator core.

In addition to warm air passing over the evaporator rejecting its heat to the cooler surfaces of the evaporator core,

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. will have a pressure of 84.1 psi. If it is heated to 125°F. the pressure will increase to 167.5 psi. 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, Refrigerant boils at 32°F.

TEMP. (°F.)	PRESSURE (PSIG)	TEMP. (°F.)	PRESSURE (PSI)
-21.7	0 (atmospheric pressure)	55	52.0
		60	57.7
-20	2.4	65	63.7
-10	4.5	70	70.1
- 5	6.8	75	76.9
0	9.2	80	84.1
5	11.8	85	91.7
10	14.7	90	99.6
15	17.7	95	108.1
20	21.1	100	116.9
25	24.6	105	126.2
30	28.5	110	136.0
32	30.1	115	146.5
35	32.6	120	157.1
40	37.0	125	167.5
45	41.7	130	179.0
50	46.7	140	204.5

Fig. 1A-18 Pressure - Temperature Relationship of Refrigerant

any moisture in the air condenses on the cool surfaces of the core, resulting in cool dehydrated air entering inside the car. By the time the refrigerant gas leaves the evaporator, it has completely vaporized and is slightly superheated.

Refrigerant passing through the evaporator is directed through a P.O.A. valve.

Low pressure refrigerant gas from the evaporator outlet enters the P.O.A. valve inlet to fill the space behind the piston. Compressor suction pressure encircles the piston, and enters the equalizer line opening to the expansion valve and also applies pressure to the bottom side of the bleed line valve (controlled to open at 5 to 12 psi differential between the pressure inside the P.O.A. valve and the pressure at the bottom of the evaporator). The valve for the evaporator suction and charging fitting is so ported that it reads evaporator suction pressure.

Whenever evaporator suction pressure is at or above the minimum pressure desired in the evaporator, suction pressure against the piston will cause the piston to move to permit the refrigerant gas to pass on to the compressor. When the evaporator pressure drops below the pressure which provides the desired temperature in the car, the spring-loaded bellows will force the piston to restrict (and even completely close) the gas passage from the top of the evaporator to the compressor.

Since the compressor continues to operate, pressure is reduced around the piston, at the equalizer line to the expansion valve, and also beneath the spring-loaded valve at the liquid bleed line. When the pressure differential exceeds 5 to 12 psi, the liquid refrigerant and oil from the evaporator bottom tank by-passes the evaporator core to flow through the bleed valve (now open because of the 5 to 12 psi differential) and to the compressor. At the same time warm air being forced by the blower through the evaporator core provides more heat to the surface of the core and thus causes the refrigerant inside the evaporator to boil. This increases the pressure within the evaporator to such a point as to overcome atmospheric and spring pressure above the diaphragm to move the piston to allow refrigerant gas from the evaporator to pass through the valve.

As the pressure differential at the liquid bleed valve falls below 5 to 12 psi the valve closes, preventing refrigerant and oil from by-passing the evaporator core. In this manner, evaporator pressure is controlled and yet oil and refrigerant are always being returned to the compressor to prevent the compresssor from being damaged by sustained operation at vacuum conditions where no oil would normally be returned to the compressor for lubrication. Refrigerant is then returned to the compressor where the refrigeration cycle is repeated.

The pressure in the evaporator is so controlled at its lowest pressure setting that any moisture condensing on the evaporator surface will not freeze. If pressure drops below the lowest controlled pressure setting, refrigerant and oil by-pass the evaporator core, to flow directly through the P.O.A. valve and then to the compressor.

REFRIGERANT

Refrigerant is shipped and stored in metal drums. It is serviced in drums and disposable cans.

It will be impossible to draw all the refrigerant out of the drums. The use of warm water when charging the system will assure the extraction of a maximum amount of refrigerant from the drum. Be sure to follow the instructions under CHARGING THE SYSTEM.

PRECAUTIONS IN HANDLING REFRIGERANT

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

All refrigerant 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 transmport or carry a drum of refrigerant 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 drum should never be subjected to excessive temperature when charging a system. The refrigerant drum should be heated for charging purposes by placing in 125°F. water. Never heat above 125°F. or use blowtorch, radiator or stove to heat the drum.

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

Discharging large quantities of refrigerant into a room can usually be done safely as the vapor would produce no ill effects. However, this should not be done if the area contains a flame- producing device such as a gas heater or running engines. While refrigerant normally is non-poisonous, heavy concentrations of it in contact with a live flame will produce a poisonous gas. The same gas will attack all bright metal surfaces.

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

WARNING: If refrigerant 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 refrigerant come in contact with the skin, the injury should be treated the same as skin which has been frostbitten or frozen.

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. As long as the system contains pure refrigerant (plus a certain amount of compressor oil which mixes with the refrigerant) 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. 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 disconnnect 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 immediately capped or plugged 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 system will carry moisture with it and the exposed surfaces will collect the moisture quickly.
2. Keep tools clean and dry. This includes the gauge set and replacement parts.
3. When adding oil, the container and the 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 a 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 system open any longer than is necessary.
5. Any time the system has been opened and sealed again, the system must be properly evacuated.

GENERAL DESCRIPTION

Pontiac's air conditioners operate by combining with the heater to provide a year-round air conditioning system. This permits the air blower to be used for both air conditioning and/or heater operation and provides dehumidified air in all seasons if desired. Outside air entering the system is taken through the plenum chamber providing air that is free of dust, foreign material, and undesirable fumes.

The use of outside air provides constant and rapidly changing air inside the car, eliminating a stuffy, smoke-filled interior and keeps the occupants fresh and comfortable.

The driver has fingertip control of the temperature of conditioned air entering the car.

TEMPERATURE CONTROL

Air entering the vehicle first passes over the evaporator which may or may not be operating depending on the control setting. Portions of this air may then be reheated, depending on temperature door setting, by directing air flow over the heater core. Since the operator has control of the temperature door, he may vary in car temperatures to suit his needs.

BLOWER CONTROL

The operator not only controls the temperature of the air flow but also the quantity of air flow. By varying the blower speed setting, he can increase or decrease the air flow, depending on his individual needs and the number of passengers in the car.

AIR CONTROL

The operator also has control of what air will be used by the system and where it will flow. He can choose to use outside air in normal situations or inside air in dusty or odorous areas. The conditioned air can then be directed through the cold air and warm air ducts or through each separately. Finally, if conditions warrant, air may be directed to the windshield for defrosting operations.

REFRIGERATION COMPONENTS

EXPANSION VALVE

DESCRIPTION

The expansion valve (Fig. 1A-19) consists of a capillary bulb and tube connected to an operating diaphragm (which is sealed within the valve itself) and an equalizer line which connects the valve and the low pressure return line.

The valve contains three operating pins (spaced approximately 120° apart), valve stationary seat, valve, valve carriage, adjusting spring and screw, an inlet which has a fine

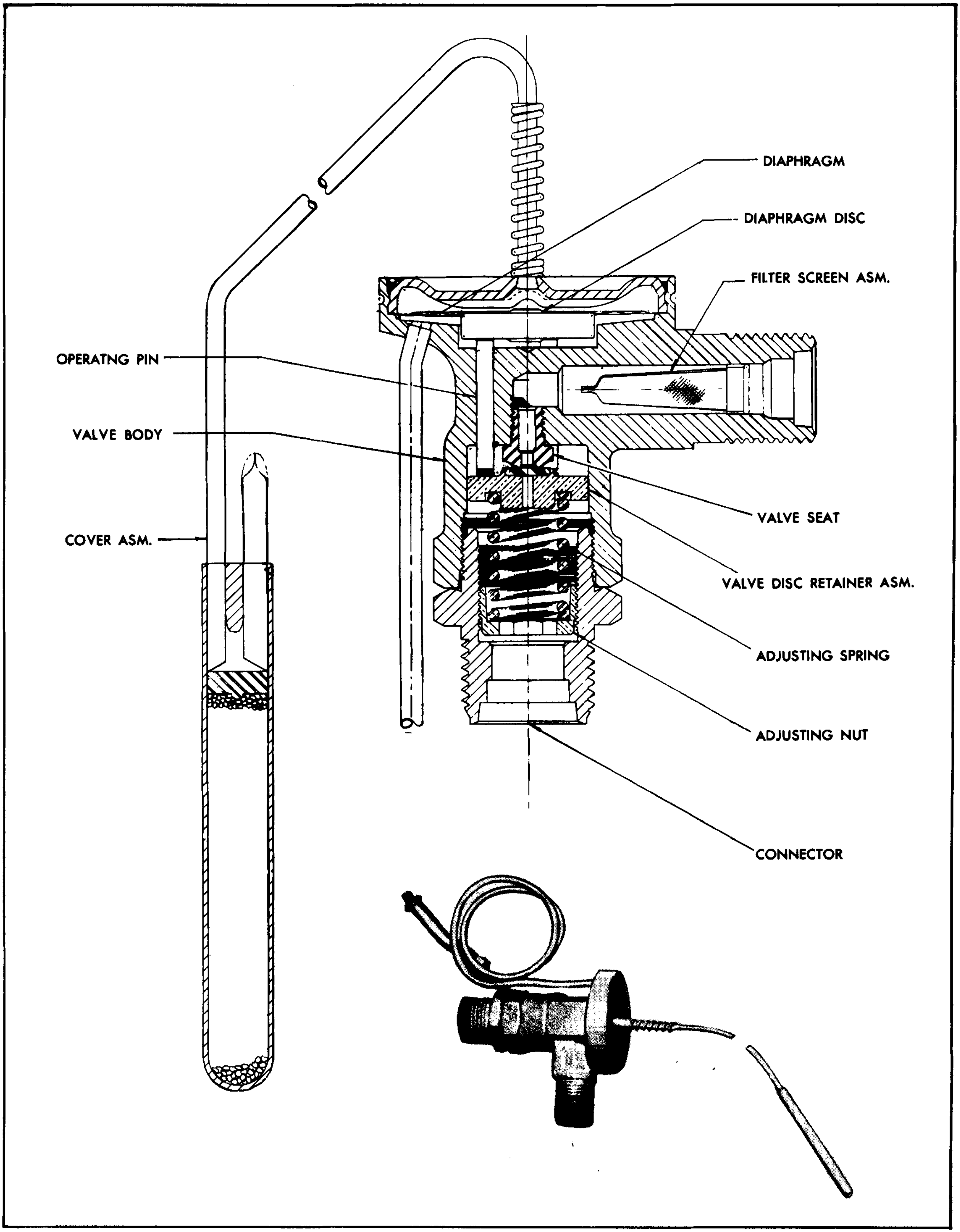


Fig. 1A-19 Cross Section - Expansion Valve mesh screen and an outlet connection (which attaches to the evaporator). The fine mesh screen at the inlet of the valve provides protection to the valve by preventing dirt and other foreign material from entering the valve.

While this valve is located at the inlet of the evaporator (at the bottom of the evaporator), the thermo bulb is attached to the evaporator outlet pipe and is insulated from temperature other than that of the evaporator outlet pipe.

The equalizer line joins the expansion valve to the P.O.A. valve so that compressor inlet pressure will register in the expansion valve. Under high load conditions this pressure is essentially the same as evaporator pressure, and the expansion valve functions in a normal manner. Under light load conditions (low ambient temperature or extreme modulation of outlet nozzle temperatures) the pressure transmitted to the expansion valve diaphragm is considerably lower than evaporator pressure.

This low pressure, plus the thermo bulb reading on the evaporator outlet pipe, tricks the expansion valve into admitting more liquid refrigerant into the evaporator than is required for the cooling demand. This high refrigerant flow rate insures that compressor oil will flow through the evaporator and back to the compressor, thereby keeping the compressor adequately supplied with oil, and preventing the evaporator from becoming oil-logged.

FUNCTION

The purpose of the expansion valve is to regulate the flow of liquid refrigerant into the evaporator automatically in accordance to the requirements of the evaporator.

The valve is the dividing point in the system between high pressure liquid refrigerant supplied from the receiver-dehydrator and relatively low pressure liquid and gaseous refrigerant in the evaporator. It is so designed that the temperature of the refrigerant at the evaporator outlet must have 10.6°F. of superheat before more refrigerant is allowed to enter the evaporator. Superheat is an increase in temperature of the gaseous refrigerant above the temperature at which the refrigerant vaporizes.

A capillary tube filled with carbon dioxide and the equalizer line provide the temperature regulation of the expansion valve. This capillary tube is fastened to the low pressure refrigerant pipe coming out of the evaporator so that it communicates the temperature of the refrigerant at this point to the expansion valve. If the superheat at the outlet decreases below 10.6°F., the expansion valve will reduce the amount of refrigerant entering the evaporator, thus reducing the amount of cooling. If the superheat increases, the expansion valve will automatically allow more refrigerant to enter the evaporator, thus increasing the cooling.

The equalizer line joining the P.O.A. valve with the area behind the operating diaphragm acts with the capillary to measure superheat.

It is the temperature of the air passing over the evaporator core that determines the amount of refrigerant that will enter and pass through the evaporator. When the air is very warm, the heat transfer from the air to the refrigerant is great and a greater quantity of refrigerant is required to cool the air and to achieve the proper superheat on the refrigerant gas leaving the evaporator. When the air passing over the evaporator is cool, the heat transfer is small and a lesser quantity of refrigerant is required to cool the air and to achieve the proper superheat on the refrigerant gas leaving the evaporator.

A mechanical adjusting nut located within the valve is provided to regulate the amount of refrigerant flow through the valve and moves the spring seat to increase or decrease the tension on the valve carriage spring. By varying the tension on this spring, it is possible to regulate the point at which the valve begins to open or close, thereby regulating refrigerant flow into the evaporator. As this adjustment feature is inside the valve, no external adjustment is possible. All valves are preset at the time of manufacture.

Since the evaporator outlet pressure is proportionate to the amount of heat (superheat) picked up by the refrigerant gas passing through the evaporator, it can be seen that adjusting spring tension, which works against capillary pressure and equalizer line pressure, controls the volume of refrigerant entering the evaporator as signaled by the temperature and pressure in the evaporator outlet pipe.

OPERATION

When the air conditioning system has not been operating, all pressures within the expansion valve assembly will have equalized at the ambient (surrounding air) temperature. Thus, the pressure above and below the operating diaphragm and at the inlet and outlet side of the valve will be equal (Fig. 1A-19). Pressure under the diaphragm is evaporator pressure. It reaches this area by means of clearance around the operating pins in the valve body which connects the area under the diaphragm with the evaporator pressure area. While pressures in the expansion valve are almost equal, the addition of the valve adjusting spring pressure behind the valve will hold the valve over to close the valve orifice.

When the air conditioning system first begins to operate, the compressor will immediately begin to draw refrigerant from the evaporator, lowering the pressure in the evaporator and in the area under the operating diaphragm. As the pressure in this area decreases, the pressure above the diaphragm exerted by the carbon dioxide in the capillary tube will overcome spring pressure and push the diaphragm against the operating pins, which in turn will force the needle valve off its seat.

Refrigerant will then pass through the expansion valve into the evaporator where it will boil at a temperature corresponding to the pressure in the evaporator. This will begin cooling the air passing over the evaporator. It will also begin to cool the evaporator outlet pipe.

As the evaporator outlet pipe cools, the pressure of the carbon dioxide in the capillary tube (contacting this outlet pipe) decreases, exerting less force on the operating diaphragm.

The valve adjusting spring is calibrated so that the pressure of the refrigerant in the evaporator plus the spring force, will equal the force above the operating diaphragm when the temperature of the refrigerant in the evaporator outlet is 10.6°F. above the temperature of the refrigerant entering the evaporator. In other words, the refrigerant should remain in the evaporator long enough to completely vaporize and then warm (superheat) 10.6°F.

If the temperature differential begins to go below 10.6°F. (outlet pipe becomes too cold), carbon dioxide pressure in the capillary tube and the area above the diaphragm decreases, allowing the valve adjusting spring to move the needle toward its seat, closing off the flow of refrigerant past the needle valve.

If the temperature differential begins to go above 10.6°F. (outlet pipe too warm), the pressure in the capillary tube and area above the operating diaphragm will increase, pushing this diaphragm against the operating pins to open the needle valve further, admitting more refrigerant to the evaporator.

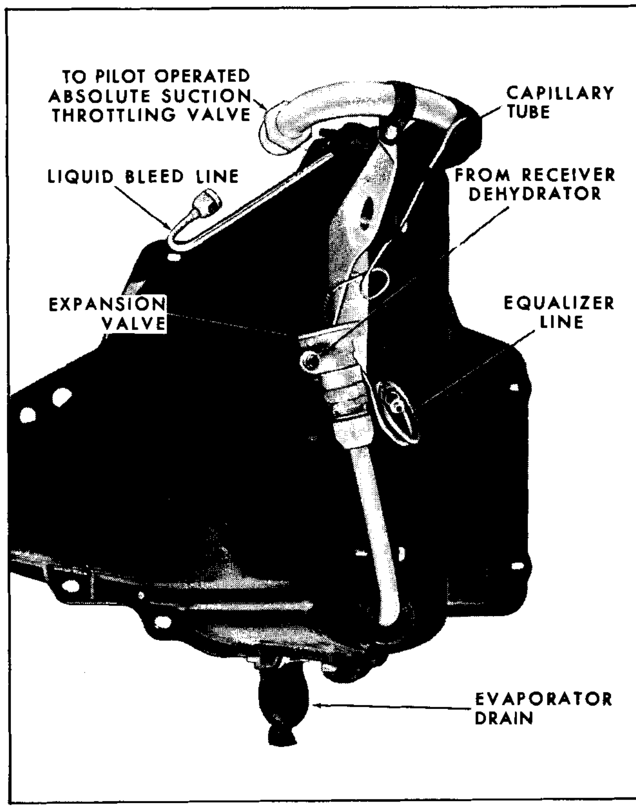


Fig. 1A-20 Typical Evaporator Core and Case Assembly

EVAPORATOR

DESIGN

The evaporator core consists of a series of plates which when joined together form the refrigerant tubes and the top and bottom tanks. Between the tubes corrugated strips of aluminum serve as air fins. This type of construction is called a channel plate-type core. The nature of this design is such that the refrigerant travels a relatively short distance with little or no pressure drop resulting between the inlet and the outlet. Therefore, the inlet pressures and outlet pressures are about equal and exactly controlled to maintain the refrigerant boiling point at a temperature which cools the air passing over the evaporator to a temperature at or just above the freezing point of water.

The evaporator core with this design permits a very efficient distribution of refrigerant at the moment refrigerant enters the core.

The evaporator housing is constructed of a reinforced plastic material for strength. A self-opening rubber nozzle serves as a water drain and is located at the bottom of the housing. A typical unit is shown in Fig. 1A-20.

FUNCTION

The evaporator is actually the device which cools and dehumidifies the air before it enters the car. High pressure liquid refrigerant flows through the valve orifice in the expansion valve into the low pressure area of the evaporator. This regulated flow of refrigerant boils immediately. Heat from the core surface is lost to the boiling and vaporizing refrigerant, which is cooler than the core, thereby cooling the core. The air passing over the evaporator loses its heat to the cooler surface of the core, thereby cooling the air. As the process of heat loss from the air to the evaporator core surface is taking place, any moisture (humidity) in the air condenses on the outside surface of the evaporator core and is drained off as water.

Since the refrigerant will boil at 21.7°F. below zero at atmospheric pressure and water freezes at 32°F., it becomes obvious that the temperature in the evaporator must be controlled so that the water collecting on the core surface will not freeze in the fins of the core and block off the air passages. In order to control the temperature, it is necessary to control pressure inside the evaporator and this is done by the P.O.A. valve.

To obtain maximum cooling, the refrigerant must remain in the core long enough to completely vaporize and then superheat a minimum of 10.6°F. If too much or too little refrigerant is present in the core, then maximum cooling efficiency is lost. An expansion valve in conjunction with the P.O.A. valve is used to provide this necessary refrigerant and pressure control.

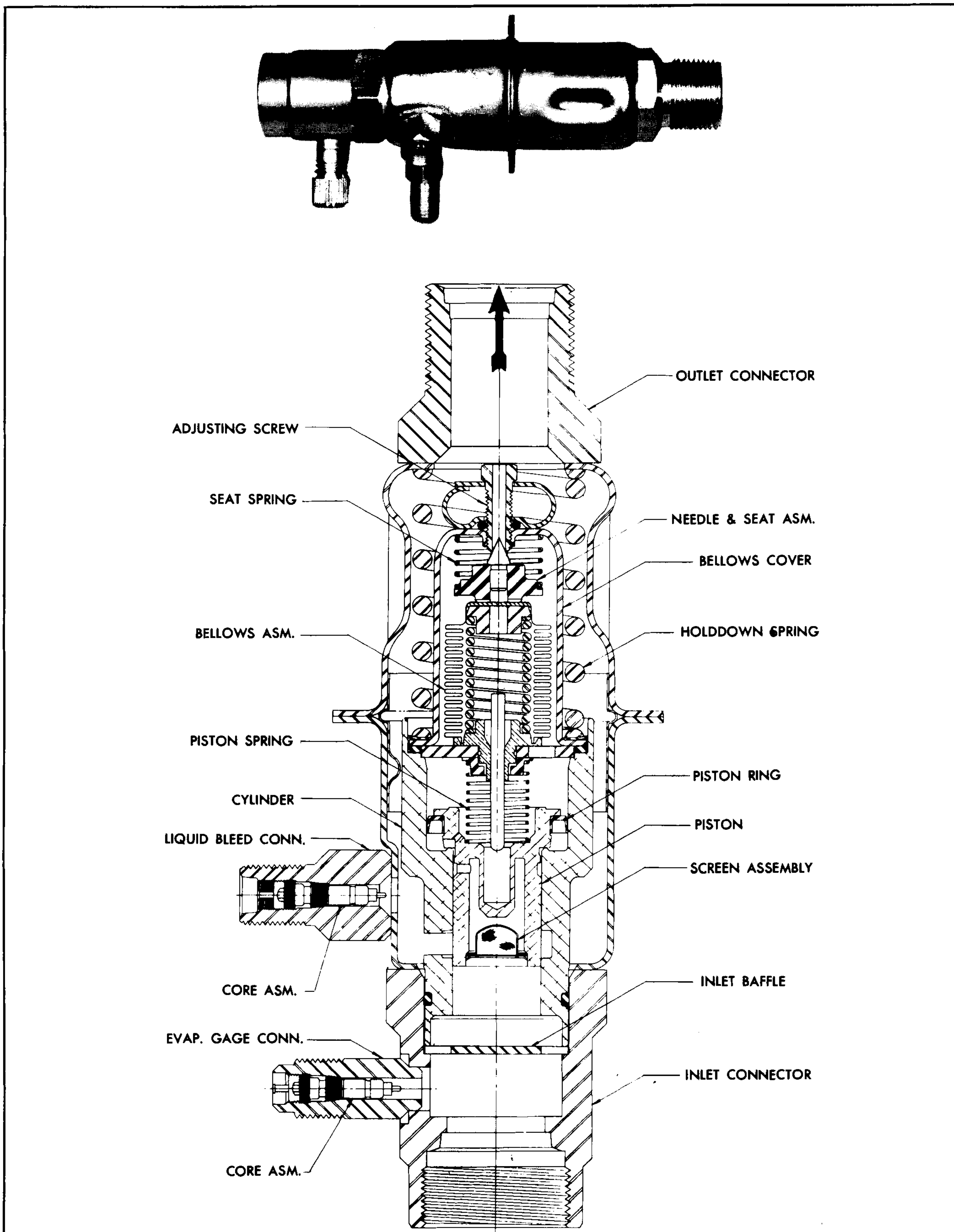


Fig. 1A-21 Cross Section - P.O.A. Valve

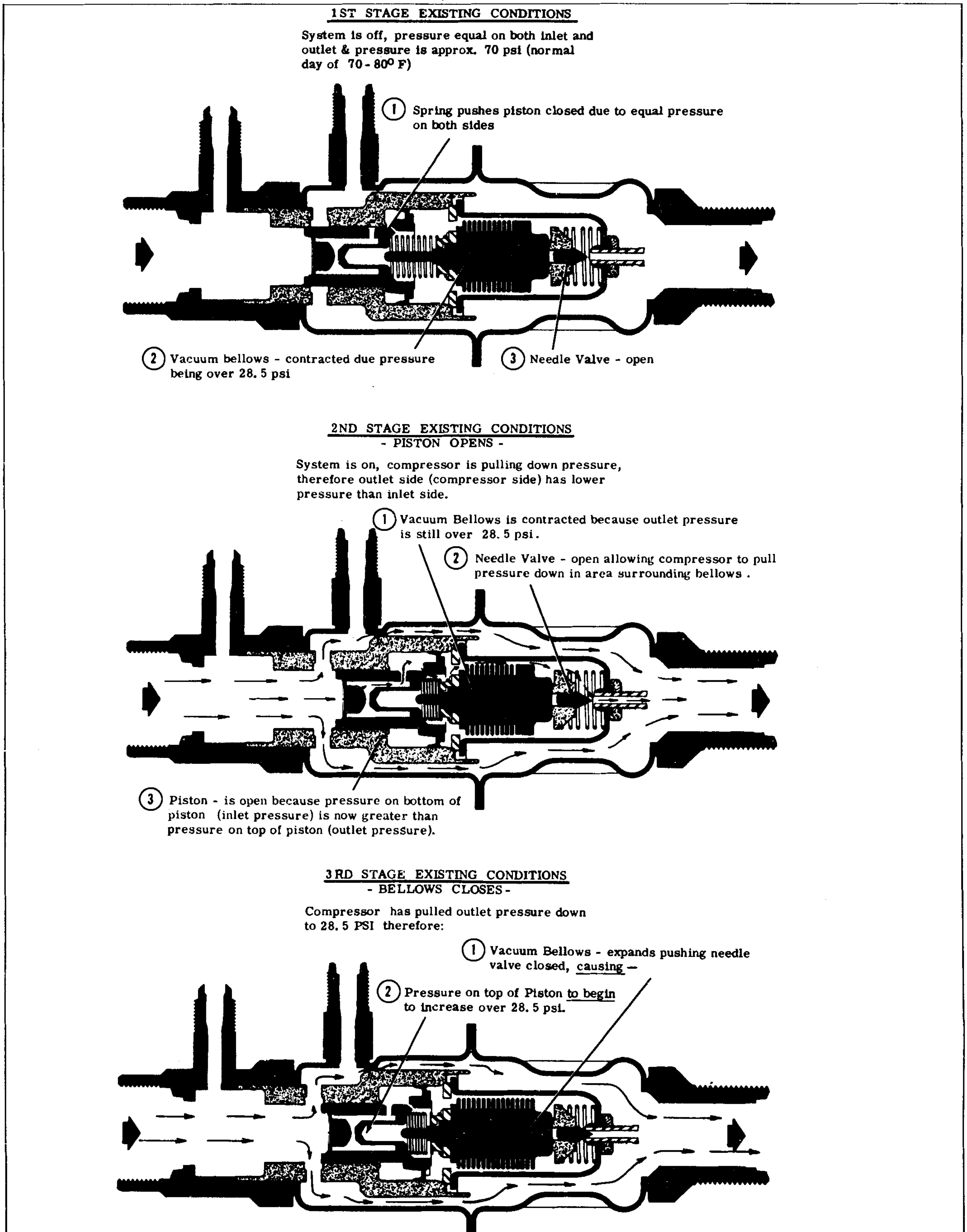


Fig. 1A-22 P.O.A. Valve - Basic Operation

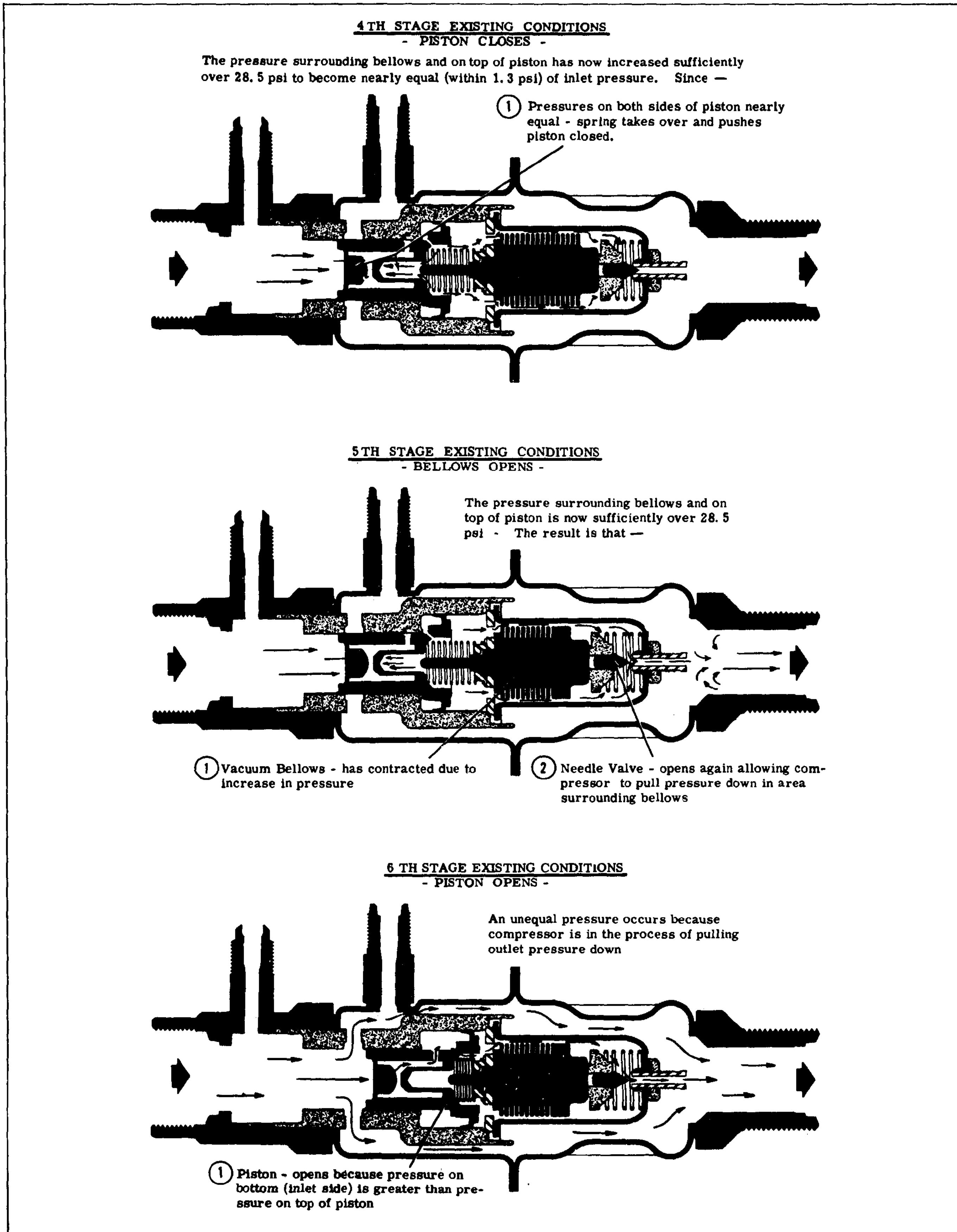


Fig. 1A-23 P.O.A. Valve - Basic Operation

EVAPORATOR CORE PURGING - F SERIES

The evaporator case (left half) on F Series models contains an air door which is controlled by a vacuum diaphragm mounted on top of the case. The door and diaphragm are designed to work with the blower motor to purge condensation (moisture) from the evaporator core.

The purge door and diaphragm operate as follows:

The purge door rests against the opening in the left evaporator case toward the engine. When the engine is started and the air conditioning control panel is set to the OFF position, vacuum is applied to the diaphragm and the purge door swings to seal the dash opening from the evaporator core.

On air conditioned F Series models, the blower motor operates whenever the ignition switch is ON. When the key is on and the A/C control panel is in the OFF position, the blower motor will operate in the low position.

With the purge door against the dash opening, the blower motor passes inlet air through the evaporator case and out the opening in the left half of the case. This air flow will pick up any moisture from the evaporator core and empty into the engine compartment.

When the control panel is switched to any position other than OFF vacuum is no longer present at the diaphragm and the purge door returns to seal the opening in the left evaporator case half and inlet air passes through the evaporator core and into the dash opening.

Because moisture is not allowed to collect at the evaporator core, dry air will be passed into the air distribution system when the control panel is switched from OFF to any other position. This eliminates windshield fogging when system is turned on.

SUCTION THROTTLING (P.O.A.) VALVE

FUNCTION

The main function of the P.O.A. valve (Fig. 1A-21) is to maintain the evaporator pressure at a sufficiently high level to avoid freezing of moisture on the evaporator core and at the same time provide maximum cooling efficiency.

BASIC OPERATION (Figs. 1A-22 and 1A-23)

A bronze bellows is used to control a small needle valve, which in turn controls a large piston. The bellows is constructed so that it has a tendency to expand when the pressure surrounding it goes below 28.5 psi, or contract when the pressure goes above 28.5 psi. Each time the bellows expands and closes, the needle valve-pressure surrounding the bellows increases. When the pressure increases sufficiently, the bellows contracts and opens the needle valve, then pressure surrounding the bellows drops. When the pressure drops sufficiently, the bellows expands, etc.

Because of the compressor drawing on the outlet end of the P.O.A. valve, a lower pressure exists at the outlet than at the inlet. When the bellows expands and the pressure around the bellows starts to increase, simultaneously the lower pressure on the top side of the piston approaches the pressure on the underside. The closer the two pressures come to being equal, the more the spring pushes the piston closed. The more the two pressures become unequal, the more the bottom (higher) pressure pushes the piston open.

SUMMARY

When the bellows expands, the pressure increases on top of the piston to nearly equal the pressure below the piston with the result that the spring pushes the piston closed. When the bellows contracts and the pressure drops on top of the piston, the higher pressure below the piston pushes it open.

COMPRESSOR ASSEMBLY

The compressor (Figs. 1A-24, 1A-25 and 1A-26) is the same for all series except for belt pulley size. The A Series pulley with the 6 cylinder engine is slightly larger. Both units are of basic double-action piston design. Three horizontal double acting pistons make up a six-cylinder compressor, and are mounted axially around the compressor shaft to operate in a front and rear cylinder assembly. These pistons operate in a 1 1/2" bore, have a 1 3/16" stroke and are actuated by a swash plate pressed on the compressor crankshaft.

Reed-type suction and discharge valves are mounted in valve plates between the cylinder assembly and the head at each end of the compressor. The heads are connected with each other by gas-tight passage ways which direct refrigerant gas to a common output.

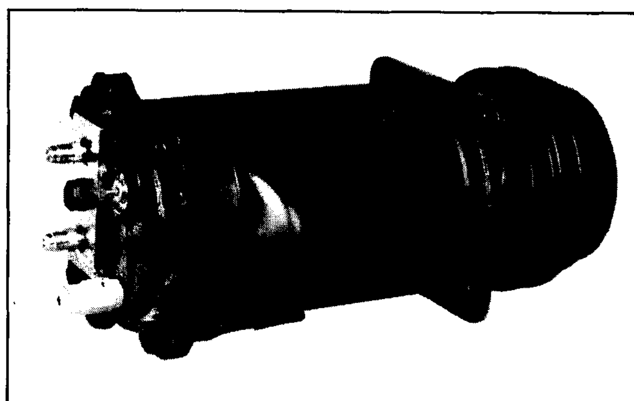


Fig. 1A-24 Compressor Assembly

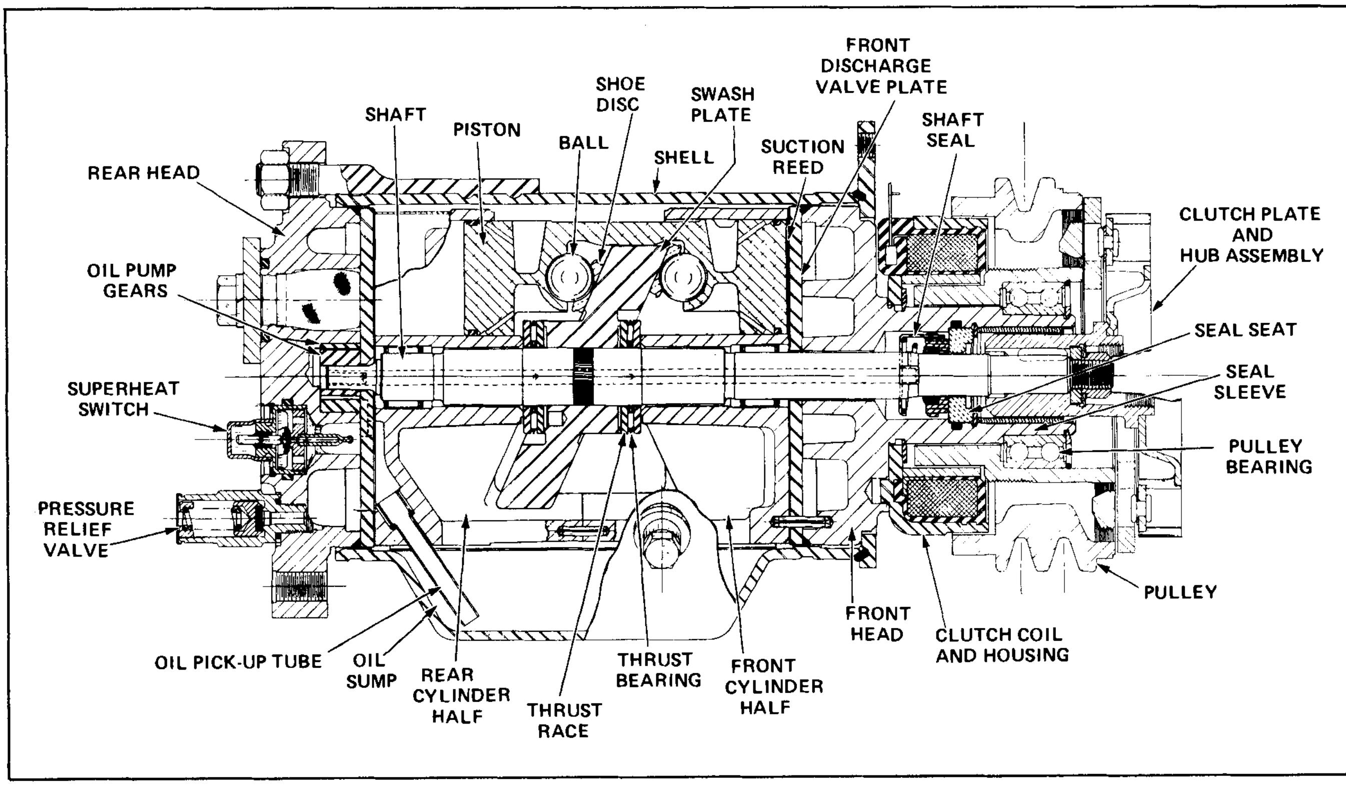


Fig. 1A-25 Cross Section - Compressor Assembly

SUCTION VALVES

A three-reed suction valve disc is assembled to both the front and rear cylinder heads. These reeds open when the pistons are on the intake portion of their stroke to allow the low pressure vapor to flow into the cylinders.

When the pistons reverse and are on the compression portion of their stroke, the reed valve closes against their seats to prevent the high pressure vapor from being forced into the low side of the system.

DISCHARGE VALVES

There are two discharge valve plate assemblies, each having three reeds and retainers positioned to direct the high pressure vapor from the cylinders into the outer annular cavities of the front and rear head castings. When the piston has completed its compression stroke and reverses to the suction stroke, the high pressure vapor in the discharge cavity causes the reeds to close, thus maintaining the differential of pressure between the high and low pressure areas.

CYLINDER HEAD

Each cylinder head contains suction and discharge cavities. In addition, the rear head contains an oil pump cavity, in the center of the suction cavity, to house the oil pump gears (which are driven by the compressor mainshaft). The suction cavity in the rear head also contains the port opening to the superheat shut-off switch cavity.

The suction cavity is in the center and idexes with the suction reeds. The discharge cavity is around the outside and indexes with the discharge reeds.

The superheat switch port opening allows the superheat switch to be affected by suction gas pressure and temperature for operation of the low refrigerant protection system which prevents compressor damage under low refrigerant charge conditions. See LOW REFRIGERANT CHARGE PROTECTION.

These cavities are sealed from each other with a teflon seal molded onto the rear cylinder head. The discharge cavity is sealed from the outside of the compressor by an O-ring seal which rests in a chamfered relief in the cylinder head and compresses against the compressor body.

Both cylinder heads are connected with each other; the suction cavities by a flat suction crossover cover, the discharge cavity by a tube pressed into each head. Service discharge crossover tube assemblies are seated with O-rings and spacers.

OIL PUMP

An oil pump mounted at the rear of the compressor picks up oil from the bottom of the compressor oil sump and pumps it to the internal parts.

The multi-lobed oil pump gears are made of sintered iron. The inner gear is the driver and has a "D" shaped hole in the center which fits over a matching "D" flat on the rear

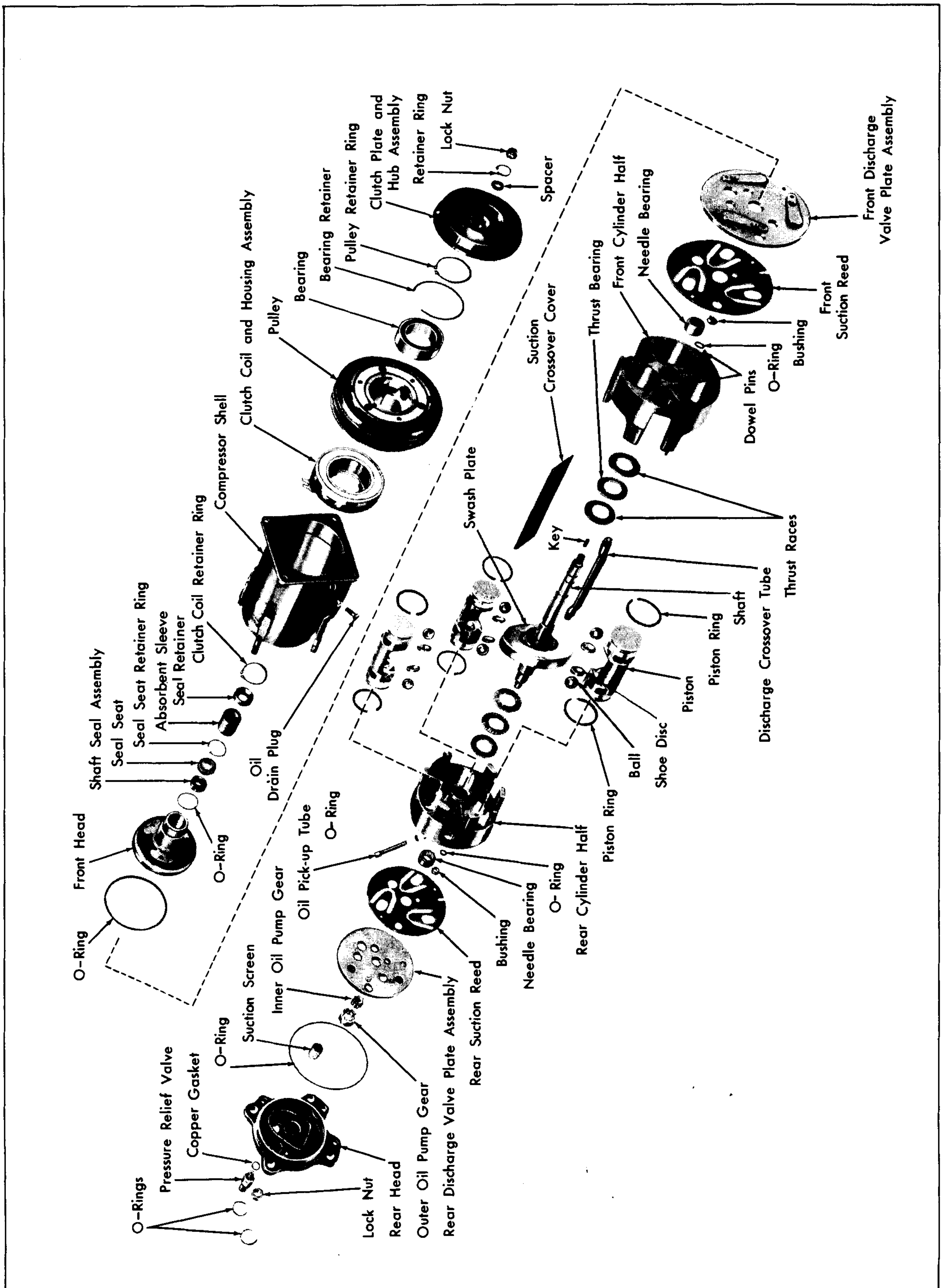


Fig. 1A-26 Exploded View - Compressor Assembly of the mainshaft. The outer gear, which is driven, has internal gear teeth mating with the external teeth on the inner (drive) gear.

OIL FLOW

The internal parts of the compressor are lubricated by the oil pump. Oil is picked up from the sump by the oil pump gears through the pick-up tube and into the pump cavity. From here oil is forced through the drilled hole, through the center of the mainshaft and to three outlets; one at each mainshaft thrust bearing and one at the compressor shaft seal.

Oil from the mainshaft seal drains back into the sump via a hole built in the discharge plate, a notched slot in the suction reed that indexes with a cast passage (slanted) in the front face of the front head casting, around the mainshaft and through the mainshaft front bearing, between the mainshaft and front head casting hub, to the mainshaft front thrust bearing and into the sump.

Oil directed through each mainshaft thrust bearing flows through the bearing and dumps into the sump. The mainshaft rear bearing is lubricated from oil emitting from clearances at the oil pump gears.

Oil that travels into the compressor assembly with the refrigerant that is forced past the piston rings returns to the sump as the pistons travel on their suction stroke. The design of the piston rings is such that the scraper grooves at the side of the ring facing the inside of the compressor force the oil through two oil return holes behind the ring groove (and extend toward the center area of the piston) to dump oil into the compressor pump.

MAINSHAFT

The compressor mainshaft is driven by the pulley when the clutch coil is energized. It extends through the compressor front head, to the compressor rear head and drives the oil pump in the rear head pump cavities. The shaft is supported by a needle bearing located in the front half of the cylinder and a similar needle bearing in the rear half of the cylinder.

A 3/16" diameter oil hole in the shaft extends from the rear oil pump cavity to the shaft seal cavity. Four .078" (5/64") diameter holes are drilled 90° to the main oil passage. These drilled passages direct oil under pump pressure to the shaft seal surfaces, thrust bearings, and shaft roller needle bearings.

THRUST BEARING AND RACES

Two flat-type thrust needle bearings are seated around the shaft and are located near the center of the compressor. These bearings have rollers placed radially in their separators. Each bearing is sandwiched between two steel thrust races, and this combination of three pieces is placed between the shoulders of the swash plate and the shoulders of the cylinder hubs on the front and rear halves of the cylinder.

The front end combination, consisting of a needle bearing with a thrust race on each side, is selected to provide the proper piston head clearance below the top of the cylinder and the underside of the suction and discharge valve plates.

The rear end combination, consisting of a needle bearing with a thrust race on each side, is selected to obtain .0003" (low limit) to .0013" (high limit) running clearance between the hub surfaces of the swash plate and the front and rear hubs of the cylinder. This allows .001" tolerance between the high and low limits of running clearance.

CYLINDER BLOCK

The cylinder block consists of two halves, front and rear. Three piston bores in each half are line bored as one piece during production to assure proper alignment and parallelism. After boring, the cylinder block is cut apart at the center and the faces are ground parallel to the two outer ends of the cylinder.

Alignment and indexing of the two halves are maintained by two cylindrical locator (squeeze) pins. It is important that the two halves of the cylinder be kept together to assure correct relationship of parts.

PISTONS

The double end pistons are made of cast aluminum, with a bridge connecting each end. Each piston has a notch cast in this bridge. This notched end of the piston is positioned toward the front (pulley) end of the compressor.

Both ends of the piston have a groove to receive a piston ring. Two oil return holes are drilled behind the ring groove and extend toward the center area of the piston to dump oil to the compressor oil sump. The piston rings have an oil scraper groove at one edge (toward the center of the piston) to wipe any excess oil back into the oil sump (reservoir) through the oil return holes.

A spherical cavity is located in the inside center on each side of the piston to receive the hardened steel piston drive balls.

SHOE DISCS

Shoe discs are made of bronze and one side is a flat surface which contacts the surface of the swash plate. The opposite side has a coined concave surface into which is assembled the piston drive ball.

These shoes are provided in .0005" thickness variations and eleven sizes are available for servicing these parts. Included in these eleven is a basic ZERO shoe to permit simple gauging operations.

All service shoes will be marked with the shoe size, which will also correspond to the last three digits of the piece part number.

SWASH PLATE

An angular shaped member (swash plate) is located near the center of the compressor. The swash plate changes the rotating action of the shaft to provide a reciprocating driving force to each of the three pistons. This driving force is applied, through the shoes and balls, to the midpoint of each of the double end pistons. The swash plate has two angular faces ground smooth and parallel to permit smooth sliding of the shoe discs.

The plate is a .0005" - .0010" press fit into the 3/4" diameter shaft and is positioned by a woodruff key located in the shaft.

SUCTION CROSS-OVER AND COVER

Since the pistons are double-acting, low pressure vapor from the cooling coil must be supplied to both ends of the compressor and pistons.

The inlet (suction) port on the rear head of the compressor is connected by a hose to the outlet side of the evaporator (cooling coil). A fine mesh suction screen is located in the low pressure inlet cavity of the rear head. Its purpose is to trap any material (larger than the mesh size) that would damage the compressor mechanism.

A flat rectangular cavity is cast into the outer face of the front and rear cylinder block halves. The edges of this cavity are machined into a dovetail shape to retain a rectangular suction crossover cover. This cover and gasket form a passage for the low pressure vapor to flow from the rear head of the compressor to the front head and thus apply suction refrigerant to the pistons and cylinders at the front of the compressor.

The sides of the cover seal it to the suction crossover cavity and the narrow ends of the cover form a seal with the underside of the suction and discharge valves when they are assembled to the cylinder heads.

DISCHARGE CROSS-OVER TUBE- PRODUCTION TYPE

The double-acting pistons also produce high pressure vapor at both ends of the compressor. The outlet (discharge) port for the high pressure vapor is located in the rear head of the compressor.

A discharge vapor tube is used to connect the front head discharge cavity to the rear head discharge cavity. This tube has cylindrical ends that are spun into holes in the front and rear cylinder head halves to provide a vapor tight joint. The center of this tube has a flattened cross-section to provide clearance between the swash plate and tube.

When the pistons in the front end of the cylinder are on their compression stroke, the high pressure vapor is caused to flow into the discharge cavity in the front head, through the discharge tube and into the rear head discharge cavity. This vapor combines with the high pressure vapor produced by the pistons in the rear cylinder head during their compression stroke and flows out the compressor discharge port.

DISCHARGE CROSS-OVER TUBE- SERVICE TYPE

The purpose, function, and design of the service discharge tube are the same as those for the production-type tube with the exception of shouldered sleeves located in both ends of the service tube. These shoulders provide a surface for the O-rings and compression bushings. Since the production discharge tube is vapor sealed to the front and rear cylinder heads by spinning in the ends of the tube, equipment to perform this spin in operation during service operations would not be economical. Therefore, it if should be necessary to separate the cylinder halves during a service operation, a service-type discharge tube should be used when reassembling the mechanism.

PRESSURE RELIEF VALVE

The compressor is fitted with a high pressure relief valve. If the discharge pressure ever exceeds approximately 440 psi, the relief valve opens automatically to relieve the pressure and closes again when the pressure recedes.

Opening of the relief valve will be accompanied by a loud popping noise and perhaps the ejection of some oil with the refrigerant. Any condition that causes this valve to open should be corrected immediately.

OIL TEST OUTLET

An oil test outlet is located on the underside of the compressor shell. This outlet is a screw having a hole drilled lengthwise through its center to the head which indexes with a hole drilled crosswise just above the head. This allows oil to enter the drilled holes and be emitted when the screw is loosened.

The proper method of checking oil level is outlined under CHECKING COMPRESSOR OIL LEVEL AND ADDING OIL.

SHELL

The shell of the compressor has a mounting flange on the front end and four threaded screws welded to the outside at the rear. An oil sump is formed into the bottom of the shell, with a baffle plate over the sump on the inside of the shell. There is an oil charging screw and gasket (which also serves as an oil test outlet) in the wall of the shell.

The compressor serial number is located on a plate on top of the compressor. This number should be included in all reports, claims or correspondence concerning the compressor. The compressor part number is also shown on the serial number plate.

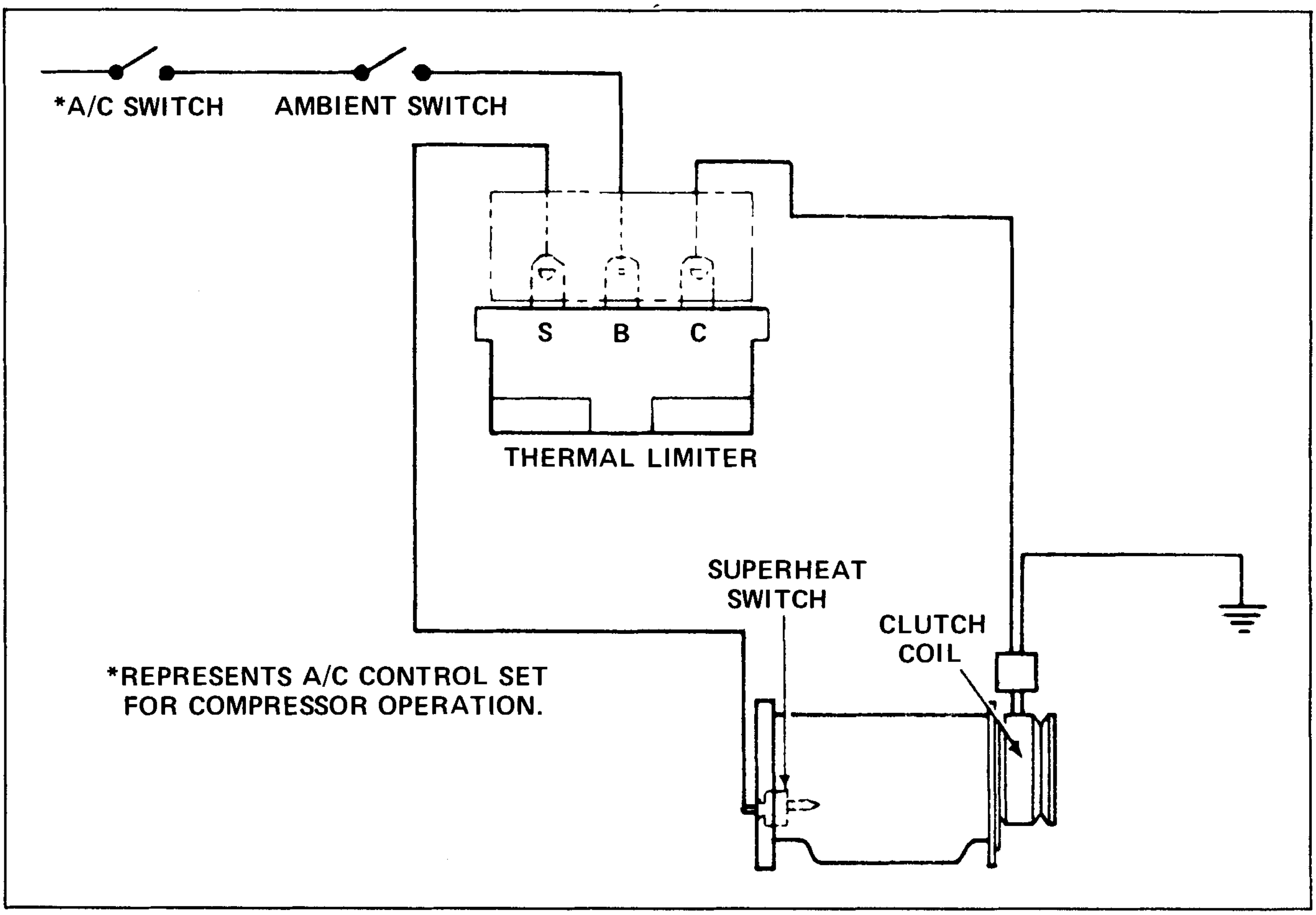


Fig. 1A-27 Low Refrigerant Charge Protection System

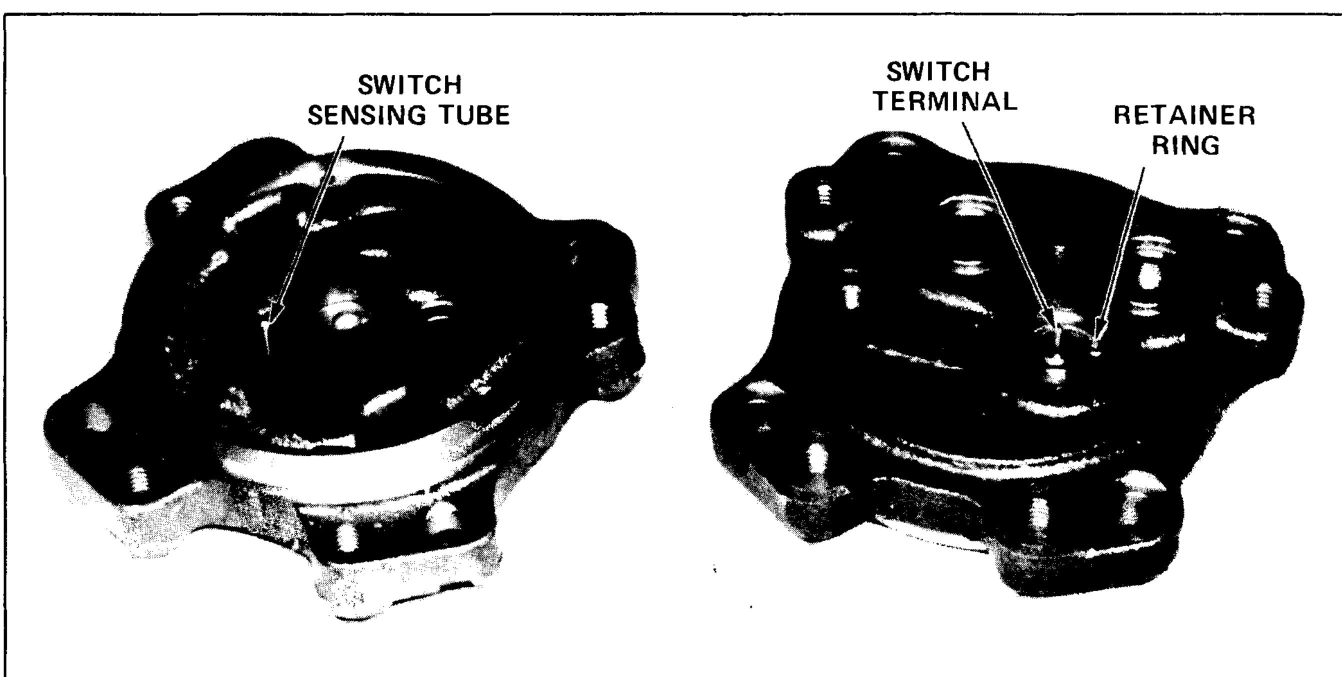


Fig. 1A-28 Superheat Shut-Off Switch in Rear Head

LOW REFRIGERANT CHARGE PROTECTION

A low refrigerant charge protection system (Fig. 1A-27) is incorporated in all compressor clutch coil electrical circuits. This circuit prevents damage to the compressor assembly as the result of refrigerant loss.

The protection system consists of:

1. The superheat shut-off switch located in the compressor rear head.
2. The thermal limiter assembly located under the compressor front brace on eight cylinder engine models or strapped to the A/C engine wire harness on A Series models with six cylinder engine.
3. A wire assembly which connects the protection system in series with the compressor clutch coil circuit.

SUPERHEAT SHUT-OFF SWITCH

The superheat shut-off switch in the compressor rear head (Fig. 1A-28) senses low refrigerant charge conditions in the compressor to activate the protection system.

A cross sectional view of the superheat shut-off switch construction is shown in Fig. 1A-29. The switch consists of a diaphragm, sensing tube and base assembly which threads into the switch housing and terminal assembly. The switch terminal pin is hermetically sealed with a glass-to-metal seal in the switch housing. The diaphragm and sensing tube mounting base contains four holes for passage of refrigerant vapor in and around the diaphragm permitting the operating suction pressures to affect external diaphragm assembly pressure. The diaphragm and sensing tube assembly is charged with R-114 refrigerant and the sensing tube protrudes into the suction cavity of the rear compressor head to sense suction gas temperatures. The internal pressure of the diaphragm and sensing tube assembly is affected thermally by the suction gas temperature and the diaphragm is affected externally by the suction pressure.

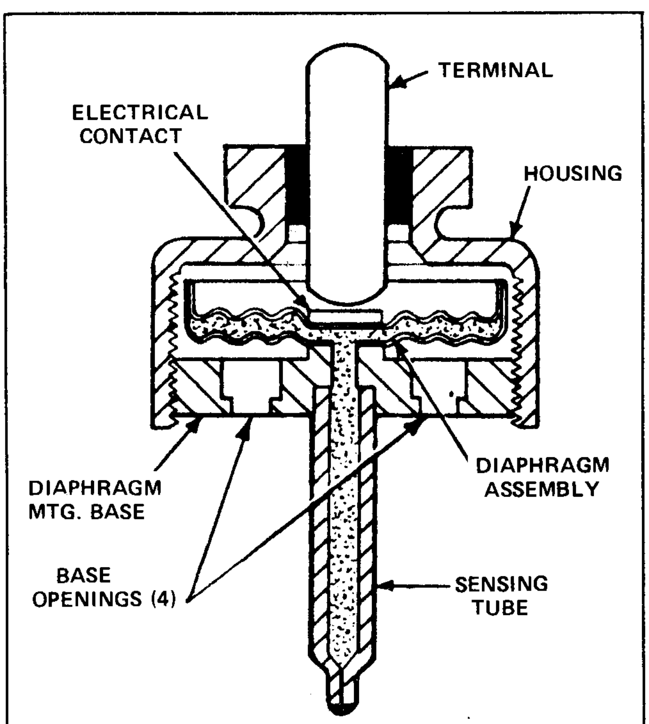


Fig. 1A-29 Cross Section - Superheat Shut-Off Switch

The electrical contact welded to the diaphragm will only contact the terminal pin during a low pressure-high temperature condition. High pressure-high temperature or low pressure-low temperature conditions will not cause the contacts to close. Fig. 1A-30 shows the temperature-pressure curve of the superheat shut-off switch. The contacts may be either "open" or "closed" in the tolerance zone depending on the characteristics of the switch and accuracy of pressure and temperature readings taken.

The superheat switch is mounted and sealed in the rear head by means of an O-ring between the switch housing and the cavity wall of the rear head. A special formed retaining ring holds the switch in place and electrically grounds the switch housing to the compressor. The switch retaining ring must be installed with the high point of the curved sides adjacent to the switch housing. The flat side of the retainer ring provides a positive seat in the retaining ring groove and the tips of the ring give a more positive electrical continuity.

THERMAL LIMITER ASSEMBLY

The thermal limiter assembly (Fig. 1A-31) consists of a temperature sensitive fuse link between terminals B and C

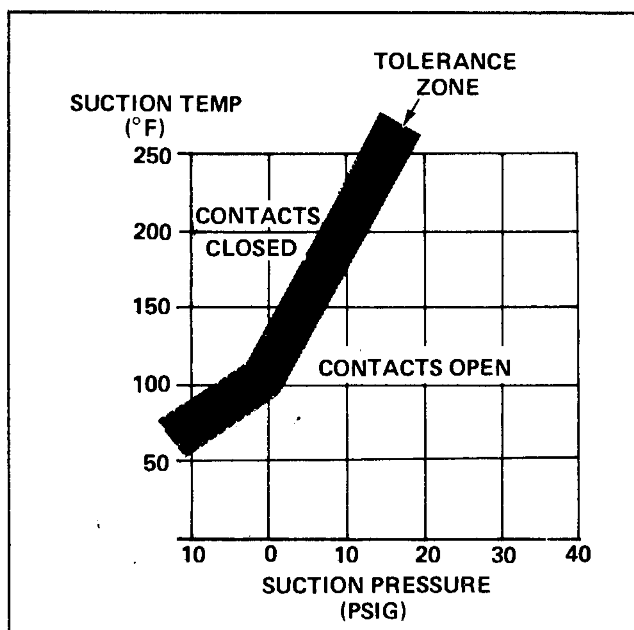


Fig. 1A-30 Operating Characteristics - Superheat Shut-Off Switch

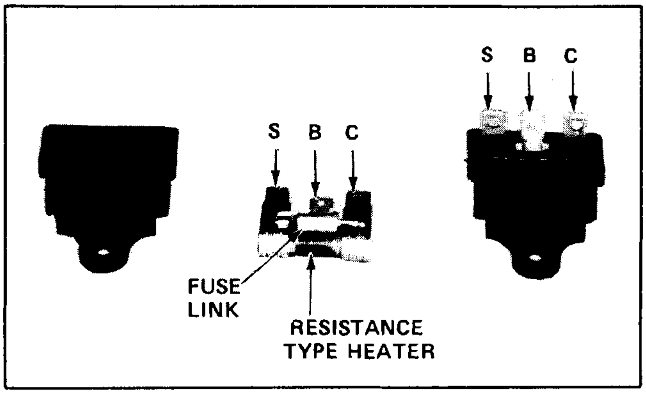


Fig. 1A-31 Thermal Limiter Assembly

and a resistance type heater between terminals C and S. Between terminals B and S are the fuse link and heater in series. The heater portion of the limiter provides a time delay by gradually heating up until the specific melt temperature of the fuse link is achieved and the fuse link opens (blows). The thermal limiter must be replaced once the fuse link is blown.

Since the thermal limiter fuse link is temperature sensitive, location of the limiter assembly is critical. Excessive exterior heat may cause the fuse link to blow without a loss of refrigerant. If the limiter is located in a cold area, the fuse link may not receive enough heat from the heater to cause the link to open when refrigerant charge is lost.

SYSTEM OPERATION

Compressor operation, with or without the low refrigerant charge protector, is achieved by applying 12 volts to the compressor clutch coil to activate the compressor clutch. This 12 volt source is supplied through a switch in the control panel and through the ambient temperature switch. With the low refrigerant charge protection system in the compressor clutch coil circuit, the 12 volt source is applied to terminal B of the thermal limiter rather than directly to the clutch coil connector. From terminal B to ground there are two possible circuits.

Under normal operating conditions, the superheat shut-off switch contacts are open and the only complete circuit is through the fuse link in the thermal limiter to terminal C and on through the clutch coil to ground.

If refrigerant loss occurs, the superheat shut-off switch contacts close as a result of the superheat switch sensing decreased pressure and increased temperature of suction gas in the compressor. When the switch contacts close, the terminal on the superheat switch is grounded and a circuit is completed from terminal B of the limiter through the fuse link and heater in the limiter, to terminal S and through the superheat shut-off switch to ground. When this circuit is completed, the heater in the thermal limiter starts to get warm and increases in temperature until the fuse link is heated to its specific melt temperature and opens the circuit to the compressor clutch coil and the circuit to the superheat shut-off switch. This stops compressor operation and prevents damage to the compressor assembly.

When the cause of refrigerant loss is detected and corrected and the system is recharged, the thermal limiter must be replaced with a new part to restore compressor operation with low refrigerant charge protection.

CLUTCH AND PULLEY ASSEMBLY

The pulley assembly contains an electrically controlled magnetic clutch. The compressor clutch (Fig. 1A-32) and the compressor are off when the system selector lever on the control panel is in the OFF position. On B Series the clutch and compressor are also off in the VENT and HEATER positions. In the other positions of the system selector lever the clutch will be engaged or disengaged depending upon ambient temperature and the position of the Vent-Normal switch (except B Series) on the control panel. At approximately 32 °F. ambient temperature, the ambient switch located in the air inlet assembly will close to complete the circuit to the compressor clutch. Below 32°F. the ambient switch is open and the compressor cannot operate. Above 32°F. (ambient switch closed), compressor operation is controlled by the Vent-Normal switch (except B Series). With a given control panel setting of the system selector, placing the Vent-Normal switch to VENT will turn the compressor off. As the system selector lever is moved from one position to another, the Vent-Normal switch will automatically return to the NORM (normal) position and the compressor will be running. If refrigeration is not desired, the switch must be returned to the VENT position every time the system selector lever is moved.

The armature plate is the movable member of the clutch. The plate is attached to a driven ring by driver springs, which are riveted to the armature plate and the driven ring. The driven ring is attached to the clutch hub by a rubber disc, which is bonded to both the driven ring and the clutch hub. The clutch hub is pressed onto the compressor shaft and is aligned with a square drive key located in the keyway of the compressor shaft. This hub and drive plate assembly is retained by a spacer and retainer ring (assembled to the shaft) and is held in place with a hexagonal lock nut.

The rubber disc isolates the compressor shaft from the drive pulley to prevent vibrations from being transmitted either into or out of the compressor shaft.

The pulley hub and ring assembly consists of three parts:

1. Pully rim, which contains the belt groove.
2. Power element ring.
3. Pulley hub.

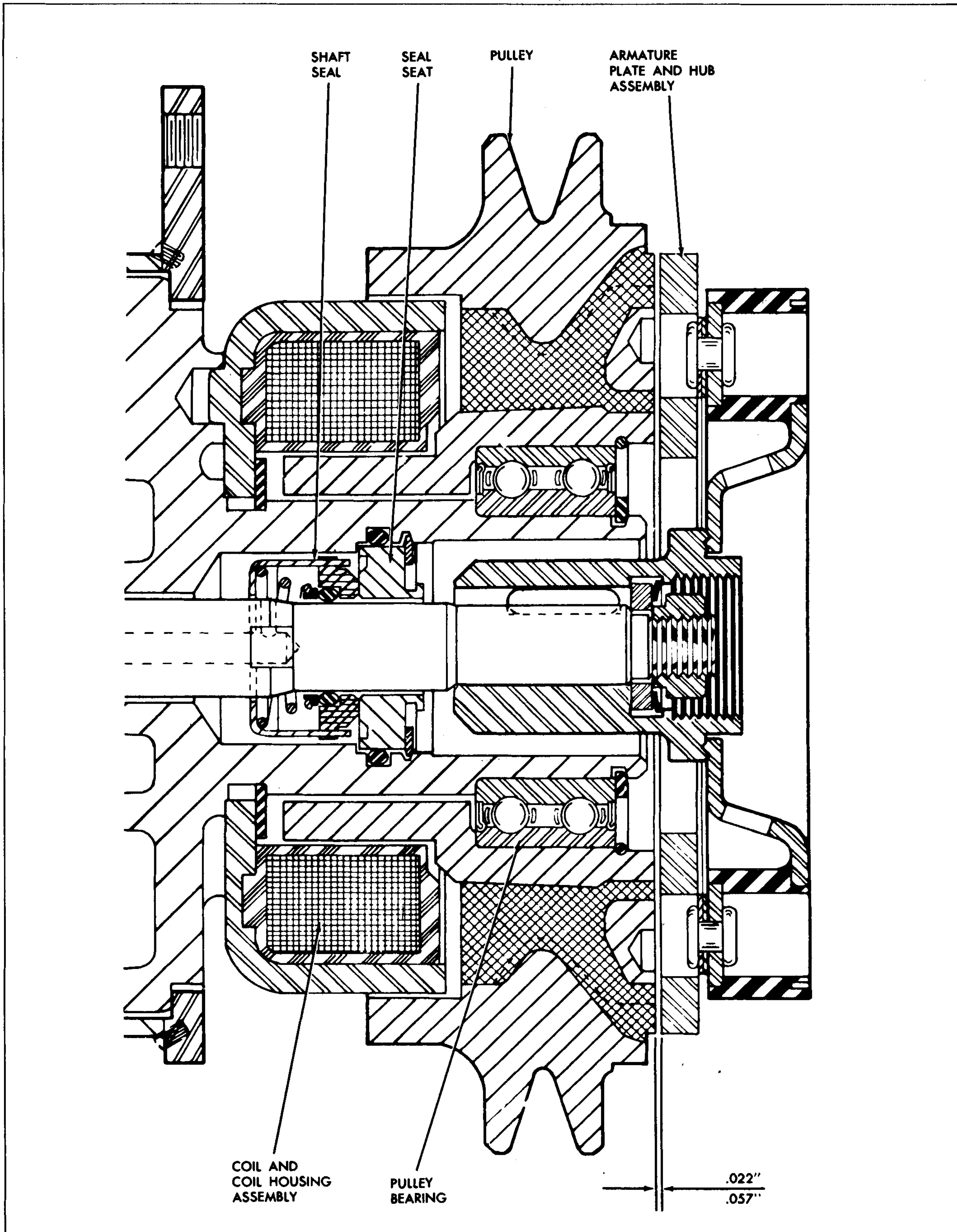


Fig. 1A-32 Cross Section-Clutch Assembly

These parts are formed into an assembly by molding a frictional material between the hub and the rim. The power element ring is embedded in the forward face of the assembly, between the outer rim and the inner hub.

A two-row ball bearing is pressed into the hub of the pulley and held in place by a retainer ring. This pulley and bearing assembly is pressed over the front head of the compressor and held in place by a retainer ring.

CLUTCH COIL

The clutch actuating coil is molded into the coil housing with a potted epoxy resin; therefore, the coil and housing are replaceable only as a complete assembly. The coil has 3.85 ohms resistance at 80°F. (surrounding temperature) and should not demand more than 3.2 amperes at 12 volts D.C.

Three protrusions on the rear face of the coil housing fit into alignment holes in the front head of the compressor. When the coil and housing assembly is aligned and engaged with the front head (and indexed with the protrusions), it is secured in place by a retainer ring.

COMPRESSOR SHAFT SEAL

A replaceable seal is used at the front of the compressor to seal the air conditioning system from atmosphere when the compressor is operating or at rest, regardless of pressures in the compressor.

Components of the seal located in the neck of the front head of the compressor (Fig. 1A-33) are the retaining ring, the small O-ring, the compressor spring-loaded shaft seal,

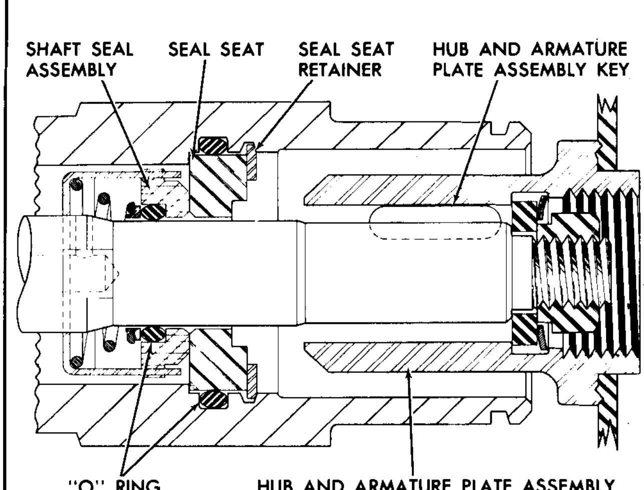


Fig. 1A-33 Cross Section-Compressor Shaft Seal Area

the ceramic seal seat and the large O-ring. The seal indexes with two flats machined on the compressor shaft and turns with the compressor shaft.

A spring in the shaft seal assembly holds the seal against the seal seat, which is held stationary in the neck of the compressor front head by a retainer ring. The tapered side of the retained ring should be assembled toward the front of the compressor. Because of the constant pressures inside the compressor, the seal surfaces must be protected against any damage, such as scratches and nicks (even finger markings may cause surface damage) to prevent oil and/or refrigerant leaks past this seal.

The small O-ring seals between the shaft and the seal, and the large O-ring seals between the seal seat and the compressor front head.

Service shaft seal parts are supplied in a complete kit containing all necessary replacement parts.

COMPRESSOR OPERATION

Current flowing through the coil creates a magnetic force which flows through the pulley to draw the armature plate (forward of the pulley assembly) rearward toward the pulley. As the armature plate moves toward the pulley, it contacts the pulley shaft face (which rotates freely about the compressor shaft).

The design of the clutch and coil is such that maximum magnetic holding force is obtained to magnetically lock the armature plate and pulley together as one unit. Since the clutch hub is pressed on and keyed to the compressor shaft, the compressor shaft will then turn with the pulley.

When ambient temperature is below 32°F. or the control panel system selector lever is set at OFF (also VENT or HEATER on B Series) or the Vent-Normal switch (except B Series) is turned to VENT, the electrical circuit to the compressor clutch is opened and the magnetic pull on the clutch no longer exists. The armature plate to driven ring actuating springs will then pull the armature plate away from the pulley and the plate loses contact with the pulley. With the clutch released, the pulley rotates freely on its bearing. In this condition, the compressor shaft does not rotate.

It may be noted that if the air conditioning system was in use when the engine was turned off, the armature plate may remain in contact with the pulley, due to residual magnetism. This will cause no trouble, as the armature plate and pulley will separate as soon as the engine is started.

COMPRESSOR FITTINGS ASSEMBLY

The muffler and compressor fittings assembly (Fig. 1A-34) contains an open passage into the compressor from the evaporator (low pressure) and an open passage from the compressor to the condenser.

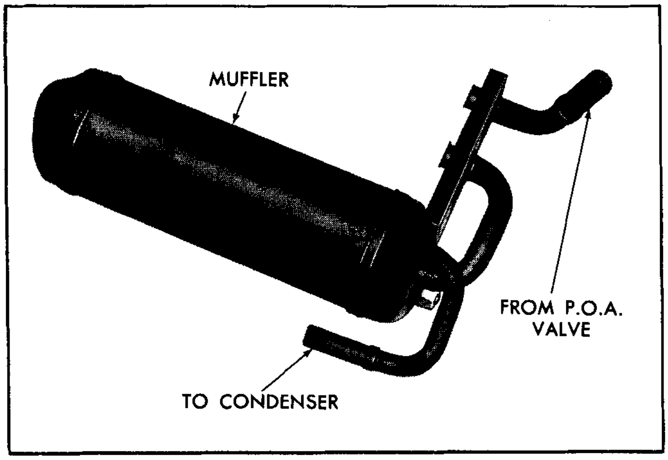


Fig. 1A-34 Typical Muffler and Compressor Fitting

A gauge fitting containing a check valve is in the discharge passage to permit pressure gauge readings.

On F Series models the muffler and the compressor fitting assembly are separate components with the muffler located on the fender skirt. on X Series models a muffler is unnecessary due to system design and only a fitting assembly is used.

CONDENSER

The condenser is similar to the ordinary car radiator but is designed to withstand much higher pressures. It is made up of tubes which carry the refrigerant and cooling fins which provide rapid transfer of heat. The condenser is made completely of aluminum.

The condenser is located in front of the engine cooling system radiator so that it receives a high volume of air from the movement of the car and from the engine fan. Air passing over the condenser cools the hot, high pressure refrigerant gas causing it to condense into high pressure liquid refrigerant.

RECEIVER DEHYDRATOR

The receiver-dehydrator (Fig. 1A-35) is mounted in the area of the right side of the radiator support.

The purpose of the receiver part of this assembly is to insure a solid column of liquid refrigerant to the expansion valve at all times, when the system is properly charged.

The liquid indicator (many times referred to as a sight glass) is in the refrigeration system as an aid to diagnosis. The appearance of bubbles or foam beneath the sight glass (liquid indicator) above 70°F. ambient indicates air or a partial discharge of refrigerant in the system. A solid liquid column as seen in the sight glass is difficult to tell from one that has no refrigerant in the system at all. Two ways to determine whether the system is properly charged or empty are to feel the suction pipe in the P.O.A. valve or to disconnect the compressor clutch while observing the sight glass. If the system has the proper refrigerant charge, the suction line at the P.O.A. valve will be cool. Also the refrigerant column in the sight glass will be seen to collapse soon after the clutch has been disconnected. Foam may be noted in the sight glass below 70°F. even when the system is free of air and properly charged. Details of this condition are in the DIAGNOSIS section.

Liquid refrigerant from the condenser flows into the upper portion of the receiver which contains a bag of desiccant (moisture absorbing material). As the refrigerant flows through an opening in the lower portion of the receiver, it is also filtered through a mesh screen attached to a baffle at the bottom of the receiver.

The desiccant in this assembly is to absorb any moisture that might be present in the system after assembly. The function of the screen is to trap any foreign material which may enter the system during assembly. These features of the assembly prevent obstruction to the valves or damage to the compressor.

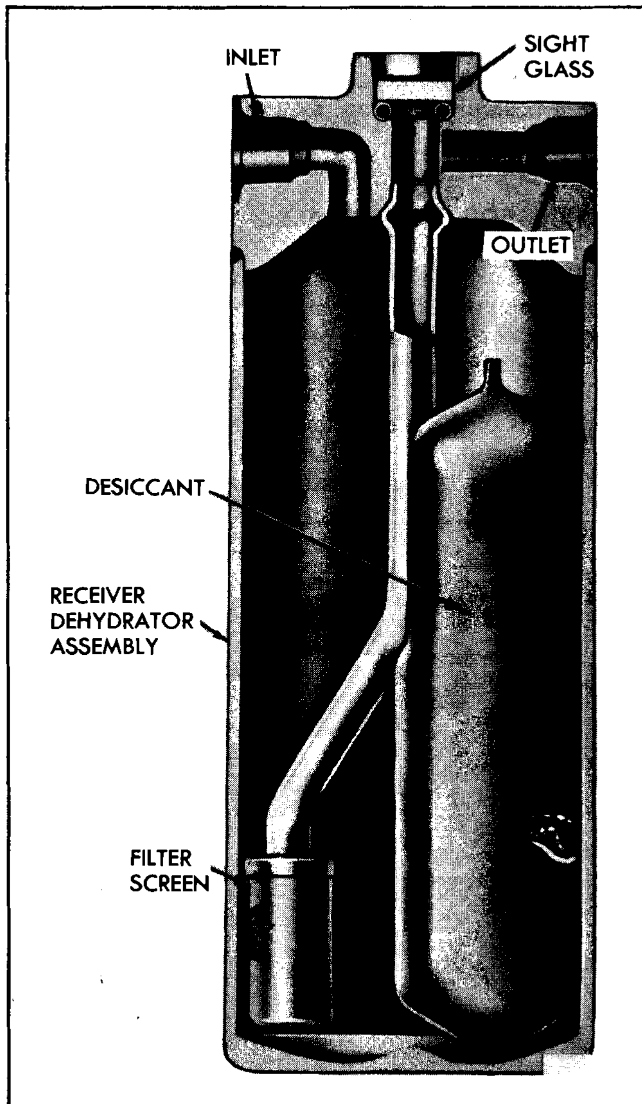


Fig. 1A-35 Receiver Dehydrator Assembly - Inside View

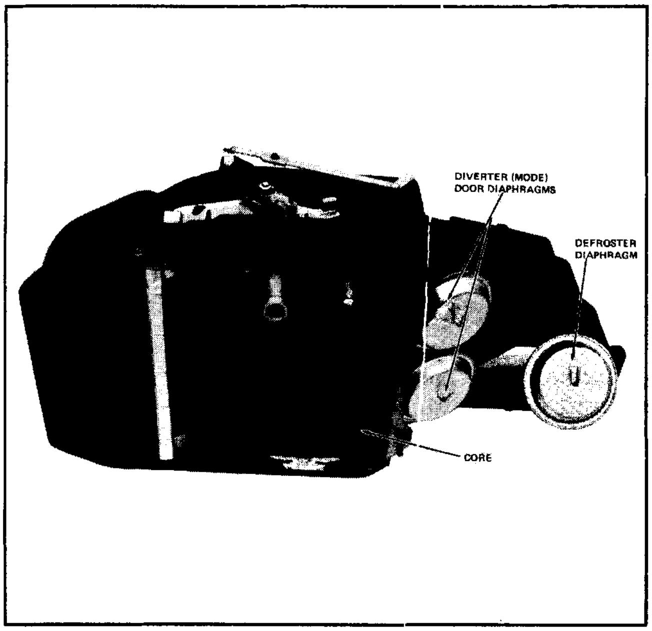


Fig. 1A-36 B Series A/C Heater Core and Case Assembly

HEATER COMPONENTS

HEATER CORE AND CASE

The heater core consists of coolant tubes and air fins between the tubes. Because of the core design, coolant travels a relatively short distance, therefore, maintaining a nearly equal pressure at the inlet and outlet. This controlled pressure maintains a higher coolant boiling point (cooling system pressure will not allow coolant to boil below approximately 250°F.).

Air passing between the core fins is warmed by the coolant tubes carrying hot coolant. This warm air is then directed into the passenger compartment by the blower and ducts.

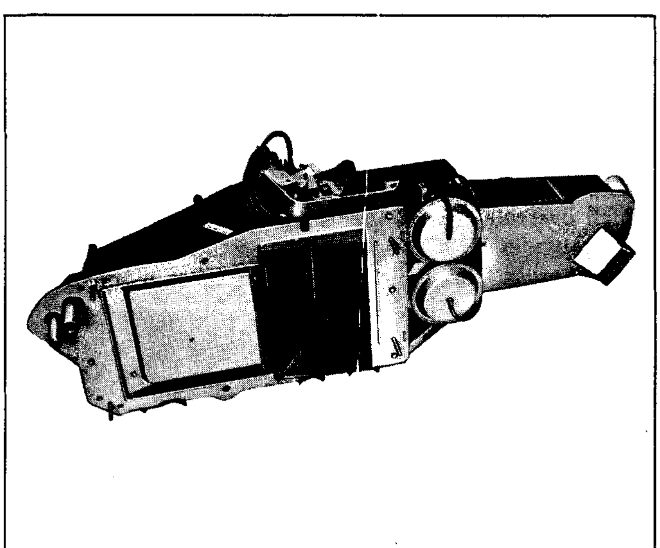


Fig. 1A-37 Typical A/C Heater Core and Case Assembly - Except B Series

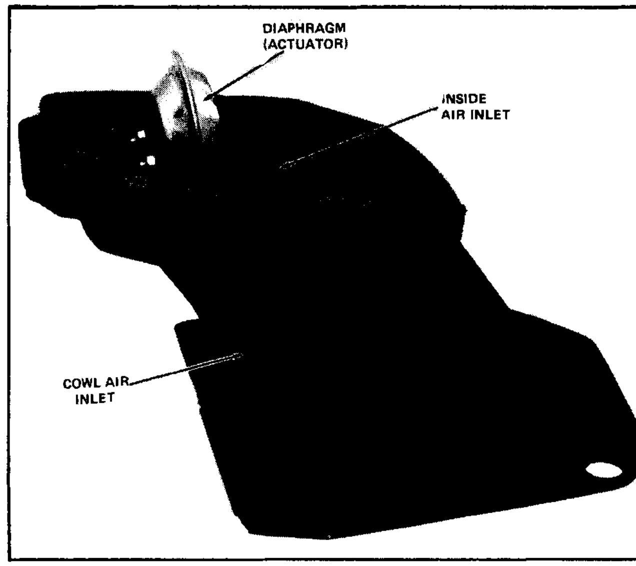


Fig. 1A-38 B Series Air Inlet Assembly

A B Series A/C heater core and case assembly is shown in Fig. 1A-36. A typical A/C heater core and case assembly other than B Series is shown in Fig. 1A-37.

WATER CONTROL VALVE - B SERIES

The water valve controls the flow of coolant to the heater core. The valve is open at all settings of the custom air conditioner except when the control panel is in A/C and

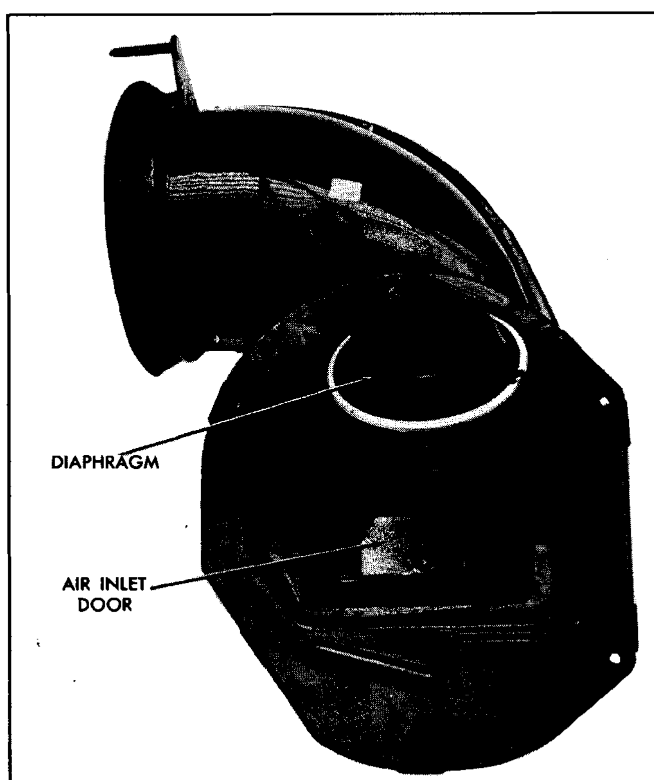


Fig. 1A-39 A and G Series Typical Air Inlet Assembly the temperature is set for full cold. Vacuum applied to the diaphragm in the water control valve causes the valve to close, thus preventing hot water from flowing through the heater core. This allows maximum cold air to be available in the passenger compartment when desired.

AIR INLET

Air flow and vacuum components for all series are essentially the same although control of each system varies slightly. Air enters the system through the plenum chamber from the rear edge of the hood. It then passes through an air inlet assembly located in the plenum on B Series (Fig. 1A-38) and in the right hand kick pad area on A and G Series (Fig. 1A-39). Next air passes through the evaporator and the heater case. From here the air is directed to either the defroster, cold air or heater ducts in varying amounts, depending upon control panel settings.

CONTROL PANEL

B SERIES

The B Series A/C control panel (Fig. 1A-40) consists of:

SYSTEM SELECTOR LEVER:

The system selector lever (air control lever) determines the mode of operation: OFF, A/C, VENT, HEATER, BILEVEL or DEFROST. When the system selector lever is placed in the A/C, BILEVEL or DEFROST position electrical circuit connection is made to the compressor clutch through the control panel switch, the ambient switch, and the thermal limiter assembly. If the ambient switch is closed (ambient temperature above 32°F.), the compressor will run. In the OFF, VENT or HEATER position the compressor is not energized.

The system selector lever also determines the direction of outlet air flow. Moving the lever from position to position varies the position of a rotary vacuum valve on the control. The position of the vacuum valve will supply vacuum

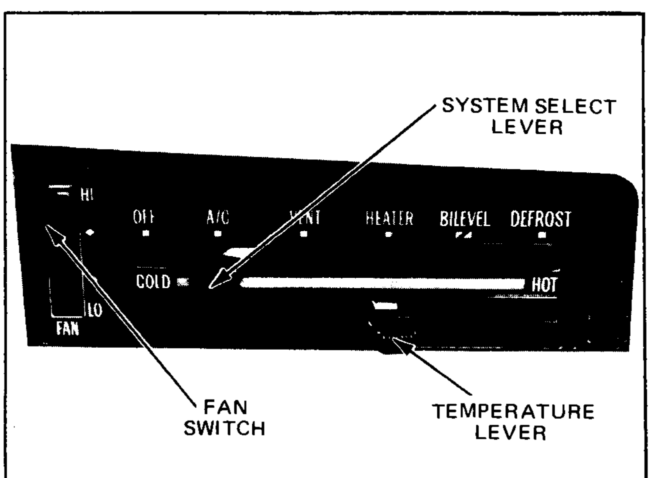


Fig. 1A-40 A/C Control Panel - B Series

to, or vent, vacuum diaphragms which position the upper and lower mode and defroster air doors in the A/C heater case. The position of these air doors determines if output air flow is from the heater outlet only (OFF), the heater outlet with slight air flow from defroster nozzles (HEATER), heater and A/C outlets (VENT), A/C outlet only (A/C), heater, A/C and defroster outlets (BILEVEL), or the defroster nozzles with slight air flow from the heater outlet (DEFROST).

TEMPERATURE LEVER:

The temperature lever determines the temperature of outlet air flow from the A/C system by positioning the temperature door in the heater case through the motion of a bowden cable linking the control panel lever to the temperature door. In addition, the temperature lever is connected to a second vacuum valve on the control panel.

This valve provides vacuum to the water control valve in the heater water inlet hose when cold air is desired and the water control valve stops the flow of hot water to the heater core. The vacuum valve also supplies vacuum to the air inlet diaphragm through the system selector lever rotary vacuum valve when system is in A/C and the temperature lever is at full COLD. This positions the air inlet door to reduce the supply of outside air to the system from 100% to approximately 20%. The remainder of the air input (80%) to the A/C system is then taken from the interior of the passenger compartment. This recirculation of interior air (recirc. operation) provides a source of fast cool down of interior temperatures. When the control panel is set at A/C mode and full COLD position, internal wiring in the control panel automatically provides high blower operation.

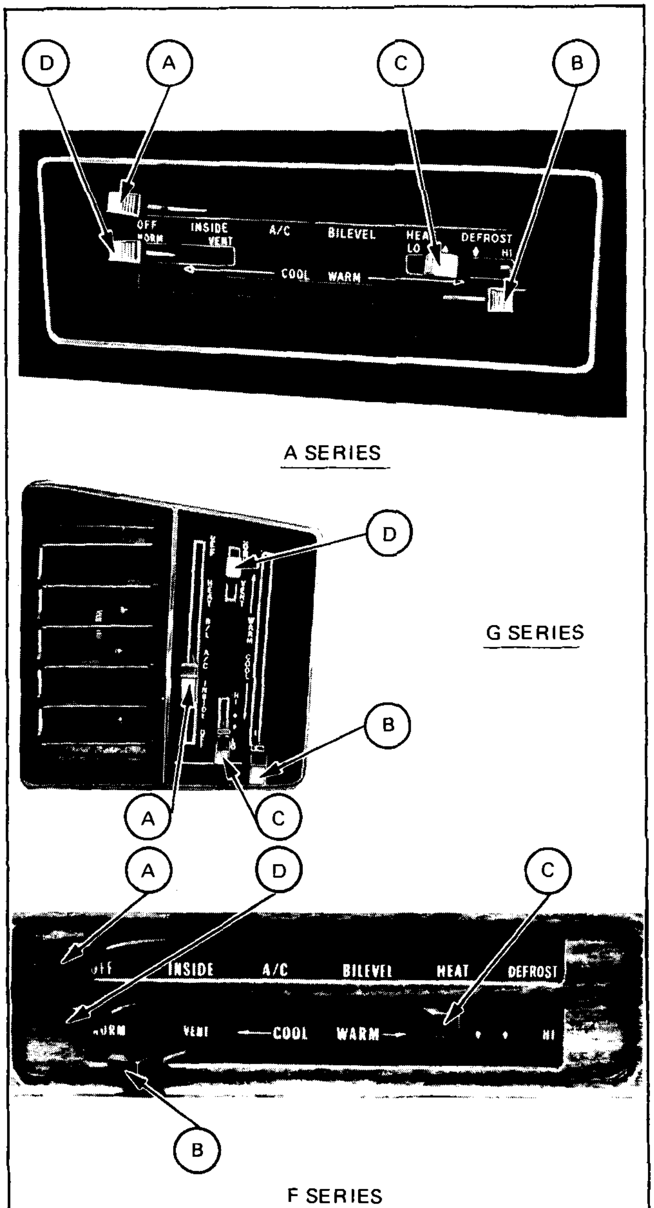
FAN SWITCH

The FAN (blower) switch provides a means of selecting the amount of air flow from the A/C system by regulating the speed of the blower motor. There are, however, limitations to the control of blower speed. To provide constant ventilation (as described in Section 1 of this manual), the blower motor electrical circuitry prevents the blower motor from being shut off when the ignition switch is in the RUN position. Therefore, the blower speeds available are HI, LO and two medium speeds.

The control panel also has a "recirc. override" switch which overrides the blower speed switch and automatically provides HI blower speed when the system selector lever is in A/C and the temperature lever is set to full COLD.

A, G AND F SERIES

Air conditioning control panels for the A, G and F Series (Fig. 1A-41) are slide-lever operated. A Series and F Series levers move in a horizontal plane while G Series levers move in a vertical plane. All three control panels operate in the same manner to control the mode of operation, temperature, blower motor speed and compressor operation.



A–SYSTEM SELECTOR LEVER
B–TEMPERATURE LEVER
C–FAN SWITCH
D–COMPRESSOR CLUTCH
(VENT-NORM) SWITCH

Fig. 1A-41 A/C Control Panels - A, G and F Series

AIR CONTROL LEVER

The system selector lever (air control lever) determines the mode of operation desired of the system:

OFF-In the OFF position, the entire system is turned off. The blower motor will operate on F Series to achieve evaporator core purging.

INSIDE-Passenger compartment air is recirculated, blended with a small amount of outside air and then conditioned before returning to the air outlets.

A/C-In the air conditioning (A/C) position, fresh outside air is conditioned and directed out the five (5) upper air outlets.

BILEVEL-The BILEVEL position provides fresh conditioned outside air through the five upper air outlets mentioned above, as well as the lower heater outlet. Air from the upper outlets is slightly cooler than air from the lower outlets. This provides excellent ventilation on cool sunny days.

HEAT-In the HEAT position, fresh outside air is conditioned and directed out the lower heater duct. A small amount of air is also directed to the windshield. This provides clear vision under normal operating conditions.

DEFROST-The DEFROST position directs maximum air flow to the windshield. This quickly clears the windshield of fog or frost.

WARNING: Operate the A or G Series system in heater or air conditioning mode for 30 seconds before switching to DEFROST. This will remove humid air from the system and reduce possible rapid formation of fog or frost on the inside of the windshield during initial operation under certain atmospheric conditions. In addition, clear any snow or ice from cowl air vents (at outside base of windshield).

TEMPERATURE CONTROL LEVER

The temperature control lever regulates the temperature of air entering the passenger compartment. The lever may be set at full COOL, full WARM, or any point between the two.

FAN SWITCH

The fan speed lever (blower speed switch) controls the speed of the blower motor in delivering air to the passenger compartment. The blower speed switch provides low and high speeds of the blower motor plus two intermediate speeds.

NORM-VENT LEVER

The Vent-Normal switch serves as an ON-OFF switch for the compressor. If conditioned air is desired, the NORM position should be used. Whenever the system is changed from one mode to another, the Vent-Normal switch will automatically be in the normal position. Moving the lever to the VENT position will eliminate conditioning of the air, turn the compressor off and supply outside air directly to the passenger compartment.

X SERIES

The X Series control panel (Fig. 1A-42) is slide-lever designed and controls the A/C system by means of three levers and a fan (blower speed) switch.

TEMPERATURE LEVER

The temperature lever (left hand lever when facing control panel) is the main system control lever. When this lever is in the OFF position, the entire A/C system is inoperative. Moving the lever down from the OFF position will automatically provide blower motor operation.

When the temperature lever is placed in VENT, outside air is distributed from the system outlets. This fresh, outside air is not conditioned since the compressor is not operational in the VENT position.

When the lever is moved to the MAX. COLD position, the compressor is allowed to operate. However, the compressor will not operate if the ambient temperature is below approximately 40°F. or if the air control lever is in the HEATER position. The MAX. COLD setting provides recirculation operation by opening the kick panel air door.

Moving the temperature lever to NORM. COLD (normal air conditioning) causes the kick panel air door to close.

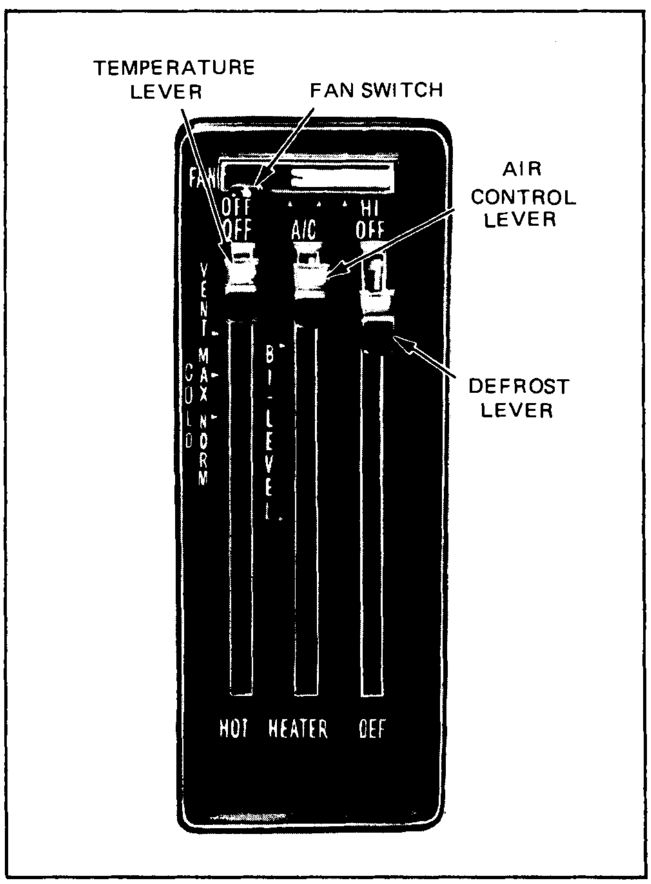


Fig. 1A-42 A/C Control Panel - X Series

This provides fresh outside air to the A/C system. The remainder of the system operates in the same manner as described under MAX. COLD.

The position of the temperature lever as it is moved from NORM. COLD to HOT determines the temperature of the air output from the A/C system.

AIR CONTROL LEVER

The center lever on the control panel determines the air distribution from the A/C system. In the "A/C" position all air flow is from the instrument panel air outlets. In BI-LEVEL the air distribution is divided between the instrument panel outlets and the floor outlets with the temperature of the air from the floor outlets slightly warmer than the air from the upper air outlets. When the lever is set to HEATER, all air is distributed from the floor outlets and/or the defroster outlets at the base of the windshield. In the HEATER position, the compressor is automatically shut down.

DEFROST LEVER

The defroster lever is used to provide windshield defrosting or defogging. When the lever is in the OFF position, most of the air directed to the heater (floor) outlets is distributed to the floor with a slight amount of air distributed to the windshield. As the lever is moved toward DEFROST, the amount of air distributed to the windshield increases until the lever reaches DEFROST. When the lever is in DEFROST, all air from the heater outlet portion of the heater case is directed to the windshield. Since the defrost lever controls only that air which is directed toward the heater (floor) outlets, the air control lever should be placed in the HEATER position for maximum defrosting of the windshield (in the HEATER position of the air control lever, all air flow is directed toward the heater outlets).

FAN SWITCH

The Fan Switch controls the speed of the fan (blower motor). When the temperature lever is in OFF, the blower motor does not operate. In any other mode of operation the blower motor is operational and blower speed is determined by the position of the fan switch. There are four fan speeds available.

CONTROL OPERATION

For maximum heat the control panel temperature lever should be set to HOT, the air control lever to HEATER, the defrost lever to OFF and the fan switch to HI.

Maximum cooling is attained by setting the temperature lever at MAX. COLD, the air control lever at A/C, and the fan switch at HI.

For removing frost or fog from the windshield, set all three levers to the full down position (HOT, HEATER and DEFROST positions) and set the fan switch at HI.

AIR DISTRIBUTION

Air distribution in the air conditioning system is similiar to that in the heater system when the controls are set to the HEATER mode or the DEFROST mode. In the air conditioning system, however, there are upper air outlets provided and cooled air can be obtained. When the air conditioning (A/C) mode is selected, air flows exclusively from the upper outlets. When BILEVEL is selected, the air flow will be from both the upper outlets and the heater outlet.

Air distribution is common to both positions of the "NORM-VENT" (A, G and F Series) switch. For typical air distribution details, see Figs. 1A-43 thru 1A-45.

FUNCTIONAL TEST

To determine if the air conditioning system is performing as it should, the following functional test should be used to evaluate system operation:

B SERIES

This test must be performed on complete car with engine running, coolant warm and environment above 45°F.

1. Move selector lever to OFF, set fan switch at HI (full up) and move temperature lever to full HOT (all the way to the right).

   A. The blower will run on Lo speed with air flow out the heater outlet only.

   B. The compressor is not running.

2. Move selector lever to DEFROST. (Each lever position has a detent to lock the lever in place.)

   A. Blower comes on high speed.

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

   C. Compressor is running.

3. Move selector lever to BILEVEL.

   A. Hot air comes from heater outlet and A/C outlet with a slight bleed of air from defroster nozzles.

   B. The compressor continues to run.

4. Move selector lever to HEATER.

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

   B. Compressor is not running.

5. Move selector lever to VENT.

   A. Hot air comes from heater outlet and A/C outlets. Air may come from defroster nozzle for first 20 to 30 seconds and then stop.

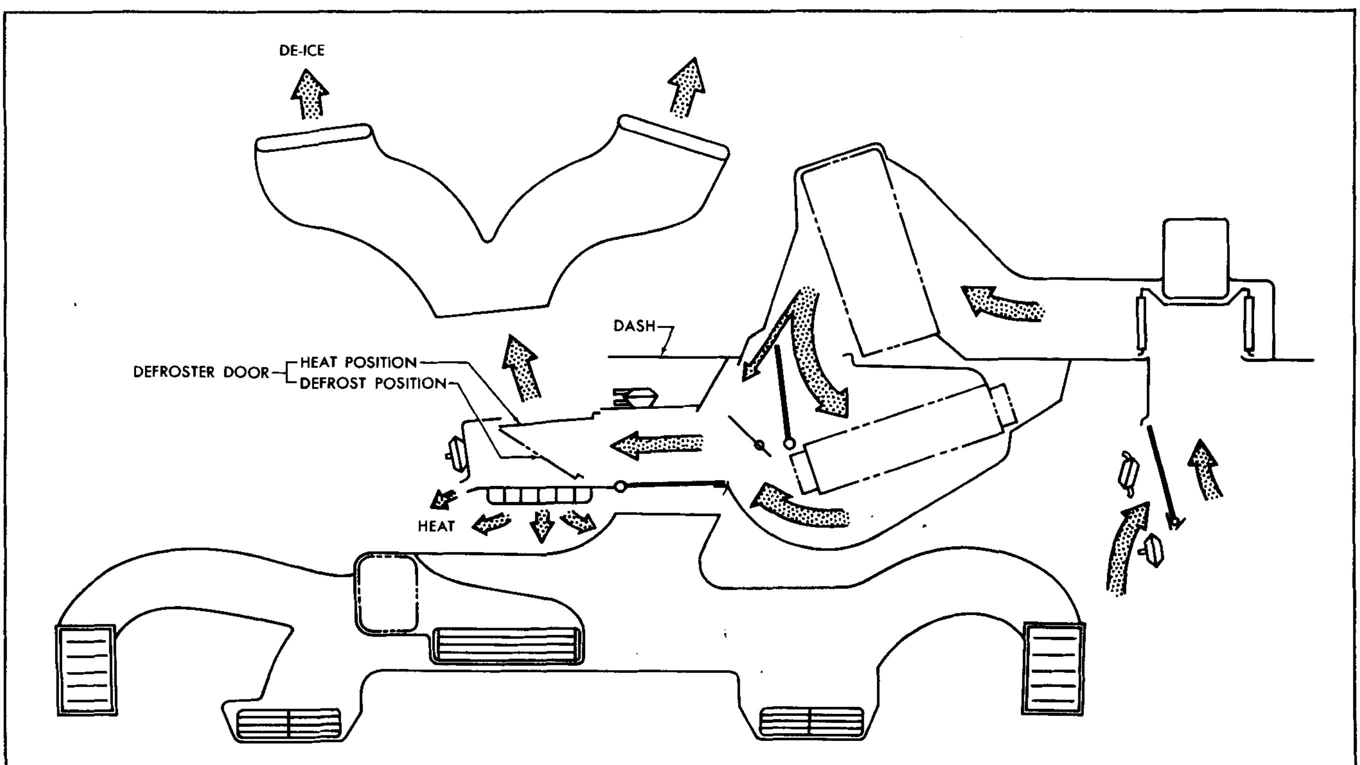


Fig. 1A-43 Typical Heater Mode Air Flow

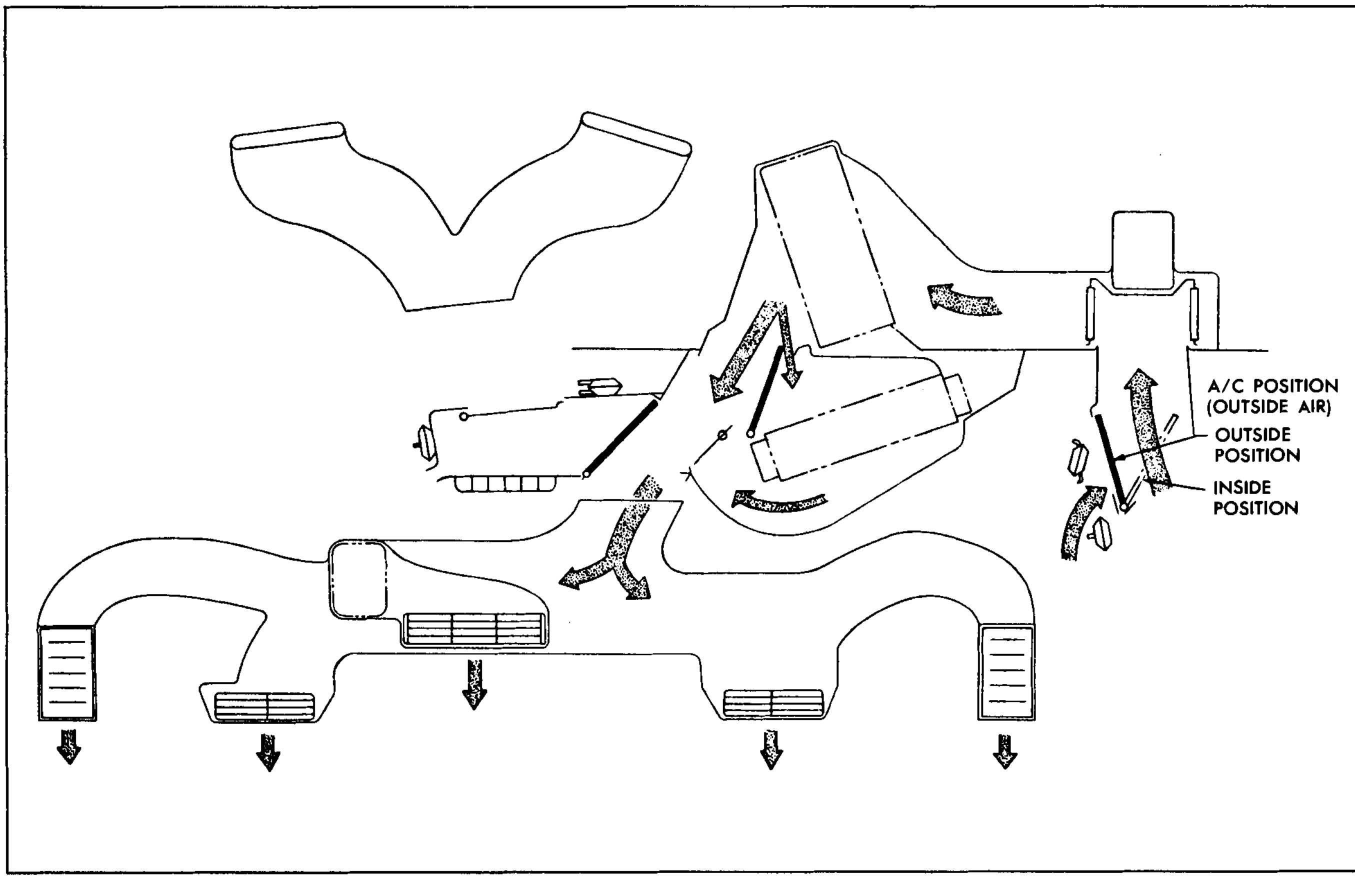


Fig. 1A-44 Typical A/C Mode Air Flow

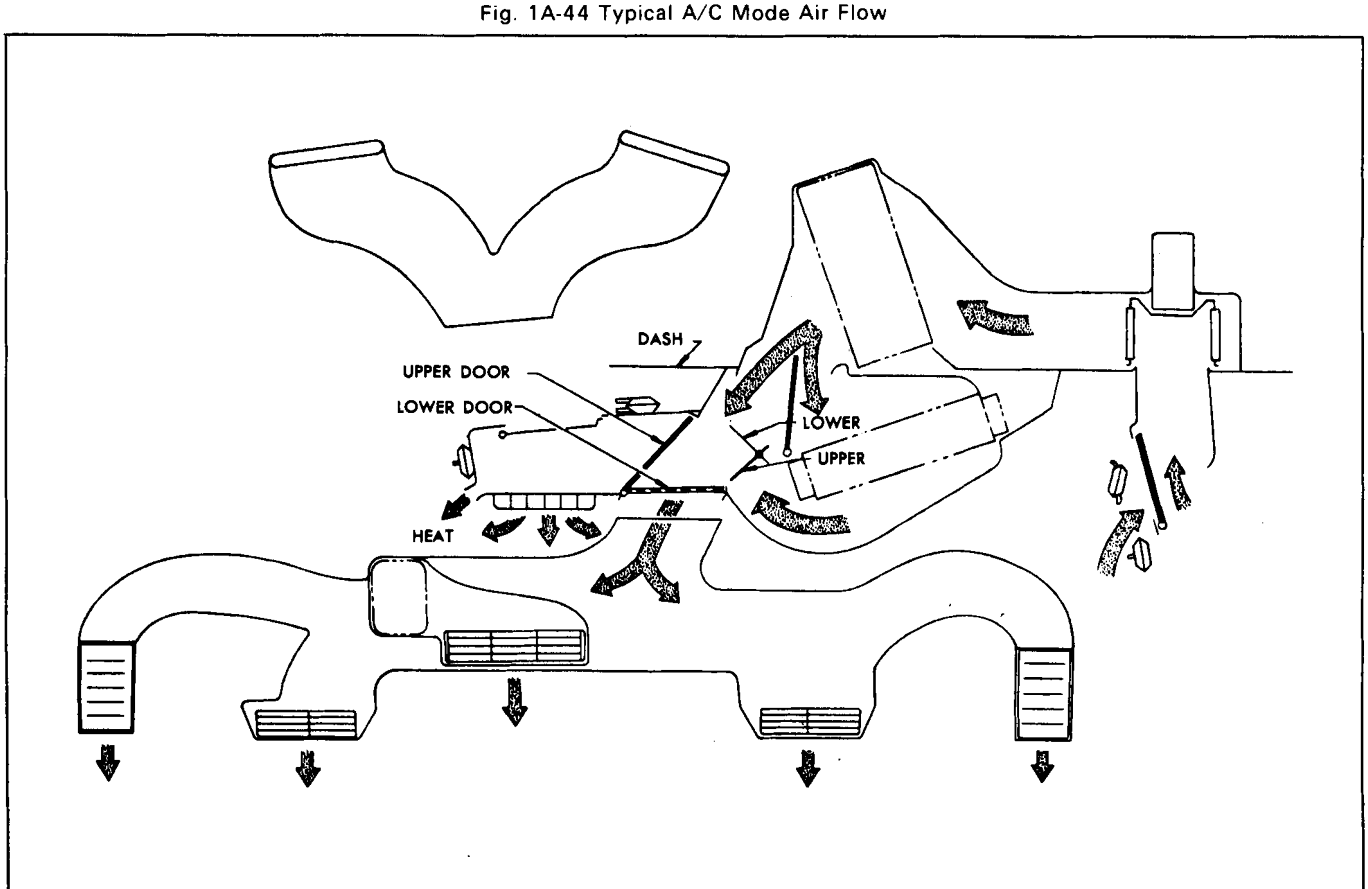


Fig. 1A-45 Typical Bi-Level Mode Air Flow

B. The compressor is not running.

6. Move selector lever to A/C (air conditioning) and temperature lever to a point below the word "A/C" (most of the way to the left).

   A. Cold air comes from the air conditioning outlets.

   B. Compressor is running.

7. Move fan switch to full down pausing at each detent on way.

   A. Blower speed and air flow decrease a step at each position.

8. Move temperature lever to full COLD (rest of the way to the left).

   A. Blower comes on high speed.

   B. Air noise is heard from R.H. front corner of passenger compartment as system goes on inside air.

There is a restrictor in the vacuum line which will delay obtaining air from the defroster nozzle in the heater mode when coming from any position except BILEVEL or DEFROST.

A, G AND F SERIES

This test must be performed on complete car with engine running, coolant warm and environment above 45°F.

1. Move selector lever to OFF, set blower switch to HI, and move temperature lever to full WARM.

   a. No air flow from any outlets.

   b. Compressor is not running.

   c. On F Series, blower motor is running on low speed to achieve evaporator purging but no air enters the car.

2. Move selector lever to DEFROST (each lever position has a detent to lock the lever in place).

   a. Blower comes on high speed.

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

   c. Compressor is running.

3. Move selector lever to HEAT.

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

   b. Compressor is running.

4. Move selector lever to BILEVEL and temperature lever to mid-travel.

   a. Air flows from both heater and air conditioning outlets.

   b. Air conditioning outlet air slightly cooler than heater outlet air.

   c. Compressor is running.

5. Move selector lever to A/C (air conditioning) and temperature lever to full COOL.

   a. Cold air comes from the air conditioning outlets.

   b. Compressor is running.

6. Move compressor (VENT-NORM) switch to VENT.

   a. Outside air comes directly through air conditioning outlets with no heating or cooling.

   b. Compressor does not run.

7. Move selector lever to INSIDE.

   a. Blower noise level increases, also a slight increase in air flow.

   b. Compressor switch returns to the NORM position.

   c. Compressor is running.

8. Move the blower switch to LO pausing at each detent on way.

   a. Blower speed and air flow decrease a step at each position.

SERVICE PROCEDURES

PRECAUTIONARY SERVICE MEASURES

Before any service is attemped which requires opening of refrigeration pipes or units, the person doing the work should be thoroughly familiar with the procedures and information under PRECAUTIONS IN HANDLING REFRIGERANT and should follow very carefully the 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. Dirt contaminant is apt to cause leaky valves or wear in the compressor, and moisture will freeze into ice at the expansion valve and freeze the valve stem.

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

REFRIGERATION SUB-ASSEMBLIES

1. All sub-assemblies are shipped, sealed and dehydrated. They are to remain sealed until just prior to making connections.

2. All sub-assemblies should be at room temperature before uncapping. (This prevents condensation of moisture from the air that enters the system.).

3. If, for any reason, caps are removed but the connections are not made, then the tubes and other parts should not remain unsealed for more than 15 minutes. Reseal connections if period is to be longer. This applies particularly to partially built-up systems that will be left overnight.

4. Compressors are shipped with 10-11 oz. of 525 viscosity refrigeration oil and charged with a mixture of refrigerant and dry nitrogen to provide an internal pressure at slightly above atmospheric pressure.

ASSEMBLY

1. All precautions should be taken to prevent damage to fittings or connections. Even minute damage to a connection could cause it to leak.

2. Any fittings getting grease or dirt on them should be wiped clean with a cloth dampened with alcohol. Do not use chlorinated solvents such as trichlorethylene for a cleaning agent, as they are contaminants. If dirt, grease or moisture get inside pipes and cannot be removed, pipe is to be replaced.

3. Sealing caps should be removed from sub-assemblies just prior to making connections for final assembly.

4. Use a small amount of clean refrigeration oil (525 viscosity) on all tube and hose joints, and dip the O-ring gasket in this oil before assembling joint. This oil will help in making a leak-proof joint.

5. When tightening joints, use another wrench to hold stationary part of the connection so that a solid feel can be attained. This will indicate proper assembly.

CAUTION: *Tighten all tubing connections as shown in Fig. 1A-46. Insufficient or excessive torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage.*

6. Do not connect receiver dehydrator assembly until all other sealed sub-assemblies have been connected. This is necessary to insure optimum dehydration and maximum moisture protection of the refrigeration system.

Metal Tube Outside Diameter	Thread and Fitting Side	Steel Tubing Torque Lb.-Ft.	Aluminum or Copper Tubing Torque Lb.-Ft.	Nominal Torque Wrench Span
1/4	7/16	10-15	5-7	5/8
3/8	5/8	30-35	11-13	3/4
1/2	3/4	30-35	15-20	7/8
5/8	7/8	30-35	21-27	1 1/16
3/4	1 1/16	30-35	28-33	1 1/4

If a connection is made with steel to aluminum or copper, use torques for aluminum. In other words, use the lower torque specification.

Fig. 1A-46 Pipe and Hose Connection Torque Chart

DEPRESSURIZING THE SYSTEM

1. Remove caps from suction gauge fitting on P.O.A. valve and discharge valve gauge fitting on compressor.

2. With both valves on manifold gauge set J 5725-04 closed (clockwise), attach manifold to P.O.A. valve and compressor, using J 5420 valve adapter at suction gauge fitting and J 9459 valve adapter at discharge gauge fitting.

3. Fully open high pressure valve on manifold gauge set to allow escape of refrigerant from system through the manifold gauge set and out center fitting and hose. (Place end of hose in clean container to collect oil loss due to rapid discharge of system.)

4. When hissing ceases (indicating all refrigerant has escaped) close high pressure valve on manifold gauge set by turning valve clockwise.

EVACUATING THE SYSTEM

When the refrigeration system is depressurized and opened for service, some air will enter lines regardless of how quickly openings are capped. In order to remove this air and as much as possible of the moisture it contains, the complete system must be evacuated. Evacuating is merely the process of removing all air from the system, thereby creating a vacuum in the system.

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 refrigeration systems.*

PREPARATIONS FOR EVACUATING COMPLETE SYSTEM

1. Check the low pressure gauge for proper calibration. With the gauge disconnected from the refrigeration

system, be sure that the pointer indicates to the center of "O". Lightly tap gauge a few times to be sure pointer is not sticking. If necessary, calibrate as follows:

a. Remove cover from gauge.

b. Holding gauge 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 gauge a few times to be sure pointer is not sticking. Replace gauge cover.

2. If gauge set is not already connected to P.O.A. valve and compressor, connect as follows (Fig. 1A-47):

a. Close hand shut-off valves on gauge set by turning clockwise.

b. Remove caps from gauge fittings on P.O.A. valve and compressor.

c. Attach valve adapter J 5420 to end of hose from low pressure gauge and connect this adapter fitted hose to suction gauge fitting.

d. Attach valve adapter J 9459 to end of hose from high pressure gauge and connect this adapter fitted hose to discharge gauge fitting.

3. Attach a flexible gauge hose to center fitting of the gauge set and attach the other end of this hose to vacuum pump J 5428-03.

4. The system can now be evacuated.

EVACUATING COMPLETE SYSTEM

1. Turn hand shut-off valve on low pressure gauge of gauge set to full clockwise position.

2. Slowly turn valve on high pressure gauge counterclockwise from full clockwise position, letting any pressure build-up escape completely. Close high pressure valve.

3. Check oil level in vacuum pump and, if necessary, add refrigeration oil. Make sure dust cap on discharge side of vacuum pump has been removed.

4. Start the vacuum pump and slowly open low and high pressure sides of manifold gauge set to avoid forcing oil out of refrigeration system and pump. Pressure is now being reduced on both sides of the refrigeration system. NOTE: If oil is blown from vacuum pump, it should be refilled to the proper level.

5. Observe low pressure gauge and operate vacuum

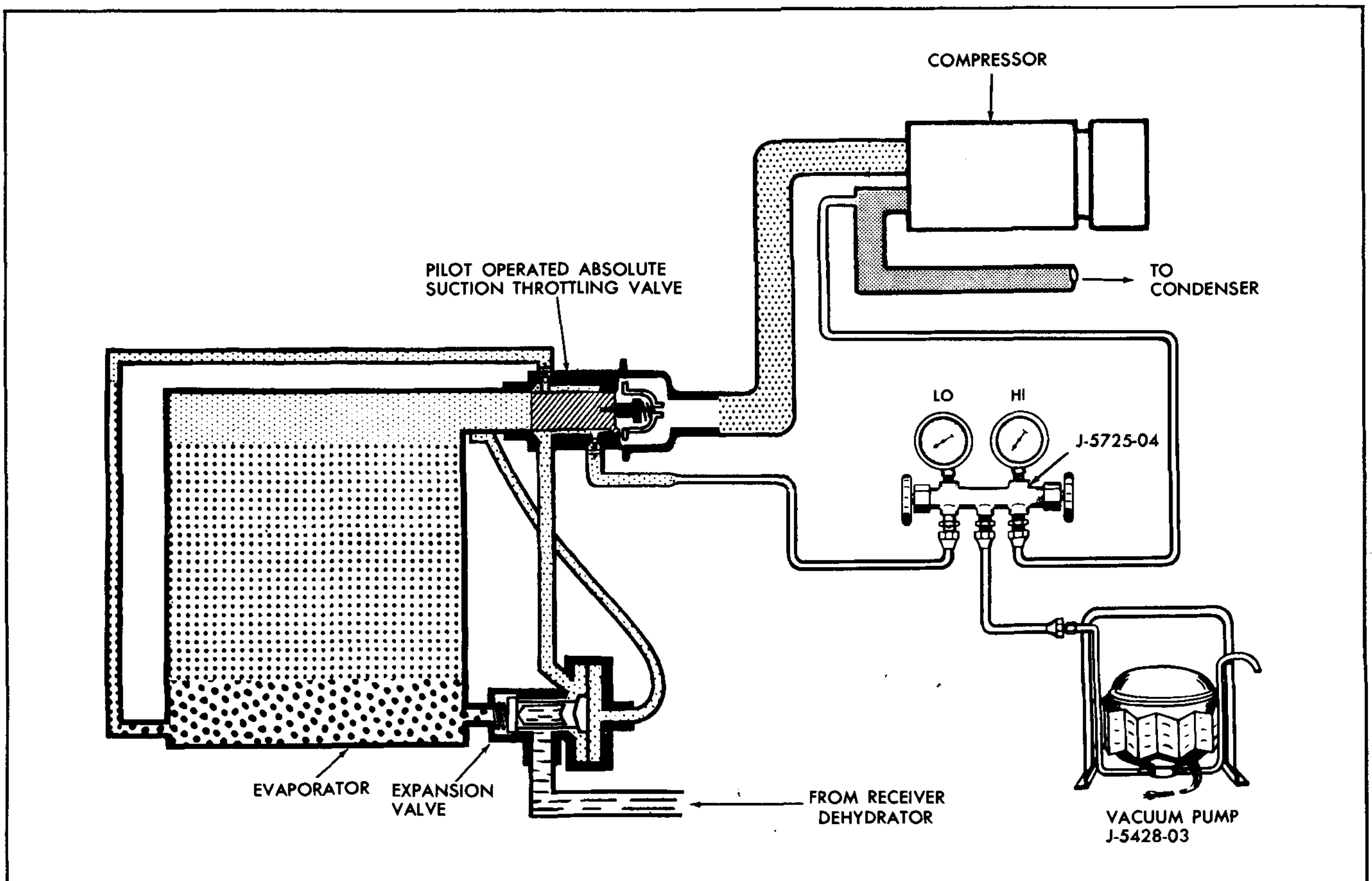


Fig. 1A-47 Schematic - Evacuating Refrigerant System pump until gauge shows 28-29" vacuum. (NOTE: In all evacuating procedures specification of 28-29 inches of vacuum is used. This evacuation can only be attained at or near sea level. For each 1000 feet above sea level where this operation is being performed, specification should be lowered by one inch of mercury vacuum. At 5000 feet elevation only 23" to 24" of vacuum can normally be obtained.)

If vacuum cannot be pulled to the minimum specification for the respective altitude, it indicates a leak in the system or gauge connections or a defective vacuum pump. In this case, it will be necessary to check for leaks as described under LEAK TESTING THE REFRIGERANT SYSTEM.

6. When specified vacuum level (28-29 inches at sea level) is obtained, continue to run vacuum pump for ten additional minutes. During these ten minutes:

   a. Prepare for charging the system. If using a charging station, fill charging cylinder. If using manifold gauge set, make all preparations for charging system as described under DISPOSABLE CAN METHOD or REFRIGERANT DRUM METHOD.

   b. Measure oil loss collected as a result of rapid discharge.

   c. Uncap J24095 compressor oil injector (Fig. 1A-47A) and open valve. Flush tool with refrigerant, close valve and insert pick-up tube into graduated container of clean refrigerant oil.

   d. Connect J24095 to suction fitting at P.O.A. valve. (Note: When valve on tool is opened, the vacuum applied to the discharge side of the system will suck oil into system from container. Therefore, close observation of oil level in the container is necessary.)

   e. Note level of oil in container. Open valve on oil-adding tool until oil level in container is reduced by an amount equal to that lost during discharge of system, then shut valve. Take care not to add more oil than was lost.

   f. Disconnect oil injector and connect pick-up tube to injection fitting to protect tool from moisture and foreign material.

7. Turn hand shut-off valves at low and high pressure gauges of gauge set to full clockwise position with vacuum pump operating, then stop pump. Carefully check low pressure gauge for two minutes to see that vacuum remains constant. If vacuum reduces, it indicates a leak in the system or gauge connections.

LEAK TESTING THE REFRIGERANT SYSTEM

After evacuating the complete system, leak test the system as follows:

1. Turn hand shut-off valves at low and high pressure gauges of gauge set to the full clockwise position with the vacuum pump operating; then stop pump.

2. Connect flexible line from center fitting of the gauge set to refrigerant drum (drum should be at room temperature).

3. Open shut-off valve on drum and loosen flexible line fitting at center fitting of gauge set so that refrigerant will purge all air from line. Tighten flexible line fitting when certain all air has been purged from line.

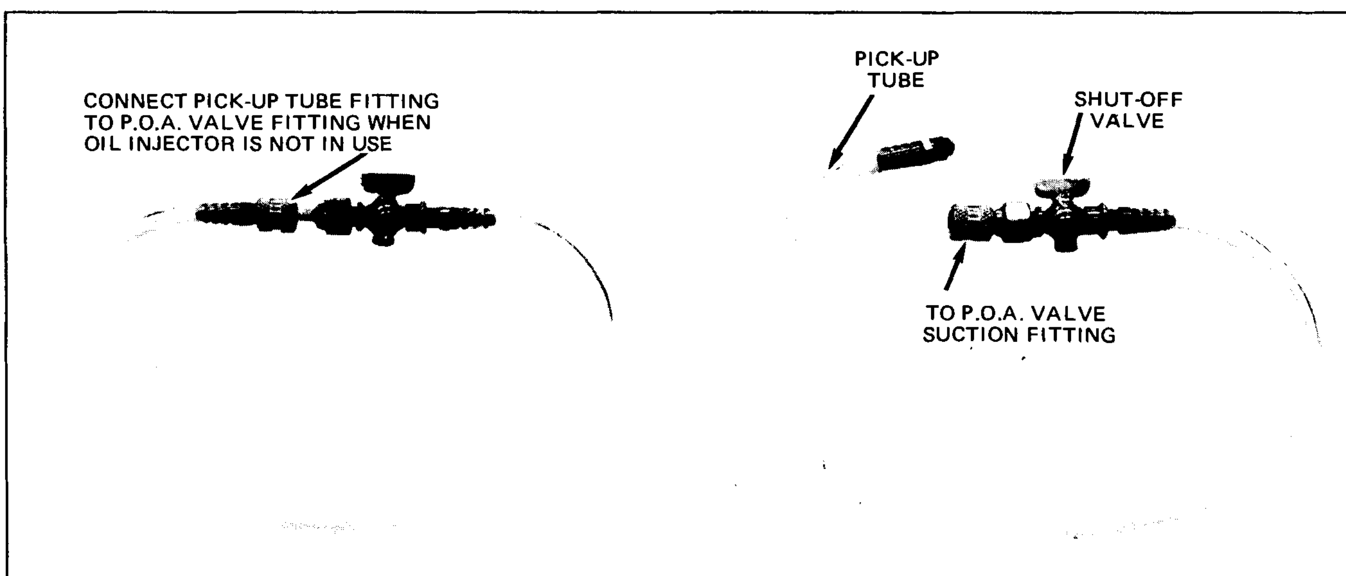


Fig. 1A-47A J-24095 Compressor Oil Injector

4. Open suction valve on gauge set. This will allow refrigerant to pass from the drum into the system. When pressure stops rising, close suction valve on gauge set and valve at refrigerant drum (Since the refrigerant drum is at room temperature, only a small refrigerant charge will enter the system).
5. Using leak detector J 6084, check compressor shaft seal and all fittings in the system and on the gauge set for evidence of leakage. When general area of leak has been found with the test torch, a liquid leak detector may be helpful in locating the exact point of leakage.
6. After leak has been corrected, evacuate the system again.

CHARGING THE SYSTEM

CAUTION: *The refrigerant system should be charged only after being evacuated as outlined in EVACUATING THE SYSTEM.*

REFRIGERANT DRUM METHOD

1. Connect center flexible line of gauge set to refrigerant drum.
2. Place refrigerant drum in a pail of water which has been heated to a maximum of 125°F.

WARNING: Do not allow temperature of water to exceed 125_F. High temperature will cause excessive pressure and possible softening of fusible safety plugs in the refrigerant drum. It may not be necessary to use hot water if a large drum is used (over approximately 100 lbs.).

3. Place refrigerant drum (in pail of water) on scales (bathroom or commercial, preferably commercial), Fig. 1A-48.

CAUTION: *Do not turn refrigerant drum upside down as this would allow liquid refrigerant to enter compressor which may cause damage.*

4. If line at center gauge fitting has not been purged of air, loosen line at center fitting on gauge set and crack valve on refrigerant drum to blow air from line. Retighten line at center fitting and record exact weight of refrigerant tank in water on the scales.
5. Open valve on refrigerant drum and both valves on gauge set to allow refrigerant to flow into system. Continue charging until the scales show that the correct amount of refrigerant (in pounds) as specified on label on the compressor has been transferred from refrigerant drum to system.

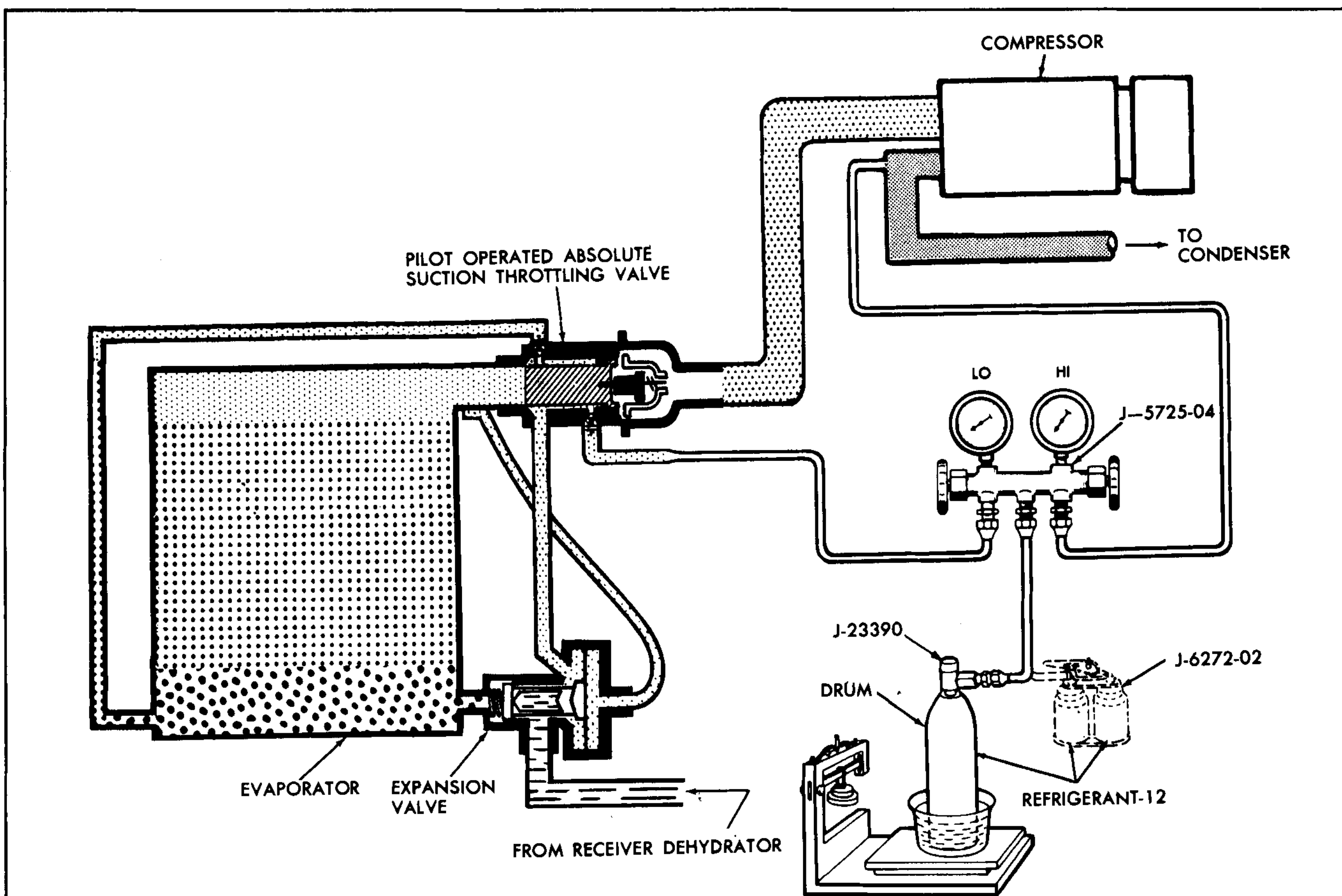


Fig. 1A-48 Schematic - Charging Refrigerant System

If full charge cannot be obtained, close both valves on gauge set, disconnect thermal limiter and jumper terminals B and C on limiter connector, start engine, and set temperature control lever to full cold position with system in A/C mode. Open low pressure valve on gauge set slowly and leave open until full charge is added.

WARNING: Observe high pressure gauge while charging with compressor running. Shut off engine if pressure exceeds 535 psi. A large fan placed in front of the car will help reduce excessively high head pressure.

6. Close both valves on gauge set (high pressure valve will already be closed if charging was completed by running compressor) and close valve on refrigerant drum.

   If the engine was used to complete the charge into the system, close valve on refrigerant drum to permit compressor to draw any refrigerant left in the line from the drum to the center fitting of the gauge set, then close the low pressure valve on the gauge set.
7. Operate engine at 2000 rpm with temperature control lever at full cold, blower speed switch on high and system in the A/C position. After a few minutes of operation, observe appearance of refrigerant in receiver-dehydrator liquid indicator (sight glass). If bubbles are observed, open low pressure gauge valve and valve on refrigerant drum to allow more refrigerant to enter system. Close valve when sight glass clears.

   (NOTE: If air inlet temperature is below 70°F. when this check is made, bubbles may appear even though the proper amount of refrigerant is in the system. Air inlet temperature must be 70°F. or above to make an accurate check.)
8. When refrigerant has been installed, continue to operate system and test for proper system pressures as outlined under OPERATIONAL TEST.
9. When satisfied that the air conditioning system is operating properly, stop engine, remove gauge set and replace protective caps on P.O.A. valve and compressor fittings.

WARNING: A considerable amount of refrigerant will collect in the high pressure line, since some of this refrigerant will have condensed into liquid refrigerant. Wrap the high pressure gauge fitting at the compressor with a shop cloth before disconnecting the valve from the gauge fitting, to prevent injury to personnel.)

10. Using leak detector, check complete system for leaks, as explained under LEAK DETECTORS.
11. Remove jumper from thermal limiter connector terminals, check superheat switch terminal to ground for open switch (no continuity) and connect limiter.

DISPOSABLE CAN METHOD

After having depressurized, repaired (if necessary) and evacuated the refrigerant system, the system may be charged as follows using refrigerant in disposable cans:

1. Obtain five 15 oz. cans or one 12 lb. can of refrigerant.
2. If using 15 oz. cans, mount four cans in J 6272-02 (multi-opener) or attach J 6271 (single-can opener-valve) on one can. If using the 12 lb. disposable can, attach J 23390 (disposable can control valve) on can.

WARNING: Make sure outlet valve on opener is closed (clockwise) before installing opener.

   a. If the J 6272-02 multi-opener is used, raise locking lever, position four cans of refrigerant and force locking lever down to secure cans and at same time puncture top of can to make it ready for charging.

   b. If the J 6271 valve is used, back off the valve from the can top retainer, slip the valve onto the can and turn the valve into retainer until tight. DO NOT open outlet valve during this operation as turning the valve into the retainer punctures top of can to make it ready for charging.
3. Connect center flexible line of gauge set to fitting on a can opener valve. NOTE: If line at center gauge fitting has not been purged of air, loosen line at center fitting on gauge set and "crack" valve at can opener (for a second or two) to force air from the line. Retighten line at center fitting.
4. Open valve at refrigerant source and at low and high pressure valves on manifold gauge set. Leave valve open at refrigerant source until all refrigerant (when using 15 oz. can) has entered the refrigeration system or system is fully charged. Close valve on can.

   a. If the system is charged using 15 oz. cans and the J 6271 valve, disconnect valve from can. Leave valve closed to flexible line to the center fitting of the manifold gauge set. Install valve on a new and full disposable can of refrigerant and repeat until a sufficient number of 15 oz. cans of refrigerant have been used to charge system to level specified on compressor.

   b. If system is charged using J 6272-02, close the valve of opener after all cans are empty. Release the locking lever and discard the four empty cans. If this tool will be used to complete the charge with additional cans to provide the required refrigerant charge, leave three of the empty cans in position, locate one full can and lock the lever into place. (These empty cans balance the assembly and prevent the loss of refrigerant through the open "series" passage.)

(NOTE: Align the pierced hole in the empty can with the punch in the cover of the tool.)

If the J 6271 valve for single cans is available, complete charging as explained in 4a above.

5. Close valves on manifold gauge set. Disconnect thermal limiter connector and jumper terminals B and C on connector.

6. Operate engine at 2000 rpm with temperature control lever at full cold position and blower speed on high in A/C mode. (NOTE: If air inlet temperature at the condenser is below 70 degrees F. when this check is made, bubbles may appear even though the proper amount of refrigerant is in the system. Air inlet temperature must be 70 degrees F. or above to make an accurate check.)

7. When refrigerant has been installed, continue to operate system and test for proper system pressures as outlined under OPERATIONAL TEST.

8. When satisfied that the air conditioning system is operating properly, stop engine, remove gauge set and replace protective caps on suction and discharge fittings.

WARNING: A considerable amount of refrigerant will collect in the high pressure line, since some of this refrigerant will have condensed into liquid refrigerant. Wrap the high pressure fitting at the compressor with a shop cloth before disconnecting the valve from the gauge fitting to prevent damage or injury to personnel.)

9. Using leak detector, check complete system for leaks as explained under LEAK DETECTORS.

10. Remove jumper from thermal limiter connector terminals, check superheat switch to insure that switch is open and connect limiter.

CHARGING STATION METHOD

CONNECTING THE CHARGING STATION

1. Be certain compressor hand shut-off valves to gauge fittings are closed (counterclockwise).

2. Be certain all valves on charging station are closed.

3. Connect high pressure gauge line to compressor high pressure gauge fitting.

4. Turn high pressure hand shut-off valve one turn clockwise, and high pressure control one turn counterclockwise (open). Crack open low pressure control and allow refrigerant gas to hiss from low pressure gauge line for three seconds, then connect low pressure gauge line to low pressure gauge fitting on P.O.A. valve. (Place J 9459 adapter on hose, then attach adapter to gauge fitting.)

CHARGING THE SYSTEM

1. With charging station connected as previously described, remove low pressure gauge line at P.O.A. valve.

2. Fully open high and low pressure control valves on station and allow refrigerant gas to purge from system through common hose into a container to collect oil loss due to rapid discharge.

3. When refrigerant flow nearly stops, connect low pressure gauge line to P.O.A. valve.

4. Turn on vacuum pump and open vacuum control valve.

5. With system purged as above, run pump until 28-29 inches of vacuum is obtained.

   NOTE: In all evacuating procedures, the specification of 28-29 inches of mercury vacuum is used. These figures are only attainable at or near sea level. For each 1000 feet above sea level where this operation is being performed, the specifications should be lowered by 1 inch. At 5000 ft. elevation, only 23 to 24 inches vacuum can normally be obtained.)

6. If 28-29 inches vacuum (corrected to sea level) cannot be obtained, close vacuum control valve and shut off vacuum pump. Open refrigerant control valve and allow some refrigerant to enter system. Locate and repair all leaks.

7. When specified vacuum level (28-29 inches at sea level) is obtained, continue to run vacuum pump for ten additional minutes. During these ten minutes:

   a. Fill charging station cylinder (see FILLING CHARGING CYLINDER).

   b. Measure oil loss collected as a result of rapid discharge.

   c. Uncap J24095 compressor oil injector and open valve. Flush tool with refrigerant, close valve and insert pick-up tube into graduated container of clean refrigerant oil.

   d. Connect oil injector to suction fitting at P.O.A. valve. (Note: When valve on oil injector tool is opened, the vacuum applied to the discharge side of the system will suck oil into system from container. Therefore, close observation of oil level in the container is necessary.)

   e. Note level of oil in container. Open valve on oil injector tool until oil level in container is reduced by an amount equal to that lost during discharge of system, then shut valve. Take care not to add more oil than was lost.

f. Disconnect oil injector tool and re-cap all openings.

8. Turn off vacuum pump valves with pump operating, then shut off pump. Check low pressure gauge for approximately 2 minutes to make sure vacuum remains constant (no leak).

9. Only after evacuating as above, system is ready for charging. Note reading on sight glass of charging cylinder. If it does not contain a sufficient amount for a full charge, fill to proper level.

10. Close low pressure valve on charging station. Fully open station refrigerant control valve and allow all liquid refrigerant to enter system. When full charge of refrigerant has entered system turn off refrigerant control valve and close both hand shut-off valves.

11. If full charge of refrigerant will not enter system, close high pressure control and refrigerant control valves. Disconnect thermal limiter and jumper terminals B and C of limiter connector. Start engine and run at low idle with compressor operating. Crack refrigerant control valve and low pressure control on station. Watch low side gauge and keep gauge below 50 psi by regulating refrigerant control valve. Closing valve will lower pressure. This is to prevent liquid refrigerant from reaching the compressor while the compressor is operating. When required charge has entered system, close refrigerant control valve and close low pressure control.

12. System is now charged and should be performance tested before removing gauges.

13. Remove jumper and connect thermal limiter.

FILLING CHARGING CYLINDER

1. Open control valve on refrigerant container.

2. Open valve on bottom of charging cylinder allowing refrigerant to enter cylinder.

3. Bleed charging cylinder to valve (behind control panel) only as required to allow refrigerant to enter cylinder. When refrigerant reaches desired charge level, close valve at bottom of charging cylinder and be certain cylinder bleed valve is closed securely.

   (NOTE: While filling the cylinder, it will be necessary to close the bleed valve periodically to allow boiling to subside so that refrigerant level in the charging cylinder can be accurately read.)

ADDING REFRIGERANT

The following procedure should be used in adding small amounts of refrigerant that may have been lost by leaks or while opening system for servicing the compressor. Before adding refrigerant to replace that lost by leaks, check for evidence of oil loss, and add oil if necessary. See ADDING OIL.

This procedure will only apply if the air inlet temperature is above 70°F. at the condenser.

1. Disconnect thermal limiter and place jumper wire between terminals B and C of limiter connector. Remove caps from P.O.A. valve and compressor gauge fittings. Attach gauge set to gauge fittings, making sure adapter J 5420 is between low pressure gauge hose and suction gauge fitting, and J 9459 is between high pressure gauge hose and discharge gauge fitting.

2. Start engine, turn air conditioning temperature control lever to full cold position, blower switch to high speed and system selector lever to the A/C mode. Operate for ten minutes at 2000 rpm to stabilize system.

3. Observe the refrigerant through the sight glass cover of receiver-dehydrator with the system operating, to see if there are any bubbles evident.

   a. If no bubbles are evident, then bleed system slowly through the discharge valve until bubbles appear in the receiver-dehydrator. Add one-half pound of refrigerant as explained under CHARGING THE SYSTEM.

   b. If bubbles are visible in the receiver-dehydrator with the temperature control lever in the full cold position and the blower at HI speed, it indicates a partial or complete plug in a line, a shortage of refrigerant, or both. Correct condition. Add refrigerant until the slight glass clears, then add another one-half pound of refrigerant.

4. Attach flexible hose from center fitting of gauge set loosely to refrigerant drum or on disposable can valves. Open high and low pressure valves on the gauge set slightly to purge pressure gauge lines of air. Tighten fitting of refrigerant drum or can when satisfied that all air has been removed from gauge lines. Close (clockwise) both hand shut-off valves of gauge set.

5. Partially charge system.

   REFRIGERANT DRUM METHOD:

   a. Place pail containing hot water that does not have a temperature exceeding 125°F. on scales, place refrigerant drum in pan containing water, note weight and only open low pressure valve on gauge set.

   b. Start engine, move temperature control lever to full cold position and place blower switch on high speed. Operate engine for ten minutes at 2000 rpm to stabilize system.

c. With compressor operating, slowly open valve on refrigerant drum and allow refrigerant to flow into system (through manifold guage set) until liquid indicator clears up and immediately shut off valve at gauge set or on refrigerant drum. Check weight of refrigerant drum and pail of water. Then slowly open valve on gauge set (or refrigerant drum) and add one-half pound of refrigerant. Note total amount of refrigerant added.

DISPOSABLE CAN METHOD:

a. Make sure the outlet valve on the J 6271 valve is fully clockwise and attach the J 6271 to a 15 oz. can of refrigerant by backing off the valve from the top of the retainer, slipping the valve onto the can and turning the valve into the retainer until tight. DO NOT accidentally open outlet valve during this operation as turning the valve into the retainer punctures the top of the can to make it ready for charging.

b. Connect center flexible line of gauge set to the fitting on the valve.

c. Start engine, move temperature control lever to full cold position, set blower switch to high speed and system to A/C mode. Operate engine for ten minutes at 2000 rpm to stabilize system.

d. With compressor operating, slowly open valve on refrigerant can and allow refrigerant to flow into system (through manifold gauge set) until liquid indicator clears up and immediately shut off valve at guage set and on refrigerant can. Check weight of can and valve assembly and record.

e. Add an additional one-half pound of refrigerant by adding refrigerant from the can just weighed until can weighs one-half pound less. If can is empty before one-half pound is added to system, attach another can and add refrigerant until the entire one-half pound has been added.

6. Close valves at refrigerant drum or can.

7. Test for leaks and make pressure check of system as outlined under OPERATIONAL TEST.

8. Disconnect thermal limiter jumper and connect limiter.

CHECKING COMPRESSOR OIL LEVEL AND ADDING OIL

The refrigeration system with the six-cylinder axial compressor requires 11 fluid ozs. of 525 viscosity oil. After the system has been operated, oil circulates throughout the system with the refrigerant. Hence, while the system is running, oil is leaving the compressor with the high pressure gas and is returning to the compressor with the suction gas.

To enhance return of oil to the compressor under partially depleted refrigerant charge conditions, an oil bleed line from the evaporator to the suction line at the P.O.A. valve has been provided. The core in the bleed line fitting at the P.O.A. valve has a special low force spring in it which allows the core to open a 5 to 12 psi pressure difference. It is important that this core not be replaced with a standard tire core.

The oil level in the compressor should not be checked as a matter of course, such as is done in the car engine crankcase. In general, the compressor oil level should be questioned only in cases where there is evidence of a major loss of system oil such as:

a. Broken hose or severe hose fitting leak.

b. Oil sprayed in large amounts under the hood due to a badly leaking compressor seal.

c. Collision damage to refrigeration system components.

REPLACING REFRIGERATION SYSTEM COMPONENTS OTHER THAN COMPRESSOR

If there are no signs of excessive oil leakage, add the following amount of oil depending on component replaced:

1. Evaporator - 3 fluid ozs.
2. Condenser - 1 fluid oz.
3. Receiver - 1 fluid oz.
4. No oil for P.O.A. valve, expansion valve or hoses.

When refrigerant system components other than the compressor are replaced and there are signs of abundant oil leakage, the compressor must also be removed and oil drained from the compressor. The amount of oil to put back into the compressor is found as follows:

DO NOT add any more oil than is necessary or maximum cooling will be reduced.

1. Remove the compressor and place in a horizontal position with the compressor drain plug downward, drain oil from compressor into an empty graduated bottle, measure the amount of oil and discard this oil.
2. If the quantity of oil measured is more than 4 fluid ozs., replace into the compressor the same amount of clean oil as the oil drained, plus the following amount for the refrigeration system component being changed:

a. Evaporator-3 fluid ozs.

b. Condenser-1 fluid oz.

c. Receiver dehydrator assembly-1 fluid oz.

Neglect any fluid oil coating loss in case of line change.

3. If the oil quantity drained from the compressor is less than 4 ozs., replace into the compressor 6 fluid ozs. of clean oil, plus the amount shown above for the respective component replacement.

4. Replace compressor and system components.

5. Evacuate, charge and perform operational test.

COLLISION SERVICE

The severity and circumstances of the collision will determine the extent of repair required. Good judgment must be used in deciding what steps are necessary to put the system back into operation.

Each part of the system must be carefully inspected. No attempt should be made to straighten kinked tubes or repair any bent or broken units. Check especially for cracks at soldered connections.

REFRIGERANT SYSTEM OPEN TO ATMOSPHERE

Broken tubes or units will allow air, moisture and dirt to enter. These parts should be sealed as soon as possible until such time as they are replaced.

If the system is open for more than 15 or 20 minutes (depending on humidity), the receiver-dehydrator assembly will absorb an excessive amount of moisture and should be replaced, and each component of the system should be cleaned with dry nitrogen and flushed with liquid refrigerant to remove dirt and moisture.

1. Remove and cap openings in P.O.A. valve, expansion valve, compressor and receiver dehydrator.
2. Flush P.O.A. valve to compressor hose (includes compressor fitting) and cap openings.
3. Flush evaporator core and cap openings.
4. Flush compressor to condenser hose (includes muffler and compressor fitting), condenser and condenser to receiver hose as an assembly. Cap openings.
5. Flush receiver to expansion valve hose and cap openings.
6. Flush P.O.A. valve, expansion valve and compressor and install in system.
7. Discard receiver dehydrator and replace with new part. Add one ounce of refrigerant oil to new receiver and install in system.

FLUSHING SYSTEM

Flushing can be accomplished by connecting a refrigerant drum to the unit to be flushed and then turning the drum upside down and opening the drum shut-off valve to pour refrigerant through the unit in reverse direction of normal system flow. The unit should be supported so that the refrigerant passing through it will be directed into an area where -21.7°F. will do no damage. (Remember that when liquid refrigerant is poured from the drum into an area where atmospheric pressure exists, its temperature will immediately drop to -21.7°F.)

In order to keep the expansion valve open when flushing the evaporator, the expansion valve bulb must be detached from the evaporator outlet tube.

INSPECTING COMPRESSOR

If there is no visible evidence of damage, rotate compressor shaft to test for normal reaction. A quick check for broken reed valves is to turn compressor shaft (using box end wrench on compressor shaft nut) and check for resistance when turning the shaft. An irregular resistance force will be felt as each of the pistons goes over top center for each revolution of the crankshaft. If this pattern is not felt, it indicates one or more broken compressor reed valves and the compressor must be repaired.

Inspect oil for foreign material which would indicate internal damage to the compressor. If no foreign matter is found in oil, compressor can be used. Flush entire refrigeration system with refrigerant, drain oil from compressor and pour in 11 oz. avoirdupois of new 525 viscosity oil.

REFRIGERANT HOSE ASSEMBLIES

REPAIR

The refrigerant hoses used in the refrigeration system (Figs. 1A-49 thru 1A-53A) are not serviced in complete assemblies. These hoses are repaired using a minimum number of hose fitting packages, hose clamps, O-ring seals and bulk hose as follows:

1. Depressurize system if necessary.
2. Remove defective hose assembly if removal is necessary to repair hose and cap all openings.
3. Consult parts book for available fitting packages and hose repair parts and repair hose assemblies observing the folloiwng precautions:

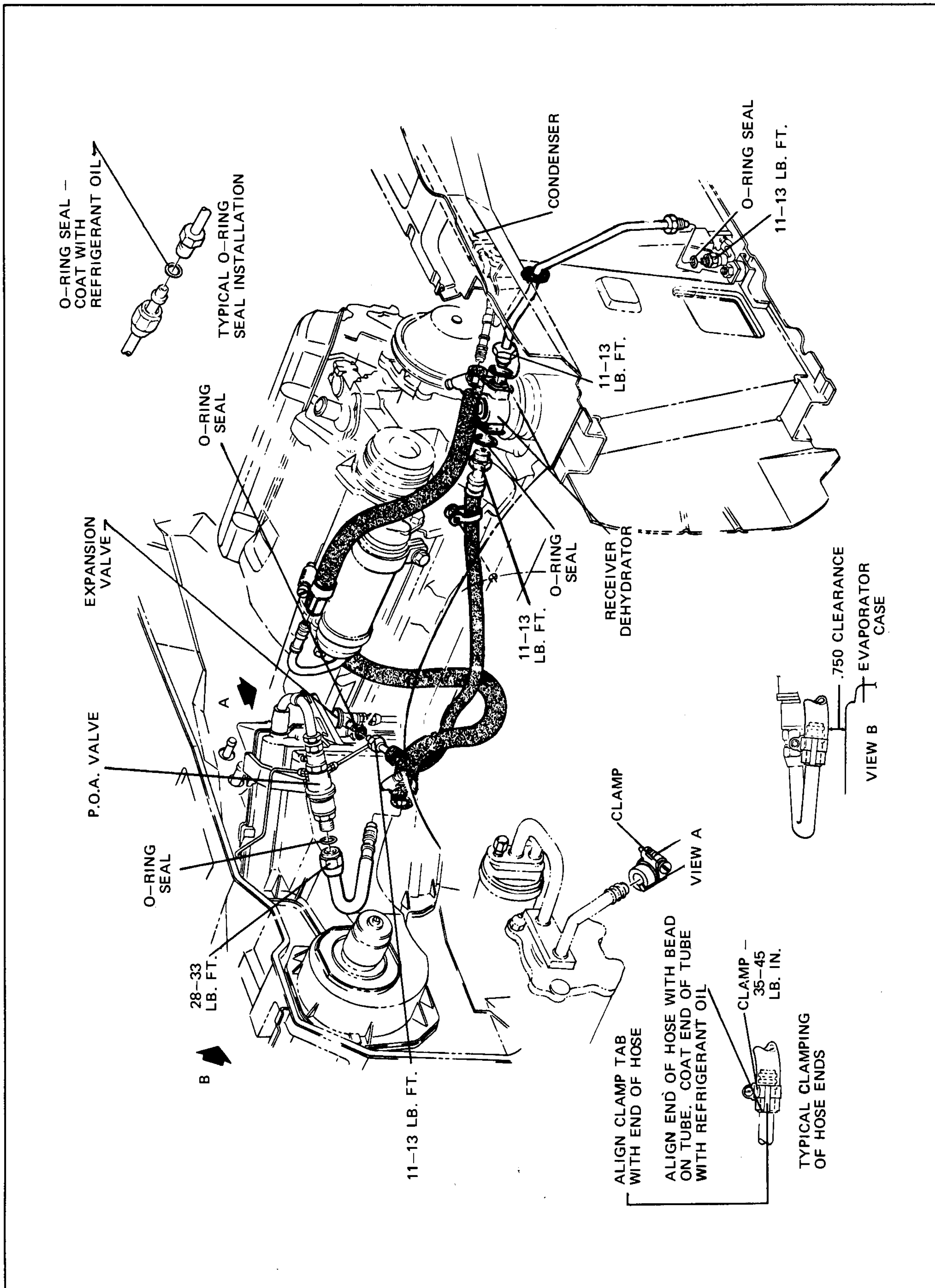


Fig. 1A-49 Refrigeration System - B Series

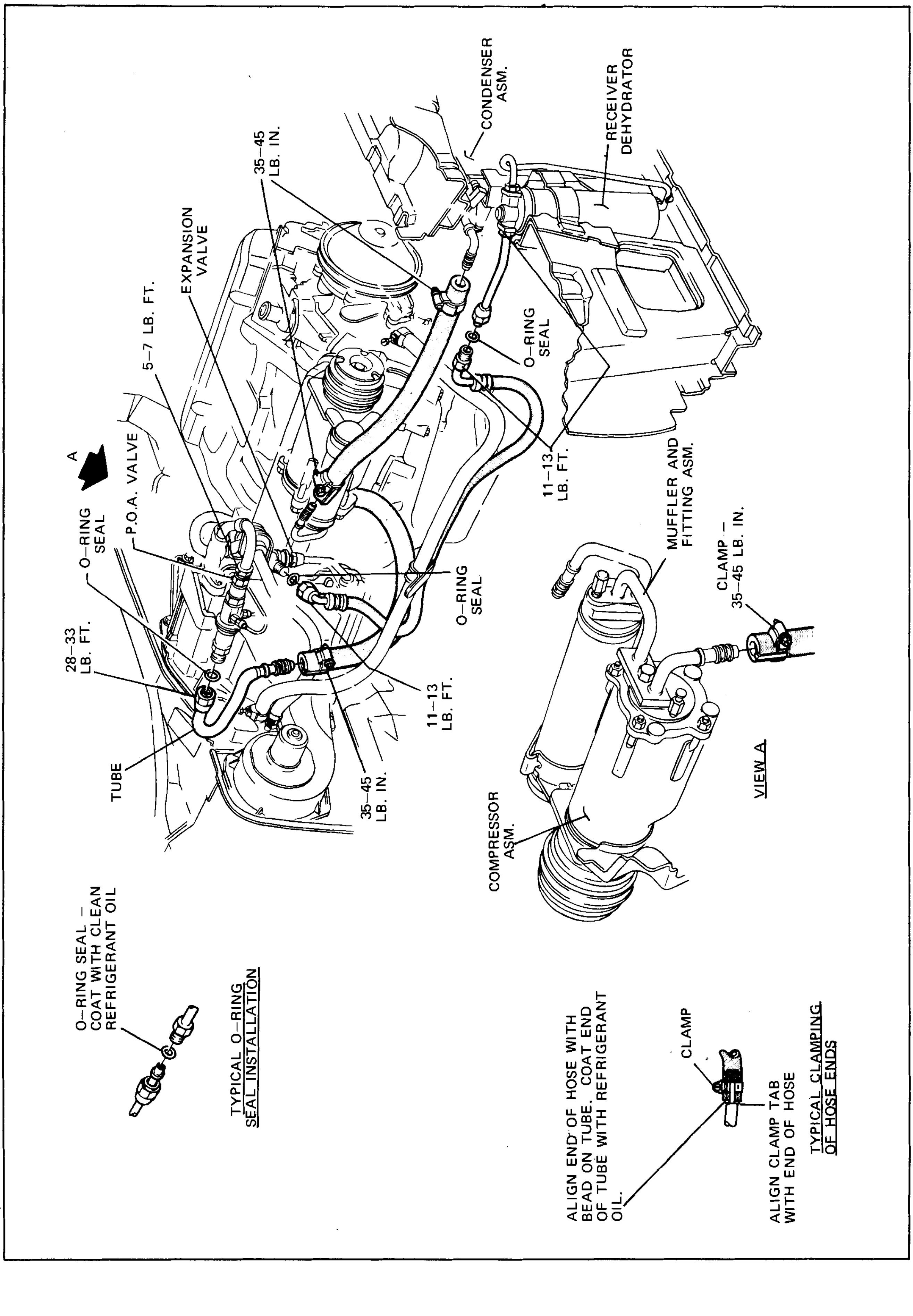


Fig. 1A-50 A and G Series Refrigeration System (V-8)

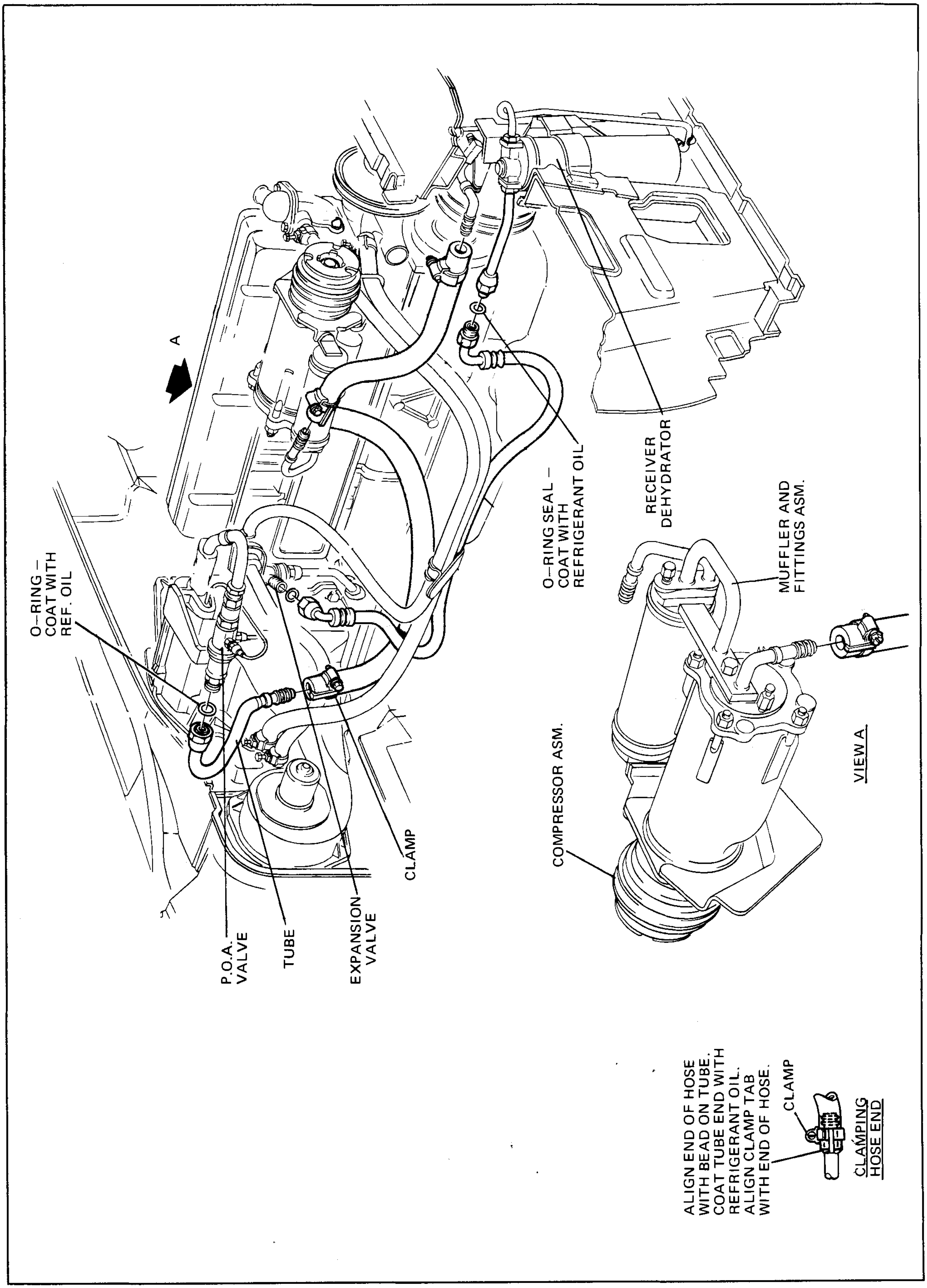


Fig. 1A-51 A Series Refrigeration System (6-Cyl. Engine)

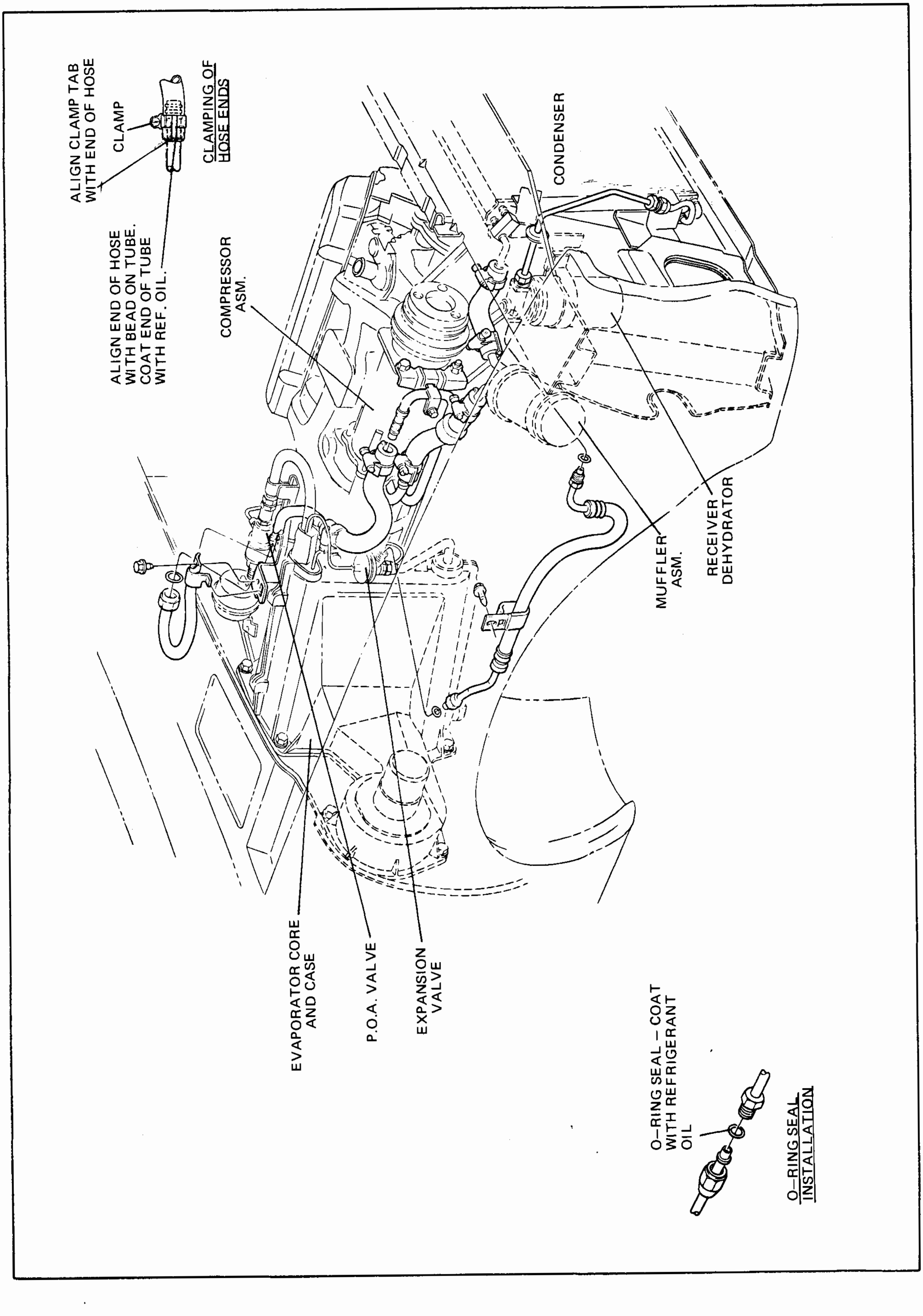


Fig. 1A-52 Refrigeration System - F Series

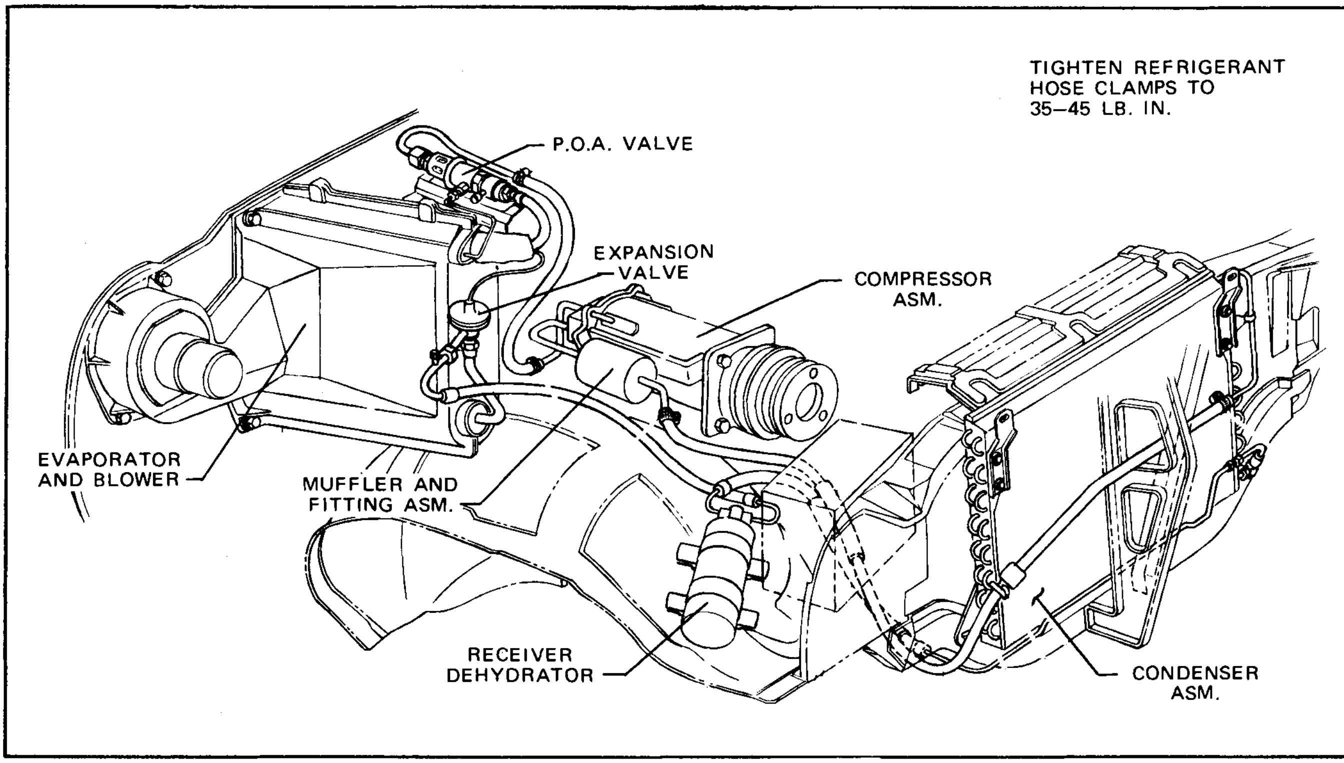


Fig. 1A-53 Refrigeration System - X Series (350 Engine)

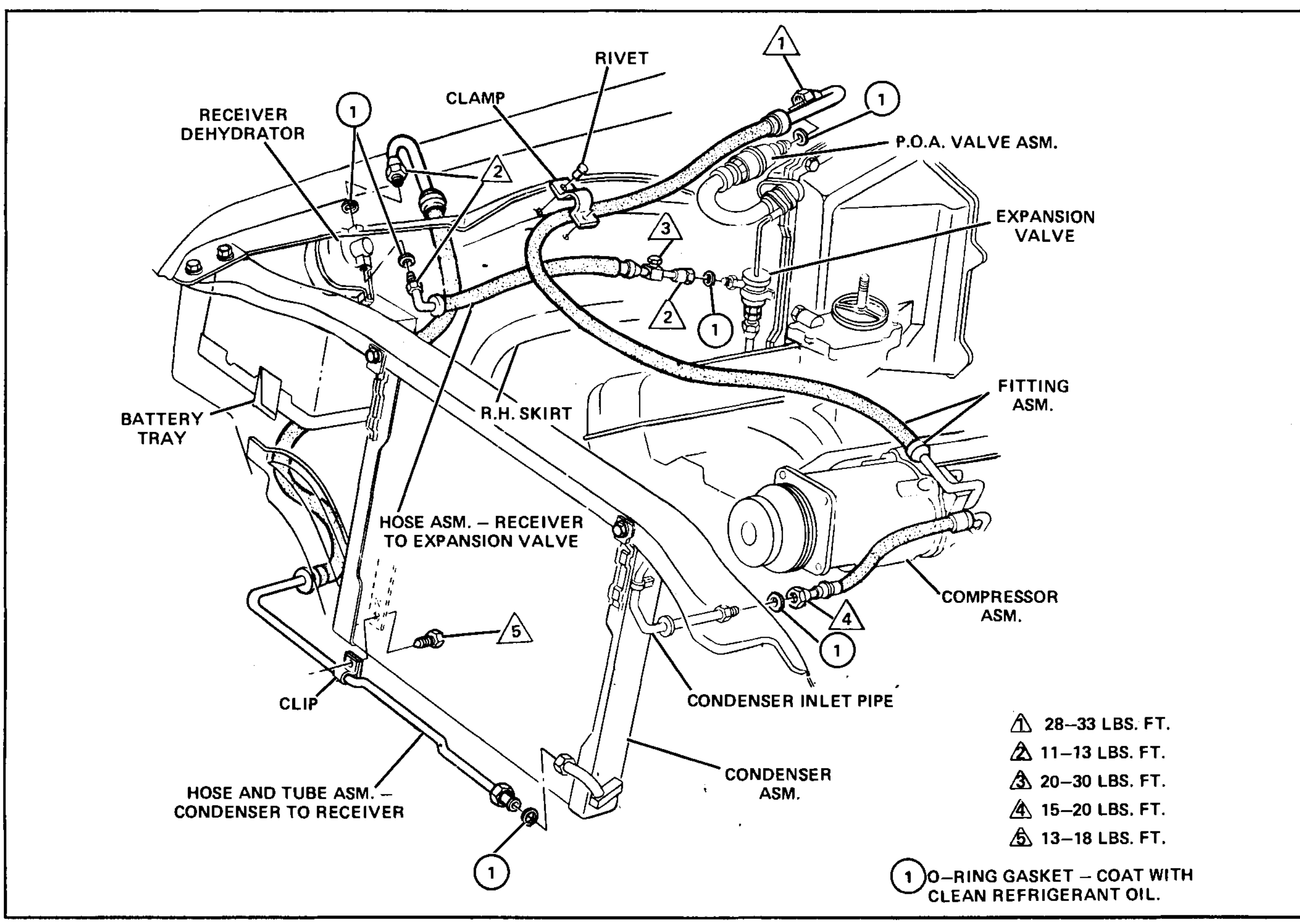


Fig. 1A-53A Refrigeration System - X Series (307 Engine)

a. All hose ends must be cut off straight.

b. Hose clamps must be properly installed as indicated by the locating tab on each clamp and torqued to 40 lbs. in. with a torque wrench.

c. When installing a fitting, the hose must be seated against the shoulder on the fitting.

d. All repaired hose assemblies must be equal in length to the original assembly. Use necessary fittings and hose to make the repair without changing the length and/or contour of the hose assembly. This is particularly important on hose assemblies which are routed through or near sheet metal to avoid possible chafing of the hose.

4. Re-install hose assemblies and tighten all connections.

5. Evacuate, charge and leak test refrigerant system.

COMPRESSOR ASSEMBLY

REMOVE AND REPLACE

Some replacement parts do not require removing the compressor for replacement. Operations which can be performed without compressor removal or discharging the refrigerant system are:

1. Compressor drive belt.
2. Compressor clutch hub and drive plate.
3. Compressor pulley and/or bearing.
4. Compressor clutch coil.

The compressor shaft seal and seat and associated parts require depressurizing the system for replacement but compressor removal is not necessary.

For replacement of the above components refer to SERVICE PROCEDURES - COMPRESSOR ASSEMBLY.

SERVICE PROCEDURES - COMPRESSOR ASSEMBLY

The compressor, when removed, must be closed immediately. If the system has been or can be operated for more than two minutes, circulation of oil from compressor to other components of system will require adjustment of the oil charge in the new compressor as explained under REPLACING COMPONENTS OTHER THAN COMPRESSOR.

After draining and measuring the oil from crankcase and head of the compressor removed, the amount that has migrated to other parts of the system can be determined by subtracting the amount drained from the original oil charge of 11 fluid ozs. The amount of oil equal to this loss must be drained from the new compressor before it is installed.

INSTALLING COMPRESSOR

Idle (on car) compressor to be replaced for 10 minutes at 1500-2000 engine rpm, at maximum A/C and blower at high speed. DO NOT add any more oil to the compressor than is necessary or maximum cooling will be reduced.

Compressor replaced with new compressor:

1. Remove compressor and place in a horizontal position with drain plug downward, drain compressor, measure quantity of oil drained and discard oil.

2. Drain oil from replacement compressor and save it.

3. If amount of oil drained in step 1 is more than 4 ozs., place into the new compressor the same amount of oil drained from the replaced compressor.

   If amount of oil drained in step 1 is 4 ozs. or less, place 6 ozs. of oil in the replacement compressor.

4. Install compressor.

Compressor replaced with a field repaired (overhauled) compressor:

1. Follow procedure for replacement with new compressor.

2. Add one additional ounce of oil. (More oil is retained in a drained compressor than one that has been rebuilt.)

REPLACING AN INOPERATIVE COMPRESSOR

In the event it is not possible to idle the compresser to be replaced to effect oil return to it, the following will apply:

1. Remove compressor from car, drain and measure the oil.

2. If amount of oil drained is more than 1-1/2 fluid ozs., subtract this amount from the original oil charge of 11 ozs. to obtain "oil loss". If little or no oil has been lost from the system (major leak not indicated), drain amount of oil loss from the new compressor assembly.

   EXAMPLE: If 3 1/2 ozs. of oil were drained from an inoperative compressor, the oil loss would be 7 1/2 ozs. (11 - 3 1/2) and 7 1/2 ozs. would be drained from the new compressor.

3. If the amount of oil drained in step 1 is less than 1 1/2 ozs. and/or the system appears to have lost an excessive amount of oil:

   a. Disconnect the expansion valve outlet connection (evaporator inlet).

   b. Plug suction line connection at P.O.A. valve outlet.

   c. Disconnect oil bleed line at P.O.A. valve, using care not to damage line.

   d. Connect a cylinder of refrigerant regulated to not exceed 125 psi to this oil bleed fitting to force any retained oil from the evaporator out the evaporator inlet fitting. (Reverse flush the evaporator.) Catch any oil reverse flushed in this manner. If oil flushed from the system appears clean, install new compressor with 6-7 ounces of oil.

4. If oil drained in step 1 contains any foreign material such as chips, or there is evidence of moisture in the system, replace the receiver-dehydrator assembly and flush all component parts or replace if necessary. After flushing refrigerant system in this manner, the full oil charge (11 ozs.) should be left in the new service compressor.

COMPRESSOR REMOVAL

1. Connect the high and low pressure gauge lines from the gauge set to the respective connections on the P.O.A. valve and compressor. Disconnect thermal limiter connector and jumper terminals B and C. Be sure valves on gauge set are fully clockwise to close gauge set to center fitting and that a J 5420 or J 9459 adapter is between the low pressure hose and suction gauge fitting and also at the discharge gauge fitting.
2. Remove the flare nut from center connection on gauge manifold or the plug in the gauge line attached to the center connection. Wrap the line at the outlet with a cloth to protect personnel and car surfaces from oil or refrigerant.
3. Depressurize refrigeration system.
4. After the system is completely depressurized, very slowly loosen screw which retains compressor fittings assembly to compressor (Figs. 1A-54 thru 1A-57). As screw is being loosened, work fittings assembly back and forth to break seal and carefully bleed off any remaining pressure.

WARNING: High pressure may still exist at the discharge fitting. If this pressure is released too rapidly, there will be a considerable discharge of refrigerant and oil.

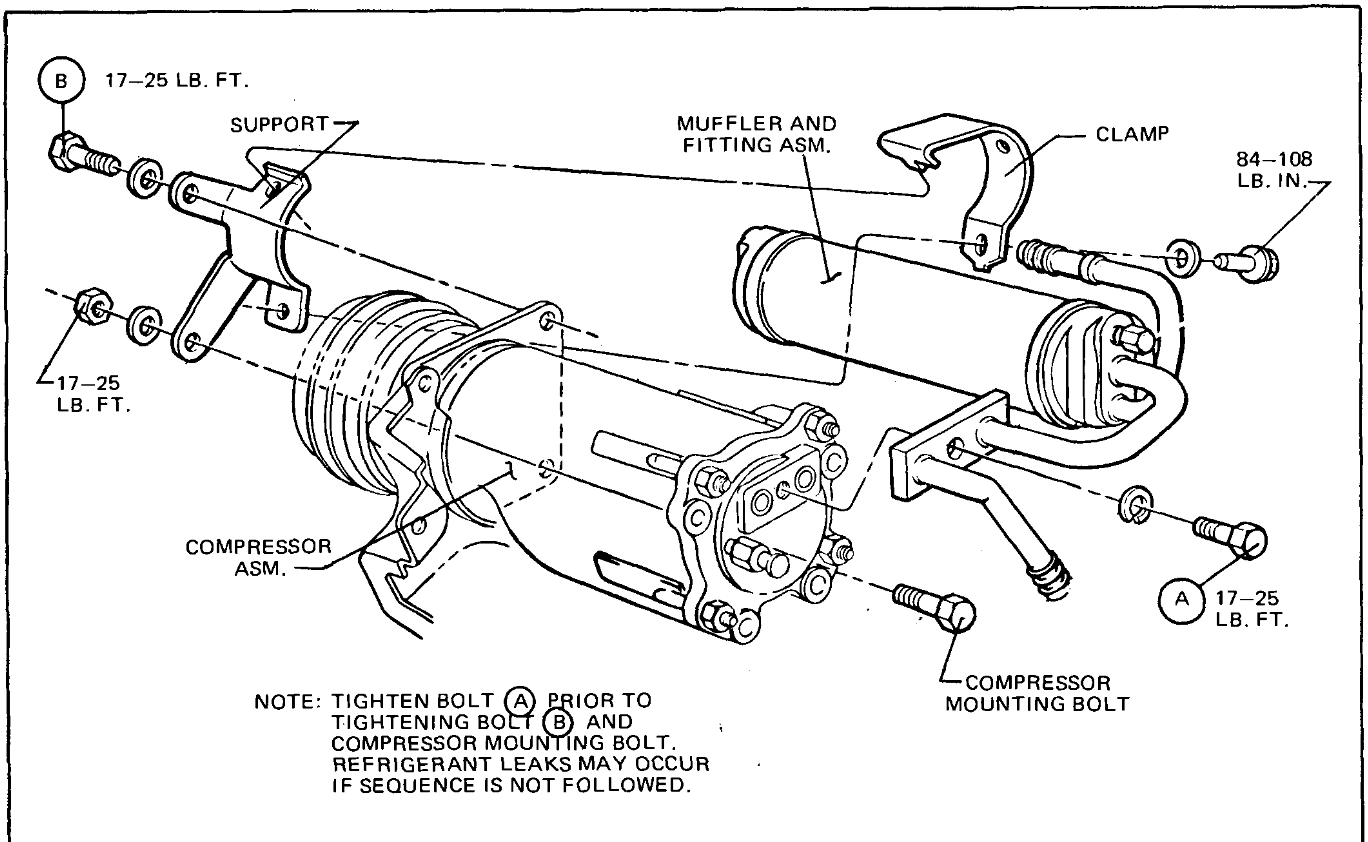


Fig. 1A-54 B Series Muffler and Compressor Fittings Assembly

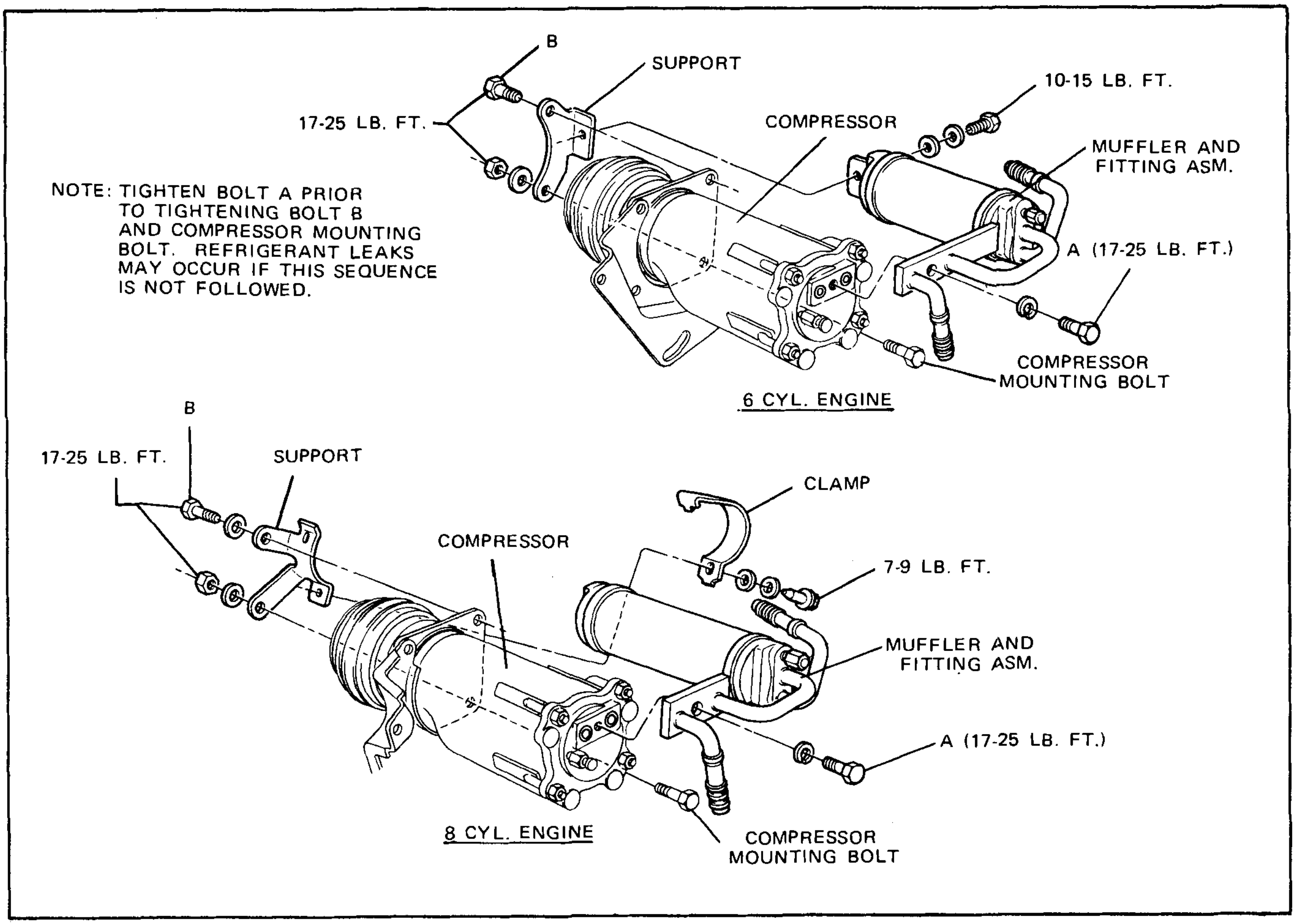


Fig. 1A-55 A and G Series Muffler and Compressor Fittings Assembly

5. When all pressure has been relieved, remove screw, fittings assembly and O-ring seals.

6. Immediately cover all openings in compressor and rest of system.

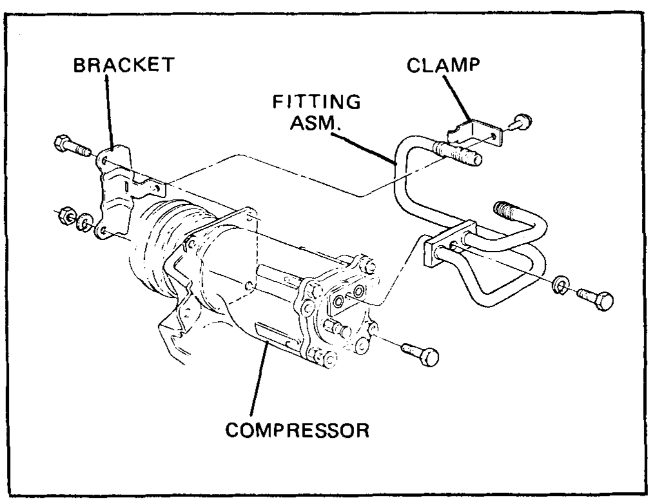


Fig. 1A-56 F Series Compressor Fittings Assembly

A simple way to cover compressor openings is with a plate (similar to the one on new compressor) which can be attached with fittings assembly screw, using the O-rings to provide a seal.

7. Disconnect compressor clutch coil wire and superheat switch wire, remove compressor mounting plates to bracket bolts (front and rear) and remove compressor from car. Refer to Figs. 1A-58 thru 1A-59 for compressor mounting.

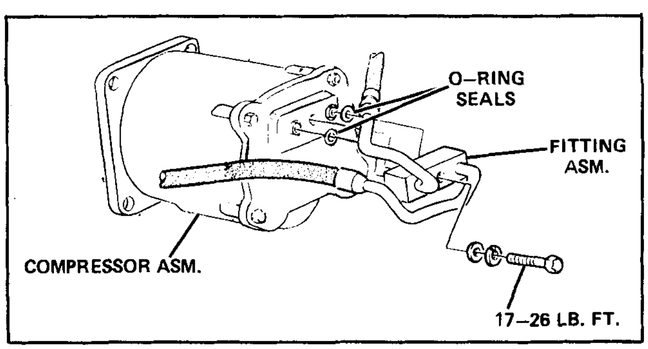


Fig. 1A-57 X Series Compressor Fittings Assembly

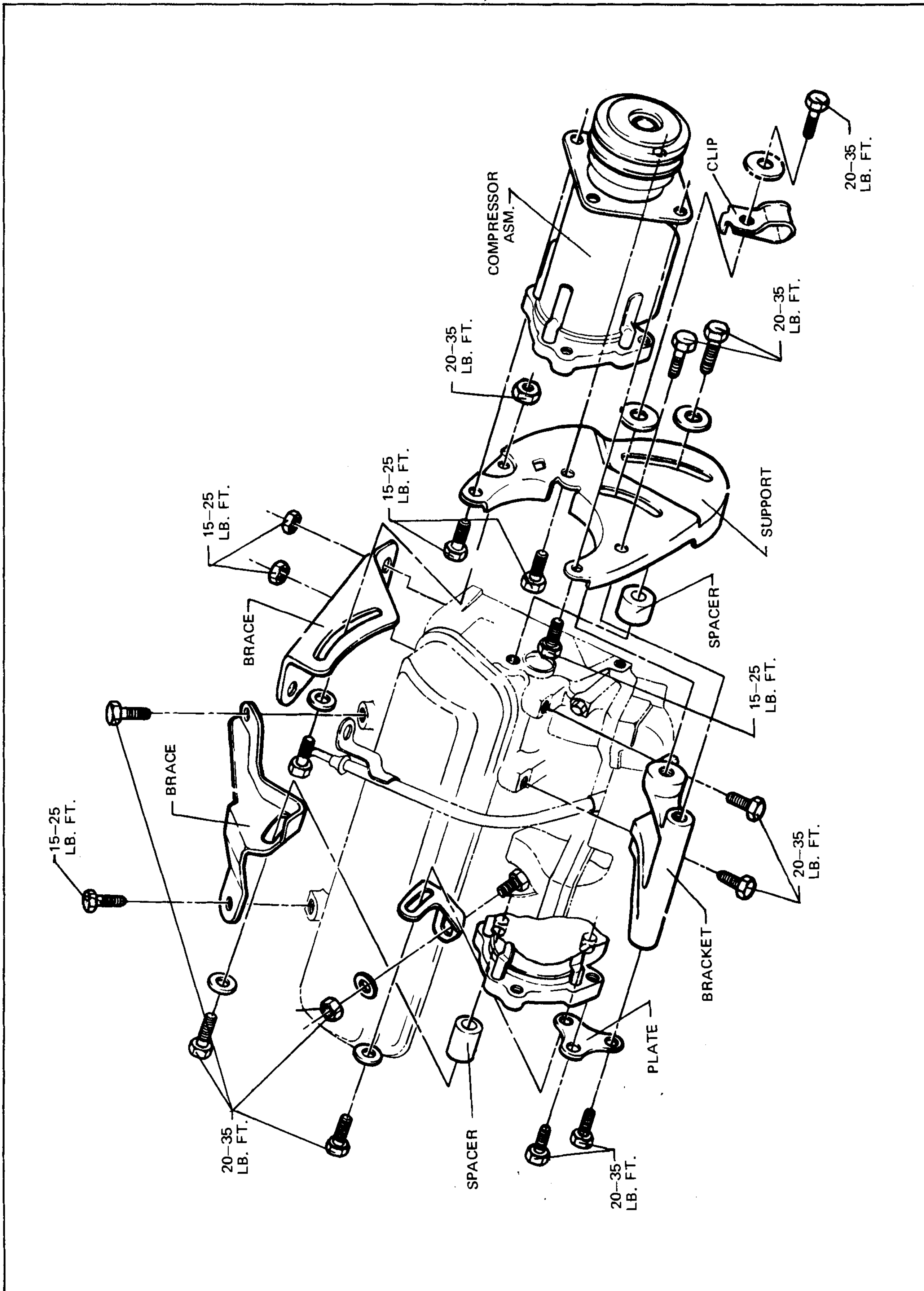


Fig. 1A-58 8-Cylinder Engine Compressor Mounting - Except 307 Engine

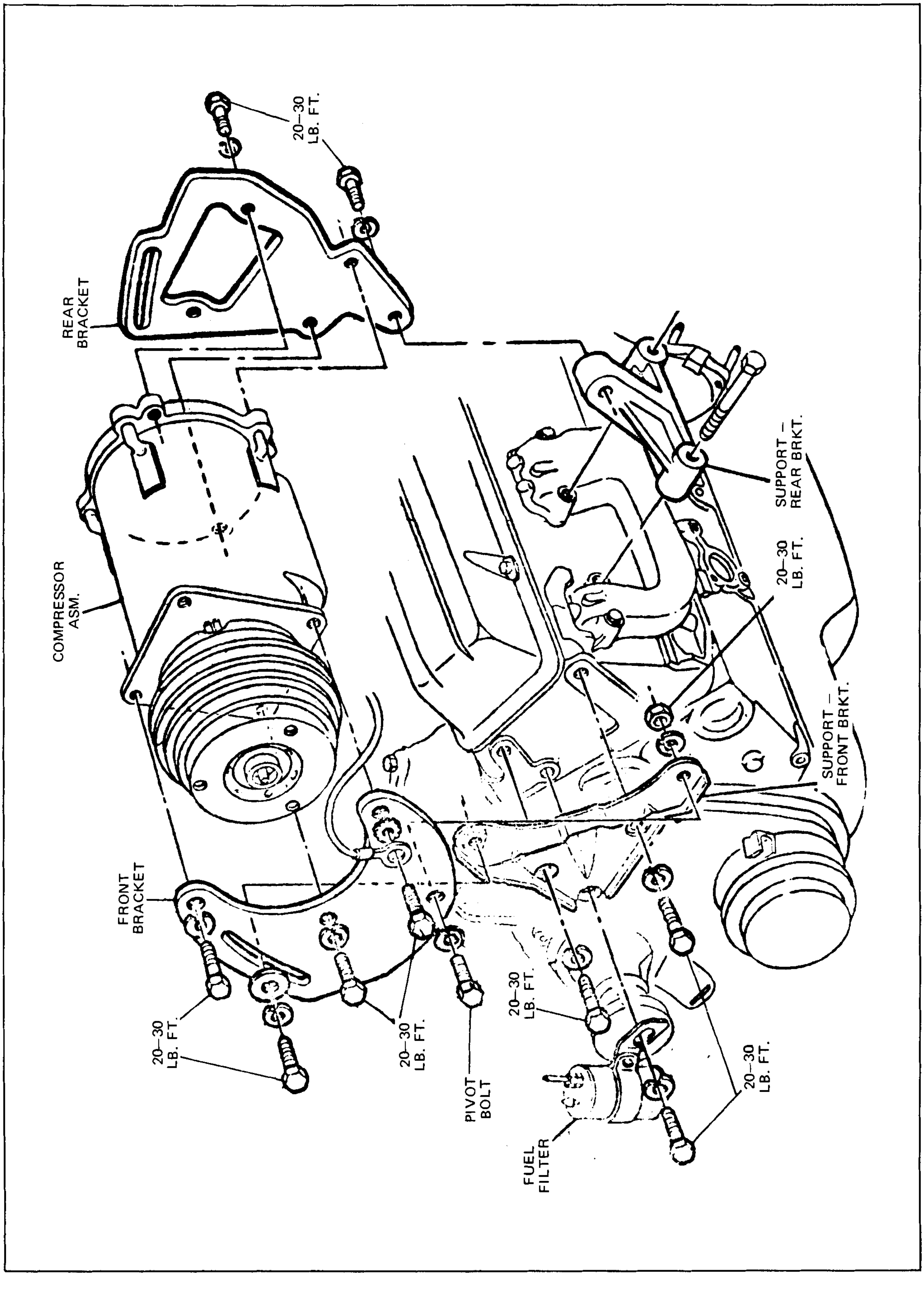


Fig. 1A-58A X Series Compressor Mounting - 307 Engine

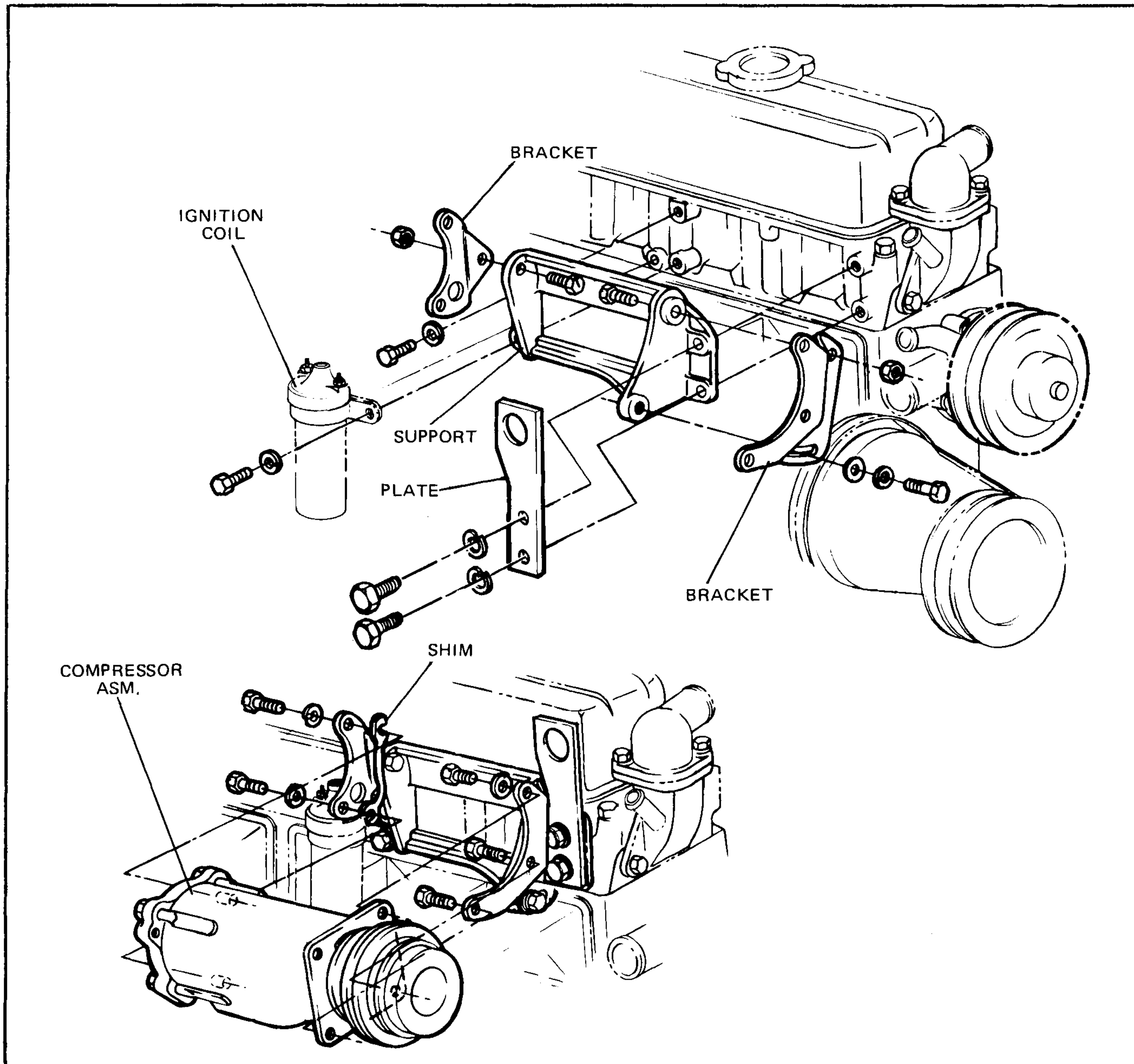


Fig. 1A-59 A Series 6-Cylinder Engine Compressor Mounting

8. If there is any possibility that broken parts from the compressor got into the discharge line or the condenser, all refrigeration system parts should be cleaned and a new receiver-dehydrator assembly should be installed.

9. Drain all oil from compressor just removed into a clean dry container and replace compressor drain plug screw. Measure amount of oil drained. See CHECKING COMPRESSOR OIL LEVEL AND ADDING OIL.

COMPRESSOR REPLACEMENT

CAUTION: *Before installing a new compressor, rotate compressor shaft four or five times. This permits proper lubrication of compressor seal over all of its surface. Before compressor clutch is mounted to the new compressor, wipe the front face of the compressor thoroughly with a clean dry cloth and, if necessary, clean front of compressor with a solvent to remove any excess oil. Cleaning compressor in this manner will prevent any oil from being thrown onto the clutch surfaces which could cause slippage and eventual clutch failure.*

1. Stamp refrigerant charge of system on new compressor in space on plate provided for this information.

2. Install new compressor on car, leaving compressor fittings opening cover plate on compressor.

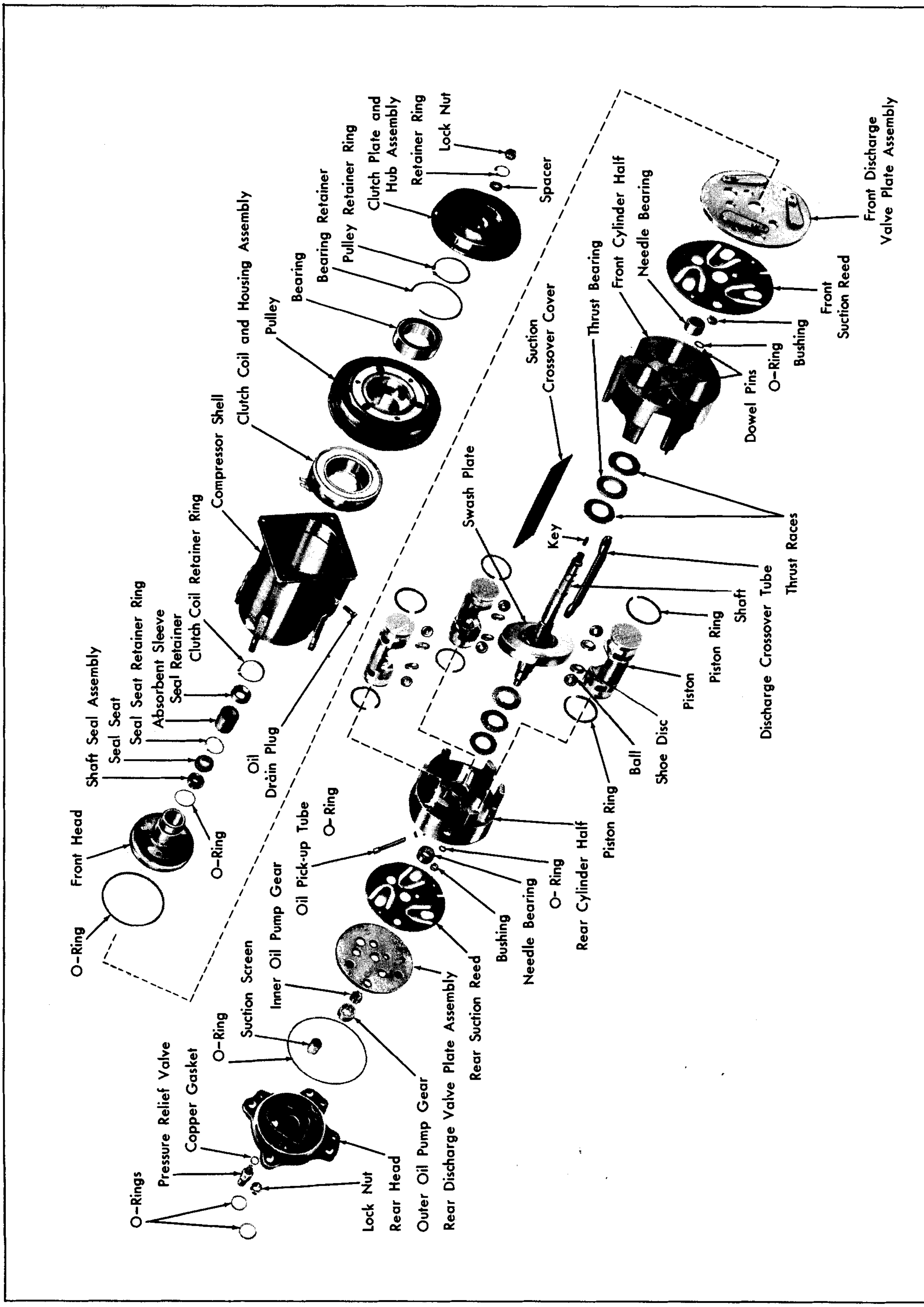


Fig. 1A-60 Exploded View - Compressor Assembly

3. Remove cover plate from compressor openings very slowly to bleed off pressure.

WARNING: New compressors are charged with a mixture of nitrogen, refrigerant and 11 fluid ozs. of 525 viscosity refrigeration oil. If the cover is removed too rapidly, the oil may be blown out violently due to the sudden release of pressure.

4. Install coil and clutch parts if not already installed.
5. Evacuate, charge and leak test the system. Disconnect jumper wire from limiter connector and connect thermal limiter.

COMPRESSOR HUB AND DRIVE PLATE ASSEMBLY - REMOVE AND REPLACE

REMOVE:

1. Hold the clutch hub with J 9403 wrench and, using J 9399 (special thin wall 9/16" socket), remove hub and drive plate assembly lock nut from shaft (Figs. 1A-60 and 1A-61).
2. Remove hub and drive plate assembly retainer ring, using J 5403 (No. 21 pliers). Remove spacer (Fig. 1A-62).
3. Screw threaded hub puller J 9401 into the hub. Holding body (J 9401-2) of tool with a wrench, tighten the center screw (J 9401-1) to remove hub and drive plate assembly (Fig. 1A-63). Remove J 9401 puller.

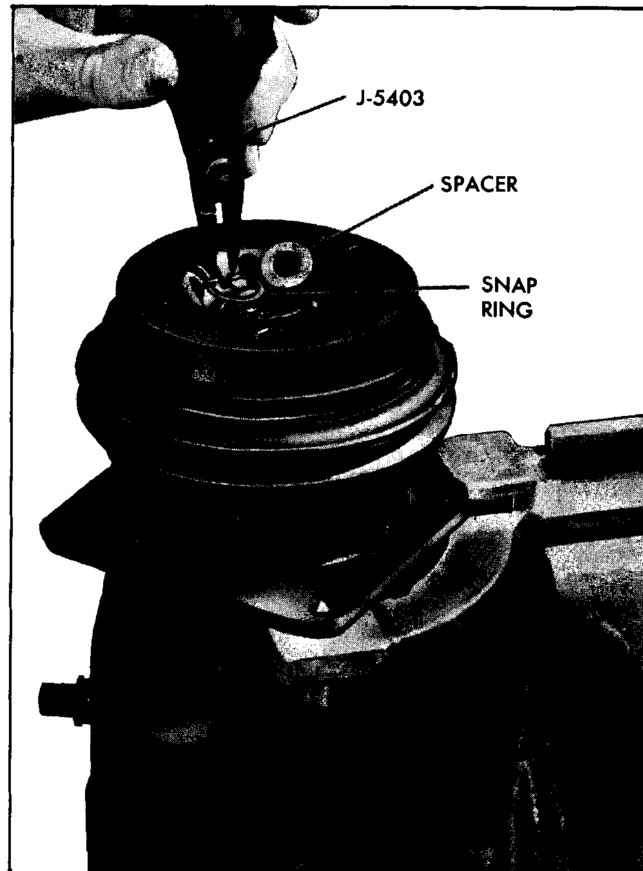


Fig. 1A-62 Removing Hub Retainer Ring and Spacer

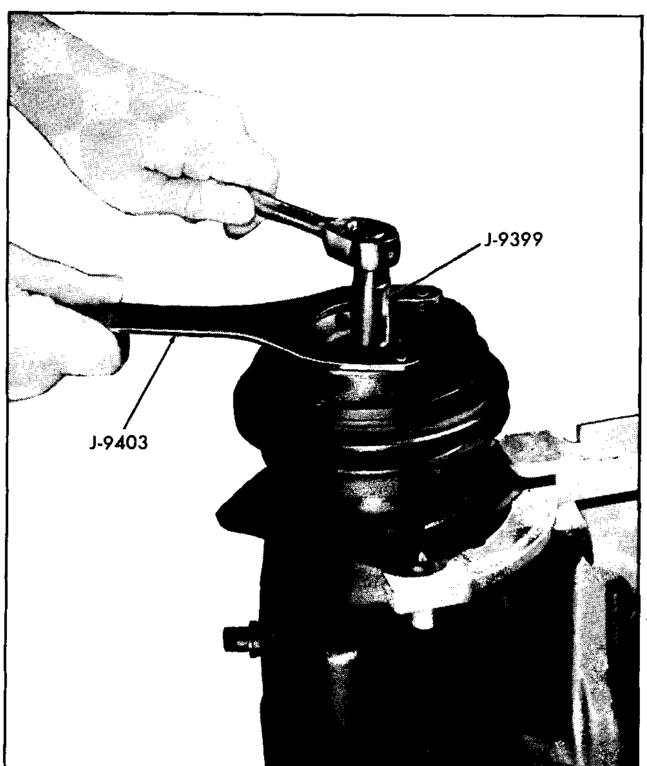


Fig. 1A-61 Removing Hub and Drive Plate Lock Nut

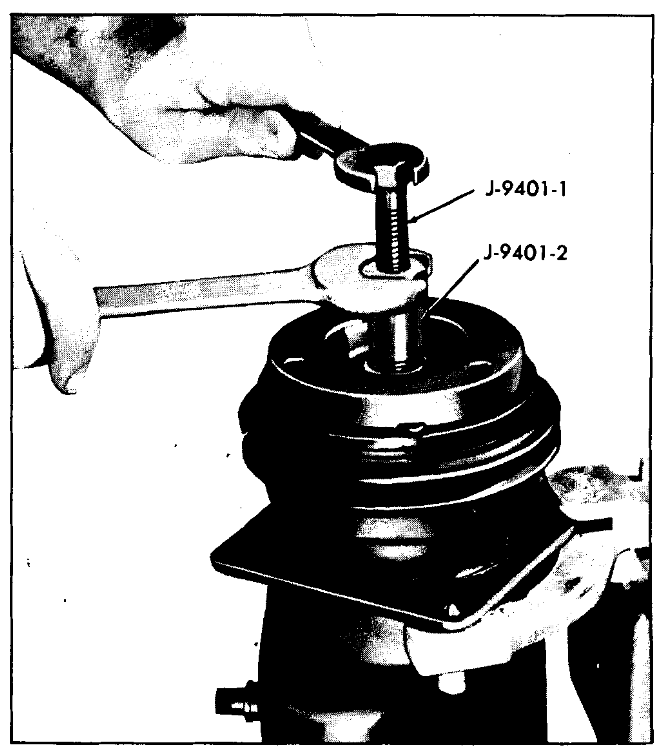


Fig. 1A-63 Removing Hub and Drive Plate Assembly

4. Remove hub and drive plate assembly key from shaft.

REPLACE:

1. Insert square drive key into shaft so that it projects approximately 3/16" out of end of keyway (Fig. 1A-64). Wedge into keyway with blunt tool.
2. Line up keyway in hub with key way in shaft.

   CAUTION: *To avoid internal damage to the compressor, DO NOT drive or pound on hub and drive plate assembly or on end of shaft. If proper tools to remove and replace clutch parts are not used, it is possible to disturb the position of the swash plate (keyed to main shaft) resulting in compressor damage.*

3. Position hub and drive plate assembly into compressor front end casting.
4. Place J 9480-2 "free" spacer on hub and drive plate assembly and screw the J 9480-1 drive plate installing tool on threaded end of compressor shaft approximately three full turns (to prevent tool from forcing key out of keyway). Make certain key remains in place when pressing hub on shaft.
5. Using wrench on end of tool body and another wrench on hex nut, tighten nut to press hub and drive plate assembly onto shaft approximately 1/4".
6. Remove tool and look into armature plate hub to make certain key remains in place.

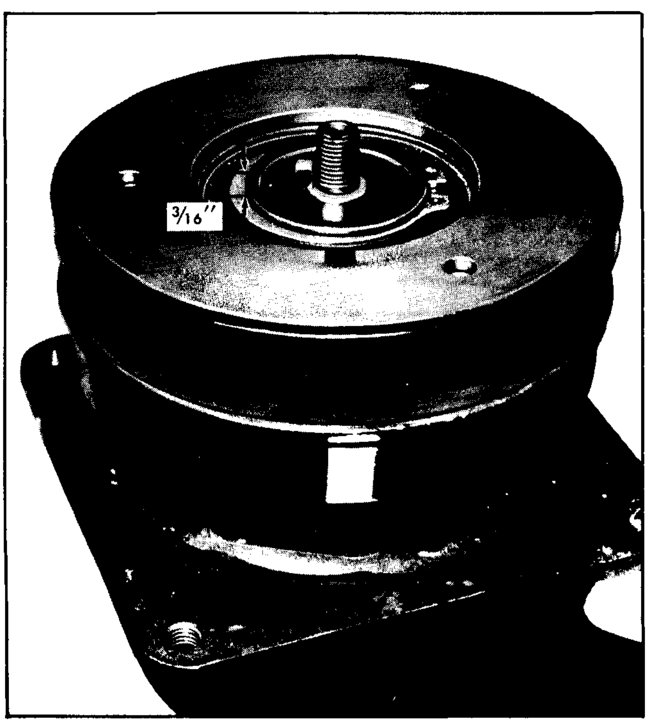


Fig. 1A-64 Proper Position of Hub and Drive Plate Key

7. Install J 9480-01 and press until there is approximately .002"-.057" (1/32"-1/16") space between the frictional faces on pulley and drive plate (Fig. 1A-65).
8. Remove J 9480-01 assembly.
9. Install hub spacer washer.
10. Install hub and drive plate assembly retainer ring with flat side of ring facing spacer, using J 5403 (No. 21 pliers). J 9399 can be used to "snap" retainer ring in place.
11. Install a new armature plate and hub lock nut, using J 9399 (special thin wall 9/16" socket). Tighten to 15 lb. ft. torque. The air gap between the friction faces of pulley and drive plate should now be between .002" to .057" (1/32" to 1/16") clearance.
12. Operate engine and refrigeration system with suction pressure of at least 30 psi and discharge pressure of at least 150 psi. Cycle clutch (by turning air conditioning off and on) at least twenty times at approximately one-second intervals to "seat" or "run-in" mating parts of clutch.

COMPRESSOR PULLEY AND/OR BEARING ASSEMBLY - REMOVE AND REPLACE

REMOVE:

1. Remove hub and drive plate assembly.

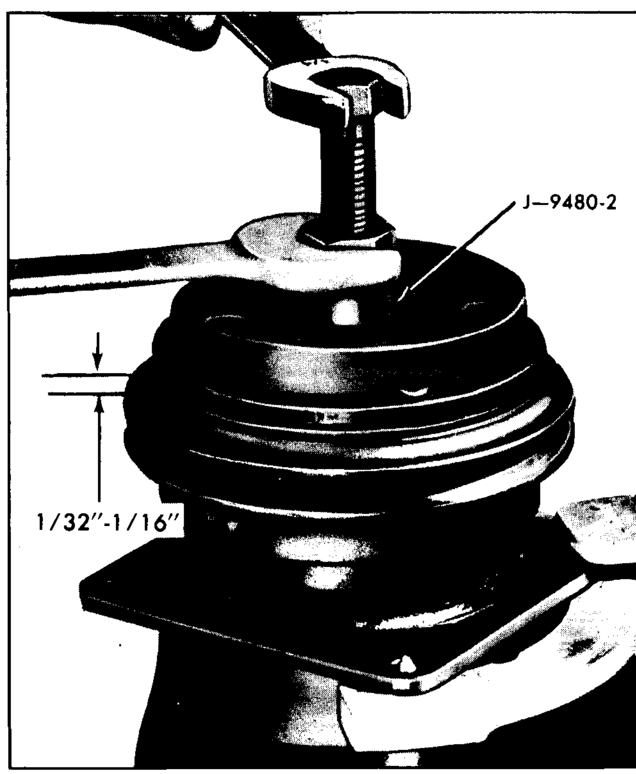


Fig. 1A-65 Installing Hub and Drive Plate Assembly

2. Remove pulley assembly retainer ring, using J 6435, No. 26 pliers, (Fig. 1A-66).
3. Place J 9395 puller pilot over compressor shaft and remove pulley assembly, using J 8433 pulley puller.
4. Remove puller and pilot.
5. Remove pulley bearing wire retainer ring with an awl or a small screwdriver (Fig. 1A-67).
6. Remove bearing assembly, using J 9398 bearing remover and J 8092 handle to press out bearing.

REPLACE:

If the existing pulley and drive plate and hub assembly are to be reused, clean the drive faces on each part with alcohol or similar solvent. If these parts show evidence of warpage due to overheating, they should be replaced.

1. When placing a new bearing assembly into pulley, use J 9481 pulley bearing installer (Fig. 1A-68).
2. Replace the pulley assembly wire retainer ring in pulley.

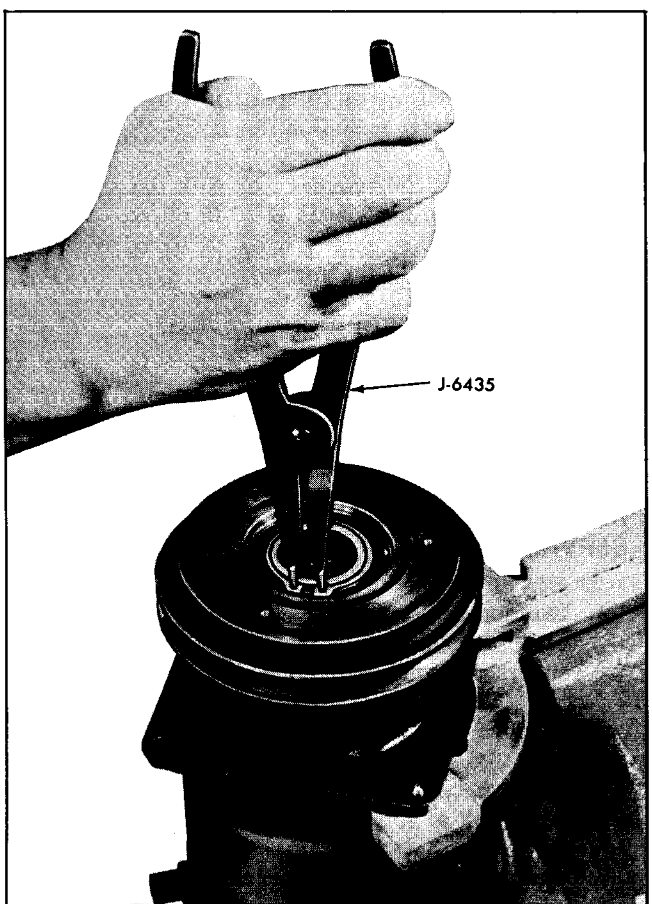


Fig. 1A-66 Removing Pulley and Bearing Assembly Retainer Ring

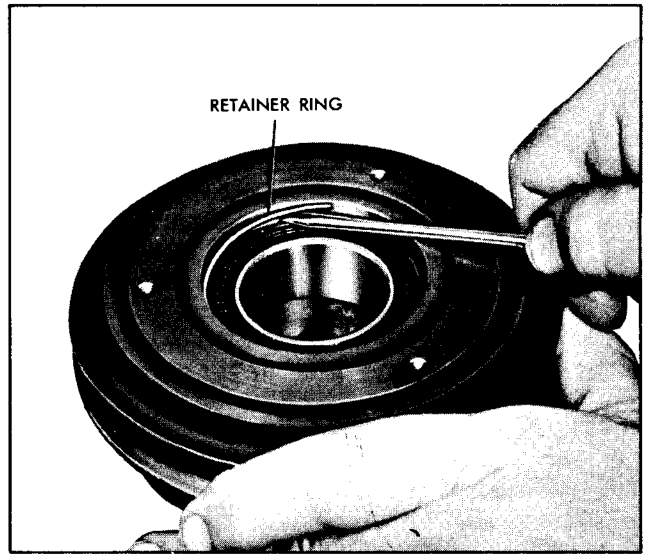


Fig. 1A-67 Removing Pulley Bearing Retainer Ring

3. Press or tap pulley and bearing assembly on the neck of the compressor, using J 9481 (Fig. 1A-69).

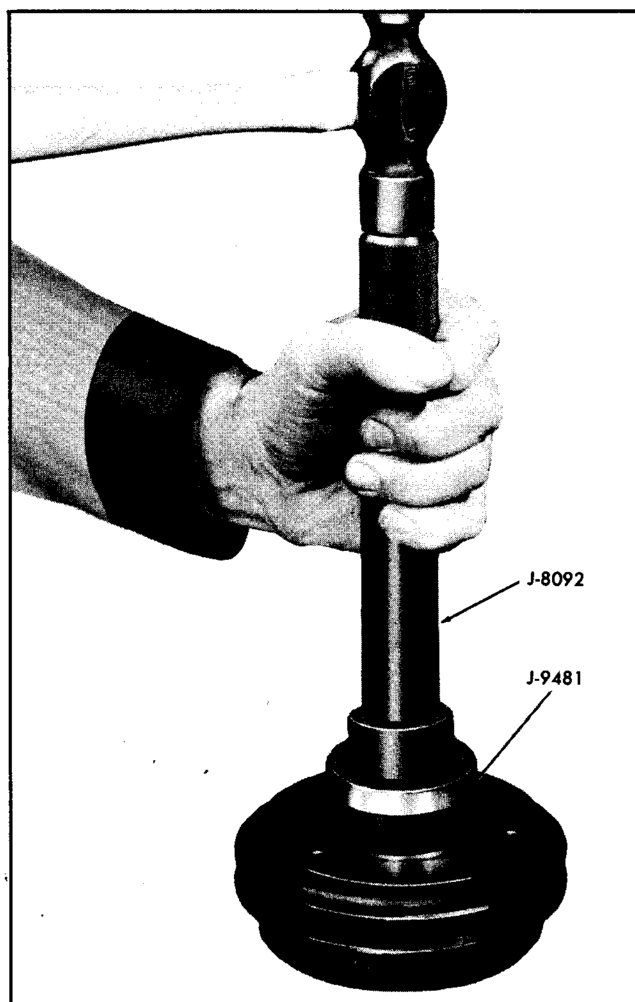


Fig. 1A-68 Installing Bearing on Pulley

4. The pulley should rotate freely.
5. Install pulley snap ring retainer, using J 6435 (No. 26 pliers). Assure installation of snap ring by tapping with J 9481.
6. Replace hub and drive plate assembly; be sure to use the proper tools to replace this assembly. DO NOT drive or pound on hub assembly.

COMPRESSOR CLUTCH COIL AND HOUSING ASSEMBLY - REMOVE AND REPLACE

REMOVE:

1. Remove hub and drive plate assembly.
2. Remove pulley and bearing assembly.
3. Remove electrical connector from terminals on coil.
4. Note position of electrical terminals and scribe location of coil housing terminals on compressor body.
5. Use J 6435 (No. 26 pliers) and remove coil housing retainer ring (Fig. 1A-70).

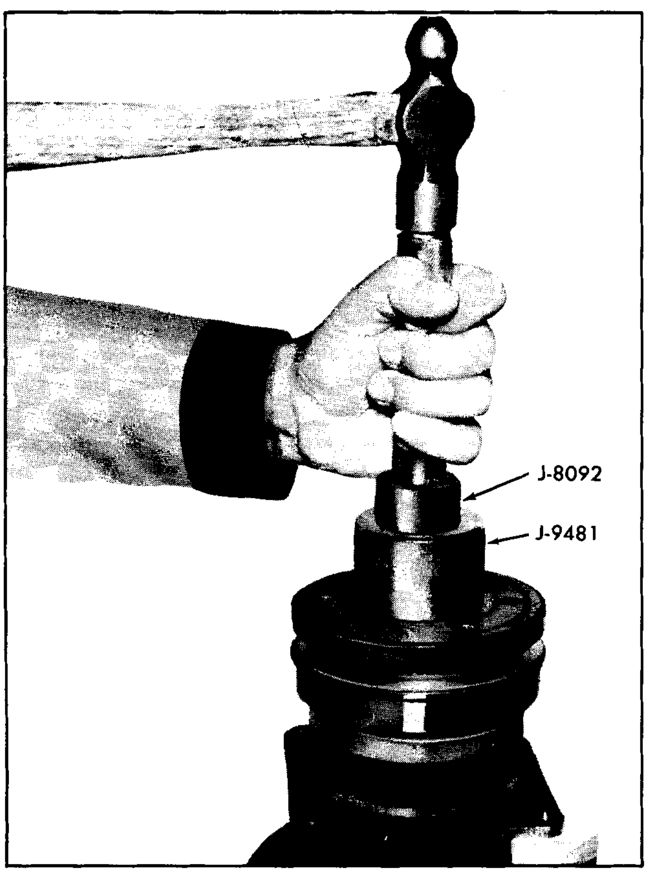


Fig. 1A-69 Installing Pulley and Bearing Assembly

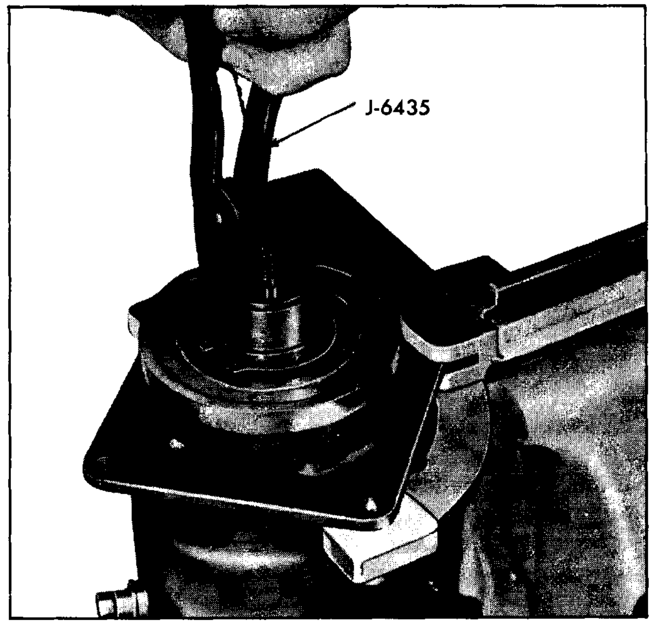


Fig. 1A-70 Removing Coil Housing Retainer Ring

6. Remove coil housing assembly.

REPLACE:

1. Position clutch coil on compressor front head casting so electrical terminals are in their proper location as previously scribed on compressor body. Make certain coil is properly seated on dowels.
2. Replace the coil retainer ring with flat side of ring facing coil, using J 6435 (No. 26 pliers).
3. Connect electrical connector.
4. Replace pulley and bearing assembly.
5. Replace hub and drive plate assembly, using the proper tools. DO NOT drive or pound on hub assembly.

REMOVING COMPRESSOR ASSEMBLY TO SERVICE ENGINE

1. Disconnect compressor clutch coil ground wire at compressor and wire connector at coil. Disconnect superheat switch wire connector at rear head.
2. Remove compressor drive belt.
3. Remove compressor rear brace to cylinder head brace bolt at compressor mounting bracket.
4. Remove compressor front plate to mounting bracket upper bolts and lower adjusting bolt.
5. Remove compressor rear plate to mounting bracket lower adjusting bolt.

6. Pad fender and fender skirt and place compressor near top of fender skirt, securing compressor to right fender brace (with wire, rope, etc.).

   CAUTION: *Do not kink any hoses or place excessive tension on the hose.*

7. Replace by reversing the above procedure.

8. Tighten compressor belt to proper tension as indicated on belt tension gauge (See Engine Section of this manual).

COMPRESSOR SHAFT SEAL ASSEMBLY - REMOVE AND REPLACE

When refrigeration 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 broken shaft seal. See CHECKING COMPRESSOR OIL LEVEL AND ADDING OIL.

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 a propane torch (or electronic) type leak detector in good condition.

REMOVE:

1. Disconnect thermal limiter and jumper terminals B and C of limiter connector.

2. Depressurize refrigerant system.

3. Remove hub and drive plate assembly and shaft key.

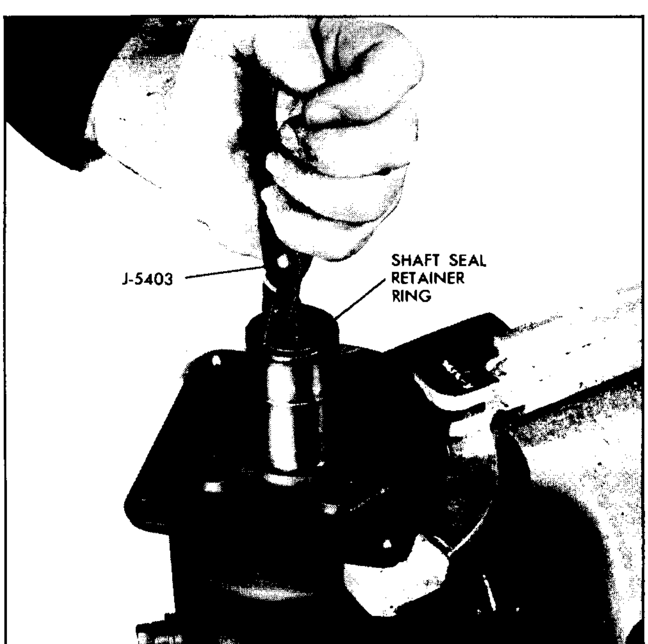


Fig. 1A-71 Removing Shaft Seal Seat Retainer

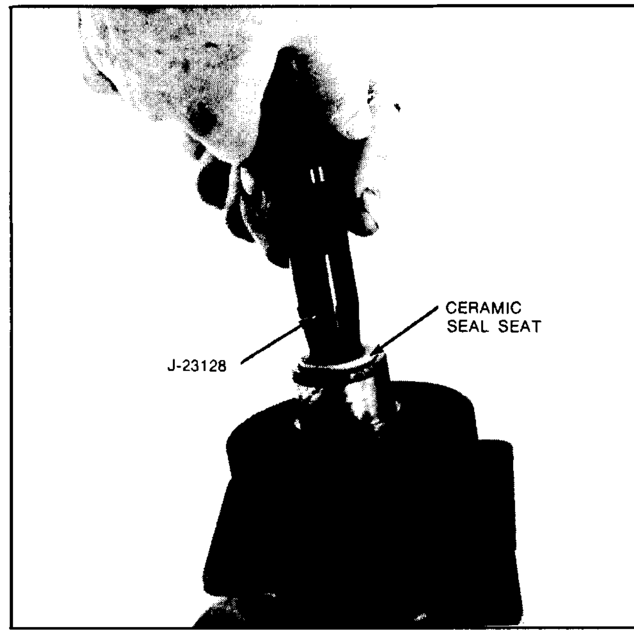


Fig. 1A-72 Removing Shaft Seal Seat

4. The compressor has an absorbent sleeve in the neck; pry out sleeve retainer and remove sleeve.

5. Remove shaft seal seat retaining ring, using J 5403 pliers (Fig. 1A-71).

6. 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

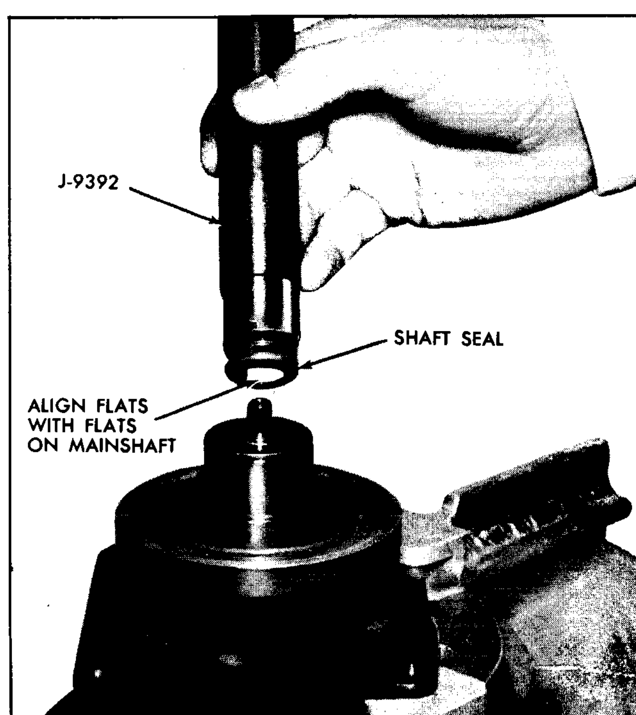


Fig. 1A-73 Removing Shaft Seal Assembly

to prevent any dirt or foreign material from getting into compressor.

7. Remove shaft seal seat using J 23128. Insert the knurled collet into the recess in the seal and tighten the knurled handle as tightly as possible by hand and remove seal seat with a twisting motion (Fig. 1A-72).

8. Engage tabs on shaft seal assembly with locking tangs on J 9392 seal installer and remover. Press down on tool and twist clockwise to engage seal. Remove seal assembly by pulling straight out from shaft (Fig. 1A-73).

9. Remove O-ring from interior of compressor neck using J 9553. (A wire with a hook formed on end may be used. This hook may be made in a manner shown in Fig. 1A-74.)

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

REPLACE:

1. Coat the new seal seat O-ring with clean refrigeration oil and install it in its groove in the compressor neck. Tool J 21508 may be used.

2. Place seal protector J 25574 over end of shaft. Coat the O-ring and seal face of the new seal assembly with clean refrigeration oil and install new seal assembly on the shaft, using J 9392. NOTE: Take care to prevent chipping ceramic seal seat.

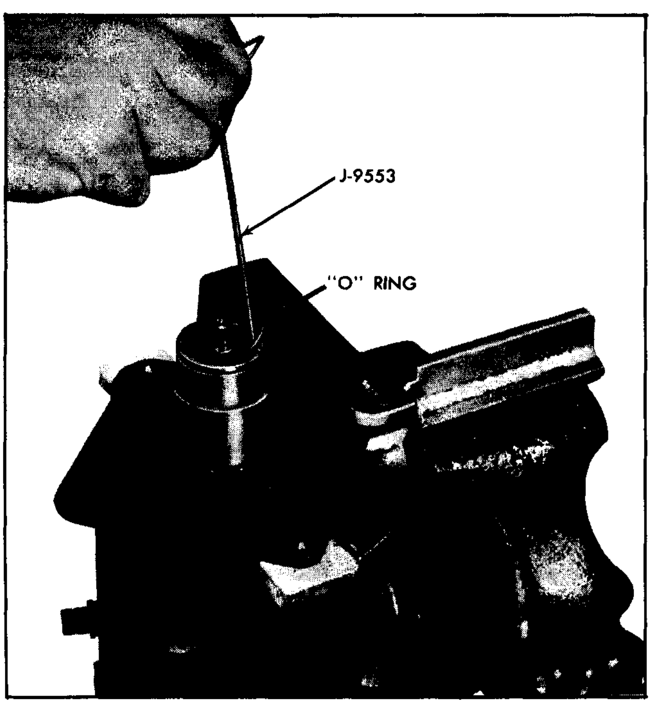


Fig. 1A-74 Removing O-Ring Seal

3. Coat the seal face of the new seal seat with clean refrigeration oil and install the new seal seat, using J 23128. Be sure the seal seat O-ring is not dislodged and seal seat is making a good seal with O-ring.

4. Install new seal seat retainer ring, using J 5403 (No. 21 pliers), with flat face against seal seat. The sleeve from J 9393 may be used to press on retainer ring so that it snaps into place. Remove seal protector J 25574 from end of shaft.

5. Leak test compressor and correct any leaks found.

6. Wipe out any excess oil inside the compressor neck and on the shaft.

7. Install new absorbent sleeve by rolling the material into a cylinder, overlapping ends and slipping sleeve into compressor neck with overlap toward top of compressor. With a small screwdriver or similar instrument carefully spread sleeve to remove the overlap so that in the final position the ends of sleeve will butt at top vertical centerline.

8. Position new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Tool J 9395 or the sleeve from J 9393 may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place, until the outer edge of the retainer is recessed approximately 1/32" from the face of the compressor neck.

9. Reinstall the hub and drive plate assembly.

10. Evacuate and charge refrigeration system.

11. Perform leak test. Check system operation.

12. Disconnect jumper wire and restore thermal limiter connection.

COMPRESSOR ASSEMBLY-OVERHAUL

The following operations are based on the use of recommended service tools and the availability of an adequate stock of service parts.

Service parts should include:

1. Standard size piston drive balls.
2. Shoe discs--total of 10 sizes, including ZERO shoe.
3. Thrust races--total of 14 sizes, including the ZERO race.
4. Pistons--both standard head and re-expansion heads.
5. Main shaft-needle bearings.
6. Thrust bearings.

7. Compressor shaft, swash plate and key assembly.
8. Service cylinder assembly-front and rear halves with main bearing in place and halves dowel-pinned together.
9. Major interior mechanism assembly.
10. Suction reed valve-front, rear.
11. Discharge valve assembly-front, rear.
12. Gasket service kit-containing all gaskets, seals, O-rings, etc. This is to be used each time a compressor is rebuilt after a teardown.
13. Shaft seal kit.
14. Nuts-head to shell and shaft.
15. Ring-retainers.
16. Cylinder locator pins.
17. Valve and head locator pins.
18. Service type-discharge crossover tube kit.

A clean work bench, orderliness of the work area and a place for all parts being removed and replaced is of great importance. Any attempt to use makeshift or inadequate equipment may result in damage and/or improper operation of compressor.

CARE AND HANDLING OF SERVICE PARTS

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

In addition, some parts are identified on the piece part to denote its size or dimension. This applies to the piston shoe discs and the shaft thrust races.

To provide suitable and adequate quantities and grouping of parts for servicing the compressor, kits are available which contain these necessary parts. The gasket kit should be used whenever it is necessary to overhaul or rebuild the entire compressor internal mechanism or when replacing some individual internal part.

OVERHAUL PREPARATIONS

Anytime a major overhaul or rebuilding operation is to be performed on the compressor, obtain and install compressor gasket kit. Kit includes all of the necessary O-rings and gaskets. An ample supply of piston rings should also be obtained.

1. Remove drive plate and hub assembly.
2. Remove pulley and bearing assembly.
3. Remove clutch coil and coil housing assembly.
4. Remove compressor assembly, leaving fittings assembly attached to refrigerant lines. Keep compressor horizontal at all times. Placing the compressor on either end will allow oil from the compressor sump to enter the head.
5. Seal compressor fittings opening and openings in compressor rear head.
6. Thoroughly clean exterior of compressor assembly and blow dry with compressed dry air.
7. Clean compressor assembly on clean, dry work bench.

   CAUTION: *Under no circumstances should compressor be placed on the pulley end.*

REMOVING REAR HEAD ASSEMBLY

1. Remove compressor oil plug, tilt compressor and drain oil into clean dry container. It may be possible to get only 4 to 6 ozs. of oil from the compressor at this time.
2. Attach J 9396 holding fixture to compressor and mount in vise.
3. Remove compressor pressure relief valve.
4. Remove four lock nuts from threaded studs welded to compressor shell and remove rear head. (NOTE: Some oil may drain when the head is removed.)
5. Examine surface on rear head casting web. If any damage is observed, the head should be replaced (Fig. 1A-75).

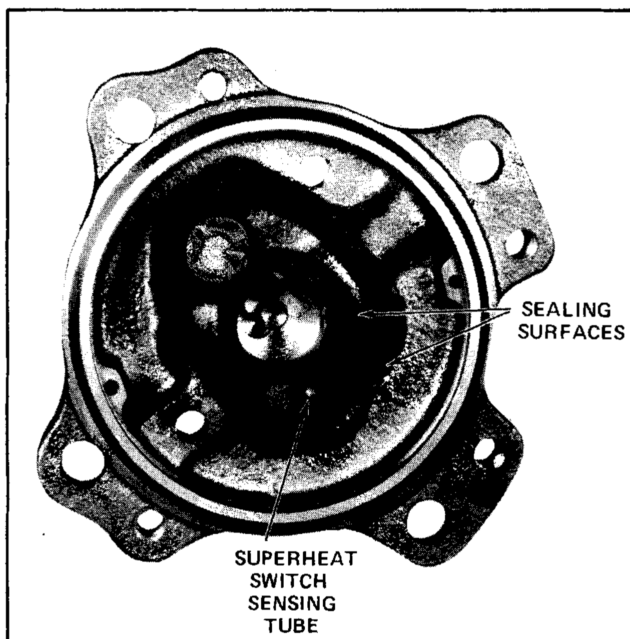


Fig. 1A-75 Sealing Surface on Head Casting Web

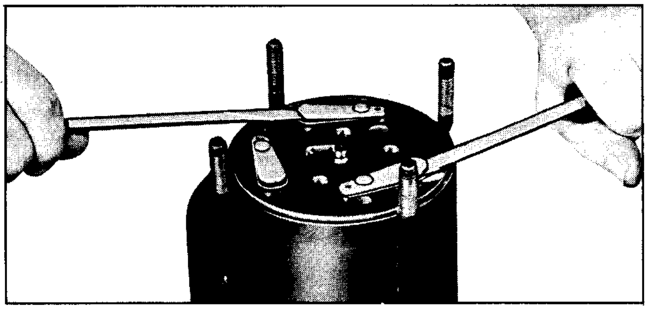


Fig. 1A-76 Removing Discharge Valve Plate

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

7. Remove oil pump gears noting how they are mated (end-to-end) and inspect for damage. Replace both gears if one or both show damage. Keep gears mated as they were when removed.

8. Remove rear head to compressor shell O-ring seal and inspect for damage, cuts nicks or imperfections. A damaged seal may cause a refrigerant leak. In any event, this O-ring seal must be replaced with a new one.

9. Carefully remove rear discharge valve plate assembly by prying up on assembly (Fig. 1A-76), and examine discharge valve reeds and seats. Replace entire assembly if excessively scored or if one of the three reeds is broken or seats are damaged.

10. Carefully remove rear suction reed and examine for any damage. Replace if necessary (Fig. 1A-77).

REMOVING, INSPECTING AND CHECKING MAJOR INTERIOR MECHANISM

1. Remove shaft seal seat retainer ring, using J 4245 (No. 23 pliers).

2. Remove shaft seal seat, using J 23128.

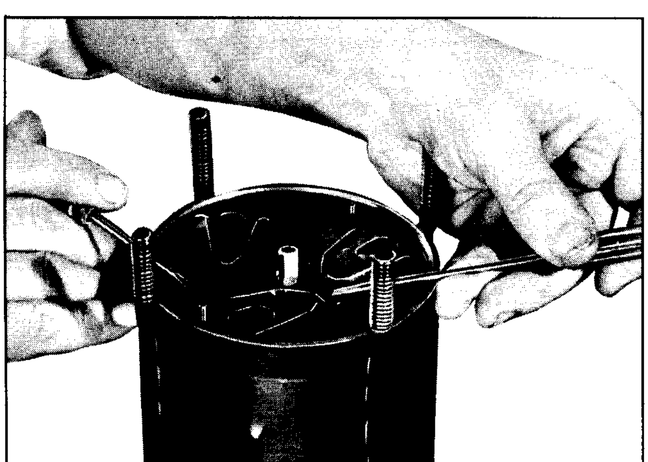


Fig. 1A-77 Removing Suction Reed

3. Engage tabs on compressor shaft seal assembly with locking tangs on J 9392 seal installer and remover. Press down on tool and twist clockwise to engage seal. Remove seal assembly by pulling straight out from shaft.

4. Remove O-ring from interior of front head casting bore.

5. Remove oil pick-up tube and O-ring, using a wire with a hook formed in one end or J 5139 oil pick-up tube remover (Fig. 1A-78).

6. Push on front end of compressor head to remove mechanism from rear of shell. DO NOT hammer on end of compressor shaft or use undue force to remove the compressor internal mechanism. This assembly will slide out easily. (NOTE: Some oil will drain from compressor when assembly is removed.)

7. Remove compressor front head casting assembly from compressor shell. Examine sealing surface for damage and/or deep scratches. Replace if necessary.

8. Remove compressor front head casting to shell O-ring seal and inspect for damage, cuts, nicks or imperfections. A damaged seal may cause a refrigerant leak. In any event, this O-ring must be replaced with a new one.

9. Remove the front discharge reed plate and suction reed and examine for damage.

10. Examine internal mechanism for any obvious damage. Turn compressor shaft and check for smoothness of operation as well as for any scratches in bores, etc. (NOTE: If mechanism has sustained major damage due possibly to loss of refrigerant and/or oil, it may be necessary to use the service interior mechanism or the service cylinder assembly rather than replace individual parts.)

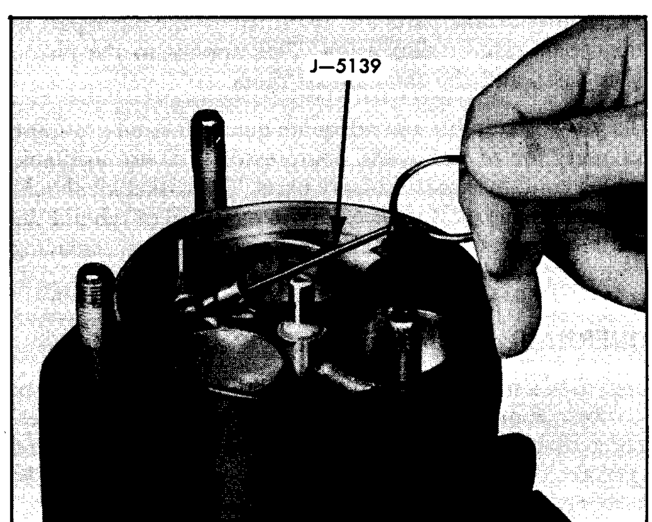


Fig. 1A-78 Removing Oil Pick-up Tube

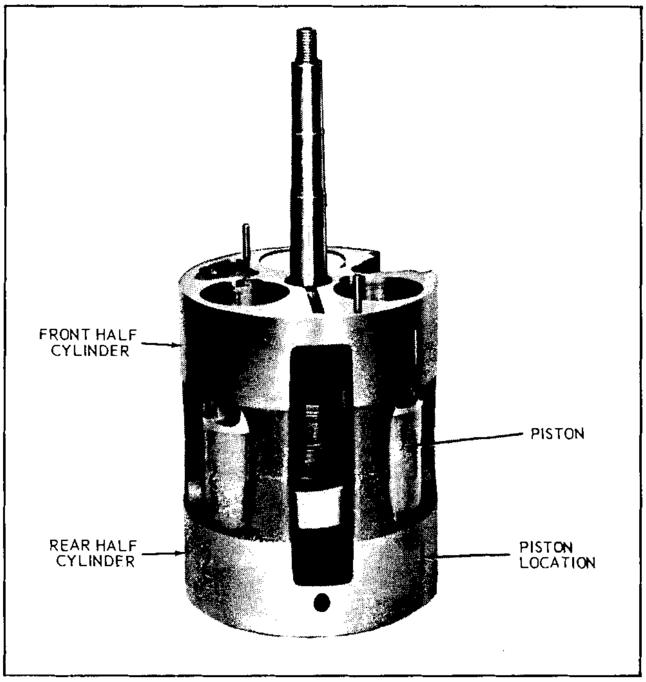


Fig. 1A-79 Pistons and Cylinders

11. Remove suction crossover cover by sliding out of slots.

DISASSEMBLE:

Obtain clean J 9402 assembly parts tray to retain compressor parts during disassembly.

1. Number pistons (1, 2 and 3) and their bores so that parts can be replaced in their original locations (Fig. 1A-79).
2. Turn compressor shaft to position swash plate toward front of compressor in area of discharge crossover tube. Drive discharge crossover tube out of rear

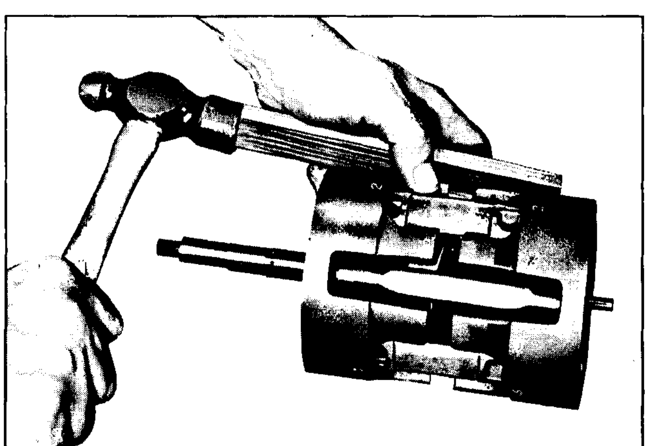


Fig. 1A-80 Separating Cylinder Halves

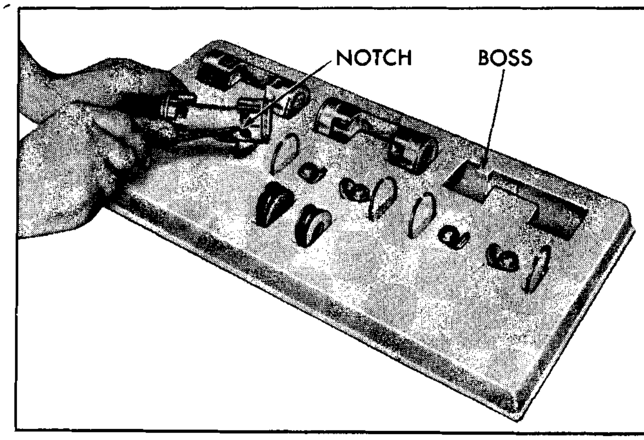


Fig. 1A-81 Compressor Parts in Tray

head assembly toward front of compressor using a wooden block as shown in Fig. 1A-80. Use care so that discharge crossover tube is not damaged by swash plate.

3. Separate front and rear cylinder assemblies being careful not to damage any parts during separation.
4. Remove rear cylinder half from pistons.
5. Drive discharge crossover pipe from front head.
6. Push on compressor shaft and carefully remove pistons, piston rings, shoes and balls; one assembly at a time. Place parts in J 9402 tray to keep parts together (Fig. 1A-81). The front end of piston has an identifying notch in the casting web (Fig. 1A-82).
7. Remove all piston shoe discs, examine for indication of failure or probable cause of failure, then discard all shoe discs.
8. Examine piston balls and, if satisfactory for reuse, put aside in assembly tray in compartment associated with proper end of piston.

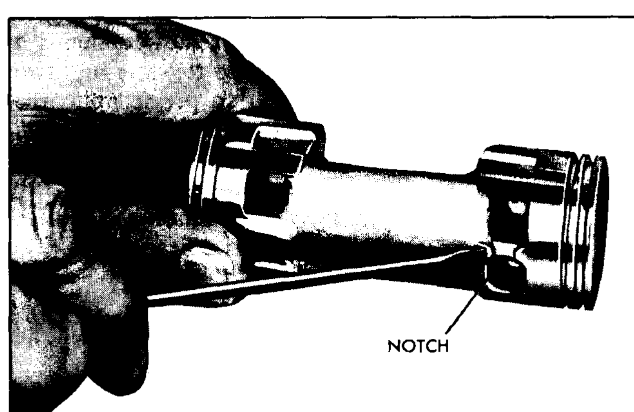


Fig. 1A-82 Piston Front End Identification

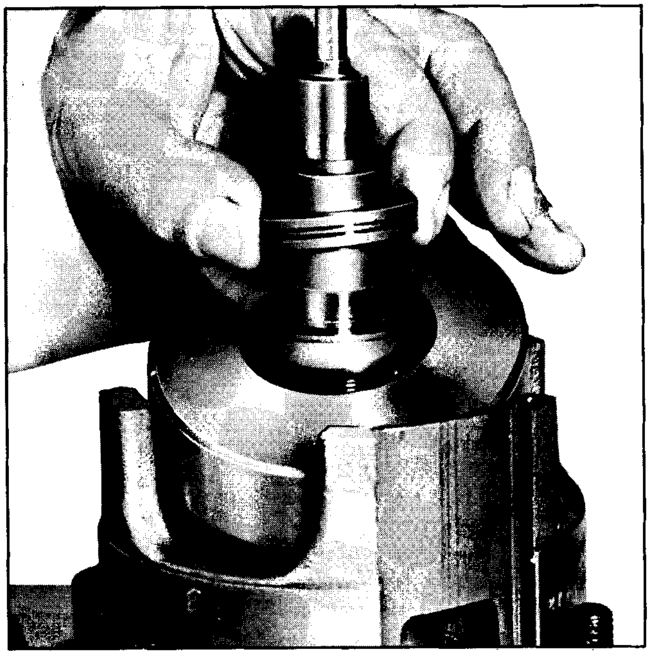


Fig. 1A-83 Removing Rear Thrust Races and Bearing

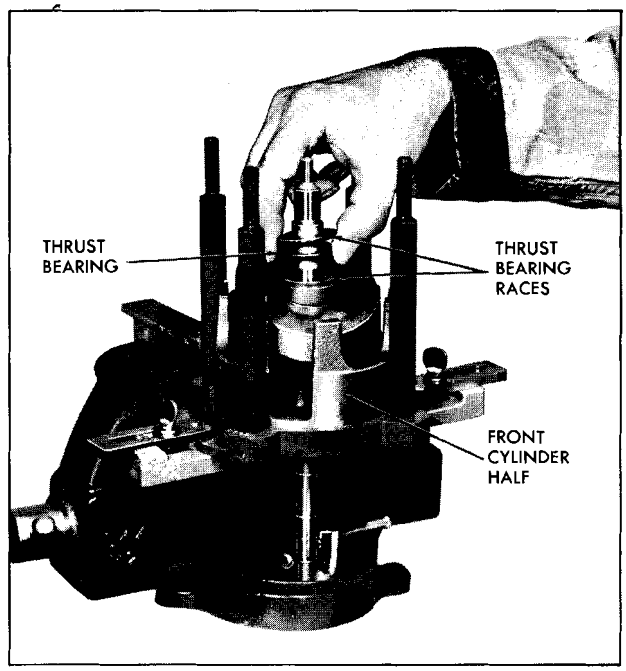


Fig. 1A-84 Mainshaft Thrust Bearing Installed

9. Remove rear combination of thrust races and thrust bearing (Fig. 1A-83). Discard all three pieces.
10. Push on shaft to remove shaft from front cylinder half.
11. Remove front combination of thrust races and thrust bearing. Discard all three pieces.
12. Examine swash plate surfaces for excessive scoring or damage. If satisfactory, reuse. If necessary, replace main shaft and swash plate assembly.
13. Wash all parts to be reused in a tank of clean alcohol or similar solvent. Blow all parts dry using clean, dry air.
14. Examine the front and rear cylinder halves and replace if cylinder bores are deeply scored or damaged. (NOTE: The service cylinder assembly contains a front half and a rear half doweled together and two main bearings; one main bearing pressed into the proper location in the front half and the other in its proper location in the rear half.)
15. Check main shaft bearings for roughness and replace if necessary. Use J 9592 to replace bearings.

GAUGING FOR NEW PARTS

Obtain the parts discussed in the introduction of this section. If thrust bearings and races are to be replaced, use parts outlined in following procedure; if not, use existing bearings and races.

1. Secure four ZERO thrust races, three ZERO shoe discs and two new thrust bearings.
2. Stack a ZERO thrust race, a new thrust bearing and a second ZERO thrust race. Assemble this "sandwich" of parts to FRONT end of compressor main shaft.
3. Place FRONT half of cylinder on J 9397 compressing fixture. Insert threaded end of shaft (with front bearing assembly) through front cylinder half and allow thrust race assembly to rest on hub of cylinder.
4. Stack a ZERO thrust race, a new thrust bearing and a second ZERO thrust washer. Assemble this "sandwich" of parts to REAR of compressor main shaft so it rests on hub of swash plate (Fig. 1A-84).
5. Apply a light coat of clean refrigerant oil to ball pockets of each of three pistons.
6. Place balls in piston pockets.
7. Apply a light coat of clean refrigerant oil to cavity of three new ZERO shoe discs.
8. Place a ZERO shoe over each ball in FRONT end of piston (Fig. 1A-85). Front end of piston has an identifying notch in casting web.
9. Place a ball only in rear ball pocket of each of three pistons. NOTE: Do not assemble any piston rings at this time.
10. Rotate shaft and swash plate until high point of swash plate is over piston cylinder bore, which had

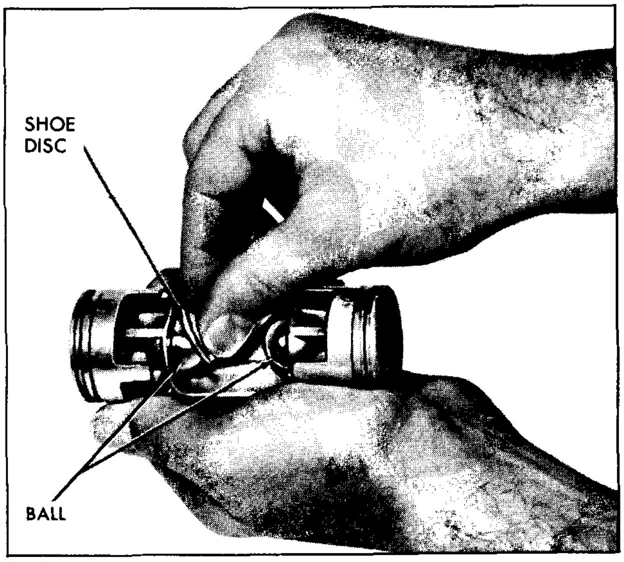


Fig. 1A-85 Zero Shoe and Ball at Front of Piston

been identified as No. 1. Insert front end of No. 1 piston (notched end) in cylinder bore (toward front of compressor) and, at the same time, place front ball and shoe and rear ball only over swash plate (Fig. 1A-86).

It may be necessary to lift shaft assembly to aid in installing pistons. Hold front thrust bearing pack tightly against swash plate hub while lifting shaft.

11. Repeat this operation for No. 2 and No. 3 pistons. Balls and shoes must adhere to piston during this assembly.

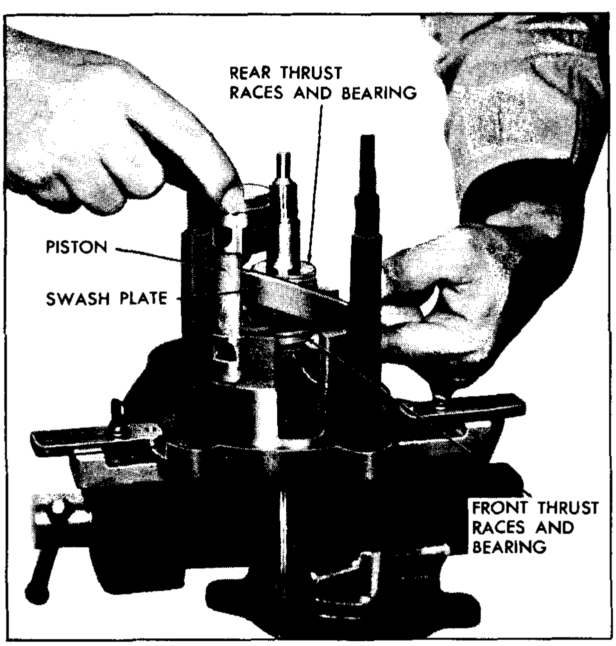


Fig. 1A-86 Installing Piston and Balls

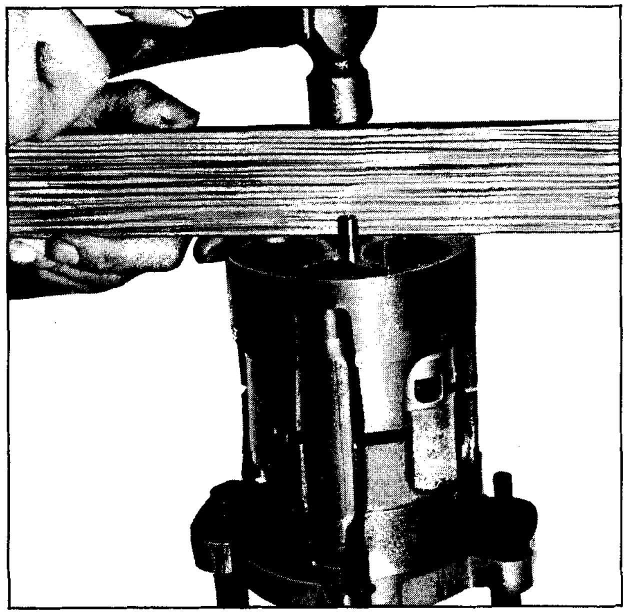


Fig. 1A-87 Installing Rear Cylinder Half on Front Cylinder Half

12. Align rear cylinder casting with bores, suction passage, discharge crossover holes, dowel pins, etc. Tap into place using a hard wood or plastic block and mallet (Fig. 1A-87).

13. Place cylinder assembly in J 9397 compressing fixture with front of compressor shaft pointing down, positioning discharge tube opening between fixture bolts. This will permit access for the feeler gauge. Assemble fixture head ring and nut to the cage, tighten nuts evenly to 25 lb. ft. torque (Fig. 1A-88).

14. Use a leaf-type feeler gauge to check clearance between REAR ball and swash plate for each piston as follows:

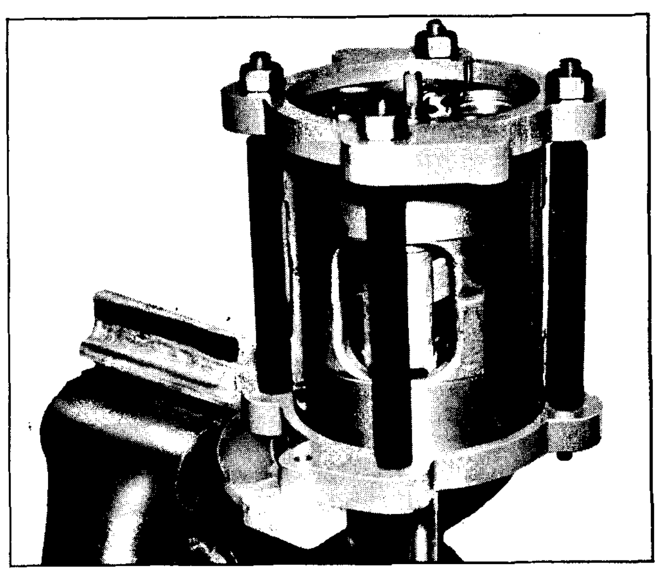


Fig. 1A-88 Internal Mechanism in Fixture

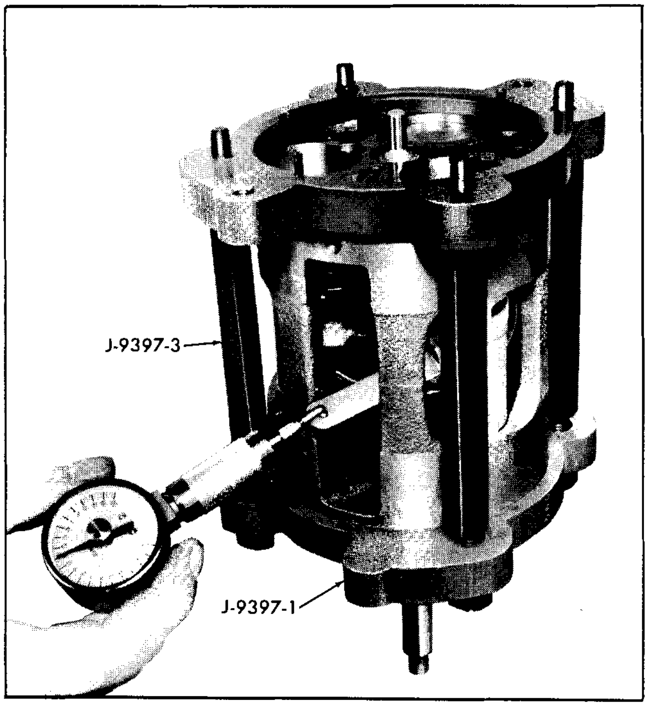


Fig. 1A-89 Measuring For Proper Shoe

a. Use J 9661 gauge set, selecting a suitable feeler gauge leaf to result in a 4 to 8 oz. pull on the scale between ball and swash plate (Fig. 1A-89). If the pull is just less than 4 ozs., add .0005" to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ozs., then subtract .0005" from the thickness of the feeler stock. Select a shoe accordingly.

b. Rotate the shaft approximately 120° and make a second check with feeler gauge between same ball and plate.

c. Rotate shaft again approximately 120° and repeat check with feeler gauge between these same parts.

d. From this total of three checks between the same ball and swash plate at 120° increments on swash plate for each piston, use the minimum gauge reading to select a numbered shoe to correspond to this reading (Fig. 1A-90).

A selection will be made from shoe packages shown in Fig. 1A-91, which will provide a .0005" to .0010" total clearance between shoes and the swash plate at the tightest point throughout its 360° rotation. The reading or resultant reading will correspond to the last three numbers of the part number of the part to be used.

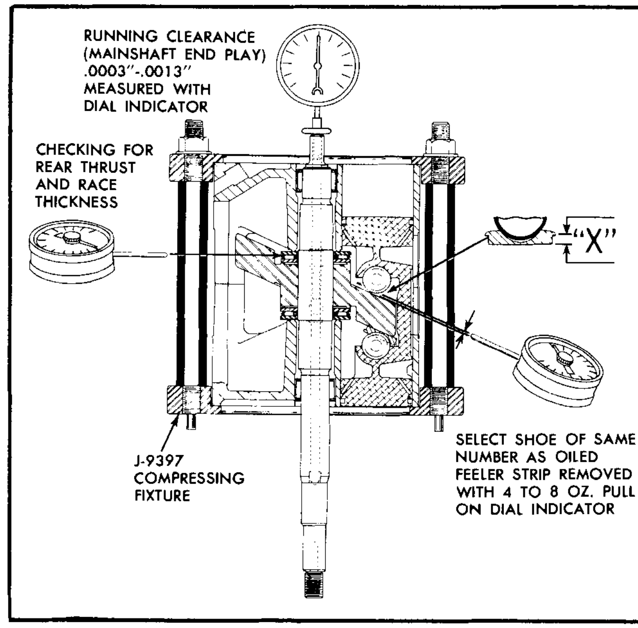


Fig. 1A-90 Measuring Service Shoes and Thrust Races

Once proper selection of shoes has been made, it is imperative that the matched combination of shoe to ball and spherical cavity in the piston be kept intact during disassembly after gauging operation and final reassembly of mechanism. The parts tray (J 9402) with individual compartments for each component of the mechanism will keep parts in their proper relationship.

e. Mark piston number (1, 2 or 3) on shoe package.

f. Place shoes in J 9402 assembly tray in compartment corresponding to piston number and rear ball pocket position.

g. Repeat in detail the same gauging procedure for each of the other two pistons.

15. The next gauging operation is to determine space between REAR thrust bearing and upper or outer-rear thrust race. Check compressor shaft end play as follows (Fig. 1A-92):

SHOE DISC		THRUST BEARING RACE	
PART NO. ENDING IN	IDENTIFICATION STAMP	PART NO. ENDING IN	IDENTIFICATION STAMP
000	0	000	0
175	17½	055	5½
180	18	060	6
185	18½	065	6½
190	19	070	7
195	19½	075	7½
200	20	080	8
205	20½	085	8½
210	21	090	9
215	21½	095	9½
220	22	100	10
		105	10½
		110	11
		115	11½
		120	12

Fig. 1A-91 Available Service Shoes and Thrust Races

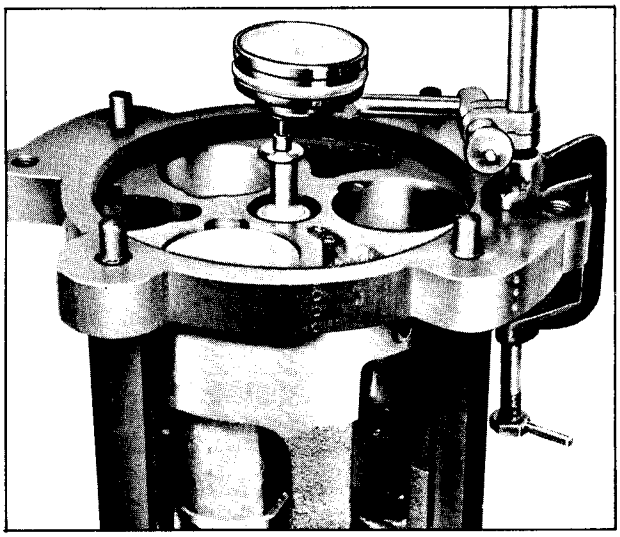


Fig. 1A-92 Checking Compressor Mainshaft End Play

a. Mount dial indicator to read clearance at end of compressor shaft.

b. Move compressor shaft along its longitudinal axis and measure end play. (NOTE: 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.)

c. An alternate method of selecting a proper race is to use J 9661 gauge set, selecting a suitable feeler gauge leaf until the result is a 4 to 8 oz. pull on the scale between the rear thrust bearing and upper (or outer rear) thrust race (Fig. 1A-93). If the pull is just less than 4 ozs., add .0005" to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ozs., then subtract .0005" from the thickness of the feeler stock. Select a race accordingly.

d. Select from stock a numbered thrust race that corresponds to dial indicator reading. (Thrust races are made of steel and ground to a fixed thickness. A total of fourteen thrust races are available for field service in increments of .0005" thickness to provide the required clearance.)

The thrust races will be identified on the part by their thickness, and the number on thrust race will correspond to the last three digits of the piece part number.

If an improper selection of thrust races or shoes is made and the tolerance is GREATER than the maximum clearance, noisy operation of the compressor will result. If the tolerance is LESS than the minimum clearance, it is likely that the mechanism assembly will be too tight. This may result in galling and seizure of parts.

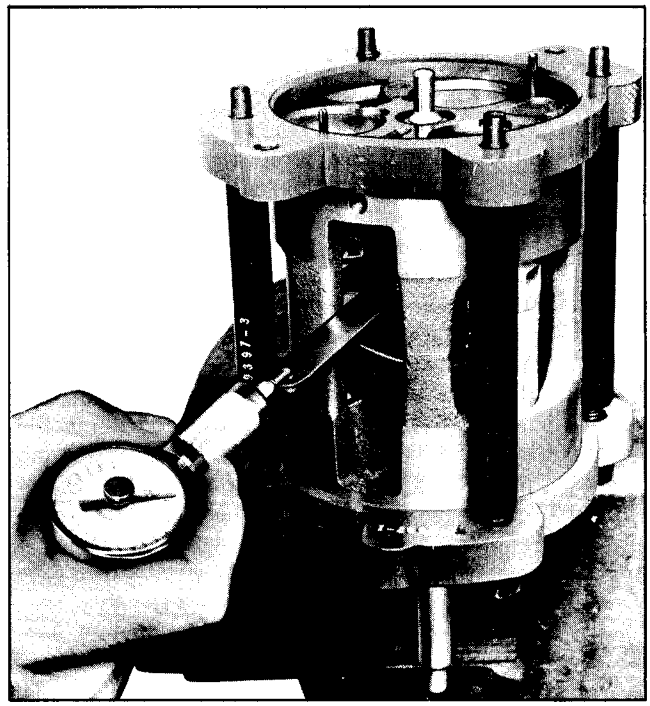


Fig. 1A-93 Measuring for Proper Thrust Race

Therefore, it is very important that care be used during gauging operations and the proper selection of parts be made. Once selection has been made, be sure parts are assembled into the correct position in the mechanism.

e. Mark the package "REAR thrust race" or place it in J 9402 assembly parts tray corresponding to this position.

16. Loosen and remove nuts and ring from J 9397 compressing fixture.

17. Separate cylinder halves (it may be necessary to use a fiber block and mallet).

18. Remove rear half cylinder.

19. Carefully remove one piston at a time from swash plate and front half cylinder. Do not lose relationship or position of front ball and shoe and rear ball. Transfer each piston, balls and shoe assembly to its proper place in the J 9402 assembly tray.

20. Remove REAR outer ZERO thrust race from shaft and replace it with numbered thrust race determined in step 15. Apply a LIGHT smear of petrolatum to thrust races to aid in holding them in place during assembly. NOTE: This ZERO thrust race may be put aside for reuse in additional gauging and/or rebuild operations.

21. Apply a light smear of petrolatum to numbered shoes and place them over correct ball in rear of piston.

ASSEMBLE WITH NEW PARTS

Be sure to install all new seals, gaskets and O-rings. These are all included in the compressor gasket kit.

1. Assemble a piston ring, scraper groove toward the center of piston, to each end of three pistons.

2. Place front cylinder half on J 9397 compressing fixture with compressor main shaft threaded end projecting downward through the fixture. Rotate swash plate so high point is above cylinder base No. 1. With open end of ring toward center of compressor, carefully assembly No. 1 piston (complete with ball and a ZERO shoe on front end and ball and numbered shoe on REAR end) over swash plate. Compress and enter piston ring into front cylinder half. Repeat this operation for pistons No. 2 and No. 3.

3. Assemble one end of service discharge crossover tube into hole in front cylinder (Fig. 1A-94).

4. Rotate shaft to position pistons in a "stair step" arrangement. Place rear cylinder half over shaft and start pistons into cylinder bores.

5. Invert cylinder on fixture to complete assembly as follows:

   a. Compress piston ring on each piston so as to permit its entrance into cylinder.

   b. When all three pistons and rings are in their respective cylinders, align end of the discharge crossover tube with hole in rear cylinder half, making sure flattened portion of this tube faces inside of compressor (for swash plate clearance).

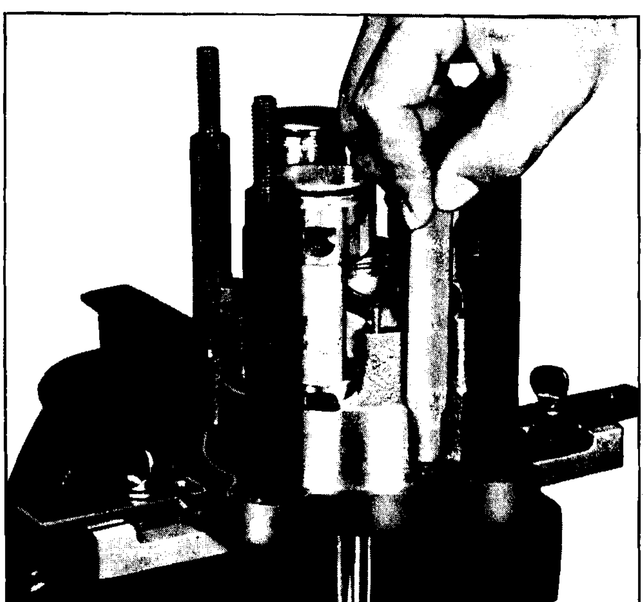


Fig. 1A-94 Installing Service Discharge Crossover Tube

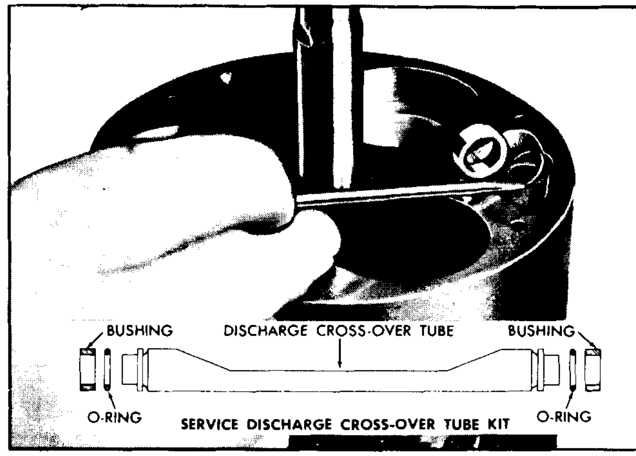


Fig. 1A-95 Installing Service Discharge Crossover Parts

   c. When satisfied that all parts are in proper alignment, tap with a fiber block mallet to seat rear cylinder over locating dowel pins.

6. Generously lubricate all moving parts with clean refrigeration (525 viscosity) oil. Check for free rotation of mechanism.

7. Check operation and smoothness of piston travel before proceeding with remainder of assembly. If any improper operation is observed during this check, the mechanism may have to be regauged. Complete assembly when correct operation is obtained.

8. Install crossover cover in cylinder.

9. Place internal mechanism in J 9397 compressing fixture if cylinder head dowel pins are to be replaced.

10. Replace two dowel pins in front cylinder if previously removed. (A rod drilled 1/4" deep to O.D. of dowel pins will aid in installing pins.)

11. Remove internal mechanism from J 9397 fixture.

REPLACE:

1. Install service discharge crossover pipe, front O-ring and spacer (Fig. 1A-95).

2. Assemble suction reed valve to front end of cylinder. Align dowel pin holes, suction ports and oil return slot.

3. Assemble front discharge valve plate, aligning holes with dowel pins and proper openings in head. (The front discharge valve plate has a large diameter hole in the center, Fig. 1A-96.)

4. Remove oil charging screw from compressor shell, inspect for damage, dirt or contamination, clean and replace.

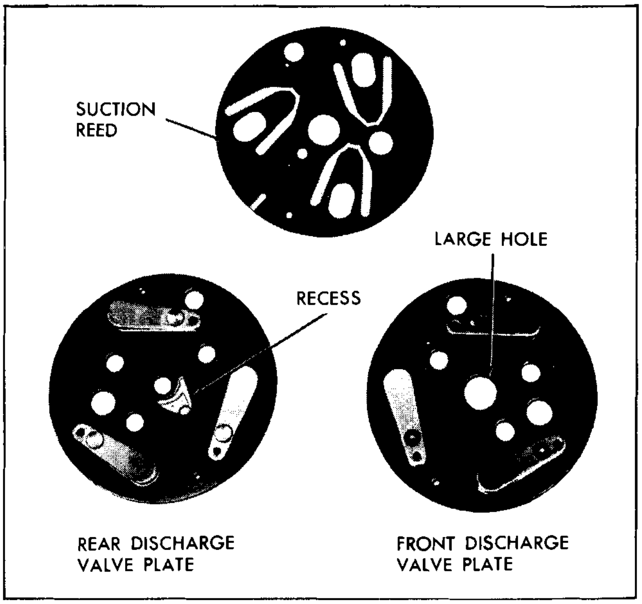


Fig. 1A-96 Identification of Front and Rear Discharge Valve Plates

5. Coat sealing surfaces on webs of compressor front head casting with clean 525 viscosity refrigeration oil.

6. Examine location of dowel pins and contour of webs (mark dowel location). Rotate head casting so as to position it properly over discharge reed retainers. Use care to avoid damaging sealing surfaces. When in proper alignment, seat compressor front head casting on internal cylinder assembly with light mallet taps (Fig. 1A-97).

7. If previously removed, place compressor shell with J 9396 holding fixture in vise so shell is up. Examine corners of oil baffle to be sure they do not damage O-rings on reassembly. Tap corners at oil baffle down carefully with small ball peen hammer.

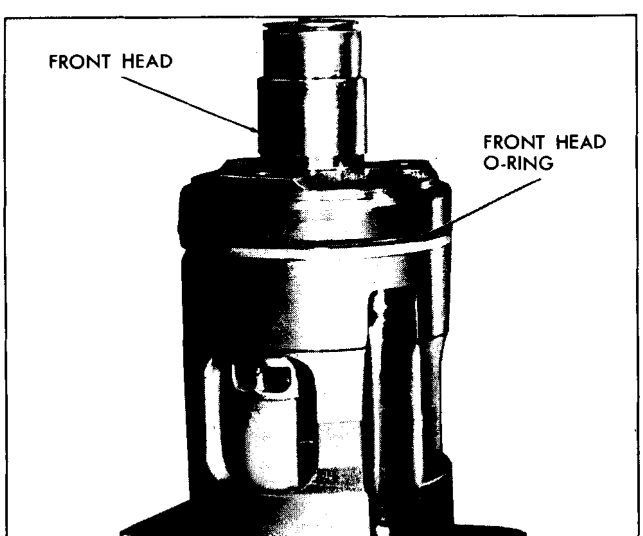


Fig. 1A-97 Installing Front Head Casting

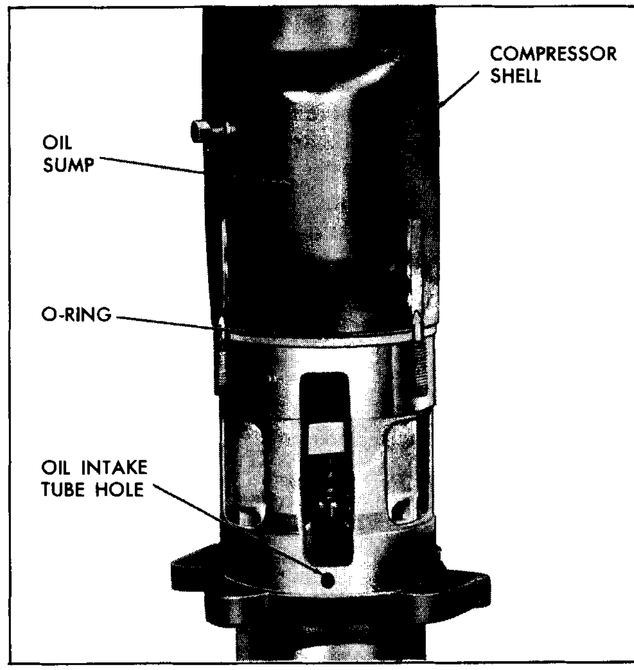


Fig. 1A-98 Installing Compressor Shell

8. Apply an ample amount of clean 525 viscosity refrigeration oil around angle groove at the lower edge of casting. Coat large diameter head to shell O-ring and assemble O-ring on shoulder of shell at front (Fig. 1A-98).

9. Coat the inside machined surfaces of shell with clean 525 viscosity refrigeration oil. Line up oil sump with oil intake tube hole and slide mechanism into shell. Maintain this alignment when lowering mechanism into place (Fig. 1A-98).

Fig. 1A-99 Installing Oil Intake (Pick-Up) Tube

10. Place an O-ring on the oil pick-up tube, apply oil to cavity and O-ring. Insert tube and O-ring (Fig. 1A-99), rotating compressor mechanism as necessary and align tube with hole in the shell baffle. Be sure O-ring and intake tube are properly seated.

11. Replace split dowel pins (in rear cylinder) if previously removed. (A rod drilled 1/4" deep to O.D. of dowel pins will aid in installing pins.)

12. Install service discharge crossover pipe rear O-ring and spacer.

13. Position rear suction reed valve to align with dowel pins, reed tips and ports in head.

14. Position rear discharge valve assembly to align with dowel pins and ports and slide it into place over pins.

15. Position rear head casting to align with dowel pins. Rotate mechanism assembly back and forth by hand, if necessary, to permit this alignment and assure proper seating of front head cylinder assembly. Remove rear head from this trial assembly.

16. Assemble inner oil pump gear over "D" shaped flat on shaft. Place outer oil pump gear over inner oil pump gear.

    Before attempting the final assembly of the rear head casting, position outer gear as follows:

    a. Observe position of oil pump in shell.

    b. Note position of pump race in head.

    c. Align pump (Fig. 1A-100) with head and install head.

REPLACING REAR HEAD ASSEMBLY

1. Generously oil valve plate around outer edge where large O-ring will be placed. Oil valve reeds, pump gears and area where teflon gasket will contact valve plate.

2. Coat new head-to-shell O-ring with oil and place it on valve plate in contact with shell.

3. Replace suction screen in rear head.

4. Assemble rear head to compressor shell, using care not to damage sealing surface (Fig. 1A-101).

5. Assemble new nuts to threaded shell studs and tighten (25-28 lb. ft. torque).

6. Replace pressure relief valve, if removed, using new copper washer.

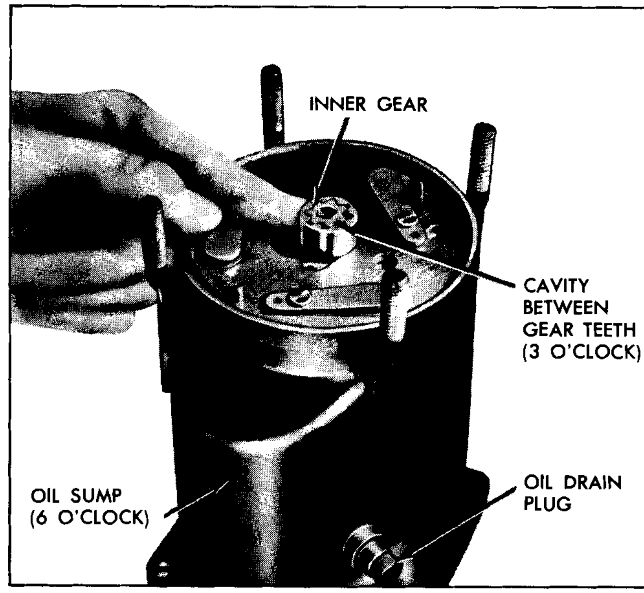


Fig. 1A-100 Positioning Oil Pump Outer Gear

7. Coat the new seal seat O-ring with clean refrigerant oil and install it in its groove in the compressor neck. Tool J 21508 may be used.

8. Place seal protector over end of shaft. Coat O-ring and face of new seal assembly with clean refrigerant oil and install new seal assembly on shaft, using J 9392.

9. Coat face of new seal seat with clean refrigerant oil and install seat, using tool J 23128. Be sure seal seat O-ring is not dislodged and seal seat is making a good seal with the O-ring.

10. Install new seal seat retainer ring with tool J 5403, with flat face against seal seat. The sleeve from tool J 9393 may be used to press on the retainer ring so that it snaps into place (Fig. 1A-102).

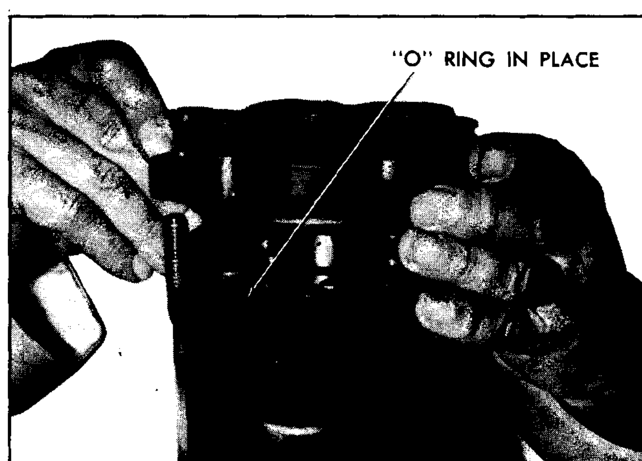


Fig. 1A-101 Installing Rear Head

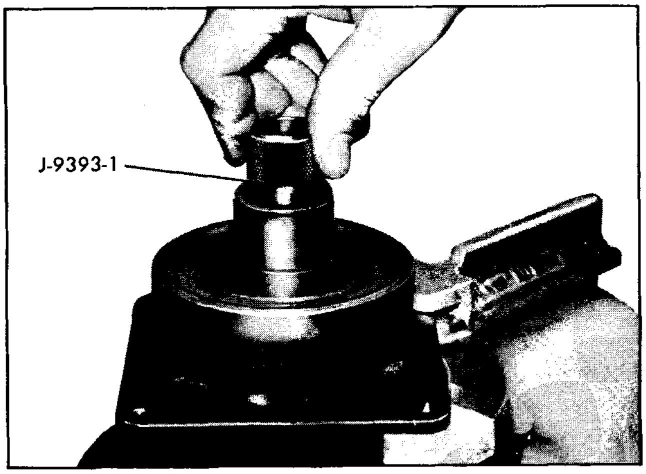


Fig. 1A-102 Seating Seal Seat Retainer

11. Leak test compressor using a propane torch type (or electronic) leak detector, in good condition. Correct any leaks found.

12. Wipe out any excess oil inside compressor neck and on shaft, resulting from installing new seal parts.

13. Install new absorbent sleeve by rolling the material into a cylinder, overlapping the ends and slipping sleeve into compressor neck with overlap toward the top of the compressor. With a small screwdriver or similar instrument, carefully spread sleeve to remove overlap so that in final position ends of sleeve will butt at top vertical centerline.

14. Position new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Tool J 9395 or the sleeve from tool J 9393 may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place, until the outer edge of the retainer is recessed approximately 1/32" from the face of the compressor neck.

15. Reinstall the clutch driven plate.

SUPERHEAT SHUT-OFF SWITCH

REMOVE AND REPLACE

1. Disconnect electrical connector from thermal limiter assembly.

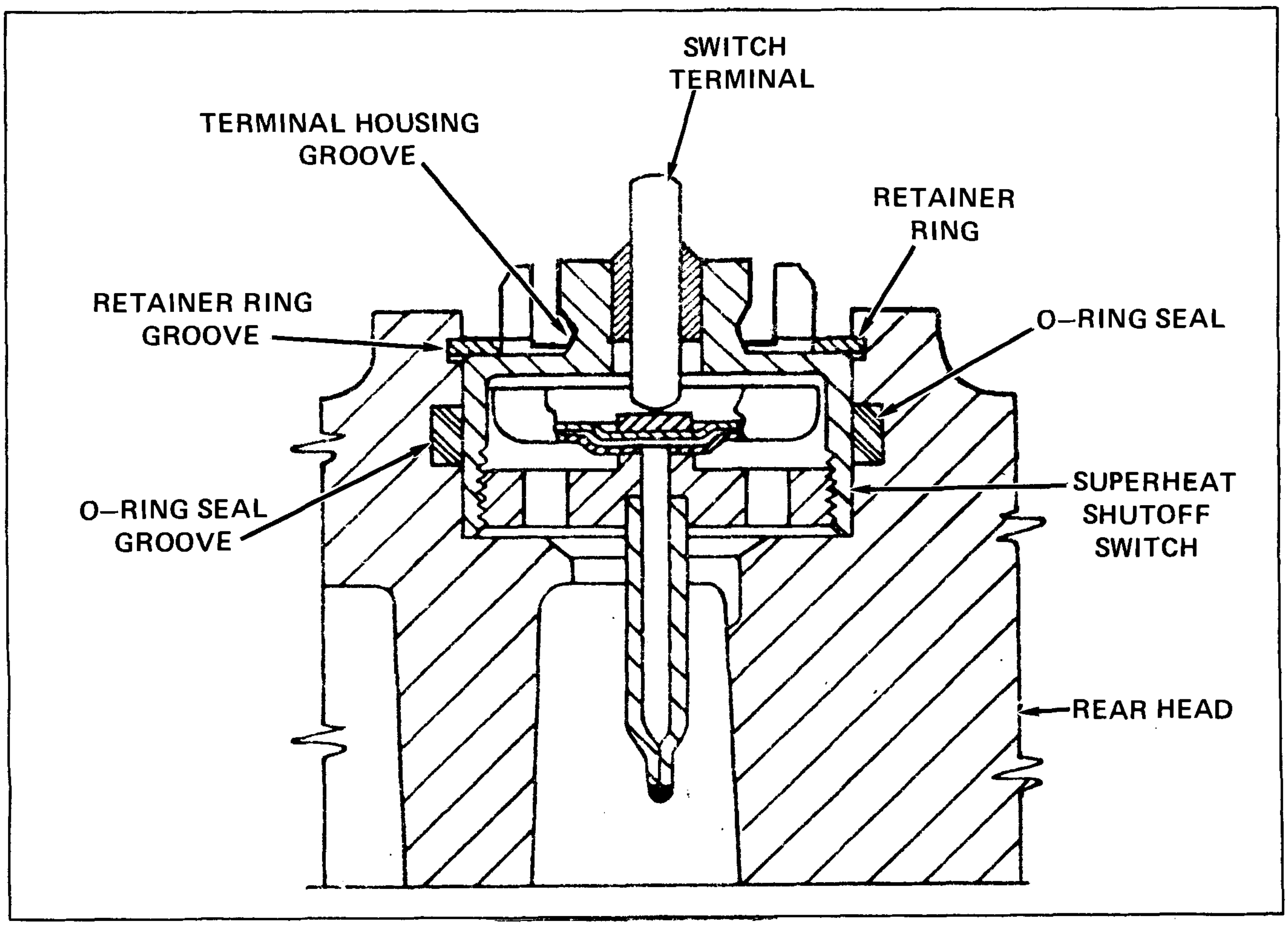


Fig. 1A-102A Cross Sectional View - Superheat Shut-Off Switch in Rear Head

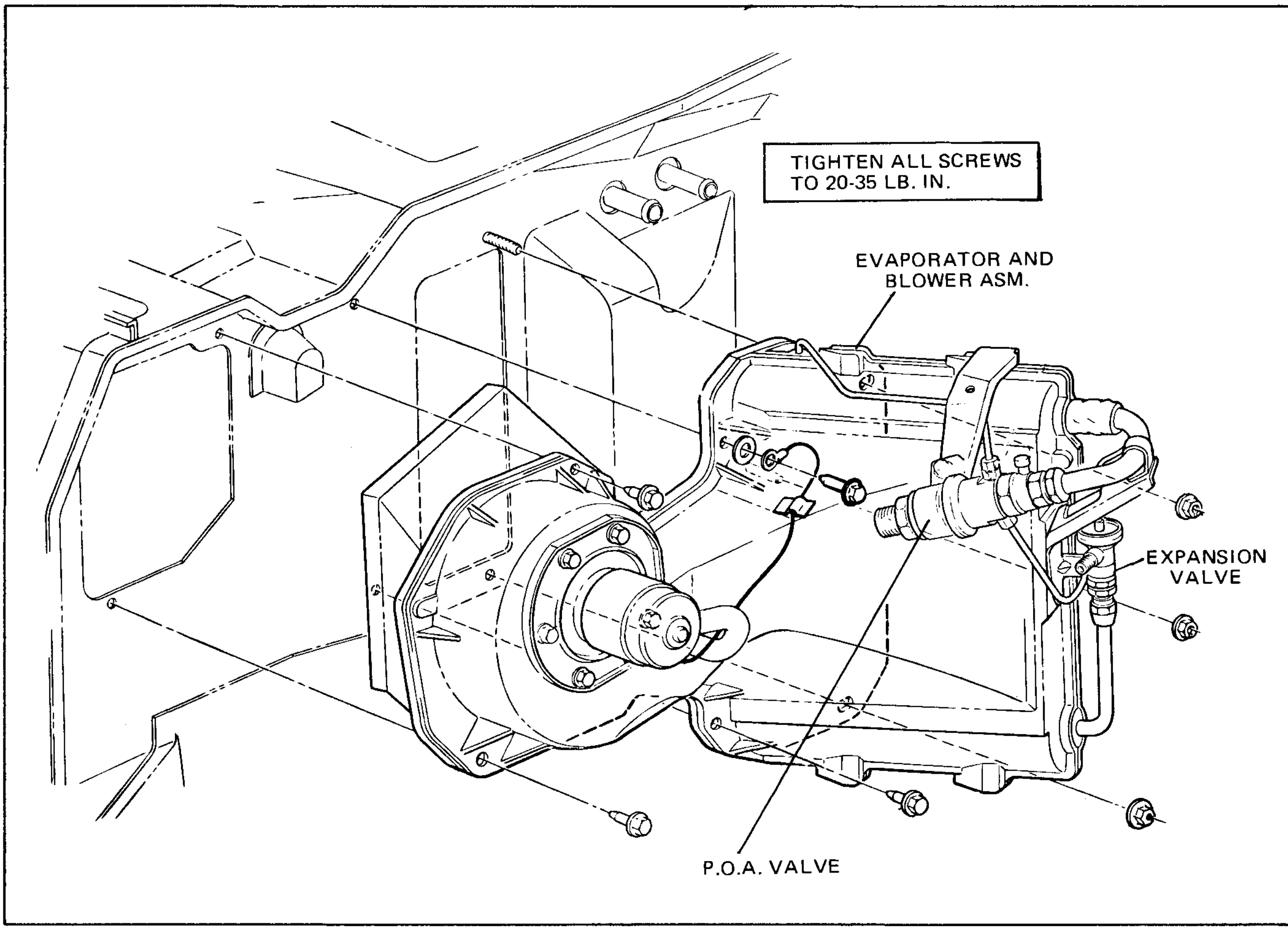


Fig. 1A-103 B Series Evaporator and Blower Assembly

2. Discharge refrigerant system.

3. Disconnect superheat switch electrical connector.

4. Remove switch retaining ring (Fig. 1A-28) using J-5403 internal snap ring pliers.

5. Remove switch from compressor rear head by pulling on terminal housing groove with J-9393 seal seat remover and installer.

6. Remove O-ring seal from switch cavity in rear head using J-9553 O-ring removal tool or equivalent.

7. Check superheat shut-off switch as described in Diagnosis portion of this section and replace switch if necessary.

8. Check superheat switch cavity and O-ring groove (Fig. 1A-102A) in the rear head for dirt or foreign material and clean if necessary. Install new O-ring coated with clean refrigerant oil into groove in switch cavity.

9. Lubricate superheat switch housing with clean refrigerant oil and carefully insert switch into switch cavity until switch bottoms in cavity. J-9393 seat seat remover and installer may be used to install the switch. NOTE: Switch terminal is mounted in glass insulation and switch must be handled with care.

10. Using J-5403 snap ring pliers, install switch retaining ring with high point of curved sides adjacent to the switch housing. Be sure retainer ring is properly seated in the switch cavity groove.

11. Check for electrical continuity between superheat switch housing and compressor rear head.

12. Evacuate, recharge and leak test the refrigerant system. Repair any leaks, check and add refrigerant oil as required and assure proper operation of system.

13. Check electrical continuity between superheat switch terminal and housing to insure that switch contacts are open (no continuity). Connect switch terminal connector.

14. Remove jumper from thermal limiter connector, replace limiter if fuse link is open (no continuity between terminals B and C) and reconnect limiter connector.

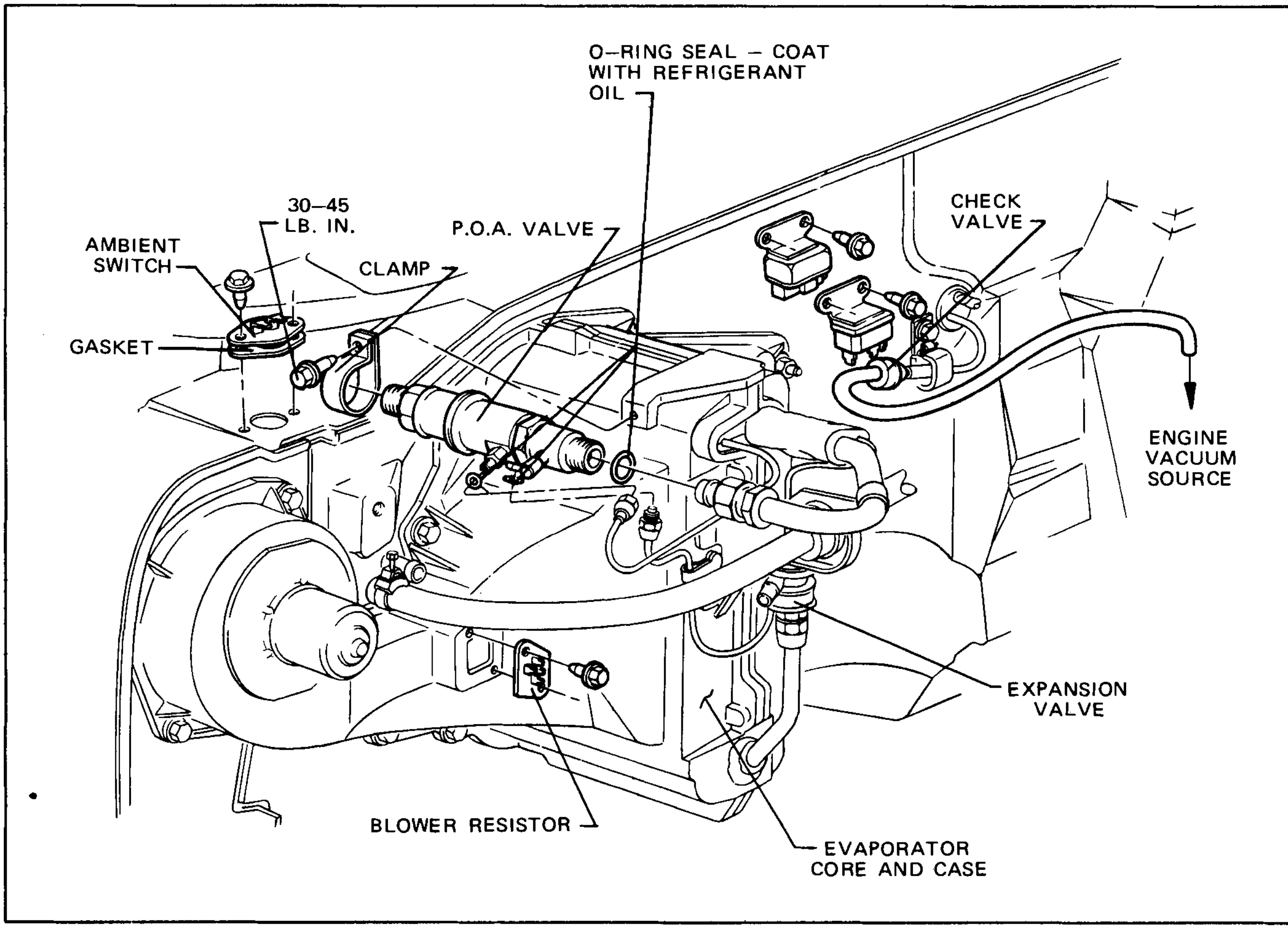


Fig. 1A-104 G Series P.O.A. Valve and A/C Relays

P.O.A. VALVE

REMOVE AND REPLACE - ALL

1. Depressurize system.
2. Disconnect oil bleed fitting.
3. Disconnect equalizer fitting.
4. Disconnect inlet and outlet fittings.
5. Remove valve from bracket. If valve is not immediately replaced, cap openings to prevent entry of dirt and moisture.
6. Replace by reversing above procedure, using new O-ring seals coated with clean compressor oil.
7. Evacuate and charge system.

For P.O.A. Valve installation, refer to Figs. 1A-103 (B Series), 1A-104 (G Series), 1A-105 (A Series), 1A-106 (F Series) and 1A-107 and 1A-107A (X Series).

EXPANSION VALVE AND SEALS

REMOVE AND REPLACE

1. Depressurize system.
2. Remove thermo bulb from insulation at evaporator outlet.
3. Disconnect equalizer line at P.O.A. valve.
4. Remove inlet and outlet fittings of valve.
5. If valve is not immediately replaced, cap openings to prevent entry of dirt and moisture.
6. Replace by reversing above procedure using new O-ring seals coated with compressor oil.
7. Evacuate and charge system.

CONDENSER AND SEALS

B SERIES - REMOVE AND REPLACE

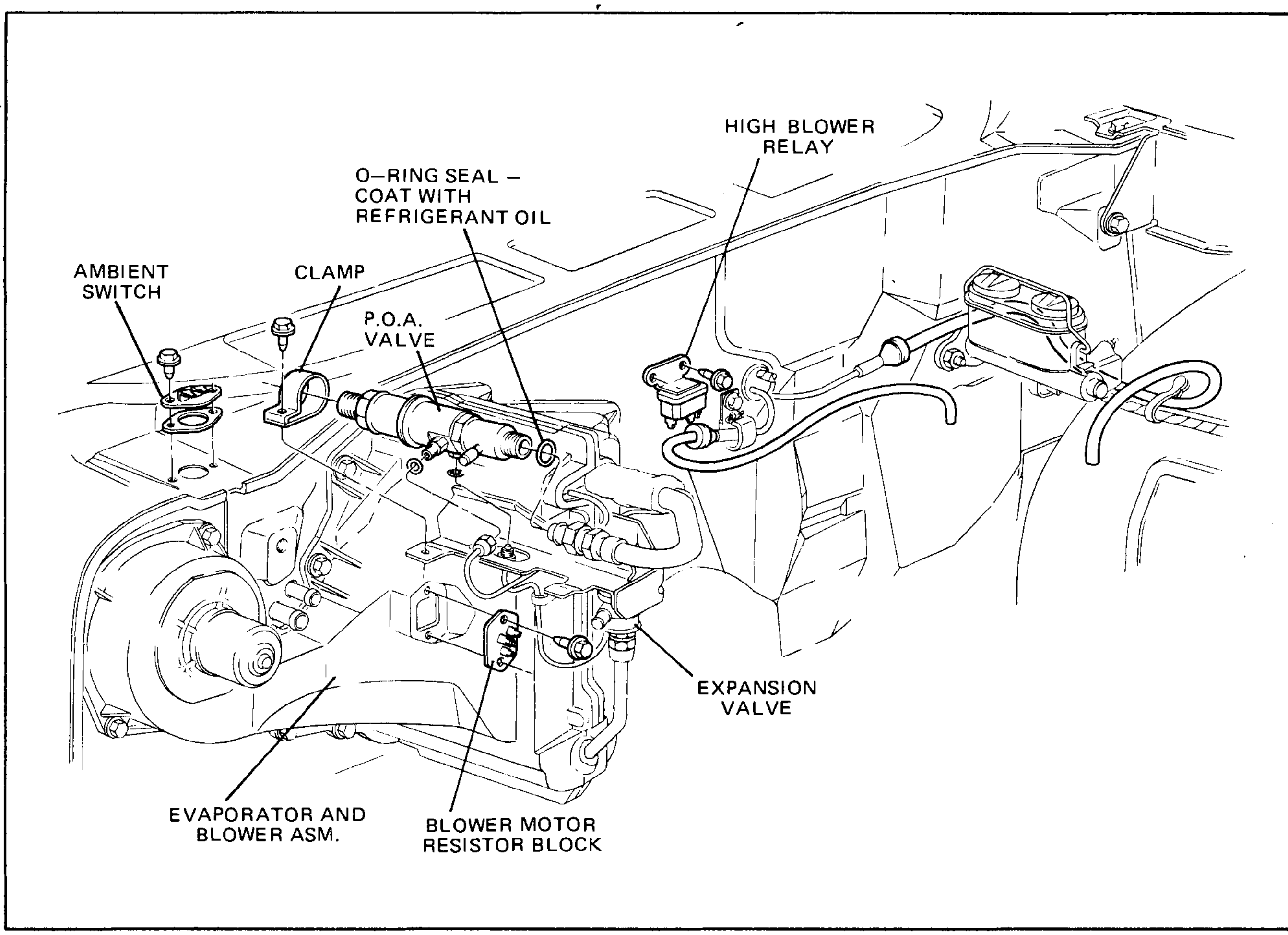


Fig. 1A-105 A Series P.O.A. Valve and A/C Relays

1. Disconnect thermal limiter and depressurize refrigerant system.
2. Disconnect refrigerant hose at upper condenser tube and cap openings.
3. Disconnect battery cables and remove battery.
4. Raise front of car and remove hood latch support (6 screws).
5. Remove lower air baffle (5 screws).
6. Remove LH headlamp filler panel support (2 screws).
7. Disconnect refrigerant hose at lower condenser tube and cap openings.
8. Remove condenser assembly (Fig. 1A-108) by removing 4 retaining screws and removing condenser from bottom of car. Tip LH side of condenser downward when beginning to lower the assembly.
9. To replace, reverse removal procedure. Add one ounce of clean refrigerant oil to new condenser.
10. Evacuate and charge system. Connect thermal limiter connector.

A AND G SERIES - REMOVE AND REPLACE

1. Depressurize refrigeration system.
2. Remove front valance panel.
3. Remove bumper assembly.
4. Remove hood latch and support brace.
5. Disconnect receiver outlet.
6. Disconnect condenser inlet.
7. Remove condenser bracket retaining screws.
8. Remove condenser assembly (Fig. 1A-109) by pulling left side of condenser (driver side) forward and down.
9. Cap all openings.
10. Separate condenser from brackets and dehydrator.

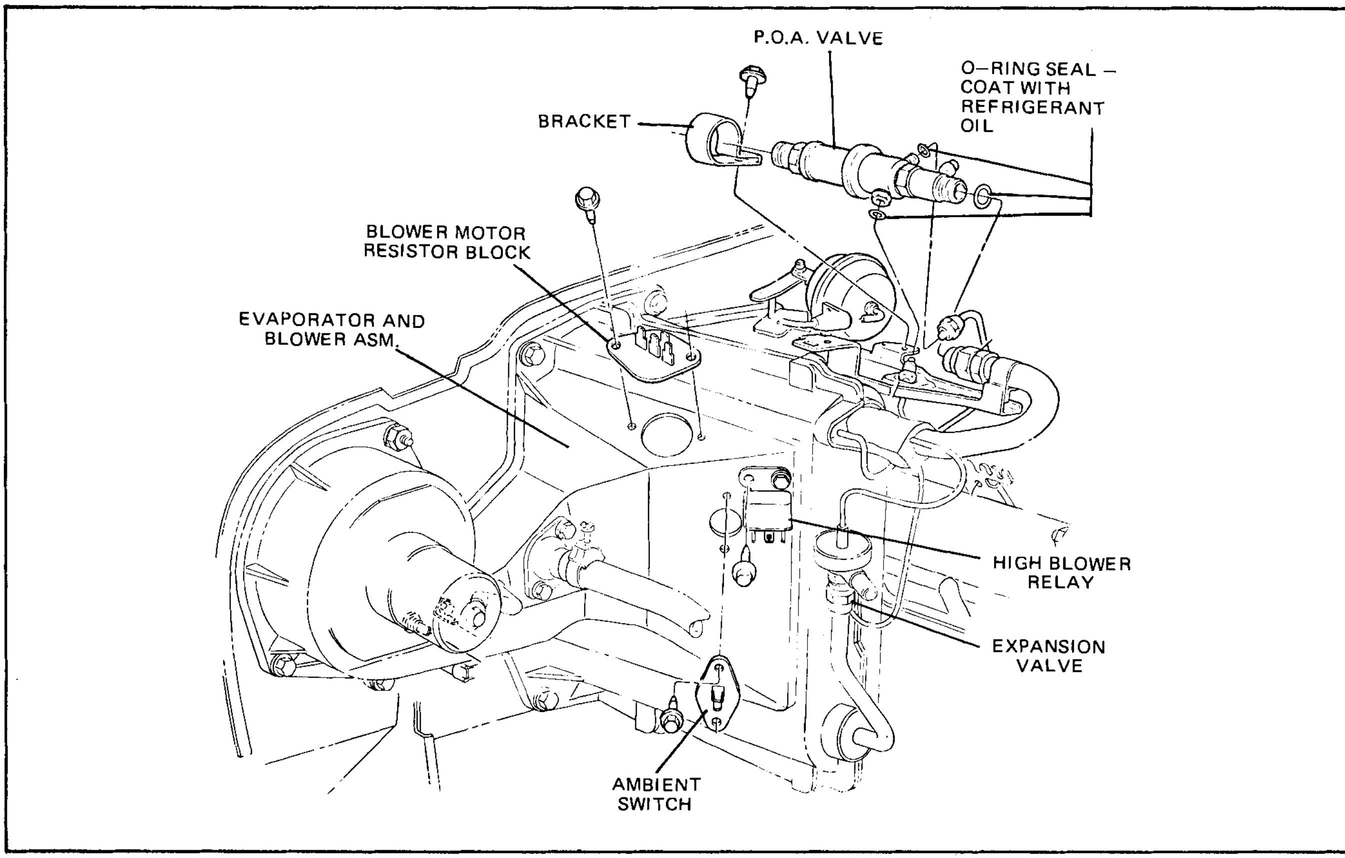


Fig. 1A-106 F Series Evaporator and Blower Assembly

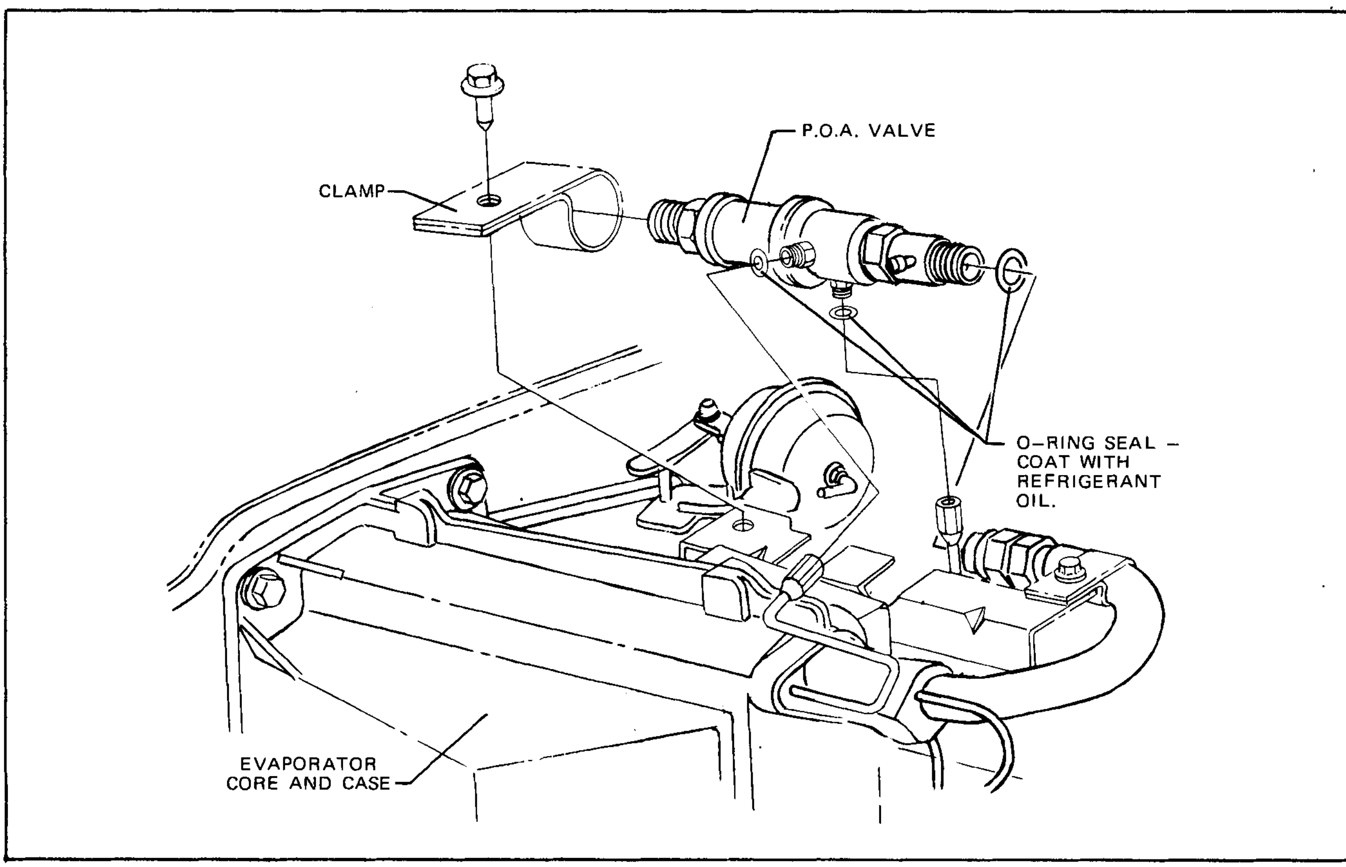


Fig. 1A-107 X Series P.O.A. Valve Installation (with 350 Engine)

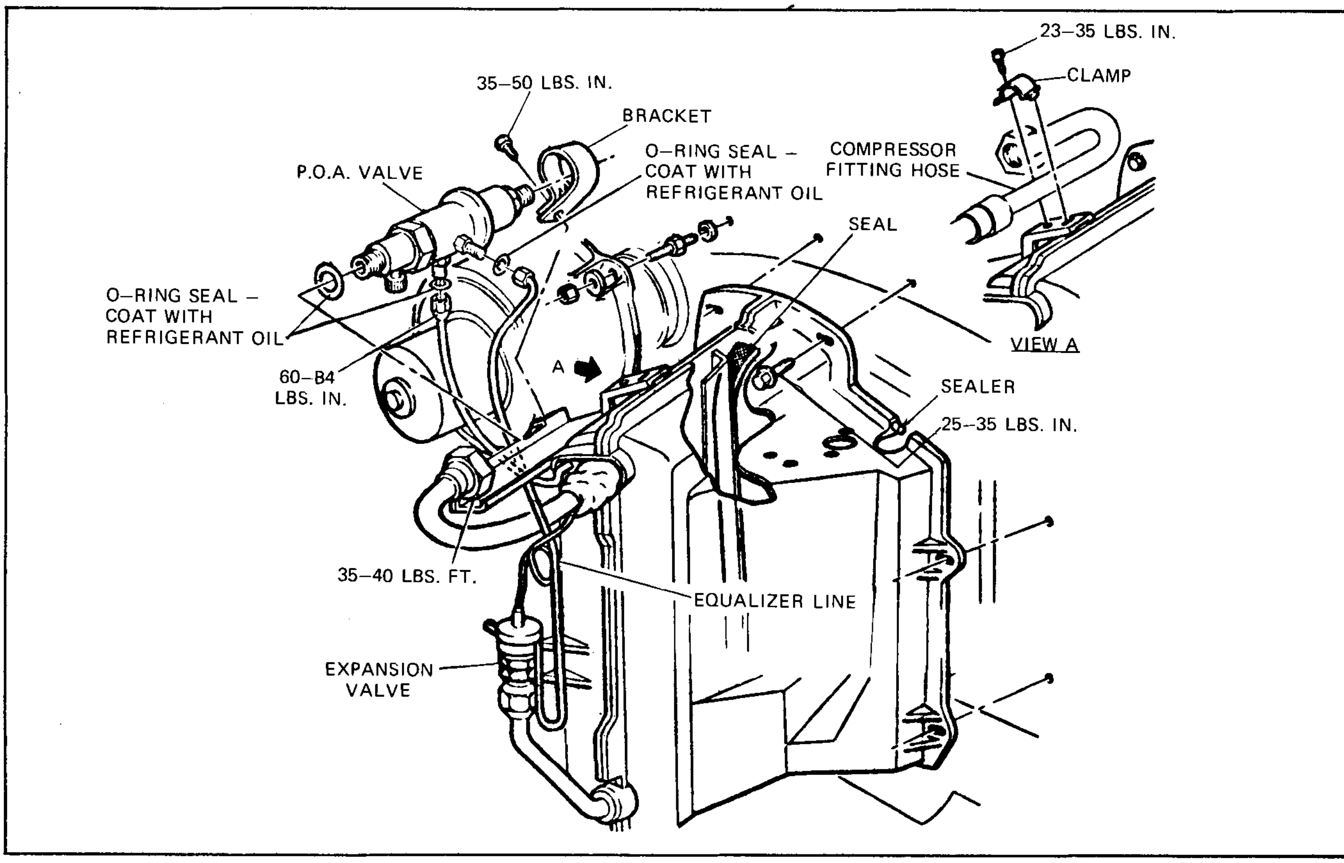


Fig. 1A-107A X Series Evaporator and Blower Assembly (with 307 Engine)

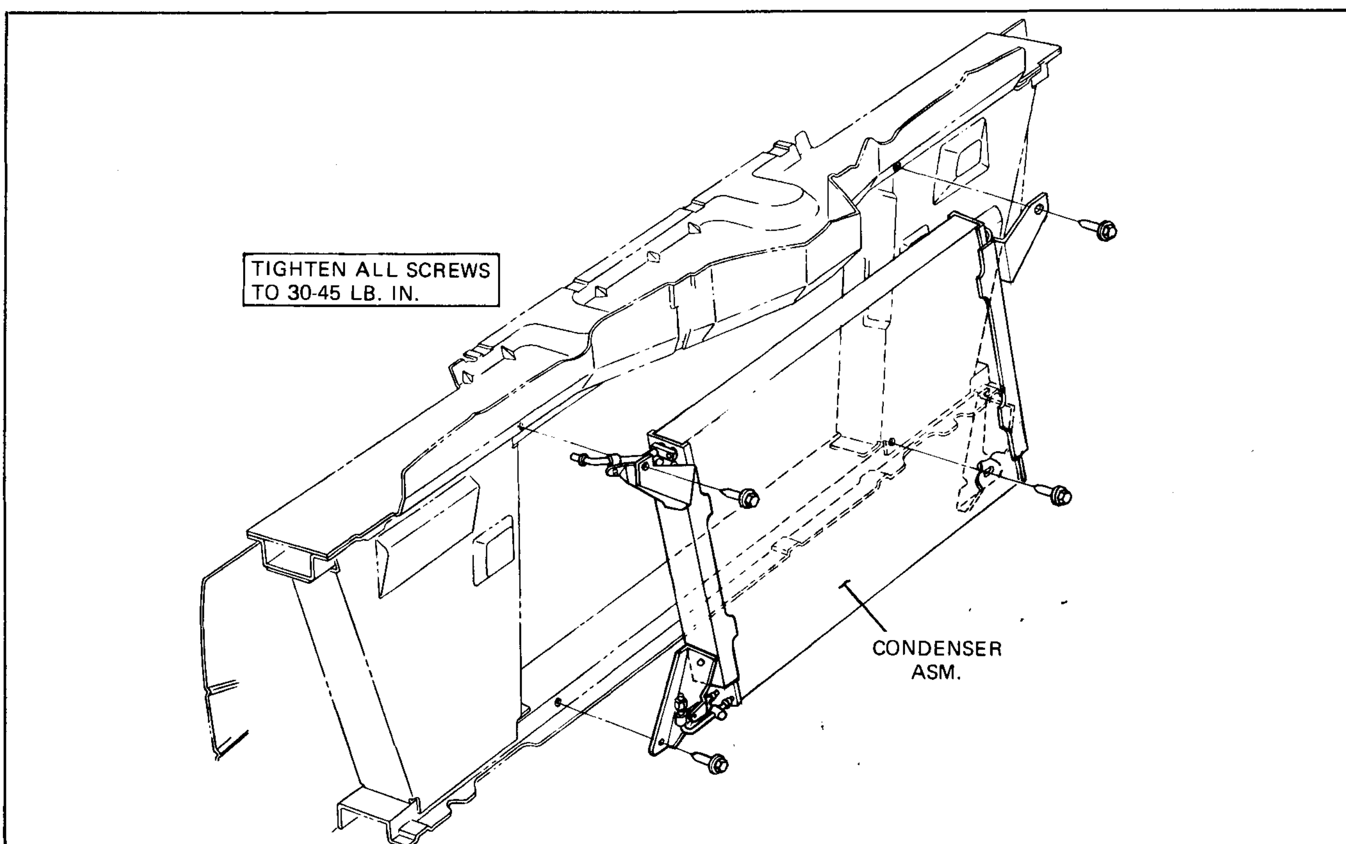


Fig. 1A-108 Condenser Mounting - B Series

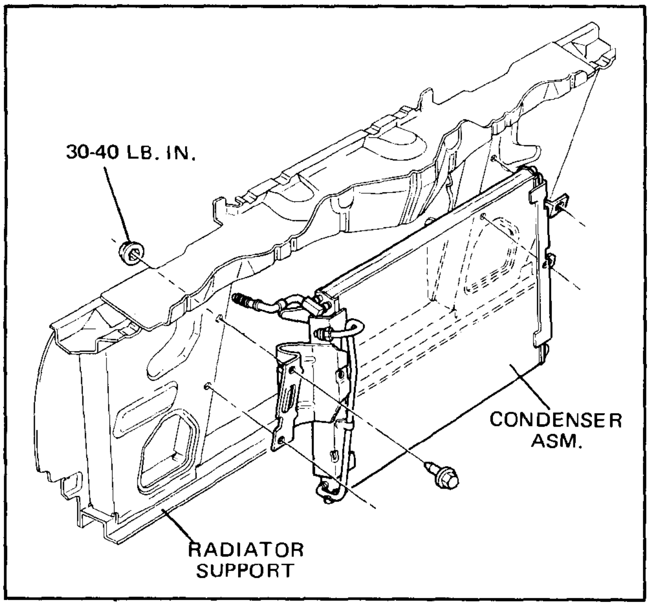


Fig. 1A-109 Condenser Assembly - A and G Series

11. To replace, reverse removal procedure. Add one ounce of refrigerant oil.

12. Evaucate and charge system.

F SERIES - REMOVE AND REPLACE

1. Depressurize system.

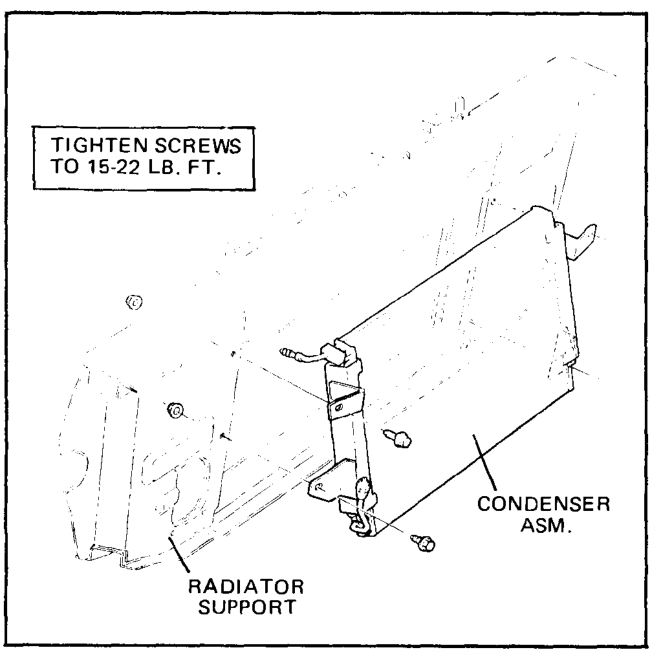


Fig. 1A-110 F Series Condenser Mounting

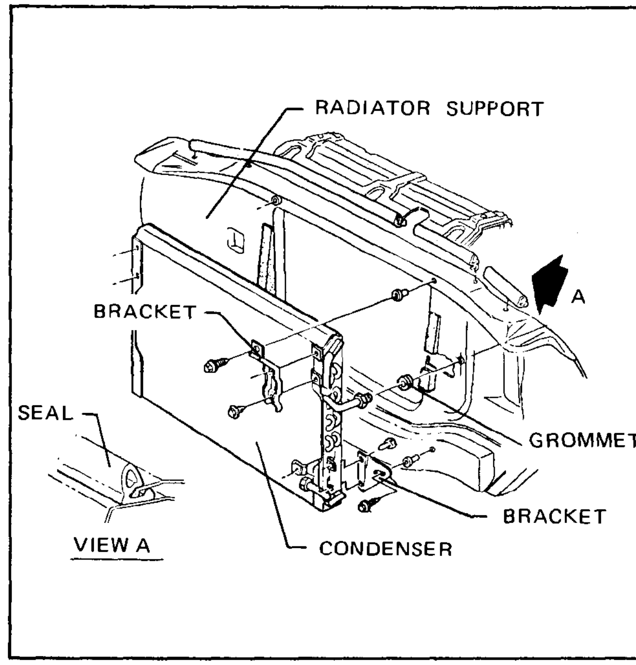


Fig. 1A-111 Condenser Mounting - X Series

2. Remove plastic radiator filler panel.

3. Remove front valance panel.

4. Remove horns.

5. Disconnect refrigerant lines at condenser.

6. Remove center hood latch support.

7. Remove (4) condenser mounting nuts (Fig. 1A-110).

8. Loosen top of radiator to allow clearance of condenser pipes, raise front of car and remove condenser from below car.

9. Cap all openings in refrigerant system.

10. To replace, reverse removal procedure. Add one ounce of refrigerant oil.

11. Evacuate and charge system.

REMOVE AND REPLACE - X SERIES

To replace the condenser on X Series (Fig. 1A-111), remove front bumper and hood latch support. When disconnecting refrigerant hoses, cap all openings. Disconnect thermal limiter prior to depressurizing refrigerant system.

Add one ounce of clean refrigerant oil to new condenser, use new O-ring seals coated with clean refrigerant oil and connect thermal limiter after evacuation and charging of system.

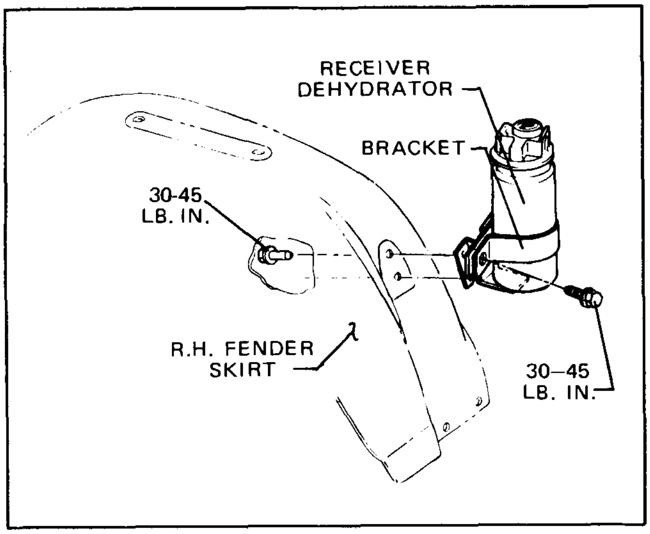


Fig. 1A-112 Receiver Dehydrator Mounting - B Series

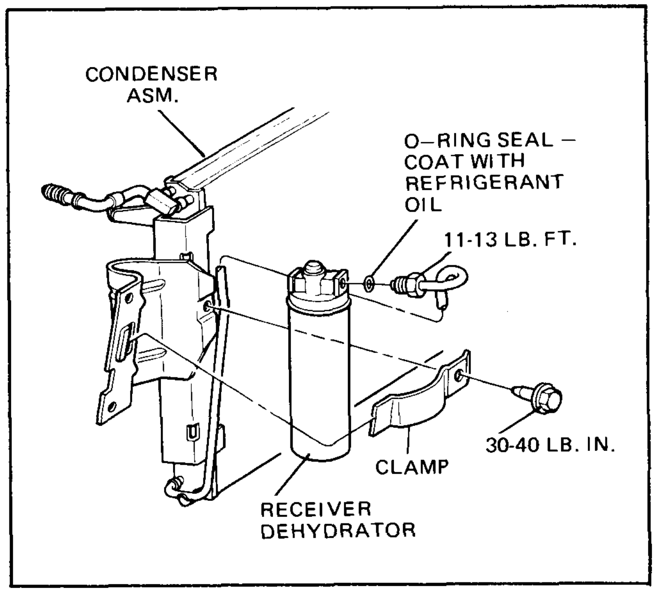


Fig. 1A-113 Receiver Dehydrator Mounting - A and G Series

RECEIVER DEHYDRATOR

B SERIES - REMOVE AND REPLACE

1. Disconnect thermal limiter connector and depressurize refrigerant system.
2. Disconnect refrigerant lines at receiver assembly and cap all openings.
3. Remove receiver bracket screw and remove receiver dehydrator assembly (Fig. 1A-112).
4. To replace, reverse removal procedure. Add one ounce of clean refrigerant oil.
5. Evacuate and charge refrigerant system. Connect thermal limiter.

A SERIES AND G SERIES - REMOVE AND REPLACE

1. Disconnect thermal limiter and depressurize system.
2. Remove valance panel.
3. Disconnect inlet and outlet fittings.
4. Remove bracket retaining screw.
5. Remove front strap.
6. Remove receiver (Fig. 1A-113).
7. To replace, reverse removal procedure. Add one ounce of clean refrigerant oil.
8. Evacuate and charge system. Connect thermal limiter.

F SERIES - REMOVE AND REPLACE

1. Depressurize system.
2. Disconnect inlet and outlet refrigerant fittings at receiver dehydrator and cap all openings.
3. Loosen bracket screw and remove receiver dehydrator assembly (Fig. 1A-114).
4. To replace, reverse removal procedure. Add one ounce of refrigerant oil.
5. Evacuate and charge system.

REMOVE AND REPLACE - X SERIES

1. Depressurize refrigerant system.
2. Disconnect battery cables and remove battery.
3. Remove receiver bracket screws.
4. Disconnect receiver inlet and outlet fittings and remove receiver dehydrator assembly (Fig. 1A-115).
5. Separate receiver dehydrator from brackets.
6. Add one fluid ounce of clean refrigerant oil to new receiver dehydrator.
7. Replace by reversing removal procedure, using new O-ring seals coated with clean refrigerant oil.
8. Evacuate and charge refrigerant system.

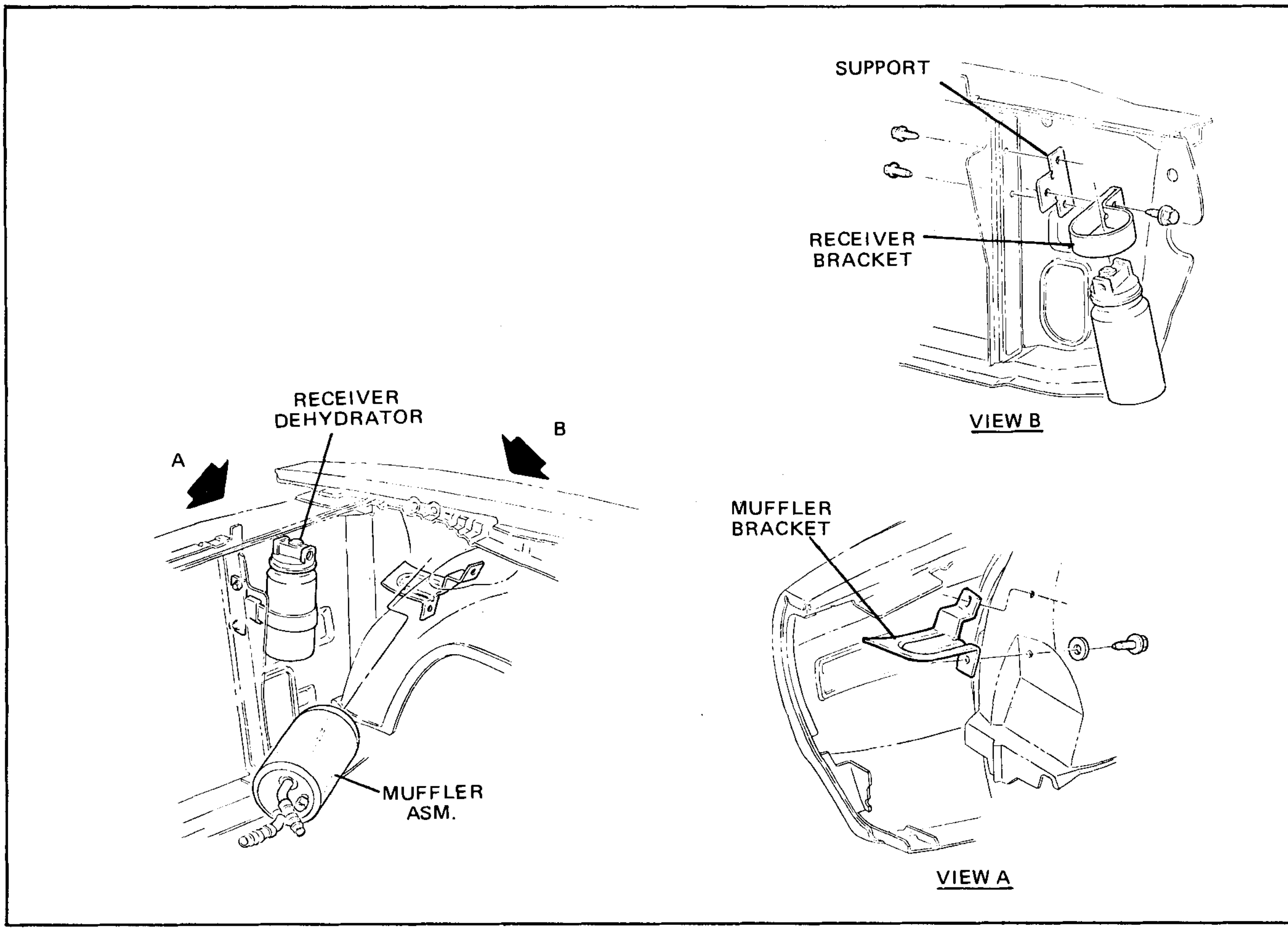


Fig. 1A-114 F Series Receiver and Muffler Mounting

EVAPORATOR CORE

REMOVE AND REPLACE - EXCEPT X SERIES

1. Depressurize refrigeration system. On F Series, remove hood and RH hood hinge while depressurizing system.
2. Disconnect oil bleed and equalizer line at P.O.A. valve.
3. Disconnect P.O.A. inlet and expansion valve outlet fittings and cap all openings.
4. Remove insulation at expansion valve thermo bulb and remove clamps.
5. Remove screw retaining expansion valve to bracket.
6. Remove screws retaining P.O.A. valve to bracket.
7. Remove screws and nuts retaining left half of case (inboard side) to dash and to right half of case, Figs. 1A-103, 1A-116 and 1A-117.
8. Disconnect and remove expansion valve (and P.O.A. valve on F Series).
9. Gently pry case from sealer (if equipped with gasket use care not to destroy).
10. On A Series (V-8), use a long bar and pry up slightly on right side of engine to allow removal of case. On A Series (6-cylinder models) and F Series, remove left case half.

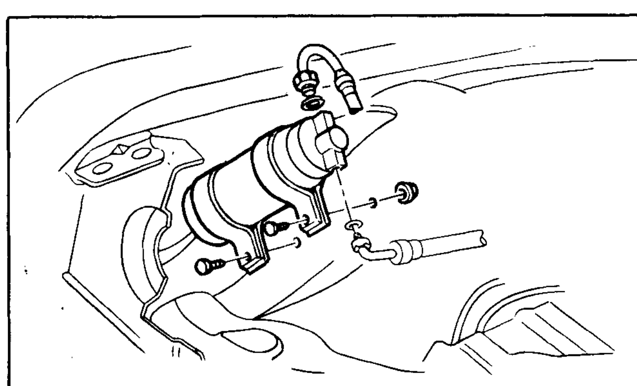


Fig. 1A-115 Receiver Dehydrator Assembly - X Series

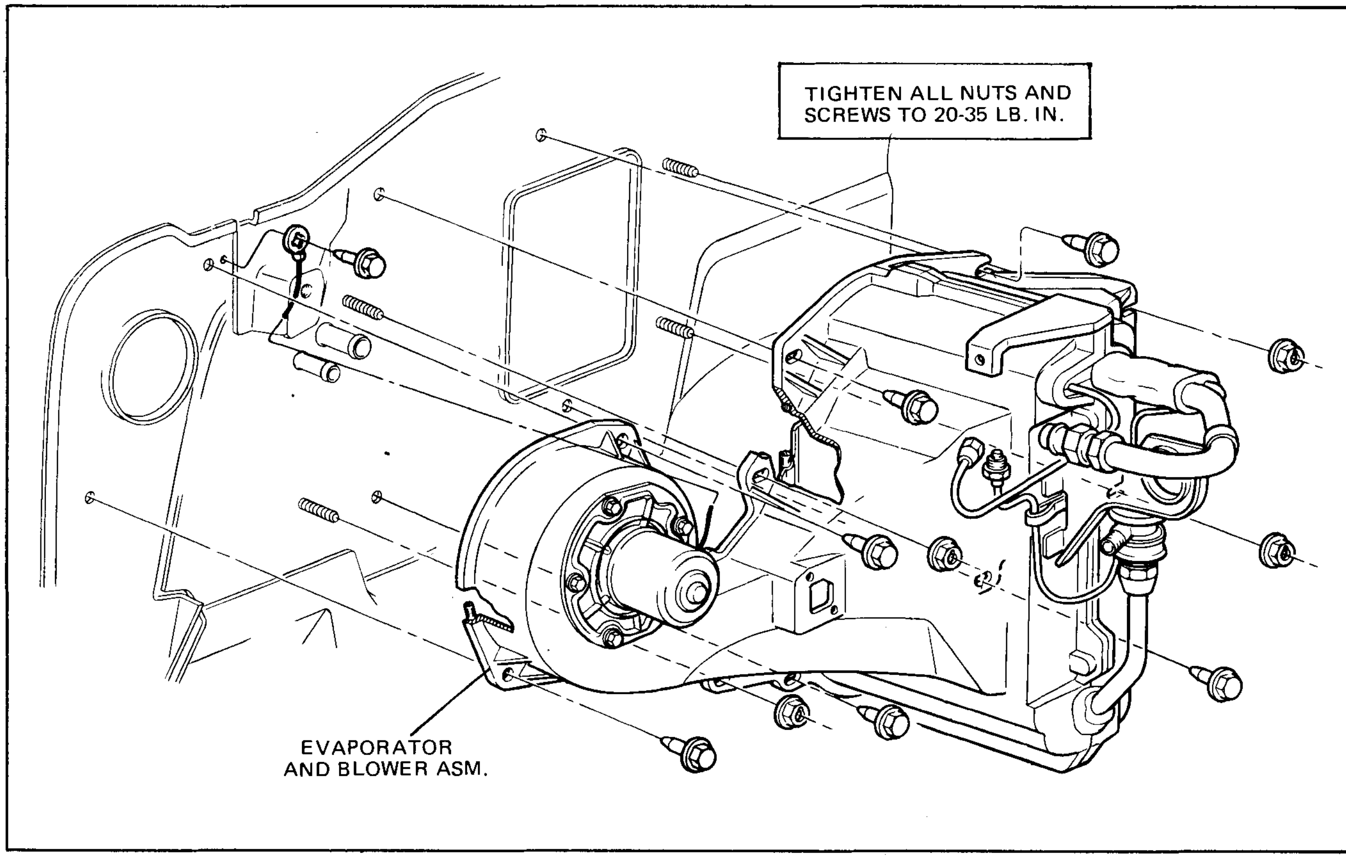


Fig. 1A-116 A and G Series Evaporator Core and Case Installation

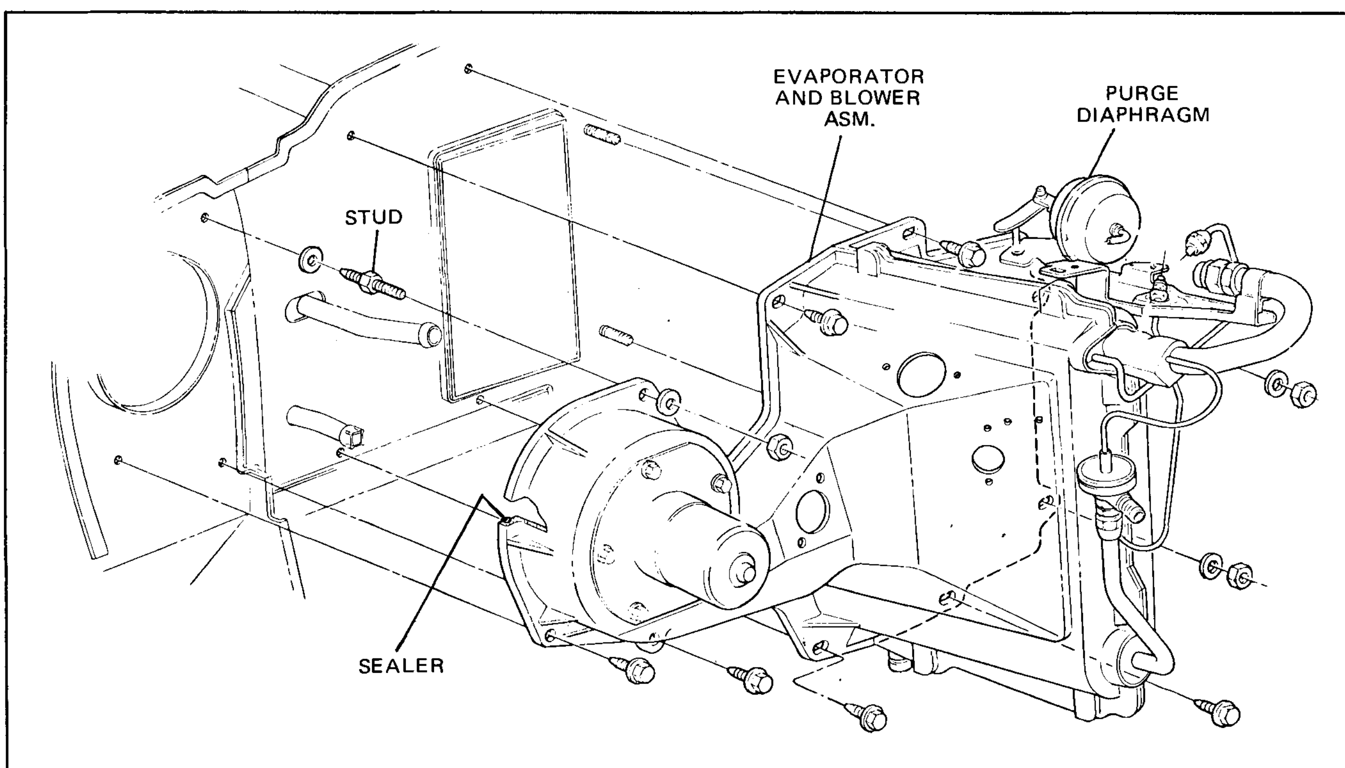


Fig. 1A-117 F Series Evaporator Core and Case Installation

11. Remove core.
12. To replace, reverse removal procedure. Use care to reseal case halves and case to dash.
13. Evacuate and charge system.

REMOVE AND REPLACE - X SERIES

1. Depressurize refrigerant system.
2. Disconnect oil bleed line and equalizer line at P.O.A. valve (Fig. 1A-107 or 1A-107A).
3. Disconnect evaporator outlet fitting at P.O.A. valve and evaporator inlet fitting at expansion valve. Cap all openings to prevent foreign material from entering refrigeration system.
4. Remove thermo bulb from evaporator outlet line.
5. Disconnect all electrical connections at evaporator case.
6. Remove all screws and nuts retaining left half of evaporator case to right half of case and to dash.
7. Disconnect and remove expansion valve.
8. Pull left half of evaporator case outward and upward from core, being careful not to damage core.
9. Remove core retaining screws and remove core.
10. Add three fluid ounces of clean refrigerant oil to new core.
11. Replace core by reversing steps 1 through 9.
12. Evacuate and charge refrigerant system.

EVAPORATOR CASE (LEFT HALF)

REMOVE AND REPLACE - A AND G SERIES

1. Remove screws attaching left half of evaporator case to dash and right case half. Remove expansion valve bracket retaining screw.
2. Pry gently on case and separate from dash and right case half. On V-8's, use a long bar to lift right side of engine slightly to allow removal of case.
3. Remove case and carefully reseal when replacing.

REMOVE AND REPLACE - F SERIES

For removal and replacement of the left evaporator case half, follow procedure for evaporator core replacement. Transfer parts from old case half to the new half before installing core and replacing on car.

REMOVE AND REPLACE - X SERIES

To replace the evaporator case left half refer to evaporator core removal procedure and transfer parts to new left case half.

AIR INLET AND VALVE

A AND G SERIES - REMOVE AND REPLACE

1. Remove kick panel.
2. Remove vacuum hoses (Fig. 1A-118).
3. Remove cold air distributor duct.
4. Remove inlet assembly retaining screws.
5. Remove blower motor case as outlined under Blower Motor or Case Removal.
6. Remove three upper retaining screws.
7. To replace reverse removal procedure.

BLOWER MOTOR AND/OR IMPELLER

REMOVE AND REPLACE - EXCEPT X SERIES

1. Raise car and remove right front wheel.
2. Cut access hole along outline stamped in right hand fender skirt with pneumatic chisel or equivalent.
3. Disconnect blower feed wire.
4. Remove blower motor and transfer impeller.
5. To install, reverse procedure for removal. Cover hole in fender skirt as described under blower motor replacement in Section 1 of this manual.

REMOVE AND REPLACE - X SERIES

1. Disconnect battery.
2. Detach heater hoses from clips on right fender skirt.
3. Raise car on hoist.
4. Remove all fender skirt attaching bolts except those attaching skirt to radiator support.
5. Pull out then down on skirt and place block of wood between skirt and fender to allow clearance for blower motor removal.

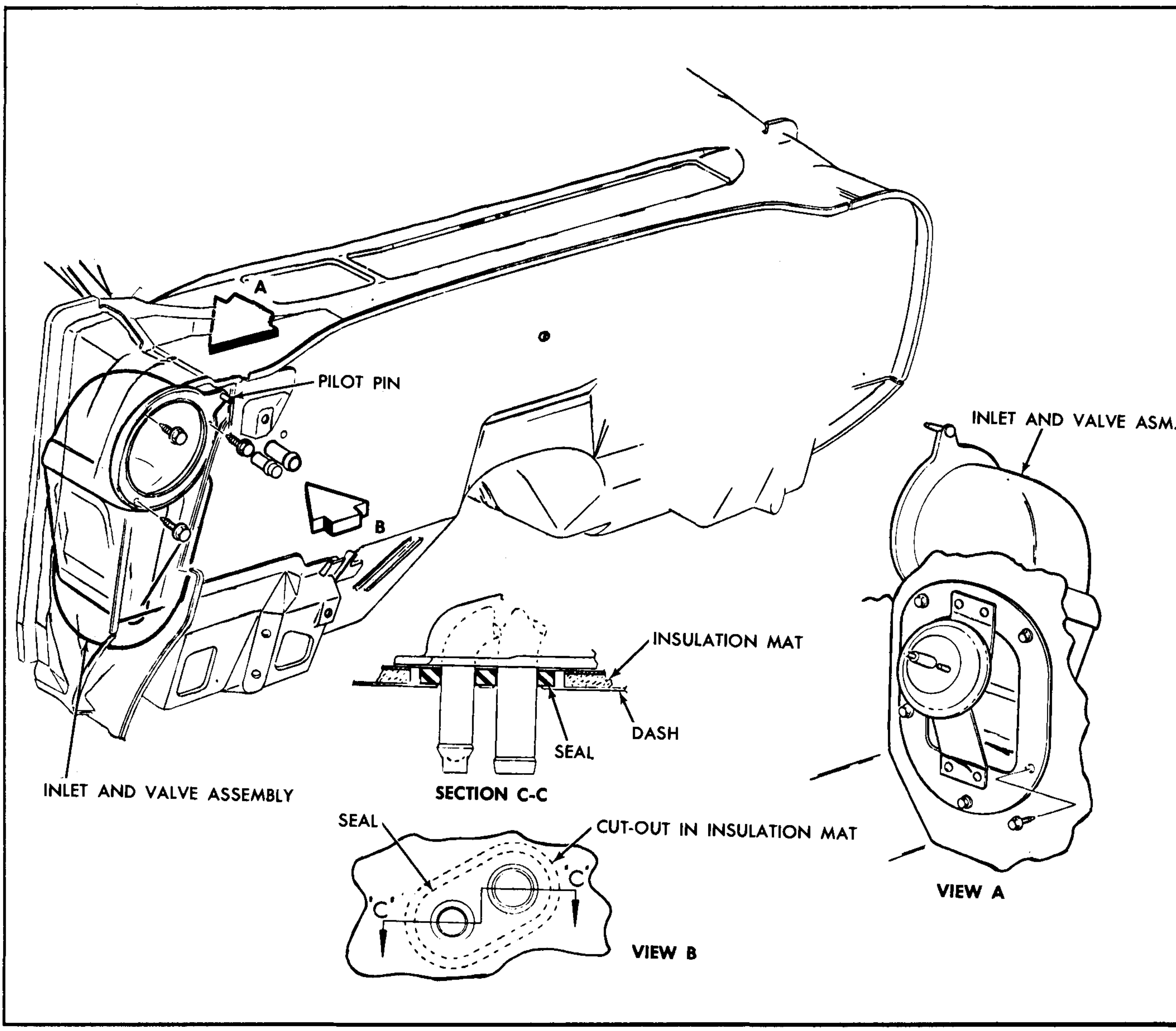


Fig. 1A-118 Air Inlet Assembly - A and G Series

6. Disconnect blower motor cooling tube and electrical connections at blower motor.
7. Remove blower motor attaching screws and remove blower motor. Pry motor flange gently if sealer acts as an adhesive.
8. Remove impeller retaining nut and separate impeller from motor.
9. To replace, reverse removal procedure.

A/C HEATER CORE AND CASE ASSEMBLY

REMOVE AND REPLACE - B SERIES

1. Drain radiator.
2. Disconnect water hoses at heater core tubes.
3. Remove 3 nuts and one screw retaining core and case assembly to dash.
4. Remove glove box. Remove upper and lower I.P. trim plates.
5. Remove radio.
6. Remove cold air duct.
7. Remove heater outlet duct.
8. Remove defroster duct to heater case screw.

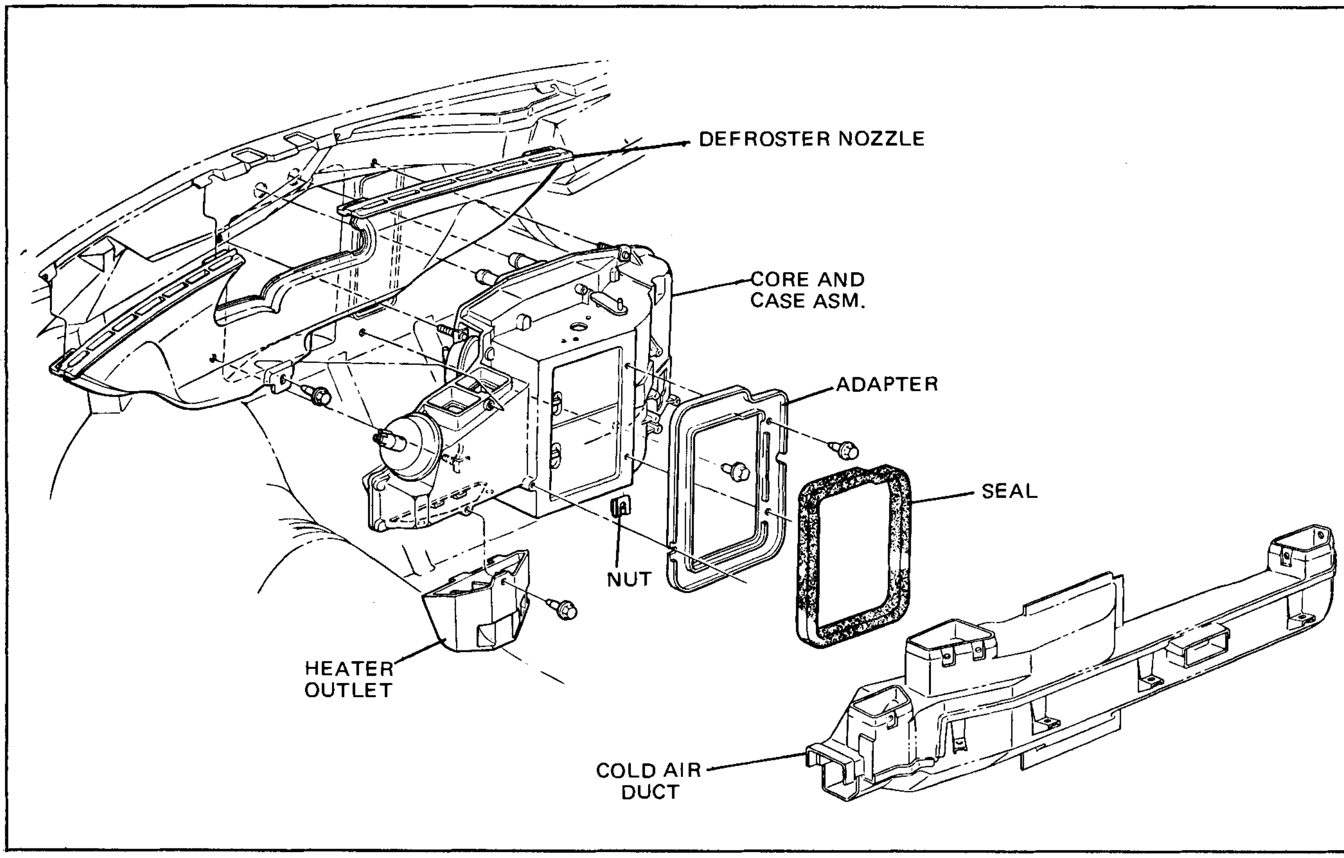


Fig. 1A-119 B Series A/C Heater Core and Case Installation

9. Disconnect A/C temperature cable at heater case.

10. Disconnect vacuum hoses from diaphragms on heater case and remove core and case assembly from car.

11. Remove core from case (3 screws).

12. To replace core, reverse removal procedure. If case is to be replaced, transfer parts (cam, diaphragms, etc.) to new case. Refer to Fig. 1A-119 for installation of core and case assembly.

REMOVE AND REPLACE - A AND G SERIES

1. Drain coolant.

2. Remove two water hoses attached to heater core.

3. Remove lower duct and outlet assembly.

4. Remove glove box.

5. Remove defroster duct attaching screw.

6. Remove screws retaining case to dash.

7. Move core and case assembly rearward to free attaching studs from cowl and remove core and case assembly.

8. Disconnect cables and wire connectors.

9. Adequately mark heater cam and bracket assembly in three places to insure proper reinstallation.

10. Remove heater cam and bracket assembly.

11. Remove front case to rear case attaching screws.

12. Separate front and rear case.

13. Remove screws retaining core attaching bands and remove core.

14. Replace by reversing the above procedure. See Fig. 1A-120.

CORE REMOVE AND REPLACE - F SERIES

1. Drain coolant.

2. Remove glove compartment and door.

3. Remove cold air duct (lower right hand duct).

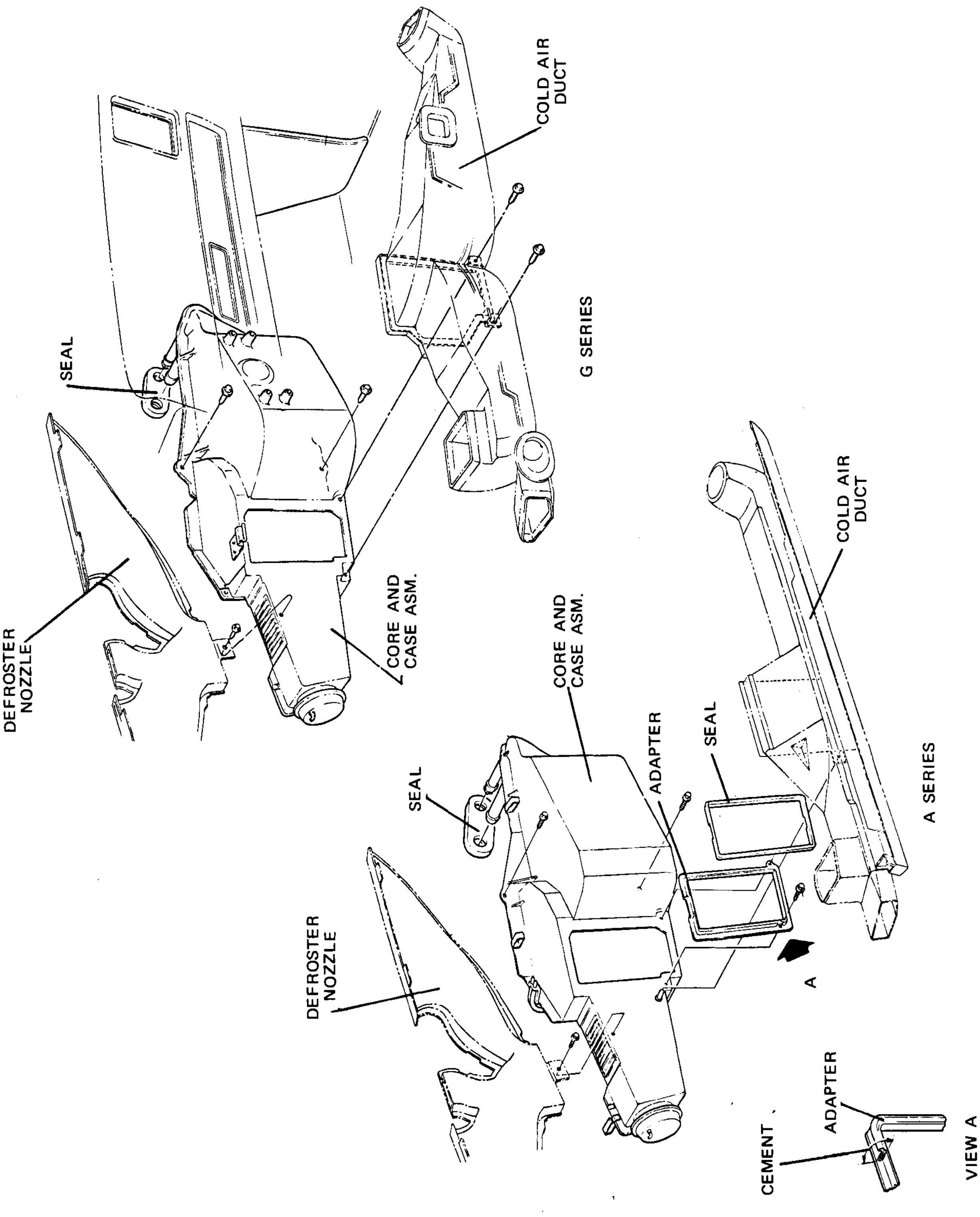


Fig. 1A-120 A/C Heater Core and Case - A and G Series

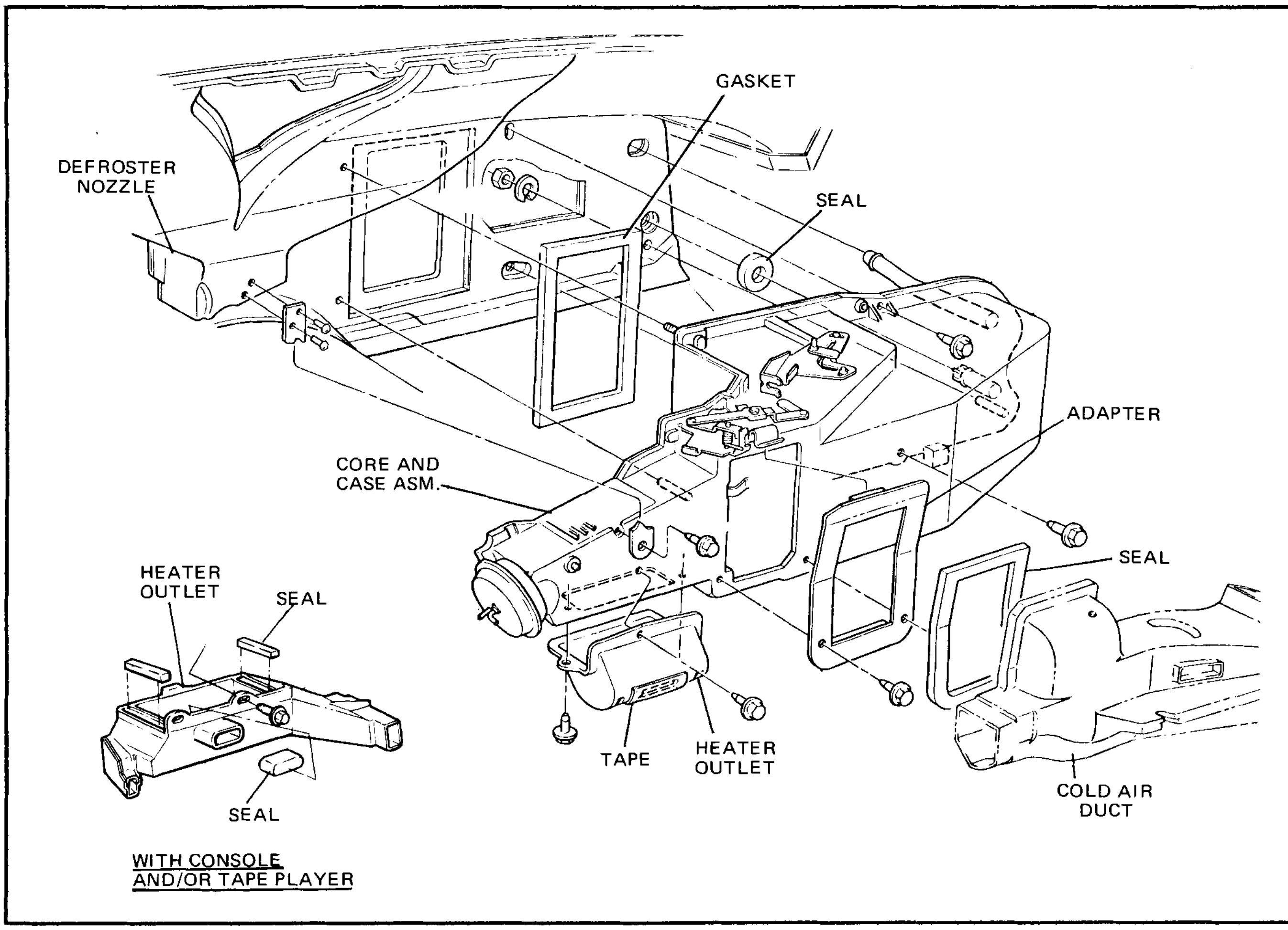


Fig. 1A-121 F Series A/C Heater Core and Case

4. Remove left and center lower A/C ducts.
5. Jack right front area of car and place on safety stand.
6. Remove rocker panel trim on right side and remove screws holding forward portion of rocker panel trim attaching bracket.
7. Remove (3) lower fender bolts at rear of fender.
8. Remove (4) fender to skirt bolts at rear of wheel opening.
9. Remove (2) fender skirt bolts near blower motor area.
10. Pry rear portion of fender out at bottom to gain access to hose clamp on lower core hose and disconnect hose at heater core.
11. Disconnect water pump to core hose at core.
12. Remove (2) heater case retaining nuts under hood at dash (Fig. 1A-121).
13. Remove (2) heater case retaining bolts inside car.
14. Remove console if equipped. If equipped with console and tape player, remove console with tape player intact. If equipped with tape player and no console, remove tape player.
15. Disconnect temperature cable at heater case.
16. Remove heater outlet duct.
17. Remove lower defroster duct screw at heater case.
18. Remove right kick panel.
19. Remove heater core and case (Fig. 1A-121).
20. Disconnect vacuum hoses from heater case.
21. Remove core from case.
22. To replace, reverse removal procedure. Be certain that core is properly sealed in case.

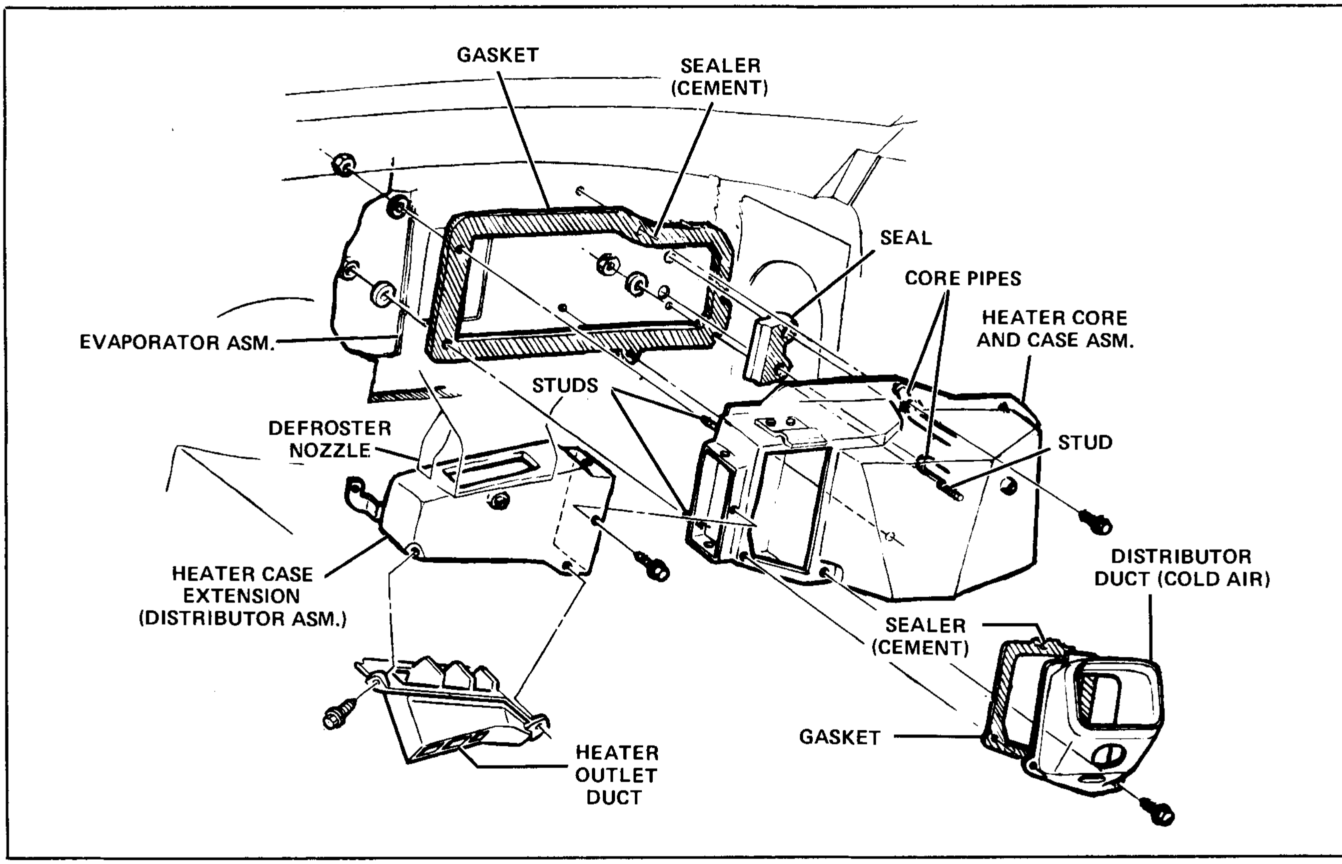


Fig. 1A-122 A/C Heater Core and Case Assembly - X Series

CASE REMOVE AND REPLACE - F SERIES

1. Perform steps 1 through 21 of heater core replacement procedure.
2. Transfer parts to new heater case.
3. Reverse procedure for heater core removal.

CORE REMOVE AND REPLACE - X SERIES

1. Disconnect battery.
2. Drain coolant.
3. Disconnect upper heater hose at core pipe and remove accessible heater core and case assembly attaching nuts.
4. Remove right front fender skirt bolts and lower skirt to gain access to lower heater hose clamp.
5. Loosen hose clamp and disconnect lower heater hose from core pipe. Remove lower right hand heater core and case assembly attaching nut.
6. Install plugs in heater core pipes to prevent spilling coolant.
7. Remove glove compartment and door.
8. Remove recirculation vacuum diaphragm at right hand kick panel.
9. Remove heater outlet (at bottom of heater case).
10. Remove cold air distributor duct from heater case.
11. Remove heater case extension screws and separate extension from heater case (Fig. 1A-122).
12. Disconnect heater cables and electrical connectors from heater case and remove heater core and case assembly.
13. Separate core from case.
14. To replace, reverse removal procedure. Be sure core is properly sealed.

CASE REMOVE AND REPLACE - X SERIES

To replace case, follow A/C heater core replacement procedure and transfer case parts to new heater case.

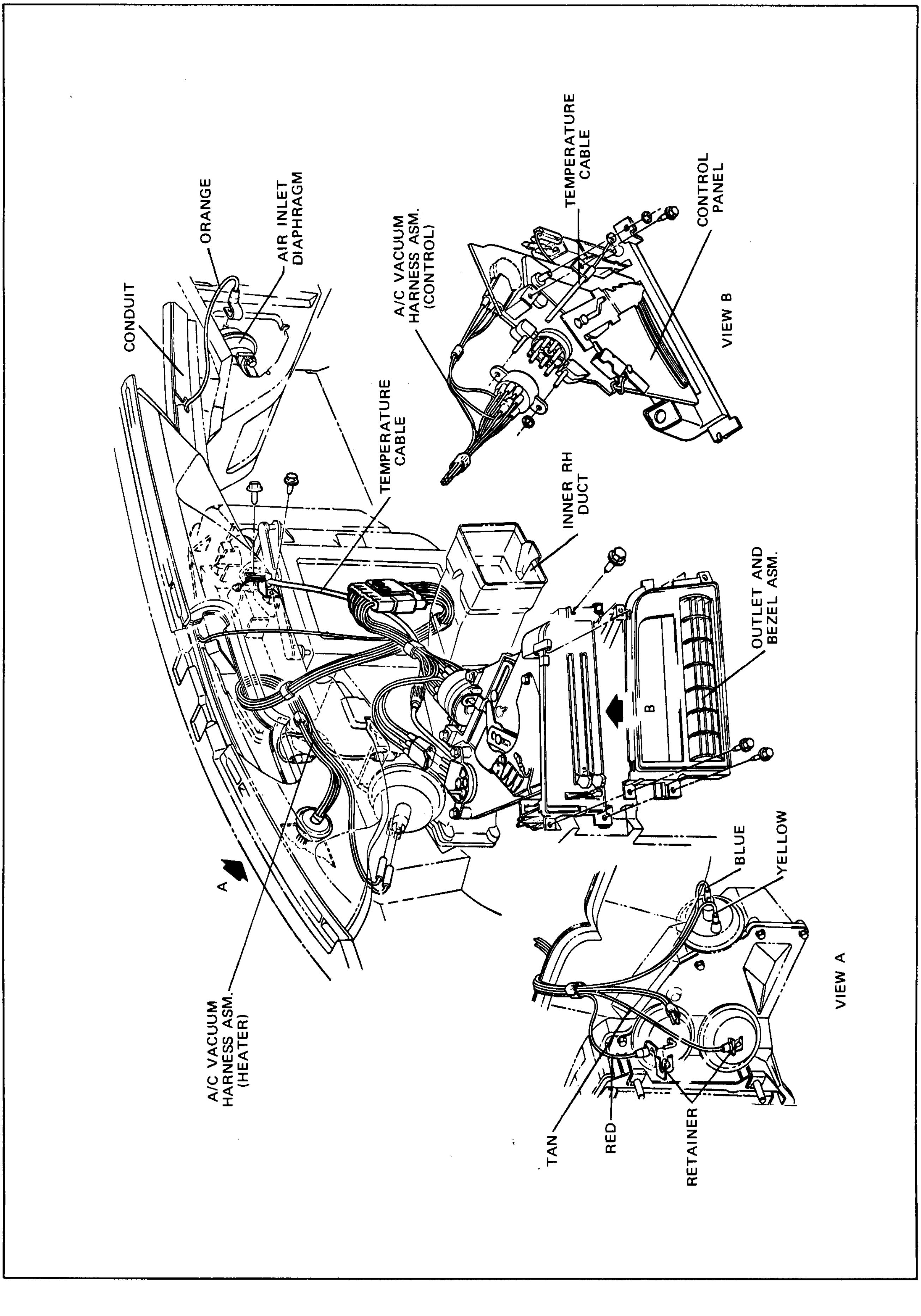


Fig. 1A-123 B Series Control Cable and Vacuum Harness Routing

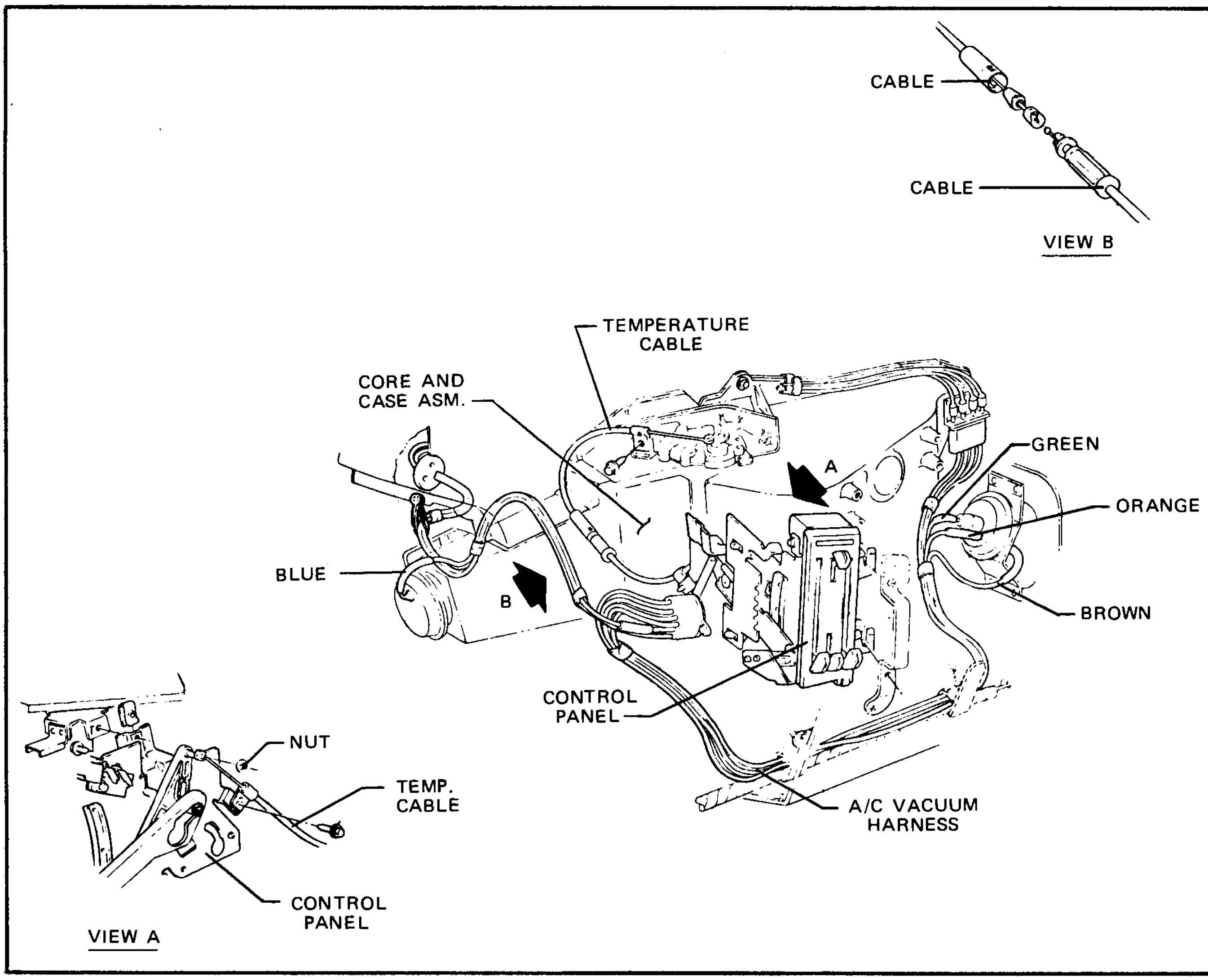


Fig. 1A-124 G Series Control Cable and Vacuum Harness Routing

VACUUM HOSE HARNESS

REMOVE AND REPLACE - ALL

To remove vacuum harness, refer to Figs. 1A-123 thru 1A-127 for harness routing and connections.

PLENUM AIR INLET DOOR DIAPHRAGM

REMOVE AND REPLACE - F SERIES

1. Remove cowl vent grille.
2. Remove attaching screws and link actuator screw.
3. Remove diaphragm (Fig. 1A-128).
4. To replace, reverse removal procedure.

REMOVE AND REPLACE - X SERIES

1. Remove windshield wiper arms.
2. Remove cowl vent grille.
3. Remove plenum diaphragm assembly to plenum chamber attaching screws (Fig. 1A-129).
4. Disconnect vacuum hose at diaphragm.
5. Position door in closed position and lift assembly from car.
6. Remove diaphragm to bracket and link screws and remove diaphragm.
7. To replace, reverse removal procedure.

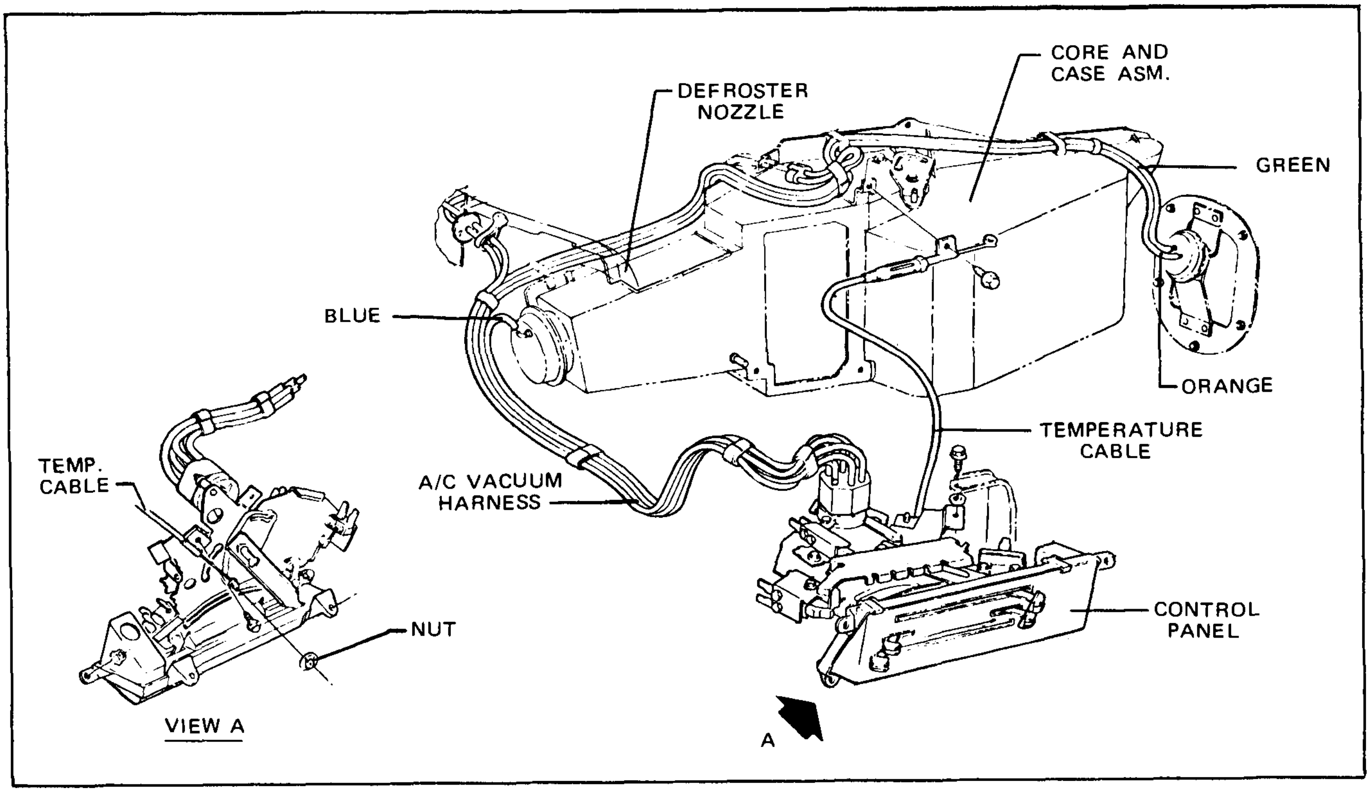


Fig. 1A-125 A Series Control Cable and Vacuum Harness Routing

DIVERTER DOOR DIAPHRAGMS

REMOVE AND REPLACE - ALL

1. Remove heater case assembly.
2. Remove vacuum hoses noting arrangement.
3. Remove retaining screws.
4. Remove actuator link attaching screw.
5. Remove diaphragms.

DEFROSTER DIAPHRAGM

REMOVE AND REPLACE - ALL

1. Remove heater core and case assembly from car (F Series only).
2. Remove heater outlet duct.
3. Remove two retaining screws and actuator link retaining screw.
4. Remove vacuum hose, then diaphragm.
5. To replace, reverse removal procedure.

AIR INLET DIAPHRAGM

REMOVE AND REPLACE - EXCEPT X SERIES

1. Remove kick panel (except B Series). On B Series remove glove box.
2. Remove vacuum hoses.
3. Remove two attaching screws.
4. Remove link actuator attaching screws.
5. Remove diaphragm.
6. To replace, reverse removal procedure.

KICK PANEL DIAPHRAGM

REMOVE AND REPLACE - X SERIES

1. Remove kick panel diaphragm cover (Fig. 1A-130).
2. Disconnect vacuum hose at diaphragm.
3. Remove (2) diaphragm to kick panel attaching screws.
4. Disconnect link and spring at recirc air door and remove diaphragm and bracket as an assembly.

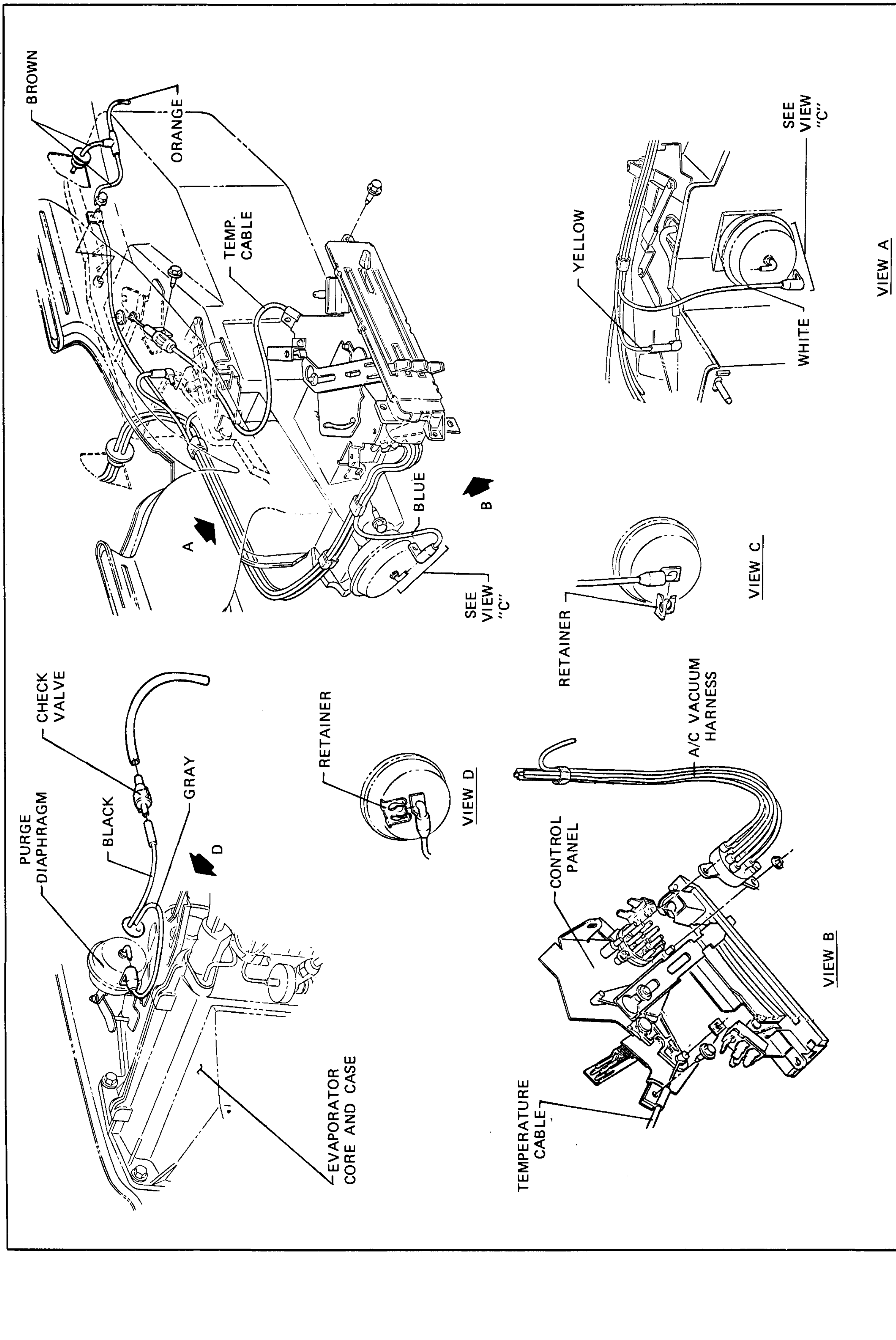


Fig. 1A-126 F Series Control Cable and Vacuum Harness Routing

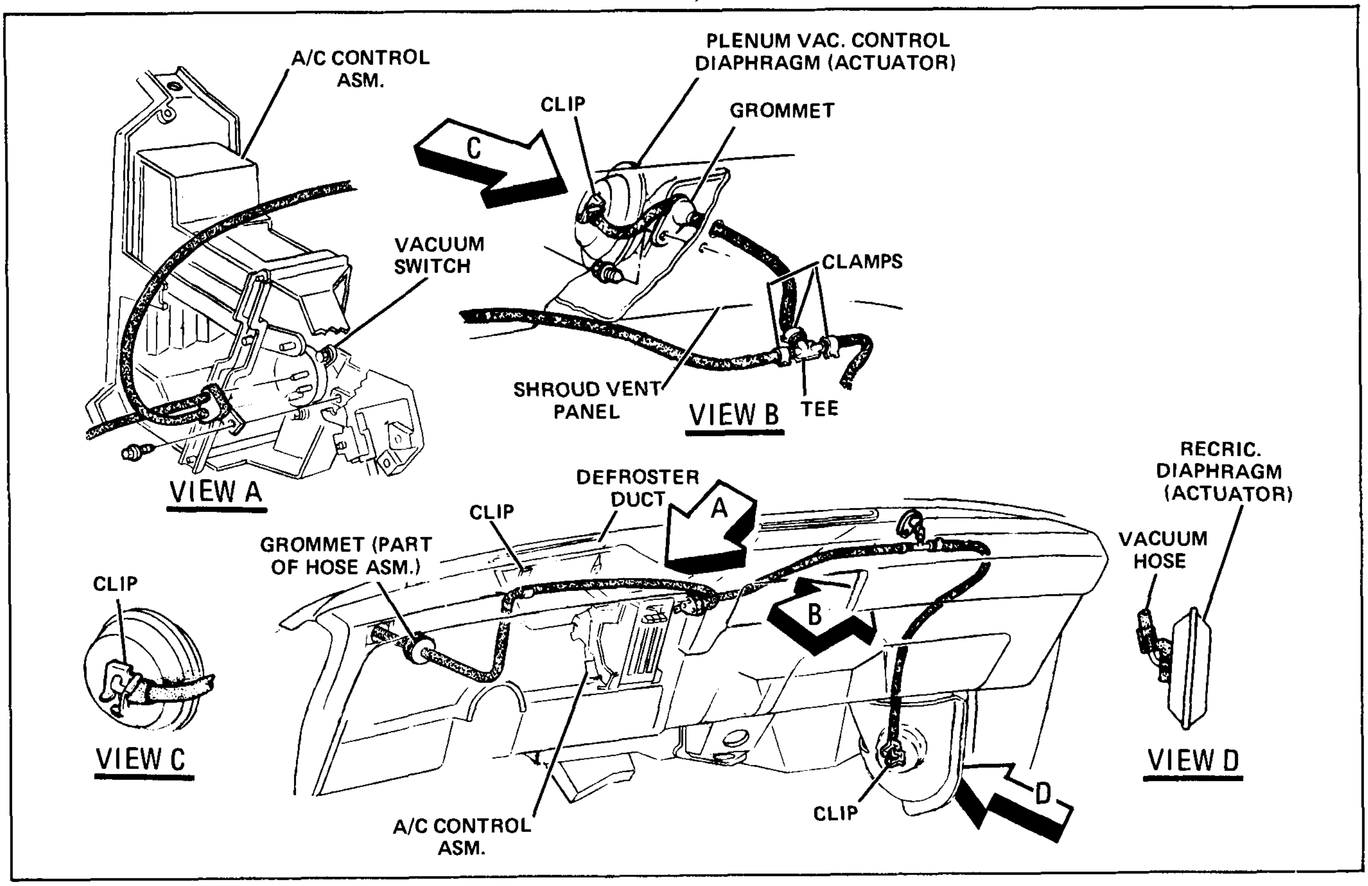


Fig. 1A-127 X Series A/C Vacuum Hose Routing

5. Separate diaphragm from bracket (3 screws).
6. To replace, reverse removal procedure.

CAM ASSEMBLY-TEMPERATURE DOOR

REMOVE AND REPLACE

1. Remove glove compartment on all except G Series with console.
2. Scribe alignment marks on heater case for cam placement.
3. Remove control cable.
4. Remove cam hold down screws.
5. Remove cam.
6. To replace reverse removal procedure.
7. Adjust cable.

TEMPERATURE CABLE

REMOVE AND REPLACE - EXCEPT X SERIES

1. Remove cold air duct (except B Series).
2. Remove glove compartment and disconnect cable at heater case.
3. Disconnect cable at control panel. On B Series remove control panel from I.P. with cable attached, then disconnect cable.
4. To replace reverse removal procedure, check operation and adjust if necessary.

A/C HEATER CABLES

REMOVE AND REPLACE - X SERIES

To replace the A/C heater cables (air cable, defroster cable and temperature cable) refer to Figs. 1A-131 and 1A-132 for cable routing. Perform steps 1 through 3 of control panel procedure and disconnect cable from control assembly. To disconnect heater case end of the defroster cable, it may be necessary to remove the heater core and case assembly from the car.

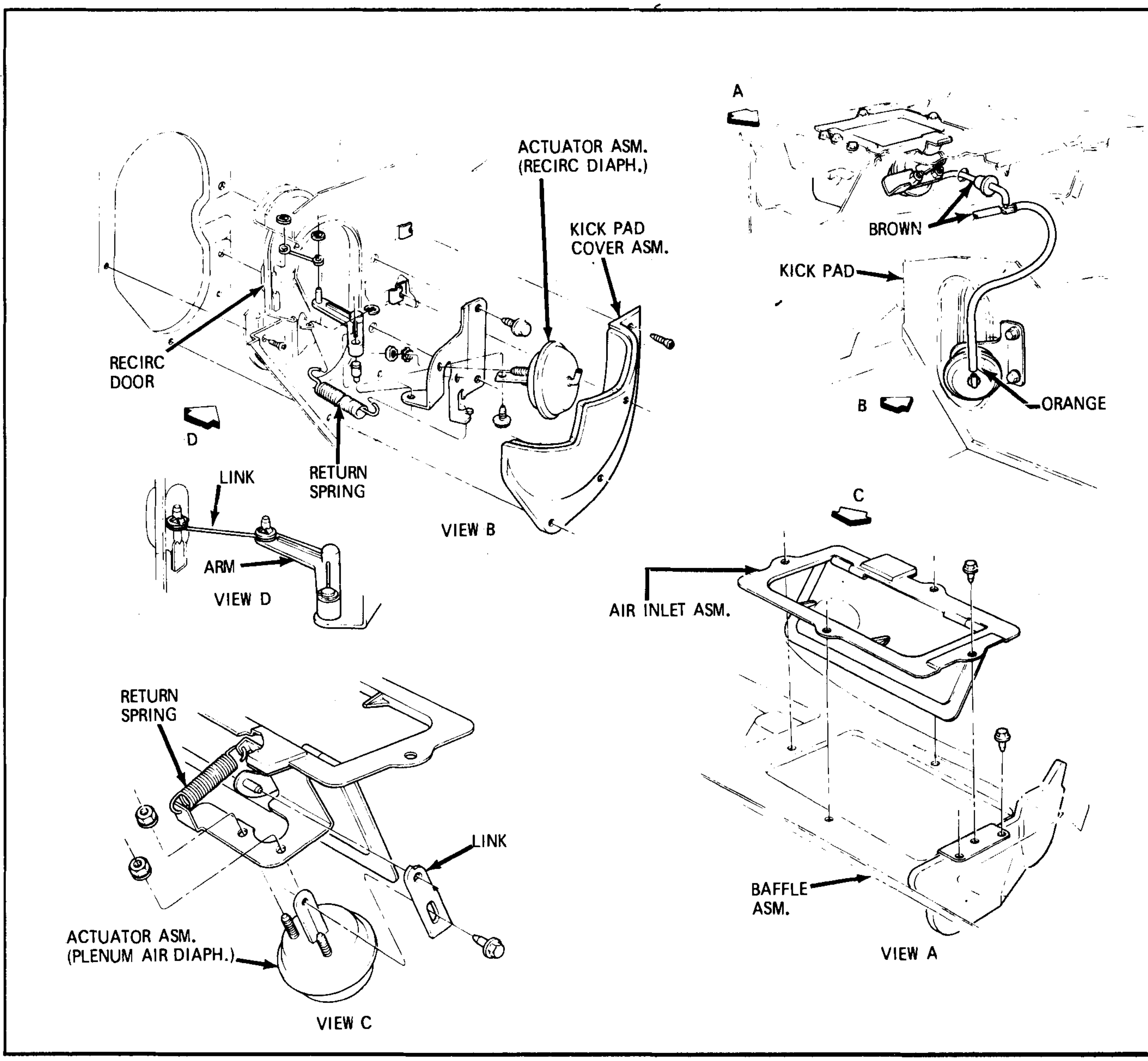


Fig. 1A-128 F Series Air Doors and Vacuum Diaphragms

TEMPERATURE CABLE ADJUST

Temperature cables on all standard air conditioned models except X Series are bowden type with an adjusting turnbuckle. Rotating the turnbuckle in one direction extends the outer sleeve and rotating in the other direction shortens the sleeve.

Adjustment is to be made after cables are securely connected at both ends and routed smoothly and free of bends and/or kinks.

B SERIES

1. Place temperature lever on control panel at full COOL (COLD).
2. Adjust turnbuckle until cam roller bottoms at end of slot in cam.
3. Move temperature lever to full WARM (HOT) and back to full cold. Cam should return to rest at end of slot.
4. If cam is not at end of slot or temperature lever did not go full travel, repeat steps 2 and 3 until cable is properly adjusted.

G AND A SERIES

1. Place control panel temperature lever 1/16 inch from full cold (COOL) position.

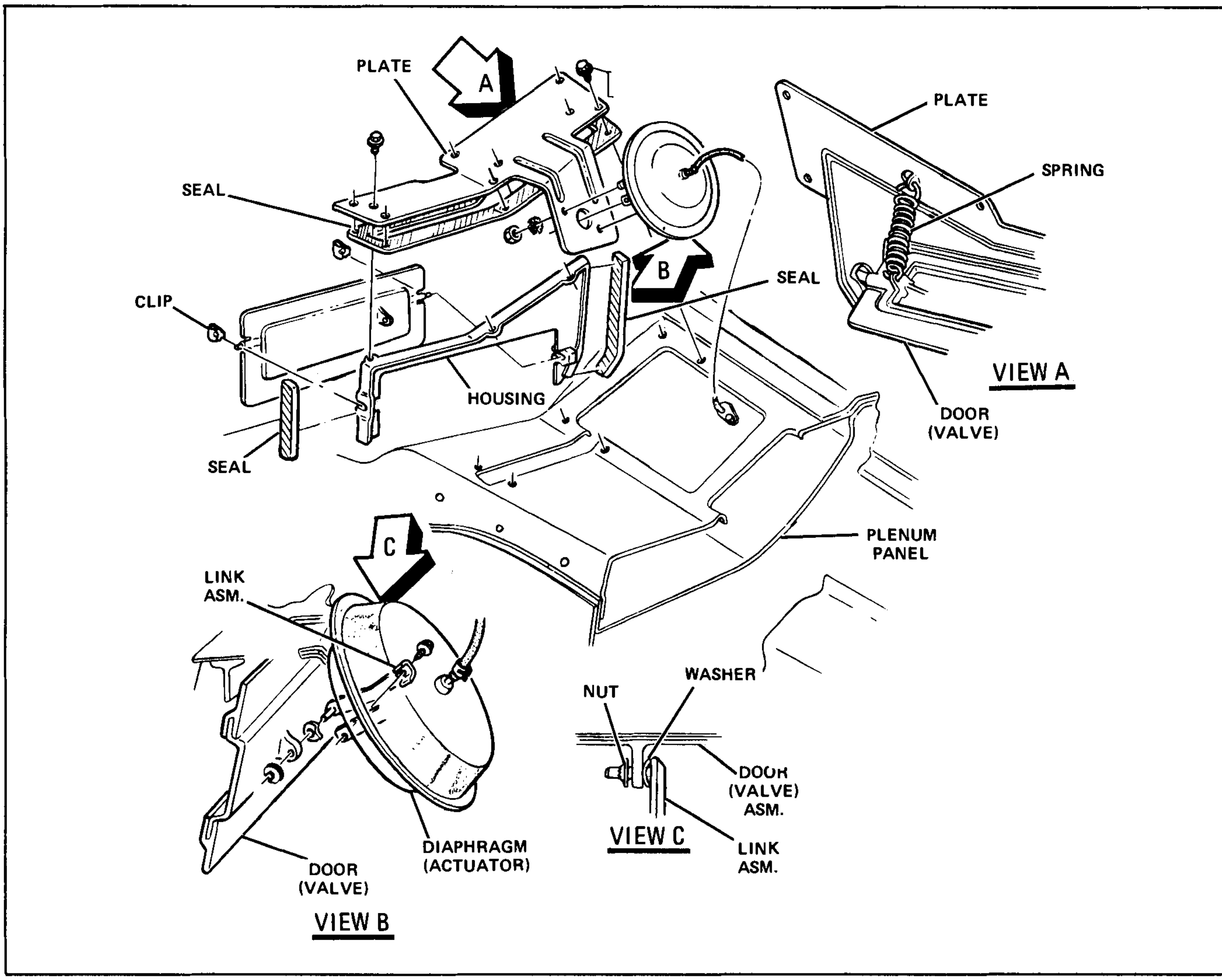


Fig. 1A-129 Plenum Air Inlet Diaphragm - X Series

2. Adjust cable turnbuckle until cam roller bottoms at end of slot in cam.

3. Move temperature lever to full WARM and back to full COOL. Cam should return to rest at end of slot and lever should stop slightly short of end of slot.

4. If cam is not at end of slot or if lever is more than 1/8 inch from end of travel, repeat steps 2 and 3 until cable is properly adjusted.

F SERIES

1. Place control panel temperature lever 1/16 inch from full COOL position.

2. Adjust turnbuckle until temperature door is seated.

3. Move temperature lever to full WARM and back to full COOL. Door should be heard hitting its seat and lever should stop slightly short of end of slot.

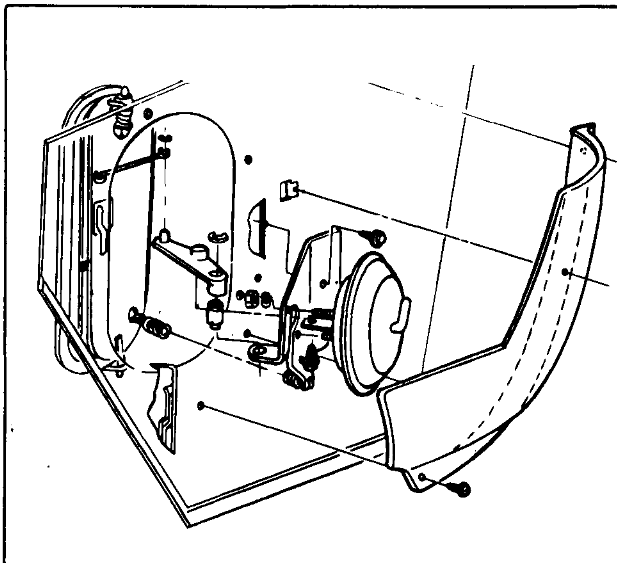


Fig. 1A-130 Kick Panel (Recirc) Diaphragm - X Series

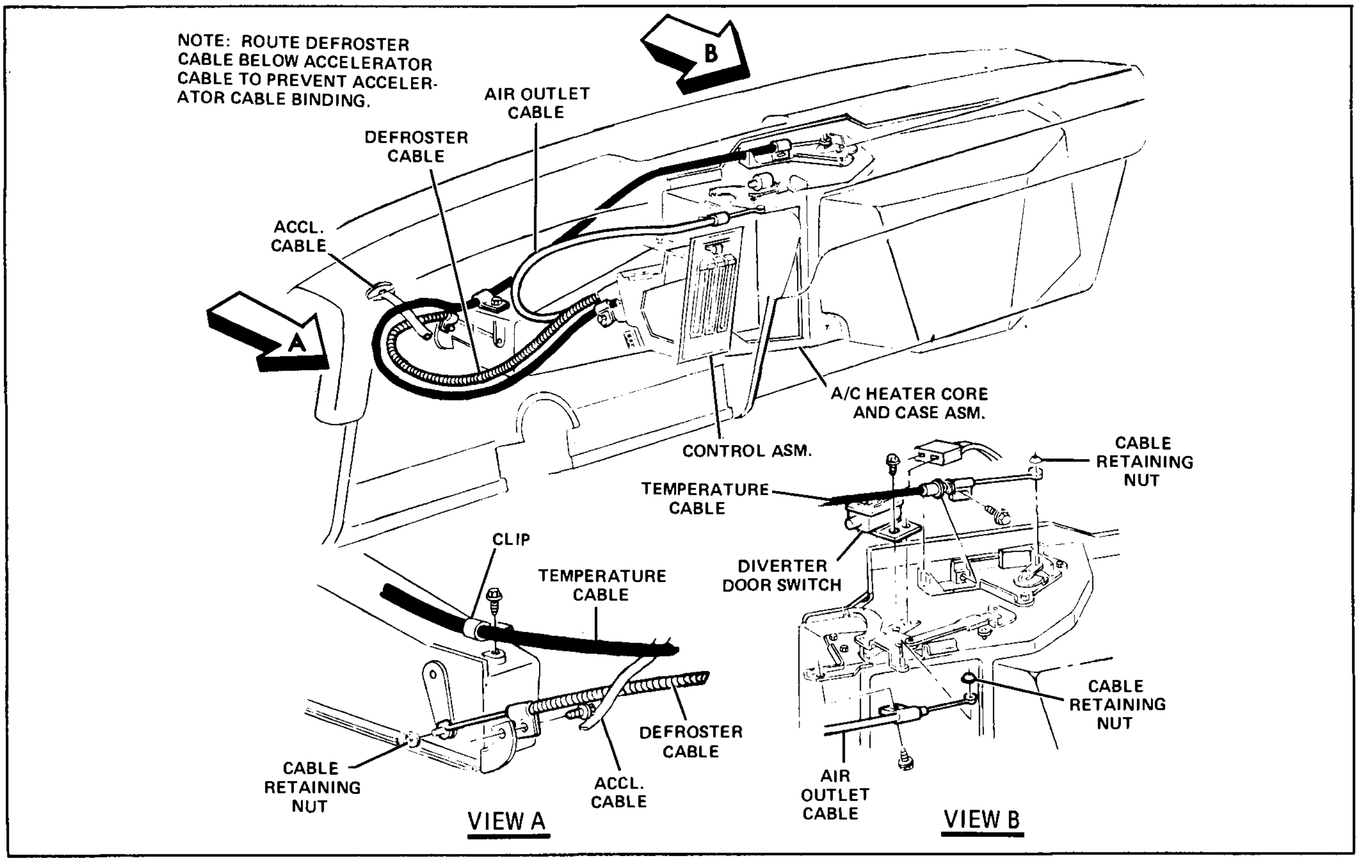


Fig. 1A-131 A/C Heater Cable Routing - X Series

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. See Fig. 1A-126 for cable installation and routing.

A/C CONTROL PANEL

REMOVE AND REPLACE - A AND G SERIES

1. Disconnect battery.
2. Remove cold air duct.
3. Remove radio.
4. Remove electrical and vacuum connections at control panel. NOTE: Identify wire connectors to switches and vacuum connectors for correct reassembly.
5. Remove control panel retaining screws (nuts on A Series).
6. Lower control panel assembly.
7. Disconnect temperature control cable and remove control.
8. To replace, reverse removal procedure. See installation of control panels on Figs. 1A-124 (G Series) and 1A-125 (A Series).

REMOVE AND REPLACE - B AND F SERIES

1. Disconnect battery.
2. Remove steering column trim.
3. Remove instrument panel trim plate (at cluster).
4. On F Series, remove rally gage cluster (fuel, volts) if applicable.
5. Remove glove compartment and door.
6. Disconnect temperature cable at heater case.
7. Remove control panel retaining screws.
8. Disconnect vacuum connectors at control (See Figs. 1A-123 and 1A-126).
9. On F Series, remove rear control panel retaining screw at radio support.
10. Remove control from instrument panel, disconnect-

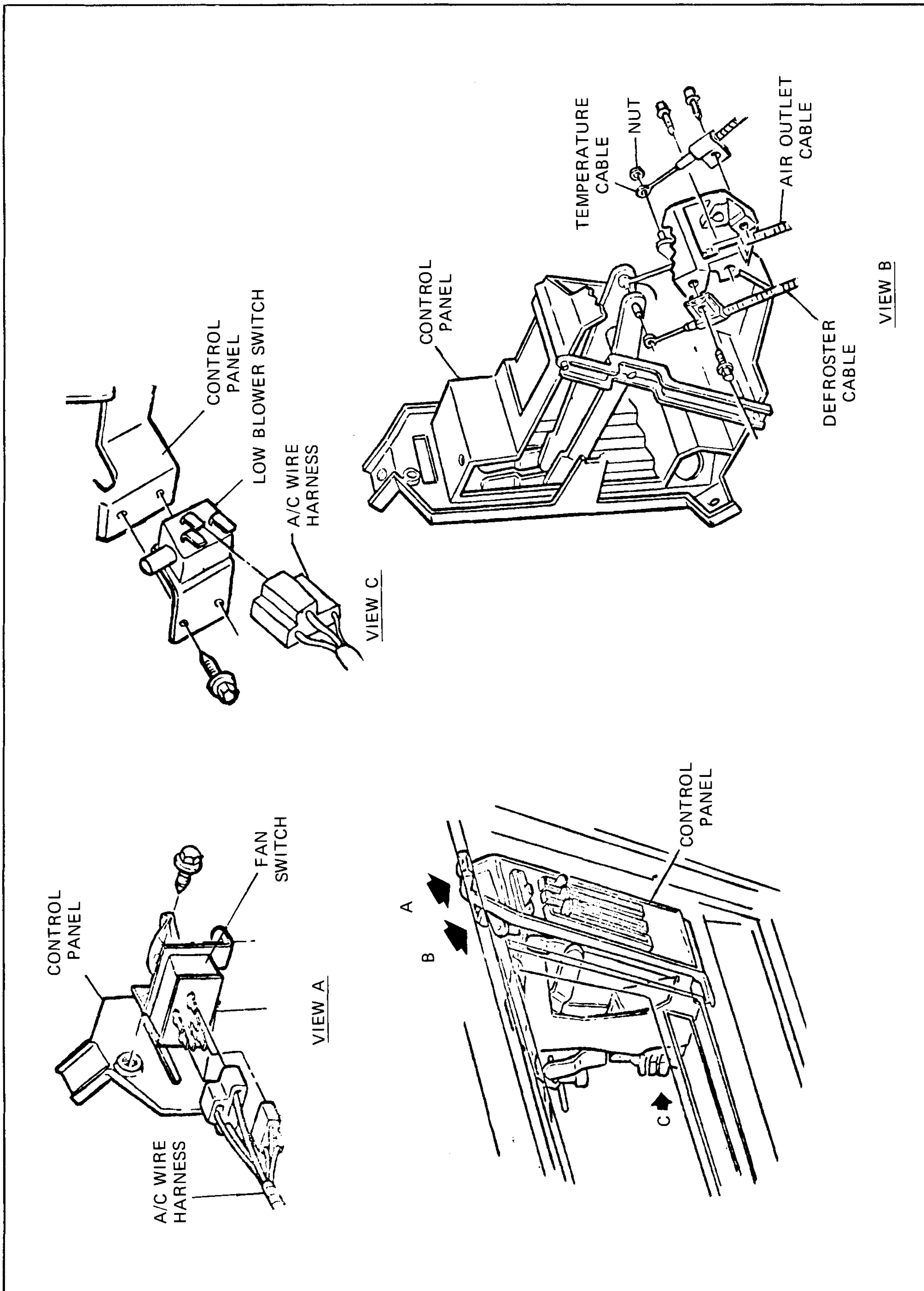


Fig. 1A-132 A/C Control Panel Installation - X Series

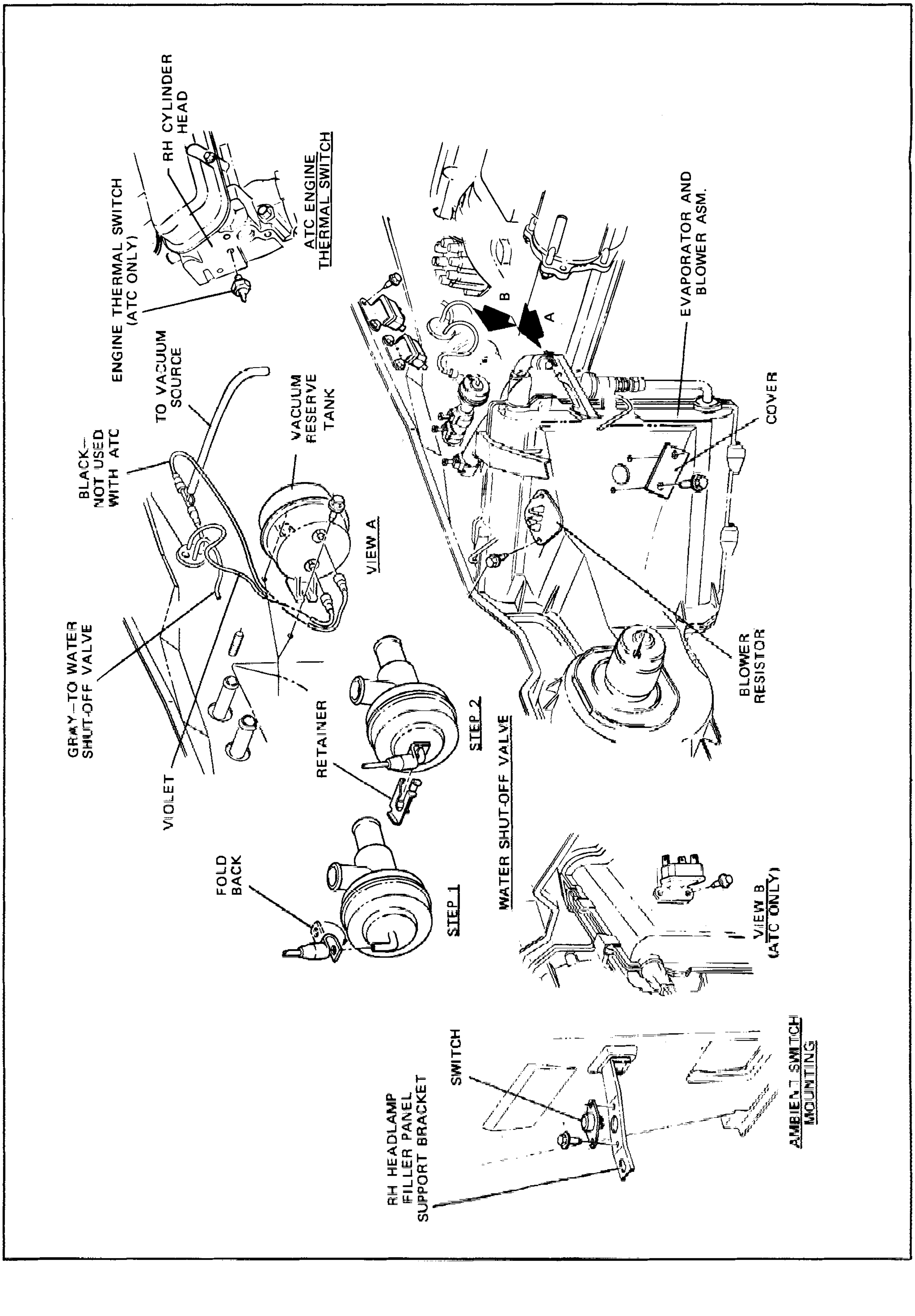


Fig. 1A-133 Engine Compartment A/C Components - B Series

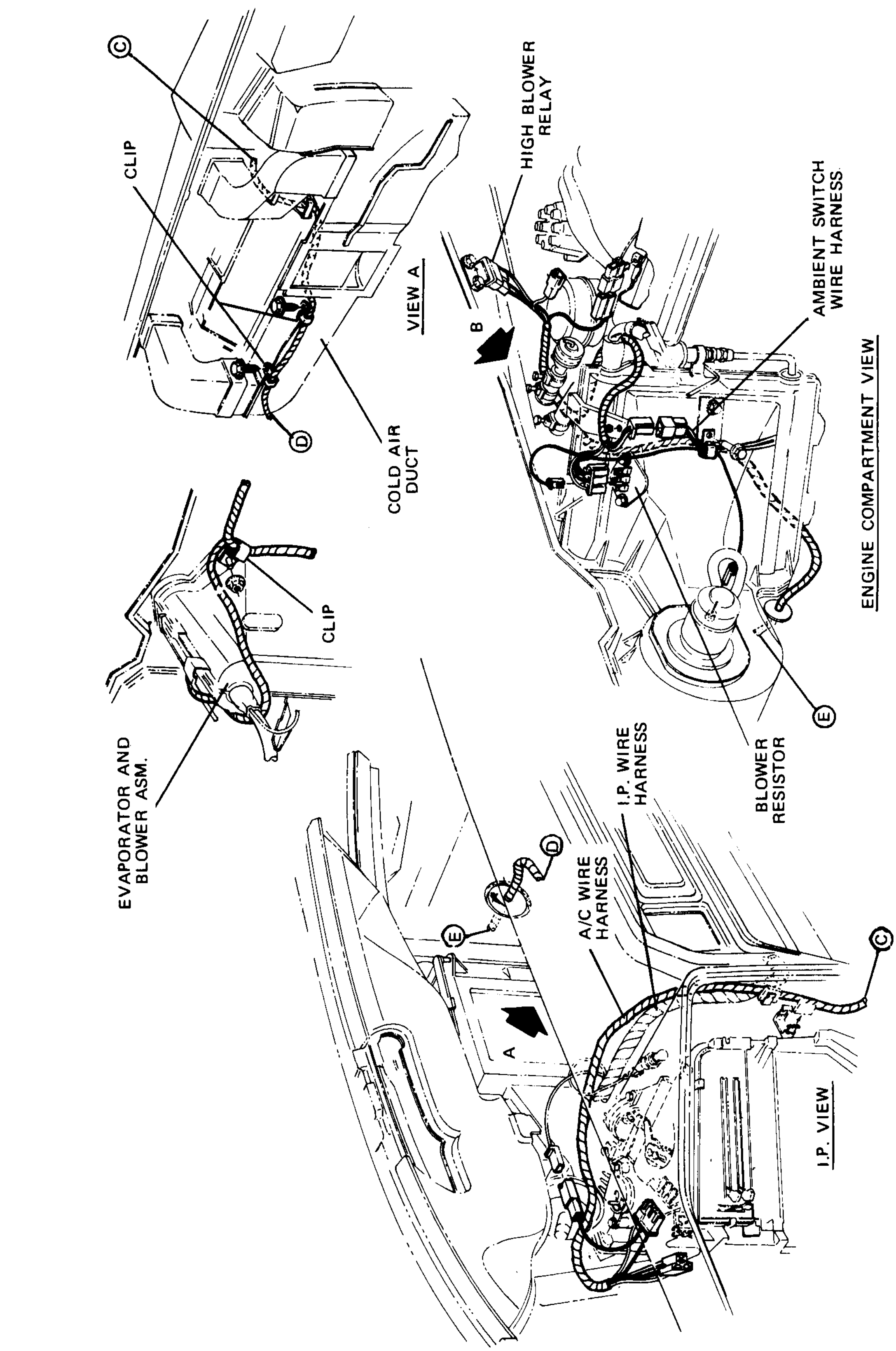


Fig. 1A-134 B Series A/C Wire Harness Routing

ing electrical connectors, lamp socket lead and temperature cable while control is on the way out.

11. To replace, reverse removal procedure.

REMOVE AND REPLACE - X SERIES

1. Disconnect battery.
2. Remove radio.
3. Remove control panel to instrument panel retaining screws and lower control panel (Fig. 1A-132) slightly from instrument panel.
4. Disconnect electrical connections and heater cables from control panel and remove control panel.
5. To replace, reverse removal procedure.

MASTER SWITCH REMOVE AND REPLACE - F SERIES

1. Perform steps 1 through 4 of procedure for A/C control panel.
2. Remove switch knob from front of control.
3. Disconnect electrical connector, remove switch retaining screws and remove switch through rally gage opening.
4. To replace, reverse removal procedure.

COMPRESSOR CLUTCH (VENT-NORMAL) SWITCH REMOVE AND REPLACE - F SERIES

1. Disconnect battery.
2. Remove lower instrument panel trim at steering column to gain access to bottom of A/C control panel.
3. Disconnect electrical connector at clutch switch.
4. Remove switch retaining screw and switch.
5. To replace, reverse removal procedure.

BLOWER SPEED SWITCH REMOVE AND REPLACE - F SERIES

To replace the blower speed switch, follow procedure for removal of master switch.

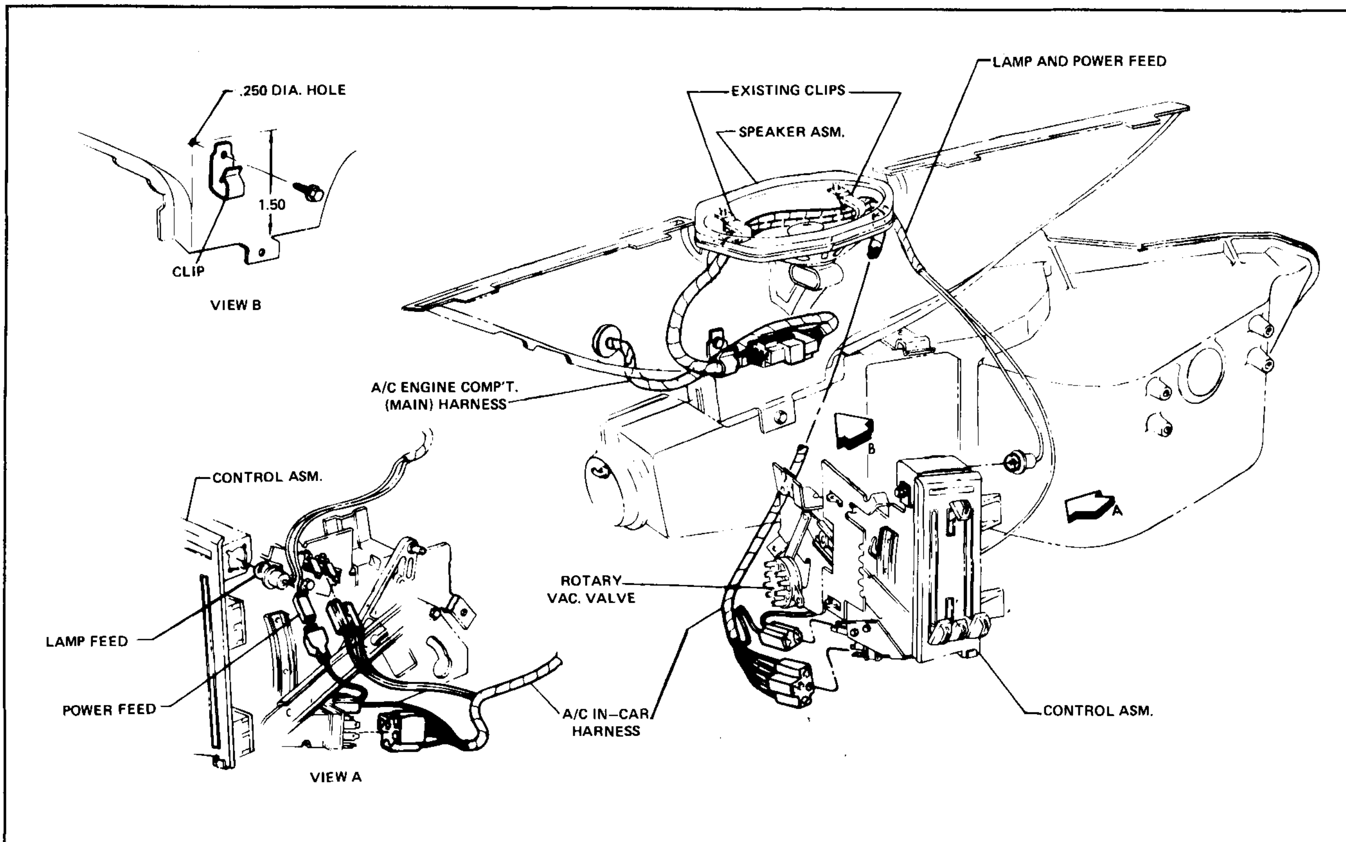


Fig. 1A-135 G Series A/C In-Car Wiring

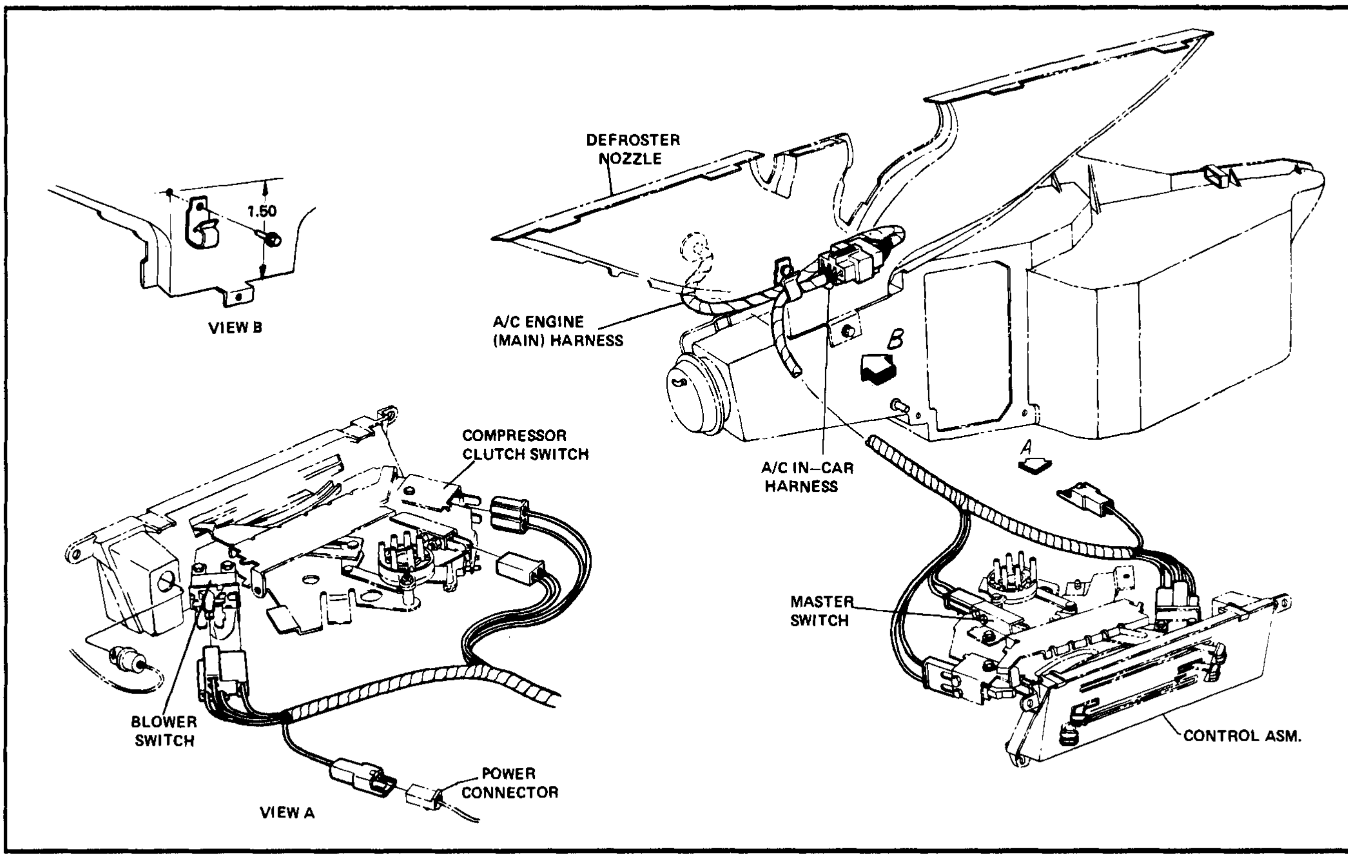


Fig. 1A-136 A Series A/C In-Car Wiring

A/C AMBIENT SWITCH

REMOVE AND REPLACE - B SERIES

The B Series ambient switch is located on the RH headlamp filler panel support bracket (Fig. 1A-133). To remove the switch, remove (2) support bracket screws and allow bracket to hang down between grille and condenser. Disconnect switch connector, remove support bracket and remove switch from bracket.

REMOVE AND REPLACE - EXCEPT B SERIES

The ambient switch on all models except B Series is located in the evaporator case or the cowl air inlet. The switch can be easily replaced by disconnecting the wire connector and removing two switch retaining screws.

A/C ELECTRICAL WIRING HARNESS

REMOVE AND REPLACE - B SERIES

1. Disconnect battery.
2. Remove cold air duct.
3. Remove glove compartment and door.
4. Disconnect electrical connectors at control panel.
5. Remove harness from clips retaining harness to instrument panel.
6. Underhood, disconnect electrical connectors from HI blower relay, engine harness, ambient switch wire asm. and blower motor resistor. Refer to Fig. 1A-134 for connections and routing.
7. Release harness from retaining clips, remove dash grommet and pull harness out of dash opening.
8. To replace, reverse removal procedure. Reseal dash grommet when replacement is completed.

A/C IN-CAR WIRE HARNESS

REMOVE AND REPLACE - A AND G SERIES

1. Disconnect battery.
2. Remove cold air duct.
3. On A Series remove radio.
4. Disconnect connector at main (engine) wire harness (Two connectors on G Series).
5. Disconnect all connections at control panel (includes power connector from instrument panel harness).
6. Remove harness.

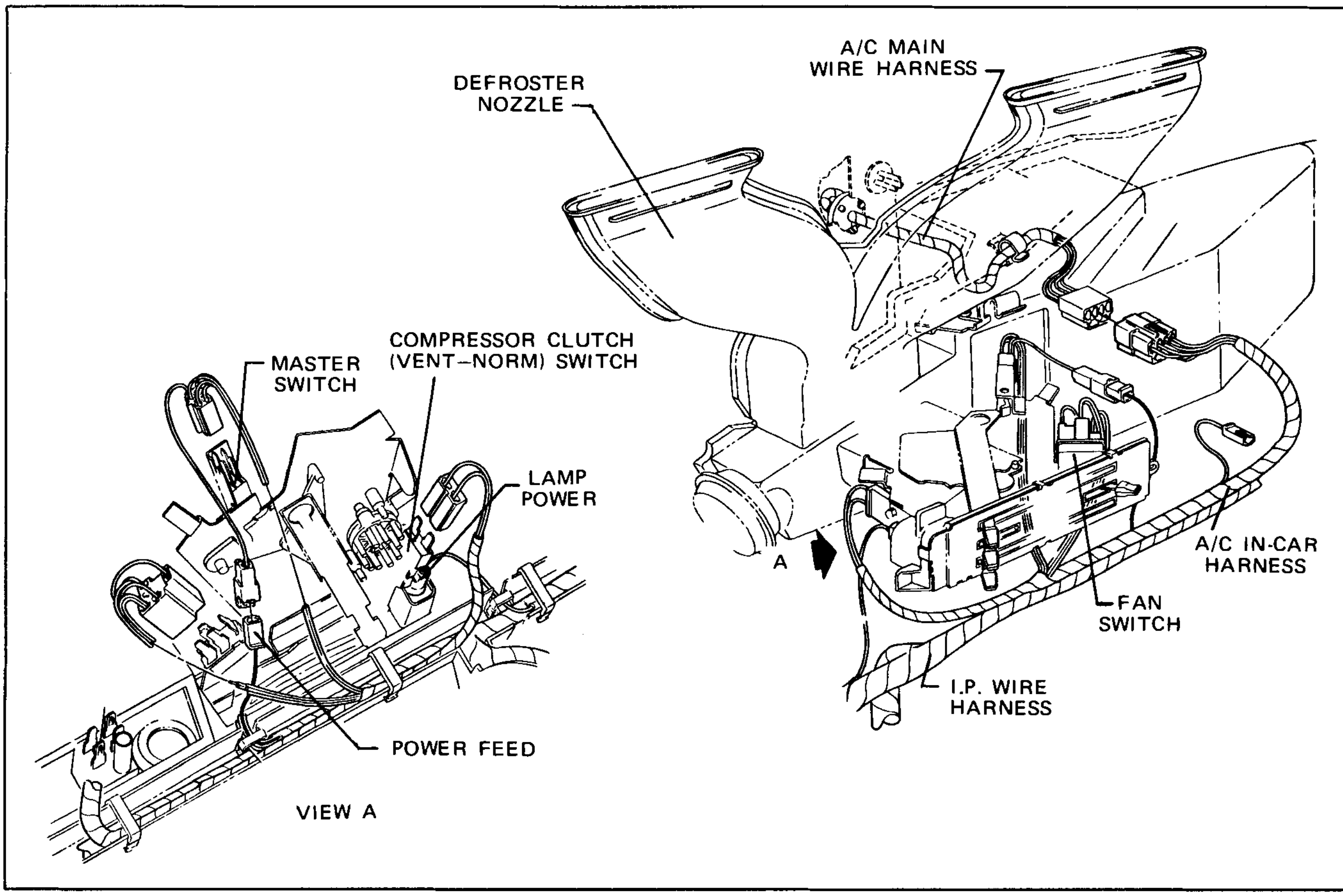


Fig. 1A-137 F Series A/C In-Car Wiring

7. To replace reverse removal procedure. See Figs. 1A-135 (G Series) and 1A-136 (A Series) for installation.

REMOVE AND REPLACE - F SERIES

1. Disconnect battery.
2. Remove glove compartment and door.
3. Remove right hand lower A/C duct (cold air duct).
4. Disconnect harness connections at right side of control panel.
5. Remove lower instrument panel trim at steering column.
6. Disconnect harness connections at left side of control panel.
7. Disconnect harness at connection to main (engine) harness and remove harness. See Fig. 1A-137.
8. To replace, reverse removal procedure.

REMOVE AND REPLACE - X SERIES

X Series in-car A/C wiring can be easily removed by referring to Fig. 1A-138 for harness connections and routing. For remainder of harness routing and connections, refer to Fig. 1A-142 and/or 1A-142A.

A/C UNDERHOOD (MAIN) WIRE HARNESS

REMOVE AND REPLACE - A AND G SERIES

1. Perform steps 1 thru 4 of A/C In-Car Wire Harness procedure.
2. Remove grommet and feed harness thru dash into engine compartment.
3. Remove harness from clips and disconnect harness from blower motor, blower resistor, ambient switch, high blower relay and compressor wire harness. Remove harness (Figs. 1A-139 and 1A-140).
4. To replace, reverse removal procedure.

REMOVE AND REPLACE - F SERIES

1. Disconnect battery.
2. Remove glove compartment and door.

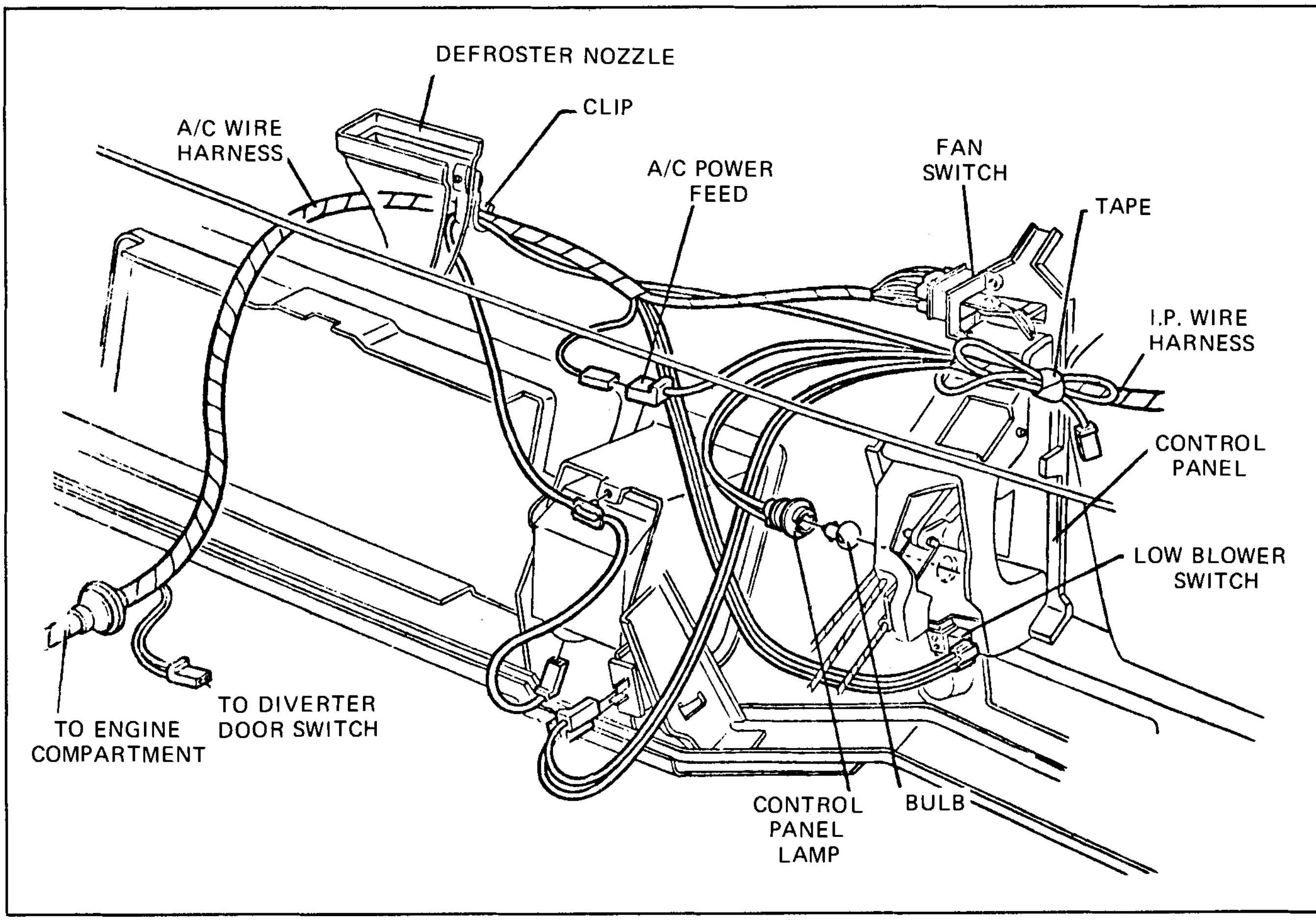


Fig. 1A-138 X Series A/C In-Car Wiring

3. Disconnect harness from in-car wire harness (Fig. 1A-137).
4. Remove grommet and feed harness through dash opening into engine compartment.
5. Disconnect harness connections at blower motor, blower resistor, ambient switch, high blower relay and compressor wire harness (Fig. 1A-141).
6. Release harness from clips and remove harness.
7. To replace, reverse removal procedure.

A/C COMPRESSOR WIRE HARNESS

REMOVE AND REPLACE

For removal of the compressor A/C wire harness, refer to Figs. 1A-142 (V-8 engines except X Series with 307 engine) and 1A-142A (X Series with 307 engine) for harness routing and electrical connections.

A/C AMBIENT SWITCH WIRE HARNESS

REMOVE AND REPLACE - B SERIES

1. Remove RH headlamp filler panel support bracket screws to allow support bracket to be positioned for disconnecting ambient switch connector.
2. Disconnect harness at ambient switch and feed wire harness through radiator support (Fig. 1A-143).
3. Release wire harness from retaining clips.
4. Disconnect harness from main A/C electrical harness at evaporator case and remove harness.
5. To replace, reverse removal procedure.

A/C (MAIN) COLD AIR DUCT

REMOVE AND REPLACE - B SERIES

1. Disconnect battery.
2. Remove instrument panel lower trim plate.
3. Remove instrument panel upper trim plate (includes removal of radio knobs and bezels).
4. Remove glove box, disconnect radio connectors and antenna lead and remove radio.

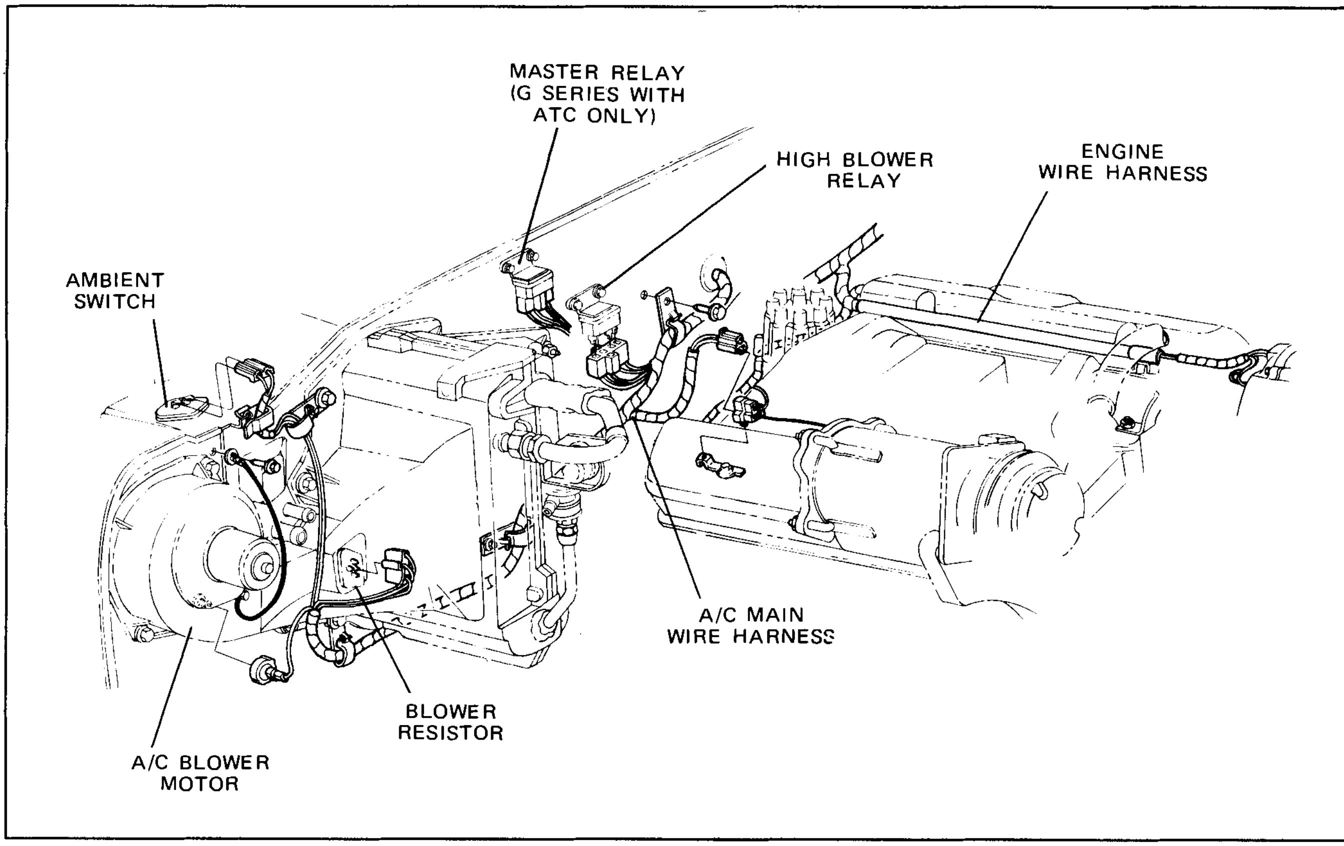


Fig. 1A-139 A/C Underhood (Main) Wire Harness - A and G Series (V-8)

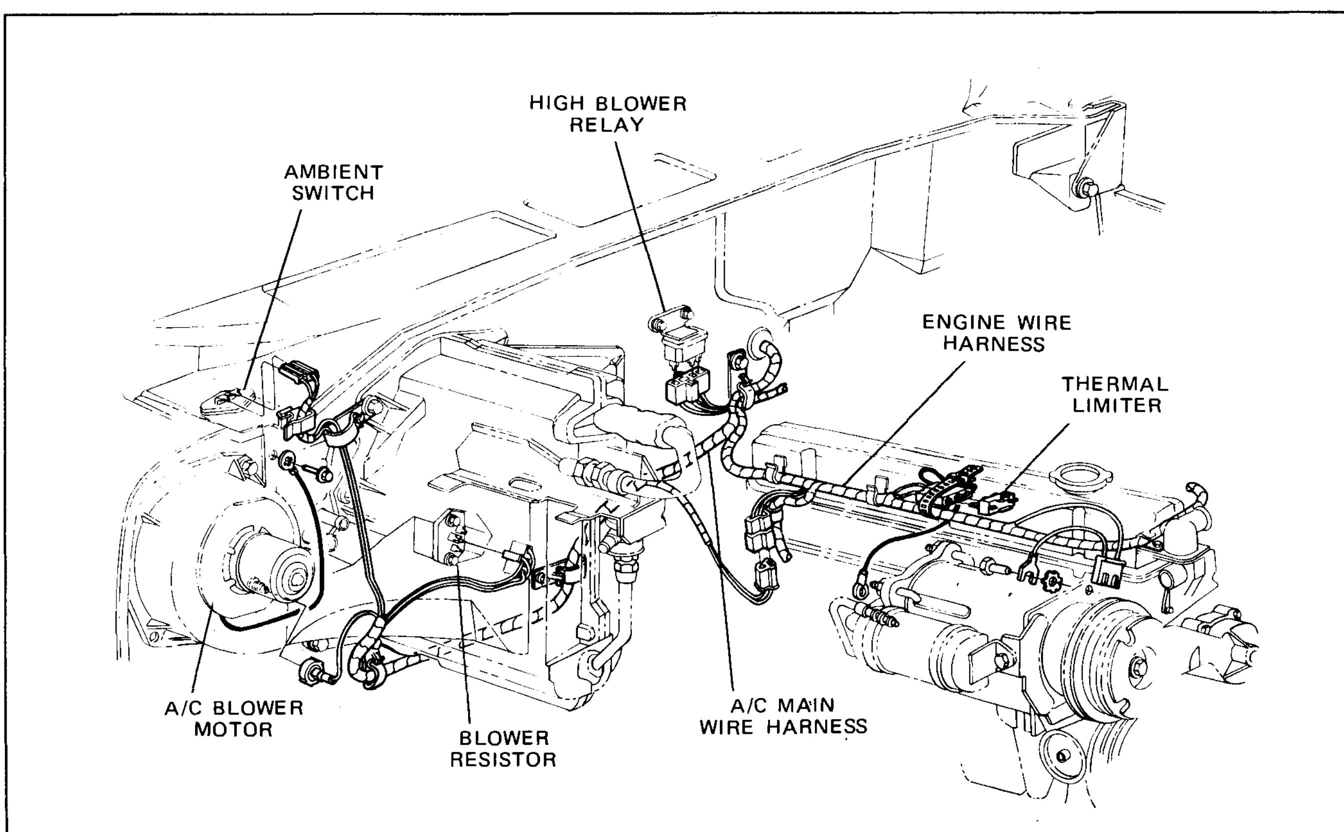


Fig. 1A-140 A/C Underhood (Main) Wire Harness - A Series (6 Cyl. Engine)

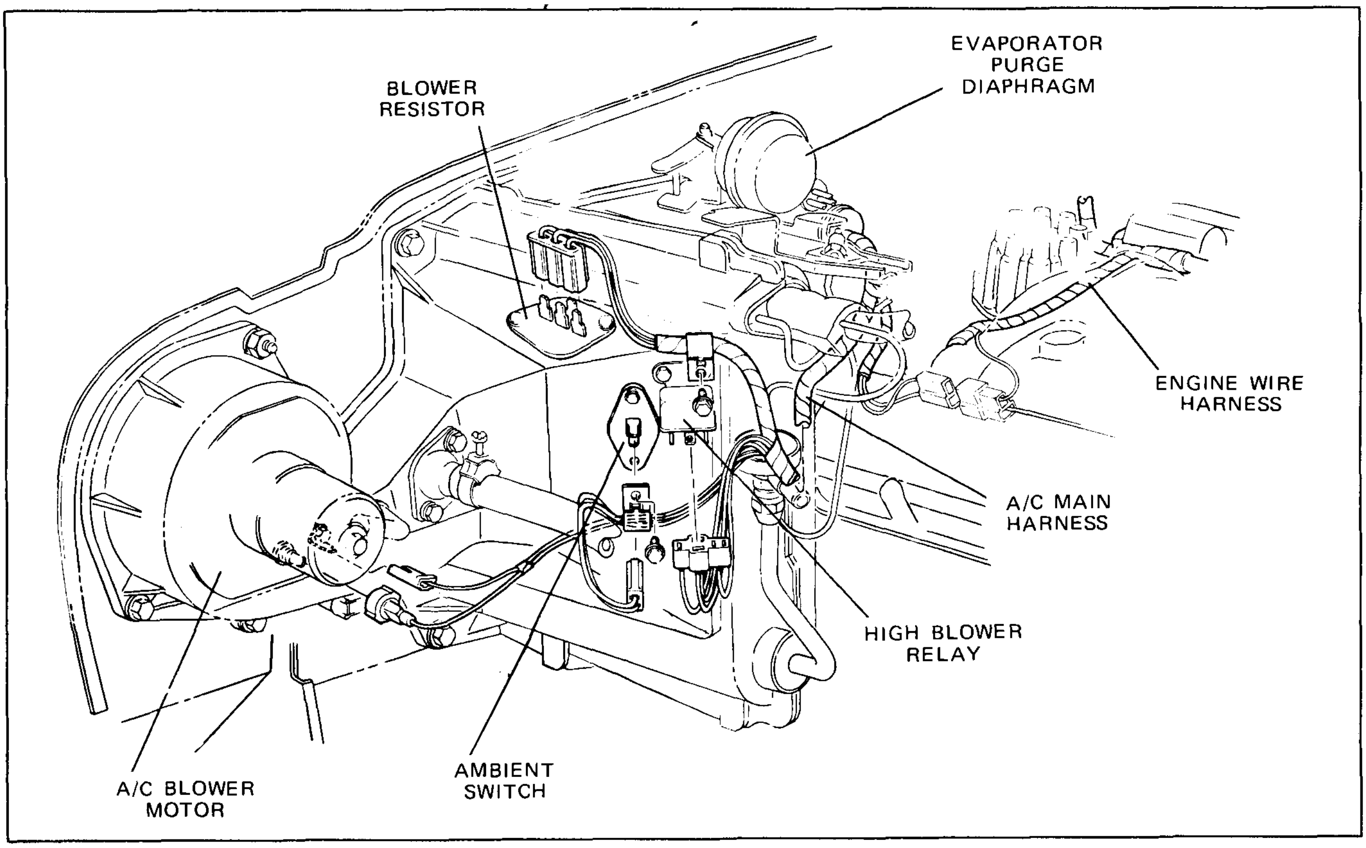


Fig. 1A-141 A/C Underhood (Main) Wire Harness - F Series

5. Remove RH instrument panel ash tray and remove cold air duct to upper duct screw.
6. Through radio opening, remove three screws from cold air duct to center A/C outlet ducts.
7. Remove cold air duct to LH lower A/C duct screw.
8. Remove (4) cold air duct to I.P. screws, disconnect A/C electrical harness clips from duct and remove duct.
9. To replace, reverse removal procedure. Refer to Fig. 1A-145 for duct installation.

REMOVE AND REPLACE - A AND G SERIES

The cold air duct can be removed by simply removing three screws and the duct on A Series (Fig. 1A-147). On G Series (Fig. 1A-146), a fourth screw attaching the cold air duct and left extension duct must also be removed.

LEFT HAND LOWER A/C DUCT

REMOVE AND REPLACE - F SERIES

1. Remove lower instrument panel trim at steering column.
2. Remove screw retaining duct to center lower A/C duct (Fig. 1A-148).
3. Remove retainer holding lower left hand duct to left hand extension duct.
4. To replace reverse removal procedure.

CENTER LOWER A/C DUCT

REMOVE AND REPLACE - F SERIES

1. Remove left hand lower A/C duct.
2. Remove center lower A/C duct to instrument panel screw and remove duct (Fig. 1A-148).
3. To replace, reverse removal procedure.

RIGHT HAND LOWER (COLD AIR) A/C DUCT

REMOVE AND REPLACE - F SERIES

1. Remove glove compartment and door.
2. Remove screw retaining support strap to upper portion of right hand extension duct (Fig. 1A-148).

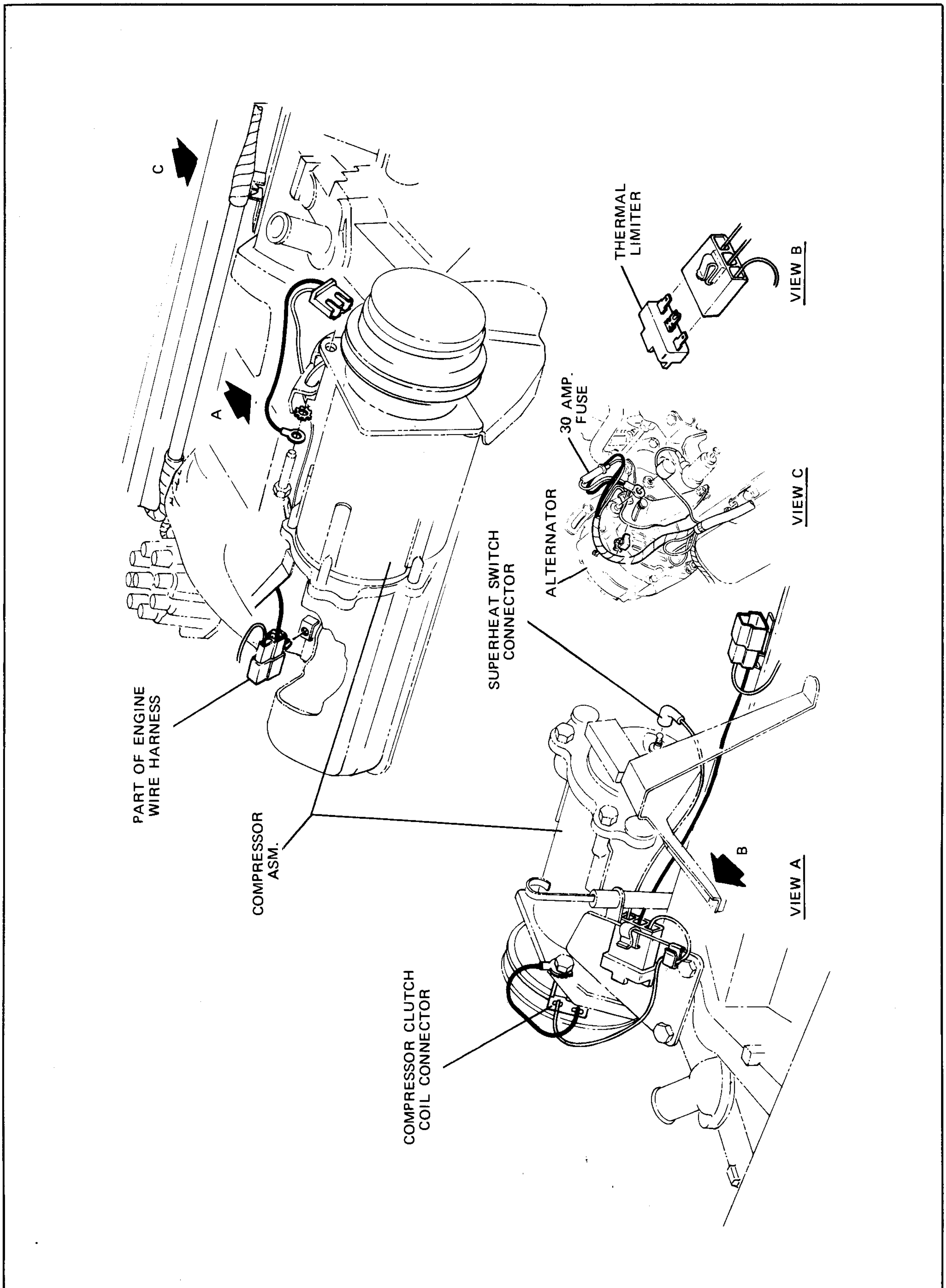


Fig. 1A-142 A/C Compressor (Engine) Wire Harness Routing - V-8 Engine (Except 307)

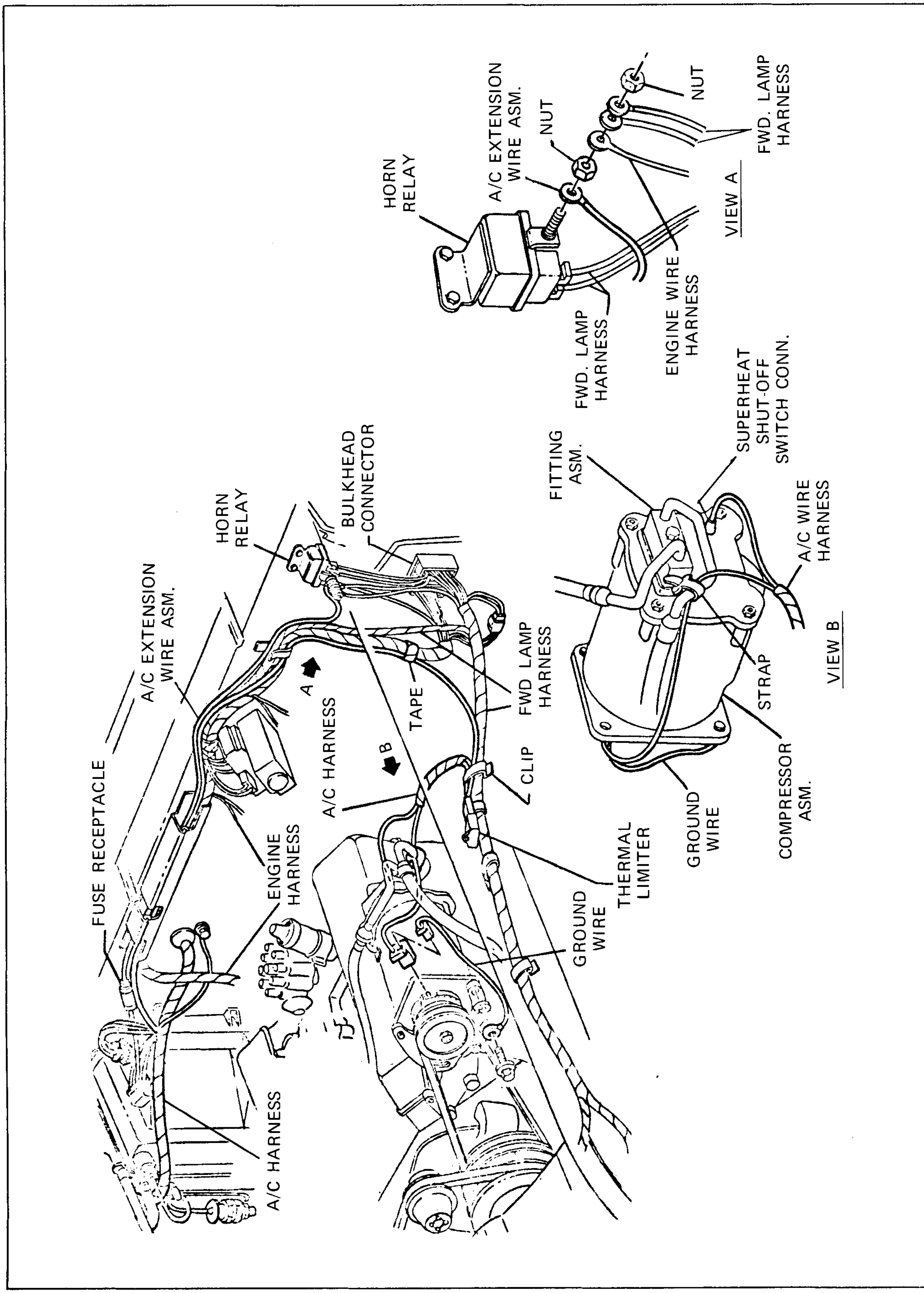


Fig. 1A-142A A/C Compressor Wire Harness Routing - X Series (307 Engine)

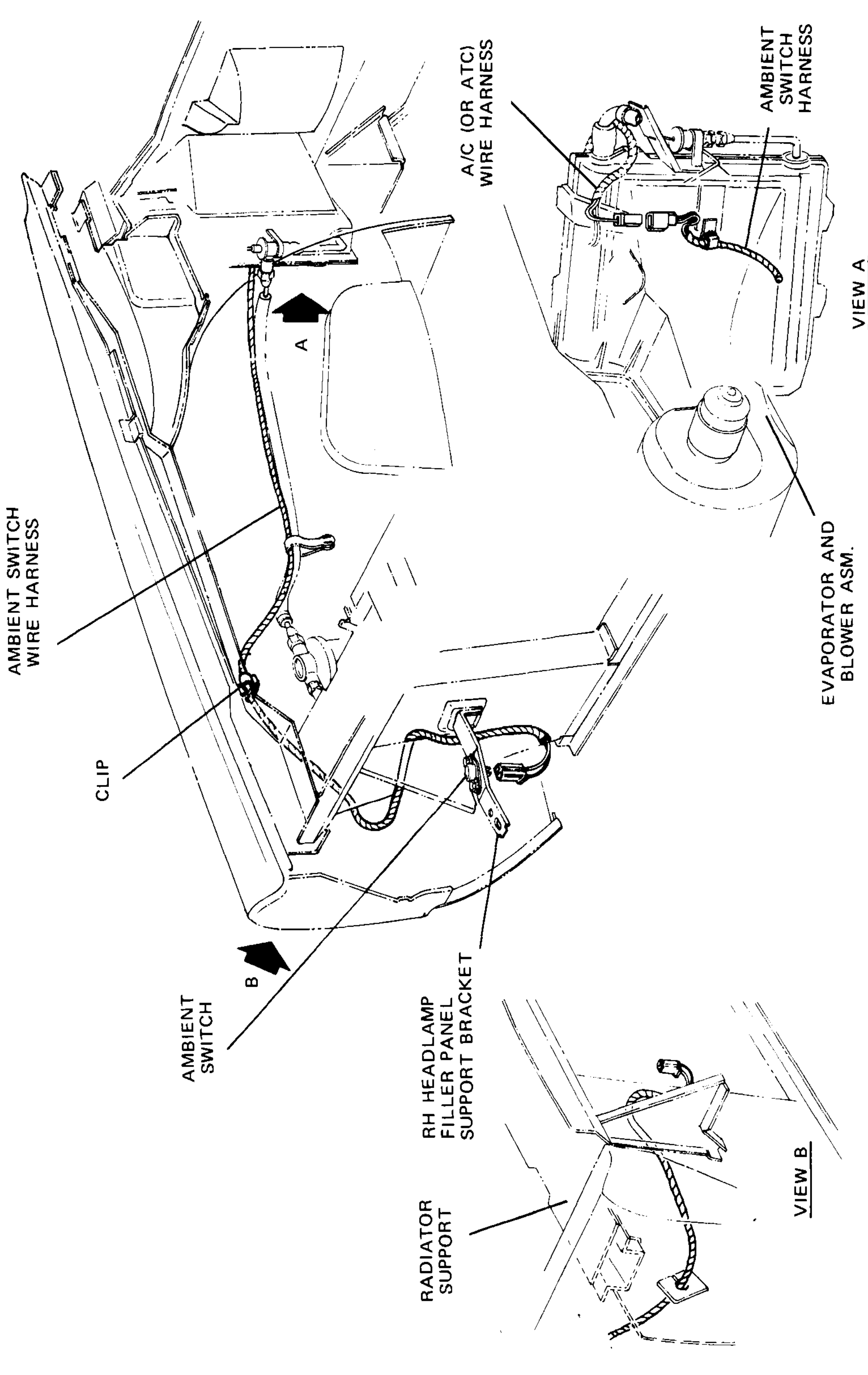


Fig. 1A-143 A/C Ambient Switch Wiring - B Series

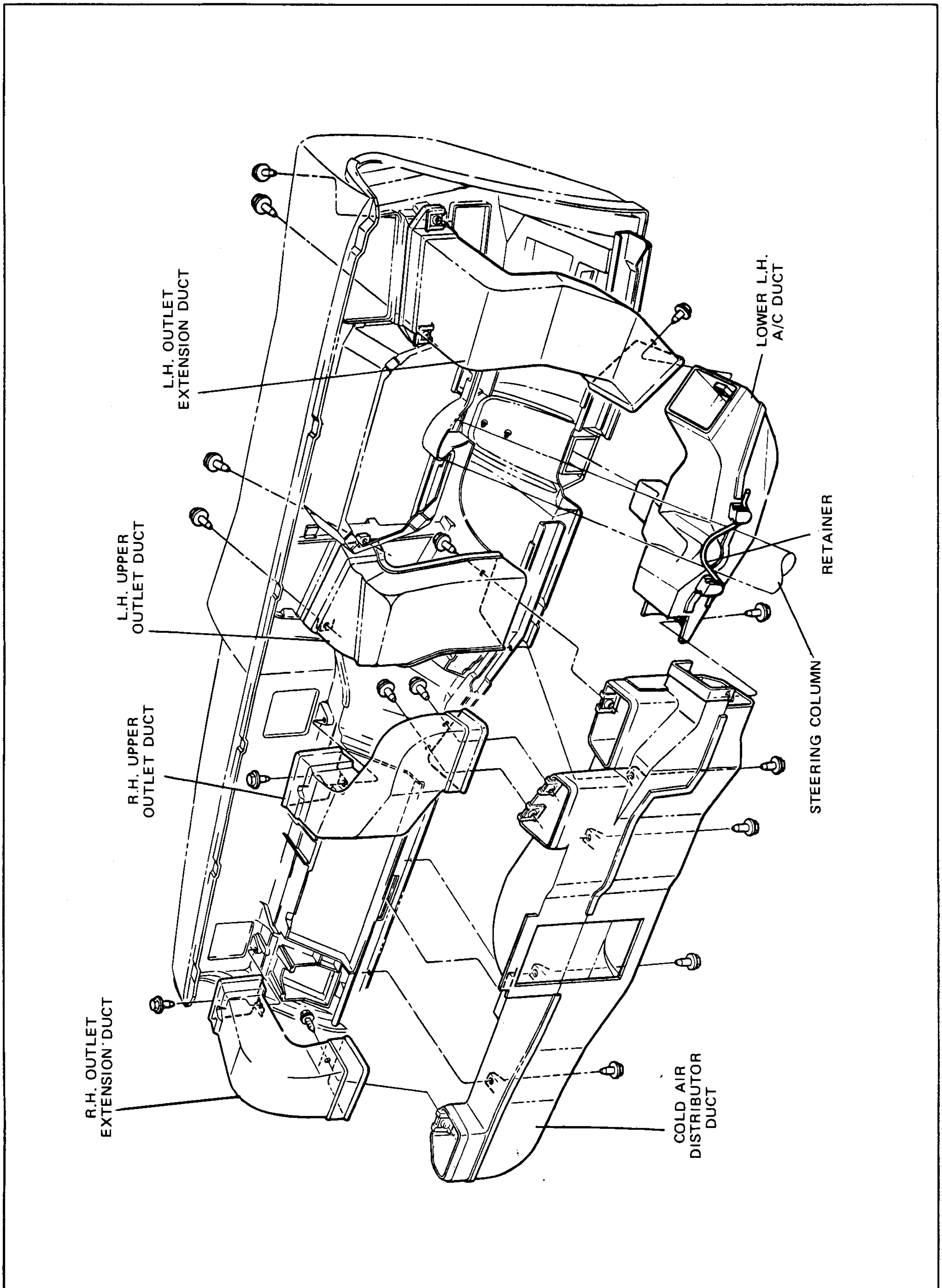


Fig. 1A-145 B Series A/C Air Distribution Ducts

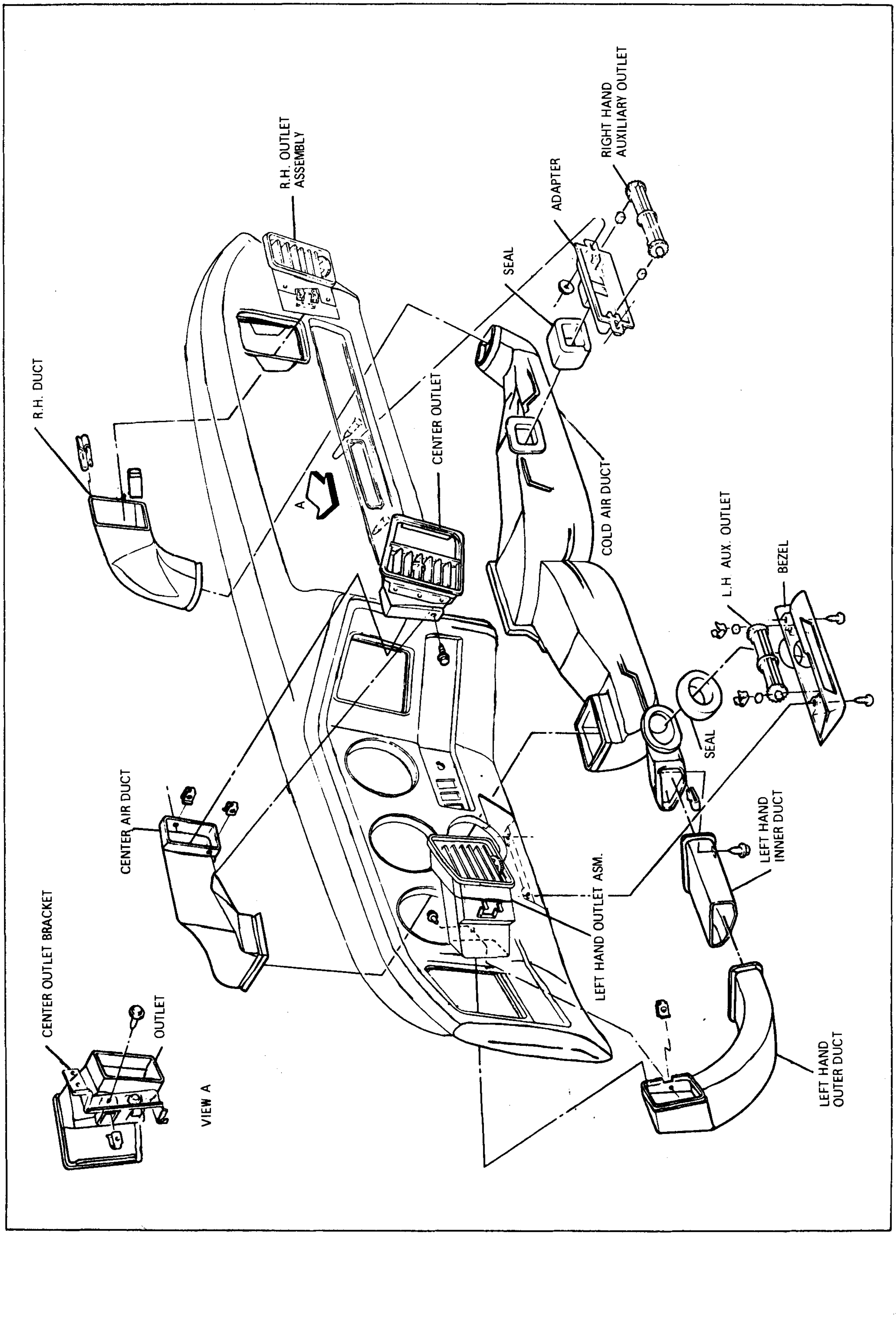


Fig. 1A-146 G Series A/C Air Distribution Ducts

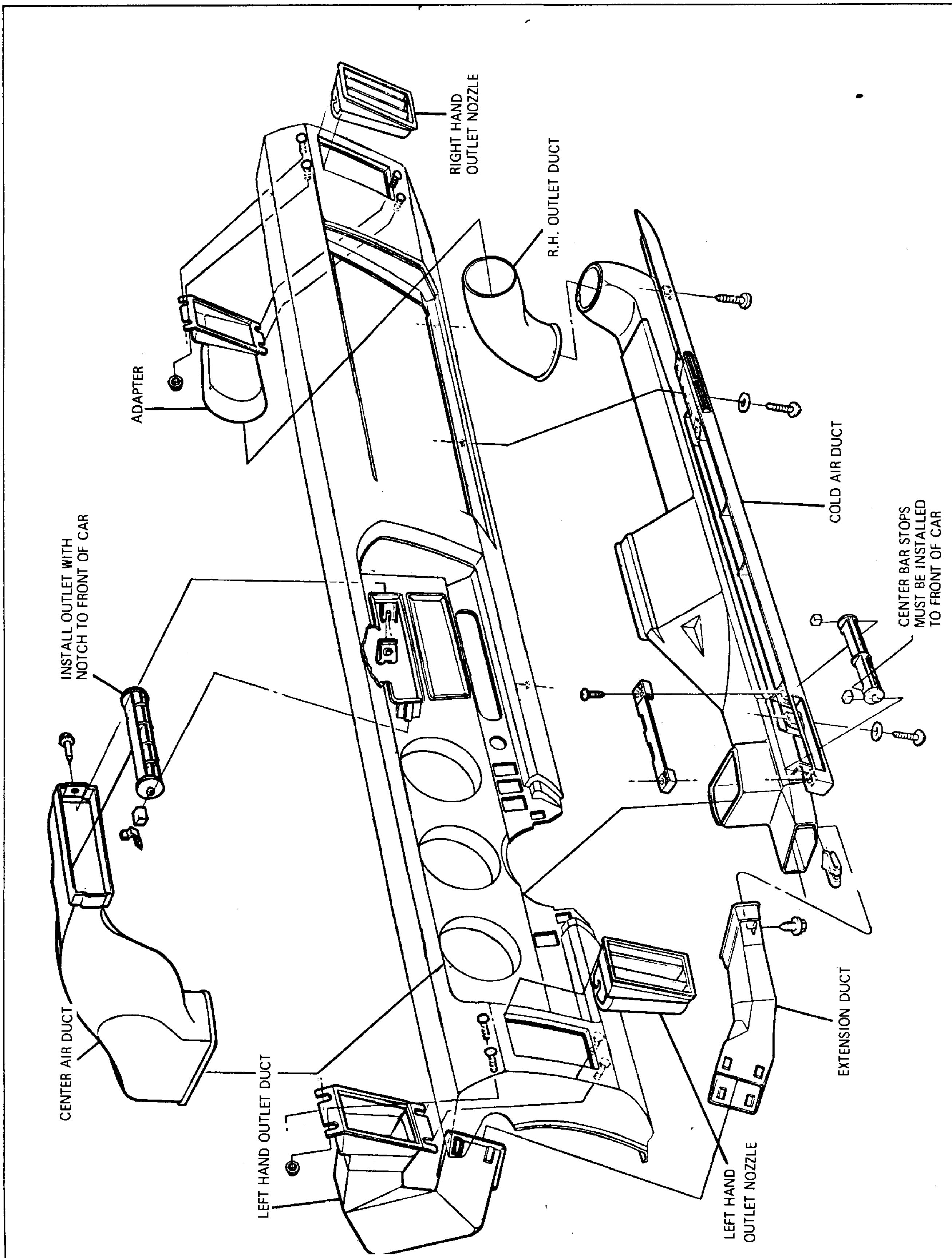


Fig. 1A-147 A Series A/C Air Distribution Ducts

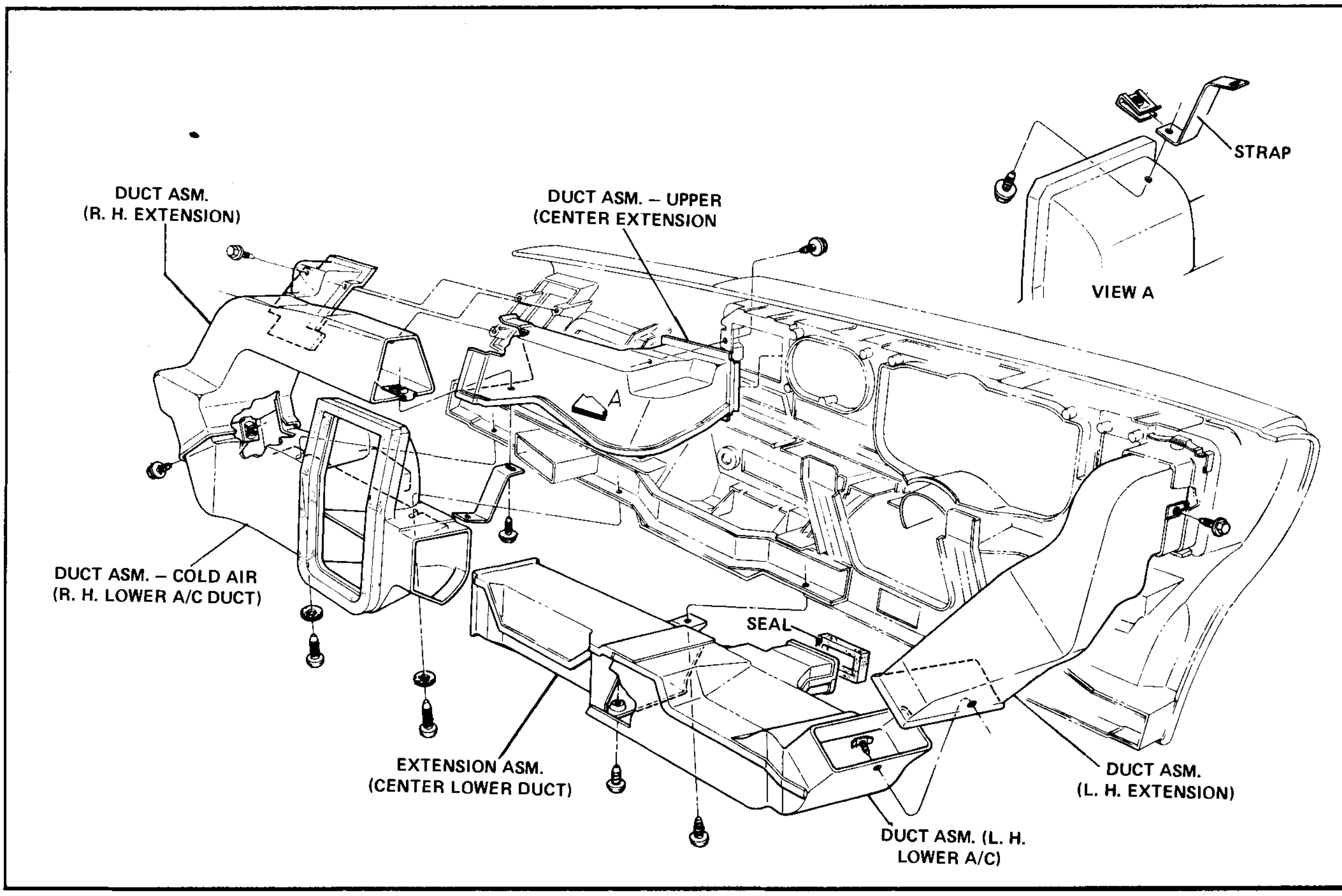


Fig. 1A-148 F Series A/C Air Distribution Ducts

3. Remove remaining retaining screws (duct to instrument panel reinforcement and duct to right hand extension duct) and remove duct.

4. To replace, reverse removal procedure.

RIGHT HAND A/C OUTLET EXTENSION DUCT

REMOVE AND REPLACE - F SERIES

1. Disconnect battery.

2. Remove lower instrument panel trim and upper trim plate.

3. Remove lower left hand A/C duct.

4. Remove steering column support bracket, (4) bolts.

5. Remove (4) steering column nuts and lower column.

6. Remove glove compartment and door.

7. Remove right hand lower A/C duct (cold air duct).

8. Remove windshield side garnish moldings.

9. Disconnect emergency brake release cable.

10. Remove (2) lower I.P. bolts at extreme corners of I.P. and remove console to I.P. screws if applicable.

11. Remove (3) upper I.P. screws at cluster and (3) nuts from I.P. pad studs above glove box opening.

12. Lift instrument panel pad and tip top out toward rear of car.

13. Remove (3) retaining screws and right hand A/C extension duct (Fig. 1A-148).

14. To replace, reverse removal procedure.

LEFTHAND A/C OUTLET EXTENSION DUCT

REMOVE AND REPLACE - F SERIES

1. Perform steps 1 through 12 of procedure for replacement of righthand A/C outlet extension duct.

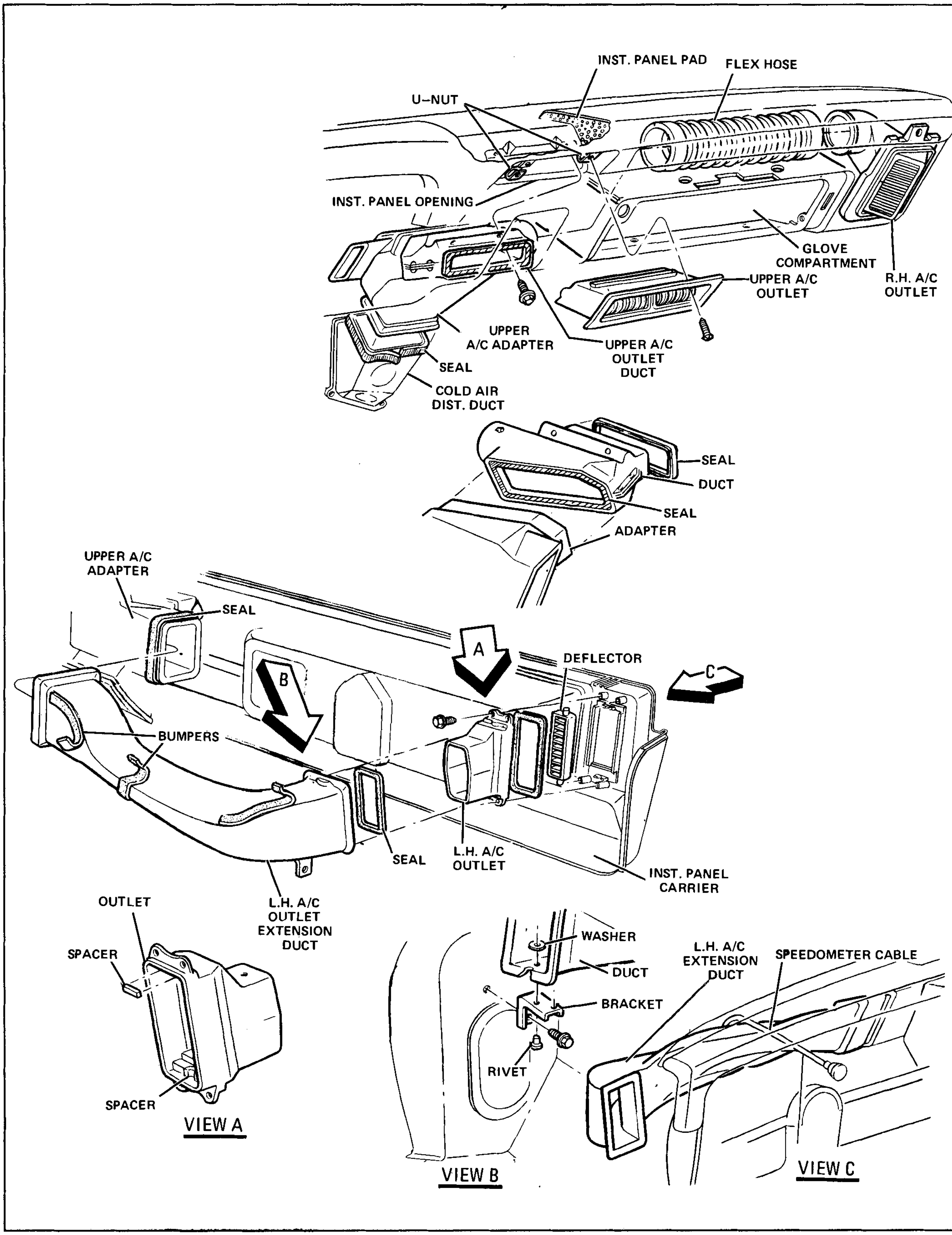


Fig. 1A-149 A/C Air Distribution Ducts - X Series

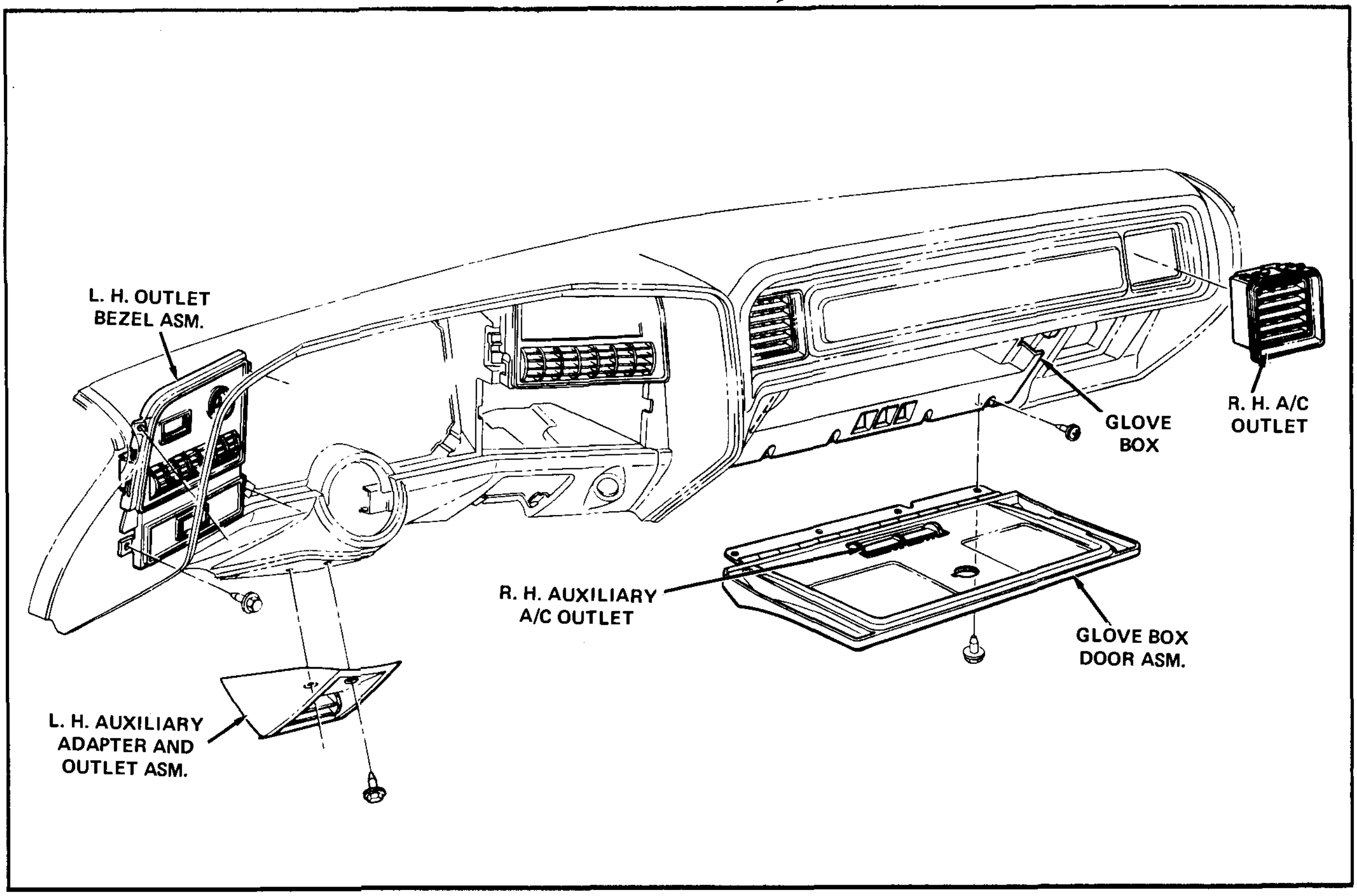


Fig. 1A-150 B Series Air Distribution Outlets

2. Remove retaining screw at outlet and remove left extension duct.
3. To replace, reverse removal procedure.

CENTER (UPPER) DUCT

REMOVE AND REPLACE - A AND G SERIES

1. Remove cold air duct.
2. On A Series, remove radio.
3. Remove control panel.
4. Remove screws attaching duct to outlet adapter (2 screws on G Series and one screw on A Series).
5. To replace, reverse removal procedure.

CENTER A/C OUTLET EXTENSION DUCT

REMOVE AND REPLACE - F SERIES

1. Remove steering column trim.
2. Remove glove compartment and door.
3. Remove righthand lower A/C duct.
4. Remove instrument panel trim plate (at cluster).
5. Remove center A/C outlet (4 screws).
6. Remove (2) duct retaining screws and remove center extension duct through glove compartment opening (Fig. 1A-148).
7. To replace, reverse removal procedure.

X SERIES A/C AIR DISTRIBUTION DUCTS AND OUTLETS

Removal and replacement of air distribution components on the X Series can be performed by referring to Fig. 1A-149 for duct and outlet installation.

A/C OUTLET NOZZLES

REMOVE AND REPLACE - B SERIES

For location of outlet nozzles on the B Series, refer to Fig. 1A-150.

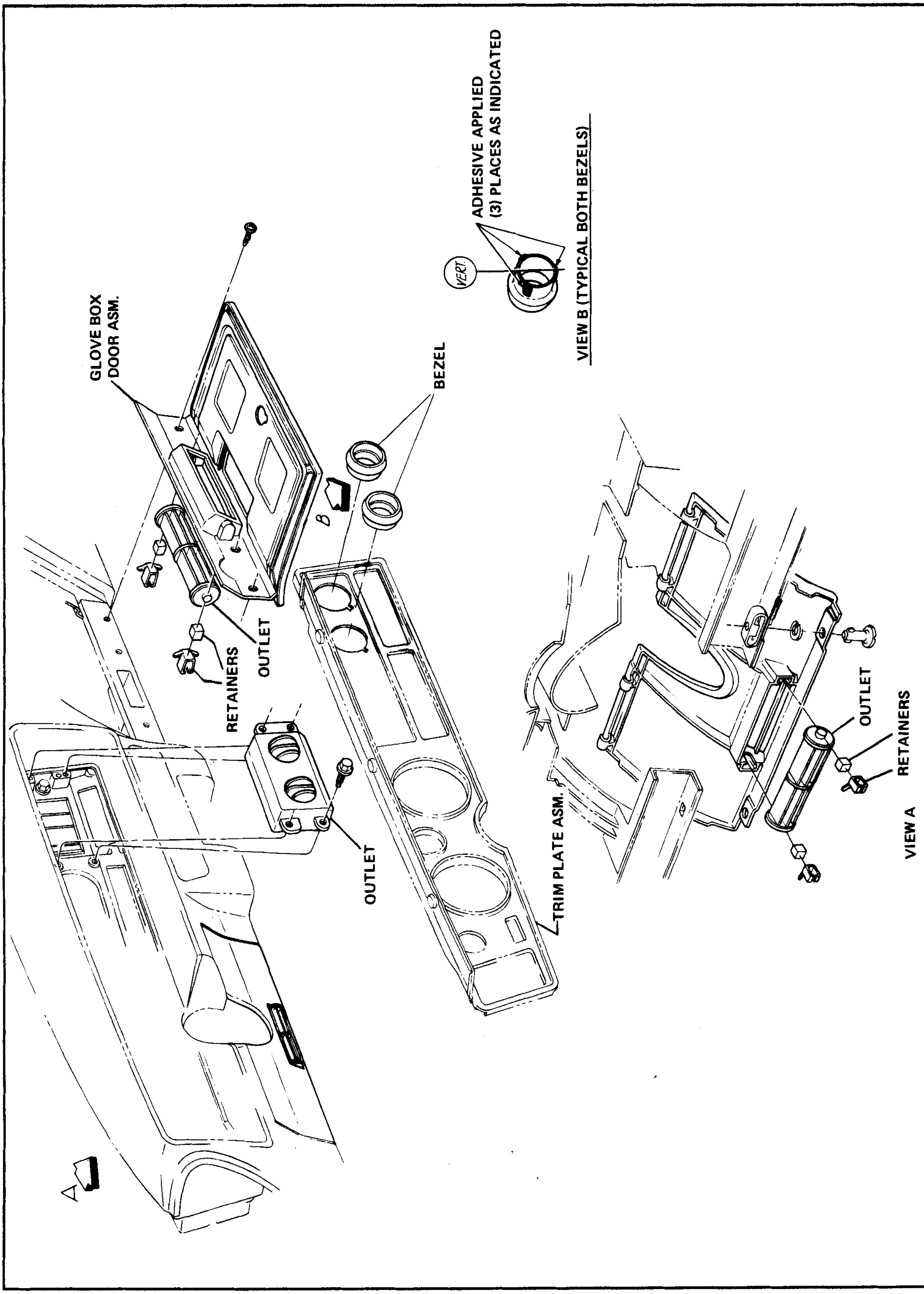


Fig. 1A-151 F Series Air Distribution Outlets

CENTER (UPPER) OUTLET NOZZLE AND/OR ADAPTER

REMOVE AND REPLACE - A AND G SERIES

1. Follow procedure for removal of center duct. On A Series, nozzle can be removed by pulling it free from instrument panel. On G Series, outlet assembly can be pulled out from rear of car.
2. To replace, reverse removal procedure.

LEFTHAND AND RIGHTHAND OUTLET NOZZLES

REMOVE AND REPLACE - A AND G SERIES

Right and left hand nozzles on A Series models may be removed by inserting a thin blade screwdriver approximately 3/4 inch between instrument pad and upper edge of nozzle to disengage two retaining tabs. There is a tab on each corner.

Nozzles on G Series models are retained by two metal clips, one on each side. The cold air duct attachment to the extension ducts must be disengaged. The nozzle may then be removed by inserting a screwdriver into the nozzle and disengaging these retainers, pulling the nozzles out (toward rear of car) and removing screw which holds duct to nozzle.

OUTLET NOZZLES

REMOVE AND REPLACE - F SERIES

The left and right A/C outlet nozzles (Fig. 1A-151) can be removed by inserting a thin blade screwdriver between instrument panel and top of outlet to release retaining (2) tabs. The outlets can then be removed and the nozzles released from slots in the outlets. The left hand outlet requires removal of the lower and upper instrument panel trim for removal of outlet.

To remove the center outlet, remove the lower and upper instrument panel trim, remove (4) retaining screws and remove outlet. The nozzles are part of the outlet assembly.

The auxiliary outlets are incorporated in the lower instrument panel trim (left auxiliary outlet) and the glove compartment door (right auxiliary outlet). To replace the nozzles, remove the appropriate part and remove nozzle from it.

SECTION 1B

AUTOMATIC TEMPERATURE CONTROL

CONTENTS OF THIS SECTION

B SERIES ATC DIAGNOSIS

ATC TESTER J 23678

Automatic Temperature Control (ATC) Tester J 23678 (Fig. 1B-1) has been designed and developed to be used in troubleshooting the Automatic Temperature Control system on the B Series. The tester can be used to isolate a malfunction to the control panel, the sensor string, the ATC vacuum system or the programmer. If a malfunction is determined to be in the programmer, the tester can also be used to completely troubleshoot each component in the programmer.

A hard rubber, dummy plug, two sizes of vacuum tees and a supply of hose unions are located in the tester's storage compartment. The rubber dummy plug is used to plug all of the vacuum ports on the programmer except the raw vacuum input for isolating a vacuum problem between the programmer and the ATC vacuum system. The tees and unions are used to connect the rubber hose from the tester's vacuum gauge into the system to make various vacuum checks.

The wiring harness from the tester is actually a patch-cable which can be plugged into the programmer and into the car electrical harness.

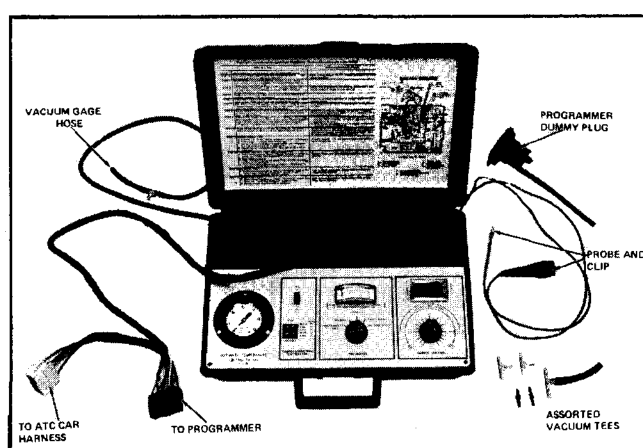


Fig. 1B-1 ATC Tester J 23678

The voltmeter on the tester panel has a range of 0 to 15 volts D.C. The voltage monitored by the meter is controlled by the knob just below the meter at all times except when the Temperature Dial Calibration switch is in the "CAL." (calibrate) position. The "#2 Programmer" position allows the tester to directly monitor the input voltage to the programmer. The "#6 Blower" position allows the tester to directly monitor the voltage applied to the blower motor. The "#7 LO-Relay" position indicates that the Lo-relay has energized and that the relay contacts have closed if battery voltage is read on the meter. The "#8 Auto-Relay" position indicates that the auto-relay has energized and that the relay contacts have closed if battery voltage is read on the meter. The "Probe and Clip" position connects the probe and clip in the tester's storage compartment directly to the voltmeter. This makes it possible to use the voltmeter to check various other voltages in the ATC system. The red probe should always be connected to positive and the alligator clip lead should always be connected to the more negative terminal.

When the Manual-Automatic switch is in the AUTOMATIC position and the Temperature Dial Calibration switch is OFF, the tester monitors voltages on the voltmeter according to the voltage knob position. When the Manual-Automatic switch is in the MANUAL position, the temperature dial on the control panel, the ambient sensor and the in-car sensor are disabled and the Manual Control knob replaces them. The numbers around the Manual Control knob represent the resistance in ohms that is replacing the resistance of the temperature dial, the ambient sensor and the in-car sensor. If the knob is rotated to the MAX. COLD position, the programmer should move to the full A/C position. If the knob is rotated to the MAX. HEAT position, the programmer should move to the maximum heat position. The Manual Control knob is operational when the Manual-Automatic switch is in the MANUAL position.

When the Temperature Dial Calibration switch is in the "CAL." position, the voltmeter monitors the voltage directly across the temperature dial on the control head. When the "COMPARE" button is pressed, the voltmeter reads the voltage across a precision resistor in the tester. By moving the temperature dial on the control panel, the two voltage readings can be made the same. After this is accomplished, the temperature dial on the control head should read the correct temperature as indicated on the tester panel. If it does not, the temperature dial clutch should be held and the dial slipped to read the correct temperature (see Temperature Dial Calibration Procedure).

The Temperature Dial Calibration switch should always be in the OFF position unless the temperature dial on the control head is being calibrated.

DIAGNOSTIC PROCEDURE

Diagnosis of a malfunction in the system can be simplified by a logical, systematic procedure which can minimize diagnosis time and effort. Lack of a logical, systematic procedure could complicate diagnosis of a relatively minor malfunction or waste time and effort attempting to diagnose a malfunction which does not actually exist.

To simplify diagnosis of the ATC system, the following procedure should always be employed:

A. UNDERSTAND SYSTEM OPERATION.

Before a malfunction in the ATC system can be diagnosed and corrected, an understanding of how the system operates under normal conditions is essential. System operation is described in GENERAL DESCRIPTION and B SERIES DESCRIPTION.

B. OBSERVE SYSTEM OPERATION.

The most important part of diagnosing a problem is to determine exactly what the complaint is and whether this complaint actually stems from a malfunction in the system. (Without a thorough understanding of how the system is supposed to operate, a complaint stemming from misunderstanding of system operation or improper setting of the control panel lever could result in the search for a malfunction that does not exist.) If complaint is of a condition that occurs only periodically (intermittent), the malfunction should be observed before diagnosis and repair are attempted.

C. ISOLATE THE MALFUNCTION.

The main objective when troubleshooting the ATC system is to isolate the malfunction to either the control head (control panel), the sensor string, the ATC vacuum system on the car, the car electrical system or the programmer. To isolate the malfunction refer to ON CAR PROCEDURE. After this preliminary isolation is completed, the actual malfunction can then be diagnosed quickly.

ON CAR PROCEDURE

Do not skip any steps in the Troubleshooting Procedure unless instructed to do so.

1. Start car and place control head selector lever in the AUTO position and the temperature dial at 75°. Allow enough time for the car engine to warm up and the ATC system to come on if the system were acting normally. If the system does not come on, skip to Step 3.

2. After the system has turned on, rotate the temperature dial slowly back and forth looking for abnormal operation of the system. Then move the selector lever to each of the various positions and look for any malfunction in system operation. By observing a malfunction and noting when it occurs, it is often possible to isolate the problem to a certain area of the system.

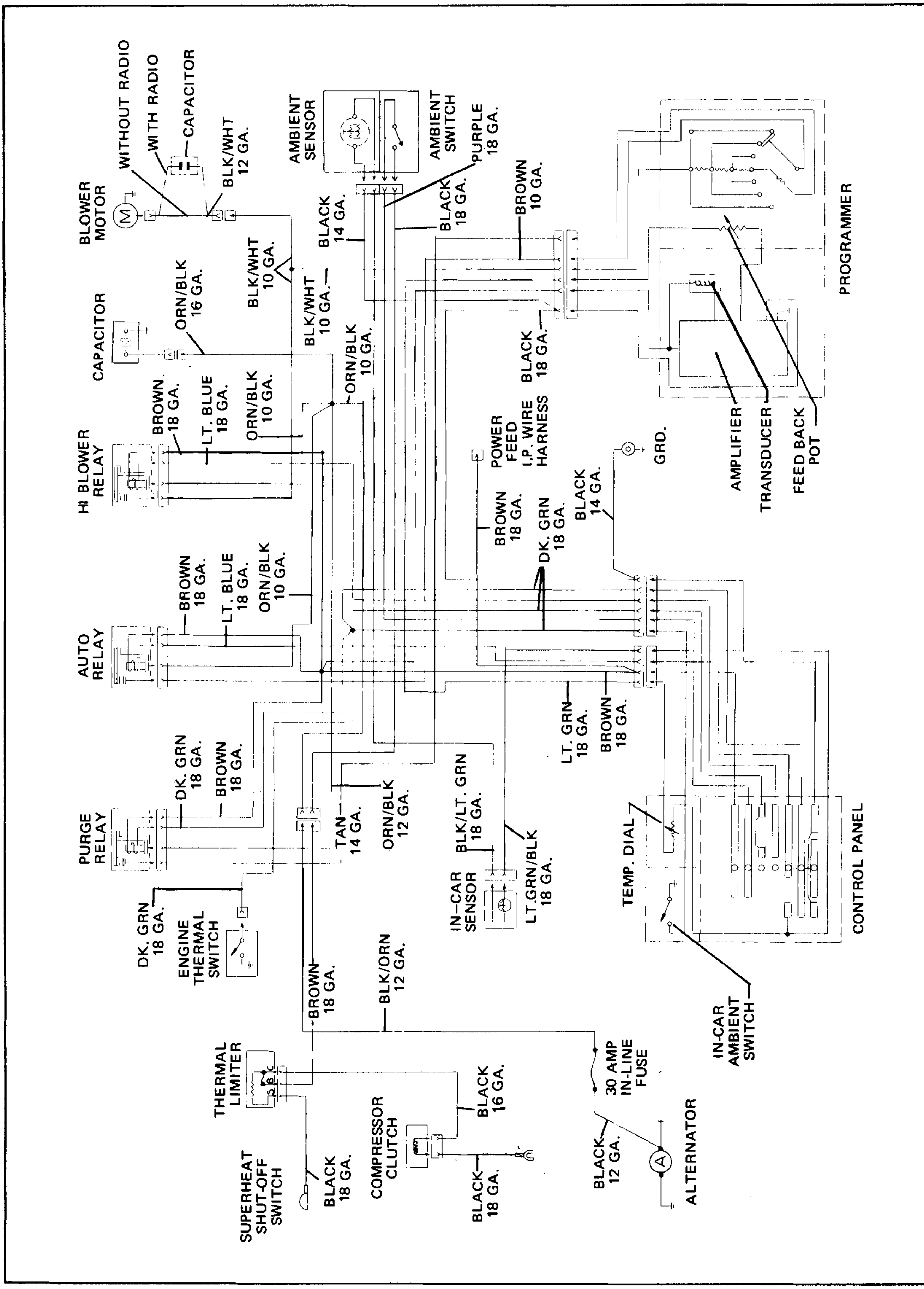


Fig. 1B-2 ATC Wiring Circuit Diagram - B Series

3. Remove the cover of the programmer (while it is still mounted in the car) and connect the J 23678 ATC Tester electrical harness to the programmer and the car ATC harness.

4. Place the control head selector lever in the AUTO position and the temperature dial at 75°.

5. On the tester, place the Temperature Dial Calibration switch in the OFF position and the Manual-Automatic switch in the MANUAL position.

6. Rotate the Manual Control knob to MAX. HEAT. The programmer should move to the full heat position and the fan should run at high blower speed. (The vacuum motor mechanism will move into the vacuum motor.) Rotate the knob to MAX. COLD. The programmer should move to the full A/C position and the fan should run at high blower speed. (The vacuum motor mechanism will move out of the vacuum motor.) If only partial programmer movement occurs or "Hi blower" is not obtained at both extremes, make the air mix (temperature) door link adjustment before proceding to the next step. If the programmer does not move at all, skip to Step 9.

7. Rotate the Manual Control knob slowly counterclockwise. The vacuum motor mechanism should first start to move at precisely 180 ohms ($\pm$ 1 ohm) on the Manual Control knob. If this first movement occurs before or after 180 ohms, make the Programmer Amplifier Calibration (Feedback "Pot" Adjustment) described under ON BENCH PROCEDURE-PROGRAMMER.

8. Rotating the Manual Control knob to the MAX. COLD position should cause the system to shift to full A/C operation and the vacuum motor mechanism will move out of the vacuum motor. If the programmer moves normally when rotating the Manual Control knob, skip to Step 11.

PROGRAMMER DOES NOT MOVE.

9. On the ATC Tester, place the Temperature Dial Calibration switch in the OFF position and the VOLTMETER control in the "PROGRAMMER 12-V SUPPLY" position. Battery voltage should appear on meter. No voltage indicates the lack of a ground on terminal #1 of the programmer or the lack of battery supply to terminal #2 of the programmer.

   a. If battery voltage appears on voltmeter, proceed to step 10.

   b. If no voltage appears on voltmeter, place voltmeter knob in the "Probe and Clip" position. Determine if programmer terminal #1 is ungrounded and/or terminal #2 has no battery voltage applied to it. Trace appropriate wire(s) to find malfunction in car ATC electrical system (See Fig. 1B-2).

10. Plug the tester dummy vacuum plug on the programmer vacuum valve. Connect the dummy plug hose to the vacuum supply hose (Port #2) in the car vacuum harness. Make sure vacuum is present. The programmer now has vacuum supply with no car vacuum system components connected. If the programmer functions using the MANUAL CONTROL on the tester, troubleshoot the ATC vacuum system (See Figs. 1B-3, 1B-4 and 1B-5). If the programmer does not function, the defect is in the programmer. Remove the dummy plug and reconnect the vacuum harness after making this test. If defect is in programmer, remove the programmer and follow procedure under ON BENCH PROCEDURE-PROGRAMMER.

Sensor String Test

NOTE: *Do not perform sensor string test on car which has been run at idle for a long period of time in a heated building. This condition produces sufficient engine heat to heat the ambient sensor and cause lower resistance readings than specified in following procedure even though no problem exists in the sensor string.*

11. Place the control head selector lever in the AUTO position and the temperature dial on 75°.

12. On the J 23678 ATC Tester, place the Manual-Automatic switch in the AUTOMATIC position.

13. Observe position of vacuum motor mechanism.

14. On the ATC Tester, switch the Manual-Automatic switch to the MANUAL position and adjust the Manual Control knob until the vacuum motor mechanism assumes the same position it had in Step 13. When the Manual Control knob is properly adjusted, switching the Manual-Automatic switch back and forth will result in no movement of the vacuum motor mechanism.

15. Read the setting of the MANUAL CONTROL. This resistance reading is the same as the resistance of the two sensors and the temperature dial combined and should be 120 to 150 ohms at 70° to 75° F. room temperature. If this reading is incorrect, try calibrating the temperature dial (See TEMPERATURE DIAL CALIBRATION - B SERIES). If the calibration can be accomplished, the temperature dial is "good". Visually check the ambient and in-car sensors for shorts or bad connections.

Lo Relay Test

16. Place the tester Temperature Dial Calibration switch in the OFF position and the Voltmeter knob in the "LO RELAY" position.

17. Place the control head selector lever in VENT or DEFROST position. If the Lo Relay is energized, the

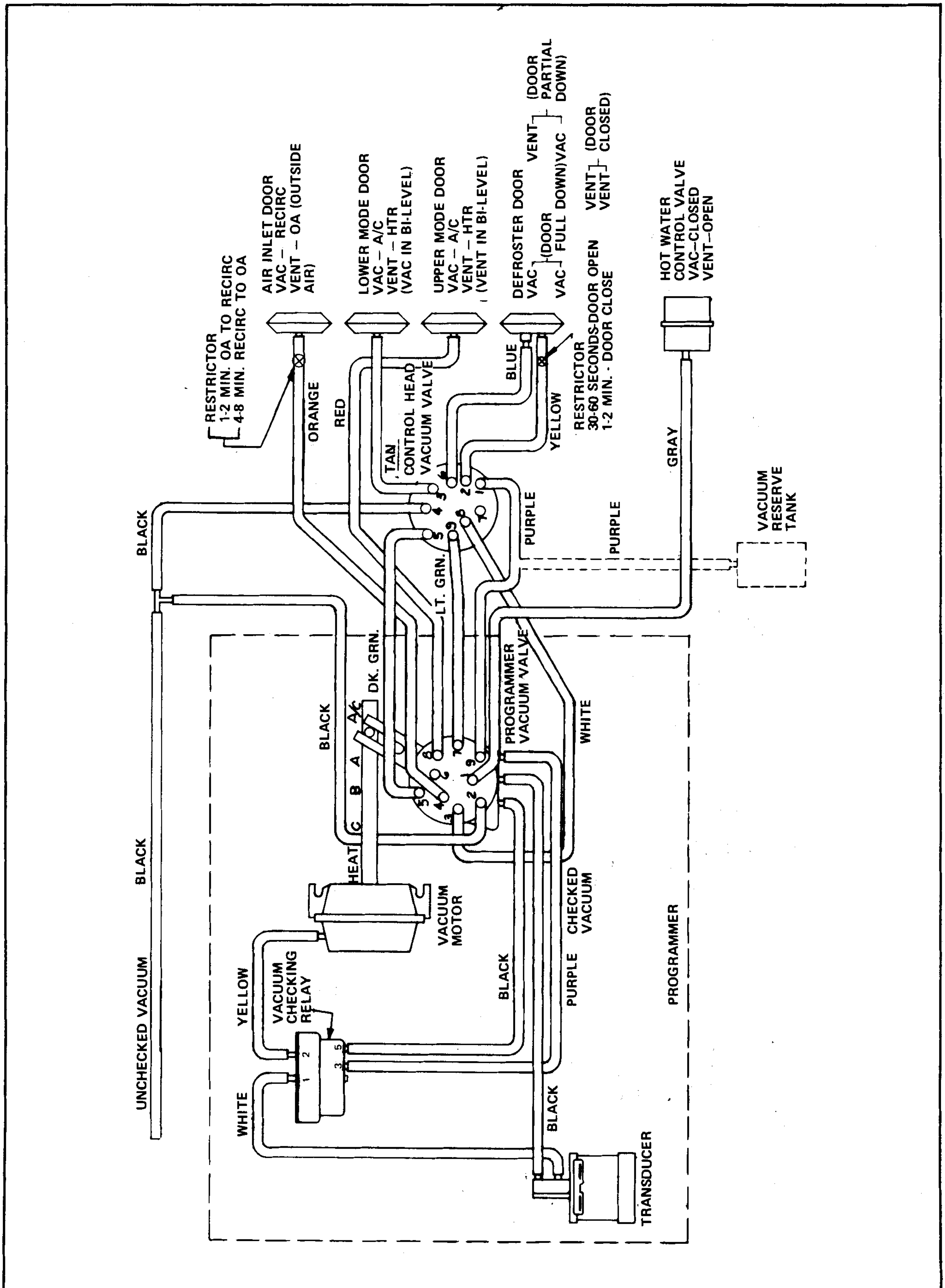


Fig. 1B-3 ATC Vacuum Schematic - B Series

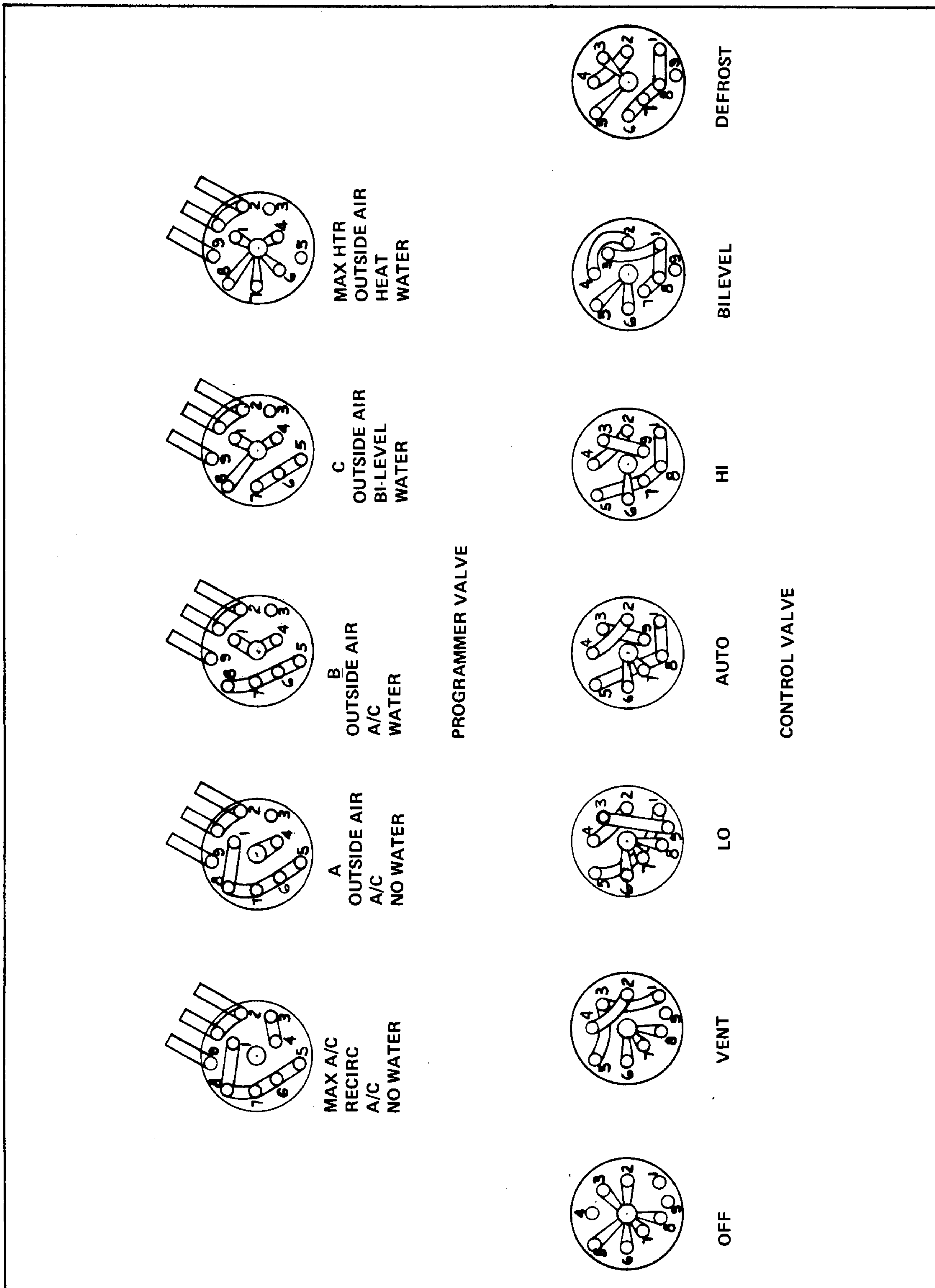


Fig. 1B-4 ATC Vacuum Valve Positions - B Series

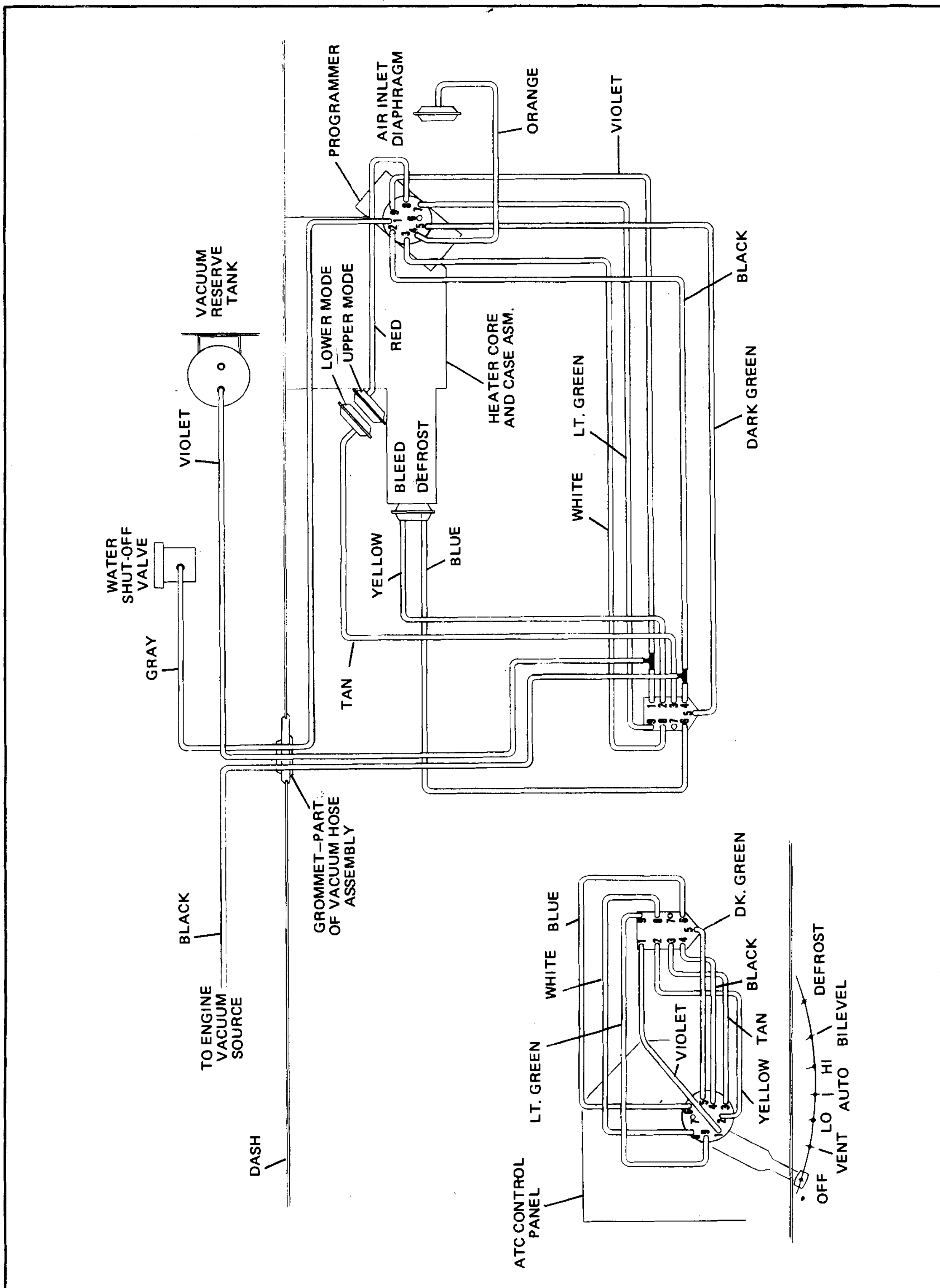


Fig. 1B-5 B Series ATC Vacuum Hose Diagram voltmeter will read battery voltage. The Lo Relay is operated by:

a. Hot engine thermal switch.

b. Hot in-car temperature switch.

c. Control head in VENT or DEFROST position.

If the relay does not energize in VENT or DEFROST, the relay or the control head printed circuit switch is defective.

Auto Relay Test

18. Place the tester Temperature Dial Calibration switch in the OFF position and the Voltmeter knob in the "AUTO RELAY" position.

19. Place the control selector lever in the DEFROST position. If full battery voltage is not obtained, there is a defect in the auto relay circuit. The Auto Relay is operated by:

a. Hot engine thermal switch.

b. Hot in-car temperature switch.

c. Control head in DEFROST.

If the relay does not energize in control head DEFROST position, the relay or the control head printed circuit switch is defective.

Programmer Blower Switch Test

20. Place ATC Tester Temperature Dial Calibration switch in the OFF position, the Voltage knob in the "BLOWER" position, and the Manual- Automatic switch in the MANUAL position.

21. Using the MANUAL CONTROL, move the programmer from full heat to the full A/C position. The voltage at the blower (coming from programmer terminal #6) should be battery voltage in full heat. As the programmer moves from full heat, the voltage should drop in steps, indicating different blower speeds, and then increase in steps to battery voltage in full A/C. If the voltage steps are not present or battery voltage is not indicated on the tester voltmeter when in full heat and full A/C operation, the programmer is defective. Remove and troubleshoot the programmer (See ON BENCH PROCEDURE-PROGRAMMER).

ON BENCH PROCEDURE-PROGRAMMER

Before attempting to repair or adjust the programmer, locate the output shaft, the feedback potentiometer, the vacuum motor, the blower switch, the vacuum checking relay, the transducer and the rotary vacuum valve. Refer to Fig. 1B-6 for identification of all programmer components.

Equipment required:

1. D.C. power supply rated at 5 amperes at 12 volts.
2. J 23678 Automatic Temperature Control Tester.
3. Vacuum supply capable of 20 inches of Hg. or more.
4. 1/4" hollow socket and drive.
5. Medium size blade screwdriver.
6. Long-nose pliers.
7. J 23713 electrical test connector.

When following the troubleshooting procedure, do not skip any steps unless instructed to do so. The ATC Tester Manual-Automatic switch should always be in the MANUAL position and the Temperature Dial Calibration switch should always be in the OFF position when troubleshooting the programmer on the bench.

1. Plug male connector of ATC Tester electrical harness into programmer.

2. Plug J 23713 electrical test connector into female connector of ATC Tester electrical harness.

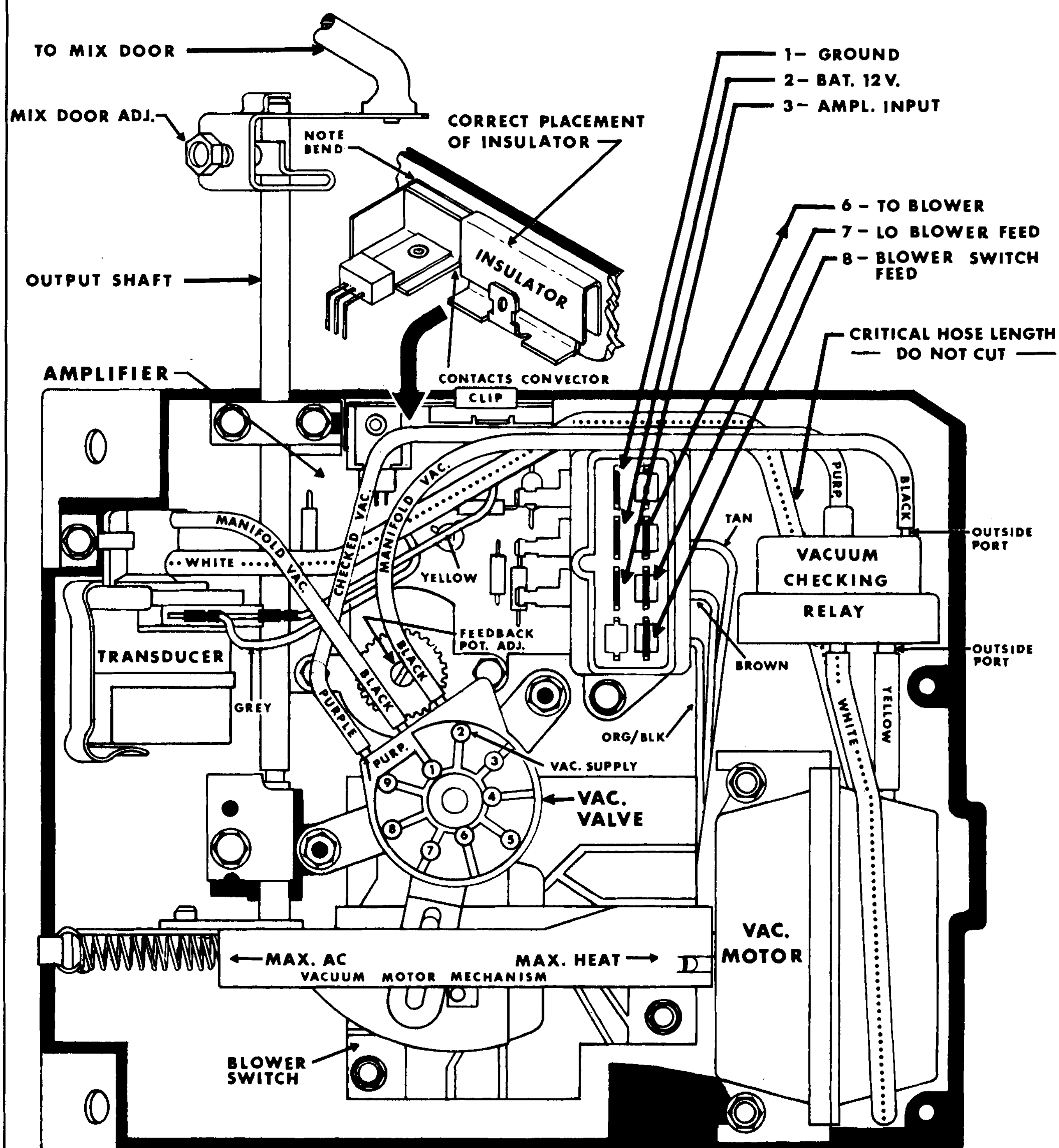
3. Plug dummy plug from tester onto the programmer rotary valve and connect it to the vacuum supply. Turn on the vacuum supply to 20 inches Hg. or more.

4. Connect positive lead of 12 volt DC power supply to yellow wire from electrical test connector. Connect negative lead of power supply to black wire of test connector. Voltmeter on tester should read 12 volts when in "#2 Feed" position, "#7 Lo-Relay" position and "#8 Auto Relay" position. If it does not, check the voltage supply and hook-up.

5. On the ATC Tester, place the Manual-Automatic switch in the MANUAL position and the Temperature Dial Calibration switch in the OFF position.

6. Rotate the ATC Tester Manual Control knob from MAX. HEAT to MAX. COLD. (Make sure the power supply is adjusted for 12 volts DC and vacuum supply is at 20 inches Hg. or more.) The programmer output shaft should rotate 120 degrees (1/3 rotation of shaft) from maximum heat to maximum cold. If it does rotate normally, skip to Step 18.

7. If the programmer output shaft does not operate properly in Step 6, remove the cover of the programmer and reconnect the tester electrical connector and the rotary vacuum valve dummy plug. Recheck programmer operation as described in Step 6. If the pro-



VACUUM VALVE PORTS

1 - HOT WATER VALVE
2 - VAC. SUPPLY INPUT
3 - RECIRC. INPUT
4 - RECIRC. DOOR
5 - MODE INPUT
6 - UPPER MODE DOOR (NO BI-LEVEL)
7 - LOWER MODE SIGNAL
8 - UPPER MODE DOOR (BI-LEVEL)
9 - CHECKED VACUUM

Fig. 1B-6 Identification of B Series Programmer Components grammer output shaft now operates normally, look for pinched vacuum hose, loose electrical connection, pinched or shorted Darlington Amplifier heat sink or a mechanical bind with the programmer cover. Be sure to tap the programmer components with the handle of a screwdriver to check for intermittent problems.

AMPLIFIER TEST

8. If the programmer output shaft still does not operate properly, place the Voltage knob of the tester in the "Probe and Clip" position. Connect the alligator clip lead to the transducer terminal with the gray wire.

   CAUTION: *Do not short transducer terminals together or amplifier will be damaged.*

   Push the probe into the programmer connector body making contact with terminal #2 which connects to a yellow wire.

9. Rotating the Manual Control knob from MAX. HEAT to MAX COLD (or vice-versa), the voltmeter reading should change 5 volts or more (after it is stabilized). This change indicates that the amplifier is "good". If the 5 volts or more change is not obtained, check the amplifier heat sink insulator for proper positioning. (NOTE: If the heat sink is shorted to the programmer chassis, the programmer will go to the full A/C position.) If the voltage change cannot be obtained and the insulator is okay, check the calibration of the amplifier according to the instructions in Step 18. If the programmer still does not function properly, replace the amplifier circuit board and be sure to install the new heat sink insulator properly. The new amplifier must be calibrated according to Step 18 after installation.

TRANSDUCER TEST

10. If the 5 volts change was present in the amplifier check in Step 9 but the programmer output shaft does not operate normally, leave the "Probe and Clip" connected as instructed in Step 8 throughout transducer test procedure.

11. Disconnect vacuum hose from the small diameter port of the transducer and connect tester hose from vacuum gauge directly to this hose. About 20 inches Hg. or more vacuum should be present on this transducer vacuum supply hose. If proper vacuum is present, restore hose connection. If 20 inches Hg. or more vacuum is not present, check the vacuum supply vacuum level and then go to Steps 14 through 17 to check for vacuum leaks in the vacuum checking relay and the rotary vacuum valve.

12. To check for proper regulated vacuum output from the transducer, disconnect the long hose from the transducer to the vacuum checking relay at the relay (NOTE: This long hose must be at least 15 inches long or the transducer will make a buzzing noise). Connect the ATC Tester's vacuum gauge directly to the long hose at the vacuum checking relay.

13. Position the programmer in an upright position so that the output shaft points straight up. With the Manual Control knob in the maximum heat position, "0" volts should be read on the voltmeter and the vacuum should be 9 to 11 inches. Turning the Manual Control knob to the MAX. COLD position should make the vacuum drop to "0" inches and the voltage should increase 5 volts or more. If these indications do not occur, the transducer is defective. After the check is completed, restore hose connection. Disconnect probe and clip from the programmer.

ROTARY VACUUM VALVE AND VACUUM CHECKING RELAY TEST

14. Connect the tester's vacuum gauge into the vacuum feed line to the dummy plug on the programmer rotary vacuum valve. Disconnect the center hose from the side port of the rotary vacuum valve and seal off the port by placing your finger over the port. The tester's vacuum gauge should read 20 inches Hg. or more. If it does not, either the vacuum checking relay or the rotary vacuum valve is leaky. If 20 inches Hg. or more vacuum is read, skip to Step 16 and restore the hose connection.

15. Remove all three hoses from the side ports of the rotary vacuum valve. Remove the short hose from the transducer and connect it across the two outer ports on the side of the rotary valve. Place finger over center side port of the rotary vacuum valve. If the tester's vacuum gauge now reads 20 inches Hg. or more, the vacuum checking relay is defecitve. If it does not, the rotary valve is defective and leaking. After repair of programmer, restore all hose connections.

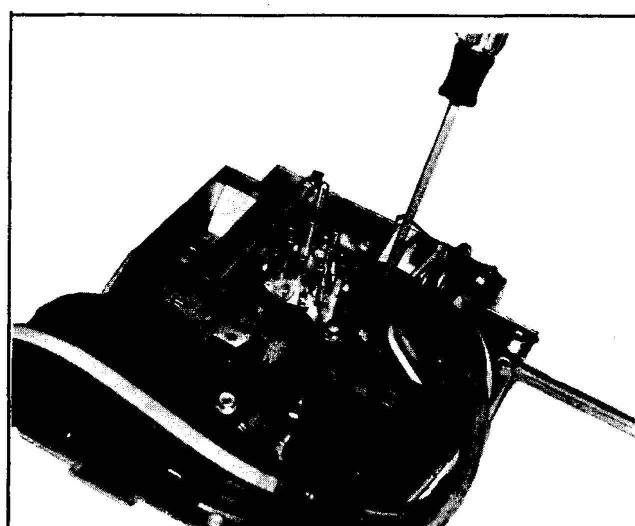


Fig. 1B-7 Adjusting Programmer Amplifier Feedback Back Pot

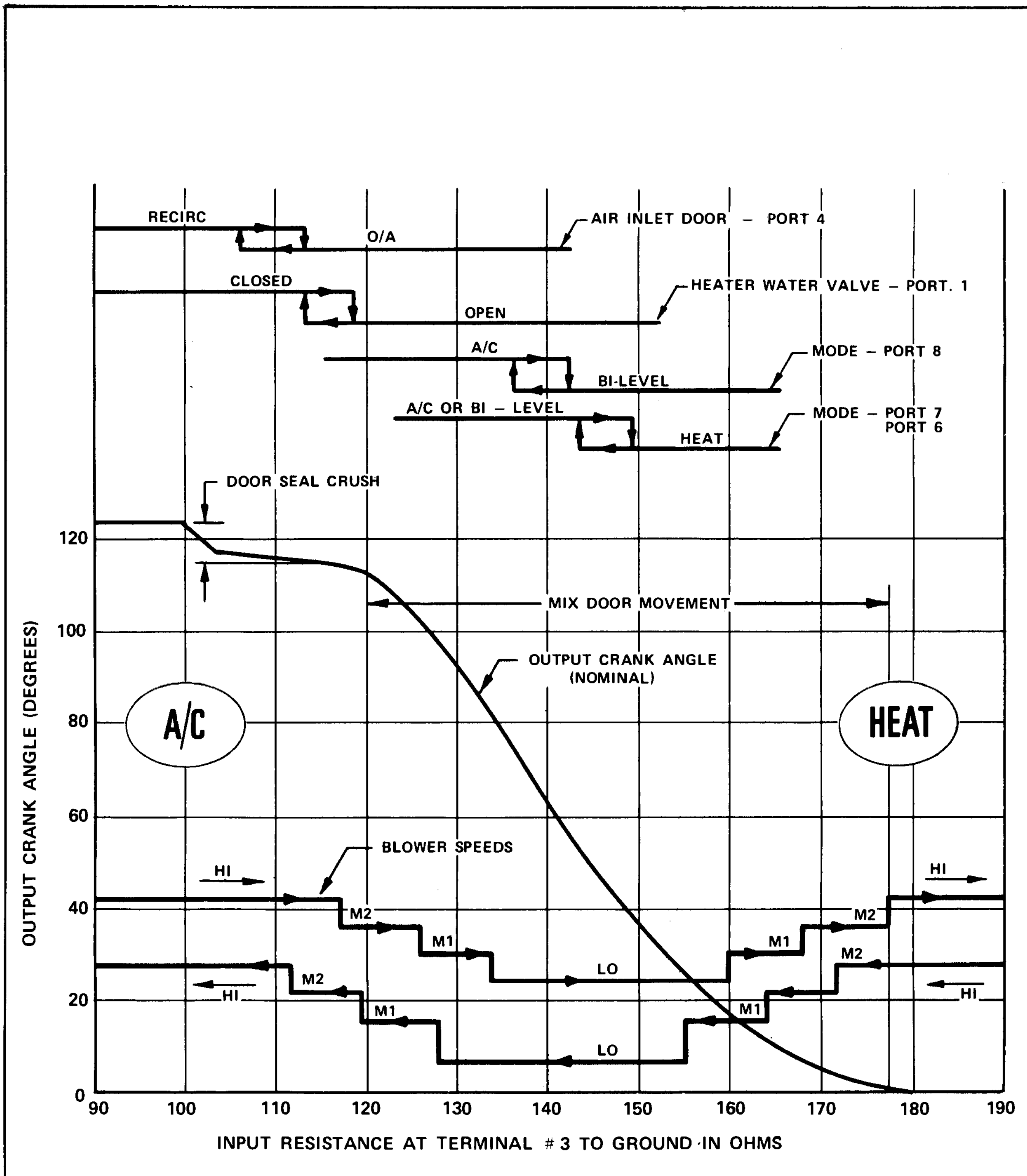


Fig. 1B-8 Typical Programmer Operating Characteristics

VACUUM MOTOR AND VACUUM CHECKING RELAY TEST

16. Disconnect electrical connector from programmer. Do not disconnect vacuum input to programmer. The programmer should go to the full heat position (the vacuum motor mechanism will move into the vacuum motor). If it does not, either the vacuum checking relay or the vacuum motor has a severe leak. If it does go to full heat, a slight leak may be present and the vacuum motor will move toward maximum cold after removing the rubber dummy plug from the programmer.

17. If the vacuum motor mechanism moves, the vacuum motor or vacuum checking relay is leaking. Disconnect the short hose at vacuum motor. Apply raw vacuum to the vacuum motor input port then pinch the hose at the vacuum motor with long nose pliers and hold for 30 seconds. If the mechanism moves, the vacuum motor is defective. If it does not move, the vacuum checking relay is defective.

AMPLIFIER CALIBRATION (FEEDBACK "POT" ADJUSTMENT)

18. A. Remove the programmer cover and make the connections to programmer as described in Steps 1 through 4.

    B. Using a screwdriver, slip the shaft of the feedback potentiometer, turning the shaft fully counter-clockwise (gear does not move). See Fig. 1B-7. The vacuum motor should now be in the full heat position. (The vacuum motor mechanism will move into the vacuum motor.)

    C. Place the Manual-Automatic switch in the MANUAL position. Rotate the Manual Control to the MAX. HEAT position.

    D. Carefully adjust the Manual Control to "180" and do not overshoot.

    E. Slip the shaft of the feedback "pot" very slowly clockwise looking for signs of vacuum motor mechanism movement. (Do not watch the output shaft.) Stop the adjustment when movement first occurs.

    F. Check the adjustment with the Manual Control. Rotate the Manual Control to the MAX. HEAT position. Watch for signs of vacuum motor mechanism movement while slowly rotating the Manual Control back toward "180". The first sign of movement should occur when the Manual Control knob is exactly on "180". Touch up the feedback potentiometer adjustment in the programmer so that the mechanism movement occurs exactly at "180".

PROGRAMMER BLOWER SWITCH TEST

19. Place the Voltage knob in the "#6 Blower" position. Rotate the Manual Control knob to the MAX. HEAT position. The voltmeter reading should be 12 volts D.C. (supply voltage). As the Manual Control knob is slowly rotated toward MAX. COLD at about "175" the voltage will drop slightly (See Fig. 1B-8). At about "160" the voltage will again drop slightly, and again at about "155". At about "130", the voltage will increase slightly. At about "120", the voltage will again increase slightly and again at about "110" a slight increase should be noted. If these steps in blower voltage are not present, the blower switch in the programmer is defective.

20. Tap components of the programmer while rotating the Manual Control knob and watch for any erratic operation due to intermittent problems. Replace programmer cover and rotate Manual Control knob checking for normal rotation of the output shaft.

G SERIES DIAGNOSIS

ATC TESTER J 22684-01

Automatic Temperature Control (ATC) Tester J 22684-01 (Fig. 1B-9) is a valuable tool for locating a malfunctioning component of the G Series ATC system. Once the tester is connected into the system, input and output voltages can be quickly measured with a turn of one control switch. These measurements may be made with entire "on-car" system or with sensor string and potentiometer replaced by a variable resistance. Thus, a normally operating system can be placed in any mode of operation regardless of ambient or in-car temperatures. A probe is provided to measure additional voltages to further aid in locating the malfunctioning component. The tester also provides a means of quickly calibrating the control panel potentiometer and thereby eliminates time required to stabilize the in-car temperature.

TESTER COMPONENTS

The tester is composed of four switches and two calibrated dials, one a D.C. voltmeter and the other an ammeter used for calibration purposes. Two dual position switches are used, S1 for test and calibrate and S2 for automatic or manual operation. The lower rotating switch operates a variable resistance and is used to simulate sensor string voltage. The upper or position switch allows the various ATC circuits to be measured on the voltmeter. The probe position allows measurement of additional circuits in the system.

One large loom attached to the tester allows it to be inserted into the programmer circuitry. In addition, a probe is provided for use in the probe setting on the position switch. The green wire is used for calibration of the con-

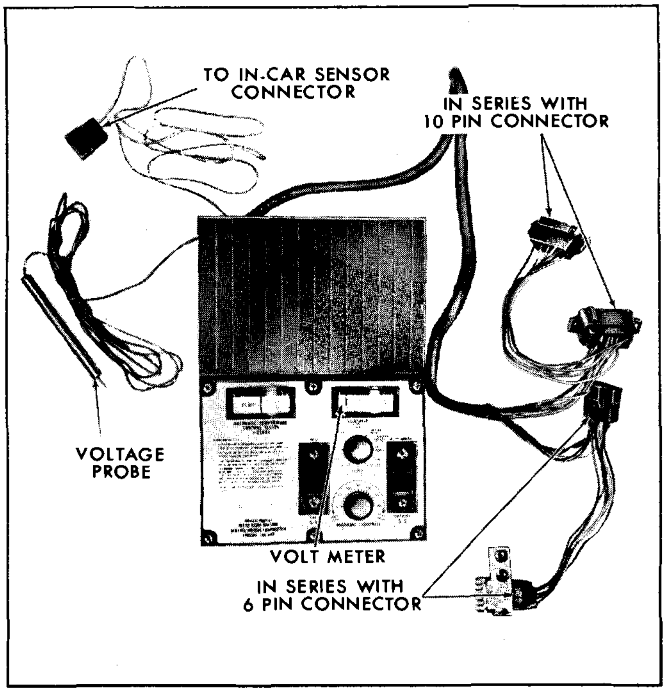


Fig. 1B-9 ATC Tester J 22684-01

trol panel potentiometer (See TEMPERATURE LEVER CALIBRATION).

ATTACHMENT OF TESTER TO CAR

The tester is attached to the system in the following manner:

1. Remove glove compartment (models with bench seat only).

2. Remove three wiring connections from programmer.

3. The J 22684-51 Automatic Temperature Control Tester Adapter (Fig. 1B-10) is required for attachment of the J 22684-01 tester to the ATC system. Attach J 22684-51 adapter to ATC system by inserting the appropriate 6-terminal connector and 1-terminal connector of the adapter into the mating connectors on the in-car wire harness and the remaining 6-terminal and 1-terminal connectors of the adapter into the corresponding connectors of the harness from the programmer.

4. Insert the remaining connector on the in-car harness into the appropriate connector of tester J 22684-01 and insert the equivalent connector of the tester into the connector opening on the programmer.

5. Connect the two 10-terminal connectors (3 terminals are not used) of the tester to the corresponding connectors of the J 22684-51 adapter.

TEMPERATURE LEVER CALIBRATION

Before proceeding with the various readings, the temperature select lever on the control panel may be calibrated to insure accuracy. Calibration is accomplished in the following manner:

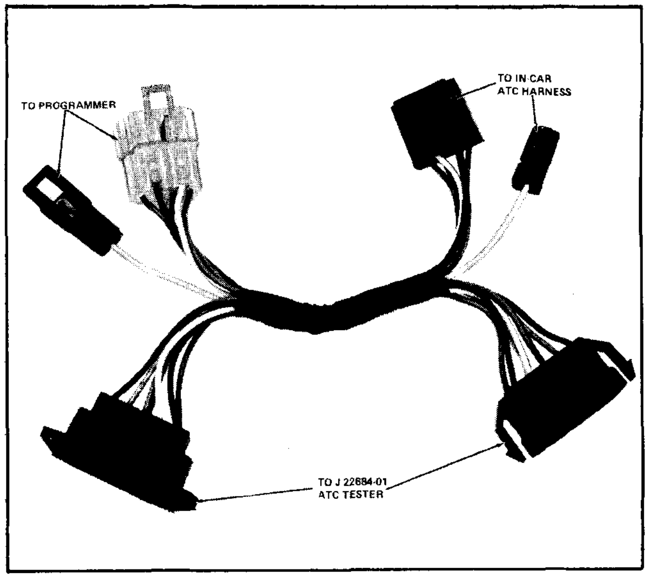


Fig. 1B-10 J 22684-51 Adapter

1. Remove connector containing leads to in-car sensor at control panel (black with a single light green stripe and light green).

2. Connect the tester temperature lead assembly (green lead) to the lead previously removed from the in-car sensor.

3. Set control panel temperature lever on 75 and set tester as follows:

   a. Manual Control at 50.

   b. Switch S-2 to AUTOMATIC.

   c. Switch S-1 to CAL.

4. Readjust control panel temperature lever until the temperature dial cal. centers itself on the meter.

TEST PROCEDURE

The test procedure in its complete form is given on the cards (Fig. 1B-11) attached to the tester. The instructions give control panel setting, tester setting, expected voltmeter readings and the suggested service procedure to use if values are other than expected.

ATC DIAGNOSIS GUIDE

The ATC diagnosis guide can be used several ways. In conjunction with the diagnosis guide the following illustrations may be of great assistance: ATC Wiring Circuit

MAIN TROUBLE-SHOOTING CARD

J - 22684
PONTIAC 1968 AUTOMATIC TEMPERATURE CONTROL TESTER
OPERATING INSTRUCTIONS
TROUBLE SHOOTING PROCEDURE

FIRST CHECK ALTERNATOR AND POWER LEAD FUSES.
SET S-1 TO TEST ON ALL FOLLOWING:

STEP	CONTROL PANEL SETTING: PUSHBUTTON DEPRESSED	CONTROL PANEL SETTING: BLOWER RANGE	CONTROL PANEL SETTING: S-2	TESTER SETTINGS: MANUAL CONTROL	TESTER SETTINGS: VOLTAGE SWITCH	NORMAL VOLTMETER READING	TO CORRECT ABNORMAL CONDITIONS
1.	OFF	LO OR HI	AUTO	...	AMPL. SOURCE	NO VOLTAGE	CHECK SUBSTEPS 1A & 1B
2.	NORMAL				AMPL. SOURCE	BATTERY VOLTAGE	CHECK FUSE OF POWER LEAD CHECK SUBSTEPS 2A & 2B.
3.	NORMAL				MASTER RELAY COIL	BATTERY VOLTAGE	CHECK PROGRAMMER HEAT SENSOR OR SEE PROGRAMMER DIAGNOSIS GUIDE IN 1968 DIAGNOSIS MANUAL
4.	OFF				MASTER RELAY COIL	NO VOLTAGE	CHECK WIRING TO PROG. OR IF WIRING O.K., REPLACE DE-ICE SWITCH.
5.	NORMAL				PROG. INPUT	BATTERY VOLTAGE	IF STEP 7 ABNORMAL, CHECK ALTERNATOR FUSE & SUBSTEP 5A: OTHERWISE CHECK SUBSTEPS 5B & 5C.
6.	NORMAL				LOCATION SWITCH	NO VOLTAGE	CHECK SUBSTEPS 6A & 6B.
7.	OFF				LOCATION SWITCH	BATTERY VOLTAGE	CHECK SUBSTEPS 7A THRU 7C.
8.	NORMAL				DE-ICE	4 TO 8 VOLTS	IF BATTERY VOLTAGE IS MEASURED CHECK SUBSTEP 8A & 8B IF NO VOLTAGE IS MEASURED CHECK SUBSTEP 8C.
9.	DE-ICE	LO OR HI	AUTO		DE-ICE	BATTERY VOLTAGE	CHECK SUBSTEPS 9A & 9B.
10.	NORMAL	LO	MAN.	MAX. HEAT	HI	BATTERY VOLTAGE	CHECK FOR BINDING TEMP. DOOR OR LINKAGE. SEE PROGRAMMER DIAGNOSIS GUIDE IN 1968 DIAGNOSIS MANUAL.
11.	NORMAL	LO		MAX. COLD	HI	BATTERY VOLTAGE	SAME AS IN STEP 10.
12.	NORMAL	LO	MAN.	MAX. COLD	M3, M2 & M1	BATTERY VOLTAGE	LOW VOLTAGE - CHECX WIRING TO PROG. (6 TERMINAL CONNECTOR) NO VOLTAGE - CHECK WIRING TO PROG. OR REPLACE RESISTOR BLOCK.

TEMPERATURE DIAL CALIBRATION: SET MANUAL CONTROL ON 50
SET TEMPERATURE DIAL ON 75

ADDITIONAL CHECKS

COMPLAINT	TEST
BLOWER WILL NOT OPERATE	IF STEP 12 IS NORMAL PLACE PROBE ON BROWN WIRE OF BLOWER MOTOR. IF NO VOLTAGE CHECK BROWN LEAD TO RESISTOR BLOCK. OTHERWISE CHECK BLOWER MOTOR GROUND STRAP OR REPLACE MOTOR.
TEMPERATURE EXTREMELY WARM	CHECK STEPS 10 & 11 & TEMP. DIAL CALIBRATION. IF TEMP. DIAL CALIBRATION METER WILL NOT NULL, CHECK FOR LOOSE CONNECTION OR REPLACE TEMP. DIAL POT. OTHERWISE CHECK FOR OPEN LEAD OR SENSOR IN SENSOR STRING.
TEMPERATURE EXTREMELY COLD	SAME AS ABOVE STEP EXCEPT CHECK FOR SHORTED LEAD OR SENSOR IN SENSOR STRING.

7306890
PRINTED IN UNITED STATES OF AMERICA

SUB TROUBLE-SHOOTING CARD

NOTE: PLACE VOLTAGE SWITCH IN PROBE POSITION FOR ALL SUBSTEP CHECKS

SUBSTEP	PLACE PROBE AT	★READING EXPECTED	IF READING EXPECTED IS OBTAINED
1A	RED LEAD OF MASTER SWITCH	NO VOLTAGE	MASTER SWITCH POSSIBLY BYPASSED. CHECK WIRING FROM MASTER SWITCH TO PROGRAMMER
1B			REPLACE MASTER SWITCH.
2A	RED LEAD ON MASTER SWITCH	BATTERY VOLTAGE	REPAIR OR REPLACE LEAD TO PROG.
2B	BROWN LEAD ON MASTER SWITCH	BATTERY VOLTAGE	REPLACE MASTER SWITCH.
2C			CHECK WIRING REPAIR OR REPLACE POWER FEED LEAD.
5A	BLACK DOUBLE ORANGE STRIPE. LEAD ON MASTER RELAY	BATTERY VOLTAGE	REPLACE MASTER RELAY OR IF NO VOLT. REPAIR OR REPLACE ALTERNATOR LEAD
5B	BLACK SINGLE RED STRIPE LEAD ON MASTER RELAY	BATTERY VOLTAGE	CHECK WIRING TO PROG. REPAIR OR REPLACE LEAD.
5C			REPLACE MASTER RELAY.
6A	YELLOW DOUBLE BLACK STRIPE LEAD ON MASTER RELAY	NO VOLTAGE	CHECK WIRING TO PROGRAMMER.
6B			REPLACE MASTER RELAY.
7A	YELLOW DOUBLE BLACK STRIPE LEAD ON MASTER RELAY	BATTERY VOLTAGE	CHECK WIRING TO PROG. REPAIR OR REPLACE LEAD.
7B	BLACK DOUBLE ORANGE STRIPE LEAD ON MASTER RELAY	BATTERY VOLTAGE	REPLACE MASTER RELAY.
7C	SEE STEP 5		
8A	PURPLE LEAD ON DE-ICE SWITCH	4 TO 8 VOLTS	CHECK WIRING FROM SWITCH TO PROG.
8B			IF FULL BATTERY VOLTAGE MEASURED ON PURPLE LEAD REPLACE DE-ICE SWITCH
8C			IF NO VOLT MEASURED REPLACE PROG. OR PROGRAMMER AMPLIFIER.
9A	PURPLE LEAD OF DE-ICE SWITCH	BATTERY VOLTAGE	CHECK WIRING.
9B			REPLACE DE-ICE SWITCH.

★ IF READING IS NOT OBTAINED GO TO NEXT SUBSTEP.
SEE SERVICE MANUAL FOR ADDITIONAL INFORMATION.

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NOTE: WHEN SERVICING 1972 A.T.C. SYSTEMS, ALL REFERENCE TO SERVICE AND DIAGNOSIS MANUALS IS SUPERSEDED BY THE 1972 SERVICE MANUAL.

Fig. 1B-11 Trouble Shooting Cards - J 22684-01 ATC Tester

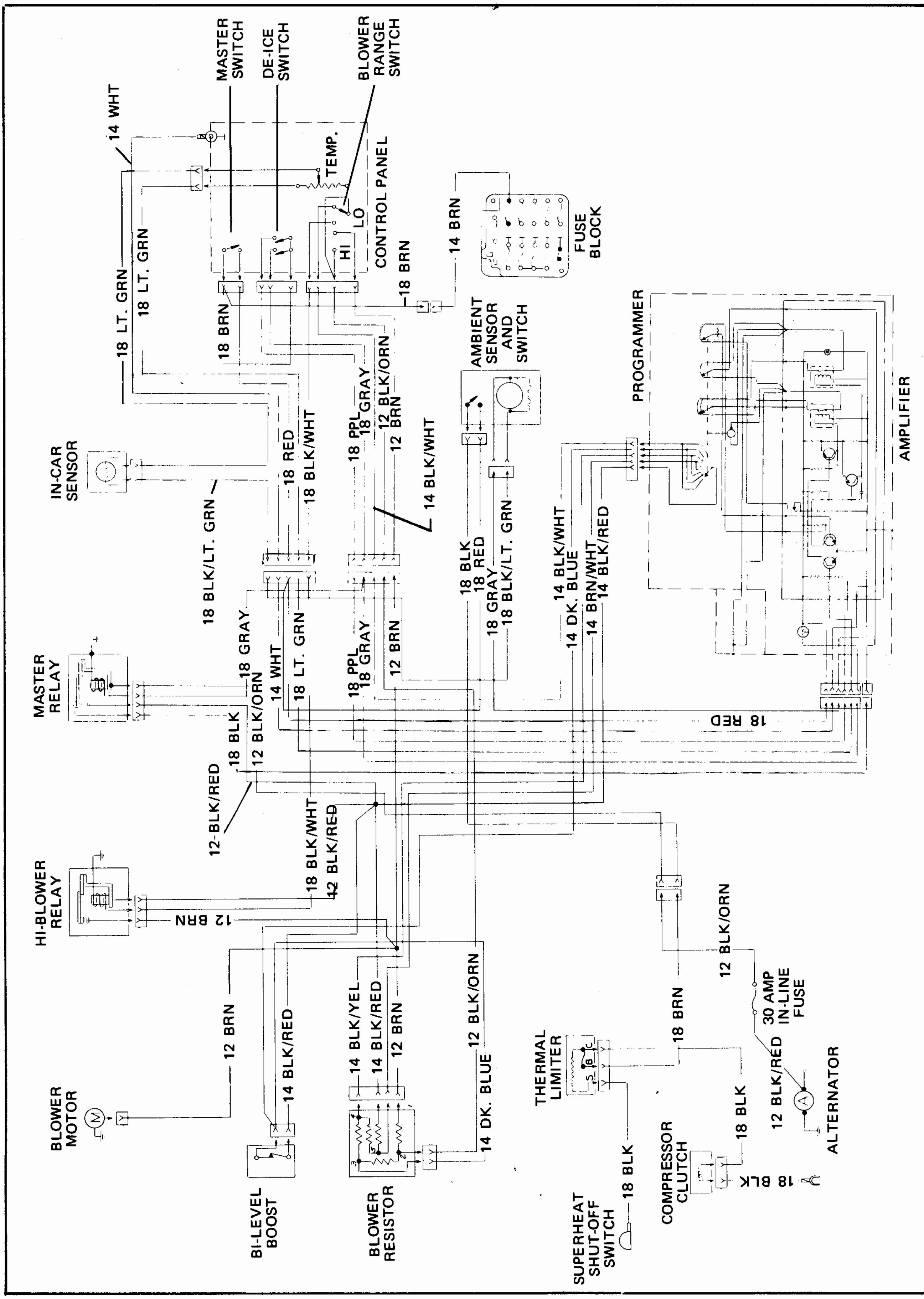


Fig. 1B-12 ATC Wiring Circuit Diagram - G Series

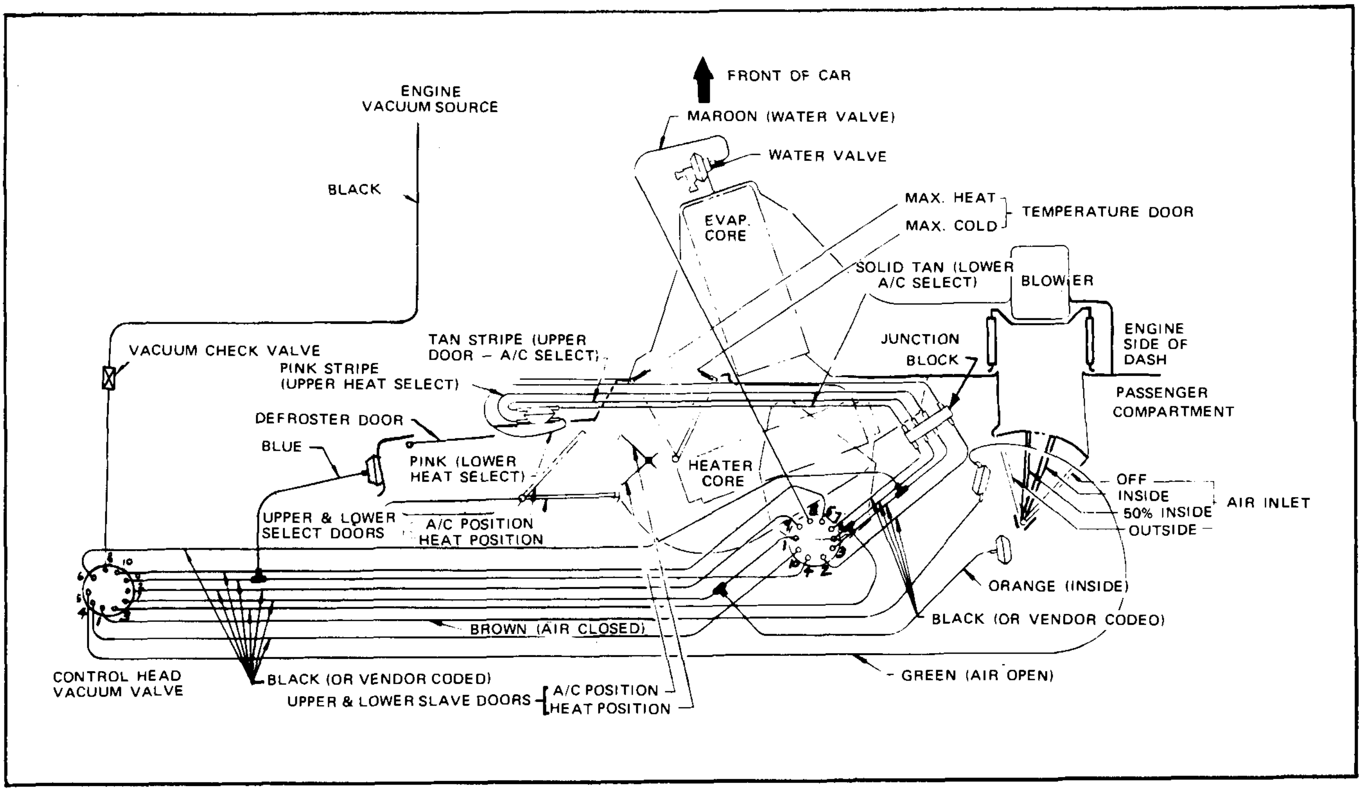


Fig. 1B-13 ATC Vacuum Schematic - G Series

Diagram (Fig. 1B-12), ATC Vacuum Schematic (Fig. 1B-13) and ATC Vacuum Valve Positions (Figs. 1B-14 and 1B-15).

Until one becomes familiar with the system, the entire diagnosis procedure will probably be most helpful. If an individual component is suspected, the following table will be of help. It lists the tests as well as the components which are checked by each test found in the diagnosis guide.

TEST	CHECKS SYSTEM FOR
A	Master Switch
	Master Relay
B	Fuse from alternator
	Programmer
	Master Relay
C	Control Panel Vacuum Valve
	Air Inlet Door Dual Diaphragm
D	Fuses
	Master Relay
	Resistor Block
	Blower Range Switch
	Blower Motor
	Programmer
E1	Water Control Valve
	Temperature Door Adjustment
	Control Panel Vacuum Valve
	Vacuum Supply Hose
	Programmer Vacuum Valve
E2	Diverter Door Operation
	Programmer Vacuum Valve
F	Hi Blower Relay
	Blower Range Switch
	Programmer
G1	Compressor Clutch
	Ambient Switch
G2	Sensor String
	Temperature Door Adjustment
	Programmer
G3	Diverter Door Diaphragm
H	Defroster Door Diaphragm
	Vacuum Hose
	Control Panel Vacuum Valve
I	De-Ice Switch
	Programmer
J	(Same as Test H with system in DEFROST)
K	Dual Diaphragm Air Inlet Door
	Control Panel Vacuum Valve
	Programmer Vacuum Valve
L	Bi Level Boost Switch
M	Single Diaphragm - Air Inlet Door
	Control Panel Vacuum Valve

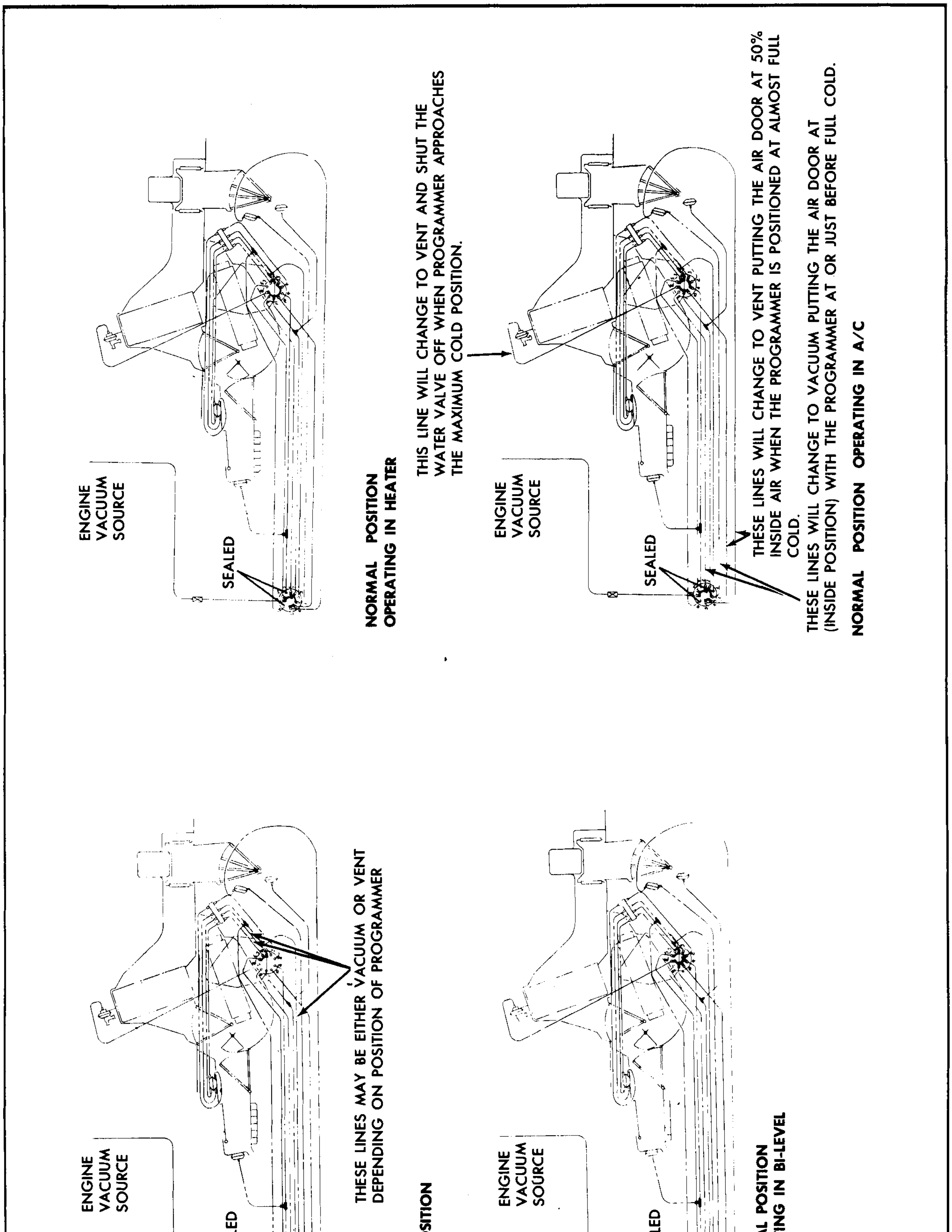


Fig. 1B-14 ATC Vacuum Valve Positions - G Series

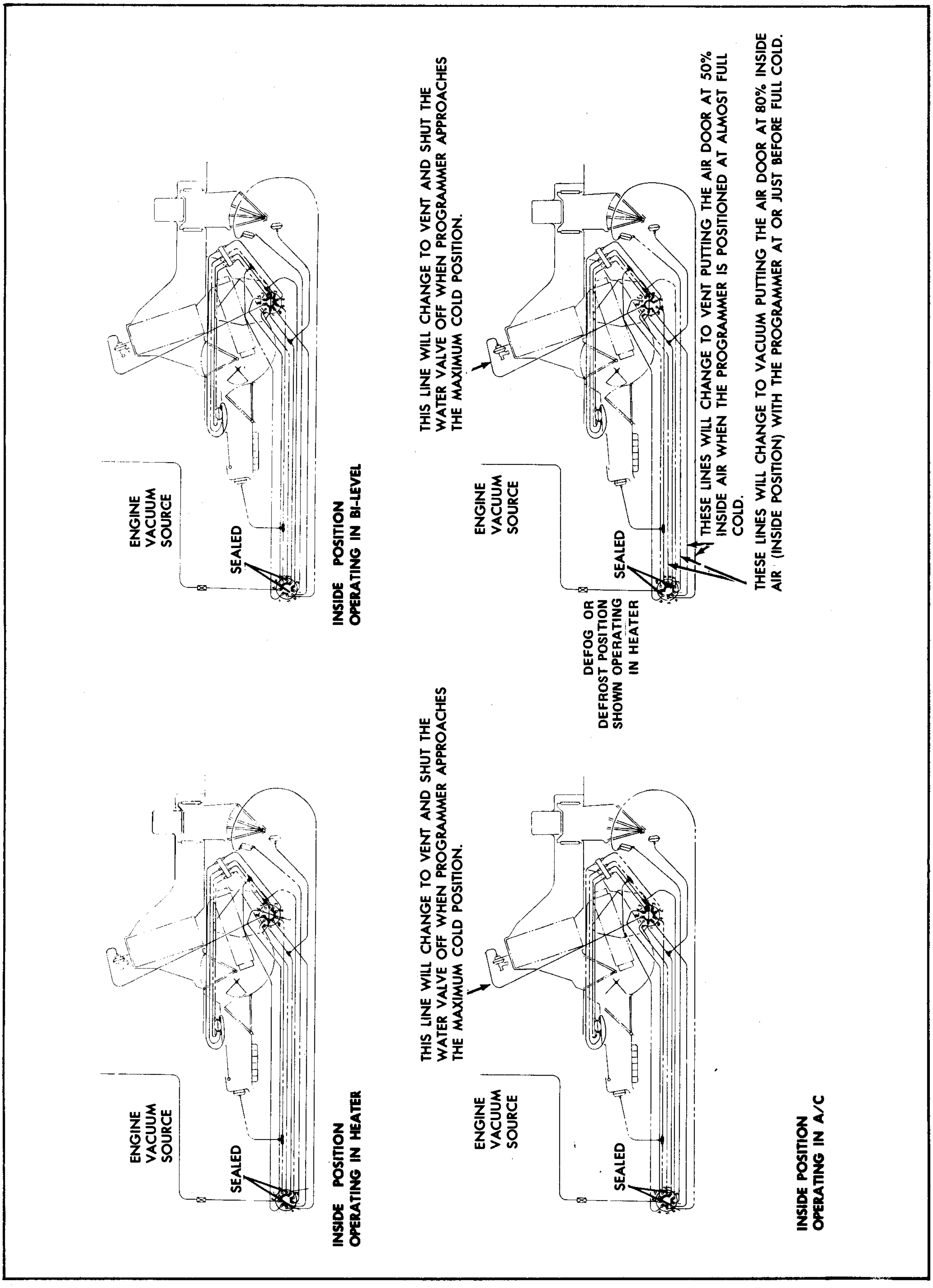


Fig. 1B-15 ATC Vacuum Valve Positions - G Series

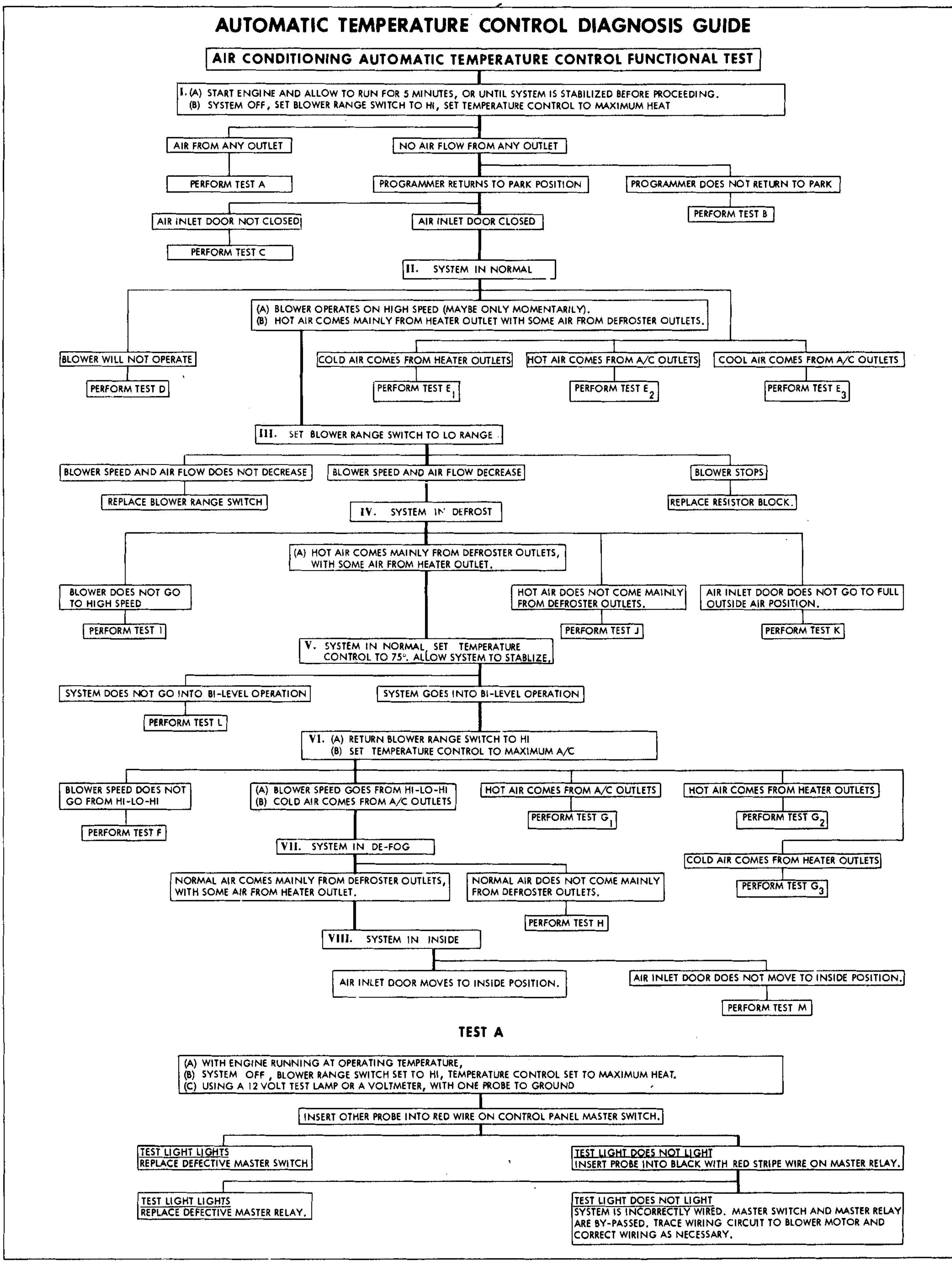


Fig. 1B-16 ATC Diagnosis Guide

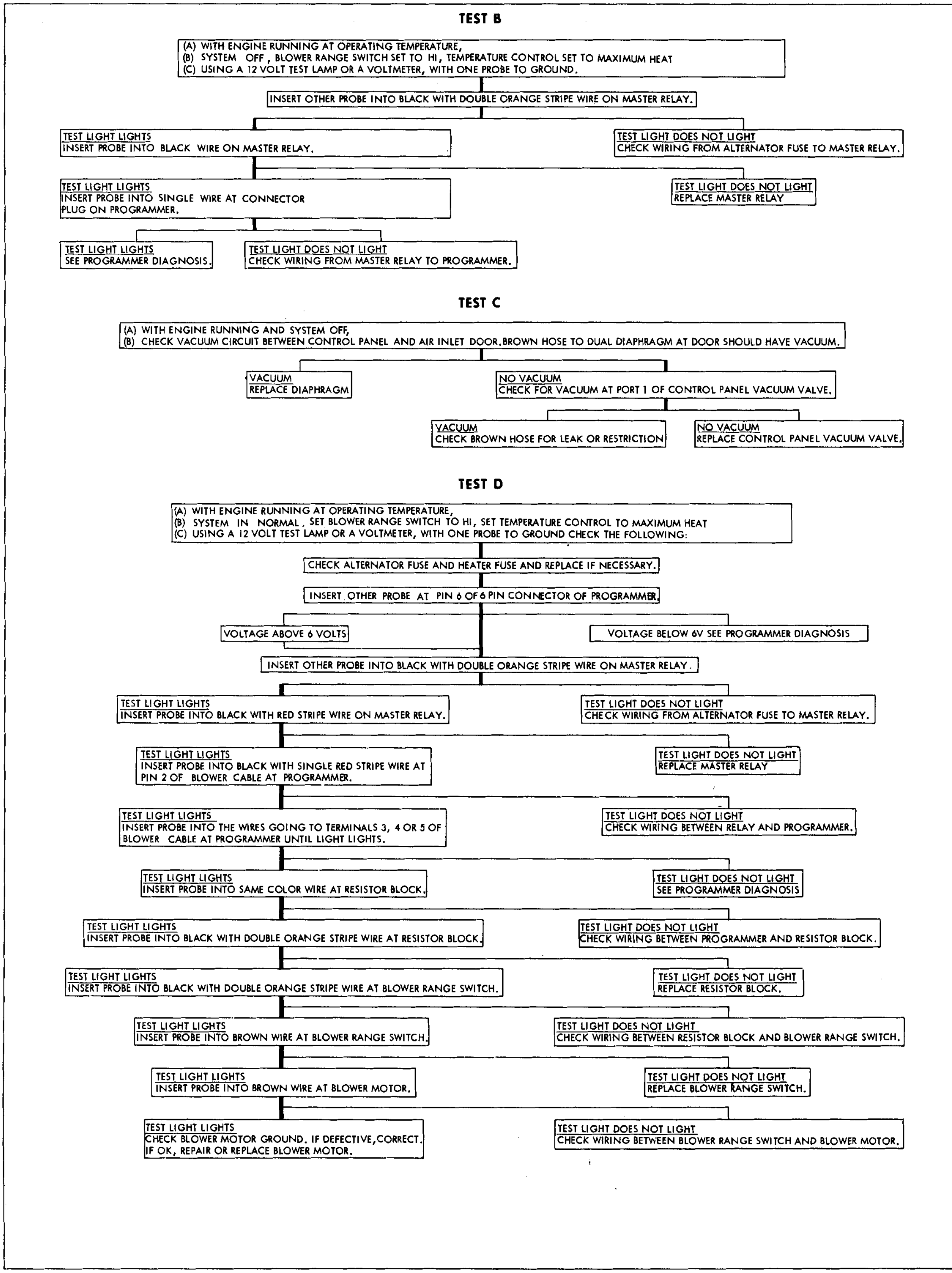


Fig. 1B-17 ATC Diagnosis Guide

TEST E_1

(A) WITH ENGINE RUNNING AT OPERATING TEMPERATURE, SYSTEM IN NORMAL, TEMPERATURE CONTROL AT MAXIMUM HEAT, BLOWER RANGE SWITCH ON HI,
(B) REMOVE MAROON HOSE FROM WATER CONTROL VALVE AND CHECK FOR VACUUM.

- VACUUM — CHECK WATER CONTROL VALVE FOR PROPER OPERATION.
  - SATISFACTORY — CHECK POSITION OF TEMPERATURE DOOR AND PROGRAMMER ARM ASSY. DOOR SHOULD BE FULLY CCW. IF NOT REPAIR DOOR, ADJUST ARM OR REPLACE PROGRAMMER AS NECESSARY.
  - DEFECTIVE — REPLACE WATER CONTROL VALVE.
- NO VACUUM — CHECK FOR VACUUM AT PORT 8 OF PROGRAMMER VACUUM VALVE.
  - VACUUM — CHECK FOR LEAK OR RESTRICTION IN MAROON HOSE.
  - NO VACUUM — CHECK FOR VACUUM AT BLACK HOSE TO PORT 1 OF PROGRAMMER VACUUM VALVE.
    - VACUUM — REPLACE PROGRAMMER VACUUM VALVE.
    - NO VACUUM — CHECK FOR VACUUM AT PORT 7 OF CONTROL PANEL VACUUM VALVE.
      - VACUUM — CHECK FOR LEAK OR RESTRICTION IN BLACK HOSE BETWEEN PORT 7 OF CONTROL PANEL VACUUM VALVE AND PORT 1 OF PROGRAMMER VACUUM VALVE.
      - NO VACUUM — CHECK FOR VACUUM AT PORT 10 OF CONTROL PANEL VACUUM VALVE.
        - VACUUM — REPLACE CONTROL PANEL VACUUM VALVE.
        - NO VACUUM — CHECK FOR LEAK OR RESTRICTION IN BLACK HOSE SUPPLYING ENGINE VACUUM.

TEST E_2

(A) WITH ENGINE RUNNING AND AT OPERATING TEMPERATURE, SYSTEM IN NORMAL, TEMPERATURE CONTROL AT MAXIMUM HEAT, BLOWER RANGE SWITCH ON HI
(B) CHECK VACUUM CIRCUITRY TO DIVERTER DOORS. TAN AND TAN STRIPE HOSES SHOULD BE VENTED, PINK AND PINK STRIPE HOSES SHOULD HAVE VACUUM.

- VACUUM — CHECK FOR BINDING DOORS. REPAIR AS NECESSARY.
- NO VACUUM — CHECK FOR VACUUM AT PORT 2 OF PROGRAMMER VACUUM VALVE.
  - VACUUM — CHECK FOR LEAK OR RESTRICTION IN PINK HOSE OR PINK STRIPE HOSE.
  - NO VACUUM — REPLACE DEFECTIVE PROGRAMMER VACUUM VALVE.

TEST E_3

TEST E_3 CONSISTS OF TEST E_1 PLUS TEST E_2.
IF ABOVE CHECKS ARE OK, CHECK FOR SHORT IN SENSOR STRING, AND REPLACE OR REPAIR AS NECESSARY.

TEST F

(A) WITH ENGINE RUNNING AT OPERATING TEMPERATURE,
(B) SYSTEM IN NORMAL, BLOWER RANGE SWITCH SET TO HI, TEMPERATURE CONTROL SET TO MAXIMUM HEAT.
(C) ROTATE TEMPERATURE CONTROL TO MAXIMUM A/C. OBSERVE MOVEMENT OF PROGRAMMER ASSY. ARM. IT SHOULD EXTEND FURTHER OUT OF PROGRAMMER.

- PROGRAMMER ARM MOVES
  - (D) HI-BLOWER RELAY SHOULD PICK UP
  - (E) USING A 12 VOLT TEST LAMP OR A VOLTMETER, WITH ONE PROBE TO GROUND
  - INSERT OTHER PROBE INTO BLACK WITH SINGLE WHITE STRIPE WIRE AT HI-BLOWER RELAY.
    - TEST LIGHT LIGHTS — REPLACE HI-BLOWER RELAY.
    - TEST LIGHT DOES NOT LIGHT — INSERT PROBE INTO BLACK WITH SINGLE WHITE STRIPE WIRE AT BLOWER RANGE SWITCH.
      - TEST LIGHT LIGHTS — CHECK WIRING BETWEEN HI-BLOWER RELAY AND BLOWER RANGE SWITCH.
      - TEST LIGHT DOES NOT LIGHT — INSERT PROBE INTO BLACK WITH DOUBLE WHITE STRIPE WIRE AT BLOWER RANGE SWITCH.
        - TEST LIGHT LIGHTS — REPLACE BLOWER RANGE SWITCH.
        - TEST LIGHT DOES NOT LIGHT — INSERT PROBE INTO BLACK WITH DOUBLE WHITE STRIPE WIRE AT PROGRAMMER.
          - TEST LIGHT LIGHTS — SEE PROGRAMMER DIAGNOSIS
          - TEST LIGHT DOES NOT LIGHT — CHECK WIRING BETWEEN BLOWER RANGE SWITCH AND PROGRAMMER.
- PROGRAMMER ARM DOES NOT MOVE — CHECK FOR OPEN CIRCUIT IN SENSOR STRING OR TEMPERATURE CONTROL.
  - SENSOR STRING OPEN REPAIR OR REPLACE AS NECESSARY
  - SENSOR STRING OK SEE PROGRAMMER DIAGNOSIS.

TEST G_1

(A) WITH ENGINE RUNNING AT OPERATING TEMPERATURE,
(B) SYSTEM IN NORMAL, BLOWER RANGE SWITCH SET TO HI, TEMPERATURE CONTROL SET TO MAXIMUM A/C
(C) OBSERVE A/C COMPRESSOR. IT SHOULD BE RUNNING.
(D) USING A 12 VOLT TEST LAMP OR A VOLTMETER, WITH ONE PROBE TO GROUND

- COMPRESSOR RUNNING — CHECK AND REPAIR A/C SYSTEM AS NECESSARY.
- COMPRESSOR NOT RUNNING — INSERT OTHER PROBE INTO BLACK WIRE AT COMPRESSOR CLUTCH.
  - TEST LIGHT LIGHTS — CHECK COMPRESSOR CLUTCH GROUND. IF DEFECTIVE, CORRECT. IF GOOD, REPAIR OR REPLACE CLUTCH AS NECESSARY.
  - TEST LIGHT DOES NOT LIGHT — INSERT PROBE INTO RED WIRE AT AMBIENT SWITCH.
    - TEST LIGHT LIGHTS — REPLACE AMBIENT SWITCH.
    - TEST LIGHT DOES NOT LIGHT — CHECK WIRING BETWEEN AMBIENT SWITCH AND MASTER SWITCH.

Fig. 1B-18 ATC Diagnosis Guide

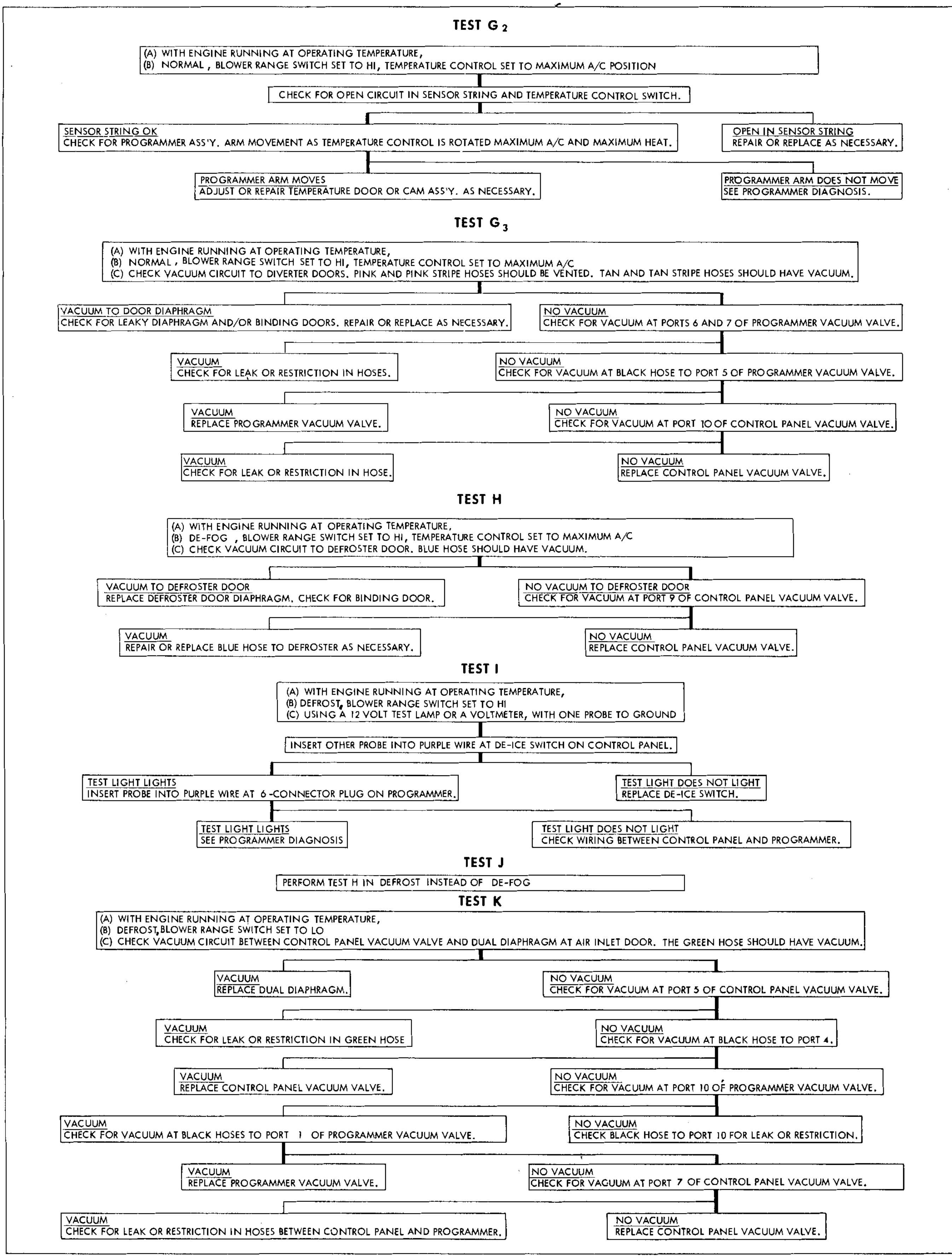


Fig. 1B-19 ATC Diagnosis Guide

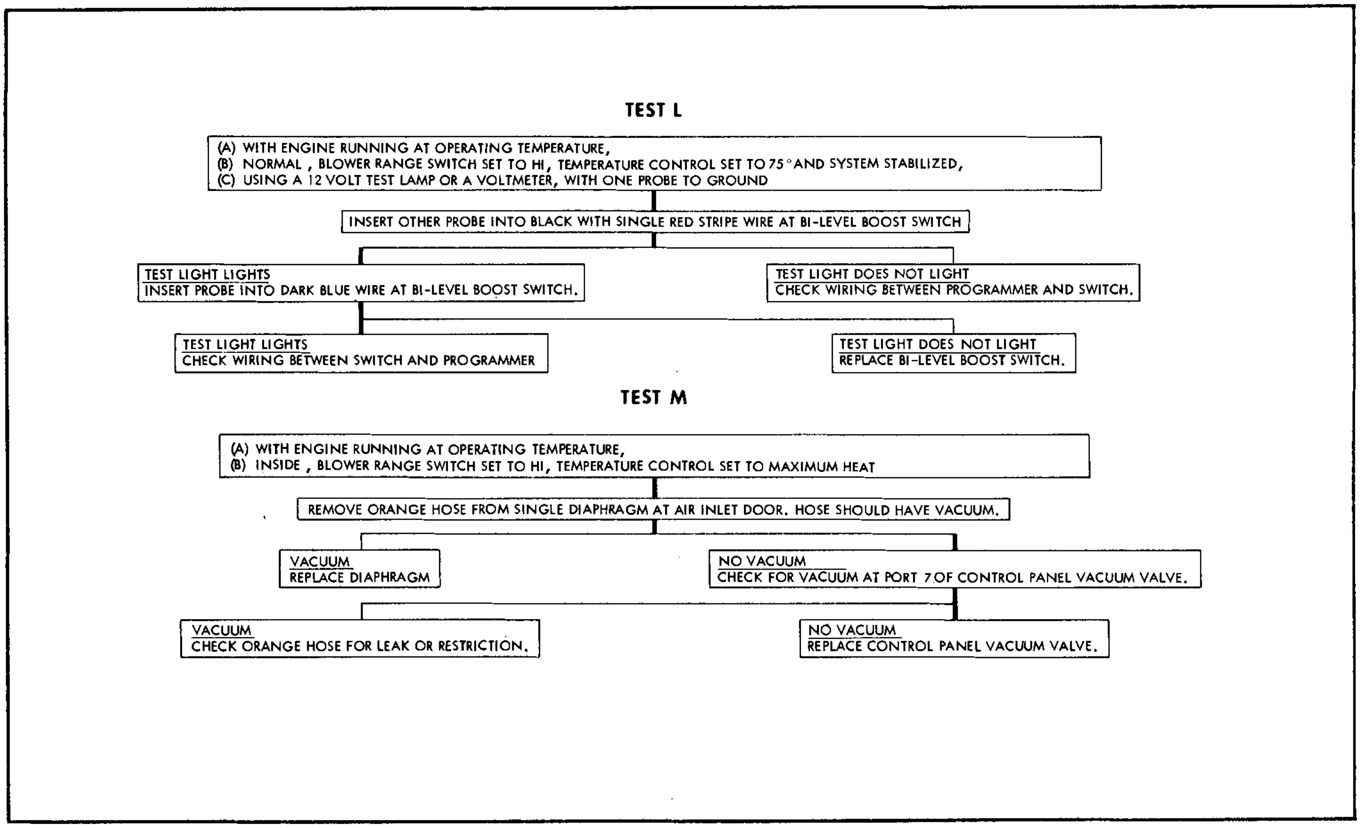


Fig. 1B-20 ATC Diagnosis Guide

GENERAL DESCRIPTION

Automatic Temperature Control (ATC), an expanded version of the Custom Air Conditioning system(A/C), provides automatically controlled interior temperatures. With this system the driver can set desired interior comfort level with a lever (or dial) located on the ATC control panel. The Automatic Temperature Control system will then maintain the set comfort level regardless of weather and requires little or no change in setting to compensate for changes due to outside weather conditions.

Automatic control of temperature is beneficial in both summer and winter. In hot weather, it will cool the car rapidly to a pre-set comfort level and then modulate cooling to whatever degree is required to maintain constant comfort. In mild weather, the interior of the vehicle remains comfortable without having to reset controls. In cold weather, the system will heat the car quickly to a desired temperature, stabilize and then maintain the preset comfort level. This control, however, will not compensate for variations in comfort level desired by individual passengers.

The system, when in operation, will remove excess moisture from the air when the compressor is engaged and in operation. This removal of excess moisture from the air increases passenger comfort, particularly while traveling in humid weather, and limits window fogging and interior condensation.

The Automatic Temperature Control system makes use of two temperature-sensing devices, called thermistors, for its operation. One, near the glove box on the instrument panel, senses vehicle interior temperature. Another, located in air passage from the cowl vent opening, senses temperature of incoming air. These sensors are wired in series with a temperature potentiometer (variable resistor) on the control panel. As temperature in the area of the sensors varies, the total series resistance also changes and a variable input signal is supplied to a D.C. amplifier. This variable signal through the amplifier determines the amount of heating or cooling by changing the position of a unit called the programmer, which controls the temperature door in the heater case, the rotary vacuum valves and the blower, which in turn regulate the air temperature, air quantity (blower speed) and air distribution patterns (heating and/or air conditioning). The remainder of the system is basically the same as the Custom Air Conditioning system.

SENSORS (THERMISTORS)

A sensor (semi-conductor thermistor) is extremely sensi-

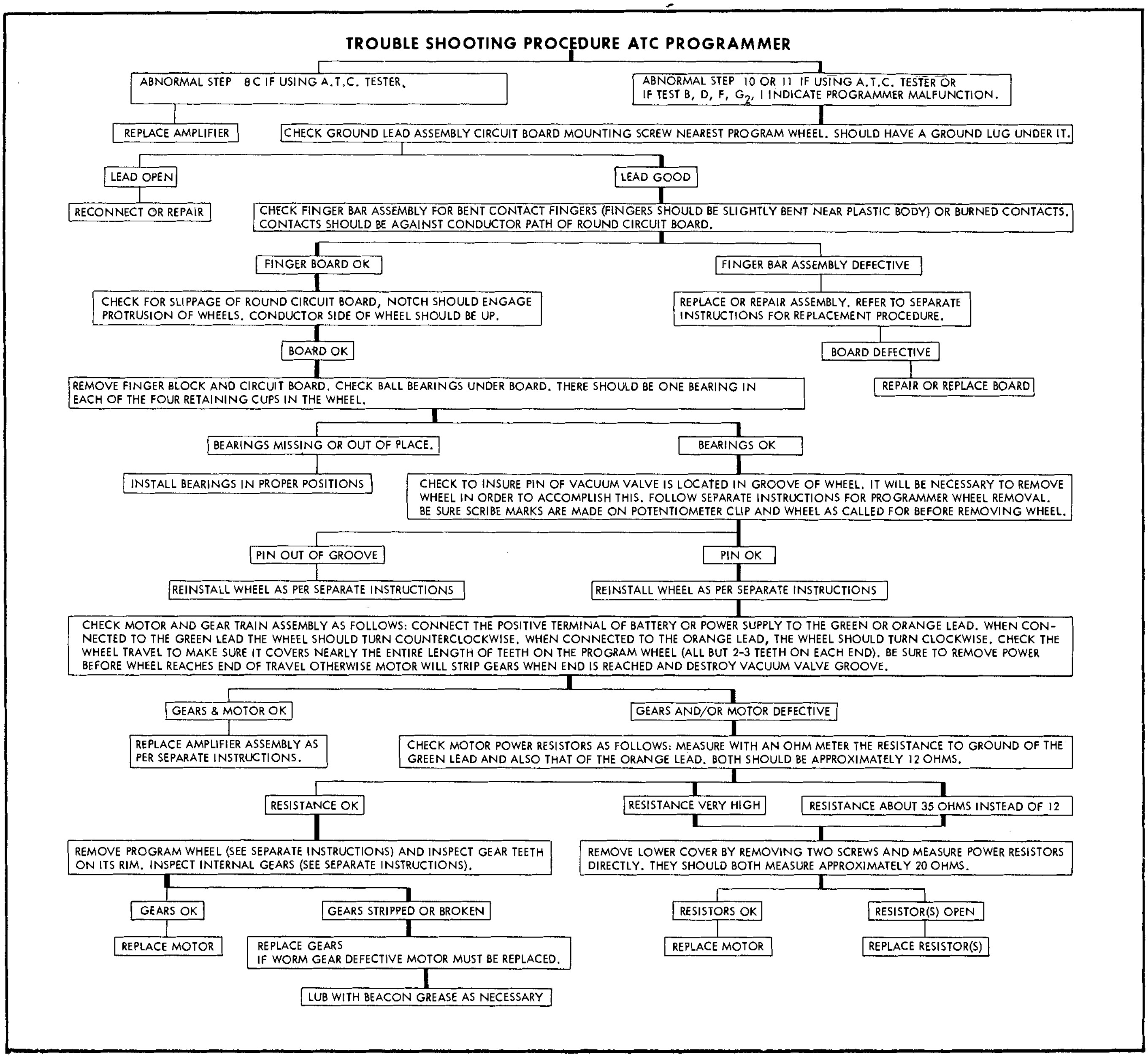


Fig. 1B-21 Trouble Shooting Procedure - ATC Programmer

tive to changes in temperature and its resistance values change inversely to temperature change. When the temperature increases, the resistance value of the sensor decreases; or when the temperature decreases, the resistance value of the sensor increases.

Two sensors, the in-car sensor and the ambient sensor and switch assembly (Fig. 1B-22), form the sensor string which is wired in series with the temperature potentiometer on the control panel to form a voltage divider network that supplies a signal to the base of the first transistor in the amplifier. This amplifier is located in the programmer assembly. The B Series ambient sensor is independent of the ambient switch. The sensor is mounted in the evaporator case while the switch is mounted behind the headlamp filler panel and grille.

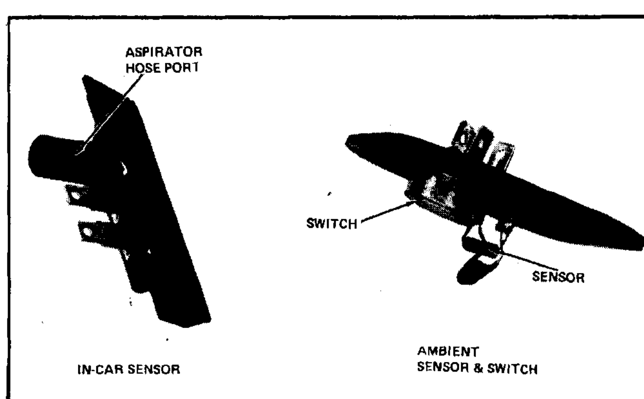


Fig. 1B-22 Typical In-Car Sensor and Ambient Sensor and Switch

ASPIRATION

The in-car sensor assembly is connected by a hose to the aspirator (Fig. 1B-23) located on the top of the heater case. The aspirator is designed to pass a small amount of air flow from the cold air portion of the heater case toward the front of the car. This flow of air causes a slight vacuum effect at the end of the aspirator to which the in-car sensor hose is connected. The result is that air from the passenger compartment is pulled through the sensor grille, across the sensor, through the hose and aspirator toward the front of the car. In this manner, the in-car sensor will be sensing true in-car air and adjusting the signal to the programmer amplifier to compensate for in-car temperature changes.

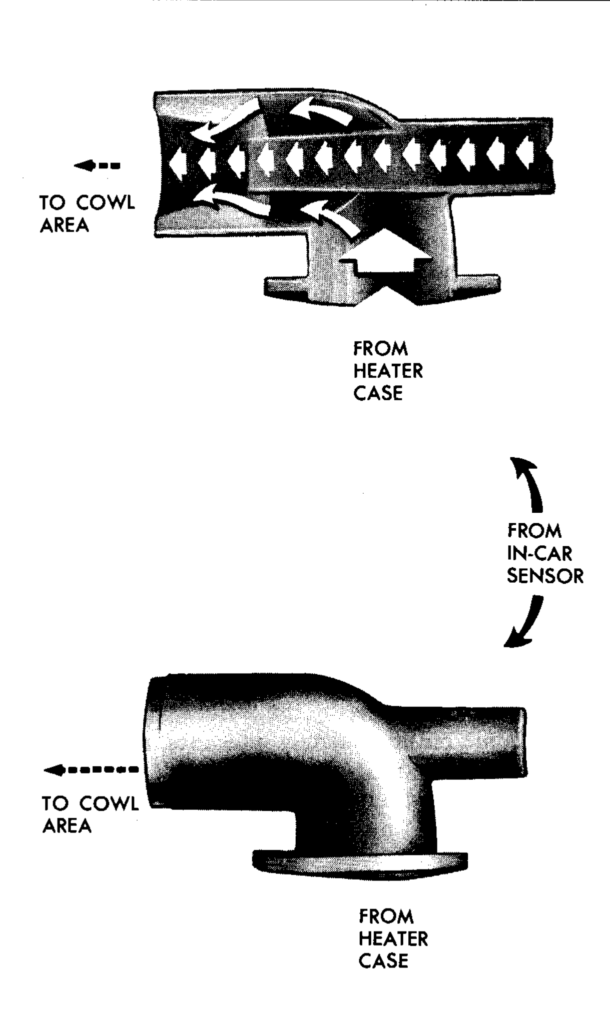


Fig. 1B-23 Aspirator

B SERIES DESCRIPTION

Due to the differences in programmer and control panel design and the means by which the signal at the input to the programmer amplifier regulates the ATC systems on the B and G Series, the two systems are described separately.

The following information describes the B Series ATC system components and operation. Operation and components of the G Series ATC system are described under G SERIES DESCRIPTION.

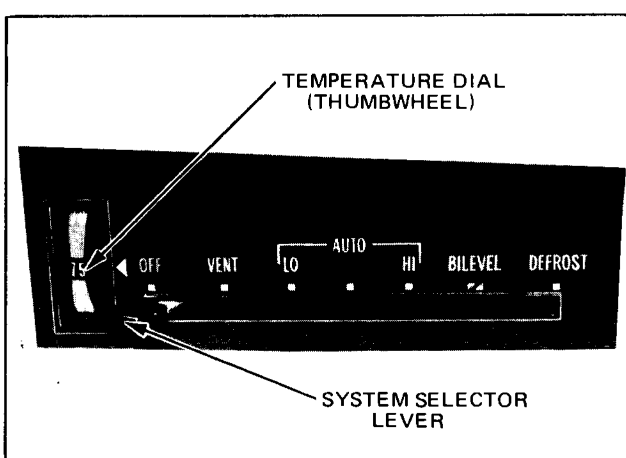


Fig. 1B-24 ATC Control Panel - B Series

BASIC SYSTEM OPERATION

The numbers on the temperature dial thumbwheel control located on the control head (control panel, Fig. 1B-24) indicate the various temperatures which can be obtained in the passenger compartment of the car. This temperature dial serves the same function as the thermostat in your home. The temperature dial controls the in-car temperature when the selector lever is in the OFF, LO, AUTO, HI, BILEVEL, or DEFROST positions.

OFF Position

The B Series Automatic Temperature Control System is completely "shut-off" when the ignition switch of the car is in the OFF position. When the car ignition switch is turned on, the electrical circuit to the ATC system is accomplished. With the control head selector lever in the OFF position, the system will come on when the engine water temperature reaches about 120° F. If the temperature inside the car is above approximately 75°F., the system will come on as soon as the ignition switch is turned on. The fan (blower motor) will run at "lo (purge) blower" speed and air will flow from the heater outlets (See. Fig. 1B-25). The temperature of the air depends on the control head temperature dial setting.

VENT Position

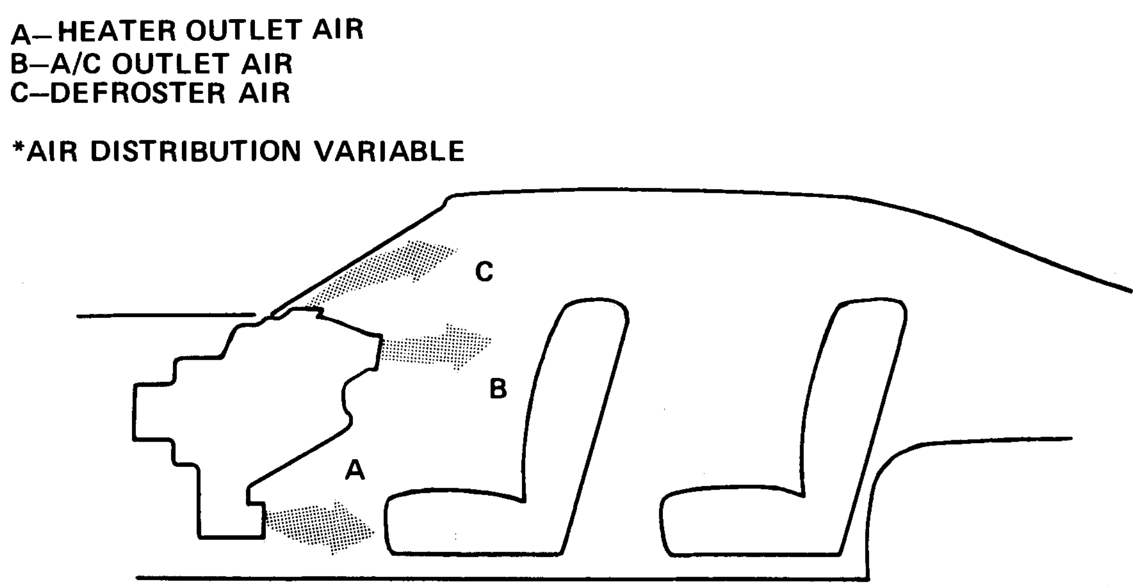
When the selector lever is in the VENT position, the system will come on immediately whenever the ignition switch is placed in the RUN position. The blower runs at "lo blower" speed and outside air is distributed into the passenger compartment of the car through the A/C outlets (See Fig. 1B-25).

LO Position

With the control head selector lever in the LO position, the system will come on immediately if the inside temperature is or exceeds about 75°F. If inside temperature is below 75°F., system will come on when the engine water temperature reaches about 120°F. The blower will then operate at "lo blower" speed only. Conditioned air will flow from the A/C outlets, the heater outlets or both when the system is in "bi-level" operation.

AUTO Position

The operation of the ATC system when the selector lever is in the AUTO position is the same as the LO position except that the blower is no longer locked in "lo blower" operation. The programmer will select any of the four blower speeds (LO, MED. 1, MED. 2, and HI) in order to maintain the proper comfort level in the car (See Fig. 1B-25). The system will go into recirculation (recirc.) operation if maximum cooling is required. Recirc. operation (Max. A/C) is the recirculation of the air from inside the car through the air conditioning system and back into the car.



AIR DISTRIBUTION

POSITION	OFF	VENT	LO	AUTO	HI	BILEVEL	DEFROST
A	100%	—	*	*	*	45%	15%
B	—	100%	*	*	*	50%	—
C	—	—	*	*	*	5%	85%

Fig. 1B-25 Air Flow

HI Position

When the control head selector lever is placed in the HI position, the system is turned on in same manner as in LO or AUTO and the blower operates only at "hi blower" speed. The temperature selected on the temperature dial will be maintained inside the passenger compartment. If maximum A/C is required, the inside air will be recirculated through the A/C system for maximum cooling. When system operation has stabilized, conditioned air will be distributed from both the A/C and heater outlets. This is "bi-level" operation.

BILEVEL Position

The blower operates at LO, MED. 1, MED. 2 or HI speeds when the control head selector lever is in the BILEVEL position. The desired temperature level inside the car will be maintained. Conditioned air is distributed from the heater and A/C outlets with a slight bleed of air from the defroster outlets resulting in "tri-level" operation. The system will come on immediately when the engine thermal switch or the in-car temperature switch is closed.

DEFROST Position

With the control head selector lever in the DEFROST position, the system comes on immediately when the ignition switch is turned on. The fan is locked on "hi blower" speed and all of the air is distributed from the defroster outlets onto the windshield. The comfort level selected on the temperature dial will be maintained in the car.

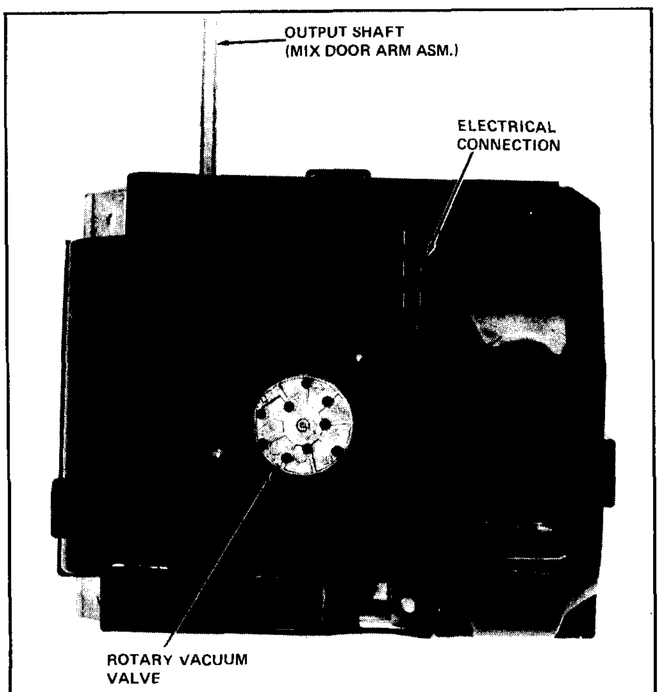


Fig. 1B-26 Programmer Assembly - B Series

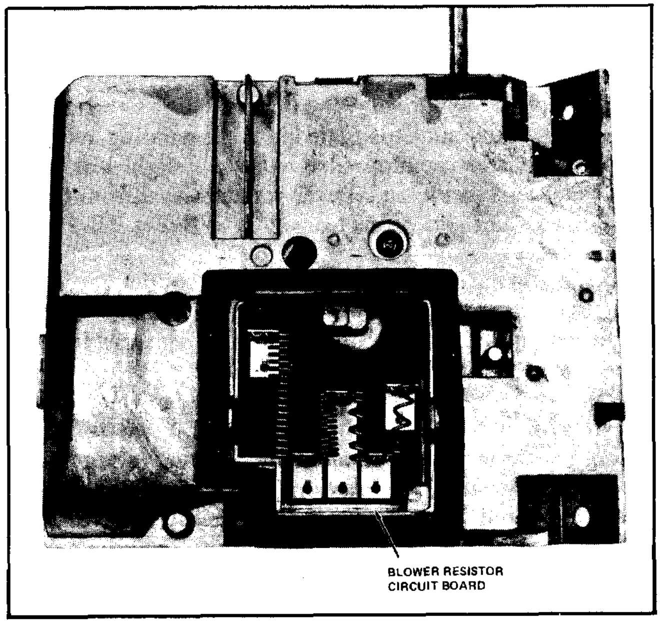


Fig. 1B-27 Blower Resistor Assembly - Programmer

ATC PROGRAMMER

The programmer (Fig. 1B-26) consists of a three-stage D.C. amplifier, a transducer, a vacuum checking relay, a vacuum motor, a rotary vacuum valve and an output shaft (refer to Fig. 1B-6 for identification of programmer components). The blower motor resistor assembly (Fig. 1B-27), which regulates blower motor speed, is also contained in the programmer.

The DC amplifier enlarges (amplifies) the signal supplied from the sensors and the temperature dial and feeds this strong signal to the transducer.

The transducer is actually a solenoid with a vacuum valve connected to the end of the plunger which is located inside the windings. The plunger is positioned inside the wind-

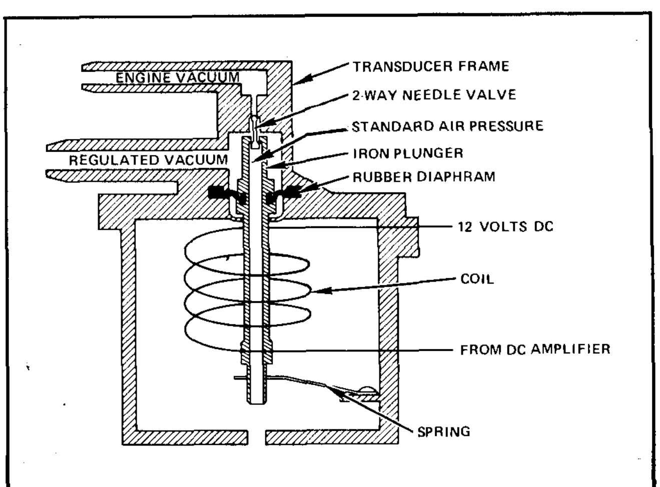


Fig. 1B-28 Cross Section - Transducer

ing, depending upon the amount of current flow from the amplifier. The transducer plunger is spring loaded so that with no current flow through the windings, the plunger is pulled out of the windings. When current flows through the windings, the plunger is pulled into the winding, causing the transducer vacuum valve to have a slight leak to outside air. This results in a lower vacuum level from the regulated vacuum port of the transducer (See Fig. 1B-28).

If a decrease in current flow from the DC amplifier occurs, the plunger moves out of the winding, opening the transducer vacuum valve and resulting in more vacuum from the regulated vacuum port of the transducer.

The vacuum output from the transducer is fed to the vacuum checking relay. When engine vacuum is applied to the checking relay, the relay opens (Fig. 1B-29) allowing the regulated vacuum output from the transducer to be fed directly to the vacuum motor, positioning the motor. If engine vacuum to the checking relay is not present, the relay closes (Fig. 1B-30), sealing the vacuum applied to the vacuum motor. This locks the vacuum motor in place until engine vacuum is again applied to the vacuum relay.

The vacuum checking relay also has another section which checks the input vacuum to the door diaphragms whenever engine vacuum is not present. This holds the doors in place until engine vacuum is again present.

The vacuum motor mechanism is positioned as the result of the vacuum from the transducer. The vacuum motor mechanism is directly connected to electrical wiper contacts that control the various blower speeds.

The mechanism is also connected to a rotary vacuum valve in the programmer and to an output shaft.

The rotary vacuum valve channels vacuum to various vacuum diaphragms and to the rotary vacuum valve on

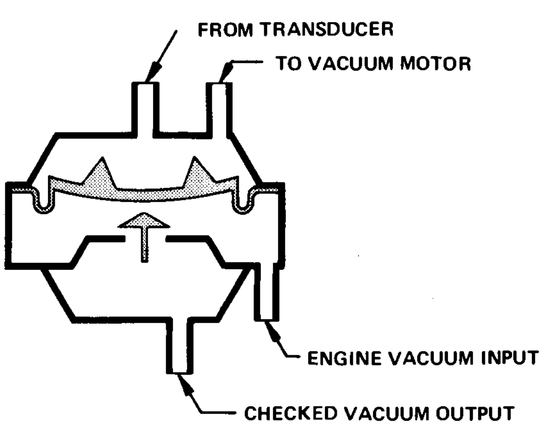


Fig. 1B-29 Checking Relay - Open

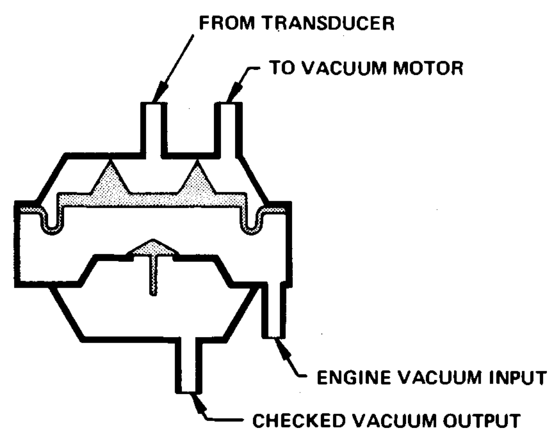


Fig. 1B-30 Checking Relay - Closed

the control head. The output shaft controls the position of the air-mix door (temperature door) controlling the temperature of the air which is distributed into the passenger compartment.

As the vacuum motor in the programmer moves, a gear meshed with the mechanism rotates the amplifier feedback potentiometer. This potentiometer indicates when the vacuum motor has reached the proper position and cancels out the change in resistance of the sensor string or the temperature dial. This signals the amplifier to stop the movement of the vacuum motor.

Whenever an appreciable amount of variation in resistance occurs in the sensor string or the temperature dial, the vacuum motor moves to supply either warmer or cooler conditioned air to counteract the resistance change.

AMPLIFIER THEORY OF OPERATION

The purpose of the three-stage amplifier used in the Automatic Temperature Control System is to amplify the DC signals that are created due to resistance changes in either the temperature dial, the in-car sensor or the ambient sensor. The feedback potentiometer (Fig. 1B-31), temperature dial, in-car sensor, ambient sensor and R12 form a voltage divider circuit that results in a voltage at the base of Q1. Also at Q1 in the emitter circuit, R13, R15 and D1 form a voltage divider resulting in a fixed voltage on the emitter of Q1. During stable operation of the ATC system, the voltage difference between the base and the emitter remains constant. This causes Q1 to conduct a constant amount of current (electron flow).

This current flow in Q1 actually flows from ground, through the E-B diode of Q3, through the E-B diode of Q2 and through Q1. This current flow forward biases Q2 and Q3, the Darlington amplifier, and causes it to conduct.

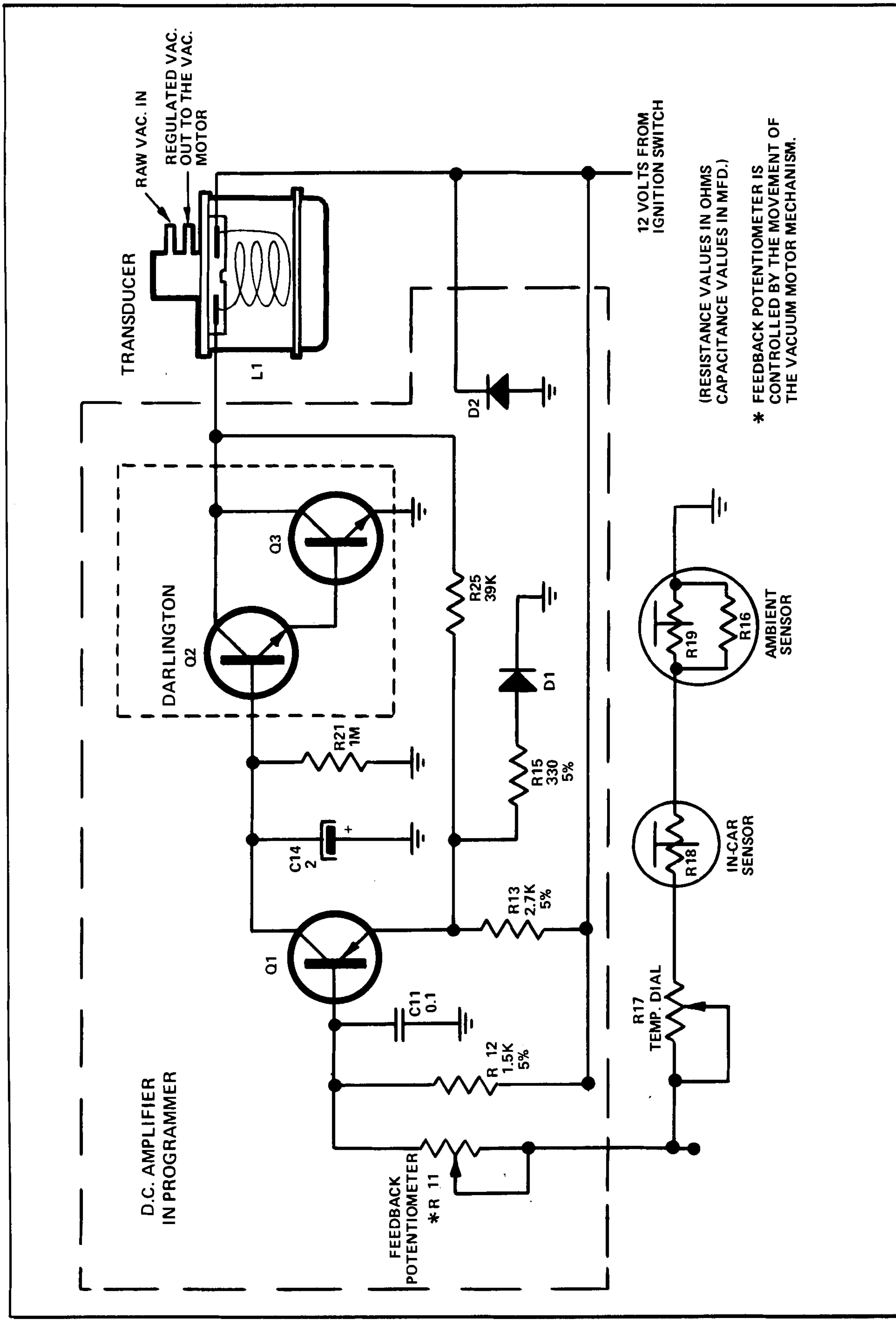


Fig. 1B-31 Amplifier Circuit Schematic

This results in current flow through the transducer. This constant current through the transducer produces a constant vacuum output from the transducer.

If the resistance of a sensor increases as the result of a temperature decrease or if the temperature setting on the temperature dial is increased, a larger voltage will be present at the base of Q1. This reduces the current flow through Q1, which in turn reduces the conduction of the Darlington amplifier through the transducer. Low transducer current produces high vacuum at the transducer vacuum output. The vacuum motor moves in the direction of "more heat". The feedback potentiometer is mechanically connected to the vacuum motor mechanism. As the vacuum motor moves to the "increased heat" position, the feedback "pot" reduces in resistance. This movement yields a cancelling effect to the increased resistance which caused the movement. When the feedback "pot" completely offsets the increase, the voltage at the base of Q1 is the same as earlier described in the stable operation and the movement stops.

If the temperature at a sensor increases or the temperature dial is moved to a lower temperature setting, the voltage at the base of Q1 will decrease. More current will now conduct through Q1, Q2 and Q3. The increased current flow through Q1 causes Q2 and Q3 to conduct more current through the transducer. The vacuum at the transducer output will now decrease, causing the vacuum motor to move in the direction of more cooling. As the vacuum motor moves, the feedback "pot" increases in resistance, offsetting the original resistance decrease. The amplifier has now stabilized again and the movement stops.

The .1 Mfd. capacitor at the base of Q1 filters out any high-frequency AC signals from entering the DC amplifier. AC signals result in erratic operation of the ATC system. The 2 Mfd. capacitor controls the reaction time of the amplifier and helps to stabilize its operation. This eliminates any oscillations in the system operation. R25 is a feedback resistor that reduces the gain of the DC amplifier and results in more stable operation of the system.

Diode D1 is physically located under the Darlington amplifier. When the Darlington heats up, it tries to conduct more current. D1 also heats up and reduces in resistance. This lowers the emitter voltage of Q1 and reduces its conduction. This results in lower conduction of the Darlington amplifier, thereby bringing it back to its original conduction level.

Diode D2 is a spike suppression diode. This prevents any voltage spikes from the input supply line from entering the amplifier.

ELECTRICAL SYSTEM OPERATION

OFF Position

When the control head selector lever is in the OFF position (Fig. 1B-32), the system is locked in "LO blower" operation when the ignition switch is in the RUN position and the engine thermal switch or the in-car temperature switch are closed. The engine thermal switch closes whenever the engine water temperature is above 120°F. The in-car temperature switch closes whenever the in-car temperature is above 75° F.

With ignition switch in the RUN position, power is supplied to the programmer allowing it to operate. The in-car sensor, the ambient sensor and the temperature dial setting on the control head cause the programmer to move the air-mix door. The proper air mixture is then distributed from the heater outlets maintaining the in-car temperature at the comfort level selected on the temperature dial (the compressor is not running in the OFF position and comfort level is limited to outside air when dial is set at the minimum setting).

VENT Position

With the selector lever in the VENT position (Fig. 1B-33), the LO Relay will be closed and the system will come on immediately with the fan locked on "Lo blower" speed. The vacuum motor in the programmer is in the A/C position since the in-car sensor and the ambient sensor are shorted out by the control head switch. The ambient switch is closed when the ambient temperature is above 32° F. However, the compressor will not run since no voltage is applied to it through the control head switch. The Auto Relay and Hi Relay are always open in the VENT position.

LO Position

With the selector lever in the LO position (Fig. 1B-34), the system will come on when the in-car temperature is above 75° F., which closed the in-car temperature switch or when the engine water temperature reaches 120° F. The Lo Relay is then closed, allowing the blower to be locked on "Lo blower" speed. The Auto Relay and Hi Relay remain open. When the ambient temperature is above 32° F., the ambient switch is closed, supplying voltage to energize the compressor clutch via the control head switch.

AUTO Position

With the selector lever in the AUTO position (Fig. 1B-35), the system will come on when the in-car temperature is above 75° F., which closes the in-car temperature switch or when the engine water temperature reaches 120° F. The Lo Relay and the Auto Relay are both closed and the position of the blower wiper contacts in the programmer determines the speed at which the blower operates. When the ambient temperature is above 32° F., the compressor clutch is energized via the ambient switch and the control head switch. The Hi Relay always remains open. If the system is calling for maximum cooling, the system will operate in the recirculation mode; however, there is no change in the electrical function when this mode is achieved.

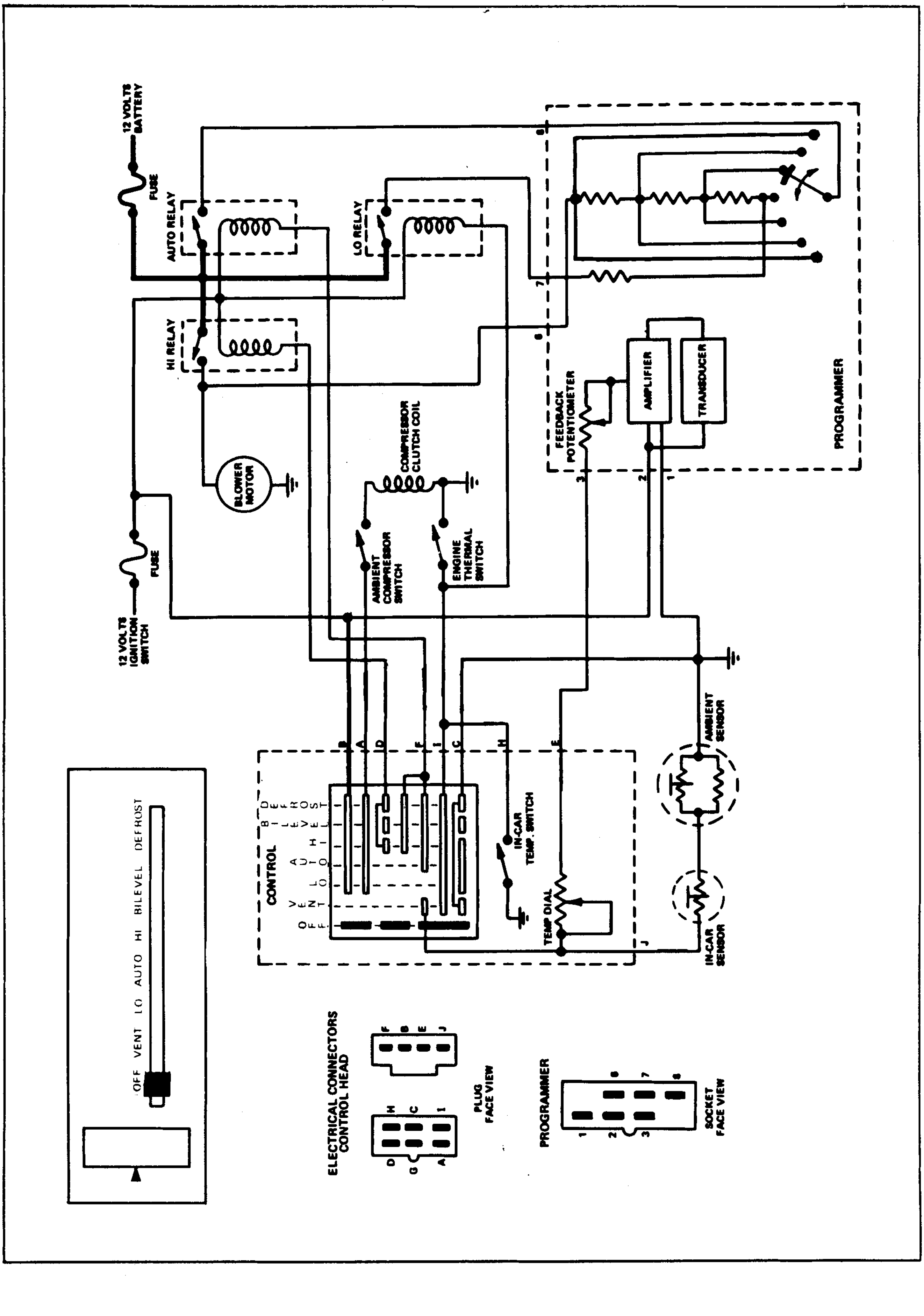


Fig. 1B-32 Electrical Operation - OFF Position

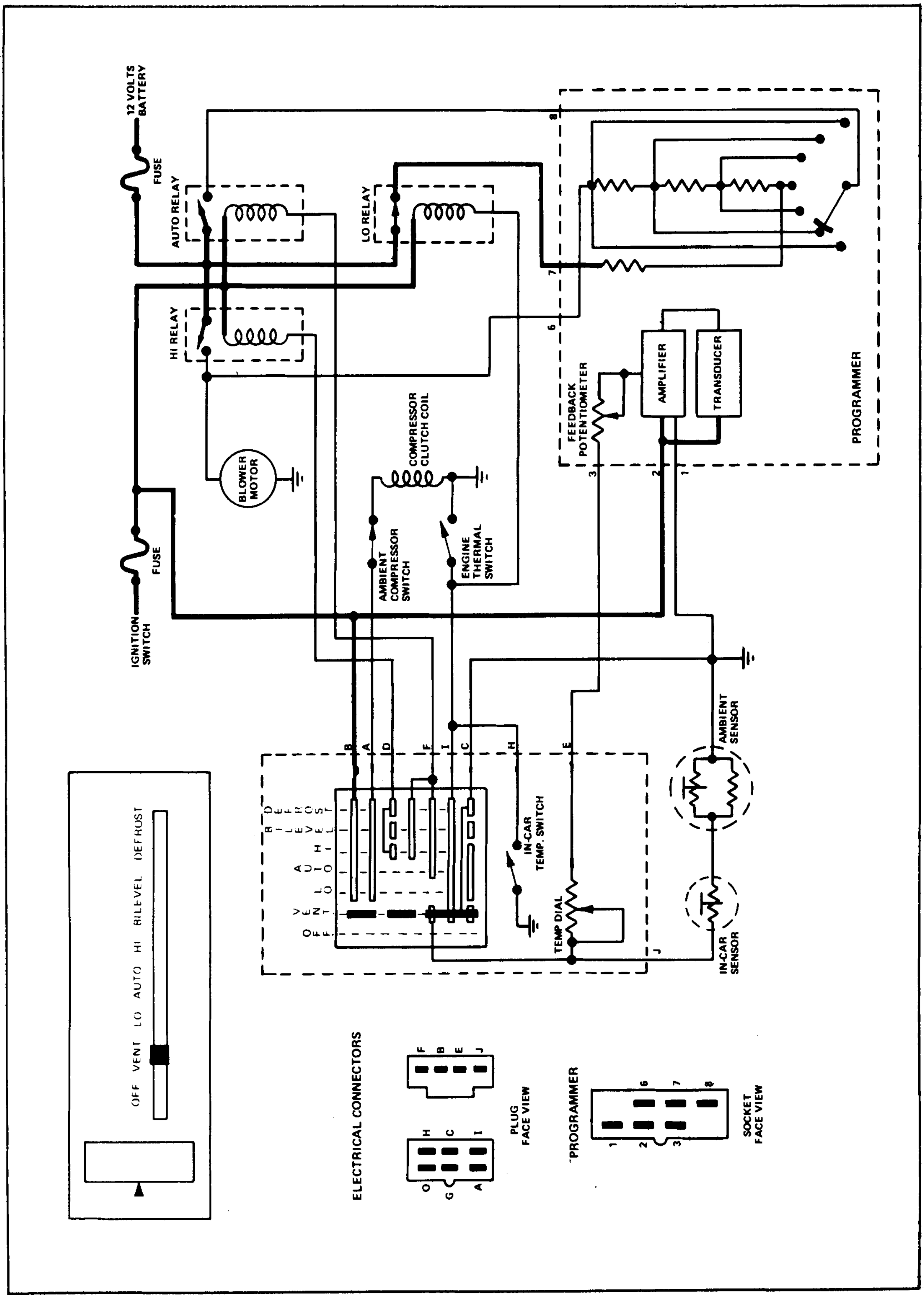


Fig. 1B-33 Electrical Operation - VENT Position

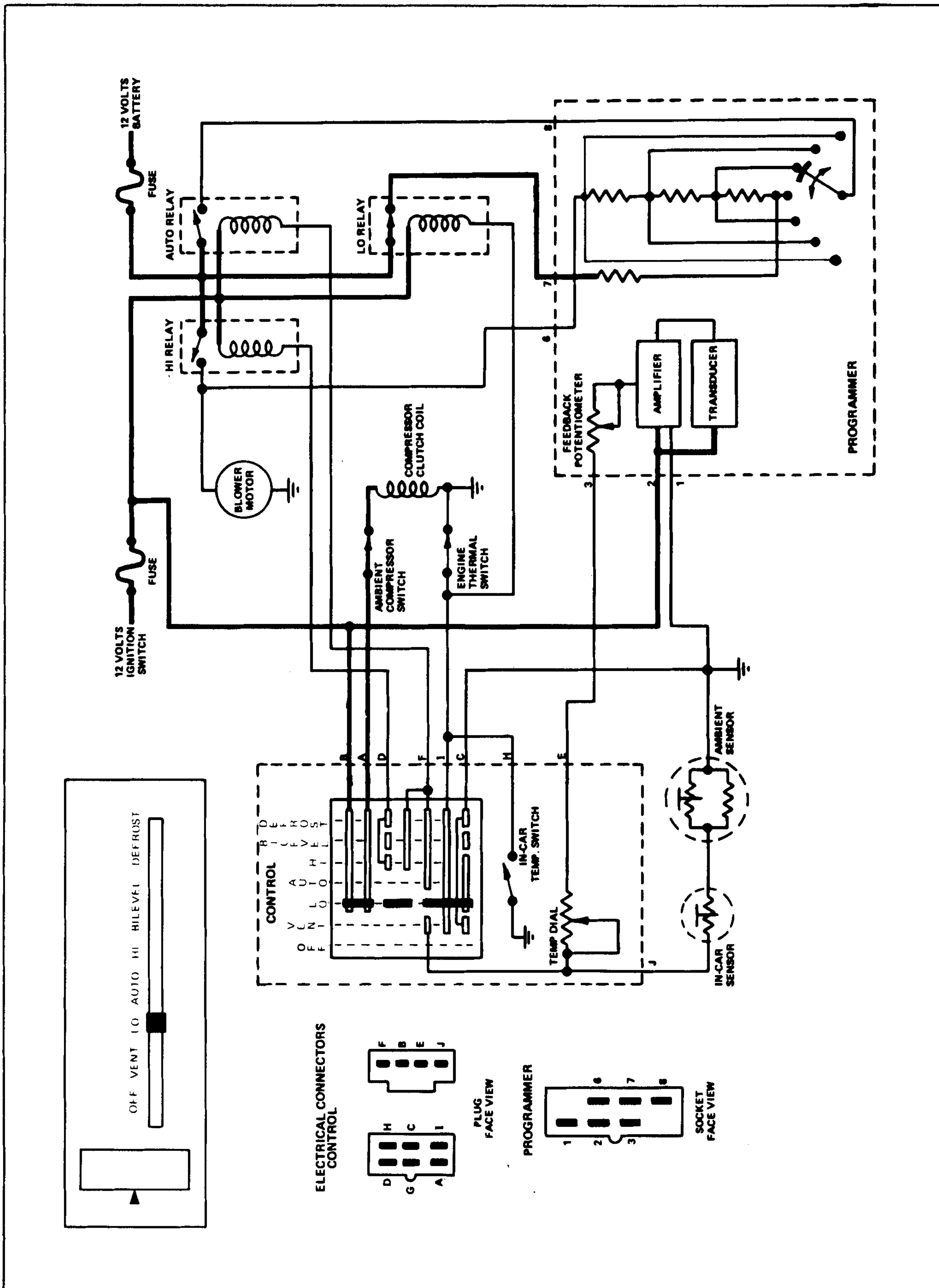


Fig. 1B-34 Electrical Operation - LO Position

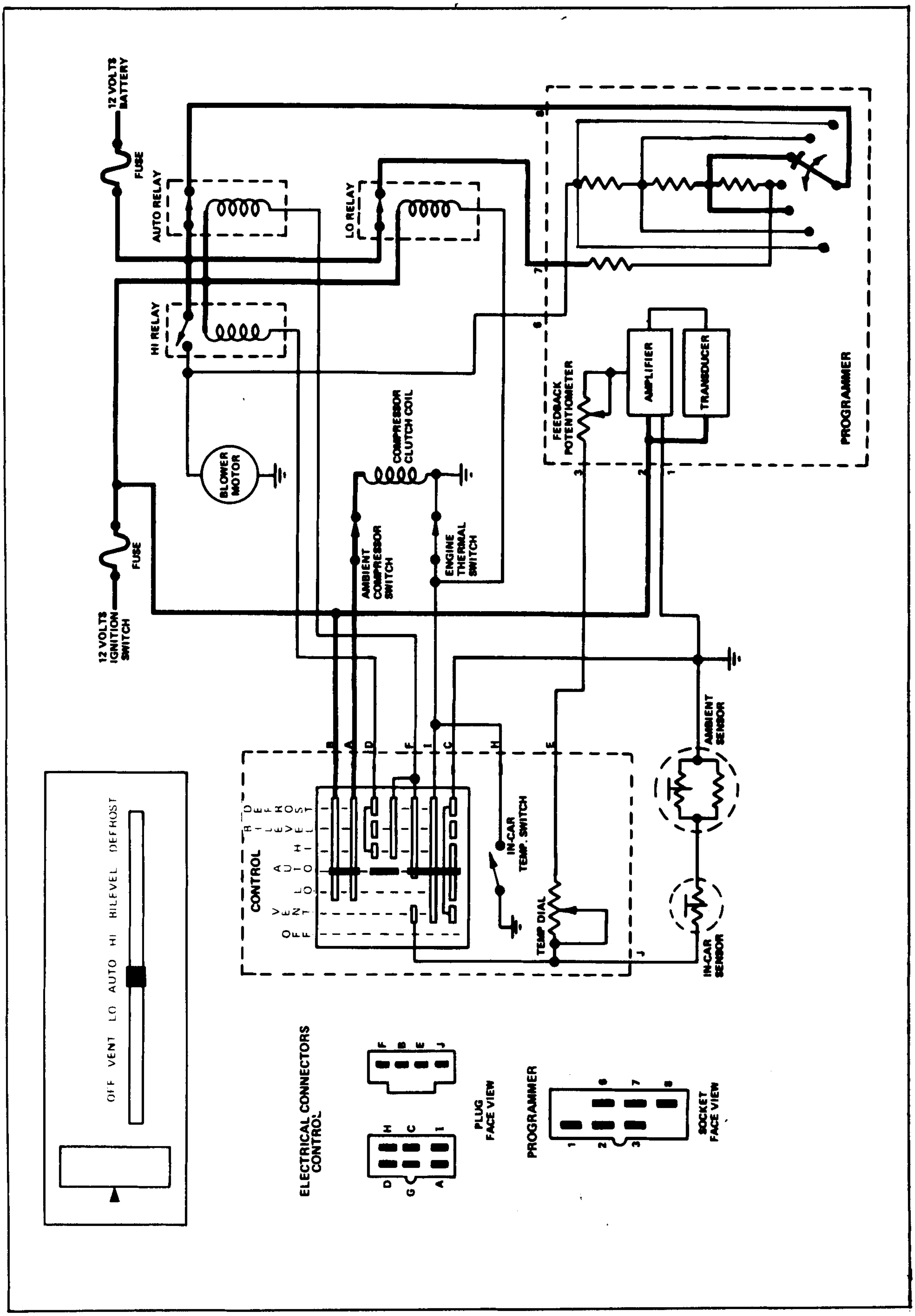


Fig 1B-35 Electrical Operation - Auto Position

HI Position

When the selector lever is in the HI position (Fig. 1B-36), the system turn-on is the same as described for the AUTO position. Both the Lo and Auto relays are closed when the system is operating but a direct current path via the control head switch is connected from the battery circuit through the Hi Relay to the blower motor. This locks the blower on "Hi blower" operation. When the ambient temperature is above 32° F., the ambient switch is closed and the compressor clutch is energized. If the system is calling for maximum cooling, the system will operate in the recirculation mode; however, there is no change in the electrical function when this mode is achieved.

BILEVEL Position

With the selector lever in the BILEVEL position (Fig. 1B-37), the system turn-on is the same as described for the AUTO position. The Lo and Auto relays are both closed and the position of the blower wiper contacts in the programmer determines the speed at which the blower operates. When the ambient temperature is above 32° F., the ambient switch is closed and the compressor clutch is energized. The Hi Relay always remains open.

DEFROST Position

With the selector lever in the DEFROST position (Fig. 1B-38), the system comes on immediately and the blower is locked on "Hi" speed. The Lo Relay, the Auto Relay and the Hi Relay always remain energized. Battery voltage is applied directly to the blower motor as in HI position. Electrical functions in DEFROST and HI differ only in that the DEFROST position has immediate turn on of system.

VACUUM SYSTEM OPERATION

OFF Position

With the selector lever in the OFF position and the engine running, the system is turned on whenever the engine thermal switch or the in-car temperature switch is closed. The vacuum motor in the programmer moves to a position that will moderate the in-car temperature. Air flows from the heater outlets at "Lo blower" speed. Unless system calls for warm air, vacuum is applied to the hot water control valve and valve is closed to prevent passage of water to the heater core.

VENT Position

Air is drawn in through the outside air door and is distributed from the A/C and defroster outlets at "Lo blower" speed. The programmer is in the maximum A/C position.

LO Position

When maximum cooling is required, cold air is distributed from the A/C outlets. The blower is locked on "Lo blower" speed. Recirculation of air is not possible in the LO selector lever position. A small amount of this cold, dry air is also blown onto the windshield.

When the vacuum motor moves from maximum A/C, the porting in the programmer vacuum valve changes.

As the air temperature from the outlets reaches a moderate temperature, the system goes into "Bi-level" operation and air flows from the A/C and the heater outlets. Some moderate temperature, dry air is also released from the defroster outlets onto the windshield.

When heating is required, hot air is distributed from the heater outlets. A small amount of hot, dry air is also released from the defroster outlets.

AUTO Position

When maximum cooling is required, the outside air door is closed and the passenger compartment air is recirculated through the cooling system. Air flows from the A/C outlets at "Hi blower" speed. A small amount of cold, dry air is also released from the defroster outlets.

As the in-car temperature begins to lower, the programmer moves out of the maximum A/C position and outside air is drawn into the car.

When the outlet air temperature reaches a moderate temperature, the system goes into "Bi-level" operation. Conditioned air flows from both the heater and A/C outlets. Also, a small amount of moderate, dry air is distributed from the defroster outlets.

When maximum heating is required from the system, air is distributed from the heater outlets at "Hi blower" speed. Some hot, dry air is also blown onto the windshield.

HI Position

The passenger compartment air is recirculated through the A/C system when maximum cooling is required. Cold air is distributed from the A/C outlets at "Hi blower" speed and a small amount of cold, dry air is also blown onto the windshield.

As the programmer moves from the maximum A/C position, air is drawn in from outside the car to be conditioned. This air is distributed from the A/C and defroster outlets at "Hi blower" speed.

As the outlet air reaches moderate temperature, the system begins to operate in the "bi-level" mode. Some cool, dry air is also released from the defroster outlets.

When the system goes into heater operation, the warm air is released from the heater outlets at "Hi blower" speed.

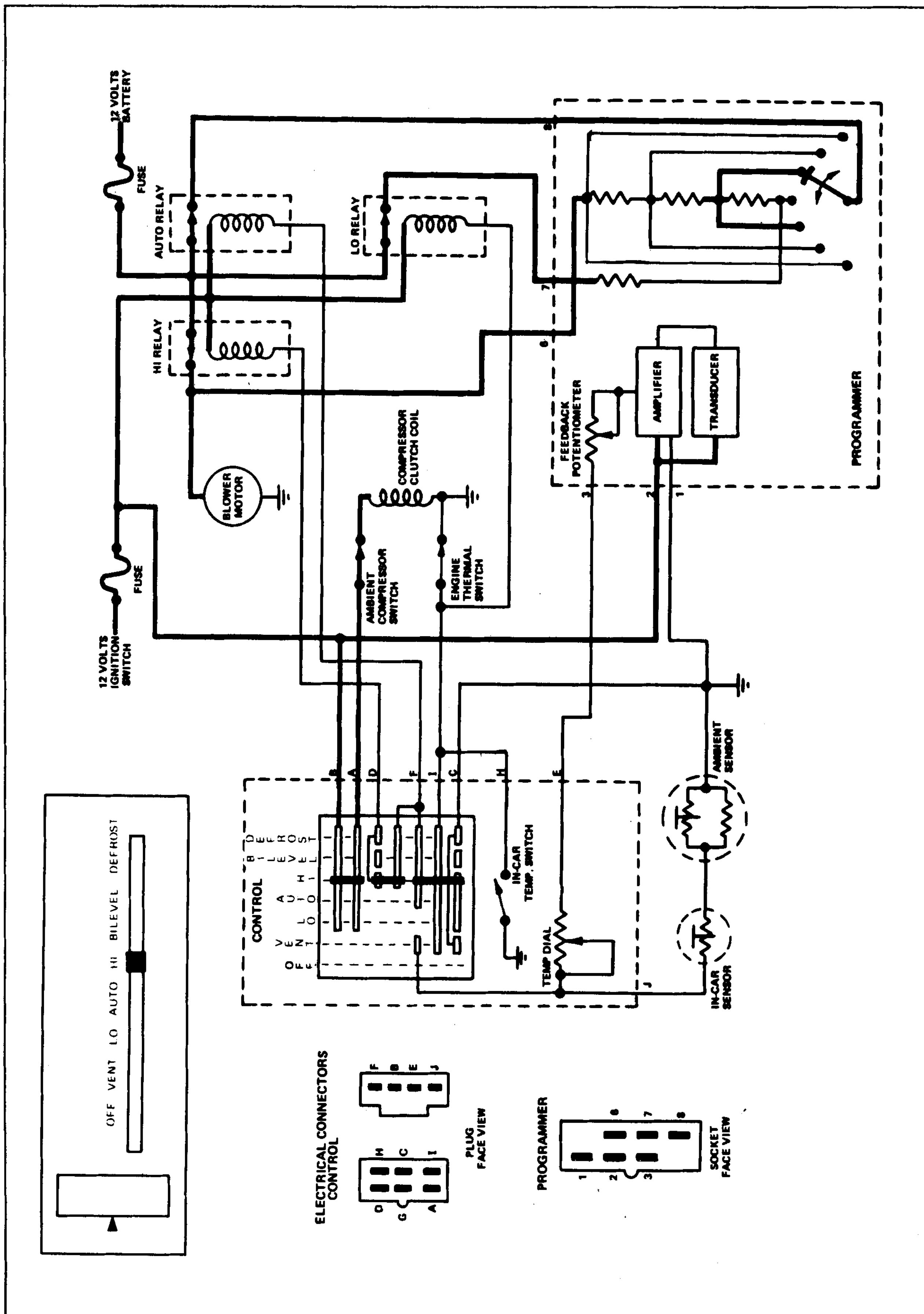


Fig. 1B-36 Electrical Operation - HI Position

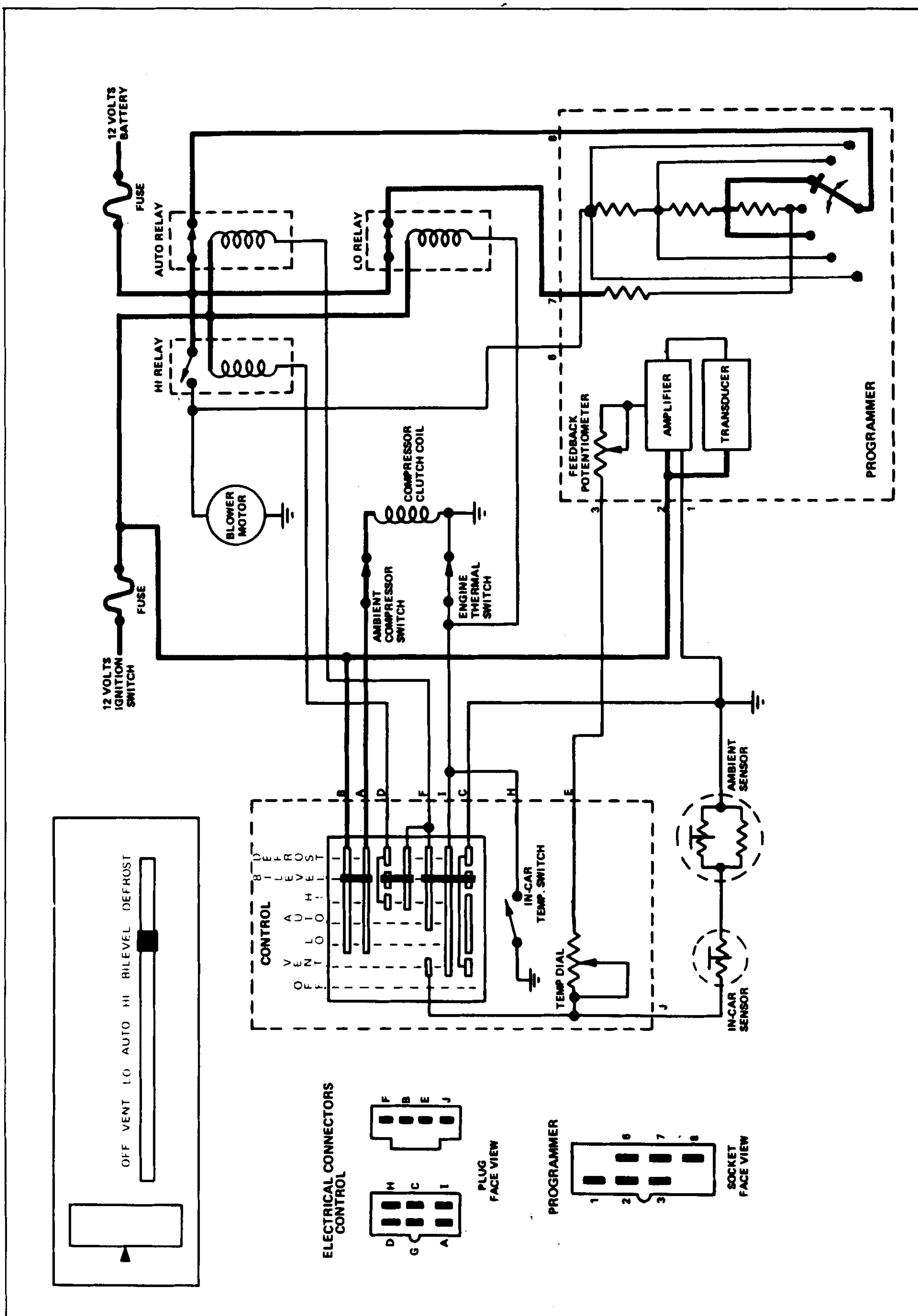


Fig. 1B-37 Electrical Operation - BILEVEL Position

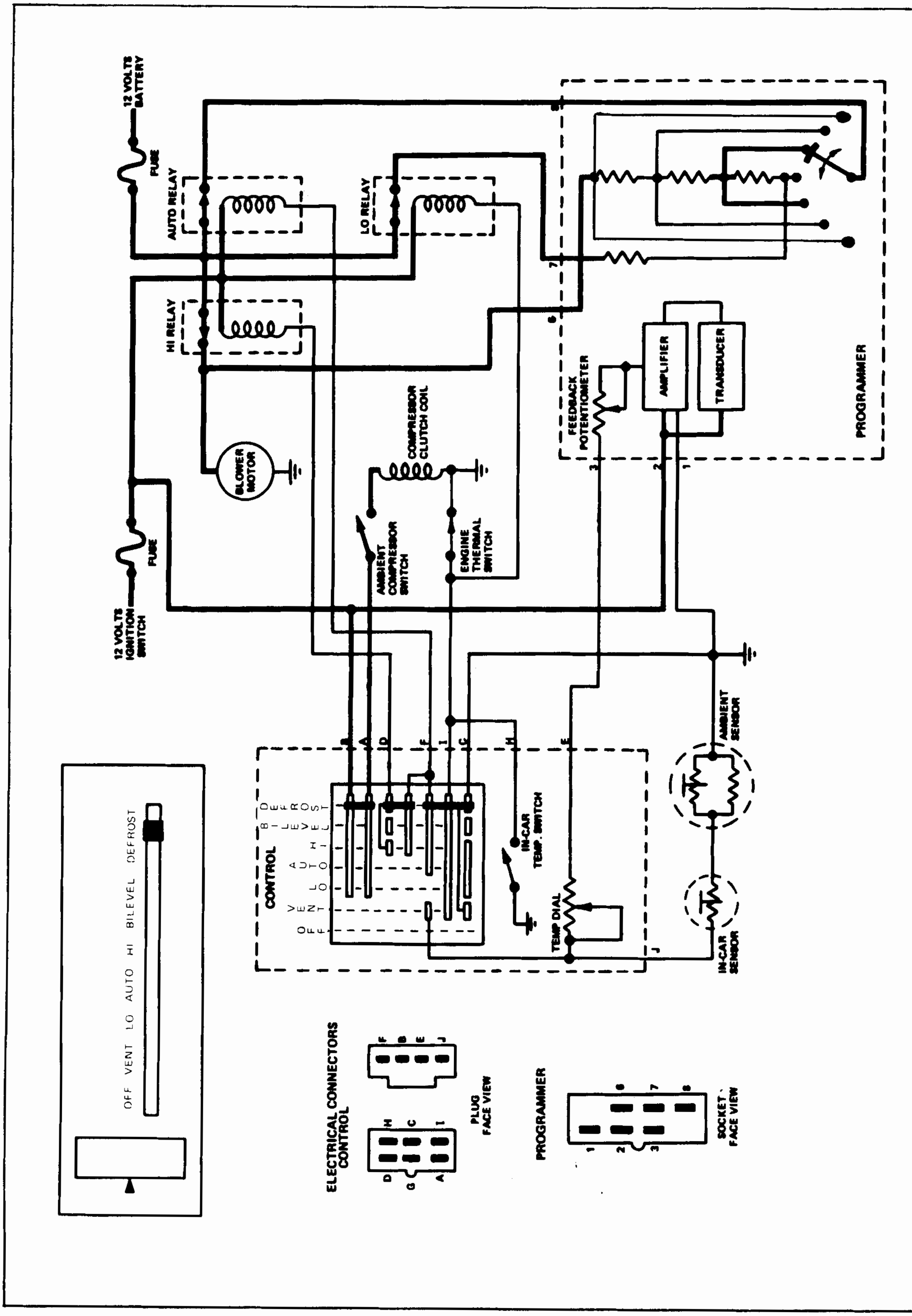


Fig. 1B-38 Electrical Operation - DEFROST Position

Some warm, dry air is also released from the defroster outlets.

BILEVEL Position

If maximum cooling is required, the outside air door is closed for recirculation operation and the blower is operating at "Hi blower" speed. Cold, dry air is distributed from the heater and A/C outlets with a slight bleed of air from the defroster outlets, resulting in "tri-level" operation.

When maximum cooling is no longer required, the outside air door opens and the blower speed decreases. Complete blower programming is used in the BILEVEL position. When heating is required from the system, the blower speed increases and reaches "Hi blower"speed at maximum heating.

DEFROST Position

With the selector lever in the DEFROST position, the outside air door is closed when maximum cooling is required. All of the air is directed onto the windshield from the defroster outlets at "Hi blower" speed. When maximum cooling is no longer required, the outside air door opens but the fan remains on "Hi blower" speed.

FUNCTIONAL TEST

This functional test is to be made on complete car with engine running, coolant warm, hood closed and in approximately 75°F. ambient temperature.

Each position of the control panel selector lever has a detent to retain lever in that position. Be sure lever engages in detent.

Variations in ambient and in-car temperatures will effect system response and cause one or two mode shifts with a given setting of the control panel.

Terms used in the functional test are defined as follows:

HEATER MODE: Air flow is from heater outlet with slight air flow from defroster nozzles.

A/C MODE: Air flow is from A/C outlets only.

BILEVEL MODE: Air flow is from heater and A/C outlets with a slight bleed from the defroster nozzles at the same time.

DEFROST MODE: Air flow is from defroster nozzles with slight air flow from heater outlet and no air flow from A/C outlets.

LO BLOWER: Lowest available blower speed. This speed is the only speed available in OFF, VENT and LO positions.

HI BLOWER: Highest blower speed available. This speed is the only speed available in HI and DEFROST.

BLOWER CONTROL: Blower speed is variable and controlled by the programmer. When blower control is provided (AUTO and BILEVEL), low speed is higher than that in LO BLOWER and high speed is less than HI BLOWER.

MODE CONTROL: System can vary modes to compensate for changes in temperature, either ambient (outside air) or in-car.

MAX. HEAT: Maximum heating called for. This is achieved by setting temperature dial at highest setting.

MAX. A/C: Maximum cooling called for. This is achieved by setting temperature dial at lowest setting.

TEMPERATURE CONTROL: Temperature of outlet air flow can be varied by temperature dial setting.

TEST PROCEDURE

Test is to be performed in order indicated and time must be allowed between steps for programmer to function and system to stabilize, particularly when checking for air temperature changes.

1. Set control panel selector lever to OFF and temperature dial to MAX. HEAT.

   A. Blower runs at low speed and warm air flows from heater outlet only.

   B. Step assures: purge (Lo) blower, sealed defroster, open water control valve and compressor not energized.

2. Move selector lever to VENT.

   A. Blower speed remains low. Cool air flows from A/C outlets.

   B. Step assures: Lo blower, A/C mode, minimum temperature, no compressor operation and closed water valve.

3. Move selector lever to LO.

   A. Blower speed remains low. Air flow is from heater outlet or heater and A/C outlets (depending upon ambient temperature) and air temperature increases from that in step 2.

   B. Step assures: Lo blower, mode control, temperature control and operational compressor.

4. Move temperature dial to MAX. COLD.

A. Blower speed remains low. Air temperature is lower than that in step 3 and air flow is from A/C outlets or A/C and heater outlets.

B. Step assures: Lo blower, mode control, temperature control and operable compressor.

5. Move selector lever to AUTO.

A. Blower speed increases. Air flow and air temperature remain same as in step 4.

B. Step assures: blower control, temperature control, mode control and operable compressor.

6. Move temperature dial to MAX. HEAT.

A. Blower speed decreases then increases when temperature dial is being moved. Air flow is from heater outlet or A/C and heater outlets at increased temperature from step 5.

B. Step assures: blower control, mode control, temperature control and operational compressor.

7. Move selector lever to HI.

A. Blower operates at high speed. Air flow and temperature remain same as step 6.

B. Step assures: Hi blower, mode control, temperature control and operational compressor.

8. Move selector lever to BILEVEL.

A. Blower operates at high speed (lower speed than step 7). Air flow is from heater and A/C outlets (bi-level) and temperature remains warm.

B. Step assures: Bi-level mode, blower speed control, temperature control and operable compressor.

9. Move temperature dial to MAX. COLD.

A. Blower speed decreases then increases as temperature dial is varied. Air temperature decreases and air flow remains bi-level.

B. Step assures: Bi-level mode, blower speed control, temperature control and operable compressor.

10. Move selector lever to DEFROST.

A. Blower speed is high (same as step 7). Air flow remains cool but is distributed from defroster nozzles.

B. Step assures: high blower, DEFROST mode, temperature control and operable compressor.

11. Move temperature dial to MAX. HEAT.

A. Blower speed and air flow remain same as step 10 but air temperature increases.

B. Step assures: high blower, DEFROST mode, temperature control and operable compressor.

G SERIES DESCRIPTION

Due to the difference in control panel and programmer design and operation, the B Series and G Series ATC systems are described separately.

The following information describes the G Series ATC System and components. For description of the B Series system and components see B SERIES DESCRIPTION.

PROGRAMMER

The G Series programmer (Fig. 1B-39) is located on the heater core and case assembly. The DC amplifier in the programmer amplifies the varying signal from the sensor string. The amplified signal opens and closes relays which control an electric motor in the programmer. Movement of the motor controls vacuum, blower motor speed and position of the temperature door. The unit is not adjustable, although the link from the programmer to the temperature door is.

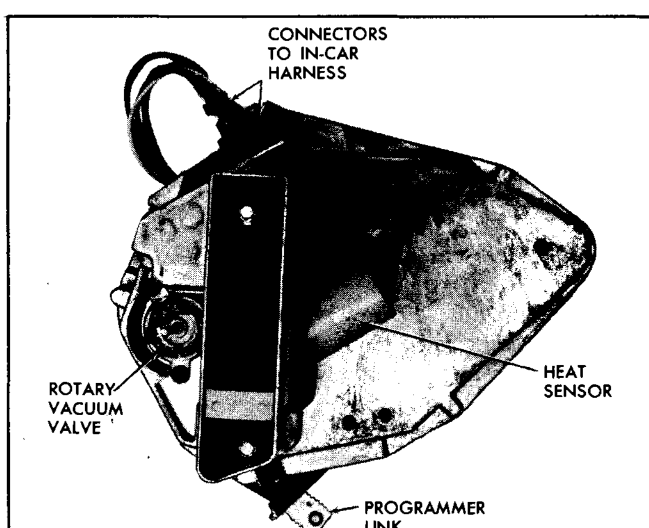


Fig. 1B-39 Programmer Assembly - G Series

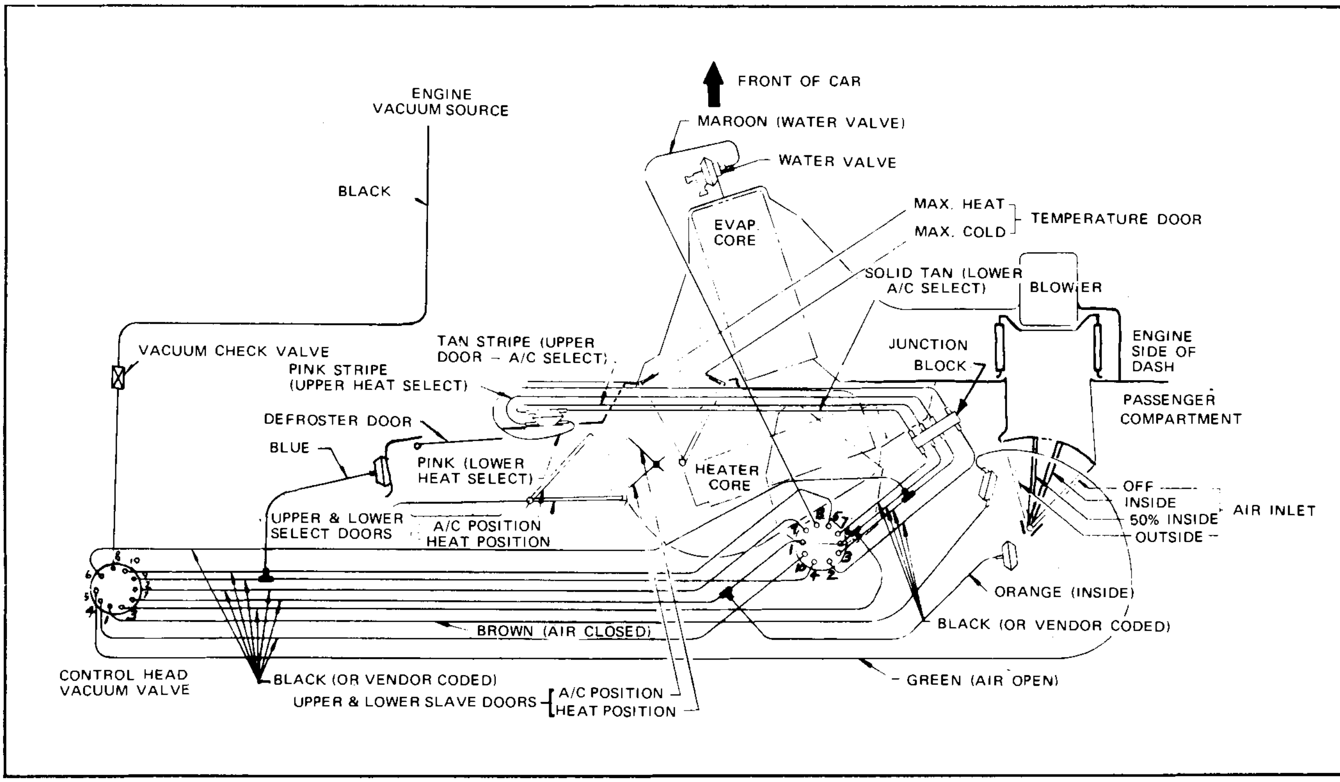


Fig. 1B-40 ATC Vacuum Schematic - G Series

VACUUM COMPONENTS

Vacuum control of various air valves in the system is achieved by using two rotary vacuum valves (Fig. 1B-40), one located in the control panel and the other in the programmer. Vacuum is supplied to the rotary valves from the carburetor through a check valve. The two rotary valves are linked by a vacuum hose harness which consists of vacuum hoses connecting numbered spigots on the valves.

CONTROL PANEL

The control panel (Fig. 1B-41) uses three levers to dictate system operation. The air control lever (system selector lever) selects the mode of operation desired by the operator. In all but extreme conditions, the "Normal" mode will be exclusively selected for maximum comfort. Control panel settings for various conditions are listed in the owners manual.

TEMPERATURE CONTROL

The temperature lever on the control panel regulates temperature of the air distributed to the passenger compartment to maintain the desired comfort level in the car. Once set, control requires no change from day to day or season to season except to satisfy changes in requirements for personal comfort.

BLOWER CONTROL

The blower speed lever on the control panel permits selection of two ranges of air flow - High or Low. Air flow varies automatically in either range due to demand placed

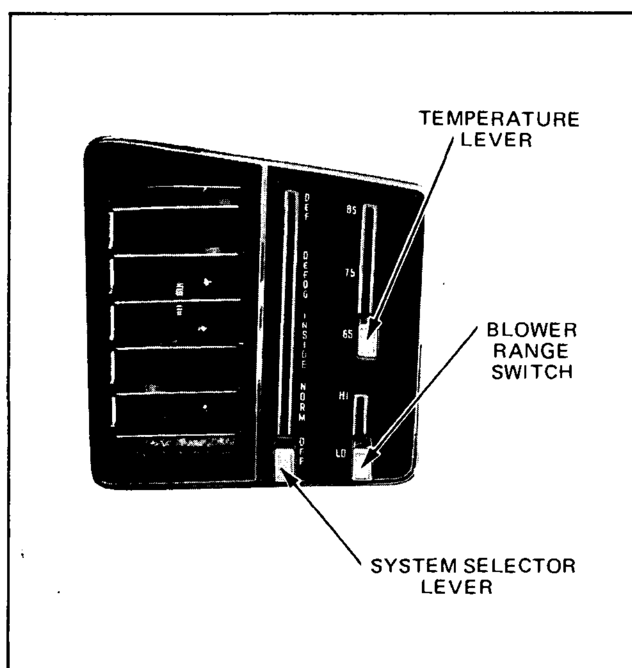


Fig. 1B-41 ATC Control Panel - G Series

upon the system by varying weather conditions. High range will give most uniform comfort throughout the car, especially with rear seat passengers.

ELECTRICAL COMPONENTS

In addition to vacuum functions, the programmer also performs electrical functions. A small current passing through the sensors and control panel variable resistor creates an electrical signal which controls the programmer. The voltage signal which the programmer receives is dependent on the resistance offered by sensors. (Sensor resistance is high at low temperatures and low at high temperatures). The programmer takes this voltage signal, amplifies it and then passes it through a small motor, which drives a wheel. The surface of the wheel has several switches on it which direct current to various portions of the system. In addition, the wheel is linked to the temperature door, the position of which determines the outlet temperature of the system.

The programmer controls blower speed by directing current through one or more of several resistors in a resistor block located on the evaporator case. As the number of resistors through which the current must pass increases, voltage supplied to blower motor decreases, thereby decreasing its speed.

The limit switch and location switch, also on the surface of programmer wheel, have the following functions. The limit switch stops the movement of the motor and wheel when it reaches its extreme point of travel in either direction. The location switch allows current to drive programmer wheel (and temperature door) to a midway position after system is turned off. This eliminates extreme hot or extreme cold blasts of air when the system is first started.

The bi-level boost switch has the special function of speeding up the blower motor when the diverter doors move into bi-level mode. The switch is mechanically operated by the movement of the diverter doors. When the switch is closed, a path through the resistor block which provides a relatively high blower speed is provided. This is done because all the distribution ducts are used in the bi-level mode which requires a greater quantity of air movement.

The remainder of the electrical components such as the hi blower relay, compressor clutch coil, line and fuse block fuses and ambient switch all function the same and are located in the same positions as corresponding components of the Custom Air Conditioning (A/C) system.

AIR FLOW COMPONENTS

Air flow in the ATC system is the same as in the Custom A/C system. Vacuum functions are initiated in a slightly different manner, however. The programmer directs vacuum to various diaphragms in the system via a vacuum switch. The switch is rotated by a wheel which is in turn driven by the programmer motor. Vacuum from this switch controls the water control valve, diverter doors, defroster door and the air inlet door. It is important to note that some of this vacuum control is also initiated by the control head vacuum valve.

FUNCTIONAL TEST

This test must be performed on complete car with engine operating, coolant warm, hood closed and approximately 75°F. ambient temperature.

1. Move selector lever to OFF, set blower switch to HI range and move temperature lever to full WARM (all the way up).

   A. No air flow from any outlets.

2. Move selector lever to NORMAL. (Each lever position has a detent to lock the lever in place.)

   A. Blower comes on low speed and progresses to high speed.

   B. Hot air comes chiefly from heater outlet with some air from defroster nozzles. None from A/C outlets.

3. Move temperature lever to full cold (all the way down).

   A. Air will come out A/C and heater outlets at the same time and then from A/C outlets only. Finally, blower noise level will increase with cold air coming from A/C outlets only.

   B. Blower speed goes from "Hi-Lo-Hi" with an increase in blower speed in bi-level (warm air out heater and cool air out A/C outlets).

4. Move temperature lever slowly up until air comes out A/C and heater outlets at the same time, then move selector lever to INSIDE.

   A. Blower air noise level will increase.

5. Move temperature lever back to full cold and put selector lever in the DEFOG position.

   A. Cold air comes chiefly from defroster nozzles, with some air from heater outlet.

6. Move selector lever to DEFROST.

   A. Air continues to come chiefly from defroster nozzle with some air from heater outlet; but temperature changes from cold to hot.

   B. Blower goes to high speed.

7. Move blower switch to LO range.

   A. Blower speed and air flow decrease.

OPERATIONAL INSTRUCTIONS

After initial settings are made, it is not necessary to turn the system off. The Automatic Temperature Control System will automatically operate whenever the car is started; starting almost immediately in warm weather, but delaying operation in cold weather until heat is available from the engine cooling system. Moving the system selector lever to the DEFROST (DEF) mode overrides the automatic control and directs maximum available heat toward the windshield.

SERVICE PROCEDURES

The refrigeration portion of the ATC system is the same as the Custom Air Conditioning system and can be serviced by referring to Section 1A.

IN-CAR SENSOR

REMOVE AND REPLACE

1. Remove glove box (cold air duct on G Series with console).
2. Disconnect wire connector from sensor.
3. Disconnect aspirator hose from sensor.
4. Remove retaining screws.
5. Remove sensor.
6. To replace, reverse removal procedure.

For installation, see Figs. 1B-42 (B Series) and 1B-43 (G Series).

AMBIENT SENSOR

REMOVE AND REPLACE

1. Remove ambient sensor and switch connector (2 connectors on G Series) or ambient sensor connector (B

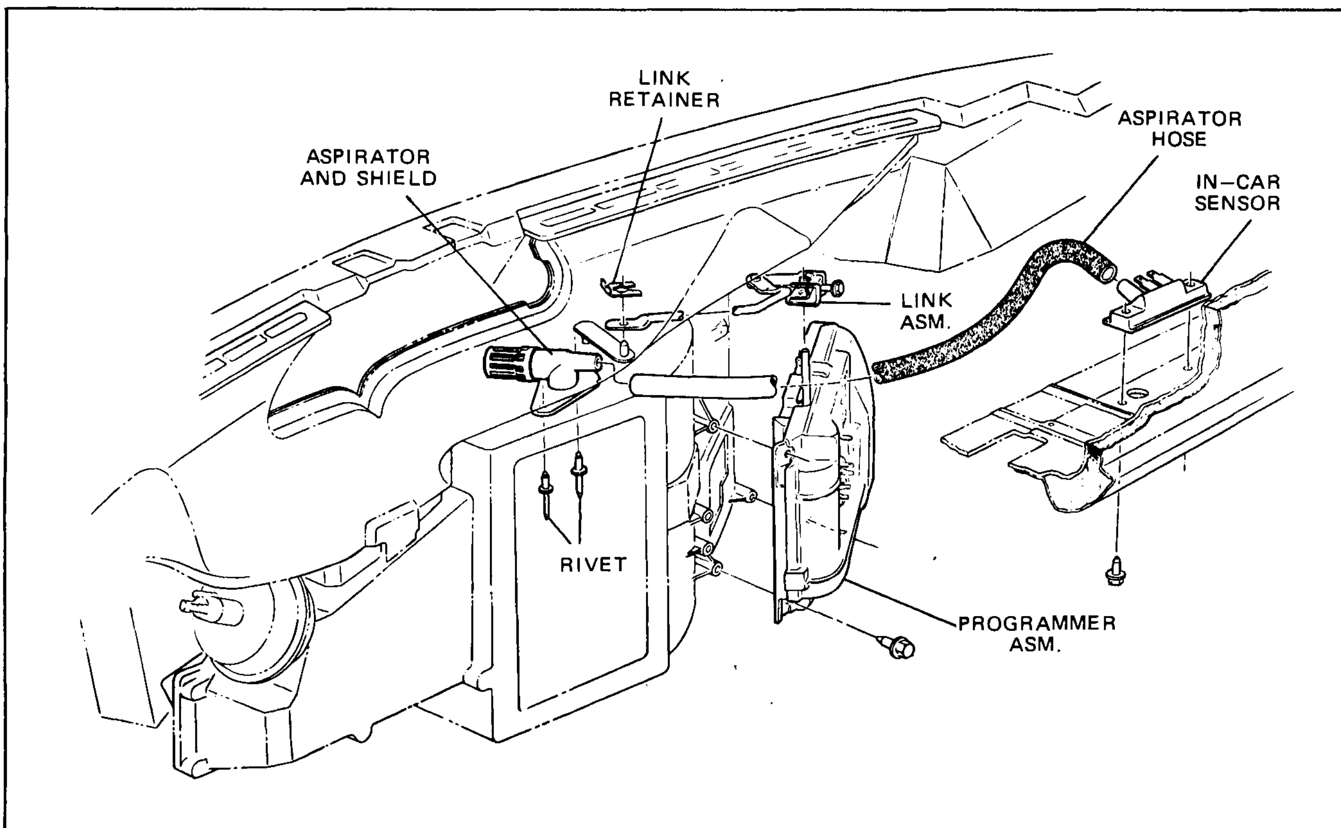


Fig. 1B-42 B Series Programmer Installation

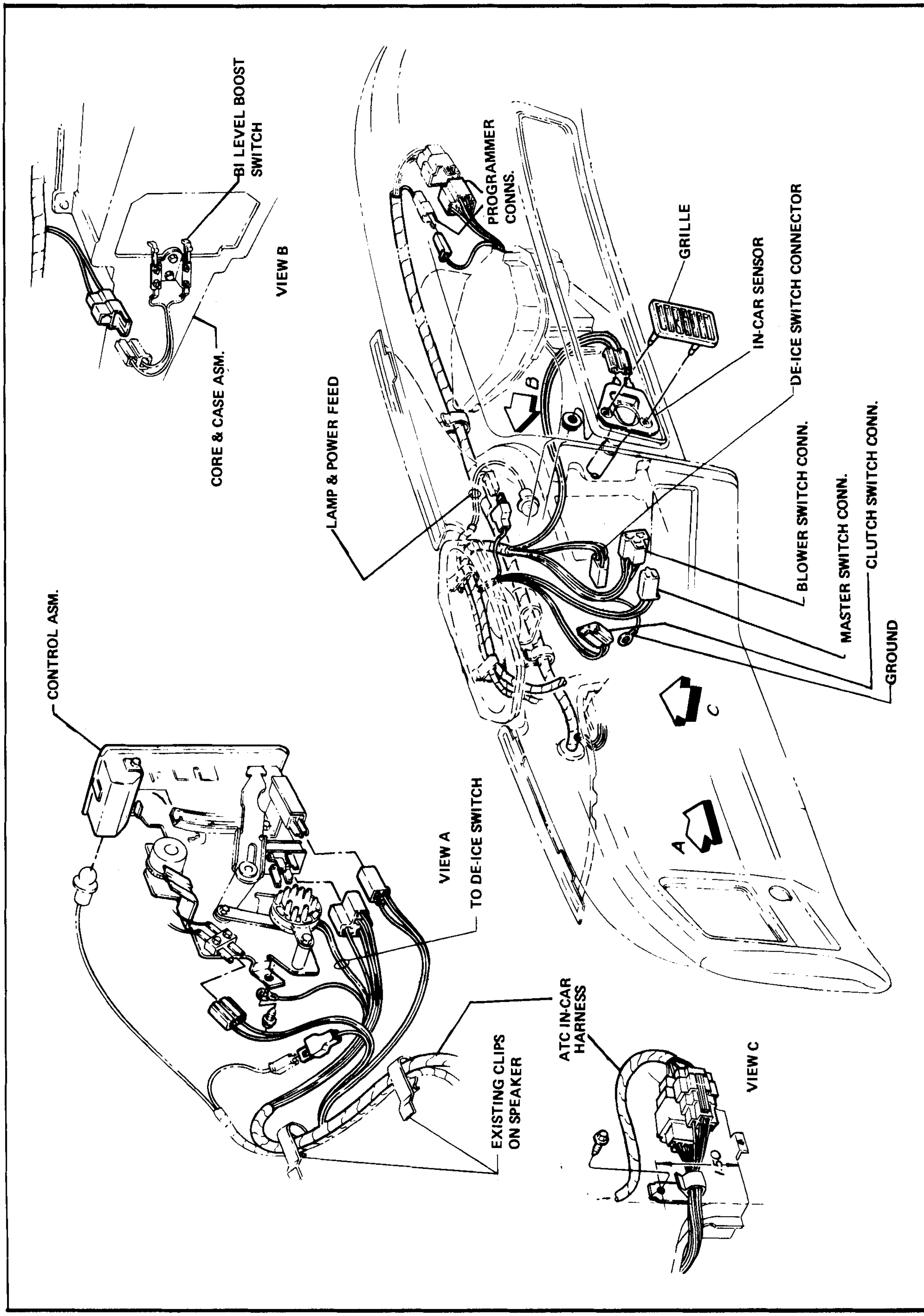


Fig. 1B-43 G Series ATC In-Car Wiring

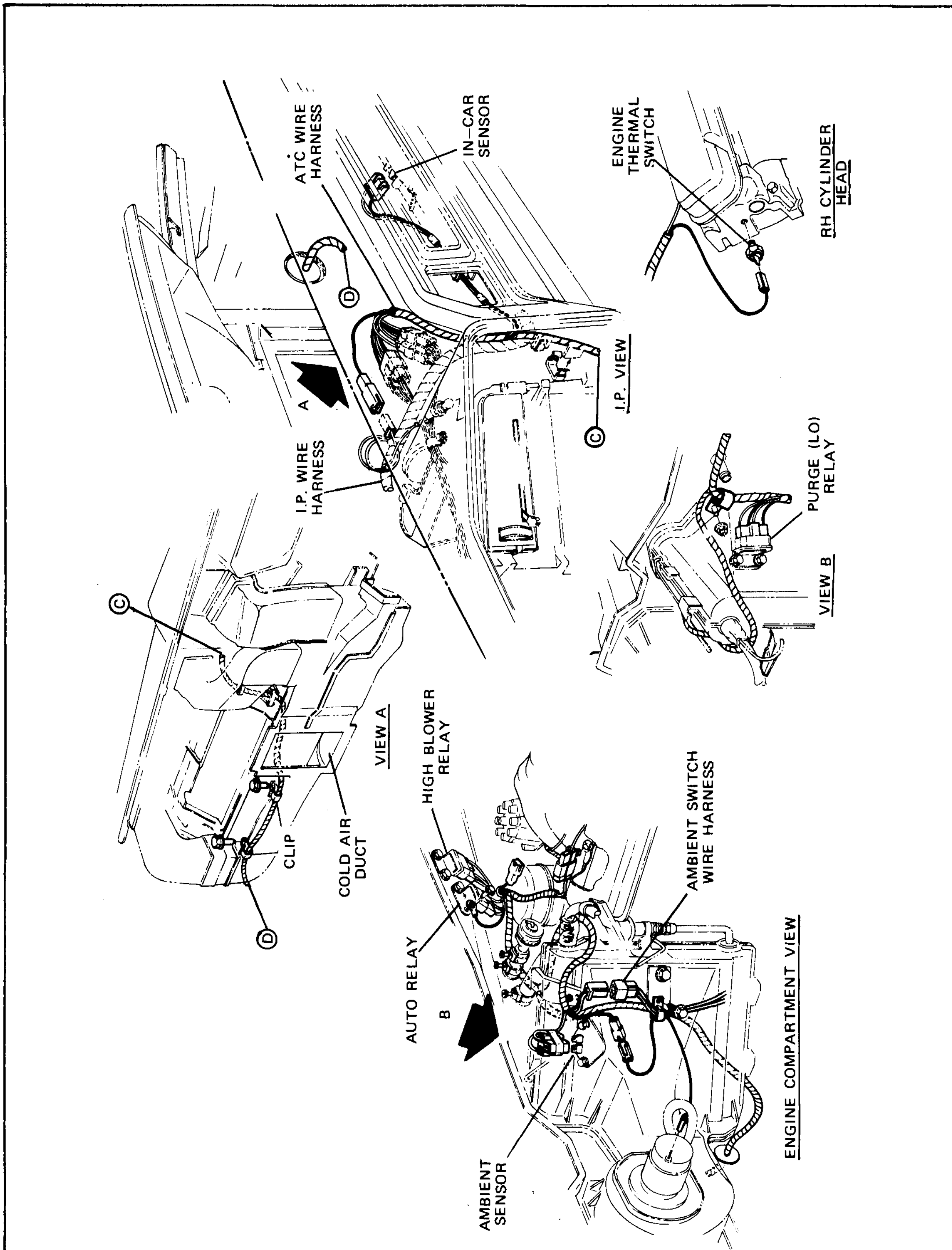


Fig. 1B-44 B Series ATC Wire Harness Routing

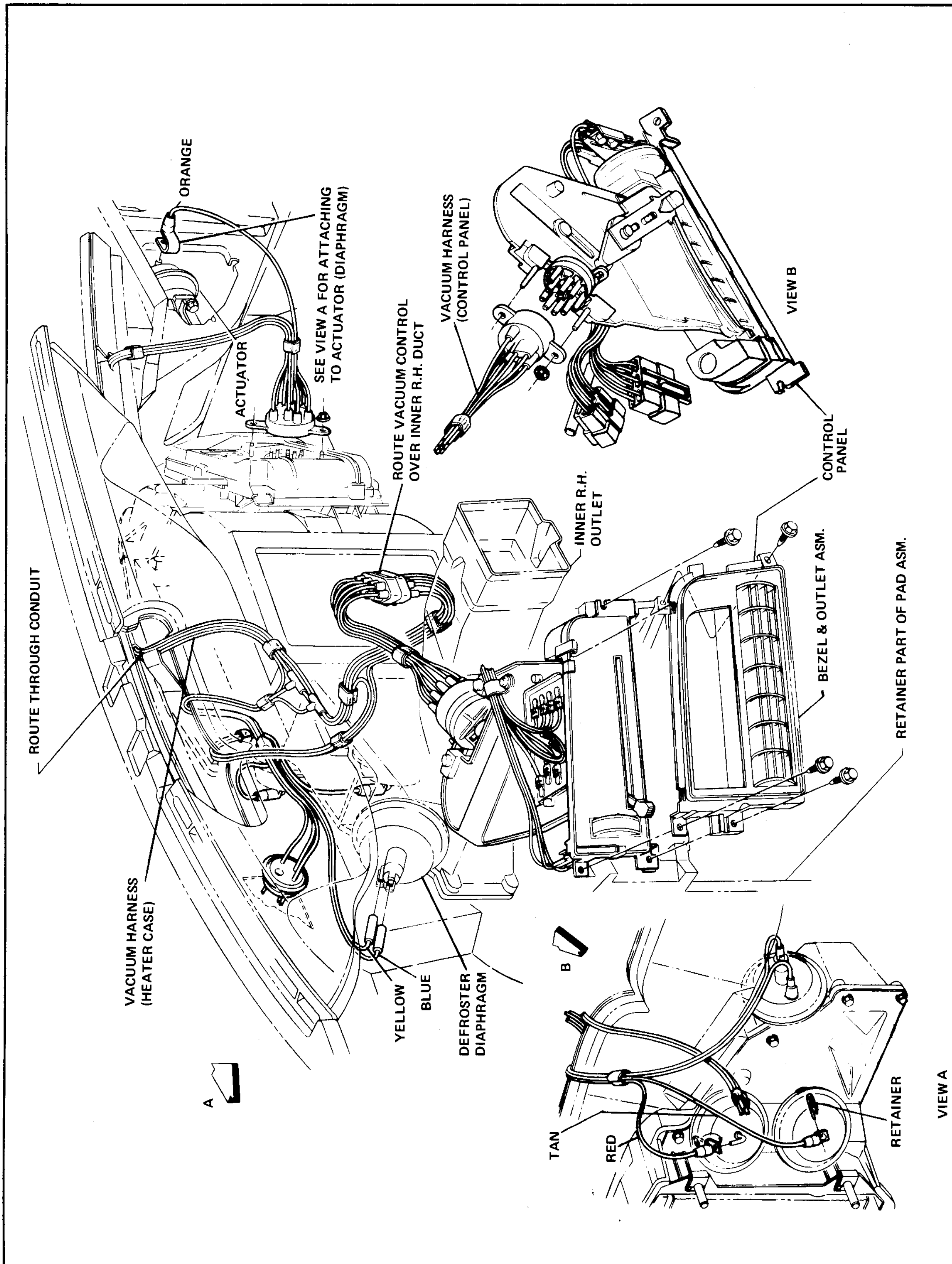


Fig. 1B-45 B Series ATC Vacuum Harness and Control Panel Installation

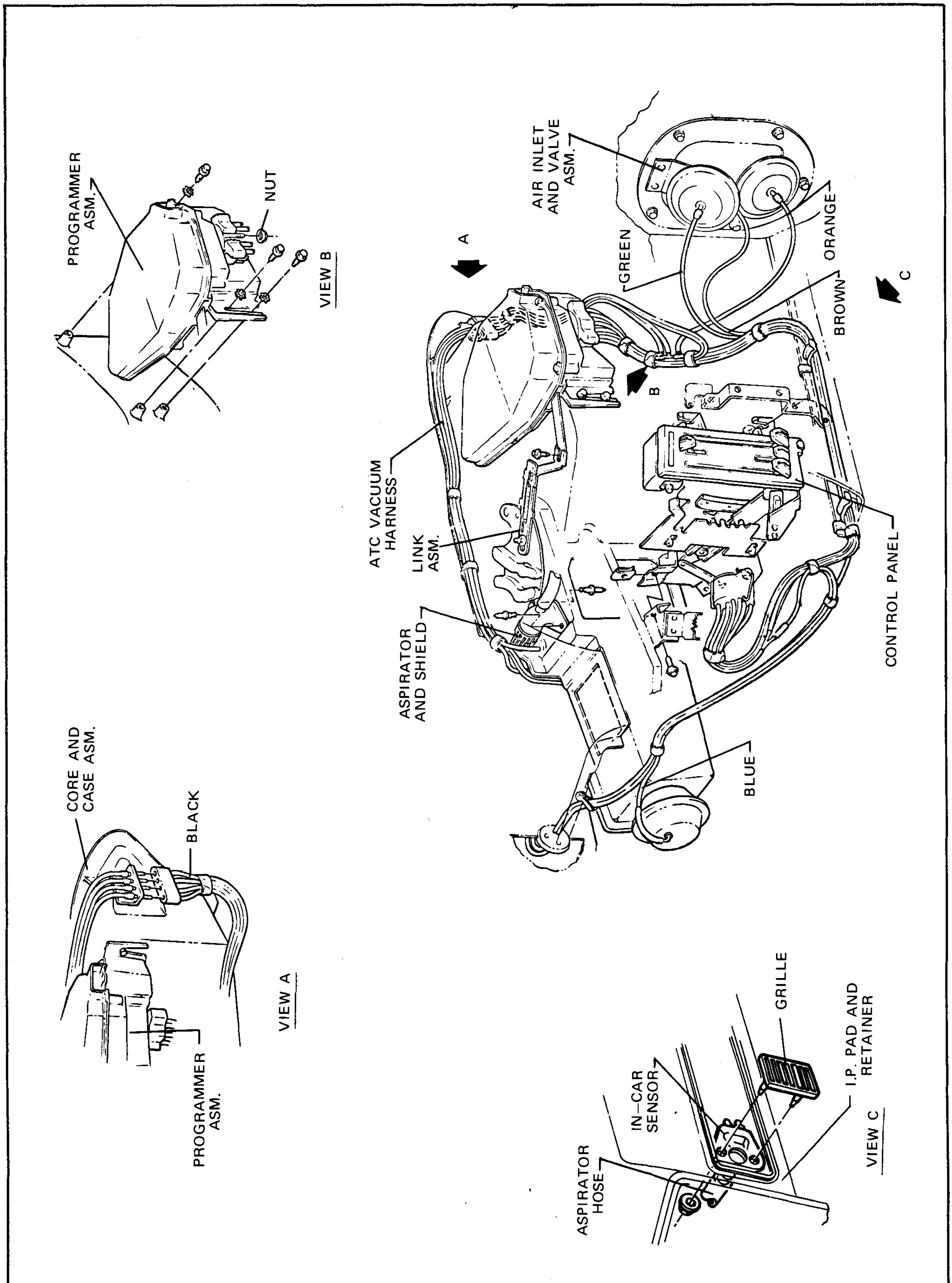


Fig. 1B-46 G Series ATC Vacuum Harness and Programmer Installation

Series) and remove sensor attaching screws, Fig. 1B-44 (B Series).

2. To replace, reverse removal procedure.

ATC ELECTRICAL HARNESSES

The electrical harnesses used with the ATC system can be serviced by performing the operations for A/C electrical harnesses in Section 1A of this manual. The B Series ATC harness and the G Series ATC in-car harness require disconnecting and connecting of electrical connectors at the bi-level boost switch (G Series), the in-car sensor, the programmer, ATC relays, ambient sensor and the potentiometer on the control panel in addition to the procedure in Section 1A. For B Series ATC electrical harness and G Series ATC in-car harness installation, see Figs. 1B-44 (B Series) and 1B-43 (G Series).

The G Series ATC engine (main) harness requires the disconnection of the connector at the master relay and a second connector at the ambient switch and sensor. The remainder of the main harness can be serviced by using the procedures in Section 1A for main A/C harness.

VACUUM HOSE HARNESS

REMOVE AND REPLACE

1. Remove cold air distributor duct.
2. Remove glove box (except G Series with console).
3. Follow procedures for A/C vacuum harness replacement in Section 1A of this manual with the addition of disconnecting and connecting the vacuum connector at the programmer rotary vacuum valve. Vacuum hose harness routing is illustrated in Figs. 1B-45 and 1B-46 for B and G Series respectively.

TEMPERATURE DOOR LINK TO PROGRAMMER

ADJUST - B SERIES

1. Remove cold air duct and glove compartment and loosen the hex screw of the door link at the output shaft of the programmer (Fig. 1B-42).
2. Place the control head selector lever in the DEFROST position.
3. Remove the electrical connector from the programmer. This results in the proper position of the output shaft of the programmer (full heat position).
4. Check to make sure that the temperature (air mix) door is in the full heat position. The blower air flow will not hold the door in the proper position.
5. Without disturbing the door link or the output shaft position, tighten the hex screw on the door link.
6. Check the adjustment.

   A. Connect ATC Tester J 23678 into the wiring harness and the programmer. Place the control head in AUTO. Place the Manual Automatic switch in the MANUAL position. Using the MANUAL CONTROL, swing the programmer to MAX. HEAT then to MAX. COLD. Hi blower should be obtained in both positions.

   B. Check for recirculation operation. Operate the system with the MANUAL CONTROL on "150" for 5 minutes so the restricted vacuum line can move the outside air door to the outside air position. With the control head in HI, move the MANUAL CONTROL to MAX. COLD. With all the car doors and windows closed, the blower noise level should increase when recirculation occurs (approximately 3 minute delay due to the restrictor).

ADJUST - G SERIES

1. Remove cold air duct.
2. Remove glove compartment (except models with console).
3. Loosen screw retaining link to programmer arm and separate the units (Fig. 1B-47).
4. Disconnect programmer connector shown in Fig. 1B-48.
5. With ignition on and control lever off, ground terminals 2, 3 and 4.

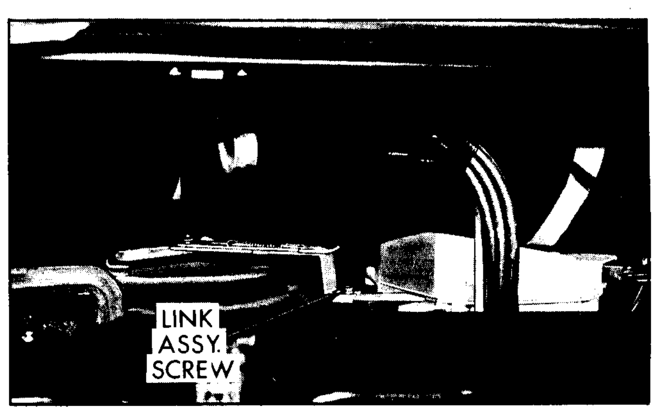


Fig. 1B-47 Programmer Link Assembly - G Series

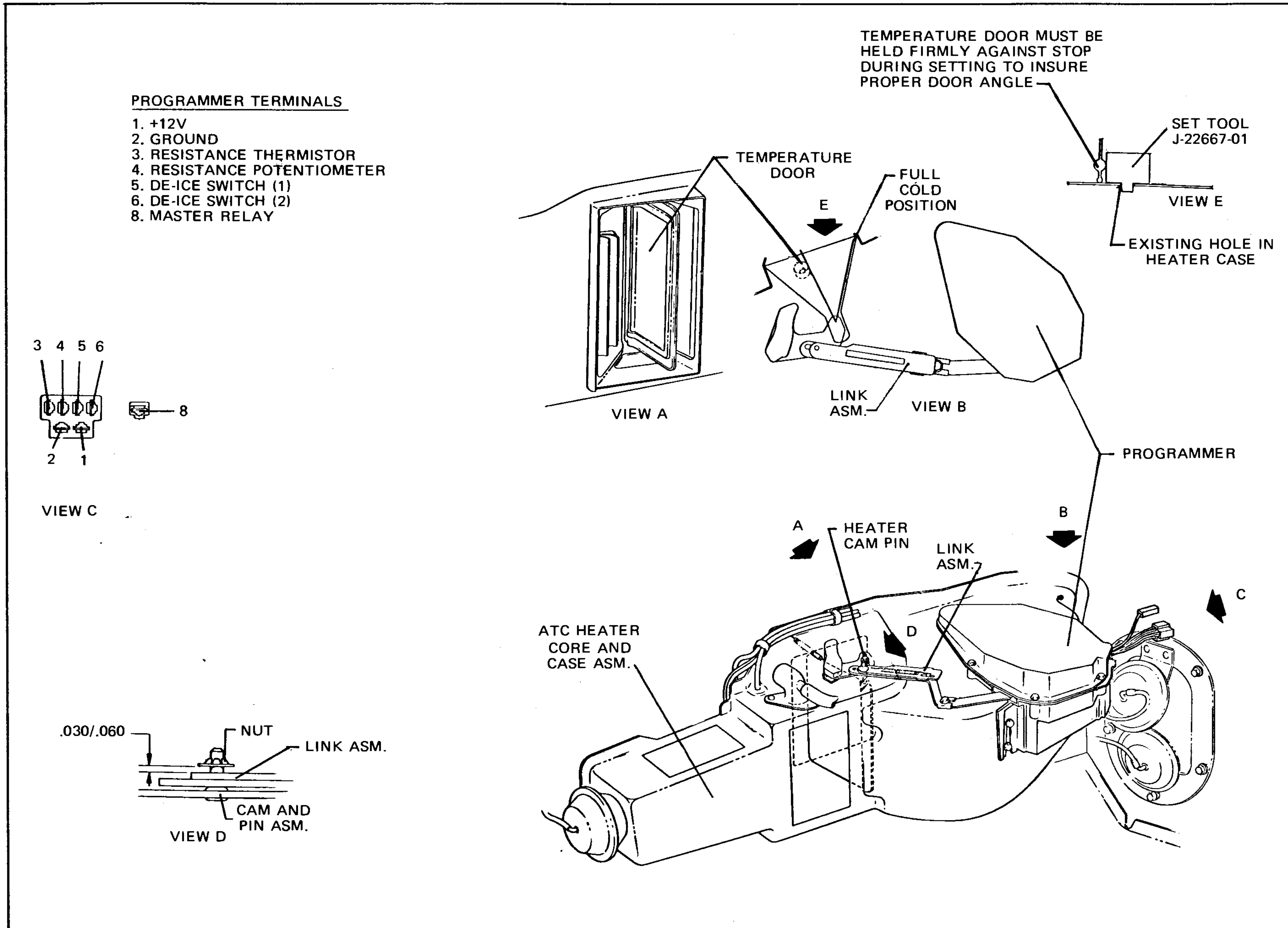


Fig. 1B-48 Temperature Door Adjustment - G Series

6. Apply + 12 volts DC (available at BAT terminal of fuse block) to terminal number 1 (one) only. This will cycle the programmer to the full cold position. Allow minimum time of 30 seconds for this operation.
7. Remove + 12 volts DC from terminal number one (1) and apply to terminal # 8 only. This will cycle the programmer to the A/C park position. A minimum time of 15 seconds should be allowed for this operation.
8. Push lower diverter door inward if necessary and install tool J 22667-01 in hole in heater core and case assembly (Fig. 1B-49).
9. Position temperature door against tool, attach link to programmer arm and tighten adjusting screw.
10. Apply + 12 volts DC to terminal # 1 only. Programmer will cycle to full cold allowing removal of tool.
11. Connect programmer connector.
12. Replace glove compartment and cold air duct.

CONTROL PANEL

REMOVE AND REPLACE

Control panels for Automatic Temperature Control systems can be removed by using procedures for A/C control panel replacement. These procedures are in section 1A.

Fig. 1B-49 Tool J 22667-01 Installed

CONTROL PANEL COMPONENTS

Several items on the Automatic Temperature Control panel are serviced. They include the rotary vacuum valve, switches, variable resistor, etc.

Figs. 1B-50 and 1B-51 show the B and G Series panels respectively and should be referred to when servicing individual components.

VARIABLE RESISTOR (POTENTIOMETER) - G SERIES

Two methods of adjusting the temperature control variable resistor are available. Use the first method to adjust the unit in the car and the second to adjust the variable resistor after installing a new one.

When replacing potentiometer note position and scribe alignment marks to assure proper positioning of new potentiometer.

ADJUST IN CAR:

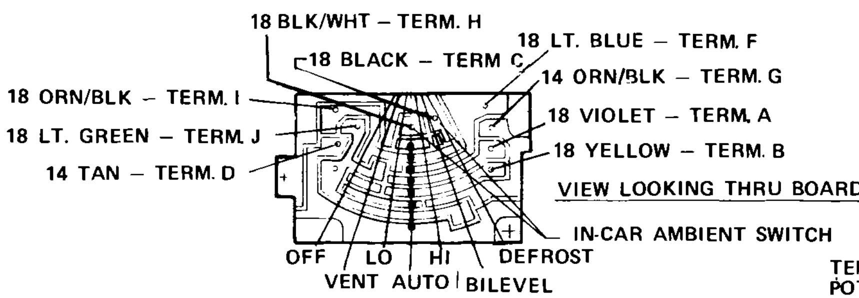
1. To lower the in-car temperature to suit owner preference, insert tool J 23187 in system selector lever slot (Fig. 1B-52).
2. Engage teeth on variable resistor and pull towards you to lower outlet temperature.
3. To raise the in-car temperature, push the variable resistor gear away from you with tool J 23187.

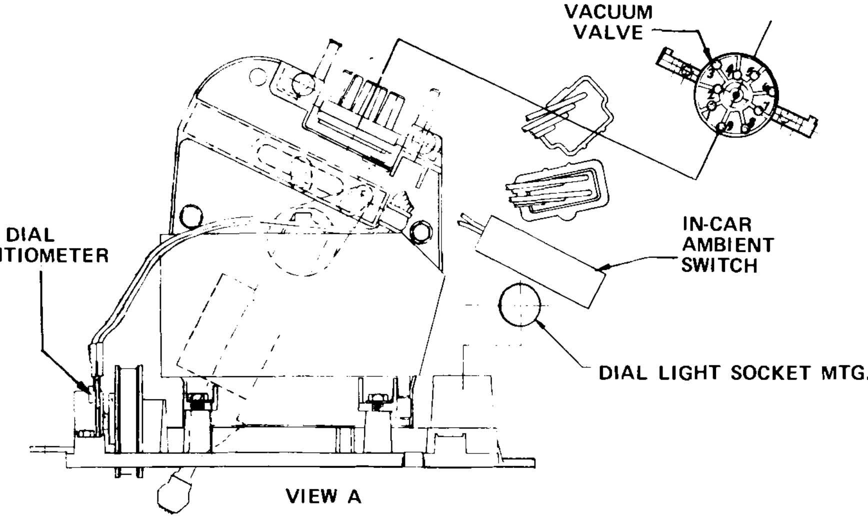
ADJUST ON BENCH:

1. Connect a calibrated ohm meter across the two green leads at the potentiometer connector. Set temperature lever on control panel at "75" and observe meter. Meter should read "560 ohms".
2. If meter reading is not 560 ohms, lift the small plastic gear on potentiometer shaft from gear teeth on plastic cam attached to temperature lever.
3. Rotate small gear in direction which causes meter indication to approach 560 ohms. Stop when 560 ohms is reached.
4. Push small plastic gear down onto shaft until gear teeth engage teeth on the temperature cam.
5. Stake end of potentiometer shaft (center punch may be used) to retain plastic gear.

TEMPERATURE DIAL CALIBRATION - B SERIES

Be sure to allow sufficient time for car engine to warm up and ATC system to turn-on before attempting calibration.

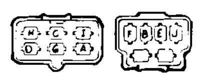




PORT NO.	FUNCTION	OFF	VENT	LO	AUTO	HI	DEFOG	DE ICE
1	INPUT CHECKED	SEAL	CONN 3,5	CONN 5	CONN 5,8	CONN 5,7,8	CONN 3,7,8	CONN 6,7,8
2	DEF. BLEED	VENT	CONN 4	CONN 4	CONN 4	CONN 4	CONN 4	CONN 4
3	MODE DIA. LOWER	VENT	CONN 1,5	CONN 9	CONN 9	CONN 9	CONN 1,7,8	VENT
4	INPUT MAN.	SEAL	CONN 2	CONN 2	CONN 2	CONN 2	CONN 2	CONN 2
5	MODE SIG. UPPER	VENT	CONN 1,3	CONN 1	CONN 1,8	CONN 1,7,8	VENT	VENT
6	DEF.	VENT	VENT	VENT	VENT	VENT	VENT	CONN 1,7,8
7	NOT USED	VENT	VENT	VENT	VENT	CONN 1,5,8	CONN 1,3,8	CONN 1,6,8
8	RECIRC SIG.	VENT	VENT	VENT	CONN 1,5	CONN 1,5,7	CONN 1,3,7	CONN 1,6,7
9	MODE SIG. LOWER	SEAL	SEAL	CONN 3	CONN 3	CONN 3	SEAL	SEAL

SELECT SWITCH FUNCTION

	CONNECTIONS
OFF	NO CONNECTION
VENT	C–I–J
LO	A–B
AUTO	F–I; A–B
HI	A–B; F–I; D–G
B/L	A–B; F–I
DEFST.	A–B; C–F–I; D–G



PACKARD CONN CONNECTION	WIRE COLOR	CONNECTION
A	VIOLET 18	COMPRESSOR
B	YELLOW 18	12V IGNITION
C	BLACK 18	GROUND
D	TAN 14	RELAY COIL FEED – HI RELAY
E	LT. GRN 18	FEEDBACK POTENTIOMETER – PROGRAMMER
F	LT. BLUE 18	RELAY COIL – AUTO RELAY
G	ORN/BLK 14	CONNECT TO F
H	BLK/WHT 18	ENGINE THERMAL SWITCH
I	ORN/BLK 18	THERMAL SWITCHES
J	LT. GRN 18	IN CAR SENSOR

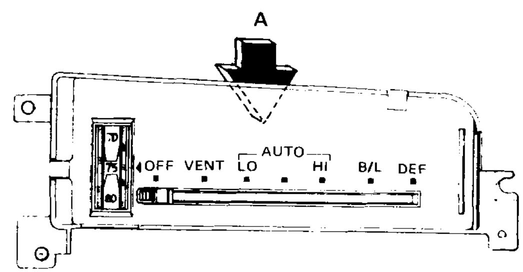
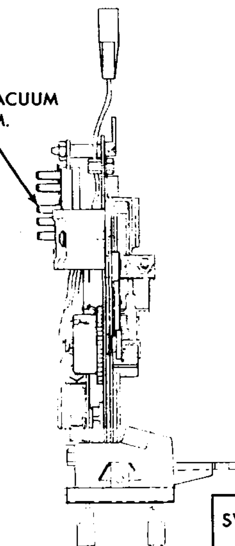


Fig. 1B-50 B Series Control Panel Outline

BLOWER SWITCH OPERATION CHART

TERMINAL	LO	HI
G	TERM K	TERM H
H	OPEN	TERM G
J	OPEN	TERM K
K	TERM G	TERM J



VACUUM VALVE CHART

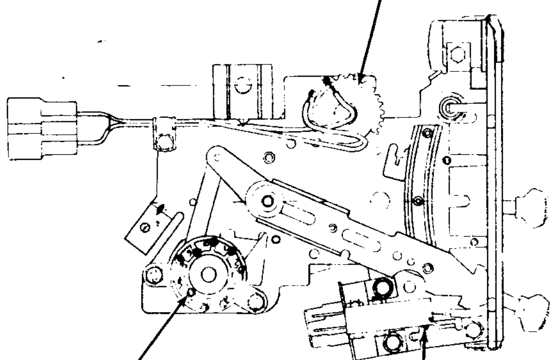
		POSITION				
PORT NO.	CONNECTION	OFF	NORMAL	INSIDE	DE-FOG	DEFROST
1	OUTSIDE AIR CLOSED	VAC	CONN. 2	CONN. 3	CONN. 2	CONN. 2
2	PROGRAMMER #9	SEAL	CONN. 1	SEAL	CONN. 1	CONN. 1
3	PROGRAMMER #6	SEAL	SEAL	CONN. 1	SEAL	SEAL
4	PROGRAMMER #10	CONN. 5	CONN. 5	SEAL	CONN. 5	CONN. 5
5	OUTSIDE AIR OPEN	CONN. 4	CONN. 4	CONN. 6	CONN. 4	CONN. 4
6	PROGRAMMER #3	SEAL	SEAL	CONN. 5	SEAL	SEAL
7	PROGRAMMER #1	VENT	VAC →	→	→	→
8	INPUT	VAC →	→	→	→	→
9	PROGRAMMER #4	VENT →	→	→	VAC	VAC
10	PROGRAMMER #5	VAC →	→	→	VENT	VENT

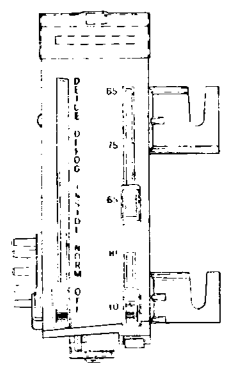
VENT—MEANS LINE VENTED TO ATMOSPHERIC PRESSURE
VAC—MEANS VACUUM APPLIED TO LINE
CONN—MEANS PORT CONNECTED TO ANOTHER PORT
SEAL—MEANS LINE SEALED AT END

SWITCH CHARTS

SWITCH	POSITION	
	NORMAL	DEFRST
DE-ICE	OPEN	CLOSED

SWITCH	POSITION					
	OFF	INSIDE	A/C	B/L	HEAT	DEFST
MASTER	OPEN	CLOSED →	→	→	→	→





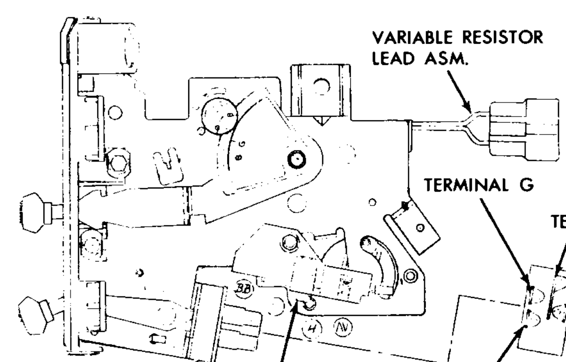


Fig. 1B-51 G Series Control Panel Outline

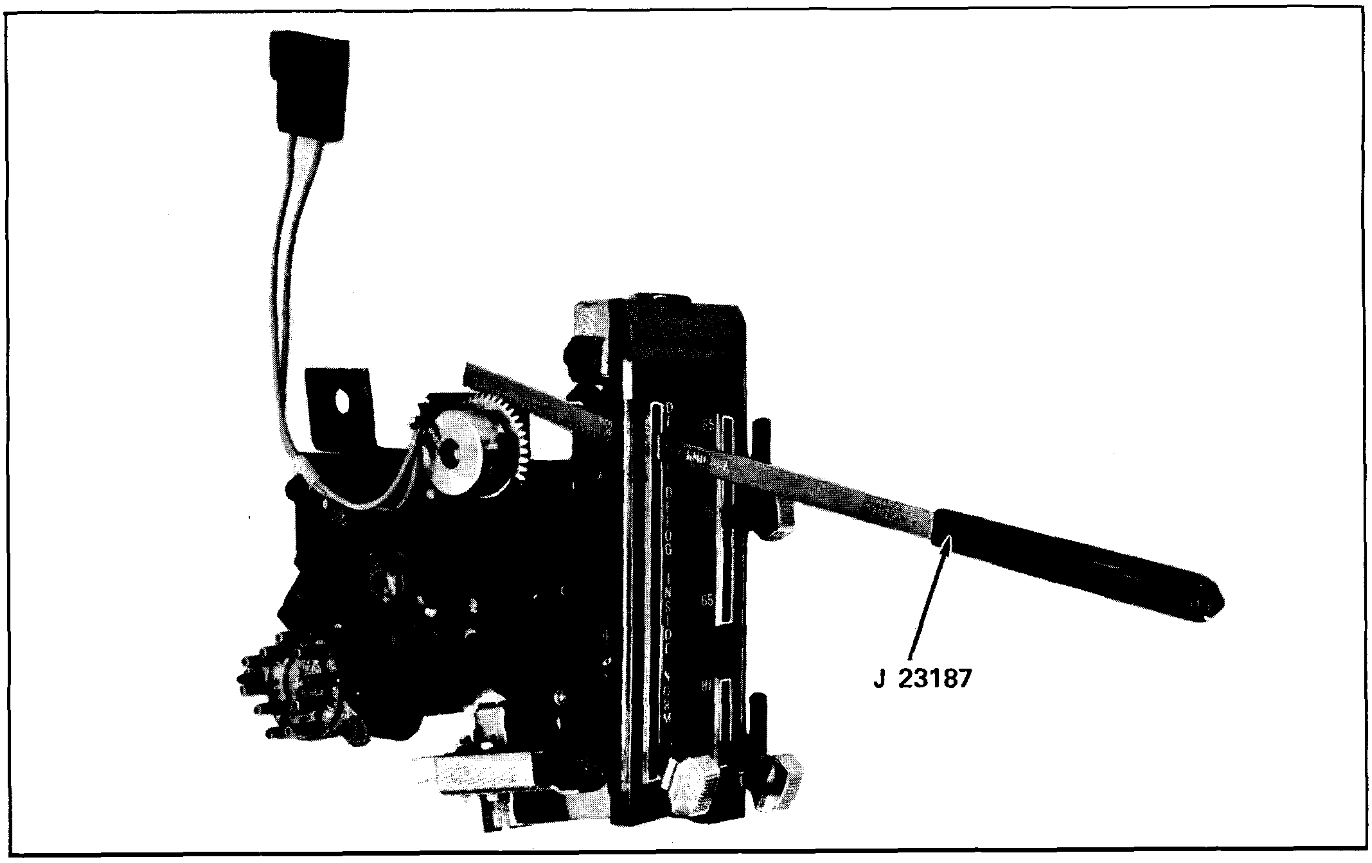


Fig. 1B-52 G Series Potentiometer Adjustment

1. Connect ATC Tester J 23678 into the ATC wiring harness and the programmer.
2. Place control panel selector lever in VENT.
3. Place Manual-Automatic switch on tester in the MANUAL position.
4. Place the Temperature Dial Calibrator switch on the tester in the CAL. position.
5. Note the voltmeter reading on tester.
6. Press "COMPARE" button and note voltmeter reading.
7. With the "COMPARE" button pressed in, rotate the temperature dial on the control panel until the voltmeter reading is the same as it was in step 5 (button not pressed in).
8. The control panel temperature dial should be set at the temperature dial setting on the tester panel ("75"). If it does not, use tool J 21530 (Fig. 1B-53) to hold the gear on the left side of the temperature dial and slip the dial to the correct setting. If the temperature dial cannot be calibrated using this procedure, it is defective.

B SERIES PROGRAMMER

REMOVE AND REPLACE

1. Disconnect battery.

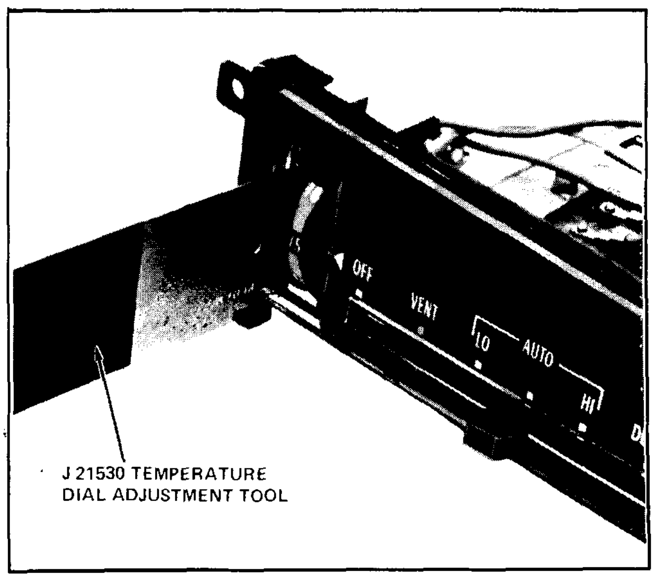


Fig. 1B-53 B Series Temperature Dial Adjustment

2. Remove glove compartment.
3. Loosen screw and remove programmer link from programmer output shaft (Fig. 1B-42).
4. Disconnect vacuum connector and electrical connector from programmer.
5. Remove programmer assembly toward rear of car to avoid damaging blower motor resistor.
6. To replace, reverse removal procedure. Adjust temperature door link.

PROGRAMMER COMPONENTS - REMOVE AND REPLACE

VACUUM VALVE

1. Identify vacuum hoses connected to the two outboard side ports of the vacuum valve and the port to which each is connected. Disconnect the two vacuum hoses.
2. Disconnect vacuum hose to center port on valve at the transducer.
3. Remove two vacuum valve retaining studs and remove valve. Lift valve drive arm off of vacuum motor mechanism boss when removing valve.
4. To replace, reverse removal procedure. Make certain vacuum valve spring is in place. Refer to Figs. 1B-54 and 1B-55.

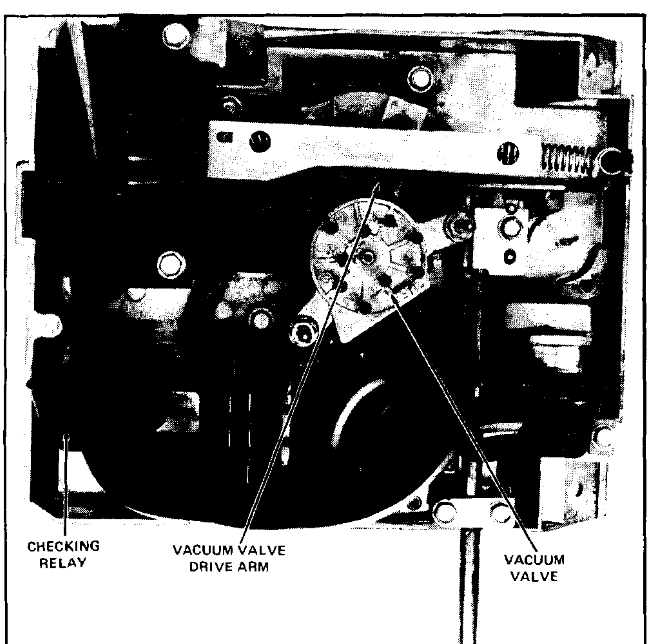


Fig. 1B-54 Internal View - Programmer

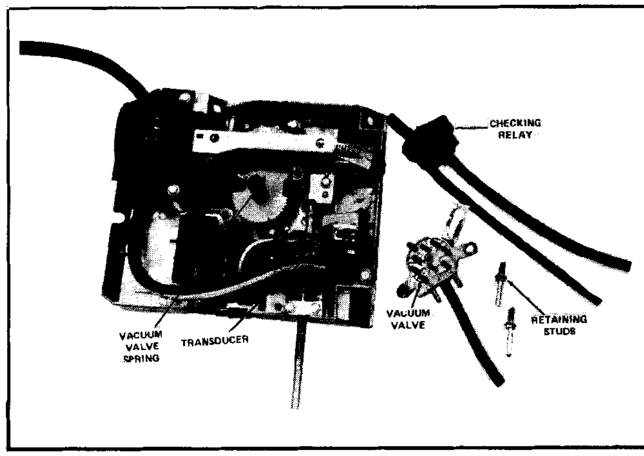


Fig. 1B-55 Vacuum Valve and Checking Relay

CHECKING RELAY

1. Disconnect two vacuum hoses from vacuum valve at the relay. Identify hoses and relay ports to which they connect for reconnecting.
2. Disconnect long vacuum hose at other side of relay and short vacuum hose at the vacuum motor and remove relay.
3. To replace, reverse removal procedure. See Figs. 1B-54 and 1B-55.

NOTE: *If long vacuum hose (from checking relay to transducer) is replaced, the replacement hose must be at least 15" in length.*

TRANSDUCER

1. Disconnect two vacuum hoses at transducer; identify hoses and ports for reconnection.
2. Disconnect and identify two electrical terminals to transducer.

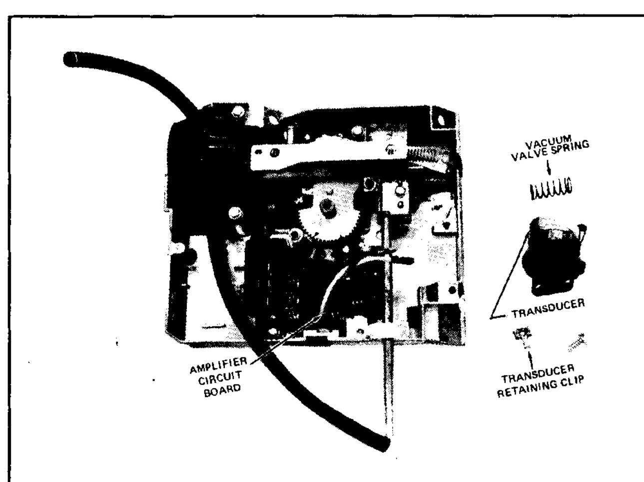


Fig. 1B-56 Vacuum Transducer Removed

3. Remove hex screw, retaining clip and transducer.

4. To replace, reverse removal procedure. Refer to Figs. 1B-55 and 1B-56.

AMPLIFIER CIRCUIT BOARD

1. Remove vacuum valve.

2. Remove two programmer electrical connector retaining screws and lift connector body from amplifier terminals.

3. Remove amplifier heatsink retainer clip and insulator.

4. Remove (2) amplifier retaining screws at amplifier feedback potentiometer.

5. Disconnect two wires at transducer. Note which wire connects to each terminal.

6. Remove amplifier circuit board.

7. To replace, reverse removal procedure and calibrate feedback potentiometer. See Figs. 1B-56 and 1B-57.

VACUUM MOTOR

1. Remove vacuum valve retaining studs and lift vacuum valve to remove drive arm from boss on vacuum motor mechanism.

2. Remove retaining clip and power spring from motor mechanism.

3. Disconnect vacuum hose from port on motor.

4. Remove (2) motor retaining screws and remove motor, lifting upward.

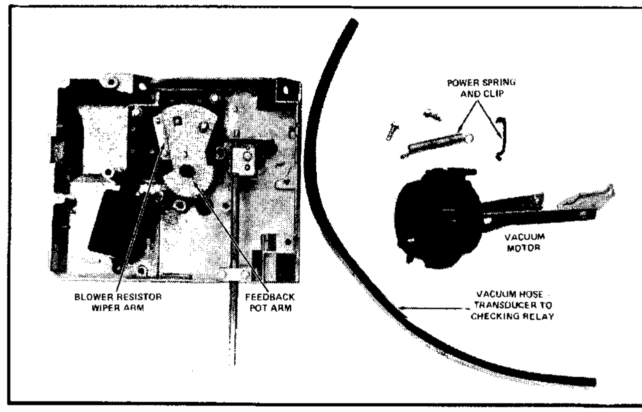


Fig. 1B-58 Vacuum Motor and Power Spring

5. To replace, reverse removal procedure. See Figs. 1B-57 and 1B-58.

BLOWER RESISTOR WIPER ARM ASSEMBLY OR FEEDBACK POT ARM ASSEMBLY

1. Remove vacuum valve and spring.

2. Remove vacuum motor and power spring.

3. Lift blower resistor wiper arm and feedback pot arm off of blower resistor circuit board. Take care to locate single ball bearing making certain it is located in bearing cup on blower resistor circuit board.

4. Separate blower resistor wiper arm from feedback pot arm. Be sure to locate (2) single ball bearings and insure their location in bearing cups on wiper arm.

5. To replace, reverse removal procedure. Make sure ball bearings are properly located in bearing cups. See Figs. 1B-58 and 1B-59.

MIX DOOR OPERATING ARM

1. Remove vacuum valve.

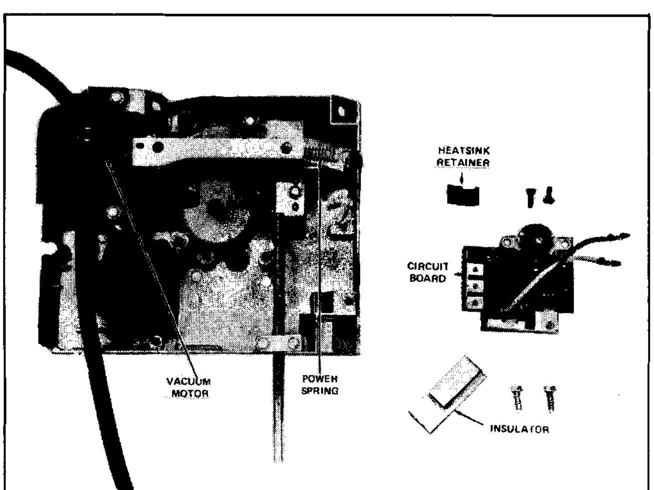


Fig. 1B-57 Amplifier Circuit Board

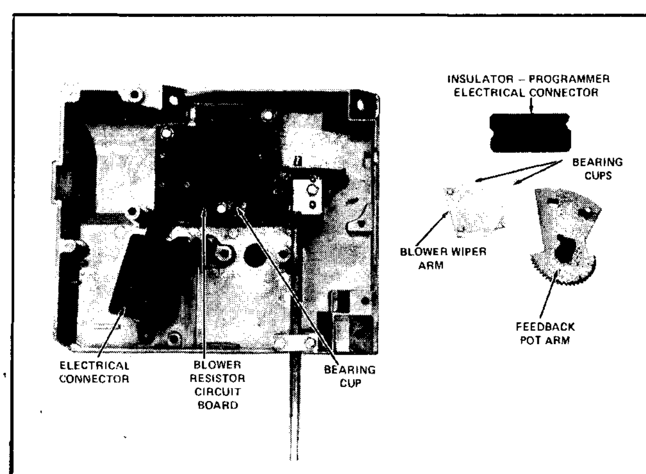


Fig. 1B-59 Blower Wiper Arm and Feedback Pot Arm

2. Remove vacuum motor retaining screws and power spring. Position motor mechanism to disengage mix door operating arm (programmer output shaft).

3. Disconnect electrical terminals and vacuum hoses at transducer. Identify connections for reassembly.

4. Remove (3) retaining screws and (2) retaining clips and remove mix door arm.

5. To replace, reverse removal procedure. See Figs. 1B-59 and 1B-60.

BLOWER RESISTOR CIRCUIT BOARD

1. Remove blower resistor wiper arm assembly using correct procedure.

2. Remove (3) retaining screws and blower resistor circuit board. Take care that single ball bearing is kept located in bearing cup on circuit board.

3. Remove (3) electrical terminals from programmer electrical connector body.

4. To replace, reverse removal procedure. See Figs. 1B-60 and 1B-61.

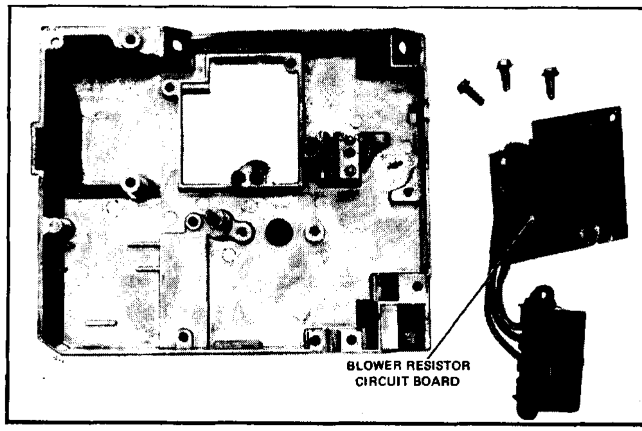


Fig. 1B-61 Blower Resistor Circuit Board

4. Remove vacuum harness connector from programmer.

5. Disconnect three electrical connectors.

6. Remove programmer retaining screws (Fig. 1B-46).

7. Pull programmer carefully rearward so as not to break heat sensor.

8. To replace, reverse removal procedure.

G SERIES PROGRAMMER

REMOVE AND REPLACE

1. Disconnect battery.

2. Remove cold air duct and glove compartment (except with console).

3. Remove programmer link screw (scribe marks for reinstallation). If new programmer is installed or new parts placed in programmer, adjust door link.

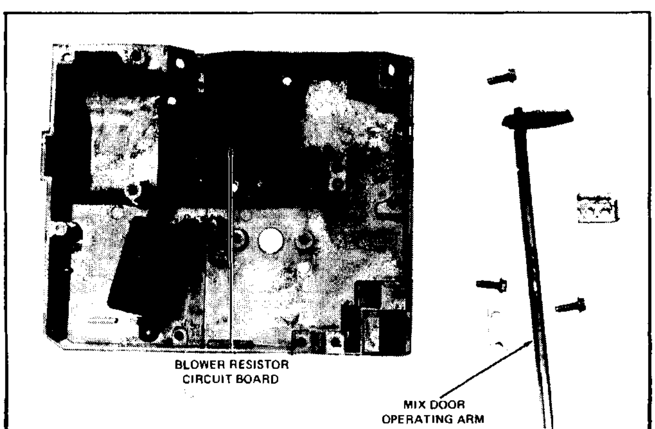


Fig. 1B-60 Mix Door Operating Arm

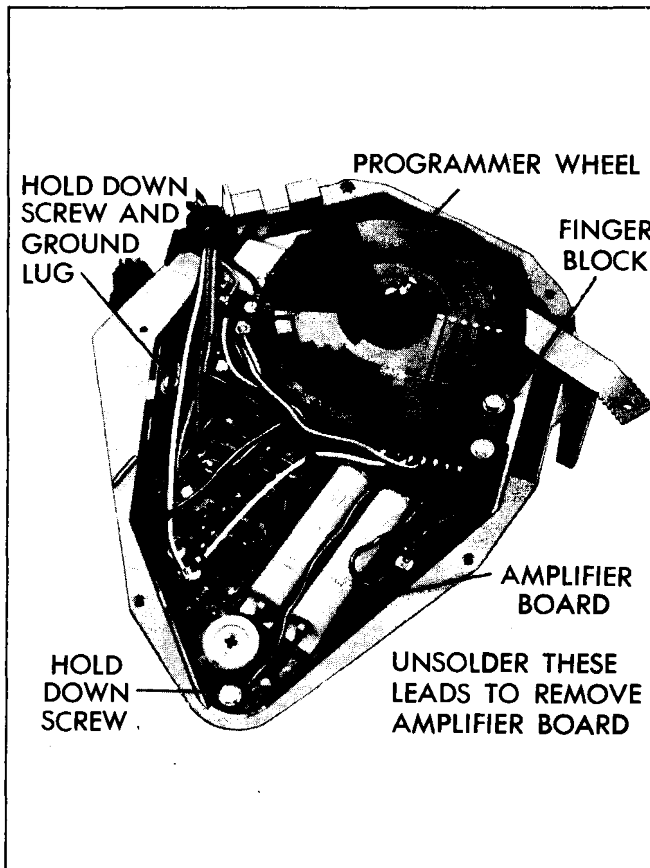


Fig. 1B-62 Programmer Amplifier

PROGRAMMER AMPLIFIER REMOVE AND REPLACE

1. Remove cover from programmer by removing five screws and carefully lift away cover from programmer without bending fingers on finger block assembly.

2. Remove finger block screws and move out of way (Fig. 1B-62).

3. Unsolder nine leads where leads attach to amplifier, Fig. 1B-62. Remove two circuit board mounting screws. Lift board carefully straight up and off finger block mounting post.

4. Install new board by reversing removal procedure and secure with two mounting screws making certain that ground lug is under the mounting screw nearest wheel. Note that circuit board comes with a new finger block and lead cable attached.

5. Solder previously disconnected leads. Use resin core solder for all soldering operations.

6. Install finger block and rubber cable clamp. Make certain that cable clamp is properly seated in its bracket.

7. Replace cover with five screws.

PROGRAMMER WHEEL - REMOVE

1. Scribe a thin line (using a screwdriver, knife or other sharp instrument) on the potentiometer clip in line with edge of wheel rib so that clip can be replaced in same position on wheel, Fig. 1B-63. There is a white paint mark in this area.

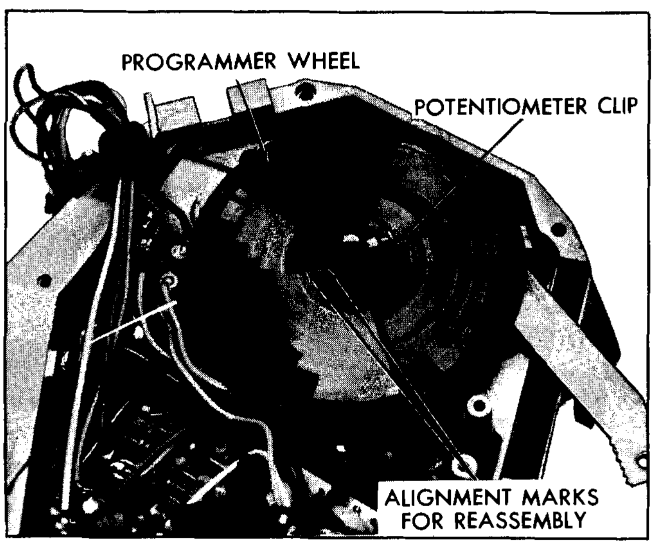


Fig. 1B-63 Marking Programmer Wheel

2. Remove finger block assembly and move out of way.

3. Remove retaining screw in hub of wheel and remove potentiometer clip. Programmer wheel may now be slipped off.

4. To replace reverse removal procedure.

GEAR INSPECTION

1. Remove programmer wheel as previously described.

2. Carefully remove wire clamps by placing a small screwdriver under the higher of the two locking tabs and gently work clips off mounting studs.

3. Remove two mounting screws on circuit board and lift board off finger block mounting post and out of way. Do not put undue strain on attached wiring.

4. Remove potentiometer bracket being careful of attached leads. The gears and motor are located directly below the bracket.

5. Inspect gears, Fig. 1B-64, for broken teeth or other abnormal conditions. Replace gears if broken or inoperative.

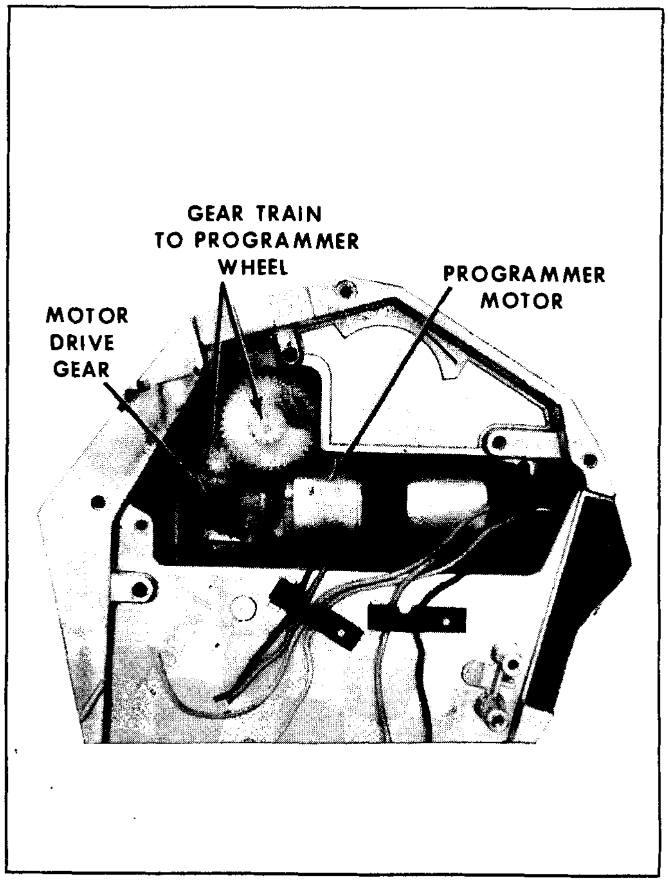


Fig. 1B-64 Programmer Gears and Motor

MOTOR - REMOVE AND REPLACE

1. Follow procedure for programmer wheel removal and gear inspection.
2. Remove motor by moving it back and up from its normal position.
3. Unsolder orange lead to motor from circuit board and solder orange lead from new motor to same point. Transfer green motor wire in same manner. Be sure to use resin core solder.
4. Install new motor making certain that worm gear is properly seated in its bearing block and properly meshed with helical spur gear.
5. Reassemble unit by reversing disassembly procedure. When reinstalling programmer wheel, follow special instructions provided below.

PROGRAMMER WHEEL - REPLACE

1. Position vacuum valve approximately in center of its travel.

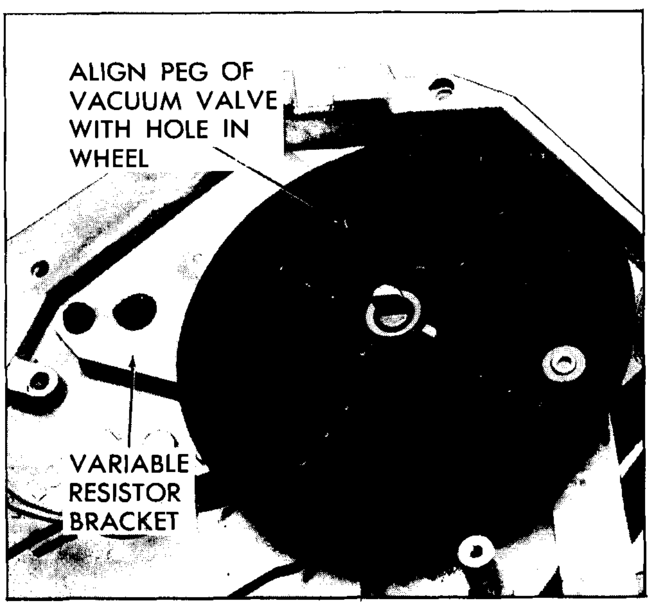


Fig. 1B-65 Aligning Vacuum Valve With Track In Programmer Wheel

2. Install programmer wheel so that peg on vacuum valve is visible through alignment hole in wheel (Fig. 1B-65). It may be necessary to move the vacuum valve slightly to accomplish this.
3. Install potentiometer clip and rotate so that scribe marks (made previously) on programmer wheel and clip line up. Tighten retaining screw on programmer wheel hub.
4. Slip the round circuit board off of wheel and check to be certain that four ball bearings are still in their proper positions in bearing retainer cups. Replace board and reinstall finger block with two screws.

POWER RESISTOR - REMOVE AND REPLACE

1. Remove cover plate on lower side of programmer.
2. Unsolder green and orange lead.
3. Install new resistor board and solder leads.
4. Replace cover plate.

BI-LEVEL BOOST SWITCH

G SERIES - REMOVE AND REPLACE

1. Remove cold air duct (except models with console).
2. Check both switches for operation.
3. Remove gasket seal.
4. Remove defective switch or switches.
5. To replace, reverse removal procedure.

Section 2

FRAME AND BODY MOUNTINGS

CONTENTS OF THIS SECTION

FRAME

A, B AND G SERIES

The frames used on the A, B, and G Series are of a swept perimeter design (Fig. 2-1). The perimeter frame has two advantages: Frist, the body comes down over the frame and forms an integrated structure with body sheet metal contributing greatly to the strength of the car; secondly, although the body and frame strenthen each other, there is no metal-to-metal contact, because they are connected by means of rugged butyl rubber body mounts which isolate the driver and passenger from engine, transmission, drive-line, and road disturbances. The B Series station wagon frame is of a unique design with the rear crossmember moved forward to provide clearance for the glide a-way gate.

F & X SERIES

F & X Series frames are of a unitized construction. A partial frame supports the front end sheet metal, front suspension, engine, and other mechanical components. Unitized construction demands that underbody components be properly aligned to ensure 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 established suspension locations.

HOIST LIFTING POINTS

A, B AND G SERIES

Lifting can be accomplished without adapters when using drive-on, or twin post type hoists, with hoists or lifts making contact with front suspension lower control arms or rear axle. Since the frame is perimeter type, some hoists designed to contact side rails require adapters to raise the car without damage to parts of exhaust system, body, floor, etc. Suppliers of original lifting equipment should have information on adapters to use on A, B and G Series cars. Refer to Fig. 2-2 for proper lift point connections.

NOTE: *The vehicle should never be lifted by the rear lower control arms.*

F & X SERIES

Like the series with swept perimeter type frame, the F & X Series can be lifted in a similar manner on a twin post hoist by making contact with the front suspension lower contorl arms and the rear axle. Since there is a bolted on stub frame in front and welded side rails at the rear. The car may also be lifted at the points illustrated in Fig. 2-3. Proper adapters must be used to prevent damage to the various parts of the underbody. Caution should be exercised so as not to nick the rear springs.

UNDERBODY ALIGNMENT

The dimensions for X, Y and Z in Figures 2-2 and 2-4 are not given but are used merely to illustrate points for taking diagonal measurements for checking squareness of the frame. Holes or rivet heads are located on the frame at approximate terminal point of arrowheads, and can be used for this purpose. Refer to Fig. 2-4 for frame dimensions. For underbody dimensions on the F & X Series refer to Section 3 or the Body Manual.

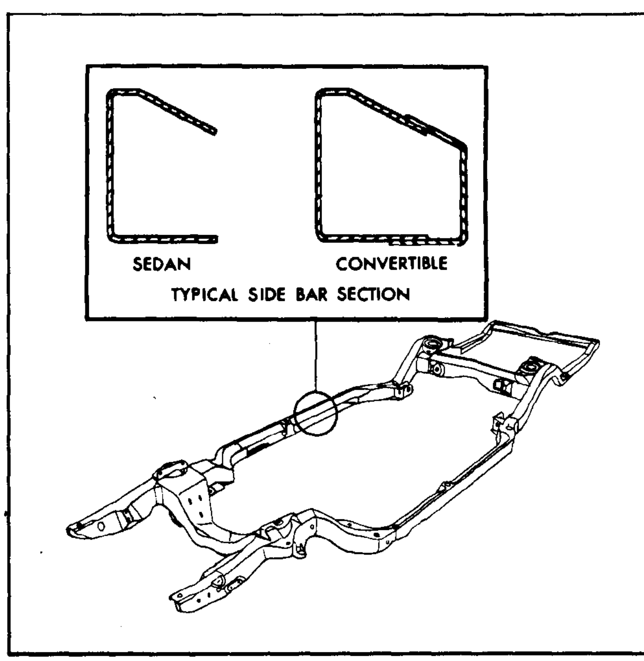


Fig. 2-1 Typical Perimeter Design Frame

BODY TO FRAME MOUNTING

A, B AND G SERIES

With the use of a perimeter frame, noise isolation from the body is accomplished with soft butyl-rubber mounts, see Figure 2-5.

F & X SERIES

The frame is isolated from the unitized body by means of soft butyl rubber mounts, refer to Fig. 2-3.

FRAME IDENTIFICATION

The manufacturer's identification is stamped on the left rear side rail as illustrated in Fig. 2-6.

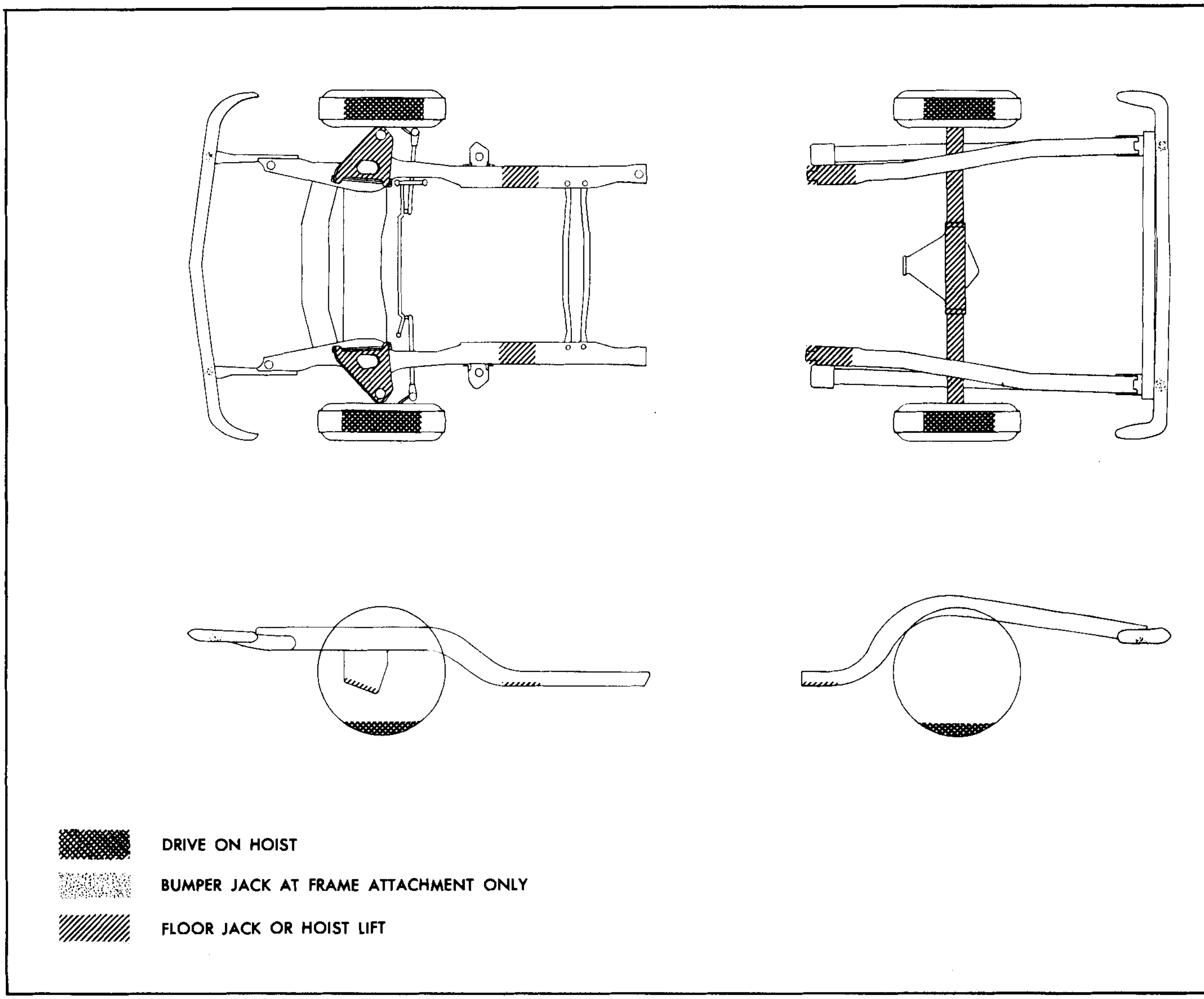


Fig. 2-2 Lift Point Locations

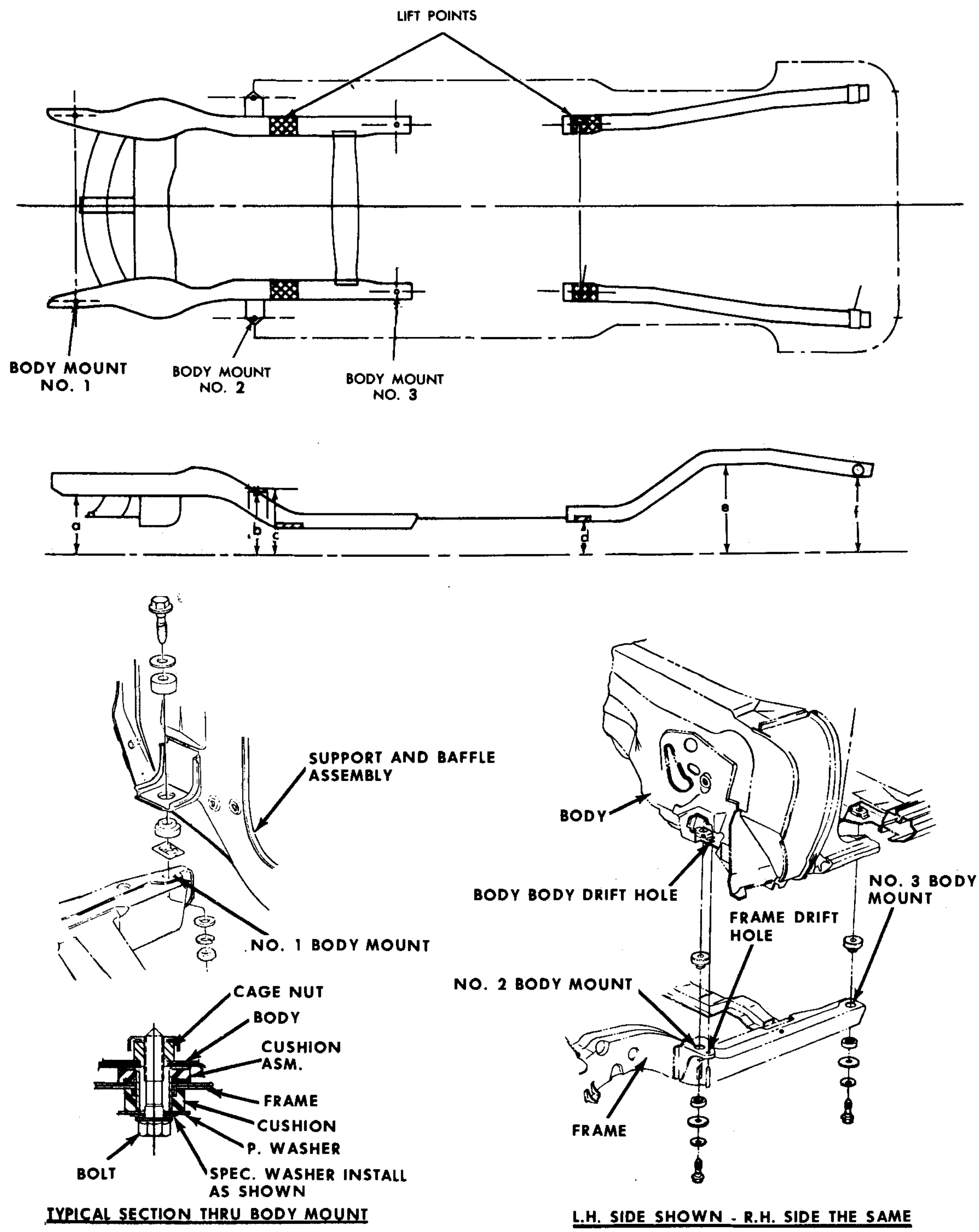
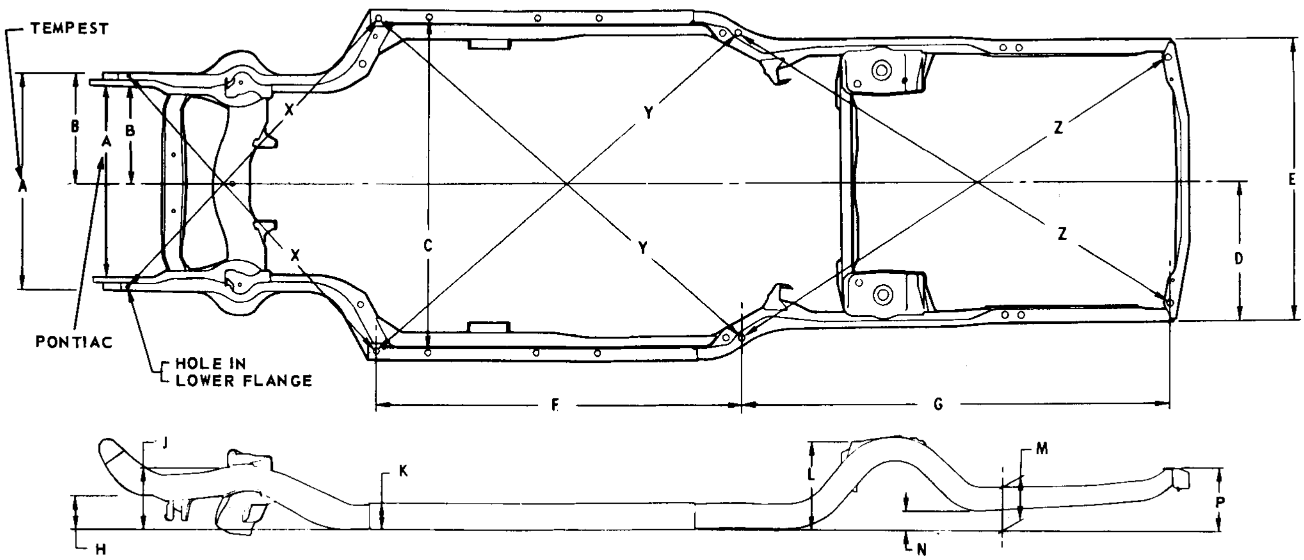
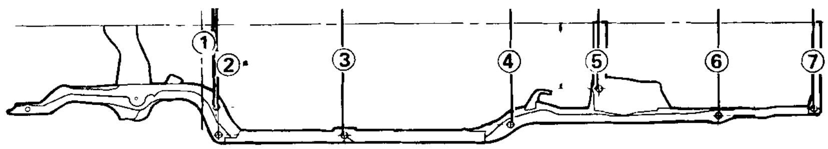


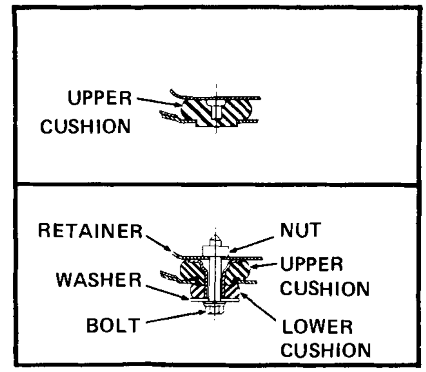
Fig. 2-3 F & X Series Lift Points and Body Bolt Locations



BODY STYLES	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
B SERIES SWB EXCEPT STATION WAGON	36.56	18.28	55.40	27.46	54.92	68.58	72.28	6.74	10.09	4.83	16.55	7.43	3.41	7.63	46.62
B SERIES LWB EXCEPT STATION WAGON	36.56	18.28	55.40	27.46	54.92	68.58	72.28	6.74	10.09	4.83	16.55	7.43	3.41	7.63	49.12
B SERIES STATION WAGON	36.56	18.28	55.40	24.43	48.86	70.16	66.46	6.74	10.09	4.83	13.98	10.25	3.38	7.98	46.62
G SERIES	41.30	20.65	53.04	21.59	43.18	62.19	68.18	7.10	12.07	4.85	12.38	8.06	4.76	10.78	
A SERIES 4 DOOR MODELS	41.30	20.65	53.04	21.59	43.18	66.19	68.18	7.03	11.05	4.30	14.11	7.91	4.59	10.63	
A SERIES 2 DOOR MODELS	41.30	20.65	53.04	21.59	43.18	62.19	68.18	7.03	11.05	4.30	14.11	7.91	4.59	10.63	
A SERIES STATION WAGON	41.30	20.67	53.04	21.59	43.18	66.19	78.38	7.03	11.05	4.30	14.11	7.91	4.59	9.43	

Fig. 2-4 Frame Alignment Chart





MODELS	1 MOUNT	2 MOUNT	3 MOUNT	4 MOUNT	5 MOUNT	6 MOUNT	7 MOUNT
B Series Exc. Station Wagon & Heavy Duty Chassis	B	A	E	C	B	C	C
B Series Station Wagon	A	A	D	A	–	P	P
B Series Heavy Duty Chassis	A	A	O	–	–	–	–
A Series 2 Dr. LeMans	G	K	H	M	M	M	J
A Series 2 Dr. LeMans Sport & LeMans Luxury	G	K	H	M	M	F	J
A Series Conv. & Station Wagon	L	K	H	F	M	F	J
A Series 4 Dr. Exc. Station Wagon	L	K	M	M	M	F	J
G Series	G	N	H	M	M	F	J

MOUNT COMBINATION	NUT	UPPER CUSHION	LOWER CUSHION	WASHER	BOLT
A	–	483451	3991230	–	3859709
B	–	483480	–	–	–
C	–	483452	3991230	–	3859709
D	–	483451	3993679	–	3859709
E	–	483452	3993679	–	3859709
F	–	483734	9787703	3760886	1366144 3859709
G	–	479055	–	–	–
H	–	483734	9787703	3760886	3902231
J	–	483735	9787703	3760886	3859709 3902231
K	8779124	9791997	9787703	3760886	3859709 3902232
L	8779124	483734	9787703	3760886	3859709 3902232
M	–	9798420	–	–	–
N	8779124	9791997	399673	3760886	3859709 3902232
O	–	484268	3993679	–	3859709
P	–	486374	3991230	–	3859709

Fig. 2-5 A, B and G Frame Body Mounts

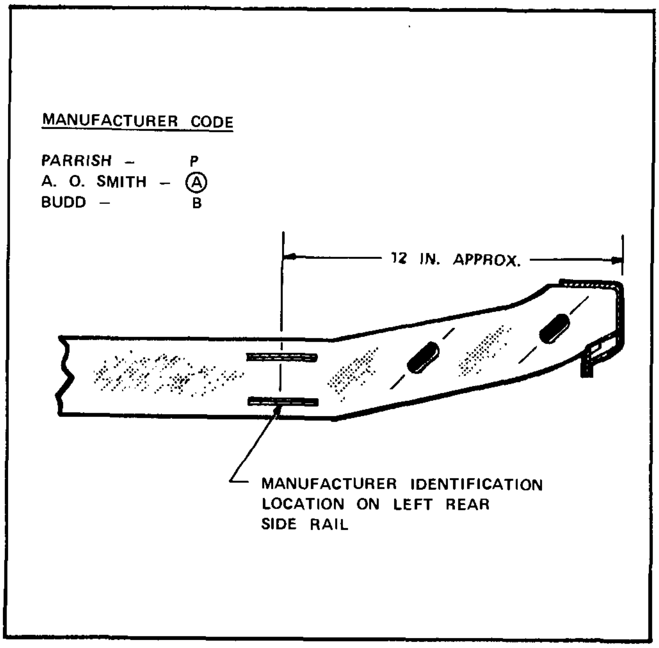


Fig. 2-6 Frame Identification

SECTION 3

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

TROUBLE DIAGNOSIS AND TESTING

TIRES WEARING UNEVEN OR SCUFFING

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Tires improperly inflated.	a. Inflate tires to recommended pressure.
b. Excessive speed on turns.	b. Caution driver.
c. Excessive wheel or tire run-out.	c. Check wheels and tires for wobble and proper mounting.
d. Toe-in incorrect.	d. Adjust toe-in as required.
e. Uneven camber.	e. Check camber and adjust as necessary.
f. Incorrect toe-out on turns.	f. Steering linkage is bent and damaged part must be replaced.
g. Control arm or steering knuckle bent.	g. Inspect bushings, control arm or steering knuckle. Bent and damaged parts must be replaced.

TIRES CUPPING

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Tires improperly inflated.	a. Inflate tires to recommended pressure.
b. Excessive mileage without rotating tires.	b. Rotate tires every 6,000 miles.
c. Wheel bearings incorrectly adjusted or worn.	c. Adjust or replace parts as necessary.
d. Uneven camber.	d. Check camber and adjust as necessary.
e. Toe-in incorrect.	e. Adjust toe-in as required.
f. Tires out of balance	f. Balance wheel and tire assemblies

FRONT WHEEL SHIMMY AT LOW SPEEDS

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Low or uneven tire pressure.	a. Inflate tires to recommended pressure.
b. Eccentric or bulged tires.	b. Replace tires as necessary.
c. Excessive wheel or tire run-out.	c. Check wheels and tires for wobble, radial run-out and proper mounting.
d. Front wheel bearings incorrectly adjusted or worn.	d. Adjust or replace bearings as necessary.
e. Stabilizer shaft inoperative.	e. Inspect bushings and links and replace worn parts.
f. Steering linkage incorrectly adjusted or worn.	f. Adjust or install new parts as necessary.
g. Steering gear incorrectly adjusted.	g. Adjust steering gear.
h. Incorrect or uneven caster.	h. Check and adjust caster as necessary.
i. Toe-in incorrect.	i. Adjust toe-in as required.
j. Steering knuckle bent or control arm bushing loose or bent.	j. Inspect bushings, control arm or steering knuckle. Bent and damaged parts must be replaced.

TROUBLE DIAGNOSIS (Continued)

FRONT WHEEL TRAMP AT HIGH SPEEDS

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Eccentric or bulged tires.	a. Replace tires as necessary.
b. Wheel or tire not concentric.	b. Replace wheel or tire.
c. Wheels, tires or brake drums out of balance.	c. Balance wheels and tires. Also check for out-of-balance brake drums.
d. Stabilizer shaft inoperative.	d. Inspect bushings and links and replace worn parts.
e. Shock absorbers inoperative.	e. Install new shock absorbers.

ROAD SHOCK OR STEERING KICK BACK OVER ROUGH ROADS OR BUMPS

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. High air pressure in tires.	a. Bleed tires to recommended pressure but not when warm.
b. Wrong type or size tires used.	b. Install new tires of correct type and size.
c. Front wheel bearing incorrectly adjusted or worn.	c. Adjust or replace bearings as necessary.
d. Steering gear or connections incorrectly adjusted.	d. Adjust steering gear and connections. Refer to Section 9 for diagnosis of steering kick back in steering system.
e. Excessive caster.	e. Check caster and adjust as necessary.
f. Shock absorbers inoperative.	f. Install new shock absorbers.

HARD STEERING

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Low or uneven tire pressure.	a. Inflate tires to recommended pressure, Section 10.
b. Insufficient or incorrect lubricant.	b. Check lubricant in steering gear and lubricate steering system as required.
c. Steering gear or connections adjusted too tight.	c. Test steering system for bind with front wheels off floor. Refer to Section 9 for diagnosis of HARD STEERING in steering systems.
d. Front spring sagged.	d. Check front end jounce height. Jounce height should be approximately the same at both wheels. Compare dimensions with those on car having about same mileage and equipment and believed to be standard. Replace front springs if sagged.
e. Excessive caster.	e. Check caster and adjust as necessary.

TROUBLE DIAGNOSIS (Continued)

HARD STEERING (Continued)

CAUSE	CORRECTION
f. Control arm or steering knuckle bent.	f. Inspect bushings, control arm or steering knuckle. Bent and damaged parts must be replaced.
g. Frame bent or broken.	g. Repair or replace frame as necessary.

ERRATIC STEERING ON BRAKE APPLICATION

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Low or uneven tire pressure.	a. Inflate tires to recommended pressure.
b. Front wheel bearings incorrectly adjusted.	b. Adjust bearings as necessary.
c. Brakes incorrectly or unevenly adjusted.	c. Adjust brakes.
d. Oil or brake fluid on brake lining.	d. Replace lining and correct leaks.
e. Front spring sagged.	e. Check front end jounce height. Jounce height should be approximately the same at both wheels. Compare dimensions with those on car having about same mileage and equipment and believed to be standard. Replace front springs if sagged.
f. Incorrect or uneven caster.	f. Check and adjust caster as necessary.
g. Steering gear off center position.	g. Adjust or repair steering gear.

CAR PULLS TO RIGHT OR LEFT

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Low or uneven tire pressure.	a. Inflate tires to recommended pressure.
b. Wheel bearings adjusted too tight.	b. Adjust wheel bearings.
c. Brakes incorrectly or unevenly adjusted.	c. Adjust brakes.
d. Front springs sagged.	d. Check as outlined under HARD STEERING.
e. Incorrect or uneven caster or camber.	e. Check caster and camber and correct by adjustment or by replacing worn or faulty parts.
f. Toe-in incorrect.	f. Adjust toe-in as required.
g. Rear wheels not tracking with front wheels.	g. Check entire rear suspension.
h. Steering knuckle, control arm or steering linkage bent.	h. Replace damaged parts.
i. Frame bent or broken.	i. Check frame for proper alignment and repair or replace frame as necessary.

TROUBLE DIAGNOSIS (Continued)

CAR WANDERS

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Low or uneven tire pressure.	a. Inflate tires to recommended pressure.
b. Steering gear or connections adjusted too loose or worn.	b. Adjust or install new parts as necessary.
c. Steering gear or connections adjusted too tight.	c. Test steering system for bind with front wheels off floor. Refer to Section 9 for steering system diagnosis.
d. Stabilizer shaft inoperative.	d. Inspect bushings and links and replace worn parts.
e. Bind in upper control arm shaft.	e. Free up or replace parts.
f. Front suspension control arm or steering knuckle bent.	f. Check steering axis inclination. If it is incorrect, control arm or steering knuckle is bent and damaged parts must be replaced.
g. Incorrect or uneven caster or camber.	g. Check caster and camber and correct by adjusting or by replacing worn or faulty parts.
h. Toe-in incorrect.	h. Adjust toe-in as required.
i. Rear axle shifted.	i. Check entire rear suspension.
j. Frame bent or broken.	j. Check frame for proper alignment and repair or replace frame as necessary.

SHOCK ABSORBER DIAGNOSIS

Shock absorber diagnostic procedures are divided into two sections:

A. - On Car Checks

B. - Bench Checks

A. ON CAR CHECKS

Follow the Procedures Outlined Below in the Order Indicated

I. Preliminary Inspection and Ride Test

a. Tire Pressure

Check tire pressure to vehicle specifications and adjust as required. *Poor vehicle control and ride complaints are caused in many cases by improper tire inflation.*

b. Special Suspension Equipment

Check with owner for any special suspension equipment; such as, a ride and handling package, heavy duty suspension, etc. Cars equipped with this type of option may have a somewhat stiffer ride, and this should be kept in mind during the following tests. If a complaint about stiffness should occur while car is still new (under 5,000 miles), owner should be advised to have ride rechecked after 7,000 to 8,000 miles.

c. Vehicle Load Conditions

Note any exceptional load conditions under which the car normally operates, such as, large tool boxes full of tools, trunk full of books, etc. If exceptional loading is apparent, check the distribution of this weight. Note if it is all toward one side of the vehicle or at the extreme rear of the trunk. Reposition load as required to obtain a more uniform weight distribution.

d. Check Vehicle Ride and Handling

After completing previous checks, ride vehicle with owner to determine if problem has been corrected or to definitely establish type of problem that still exists. If problem still exists (poor handling, bottoming, noise, ride sway, etc.), proceed to Step II.

II. Inspection and Testing the Shocks

Three procedures are included in this step. They are (a) Bounce Test, (b) Inspecting Shock Mountings for Noise (Looseness) and (c) Manually Operating Shocks to Determine if Shocks are Weak, Leaking Hydraulic Fluid, and/or if Shocks have an Internal Noise Condition.

TROUBLE DIAGNOSIS (Continued)

NOTE: *Test procedures (b) and (c) require vehicle to be on a hoist that supports wheels.*

a. Bounce Test

NOTE: *This is only a comparison type test to help locate the suspected shock or noise condition before proceeding to Steps (b) and (c).*

Test each front and rear shock by bouncing each corner of the vehicle. This can usually be done by lifting up and pushing down on the end of the bumper near each corner of the vehicle until maximum movement up and down is reached. Then let go of bumper and observe if the up and down motion stops very quickly. If up and down motion continues longer at one corner when compared to opposite corner (example, both front shocks), the one having the longer up and down motion may be suspect. *Do Not* compare front to rear. If complaint is noise, this test should help to locate the suspected area.

b. Inspecting Shock Mountings

If noisy and/or loose shock mountings are suspected, place vehicle on hoist that supports wheels and check all mountings for the following conditions:

1. Worn or defective grommets
2. Loose mounting nuts
3. Possible interference condition
4. Bump stops (rubber rebound bumpers) missing

If no apparent defects are noted in this step but noise condition still exists when vehicle is bounced up and down, proceed to test procedure C.

c. Inspecting Shocks for Leaks and Manually Operating Shocks

This procedure is sub-divided into two general areas, (1) Inspecting Shocks for Loss of Hydraulic Fluid and (2) Manually Operating Shocks. It should aid to localize defective shocks caused by internal noise in the shock, weak, leaking, etc.

1. Inspecting Shocks for Possible Loss of Hydraulic Fluid

(a) Disconnect each shock lower mounting as required and pull down on the shock until it is fully extended.

(b) Inspect shocks for leaks in seal cover area. Shock fluid is a very thin hydraulic fluid and has a characteristic odor and dark brown tint. See Fig. 3-1.

Certain precautions should be observed when inspecting shocks for leaks:

- Shocks may have glossy paint on them. Do not confuse this paint with a leak condition.

- A slight trace of shock fluid around the seal cover area is *not* cause for replacement. The shock seal is engineered to permit a very slight seepage to lubricate the rod. The shock absorber has reserve fluid to compensate for the slight seepage.

- Shocks are sometimes incorrectly diagnosed as leakers due to oil spray originating from some other source. If in doubt, wipe the wet area and manually operate shock as described in Step (2). Fluid will reappear if shock is leaking.

2. Manually Operating Shocks

NOTE: *It may be necessary with certain types of shock mountings to fabricate a bracket that can be installed on a shock to enable a secure grip of the shock when manually operating the shock. See Fig. 3-2 for suggested methods of providing a temporary grip.*

This test should help to isolate the following shock defects:

- loose piston
- binding condition internally
- verify leaking shock
- improper or defective valving

(a) If suspected problem is in front shocks, disconnect both front shock lower mountings and stroke each shock as follows: Grip the lower end of the shock securely and pull down (rebound stroke) then push up (compression

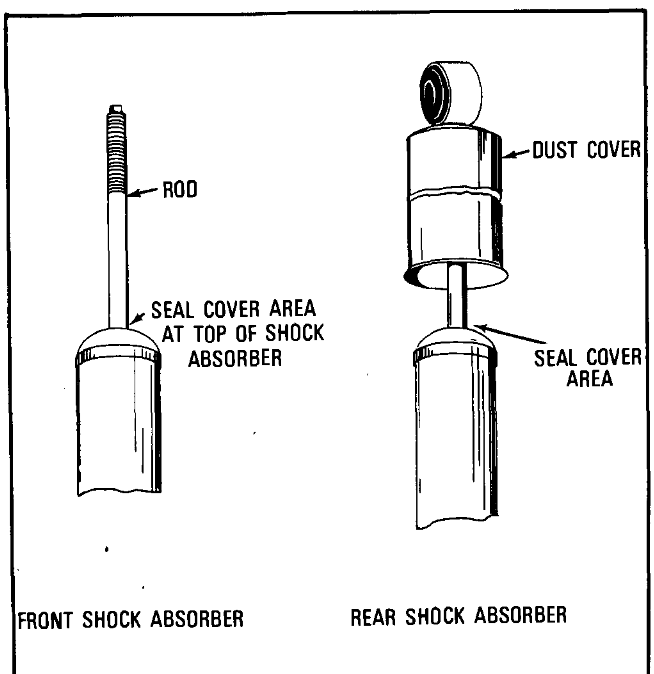


Fig. 3-1 Seal Cover Area of Shock

TROUBLE DIAGNOSIS (Continued)

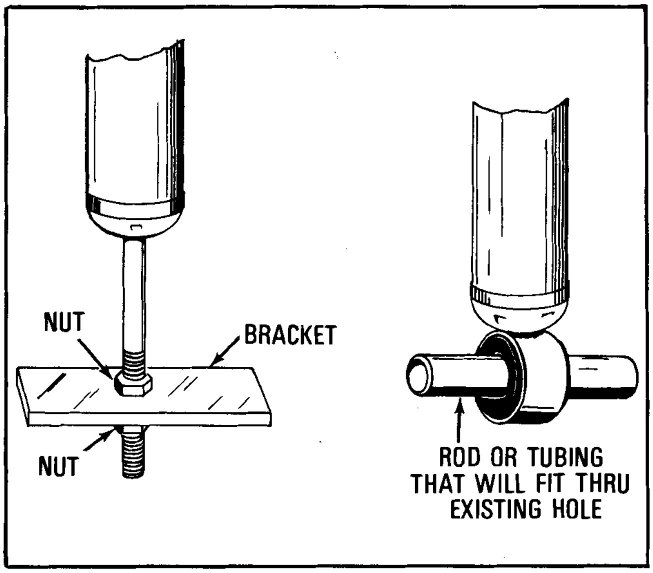


Fig. 3-2 Gripping Methods for Manually Operating Shocks

stroke). The control arms will limit the movement of the front shocks during the compression stroke. Compare the rebound resistance between both front shocks, then compare the compression resistance. If a noticeable difference can be felt during either stroke, usually the shock having the least resistance is at fault.

(b) If shock has an internal noise condition, extend shock fully, then exert an extra pull. If a small additional movement is felt, a loose piston is indicated and shock should be replaced. Other noise conditions that require shock replacement are:

- a grunt or squeal after one full stroke in both directions

- a clicking noise on fast reverse

- a skip or lag at reversal near mid-stroke

(c) If suspected problem is in rear shocks, follow the same procedure described for front shocks (Steps a. and b. above).

NOTE: *When air adjustable shocks (Superlift) are being manually operated, the air line must be disconnected at the shock absorber.*

B. BENCH CHECKS

The bench checks are recommended if the proper type hoist is not available to perform the "on car" tests, or if there is still some doubt as to whether the shocks are defective. In addition, the bench test allows a more thorough visual inspection.

Bench check procedures are discussed for two general types of shocks. Refer to Figures 3-3 and 3-4.

I. Spiral Groove Reservoir

II. Superlift

I. Spiral Groove Reservoir

The spiral groove reservoir type shock is installed as original equipment.

NOTE: *If this type of shock has been stored or allowed to lay in a horizontal position for any length of time, an air void will develop in the pressure chamber of the shock absorber. This air void, if not purged, can cause the shock to be diagnosed as defective. To purge the air from the pressure chamber, proceed as follows: (See Fig. 3-5).*

(a) Holding the shock in its normal vertical position (top end up), fully extended shock.

(b) Hold the top end of the shock *down* and fully collapse the shock.

(c) Repeat Steps (a) and (b) at least five (5) times to assure air is purged.

a. Bench Test Procedure

1. This is a comparison type test. If possible, obtain a new or known good shock with same part number as shock under test.

2. With shocks in vertical position (top end up) clamp bottom mounts in vise.

CAUTION: *Do not clamp on reservoir tube or mounting threads.*

3. Manually pump each shock by hand at various rates of speed and compare resistance of suspected shock with the new one.

NOTE: *Rebound resistance (extending the shock) is normally stronger than the compression resistance (approximately 2:1). However, resistance should be smooth and constant for each stroking rate.*

4. Observe or listen for the following conditions that will indicate a defective shock:

- a skip or lag when reversing stroke at mid travel

seizing or binding condition except at extreme end of either stroke

TROUBLE DIAGNOSIS (Continued)

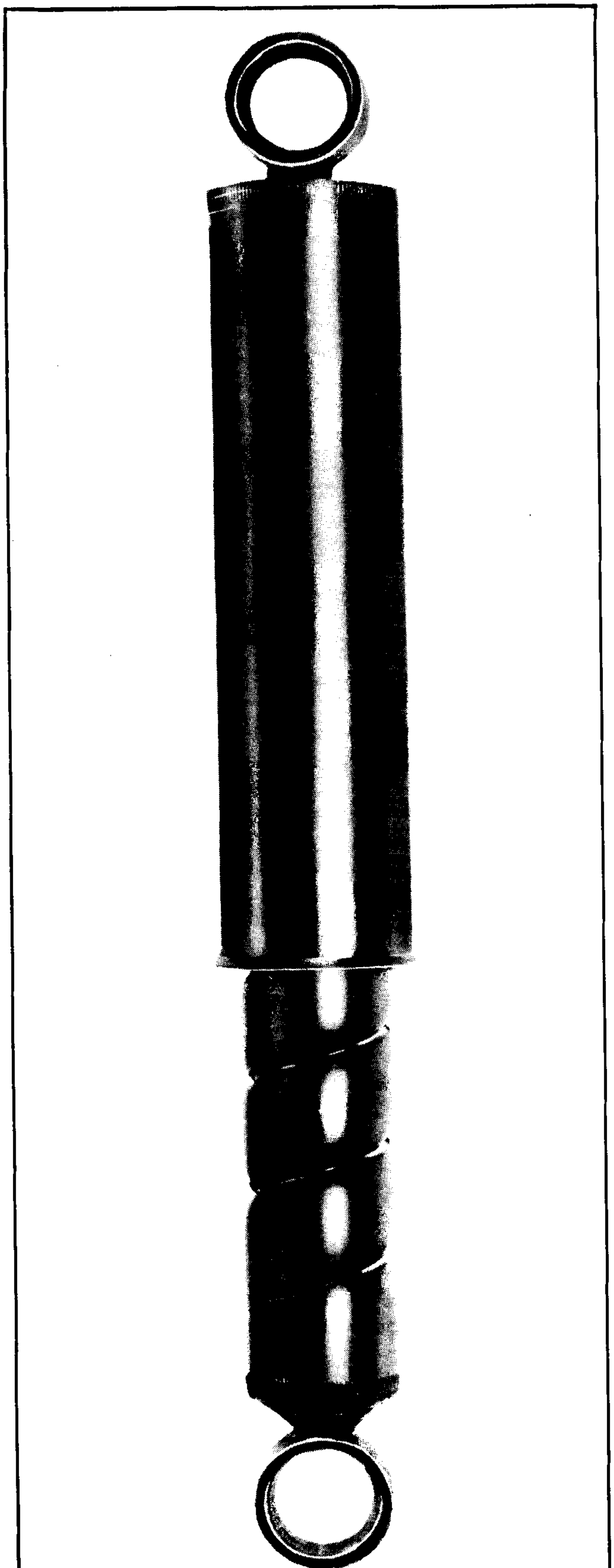


Fig. 3-3 Spiral Groove Reservoir Shock Absorber

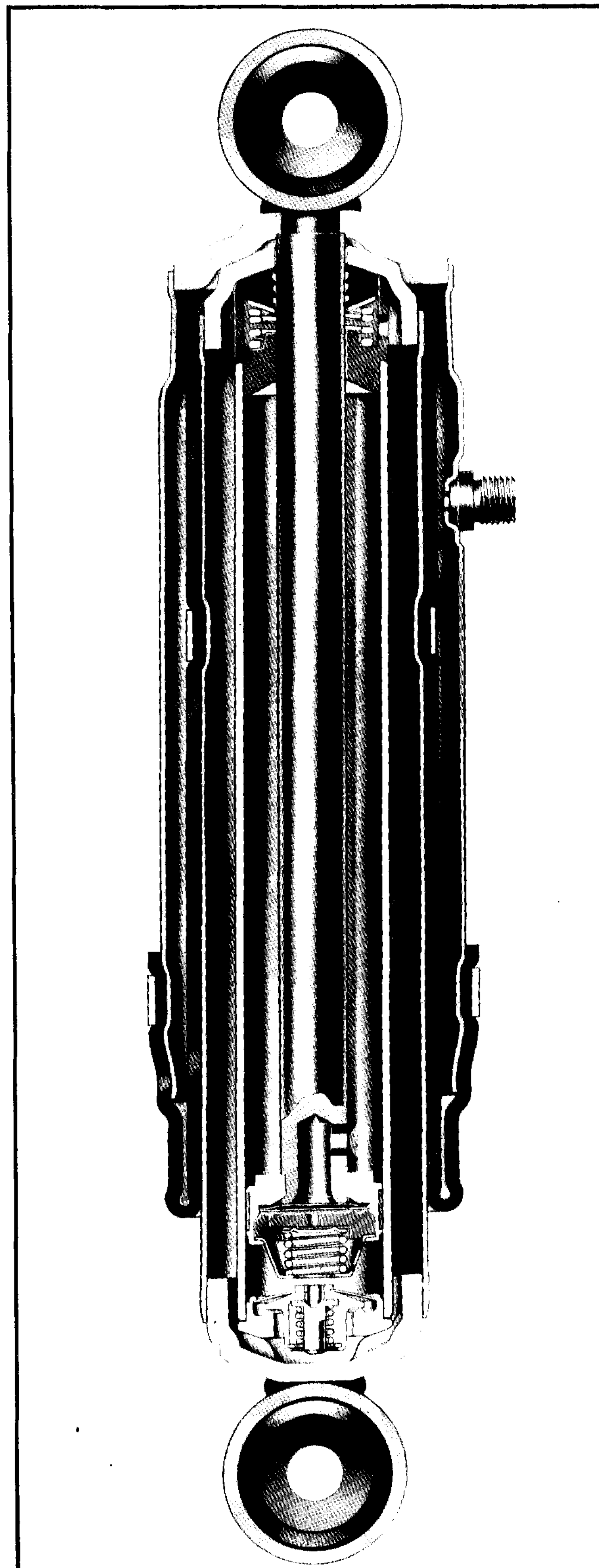


Fig. 3-4 Superlift Shock Absorber

TROUBLE DIAGNOSIS (Continued)

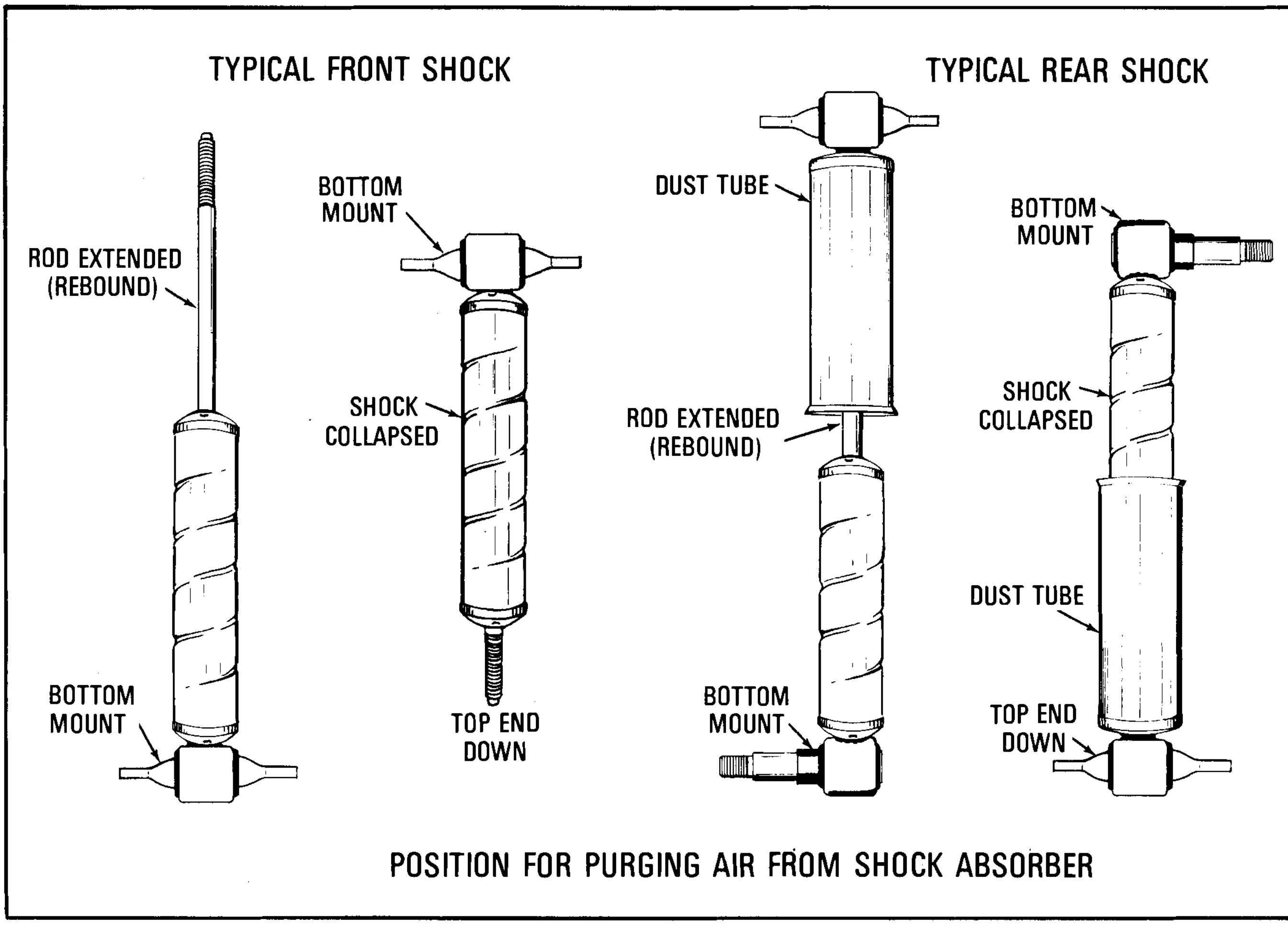


Fig. 3-5 Position for Purging Air from Shock

- a noise, such as a grunt or squeal, after completing one full stroke in both directions
- a clicking type noise at fast reversal
- fluid leakage

5. To check for a loose piston, completely extend shock to full rebound; then exert an extra hard pull. If a give is felt, a loose piston is indicated and shock should be replaced.

II. Gas Filled Cell

The reservoirs of gas-filled cell shocks are smooth, compared to the spiral goove type. The cell takes the place of air in the reservoir. Thus, aeration or foaming of the fluid is eliminated, as air and fluid cannot mix.

Due to this feature, these shocks should be bench checked in an inverted position (top end down). If, when stroked, a lag is notices, it means the gas-filled cell has been ruptured, and the shock should be replaced. If no lag is noticed, the remainder of the bench check is the same as given in the Spiral Groove Reservoir, Section I, Bench Check Procedure.

The gas-filled cell feature is used in the service replacement shocks.

III. Superlift

These shocks contain an air chamber like the spiral groove reservoir type, and must have the air purged from the working chamber. See Section I, Spiral Groove Reservoir. After air has been purged from shock, proceed as follows:

a. Clamp lower shock mounting ring in vise in vertical position with larger diameter tube at the top.

b. Pump unit by hand. Smooth resistance should be felt throughout the length of the stroke. Since the units are normally pressurized, the sound of air bubbles or a gurgling noise is normal.

c. The remainder of the bench check is the same as given in the Spiral Groove Reservoir, Section I, Bench Check Procedure.

TROUBLE DIAGNOSIS (Continued)

C. LISTED BELOW ARE CONDITIONS OR CAUSES OF THE MOST COMMON SHOCK ABSORBER COMPLAINTS AND THE CORRECTIVE ACTION WHICH SHOULD BE TAKEN.

CONDITION OR CAUSE	CORRECTION
1. Shock Leaking	
a. Slight seepage	None - Normal condition (II, C, 1)
b. Chassis black paint	None - Normal condition, gives appearance of leak (II, C, 1)
c. Oil spray from other source	Locate source and correct (II, C, 1)
d. Leaking	Replace unit
2. Shock Noisy	
a. Loose mounting	Tighten to proper torque
b. Worn or defective grommets	Replace grommets if possible
c. Interference	Eliminate interference
d. Internal noise	Disconnect bottom end and stroke shock. Replace if noisy.
3. Ride Sway or Body Lean In Corners	
a. Improper tire inflation	Check and adjust to vehicle specifications
b. Incorrect shocks	Compare to parts book
c. Incorrect springs	See SECTIONS 3 & 4 - FRONT AND REAR SUSPENSION
d. Stabilizer bar loose	See SECTION 3 - FRONT SUSPENSION
e. Front alignment	See SECTION 3 - FRONT SUSPENSION
f. Shock leaking	See Condition One
g. Weak shock	Bounce test (II, A), replace one (1) shock if noticeably waker than mate
h. Steering system	See Shop Manual - STEERING
4. Large Body Motions or Ride Too Soft	
a. Secondary or rough roads	Normal - Recommend HD shocks at owner's expense
b. Incorrect shock	Compare to parts book
c. Shock leaking	See Condition One
d. Weak shock	Bounce test (II, A), replace one (1) shock if noticeably weaker than mate
5. Bottoming (Light Load - Driver and One Passenger)	
a. Incorrect springs or low standing height	See shop manual - front and rear suspension
b. Incorrect shock	Compare to parts book
c. Leaking shock	See Condition One
d. Weak shock	Bounce test (II, A), replace one (1) shock if noticeably weaker than mate
e. Bump stop missing	Inspect and replace
f. Secondary or rough roads	Recommend Superlifts at owner's expense
6. Bottoming (Heavy Load - More Than Above)	
a. Exceeding maximum rated load for vehicle	Inform owner and recommend Superlifts at owner's expense
b. Incorrect springs or low standing height	See shop manual - front and rear suspension
c. Incorrect shock	Compare to parts book
d. Secondary or rough roads	Recommend Superlifts at owner's expense
7. Low or Uneven Trim Height	
a. Shock cannot correct	See shop manual - front and rear suspension

TROUBLE DIAGNOSIS (Continued)

CONDITION OR CAUSE (Continued)	CORRECTION (Continued)
8. Abnormal Tire Wear a. System variations	Almost always due to variations in the system other than shock absorbers. Only a totally inoperative shock can contribute to abnormal tire wear.
9. Hard Ride	
a. Overinflated tires	Check and adjust to vehicle specifications
b. Incorrect springs or low standing height	See shop manual - front and rear suspension
c. Incorrect shocks	Compare to parts book
d. Heavy duty suspension	Normal
e. Bump stop missing	Inspect and replace
f. Shock binding	Disconnect bottom end and stroke shock Replace if binding
g. Weak shock	Bounce test (II, A), replace one (1) shock is noticeably weaker than mate

GENERAL DESCRIPTION

Independent front suspension is used on all models (Fig. 3-6). Each wheel is attached to the frame by means of a steering knuckle, upper and lower control arm and ball joint assembly (Fig. 3-7). The front wheels are held in proper relation to each other for steering by linkage which attaches to the steering knuckle (see Section 9, STEERING).

An integral steering knuckle which is a combination steering knuckle, brake caliper support and steering arm is used on B Series and F Series. The spindle is pressed into the steering knuckle, however, the spindle and steering knuckle are only serviced as a complete assembly.

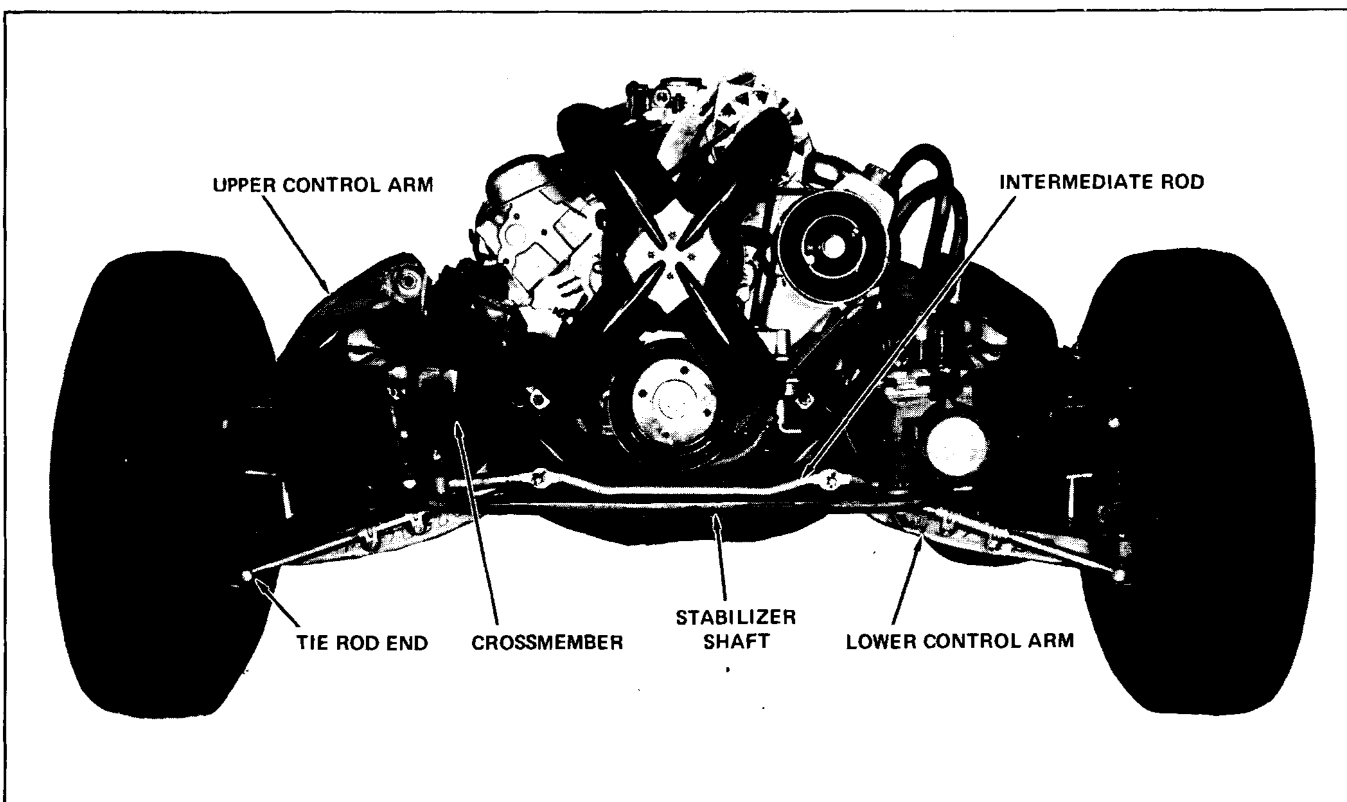


Fig. 3-6 Typical Independent Suspension (B Series Shown)

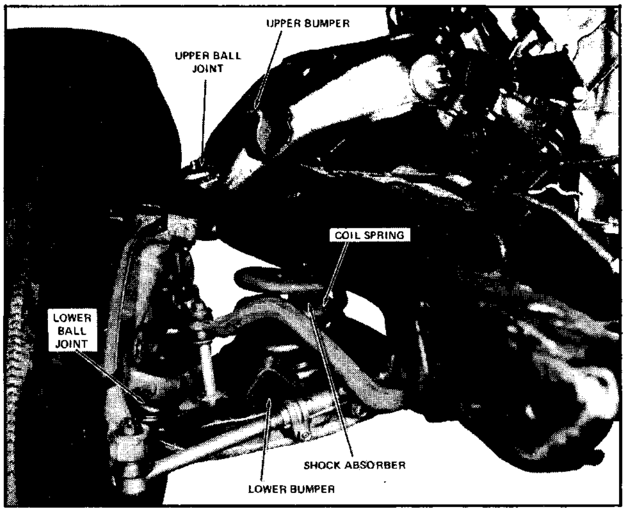


Fig. 3-7 Front Suspension Components

The inner end of the lower control arm is connnected to the frame with rubber pivot bushings and the outer end to the steering knuckle with a ball joint.

The inner end of the upper control arm is attached with rubber bushings to a cross shaft which bolts to the frame. Shims are located between the cross shaft and frame to adjust caster and camber to specifications. The outer end of the upper control arm is attached to the steering knuckle with a ball joint.

Both upper and lower ball joints have lubrication fittings. Fixed boot neoprene grease seals protect the ball joints from dirt and water and act as a grease retainer. The seal is not serviced. Removal or damage to the seal necessitates replacement of the complete ball joint assembly. The seal has a one-way relief valve so that service lubrication can be performed.

Side roll stability is maintained with a steel stabilizer shaft (Fig. 3-6). All series have a stabilizer shaft except X Series - 6 cyl. without air conditioning. It is mounted in rubber bushings, supported by brackets at each frame side rail forward of the springs. The ends of the stabilizer shaft are connected to the lower control arm by short links which have rubber grommets at both ends to prevent rattle, except the A Series handling option (not firm ride) used plastic grommets.

Coil springs are located between each frame side rail and lower control arm. Sealed, direct-acting, double-action shock absorbers are located inside each front coil spring.

Maximum full compression or rebound travel of the suspension is restricted from metal-to-metal contact by rubber bumpers. Bumpers attached to the frame below the upper control arm or on some models to the upper control arm cushion rebound travel. Bumpers attached to the lower control arm cushion compression travel (Fig. 3-7).

SHOCK ABSORBERS

DESCRIPTION

Shock absorbers are hydraulic devices that help to control the up-and- down and rolling motion of a car body while at the same time controlling wheel and axle motions. The car's springs support the body, but shock absorbers work with the springs to control movements of the body, wheel, and axle. They do this by changing the energy of these movements into heat. This energy transformation (damping) is accomplished by forcing an incompressible fluid through a system of small orifies (holes) and valves. Shock absorbers generate enough heat during operation that they often are too hot to touch after a car has been driven over a rough road. The hydraulic fluid used in shock absorbers was developed to withstand these high temperatures as well as low temperatures encountered during winter months.

There are four shock absorbers on a car; one located near each wheel. They are direct-acting because of their direct connection between the car frame (body) and the axle (or wheel mounting member). They are also double-acting because they control motion in both directions of the suspension travel. Upward movements of the body are termed *rebound* and downward movements, *compression*.

The rapid movement of the fluid between the chambers during the rebound and compression strokes can cause aeration or foaming of the fluid (aeration is the mixing of free air and the shock fluid). When aeration occurs, the shock develops lag (piston moving through an air pocket which offers no resistance). There are two means of eliminating aeration used. One is a spiral groove reservoir tube, installed as original equipment, which breaks up the air bubbles in the fluid. The other is a gas filled cell, used for service replacement, which replaces the free air in a shock absorber.

Standard and heavy duty shock absorbers are filled with a calibrated amount of fluid and sealed during production. They are non-adjustable, nonrefillable and cannot be disassembled. The only service they require is replacement if they have lost their resistance, are damaged, or leak oil.

OPERATION

Although a shock absorber operates according to basic hydraulic principles, it may appear somewhat complicated. Fig. 3-8 gives an easier understanding of how a shock absorber works by dividing the shock absorber into four distinct chambers: A-The chamber above the piston, B-The chamber below the piston, C-The reservoir chamber below the fluid level and D-The air volume in the reservoir above the fluid level.

When the car wheel strikes a bump, it forces the axle and bottom section of the shock absorber up toward the body. This makes the shock absorber sections move toward each other (called compression) and build up pressure against the fluid in chamber B of the cylinder tube.

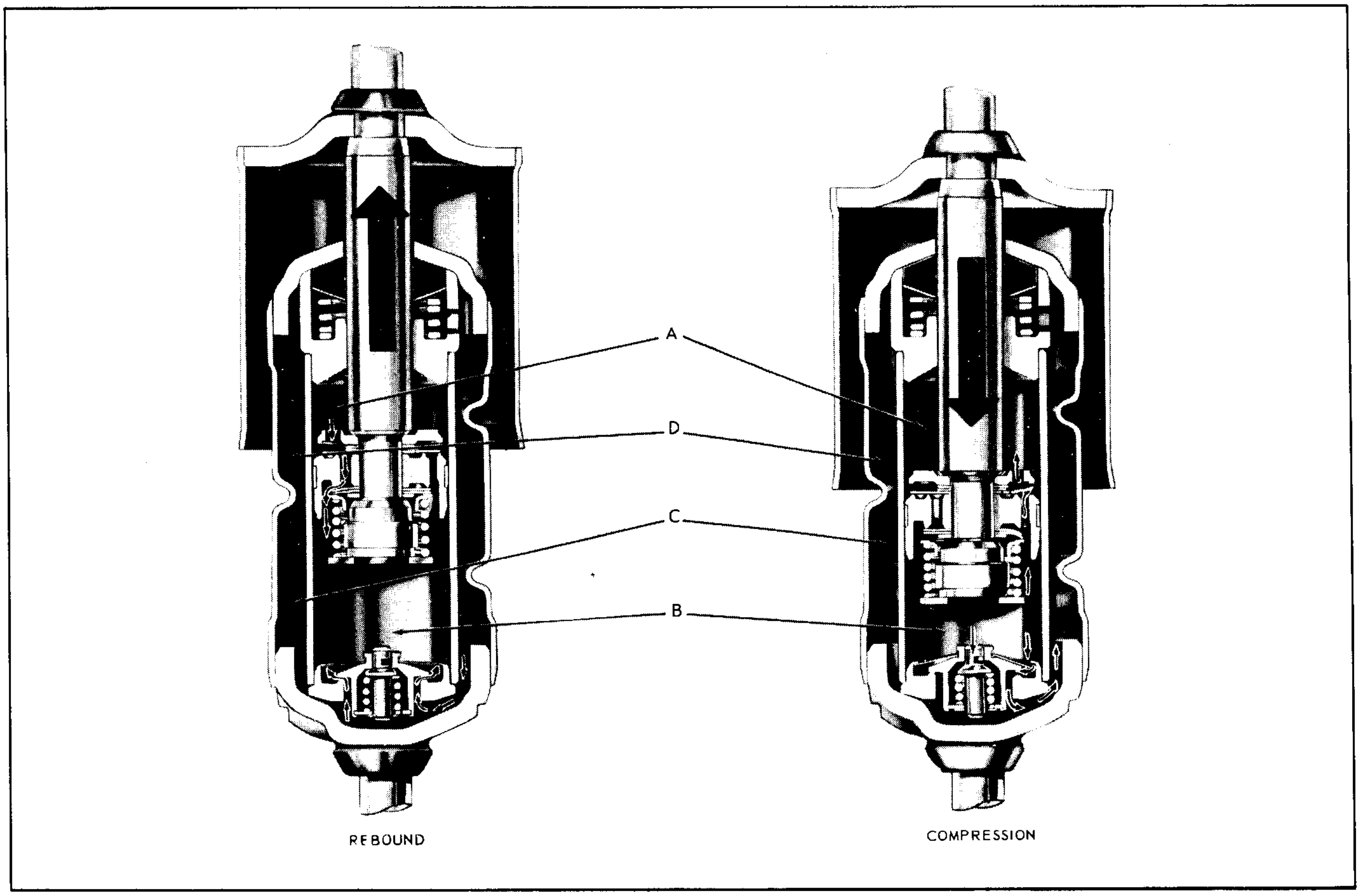


Fig. 3-8 Shock Absorber

This pressure forces fluid through the intake valve into chamber A. Because of the space taken up by the piston rod, chamber A cannot hold all of the fluid from chamber B and the excess fluid from B is forced through the base valve into chamber C. As more fluid moves into chamber C, the air in chamber D is squeezed and the pressure increases.

When the energy of the bump is used up, the axle starts down and the shock absorber begins to move apart on the rebound stroke (Fig. 3-8). When this happens, fluid from chamber A is forced into chamber B through the rebound valve. At the same time, the cylinder intake valve opens, letting fluid from chamber C go back into chamber B. Because the movement of the piston is slowed by the fluid, the motion of the car body is also checked.

SUSPENSION ALIGNMENT

Front suspension components are adjusted to a specific alignment while the vehicle is motionless and at curb weight and height (see Curb Height chart in Section 0) so that suspension components can properly function together when vehicle is moving to minimize tire wear and maintain desirable steering and handling characteristics.

Steering axis inclination, toe-out on turns and rear suspension alignment is maintained by design and is not adjustable.

CASTER

Caster is the forward or rearward tilt of ball joints compared to a vertical line when viewing the vehicle from the side (Fig. 3-9). Caster is provided to give directional stability in the vehicle.

Improper caster will cause very poor steering response and front wheel shimmy. Caster is adjusted by placing small steel shims between the upper control arm shaft and frame support. The shims can be placed either at the front or rear of the frame support. Adding shims to the front or removing shims from the rear of the support will cause the caster angle to tilt forward (negative caster). Adding shims to the rear or removing shims from the front of the support will cause the caster angle to tilt rearward (positive caster). The thickness of the shims used governs the amount of caster angle measurement.

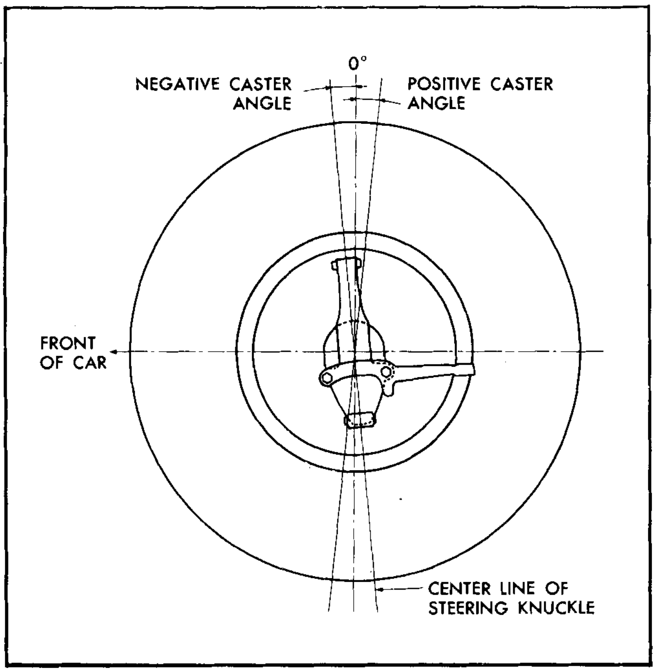


Fig. 3-9 Caster

CAMBER

Camber is a specific inward or outward tilt of the front wheel as compared to a vertical line when viewing the vehicle from the front (Fig. 3-10). Correct camber prevents the vehicle from pulling to the left or right when driven in a straight line and provides longer tire life.

Camber is adjusted by placing small steel shims between the upper control arm shaft and frame support. If shims are added, the camber angle will move inward (negative camber); if shims are removed, the camber angle will move outward (positive camber). Like caster, the thickness of the shim governs the amount of angle movement.

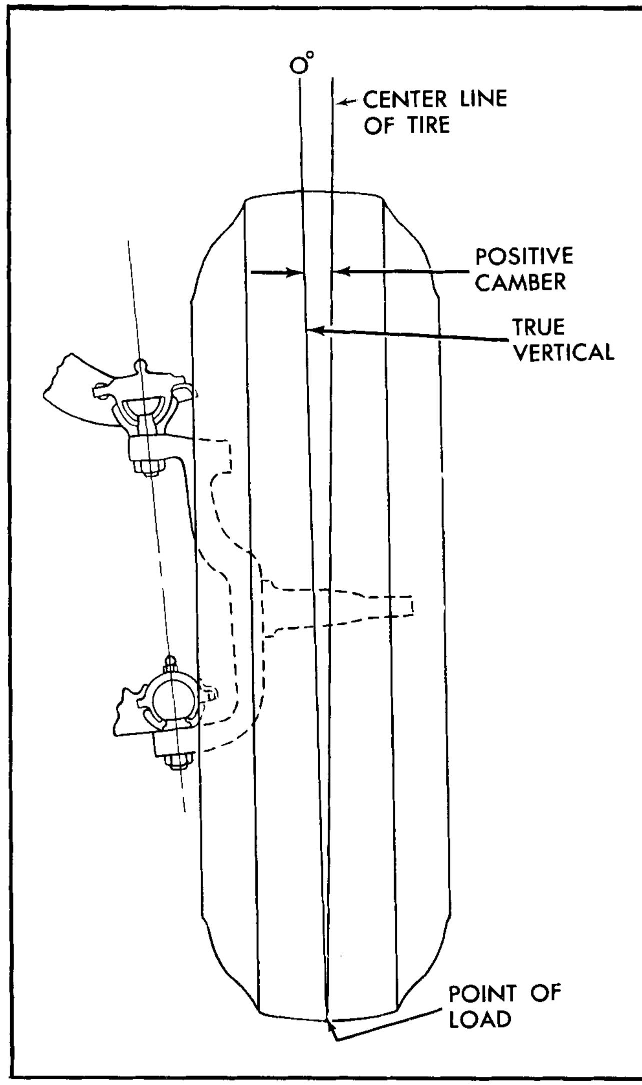


Fig. 3-10 Camber

TOE-IN

Toe-in is a measurement of the difference between the front and rear edges of the front tires as viewed from the top side of the front suspension system (Fig. 3-11). The measurement is taken with the vehicle standing still and will compensate for a stack up of clearance present in the steering system when the vehicle is driven. When a vehicle is moving, the front wheels have a tendency to turn outboard at the front. This is called toe-out; toe-in counteracts this tendency. This will result in good tire wear. One should keep in mind that toe-in is the most important alignment specification for good tire life.

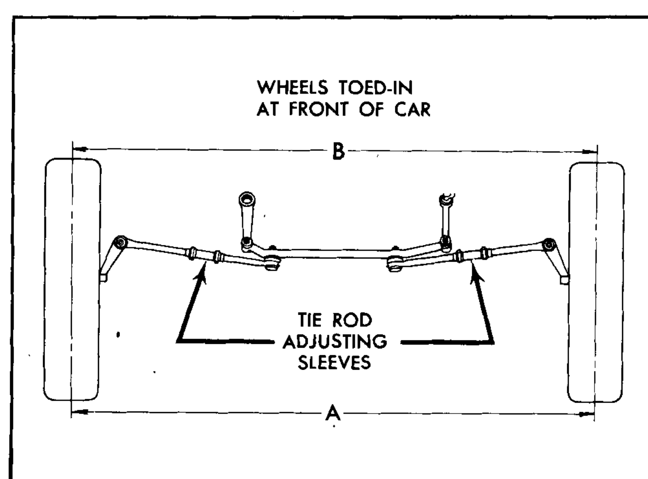


Fig. 3-11 Toe-In

CROSS CASTER AND CAMBER

This is the comparison of left side caster to right side caster and left side camber to right side camber.

CURB WEIGHT AND HEIGHT

All suspension (front wheel) alignment checks and adjustments must be made with car at curb weight and height.

Curb weight means weight of vehicle including production options and full capacity of engine oil, fuel and coolant. Tire pressures, accumulated dirt, mileage, etc. must be considered when checking curb height. To determine if car is at normal curb height, compare with a car of similar mileage, body style and comparable equipment.

Before measuring curb height, be sure suspension parts are properly lubricated. Jounce the front and rear of the car up and down, decreasing the amount of movement until the suspension parts are equalized.

> **NOTE:** *The dimensions shown in Section 0 are for new cars. Cars with service miles on them will average up to about 1" less than that specified for new cars.*

If curb height is out of limits, install spacers or replace springs as necessary.

> **NOTE:** *Good judgment must be exercised before replacing a spring from a car whose curb height is only slightly out of limits or, although low, is about the same at all four locations. Spring replacement under conditions of excessive weight from undercoating, road dirt, etc. will accomplish very little.*

BALL JOINT INSPECTION

UPPER BALL JOINT

The upper ball joint used on all models is a tension type ball joint. This ball joint is equipped with a rubber preload cushion and therefore, does not normally display looseness (Fig. 3-12). The accurate method for checking a ball joint for excessive wear is outlined below:

1. Be sure front suspension has been properly lubricated.
2. Raise front wheel and tire assembly off ground by supporting the lower control arm with a floor jack. Raise wheel and tire high enough so rubber rebound bumper is not touching the upper control arm or frame.
3. Examine all rubber bushings at upper and lower control arm. If split or worn, they must be replaced. Small cracks on the rubber surface are normal with age and do not affect bushing function.
4. Remove ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

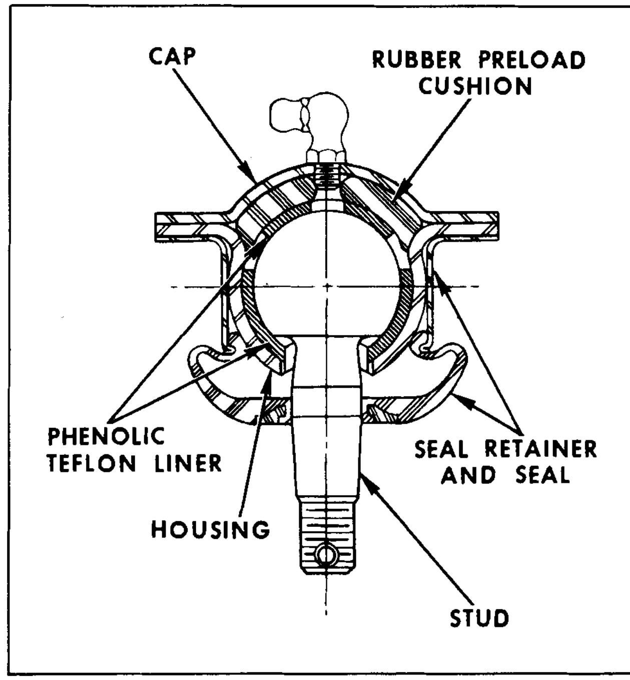


Fig. 3-12 Typical Upper Ball Joint (B Series Shown)

> **NOTE:** *Instead of using a pry bar, the PREFERRED METHOD using tool J 23742-1 can be used (Fig. 3-23).*

5. Raise upper control arm up and try to move control arm in and out or side to side. If there is any noticeable movement, the upper control arm bushings must be replaced.
6. Install ball joint retaining nut on ball stud. Using a socket and torque wrench, measure amount of torque required to turn the ball stud in its socket.

> **CAUTION:** *If any torque is required to rotate the ball stud, indications are that the ball joint is in a satisfactory condition. If zero torque is observed, sufficient wear has taken place and the ball joint should be replaced. In instances where a torque wrench is not available the ball joint can be satisfactorily checked by attempting to rotate the ball stud by hand. Some resistance should always be present.*

LOWER BALL JOINT - B & F SERIES

The lower ball joint used on B & F Series is a tension type ball joint. This ball joint is equipped with a rubber preload cushion and, therefore, does not normally display looseness (Fig. 3-12). The accurate method for checking a ball joint for excessive wear is outlined below:

1. Raise car and support front lower control arm under spring seat.

WARNING: THIS KEEPS SPRING COMPRESSED.

2. Remove hub and backing plate assembly or brake caliper assembly [see STEERING KNUCKLE (A, G & X Series) - REMOVE steps 2 through 5].

3. Remove lower ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 23742-1 can be used (Fig. 3-23).*

4. Install ball joint retaining nut on ball stud. Using a socket and torque wrench, measure amount of torque required to turn the ball stud in its socket.

   CAUTION: *If any torque is required to rotate the ball stud, indications are that the ball joint is in a satisfactory condition. If zero torque is observed, sufficient wear has taken place and the ball joint should be replaced. In instances where a torque wrench is not available the ball joint can be satisfactorily checked by attempting to rotate the stud by hand. Some resistance should always be present.*

LOWER BALL JOINT - A, G & X SERIES

The lower ball joint used on all A, G & X Series is a tension type joint. This type of ball joint is designed so that the coil suspension spring pressure is always keeping the ball stud, inside the ball joint, firmly in its seat. With this type ball joint, looseness will not normally be present. The accurate method for checking wear in this type ball joint is given below:

1. Raise car and support front lower control arm under spring seat.

WARNING: THIS KEEPS SPRING COMPRESSED.

2. Remove lubrication fitting from the ball joint.

3. Remove hub and backing plate assembly or brake caliper assembly [see STEERING KNUCKLE (A, G & X Series) - REMOVE steps 2 through 5].

4. Remove lower ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 23742-1 can be used (Fig. 3-23).*

5. Mount a dial indicator, using a "C" clamp and extension on lower control arm.

6. Position plunger of dial indicator into lubrication fitting hole so that plunger is touching base of ball stud inside ball joint.

7. Tighten all connections of the dial indicator mounting and set indicator to zero.

8. Grasp threaded portion of ball stud and pull straight up and down, noting reading of dial indicator. Repeat this step several times to get a stable average reading. If reading is over .050", the ball joint must be replaced.

GENERAL INFORMATION

Periodic service of the suspension system consists of regular lubrication as outlined in Section 0. Never attempt to straighten a bent part, replace it with a new part.

Lubrication fittings are provided at the front suspension ball joints. Shock absorbers do not require lubrication and, in case of leaks or malfunction, they should be replaced.

Periodically it may be necessary to make certain adjustments and checks of the suspension system to maintain desirable handling and steering characteristics and minimize tire wear. These checks are: front wheel bearings, wheel and tire balance, wheel and tire lateral run-out, upper and lower control arm spherical ball joints, chassis springs, shock absorbers, and wheel alignment. They are made with the parts on the car.

FRONT WHEEL BEARINGS

CHECK ADJUSTMENT

NOTE: *Tapered roller bearings are used on all series and they have a slightly loose feel when properly adjusted. This differs from ball bearings which may be pre-loaded without adverse effect. A design feature of front wheel taper roller bearings is that they must never be preloaded. Damage can result by the steady thrust on roller ends which comes from pre-loading (Figs. 3-13, 3-14 and 3-15).*

1. Raise car and support at front lower control arm.

2. Spin wheel to check for unusual noise.

3. If bearings are noisy or excessively loose, they should be cleaned and inspected prior to adjustment.

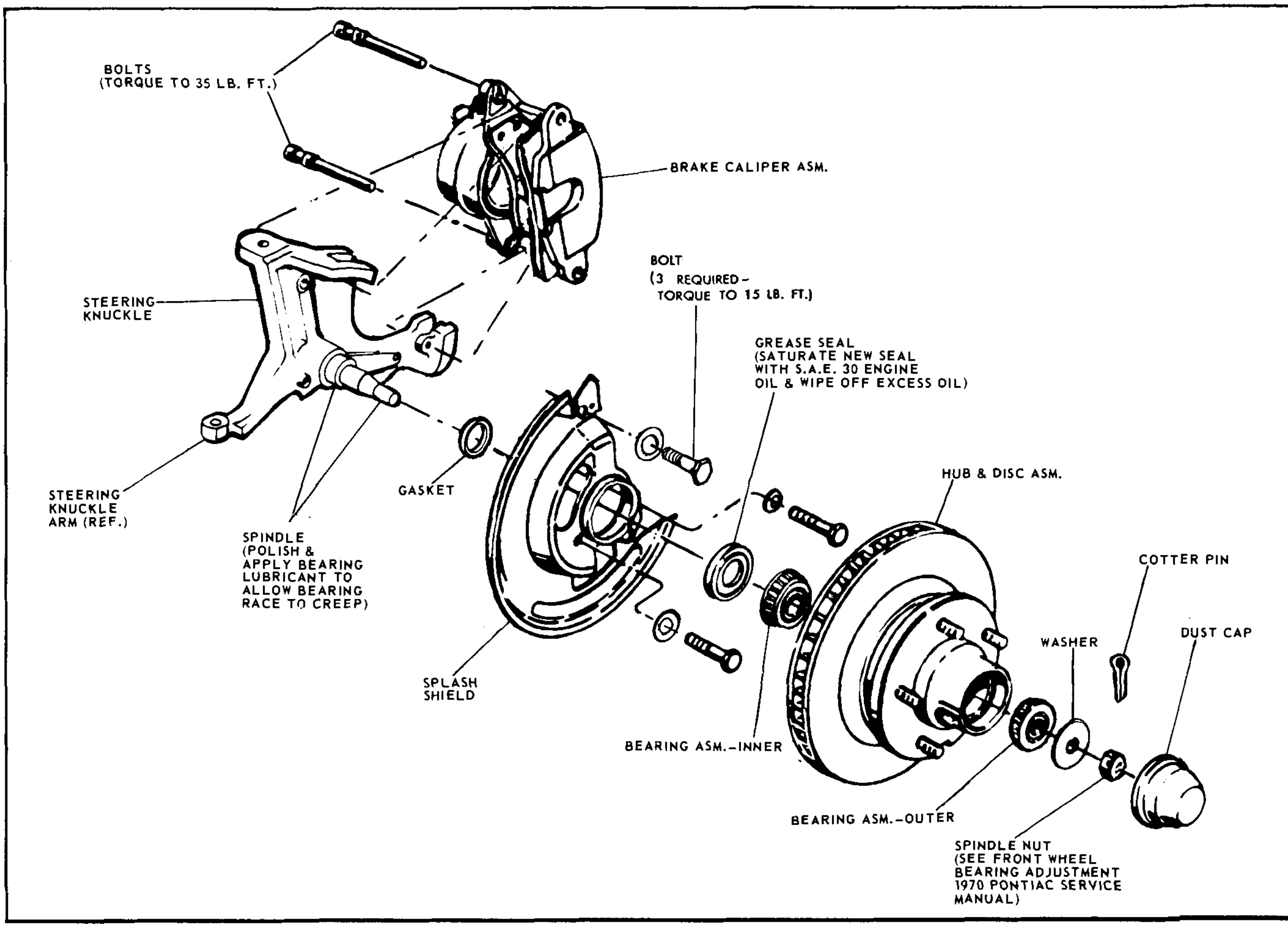


Fig. 3-13 Installation of Steering Knuckle, Hub and Disc Assembly (B & F Series)

NOTE: *To check for loose bearings, grip the tire at the top and bottom and move the wheel assembly in and out on the spindle. Movement greater than .005" indicates a loose bearing. If necessary to inspect bearings, see MINOR SERVICES - WHEEL BEARING REMOVE AND INSTALL.*

ADJUSTMENT

1. Raise car and support at front lower control arm.
2. Remove hub cap or wheel disc from wheel.
3. Remove dust cap from hub.
4. Remove cotter pin from spindle and spindle nut.
5. Adjust bearing as shown in Fig. 3-16.
6. Insert cotter pin and bend ends against nut, cut off extra length to ensure ends will not interfere with dust cap.
7. Install dust cap on hub.
8. Install hub cap or wheel disc.
9. Lower car to ground.

SUSPENSION ALIGNMENT

Front suspension components are adjusted to a specific alignment while the vehicle is motionless and at curb weight and height (see Curb Height chart in Section 0) so that suspension components can properly function together when the vehicle is moving to minimize tire wear and maintain desirable steering and handling characteristics.

Satisfactory vehicle operation may occurr over a wide range of front end (wheel) alignment settings. Nevertheless, should settings vary beyond certain tolerances, readjustment of alignment is advisable. The specifications stated in column 1 of the applicable vehicle chart in the specifications at the end of this section should be used by owners, dealers and repairmen as guidelines in vehicle

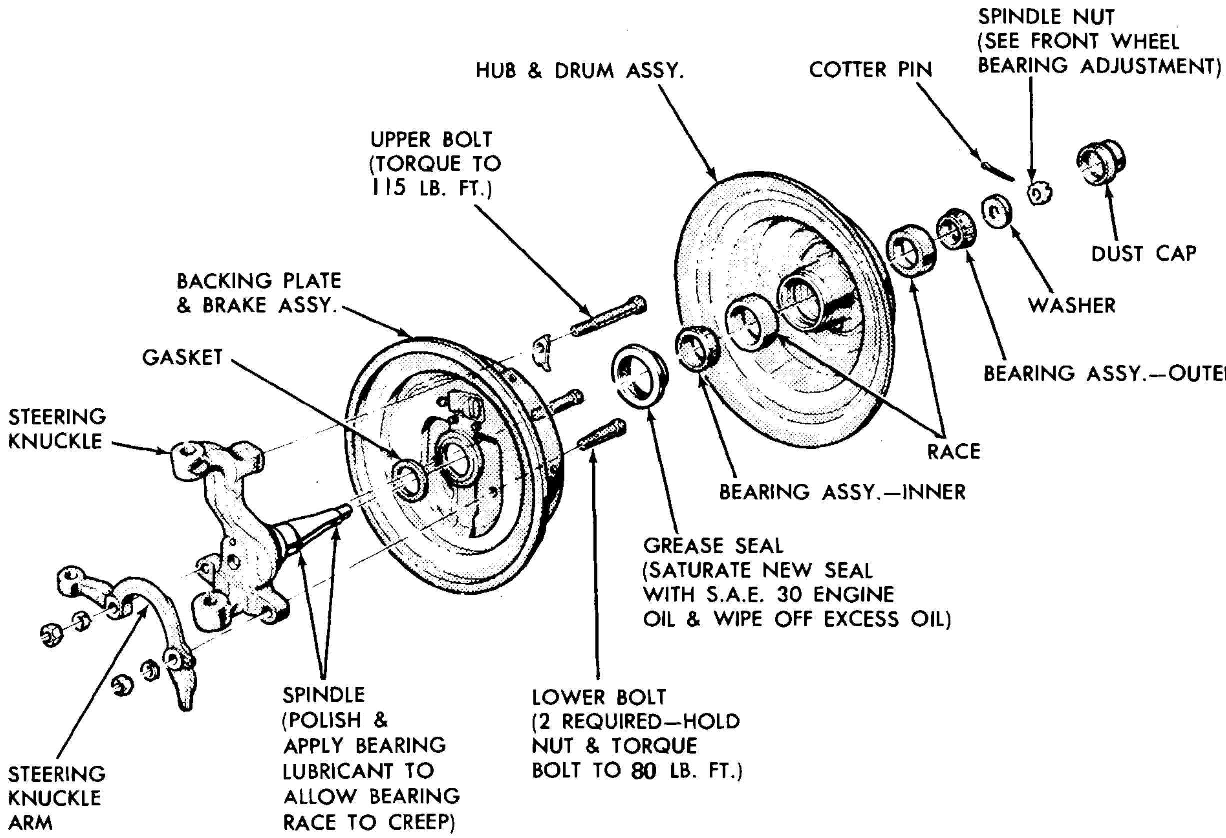


Fig. 3-14 Installation of Steering Knuckle, Hub and Drum Assembly (A & X Series)

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 colun 2 of the aforesaid applicable chart 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, Pontiac recommends that the specifications given in column 3 of the aforesaid applicable chart be used.

INSPECTION BEFORE CHECKING FRONT WHEEL ALIGNMENT

Before any checking or corrective work is started on wheel alignment elements, including toe-in, caster, camber, steering axis inclination, and toe-out on turns, the following items which will affect steering should be considered:

1. Check tire inflation and bring to recommended pressure.
2. Check front wheel bearing adjustment and correct if necessary.
3. Check wheel and tire run-out.
4. Check wheel and tire for excessive unbalance which would affect steering.
5. Check spherical ball joints.
6. Check steering linkage for looseness. Replace or tighten parts.
7. Check shock absorbers for leaks or lack of control.
8. Check for extraordinary load in car. Remove load or compensate for setting height. (Samples, tools, etc., carried regularly should not be considered extraordinary load.)

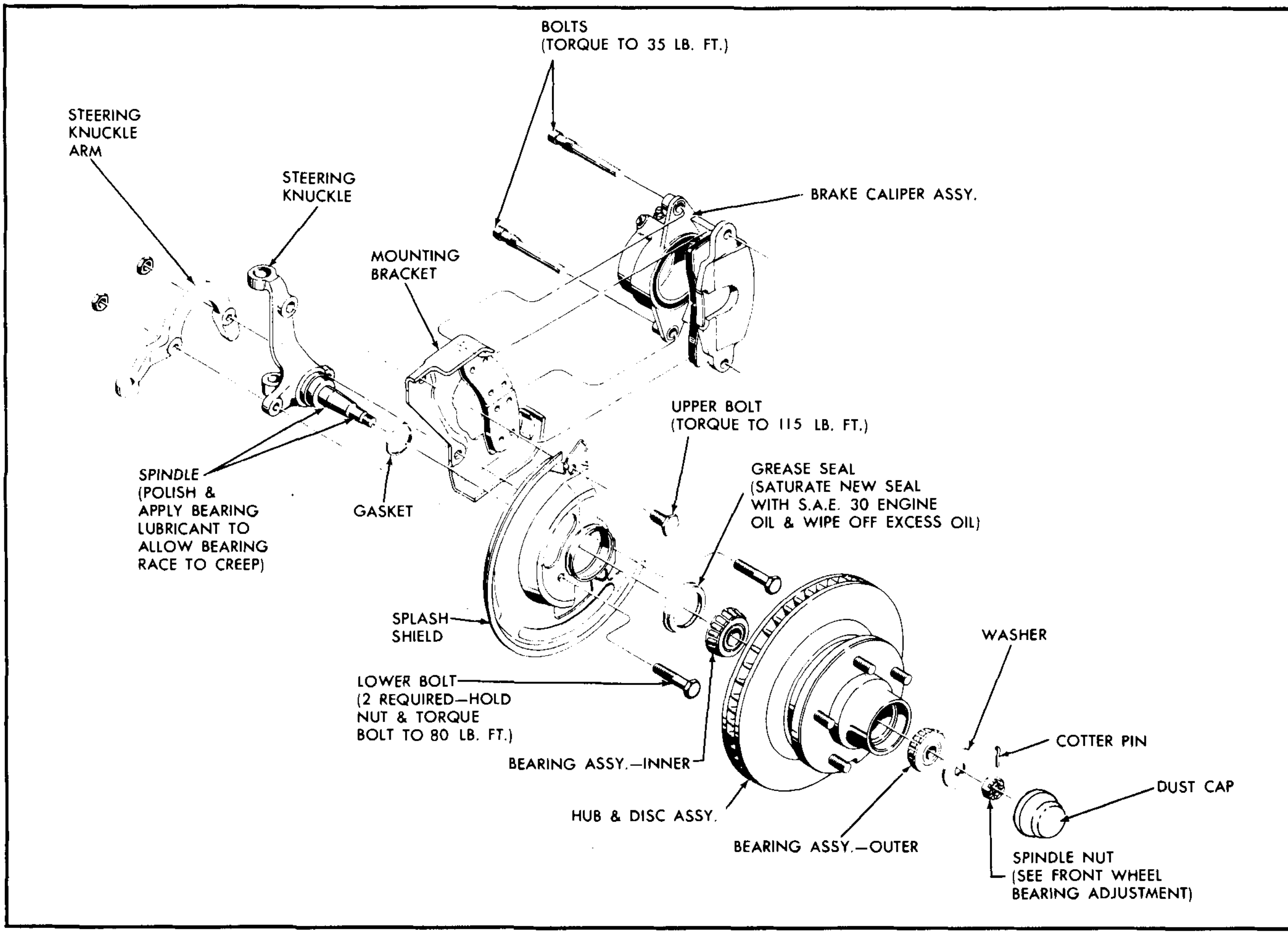


Fig. 3-15 Installation of Steering Knuckle, Hub and Disc Assembly (A, G & X Series)

9. Check for proper lubrication of front end suspension components.

CHECKING AND ADJUSTING SEQUENCE-FRONT WHEEL ALIGNMENT

All measurements and adjustments should be made in the following order.

a. Curb weight and height (see Curb Height chart in Section 0).

b. Caster and camber.

c. Cross.

d. Toe-in.

ADJUST CASTER AND CAMBER

Caster and camber are adjusted to specifications by placing shims between the upper control arm shaft and the frame support (Fig. 3-17). Both adjustments can be made at the same time. In order to remove or install shims, loosen the control arm shaft to frame support bolts. Tool J 22618 can be used to loosen upper control arm shaft to frame support bolts on the B Series (Fig. 3-18).

NOTE: *A shim pack should not exceed 3/4 inch maximum, with a maximum difference of 3/8 inch between front and rear shim packs.*

1. To increase negative caster add shims to front bolt or remove shims from rear bolt.

2. To decrease negative caster (increase positive caster) remove shims from front bolt or add shims to rear bolt.

3. To increase positive camber remove shims from both front and rear bolts.

4. To decrease positive camber (increase negative camber) add shims to both front and rear bolts.

NOTE: *By adding or subtracting an equal amount of shims from front and rear bolts, camber will be changed without affecting caster.*

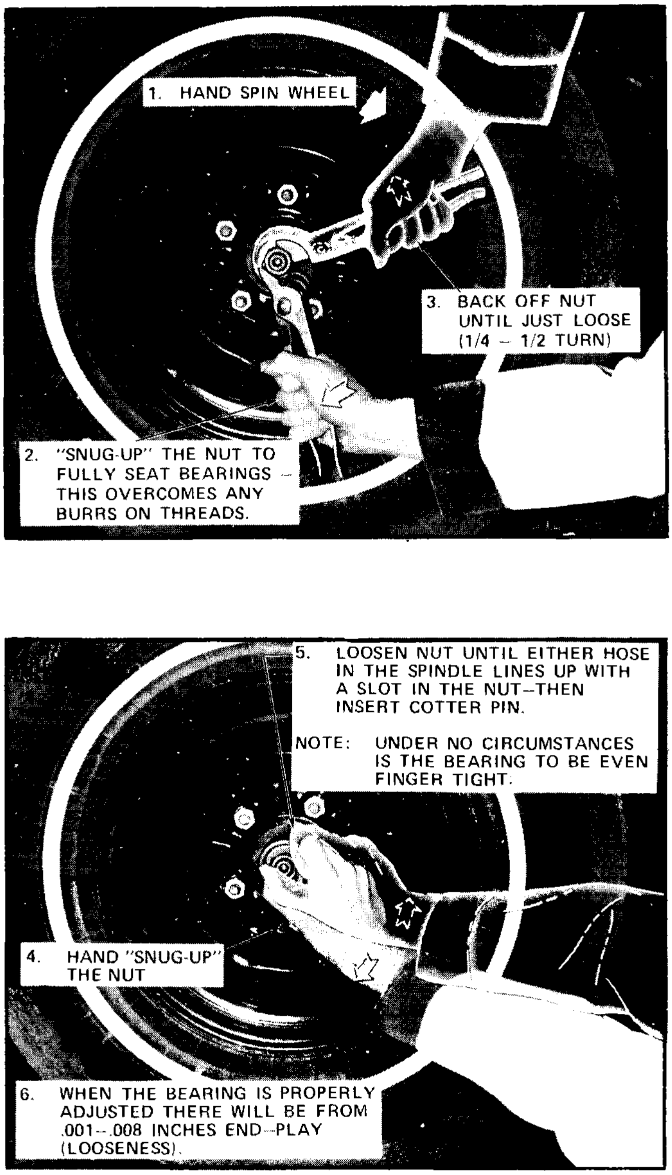


Fig. 3-16 Wheel Bearing Adjustment

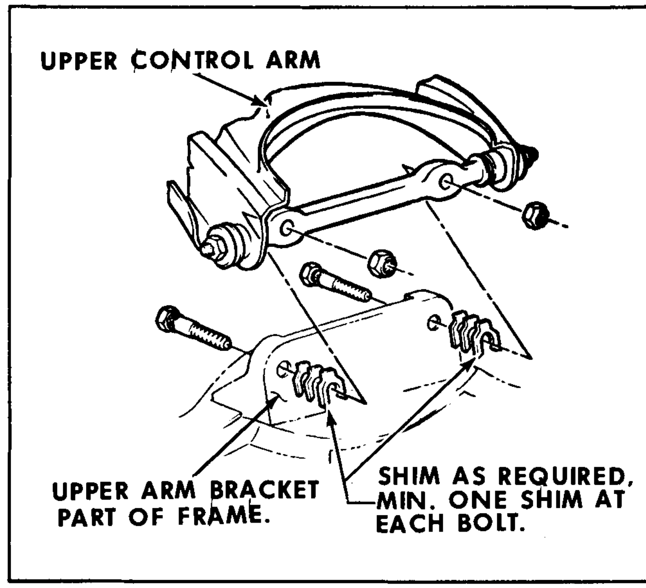


Fig. 3-17 Caster-Camber Shims (A & G Series Shown)

CHECK AND SET TOE-IN

Check and set toe-in (see SPECIFICATIONS) with a trammel or with other reputable front end aligning equipment, measuring from sidewall of tire or wheel felloes, using methods given below.

MEASURING BY TRAMMEL

1. After moving car forward on level floor, chalk mark tread on both front tires at point 9" above floor at front of wheels.
2. With trammel set at center-to-center distance of front tires, make a chalk mark on each front tire exactly trammel width apart.
3. Push car forward (never backward) until chalk mark with trammel marks is 9" above floor at rear of wheels.
4. Measure difference from trammel marks made when chalk mark was in front of wheel; if trammel marks are now greater than when marked at front, wheels toe-in by this amount (see SPECIFICATIONS).

Fig. 3-18 Removing B Series Upper Control Arm Nuts With J 22618

EQUIPMENT MEASURING FROM SIDEWALL OR WHEEL FELLOES

When using this type of equipment, wheel run-out will have a very direct bearing on the readings. Since the allowable run-out is 1/8", the readings could possibly be off as far as 1/8" on each wheel if the effect of run-out is not cancelled. By taking the average of three readings with the wheel rotated 120° for each reading, the error due to wheel run-out can be cancelled. This should be done as follows:

1. After moving the car forward on level floor, take first reading.
2. Mark sidewall of both tires with the number "1" at rear of tire where instrument bears.
3. At 120° intervals (i.e. 1/3 and 2/3 distance around the tire) mark the numbers "2" and "3" on both tires.
4. Raise wheels off floor and hand spin until the number "2" is in the position which number "1" occupied when the first reading was taken.
5. Push car back one foot and bring forward to position and take second reading. This reading will then be taken with the instrument bearing 120° around the wheel from where the first reading was taken.
6. Use the same procedure for taking the third reading.
7. Average the three readings to find the actual toe-in.

SET TOE-IN

1. Remove steering wheel trim cover or horn button and set steering gear on center position (high point of worm) by turning steering wheel until index mark on steering shaft is exactly at top. This mark locates the high point, or middle of gear travel.
2. Loosen all tie rod adjuster sleeve clamp bolts. To increase toe-in turn left tie rod adjuster sleeve in direction of rotation of wheels, when car moves forward; turn right tie rod adjuster sleeve in opposite direction. Turn both sleeves an equal amount until toe-in is set at proper specification.

   CAUTION: *Discard the nut and bolt of an adjuster sleeve clamp if rusted and after breakaway (nut starts to turn) the removal torque of the nut exceeds 7 lb. ft. (84 lb. in.). Install a new nut and bolt having the same part number to assure proper clamping at the specified nut torque.*

3. Make sure front wheels are straight ahead by measuring from a reference point at same place on each side of frame center to front of wheel rims. If measurements are not equal, turn both tie rod adjuster sleeves in same direction (so as not to change toe-in) until measurements become equal. Recheck toe-in since toe-in measurement is accurate only with wheels in straight-ahead position.

   CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 4.*

4. Tighten tie rod adjuster sleeve clamp nuts to 20 lb. ft. torque on B, A, G and F Series or to 12 lb. ft. torque on X Series.

   CAUTION: *Before tightening, apply penetrating oil between each clamp and adjuster sleeve that is rusted. Rotate the clamps until they move freely. Open end of clamps should be 0°-45° forward from a vertical "down" position on B, A, G and F Series. Open end of clamps should be 0°-30° forward or rearward from a vertical "up" position on X Series.*

CROSS CASTER AND CAMBER

Reset either or both sides accordingly when checking or after resetting alignment so that cross for the left side caster to right side caster and left side camber to right side camber is less or equal to specification. When resetting for cross, maintain the caster and camber on each side within their respective specifications.

MINOR SERVICE

WHEEL BEARING (B & F SERIES)

REMOVE

1. Raise car and support at front lower control arm.
2. Remove hub cap or wheel disc from wheel.
3. Remove wheel and tire assembly.
4. Remove brake caliper assembly.

   CAUTION: *Brake hose is still connected to caliper assembly; therefore, caliper assembly must be moved out of way and supported so brake hose will not be damaged.*

5. Remove dust cap from hub.

6. Remove cotter pin, spindle nut and washer from spindle.

7. Remove hub and disc assembly from spindle.

CAUTION: *When hub and disc assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.*

8. Remove inner bearing from hub by tapping out inner grease seal with a brass drift. DISCARD SEAL.

9. Wipe old grease out of hub and from spindle of steering knuckle.

10. Wash bearings in solvent and air-dry. Do not spin dry with compressed air. Inspect bearings and races for cracking, pitting, etching, etc.

NOTE: *If necessary to replace either a bearing (inner race and rolls assembly) or its outer race, both bearing and outer race should be replaced together.*

When inspecting or replacing bearing (inner race and rolls assembly), make sure the race is free to creep on spindle. The inner race is designed to creep on the spindle in order to afford a constantly changing load contact between the race and the roller bearings. Polishing the spindle and applying bearing lubricant will permit creeping and prevent rust forming between race and spindle (Fig. 3-13).

11. If necessary to replace an outer race, drive out old race from the hub with a brass drift inserted behind race in notches in hub. Install new race by driving it into hub with a brass drift.

NOTE: *Use care when installing new race to start it squarely into hub, to avoid distortion and possible cracking.*

12. Use a bearing lubricator if available and thoroughly lubricate bearing assemblies with new high melting point wheel-bearing lubricant. Remove any excess lubricant.

NOTE: *Be sure bearing parts have been thoroughly cleaned and air-dried because bearing lubricant will not adhere to wet or oily surfaces.*

INSTALL

NOTE: *Inspect rotor lining contact area for grease. Clean with a non-flammable non-toxic solvent (such as denatured alcohol). Make sure wiping cloth and fluid do not become loaded with grease from repeated use.*

Inspect brake linings for grease contamination. Clean by wiping with a non-flammable, non-toxic solvent (such as denatured alcohol).

1. Apply a light coat of lubricant to spindle and inside surface of hub (Fig. 3-13).

2. Place inner bearing in race of hub.

3. Install a new grease seal in hub.

4. Carefully install hub and disc assembly on spindle.

5. Install outer wheel bearing.

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 6, 8 and 10.*

6. Install washer and spindle nut.

7. Adjust wheel bearings as outlined under ADJUSTMENT PROCEDURES.

8. Position caliper, install and tighten two caliper mounting bolts to 35 lb. ft. torque.

9. Install dust cap on hub.

10. Install wheel and tighten nuts to 70 lb. ft. torque.

11. Install hub cap or wheel disc.

12. Lower car to ground.

WHEEL BEARING (A, G & X SERIES)

REMOVE

1. Raise car and support at front lower control arm.

2. Remove hub cap or wheel disc from wheel.

3. **Drum Brakes:** Remove dust cap from hub.

Disc Brakes: Remove wheel and tire assembly before removing dust cap from hub.

4. **Drum Brakes:** Remove cotter pin, spindle nut and washer from spindle, then remove wheel with hub and drum assembly from spindle with a gentle rocking motion.

CAUTION: *When hub and wheel assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.*

NOTE: *In some cases it may be necessary to back off brake adjustment to remove hub and wheel assembly.*

Disc Brakes: Remove brake caliper assembly before removing cotter pin, spindle nut and washer from spindle. Then remove hub and disc assembly from spindle.

CAUTION: *Brake hose is still connected to caliper; therefore, caliper must be moved out of way and supported so brake hose will not be damaged.*

CAUTION: *When hub and disc assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.*

5. Remove inner bearing from hub by tapping out inner grease seal with a brass drift. DISCARD SEAL.

6. Wipe old grease out of hub and from spindle of steering knuckle.

7. Wash bearings in solvent and air-dry. Do not spin dry with compressed air. Inspect bearings and races for cracking, pitting, etching, etc.

   CAUTION: *If necessary to replace either a bearing (inner race and rolls assembly) or its outer race, both bearing and outer race should be replaced together.*

   When inspecting or replacing bearing (inner race and rolls assembly), make sure the race is free to creep on spindle. The inner race is designed to creep on the spindle in order to afford a constantly changing load contact between the race and the roller bearings. Polishing the spindle and applying bearing lubricant will permit creeping and prevent rust forming between race and spindle (Figs. 3-14 and 3-15).

8. If necessary to replace an outer race, drive out old race from the hub with a brass drift inserted behind race in notches in hub. Install new race by driving it into hub with a brass drift.

   NOTE: *Use care when installing new race to start it squarely into hub, to avoid distortion and possible cracking.*

9. Use a bearing lubricator if available and thoroughly lubricate bearing assemblies with new high melting point wheel-bearing lubricant. Remove any excess lubricant.

   NOTE: *Be sure bearing parts have been thoroughly cleaned and air-dried because bearing lubricant will not adhere to wet or oily surfaces.*

INSTALL

NOTE: *Clean loose material from brake drum on standard brakes with compressed air. Be sure inner hub and bearings are covered. Inspect lining contact area for grease. Clean with a non-flammable non-toxic solvent (such as denatured alcohol). Make sure wiping cloth and fluid do not become loaded with grease from repeated use.*

Inspect brake linings for grease contamination. Clean by wiping with a non-flammable, non-toxic solvent (such as denatured alcohol).

1. Apply a light coat of lubricant to spindle and inside surface of hub (Figs. 3-14 and 3-15).

2. Place inner bearing in race of hub.

3. Install a new grease seal in hub. Saturate felt type seal with S.A.E. 30 engine oil and wipe off excess oil from seal.

   NOTE: *Saturating felt type seal with S.A.E. 30 engine oil prevents absorption and retention of moisture by the seal and improves resistance to water entry into the front wheel inner bearing.*

4. **Drum Brakes:** Carefully install hub and drum assembly with wheel on spindle.

   Disc Brakes: Carefully install hub and disc assembly on spindle.

5. Install outer wheel bearing.

   CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 6, 8 and 10.*

6. Install washer and spindle nut.

7. Adjust wheel bearings as outlined in this section under ADJUSTMENT PROCEDURES.

8. **Drum Brakes:** Check brake adjustment if needed.

   Disc Brakes: Position caliper, install and tighten two caliper mounting bolts to 35 lb. ft. torque.

9. Install dust cap on hub.

10. **Disc Brakes:** Install wheel and tighten nuts to 70 lb. ft. torque.

11. Install hub cap or wheel disc.

12. Lower car to ground.

SHOCK ABSORBER

REMOVE

1. Remove nut, retainer and grommet which attach upper end of shock absorber to frame bracket (Fig. 3-19).

   CAUTION: *Shock absorber stud must not turn while loosening nut. If necessary, use pliers or wrench to hold top of stud while removing nut.*

2. Raise car sufficiently to allow removal of shock.

3. Remove two shock absorber lower attaching screws and remove shock absorber through lower control arm.

INSTALL

1. Install shock absorber by reversing the above steps (Fig. 3-19).

   CAUTION: *Make sure all grommets and retainers are correctly installed. Upper stud nut must be tightened until it bottoms at end of steel threads.*

2. Tighten upper stud nut to 10 lb. ft. torque and torque two lower attaching screws to 20 lb. ft.

STABILIZER SHAFT

REMOVE

1. Raise car and support front end with stands at frame side rails.

2. Disconnect both links from stabilizer shaft by removing each link nut and rotating shaft up from lower control arm (Fig. 3-20).

3. Remove screws holding two stabilizer shaft brackets to frame and remove two brackets and rubber insulators from shaft.

4. Remove shaft.

INSTALL

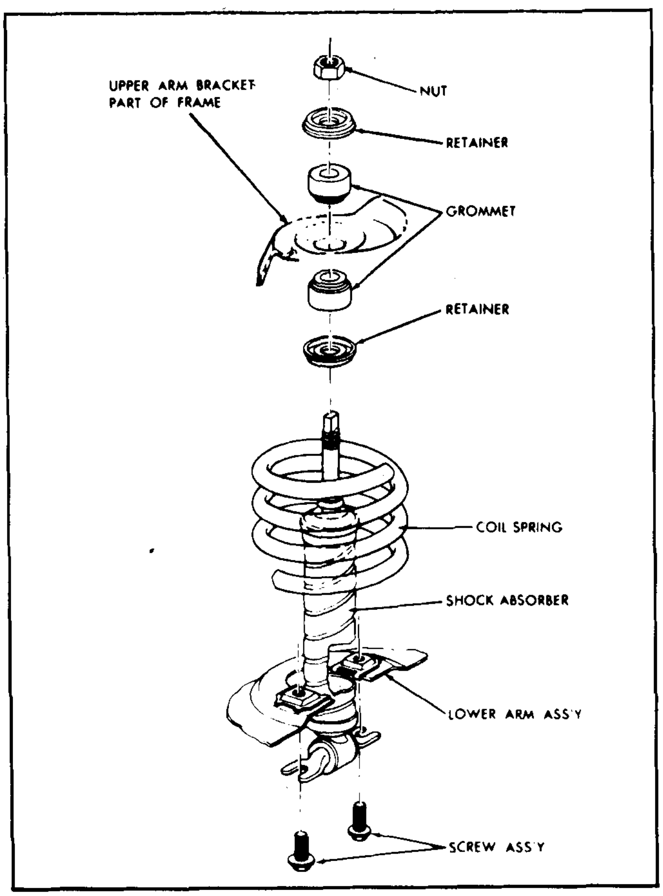


Fig. 3-19 Shock Absorber Installation

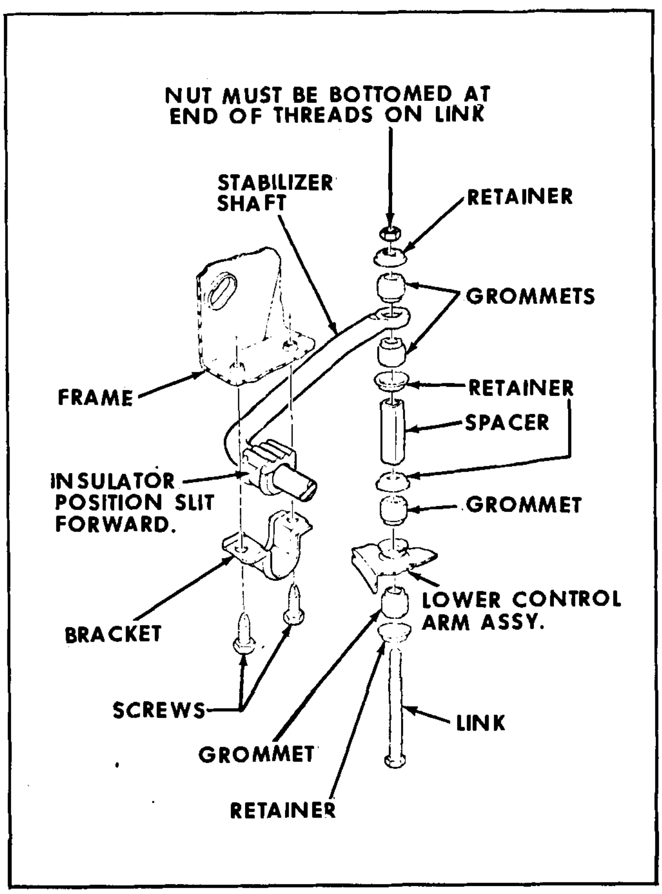


Fig. 3-20 Stabilizer Link Installation

1. Install by reversing the above steps.

2. Tighten bracket attaching screws to 25 lb. ft. torque with car at curb height.

3. Install link assembly as shown in Fig. 3-20. Tighten nut to 15 lb. ft. torque on all models except Formula and Trans Am or to 23 lb. ft. torque on Formula and Trans Am.

MAJOR SERVICE

SPRING

REMOVE

1. Raise car and support front end with stands at frame side rails.

2. Remove two shock absorber lower attaching screws and push shock up through hole in lower control arm.

3. Remove stabilizer link nut, link, spacer, grommets and retainers (Fig. 3-20).

4. Position hydraulic transmission jack with adjustable spring removal tool J 23028 bolted onto the jack under the two lower control arm bushings (Fig. 3-21).

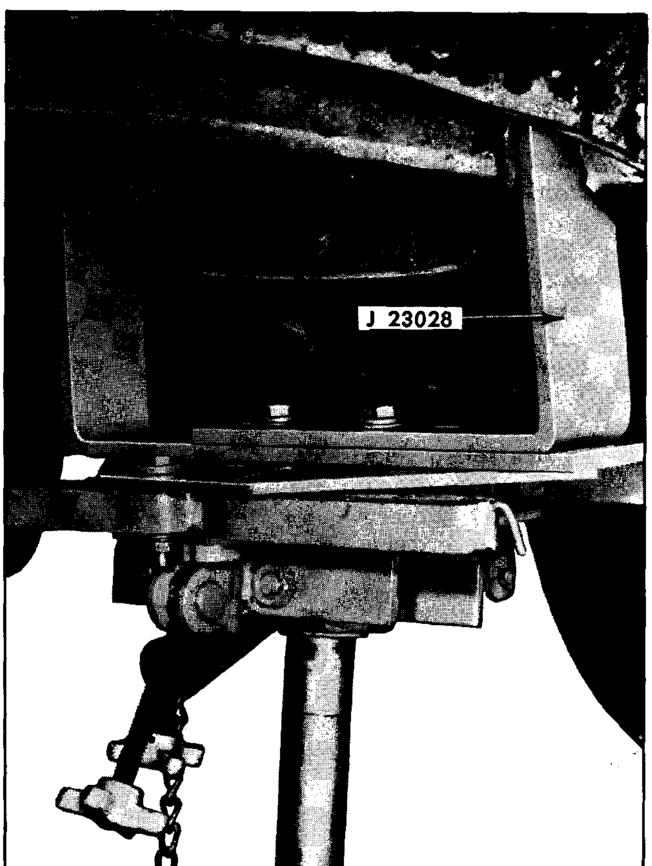


Fig. 3-21 Removing Coil Spring with J 23028

NOTE: *When positioning spring tool under lower control arm bushings, on some models it is necessary to tilt the tool at a slight angle to provide clearance to let control arm swing down.*

5. Remove the two lower control arm to front frame crossmember pivot bolts.

6. Carefully allow lower control arm to swing down by lowering jack.

WARNING: ALLOW SPRING TO COMPLETELY EXPAND BEFORE ATTEMPTING TO REMOVE IT.

7. Remove spring.

INSTALL

1. Install by reversing the above steps. Take care to ensure that spring is properly installed as shown in Fig. 3-22.

CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 2.*

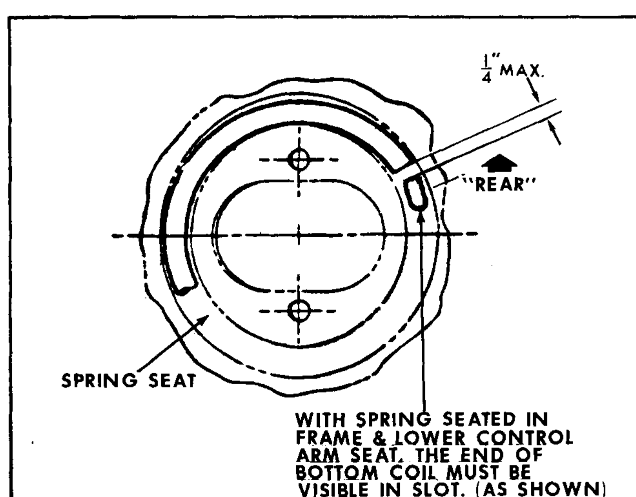


Fig. 3-22 Coil Spring Position In Lower Control Arm Spring Seat

2. Tighten lower control arm pivot bolts to 120 lb. ft. torque or nuts to 90 lb. ft. torque with lower control arm in normal curb height position.

   CAUTION: *Install pivot bolt head towards front of car.*

3. Tighten shock absorber lower attaching screws to 20 lb. ft.

4. Tighten stabilizer link nut to 15 lb. ft. torque on all models except Formula and Trans Am or to 23 lb. ft. torque on Formula and Trans Am.

STEERING KNUCKLE AND/OR STEERING KNUCKLE ARM (B & F SERIES)

REMOVE

1. Raise car and support at front lower control arm.

WARNING: THIS KEEPS SPRING COMPRESSED.

2. Remove hub cap or wheel disc from wheel.

3. Remove wheel and tire assembly before removing dust cap from hub.

4. Remove brake caliper assembly.

   CAUTION: *Brake hose is still connected to caliper assembly; therefore, caliper assembly must be moved out of way and supported so brake hose will not be damaged.*

5. Remove cotter pin, spindle nut and washer from spindle.

6. Remove hub and disc assembly from spindle.

   CAUTION: *When hub and disc assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.*

7. Remove splash shield from steering knuckle.

8. Remove tie rod stud from steering arm by prying on tie rod using a suitable pry bar and tapping sharply on arm in area of stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 6627 can be used. Use care not to damage rubber seal around tie rod.*

9. Remove upper and lower ball joint studs from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 23742-1 can be used (Fig. 3-23).*

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2, 3, 5 and 7.*

1. Install steering knuckle by reversing above steps.

2. Tighten upper ball joint stud nut to 40 lb. ft. torque. Tighten lower ball stud nut on B Series to 80 lb. ft. torque or on F Series to 70 lb. ft. torque. Insert cotter pins.

   CAUTION: *Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 70 lb. ft. on upper ball joint or 110 lb. ft. on B Series lower ball joint or 100 lb. ft. on F Series lower ball joint.*

3. Tighten tie rod stud nut to 30 lb. ft. torque. Insert cotter pin.

   CAUTION: *Care should be taken to insure that steering arm hole, stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only (1/6 turn maximum) to align slot with hole in tie rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 70 lb. ft. on B Series or 50 lb. ft. on F Series.*

4. Tighten splash shield mounting bolts to 15 lb. ft. torque.

5. Tighten two caliper assembly mounting bolts to 35 lb. ft. torque.

6. Adjust wheel bearings as outlined under ADJUSTMENT PROCEDURES.

7. Tighten wheel nuts to 70 lb. ft. torque.

STEERING KNUCKLE (A, G & X SERIES)

REMOVE

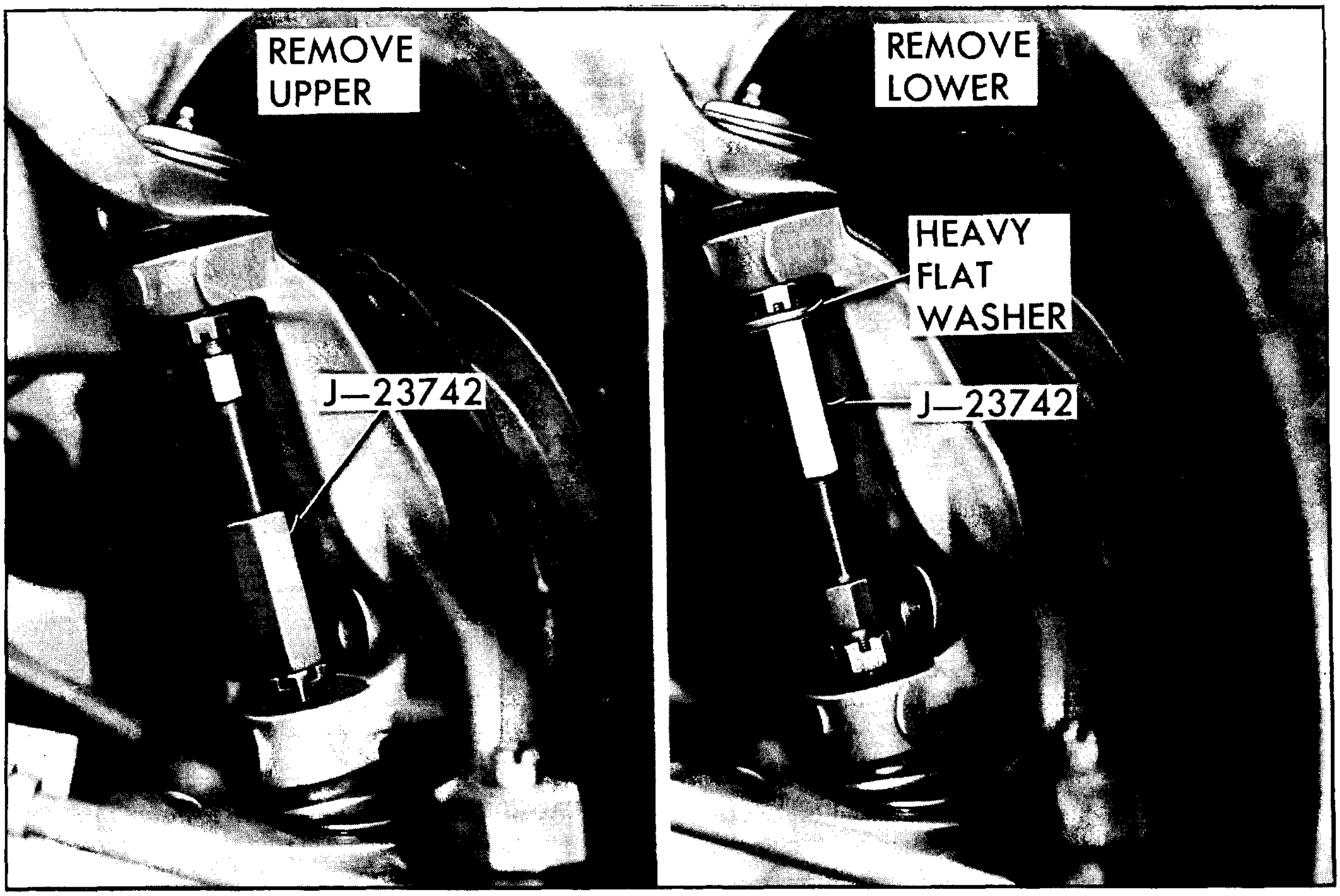


Fig. 3-23 Removing Ball Joint Stud with J-23742

1. Raise car and support at front lower control arm.

WARNING: THIS KEEPS SPRING COMPRESSED.

2. Remove hub cap or wheel disc from wheel.

3. **Drum Brakes:** Remove dust cap from hub.

   Disc Brakes: Remove wheel and tire assembly before removing dust cap from hub.

4. **Drum Brakes:** Remove cotter pin, spindle nut and washer from spindle, then remove wheel with hub and drum assembly from spindle with a gentle rocking motion.

   CAUTION: *When hub and wheel assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.*

   NOTE: *In some cases it may be necessary to back off brake adjustment to remove hub and wheel assembly.*

   Disc Brakes: Remove brake caliper assembly before removing cotter pin, spindle nut and washer from spindle. Then remove hub and disc assembly from spindle.

   CAUTION: *When hub and disc assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.*

5. **Drum Brakes:** Remove backing plate and brake assembly from steering knuckle and move steering arm out of way.

   Disc Brakes: Remove splash shield and mounting bracket from steering knuckle and move steering arm out of way.

   CAUTION: *Brake hose is still connected to backing plate and brake assembly or brake caliper assembly; therefore, either one must be moved out of way and supported so brake hose is not damaged.*

6. Remove upper and lower ball joint studs from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 23742-1 can be used (Fig. 3-23).*

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2, 3 and 5.*

1. Install steering knuckle by reversing above steps.
2. Tighten lower ball joint stud nut to 70 lb. ft. torque and upper ball joint stud nut to 40 lb. ft. torque. Insert cotter pins.

   CAUTION: *Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 70 lb. ft. on upper ball joint or 100 lb. ft. on lower ball joint.*

3. **Drum Brakes:** Tighten backing plate and brake assembly upper bolt to 115 lb. ft. torque and two lower bolts to 80 lb. ft. torque while holding nuts.

   Disc Brakes: Tighten splash shield and mounting bracket upper bolt to 115 lb. ft. torque and two lower bolts to 80 lb. ft. torque while holding nuts. Tighten two caliper assembly mounting bolts to 35 lb. ft. torque.

4. Adjust wheel bearings as outlined in this section under ADJUSTMENT PROCEDURES.
5. **Disc Brakes:** Tighten wheel nuts to 70 lb. ft. torque.

UPPER CONTROL ARM

REMOVE

1. Raise car and support at front lower control arm.

WARNING: THIS KEEPS SPRING COMPRESSED.

2. Remove wheel and tire assembly.
3. Remove upper ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 23742-1 can be used (Fig. 3-23).*

4. Remove two self-locking nuts, washers and bolts holding upper control arm shaft to frame support; remove shims, control arm and shaft assembly. Use tool J 22618 on B Series (Fig. 3-18).

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 1, 2 and 4.*

1. Position control arm and shaft assembly to frame support and install two bolts, shims, washers and self-locking nuts. Tighten nuts to 80 lb. ft. torque on B & F Series or to 50 lb. ft. on A, G & X Series while holding bolts.
2. Insert upper ball joint stud into steering knuckle hole and tighten nut to 40 lb. ft. torque. Insert cotter pin.

   CAUTION: *Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 70 lb. ft.*

3. Tighten the control arm shaft nuts if control arm bushings have been replaced. Torque nuts to 50 lb. ft. with control arm in normal curb height position.
4. Install wheel and tighten nuts to 70 lb. ft. torque.
5. Lower car and check front end alignment.

UPPER CONTROL ARM SHAFT AND/OR BUSHINGS (CONTROL ARM REMOVED FROM CAR)

REMOVE

1. Remove nut and retainer from both ends of control arm shaft.
2. Place control arm in an arbor press and position tools J 9502-3 and J 22899 as shown in Fig. 3-24.

   CAUTION: *Be certain flange of bushing does not contact tool J 22899.*

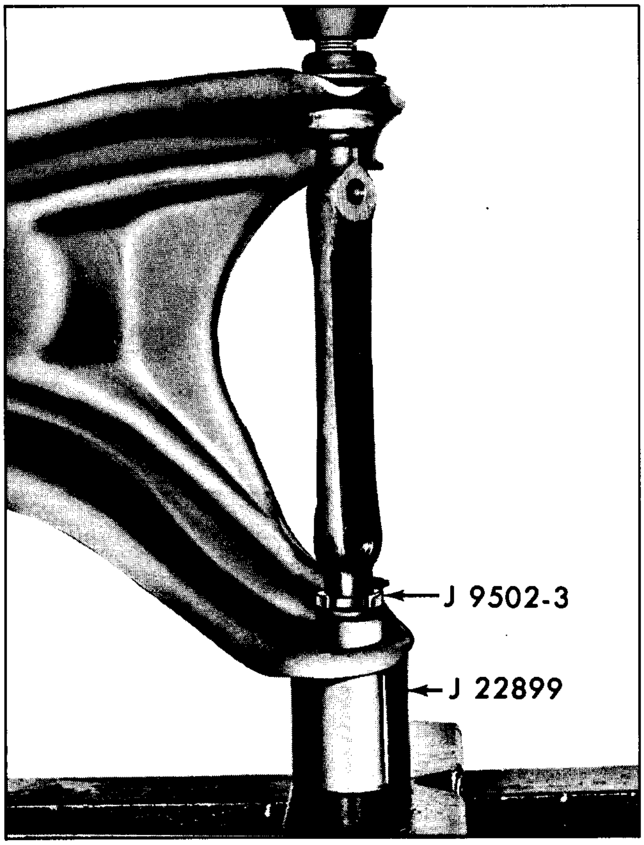


Fig. 3-24 Removing Upper Control Arm Bushing

3. Press out one bushing, invert control arm and repeat process on other bushing. Discard bushings.

INSTALL

1. Place tool J 7167 in position as shown in Fig. 3-25 and expand until tool is snug between inner faces of arm.
2. Position shaft in control arm.
3. Insert bushings on ends of shaft.
4. Press bushings in control arm with arbor press, using two large sockets or J 22899 for installers (Fig. 3-25).

CAUTION: *Control arm shaft should be able to be turned by hand.*

5. Install retainer and nut on both ends of shaft.

CAUTION: *Do not tighten nuts until control arm is installed on car and is in normal curb height position.*

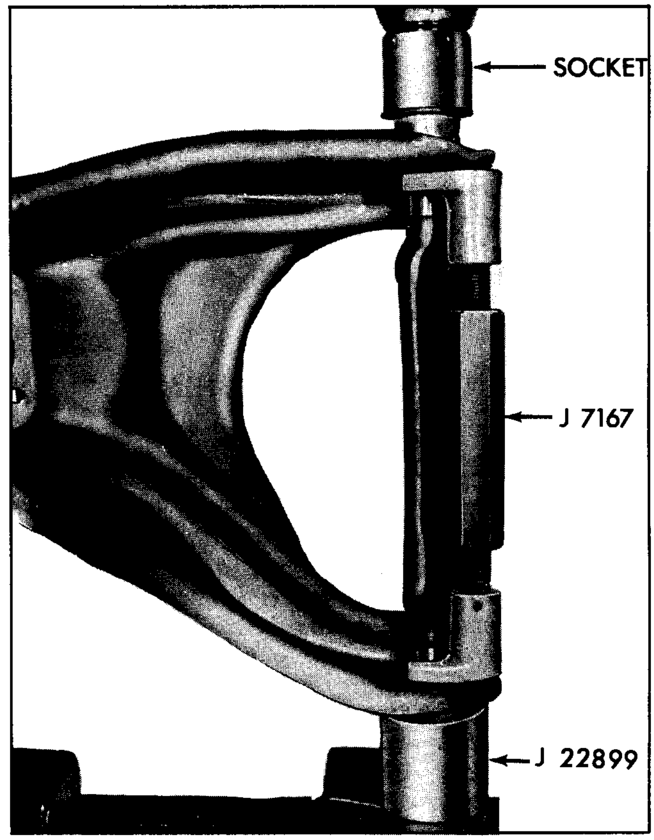


Fig. 3-25 Installing Upper Control Arm Bushing

LOWER CONTROL ARM

REMOVE

1. Remove spring (see SPRING - REMOVE).
2. Remove lower ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 23742-1 can be used (Fig. 3-23).*

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 1.*

1. Insert lower ball joint stud into steering knuckle hole and tighten nut on B Series to 80 lb. ft. torque or on A, G, F & X Series to 70 lb. ft. torque. Insert cotter pin.

CAUTION: *Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut.* **NOTE:** *Turn nut in tightening direction only to align slot with hole to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 110 lb. ft. on B Series or 100 lb. ft. on A, G, F & X Series.*

2. Install spring (see SPRING - INSTALL).

LOWER CONTROL ARM BUSHING

NOTE: *If the control arm is not removed from car. The bushings can be replaced without removing control arm from car by disconnecting control arm from frame at the two pivot bolts. When performing the repair in this manner, care must be taken to raise car off ground and support weight of car at frame side rail. Then place a jack under the lower control arm, remove pivot bolts and carefully lower control arm until there is clearance to install bushing removal tools. After bushings are replaced, reposition control arm to frame and install pivot bolts, tighten bolts to proper torque with control arm at curb height position. Use tool J 23028 to lower and raise control arm. (see SPRING - REMOVE, step 5).*

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to above.*

REAR BUSHING

REMOVE

1. Remove lower control arm (see LOWER CONTROL ARM - REMOVE).

2. Remove bushing from control arm by arranging tools as shown in Fig. 3-26.

INSTALL

1. Install bushing in lower control arm by arranging tools as shown in Fig. 3-27 and press bushing into arm.

2. Install lower control arm (see LOWER CONTROL ARM - INSTALL).

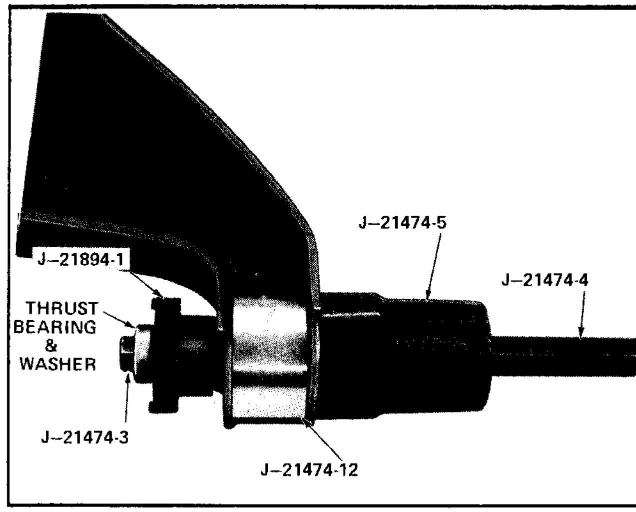


Fig. 3-26 Removing Lower Control Arm Rear Bushing

FRONT BUSHING

REMOVE

1. Remove lower control arm (see LOWER CONTROL ARM - REMOVE).

2. Remove bushing from control arm by arranging tools as shown in Fig. 3-28.

INSTALL

1. Install bushing in control arm by arranging tools as shown in Fig. 3-29.

2. Install lower control arm (see LOWER CONTROL ARM - INSTALL).

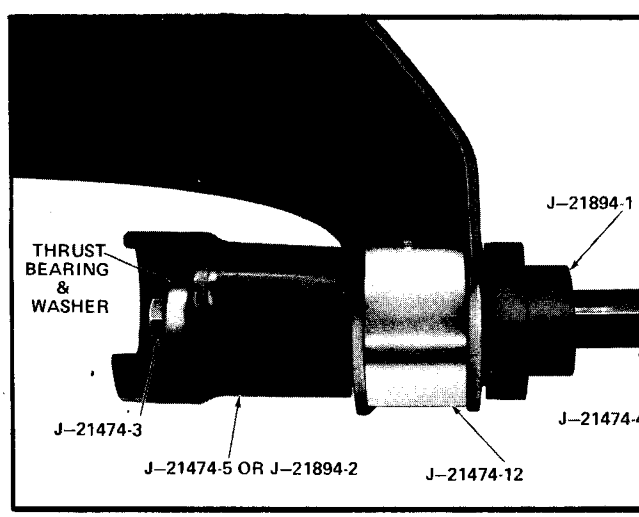


Fig. 3-27 Installing Lower Control Arm Rear Bushing

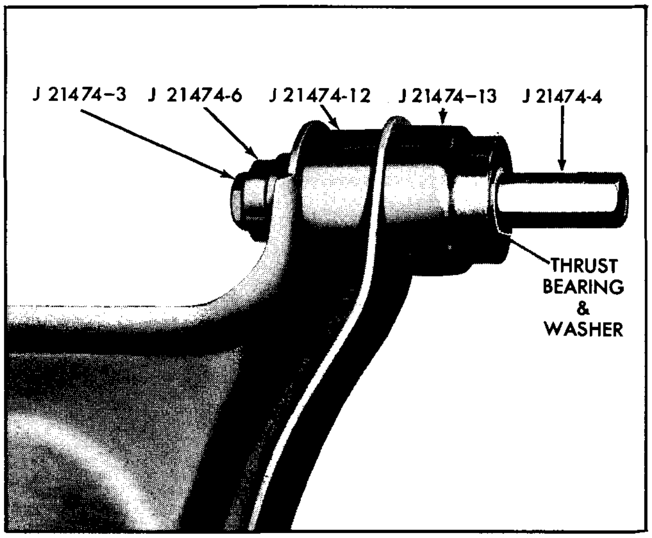


Fig. 3-28 Removing Lower Control Arm Front Bushing (G, A and X Series)

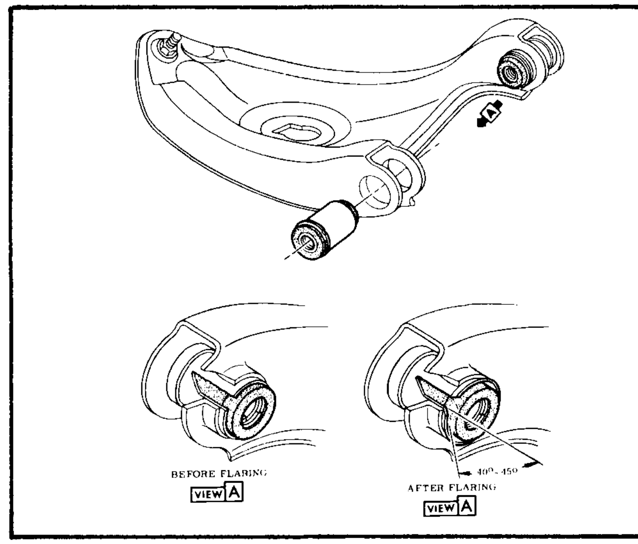


Fig. 3-30 Flaring Lower Control Arm Front Bushing (B & F Series)

UPPER BALL JOINT

REMOVE

1. Raise car and support lower control arm.

WARNING: THIS KEEPS SPRING COMPRESSED.

2. Remove wheel and tire assembly.

3. Remove ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on steering knuckle in area of ball stud.

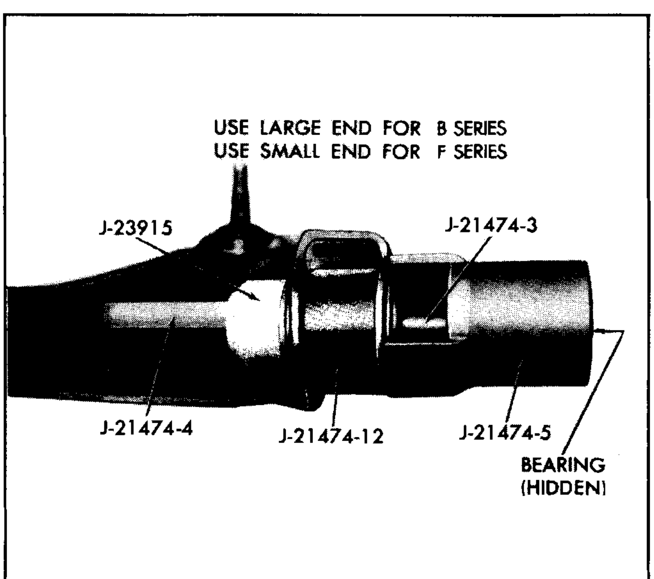


Fig. 3-29 Removing Lower Control Arm Front Bushing (B & F Series)

NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 23742-1 can be used (Fig. 3-23).*

4. Remove ball joint assembly from upper control arm by chiseling or drilling rivet heads which retain ball joint assembly to control arm, and drive out rivets.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 1, 3 and 4.*

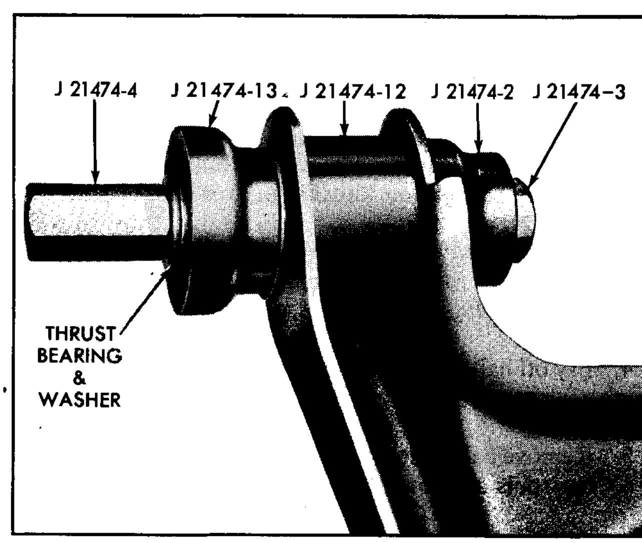


Fig. 3-31 Installing Lower Control Arm Front Bushing

1. Install new ball joint assembly using the special bolts, washers and nuts supplied with ball joint package.

2. Tighten ball joint assembly attaching nuts to 9 lb. ft. torque.

3. Insert ball stud in steering knuckle hole and tighten nut to 40 lb. ft. torque. Insert cotter pin.

   CAUTION: *Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 70 lb. ft.*

4. Install wheel and tighten nuts to 70 lb. ft. torque.

5. Lower car.

LOWER BALL JOINT

REMOVE

1. Raise car and support front lower control arms under spring seats.

WARNING: THIS KEEPS SPRING COMPRESSED AND ALLOWS CLEARANCE TO POSITION TOOL J 9519-10.

2. **B & F Series:** Remove brake caliper assembly (see STEERING KNUCKLE AND/OR STEERING KNUCKLE ARM - REMOVE, steps 2 through 7).

   A, G & X Series: Remove hub and backing plate assembly or brake caliper assembly (see STEERING KNUCKLE - REMOVE, steps 2 through 5).

3. Remove lower ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 23742-1 can be used (Fig. 3-23).*

4. Pry off ball joint seal and retainer with a screwdriver.

5. Remove ball joint from lower contorl arm by arranging tools as shown in Fig. 3-32.

6. Turn down on hex head screw of tool J 9519-10 until the ball joint assembly is pushed out of the control arm.

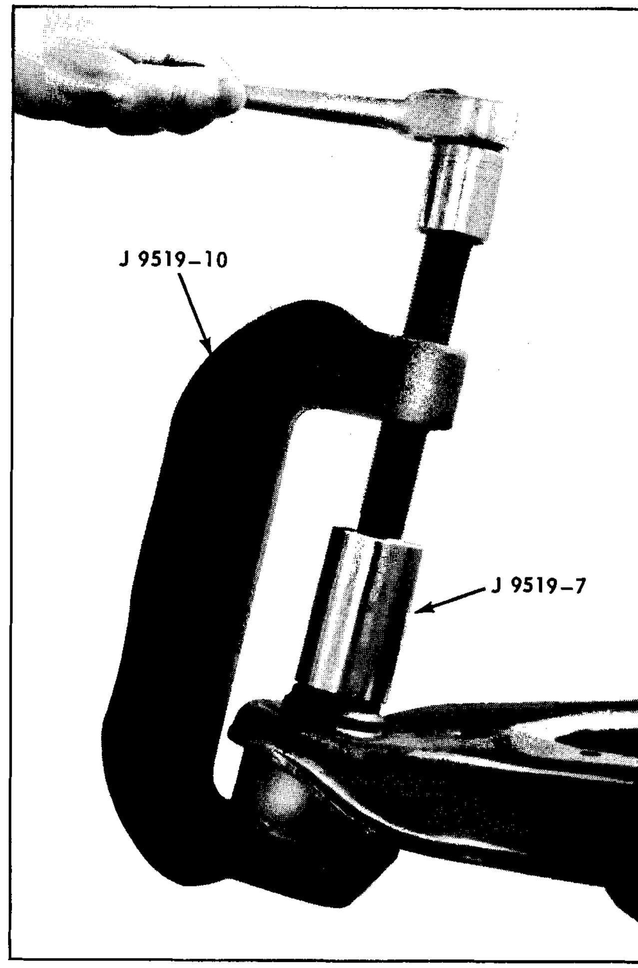


Fig. 3-32 Removing Lower Ball Joint

INSTALL

1. Start the replacement ball joint assembly into the control arm and arrange tools as shown in Fig. 3-33.

2. Turn down on hex head screw of tool J 9519-10 until the ball joint assembly is seated properly in the control arm.

   CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 3.*

3. Insert ball joint stud into steering knuckle hole and tighten nut on B Series to 80 lb. ft. torque or on A, G, F & X Series to 70 lb. ft. torque. Insert cotter pin.

   CAUTION: *Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with*

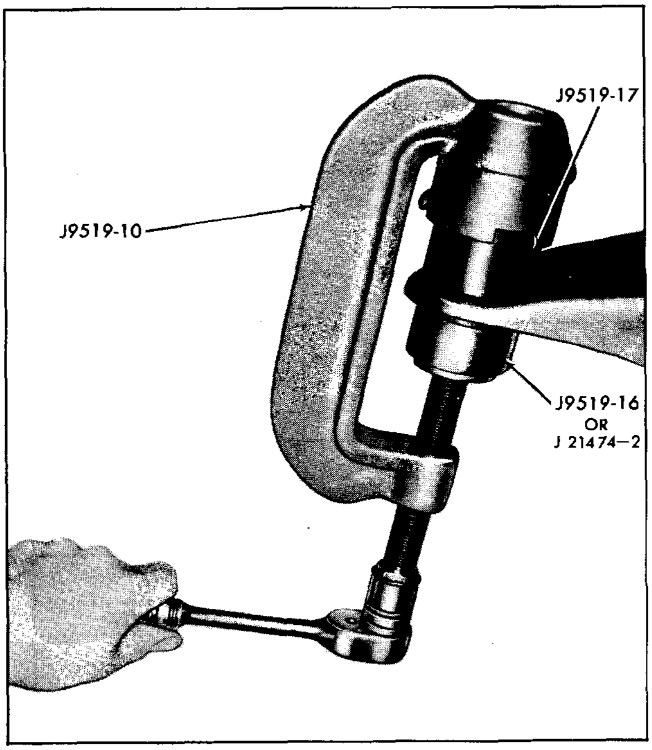


Fig. 3-33 Installing Lower Ball Joint

hole not to exceed 110 lb. ft. on B Series or 100 lb. ft. on A, G, F & X Series.

4. **B & F Series:** Install brake caliper assembly (see STEERING KNUCKLE AND/OR STEERING KNUCKLE ARM - INSTALL, steps 4 through 7).

   A, G & X Series: Install hub and backing plate assembly or brake caliper assembly (see STEERING KNUCKLE - INSTALL, steps 3 through 5).

TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise specified

APPLICATION	TORQUE
Nut, Upper Control Arm Bushing	50
Nut, Upper Ball Joint to Steering Knuckle (70 lb. ft. max. to insert cotter pin)	40*
Nut, Lower Ball Joint to Steering Knuckle	
B Series (110 lb. ft. max. to insert cotter pin)	80*
Except B Series (100 lb. ft. max. to insert cotter pin)	70*
Nut, Tie Rod Adjuster Sleeve Clamp	
Except X Series	20
X Series	12
Nut, Wheel Stud	70
Nut, Tie Rod to Steering Knuckle Arm	
B Series (70 lb. ft. max. to insert cotter pin)	30*
Except B Series (50 lb. ft. max. to insert cotter pin)	30*
Bolt (Lower), Backing Plate to Steering Arm (Drum Brake)	80
Bolt (Upper), Backing Plate to Steering Knuckle (Drum Brake)	115
Bolt (Lower), Splash Shield & Mounting Bracket to Steering Arm (Disc Brake except B & F Series)	80
Bolt (Upper), Splash Shield & Mounting Bracket to Steering Knuckle (Disc Brake except B & F Series)	115
Bolt, Splash Shield to Steering Knuckle (B & F Series)	15
Bolt, Brake Caliper Assembly Mounting	35
Nut, Upper Control Arm to Frame	
B & F Series	80
B Series (using J 22618 and 12" Torque Wrench)	65
A, G & X Series	50
Nut, Lower Control Arm to Frame (Pivot)	90
Bolt, Lower Control Arm to Frame (Pivot)	120
Nut, Shock Absorber Upper Stud	10
Screw, Shock Absorber to Lower Control Arm	20
Nut, Stabilizer Link to Shaft	
Except Formula and Trans Am	15
Formula and Trans Am	23
Screw, Stabilizer Shaft Bracket to Frame	25
Nut, Upper Ball Joint Assembly to Control Arm (Service)	9

WHEEL ALIGNMENT SPECIFICATIONS* (All Vehicles at Curb Height and Weight**)

Models	(I)* 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	0° to +2°	−1° to +3°	+1° ± 1/2°
Camber	0° to +1 1/2°	−3/4° to +2 1/4°	+3/4° ± 1/2°
Toe-In	1/16" to 5/16"	9/16" Toe-In to 3/16" Toe-Out	3/16" ± 1/16"
Cross Caster	1°	———	1/2°
Cross Camber	1°	———	1/2°
A & G Series			
Caster	−2 1/2° to −1/2°	−3 1/2° to +1/2°	−1 1/2° ± 1/2°
Camber	−3/4° to +3/4°	−1 1/2° to +1 1/2°	0° ± 1/2°
Toe-In	1/16" to 5/16"	9/16" Toe-In to 3/16" Toe-Out	1/8" ± 1/16"
Cross Caster	1°	———	1/2°
Cross Camber	1°	———	1/2°
F Series			
Caster	−1° to +1°	−2° to +2°	0° ± 1/2°
Camber	+1/4° to +1 3/4°	−1/2° to +2 1/2°	+1° + 1/2°
Toe-In	1/16" to 5/16"	9/16" Toe-In to 3/16" Toe-Out	3/16" ± 1/16"
Cross Caster	1°	———	1/2°
Cross Camber	1°	———	1/2°
X Series			
Caster	−1/2° to +1 1/2°	−1 1/2° to +2 1/2°	+1/2° ± 1/2°
Camber	−1/2° to +1°	−1 1/4° to +1 3/4°	+1/4° ± 1/2°
Toe-In	1/16" to 5/16"	9/16" Toe-In to 3/16" Toe-Out	3/16" ± 1/16"
Cross Caster	1°	———	1/2°
Cross Camber	1°	———	1/2°

* *See explanatory copy in Front Suspension Section.*

** *Curb weight means weight of vehicle including production options and full capacity of engine oil, fuel and coolant.*

NOTE: If vehicle is normally driven on roads with excessive road crown, the left wheel may be given 1/4° more camber than the right wheel to correct for vehicle drifting to the right. Maintain the cross within its specification when setting camber this way.

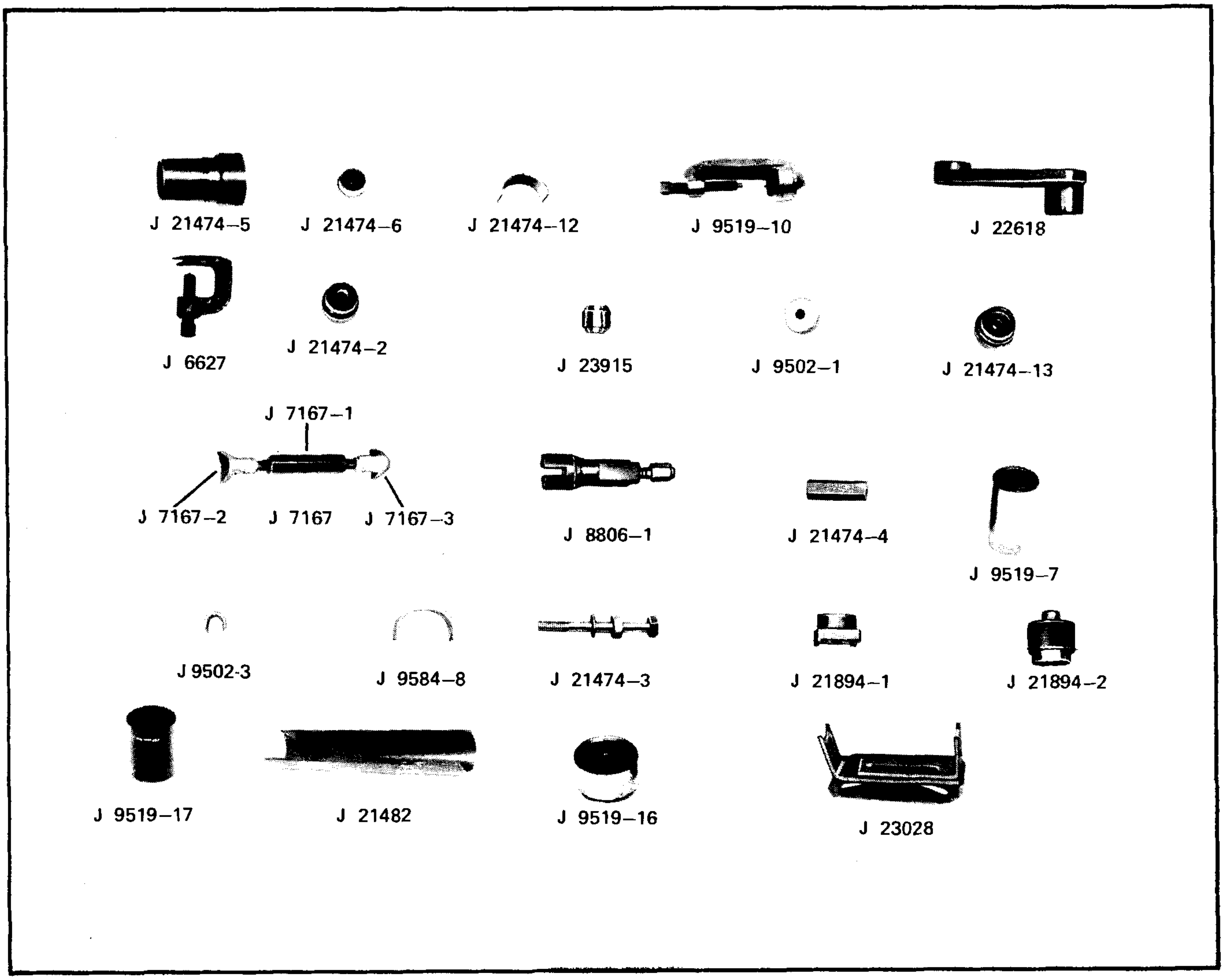


Fig. 3-34 Special Tools

Tool No.	Name
J 6627	Ball Joint Remover
J 7167	Upper Control Arm Spreader
J 9502-1	Front Upper Control Arm Bushing Remover & Installer
J 9502-3	"C" Washer Upper Control Arm Bushing
J 9519-7 J 9519-10 J 9519-16 J 9519-17	Ball Joint Remover & Installer
J 9584-8	Control Arm Bushing Remover & Installer
J 21474-2 J 21474-3 J 21474-4 J 21474-5 J 21474-6 J 21474-12 J 21474-13	Control Arm Bushing Service Set

Tool No.	Name
J 21482	Front Upper Control Arm Spacer
J 21894-1 J 21894-2	Lower Control Arm Oblong Bushing Installer
J 22618	Upper Control Arm Torque Wrench Adapter
J 23028	Front Coil Spring Remover & Installer
J 23742-1	Ball Joint Remover

SECTION 4

REAR 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

TROUBLE DIAGNOSIS AND TESTING

SUPERLIFT SYSTEM LEAKS AIR PRESSURE

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

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 IS DRIVEN

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

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, replace Superlifts.

AUTOMATIC LEVEL CONTROL WILL NOT RAISE WITH CAR LOADED

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. External damage or breakage.	a. Inspect lines, linkage, control valve and Superlifts. Repair or replace any damaged parts.
b. Lines or fittings leaking.	b. Leak test lines and repair if leaking.
c. Control valve setting incorrect.	c. Perform trim height adjustment.
d. Defective component.	d. Perform system test as outlined in service section and repair as needed.

TROUBLE DIAGNOSIS (Continued)

AUTOMATIC LEVEL CONTROL RAISES CAR TO PROPER HEIGHT BUT LEAKS DOWN

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Lines or fitting leaking.	a. Leak test lines and fitting from the control valve to Superlifts and the crossover lines. Repair if leaking.
b. Control valve exhaust leaking.	b. Perform on car control valve test and repair if leaking.
c. Superlifts leaking.	c. Perform Superlift leak test and replace if leaking.
d. Control valve leaking.	d. Perform off car control valve test and repair as needed.

AUTOMATIC LEVEL CONTROL ONLY PARTIALLY RAISES CAR WHEN LOADED

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Excessive load over axle.	a. Distribute load, shift forward if practical and caution owner of car.
b. Control valve setting incorrect.	b. Perform trim height adjustment.
c. Low pressure in system.	c. Perform compressor output test and repair as needed.

AUTOMATIC LEVEL CONTROL RAISES CAR TOO HIGH WHEN CAR IS UNLOADED

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. External damage or breakage.	a. Inspect lines, linkage, control valve, and Superlifts. Repair or replace damaged parts.
b. Control valve setting incorrect.	b. Perform trim height adjustment.
c. Defective control valve.	c. Perform off car control valve test and repair as needed.

AUTOMATIC LEVEL CONTROL RAISES CAR WHEN LOADED BUT LEAKS DOWN ONLY WHEN CAR IS DRIVEN

CAUSE	CORRECTION
a. Time delay mechanism malfunctioning.	a. Test and repair time delay mechanism.

TROUBLE DIAGNOSIS (Continued)

QUICK CHECK OF AUTOMATIC LEVEL CONTROL SYSTEM

1. Record rear trim height of empty car (measure from center of rear bumper to ground).

   NOTE: *Fill compressor through service valve with air at available line pressure.*

2. Add weight equivalent to two passenger load (300 lbs.) to rear bumper or tailgate. Car should begin to level in 4-18 seconds. Final position should be within 1" of original measurement.
3. Remove weight. Car should begin to settle in 4-18 seconds. Final position should be within 1" of original measurement.

AUTOMATIC LEVEL CONTROL TEST GAGE

To properly service the Automatic Level Control, it will be necessary to obtain Test Gage J 5907 with adaptor package J 22695 or equivalent. A test gage can be made up by collecting and assembling the following parts:

1. Fill valve.
2. A tee, which has three 1/8" female taper pipe threads.
3. One adapter, which has a 1/4" female taper pipe thread on one end and a 1/8" male taper pipe thread on the other end.
4. Air Pressure Gage J 5907.
5. One male connector, which has a 1/8" male taper pipe thread on one end and a 3/8"-24 male straight thread on the other end.
6. Two metal sleeves, rubber seals and tube nuts.
7. A length of 1/8" tubing.

ASSEMBLE

1. Install adapter in tee.
2. Install connector in one end of tee.
3. Install fill valve in other end of tee.
4. Install Pressure Gage J 5907 in adapter.
5. Install fitting nut on tubing, then install metal sleeve and rubber seal over end of tubing until tubing bottoms in rubber seal. Tubing, nut and seal assembly can now be installed on connector opposite the fill valve. Tighten fitting nut to 70 lb. in. torque.

   CAUTION: *Make certain all fittings are air tight.*

COMPRESSOR OUTPUT TEST--ON CAR

1. With all engine operated accessories turned off and ignition turned off, deflate system through service valve.
2. Remove high pressure line at regulator and connect test gage (Fig. 4-1).
3. Inflate reservoir to 70 psi through service valve.
4. Observe test gage for evidence of compressor air leak.
5. If leaking, proceed to leak test the compressor, reservoir and regulator as outlined below. If not leaking, continue with this test.
6. With engine running at slow idle, observe reservoir build-up for five minutes. Reservoir pressure should build up to a minimum of 90 psi.
7. If compressor fails to cycle, make sure the vacuum line and filter is open and unobstructed before removing compressor for repair.
8. If build-up is too slow, proceed to repair compressor as outlined in service procedures.

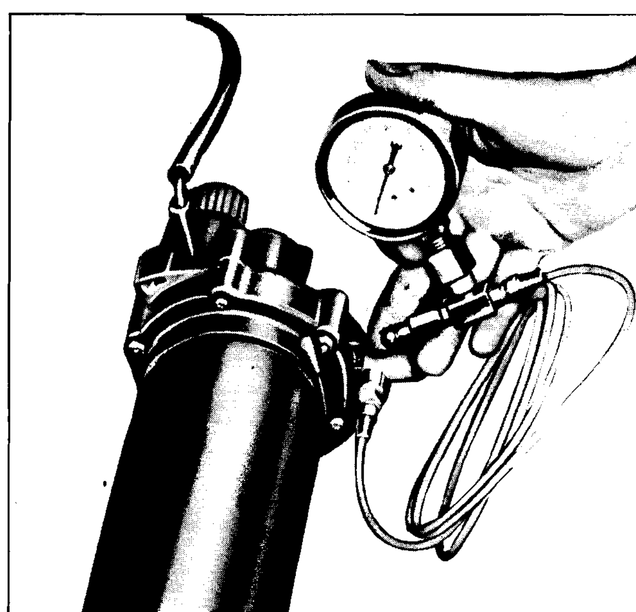


Fig. 4-1 Test Gage Installed on Regulator Valve

TROUBLE DIAGNOSIS (Continued)

9. Satisfactory build-up indicates system problem to be in the control section. However, again observe the test gage for evidence of an air leak and proceed accordingly.

PRESSURE REGULATOR TEST

Performance test the regulator with a known good compressor on the car.

1. Deflate system through service valve and disconnect line at pressure regulator valve.
2. Install test gage on regulator valve high pressure fitting (Fig. 4-1).
3. Inflate system through service valve to maximum available pressure (Fig. 4-2).

   NOTE: *If available pressure is less than 140 psi, start engine to build-up reservoir to this pressure.*

4. Regulated pressure should build-up to and hold steady at 100-130 psi on test gage.
5. Check regulated pressure by momentarily (not more than one second) depressing valve core on test gage and observe gage reading.
6. If regulated pressure now reads less than 100 psi, replace regulator assembly.
7. If regulated pressure exceeds 130 psi, replace regulator assembly.

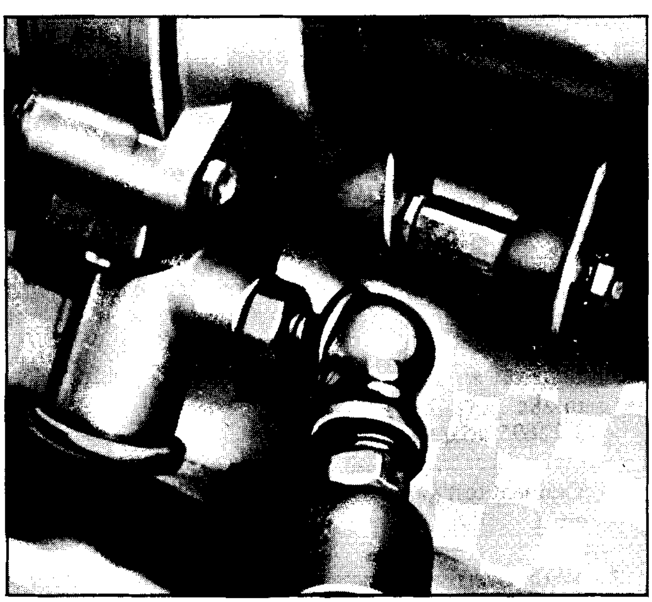


Fig. 4-2 Filling System through Service Valve

HEIGHT CONTROL VALVE TEST--ON CAR EXHAUST (SUPERLIFTS INFLATED)

1. Disconnect overtravel lever from link.
2. Hold lever down in exhaust position until Superlifts deflate or for a minimum of 15 seconds.
3. If Superlifts deflate, perform Intake Check.
4. If Superlifts do not deflate, remove exhaust adapter from control valve and hold lever down as in Step 2. Replace adapter, "O" ring and filter if this deflates Superlifts.
5. Replace control valve if none of the above steps corrects problem.

INTAKE (RESERVOIR PRESSURE 125 PSI MINIMUM)

1. Disconnect overtravel lever from link.
2. Hold lever up in intake position until Superlifts inflate or for a minimum of 15 seconds.
3. If Superlifts inflate and hold, proceed to TIME DELAY CHECK.
4. If Superlifts inflate and then leak down, perform leak test on lines and fittings and then on Superlifts. Also check and, if necessary, replace HCV intake and exhaust screens and "O" rings. If Superlifts still do not inflate, perform leak test on valve. Repair as indicated and proceed to TIME DELAY CHECK.

TIME DELAY CHECK

1. Disconnect overtravel lever from link.
2. Disconnect lines at Superlift and intake port.
3. Connect test gage to intake valve port and open air pressure (95 psi). Move overtravel lever approximately 1" down from neutral position, as measured from end of lever.
4. Quickly move overtravel lever upward 2". At the same time, begin timing number of seconds before air starts to escape from Superlift port. This delay should be from 4-18 seconds. Repeat check. This will check the air intake time delay. Proceed with check to determine air exhaust time delay.

TROUBLE DIAGNOSIS (Continued)

5. Remove test gage and plug intake port with fill valve from J 22695 adaptor package.

6. Connect test gage to Superlift port and open air pressure (95 psi). Move overtravel lever approximately 1" up from neutral position, as measured from end of lever.

7. Quickly move overtravel lever downward 2". At the same time, begin timing number of seconds until air begins to escape from exhaust port. This delay should be 4-18 seconds. Repeat check.

   If either delay is not within specification, there has either been a loss of silicone fluid or valve has lost its adjustment due to damage or wear. Valve must be replaced.

COMPRESSOR, RESERVOIR AND REGULATOR - LEAK TEST

1. Remove assembly intact.

2. Connect test gage to regualtor. Inflate reservoir through service valve to 80-110 psi.

3. Route an 8" piece of rubber hose between vacuum and vent ports (Fig. 4-3).

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.*

   a. Reservoir weld seam.

   b. Reservoir to compressor "O" ring. A stream of bubbles may appear in this area and then cease.

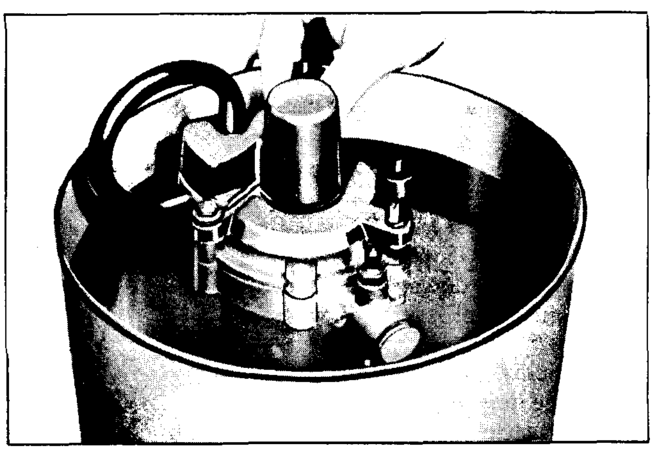


Fig. 4-3 Checking Compressor, Reservoir and Regulator for Leaks

   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.

   c. Regulator to compress "O" ring.

   d. Regulator boot--defective internal "O" ring.

   e. Diaphragm between first and second stage housings--tightening through-bolts may correct the leak.

   f. Service valve.

   g. 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 inadvertenly 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 adaptor package.

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.

TROUBLE DIAGNOSIS (Continued)

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.

GENERAL DESCRIPTION

COIL SPRING

A four link rear suspension is used on all models except B Series station wagons, commercial chassis and F & X Series. 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. Upper and lower control arm bushings are the same size but are not interchangeable in some applications as different rubber specifications are required for particular locations. 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 (Fig. 4-4).

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 (Fig. 4-5). 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, 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 A Series with the GTO or GT 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 cross member to prevent metal-to-metal contact during compression travel or bottoming of the suspension.

LEAF SPRING

The rear suspension (Fig. 4-6) on B Series station wagons,

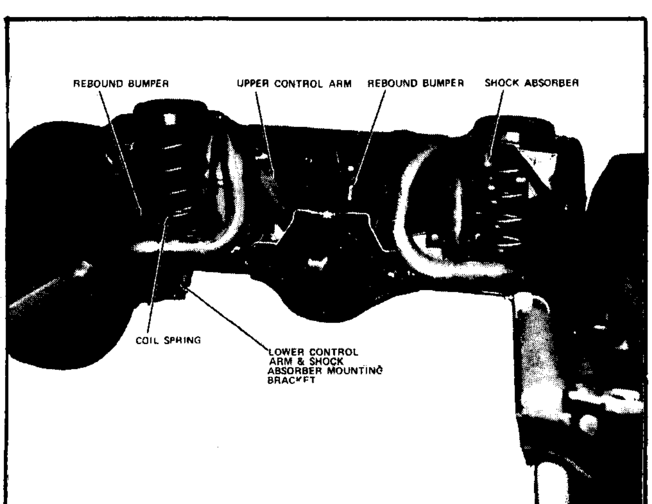


Fig. 4-4 Typical Coil Spring Rear Suspension

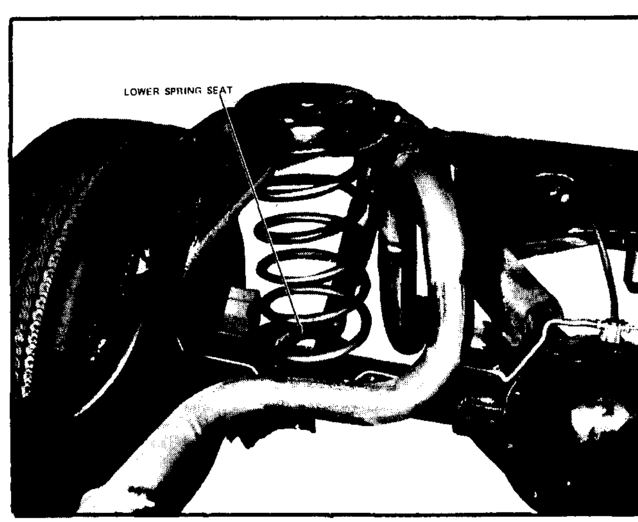


Fig. 4-5 Typical Coil Spring Lower Seat

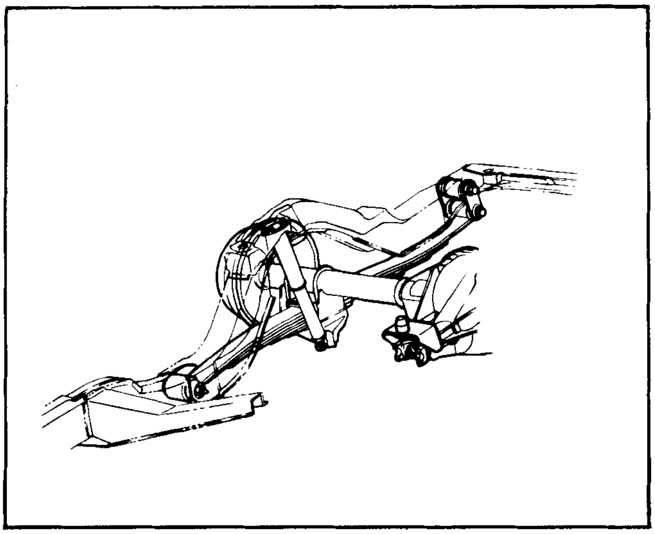


Fig. 4-6 Typical Leaf Spring Rear Suspension

commercial chassis and all F & X Series consists of two leaf springs and two sealed shock absorbers mounted between the spring lower seats (anchor plates) and frame (B Series station wagon and commerical chassis) or underbody floor pan (F & X Series). B & F Series are equipped with multiple leaf springs. A single leaf spring is standard on the X Series and a multiple leaf spring is utilized with special performance suspension. F & X Series have staggered shock absorbers with the right shock absorber in front and left shock absorber behind the axle housing tubes. Staggering the shock absorbers reduces spring wrap-up during acceleration and braking. Both shock absorbers are placed in front of the axle housing tubes on B Series station wagons and commercial chassis. The springs are rubber mounted at the axle and frame side rail (B Series) or underbody side rail (F Series) attaching points, thus ensuring uniform spring loading, minimizing transmittal of road vibration to passenger compartment and providing a pivot point to absorb axle wind-up. The springs are positioned to the axle spring seats by a locating bolt placed close to the center of the spring.

A dampener (weight) is added to the single leaf spring on X Series models without special performance suspension. This weight is strapped 10" rearward of the spring front eye bushing and its purpose is to dampen out excessive or unwanted spring oscillations.

A steel stabilizer shaft is used to improve side roll stability on Formula and Trans Am models (Fig. 4-7). A steel stabilizer shaft is also used on X Series with special performance suspension. The shaft ends are mounted in rubber insulators supported by brackets bolted below each spring and shock absorber anchor plate. Two supports (struts) connect the shaft to the underbody side rails. Each support lower end clamps around a rubber bushing on the stabilizer shaft and the upper end contains a pressed-in rubber bushing for attaching by a pivot bolt to a U-shaped bracket welded below the underbody side rail in the kick up area. The support and pressed-in rubber bushing are not serviced separately, but only as an assembled unit.

Rubber bumpers are mounted near the outer ends of the axle housing and at the center on a bracket bolted to the front of the differential assembly (B Series) or bolted to the underbody (F & X Series) to prevent metal-to-metal contact during compression travel or bottoming of the suspension.

SHOCK ABSORBERS STANDARD AND HEAVY DUTY

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 leak oil. See Section 3 for operation and diagnosis of standard and heavy duty shock absorbers.

SUPERLIFT

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. 4-8). 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 except B Series station wagons and commercial chassis which have the valve located on the top right side of the radiator support and baffle assembly. Since one valve serves both units, air pressure is equal at all times. Superlifts are available on B 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.

FILL VALVE ASSEMBLY

A fitting at the rear bumper or on B Series station wagons and commercial chassis at the top right side of the radiator support and baffle assembly contains a tire-type valve which provides a means of filling the shocks with air and exhausting air from the shocks.

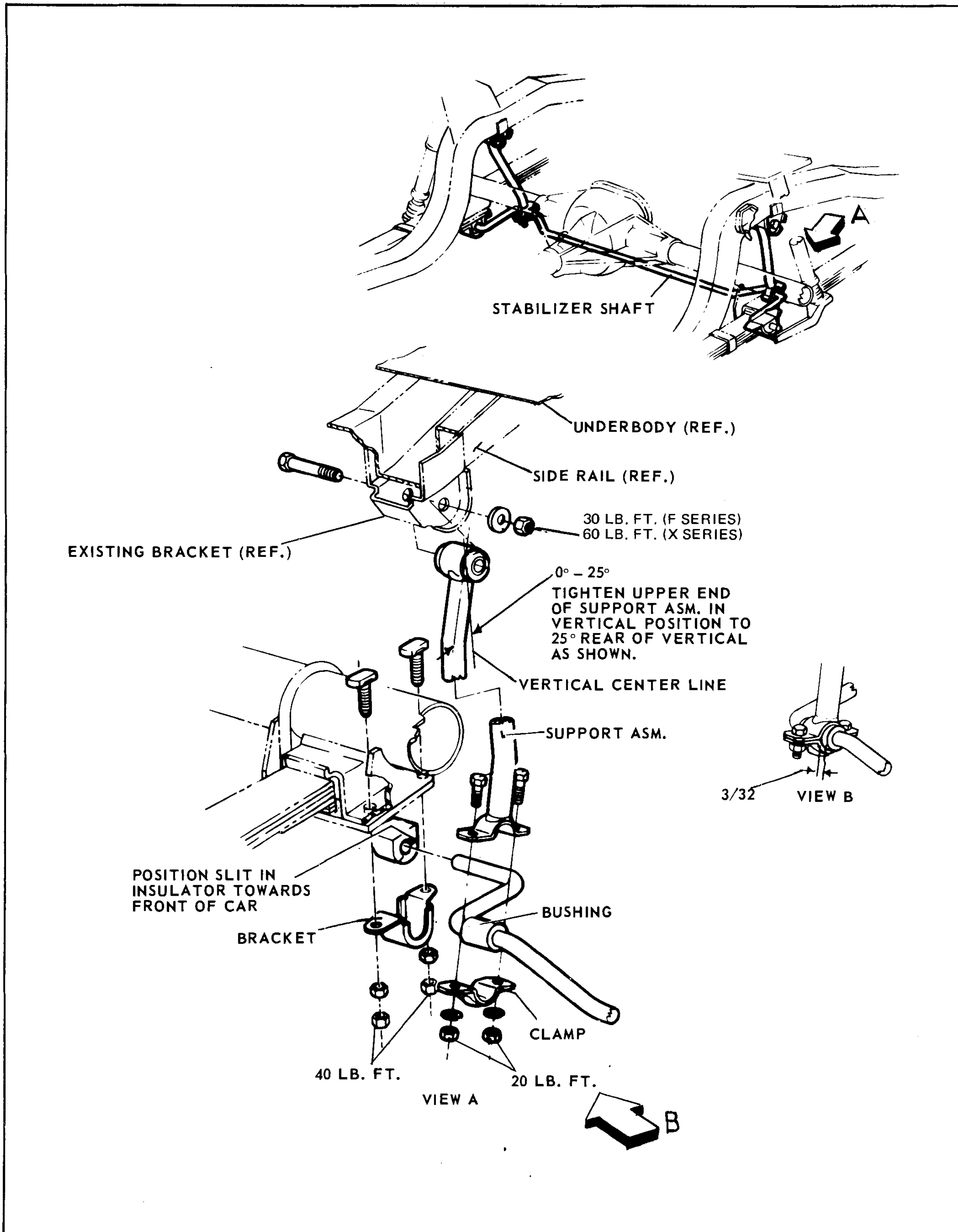


Fig. 4-7 Installation of Stabilizer Shaft on Formula, Trans Am & X Series

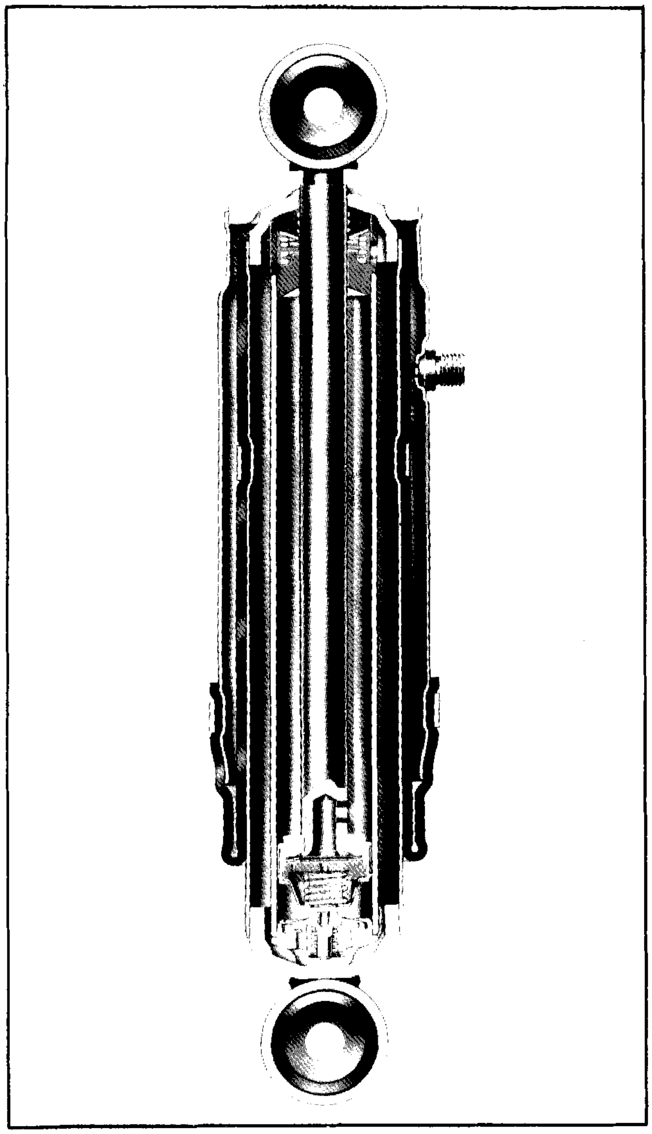


Fig. 4-8 Superlift Shock Absorber

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. 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.*

PRECAUTIONS

To insure satisfactory functioning of the Superlift system, observe the following precautions:

a. Maintain a minimum of 10 psi for best ride characteristics with an empty car.

b. Vary pressure up to a maximum of 90 psi to level the car with loads.

AUTOMATIC LEVEL CONTROL

B & G SERIES

Automatic Level Control, available as a factory or dealer installed option on B and G 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 tank and pressure regulator assembly, height control valve, link, two Superlift rear shocks and flexible air lines. See Compressor Assembly and Pressure Regulator Valve (Fig. 4-9 and 4-10).

The compressor is a two-stage, vacuum actuated type, requiring no lubrication. Vacuum supply is taken from the positive crankcase hose. High pressure air is supplied to the reservoir tank by the second stage of the two-stage compressor. The first stage intake stroke draws air at atmospheric pressure through a oneway check valve located in the end of the first stage housing under the first stage housing cover (Fig. 4-11). On the first stage compression stroke, the intake valve is closed and the oneway check valve in the second stage end of the piston is opened. This allows the air from the first stage cylinder to flow through the hollow piston into the second stage cylinder for high pressure compression (Fig. 4-12). The second stage compression stroke closes the check valve in the piston and opens the check valve in the end of the second stage houswng (Fig. 4-11).

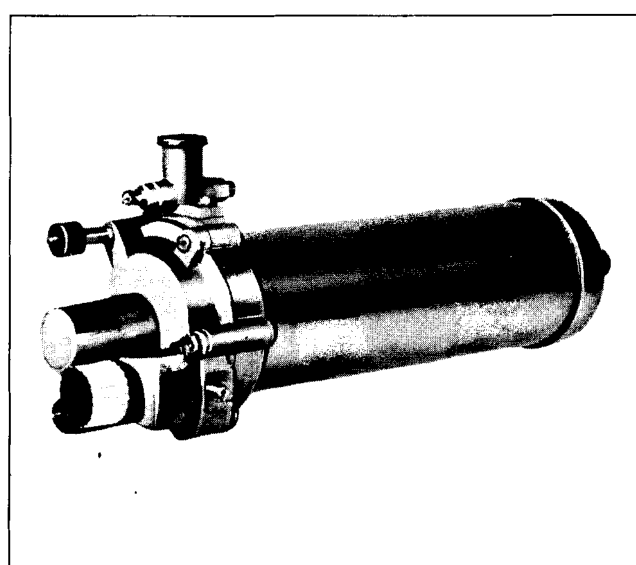


Fig 4-9 Compressor Assembly

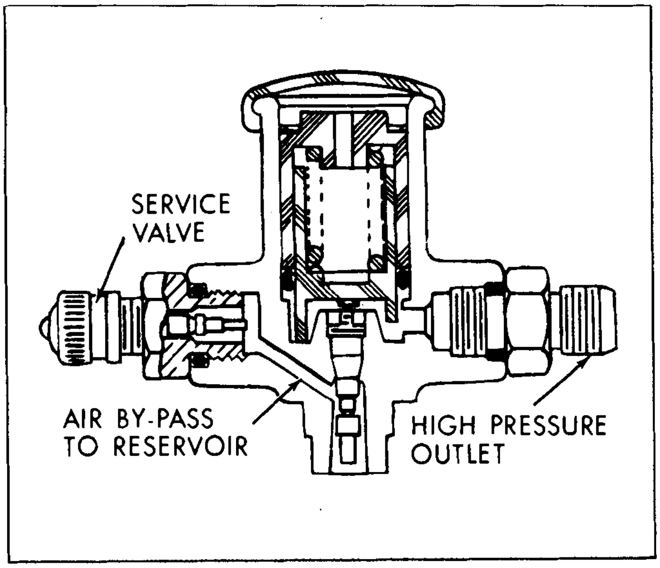


Fig. 4-10 Pressure Regulator Valve

The intake and compression strokes are controlled by a sliding distributor valve that is actuated through an arm that is tripped by the piston as it nears the end of each stroke. Each time the arm actuates the distributor valve, a different set of holes are covered in the first stage housing. The distributor valve controls the flow of intake manifold vacuum and air sides of the compressor diaphragm. (Fig. 4-11 and 4-12).

As the compressor cycles, the reservoir air pressure gradually increases causing a back pressure on the second stage piston until it equals the push of pressure against the diaphragm. At this point, a balanced condition is reached and the unit stops operating. After reservoir pressure drops due to system air usage, the compressor again begins to cycle and replenish the reservoir.

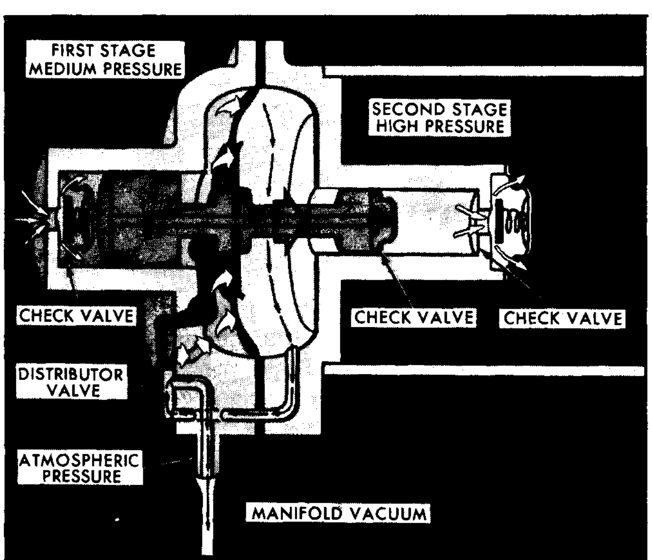


Fig. 4-11 First Stage Intake Stroke

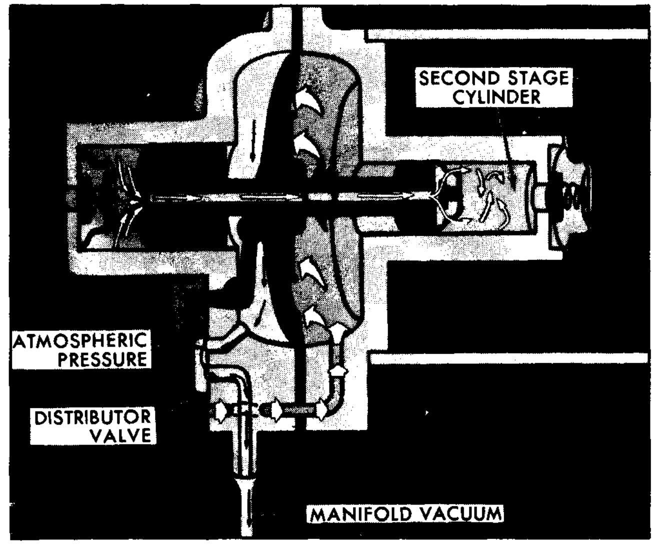


Fig. 4-12 First Stage Compression Stroke

Pressure balance will depend upon the prevailing manifold vacuum and atmospheric pressure. Both are affected by altitude above or below sea level. Balance pressure will vary from approximately 150 to 275 psi.

The pressure regulator valve is preset and limits the reservoir outlet pressure to approximately 125 psi to avoid damage to the height control valve and Superlift shocks (Fig. 4-10).

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 (Fig. 4-13). When this valve is open,

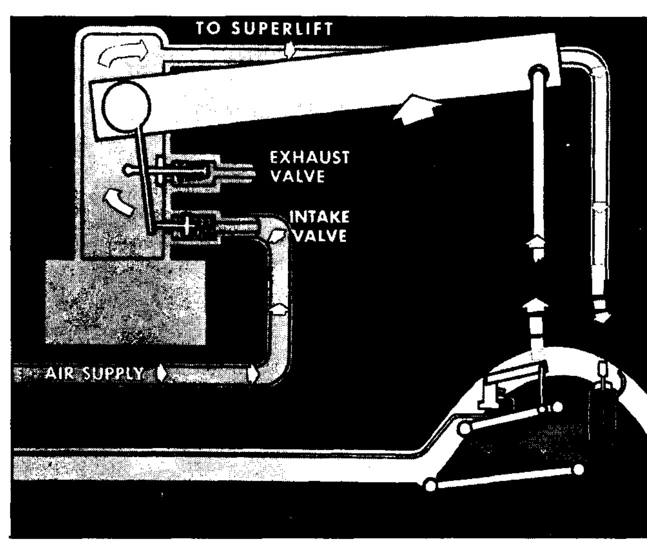


Fig. 4-13 Load Added to Car

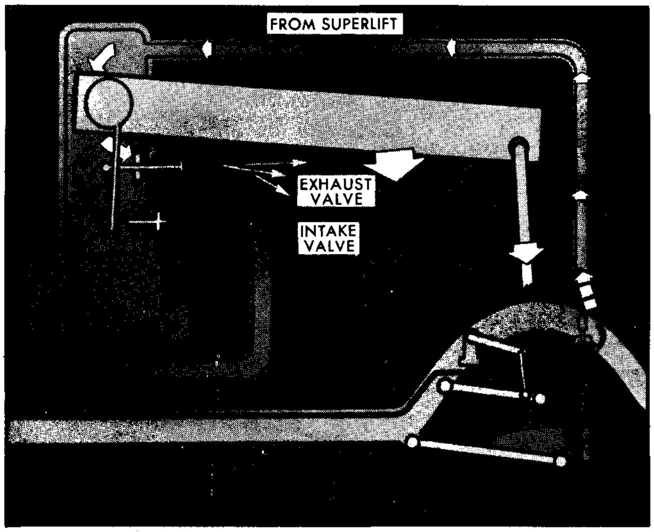


Fig. 4-14 Load Removed from Car

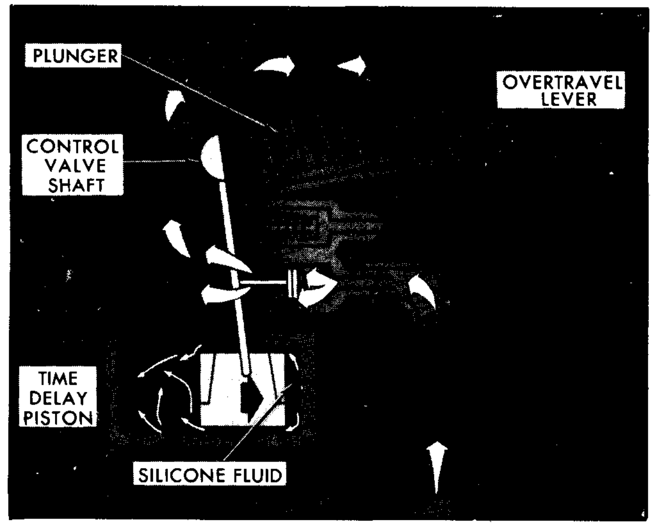


Fig. 4-16 Load Movement of Overtravel Lever

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 level 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 (Fig. 4-14).

A 4-18 second time delay mechanism, which is built into the height control valve, prevents air transfer due to normal ride movements. The overtravel 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 (Fig. 4-15).

During changes due to loading, the time delay mechanism will allow the overtravel shaft to open either the intake or exhaust valve as required, since this is not a rapid movement (Fig. 4-16).

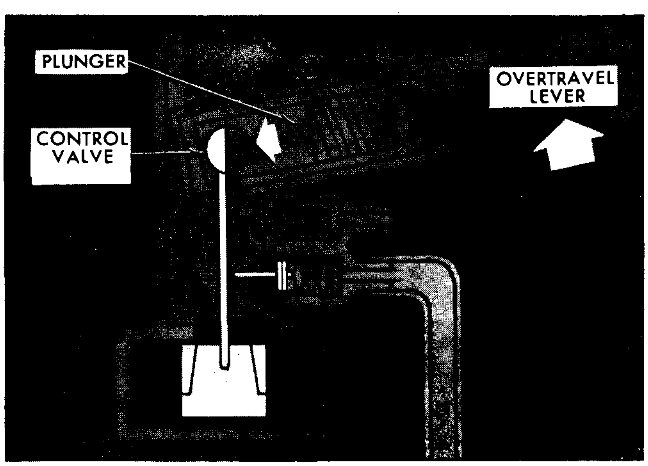


Fig. 4-15 Rapid Movement of Overtravel Lever

SUPERLIFT SHOCK ABSORBER

The Superlift shock absorber is essentially a conventional hydraulic unit with a pliable nylon reinforced neoprene boot acting as an air chamber (Fig. 4-8).

The unit 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.

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.*

GENERAL INFORMATION

Shock absorbers do not require lubrication and in case of leaks or malfunction, they should be replaced.

On the Automatic Level Control System an air filter located on the compressor should be inspected periodically to see if it has become plugged. The compressor does not require lubrication as the unit is designed to operate dry.

ADJUSTMENT PROCEDURES

Automatic Level Control on car trim adjustment should be performed with a full fuel tank (or an equivalent load at the rate of six pounds per gallon of gasoline). The proper adjustment procedure is listed below:

1. Fill compressor through service valve with air at available line pressure.
2. Raise the car on two-post or drive-on hoist.

CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

3. Disconnect the link from the height control valve lever.
4. Move the height control valve lever downward until air stops escaping from the exhaust port on the height control valve. The Superlifts will now automatically hold 8-15 psi.
5. Let the lever go to its neutral position and loosen the lever adjustment nut.
6. Connect the link to the height control valve lever and tighten the lever adjustment nut.

NOTE: *Do not move control valve lever and over travel body while tightening nut.*

MAJOR SERVICE

SHOCK ABSORBER

NOTE: *To test Superlift shock absorber for air leaks remove shock absorber as outlined below and inflate to 80-110 psi utilizing fill valve from J 22695 package, submerge in water and observe for leaks. See Precautions under AUTOMATIC LEVEL CONTROL SYSTEM - B & G SERIES for further superlift information.*

REMOVE

1. Raise car at axle housing.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

2. Remove wheel and tire assembly on B Series station wagon.
3. a. Remove nut, retainer and grommet or nut and lock washer which attach lower end of shock absorber to its mounting (Fig. 4-17; Fig. 4-18; Fig. 4-19, View A; or Fig. 4-20, View D).

   CAUTION: *Shock absorber stud must not turn while loosening nut. If necessary, use pliers or wrench to hold bottom of stud while removing nut.*

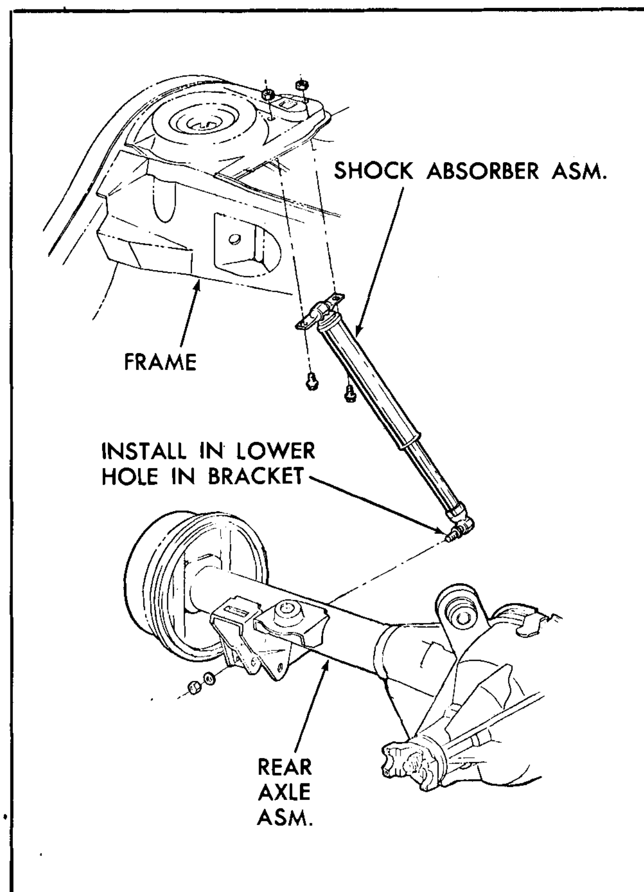


Fig. 4-17 Installation of Shock Absorber (Coil Spring Suspension)

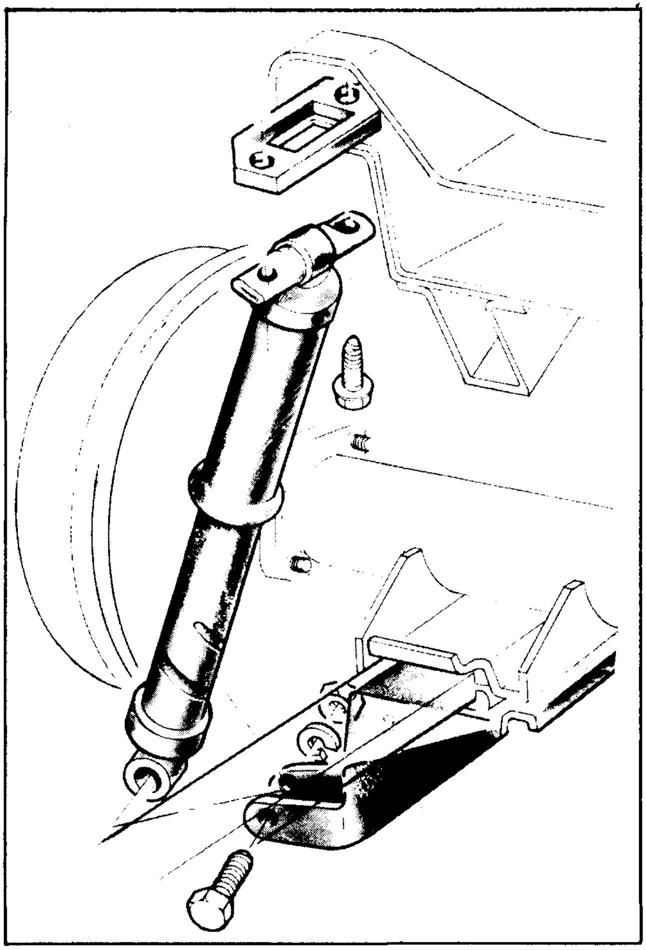


Fig. 4-18 Installation of Shock Absorber on X Series

b. Disconnect air line from Superlift.

CAUTION: *To prevent damage to neoprene boot on Superlift unit, do not rotate free end with opposite end still attached.*

4. Remove two shock absorber upper attaching screws and remove shock absorber (Fig. 4-17; Fig. 4-18; Fig. 4-19, View A; or Fig. 4-20, View C).

NOTE: *Clean and inspect rubber bushings. If rubber bushings have shifted from their original position in either eye, replace shock absorber. Inspect rubber grommets for damage and deterioration. Replace as required.*

INSTALL

1. Install shock absorber by reversing the above steps.

CAUTION: *Make sure all grommets and retainers are correctly installed.*

2. Tighten two upper attaching screws to 15 lb. ft. torque. Tighten lower nut to 65 lb. ft. torque on B, A & G Series or to 10 lb. ft. torque on F Series or to 55 lb. ft. torque on X Series.

CAUTION: *Shock absorber stud must not rotate while tightening nut.*

3. Lower car and test shock absorber action.

COIL SPRING

REMOVE

1. Raise rear of car.
2. Remove clip attaching brake hose to frame cross-member.

NOTE: *Do not disconnect brake line from connector.*

3. a. Place jack stand under frame side rail for support if car raised with jack placed under axle housing.

   b. Place jack stand under axle housing tube for support if car raised with jack placed under frame side rail.

4. Remove nut and lock washer from shock absorber lower end stud and disconnect shock absorber from axle housing bracket (Fig. 4-21).
5. a. If axle housing is supported by jack, carefully lower axle housing.

   b. If frame side rail is supported by jack, carefully raise frame side rail.

CAUTION: *Care must be taken to prevent contact between the rear lower control arm upper flange and the rear lower control arm axle housing bracket when lowering the axle housing.*

6. Remove spring.
7. Remove rubber insulator from upper spring seat, inspect and replace if in poor condition.

INSTALL

1. Install spring, making sure that the end of the bottom coil is towards the rear of car, Fig. 4-22.
2. Either raise axle housing or lower car until shock absorber can be connected to axle housing bracket.

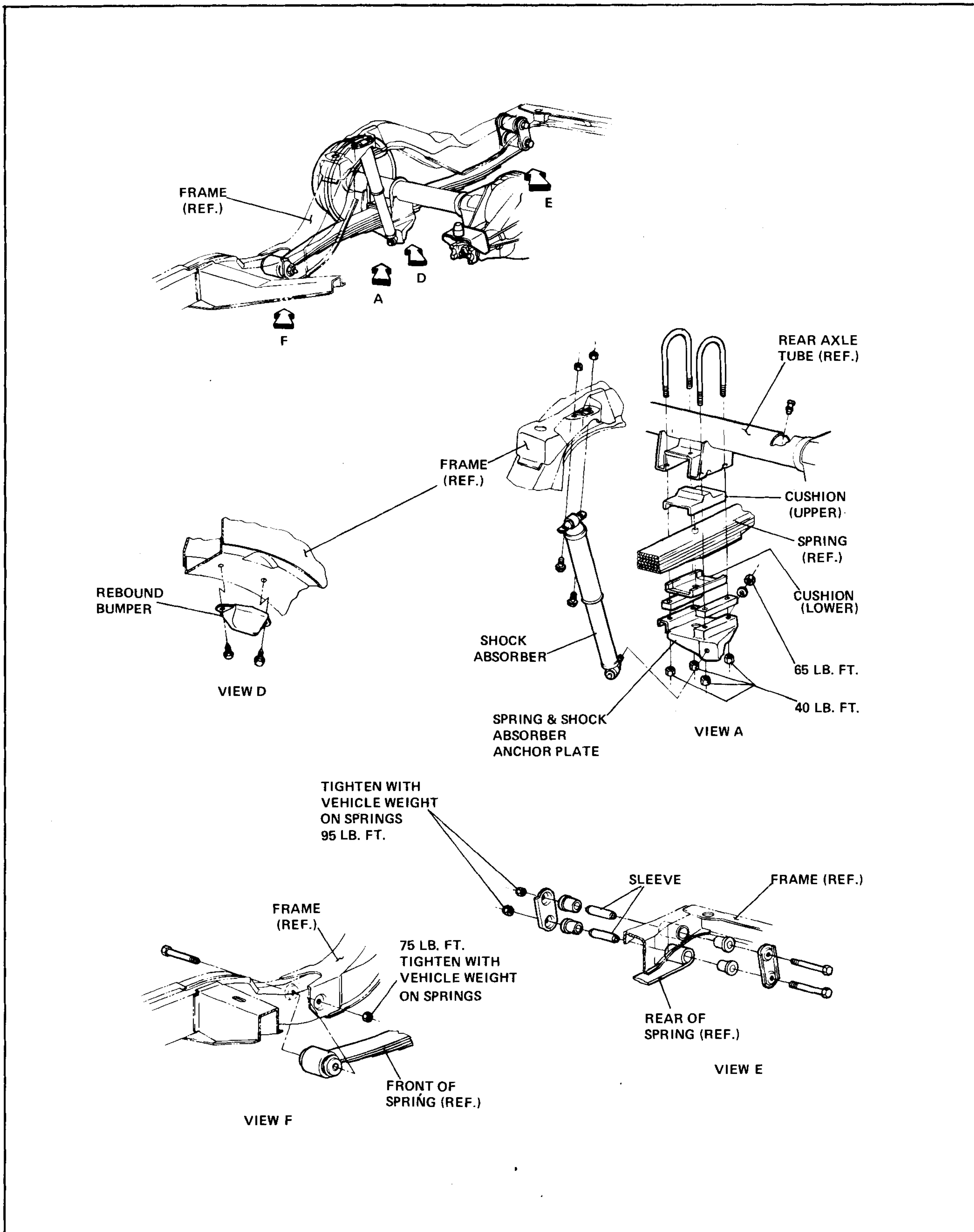


Fig. 4-19 Installation of Rear Suspension on B Series Station Wagon (Leaf Spring Suspension)

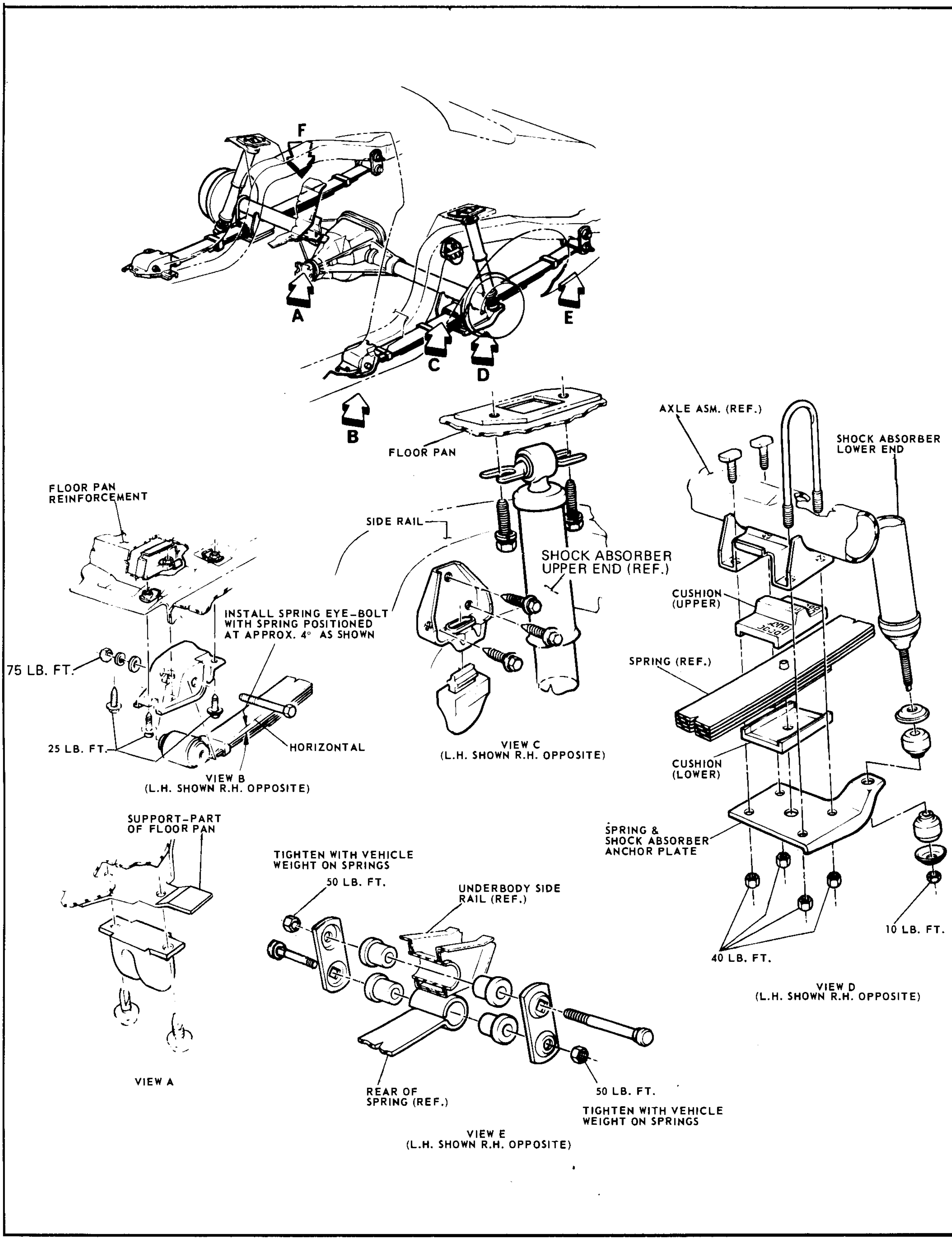


Fig. 4-20 Installation of Rear Suspension on F Series (Leaf Spring Suspension)

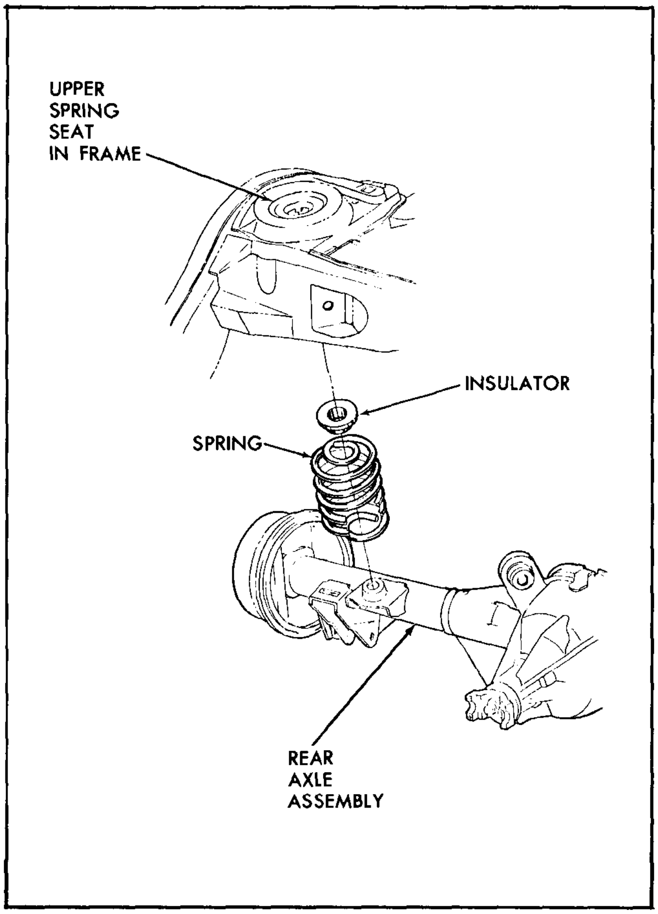


Fig. 4-21 Installation of Coil Spring

3. Install lock washer and nut on shock absorber stud. Tighten nut to 65 lb. ft. torque.

   CAUTION: *Shock absorber stud must not rotate while tightening nut.*

4. Position brake hose to bracket and install retaining clip.

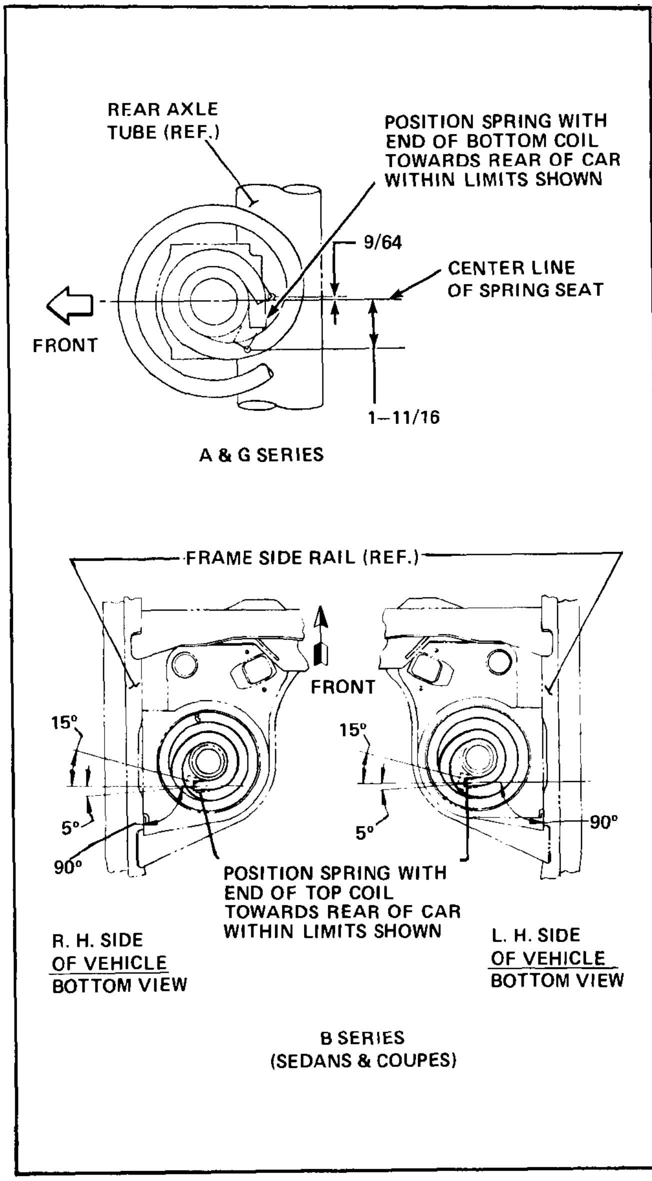


Fig. 4-22 Coil Spring Position in Spring Seat

LEAF SPRING

REMOVE

1. Raise car at axle housing.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

   NOTE: *Support weight of car at both frame side rails (B Series) or underbody side rails (F Series) near front eye of springs with jack stands.*

2. Remove nut, retainer and grommet or nut and lock washer which attach lower end of shock absorber to spring and shock absorber anchor plate (Fig. 4-18; Fig. 4-19, View A; or Fig. 4-20, View D).

   CAUTION: *Shock absorber stud must not turn while loosening nut. If necessary, use pliers or wrench to hold bottom of stud while removing nut.*

3. Compress shock to move out of way.

4. Remove spring and shock absorber anchor plate nuts; withdraw anchor plate with lower spring cushion pad.

5. Raise axle housing off spring and remove upper spring cushion pad.

6. Loosen upper and lower spring shackle pin nuts.

7. Loosen spring front eye bolt (Fig. 4-19, View F; Fig. 4-10, View B; or Fig. 4-23).

8. **B Series:** Remove spring front eye bolt and carefully let spring swing down.

   F & X Series: Remove screws securing the spring front mounting bracket to the floor pan and carefully let spring swing down.

9. **F & X Series:** Remove front mounting bracket from spring.

10. Support spring; then remove lower shackle pin from spring. Separate shackle and withdraw spring from vehicle.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 1, 2, 3 and 8.*

1. **F & X Series:** Position spring front mounting bracket to spring front eye and loosely install spring eye bolt and nut.

   CAUTION: *Do not tighten spring eye bolt nut until weight of car is on springs.*

2. **B Series:** Raise front end of spring and loosely install spring eye bolt and nut.

Fig. 4-23 Installation of Rear Spring on X Series

   CAUTION: *Do not tighten spring eye bolt nut until weight of car is on springs. Position parking brake cable on top side of spring.*

3. Install sleeves (B Series) and bushing halves in spring rear eye, place spring to shackles and loosely install lower shackle pin and nut.

   CAUTION: *Do not tighten shackle pin nuts until weight of car is on springs.*

   F & X Series: Raise front end of spring and position mounting bracket to floor pan.

   CAUTION: *Be sure tab on spring mounting bracket is indexed in slot provided in the floor pan. Position parking brake cable on top side of spring.*

4. **F & X Series:** Install spring front mounting bracket attaching screws and tighten to 25 lb. ft. torque.

5. Place upper spring cushion pad on spring so cushion is indexed on spring center locating bolt head.

6. Lower axle housing onto spring.

   CAUTION: *Index rib of upper spring cushion pad into groove of spring mounting bracket on axle housing.*

7. Place lower spring cushion pad in spring and shock absorber anchor plate with dimple on cushion indexed in hole of plate.

8. Position spring and shock absorber anchor plate to spring with nut of spring center locating bolt indexed in dimple of lower spring cushion pad. Tighten anchor plate attaching nuts to 40 lb. ft. torque.

9. Install shock absorber lower end stud in spring and shock absorber anchor plate. Tighten shock absorber lower end stud nut to 65 lb. ft. torque on B Series or to 10 lb. ft. torque on F Series or 55 lb. ft. torque on X Series.

   CAUTION: *Make sure all grommets and retainers are correctly installed (F Series). Shock absorber stud must not rotate while tightening nut.*

10. Raise car so weight of car is on springs.

11. Tighten spring front eye bolt nut to 75 lb. ft. torque and shackle pin nuts to 95 lb. ft. torque on B Series or to 50 lb. ft. torque on F & X Series.

12. Remove jack stands and lower car.

SPRING DAMPENER (X SERIES)

REMOVE

1. Raise rear of car.
2. Install "C" clamp over dampener.
3. Straighten tab of dampener retainer.
4. Remove "C" clamp, dampener retainer, dampener and rubber cushion.

INSTALL

1. Install rubber cushion ten (100) inches from centerline of spring front eye bushing.
2. Place dampener and retainer into position.
3. Place a steel bar with approximate dimensions of 1" x 2" x 6" on top of rubber cushion and retainer.
4. Install two (2) "C" clamps in the locations shown in Fig. 4-24.

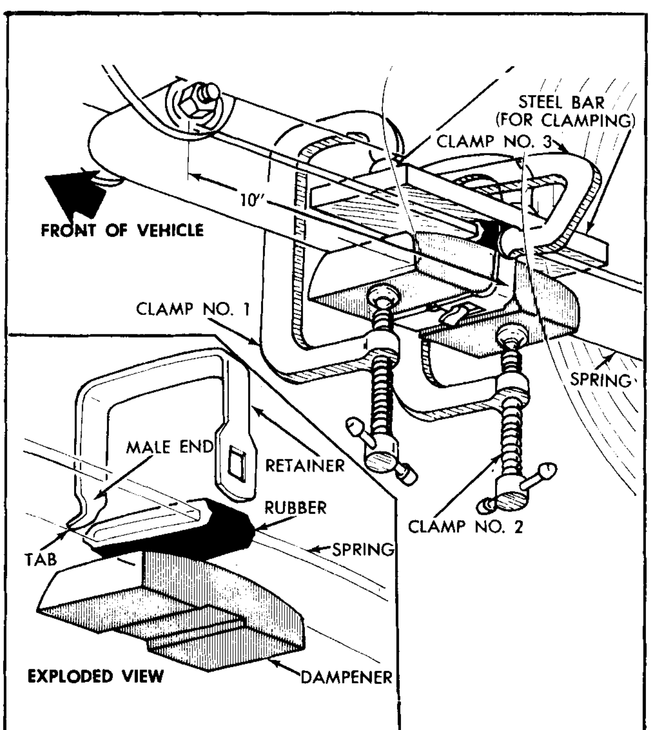


Fig. 4-24 Installation of Spring Dampener on X Series with Single Leaf Spring

5. Compress rubber cushion in the following sequence (Fig. 4-24).
   a. Tighten clamps No. 1 and No. 2 equally until maximum deflection of rubber is achieved.
   b. Install clamp No. 3 and tighten to obtain additional rubber compression.
6. Bend male end of retainer towards spring until flush.
7. Repeat Step 4 with female retainer leg fitting slot over tab. Remove any excess bends in retainer strap before finally bending tab back to lock retainer in position.
8. Test dampener retention assuring that no movement exists between strap and dampener.

NOTE: *Do not confuse rubber resilience with possible looseness.*

MAIN LEAF (LEAF SPRING)

REMOVE

NOTE: *The main leaf (Fig. 4-25) is the only leaf of the spring that is replaceable. If any of the smaller leafs require replacement, the entire spring assembly must be replaced.*

1. Remove spring (See LEAF SPRING - REMOVE).
2. Pry the tabs of the spring leaf cips up with a screwdriver and remove clips and clip liners from spring.
3. Install "C" clamp near the center locating nut and bolt of spring to keep spring leafs compressed together.
4. Remove the center locating nut and bolt.
5. Carefully release the "C" clamp.
6. Separate the smaller leafs of the spring from the main leaf.

CAUTION: *Be sure to note the position of each leaf in regard to the front of the spring. If a leaf is installed beackwards, the spring will be damaged and the designed strength of the spring effected.*

INSTALL

1. Reverse the above steps for reassembly.

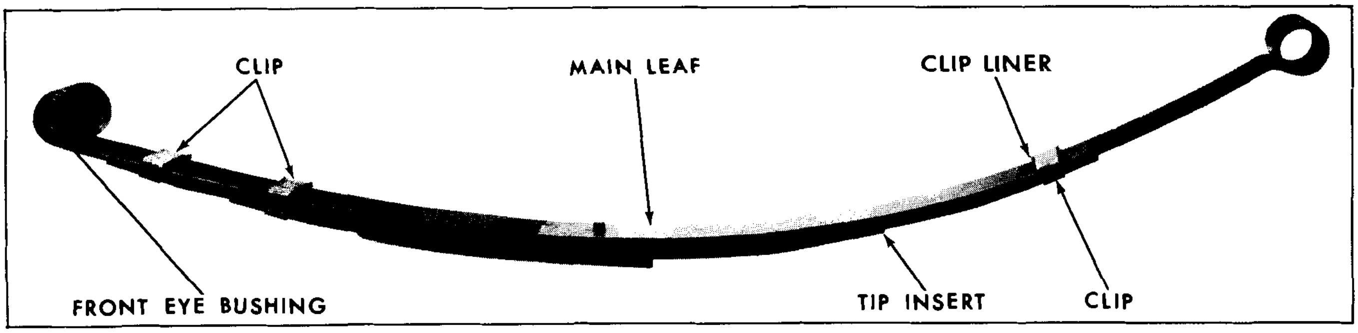


Fig. 4-25 Main Leaf of Leaf Spring

NOTE: *If any leaf clips or clip liners are damaged or worn, they must be replaced.*

2. Tighten spring center locating bolt nut to 23 lb. ft. torque.
3. Install spring (see LEAF SPRING - INSTALL).

TIP INSERTS (LEAF SPRING)

REMOVE

1. Raise rear of car until wheel and tire assembly is off of ground.

   NOTE: *Spring must be able to hang in rebound position. On some leafs, the leaf spring clip may have to be removed prior to separating the leaf for insert removal.*

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

2. Using a suitable pry bar placed between spring leafs, separate leafs enough to allow removal of insert.

INSTALL

Install by reversing the above steps.

SPRING AND SHOCK ABSORBER ANCHOR PLATE OR SPRING CUSHION PADS (LEAF SPRING)

REMOVE

1. Raise car at axle housing.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

2. Remove nut, retainer and grommet or nut and lock washer which attach lower end of shock absorber to spring and shock absorber anchor plate (Fig. 4-18; Fig. 4-19, View A; or Fig. 4-20, View D).

   CAUTION: *Shock absorber stud must not turn while loosening nut. If necessary, use pliers or wrench to hold bottom of stud while removing nut.*

3. Compress shock to move out of way.
4. Place jack stand under underbody side rail and lower axle to relieve load on axle.
5. Remove spring and shock absorber anchor plate nuts; withdraw anchor plate with lower spring cushion pad (Fig. 4-19, View A; Fig. 4-20, View D; or Fig. 4-23).
6. Raise axle housing off spring and remove upper spring cushion pad.

INSTALL

1. Install by reversing the above steps.

   CAUTION: *Place upper and lower spring cushion pads on spring so that cushions are indexed on spring center locating bolt and nut. Upper cushion and lower cushion will be aligned if installation is correct (see LEAF SPRING - INSTALL steps 5 through 8).*

   CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 2.*

2. Tighten anchor plate attaching nuts to 40 lb. ft. torque.

3. Tighten shock absorber lower end stud nut to 65 lb. ft. torque on B Series or to 10 lb. ft. torque on F Series or to 55 lb. ft. on X Series.

CAUTION: *Make sure all grommets and retainers are correctly installed (F Series). Shock absorber stud must not rotate while tightening nut.*

FRONT BUSHING (LEAF SPRING)

REMOVE

NOTE: *On B Series, remove spring (see LEAF SPRING - REMOVE) and then follow procedure in steps 8 through 12 outlined below.*

1. **F & X Series:** Raise car at axle housing.

NOTE: *Support weight of car at both underbody side rails (F & X Series) near front eye of springs with jack stands.*

2. **F & X Series:** Remove nut, retainer and grommet or nut and lock washer which attach lower end of shock absorber to spring and shock absorber anchor plate (Fig. 4-18 or Fig. 4-20, View D).

CAUTION: *Shock absorber stud must not turn while loosening nut. If necessary, use pliers or wrench to hold bottom of stud while removing nut.*

3. **F & X Series:** Compress shock to move out of way.
4. **F & X Series:** Loosen spring front eye bolt (Fig. 4-20, View B or Fig. 4-23).
5. **F & X Series:** Remove the screws securing the spring front mounting bracket to the floor pan.
6. **F & X Series:** Lower axle assembly enough to permit access to spring front mounting bracket and remove bracket from spring.
7. **F & X Series:** Insert wood wedge or plank between spring and underbody side rail to pry spring eye down for clearance to use bushing removal tool.
8. Position remover adapter J 21978-1 over puller screw J 21058-15 so that adapter is against head of puller screw (Fig. 4-26).

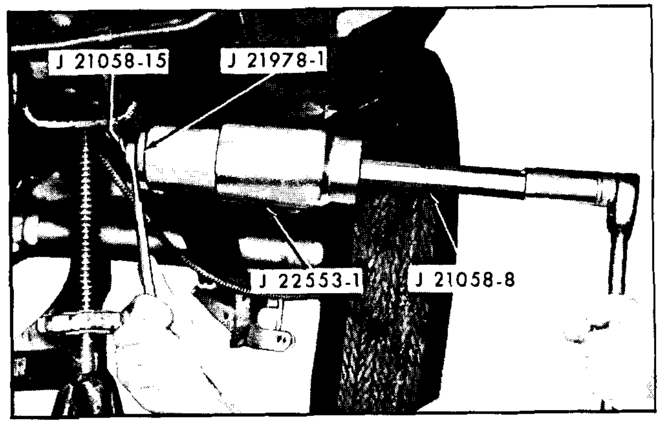


Fig. 4-26 Removing Leaf Spring Front Bushing (F Series Shown)

9. Position puller screw through eye of bushing so that remove adapter J 21978-1 is against unflanged side of bushing.
10. Position large end of barrel J 22553-1 over puller screw and seat barrel against spring eye.
11. Position thrust bearing and washer on puller screw. Then install and tighten nut J 21058-8 against thrust bearing.
12. Check to make sure that all puller parts are properly aligned. Then proceed to tighten nut until bushing is pulled free of spring eye. Disassemble puller tool.

INSTALL

NOTE: *On B Series, follow procedure in Steps 1 through 6 outlined below and then install spring (see LEAF SPRING - INSTALL).*

1. Position installer adapter J 22553-2 over flange end of bushing (Fig. 4-27).

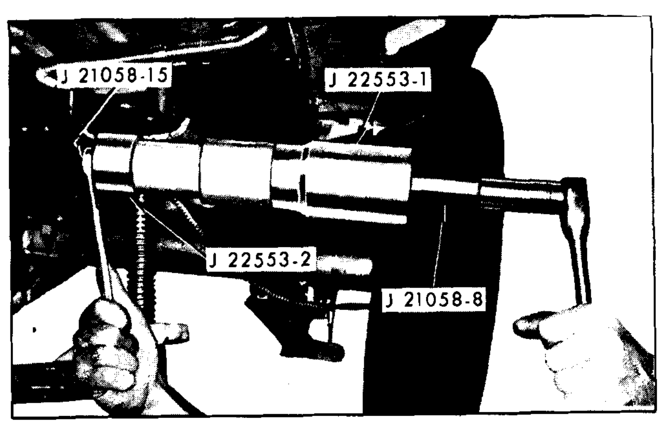


Fig. 4-27 Installing Leaf Spring Front Bushing (F Series Shown)

2. Position puller screw J 21058-15 through installer adapter and bushing.

3. Position puller screw through spring eye until bushing contacts spring.

4. Install small end of barrel J 22553-1 over puller screw and seat barrel against spring.

5. Install thrust bearing, washer and nut J 21058-8 on puller screw. Check puller tools and bushing for proper alignment; then tighten nut to pull bushing into spring. Install bushing until bushing is centered in spring eye.

 CAUTION: *Do not apply additional torque to nut J 21058-8 after bushing flange contacts spring. Torque applied after flange is seated will tend to distort flange and reposition bushing in spring.*

6. Disassemble bushing installation tools and remove from spring.

 CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 7.*

7. **F & X Series:** Position spring front mounting bracket to spring front eye and loosely install spring eye bolt and nut.

 NOTE: *Do not tighten spring eye bolt nut until weight of car is on spring.*

8. **F & X Series:** Remove wood wedge or plank.

9. **F & X Series:** Raise front end of spring and position mounting bracket to floor pan.

 CAUTION: *Be sure tab on spring mounting bracket is indexed in slot provided in the floor pan.*

10. **F & X Series:** Install spring front mounting bracket attaching screws and tighten to 25 lb. ft. torque.

11. **F & X Series:** Install shock absorber lower end stud in spring and shock absorber anchor plate. Tighten shock absorber lower end stud nut to 10 lb. ft. torque on F Series or to 55 lb. ft. on X Series.

 CAUTION: *Make sure all grommets and retainers are correctly installed (F & X Series). Shock absorber stud must not rotate while tightening nut. If necessary, use pliers or wrench to hold bottom of stud while tightening nut.*

12. **F & X Series:** Raise car so weight of car is on springs.

13. **F & X Series:** Tighten spring front eye bolt nut to 75 lb. ft. torque.

14. **F & X Series:** Remove jack stands and lower car.

SHACKLES, PINS, BUSHINGS AND SLEEVES (LEAF SPRING)

NOTE: *Sleeves used on B Series only.*

REMOVE

1. Raise car at axle housing.

 NOTE: *Support weight of car at both frame side rails (B Series) or underbody side rails near front eye of springs with jack stands.*

2. Lower axle housing enough so shackles are not carrying weight of car or axle housing.

3. Loosen upper and lower spring shackle pin nuts (Fig. 4-19, View E; Fig. 4-20, View E; or Fig. 4-33).

4. **B Series:** Remove upper spring shackle pin, shackle, bushings and sleeve from frame side rail.

 F & X Series: Remove upper spring shackle pin, shackle and bushings from underbody side rail.

5. **B Series:** Insert wood wedge or plank near rear spring eye between spring and frame side rail to pry spring eye down for clearance.

 F & X Series: Insert wood wedge or plank near rear spring eye between spring and underbody side rail to pry spring eye down below bottom of fuel tank for clearance.

6. **B Series:** Remove lower spring shackle pin, shackle, bushings and sleeve from spring eye.

 F & X Series: Remove lower spring shackle pin, shackle and bushings from spring eye.

INSTALL

1. Install by reversing the above steps.

 CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 2.*

2. Tighten shackle pin nuts to 95 lb. ft. torque on B Series or to 50 lb. ft. torque on F & X Series.

CAUTION: *Do not tighten shackle pin nuts until weight of car is on springs.*

STABILIZER SHAFT (GTO & GT)

NOTE: *Shaft will support weight of car when two-post axle engaging hoist is used for lifting.*

Place jack stand under each frame side rail for support if car raised with hoist engaging shaft and then lower hoist enough so shaft can be removed.

REMOVE

1. Raise rear of car.
2. Remove bolts attaching stabilizer shaft to each lower control arm (Fig. 4-28).
3. Remove shaft and spacer shims if present.

INSTALL

1. Install by reversing the above steps.

   CAUTION: *If any shims were removed, replace as evenly as possible each side.*

   CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 2.*

2. Tighten nuts for shaft attaching bolts to 50 lb. ft. torque.

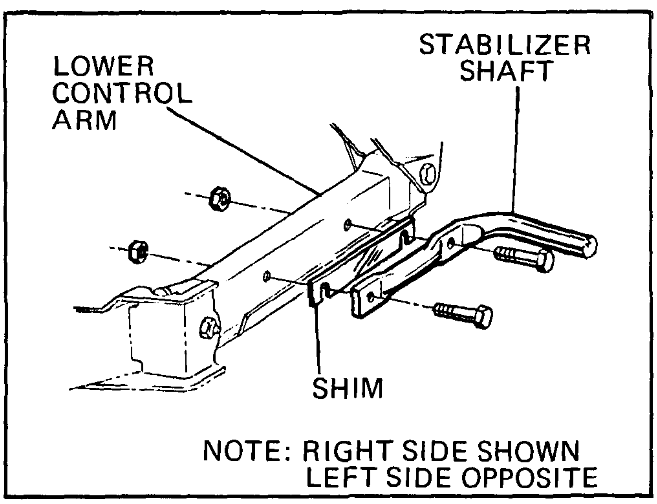


Fig. 4-28 Installation of Stabilizer Shaft on GTO

STABILIZER SHAFT (FORMULA, TRANS AM & X SERIES)

REMOVE

1. Raise rear of car.
2. Disconnect lower end of each support assembly from stabilizer shaft by removing clamping bolts (Fig. 4-7, View A).
3. Remove insulator and bracket from below each spring and shock absorber anchor plate (Fig. 4-7, View A).

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2 and 3.*

1. Install by reversing the above steps.

   CAUTION: *Slit in insulator should be positioned towards front of car (Fig. 4-7, View A).*

2. Tighten insulator bracket nuts to 40 lb. ft. torque.
3. Tighten support assembly lower end clamping nuts to 20 lb. ft. torque.

LOWER SUPPORT BUSHING (FORMULA, TRANS AM & X SERIES STABILIZER SHAFT)

REMOVE

1. Raise rear of car.
2. Disconnect lower end of support assembly from stabilizer shaft by removing clamping bolts (Fig. 4-7, View A).
3. Remove stabilizer shaft insulator and bracket from below spring and shock absorber anchor plate on same side of stabilizer shaft that support bushing is being removed (Fig. 4-7, View A).
4. Remove bushing from stabilizer shaft.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2 and 3.*

1. Install by reversing the above steps.

   CAUTION: *Do not slit bushing to install, instead bushing can be lubricated with liquid soap to ease installation. Do not use oil or grease lubricant. Slit in insulator mounted on stabilizer shaft end should be positioned towards front of car (Fig. 4-7, View A).*

2. Tighten insulator bracket nuts to 40 lb. ft. torque.
3. Tighten support assembly lower end clamping nuts to 20 lb. ft. torque.

INSULATOR AND/OR BRACKET (FORMULA, TRANS AM & X SERIES STABILIZER SHAFT)

REMOVE

1. Raise rear of car.
2. Remove insulator and/or bracket from below spring and shock absorber anchor plate (Fig. 4-7, View A).

INSTALL

1. Install by reversing the above steps.

   CAUTION: *Slit in insulator should be positioned towards front of car (Fig. 4-7, View A).*

   CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 2.*

2. Tighten insulator bracket nuts to 40 lb. ft. torque.

SUPPORT (FORMULA, TRANS AM & X SERIES STABILIZER SHAFT)

REMOVE

1. Raise rear of car.
2. Disconnect lower end of support assembly from stabilizer shaft by removing clamping bolts (Fig. 4-7, View A).
3. Remove pivot bolt from upper end of support assembly.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2 and 3.*

1. Install by reversing the above steps.
2. Tighten support assembly upper end pivot bolt nut to 30 lb. ft. torque on F Series or to 60 lb. ft. torque on X Series.

   CAUTION: *Tighten upper end of support assembly in vertical position to 25° rearward of vertical (Fig. 4-7, View A).*

3. Tighten support assembly lower end clamping nuts to 20 lb. ft. torque.

UPPER CONTROL ARM (COIL SPRING SUSPENSION)

REMOVE

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.

1. Raise rear of car.
2. Support nose of axle housing with a jack stand.
3. Remove pivot bolt at axle housing and lift upper control arm to clear boss on axle housing (Fig. 4-29).
4. Remove pivot bolt at frame cross-member and remove upper control arm.

   NOTE: *Clean and inspect rubber bushings. If worn, replace as outlined in this section.*

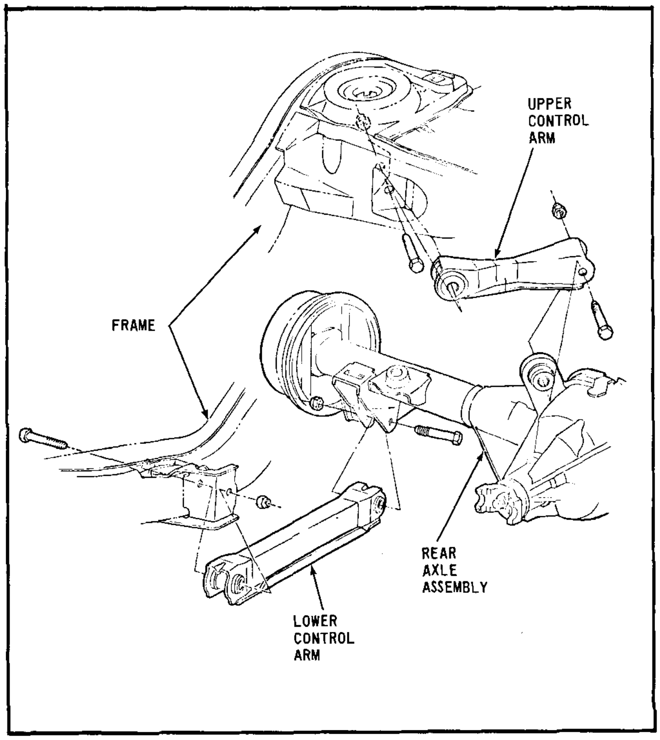


Fig. 4-29 Installation of Control Arms (Coil Spring Suspension)

INSTALL

1. Install by reversing the above steps.

   CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 2.*

2. **B Series:** While holding nut, tighten rear pivot bolt to 110 lb. ft. torque or while holding rear pivot bolt, tighten nut to 80 lb. ft. torque. While holding nut, tighten front pivot bolt to 140 lb. ft. torque or while holding front pivot bolt, tighten nut to 110 lb. ft. torque.

   CAUTION: *Car must be at curb height when tightening pivot bolts.*

   A & G Series: While holding nut, tighten pivot bolt to 110 lb. ft. torque or while holding pivot bolt, tighten nut to 80 lb. ft. torque.

   CAUTION: *Car must be at curb height when tightening pivot bolts.*

UPPER CONTROL ARM BUSHING (COIL SPRING SUSPENSION)

REMOVE (IN AXLE HOUSING)

1. Raise rear of car.
2. Support nose of axle housing with jack stand.
3. Remove pivot bolt at axle housing and lift upper control arm to clear boss on axle housing.
4. Arrange tools as shown in Fig. 4-30 and press bushing from axle housing.

   NOTE: *Replacing a left side upper control arm bushing in the type "C" differential axle housing may require modification of tool J-21474-8 before positioning tools from set J-21474.*

INSTALL (IN AXLE HOUSING)

1. Install bushing in axle housing by arranging tools as shown in Fig. 4-31 and press into place.

   CAUTION: *Use care to keep bushing properly aligned.*

   CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 2.*

2. Position control arm in place and install pivot bolt.
3. While holding nut, tighten pivot bolt to 110 lb. ft. torque or while holding pivot bolt, tighten nut to 80 lb. ft. torque.

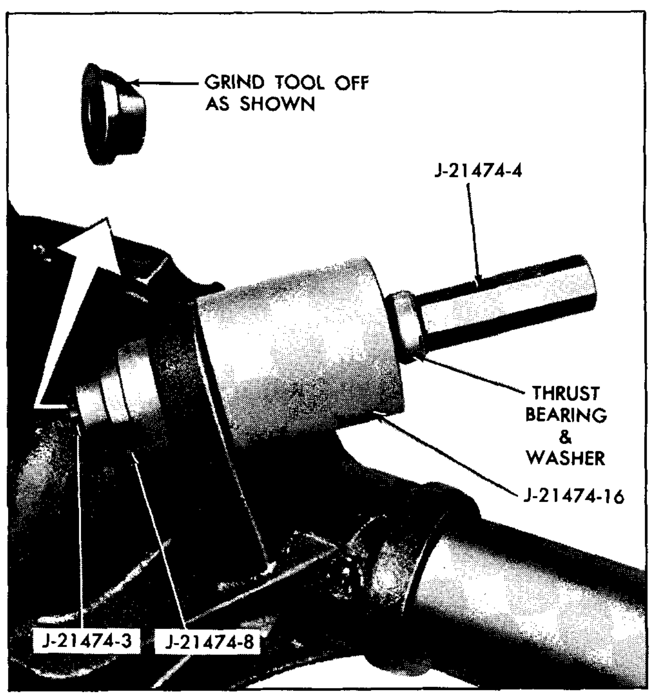


Fig. 4-30 Removing Upper Control Arm Rear Bushing (Coil Spring Suspension)

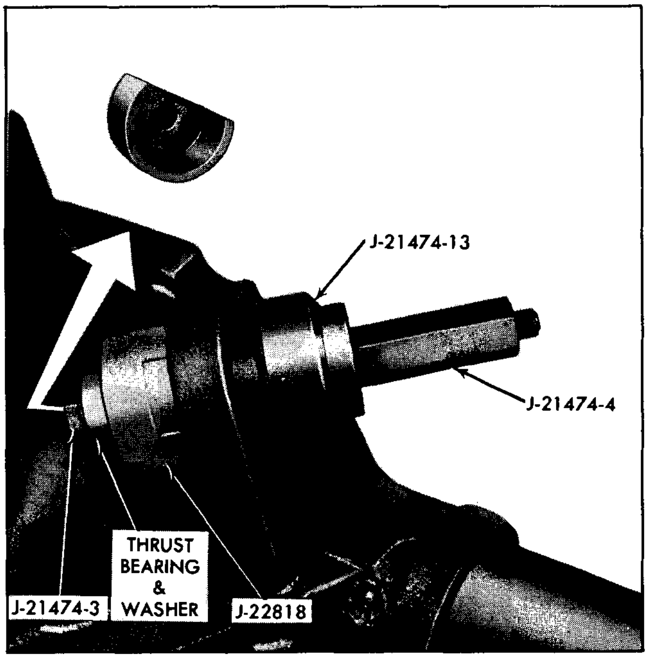


Fig. 4-31 Installing Upper Control Arm Rear Bushing (Coil Spring Suspension)

CAUTION: *Car must be a curb height when tightening pivot bolts.*

4. Remove jack stand and lower car.

REMOVE (IN CONTROL ARM)

1. Remove upper control arm (see UPPER CONTROL ARM - REMOVE).
2. Arrange tools as shown in Fig. 4-32 and press bushing from control arm.

INSTALL (IN CONTROL ARM)

1. Install bushing in control arm by arranging tools as shown in Fig. 4-33 and press into place.

   CAUTION: *Use care to keep bushing properly aligned.*

2. Install upper control arm (see UPPER CONTROL ARM - INSTALL).

LOWER CONTROL ARM (COIL SPRING SUSPENSION)

REMOVE

CAUTION: *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 might occur with both lower control arms removed, making replacement difficult.*

1. Raise rear of car.
2. Support nose of axle housing with a jack stand.

   NOTE: *Disconnect stabilizer shaft on A Series with GTO or GT option (see STABILIZER SHAFT - REMOVE AND INSTALL).*

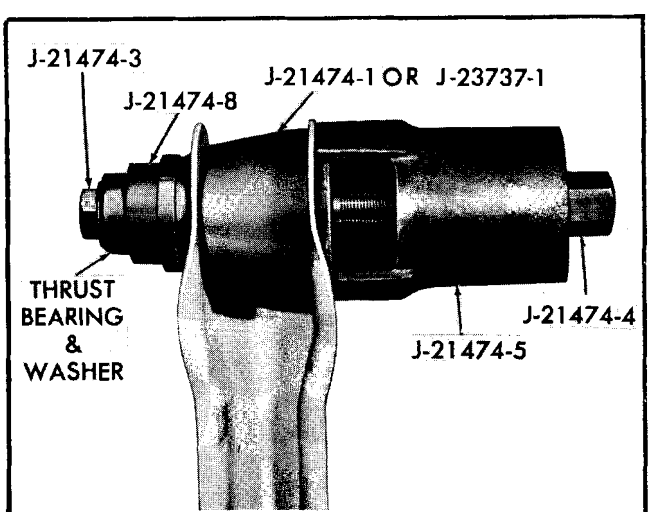


Fig. 4-32 Removing Upper or Lower Control Arm Bushing (Coil Spring Suspension)

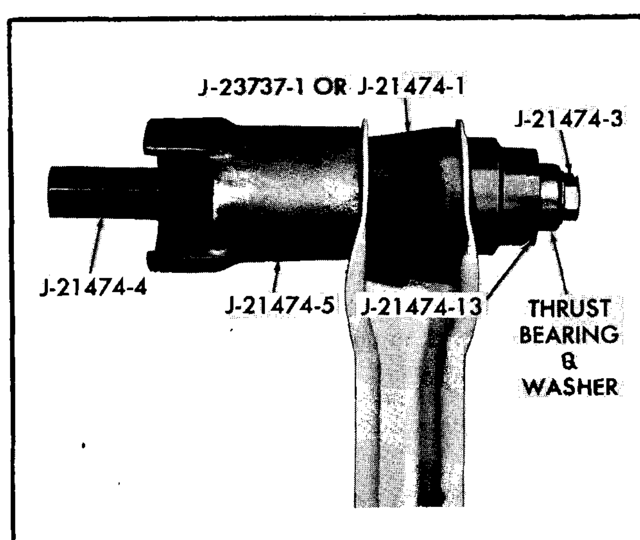


Fig. 4-33 Installing Upper or Lower Control Arm Bushing (Coil Spring Suspension)

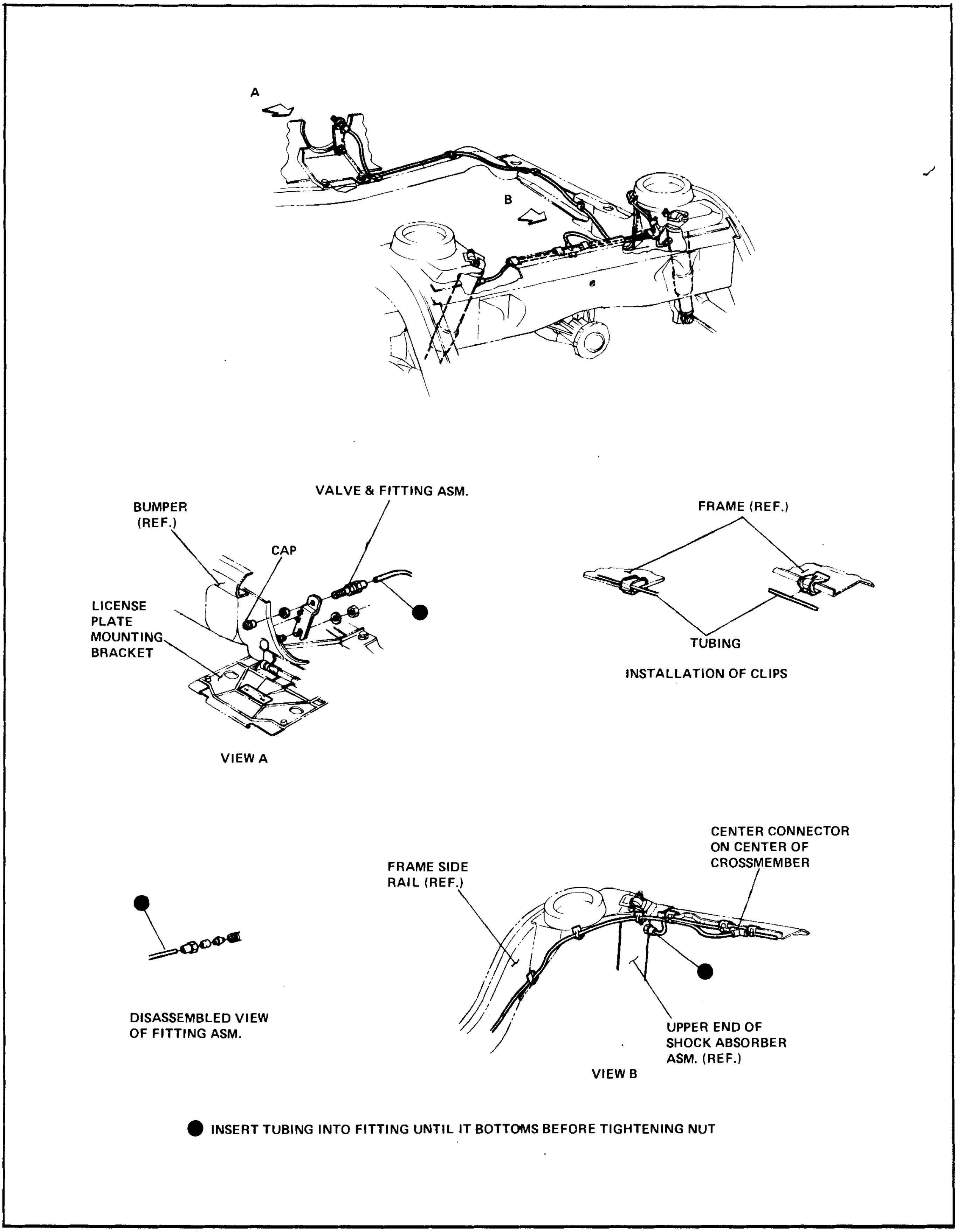


Fig. 4-34 Installation of Superlift Shock Absorber on B Series (Sedans and Coupes)

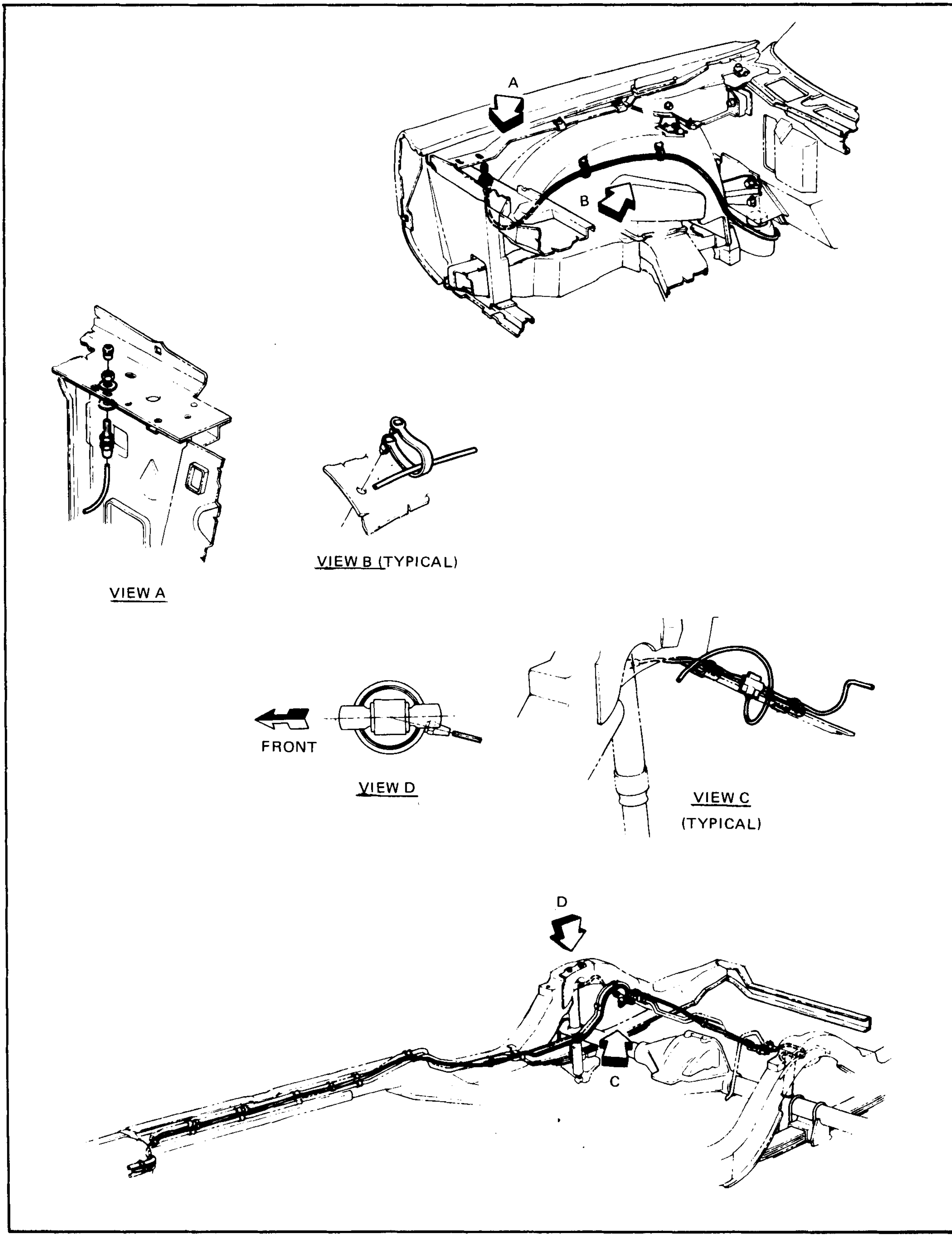


Fig. 4-35 Installation of Superlift Shock Absorber on B Series (Station Wagons)

3. Remove pivot bolt at axle housing bracket (Fig. 4-29).

4. Remove pivot bolt at frame side rail and remove control arm.

NOTE: *Clean and inspect rubber bushings. If worn, replace as outlined in this section.*

INSTALL

1. Install by reversing the above steps.

CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 2.*

2. **B Series:** While holding nut, tighten pivot bolt to 140 lb. ft. torque or while holding pivot bolt, tighten nut to 110 lb. ft. torque.

CAUTION: *Car must be at curb height when tightening pivot bolts.*

A & G Series: While holding nut, tighten pivot bolt to 110 lb. ft. torque or while holding pivot bolt, tighten nut to 80 lb. ft. torque.

CAUTION: *Car must be at curb height when tightening pivot bolts.*

LOWER CONTROL ARM BUSHING (COIL SPRING SUSPENSION)

REMOVE

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.

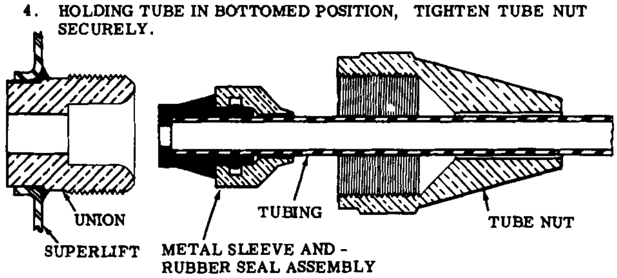


Fig. 4-36 Instructions for Fastening Tubing

1. Remove lower control arm (see LOWER CONTROL ARM - REMOVE).

2. Remove bushing using components of tool J 21474 as shown in Fig. 4-32.

INSTALL

1. Install bushing using components of tool J 21474 as shown in Fig. 4-33.

2. Install lower control arm (see LOWER CONTROL ARM - INSTALL).

AUTOMATIC LEVEL CONTROL SYSTEM (B & G SERIES)

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. 4-36). 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 (Figs. 4-37 and 4-38).

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 (Figs. 4-37 and 4-38).*

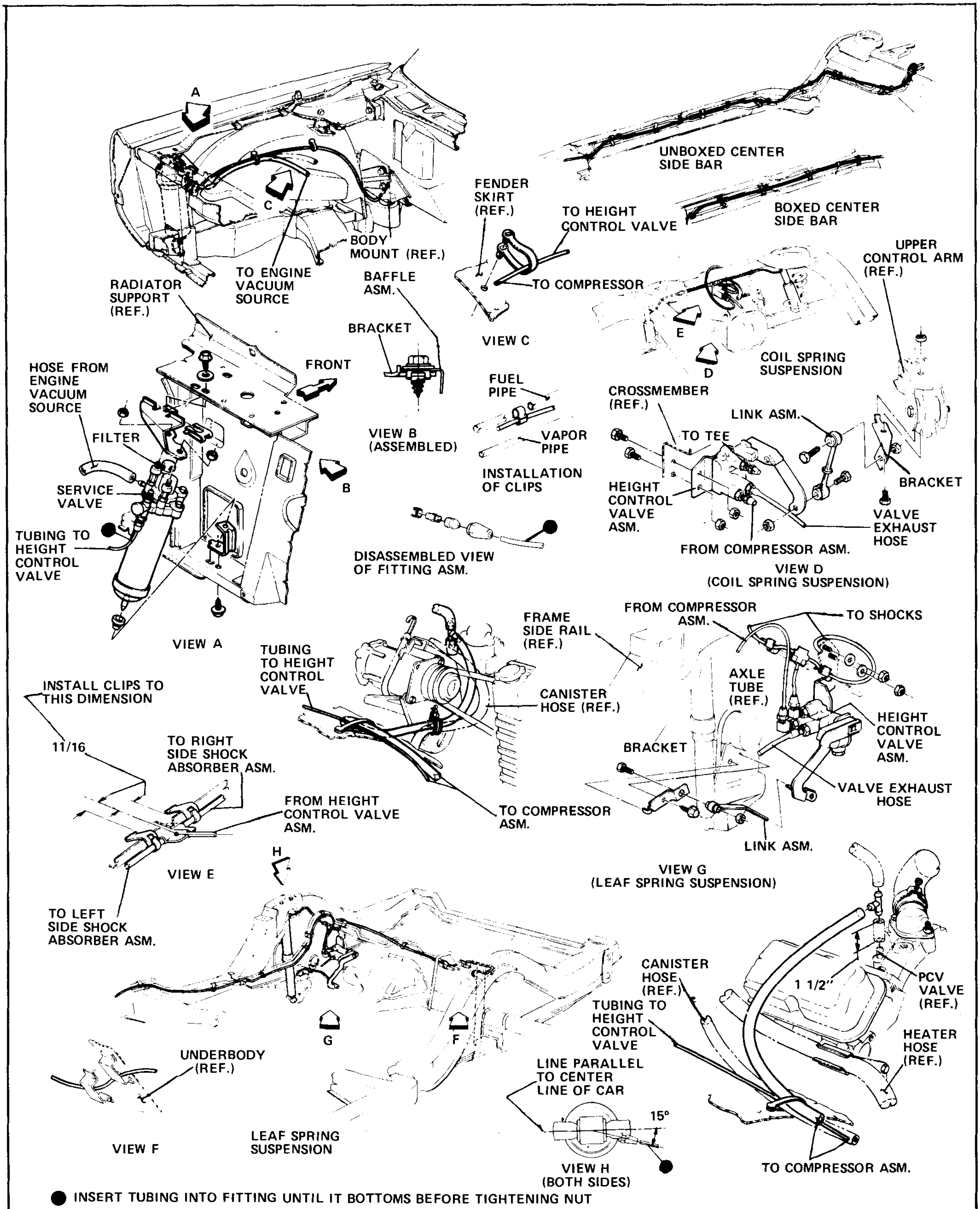


Fig. 4-37 Installation of Automatic Level Control System on B Series

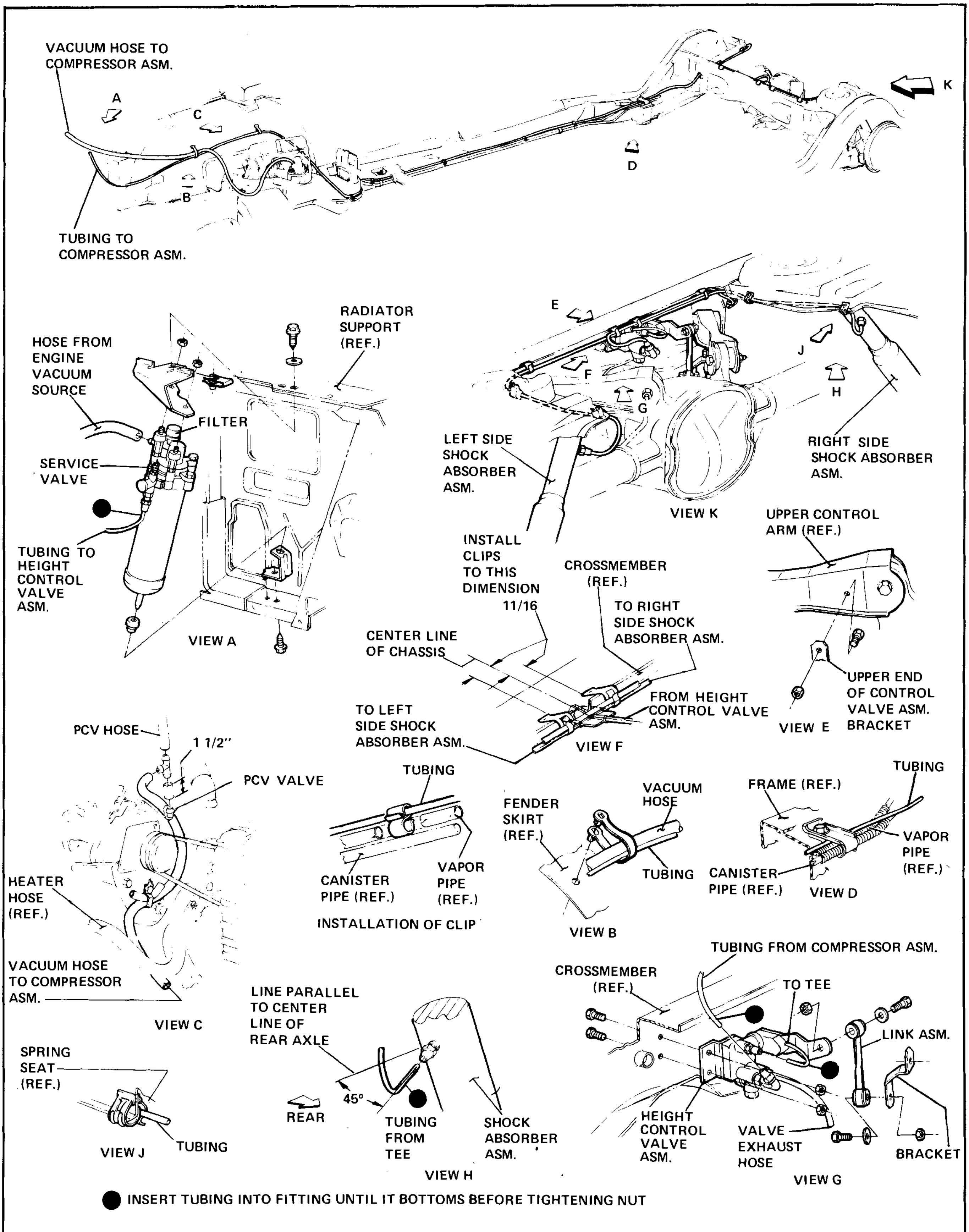


Fig. 4-38 Installation of Automatic Level Control System on G Series

INSTALL

1. Preassemble metal sleeve and rubber seal.
2. Place nut on tubing.
3. Insert tube into metal sleeve and rubber seal until tube bottoms.
4. Hold tube in bottomed 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 (Figs. 4-37 and 4-38).
2. Disconnect high pressure line at pressure regulator valve. Also disconnect vacuum line at compressor.
3. Remove upper bracket screw securing assembly to car and withdraw assembly.

INSTALL

1. Install assembly in bracket and tighten nuts to 20 lb. in. torque.
2. Install assembly in car and tighten upper bracket attaching screw to 20 lb. ft. 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 (Fig. 4-2).

   NOTE: *If available pressure is less than 140 psi, start engine to build up reservoir to this pressure.*

DISASSEMBLE

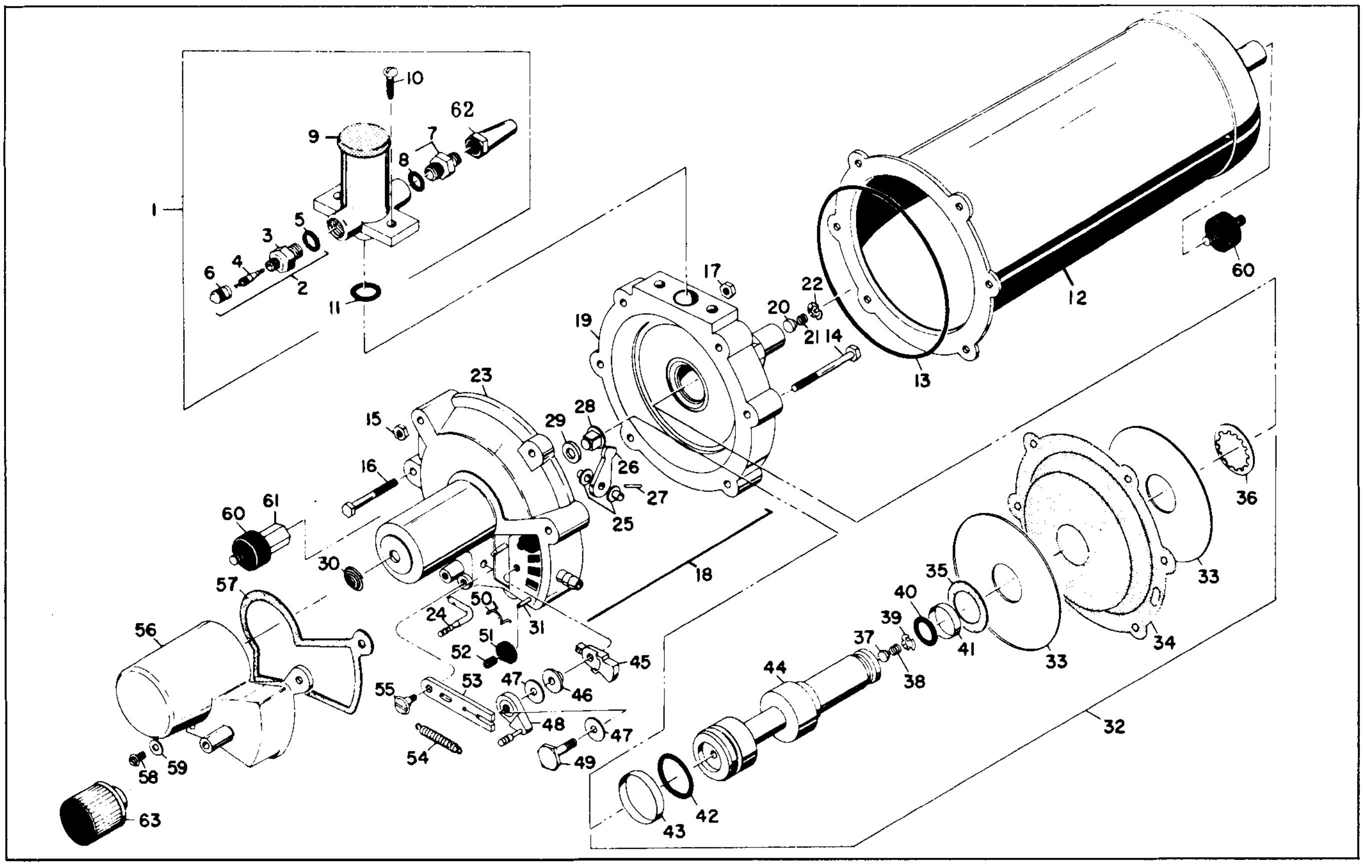
The compressor (Fig. 4-39) is a precision-built mechanism that should be carefully handled and assembled. Care must be taken to prevent entrance of dirt or other foreign matter.

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 short 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. Separate 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 diaphragm assembly can now be removed from first stage housing by carefully sliding the assembly straight out of housing.



1. Regulator Assy.
2. Adapter Assy.
3. Adapter
4. Valve Core
5. O-Ring
6. Cap
7. Adapter Assy.
8. O-Ring
9. Boot
10. Screw, Regulator Retaining
11. O-Ring, Regulator to Compressor
12. Reservoir
13. O-Ring, Reservoir to Compressor
14. Thru Bolt, Reservoir Retaining
15. Nut, Thru Bolt Reservoir
16. Thru Bolt, Compressor Retaining
17. Nut, Thru Bolt Compressor
18. Compressor Assy.
19. Housing, 2nd Stage
20. Check Valve
21. Spring
22. Expansion Plug Retainer
23. Housing, 1st Stage
24. Arm, Swivel
25. Bushing
26. Arm, Rocker
27. Pin, Rocker Arm Ret.
28. Intake Valve
29. Washer
30. Spring, Intake Valve Ret.
31. Pin, Bushing Retaining
32. Piston Assy.
33. Plate, Diaphragm
34. Diaphragm
35. Washer (.760-.765 I.D.)
36. Retainer, Diaphragm
37. Check Valve
38. Spring
39. Expansion Plug Retainer
40. O-Ring (.357-.367 I.D.)
41. Seal (.569-.571)
42. O-Ring (.732-.742 I.D.)
43. Seal (.943-.945)
44. Piston
45. Distributor Valve
46. Bushing, Distributor Valve
47. Washer (.160-.163 I.D.)
48. Arm Assy., Distributor
49. Screw
50. Spring, Valve Tension
51. Bushing, Distributor Valve Stop
52. Bushing, Arm Assy. Stop
53. Arm Actuating
54. Spring, Arm Tension
55. Screw, Arm Pivot
56. Cover
57. Gasket
58. Screw, Cover Retaining
59. Gasket, Cover
60. Mount, Flexible
61. Adapter
62. Tube Fitting
63. Filter

Fig. 4-39 Exploded View of Compressor

PISTON--DIAPHRAGM ASSEMBLY

DISASSEMBLE

1. Remove diaphragm retainer with diagonal pliers and discard retainer (Fig. 4-40).
2. Remove diaphragm plate, diaphragm, second diaphragm plate and corprene 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 end and tapping.

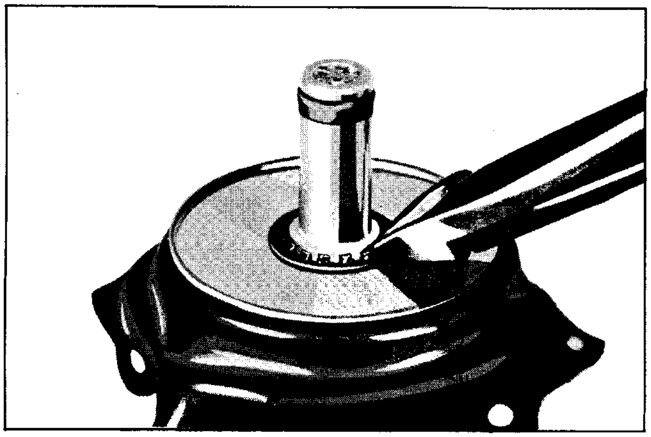


Fig. 4-40 Removing Diaphragm Retainer

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. 4-41).

2. Remove two arm assembly stop bushing and two distributor valve stop bushings.

3. Remove distributor valve, being careful not to distort valve tension spring.

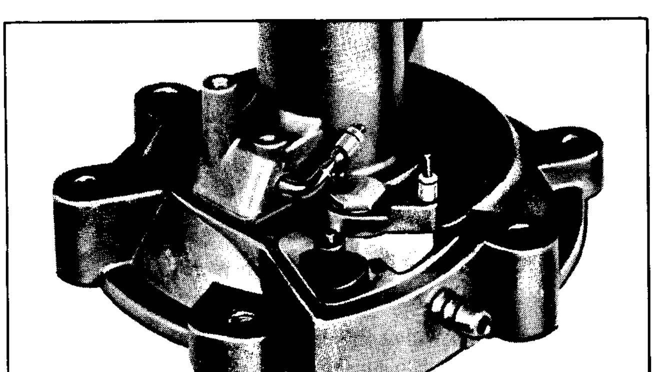


Fig. 4-41 Distributor Valve Assembly

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 Figs. 4-43 and 4-44).*

5. Remove intake check valve retaining spring, intake check valve and washer, using a pocket knife.

6. If necessary, remove rocker and swivel arms. Grip pin with pliers and remove pin (Fig. 4-42).

SECOND STAGE HOUSING

DISASSEMBLE

Remove check valve in second stage housing by inserting a suitable punch or piece of 3/32" welding rod through air passage and tapping.

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.

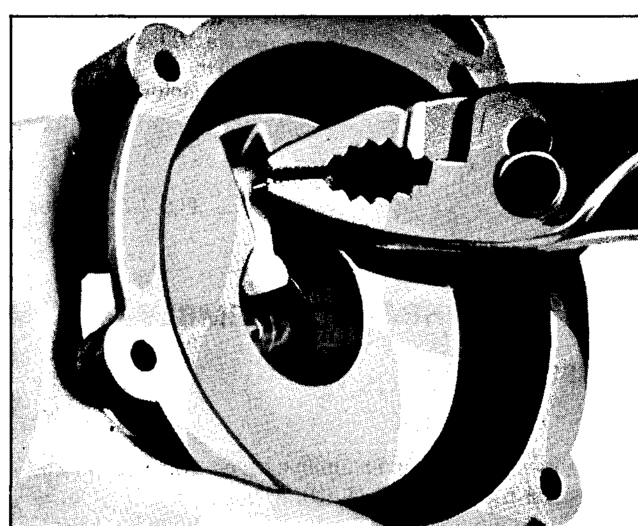


Fig. 4-42 Removing Rocker Arm Pin

FIRST STAGE HOUSING AND VALVE MECHANISM

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 check valve seat. Seat should be smooth and clean.
3. Inspect housing for cracks or damage and replace if necessary.

SECOND STAGE HOUSING

ASSEMBLE

1. Install new check valve and spring.

Fig. 4-43 Installing Expansion Plug Retainer

2. Insert new expansion plug retainer and tap in until it bottoms (Fig. 4-43).

FIRST STAGE HOUSING AND VALVE MECHANISM

ASSEMBLE

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. 4-44).
4. Position distributor valve so that short foot of tension spring fits under valve and vertical leg is in slot (Fig. 4-45).
5. Install distributor valve bushing, washer, distributor arm assembly, washer and secure with screw (Fig. 4-46). 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.*

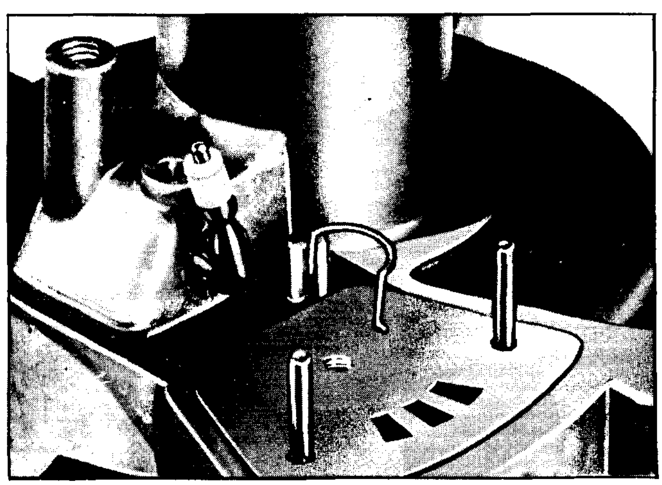


Fig. 4-44 Installing Valve Tension Spring in Boss

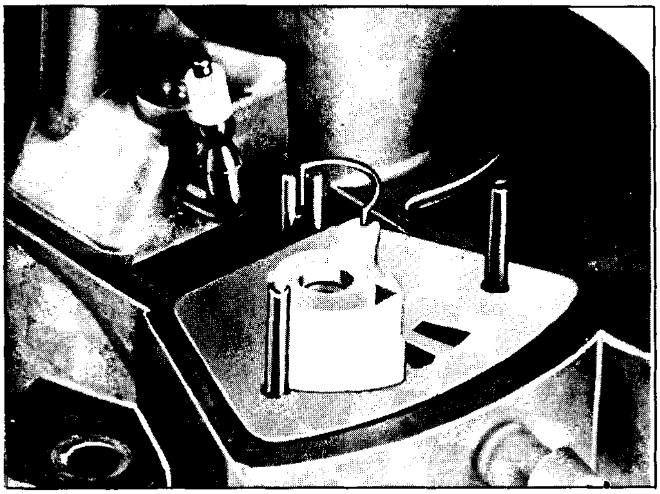


Fig. 4-45 Positioning Distributor Valve

PISTON--DIAPHRAGM ASSEMBLY

ASSEMBLE

1. Install new corprene washer, old 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. 4-47).

   CAUTION: *Be sure retainer is securely seated in order to affect an air tight seal against the co-prene seal.*

3. Install new "O" rings by rolling into groove. Relieve any resulting twist.

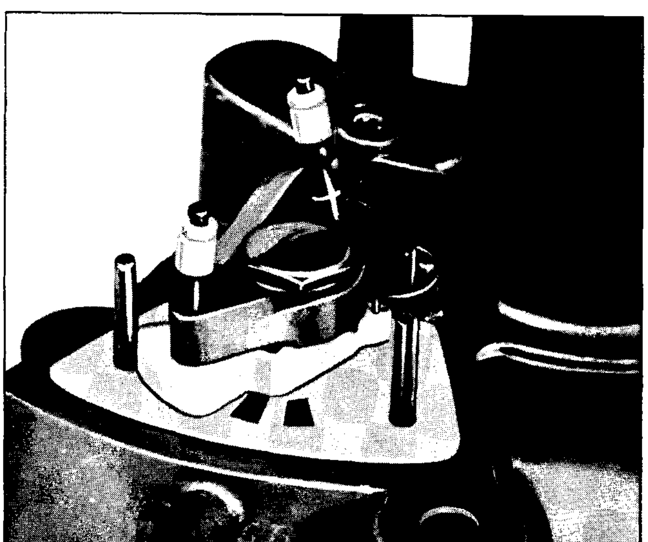


Fig. 4-46 Installing Distributor Arm

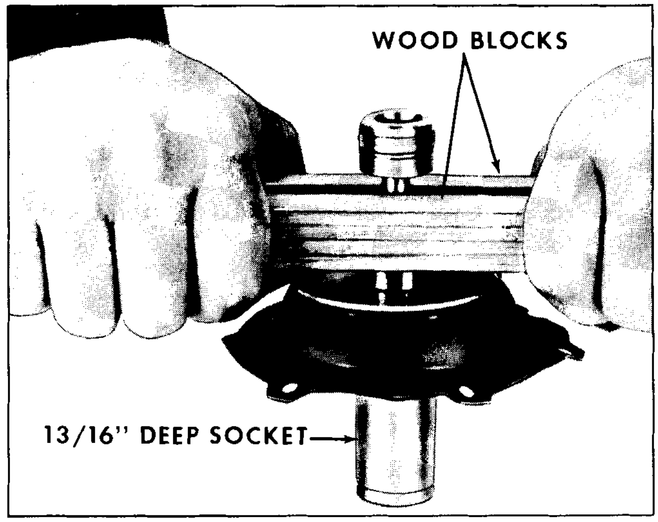


Fig. 4-47 Installing Diaphragm Retainer

4. Install new seals, using a piece of .020" shim stock (Fig. 4-48).

   CAUTION: *Make sure shim stock has no sharp edges that may cut seal. 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.
3. Connect arm tension spring to swivel arm.

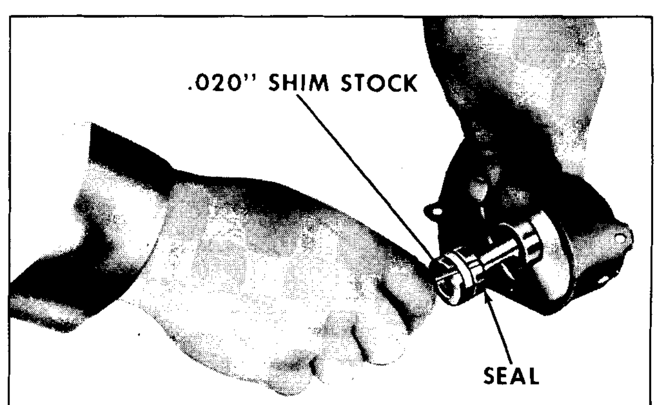


Fig. 4-48 Installing Piston Seal

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

APPLICATION	TORQUE
COIL SPRING ONLY:	
Bolt, Upper or Lower Control Arm	
A & G Series	110
B Series except rear upper	140
B Series rear upper	110
Nut, Upper or Lower Control Arm	
A & G Series	80
B Series except rear upper	110
B Series rear upper	80
Nut, Shock Absorber to Lower Mount	65
Nut, Shock Absorber Upper Mount	15
Nut, Stabilizer Shaft to Lower Control Arm	50
Nut, Spring Front Eye Bolt	75
Screw, Spring Front Bracket to Floor Pan	
F & X Series	25
Nut, Spring Rear Shackle Pin	
B Series	95
F & X Series	50
Nut, Support (Strut) to Stabilizer Shaft	
F & X Series	20
Nut, Support (Strut) to Side Rail Bracket (Pivot)	
F Series	30
X Series	60
Nut, Spring Center Locating Bolt	23
LEAF SPRING ONLY:	
Nut or Bolt, Shock Absorber to Lower Mount	
B Series	65
F Series	10
X Series	55
Nut or Screw, Shock Absorber Upper Mount	15
Nut, Spring and Shock Absorber Anchor Plate Attaching	40
AUTOMATIC LEVEL CONTROL ONLY:	
Nut, Air Line Fitting	70 (lb. in.)
Nut, Height Control Valve Mounting	75 (lb. in.)
Screw, Compressor Bracket to Radiator Support	20
Nut, Upper & Lower Link	75 (lb. in.)
Nut, Compressor Mounting Stud to Compressor Bracket	20 (lb. in.)

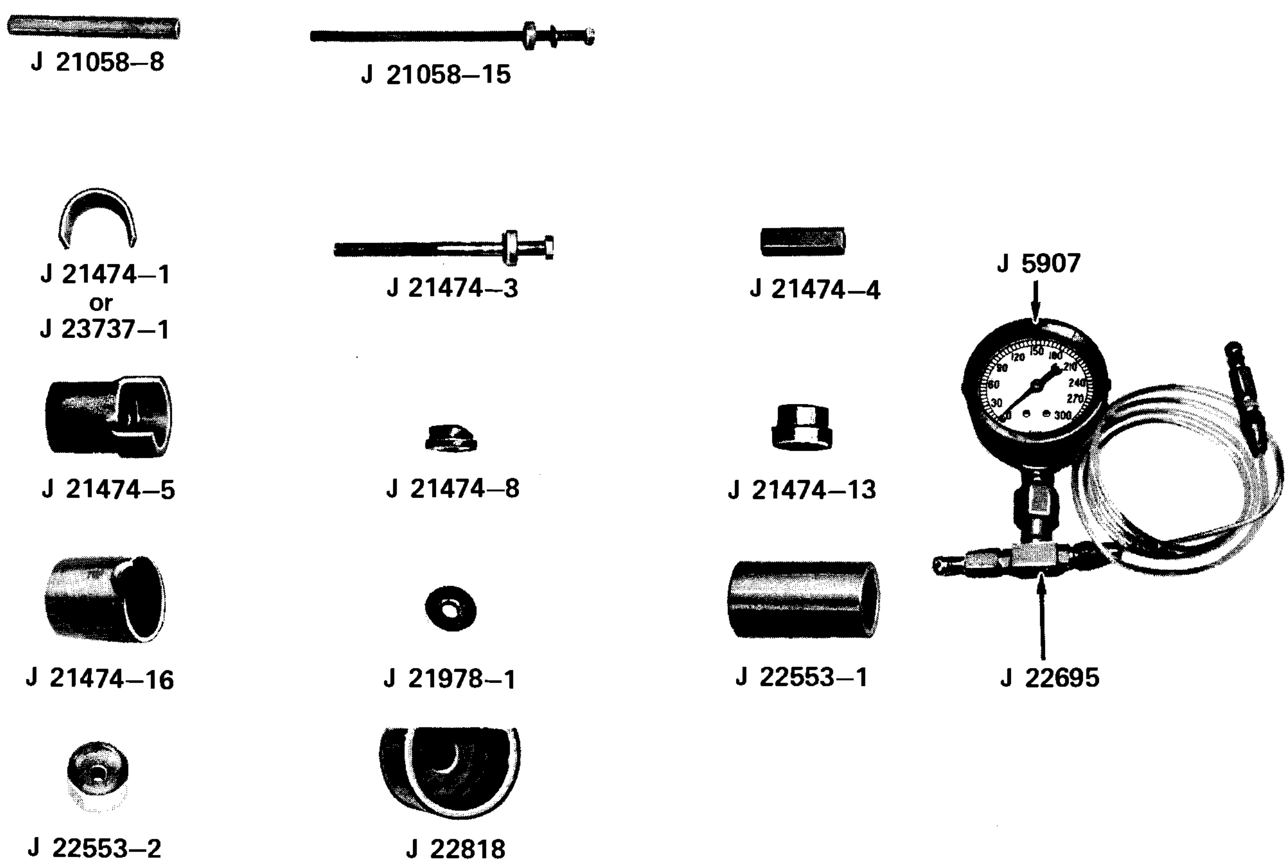


Fig. 4-49 Special Tools

Tool No. **Name**

J 5907 Universal Pressure Checking Gage J 21058-8 Nut
J 21058-15 Screw Assembly
J 21474-1 Rear Upper & Lower Control Arm Spacer
J 21474-3 Screw Assembly
J 21474-4 Nut
J 21474-5 Receiver
J 21474-8 Upper & Lower Control Arm Bushing Remover
J 21474-13 Upper & Lower Control Arm Bushing Installer
J 21474-16 Rear Control Arm Bushing Receiver
J 21978-1 Rear Spring Bushing Remover
J 2253-1 Rear Spring Bushing Receiver
J 22553-2 Rear Spring Bushing Installer
J 22695 Automatic Level Control Pressure Gage Assembly
J 22818 Control Arm Bushing Receiver
J 23553-2 Rear Upper & Lower Control Arm Spacer

SECTION 4A

NON TYPE C DIFFERENTIAL

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

TROUBLE DIAGNOSIS AND TESTING

Many noises reported as coming from the rear axle actually originate from other sources such as tires, road surfaces, wheel bearings, engine, transmission, muffler or body drumming. A thorough and careful check should be made to determine the source of the noise before disassembling the differential. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle. It should also be remembered that differential gears, like any other mechanical device, are not absolutely quiet and should be accepted as being commercially quiet unless some abnormal noise is present.

To make a systematic check for axle noise under standard conditions, observe the following:

1. Select a smooth, level tarvia or asphalt road to reduce tire noise and body drumming.
2. Drive car far enough to thoroughly warm up rear axle lubricant.
3. Note speed at which noise occurs. Then stop car and, with clutch disengaged or automatic transmission in neutral, run engine slowly up and down through engine speeds, corresponding to car speed at which noise was most pronounced, to determine if it is caused by exhaust, muffler roar or other engine conditions. Repeat, while engaging and disengaging clutch (transmission in neutral), to determine if noise is in transmission. (Transmission rear bearing noise can only be isolated by removing propeller shaft and operating transmission in high.)
4. 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 between pull and coast, but tire noise remains about the same. Distinguish between tire noise and differential noise by noting if noise varies with various speeds or sudden acceleration and deceleration; exhaust and axle noise show variations under these conditions while tire noise remains constant and is more pronounced at speeds of 20 to 30 miles per hour. Further check for tire noise by driving car over smooth pavements or dirt roads (not gravel) with tires at normal pressure. If noise is caused by tires, it will noticeably change or disappear and reappear with changes in road surface.

5. 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 dimish, 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, also by shaking wheels to determine if bearings are loose.

6. Rear suspension rubber bushings and spring insulators dampen out rear axle noise when correctly installed. Check to see that no metallic contact exists between the springs and spring opening in frame or between upper and lower control arm bushings and frame or axle housing brackets. Metal-to-metal contact at those points may result in telegraphing road noise and normal axle noise which would not be objectionable if dampened by bushing.

7. It is important that a check also be made to ensure that the floor of body is not in metallic contact with frame. After the noise has been determined as being in the axle by following the above appraisal procedure, the type of axle noise should be determined to aid in making repairs if necessary.

CAUSE	REMEDY
Differential Side Gear and Pinion Noise	Seldom cause noise on straight ahead driving, as their movement is relatively slight. Noise produced by these gears will be most pronounced on turns.
Ring and Pinion Gear Noise	This type of rear axle noise normally appears first as a whine, audible between 20 and 65 mph and under four driving conditions; 1. Drive-Acceleration or heavy pull. 2. Road Load - Car under steady load or at constant speed. 3. Float - Maintaining constant car speed at light throttle on a level road, or using enough throttle so that engine is not actually driving the car - car slows down gradually while engine still pulls slightly. Gear noise most frequently has periods where noise is more prominent - usually 30 to 40 mph and 50 to 60 mph. When objectionable axle noise is encountered, note the driving condition and speed range. If the problem is diagnosed as gear noise, remove the differential cover and perform a red lead check. Shim and adjust to obtain the best possible tooth pattern. If noise still persists, replace the gear set.
Bearing Noise	Bad bearings generally produce a rough growl or grating sound, rather than the whine typical of gear noise. Bearings fail by lapping, spalling or locking:

LAPPING-Lapping is caused by fine particles of abrasive material such as scale, sand or emery which are circulated by oil and which cause wearing away of roller and race surfaces. Bearings which are worn loose, but remain smooth without spalling or pitting, are the result of dirty oil.
SPALLING-Spalling failure of bearings is caused by overload or faulty assembly. Bearings which failed by spalling have either flaked or pitted rollers or races. Faulty assembly consists of misalignment, cocking of bearings or adjustments which are too tight.
LOCKING-Locking of bearings is caused by large particles of foreign material becoming wedged between rollers and race, usually causing one of the races to turn. Preloading of taper roller bearings higher than specified can also cause locking of bearings.
1. Pinion Bearing Noise - Rough or brinelled pinion bearings produce a continuous low pitch whirring and frequently throbs at bearing rpm. Pinion bearing noise is torque sensitive and usually heard at low speeds.
2. Side Bearings - Since side bearings are pre-loaded, noise should not go away or diminish appreciably when the differential is run with wheels off the ground. Noise in this area can easily be confused with rear wheel bearing noise. Inspect and replace as required.
3. Rear Wheel Bearings - A rough rear wheel bearing produces a vibration or growl which continues with car coasting and transmission in neutral. Since wheel bearings are not pre-loaded, noise should diminish if differential is run with wheels off ground. A brinnelled rear wheel bearing causes a knock or click approximately every two revolutions of the rear wheel as 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.

Knock at Low Speeds

Low speed knock can be caused by worn and brinelled universal joints or a side gear hub counterbore in the case worn oversize. Inspect and replace universal joint or case and side gear as required.

Drive-Line Snap

A snap on sudden start, either forward or reverse, may be caused by a loose companion flange. Remove flange, turn 180°, apply white lead and oil to spline and reinstall. Pinion nut must be tightened to original position.

Backlash Clunk

Excessive clunk with acceleration and deceleration is caused by worn differential pinion shaft, excessive clearance between axle shaft and side gear splines, excessive clearance

	between side gear hub and counterbore in case, worn thrust washers and excessive drive pinion and ring gear backlash. Remove worn parts and replace as required, selecting close fitting parts when possible. Adjust pinion and ring gear backlash.
Drive-Line Squeal and Squeak	Squeals and squeaks are audible at low speeds, seldom over 20 mph. A continuous squeal is from the pinion oil seal. Seal squeaks frequently correct themselves; a persistent squealing seal should be replaced.
Propeller Shaft Vibration	Objectional vibrations at high speed (65 mph or higher) may be caused by a propeller shaft that is out of balance. Out of balance may be due to a bent shaft. To determine whether propeller shaft is causing vibration, drive car through speed range and note speed at which vibration is most pronounced. Shift transmission into lower gear range and drive car at same engine speed as when vibration was most pronounced in direct drive. Note effect on vibration. To determine engine speed, divide vehicle speed by the lower transmission gear ratio used (can be found at end of appropriate chapter in shop manual). If the vibration is still present at the same engine speed, whether in direct drive or in the lower gear, since the propeller shaft speed varies, this cannot be the fault. If the vibration decreases or is eliminated in the lower gear, then the propeller shaft is out of balance and should be rebalanced or replaced. See propeller shaft Section 4E for further trouble diagnosis.
Oil Leaks	It is difficult to determine the source of some oil leaks. Even after the point of leakage has been determined, it is hard to tell whether the oil is leaking past the lip of the seal or past the O.D. of the seal. Therefore, it is a good idea to make sure the leak is stopped by using a nonhardening sealing compound around the O.D. of the new seal.

PRE-REPAIR INVESTIGATION

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 gained, with the report of malfunctioning, will provide a basis for determining the degree of disassembly required. Since the frequent causes of axle noise are improper backlash or side bearing preload, or both, a few simple adjustments may be all that is 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:

A. Backlash

B. Pinion Bearing Preload

C. Red Lead 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.

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 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 and before it is installed. Allowable 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.

RED LEAD TEST

1. Mix a small amount of gear marking compound, part no. 1051196 or powered red lead (available from paint manufacturers and suppliers) with a drop of engine oil. 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.
2. Tighten bearing cap bolts to 70 lb. ft. torque, tapping heads of bolt intermittently while tightening, to ensure proper seating of caps and sufficient tightness.
3. Insert crank (Fig. 4A-1) in companion flange and, while turning, apply pressure to back side of ring gear by hand (a leather glove can be used). A test made without loading the gears will not give a satisfactory pattern. Turn companion flange so that ring gear rotates one full revolution, then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear may indicate good tooth pattern because one or two teeth are making proper contact.

   NOTE: *The crank in Fig. 4A-1 may be easily made as follows:*

   a. Weld a 3/8" heavy duty flat washer to a piece of 1/4" diameter rod, approximately 6" long and form as shown.

   b. Tap door knob for 3/8" bolt and attach knob to crank as shown. Leave bolt loose enough to permit knob to turn.

4. Closely inspect tooth pattern on ring gear to determine whether pressure lines are apparent. If observation reveals pressure lines are present (dark narrow band at edge of pattern), examine for pressure line position on drive and coast sides of ring gear. If lines on drive side are too deep and those on coast side are too high (near heel and toe respectively), additional shims to bring pinion gear out (providing a more centrally located tooth pattern on ring gear) will result in a noisy tooth contact. This occurs because the pressure line has been moved deeper into the tooth on the drive side and farther out on the coast side. It does not follow that the ring gear and pinion are not good or should be destroyed. It only means they will not operate quietly in the carrier in which they are presently installed. These same parts may operate quietly in another carrier when tooth pattern is checked.

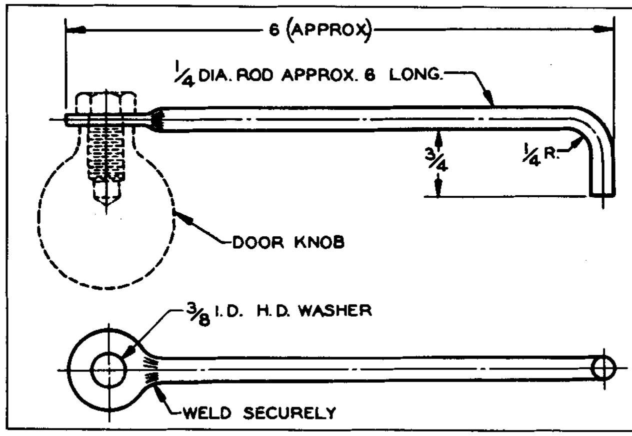


Fig. 4A-1 Differential Cranking Tool

Removing backlash moves ring gear into pinion gear, driving the pinion deeper into the ring gear. Whenever pressure lines are noted, as explained above, install another ring gear and pinion set.

5. Observe pattern on ring gear teeth and compare with Fig. 4A-2.

EFFECTS OF INCREASING LOAD ON TOOTH CONTACT PATTERN

When "load" on ring and pinion gear is increased, such as when car is accelerated 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. 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 red lead tests, dependent upon degree of "loading", approximate a normal light load. For this reason, they will extend only about halfway (Fig. 4A-2A). The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will effect tooth contact pattern: backlash and position of drive pinion in

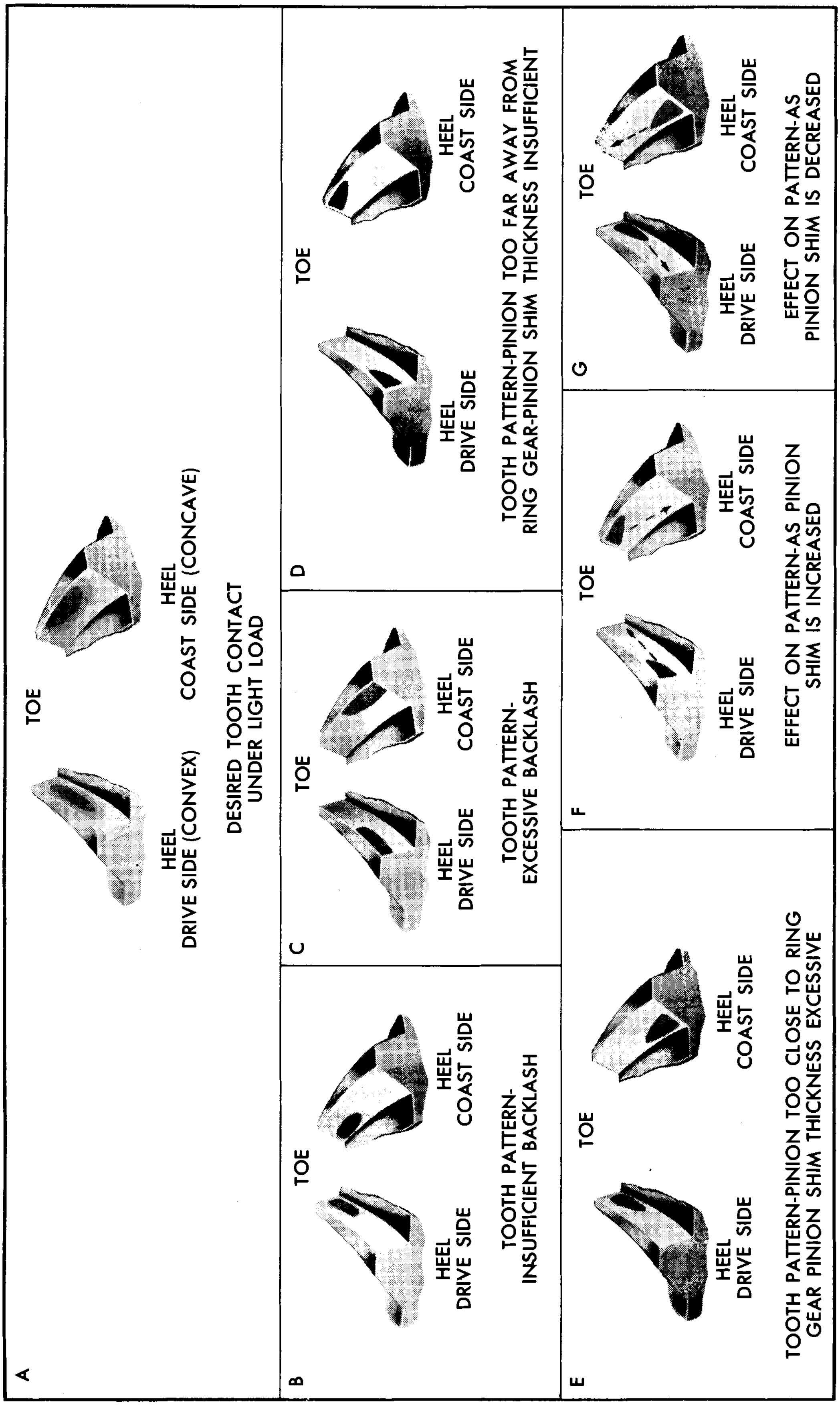


Fig. 4A-2 Red Lead Test Contact Patterns carrier. The effects of bearing preloads are not readily apparent on (hand loaded) red lead tests: however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

Backlash is adjusted by means of the side bearing adjusting shims which move 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 preload.)

The position of the drive pinion is adjusted by increasing or decreasing the shim pack between the pinion head and inner race of rear bearing. The shim pack is used in the differential to compensate for manufacturing tolerances. Increasing shim pack thickness will move the pinion closer to centerline of the ring gear; decreasing shim pack thickness will move pinion farther away from centerline of the ring gear.

EFFECTS OF BACKLASH ON TOOTH PATTERN

The terms "excessive" and "insufficient" refer to settings which are greater than .009" or less than .005" as specified. With respect to tooth contact patterns, "excessive" refers to backlash which, although less than .009", is more than necessary to provide the desired pattern. Similarly, "insufficient" refers to backlash which, although .005" or more, is less than necessary to provide the desired pattern.

Provided the pinion is properly positioned, excess backlash will give a high heel pattern on both drive and coast sides (Fig. 4A-2C). Decreasing backlash by moving the case and ring gear assembly closer to the pinion will cause the pattern to move toward the toe end and down toward center of the tooth on both drive and coast sides.

Insufficient backlash, provided the pinion is properly positioned, will give a low toe pattern on both drive and coast sides (Fig. 4A-2B). Increasing backlash will cause the pattern to move toward the heel end and up toward top of the tooth on both drive and coast sides.

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 drive side and a high toe contact on coast side (Fig. 4A-2D), provided backlash is within specifications of .005" to .009". Moving the pinion closer to center line of the ring gear by increasing shim pack 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. 4A-2F).

When the pinion is too close to the ring gear, the pattern will be a low toe contact on drive side and a low heel contact on coast (Fig. 4A-2E), provided backlash is within specifications of .005" to .009". Moving the pinion farther away from the ring gear by decreasing shim pack thickness will cause low toe contact on drive side to raise and move toward the heel; low heel contact on coast will raise and move toward the toe (Fig. 4A-2G).

GENERAL DESCRIPTION

NOTE: *Specific information on the "C" type differential is found in Sections 4C and 4D.*

The rear axle and differential is of modified Hotchkiss drive construction, utilizing a hypoid ring gear and pinion set as a means of transmitting power (torque) from the propeller shaft through a differential and then to semi-floating axle shafts.

The non type C differential, as described below, is used in all A and G Series vehicles, except those equipped with the 455 cu. in. engine. An identical differential with larger ring gear and internal components is also used in some B Series Catalina vehicles equipped with the 400 cu. in. engine. A and G Series vehicles with the 455 cu. in. engine, all F and X Series vehicles and all other B Series vehicles use the "C" type differential. Two rear axle housing upper control arms and two lower control arms (Fig. 4A-3), with rubber bushings at connecting pivot points, form the basic links of the rear suspension. The functions of the lower control arms are to maintain the axle in line relative to frame and to oppose torque reaction of the rear axle. The upper control arms control rear axle windup and maintain lateral stability of the car on the axle.

The upper ends of rear coil springs are retained in seats formed in the frame, while the lower ends ride on spring pads welded to the housing just forward of the center line of axle assembly on the A and G series and directly over the center line of the axle housing on B Series models. F Series vehicles and B Series station wagon models use multiple leaf springs. F Series models utilize a staggered shock absorber arrangement.

Direct-acting sealed shock absorbers are mounted with upper ends inclined toward center of vehicle. Rubber bumpers, inserted in a bracket on the rear axle, cushion extreme downward movement of the frame and body.

All parts necessary to transmit power from the propeller

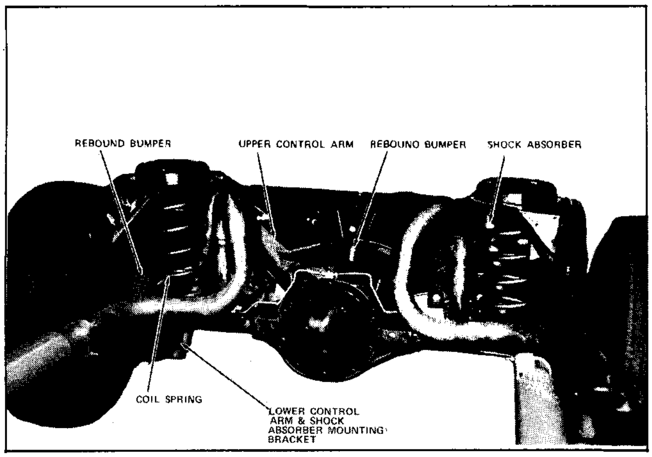


Fig. 4A-3 Typical Rear Axle View

shaft to the rear wheels are enclosed in a salisbury type axle housing (an iron casting with tubular axle housings 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 rear axle from the car. Rear axle shafts are mounted on roller bearings located at the outer ends of the rear axle housing. Axle shaft bearings are of two different types - unit and direct-on type. The unit bearing, which is used in all standard differentials as described in this section, consists of the bearing rollers and an inner and outer race. The direct-on bearing, used in all "C" type axles, is so named because it consists only of the bearing rollers and an outer race. A machined surface on the axle shaft serves as the inner race of the direct-on bearing. The unit bearing assembly is pressed to a shoulder on the shaft and is additionally held in place by a pressed-on inner retainer ring. An outer retainer, which also clamps the brake backing plate to the axle housing, secures the bearing in the end of the axle housing. All axle shafts have outboard seals with roller bearings lubricated by differential lubricant. Seals prevent oil seepage from the axle housing into the wheel bearing cavity and onto the brake assembly.

To prevent pressure build up, a breather vent is provided at the right side of the axle housing.

DESIGN

Hotchkiss drive (open drive line) is the basic design used to transmit power from the drive shaft to the rear wheels, but the design is modified to include torque reaction links (upper and lower control arms) rather than leaf springs. A universal joint connects the end of the propeller shaft to a companion flange, having a splined end which fits over and drives the rear axle drive pinion gear. This companion flange is securely fastened to the pinion shaft by a special self-locking nut which bears against a special washer.

Two preloaded tapered roller bearings support the drive 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 companion 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 maintain a load on the front bearing inner race and pinion stem and to prevent the inner race of the front bearing from turning on the pinion stem.

Adjustment of the pinion along its axis is obtained by placing shims between the pinion rear bearing inner race and the pinion gear. Torque from the pinion gear is transmitted to a ring gear attached to a differential case by special hex head bolts.

The differential is a device that divides the torque equally between axle shafts. It permits the rear wheels to turn together at the same speed, or to turn at different speeds, as when making turns, etc. It is so designed that it will exert force to the wheel having the least traction.

The differential case is of one piece construction. Two side gears and two pinion gears are housed in the case. The two side gears have splined bores for indexing with and driving the axle shafts. They are positioned to turn in counterbored cavities in the case. The two differential pinion gears 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 act as idler gears when the rear wheels are turning at different speeds.

OPERATION

Power from the engine is transferred to the transmission via a clutch, or a fluid coupling with an automatic transmission. 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 pinion gear at the companion flange, the transmission output shaft, propeller shaft and differential pinion all turn at the same speed.

Power from the pinion gear is transmitted to the differential ring gear which is bolted to the differential case. When there is equal resistance on each rear wheel, the force through the 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 one. The inner wheel, turning slower with respect to the outer wheel, slows the differential side gear (as the axle shaft is splined to the side gear) and the differential pinion gear will roll over the slowed

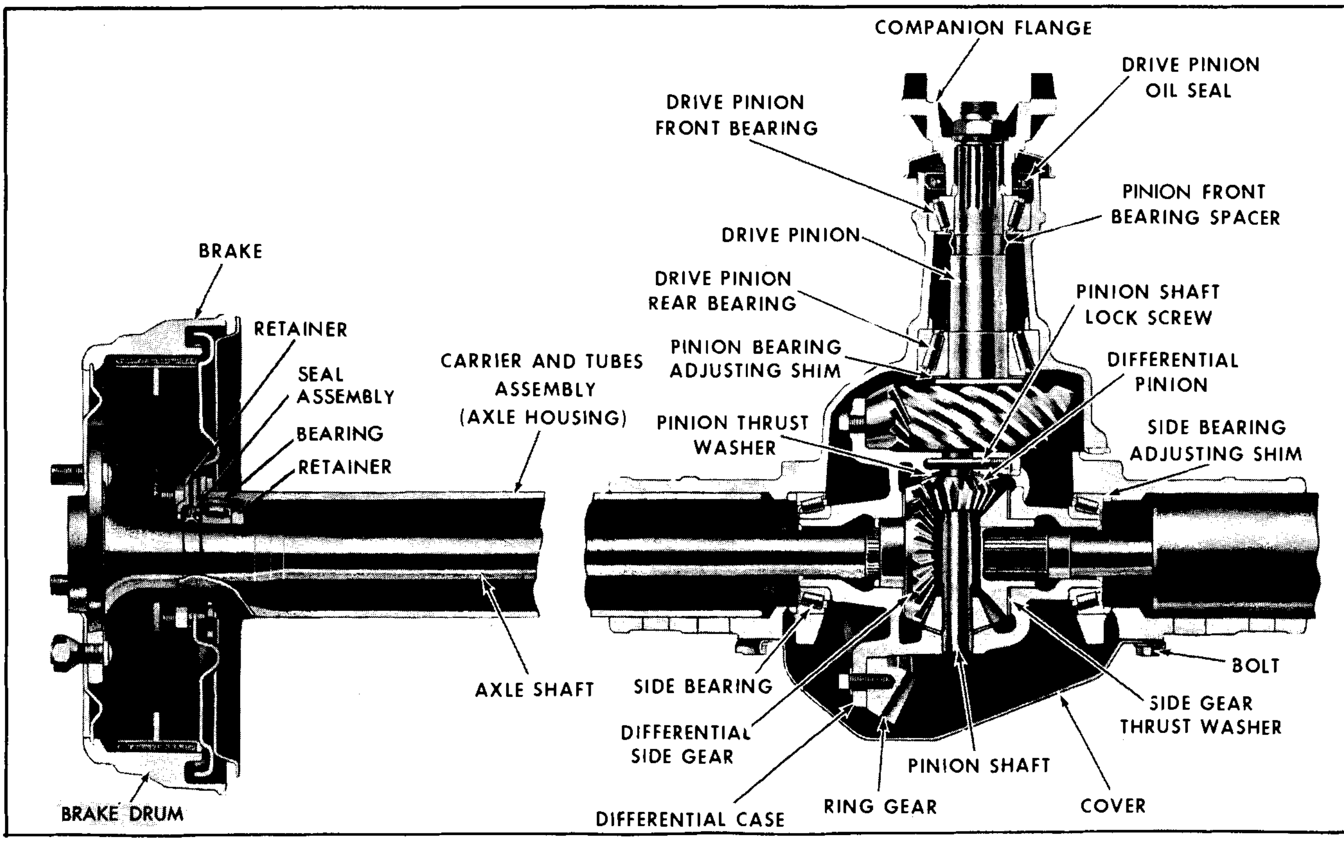


Fig. 4A-4 Typical Cross Section of Pontiac Rear Axle and Differential

differential side gear, driving the other differential side gear and wheel faster.

The differential allows both wheels to be mounted on individual axles and driven by a single shaft, yet it permits each wheel to move independently and at different speeds when the need arises.

AXLE RATIOS

Axle ratios can be identified by a three letter code stamped on the axle tube adjacent to the carrier. All codes are located on on the front of the right hand tube. The third letter of the differential code may be used to distinguish between the two types of differentials (Non C or "C"-type). Non type C axles may be identified by codes: "B", "O", or "P". All "C" type axles have one of the following as a last letter code: "G", "K" "P", "W" or "M". "P" coded axles in A and G Series vehicles are all of the non-type C type; whereas, all other "P" coded axles are of the "C" type. After determining the axle code from the right hand axle tube, reference should be made to the axle charts at the rear of this section to verify axle type and determine ratio, etc.

Cases differ in ring gear mounting dimensions depending on ratio. Cases also differ between locking or non-locking types.

When changing axle ratios, be sure to consult parts book for proper differential case. Available ratios and individual codes are shown in the axle ratio code chart.

NEW CAR PRE-DELIVERY INSPECTION

TORQUE

Check torque specifications at rear axle.

1. With weight of car on suspension, tighten all rear suspension control arm pivot bolts to 110 lb. ft. torque or tighten nuts to 80 lb. ft. torque.

2. Tighten rear shock absorber to axle housing nut to 65 lb. ft. torque, and shock absorber to frame bolt to 20 lb. ft. torque.

3. Tighten universal joint retaining bolts to 12 lb. ft. torque (single cardon joint) or 70 lb. ft. torque (with double cardon joint).

LUBRICATION

Check differential oil level and, if necessary, add sufficient amount of multi-purpose hypoid gear lubricant to bring

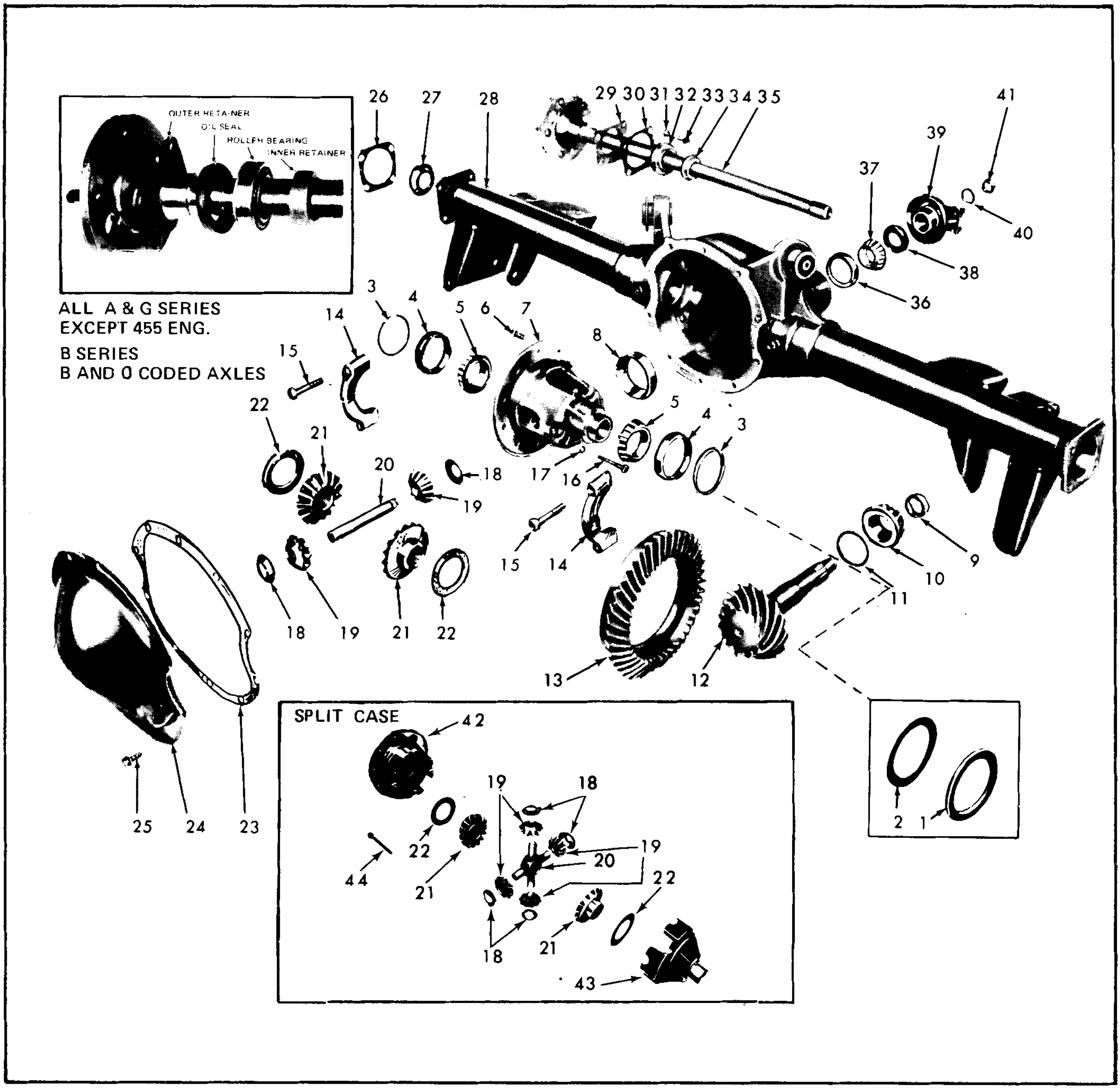


Fig. 4A-5 Exploded View of Typical Differential Assembly

1. Spacer
2. Differential Side Bearing Shim (Service)
3. Side Bearing Shim (Production)
4. Side Bearing Race
5. Differential Side Bearing
6. Ring Gear to Differential Case Bolt
7. Differential Case
8. Rear Pinion Bearing Outer Race
9. Bearing Spacer
10. Drive Pinion Bearing
11. Bearing Shim
12. Drive Pinion Gear
13. Ring Gear
14. Differential Side Bearing Cap
15. Cap Bolt
16. Pinion Shaft Lock Bolt
17. Washer
18. Pinion Gear Thrust Washer
19. Differential Pinion Gear
20. Differential Pinion Shaft
21. Differential Side Gear
22. Side Gear Thrust Washer
23. Cover Gasket
24. Cover
25. Cover Bolt
26. Inner Retainer Gasket
27. Axle Shaft Oil Seal
28. Carrier & Tube Assy.
29. Outer Retainer
30. Outer Retainer Gasket
31. Nut
32. Axle Shaft Bearing
33. Brake Assy. to Housing Bolt
34. Inner Retainer
35. Axle Shaft
36. Front Pinion Bearing Outer Race
37. Front Pinion Bearing
38. Pinion Oil Seal
39. Companion Flange
40. Washer
41. Pinion Nut
42. Flange Half of Case
43. Cap Half of Case
44. Case Half Bolts

level to bottom of filler plug hole. (A, G, F and X vehicles). On B Series vehicles, lubricant may be flush to 3/4" below filler plug on P and M coded axles, and flush to 3/8" below filler plug on B, G, K and O coded axles.

PERIODIC SERVICE

LUBRICATION

Lubricant change in the differential is not recommended unless repair work is being done. The differential should be checked for leaks at each chassis lubrication. If there is evidence of leakage, the leak should be corrected and lubricant added if needed. Use MPG SAE 80 or 80-90 (GL-5) lubricant in the standard differential. Because of the importance of using factory recommended lubricant, a container of this lubricant is furnished with each service ring gear and pinion set or differential carrier assembly. This lubricant is also available through regular parts channels. See Section 4B SPECIFICATIONS for Safe-T-Track Lubricant Recommendations.

SHOCK ABSORBERS

Give visual inspection for leaks and jounce car at each lubrication period to see that shock absorbers are in an operative condition. If inoperative or if leaks are found, refer to suspension section of manual and thoroughly diagnose problem before replacing units.

MINOR SERVICE AND REPAIRS

CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

Most rear axle service repairs can be made with the rear axle assembly in the car by raising the rear end, with the rear axle hanging on the shock absorbers. Rear axle lubricant may be drained by backing out all cover bolts and breaking cover loose at the bottom.

COMPANION FLANGE

REMOVE

NOTE: *When replacing companion flange, it is important that new flange be properly installed to provide correct pinion bearing preload. The following procedure must be used to ensure correct pinion bearing adjustment:*

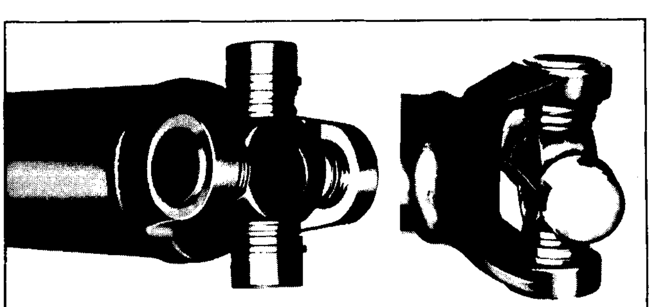


Fig. 4A-6 Bearings Held in Place by Tie Wire

1. With rear wheels off floor, turn wheels and tap brake backing plates with a soft hammer to ensure that brakes are free.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

2. Remove bolts which hold rear universal joint to companion flange. Use a heavy 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 (Fig. 4A-6).
3. Additional clearance to check preload can be obtained between differential and body by raising body a few inches by means of a jack or stand placed under frame at rear.
4. Attach a 1/2" drive adapter and socket to a lb. in. torque wrench. Place socket over drive pinion nut and turn pinion two or three revolutions to ensure free movement. Then take a torque reading while rotating pinion to measure bearing preload (Fig. 4A-7). Record reading.

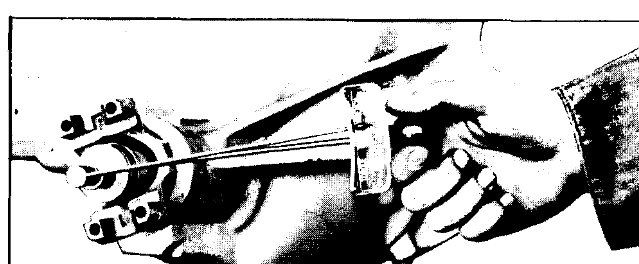


Fig. 4A-7 Checking Pinion Bearing Preload

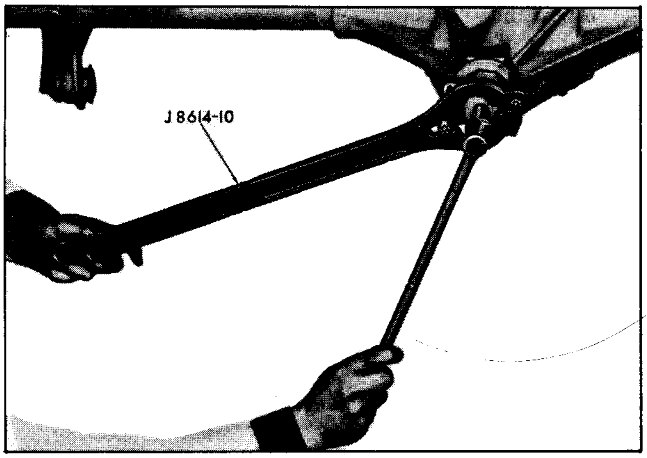


Fig. 4A-8 Removing Drive Pinion Nut

5. Hold companion flange with tool J 8614-1 (Fig. 4A-8) and remove drive pinion nut and washer using heavy duty socket.

6. Remove companion flange, using puller J 8614-2 and 3 (Fig. 4A-9).

REPLACE

CAUTION: *See caution on Page 1 of this section regarding fasteners referred to in Step 2 below.*

1. Replace companion flange and washer and nut. Hold companion flange with tool J 8614-10 and tighten nut only a little at a time, stopping frequently to check preload (step 3 above). Tighten nut to reading noted in step 3: however, if reading obtained in step 3 was less than 12 lb. in., increase preload to 16 lb. in.

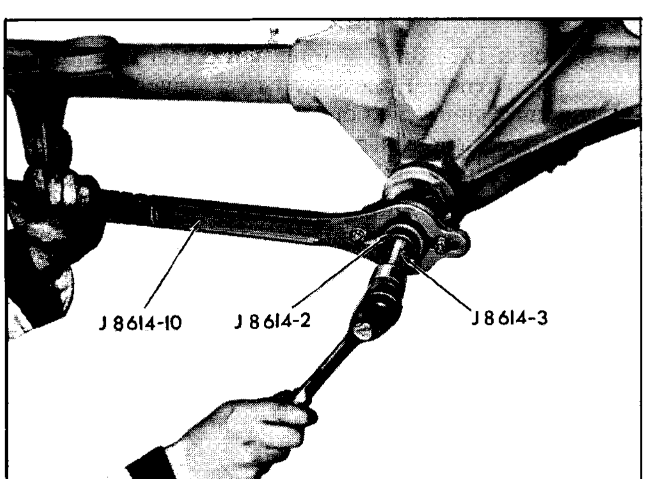


Fig. 4A-9 Removing Companion Flange

2. Connect universal joints. Install and tighten U-joint to companion flange bolts to 12 lb. ft. torque on the single cardon joint or 70 lb. ft. torque on the double cardon joint.

PINION BEARING OIL SEAL

REMOVE

CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

Check pinion bearing preload before removing companion flange. Proper preload can then be maintained if inspection of the flange after removal shows damage requiring replacement.

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. Remove retaining bolts which hold rear universal joint to companion flange. Use a heavy 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 (Fig. 4A-6).

3. Scribe a line on end of pinion stem, extending down along side of stem threads and onto companion 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.

   NOTE: *Additional clearance to check preload can be obtained between differential and body by raising body a few inches by means of a jack or stand placed under frame at rear.*

5. Using a lb. in. torque wrench with a 1/2" drive adapter and socket placed over drive pinion nut, turn two or three revolutions to ensure free movement. Then, take a torque reading while rotating pinion to measure bearing preload (Fig. 4A-7). Record reading.

6. Count the number of exposed threads from top of pinion stem to lock nut. Remove lock nut with a heavy duty socket, while holding companion flange with J 8614-10 (Fig. 4A-8).

7. Remove companion flange, using puller J 8614-2 and 3 (Fig. 4A-9).

   CAUTION: *When removing seal, use care to keep dirt and other foreign matter out of exposed front pinion bearing.*

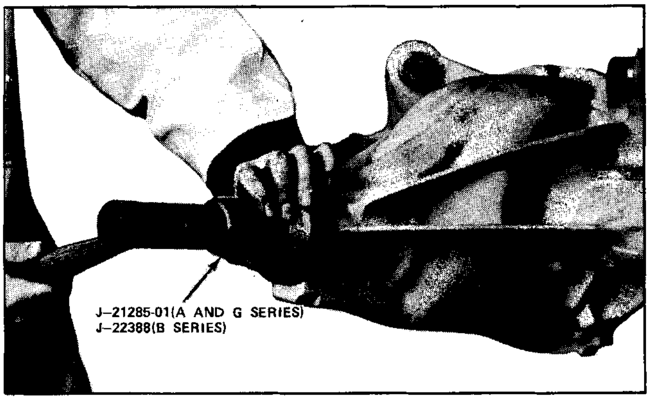


Fig. 4A-10 Installing Pinion Oil Seal

8. 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.

REPLACE

1. Lubricate lip of new seal with clean gear lube. Coat outer diameter of seal case with suitable sealer. Install seal by tapping into place, using J 21285-01 (Fig. 4A-10).
2. Before installing companion 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 a new companion flange is installed, refer to step 2 under COMPANION FLANGE - REPLACE.
   b. If inspection shows the original companion 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 holes and scribe line are in alignment. Tighten lock nut an additional 1/32" beyond this alignment.

CAUTION: *DO NOT exceed the additional tightening of the nut by a distance of more than 1/32" from its original position, as tightening the nut in excess of this amount will disturb the pinion and ring gear tooth contact pattern.*

CAUTION: *See caution on Page 1 of this section regarding the fasteners referred to in Step 3 below.*

3. Connect rear universal joint. Tighten U-joint to companion flange bolts (single cardon joint), or 70 lb. ft. torque on double cardon to joint.

AXLE SHAFT, AXLE SHAFT BEARING, BEARING OIL SEAL AND/OR WHEEL BOLT

REMOVE AXLE SHAFT ASSEMBLIES

NOTE: *For "C" type axle, see Section 4C.*

Design allows for axle shaft end play up to .032". 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 .032" is excessive. Inserting a shim inboard of the bearing to compensate for the end play is not recommended. This ignores end play of the bearing itself and may result in improper seating of the gasket or backing plate against the housing. If the end play is excessive, the axle shaft and bearing assembly should be removed and the cause of excessive end play determined and corrected.

CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

1. Remove wheels. (Both right and left wheels have right hand threads.)
2. Remove brake drums.
3. Remove nuts holding retainer plates and brake backing plates. Pull retainers clear of bolts. Reinstall two lower nuts finger tight to hold brake backing plate in position.
4. Pull out axle shaft assemblies, using puller J 21579 and adapter J 2619-4 with slide hammer J 2619. The axle seal will come out as a part of the axle shaft assembly.

CAUTION: *The outer race of the axle bearing MAY remain in the axle tube. In such a case, the bearing rollers will be exposed when the shaft is removed and extra care must be taken to keep them clean. To remove the outer race from the axle tube it will be necessary to "walk" out the race with a hooked implement. Do not attempt to pull the race out straight as this will cause it to bind.*

If the same bearing is to be re-used the race need not be removed from the axle tube. For differential repairs, the axle shafts may be removed and replaced without using new parts.

AXLE SHAFT BEARING

REMOVE

1. Support the axle shaft under the inner retainer and, using a hammer and chisel, cut a crosswise groove

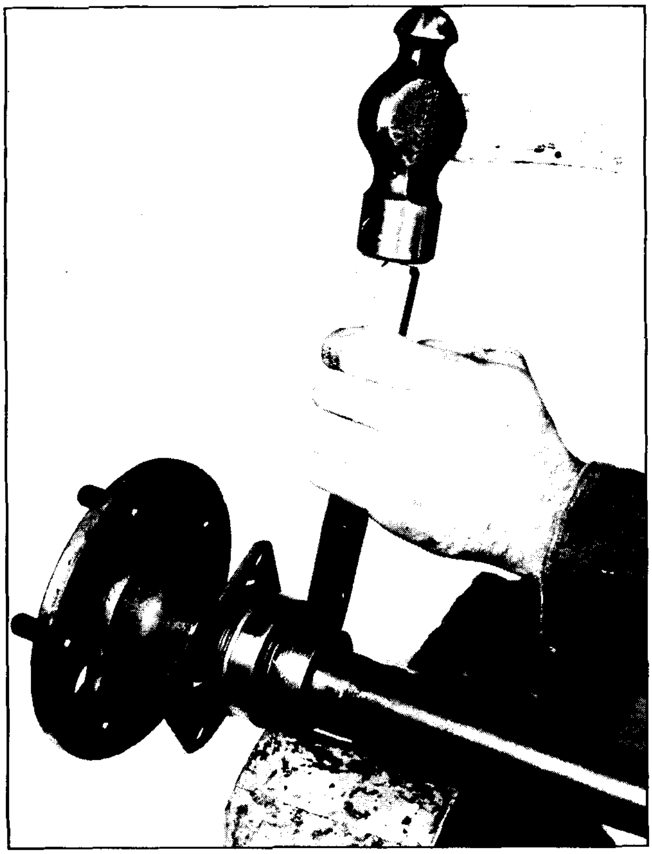


Fig. 4A-11 Cutting Groove in Inner Race

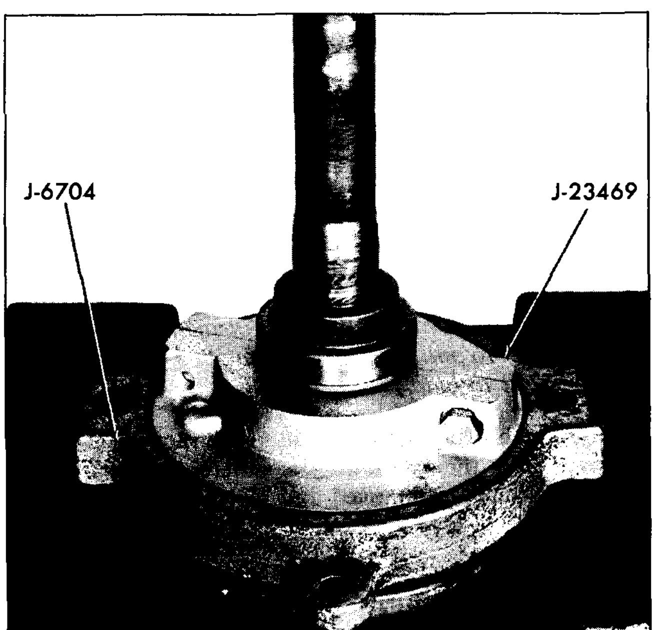


Fig. 4A-12 Pressing Off Axle Bearing (A and G Series)

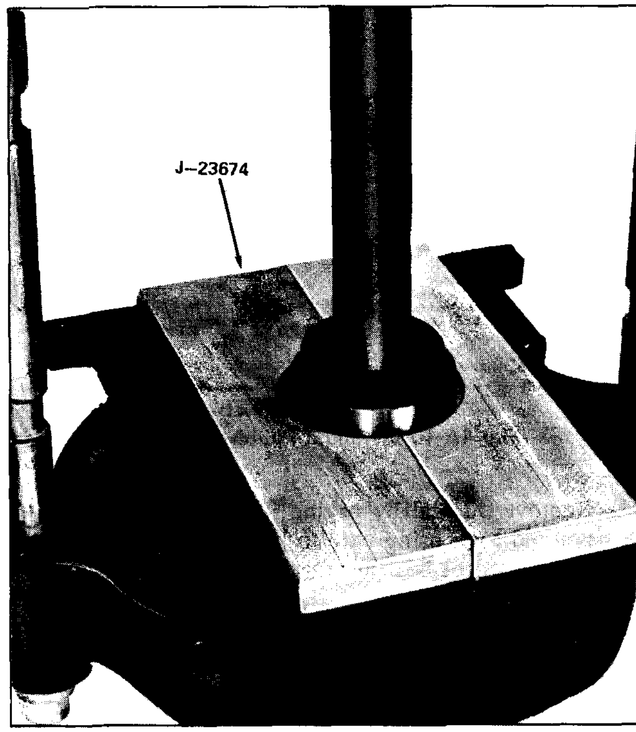


Fig. 4A-13 Pressing Off Axle Bearing (B Series)

approximately 1/16" deep into the retainer (Fig. 4A-11).

2. Clean seal surface of axle and then push axle seal as far as possible away from the bearing.

3. In order to lessen the chance of damaging the seal surface on the axle during bearing removal, coat the inner diameter of remover J 23469 (A and G Series, "P" coded axle) or J 23674 (B Series, "B" or "O" coded axle) with grease Tighten tool retaining bolts only finger tight.

4. Press off axle shaft bearing and inner retainer using plate J 6407 and remover J 23469 or J 23674 (Figs. 4A-12 and 4A-13).

CAUTION: *This tool is designed to contact the inner race. Do not press on the outer race as bearing damage will result. The axle seal surface is extremely critical. Use great care during the pressing operation to avoid any scratches.*

REPLACE

1. Install new retainer plate on axle.

2. Lubricate seal inner lip and O.D. with lithium soap grease and install seal on axle. Always use a new seal.

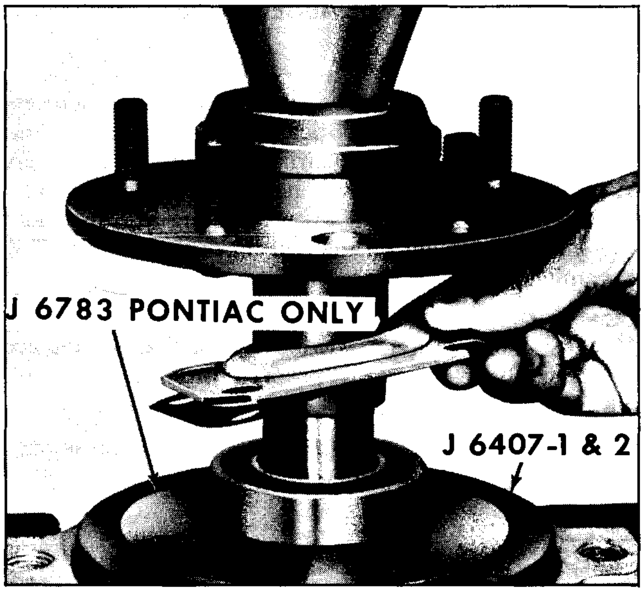


Figure 4A-14 Installing Axle Bearing

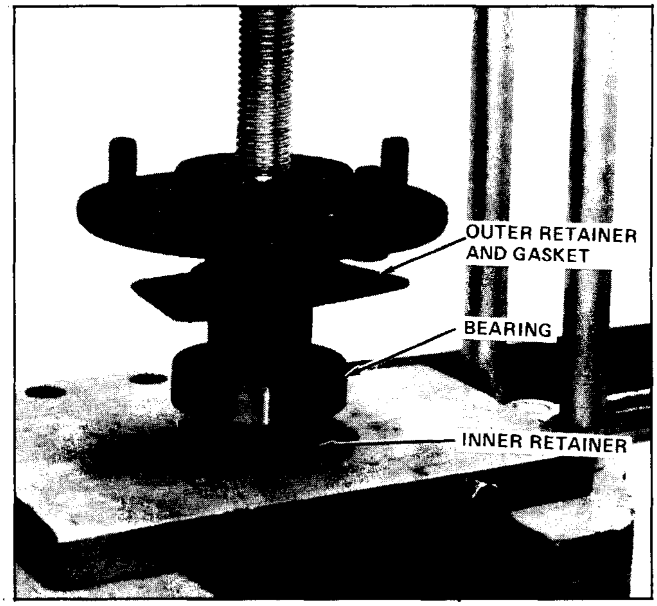


Fig. 4A-16 Installing Retainer - B Series

3. Press on bearing using plate J 21022. (A and G Series, "P" coded axle) or J 23674 (B Series, "B" or "O" coded axle). Two types of bearings are used, one with tapered and one with straight rollers. The straight roller bearing can be installed with either face towards the axle spline. The tapered roller bearing is printed with the manufacturer's name on one face. This bearing must be installed with this printed face pointing towards the axle spline and the retaining ring pointed away from the axle spline (see Figure 4A-14).

4. Press on outer retainer. Always use a new retainer (Figs. 4A-15 and 4A-16).

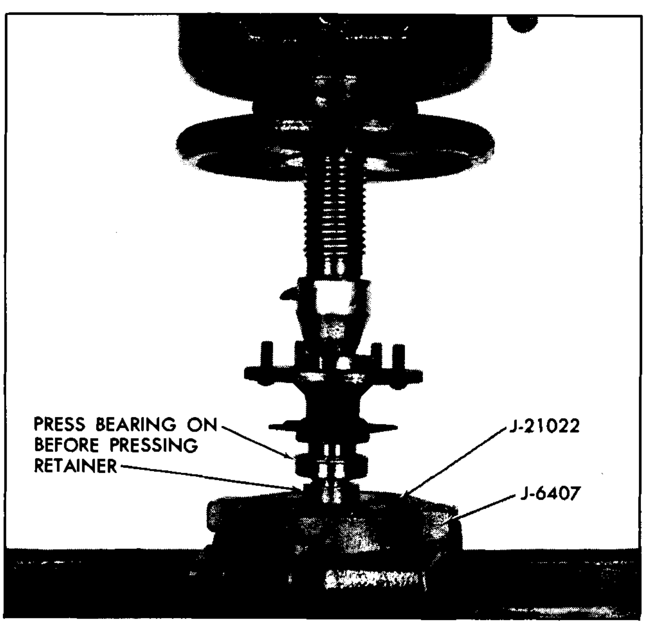


Fig. 4A-15 Installing Retainer - A and G Series

REAR WHEEL BOLT - REMOVE

Remove and install rear wheel bolt with axle shaft in car using J 5504 to push out stud (Fig. 4A-17).

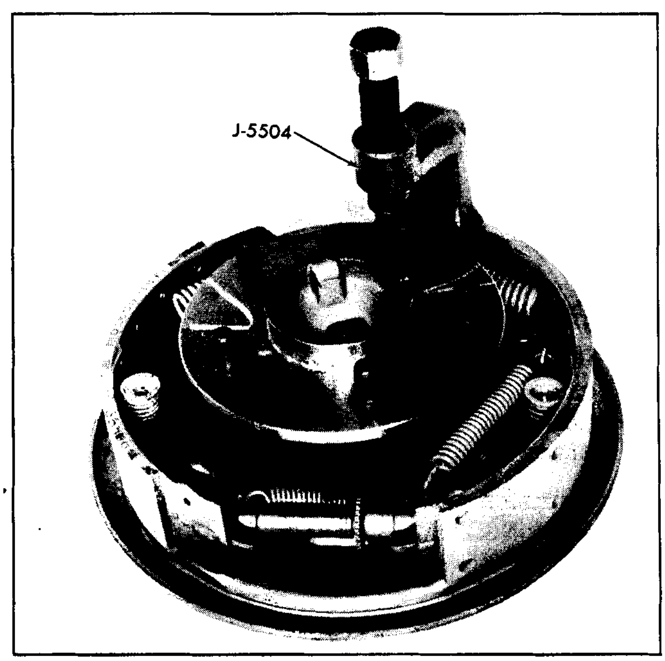


Fig. 4A-17 Removing Rear Wheel Bolt

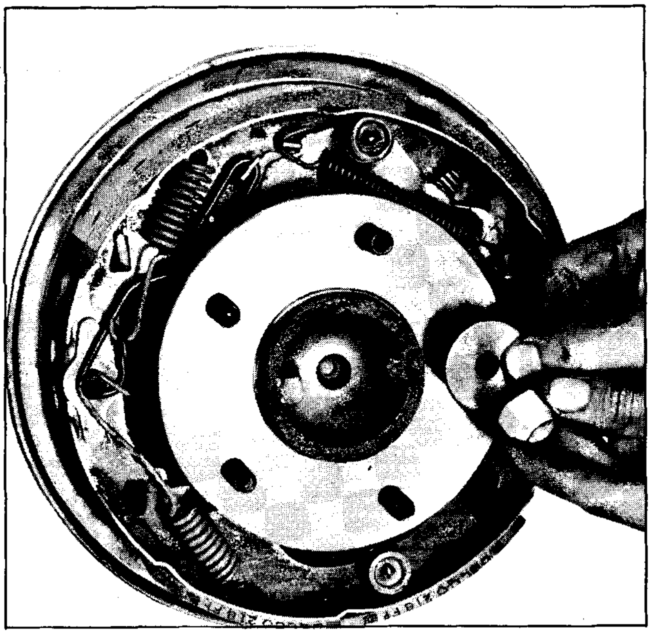


Fig. 4A-18 Replacing Wheel Stud

REPLACE

1. Place new rear wheel bolt through axle flange.

   CAUTION: *Wheel stud must be pulled through with drum removed to avoid distorting the drum.*

2. Use a washer and the flat side of a wheel lug nut to pull stud into place (Fig. 4A-18).

REPLACE AXLE SHAFT ASSEMBLIES

1. Apply a coat of wheel bearing grease in bearing recess of housing. Lightly lubricate axle shaft with axle lubricant, from sealing surface to approximately six inches inboard. This will help prevent damage to lip of wheel bearing seal when installing axle shaft and ensure lubricant on the seal lip during the first few miles of operation.

2. Install brake assembly to axle housing bolts and place brake backing plate in proper position.

3. Carefully insert axle shaft assembly into housing until splines engage differential.

4. Drive axle shaft assembly into position with soft faced hammer.

5. Place the new outer retainer gasket (B Series) and retainer over studs and install nuts. Tighten nuts to 35 lb. ft. torque.

6. Install brake drums over wheel bolts.

   CAUTION: *See caution on Page 1 of this section regarding fasteners referred to in Step 7 below.*

7. Install wheels and tighten wheel nuts to 75 lb. B Series, 70 lb. ft. A and G Series.

MAJOR REPAIRS

REAR AXLE 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:

REMOVE

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.

   WARNING: PLACE CAR STANDS SOLIDLY UNDER FRAME MEMBERS ON BOTH SIDES.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

2. Disconnect rear universal joint from companion flange by removing retaining bolts. Rubber band or tape bearings onto journal, to prevent loss of bearing rollers when joint is disconnected if tie wire has been removed (Fig. 4A-6). Support propeller shaft out of the way.

3. Remove both axle shafts.

4. Support both brake backing plates out of the way.

5. Disconnect rear brake hose bracket by removing top cover bolt. Remove brake line from housing by bending back tabs.

6. Loosen remaining cover bolts, break loose cover about 1/8" and allow lubricant to drain.

7. Disconnect shock absorbers at axle housing.

8. Lower jack under axle housing until rear springs can be removed.

9. Disconnect upper control arms at axle housing.
10. Disconnect lower control arms at axle housing and remove rear axle assembly from under car.

REPLACE

CAUTION: *See caution on Page 1 of this section regarding the fastener referred to in Steps 1 through 8 below.*

1. Rest car solidly on stands placed under frame side members, with rear end of car high enough to permit working underneath. Position axle assembly under car.
2. Connect lower control arms to axle housing but do not torque.
3. Connect upper control arms to axle housing but do not torque.
4. Place rear springs in position and jack axle housing upward until shock absorbers will reach.
5. Connect shock absorbers and tighten nuts to 65 lb. ft.
6. Tighten upper and lower control arm bolts to 110 lb. ft. or nuts to 80 lb. ft.

NOTE: *Upper and lower control arms and lower shock absorber nuts must be torqued with suspension loaded.*

7. Install new axle housing to brake backing plate and outer retainer gaskets, then place backing plates in proper position and install axle shafts and wheels.

CAUTION: *When installing drive shaft, U-bolt nuts must be torqued as specified, as over-tightening will distort bearings and cause early failure.*

8. Connect rear universal joint to companion flange. Install U-joint retaining bolts. Tighten bolts evenly to 12 lb. ft. on single cardon joint or 70 lb. ft. torque on double cardon joint.
9. Connect rear brake hose to top of housing and bend tabs over brake lines on housing.
10. Fill rear axle with specified gear lubricant.
11. Bleed rear brakes as outlined in Sections 5 and 5E.

DIFFERENTIAL CASE

REMOVE

NOTE: *Before removing case from housing, be sure the checks under pre-repair investigation have been completed.*

1. With rear wheels off floor, rotate rear wheels and tap brake backing plates with a soft hammer to ensure that brakes are free.

CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

2. Remove both axle shafts.
3. Remove retaining bolts which hold rear universal joint to companion flange. On standard propeller shaft with single cardon joint, use a heavy 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 (Fig. 4A-6).
4. Thoroughly clean differential housing cover and surrounding area of axle housing to avoid dirt entering housing or falling on the gears.
5. Drain oil by loosening all cover attaching bolts and breaking loose cover about 1/8".
6. Allow oil to drain thoroughly, then remove attaching bolts and cover from housing.
7. Remove the four bearing cap bolts and reinstall bearing caps, using four (7/16"-14 x 4 1/2") bolts finger tight as a safety precaution. Bearing caps are not marked for identification. Use punch marks to identify, as the caps are not interchangeable.

NOTE: *Ring gear to case bolts have left hand threads.*

8. Remove two ring gear to case assembly bolts. Install ring gear and case remover J 21322, left hand bolt

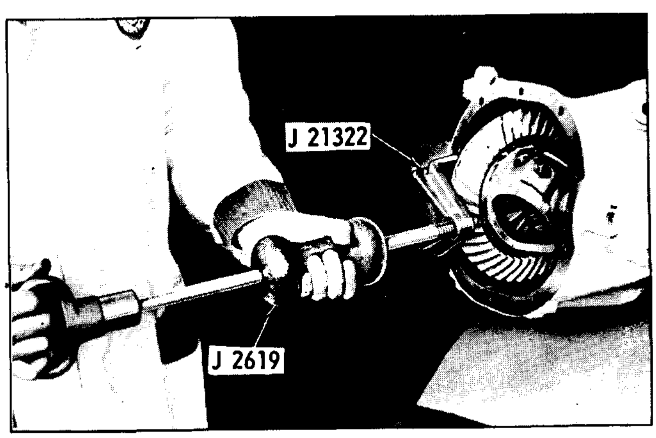


Fig. 4A-19 Removing Differential Case

and sleeve set J 22042 and slide hammer J 2619 (Fig. 4A-21).

9. Loosen case from housing with slide hammer until it is free. Safety bolts installed in step 7 will catch assembly.

10. Support case assembly in one hand and remove safety bolts. CAREFULLY remove case so as not to let bearing races or shims fall from housing.

NOTE: *Place right and left bearing outer race and shim in sets with marked bearing caps. Measure thickness of each shim and record.*

DISASSEMBLE

1. All models, before disassembling differential case, inspect differential side bearings for visible damage of rollers and outer races.

2. Place one outer race onto its matching inner race and roller assembly and turn slowly, applying hand load.

3. If bearing outer race turns smoothly and no visible damage is found, bearing can probably be reused.

4. Repeat above operation with other outer race and matching bearing.

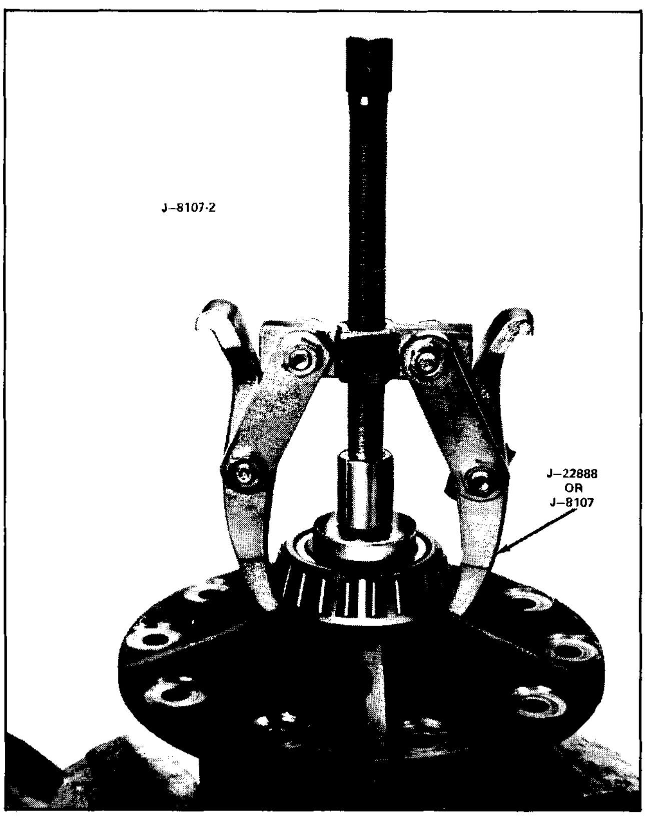


Fig. 4A-20 Removing Differential Side Bearings

NOTE: *Side bearings and their outer races are matched parts. If either bearing is to be replaced, its matching outer race must also be replaced.*

5. Inspect fit of inner races on case hubs by prying against shoulders at puller recesses. Bearing inner races must be tight on case hubs.

NOTE: *If either bearing is loose on case, the entire case must be replaced.*

6. If bearing inspection indicates that bearings should be replaced, insert differential case in vise and remove side bearing, using side bearing puller J 8107 and adapter J 8107-2 or a suitable puller (Fig. 4A-20).

7. Turn differential case in vise and remove other side bearing in same manner.

8. Remove pinion shaft locking bolt and washer.

9. Drive pinion shaft out of case, using brass drift (Fig. 4A-21).

10. Remove differential pinion gears, thrust washers and side gears. Place them in sets so they may be reinstalled in their original position.

NOTE: *Ring gear to case bolts have left hand threads.*

11. If ring gear is to be removed, clamp case in vise so jaws are 90° to pinion shaft holes. Remove ring gear retaining bolts.

12. Partially reinstall two bolts on opposite sides of ring gear.

CAUTION: *Do not pry between case and ring gear.*

13. Remove ring gear from case by alternately tapping on bolts.

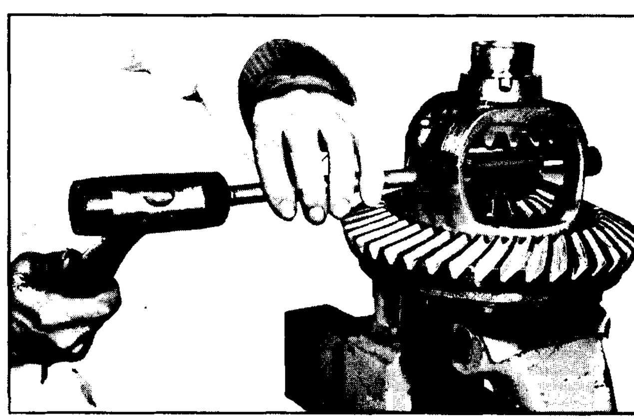


Fig. 4A-21 Removing Pinion Shaft

CLEAN AND INSPECT

1. Thoroughly clean differential case and inspect, paying particular attention to ring gear mounting flange, ring gear pilot, side bearing hubs, thrust washer surfaces, pinion shaft bore and side gear hub bores.

2. Remove nicks and burrs with mill file.

   NOTE: *When using a new case, thoroughly clean new case in suitable solvent, making certain all holes and bores are clean of steel filings and foreign material.*

3. Clean side gears, pinion gears, pinion shaft and thrust washers with suitable solvent. Inspect for excessive wear.

4. Thoroughly clean ring gear and inspect back side for any adhering material which may cause runout.

5. Position ring gear on case and check fit of gear on flange and pilot. It should be from .002" tight to .001" loose. If ring gear easily falls into position, it must be replaced.

   NOTE: *If ring gear is replaced, pinion gear must also be replaced as they are only serviced in matched sets.*

6. Replace parts as necessary and coat with clean gear lube before installing in case.

ASSEMBLE

ALL EXCEPT GRAND PRIX MEDIUM DUTY

1. After making sure that mating surfaces are clean and free of burrs, position ring gear on case so holes are in line.

2. Lubricate attaching bolts with clean engine oil and install.

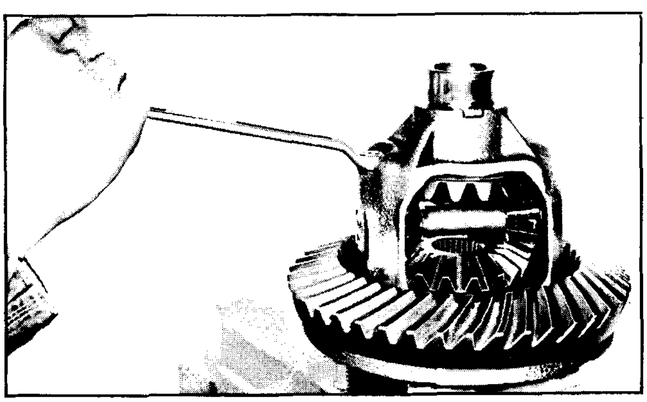


Fig. 4A-22 Installing Pinion Shaft Locking Bolt

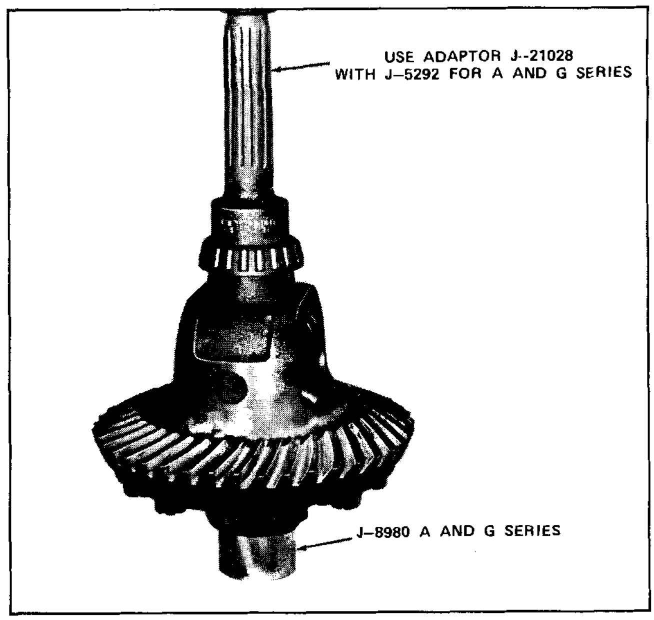


Fig. 4A-23 Installing Right Differential Side Bearing - A and G Series

CAUTION: *Do not use hammer to force ring gear on case.*

3. Pull ring gear onto case by diagonally tightening bolts across case. When all bolts are snug, tighten bolts evenly and diagonally across diameter to 90 lb. ft. torque.

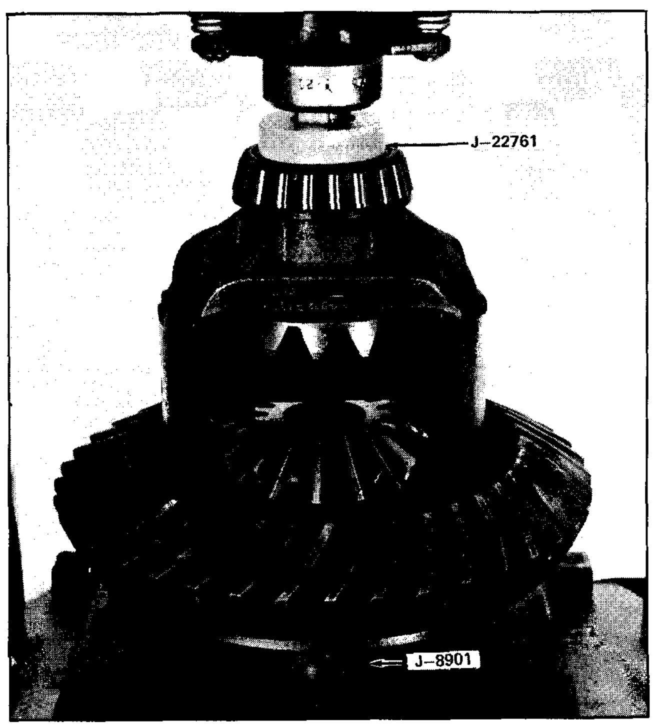


Fig. 4A-24 Installing Right Differential Side Bearing - B Series

4. Place side gear thrust washers over side gear hubs and install side gears in case. Replace any reused parts in original sides.

5. Position one pinion (without washer) between side gears and rotate gears until pinion is directly opposite from loading opening in case. Place other pinion between side gears so that pinion shaft holes are in line, then rotate gears to make sure holes in pinions will line up with holes in case.

6. When holes line up, rotate pinions back toward loading opening just enough to permit sliding in pinion thrust washers.

7. Install pinion shaft and pinion shaft locking bolt. Torque to 15 lb. ft. (Fig. 4A-22).

8. Using installer J 22761 (B Series), J 21028 (A and G Series) press on right side bearing with arbor press. Support opposite bearing with J 8901 (B Series), J 8980 (A and G Series) if already installed (Figs. 4A-23 and 4A-24).

9. Reverse differential case, support previously installed side bearing with J 8901 (B Series), J 8980 (A and G Series) and press on other side bearing, using J 22761 (B Series) J 21028 (A and G Series) (Fig. 4A-25 and 4A-26).

10. Lubricate outer bearing surfaces.

PINION ASSEMBLY

REMOVE

1. Check pinion bearing preload. If there is no preload reading, check for looseness of pinion assembly by shaking. Looseness indicates need for bearing replacement. If assembly is run with loose bearings for any extended period, ring gear and pinion will also need to be replaced.

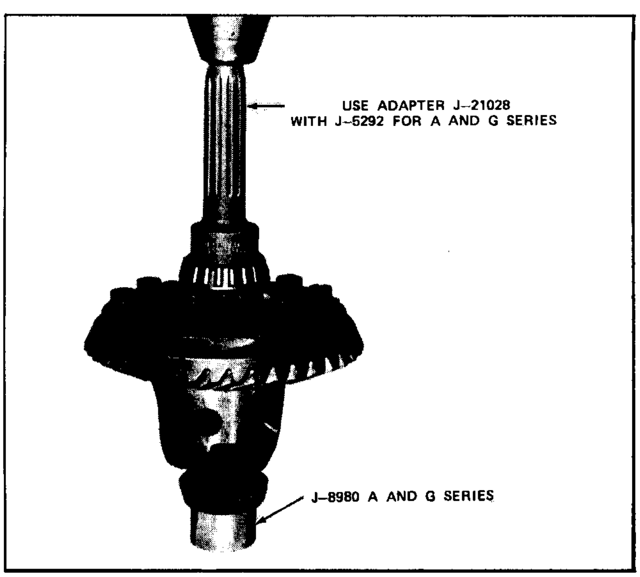


Fig. 4A-25 Installing Left Differential Side Bearing - A and G Series

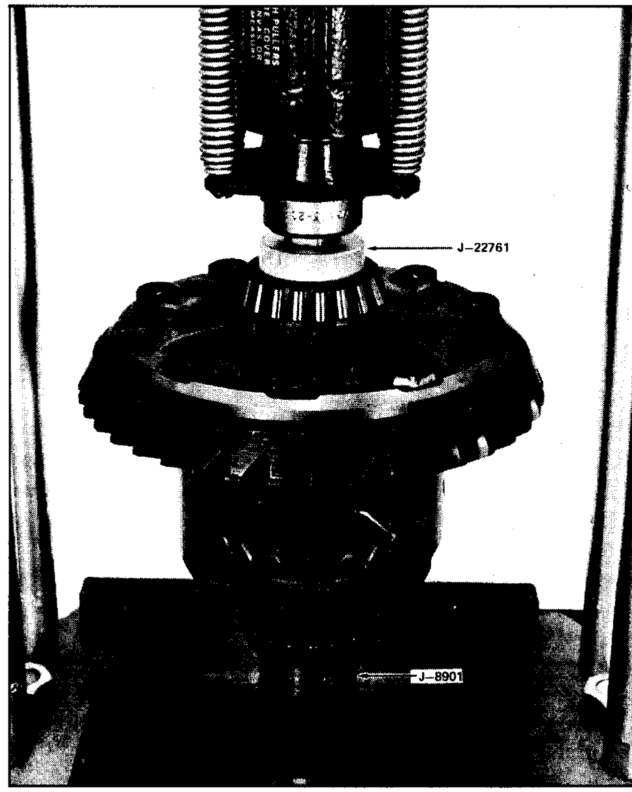


Fig. 4A-26 Installing Left Differential Side Bearing - B Series

2. Install holder J 8614-10 on pinion flange by using two 5/16" bolts with flat washers. Remove pinion nut and washer (Fig. 4A-27).

3. Pull companion flange from pinion, using puller J 8614-2 and 3 in holder J 8614-10. To install puller,

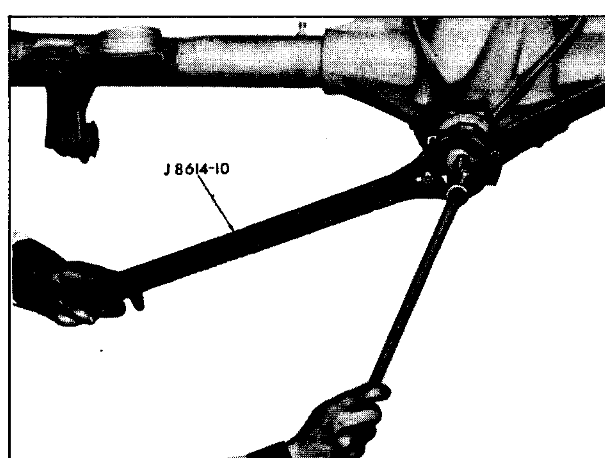


Fig. 4A-27 Removing Pinion Nut

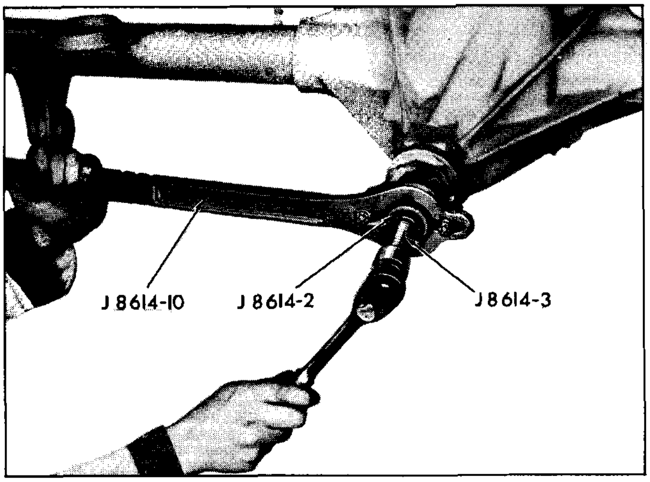


Fig. 4A-28 Removing Companion Flange

back out puller screw, insert puller through holder and rotate 1/8 turn (Fig. 4A-28).

4. Remove pinion assembly. If necessary, tap pinion out with soft hammer, being careful to guide pinion with hand to avoid damage to bearing outer races.

DISASSEMBLE

NOTE: *Both front bearing and outer race, and rear bearing and outer race, are matched parts. If either bearing is to be replaced, its matching outer race must also be replaced.*

1. If replacing rear pinion bearing or changing pinion depth setting, remove rear pinion bearing from pinion shaft, using remover J 8612 (B Series), J 21493 (A or G Series) with holder J 6407-1 (Fig. 4A-29).
2. If replacing rear pinion bearing, drive outer race from carrier, using a drift.
3. Pry pinion oil seal from carrier and remove front pinion bearing. If replacing this bearing, drive its outer race from carrier, using a drift.

CLEANING AND INSPECTION

1. Check drive pinion stem and gear for excessive wear.

   NOTE: *Ring gears and pinions are matched at the factory and are serviced only in sets. Never attempt to replace either a ring gear or pinion without its matching member.*

2. Thoroughly clean and inspect carrier for cracks or other damage.
3. Be sure oil passage in carrier is clean and clear.
4. Inspect bearing cap and bolt threads in carrier. Clean out metal filings and chips.
5. Carefully inspect pinion bore and shoulders against which pinion bearing outer races seal. They must be free of burrs, nicks or material which would prevent proper seating of bearing outer races.

   NOTE: *If axle housing (carrier and tube assembly) is being replaced, thoroughly clean and inspect new housing, paying particular attention to machined surfaces in bearing caps and carrier. Be sure all metal filings and foreign material are removed from the bearing cap bolt*

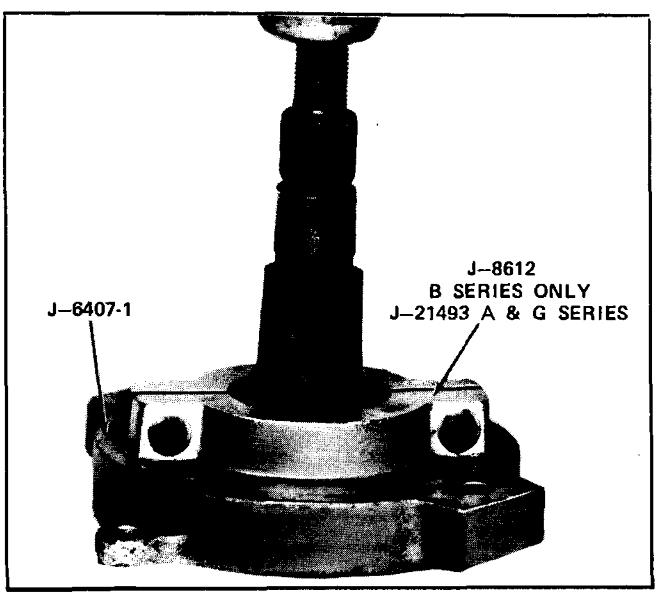


Fig. 4A-29 Removing Rear Pinion Bearing

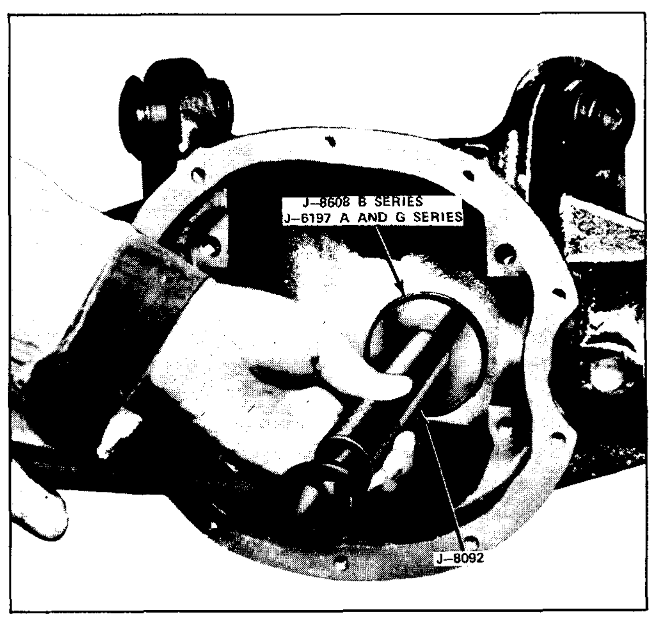


Fig. 4A-30 Installing Rear Pinion Bearing Outer Race

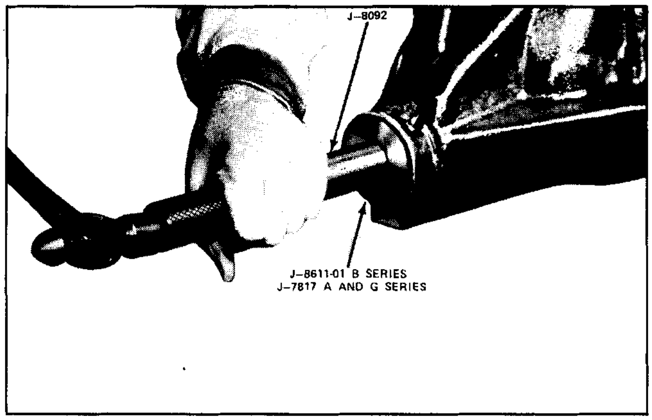


Fig. 4A-31 Installing Front Pinion Bearing Outer Race

holes in the carrier. Be sure bearing caps seat squarely on carrier. Use mill file lightly to remove nicks and burrs.

PINION BEARING OUTER RACES

REPLACE

1. If replacing rear pinion bearing, install new outer race by using installer J 8608 (B Series), J 6197 (A or G Series) with driver handle J 8092 (Fig. 4A-30).

2. If replacing front pinion bearing, install new outer race by using installer J 8611-01 (B Series), J 7817 (A or G Series) with driver handle J 8092 (Fig. 4A-31).

SETTING PINION DEPTH

The pinion bearing shim thickness (pinion depth) must be determined:

a. whenever a new housing (carrier and tube assembly) is to be used, and/or

b. new bearings and races are installed, or

c. the pre-repair investigation indicates the drive pinion bearing shim should be changed.

Ring and pinion gear sets are matched in a special test machine. All production pinions are marked on the face of the pinion gear in thousandths of an inch if they vary from a "nominal" setting. When a pinion is marked "+" (plus), it means that the pinion is located too far away from the centerline of the ring gear. Shims must be added to move the pinion closer to the ring gear and position the pinion at the nominal setting. When a pinion is marked "–" (minus), it means the pinion shims must be removed to move the pinion away from the ring gear and position the pinion at the nominal setting.

Pinion depth is set with pinion depth setting gauge J 21777 which consists of the following: one J 21777-1 cross shaft assembly, two J 21777-3 discs (B Series) or J 8619-10 (A and G Series), one J 21777-26 gauge plate and bar (B Series), one J 21777-2 "A"&"B" gauge plate, (A or G Series), one J 5647-37 (B Series) or J 8619-12 (A and G Series) pilot, one J 21777-8 washer (B Series only) and one J 8619-13 bolt and nut. A J 8001 dial indicator must also be used with the cross shaft. The pinion depth setting gauge provides in effect a "nominal" or "zero" pinion as a gauging reference.

1. Make certain all gauge parts are clean. Check particularly the discs, gauge pin ends, dial indicator tip and gauge plate surface.

2. Lubricate front and rear pinion bearings with gear lubricant and position them in their respective races in carrier. Bearings used with gauge must be those to be installed in car, in order to ensure accurate reading.

3. Assemble pinion setting gauge assembly, as shown in Fig. 4A-32, into carrier assembly and tighten hex nut while rotating gauge plate. Check that gauge plate is centered over bearing (Fig. 4A-33,and 4A-34), then torque nut to obtain a bearing preload reading of 20 lb. in. (obtained with gauge plate assembly in rotation).

4. Make certain differential side bearing support bores are clean and free of burrs.

5. Position the dial indicator, J 8001, on the mounting post of the gauge shaft with the contact button touch-

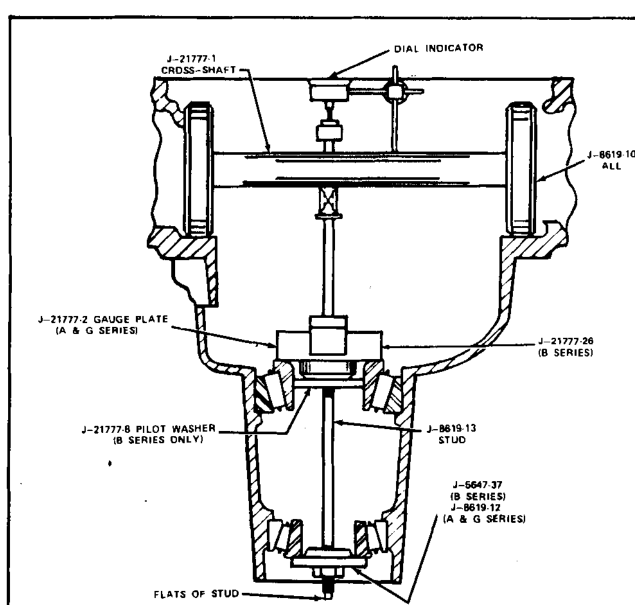


Fig. 4A-32 Pinion Gauge Tools

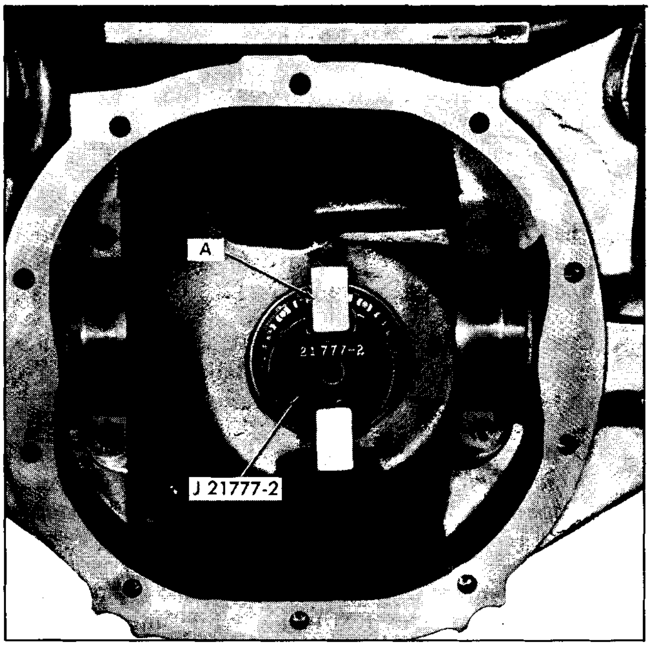


Fig. 4A-33 Pinion Gauge Tools Installed - A and G Series

ing the indicator pad. Set the dial indicator on zero, then depress the dial indicator until the needle rotates 3/4 turn clockwise. Tighten the dial indicator in this position.

6. Install discs on gauge shaft assembly as shown in Fig. 4A-33 and 4A-34 and position in the carrier so that the dial indicator contact rod is directly over the gauging area of the gauge plate. The discs must be fully seated in the side bearing bores.

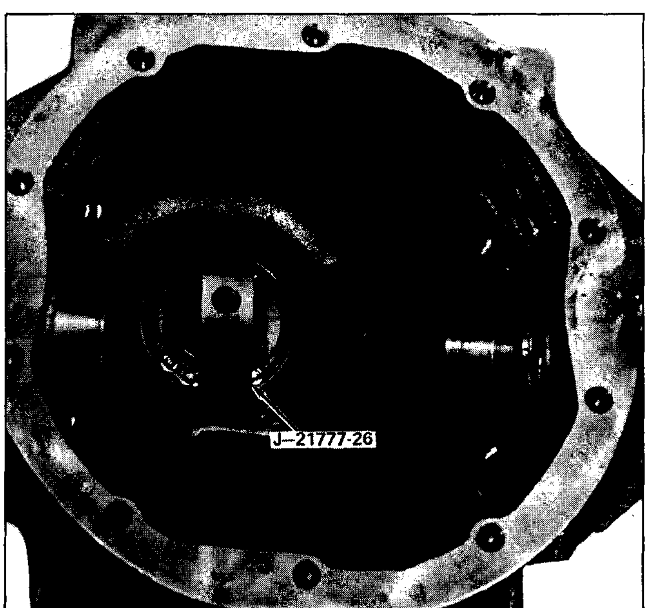


Fig. 4A-34 Pinion Gauge Tools Installed - B Series

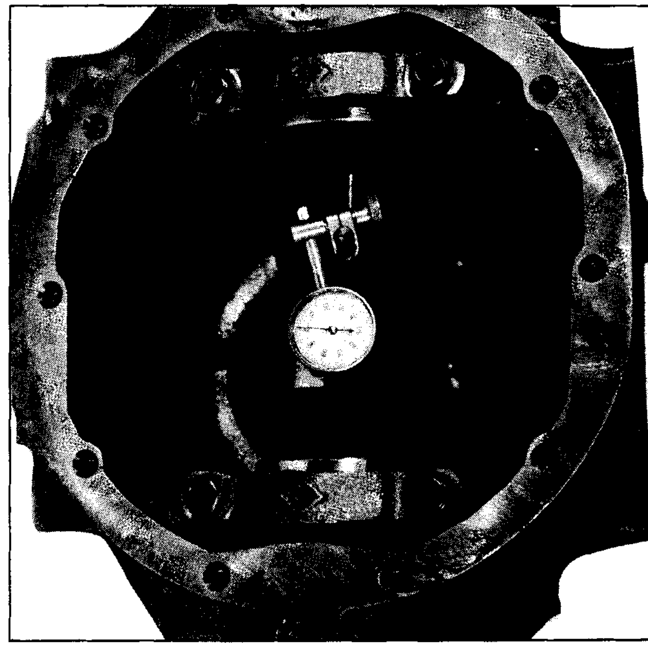


Fig. 4A-35 Checking Pinion Depth

7. Install bearing caps over gauge shaft discs.

8. Position gauge shaft so that the dial indicator rod contacts the gauging area of J-21777-26 for B Series vehicles, or the "A" gauging area of J-21777-2 for A and G Series. Rock gauge shaft slowly back and forth until the dial indicator records the greatest deflection, (the point where dial indicator needle changes rotational direction) at the point of largest deflection, set dial indicator to zero (Fig. 4A-35). Repeat rocking action of gauge shaft to verify the zero setting.

9. After the zero setting is obtained, rotate gauge shaft until the dial indicator rod is removed from the gauging area. The dial indicator will read the pinion depth directly.

10. Select correct pinion shim to be used during pinion reassembly on the following basis B Series - Fifteen (15) shims are available in increments of (.002") two thousandths from .020" to .050".

A or G Series - Ten (10) shims are available in increments of (.002") two thousandths from .020" to .038".

a. If reusing production pinion, and pinion is marked "+" (plus), correct shim will have a thickness equal to gauge reading plus the amount specified on pinion.

b. If production pinion is marked "–" (minus), correct shim will have a thickness equal to gauge reading, less the amount specified on pinion.

c. If using production or service pinion which has no marking, the correct shim will have a thickness equal to the gauge reading.

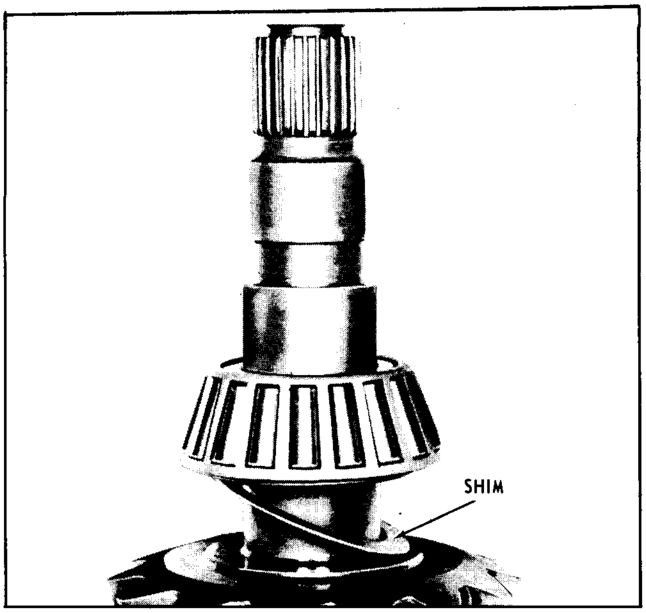


Fig. 4A-36 Pinion Shim

11. Remove pinion gauge assembly and both bearings from case.

12. Slide pinion shim onto pinion shaft and install rear pinion (Fig. 4A-36) bearing on pinion, using installer J 8609 (B Series), J 21022 (A or G Series) and holder J 6407-1 and 2 in a press, as shown in Fig. 4A-37.

PINION ASSEMBLY

REPLACE PINION ASSEMBLY AND ADJUST PINION PRELOAD

1. Examine ring gear and pinion for nicks, burrs or

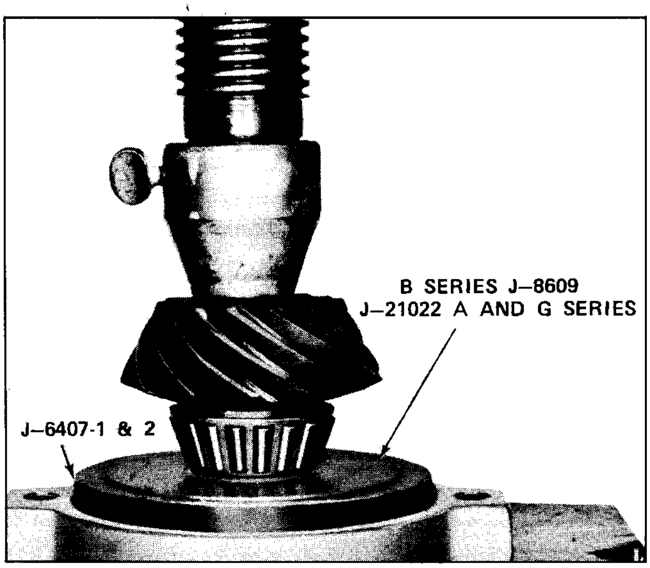


Fig. 4A-37 Installing Rear Pinion Bearing

scoring. Any of these conditions will require replacement of gear set.

2. Position pinion assembly in carrier and install new collapsible spacer. Tap rear of pinion assembly with soft hammer to assure seating of rear pinion bearing to its outer race in carrier.

3. Place front pinion bearing in position on pinion. Hold pinion fully forward and drive bearing over pinion until seated, using installer J 21285-01.

4. Coat O.D. of pinion oil seal with sealing compound and install in carrier, using installer J 21285-01 (A and G Series) or J 22388 (B Series) (Fig. 4A-10).

5. Coat lips of pinion oil seal and seal surface of companion flange with gear lube. Install companion flange on pinion, by tapping with a soft hammer until a few pinion threads project through flange.

6. Install pinion washer and nut. Hold companion flange with holder J 8614-10. While intermittently rotating pinion to seat bearings, tighten pinion nut until end play begins to be taken up.

   CAUTION: *When no further end play can be determined, and holder J 8614-10 will no longer pivot freely as pinion is rotated, preload is being applied. Further tightening should be done only after preload has been checked.*

7. Check preload by using a lb. in. torque wrench (Fig. 4A-38).

   CAUTION: *After preload has been checked, final tightening should be done very cautiously. Tighten the pinion nut further, only a little at a time, and check preload after each slight amount of tightening. Exceeding preload specifications will compress the collapsible spacer too far and require its replacement. Backing off nut to correct excessive preload will unload the front bearing and pinion nut, allowing bearing to turn on shaft.*

8. While observing the preceding caution, carefully set preload drag to 25 lb. in. on new bearings or 17 lb. in. on used bearings.

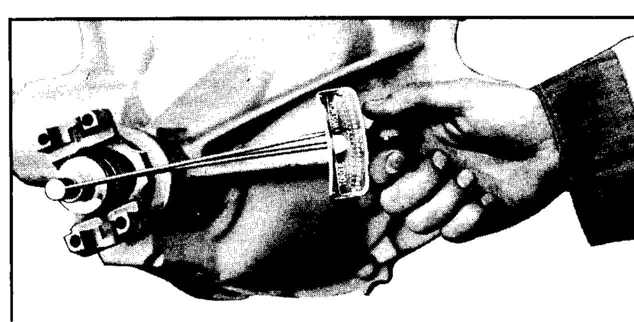


Fig. 4A-38 Checking Pinion Bearing Preload

9. Rotate pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced by rotating pinion, re-set preload to specification.

DIFFERENTIAL CASE

REPLACE DIFFERENTIAL CASE AND ADJUST SIDE BEARING PRELOAD

Production shims are cast iron and vary in thickness from .210" to .272", in increments of .002".

> **NOTE:** *Whenever a case assembly is removed from the housing, measure the production shims for thickness and discard them (Fig. 4A-39).*

This figure will be used to determine the approximate shim pack needed in step 3 (below). Use standard .170" service spacers and steel service shims (available from .032" to .064", in increments of .002") for all service repairs.

> **NOTE:** *Do not attempt to reinstall the production shims as they may break when tapped into place. If service shims were previously installed, they can be reused, but (whether using new or old bearings) adhere to the following procedure in all cases.*

> **CAUTION:** *To adjust differential side bearing preload, change the thickness of the right and left shims equally, thus leaving the original backlash undisturbed.*

1. Before installation of case assembly, make sure side bearing surfaces are clean and free of burrs. Lubricate side bearings with gear lube. If reusing original bearings, the original outer races must also be used.

2. Place differential case, with bearing outer races in position, in carrier.

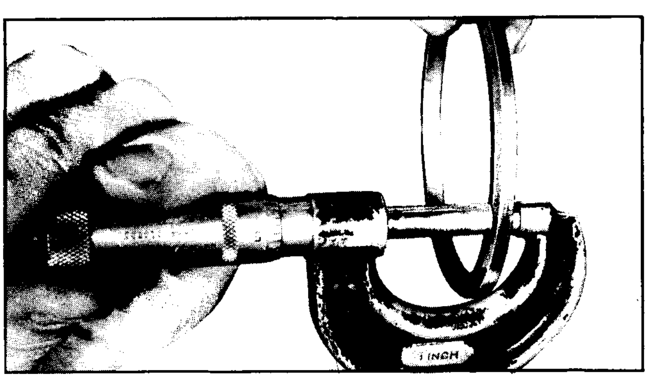


Fig. 4A-39 Measuring Original Production Shim

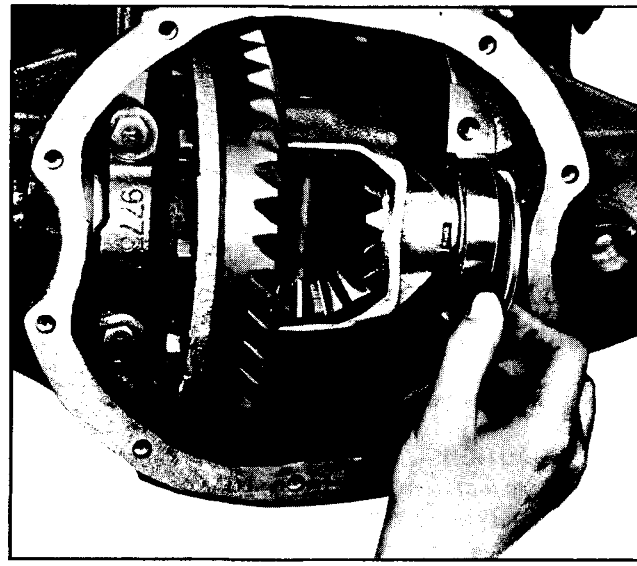


Fig. 4A-40 Installing Service Spacer

> **NOTE:** *As a safety precaution, install the left bearing cap loosely so that the case may be moved while checking adjustments (one 7/16"-14 x 4 1/2" bolt can be added as an extra safety precaution in the lower right bearing cap hole). This will prevent the case from dropping while making shim adjustments.*

3. Achieve a slip fit between the carrier and the side bearings as follows:

> **NOTE:** *A slip fit means zero pre-load, or the point at which bearings have no play and no drag. At this point, in and out movement of the case is possible, but side to side movement is not.*

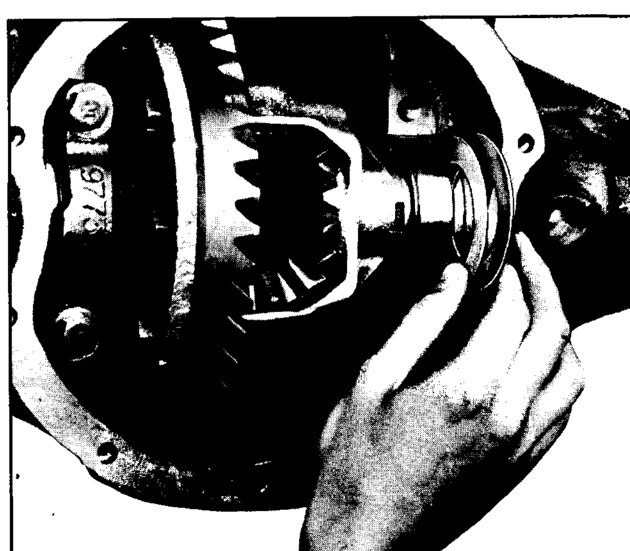


Fig. 4A-41 Installing Service Shims

a. Measure production spacers (Fig. 4A-39), and subtract .004" from each reading. Do not mix the left and the right spacers.

b. Using a service spacer (.170") and service shims make up a shim pack for each side equal to the thickness of the original shim minus .004" and install as shown in Fig. 4A-40 and 41 (flat edge of spacer against housing). This will duplicate the original setting minus pre-load.

c. If this does not provide the proper slip fit, shims must be added or removed equally from both sides as necessary.

CAUTION: *If insertion of shims causes excessive pinion to ring gear contact (noticeable difficulty in rotation of the case), select thinner left shim and add difference to the right side. Keep total shim thickness at a value equal to that obtained in step 3.*

NOTE: *Original light drag is caused by weight of the case against the carrier while additional drag is caused by side bearing preload.*

For convenience in setting backlash and tooth contact, the preload will not be added until the final step.

4. Check backlash and tooth pattern as described in the following section. The bearing caps must be installed and the bolts torqued to 70 lb. ft.

5. When backlash and tooth pattern operations are complete, remove shim packs taking care not to mix them. Select new shim packs for each side .004" thicker than those removed and install each shim pack on its proper side. This additional thickness will provide proper bearing preload. It will be necessary to tap the final shim into place with a soft hammer or with BT 6623 (A and G Series) (Fig. 4A-42).

ADJUST DIFFERENTIAL BACKLASH

1. Rotate differential case several times to seat bearings, then mount dial indicator (Fig. 4A-43). 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 .002" around ring gear. If variation is over .002", 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 .005" to .009" for all new gears. If original gear set having a wear pattern is being reinstalled, original gear lash should be maintained.

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 preload will be maintained. Shift .002" in shim thickness for each .001" change in backlash desired. If backlash is .001" too much, decrease thickness of right shim .002" and increase thickness of left shim .002". If backlash is .002" too little, increase thickness of right shim .004" and decrease thickness of left shim .004".

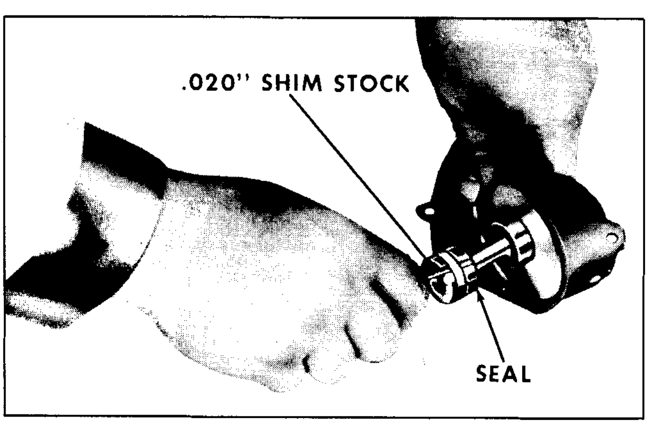


Fig. 4A-42 Tapping Final Shim into Place

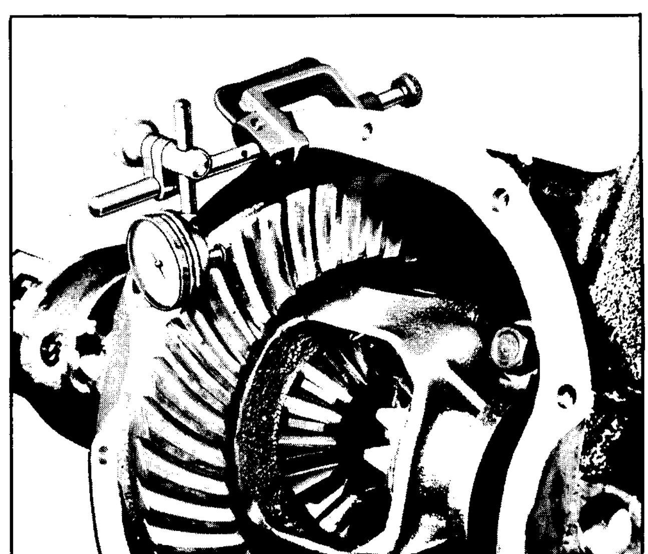


Fig. 4A-43 Checking Ring Gear to Pinion Backlash

B SERIES AXLE USAGE CHART

VEHICLE SERIES	STANDARD CODE	SAFE-T-TRACK CODE	MANUFACTURER'S IDENTIFICATION CODE+	AXLE TYPE NON "C" TYPE@	AXLE TYPE "C" TYPE∞	RATIO AVAIL-ABILITY	TRANS.	ENGINE
B EXCEPT STA. WGN.	UD	VD	P		X	2.73*	M40	400 2 Bbl.
	UD	VD	M		X			
	NK	NT	G		X			
	NK	NT	K		X			
	NK	NT	B	X				
	NK	NT	O	X				
	NA	NP	G		X	3.08		
	NA	NP	K		X			
	NA	NP	B		X			
	NA	NP	O		X			
	NJ	NR	G		X	3.23		
	NJ	NR	K		X			
	NJ	NR	B		X			
	NJ	NR	O		X			
	UC	VC	P		X	2.56	M40	400 4 Bbl.
	UC	VC	M		X			
	UF	VF	P		X	3.08*		
	UF	VF	M		X			
	UG	VG	P		X	3.23		
	UG	VG	M		X			
	UC	VC	P		X	2.56	M40	455 2 Bbl.
	UC	VC	M		X			
	UD	VD	P		X	2.73*		
	UD	VD	M		X			
	UF	VF	P		X	3.08		
	UF	VF	M		X			
	UG	VG	P		X	3.23		
	UG	VG	M		X			
	UC	VC	P		X	2.56	M40	455 4 Bbl.
	UC	VC	M		X			
	UF	VF	P		X	3.08*		
	UF	VF	M		X			
	UG	VG	P		X	3.23		
	UG	VG	M		X			
B STA. WGN.	YD	ZD	P		X	2.73*	M40	400 2 Bbl.
	YF	ZF	P		X	3.08		
	YG	ZG	P		X	3.23		
	YF	ZF	P		X	3.08*	M40	400 4 Bbl.
	YG	ZG	P		X	3.23		
	YF	ZF	P		X	3.08*	M40	455 2 Bbl.
	YG	ZG	P		X	3.23		
	YF	ZF	P		X	3.08*	M40	455 4 Bbl.
	YG	ZG	P		X	3.23		
LIGHT DUTY POLICE	WP	XJ	P		X	3.08*	M40	ALL
	YF (Sta. Wgn.)	ZF (Sta. Wgn.)	P		X			
POLICE FWY. ENFORCER	WA	XL	P		X	3.23*	M40	ALL
	YG (Sta. Wgn.)	ZG (Sta. Wgn.)	P		X			
AMB. & HEARSE	YG	ZG	P		X	3.23*	M40	ALL
COACH & LIMO.	YH	ZH	P		X	3.42*	M40	ALL

* Current Standard Axle Ratio
@ Unit Type Axle Shaft Bearing
∞ Direct on Axle Shaft Bearing
+ Manufact. Ident. Code may appear as part of 3 letter code or as separate letter on axle tube

Fig. B Series Axle Usage Chart

A AND G SERIES AXLE USAGE CHART

VEHICLE SERIES	STANDARD RATIO CODE	SAFE-T-TRACK RATIO CODE	MANUFACTURER'S IDENTIFICATION CODE††	AXLE TYPE NON "C" TYPE@	AXLE TYPE "C" TYPE∞	RATIO AVAIL-ABILITY	TRANS.	ENGINE
A	WE	XE	P	X		3.08*	M35	250
	WF	XF	P	X		3.23		
	WC	XC	P	X		2.78	M38	
	WE	XE	P	X		3.08*		
	WF	XF	P	X		3.23		
	WF	XF	P	X		3.23*	3 Spd. Man.	
	WC	XC	P	X		2.78*	M35	350 2 Bbl.
	WE	XE	P	X		3.08+		
	WH	XH (4 pinion)	P	X		3.55		
	WB	XB	P	X		2.56*	M38	
	WC	XC	P	X		2.78+		
	WE	XE	P	X		3.08		
	WF	XF	P	X		3.23		
	WE	XE	P	X		3.08	3 Spd. Man.	
	WF	XF	P	X		3.23*		
	WH	XH (4 pinion)	P	X		3.55		
	WE	XE	P	X		3.08	4 Spd. Man.	
	WF	XF	P	X		3.23*		
	WH	XH (4 pinion)	P	X		3.55		
	WC	XC	P	X		2.78*	M40	400 2 Bbl.
	WE	XE	P	X		3.08		
	WE	XE	P	X		3.08	M40	400 4 Bbl.
	WF	XF	P	X		3.23 *		
	WH	XH (4 pinion)	P	X		3.55$		
	WF	XF	P	X		3.23	3 Spd. Man.	
	WH	XH (4 pinion)	P	X		3.55*		
	WF	XF	P	X		3.23	4 Spd. Man. (Wide Ratio)	
	WH	XH (4 pinion)	P	X		3.55*		
	WH	XH	P	X		3.55	4 Spd. Man. (Close Ratio)	
	WT	XT	K		X	3.07	M40	455 4 Bbl.
	WV	XV	K		X	3.55		
	WU	XU	K		X	3.31*		
	WT	XT	K		X	3.07	M40	455 H.O. 4 Bbl.
	WV	XV	K		X	3.55		
	WU	XU	K		X	3.31	4 Spd. Man. (Close Ratio)	
	WV	XV	K		X	3.55*		
G	AB	BE (4 pinion)	P	X		3.08*	M40	400 4 Bbl.
	AF	BF (4 pinion)	P	X		3.23		
	WT	XT	K		X	3.07*	M40	455 4 Bbl.
	WU	XU	K		X	3.31		

- * Standard Axle Except Station Wagon and GTO
- \+ Standard Axle – Station Wagon Only)
- $ Standard Axle – GTO Only
- @ Unit Type Axle Shaft Bearing
- ∞ Direct On Type Axle Shaft Bearing
- †† Manufact. Ident. Code may appear as part of 3 letter code or as separate letter on axle tube

Fig. A and G Series Axle Usage Chart

5. When backlash is adjusted to specifications, tighten bearing cap bolts to 70 lb. ft. torque.

6. Check tooth contact pattern with red lead test as specified in this section.

NOTE: *It may be necessary to readjust the backlash to obtain the correct tooth contact pattern. On high mileage gear sets where a definite wear pattern has been established, it may be necessary to exceed .009" backlash to obtain the desired tooth contact. It is important, however, not to exceed .009" backlash on new gear sets.*

If readjusting the backlash does not give the correct tooth contact pattern, the pinion depth must be readjusted.

7. When correct tooth contact pattern is obtained, install cover with new gasket on housing. DO NOT USE GREASE TO RETAIN GASKET. Insert two upper cover bolts carefully through cover and gasket. Be sure gasket is flat and not twisted between cover and housing. Be sure all cover bolts pass through gasket holes. Torque to 25 lb. ft.

F AND X SERIES AXLE USAGE CHART

VEHICLE SERIES	STANDARD RATIO CODE	SAFE-T-TRACK RATIO CODE	MANUFACTURER'S IDENTIFICATION CODE	AXLE TYPE NON "C" TYPE @	AXLE TYPE "C" TYPE ∞	RATIO AVAILABILITY	TRANS.	ENGINE
F	GX	GY	G		X	3.08*	M35	
	GX	GY	G		X	3.08*	M38	250
	GX	GY	G		X	3.08*	3 Spd. Man.	
	GZ	CA	G		X	2.73*	M35	
	GX	GY	G		X	3.08		
	GZ	CA	G		X	2.73*	M38	350
	GX	GY	G		X	3.08		2 Bbl.
	CK	CJ	G		X	3.42*	3 Spd. Man.	
	CK	CJ	G		X	3.42*	4 Spd. Man.	
	GZ	CA	G		X	2.73*	M40	400
	GX	GY	G		X	3.08		2 Bbl.
	GX	GY	G		X	3.08*	M40	
	CK	CJ	G		X	3.42		
	CK	CJ	G		X	3.42*	3 Spd. Man.	400
	....	CG	G		X	3.73		4 Bbl.
	CK	CJ	G		X	3.42*	4 Spd. Man.	
	....	CG	G		X	3.73		
	CK	CJ	G		X	3.42*	M40	455
	GX	GY	G		X	3.08		4 Bbl.
	CK	CJ	G		X	3.42*	M40	
	GX	GY	G		X	3.08		
	CK	CJ	G		X	3.42*	3 Spd. Man.	455 H.O.
	....	CG	G		X	3.73		4 Bbl.
	CK	CJ	G		X	3.42*	4 Spd. Man.	
	....	CG	G		X	3.73		
X	GR	GS	G		X	3.08	M35	250
	GR	GS	G		X	3.08*	3 Spd. Man.	
	GJ	GK	G		X	2.56	M38	350 2 Bbl.
	GJ	GK	G		X	2.56	M38	
	GR	GS	G		X	3.08	M35	307 2 Bbl.
	GR	GS	G		X	3.08	3 Spd. Man.	

* Standard Axle Ratio
@ Unit Type Axle Shaft Bearing
∞ Direct On Type Axle Shaft Bearing

Fig. F and X Series Axle Usage Chart

VEHICLE SERIES	AXLE MANUFACT. CODE	RING GEAR SIZE	AXLE TYPE "C"	AXLE TYPE NON "C"
A	P	8 1/8"		X
	K	8 7/8"	X	
B	B	8 1/2"		X
	G	8 1/2"	X	
	K	8 1/2"	X	
	M	8 7/8"	X	
	O	8 1/2"		X
	P	8 7/8"	X	
G	P	8 1/8"		X
	K	8 7/8"	X	
F	G	8 1/2"	X	
X	W	8 1/2"	X	

AXLE MANUFACTURER'S USAGE CHART

OIL LEAKS

It is difficult to determine the source of some oil leaks. Even after the point of leakage has been determined, it is hard to tell whether the oil is leaking past the lip of the seal or past the O.D. of the seal. Therefore, it is a good idea to make sure the leak is stopped by using a nonhardening sealing compound around the O.D. of the new seal.

B – Buick
G – Chevrolet
K – GM of Canada
M – GM of Canada
O – Oldsmobile
P – Pontiac
W – Chevrolet (Warren)

AXLE MANUFACTURER'S IDENTIFICATION LETTERS

Fig. Axle Manufacturer's Identification Chart

SPECIFICATIONS

REAR AXLE

Type .... Semi-Floating
Type of Drive .... Modified Hotchkiss
Drive-Final .... Hypoid Gear
Lubricant Capacity
B Series-B and O Coded Axles 68 fl. oz. or 4.25 pints
A or G Series-P Coded Axles .... 48 fl. oz. or 3 pints

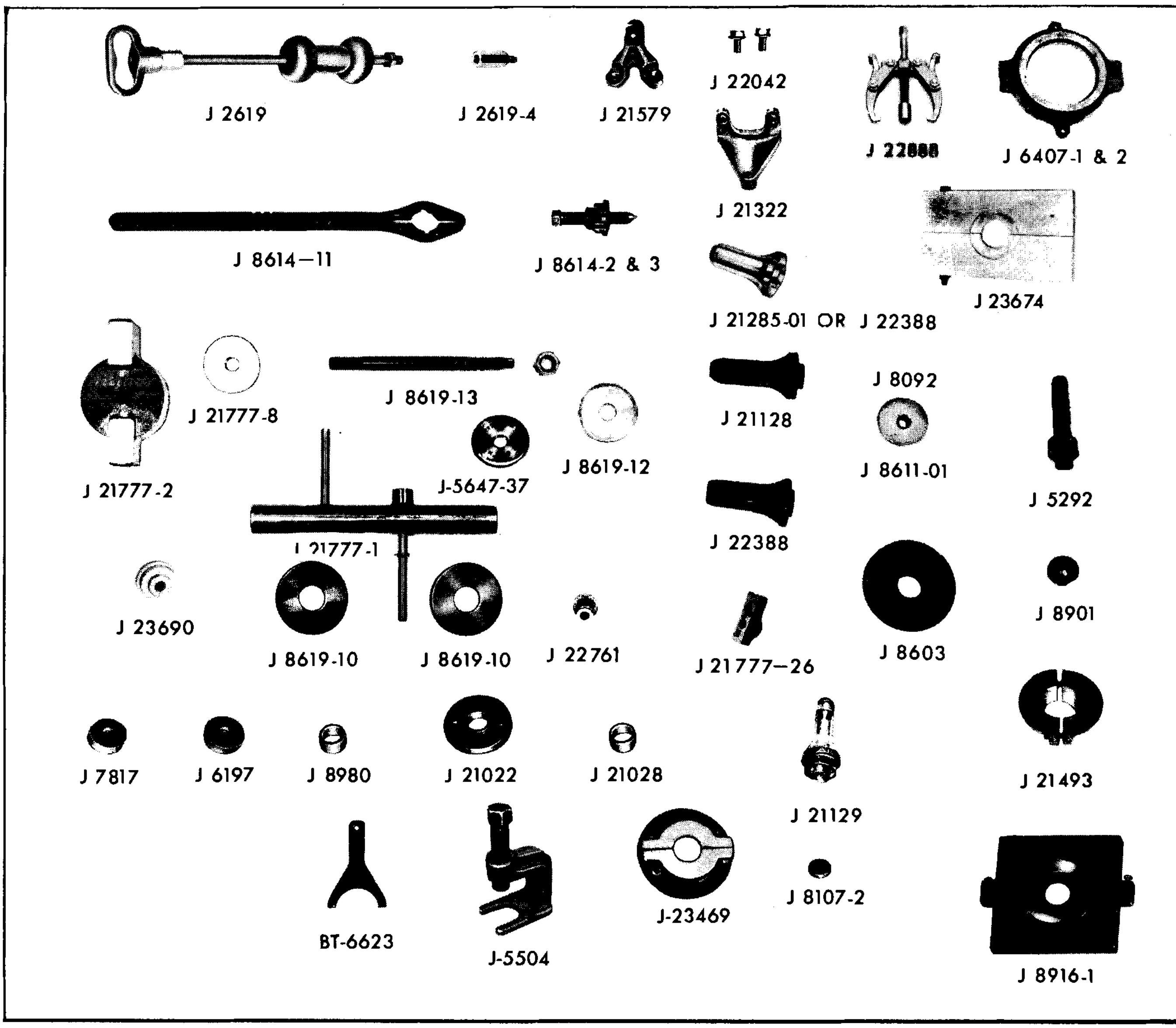
Lubricant .... MPG SAE 80 or 80-90 (GL-5)
Lubricant Level
A, G, F and X Series .... Bottom of Filler Plug Hole
B Series
P and M Coded Axles Filler Plug to 3/4" Below
B, G, K and o Coded Axles Filler Plug to 3/8" Below

RING AND PINION GEAR

Backlash	.005"-009"
Ring gear run-out maximum	.002"
Ratios	See Charts
Pinion Bearing Preload (with Ring Gear)	
New Bearings (New Seal)	25 lb. in.
Old Bearings (New Seal)	17 lb. in.
Side Bearing Preload	Slip Fit Plus .008"

TORQUE SPECIFICATIONS

TORQUE	LB. FT.
Differential Cover to Carrier Bolts	25
Differential Bearing Caps to Carrier Bolts	70
Differential Ring Gear to Case Bolts	90
Differential Pinion Shaft Lock Screw	15
Rear U-Joint Companion Flange Nut with Lock Plates	12
Rear U-Joint Companion Flange Nut with Lockwashers	14
Rear Axle Upper Control Arm Assy. to Axle Housing Bolt	110
Rear Axle Upper Control Arm Assy. to Axle Housing Nut	80
Rear Axle Lower Control Arm Assy. to Axle Housing Bolt	110
Rear Axle Lower Control Arm Assy. to Axle Housing Nut	80
Rear Axle Bumper Spacer to Axle Housing Bracket Bolt and Nut (Station Wagon)-A Series	50
Rear Axle Upper Control Arm Assy. to Frame Bolt	110
Rear Axle Upper Control Arm Assy. to Frame Nut	80
Rear Axle Lower Control Arm Assy. to Frame Bolt	110
Rear Axle Lower Control Arm Assy. to Frame Nut	80
Rear Shock Absorber to Axle Housing Bracket Nut	65
Shock Absorber to Frame Bolt	20
Rear Wheel and Drum to Axle Shaft Nut-	
B Series	75
A, G and F Series	70
X Series	65
Rear Brake Assy. to Axle Hsg. Bolt and Nut	35
Pinion Nose Bumper	8
Differential Case Bolts-G Series Medium Duty	30



J 8608	Rear Pinion Outer Race Installer
J 8609	Rear Pinion Bearing Installer
J 8612	Rear Pinion Bearing Remover
J 8614-10	Companion Flange Holding Tool
J 8614-2 & 3	U-Joint Companion Flange Puller
J 8619-10	Pinion Depth Gauge Discs
J 8619-12	Pilot
J 8619-13	Pinion Depth Gauge Bolt & Nut
J 8901	Side Bearing Support
J 2619	Slide Hammer
J 2619-4	Adapter
J 5292	Side Bearing Installer
J 6197	Rear Pinion Bearing Outer Race Installer
J 6407-1 & 2	Press Plate Holder & Insert
J 7817	Front Pinion Bearing Outer Race Installer
J 8092	Drive Handle (Not Shown)
J 8107	Side Bearing Puller (Not Shown)
J 8916-1	Split Plate

J 8980	Differential Side Bearing Installer
J 9746	Rear Pinion Bearing Remover
J 21022	Axle Shaft Bearing Installer
J 21028	Differential Side Bearing Installer
J 21129	Axle Shaft Oil Seal Installer
J 21285-01	Pinion Oil Seal Installer
J 21322	Case Remover
J 21493	Rear Pinion Bearing Remover
J 21579	Axle Shaft Remover
J 21777	Pinion Depth Gauge
J 21777-1	Cross Shaft Assy.
J 21777-2	Gauge Plate
J 21777-8	Washer
J 21777-26	Gauge Plate
J 22042	Left Hand Bolt and Sleeve Set
J 22388	Pinion Oil Seal Installer
J 23469	Axle Bearing Remover
J 23674	Axle Bearing Remover
J 5504	Wheel Stud Remover
BT-6623	Shim Installer

Fig 4A-44 Special Tools

SECTION 4B

NON TYPE C SAFE-T-TRACK DIFFERENTIAL

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS TESTING

Diagnosis is the same as listed in section 4-A except as follows:

TESTING FOR CORRECT OPERATION

If there is any doubt as to the proper functioning of the standard Safe-T-Track differential, the following simple test should be performed:

1. Place the car on a hoist with engine off and the transmission selector lever in park if automatic, or in low gear if manual.
2. Attempt to turn either wheel.
3. The average man will find it extremely difficult, if not impossible, to manually turn either wheel. This is because one wheel will provide approximately 400 lbs. draw bar pull, with zero traction at the opposite wheel.

GENERAL DESCRIPTION

NOTE: *For description and service of "C" type Safe-T-Track differential, see Section 4D.*

The non type C Safe-T-Track differential is available as optional equipment in all rear axle ratios in 1972 A and G Series and some B Series models ("B" and "O" coded axles) and can be identified by a tag attached to the lower right section of axle cover. The non type C Safe-T-Track differential described in this section may be identified by the last letters in the three letter axle code. See charts in Section 4A.

It is designed to direct the major driving force to the wheel with greater traction, thereby reducing the possibility of the car becoming stuck while driving under adverse conditions. Unlike the conventional differential, when one wheel is on a slippery surface (ice, snow, mud, etc.) the car will retain traction since both wheels are frictionally connected and rotating at the same speed, allowing the wheel on dry surface to provide necessary traction.

Rough roads, crushed stone, railroad tracks, etc. adversely affect rear wheel action, With a conventional differential, when one wheel bounces free of the road, it picks up speed. When this rapidly spinning wheel contacts the road again, it causes shock loads to the suspension and drive train. With the Safe-T-Track differential, the free wheel continues to rotate at the same speed as the wheel on the road, thereby minimizing shock.

The Safe-T-Track differential is also superior to the conventional differential under conditions of deceleration, cornering and braking.

B SERIES (O CODED AXLE)

The Safe-T-Track differential (Fig. 4B-1) is similar to, and interchangeable with, the standard differential case assembly (the ring gear and side bearings are identical) provided they have the same last letter in the three letter axle code.

The case is of one piece design and houses the conventional side gears, pinion gears, thrust washers and pinion shaft. In addition, it retains four removable case hardened steel guides which, in turn, house a nine piece clutch pack behind each side gear. Five discs are retained with tabs in the guides and thus to the case. The remaining four alternate discs are splined to the side gear which, in turn, is splined to the axle shaft. Between the side gears is a two piece thrust block which houses two calibrated preload springs that apply a force on the side gears and thus to each clutch pack. Some units also have one or more shims behind the clutch pack to obtain the proper backlash between the differential gears. The shims are available in sizes .005", .007", and .010".

A AND G SERIES (P CODED AXLE)

There are two types of Safe-T-Track differentials in addition to the "C" type (Section 4D): a medium duty, and a heavy duty. A Series uses the heavy duty four pinion coded XH. G Series uses the medium duty four pinion coded BE or BF. The medium duty Safe-T-Track differential has four pinion gears and a gray iron carrier. Cold extruded axle shafts are used with the medium duty Safe-T-Track. The heavy duty Safe-T-Track also has four pinion gears but the carrier is nodular iron. The heavy duty axle shafts are hot forged.

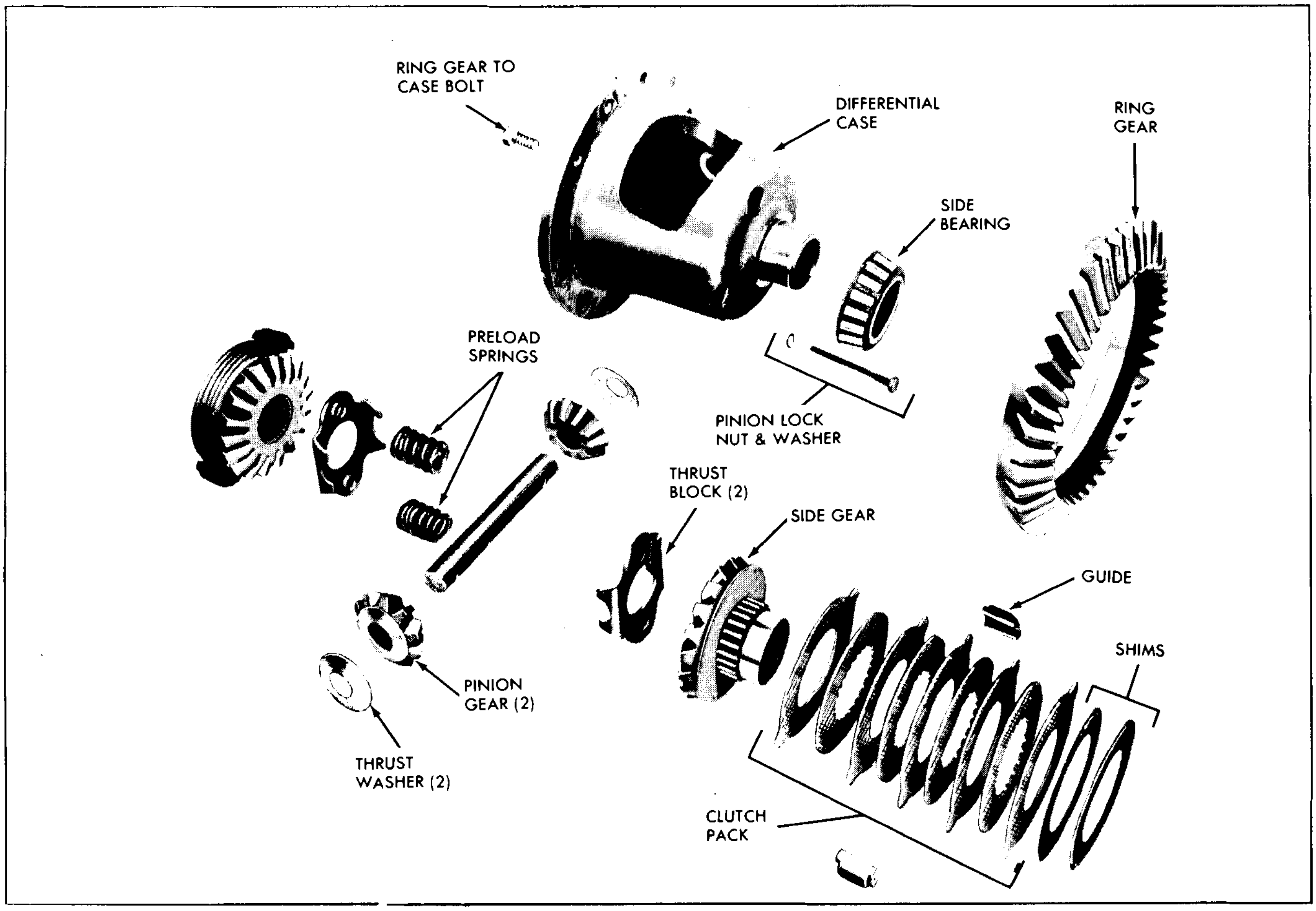


Fig. 4B-1 Exploded View of Safe-T-Track - B Series - "O" Axle

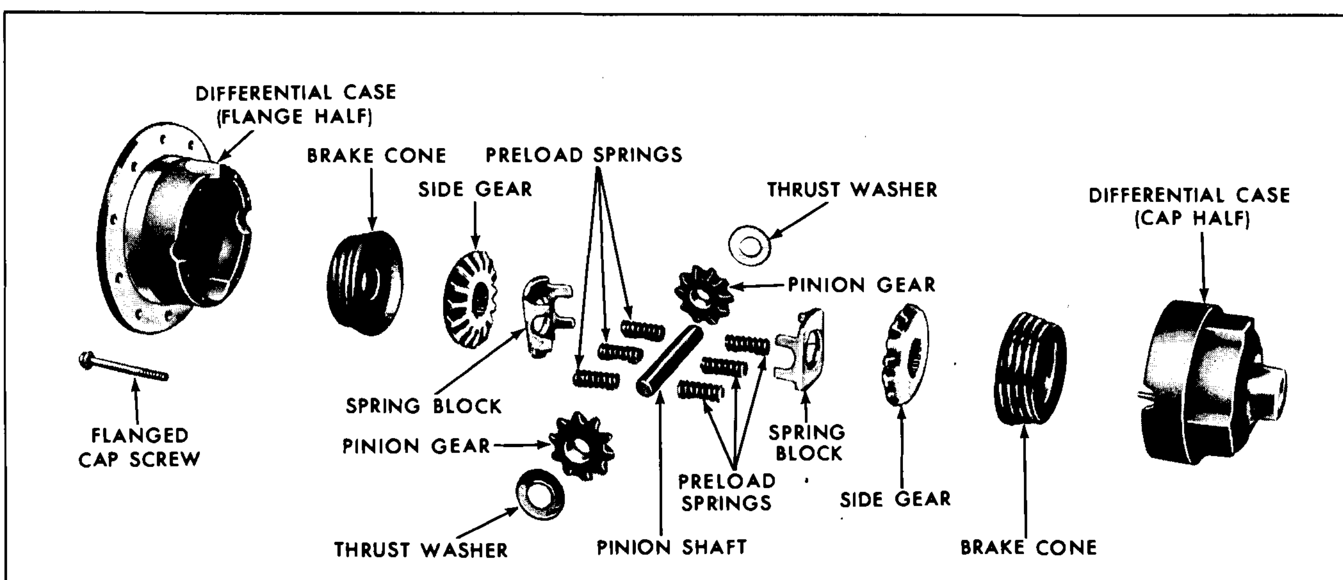


Fig. 4B-2 Exploded View of Two Pinion Safe-T-Track - A and G Series - "P" Axle

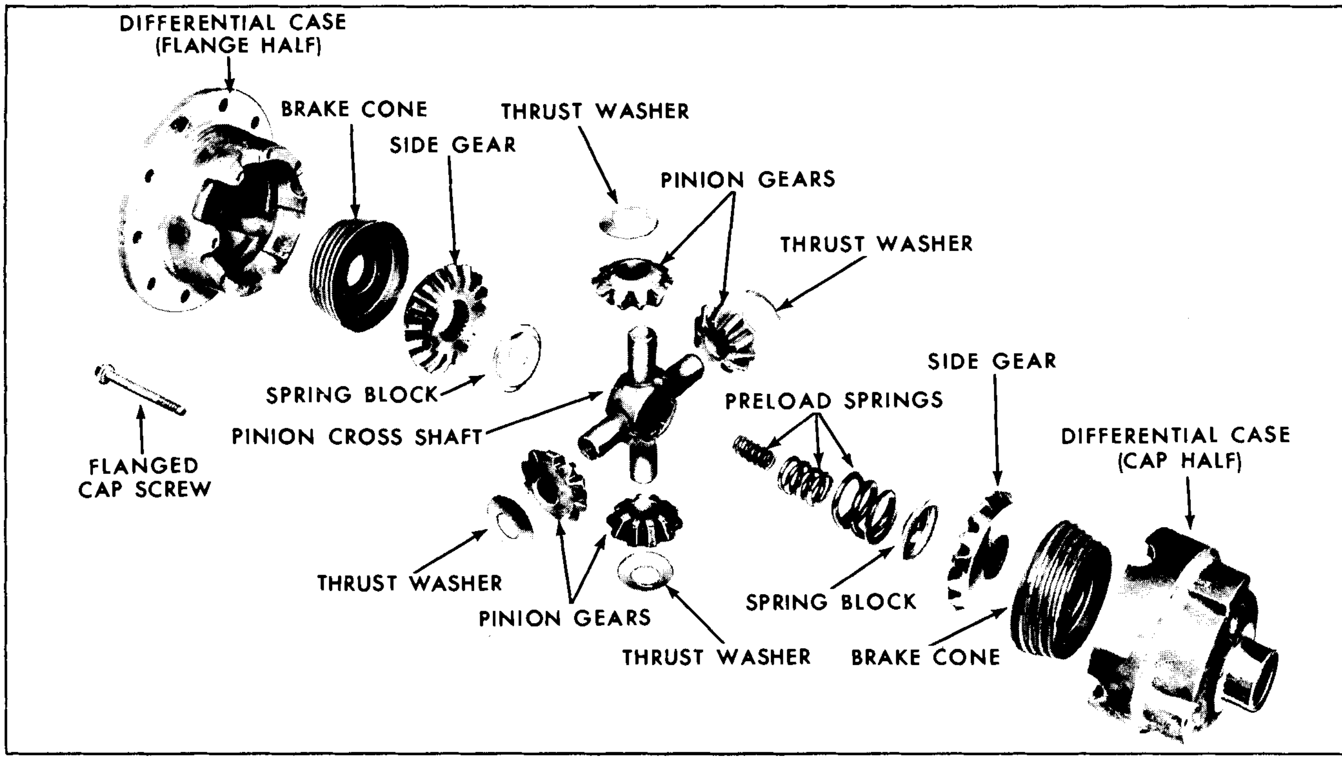


Fig. 4B-3 Exploded View of Four Pinion Safe-T-Track - A and G Series - "P" Axle

IMPORTANT: *Due to the material or manufacturing differences in the medium duty and heavy duty axle parts, they should NEVER be interchanged.*

A AND G SERIES (P AND K CODED AXLES) AND B SERIES (B CODED AXLE)

With the exception of the "C" type axle, all rear axle parts of cars equipped with the Safe- T-Track two pinion differential (Fig. 4B-2) or the Safe-T-Track four pinion differential (Fig. 4B-3) are interchangeable with those equipped with the conventional differential, which have the same last letter in the three letter axle code, **except** for the case assembly and as noted above. It is similar in all respects to the conventional case assembly, with the addition of brake cone behind each side gear. The frictional surface of these cones consists of a coarse spiral thread that provides passages for flow of lubricant. The cones are statically preloaded with springs (against the cone cavities in each half of the case assembly) to provide an internal resistance to differential action under low tractive conditions at one rear wheel.

The case assembly is held together with eight bolts. In addition to the above parts, it also houses the differential pinion shaft, pinion gears, thrust washers and the two piece spring thurst block (two pinion differential) or two spring thrust plates (four pinion differential).

OPERATION

ALL SERIES

The Safe-T-Track differential operates in reverse and deceleration, as well as all forward speeds. Torque is applied by the drive pinion to the ring gear, which is bolted to the case assembly, thereby causing it to rotate. The preload force from the springs, plus the inherent separating force between the pinion gears and side gears as the case rotates, forces the side gears against their respective clutch pack or cone. Since each disc is alternately attached to the case and side gear, which is splined to the axle shaft, each shaft is frictionally connected to the case so the shafts, in effect, are locked together and rotate at the same speed.

When turning corners, the axles are automatically unlocked as torque created by differential action overcomes the frictional forces between the clutch discs or cones, allowing them to turn with respect to each other.

When the rear wheels are under conditions of extremely unbalanced traction, such as one wheel on dry pavement and the other on ice, wheel spin may occur if over-acceleration is attempted. However, even when wheel spin does occur, the major driving force is directed to the non-spinning wheel.

NOTE: *Continued spinning may cause a whirring sound due to the overrunning brake cones (A & G Series, "P" coded axles and B Series, "B" coded axles) lacking sufficient lubricant. Such a condition or sound does not indicate failure of the unit.*

LUBRICATION

The differential should be checked for leaks every 6000 miles. No periodic lubricant change is recommended. However, if necessary to add lubricant, use only specially formulated lubricant for Safe-T-Track differentials - GM Part Number 1051022 or equivalent.

CAUTION: *Never use any other lubricant in a Safe-T-Track differential or a severe chatter may result, especially when turning corners.*

If the wrong lubricant is added, drain it from housing and flush with special lubricant, and refill the unit. It may be necessary to drive the car several miles to allow the lubricant to work through the clutches and eliminate the chatter. If chatter persists, drain and refill again to eliminate contamination. It may require 2 or 3 flushings to correct. An alternate procedure is disassembly and cleaning with solvent.

SERVICE PROCEDURES

NOTE: *Service procedures for the two and four pinion cone type differential case used in A and G Series models is presented for information only or in the event that cleaning of component parts should be necessary. The case assembly of the cone type differential is a non-serviceable item and must be replaced as a unit.*

All rear axle service procedures are the same for the Safe-T-Track as for the conventional differential, provided they have the same last letter in the three letter axle code, except for servicing the case assembly.

WARNING: TWO PRECAUTIONS MUST BE OBSERVED WHEN WORKING ON ALL CARS WITH SAFE-T-TRACK DIFFERENTIALS:

1. NEVER raise one wheel and run the engine with the transmission in gear. The driving force to the wheel on the floor will cause the car to move.
2. Do not use "on the car" type wheel balancers on the rear wheels, unless BOTH wheels are off the floor. See Section 10.

MAJOR REPAIRS

DIFFERENTIAL CASE

DISASSEMBLE - B SERIES (O CODED AXLE)

NOTE: *Keep side bearing outer races with side bearings, so these matched parts can be correctly replaced during build-up.*

1. Before disassembling differential case, inspect differential side bearings for visible damage of rollers and outer races.
2. Place one outer race onto its matched inner race and roller assembly and turn slowly, applying hand load.
3. If bearing outer race turns smoothly and no visible damage is found, bearing can probably be reused.
4. Repeat above operations with other outer race and matched bearing and check for smoothness.

NOTE: *Both side bearings and their races are matching parts. If either bearing is to be replaced, its matching outer race must also be replaced.*

5. Inspect fit of inner races on case hubs by prying against shoulders at puller recesses. Bearing inner races must be tight on case hubs.

NOTE: *If either is loose on case, the entire case must be replaced.*

CAUTION: *When removing side bearings make certain ends of puller arms are firmly seated in recesses in sides of hubs and fully against inner race of bearing.*

6. If bearing inspection indicates that bearings should be replaced, insert differential case in vise and, using side bearing puller J 8107 remove side bearing (Fig. 4B-4).
7. Turn differential case in vise and remove other side bearing in same manner.

NOTE: *Ring gear to case bolts have left hand threads.*

8. If removing ring gear, clamp case in vise so jaws are 90° to pinion shaft holes and remove ring gear retaining bolts.

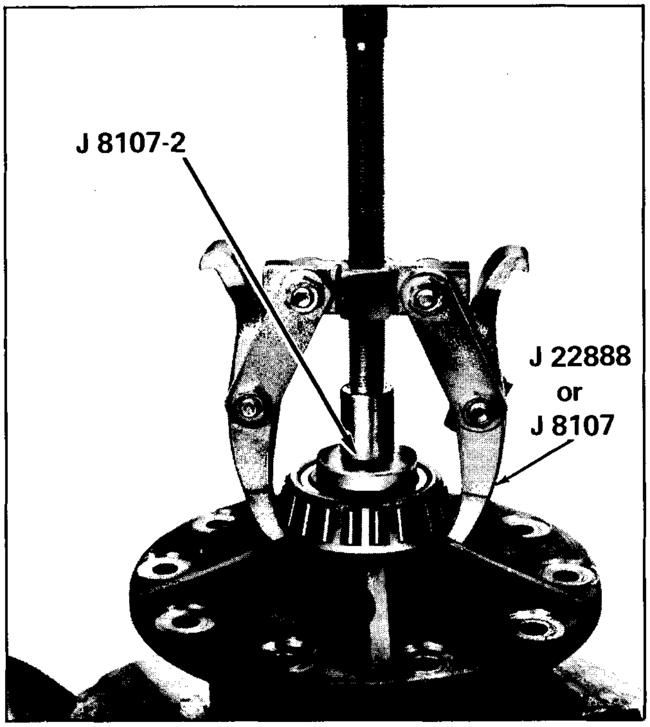


Fig. 4B-4 Removing Differential Side Bearing

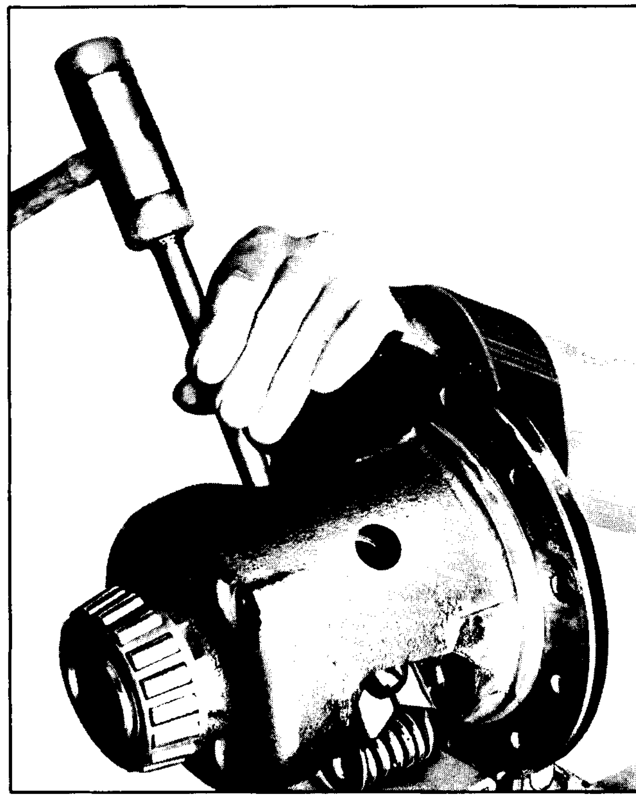


Fig. 4B-5 Removing Preload Springs and Retainer - B Series - "O" Axle

9. Partially install two bolts on opposite sides of ring gear.

10. Remove ring gear from case by alternately tapping on bolts.

CAUTION: *Do not pry between case and ring gear.*

11. Remove pinion shaft lock screw and washer and tap out pinion shaft from case.

12. Remove preload spring retainer and springs from case (Fig. 4B-5).

13. Rotate side gears until pinions are in open area of case. Remove pinions and thrust washers.

14. Remove a side gear, clutch pack and shims from case. Note location in case to aid in reassembly. Remove side gear clutch pack and shims from opposite side.

NOTE: *If a side gear of clutch pack cannot be readily removed from case, drive out with brass drift (Fig. 4B-6).*

15. Remove clutch plate guides and separate shims and clutch plates from side gears.

NOTE: *Keep clutch plates in their original location in clutch pack.*

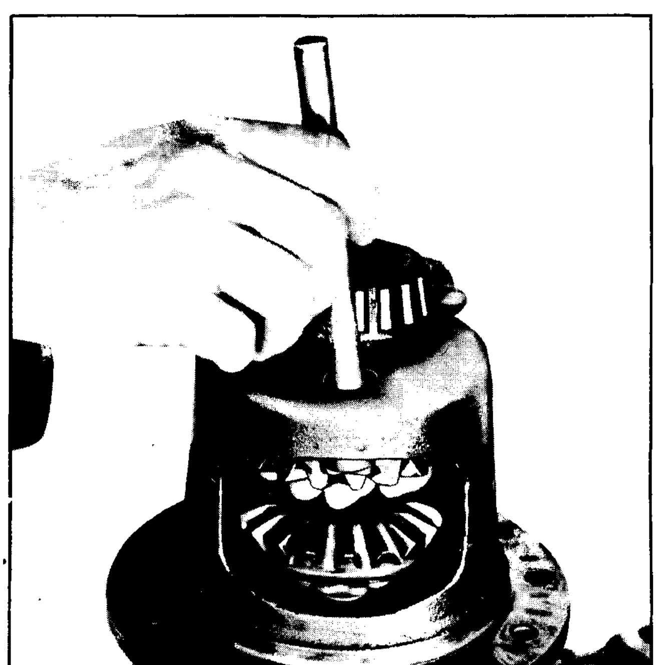


Fig. 4B-6 Driving Out Clutch Pack - B Series - "O" Axle

A AND B SERIES (2 pinion or 4 pinion) AND G SERIES (4 pinion)

1. Before disassembling differential case, inspect differential side bearings for visible damage of rollers and outer races.
2. Place one outer race onto its matched inner race and roller assembly and turn slowly, applying hand load.
3. If bearing outer race turns smoothly and no visible damage is found, bearing can be reused.
4. Repeat above operation with other race and matched bearing and check for smoothness.

   NOTE: *Both side bearings and their outer races are matched parts. If either bearing is to be replaced, its matching outer race must also be replaced.*

5. Inspect fit of inner races on case hubs by prying against shoulders at puller recesses. Bearing inner races must be tight on case hubs. If either bearing is loose on case, entire case must be replaced.
6. If bearing inspection indicates that bearings should be replaced, remove side bearings by using side bearing puller J 8107 (two pinion) or J 22888 (four pinion) and adapter J 8107-2 (Fig. 4B-4).

   CAUTION: *Make certain that ends of puller arms are fully against inner race of bearing.*

7. Turn differential case in vise and remove other side bearing in same manner.

   CAUTION: *Ring gear to case bolts have left hand threads.*

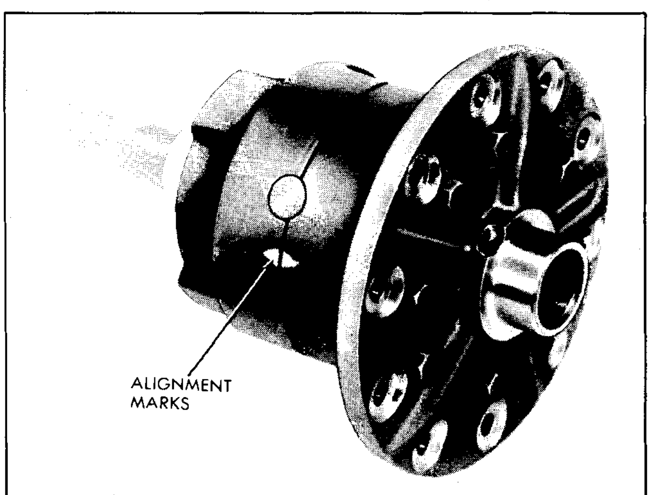


Fig. 4B-7 Paint on Alignment Marks Before Disassembly

8. If removing ring gear, clamp case in vise so jaws are 90° to pinion shaft holes and remove ten ring gear retaining bolts.
9. Partially install two bolts on opposite sides of ring gear.
10. Remove ring gear from case by alternately tapping on bolts.

    CAUTION: *Do not pry between case and ring gear.*

11. Scribe mark or paint differential case halves (Fig. 4B-7) to aid in alignment of case when assembling.
12. Remove differential case half attaching bolts.

    NOTE: *Shims are used in some units between the side gear and cone to maintain proper backlash between pinion gears and side gears. Keep these parts with cap half of case assembly after disassembly.*

13. Lift cap half of case from flange half. Remove clutch cone, side gear, spring block, preload springs and shims, if provided.
14. Remove corresponding parts from flange half of case and keep them with flange half of case assembly.

CLEANING AND INSPECTION OF CASE - B SERIES (O CODED AXLE)

1. Thoroughly clean differential case and inspect, paying particular attention to ring gear mounting flange, ring gear pilot and side bearing hubs.
2. Remove nicks and burrs with mill file.

   NOTE: *If using new case, thoroughly clean case in suitable solvent, making certain bolt holes and bolts are clean of steel filing and foreign material.*

3. Clean side gears, pinion gears and thrust washers with suitable solvent and inspect for excessive wear.
4. Clean side bearings thoroughly in clean solvent (do not use a brush). Examine bearings visually and by feel. Bearings should feel smooth when oiled and rotated, while applying as much hand pressure as possible. Minute scratches and pits that appear on rollers and races at low mileage are due to the initial preload. Bearings having these marks should not be rejected.
5. Thoroughly clean ring gear and inspect back side for any adhering material which may cause runout.

6. Examine ring gear and drive pinion teeth for nicks, burrs or scoring. Any of these conditions will require replacement of gear set.

7. Position ring gear on case and check fit of gear on flange and pilot. It should be .002" tight to .001" loose. If ring gear easily falls into position, it must be replaced.

   NOTE: *If ring gear is replaced, pinion gear must also be replaced as they are only serviced in matched sets.*

8. Check press fit of side bearing inner race on differential case. Side bearings must be a tight press fit on hub.

9. Inspect clutch plates for scored, worn, cracked or a distorted condition. If any of these conditions exist, new clutch plates must be installed.

10. Replace parts as necessary and coat with clean engine oil before installing in case.

A AND B SERIES (2 pinion or 4 pinion) AND G SERIES (4 pinion)

1. Make certain all parts are absolutely clean and dry.

2. Inspect pinion shaft, pinion and side gears, brake cone surfaces and corresponding cone seats in case.

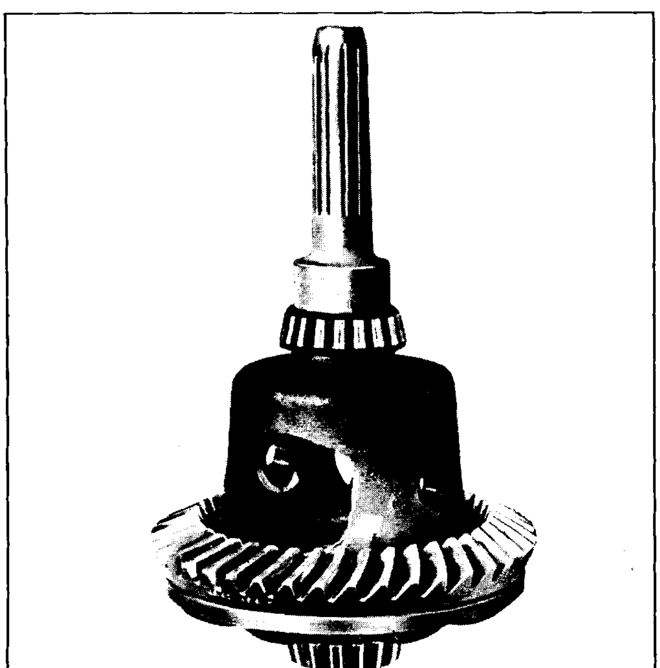


Fig. 4B-8 Installing Differential Side Bearing

The cone seats in case should be smooth and free of any excessive scoring. Slight grooves or scratches, indicating passage of foreign material, are permissible and normal. The land surface on the heavy spirals of male cones will duplicate case surface condition. Replace any parts which are excessively scored, pitted or worn. Both halves of case must be replaced if one half is damaged or worn.

DIFFERENTIAL CASE - ASSEMBLE - B SERIES (O CODED AXLE)

1. After making sure that matching surfaces are clean and free of burrs, position ring gear on case so holes are in line.

2. Lubricate attaching bolts with clean engine oil and install.

   CAUTION: *Do not use hammer to force ring gear on case.*

3. Pull ring gear onto case by alternately tightening bolts around case. When all bolts are snug, tighten bolts evenly and alternately across diameter to 90 lb. ft. torque.

4. If side bearings were removed, lubricate the bearings and install on case hubs, as shown in Fig. 4B-8, using tool J 22761.

5. Apply special lubricant to the clutch plates.

6. Assemble the clutch packs as follows:

   a. Alternately position nine clutch plates on the side gear, starting and ending with a clutch plate having external lugs.

   b. Install the two clutch guides over the clutch plate lugs.

   c. Install the same shims which were removed, or an equal amount, on the clutch plate.

   d. Repeat steps a, b, and c on the other clutch pack.

7. Check the pinion to side gear clearance as follows:

   a. Install one side gear with clutch pack and shims in the case.

   b. Position the two pinion gears and thrust washers on the side gear and install the pinion shaft.

   c. Compress the clutch pack by inserting a screwdriver or wedge between the side gear and the pinion shaft.

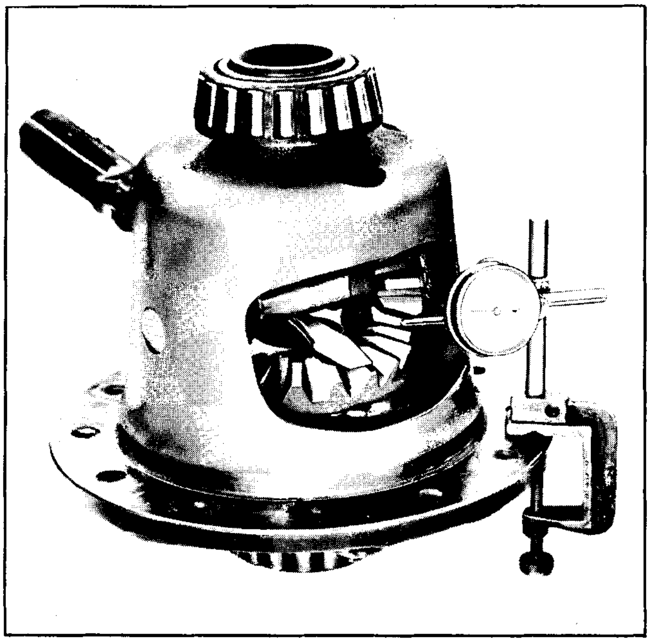


Fig. 4B-9 Checking Pinion Gear to Side Gear Clearance - B Series - "O" Axle

d. Install dial indicator with the contact button against the pinion gear (Fig. 4B-9).

e. Rotate pinion gear. Clearance should be .001" to .006". Add or subtract necessary shims to reach this figure.

f. Remove side gear and repeat procedure with opposite clutch pack on the side of case.

8. Remove pinion shaft, pinions and thrust washers.

9. Install remaining side gear and clutch pack with correct shims in case.

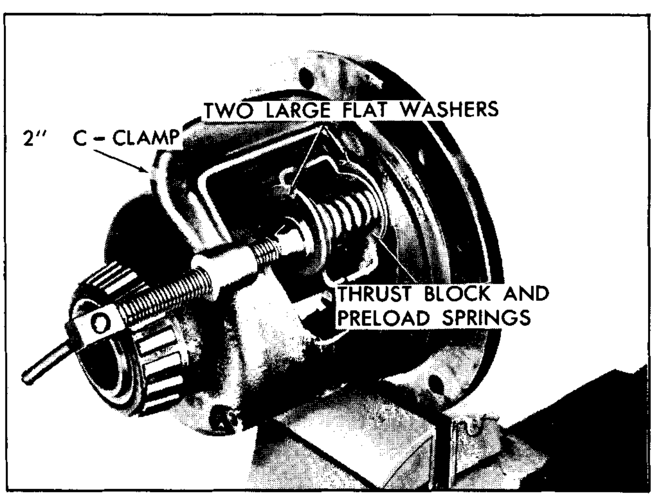


Fig. 4B-10 Compressing Pre-load Springs - B Series - "O" Axle

10. Place pinion gears on side gears and rotate into correct position.

11. Compress the preload springs with a 2" C clamp, as shown in Fig. 4B-10, and drive the preload retainer and springs between side gears.

12. Insert thrust washers behind pinion gears.

13. Install pinion shaft and retain with lock screw.

14. Check side gear splined hole to be certain it is in line with hole in the preload spring retainer. The spring retainer can be moved slightly to correct misalignment.

A AND G SERIES (P CODED AXLES)

The following procedure is to be used in assembling both the two pinion differential and the four pinion differential. Slight differences are noted in steps 4 and 5.

CAUTION: *When assembling unit, use axle shafts as mounting tools to assure proper gear and cone spline alignment. Do not ignore this procedure or it will be impossible to install shafts at final assembly. Attempting to force shafts into position may result in damage to spring thrust blocks.*

1. Clamp one axle shaft in vise, allowing three inches to extend above vise jaws. Then place cap half of differential case over extended axle shaft, with interior of case facing up (Fig. 4B-11).

NOTE: *Be certain that each cone is installed in proper case half, since tapers and surfaces become matched and their positions should not be changed.*

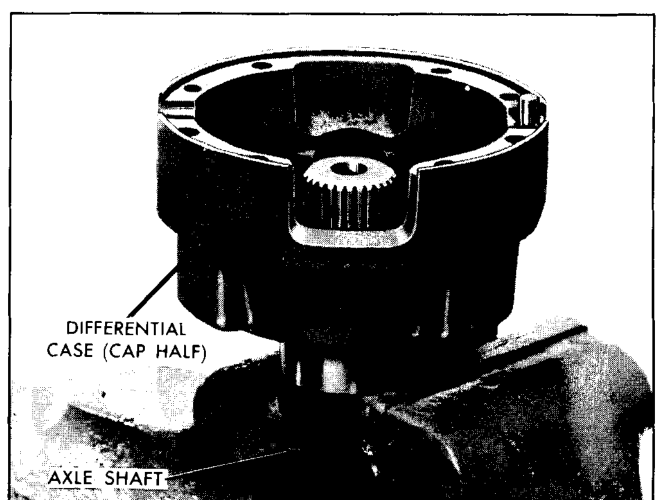


Fig. 4B-11 Axle Shaft and Cap Half of Case - Two or Four Pinion

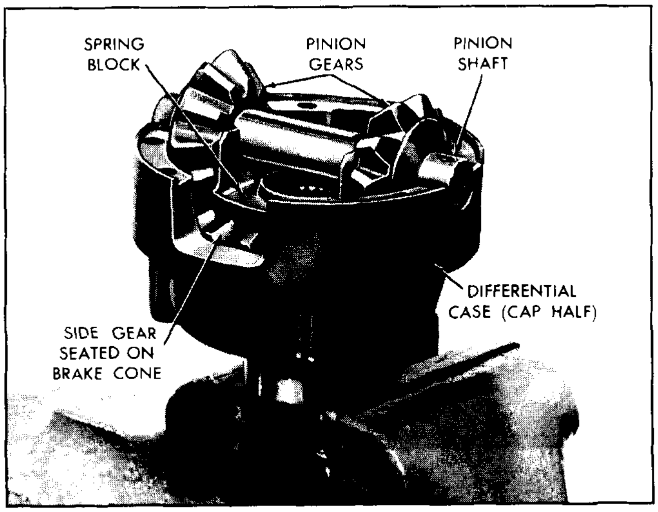


Fig. 4B-12 Installing Parts in Cap Half - Two Pinion

2. Install proper cone over axle shaft splines, seating it into position in cap half of case.

3. If unit was originally assembled with shims located between side gears and cones for backlash adjustment, reinstall side gear with shim so that gear may seat on shim. If unit was originally assembled without shims, reassemble same way.

4. (2 pinion) Place one spring block in position over gear face, in alignment with pinion gear shaft grooves. Install pinion shaft, pinion gears and thrust washers into cap half of differential case in such a manner that pinion shaft retaining dowel can be inserted through pinion gear shaft into differential case. This prevents pinion shaft from sliding out and causing damage to carrier (Fig. 4B-12).

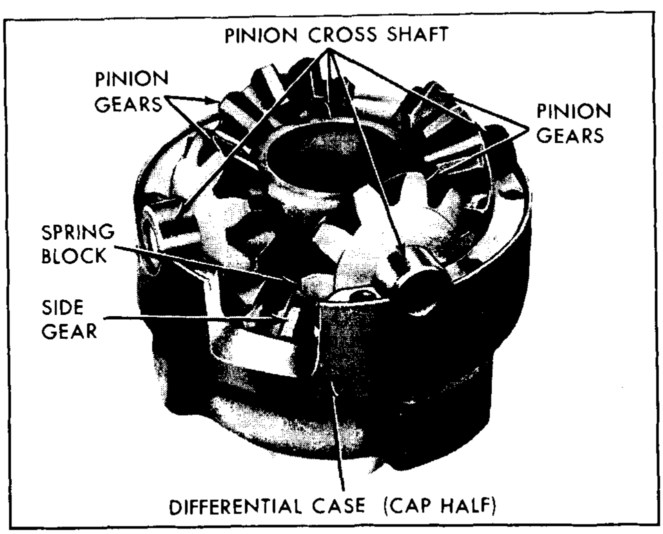


Fig. 4B-13 Installing Parts in Cap Half - Four Pinion

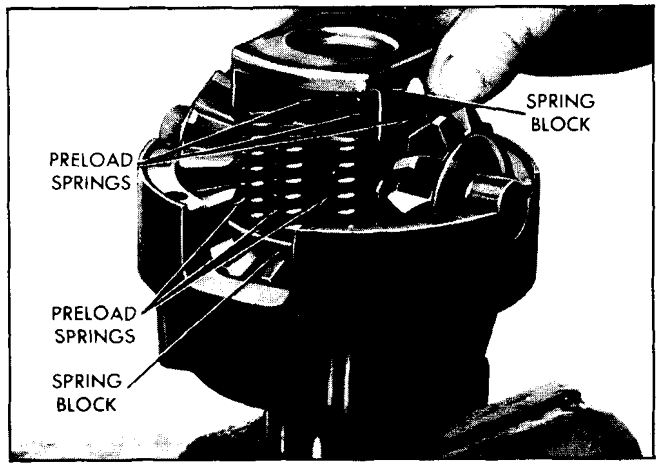


Fig. 4B-14 Installing Second Spring Block - Two Pinion

(4 pinion) Place one spring block in central position over gear face. Assemble the four pinions and four thrust washers onto the pinion cross shaft and place in position in the cap half of the differential case (Fig. 4B-13).

5. (2 pinion) Insert six springs into spring block that is already installed into case, then place second spring block over springs. Note offset construction of spring block tabs (Fig. 4B-14).

   (4 pinion) Insert three springs through center of pinion cross shaft onto spring block that is already installed into case, then place second spring block on top of springs (Fig. 4B-15).

6. Install second side gear, face down on spring block so that side gear will mesh with pinion gears.

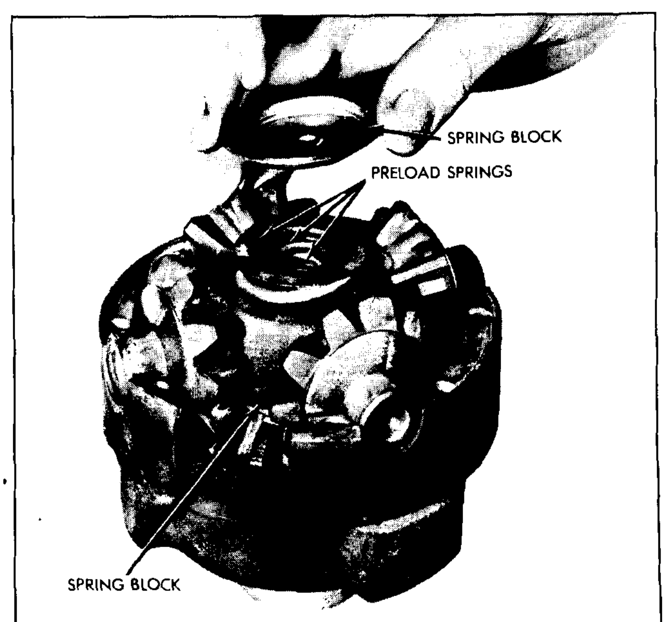


Fig. 4B-15 Installing Second Spring Block - Four Pinion

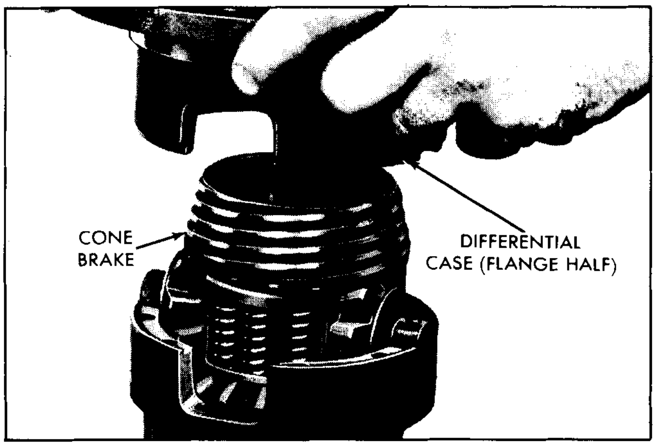


Fig. 4B-16 Installing Flange Half of Differential Case - Two or Four Pinion

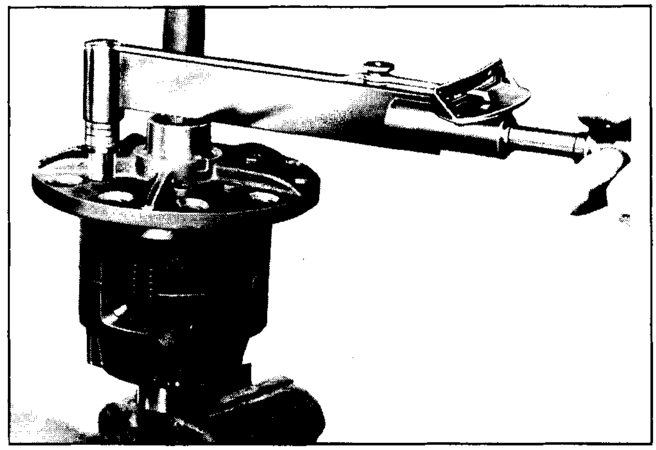


Fig. 4B-17 Torquing Case Half Bolts - Two or Four Pinion

7. Place shim, if provided, and remaining cone over side gear.

8. Install flange half of differential case over cone, in proper position to match alignment marks; insert two case half bolts finger tight, 180° apart (Fig. 4B-16).

9. Install other axle shaft through flange half of differential case, rotating axle to enter cone splines and then side gear splines. Leaving the axle shaft in this position, insert remaining bolts and tighten to 30 lb. ft. (Fig. 4B-17).

10. Remove axle shafts (A slight tapping on the shafts with a soft hammer may be necessary to align the splines during assembly. The shafts can then be readily reinstalled without spline interference during final assembly).

11. If side bearings were removed, lubricate outer bearing surfaces and press on bearings as described in Section 4-A.

12. After making sure that matching surfaces are clean and free of burrs, position ring gear on case so holes are in line.

13. Lubricate attaching bolts with clean engine oil and install.

    CAUTION: *Do not use hammer to force ring gear on case. Ring gear to case bolts have left-hand threads.*

14. Pull ring gear onto case by alternately tightening bolts around case. When all bolts are snug, tighten bolts evenly and alternately across diameter to 90 lb. ft. torque.

15. Install unit into axle carrier following instructions given for Standard Differential.

SPECIFICATIONS

REAR AXLE

Type .... Semi-Floating
Type of Drive .... Modified Hotchkiss
Drive-Final .... Hypoid Gear
Lubricant Capacity
  P-M Coded Axles .... 88 fl. oz. or 5 1/2 Pints
  B, O, G and K Coded Axles 68 fl. oz. or 4 1/4 Pints
  W Coded Axles .... 75 fl. oz. or 4.4 Pints
Lubricant.. GM Part Number 1051022 or equivalent
Lubricant Level
  Bottom of Filler Plug Hole for A and G Series.
  B Series - P.M. Coded Axles - Bottom of Filler Plug to 3/4" below
  B, G, K and O Coded Axles Flush to 3/8" Below Filler Plug.

RING GEAR AND PINION

Backlash .... .005"-.009"
Ring gear run-out maximum .... .002"
Ratios .... See Ratio Chart
Pinion Bearing Preload (with Ring Gear)
  New Bearings (New Seal) .... 25 lb. in.
  Old Bearings (New Seal) .... 17 lb. in.
Side Bearing Preload .... Slip Fit Plus .008"

TORQUE SPECIFICATIONS

TORQUE	LB. FT.
Differential Cover to Carrier Bolts	25
Differential Bearing Caps to Carrier Bolts	70
Differential Ring Gear to Case Bolts	90
Differential Pinion Shaft Lock Screw	15
Rear U-Joint Companion Flange Nut with Lock Plates	12
Rear U-Joint Companion Flange Nut with Lockwashers	14
Rear Axle Upper Control Arm Assy. to Axle Housing Bolt-A, B or G Series	110
Rear Axle Upper Control Arm Assy. to Axle Housing Nut	80
Rear Axle Lower Control Arm Assy. to Axle Housing Bolt	110
Rear Axle Lower Control Arm Assy. to Axle Housing Nut	80
Rear Axle Bumper Spacer to Axle Housing Bracket Bolt and Nut (Station Wagon)- A Series	50
Rear Axle Upper Control Arm Assy. to Frame Bolt	110
Rear Axle Upper Control Arm Assy. to Frame Nut	80
Rear Axle Lower Control Arm Assy to Frame Bolt	110
Rear Axle Lower Control Arm Assy. to Frame Nut	80
Rear Shock Absorber to Axle Housing Bracket Nut	65
Shock Absorber to Frame Bolt	20
Rear Wheel and Drum to Axle Shaft Nut- B Series	75
A, G and F Series	70
X Series	65
Rear Brake Assy. to Axle Housing Bolt and Nut	8
Pinion Nose Bumper	8
Differential Case Bolts (Safe-T-Track)- A or G Series	30

SPECIAL TOOLS

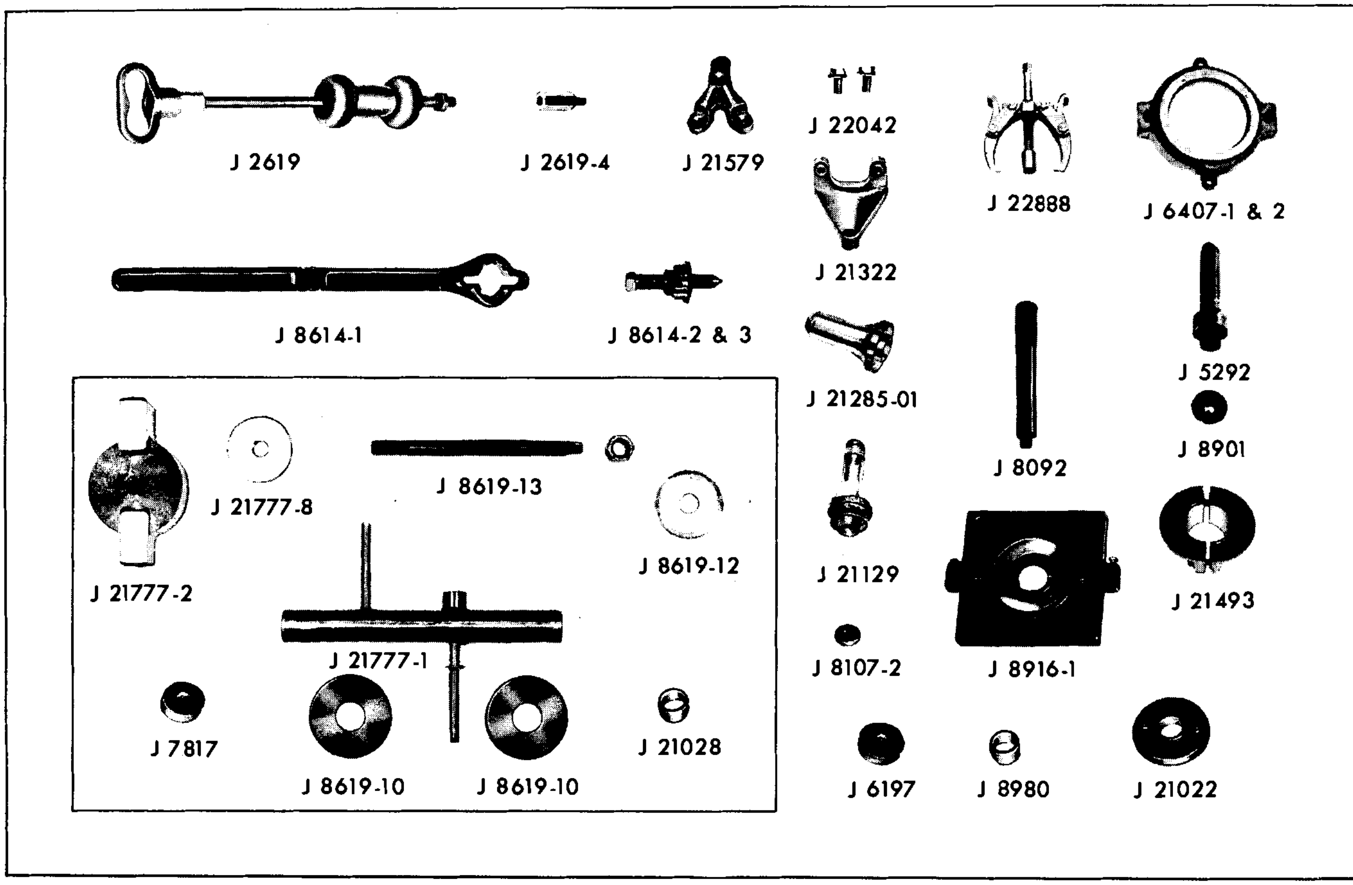


Fig. 4B-18 Special Tools

J 8608	Rear Pinion Outer Race Installer
J 8609	Rear Pinion Bearing Installer
J 8612	Rear Pinion Bearing Remover
J 8614-10	Companion Flange Holding Tool
J 8614-2 & 3	U-Joint Companion Flange Puller
J 8619-10	Pinion Depth Gauge Discs
J 8619-12	Pilot
J 8619-13	Pinion Depth Gauge Bolt & Nut
J 8901	Side Bearing Support
J 2619	Slide Hammer
J 2619-4	Adapter
J 5292	Side Bearing Installer
J 6197	Rear Pinion Bearing Outer Race Installer
J 6407-1 & 2	Press Plate Holder & Insert
J 7817	Front Pinion Bearing Outer Race Installer
J 8092	Drive Handle
J 8107	Side Bearing Puller (Not Shown)
J 8916-1	Split Plate
J 8980	Differential Side Bearing Installer
J 9746	Rear Pinion Bearing Remover
J 21022	Axle Shaft Bearing Installer
J 21028	Differential Side Bearing Installer
J 21129	Axle Shaft Oil Seal Installer
J 21285-01	Pinion Oil Seal Installer
J 21322	Case Remover
J 21493	Rear Pinion Bearing Remover
J 21579	Axle Shaft Remover
J 21777	Pinion Depth Gauge
J 21777-1	Cross Shaft Assy.
J 21777-2	Gauge Plate
J 21777-8	Washer
J 21777-26	Gauge Plate
J 22042	Left Hand Bolt and Sleeve Set
J 22388	Pinion Oil Seal Installer
J 22888	Side Bearing Puller (Four Pinion Differential)
J 23469	Axle Bearing Remover
J 23674	Axle Bearing Remover
J 5504	Wheel Stud Remover
BT-6623	Shim Installer

SECTION 4C

TYPE C STANDARD DIFFERENTIAL

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

TROUBLE DIAGNOSIS AND TESTING

Trouble diagnosis and testing for the "C" type axle is the same as described in Section 4A.

GENERAL DESCRIPTION

The type "C" is a semi-floating differential designed for an open driveline and either leaf or coil springs. Its design is similar but not identical to the standard differentials described in Section 4A and 4B (Fig. 4C-1). The rear axle wheel bearings consist of an outer race, 15 rollers and two snap rings which retain the cage and rollers in the outer race. The outer race and roller assembly is press fit in the outer end of the rear axle tube at a predetermined depth and is followed by the axle shaft seal. The axle shaft inner splines engage the differential side gears with a floating fit. The shaft has two machined and polished surfaces near the flange end. One of these surfaces is a mating or sealing surface for the axle seal and the other surface is the inner race for the direct-on rear axle bearing. The axle shafts are retained in the differential assembly by means of "C" locks that are positioned in circular grooves machined near the inner end of the axle shafts. When the axle shafts and "C" locks are properly installed, the outer portion of the "C" lock will be positioned in a machined recess in the side gear which prevents removal of the "C" lock and the axle shaft. The pinion shaft, when installed, prevents the axle shaft from moving inward to release the "C" lock. Pinion depth and backlash are calculated in a similar manner to the standard differential. A different type collapsible spacer is used. The spacer is longer and bears against the inner races of both the front and rear pinion bearings.

The car weight is carried on the axle shafts through the roller bearings enclosed in the outer axle housing tubes. Drive from the differential housing is transmitted to the frame members through two upper and two lower control arms which are designed to absorb vibration and noise. The upper control arms are angle mounted to hold the

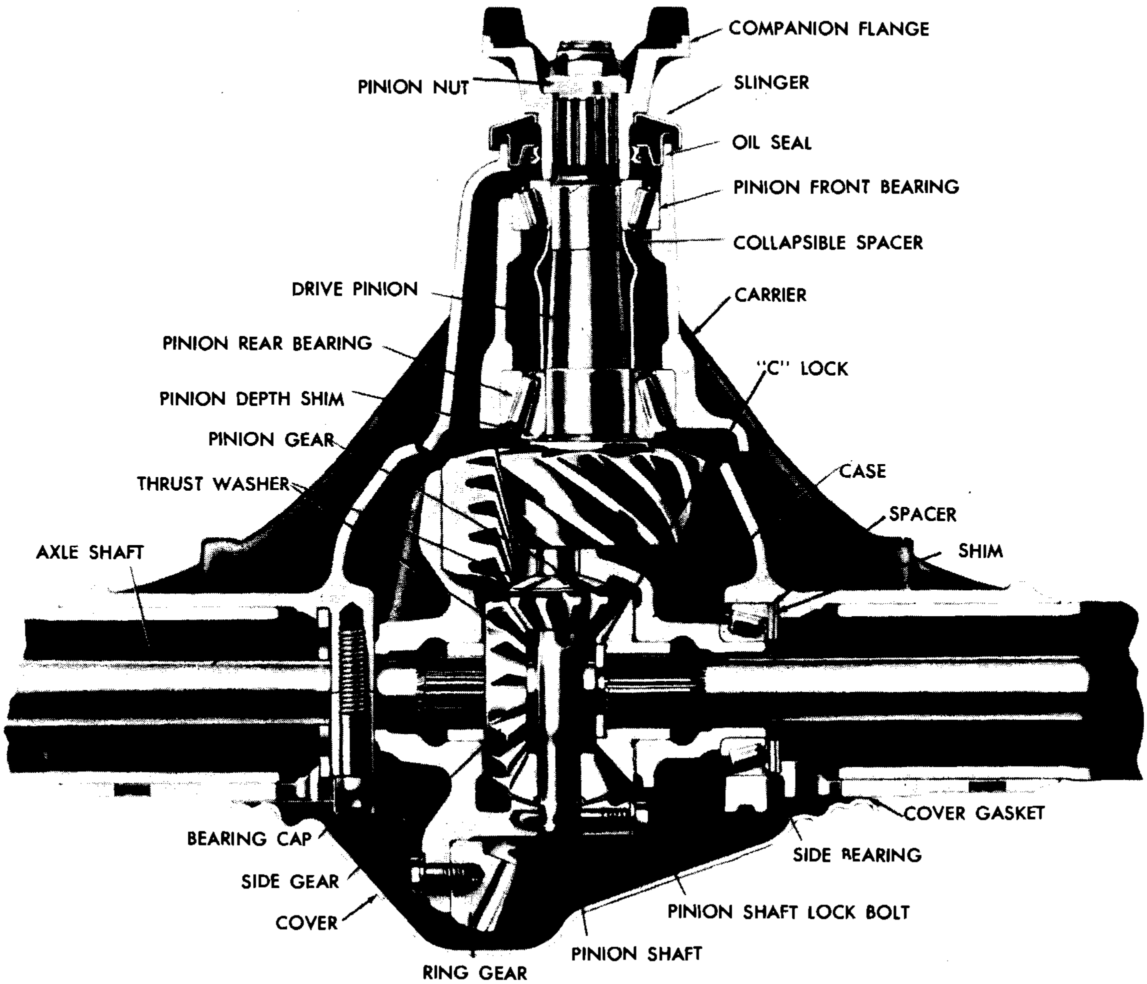


Fig. 4C-1 "C" Differential Cross Section

frame in sidewise alignment with the differential assembly.

The final drive has a ring gear and pinion with the centerline of the pinion below the centerline of the ring gear (hypoid type).

The drive pinion is mounted in two tapered roller bearings which are preloaded by the collapsible spacer during assembly. The pinion is positioned by shims located between the drive pinion shoulder and the rear bearing. The pinion and front bearing are held in place by a large pinion nut and washer. The differential case is supported in the carrier by two tapered roller side bearings which are preloaded by inserting shims between the outer race and the carrier. Ring gear to pinion backlash is changed by varying the shim thickness from one side of the case to the other. The case houses two side gears in mesh with two pinion gears. Both the side gears and the pinion gears are backed by thrust washers. The pinion gear shaft is anchored in the case by a bolt and lock washer.

The differential carrier is a nodular iron casting with tubular axle housings pressed into sides to form a complete assembly (salsbury type). A removable heavy steel cover is bolted to the carrier to permit servicing of the differential without removing the entire assembly from the car.

An oil feed passage to the pinion bearings and an oil return hole are provided in the carrier casting for lubricant to circulate. A pinion oil seal is located in the front of the carrier and bears against the pinion flange. The oil filler plug is located on the right side of the carrier.

The outboard axle shaft bearings receive lubrication from the carrier housing through slots in the shim seats. Lubricant flows from the carrier housing, through the slots in the shim seats to the axle tubes. It then flows down a groove in the tubes to the axle shaft bearing.

OPERATION

As the pinion rotates, power is transferred to the differential case through the ring gear. Since the differential side gears are in mesh with the pinion gears and the pinion gears are held in one position in the differential case by the pinion shaft, power is distributed evenly to each axle shaft providing the road surface resistance to each rear wheel is equal.

If the road surface at one rear wheel is soft or slippery it will offer less resistance to spin for that wheel. When this situation occurs the differential case still tries to transmit equal power to each side gear but in meeting with greater resistance to motion by one side gear, the pinion gears will rotate or walk around this side gear which in turn aids the pinion gears and differential case in distributing increased power to the side gear of less resistance thus causing the one wheel to spin.

The differential acts in the same manner when the car is turning a corner except that both wheels are turning. In this case the inside wheel and side gear are rotating slower than the outside wheel and side gear. The pinion gears are at this time revolving with the slower side gear and also rotating on the pinion shaft to increase the speed of the outside side gear and wheel.

USAGE OF C DIFFERENTIAL

The type "C" differential is used on all A Series models with the 455 cu. in. engine, all 455 cu. in. G Series models, all F and X Series models and all B Series Models, except those axles identified by a "B" or "O" last letter in the three letter axle code. The type "C" differential can be distinguished from standard differentials by this last letter of the three letter axle code. Type "C" identifying codes are as follows: A and G Series - "K", B Series - "G", "K", "P" or "M", F Series .... "G", X Series - "G".

GEAR RATIO CODES AND IDENTIFICATION OF C DIFFERENTIAL

The three letter identifying code for the type "C" differential is located in the same place as in the standard differential - the front face of the right hand axle tube next to the carrier housing. After the axle code has been determined, reference should be made to the axle charts at the end of Section 4A to determine ratio, etc.

SERVICE PROCEDURES

AXLE SHAFT, BEARING AND SEAL

REMOVE

1. Raise and suitably support car leaving the rear wheels and differential assembly suspended.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

2. Remove rear wheel(s) and brake drum(s).
3. Remove differential carrier cover and allow lubricant to drain.
4. Remove pinion shaft lock bolt and pinion shaft. See Fig. 4C-2.
5. Push axle shaft(s) inward to permit removal of "C" locks then remove axle shaft(s). See Fig. 4C-3.
6. Install axle shaft bearing and seal remover J-22813 (all A, X and G Series "G" or "K" coded axles), or J-23689 (B Series, "G", "K", "P" or "M" coded axles and F Series, G coded axle) and slide hammer and remove the bearing and seal. See Fig. 4C-4.

INSTALL

1. A, X and G Series - Using special tool J-5292, install the bearing and then the seal. See Fig. 4C-5.

   B and F Series - Because the axle shaft bearing and seal are each installed to a predetermined depth in the axle tubes, they must be installed separately using individual special tools. Install the bearing first, using special tool J-23690, and then install the seal using special tool J-21128.

2. Carefully insert axle shaft through the seal and bearing as far as possible through the side gear.

   CAUTION: *Care should be taken when installing the axle shaft, as careless installation could damage the seal.*

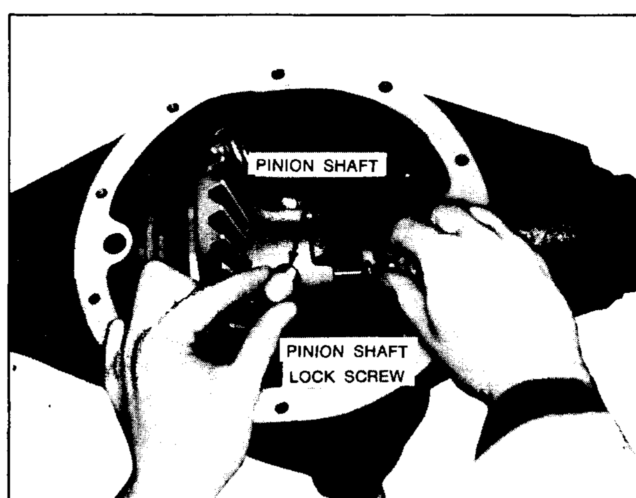


Fig. 4C-2 Pinion Shaft Lock Bolt

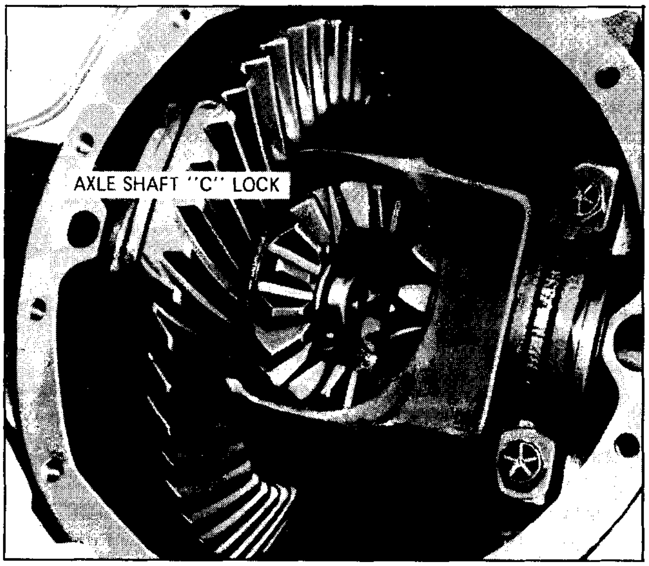


Fig. 4C-3 - Axle Shaft "C" Locks

3. 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.

4. Install pinion shaft and secure with lock bolt (15 lb.ft.)

5. Install cover, using new gasket, torque bolts to 25 lb.ft.

6. Install lubricant.

   Standard Axle - SAE 80 or SAE 90, GL-5, multipurpose gear lube.

   Positive Traction Axle - SAE 90 gear lube meeting specification for GM part #1051022 or equivalent.

CAUTION: *See caution on Page 1 of this section regarding the fasteners referred to in STep 7 below.*

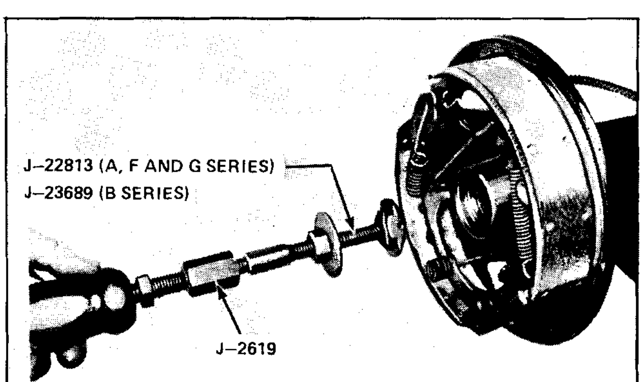


Fig. 4C-4 Tool for Axle Shaft Bearing and Seal Removal

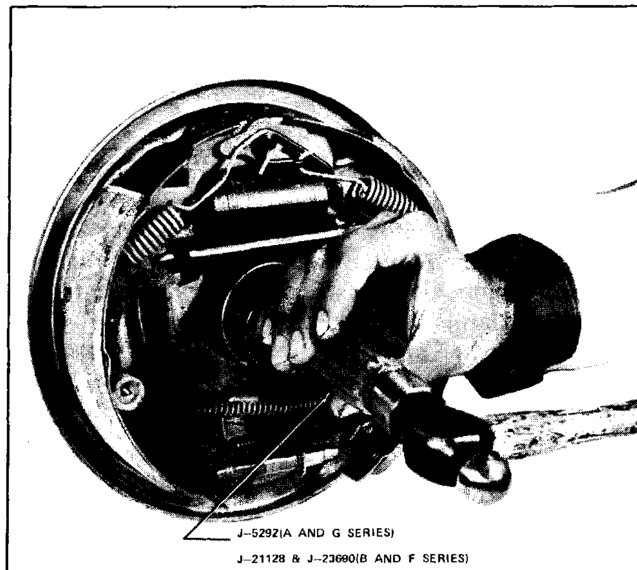


Fig. 4C-5 Installing Axle Shaft Bearing and Seal

7. Install brake drum(s) and wheel(s). Torque wheel nuts to 65 lb.ft. X Series, 75 lb. ft. B Series, 70 lb. ft. A, G, F Series.

8. Raise the car to remove supports (jack stands) and lower the car.

CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

DIFFERENTIAL CASE AND DRIVE PINION

REMOVAL

1. Remove axle shafts as outlined.

2. Mark one bearing cap and the carrier to insure correct position during reassembly.

3. Remove bearing cap bolts and caps and carefully pry out ring gear and case assembly. See Fig. 4C-6. Place bearing cups and shims with respective bearing cap.

CAUTION: *Do not pry on bearing caps as the machined face may become damaged. Do not drop case assembly as damage could result.*

CASE ASSEMBLY

DISASSEMBLE

1. Roll out pinion gears and thrust washers and remove the side gears and thrust washers.

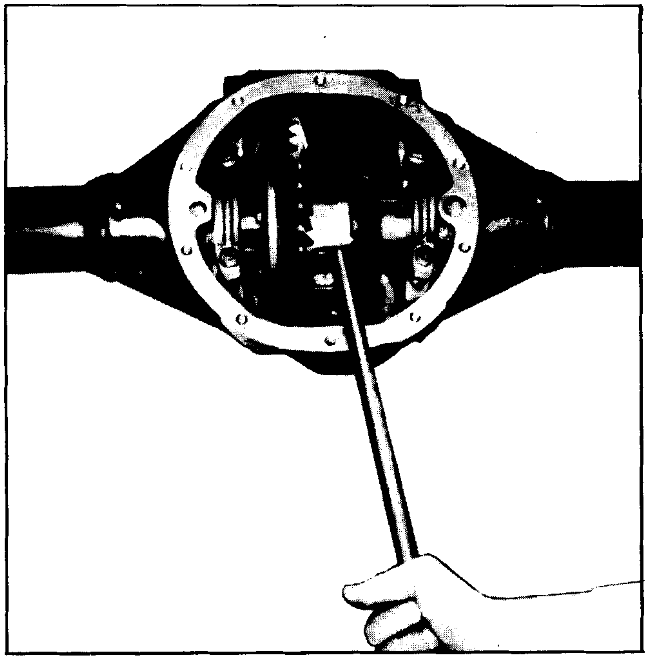


Fig. 4C-6 Removing Differential Case

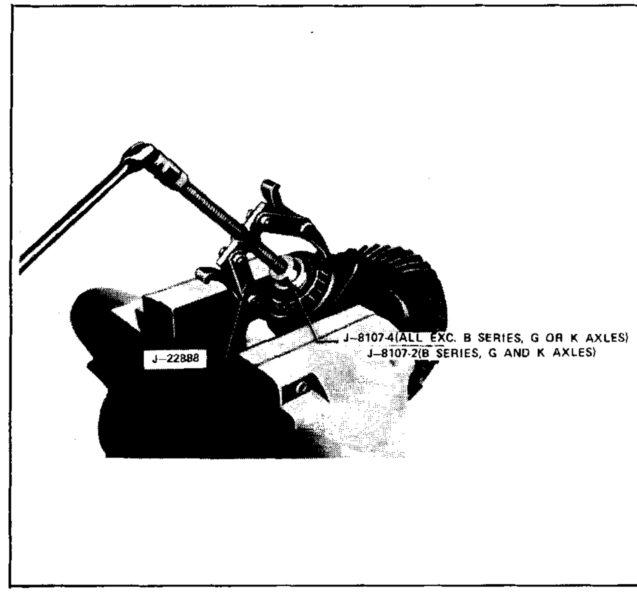


Fig. 4C-7 Removing Differential Side Bearings

2. Position case in vise and remove side bearings using Puller J-22888 and Plug J-8107-4 (all exc. B Series, "G" and "K" coded axles) or plug J-8107-2 (B Series, "G" and "K" coded axles). See Fig. 4C-7.

3. Loosen and remove ring gear to case attaching bolts and lock washers. Tap ring gear off case using a soft face hammer.

CAUTION: *Do not pry ring gear from case as machined surfaces may become damaged.*

ASSEMBLE

1. Install guide pins, made from 3/8"-24x1-1/2" long cap screws with heads cut off and ends slotted, into ring gear.

2. Position ring gear over pilot diameter of case with guide pins aligned in case holes. Install ring gear bolts and lock washer and tighten evenly and alternately to specifications (90 lb.ft.)

3. Install case side bearings using Installer J-5292 (all A and G Series). J-22761 (all F, X and B Series with "G" or "K" coded axles) or J-8901 (B Series, "P" or "M" coded axles). See Fig. 4C-8.

4. Install side gears and respective thrust washers.

5. Install Pinion Gears as follows: Turn case so that the access hole is pointed upwards. Install one pinion gear and its thrust washer. Without moving side or pinion gears, turn case so that access hole is pointed downward. Install second pinion gear and thrust washer 180° from the first. Hold lower pinion gear in place, and carefully turn the case 90° to align gears with the pinion shaft holes. Hold one pinion gear through the lower pinion shaft hole and carefully rotate the entire assembly until the pinion shaft hole is in an accessable position.

DRIVE PINION

REMOVE AND DISASSEMBLE

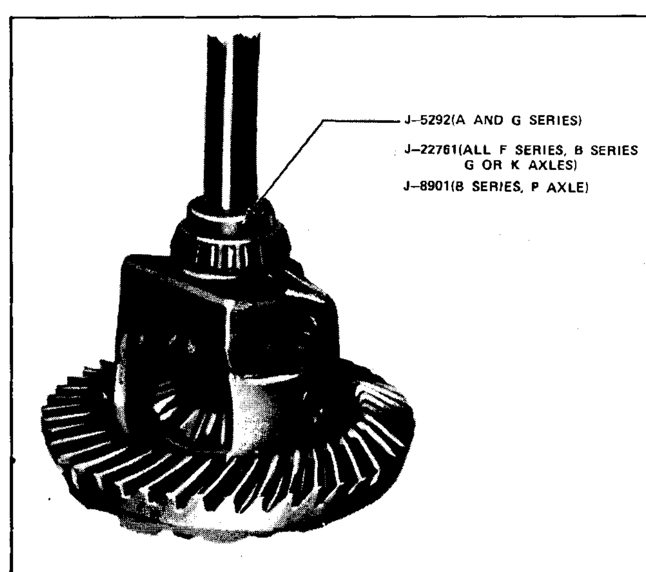


Fig. 4C-8 - Installing Differential Side Bearing

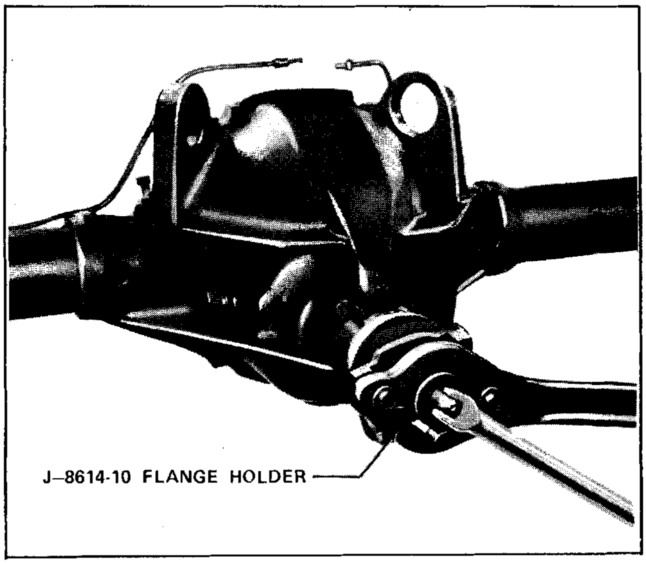


Fig. 4C-9 Removing Pinion Nut

1. Install pinion Flange Holder J-8614-10 to pinion flange and remove pinion nut. See Fig. 4C-9.

2. Install flange removing portion of Tool J-8614-10 and remove pinion flange. See Fig. 4C-10.

3. By pulling on the gear end of the pinion with one hand and tapping the threaded end with a soft faced hammer, remove the pinion and collapsible spacer.

CAUTION: *Do not drop drive pinion as damage could result.*

4. Using a screwdriver or other suitable tool remove the pinion seal and front bearing.

5. Remove rear pinion bearing using Remover J-8612 (all exc. B Series, "P" and "M" coded axles), J-9746 (B Series, "P" and "M" coded axles), or J-21493 (X Series) and note the shim used. See Fig. 4C-11.

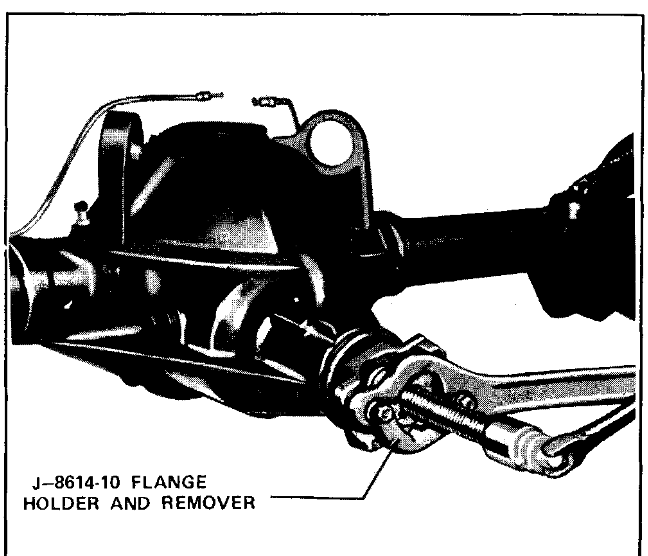


Fig. 4C-10 Removing Pinion Flange

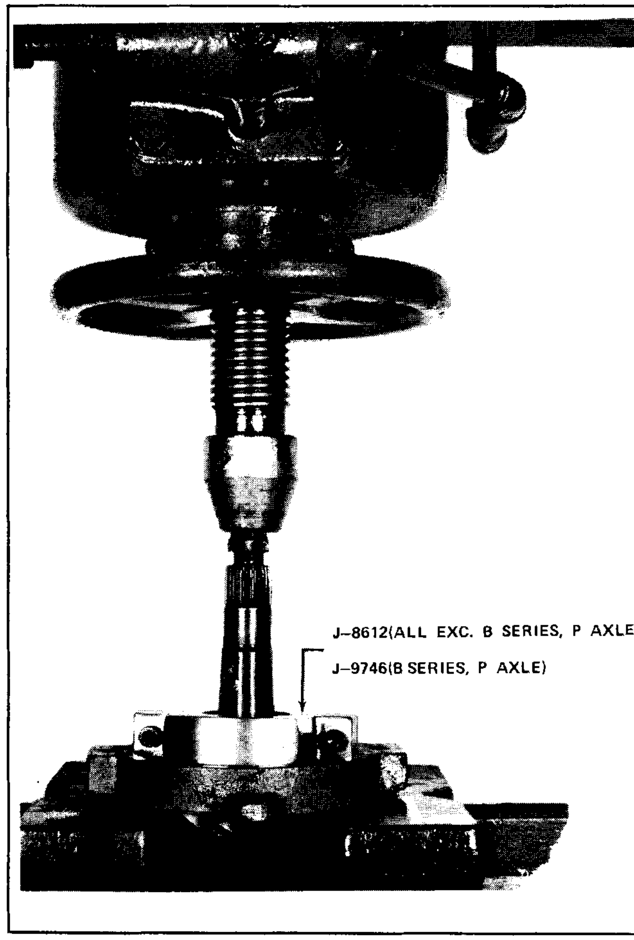


Fig. 4C-11 Removing Rear Pinion Bearing

6. The front and rear pinion bearing outer races can be removed with the use of a brass drift.

ASSEMBLE AND INSTALL

1. Install the front pinion bearing outer race using Installer J-8611-01 (J 7817 X Series) and Drive Handle J-8092. See Fig. 4C-12.

2. To install the rear pinion bearing outer race use Installer J-8608 (all exc. B Series, "P" coded axles), J-9745 (B Series, "P" coded axles) or J 6197 (X Series) and Drive Handle J-8092. See Fig. 4C-13.

3. Lubricate pinion bearings with gear lubricant. Assemble pinion bearings, pinion setting Gage Plate J-21777-23, (A and G Series, "G" and "K" coded axles), J-21777-26 (all F Series and B Series, "G" or "K" coded axles) or J-21777-2 (B Series, "P" or "M" coded axles, (X Series) Stud Assembly J-8619-13 and front bearing Pilot J-5647-37 (all A and G Series) or

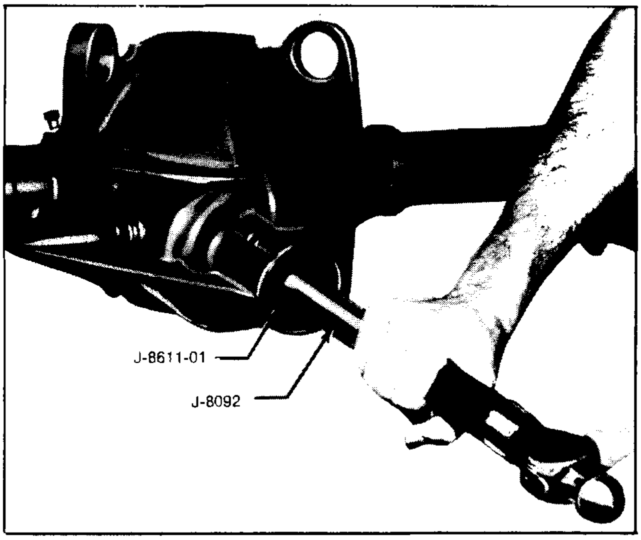


Fig. 4C-12 Installing Front Pinion Bearing Outer Race

J-8619-12 (B, X, and F Series) into carrier assembly and tighten hex nut to 20-25 lb. in. (new bearings) or 10-15 lb. in. of (old bearings) which is sufficient torque to rotate the bearings. Position J-21777-23, J-21777-26 or J-21777-2 pointing upwards. See Fig. 4C-14.

NOTE: *For an explanation of when and why gauging is necessary, see Section 4A.*

4. Make certain differential side bearing support bores are clean and free of burrs.

5. Position the dial indicator, J 8001, on the mounting post of the gauge shaft with the contact button touching the indicator pad. Set the dial indicator on zero, then depress the dial indicator until the needle rotates 3/4 turn clockwise. Tighten the dial indicator in this position.

6. Install J 21777-3 (all exc. F Series and B Series "G" or "K" codes axles) or J-8619-10 (all F, X, and B Series, "G" or "K" coded axles) discs on gauge shaft assembly and position in the carrier so that the dial indicator contact rod is directly over the gauging area of the gauge plate. NOTE: The discs must be fully seated in the side bearing bores. (Fig. 4C-14 and 4C-15).

7. Position gauge shaft so that the dial indicator rod contacts the gauging area. Rock gauge shaft slowly back and forth until the dial indicator records the greatest deflection, (the point where dial indicator needle changes rotational direction). At the point of largest deflection, set dial indicator to zero. Repeat rocking action of gauge shaft to verify the zero setting.

8. After the zero setting is obtained, rotate gauge shaft until the dial indicator rod is removed from the gaug-

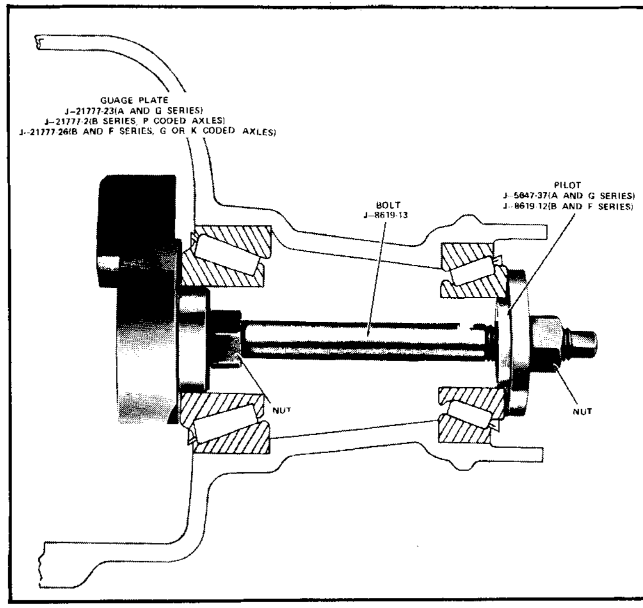


Fig. 4C-14 Pinion Gage Tools

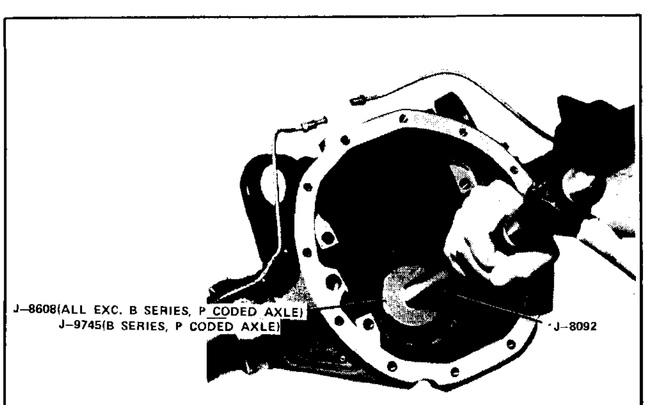


Fig. 4C-13 Installing Rear Pinion Bearing Outer Race

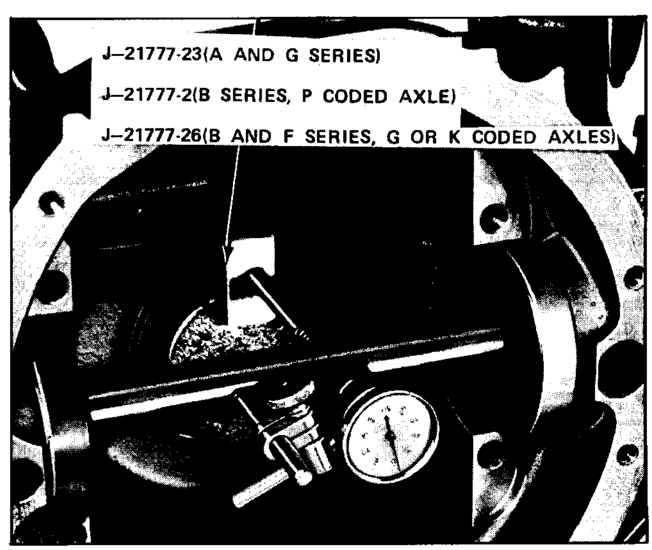


Fig. 4C-15 Pinion Setting Gage Assembly Installed ing area. The dial indicator will read the pinion depth directly. Record reading.

9. All drive pinions are stamped with a code number on the rear I.D. of the pinion gear (Fig. 4C-16). The code number in the chart below indicates the amount to be added or subtracted from gauge reading obtained in step 8.

DRIVE PINION CODE

40	-.005
41	-.004
42	-.003
43	-.002
44	-.001
45	.000
46	+.001
47	+.002
48	+.003
49	+.004
50	+.005

EXAMPLE: If dial indicator reading is .035" and pinion code is 48, shim required is .035" plus .003". Shim required is .038".

NOTE: *All service pinions have a number 45 code.*

10. Install proper shim on shaft of pinion gear.

NOTE: *Shims are available in .001" increments ranging from .021" to .037". Each shim has its thickness etched on it for easy identification.*

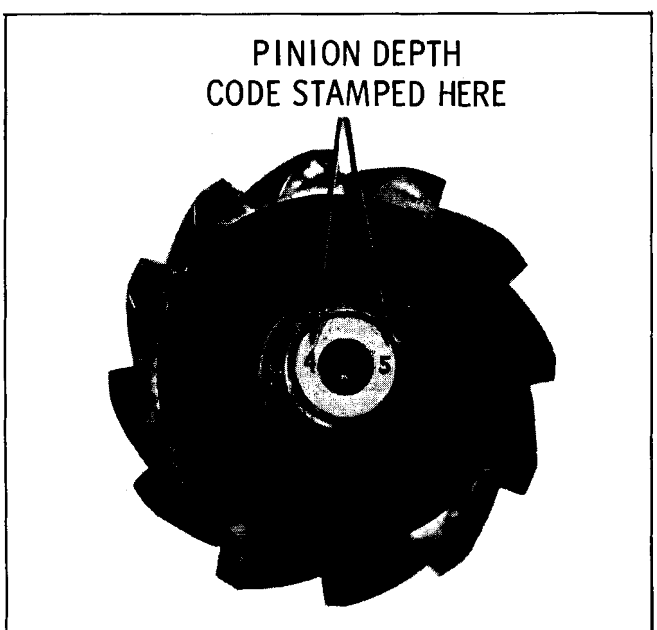


Fig. 4C-16 Drive Pinion Code

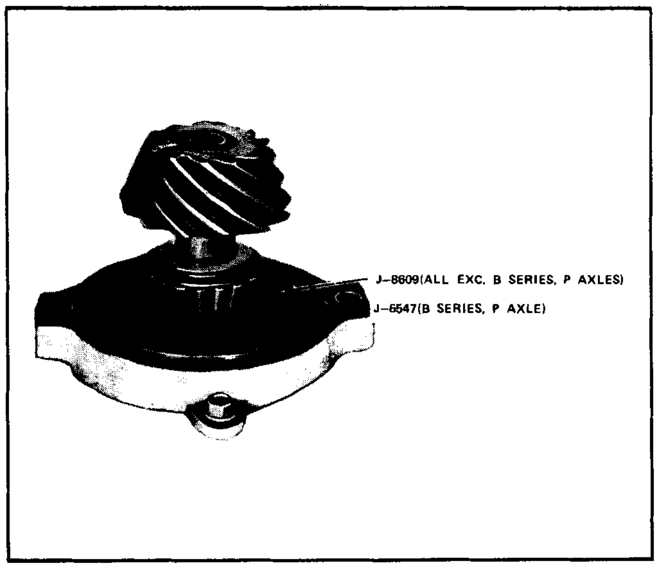


Fig. 4C-17 Installing Rear Pinion Bearing

11. Install selected shim and rear pinion bearing onto drive pinion using installer J-8609 (All exc. B Series "P" or "M" coded axles), J-6547 (B Series, "P" and "M" coded axles) or J 21022 (X Series) and press. See Fig. 4C-17.

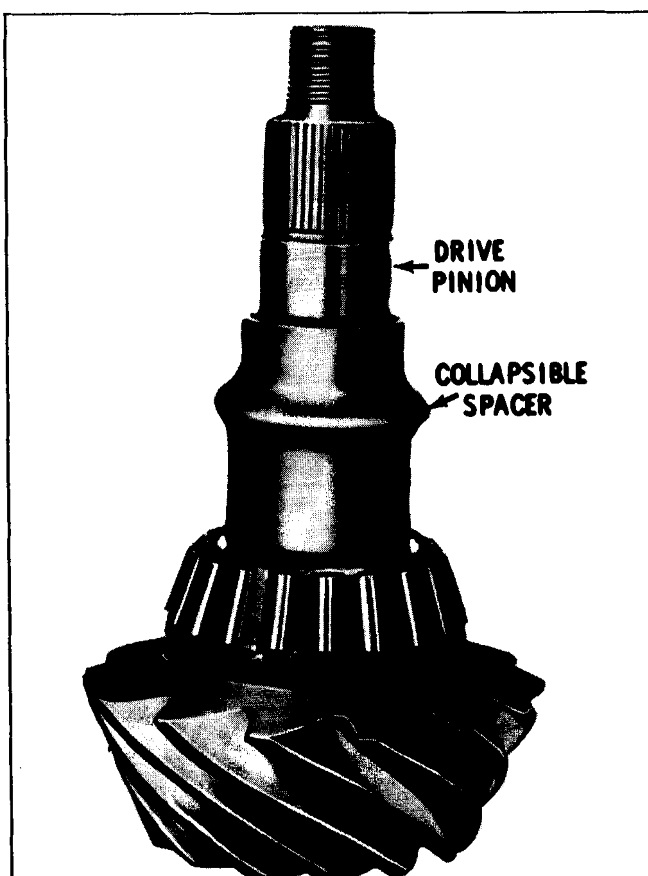


Fig. 4C-18 Collapsible Spacer

12. Examine ring gear and pinion. Nicks, burrs, or scoring will require replacement of gear set.

13. Slide a new collapsible spacer on the pinion shaft, (Fig. 4C-18) position pinion assembly in carrier and install front pinion bearing onto pinion shaft using installer J-22836.

14. Coat cavity between pinion oil seal lips with front wheel bearing grease and install the seal into the carrier bore using Installer J-22836 and Spacer J-22804-1 (all A and G Series) Installer J-22388 (B and F Series), or Installer J 23911 and Spacer J 22804-2 (X Series). The spacer is not required in installing the seal in B or F Series axles. Rotate spacer occasionally to insure that seal is not slanted in carrier bore. See Fig. 4C-19.

15. Install pinion flange and flange holder J-8614-10.

16. Pack the cavity between the end of the pinion splines and the pinion flange with a nonhardening sealer (such as Permatex type A or equivalent).

17. Install washer and new self-locking pinion nut on pinion. Tighten nut to remove pinion end play. When end play is removed, alternately tighten nut and check pinion preload until a torque of 20-25 lb.in is required to rotate the pinion with new bearings and seal installed or 10-15 lb.in. when used parts are reinstalled. See Fig. 4C-20.

DIFFERENTIAL CASE

INSTALL

Differential side bearing preload is adjusted by changing the thickness of both the right and left shims by an equal amount.

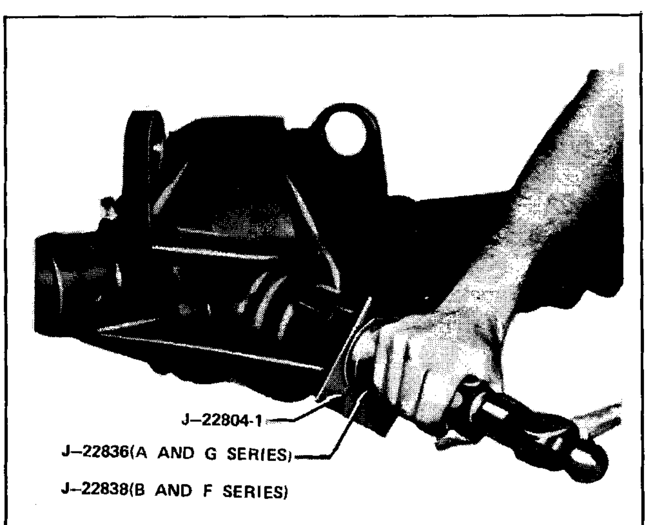


Fig. 4C-19 Installing Pinion Oil Seal

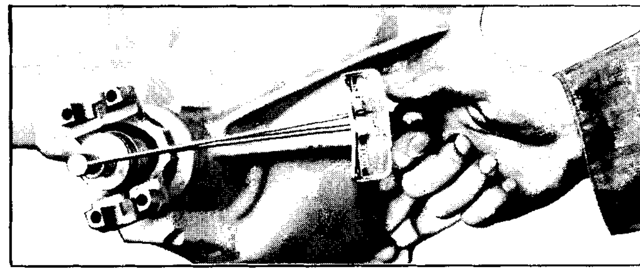


Fig. 4C-20 Checking Pinion Preload

By changing the thickness of both shims equally, the original backlash will be maintained. All differential side bearing preload 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, .160" + or − .001" thick, cast spacer. Stamped steel service shims must be used when differential repairs are made that require removal of the case assembly. Service, steel, adjusting shims are available in thickness ranging from .032" to .064" in increments of .002".

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. If same bearings are being reused, they must have original outer races in place.

2. Achieve a slip fit between the carrier and the side bearings as follows:

   NOTE: *A slip fit means zero pre-load, or the point at which bearings have no play and no drag. At this point, in and out movement of the case is possible but side to side movement is not.*

   a. Use a micrometer to measure production shims, and subtract .004" from each reading. Do not mix the left and the right shims.

   b. Using a service spacer (.170") and service shims, make up a shim pack for each side equal to the thickness of the original shim minus .004" and install as shown in Fig. 4C-21 (flat edge of spacer against housing). This will duplicate the original setting minus pre-load.

   c. If this does not provide a proper slip fit, spacers must be added or removed equally from both sides as necessary.

   d. Install side bearing caps as previously marked, and tighten bolts to 70 lb. ft. Check backlash and do red lead test before adding side bearing preload.

3. Rotate differential case several times to seat bearings, then mount dial indicator as shown in Fig. 4C-22.

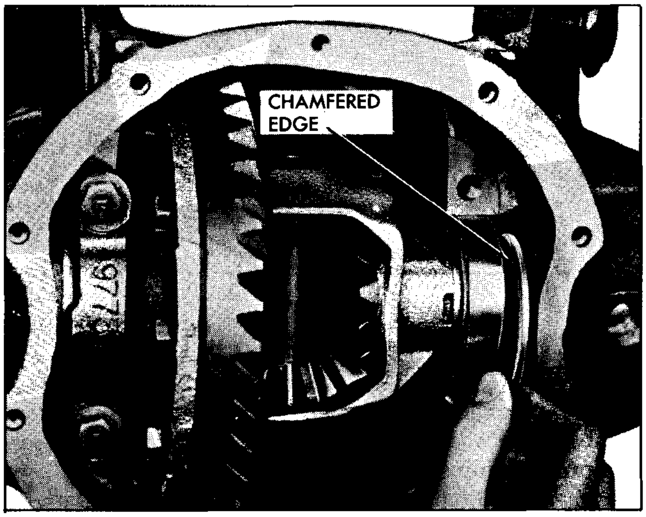


Fig. 4C-21 Installing Service Spacer

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.

4. 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.

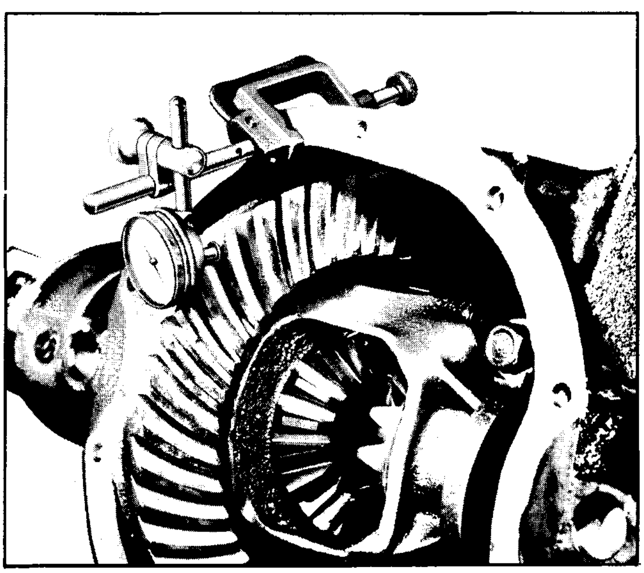


Fig. 4C-22 Checking Ring Gear to Pinion Backlash

5. Ring gear to pinion backlash should be in the range of .005" to .008".

   If original gear set is being reinstalled, original gear lash should be maintained within + or – .001".

6. If gear backlash is not within specifications, correct by increasing thickness of one differential shim and decreasing thickness of other shim the same amount.

   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".

7. Check contact pattern with red lead as outlined in Section 4A. The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth towards the toe end.

8. After backlash and tooth pattern operations are complete, remove shim packs taking care not to mix them. Select new shim packs for each side .004" thicker than those removed and install each shim pack on its proper side. This additional thickness will provide proper side bearing preload. It will be necessary to tap the final shim into place with a soft hammer.

AXLE SHAFT

INSTALL

Install axle shafts as outlined under "Axle Shaft Bearing and Seal".

PROPELLER SHAFT TO PINION FLANGE CONNECTION

> **CAUTION:** *See caution on Page 1 of this section regarding the fasteners referred to below.*

Connect propeller shaft to pinion flange with respect to the alignment marks. Torque the four nuts to 12 lb. ft. (see Section 4E).

SPECIFICATIONS

REAR AXLE

Rear Axle Type .... Semi-Floating Hypoid
Drive and Torque .... Through 4 Arms
Rear Axle Oil Capacity
B Series - P, M Coded Axles 88 fl. oz. or 5 1/2 Pints
G, K Coded Axles .... 68 fl. oz. or 4 1/4 Pints
A Series - K Coded Axles .. 78 fl. oz. or 4 7/8 Pints
X Series .... 75 lf. oz. or 4.4 Pints
Ring & Pinion Gear Set Type .... Hypoid
Differential Lubricant
(Standard Axle)........ MPG SAE 80 or 80-90 (GL-5)
Bottom of Filler Plug Hole - A, G, F and X Series
Bottom of Filler Plug to 3/8" Below Filler - B Series - G and K Coded Axles
Bottom of Filler Plug to 3/4" Below Filler - B Series - P and M Coded Axles

RING AND PINION GEAR

Pinion Bearing Preload (measured at pinion flange nut)
New Bearings .... 20-25 Lb. In. Rotating Torque with New Seal
Reused Bearings .... 10-15 Lb. In. Rotating Torque with New Seal
Total Assembly Bearing Preload

(Measured at Pinion Flange Nut)
New Bearings .... 35-40 Lb. In.
Reused Bearings .... 20-25 Lb. In.
Ring Gear Back Lash................................ .005" - .008"

TORQUE SPECIFICATIONS

TORQUE	LB. FT.
Differential Cover to Carrier Bolts	25
Differential Bearing Caps to Carrier Bolts	70
Differential Ring Gear to Case Bolts	90
Differential Pinion Shaft Lock Bolt	15
Rear U-Joint Companion Flange Nut with Lock Plates	12
Rear U-Joint Companion Flange Nut with Lockwashers	14
Rear Axle Upper Control Arm Assy. to Axle Housing Bolt	110
Rear Axle Upper Control Arm Assy. to Axle Housing Nut	80
Rear Axle Lower Control Arm Assy. to Axle Housing Bolt	110
Rear Axle Lower Control Arm Assy. to Axle Housing Nut	80
Rear Axle Bumper Spacer to Axle Housing Bracket Bolt and Nut (Station Wagon)- A Series	50
Rear Axle Upper Control Arm Assy. to Frame Bolt	110
Rear Axle Upper Control Arm Assy. to Frame Nut	80
Rear Axle Lower Control Arm Assy. to Frame Bolt	110
Rear Axle Lower Control Arm Assy. to Frame Nut	80
Rear Shock Absorber to Axle Housing Bracket Nut	65
Shock Absorber to Frame Bolt	20
Rear Wheel and Drum to Axle Shaft Nut- B Series	75
A, G and F Series	70
X Series	65
Rear Brake Assy. to Axle Hsg. Bolt and Nut	35
Pinion Nose Bumper	8
Differential Case Bolts-G Series Medium Duty	30

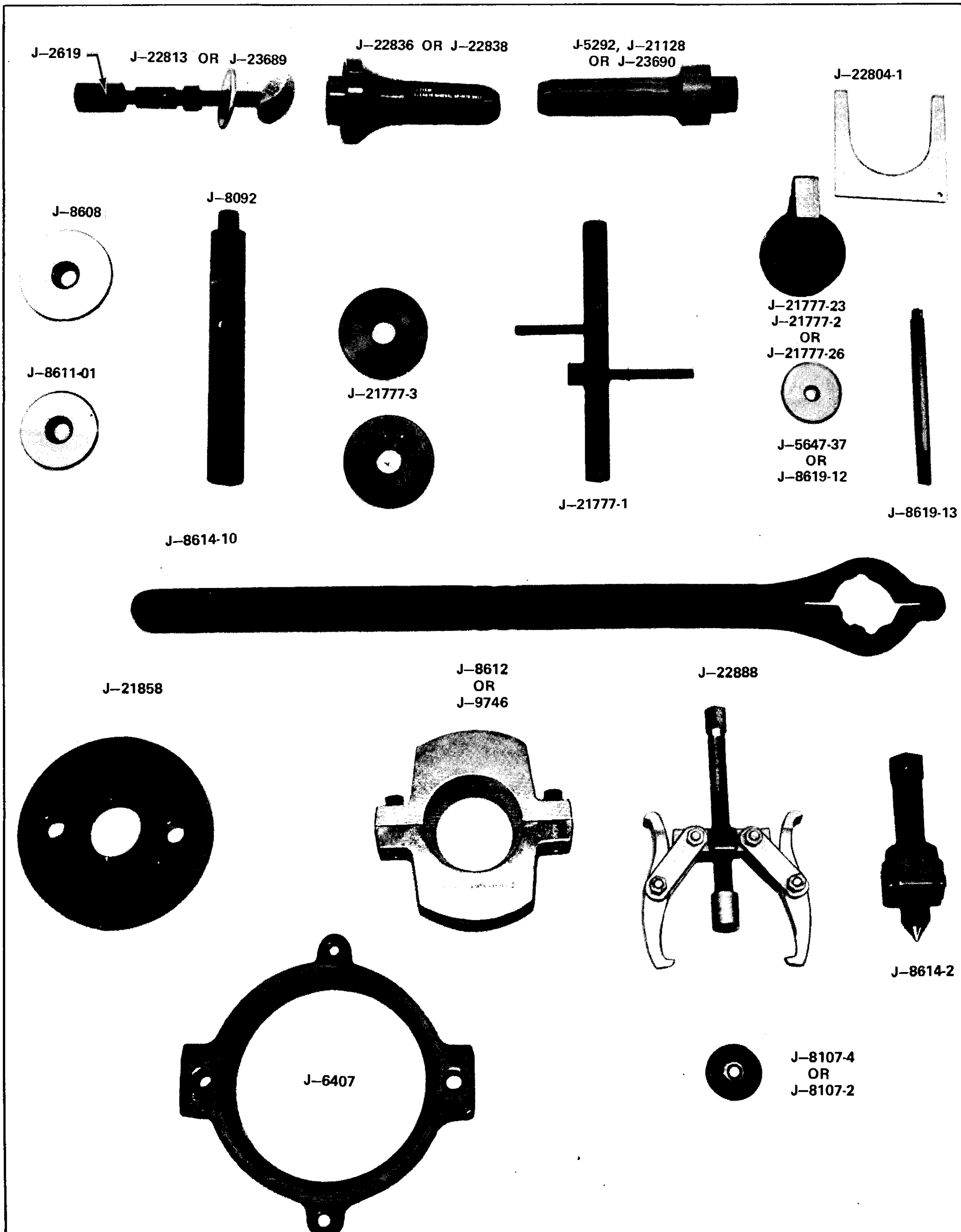


Fig. 4C-23 Special Tools

J 5292	Bearing & Seal Installer
J 5647-37	Front Pinion Bearing Pilot
J 6407	Press Plate Holder
J 8092	Drive Handle
J 8107-2	Plug
J 8107-4	Plug
J 8608	Rear Pinion Bearing Outer Race Installer
J 8611-01	Front Pinion Bearing Outer Race Installer
J 8612	Rear Pinion Bearing Remover
J 8614-10	Companion Flange Holder
J 8614-2	Companion Flange Puller
J 8619-12	Front Pinion Bearing Pilot
J 8619-13	Stud Assembly
J 9746	Rear Pinion Bearing Remover
J 21777-1	Pinion Depth Gauge Cross Shaft
J 21777-2	Pinion Setting Gauge Plate
J 21777-3	Pinion Depth Gauge Discs
J 21777-26	Pinion Setting Gauge Plate
J 2238	Pinion Oil Seal Installer
J 22761	Case Side Bearing Installer
J 22804-1	Front Pinoin Oil Seal Spacer
J 21858	Axle Bearing Remover
J 22813	Axle Shaft Bearing & Seal Remover
J 22836	Front Pinion Bearing Installer
J 22888	Case Side Bearing Puller
J 23689	Axle Shaft Bearing & Seal Remover

SECTION 4D

TYPE C SAFE-T-TRACK DIFFERENTIAL

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

TROUBLE DIAGNOSIS AND TESTING

Trouble diagnosis for the "C" type Safe-T-Track differential is the same as outlined in Section 4-A and 4-B except as listed below.

If there is a doubt that a car is equipped with a "C" type Safe-T-Track differential, or to determine if this option is performing satisfactorily, a simple test can be performed.

1. With the transmission in neutral, raise one wheel and place a block of wood in front of the opposite wheel.
2. Remove opposite wheel and install special tool J 21579 with adaptor J 2619-4. As shown in Figure 4D-1.
3. Install torque wrench and turn wheel. Disregard breakaway torque and observe only torque required to continuously turn wheel smoothly. If differential assembly is equipped with Safe-T-Track, the rotating torque will be at least 30 lb.ft.

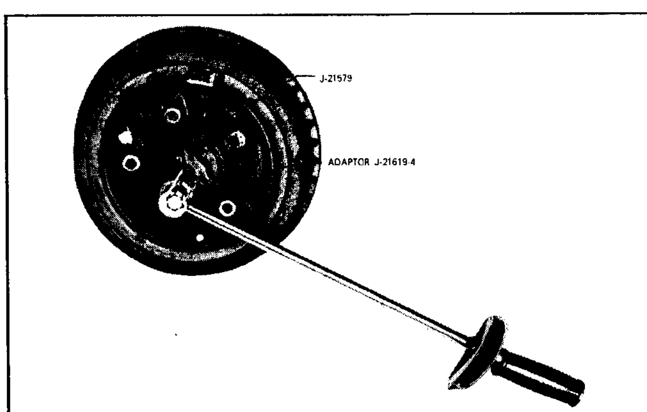


Fig. 4D-1 Testing Safe-T-Track

DESCRIPTION

The C Type Safe-T-Track differential described in this section may be identified by the three letter code located on the front of the right hand axle tube. This three letter code should be compared with the axle code charts at the end of Section 4A to determine axle type and ratio.

The "C" type Safe-T-Track differential is designed to perform all the functions of the conventional differential while overcoming its limitations. It is identical in function and operation to the standard Safe-T-Track differential described in Section 4B.

As is the case in the standard Safe-T-Tracks, the type "C" differentials are two distinct types. All A and G Series vehicles equipped with the "C" Type axle (as identified by the three letter axle code) operate through a clutch pack.

In B Series vehicles, all axles whose three letter code ends in a "P" or "K" also contain clutch packs, while those which have a third letter "G" may be either the clutch or cone type. Further identificaton is possible in the "G" coded axle to distinguish between those containing clutch packs and those containing cones by means of a single letter code located inboard of the three letter code and closer to the carrier assembly. A "W" code in this area identifies a cone type Safe-T- Track and an "E" a clutch pack type. F Series "C" type Safe-T-Track differentials use either a clutch or cone type. As in the B Series, A "W" identifies a cone type and a "E" identifies a clutch pack type. X Series "C" type Safe-T-Track differentials are either a cone or clutch type, identified by a "W" - cone type or a "E" for a clutch type differential.

With a conventional differential, when one wheel is on a slippery surface, pulling power is limited by the wheel with the lowest traction. The Safe-T-Track unit transfers power to the wheel with the most traction.

It will, however, release before excessive driving force can be directed to one rear wheel. This eliminates the possibility of dangerous steering reaction. When the rear wheels are under extreme conditions of unbalanced traction, such as having one wheel on ice and the other on dry pavement, wheel spin can occur if over-acceleration is attempted. However, even when wheel spin does occur, the major driving force is directed to the non-spinning wheel.

The case assemblies of differentials in A and G Series models, B Series with "P" or "K" coded axles and B Series with "G" coded axles and a single letter "E" code closest to the carrier, incorporate two clutch packs, two spring retainers and four preload springs which are not used in the standard differential.

The case of differentials used in B Series models with "G" coded axles and a letter "W" immediately adjacent to the carrier; and all F Series models is similar to the conventional case assembly, with the addition of a brake cone behind each side gear. All axle assemblies containing cones rather than clutch packs are of the two pinion design.

OPERATION

CLUTCH PACK TYPE

Pinion gears and side gears operate in a manner similar to those in a conventional differential. The clutch pack installed behind each side gear is spring preloaded to provide an internal resistance to the differential action within the case itself, (Fig. 4D-2). This preload assures an adequate amount of pull under unbalanced low traction conditions such as ice, mud or snow encountered at one rear wheel. It also provides smooth transfer of torque when conditions of altering traction are encountered at either rear wheel.

During application of torque to the axle, the initial spring loading of the clutch packs is supplemented by the gear separating forces between the side and spider gears which progressively increases the resistance in the differential. The unit therefore provides greater resistance under greater torque loads. The non-fully locking feature, however will allow the unit to release before excessive force is applied to one rear wheel.

BRAKE CONE TYPE

The frictional surface of the brake cones consist of a coarse spiral thread that provides passages for the flow of lubricant. The cones are statically preloaded with springs against the cone cavities in each half of the case assembly to provide an internal resistance to differential action under low tractive conditions at one rear wheel (Fig. 4D-3).

Torque is applied by the drive pinion to the ring gear, which is bolted to the case, thereby causing it to rotate. The preload force from the springs, plus the inherent separating force between the pinion gears and the side gears as the case rotates, forces the side gears against their respective cone. Since the brake cones are splined to the axle shafts, in effect the shafts are locked together and rotate with the case. When turning corners, the axles are automatically unlocked as torque created by differential action overcomes the calibrated spring load on the brake cones, allowing them to overrun.

WARNING: WHEN WORKING ON A CAR WITH A SAFE-T-TRACK DIFFERENTIAL, NEVER RAISE ONE REAR WHEEL AND RUN THE ENGINE WITH THE TRANSMISSION IN GEAR. THE DRIVING FORCE TO THE WHEEL ON THE FLOOR MAY CAUSE THE CAR TO MOVE.

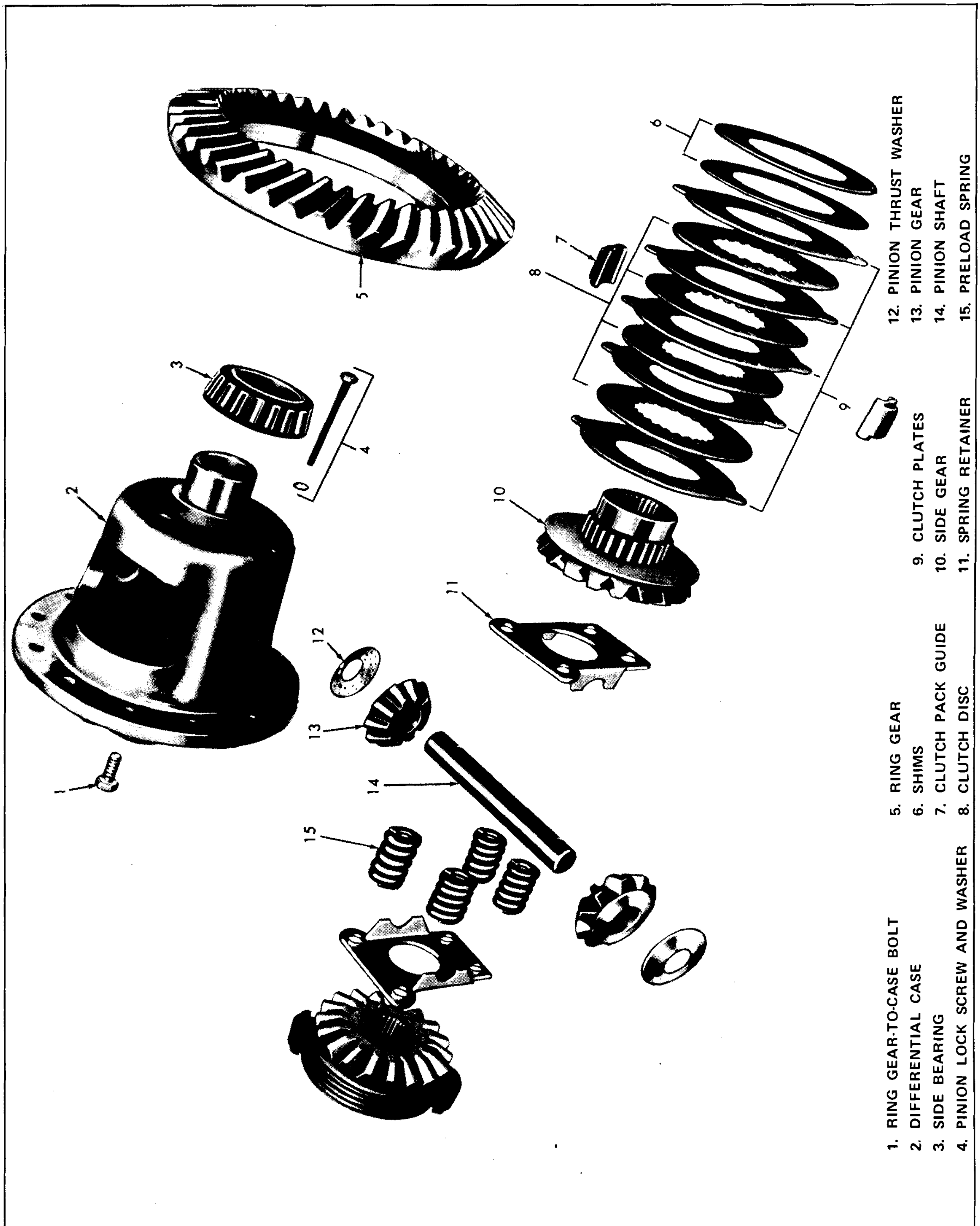


Fig. 4D-2 Type "C" Safe-T-Track Differential (With Clutch Packs) - Exploded View

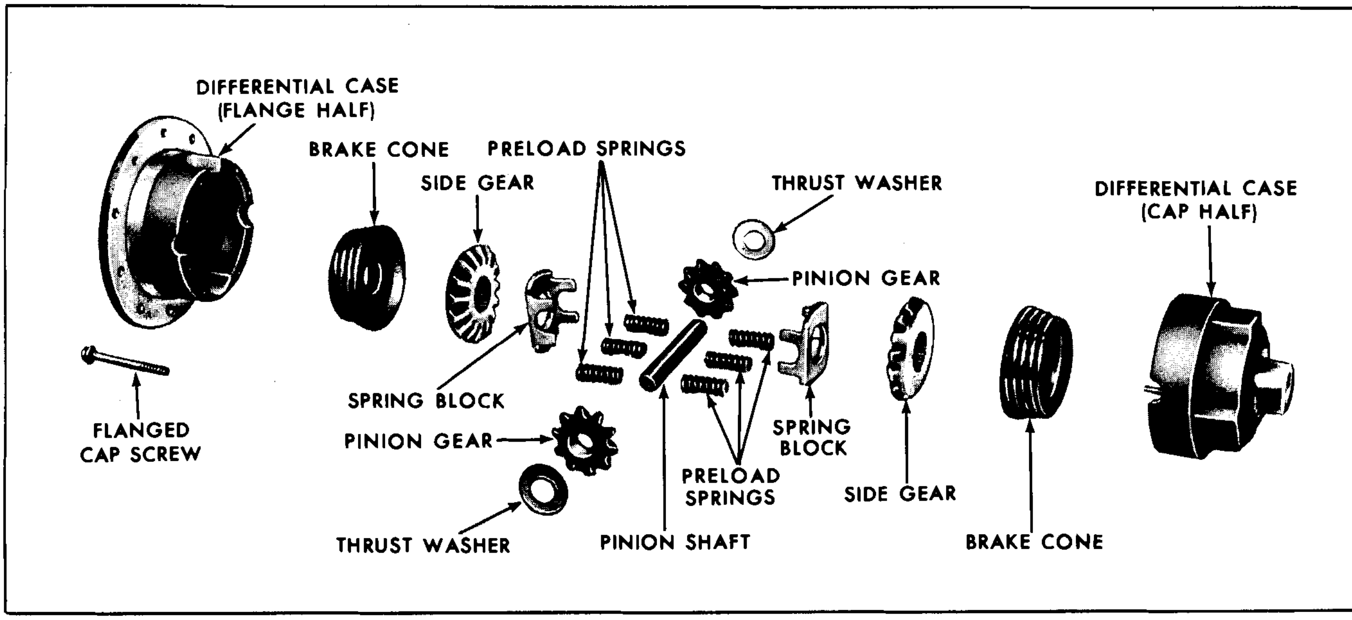


Fig. 4D-3 Type "C" Safe-T-Track Differential (With Brake Cones) - Exploded View

SPECIFICATIONS AND ADJUSTMENTS

NOTE: *All specifications and adjustments, except for the lubricant used are the same as those listed in Section 4C.*

LUBRICATION

The differential should be checked for leaks at each chassis lubrication. Lubricant level should be maintained flush with filler plug hole for A, G, F and X Series. Flush to 3/4" below for B Series P and M coded axles. flush to 3/8" below for B Series G and K coded axles. If a leak is discovered or it becomes necessary to add lubricant, use Special Safe-T-Track Lubricant meeting specification for GM Part No. 1051022 or equivalent.

CAUTION: *Never use standard differential lubricant in a positive traction differential.*

SERVICE PROCEDURES

NOTE: *Service procedures for the cone type differential is presented for information only or in the event that cleaning of component parts should be necessary. The case assembly of the cone type differential is a non- serviceable item and must be replaced as a unit.*

Overhaul procedures for the "C" Safe-T-Track are the same as the standard "C" type differential for the same series models and axle assemblies within the series which have the same last letter in the three letter axle code except for the clutch or cone and spring portion of the case assembly. Also, the ring gear must be removed in order to perform repairs inside the case.

DISASSEMBLY - CLUTCH PACK TYPE

NOTE: *Clutch plates and discs are not serviced separately, if replacement is necessary, the clutch pack must be replaced as an assembly.*

1. Remove pinion shaft lock bolt, lock washer and pinion shaft.
2. Remove differential case and ring gear following the procedures in Section 4C.

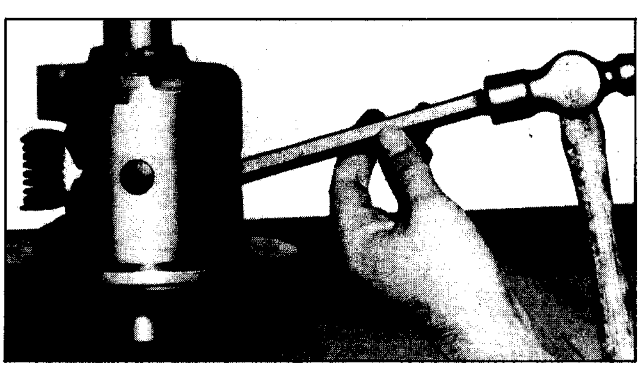


Fig. 4D-4 Partial Removal of Preload Springs and Retainers

3. Insert a brass drift through observation hole in the case and by tapping on the spring retainers, partially remove the preload springs and retainers. See Fig. 4D-4.
4. Install 1/4" bolts through retainers and springs and secure each bolt with a nut.
5. Continue to drive spring and retainer assembly from case until retainers are sufficiently exposed to permit installation of bar stock and a C-clamp over the center of the axle shaft holes. Tighten C-clamp to compress the spring pack for removal. See Fig. 4D-5.
6. The spring pack can be disassembled and reassembled with the use of a vise.
7. Rotate side gears to remove pinion gears and thrust washers.
8. Remove side gears, clutch packs and shims from the case noting their location in the case to aid in reas-

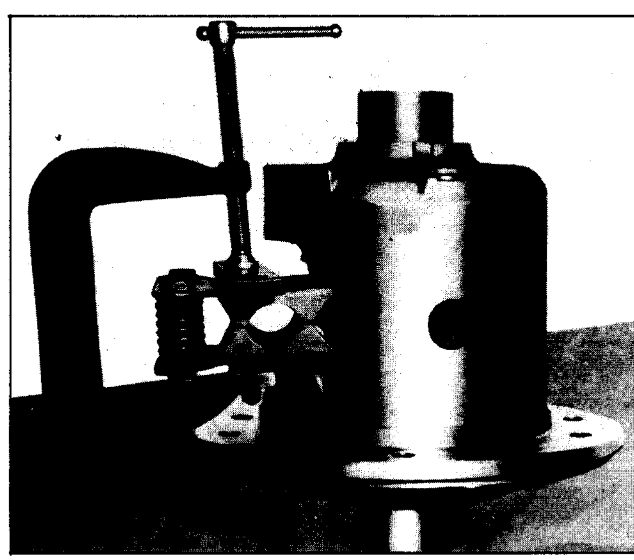


Fig. 4D-5 Install 1/4" Bolts, Bar Stock and C-Clamp

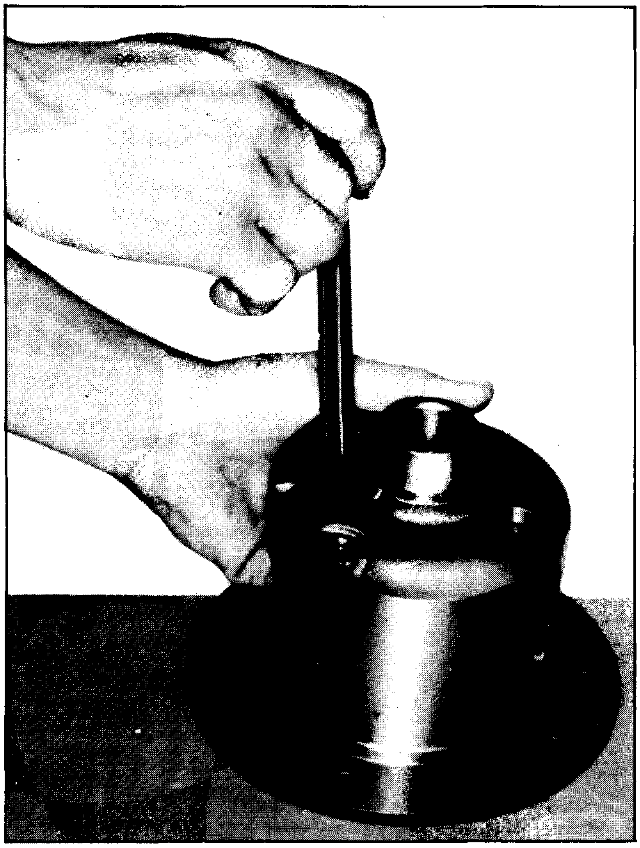


Fig. 4D-6 Removing Clutch Pack

sembly. Clutch packs and side gears are removed by tapping as shown in Fig. 4D-6.

NOTE: *Keep the clutch plates and discs in their original location in the clutch pack.*

9. Remove the clutch pack guides and separate the clutch discs and plates from the side gears.

DISASSEMBLY - BRAKE CONE TYPE

1. Remove side bearings and ring gear as described in Section 4B.
2. Scribe mark or paint differential case halves (see Fig. 4D-7) to aid in alignment of case when assembling.
3. Remove differential case half attaching bolts.

   NOTE: *Shims are used in some units between the side gear and cone to maintain proper backlash between pinion gears and side gears. Keep these parts with cap half of case after disassembly.*

4. Lift cap half of case from flange half. Remove clutch cone, side gear, spring block, preload springs and shims, if included (see Fig. 4B-2).

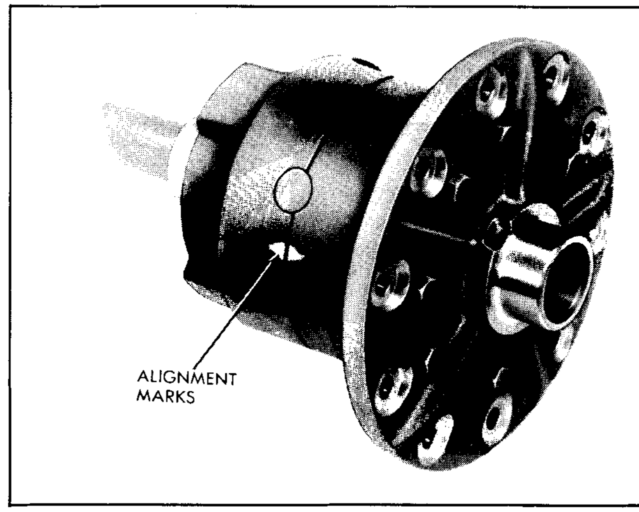


Fig. 4D-7 Paint on Alignment Marks Before Disassembly

5. Remove corresponding parts from flange half of case and keep them with flange half of case assembly.

CLEANING AND INSPECTION

1. Make certain that all differential parts are absolutely clean and dry. Contamination may result in differential chatter.
2. Inspect pinion shaft, pinion and side gears. Replace any parts which are excessively scored, pitted or worn.
3. In units which use clutch packs, inspect clutch discs and plates for worn, cracked or distorted condition. If any of these defects exist, new clutch packs must be installed.
4. In units of cone construction, inspect brake cone surfaces and corresponding cone seats in case. The cone seats in the case should be smooth and free of any excess scoring. Slight grooves or scratches, indicating passage of foreign material, are permissable and normal. The land surface on the heavy spirals of male cones will duplicate case surface condition. Should any parts be excessively scored, pitted or worn, replacement of the entire case assembly will be required, as parts are matched sets within each individual case and are not serviced separately.

ASSEMBLY - CLUTCH PACK TYPE

1. Lubricate clutch plates and discs with special positive traction lubricant. (GM Part No. 1051022 or equivalent).

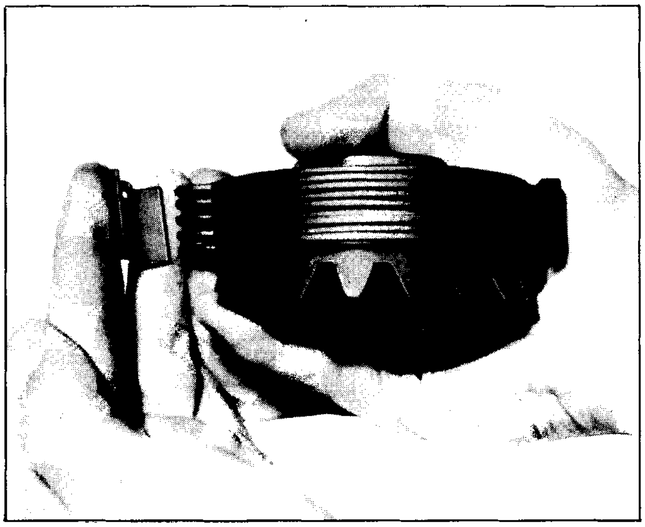


Fig. 4D-8 Assembling Clutch Pack

2. Alternately install a clutch plate and a clutch disc on each side gear in their original position totalling 5 clutch plates and 4 clutch discs in each clutch pack. See Fig. 4D-8.

3. Install clutch pack guides on the clutch pack lugs making sure that the clutch disc lugs are engaged in the side gear splines.

4. Select side gear shims of equal thickness to those removed from the case, or if old shims are suitable, reinstall them on the side gear hub.

5. Check the pinion to side gear clearance as follows:

   a. Install one side gear, clutch pack and shims in the case.

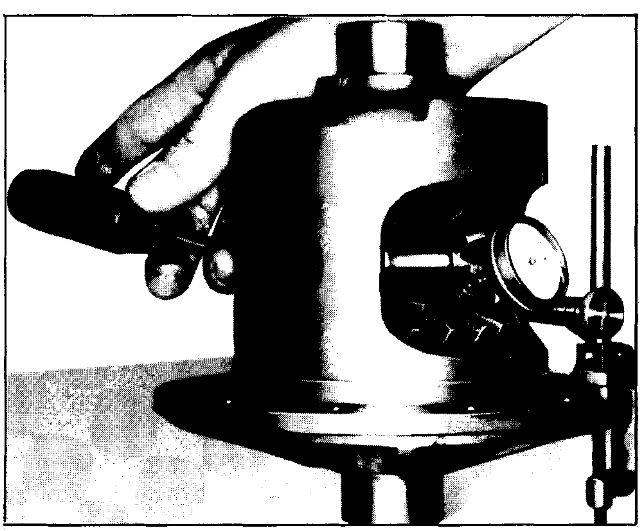


Fig. 4D-9 Checking Pinion to Side Gear Clearance - Clutch Pack Type

   b. Install both pinion gears, thrust washers, pinion shaft and lock bolt.

   c. Compress the clutch pack by inserting a screwdriver or other suitable wedge between the pinion shaft and the side gear (Fig. 4D-9).

   d. Install dial indicator with the contact button against a pinion gear tooth, (Fig. 4D-9).

   e. Rotate pinion gear back and forth and observe clearance. Pinion to side gear clearance should be within .001" - .006".

   f. If clearance is more than .006", increase shim thickness between the clutch pack and case. If clearance is less than .001", decrease shim thickness. A change in shim thickness of .002" will alter the clearance by approximately .001". If it is necessary to change the shim thickness, recheck the pinion to side gear clearance.

   g. Remove this side gear assembly and install the other side gear assembly in the opposite side of case and repeat the procedure.

   h. When the correct clearance has been obtained, remove pinion shaft and pinion gears, install both side gears, clutch packs, and all shims, reinstall

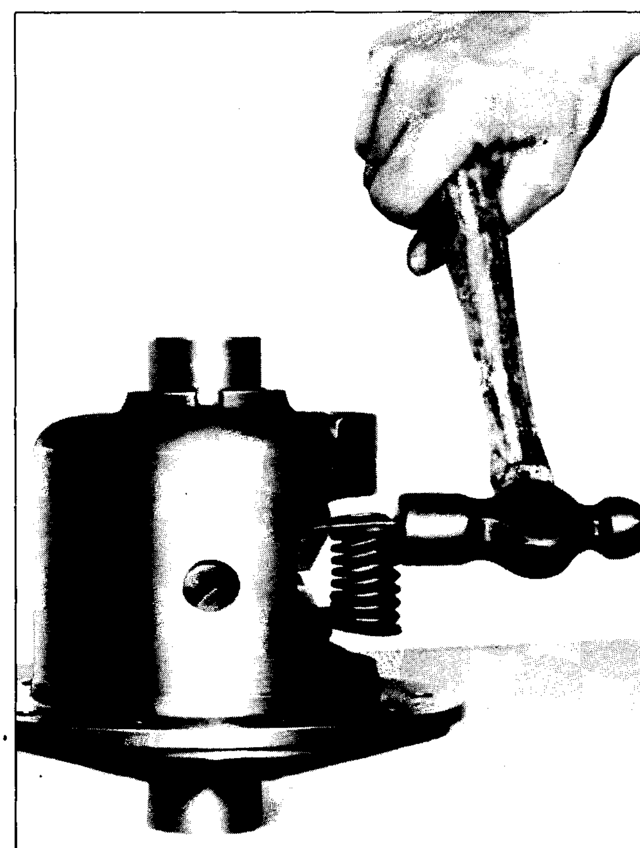


Fig. 4D-10 Installing Preload Springs and Retainers - Clutch Pack Type pinion gears with thrust washers and rotate into their operating position.

6. Reassemble preload springs and retainers with the aid of a vise, C-clamp with bar stock and two 1/4 inch bolts and nuts.

7. Insert spring pack between side gears sufficiently to remove C clamp and bar stock.

8. Tap spring pack further into position and remove 1/4 inch bolts and nuts. Then complete the installation. See Fig. 4D-10.

9. Install ring gear and torque the attaching bolts to 50 lb.ft.

10. Install case assembly into carrier following the procedures in Section 4C.

11. Install axle shaft assemblies pinion gears, "C" washers and pinion shaft as outlined in Section 4C.

12. Install differential cover using new gasket. Torque bolts to 25 lb. ft.

13. Install GM Part Number 1051022 Positive Traction Lubricant or equivalent.

CAUTION: *See Caution on page 1 of this Section regarding the fasteners referred to in step 14 below.*

14. Install brake drums and wheels. Torque wheel nuts to 65 lb. ft. X Series, 70 lb. ft. A, G and F Series, and 75 lb. ft. B Series.

ASSEMBLY - BRAKE CONE TYPE

The following procedure is to be used in assembling the two pinion brake cone type "C" differential.

CAUTION: *When assembling unit, use axle shafts as mounting tools to assure proper gear and cone spline alignment. Do not ignore this procedure or it will be impossible to install shafts at final assembly. Attempting to force shafts into position may result in damage to spring thrust blocks.*

1. Clamp one axle shaft in vise, allowing three inches to extend above vise jaws. Then place cap half of differential case over extended axle shaft, with interior of case facing up (Fig. 4D-11).

NOTE: *Be certain that each cone is installed in proper case half, since tapers and surfaces become matched and their positions should not be changed.*

2. Install proper cone over axle shaft splines, seating it into position in cap half of case.

3. If unit was originally assembled with shims located between side gears and cones for backlash adjustment, reinstall side gear with shim so that gear may seat on shim. If unit was originally assembled without shims, reassemble same way.

4. Place one spring block in position over gear face, in alignment with pinion gear shaft grooves. Install pinion shaft, pinion gears and thrust washers into cap half of differential case in such a manner that pinion shaft retaining dowel can be inserted through pinion gear shaft into differential case. This prevents pinion shaft from sliding out and causing damage to carrier (Fig. 4D-12).

5. Insert six springs into spring block that is already installed into case, then place second spring block over springs. Note offset construction of spring block tabs (Fig. 4D-13).

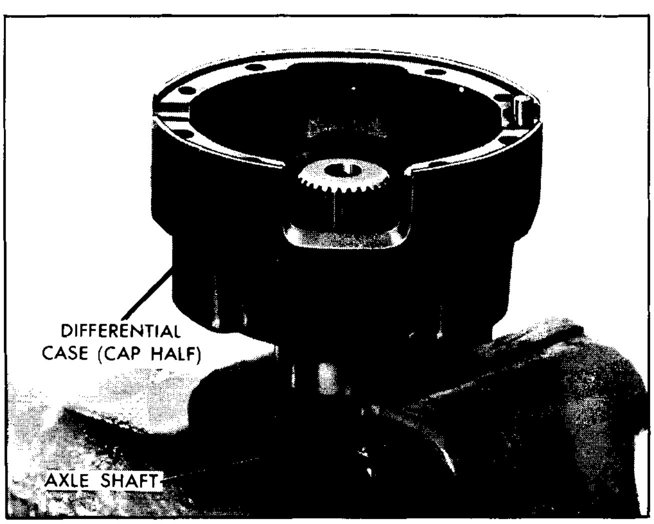


Fig. 4D-11 Axle Shaft and Cap Half of Case

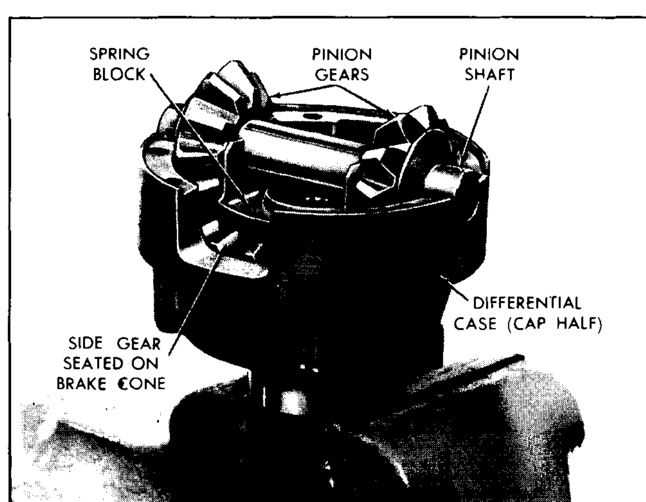


Fig. 4D-12 Installing Parts in Cap Half

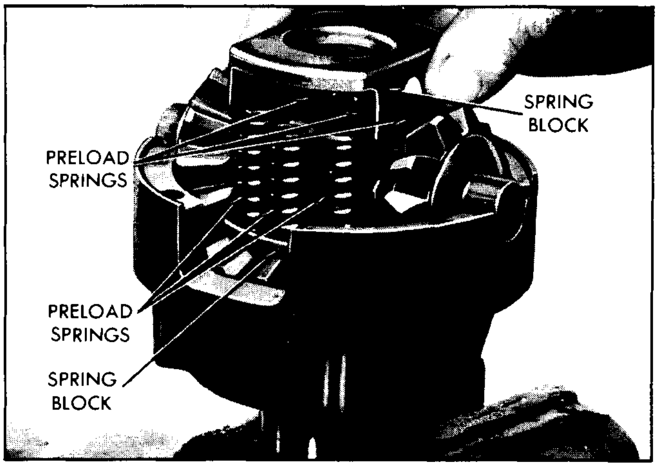


Fig. 4D-13 Installing Second Spring Block

6. Install second side gear, face down on spring block so that side gear will mesh with pinion gears.

7. Place shim, if provided, and remaining cone over side gear.

8. Install flange half of differential case over cone, in proper position to match alignment marks; insert two case half bolts finger tight, 180° apart (Fig. 4D-14).

9. Install other axle shaft through flange half of differential case, rotating axle to enter cone splines and then side gear splines. Leaving the axle shaft in this position, insert remaining bolts and tighten to 30 lb. ft. (Fig. 4D-15).

10. Remove axle shafts (a slight tapping on the shafts with a soft hammer may be necessary to align the splines during assembly. The shafts can then be readily reinstalled without spline interference during final assembly).

11. If side bearings are removed, lubricate outer bearing surfaces and press on bearings as described in Section 4A.

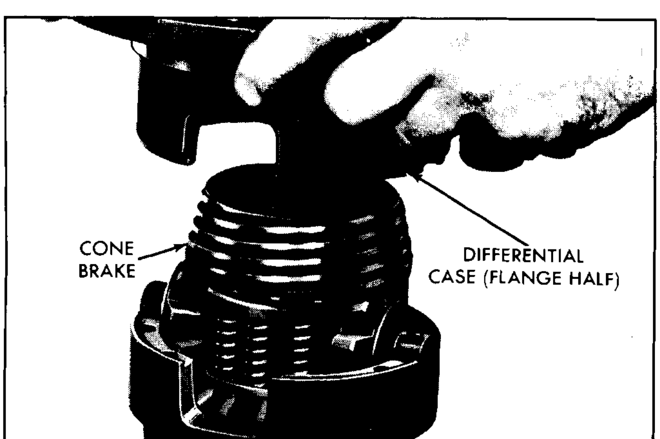


Fig. 4D-14 Installing Flange Half of Differential Case

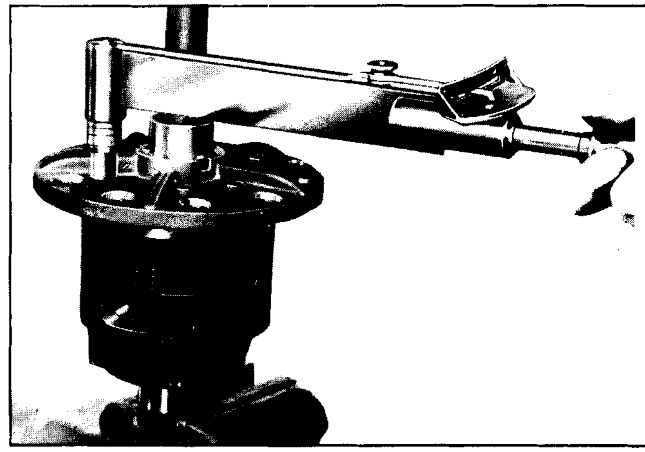


Fig. 4D-15 Torquing Case Half Bolts

12. After making sure that matching surfaces are clean and free of burrs, position ring gear on case so holes are in line.

13. Lubricate attaching bolts with clean engine oil and install.

    CAUTION: *Do not use hammer to force ring gear on case. Ring gear to case bolts have left-hand threads.*

14. Pull ring gear onto case by alternately tightening bolts around case. When all bolts are snug, tighten bolts evenly and alternately across diameter to 90 lb. ft. torque.

15. Install unit into axle carrier following instructions given for Standard Differential.

FLUSHING PROCEDURE

Lubricant contamination will result in chatter. The following procedure is established for flushing this 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.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

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 insure complete removal of the foreign lubricant.
7. Install Safe-T-Track Lubricant (SAE 90 gear lube meeting specification for GM Part No. 1051022) or equivalent.

SPECIFICATIONS

REAR AXLE

Type	Semi-Floating
Type of Drive	Modified Hotchkiss
Drive-Final	Hypoid Gear
Lubricant Capacity	
P-M Coded Axles	88 fl. oz. or 5 1/2 Pints
B, O, G and K Coded Axles	68 fl. oz. or 4 1/4 Pints
W Coded Axles	75 fl. oz. or 4.4 Pints
Lubricant	Part Number 1051022 or equivalent

Lubricant Level
- Bottom of Filler Plug Hole for A, G, F and X Series.
- B Series - P.M. Coded Axles - Bottom of Filler Plug to 3/4" below
- B, G, K and O Coded Axles Flush to 3/8" Below Filler Plug.

RING GEAR AND PINION

Backlash	.005"-.009"
Ring gear run-out maximum	.002"
Ratios	See Ratio Chart
Pinion Bearing Preload (with Ring Gear)	
New Bearings (New Seal)	25 lb. in.
Old Bearings (New Seal)	17 lb. in.
Side Bearing Preload	Slip Fit Plus .008"

TORQUE SPECIFICATIONS

TORQUE	LB. FT.
Differential Cover to Carrier Bolts	25
Differential Bearing Caps to Carrier Bolts	70
Differential Ring Gear to Case Bolts	90
Differential Pinion Shaft Lock Screw	15
Rear U-Joint Companion Flange Nut with Lock Plates	12
Rear U-Joint Companion Flange Nut with Lockwashers	14
Rear Axle Upper Control Arm Assy. to Axle Housing Bolt-A, B or G Series	110
Rear Axle Upper Control Arm Assy. to Axle Housing Nut	80
Rear Axle Lower Control Arm Assy. to Axle Housing Bolt	110
Rear Axle Lower Control Arm Assy. to Axle Housing Nut	80
Rear Axle Bumper Spacer to Axle Housing Bracket Bolt and Nut (Station Wagon)-A Series	50
Rear Axle Upper Control Arm Assy. to Frame Bolt	110
Rear Axle Upper Control Arm Assy. to Frame Nut	80
Rear Axle Lower Control Arm Assy to Frame Bolt	110
Rear Axle Lower Control Arm Assy. to Frame Nut	80
Rear Shock Absorber to Axle Housing Bracket Nut	65
Shock Absorber to Frame Bolt	20
Rear Wheel and Drum to Axle Shaft Nut-	
B Series	75
A, F and G Series	70
X Series	65
Rear Brake Assy. to Axle Housing Bolt and Nut	8
Pinion Nose Bumper	8
Differential Case Bolts (Safe-T-Track)-A or G Series	30

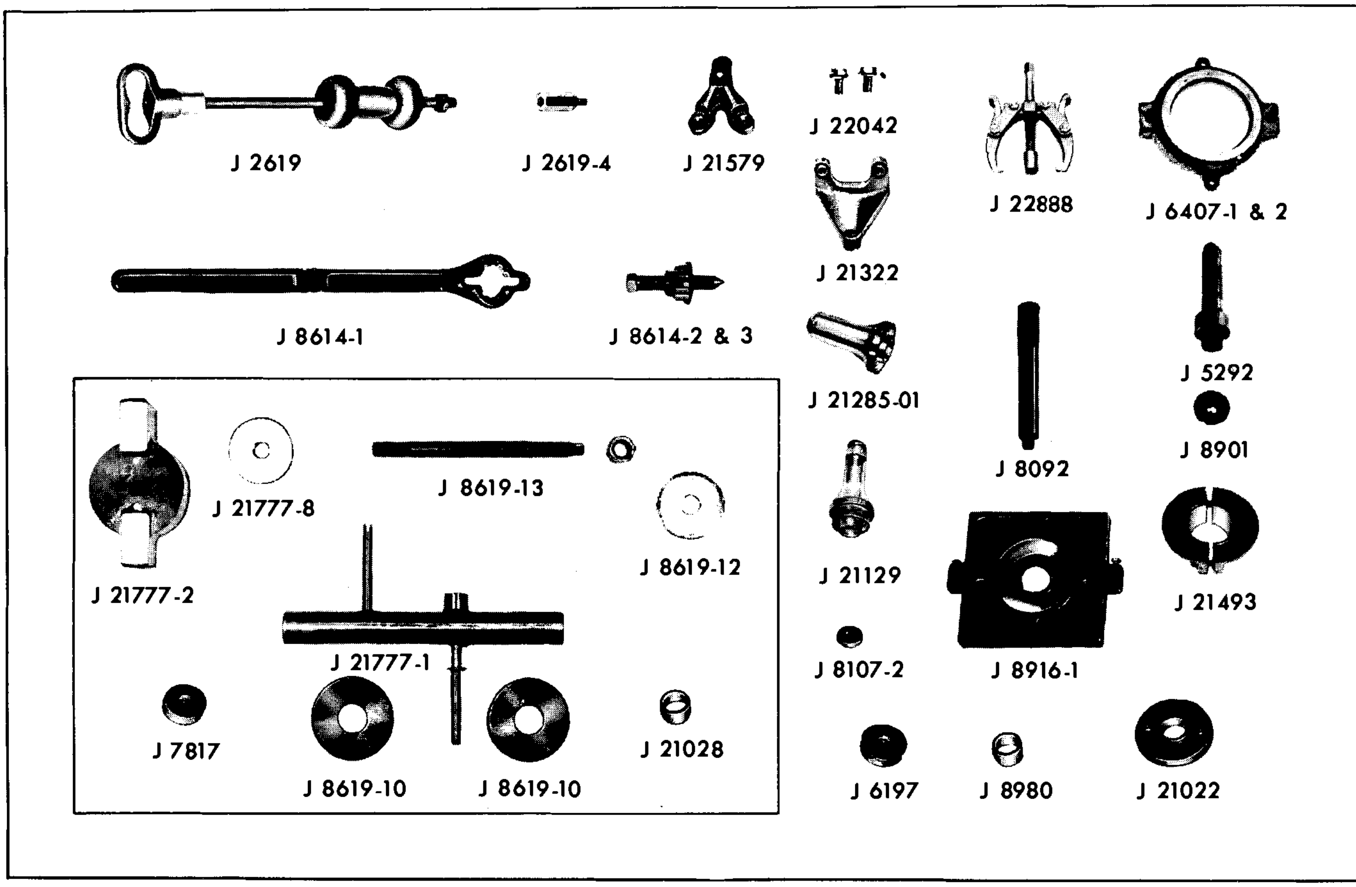


Fig. 4D-16 Special Tools

J 8608	Rear Pinion Outer Race Installer
J 8609	Rear Pinion Bearing Installer
J 8612	Rear Pinion Bearing Remover
J 8614-10	Companion Flange Holding Tool
J 8614-2 & 3	U-Joint Companion Flange Puller
J 8619-10	Pinion Depth Gauge Discs
J 8619-12	Pilot
J 8619-13	Pinion Depth Gauge Bolt & Nut
J 8901	Side Bearing Support
J 2619	Slide Hammer
J 2619-4	Adapter
J 5292	Side Bearing Installer
J 6197	Rear Pinion Bearing Outer Race Installer
J 6407-1 & 2	Press Plate Holder & Insert
J 7817	Front Pinion Bearing Outer Race Installer
J 8092	Drive Handle
J 8107	Side Bearing Puller (Not Shown)
J 8916-1	Split Plate
J 8980	Differential Side Bearing Installer
J 9746	Rear Pinion Bearing Remover
J 21022	Axle Shaft Bearing Installer
J 21028	Differential Side Bearing Installer
J 21129	Axle Shaft Oil Seal Installer
J 21285-01	Pinion Oil Seal Installer
J 21322	Case Remover
J 21493	Rear Pinion Bearing Remover
J 21579	Axle Shaft Remover
J 21777	Pinion Depth Gauge
J 21777-1	Cross Shaft Assy.
J 21777-2	Gauge Plate
J 21777-8	Washer
J 21777-26	Gauge Plate
J 22042	Left Hand Bolt and Sleeve Set
J 22388	Pinion Oil Seal Installer
J 22888	Side Bearing Puller (Four Pinion Differential)
J 23469	Axle Bearing Remover
J 23674	Axle Bearing Remover
J 5504	Wheel Stud Remover
BT-6623	Shim Installer

SECTION 4E

PROPELLER SHAFT

(DRIVE SHAFT)

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

TROUBLE DIAGNOSIS AND TESTING

LEAK AT FRONT YOKE

NOTE: *An occasional drop of lubricant from splined yoke is normal and requires no attention.*

CAUSE	CORRECTION
a. Rough outside surface on splined yoke.	a. 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.
b. Defective transmission rear oil seal.	b. Replace transmission rear oil seal.

KNOCK IN DRIVE LINE

(Clunking noise when car is operated under floating condition at 10 mph in high gear or neutral)

CAUSE	CORRECTION
a. Worn or damaged universal joints.	a. Disassemble universal joints, inspect and replace worn or damaged parts.
b. Side gear hub counterbore in differential worn oversize.	b. Replace differential case and/or side gears as required.

PING, SNAP OR CLICK IN DRIVE LINE

(Usually occurs on initial load application after transmission has been put in gear, either forward or reverse.)

CAUSE	CORRECTION
a. Loose upper or lower control arm bushing bolts.	a. Tighten.
b. Loose companion flange.	b. Remove companion flange, turn 180° from its original position, apply white lead to splines and reinstall. Pinion nut must be tightened to original position.

ROUGHNESS OR VIBRATION

With tachometer installed in car, determine whether propeller shaft is cause of complaint by driving through speed range and note the engine speed (rpm) at which vibration (roughness) is most pronounced. Then, shift transmission to a different gear range and drive car at same engine speed (rpm) at which vibration was noted before. Note the effect on the vibration:

If vibration occurs at the same engine speed (rpm), regardless of transmission gear range selected, propeller shaft assembly is **not** at fault.

If vibration decreased, or is eliminated, in a different gear range but at the same engine speed (rpm), check the following possible causes:

CAUSE	CORRECTION
a. Bent or dented propeller shaft.	a. Replace.
b. Undercoating on propeller shaft.	b. Clean propeller shaft.
c. Tire unbalance.	c. Balance wheel and tire assemblies or replace from a known good car.
d. Excessive U-bolt torque.	d. Check and correct.
e. Tight universal joints.	e. Impact yokes with a hammer to free up. Overhaul joint if unable to free up or if joint feels rough when rotated by hand.
f. Worn universal joints.	f. Overhaul, replacing necessary parts.
g. U-joint retainer bent against bearing cup.	g. Overhaul, replacing necessary parts.
h. Burrs or gouges on companion flange.	h. Rework or replace companion flange.
i. Propeller shaft or companion flange unbalance.	i. Check for missing balance weights on propeller shaft. Remove and reassemble propeller shaft to companion flange, 180° from original position.
j. Incorrect rear joint angle.	j. Check and correct trim height at curb weight.

GENERAL DESCRIPTION

The propeller shaft (drive shaft) is a steel tube which is used to transmit power from the transmission output shaft to the differential (Fig. 4E-1).

To accomodate various model wheelbase, transmission combinations and differential pinion nose angles, propeller shafts differ in length, diameter, type of splined yoke and rear universal joint usage.

Each shaft is installed in the same manner. 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 splined slip yoke permits fore and aft movement of the propeller 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 splined yoke from dust, dirt and other harmful material. On all A, F, G and X Series models and B Series station wagon models, a standard single cardon universal joint (Fig. 4E-1) attached by either two U-bolts or four attaching bolts and two straps, is used where the prop shaft mates to the differential companion flange.

A double cardon constant velocity type universal joint is used at the differential end of the propeller shaft on all B Series vehicles except station wagons (Fig. 4E-2). The double cardon joint is necessary on these B Series models because of the extreme angle of the differential pinion nose.

Universal joint needle bearings are held in place by the journal. There is a groove in the O.D. of this journal (Fig. 4E-11) which mates with another groove in the I.D. of the propeller shaft yoke (Fig. 4E-1). Once the grooves are properly aligned on A, G, F and B Series vehicles, a nylon composition material is injection molded between them, through a hole in the yoke. This retains the journal to the yoke. Service universal joints for both the single and double cardon joints will, however, use snap rings for bearing cap retention. On X Series vehicles the journal is retained to the yoke by snap rings.

The double cardon constant velocity universal joint is composed of two single joints connected by a special link yoke. A center ball and socket between the joints maintains the relative position of the two joints (Fig. 4E-2). The center ball seat consists of three replaceable steel seat inserts.

The propeller shaft assembly requires very little periodic service. The universal joints are lubricated for life and cannot be lubricated while on the car. A service kit for both the single and double cardon joints, which consists of journal with bearing assemblies and snap rings, must be installed on the car if a universal joint becomes worn or noisy. A second service kit is available for the double cardon joint center ball seat and consists of the three ball seats, seal, washer and spring. If it becomes necessary to repair or service a universal joint, the entire propeller shaft must be removed from the car.

Since the propeller shaft assembly is a balanced unit, it should be kept completely free of undercoating and other foreign material which could upset shaft balance. It is essential that the locating mark on companion flange be in alignment with mark on propeller shaft yoke for optimum balance.

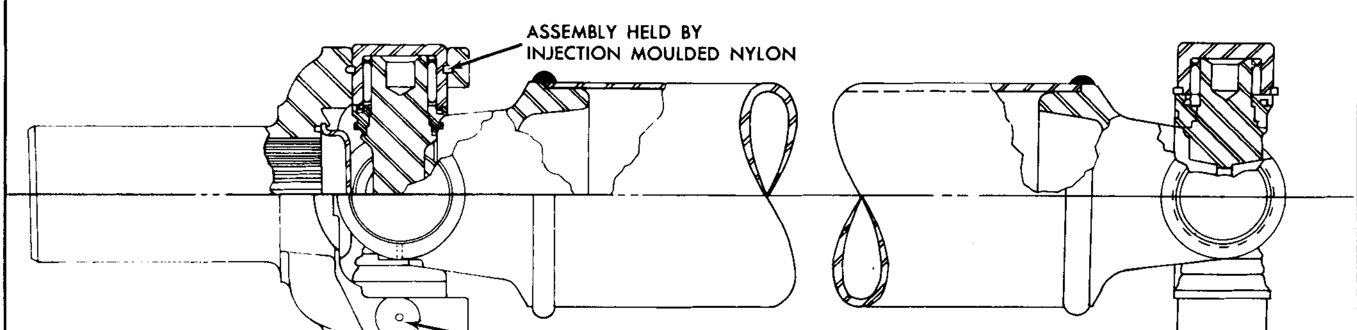


Fig. 4E-1 Typical View of Propeller Shaft with Single Cardon Rear U-Joint

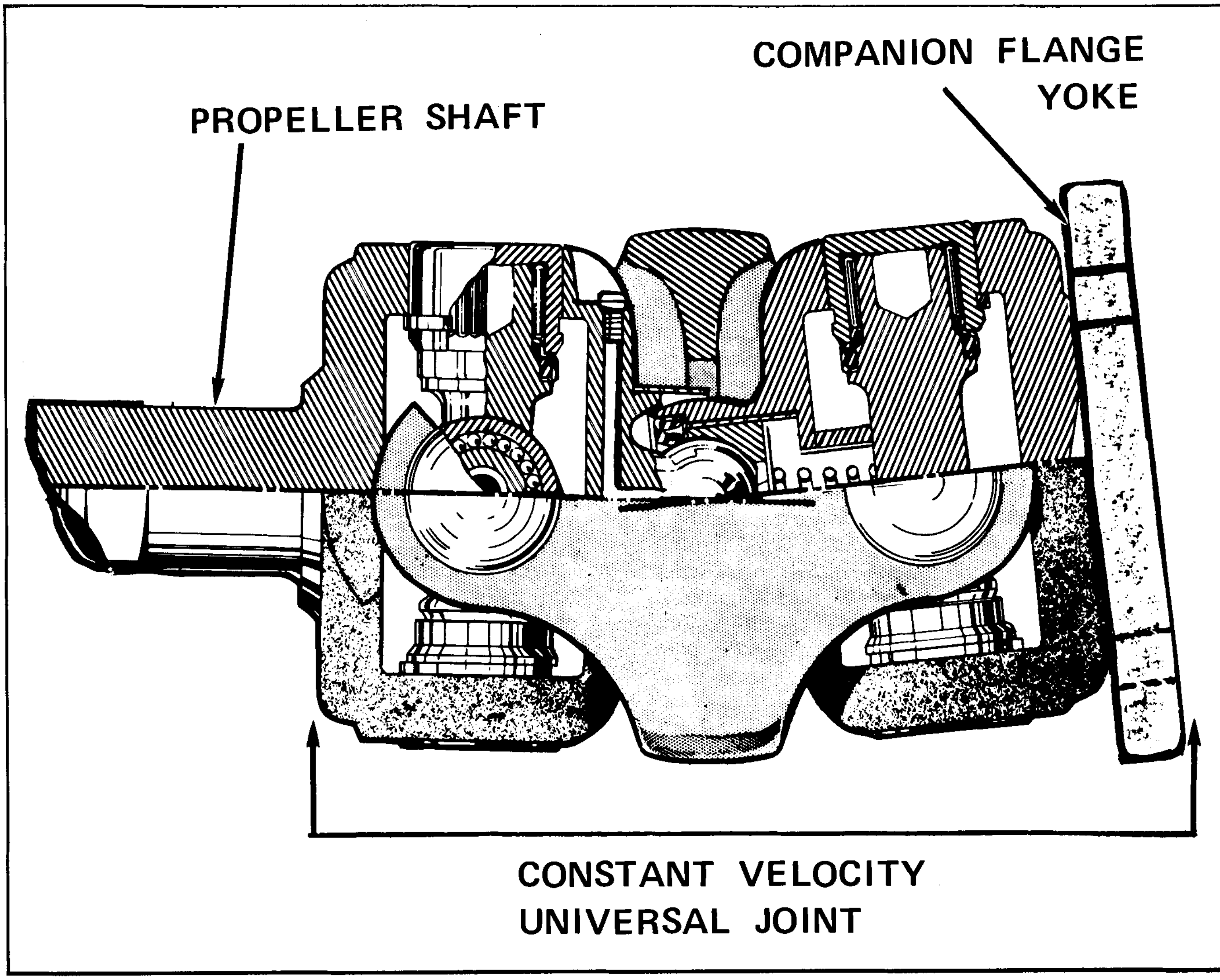


Fig. 4E-2 Cross Section of Double Cardon Constant Velocity U-Joint

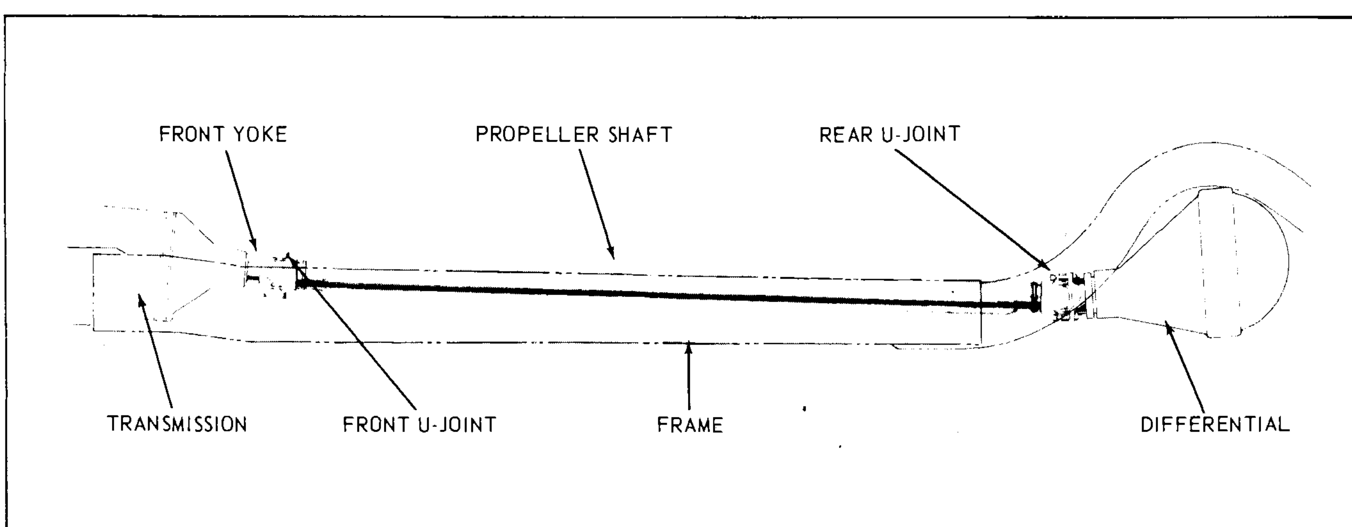


Fig. 4E-3 Relationship of Propeller Shaft to Transmission, Differential and Frame

INSPECTION

No periodic inspection of propeller shaft assembly is required.

MINOR SERVICES AND REPAIRS

ALIGNMENT OF ENGINE AND PROPELLER SHAFT

All necessary differential pinion angle requirements are designed and built into rear upper and lower control arm geometry. Slots in the engine support rear crossmember provide for fore and aft movement of engine-transmission assembly to provide for minor variation in positioning.

MAJOR REPAIRS

REMOVE PROPELLER SHAFT

> **CAUTION:** *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

1. Mark propeller shaft rear yoke (single cardon joint) or universal joint flange (double cardon joint) and

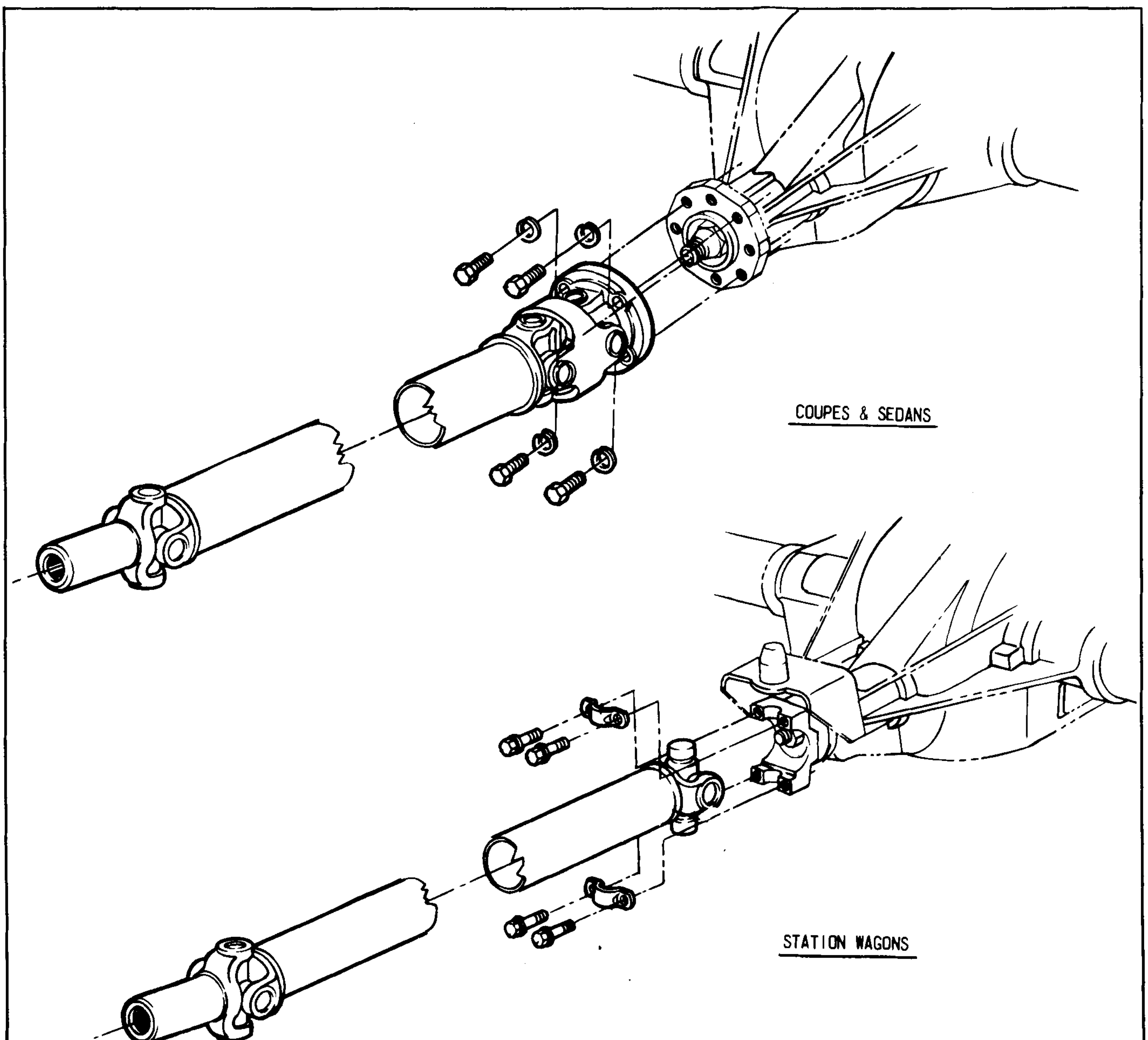


Fig. 4E-4 Propeller Shaft Installation - B Series

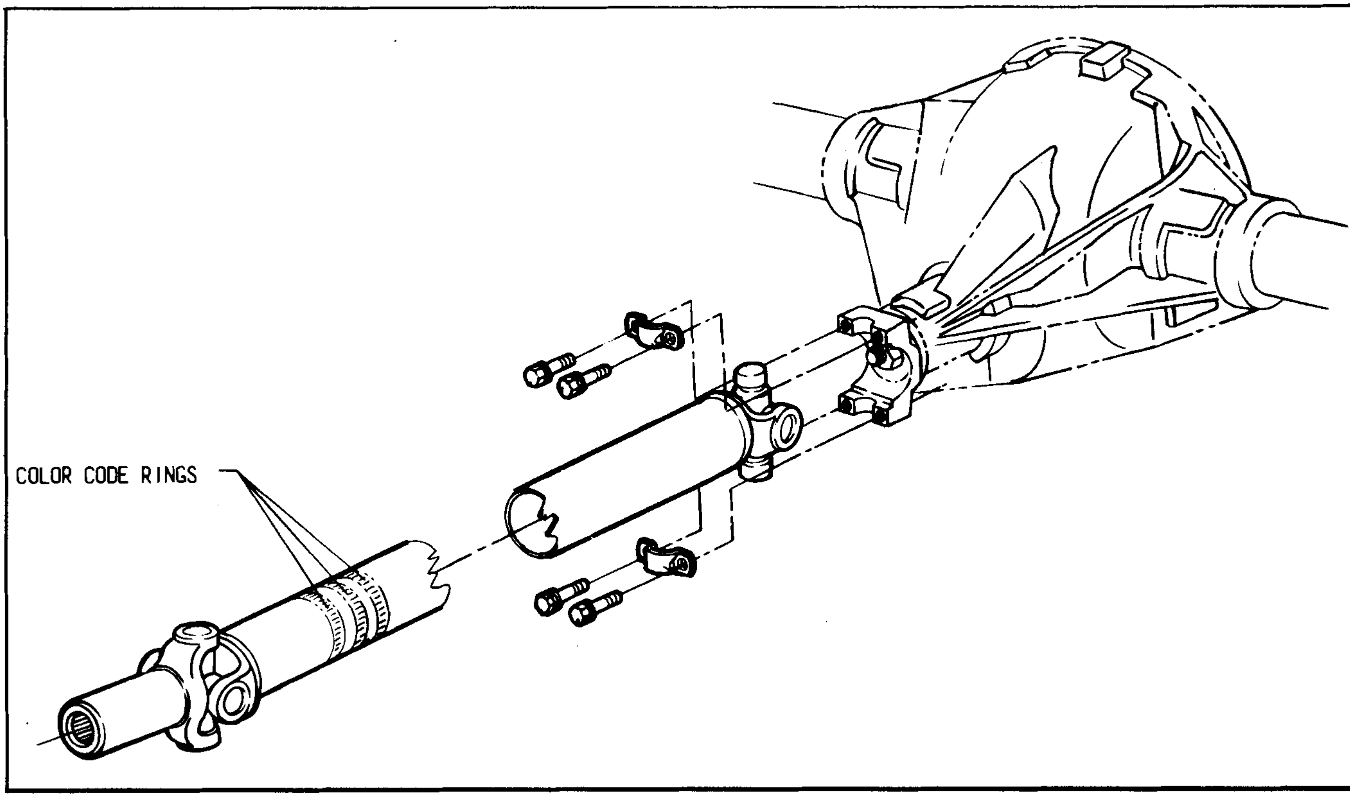


Fig. 4E-5 Propeller Shaft Installation - F Series

differential companion flange to insure their correct alignment on re-assembly.

2. Remove U-bolt nuts (or four bolts), lockplates (or lockwashers) and U-bolts (or straps) from rear axle drive pinion companion flange.

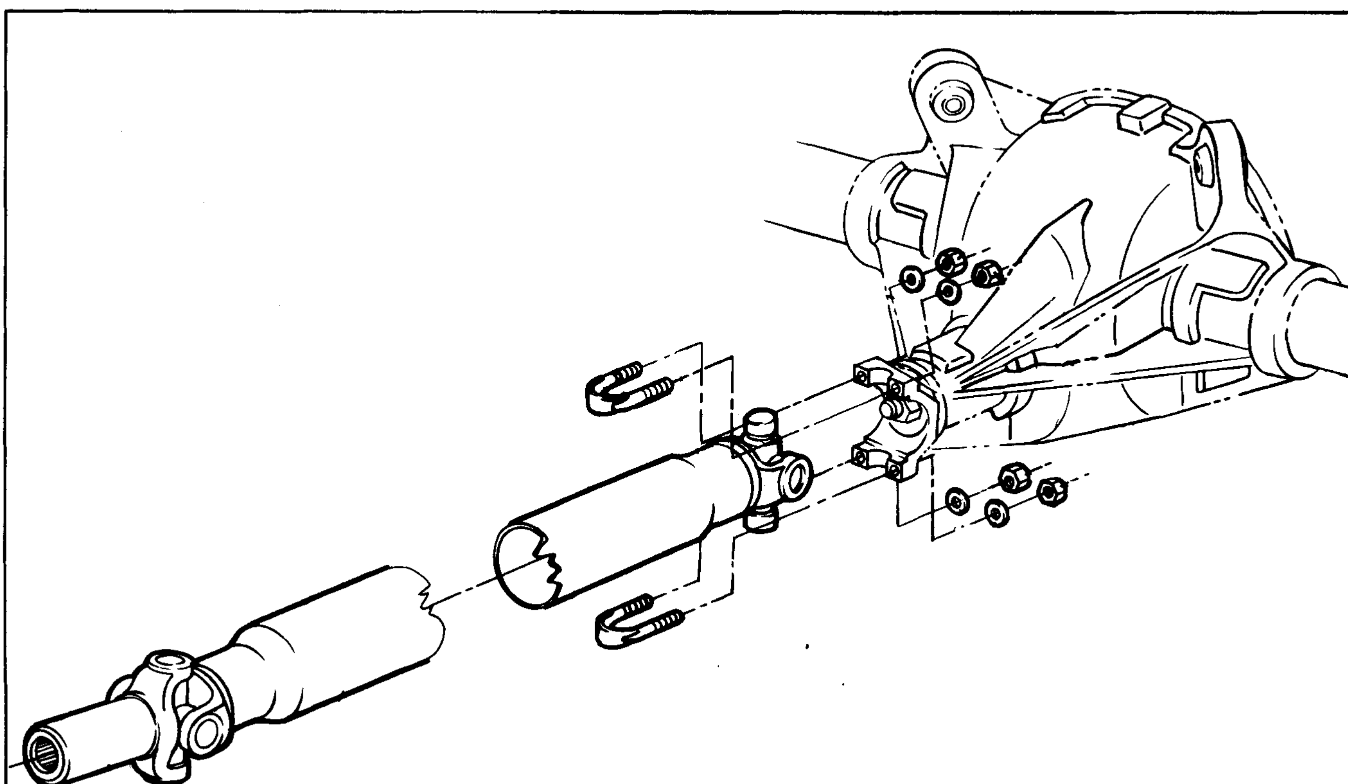


Fig. 4E-6 Propeller Shaft Installation - A and G Series

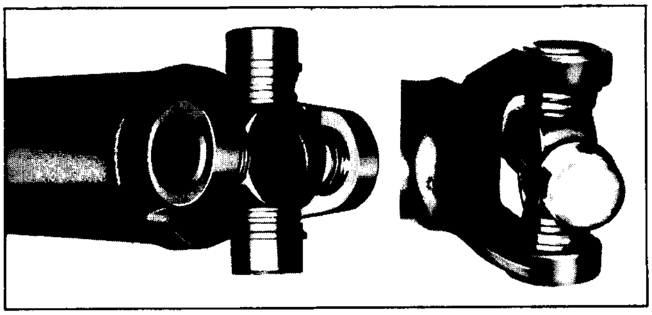


Fig. 4E-7 Bearings Held in Place by Tie Wire

3. If bearing tie wire has been removed, use suitable rubber band or tape to hold bearings onto journal, thus preventing loss of bearing rollers while rear universal joint is being disconnected (Fig. 4E-7).

4. Remove complete propeller shaft assembly by sliding it downward and rearward to disengage splined yoke from splines on transmission output shaft.

CAUTION: *Do not bend double cardon constant velocity joint to its extreme angle at any time.*

DISASSEMBLE UNIVERSAL JOINTS

NOTE: *Because of elastic properties of nylon retainers used on the universal joint bearings, they must be pressed out. This shears nylon retainers in half, rendering bearings and journal unsuitable for re-use. Therefore, upon reassembly, new bearing and journal assemblies employing conventional snap ring retainers MUST be used. Consult parts book for repair kit part number.*

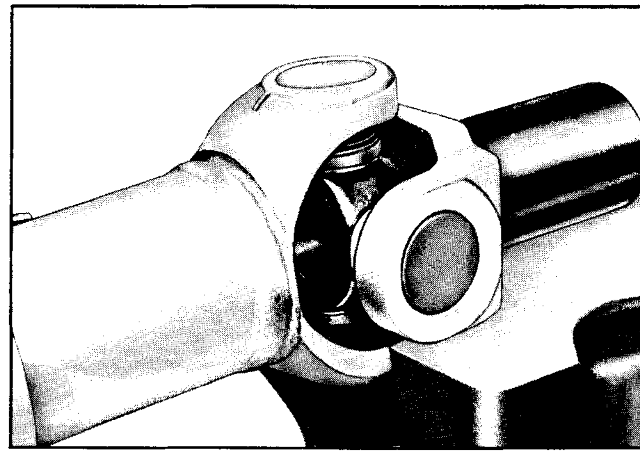


Fig. 4E-9 Supporting Splined Yoke

FRONT U-JOINT OR SINGLE CARDON REAR U-JOINT

1. Support splined yoke (front universal) or journal (rear universal) on a press bed in manner that will allow propeller shaft fixed yoke to be moved downward (Fig. 4E-8 and 4E-9). Use a stand to support the propeller shaft in a horizontal position. Be sure weight is evenly distributed on each side of splined yoke.

CAUTION: *Never clamp propeller shaft tubing in a vise as the tube is easily dented. Always clamp on one of the yokes.*

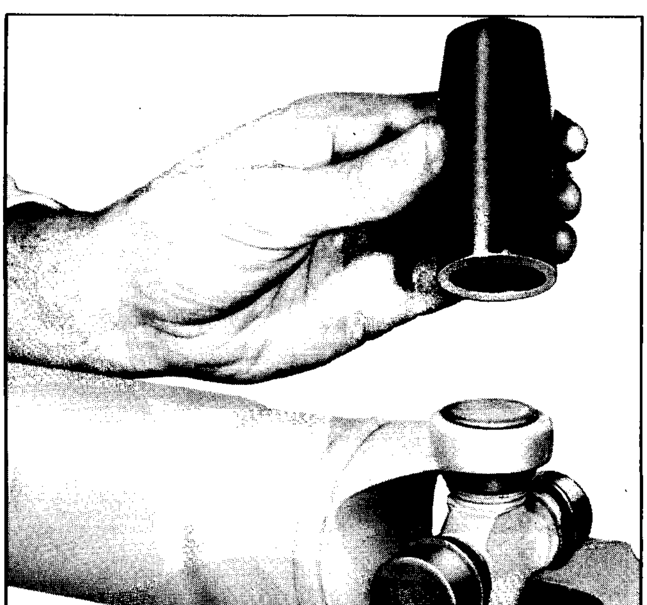


Fig. 4E-8 Removing Bearing From Yoke With 1-1/8" Pipe

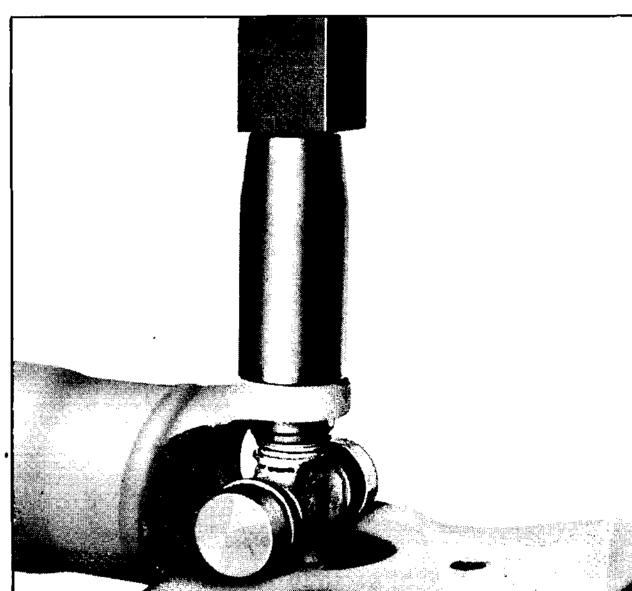


Fig. 4E-10 Pressing Out Bearing

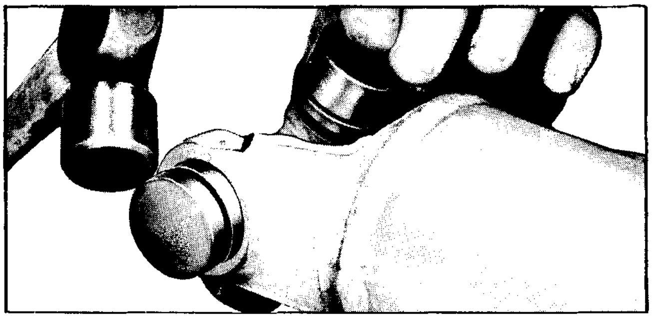


Fig. 4E-11 Tapping Out Bearing

2. Using piece of pipe or similar tool with diameter sufficiently large (slightly larger than 1 1/8") to encircle the bearing shell, apply force on propeller shaft fixed yoke until downward movement of propeller shaft fixed yoke and stationary position of journal forces the bearing assembly almost completely out top of yoke (Fig. 4E-10). This will shear nylon retainers which hold bearings in place).

3. Rotate propeller shaft 180° and repeat preceeding step to partially remove opposite bearing.

4. Complete removal of these bearings by tapping around circumference of exposed portion of bearing with small hammer (Fig. 4E-11).

5. Remove journals from propeller shaft fixed yoke.

6. Remove bearings and journal from splined yoke in a similar manner.

DOUBLE CARDON CONSTANT VELOCITY REAR U-JOINT

NOTE: *For ease of disassembly, remove universal joint bearings from flange yoke first.*

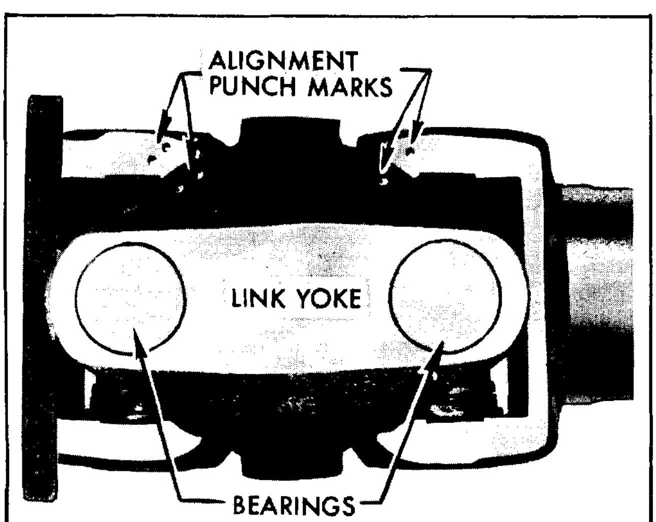


Fig. 4E-12 Alignment Marks on Link Yoke

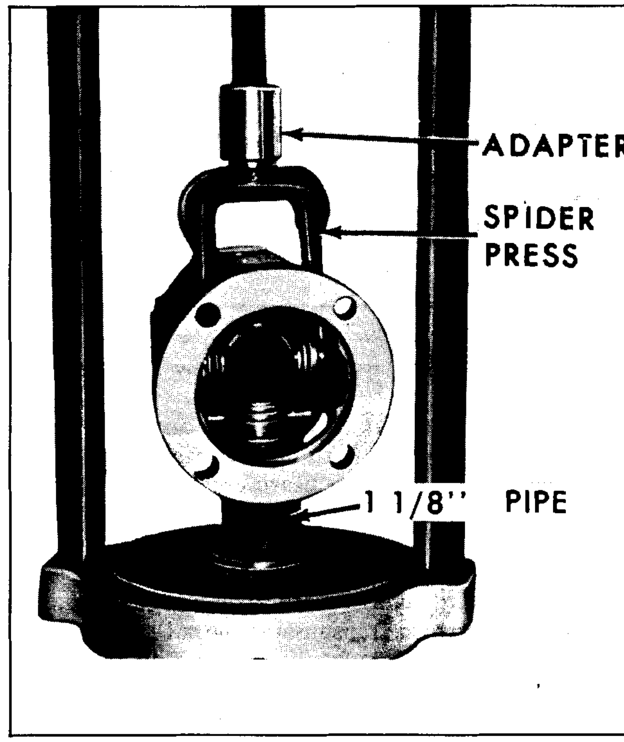


Fig. 4E-13 Disassembling Double Cardon Rear U-Joint

1. Mark yokes with a punch or scribe before disassembly to insure reassembly in their original position to maintain proper balance (Fig. 4E-12).

2. Support front of propeller shaft on a stand in a horizontal position. Using J 8609 (Differential Rear Pinion Bearing Installer) as a base plate on a press bed and a tool such as a piece of 1 7/8" pipe, support the flange yoke as shown in Fig. 4E-13.

3. Install Spider Press, J 9522-3 as illustrated in Fig. 4E-13.

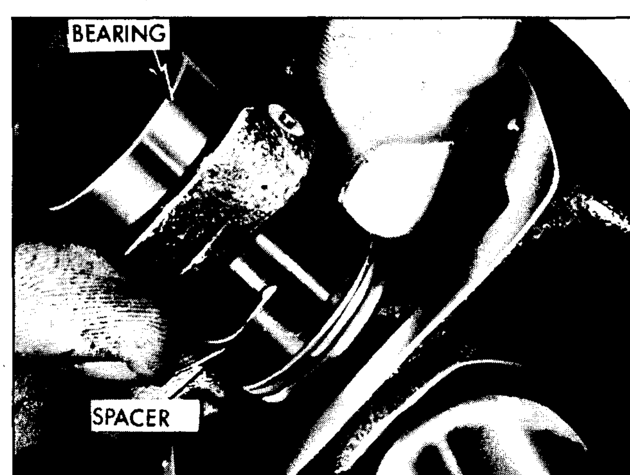


Fig. 4E-14 Installing Spacer

4. Actuate the press pump and force the spider against the lower bearing to shear the nylon injection ring which retains the bearing cap in the yoke. Press the bearing as far out of the yoke as possible.

5. Release the pump and rotate the propeller shaft 180° to the opposite side. Repeat Step 4.

6. Complete removal of bearings by tapping around circumference of exposed portion of bearing with small hammer (Fig. 4E-11). As an alternate method, Spacer J 9522-5 may be used and installed over the spider journal in space provided by having forced the bearing partially through the flange yoke (Fig. 4E-14).

7. If using the spacer, reposition the propeller shaft in the press and with the added assistance of the spacer, press the bearing completely out of the yoke.

8. Remove flange yoke.

9. Remove 1 7/8" section of pipe from fixture and position double cardon joint in fixture to remove link yoke universal bearings next. Proceed and remove remaining bearings by repeating steps 2 thru 7.

DISASSEMBLY OF BALL STUD SEAT

1. Position flange yoke in a vise so that the ball stud seat is accessible for removal.

2. With a screwdriver, pry out the seal and remove the spacer, ball seats, washer and spring (Fig. 4E-15).

CLEANING AND INSPECTION

Clean and inspect outer surface of propeller shaft splined yoke to ensure that it is not burred, since burrs will damage transmission seal. Also, inspect splines of front yoke for freedom from dirt.

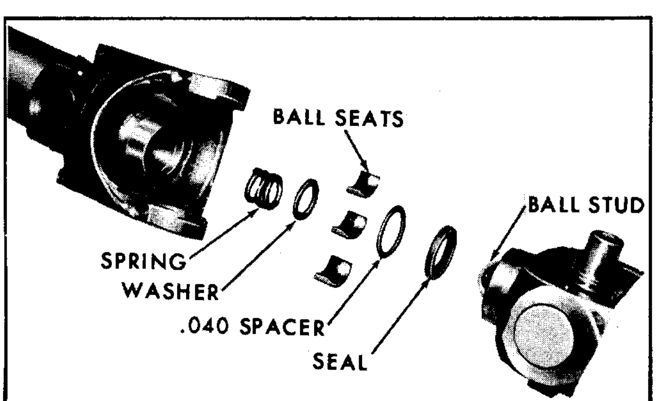


Fig. 4E-15 Ball Stud Seat - Exploded View

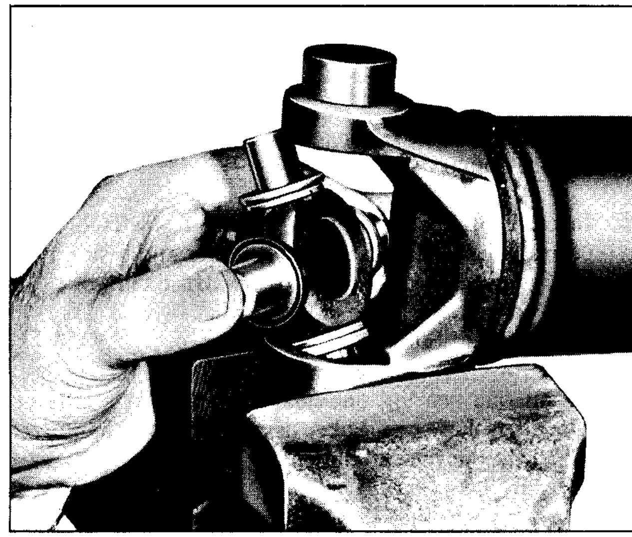


Fig. 4E-16 Installing Journal to Yoke

ASSEMBLE UNIVERSAL JOINTS

NOTE: *If original universal joints are disassembled, new bearing and journal assemblies must be used for reassembly. Consult parts book for repair kit part number.*

A. Transmission End

1. Install one bearing one-quarter way in one side of splined yoke, using soft-faced hammer. Check for proper alignment.

2. Insert journal into splined yoke so that arm of journal seats in bearing and tap bearing in the remainder of the way (Fig. 4E-16).

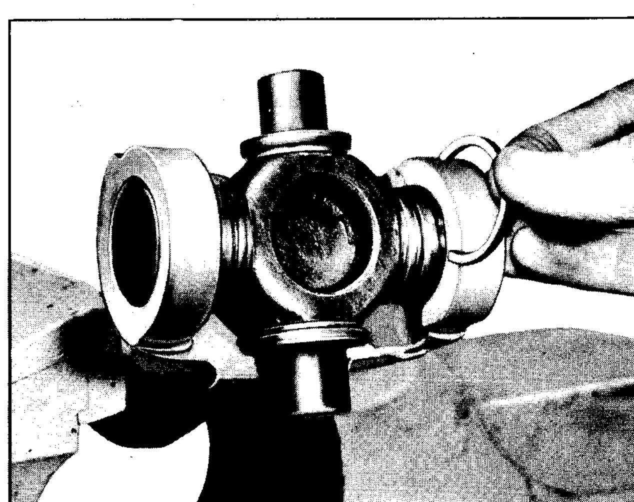


Fig. 4E-17 Installing Snap Ring Retainer

3. Install opposite bearing, ensuring that bearing rollers do not jam on journal. Check for free movement of journal in bearings.

4. Install snap ring retainer in each journal with gaps toward splined yoke (Fig. 4E-17).

5. Install bearings and splined yoke to front fixed yoke of propeller shaft in a similar manner and install two snap ring retainers with gaps toward fixed yoke.

Differential End Single Cardon Joint.

1. Install one bearing one-quarter way in one side of propeller shaft rear yoke, using soft-faced hammer. Check for proper alignment.

2. Insert journal into rear yoke so that arm of journal seats in bearing and tap bearing in the remainder of the way (Fig. 4E-16).

3. Install opposite bearing, ensuring that roller bearings do not jam on journal. Check for free movement of journal in bearings.

4. Install snap ring retainer in each journal with gaps toward rear fixed yoke (Fig. 4E-17).

5. Install two remaining bearings onto journal arms, using suitable rubber band or tape to hold bearings to journal.

Differential End - Double Cardon Joint

Examine ball stud seat and ball stud for scores or wear. Worn seats can be replaced using a replacement kit consisting of three seats, one spring, a washer and seal. Since the ball stud is an integral part of the propeller shaft yoke, any scoring or wear of the ball will require replacement of the entire propeller shaft yoke and flange assembly.

1. Thoroughly clean ball seat cavity. Proceed as follows:

   NOTE: *Inspect ball seat cavity. If the ball seat bore is scored or worn, replacement of the propeller shaft assembly will be required.*

2. Pack spring cavity with grease supplied in repair package.

3. Install spring, washer, ball seats and spacer. Apply a thin coat of non-hardening sealer to the outer diameter of the seal and install the seal with the lip towards the seat using Special Tool J 23694, (Fig. 4E-18).

4. Stake the seal lightly in four places in the same location as staked prior to removal. Use care not to overstake so as to damage or distort the seal.

5. Install bearings and journals as described in steps 1 thru 5 of B above, making sure to align punch or scribe marks on yokes (Fig. 4E-12).

INSTALL PROPELLER SHAFT ASSEMBLY

1. Inspect outer diameter of splined yoke to ensure that it is not burred, as this will damage transmission seal.

2. Apply engine oil to inside spline and outside diameter of yoke and slide propeller shaft splined yoke onto transmission output shaft.

   NOTE: *When installing rear universal, be sure to align mark on companion flange with mark on propeller shaft rear yoke.*

3. Position rear universal joint to rear axle companion flange, making sure bearings are properly aligned in companion flange yoke.

   CAUTION: *See Caution on page 1 of this Section regarding the fasteners referred to in step 4 below.*

4. Install U-bolts (or straps), lockplates (or lockwashers), nuts (or bolts) and tighten U-bolt nuts (or bolts) to 12 lb. ft. torque (single cardon joint) or 70 lb. ft. torque (double cardon joint).

TORQUE SPECIFICATIONS

U-Bolt Nuts or Straight Bolts

12 lb. ft. (with lock plates)
14 lb. ft. (with lock washers)
70 lb. ft. (double cardon joint bolts)

PROPELLER SHAFT CHART		
VEHICLE	COLOR BANDS	USAGE
A Series 4 Door Station Wagon	1 Red, 1 Pink 1 Red, 1 White	V 400, V 455, with M 40, 4 Spd. Man. , 4 Spd. Man. V 400, V 455 with 3 Spd. Man., 3 Spd. Man. L 250, V 350/2 Bbl., with 3 Spd. Man.,4 Spd. Man., M 35, M 38
A & G Series 2 Door Convertible	3 Blue 1 Black, 1 Purple	V 400, V 455 with M 40, 4 Spd. Man. V 400, V 455 with 3 Spd. Man. L 250, V 350/2 Bbl., with M 35, M 38, 3 Spd. Man.,4 Spd. Man.
B Series Sedan	1 Red, 1 Brown 1 Green, 1 Pink	V 400/4 Bbl., V 455 with M 40 V 400/2 Bbl., with M 40
B Series Station Wagon	1 Red, 1 Yellow	All
F Series	1 Orange, 1 White, 1 Black 1 Orange, 1 White, 1 Yellow 1 Orange, 1 White, 1 Brown	L 250, with M 35, M 38, 3 Spd. Man. V 400 & V 455 with M 40, 4 Spd. Man. V 400, V 455 with 3 Spd. Man. V 350 with M 35, M 38, 3 Spd. Man, 4 Spd. Man.
X Series	1 Orange, 1 Purple, 1 Pink 1 Orange, 1 Purple, 1 Brown	L 250, V 307 V 350

Fig. 4E-18 Propeller Shaft Comparison and Usage Information

SECTION 5

BRAKES - GENERAL

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

TROUBLE DIAGNOSIS AND TESTING

TESTING FOR LEAK IN HYDRAULIC SYSTEM

NOTE: *If there is any evidence of air in system, brakes must be bled before making this test.*

1. Apply brakes manually, holding as steady a force as possible.

2. If pedal sinks slowly toward floor, a leak is indicated. Check for location of the leak by examining all lines, connections and wheel cylinders. If external leak is not found, remove master cylinder, disassemble and inspect parts. Leaks will usually be past primary piston cup due to porous or damaged cup or cylinder bore.

NOTE: *Linings should be replaced if suitable solvent will not adequately clean brake fluid from linings.*

Following is a list of common troubles occurring in the brake system with possible causes and remedies:

LOW PEDAL

CAUSE	REMEDY
Hydraulic System Failure.	Check master cylinder for empty reservoir. Check for leak at master cylinder, wheel cylinder, hoses, metal pipes, and all connections.

Automatic adjustors not working.	Inspect for incorrect installation or frozen adjuster screw and correct as necessary.
Low fluid level in master cylinder reservoir.	Low fluid level in reservoir will permit air to be pumped into hydraulic lines. This necessitates refilling reservoir and bleeding lines. Find cause of low fluid and correct.
External leak in hydraulic system, or leak past master cylinder primary piston cup.	Check for leak in system as outlined above.
Air trapped in hydraulic system.	Air trapped in hydraulic system gives pedal a very soft feel at the beginning of travel. Bleed brakes.
Improper fluid.	Improper fluid may boil at high temperature. Flush system and refill with brake fluid complying with specifications.

ONE WHEEL DRAGS

CAUSE	REMEDY
Improperly adjusted parking brake cables (rear wheels only) or stuck cable.	Adjust parking brake cables and lubricate.
Weak or broken brake shoe return springs.	Replace defective brake shoe springs and lubricate brake shoe ledges and shoe contact at anchor pin with wheel bearing grease or brake lubricant.
Brake shoe to drum clearance too small.	Readjust brakes.
Loose or incorrect front wheel bearings.	Adjust front wheel bearings or replace.
Wheel cylinder piston cups swollen or distorted or piston stuck.	Replace inoperative or damaged parts. Look for evidence of dirt in hydraulic system which could cause damage to the cylinders or cups. See first item under **ALL BRAKES DRAG . .**
Obstruction in line.	Obstruction in line may be caused by foreign material or flattened or kinked tube. If dirt is found in line, remove obstruction and flush hydraulic system with fresh brake fluid. If tube is flattened or kinked, replace damaged parts.
Backing plate shoe pads grooved.	Grind or file pads smooth and lubricate.
Incorrect brake shoe radius.	Replace malfunctioning brake shoe.

ALL BRAKES DRAG OR PEDAL BUILDS UP WITH USE AFTER ADJUSTMENT IS CHECKED AND FOUND TO BE CORRECT

CAUSE	REMEDY
Mineral oil, etc., in system.	The presence in the hydraulic system of any mineral oil, kerosene, gasoline, shock absorber or transmission fluid, or carbon tetrachloride will cause swelling of rubber piston cups, and valves, so they become inoperative. This is first noticed in the master cylinder. Brakes will not release freely if master cylinder primary piston cup has swollen

CAUSE	REMEDY
	sufficiently to obstruct the compensating port. Flush system thoroughly with a good grade of clean brake fluid and replace all internal rubber parts in brake system.
Pedal does not return freely.	Lubricate pedal linkage and make certain no bind exists. See that stop light switch is not defective, incorrectly adjusted, or that switch plunger is not binding on pedal due to lack of lubrication.
Compensating port of master cylinder closed.	The compensating port in master cylinder must be completely clear when pedal is in released position. 1. See that pedal returns freely and is not stopped by contact with stop light switch body or pedal bracket. 2. See that compensating ports are not plugged by dirt. To check compensating port, remove master cylinder reservoir cover and watch the fluid in the cylinder as the brake pedal is moved. A geyser should be seen as the pedal is first depressed. If no geyser is seen, the compensating port is blocked. 3. Inspect master cylinder primary piston cup and if found to be swollen or elongated, flush system and replace damaged parts.

BRAKES DO NOT AUTOMATICALLY ADJUST

CAUSE	REMEDY
Worn, bent or distorted adjuster lever.	Replace adjuster lever.
Improper secondary lining to drum clearance.	Adjust clearance.
Brake linings excessively worn.	Install new linings.

SPONGY PEDAL

CAUSE	REMEDY
Air trapped in hydraulic system.	Remove air by bleeding (check compensating port for clearance of cup to provide full open port).
Brake adjustment not correct.	Adjust brakes.
Bent shoes.	Replace.
Compensating port closed.	See all brakes drag.

CAR PULLS TO ONE SIDE

CAUSE	REMEDY
Grease or fluid on lining.	Replace with new linings. Except on new cars it is almost always necessary to replace linings of both front brakes if one is damaged. See **BRAKE CAUTIONS**. Linings with even a slight trace of grease or fluid may effect the operation of the brakes and can seldom be salvaged by cleaning. Correct cause of grease or fluid reaching linings.
Improper lining contact with drum.	Grind or replace lining.

Wheel bearings excessively loose.	Adjust wheel bearings.
Loose backing plate at rear axle or front knuckle.	Tighten backing plate.
Linings not to specifications, or primary and secondary shoes reversed. New and used linings mixed on one end of car.	Various kinds of linings have different frictional effects on the drums and on each other. Each wheel must have similar linings. The primary and secondary linings must not be interchanged. Use only factory specified linings.
Tires not properly inflated or unequal wear of tread. Different tread design.	Inflate tires to specified pressures. Rearrange tires so that a pair with non-skid tread surfaces of similar design and equal wear will be installed on front wheels and another pair with like tread will be installed on rear wheels.
Linings charred or drums scored.	Sand surfaces of linings and drums. Remove particles of metal that have become embedded in surfaces of linings. See **COMPLETE BRAKE RECONDITIONING** regarding road dirt grooving brake drums. Seriously charred linings should be replaced.
Wheel cylinder link off shoe.	Check boot for holes. Check for burrs on wheel cylinder piston caused by piston forced against stop. Reinstall link.
Defective wheel cylinder.	Repair or replace as required.
Obstruction in line.	Clear or replace as required.
Water, mud, etc., in brakes.	Remove any foreign material from all brake parts and the inside of drums. Lubricate shoe ledges and rear brake cable ramps with grease. Examine support assembly for damage.
Weak chassis springs, loose steering gear, etc.	Replace springs, adjust steering gear, etc.
Incorrect geometry setting of front suspension.	Adjust geometry so that car does not have a tendency to lead when driven on a level road.
Rigid and flexible shoes intermixed.	Use only approved parts, in sets.

EXCESSIVE PEDAL PRESSURE REQUIRED TO STOP CAR

CAUSE	REMEDY
Brake adjustment not correct.	Adjust brakes.
Improper lining.	Install factory specified shoes.
Improper shoes.	Install factory specified shoes.
Grease or fluid soaked linings. See **BRAKE CAUTIONS**.	Correct cause and replace linings, if necessary.
Rusted wheel cylinder.	Replace necessary parts.
Wheel cylinder link incorrectly aligned.	Check wheel cylinder piston and boot for damage. Install link.

CAUSE	REMEDY
Compensating port not cleared. See also **COMPENSATING PORT** under **ALL BRAKES DRAG**.	Check pedal linkage, stop light switch adjustment.

LIGHT PEDAL PRESSURE - BRAKES TOO SEVERE

CAUSE	REMEDY
Brake adjustment not correct.	Adjust brakes.
Loose support assembly on rear axle or front steering knuckle.	Adjust front wheel bearings and tighten front backing plates. Tighten rear backing plates. Adjust brakes.
Small amount of grease or fluid on linings.	Correct cause and replace linings. See **BRAKE CAUTIONS**.
Charred linings or scored drums.	Sand surfaces of linings and drums. Clean loose dust from brake. In severe cases replace shoes. Warn owner regarding abuse of brakes. Remove all particles that have become imbedded in surfaces of linings. Slightly scored drums do not require replacing or turning.
Improper linings.	Install factory specified linings.

BRAKE NOISES

SQUEAK IN BRAKE WITH CAR STATIONARY (SOMETIMES MISTAKEN FOR PEDAL SQUEAK)

CAUSE	REMEDY
Shoe pads on backing plates dry and rusty.	Pry shoes out with screwdriver-apply grease sparingly to shoe pads with feeler stock.

CREAK WHEN BRAKES ARE APPLIED AT LOW CAR SPEED

CAUSE	REMEDY
Anchor pins dry.	Grease anchor pins where shoes bear.

SCRAPE IN BRAKES AS PEDAL IS APPLIED, CAR STATIONARY

CAUSE	REMEDY
Hold-down nail heads dry.	Lubricate. Although adjusting brakes temporarily changes these noises, lubrication will remedy.

PEDAL SQUEAK

CAUSE	REMEDY
Return spring or stop light switch rubbing pedal.	Lubricate.

CRUNCH OR GROAN, HOLDING CAR ON HILL

CAUSE	REMEDY
Brake dust and possibly linings which have been overheated.	Sand linings and remove dust from brakes.

HIGH PITCH SQUEAK WHILE BRAKES OPERATE

CAUSE	REMEDY
New linings not yet fully burnished.	Burnish further or sand off high spots of linings.
Persistent squeak-no apparent cause.	Sand linings for temporary cure or mild cases. Install drum springs for stubborn cases of high pitch squeak.
Bonded linings.	Install factory specified shoes.

LOUD LOW PITCH SQUEAL AT END OF HIGH RATE STOP

CAUSE	REMEDY
New linings not fully burnished.	Check adjustment. Sand lining high spots.
Angle on shoe web at adjusting screw notch.	File straight.
Bent backing plate. Top of shoe webs should be in line with each other looking down on them. Check after pushing shoes toward backing plate at top.	Straighten or replace.
Incorrect adjustment.	Adjust brakes.

NOTE: *Drum springs not effective against low pitch squeal or howl.*

CLICKS DURING HIGH RATE STOPS, USUALLY ONCE PER WHEEL REVOLUTION IN ONE WHEEL ONLY

CAUSE	REMEDY
Threaded drum.	Cross sand.

CHATTER AT HIGH SPEED

CAUSE	REMEDY
Drum out-of-round with 2 or more distinct high spots in circumference.	Sometimes corrects with usage. Turn drum.

PEDAL THROB AT LIGHT APPLICATIONS AT LOW SPEED

CAUSE	REMEDY
Drum out-of-round or off center.	Turn drum.

ROUGH FEEL DURING HIGH RATE STOPS FROM MODERATE SPEED

CAUSE	REMEDY
Tool chatter. Look for faint light and darker stripes running across the braking surface.	Turn drum.

CLICK FIRST APPLICATION AFTER REVERSING

CAUSE	REMEDY
Shoes out from anchor pins.	File shoe pads on backing plates; lubricate. Although adjusting brakes temporarily changes these noises, lubrication will remedy.

Further diagnosis is contained in Figure 5-1.

BRAKE CAUTIONS

1. Do not use reclaimed brake fluid or substitute for recommended brake fluid.
2. Do not allow grease, paint, oil or brake fluid to come in contact with brake lining.
3. Do not handle brake shoes or drums with greasy hands.
4. Do not clean rubber parts or inside of cylinders with anything but clean alcohol.
5. Do not use any linings other than those specified by the factory.
6. Do not allow master cylinder reservoir to become less than half full of brake fluid.
7. Under no circumstances should brakes be severely tested after new linings are installed. They should be given moderate use for several hundred miles until linings become well burnished. Severe applications will cause erratic brake action and may permanently injure brake linings.
8. When linings of one brake require replacement, the linings should also be replaced on the other brake at the same end of the car (except on very low mileage new cars and only when the brakes have not been abused - see Inspection and Cleaning under Brake Mechanism and Drums).
9. Do not weld cracked or broken drums.
10. If it becomes necessary to replace brake fluid lines, use only steel lines with double flared ends.

GENERAL DESCRIPTION

All A and X Series models are equipped with duo-servo self-adjusting hydraulic brakes with fixed anchor pins both front and rear. A Series station wagon models, however, are complimented by the addition of power assist to the standard system. B, F and G Series models use this system only on rear brakes. The standard front brake system on the B and G Series is power disc, while the F Series uses manual disc brakes on the front. The standard system consists of a brake pedal, dual master cylinder, hydraulic lines, a distributor switch, two-front brake assemblies, and two rear brake assemblies. In addition all disc brake cars except station wagons and B Series vehicles are equipped with a proportioning valve and a metering valve. The proportioning valve, metering valve and distributor switch on all disc brake vehicles, except station wagons and B Series models, are enclosed in a single common housing (See Section 5E). Station Wagons and B Series vehicles with disc brakes use an identical appearing one piece combination valve, which does not include the proportioning valve components. Master cylinder design will vary from model to model depending on fluid displacement requirements.

The brake pedal is suspended with nylon bushings at the pivot points of the brake pedal mounting bracket which is attached to the dash. A self-adjusting brake-light switch is attached to the brake pedal mounting bracket

The dual master cylinder (Fig. 5-2) is attached to the engine side of the dash and is connected to the brake pedal with a pushrod. The separate front and rear hydraulic systems provided by the dual master cylinder prevents a hydraulic failure in either system from affecting the other system. A hydraulic failure in one circuit will activate the parking brake warning light on the instrument panel. In addition, vehicle braking with only the front or rear brakes functioning will require greater pedal effort and travel. The dual master cylinder provides two hydraulic fluid reservoirs, cast integrally with, and connected to the bore through separate sets of compensating and fluid inlet (bypass) ports. Both reservoirs are sealed by a rubber diaphragm inside the bale-type cover. A primary piston (rear) assembly with secondary seal, primary cup, protector, spring, screw and spacer; a secondary piston (front) assembly with two back-to-back secondary seals, primary

CAUSE \ SYMPTOM	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	X													X
Leaking Wheel Cylinder or Piston Seal	X	X		X				X							X
Leaking Master Cylinder	X	XX													X
Air In Brake System	XX								X						X
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	XX		X	
Glazed Brake Lining - Sand Lightly			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 - Remove with Air			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						
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 (Disc Only)	X		X	X	X	X	X		X						X
Brake Pedal Linkage Interference or Binding			X		X	X	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	

XX - Indicates more probable cause(s) X - Indicates causes

Fig. 5-1 Brake System Diagnosis Chart

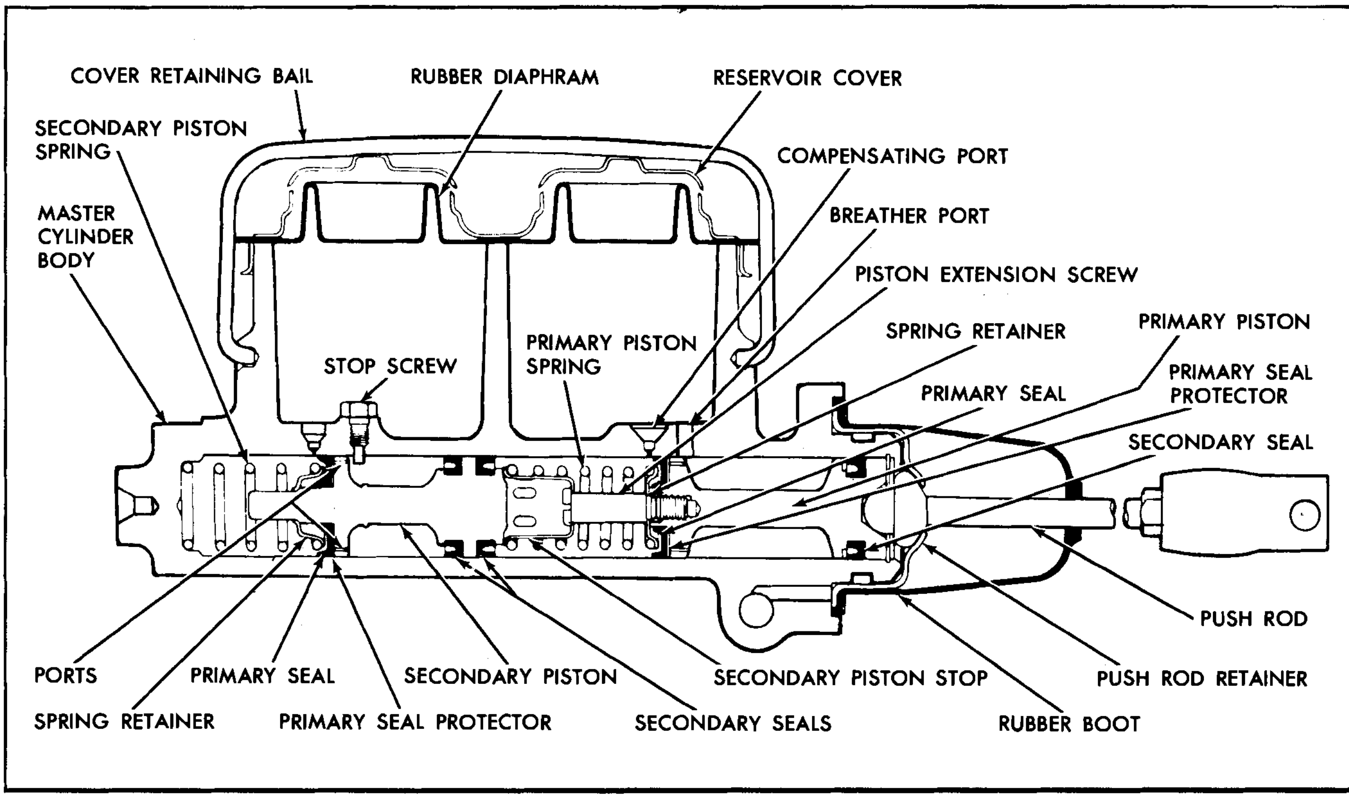


Fig. 5-2 Typical Master Cylinder

cup, protector, spring and spring retainer; a piston stop screw and O-ring seal; springs and tube seat retainers mounted in the two outlet ports provide the operating components of the two separate hydraulic systems.

The master cylinder front piston supplies the correct fluid displacement for the front wheel brake requirements. The rear piston supplies the correct fluid displacement for the rear wheel brake requirements. The hydraulic pressure developed in both systems is equal at all times since the front piston is balanced between the hydraulic pressure in both systems. If the front system fails, the front piston and spring bottom against the end of the bore and then the rear piston develops hydraulic pressure to the rear wheels. If the rear system fails, the rear piston and spring bottom against the front piston and then mechanically force the front piston forward to develop hydraulic pressure to the front wheels.

The parking brake warning light, a telltale lamp in the instrument cluster, also operates as the brake hydraulic system failure warning light. Warning of hydraulic system irregularities is indicated with the foot brake applied and the parking brake in the released position. A sliding piston pressure switch in the junction block which is located on the frame in drum brake vehicles and in the combination valve in disc brake vehicles is normally held in the off position by equal pressures from the front and rear hydraulic systems. The sliding piston switch is activated when a pressure differential is caused by a drop in pressure of either the front or rear brake lines. A rubber diaphragm covers the brake fluid reservoirs to seal the brake system from contamination.

Wheel cylinders have corrosion-resistant, double pistons for even distribution of pressure to each brake shoe. Internal design rubber boots seal against dust, moisture, and foreign material.

OPERATION

SELF ADJUSTING BRAKE MECHANISM

The self-adjusting brake mechanism (Fig. 5-3) operates only when brakes are applied while the car is moving rearward. This action causes the secondary shoe to move a pre-determined distance toward the brake drum providing the brake linings are worn enough to allow this movement.

As the car moves in reverse with brakes applied, the primary shoe is forced against the anchor pin. At the same time, hydraulic pressure in the wheel cylinder forces the upper end of the secondary (rear) shoe away from the anchor pin. As the secondary shoe moves away from the anchor pin, the upper end of the adjuster lever is prevented from moving by the actuating link which is attached to the anchor pin. Since the adjuster lever pivots on the secondary shoe, this movement forces the lower end of the adjuster lever against the adjusting screw star wheel.

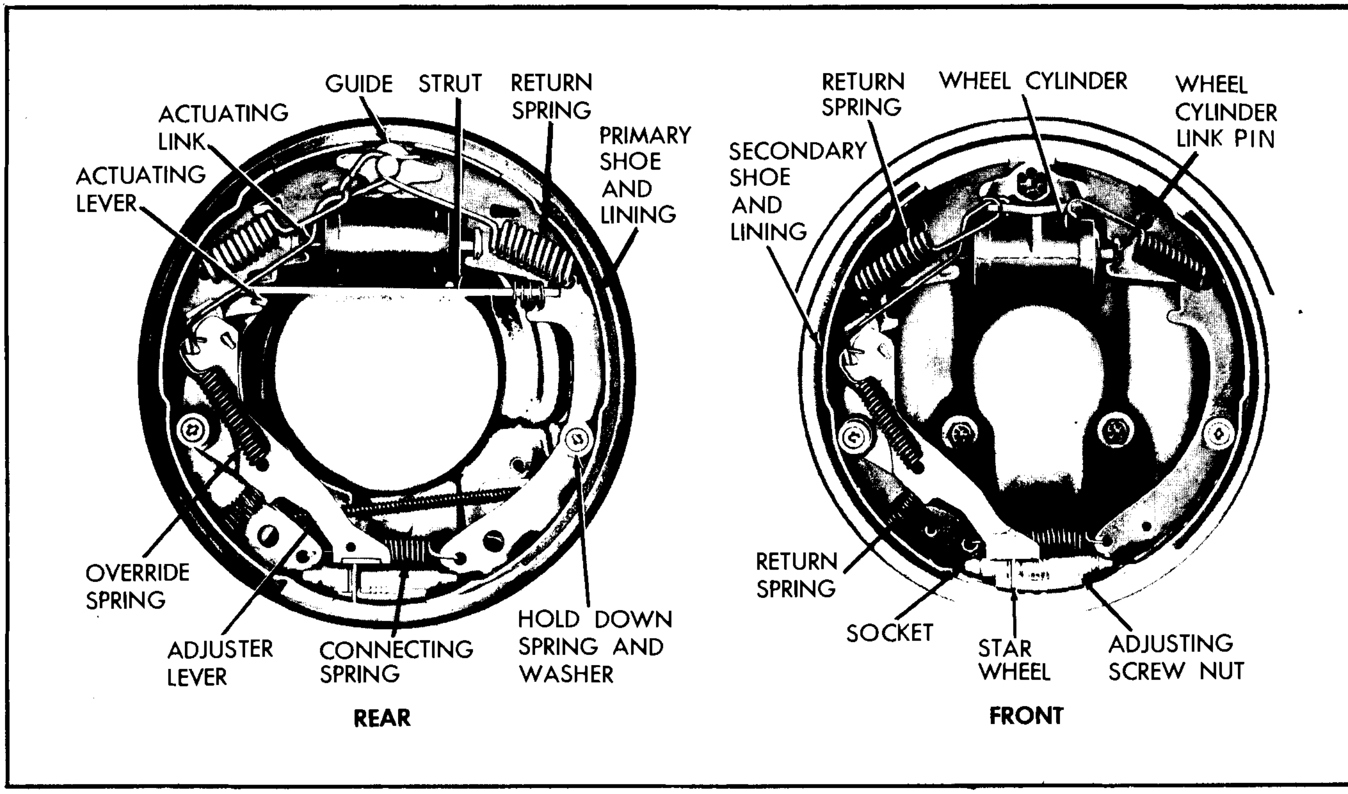


Fig. 5-3 Typical Right Hand Self-Adjusting Brake Assemblies

If the brake linings are worn enough to allow the secondary shoe to move, the adjuster lever will turn the adjusting screw star wheel one or two teeth, depending on amount of lining wear. If the secondary shoe does not move, adjuster lever movement will not be enough to rotate the adjusting screw star wheel.

When brakes are released, the actuating lever return spring will reposition the actuating lever into adjusting position on the adjusting screw star wheel.

An override feature is incorporated into the self-adjusting brake which allows the secondary shoe to be applied in reverse in event the adjusting screw is frozen.

When the car is moving forward and brakes are applied, the upper end of the secondary shoe is forced against the anchor pin, and the self-adjuster does not operate.

HYDRAULIC SYSTEM

Depressing the brake pedal moves the master cylinder push rod and pistons, forcing hydraulic fluid out through the hydraulic lines into the wheel cylinders, (Fig. 5-18) forcing the wheel cylinder pistons outward and expanding the brake shoes against the drums.

When the brake pedal is released quickly, the master cylinder pistons return to the released position faster than fluid returns from the lines. Holes in the piston heads allow fluid to pass from the rear to the front of the piston heads, past the primary cups to fill in this space. At the same time the brake shoe return springs force the wheel cylinder pistons to return. Fluid forced out of the wheel cylinders by this action returns to the master cylinder. As this fluid returns, the excess portion will return to the reservoir through the compensating ports which are uncovered when the master cylinder pistons are in the released position.

PARKING BRAKE

When the parking brake lever is depressed the cables connected to the rear brakes are pulled taut. Each rear brake cable attaches to an actuating lever which pivots at a hole in the secondary shoe web. When the lever is moved forward by the brake cable, it engages a strut which forces the primary shoe against the brake drum. After the primary shoe is applied, the secondary shoe is then forced against the drum.

The rear brake assemblies serve a dual purpose in that they are utilized both as a hydraulically operated brake and a mechanically operated parking brake. Adjustment of the hydraulic brake, also adjusts the parking brake.

> **NOTE:** *Automatic brake adjusters normally keep the parking brake adjusted correctly. However, there may be a condition where the parking brake system will require additional adjustment even though the service brakes are perfectly satisfactory.*

SERVICE OPERATIONS

INSPECTING BRAKE SYSTEM

Complete brake system inspections must be performed at least every 12,000 miles. Need for future service should be estimated at this time.

All metal and rubber brake lines should be checked for cracks, leaks, and evidence of chafing. The master cylinder and wheel cylinders should be checked for leaks. Brake shoe return springs must be replaced if evidence of excess heat is found.

It is particularly important that the brake fluid level is correct and that linings have not worn beyond safe limits.

Any necessary corrections should be made as outlined in this manual.

In addition, each time the car is serviced for any reason there is an opportunity and obligation to check the operation of the brake system. For example, each time the car is lubricated, or if the car is raised on a lift, brake lines, hoses, and cables should be visually inspected for signs of chafing, deterioration, or other damage. A careful check for leaks should also be made. If the brake pedal has excessive travel when brakes are applied, or if pulls, grabs, or other irregularities are noted, a need for brake service exists. No car should leave the service department with brakes that are not safe. Repairs as necessary should be made as outlined in this manual.

BRAKE PEDAL

REMOVE

NOTE: *Refer to Section 1A for removal of air conditioning components if necessary.*

1. A, X, F and G Series - Remove brake pedal clevis pin retainer and pin (Figs. 5-5, 5-6, 5-7, 5-8, 5-9).

B Series (Power Brake) - Clevis pin is part of pedal assembly (Fig. 5-4).

2. Remove nut from brake pedal pivot bolt.

NOTE: *The brake pedal pivot shaft bolt is also the clutch pedal pivot on all manual transmission models. A separate bolt, located at top of mounting bracket, is used on Pontiac with power brakes.*

3. Slide pedal pivot shaft bolt to left enough to clear brake pedal.

NOTE: *Manual brake pedals on A Series vehicles with cruise control have a return spring on the pedal hub (Fig. 5-5).*

4. Withdraw brake pedal, spacer and nylon bushings.

REPLACE

1. Lubricate and install nylon bushings and spacer in pedal hub. (Manual brakes on A Series with cruise control - install return spring on pedal hub.)
2. Install brake pedal in support brace.
3. Slide pedal pivot shaft bolt through support brace and pedal hub.

CAUTION: *See Caution on page 1 of this Section regarding the fasteners referred to in step 4 below.*

4. Install nut on pedal pivot shaft bolt and torque to 30 lb. ft.
5. Install clevis pin (A, X, F and G Series), and retainer, (all models).

NOTE: *Retainer must be tight enough to scribe a mark on pin as installed.*

PEDAL HEIGHT

Pedal height is *not* adjustable, and no attempt should be made to change this factory setting. A, X, F and G Series - The zip-on nut which holds the clevis to the pushrod must be firmly seated.

CAUTION: *If pedal bracket prevents full return of brake pedal and master cylinder push rod, the master cylinder pistons may be prevented from returning to their stops. This can block off the compensating ports which prevents brake shoes from returning fully when the pedal is released. A further complication which follows a blocked compensating port is lining drag and rapid brake burnup. It is necessary that the primary cups be entirely clear of the compensating ports to provide a safety factor against normal rubber swell and expansion and deflection of body parts and pedal linkage.*

BRAKE WARNING LIGHT CHECKING PROCEDURE

NOTE: *Caution should be taken to prevent air from entering hydraulic system during checks on switch.*

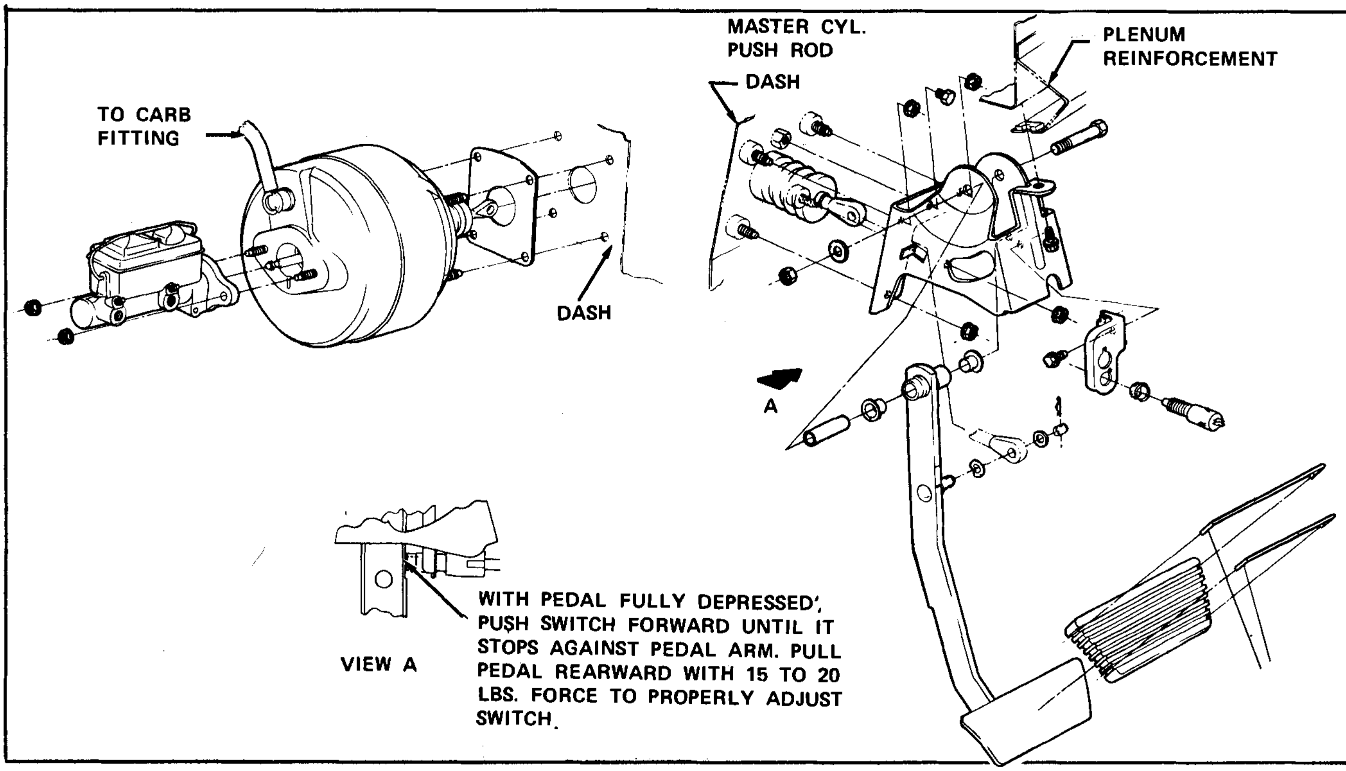


Fig. 5-4 B Series Power Brake System

1. Turn ignition on.
2. Determine if bulb is functioning by depressing and then releasing parking brake.
3. Check to make sure both master cylinder reservoirs are full.
4. Open one wheel cylinder bleed screw in rear brake system. (Leave front system secure).
5. Depress brake pedal. **Do not release pedal.** The light should come on due to a pressure difference between front and rear systems. Approximately 150-250 psi differential is needed to operate brake light.

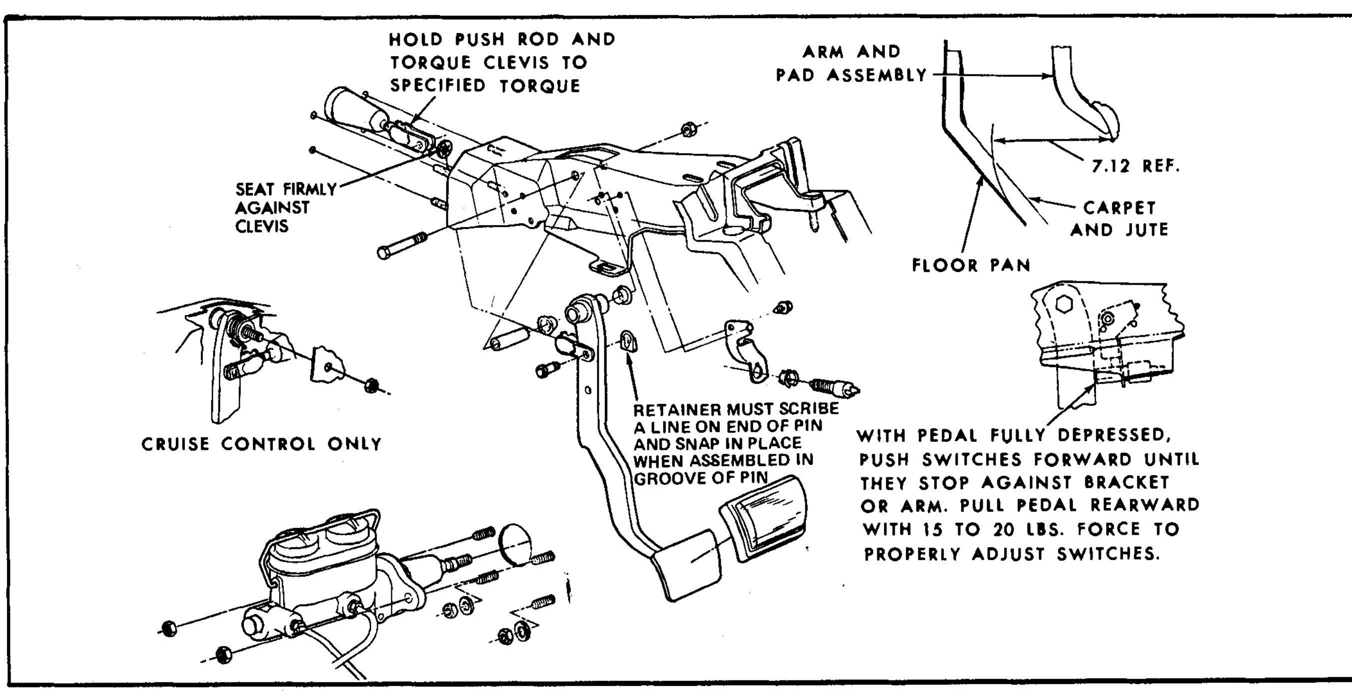


Fig. 5-5 A Series Manual Brake System

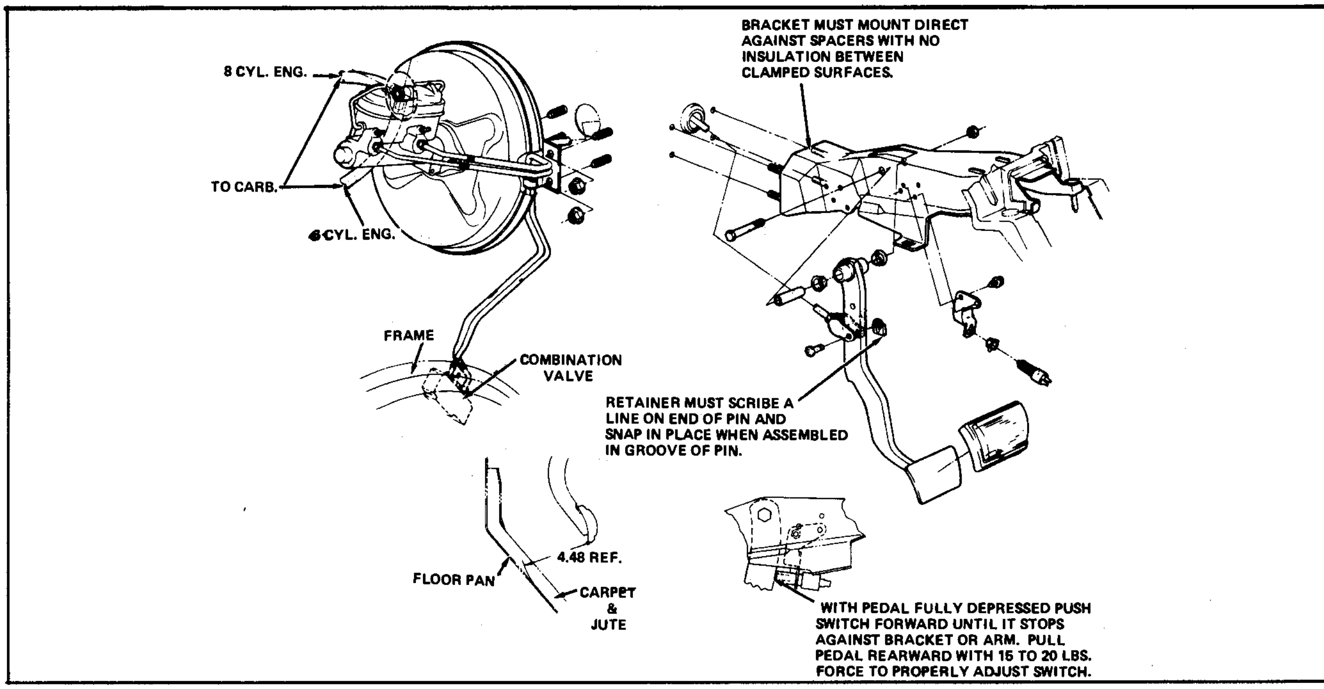


Fig. 5-6 A and G Series Power Brake System

6. Close bleed screw. Release brake pedal. Refill rear reservoir, if needed.
7. Repeat by opening one front brake bleed screw. (Leave rear system secure).
8. Turn ignition off.
9. Re-fill master cylinder (Fig. 5-11).

The recommended checking interval should be 24 months or 24,000 miles, any time major brake work is done or any time there are complaints of excessive pedal travel.

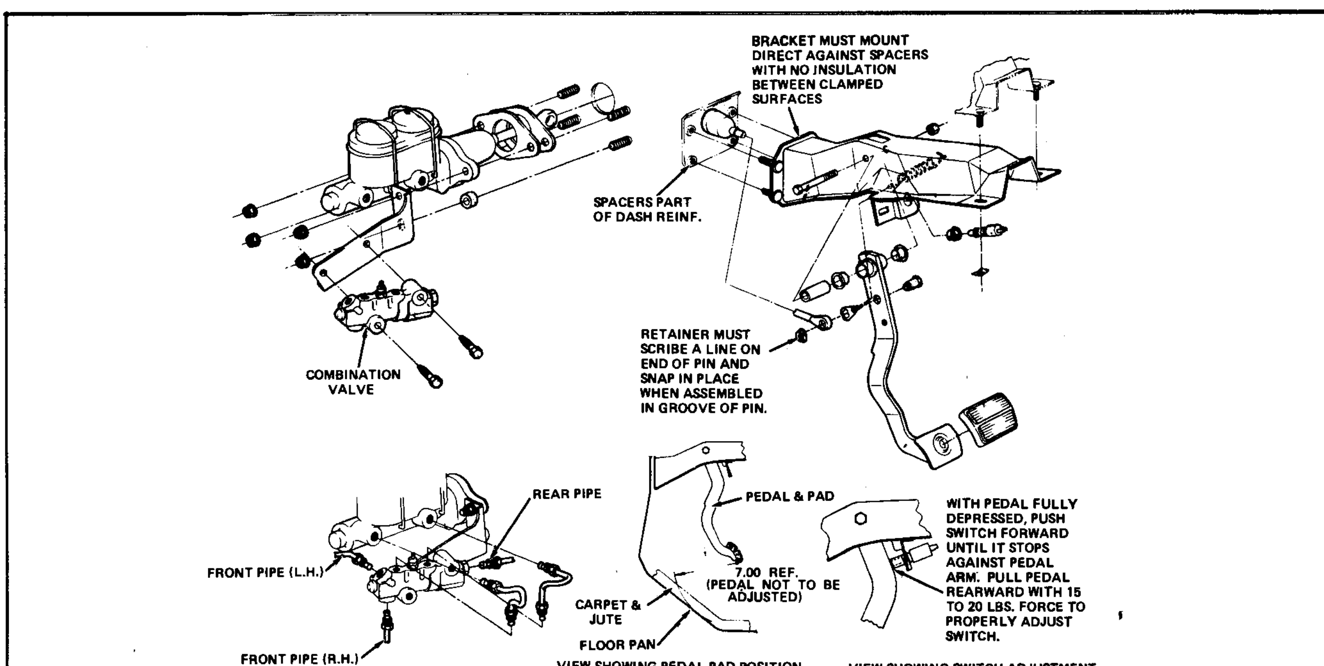


Fig. 5-7 F Series Manual Brake System

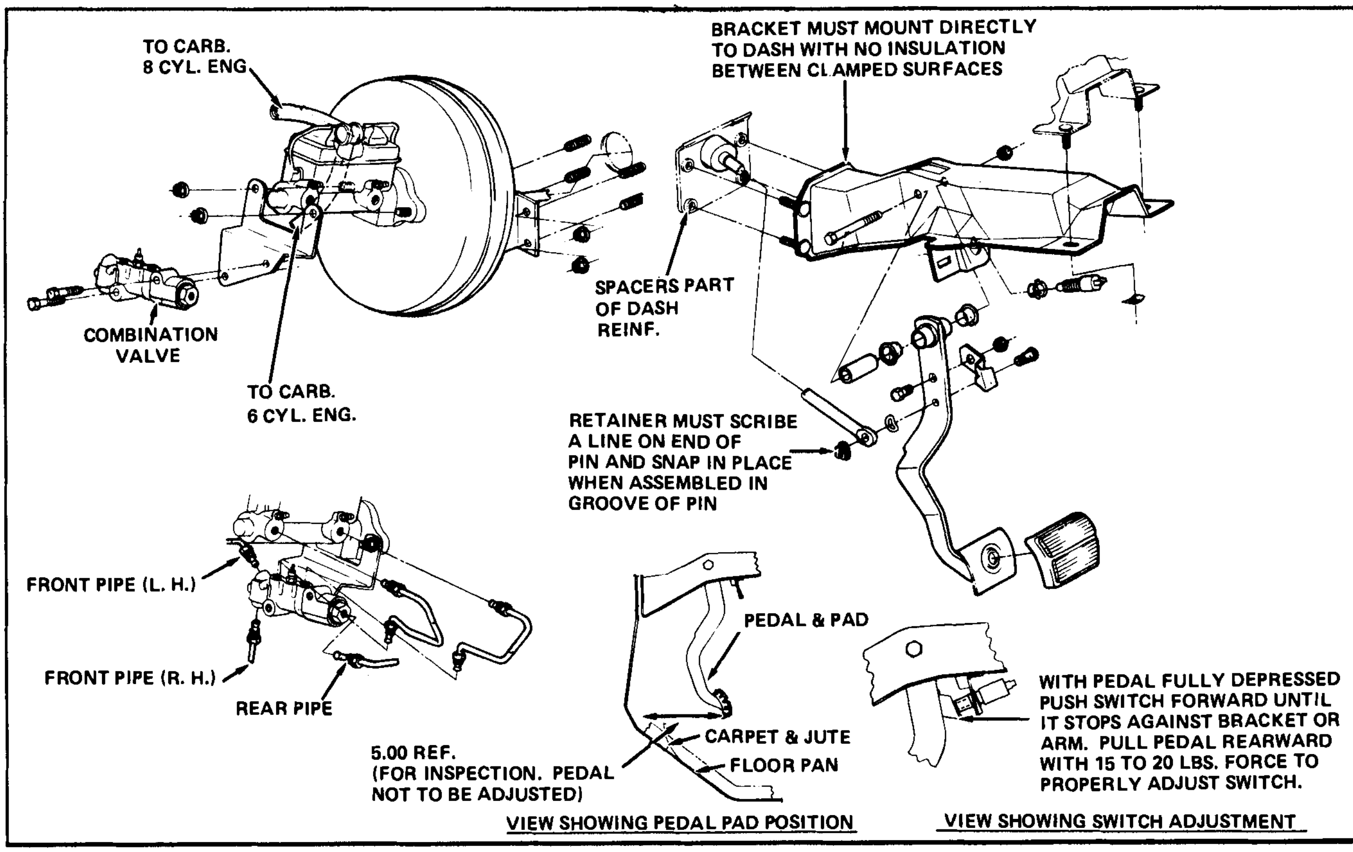


Fig. 5-8 F Series Power Brake System

STOP LIGHT SWITCH

REMOVE

1. Disconnect wires from switch.
2. Remove switch by pulling out of retainer.

REPLACE

1. Position stop light switch in retainer and push in to maximum distance.
2. Connect wires to switch.

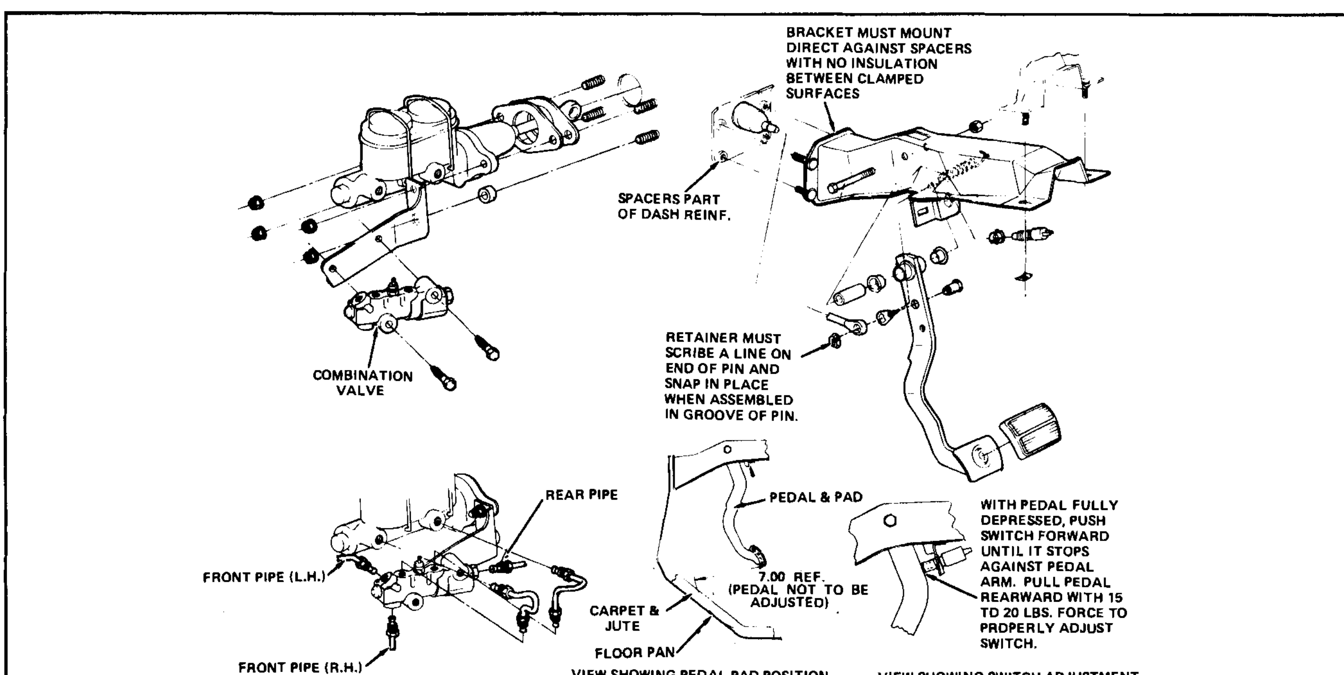


Fig. 5-9 X Series Manual Brake System

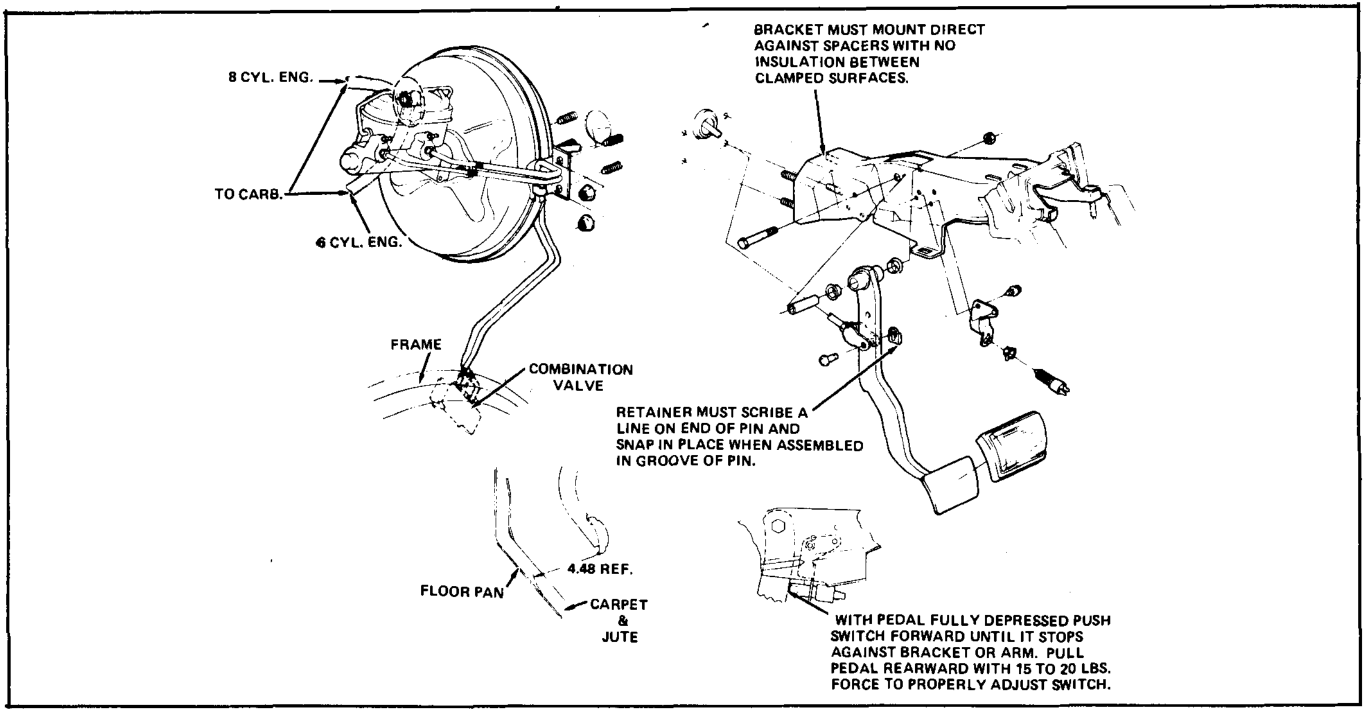


Fig. 5-10 X Series Power Brake System

3. Lift brake pedal with 15-20 lb. effort, brake pedal arm will automatically position switch correctly.

BRAKE MECHANISM AND DRUMS

ADJUST

All four brake assemblies incorporate a mechanism to automatically adjust the brake shoes when the car is operated in reverse. This mechanism also has an override feature which prevents over-adjustment.

NOTE: *Normally, the self-adjusting feature of the brake system provides the proper shoe-to-drum clearance, but if a need for adjustment exists, it is recommended that the shoes be adjusted with the drums removed, using tool number J 22364, not only to give a more accurate clearance, but also to allow a thorough inspection of the brake mechanism for possible defects which may have caused the need for adjustment.*

A manual adjustment is always required when brake shoes

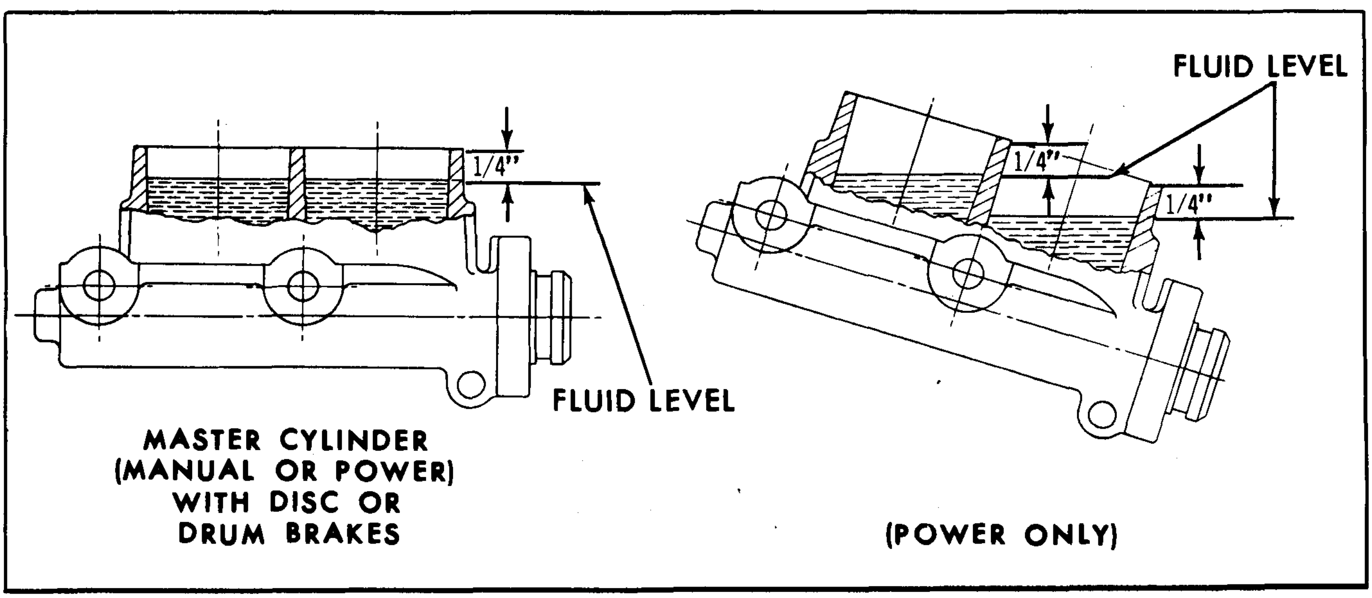


Fig. 5-11 Master Cylinder Fluid Levels

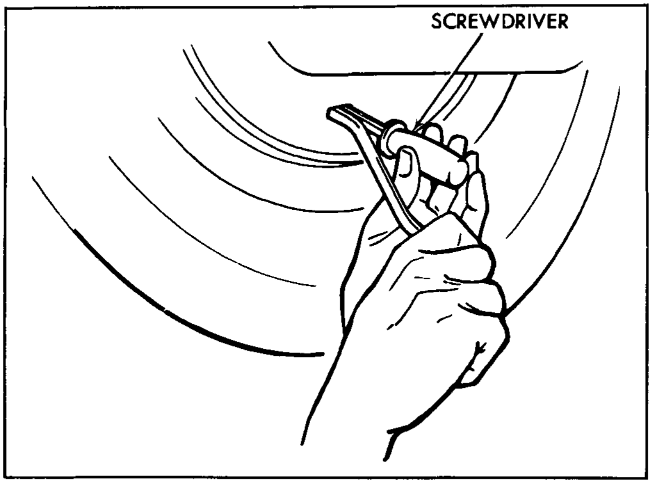
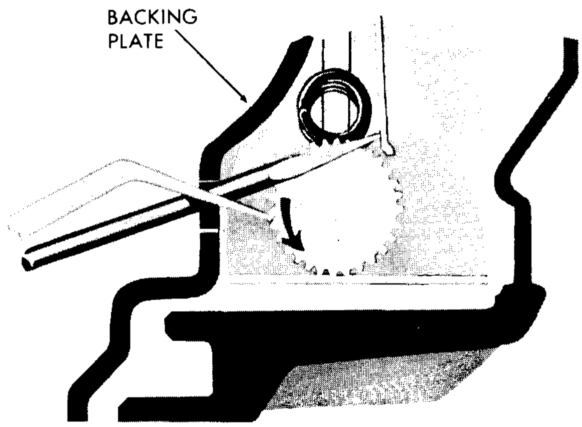


Fig. 5-12 Preparing to Back Off Adjusting Screw

are replaced or the setting of the star wheel adjuster has been changed during some other service operation.

1. Remove wheels and brake drums. It may be necessary to back off the brake shoe adjustment before the brake drums can be removed. If this is the case, insert a small rod or screwdriver through the adjusting screw slot in the backing plate and hold automatic adjuster lever away from adjusting screw star wheel and rotate adjusting screw downward (Fig. 5-12 and 5-13). On rear brake drums on A, B and F Series vehicles, it will be necessary to knock out the lanced area in the web of the backing plate using a chisel or similar tool in order to gain access to the adjusting screw on rear wheel brake assemblies.

   CAUTION: *Be sure to remove the metal knock-out plug from the backing plate before reinstalling. Remove all metal from the brake compartment. Replace the metal knock-out plug with a rubber service plug.*



INSERT SMALL SCREW DRIVER OR AWL THROUGH BACKING PLATE SLOT AND HOLD ADJUSTER LEVER AWAY FROM SPROCKET BEFORE BACKING OFF BRAKE SHOE ADJUSTMENT

Fig. 5-13 Backing Off Adjusting Screw

2. Remove ridge at open end of drum with #40 grit sandpaper, or equivalent. Adjust tool J 22364 to diameter of drum, then adjust brake shoes to fit opposite side of tool (Fig. 5-14).

3. Install wheels and drums.

   CAUTION: *See Caution on page 1 of this Section regarding the fasteners referred to in the note below.*

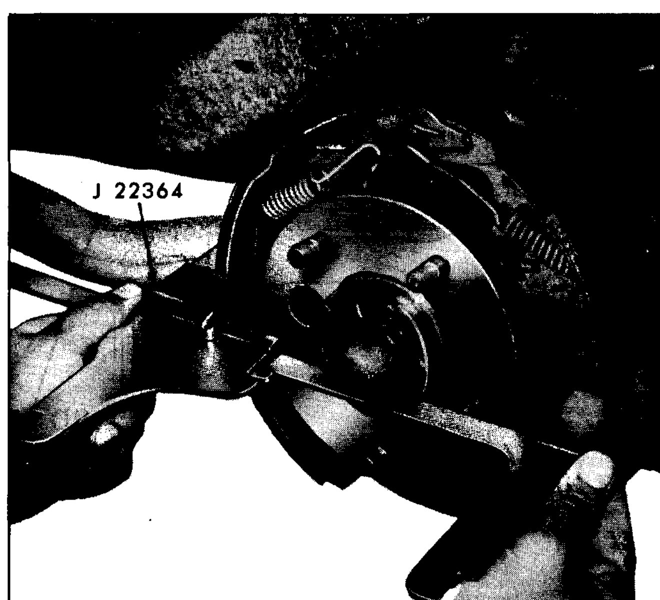


Fig. 5-14 Gauging Shoe to Drum Clearance

NOTE: *Front wheel bearings must be adjusted as outlined in Section 3 of this manual. At completion of adjustment, drum must rotate without any drag. Replace any parts that prevent free rotation.*

Proper clearance can also be obtained by lengthening the star wheel adjuster screw until a heavy drag is felt on the outer diameter of the brake drum (with wheel removed). Back-off adjusting screw one complete turn (B Series - 30 notches; A, F and G Series - 26 notches).

4. Check to make certain parking brake mechanism and linkage are properly adjusted.
5. Check fluid level in master cylinder. The level should be within 1/4 inch from top of reservoir (Fig. 5-11).
6. Drive car alternately forward and backward, lightly applying brakes in each direction to check for proper operation.

CAUTION: *New linings must be protected from severe use for several hundred miles. This should be conveyed to owner along with instructions to follow proper burnishing procedure as outlined in Owner's Manual.*

DISASSEMBLY

CAUTION: *Extreme care must be taken to prevent oil, grease or brake fluid from getting on linings. Even oily fingerprints on linings may affect the operation of brakes.*

1. Raise all four wheels off ground.

CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

2. Remove front wheels, front hub and drum assemblies, rear wheels and rear drums.

NOTE: *It may be necessary to back off the brake shoe adjustment before the brake drums can be removed. To back off shoe adjustment*

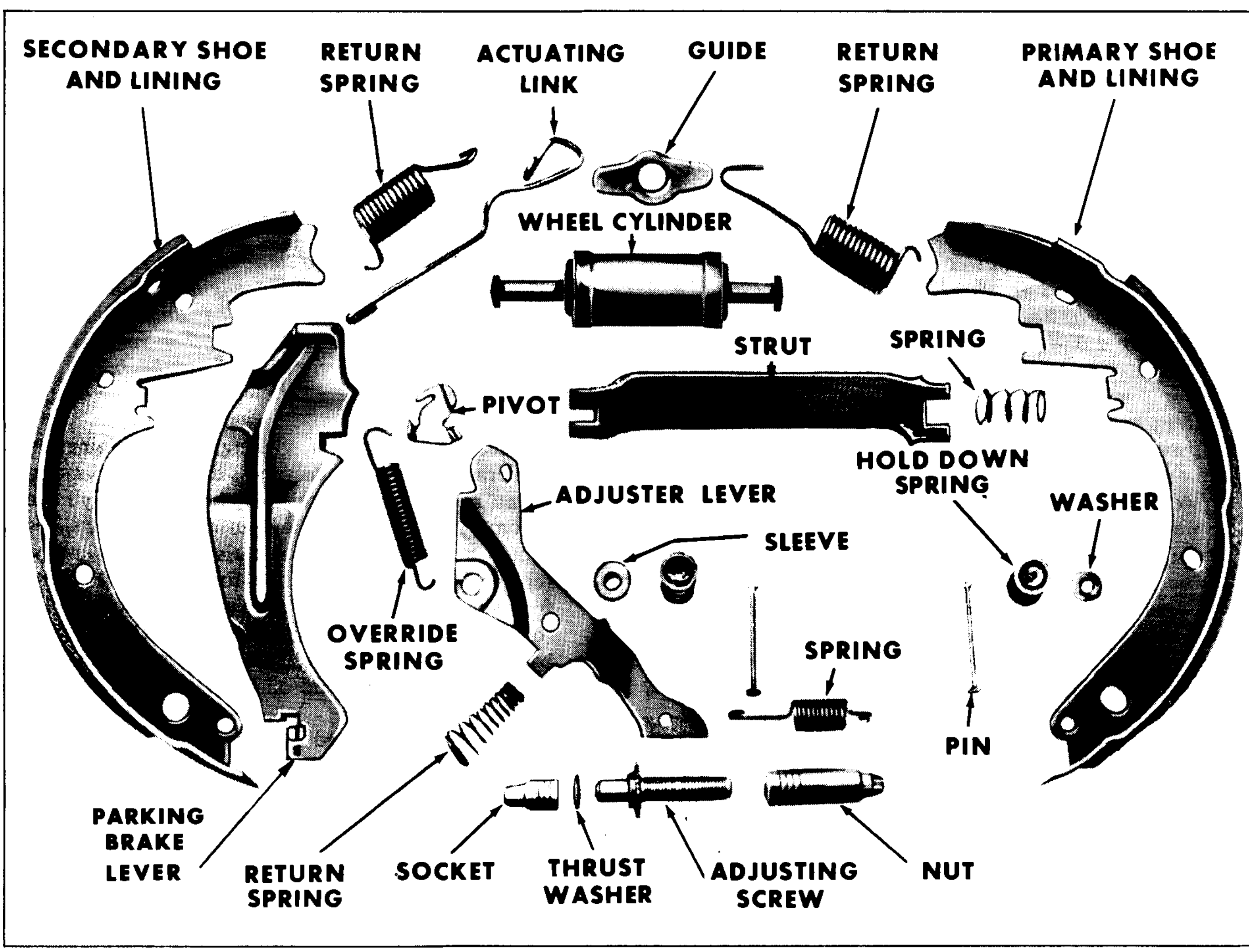


Fig. 5-15 Exploded View - Typical Right Rear Self-Adjusting Brake Assembly

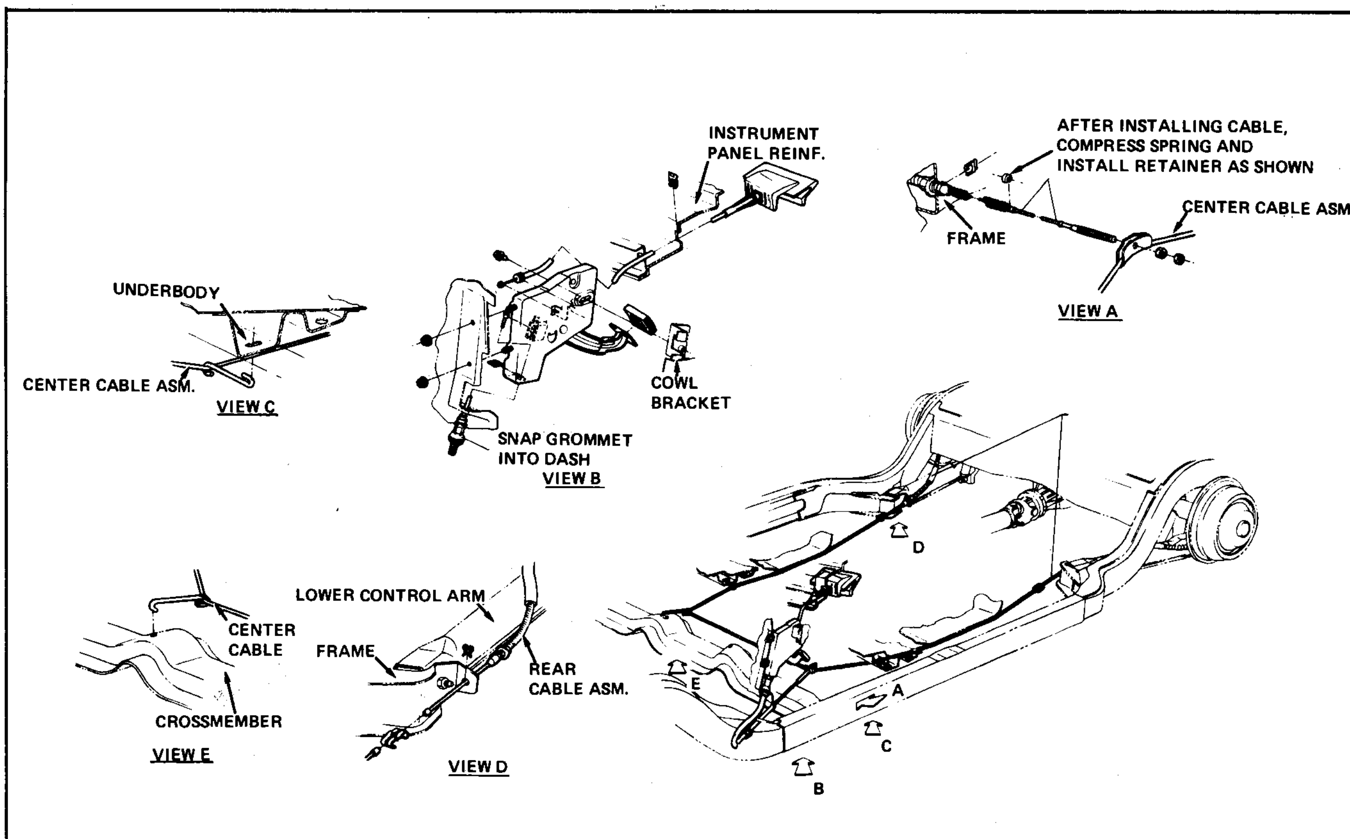


Fig. 5-16 B Series Parking Brake System

insert a small rod or screwdriver through the adjusting screw slot in the backing plate and hold automatic adjuster lever away from adjusting screw star wheel and rotate adjusting screw downward (Figs. 5-12 and 5-13). Also, see step 1 and **CAUTION** note under **ADJUSTMENT.**

3. Remove the primary and secondary shoe return springs.

4. Remove the brake shoe hold-down springs, pins and washers, and the adjuster lever and return spring (Fig. 5-15).

5. Spread shoes to clear wheel cylinder links, then remove the primary and secondary shoes as an assembly. On rear brakes spread shoes slightly and remove the parking brake lever strut and spring, then disconnect the parking brake cable from the operating lever.

6. Remove the primary to secondary shoe spring and the adjusting screw.

7. On rear brakes, remove the parking brake lever from the secondary shoe.

8. Remove the actuating links from the wheel cylinder boots only if necessary (Fig. 5-15).

INSPECTION AND CLEANING

NOTE: *All F Series, and some B Series vehicles equipped with the 350 cu. in. engine, use brake shoe assemblies on which the linings are bonded to the brake shoe. All other vehicles have linings which are riveted to the brake shoe.*

1. Inspect linings for wear, glazing, oil contamination and cracks. Clean brake shoes, drums and backing plates, removing any foreign particles that may have become imbedded in lining surface. Riveted shoes should be examined for loose rivets which must be replaced. Inspect bonded shoes for lining pulled loose from the shoe. Install new shoe and lining assemblies (bonded type) or reline (riveted type) if linings are badly burned or worn or if linings show evidence of oil, grease or brake fluid on the surface.

2. When replacing riveted linings, start riveting at the center of show and lining. After riveting is completed, lining must seat snugly against the shoe with no more than .005" separation between the shoe and lining midway between the rivets. Check separation with a feeler gage.

3. Test for leakage past piston cups by carefully pulling wheel cylinder links out of the boots. A slight amount of fluid is nearly always present and acts as lubricant

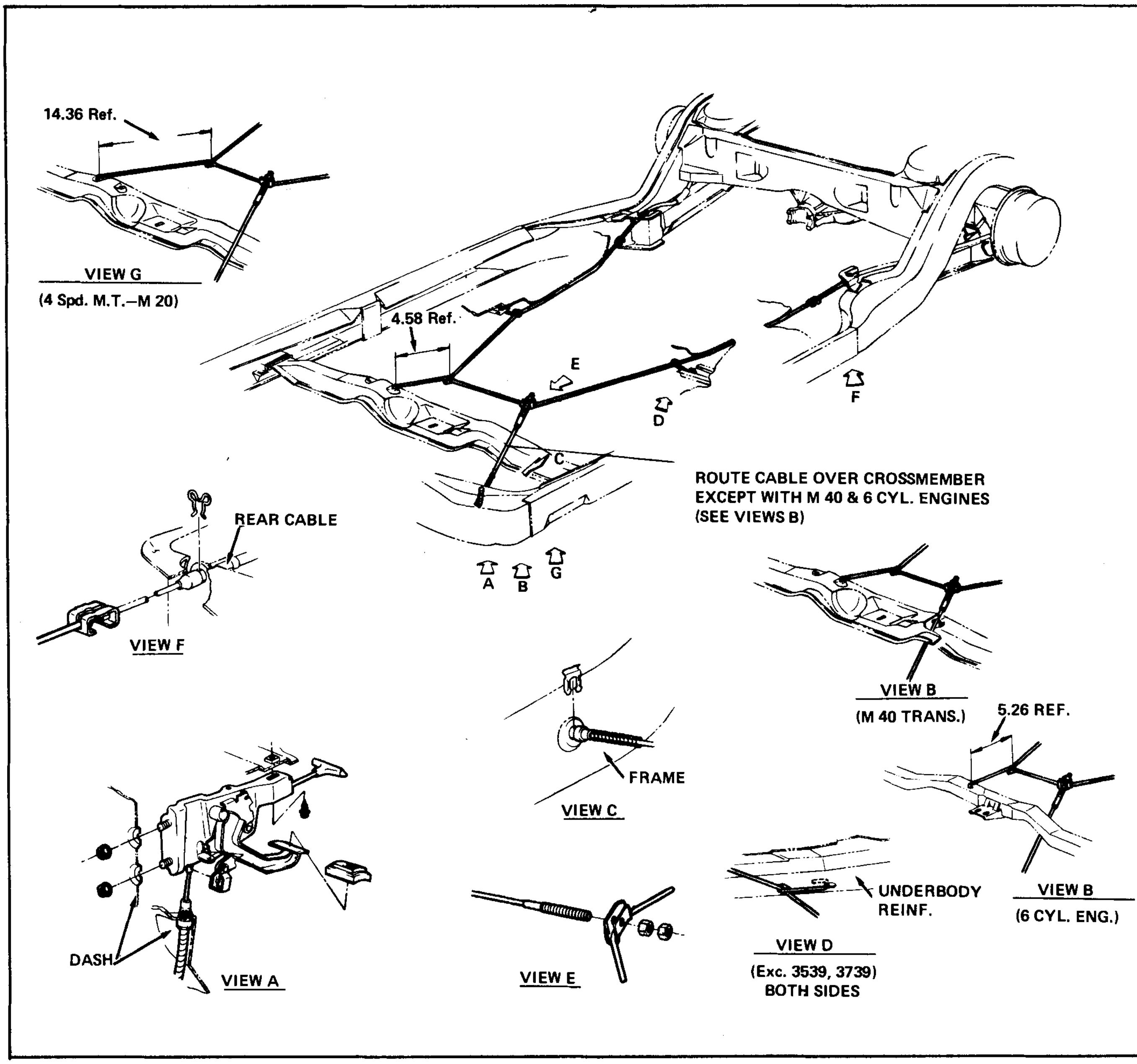


Fig. 5-17 A and G Series Parking Brake System

for the piston, but if an excessive amount of fluid is present, overhaul wheel cylinder. See Hydraulic System.

4. Clean inner surfaces of brake backing plates and all shoe contacting points. Sand shoe pads if necessary to remove grooves.

5. Disassemble the adjusting screw assembly and inspect as follows:

   a. Inspect teeth on star wheel for wear.

   b. Remove all foreign material from adjusting screw and nut. Nut must rotate freely on threads.

6. Check adjuster lever to be certain it is not bent or distorted, and that foot is not worn excessively. Replace if necessary.

7. Check the override pivot for wear or deformed parts.

8. Inspect brake drums for scoring, cracks, deep grooves and out-of-round. Road dirt frequently cuts grooves in drums which does not impair operation of brakes unless grooving is extremely severe. When drums are badly scored (deeper than .020") inspect brake shoe linings carefully for imbedded foreign material. Replace or recondition only if drums are badly scored.

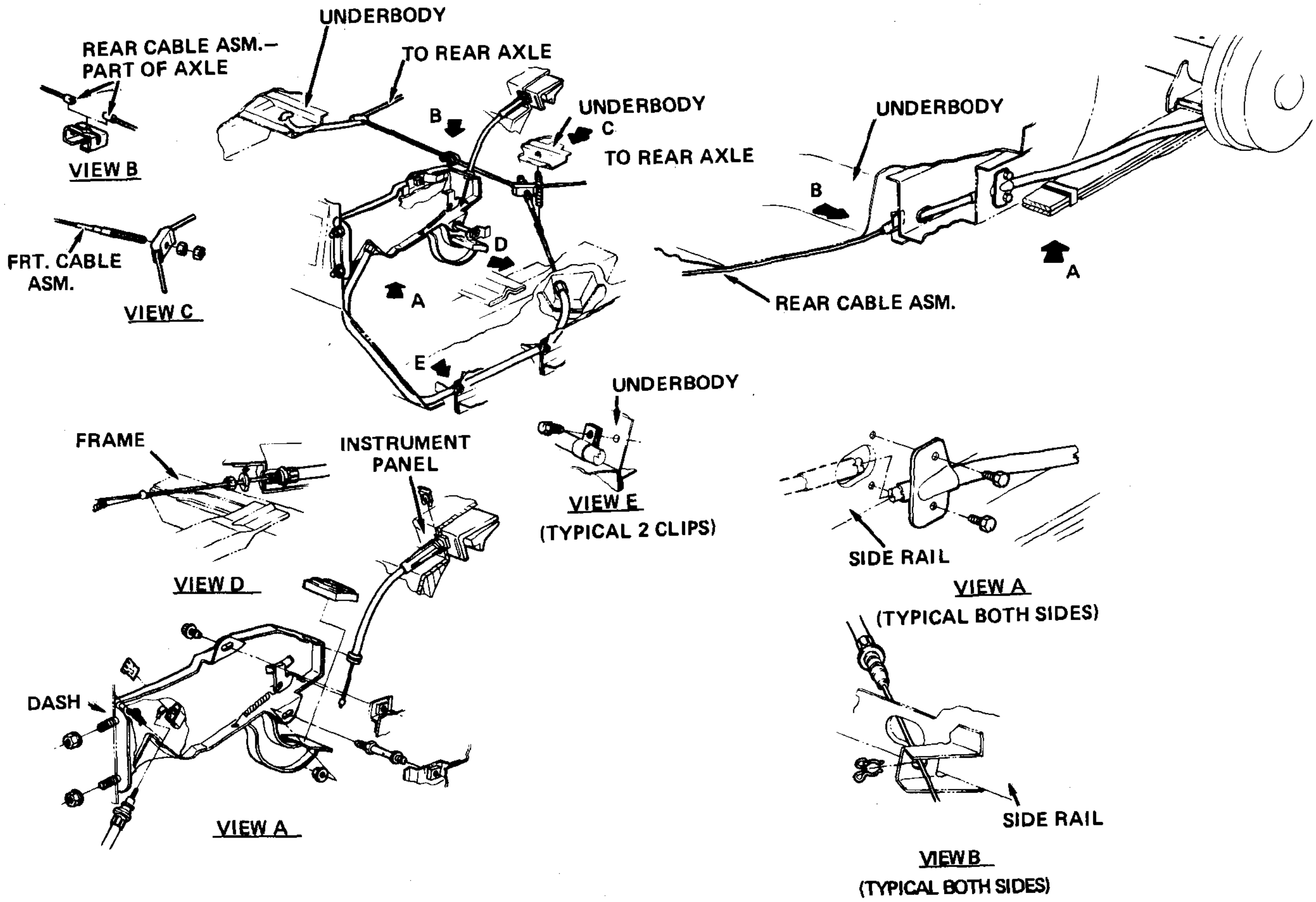


Fig. 5-18 F Series Parking Brake System

NOTE: *If drums are not scored deeper than .020" or do not exceed maximum out-of-round tolerances (see Specifications), they should be cross-sanded, rather than turned. Cross-sanding of drums may be accomplished using a 90 degree offset 1/4" or 3/8" drill adapter, with a 1" sanding disc (40 grit). The drums should show a uniform finish after cross-sanding. This method of refinishing drums will allow the proper drum surface necessary to burnish new linings.*

WARNING: REMOVING MATERIAL FROM BRAKE DRUM REDUCES THE STRENGTH OF THE DRUM AND ALSO ITS ABILITY TO DISSIPATE HEAT. NEVER REMOVE MORE THAN IS ABSOLUTELY NECESSARY AND IN NO CASE REMOVE MORE THAN 0.030" (INCREASING DIAMETER BY 0.060"). IF IT SHOULD BE DETERMINED THAT IT IS NECESSARY TO TURN A DRUM IN EXCESS OF .030" (INCREASING DIAMETER BY .060"), THE DRUM SHOULD BE REPLACED.

The "Discard" dimension stamped on the drum includes a wear factor of .030" above the maximum turning dimen-

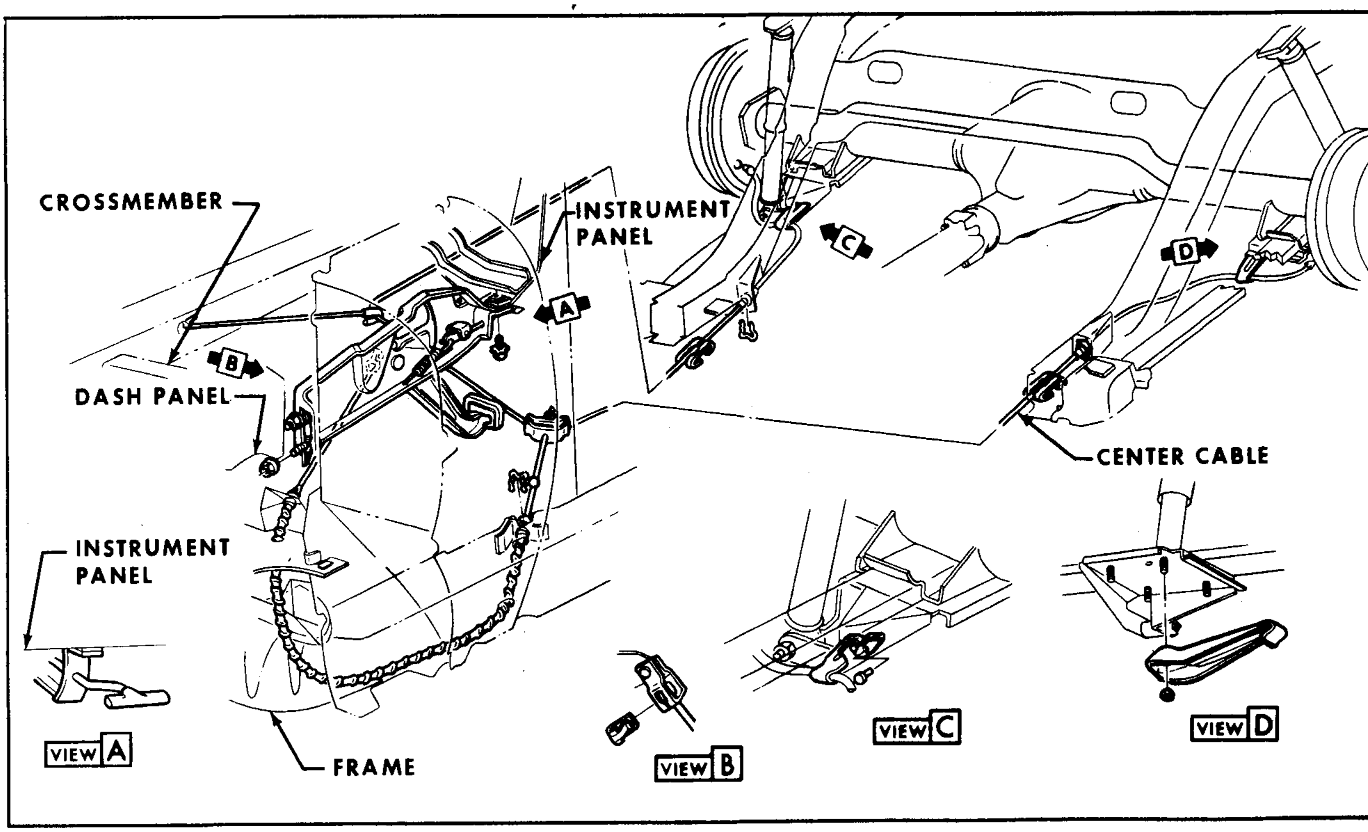


Fig. 5-19 X Series Parking Brake System

sion, and therefore drums should never be turned to the "discard" dimension. After a drum is turned, be sure it is free of all metal particles. Whenever a drum is turned, the drum on the opposite side should also be turned. If the drum diameter is less than 0.030" oversize after refinishing, standard linings may be installed. If drum diameter is 11.030-11.060", (B Series except Station Wagon) 12.030-12.060" (B Series Station Wagon) or 9.530-9.560 (A, F, X and G Series), oversize linings must be installed.

NOTE: *If new linings are installed on one wheel, they must also be installed on the opposite side of the car, except in cases where lining wear on one side only is encountered at relatively low mileage and is due to oil or grease on linings, defective lining material, etc. Linings may be replaced on one side only, provided the lining on the opposite side is not less than 3/16" thick (front) or 1/8" thick (rear).*

9. Check brake drum for build-up of rust and dirt at outer circumference. Remove build-up so that drums can be installed over pre-adjusted linings.
10. Inspect front wheel bearings and oil seals and replace as necessary. When installing new seal, saturate with S.A.E. 30 engine oil and wipe off excess. Saturating seal with S.A.E. 30 oil prevents absorption and retention of moisture by the seal and improves resistance to water entry into the front wheel inner bearing.
11. Inspect hoses and hydraulic lines for wear, kinks, or damage and replace as necessary.
12. Clean exposed portions of parking brake cables and examine for broken strands. Lubricate at points where exposed cable comes into contact with body.

CAUTION: *See Caution on page 1 of this Section regarding the fasteners referred to in step 13 below.*

13. Check to make sure all bolts and nuts securing backing plate to suspension are tightened to 100 lb. ft. torque at upper plate to knuckle bolt, 75 lb. ft. torque at lower bolt, and 35 lb. ft. torque on all rear plate to axle flange bolts.

ASSEMBLY

1. Lubricate the adjusting screw threads, shoe pads on backing plate and all other contacting surfaces with a small amount of brake lubricant or wheel bearing lubricant. Do not lubricate teeth of star wheel.
2. Pull parking brake cable forward and rearward through conduit and lubricate freely with light grease or chassis lubricant. Remove any excess lubricant.
3. Assemble the adjusting screw.

4. Attach the adjusting screw tension spring to the shoes and install the adjusting screw. The spring must not contact the adjusting screw star wheel.

   NOTE: *The right front and right rear adjusting screws have left hand threads and can be identified by the number of grooves in the adjusting screw as follows:*

B SERIES

Right rear .... 1 wide groove.
Left rear .... 1 V groove.

A AND X SERIES

Right front and rear .... 2 wide grooves.
Left front and rear .... 2 V grooves.

F AND G SERIES

Right rear .... 2 wide grooves.
Left rear .... 2 V grooves.

All adjusting screws must be installed with the star wheel end of the screw toward the rear of the car.

5. On rear brake assemblies, install the parking brake lever to the secondary shoe and connect cable.

6. Position shoe assembly on the backing plate. Be sure wheel cylinder links are properly positioned in the shoe notches. On rear brakes install strut and spring between lever and primary shoe.

   NOTE: *When replacing shoes, always be certain to assemble secondary shoes to the rear and primary shoes to the front. Linings of primary shoes are usually shorter than secondary linings.*

7. Position the upper end of actuating link over anchor pin.

8. Engage the adjuster lever with the override pivot, then position the adjuster lever and override spring assembly on the secondary shoe. Fasten with the hold-down spring assembly (Fig. 5-15).

   NOTE: *THE FRONT BRAKE SPRING RETAINING PINS ARE IDENTIFIED WITH THE NUMERAL 4 (A SERIES ONLY) STAMPED ON THE OUTER FACE. THE REAR BRAKE RETAINING PINS ARE IDENTIFIED WITH THE NUMERAL 8 (B SERIES) OR 2 (A, F AND G SERIES) STAMPED ON THE OUTER FACE.*

Install the primary hold-down spring

9. Install the primary and secondary brake shoe return springs.

   CAUTION: *New brake shoe return springs should be installed if old springs have been overheated or strength is doubtful. Overheated springs may be indicated by burned paint, end coils opened up, or failure of shoes to return to anchor pin.*

10. Sand linings lightly to remove any trace of dirt.

11. Check to see that adjuster lever can turn adjusting screw star wheel with minimum of effort.

12. Adjust brake shoe-to-drum clearance as outlined under ADJUSTMENT.

13. Install drums.

    NOTE: *Front wheel bearings must be adjusted as outlined in Section 3 of this manual.*

14. If wheel cylinder has been replaced or repaired, or hydraulic line has been replaced, bleed brakes as described in this section on BLEEDING BRAKES.

15. Check parking brake cable adjustment and, if necessary, adjust as outlined under PARKING BRAKE - ADJUSTMENT.

16. Check fluid level in master cylinder as shown in Fig. 5-11.

    CAUTION: *See Caution on page 1 of this Section regarding the fasteners referred to in step 17 below.*

17. Install wheels. Tighten nuts evenly and alternately (B Series) 75 lb. ft. (A, F and G Series) 70 lb. ft. (X Series), 65 lb. ft. torque.

18. Check brake pedal travel to be sure it is within specifications, then road test car for proper operation of the brake system.

    CAUTION: *New linings must be protected from severe use for several hundred miles. This should be conveyed to owner, along with instructions to follow proper burnishing procedure as outlined in Owner's Manual.*

HYDRAULIC SYSTEM

The dual master cylinder is designed and built to satisfy individual brake system displacement requirements (Fig. 5-2 and 5-20).

The lengths of component pistons in a master cylinder are critical factors in displacement capabilities of a master cylinder. Pistons are coded, using rings or grooves in shank of piston. When pistons are replaced, replacement piston must contain same identification marks and same contour at push rod end as piston which was removed.

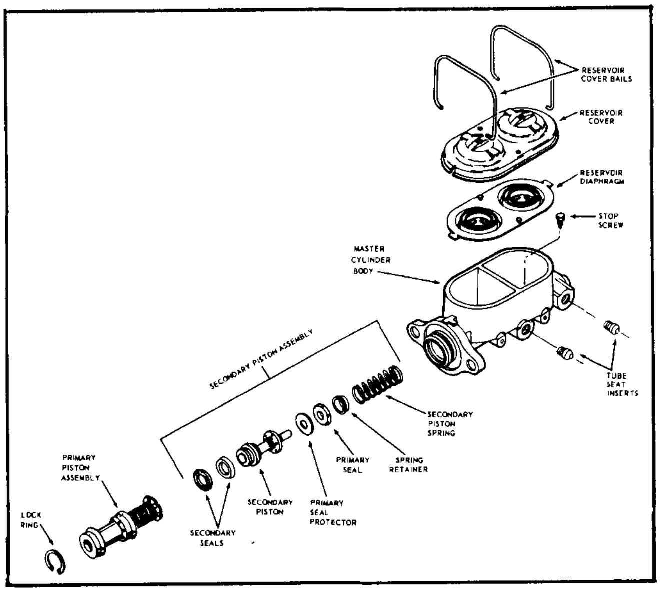


Fig. 5-20 Master Cylinder - Exploded View

MASTER CYLINDER

REMOVE

1. Disconnect master cylinder push rod from brake pedal.

2. Disconnect brake lines from two outlets on master cylinder and cover end of lines and outlet ports to prevent entrance of dirt.

3. Remove master cylinder from dash.

DISASSEMBLE

1. Remove master cylinder reservoir cover and drain fluid. Pump fluid from master cylinder by depressing push rod.

2. A retained push rod is used on all standard brake applications. Pull back boot to uncover push rod retainer. The retainer has a small, depressed tab in the side which may be pried up to release retainer. Tab serves to hold retainer and push rod on master cylinder while it is being shipped and it is not necessary to bend tab down at reassembly. Retainer is held in place between master cylinder and dash when master cylinder is bolted in place.

3. Remove small secondary piston stop bolt from bottom of front fluid reservoir of master cylinder.

4. Place master cylinder in soft jaws of vise. Remove lock ring from small groove in inside diameter of bore. Remove primary piston (rear). Remove secondary (front) piston, piston spring and retainer by applying air pressure through front piston stop bolt hole. Do not attempt to disassemble rear piston since complete new assembly is provided in repair kit.

NOTE: *If air is not available, a piece of wire may be used. Bend one fourth inch of one end of wire into right angle and hook end under edge of floating piston to remove.*

5. With master cylinder in vise (outlet holes up), drill out the tube fitting insert with a 13/64" drill and then tap the hole, using a 1/4" x 20 tap. Place a 1/2" to 3/4" long, 1/4" x 20 bolt through a thick washer and then thread the bolt into the insert. Tighten the bolt against the washer until the insert is removed.

6. Remove master cylinder from vise and inspect bore for corrosion, pits and foreign matter. Make sure outlet ports are clean and free of brass cuttings from tube-seat removal operation. Inspect fluid reservoirs for foreign matter. Check bypass and compensating ports to master cylinder bore to insure they are not restricted.

7. Remove primary seal, primary seal protector and secondary seals from front piston.

CLEANING

CAUTION: *Honing of master cylinders is not recommended as it creates a finish which is much rougher than original. It is best to replace a corroded master cylinder. Discolored or stained areas may be polished with crocus cloth. Use a circular motion. Do not slide the cloth in a lengthwise direction under pressure. Do not use any other form of abrasive or abrasive cloth.*

Use alcohol or clean brake fluid to clean all metal brake parts thoroughly. Immerse parts in cleaning fluid using a bristle 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 cloth.

NOTE: *Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean until reassembly. Rewash at reassembly if there is any occasion to doubt cleanliness.*

ASSEMBLE (FIG. 5-2 AND 5-20)

1. Place master cylinder in vise, with outlet holes up.

2. Place new brass tube seat in outlet holes. Be sure that it is not cocked, as this would cause burrs. Recommended method of inserting tube seat is to thread a spare brake line tube nut into outlet hole and turn nut down until tube seat bottoms. (Remove tube nut and check outlet hole for burrs, which might have been turned up when the tube seat was pressed down.)

3. Put new secondary seals in the two grooves in the end of front piston. Seal which is nearest the end of the piston will have its lips facing toward that end. The second groove seal should have its lips facing toward

the portion of front piston which contains small compensating holes.

4. Assemble a new primary seal and protector over end of front piston with flat side of seal seating against seal protector and protector against flange of piston which contains the small compensating holes.

5. All master cylinder overhaul kits contain assembled primary piston, making it unnecessary to assemble any primary piston component parts.

6. Coat bore of master cylinder, primary and secondary seals on front piston with clean brake fluid. Insert secondary piston spring retainer into secondary piston spring. Place retainer and spring down over end of front piston locating retainer inside lips of primary cup.

7. Holding master cylinder with open end of bore down, push front piston into bore, seating spring against closed end of bore.

8. Place master cylinder in vise with open end of bore up. Coat primary and secondary seal on rear piston with clean brake fluid. Push rear piston assembly, spring end first, into bore of master cylinder. Hold piston down and snap lock ring into position in small groove in I.D. of bore.

9. Continue to hold rear piston down, which will move front piston forward far enough to clear stop screw hole located in bottom of front fluid reservoir. Position stop screw in its hole and tighten to a torque of 33 lb. in.

10. Install a new reservoir diaphragm in reservoir cover, if needed. Install cover on master cylinder. Beaded side faces casting to insure positive sealing. Push bail wires into position to hold reservoir cover.

11. Assemble push rod through push rod retainer, if disassembled.

12. Push retainer over end of master cylinder. Assemble new boot over push rod and press it down over push rod retainer.

REPLACE

CAUTION: *See Caution on page 1 of this Section regarding the fasteners referred to in step 1 below.*

1. Mount and secure master cylinder to dash, tighten fasteners to 25 lb. ft. torque. The flange on the push rod retainer and flange on boot will be held between the dash and master cylinder.

2. Connect push rod to brake pedal and attach brake lines to appropriate bosses on master cylinder. Outlet boss thread sizes and brake line fittings for front and rear are different sizes to assure that correct connections are made, providing original brake lines have not been changed.

3. Fill and bleed master cylinder as though it were two separate units. See section on bleeding brakes. After bleeding, fill reservoirs with brake fluid to within 1/4" of top of reservoir (Fig. 5-11).

WHEEL CYLINDER

REMOVE

1. Raise wheels of vehicle and remove wheel and drum assembly.

2. Remove brake shoes to protect them from dropping fluid.

3. Disconnect hose (front wheels) or pipe (rear wheels), from wheel cylinder.

4. Remove wheel cylinder.

The internal wheel cylinder boots should be removed from cylinder body only when they are visibly damaged or leaking fluid.

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 the link pin. Fluid coatings on the piston within the cylinder and on the end of the link pin removed from the boot are normal, as the cylinder contains a porous piston which is impregnated with a corrosion-inhibiting fluid. Fluid spilling from the boot center hole, after the link pin is removed, indicates cup leakage and the necessity for completely overhauling the cylinder.

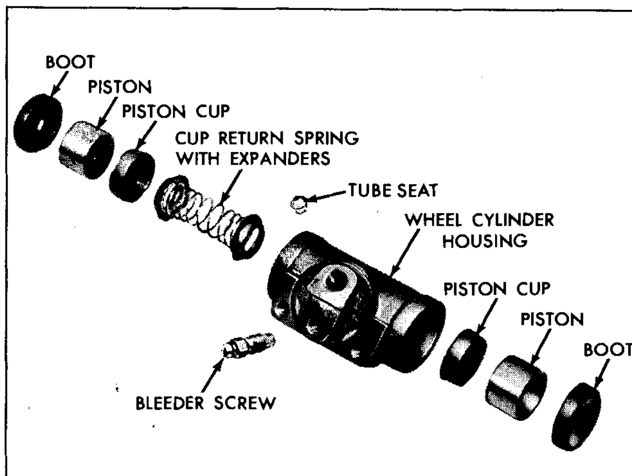


Fig. 5-21 Wheel Cylinder - Exploded View

DISASSEMBLE

1. Pull boots from cylinder ends with pliers and discard boots.
2. Extract and discard pistons and cups.
3. Inspect cylinder bore. Check for staining or corrosion. It is best to discard a corroded cylinder.

   NOTE: *Staining is not to be confused with corrosion. Corrosion can be identified as pits or excessive bore roughness.*

4. Polish any discolored or stained area with crocus cloth. Use a circular motion. Do not slide the cloth in a lengthwise direction under pressure. Do not use any other form of abrasive or abrasive cloth.
5. Rinse the cylinder in alcohol or brake fluid.
6. Shake excess rinsing fluid from the cylinder. Do not use a rag to dry the cylinder, as lint from the rag cannot be kept from the cylinder bore surfaces.

ASSEMBLE

1. Lubricate the cylinder bore and counterbore with brake fluid and insert spring-expander assembly.
2. Install new cups making sure cups are lint and dirt free. Do not lubricate cups prior to assembly.
3. Install new pistons in the "as received" condition to insure proper corrosion inhibiting properties. Do not lubricate pistons with brake fluid.
4. Press new boots into cylinder counterbores by hand. Do not lubricate boots prior to assembly.

REPLACE

CAUTION: *See Caution on page 1 of this Section regarding the fasteners referred to in step $EN4 1 below.*

1. Install wheel cylinder on backing plate with screws and lock washers. Tighten screws to 14 1/2 lb. ft. torque (B Series) 8 lb. ft. torque (A, X, F and G Series).
2. Replace wheel cylinder link pins.
3. Install brake shoes and springs.
4. Connect hose or pipe to wheel cylinder. (Use new gasket with hose).
5. Install brake drums. Adjust front wheel bearings (as described in Section 3, SUSPENSION).
6. Bleed all brake lines affected as described under BLEEDING BRAKES in this section.
7. Adjust and test brakes as previously described in this section.

BRAKE HOSES

Front and rear brake hoses must be periodically inspected as outlined under Service Operations in this section. Necessary replacements should be made as follows:

CAUTION: *Use care not to damage steel brake pipes by twisting. Soak all connections with ample amounts of penetrating oil. If replacement is necessary, use only steel pipe with double flared ends.*

FRONT HOSE

REMOVE

1. Carefully disconnect metal brake pipe from female hose fitting at frame end.
2. Remove "C" washer from flexible hose at frame bracket, and remove hose from bracket.
3. All Series (Disc Brakes) - unscrew flexible hose from caliper assembly. A and X Series (Drum Brakes) - unscrew metal pipe from wheel end of the hose and remove "C" washer.

INSTALL

1. Using new washers (where used), install new hose by reversing the above procedure.

   NOTE: *Position hose with suspension loaded, and wheels straight. Hose must be free of kinks.*

   CAUTION: *ON VEHICLES EQUIPPED WITH DISC BRAKES, THE SKIRT OF THE METAL FITTING AT THE END OF THE HOSE ATTACHING TO THE CALIPER MUST BE INSTALLED BETWEEN THE EARS ON THE INSIDE OF THE CALIPER (FIG. 5-22).*

2. Bleed both front brakes as outlined. With disc brake cars, hold off metering valve with tool J 23709.

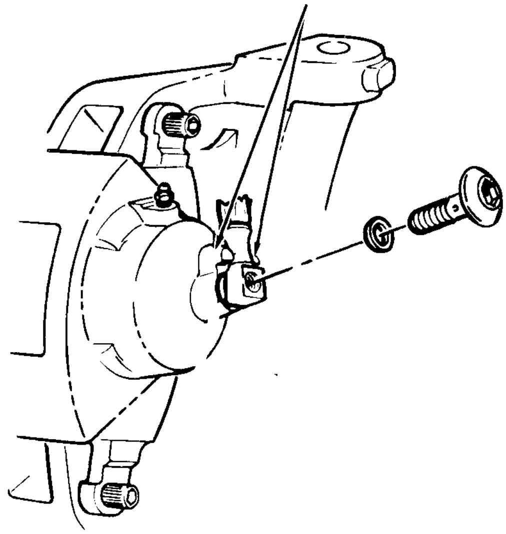


Fig. 5-22 Installation Drawing - Brake Hoses - Disc Brakes

3. Re-fill master cylinder (Fig. 5-11).

4. Inspect entire hydraulic system for leaks under pressure. Turn wheel both ways to full lock and inspect. See that hose does not rub any other part.

REAR HOSE

REMOVE

1. Raise car and support the frame so the rear axle can be lowered to its full extent of travel. Lower axle.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

   NOTE: *It may be necessary to soak the connections with penetrating oil.*

2. Remove front metal brake line, taking care to avoid damage.

3. Remove "C" clip and release hose from its front bracket.

4. Unscrew the fittings from the two metal brake lines at the rear of the hose.

   NOTE: *Observe the angle at which this fitting is mounted to the axle housing. When installing the new hose, be sure that this fitting is at the same angle.*

5. Unscrew the bolt which holds the hose to the rear axle and remove the hose.

   NOTE: *Take care not to distort metal brake lines when removing hose. Pull pipe away at fitting, and only as far as necessary to provide clearance.*

INSTALL

1. Reverse the above procedure being sure that the rear hose fitting mounts at the proper angle, and that the hose is free of kinks and that the metal pipes are well seated in their clips on the axle housing. Kinked metal pipes should be replaced.

2. Bleed the rear brakes, as outlined.

   NOTE: *If for any reason the front brakes must also be bled on a disc brake car, be sure to release the metering valve using tool J 23709.*

3. Re-fill master cylinder to proper level (Fig. 5-11).

4. Inspect the entire system for leaks while applying full pedal pressure on brake system.

STEEL BRAKE TUBING

Hydraulic brake pipes are double layer annealed steel terne plate tubing which resist corrosion and have the physical strength to stand up under the high pressures which are developed when applying the brakes. In making up hydraulic brake pipes, it is important that the proper double flaring tool be used to flare the ends of the tubing for the compression couplings. Unless the tubing is properly flared, the connections will leak and the brakes will become ineffective.

WARNING: WHEN NECESSARY TO REPLACE BRAKE TUBING, ALWAYS USE SPECIAL STEEL TUBING, PART NUMBER 3830195 (3/16"), 3830196 (1/4") OR EQUIVALENT, WHICH IS DESIGNED TO WITHSTAND HIGH PRESSURE AND RESIST CORROSION. ORDINARY COPPER TUBING IS NOT SATISFACTORY AND SHOULD NOT BE USED.

THIS SAFETY STEEL TUBING MUST BE DOUBLE-LAP FLARED AT THE ENDS IN ORDER TO PRODUCE A STRONG LEAK-PROOF JOINT.

A BRAKE PIPE FLARING PROCEDURE IS ILLUSTRATED IN FIG. 5-23.

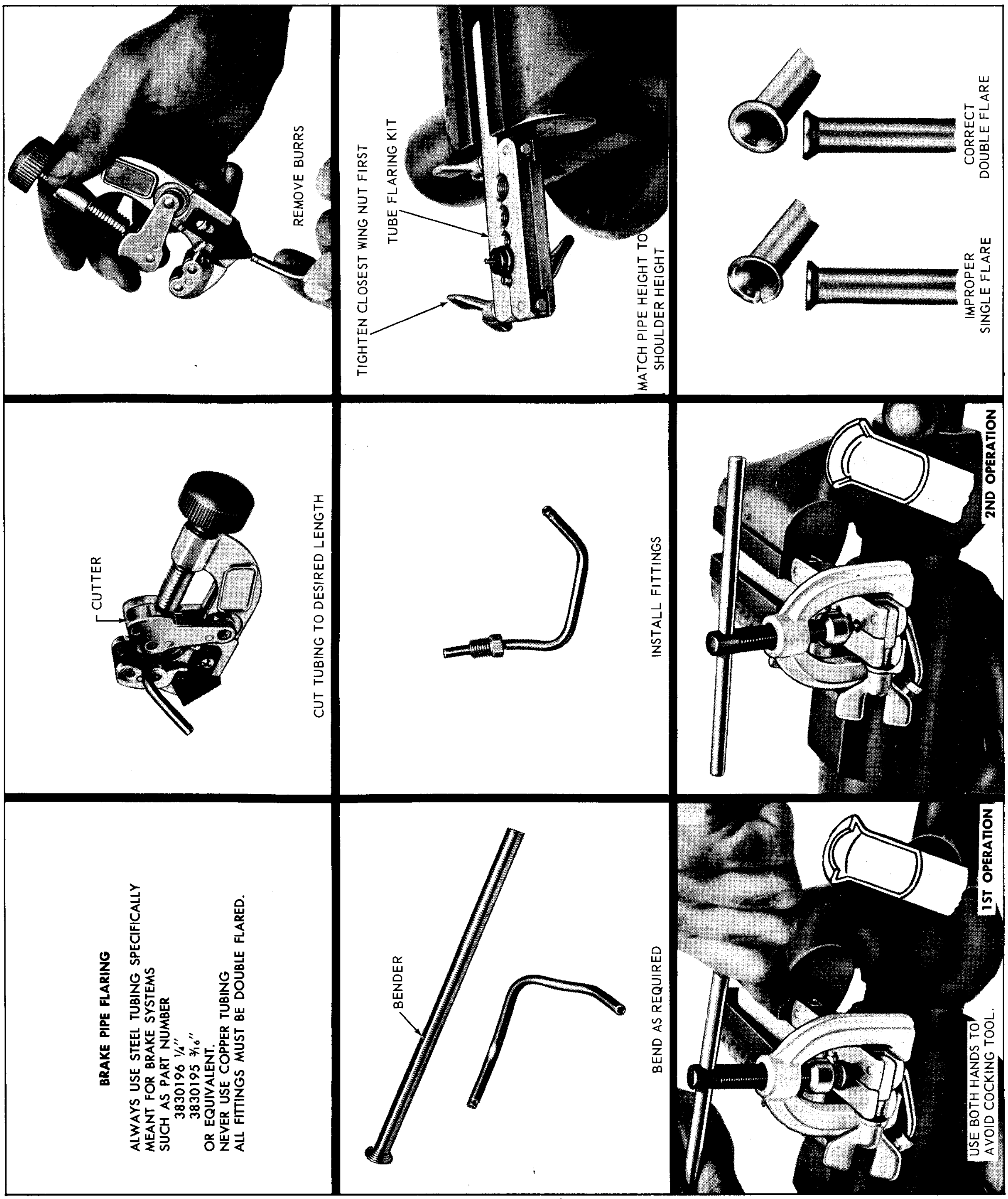


Fig. 5-23 Brake Pipe Flaring

BLEEDING BRAKES

NOTE: *On disc brake cars a combination valve is in the hydraulic system and mounted either on the frame rail or under the main cylinder. This valve must be held in the open position while bleeding. This can be accomplished by installing Tool J-23709 with the open slot under the mounting bolt and pushing in on the pin in the end of the valve.*

Depressing the pedal with a low fluid level in master cylinder reservoir or disconnecting any part of the hydraulic system permits air to enter the system. Air may also enter the system occasionally when brake shoes are replaced. This air must be removed by bleeding.

Bleeding may either be done by using pressure bleeding equipment or by manually pumping the brake pedal using bleeder tube as outlined below.

CAUTION: *Always clear away any dirt around master cylinder reservoir cover before removing cover for any reason. Never depress pedal while brake drums are removed unless bleeder valve is open.*

When bleeding by operating pedal, proceed as outlined below:

NOTE: *Do not exert excessive pressure when bleeding.*

1. Fill master cylinder reservoirs with recommended brake fluid.

CAUTION: *Never use an inferior or reclaimed brake fluid as this will positively result in brake trouble. Even though reclaimed fluid may look clear, tests have shown such fluid to be corrosive. If there is doubt as to the grade of fluid in the system, flush out system and fill with recommended brake fluid such as Delco Supreme 11 or equivalent.*

2. On models equipped with master cylinder bleeder screws bleed master cylinder by the following procedure: Attach bleeder tube to valve and allow tube to hang submerged in brake fluid in a clean quart glass jar. Using brake bleeder wrench or equivalent, unscrew bleeder valve three-quarters of a turn. Depress pedal full stroke and allow it to return slowly making sure end of bleeder tube is under surface of liquid in container. Continue operating pedal, refilling reservoir after each five strokes (unless an automatic filling device is used), until liquid containing no air bubbles emerges from bleeder tube.

3. Close bleeder valve assembly and bleed other master cylinder bleeder valve.

NOTE: *If a power brake unit has been installed and the original manual master cylinder (without bleeder valves) is used, these units may be bled by unscrewing the master cylinder brake line three-quarters of a turn, depressing brake pedal, tightening brake line, then releasing brake pedal.*

4. After master cylinder has been bled, wheel cylinders may be bled in the following order using the above procedure: right rear, left rear, right front and left front.

CAUTION: *Bleeder tube should always be used when bleeding brakes, and end of tube must be below level of brake fluid in glass jar when bleeding other than by pressure.*

5. When bleeding operation is completed, refill reservoirs as shown in Fig. 5-9, then replace reservoir cover.

When using pressure bleeding equipment, follow instructions of the equipment manufacturer and always use bleeder tube attached to wheel cylinder to prevent brake fluid from running inside the brake assembly and ultimately on the brake linings.

When using a pressure tank, air bubbles may form in the tank and enter the brake hydraulic system. To avoid this, observe the following points when handling a pressure tank: (1) Do not shake or agitate the pressure tank after air pressure has been added or is being added. (2) Allow pressure tank to stand in one position as much as possible and bring air hose over to tank when adding head of air. (3) Make certain the valves on the pressure tank lines are not defective allowing air to be sucked in when fluid passes through the lines. (4) Pressure tank should be kept at least 1/3 full of fluid to avoid air bubbles forming, (5) If pressure tank is full of air bubbles, release air pressure and those bubbles will increase in size, be forced to top of fluid and escape.

Pressure bleeding equipment must be of the diaphragm type; that is, it must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil, and other contaminates from entering the hydraulic system.

1. Thoroughly clean master cylinder reservoir cover and surrounding area; then remove cover and diaphragm.

2. Make sure that pressure tank is at least 1/3 full of specified brake fluid and that hose and master cylinder reservoir are filled with fluid. Attach hose to master cylinder reservoir adapter J-23518.

3. Install Bleeder Wrench J-21472 on bleeder valve. Slip a brake bleeder tube over ball of wheel cylinder bleeder valve. Place lower end of bleeder tube in a clean glass jar with enough clean brake fluid in it to keep end of hose submerged. Unscrew bleeder valve 3/4 of a turn.

4. Open pressure tank hose valve to apply fluid to master cylinder under pressure that does not exceed 35 pounds. It is not necessary to pump the brake pedal when using pressure tank.

5. When fluid flows from bleeder tube into glass jar in a solid stream that is free of air bubbles, that particular cylinder and line are bled; tighten bleeder valve securely and remove bleeder tube.

6. When bleeding operation is completed at all wheel cylinders where needed, make sure that fluid level is 1/4" (plus or minus 1/8") from the lowest portion of the top of each reservoir (see Fig. 5-11), install rubber diaphragm and cover.

FLUSHING HYDRAULIC SYSTEM

It may sometimes become necessary to flush out the brake hydraulic system due to the presence of mineral oil, kerosene, gasoline, carbon tetrachloride, etc., which will cause swelling and/or deterioration of rubber piston cups and valves so they become inoperative.

To flush hydraulic system, proceed as follows:

1. Attach bleeder tube and open bleeder valve at left front wheel.

2. Flush out system thoroughly with clean brake fluid, pumping the fluid from master cylinder reservoir and out of wheel cylinder bleeder valve.

3. Repeat steps 1 and 2 at remaining wheel cylinders. To ensure thorough flushing, approximately 1/2 pint of fluid should be bled through each wheel cylinder.

4. Replace all rubber parts in master and wheel cylinders. Thoroughly clean cylinders and pistons in alcohol before installing new parts. Remove all traces of alcohol before installation.

5. After installing parts, fill system with recommended brake fluid and follow steps 2 through 4 under BLEEDING BRAKES to flush system of cleaning solution and to bleed brakes. In doing this, pump brake fluid from wheel cylinder bleeder valves until clear fluid flows from bleeder tube and then continue until no air bubbles emerge from bleeder tube.

BRAKE FLUID PRECAUTIONS

Brake fluid is adversely affected by contamination from dirt, automotive petroleum products and water absorbed from the atmosphere. Contaminants can plug parts of the hydraulic system, cause rapid wear or swelling of rubber parts, and lower the boiling point of the fluid. The following precautions should be observed when dealing with brake fluid:

1. Use only government and S.A.E. approved brake fluid, such as Delco Supreme 11 or equivalent. Never use "hydraulic fluid" as it has a petroleum or synthetic base and is not intended for brake systems.

2. Never re-use brake fluid, or use fluid which is cloudy, dirty, or has air bubbles.

3. Do not mix brake fluids.

4. Store brake fluid in a clean dry place in the original sealed container. Cap container tightly, do not use it for other purposes, do not puncture a "breather hole".

5. Use only clean brake fluid to flush the hydraulic system. Dissassembled brake parts may be cleaned with alcohol provided all traces are removed.

6. Before opening master cylinder remove dirt from around cap.

PARKING BRAKE

The rear brake assemblies serve a dual purpose in that they are utilized both as a hydraulically operated brake and a mechanically operated parking brake. In view of this dual purpose, the hydraulic brake must be properly adjusted as a base for parking brake adjustment.

> **NOTE:** *Automatic brake adjusters normally keep the parking brake adjusted correctly. However, there may be a condition where the parking brake system will require additional adjustment even though the service brakes are perfectly satisfactory.*

INSPECTION, CLEANING AND LUBRICATION

If parking brake will not release completely unless the pedal is forcibly returned to its position, or if the application effort is high, check parking brake pedal assembly for free operation.

If operation is sticky or a bind is experienced, correct as follows:

1. Clean and lubricate cables (within conduits) and cable contact areas with lithium soap grease or equivalent.

2. Inspect parking brake pedal assembly for straightness and alignment.

3. Clean and lubricate parking brake pedal assembly with bearing or chassis grease.

4. Check routing of cables for kinks, binds and broken strands.

ADJUSTMENT

CAUTION: *It is very important that parking brake cables are not adjusted too tightly causing brake drag. With automatic brake adjusters, a tight cable causes brake drag and also positions the secondary brake shoe, hence the adjuster lever, so that it continues to adjust to compensate for wear caused by the drag. The result is a cycle of wear and adjustment that can wear out linings very rapidly.*

1. Jack up both rear wheels.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

2. Be sure that hydraulically operated brakes are properly adjusted.
3. Push parking brake pedal four to eight notches from fully released position.
4. Loosen the equalizer rear lock nut. Adjust the forward nut until a light to moderate drag is felt when rear wheels are rotated.
5. Tighten lock nut.
6. Fully release parking brake and rotate rear wheels; no drag should be present.

PARKING BRAKE PEDAL

REMOVE

CAUTION: *Remove positive cable from battery to eliminate the possibility of creating short circuits under dash.*

1. Place parking brake pedal in released position.
2. Remove two attaching nuts from mounting studs located in engine compartment.
3. Remove pedal to dash brace attaching screw.
4. Remove brake pedal switch wire.
5. Remove front cable retainer from clevis.
6. Remove pedal assembly by lowering rear slightly to avoid scratching instrument panel.

INSTALL

1. Place pedal in position with the two mounting studs protruding through the holes provided in the firewall.
2. Position front cable retainer into pedal clevis.
3. Install and tighten pedal to dash brace attaching screw.
4. Install parking brake switch wire.
5. Install and tighten two attaching nuts on mounting studs located in engine compartment.
6. Connect positive battery cable.

FRONT CABLE

REMOVE

CAUTION: *Remove positive cable from battery to eliminate the possibility of creating short circuits under dash.*

1. Place parking brake pedal in released position.
2. Remove equalizer check nut, and separate cable stud from equalizer.
3. Remove clip from cable at inner side of frame rail.
4. Remove end of cable from pedal clevis.
5. Position left fender and inner fender panel to allow access to cable.
6. Compress expanded conduit locking fingers at toe pan and withdraw cable from under car.

INSTALL

1. Position cable and conduit tip through cutout in firewall. Make sure conduit locking fingers are fully expanded and secured in cutout, then position cable retainer into pedal clevis.
2. Feed threaded end of cable through frame rail and secure with retainer on inner side of frame.
3. Replace inner fender panel and left fender.
4. Place one check nut on cable stud and insert stud through equalizer (make sure center cable is in position), then place check nut on stud.
5. Adjust parking brake as outlined under Parking Brake Adjustment.
6. Connect positive battery cable.

CENTER CABLE

REMOVE AND INSTALL

1. Place parking brake pedal in released position.
2. Remove equalizer check nut and remove equalizer from cable.
3. Remove cable from cable guides.
4. Disconnect center cable from rear cables at connectors.
5. To install, reverse above procedures and adjust as outlined under Parking Brake Adjustment.

REAR CABLES

REMOVE AND INSTALL

1. Place parking brake pedal in released position.
2. Remove equalizer jam nut and remove equalizer from cable.
3. Remove rear cable from connector.
4. Remove retainer from rear cable at frame bracket. Pull cable out of bracket.
5. Remove rear brake drums.
6. Remove rear brake shoes.
7. Remove cable end from parking brake actuating lever.
8. On models having conduit locking fingers, compress expanded conduit locking fingers at flange plate entry hole and withdraw cable.

   On other models, remove cable anchor screws at backing plate and withdraw cable.
9. To install, reverse above procedure and adjust as outlined under Parking Brake Adjustment.

SPECIFICATIONS

B SERIES

NEW DRUMS (REAR ONLY)

GEOMETRY:
Inside Diameter
All Exc. Station Wagon .... 11"
Station Wagon .... 12"
Out-of-round
Maximum .... .002"
Eccentricity
Rear .... .006"
Rapid change of runout:

Indicator shall not change more than .0005" in any inch of circumference.

REVERSALS:

Only one indicator reversal in excess of .0008".

SURFACE FINISH:

60-120 micro-inch with a non-directional lay.

FLUID

Fluid which complies with heavy duty standards of SAE 70-R-3 specifications.

LINING

Width (Rear) .... 2"
Thickness (Rear)
Primary .... .220"
Secondary .... .260"
Effective braking surface area .... 187 sq.in.

MASTER CYLINDER BORE

Disc Brake system .... 1.125"

PEDAL HEIGHT

(Underside of power brake pedal pad
to floor pan) .... 3 7/8"

WHEEL CYLINDER BORE

Rear .... 15/16"

A, F, X and G SERIES

NEW DRUMS

GEOMETRY:
Inside diameter
Front and Rear .... 9 1/2"

Out-of-round
- Maximum .... .002″

Eccentricity
- Front .... .005″
- Rear .... .006″

Rapid change of runout:

REVERSALS:

SURFACE FINISH:

FLUID

Fluid that complies with heavy-duty standards of SAE 70-R-3 specifications.

LINING

Width
- Front .... 2 1/2″
- Rear .... 2″

Thickness (Front and Rear)
- Primary .... .196″
- Secondary .... .265″

Effective braking surface area .... 149.4 sq. in.

MASTER CYLINDER BORE

Standard system .... 1″
Disc brake system .... 1.125″

PEDAL HEIGHT

(Underside of Pedal Pad to Floor Pan)
- A Series (Standard System) .... 7 1/8″
- A & G Series (Power Brake) .... 4 1/2″
- F Series (Standard Disc) .... 7″
- F Series (Power Disc) .... 5″

WHEEL CYLINDER BORE

Front .... 1 1/8″
Rear .... 7/8″

TORQUE SPECIFICATIONS

Torque in lb. ft. Unless Otherwise Specified.

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	75 lb. in.
Bolt and Nut-Brake and Clutch Pedal Shaft	30
Nut-Brake and Clutch Pedal Mtg. Bracket to Dash	24
Bolt-Parking Brake Lever to Instrument Panel	8
Nut-Parking Brake Lever to Dash	8
Nut-Brake Master Cylinder to Dash	24
Bolt-Parking Brake Rear Cable Anchor to Brake	25
Screw-Front Brake Hose Bracket to Frame	8
Screw-Rear Brake Hose Bracket to Axle Housing	8
Screw-Brake Pipe Distributor Block Bracket to Frame	8
Nut-Brake Pipe Connector	18

A, F AND G SERIES

APPLICATION	TORQUE
Front brake to steering knuckle-lower bolt and nut	75
Front brake to steering knuckle-upper bolt (bolt lubricated)	100
Rear brake to axle housing bolt and nut	35
Brake master cylinder to dash nut	24
Wheel cylinder to backing plate bolt	8
Wheel brake cylinder bleeder screw	75 lb. in.
Parking brake lever to dash nut	8
Parking brake front cable to equalizer nut	6
Parking brake lever to instrument panel bolt	8
Screw-Front brake hose bracket to frame	8
Screw-Rear brake hose bracket to axle housing	8
Screw-Brake pipe distributor block bracket to frame	8

X SERIES

APPLICATION	TORQUE
Front Brake to Steering Knuckle Lower Bolt	70
Front Brake to Steering Knuckle Upper Bolt	140
Rear Brake to Axle Housing Bolt	35
Master Cylinder to Dash	24
Wheel Cylinder to Backing Plate	50 in. lbs.
Bleeder Screws	75 in. lbs.

APPLICATION	TORQUE
Parking Brake Assembly to Dash	100 in. lbs.
Parking Brake Cable to Equalizer	90 in. lbs.
Screw Brake Line to Frame	100 in. lbs.
Combination Valve Mounting	150 in. lbs.
Brake Line Clip to Frame Screw	30

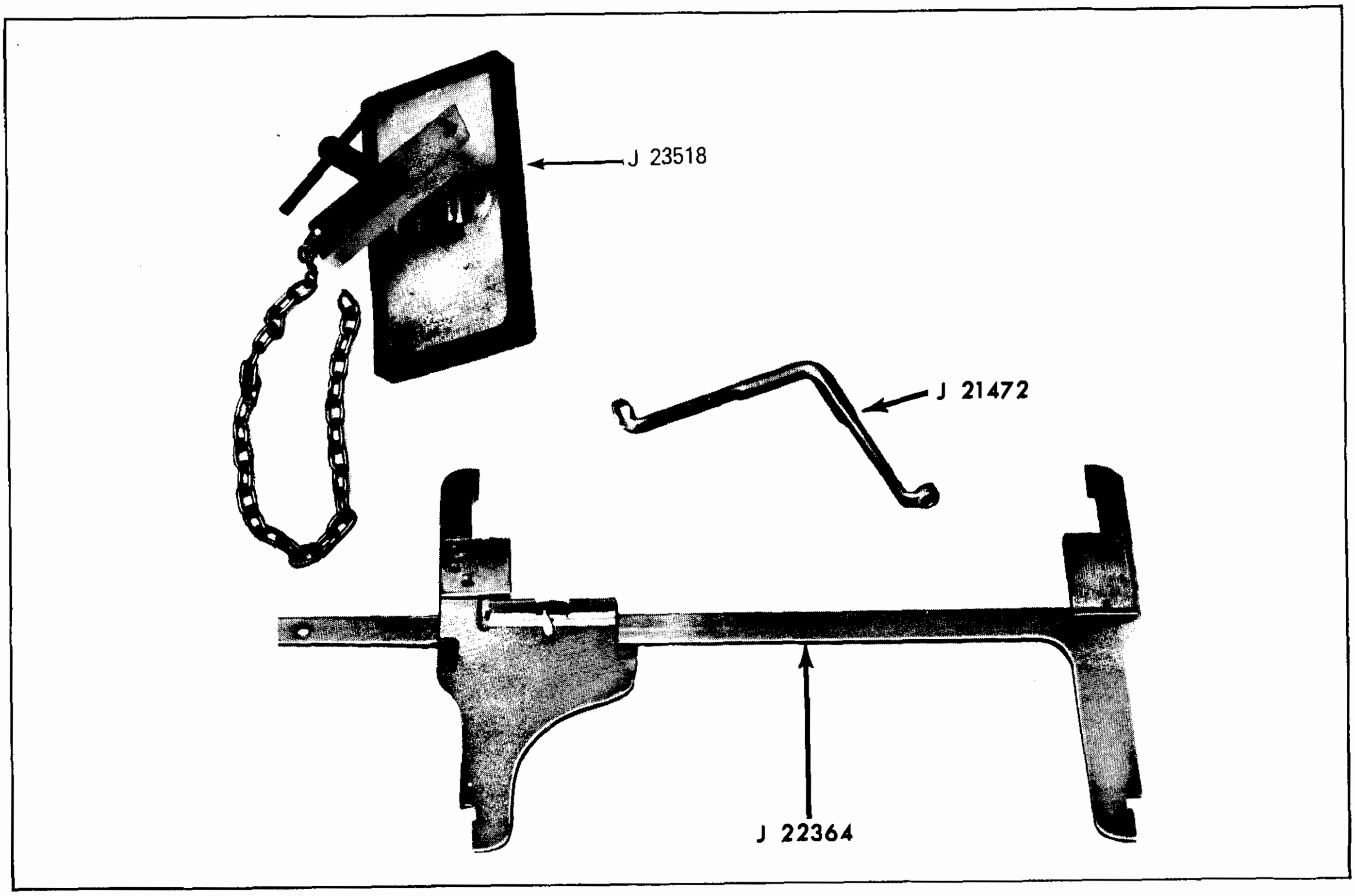


Fig. 5-24 Special Tools

SECTION 5A

DELCO-MORAINE POWER BRAKE

SINGLE DIAPHRAGM

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

TROUBLE DIAGNOSIS AND TESTING

SYSTEM TESTS

Road test the brakes by making a brake application at about 40 mph to determine if the vehicle stops evenly and quickly. If the pedal has a spongy feel when applying the brakes, air may be present in the hydraulic system and bleeding of brakes may be required.

When the engine is stopped and the transmission is in neutral, apply brakes several times to deplete all vacuum reserve in the system. Depress brake pedal, hold light-foot pressure on the pedal, and start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure, and less pressure will be required to hold pedal in applied position. If no action is felt, the vacuum system is not functioning.

Stop engine and deplete all vacuum reserve in the system. Depress the brake pedal and hold foot pressure on the pedal. If the pedal gradually falls away under foot pressure, the hydraulic system is leaking.

If the brake pedal travels to within one inch of the toeboard, the brake shoes require adjustment or relining.

Start engine with brakes off, run to medium speed and turn off the ignition. Immediately close the throttle to build up vacuum. Wait at least 90 seconds, then try brake action. If not vacuum assisted for two or more applications, vacuum check valve is faulty or leak exists in vacuum system.

The same types of brake trouble are encountered with power brakes as with standard brakes. Before checking the power brake system for the source of trouble, refer to the trouble diagnosis of standard brakes in Section 5. After these possible causes have been eliminated, check for the cause as outlined below:

HARD PEDAL

Vacuum failure due to:

a. Faulty vacuum check valve.

b. Collapsed vacuum hose to manifold.

c. Internal leaks in power brake unit.

Tight pedal linkage.

Power brake unit trouble.

a. Jammed air valve.

b. Vacuum leaks in unit caused by: faulty air valve seal or support plate seal, damaged floating control valve, faulty seal of master cylinder, or power cylinder mounting studs in housings, faulty seal on master cylinder push rod or a faulty seal of the diaphragm bead between the housings, or at power piston. It is also possible to have faulty vacuum check valve grommet.

c. Defective rolling diaphragm.

d. Restricted air filter elements.

e. Worn or badly-distorted reaction plate or levers.

f. Cracked or broken power piston or reaction retainer.

GRABBY BRAKES (APPARENT OFF-AND-ON CONDITION)

Power brake unit valve trouble.

a. Sticking air valve.

b. Restricted diaphragm passage.

Reaction system.

a. Dislodged reaction levers.

b. Broken air valve spring.

c. Worn or distorted levers or plates.

PEDAL GOES TO THE FLOOR OR ALMOST TO THE FLOOR

Fluid reservoir needs replenishing.

Power brake hydraulic system leakage.

a. Defective primary or secondary cups.

b. Cracked master cylinder casting.

c. Leaks at wheel cylinder, pipes hoses or connections.

Faulty master cylinder check valve has permitted air to enter system, causing spongy pedal.

BRAKES FAIL TO RELEASE

Faulty hydraulic check valve.

Blocked passage in power piston.

Air valve sticking.

Broken piston return spring.

Broken air valve spring.

Tight brake pedal clevis pin.

GENERAL DESCRIPTION

The single diaphragm Moraine power brake (Fig. 5A-1) is used on A, F, G and some X Series vehicles with either drum or disc brakes. It can be identified by the gold color of the power unit and master cylinder cover. Always make sure that the correct master cylinder is used whenever replacement is necessary.

It is a combined vacuum and hydraulic unit which utilizes engine intake-manifold vacuum and atmospheric pressure to provide power assisted application of vehicle brakes. The unit consists of a power unit and a master cylinder.

From the master cylinder connection outward to the wheel units, there is no other change in the brake system. In addition to the master cylinder connections, the unit requires a vacuum connection to the engine intake-manifold (through a vacuum check valve) and a mechanical connection to the brake pedal. The unit is self-contained with no external rods or levers exposed to dirt or moisture.

The power brake provides lighter pedal pressures and reduced pedal travel, making it possible to bring the brake

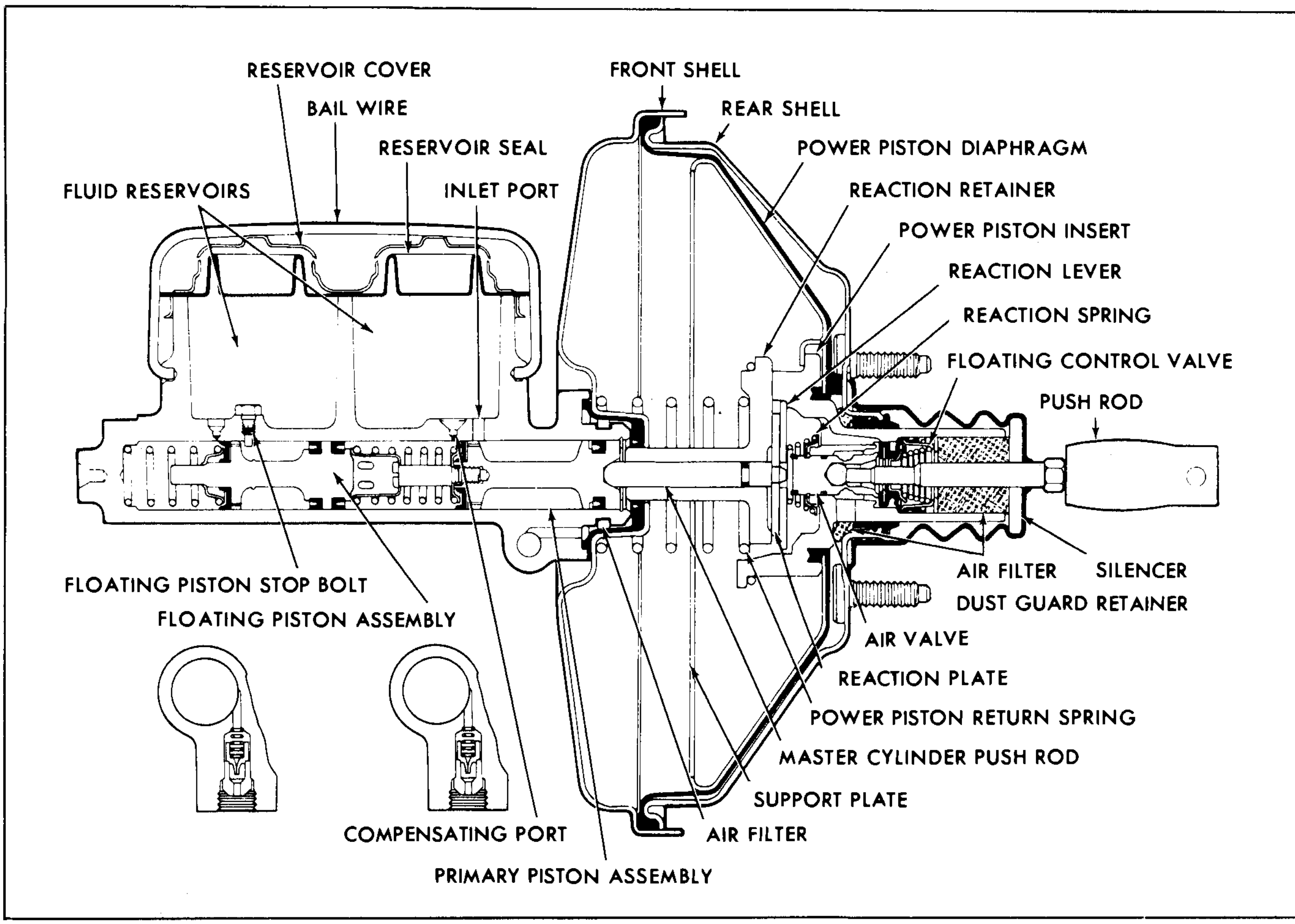


Fig. 5A-1 Delco Moraine Power Brake

pedal down to the approximate height of the accelerator. A reserve vacuum supply and the vacuum check valve permit several applications of the power brake with vacuum assist after the engine has stopped. After the vacuum stored in the unit has been lost, or in case of vacuum failure the brakes can be applied in the conventional manner, although considerable effort will be required due to the loss of the power assist.

DESIGN

The unit is composed of two main sections: the vacuum power cylinder and the hydraulic dual master cylinder.

The vacuum power cylinder contains the power piston assembly which in turn houses the control valve, reaction mechanism, and the power piston return spring. The control valve is composed of the air valve and the floating control valve assembly. This valve is controlled by the valve operating rod that projects through the end of the power cylinder housing.

The reaction mechanism consists of a hydraulic piston reaction plate and a series of levers. An air filter element, protected by a rubber boot, is assembled around the valve operating rod and fills the cavity inside the hub of the power piston. The push rod, which operates the air valve, projects out of the end of the power cylinder housing through the boot. A vacuum check valve assembly is mounted in the front housing assembly for connection to the vacuum source.

Fluid reservoirs are integrally cast with the master cylinder and supply fluid to the spaces between the primary and secondary seals through holes in the casting. Two hydraulic outlets connect independently to the front and rear wheel cylinders.

PRINCIPLES OF OPERATION

Principles of operation are basically the same as for the Delco Moraine tandem power brake (Section 5D), except that the tandem unit has two diaphragms for added assist in heavy duty applications.

A simplified explanation of basic power brake theory is shown in Fig. 5A-3.

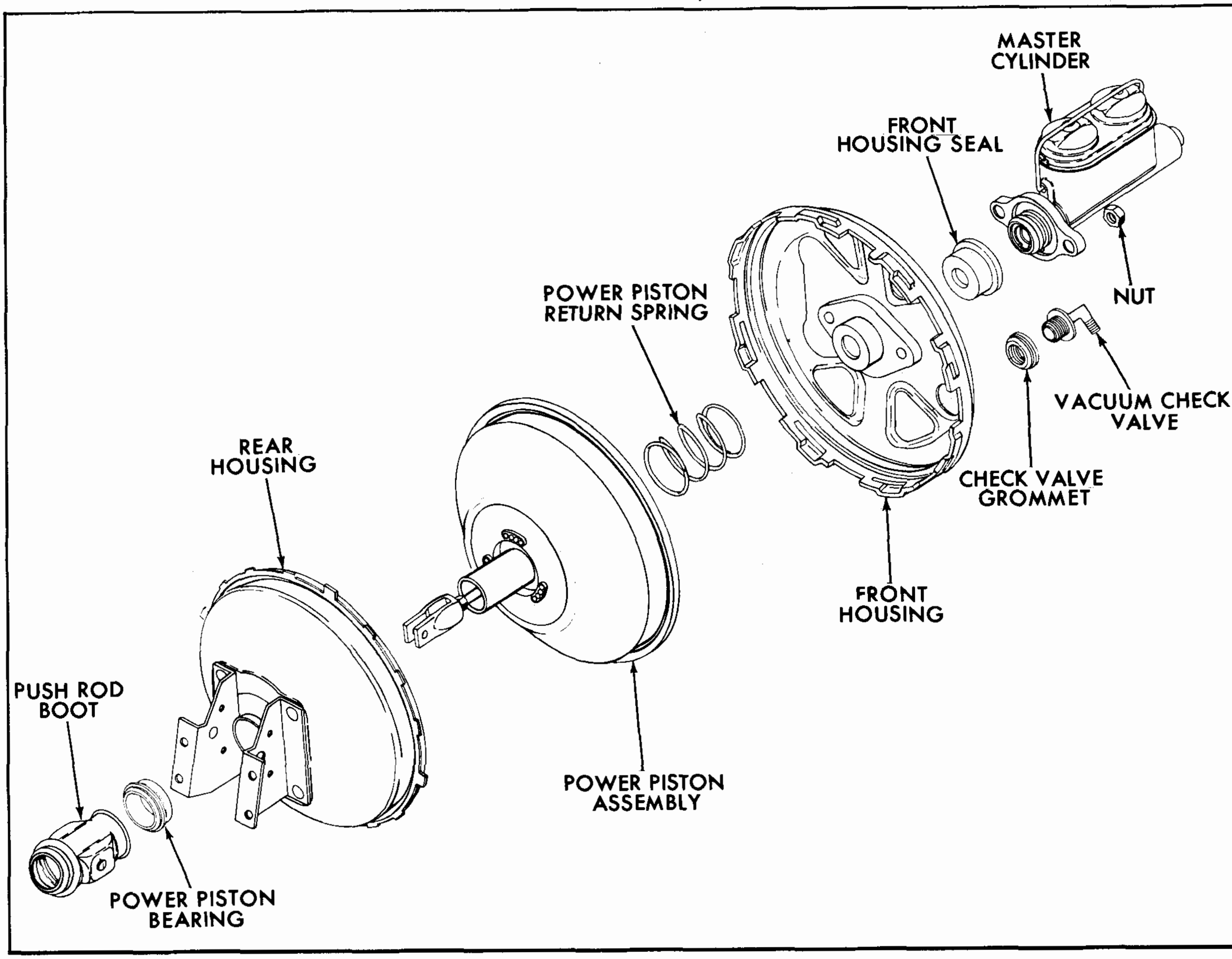


Fig. 5A-2 Exploded View A, G, F and X Series Power Brake Unit

VACUUM FAILURE

In case of vacuum source interruption, as the pedal is pushed down, the end of the air valve contacts the reaction levers and forces them, in turn, against the hydraulic reaction plate. Since the hydraulic reaction plate is fastened to the vacuum cylinder push rod, it forces the rod against the master cylinder pistons, which build up the hydraulic line pressure.

The pedal pressure required for a manual application, such as described, is considerably greater than with vacuum assist.

CHECKS AND ADJUSTMENTS ON CAR

1. Check for free operation of brake pedal. If binding exists, check pivot points for binding and lubricate as required.
2. Check stop light switch for proper setting and operation.
3. Check fluid level in hydraulic cylinder reservoirs. Fluid level should be as shown in Fig. 5-11.
4. Check vacuum hose, check valve grommet and carburetor vacuum fitting for possible air leaks.
5. Check engine for good stall-free idle. Correct as required.

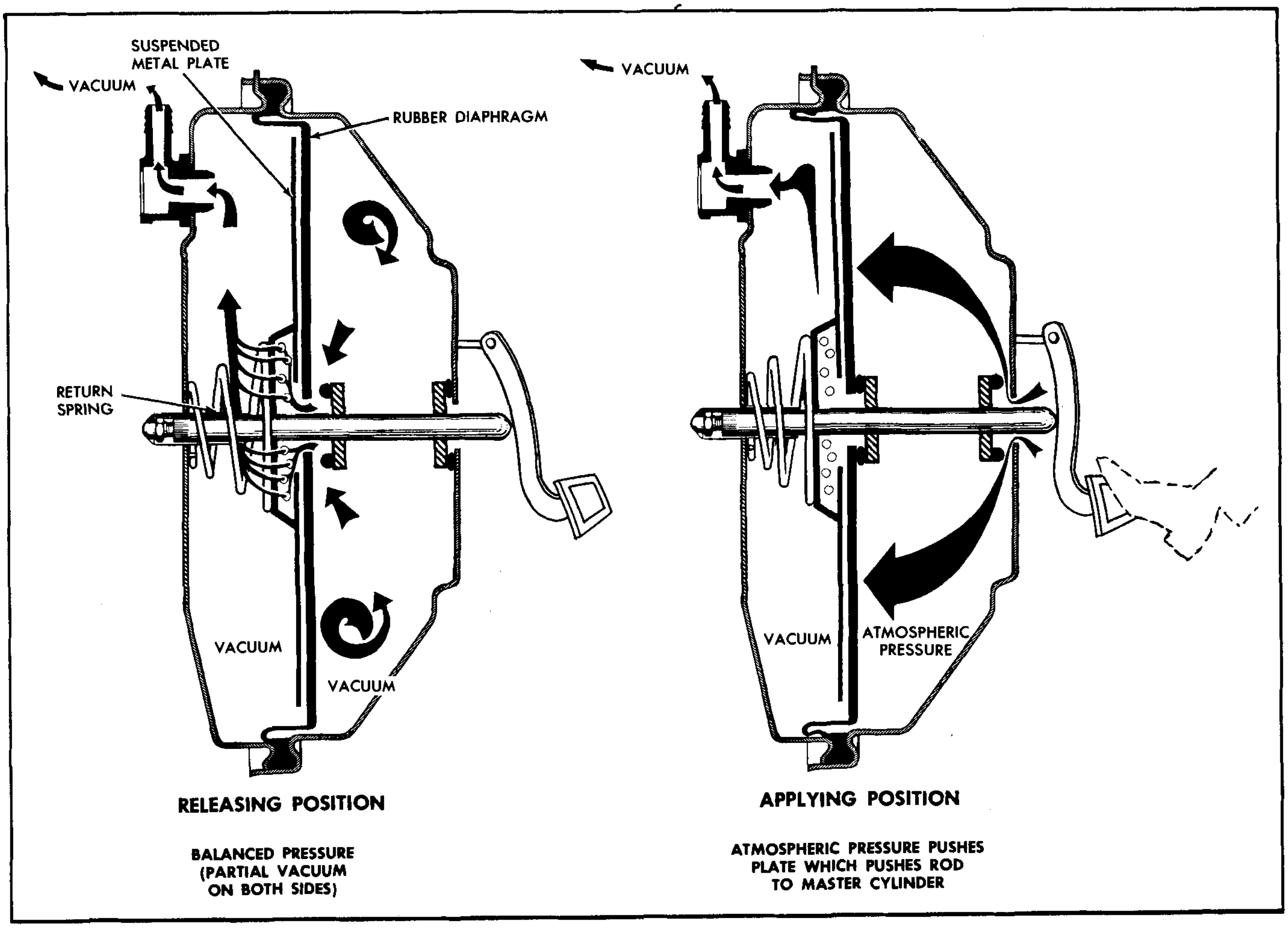


Fig. 5A-3 Simplified Power Brake Theory

MINOR SERVICE

BLEEDING BRAKES

Brakes should be bled in the same manner as non-power brakes, see Section 5. Bleed with engine off and vacuum reserve depleted.

STOP LAMP SWITCH

(See Section 5 for service.) All models use the same switch for both standard and power brakes.

MASTER CYLINDER ONLY

REMOVE

Certain repair operations, such as replacement of master cylinder internal parts, permits the master cylinder to be removed by itself, leaving the power cylinder, pedal and brackets in the car.

1. Disconnect hydraulic lines at master cylinder, pump fluid from cylinder into a container and dispose of fluid. Cover cylinder openings and ends of both pipes to exclude dust, dirt, etc.

2. Remove master cylinder attaching nuts and remove master cylinder from vacuum power section.

FRONT HOUSING

REMOVE

1. Remove vacuum check valve from front housing and discard grommet.

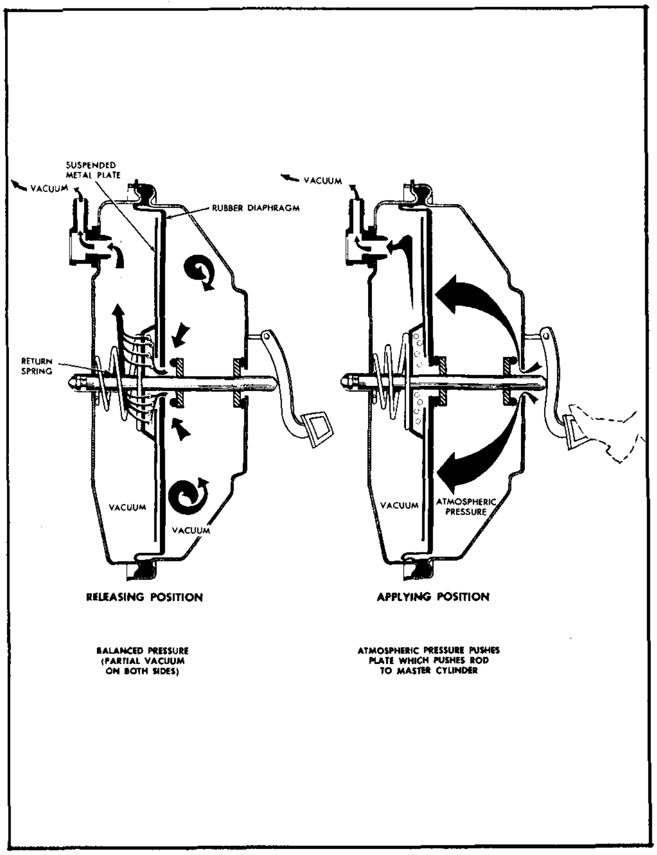


Fig. 5A-4 Removing Front Housing

2. Remove master cylinder and position it away from the vacuum cylinder.

3. Scribe a line across front and rear housings to facilitate reassembly.

4. Install tool J 22805-01 at front housing. Insert a 22" long x 1 1/4" square channel tube in end of tool.

5. Using a 14" crescent wrench or equivalent, twist the square channel tube **counterclockwise** enough to separate front housing from rear housing (Fig. 5A-4).

6. Remove front housing and power piston return spring.

POWER PISTON

REMOVE

1. Remove clevis pin retainer and pin at brake pedal.

2. Remove clevis and lock nut from push rod.

3. **Slowly** pull power piston assembly out from the rear housing, being careful not to damage the power piston bearing or push rod boot.

DISASSEMBLE (Fig. 5A-5)

CAUTION: *Care must be taken in handling diaphragm of power piston group. Diaphragm should be guarded against grease, oil and foreign matter and must be protected from nicks or cuts that might be caused by rough surfaces, damaged tools or dropping the piston.*

1. Place power piston in vise, as shown in Fig. 5A-6. Remove lock ring from power piston by prying from under locking lugs.

2. Remove reaction retainer, vacuum cylinder push rod, reaction plate, three reaction levers and air valve spring (Fig. 5A-7).

3. Remove hydraulic cylinder push rod from center of reaction retainer and O-ring seal from groove on the rod.

4. Remove small reaction bumper and air valve spring retainer from air valve. Remove power piston from vise.

5. Place square end of tool J 21524 in vise holding support plate and power piston with push rod facing up.

6. Pull diaphragm edges away from support plate and position assembly on tool J 21524 so that three lugs on tool fit into three notches in power piston (Fig. 5A-8).

7. Press down on support plate and rotate counterclockwise until support plate separates from power piston (Fig. 5A-9).

8. Remove diaphragm from support plate.

9. Remove foam air filter ring from outside of power piston hub.

10. Position power piston in vise padded with shop towels with hub end down.

    CAUTION: *Do not clamp on hub as outside surface serves as bearing and sealing surface.*

11. Remove snap ring on air valve using snap ring pliers and place power piston with tube end down in arbor press.

12. Press air valve from power piston hub using rod not exceeding 1/2" diameter. Removal of valve releases floating control valve, floating valve retainer, push rod limiter washer and air filter materials (Fig. 5A-10).

13. Remove O-ring seal from the air valve in second groove from air valve operating rod end.

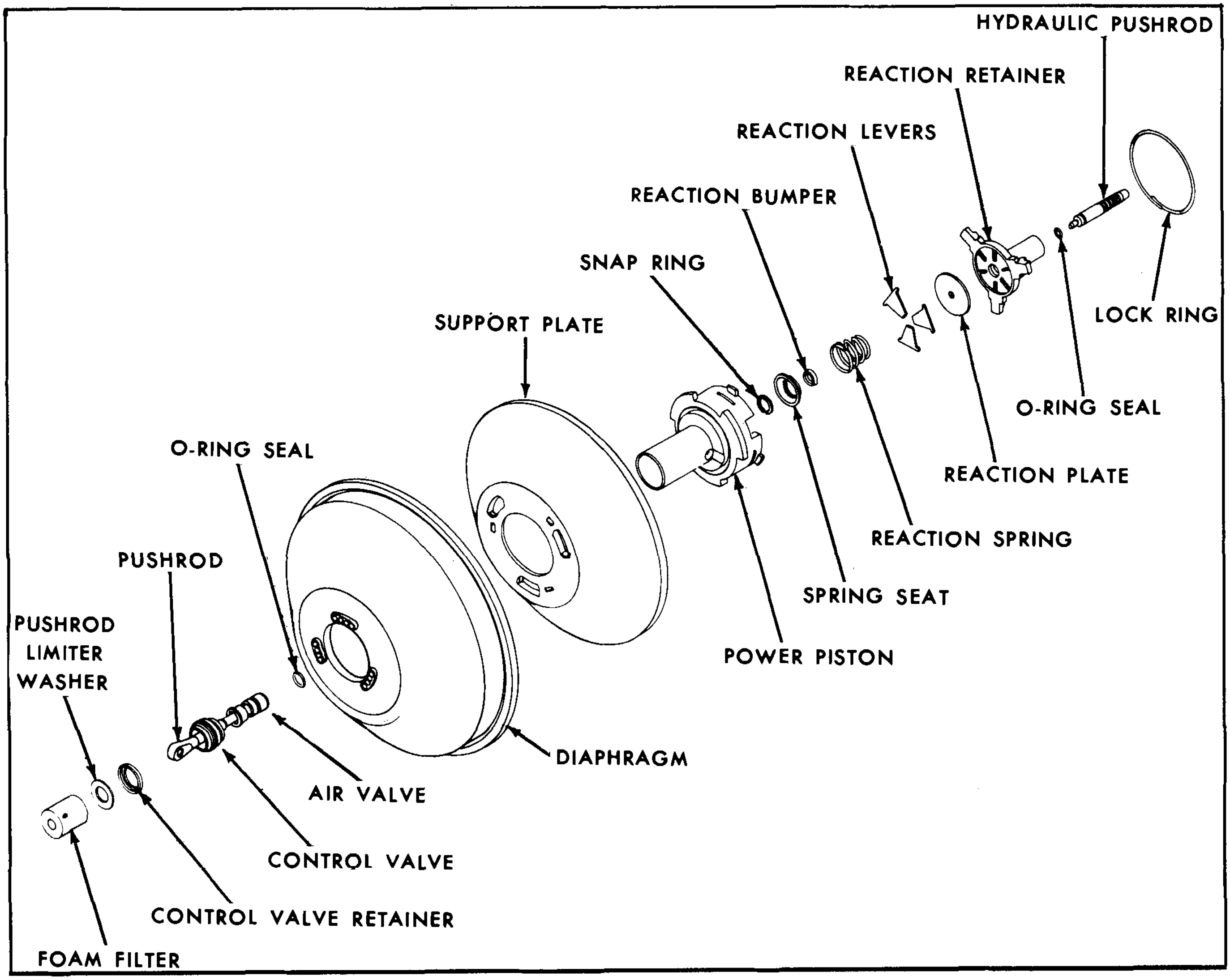


Fig. 5A-5 Exploded View of Power Piston

14. Remove power piston bearing from rear housing.

MASTER CYLINDER

DISASSEMBLE

Refer to Section 5 - Brakes-General for master cylinder disassembly and service procedures.

INSPECTION AND CLEANING

CAUTION: *It is important that all parts be placed on a clean paper after being cleaned to prevent the possibility of dirt being assembled into unit or grease contacting any rubber parts. Dirt is a major cause of trouble in service. Re-wash at time of assembly if there is any reason to doubt cleanliness.*

Thoroughly wash all parts in alcohol and air dry. Blow dust and cleaning fluid out of all internal passages. Inspect all metal parts for scoring, pitting, dents or nicks. Small imperfections can be smoothed out with fine emery cloth. Replace if badly nicked, scored or otherwise damaged. Do not attempt to repair any plastic part.

AIR FILTER

Replace air filter elements if dirty. Do not clean.

MASTER CYLINDER

ASSEMBLE

Refer to Section 5 - Brakes-General for assembly procedures.

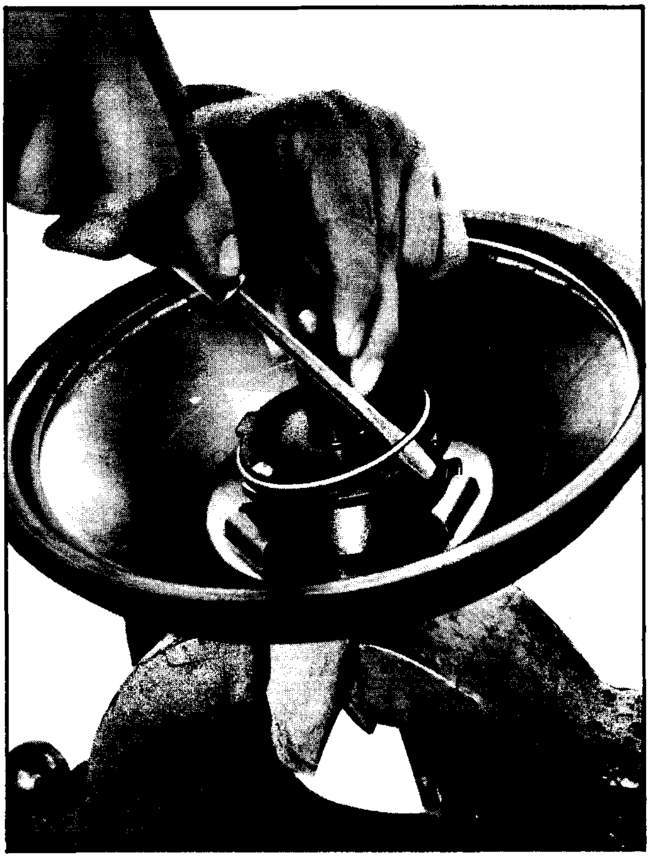


Fig. 5A-6 Removing Locking Ring From Power Piston

Fig. 5A-7 Removing Reaction Retainer

Fig. 5A-8 Positioning Power Piston on Support Plate Remover

POWER PISTON

ASSEMBLE

1. Place a new O-ring seal in groove on hydraulic cylinder push rod. Wipe thin coat of power brake lubricant on O-ring.

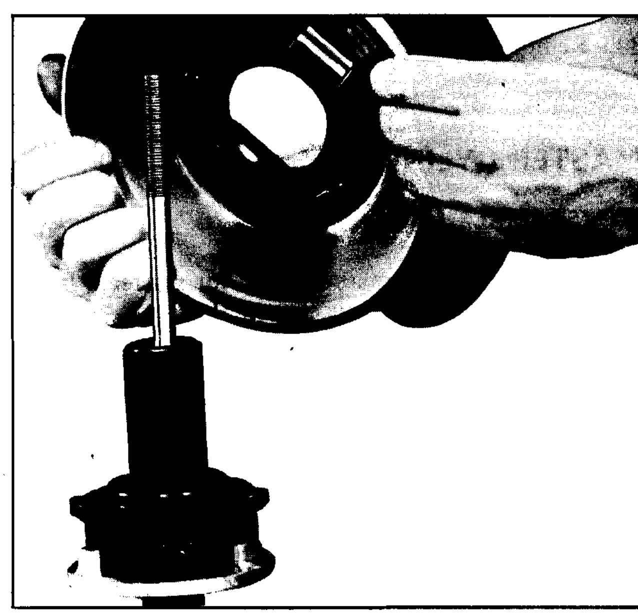


Fig. 5A-9 Removing Support Plate

2. Insert hydraulic cylinder push rod through reaction retainer so that end of rod with small pilot protrudes from flat side of reaction retainer.

3. Place power piston installer, J 21524, in vise and position power piston with three lugs fitting into notches in piston.

4. Install new O-ring seal on air valve in second groove from valve operating rod end.

5. Wipe thin film of power brake lube on large O.D. of floating control valve and on O-ring of air valve.

6. Press air valve - push rod - floating control valve assembly, air valve first, to its seat in tube of power piston.

7. Place floating control valve retainer over push rod so that flat side seats on floating control valve.

8. Start floating control valve and its retainer into power piston hub. Use tool J 21601 to press floating valve to seat in tube by placing tool on top of retainer and pressing down.

9. Position push rod limiter washer over push rod to floating control valve and install air filter element over end of push rod and into power piston hub.

10. Install felt silencer and retaining clip in end of power piston hub.

11. Assemble power piston diaphragm to support plate from side of plate opposite locking tangs and press raised flange of diaphragm through hole in center of plate.

   NOTE: *Be sure that edge of center hole fits into groove in flange of diaphragm.*

12. Pull diaphragm away from O.D. of support plate so that the plate can be gripped with hands. Wipe power brake lubricant on all surfaces of small bead of diaphragm which contacts power piston.

13. Holding support plate on bare metal, with locking tangs down, place support plate and diaphragm assembly down over hub of power piston. Flange of diaphragm will fit into groove on power piston.

14. Press down and rotate support plate clockwise until lugs on power piston come against stops on support plate.

15. Invert assembly and place in padded vise with power piston hub end down and insert snap ring on air valve using snap ring pliers.

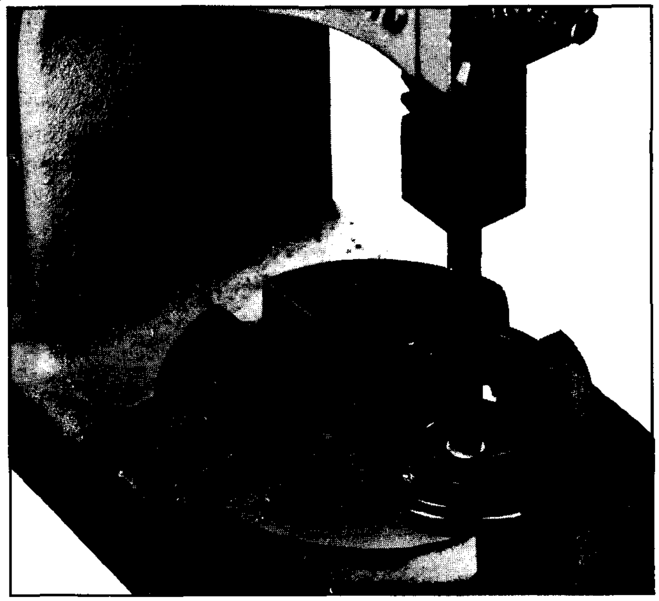


Fig. 5A-10 Removing Air Valve

16. Install air valve spring retainer so that it seats on snap ring and assemble reaction bumper into groove in end of air valve.

17. Position reaction spring on spring retainer.

18. Position three reaction levers in slots on power piston. Narrow ends will rest on reaction spring.

19. Position reaction plate, with numbered side up, on top of reaction levers and press down on plate until large ends of reaction levers pop up and plate rests flat on levers. Be sure that reaction plate is centered.

20. Place small end of hydraulic push rod in hole in center of reaction plate, and line up ears on reaction retainer with notches in power piston and push reaction retainer down until ears seat in notches.

21. Maintain pressure on reaction retainer and position large lock ring down over master cylinder push rod so that one end of lock ring goes under lug on power piston raised divider.

   NOTE: *Lock ring is positioned around power piston so that it goes alternately over ear of reaction retainer and under lug of power piston until end of ring is seated under lug with raised divider.*

   CAUTION: *Make sure that both ends of lock ring are securely under large lug.*

22. Remove power piston assembly from vise. Install large foam air filter ring over neck of power piston hub.

POWER PISTON

INSTALL

1. Place new power piston bearing in center of rear housing so that flange on center hole of housing fits into groove of power piston bearing. Large flange on power piston bearing will be on stud side of housing.

2. Liberally coat inside of power piston bearing with power brake lube.

3. Wipe power piston hub with power brake lube.

4. Push hub of power piston through rear housing seal.

5. Wipe O.D. of reaction retainer with power brake lube.

FRONT HOUSING

REPLACE

1. Place new front housing seal in center of front housing so that flat surface of cup lies against bottom of depression in housing.

Fig. 5A-11 Installing Front Housing

2. Install new vacuum check valve grommet.

3. Attach tool J 22805-01 to front housing. Lubricate I.D. of support plate seal with power brake lube.

   NOTE: *It is important that the front shell be started using only the hands, in order to make sure the housings will be completely mated after assembly, and to eliminate any possibility of cutting the diaphragm.*

4. 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 (Fig. 5A-11).

5. Insert square channel tube in end of tool J 22805-01, and using a crescent wrench, turn front housing **clockwise** until fully locked.

6. Remove all tools.

GAGING PROCEDURE

NOTE: *GAGING IS TO BE PERFORMED WITHOUT VACUUM.*

1. Place the 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 (Fig. 5A-12).

The center section of the gage has two levels. The piston rod end should always touch the longer section of the gage which extends into the front housing. The piston rod end should never touch the shorter section of the gage.

NOTE: *Any variation beyond these limits must be compensated for by obtaining service adjust-*

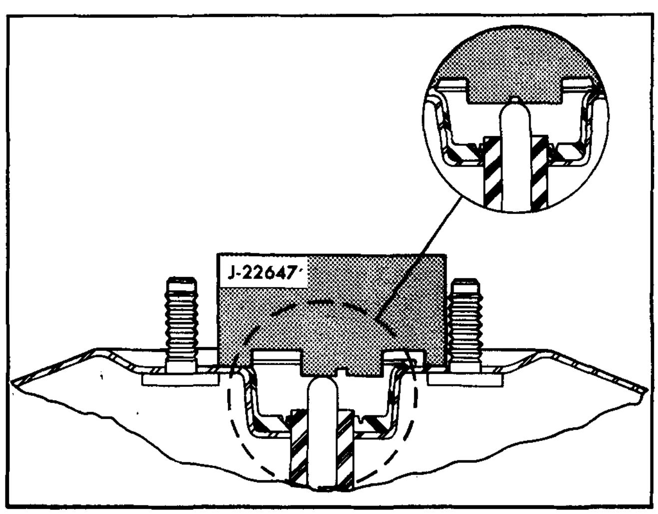


Fig. 5A-12 Push Rod Adjustment

able push rod and adjusting screw in end to match height of gage. Variation beyond these limits can cause the primary cup to overlap the compensating port of the master cylinder which will trap fluid in the hydraulic system causing brake drag.

CAUTION: *See caution on Page 1 of this section regarding the fasteners referred to in steps 2, 4 and 5 below.*

2. Replace master cylinder on front housing studs. Install attaching nuts on studs. Torque to 25 lb. ft.
3. Install vacuum check valve.
4. Install clevis lock nut to push rod, finger tight. Attach clevis and tighten clevis against lock nut to 90 lb. in. seat zip-nut firmly against clevis.

   NOTE: *Do not omit lock nut or pedal height will be too low.*

5. Attach clevis pin and retainer at brake pedal.
6. Check stop light switch adjustment. See Section 5.

TORQUE SPECIFICATIONS

Power Cylinder Housing to Master Cylinder Nuts	25 lb. ft.
Rear Housing to Pedal Bracket Nuts	24 lb. ft.
Push Rod Clevis	90 lb. in.

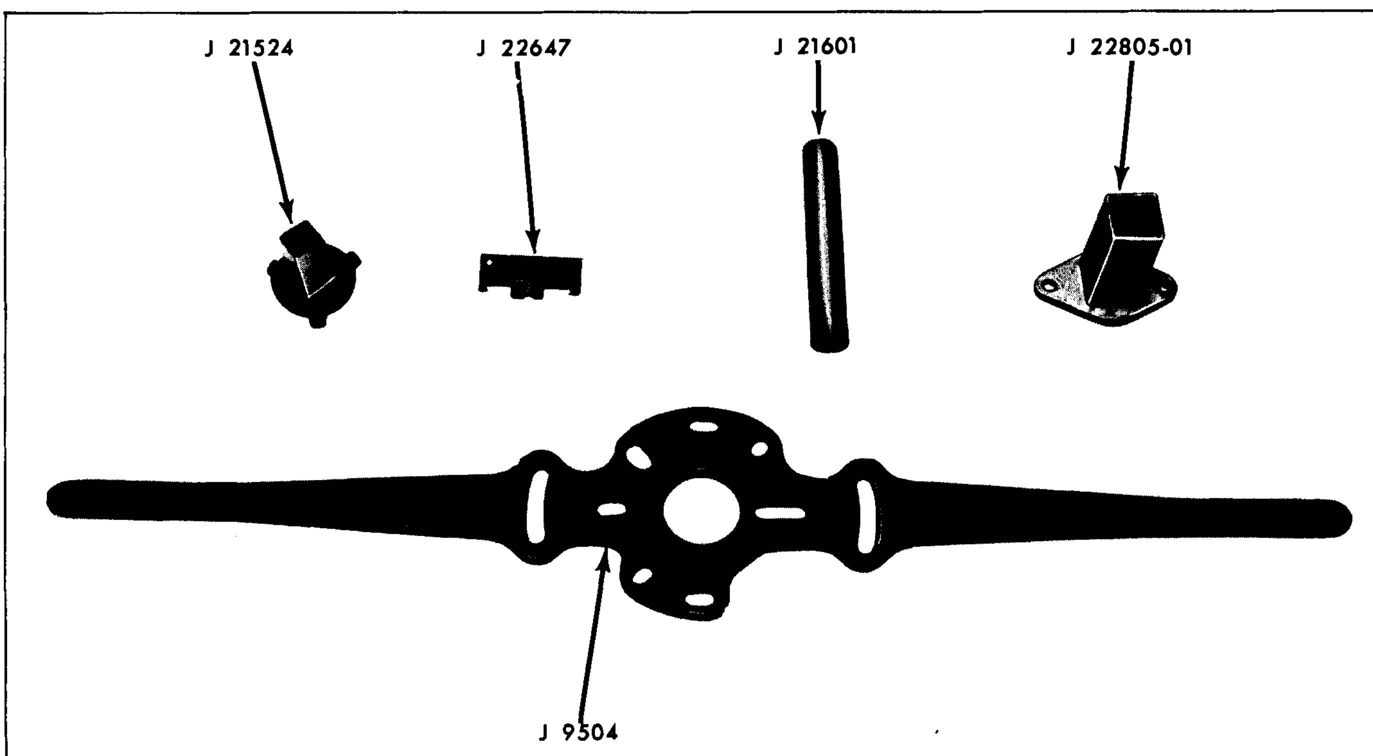


Fig. 5A-13 Special Tools

SECTION 5B

BENDIX POWER BRAKE

SINGLE DIAPHRAGM

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

TROUBLE DIAGNOSIS AND TESTING

SYSTEM TESTS

Road test the brakes by making a brake application at about 40 mph to determine if the vehicle stops evenly and quickly. If the pedal has a spongy feel when applying the brakes, air may be present in the hydraulic system and bleeding of brakes may be required.

When the engine is stopped and the transmission is in neutral, apply brakes several times to deplete all vacuum reserve in the system. Depress brake pedal, hold light-foot pressure on the pedal, and start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure, and less pressure will be required to hold pedal in applied position. If no action is felt, the vacuum system is not functioning.

Stop engine and deplete all vacuum reserve in the system. Depress the brake pedal and hold foot pressure on the pedal. If the pedal gradually falls away under foot pressure, the hydraulic system is leaking.

If the brake pedal travels to within one inch of the toeboard, the brake shoes require adjustment or relining.

Start engine with brakes off, run to medium speed and turn off the ignition. Immediately close the throttle to build up vacuum. Wait at least 90 seconds, then try brake action. If not vacuum assisted for two or more applications, vacuum check valve is faulty or leak exists in vacuum system.

The same types of brake trouble are encountered with power brakes as with standard brakes. Before checking the power brake system for the source of trouble, refer to the trouble diagnosis of standard brakes in Section 5. After these possible causes have been eliminated, check for the cause as outlined below:

HARD PEDAL

Vacuum failure due to:

a. Faulty vacuum check valve.

b. Collapsed vacuum hose to manifold.

c. Internal leaks in power brake unit.

Tight pedal linkage.

Power brake unit trouble.

a. Jammed poppet valve.

b. Vacuum leaks in unit caused by: faulty poppet valve seal or support plate seal, damaged floating control valve, faulty seal of master cylinder, or power cylinder mounting studs in housings, faulty seal on master cylinder push rod or a faulty seal of the diaphragm bead between the housings or at power piston. It is alwo possible to have faulty vacuum check valve grommet.

c. Defective rolling diaphragm.

d. Restricted air filter elements.

e. Worn or badly-distorted reaction disc.

f. Cracked or broken power piston or reaction retainer.

GRABBY BRAKES (APPARENT OFF-AND-ON CONDITION)

Power brake unit valve trouble.

a. Sticking poppet valve.

b. Restricted diaphragm passage.

Reaction system.

a. Broken poppet valve spring.

b. Worn or distorted disc.

PEDAL GOES TO THE FLOOR OR ALMOST TO THE FLOOR

Fluid reservoir needs replenishing.

Power brake hydraulic system leakage.

a. Defective primary or secondary cups.

b. Cracked master cylinder casting.

c. Leaks at wheel cylinder, pipes, hoses or connections.

Faulty master cylinder check valve has permitted air to enter system, causing spongy pedal.

BRAKES FAIL TO RELEASE

Faulty hydraulic check valve.

Blocked passage in power piston.

Air valve sticking.

Broken diaphragm return spring.

Broken poppet valve spring.

Tight brake pedal clevis pin.

GENERAL DESCRIPTION

The single diaphragm power brake - Bendix is used on some X Series models. It can be identified by the black color of the power unit, and master cylinder cover. Always make sure that the correct master cylinder is used whenever replacement is necessary.

The power brake unit is a combined vacuum and hydraulic unit for power braking. It consists of a power unit and a dual-system master cylinder. This brake assembly has an over-all ratio of 2.9 to 1 (2.9" of pedal travel moves the power piston 1"). The wheel brakes are the same, manual or power.

Pedal travel and pressure compared to the conventional braking system are greatly reduced. The brake pedal height is approximately 1" above the accelerator pedal, permitting the driver to shift his toe from the one pedal to the other without lifting his heel from the floor.

The power brake unit utilizes engine intake manifold vacuum and atmospheric pressure in its operation. These units are self contained, requiring no additional external rods or levers. The external vacuum line connection of this unit is to the carburetor.

A vacuum check valve is connected in the vacuum line at the front housing to prevent loss of vacuum when manifold vacuum falls below that in the power brake system.

In case of engine failure and consequent loss of engine vacuum, several applications of the brakes are possible by using vacuum retained in the power unit. In case of complete vacuum loss, brakes can be applied in the conventional manner, although considerable effort is required due to loss of power assist.

DESIGN

The vacuum power cylinder contains a power diaphragm

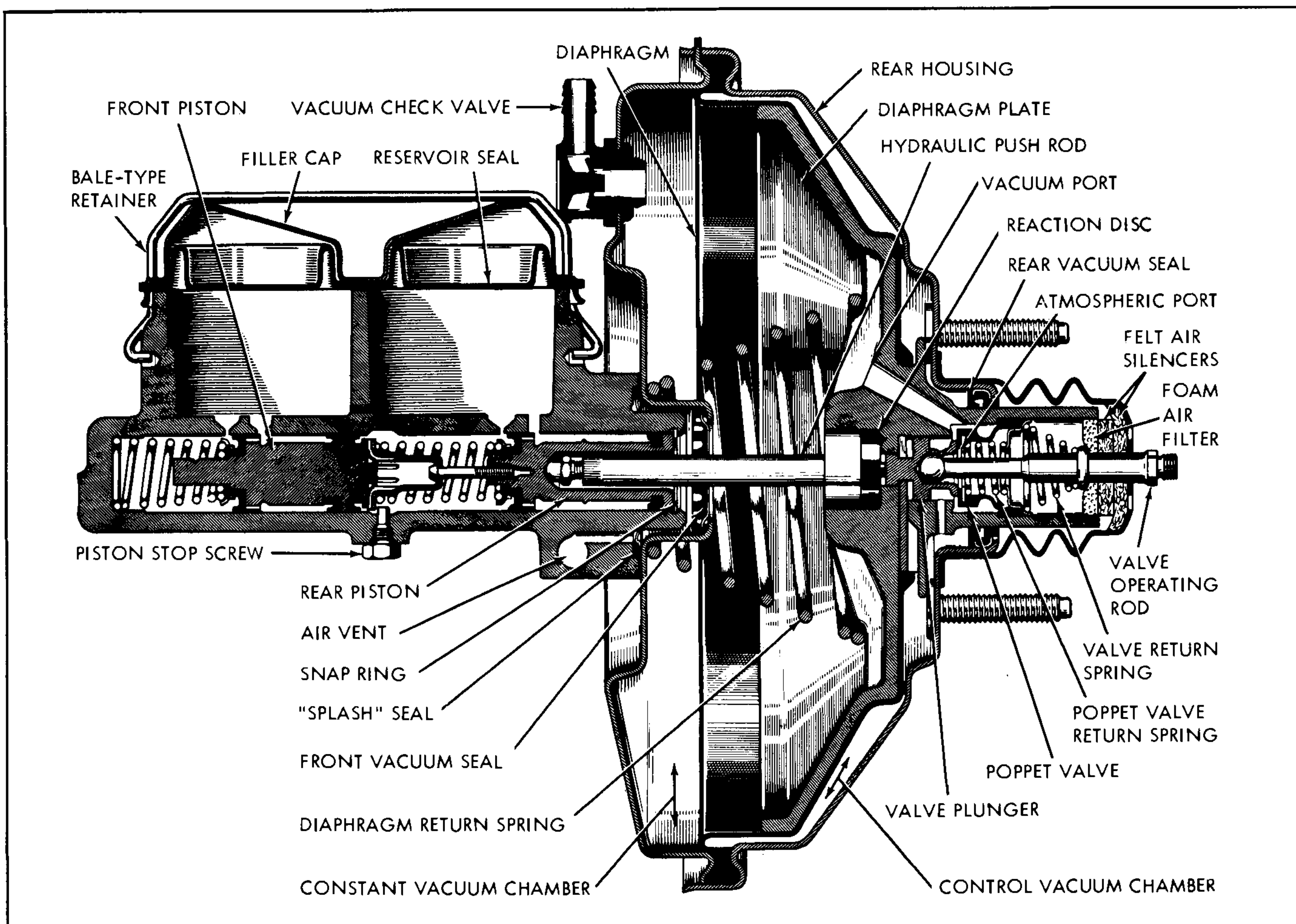


Fig. 5B-1 Bendix Power Brake Cross Section assembly. This assembly houses the control valve, reaction mechanism and the power diaphragm return spring. A rod contacts the rear piston in the hydraulic master clyinder. The control valve is made up of a single poppet with an atmospheric port and a vacuum port. A power diaphragm and return spring give quick response, lighter pedal effort and improved control.

The reaction mechanism consists of a hard rubber disc which distributes pressure between the diaphragm plate and the valve plunger in proportion to their contact areas, which provides the normal brake feel. A valve operating rod, which operates the control valve, projects out the end of the power cylinder housing through a boot and attaches to the brake pedal. A vacuum seal between the cylinder housing and the control valve hub seals the rear power cylinder chamber against atmospheric pressure leaks. The dual system (double piston) master cylinder attaches to the vacuum power cylinder front housing. A vacuum seal between these two units seals the front power cylinder chamber against atmospheric pressure leaks. A secondary seal around the rear master cylinder piston prevents hydraulic fluid in the master cylinder from leaking into the cavity of the power cylinder and the front vacuum seal.

Free breathing for this cavity, during braking, is provided by the two intersecting air passages in the mounting flange of the master cylinder.

Two hydraulic fluid reservoirs are cast integrally with the master cylinder. A rubber diaphragm covers both reservoirs to seal the brake system from contamination and prevent corrosion and subsequent leakage. Inside the master cylinder, there are parts for the two separate hydraulic systems: a rear piston assembly, which includes a secondary seal, primary cup and spring, screw and spacer; a front piston assembly, which includes two back-to-back secondary seals, a primary cup and a spring and spring retainer and a piston stop screw and seal.

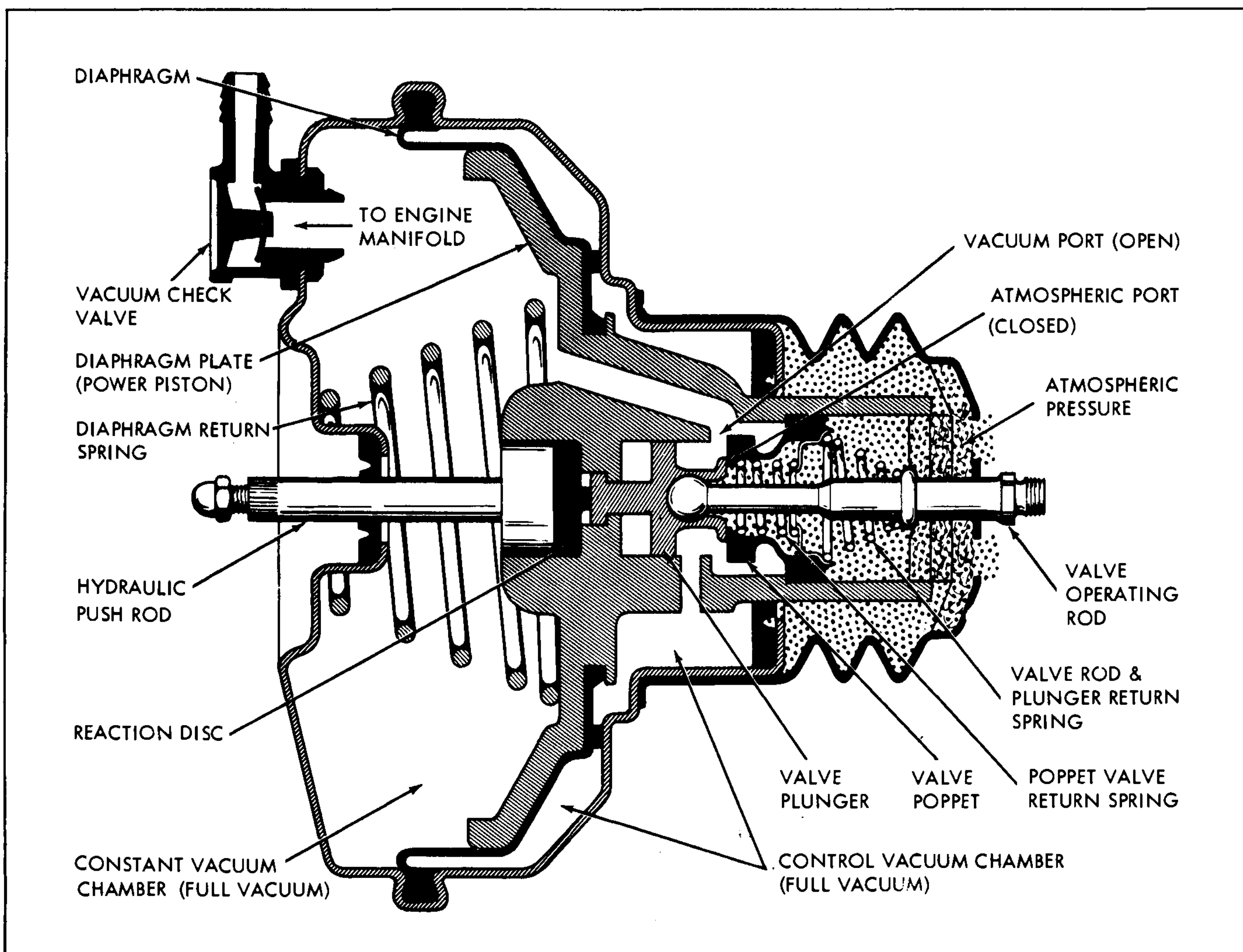


Fig. 5B-2 Released Position

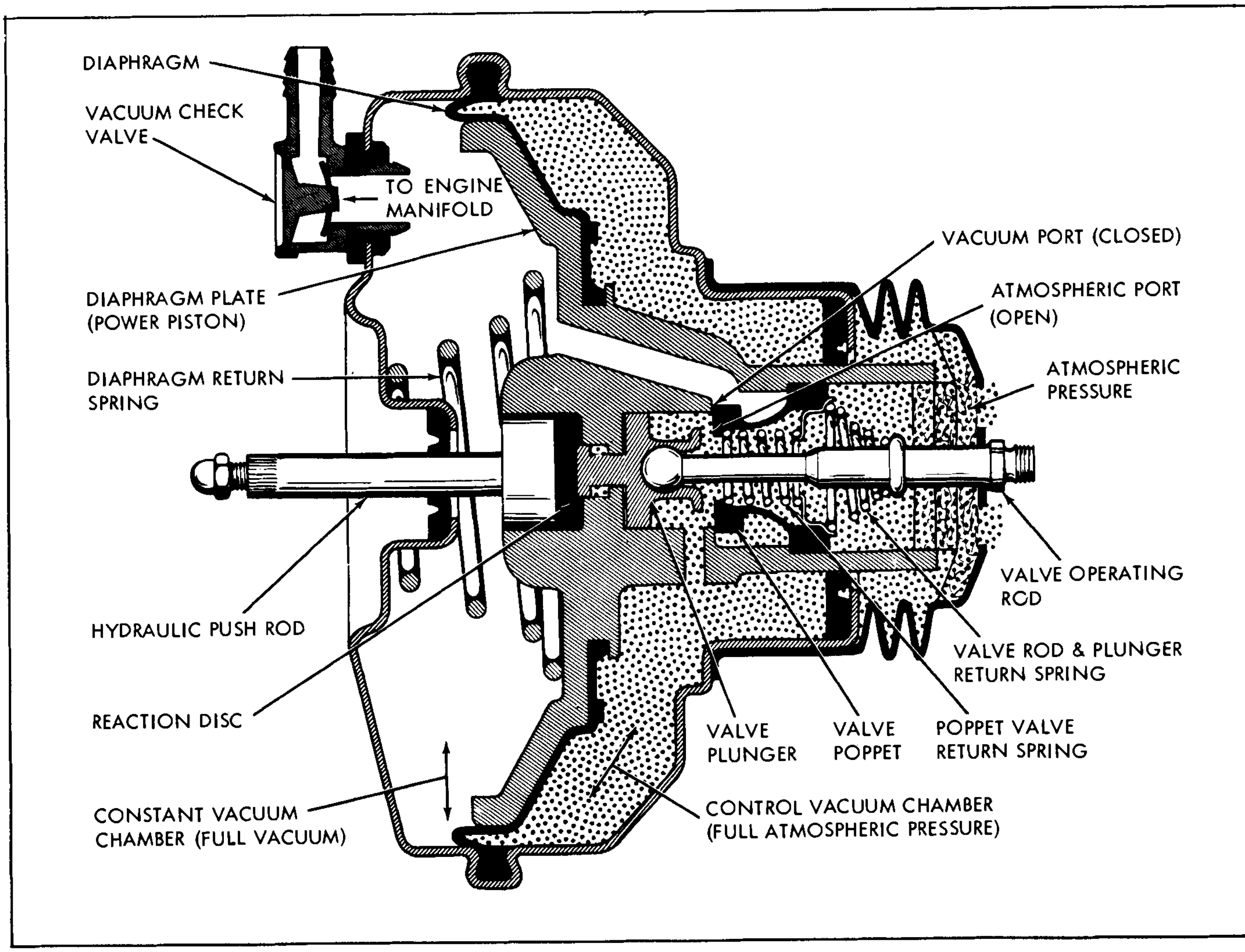


Fig. 5B-3 Applying Position

PRINCIPLES OF OPERATION

RELEASED POSITION (Fig. 5B-2)

With the engine running and the brake pedal released, vacuum created by the engine removes the air from the power brake chamber via a hose connection from the vacuum check valve mounted in the front housing to a hose nipple in the base of the carburetor. In the released position, the valve operating rod and valve plunger are held to the right (as illustrated) by the valve return spring thereby closing the atmospheric port and opening the vacuum port. With the vacuum port open, the chamber to the rear (right) of the diaphragm is open to vacuum and the diaphragm is balanced or suspended by vacuum on both sides. With the power piston assembly in the released position, the hydraulic push rod and master cylinder pistons are also released and fluid in the two master cylinder sections is free to return from the brake systems to the fluid reservoirs or to enter either brake system from its reservoir in order to compensate for the expansion or loss of fluid in either system.

APPLYING POSITION (Fig. 5B-3)

As the brakes are applied by the driver, the valve operating rod and plunger assembly moves forward (toward the left in Fig. 5B-3), in the power piston assembly to compress the valve return spring and bring the poppet valve into contact with the vacuum port seat in the valve housing to CLOSE the vacuum port. Any additional movement of the valve operating rod in the applied direction, moves the valve plunger away from the poppet valve to OPEN the atmospheric port and admit atmospheric pressure through the air filter and passages to the control vacuum chamber, to the right of the power piston and diaphragm assembly. With constant vacuum to the left of the piston and diaphragm, the atmospheric pressure on the right side exerts force to move the power piston and diaphragm and hydraulic push rod and pistons to the left to close the compensating ports in both systems and force hydraulic fluid under pressure through the brake tubes into the brake wheel cylinders. As hydraulic pressure is developed in the master cylinder, a counter-force (to the right), acting through the hydraulic push rod and rubber reaction disc, sets up a reaction force against the vacuum

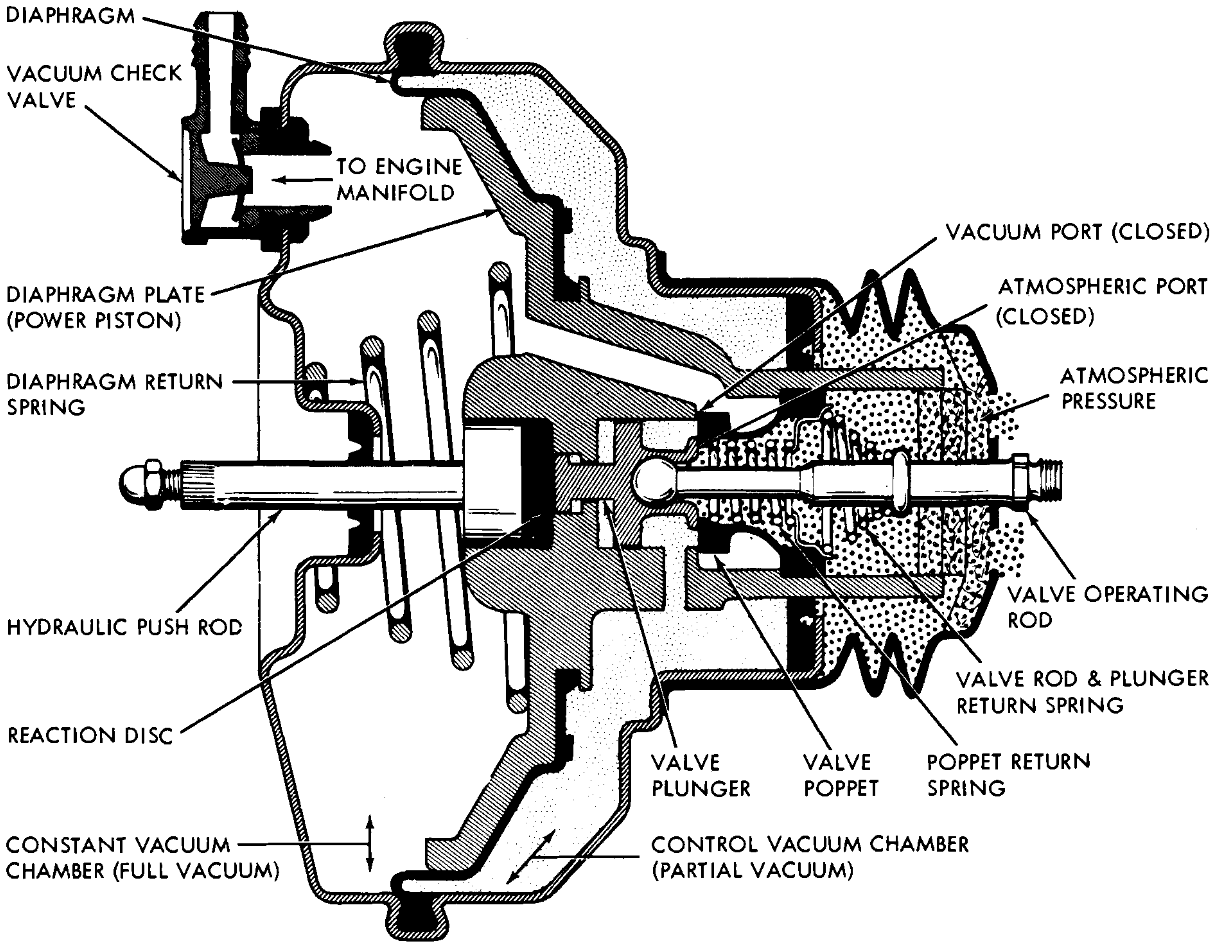


Fig. 5B-4 Holding Position

power piston and valve plunger. The rubber disc distributes the pressure between the vacuum power piston and the valve plunger in proportion to their respective contact areas.

The pressure acting against the valve plunger and valve operating rod tend to move the valve plunger slightly to the right in relation to the valve housing of the power piston to close off the atmospheric port. Since part of the counter-force (to the right) reacts through the valve plunger and valve operating rod against the driver's foot, a feel of the braking effort is provided. This reaction force is in direct proportion to the hydraulic pressure developed within the brake system. As shown in Fig. 5B-3, full power application has been attained with full atmospheric pressure admitted to the control vacuum chamber (to the right) and with constant vacuum to the left of the power piston and diaphragm assembly. Any increase in hydraulic pressure to the wheel brakes beyond this point must be supplied by physical effort of the driver.

HOLDING POSITION (Fig. 5B-4)

During application of the brakes, the reaction against the valve plunger is working against the driver to close the atmospheric port. With both the atmospheric and vacuum ports closed, the power brake is in the holding position. When both ports are closed, any degree of braking application attained will be held until either the atmospheric port is reopened by an increase in pedal pressure to further increase the brake application or by a decrease in pedal pressure to re-open the vacuum port to decrease the brake application. Whenever the pressure applied to the brake pedal is held constant for a moment, the valve plunger and poppet return to their holding position. However, upon reaching the fully applied position (as shown in Fig. 5B-3), the valve plunger is held away from the valve poppet seat to admit atmospheric pressure to the control vacuum chamber (to the right) of the power piston and diaphragm. As the power piston and hydraulic master cylinder piston move back, the fluid from the wheel cylinders flows back into the two master cylinder sections and into the reservoirs.

The fluid reservoirs, cast integrally with the master cylinder, supply fluid to the space around each piston between the primary and secondary seals through a by-pass hole in the casting. When the brake pedal is released quickly, fluid pressure and the two return springs force the master cylinder pistons to return immediately to the released position. If hydraulic fluid from the lines cannot return as quickly as the master cylinder piston, compensation is provided by a flow of fluid from the space between the primary cup and secondary seal through the holes in the piston and around the edge of the primary cup. The excess fluid then in the system flows back to the reservoir through the compensating port. The secondary seal on the front piston that faces toward the rear system prevents any flow of fluid from the rear system to the front system and the other secondary seal facing forward on the front piston prevents any fluid flow from the front to the rear system. The front, or floating piston, supplies the correct fluid displacement for the front wheel brake requirements. The rear (or primary) piston supplies the correct fluid displacement for the rear wheel brake requirements. The hydraulic pressure developed in both systems is equal at all times since the front, or floating piston, is balanced between the two hydraulic pressures. If the front system fails, the front piston and spring bottom and then the rear piston develops hydraulic pressure to the rear wheels. If the rear system fails, the rear piston and spring bottom against the front piston and then mechanically force the front piston forward to develop hydraulic pressure to the front wheels. Failure in either system has no effect on the other system but is immediately evident to the driver because of the additional pedal travel required to actuate the remaining half of the dual brake system.

CHECKS AND ADJUSTMENTS ON CAR

1. Check for free operation of brake pedal. If binding exists, check all pivot points for binding and lubricate as required.
2. Check stop light switch for proper setting and operation.
3. Check fluid level in hydraulic cylinder reservoirs. Fluid level should be as shown in Fig. 5-11.
4. Check vacuum hose, check valve grommet and carburetor vacuum fitting for possible air leaks.
5. Check engine for good stall-free idle, and correct as required.

MINOR REPAIRS

BLEEDING BRAKES

Brakes should be bled in the same manner as standard brakes. Bleed with engine off and vacuum reserve depleated. See Sections 5 and 5E for brake bleeding information.

OVERHAUL BENDIX POWER BRAKE

MASTER CYLINDER ONLY - REMOVE

Certain repair operations, such as replacement of master cylinder internal parts, permit the master cylinder to be removed by itself, leaving the power cylinder on the car.

1. Disconnect hydraulic lines at master cylinder, pump fluid from cylinder into a container and dispose of fluid. Cover openings in master cylinder and ends of both pipes to prevent entry of dust, dirt, etc.
2. Remove master cylinder attaching nuts and lock washers. Remove master cylinder from vacuum power section.

POWER BRAKE VACUUM CYLINDER - REMOVE

1. Remove vacuum hose from front housing and discard grommet. Remove master clyinder and position away from power section. DO NOT disconnect fluid lines.
2. Remove clevis pin retainer from brake pedal inside the car.
3. Remove nuts from vacuum cylinder studs under dash and remove vacuum power section.
4. Clean exterior of power brake.

POWER UNIT - DISASSEMBLE (Fig. 5B-5)

NOTE: *Tools BT 7004 or J 23456 (Fig. 5B-6) may be used for housing disassembly as an alternate to the following method.*

1. Using tool J 22805-01, mount power brake assembly in vise, clamping on tool so that valve operating rod is up.
2. Scribe a line across the front and rear housings to facilitate reassembly.
3. Using tool J 9504, press down firmly and rotate tool and housing clockwise so that cut-outs in rear housing line up with indentation of front housing.

WARNING: REMOVE REAR HOUSING CAREFULLY AS IT IS SPRING-LOADED AND WILL TEND TO FLY AWAY FROM THE FRONT HOUSING.

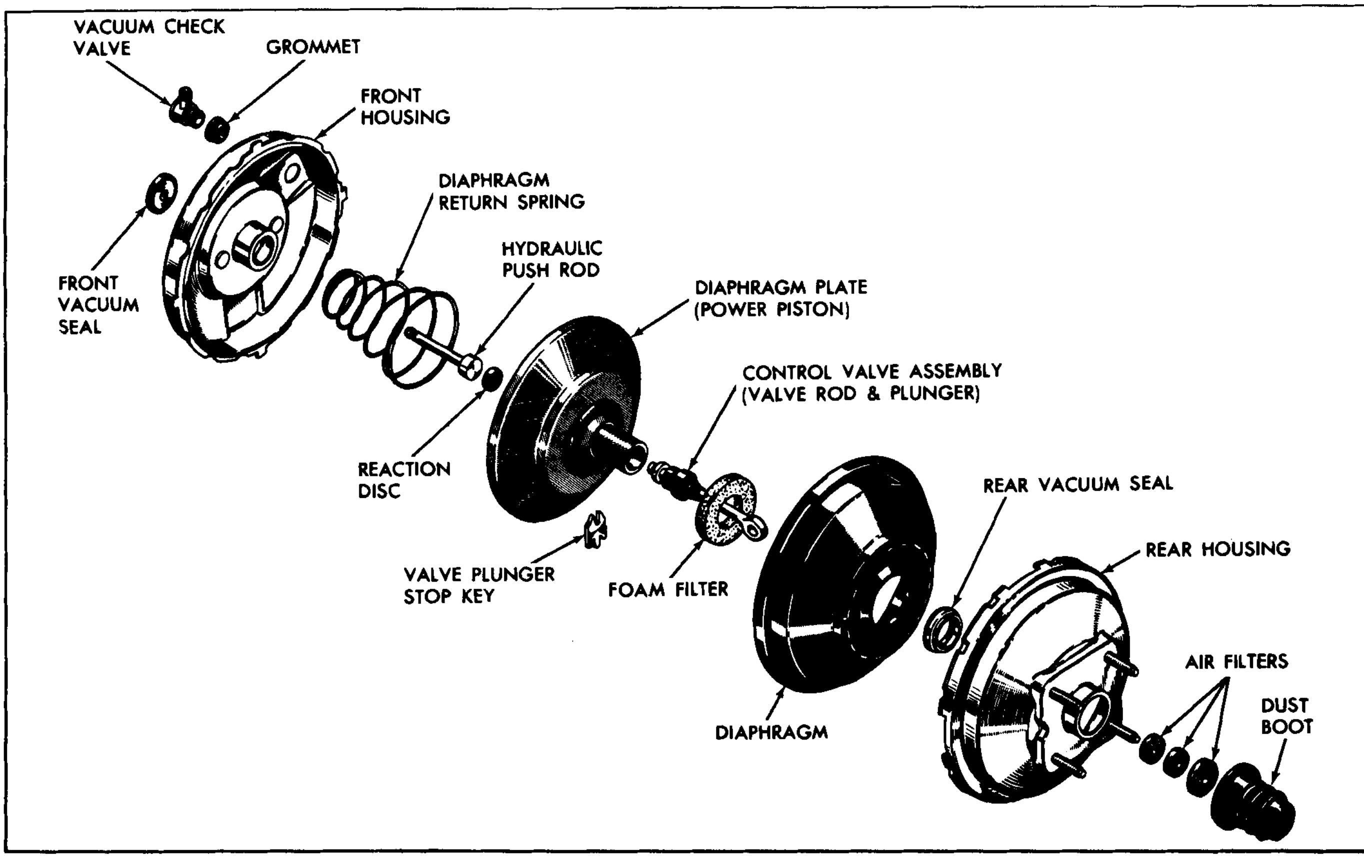


Fig. 5B-5 Power Unit - Exploded View

4. Remove tool, housing, hydraulic push rod from diaphragm plate (power piston) and return spring from front housing.

5. Remove assembly from vise and remove tool J 22805-01 from front housing.

6. Remove front vacuum seal with blunt tool.

POWER PISTON - DISASSEMBLE (Fig. 5B-7)

CAUTION: *Exercise extreme care in handling power piston, rubber surfaces and metal parts in this assembly. They should be guarded against grease, oil and foreign matter and must be protected from nicks or cuts that might be caused by rough surfaces or damaged tools.*

1. Remove boot and foam filter from power unit.

2. Remove the foam air silencers. Be careful not to chip plastic housing.

3. Remove diaphragm plate (power piston) from rear housing.

4. Carefully remove rubber diaphragm from diaphragm plate.

5. Tilt diaphragm plate and depress valve operating rod slightly to remove valve assembly retainer (valve plunger stop key). See Fig. 5B-8.

6. Pull control valve assembly straight out from diaphragm plate and with a blunt tool, push reaction disc out front of plate. Do not disassemble control valve assembly.

7. Inspect rear shell vacuum seal. Remove only if necessary to replace by driving out with a screwdriver or punch.

MASTER CYLINDER - DISASSEMBLE

1. Pry splash seal and retainer out of shallow cavity around master cylinder hub.

2. Press in against rear piston with round-end rod to relieve spring load on piston stop screw under master cylinder bore. Use 3/8" wrench to remove stop screw and O-ring seal. Maintain pressure on rear piston and use snap ring pliers to remove snap ring from groove in master cylinder bore.

3. Remove rear piston and spring assembly and discard. Do not attempt to disassemble it since complete new

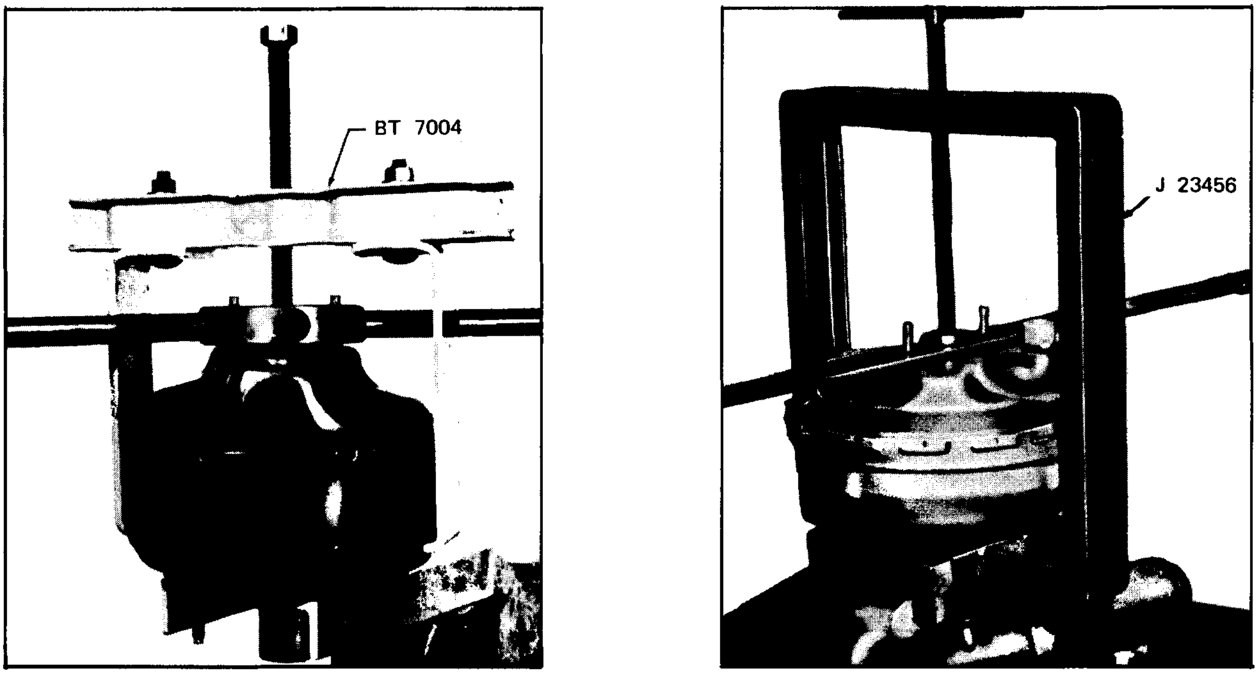


Fig. 5B-6 Tools for Disassembly of Power Unit

assembly is provided in repair kit.

4. Remove front piston assembly, front return spring and retainer. Slide primary cup and protector off nose of front piston. Use dull scribe to lift both secondary seals from the grooves at rear end of front piston. Discard all old rubber parts.

INSPECTION - CLEANING

CAUTION: *It is important that all parts be placed on a clean paper or cloth after being cleaned to prevent the possibility of dirt being assembled into unit or grease contacting any rubber parts.*

Thoroughly wash all parts in alcohol and air dry. Blow dust and cleaning fluid out of all internal passages. If inside of front housing is slightly scored or scratched, clean with crocus cloth or fine emery cloth. If scratches cannot be removed, replace housing.

All rubber parts should be replaced, regardless of condition, and those parts which come in contact with brake fluid should be rewashed in clean alcohol before reassembly.

INSPECT POWER BRAKE ASSEMBLY

Inspect all parts for scoring, pitting, dents or nicks. Small imperfections can be smoothed out with a fine emery cloth or parts replaced if badly nicked, scored, or otherwise damaged.

INSPECT HYDRAULIC MASTER CYLINDER ASSEMBLY

Inspect bore from the open end. The bore should be free of scoring, rust pitting or etching. If any of these are

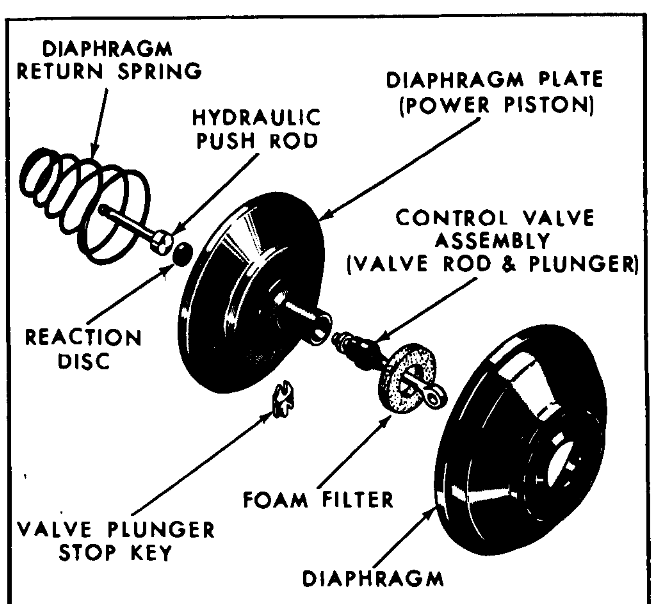


Fig. 5B-7 Power Piston - Exploded View

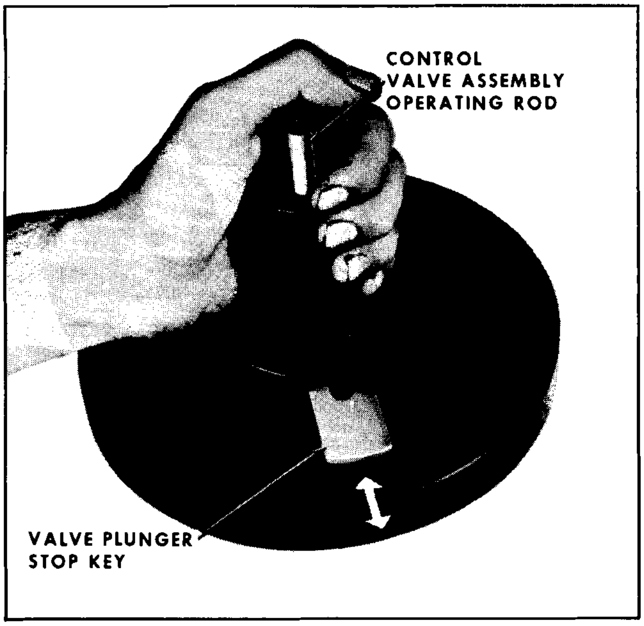


Fig. 5B-8 Valve Plunger Stop Key - Remove and Install

apparent, master cylinder must be replaced. If it appears that contaminants have damaged the bore, replace damaged parts and flush out entire brake system including wheel cylinders.

The sealing surfaces should be clean and smooth. Check for cracks and damaged threads. Be sure that the by-pass and compensating ports to the master cylinder reservoirs are not restricted.

Check for distortion of all springs and deterioration of all rubber parts. Any evidence of soft or swollen rubber parts indicates contaminated brake fluid, requiring flushing of the entire brake system and replacement of wheel cylinder cups as well as all rubber parts in master cylinder.

INSPECT AIR FILTERS

Replace air filters if dirty. Do not clean.

POWER UNIT AND MASTER CYLINDER - ASSEMBLE

MASTER CYLINDER - ASSEMBLE

1. Clamp master cylinder in vise with open end slightly above horizontal.
2. Install new secondary seals, back to back, in grooves on rear end of front piston. Dip seals in brake fluid and lift them carefully into grooves with dull scribe. Slide protector and primary cup onto nose of front piston.
3. Stack front piston return spring and retainer on nose of front piston and dip assembly in brake fluid. Press and twist piston to ease cups past snap ring groove into bore. Slide assembly to bottom of bore.
4. Dip new rear piston and spring assembly in brake fluid and slide assembly into bore. Use scribe and press piston to ease cups into bore.
5. Press in against rear piston with rough-end rod to compress return springs. Do NOT use screwdriver or other sharp-edged tool since this will damage the push rod seat inside the piston. Maintain pressure on piston and use snap-ring pliers to install snap ring in groove inside bore. Make certain that snap ring is securely seated in groove.
6. Maintain pressure on rear piston while installing piston stop screw and new O-ring seal in port underneath bore. Torque screw with 3/8" wrench to 40 lb. in.
7. Remove master cylinder assembly from vise.

POWER PISTON - ASSEMBLE (Fig. 5B-7)

1. If rear vacuum seal was removed, place rear housing on bench with studs down and press new seal carefully into cavity in housing, plastic side first, using tool J 22677. (Fig. 5B-9). Use hands to press seal about 7/16" below inner housing surface or until metal shoulder bottoms. DO NOT CRACK PLASTIC.
2. Lubricate outside diameter of diaphragm plate hub, bearing surfaces of the valve plunger, and outer edge of valve poppet with power brake lubricant.
3. Insert control valve assembly into diaphragm plate

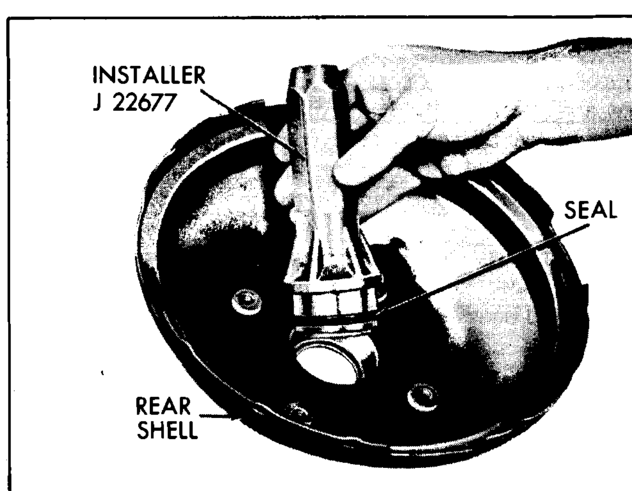


Fig. 5B-9 Installing Rear Vacuum Seal

hub. Push on valve enough to insert the valve plunger stop key (Fig. 5B-8).

4. Assemble diaphragm on diaphragm plate, making sure the inner bead of the diaphragm is seated in the groove in plate.
5. Install silencers over valve operating rod. Be careful not to chip the plastic.
6. Apply power brake lubricant to seal in rear housing and around hub of diaphragm plate. Install rear housing over hub of diaphragm plate.
7. Install large foam air filter and boot. Press boot onto housing until it bottoms.
8. Coat all surfaces of reaction disc with power brake lubricant and install disc, button side first, in hub cavity of diaphragm plate.
9. Apply power brake lubricant to piston end and shaft of hydraulic push rod and install firmly against reaction disc in diaphram plate. DO NOT LUBRICATE ADJUSTING NUT END OF PUSH ROD.

POWER UNIT - ASSEMBLE (Fig. 5B-5)

NOTE: *Tool BT 7004 or J 23456 (Fig. 5B-6) may be used for housing assembly as an alternate to the following method.*

1. Coat front vacuum seal with power brake lubricant and install in cavity of front housing, rubber side toward master cylinder. Make certain rubber portion does not separate from metal plate.
2. Install tool J 22805-01 on front housing. Torque bolts to 25 lb. ft.
3. Install check valve and grommet in front housing if they were removed. Lubricate with alcohol for easier assembly.
4. Place tool J 22805-01 in vise with front housing up.
5. Place diaphragm return spring in front housing, small end down.
6. Apply silicone grease or talcum powder to all surfaces of outer bead of diaphragm that bear against front and rear housings.
7. Place rear housing assembly over diaphragm return spring and, using tool J 9504 press down firmly on rear housing, guiding push rod into front housing seal while making certain scribe marks will align when housings are locked together. Rotate tool counterclockwise to lock the two housings. Vacuum may be applied to the check valve to help draw the housings together.

CAUTION: *Do not release pressure on rear housing until the housings are fully locked.*

NOTE: *Be sure diaphragm is not pinched during assembly.*

Remove power brake assembly from vise and remove tool J 22805-01.

NOTE: *Before reassembling master cylinder to power section, the distance from the outer end of the push rod to the master cylinder must be measured as explained under PUSH ROD ADJUSTMENT below.*

PUSH ROD ADJUSTMENT

The push rod is designed with a self-locking adjustment screw to provide the correct relationship between the vacuum power piston and master cylinder piston. The adjustment screw is set to the correct height at the time of original assembly of the power unit. Under normal service conditions the adjustment screw does not require any further attention providing the push rod assembly remains in the original unit.

Whether a new push rod is used or the push rod assembly is transferred to a unit other than the original one, the distance from the end of the adjustment screw to the mounting face of the power cylinder should be rechecked either with a micrometer depth gage to a dimension of 1.225 to 1.210" or with height gage J 22644. Place gage over the push rod on the front housing. Cutout portion of the gage should never be lower than the adjustment screw end of the push rod and the gap between the cutout and edge of the push rod end should never exceed .010" (Fig. 5B-10).

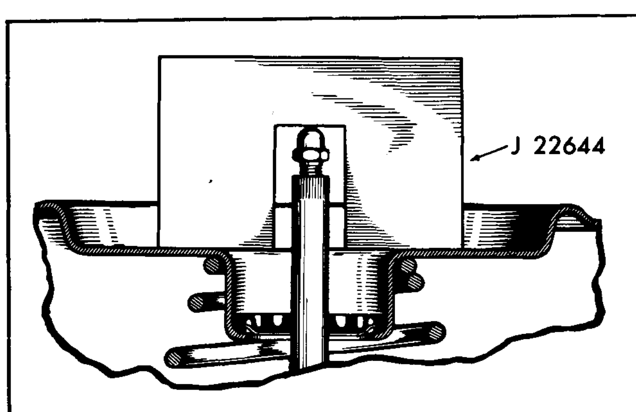


Fig. 5B-10 Gauging Push Rod Length

To adjust push rod, grip splined area of push rod with pliers, being careful not to scratch machined shaft. (DO NOT REMOVE PUSH ROD FROM POWER CYLINDER SINCE REACTION DISC MIGHT BE PULLED OUT OF DIAPHRAGM PLATE AND FALL INTO FRONT VACUUM CHAMBER.) Use a 5/16" wrench to turn adjusting nut "in" to shorten, or "out" to lengthen push rod.

After assembly of the master cylinder to the power unit, the primary cups of the master cylinder must clear the compensating hole when the unit is in the released position. This can be checked by partially filling the reservoirs, and then stroking the power unit. If fluid spurts, the compensating ports are clear. If the primary cups overlap the compensating ports, there will be no flow of air or fluid through the compensating port when stroked. If this condition exists, the adjusting screw should be turned into the push rod a slight amount, or until the compensating port is open. Failure to clear the compensating port in the released position traps fluid in the hydraulic lines and wheel cylinders and causes brake drag when the fluid warms up.

If compensating port is blocked, fluid from pressure bleeder will flow thru bypass main metering port behind primary cup and then thru holes in piston, around lip of primary cup to wheel cylinder.

POWER BRAKE ASSEMBLY - INSTALL

CAUTION: *See caution on Page 1 of this section regarding fasteners referred to in Steps 1 and 5 below.*

1. Place power brake into position and install four rear housing to dash attaching nuts from inside of car. Tighten nuts to 25 lb. ft. torque.
2. Install clevis pin retainer.
3. Adjust stop light switch if necessary. See Section 5 for service.
4. Attach vacuum hose to vacuum check valve.
5. Attach master cylinder to power unit. Torque nuts to 25 lb. ft.
6. Bleed brakes as necessary and fill fluid reservoirs. Fluid level should be as shown in Fig. 5-11.

TORQUE SPECIFICATIONS

Master Cylinder to Power Unit Housing Nuts	25 lb. ft.
Power Unit to Dash Nuts	25 lb. ft.
Push Rod to Clevis	14 lb. ft.
Piston Stop Screw	40 lb. in.

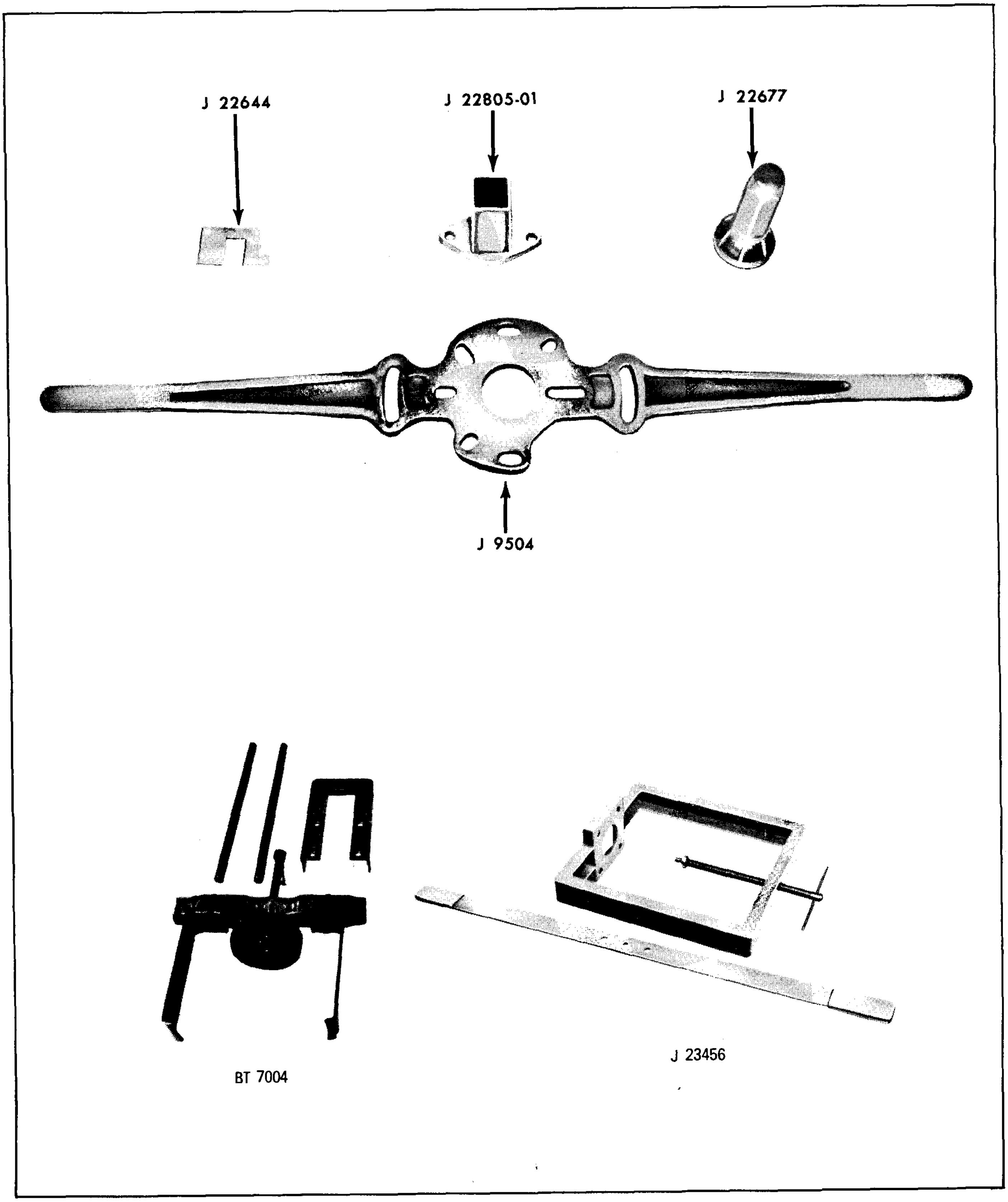


Fig. 5B-11 Special Tools

BT 7004	Power Brake Housing Disassembly Tools
J 9504	Power Brake Housing Disassembly Tools
J 22644	Pushrod Gauge
J 22677	Rear Vacuum Seal Installer
J 22805-01	Power Brake Unit Mounting Tool
J 23456	Power Brake Housing Disassembly Tools

SECTION 5C

BENDIX POWER BRAKE

TANDEM DIAPHRAGM

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

TROUBLE DIAGNOSIS AND TESTING

The same types of brake trouble may be encountered with power brakes as with standard brakes. Before checking power brake system for source of trouble, refer to trouble diagnosis of standard brakes. After these possible causes have been eliminated, check for cause as outlined below.

SYSTEM TEST

1. VACUUM LEAK IN RELEASED POSITION

Run engine with transmission in neutral or park and brake released. Stop engine and wait one minute. Apply brake several times. Each application should provide less and less pedal travel following normal depletion of reserve vacuum. Number of applications possible on reserve vacuum will depend on how hard pedal is pressed and how far pedal moves. If vacuum assist is not present, an air leak is indicated.

2. UNIT OPERATION

After depleting reserve vacuum put light pressure on pedal and start engine. If power system is functioning properly, pedal will fall away slightly.

3. VACUUM LEAK IN HOLDING POSITION

With transmission in neutral or park, stop engine while holding a moderately heavy load steadily on pedal. After one minute release and apply pedal several times. If there is no vacuum assist during this test but system was normal during test No. 1 above there is an air leak within unit.

NOTE: *Some units on this test will leak air internally if pedal load is light. This is a normal condition.*

4. HYDRAULIC LEAK

a. Depress brake pedal while engine is running, maintaining constant pressure. If pedal falls noticeably in one minute, the hydraulic system is leaking.

b. If pedal has a spongy feel when applying brakes, air may be present in the hydraulic system.

Road test brakes by making a brake application at about 40 mph to determine if vehicle stops evenly and quickly.

If system checks are satisfactory and the brake pedal travels to within 1" of floor-board, brake shoes require adjustment or replacement. Lubricate self-adjusting components.

HARD PEDAL

1. Vacuum failure due to:
   a. Faulty vacuum check valve.
   b. Vacuum hose or pipe collapsed, plugged, kinked or disconnected.
   c. Internal leaks in power brake unit.
2. Tight brake pedal clevis pin.
3. Power brake unit trouble.
   a. Vacuum Leaks in unit caused by improper assembly, missing parts, damaged parts and/or foreign material.
   b. Hydraulic.
      1. Cups swollen by improper fluid.
      2. Compensating port not cleared by primary cup.
      3. Solid hub seals should never be installed between the master cylinder and front housing.
   c. Mechanical.
      1. Badly dented vacuum cylinder.
      2. Bound up pedal linkage.
      3. Improperly adjusted stop light switch.
      4. Galled valve plunger.
      5. Broken or missing springs.

GRABBY BRAKES (APPARENT OFF-AND-ON CONDITION)

1. Faulty pedal linkage.
2. Dented vacuum cylinder.
3. Sticking valve plunger.
4. Defective vacuum check valve.
5. Loose vacuum connections.

PEDAL GOES TO FLOOR OR ALMOST TO FLOOR

1. Brake adjustment.
2. Air in hydraulic system.
3. Fluid reservoir empty.
4. Hydraulic fluid leakage:
   a. Defective filler cap, missing baffle, or filler cap gasket.
   b. Cracked master cylinder casting.
   c. Leaks at wheel cylinder, in pipes, hose or at connections.
   d. Defective secondary seal on master cylinder piston. (Brake fluid in cavity around master cylinder for front vacuum seal).
   e. Faulty primary cup which causes pedal to sink to the floor under constant load but does not empty reservoir.

GENERAL DESCRIPTION

The tandem diaphragm Bendix power brake is used on some B Series models. It can be identified by the black color of the power unit and master cylinder cover. Always make sure that the correct master cylinder is used whenever replacement is necessary.

The tandem diaphragm power brakes will deliver almost twice the hydraulic output before vacuum depletion as standard power brakes. The tandem diaphragm type power brake is a self-contained vacuum hydraulic power braking unit of the vacuum-suspended type which uses engine intake manifold vacuum to take advantage of atmospheric pressure for power. The unit consists of a power unit and a master cylinder.

This power brake permits the use of a low brake pedal and provides reduced pedal effort, compared to the conventional (non-power) hydraulic braking system. The dual system hydraulic section of the power brake is similar to the manually-operated dual system master cylinder except that the hydraulic push rod is a part of the power section. The separate front and rear hydraulic systems provided by this master cylinder prevent a hydraulic failure in either system from affecting the other system. If a hydraulic failure does occur, the driver is made aware of it by the increased pedal travel and effort required to get braking action. A pressure differential sensing switch in the system also actuates the parking brake light on the instrument panel. In addition, braking with only the front or rear brakes will, usually, be less effective, requiring either greater pedal effort for the same stopping distance or greater distance.

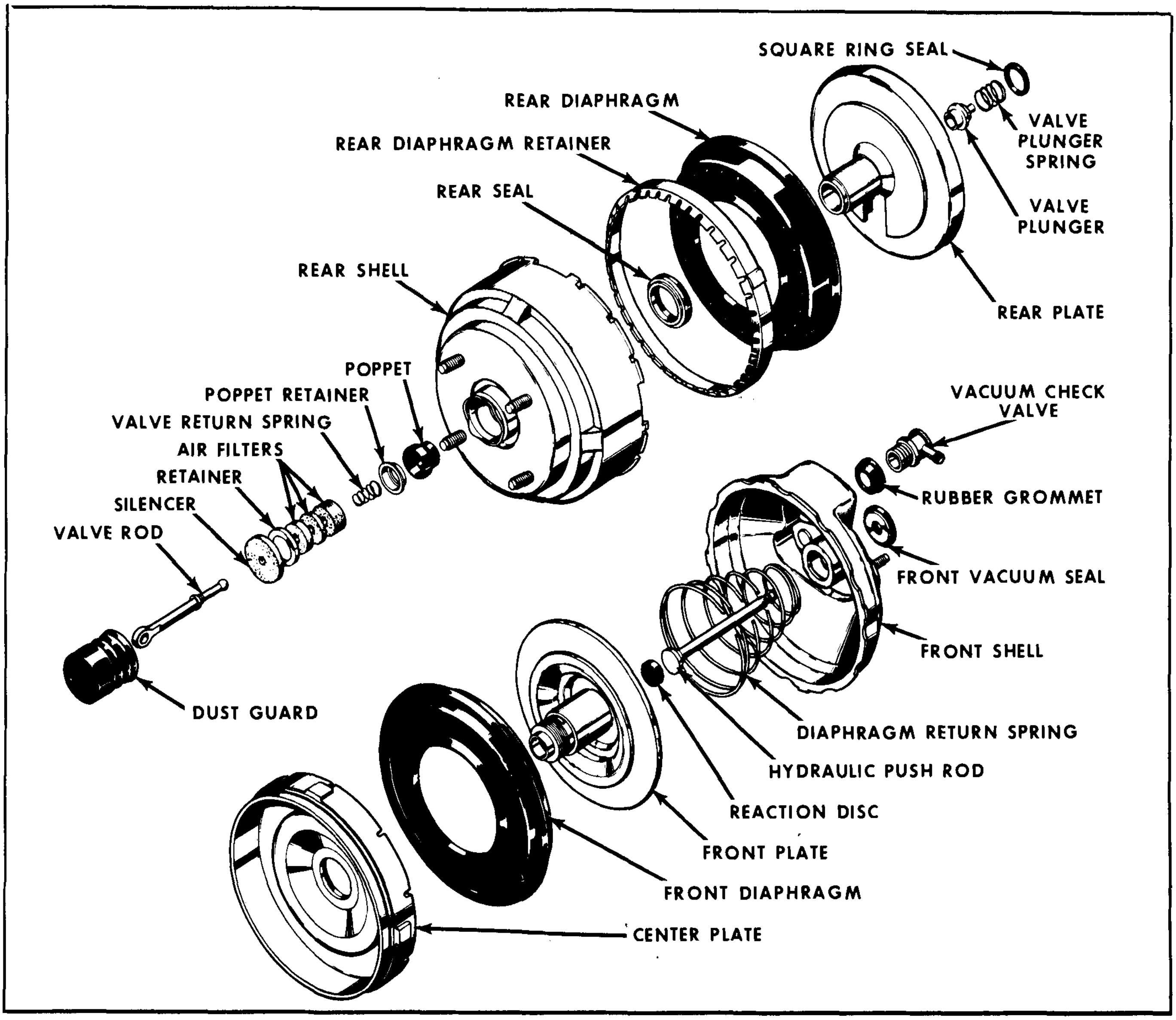


Fig. 5C-1 Power Unit Exploded View

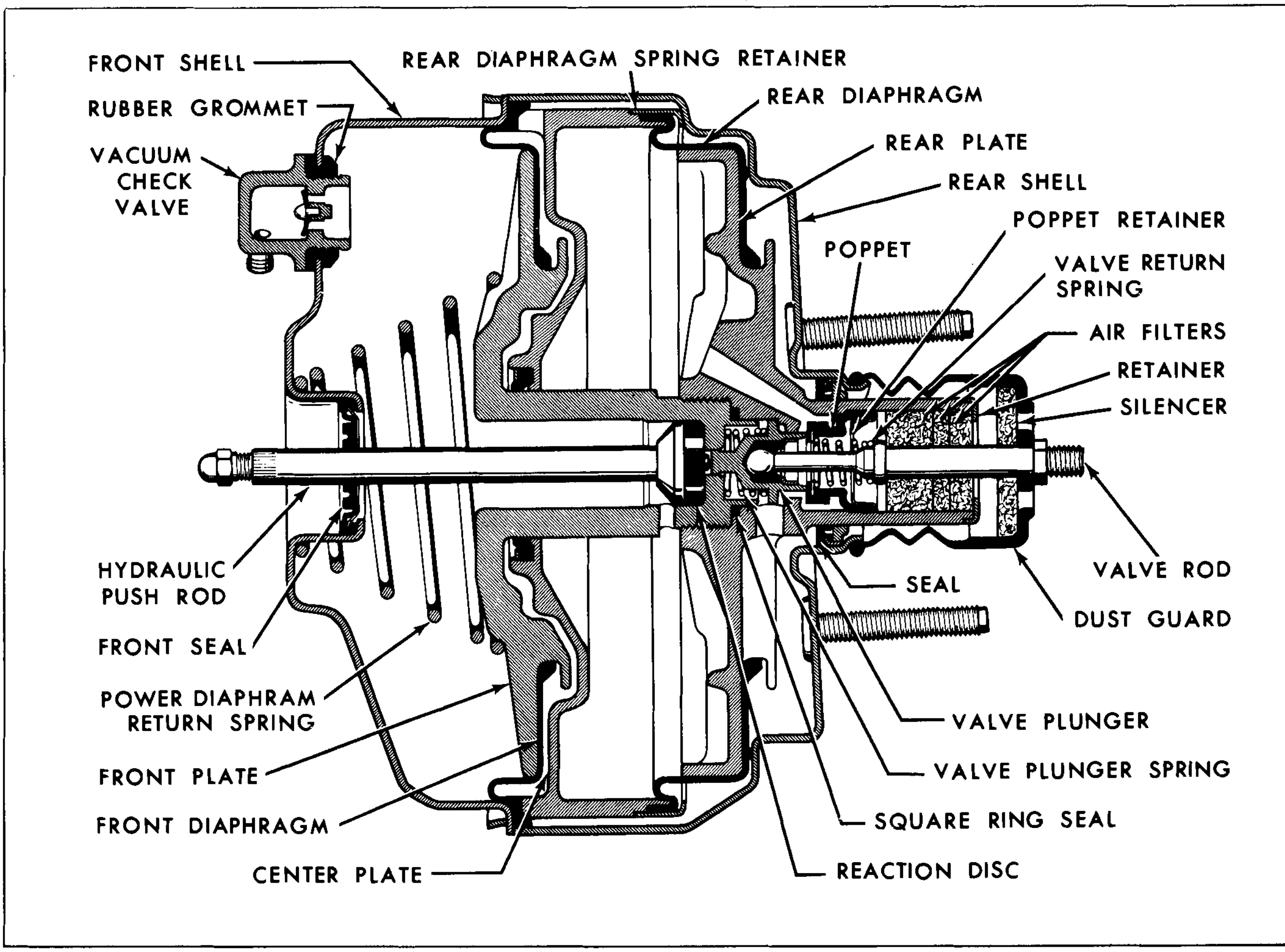


Fig. 5C-2 Bendix Tandem Diaphragm Power Brake

Three basic elements are combined into a single unit (Figs. 5C-1 and 5C-2).

These three basic elements are:

1. A vacuum power chamber which consists of a front and a rear shell, a center plate, a front and a rear diaphragm and plate assembly, a hydraulic push rod and a vacuum diaphragm and plate return spring.

   NOTE: *BOTH HYDRAULIC PISTONS MUST RETURN FAR ENOUGH TO OPEN BOTH COMPENSATING PORTS, BUT THE HYDRAULIC PUSH ROD SHOULD ALWAYS REMAIN IN CONTACT WITH THE REAR PISTON.*

2. A mechanically actuated control valve integral with the vacuum power diaphragms that controls the degree of power brake application or release in accordance with the foot pressure applied to the valve operating rod through the brake pedal linkage. The control valve consists of a single poppet with an atmospheric port and a vacuum port. The vacuum port seat is a part of the valve body attached to the diaphragm assembly. The atmospheric port seat is a part of the valve plunger which moves within the valve housing hub of the diaphragm plates.

3. A hydraulic dual-system master cylinder with two hydraulic fluid reservoirs, cast integrally with, and connected to, the bore through separate sets of compensating and fluid inlet (bypass) ports. Both reservoirs are sealed by a rubber diaphragm inside the bale-type cover. A primary piston (rear) assembly with secondary seal, primary cup, protector, spring, screw and spacer; a secondary piston (front) assembly with two back-to-back secondary seals, primary cup, protector, spring and spring retainer; a piston stop screw and O-ring seal are the operating components of the two separate hydraulic systems.

The vacuum power diaphragms and parts that make up the valve assembly are connected to the brake pedal through the valve operating rod and pedal linkage. The valve operating rod is connected to the valve plunger which moves within the hub of the power diaphragm assembly. A valve return spring returns the valve plunger and valve rod to the released position when pressure is released from the brake pedal. The valve poppet is of the flexible rubber type and is supported by the valve body.

In the released position, a return spring holds the poppet against the atmospheric port seat. A special type of seal is used for the opening between the valve body sleeve and the rear shell. Vacuum is supplied to the power brake unit from the base of the carburetor, through a vacuum hose and check valve. Atmospheric air for operation is admitted through the air filter located inside the rubber dust guard and through silencers and filters within the valve housing. A rubber valve rod guard keeps dust and dirt from getting into the valve mechanism.

At its front end, the unit incorporates another special seal to close the opening between the front shell and the hydraulic push rod. The hydraulic push rod is the link between the vacuum power diaphragm assembly and the hydraulic piston of the master cylinder. The center plate located between the two diaphragms divides the power unit into four chambers. A long, threaded hub on the front plate slides through the center hole in the center plate and is screwed into the hub of the rear plate to maintain a set separation between the two diaphragms as the front and rear plates and diaphragms move backward and forward. This front plate hub is sealed by a vacuum seal that is permanently installed in the stationary center plate.

PRINCIPLES OF OPERATION

RELEASED POSITION (Fig. 5C-3)

With engine running and the brakes released, vacuum from the intake manifold is admitted through the vacuum check valve to the front (left) vacuum chamber and,

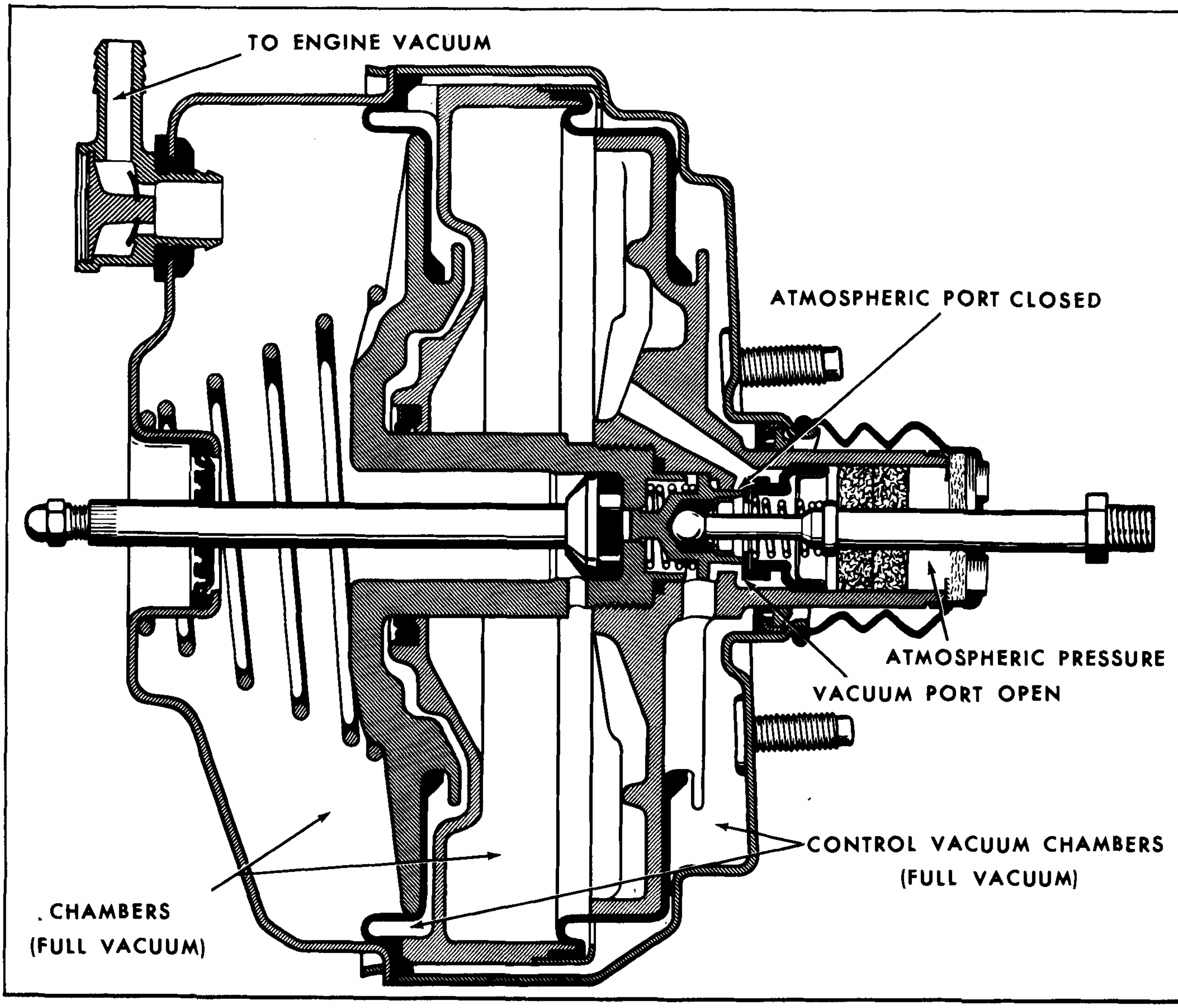


Fig. 5C-3 Released Position

through a port in the hub of the front plate, to the vacuum chamber to the front (left) of the rear diaphragm. In the released position (no pressure applied to the brake pedal), the valve operating rod and valve plunger are held to the right in the valve housing by the valve return spring to close the atmospheric port and open the vacuum port.

With the valve in this position, the chambers to the rear of both the front and rear diaphragm are open to vacuum through the portings in the hub of the valve housing and around the edge of the center plate. The vacuum power diaphragms are then balanced or suspended in vacuum, since vacuum is present on both sides of both diaphragms. The vacuum power diaphragm return spring is then free to return the diaphragm and plate assembly with the hydraulic push rod to the fully released position.

With the hydraulic push rod in the released position, the hydraulic compensating port in the master cylinder is open to permit brake fluid either to return from the brake system to the fluid reservoir or enter the brake system from the reservoir to compensate for expansion or loss of fluid from the brake system.

APPLIED POSITION (Fig. 5C-4)

As the brakes are applied by the driver, the valve operating rod and valve plunger move to the left in the diaphragm and plate assembly to compress the valve return spring and bring the poppet valve into contact with the vacuum valve seat in the vale housing to close the vacuum port. Any additional movement of the valve operating rod in the applied direction moves the valve plunger away from the poppet valve to open the atmospheric port and admit atmosphere through the air filter, poppet and passages to the pressure chambers at the right sides of both the front and rear diaphragms.

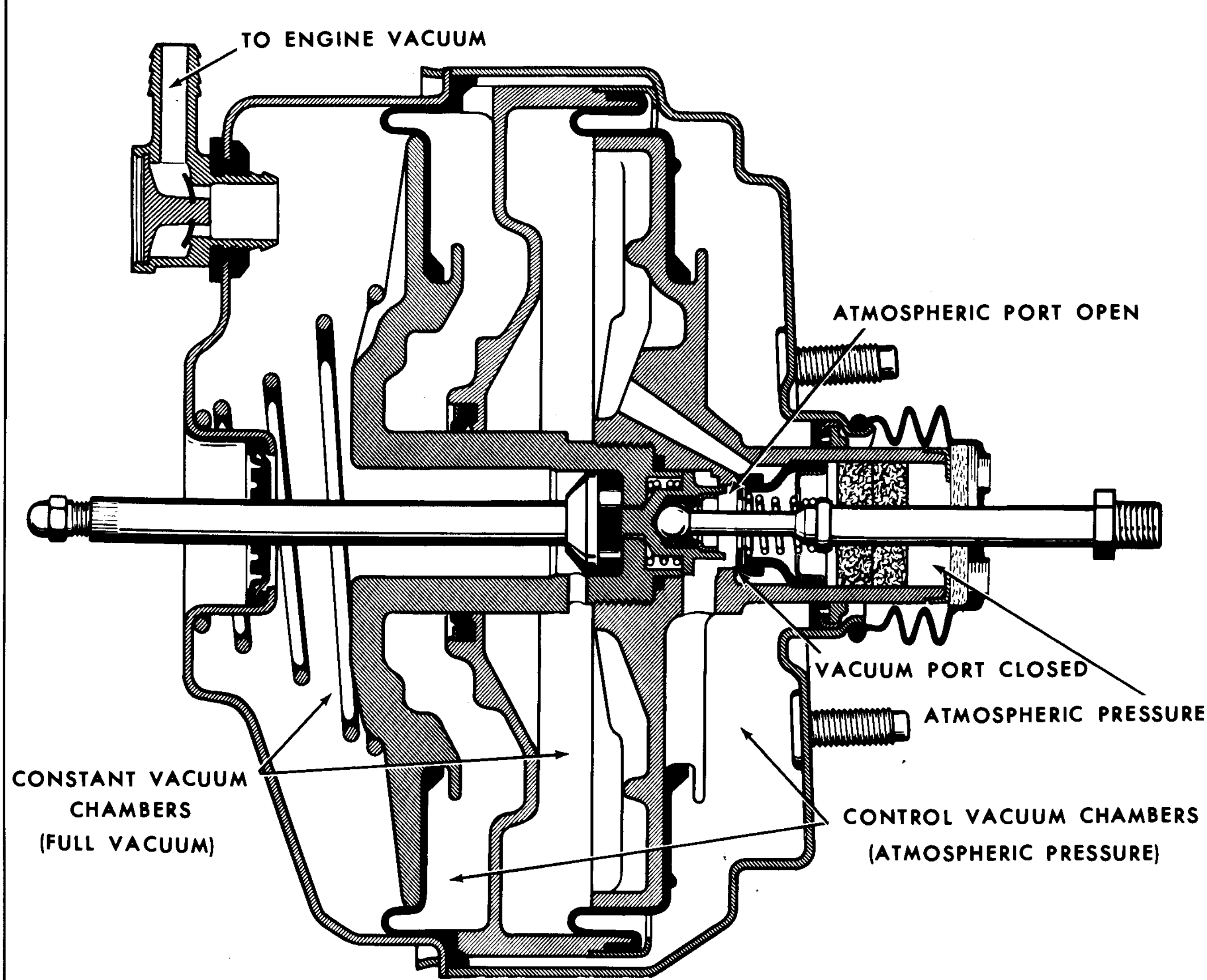


Fig. 5C-4 Applying Position

With vacuum on the left side and atmospheric pressure on the right side of both diaphragms, a force is developed to move the vacuum power diaphragm and plate assembly, hydraulic push rod and hydraulic piston to the left. This movement closes the compensating port in the master cylinder and forces brake fluid under pressure through the brake tubes into the brake wheel cylinders.

As hydraulic pressure is developed in the master cylinder, a counter-force (to the right), acting through the push rod, sets up a reaction force against the hub of the diaphragm plates and against the valve plunger through a rubber reaction disc at the end of the hydraulic push rod piston. The rubber disc reacts like hydraulic fluid to distribute the pressure between the diaphragm plate hub and the valve plunger head in proportion to their respective contact areas. This reaction pressure acting against the valve plunger and valve operating rod tends to move the valve plunger slightly to the right, in relation to the valve housing, to close the atmospheric port.

Since part of the counter-force (to the right) reacts through the valve plunger and valve operating rod against the driver's foot, a feel of the braking effort is provided. The amount of reaction transmitted to the valve plunger is designed into the power brake to assure maximum power consistent with the assurance that the driver always maintains a feel of the amount of brake that is being applied. This reaction force is in direct proportion to the hydraulic pressure developed within the brake system.

HOLDING POSITION (Fig. 5C-5)

During application of the brakes, the reaction against the valve plunger is working against the driver, attempting to close the atmospheric port. When both the vacuum and atmospheric ports are closed, the power brake is in the holding position and any degree of braking application attained will be held until pedal pressure is increased or decreased. This holding position occurs whenever brake pedal pressure is held constant for a moment; however, as described above, when the power section is fully applied, the valve plunger is held away from the atmospheric port seat to admit full atmospheric pressure, as shown in Fig. 5C-4. When the brake pedal is released, the diaphragm and plate assembly and the hydraulic pistons are returned by their return springs to the released position and fluid from the wheel cylinders and brake tubes flows slowly back to the master cylinder sections and reservoirs.

> **NOTE:** *BOTH HYDRAULIC PISTONS MUST RETURN FAR ENOUGH TO OPEN BOTH COMPENSATING PORTS, BUT THE HYDRAULIC PUSH ROD SHOULD ALWAYS REMAIN IN CONTACT WITH THE REAR PISTON.*

Both fluid reservoirs, cast integrally with the master cylinder, supply fluid to the space around its piston between the primary and secondary seals through the fluid inlet (bypass) port in the casting. When the brake pedal is released quickly, the two return springs in the master cylinder force the hydraulic pistons to the released position faster than fluid can flow from the wheel cylinders. Fluid compensation is provided by a flow of fluid from the space between the primary cup and secondary seal through holes in the head of the piston and around the edge of each primary cup. The excess fluid then in the system flows back to the reservoirs through the compensating ports. The secondary seal on the rear piston prevents loss of fluid from the hub end of the master cylinder bore. The secondary seal on the front piston that faces toward the rear system prevents any flow of fluid from the rear system to the front. The other secondary seal on the front piston, facing toward the front, prevents any fluid flow from the front system to the rear.

The front or floating piston supplies the correct fluid displacement for the front wheel brake requirements. The rear piston supplies the correct fluid displacement for the rear wheel brake requirements. The hydraulic pressure developed in both systems is equal at all times since the front or floating piston is balanced between the hydraulic pressure in both systems. If the front system fails, the front piston and spring bottom against the end of the bore and then the rear piston develops hydraulic pressure to the rear wheels. If the rear system fails, the rear piston and spring bottom against the front piston and then mechanically force the front piston forward to develop hydraulic pressure to the front wheels. Failure in either system has no effect on the other system but is immediately evident to the driver because of the additional pedal travel required to actuate the remaining half of the dual brake system. (In addition, a brake warning light switch also actuates the parking brake light on the instrument panel.)

LOSS OF VACUUM POWER

In the event of engine failure, the vacuum chambers within the power brake provide adequate vacuum reserve for two or three brake applications. If the vacuum check valve is defective or after braking has depleted the vacuum reserve, the driver can still operate the brakes manually but pedal effort is considerably greater.

CHECKS AND ADJUSTMENTS ON CAR

1. Check for free operation of brake pedal. If binding exists, check all pivot points for binding and lubricate as required.

2. Check stop light switch for proper setting and operation. See Section 5.

3. Check fluid level in hydraulic cylinder reservoirs. See Fig. 5-11.

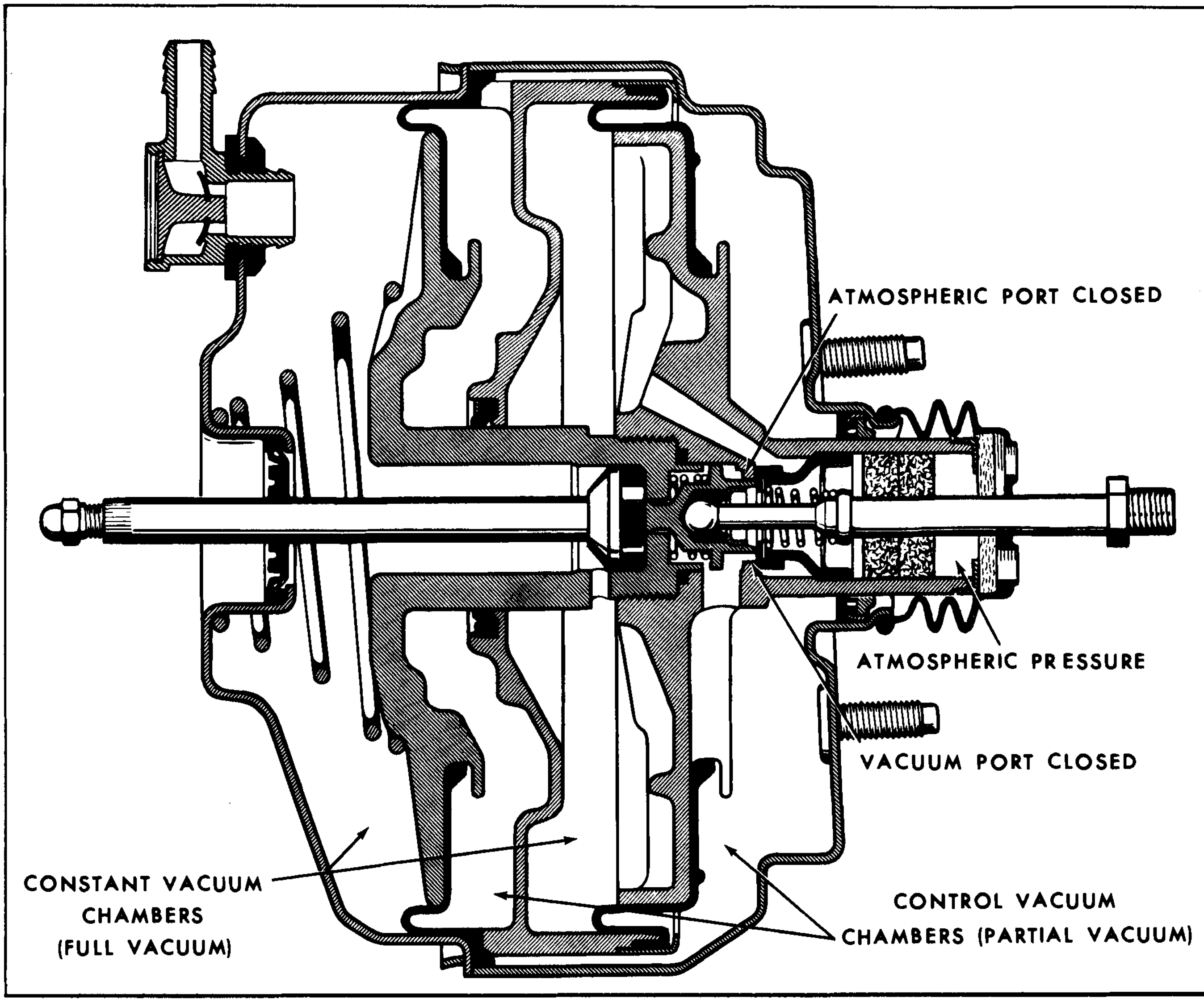


Fig. 5C-5 Holding Position

4. Check vacuum hose, check valve grommet and carburetor vacuum fitting for possible air leaks.
5. Check engine for good stall-free idle and correct as required.

MINOR REPAIRS

BLEEDING BRAKES

Brakes should be bled in the same manner as standard brakes. Bleed with engine off and vacuum reserve depleted. With disc brakes, hold off metering valve with J 2370. For bleeding information see Sections 5 and 5E.

STOP LAMP SWITCH

See Section 5 for service.

MAJOR REPAIRS

POWER BRAKE AND MASTER CYLINDER ASSEMBLY

REMOVE

1. Remove vacuum check valve from front housing and discard grommet.
2. Disconnect pipes from master cylinder hydraulic ports and cover openings in master cylinder and ends of pipes to prevent entry of dust, dirt, etc.
3. Remove clevis pin retainer from brake pedal inside the car.
4. Remove nuts from power cylinder studs and remove power cylinder.
5. Clean exterior of power brake assembly and drain reservoirs of hydraulic fluid.

MASTER CYLINDER AND EXTERNAL PARTS

REMOVE

1. Remove the two master cylinder attaching nuts and lockwashers and remove master cylinder. Remove hydraulic push rod by pulling it straight out of front shell.
2. Carefully remove push rod boot and air filter from valve rod.

VALVE ROD, RETAININERS FILTER AND POPPET PARTS

REMOVE (Fig. 5C-6)

1. Carefully remove stamped steel hub protector and foam air filter from valve hub. USE CARE TO AV-OID DAMAGING PLASTIC HUB.
2. With valve rod in vertical position, squirt alcohol down rod to wet rubber grommet in valve plunger on ball end of valve rod.

   CAUTION: *When separating valve rod from plunger, hold power unit to prevent it from falling to floor. Use care when prying with wrenches to avoid damaging plastic valve hous-ing.*

3. Reinstall hub protector. Position two small blocks of wood on either side of eye and clamp this assembly

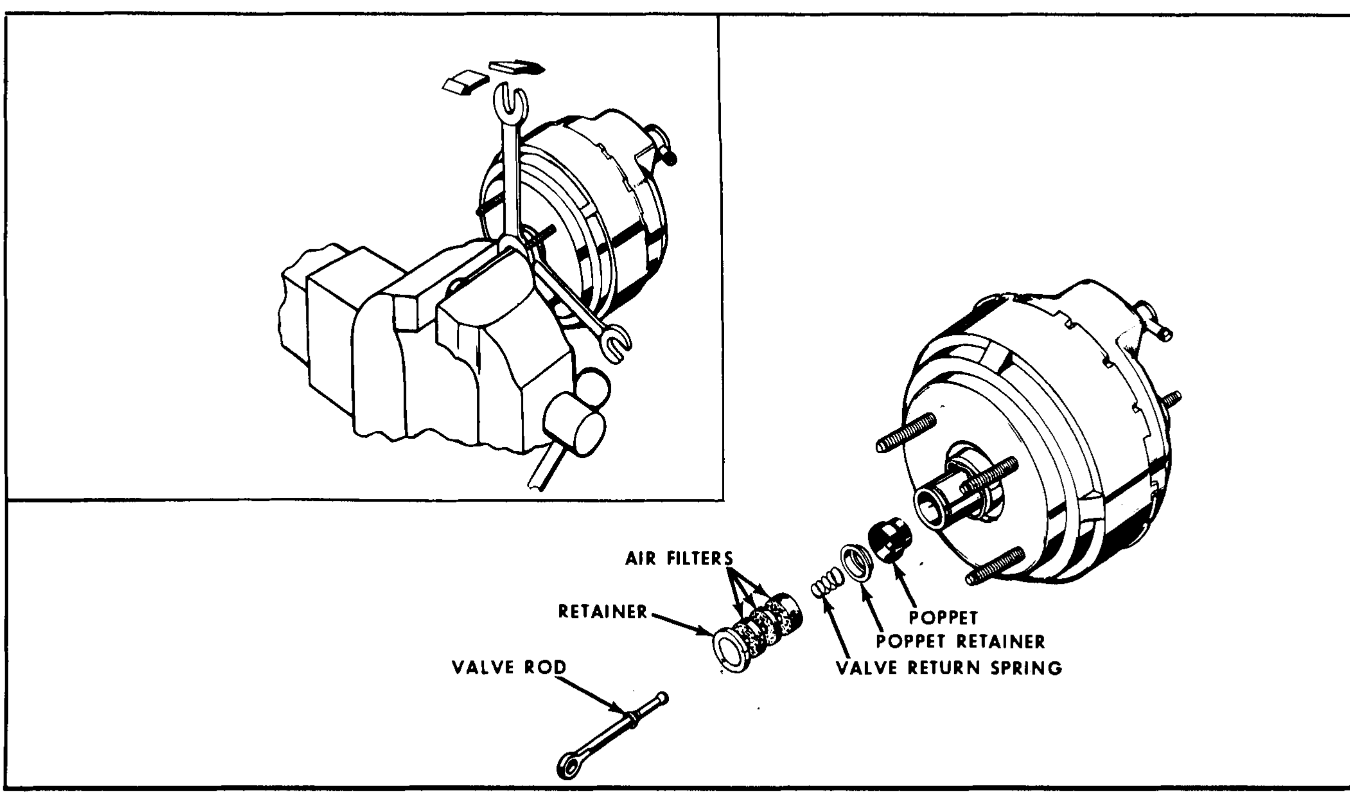


Fig. 5C-6 Valve Rod Retainers, Filters and Poppet

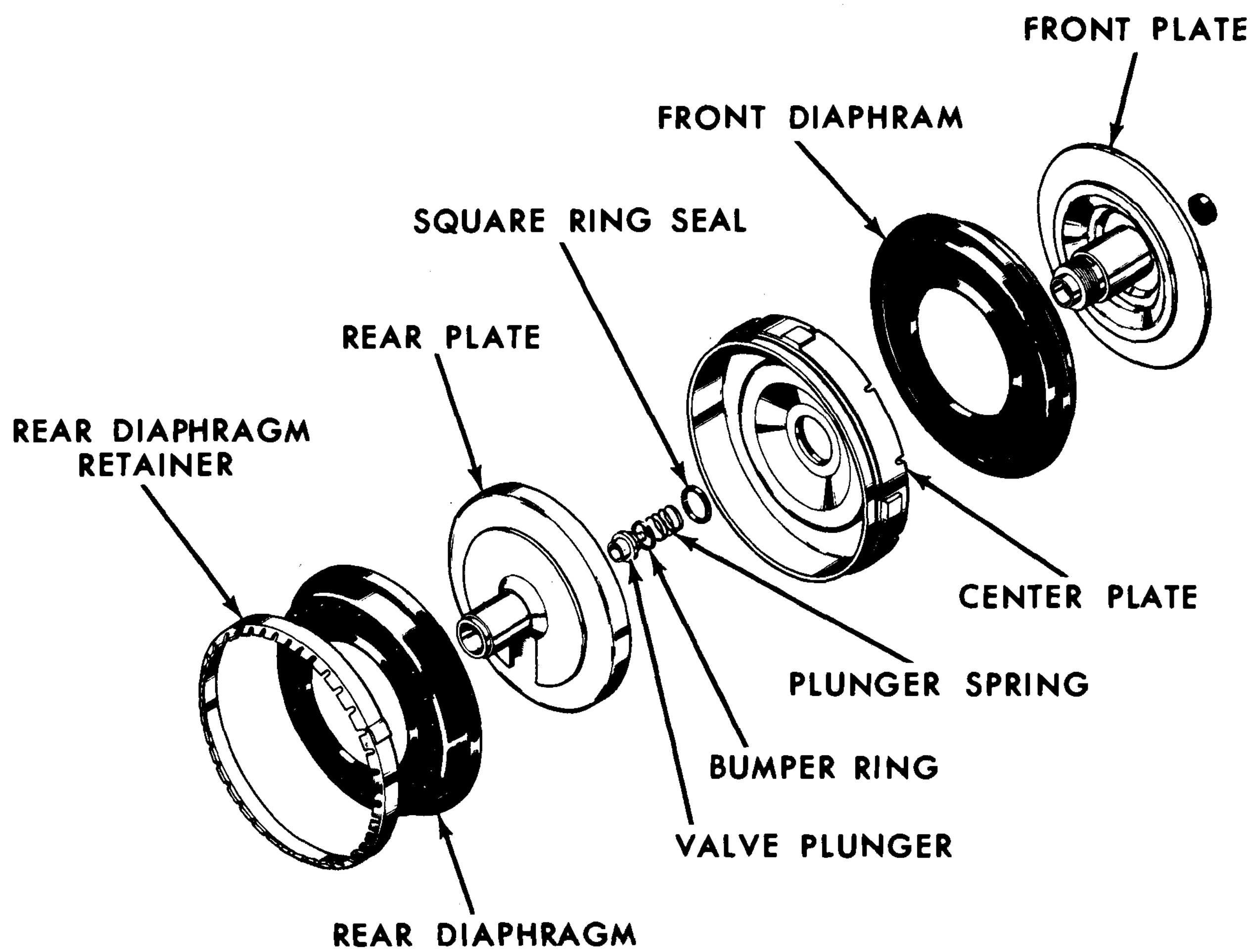


Fig. 5C-7 Diaphragms, Plates, Retainer and Plunger

securely in vise (see Fig. 5C-6 inset). Leave just enough space between steel retainer on plastic valve hub and side of vise jaw to insert two medium-sized open end wrenches. Use wrench nearest vise as a pry to force the valve plunger grommet (and power section) off the ball end of the valve rod.

4. Remove valve rod from vise. Carefully remove hub protector, valve return spring, poppet retainer and poppet.

POWER SECTION

DISASSEMBLE (Fig. 5C-7)

NOTE: *Special tool BT 7004 or J 23456 (Fig. 5C-8) may be used for housing disassembly as an option to the following method:*

1. Assemble special tool combination as shown in Fig. 5C-9.

2. Place assembly in arbor press (Fig. 5C-10) with rear shell and spanner wrenches up. Secure tool J 8433 to press to prevent tilting of front shell.

   NOTE: *On some models it will be necessary to pry open the four tangs located at the seam, to allow shell separation.*

   CAUTION: *Do not compress assembly to the point of damaging power unit.*

3. Compress assembly sufficiently enough to allow rotation of tools J 9504.

4. Scribe a mark across front and rear shell to facilitate assembly.

WARNING: DIAPHRAGM RETURN SPRING IS UNDER PRESSURE. USE CARE IN SEPARATING SHELLS TO AVOID THE SPRING FLYING OUT.

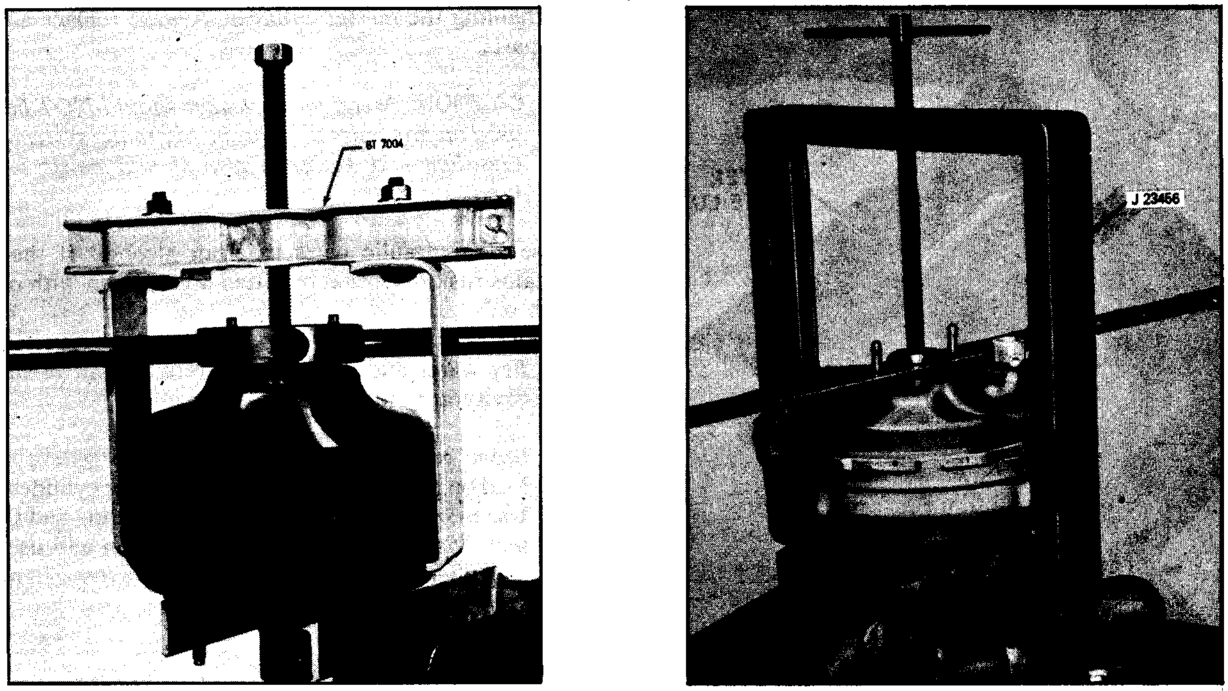


Fig. 5C-8 Tools for Disassembly of Power Brake Housing

5. Rotate spanner wrenches (J 9504) counterclockwise to release position (to point where cutouts in front shell are in line with lances in rear shell).
6. Slowly release pressure on assembly.
7. Using fingers, remove diaphragm assembly from rear shell (Fig. 5C-11).

REAR SHELL VACUUM SEAL

REMOVE (Fig. 5C-1)

NOTE: *Do NOT remove rear seal unless seal is defective.*

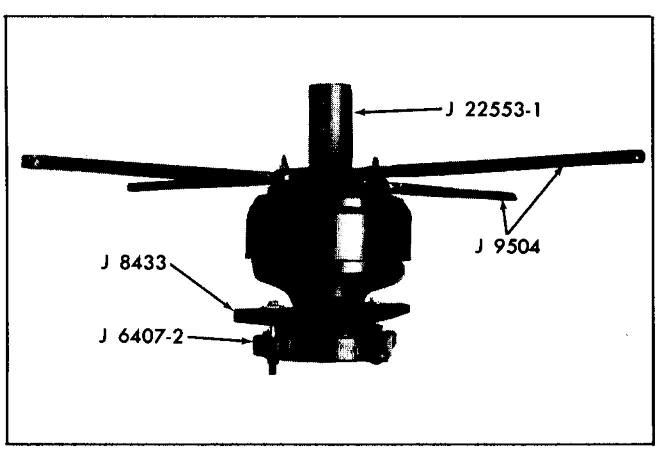


Fig. 5C-9 Power Unit Special Tool Combination

Place rear shell on bench with studs up and drive out seal with punch or screwdriver.

DIAPHRAGMS, PLATES, RETAINER AND PLUNGER

DISASSEMBLE (Fig. 5C-7)

1. Wet rear diaphragm spring retainer with alcohol and remove, using fingers only. Remove rear diaphragm from rear plate.

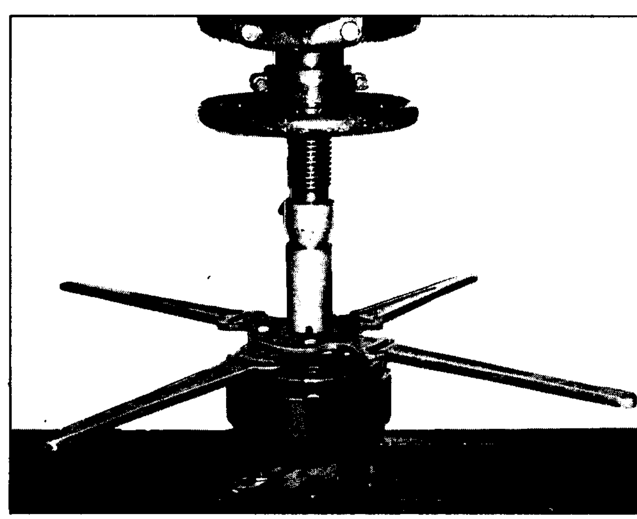


Fig. 5C-10 Power Unit Mounted in Press

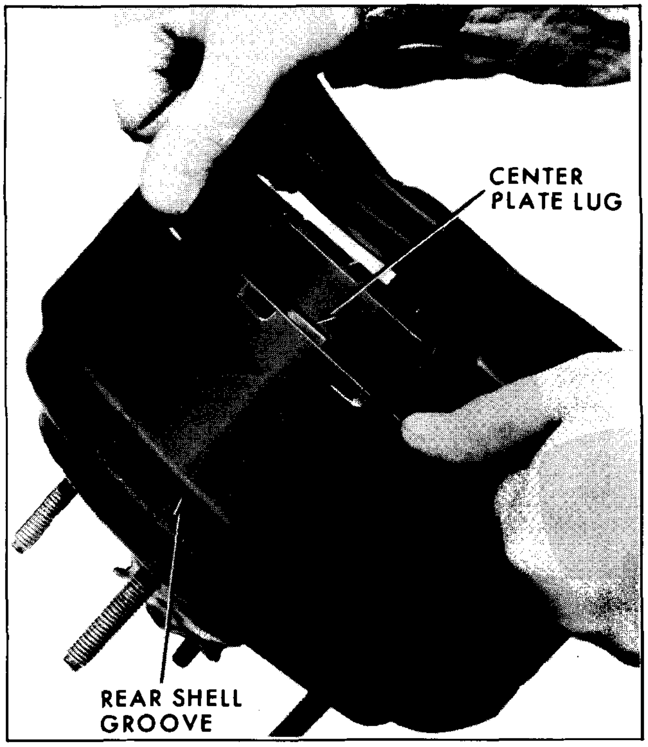


Fig. 5C-11 Removing Center Plate from Rear Shell

2. Set 1-1/16" hex bar stock about 2" long or tool J 22839 in bench vise. Set Diaphragm and Plate assembly on hex stock with hex opening in center of front plate on bar. Twist rear plate counterclockwise, using hand leverage only either on atmospheric pressure channel or on outside circumference of rear plate.

   After plates have been loosened, remove assembly from vise and complete disassembly on bench, front plate down.

3. Unscrew rear plate completely and carefully lift it off front plate hub, grasping valve plunger and spring with other hand and remove them from bore of front plate hub.
4. Remove square ring seal from shoulder of plate. Seal may stick to shoulder of either front or rear plate.
5. Using small rod or screwdriver through center bore of front plate, push out reaction disc.
6. Loosen front diaphragm from center plate and slide center plate carefully off front plate hub.

   CAUTION: *DO NOT DAMAGE OR REMOVE SEAL FROM CENTER BORE OF CENTER PLATE.*

MASTER CYLINDER

DISASSEMBLE (Fig. 5C-12)

Always use the correct master cylinder repair kit when overhauling the master cylinder. Always replace all rubber parts.

> **CAUTION:** *Metal parts cleaner should NOT be used on any parts used in the hydraulic system. Gasoline and kerosene also should never be used.*

Rinse all hydraulic parts in clean alcohol. If the bore contains rust, corrosion or pitted areas, clean with crocus cloth only.

1. Pry water and dirt seal and retainer out of shallow cavity around master cylinder hub.
2. Move rear piston with blunt tool to relieve spring load on piston stop screw under master cylinder bore. Use a 3/8" wrench to remove stop screw and O-ring seal. Maintain pressure on rear piston and use snap ring pliers to remove snap ring from groove in master cylinder bore.

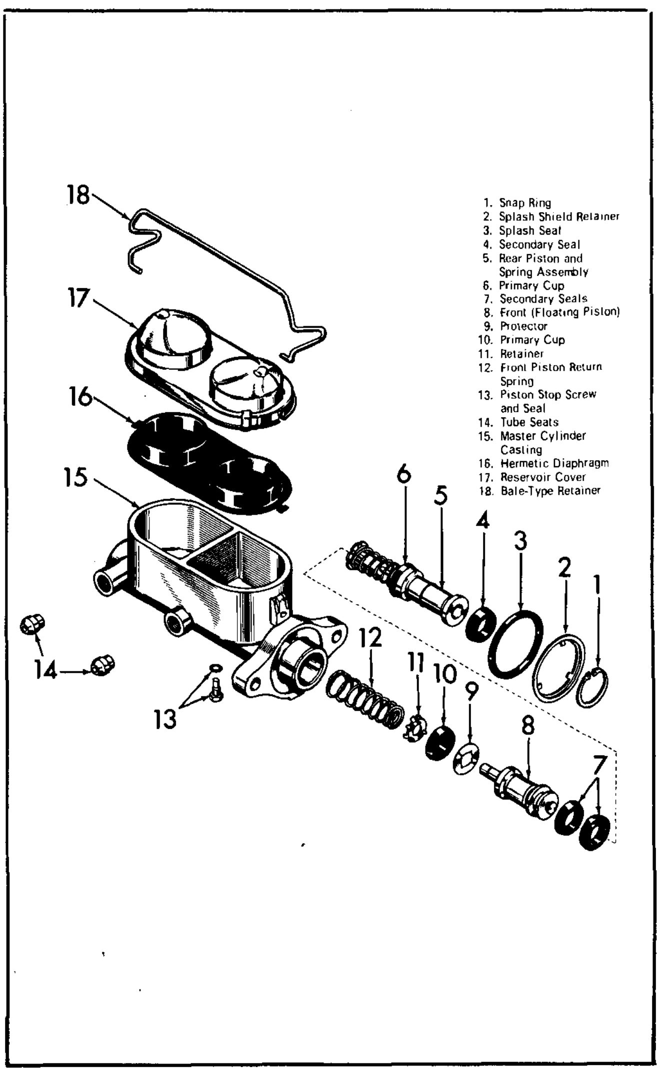


Fig. 5C-12 Master Cylinder Exploded View

3. Remove rear piston and spring assembly and discard. Do NOT attempt to disassemble it since a complete new assembly is provided in the repair kit.

4. Remove front piston assembly, front return spring and retainer. Slide primary cup and protector off nose of front piston. Use dull scribe to lift both secondary seals from the grooves at the rear end of the piston. Discard all old rubber parts.

CLEANING

Wash all hydraulic system parts in alcohol. Remove spots, deposits or pitted areas inside the master cylinder bore with crocus cloth. Discard all old rubber parts, except reservoir diaphragm.

INSPECTION

Inspect all metal parts for damage or excessive wear. Replace any damaged or worn parts.

MASTER CYLINDER

ASSEMBLE (Fig. 5C-12)

1. Clamp master cylinder in vise with open end tilted slightly upward.

2. Install new secondary seals, back to back, in grooves on rear end of front piston. Dip seals in brake fluid and lift them carefully into grooves with dull scribe. Slide protector and primary cup onto nose of front piston.

3. Stack front piston return spring and retainer on nose of front piston and dip assembly in brake fluid. Slide assembly to bottom of master cylinder bore. Press and twist piston to ease cups past snap ring groove.

4. Dip new rear piston and spring assembly in brake fluid and slide assembly into bore. Use scribe and press piston to ease cups into bore.

5. Press in against rear piston with blunt tool to compress return springs. Do NOT use screwdriver or other sharp-edged tool since this will damage the push rod seat inside the piston. Maintain pressure on piston and use snap ring pliers to install snap ring in groove inside bore. Make sure snap ring is seated securely in groove.

6. Maintain pressure on rear piston while installing piston stop screw and new O-ring seal in port underneath bore. Torque screw with 3/8" wrench to 40 lb. in.

7. Remove master cylinder from vise. Install reservoir diaphragm and cover and plug ports, temporarily, to prevent entry of dust or dirt.

VACUUM SEAL IN REAR SHELL

ASSEMBLE

Place rear shell on block of wood, studs down, and using seal installer J 22677, press new seal, plastic bearing face first, into recess in rear shell. Top outside flange of seal should be pressed .305" (approximately 5/16") below flat shell surface next to seal cavity (Fig. 5C-13).

PLATES PLUNGER AND DIAPHRAGM

ASSEMBLE

1. Install front diaphragm on front plate.

2. Apply a light film of power brake lubricant to outside surface of front plate and hub and liberally to the seal in the center plate bore. Carefully guide center plate and seal assembly, seal side first, onto front plate hub using tool J 22733. (See Fig. 5C-14).

3. Install square ring seal firmly against shoulder of front plate hub.

4. Apply power brake lubricant lightly to front and rear bearing surfaces of valve plunger, being careful NOT to get any lubricant on rubber grommet inside plunger. Assemble valve plunger return spring on

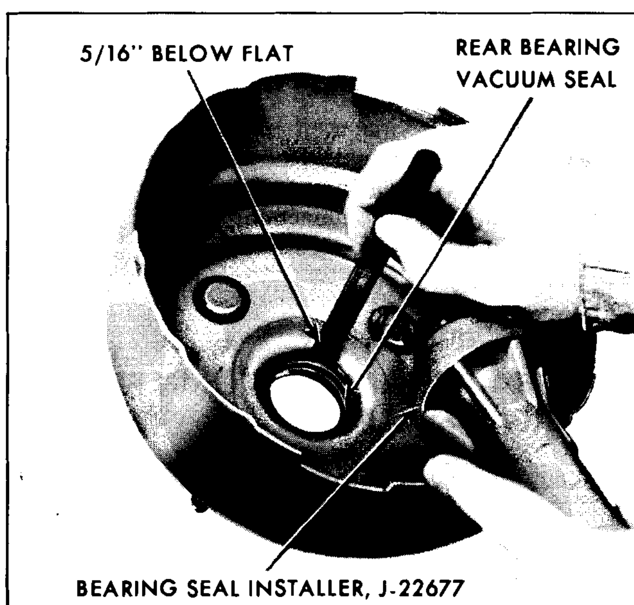


Fig. 5C-13 Installing Rear Shell Vacuum Seal

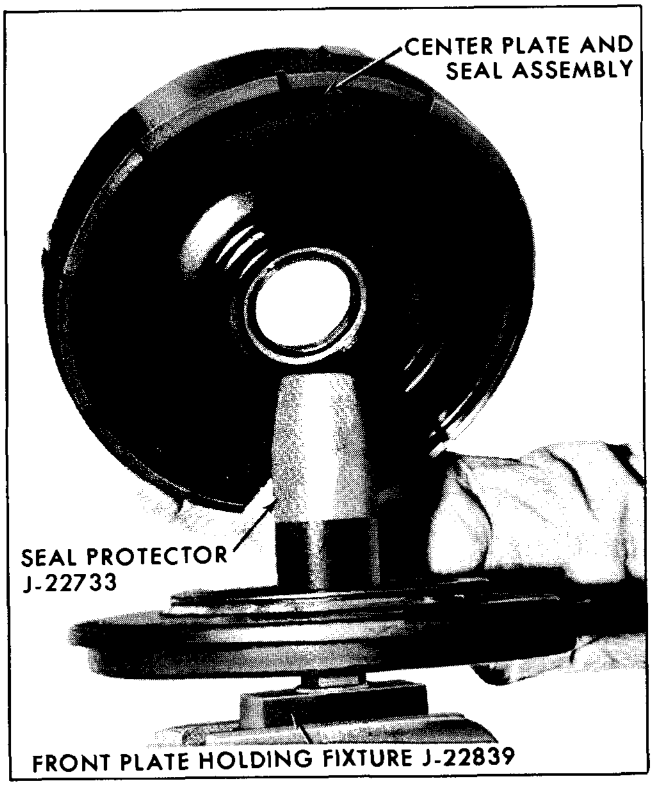


Fig. 5C-14 Installing Center Plate

valve plunger as shown and set spring and plunger in recess of front plate hub, grommet side up.

5. Set rear plate, threaded bore down, over valve plunger and, using hands only, screw rear plate onto front plate hub. To tighten plates, place 1-1/16" hex bar stock or tool J 22839 in vise and set plate assembly, front plate down, on hex bar. Using air channel slot or rear plate edges, hand torque plates to 12 1/2 lb. ft.
6. Remove plate assembly from vise.
7. Install rear diaphragm on rear plate and over lip of center plate. Assemble rear diaphragm spring retainer over rear diaphragm and lip of center plate. Using fingers, press retainer onto center plate until it seals against shoulder of center plate.

DIAPHRAGMS AND PLATES IN FRONT AND REAR SHELLS

ASSEMBLE

1. Apply power brake lubricant liberally to bearing seal in rear shell.
2. Apply power brake lubricant liberally to scalloped cut-outs on edge of front shell.
3. When assembling diaphragm and plate assembly in rear shell, the rear diaphragm and center plate lugs must be aligned between lances on rear shell.
4. Carefully guide valve housing sleeve through bearing seal in rear shell, keeping diaphragm and plates in correct alignment. Work outer rim of front diaphragm into rear shell so that outer rim of front diaphragm is under each of retaining lances on rear shell.

   NOTE: *Tool BT 7004 or J 23456 (Fig. 5C-8) may be used for housing assembly as an alternate to the following method.*

5. Secure power section front shell to tool J 8433 and J 9407-02 as in Fig. 5C-9.
6. Assemble rear shell to spanner wrenches J 9504 as shown in Fig. 5C-9.
7. Secure front shell to arbor press.
8. Place power diaphragm return spring in front shell, small coil first.
9. Position rear shell, spanner wrenches, and tool J 22553-1 over spring so that scribe marks will be aligned when the shells are locked together.
10. Slowly compress assembly keeping in a parallel plane.

    CAUTION: *Do not compress assembly to the point of damaging power unit.*

11. When front and rear shells are mated, rotate spanner wrenches until the two shells are locked together. Bend locking tangs "in" on rear shell, if so equipped.
12. Release pressure from assembly and remove all tools from front and rear shells.

REACTION DISC, PUSH ROD AND VACUUM CHECK VALVE GROMMET

ASSEMBLE (Fig. 5C-1)

CAUTION: *Under NO condition should lubricant be allowed to get on adjustment screw or threads.*

1. Apply power brake lubricant liberally to entire surface of rubber reaction disc and to piston end of hydraulic push rod.
2. Place reaction disc on piston end of push rod.
3. Insert push rod with reaction disc on piston end into cavity in front plate hub. Twist push rod to make

certain reaction disc is seated in front plate hub and to eliminate air bubbles between hub, disc and push rod piston.

4. Assemble seal, support plate side first, over adjustment screw end of push rod. Press seal into recess in front shell until seal bottoms against shell.

5. Wet new vacuum check valve grommet in alcohol and press grommet into front shell, beveled side first. Make certain grommet is seated in shell.

VALVE ROD, AIR FILTER, RETAINER AND POPPET PARTS

ASSEMBLE (Fig. 5C-6)

1. Wet poppet valve in alcohol and assemble poppet in valve housing, small diameter end of poppet first; wet poppet retainer in alcohol and assemble in housing with flange out. Press in against retainer to make certain shoulder on retainer is positioned inside poppet.

2. Assemble retainer, air filter and valve return spring over ball end of valve rod as shown (Fig. 5C-6).

3. Wet rubber grommet in valve plunger inside valve hub and ball end of valve rod with alcohol.

4. Guide spring, filters and silencers into hub and assemble ball end of valve rod in valve plunger.

5. Tap end of valve rod with soft hammer to lock ball end of rod in valve plunger grommet.

6. Press foam air filter into position inside hub and assemble retainer on end of hub, being careful not to chip plastic.

PUSH ROD BOOT AND MASTER CYLINDER

ASSEMBLE TO POWER UNIT

1. Install air filter in push rod boot and assemble boot over end of valve rod, using care to avoid tearing. Press boot against rear shell.

CAUTION: *See caution on Page 1 of this section regarding fastener referred to in step 2 below.*

2. Before mounting master cylinder, check distance A (Fig. 5C-15) from hydraulic push rod to master cylinder mounting face on front shell. This dimension A, as shown in Figure 5C-15, should be 1.200". If push rod length is not correct, follow adjustment procedure below. When push rod length is correct, attach master cylinder to power section with lockwashers and nuts. Tighten nuts to 24 lb. ft. torque.

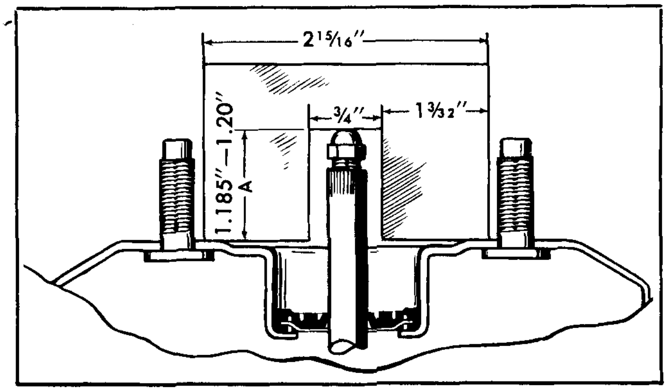


Fig. 5C-15 Gaging Push Rod Length

PUSH ROD

ADJUST

The self-locking adjustment screw is set to correct dimension at time of original assembly of power unit. Under normal service, no further adjustment should be needed provided push rod assembly remains in original unit. If, however, push rod is transferred to another unit or new push rod is used, adjustment will be necessary. To adjust push rod, hold serrated end of push rod with pliers and turn adjusting screw IN to shorten or OUT to lengthen push rod. Measure push rod height with push rod installed in unit, using tool J 7723-01.

POWER BRAKE ASSEMBLY

INSTALL

CAUTION: *See caution on Page 1 of this section regarding fastener referred to in step 2 below.*

1. Place power brake assembly into position and install four rear housing to dash attaching nuts from inside of car. Tighten nuts to 24 lb. ft. torque.

2. Install clevis pin retainer.

3. Adjust stop light switch if necessary. See Section 5 for service.

4. Install vacuum check valve and vacuum line.

5. Attach hydraulic lines.

6. Bleed brakes as necessary and fill fluid reservoirs. Fluid level should be as shown in Fig. 5-11.

TORQUE SPECIFICATIONS

Power Cylinder Housing to Master Cylinder Nuts	24 lb. ft.
Rear Housing to Dash Nuts	24 lb. ft.

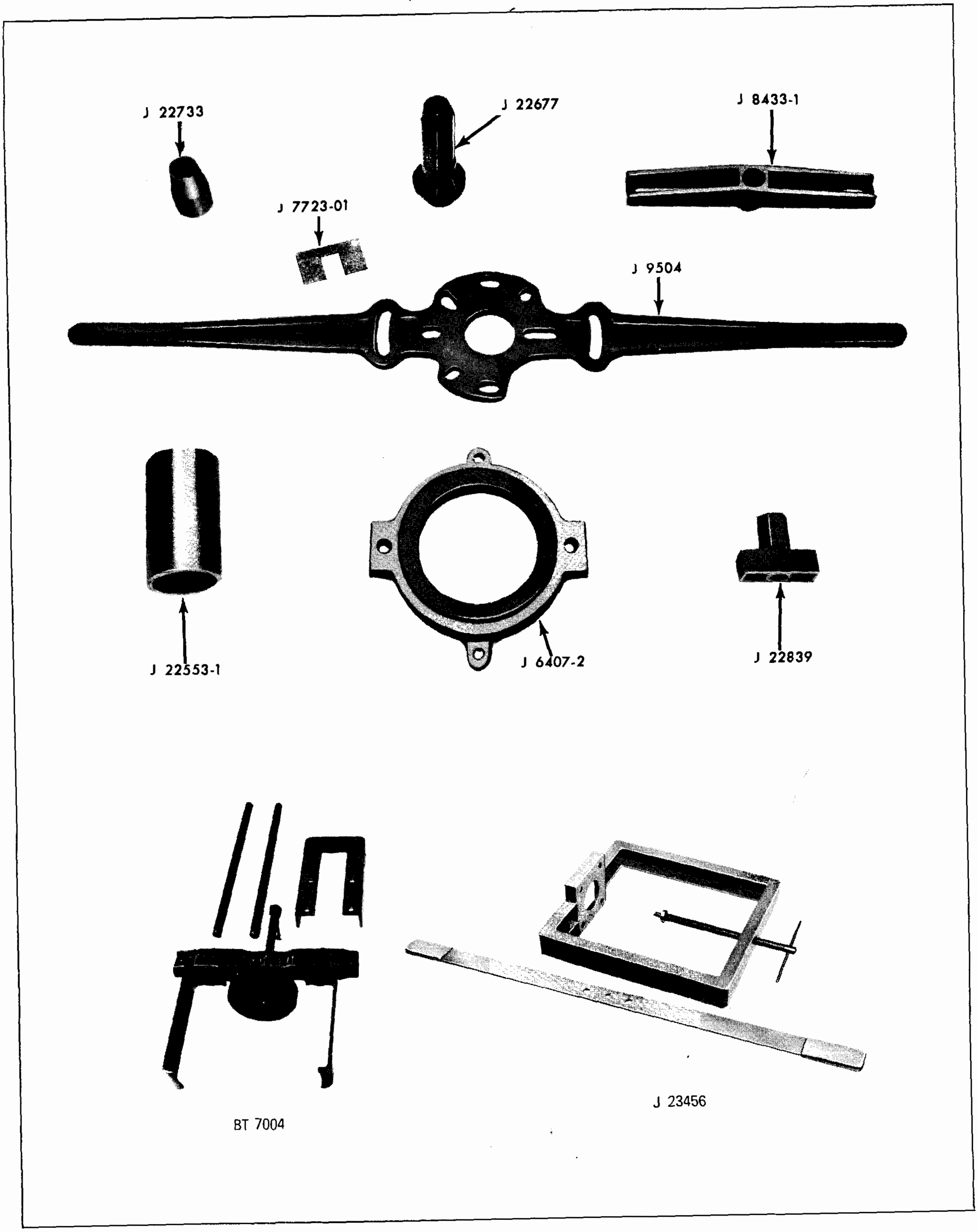


Fig. 5C-16 Special Tools

SECTION 5D

DELCO-MORAINE POWER BRAKE

TANDEM DIAPHRAGM

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

TROUBLE DIAGNOSIS AND TESTING

Start engine. With transmission in Park or Neutral, open throttle to medium speed. Close throttle and turn off engine. This evacuates the housing chambers. Wait no less than 90 seconds, then try brake action. If not vacuum-assisted for two or more applications, vacuum check valve is faulty or there is a leak in the vacuum system.

With engine off, deplete all vacuum reserve in the system. Depress the brake pedal and hold foot pressure on the pedal. If the pedal gradually falls away under foot pressure, the hydraulic system is leaking.

If the brake pedal travels to within one inch of the toeboard, the brake shoes require adjustment or relining.

With vacuum reserve depleted, depress brake pedal, hold light foot pressure on the pedal, and start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure, and less pressure will be required to hold pedal in applied position. If no action is felt, the vacuum system is not functioning.

Road test brakes by making a brake application at about 20 mph to determine if the vehicle stops evenly and quickly. If the pedal has a spongy feel when applying the brakes, air may be present in the hydraulic system. Bleed system as described in Section 5.

The same types of brake trouble are encountered with power brakes as with standard hydraulic brakes and disc brakes. Before checking the power brake system for the source of trouble, refer to the trouble diagnosis of standard hydraulic and disc brakes. After these possible causes have been eliminated, check for the cause as outlined below:

HARD PEDAL

1. Broken or damaged front or rear hydraulic brake line.
2. Vacuum failure due to:
   a. Faulty vaccuum check valve.
   b. Collapsed or damaged vacuum hose to manifold.
   c. Plugged or loose vacuum fittings.
3. Bound up pedal mechanism.
4. Power brake unit trouble:
   a. Jammed air valve.
   b. Vacuum leaks in unit caused by faulty air valve "O" ring seal or support plate seals. Also, a damaged, floating control valve, bad seal of master cylinder, or power cylinder mounting studs in housings, or a bad seal of the secondary diaphragm bead between the housings, or at power piston. It is possible to have faulty vacuum check valve grommet.
   c. Defective primary or secondary diaphragm.
   d. Restricted air filter element.
   e. Worn or badly-distorted reaction disc.
   f. Cracked or broken primary or secondary power piston or piston rod retainer.
   g. Incorrect selective reaction piston.

GRABBY BRAKES

(Apparent Off-and-on Condition)

1. Power brake unit valve trouble:
   a. Sticking air valve.
   b. Restricted diaphragm passage.
2. Reaction system:
   a. Broken air valve spring.
   b. Worn or distorted reaction disc or reaction piston.

PEDAL GOES EITHER TO THE FLOOR OR DROPS OFF ABOUT HALF THE DISTANCE FROM ITS NORMAL POSITION

1. Broken or damaged front or rear hydraulic brake line.
2. Fluid reservoir needs replenishing.
3. Power brake hydraulic leakage:
   a. Defective primary or secondary seals.
   b. Cracked master cylinder casting.
   c. Leaks at front disc brake calipers or rear wheel cylinders in pipes or connections.
4. Air in hydraulic system.

BRAKES FAIL TO RELEASE

1. Blocked passage in primary or secondary power piston.
2. Air valve sticking shut.
3. Broken piston return spring.
4. Broken air valve spring.
5. Tight pedal linkage.

GENERAL DESCRIPTION

The tandem diaphragm power brake - Moraine is used on some B Series models. It can be identified by the gold color of the power unit and master cylinder cover. Always make sure that the correct master cylinder is used whenever replacement is necessary.

The Delco Moraine tandem power brake unit is composed of two major assemblies: The vacuum tandem power head and the hydraulic dual master cylinder. The dual master cylinder is similar to those used for standard Delco Moraine power brakes except for an increase in reservoir capacity.

The power cylinder contains the power piston assembly and the power piston return spring (1). The power piston assembly is composed of three basic parts: a plastic primary power piston (4), a plastic secondary power piston (6), and a steel housing divider (5).

The primary power piston contains the valving mech-

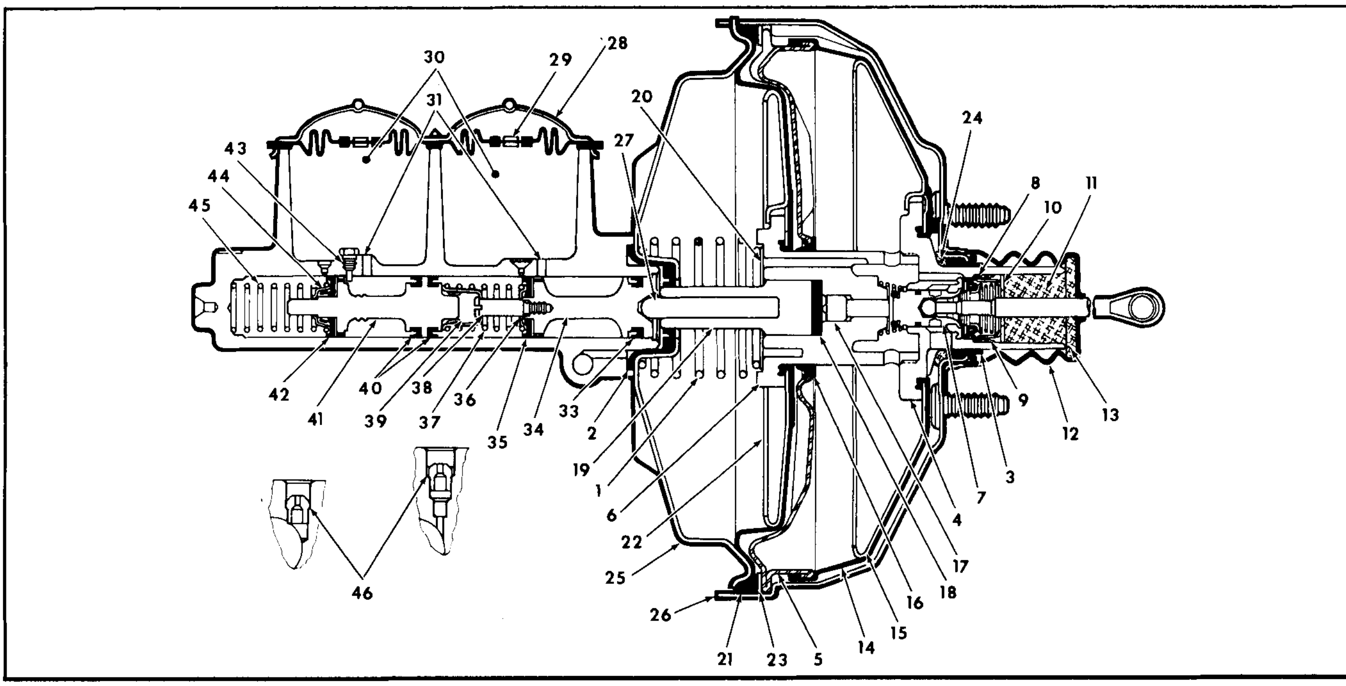


Fig. 5D-1 Construction of Delco Moraine Power Brake

anism, which consists of the air valve and push rod assembly, (7) and the floating control valve assembly (8). The air valve and push rod assembly is retained in the primary power head piston by a snap ring. The floating control valve assembly is held in place in the primary power piston by the floating control valve retainer (9). A push rod limiter washer (10), located immediately behind the floating control valve, is included to prevent the push rod from contacting the plastic tube of the primary power piston. The push rod ball is permanently staked to the air valve; the push rod eye end protrudes from the power head rear housing through a filter element (11), located behind the limiter washer, and a boot (12) containing a silencer (13).

The bead on the I.D. of the primary diaphragm (14) is held in a sealed position on the primary power head piston when the primary diaphragm support plate (15) is rotated into a locked position on the primary power piston.

The primary power piston bearing (3) is located in the center opening of the rear housing and provides a seal as well as a sliding surface for the tubular section of the primary power piston. A power head silencer (24) is positioned around the O.D. of the tubular section of the primary power piston.

The secondary power piston bearing (16) is posiitoned on the I.D. of the housing divider (5). The threaded end of the secondary power piston slides through the bearing in the housing divider and screws into the primary power piston.

The primary diaphragm is held in position on the O.D. of the housing divider by stretching the bead on the O.D. of the diaphragm and positioning it over the turned-up edge of the divider. When the front and rear housings are locked together, the housing divider is held in a stationary position between the housings.

The secondary power piston contains the reaction mechanism, which consists of the reaction piston (17), the rubber reaction disc (18), and the (plastic) piston rod retainer (19). The piston rod retainer houses the piston rod (27) which contacts the master cylinder primary piston. The piston rod retainer is held in place by a retainer plate (20) which is positioned on the "lug" end of the secondary power piston and held in place by the power piston return spring.

The unit is sealed when the housings are rotated into a locked position.

A front housing seal (2) is located in the depression in the front housing. A vacuum check valve assembly is located in the front housing for connection to the vacuum source.

Two fluid reservoirs (30) are integrally cast with the master cylinder body and supply fluid to the spaces between the primary and secondary seals through the drilled compensating holes (31) in the casting.

Within the bore of the master cylinder is the primary piston assembly (34), which includes a secondary seal (33), primary seal (35), primary seal protector, spring retainer (36), primary piston spring (37), secondary piston stop (39), and piston extension screw (38). The secondary piston assembly (41) includes two secondary seals (40), a primary seal (42), primary seal protector, spring retainer (44), and secondary piston spring (45).

The reservoir diaphragm (29) and cover (28) provide protection from contamination of the brake fluid. A stop screw (43) is located in the bottom of the front fluid reservoir. The stop screw aids in assembly and prevents rearward movement of the secondary piston when pressure bleeding.

Connection is made to the front disc brake caliper pistons and rear wheel cylinders through the two hydraulic outlets (46).

PRINCIPLES OF OPERATION

A line from a vacuum source on the engine is connected to the vacuum check valve in the front housing of the power brake. The check valve serves to prevent loss of vacuum in the power brake when the vacuum from the engine is low or not available.

RELEASED POSITION (FIG. 5D-2)

In the released position the air valve is seated on the floating control valve, and prevents the floating control valve from seating on the primary power piston. The floating control valve assembly is held against the air valve seat by a spring. Atmospheric air is thus shut off to the chambers behind the diaphragms.

At rest, the position of the power piston assembly is determined by the primary piston which is held against the rear housing. The air valve spring holds the air valve back, so that it retaining ring rests against the primary power piston.

In the released position an equal amount of vacuum is present on both sides of both power pistons. Vacuum, which is present at all times in the spaces to the left of each power piston, is now also present on the right side of each power piston.

With the power head in the released position, the primary seals on the primary piston and secondary piston are held back past the two by-pass holes in the bore of the master cylinder. In this position, no hydraulic pressure is present in the system.

APPLYING POSITION (FIG. 5D-3)

As the brake pedal is depressed, the air valve push rod assembly moves in the direction of the matster cylinder. The floating control valve, being loaded by the spring immediately behind it, follows the air valve until it contacts the seats on the primary power piston. With the floating control valve seated on the primary power piston, a passage way is closed and the vacuum source is shut off

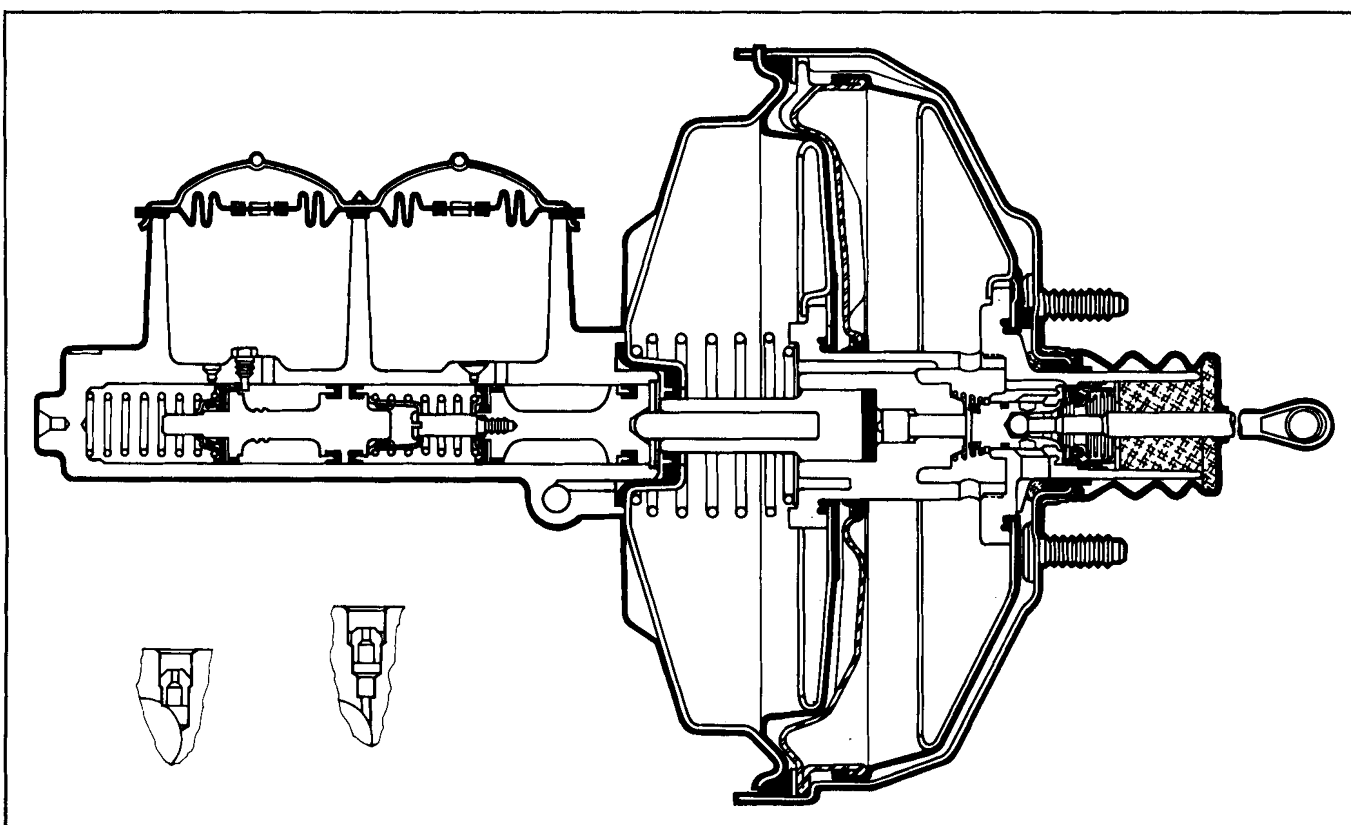


Fig. 5D-2 Released Position

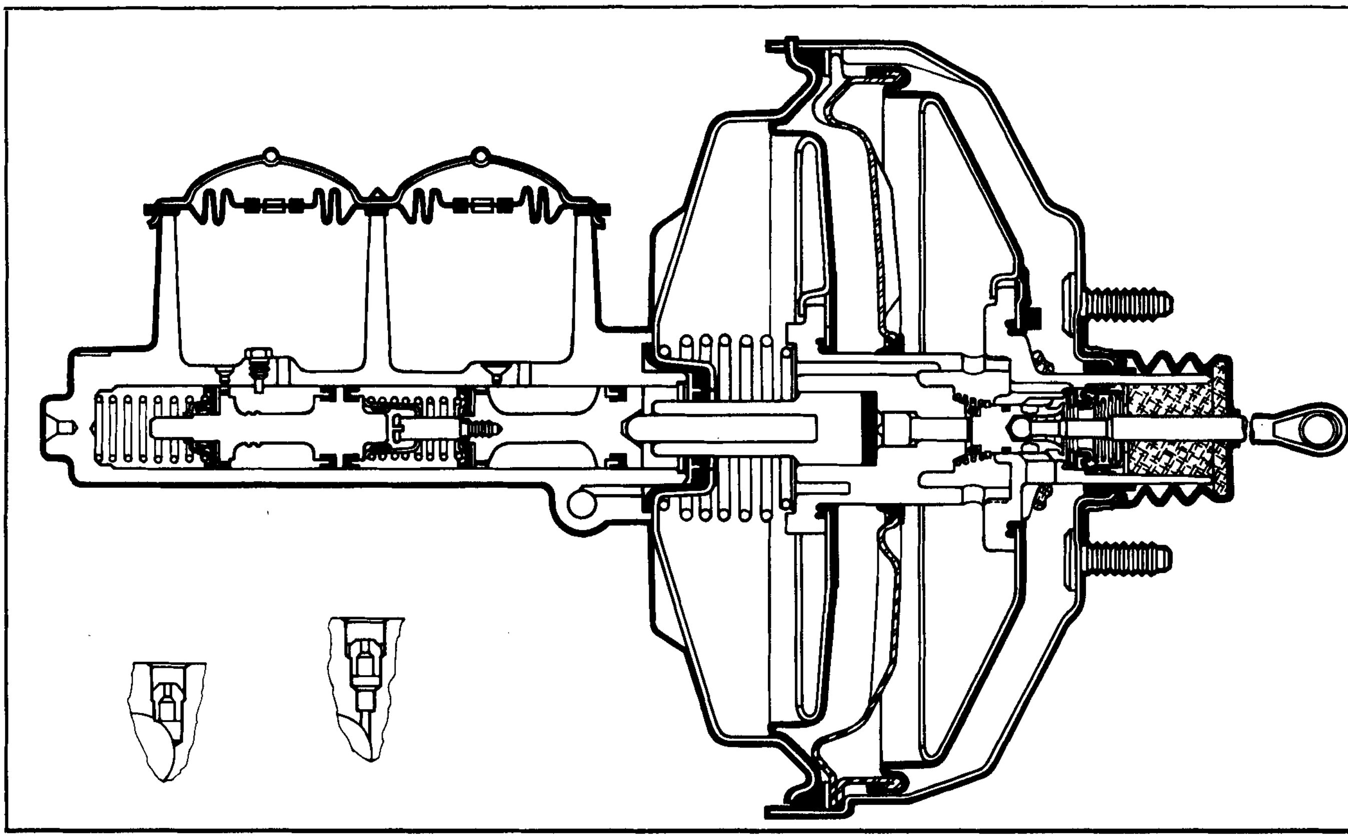


Fig. 5D-3 Applied Position

from the areas behind both power pistons. As the air valve continues to move in the direction of the master cylinder it unseats from the floating control valve.

When the air valve unseats from the floating control valve, a passage is opened to air at atmospheric pressure. Air at atmospheric pressure travels through holes in the boot, around the silencer, through the filter, through the center of the floating control valve and through the open passage into the areas behind both power pistons.

In this position a differential atmospheric pressure forces the power pistons to travel toward the master cylinder.

As the power pistons travel in the direction of the master cylinder, the piston rod actuates the master cylinder.

As pressure builds up ahead of the master cylinder primary piston, an equal force is also created in the direction of the brake pedal. This *reaction* force on the end of the piston rod is transmitted through the piston rod retainer. The piston rod retainer compresses the rubber reaction disc and causes the reaction disc to exert a portion of the reaction force against the reaction piston. This results in a movement of the reaction piston toward the air valve. The air valve and the reaction piston contact each other to transmit this *reaction* force through the push rod to the brake pedal.

HOLDING POSITION (FIG. 5D-4)

When the desired braking is reached and no additional pressure is applied to the brake pedal, the power brake will go into the holding or poised position.

The power pistons travel toward the master cylinder only far enough to bring the floating control valve into contact with the air valve assembly shutting off the flow of air. Since the floating control valve has maintained its seated position on the power piston, the vacuum source is still shut off to the areas behind the power pistons.

In the hold position, the rubber reaction disc is compressed and extrudes into the cavity in the area of the reaction piston. The reaction piston is now in full contact with the end of the air valve.

The reaction force and the apply force at the push rod are now balanced; the relative positions of the power pistons, valving, the reaction mechanism will be maintained until either more pressure is applied to the brake pedal or the brake pedal is released.

RELEASING POSITION (FIG. 5D-5)

As the pressure at the brake pedal is released, the air valve spring forces the air valve assembly back until its retaining

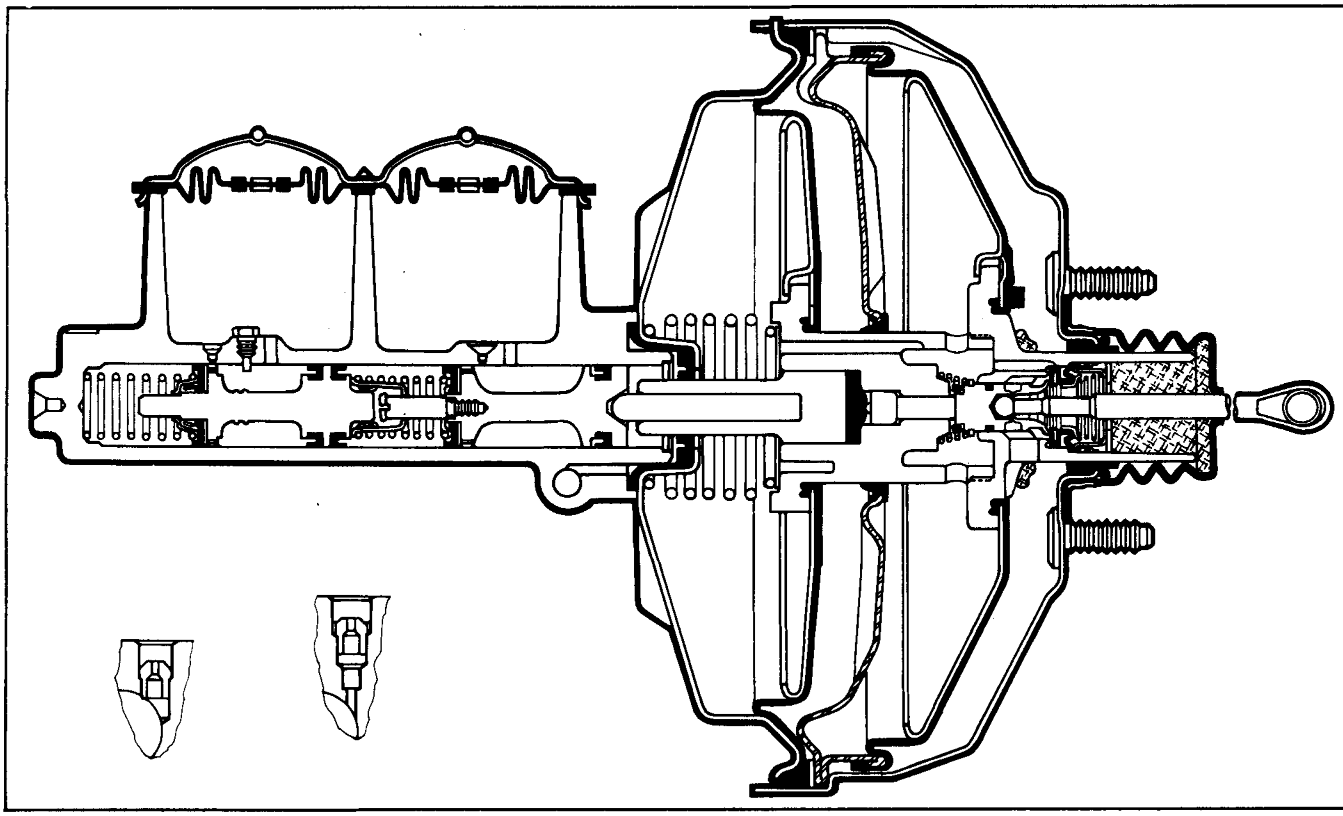


Fig. 5D-4 Holding Position

ring rests against the primary power piston. The contact of the air valve assembly with the floating control valve shuts off the flow of atmospheric pressure air. As the air valve spring forces the air valve assembly into its released position, the air valve lifts the floating control valve from its seat on the primary power piston. The air valve seating on the floating control valve shuts off the outside air. The unseating of the floating control valve from the power piston opens the vacuum source to the area to the right of the power pistons.

Vacuum, which is present at all times in the spaces to the left of each power piston is now also present on the right side of each power piston.

Now that both sides of both power pistons are exposed to equal vacuum, a spring will return to the released or at rest position. This will release the master cylinder.

If the brake pedal is released quickly, the master cylinder pistons immediately return to the released position. When the fluid in the lines cannot return as quickly as the pistons, a low pressure area is created in front of both primary cups. This low pressure area is compensated for by the flow of fluid from the reservoir through the compensating holes to the space between the primary cups and secondary seals and through the holes in the pistons. The excess fluid introduced into the system during compensation will return to the fluid reservoirs through the small by-pass holes in the master cylinder bore.

VACUUM SOURCE FAILURE

In case of vacuum source interruption, enough vacuum is available in the power brake to make about three power assisted stops.

If the vacuum check valve should fail or if the vacuum stored in the unit is exhausted, it is still possible to operate the power brake manually. Considerable effort is required, however.

CHECKS AND ADJUSTMENTS ON CAR

1. Check for free operation of brake pedal. If binding exists, check all pivot points for binding and lubricate as required.

2. Check stoplight switch for proper setting and operation, see Section 5.

3. Check fluid level in hydraulic cylinder reservoirs. Fluid level should be as shown in Fig. 5-11.

4. Check vacuum line and connections at carburetor and vacuum check valve for possible vacuum leaks.

5. Check engine for good stall - free idle and correct as required.

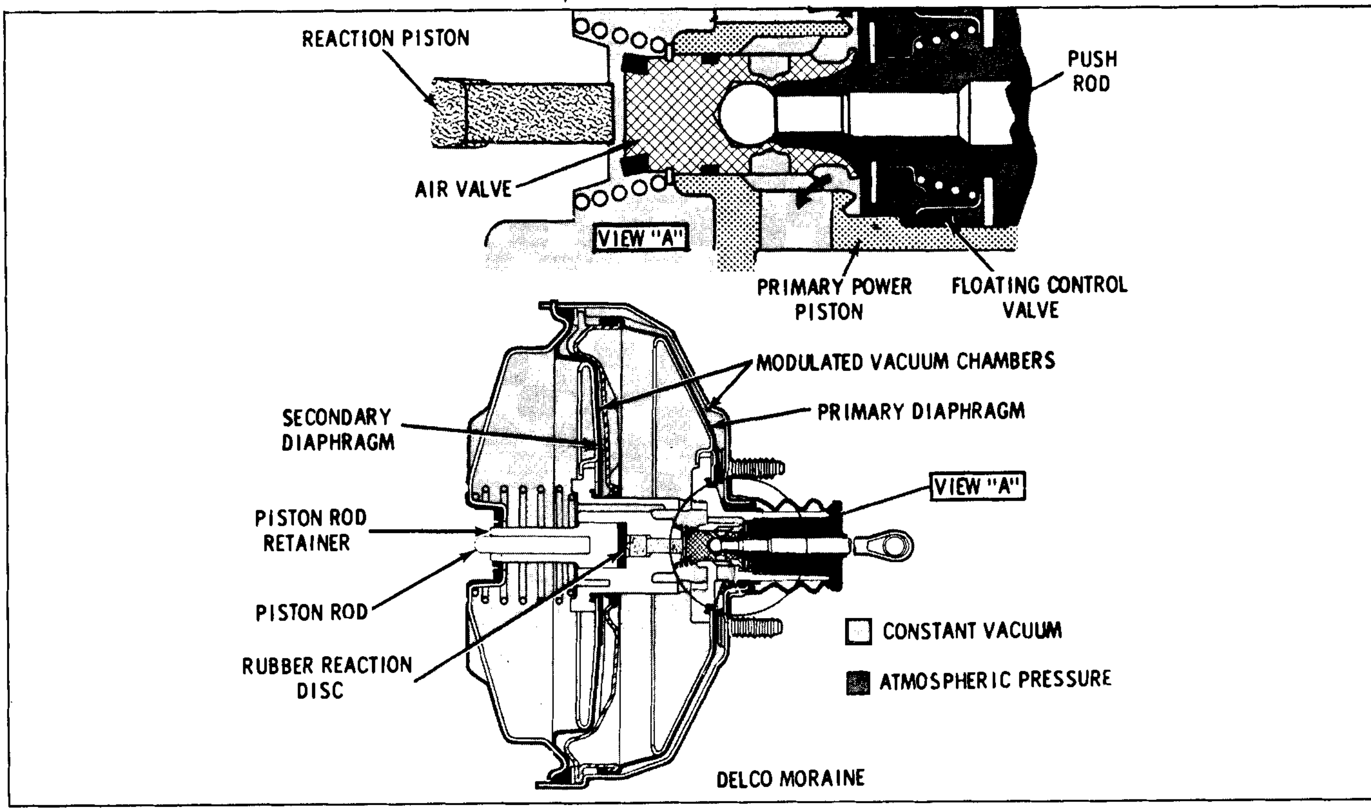


Fig. 5D-5 Releasing Position

MINOR REPAIRS

BLEEDING BRAKES

Brakes should be bled in the same manner as standard brakes: Bleed with engine off and vacuum reserve depleted. Hold off disc brake metering valve with tool J 23709. For information on bleeding brakes see Sections 5 and 5E.

STOP LAMP SWITCH

See Section 5 for service.

MAJOR REPAIRS

MASTER CYLINDER ONLY

REMOVE

Certain repair operations, such as replacement of master cylinder internal parts, permit the master cylinder to be removed by itself, leaving the power cylinder, pedal, and brackets in the car.

1. Remove hydraulic connections from master cylinder, pump fluid from cylinder into a container and dispose of fluid. Cover openings at cylinder and pipes to exclude dust, dirt, etc.

2. Remove master cylinder attaching nuts and remove master cylinder from power section.

POWER CYLINDER ONLY

REMOVE

1. Remove vacuum check valve.

2. Remove master cylinder and position it away from power cylinder.

   CAUTION: *Do not disconnect hydraulic fluid lines; be careful not to bend or kink lines.*

3. Remove clevis pin retainer at brake pedal.

4. Remove four power unit to dash attaching nuts.

5. Remove power cylinder.

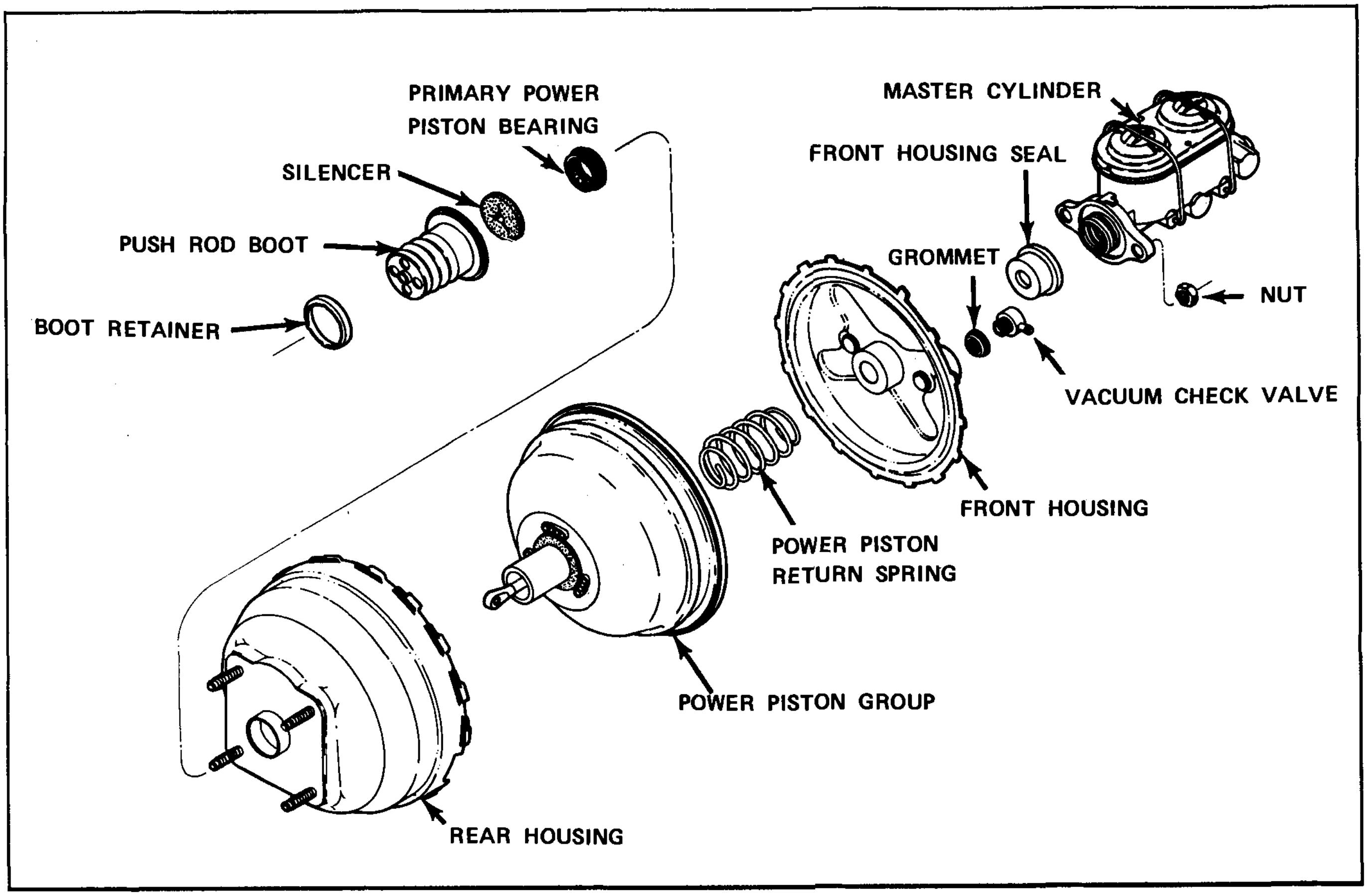


Fig. 5D-6 Power Cylinder - Exploded View

POWER CYLINDER

DISASSEMBLE (Fig. 5D-6)

1. Clean exterior of power cylinder.
2. Scribe a line across front and rear housings to facilitate reassembly.
3. Remove front housing seal.

   NOTE: *Special tool BT 7004 or J 23456 (Fig. 5D-7) may be used for housing disassembly as an alternate to the following method.*

4. Attach tool J 22805-01 to master cylinder studs of power cylinder with two nuts.
5. Place assembly in vise. Attach tool J 9504 over rear housing studs. (Fig. 5D-8).

   CAUTION: *When separating housings, rotate slowly as unit is under spring tension.*

6. Applying downward pressure, rotate rear housing counterclockwise to unlock housings. It is normal for this operation to require heavy pressure to unlock housings.
7. Remove rear housing and power piston assembly by lifting straight up slowly and lay it aside on a clean smooth surface.
8. Remove power piston return spring and retainer plate.
9. Dispose of vacuum check valve grommet in front housing.
10. Remove boot retainer and boot from rear housing. The boot and felt silencer must be pulled over the pushrod "eye" to remove.
11. Remove power piston group from rear housing and remove primary piston bearing from center opening of rear housing.

POWER PISTON

DISASSEMBLE (Fig. 5D-9)

CAUTION: *Exercise extreme care in handling power piston, rubber surfaces and metal parts in this assembly. They should be guarded against grease, oil and foreign matter and must*

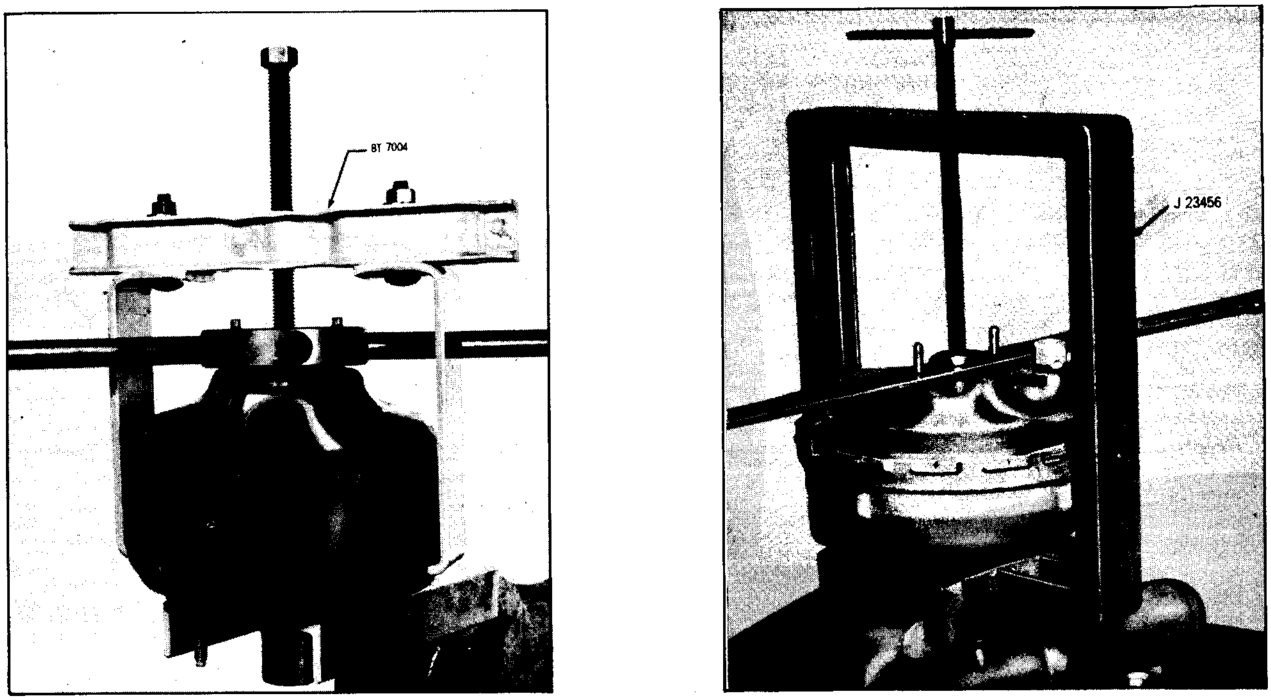


Fig. 5D-7 Tools for Disassembly of Power Brake Housing

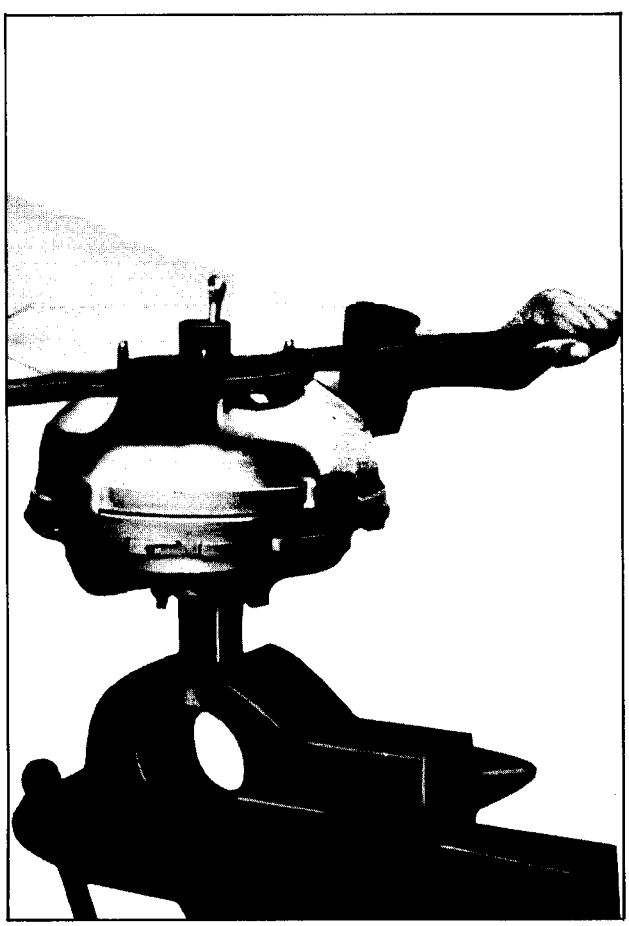


Fig. 5D-8 Separating Front and Rear Shells

be protected from nicks or cuts that might be caused by rough surfaces or damaged tools.

1. Lift bead on O.D. of secondary diaphragm and remove diaphragm support ring.
2. Remove piston rod retainer and piston rod from secondary piston.
3. Mount double-ended tool J 23101 (with large diameter end up) in a vise. Position the secondary power piston so that the two radial slots in piston fit over ears of tool (Fig. 5D-1).
4. Fold back primary diaphragm from O.D. of primary support plate. Grip edge of support plate with hands and rotate counterclockwise to unscrew primary power piston from secondary power piston. (Fig. 5D-11).

   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 primary support plate counterclockwise. Tabs ("stops") on primary support plate will temporarily lock primary support plate to primary power piston and permit continued counterclockwise rotation to unscrew primary power piston from secondary power piston.*

5. Remove housing divider from secondary power piston. Remove secondary power piston bearing from housing divider.

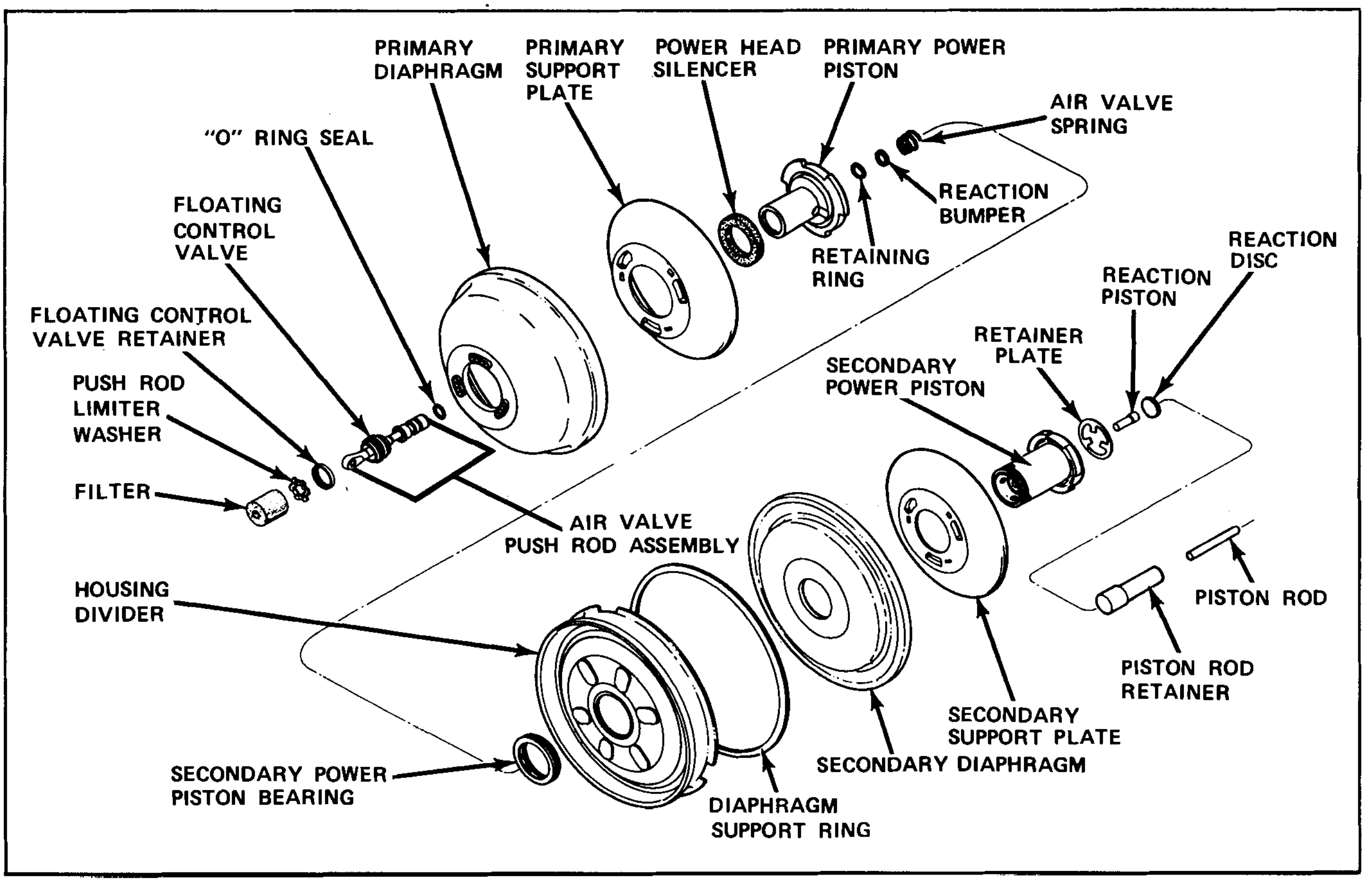


Fig. 5D-9 Power Piston - Exploded View

6. The secondary power piston should still be positioned on tool J 23101. Fold back secondary diaphragm from O.D. of secondary support plate. Grip edges of support plate with hands and rotate clockwise to unlock secondary support plate from secondary power piston.

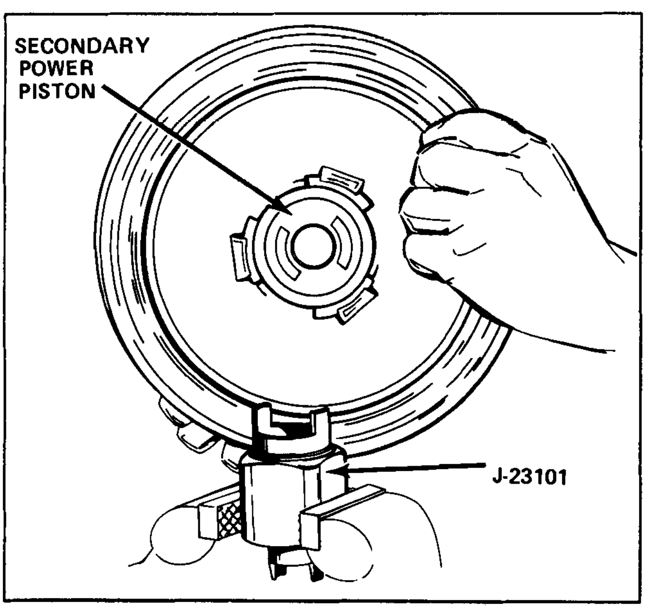


Fig. 5D-10 Preparing to Separate Primary and Secondary Pistons

7. Remove secondary diaphragm from secondary support plate.

8. Remove reaction piston and rubber reaction disc from center of secondary power piston by pushing down on end of reaction piston with a small object,

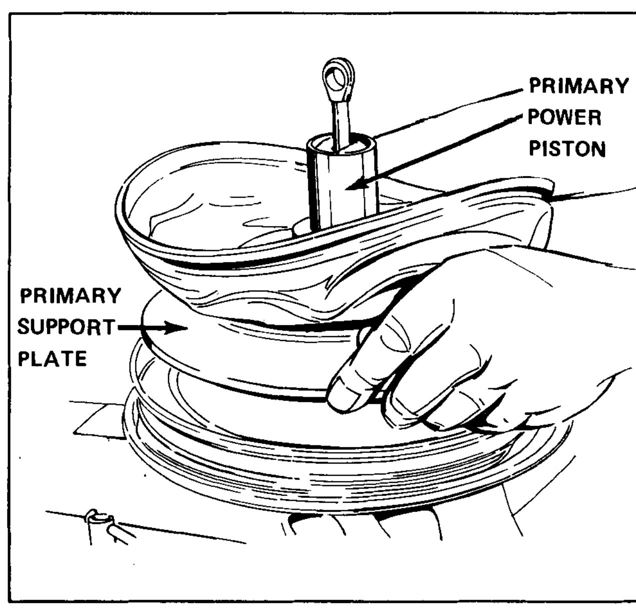


Fig. 5D-11 Removing Primary Power Piston such as a pencil, wooden dowel, or metal rod.

9. Remove air valve spring from end of air valve (if it did not come off during disassembly of power piston).
10. Mount tool J 23101 in vise (with small diameter end up). Position primary power piston so that the two radial slots in piston fit over ears of tool. (Fig. 5D-12)
11. Remove power head silencer from neck of power piston tube.
12. Fold back primary diaphragm from support plate. Grip edge of support plate with hands and rotate in a counterclockwise direction to unlock support plate from power piston.
13. Remove primary diaphragm from primary support plate.
14. Remove air filter and pushrod limiter washer from tubular section of primary piston.
15. Remove rubber reaction bumper from end of air valve.
16. Using snap ring pliers, remove retaining ring from air valve.
17. Remove air valve-pushrod assembly from tube end of primary piston. It is recommended that a round-shanked screwdriver be inserted through the pushrod eye, and using the screwdriver as a handle, pull the air valve-pushrod assembly straight out (Fig. 5D-13).

NOTE: *Removal of the air valve-pushrod assembly will also release the control valve and retainer.*

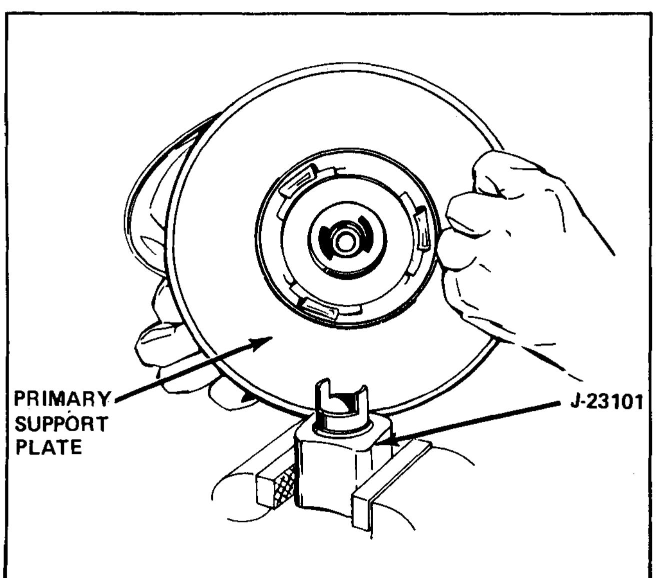


Fig. 5D-12 Preparing to Remove Primary Support Plate

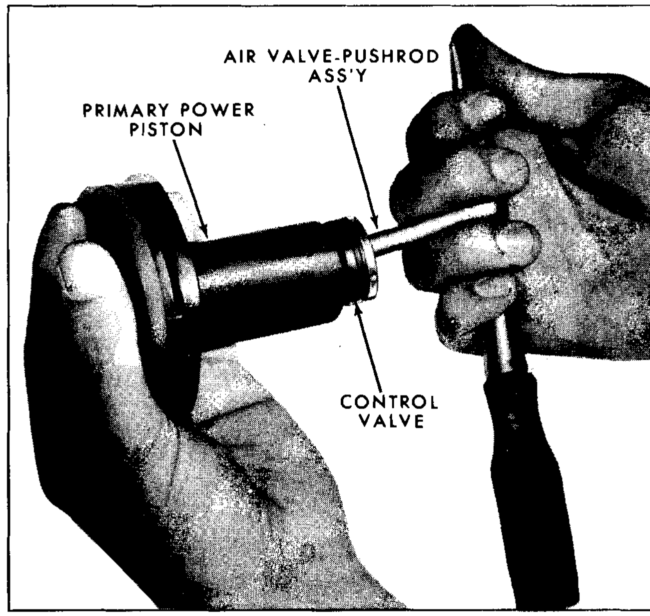


Fig. 5C-13 Removing Air Valve-Pushrod Assembly

18. Remove "O" ring seal from air valve.

NOTE: *The floating control valve cannot be removed from the pushrod - hence, the air*

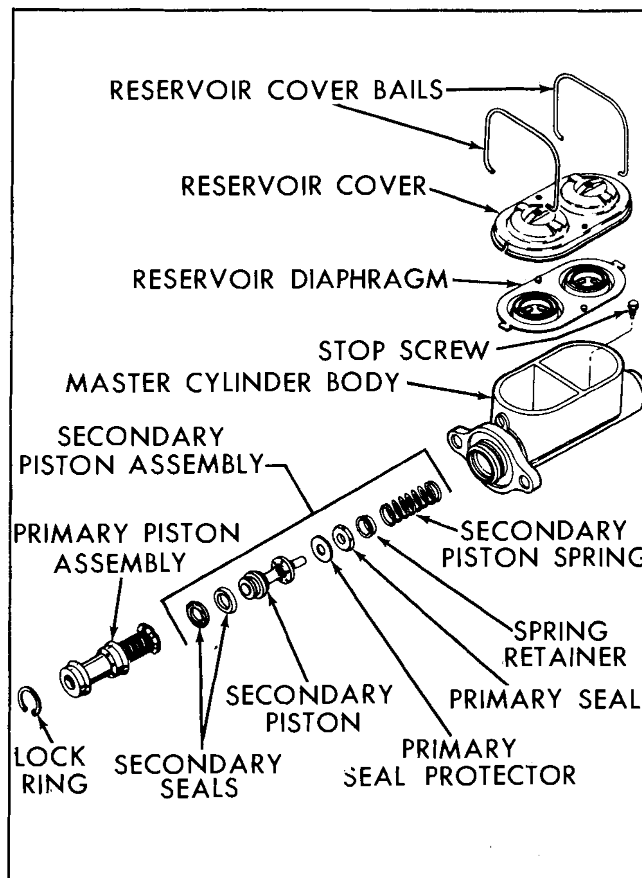


Fig. 5D-14 Master Cylinder - Exploded View *valve-pushrod assembly is serviced as a complete assembly.*

MASTER CYLINDER

DISASSEMBLE (Fig. 5D-14)

Refer to Section 5 - BRAKES-GENERAL for disassembly procedure.

NOTE: *Do not remove front outlet tube seat unless tube seat is damaged and requires replacement.*

INSPECTION AND CLEANING

CAUTION: *It is important that all parts be placed on a clean paper after being cleaned to prevent the possibility of dirt being assembled into unit or grease contacting any rubber parts.*

Thoroughly wash all parts in alcohol and air dry. Blow dust and cleaning fluid out of all internal passages.

POWER BRAKE

INSPECT

Inspect all parts for scoring, pitting, dents or nicks. Small imperfections can be smoothed out with fine emery cloth. Replace if badly nicked, scored or otherwise damaged.

MASTER CYLINDER

INSPECT

Inspect bore from the open end. The bore should be free from scores, deep scratches and corrosion. If it appears that corrosive brake fluid has damaged the bore, replace damaged parts and flush out entire brake system including wheel cylinders.

The sealing surfaces should be clean and smooth. Check for cracks and damaged threads. Be sure that the by-pass and compensating ports to the master cylinder are not restricted.

Check for distortion of all springs and deterioration of all rubber parts. Any evidence of soft or swollen rubber parts indicates contaminated brake fluid requiring flushing of the entire brake system and replacement of wheel cylinder cups, as well as all rubber parts in master cylinder.

AIR FILTER

INSPECT

Replace air filter element if dirty. Do not clean.

MASTER CYLINDER

ASSEMBLE

Refer to Section 5 - BRAKES-GENERAL for assembly procedures.

POWER PISTON

ASSEMBLY (Fig. 5D-9)

1. Lubricate the "O" ring seal with silicone lubricant and place in groove on air valve.

2. Wipe a thin film of silicone lubricant on large and small O.D. of floating control valve.

   NOTE: *If floating control valve requires replacement, it will be necessary to replace the complete air valve-pushrod assembly, since the floating control valve is a component part of this assembly and cannot be removed.*

3. Place the air valve end of the air valve-pushrod assembly into the tube of the primary piston. Manually push the air valve-pushrod assembly until the air valve starts into its bore. Push the control valve assembly into the tube so that the complete control valve is just inside the tube.

4. Insert control valve retainer over end of control valve so that closed side of retainer rests against control valve.

5. Installer tool J 23175 fits the I.D. of the floating control valve retainer. Push floating control valve assemlby to its seat in tube of power piston (Fig. 5D-15).

6. Place pushrod limiter washer over pushrod and position against floating control valve retainer.

7. Stretch the foam filter element over pushrod eye and press into primary power piston tube.

8. Using snap ring pliers, place the retaining ring into groove on air valve (Fig. 5D-16).

9. Position the rubber reaction bumper on end of air valve.

   NOTE: *Tolerances of the component parts af-*

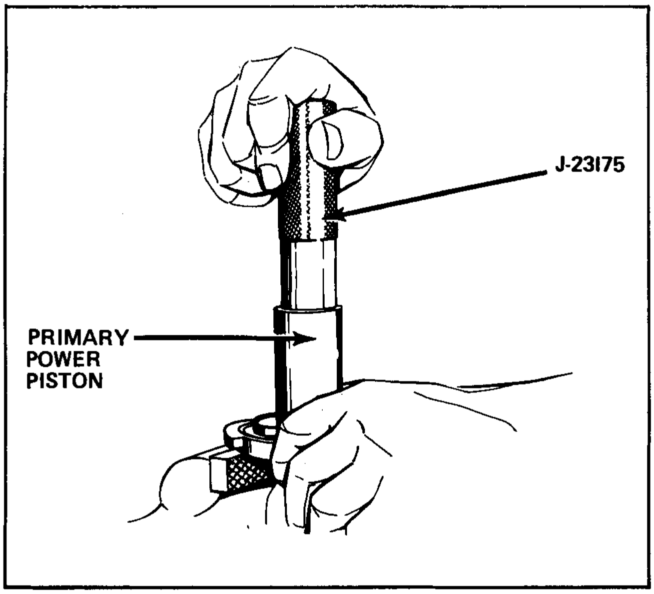


Fig. 5D-15 Installing Control Valve and Retainer

fecting output of the tandem power brake are very critical. In order to maintain correct power brake output, the power piston assembly must be gaged for selective fit of reaction piston whenever the primary power piston and/or secondary power piston are replaced during servicing. This gaging operation is not required if neither power piston is replaced during servicing.

10. The gaging procedure is to be performed as follows:- (Fig. 5D-17).

    a. Hand-tighten the secondary power piston to the primary power piston without installing the air valve spring. (The air valve-pushrod assembly should be secured to the primary power piston as described in step 8.)

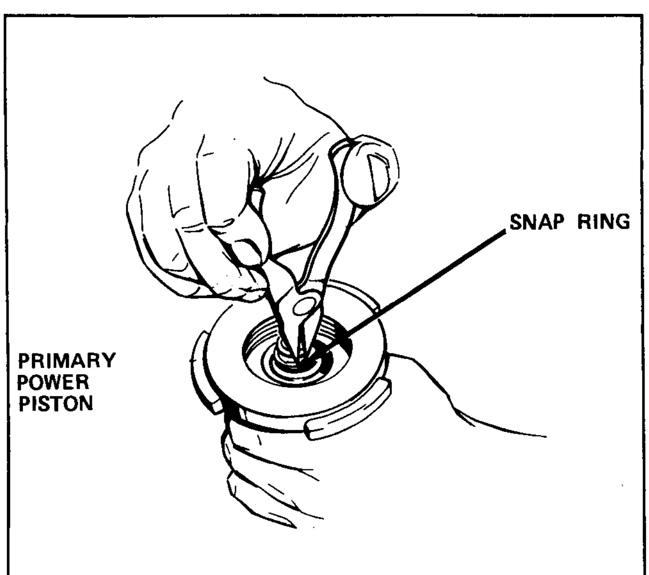


Fig. 5D-16 Installing Snap Ring on Air Valve

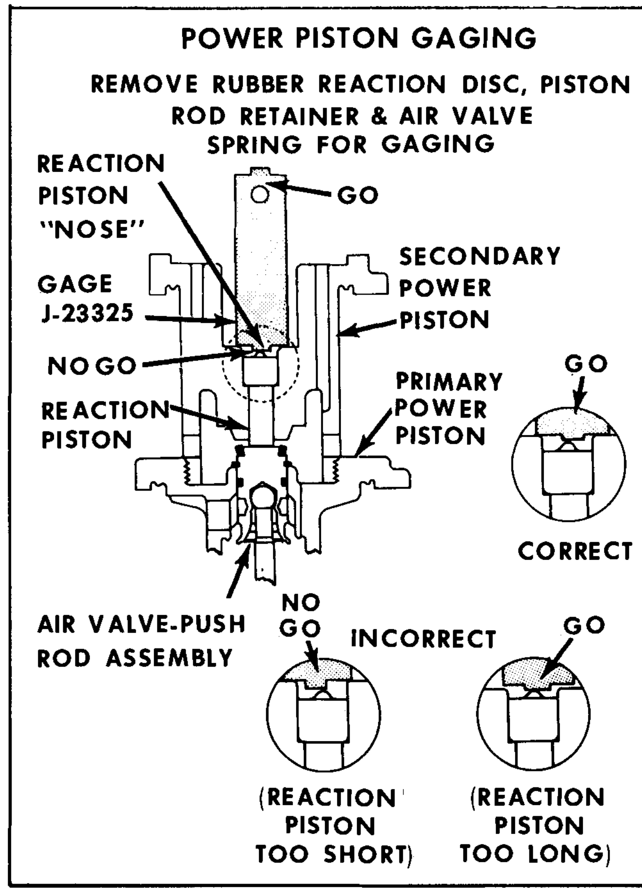


Fig. 5D-17 Gaging Reaction Piston

    b. Insert the reaction piston into its cavity in the secondary power piston. This is accomplished by placing reaction piston, small diameter first, through large cavity and into smaller cavity.

    c. With secondary power piston up, push on reaction piston to insure that it is seated on air valve.

    d. Place gage J 23327 in secondary power piston so that outer edges rest on bottom of large cavity, and center section of gage rests over "nose" of reaction piston. Both ends of gage must be used to perform gaging operation.

    e. Move gage to left or right of "nose" on reaction piston. Reaction piston is correct length if "nose" of piston hits "NO GO" level of gage and clears "GO" level of gage, while outer edges of gage remain seated on larger cavity of secondary power piston.

NOTE: *If reaction piston is too long, "GO" level of gage will not clear "nose" without moving outer edges of gage off the seat in large* *cavity of power piston. If reaction piston is too short, both levels of gage will clear "nose" of reaction piston. If either condition exists, a separate kit of three selective reaction pistons (differeing in length and color) must be obtained to permit use of piston that meets correct size requirements of step (e).*

Care must be taken to insure that gage is not "cocked".

11. After determination of correct reaction piston, apply a light film of silicone lubricant to O.D. of rubber reaction disc, place disc in large cavity of secondary power piston and push disc down to seat on reaction piston.

12. Unlock secondary power piston from primary power piston.

13. Assemble primary diaphragm to primary support plate from side of support plate opposite locking tangs. Press raised flange on I.D. of diaphragm through center hole of support plate. Be sure that edge of support plate center hole fits into groove in raised flange of diaphragm. Lubricate diaphragm I.D. and raised surface of flange (that fits into groove in primary power piston) with light coat of silicone lubricant.

14. Mount Tool J 23101 (small diameter end up) in a vise. Position primary power piston so that the two radial slots in piston fit over ears of tool.

15. Fold primary diaphragm away from O.D. of primary support plate.

16. Holding edges of support plate, with locking tangs down, place primary support plate and diaphragm assembly over tube of primary power piston. Flange on I.D. of primary diaphragm will fit into groove in primary power piston.

17. Grip edges of primary support plate, press down, and rotate clockwise until tabs on primary power piston contact the stops on support plate.

18. Place power head silencer on tube of primary power piston so that holes at base of tube are covered.

19. Apply silicone lubricant to O.D. of primary power piston tube.

20. Remove primary piston assembly from Tool J 23101 and lay it aside.

21. Assemble secondary diaphragm to secondary support plate form side of support plate opposite locking tangs. Press raised flange on I.D. of diaphragm through center hole of support plate. Be sure that edge of support plate center hole fits into groove in raised flange of diaphragm. Apply thin coat of silicone lubricant to I.D. of secondary diaphragm and raised surface of flange (that fits into groove in secondary power piston).

22. Mount Tool J 23101 (with large diameter end up) in vise. Position secondary power piston so that radial slots in piston fit over ears of tool. Apply light coat of silicone lubricant to tube of secondary power piston.

23. Fold secondary diaphragm away from O.D. of secondary support plate.

24. Holding edges of support plate, with locking tangs down, place secondary diaphragm and support plate assembly over tube of secondary power piston. Flange on I.D. of secondary diaphragm will fit into groove in secondary piston.

25. Grip edges of secondary support plate, press down, and rotate counterclockwise until tabs on secondary power piston contact stops on support plate. Fold secondary diaphragm back into position on secondary support plate. Leave the secondary power piston assembly on Tool J 23101 in vise.

26. Apply light coat of talcum powder or silicone lubricant to bead on O.D. of secondary diaphragm. This will facilitate reassembly of front and rear housings.

27. Place secondary diaphragm support ring on secondary power piston assembly so that it rests on edge of diaphragm.

28. Hold housing divider so that formed over flange (that holds the primary diaphragm) of divider faces down. Place secondary bearing in I.D. of divider so that extended lip of bearing faces up.

29. Lubricate I.D. of secondary bearing with silicone lubricant.

30. Position secondary bearing protector Tool J 23188 on threaded end of secondary power piston.

31. Hold housing divider with formed flange (that holds the primary diaphragm) facing up. Press divider down over tool and onto secondary power piston tube where it will rest against diaphragm support ring (Fig. 5D-18). Remove Tool J 23188 from secondary power piston, however, do not remove secondary power piston subassembly from Tool J 23101.

32. Pick up primary power piston assembly and position small end of air valve return spring on air valve so that it contacts air valve retaining ring.

33. Fold primary diaphragm away from O.D. of primary support plate.

34. Position primary power piston on tubular portion of secondary power piston, making sure that air valve

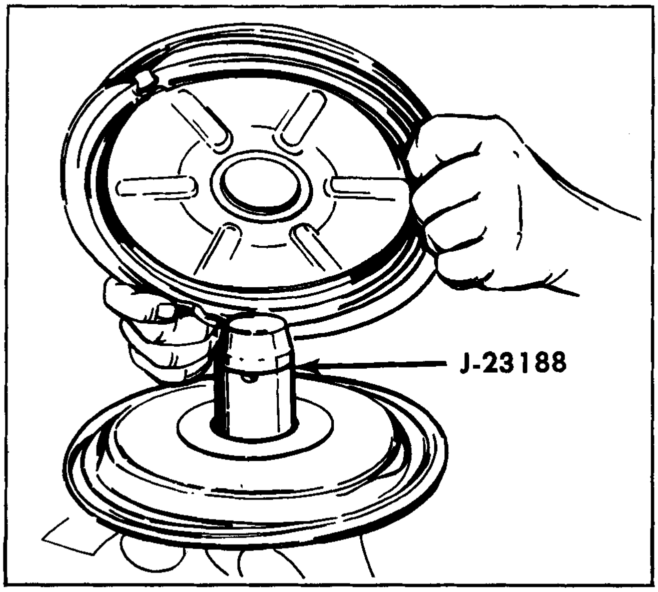


Fig. 5D-18 Installing Housing Divider

return spring seats down over raised center section of secondary piston.

35. Grip edge of primary support plate with hands, press down, and start threads on secondary power piston into threaded portion of primary power piston by rotating in a clockwise direction.

36. Continue to tighten primary power piston until it is securely attached to secondary power piston.

37. Fold primary diaphragm back into position on primary support plate and pull diaphragm O.D. over formed flange of housing divider. Check that bead on diaphragm is seated evenly around the complete circumference. Remove assembly from tool.

38. Wipe thin film of silicone lubricant on O.D. of piston rod retainer. Insert master cylinder piston rod retainer into cavity in secondary power piston so that flat end bottoms against rubber reaction disc in bottom of cavity.

39. Place primary power piston bearing in rear housing center hole so that formed flange of housing center hole fits into groove of primary power piston bearing. Thin lip of bearing will protrude to outside of housing.

40. Coat I.D. of primary power piston bearing with silicone lubricant.

41. If check valve grommet was removed during servicing, replace with new grommet in front housing.

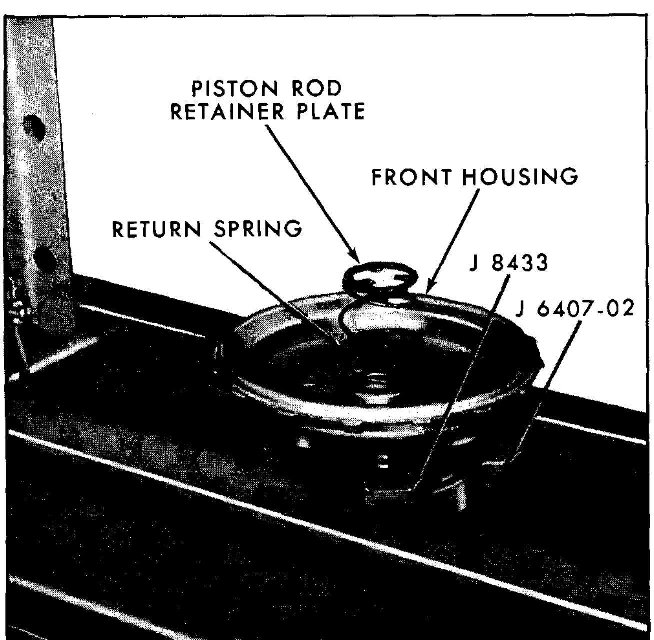


Fig. 5D-19 Securing Front Housing to Arbor Press

POWER CYLINDER

ASSEMBLE

NOTE: *Special Tool BT 7004 or J 23456 (Fig. 5D-7) may be used for housing assembly as an alternate to the following method.*

1. Secure power section front housing to tools J 8433 and J 6407-02 as shown in Fig. 5D-19.

2. Secure front housing to arbor press (Fig. 5D-19).

3. Position power piston return spring over inset in front housing.

4. Place piston rod retainer plate on end of power piston return spring in front housing.

5. Assemble power piston group to rear housing by pressing tube of primary power piston through rear housing bearing. Press down until housing divider seats in rear housing and primary power piston bottoms against housing.

6. Assemble rear housing to spanner wrenches J 9504 as shown in Fig. 5D-20.

7. Hold rear housing assembly (with mounting studs up) over front housing, so that scribe marks will be aligned when housings are locked together.

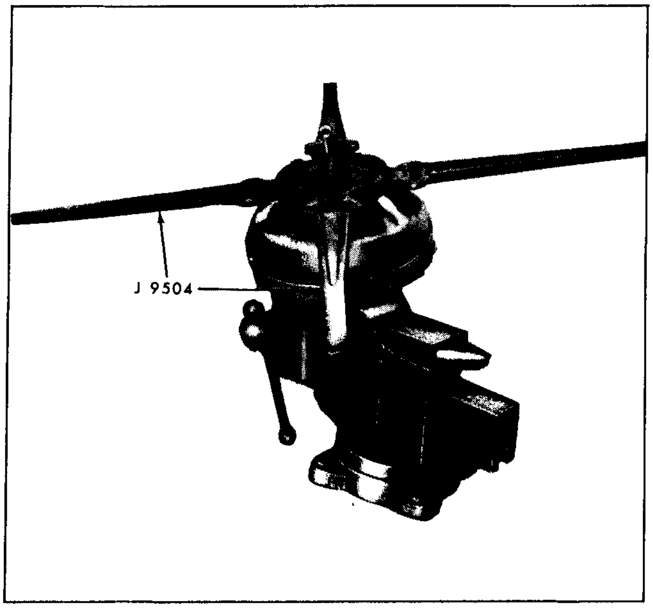


Fig. 5D-20 Securing Rear Housing to Tools

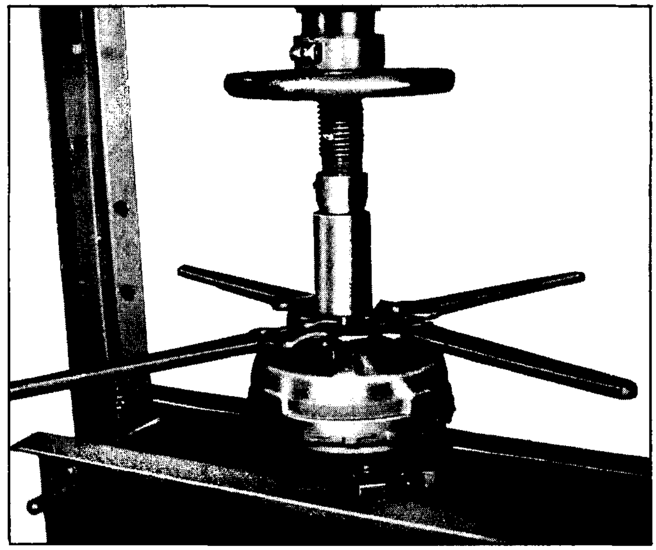


Fig. 5D-21 Joining Front and Rear Housings

NOTE: *While joining the housings, care must be taken to assure that the piston rod retainer plate is centered on the piston rod retainer.*

CAUTION: *Do not compress assembly to the point of damaging power unit.*

8. Slowly compress assembly keeping in a parallel plane (Fig. 5D-21).
9. When front and rear housings are mated, rotate spanner wrenches until housings are locked together.
10. Release pressure from assembly and remove all tools from unit.
11. Place front housing seal in cavity of front housing, making sure flat surface of cup lies against bottom of depression in housing.
12. Place felt silencer in dust boot, and push to closed end. Insert boot retainer over boot. Stretch boot over pushrod and over flange in center of rear housing.

GAGING PROCEDURE (Fig. 5D-22)

1. Place power cylinder assembly in padded vise (front housing up). DO NOT CLAMP TIGHT
2. Insert master cylinder piston rod, flat end first, into piston rod retainer.
3. Press down on master cylinder piston rod to assure that it is properly seated.
4. Place gage J 22647 over piston rod in a position which will allow gage to be slipped to the right or left without contacting the studs (Fig. 5D-22).

NOTE: *GAGING IS TO BE PERFORMED WITHOUT VACUUM*

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.

Any variation beyond these two limits must be compensated for by obtaining the service adjustable pushrod, and adjusting the self-locking screw to meet gaging specifications.

POWER CYLINDER ONLY

INSTALL

CAUTION: *See caution on Page 1 of this section regarding fasteners referred to in Steps 1 and 2 below.*

1. Mount power cylinder to dash. Install four power unit to dash attaching nuts. Torque nuts to 24 lb. ft.
2. Attach pushrod "eye" to pedal arm pin with retainer clip.
3. Position master cylinder over attaching studs and install two nuts. Torque nuts to 25 lb. ft.
4. Install vacuum hose and vacuum check valve.
5. Check stop light switch adjustment (see Section 5).

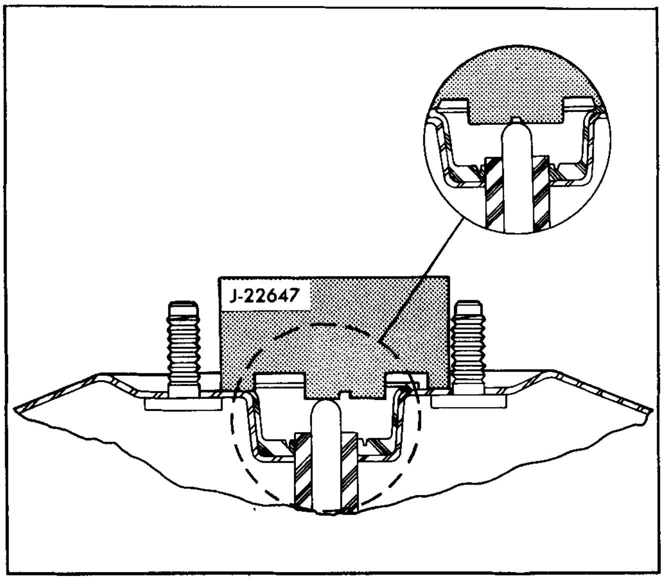


Fig. 5D-22 Gaging Master Cylinder Piston Rod

MASTER CYLINDER ONLY

INSTALL

CAUTION: *See caution on Page 1 of this section regarding fasteners referred to in Step 1 below.*

1. Position master cylinder on power cylinder studs. Secure master cylinder with two nuts; torque to 25 lb. ft.

2. Attach hydraulic fluid lines.

3. Fill master cylinder reservoirs and bleed brakes as described in Section 5.

TORQUE SPECIFICATIONS

	LB. FT.
Power Cylinder to Master Cylinder Attaching Nuts	25
Power Cylinder to Dash Attaching Nuts	24

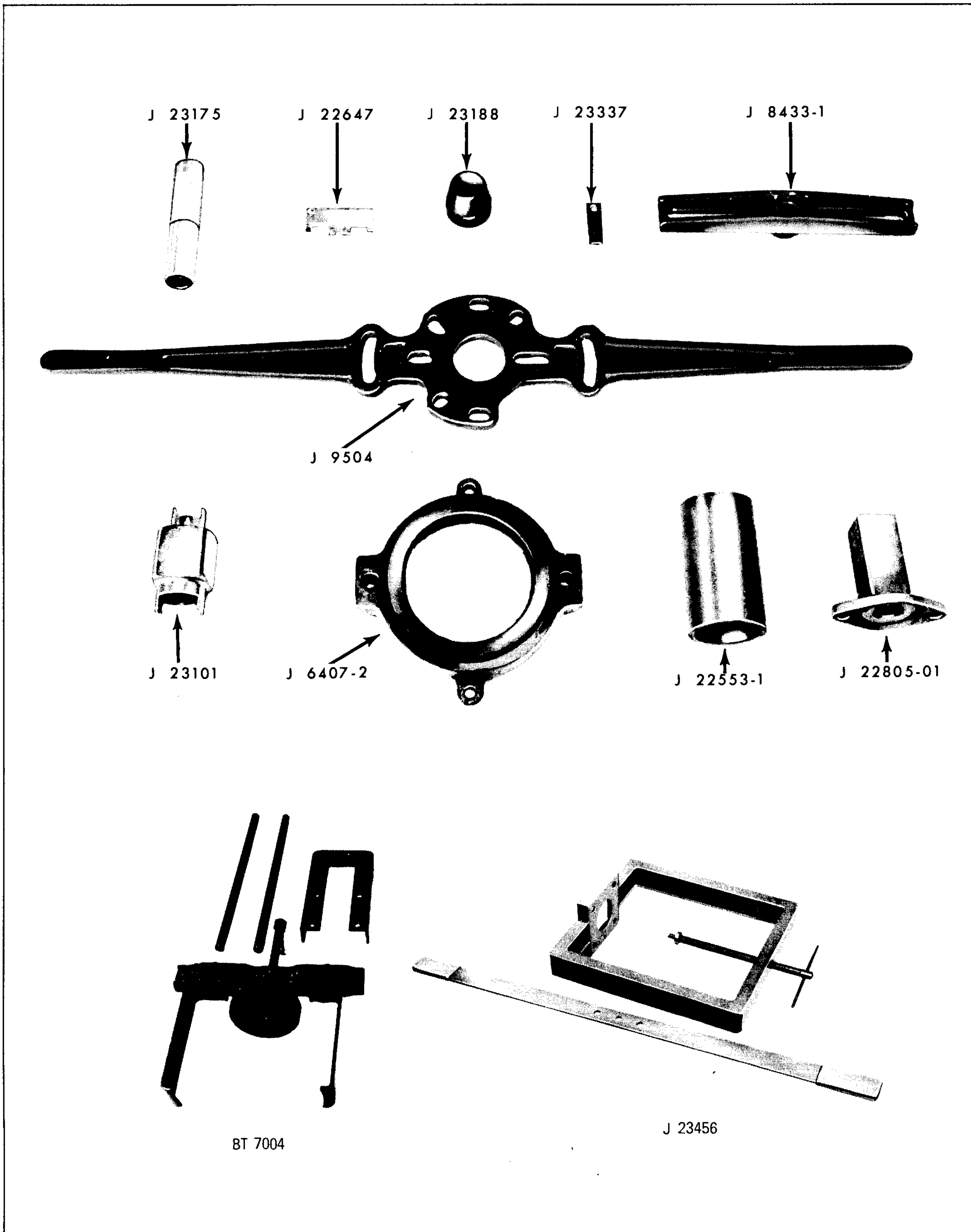


Fig. 5D-23 Special Tools

SECTION 5E

DISC BRAKES

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

TROUBLE DIAGNOSIS AND TESTING

Since the car is equipped with drum-type rear brakes, also refer to Section covering drum brakes to diagnose brake problems.

TESTING PROPORTIONING VALVE

Premature rear wheel lock-up may be caused by a malfunction of the proportioning valve section of the combination valve. This portion of the valve may be tested as follows:

1. Remove brake pipes and install suitable pressure gauge at outlet to rear brakes (Fig. 5E-23).
2. Install "T" fitting on pipe to master cylinder. Connect one outlet of "T" to rear brake outlet and the other to a suitable pressure gauge.
3. Have brakes applied and compare inlet and outlet pressure readings.
4. When inlet pressure is 500 p.s.i., outlet pressure should be 415-460 p.s.i. When inlet pressure is 600 p.s.i., outlet pressure should be 455-460 p.s.i.
5. If a malfunction exists, the entire combination valve must be replaced.

EXCESSIVE PEDAL TRAVEL (Low Pedal)

CAUSE	CORRECTION
1. Master cylinder fluid level low.	1. Fill to proper level with approved fluid.

Cause	Correction
2. Poor quality brake fluid (low boiling point) in system.	2. Drain hydraulic system and fill with approved fluid.
3. Air in hydraulic system.	3. Bleed hydraulic system and refill with approved fluid.
4. Hoses soft or weak (expanding under pressure).	4. Replace defective hoses.
5. Caliper seals soft or swollen.	5. Drain hydraulic system, flush system with alcohol and replace all cups and seals in complete brake system.

HARD PEDAL (Excessive Pedal Pressure Needed to Stop Vehicle)

CAUSE	CORRECTION
1. Power brake malfunctioning.	1. Check and repair power unit.
2. Linings soiled with brake fluid, oil or grease.	2. Replace shoes and linings.
3. Lines, hoses or connections dented, kinked, collapsed or clogged.	3. Repair or replace defective parts.
4. Master cylinder cups swollen.	4. Drain hydraulic system, flush system with brake fluid and replace all cups and seals in complete brake system.
5. Master cylinder bore corroded or rough.	5. Repair or replace master cylinder.
6. Caliper pistons frozen or seized.	6. Disassemble caliper and free up pistons (replace if necessary).
7. Caliper cylinder bores corroded or rough.	7. Disassemble caliper and remove corrosion or roughness, or replace caliper.
8. Pedal push rod and linkage binding.	8. Free up and lubricate.
9. Metering valve not working.	9. Replace combination valve.

GRABBING OR PULLING (Severe Reaction To Pedal Pressure and Out of Line Stops)

CAUSE	CORRECTION
1. Linings soiled with brake fluid, oil or grease.	1. Replace shoes and linings.
2. Caliper loose.	2. Tighten caliper mounting bolts to specified torque.
3. Lines, hoses or connection dented, kinked, collapsed or clogged.	3. Repair or replace defective parts.
4. Master cylinder bore corroded or rough.	4. Repair or replace master cylinder.
5. Caliper pistons frozen or seized.	5. Disassemble caliper and free up pistons (replace if necessary).
6. Caliper cylinder seals soft or swollen.	6. Drain hydraulic system, flush system with brake fluid and replace all cups and seals in complete brake system.
7. Caliper cylinder bores corroded or rough.	7. Disassemble caliper and remove corrosion or roughness, or replace caliper.
8. Pedal linkage binding (and suddenly releasing).	8. Free up and lubricate linkage.
9. Metering valve not functioning properly.	9. Replace combination valve.

FADING PEDAL (Pedal Falling Away Under Steady Pressure)

CAUSE	CORRECTION
1. Poor quality brake fluid (low boiling point) in system.	1. Drain hydraulic system and fill with approved fluid.
2. Hydraulic connections loose; lines or hoses ruptured (causing leakage).	2. Tighten or replace defective parts.

Cause	Correction
3. Master cylinder primary cup worn or damaged.	3. Repair master cylinder.
4. Master cylinder bore corroded, worn or scored.	4. Repair or replace master cylinder.
5. Caliper cylinder seals worn or damaged.	5. Replace seals.
6. Caliper cylinder bores corroded, worn or scored.	6. Disassemble caliper and remove corrosion or scoring, or replace caliper.
7. Bleed screw open.	7. Close bleed screw and bleed hydraulic system.

NOISE AND CHATTER (May Be Accompanied By Brake Roughness and Pedal Pumping)

CAUSE	CORRECTION
1. Disc has excessive lateral runout.	1. Replace or machine disc.
2. Disc has excessive thickness variations (out of parallel).	2. Replace or machine disc.
3. Disc has casting imperfections.	3. Replace disc.
4. Car creeping or moving slowly with brakes applied (may produce groan or crunching noise).	4. Increase or decrease pedal effort slightly.
5. Squeal, during application.	5. A small amount of high-pitches squeal is inherent in disc brake design and must be considered normal.

DRAGGING BRAKES (Slow or Incomplete Release of Brakes)

CAUSE	CORRECTION
1. Lines, hoses or connections dented, kinked, collapsed or clogged.	1. Repair or replace defective parts.
2. Master cylinder compensating port restricted by swollen primary cup.	2. Drain hydraulic system, flush system with brake fluid and replace all cups and seals in complete brake system.
3. Residual pressure check valve in lines to front wheels.	3. Remove check valve.
4. Caliper pistons frozen or seized.	4. Disassemble caliper and free up pistons (replace if necessary).
5. Caliper cylinder seals swollen.	5. Drain hydraulic system, flush system with clean brake fluid and replace all cups and seals in complete brake system.
6. Caliper cylinder bores corroded or rough.	6. Disassemble caliper and remove corrosion or roughness, or replace caliper.
7. Hydraulic push rod on power brake out of adjustment or binding (causing primary cup to restrict master cylinder compensating port).	7. Adjust or free up and lubricate.

GENERAL DESCRIPTION

The single piston, sliding caliper, disc brake (Fig. 5E-1) is standard equipment on all B, F and G Series models and optional on the A Series. In addition, B and G Series vehicles are equipped with power assist as standard equipment.

The caliper assembly is constructed from a single casting which contains one large piston bore in the inboard section with a fluid inlet hole and bleeder valve hole connecting directly to the piston bore.

The cylinder contains a piston and seal. A seal groove is machined into the sidewall of the piston bore. The groove is machined, so that it is shallower toward the bottom of the piston bore. The purpose of this is to put more compression on the edge of the square cut seal which faces the brake fluid pressure. The seal is located in the groove and fits around the outside diameter of the piston to provide a hydraulic seal between the piston and cylinder wall.

The top of the piston bore is counterbored to accept a sealing dust boot. The dust boot contains a metal retainer as a part of the boot. The retainer part of the boot is pressed into the recess in the top of the piston bore. The inside diameter of the boot fits into a groove which is machined in the piston.

The piston is formed from steel, precision ground and nickle-chrome plated, giving it a very hard and durable surface. The use of abrasives or any attempt to re-machine the piston will destroy the plating.

The machined caliper casting has two mounting holes at each end of the caliper. The holes in the inboard ears are larger in diameter than the holes in the outboard ears.

Sleeves and rubber bushings are assembled through the two large holes in the inboard ears.

The caliper on A and G Series models is attached to a support bracket mounted on the suspension. Bolts are inserted through the sleeves, support bracket, under the ears on the inboard shoe and through the outboard ears on the caliper. The bolt threads engage tapped holes in the support bracket and the bolt heads are tightened against the ends of the sleeves. The caliper on B, F and X Series mounts directly to an integral one piece steering knuckle and brake caliper support (Fig. 5E-18). There is, therefore, no separate mounting braket on these models. The caliper is free to slide on the sleeves at the inboard ears and on the bolt at the outboard ears.

The shoe and lining assemblies are constructed of a stamped metal shoe with riveted lining.

The rotor is a cast iron ventilated type with two machined braking surfaces separated by fins.

OPERATION

The Significant feature of the single piston caliper operation is that it is free to slide on the two mounting bolts which thread into the support bracket. Lining wear is automatically compensated for by this sliding caliper feature. Fig. 5E-2 shows a simplified cross section of the caliper, with both new and worn linings, and the forces at work when the brakes are applied.

Upon application of the brakes, pressure is exerted equally against the bottom of the piston and the bottom of the piston bore. The pressure applied to the piston is transmitted to the inboard shoe and lining, forcing the lining against the inboard rotor surface. The pressure applied to the bottom of the piston bore forces the caliper to slide or move on the mounting bolts toward the inboard side, or toward the car. Since the caliper is one piece, this movement toward the car causes the outboard section of the caliper to apply pressure against the back of the outboard shoe and lining assembly, forcing the lining against the outboard rotor surface.

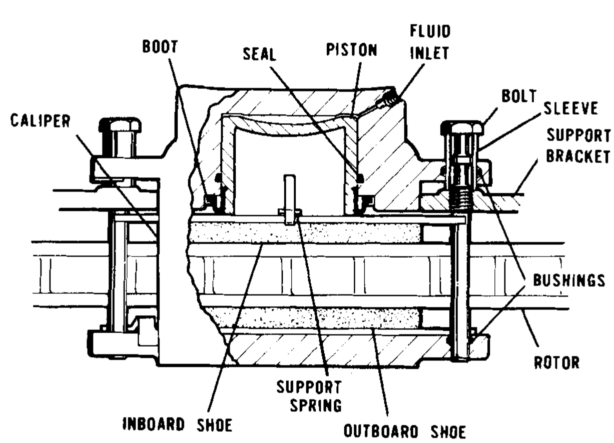


Fig. 5E-1 Disc Brake Assembly

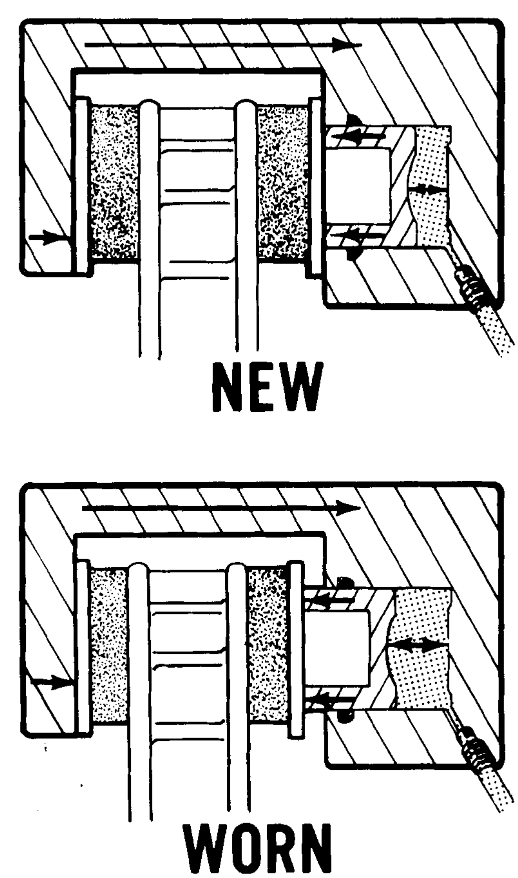


Fig. 5E-2 Simplified Single-Piston Disc Brake

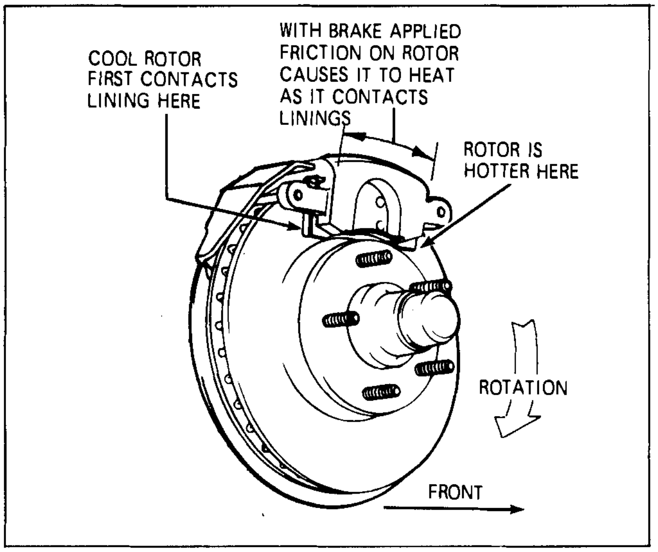


Fig. 5E-3 Disc Brake Heat Patterns

In actual practice the application and release of the brake pressure causes a very slight movement of the piston and claiper. Upon release of the braking effort, the piston and claiper merely relax into a released positon. The shoes do not retract any appreciable distance from the rotor surfaces.

As the brake lining wears, the piston moves out of the caliper bore and the caliper repositions itself on the mounting bolts. In this manner, disc brakes are self-adjusting.

Some inherent features of disc brakes are:

1. They are self-adjusting.
2. They are less subject to fade than are drum brakes because heat expansion pushes the rotor into, rather than away from the linings.
3. The centrifugal force of the spinning rotor allows the disc to throw off water.
4. Disc brakes are less subject to pull because they do not have the inherent self-energizing feature of drum brakes.

Disc-Brake Pad Wear

Disc brake linings normally wear more in the front of the lining than in the back (tapered wear). This is due to the presence of greater heat in the front as illustrated in Fig. 5E-3. The rate and the type of wear will vary considerably with driving conditions.

COMBINATION VALVE

A two function or three function combination valve is used on all cars equipped with disc brakes. The two function combination valve, used on station wagon models and all B Series vehicles, combines the functions of the front brake metering (hold-off) valve and distributor switch (the hydraulic differential pressure switch) into a single housing. In addition to the above two functions, the three

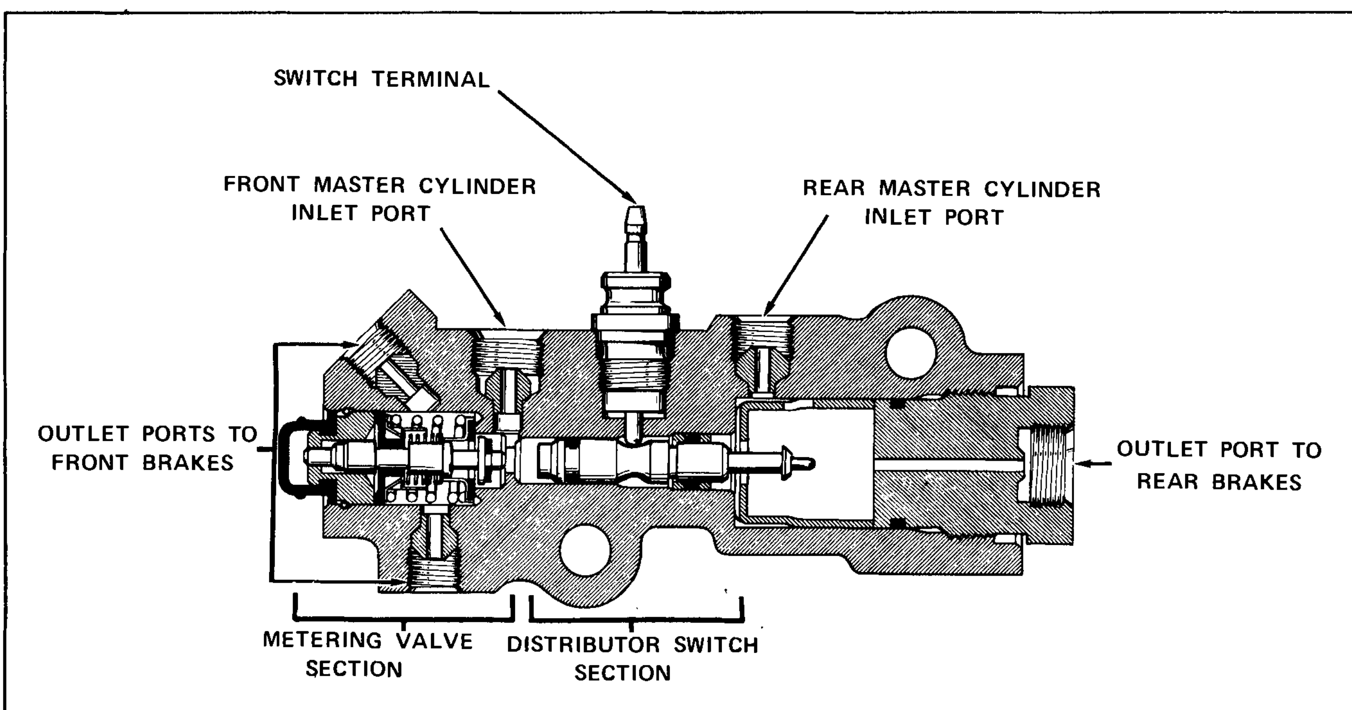


Fig. 5E-4 Cross Section of Two Function Combination Valve

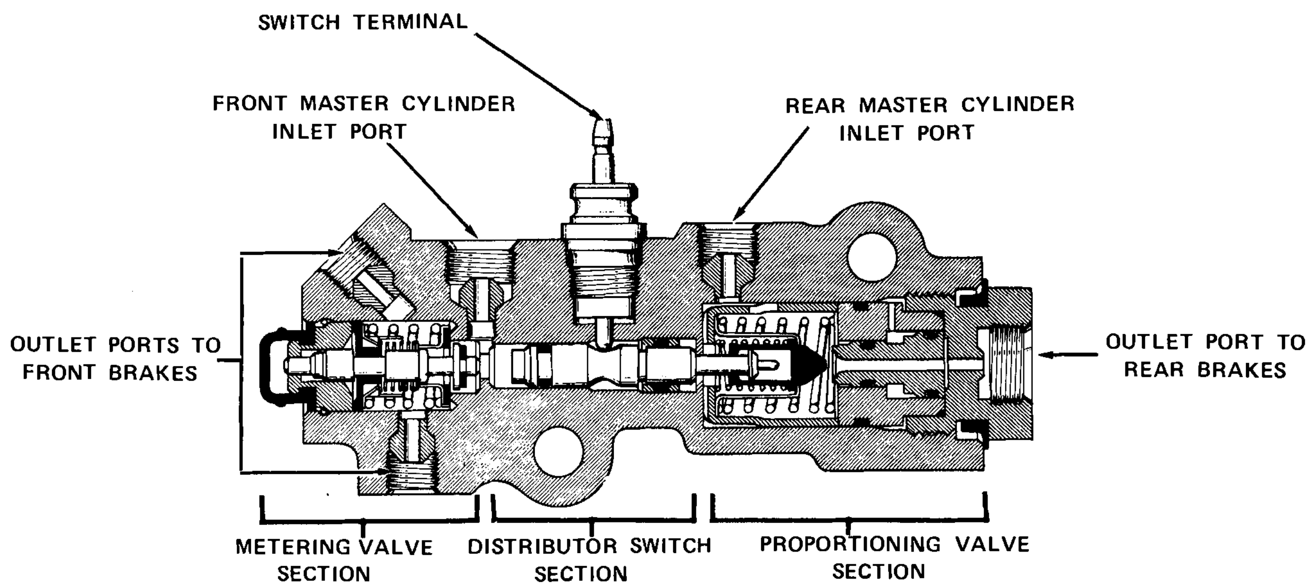


Fig. 5E-5 Cross Section of Three Function Combination Valve

function combination valve (which is used on all disc brake equipped vehicles other than station wagons and B Series cars) incorporates the rear brake pressure proportioning valve in the same housing. The two combination valves are physically identical, except that the parts of the proportioning section are omitted from the two function valve. A cross section of each valve is shown in Figures 5E-4 and 5E-5. The combination valve is mounted on the left front side rail of the frame on all but the F and X Series vehicles, where it is mounted on a bracket immediately below the master cylinder. A wiring harness connects the electrical terminal of the distributor switch to the brake warning light on the instrument panel.

OPERATION

The metering valve (hold-off) section prevents front brake application until 110-150 p.s.i. pressure has built up in the hydraulic system, so that the rear drum brake linings contact the drum at the same time the front disc brakes apply braking pressure to the discs. The metering valve allows free flow of brake fluid when the brakes are not applied (below 3 p.s.i.). Upon brake application, flow restriction is maintained until hydraulic pressure reaches the range of 440-750 p.s.i., at which time the valve permits unrestricted flow of hydraulic pressure.

The Distributor Switch (or Failure Warning Switch) is activated when there is a failure in either the front or rear brake systems and, when activated, completes a circuit to the brake warning lamp in the instrument panel. The switch is designed to compare front and rear brake pressure and is activated at 100 p.s.i. minimum to 300 p.s.i. maximum pressure differential. When activated, the switch latches in the "on" position and can be turned off only when the failure has been repaired and an equal pressure in each of the hydraulic systems of 450 p.s.i. is applied. After the repair is completed, the switch can be reset by applying moderate pressure on the brake pedal with the engine running (to get power assist).

The Proportioning section (included in all combination valves except those used on station wagons) proportions pressure to the rear brakes after a pre-determined line pressure has been reached. This prevents rear wheel lock up on vehicles with light rear wheel loads or upon high deceleration stops when a percentage of the weight over the rear wheels is transferred forward. The proportioner does not operate during normal brake stops. The valve is also designed to provide a "by-pass" feature which assures full pressure to the rear brake system in the event of a front brake system failure.

The combination valve is a non-serviceable unit and, as such, the complete assembly must be replaced should a failure occur in any portion of the valve.

SERVICE

LINING INSPECTION

Complete disc brake system inspections should be performed at least every 12000 miles. Need for future service should be estimated at this time. Particular attention should be paid to disc brake lining wear. If the lining wears too thin the rivets may cut into the rotor and repairs will be unnecessarily extensive.

NOTE: *Inspect disc brake linings every 6,000 miles.*

In addition, inspect the brake linings 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 (Fig. 5E-6). 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 it 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 within 1/8" of the metal shoe, all shoe and lining assemblies on both sides should be replaced.

NOTE: *Wheel must be removed to inspect lining.*

SHOE AND LINING REPLACEMENT

NOTE: *When replacing shoe and lining assemblies on disc brake vehicles after mileage accumulation it is sometimes necessary to rebuild the caliper due to rust and corrrosion build up behind the piston. The thickness of the new linings forces the piston back into the rusted areas which may cause the piston to stick in the bore.*

CALIPER

REMOVE

1. Remove two thirds of the total fluid capacity from the front master cylinder reservoir. 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.

   NOTE: *Removal of the fluid is necessary to prevent reservoir overflow when the caliper piston is pushed back in its bore during lining replacement.*

2. Raise the car and remove the wheel covers and wheel assemblies.

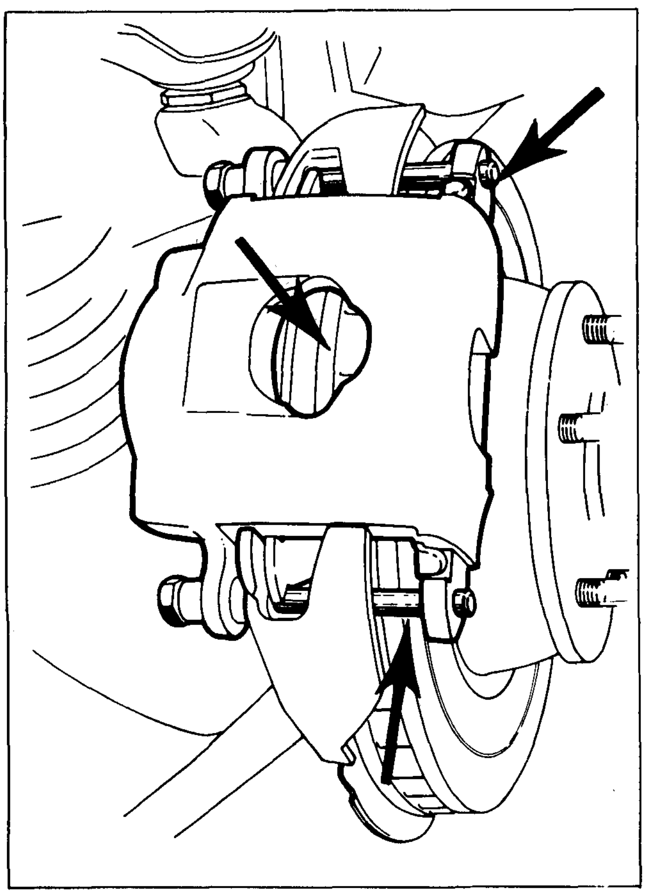


Fig. 5E-6 Lining Inspection

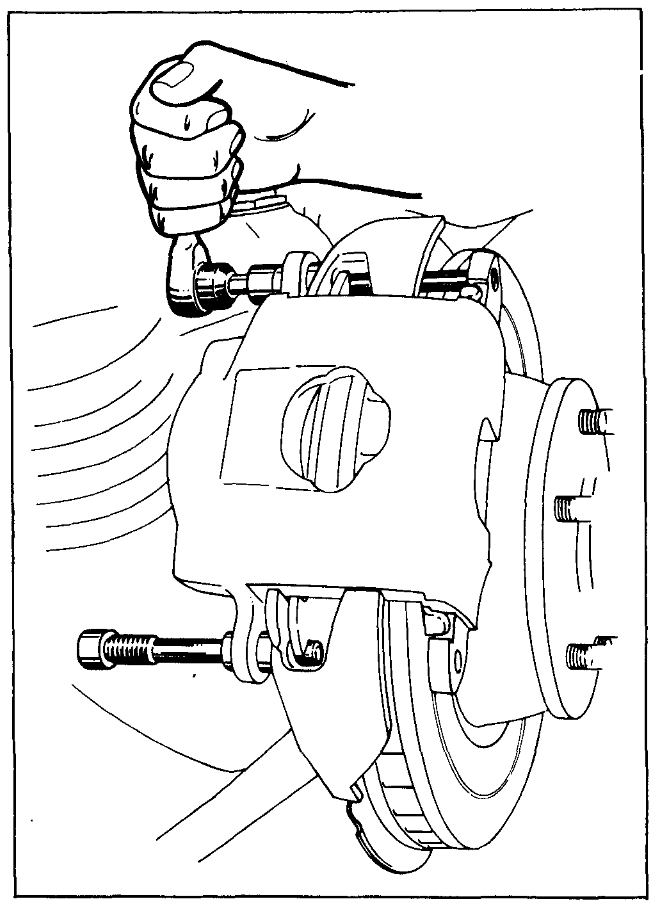


Fig. 5E-7 Removing Mounting Bolts

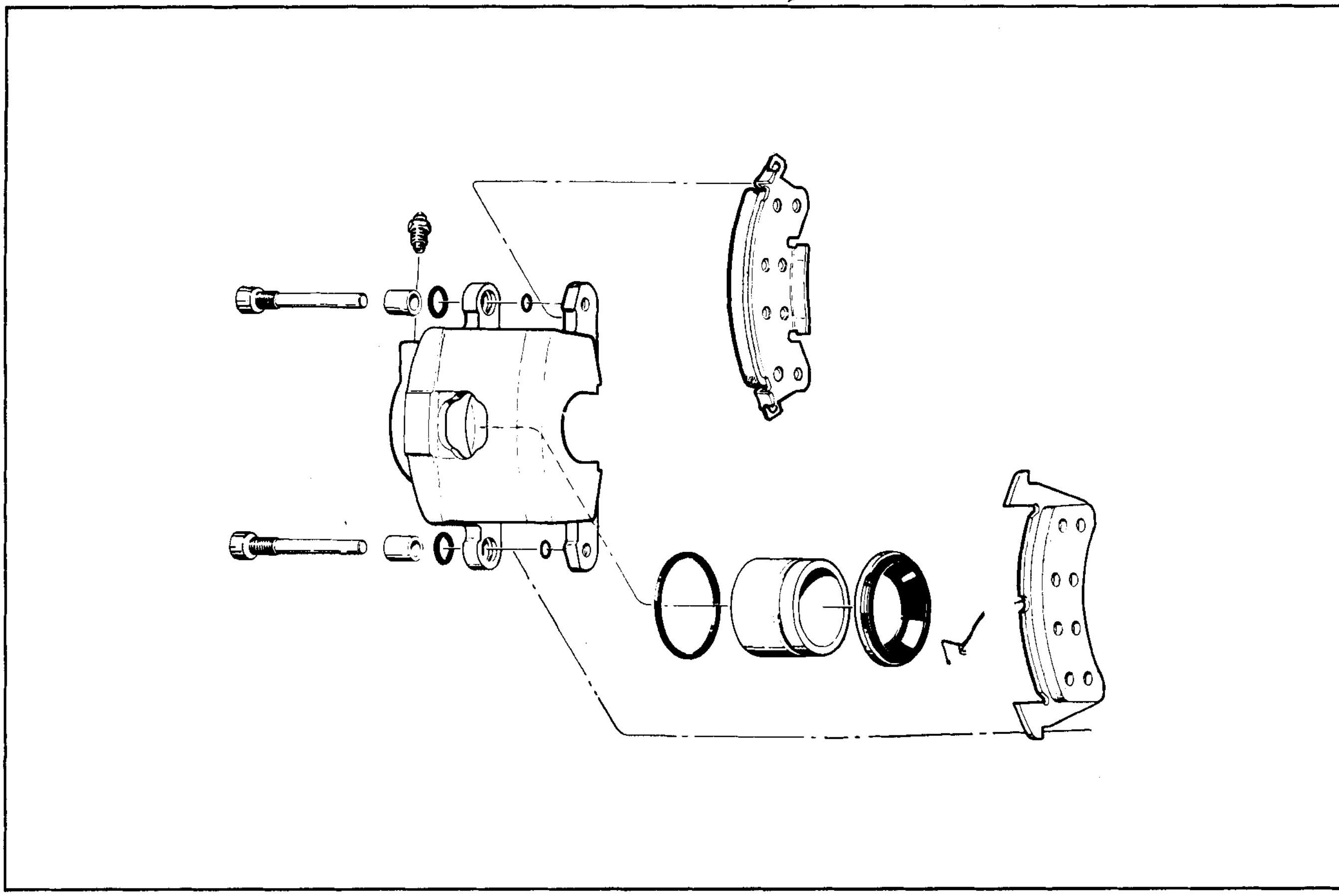


Fig. 5E-8 Exploded View of Caliper

3. Using a suitable lever, move caliper outboard as far as possible by prying against the back of the caliper (Fig. 10-11). This will push the piston to the bottom of the piston bore.

4. Remove the two mounting bolts which attach the caliper to the support bracket or steering knuckle (Fig. 5E-7).

   NOTE: *It is not necessary to disconnect the brake hose for shoe lining replacement.*

5. Lift the caliper off the rotor using equal force on each end to prevent it from binding at the mounting bracket flanges. Do not force caliper if it becomes cocked. Dislodge both shoes and position the caliper on the front suspension arm so that the brake hose does not support the weight of the caliper.

6. Transfer the inboard shoe anti-rattle spring to the new shoe and lining assembly.

7. Using hand pressure, push the sleeves from the inboard ears of the caliper. Next, remove the rubber bushings from the grooves in each of the four caliper ears (Fig. 5E-8). Discard these parts, new ones are provided with new linings.

CLEANING AND INSPECTION

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 must be replaced.

Examine the piston boot for evidence of fluid leakage. If leakage is noted, the caliper should be overhauled. (See Caliper - Overhaul.) 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 (Fig. 5E-9).

CAUTION: *Do not use compressed air to clean the inside of the caliper since this may cause the dust boot to become unseated.*

If the vehicle has a brake problem and diagnosis points to the rotor, it should be inspected and checked for runout and parallelism at this time (See Rotor Service).

INSTALL

1. Using a high quality silicon lubricant, lubricate the

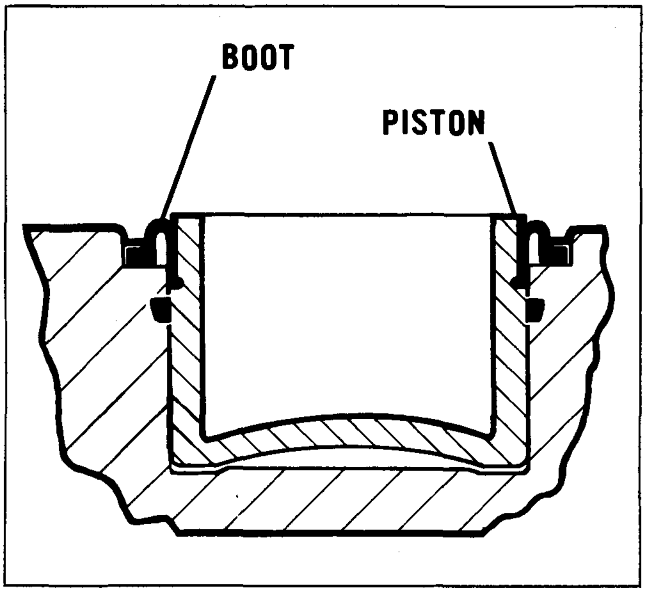


Fig. 5E-9 Boot Installation

new sleeves on all surfaces. Lubricate the new rubber bushings, bushing grooves and the small ends of mounting bolts (Fig. 5E-10). Install rubber bushings in all four caliper ears.

CAUTION: *It is essential that* **new** *sleeves and rubber bushings be used and that lubrication instructions be followed in order to insure the proper functioning of the sliding caliper design.*

2. Use hand pressure to install the sleeves. Position the sleeves so that the end toward the shoe and lining assemblies is flush with the machined surface of the ear.

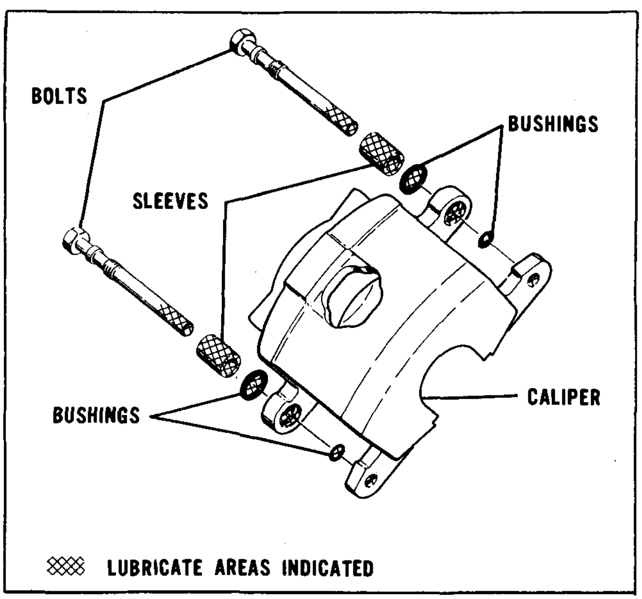


Fig. 5E-10 Lubrication Points

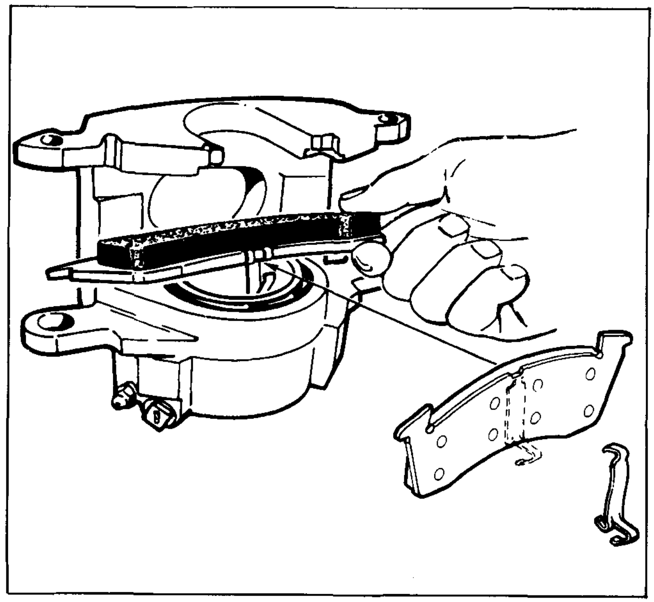


Fig. 5E-11 Shoe Support Spring

3. Install shoe support spring by placing the single tang end over the notch on the top edge of the inboard shoe. Press the double tangs over the bottom edge of the shoe. Position shoe in caliper (Fig. 5E-11). Press down on ends of shoe until it rests on piston.

4. 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 (Fig. 5E-12).

5. With both shoes installed, position the caliper so it will enter the mounting bracket without binding. Do not force caliper if it becomes cocked. Allow the

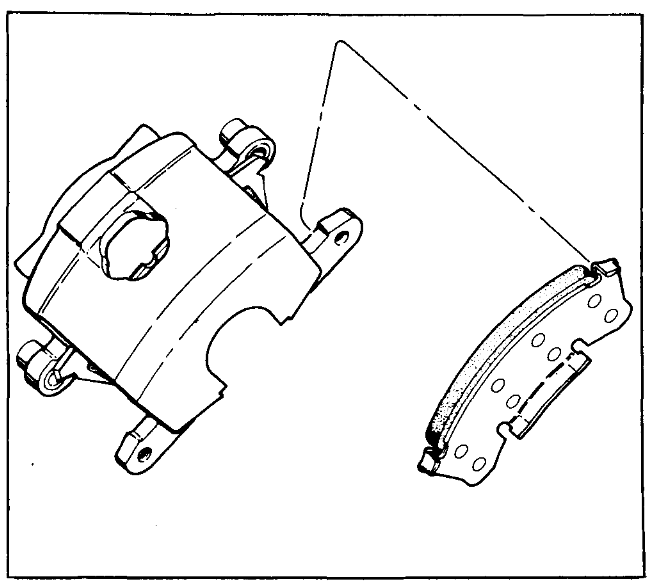


Fig. 5E-12 Installing Outboard Shoe

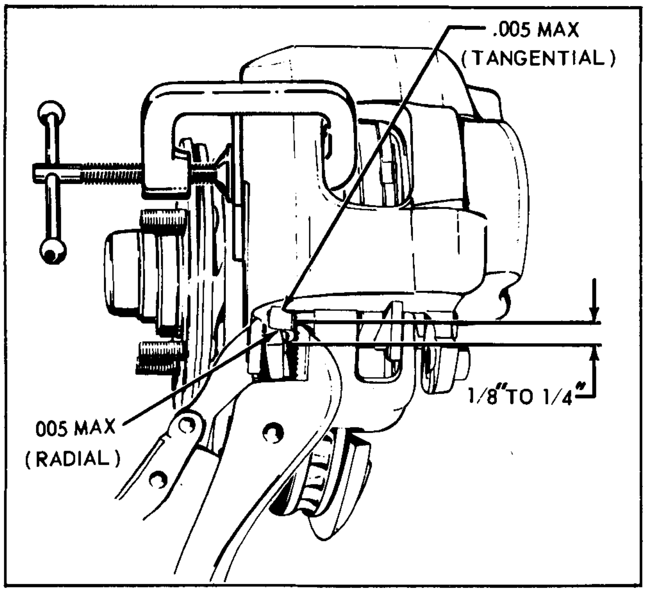


Fig. 5E-13 Clinching Outboard Shoe

bottom edge of the outboard lining to rest on the outer edge of the rotor and make sure that there is no clearance between the tab at the bottom of the outboard shoe and the caliper abutment. Clamp the outboard shoe to the caliper with moderate pressure using a 1/4" thick metal bar to bridge the caliper cut-out (Fig. 5E-13). Use a clean C clamp to avoid contamination of the brake lining and do not use excessive force which may deform the lining face.

Using gripping pliers, clinch both upper ears of the outboard shoe. Locate the pliers 1/8 to 1/4 inch from the outer edge of the shoe ear (Fig. 5E-13). After clinching, the tangential and radial clearance between the caliper and the shoe ears should not exceed 0.005 inch in either direction. Re-adjust the pliers and repeat the clinching procedure if necessary.

NOTE: *Brake rattle or click on application may occur if shoes are not properly clinched.*

6. After clinching, remove the C clamp and position the caliper over the rotor, lining up the holes in the caliper ears with the holes in the mounting bracket.

   NOTE: *Make sure that the brake hose is not twisted or kinked and that the skirt of the metal fitting which attaches to the caliper is installed BETWEEN the ears on the caliper boss as shown in Fig. 5-19.*

7. Start the bolts through the sleeves in the inboard caliper ears and the mounting bracket, making sure that the ends of the bolts pass under the retaining ears on the inboard shoe (Fig. 5E-14).

   CAUTION: *See caution on Page 1 of this section regarding fasteners referred to in Steps 8 and 9 below.*

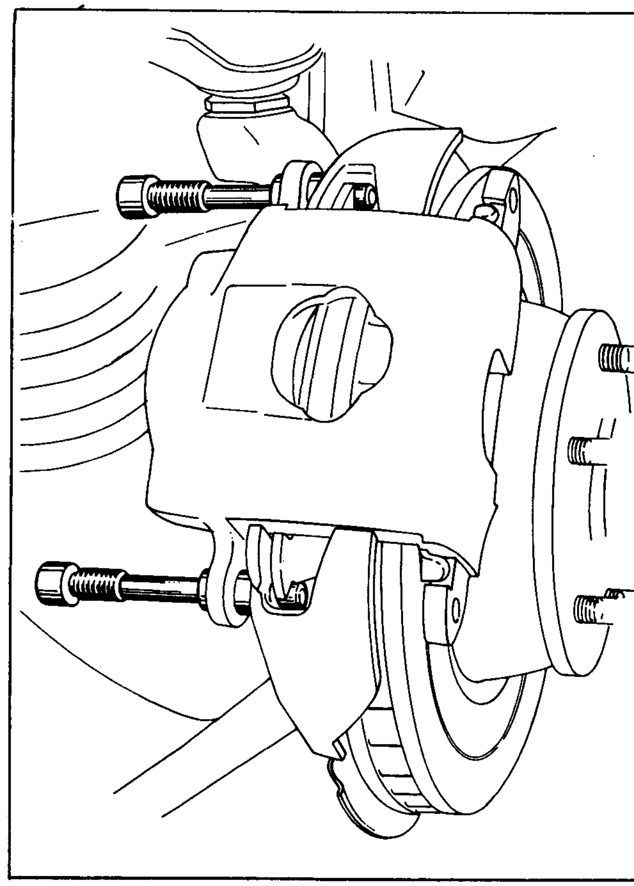


Fig. 5E-14 Installing Mounting Bolts

8. Push the bolts through to engage the holes in the outboard caliper ears, at the same time threading the bolts into the mounting bracket or steering knuckle. Torque bolts to 35 lb. ft.

   NOTE: *Replace the shoe and linings on the other front wheel disc brake in exactly the same manner as just described. Relining must be performed in full axle sets only.*

9. Install wheel and tire assemblies, and torque lug nuts to 75 lb. ft. (B Series), 70 lb. ft. (A, F or G Series), 65 lb. ft. (X Series).

10. Master cylinder fluid level should be as shown in Section 5. Fill to prescribed level.

11. Pump the brake pedal several times. Check fluid level and replenish, if necessary.

WARNING: DO NOT MOVE CAR UNTIL A FIRM BRAKE PEDAL IS OBTAINED.

NOTE: *Whenever the front wheel disc brakes are relined, the rear drum brakes should be checked also.*

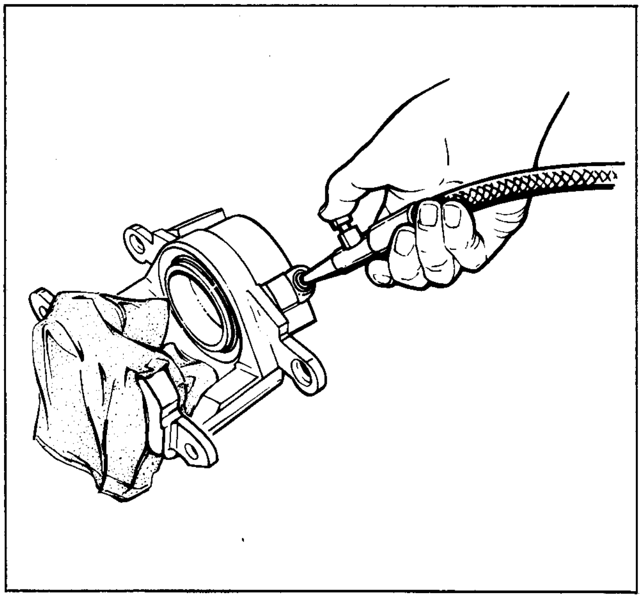


Fig. 5E-15 Removing Piston

CALIPER

REMOVE

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 at the caliper. Discard the copper gasket on each side of the brass hose fitting.

DISASSEMBLE

1. Before beginning disassembly, thoroughly clean the exterior of the caliper using alcohol.
2. Remove the bleeder valve from the caliper and drain brake fluid from interior. Place caliper on a clean work surface.
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 (Fig. 5E-15).

WARNING: 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. 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

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.

Clean all other parts in alcohol or brake fluid. Use dry, filtered compressed air to dry parts and blow out all passages in the caliper and bleeder valve.

WARNING: 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.

1. 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.
2. Carefully examine outside of piston for scoring, nicks, corrosion and worn or damaged chrome plating. If any surface defects are detected, replace the piston.

   CAUTION: *The piston O.D. is the primary sealing surface in the caliper assembly. It is manufactured and plated to close tolerances and cannot be refinished or repaired.*

3. Check the bore in the caliper for major defects with the exception of plating damage. The piston bore is not plated and stains or minor corrosion can be polished with abrasive cloth. Thoroughly clean the caliper after the use of any abrasive. If the bore cannot be cleaned up in this manner, replace the caliper.

ASSEMBLE

1. Lubricate the seal groove 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 move piston until it bottoms in the bore. This will require a force of 50 to 75 pounds.

2. Position the boot in the caliper counterbore and seat with tool J 22904 (Fig. 5E-16). 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 (Fig. 5E-9). Otherwise dirt or moisture may enter the bore and cause damage or corrosion.

INSTALL

Installation of the caliper and mounting parts (rubber bushings, sleeves, shoe and lining assemblies, and bolts) is the same as for lining replacement except for the following:

1. Check the hose for worn spots, cracks or other signs of deterioration. Discard the hose, if damaged, and replace with a new part. with the open slot under the mounting bolt and pushing in on the pin in the end of the valve. The pressure needed to push the plunger Bolt the brake hose to the caliper using a new copper gasket on each side of the brass fitting.

   NOTE: *Make certain hose is not twisted or kinked. The hose used on Pontiac has a special brass fitting with raised corners; this surface must face bolt head to properly orient hose.*

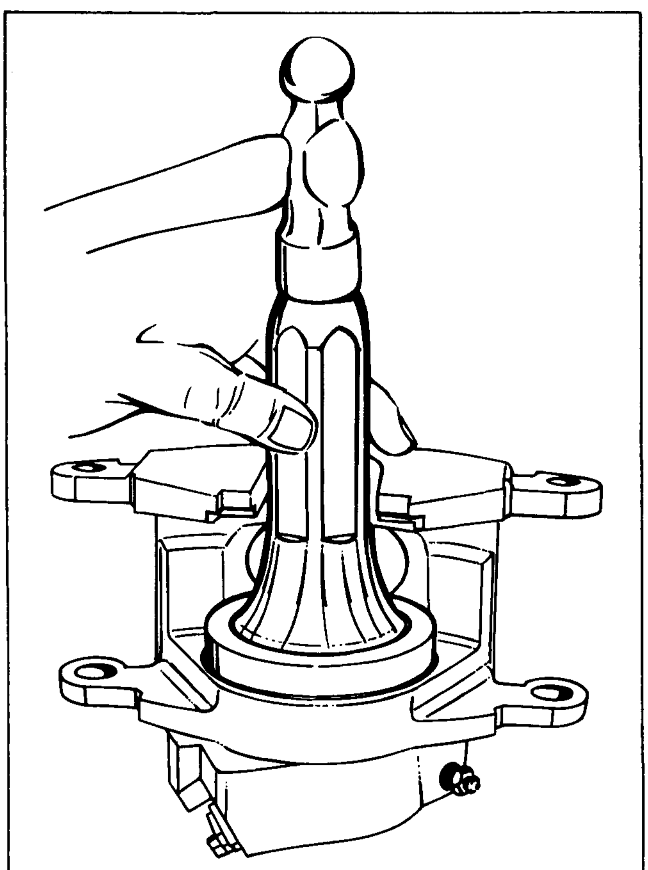


Fig. 5E-16 Seating Boot

CAUTION: *Make certain that the skirt of the metal fitting which attaches to the caliper is installed BETWEEN the ears on the caliper boss as shown in Fig. 5-19.*

2. After overhaul -- or any time that the brake hose or line is disconnected -- the calipers must be bled. Use either the manual or pressure tank method. (See - Bleeding Disc Brakes.)

BLEEDING DISC BRAKES

If the caliper was removed for overhaul, or if the brake hose or steel line was disconnected for any other reason, it will be necessary to bleed all air from the calipers and connecting lines. The bleeding operation for disc brakes is the same as for drum brakes. The only exception is that the metering or brake combination valve must be held open. This is done by depressing and holding in the plunger in the end of the valve with Tool J 23709. This can be accomplished by installing tool J 23709 with the open slot under the mounting bolt and pushing in on the pin in the end of the valve. The pressure needed to push the plunger in should never exceed 25 lbs. Brakes should be bled in this order: Master cylinder, right rear, left rear, right front, left front.

BRAKE ROTOR

REMOVE

1. Raise car and remove front wheels.
2. Remove caliper assembly and rest on front suspension, as described in Shoe and Lining Replacement: Caliper - Remove.
3. Remove spindle nut and hub and rotor assembly.

REPLACE (Fig. 5E-17 and 5E-18)

1. Install new bearings or seal as necessary.
2. Install hub and rotor assembly on spindle. See Section 3 for proper Wheel Bearing Adjustment Procedure.
3. Install caliper assembly and torque mounting bolts to 35 lb. ft. (See Caliper - Install).

   CAUTION: *See caution on Page 1 of this section regarding fasteners referred to in Step 4 below.*

4. Install wheel and tire assemblies, and torque lug nuts to 75 lb. ft. (B Series), and 70 lb. ft. (A, F and G Series).

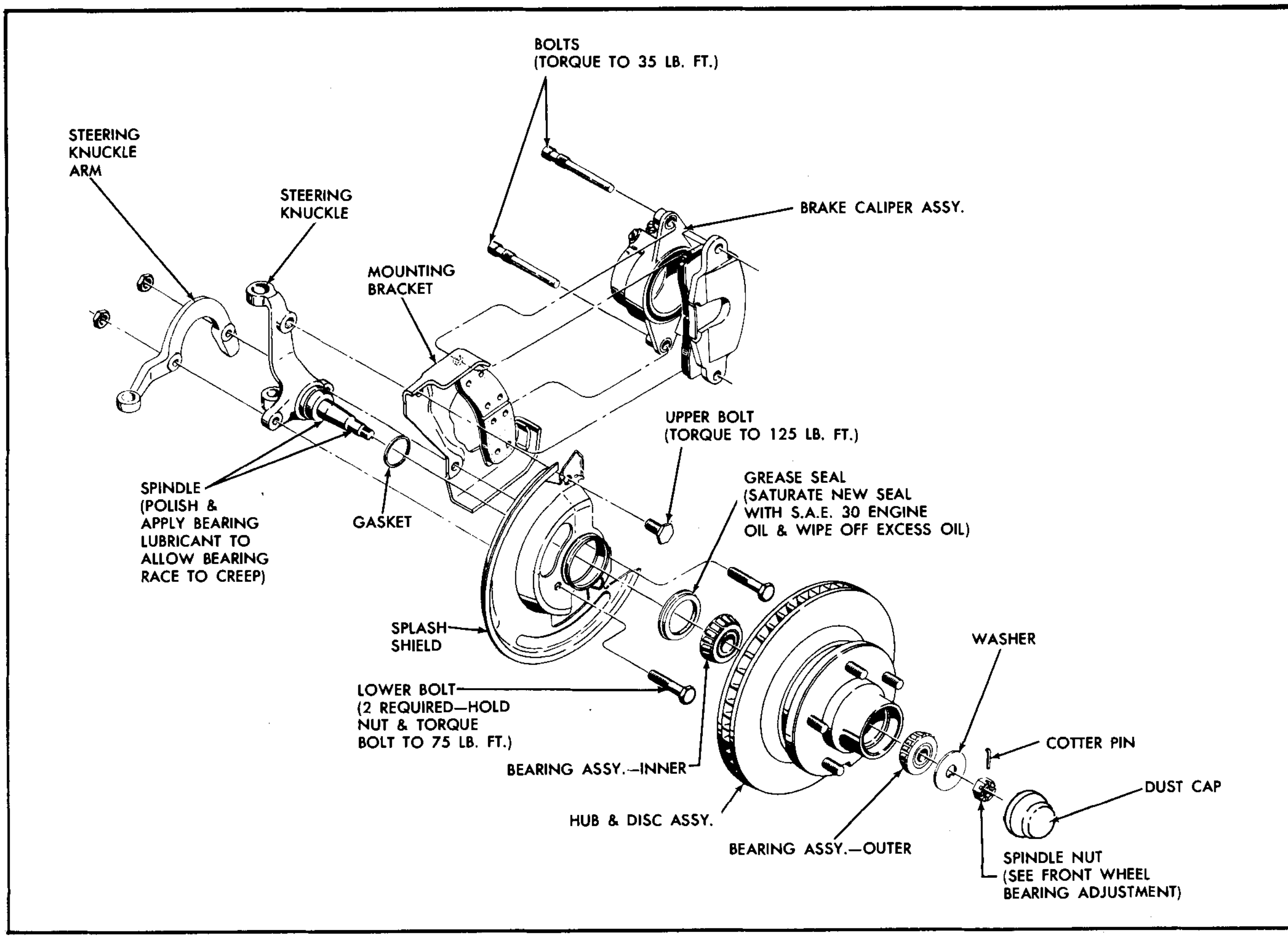


Fig. 5E-17 Installation of Steering Knuckle Hub and Disc Assembly - A and G Series

5. Depress brake pedal several times to seat linings on rotor.

WARNING: DO NOT MOVE CAR UNTIL A FIRM BRAKE PEDAL IS OBTAINED.

ROTOR

INSPECTION

(CHECK ROTORS ONLY WHEN A SPECIFIC COMPLAINT POINTS TOWARD A PROBLEM IN THIS AREA.)

LATERAL RUNOUT CHECK

Lateral runout is the movement of the rotor from side to side as it rotates. This could be described as "rotor wobble" and causes the piston to seat back into its bore.

To check lateral runout (Fig. 5E-19) first adjust the wheel bearings until all of the end play is eliminated. Fasten a dial indicator to some portion of the suspension so the stylus contacts the rotor face approximately one inch from the rotor edge. Set the dial at zero. Move the rotor one complete rotation, checking the indicator as the rotor moves.

NOTE: *Runout must be checked on car or on bench - mounted spindle. Do not check runout on disc turning lathe.*

For lateral runout specifications see - SPECIFICATIONS.

PARALLELISM CHECK (THICKNESS VARIATION)

Parallelism is the measurement of the variations in thickness of the rotor at several points around the circumference of the rotor. Measurements must be made at the same distance from the edge of the rotor and an indicator which reads .0001" must be used (Fig. 5E-20). An acceptable, but less preferable, method would be to use a micrometer

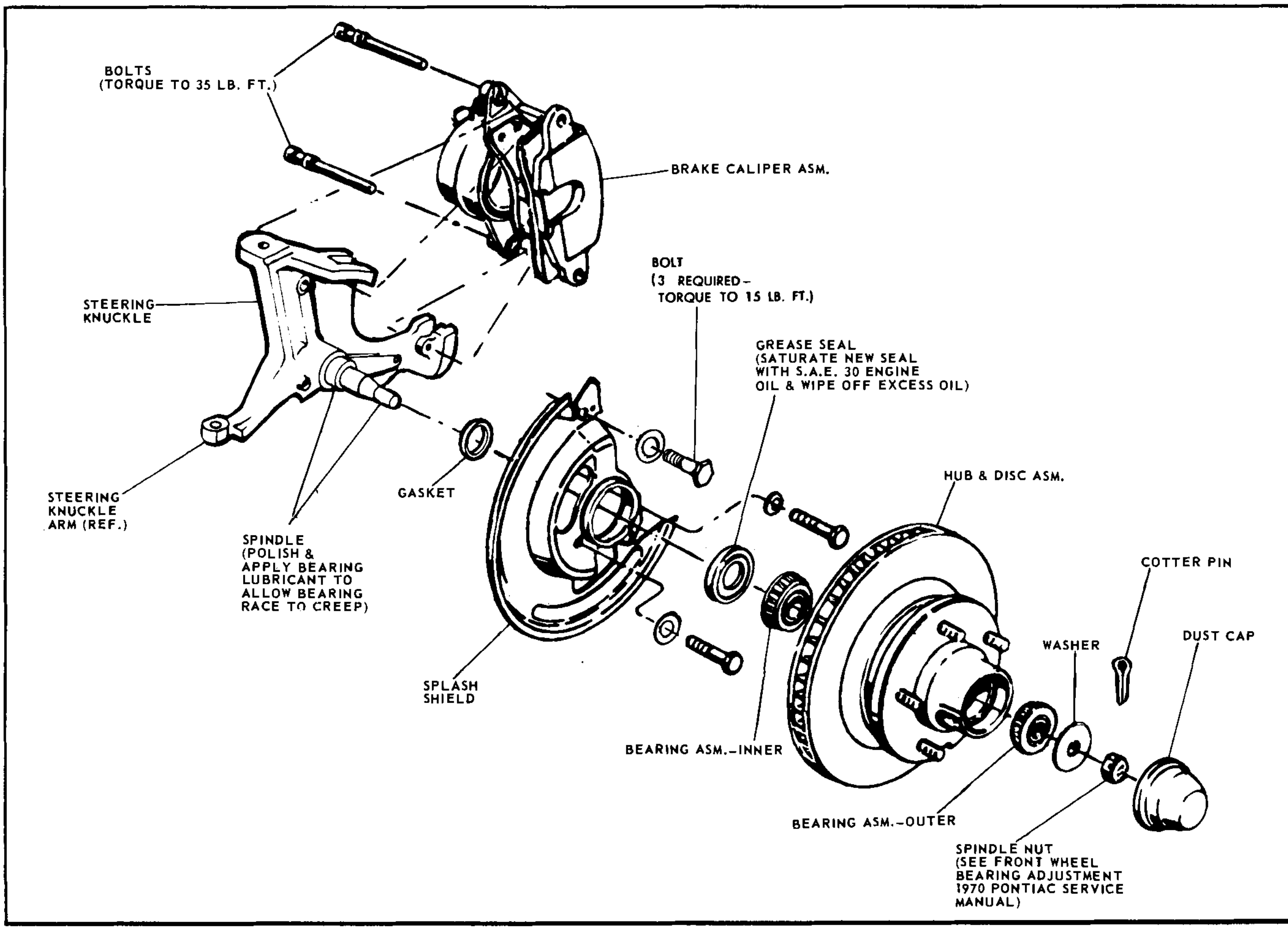


Fig. 5E-18 Installation of Steering Knuckle Hub and Disc Assembly - B and F Series

to measure the rotor thickness at a minimum of twelve places around the rotor.

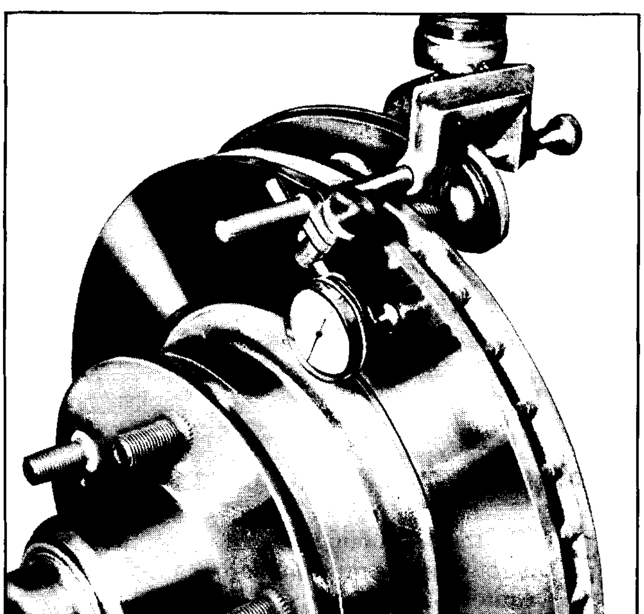


Fig. 5E-19 Checking Rotor for Lateral Runout

Disc brake roughness is most often caused by bad parallelism. The specification (.0007), (.0005 X Car) is extremely

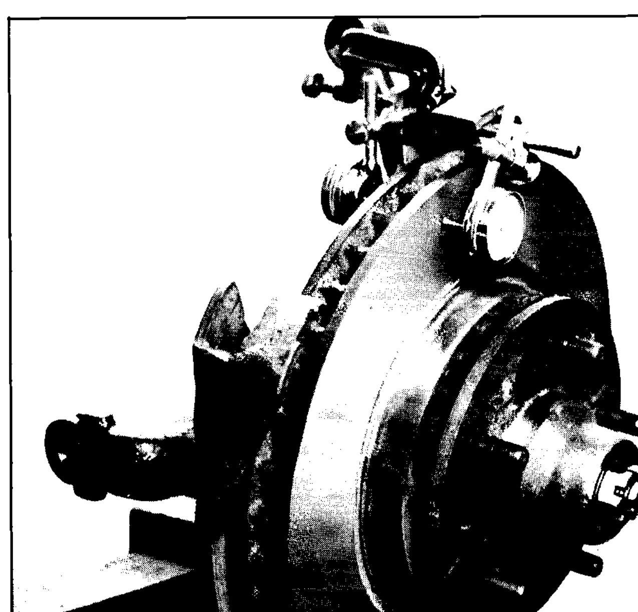


Fig. 5E-20 Measuring Parallelism

close, and even small deviations may cause a brake vibration. A rotor that does not meet the specifications must be discarded and replaced with a new rotor, or machined to specification.

SURFACE TOLERANCE AND FINISH

Improper surface finish will shorten lining life. Differences in finish smoothness between rotors may cause a brake pull. Surface finish can not be measured with normal service equipment.

Light scoring of the rotor surfaces not exceeding 0.015" in depth, which may result from normal use, is not detrimental to brake operation.

THICKNESS

Measure thickness with a micrometer.

> **NOTE:** *When total rotor thickness is less than .965" (A, X, F and G Series) or 1.215" (B Series), rotor must be replaced. If rotor is too thin, the linings may dislodge.*

SERVICE

Extremely close control of the disc rubbing surfaces is necessary. The specification for parallelism of the two rotor faces is particularly critical with regard to brake roughness. Differences in finish smoothness between rotors will cause a brake pull. If the rotor is too thin, the linings may become dislodged.

Because of the accuracy required, refinishing of the rubbing surface is not recommended unless precision equipment is available and surfaces can be held within specifications listed. Specifically, adapters which mount against the bearing surface of the race should be used, as it has been found that other adapters actually put runout **into** the rotor (Fig. 5E-21 and 5E-22).

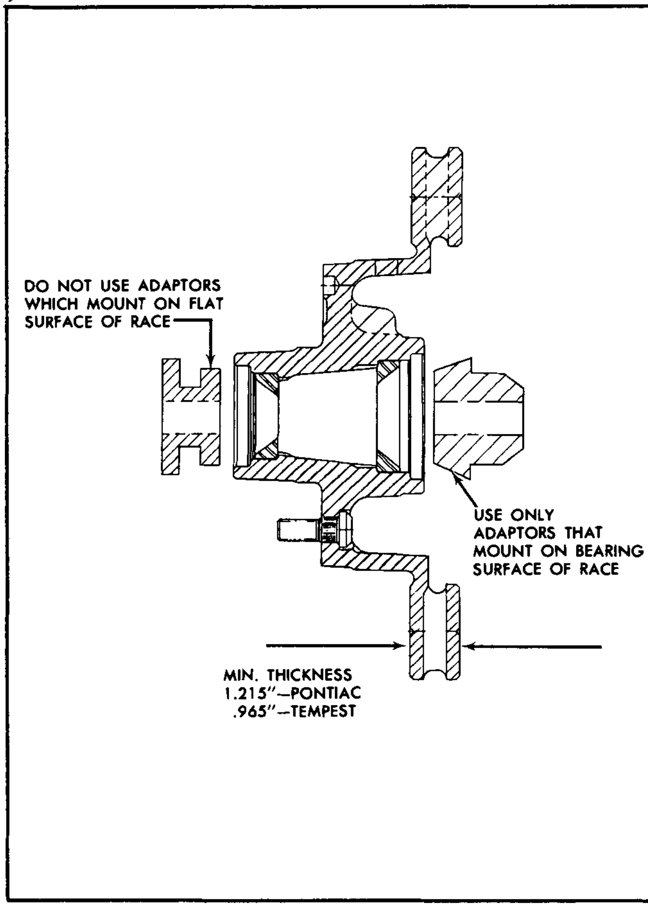


Fig. 5E-22 Disc Rotor Turning

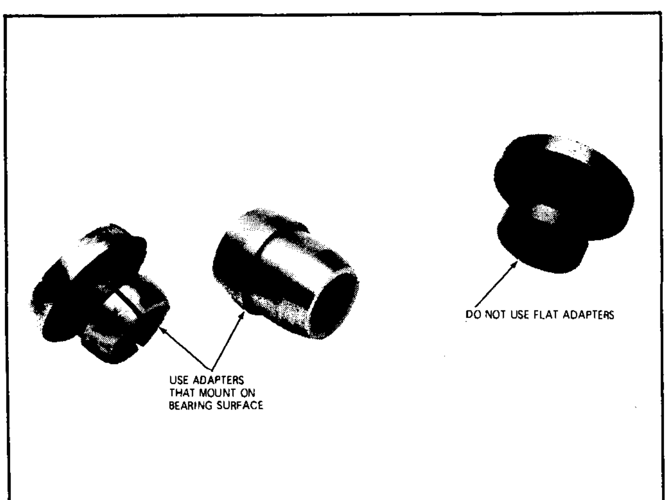


Fig. 5E-21 Disc Rotor Turning Adaptors

When turning rotors, it is very important that **BOTH** sides be turned. It is not necessary, however, that equal amounts be removed from each side. Always remove as little metal as possible.

Disc turning is primarily for correction of bad runout or parallelism. Turning to correct minor scoring is also acceptable provided the disc is not turned below the minimum thickness.

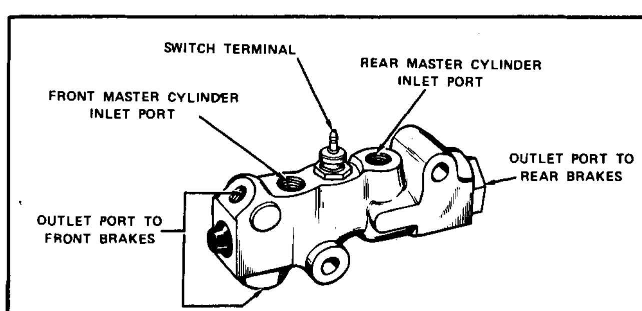


Fig. 5E-23 Combination Valve

After machining; surface refinishing with rotary grinder is manditory to impart the proper non-directional micro-finish.

After machining, measure rotor for parallelism, runout, and thickness as outlined above.

> **WARNING: UNDER NO CIRCUMSTANCES SHOULD ROTORS BE MACHINED BELOW MINIMUM THICKNESS OF .98" (A, X, F AND G SERIES) OR 1.23" (B SERIES). THICKNESS MUST BE MEASURED BEFORE AND AFTER TURNING SINCE PRODUCTION ROTORS ARE NOT ALL BUILT TO ONE THICKNESS.**
>
> **THE STAMPED FIGURE ON THE ROTOR IS INTENDED AS A "DISCARD" DIMENSION ONLY. UNDER NO CIRCUMSTANCES SHOULD A ROTOR BE MACHINED TO THIS DIMENSION.**

COMBINATION VALVE

REMOVAL AND INSTALLATION

The Combination Valve (Fig. 5E-25) is not repairable and is, therefore, serviced only as a complete assembly.

1. Disconnect hydraulic brake lines from the combination valve. Cover or plug open lines with clean, lint free material to prevent entrance of foreign matter or loss of fluid.
2. Disconnect wire from switch terminal.
3. Remove two screws retaining combination valve to the frame (A, B and G Series) or mounting bracket below the master cylinder (F and X Series) and remove valve.
4. To install reverse the above procedure.
5. Bleed entire brake system following the procedure described under BLEEDING DISC BRAKES.

SPECIFICATIONS

Disc Brake Type .... Fixed Rotor, Sliding Caliper
Location .... Front Wheels Only
Rotor Type .... Ventilated-Cast Iron
Rotor Diameter .... B Series-11.75"
.... A, X, F and G Series-11"
Rotor Runout (Maximum) .... .004"-Total
Rotor Surface Finish .... 20-60 Micro-Inch
.... (w/Non-Directional Lay)
Rotor Thickness (New)
B Series .... Up to 1.285"
A, F, X and G Series .... Up to 1.035"
Rotor Thickness (Minumum)
B Series .... 1.215"
A, F and G Series .... .965"
X Series .... .980"
Rotor Parallelism (Thickness Variation) .... .0007" max.
Rotor Parallelism (Thickness Variation) X Series
.0005" Max.
Brake Shoe and Lining Type .... Riveted
Brake Shoe and Lining Thickness (New)
Inner .... .635"
Outer .... .545"
Brake Lining Minimum
Thickness Before Replacement .... .125"
Master Cylinder Diameter .... 1.125"

TORQUE SPECIFICATIONS

APPLICATION	TORQUE
Bolt-Caliper to Mounting Bracket or Steering Knuckle	35 lb. ft.
Bolt-Splash Shield and Mounting Bracket to Knuckle (Upper) Except B and F Series Vehicles	115 lb. ft.
Bolt and Nut-Splash Shield and Mounting	
Bolt - Splash Shield to Steering Knuckle (Upper) B and F Series Vehicles	15 lb. ft.
Bracket to Knuckle (Lower) A, G and X Series Vehicles	80 lb. ft.
Screw-Caliper Bleeder	65 lb. in.

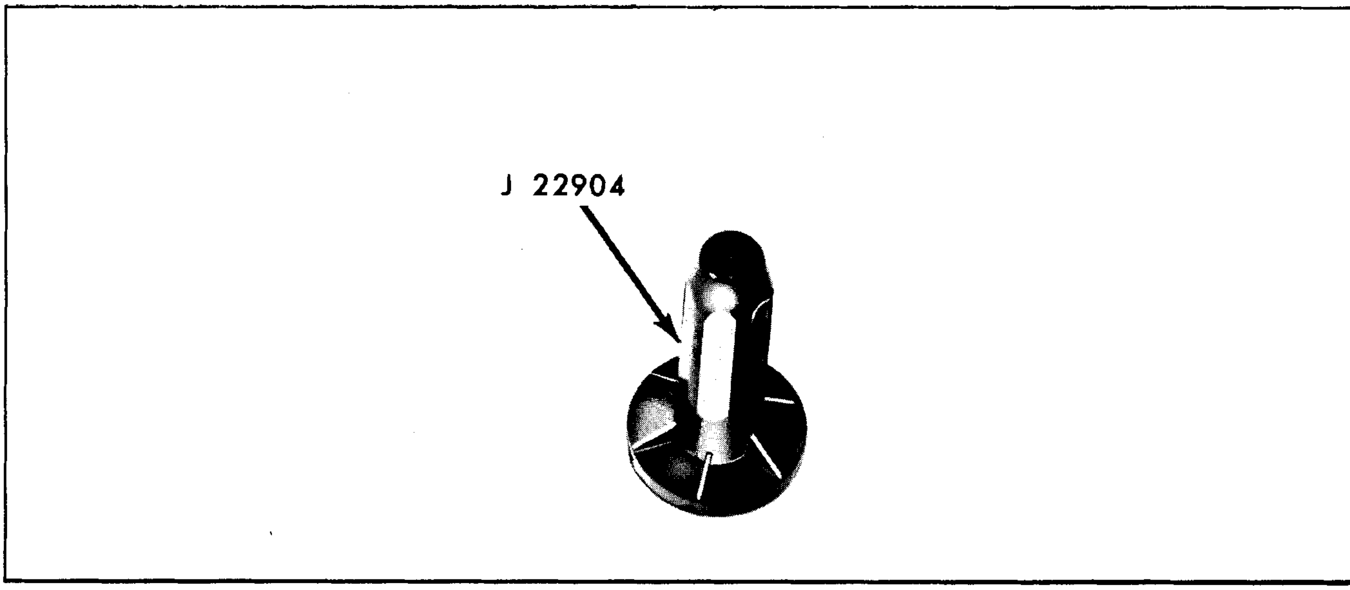


Fig. 5E-24 Special Tools

SECTION 6

ENGINE-MECHANICAL

L-6 AND V-8 ENGINES

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

ENGINE FAILS TO START

CAUSE

a. Corroded or loose battery terminal connections and/or weak battery.

b. Broken or loose ignition wires and/or faulty ignition switch.

c. Excessive moisture on plugs, caps or ignition system.

d. Damaged distributor rotor, cracked distributor cap and/or corroded distributor contact points.

e. Fouled spark plugs and/or improper spark plug gap.

f. Weak or faulty coil.

g. Carburetor flooded and/or fuel level in carburetor bowl not correct.

h. Dirt and water in gas line or carburetor.

i. Sticking choke.

j. Faulty fuel pump.

k. Faulty solenoid or starting motor.

l. Park or neutral switch inoperative.

ENGINE LOPES WHILE IDLING

CAUSE

a. Air leaks between intake manifold and heads.

b. Blown head gasket.

c. Worn timing chain or sprockets.

d. Worn camshaft lobes.

e. Overheated engine.

f. Plugged crankcase vent valve.

g. Faulty fuel pump.

ENGINE MISSES WHILE IDLING

CAUSE

a. Spark plugs damp or gap incorrectly set.

b. Excessive moisture on ignition wires and caps.

c. Leaks in ignition wiring.

d. Ignition wires making poor contact.

e. Uneven compression.

f. Burned, pitted or incorrectly set contact points.

g. Faulty coil or condenser.

h. Worn distributor cam or cracked distributor cap.

i. Incorrect carburetor idle adjustment and/or dirty jets or plugged passages in carburetor.

j. Foreign matter, such as dirt or water, in gas line or carburetor.

k. Air leak at carburetor mounting gasket.

l. Choke inoperative.

m. Faulty spark advance mechanism.

n. Burned, warped, pitted, or sticking valves.

o. Incorrect valve lifter clearance.

p. Low compression.

ENGINE MISSES AT VARIOUS SPEEDS

CAUSE

a. Dirt and water in gas line or carburetor.

b. Fouled carburetor jets.

c. Incorrect ignition timing.

d. Points dirty, pitted or incorrectly spaced.

e. Excessive play in distributor shaft.

f. Insufficient spring tension on points.

g. Distributor cam lobe worn.

h. Weak coil or condenser.

i. Spark plugs dirty or damp and/or gaps set too wide.

j. Insufficient point dwell.

k. Detonation or pre-ignition.

l. Excessively worn fuel pump diaphragm.

m. Weak valve spring.

n. Worn camshaft lobes.

o. Engine overheating.

p. Sub-standard fuel.

ENGINE STALLS

CAUSE

a. Carburetor idle speed set too low and/or idle mixture too rich or too lean.

b. Carburetor needle valve and seat inoperative.

c. Incorrect carburetor float level and/or carburetor flooding.

d. Dirt or water in gasoline or carburetor.

e. Choke improperly adjusted or sticking.

f. Faulty ignition system.

g. Spark plugs damp or dirty and/or gaps incorrectly set.

h. Faulty coil or condenser.

i. Distributor points burned, pitted, dirty, or incorrectly set.

j. Distributor advance inoperative.

k. Exhaust system restricted.

l. Leaks in carburetor mounting gasket or intake manifold.

m. Incorrect valve lifter clearance.

n. Burned, warped, or sticking valves.

o. Low compression.

p. Engine overheating.

q. Loose, corroded, or leaking wiring connections (bulkhead connector, etc.).

ENGINE HAS NO POWER

CAUSE

a. Weak coil or condenser.

b. Incorrect ignition timing.

c. Excessive play in distributor shaft or distributor cam worn.

d. Insufficient point dwell.

e. Spark plugs dirty or gaps incorrectly set.

f. Carburetor not functioning properly.

g. Improper carburetor float level.

h. Carburetor fuel mixture too rich or too lean.

i. Foreign matter, such as dirt or water, in gas line or carburetor.

j. Faulty fuel pump.

k. Valve spring weak and/or valves sticking when hot.

l. Valve timing incorrect.

m. Incorrect valve lifter clearance.

n. Worn camshaft lobes.

o. Pistons incorrectly fitted in block.

p. Blown cylinder head gasket.

q. Low compression.

r. Flow control valve inoperative (Power Steering).

s. Clutch slipping.

t. Brakes dragging.

u. Engine overheating.

v. Transmission regulator valve sticking (Hydra-Matic).

w. Sub-standard fuel.

EXTERNAL ENGINE OIL LEAKAGE

CAUSE

a. Improperly seated or broken fuel pump gasket.

b. Improperly seated or broken push rod cover gasket.

c. Improperly seated or broken oil filter gasket.

d. Broken or improperly seated oil pan gasket.

e. Gasket surface of oil pan bent or distorted.

f. Improperly seated or broken timing chain cover gasket.

g. Worn timing chain cover oil seal.

h. Worn or improperly seated rear main bearing oil seal.

i. Loose oil line plugs.

j. Engine oil pan drain plug improperly seated.

k. Rear camshaft bearing drain hole plugged.

l. Loose rocker arm cover, gasket broken, or cover distorted or bent.

EXCESSIVE OIL CONSUMPTION DUE TO OIL ENTERING COMBUSTION CHAMBER THROUGH HEAD AREA

CAUSE

a. Intake valve seals damaged or missing.

b. Worn valve stems or guides.

c. Plugged drain back holes in head.

d. Intake manifold gasket leak in conjunction with rocker cover gasket leak.

EXCESSIVE OIL CONSUMPTION DUE TO OIL ENTERING COMBUSTION CHAMBER BY PASSING PISTON RINGS

CAUSE

a. Oil level too high.

b. Excessive main or connecting rod bearing clearance.

c. Piston ring gaps not staggered.

d. Incorrect size rings installed.

e. Piston rings out of round, broken or scored.

f. Insufficient piston ring tension due to engine overheating.

g. Ring grooves or oil return slots clogged.

h. Rings sticking in ring grooves of piston.

i. Ring grooves worn excessively in piston.

j. Compression rings installed upside down.

k. Excessively worn or scored cylinder walls.

l. Oil too thin.

NO OIL PRESSURE WHILE IDLING

CAUSE

a. Faulty oil gauge sending unit.

b. Oil pump not functioning properly. (Regulator ball stuck in position by foreign material).

c. Excessive clearance at main and connecting rod bearings.

d. Loose camshaft bearings.

e. Leakage at internal oil passages.

NO OIL PRESSURE WHILE ACCELERATING

CAUSE

a. Low oil level in oil pan.

b. Leakage at internal oil passages.

BURNED, STICKING OR BROKEN VALVES

CAUSE

a. Weak valve springs.

b. Improper valve lifter clearance.

c. Improper valve guide clearance and/or worn valve guides.

d. Out-of-round valve seats or incorrect valve seat width.

e. Deposits on valve seats and/or gum formation on stems or guides.

f. Warped valves or faulty valve forgings.

g. Exhaust back pressure.

h. Improper spark timing.

NOISY VALVES

CAUSE

a. Incorrect valve lifter clearance.

b. Excessively worn, dirty or faulty valve lifters.

c. Worn valve guides.

d. Excessive run-out of valve seat or valve face.

e. Worn camshaft lobes.

f. Pulled or loose rocker arm studs.

g. Bent push rods.

NOISY PISTONS AND RINGS

CAUSE

a. Excessive clearance between piston and bore.

b. Improper fit of piston pin.

c. Excessive accumulation of carbon in heads.

d. Connecting rods improperly aligned.

e. Excessive clearance between rings and grooves.

f. Rings broken.

BROKEN PISTONS AND/OR RINGS

CAUSE

a. Undersize pistons installed.

b. Wrong type and/or size rings installed.

c. Cylinder bores tapered or eccentric.

d. Connecting rods improperly aligned.

e. Excessively worn ring grooves.

f. Pins improperly assembled.

g. Insufficient ring gap clearance.

h. Engine overheating.

i. Fuel of too low octane rating.

NOISY CONNECTING RODS

CAUSE

a. Connecting rods improperly aligned.

b. Excessive bearing clearance.

c. Eccentric or out-of-round crankshaft journals.

d. Insufficient oil supply.

e. Low oil pressure.

f. Connecting rod bolts not tightened correctly.

NOISY MAIN BEARINGS

CAUSE

a. Low oil pressure and/or insufficient oil supply.

b. Excessive bearing clearance.

c. Excessive crankshaft end play.

d. Eccentric or out-of-round crankshaft journals.

e. Sprung crankshaft.

f. Excessive belt tension.

g. Loose harmonic balancer.

NOISY VALVE LIFTERS

CAUSE

a. Broken valve springs.

b. Worn or sticking rocker arms.

c. Worn or bent push rods.

d. Valve lifters incorrectly fitted to bore size.

e. Faulty valve lifter plunger or push rod seat.

f. Plungers excessively worn causing fast leakdown under pressure.

g. Excessively worn camshaft lobes.

h. Valve lifter oil feed holes plugged causing internal breakdown.

i. Faulty valve lifter check ball. (Nicked, flat spot, or out of round.

j. Rocker arm retaining nut installed upside down.

k. End of push rod excessively worn or flaked.

ENGINE CODE	MODEL USAGE "B" SERIES	"G" SERIES	"A" SERIES	"F" SERIES	"X" SERIES	DISPLACEMENT 250 L-6	307 V-8	350 V-8	400 V-8	455 V-8	TRANS. MANUAL (3 Speed)	MANUAL (4 Speed)	AUTOMATIC	CARB. MV (1 Bbl)	WGD (2 Bbl)	2GV (2 Bbl)	4MV (4 Bbl)
W6			X			X					X			X			
Y6			X			X							X	X			
CBG				X	X	X					X			X			
CBJ				X	X	X							X	X			
CBA*			X	X	X	X					X			X			
CBC*			X	X	X	X							X	X			
CKG †					X		X				X					X	
CKH ∮					X		X						X			X	
YV					X			X					X			X	
YR			X	X				X					X			X	
WR			X	X				X			X	X			X		
YX	X		X	X					X				X			X	
WS			X						X		X						X
WK			X	X					X			X					X
YS	X	X	X	X					X				X				X
ZX*	X		X	X					X				X			X	
YH	X									X			X			X	
YC	X	X	X							X			X				X
YA	X	X								X			X				X
WM ∞			X	X						X		X					X
YB ∞			X	X						X			X				X
ZH*	X									X			X			X	

ENGINE CODE	CYLINDER HEADS Comp. Ratio 8.5:1	8.0:1	8.2:1	8.4:1	Combustion Chamber Volume 87.15 cc.	89.76 cc.	93.88 cc.	95.61 cc.	96.36 cc.	107.75 cc.	111.89 cc.	112.64 cc.	Rocker Arm Stud PRESSED-IN	THREADED	Valve Spring SINGLE	DUAL	Intake Valve Size SMALL	LARGE
W6	X						X						X		X		X	
Y6	X						X						X		X		X	
CBG	X						X						X		X		X	
CBJ	X						X						X		X		X	
CBA*	X						X						X		X		X	
CBC*	X						X						X		X		X	
CKG †	X				X								X			X	X	
CKH ∮	X				X								X			X	X	
YV		X				X							X			X	X	
YR		X				X							X			X	X	
WR		X				X							X			X	X	
YX			X						X				X			X	X	
WS			X					X						X		X		X
WK			X					X						X		X		X
YS			X					X						X		X		X
ZX*			X						X				X			X	X	
YH			X									X	X			X	X	
YC			X								X		X			X		X
YA			X								X		X			X		X
WM ∞				X						X				X		X		X
YB ∞				X						X				X		X		X
ZH*			X									X	X			X	X	

ENGINE CODE	CAMSHAFT 3864497	6262809	3896929	483555 (W)	9779066 (N)	9779067 (P)	9779068 (S)	VALVE LIFTER HIGH-BALL	LOW-BALL ✧	DISTRIBUTOR 1110489	1112005	1112039	1112118	1112119	1112121	1112122	1112127@	1112133@	1112140	1112145
W6	X							X		X										
Y6	X							X		X										
CBG	X							X		X										
CBJ	X							X		X										
CBA*		X						X		X										
CBC*		X						X		X										
CKG †			X					X			X									
CKH ∮			X					X				X								
YV				X				X					X							
YR				X				X					X							
WR				X				X											X	
YX				X				X						X						
WS						X		X							X					
WK						X		X							X					
YS						X		X							X					
ZX*					X			X						X						
YH					X			X								X				
YC						X		X												X
YA						X		X									X			
WM ∞							X		X									X		
YB ∞							X		X									X		
ZH*						X		X								X				

* Available California only; "CBA" and "CBC" equipped with A.I.R.
† California cars with manual transmission use "CAY" engine code
∮ California cars with automatic transmission use "CAZ" engine code

@ Unit distributor
∞ 455 H.O. engine
✧ Hardened iron foot

Fig. 6-1 Engine Chart - All Models

GENERAL DESCRIPTION

B SERIES ENGINES

The 400 cubic inch engine is standard on all Catalina models. Bonneville models are equipped with a standard 455 2 Bbl. engine, while Grand Ville models use a 455 4 Bbl. engine as standard.

Six different B Series engine-transmission combinations are available (Fig. 6-1).

G SERIES ENGINES

The Grand Prix model "J" uses the 400 4 Bbl. engine as standard equipment, and the model "SJ" uses the 455 4 Bbl. engine as standard.

Two different G Series engine-transmission combinations are available (Fig. 6-1).

A SERIES ENGINES

The standard engine used in the LeMans and LeMans Sport models is a 250 cubic inch inline overhead valve six cylinder engine. Luxury models are equipped with the 350 cubic inch 2 Bbl. engine as standard. Models with the G.T.O. option are equipped with a 400 4 Bbl.,engine as standard. The 455 4 Bbl. and 455 H.O. engines are also available with the G.T.O. option.

Sixteen different A Series engine-transmission combinations are available (Fig. 6-1).

F SERIES ENGINES

The F Series standard engine lineup is as follows: Firebird - 250 cu. in. 6 cylinder; Esprit - 350 cu in. V-8; Formula - 350 cu. in. V-8; Trans Am - 455 cu. in. (H.O.) V-8.

Thirteen different F Series engine-transmission combinations are available (Fig. 6-1).

X SERIES ENGINES

The standard engine in X Series vehicles is the 250 cubic inch inline six cylinder, with the 307 and 350 cubic inch 2 Bbl. engines available as options.

Six different X Series engine-transmission combinations are available (Fig. 6-1).

Bore and stroke for the four basic engines are: 3 7/8" × 3 5/8" (250), 3 7/8 × 3 1/4 (307), 3 7/8" × 3 3/4" (350), 4 1/8" × 3 3/4" (400), and 4 5/32" × 4 13/64" (455).

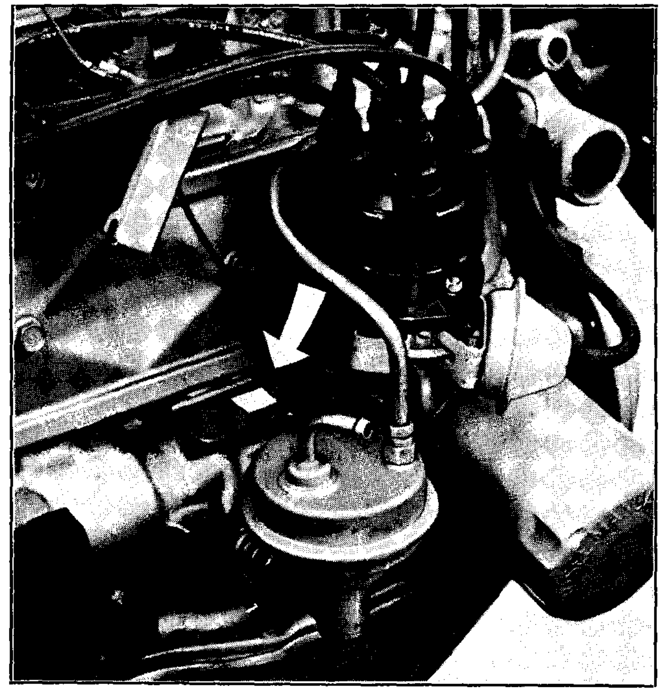


Fig. 6-2 Engine Number and Code Location (6 Cyl.)

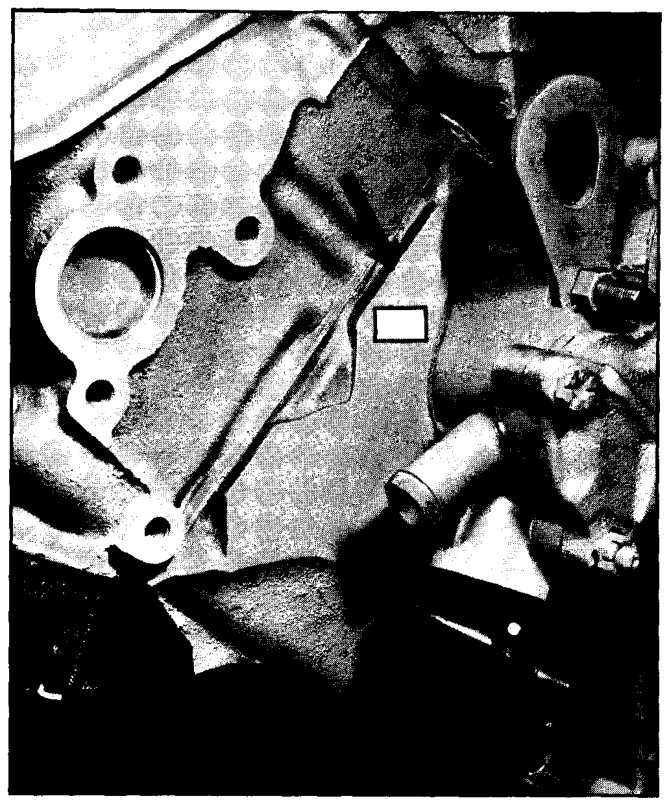


Fig. 6-3 Engine Number and Code Location (V-8)

Four compression ratios are available: 8.5:1 (250 and 307), 8.0:1 (350), 8.2:1 (400 and 455), and 8.4:1 (455 H.O.).

Engine identification for six cylinder engines is facilitated by a letter/number code stamped on the distributor mounting pad at the right side of the block (Fig. 6-2), where the vehicle identification number can also be found (Fig. 6-4). The same information for V-8 engines is located on the machined face of the cylinder block, below the R.H. cylinder head (Figs. 6-3, 6-4).

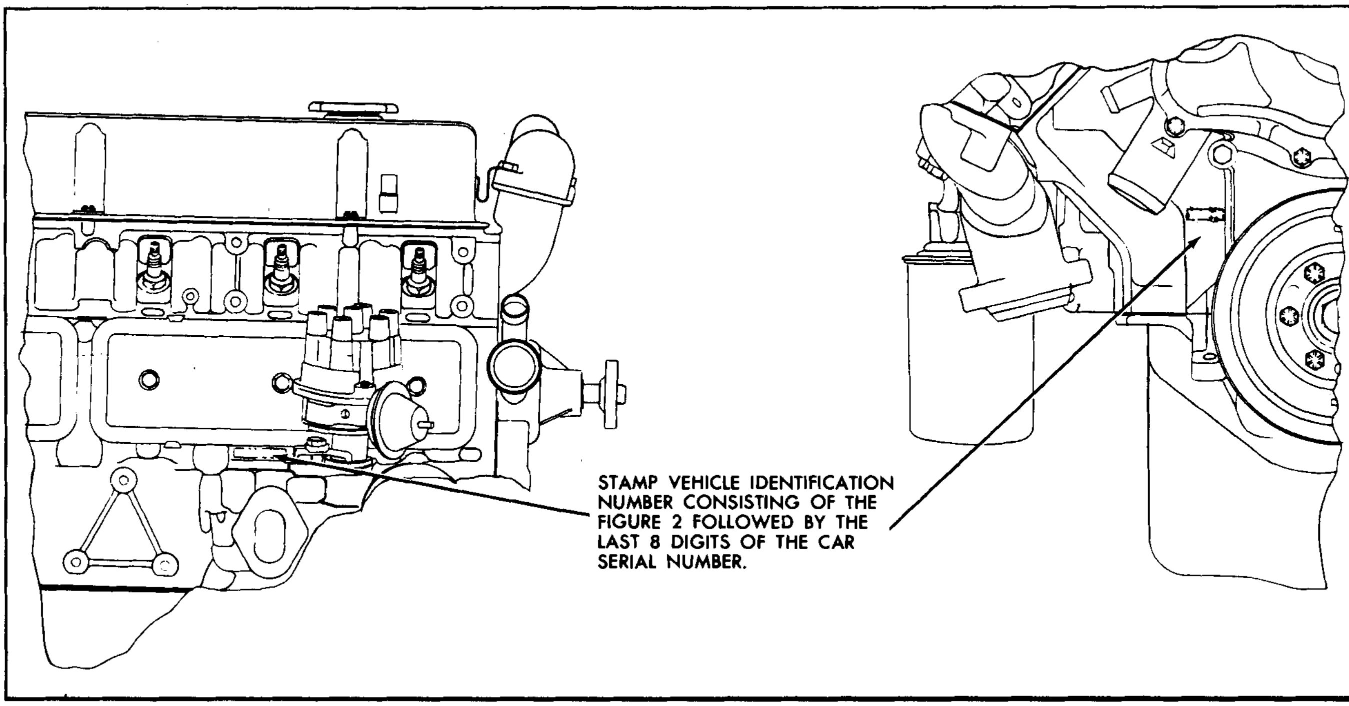


Fig. 6-4 Vehicle Identification Number Location

SIX CYLINDER ENGINE

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

CYLINDER BLOCK

The cast iron cylinder block has one vertical row of six cylinders numbered from front to rear, 1 through 6. Seven main bearings support the crankshaft (Fig. 6-7). Bearing caps fit in recesses in the block which assure accurate alignment and facilitate assembly.

Cylinders are completely encircled by coolant jackets. For details of engine cooling system, see ENGINE COOLING AND LUBRICATION, Section 6A.

CYLINDER HEAD

The cast iron cylinder head provides a compression ratio of 8.5:1.

Two large coolant ports at the rear end of the cylinder head provide coolant to passages beneath each spark plug. Coolant surrounds each spark plug mounting and valve seat. Coolant returns to the water pump through an outlet at the front of the cylinder head.

Oil is fed through hollow push rods to the upper valve train for superior lubrication.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by seven main bearings.

Main bearings are lubricated from oil holes which intersect the main oil gallery which runs parallel to the cylinder bores along the right side of the block.

A rubber floated harmonic balancer on the forward end of the crankshaft dampens any engine torsional vibrations.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by four bearings and is gear driven. A steel crankshaft gear drives the camshaft

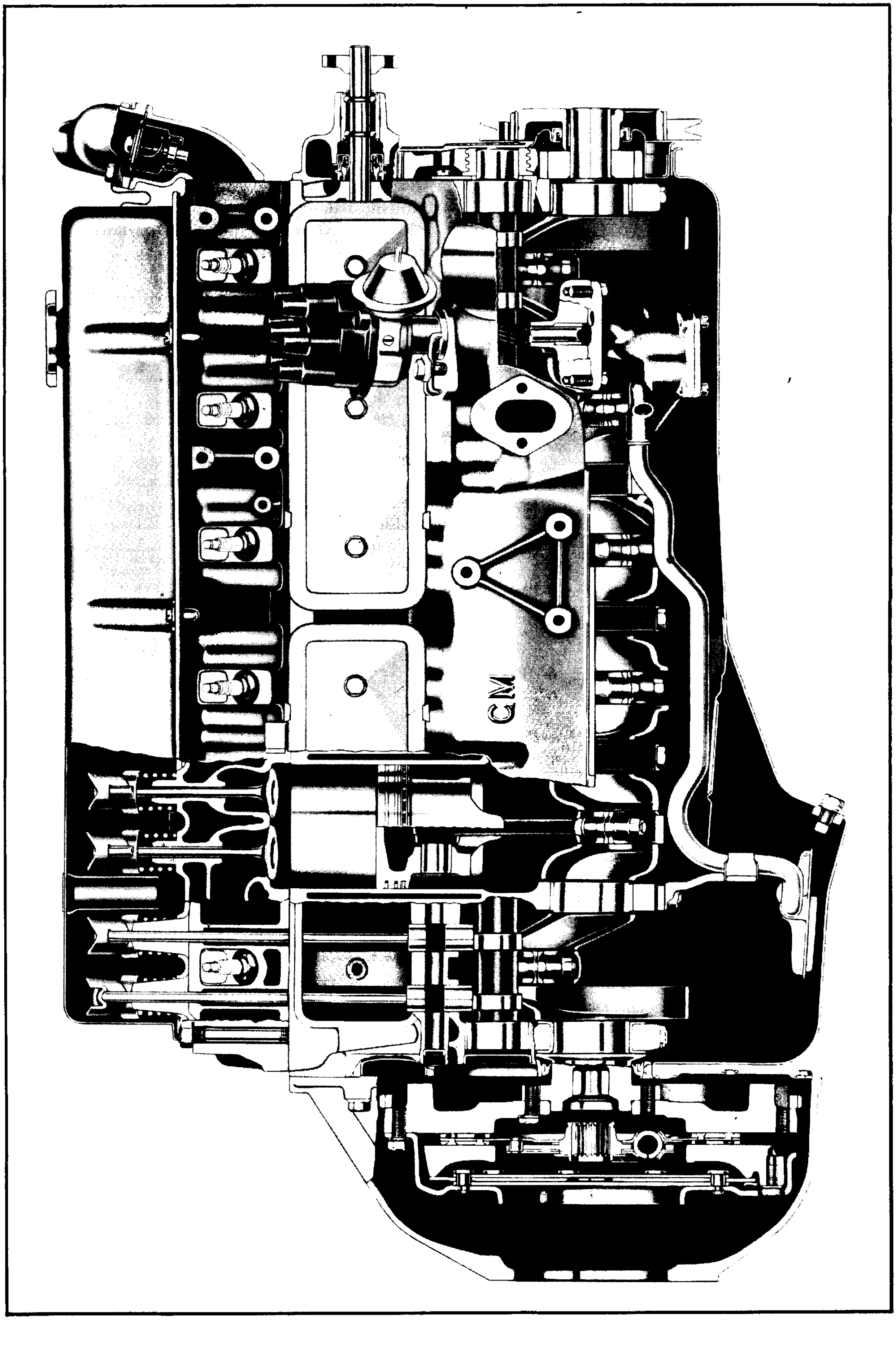


Fig. 6-5 250 L-6 Cross Section

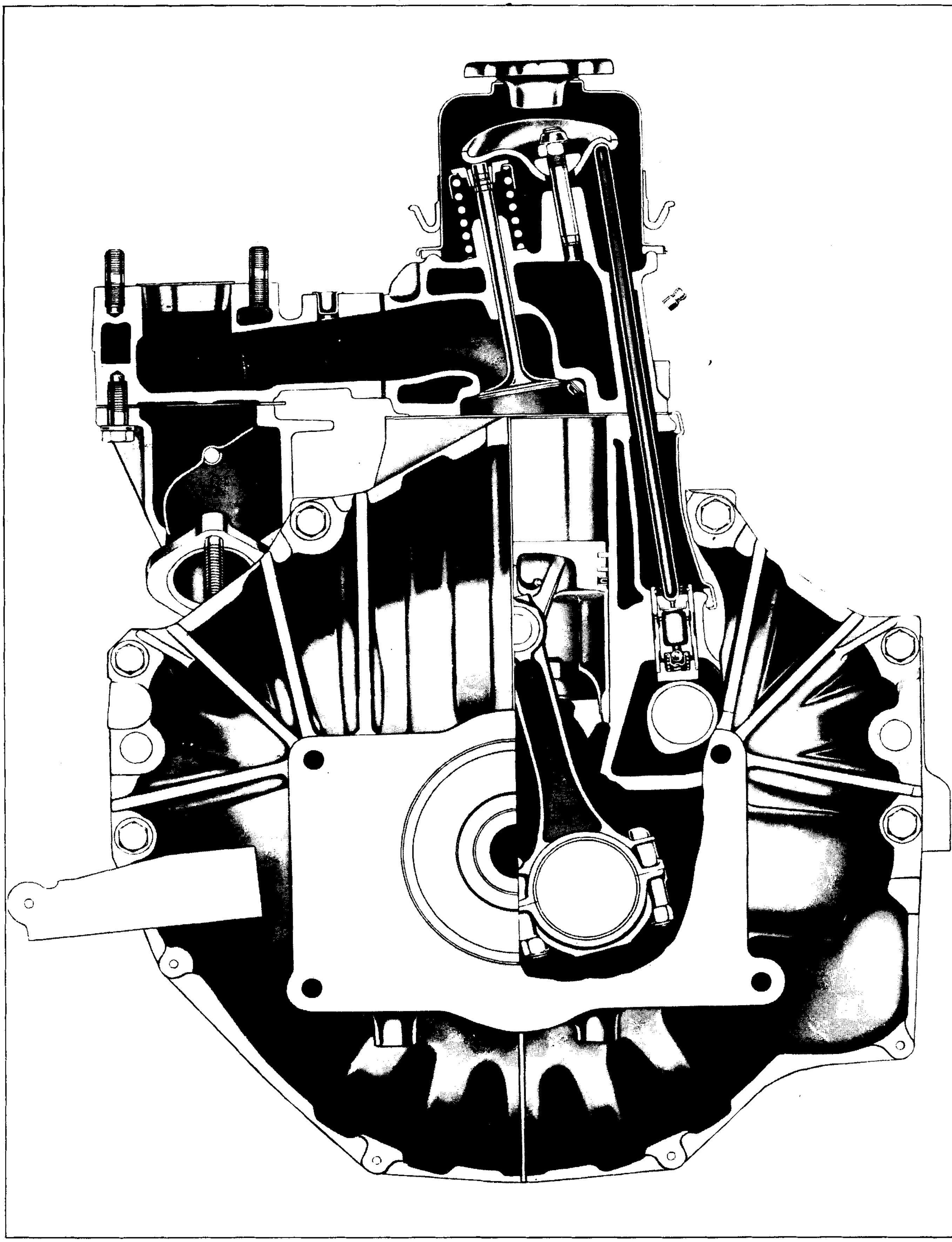


Fig. 6-6 250 L-6 Cross Section

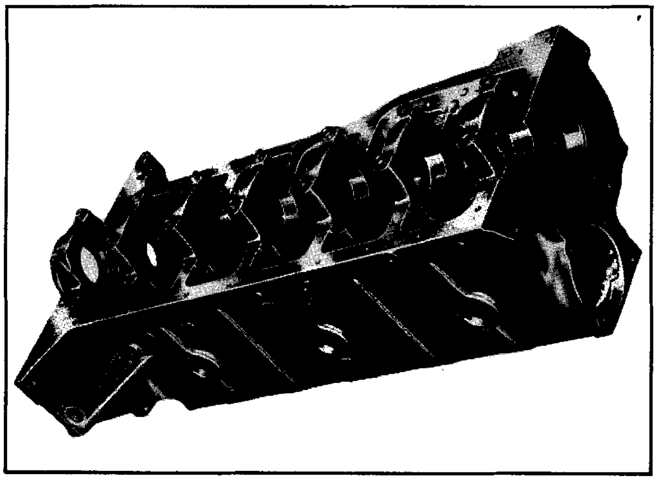


Fig. 6-7 Cylinder Block and Bearing Caps

through a bakelite fabric composition gear with steel hub (Fig. 6-8).

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. The main gallery runs parallel to the cylinder bores along the right side of the block.

PISTONS AND CONNECTING RODS

The pistons are aluminum alloy, tin plated, with steel struts to control expansion and give added strength (Fig. 6-9). Pistons are cam ground so that the diameter across the thrust faces is larger than the diameter fore and aft of the engine. The steel struts force expansion and contraction to occur to the front and rear and thus provides a constant diameter across the thrust faces. Two compression rings and one oil control ring are used, all of which are located above the piston pin.

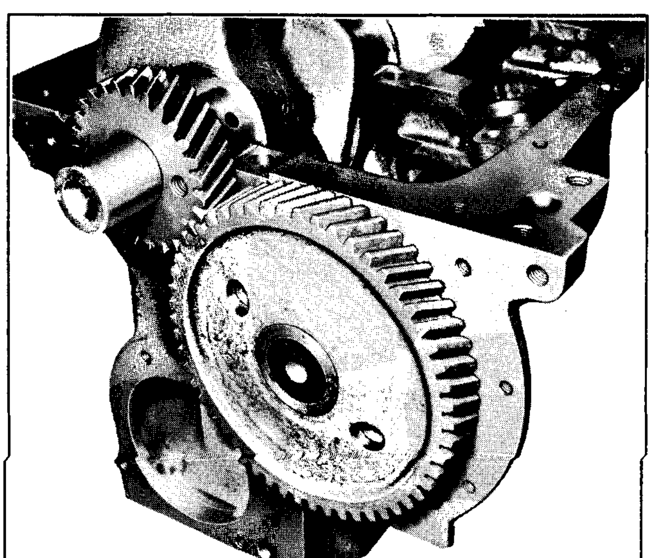


Fig. 6-8 Timing Gears

The piston top configuration is shown in Fig. 6-9.

Piston pins are offset 1/16" toward thrust side (right-hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. This feature provides quieter engine operation. 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 (Fig. 6-10). 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 maximum in durability is assured by the use of stamped steel rocker arms. In addition, all friction points in the valve train are positively lubricated.

The cylinder head has straight valve guides cast integrally (Fig. 6-10). 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 oil from entering the valve guides.

A single valve spring is used.

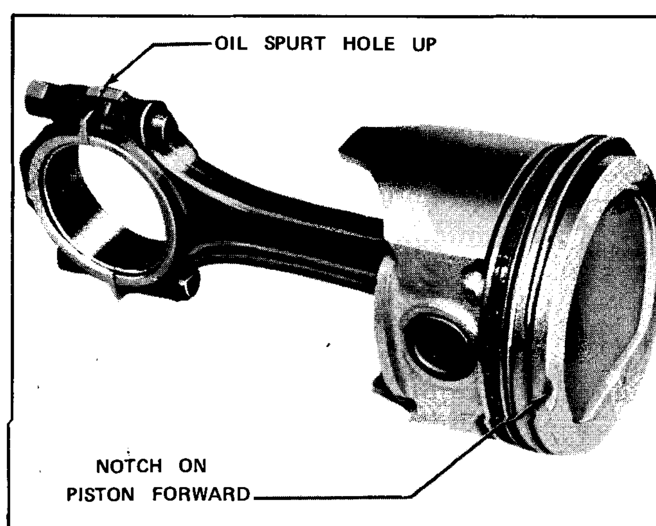


Fig. 6-9 Piston and Rod Assembly

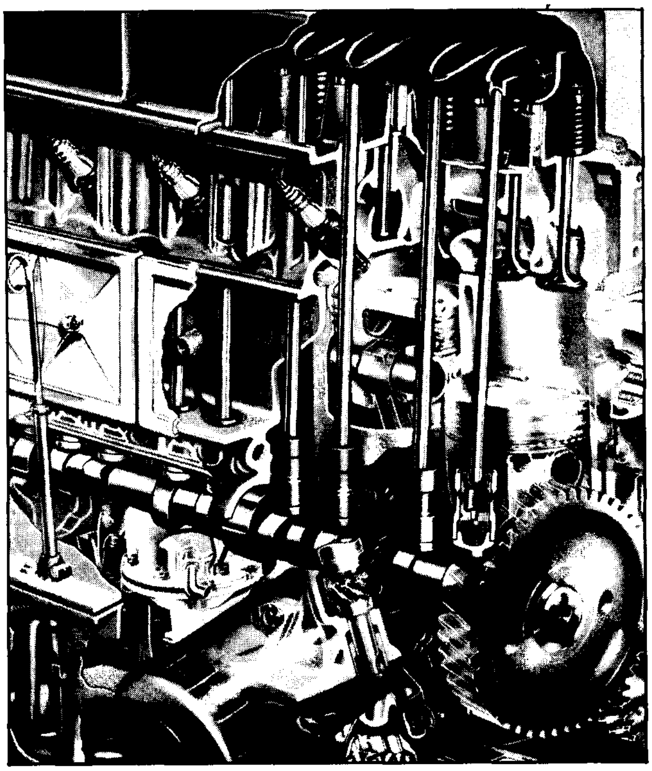


Fig. 6-10 Valve Train

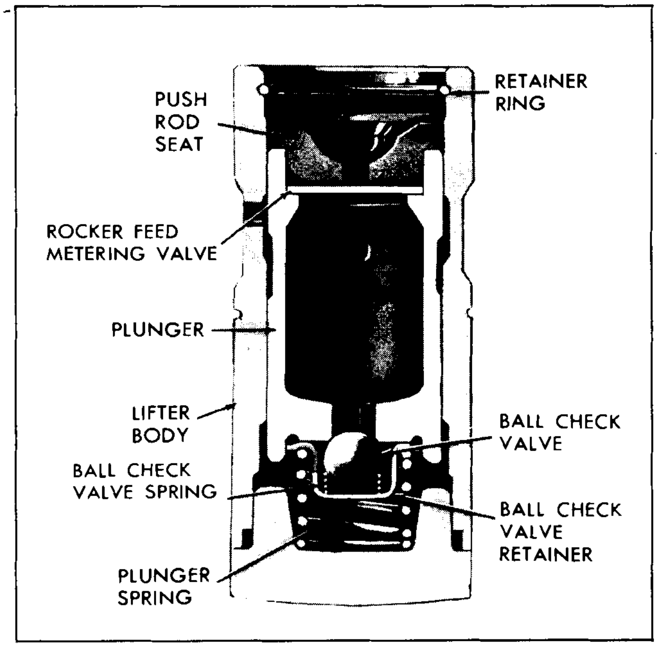


Fig. 6-11 Valve Lifter

HYDRAULIC VALVE LIFTERS

Hydraulic valve lifters are used to keep all parts of the valve train in constant contact.

The hydraulic lifter assembly (Fig. 6-11 and 6-12) includes: the cast iron body 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.

The hydraulic valve lifter functions as follows: 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 ball check valve 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.

During operation a small amount of oil leaks out of the lifter between the plunger and body. A controlled amount of leakage is important to provide continuous adjustment of the plunger position within the lifter. This leakage is called "leak-down" and must be within certain limits to provide correct operation (See "Valve Lifter - Test Leak-Down Rate").

Oil is supplied to the lifter by the cylinder block oil gallery to replace that lost through leak-down. The annular groove around the outside of the lifter body indexes with the passage drilled from the gallery to the lifter boss. Oil then enters the lifter from this groove and passes into the plunger cavity. From the plunger cavity, oil under pressure is also fed up the push rod to lubricate the friction area between the upper end of the push rod and the rocker arm and other upper valve train contact points.

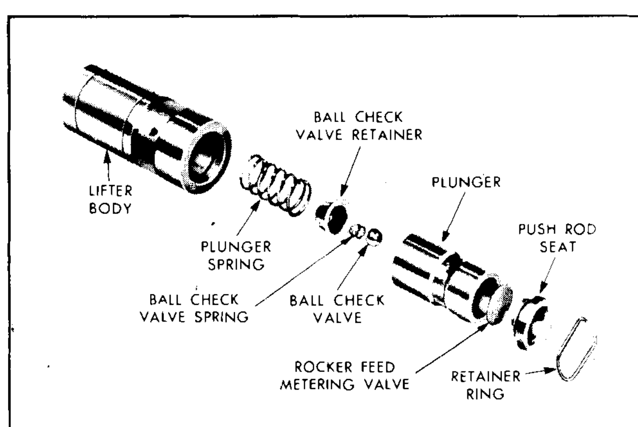


Fig. 6-12 Hydraulic Valve Lifter - Exploded View

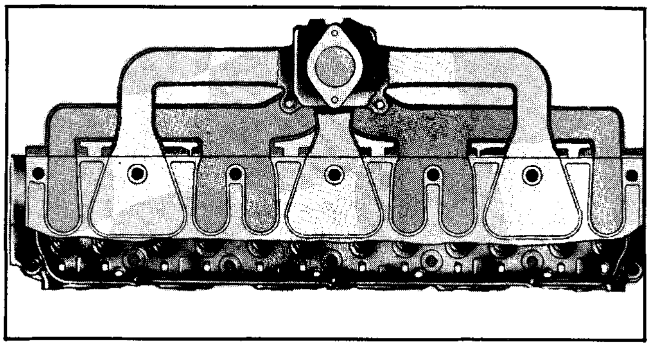


Fig. 6-13 Intake and Exhaust Manifolds

FUEL DISTRIBUTION SYSTEM

A single-barrel Monojet carburetor with an automatic choke provides fuel to the intake manifold.

The intake manifold is positioned directly above the exhaust manifold (Fig. 6-13). This design allows hot exhaust to heat the cool, incoming fuel mixture.

The side-by-side location of the intake and exhaust valves along with joined parts permit the use of a three-port intake manifold and four-port exhaust manifold (Fig. 6-13).

EXHAUST SYSTEM

The four-port, cast iron exhaust manifold contains a heat riser valve. This thermostatically controlled valve is located below the exhaust manifold in front of the exhaust pipe inlet. When the engine is cold, the valve closes, directing the exhaust upward in the exhaust manifold and causing the hot exhaust to warm the stove beneath the carburetor. The fuel mixture is warmed by passing above the stove. The heat riser valve opens as the engine warms up.

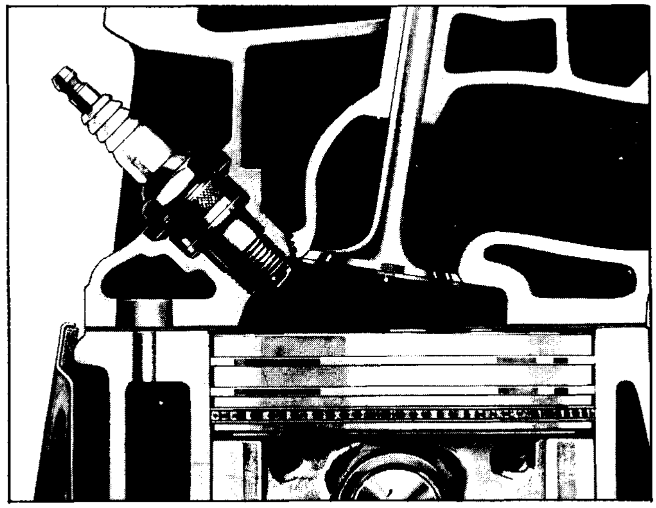


Fig. 6-14 Combustion Chamber

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.

The contoured wedge shape of the combustion chamber (Fig. 6-14) minimizes the possibility of detonation, facilitates breathing and provides swirling turbulence for smooth, complete combustion.

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°.

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.

Cleanliness is a primary factor when servicing the engine. The slightest particle of dirt that finds its way into a hydraulic lifter may cause a malfunction.

Since any dirt which may enter the oil galleries or passages in the engine could eventually get to a lifter, cleanliness should be exercised when any part of the engine is removed or disassembled.

When lifters are removed for any reason, they should immediately be placed in order in a valve lifter storage box. This is important for two reasons. First, it is the easiest way to keep the lifters clean. Second, lifters should always be replaced in the same bosses from which they were removed.

Valves, valve lifters, push rods, rocker arms, rocker arm balls and nuts should always be kept in sets and returned to their original positions. These parts will tend to mate as the engine operates and will provide more satisfactory operation when kept together. By storing lifters in a storage box and valves, push rods, rocker arms, balls and nuts in a holding stand (Fig. 6-15) whenever they are removed, they can easily be kept in sets for identification during assembly. In addition to keeping the parts in sets, the push rods should be replaced with the same end up. In other words, the same end will contact the rocker arm as before the engine was disassembled. The upper end can usually be identified by the polished surface which contacts the rocker arm. Push rods will also be polished somewhat in the area where the rod passes through the head.

When hydraulic valve lifters are disassembled, the various parts of each lifter must be kept together. This is especially important since the lifter body and plunger are selectively fitted. The use of the special tray included with cleaning tank J-5821 will aid in keeping the parts of each lifter together when lifters are being serviced.

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

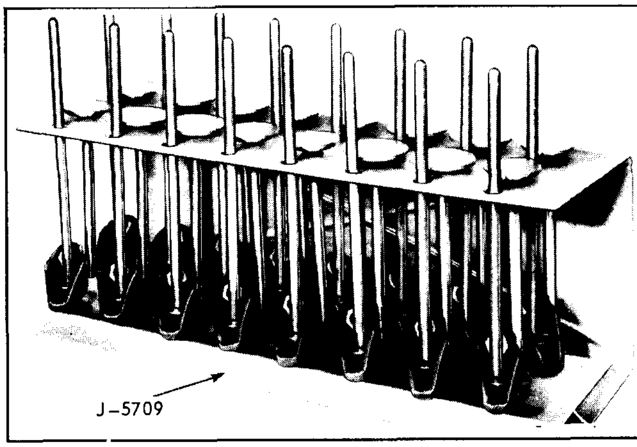


Fig. 6-15 Valve Train Holding Stand

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.

PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services connected with the engine consist of tune-up, lubrication, replacing oil filter, fuel filter, etc. Procedures and recommendations for these services will be found in appropriate sections of this manual.

SERVICE OPERATIONS ON CAR

ENGINE INSULATORS

FRONT INSULATORS

REMOVE AND REPLACE

1. Support engine with J 23515-3 adaptor and engine lifting support tool, wrapping chains around frame (Fig. 6-19). (On X Series models, it may be necessary to add washers between adapter and harmonic balancer to provide initial clearance between adapter and frame).
2. Remove insulator to engine bracket through bolts.
3. Raise engine approximately 1" above front insulators.
4. Remove front insulator by unscrewing frame bracket to insulator bolt and lifting insulator from bolt.
5. Install new insulator.
6. Lower front of engine into position and install insulator to engine bracket bolts. Tighten nuts to 45 lb. ft.

REAR INSULATOR

REMOVE AND REPLACE

1. Remove crossmember to rear insulator bolts.
2. Raise rear of engine and transmission with suitable lifting equipment.

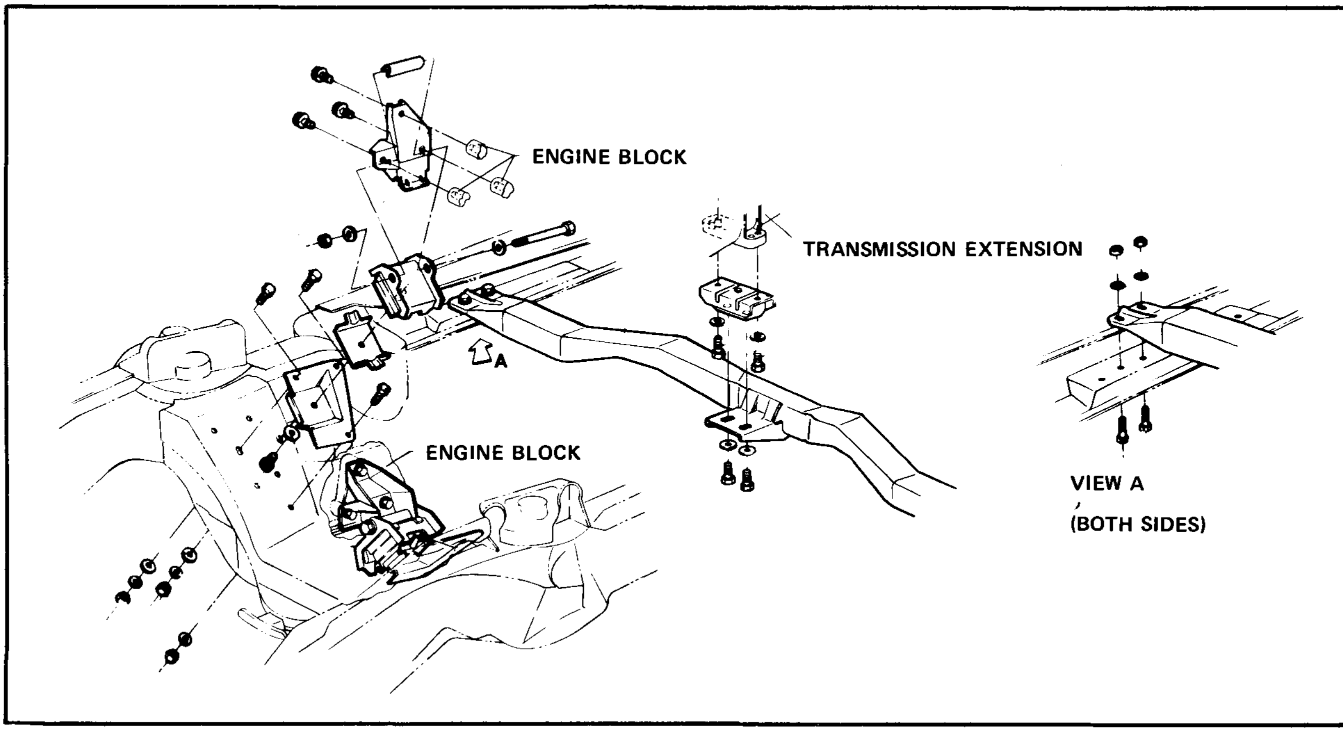


Fig. 6-16 Engine Insulators - 6 Cyl. A Series

3. Remove insulator to transmission extension bolts (Figs. 6-16, 6-17 and 6-18).

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.

DRIVE BELTS

ADJUST

Engine fan and accessory drive belts may be adjusted by use of belt tension gauge. Section 6A gives the correct specifications for the various drive belts.

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 coil, 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 upper radiator 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. Raise vehicle on hoist and drain crankcase.

12. Disconnect gas tank lines at fuel pump.

13. Disconnect exhaust pipe from manifold.

14. Remove starter.

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 and remove clutch cross shaft.

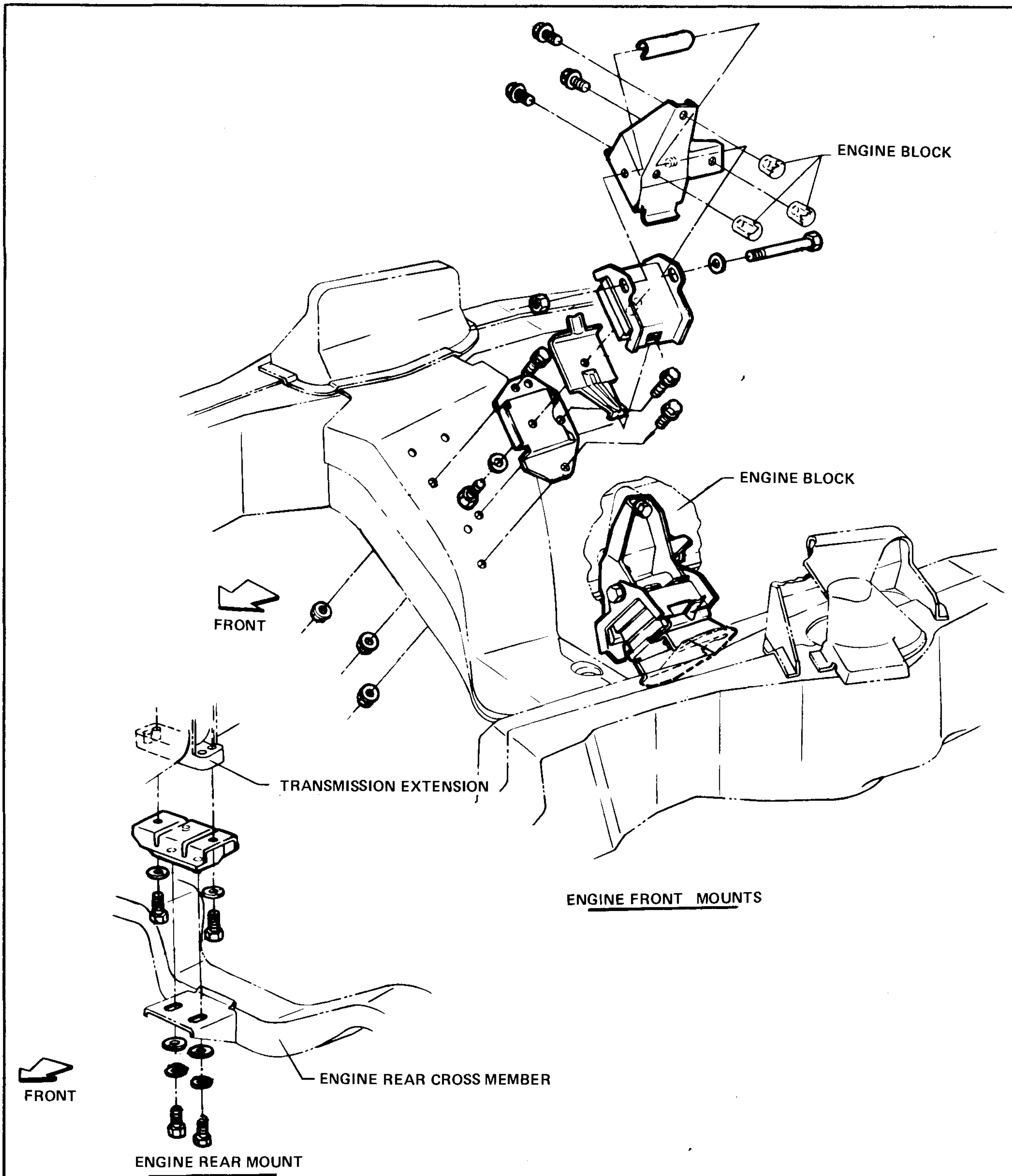


Fig. 6-17 Engine Insulators - 6 Cyl. F Series

17. Remove four lower bell housing bolts (two each side).
18. Disconnect transmission filler tube support and starter wire harness shield from cylinder head.
19. Remove two front motor mount to frame bracket bolts.
20. Lower vehicle.

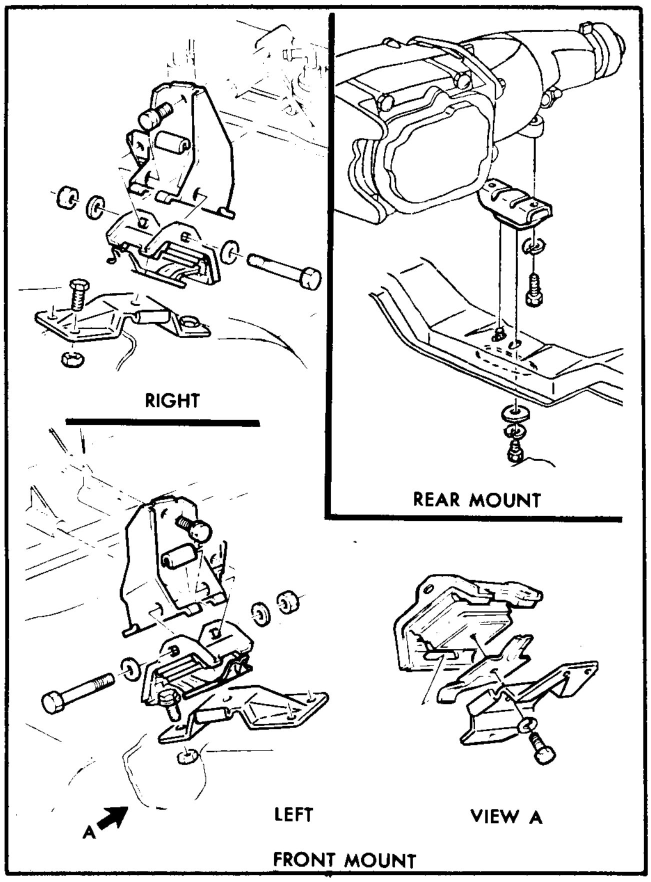


Fig. 6-18 Engine Insulators - 6 Cyl. X Series

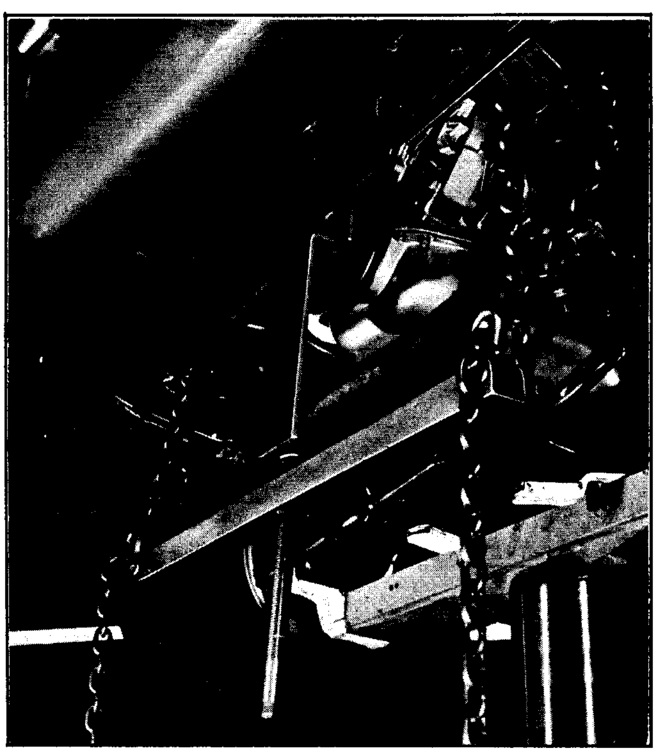


Fig. 6-19 Engine Lifting Tool Installed - Typical

21. Using jack and block of wood, support transmission.
22. Support weight of engine with chain fall.
23. Remove two remaining bell housing bolts.
24. Raise transmission slightly.
25. Position engine forward to free it from transmission; remove from car by tilting front of engine up.
26. 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 two front motor to frame bracket through bolts.
8. For remaining installation procedures, reverse steps 1 through 18.

INTAKE AND EXHAUST MANIFOLDS OR GASKETS

REMOVE

1. Remove air cleaner wing nut and air cleaner.
2. Disconnect both throttle rods at bell crank and remove throttle return spring.
3. Disconnect fuel and vacuum lines from carburetor. Disconnect thermostatic coil rod at carburetor.
4. Remove carburetor and heat shield for manifold replacement.
5. Disconnect exhaust pipe at manifold flange.

6. Remove manifold to head attaching bolts and clamps and remove manifolds as an assembly.

REPLACE

1. Clean gasket flanges on cylinder head and manifolds.
2. Check for cracks on manifold castings.
3. If necessary to replace either intake or exhaust manifold, separate them by removing 1 attaching bolt and 2 nuts at center of assembly. Reassemble manifolds using new gasket. Tighten finger tight and torque to 25 lb. ft. after assembly to cylinder head.
4. Position new gaskets over manifold end studs on head and carefully install the manifold in position, making sure the gaskets are in place.
5. Install bolts and clamp while holding manifold in place with one hand.
6. Tighten center clamp bolts to 30 lb. ft. and end bolts to 20 lb. ft. (Fig. 6-20).
7. Connect exhaust pipe to manifold using a new packing seal.
8. Reverse Steps 1-4 of Removal to complete installation procedure.

PUSH ROD COVER OR GASKET

REMOVE

1. Loosen coil to block attaching screw and rotate coil upwards for clearance.

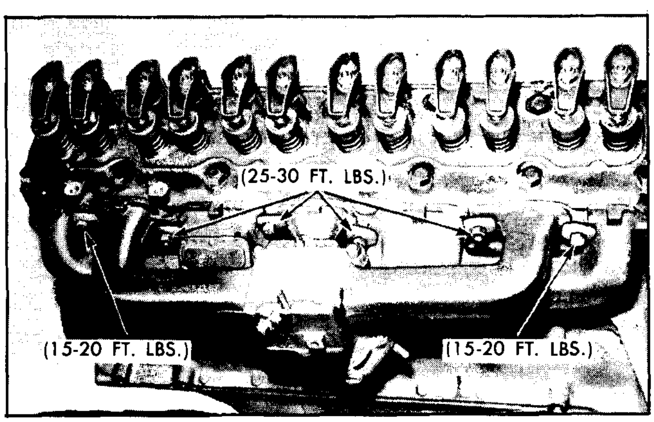


Fig. 6-20 Manifold Attaching Points

2. Remove push rod cover screws and remove cover.

REPLACE

1. Place new gasket in push rod cover.
2. Install cover to block.
3. Return coil to original position and tighten attaching screw.

VALVE SPRINGS, SHIELD OR SEALS

REMOVE

1. Remove rocker arm cover.
2. Remove rocker arm.
3. Remove spark plug from cylinder of valve(s) to be serviced.
4. After removing rocker arm, thread rocker arm nut on rocker arm stud. Insert slotted end of tool J 22891 under rocker arm nut. Compress valve spring (Fig. 6-21) and hold to allow removal of valve spring retainer cup locks, valve spring retainer cup shield and valve stem seal.
5. Remove valve spring.

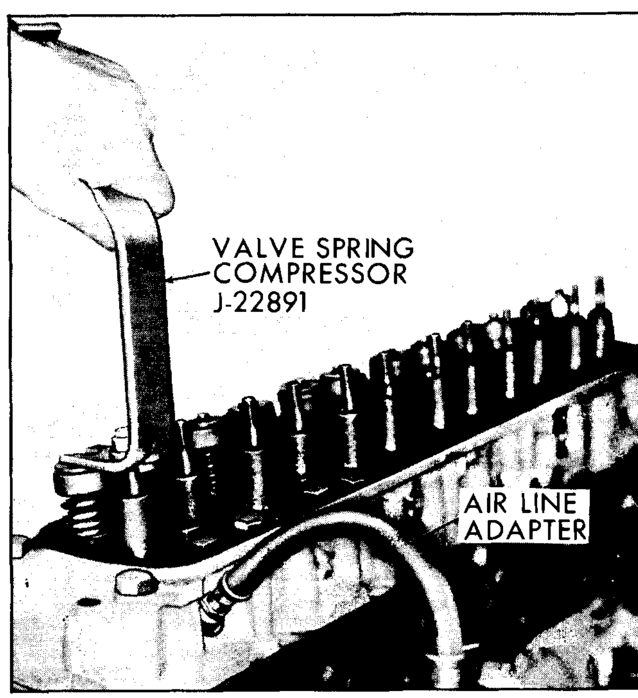


Fig. 6-21 Valve Spring Compressed

REPLACE

1. Install any new parts by reversing removal procedure steps 2-5.
2. Install spark plug after removing valve train play.
3. With lifter on base circle of camshaft, turn rocker arm down until valve train play is removed. Turn nut down one additonal turn (Fig. 6-22).
4. Install rocker arm cover.

PUSH ROD OR VALVE LIFTER

REMOVE

1. Remove rocker arm cover.
2. Loosen rocker arm and rotate it for clearance from push rod.
3. Remove push rod and store so that each push rod may be installed in original location.

   If hydraulic valve lifters are to be removed, proceed as follows:

4. Remove spark plug from cylinder of valve train being serviced.
5. Disconnect distributor primary lead.

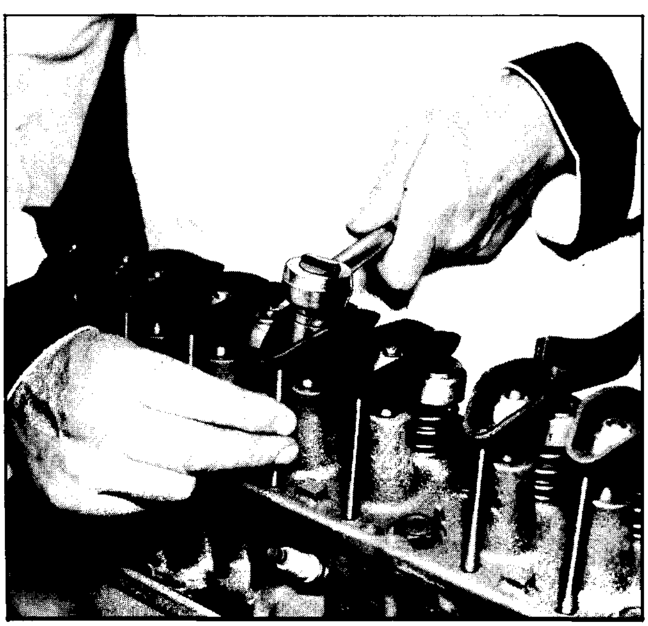


Fig. 6-22 Adjusting Valve Train Lash

6. Loosen coil mounting screw and rotate coil upwards.
7. Remove push rod covers.
8. Remove lifter. Hydraulic valve lifter remover J-3049 may facilitate removal of lifter. Store lifters so that they can be installed in exactly the same location.

   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 original lifter boss.
2. Replace push rod exactly as removed.
3. Position rocker arm on push rod.
4. With lifter on base circle of camshaft, tighten rocker arm nut until valve train play is removed. Turn nut down one additional turn (Fig. 6-22).
5. Install spark plug.
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.

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. 6-23).

   It may be necessary to unseat lifter ball, using plunger unloader, J-5097, before plunger can be pushed down.

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. 6-24) 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 (Fig. 6-25).

   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

Wash tank J-5821 is recommended for cleaning valve lifter parts. This tank consists of two chambers, a tray and a cover. One chamber is for cleaning solvent and the other is for kerosene. Whenever the tank is not being used (and when parts are soaking), the cover should be installed.

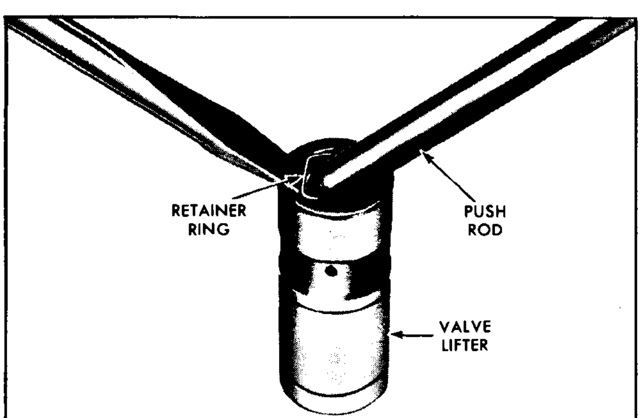


Fig. 6-23 Removing Push Rod Seat Retainer

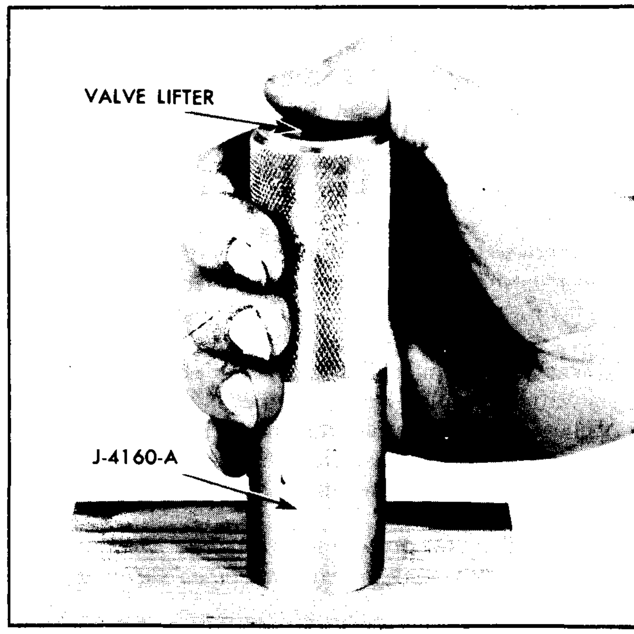


Fig. 6-24 Removing Stuck Plunger

1. Before placing tray of parts in cleaning solvent, first immerse it in kerosene chamber to remove as much engine oil as possible. (This reduces contamination of solvent, thus prolonging its useful life).

2. Submerge tray in cleaning solvent and allow to soak for approximately one hour. More time may be required, depending on varnish condition and effectiveness of solvent. Light agitation of tray in solvent at 10-15 minute intervals will hasten cleaning action.

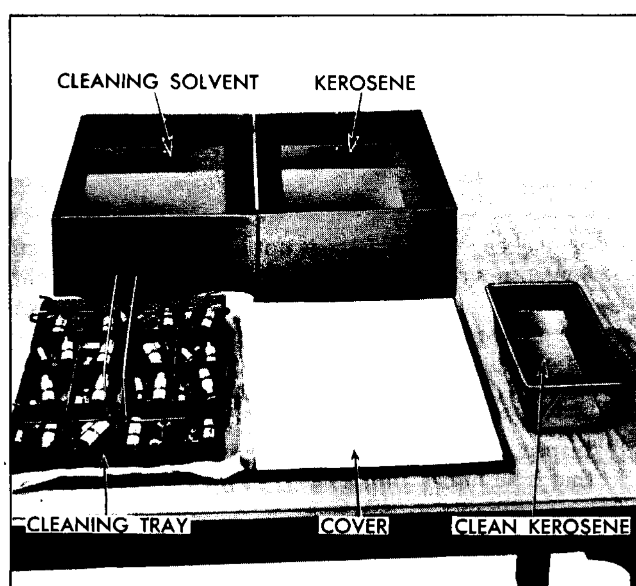


Fig. 6-25 Lifter Wash Tank and Tray

3. After varnish has dissolved or has been sufficiently softened to permit removal by wiping, suspend tray above solvent, utilizing hooks on tray handles. Allow tray and parts to drain for a brief period.

4. Rinse tray of parts in kerosene chamber to cut solvent and to avoid injury to hands (from solvent).

5. Remove tank cover and place tray of parts on cover in front of tank. A shop towel under tray and clean paper on remainder of cover will ensure cleanliness.

6. Working on one lifter at a time and using clean, lint-free cloths, thoroughly wipe off lifter parts. Clean plunger and external and internal surfaces of body with a hard wiping action. A bristle brush may be used to clean internal surface of lifter body.

   CAUTION: *Do not use wire brush or sand paper, as these may damage machined surfaces.*

   Absolute cleanliness can be assured if each lifter is inspected and assembled after cleaning, but before proceeding to the next lifter.

7. Inspect lifter body. Both inner and outer surfaces of lifter body should be inspected for scoring. Lifter assembly should be replaced if body is roughly scored, grooved, or galled. Inspect cam contact surface on lower end of lifter body. Replace lifter assembly if this surface is excessively worn, galled or otherwise damaged.

8. Inspect lifter plunger. Using a magnifying glass, inspect the check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with a rough, satiny finish will cause the plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with a fingernail are causes for replacing the lifter assembly. This rule does not apply to the slight edge which may sometimes be present where the lower end of plunger extends below the ground inner surface of the body. This edge is not detrimental unless it is sharp or burred.

   A blackened appearance is not a defective condition. Sometimes the discoloration serves to highlight slight grinder chatter marks and give the outer surface of the plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore, it may be disregarded.

9. Inspect push rod seat for roughness and to ensure that hole in center is open.

10. Inspect valve lifter ball. Carefully examine ball for nicks, embedded material or other defects which would prevent proper seating. Such defects may cause intermittently noisy lifter operation. Also inspect plunger face of ball retainer for excessive wear.

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 6-26 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.

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. 6-27) is designed to test leak-down rate of lifters to determine whether or

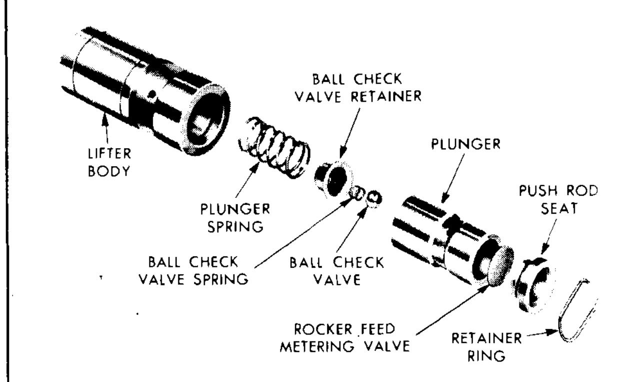


Fig. 6-26 Hydraulic Valve Lifter - Exploded View

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. 6-27). Lifter is satisfactory if rate is between 12 and 65 seconds.

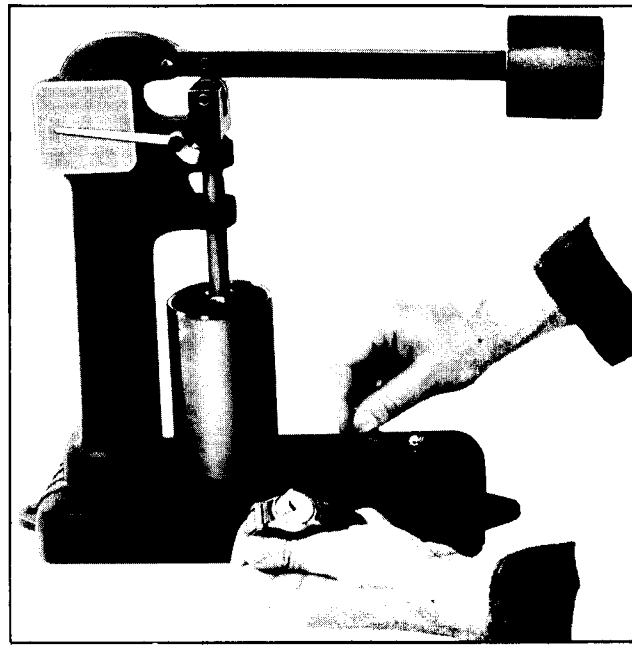


Fig. 6-27 Testing Leak-Down Rate

CYLINDER HEAD OR GASKET

REMOVE

1. Drain cooling system and remove air cleaner.

2. Disconnect accelerator pedal rod at bell crank on manifold and fuel and vacuum lines at carburetor.

3. Remove carburetor and heat shield.

4. Disconnect exhaust pipe at manifold flange, then remove manifold bolts and clamps and remove manifolds and carburetor as an assembly.

5. Remove fuel and vacuum line retaining clip from water outlet and disconnect wire harness from temperature sending unit and coil, leaving harness clear of clips on rocker arm cover.

6. Disconnect radiator hose at water outlet housing and battery ground strap at cylinder head.

7. Disconnect spark plug wires and remove spark plugs. Disconnect coil to distributor primary wire lead at coil and remove coil.

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.

2. Carefully guide cylinder head into place over dowel pins and gasket (Fig. 6-28).

3. Coat threads of cylinder head bolts with sealing compound, and install finger tight.

4. Tighten the cylinder head gradually with a torque wrench. Tighten bolts following sequence in Fig. 6-29. The final torque should be 95 lb. ft.

5. Install valve push rods through openings in the cylinder head and seat them in lifter sockets.

6. Install rocker arms, balls and nuts and tighten rocker arm nuts until all push rod play is taken up (Fig. 6-22).

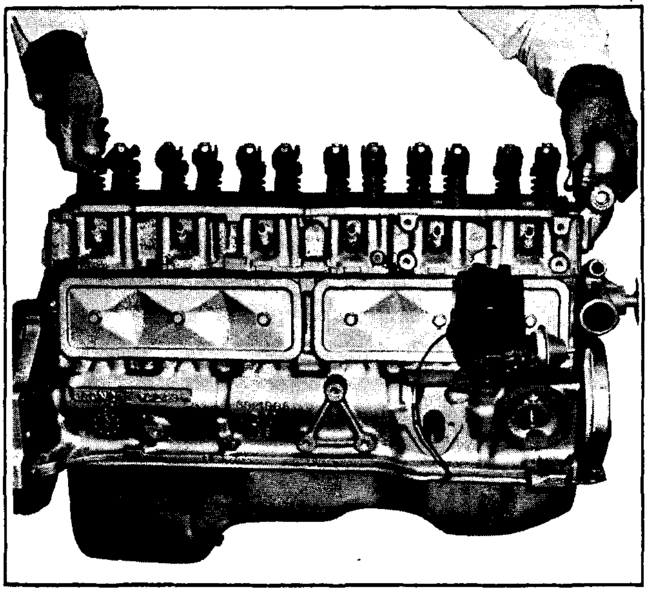


Fig. 6-28 Installing Cylinder Head

7. Connect radiator hose.

8. Clean all spark plugs with abrasive-type cleaner, inspect for damage and set the gap at .035" using a wire gauge.

9. Install coil, then connect temperature sending unit and coil primary wires, and connect battery ground cable at cylinder head.

10. Clean manifold gasket surfaces and install new gasket over manifold studs. Position manifold and slide it into place over the studs, making sure it seats against the gasket. Install bolts and clamps and tighten as shown in Fig. 6-30.

11. Install carburetor and heat shield.

12. Connect throttle linkage and adjust as shown in Section 6B.

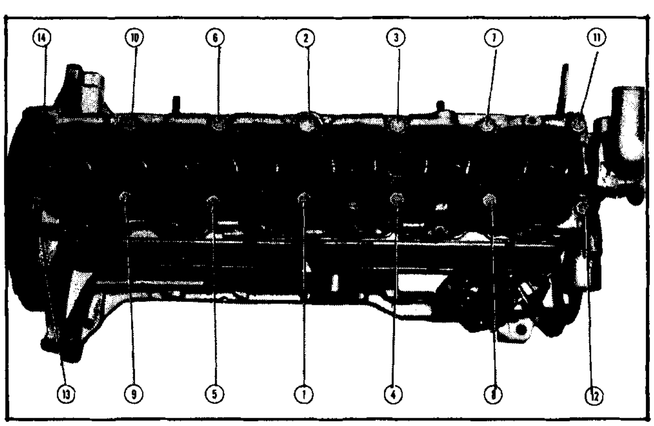


Fig. 6-29 Cylinder Head Tightening Sequence

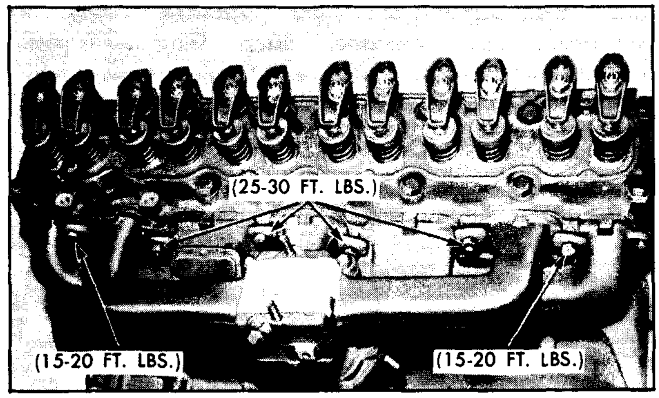


Fig. 6-30 Manifold Attaching Points

13. Connect fuel and vacuum lines to carburetor and install lines in clip at water outlet.

14. Fill cooling system and check for leaks.

15. With lifter on base circle of camshaft, tighten rocker arm nut until valve train play is removed. Tighten nuts one more turn.

16. Install spark plugs and tighten to 15 lb. ft.

17. Install rocker arm cover and position wiring harness in clips on cover.

18. Clean and install air cleaner.

ROCKER ARM STUDS

Rocker arm studs that have damaged threads may be replaced with standard studs. If the studs are loose in the head, oversize studs, available in .003" and .013" oversize, may be installed after reaming the holes with tool J-5715 for .003" oversize and J-6036 for .013" oversize.

REMOVE

1. Remove rocker arm cover.

2. Remove rocker arm.

3. If rocker arm is stripped, refer to Fig. 6-31 for rethreading and Fig. 6-32 for removing rocker arm stud.

4. Ream rocker arm stud hole if oversize stud is to be used (Fig. 6-33).

REPLACE

1. Coat press-fit area of stud with hypoid axle lubricant.

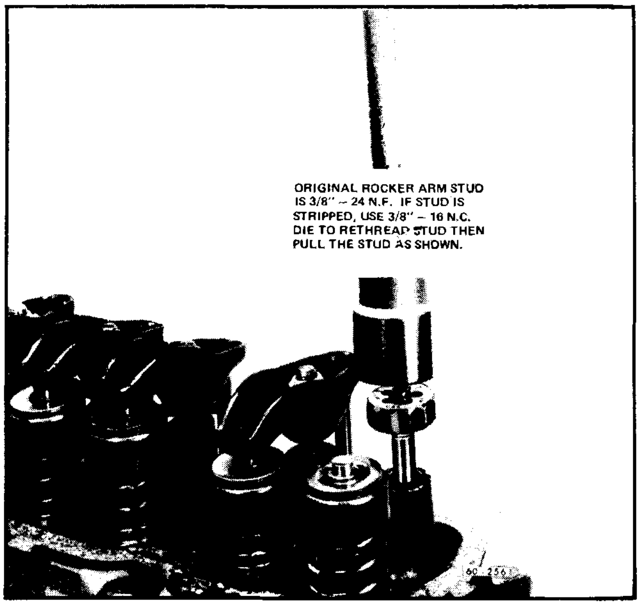


Fig. 6-31 Rethreading Stripped Rocker Arm Stud

2. Install new stud, using tool J-6880. Tool should bottom on head (Fig. 6-34).

3. Install push rod and rocker arm.

4. Remove spark plug from cylinder of valve train being serviced.

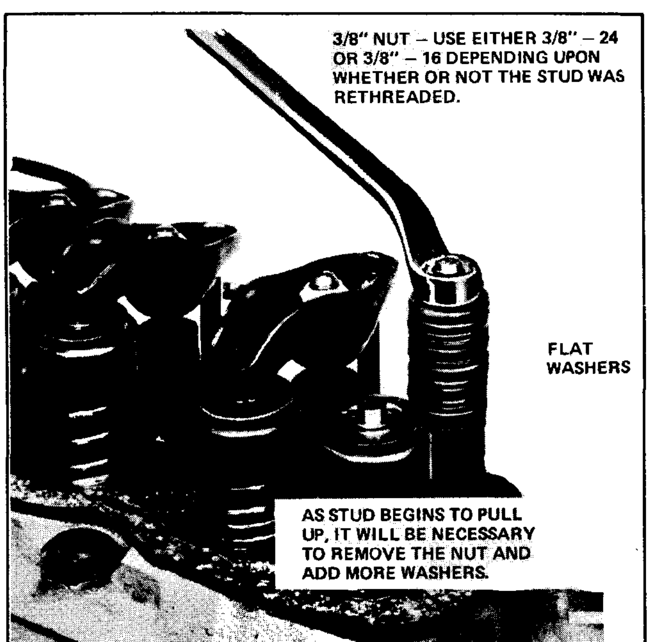


Fig. 6-32 Removing Rocker Arm Stud

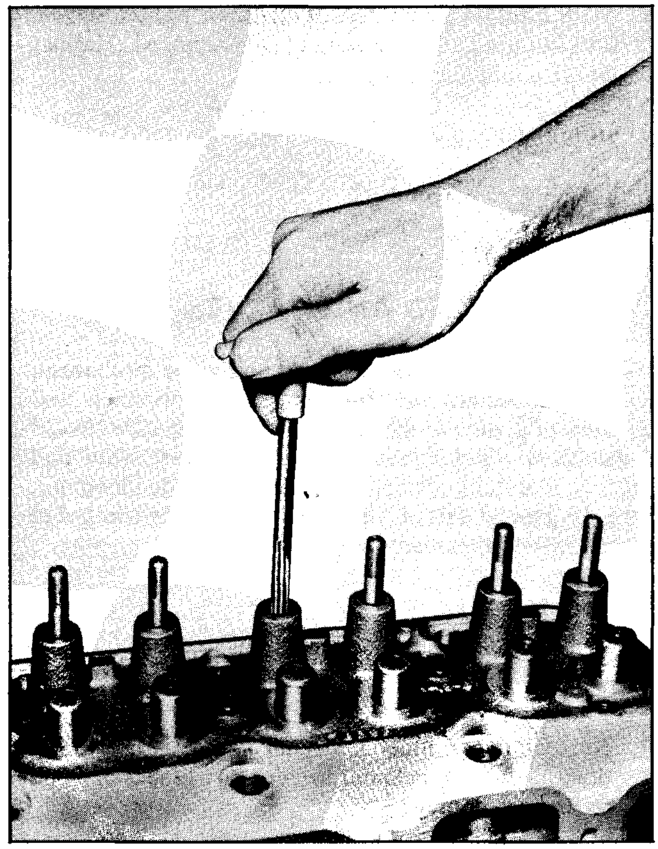


Fig. 6-33 Reaming Rocker Arm Stud Hole

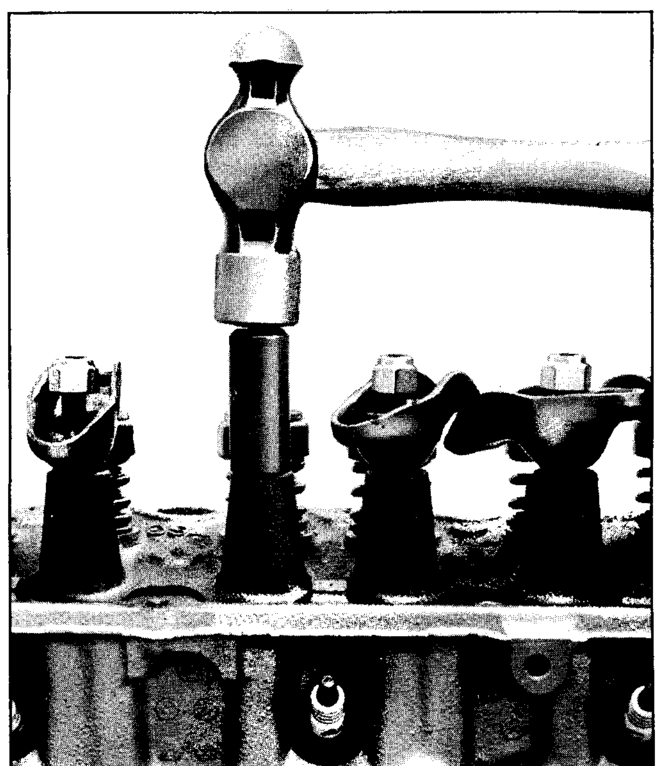


Fig. 6-34 Installing New Rocker Arm Stud

5. With lifter on base circle of camshaft tighten rocker arm nut until all valve train play is removed. Tighten nut one additional turn.

6. Install spark plug.

7. Install rocker arm cover.

CYLINDER HEAD AND VALVES

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, valve seats of correct width and correct valve adjustment.

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 arm nuts, ball seats and rocker arms.

3. Using tool J-22891, compress the valve springs and remove valve locks. Remove spring caps, spring seats, oil seals, springs and spring dampers (Fig. 6-35).

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.

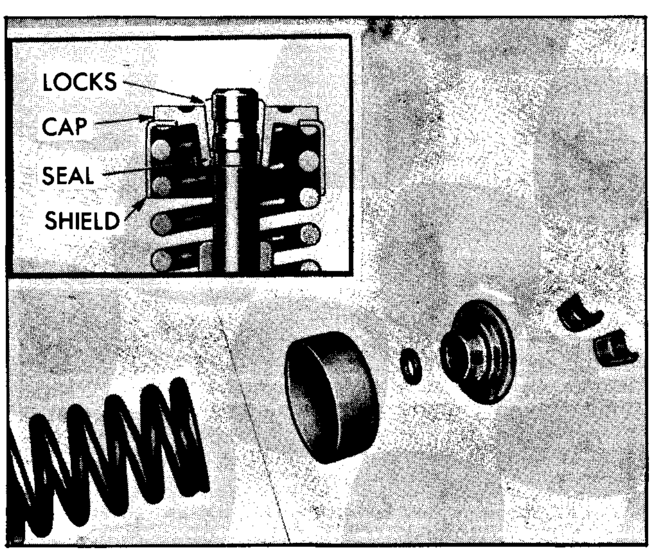


Fig. 6-35 Upper Valve Train Parts

5. Remove water outlet and thermostat, then remove thermostat housing.

CLEAN AND INSPECT

1. Clean all carbon from combustion chambers and valve ports.

2. Thoroughly clean the valve guides using tool J-8101 (Fig. 6-36).

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.

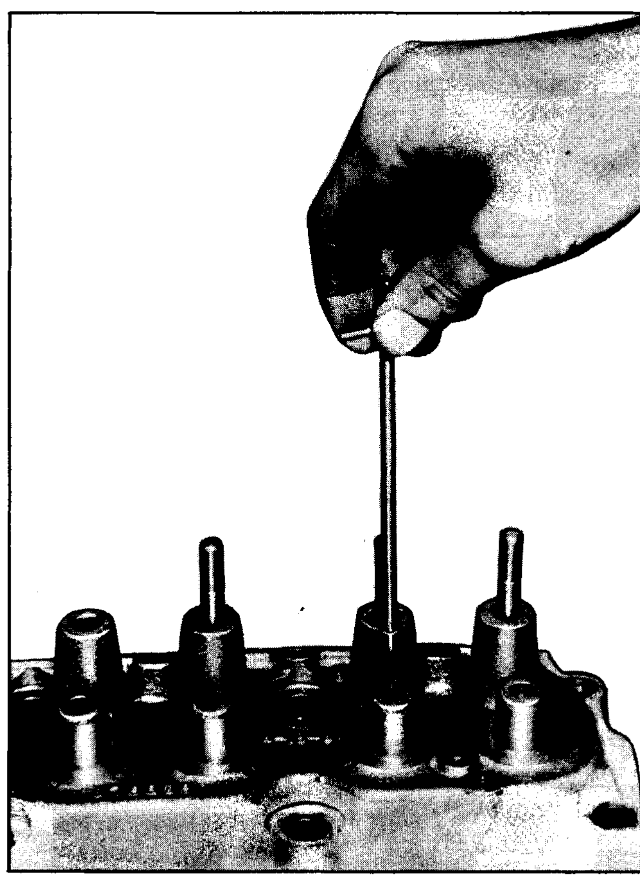


Fig. 6-36 Cleaning Valve Guide Bore

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).

   Intake valve stem-to-bore clearance should be .001" to .003" while exhaust stem clearance should be .002" to .004". By using a micrometer and a suitable telescope hole gauge, check the diameter of the valve stem in three places; top, center and bottom. Insert telescope hole gauge 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. 6-37).

10. Check valve spring tension with suitable tester (Fig. 6-38).

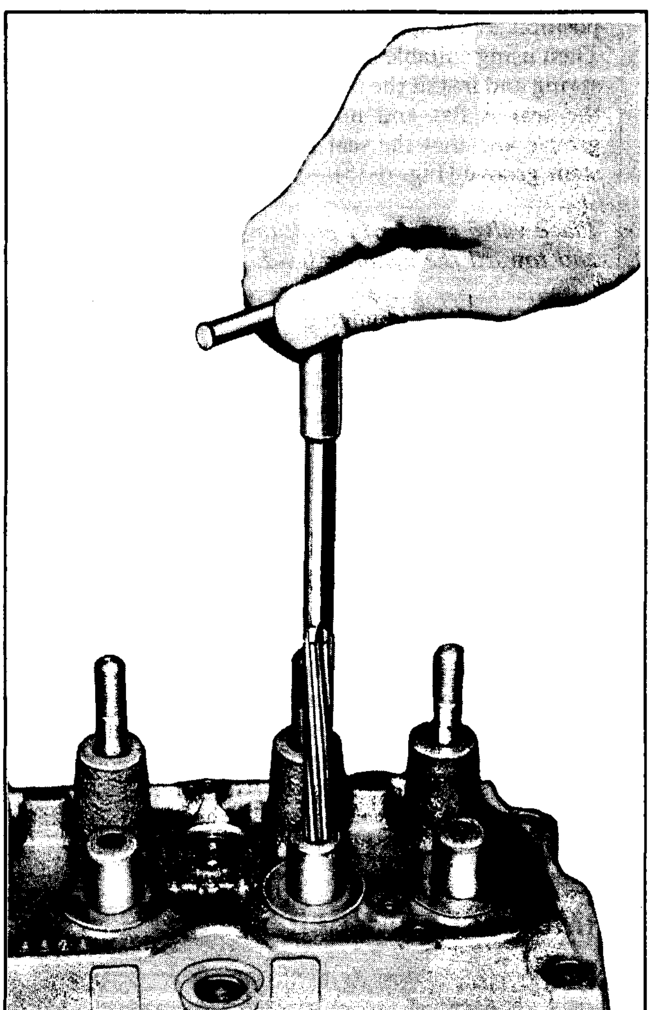


Fig. 6-37 Reaming Valve Guide Bore

Fig. 6-38 Checking Valve Spring Tension

11. Springs should be checked by compressing to a height of 1.66", at which height it should check 56-64 pounds. Weak springs affect power and economy and should be replaced if below 45 pounds.

12. Check valve lifters for free fit in block. The end that contacts the camshaft should be smooth. If this surface is worn or rough, the lifter should be replaced.

VALVE GUIDE BORE

RECONDITION

Valves with .003" oversize stems are available for inlet and exhaust valves. Use the 3/8" diameter reamer sizes, which are: J-8814, Standard and J-5830-1, .003" Oversize.

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.

Intake and exhaust valve seat angle is 46°, while both valve face angles are 45°. This will provide hairline contact between valve and seat to provide positive sealing and reduce build-up of deposits on seating surfaces (Fig. 6-39).

CAUTION: *DO NOT USE REFACING EQUIPMENT EXCESSIVELY; only enough material should be removed to true up surfaces and remove pits. The valve head will run hotter as it's thickness is diminished; therefore, if valve face cannot be cleaned up without grinding to a point where outside diameter of valve has a sharp edge, the valve should be replaced. Whenever it is necessary to replace a valve, the new valve should be of the same stem diameter as the valve removed (unless the valve guide is reamed to provide proper fit).*

2. Width of exhaust valve seats should be .0625" to .0938". Intake valve seats should be .0313" to .0625" wide. If seat width is excessive, it should be narrowed by grinding with a flat stone. This is the only method that should be used to narrow the seat.

3. Check concentricity of valve seat and valve guide by using a suitable dial indicator or prussian blue. When using a dial indicator, total runout should not exceed .002".

   When prussian blue is used, a light coat should be applied to the face of the valve only and the valve rotated in its seat. If blue appears all the way around the valve seat, the valve seat and the valve guide are concentric with one another.

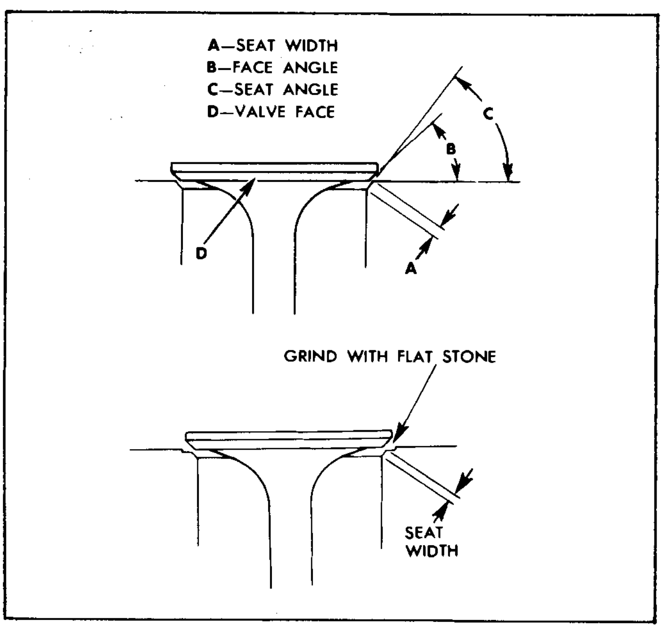


Fig. 6-39 Valve Seat and Face Angles

4. Check concentricity of valve stem and valve face. After cleaning prussian blue from valve and seat lightly coat valve seat with prussian blue again and rotate valve in guide. If blue appears all the way around the valve, the valve stem and face are concentric with each other.

   Both tests in steps 2 and 3 are necessary to ensure proper valve seating.

   If it is necessary to grind any pits from rocker arm end of valve stem, feed end squarely against grinding wheel. Only the extreme end of the valve stem is hardened to resist wear. Do not grind end excessively.

ASSEMBLE

1. Starting with No. 1 cylinder, place the exhaust valve in the port and place the valve spring and cap in position. Place spring and rotator on exhaust valves. Then using suitable spring compressor, compress the spring and install the 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. 6-35).

   Place valve springs in position with the closed coil end toward the cylinder head.

2. Assemble the remaining valves, valve springs, shields, spring caps, oil seals and valve locks in the cylinder head. Check seals by placing a vacuum cup over valve stem and cap, squeeze vacuum cup to make sure no oil leaks past oil seal.

3. Install cylinder head as previously described.

VALVE SPRING INSTALLED HEIGHT

Check the installed height of the valve springs, using a narrow, thin scale to measure from the top of the shim, or spring seat, in the head to the top of the valve spring shield. If this is found in excess of 1-23/32", install a valve spring seat shim approximately 1/16" thick above the spring seating surface in the head. At no time should the spring be shimmed to give an installed height of less than 1-21/32" (Fig. 6-40).

HARMONIC BALANCER

REMOVE

1. Drain cooling system and disconnect radiator hoses at radiator.

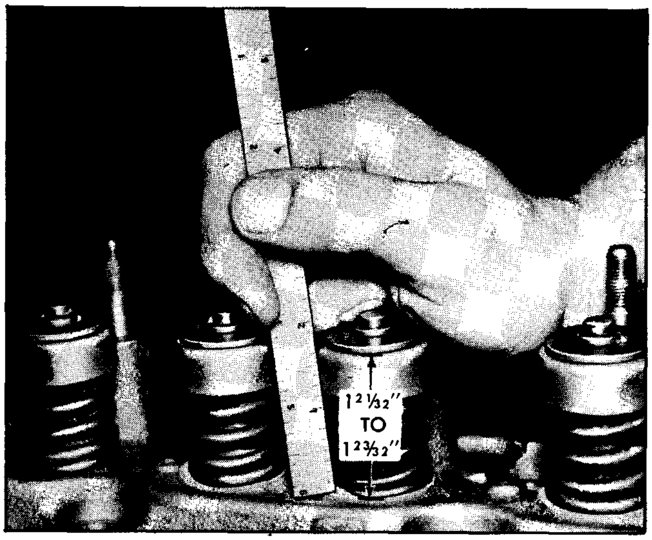


Fig. 6-40 Checking Valve Spring Installed Height

2. Remove fan and water pump pulley.

3. Remove radiator core and fan belt.

4. Install tool J-6978 to balancer and turn puller screw to remove balancer (Fig. 6-41). Then remove tool from balancer.

REPLACE

1. Coat front cover oil seal contact area of balancer with engine oil.

2. Attach balancer installer tool J-22197 to balancer (Fig. 6-42).

3. Position balancer on crankshaft and drive into position until it bottoms against crankshaft gear.

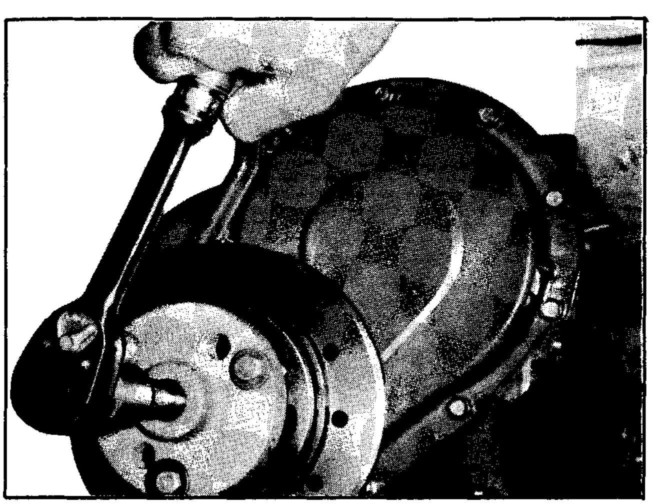


Fig. 6-41 Removing Harmonic Balancer

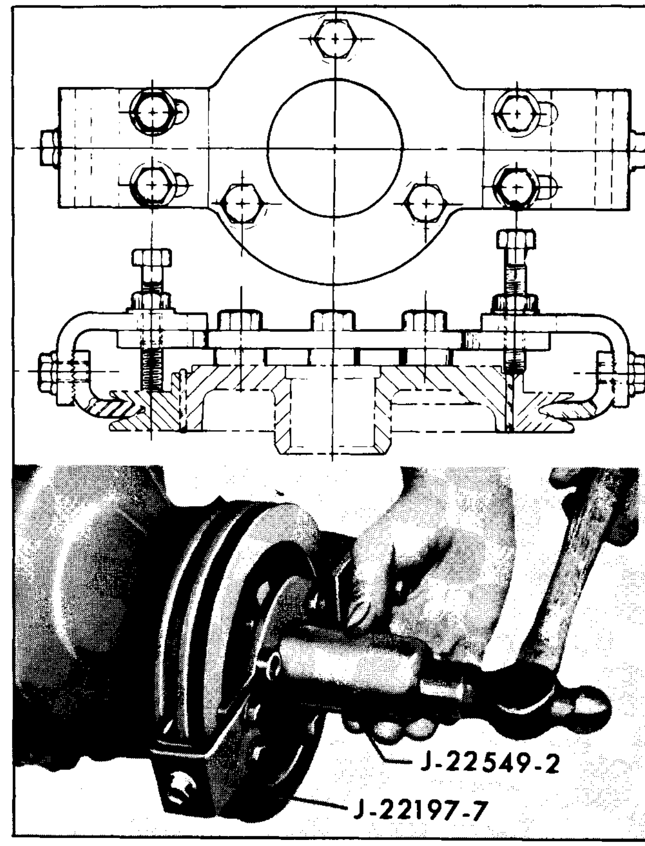


Fig. 6-42 Installing Harmonic Balancer

4. Install water pump pulley, fan and fan belt and adjust belt tension (see Section 6A).

5. Install radiator core and connect radiator hoses.

6. Fill cooling system and check for leaks.

TIMING GEAR COVER

REMOVE

1. Remove harmonic balancer as previously described.

2. Loosen oil pan bolts and let oil pan rest against front crossmember.

3. Remove timing gear cover attaching screws and remove cover and gasket.

OIL SEAL

REPLACE

(Seal can also be replaced with timing gear cover installed.)

1. After removing harmonic balancer, pry seal out of cover with a large screwdriver.
2. Install new lip seal with lip toward inside of cover and drive it into position with tool J-23042 (Fig. 6-43).

OIL NOZZLE

REPLACE

1. Remove nozzle with pliers (Fig. 6-44).
2. Drive new nozzle in place using a suitable light plastic or rubber hammer.

TIMING GEAR COVER

REPLACE

1. Clean gakset surfaces on block and cover.
2. Install centering tool J-23042 over end of crankshaft.
3. Coat the gasket with light grease and place a new cover gasket in position on block with light grease.
4. Install cover over centering tool (Fig. 6-45) and install cover screws. Torque screws to 7 lb. ft. Remove centering tool.

   It is important that centering gage be used to align cover, so that harmonic balancer installation will not damage seal, and to position seal to seal evenly around balancer hub surface.

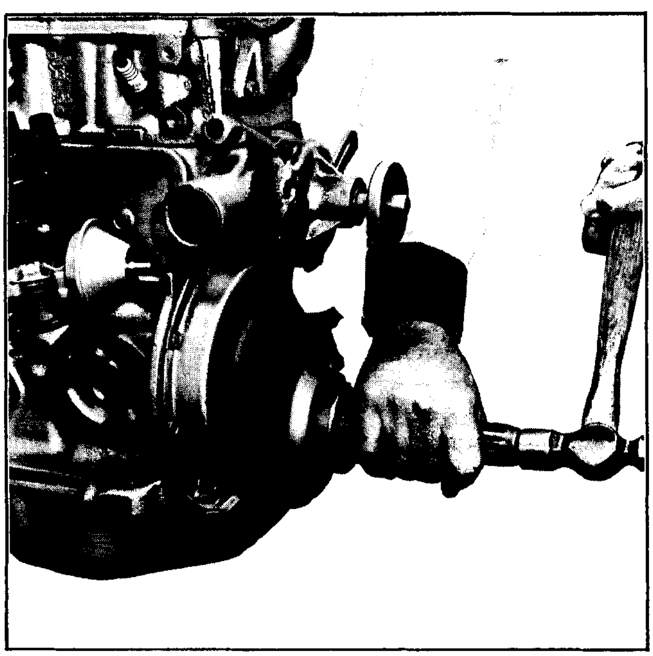


Fig. 6-43 Installing Timing Cover Oil Seal

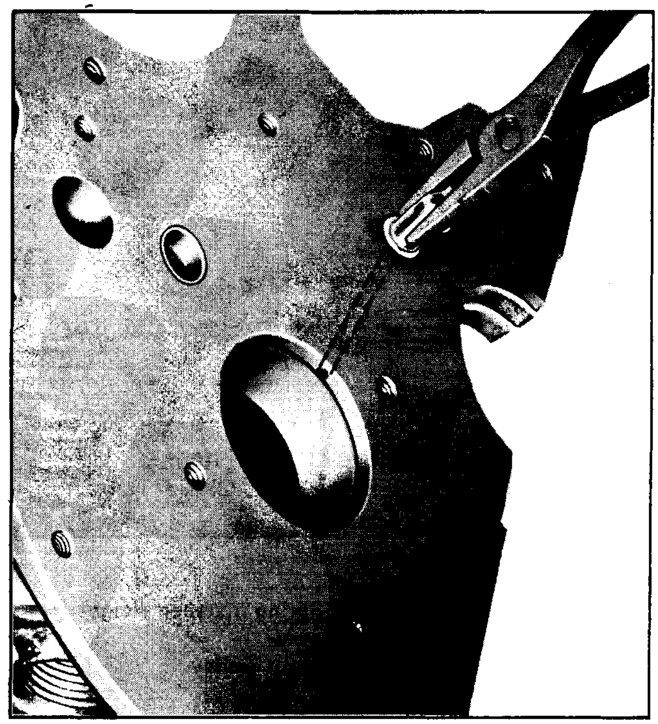


Fig. 6-44 Removing Timing Gear Oil Nozzle

5. Move oil pan into position and tighten bolts.
6. Install harmonic balancer as previously described.

CAMSHAFT

REMOVE

1. Drain crankcase and radiator.
2. Remove radiator as described in Section 6A.
3. Remove fan and water pump pulley.
4. Remove grille assembly (See Sec. 14).

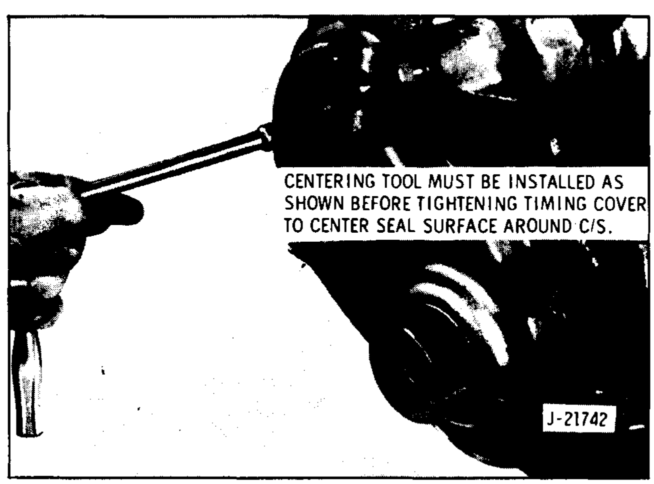


Fig. 6-45 Installing Timing Gear Cover

5. Remove valve cover and gasket, loosen valve rocker arm nuts and pivot rocker arms clear of push rods.

6. Remove distributor, fuel pump and spark plugs.

7. Remove coil, push rod covers and gasket. Remove push rods and valve lifters.

8. Remove harmonic balancer using tool J-6978. Loosen oil pan bolts and allow oil pan to drop away from timing gear cover. Remove timing gear cover.

9. Remove the two camshaft thrust plate screws by working through holes in the camshaft gear (Fig. 6-46).

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 J-947 and adaptor J-22227 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. 6-47).

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:

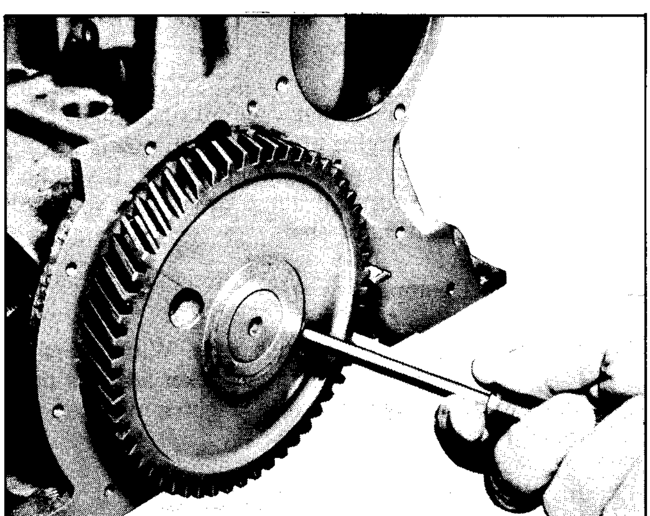


Fig. 6-46 Removing Camshaft Thrust Plate Screws

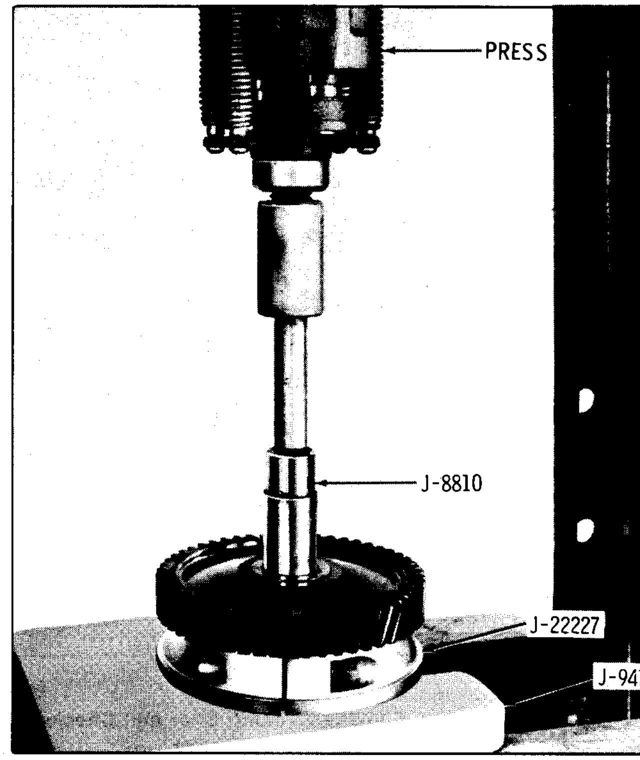


Fig. 6-47 Removing Camshaft Timing Gear

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 using tool shown in Fig. 6-48 until it bottoms against the gear spacer ring. The end clearance of the thrust plate should be .001" to .005" (Fig. 6-48). If less than .001", the spacer ring should be replaced. If more than .005", the thrust plate should be replaced.

REPLACE

1. Install the camshaft assembly in the engine block, being careful not to damage bearings or cams.

2. Turn crankshaft and camshaft so that the valve timing marks on the gear teeth will line up. Drive camshaft and gear on using J-5154. Install camshaft thrust plate to block screws and tighten to 5-8 lb. ft.

3. Check camshaft and crankshaft gear runout with a dial indicator (Fig. 6-49). The camshaft gear runout should not exceed .004" and the crankshaft gear runout should not exceed .003".

4. If gear runout is excessive, the gear will have to be removed and any burrs cleaned from the shaft or the gear replaced.

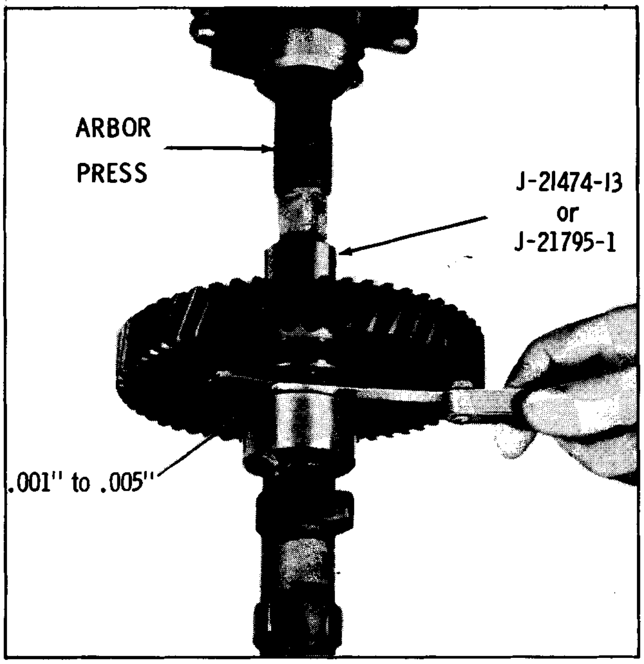


Fig. 6-48 Installing Camshaft Timing Gear and Checking Thrust Plate End Clearance

5. Check the backlash between the timing gear teeth with a dial indicator (Fig. 6-50). The backlash should not be less than .004" nor more than .006".

6. Install timing gear cover and gasket. Move oil pan up into position and tighten oil pan bolts.

7. Install harmonic balancer, using harmonic balancer installer tool J-22197.

8. Line up keyway in balancer with key on crankshaft and drive balancer onto shaft until it bottoms against crankshaft gear, using tool J 22549.

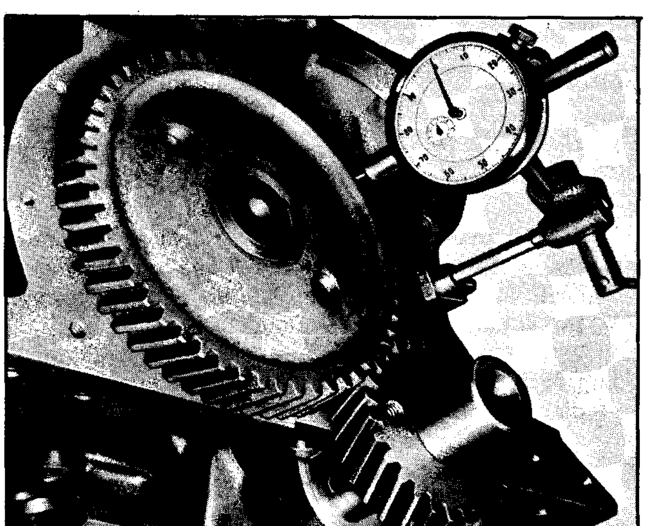


Fig. 6-49 Checking Camshaft Gear Runout

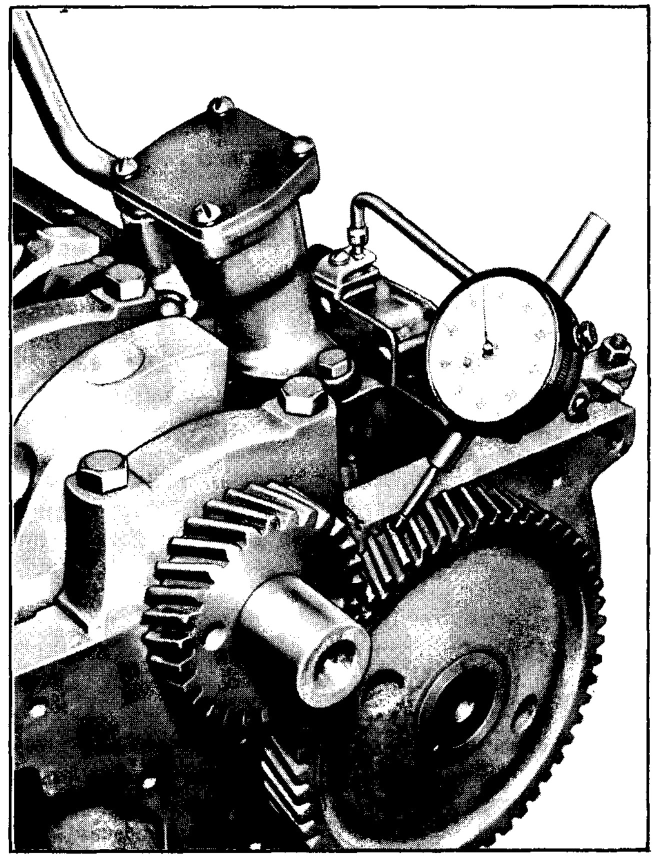


Fig. 6-50 Checking Camshaft Gear Backlash

9. Install valve lifters and push rods. Install side cover with a new gasket. Attach coil and wires. Then 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). Position new distributor to block gasket on block.

   Install distributor so that vacuum diaphragm faces the front of the engine and 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.

10. Install fuel pump.

11. Pivot rocker arms over push rods. With lifters on base circle of camshaft, tighten rocker arm nut until all valve train play is removed. Tighten nut one additional turn.

12. Install spark plugs.

13. Add oil to engine. Install water pump pulley and fan belt and adjust using tension gauge.

14. Install the radiator as described in Section 6A and fill cooling system.

15. Install grille assembly.

16. Start engine and check for leaks.

17. 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 camshaft and flywheel have been removed.

1. With camshaft and flywheel removed, drive out expansion plug from rear cam bearing by driving from inside.

2. Use Tool J-21473-1 to drive out front bearing toward rear and rear bearing toward front.

3. Install extension J-21054 on installer J-21473-1 and drive center two bearings out toward rear (Fig. 6-51).

REPLACE

1. Install each new bearing on tool.

2. Install bearings reversing removal procedure.

   CAUTION: *The front bearing must be driven approximately 1/8" behind front of cylinder block to uncover oil hole to timing gear oil nozzle. Align bearing oiling holes with block oiling holes and install new expansion plug.*

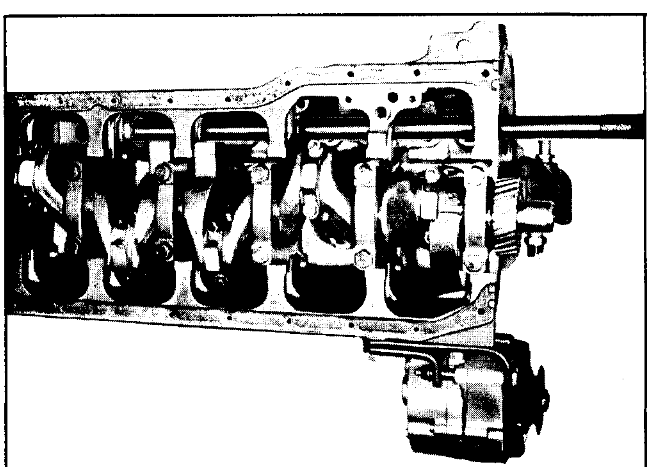


Fig. 6-51 Removing Center Camshaft Bearings

OIL PAN

REMOVE

1. Remove upper radiator shield assembly.

2. Disconnect negative battery cable.

3. Raise vehicle and drain crankcase.

4. Disconnect exhaust pipe at manifold.

5. Remove starter and set to one side.

6. Remove flywheel housing inspection cover.

7. Install engine lift support tool (J-23515-1) and adapter J 23515-3 and after wrapping chains around frame (Fig. 6-19), raise engine to remove weight from engine mounts; remove both frame bracket to engine mount through bolts.

   On X Series models, it may be necessary to add washers between adapter and harmonic balancer to provide initial clearance between adapter and frame.

8. Remove right front engine insulator.

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.*

REPLACE

1. Thoroughly clean all gasket sealing surfaces. Remove and clean oil pump pick-up screen.

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 elongated number 6 main bearing cap bolt and remove pump and screen as an assembly.
3. Remove 4 cover attaching screws, cover, gasket, idler gear and drive gear and shaft (Fig. 6-52).
4. Remove pressure regulator valve and valve parts.
5. Wash all parts in cleaning solvent and dry using compressed air.

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.

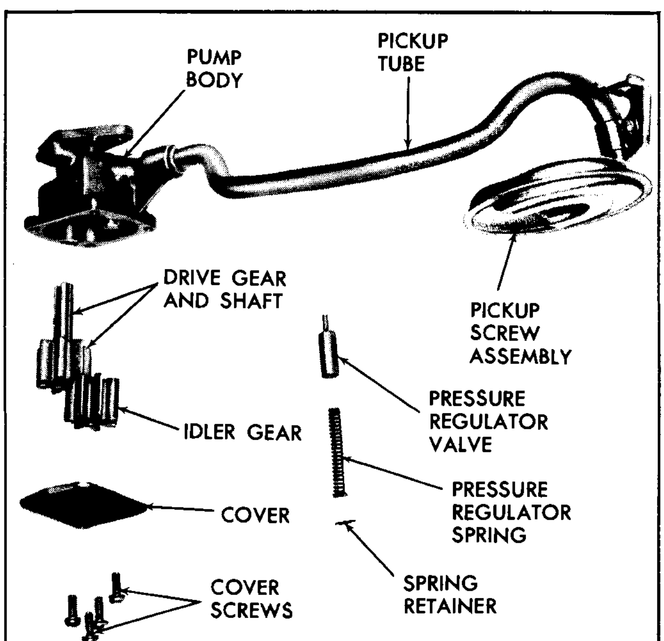


Fig. 6-52 Oil Pump - Exploded View

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 a new gasket to assure correct end clearance of the gears.
4. Install cover and attaching screws. Tighten screws to 6 lb. ft. and check to see that shaft turns freely.
5. Install regulator valve plunger, spring, retainer and pin and install oil line to pump body loosely.
6. 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 9 lb. ft. (Oil pump should slide easily into place. If not, remove and relocate slot or locate other problem).
7. Install oil pan using new gaskets and seals as outlined under Oil Pan Installation.

REAR MAIN BEARING OIL SEAL

REMOVE AND REPLACE

The rear main bearing oil seal (Fig. 6-53) 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.
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 glue) gradually push with a hammer handle until seal is rolled into place.

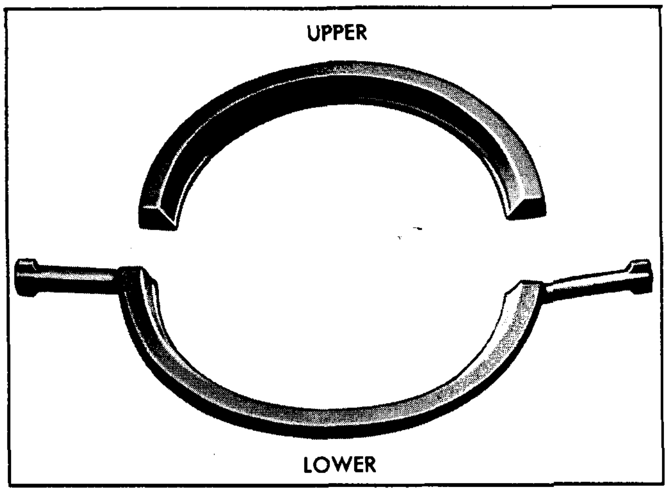


Fig. 6-53 Rear-Main Bearing Oil Seal

5. To remove the upper half of the seal, use a small hammer and brass pin punch to tap one end of oil seal (Fig. 6-54) until it protrudes far enough to be removed with pliers. Push new seal into place with lip toward engine front.

6. Install bearing cap and torque bearing cap bolts to 65 lb. ft.

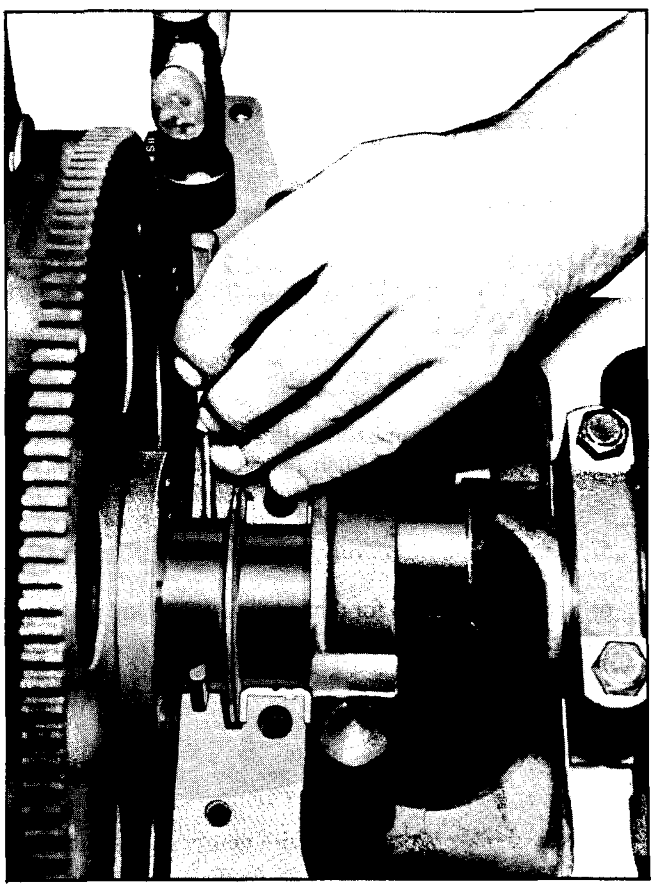


Fig. 6-54 Removing Oil Seal

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 from shell.

   If a tool is not available, a cotter pin may be bent to do the job as shown in Fig. 6-55. It may be necessary to remove oil pump when removing number 6 main bearing cap.

3. Rotate the crankshaft clockwise as viewed from front of engine. This will roll upper bearing shell out of engine.

REPLACE

1. Oil new upper bearing shell and insert plain (un-notched) end of shell between crankshaft and in-dented or notched side. Rotate the bearing into place.

2. Install new bearing shell in bearing cap.

3. Check bearing clearance using plastic gage method as outlined below.

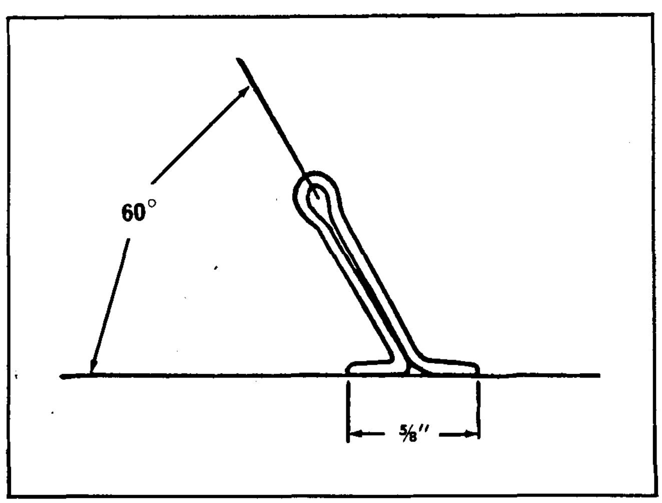


Fig. 6-55 Tool for Removing Upper Half of Main Bearing

4. Install oil pan using new gaskets and seals.

PLASTIC GAGE METHOD OF DETERMINING 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. Tighten all cap bolts to 65 lb. ft. 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. 6-56). 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. 6-57). If the bearing clearance is between .0005" and .0025", the clearance is satisfactory. If the clearance is more than .0025", 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.

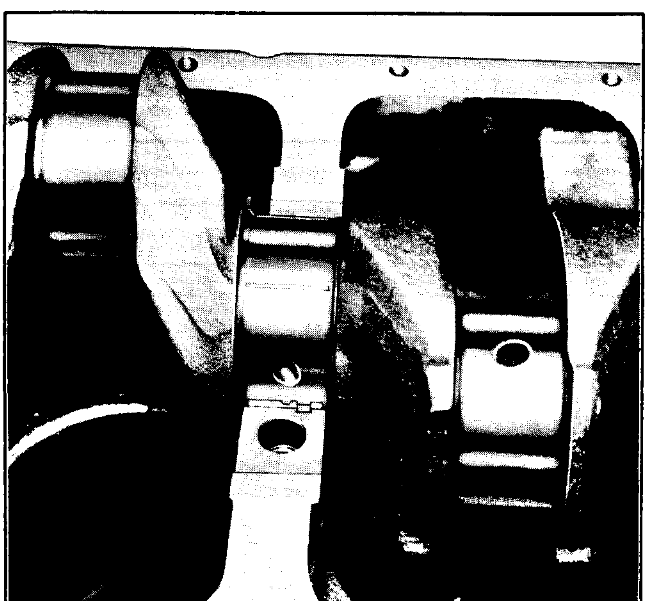


Fig. 6-56 Plastic Gauge on Journal

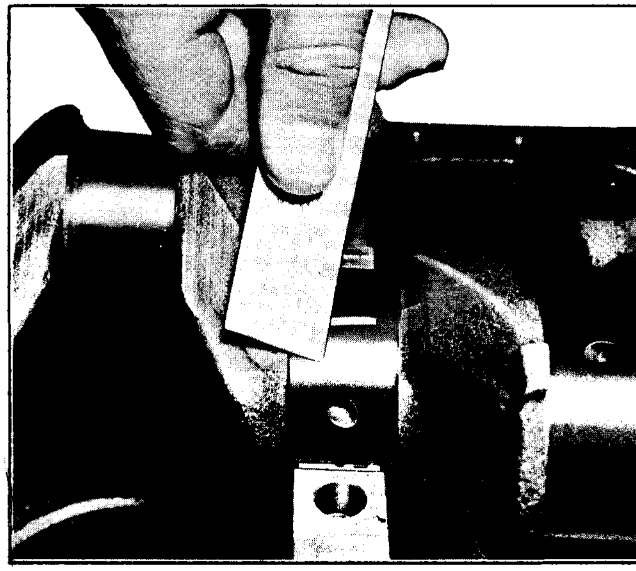


Fig. 6-57 Measuring Plastic Gage

CONNECTING ROD BEARINGS

Connecting rod bearing inserts are available in standard size and undersizes of .001" and .002". These bearings are not shimmed and when clearances become excessive the next undersize bearing insert should be used. DO NOT FILE ROD OR ROD CAPS.

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-5239 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.

REPLACE

1. Reassemble cap and rod with new bearings and check clearance with plastic gage as outlined below.
2. Install oil pan using new gaskets and seals.

PLASTIC GAGE METHOD OF DETERMINING 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. 6-56). Install the cap and tighten cap bolts 35 lb. ft. (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. 6-57). If the bearing clearance is between .0005" and .0025", the clearance is satisfactory. If the clearance is more than .0025", 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. 6-58). Clearance should be .008" - .014". If clearance is more than .014", replace connecting rod.

CONNECTING ROD AND PISTON ASSEMBLY

REMOVE

1. Remove rocker arm cover.
2. Loosen rocker arm nuts, rotate rocker arms and remove push rods.
3. Remove coil and push rod covers.
4. Remove valve lifters.
5. Disconnect fuel line and vacuum line at carburetor.
6. Remove cylinder head, intake and exhaust manifolds as an assembly. Remove spark plugs.
7. Raise Vehicle.
8. Remove oil pan.
9. Check connecting rod and piston for cylinder number identification and if necessary, mark them.
10. Remove bearing cap and install connecting rod bolt guide set J-5239.

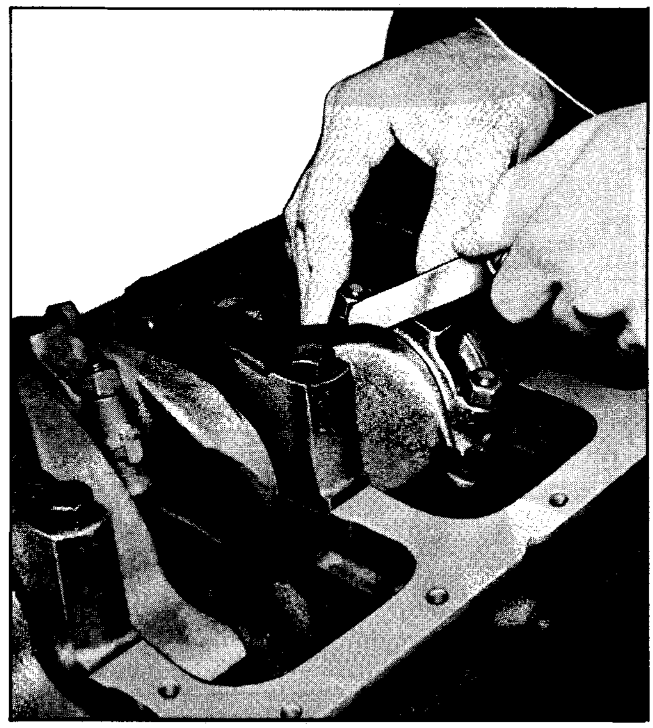


Fig. 6-58 Checking Connecting Rod Side Clearance

11. Carefully remove connecting rod and piston assembly by pushing out with knurled handle of long guide.

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 J-9510 on piston pin.
3. Install piston and connecting rod assembly on support and place assembly in an arbor press (Fig. 6-59). Press pin out of connecting rod.
4. Remove assembly from press, remove piston pin from support and remove tool from piston and rod.

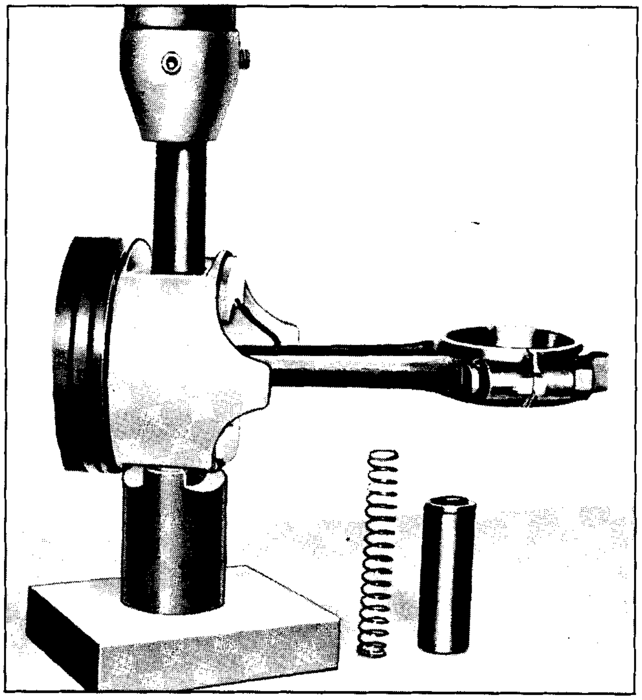


Fig. 6-59 Removing Piston Pin

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.

PISTON PIN

FIT

Piston pins are a matched fit to the piston and are not available separately. Piston pins normally do not become loose enough to cause a knock or tapping until after very high mileage and in such cases a new piston and pin assembly should be installed. Pistons and pins are serviced as assemblies.

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 (Fig. 6-60).

CYLINDER BORES

INSPECT

Inspect cylinder bores for out-of-round or excessive taper, with an accurate cylinder gauge J-8087 or comparable, at top, middle and bottom of bore. (Fig. 6-61). 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. 6-62 illustrates area in cylinder where normal wear occurs. If dimension "A" is larger than dimension "B" by .007", it indicates the necessity of cylinder boring and installing new rings and pistons. Cylinder bores can be measured by setting the cylinder gauge 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 gauge contact points with outside micrometer, with the gauge at the same zero setting when removed from the cylinder (Fig. 6-63).

Fine vertical scratches made by ring ends will not by themselves cause excessive oil consumption, therefore, honing to remove them is unnecessary.

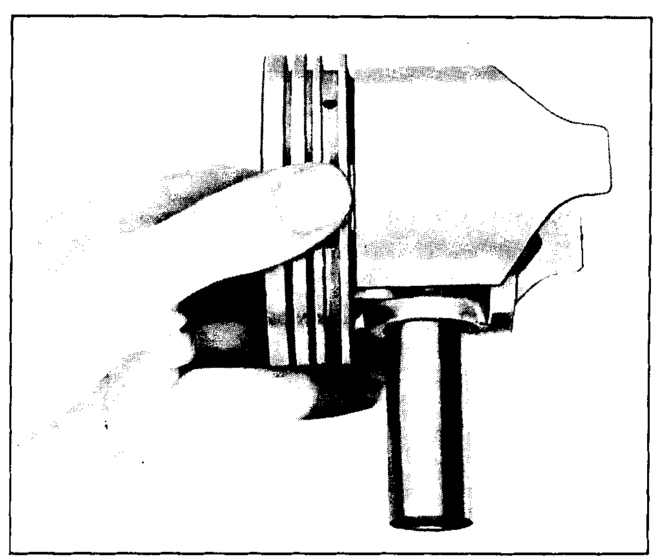


Fig. 6-60 Checking Piston Pin Fit

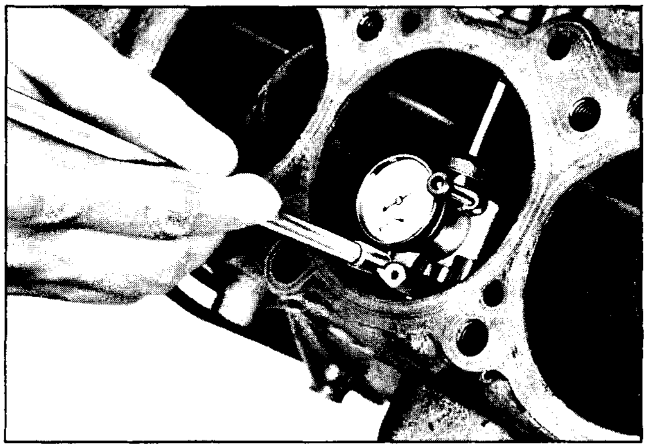


Fig. 6-61 Measuring Cylinder Bore

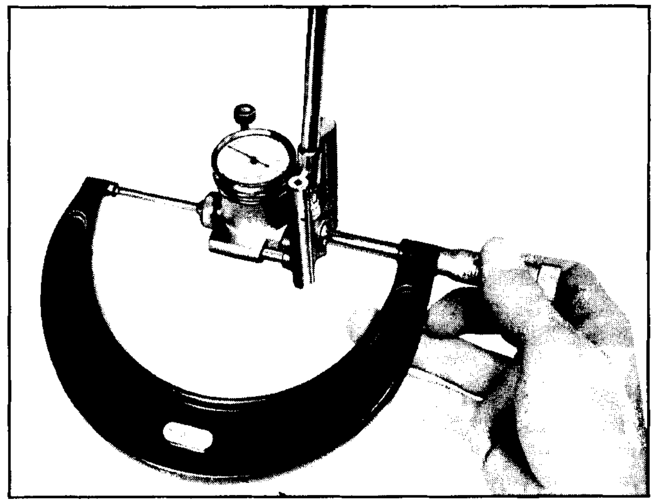


Fig. 6-63 Measuring Cylinder Gauge

HONING OR BORING

If a piston in excess of .005" oversize 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 (when installing .005" oversize piston), 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).

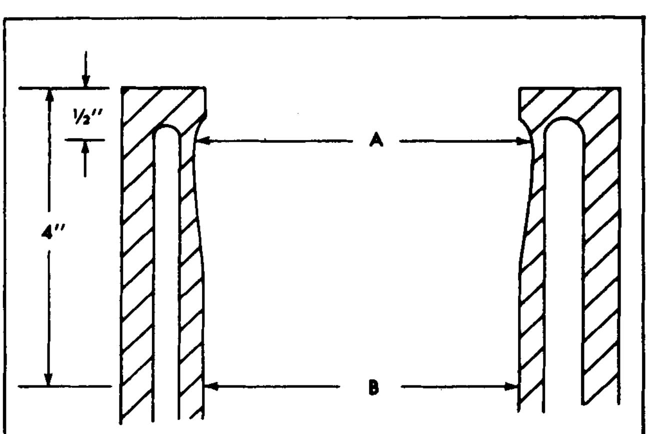


Fig. 6-62 Normal Cylinder Wear Pattern

By measuring the piston to be installed at the sizing points (Fig. 6-64) 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, 60° - 90°F.

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 Pontiac pistons from standard size, up to .030" oversize, weigh exactly the same. Pontiac does not recommend boring beyond .010" during warranty period so that, if necessary, engine can be serviced at high mileage without cylinder block replacement.

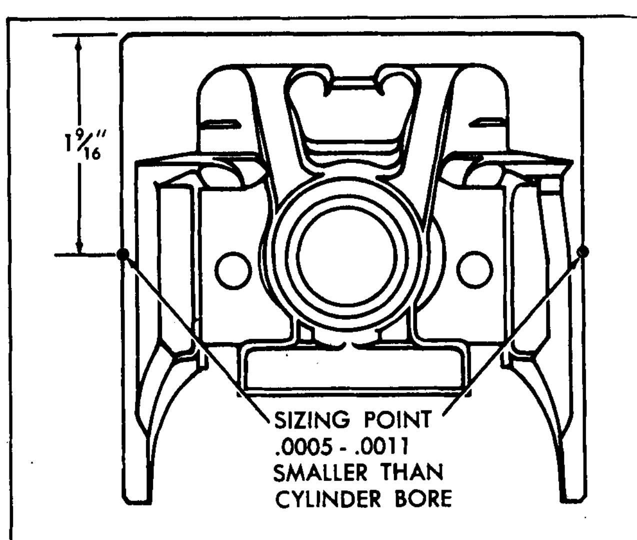


Fig. 6-64 Piston Sizing Points

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). Clearance between the piston and the cylinder bore should be .0005" to .0015".

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 gauge, 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. 6-65.

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 .005", .010", .020" and .030" oversize.

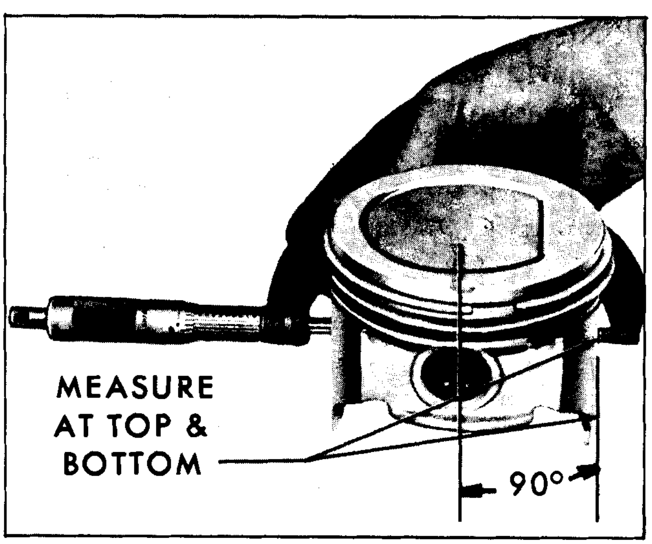


Fig. 6-65 Measuring Piston

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 TO PISTON

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 flange or heavy side of rod at bearing end will be toward front of engine (cast slot in piston top).
3. Install piston pin on installer and pilot spring and pilot in support (Fig. 6-66). Use piston pin removing and installing tool J-9510.
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.

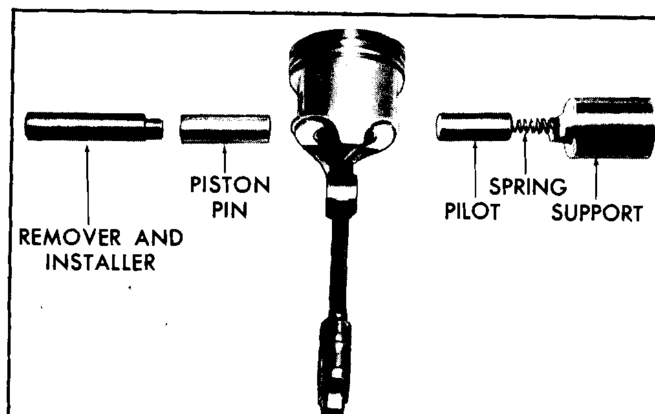


Fig. 6-66 Piston Pin Replacement

PISTON RINGS

REPLACE

1. Remove connecting rod and piston assembly (See "CONNECTING ROD AND PISTON ASSEMBLY - REMOVE AND REPLACE" in this section).

2. 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.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

4. Inspect bearing shells to see that they are not damaged. Fit of bearings should be checked when engine is being assembled.

5. Inspect cylinder bores for out-of-round or excessive taper. If bores show excessive out-of- round or taper, or if cylinder walls are badly scored, scratched or worn beyond specified limits, the cylinder block should be rebored and new pistons and rings installed.

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 taper faced and also have either a step or a chamfer on the inside diameter of the top side. The top compression ring is chrome plated. The lower compression ring may have a step.

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 .005", .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.

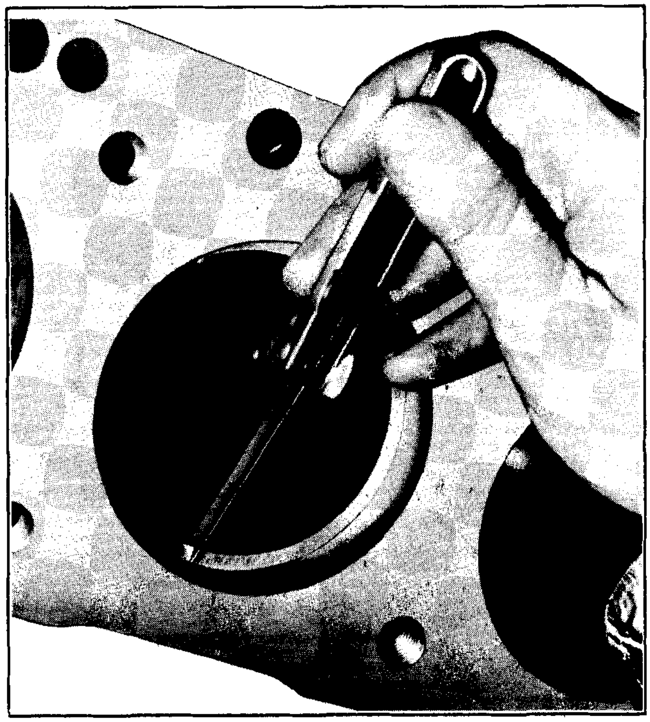


Fig. 6-67 Checking Ring Gap

3. Measure gap between ends of ring with feeler gage (Fig. 6-67). Gaps should be as follows:

Upper Compression Ring	.010" - .020"
Lower Compression Ring	.010" - .020"
Oil Ring	.015" - .055"

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore (standard, .005" oversize, etc.), 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 such as J-7135, to prevent breakage or fracture of rings, or damage to pistons.

5. Measure side clearance of rings in ring groove (Fig. 6-68) as each ring is installed. Clearance with new pistons and rings should be as follows:

Upper Compression Ring	.0012" - .0027"
Lower Compression Ring	.0012" - .0032"
Oil Control Ring	.001" - .005"

If side clearance is excessive, piston should be replaced.

CONNECTING ROD AND PISTON ASSEMBLY

REPLACE

1. Install connecting rod bolt guide set J-5239 on connecting rod bolts (Fig. 6-69).

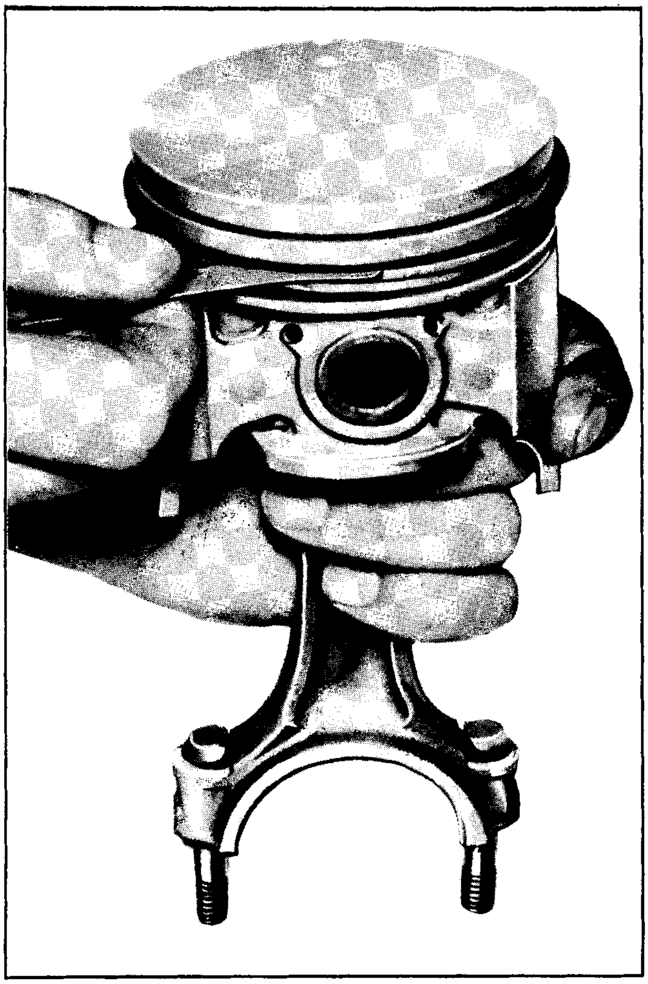


Fig. 6-68 Checking Side Clearance

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. 6-70).

3. From beneath engine, pull connecting rod with bearing into place against crankpin.

4. Remove guide set J-5239 and install bearing cap with oil groove facing camshaft. Tighten cap nuts to 35 lb. ft.

5. Install oil pan.

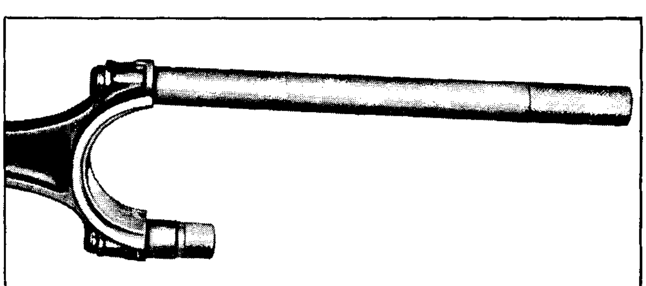


Fig. 6-69 Guide Tool J-5239 Installed

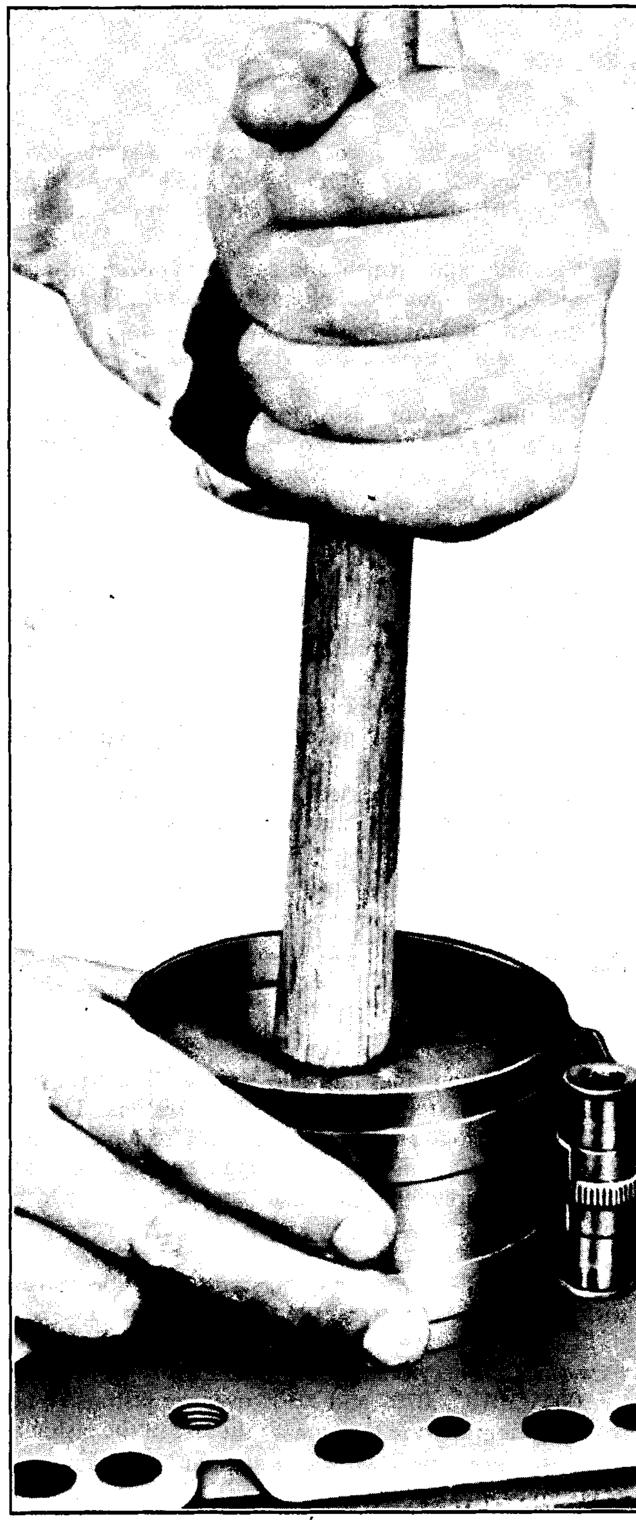


Fig. 6-70 Installing Piston in Cylinder

6. Install valve lifters.

7. Install cylinder head, intake and exhaust manifold as an assembly.

8. Connect fuel line and vacuum line to carburetor.

9. Install coil and push rod covers.
10. Install push rods, move rocker arms into position and tighten rocker arm nuts.
11. With lifter on base circle of camshaft, tighten rocker arm nut until all valve train play is removed. Tighten nut one additional turn.
12. Install spark plugs.
13. Install rocker arm cover.

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 using tool J-6978.
6. Remove oil pan and oil pump assembly.
7. Remove timing gear cover.
8. Remove crankshaft timing gear with tool J-6978 (Fig. 6-71).

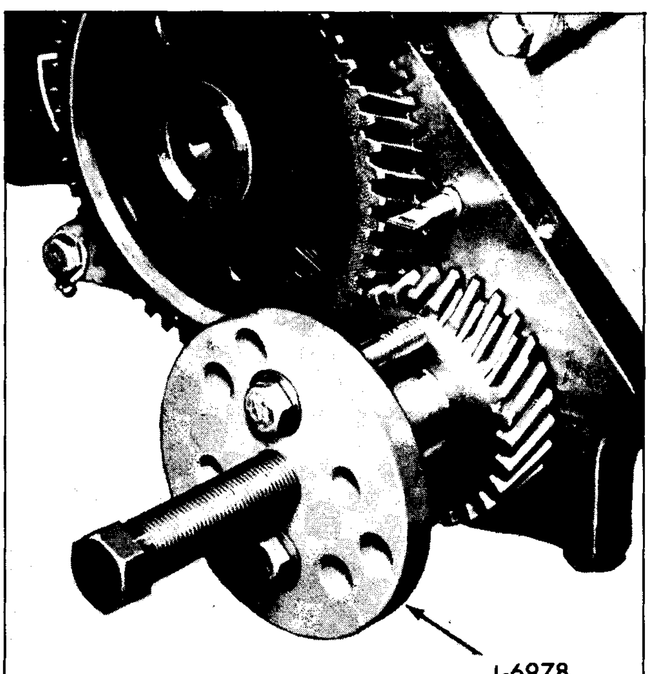


Fig. 6-71 Removing Crankshaft Timing Gear

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 upper bearings installed position crankshaft in block.
2. Install main bearing caps (with lower bearings), but do not tighten cap bolts.
3. Pull connecting rods (with upper bearings installed) and pistons into place.
4. Install rod bearing caps (with bearings), but do not tighten nuts.
5. With rubber mallet hit both ends of crankshaft to center thrust bearing.
6. Tighten main bearing caps to 65 lb. ft.
7. Tighten connecting rod bearing caps to 35 lb. ft.
8. Install key from old crankshaft keyway in new crankshaft.
9. Install crankshaft timing gear with installer tool J-5154 (Fig. 6-72).

Fig. 6-72 Installing Crankshaft Timing Gear

IMPORTANT: *ALIGN TIMING MARKS ON TIMING GEARS BY ROTATING CRANKSHAFT IF NECESSARY.*

10. Install timing gear cover using new seal and gaskets.

11. 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.

12. Coat front cover oil seal contact area of balancer with oil and drive balancer into position using balancer installer tool J-22197.

13. Install fan pulley and fan.

14. Install spark plugs.

15. Remove engine from stand.

16. Install engine in vehicle.

FITTED BLOCK ASSEMBLY

REPLACE

Fitted block assembly contains pistons, rings, pins, camshaft bearings and oil filter by-pass valve.

DISASSEMBLE

1. Remove engine from vehicle.

2. Remove starter from engine.

3. Install engine on suitable stand.

4. Remove ground strap and dipstick.

5. Disconnect spark plug wires and primary wire at coil.

6. Remove distributor hold-down clamp and vacuum advance line and remove distributor and base gasket.

7. Remove spark plugs and coil.

8. Disconnect fuel line at fuel pump and remove fuel pump.

9. Remove push rod cover, retaining screws, their gaskets, covers and cover gaskets.

10. Remove oil pressure sending switch, oil filter and oil filter connector.

11. Disconnect fuel and vacuum lines at carburetor.

12. Remove the lines by sliding them from the retaining clip at the cylinder head water outlet.

13. Remove generator mounting bolts, generator, fan belt and generator mounting bracket.

14. Remove engine insulators from engine.

15. Remove fan and water pump pulley.

16. Remove water pump.

17. Remove harmonic balancer with tool J-6978.

18. Remove timing gear cover.

19. Remove crankshaft timing gear with tool J-6978 and remove crankshaft key.

20. Remove rocker arm cover.

21. Loosen and rotate rocker arms.

22. Remove push rods and valve lifters and store in a stand and suitable box in numerical order.

23. Remove cylinder head, intake and exhaust manifolds as an assembly.

24. Remove two camshaft thrust plate screws through holes in the camshaft gear and remove camshaft through the front of the block.

25. Remove oil pan.

26. Remove oil pump and dipstick tube.

27. Remove crankshaft.

28. Remove all connecting rod and piston assemblies and identify each connecting rod according to cylinder from which it was removed.

29. Remove connecting rods from pistons.

30. Remove old block from stand and mount new block on stand.

31. Remove new piston and pin assemblies from new block and identify each according to cylinder from which it was removed.

This completes disassembly for partial engine replacement. Use new gaskets and pay special attention to torque requirements.

ASSEMBLE

1. Assemble old connecting rods to new piston and pin

assemblies *according to cylinders from which they were removed.*

2. Install connecting rod and piston assemblies in proper cylinders.

3. Install crankshaft.

4. Install oil pump over distributor lower bearing and bolt in place.

5. Install camshaft with camshaft gear. Attach thrust plate with Phillips head screws.

6. Install crankshaft key and install crankshaft timing gear with timing marks aligned.

7. Install timing gear cover oil seal in cover with tool J-5154.

8. Install timing gear cover gasket on block with grease and install cover over centering tool J-23042. Install cover screws and torque to 7 lb. ft. Remove centering tool.

9. Install harmonic balancer.

10. Install oil pan with new gaskets and seals.

11. Install starter.

12. Install cylinder head, intake and exhaust manifolds as an assembly. Torque cylinder head bolts to 95 lb. ft. Use new cylinder head gasket.

13. Install valve lifters, push rods and push rod covers.

14. 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 of harmonic balancer indexed with top dead center mark on timing pad). Position new distributor to block gasket on block.

    Install distributor so that vacuum advance unit faces the front of the engine and 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.

15. With camshaft on base circle for each cylinder, tighten rocker arm nuts until all valve train play is removed. Then tighten nut one additional turn.

16. Install spark plugs, coil, distributor cap and high tension wires.

17. Install water pump.

18. Install generator mounting bracket.

19. Install engine insulators.

20. Install fan and fan pulley. Tighten bolts to 20 lb. ft.

21. Install generator and fan belt.

22. Install fuel pump and tighten bolts to 18 lb. ft.

23. Install oil pressure sending switch.

24. Install vacuum and fuel lines and connect them to the fuel pump, distributor and carburetor.

25. Install ground strap, dipstick tube and dipstick.

26. Remove engine from stand and install flywheel, clutch (synchromesh transmission), and starter. Tighten flywheel to crankshaft bolts to 60 lb. ft.

27. Install engine and clutch in vehicle.

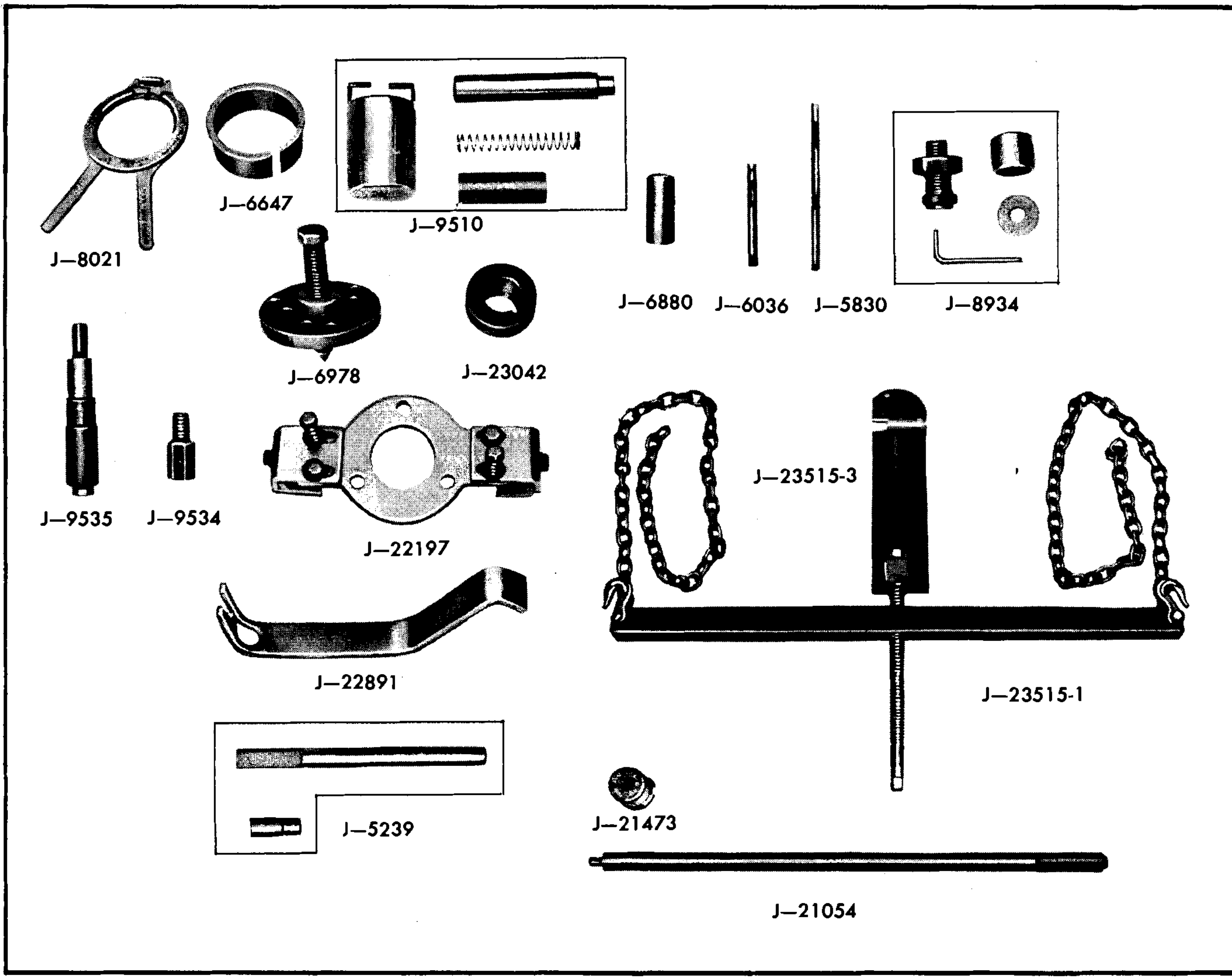


Fig. 6-73 Special Tools (6-Cyl.)

J-5239-CONNECTING ROD BOLT GUIDESET

J-5830-O.S. VALVE GUIDE REAMER (L-6)
-1 .003" O.S.
-2 .015" O.S.
-3 .030" O.S.

J-6036-ROCKER ARM STUD REAMER .013" O.S.

J-6647-PISTON RING COMPRESSOR (3⅞")

J-6880-ROCKER ARM STUD INSTALLER

J-6978-HARMONIC BALANCER PULLER

J-8021-PISTON RING REMOVER AND INSTALLER

J-8934-ROCKER ARM STUD REMOVER

J-9510-PISTON PIN ASSEMBLY TOOL

J-9534-DISTRIBUTOR BUSHING REMOVER

J-9535-DISTRIBUTOR BUSHING INSTALLER

J-21054-HANDLE-CAMSHAFT BUSHING REMOVER AND REPLACER

J-21473-ADAPTER-CAMSHAFT BUSHING REMOVER AND REPLACER

J-22891-VALVE SPRING COMPRESSOR

J-22197-TORSIONAL DAMPER INSTALLER

J-23042-FRONT COVER CENTERING GAUGE AND OIL SEAL INSTALLER

J-23515-1 ENGINE LIFTING TOOL
-3 L-6 ENGINE ADAPTER

V-8 ENGINE

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The V-8 engine (Fig. 6-75) features completely machined combustion chambers, overhead valves, ball pivot rocker arm construction, harmonic balancer, hydraulic lifters, aluminum pistons, integral valve guides, Closed Crankcase Ventilation System and an Evaporative Control System which provide the utmost in performance, economy and emission control.

Engines may be identified first by noting the engine code on the front of the block, stamped on a machined pad on the right bank of cylinders (Fig. 6-3) and then referring to the engine charts (Fig. 6-1).

Detailed descriptions of cooling and lubrication systems are given in Section 6A. Mechanical details such as valves, rocker arms, hydraulic valve lifters, etc., are described on the following pages.

CYLINDER BLOCK

The cylinder block (Figs. 6-76 and 6-77) 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.

All main bearing caps are doweled to the cylinder block to assure accurate alignment and facilitate assembly.

CYLINDER HEAD

Cylinder heads (Fig. 6-78) have fully machined combustion chambers (Fig. 6-79). In addition, all exhaust valve seats are induction hardened, making them more resistant to wear. Valve guides are cast integral with the cylinder head and valve heads are surrounded by water jackets (Fig. 6-80).

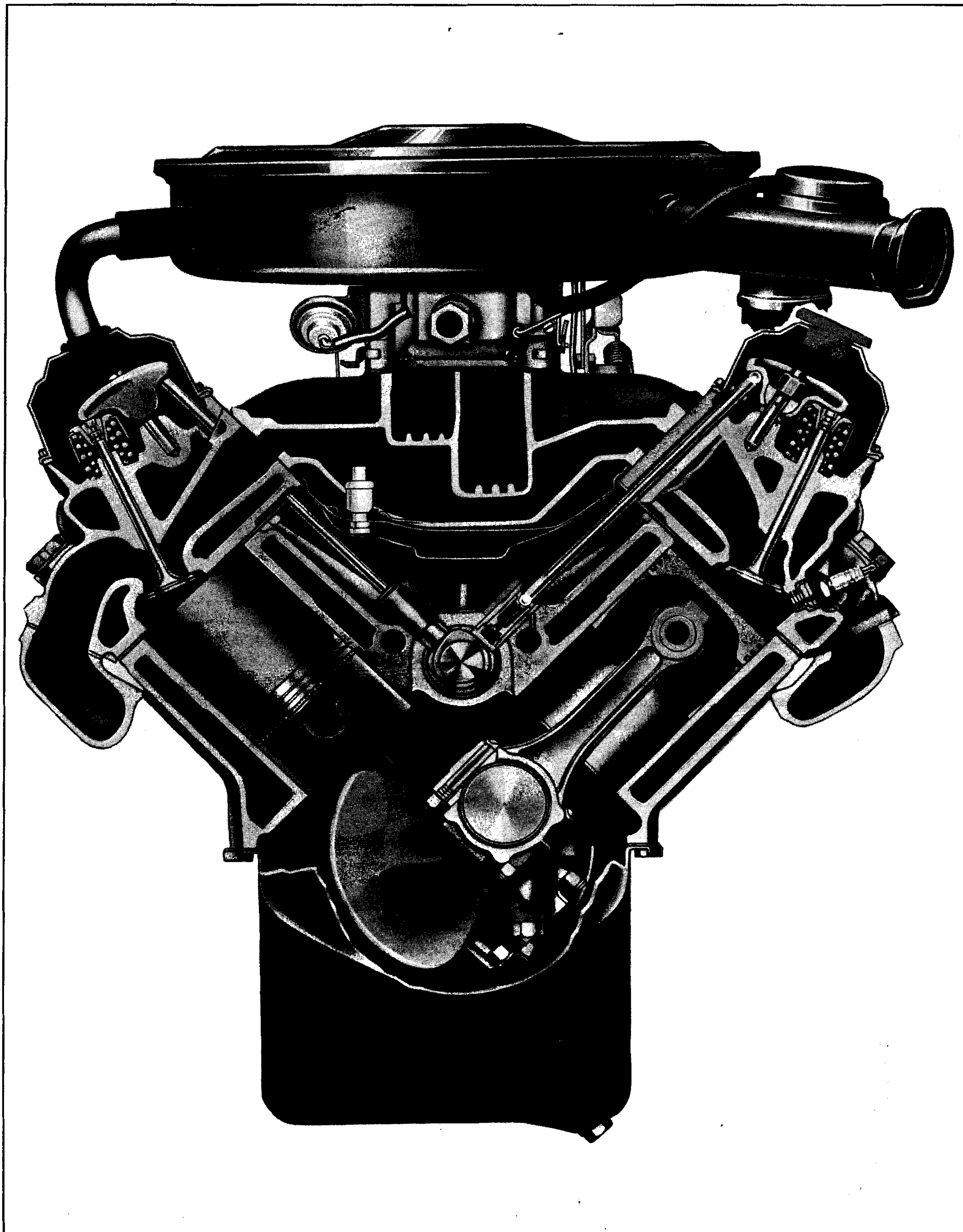


Fig. 6-75 V-8 Cross Section

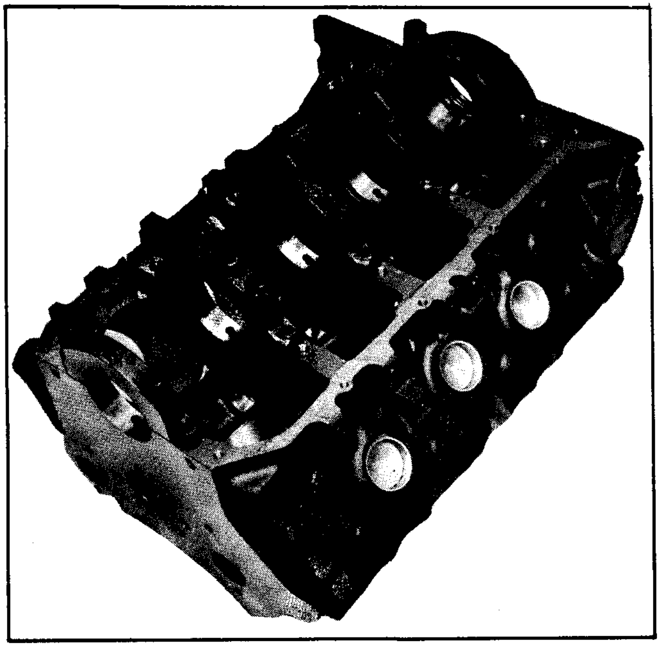


Fig. 6-76 Cylinder Block - All Except 455 H.O. Engine

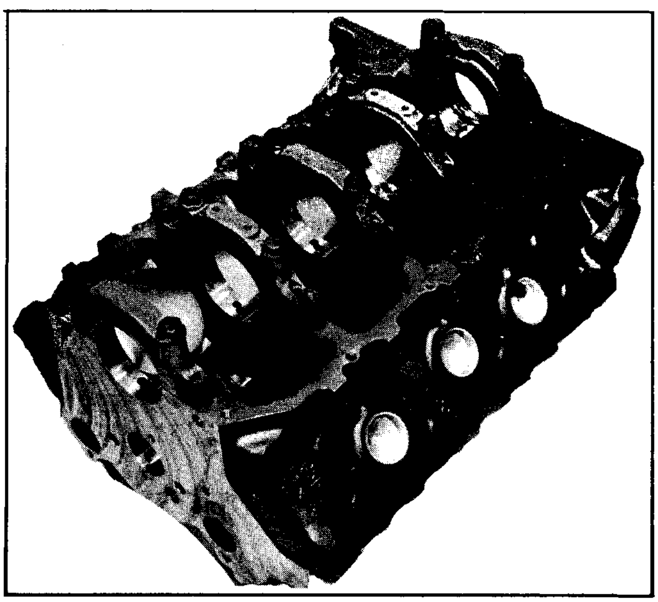


Fig. 6-77 Cylinder Block - 455 H.O. Engine

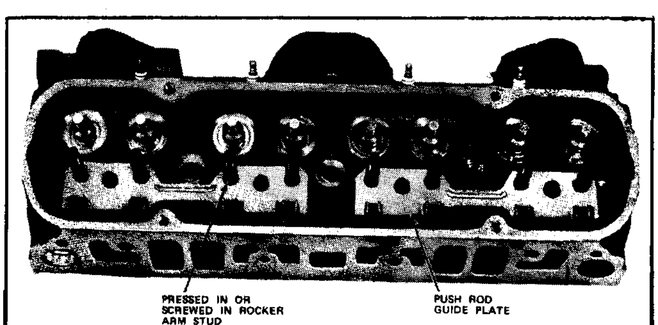


Fig. 6-78 Cylinder Head - Typical

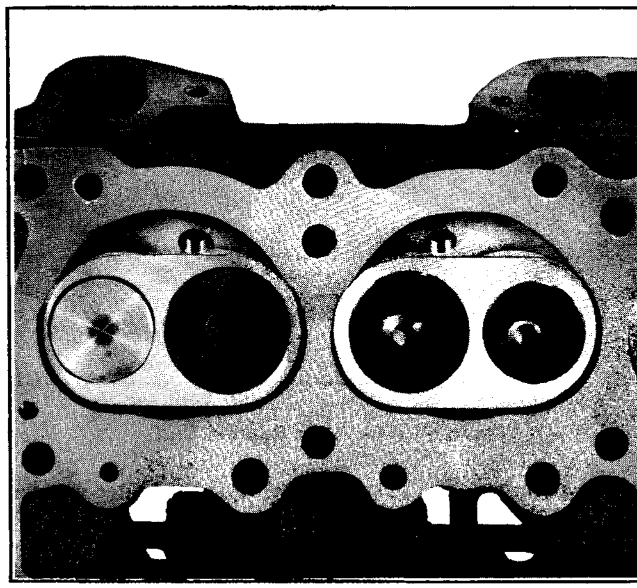


Fig. 6-79 Combustion Chamber - Typical

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 (Fig. 6-81). When replacing main bearings, it is very important that bearings are installed with the recommended material (M100-A or M400-A) located in the proper position on the crankshaft (upper & lower). Refer to V-8 engine specifications for detailed bearing usage. Torsional vibration is dampened by the harmonic balancer mounted on the front end of the crankshaft. The harmonic balancer consists of a hub and a rubber mounted

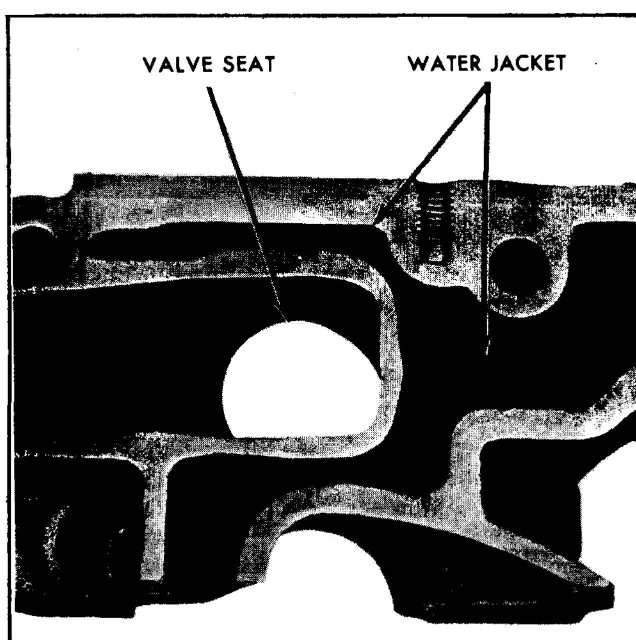


Fig. 6-80 Water Jacket for Valve Cooling

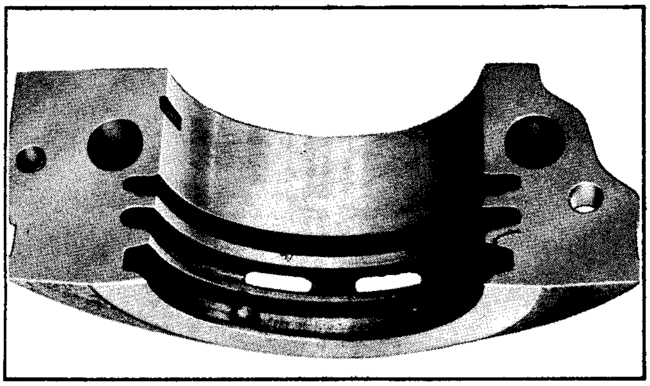


Fig. 6-81 Rear Main Bearing Cap

inertia member. The accessory pulleys are bolted to the harmonic balancer and may be changed independently of each other.

The rear main bearing is sealed by a packing (all but 307 engine), or neoprene seal (307 engine) seated in a chamfered groove in the block and bearing cap (Fig. 6-81). 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.

Two cavities are drilled in the cylinder block and cap seal groove to prevent seal rotation.

CAMSHAFT AND DRIVE

The engine chart shows the application of camshafts which can be identified by a letter stamped on the front end of the shaft.

Camshafts are cast from alloy iron and 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. The camshaft is supported by five bearings.

A 7/8" wide, 60-link timing chain is used to drive the camshaft. The 42-tooth camshaft drive sprocket is made from hardened cast iron while the 21-tooth crankshaft sprocket is made from hardened sintered iron.

PISTONS AND CONNECTING RODS

Pistons are of a light weight cast all aluminum slipper skirt type. Their light weight results in reduced inertia forces. These pistons maintain thermal control through contour grinding. The taper cam grind provides quiet piston operation and adds to overall engine smoothness. Two compression rings and one oil control ring are used, all of which are located above the piston pin. Machined reliefs on the top of the piston contribute to the determination of compression ratio and provide for valve clearance (Fig. 6-82).

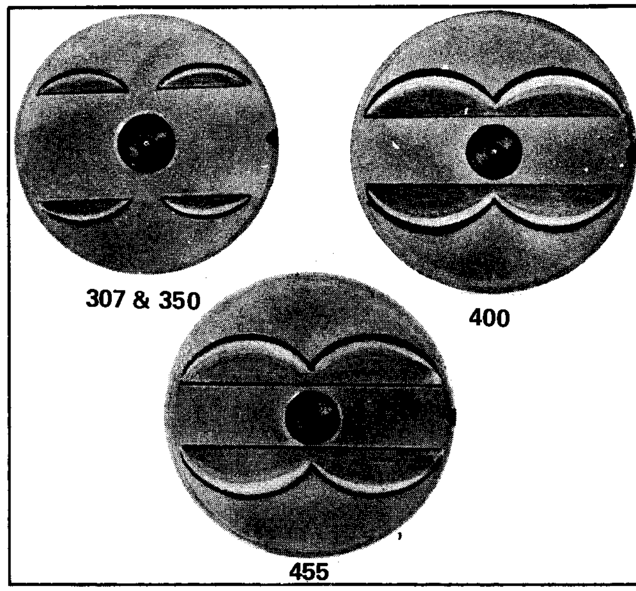


Fig. 6-82 Piston Identification

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. 6-83). This feature provides quieter engine operation. Pins are hardened steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

A lubrication groove between the connecting rod and cap directs a jet of oil onto the opposite cylinder wall to help lubricate the piston and rings during initial cold drive away operation.

VALVE TRAIN

A very simple ball pivot-type valve train is used (Fig. 6-84). Motion is transmitted from the camshaft through

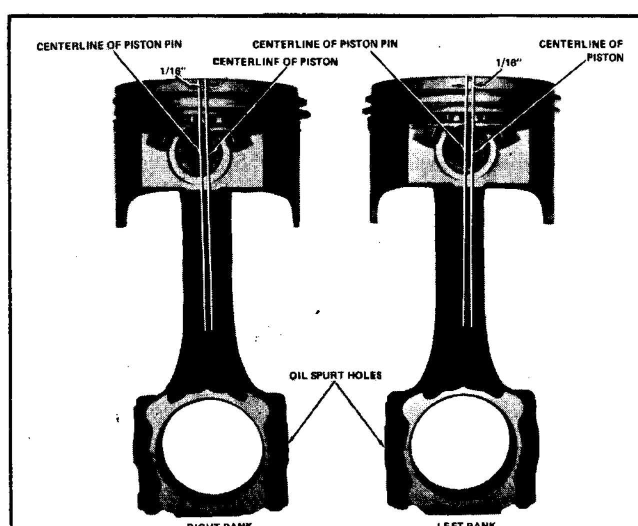


Fig. 6-83 Connecting Rod and Piston Assembly

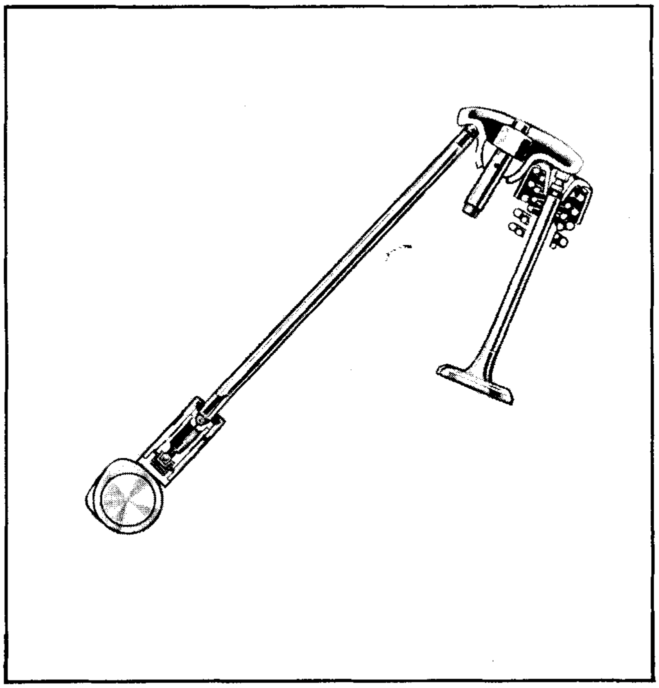


Fig. 6-84 Valve Train

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.

The maximum in durability is assured by the use of carburized and cyanide-hardened stamped steel rocker arms. In addition, all friction points in the valve train are positively lubricated.

The cylinder head has straight valve guides cast integrally (Fig. 6-85). External shields are used on both intake and exhaust valve springs to reduce the amount of oil splashed against stems. (The WK engine does not incorporate shields - see Fig. 6-1). Valve stem seals are used on exhaust as well as intake valves to prevent excessive oil from entering the valve guides; in addition, umbrella type seals are used on the intake valves of all 400 4 Bbl. and all 455 engines.

All V-8 engines use the large exhaust valves, formerly used only in 400 and 455 4 Bbl. engines. Intake valves are of two sizes - large and small. The small intake valve size is used in all V-8 engines except 400 4 Bbl., 455 4 Bbl., and 455 H.O.

The 307 engine uses positive valve rotators on exhaust valves only (Fig. 6-117). The rotators provide positive valve rotation, insuring uniform seating and extended valve life.

HYDRAULIC VALVE LIFTERS

Hydraulic lifters are used to keep all parts of the valve

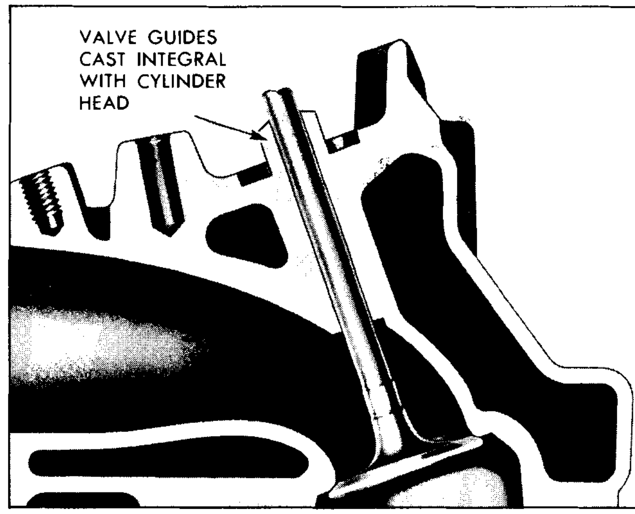


Fig. 6-85 Intake Valve Guide

train in constant contact (Fig. 6-86 and 6-87). Each lifter is an automatic adjuster maintaining zero lash under all conditions. This insures precision valve timing and silent operation, increases valve life, and eliminates the need for tappet adjustment.

Two different types of hydraulic lifters, as shown in Figs. 6-86 and 6-87, are used in V-8 engines. For correct usage, see Fig. 6-1.

The hydraulic lifter assembly includes: the cast iron body which rides in the cylinder block boss, the plunger, push rod seat, plunger spring, ball check valve and spring, ball check valve retainer, rocker feed metering valve and retainer ring.

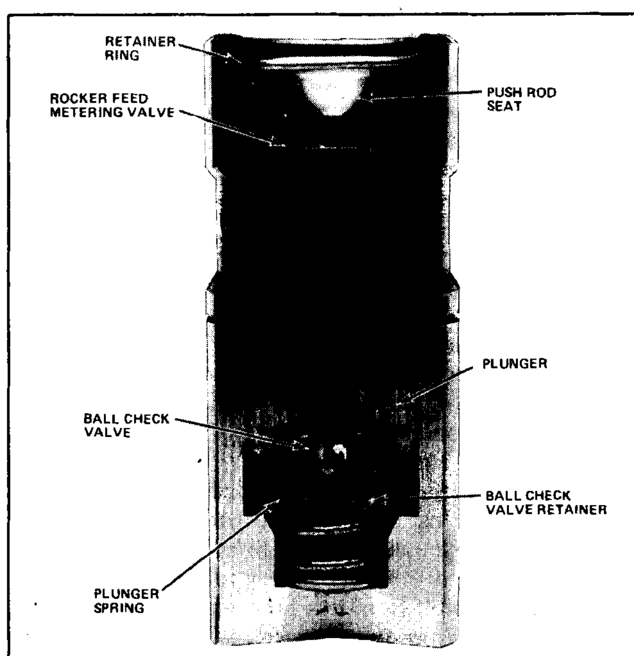


Fig. 6-86 Valve Lifter - Low Ball Type

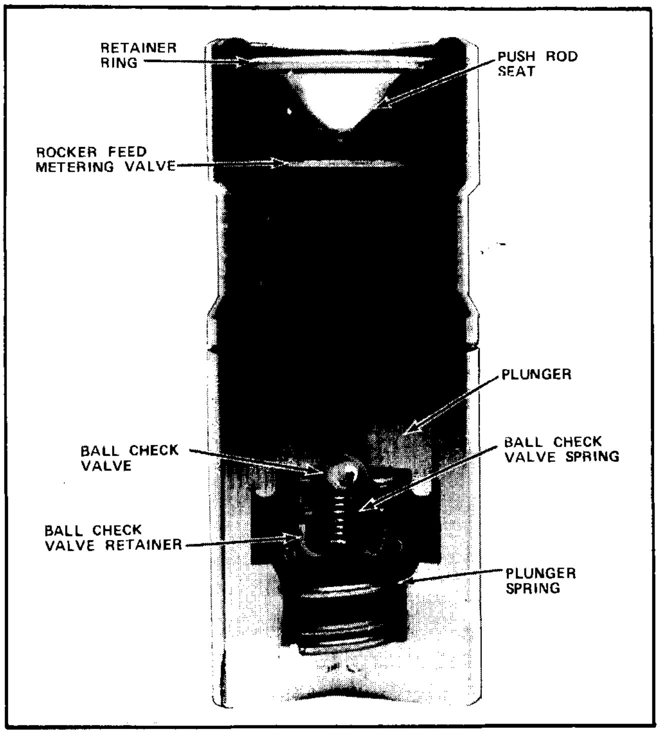


Fig. 6-87 Valve Lifter - High Ball Type

The hydraulic valve lifter functions as follows: 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 ball check valve 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.

During operation a small amount of oil leaks out of the lifter between the plunger and body. A controlled amount of leakage is important to provide continuous adjustment of the plunger position within the lifter. This leakage is called "leak-down" and must be within certain limits to provide correct operation.

Oil is supplied to the lifter by the cylinder block oil gallery to replace that lost through leak down. The annular groove around the outside of the lifter body indexes with the passage drilled from the gallery to the lifter boss. Oil then enters the lifter from this groove and passes into the plunger cavity. From the plunger cavity, oil under pressure is also fed up the push rod to lubricate the friction area between the upper end of the push rod and the rocker arm.

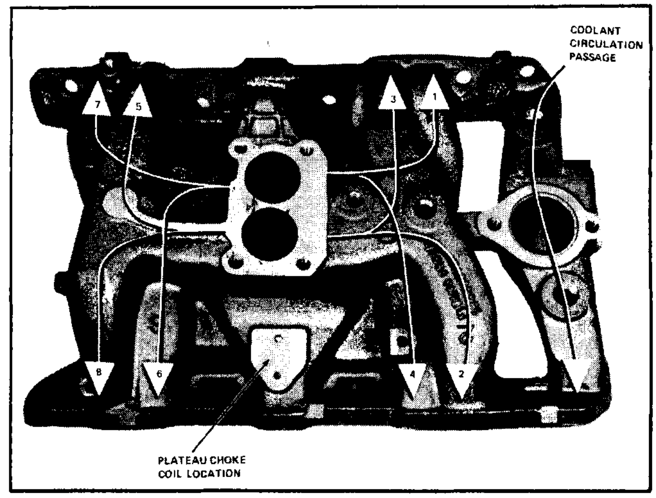


Fig. 6-88 Two Barrel Carburetor Intake Manifold - Typical

The hydraulic valve lifter used in all models incorporates a restricted orifice plate installed in the plunger counter bore between the plunger cavity and push rod seat. Its function is to meter the oil supplied under pressure through the push rod to the drilled rockers in the engine, using the push rod and drilled rockers for lubricating the upper valve train.

FUEL DISTRIBUTION SYSTEM

The intake manifold is designed to provide fuel passages which are short and practically equal in length. With the two-barrel carburetor, each throat of the carburetor feeds four cylinders as shown in Fig. 6-88. The intake manifold used with the four-barrel carburetor is fundamentally the same as with the two-barrel type, but has four openings to index with the carburetor throats. With the four-barrel carburetor the two throats on the right side feed four cylinders and the two throats on the left side feed four cylinders.

A stove is included in the intake manifold surrounding the risers which lead to the carburetor. When the engine is cold, exhaust gases from both banks of cylinders pass through a passage in the intake manifold to circulate around and heat the stove. The fuel-air mixture passing from the carburetor to the cylinders is thereby pre-heated to the desired temperature for proper combustion.

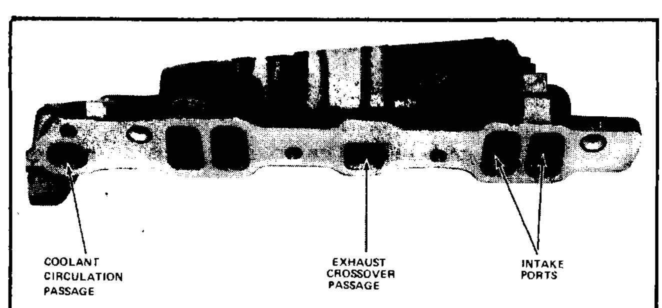


Fig. 6-89 Intake Manifold - Side View

EXHAUST SYSTEM

Two cast iron exhaust manifolds are used, one for each bank of cylinders. Exhaust gases from the left manifold pass through a cross-over pipe which passes beneath the engine to the right side. At this point the exhaust pipe from the right manifold joins the cross-over pipe and gases are carried rearward to the muffler and tailpipe.

GENERAL INFORMATION ON ENGINE SERVICE

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE AND CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

Cleanliness is a primary factor when servicing the V-8 engine. The slightest particle of dirt that finds its way into a hydraulic lifter may cause a malfunction.

Since any dirt which may enter the oil galleries or passages in the engine could eventually get to a lifter, cleanliness should be exercised when any part of the engine is removed or disassembled. When a cylinder head is removed for any purpose, it is necessary to remove the intake manifold and/or push rod cover. This exposes the lifters to any dirt which may fall from the upper portion of the block or which may be carried in the air. Thus it is wise to cover the lifter galleries until ready to reassemble the engine.

When lifters are removed for any reason, they should immediately be placed in a valve lifter storage box in the order in which they were removed. It is important for two reasons. First, it is the easiest way to keep lifters clean. Second, lifters should always be replaced in the same bosses from which they were removed.

Valves, valve lifters, push rods, rocker arms, rocker arm balls, and rocker arm ball nuts should always be kept in sets and returned to their original positions. These parts will tend to mate as the engine operates and will provide more satisfactory operation when kept together. By storing lifters in a storage box and valves, push rods, rocker arms, balls and nuts in a holding stand whenever they are removed, they can easily be kept in sets for identification during assembly. In addition to keeping the parts in sets, the push rods should be replaced with the same end up. In other words, replace push rods so that the same end contacts the rocker arm as before the engine was disassembled. Push rods will be polished somewhat in the area where the rod passes through the head.

When hydraulic valve lifters are disassembled, the various parts of each lifter must be kept together. This is especially important since the lifter body and plunger are selectively fitted. The use of the special tray included with cleaning tank J 5821 will aid in keeping the parts of each lifter together when lifters are being serviced.

Cylinder head bolts should be installed without thread sealer of any kind.

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, jacking against the oil pan may cause it to be bent against the pump. The result would be a telegraphed noise which would be difficult to trace. The crankshaft pulley is sheet steel and will not support engine weight. Always use engine lifting tool J 23515.

It should be kept in mind, while working on the engine, that the twelve-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.

Never reverse battery leads, even for an instant, as reverse polarity current flow will damage diodes in the generator.

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 to 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 the manual for specific information.

PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services connected with the engine consist of tune-up, lubrication, replacing oil filter, etc. Procedures and recommendations for these services will be found in appropriate sections of this manual, and the Owner's Manual.

SERVICE OPERATIONS ON CAR

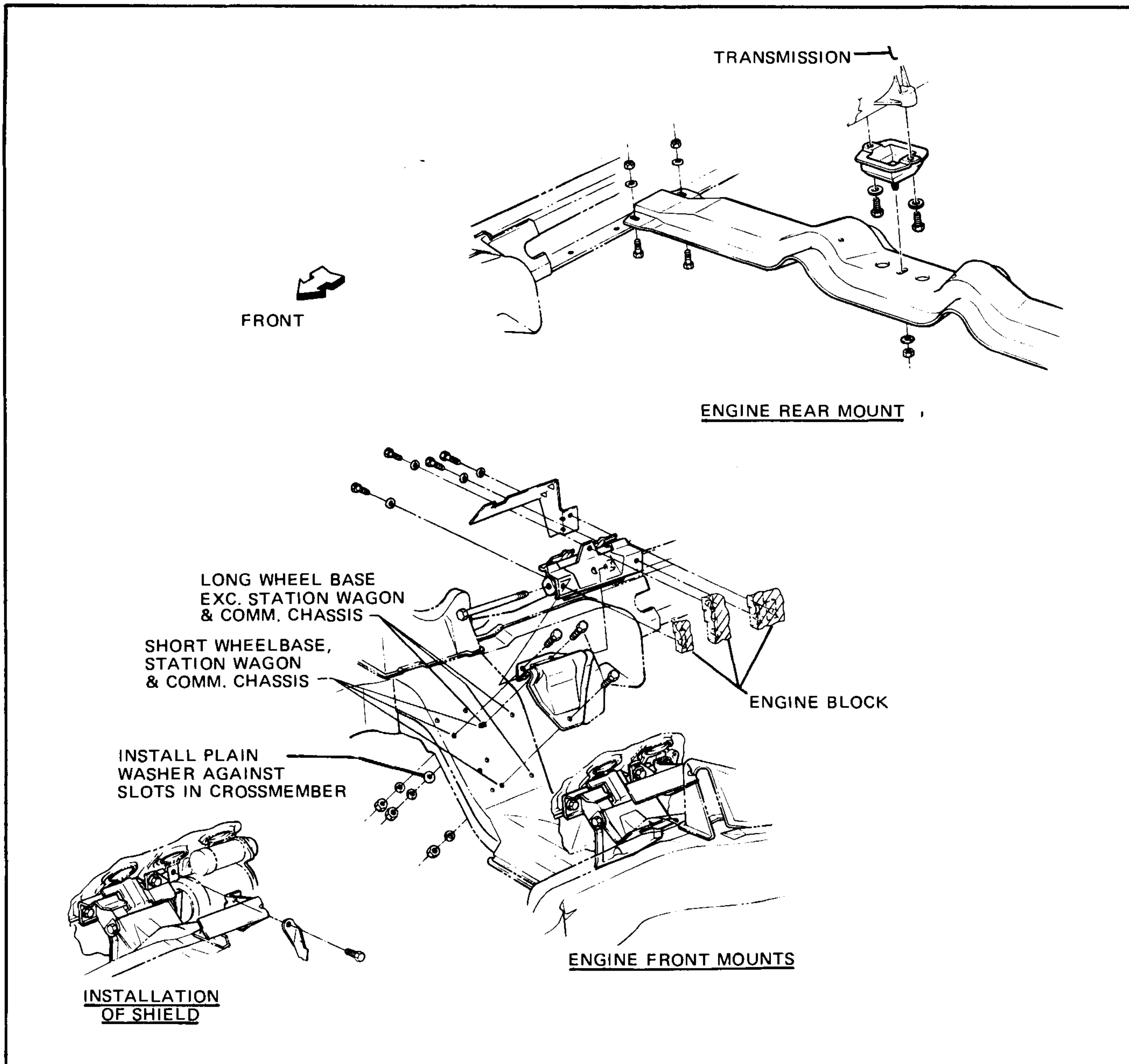


Fig. 6-90 Engine Insulators - B Series

ENGINE INSULATORS

FRONT INSULATORS

REMOVE AND REPLACE

1. Raise hood and, using J-23515-1, J-23515-2 and J-23515-16 (all except 307) or J-23515-1 and J-23515-19 (307) engine lifting tools, take weight of engine off front insulators (Figs. 6-95, 6-96, 6-97, 6-98 and 6-99). Proper Engine Lifting procedure will be found under OIL PAN AND/OR GASKET - REMOVE.

On A Series it will be necessary to remove stabilizer bracket to frame bolts. On G Series, remove idler arm to frame bolts and disconnect pitman arm from shaft.

See Fig. 6-167, Special Tools for proper assembly of engine lifting tools.

CAUTION: *Disconnect battery ground strap before raising engine. (When engine is raised, the starting motor solenoid terminals may contact the steering gear which could energize the starting motor if ground cable is not disconnected).*

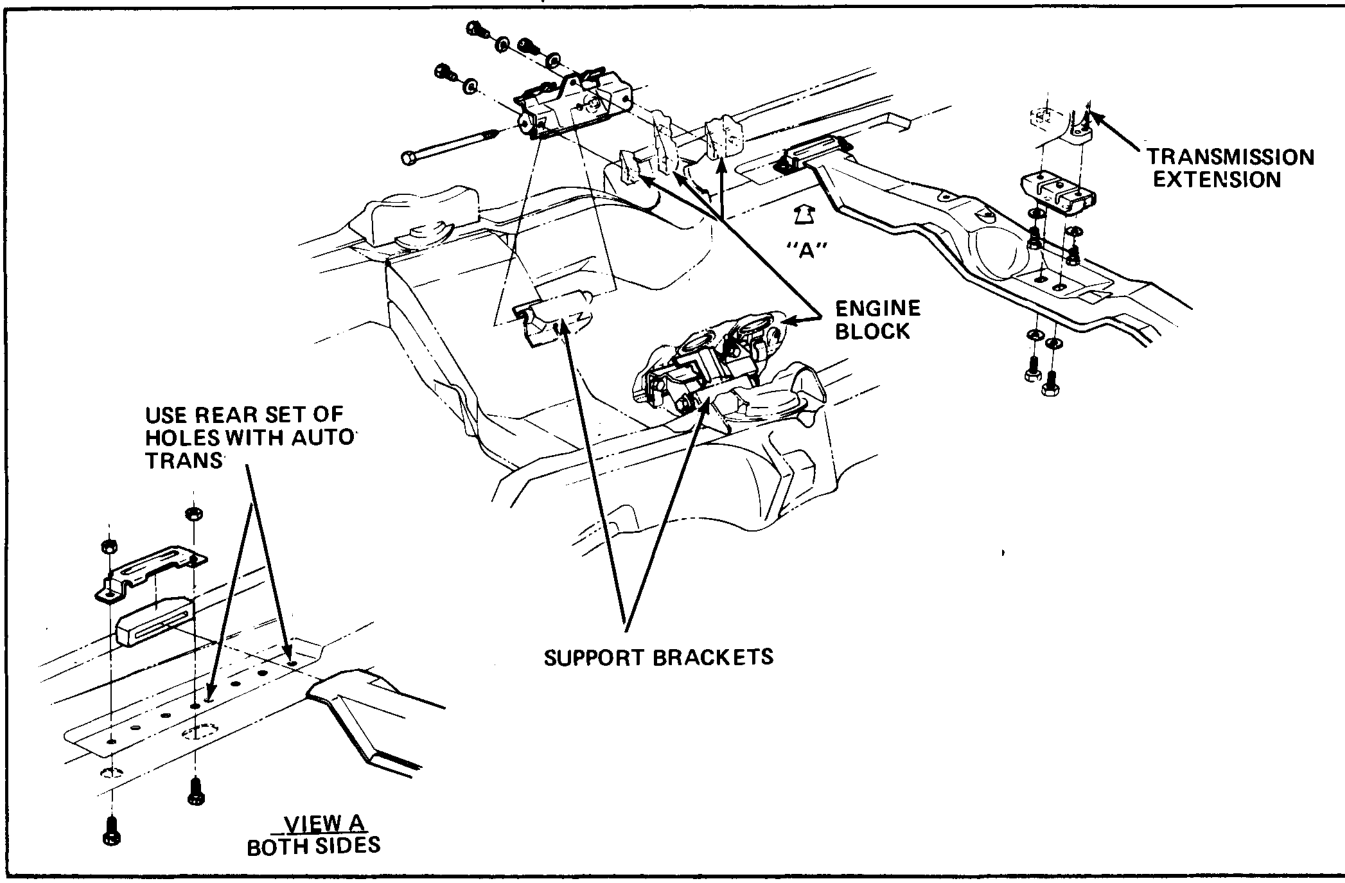


Fig. 6-91 Engine Insulators - G Series

2. Remove bolt which fastens insulators to frame.
3. Remove bolts fastening engine insulators to engine.
4. Raise engine just clear of insulator.
5. Remove insulator.
6. Position new insulator against engine and install attaching screws and washers. Tighten to 70 lb. ft.
7. Lower engine.
8. Install frame to insulator bolt (with lockwasher and plain washer, if equipped) and tighten to 50 lb. ft.

REAR INSULATOR

REMOVE AND REPLACE

1. Support transmission at rear to remove engine weight from rear insulator, using suitable lifting equipment.
2. Remove attaching nuts or bolts at insulator/cross-member, and raise transmission until insulator is clear of lower cross member support.
3. Remove insulator upper retainer bolts from transmission extension.
4. Remove insulator assembly.
5. Install by reversing above procedure, torquing all nuts and bolts to 30 lb. ft.

DRIVE BELTS

ADJUST

Engine fan and accessory drive belts may be adjusted by use of the Belt Tension Gauge. Section 6A gives the correct specifications.

ENGINE ASSEMBLY

REMOVE

1. Disconnect battery cables at battery.

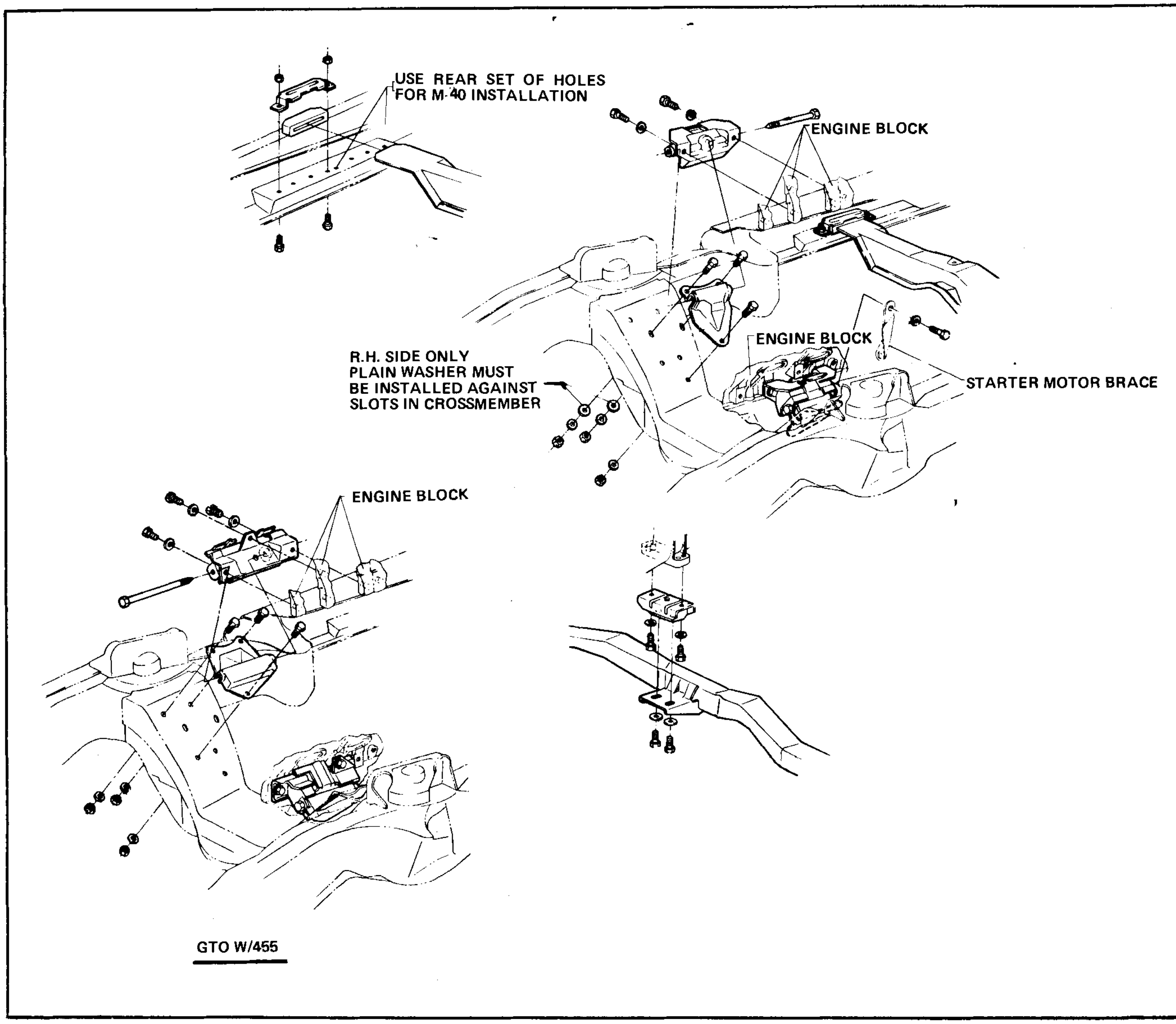


Fig. 6-92 Engine Insulators - V-8 A Series

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 and fold back out of way.
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

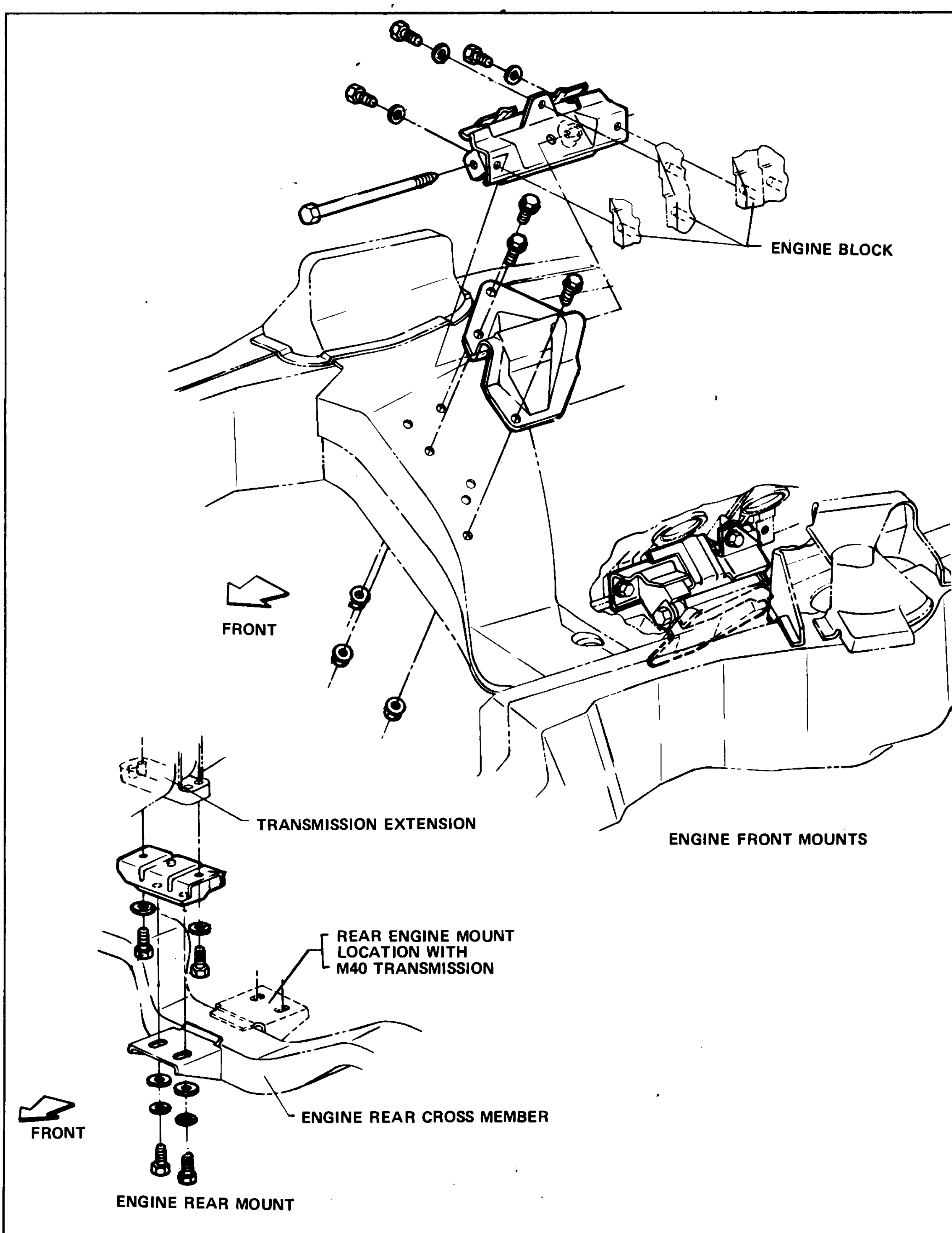


Fig. 6-93 Engine Insulators - V-8 F Series

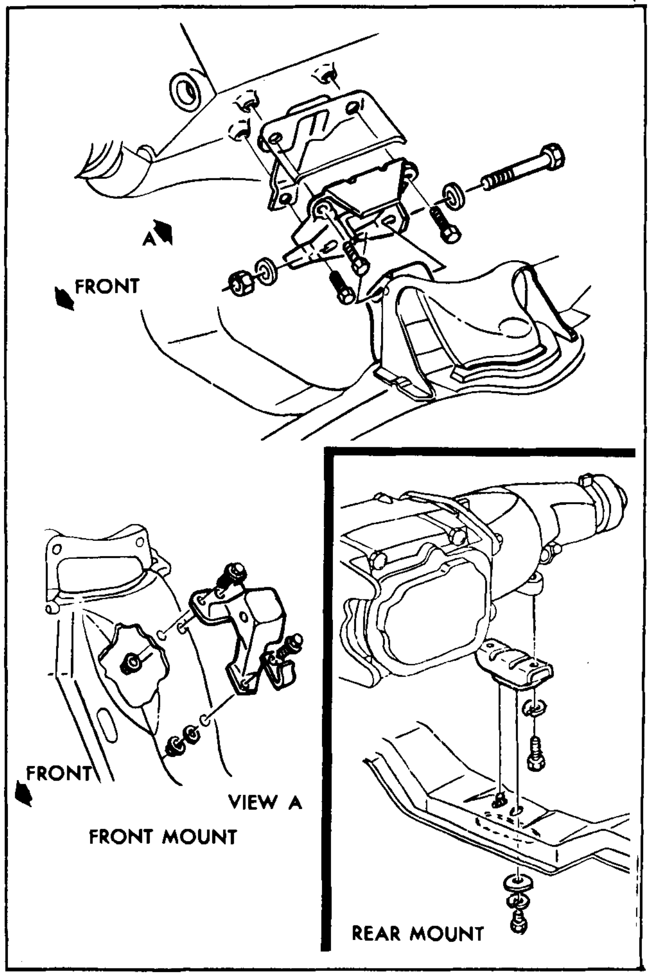


Fig. 6-94 Engine Insulators - V-8 X Series

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) and starter wire harness shield from cylinder heads.
19. Remove two front motor mount bolts at frame.
20. Lower vehicle.
21. Using jack and block of wood, support transmission (automatic 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.

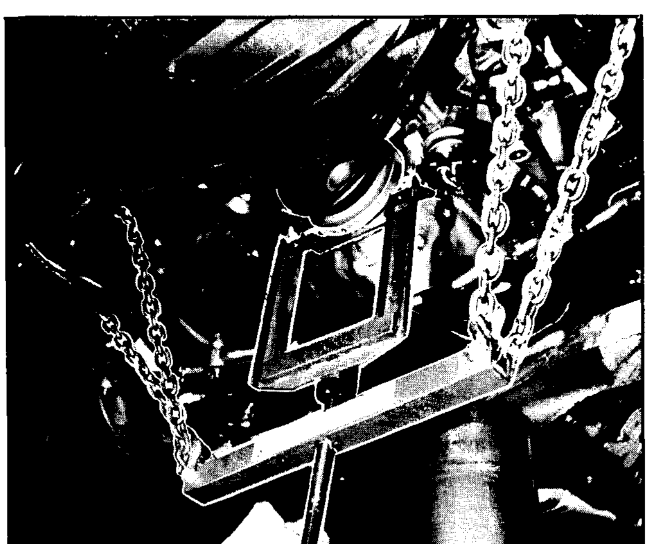


Fig. 6-95 Engine Lifting Tools Installed - B Series

Fig. 6-96 Engine Lifting Tools Installed - G Series

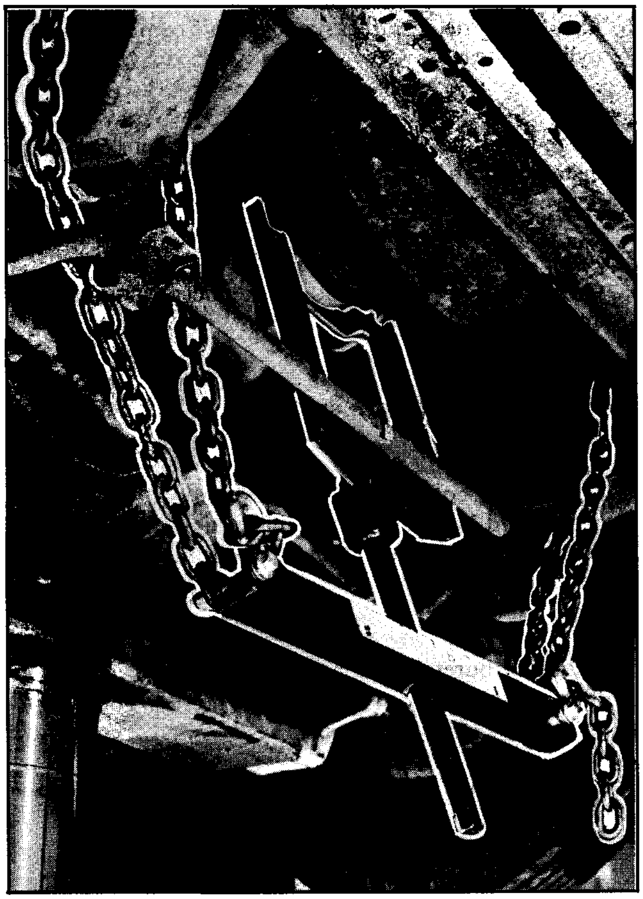


Fig. 6-97 Engine Lifting Tools Installed - V-8 A Series

7. Replace two front motor mount to frame bolts.
8. For remaining installation procedures, reverse steps 1 thru 16.

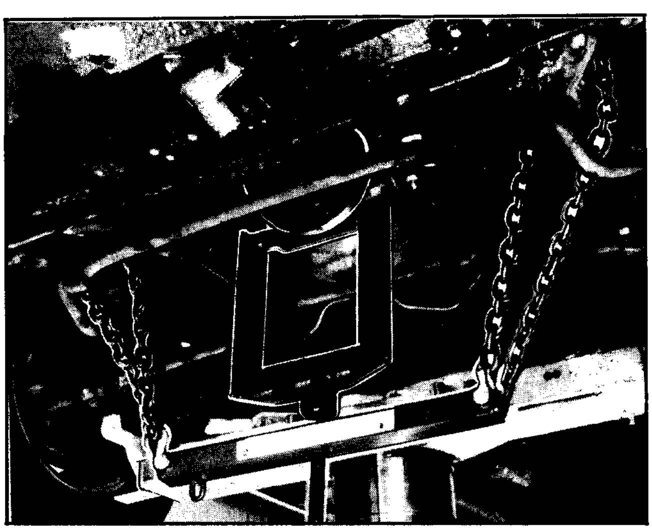


Fig. 6-98 Engine Lifting Tools Installed - V-8 F Series

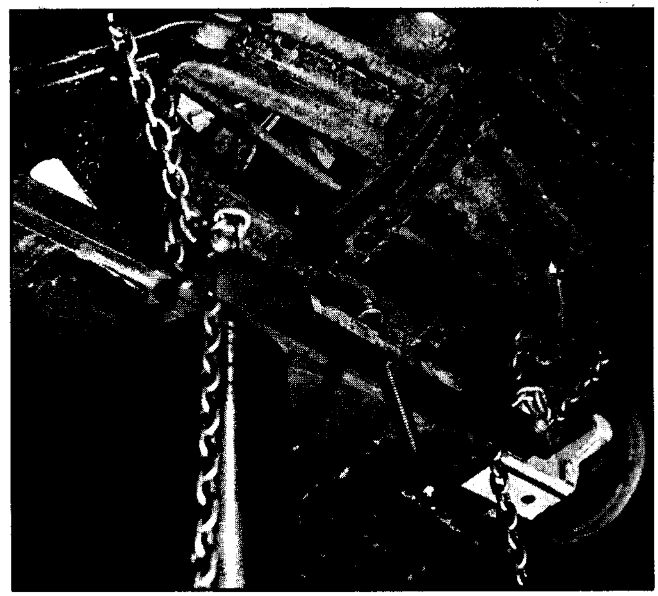


Fig. 6-99 Engine Lifting Tools Installed - V-8 X Series

MANIFOLD - VALVE TRAIN - CYLINDER HEADS

RIGHT SIDE EXHAUST MANIFOLD OR GASKET

REMOVE

1. 307 Engine - Disconnect battery ground cable.
2. 307 Engine - Remove air cleaner pre-heater stove.
3. Disconnect exhaust pipe from manifold.
4. Straighten tabs on manifold front and rear individual bolt locks and remove manifold attaching bolts, manifold, and gaskets. (Locks are used on front and rear pairs of bolts only on all except 307 engines).

REPLACE

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold.
2. Replace exhaust manifold and new gasket. Use new individual manifold bolt locks on front and rear pairs of bolts on all but 307 engines.
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 3/16" between cylinder head and exhaust manifold. After inserting gasket between head and manifold, the remaining bolts may be installed.

4. On all except 307 engines, tighten all bolts evenly and securely to 30 lb. ft. On the 307 engine, torque center bolts to 30 lb. ft. and end bolts to 20 lb. ft. Bend tab of screw locks against bolt heads (all but 307 engines).

   Be sure tabs are bent against sides of bolt heads, not on top of bolt heads.

5. Attach exhaust pipe to manifold with bolts and tighten to 30 lb. ft. Install a new flange gasket on 307 engines.
6. 307 Engine - Connect battery ground cable.
7. 307 Engine - Install air cleaner pre-heater stove.

LEFT SIDE EXHAUST MANIFOLD OR GASKET

REMOVE

1. Remove generator belt and remove generator and mounting bracket as an assembly.
2. 307 Engine - Remove spark plugs.
3. Disconnect exhaust pipe from manifold.
4. Remove carburetor air pre-heater shroud (all except 307 engine).
5. Straighten tabs on manifold individual bolt locks (all except 307 engines). Tabs can be straightened from beneath car by using long-handled screwdriver. (Locks are used on front and rear pairs of bolts only on all except 307 engines).
6. Remove manifold attaching bolts and remove manifold.

REPLACE

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold.
2. On 307 engine, install gasket over two center studs on cylinder head.
3. Place manifold in position against cylinder head and install two end bolts, leaving about 1/8" clearance between head and manifold.
4. On all but 307 engines, slide gasket between manifold and cylinder head.
5. Install remaining bolts and new bolt locks.
6. Tighten all bolts evenly and securely to 30 lb. ft., except end bolts on 307 engine which must be torqued to 20 lb. ft. Bend tabs of bolt locks against bolt heads on all except 307 and 350 engines.
7. Install carburetor air pre-heater shroud (all except 307 engine).
8. Attach exhaust pipe to manifold and tighten to 30 lb. ft.
9. 307 Engine - Install spark plugs.

ROCKER ARM COVER OR GASKET

REMOVE

1. Remove air cleaner.
2. Disconnect crankcase ventilation hoses (as required).
3. Disconnect temperature wire from rocker arm cover clips (remove rear compressor bracket and front adjustment bolt on A/C compressor and swing compressor out of way).
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. Clean gasket surfaces on cylinder head and rocker arm cover with degreaser then, using a new gasket, install rocker arm cover and torque bolts to 45 lb. in.

2. Connect crankcase ventilation hoses (if disconnected).

3. Connect temperature wire at rocker arm cover clips.

4. Install air cleaner.

INTAKE MANIFOLD OR GASKET

REMOVE

1. Drain water from radiator and from each side of cylinder block. (Most water can be drained from the block through radiator drain by raising rear end of car approximately 15" to 18" off floor).

2. Remove air cleaner and disconnect closed ventilation pipe at air cleaner, air cleaner vacuum source at manifold and hot air duct by loosening clamp holding elbow to snorkel.

3. Remove water outlet fitting bolts and position fitting out of way, leaving radiator hose attached.

4. Disconnect wire from thermogauge unit.

5. Remove spark plug wire brackets from manifold.

6. On cars equipped with power brakes, remove power brake vacuum hose from carburetor.

7. Disconnect distributor solenoid to carburetor vacuum hose.

8. Disconnect fuel line connecting carburetor and fuel pump.

9. Disconnect crankcase vent hose from intake manifold.

10. Disconnect throttle cable from carburetor. On 307 engine, disconnect accelerator linkage at pedal lever.

11. 307 Engine - Remove coil.

12. Remove screws retaining throttle control bracket assembly on all but 307 engine.

13. Remove distributor cap and mark rotor positon with chalk. Remove distributor clamp and distributor, then psoition distributor cap rearward clear of manifold.

14. Remove generator upper bracket.

15. Remove intake manifold retaining bolts and remove manifold and gaskets.

CAUTION: *Make certain O-ring seal between intake manifold and timing chain cover is retained and installed during assembly if not damaged.*

REPLACE

When a new manifold is to be installed, transfer carburetor, thermostat, heater hose adapter (307), choke coil and thermogauge fitting. Use new gaskets on those units requiring gaskets and new O-ring seal between manifold and timing chain cover (all but 307 engine).

1. On all but 307 engines, install new gaskets on cylinder heads, positioning them with plastic retainers (Fig. 6-100).

2. On 307 engine, install manifold end seals on block as shown in Fig. 6-101.

3. On 307 engine, install side gaskets on cylinder heads using sealing compound around water passages (Fig. 6-100).

4. Install intake manifold on engine.

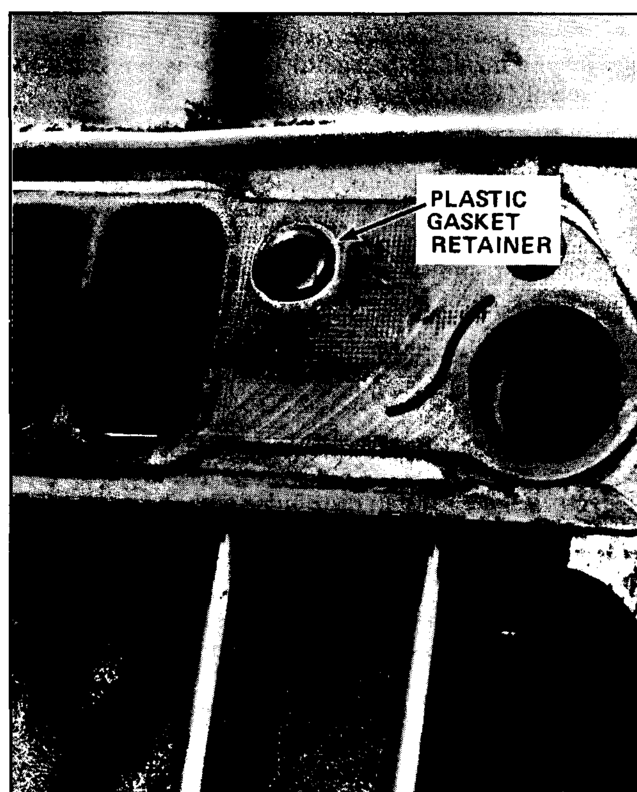


Fig. 6-100 Intake Manifold Gasket Retainers

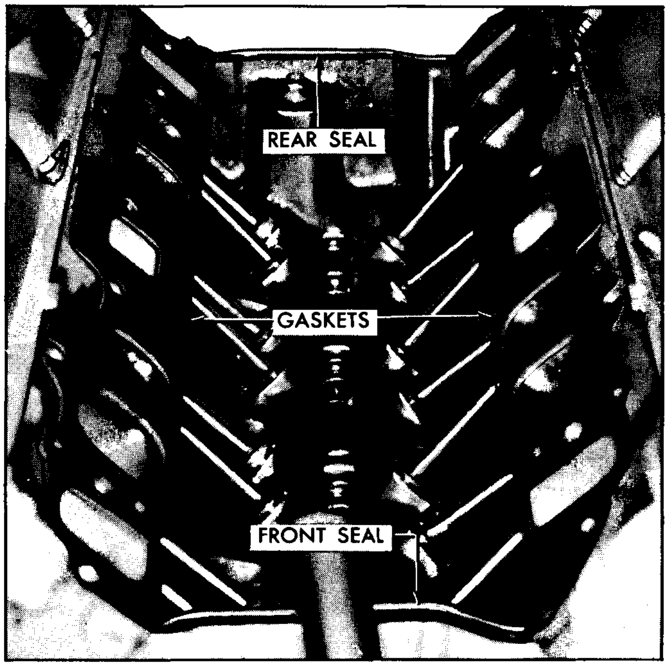


Fig. 6-101 Intake Manifold Gasket Location - 307 Engine

5. On all but 307 engine, install O-ring seal.
6. Install cap bolts loosely.
7. Position throttle control bracket assembly on manifold and install cap bolts.
8. On all but 307 engine, tighten timing chain cover to intake manifold bolt until both units are metal-to-metal (15 lb. ft.).
9. Tighten all bolts evenly to 40 lb. ft. on all but 307 engine. On 307 engine, torque manifold bolts to 30 lb. ft.
10. Connect throttle cable to carburetor, or on 307 engine, connect at pedal lever.
11. 307 Engine - Install upper radiator hose and water outlet fitting (using new gasket).
12. 307 Engine - Install coil.
13. 307 Engine - Install distributor with the rotor pointing at the chalk mark, then install distributor cap.

    NOTE: *If the crankshaft has been rotated while the distributor was removed, time distributor to number 1 cylinder as outlined in Section 6E.*

14. 307 Engine - Install generator upper bracket. Adjust belt tension and torque attaching bolts to specifications.
15. On cars equipped with power brakes, install vacuum hose to carburetor.
16. Install fuel pipe connecting carburetor to fuel pump.
17. Install crankcase vent hose to intake manifold fitting.
18. Install water outlet fitting.
19. Connect wire to thermogauge unit terminal.
20. Install vacuum hoses, connecting distributor solenoid to carburetor.
21. Install spark plug wire bracket.
22. Replace air cleaner, attaching closed ventilation pipe, vacuum source and hot air duct.
23. Close drain plugs and fill radiator to proper level.

PUSH ROD COVER OR GASKET

This operation applies to all but 307 engines. For 307 engine, see INTAKE MANIFOLD - REMOVE & REPLACE.

REMOVE

1. Remove intake manifold, retaining O-ring seal.
2. Remove crankcase ventilator hose.
3. Remove screws from push rod cover and remove cover.

REPLACE

1. Cement new gasket on push rod cover.
2. Apply silicone rubber sealer at 4 corners of cover.
3. Replace push rod cover and tighten screws.
4. Replace positive crankcase ventilation hose.
5. Install intake manifold and O-ring seal.

VALVE SPRINGS, SHIELD OR SEAL

REMOVE

1. Remove rocker arm cover, spark plug and distributor cap. (Remove rear compressor bracket on right side - all except 307 engine - or rear compressor bracket and front adjustment bolt on left side - 307 engine - on cars equipped with A/C).
2. Crank engine until distributor rotor is in position to fire cylinder being serviced.

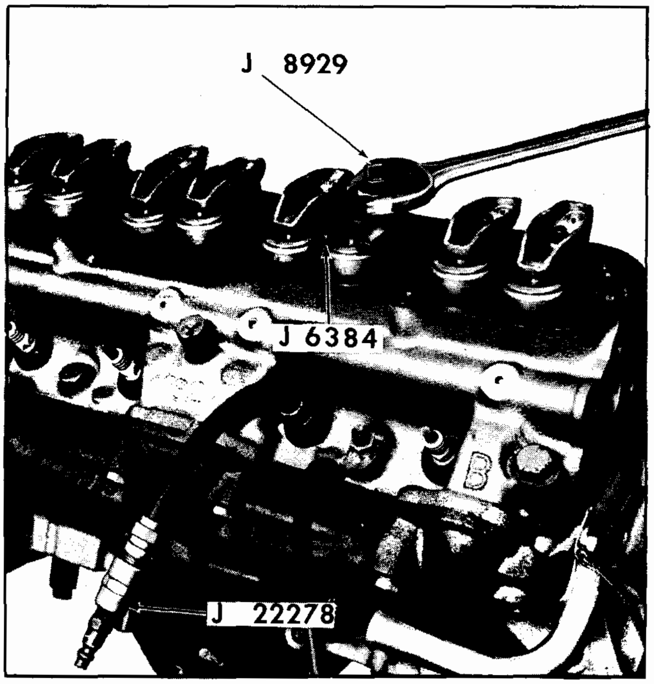


Fig. 6-102 Compressing Valve Spring

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 8929-1 on rocker arm stud and compress valve spring, using compressor J 6384-1 and nut J 8929-2 (Fig. 6-102). Remove valve spring retainer cup locks and then remove valve spring compressor, valve spring retainer cup shield or valve rotator (exhaust valves of 307 engine) and valve stem seal.

REPLACE

1. Install new part or parts, compress springs with valve spring compressor J 6384-1 and nut J 8929-2. Install valve stem seal (Fig. 6-103) and retainer cup locks. Remove spring compressor and valve holder, then test valve stem seal using suction cup end of tool J 22330 (Fig. 6-104).

2. Install rocker arm, tighten rocker arm ball retaining nut to 20 lb. ft.

3. Remove air fitting J 22278.

4. Replace rocker arm cover, spark plug, distributor cap and connect spark plug wire.

PUSH ROD OR VALVE LIFTER

REMOVE

1. Remove intake manifold, making sure timing cover to intake manifold O-ring is saved (all but 307 engine).

2. Remove push rod cover on all but 307 engine.

3. Remove rocker arm cover.

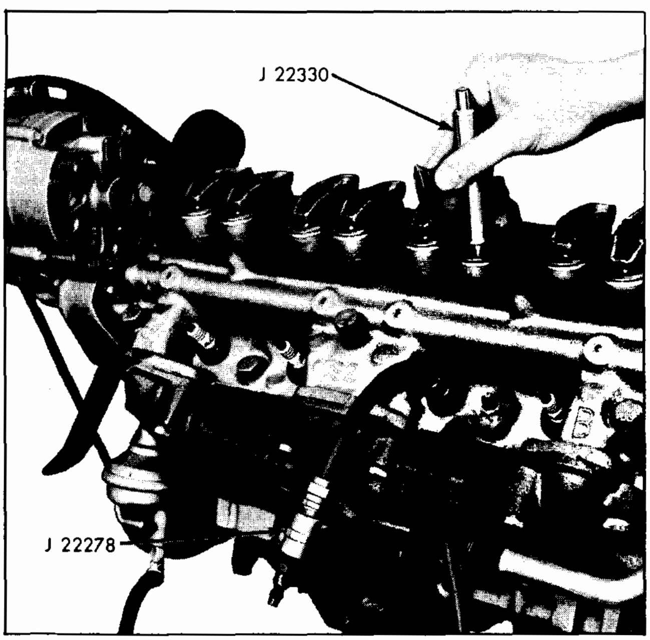


Fig. 6-103 Installing Valve Stem Seal

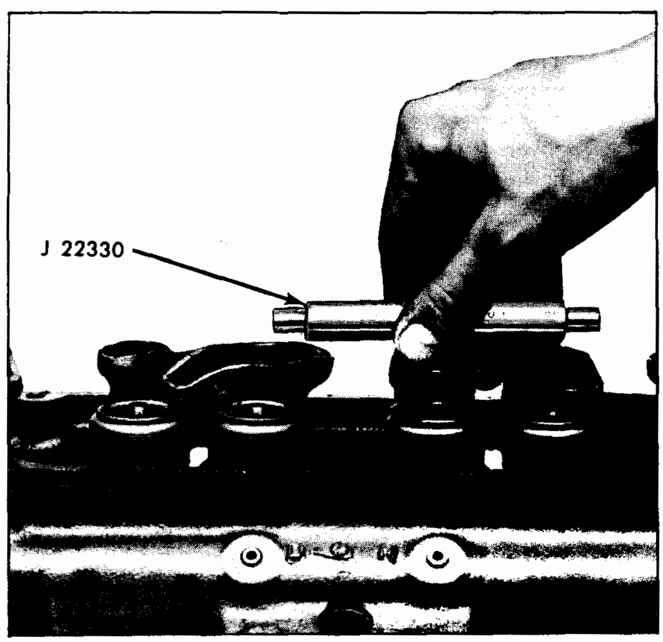


Fig. 6-104 Checking Valve Stem Seal

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.

   If more than one lifter is to be replaced, store push rods in a stand and lifters in a lifter box so they can be re-installed in exactly the same place and position. See GENERAL INFORMATION ON ENGINE SERVICE.

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. Replace push rod exactly as removed (same end against rocker arm).

   NOTE: *Whenever 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.*

3. Position rocker arm on push rod and on all but 307 engine, tighten rocker arm ball retaining nut to 20 lb. ft.

4. On 307 engine, adjust valves when lifter is on base circle of camshaft lobe as follows:

   a. Crank engine until mark on harmonic balancer lines up with center or "0" mark on the timing tab and the engine is in the number 1 firing position. This may be determined by placing fingers on the number 1 cylinder valves as the mark on the damper comes near the "0" mark on the 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 crankshaft should be rotated one more revolution to reach the number 1 position.

   b. Valve adjustment is made by backing off the adjusting nut (rocker arm stud nut) until there is play in the push rod and then tighten nut to just remove all push rod to rocker arm clearance. This may be determined by rotating push rod with fingers as the nut is tightened (Fig. 6-105). When push rod does not readily move in relation to the rocker arm, the clearance has been eliminated. The adjusting nut should then be tightened an additional 1 turn to place the hydraulic lifter plunger in the center of its travel. No other adjustment is required.

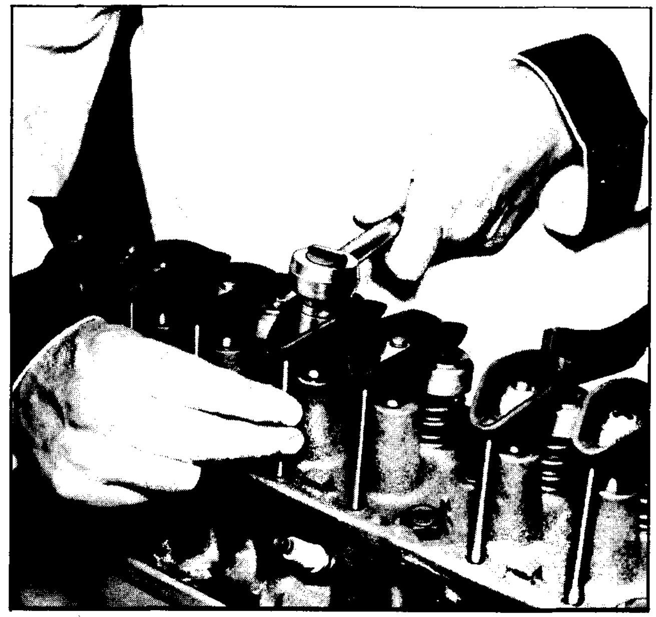


Fig. 6-105 Adjusting Valve Train Lash - 307 Engine

   c. 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

   d. Crank the engine one revolution until the pointer "0" mark and harmonic balancer mark are again in alignment. This is number 6 firing position. With the engine in this position the following valve may be adjusted.

      Exhaust - 2, 5, 6, 7

      Intake - 3, 4, 6, 8

5. Replace rocker arm cover.

6. On all but 307 engine, inspect condition of push rod cover gasket and replace if necessary; replace push rod cover and tighten screws. New gasket must be cemented securely to push rod cover before installation.

7. Replace intake manifold using new gaskets and replace O-ring seal.

VALVE LIFTER

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, cleaniness, 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 (Fig. 6-106) 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. 6-107).
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 the tool against a block of wood until plunger falls out (Fig. 6-108). (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.

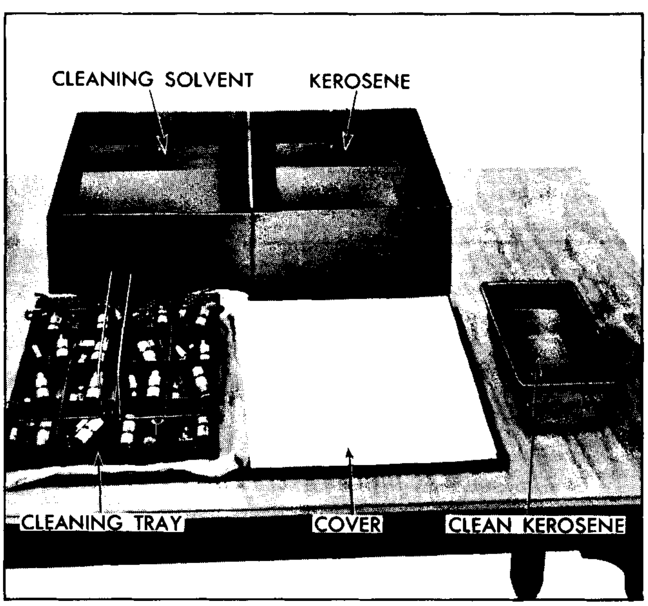


Fig. 6-106 Lifter Wash Tank and Tray

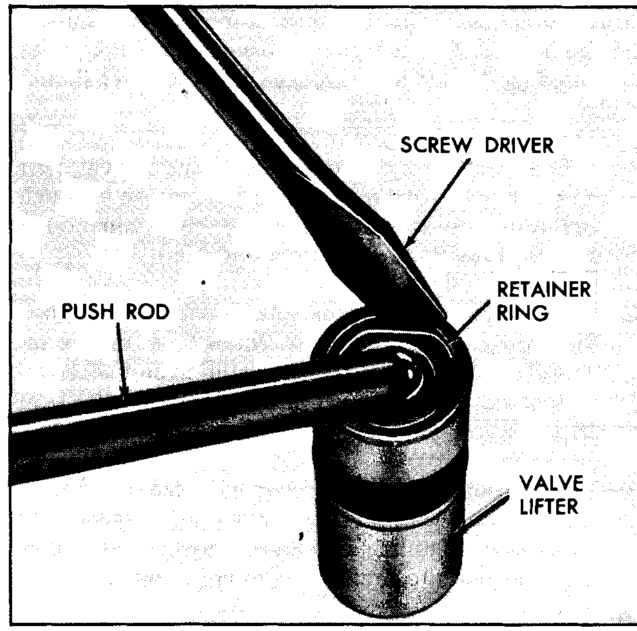


Fig. 6-107 Removing Pushrod Seat Retainer

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

Wash tank J 5821 (Fig. 6-106) is recommended for cleaning valve lifter parts. This tank consists of two chambers,

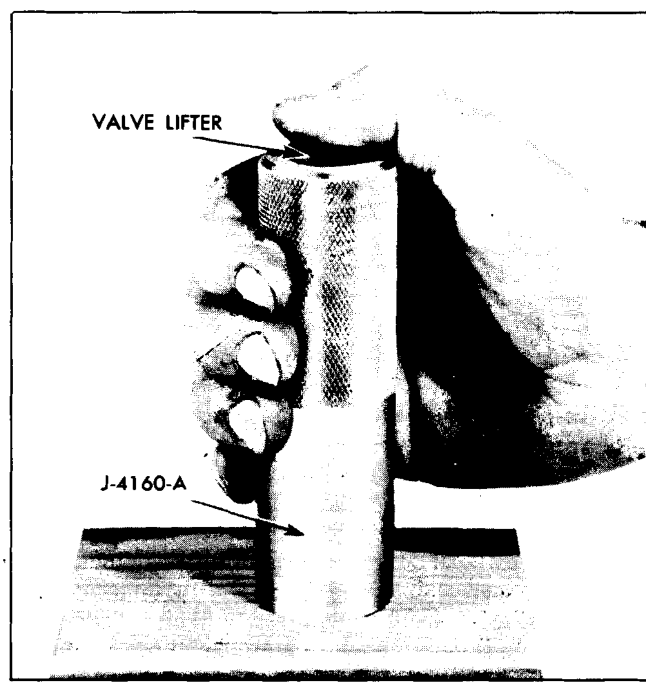


Fig. 6-108 Removing Stuck Plunger

a tray and a cover. One chamber is for cleaning solvent and the other is for kerosene. Whenever the tank is not being used (and when parts are soaking), the cover should be closed.

1. Before placing tray of parts in cleaning solvent, first immerse it in kerosene chamber to remove as much engine oil as possible. (This reduces contamination of solvent, thus prolonging its useful life.)

2. Submerge tray in cleaning solvent and allow to soak for approximately one hour. More time may be required depending on varnish condition and effectiveness of solvent. Light agitation of tray in solvent at 10-15 minute intervals will hasten cleaning action.

3. After varnish has dissolved or has been sufficiently softened to permit removal by wiping, suspend tray above solvent, utilizing hooks on tray handles. Allow tray and parts to drain for a brief period.

4. Rinse tray of parts in kerosene chamber to cut solvent and to avoid injury to hands (from solvent).

5. Wipe out tank cover and place tray of parts on cover in front of tank (Fig. 6-106). A shop towl under tray and clean paper on remainder of cover will ensure cleanliness. (Absolute cleanliness can be assured if each lifter is inspected and assembled after cleaning before proceeding to the next lifter).

6. Working on one lifter at a time and using clean, lint-free cloths, thoroughly wipe off lifter parts. Clean plunger and external and internal surfaces of body with hard wiping action. A bristle brush may be used to clean internal surface of lifter body.

   CAUTION: *Do not use wire brush or sand paper, since damage to machined surface is likely.*

7. Inspect lifter body. Both inner and outer surfaces of lifter body should be inspected for scoring. Lifter assembly should be replaced if body is roughly scored, grooved, or galled. Inspect cam contact surface on lower end of lifter body. Replace lifter assembly if this surface is excessively worn, galled or otherwise damaged.

8. Inspect lifter plunger. Using magnifying glass, inspect check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with rough, satiny finish will cause plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with fingernail are causes for replacing lifter assemby. This rule does not apply to slight edge which may sometimes be present where lower end of plunger extends below the ground inner surface of body. This edge is not detrimental unless it is sharp or burred.

   A blackened appearance is not a malfunctioning condition. Sometimes discoloration serves to highlight slight grinder chatter marks and give the outer surface of plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore, it may be disregarded.

9. Inspect push rod seat for roughness and make sure that hole in center is open.

10. Carefully examine lifter ball for nicks, imbedded material or other defects which would prevent proper seating. Such defects may cause intermittently noisy lifter operation. Also inspect plunger face of ball retainer for excessive wear.

ASSEMBLE

CAUTION: *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. 6-109 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.

2. Rinse lifter ball and place in retainer. (On high ball lifters, the lifter ball spring will be positioned in retainer before lifter ball).

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.

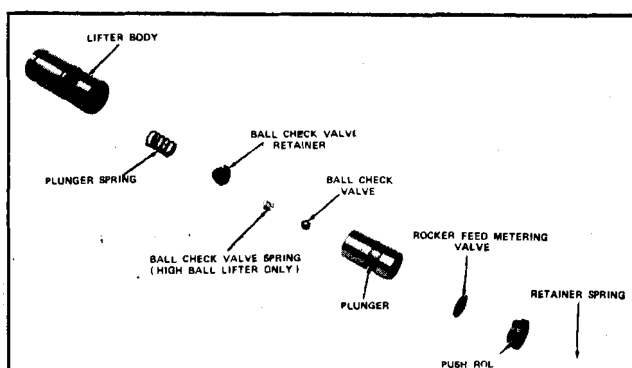


Fig. 6-109 Hydraulic Valve Lifter - Exploded View

5. Place orifice feed plate in plunger.
6. Place lifter body on clean paper; rinse and install push rod seat and retainer ring.
7. After lifter has been assembled, place in lifter box and close lid to preserve cleanliness.

TEST VALVE LIFTER 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. 6-110) 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 important. 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 your lifter tester dealer.

   NOTE: *No other type fluid is recommended or should be used.*

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 pointer is positioned on the set line (marked "S"). Tighten jam nut to maintain setting.

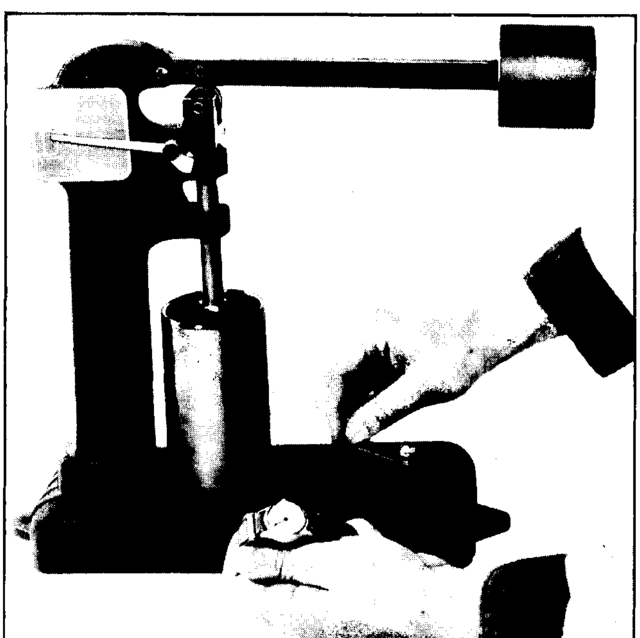


Fig. 6-110 Testing Leakdown Rate

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 .125 or 1/8" while still rotating cup with crank (Fig. 6-110).

   Lifter is satisfactory if rate is between 20 and 90 seconds (455 H.O. lifter leak-down rate should be 12 to 60 seconds).

   A doubtful lifter should be tested three or four times. Disassemble, inspect and re-test doubtful lifters. If leak-down still is not within specifications, replace lifter.

6. After each lifter is tested, replace in lifter box to insure cleaniness. Leave lifters in box until ready for installation in cylinder block.
7. When all lifters have been tested, empty cup, clean, and place cover over tester to maintain its cleaniness.

CYLINDER HEAD OR GASKET

REMOVE

1. Drain cooling system, including block.
2. Remove intake manifold, push rod cover (all but 307 engine), and rocker arm cover.
3. Loosen all rocker arm retaining nuts and move rocker arms off push rods.
4. Remove push rods and place in a support stand so they can be replaced in exactly the same position from which they were removed. See GENERAL INFORMATION ON ENGINE SERVICE.
5. On all but left head of 455 H.O., remove exhaust pipe to manifold attaching bolts.
6. In order to remove the left head of the 455 H.O., it will be necessary to remove the exhaust manifold attaching nuts and drop manifold. Remove inner panel of carburetor heat stove from two center cylinder head bolts.
7. 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.

8. Remove cylinder head bolts (dowel pins will hold head in place) and remove head with exhaust manifold attached, using lifting hooks J 4266. (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.*

9. Remove cylinder head gasket.

REPLACE

Right and left cylinder heads are the same. New heads are complete with rocker arm studs (exc. heads with screwed in studs) and all plugs.

When installing new head, transfer all serviceable parts to new head, using new seals on intake and exhaust valve stems, and new exhaust manifold gasket. Install new intake manifold gasket plastic retainers.

1. Thoroughly clean gasket surfaces of head and block. Place new gasket on block, and replace cylinder head.

2. Start all bolts. On 307 engines, the threads of cylinder head bolts should be coated with a sealing compound.

   Bolts are three different lengths. When inserted in proper holes all bolts will project an equal distance from the head. Do not use sealer of any kind on the threads, except 307 engine.

3. Tighten bolts evenly to 95 lb. ft. on all but 307 engines and to 65 lb. ft. on the 307.

4. Install push rods in same location from which they were removed and with the same end up against rocker arm.

5. Reposition rocker arms and tighten rocker arm ball retaining nuts to 20 lb. ft.

6. On 307 engines, adjust valve mechanism as described under PUSH ROD OR VALVE LIFTER - REPLACE.

7. Replace rocker arm cover and tighten screws.

8. Replace push rod cover (all except 307 engine) and tighten screws.

9. Replace battery ground strap and engine ground strap or engine ground strap and automatic transmission oil level indicator tube bracket Also replace the engine oil level indicator.

10. Replace intake manifold using new gaskets.

11. Install exhaust-pipe-to-manifold attaching nuts.

12. Refill cooling system.

ROCKER ARM STUDS

PRESSED IN STUDS

REMOVE AND REPLACE

Only .005″ oversize studs are available. This stud is to be used if old stud has become loose, broken or because of faulty threads.

The procedures shown are for replacement without removal of cylinder head. If it is found necessary to remove the cylinder head for another reason, this procedure can be used with slight modification.

1. Remove rocker arm cover.

2. Pack oily rags around stud and engine openings.

3. All except 307 engine:

   a. With rocker arm removed, file two slots 3/32″ to 1/8″ deep on opposite sides of rocker arm stud (Fig. 6-111).

      Top of slots should be 1/4″ to 3/8″ below thread travel.

   b. Place washer at bottom of rocker arm stud.

   c. Position rocker arm stud remover J 8934 on rocker arm stud and tighten screws securely with 5/32″ hex type wrench.

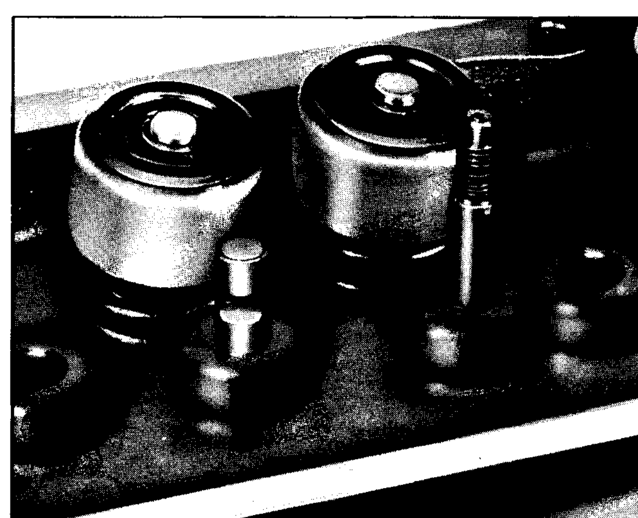


Fig. 6-111 Slots for Removing Rocker Arm Stud

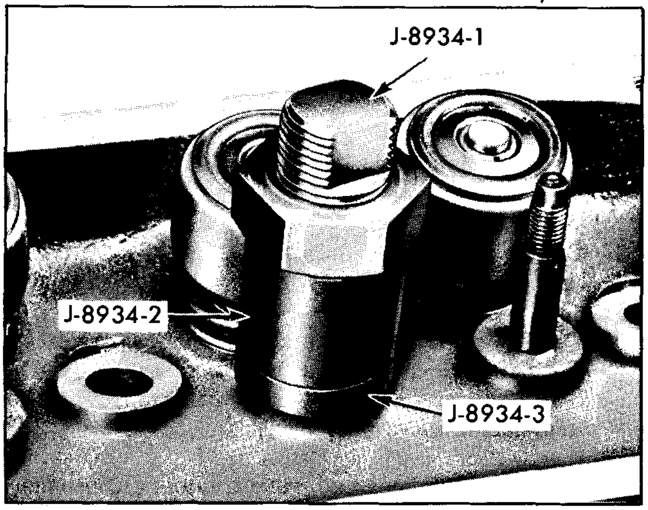


Fig. 6-112 Removing Rocker Arm Stud

d. Place spacer over stud remover J 7934.

e. Thread 7/8" standard nut on stud remover and turn nut until rocker arm stud is out of cylinder head (Fig. 6-112).

4. 307 Engine - If rocker arm is stripped, refer to Fig. 6-113 for rethreading and Fig. 6-114 for removing rocker arm stud.

5. After removing stud, carefully ream stud hole using reamer J 22126. Stud hole must first be reamed with pilot shaft attached to reamer. Pilot shaft should then be removed and stud hole must be reamed again.

6. Clean stud hole and surrounding area. (Inspect stud hole. If reamer did not clean up completely, it will be necessary to replace cylinder head).

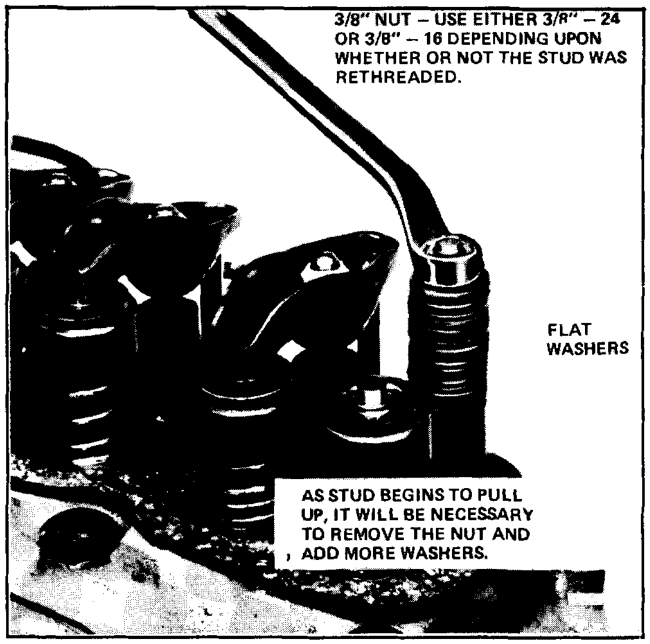


Fig. 6-114 Removing Rocker Arm Stud

7. Coat rocker arm stud with white lead and oil and place rocker arm stud installer J 23342 (all except 307 engine) or J 6880 (307 engine) on stud in place of rocker arm and ball.

8. Carefully drive stud into cylinder head until tool J 23342 or J 6880 has seated on machined rocker stud boss (Fig. 6-115).

9. Install push rod, rocker arm, ball and rocker arm ball retaining nut.

10. Replace push rod cover, intake manifold and rocker arm cover.

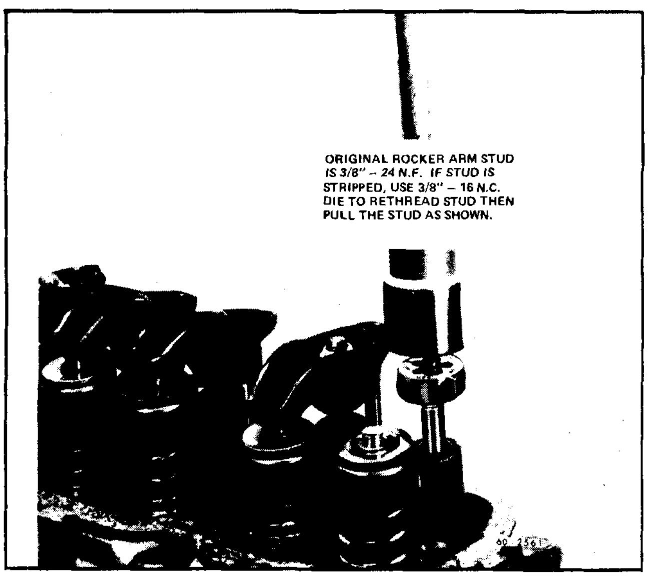


Fig. 6-113 Rethreading Stripped Rocker Arm Stud

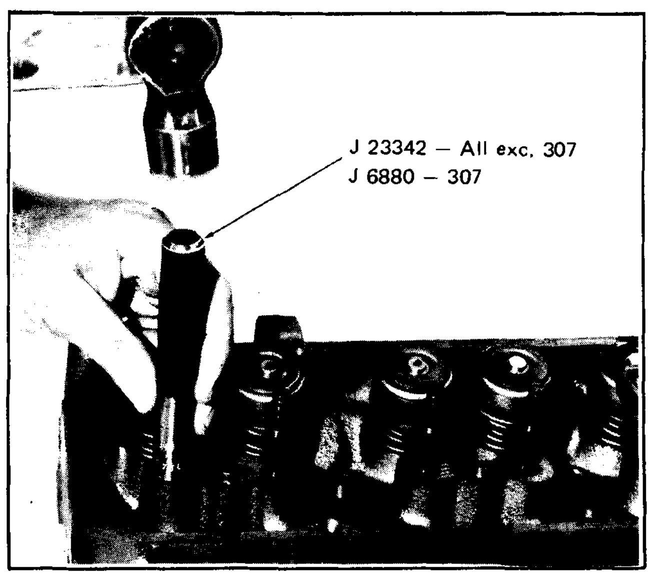


Fig. 6-115 Installing Rocker Arm Stud

SCREWED IN STUDS

REMOVE AND REPLACE

1. Remove rocker arm cover.
2. Remove rocker arm and nut.
3. Using a deep well socket, remove rocker stud.
4. Install new stud and tighten to 50 lb. ft.
5. Install rocker arm and tighten nut to 20 lb. ft.
6. Install rocker arm cover using new gasket.

CYLINDER HEAD AND VALVES

DISASSEMBLE

1. Remove valve spring retainer cup locks (keepers), valve rotators (exhaust valves of 307), valve stem oil seals, valve spring retainer cups, valve stem shields, valve springs, and valves, using valve spring compressor J 8062. Valve stem oil seals must be discarded and replaced with new seals any time they are removed.
2. Place valves in valve and valve train holding stand.

CYLINDER HEAD AND VALVES

CLEAN AND INSPECT

Efficient engine performance depends to a great degree upon the condition of engine valves. Close inspection of intake valves is especially important as excessive clearance of valve stems in guides will permit oil to be pulled into the combustion chamber, causing fouled spark plugs and clogged piston rings. Oil deposited on valve heads will carbonize and burn, causing valves to leak with resultant loss of engine power. Therefore, valves must operate properly and if inspection discloses any malfunction of valves, the trouble must be corrected to avoid future damage to valves or related engine parts.

1. Inspect valves and seats to determine condition before cleaning. Also examine water passage plugs for evidence of leakage.
2. Clean valves thoroughly to remove deposits from head and stem.
3. Clean and inspect cylinder head as follows:
   a. Clean carbon deposits from combustion chambers and all sludge or foreign matter from other areas of cylinder head. If a scraper or wire brush is used for cleaning, use care to prevent damage to valve seats (by staying clear of seat area with tool).
   b. Clean cylinder head thoroughly, using suitable cleaning equipment.
4. Clean valve guides thoroughly, using valve guide cleaner J 8101 (Fig. 6-116).
5. Visually inspect valve guides for evidence of wear, especially the end toward the spring seat. If a guide is scored or galled, install valve with proper oversize stem according to procedure.
6. Clean valve springs and valve rotators (307 engine) and inspect for damage.
7. Clean push rods and thoroughly clean out oil passage through center of rod. Inspect to see that the rod is straight.
8. Clean rocker arms and rocker arm balls, and visually inspect for evidence of wear.
9. Clean spark plugs as outlined in ENGINE ELECTRICAL SECTION.
10. Clean and inspect valve lifters.

CHECKING ROTATORS (307 ENGINE)

The valve rotators used on exhaust valves of the 307 engine 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 (Fig. 6-117).

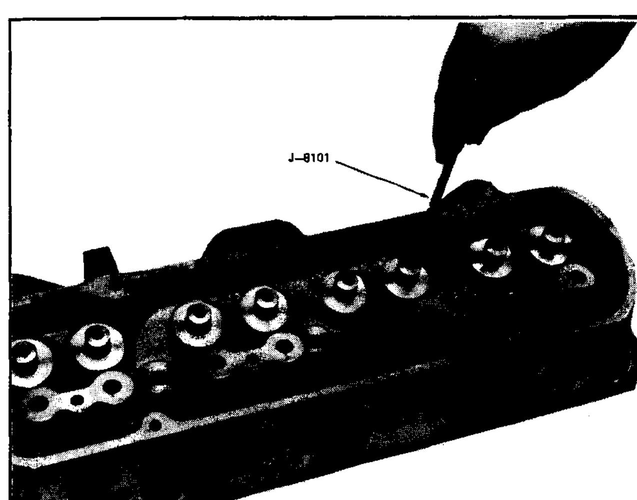


Fig. 6-116 Cleaning Valve Guide

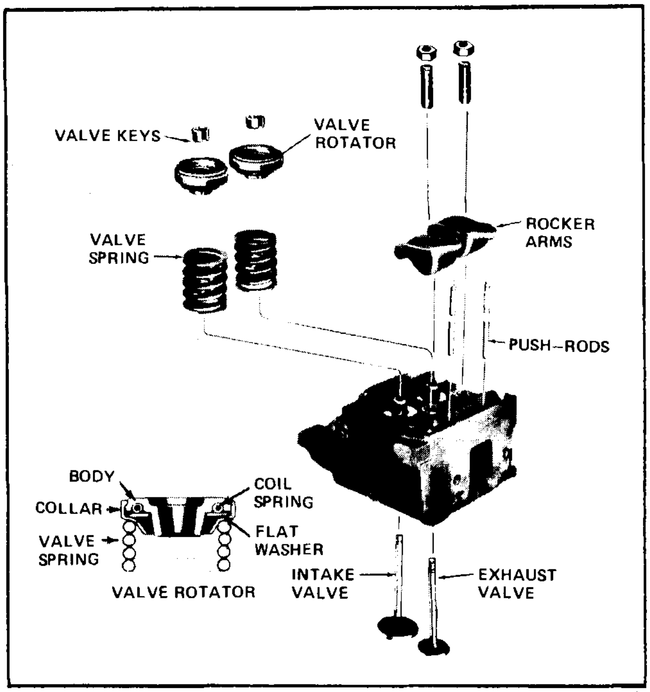


Fig. 6-117 Valve Components - 307 Engine

Run engine at approximately 1500 RPM. There should appear to be motion between the body and the collar. The body will appear to "walk" around the collar. Rotator action can be either clockwise or counterclockwise. In some instances, the direction of rotation will change upon removal and reinstallation. This does not matter so long as it rotates.

In addition, anytime the valves are removed the tips of the valve stem should be inspected for improper pattern, which could indicate valve rotator malfunction (Fig. 6-118).

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. Intake valve seat angle is 30° on all except 307 engines, 46° on 307 engines and exhaust valve seat angle is 45° on all cylinder heads. Intake valve face angle is 29° on all except 307 engine, 45° on 307 valves and exhaust valve face angle is 44° on all valves except 307, which is 45°. This will provide hairline contact between valve and seat to provide positive sealing and reduce build-up of deposits on seating surfaces (Fig. 6-119).

DO NOT USE REFACING EQUIPMENT EXCESSIVELY; only enough material should be removed to true up surfaces and remove pits. The valve head will run hotter as its thickness is diminished; therefore, if the valve face cannot be cleaned up without grinding to a point where the outside diameter of the valve has a sharp edge, the valve should be replaced. Whenever it is necessary to replace a valve, the new valve should be of the same stem diameter as the valve removed (unless the valve guide is reamed to provide proper fit).

Width of exhaust valve seats should be 1/16" (.048"-.070"). Intake valve seat should be between 3/64" and 1/16" (.045"-.071"). If seat width is excessive, it should be narrowed by grinding with a flat stone (Fig. 6-120). This is the only method that should be used to narrow the seat.

Lapping of valve seats is not required nor recommended.

2. Concentricity of valve seat and valve guide can be checked by using a suitable dial indicator or prussian blue. When using a dial indicator, total runout should not exceed .002".

   When prussian blue is used, a light coat should be applied to the face of the valve only and the valve

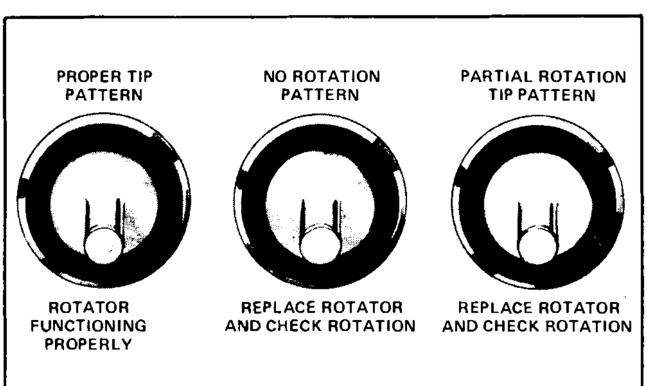


Fig. 6-118 Valve Stem Wear Patterns - 307 Engine

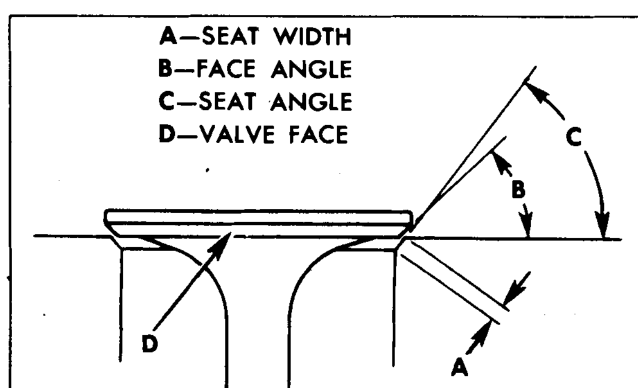


Fig. 6-119 Valve Seat and Face Angles

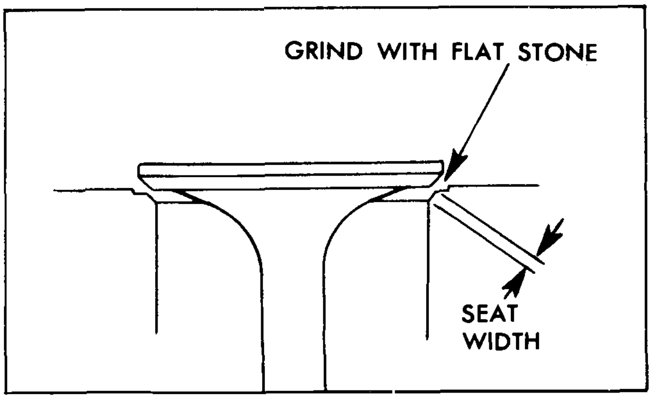


Fig. 6-120 Valve Seat After Grinding with Flat Stone

rotated in its seat. If blue appears all the way around valve seat, the valve seat and valve guide are concentric with one another.

3. After cleaning prussian blue from valve and seat following preceding check, lightly coat valve seat with prussian blue and rotate valve in guide. If blue appears all the way around valve, the valve stem and valve face are concentric with one another.

Both tests in steps 2 and 3 are necessary to insure proper valve seating.

FITTING VALVE STEMS TO GUIDES

Correct valve stem clearance for valve guides is .0016" to .0033" for intake valve and .0021" to .0038" for exhaust valve for all except 307 engines and .0010" to .0027" for intake valve and .0012" to .0029" for exhaust valves on the 307 engine.

Valves with oversize stems are available in .003" and .005" larger than standard. (Valves are marked .003 or .005 with colored ink).

The same valve stem to guide clearance applies for oversize stems.

Fig. 6-121 Reaming Valve Guide

Oversize reamers are required to enlarge valve guide holes to fit the oversize stems. When the reamer is turned through the valve guide, it will size hole to fit valve stem according to above limits.

Carefully ream valve guide using valve guide reamer J 5830-1 for .003" oversize stems and valve guide reamer J 6621 for .005" oversize stems (Fig. 6-121). For best results when installing .005" oversize valve stem, use .003" oversize reamer first and then ream to .005" oversize. Always reface valve seat after reaming valve guide.

CYLINDER HEAD AND VALVES

ASSEMBLE

1. Install valves, valve springs, valve stem shields, valve spring retainer cups, valve stem seals and retainer cup locks, using suitable spring compressor. The valve stem seals must be installed in the second groove (from end of stem). Valve stem seal installer and tester J 22330 can be used to install this seal (Fig. 6-103). Where necessary, install new umbrella type seal using suitable plastic protector over end of valve stem.

   After valves have been installed, the suction cup end of special tool J 22330 should be used to test for leaks between the valve spring retainer cup and valve stem seal (Fig. 6-104). The suction cup will tend to be held to the valve spring retainer cup by suction when seal is satisfactory. If a leak is detected, replace seal or valve spring retainer cup as necessary. It is important to have a positive seal between the valve spring retainer cup and valve stem seal to prevent excessive amounts of oil from being drawn down the valve stem which will cause exhaust smoke and oil consumption.

2. Install spark plugs.

HARMONIC BALANCER

REMOVE AND REPLACE

1. Loosen generator at adjusting strap and lower pivot bolt and remove fan belt from harmonic balancer. On 307 engine, remove fan and fan pulley. On cars equipped with power steering, also remove power steering pump belt from harmonic balancer.

2. On all but 307 engine, position fan so wide angles will be at top and bottom allowing access to balancer (Fig. 6-122).

3. Remove accessory drive pulley (307 engine) and then remove harmonic balancer attaching bolt and retainer washer (all).

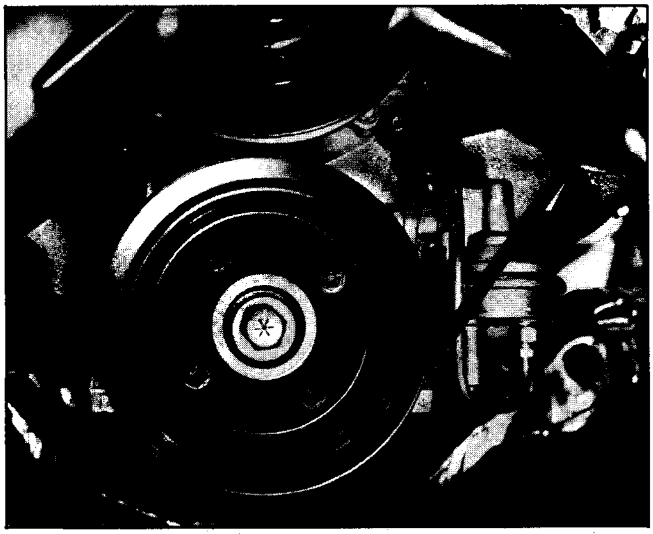


Fig. 6-122 Harmonic Balancer - Typical

4. On all but 307 engine, remove harmonic balancer by sliding it off end of crankshaft.

5. On 307 engines, install tool J-23523 to harmonic balancer and turn puller screw to remove balancer from crankshaft (Fig. 6-123).

6. Remove tool on 307 engine.

7. Remove crank pulleys and reinforcing plate.

CAUTION: *Do not pry on O.D. of harmonic balancer. Harmonic balancer is a rubber mounted inertia member and balance could be affected.*

8. All except 307 Engine:

   a. Install new harmonic balancer by reversing above steps, lining up keyway in balancer with key on crankshaft.

   b. Tighten harmonic balancer attaching bolt to 160 lb. ft. (Remove flywheel cover and lock flywheel before tightening balancer bolt).

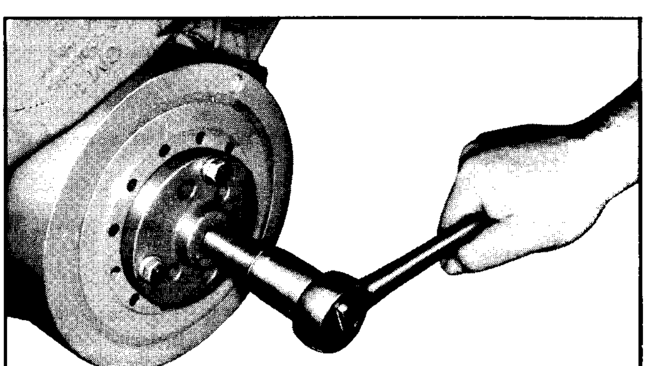


Fig. 6-123 Removing Harmonic Balancer

9. 307 Engine:

CAUTION: *It is necessary to use installer tool to prevent the inertia weight section from walking off the hub during installation of balancer.*

   a. Coat front cover seal contact area (on balancer) with engine oil.

   b. Place balancer in position over key on crankshaft.

   c. Pull balancer onto crankshaft as follows:

      1. Install appropriate threaded end of tool J-23952 into crankshaft (Fig. 6-124).

CAUTION: *Install tool in crankshaft so that at least 1/2" of thread engagement is obtained.*

      2. Position balancer on crankshaft, aligning balancer with key on crankshaft.

      3. Install plate, thrust bearing and nut to complete tool installation.

      4. Pull balancer into position.

   d. Remove tool from crankshaft.

   e. Install balancer retaining bolt and torque to 60 lb. ft., then install accessory drive pulley.

   f. Install fan pulley and fan.

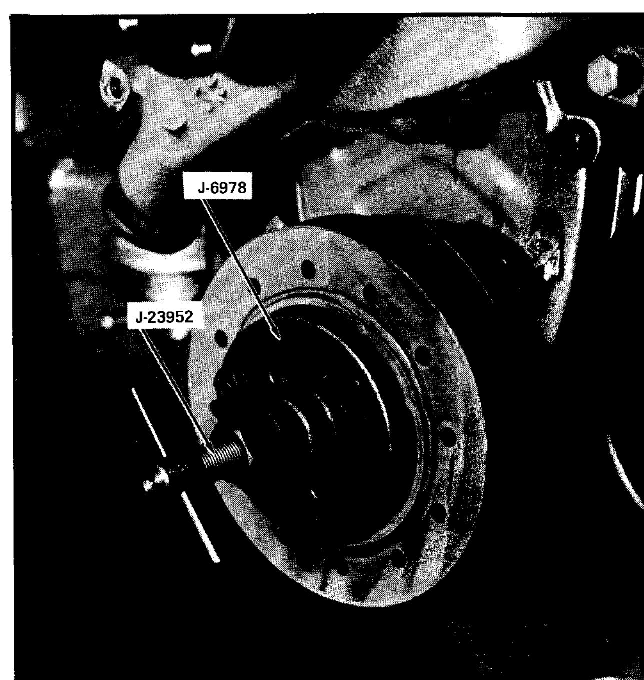


Fig. 6-124 Installing Harmonic Balancer

10. Install fan belt and adjust to specifications.

TIMING CHAIN COVER SEAL

REMOVE AND REPLACE

1. Loosen generator adjusting bolts.
2. Remove fan and accessory drive belts.
3. Remove harmonic balancer.
4. Remove timing chain cover seal by prying out of bore with a pry bar (Fig. 6-125).
5. Install new seal with lip of seal inward, using seal installer J 21147. (All except 307 engine) or J 23042 (307 engine).
6. Replace harmonic balancer.
7. Install drive belts and adjust to proper tension (see Section 6A).

TIMING CHAIN COVER, GASKET, OR FUEL PUMP ECCENTRIC

REMOVE AND REPLACE

1. Drain radiator and cylinder block.
2. Loosen generator adjusting bolts.
3. Remove fan belt and accessory drive belt.
4. Remove fan and pulley from hub of water pump.

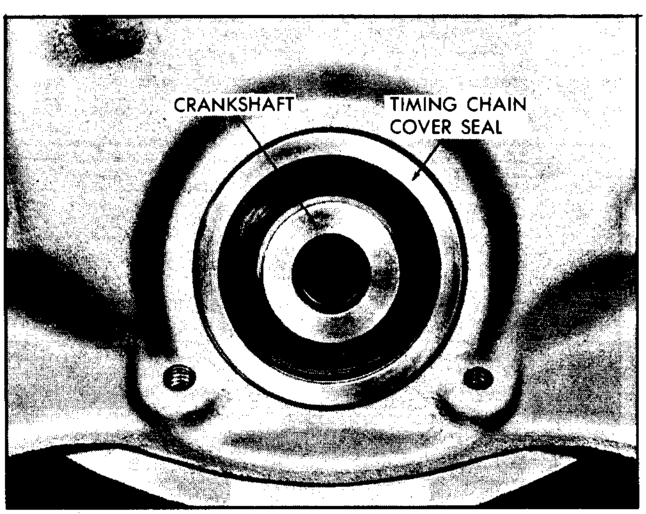


Fig. 6-125 Timing Chain Cover Seal

5. Remove water pump.
6. Disconnect lower radiator hose.
7. On all but 307 engine, remove fuel pump.
8. Remove harmonic balancer.
9. Remove front four oil pan-to-timing chain cover screws.
10. On 307 engine, remove oil pan and lower engine back down on engine mounts. (On 307 engine, timing chain cover lower seal interlocks with oil pan).
11. Remove timing chain cover to block attaching bolts and nuts and timing chain cover to intake manifold bolt.
12. Pull timing chain cover forward to clear studs and remove.
13. On all but 307 engine, remove O-ring seal from recess in intake manifold water recirculation passage.
14. 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.
15. On all but 307 engine, inspect front oil pan gasket and replace if damaged. If new gasket is installed, it should be cemented to oil pan.
16. On all but 307 engine, 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. 6-126).

    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 keyway cutout in camshaft sprocket. Insert retaining screw with retainer washer and tighten securely.

17. Position new timing chain cover gasket over studs against block.
18. Transfer water pump to new timing chain cover if new cover is to be installed.
19. On all but 307 engine, install new O-ring seal in water recirculation passage of intake manifold.
20. Position timing chain cover on engine indexing over dowels, install bolts and nuts and tighten securely.

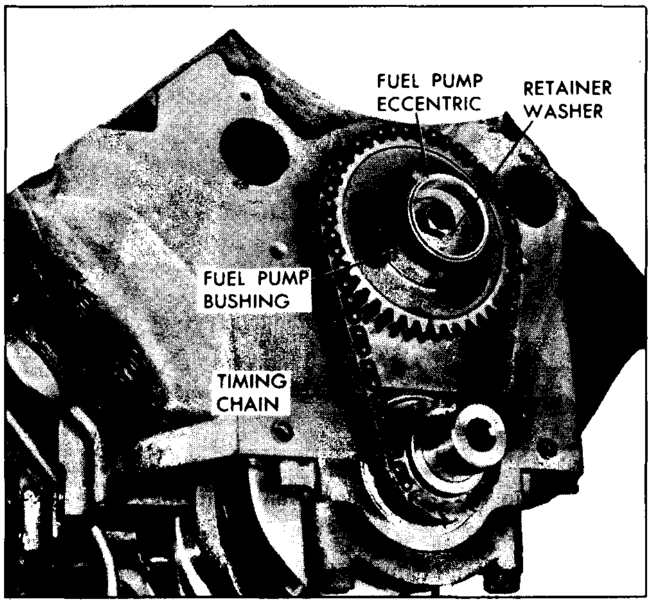


Fig. 6-126 Fuel Pump Drive - All Except 307 Engine

21. On all but 307 engine, install four oil pan to timing chain cover screws and tighten to 12 lb. ft.

22. Install harmonic balancer, retainer bolt with retainer, and tighten to 160 lb. ft. (All but 307 engine) or 60 lb. ft. (307 engine).

23. Connect lower radiator hose to pump inlet.

24. Position pulley and fan on water pump hub and install attaching bolts. Tighten to 20 lb. ft.

25. Install power steering pump and belt on cars so equipped.

26. Install generator adjusting strap.

27. Install fan belt and accessory drive belts. Adjust to proper tension (see Section 6A).

28. On all but 307 engine, install fuel pump.

29. On 307 engine, install oil pan gasket and oil pan.

30. Refill cooling system and check for leaks.

TIMING CHAIN AND SPROCKETS

REMOVE AND REPLACE

1. Remove timing chain cover, making certain O-ring seal is retained for installation at assembly.

2. Remove fuel pump eccentric and bushing (all but 307 engine) and timing chain cover oil seal.

3. Align timing marks to simplify proper positioning of sprockets during reassembly (Fig. 6-127).

4. On 307 engine, remove three camshaft sprocket retaining bolts (Fig. 6-128) and remove sprocket and chain.

5. If crankshaft sprocket is to be replaced, remove sprocket using tool J-22888 (Fig. 6-129). Refer to Fig. 6-130 for correct installation procedure.

6. Slide timing chain and sprockets off ends of crankshaft and camshaft.

7. 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. 6-119). Camshaft should extend through sprocket so that hole in fuel pump eccentric will locate on shaft.

8. On 307 engine, draw camshaft sprocket onto camshaft with three mounting bolts. (Do not attempt to drive camshaft sprocket onto camshaft as welsh plug at rear of engine can be dislodged).

9. On all but 307 engine, install fuel pump eccentric and bushing, indexing tab on eccentric with keyway cutout in sprocket. Install retainer bolt with retainer washer and tighten securely.

10. Place timing chain cover gasket over studs and dowels.

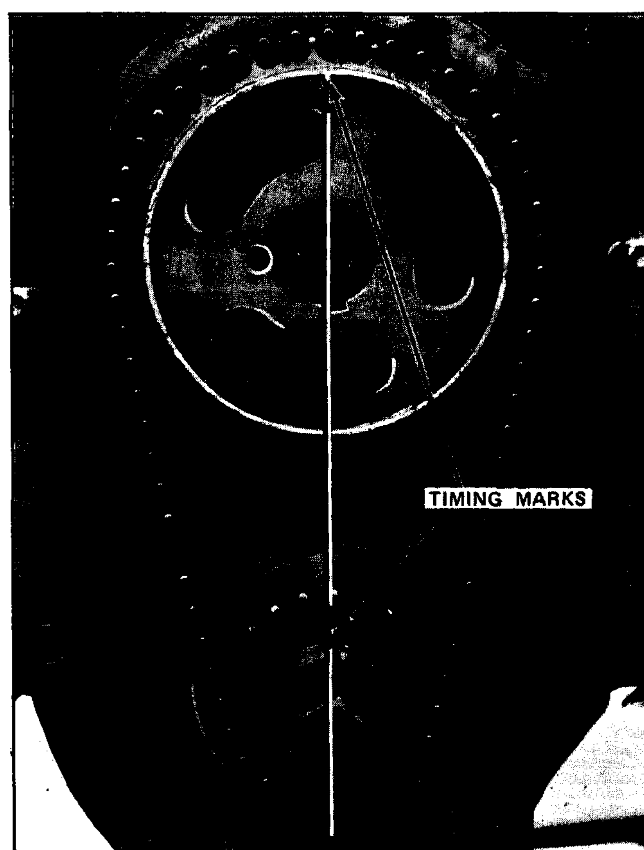


Fig. 6-127 Timing Marks Aligned at No. 1 T.D.C. - All Except 307 Engine

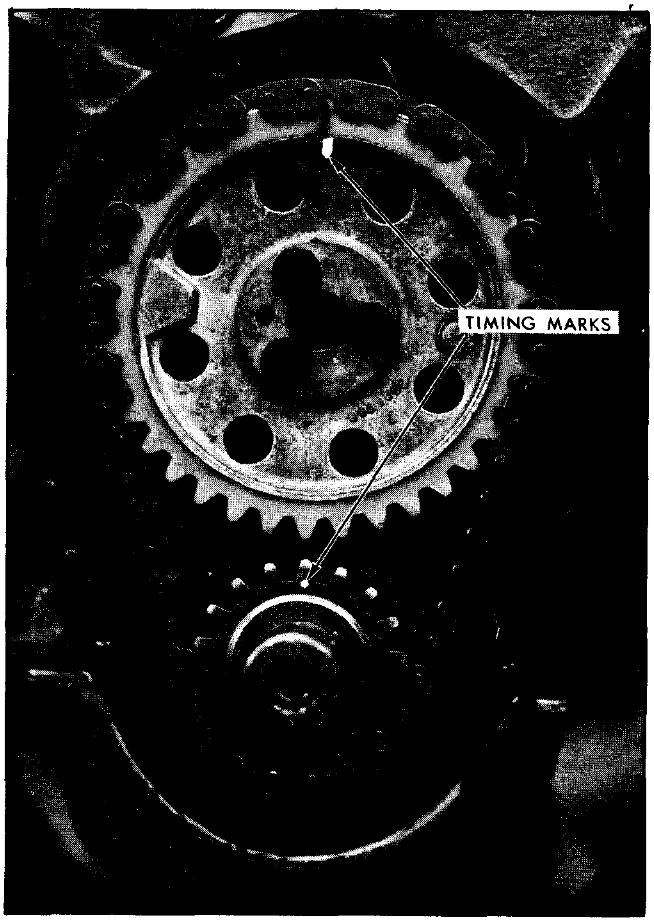


Fig. 6-128 Timing Marks Aligned at No. 1 T.D.C. - 307 Engine

11. Install timing chain cover, water pump and harmonic balancer making sure O-ring seal is in place.

CAMSHAFT AND/OR CAMSHAFT BEARING

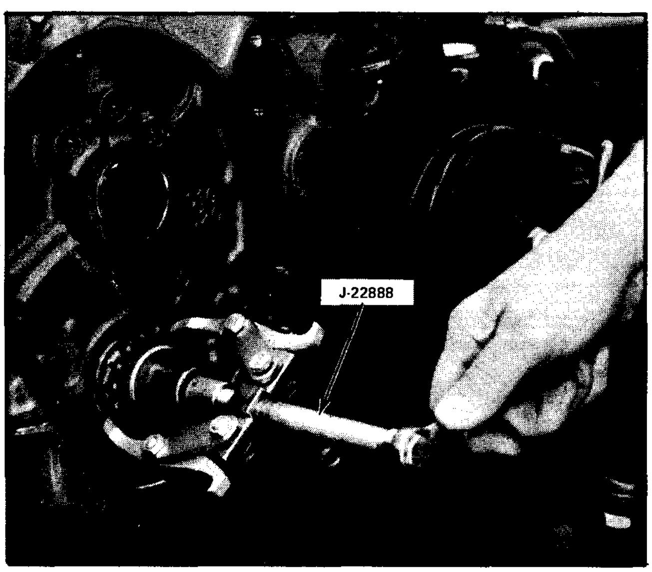


Fig. 6-129 Removing Crankshaft Sprocket

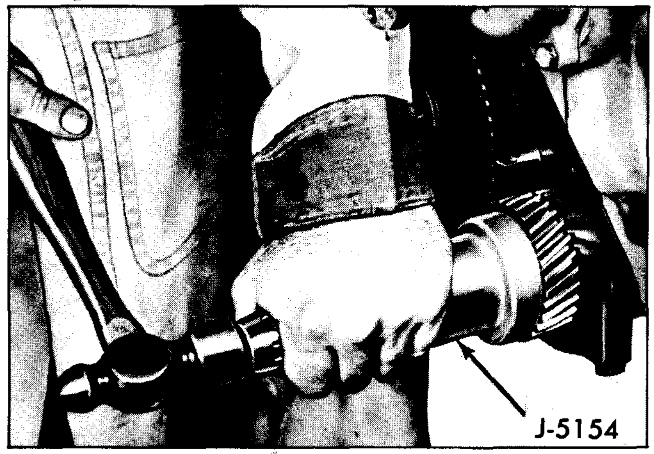


Fig. 6-130 Installing Crankshaft Sprocket

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 propeller shaft, transmission and clutch housing 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 carburetor air cleaner.
3. Disconnect all water hoses, vacuum hose and spark plug wires.
4. Disconnect carburetor linkage, fuel lines and wires to thermogauge unit.
5. Remove hood latch brace.
6. Remove radiator.
7. On air-conditioned cars, remove generator mounting bracket and generator.
8. Remove crankcase ventilator hose, and remove both rocker arm covers and gaskets.
9. Remove distributor hold-down clamp and remove distributor.
10. Remove intake manifold and gaskets.

Make certain O-ring seal between intake manifold and timing chain cover on all but 307 engines is retained and re-installed during assembly.

11. On all but 307 engine, remove push rod cover.
12. Loosen rocker arm ball retaining nuts so that rocker arms can be disengaged from push rods and turned sideways.
13. Remove push rods and hydraulic lifters. Store push rods in stand and lifters in a lifter box so they can be reinstalled in original positions.
14. Remove harmonic balancer.
15. Remove fuel pump (and pushrod - 307 engine).
16. Remove four oil-pan-to-timing-chain-cover screws (all except 307 engine) or remove oil pan (307 engine).
17. Remove timing chain cover and gasket.
18. On all but 307 engine, remove fuel pump eccentric and fuel pump bushing.
19. Align timing marks on timing chain sprockets and remove timing chain and sprockets. Refer to Figs. 6-127 and 6-128.
20. Remove camshaft thrust plate.
21. Carefully pull camshaft from engine, exercising caution so as not to damage bearings in block.

    On 307 engine, it will be necessary to install two 5/16" - 18 x 4" bolts in camshaft bolt holes to remove camshaft.

    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.

22. Stuff clean rags through openings in engine block as an aid in preventing foreign material or parts of bearing remover tool from dropping into block.

    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. All except 307 Engine:

    a. Insert remover adapter J 6173-4 into front bearing to act as a support for shaft J 6173-1 (Fig. 6-131).

    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.

    b. Insert replacer adapter J 6173-3 into rear of bearing to be removed so that shoulder on remover bears against rear edge of bearing.
    c. 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. 6-131).
    d. Insert shaft and indexing collar through remover and replacer adapters and position lug on index-

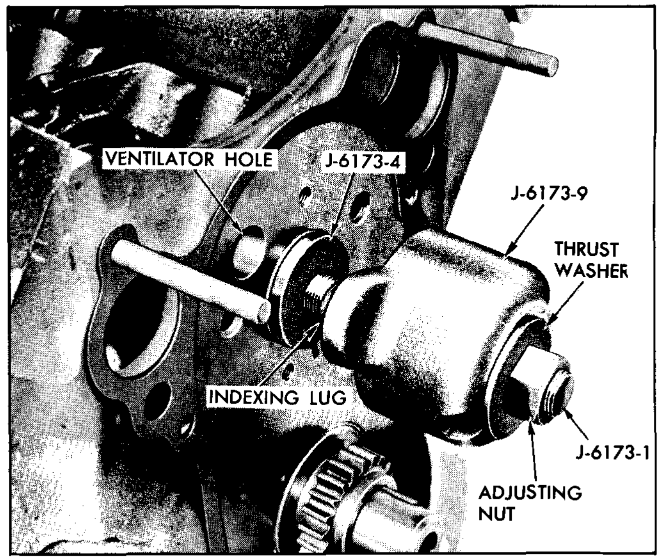


Fig. 6-131 Positioning Index Collar

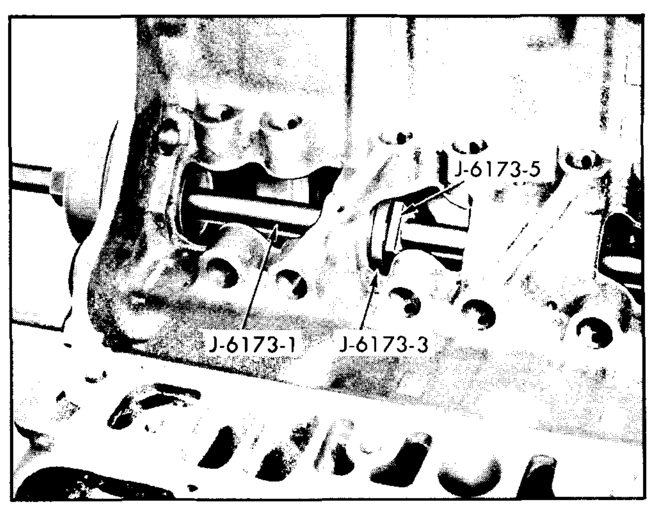


Fig. 6-132 Removing Camshaft Bearing

ing collar in ventilator hole in front of block. This indexes shaft so that it cannot rotate.

e. Slip key J 6173-5 into notches in shaft behind bearing to be removed (Fig. 6-132).

f. 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.

2. 307 Engine:

a. Use tool J-21473-1 to drive out front bearing toward rear.

b. Install extension J-21054 on intaller J-21473-1 and drive center three bearings out toward rear (Fig. 6-133).

c. To remove rear bearing it will be necessary to remove transmission and flywheel.

d. Drive out expansion plug from rear of block by driving rearward.

e. Use tool J-21473-1 to drive out rear bearing toward front.

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. All except 307 Engine:

a. Insert remover adapter J 6173-4 into front bearing to act as a support for the shaft.

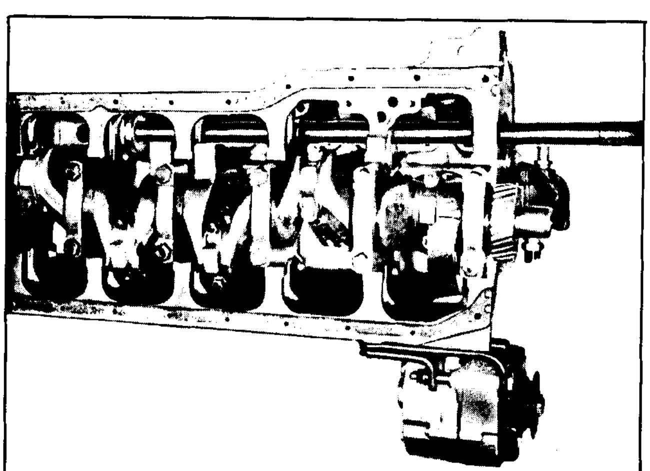


Fig. 6-133 Procedure for Removing and Installing Camshaft Bearings, L-6 and V-8

NOTE: *If front bearing is being replaced, insert remover adapter in center bearing to act as support for the shaft.*

b. Insert pilot J 6173-7 into hole in which bearing is to be installed.

c. 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.*

d. Position replacer adapter J 6173-3, with bearing in position against shoulder, against rear of hole in which bearing is to be installed (Fig. 6-134). Index mark on shoulder of replacer must point down (toward crankshaft side) to properly position bearing.

e. 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. 6-131).

f. Slip key J 6173-5 into notches in shaft behind replacer adapter J 6173-3 and tighten nut to start bearing into hole (Fig. 6-134). 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

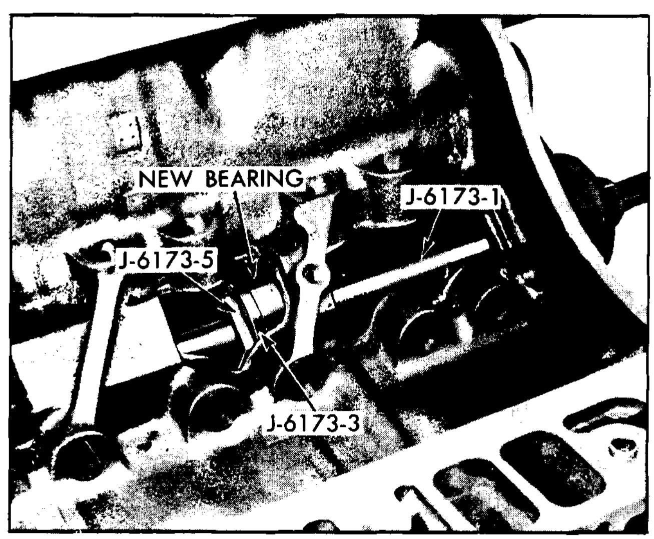


Fig. 6-134 Installing Camshaft Bearing

of counter bore for camshaft rear plug visible behind bearing.

g. Remove remover and replacer set J 6173.

3. 307 Engine:

a. Install each new bearing on tool.

b. Install bearings reversing removal procedure.

CAUTION: *Oil holes in bearings must line up with oil holes in cylinder block.*

c. Replace rear bearing plug installing it flush to 1/32" deep and being parallel with the rear surface of the cylinder block.

4. Visually observe that holes in bearing line up with drillings in block.

5. Carefully remove rags used to catch particles of metal and use magnet or vacuum cleaner to make sure that all metal particles are removed from block surfaces and oil drillings.

CAMSHAFT

REPLACE

1. Coat inner diameters of all camshaft bearings with oil. Coat camshaft lobes with heavy oil. Carefully install camshaft. 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. (all except 307 engine).

3. Install timing chain sprockets and timing chain, making sure marks on sprockets are aligned properly. Refer to Figs. 6-127 and 6-128.

4. Install fuel pump eccentric and bushing (all except 307 engine). Tighten camshaft sprocket retaining bolt to 40 lb. ft. (all except 307 engine) or 20 lb. ft. (307 engine).

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. (all except 307 engine).

7. Install fuel pump and pushrod (307 engine only) and tighten bolts to 25 lb. ft.

8. Install harmonic balancer. Tighten bolt to 160 lb. ft. (all except 307 engine) or 60 lb. ft. (307 engine).

9. Coat base of lifters with heavy oil. 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 (all except 307 engine).

12. Install intake manifold and gasket. Tighten bolts to 40 lb. ft.

    CAUTION: *O-ring seal must be installed between intake manifold and timing chain cover on all except 307 engine 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 L.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 thermogauge 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

1. Disconnect battery cable at battery.

2. If equipped with power steering remove power steering adjusting bolt, remove drive belt and tilt pump upward.

3. Remove the two (2) fan shroud screws and position shroud so it will swing up with engine.

4. Remove fan.

5. Inspect all water hoses and wiring harnesses for proper routing to avoid excessive bind when engine is raised.

6. Raise vehicle and drain crankcase.

7. Disconnect steering idler arm at frame and pitman arm from shaft (F and G Series only).

8. Disconnect exhaust pipes from manifolds.

9. Remove starter assembly (and set to one side with wires attached), starter motor bracket and flywheel inspection cover.

10. **A Series:** Remove stabilizer shaft to frame bracket attaching bolts to insure free movement of lift adaptor.

    CAUTION: *On cars equipped with heavy duty fuel pump it will be necessary to loosen fuel pump to timing cover bolts to permit clearance of engine lifting tool adapter (J23515-2).*

11. Position ENGINE LIFTING TOOL J 23515-2 (all except 307 engine) or J 23515-19 (307 engine) to engine and place J23515-16 (all except 307 engine) in position on lifting tool (Figs. 6-95, 6-96, 6-97, 6-98 and 6-99).

    Securely tighten tool to timing chain cover (all except 307 engine) or to block (307 engine) with bolts.

12. Thread jackscrew through crossbar and position engine lifting crossbar (J23515-1) to adapter (J 23515-2 or J 23515-19) and attach nut to jackscrew to hold it to the adapter.

    NOTE: *Be sure thrust bearing is in place.*

13. **A & B Series:** 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 (Figs. 6-95 and 9-96).

    F & G Series: Loosen bolts retaining steering gear to frame and slip chain around left frame rail between steering gear and frame. Attach remaining chain around right frame rail at point where crossbar is now positioned (Figs. 6-97 and 6-98).

    X Series: Wrap chains around front portions of lower control arms and attach to hooks (Fig. 6-99).

14. Place loose ends of chain across top of support to prevent chain from slipping out of hook.

15. Remove both frame bracket-to-engine mount through bolts.

16. 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.

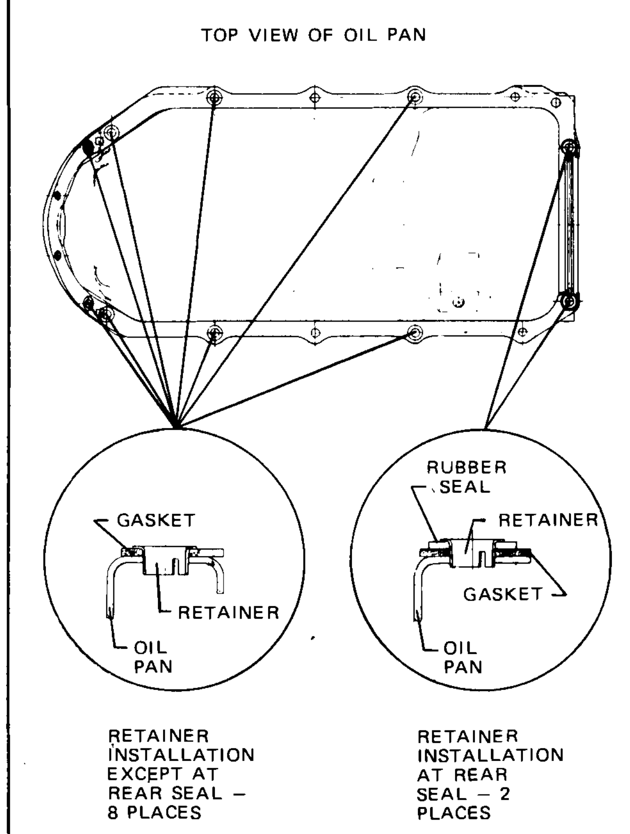


Fig. 6-135 Oil Pan Gasket Retainers

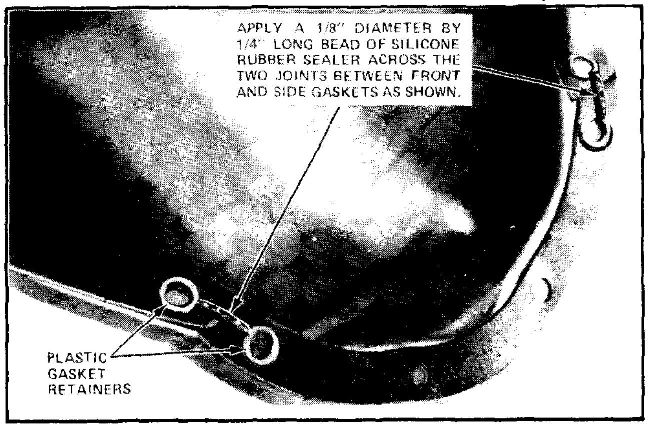


Fig. 6-136 Front Oil Pan Gasket Installation

3. Install new gaskets on oil pan (Figs. 6-135, 6-136 and 6-137).

4. Replace oil pan. Tighten retaining bolts to 12 lb. ft. (all except 307 engine) or 80 lb. in. (307 engine).

   Rear bolts (through reinforcement straps) should be tightened to 20 lb. ft.

5. Lower engine and install frame bracket-to-motor mount through bolts.

6. Remove engine lifting equipment.

7. **A Series:** Reinstall stabilizer shaft to frame bracket attaching bolts. Tighten to 30 lb. ft.

8. Replace flywheel inspection cover, starter bracket and starter.

9. Replace exhaust pipes.

10. Connect steering gear, steering idler arm and pitman arm to shaft (G and F Series only).

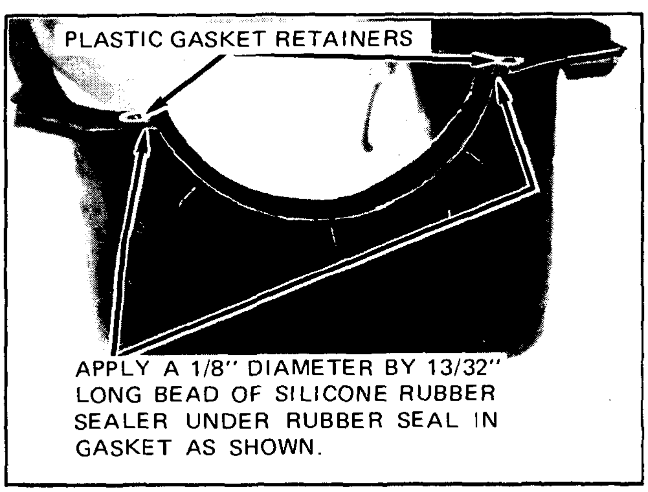


Fig. 6-137 Rear Oil Pan Gasket Installation

11. On cars equipped with heavy duty fuel pump, tighten fuel pump bolts.

12. Lower vehicle.

13. Replace fan.

14. Connect battery cable.

15. Refill engine crankcase.

OIL PUMP

REMOVE

1. Remove engine oil pan (see OIL PAN - REMOVE AND REPLACE). Remove splash baffle.

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. 6-138).

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.

OIL PUMP

DISASSEMBLE

1. Remove pressure regulator spring retainer, spring, and pressure regulator ball or valve.

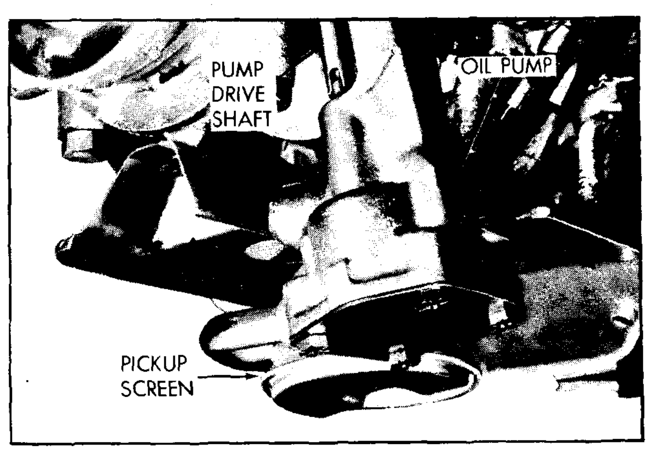


Fig. 6-138 Oil Pump and Oil Pump Drive Shaft

2. Remove screws retaining cover to oil pump body and remove cover.

3. Remove driven gear and drive gear with shaft.

   CAUTION: *Oil pump screen should not be removed from pump body. Be careful not to loosen screen.*

CLEAN AND INSPECT

1. Clean all parts thoroughly. Screen must be thoroughly cleaned by using a fluid such as used for carburetor cleaning.

2. Inspect pressure regulator spring (Figs. 6-139 and 6-140) for distortion, cracks, and wear on sides.

3. Inspect pressure regulator ball or valve to see that it is not nicked or otherwise damaged.

4. Inspect pump body, driven gear shaft and cover for evidence of wear.

5. Inspect pump gears and end of drive gear shaft for wear (Fig. 6-139 and 6-140).

6. Inspect oil pump drive shaft (distributor to pump shaft) for evidence of wear and cracks.

ASSEMBLE

1. Install drive and driven gears.

2. Install cover and turn drive shaft by hand to ensure that it turns freely.

3. Install pressure regulator ball or valve, spring and retainer.

   CAUTION: *Do not attempt to change oil pressure by varying length of pressure regulator valve spring.*

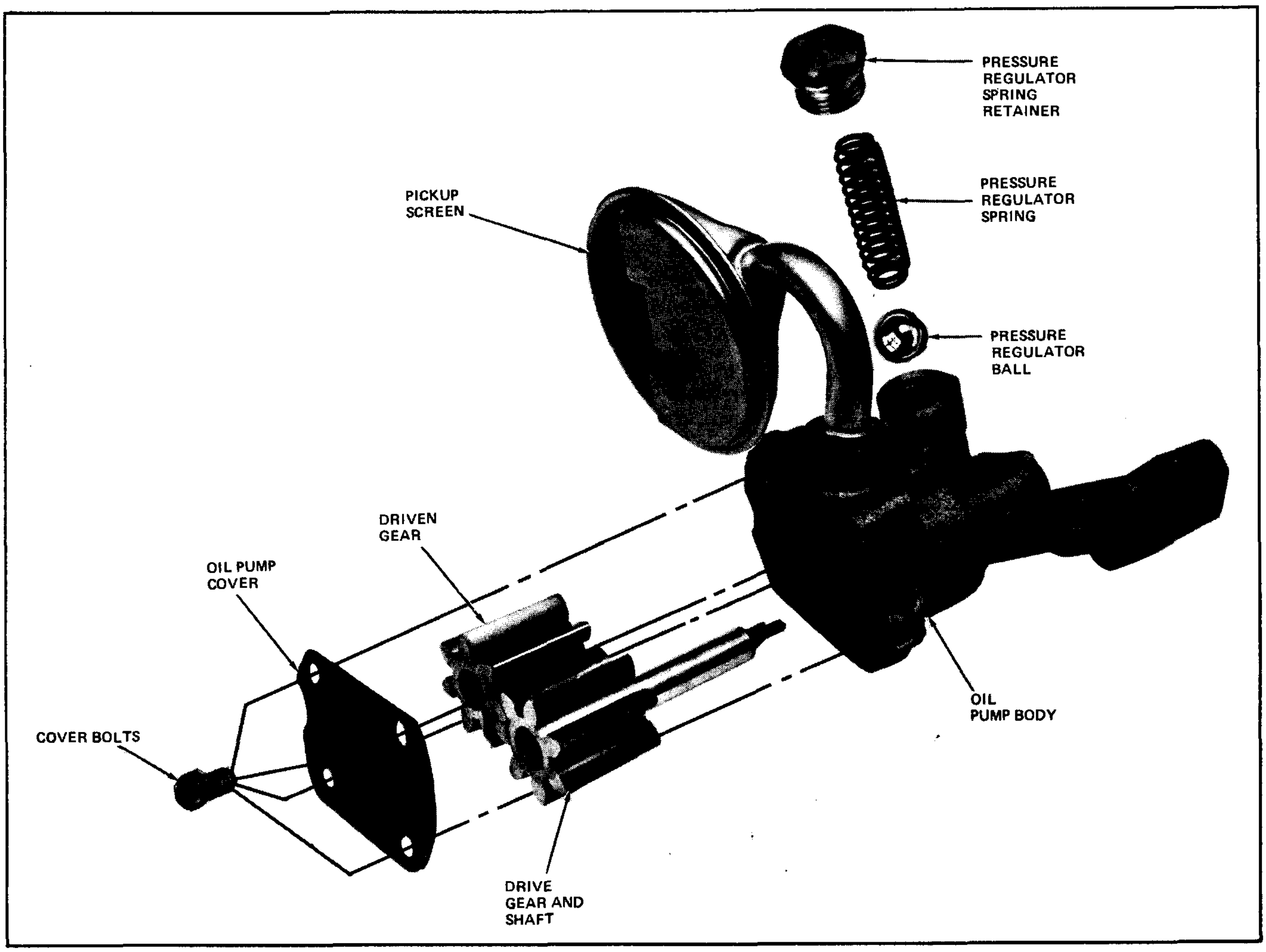


Fig. 6-139 Oil Pump-Exploded View (All Except 307 Engine)

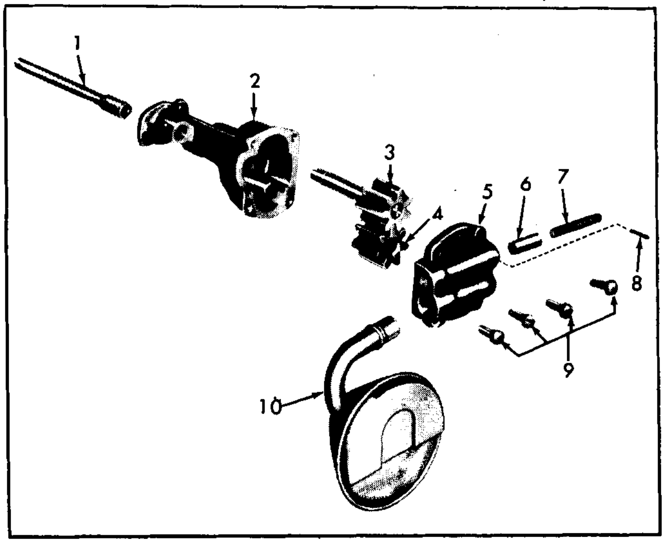


Fig. 6-140 Oil Pump - Exploded View (307 Engine)

REAR MAIN BEARING OIL SEAL

REMOVE

1. Remove oil pan (see OIL PAN - REMOVE AND REPLACE).
2. Remove oil pump and baffle.
3. Remove rear main bearing cap.
4. Upper Seal - All Except 307 Engine.
   a. Use tool shown in Fig. 6-141 made from brass bar stock to pack upper seal as follows:
   b. 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.
   c. Remove the tool and repeat at the other end of the seal in the cylinder block.
   d. Clean the block and bearing cap parting line thoroughly.
   e. Form a new seal in the cap (Fig. 6-142).
   f. Remove the newly formed seal from the cap and cut four (4) pieces approximately 3/8" long from this seal.
   g. 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.

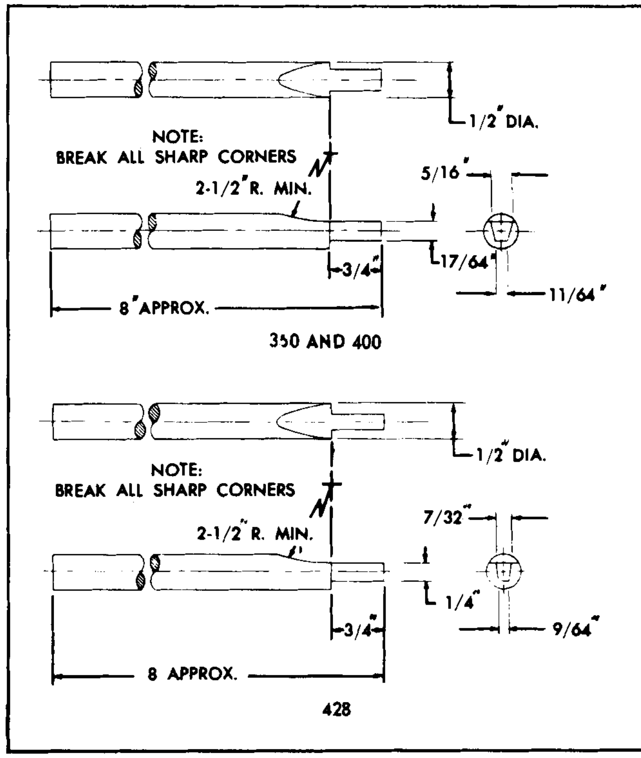


Fig. 6-141 Upper Rear Main Bearing Seal Tool

   h. Form another new seal in the cap (Fig. 6-142).
   i. Assemble the cap to the block and tighten to 120 lb. ft.

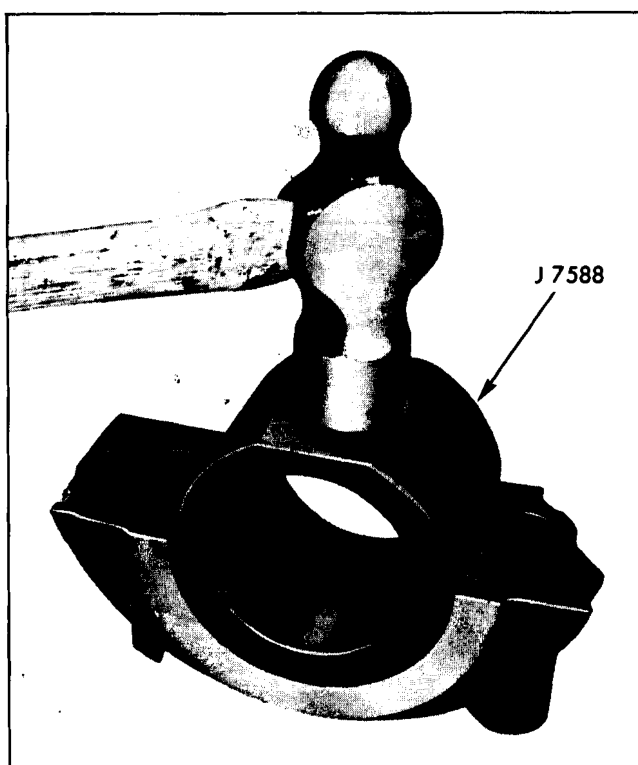


Fig. 6-142 Forming New Seal in Cap

j. 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.

k. Apply a 1/16" bead of sealer from the center of seal across to the external cork groove.

l. Reassemble the cap. Tighten to 120 lb. ft.

5. Upper Seal - 307 Engine.

a. Remove oil seal from the bearing cap by prying from the bottom with a small screw driver (Fig. 6-143).

b. 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. 6-144).

c. Clean all sealant and foreign material from cylinder case bearing cap and crankshaft, using a nonabrasive cleaner.

d. Inspect components for nicks, scratches, burrs and machining defects at all sealing surfaces, case assembly and crankshaft.

e. Coat seal lips and seal bead with light engine oil - keep oil off seal mating ends.

f. Position tip of small screwdriver between crankshaft and seal seat in cylinder case.

g. Position seal between crankshaft and tip of small screwdriver so that seal bead contacts tip of tool. (Make sure that oil-seal lip is positioned toward front of engine).

h. Roll seal around crankshaft using screwdriver as a "shoe-horn" to protect seal bead from sharp corner of seal seat surface in cylinder case.

i. Remove small screwdriver, being careful not to withdraw seal.

j. Install seal half in bearing cap, again using small screwdriver as a "shoe-horn", feeding seal into cap using light pressure with thumb and finger.

k. 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. 6-145).

l. Install the rear main bearing cap (with new seal) and torque to 75 lb. ft.

6. Install baffle and oil pump.

7. Install oil pan (see OIL PAN - REMOVE AND REPLACE).

MAIN BEARINGS

REMOVE

1. Remove oil pan (see OIL PAN - REMOVE AND REPLACE).

2. To gain access to bearing caps, remove oil baffle. To gain access to rear main, remove oil pump in addition to oil baffle.

3. Remove bearing cap of main bearing to be replaced.

4. Make a tool for removing upper half of bearing shell as shown in Fig. 6-146.

Fig. 6-143 Removing Oil Seal (Lower Half)

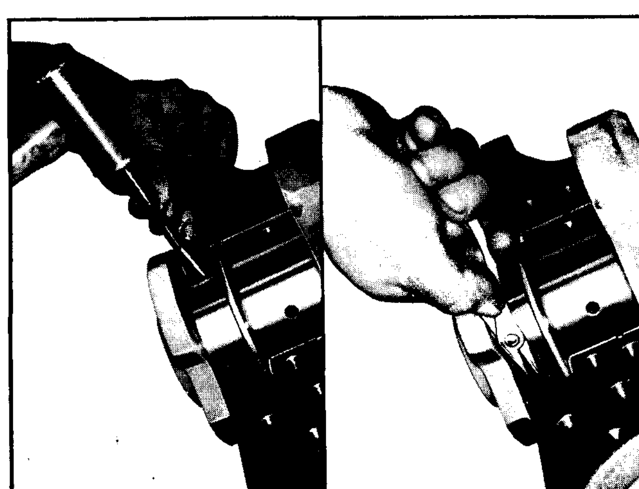


Fig. 6-144 Removing Oil Seal (Upper Half)

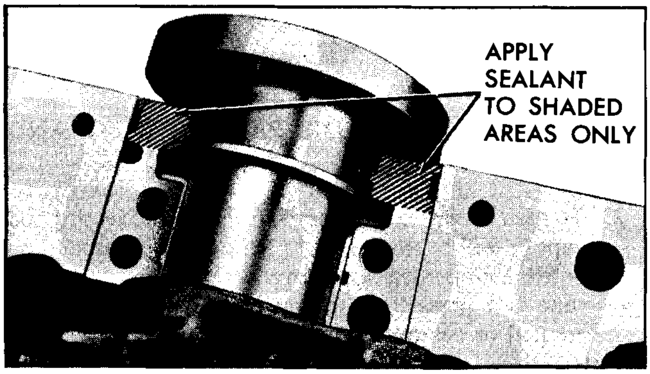


Fig. 6-145 Sealing Bearing Cap

5. Insert tool in oil hole of crankshaft and rotate crankshaft in usual direction of rotation. This will cause bearing to be moved from between shaft and bearing seat (Fig. 6-147).

6. Oil bearing surface of shell and install by inserting plain end of bearing shell at indented side of bearing seat and gently rotating shell into place by turning shaft.

7. Install new bearing lower half by inserting in bearing cap so indentation in shell and cap coincide.

8. Install bearing cap and check fit of bearing, using plastic gage as outlined below.

   CAUTION: *Under no circumstances should bearing caps be filed or shimmed in an effort to effect a fit.*

PLASTIC GAGE METHOD FOR DETERMINING MAIN BEARING CLEARANCE

When checking main bearing clearance with engine in the car, place a .002" brass shim between the crankshaft journal and the lower bearing in each bearing cap next to the one being checked (Fig. 6-148).

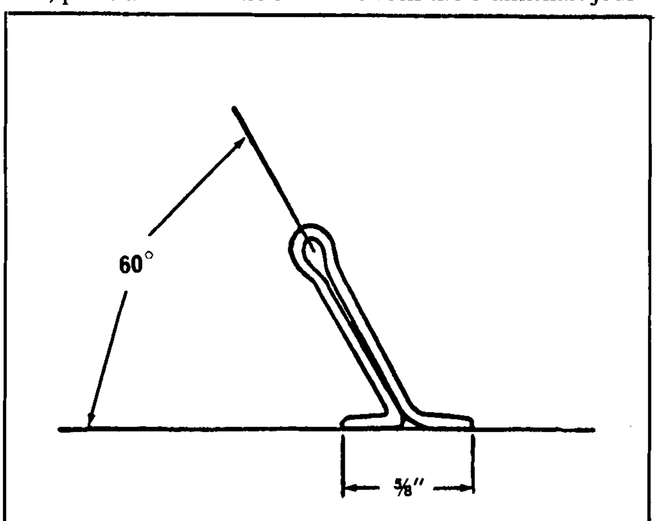


Fig. 6-146 Tool for Removing Upper Half of Main Bearing

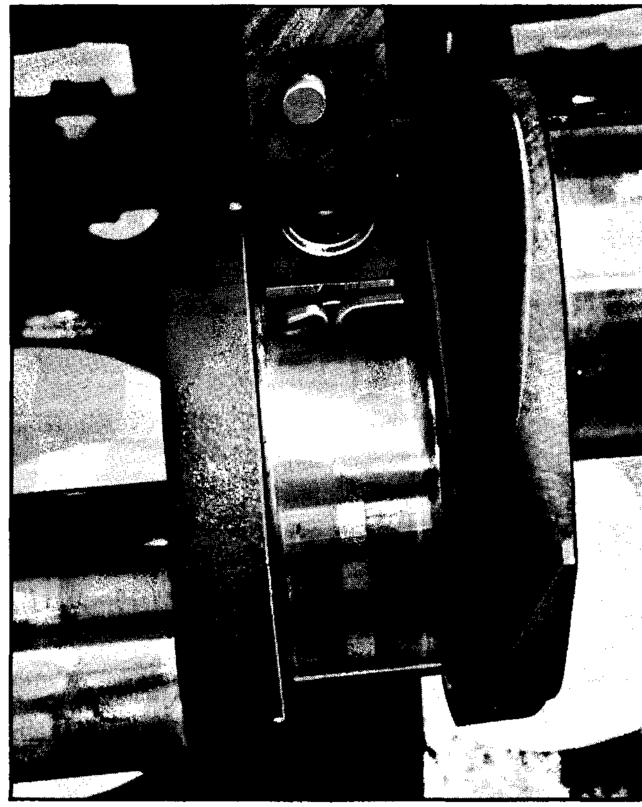


Fig. 6-147 Tool Installed for Removing Upper Half of Main Bearing

Tighten all cap bolts to proper torque as follows: rear - 120 lb. ft., all others - 100 lb. ft. (all except 307 engine) or 75 lb. ft. for all in 307 engine.

This causes the crankshaft to be forced against the upper bearing and insures an accurate measurement of the total clearance.

1. Remove the bearing cap of the bearing to be checked. Wipe the bearing and the journal free of oil.

2. Place a piece of plastic gage the width of the bearing on the journal or bearing surface. Install the cap and

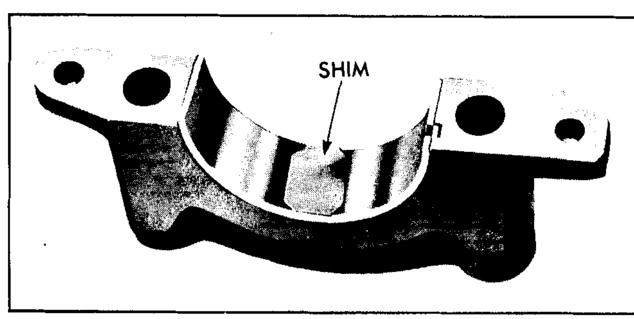


Fig. 6-148 .002" Shim Positioned in Adjacent Caps to Check Main Bearing Clearance With Engine in Car tighten cap bolts to proper torque. (Do not turn crankshaft with plastic gage in place).

3. Remove bearing cap and using plastic gage scale on envelope (Fig. 6-149), measure width of plastic gage before removing it from the bearing or journal. If the bearing clearance is between the specifications listed below, the clearance is satisfactory. If the clearance is more than the upper limit shown, replace the bearing with the next undersize bearing and recheck clearance. Bearings are available in standard size, .001" and .002" undersize.

ENGINE	BEARING CLEARANCE
307 No. 1	.0008" - .0020"
307 No. 2-3-4	.0011" - .0023"
307 No. 5	.0017" - .0033"
All others (Exc. 455)	.0002" - .0017"
455 (Exc. small valve #1 location)	.0005" - .0021"
455 (Small valve #1 location)	.003" - .0019"

4. 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.

5. Replace oil pump, cylinder block to oil baffle tube, and oil baffle if they were previously removed.

6. Replace oil pan, using new gaskets.

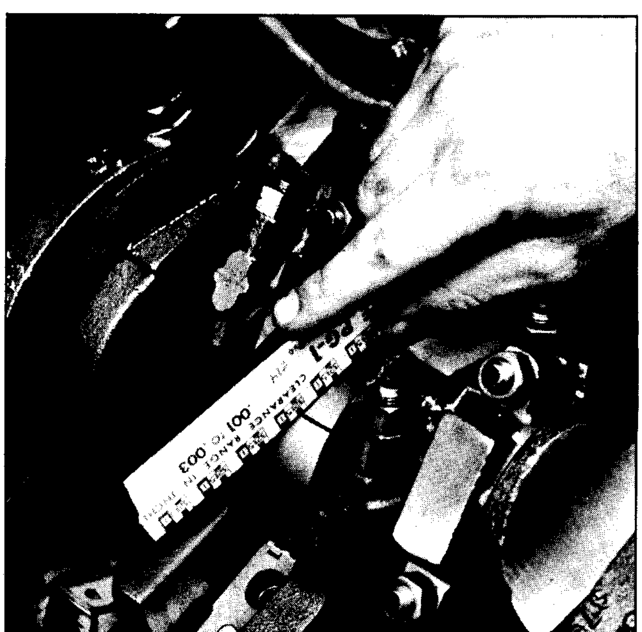


Fig. 6-149 Measuring Plastic Gage

CONNECTING ROD BEARINGS

REMOVE

1. Remove oil pan (see OIL PAN - REMOVE AND REPLACE).

2. To gain access to numbers 5, 6, 7 or 8 connecting rod caps, it will be necessary to remove oil pump and oil baffle. Pump must be removed as an assembly. Screen tube is a press fit in pump body and must not be rotated or removed.

3. Rotate crankshaft as necessary to bring crank pin carrying bearing to be replaced straight down (Fig. 6-150).

4. Remove bearing cap of bearing to be replaced.

5. Install rubber hose on connecting rod bolts (Fig. 6-151).

6. Push piston and rod assembly up far enough to allow removal of bearing shell. Remove bearing shells from rod and cap.

7. Inspect crank pin for damage, out-of-round, and taper.

8. Reassemble cap and rod with new bearing shells and check fit, using plastic gage as outlined below.

CAUTION: *Under no circumstances should a bearing cap be filed or shimmed in an effort to effect a fit.*

NOTE: *A number of 2 bbl. equipped V-8's have .010" undersize crankpins. These crankshafts may be identified by a .010" U.S. stamp on the front of the No. 1 counterweight and the rear of No. 8 counterweight. A check should be made for this undersize crankshaft before replacing rod bearings.*

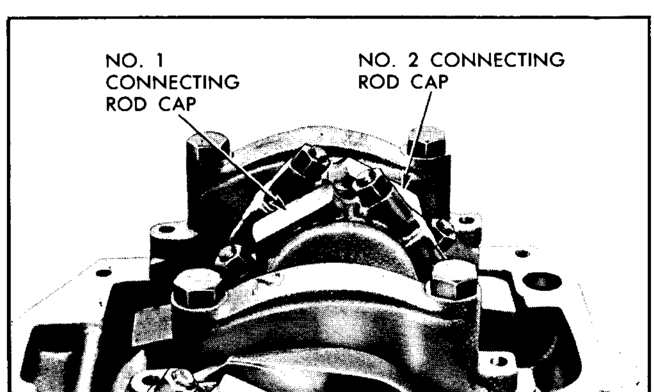


Fig. 6-150 Crankshaft Positioned for Removal of No. 1 and 2 Connecting Rod Caps

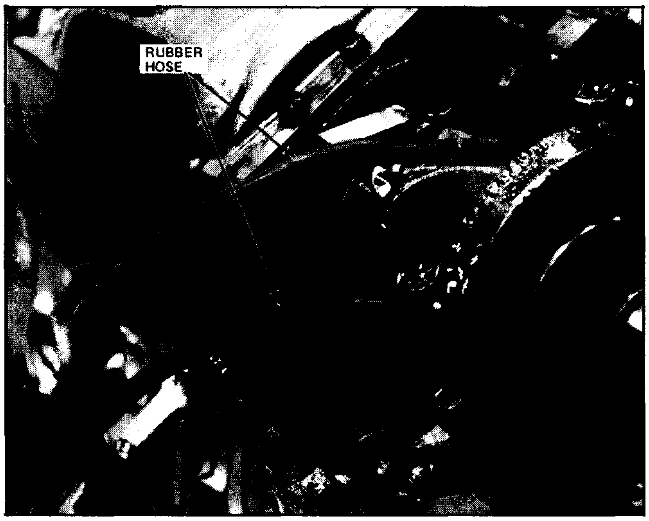


Fig. 6-151 Installing Connecting Rod

PLASTIC GAGE METHOD FOR DETERMINING 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 width of the bearing (parallel to the crankshaft) on the crankpin or bearing surface. Install the cap and tighten cap bolts to 43 lb. ft. (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. If the bearing clearance is between .0005" and .0025" (all except 307 engine) or .0013" and .0035" (307 engine), the clearance is satisfactory. If clearance is more than .0025" or .0035", replace bearing with the next undersize bearing and recheck clearance. Bearings are available in .001" and .002" undersize.
4. Rotate the crankshaft after bearing adjustment to be sure bearings are not tight.

CONNECTING ROD AND PISTON ASSEMBLY

REMOVE

1. Remove oil pan, oil baffle and oil pump (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 (Fig. 6-150).

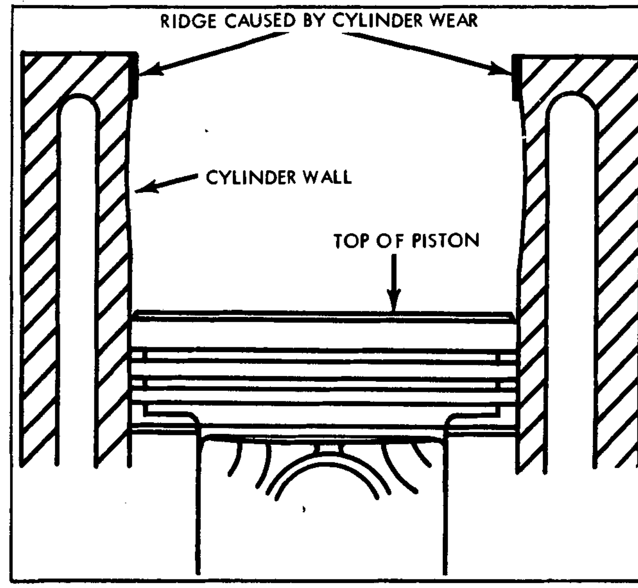


Fig. 6-152 Cylinder Ring Ridge

4. Remove ring ridge (Fig. 6-152) using suitable ring ridge remover.
5. Remove bearing cap and install rubber hoses on connecting rod bolts.
6. Carefully remove connecting rod and piston assembly by pushing out with hoses (Fig. 6-151).

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. Be certain oil spurt hole in connecting rod is toward camshaft (Fig. 6-153).

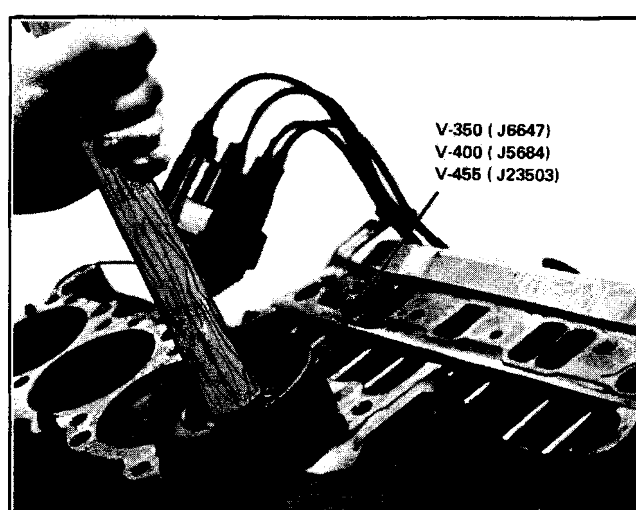


Fig. 6-153 Installing Piston Assembly

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 43 lb. ft. (all except 307 engine) or 45 lb. ft. (307 engine).

5. Replace oil pump and oil baffle, if they were removed.

6. Install cylinder head and intake manifold.

CONNECTING ROD AND PISTON ASSEMBLY

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 soft aluminum material may result.*

DISASSEMBLE

1. Remove piston rings, using proper piston ring remover. It is important that rings be removed carefully to prevent scratching or burring of ring grooves and lands).

2. Using a suitable arbor press, place the spring and plunger into the bore of the base support and position on an arbor press with the pilot plunger indexed in the bottom of piston pin bore. See insert in Fig. 6-154 for correct base support and pilot plunger for the type pistons being serviced.

3. Using the pilot plunger (or plate) indicated in Fig. 6-151 the pin may be pressed out far enough to index with the bore in the base.

4. Remove pilot plunger and spring from base.

5. Complete removal of pin using pin driver J 6901-3 (all except 307 engine) or J 9510-2 (307 engine) and base alone.

6. Remove bearing cap and bearings.

CLEAN AND INSPECT

1. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil slots in oil ring groove, using suitable cleaning tools and solvent.

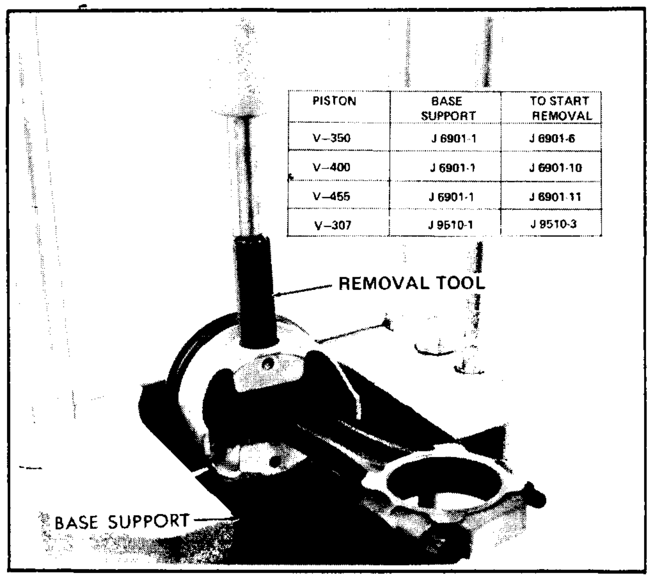
2. Clean piston pin, rod, cap, bolts and nuts in suitable solvent. Reinstall cap on connecting rod to insure against subsequent mixing of caps and connecting rods.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

   If piston pin bosses are rough or worn out-of-round and the piston is otherwise serviceable, the pin bosses may be honed for oversize pins. Before fitting oversize pins, however, it is advisable to check fit of piston in bore.

4. Inspect piston pin for scoring, roughness, or uneven wear.

5. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is being assembled.



PISTON	BASE SUPPORT	TO START REMOVAL
V–350	J 6901-1	J 6901-6
V–400	J 6901-1	J 6901-10
V–455	J 6901-1	J 6901-11
V–307	J 9510-1	J 9510-3

Fig. 6-154 Removing Piston Pin

CYLINDER BORES

INSPECT

Inspect cylinder bores for out-of-round or excessive taper with an accurate cylinder gauge (J 8087 or comparable) at top, middle and bottom of bore. Measure cylinder bore parallel and at right angles to the centerline of engine to determine out-of-round. Variation in measure from top to bottom of cylinder indicates taper in cylinder.

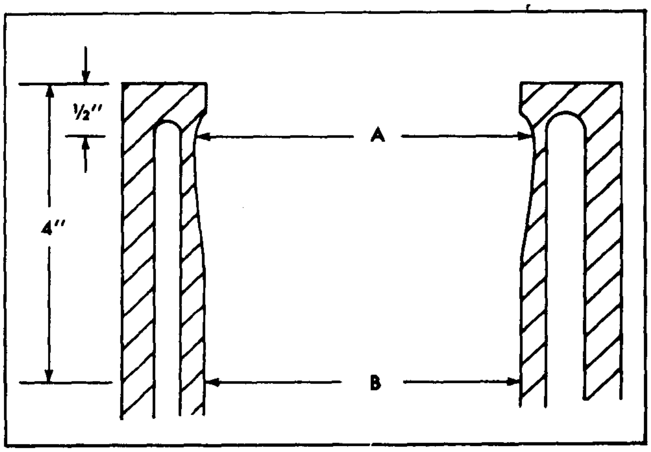


Fig. 6-155 Normal Cylinder Wear Pattern

Fig. 6-155 illustrates area in cylinder where normal wear occurs. Cylinder bore can be measured (Fig. 6-156) by setting cylinder gauge dial at zero in cylinder at the point of desired measurement. Lock dial indicator at zero before removing from cylinder, and measure across the gauge contact points with outside micrometer with gauge at the same zero setting when removed from cylinder (Fig. 6-157).

Take several measurements parallel and at right angles to the crankshaft, between 1/2" and 4" from the top of the cylinder. Subtract the smallest measurement found from the largest. If this figure exceeds .0006" (all except 307 engine) or .0011" (307 engine), a piston cannot be fitted properly, and the cylinder must be honed. New rings and a new oversized piston must then be fitted.

Fine vertical scratches made by ring ends will not cause excessive oil consumption, therefore, honing to remove these scratches is unnecessary.

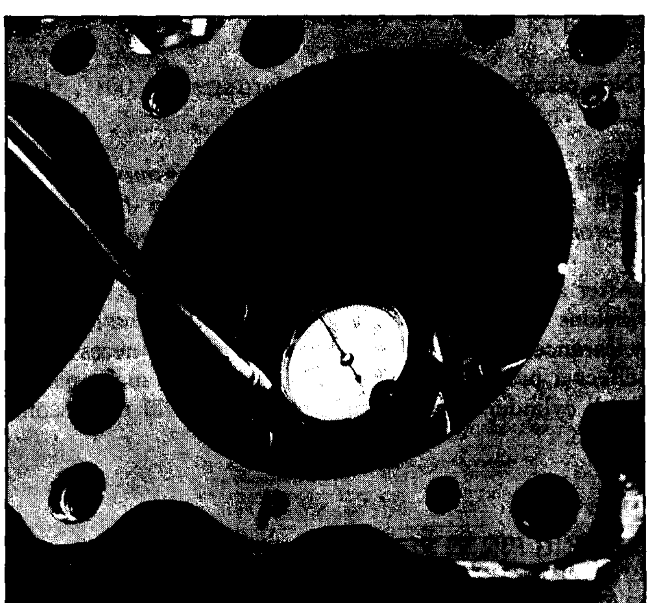


Fig. 6-156 Measuring Cylinder Bore

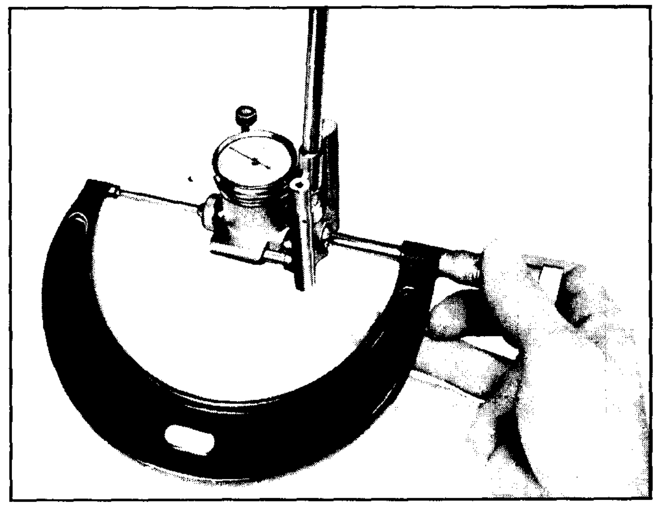


Fig. 6-157 Measuring Cylinder Gauge

HONING OR BORING

If a piston other than standard is to be installed, the cylinder should be bored, rather than honed, to effect a true bore.

To eliminate the possibility of honing taper into the cylinder, full strokes of the hone should be made in addition to checking measurement at top, middle and bottom of bore repeatedly.

Always be sure the crankshaft is out of way of 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 final cut with a boring bar, leave .001" on the diameter for finish honing to give required piston-to-cylinder clearance specifications. (Honing or boring operation must be done under close supervision so that specified clearance between pistons, rings, and cylinder bores is maintained).

By measuring the piston to be installed at the sizing points (Fig. 6-158) and adding the mean of the clearance specification, the finish hone cylinder measurement can be determined. It is important that both block and piston be measured at normal room temperature, 60° - 90 °F.

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. Pontiac does not recommend boring beyond .010" during warranty period so that if necessary, engine can be serviced at high mileage without cylinder block replacement.

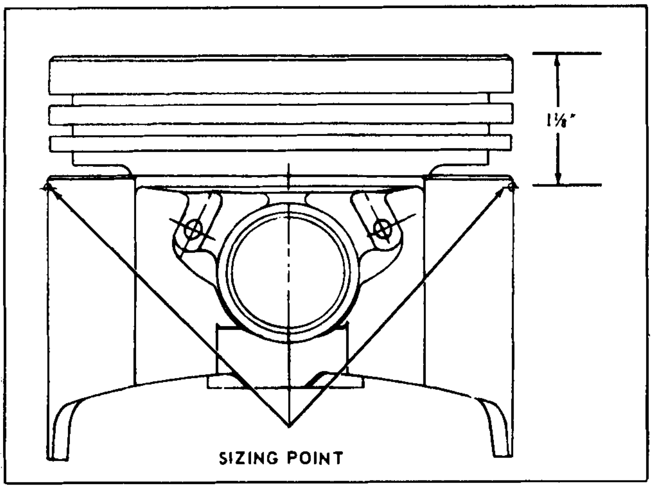


Fig. 6-158 Piston Sizing Points

FIT AND REPLACE PISTON

Pistons should be fitted in the bores by actually measuring the fit. Clearance between the piston and the cylinder bore should be .0025" to .0033" (all except 307 engine) or .0005" to .0011" (307 engine).

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 gauge, measure the cylinder bore crosswise to 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

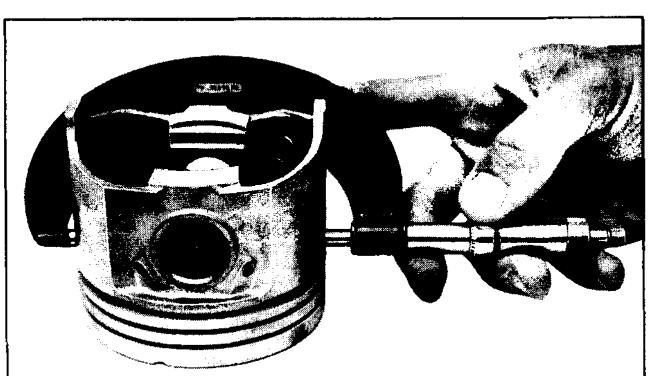


Fig. 6-159 Measuring Piston

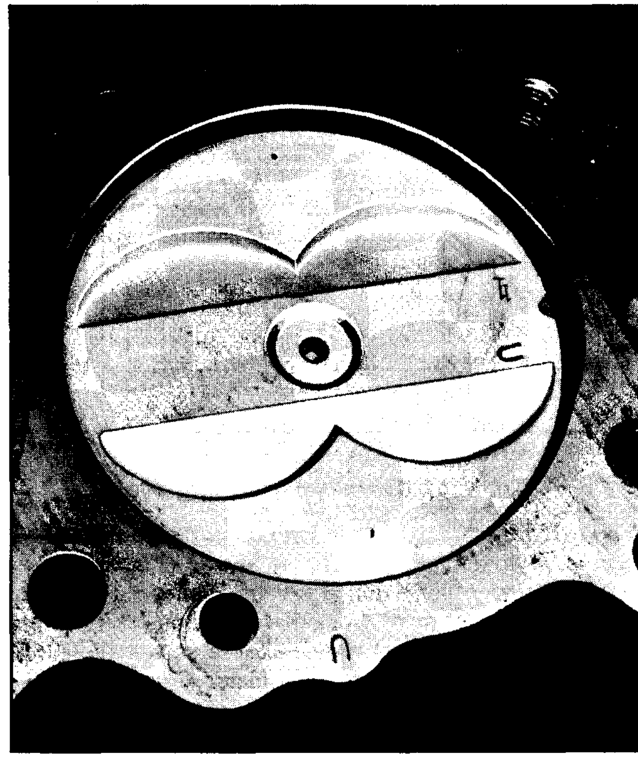


Fig. 6-160 Cylinder Bore and Piston Identification

boss (piston pin removed) and at sizing point indicated in Fig. 6-158.

Make sure the micrometer is in full contact (Fig. 6-159).

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 .001", .002", .010" and .030" oversize.

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 cylinders where they will fit with proper clearance. Honing of cylinder bore may be necessary to effect a proper fit. When properly mated, mark pistons with cylinder numbers they fit so they will not become mixed.

FITTING PIN IN PISTON

The piston pin fit in the piston is .0005" to .0007" (all except 307 engine) or .00015" to .00025" (307 engine) 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.

FITTING OVERSIZE PINS IN PISTONS AND CONNECTING ROD PIN BORES

In case the standard size piston pin does not fit properly in the piston, an oversize piston pin must be fitted. Piston pins are available in .001" and .003" oversize.

When oversize pins are used, the piston pin bosses must be honed to give required fit. It will also be necessary to hone the connecting rod pin bore to fit the oversize pin, using a precision hone.

> **CAUTION:** *A special grit hone is used for honing the connecting rod pin bore. The piston pin size should be .0008" to .0016" larger than connecting rod pin bore for proper press fit. The piston pin should not show any movement under 1500 lb. minimum load after assembly in rod.*

ASSEMBLE CONNECTING ROD TO PISTON

There is a notch cast in the top of all piston heads to facilitate proper installation. The piston assemblies should always be installed with notch toward front of engine (Fig. 6-161). Position rod in piston so that oil squirt hole is toward camshaft.

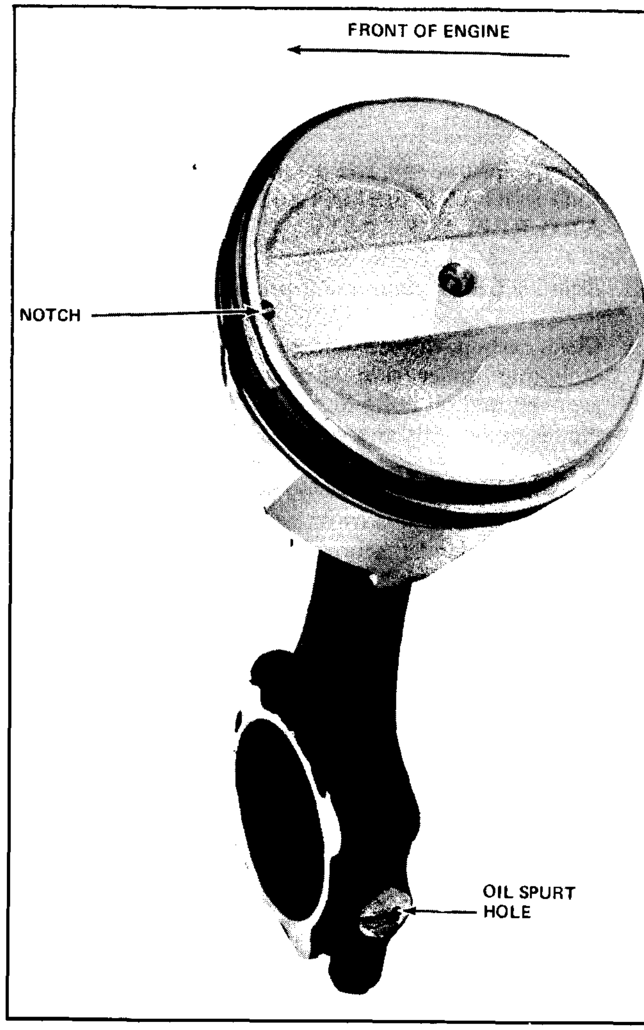


Fig. 6-161 Piston and Rod Assembly

PISTON PIN

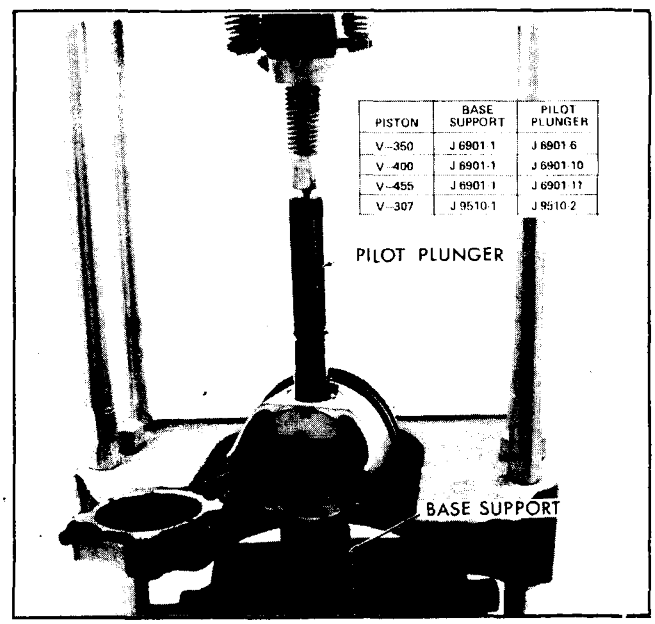
REPLACE

1. Place pilot plunger and spring in the support base to be used as a pilot end stop. See figure 6-162 insert for correct base support and pilot plunger for type pistons being serviced.

2. Place pilot plunger of tool J 6901 or J 9510 in piston pin bore and place on arbor press.

3. Coat piston pin and rod lightly with graphite lubricant.

4. Place tool J 6901-3 (all except 307 engine) or J 9510-2 (307 engine) in piston pin and press pin into piston and connecting rod (Fig. 6-162) until piston pin bottoms against plunger of tool J 6901 or J 9510. Piston must turn freely on pin. If piston binds on pin, disassemble, hone piston pin bosses slightly and reassemble.



PISTON	BASE SUPPORT	PILOT PLUNGER
V-350	J 6901-1	J 6901-6
V-400	J 6901-1	J 6901-10
V-455	J 6901-1	J 6901-11
V-307	J 9510-1	J 9510-2

Fig. 6-162 Installing Piston Pin

PISTON RINGS

REMOVE

1. Remove piston and rod assembly. See CONNECTING ROD AND PISTON ASSEMBLY - REMOVE AND REPLACE.
2. Remove piston rings using proper tool.
3. Clean carbon, varnish, and gum from piston surfaces, including under side of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.
4. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.
5. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is being assembled.
6. Inspect cylinder bores for out-of-round or excessive taper. See CYLINDER BORES-INSPECT.

PISTON RING CHECK AND INSTALL ON PISTON

Two compression rings and one 3-piece oil control ring, all above the piston pin, are used on pistons for all engines. The compression rings are taper faced and also have either a step or chamfer on the inside diameter of the bottom side. The top compression ring is molybdenum filled, which results in the center section of ring sealing edge appearing porous or grainy. The lower compression ring varies depending upon the engine. See specifications at the end of this section.

Regardless of engine type, always install compression rings with the stamped markings toward the top of piston.

New rings are serviced for the standard size pistons, and for .010" 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 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.

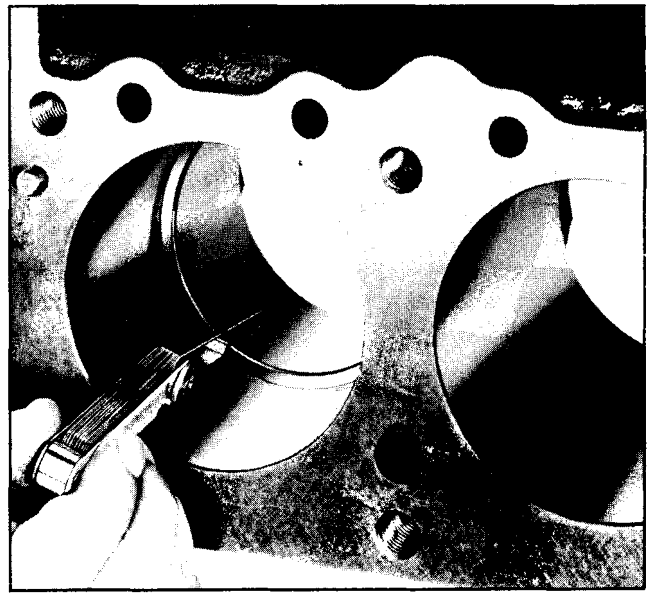


Fig. 6-163 Checking Ring Gap

3. Measure gap between ends of ring with feeler gauge (Fig. 6-163). Gaps should be as follows:

Compression Ring	
All except 307	.010" - .030"
307 - Top Ring	.010" - .020"
Second Ring	.010" - .020"
Oil Ring (All)	015"-.055"

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore (standard, .010" oversize, etc.), they should have the proper gap. It should not be necessary to alter ring gap by filing.

4. Install rings on piston, using J 8021 or J 7117 to prevent breakage or fracture of rings, or damage to pistons.
5. Measure side clearance of rings in ring groove as each ring is installed (Fig. 6-164). Clearance with new pistons and rings should be .0015"-.005" (all except 307 engine) or for 307 engine as follows: Top Ring - .0012" - .0027", Second Ring - .0012" - .0032", Oil Ring - .002" - .007".

If side clearance is excessive, piston should be replaced.

CRANKSHAFT

CHECK

These checks are to be made with oil pan and baffle removed and with all main caps and rods installed and properly torqued.

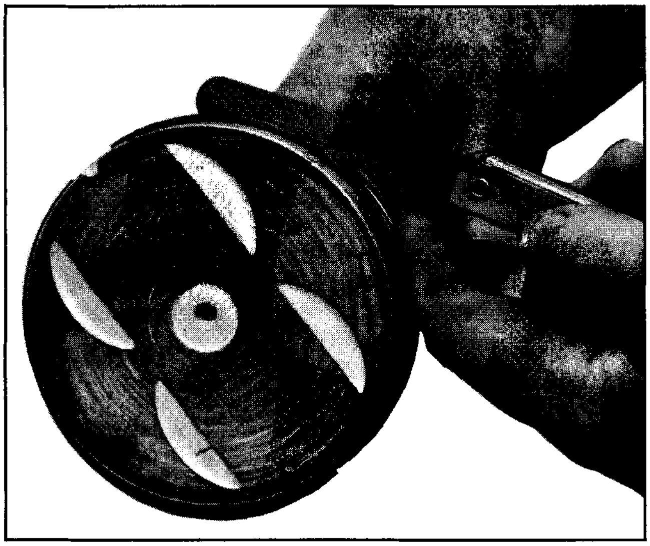


Fig. 6-164 Measuring Side Clearance of Ring in Groove

1. Check end play (Fig. 6-165). Using hammer, tap end of crankshaft at rear until it is tight against front of thrust bearing (No. 4 main bearing). Measure clearance between crankshaft counterweight and thrust bearing. Proper clearance is .003" to .009" for all except 307 engine and .002" - .006" for 307 engine. If clearance is outside these limits, a new thrust bearing in required.

2. Check connecting rod side clearance. Using hammer, gently tap lower end of connecting rod (rod most rearward) toward front of engine. Measure clearance between rear of connecting rod and counterweight. Proper clearance is .012" to .017" total for both rods for all except 307 engine and .008" to .014" for 307 engine. If clearance is outside these limits, a new rod or rods is required.

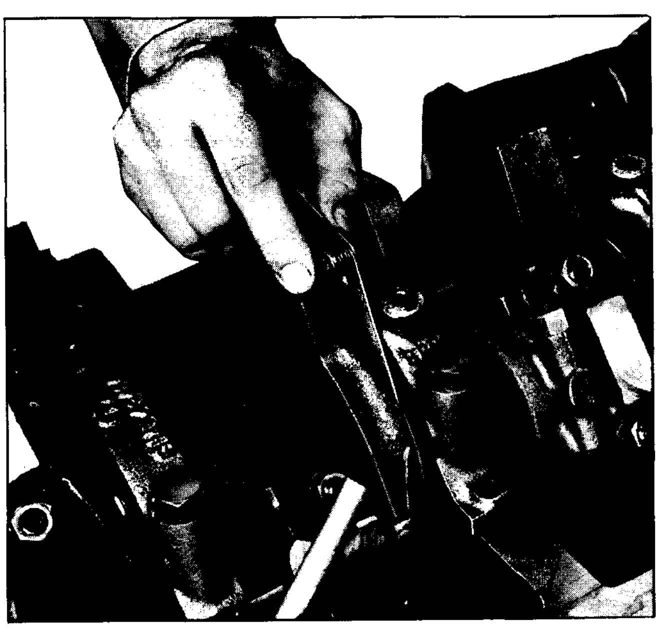


Fig. 6-165 Measuring Crankshaft End Play

REMOVE

In order to remove the crankshaft, the engine assembly must be removed from the vehicle.

The crankshaft can then be removed and replaced with cylinder heads, pistons, rods, manifolds and other upper engine components installed, but the flywheel, clutch and transmission assemblies must be removed.

1. Remove engine and clutch (SM) as an assembly. See ENGINE - REMOVE AND INSTALL.
2. Remove clutch (SM) and install engine on suitable stand.
3. Remove spark plugs.
4. Remove engine oil pan.
5. Remove oil pump assembly and oil pump drive shaft (Fig. 6-138).
6. Remove oil baffle and oil baffle tube.
7. Remove harmonic balancer.
8. Remove fuel pump.
9. Remove timing chain cover, gasket and O-ring seal.
10. Remove fuel pump eccentric and bushing (Fig. 6-126).
11. Remove sprockets and timing chain (Figs. 6-127 and 6-128).
12. Remove connecting rod caps.

    CAUTION: *Mark connecting rod caps for proper reinstallation.*

13. Remove main bearing caps from block.

    CAUTION: *Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Depress pistons until connecting rods are free of crankshaft.*

14. Lift crankshaft from block.

REPLACE

1. With upper bearings installed, position crankshaft in block.
2. Install main bearing caps (with bearing shells in place) but do not tighten retaining bolts.
3. Pull connecting rods and piston assemblies into

place, rotating crankshaft as necessary to properly seat rods. (Make sure upper bearings remain in proper position).

4. Remove tape from connecting rod threads and install connecting rod caps (with bearings) and retaining nuts, but do not tighten.

5. Check fit of all main and rod bearings with plastic gage and install proper sized new bearings.

6. Tighten rear main bearing cap to 120 lb. ft. and all remaining bearing caps to 100 lb. ft. on all except 307 engine, or all bearing caps to 75 lb. ft. on 307 engine. Tighten connecting rod bearing cap retaining nuts to 43 lb. ft. (all except 307 engine) or 45 lb. ft. (307 engine).

7. Install sprockets and timing chain, making sure timing marks on sprockets are aligned properly (Figs. 6-127 and 6-128).

8. Install fuel pump eccentric and bushing and insert sprocket retaining bolt with washer. Tighten securely.

9. Install timing chain cover, new cover gasket and new O-ring seal.

10. Install fuel pump.

11. Install harmonic balancer.

12. Install oil baffle and oil baffle tube.

13. Install oil pump drive shaft and oil pump assembly.

14. Install engine oil pan.

15. Install spark plugs.

16. Remove engine from stand and install clutch (SM) to engine.

17. Install complete assembly in vehicle.

ENGINE BLOCK CORE HOLE PLUGS AND OIL PASSAGE PLUGS

INSPECT AND REPLACE

Engine moving part failures may be caused by lack of proper lubrication. In such case it may be necessary to trace oil supply in the block to determine area of obstruction. Oil pressure drop may be caused by leaking oil passage plugs. For these reasons the following procedures and block illustrations are provided.

NOTE: *Oil circulation diagram is provided in the engine lubrication section. Figs. 6-167, 6-168, 6-169 also show the various locations of water jacket core hole plugs.*

1. With cylinder block inverted, use pen light to see that passage from oil pump to filter is open (Fig. 6-169).

2. Check passage from filter outlet to rear main bearing by inserting wire in oil filter outlet passage and using pen light to see that wire is visible in passage to rear main bearing (Fig. 6-168).

3. Visually check passage from each main bearing to corresponding camshaft bearing (Fig. 6-169).

4. Check passage from filter outlet (through left oil gallery) to main bearings. Use rubber hose to blow smoke in oil filter outlet while observing to see that smoke passes out passages leading to all main bearings.

5. With cylinder block right side up, check oil passages to left bank lifter bosses. Use rubber hose to blow smoke in oil filter outlet while observing for smoke passing out oil passages from left main oil gallery to lifter bosses (Fig. 6-167).

6. Check oil passages to right bank lifter bosses. Use rubber hose to blow smoke in passage from front main bearing to right main oil gallery while observing for smoke passing out passages from right gallery to lifter bosses (Fig. 6-168).

7. Use wire to check two drain holes in lifter gallery (Fig. 6-166).

INSTALL NEW PLUGS

The following plugs can be installed by driving into place using a flat piece of metal or hard wood, bearing against

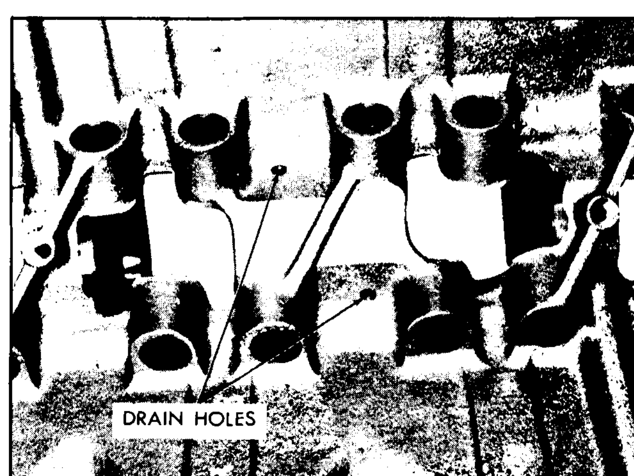


Fig. 6-166 Drain Holes in Lifter Gallery

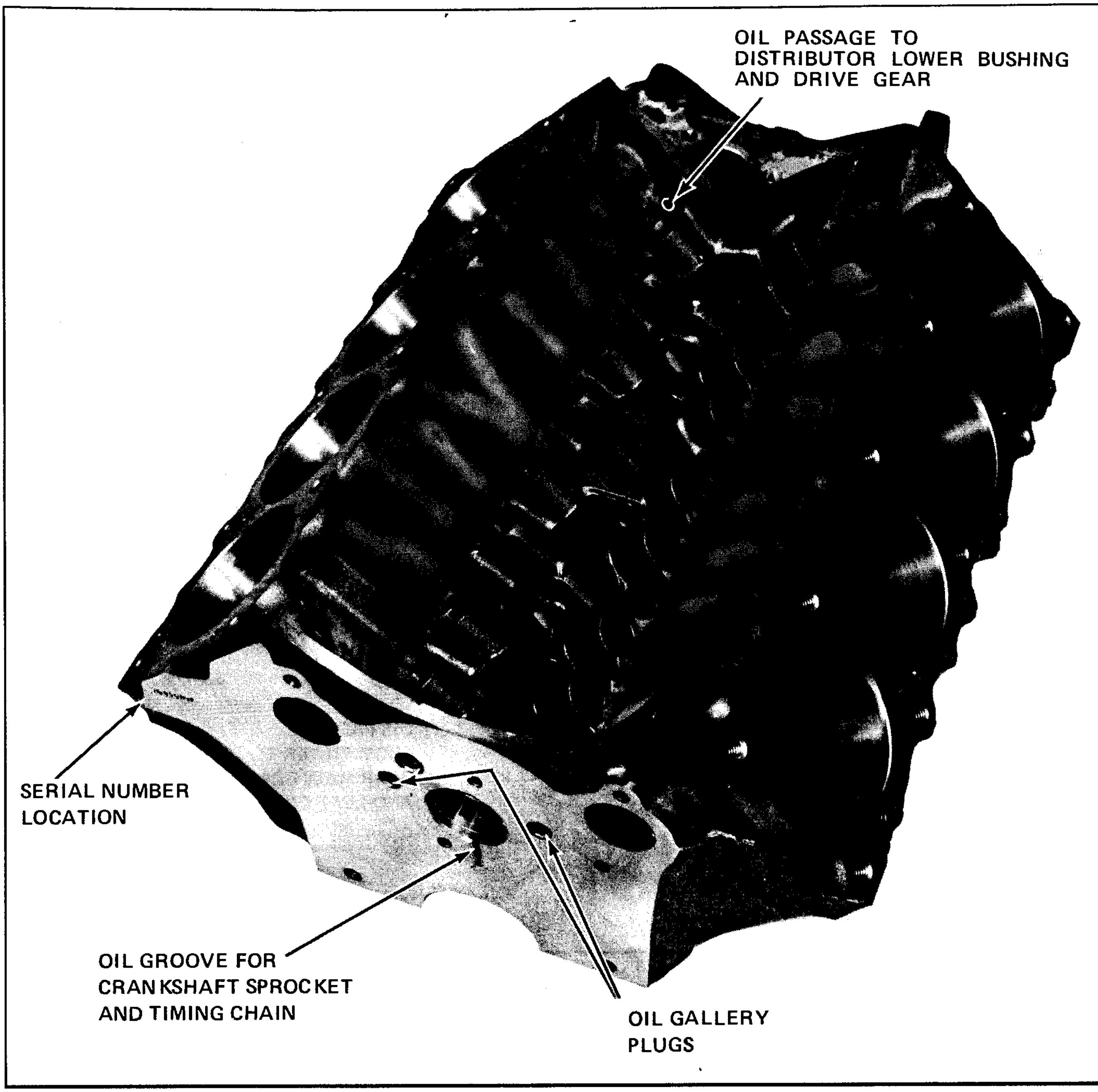


Fig. 6-167 Cylinder Block - View from Left Front

the outer surface: Camshaft plug, water jacket plugs, rear oil gallery plug in block, cylinder head and core hole plugs.

Front oil gallery plugs in the block must be driven into place using a tool which bears against the bottom of the plug. A 1/2" x 3" bolt will make a satisfactory tool for this purpose.

The camshaft rear plug should be driven in to a depth of 3/10" from the rear surface of the block.

All other plugs should be driven in until the outer edge is flush with the surrounding surface.

FITTED BLOCK ASSEMBLY

Fitted block contains pistons, rings, pins and camshaft bearings

DISASSEMBLE

1. Remove flywheel housing and clutch assembly.
2. Remove flywheel and mount engine in holding stand.
3. Remove motor mounts and linkage bracket.

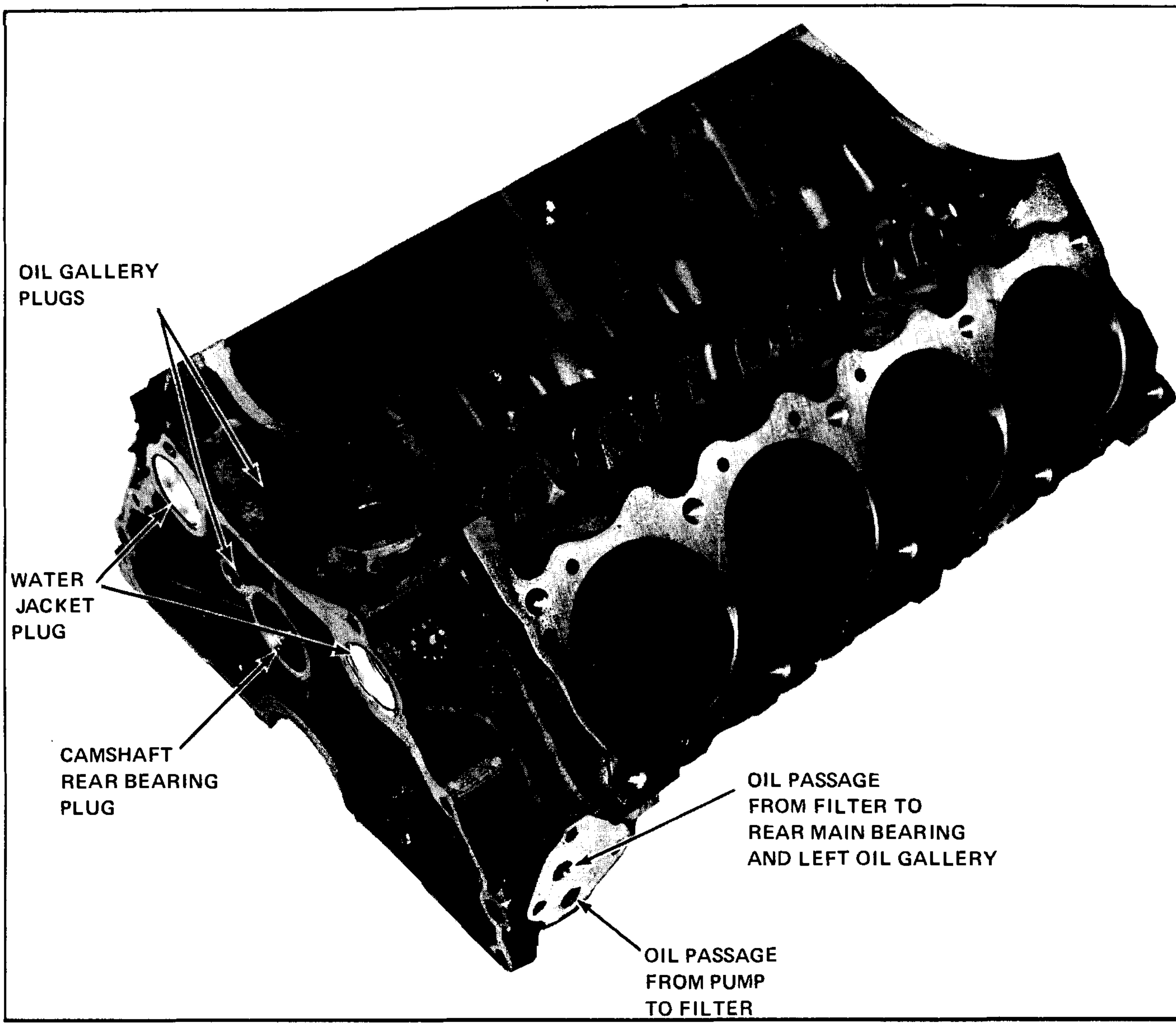


Fig. 6-168 Cylinder Block - View from Right Rear

4. Remove generator and mounting bracket.

5. Remove fuel pump.

6. Remove harmonic balancer.

7. Remove timing chain cover, fan and pulley. Remove timing cover mounting studs.

8. Remove fuel pump eccentric and bushing (all except 307 engine).

9. Slide timing chain and sprockets off end of camshaft and crankshaft.

10. Remove camshaft thrust plate.

11. Remove distributor and high tension wires.

12. Remove coil.

13. Remove starter assembly.

14. Remove intake manifold.

15. Remove push rod cover (all except 307 engine).

16. Remove oil level indicator.

17. Remove rocker arm covers.

18. Loosen rocker arm nuts, rotate rocker arms and remove push rods. Store push rods so that they may be reinstalled in the same position as removed.

19. Remove cylinder heads and exhaust manifolds.

20. Remove cylinder head gaskets.

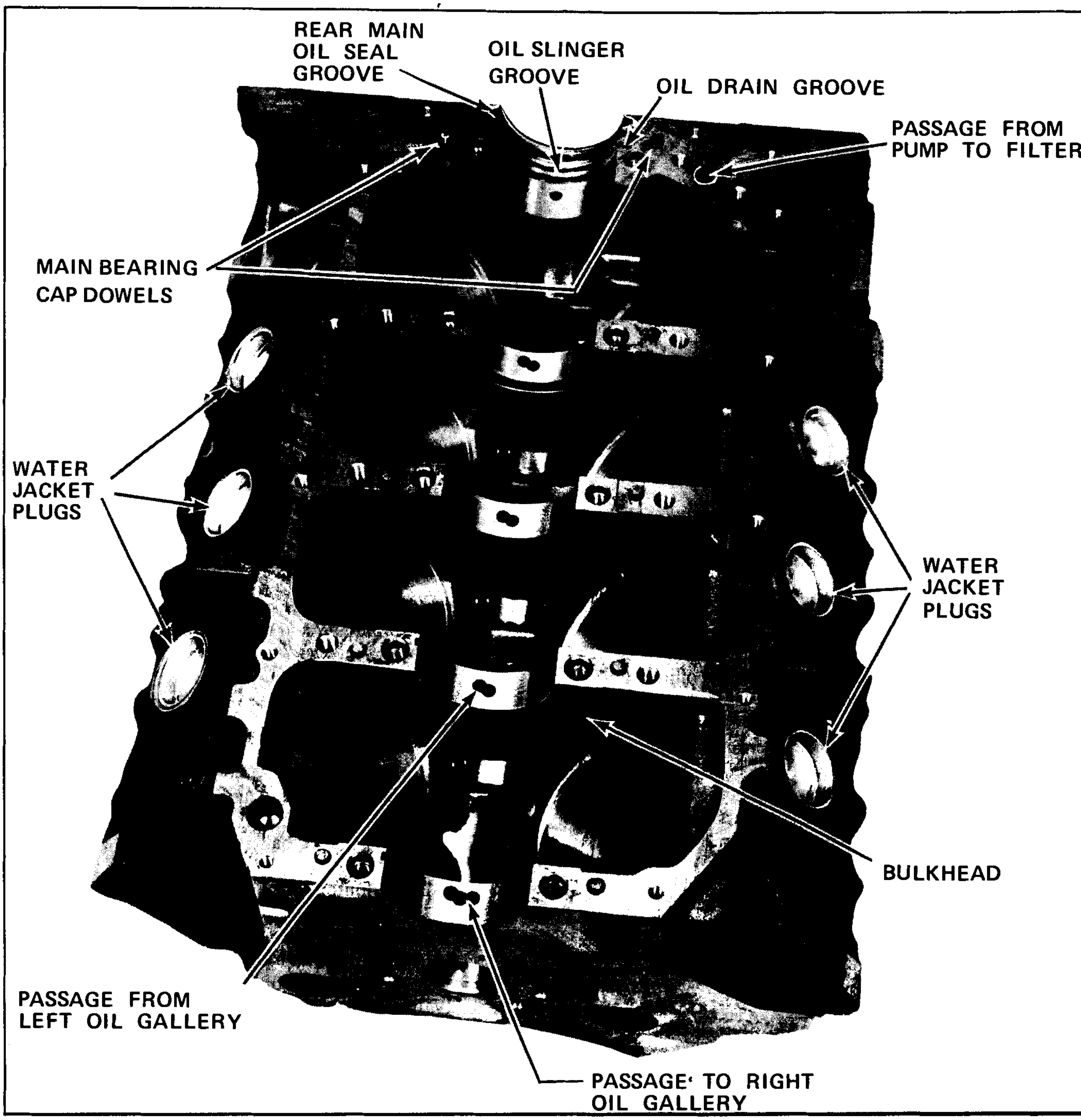


Fig. 6-169 Cylinder Block - View from Bottom

21. Remove oil filter assembly.

22. Remove valve lifters; use J 3049 if necessary.

    Place valve lifters in a storage box so lifters can be reinstalled in original location.

23. Remove camshaft.

24. Invert engine and remove oil pan and flywheel inspection cover.

25. Remove oil pump assembly and drive shaft.

26. Remove baffle and oil indicator tube extension.

27. Remove crankshaft.

28. Remove all connecting rod and piston assemblies.

29. Remove connecting rods from pistons and identify rods for installation in original location.

30. Remove old block from stand and mount new fitted block on stand.

31. Remove each piston and pin assembly from new block and identify for installation in original position.

This completes disassembly for fitted block replacement. Proceed with assembly operations. Use new gaskets throughout and pay special attention to torque requirements.

ASSEMBLE

1. Install old connecting rods to proper new piston and pin assemblies and install in cylinders from which pistons were removed.

2. Install crankshaft and plastic gage bearings.

3. Install two timing cover mounting studs.

4. Install camshaft, using care not to damage bearings.

5. Install camshaft thrust plate indexing oiling slot in plate with oil groove in block.

6. Make sure keys are in place in crankshaft and camshaft. Install timing chain and sprockets, making sure marks in sprockets are aligned exactly on a straight line passing through shaft centers (Fig. 6-127 and 6-128). (Number one cylinder is now at T.D.C. in its firing position).

   Alignment can be simplified by first installing sprockets without chain to align timing marks. If timing chain is excessively loose, new chain or new chain and sprockets should be used.

   When installing distributor, position so that rotor is in position to fire number one cylinder.

7. Position fuel pump eccentric bushing over eccentric with flange toward camshaft sprocket.

8. Install fuel pump eccentric and bushing on camshaft sprocket (all except 307 engine), indexing tang on eccentric with keyway cut-out in camshaft sprocket.

9. Position timing cover gasket over mounting studs and dowels on block.

10. Install timing cover, water pump, fan and pulley. Do not install stud nuts at this time.

11. Slide harmonic balancer onto crankshaft, and install harmonic balancer to crankshaft bolt and washer. Place hammer handle between block and crankshaft counterweight to keep crankshaft from turning and tighten harmonic balancer to crankshaft bolt to 160 lb. ft. (all except 307 engine) or 60 lb. ft. (307 engine).

12. Install baffle and oil indicator tube extension.

13. Insert oil pump drive shaft with dimpled end towards block.

14. Install oil pump gasket and oil pump.

15. Cement new gaskets to oil pan and rear main bearing cap; use retainers to hold gasket. Install oil pan and on all except 307 engine, tighten pan bolts to 12 lb. ft. Tighten four rear bolts (through reinforcement straps) to 20 lb. ft. On 307 engine, tighten all oil pan bolts to 80 lb. in. Position flywheel housing inspection cover in place and secure with bolts.

16. Position new cylinder head gasket on block.

17. Position cylinder heads and exhaust manifolds on locating pins. Install head bolts and torque to 95 lb. ft. (all except 307 engine) or 65 lb. ft. (307 engine).

    Three different length bolts are used. When inserted in proper holes, all will project an equal amount from their respective bosses.

18. Install lifters in bosses from which they were removed.

19. Install push rods in same location as originally removed and with same end facing valve lifter.

20. Tighten rocker arm ball retaining nuts to 20 lb. ft.

21. Install distributor as follows:

    a. If not already done as explained in Step number 6, turn crankshaft to firing position of number one cylinder (number one exhaust and intake valve lifters both on base circles of their cam lobes and timing mark on harmonic balancer indexed with pointer (number one intake must have just closed).

    b. Position new distributor to block gasket on block.

    c. Install distributor (without cap and wires) so that vacuum diaphragm faces left side of engine and rotor arm points toward contact in cap for number one cylinder. It will also be necessary to turn the oil pump drive shaft so it will index with distributor shaft.

22. Install distributor hold-down clamp and special bolt and tighten enough to hold distributor in place.

23. Install coil.

24. Cement new gasket to push rod cover and install push rod cover (all except 307 engine).

25. Cement new gaskets to rocker arm covers and install covers.

26. Install intake manifold gasket with plastic locating sleeves in cylinder head as shown in Figs. 6-100 and 6-101.

27. Start intake manifold to timing cover draw bolt into intake manifold, making sure rubber "O" ring (all except 307 engine) is in place.

28. Position intake manifold and install retaining screws finger-tight.

29. Tighten draw bolt to 15 lb. ft. to obtain metal to metal contact between manifold and timing cover (all except 307 engine).

30. Tighten manifold screws to 40 lb. ft. on all except 307 engine, or 30 lb. ft. on 307 engine.

31. Install oil filter assembly and gasket.

32. Install oil level indicator.

33. Install starter assembly.

34. Install fuel pump.

35. Install generator and bracket.

36. Install fan belt and adjust belt tension as covered in Section 6A.

6 CYLINDER ENGINE WRENCH TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise specified.

APPLICATION	TORQUE
Bolt and L/W-Camshaft & Gear Assy. to Cylinder Block	80 lb. in.
Nut-Connecting Rod & Bearing Assy. Cap to Rod	35
Bolt-Cover Plate Assy. to Flywheel	35
Screw and L/W-C/Case Frt. End Cover to Cylinder Block	80 lb. in.
Plug-Cylinder Block Oil Gallery	*
Bolt-Cylinder Head	95
Bolt-Distributor Hold-Clamp to Cylinder Block	20
Fitting-Distributor Intake Manifold Vacuum Hole	*
Nut-Distributor to Carburetor Vacuum Control	*
Bolt-Exhaust Manifold to Intake Manifold	25
Bolt-Engine Motor Mount Bracket to Cylinder Block	33
Bolt-Engine Motor Mount to Mount Bracket	45
Bolt-Engine Oil Pump Assy. to Block	115 lb. in.
Bolt-Engine Oil Pump Cover to Body	70 lb. in.
Bolt-Fan & Pulley to Water Pump Hub	20
Bolt-Flywheel Assy. to Crankshaft	60
Fitting-Fuel Pump Fuel Pipe to Carb. & Pump	*
Screw and L/W-Fuel Pump to Cyl. Block	18
Bolt-Ignition Coil Bracket	10
Nut-Intake and Exhaust Manifold Clamp	30
Bolt-Intake and Exhaust Manifold Clamp	30
Bolt-Intake and Exhaust Manifold Clamp at End Exh. Port	20
Bolt-Main Bearing Cap to Block	65
Stud-Main Bearing Cap to Block (No. 6)	65
Bolt-Manifolds to Head	Refer to Fig. 6-20
Nut-Manifolds to Head	Refer to Fig. 6-20
Oil Filter	Hand Tight
Bolt-Oil Pan to Cylinder Block	80 lb. in.
Bolt-Oil Pan to Cylinder Block (Also attaches Clutch Housing Cover Shield)	10
Screw-Oil Pan Drain	20
Screw-Oil Pump & Screen Supp. to Oil Pump & Screen	115 lb. in.
Nut-Oil Pump & Screen Supp. to No. 6 Crankshaft Bearing Stud	30
Plug Assy.-Spark	15†
Bolt-Thermostat Housing to Water Outlet Fitting	30
Bolt-Valve Push Rod Cover Assy. to Block	80 lb. in.
Bolt-Valve Rocker Arm Cover to Head	55 lb. in.
Bolt-Water Outlet Fitting to Cyl. Head	20
Bolt-Water Pump to Cylinder Block	15

* Torque not requirement, other means of control and-/or specificiátions used; check for alignment, bottoming, height and/or leaks.

† **CAUTION:** *Do not overtorque, as plug breakage may result upon subsequent removal.*

SPECIFICATIONS - 6 CYL. ENGINE

Type	In-Line 6
Valve Arrangement	In Head
Bore and Stroke	3.87" × 3.53"
Piston Displacement	250 cu. in.
Taxable Horsepower	36
Compression Ratio	8.5:1
Horsepower	145 @ 4200 rpm
Torque	230 lb. ft. @ 1600 rpm
Compression Pressure at Cranking Speed Wide-Open Throttle	140 psi @ 160 rpm
Firing Order	1-5-3-6-2-4
Production Engine Number	Pad at Right Front Side by Distributor Shaft Hole
Cylinder Numbers-Front to Rear	1-2-3-4-5-6

CAMSHAFT

Material-Camshaft	Hardened Alloy Cast Iron
Material-Cam Bearings	High Lead Steel Backed Babbitt
Journal Diameter	1.8682" - 1.8692"
Bearing Length	.807"
Bearing Clearance	.0007" - .0027"
End Play	.009" - .013"

CONNECTING RODS

Material-Connecting Rods	Drop Forged Steel
Material-Rod Bearings	Copper Lead Alloy or Sintered Copper Nickel
Length, center to center	5.70"
Bearing Clearance on Crankpin-Limits When New	.0007" - .0027"
End Play of Connecting Rod on Crankpin	.009" - .014"

CRANKSHAFT

Material-Crankshaft	Cast Nodular Iron
Material-Crankshaft Main Bearings	Durex 100-A Steel Backed
Journal Diameter	2.2983" - 2.2993"
Bearing Length-Overall	
1-2-3-4-5-6	.752"
7	.760"
Thrust Taken On	#7
Crankpin Journal Diameter	1.999" - 2.000"
Pin Maximum Out of Round (New)	.002"
Pin Maximum Taper (New)	.0003"
End Play-Limits When New	.002" - .006"
Main Bearing Clearance-Limits When New	.0003" - .0029"

FLYWHEEL

Teeth on Ring	153
Teeth on Starter Pinion	9

PISTONS AND CYLINDERS

Cylinder Bore Diameter	3.8745" - 3.8775"
Cylinder Bore Out-of-Round When New	.0005" (max.)
Cylinder Bore Taper When New	.0005" (max.)
Piston Material	Cast Aluminum Alloy
Piston Clearance in Cylinder	.0005" - .0015"
Piston Ring Gap	
Compression Rings	.010" - .020"
Oil Ring Segments	.015" - .055"
Piston Ring to Groove Clearance	
Compression Rings	
Upper	.0012" - .0027"
Lower	.0012" - .0032"
Oil Ring Assembly	.0001" - .005"

PISTON PINS

Piston Pin Material	Chromium Steel
Fit in Piston	.00015" - .00025" loose with piston and pin at 70° F.
Fit in Rod	Press Fit
Diameter (Selective)	.9270" - .9273"
Length	2.990" - 3.010"

SPROCKETS

Camshaft-Material	Bakelite and Fabric Composition with Steel Hub
-Number of Teeth	54
Crankshaft-Material	Steel, Sintered Iron Hub
-Number of Teeth	27

VALVE TIMING (In Crankshaft Degrees)

Camshaft (without A.I.R.)	3864497
Intake	
Opens	25° BTC
Closes	237° ATC
Duration	262°
Lift (@ Zero Lash)	.388"
Exhaust	
Opens	236° BTC
Closes	26° ATC
Duration	262°
Lift (@ Zero Lash)	.388"
Valve Overlap	.289° inches

Camshaft (with A.I.R.)	6262809
Intake	
Opens	25° BTC
Closes	237° ATC
Duration	262°
Lift (@ Zero Lash)	.388"
Exhaust	
Opens	234° BTC
Closes	36° ATC
Duration	270°
Lift (@ Zero Lash)	.405
Valve Overlap	.686° inches

VALVES

Material-Intake	Alloy Steel with Aluminized Face and Flash Chrome Plate Stem
-Exhaust	21-4N Steel with Aluminized Face and Flash Chrome Plated Stem
Lash-Intake & Exhaust	One Turn Down from Zero Lash
Head Diameter-Intake	1.715" - 1.725"
-Exhaust	1.495" - 1.505"
Stem Diameter	
Intake & Exhaust	.3410" - .3417"
Face Angle-Intake & Exhaust	45°
Seat Angle-Intake & Exhaust	46°
Stem to Guide Clearance	
Intake	.0010" - .0027"
Exhaust	.0015" - .0032"
Springs (Force @ Length)	
Valve Closed	56-64 lbs. @ 1.27"
Valve Opened	180-192 lbs. @ 1.27"

VALVE TRAIN

Lifter-Leak Down Rate	12-65 seconds with 50 lbs. load
-Plunger Travel	.0338" (Gage)
Pushrod-Material	Steel Tubing
-Length	9.61"
Rocker Arm-Material	Stamped Steel
-Ratio	1.75:1

V-8 ENGINE WRENCH TORQUE SPECIFICATIONS (EXCEPT 307 ENGINE)

Torque in lb. ft. unless otherwise specified.

APPLICATION	TORQUE
Bolt-Main Bearing Cap to Block	100
Bolt-Rear Main Bearing Cap to Block	120
Bolt-Cylinder Head	95
Bolt-Flywheel to Crankshaft	95
Nut-Connecting Rod Bearing Cap	43
Bolt-Oil Pan to Block	
Front Bolts	12
Rear Bolts (through reinforcement straps)	20
Bolt-Oil Pump to Block	30

APPLICATION	TORQUE
Bolt-Harmonic Balancer to Crankshaft	160
Bolt-Exhaust Manifold to Head	30
Bolt-Intake Manifold to Head	40
Bolt-Camshaft to Sprocket	40
Nut-Rocker Arm to Stud	20
Stud-Rocker Arm	50
Spark Plug to Head	15
Bolt-Rocker Cover	8

307 ENGINE WRENCH TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise specified.

APPLICATION	TORQUE
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.
Camshaft Sprocket	20
Oil Pan (To Crankcase)	65 lb. in.
Clutch Pressure Plate	35
Distributor Clamp	20
Flywheel Housing	30
Manifold (Exhaust)	20
Manifold (Inlet)	30

APPLICATION	TORQUE
Water Outlet	20
Water Pump	30
Connecting Rod Cap	45
Cylinder Head	65
Main Bearing Cap	75
Oil Pump	65
Flywheel	60
Harmonic Balancer	60
Temperature Send Unit	20
Oil Filter	25
Oil Pan Drain Plug	20
Spark Plug	15

SPECIFICATIONS V-8 ENGINE (EXCEPT 307 ENGINE)

Type .... 90° V-8 O.H. Valve
Bore and Stroke
- 350 cu. in. .... 3.88" × 3.75"
- 400 cu. in. .... 4.12" × 3.75"
- 455 cu. in. .... 4.15" × 4.21"

Compression Ratio
- 350 cu. in., 2-Bbl. 8.0
- 400 cu. in., 2-Bbl. 8.2
- 455 cu. in., 2-Bbl. 8.2
- 400 cu. in., Q'Jet 8.2
- 455 cu. in., Q'Jet 8.2
- 455 H.O. cu. in., Q'Jet 8.4

Compression Pressure at Cranking Speed (Wide Open Throttle)
- 350, 400 and 455.... 120-160 PSI @ 155-175 RPM

Car-Engine Serial No. Location .... Front Face of Right Cylinder Bank
Production Engine No. Location .... Front Face of Right Cylinder Bank
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
Installation Angle
- B Series
  - 123.5" W.B. .... 3.4°
  - 126" W.B. .... 3.1°
  - Station Wagon .... 3.6°
- G Series .... 4.7° (MT), 4.8° (AT)
- A Series .... 4.7° (MT), 4.8° (AT)
- F Series .... 2.7°

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"

PISTON RINGS

Compression Rings.... Two - Cast Iron Reverse Twist, Barrel Face (upper), and Taper Face (lower)
- Material
  - Upper .... Channel Moly Filled
  - Lower
    - 350, 400 and 455 2 Bbl. .... Tin-Plated
    - 400 and 455 4 Bbl. .... Channel Moly Filled
- Ring Gap
  - Upper
    - 350 and 400 .... .019"
    - 455 .... .021"
  - Lower .... .015"
- Side Clearance .... .0015" - .005"

Oil Ring .... Three Piece
- Material
  - Rails (2) .... Chrome-Plated Steel
  - Expander (All exc. 350) .... Stainless Steel
  - 350 .... Carbon Steel
- Ring Gap .... .035"
- Side Clearance .... .0015" - .005"

PISTON PIN

Material .... Extruded SAE 1016 Steel
Diameter .... .9802"
Wall Thickness .... .38"
Length .... 3.25"
Fit in Piston .... .0005" - .0007"
Fit in Rod .... Press

CONNECTING ROD

Material .... Arma Steel
Weight (oz.) 31.7
Length (Center to Center) .... 6.625"
Bearings
- Length .... .88"
- Clearance .... .0005" - .0025"
- Material
  - 350 and 400 2 Bbl. .... Moraine 100-A
  - 400 4 Bbl. and 455 .... Moraine 400-A

End Play on Crankshaft (Total for Two) .... .012" - .017"

VALVES

Material
  Intake .... GM 8440 Steel with Aluminized Face and Flash Chrome Plated Stem
  Exhaust .... 21-2 Steel with Aluminized Face and Flash Chrome Plated Stem
Diameter of Head
  Intake
    350, 400 and 455 2 Bbl. .... 1.96"
    400 and 455 4 Bbl. .... 2.11"
  Exhaust
    350, 400 and 455 .... 1.77"
Overall Length
  Intake
    350 and 400 2 Bbl. .... 4.982"
    455 (exc. H.O.) .... 4.881"
    455 H.O. and 400 4 Bbl. .... 4.960"
  Exhaust
    350 and 400 2 Bbl. .... 4.971"
    455 (exc. H.O.) .... 4.870"
    455 H.O. and 400 4 Bbl. .... 4.949"
Diameter of Stem .... .34"
Stem to Guide Clearance
  Intake... .0016" - .0033"
  Exhaust .... .0021" - .0038"
Valve Seat Angle
  Intake - Large Valves .... 30°
  Intake - Small Valves .... 45°
  Exhaust .... 45°
Valve Face Angle
  Intake - Large Valves .... 29°
  Intake - Small Valves .... 44°
  Exhaust .... 44°

VALVE TIMING (In Crankshaft Degrees)

Camshaft	483555	9779066	9779067	9779068
Intake				
Opens (BTC)	26°	30°	23°	31°
Closes (ABC)	63°	63°	70°	77°
Duration	269°	273°	273°	288°
Lift (@ Zero Lash)	.374"	.404"	.403"	.408"
Exhaust				
Opens (BBC)	72°	77°	78°	90°
Closes (ATC)	25°	23°	31°	32°
Duration	277°	282°	289°	302°
Lift (@ Zero Lash)	.407"	.408"	.406"	.406"
Valve Overlap	51°	55°	54°	63°

CRANKSHAFT

Material .... Nodular Iron
No. of Bearings 5
Main Bearing Type
  350 and 400 2 Bbl.
    All exc. #4 lower .... Moraine 100-A
    #4 lower .... Moraine 400-A
  400 4 Bbl.
    All uppers .... Moraine 100-A
    All lowers exc. #5 .... Moraine 400-A
    #5 lower .... Moraine 100-A
  455 4 Bbl.
    All exc. #5 upper .... Moraine 400-A
    #5 upper .... Moraine 100-A
  455 2 Bbl.
    All lowers .... Moraine 400-A
    All uppers .... Moraine 100-A
Thrust Taken On .... No. 4
Crankshaft Endplay .... .003" - .009"
Journal Diameter
  350 and 400 .... 3.00"
  455 .... 3.25"
Main Bearing Length
  Nos. 1, 2, 3 .... .94"
  No. 4-350 and 400 .... 1.13"
  No. 4-455 .... 1.19"
  No. 5 .... 1.59"
Main Bearing Clearance
  All exc. 455 .... .0002" - .0017"
  455(Exc. Small Valve No. 1 Location)
    .... .0005" - .0021"
  455 Small Valve No. 1 Location
    .... .0003" - .0019"
Crankpin Diameter .... 2.25"

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 .... Aluminum Alloy with Nylon Covered Teeth (Early Prod.) .... Hardened Cast Iron (Late Prod.)
- No. of Teeth 42

Timing Chain .... Link Type - Single Side Guide
No. of Links 60
Harmonic Balancer .... Cast Iron

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 exc. 455 H.O. ...... 20-90 sec. @ 50 lb. load
  - 455 H.O. .... 12-60 sec. @ 50 lb. load
- Plunger Travel (For Gaging Purposes) .... .125″

Pushrod
- Material .... Ball Ended - Steel Tubing
- Length .... 9.17″

Rocker Arm
- Material .... Stamped Steel
- Ratio .... 1.5 to 1

Rocker Arm Stud
- 350, 400 2 Bbl., 455 exc. H.O. .. Pressed into Head
- 400 4 Bbl., 455 H.O. .... Screwed into Head

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 .... Metered Jet

OIL PUMP

Type .... Spur Gear
Oil Pickup .... Stationary Screen
Pressure
- All exc. 4 Bbl. Engines
  .... 30-40 PSI @ 2600 RPM
- 4 Bbl. Engines .... 55-60 PSI @ 2600 RPM

Oil Capacity .... 5 Qts.
- With Filter .... 6 Qts.

FUEL SYSTEM

Fuel Pump Pressure (PSI) .... 5.0 - 6.5
Fuel Filter .... Sintered Bronze on 2 BBL; Pleated Paper on Q'Jet

CARBURETOR

Type
- 2-Bbl. .... Carter WGD
- 2-Bbl. .... Rochester 2GV
- 4-Bbl. .... Rochester Quadrajet

Barrel Size
- 2-Bbl. (WGD) .... 1.438″
- 2-Bbl. (2GV) .... 1.688″
- Q'Jet .... 1.375″ Primary, 2.250″ Secondary

COOLING SYSTEM

Radiator Cap Pressure (PSI) 14-17
Thermostat Opens At .... 195°
Water Pump Rate (GPM) 17

SPECIFICATIONS V-8 ENGINE (307 ENGINE)

Type .... 90°V-8 O.H. Valve
Bore and Stroke .... 3.87″ × 3.25″
Compression Ratio 8.5:1

Compression pressure at cranking speed
(Wide Open Throttle).... 150SPI@155 to 175 RPM
Car-Engine Serial No. Location
.... Front Face of Right Cylinder Bank
Production Engine No. Location
.... Front Face of Right Cylinder Bank
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

PISTONS

Clearance in Cylinder	.0005" to .0011"

PISTON RINGS

Compression Rings	
Ring Gap	
Upper	.010" - .020"
Lower	.010" - .020"
Side Clearance	
Upper	.0012" - .0027"
Lower	.0012" - .0032"
Oil Ring	
Ring Gap	.015" - .055"
Side Clearance	.002" - .007"

PISTON PIN

Diameter	.9270" - .9273"
Fit in Piston	.00015" - .00025"
Fit in Rod	Press

CONNECTING ROD

Bearings	
Material	Moraine 100-A
Clearance	.0013 - .0035
End Play on Crankshaft	
(Total for Two)	.002" - .006"

VALVE TIMING (In Crankshaft Degrees)

Camshaft	3896929
Intake	
Opens (BTC)	28°
Closes (ABC)	72°
Duration	280°
Lift (@ Zero Lash)	.390"
Exhaust	
Opens (BBC)	78°
Closes (ATC)	30 °
Duration	288°
Lift (@ Zero Lash)	.409"
Valve Overlap	58°

VALVES

Diameter of Head	
Intake	1.715-1.725
Exhaust	1.495-1.505
Overall Length	
Intake	4.902 - 4.922
Exhaust	4.913-4.933
Diameter of Stem	.3410-.3117
Stem to Guide Clearance	
Intake	.0010"-.0027"
Exhaust	.0012"-.0029"
Valve Seat Angle	
Intake	46°
Exhaust	46°
Valve Face Angle	
Intake	45°
Exhaust	45°

CRANKSHAFT

No. of Bearings	5
Main Bearing Type	Moraine 100-A
Thrust Taken on	No. 5
Crankshaft End Play	.002"-.006"
Journal Diameter	
No. 1-2-3-4	2.4484" - 2.4493"
No. 5	2.4479" - 2.4488"
Main Bearing Clearance	
No. 1	.0008" - .0020"
No. 2-3-4	.0011" - .0023"
No. 5	.0017" - .0033"
Crankpin Diameter	2.099" - 2.100"

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	18
Camshaft Sprocket	
Material- Aluminum Alloy with Nylon Covered Teeth	
No. of Teeth	36
Timing Chain	Link Type - Single Side Guide
No. of Links	46
Harmonic Balancer	Cast Iron

CAMSHAFT

Material .... Hardened Alloy Cast Iron
Bearings
Number 5
Type .... Steel Backed Babbitt
Diameter - All .... 1.8682" - 1.8692"

VALVE SYSTEM

Valve Lifter
Type .... Hydraulic
Leak - Down Rate .... 20-90 sec.@50 lb. load
Plunger Travel (for gauging purposes) .... .125"
Pushrod
Material .... Steel Tubing
Length 7.724
Rocker Arm
Material .... Stamped Steel
Ratio .... 1.5 to 1
Rocker Arm Stud .... Pressed in Head

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 .... Metered Jet

OIL PUMP

Type .... Spur Gears
Oil Pickup .... Stationary Screen
Pressure .... 40 to 45 PSI@2000 RPM
Oil Capacity .... 4 qts.
With Filter .... 5 qts.

FUEL SYSTEM

Fuel Pump Pressure (PSI) .... 5.0 - 6.5
Fuel Filter .... Sintered Bronze

CARBURETOR

Type .... Rochester 2GV (1 1/4)

COOLING SYSTEM

Radiator Cap Pressure (PSI) .... 14 - 17
Thermostat Opens At .... 195°

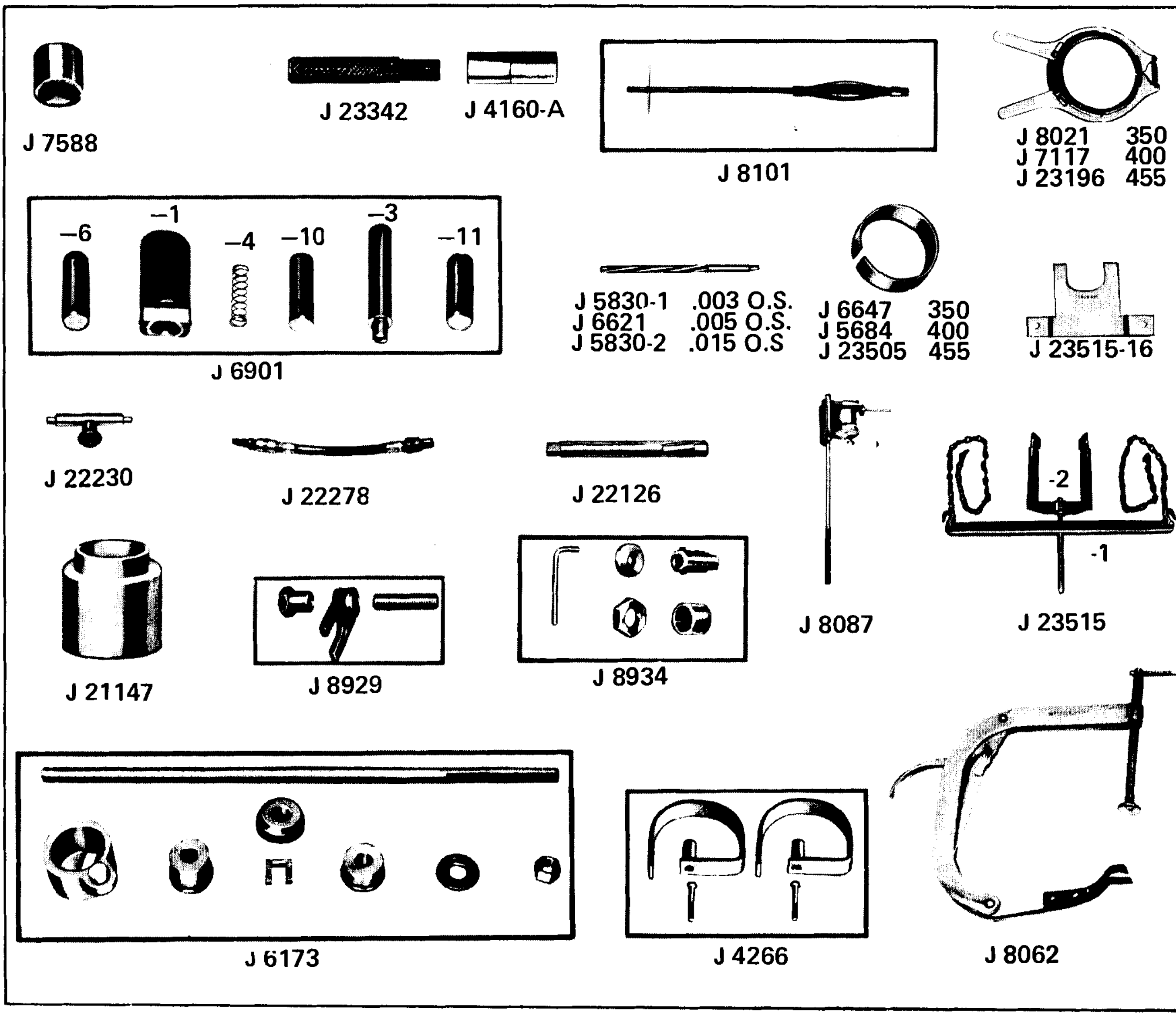


Fig. 6-170 Special Tools (V-8) - All Except 307 Engine

J 4160-A	Hydraulic Valve Lifter Plunger Remover
J 4266	Cylinder Head Lifting Tools
J 5684	Piston Ring Compressor—400
J 5830-1	Valve Guide Reamer .003 O.S.
J 5830-2	Valve Guide Reamer .015 O.S.
J 6173	Camshaft Bearing Remover and Replacer
J 8929	Valve Spring Compressor Set
J 6621	Valve Guide Reamer .005 O.S.
J 6647	Piston Ring Compressor—350
J 6901	Piston Pin Remove and Replace Set
J 7117	Piston Ring Remove and Replace Tool—400
J 7588	Rear Main Bearing Oil Seal Installer
J 8021	Piston Ring Remove & Replace Tool—350
J 8062	Valve Spring Compressor
J 8087	Cylinder Bore Gauge
J 8101	Valve Guide Cleaner
J 8934	Rocker Arm Stud Remover
J 21147	Timing Chain Cover Seal Installer
J 22126	Rocker Arm Stud Reamer .005 O.S.
J 22230	Valve Seal Installer and Tester
J 22278	Adaptor—Air Line
J 23196	Piston Ring Remove and Replace Tool -455
J 23342	Rocker Arm Stud Installer
J 23505	Piston Ring Compressor—455
J 23515	Engine Lifting Tool
-1	Crossbar
-2	V-8 Adapter
-16	Safety Crossbar

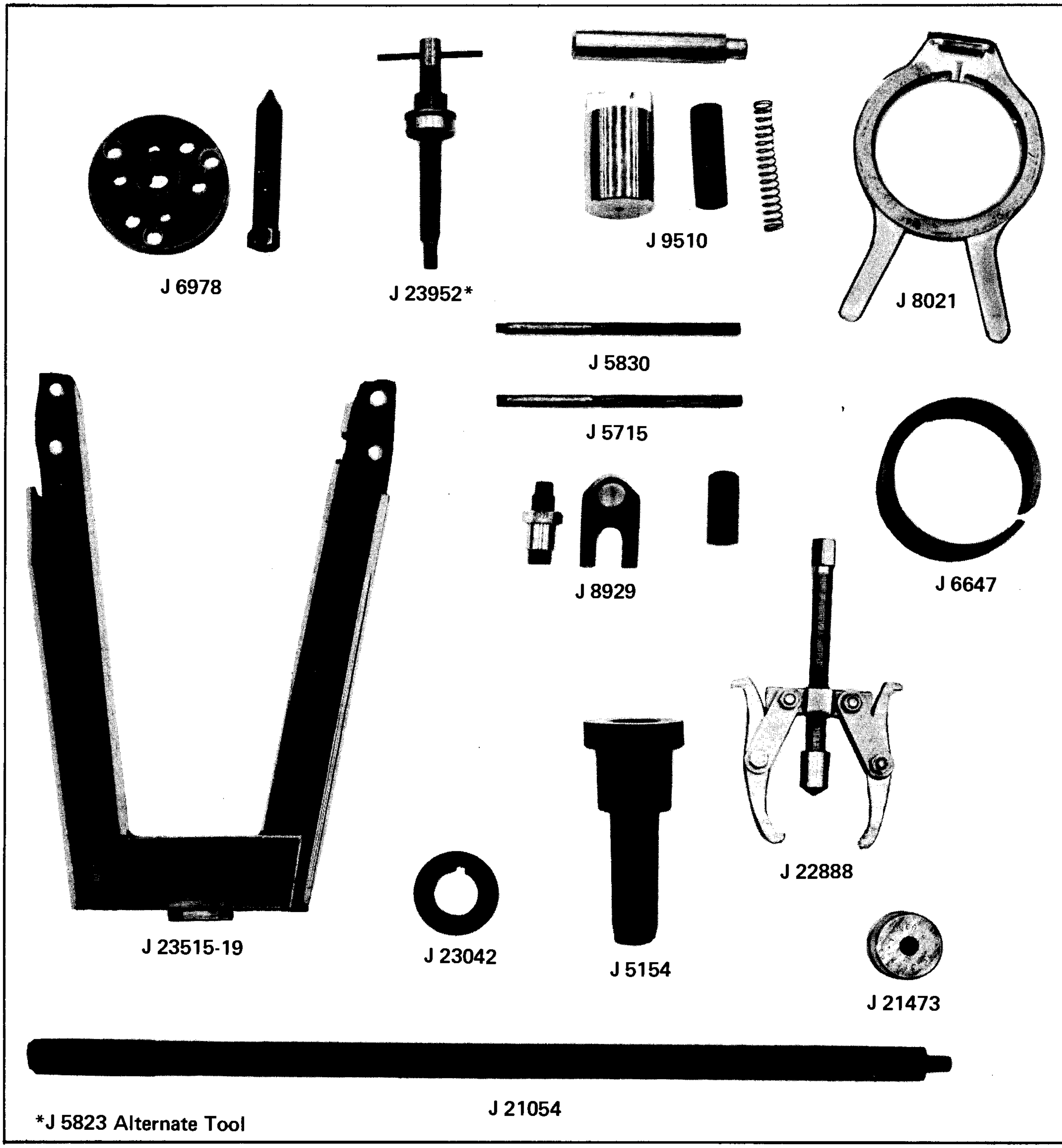


Fig. 6-171 Special Tools (V-8) - 307 Engine

J-5154	CRANKSHAFT SPROCKET INSTALLER
J-5715	ROCKER ARM STUD REAMER
J-5830	VALVE GUIDE REAMER
J-6647	PISTON RING COMPRESSOR
J-6978	HARMONIC BALANCER PULLER
J-8021	PISTON RING REMOVER AND INSTALLER
J-8929	VALVE SPRING COMPRESSOR
J-9510	PISTON PIN REMOVER AND INSTALLER
J-21054	HANDLE FOR CAM BEARING TOOL
J-21473	CAM BEARING REMOVER AND INSTALLER
J-22888	CRANKSHAFT SPROCKET PULLER
J-23042	FRONT COVER CENTERING GAUGE AND OIL SEAL INSTALLER
J-23515	ENGINE LIFTING TOOL ADAPTER
J-23952*	HARMONIC BALANCER INSTALLER

*J-5823 ALTERNATE TOOL

SECTION 6A

ENGINE COOLING AND LUBRICATION

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

FAN CLUTCH DIAGNOSTIC PROCEDURE

1. NOISE

   Fan noise is sometimes evident under the following normal conditions:

   a. when clutch is engaged for maximum cooling and
   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.

   NOTE: *Refer to Item 1, paragraph 1.*

   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 6742-01, or similar type.

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.

Fig. 6A-1 Cooling System Diagnosis Chart

DIAGNOSIS CHART

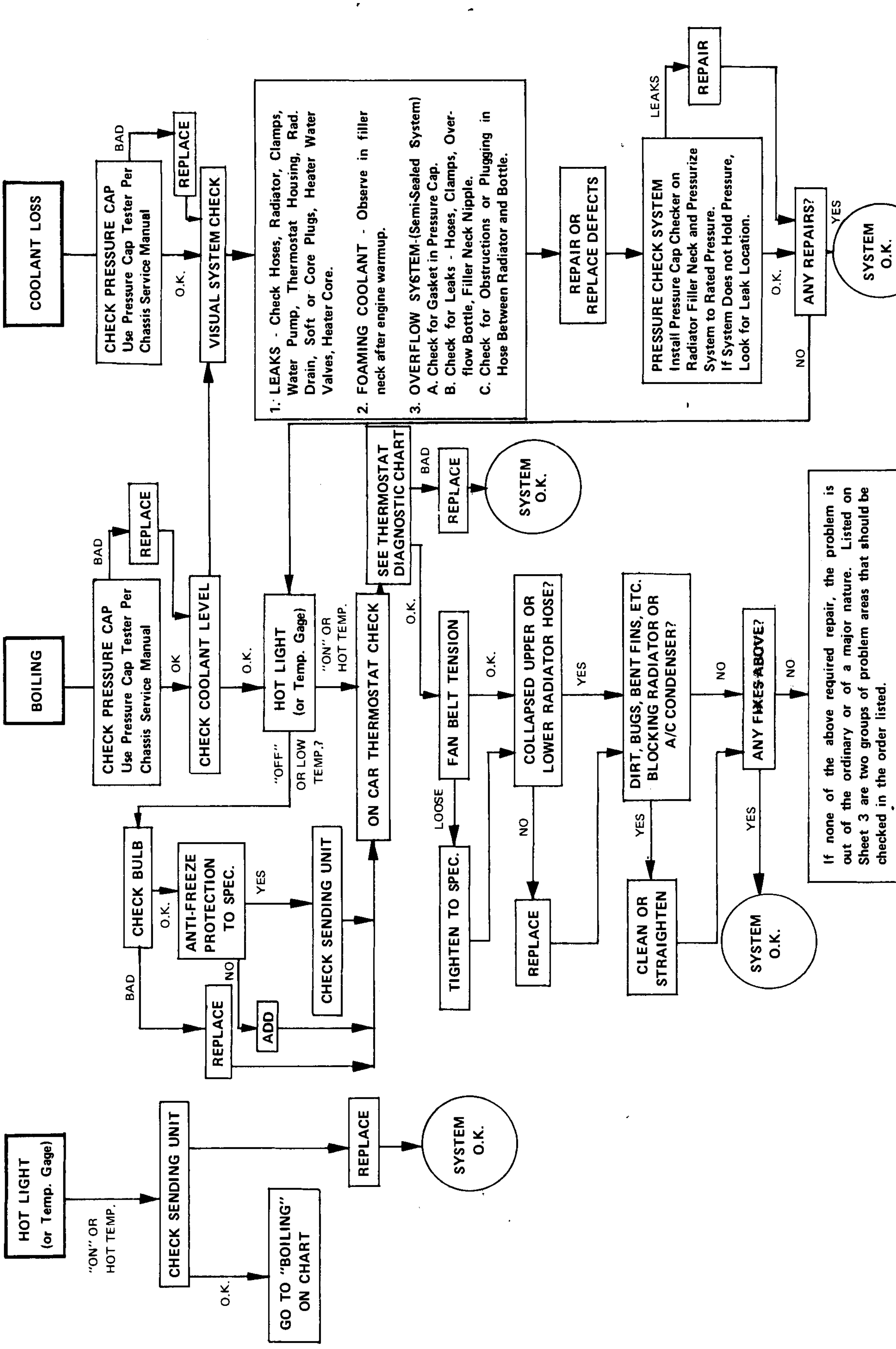


Fig. 6A-2 Cooling System Diagnosis Chart

A. PROBLEMS NOT REQUIRING DISASSEMBLY OF COOLING SYSTEM –

1. LARGE OBSTRUCTIONS BLOCKING RADIATOR OR CONDENSER
   - a. AUXILIARY OIL COOLERS – RELOCATE
   - b. LICENSE PLATES – RELOCATE
   - c. SPARE TIRES – RELOCATE
   - 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 – SEE CHASSIS SERVICE MANUAL
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

Fig. 6A-3 Cooling System Diagnosis Chart

NOTE: *J 6742-01 reads to 180 degrees F, therefore, allow approximately 3/16" pointer movement for each 10 degrees over 180 degrees.*

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 approximattely 5-15 degrees F. If the clutch did not engage between 150-190 degrees F, 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 degrees F, the unit should be replaced.

CAUTION: *Do not continue test past a thermometer reading of 190 degrees F 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.

GENERAL DESCRIPTION

ENGINE COOLING SYSTEM

The cooling system consists of the radiator cap, radiator, 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. 6A-5).

Radiators used with automatic transmissions 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.

A drain cock is located at the inside lower left hand corner of the radiator.

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. at sea level.

CAUTION: *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 antifreeze such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire. When removing filler cap, rotate cap toward left very slowly. If hissing of vapor is encountered, tighten cap immediately and wait for system to cool sufficiently to allow removal of cap. After pressure in system has been relieved, turn cap counterclockwise to first detent, push down and continue rotating counterclockwise until cap can be removed. Turn cap all the way to right*

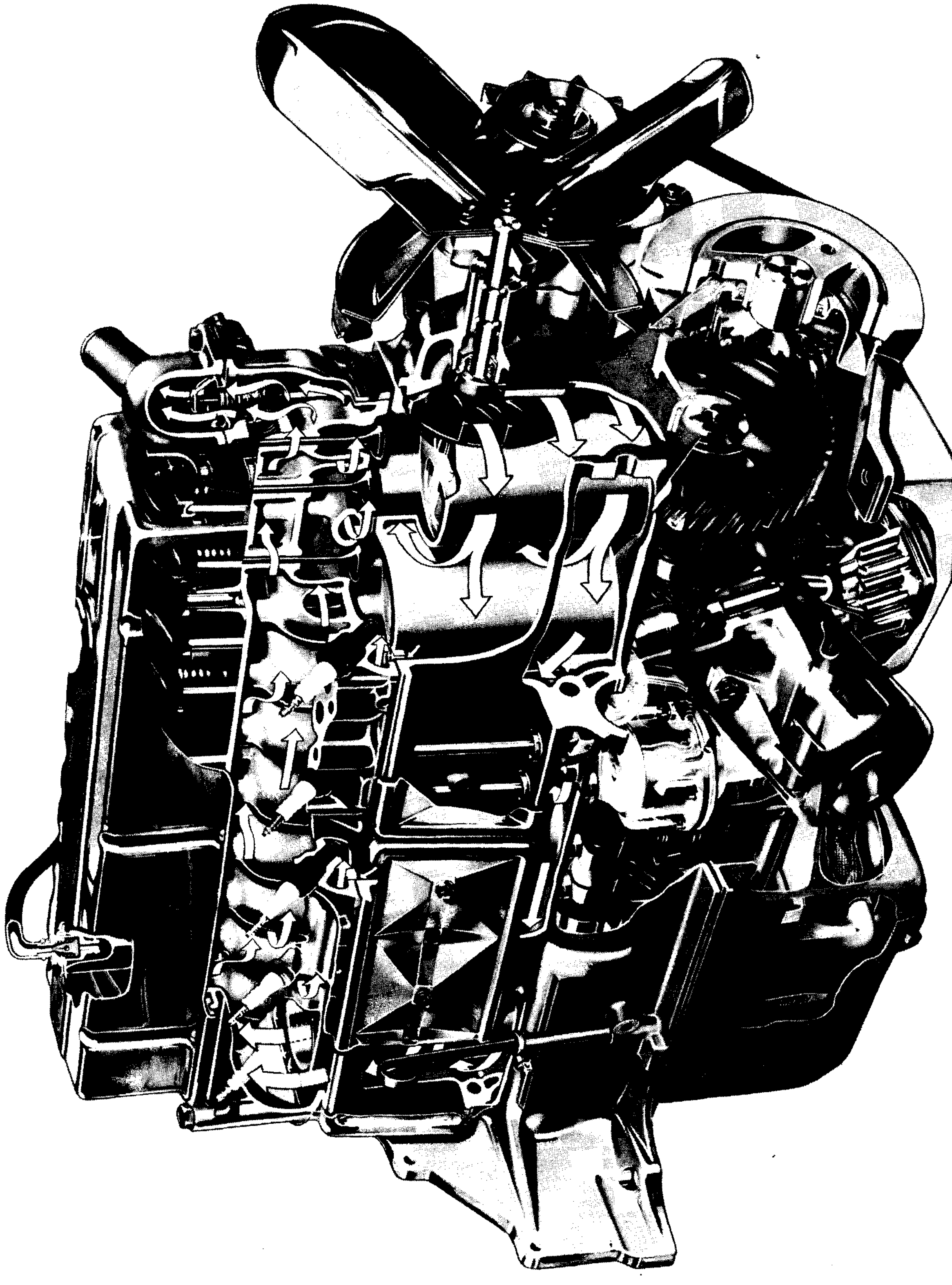


Fig. 6A-4 Engine Cooling System (6 Cyl.)

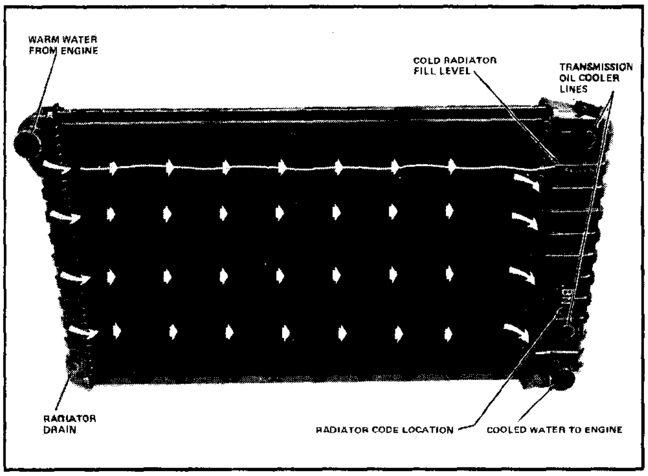


Fig. 6A-5 Cross-Flow Radiator

when installing. It should not be necessary to check coolant level unless temperature gauge or light shows over-heating, and then not until engine is stopped and allowed to cool to normal.

The pressure-type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve (Fig. 6A-6). 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.

WATER PUMP

8 CYLINDER (Except 307)

The centrifugal-type water pump, internal housing and aluminum timing chain cover are all part of the coolant circulation system (Fig. 6A-7).

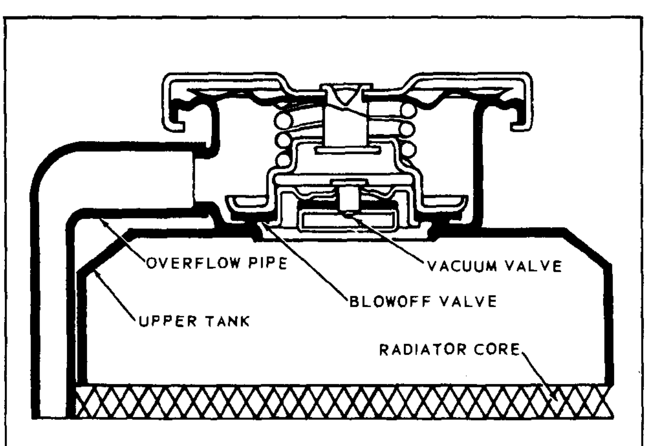


Fig. 6A-6 Pressure-Type Radiator Cap

The water pump impeller turns on a steel shaft mounted on a double row of permanently lubricated, sealed ball bearings (Fig. 6A-8). 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.

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.

307 V-8

The cooling systems water pump is of the centrifugal vane impeller-type (Figs. 6A-9). The bearings are permanently lubricated during manufacture and are sealed to prevent the loss of lubricant or the entry of dirt and water. The pump requires no care other than to make certain the air vent at the top of the housing and the drain holes in the bottom do not become plugged with dirt or grease.

Water pump components are not serviced separately; therefore, in the event of water pump failure, it will be necessary to replace the complete assembly.

6 CYLINDER

The centrifugal-type water pump contains an impeller which turns on a steel shaft which rotates in a ball bearing (Fig. 6A-10). A bellows-type seal is seated in the water pump body between the bearing and the impeller.

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. Located in the coolant outlet at the front of the cylinder head is the outlet to the heater core from beneath the thermostat.

FAN

The engine fan is used to increase the air flow through the radiator at all speeds (Fig. 6A-11).

> **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

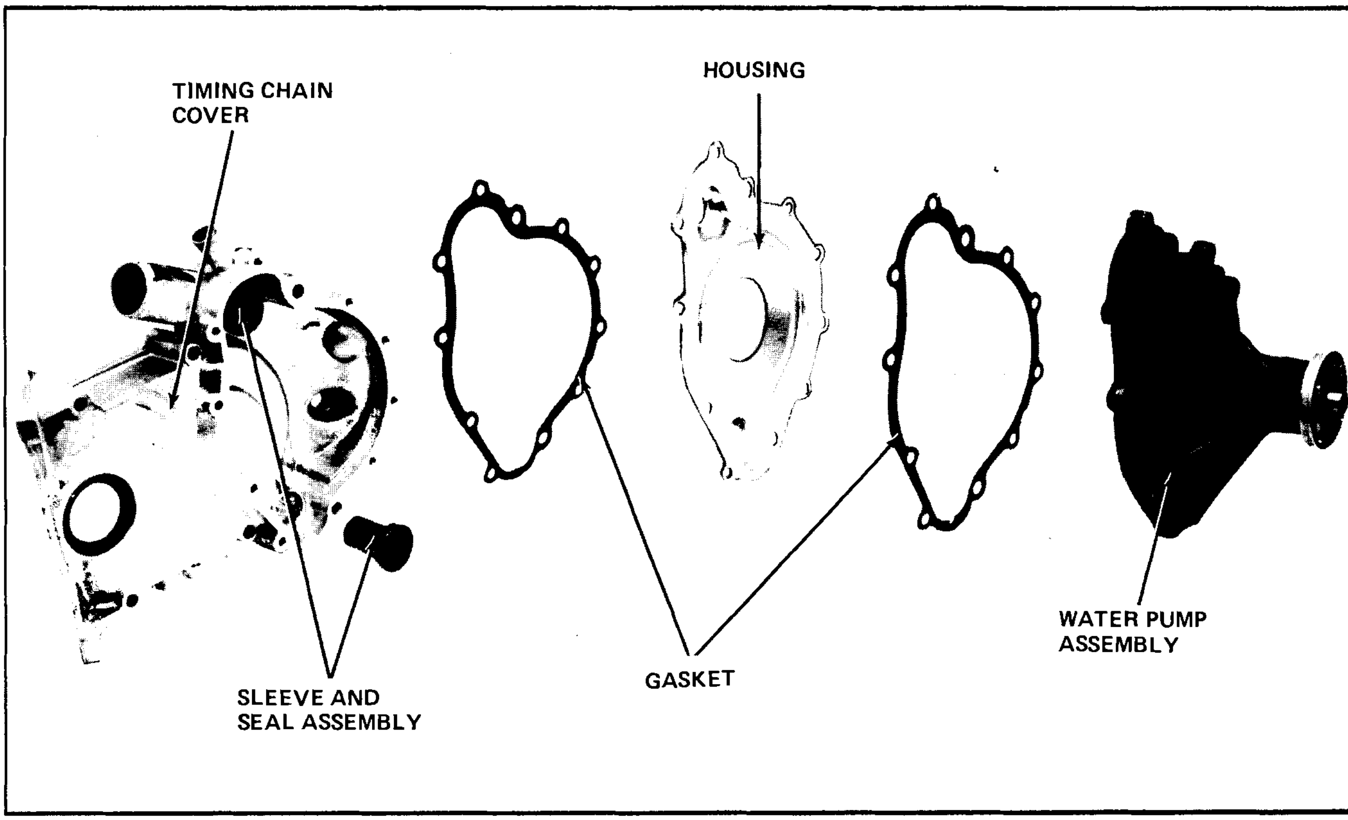


Fig. 6A-7 Water Pump Assembly & Timing Chain Cover (V-8 Except 307 V-8)

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.

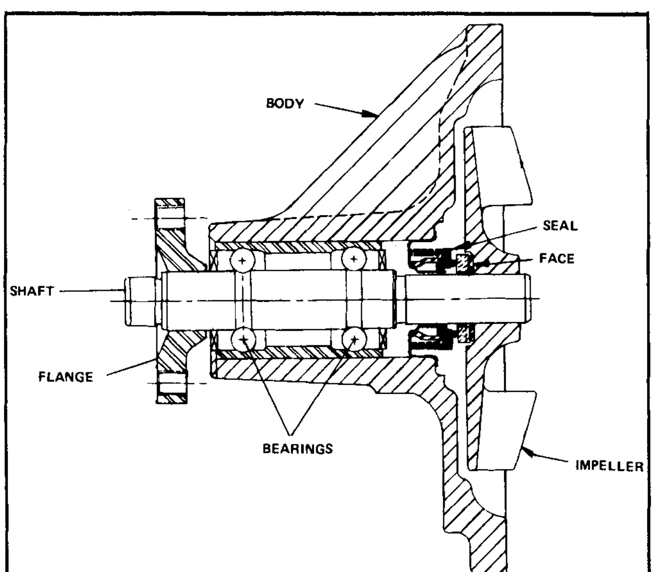


Fig. 6A-8 Cross Section of Water Pump (V-8 except 307)

A fan shroud is used to prevent recirculation of air around the fan on certain cars.

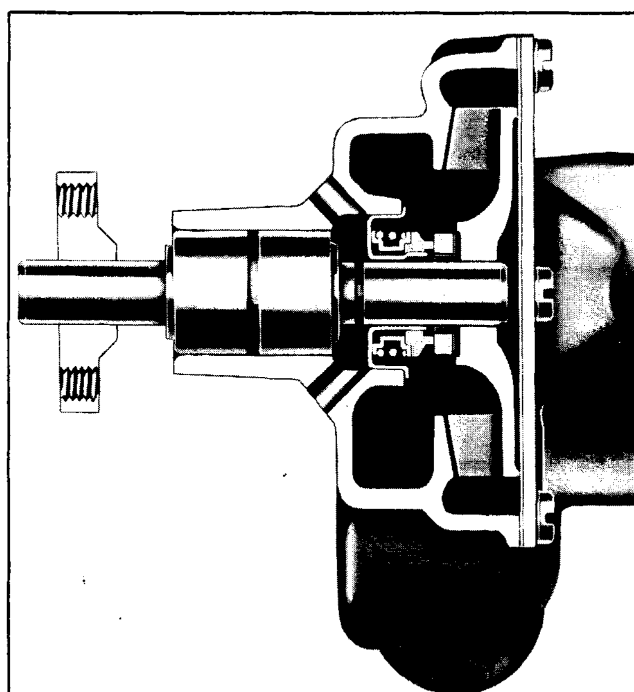


Fig. 6A-9 Cross Section of Water Pump (307 V-8)

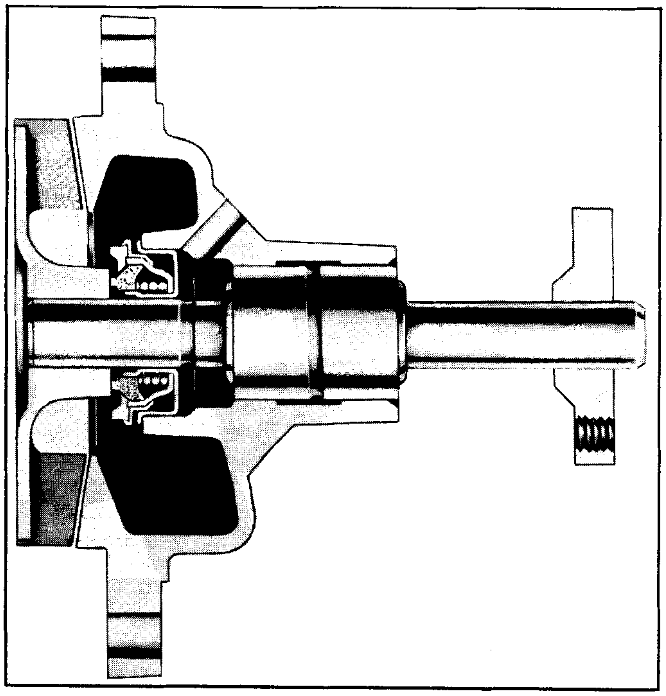


Fig. 6A-10 Cross Section of Water Pump (6 Cyl.)

POWER FLEX FAN

The five blade variable pitch fan is designed to reduce fan noise and increase cooling capacity as engine speed increases. 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 seven blade power flex fan is used on cars with police or trailer option (non-A/C).

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. 6A-12). 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

During periods of operation when radiator discharge air temperature is low (below approximately 150°F.), the clutch fan limits the fan speed to 800-1400 rpm. In this position, the clutch is disengaged since a small oil pump driven by the separator plate forces the silicone oil into the reservoir between the separator plate and the front cover assembly. In this position also, the passage from this cavity to the clutch area is closed by a slide valve.

As operating conditions produce a high radiator air temperature discharge (above approximately 150 °F.), the temperature sensitive bi-metal coil tightens to move the slide valve (attached to the coil) which opens a port in the separator plate, allowing flow of silicone oil into the clutch chamber to engage the clutch, providing a maximum fan speed of approximately 2200 rpm.

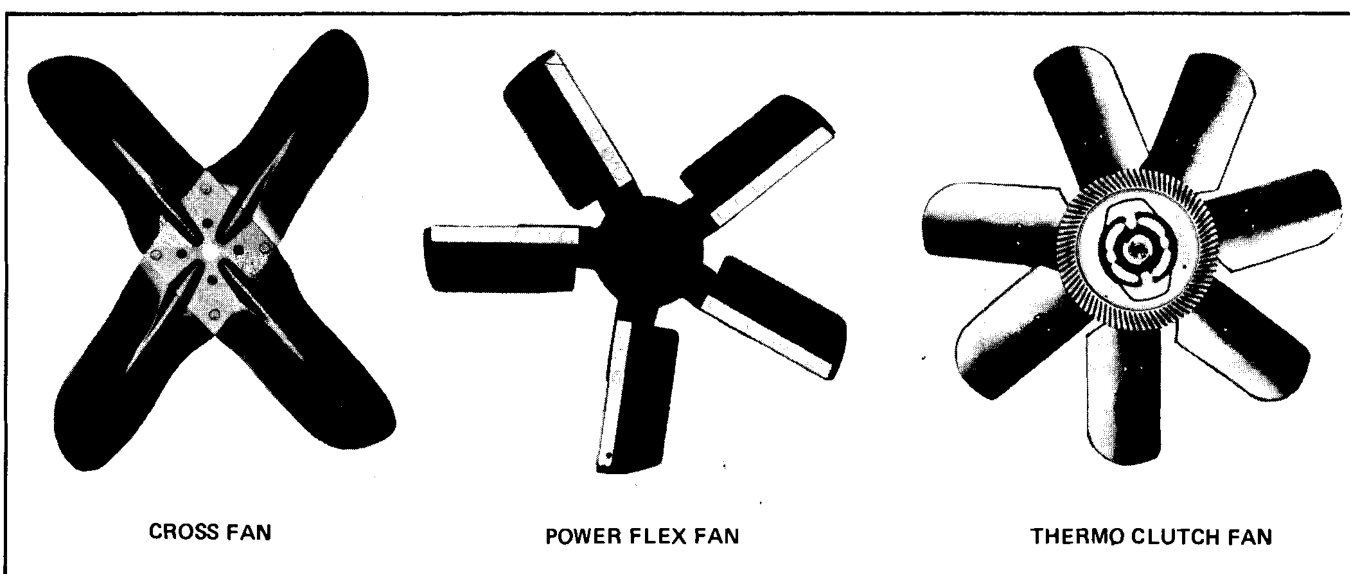


Fig. 6A-11 Engine Fans

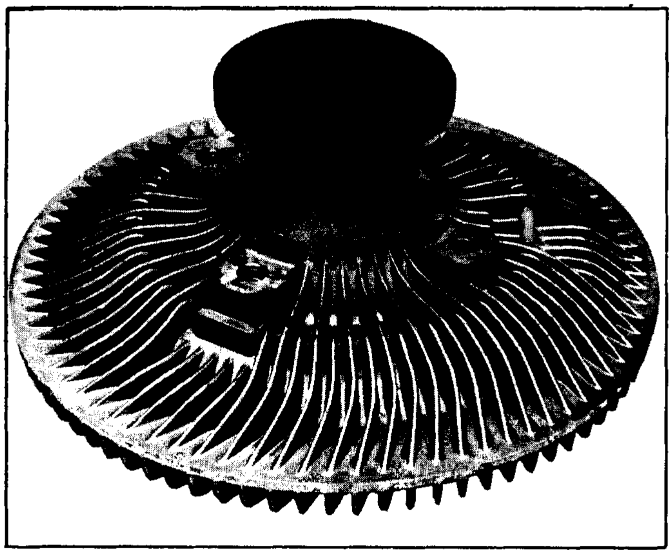


Fig. 6A-12 Fluid Clutch Fan Assembly

The clutch coil is calibrated so that with a road load at an ambient temperature of approximately 90°F., the clutch is just at a point of shift between high and low fan speed.

No attempt should be made to disturb the calibration of the engine clutch fan assembly as each assembly is individually calibrated at the time of manufacture.

Under certain temperature conditions there is an apparent lateral movement at the fan tip which should not be considered as a hub or bearing failure. This condition is a design feature of the clutch assembly which allows up to approximately 1/4" lateral movement measured at the fan tip.

> **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 free-wheel, which is a normal condition when operated in this manner. This should not be considered 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. 6A-13). 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.

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. 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.*

COOLING SYSTEM CIRCULATION

8 CYLINDER

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 cylinder block, up into cylinder heads, into front of intake manifold and back to inlet of pump via an internal recirculation passage connecting the intake manifold and timing chain cover which acts as pump body (except 307 engine).

On the 307 engine, coolant is routed past the thermostat, via a by-pass hose, directly into the water pump.

Water circulation after normal operating temperatures are reached (thermostat open) takes two courses. Part of the

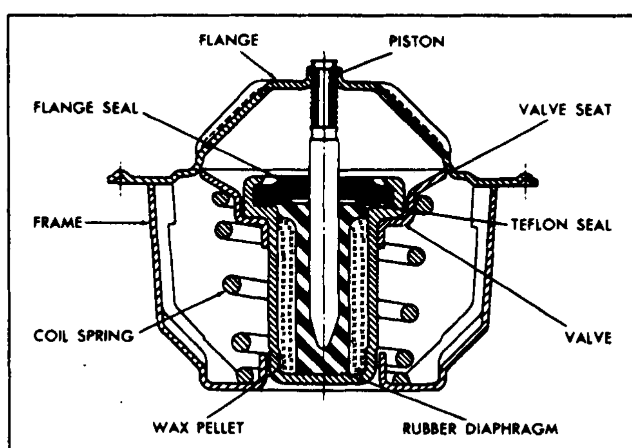


Fig. 6A-13 Pellet-Type Thermostat

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.

6 CYLINDER

The water pump discharges coolant into the water jacket chamber between the front face of the block and the number one cylinder (Fig. 6A-4). 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. Some coolant is directed through a small hole in the cylinder head gasket to an area around each spark plug.

During engine warm-up when the thermostat is closed, water is redirected to the engine.

SERVICE OPERATIONS

COOLING SYSTEM

CHECKING AND FILLING

The cooling system requires little care except for maintaining an adequate coolant level. If GM glycol-type inhibited engine coolant is used, it is not necessary to drain the coolant for summer driving because this coolant has been especially formulated to last 24 months in the cooling system. After service for 24 months, drain the system, flush it with water and refill with an inhibited year-round coolant, meeting the GM 1899M specification.

FLUSHING

1. Drain radiator and block by opening drain plug on radiator left tank and removing plug on left side of 6 cylinder engine block and on both sides of 8 cylinder engine block.

2. After system is empty, with drains open, run water into radiator. Engine should be running and occasionally accelerated to aid in circulating water and to dislodge rust and scale.

   CAUTION: *Do not introduce cold water into a hot engine or the block may be cracked. Allow engine to cool, then add water with engine running.*

3. Where there is difficulty in getting water to run clear or there is an excessive amount of rust and scale, the cooling system should be cleaned with a cleanser (reputable source) supplied for that purpose. If force-flushing equipment is used, it should be used on the radiator only (engine to radiator inlet and outlet hoses removed) as any reverse flushing of the block with the water pump in place may cause the water pump seal to leak if flushing pressure is excessive.

PREPARING COOLING SYSTEM FOR COOLANT

The cooling system should be properly prepared for the addition of coolant every two years.

To properly prepare cooling system:

1. Bring engine up to operating temperature.

2. Flush out cooling system, as indicated previously.

3. Tighten all hose connections on radiator, engine, heater and defroster. Replace any deteriorated hose. Check to see that radiator hold-down bolts are tightened properly.

4. Fill system with water and operate engine, checking for water leaks at radiator core, hose connections, water pump seal and gaskets, heater and defroster connections and head to block joint.

5. Drain sufficient water to allow addition of proper quantity of coolant.

Do not overfill. Coolant should be 1" below filler neck opening with hot engine, 3" below filler neck with cold engine for all models.

CAUTION: *A pressure radiator cap is used to provide the best cooling. When removing, rotate cap to left very slowly. If hissing noise is heard, stop and allow pressure to decrease before removing cap completely.*

NOTE: *To remove cap completely, turn counterclockwise to first detent, push down and continue rotation until removed.*

To assure most effective heater performance, all models are equipped with a 195°F. thermostat.

Non-glycol base coolant should **not** be used.

TESTING COOLANT

Two recommended methods of testing coolant are available, the hydrometer test and the refractometer test (J-23688):

HYDROMETER TEST

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). 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.

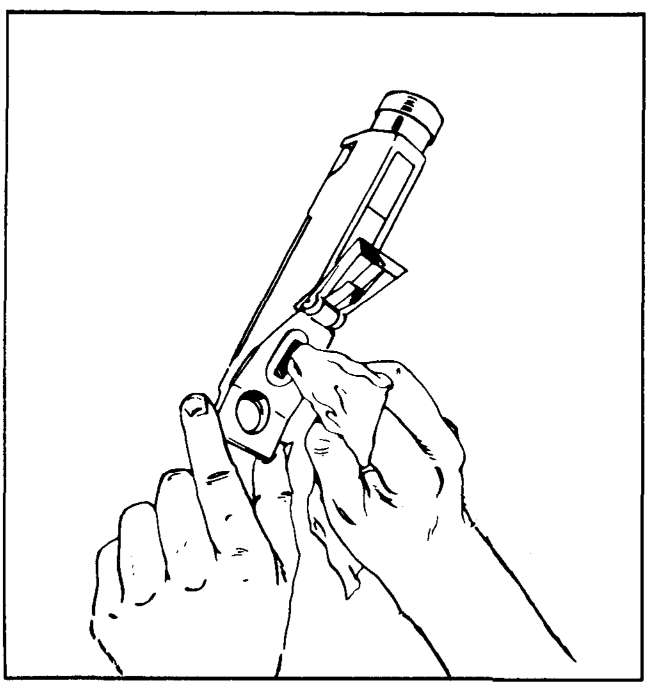


Fig. 6A-14 Cleaning Refractometer

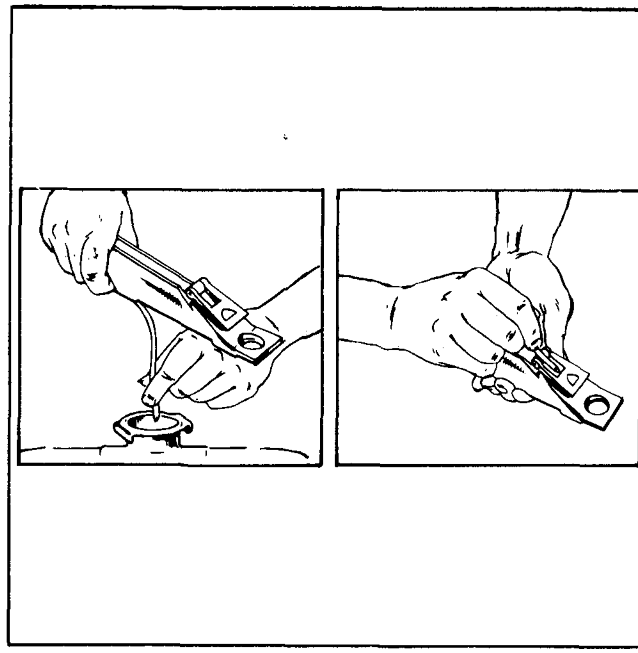


Fig. 6A-15 Procedure for Collecting Coolant Sample

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. 6A-14).

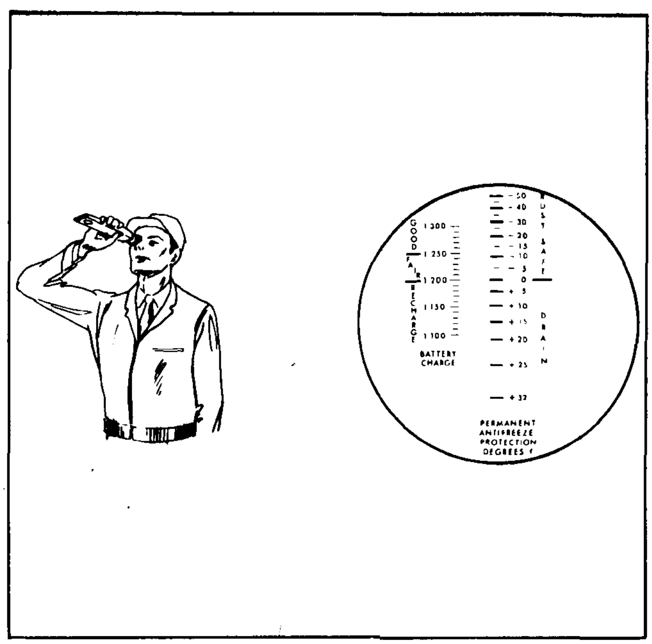


Fig. 6A-16 Reading Refractometer

TESTING

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. 6A-15). 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. 6A-15).

NOTE: *Never open plastic cover when taking readings. Evaporation of water from the fluid sample being tested can affect the reading.*

READING

Point the instrument toward any light source and look into eyepiece (Fig. 6A-16).

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. 6A-16). Readings on lower half of scale*

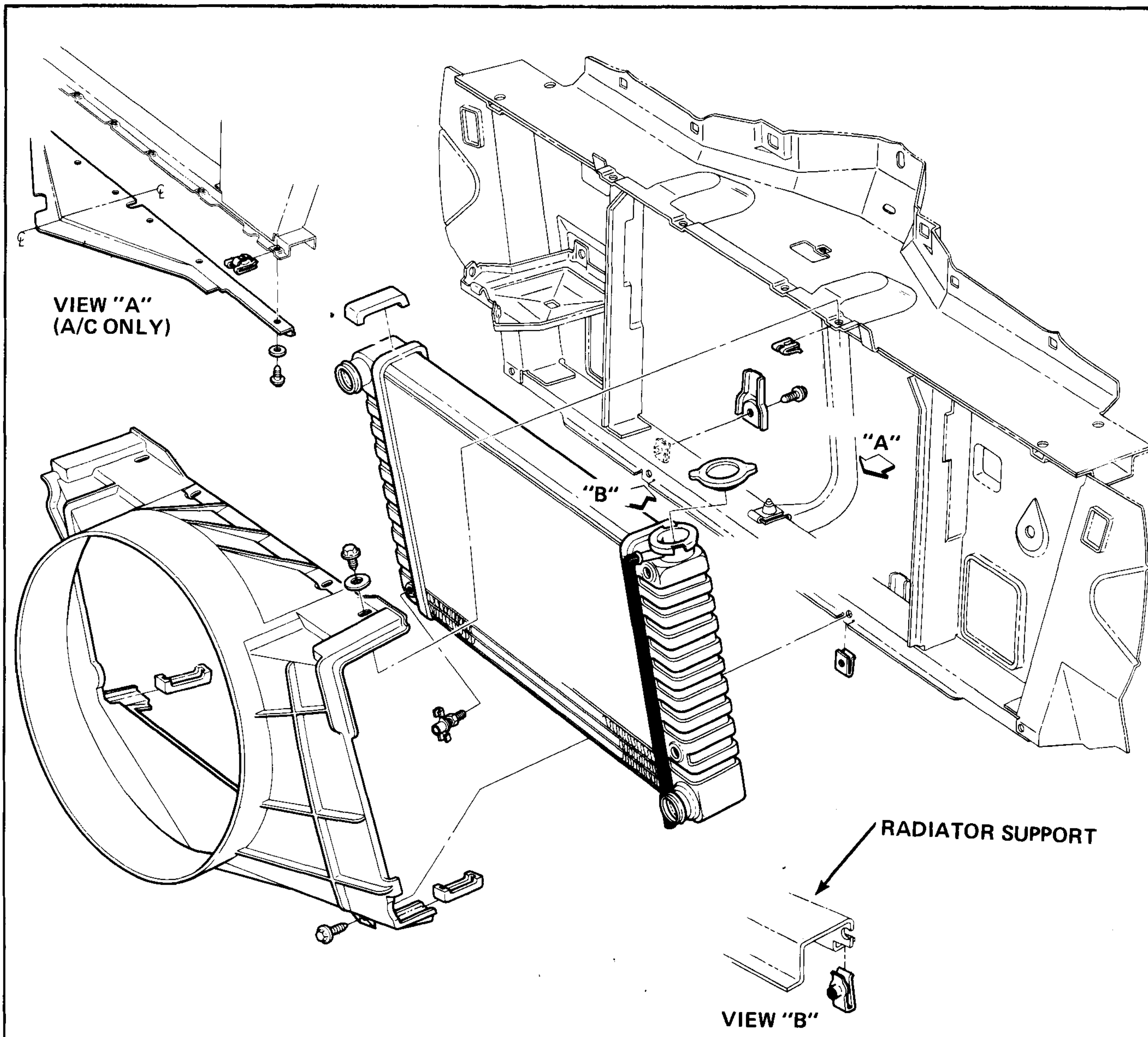


Fig. 6A-17 Radiator Mountings - B Series *(above zero readings) indicate solutions without enough anti-freeze concentration to provide adequate rust protection.*

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 REPLACE

1. Drain radiator level to below thermostat and remove water outlet assembly from cylinder head (6 cyl.) or intake manifold (8 cyl.).

   NOTE: *On some models it will be necessary to remove the rear generator brace.*

2. Remove thermostat. Unless obviously defective, test thermostat as follows before replacing with new one:

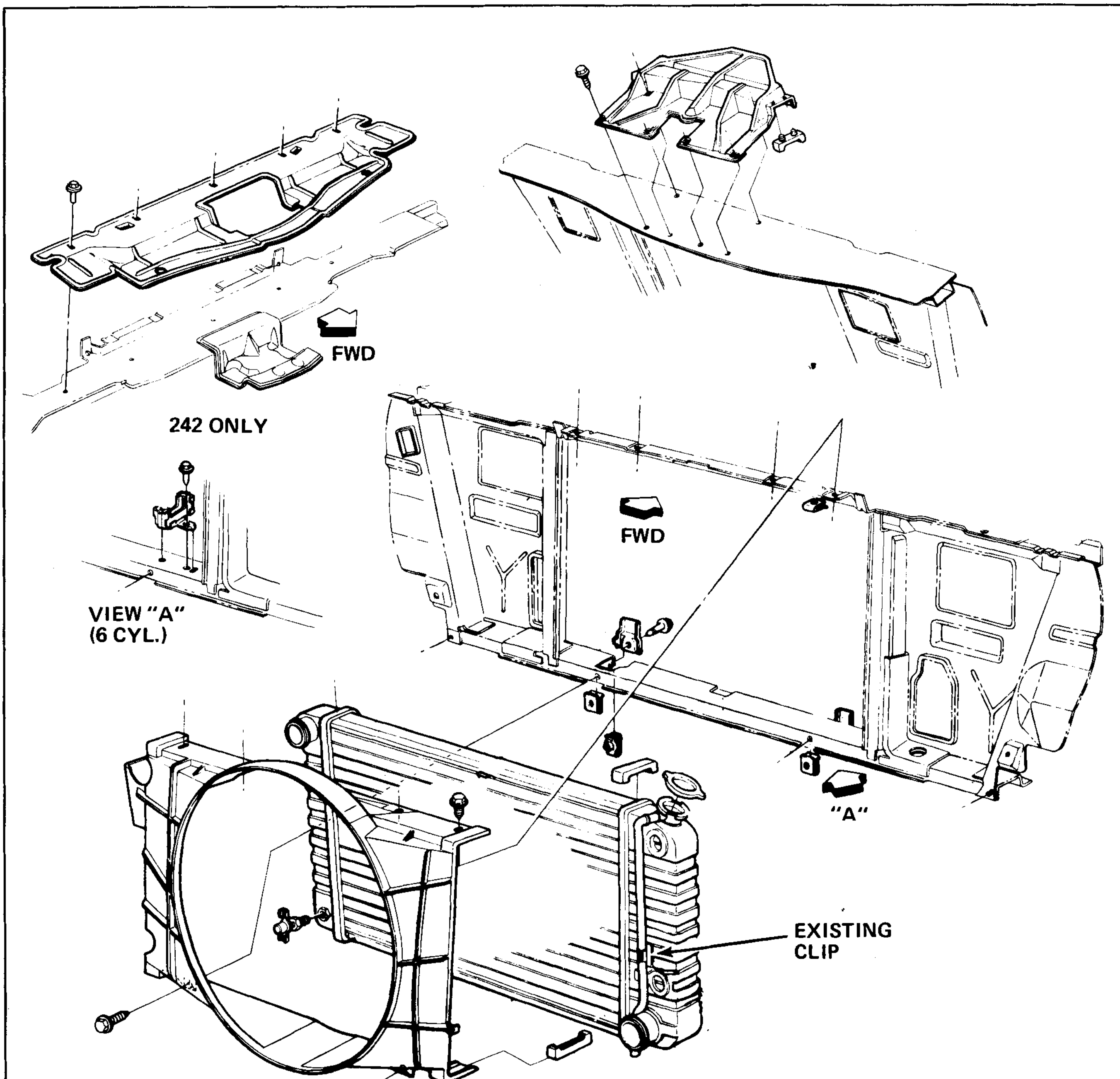


Fig. 6A-18 Radiator Mountings - G Series

a. Immerse unit and thermometer in container of 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°) valve should start to open (.002") at a temperature of 192°F. to 198°F. and should be fully open (3/8" or more) at a temperature not in excess of 222°F.

A used thermostat can be about 7°F. above or below this setting (188° - 202°) 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.

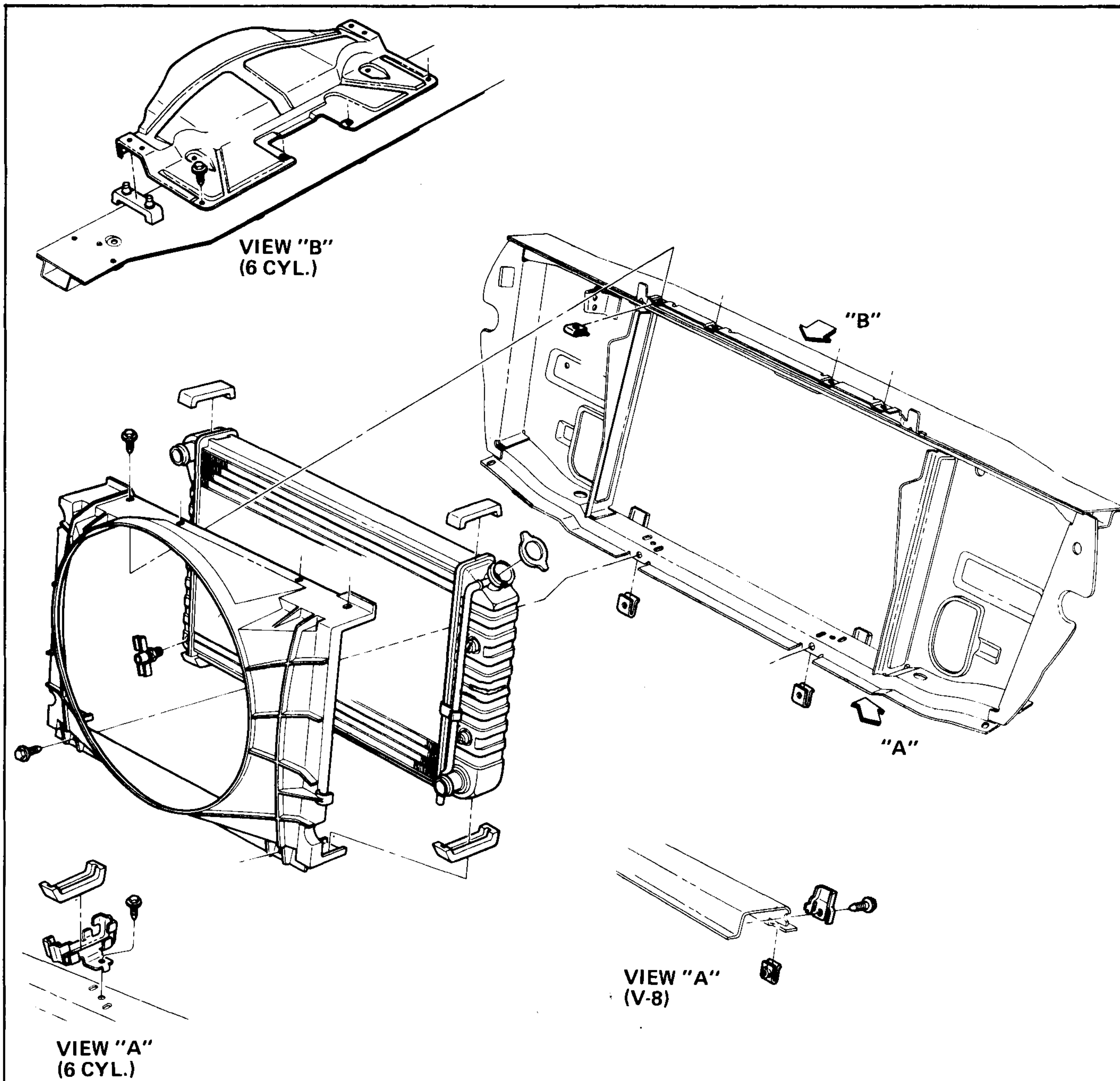


Fig. 6A-19 Radiator Mountings - A Series

6. Refill radiator to approximately 3" below filler neck for all models.

WATER PUMP

8 CYLINDER (Except 307)

REMOVE

1. Disconnect battery.
2. Drain radiator.
3. Loosen generator at adjusting strap and remove fan belt from fan pulley.
4. Remove fan and pulley.
5. Remove front generator bracket.
6. Remove heater hose and radiator hose at pump.
7. Remove water pump retaining bolts and remove pump.

NOTE: *Water pump is serviced only as an assembly.*

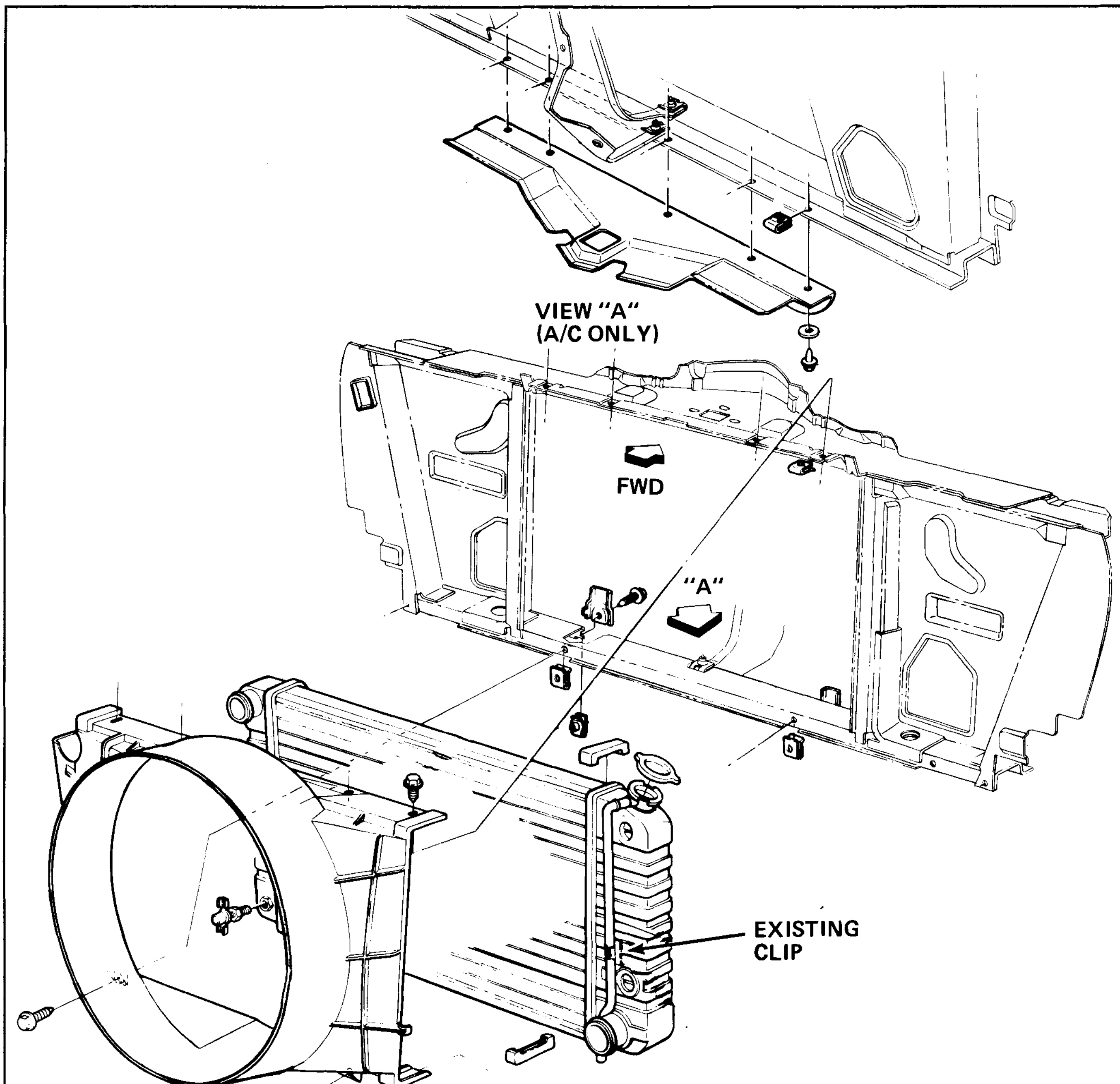


Fig. 6A-20 Radiator Mountings - F Series

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.

307 V-8

REMOVE

1. Drain radiator.

2. Remove top generator bracket.

3. Remove heater hose at water pump.

4. Remove fan belt.

5. Remove radiator hose at pump.

6. Remove power steering belt.

7. Remove water pump bolts, water pump and fan assembly.

REPLACE

1. Transfer fan blade, pulley and heater hose fitting.

2. Clean gasket surfaces and install new gaskets.

3. Install pump, torquing bolts to 30 lb. ft.

4. For remainder of installation procedure, reverse removal steps 1-6.

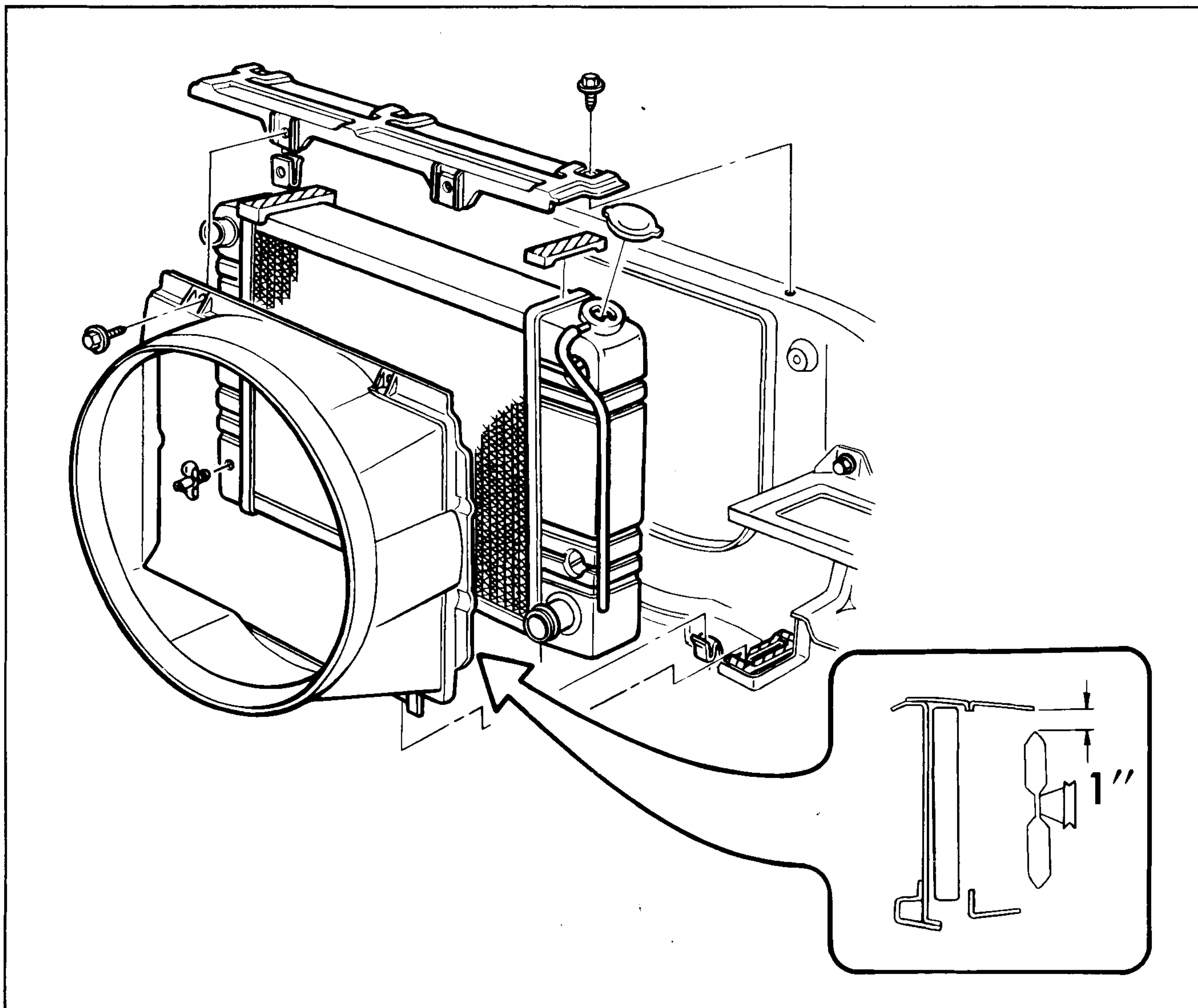


Fig. 6A-21 Radiator Mountings - X Series

6 CYLINDER

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.

REPLACE

1. Clean gasket surfaces and install new gaskets.
2. Install pump and attaching bolts. 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.

RADIATOR

REMOVE AND REPLACE (Figs. 6A-17, 6A-18, 6A-19, 6A-20 and 6A-21)

1. Drain radiator.
2. Remove fan (except B Series).
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 (L-6).
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.

ENGINE LUBRICATION SYSTEM

OIL PUMP

8 CYLINDER

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.

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 middle 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.

6 CYLINDER

Oil is circulated under pressure by a spur, gear- type pump. The pump is mounted on the right front of the cylinder block and is driven by the distributor drive gear. Maximum oil pressure is regulated by a spring-loaded pressure regulator valve. No adjustment of the pressure-regulator valve is provided.

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 screen. During normal operation, no oil can pass through this hole since the grommet around the hole is seated against the 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.

OIL CIRCULATION

8 CYLINDER

The positive pressure system delivers oil under pressure to the crankshaft, connecting rods, camshaft bearings and to valve train parts. Each cylinder wall is lubricated by a metered jet from the groove in the opposite connecting rod. Splash from the jet and off the crankshaft lubricates

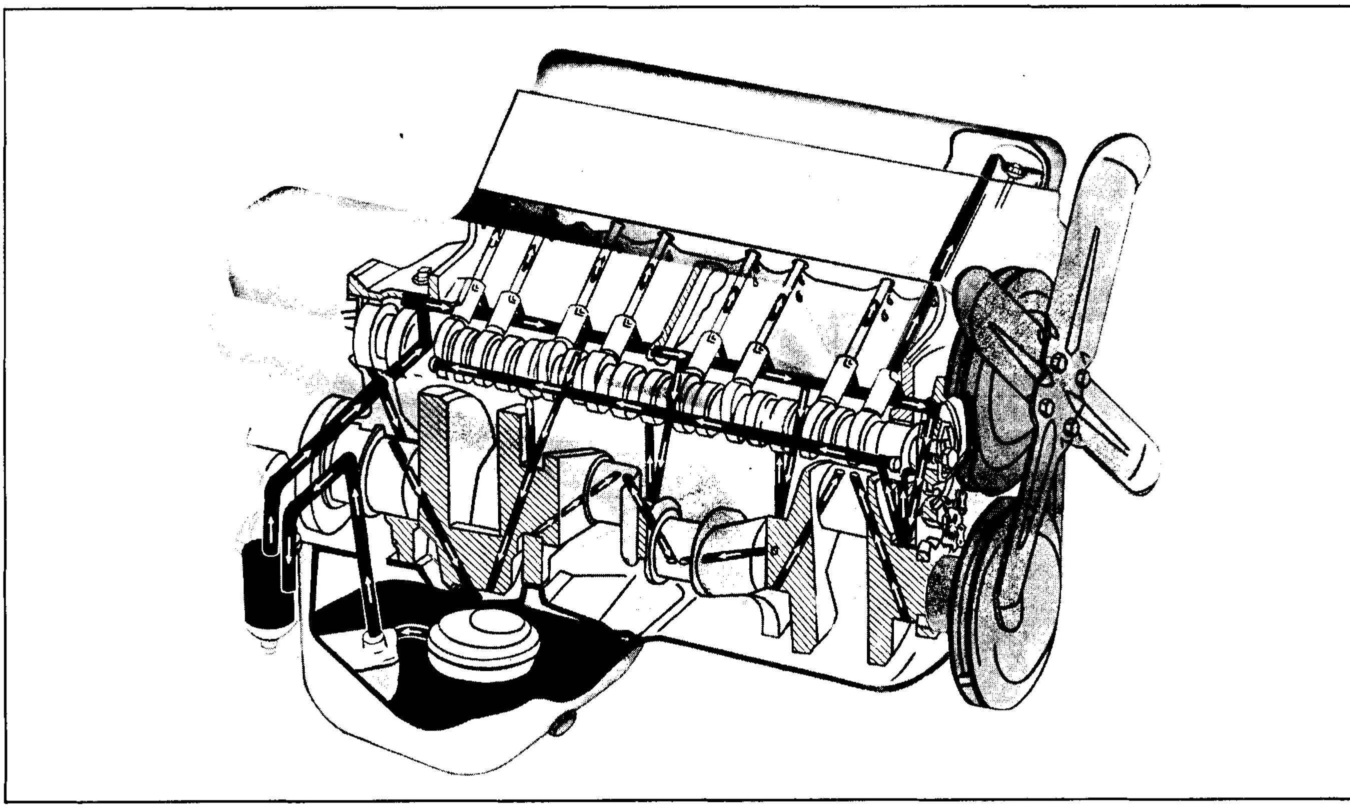


Fig. 6A-22 Engine Lubrication (V-8 except 307)

piston pins. Timing chain and sprockets receive metered jet lubrication, as do the fuel pump eccentric and rocker arms. A hole in the block from the valve lifter gallery through the distributor boss lubricates the distributor shaft and bushings.

Oil flow through the engine is as follows:

V-8 EXCEPT 307

Oil is first supplied by the pump and filter to two parallel oil galleries drilled in the block on each side of the camshaft. Oil travels from rear to front in the left gallery and from front to rear in the right gallery. The rear crankshaft and camshaft bearings receive oil from a hole drilled through the passage connecting the filter to the left gallery. All other crankshaft bearings receive oil from holes drilled into the left gallery. The remaining four camshaft bearings are supplied by a hole drilled vertically from each crankshaft bearing journal to the camshaft bearing journal above.

Hydraulic valve lifters are fed by holes drilled from each lifter boss to the oil galleries (Fig. 6A-22). Oil from each lifter is directed up through hollow push rods to the rocker arms. Oil then passes through a hole in the push rod contact area of the rocker arm and fills it. This supply lubricates the rocker arm ball. Overflow lubricates the top of the valve stem and other valve train surfaces.

Lubrication of the camshaft thrust plate, timing chain and sprockets, fuel pump eccentric and fuel pump rocker arm is provided for by a passage in the front of the camshaft. A lateral hole in the front bearing journal indexes with the camshaft bearing oil supply hole in the block once each revolution. An oil jet then squirts out of the horizontal hole in the end of the camshaft toward the front of the engine. Part of this oil is projected straight forward, against the camshaft thrust plate. Another part of the oil is projected downward through the grooves in the block and thrust plate to the crankshaft timing chain sprocket. Oil passing down the groove also is forced out the hole in the thrust plate. The jet of oil from this hole is timed to pass through one of the openings in the camshaft sprocket and strike the fuel pump eccentric and rocker arm.

The oil pan has been made as deep as possible to provide the maximum depth of oil. This minimizes splashing and foaming which would be detrimental to the operation of hydraulic lifters. It also insures a constant supply of oil during rapid acceleration and sharp turns. Additional protection against splashing and foaming is provided by the oil pan baffle. The baffle extends across the entire area of the oil pan, preventing oil which is thrown off the crankshaft from churning that in the sump.

307 V-8

Refer to Figure 6A-23 for oil circulation on 307 V-8.

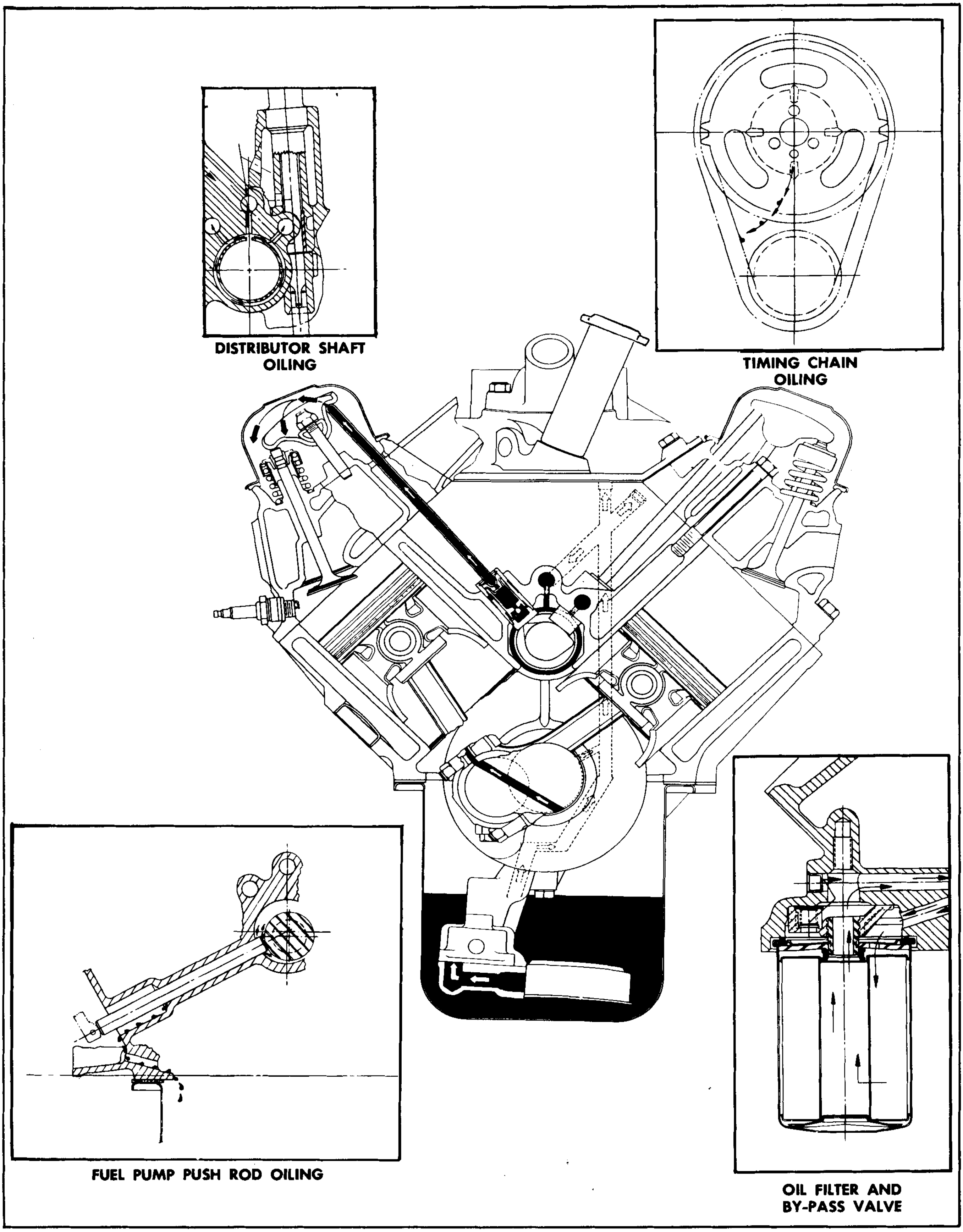


Fig. 6A-23 Engine Lubrication (307 V-8)

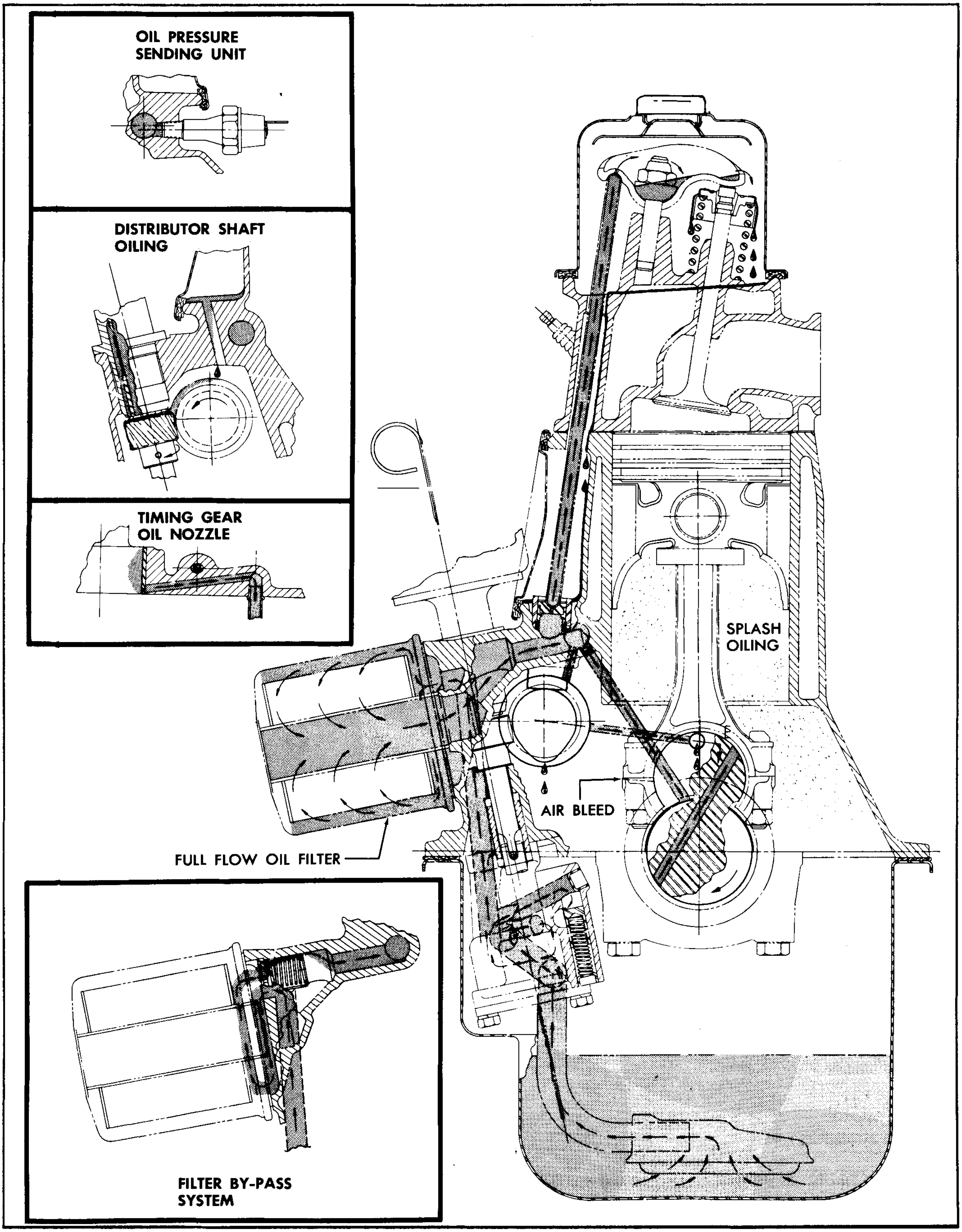


Fig. 6A-24 Engine Lubrication (6 Cyl.)

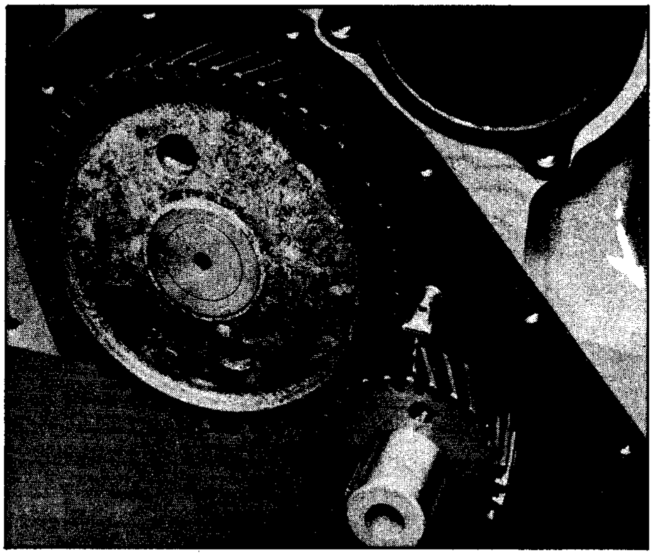


Fig. 6A-25 Timing Gear Lubrication (6 Cyl.)

6 CYLINDER

Oil is directed through the full flow oil filter and then to the main gallery (Fig. 6A-24). The main gallery intersects the lifter bores and serves as both the main and lifter gallery where oil holes direct oil through passages to the camshaft bearings and main bearings. Drilled passages in the crankshaft direct oil from the main bearings to the connecting rod bearings. Oil from each lifter is directed up through hollow push rods to the rocker arms. Oil then passes through a hole in the push rod contact area of the rocker arm and fills it. This supply lubricates the rocker arm ball. Overflow lubricates the top of the valve stem and other valve train surfaces.

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 (Fig. 6A-25).

Cylinder walls are lubricated with oil splash from the connecting rods and crankshaft as they rotate.

OIL FILTER

V-8 AND 6 CYL.

A full flow oil filter is standard equipment on the engine. The filter is mounted on a machined boss on the right front side (6 cyl.) and right rear side (V-8 except 307) of the engine block.

The filter on the 307 V-8 is located on the left rear of the block.

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 all dirt and foreign particles are removed.

A by-pass valve is located in the filter base casting to insure ample lubrication in case the filter element becomes restricted. Thus, if required, oil will flow directly through the spring-loaded, by-pass valve without any possibility of washing accumulated dirt off the filter element.

SERVICE OPERATIONS

ENGINE OIL

See GENERAL LUBRICATION SECTION.

OIL PUMP

See SECTION 6 (ENGINE MECHANICAL)

OIL FILTER

REMOVE AND REPLACE

Install a new oil filter at the first oil change and then every other oil change thereafter.

1. Turn filter counterclockwise to unscrew filter from base (Fig. 6A-26, 6A-27 and 6A-28).

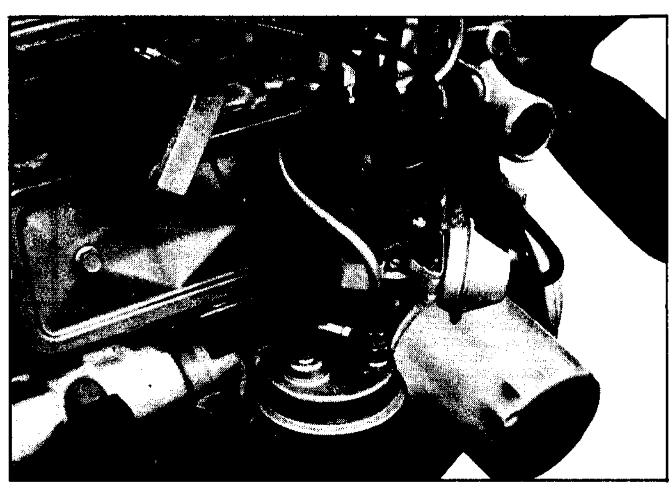


Fig. 6A-26 Oil Filter Location (6 Cyl.)

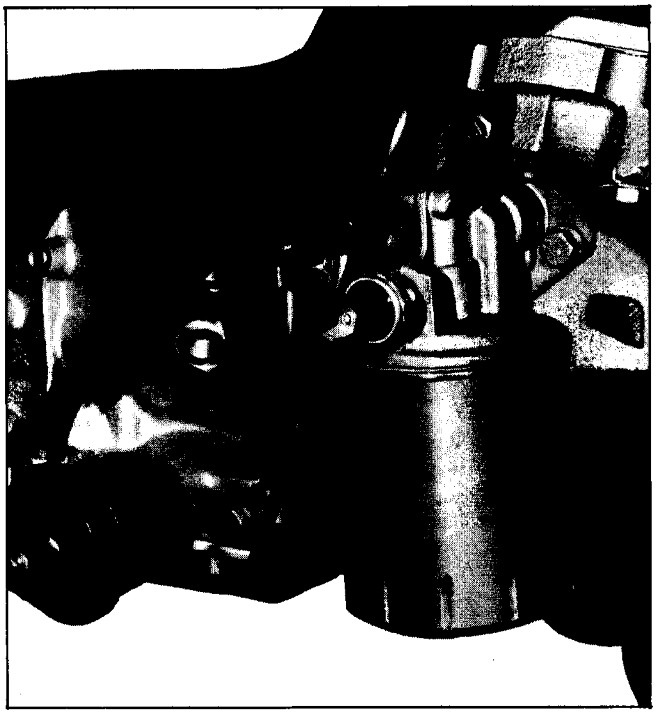


Fig. 6A-27 Oil Filter Location (V-8 except 307)

NOTE: *This operation can be done from above on the 6 cylinder engine.*

2. Wipe filter base with clean cloth.
3. Make sure filter base attaching screws are tight (V-8 except 307).

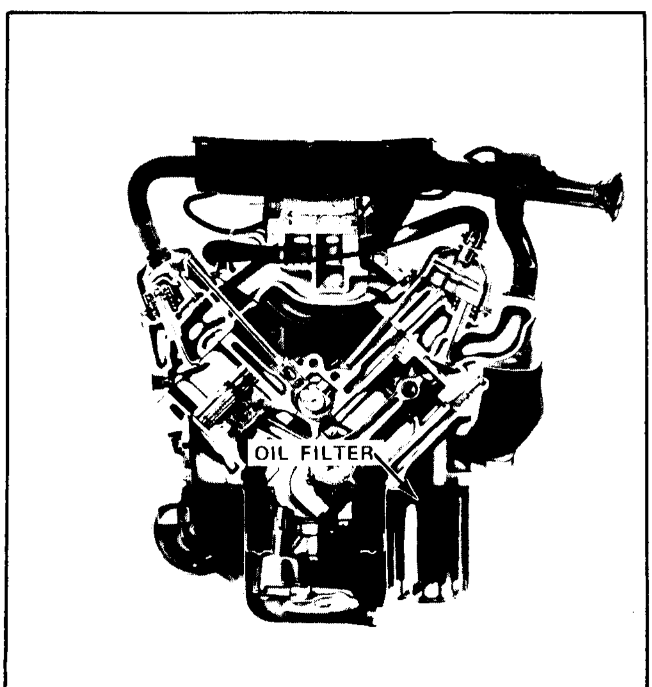


Fig. 6A-28 Oil Filter Location (307 V-8)

4. Apply light application of grease or oil on gasket.
5. Hand tighten filter on hollow oil filter connector until gasket contacts filter base, then complete tightening with additional 2/3 turn of filter. Do not over-tighten. Use care when tightening to prevent pinching of gasket. *Do not use wrench* to tighten filter.
6. Add oil to bring to FULL mark on dipstick.
7. Run engine and check for leaks at filter to base gaskets.
8. Re-check crankcase oil level. If necessary, add oil to bring level to FULL mark on dipstick.

OIL FILTER CONNECTOR (6 CYLINDER)

REMOVE AND REPLACE

1. Remove oil filter by unscrewing from connector.
2. Unscrew connector from engine block, using 1/2" Allen wrench.
3. Replace by reversing above procedure.

OIL FILTER BY-PASS VALVE ASSEMBLY (6 CYLINDER AND 307 V-8)

REMOVE AND REPLACE

1. Remove oil filter.
2. Pry valve from engine block with large screwdriver (Fig. 6A-29).
3. Align new valve in opening and tap into position, using suitable socket (9/16" thin-wall deep socket) as a driver.

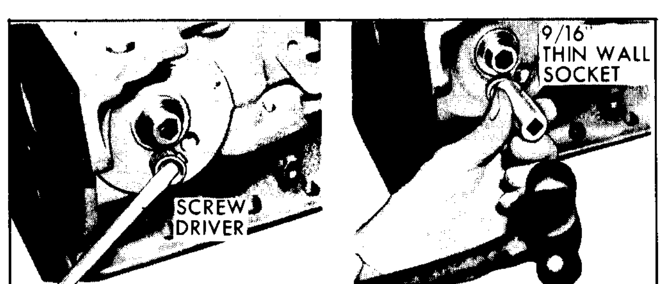


Fig. 6A-29 Removing Oil Filter By-Pass Valve (6 Cyl.)

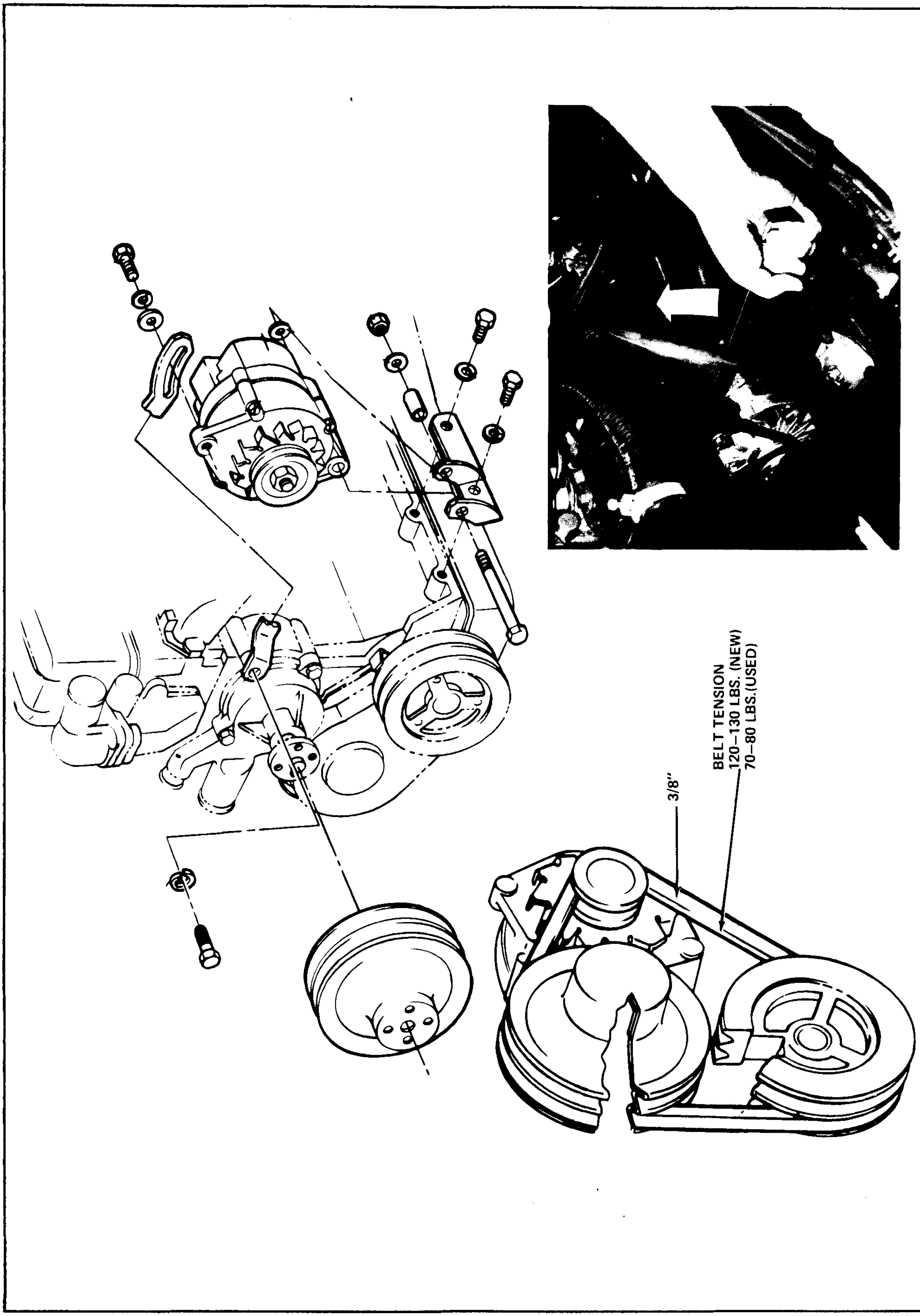


Fig. 6A-30 Accessory Drive (L-6)

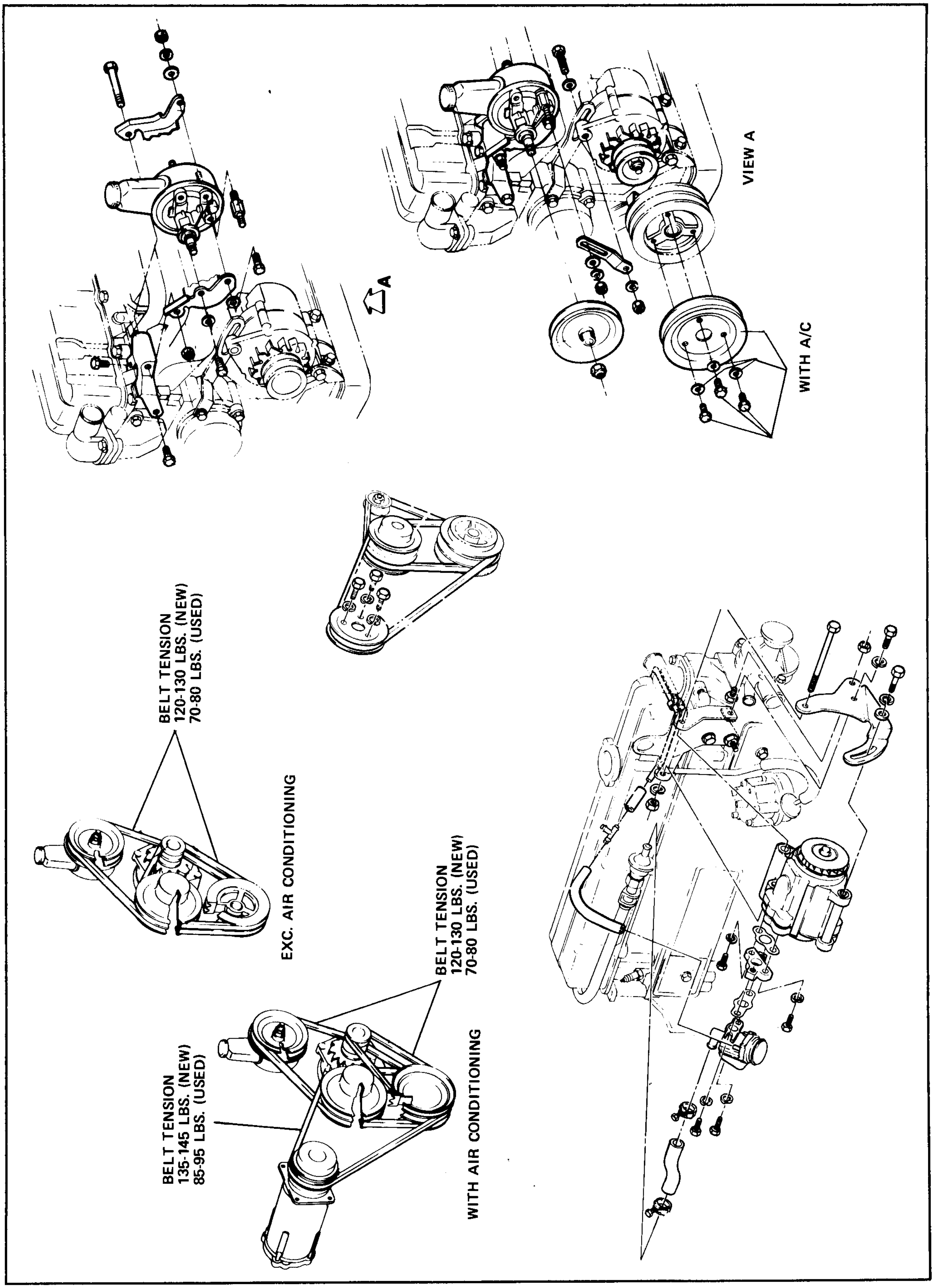


Fig. 6A-31 Accessory Drive (L-6)

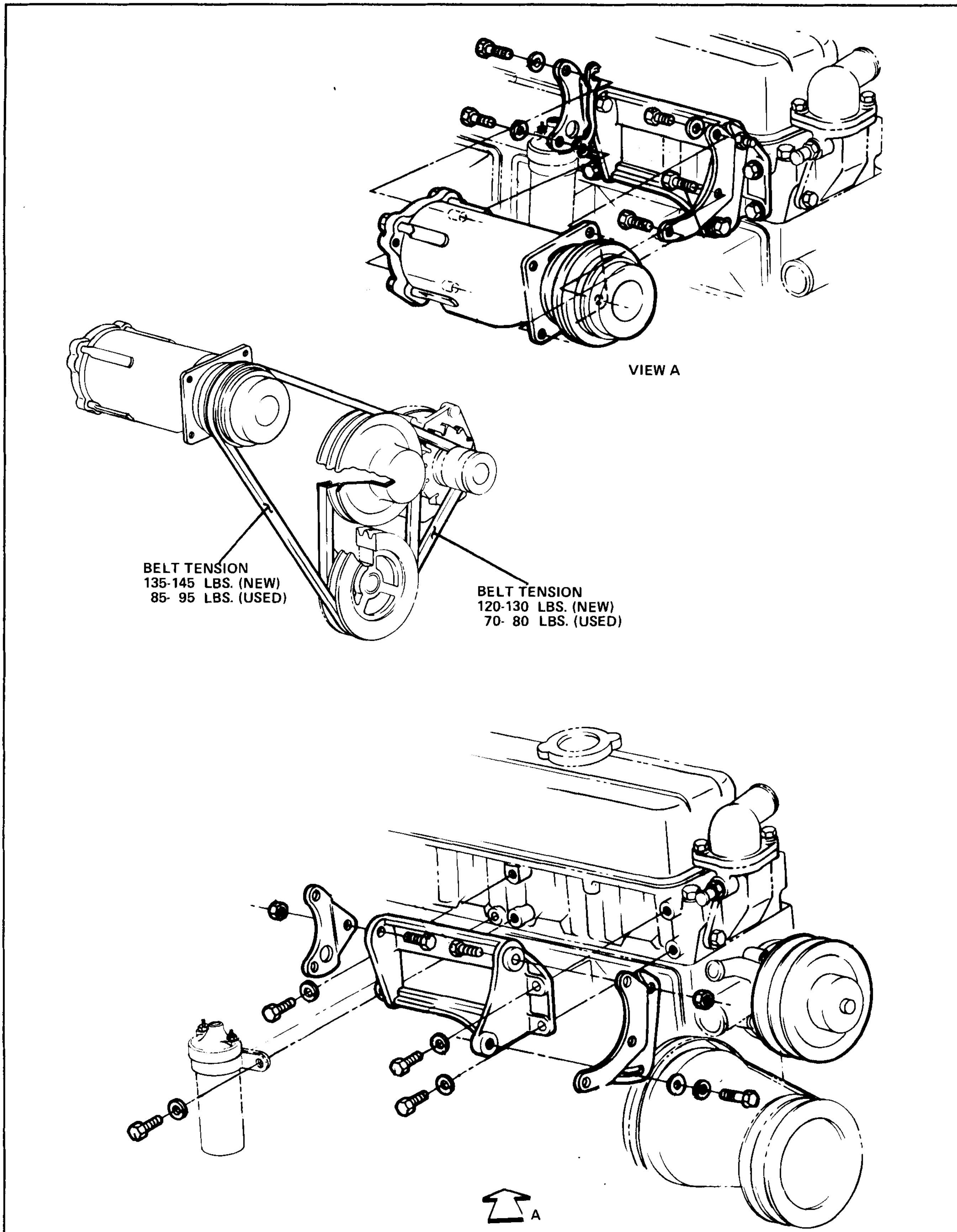


Fig. 6A-32 Accessory Drive - Air Conditioning (L-6)

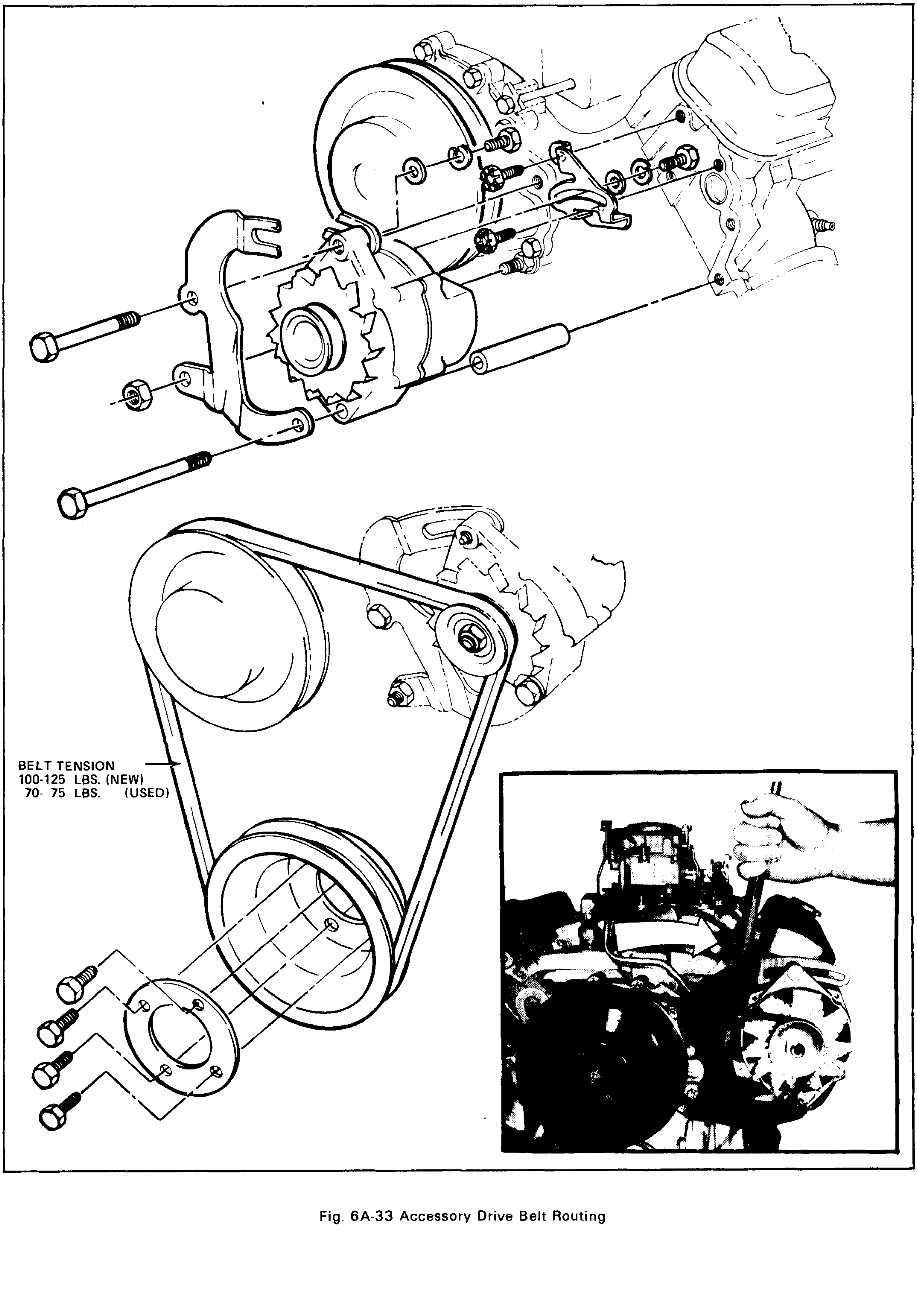


Fig. 6A-33 Accessory Drive Belt Routing

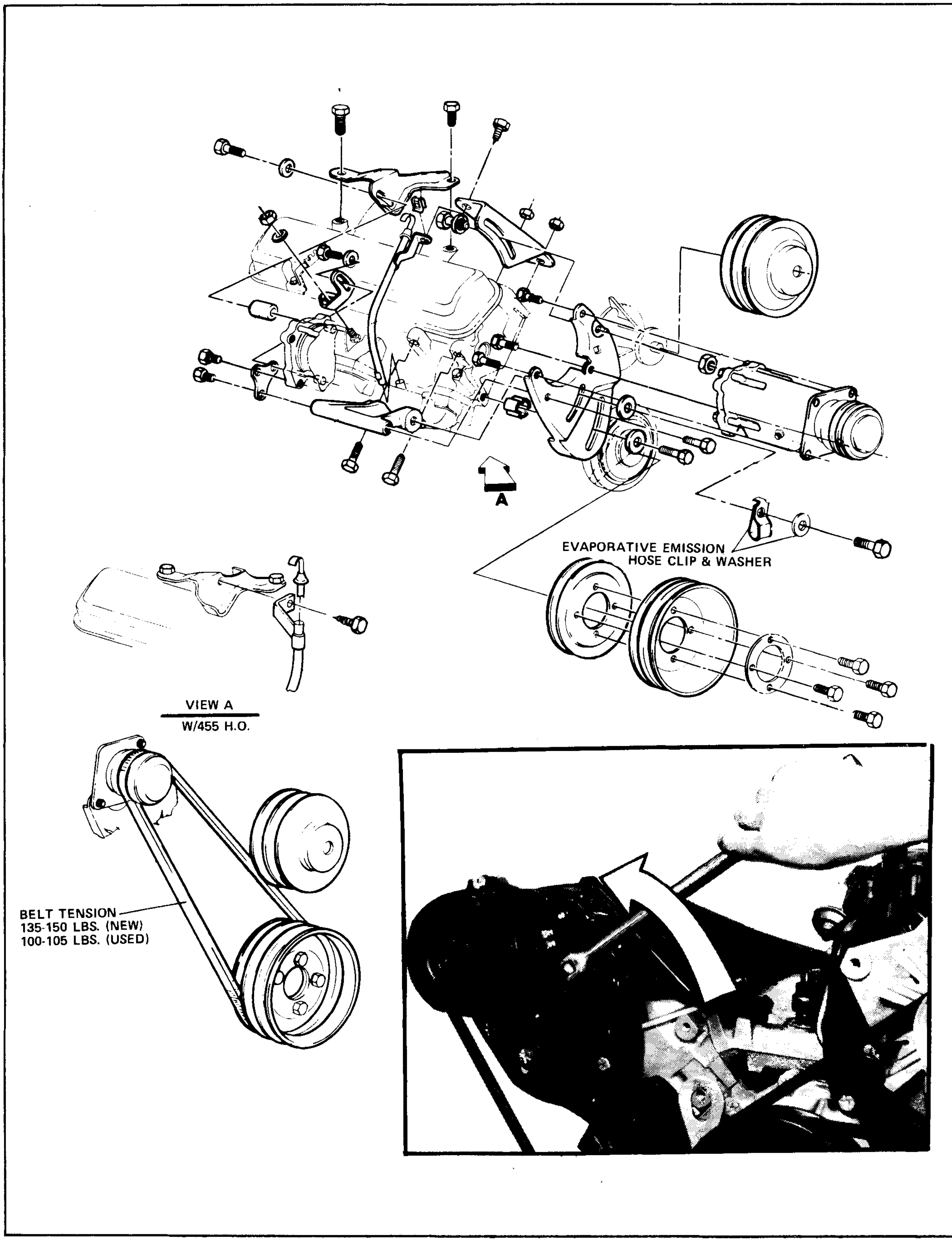


Fig. 6A-34 Accessory Drive Belt Routing

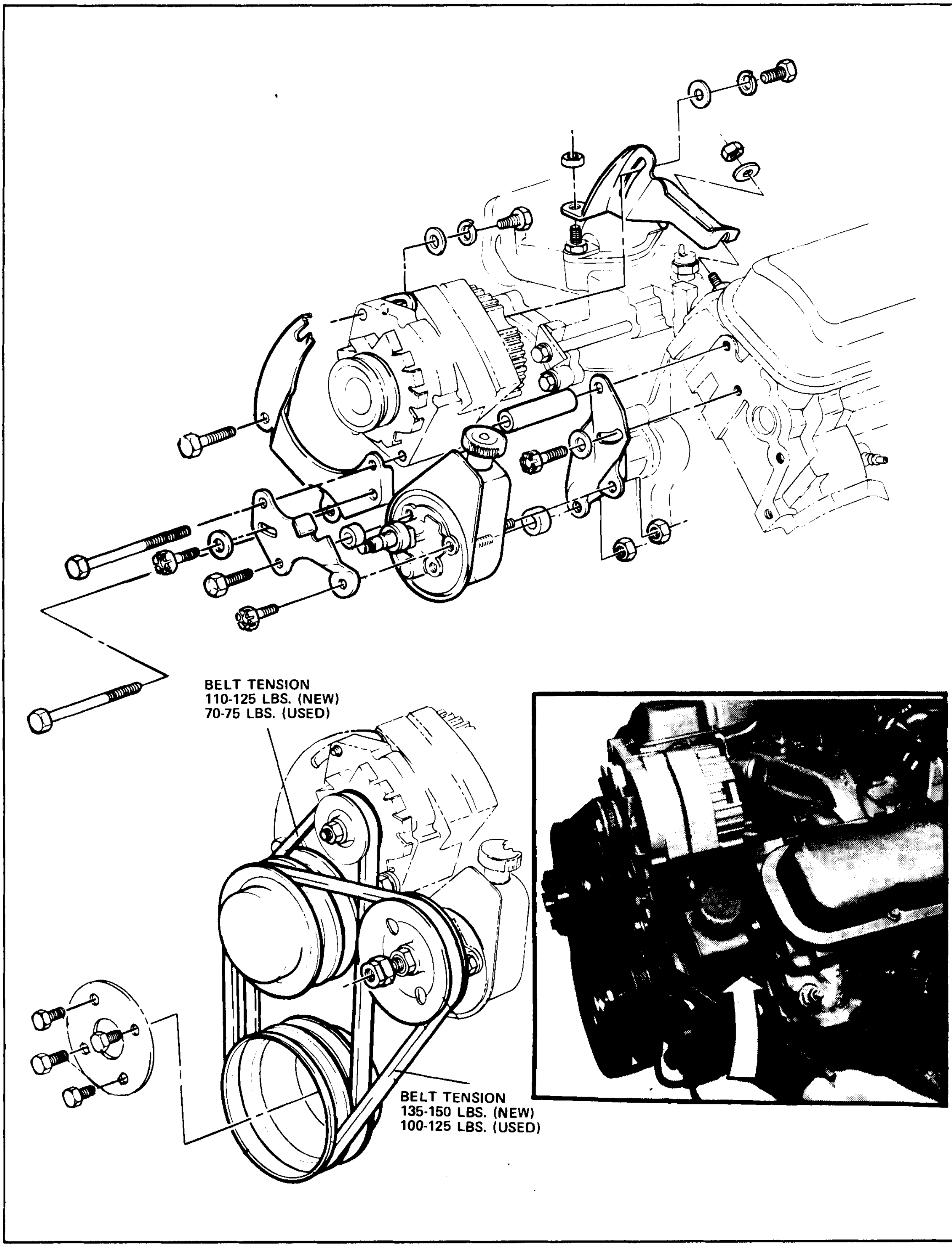


Fig. 6A-35 Accessory Drive - Power Steering Mounting (V-8)

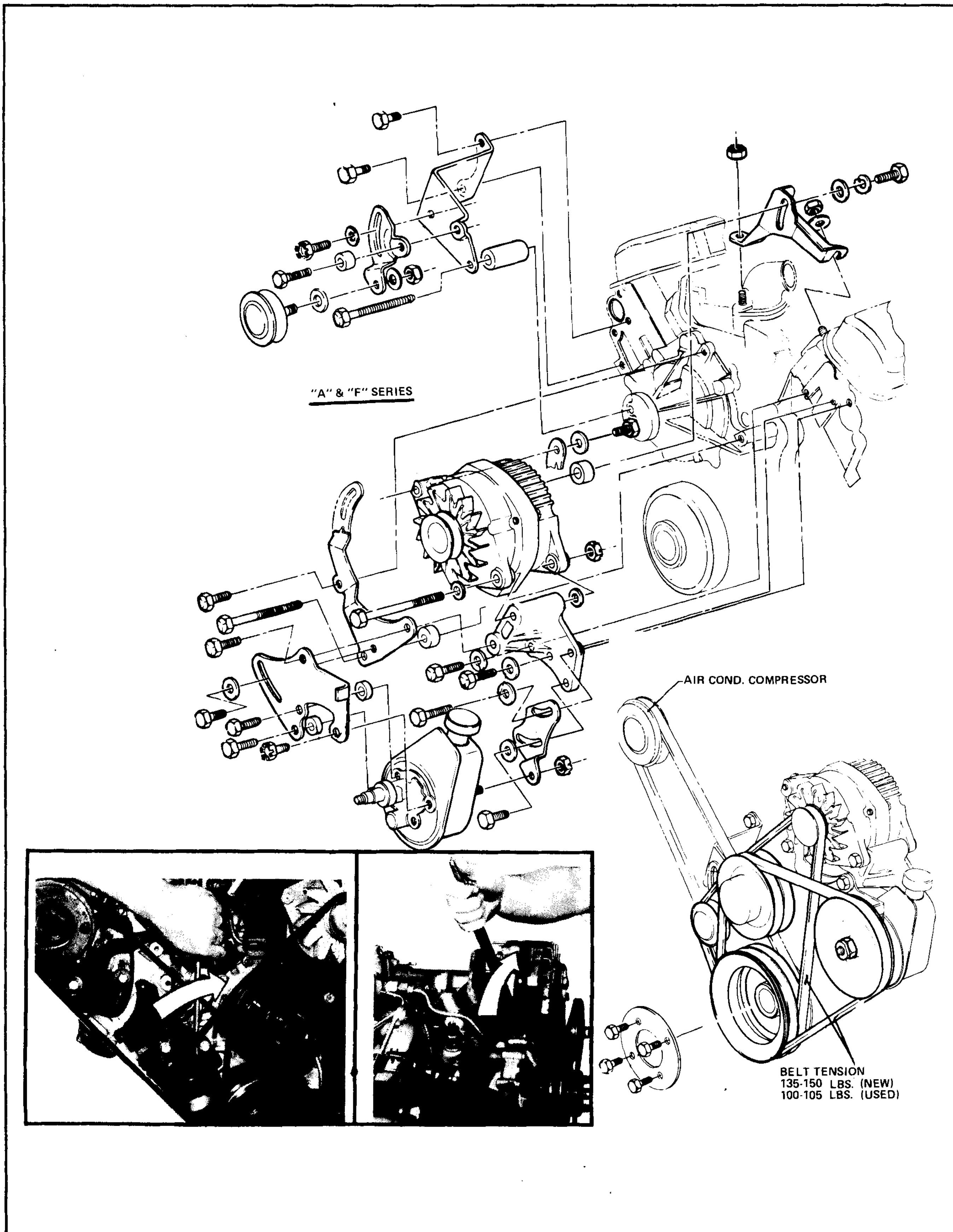


Fig. 6A-36 Accessory Drive - Generator Mounting

FAN USAGE

USAGE			SERIES					
ENGINES	OPTIONS		F	A		B	G	X
				exc. GTO	GTO			
6 CYL.	W/O A/C		1	1	–	–	–	1
	A/C		–	2	–	–	–	–
307 V-8	W/O	STD	–	–	–	–	–	9
	A/C	HEAVY DUTY	–	–	–	–	–	–
	A/C		–	–	–	–	–	10
350 400 2 Bbl. & 455 W/2 Bbl.	W/O	STD	3	3	4	3	4	4
	A/C	HEAVY DUTY	4	4	4	4	4	–
	A/C		7	6	6	6	6	6
455 Exc. H.O. & 400 4 Bbl.	W/O	STD	4	4	4	4	4	–
	A/C	HEAVY DUTY	–	–	–	–	–	–
	A/C		7	6	6	6	6	–
455 H.O.	W/O	STD	4	4	4	–	–	–
	A/C	HEAVY DUTY	–	–	–	–	–	–
	A/C		7	6	6	–	–	–

		DIA. X PITCH
1	4 Blade CROSS FAN	16-1/2" x 1-5/8"
2	7 Blade THERMO CLUTCH	18" x TAPER
3	4 Blade CROSS FAN	19" x 2-5/16"
4	5 Blade FLEX FAN	18-7/8" x 2-1/4"
5	7 Blade FLEX	19-1/4" x 2-1/4"
6	7 Blade THERMO CLUTCH	19-1/2" x 2-1/4"
7	7 Blade THERMO CLUTCH	18-7/8" x 2-1/4"
8	4 Blade CROSS FAN	18" x TAPER
9	7 Blade THERMO CLUTCH	18" x 2-1/4"

Fig. 6A-39 Fan Usage

		BASIC CAR		HEAVY DUTY (V01)		AIR COND. (C60/C61)		SUPER DUTY COOLING (V02)	
MODELS	ENGINE	M.T.	A.T.	M.T.	A.T.	M.T.	A.T.	M.T.	A.T.
252 Exc. Police	L30	N/A	N.T.	N/A	NM	N/A	NP	N/A	PP
	L65	N/A	NV	N/A	NM	N/A	NK	N/A	PP
	L78	N/A	NV	N/A	NM	N/A	NP	N/A	PP
	L66 EXC. S/W	N/A	NV	N/A	NP	N/A	NM	N/A	PP
	L66 S/W	N/A	NV	N/A	NP	N/A	NW	N/A	PO
	L75	N/A	NV	N/A	NP	N/A	NW	N/A	PO
252 Police	L65	N/A	NV	N/A	NO	N/A	PP	N/A	N/A
	L78	N/A	NV	N/A	NO	N/A	PP	N/A	N/A
	L75	N/A	NV	N/A	NO	N/A	PP	N/A	N/A
252 Police Highway	L75	N/A	NV	N/A	NO	N/A	PP	N/A	N/A
258	L65	N/A	NV	N/A	NM	N/A	NK	N/A	PP
	L66	N/A	NV	N/A	NP	N/A	NM	N/A	PP
	L75	N/A	NV	N/A	NP	N/A	NW	N/A	PO
	L78	N/A	NV	N/A	NM	N/A	NP	N/A	PP
262 Exc. Sta. Wgn. & H.D. Chassis	L66 EXC. S/W	N/A	NV	N/A	NP	N/A	NM	N/A	PP
	L66 S/W	N/A	NV	N/A	NP	N/A	NW	N/A	PO
	L75	N/A	NV	N/A	NP	N/A	NW	N/A	PO
262 Sta. Wgn. & H.D. Chassis	L66	N/A	NO	N/A	PP	N/A	PP	N/A	N/A
	L75	N/A	NO	N/A	PP	N/A	PP	N/A	N/A
	L78	N/A	NO	N/A	PP	N/A	PP	N.A.	N/A
268	L75	N/A	NV	N/A	NP	N/A	NW	N/A	PO
235, 244 Exc. G.T.O.	L20 (STD.)	DM	DJ	CQ	CQ	CQ	CQ	NOT AVAIL	
	L30 (EXC. S/W)	NU	NT	NM	NM	NY	NK**		
	L30 (S/W)	NU	NT	NM	NM	NY	NM**		
	L65	N/A	NT	N/A	NM	N/A	NM**		
	L78	NJ	NK	NY	NW	NY	NW**		
	L75	N/A	NK	N/A	NW	N/A	NZ		
	LS5	NM	NM	NY	NW	NY	NZ		
235 G.T.O.	L76 (STD.)	NJ	NK	NY	NW	NY	NW**		
	L78	NJ	NK	NY	NW	NY	NW**		
	L75	N/A	NK	N/A	NW	N/A	NZ		
	LS5	NM	NM	NY	NW	NY	NZ		
276	L78 (STD.)	N/A	NV	N/A	NW	N/A	NW**		
	L75	N/A	NK	N/A	NW	N/A	NW**		
223	L20	DM	DL	DP	DP	N/A	N/A	NOT AVAIL	
	L30	FF	FA	FH	FB	FH	FB		
	L65	N/A	FA	N/A	FB	N/A	FB		
	L78	FF	FJ	FH	FB	FH	FI		
	L75	N/A	FB	N/A	FI	N/A	FI		
	LS5	FF	FB	FH	FI	FH	FI		

** USE RADIATOR (NZ) WITH G83, G94, V82

Fig. 6A-40 Radiator Usage

TORQUE SPECIFICATIONS

(Torque in lb. ft. unless otherwise specified)

APPLICATION	TORQUE		
	V-8	6 cyl.	307
Bolt-Oil Baffle to Bearing Cap	15	15	-
Bolt-Pan to Cylinder Block (Except Rear V-8)	12	7	80**
Bolt-Pan to Cyl. Blk. (Rear V-8)	20	-	65**
Bolt-Pan to Cyl. Blk. & Clutch Hsg. Shield	15	10	-
Screw-Pan Drain	22	20	20
Bolt-Oil Pump Cover	15	6	80**
Retainer-Oil Pump Reg. Spring	13	13	-
Bolt-Oil Pump Assy. to Block	30	30	65**
Bolt-Oil Filter Pad Cover	30	30	-
Bolt-Push Rod Cover	3.5	3.5	-
Bolt-Fan to Water Pump	20	20	20
Stud-Timing Chain Cover	*	-	-
Bolt-Timing Chain Cover	30	30	80**
Nut-Timing Chain Cover	15	-	-
Bolt-Water Outlet Fitting	30	30	20

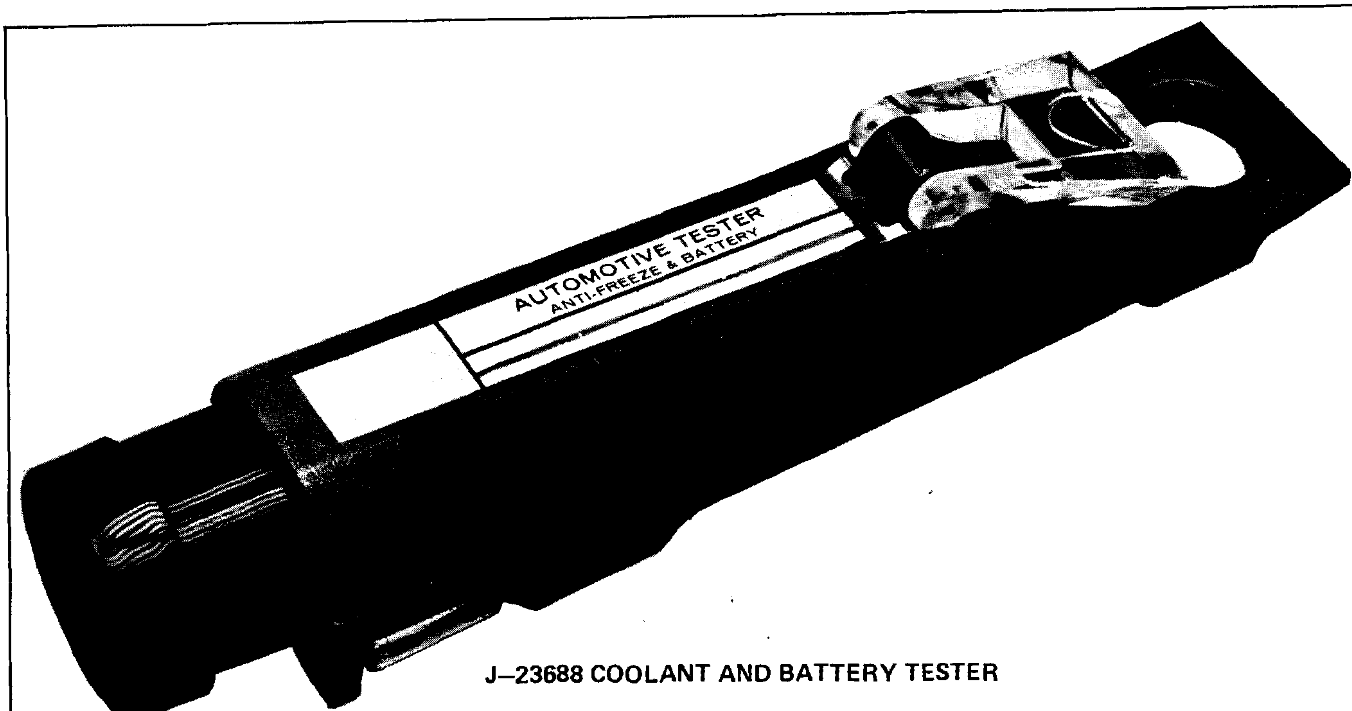
(*)Check for alignment, bottoming, height and/or leaks.

(**) lb. in.

COOLING SYSTEM

Type	Pressure with vent
Operating Pressure	14-17 PSI
Pump Type	Centrifugal
Pump and Fan Drive	V-Belt
Pump Bearings	Sealed Ball Bearings
Radiator	Tube and Center
Core Area-B, G&A Series (V-8)	480 Sq. in.
6 Cyl. Std	353 Sq. in.
6 Cyl. A/C (A Series only)	480 Sq. in.
V-8 (F Series only)	468 Sq. in.
Thermostat	Pellet type opening @ 195°F
Cooling System Cap.-250 (All)	12.4 qts.
307 (X Series - Non A/C)	15.5 qts.
307 (X Series - A/C)	16.5 qts.
350 (F Series - Non A/C)	19.5 qts.
350 (F Series - A/C)	20.5 qts.
350 (A&B Series - Non A/C)	20.2 qts.
350 (A&B Series - A/C)	21.4 qts.
400 (All Series - Non A/C)	18.6 qts.
400 (F&G Series - A/C)	19.2 qts.
400 (A&B Series - A/C)	19.8 qts.
455 (All series - Non A/C)	18.0 qts.
455 (All Series - A/C)	19.0 qts. *

(*) Std. Bonne. & Grand Ville have 18.4 qt. capacity.



J–23688 COOLANT AND BATTERY TESTER

Fig. 6A-41 Special Tools

LUBRICATION SYSTEM

Type .... Pressure
Oil Pressure-
V-8 exc. 4 Bbl. engines .... 30-40 PSI @ 2600 rpm
V-8 4 Bbl. engines .... 55-60 PSI @ 2600 rpm
307 V-8 engines .... 40-45 PSI@2000 rpm
6-Cyl .... 50 to 65 PSI @ 2000 rpm

Engine Lubricant Capacity
When Refilling-8 Cyl (exc. 307) .... 5 qts.
(6 qts. if filter element is changed)
When Refilling-307 V-8 .... 4 qts.
(5 qts. if filter element is changed)
When Refilling-6 Cyl .... 4 qts.
(5 qts. if filter element is changed)
Oil Pump Type .... Spur Gear

SECTION 6B

ENGINE FUEL

CONTENTS OF THIS SECTION

GENERAL TROUBLE DIAGNOSIS AND TESTING

All Pontiac engines have been designed to operate efficiently and with lower exhaust emissions on low lead or no lead gasolines. If low lead or no lead gasoline is not available, any leaded regular grade gasoline with a Research Octane Number of 91 or higher may be used.

When carburetor troubles are encountered they can usually be corrected by making the adjustments outlined under ADJUSTMENTS ON CAR.

NOTE: *Before any work is performed on the carburetor, make sure trouble is not due to poor compression, or fault of ignition system due to improper timing, defective spark plugs, burned ignition points, etc.*

POOR FUEL ECONOMY

NOTE: *Before any attempt is made to improve fuel economy, the actual gasoline mileage should be determined, using a tenth of a gallon tester. If mileage obtained during this test compares favorably with that found on other normal cars, the poor mileage must be attributed to driving conditions or driving habits of the owner. Also consider factors such as dragging brakes, soft tires, improper tire size and improper speedometer driven gear.*

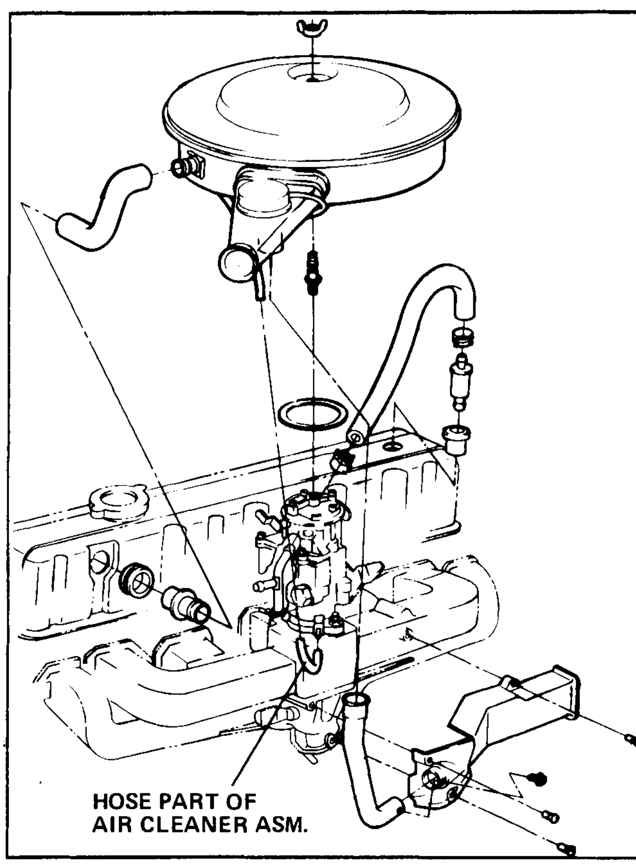


Fig. 6B-1 Air Cleaner Installation (6 Cyl.)

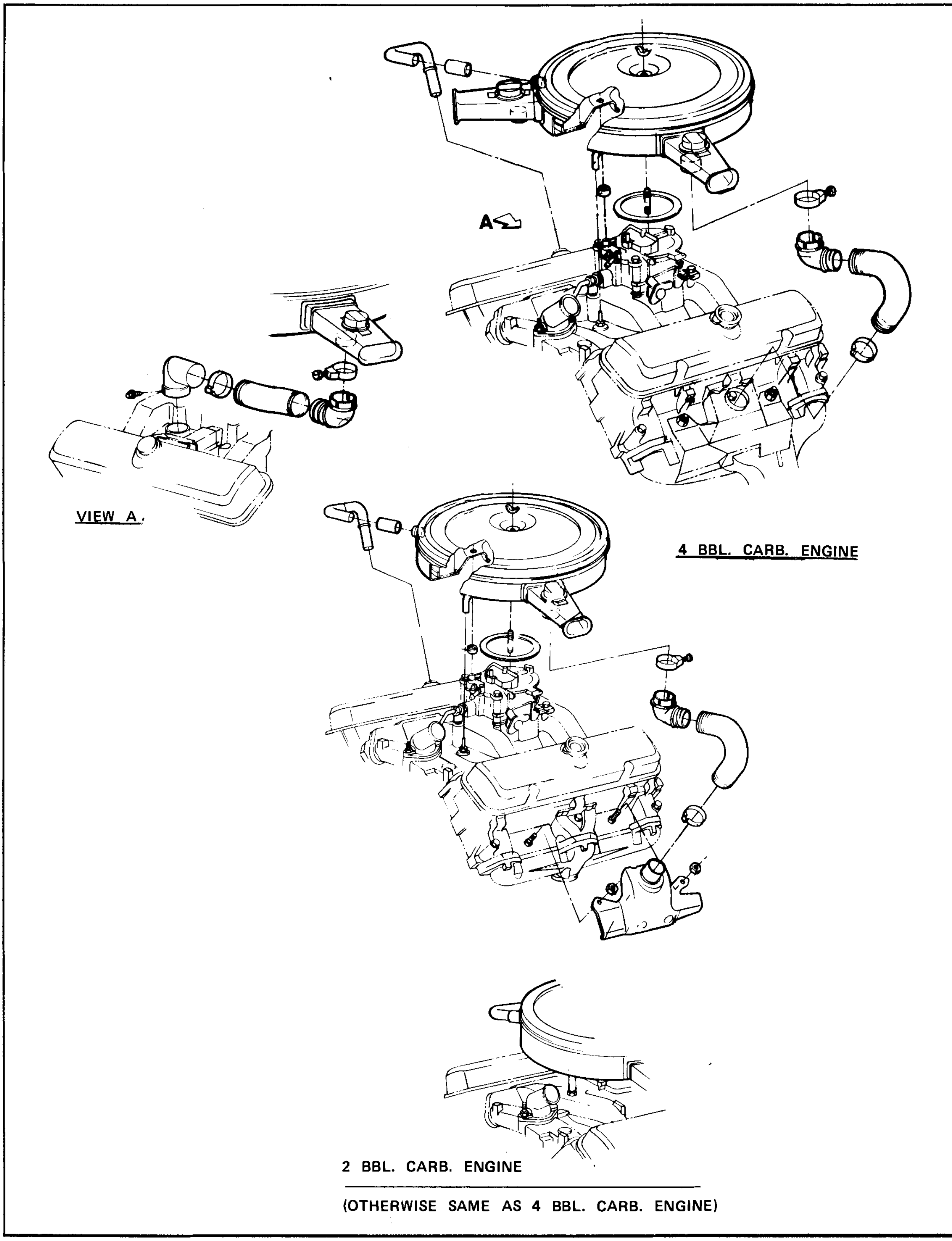


Fig. 6B-2 Air Cleaner Installation (V-8) - Std.

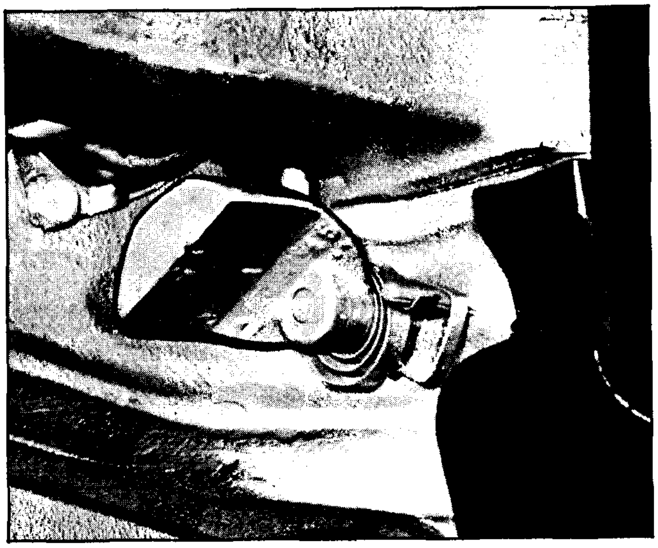


Fig. 6B-3 Heat Control Valve (6 Cyl.)

1. Check automatic choke to see that it operates properly and that it is correctly indexed.
2. Inspect manifold heat valve to see that it operates freely and thermostat is installed properly (6 cyl.).
3. Check for leaks in fuel line fittings, at fuel tank or at fuel pump.
4. Check for dirty or restricted air cleaner.
5. Test for high fuel pump pressure.
6. Disassemble carburetor and check for evidence of vacuum leaks.
7. Check float level.

CARBURETOR AIR CLEANER AND SILENCER

A combined air cleaner-silencer and air preheater with an oil wetted paper element is standard on all models.

An optional heavy duty dual stage air cleaner is available on all models except the Ram Air A and F Series engines.

This air cleaner consists of a replaceable oil wetted paper inner filter surrounded by a polyurethane foam outer filter.

The polyurethane element should be washed in solvent and re-oiled using SAE 30 engine oil at 24,000 miles or 24 months.

> **NOTE:** *Clean and re-oil after each occasion of driving under severe dust conditions. Allow excess oil to drain out of filter prior to installation.*

HEAT CONTROL VALVE

A thermostatically controlled valve in the outlet of the exhaust manifold (6 cyl.) directs the passage of exhaust

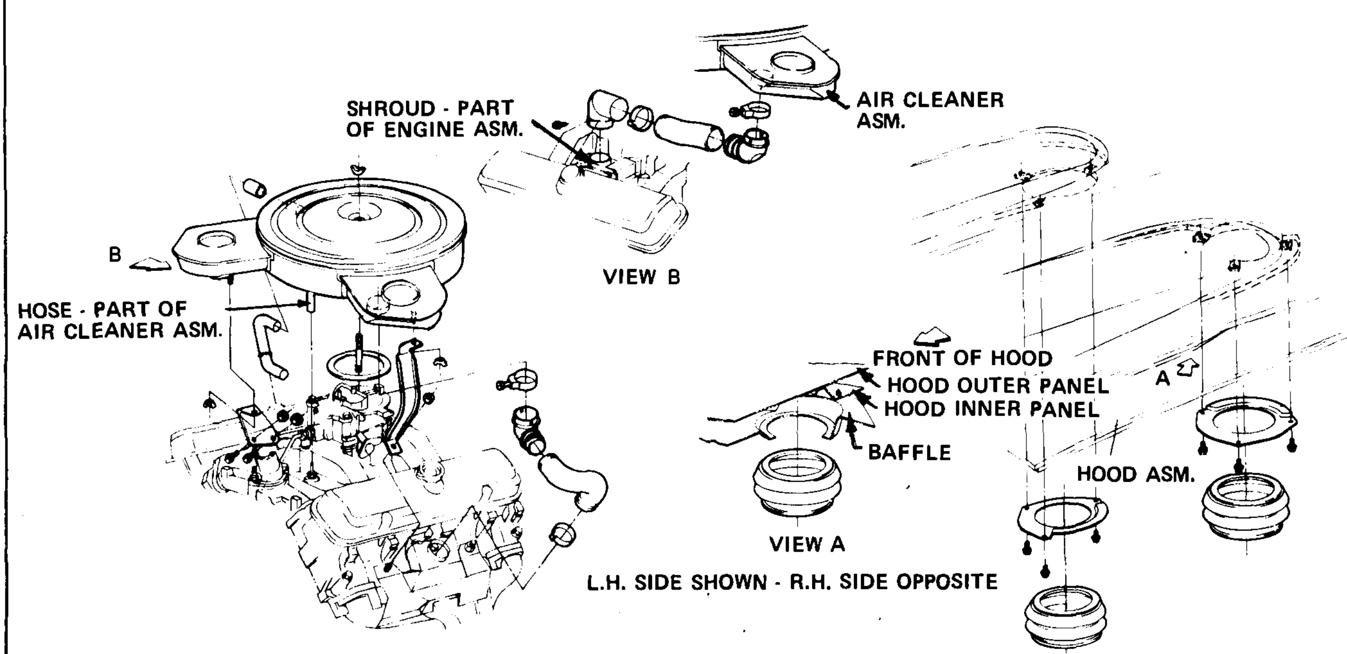


Fig. 6B-4 Air Cleaner Installation (A and F Series) - Ram Air

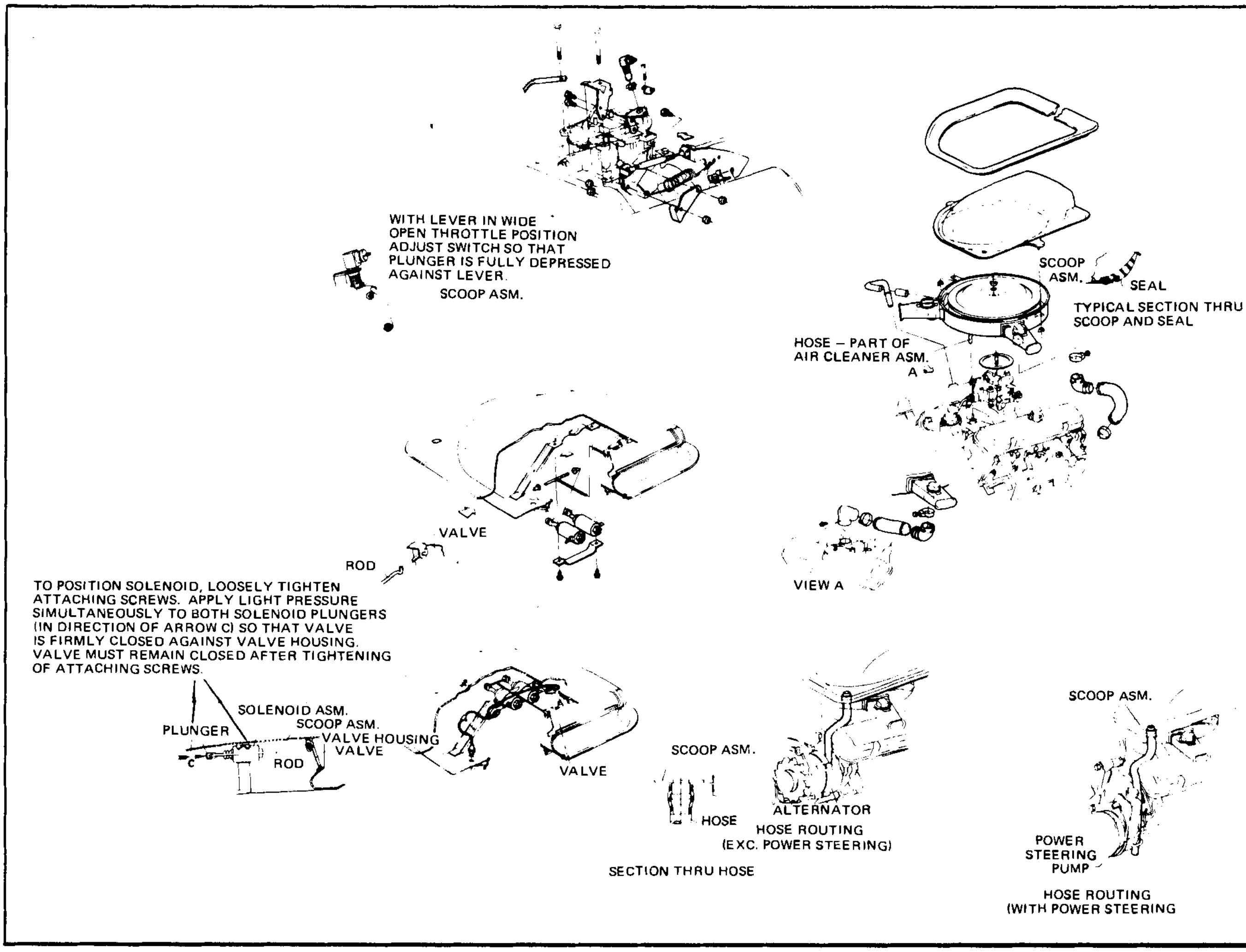


Fig. 6B-5 Air Cleaner Installation (F Series) - Trans Am

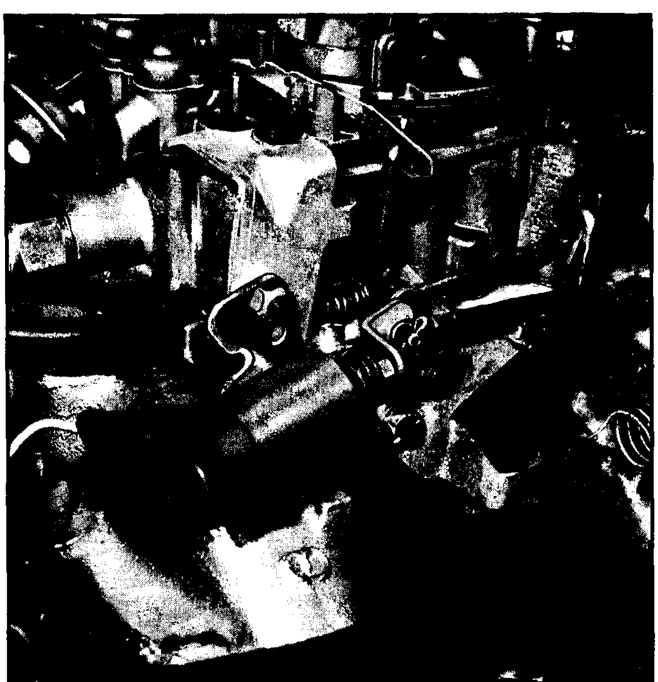


Fig. 6B-6 Idle Stop Solenoid (V-8)

gases to a stove beneath the intake manifold when the engine is cold (Fig. 6B-3).

Exhaust gases will then heat the stove, which in turn warms the incoming fuel mixture.

As the engine warms up, the thermostatic heat control valve opens allowing all gases to be exhausted via the normal route.

The assembly is kept from rattling by an anti-rattle spring mounted next to the thermostatic spring.

INTAKE SYSTEMS - RAM AIR

The Ram Air system works two ways to improve engine breathing (Figs. 6B-4 and 6B-5):

Inlets are in a high pressure area for a slight super charging effect.

Engine breathes cool outside air instead of hot under-hood air.

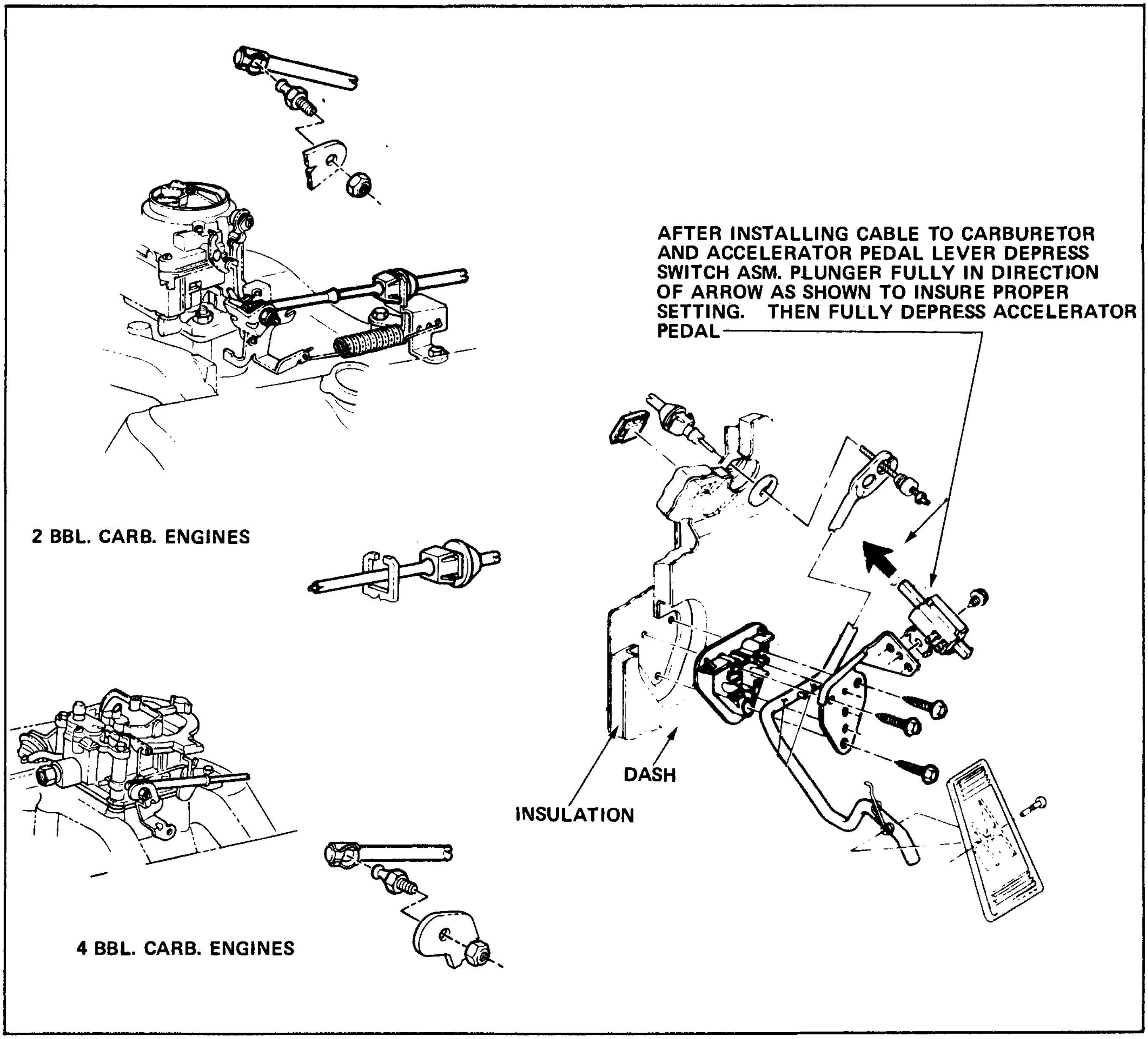


Fig. 6B-7 Accelerator Controls - B Series

IDLE STOP SOLENOID

The idle stop solenoid (used on all 6 cyl. and all 4 Bbl. V-8 engines) prevents after-run of the engine when the ignition is turned off. Refer to Section 6D for proper setting procedure.

ACCELERATOR CONTROLS

The throttle control system is of the cable type. There are no throttle linkage adjustments. Check for correct carburetor throttle opening and closing positions by operating accelerator pedal in car.

NOTE: *If any binding is present, check for correct routing of cable or pedal interference with carpets.*

HOT IDLE COMPENSATOR

The hot idle compensator is used on all 6 cyl. automatic, V-8 400 and 455 4 Bbl. with automatic transmission (except Ram-Air) and A/C equipped F Series V-8 2 Bbl. automatic engines. It consists of a bi-metal strip, a valve and housing. It functions as follows:

As engine and underhood temperatures rise to a predetermined value, the bi-metal strip lifts the valve off its seat. This allows fresh air to enter the manifold below the throt-

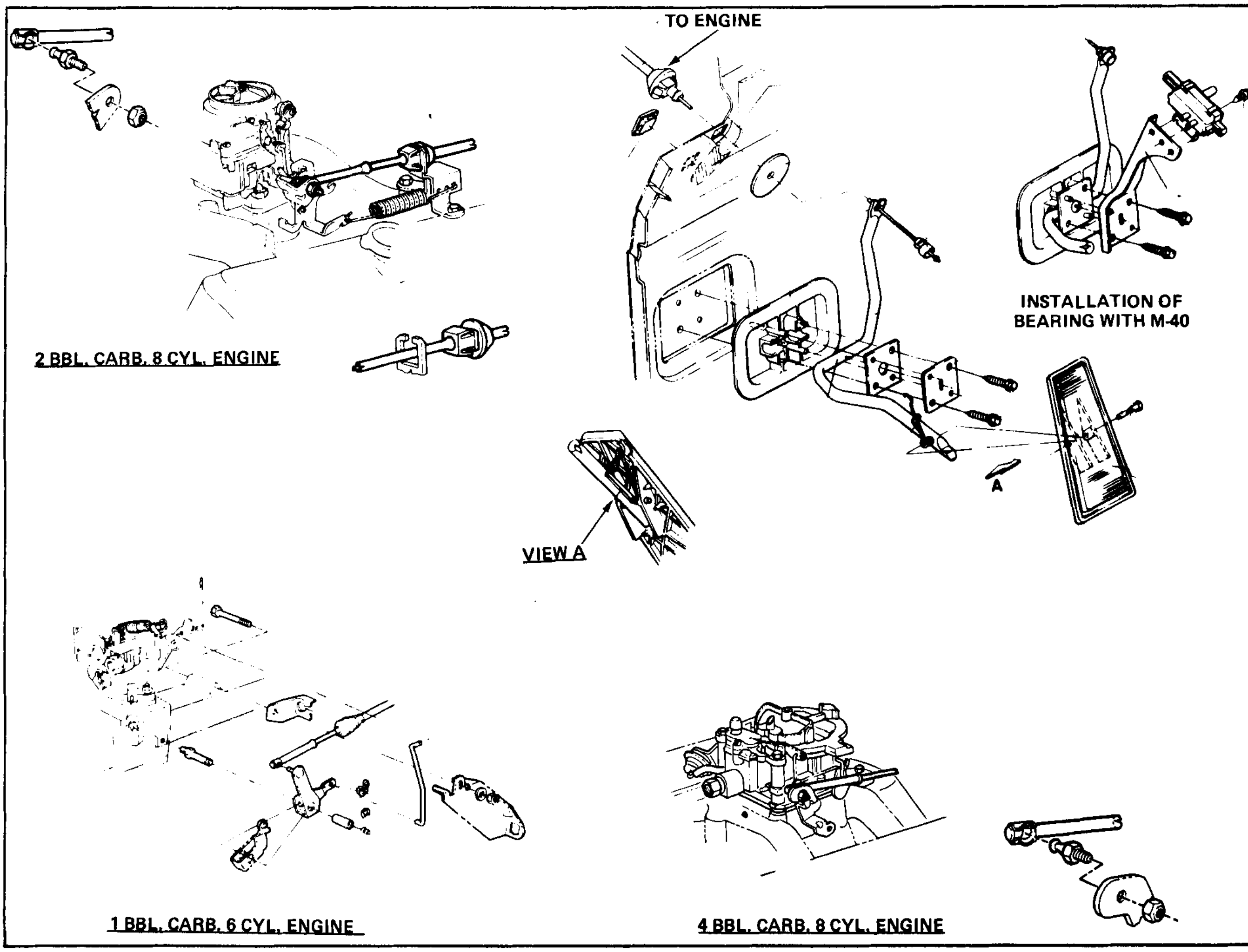


Fig. 6B-8 Accelerator Controls - A and G Series

tle valves and offset rich mixtures due to fuel vapors, which can cause rough idle and stalling.

When underhood temperatures return to normal, the bi-metal strip will lower and the compensator valve will close and normal idle operation will resume.

> **NOTE:** *No adjustments are necessary on the idle compensator. The compensator valve must be closed while adjusting engine idle.*

FUEL PUMP

DESCRIPTION (Fig. 6B-11)

The fuel pump transfers gasoline from the tank to the carburetor in sufficient quantity to meet engine requirements at any speed or load.

A unitized-type fuel pump is used, which is completely sealed (except for an air bleed on the air side of the pump), resulting in added performance, particularly during warm weather operation or prolonged idle conditions.

The vapor diverter is integral with the pump on all V-8 engines with A/C and on all 4 Bbl. engines except B Series.

The fuel pump diaphragm is retained with a crimped edge. This provides a greater effective diaphragm area which results in more efficient handling of hot fuel in a manner which will virtually eliminate vapor lock.

The rocker arm spring keeps the rocker arm in constant engagement with the eccentric on the engine camshaft so that the rocker arm moves downward and upward as the camshaft rotates. As the rocker arm is moved downward, it bears against a link which is also pivoted on the rocker arm pin. The link is hooked to the diaphragm pull rod so that the diaphragm is moved away from the fuel chamber and the diaphragm spring is compressed. The enlarging fuel chamber moves gasoline from the tank through the tubing and inlet valve and into the space below the diaphragm.

As the rotating eccentric permits the rocker arm to move away from contact with the link, the compressed diaphragm spring is free to move the diaphragm downward

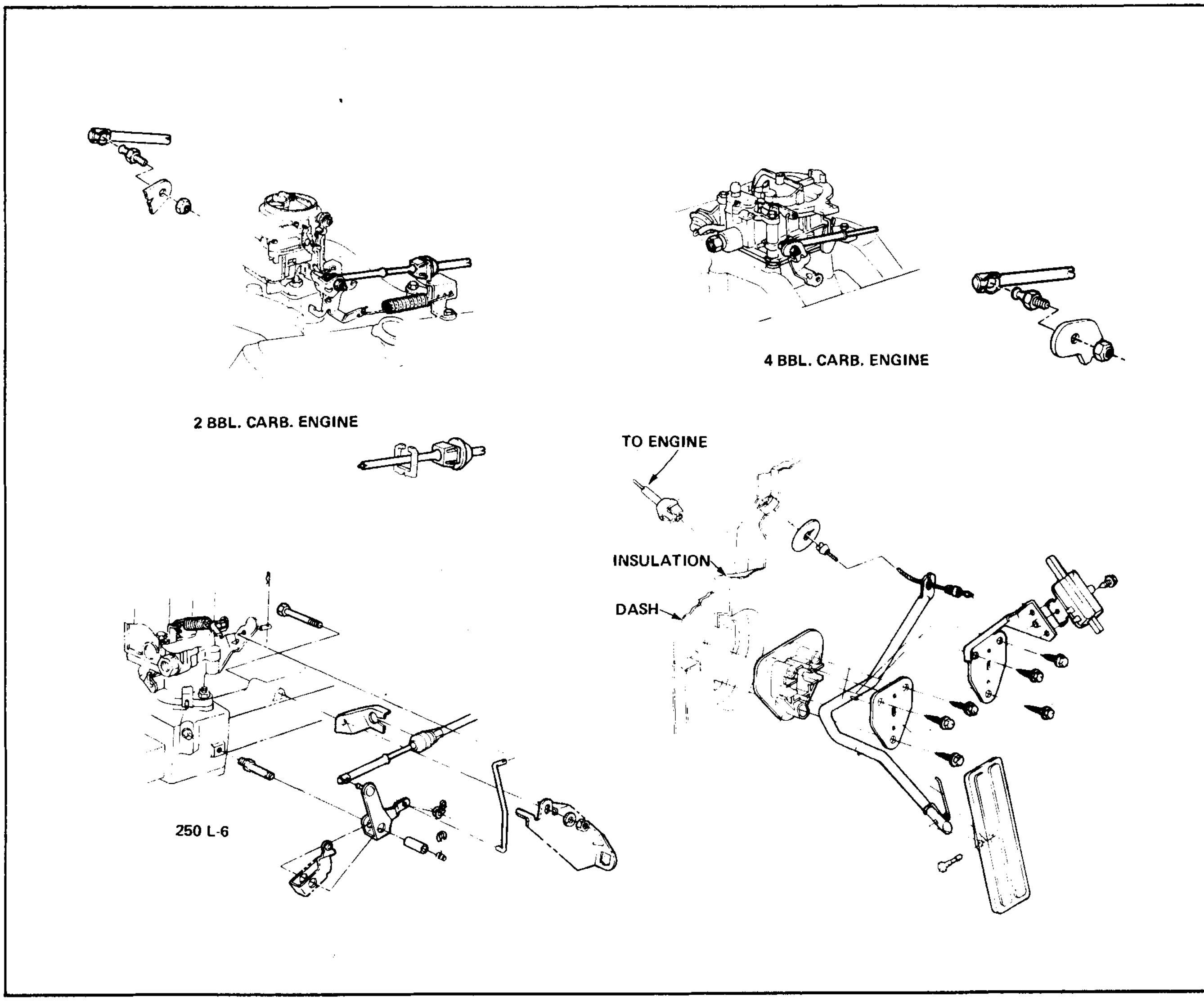


Fig. 6B-9 Accelerator Controls - F Series

to expel the fuel through the outlet valve to the carburetor bowl.

Because the diaphragm is moved downward only by the diaphragm spring, the pump delivers fuel to the carburetor only when the pressure in the outlet line is less than the pressure maintained by the diaphragm spring. Fuel is delivered to the carburetor only when the needle valve is open. When the needle valve is closed by pressure of fuel on the float, the pump builds up pressure in the space below the diaphragm and in the outlet tube until the diaphragm spring is compressed. The diaphragm then remains stationary until more fuel is required.

There are no repairs possible to the fuel pump and when a malfunction is detected, it will be necessary to replace the pump assembly.

TROUBLE DIAGNOSIS AND TESTING

There are three tests that can be performed to evaluate the fuel pump without removing the pump from the engine. It is important that the pump performs properly using all three tests:

1. Be sure there is gasoline in the tank.
2. Check for loose line connections. A leak at the pressure side of the system (line from pump to carburetor) will be indicated by dripping fuel. A leak in the suction side of the system (line from gas tank to pump) will not be apparent except in its effect of reducing volûme of fuel on the pressure side of the system.
3. Look for bends or kinks in lines or hoses which will reduce flow. Check the fuel pump inlet hose routing to be sure it is not bent or kinked.

I. FUEL FLOW TEST

1. Ground primary terminal of distributor with jumper lead so that engine can be cranked without firing.

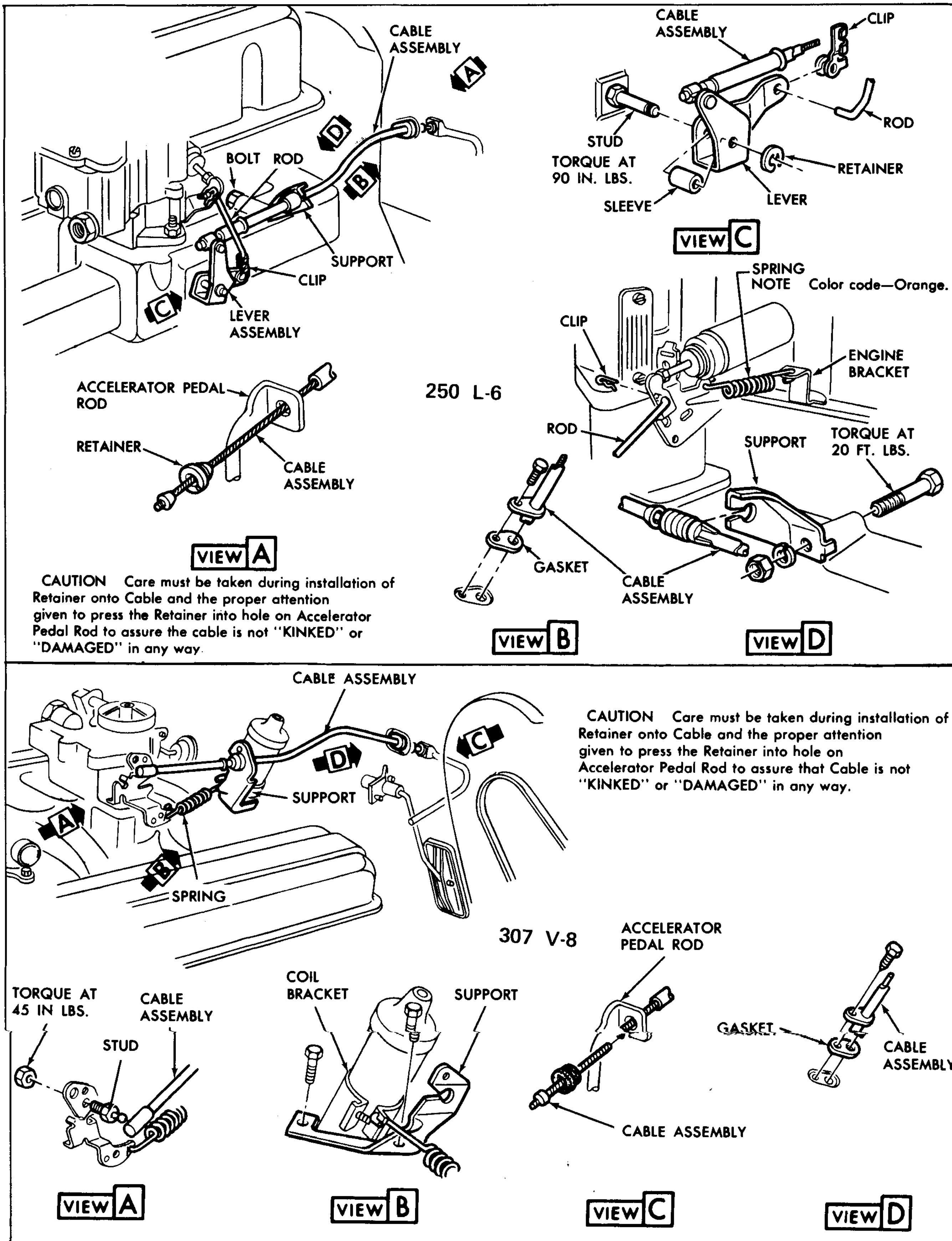


Fig. 6B-10 Accelerator Controls - X Series

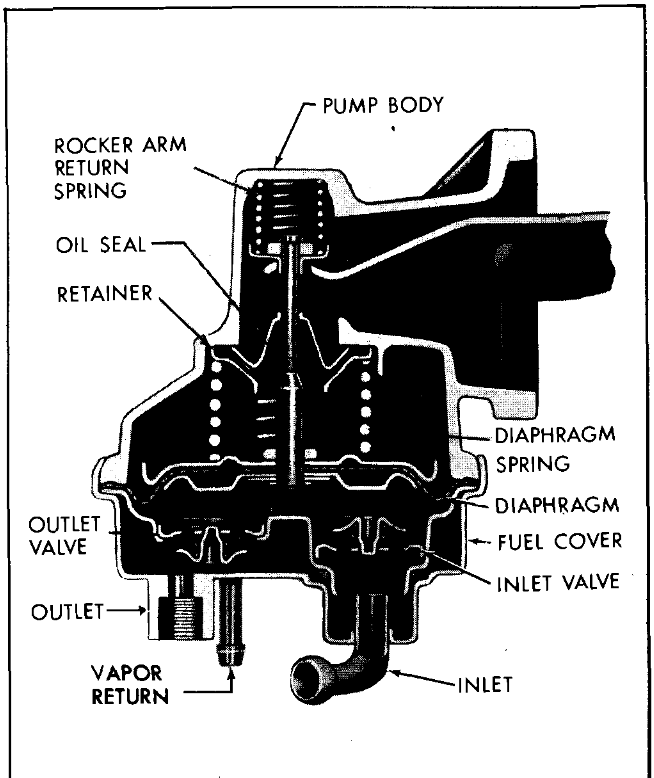


Fig. 6B-11 Fuel Pump - Typical

2. Discontinue fuel line at the carburetor inlet fitting. Install a rubber hose approximately 8-10" long over the end of the fuel line.

3. Place suitable container at end of the hose and crank engine a few revolutions.

If little or no gasoline flows from open end of line, then the fuel line is restricted, gas tank filter restricted or the pump is inoperative. Before removing pump, disconnect fuel lines at fuel pump and at gas tank and blow through them with an air hose to make sure they are clear. Reconnect fuel lines to pump and gas tank.

4. Reconnect fuel line at the carburetor, start engine and check for leaks.

II. PUMP (OUTLET) PRESSURE

Even if fuel flows in good volume from line at carburetor, it is advisable to make certain that pump is operating within limits.

1. Disconnect fuel line at the carburetor inlet fitting. Install a rubber hose approximately 8-10" long over the line and attach a low reading pressure gauge. Hold the gauge up so that it is approximately 16" above the fuel pump.

2. Start engine and run at slow idle (using gasoline in carburetor bowl) and note reading on pressure gauge.

3. If pump is operating properly, the pressure should be 3 to 6-1/2 constant for V-8 and 3 to 5 psi constant for L-6. If pressure is too high or too low or varies materially at different engine speeds, the pump should be replaced.

When checking pressure on cars equipped with a fuel return line, the return line must be plugged.

On fuel pumps without fuel return lines, there is an internal bleed valve. There may be no pressure at fuel inlet nuts at carburetor unless engine is in operation.

III. PUMP (INLET) VACUUM

Low vacuum or complete loss of vacuum provides insufficient fuel to the carburetor to operate the engine throughout normal speed range.

1. Disconnect hose from fuel tank to fuel pump at the fuel pump. Fasten hose in an up position so that fuel will not run out.

2. Connect one end of a short hose to the fuel pump inlet and attach a vacuum gauge to the other end. Start engine, gauge should register not less than 15 in. vacuum. If less than 15 in. of vacuum, replace pump.

MV MONOJET CARBURETOR

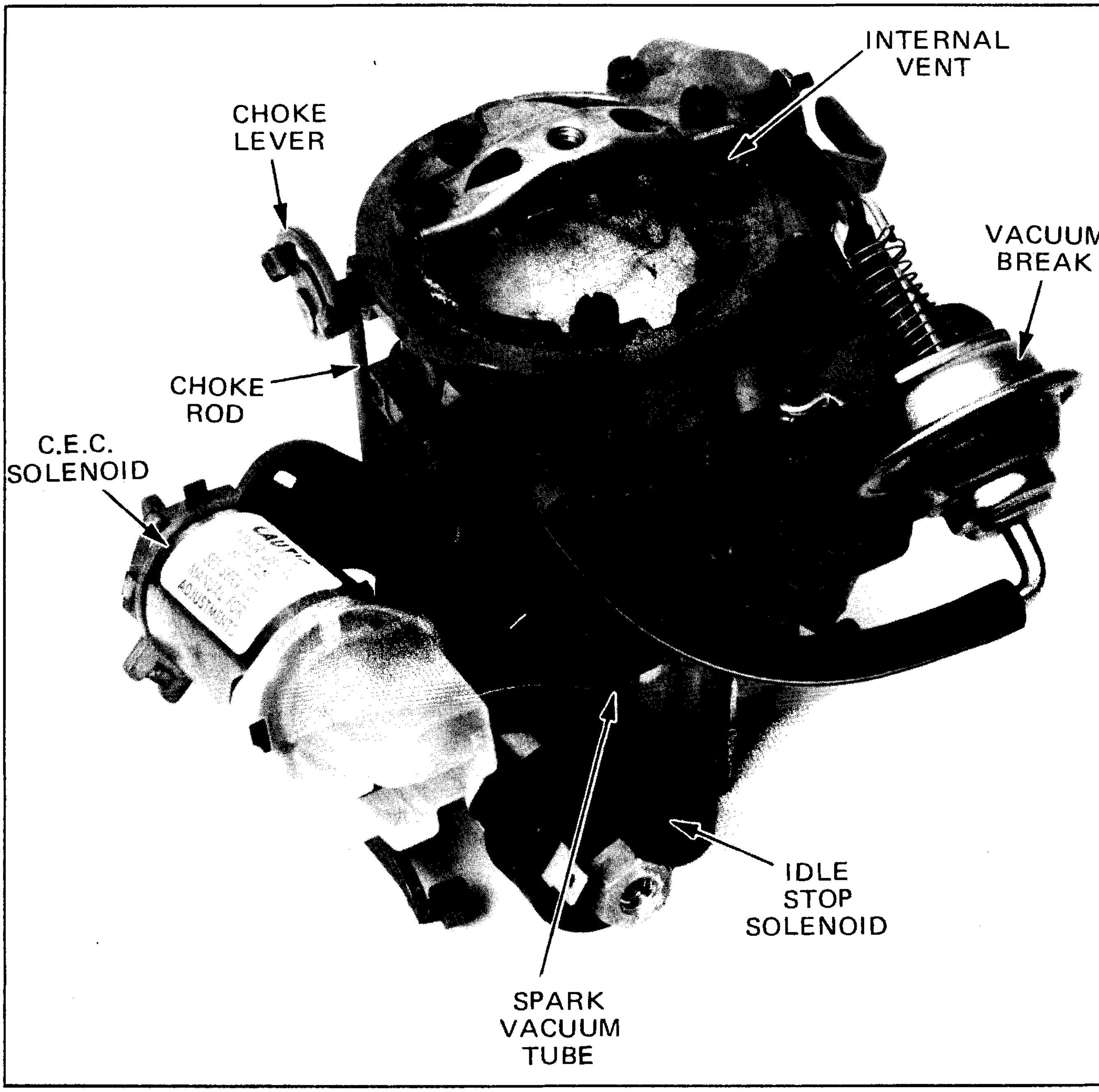
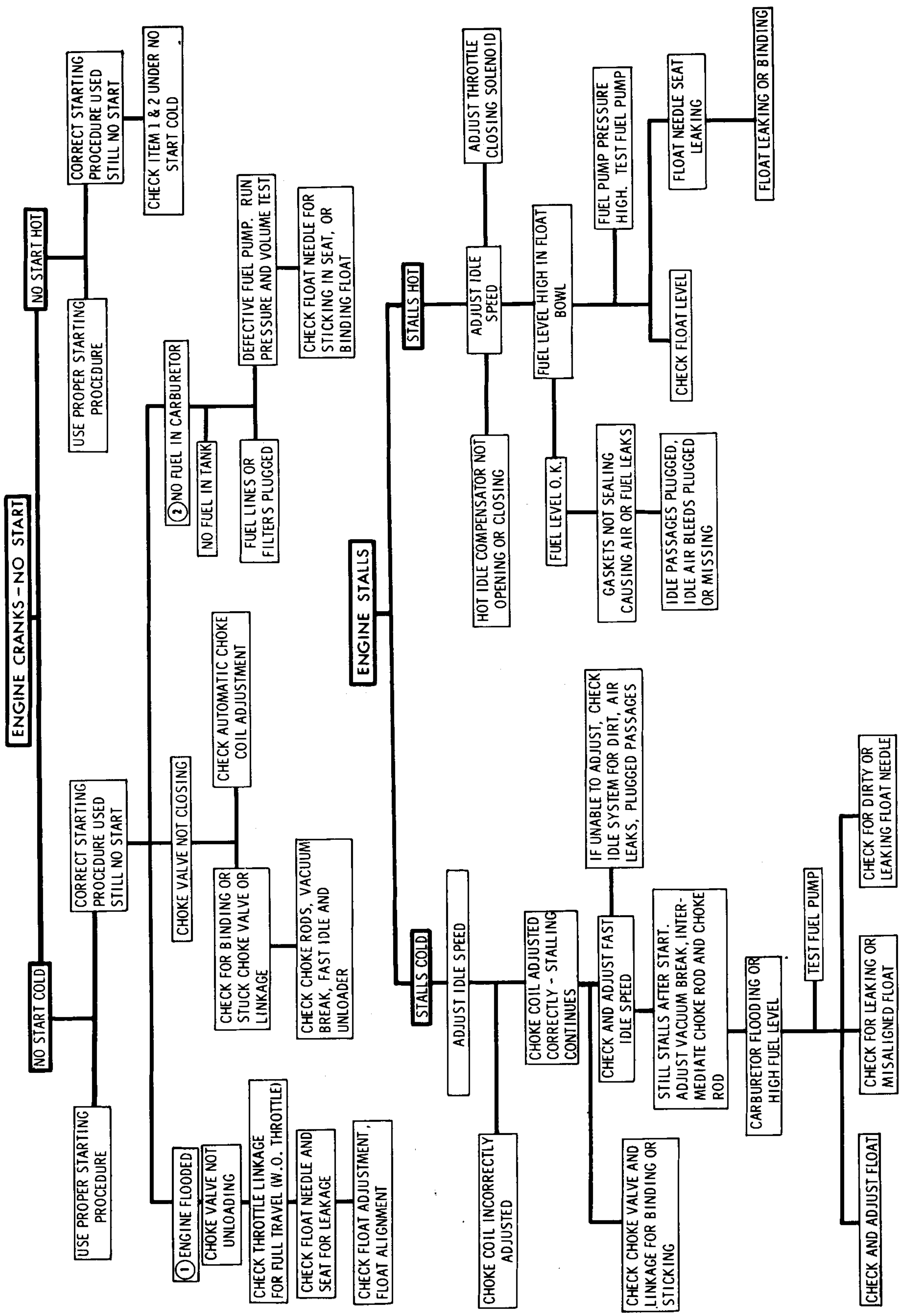


Fig. 6B-12 MV Monojet Carburetor

CARBURETOR DIAGNOSIS CHART
MODEL - MV



CARBURETOR DIAGNOSIS CHART
MODEL - MV

ENGINE SLUGGISH, FLAT ON ACCELERATION

- ENGINE FLATTENS ON ACCELERATION. WARM OR COLD
  - FUEL FILTER IN CARBURETOR DIRTY OR PLUGGED. FLOAT STICKING OR NOT PROPERLY ADJUSTED
  - MAIN METERING JETS DIRTY, PLUGGED OR INCORRECT PART. MAIN METERING ROD DIRTY, BENT, STICKING OR INCORRECT PART
  - IDLE SPEED NOT PROPERLY ADJUSTED
- ENGINE FLATTENS ON ACCELERATION DURING COLD DRIVEWAY
  - ADJUST AUTOMATIC CHOKE COIL
  - ADJUST VACUUM BREAK

CARBURETOR FLOODING

- RUN FUEL PUMP TEST. CHECK PRESSURE AND VOLUME
- CHECK FLOAT NEEDLE AND SEAT FOR DIRT, WEAR, DAMAGE OR LOOSE PART. CLEAN FUEL SCREENS AND FILTERS
- CHECK FLOAT LEVEL CHECK FOR DISTORTED FLOAT ARMS OR IMPROPER FLOAT ALIGNMENT
- CHECK FOR FLOAT BOWL LEAKS. (FILL BOWL WITH FUEL ON BENCH AND OBSERVE FOR LEAKS) CHECK SEAL ON ALL BOWL GASKETS
- CHECK HOT IDLE COMPENSATOR FOR OPENING AND CLOSING

ENGINE RUNS ROUGH, SURGES

- CHECK FUEL PUMP PRESSURE AND VOLUME
- FUEL FILTERS OR SCREENS PLUGGED OR DIRTY
- MAIN METERING JET PLUGGED, LOOSE OR WRONG PART
- METERING ROD BENT, ALTERED OR INCORRECT PART
- POWER PISTON STICKING, DIRTY, SPRING MISSING OR INCORRECT PART
- FLOAT ADJUSTMENT INCORRECT
- ADJUST IDLE SPEED TO SPECIFICATIONS
- CHECK IDLE SYSTEM FOR DIRTY OR PLUGGED PASSAGES
- GASKETS NOT SEALING MAY BE HARD OR BRITTLE, CHECK FOR LOOSE SCREWS

POOR GAS MILEAGE

- RUN MILEAGE TEST CHECK DRIVER HABITS
- IF MILEAGE IS POOR, CHECK THE FOLLOWING:
- CHECK CHOKE VALVE AND LINKAGE FOR BINDING OR STICKING
  - CHECK POWER PISTON FOR STICKING OR BEING BENT
    - CHECK POWER PISTON SPRING FOR DISTORTION
    - CHECK METERING RODS FOR BEING BENT OR WRONG PART
  - CHECK POWER PISTON VACUUM PASSAGES FOR LEAKS OR BEING PLUGGED
    - MAKE SURE GASKETS SEAL PROPERLY ON ALL VACUUM PASSAGES
- CHECK MAIN METERING JETS FOR BEING PLUGGED, LOOSE, OR INCORRECT PART
- CARBURETOR FLOODING
- CHECK FLOAT NEEDLE SEAT FOR LEAKAGE FROM DIRT, WEAR, DAMAGE LOOSENESS
- FLOAT BENT, STICKING, MISALIGNED OR MIS-ADJUSTED
- CHECK AND ADJUST IDLE SPEED
- GASKETS NOT SEALING OR CASTINGS LEAKING
- PUMP DISCHARGE BALL NOT SEATING. CHECK FOR DIRT, DEFECTIVE SEAT OR DIS-CHARGE SPRING

ROUGH IDLE, STALLS

- ADJUST IDLE SPEED TO SPECIFICATION
  - IDLE COMPENSATOR NOT OPENING OR CLOSING
- IF ROUGH IDLE CONTINUES AFTER PROPER IDLE SPEED ADJUSTMENT, CHECK AS FOLLOWS:
  - TIGHTEN ALL CARBURETOR SCREWS, TORQUE CARBURETOR TO MANIFOLD AND MANIFOLD TO ENGINE BOLTS
  - CARBURETOR IDLE PASSAGES DIRTY OR PLUGGED
  - THROTTLE VALVE STICKING OPEN
  - FLOAT NEEDLE SEAT LEAKING FLOAT NOT PROPERLY ADJUSTED
  - CHECK FOR BINDING FLOAT
  - CHECK AIR HORN TO BOWL AND THROTTLE BODY GASKETS FOR AIR LEAKS BETWEEN CASTINGS
  - CHECK POWER PISTON AND CHOKE VACUUM PASSAGES FOR AIR LEAKS

POOR HIGH SPEED PERFORMANCE

- CHECK FOR FULL THROTTLE OPENING AT CARBURETOR ADJUST THROTTLE LINKAGE
- POWER PISTON STUCK OR BINDING. CHECK FOR DISTORTED SPRING
- FLOAT SETTING INCORRECT
- MAIN METERING JETS PLUGGED, DIRTY OR INCORRECT PART
- METERING ROD ALTERED, BENT OR INCORRECT PART
- GASKETS NOT SEALING - MAY BE HARD OR BRITTLE CHECK FOR LOOSE SCREWS

HESITATES ON ACCELERATION

- PUMP CIRCUIT DIRTY, PLUGGED OR INOPERATIVE
- LOW FUEL LEVEL IN FLOAT BOWL
  - CHECK FUEL PUMP PRESSURE AND VOLUME
- PUMP JETS NOT TARGETING PROPERLY

GENERAL DESCRIPTION

The Monojet carburetor is a single bore downdraft carburetor using a triple venturi in conjunction with a plain tube nozzle.

The main venturi is 1 5/16" in diameter and the throttle bore is 1 11/16".

Fuel flow through the main metering system is controlled by a main well air bleed and a variable orifice jet. A power enrichment system is used to provide good performance during moderate to heavy accelerations and at higher engine speeds.

The idle system incorporates a hot idle compensator on models equipped with automatic transmission, to maintain smooth engine idle during periods of extreme hot engine operation

The model MV incorporates an automatic choke system. The vacuum diaphragm unit is no longer an integral part of the air horn and has been mounted externally on the air horn and connects to the thermostatic coil lever through a connecting link.

The automatic choke coil is manifold mounted and connects to the choke valve shaft by a rod.

An integral, pleated-paper fuel inlet filter is mounted in the fuel bowl behind the fuel inlet nut.

Features of the Monojet carburetor include an aluminum throttle body for decreased weight and improved heat distribution and a thick throttle body to bowl insulator gasket to keep excessive engine heat from the float bowl. The carburetor has internally balanced venting through a vent hole in the air horn, which leads from the float bowl into the bore beneath the air cleaner. A pressure relief valve system is incorporated in the air horn, which vents vapors externally during hot engine operation.

The carburetor part number is stamped on a vertical section of the float bowl, next to the fuel inlet nut (Fig. 6B-13). When replacing the float bowl assembly, follow the manufacturer's instructions contained in the service package so that the part number can be transferred to the new float bowl.

An electrically operated idle stop solenoid has been added to the carburetor float bowl and replaces the normal idle stop screw. The idle stop solenoid is used in conjunction with the combination emission control valve (C.E.C. valve). The idle stop solenoid controls the slow engine idle speed. The C.E.C. valve, when energized through the transmission, acts as a throttle stop by increasing idle speed during high gear operation of the engine, which helps in controlling overrun emissions during deceleration. The C.E.C. valve also provides full spark vacuum advance during high gear operation and is de-energized in the lower gears and at idle for retarded spark timing during this period. As mentioned, the normal idle speed setting is made by adjusting the electrically operated idle stop solenoid.

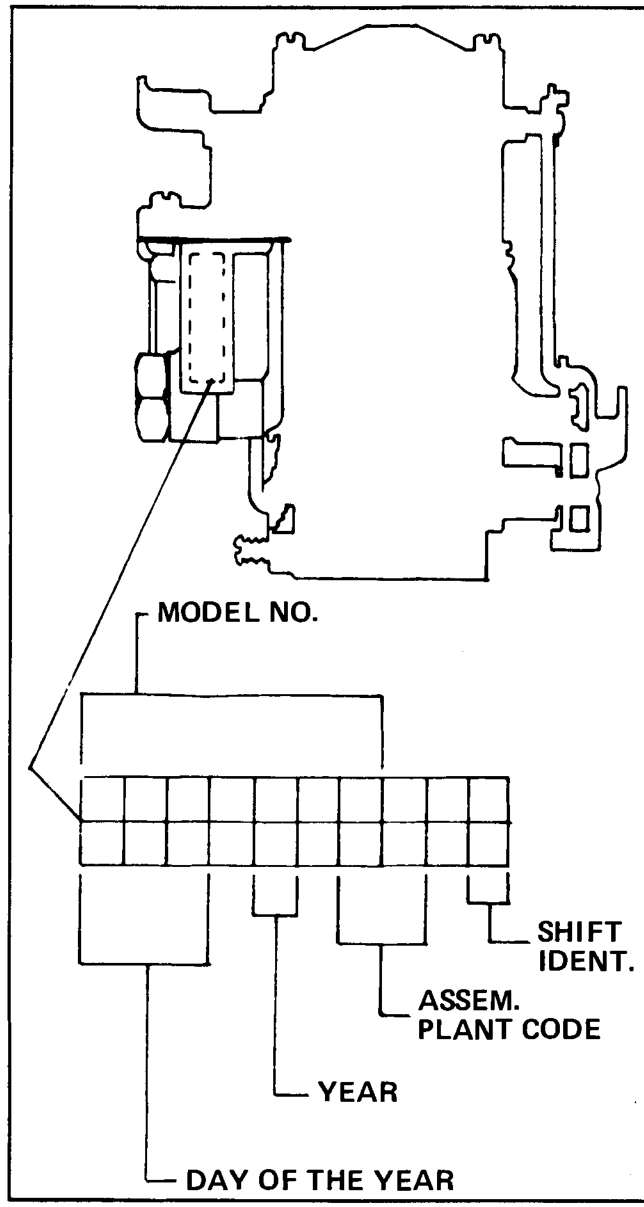


Fig. 6B-13 MV Carburetor Identification Location

The idle mixture screw has a limiter cap installed and no adjustment will be provided on the vehicle. The mixture screw will be pre-set at the factory and capped and no further adjustment should be required except during the cleaning and overhaul.

An overhaul idle mixture adjustment procedure will be provided, should the idle mixture needle need replacement or the mixture channels cleaned during the overhaul process. A new red idle mixture needle limiter cap will be provided in the overhaul kit.

Six basic systems of operation are used: float, idle, main metering, power enrichment, pump and choke. The following text describes the purpose and operation of each system.

OPERATING SYSTEMS

FLOAT SYSTEM

The float system (Fig. 6B-14) controls the amount and level of the fuel in the carburetor float bowl. Higher than specified fuel levels can cause flooding, hard, hot starting, rich fuel mixtures causing poor economy, nozzle drip at idle and stalling. Therefore, it is important that the float be set to recommended specifications.

The float system on the Monojet carburetor is located adjacent to the main venturi. It is designed so that angular maneuvers such as steep hills and sharp turns will not affect proper operation by keeping an adequate supply of fuel in the bowl at all times. The float system consists of the following: a fuel inlet filter and pressure relief spring, a solid single pontoon float made of special lightweight plastic, a conventional needle and seat and a float hinge pin. The float hinge pin fits in dual slots cast in the float bowl and is held in place by compression of the air horn gasket against the upper loop of the hinge pin.

The float operates as follows: fuel from the engine fuel pump is forced through the paper fuel inlet filter, located behind the fuel inlet nut, passes from the filter chamber up through the float needle seat and spills into the float bowl; as the float bowl fills with fuel, it lifts the float pontoon upward until the correct fuel level is reached in the float bowl. At this point, the float arm forces the float needle against the float needle seat, shutting off fuel flow.

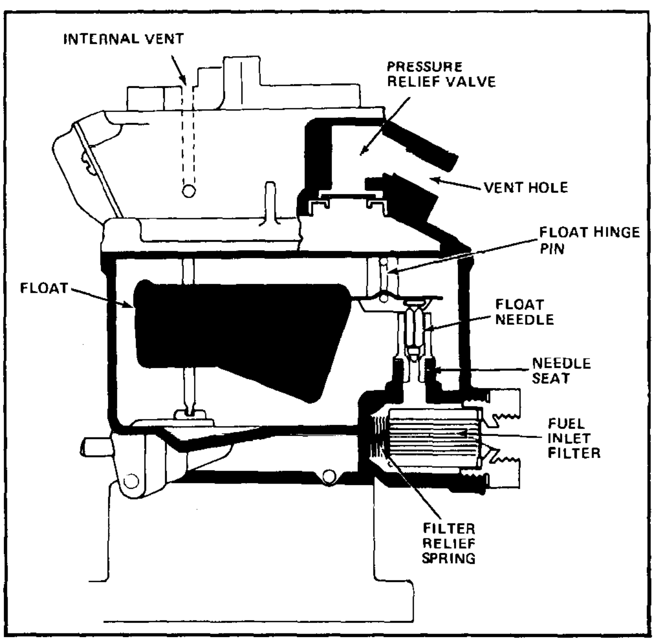


Fig. 6B-14 Float System

As fuel is used from the float bowl, the float drops downward, allowing the float needle to move off its seat and more fuel to enter the float bowl. This cycle continues throughout engine operation, constantly maintaining a positive fuel level in the float bowl.

The fuel inlet filter has a pressure relief spring located at the rear of the filter. It seats between the rear of the filter and the inlet casting. Should the filter become clogged from improper servicing or excess dirt in the system, the relief spring lets the filter move off its seat. This prevents complete stoppage of fuel flow to the carburetor until the filter can be replaced.

The carburetor float chamber is internally vented through a hole located in the air horn above the float chamber. The purpose of the internal vent is to balance air pressure on the fuel in the float bowl with carburetor inlet air. With this feature, a balanced air/fuel mixture ratio can be maintained during part throttle and power operation because the air pressure acting on the fuel in the float bowl will be balanced with the air flowing through the carburetor bore.

The carburetor external idle vent valve has been removed and is replaced by a pressure relief valve. Should excessive vapor pressure build up in the float bowl during periods of hot engine idle or hot soak, a small valve at the top of the air horn will be pushed off its seat, allowing the pressure to be relieved, thereby preventing fuel from being forced from the float bowl into the engine.

IDLE SYSTEM

The purpose of the idle system (Fig. 6B-15) is to control fuel mixtures to the engine during idle and low speed operation. The idle system is needed during this period because air requirements of the engine are not great enough to obtain efficient metering from the main discharge nozzle and venturi system.

The idle system consists of a removable idle tube, idle passages, idle channel restriction, idle air bleeds, slotted off-idle port, idle mixture adjusting needle and the idle mixture discharge hole.

During curb idle, the throttle valve is held slightly open by the idle stop screw. The small amount of air, which passes between the throttle valve and bore, is regulated by this screw to provide the correct engine idle speed. Since the engine requires very little air and fuel for idle and low speed operation, fuel is mixed by direct application of engine manifold vacuum to the idle discharge hole just

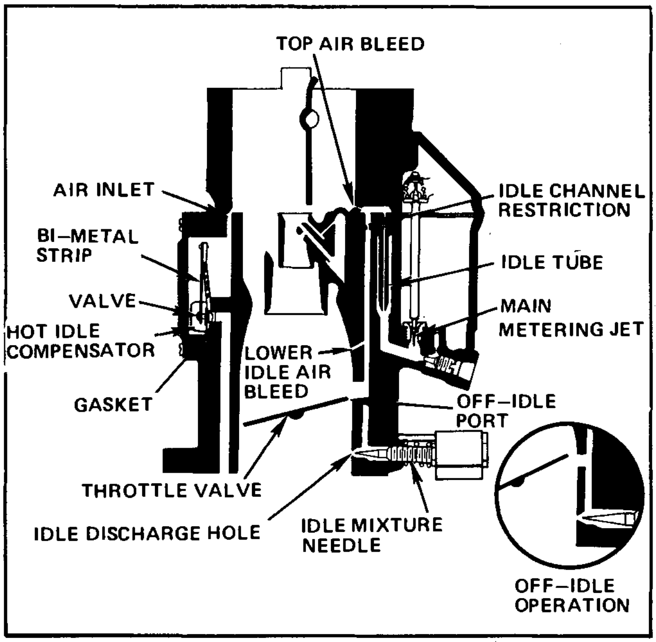


Fig. 6B-15 Idle System

below the throttle valve. With the idle discharge hole in a very low pressure area and the fuel in the float bowl vented to atmosphere, fuel flows through the idle system as follows:

Atmospheric pressure forces fuel from the float bowl down through the main metering jet into the main fuel well where it is picked up and metered at the lower tip of the idle tube. It passes up the idle tube and is mixed with air at the top of the idle channel through the idle air bleed hole. The air/fuel mixture passes over through the cross channel and then downward through the calibrated idle channel restriction where it is further metered. The mixture continues down the idle passage past the lower idle air bleed hole and off-idle discharge port just above the throttle valve, where it is again mixed with air. The air/fuel mixture then moves downward past the idle mixture needle and out through the idle discharge hole into the carburetor bore. Here it mixes with the air passing around the slightly open throttle valve and then continues through the intake manifold into the engine cylinders as a combustible mixture.

OFF-IDLE OPERATION

As the throttle valve is opened from curb idle to increase engine speed, additional fuel is needed to combine with the extra air entering the engine. This is accomplished by the slotted off-idle port. As the throttle valve is opened, it passes the off-idle port, gradually exposing it to high vacuum below the throttle valve. The additional fuel from the off-idle port mixes with the increased air flow past the opening throttle valve to meet increased engine air and fuel demands.

Further opening of the throttle valve causes increased air flow through the carburetor bore, which causes sufficient pressure drop in the multiple venturi to start fuel delivery from the main discharge nozzle. The off-idle port fuel discharge does not cease at this transfer point but rather diminishes as fuel flow from the main discharge nozzle increases. In this way, the systems are so designed that they combine to produce a smooth fuel flow at all engine speeds.

The lower idle air bleed is used strictly as an air bleed during idle operation. It supplies additional air to the idle circuit for improved atomization and fuel control at low engine speeds.

The same air bleed is used as an additional fuel feed at higher engine speeds to supplement main discharge nozzle delivery during operation of the main metering system.

The timed spark port has two tubes which supply vacuum during the off-idle and part throttle operation of the carburetor. One tube is connected by a rubber hose to the C.E.C. valve to supply spark vacuum advance during high gear operation of the vehicle. The other tube leads to the purge valve on the vapor canister to provide a means of pulling fuel vapors form the canister during periods of higher air flow through the carburetor bore. A limited amount of canister purge is also provided by a separate tube which leads from the canister to the PCV valve hose connection.

HOT IDLE COMPENSATOR

The hot idle compensator (Fig. 6B-14), with automatic transmission only, is located in a chamber on the float bowl casting, adjacent to the carburetor bore, on the throttle lever side of the carburetor. Its purpose is to offset enrichening effects caused by changes in air density and fuel vapors generated during hot engine operation.

The compensator consists of a thermostatically controlled valve, a bi-metal strip which is heat sensitive, a valve holder and bracket. The valve closes off an air channel which leads from a hole inside the air horn to a point below the throttle valve where it exits into the throttle body bore.

Normally, the compensator valve is held closed by tension of the bi-metal strip and engine vacuum. During extreme hot engine operation, excessive fuel vapors in the carburetor can enter the engine manifold causing richer than normally required mixtures. This can result in rough engine idle and stalling. At a pre-determined temperature, when extra air is needed to offset the enrichening effects of fuel vapors, the bi-metal strip bends and unseats the compensator valve, uncovering the air channel leading from the compensator valve chamber to the throttle body bore. This allows enough air to be drawn into the engine manifold to offset the richer mixtures and maintain a smooth engine idle. When the engine cools and the extra air is not needed, the bi-metal strip closes the valve and operation returns to normal.

The compensator valve assembly is held in place by the dust cover over the valve chamber. A seal is used between the compensator valve and float bowl casting.

In order to insure proper idle adjustment when the engine is hot, the compensator valve must be closed. To check this, plug the compensator inlet hole inside the air horn bore (pencil can be used). If no drop in engine rpm is noted on a tachometer, the valve is closed; if the valve is open, leave plug in hole when adjusting idle or cool engine down to a point where the valve automatically closes for proper idle adjustment.

CAUTION: *Always remove plug used in inlet hole after completing idle adjustment, otherwise, the compensator will not operate.*

MAIN METERING SYSTEM

The main metering system (Fig. 6B-16) supplies fuel to the engine from off-idle to wide open throttle operation. It feeds fuel at all times when air flow through the venturi is great enough to maintain efficient fuel flow from the main discharge nozzle. The triple venturi stack-up used in the Monojet carburetor is ultrasensitive to air flow, which results in a finer and more stable metering control from light to heavy engine loads.

The main metering system consists of a main metering jet, mechanical and vacuum operated metering rod, main fuel well, main well air bleeds, fuel discharge nozzle and triple venturi.

The main metering system operates in the following manner:

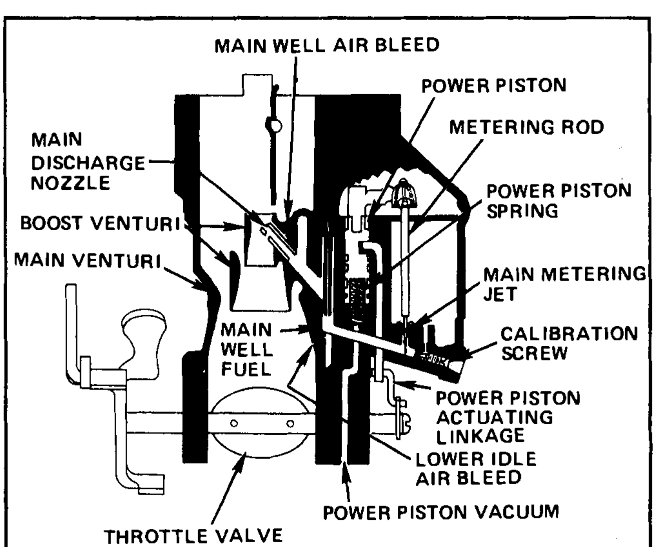


Fig. 6B-16 Main Metering System

As the throttle valve is opened beyond the off-idle range, allowing more air to enter the engine manifold, air velocity increases in the carburetor venturi. This causes a drop in pressure in the main venturi which is increased many times in the double boost venturi. Since the lower pressure (vacuum) is now in the smallest venturi, fuel flows from the main discharge nozzles in the following manner:

Fuel in the float bowl passes between the tapered metering rod and the main metering jet where it is metered and flows on into the main fuel well. In the main well the fuel is mixed with air from the air bleed at the top of the well and another air bleed which leads into the main well from the discharge nozzle cavity. After the fuel in the main well is mixed with air from the air bleeds it then passes up the discharge nozzle where it sprays into the small boost venturi. At the boost venturi, the fuel mixture then combines with air entering the engine through the carburetor bore to provide the correct air/fuel mixtures to the engine for efficient combustion.

Fuel flow to the main discharge nozzle is controlled by a tapered metering rod which is actuated by linkage connected directly to the throttle shaft. As the throttle valve is opened from idle position, the tapered metering rod is gradually raised out of the main metering jet orifice. Fuel flow from the main discharge nozzle is controlled by throttle opening and the depth of the metering rod in the main metering jet orifice. With the fuel metering mechanically controlled by the throttle valve angle, it is possible to maintain very accurate mixture ratios throughout part throttle to wide open throttle operation. An initial metering rod adjustment is required to set the depth of the rod in the main metering jet.

CAUTION: *It should be noted here that there is a supplementary fuel feed passage in the bottom of the float bowl adjacent to the main metering jet. Fuel is picked up from the float bowl and passes through a calibrated hole, past a calibration screw and on into the same fuel passage which leads from the main metering jet to the main fuel well. The purpose of the adjustable fuel feed is to allow the factory to refine part throttle calibration to meet very accurate air/fuel mixture ratios. This adjustment is made using very sensitive instrumentation and the screw should not be tampered with or it will require complete float bowl or unit replacement.*

POWER ENRICHMENT SYSTEM

The vacuum operated power enrichment system (Fig. 6B-17) is used to slightly enrichen mixture ratios during moderate to heavy loads during acceleration. The necessary enrichment is obtained by movement of a spring loaded vacuum piston which senses changes in manifold vacuum. The amount of enrichment is controlled by the clearance between the groove in the power piston and the diameter of the power piston drive rod.

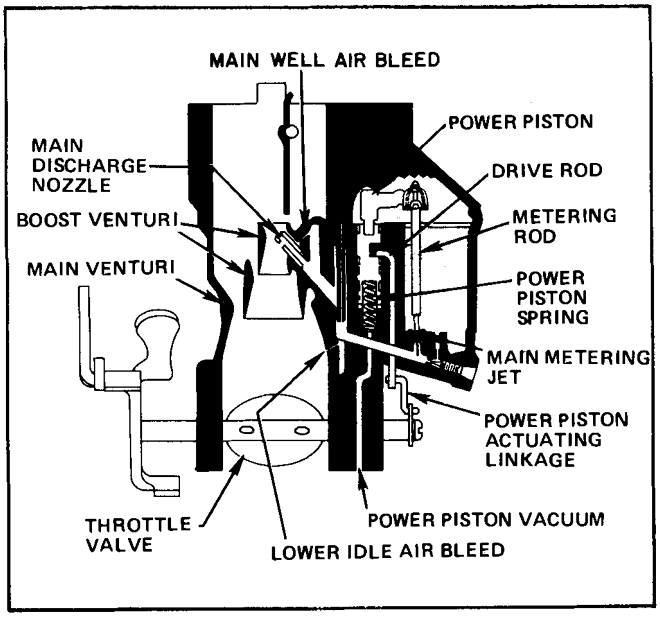


Fig. 6B-17 Power Enrichment System

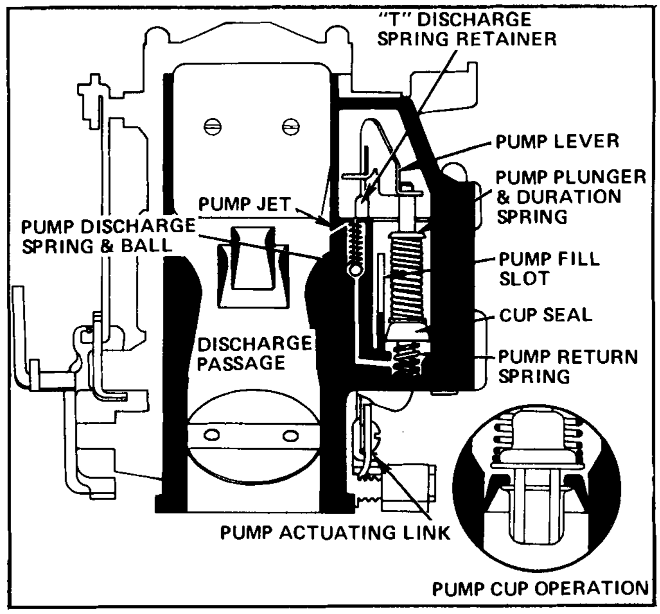


Fig. 6B-18 Pump System

During part throttle and cruising ranges, manifold vacuum is sufficient to hold the power piston down against spring tension. The upper part of the groove in the power piston is held down against the top side of the drive rod. This places the main metering rod lower in the jet for maximum economy. On moderate to heavy accelerations, manifold vacuum drops and the power piston spring pushes the power piston up so that the lower edge of the slot in the power piston strikes the bottom side of the drive rod. This moves the tapered metering rod slightly upward and out of the main metering jet, allowing more fuel to flow through the jet, enrichening the fuel mixture slightly.

ACCELERATING PUMP SYSTEM

Extra fuel for smooth, quick acceleration is supplied by a double spring loaded pump plunger (Fig. 6B-18). Rapid opening of the throttle valve, when accelerating from low speed, causes an immediate increase in air flow through the carburetor bore. Since fuel is heavier than air, it requires a short period of time for fuel flow through the main discharge nozzle to catch up with the air flow. To avoid leanness during this momentary lag in the fuel flow, the accelerator pump furnishes a metered quantity of fuel which is sprayed into the air stream. This mixes with the increased air flow to supply the extra fuel needed until the main discharge nozzles can feed the fuel required.

The accelerating pump is located at the side of the main fuel bowl, adjacent to the venturi area. It consists of a spring loaded pump plunger and pump return spring operating in a fuel well. The pump plunger is connected by linkage directly to a lever on the throttle shaft.

When the pump plunger moves upward in the pump well, as happens during throttle closing, fuel from the float bowl enters the pump well through a slot in the side of the pump well and flows past the synthetic pump cup seal into the bottom of the pump well. The pump cup is a floating type (the cup moves up and down on the pump plunger head). When the pump plunger is moved upward, the flat on the top of the cup unseats from the flat on the plunger head and allows free movement of fuel through the inside of the cup into the bottom of the pump well. This also vents any vapors which may be in the bottom of the pump well so that a solid charge of fuel can be maintained in the fuel well beneath the plunger head.

When the throttle valve is opened, as happens during acceleration, the connecting pump linkage forces the pump plunger downward. The pump cup seats instantly and fuel is forced through the pump discharge passage, where it unseats the pump discharge check ball and passes on through the passage to the pump jet located at the top of the float bowl, where it sprays into the boost venturi area.

The pump plunger is spring loaded; the upper duration spring is balanced with the bottom pump return spring so that a smooth sustained charge of fuel is delivered during acceleration.

The pump discharge check ball prevents any pull over or discharge of fuel from the pump jet when the accelerator pump is not in operation. It also keeps the pump discharge passage filled with fuel to prevent pump discharge lag.

The pump does not require adjustment in service as it is preset during manufacture.

CHOKE SYSTEM

The purpose of the choke system (Fig. 6B-19) is to provide a richer mixture for cold engine starting and operation. Richer than normal mixtures are required because vaporized fuel has a tendency to condense on cold engine parts. This occurs on the inside area of the intake manifold and cylinder heads, thereby, decreasing the amount of combustible mixture available in the engine cylinders.

The model MV carburetor is equipped with a fully automatic choke control. The thermostatic coil is mounted on the exhaust manifold and is connected by a link to the lever on the choke valve shaft. The vacuum break unit is diaphragm operated and is an integral part of the air horn casting.

The choke system operates as follows: when the engine is cold, prior to starting, depressing the accelerator pedal to the floor opens the carburetor throttle valve. This allows tension from the thermostatic coil to close the choke valve and also rotates the fast idle cam so the high step is in line with the fast idle tang on the throttle lever. As the throttle is released, the fast idle cam follower comes to rest on the high step of the fast idle cam, thus providing enough throttle valve opening to keep the engine running after cold start. During cranking, engine vacuum below the choke valve pulls fuel from the idle curcuit and main discharge nozzle. This provides adequate enrichment from the fuel circuits for good cold starts.

When the engine starts, manifold vacuum is transmitted through a vacuum channel to the vacuum break diaphragm unit mounted on the air horn casting. This moves the diaphragm plunger until it strikes the cover which, in turn, opens the choke valve to a point where the engine will run without loading or stalling. This is called the vacuum break position. A choke closing assist spring has been added to the vacuum break diaphragm plunger stem. The spring assists in closing the choke valve, along with tension from the thermostatic coil, for improved cold starting. The choke closing assist spring only exerts pressure on the vacuum break link to assist in closing the choke valve during engine starting. When the engine starts and the choke vacuum break diaphragm seats, the closing spring hits a stop on the plunger stem and no longer exerts pressure on the vacuum break link.

As the engine warms up, the thermostatic coil is heated and gradually relaxes its spring tension so that air velocity through the air horn can continue to open the choke valve. This continues until the engine is warm. At this point, the choke coil tension is completely relaxed and the choke valve is wide open.

The fast idle cam has graduated steps so that fast idle engine speed is lowered gradually during the engine warm up period. The fast idle cam follows rotation of the choke valve. When the choke valve is completely open and the engine is warm, the fast idle tang on the throttle lever will be off the steps of the fast idle cam. At this point, the idle screw controls normal engine idle speed.

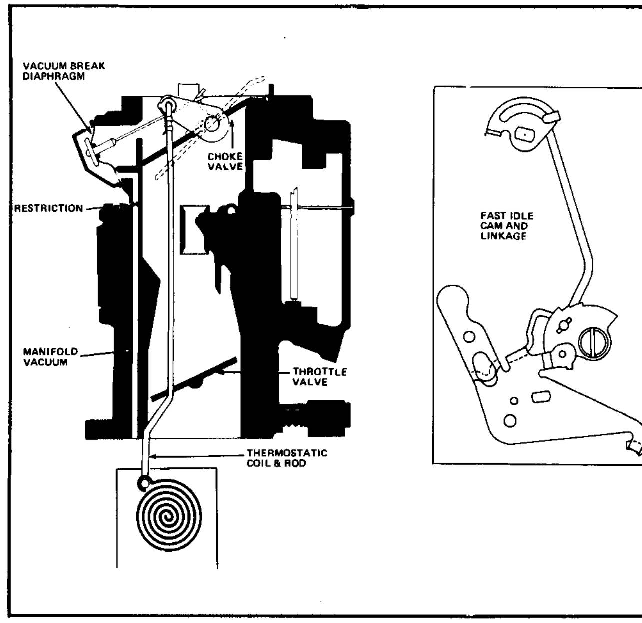


Fig. 6B-19 Choke System

An unloader mechanism is provided should the engine become flooded during the starting period. The unloader partially opens the closed choke valve to allow increased air flow through the carburetor to lean out the overly rich mixtures. This is accomplished by depressing the accelerator pedal to the floor so that wide open throttle is obtained. When this is done, a tang on the throttle lever contacts an arm on the fast idle cam and forces the choke valve partially open. The extra air leans out the fuel mixture enough so that the engine will start.

All Monojet adjustments can be performed on the car. With the exception of idle speed and mixture adjustments, outlined in Section 6D., all adjustments are included in the Overhaul and Adjustments procedure.

MV

Carburetor Model Number	A/C or Non A/C	Calif. or Non Calif.	Engine-Trans. Usage
7042014	Both	Non Calif.	250 Auto.
7042017	Both	Non Calif.	250 Man.
7042984	Non A/C	Calif.	250 Auto.
7042987	Non A/C	Calif.	250 Man.

OVERHAUL AND ADJUSTMENTS

C.E.C. VALVE ASSEMBLY

REMOVE

1. Remove vacuum hose from the C.E.C. valve and timed spark tube.
2. Bend back retaining tabs on lock washer; then remove large C.E.C. valve nut and remove valve from bracket.

   NOTE: *Do not remove C.E.C. valve bracket from the float bowl assembly unless replacement of the bracket is necessary.*

Complete replacement instructions are included in the replacement bracket kit.

3. Remove the electrically operated idle stop solenoid from the float bowl casting by screwing outward.

   CAUTION: *Do not immerse the C.E.C. valve assembly in any type of carburetor cleaner.*

AIR HORN

REMOVE (Fig. 6B-20)

1. Remove fast idle cam from boss on float bowl by removing attaching screw. Then, remove fast idle cam from choke rod and choke rod from upper choke lever. Note position of rod and cam for ease in reassembly.

   NOTE: *Upper choke lever is spun on end of choke shaft and cannot be removed.*

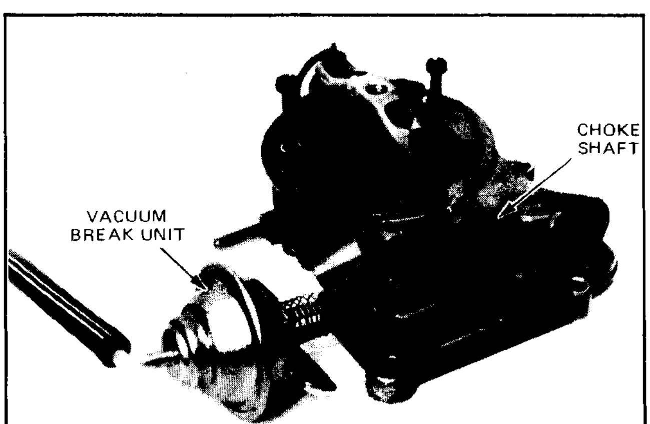


Fig. 6B-20 Air Horn Assembly

2. Remove six air horn to bowl attaching screws (three long and three short screws).

3. Remove vacuum break diaphragm unit from the air horn casting. Then, remove the vacuum break hose assembly and link from the thermostatic coil lever.

4. Remove air horn by lifting straight up, invert and place on clean bench. Air horn to float bowl gasket can remain on bowl for removal later.

   The idle vent valve on the air horn assembly has been replaced by a pressure relief valve disc. Under "AIR HORN DISASSEMBLY", this valve disc need not be removed from air horn top for cleaning. If the valve is defective, air horn replacement is necessary.

DISASSEMBLE (Fig. 6B-20)

1. If desired, the choke valve and choke shaft can be removed from air horn by first removing the thermostatic coil lever from the end of choke shaft by removing attaching screw.

   Remove the two choke valve attaching screws; then, remove the choke valve and choke shaft from air horn.

   NOTE: *The choke valve screws are held in place by Loctite so it will be necessary to restake or reuse Loctite during assembly.*

2. No further disassembly of the air horn is necessary. The pressure relief valve discs need not be removed from the top of the air horn for cleaning purposes.

FLOAT BOWL

DISASSEMBLE (Fig. 6B-21)

1. Remove air horn to float bowl gasket. Gasket is slit next to metering rod lever so that it can be slid over lever for ease in removal.

2. Remove float from float bowl by lifting upward on float hinge pin. Remove hinge pin from float arm.

3. Remove float needle, then remove float needle seat and gasket.

4. Remove fuel inlet nut and gasket, then remove filter element and pressure relief spring.

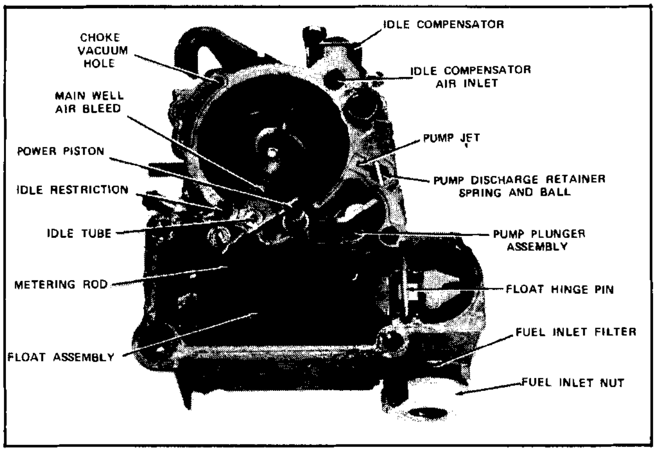


Fig. 6B-21 Float Bowl Assembly

5. Using long nosed pliers, remove "T" pump discharge guide. Pump discharge spring and ball may be removed by inverting bowl.

6. The idle tube can be removed at same time by inverting bowl.

7. To remove accelerating pump plunger and power piston - metering rod assemblies, remove actuating lever on throttle shaft by removing attaching screw in end of shaft.

8. Hold the power piston down in float bowl, then remove power piston drive link by sliding out of hole in power piston plunger rod. The power piston - metering rod can now be removed from float bowl.

NOTE: *The metering rod can be removed from holder on power piston by pushing downward on end of rod against spring tension, then slide narrow neck of rod out of slot in rod holders.*

9. Remove power piston spring from power piston cavity.

10. Remove power piston drive link from throttle actuating lever by aligning lip on rod and notch in lever.

11. Remove actuating lever from accelerator pump drive link in same manner. Note position of actuating lever for ease in reassembly.

12. Hold the pump plunger down in bowl cavity and remove drive link from pump plunger shaft by rotating link until lip on link aligns with notch in plunger shaft.

13. Remove pump plunger from float bowl.

14. Remove pump return spring from pump well.

15. Remove main metering jet from bottom of float bowl.

16. Remove two screws from hot idle compensator cover (automatic transmission only). Then remove cover, hot idle compensator and seal from recess in bowl beneath compensator.

17. Idle stop screw can be removed at this time, if desired.

No further disassembly of the float bowl is required.

THROTTLE BODY

REMOVAL AND DISASSEMBLE (Fig. 6B-22)

1. Invert carburetor bowl on bench and remove two throttle body to bowl attaching screws. Throttle body and insulator gasket may now be removed.

2. No further dis-assembly of the throttle body is necessary unless the idle mixture needle is damaged or the idle channels need cleaning. If necessary to remove the idle mixture needle, destroy plastic limiter cap as a new one is provided in the overhaul kit.

NOTE: *Due to the close tolerance fit of the throttle valve in the bore of the throttle body, do not remove the throttle valve or shaft.*

CLEANING AND INSPECTION

The carburetor should be cleaned in a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner.

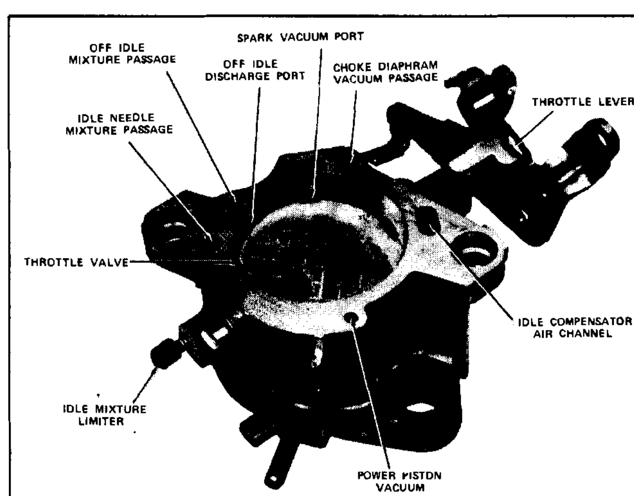


Fig. 6B-22 Throttle Body Assembly

CAUTION: *Any rubber parts, plastic parts, diaphragms, pump plungers, should not be immersed in carburetor cleaner. However, the air horn, which has the plastic pressure relief valve, will withstand normal cleaning in carburetor cleaner. Make sure the cleaner is thoroughly removed from valve cavity.*

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.
3. Inspect idle mixture needle (if removed) for damage.
4. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.
5. Inspect upper and lower casting sealing surfaces for damage.
6. Inspect holes in levers for excessive wear or out-of-round condition. If levers or rods are worn, they should be replaced.
7. Examine fast idle cam for excessive wear or damage.
8. Check throttle and choke levers and valves for binds and other damage.
9. Check all springs for distortion or loss in tension, replace if necessary.

ASSEMBLE AND INSTALL (Fig. 6B-22)

1. If removed, install idle mixture needle and spring until lightly seated. Back out four turns as a preliminary idle adjustment.

   NOTE: *The plastic limiter cap should not be installed on the idle mixture needle until the idle mixture has been adjusted as specified in Section 6D.*

2. Invert float bowl and install new throttle body to bowl insulator gasket, making sure all holes in gasket align with holes in float bowl.
3. Install throttle body on bowl gasket so that all holes in throttle body are aligned with holes in gasket.
4. Install two throttle body to bowl attaching screws. Tighten evenly and securely (12-15 lb. ft.).

The throttle body to bowl screws do not use lock washers as they have an interference fit designed into the thread for holding proper torque.

FLOAT BOWL

ASSEMBLE (Fig. 6B-21)

1. Install the electrically operated idle stop solenoid.
2. Install round seal into recess in hot idle compensator cavity in float bowl, then install hot idle compensator.
3. Install hot idle compensator cover, retaining with two attaching screws. Tighten securely.
4. Install main metering jet into bottom of float bowl. Tighten securely.
5. Install float needle seat and gasket.
6. Install idle tube flush with bowl casting.
7. Install pump discharge ball, spring and "tee" retainer into pump discharge hole.
8. Push down on pump discharge "tee" until flush with bowl casting.
9. Install fuel filter spring, filter, inlet nut and gasket.
10. Install accelerator pump return spring into bottom of pump well. Press downward on spring until seated in cavity.
11. Install power piston return spring into piston cavity in the bowl.
12. Install power piston actuating rod (right angle end) into slot in the power piston.
13. Install power piston, metering rod and actuating rod assembly into the float bowl. End of actuating rod must enter hole in bowl. Locate metering rod into jet orifice.
14. Install pump plunger assembly into pump well with actuating lever protruding through bottom of bowl casting. Push downward on pump lever and install pump assembly drive link into slot at lower end of pump shaft. Ends of drive link point inward toward carburetor bore. Tangs on ends of drive link retain link to pump shaft end of pump actuating lever.
15. Install lower end of pump link into actuator lever which fits on the end of the throttle shaft.
16. Install curved power piston actuating link into throttle actuating lever. Lower end of link protrudes outward away from throttle bore and has a tang which retains the link to the actuator lever.
17. Before fastening power piston and pump actuator lever to end of throttle shaft, hold power piston as-

sembly down and slide upper end of curved power piston actuator link into end of power piston actuator rod.

18. Install actuator lever on end of throttle shaft by aligning flats on lever with flats on shaft. Install lever retaining screw and tighten securely.

19. Install float needle valve into needle seat.

20. Install float hinge pin into float arm, then install float and hinge pin into float bowl.

After adjustment, install metering rod and tension spring.

21. Install air horn gasket on float bowl by carefully sliding slit portion of gasket over metering rod holder. Then align gasket with dowels provided on top of bowl casting and press gasket firmly in place.

FLOAT LEVEL ADJUSTMENT (Fig. 6B-23)

AIR HORN

ASSEMBLE AND INSTALL (Fig. 6B-20)

1. Install choke shaft assembly and choke valve into air horn, if removed. Align choke valve, tighten two retaining screws and stake securely or use thread lock Part No. 7041970.

2. Install air horn to float bowl by lowering gently onto float bowl until seated. Install three long and three short air horn to float bowl attaching screws. Tighten screws securely (Fig. 6B-25).

NOTE: *Install the choke vacuum break diaphragm assembly under the two short air horn screws next to the thermostatic coil lever. Con-*

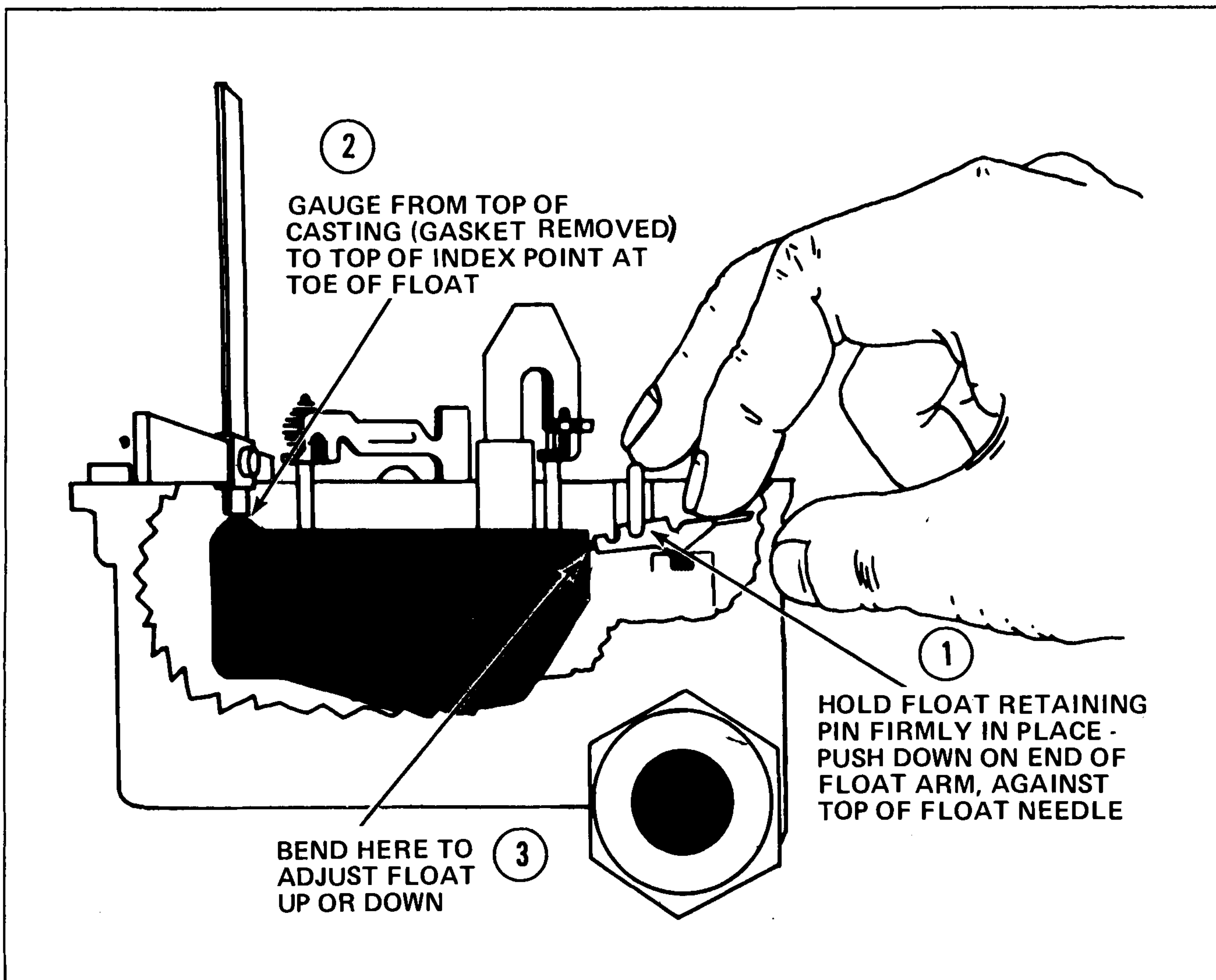


Fig. 6B-23 Float Level Adjustment

METERING ROD ADJUSTMENT (Fig. 6B-24)

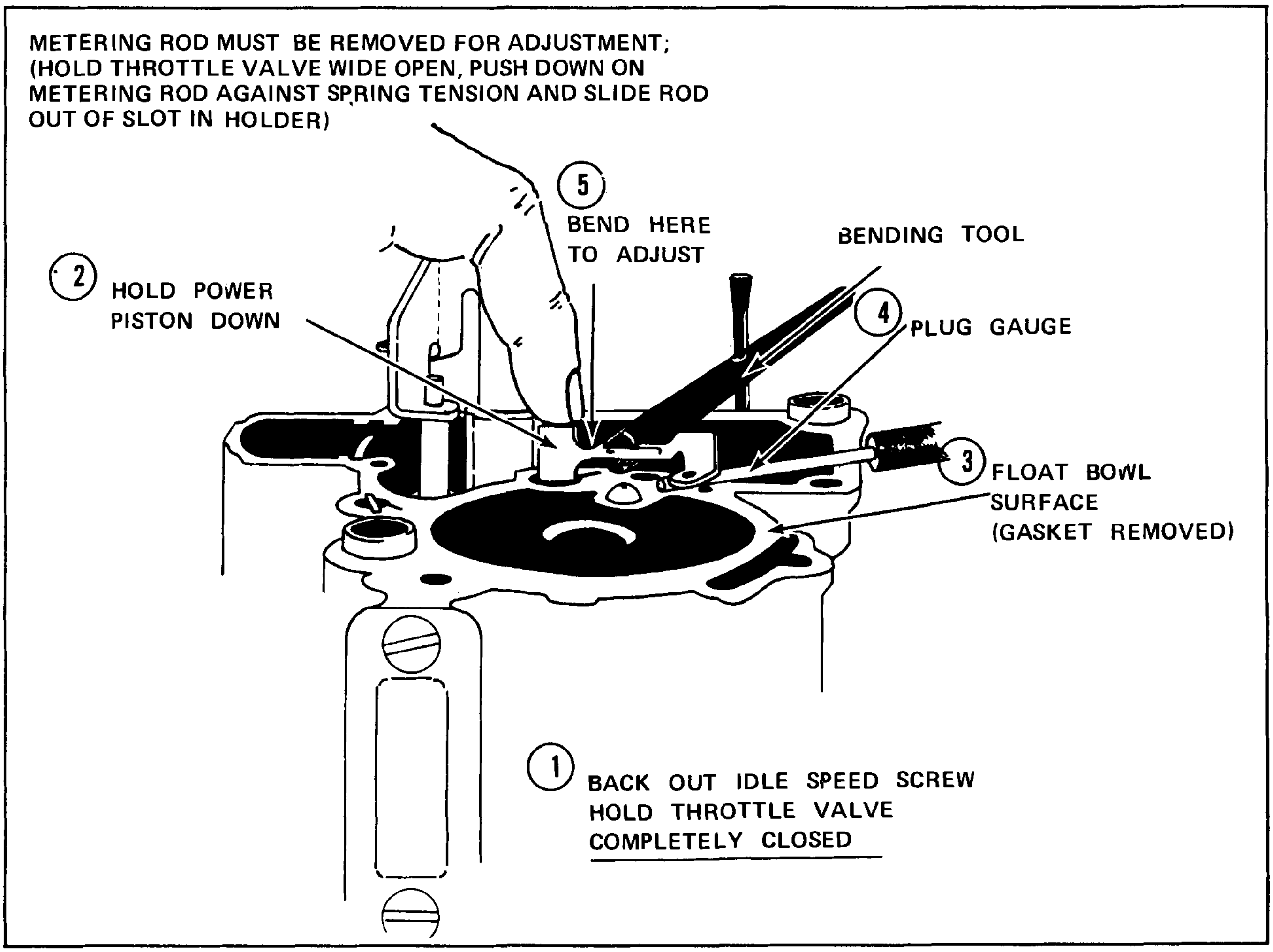


Fig. 6B-24 Metering Rod Adjustment

nect the choke vacuum break diaphragm link to the thermostatic coil lever and install lever to the end of the choke shaft, using retaining screw. Tighten all screws securely.

3. Install the choke vacuum break diaphragm hose to the diaphragm on air horn and tube on air horn.

4. Assemble choke rod into the slot in the upper choke lever. End of rod points away from air horn casting when installed properly.

5. Install lower end of choke rod into fast idle cam. Steps on fast idle cam should face fast idle tang on throttle lever. Install fast idle cam to boss on float bowl with attaching screw. Tighten securely.

6. Install C.E.C. valve into bracket on float bowl. Install large retaining nut and tighten securely. Then, bend lock retaining ears over on flats of nut so that nut is locked securely in place.

7. Install vacuum hose to the upper tube on float bowl and to outer tube on the C.E.C. valve.

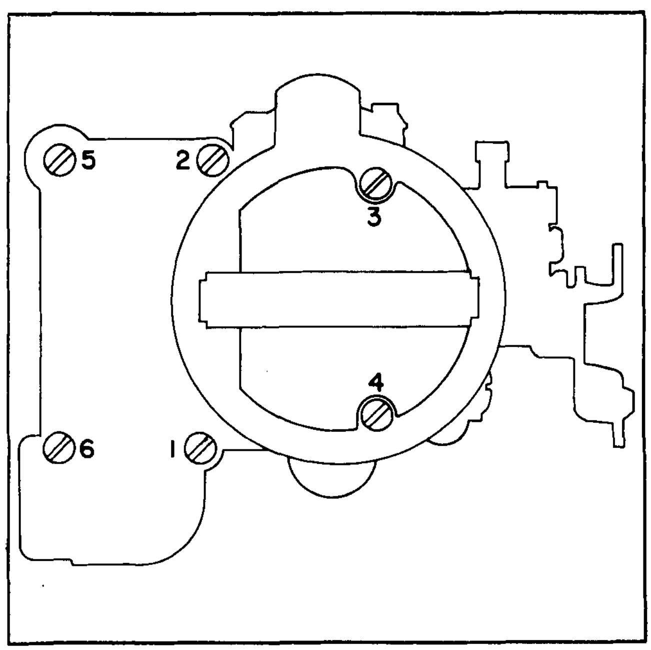


Fig. 6B-25 Air Horn Tightening Sequence

FAST IDLE ADJUSTMENT ON CAR (Fig. 6B-26)

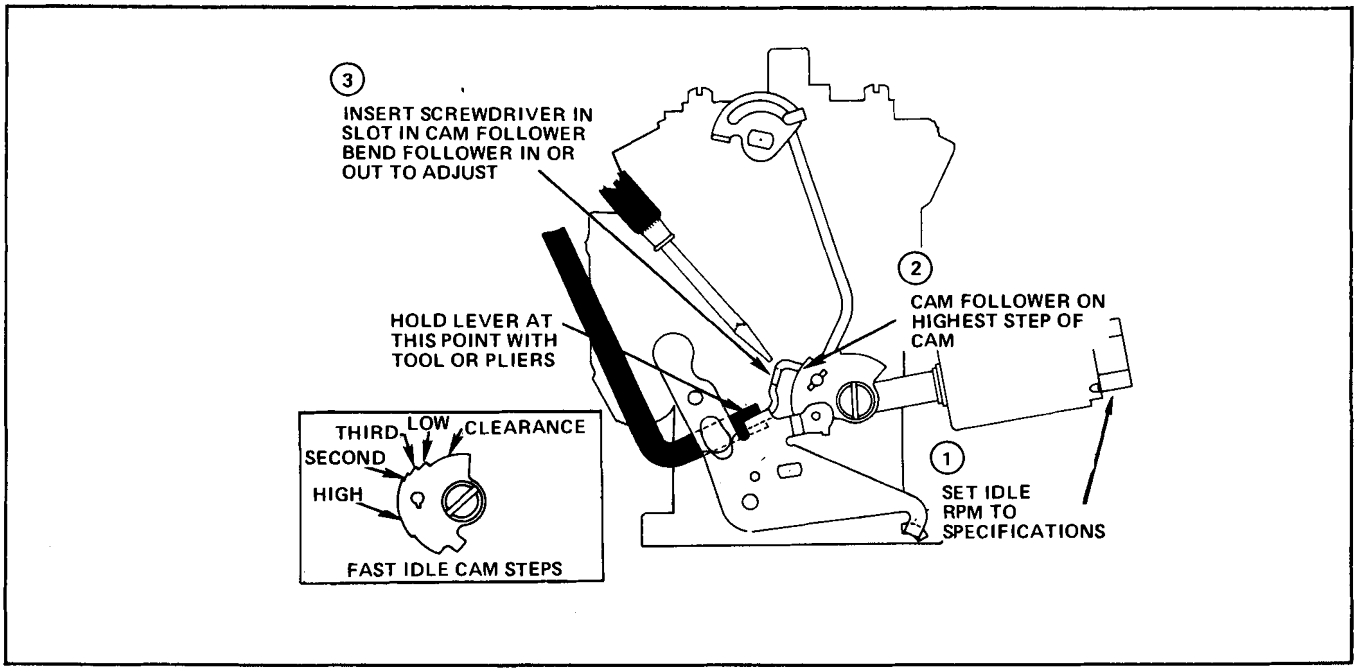


Fig. 6B-26 Fast Idle Adjustment

NOTE: *Refer to the idle speed chart in Section 6D for the remaining adjustments; Adjustments must be performed in sequence shown. Slow and fast idle RPM specifications are also shown on the chart.*

CHOKE ROD ADJUSTMENT (Fig. 6B-27)

With fast idle adjustment made.

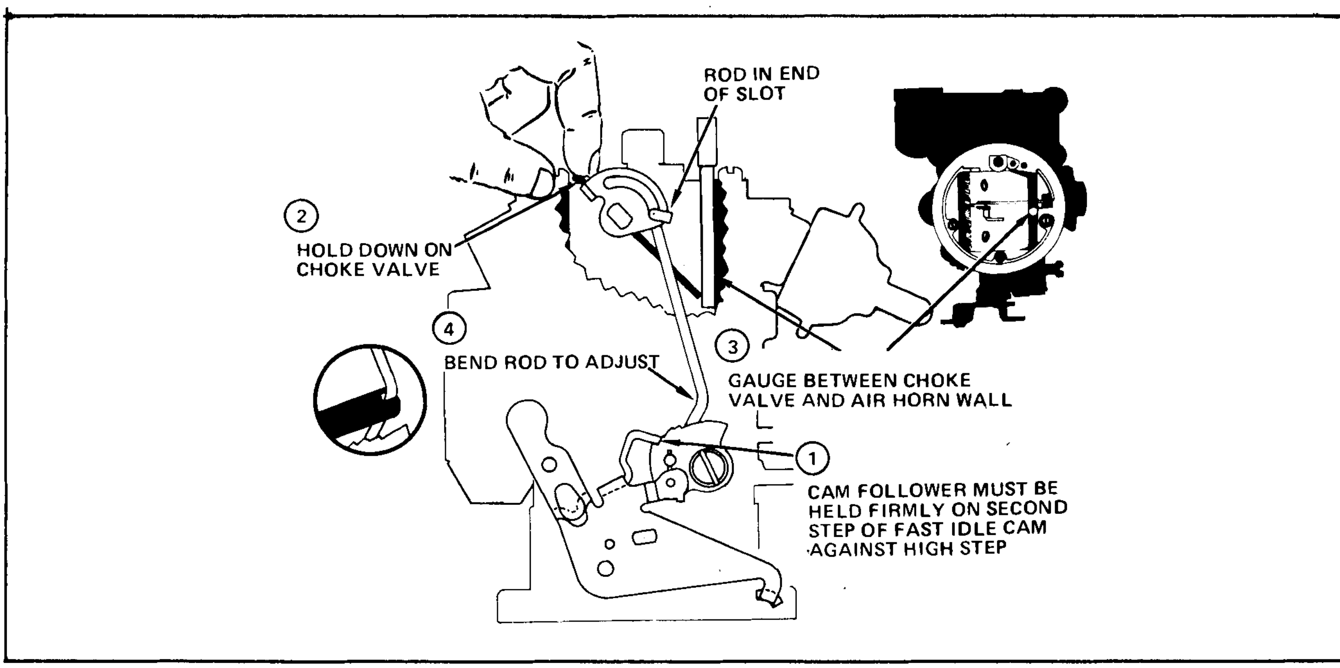


Fig. 6B-27 Choke Rod Adjustment

VACUUM BREAK ADJUSTMENT (Fig. 6B-28)

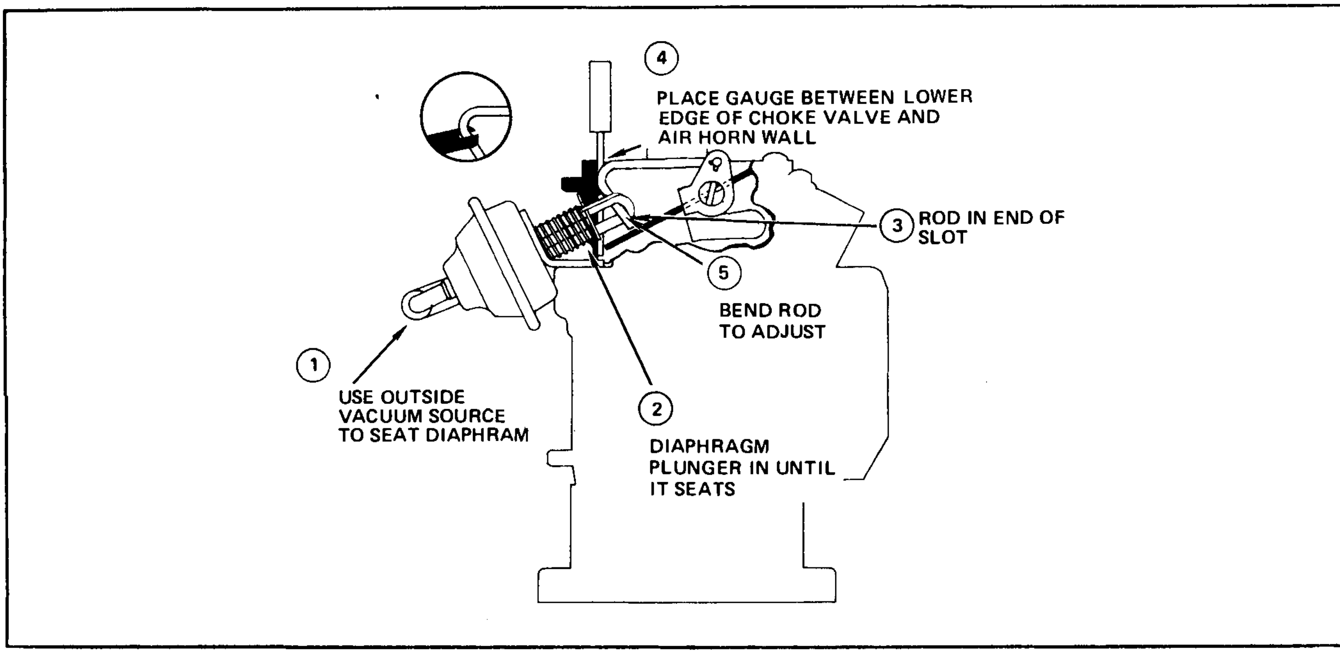


Fig. 6B-28 Vacuum Break Adjustment

CHOKE COIL ROD ADJUSTMENT (Fig. 6B-30)

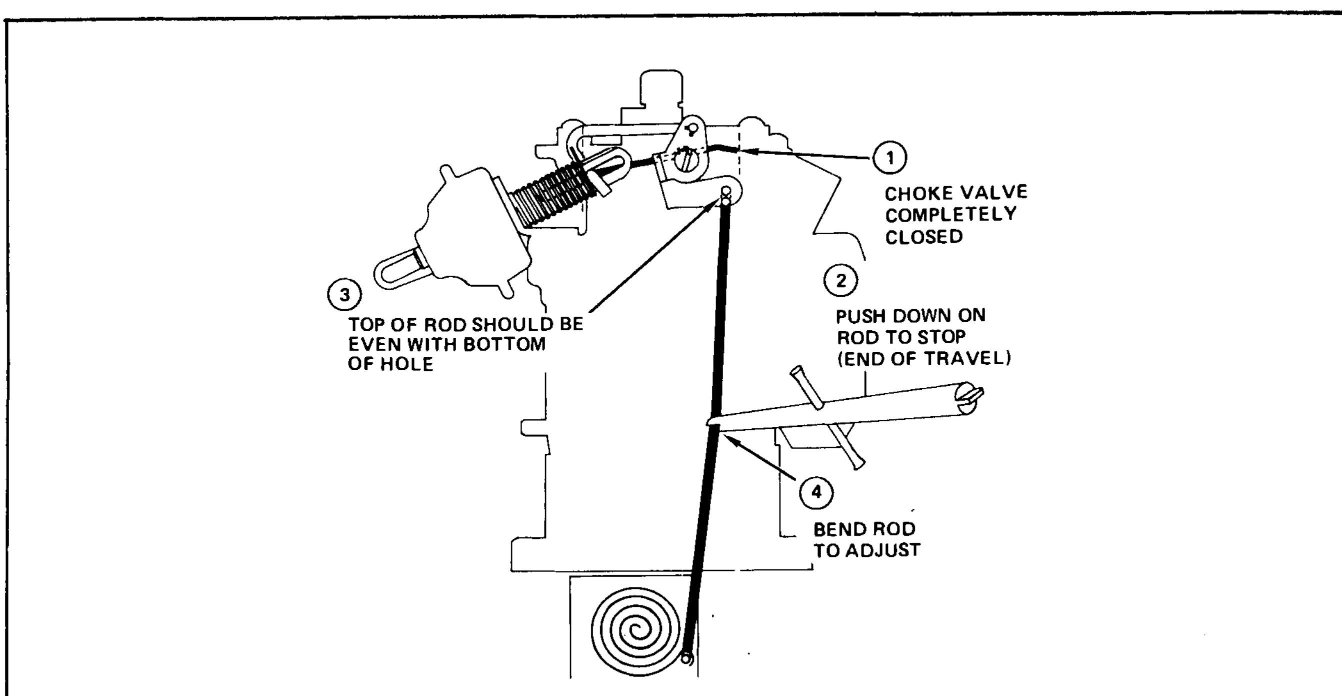


Fig. 6B-30 Choke Coil Rod Adjustment

UNLOADER ADJUSTMENT (Fig. 6B-29)

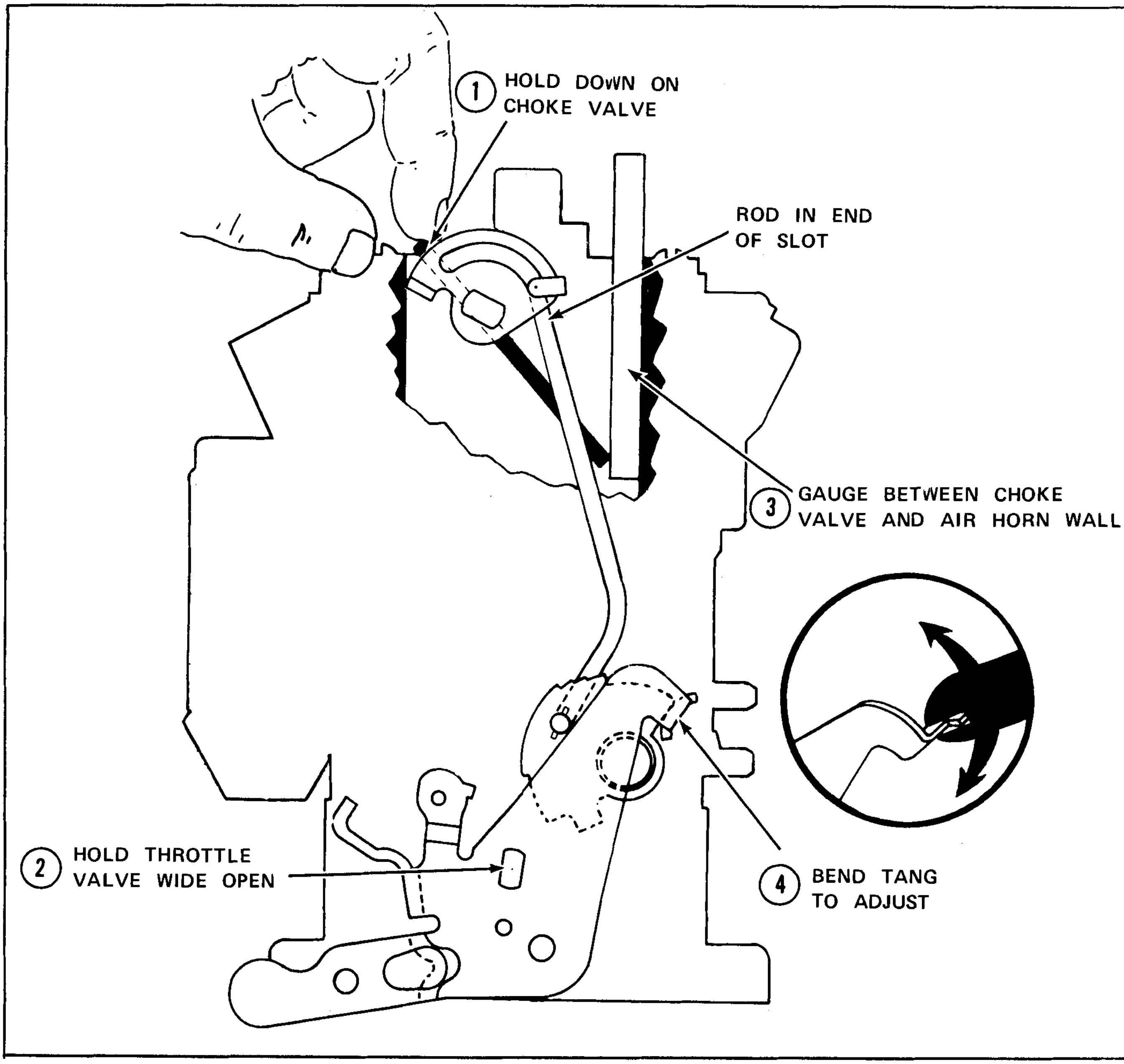


Fig. 6B-29 Unloader Adjustment

WGD CARBURETOR

DESCRIPTION AND OPERATION OF WGD 2-BARREL CARBURETOR

GENERAL DESCRIPTION

The WGD Carter carburetor used on 350 Manual engines is a 2-barrel, down draft, offset bowl type (Fig. 6B-31). It contains a float system, low speed (idle) system, high speed system, power system, accelerating system and plateau choke assembly (automatic choke).

Air enters both barrels of carburetor through the air horn which has one inlet and contains the choke valve. Fuel is supplied to both barrels from one float chamber. The float chamber is on the forward side of both barrels and contains a single float and lever assembly which operates a float needle or valve. The accelerating pump jet in each barrel is supplied with fuel from one pump located in the float chamber. The power systems of both barrels are controlled by one vacuum piston and link.

Except as noted above, each barrel forms a complete carburetor system. Each barrel contains a low speed system with a fixed adjustment screw, a high speed system with a metering rod, an accelerating pump discharge jet, a triple venturi and a throttle valve. The throttle valves of both barrels are mounted in line on one shaft. The dual construction combines the advantages of two carburetors in one compact unit. The dual carburetor and dual intake manifold provide more uniform distribution of fuel to all cylinders than would be possible with one single barrel carburetor.

Operation of each system of the WGD Carburetor carburetor is described in the following sub-paragraphs.

OPERATION OF WGD FLOAT SYSTEM

Fuel enters the carburetor at the gasoline connection and flows through the needle seat into the float chamber. When the fuel reaches the prescribed level in float chamber, the float presses the needle against its seat to shut off the flow of fuel. Thereafter, the fuel is maintained at the prescribed level by opening and closing of needle as required. The float chamber is vented internally through a port in the air horn to allow fuel to be smoothly withdrawn through the various systems (Fig. 6B-32).

Operation of WGD Low Speed or Idle System

Fuel is delivered to the engine through the low speed system at closed throttle and light load speeds up to approximately 20 MPH. The low speed system also partially controls fuel supply for light load speeds up to approximately 30 MPH.

The operation of the low speed system in each barrel of the carburetor is identical. Fuel flows from the float chamber through the metering rod jet into a passage which supplies both the low speed jet and the main nozzle. It then flows upward through the low speed jet which meters the fuel used by the low speed system. At the upper end of the low speed jet, the fuel is combined with a stream of air coming in from the carburetor throat through a bypass. The combining of the air stream with the fuel tends to atomize or break up the gasoline into a vapor (Fig. 6B-33).

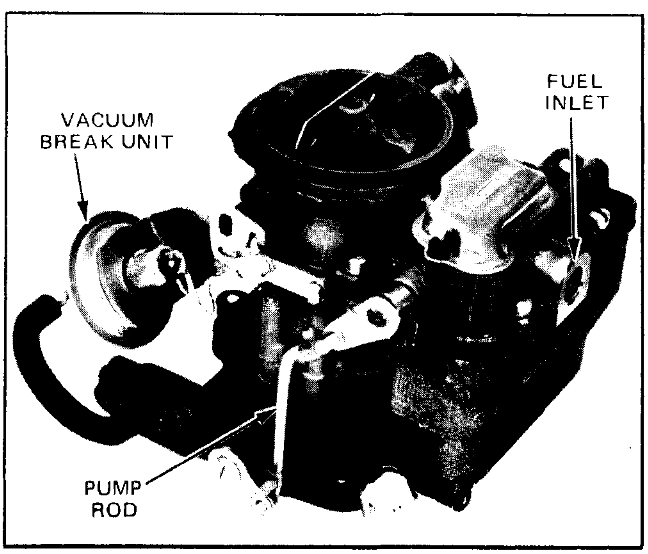


Fig. 6B-31 Carter WGD Carburetor Assembly

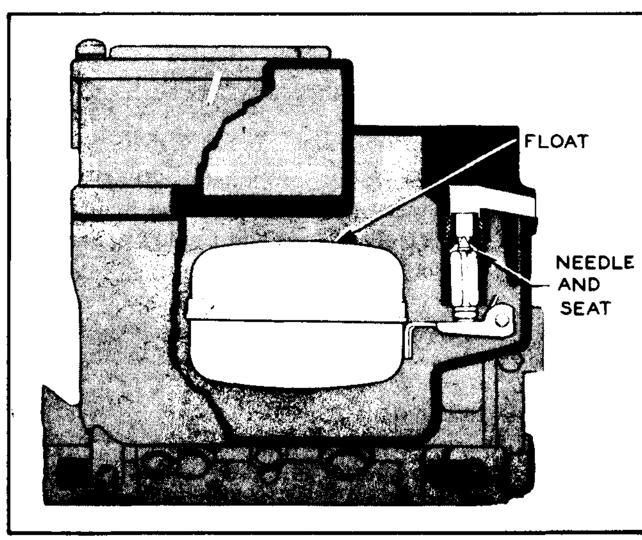


Fig. 6B-32 Float System

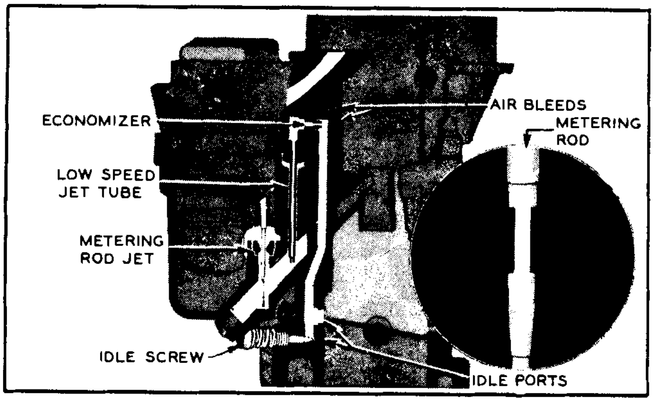


Fig. 6B-33 Low Speed System

The fuel-air mixture passes through a small drilled passage called the economizer and is combined with an additional air stream coming through the air bleed from the throat of the carburetor. This additional air tends to break the fuel particles into a still finer vapor.

The fuel-air mixture that flows downward through the idle mixture passage and out through the two idle ports is still richer than an idle mixture needs to be but, when it mixes with the air coming past the throttle valve, it forms a combustible mixture of the right proportions for idle speed. The idle adjustment screw permits regulation of the quantity of mixture supplied through the lower port. Plastic idle limiter caps are installed on all idle mixture screws.

The upper idle port is slotted vertically. As the throttle valve is opened, it not only allows more air to come in past it but also uncovers more of the idle port, thereby allowing a greater quantity of the fuel-air mixture to enter the carburetor throat from the idle mixture passage (Fig. 6B-33).

The closed position of the throttle valve is such that at idle speed of 8 to 10 MPH, it leaves enough of the slotted idle port in reverse to cover the range in speed between idle and the point where the high speed system begins to operate.

As the speed increases from approximately 20 MPH, the low speed system starts cutting out, as the high speed system is carrying the entire load and the low speed system is doing nothing.

A fuel vapor collection canister is used in all 1972 model vehicles. The purpose of the vapor canister is to store raw fuel vapors from the fuel tank which is vented to it, as the tank has no external vents.

In order to purge the canister of these raw fuel vapors, a constant purge system and a variable purge system are used.

During normal engine idle, the constant bleed purge is in operation. It is a small bleed hole located in the canister. In order to provide additional purge to the vapor canister. The purge valve on top of the vapor canister is actuated by a signal through a hose from an extra port in the throttle bore. This provides additional purge during off idle and part throttle operation.

OPERATION OF WGD HIGH SPEED SYSTEM

The high speed system controls the flow of fuel during intermediate or part throttle operation starting at approximately 20 MPH.

The operation of the high speed system in each barrel of the carbutetor is identical. Air entering the barrel through the air horn passes through the triple venturi system which increases the velocity of the air and creates a suction on the main nozzle. This causes fuel to flow from the float chamber through the metering rod jet into the main nozzle from which it is discharged into the air stream passing through the small venturi. The triple venturi system tends to atomize or break up the fuel into a vapor and mix it with the air stream (Fig. 6B-34).

If any vapor bubbles are formed in the hot gasoline in the main nozzle passage, they rise in the low speed jet well and the vapor exhausts through the anti-percolator passage into the barrel. This avoids percolating difficulties which might occur if vapor bubbles rose directly into the main nozzle.

The amount of fuel entering the high speed system is metered or controlled by the area of the opening between the metering rod jet and the end of the metering rod which extends into the jet. The lower end of the metering rod has steps with different diameters to provide different metering areas, depending upon the position of the metering rod in the jet. The metering rod is connected by a link, countershaft and connector rod to the throttle shaft so that is is raised when the throttle valve is opened and lowered when the throttle valve is closed.

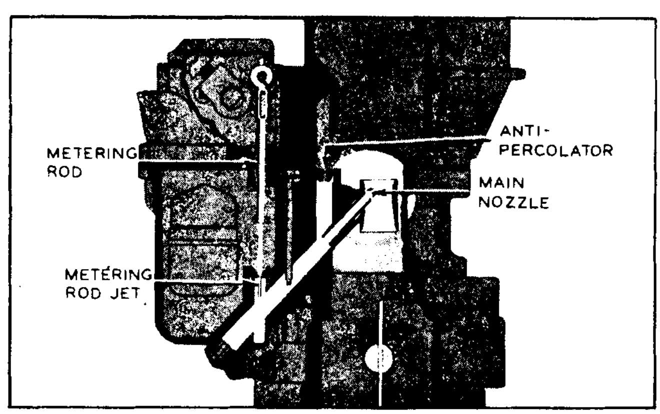


Fig. 6B-34 High Speed System

At approximately 20 MPH, the largest or economy step of the metering rod extends into the jet, thereby giving the smallest possible metering area. As the throttle valve is opened for higher speed or greater power, the metering rod is raised so that a tapered sectibn and later the smallest or power step provides increased metering area between rod and jet. At top speed, the smallest or power step is in the jet.

Engines operated at part throttle on level road use a mixture of maximum leanness. The mixture for greatest power and acceleration is somewhat richer and is furnished by the power and accelerating systems described below.

OPERATION OF WGD POWER SYSTEM

For maximum power at any speed for all operation above approximately 75 MPH, a richer mixture is required than that necessary for normal throttle opening. The richer mixture is supplied through the high speed systems of both barrels of carburetor by means of the power system.

The power system consists of a vacuum piston located in a cylinder connected to manifold vacuum, a spring which tends to push the piston upward against manifold vacuum and a vacumeter piston link attached to the piston and supporting the two metering rods (Fig. 6B-35).

Under part throttle operation, manifold vacuum is sufficient to hold the piston and link down against the tension of the spring, so that the link is held against the tongue of the metering rod arm. The metering rods are then raised and lowered mechanically as the throttle valve is opened and closed. When the throttle valve is opened to a point where additional fuel is required for satisfactory operation, manifold vacuum decreases sufficiently so that the piston spring moves the piston, link and metering rods upward to the proper metering rod step position to give the required richer mixture, independently of throttle opening. As soon as the demand is passed, manifold vacuum moves the piston link down against the metering rod arm so that the metering rods are controlled mechanically again.

OPERATION OF WGD ACCELERATING SYSTEM

The accelerating system supplies the extra quantity of fuel which is needed momentarily for smooth and rapid acceleration when the throttle valve is suddenly opened.

A pump plunger, operating in a cylinder cast into the float chamber, is mechanically operated from the throttle valve shaft by means of the throttle shaft arm, throttle connector rod, pump operating arm and countershaft assembly, pump arm and pump arm link. The pump circuit contains intake and discharge check valves and discharge passage leading to a pump jet in each barrel of carburetor (Fig. 6B-36).

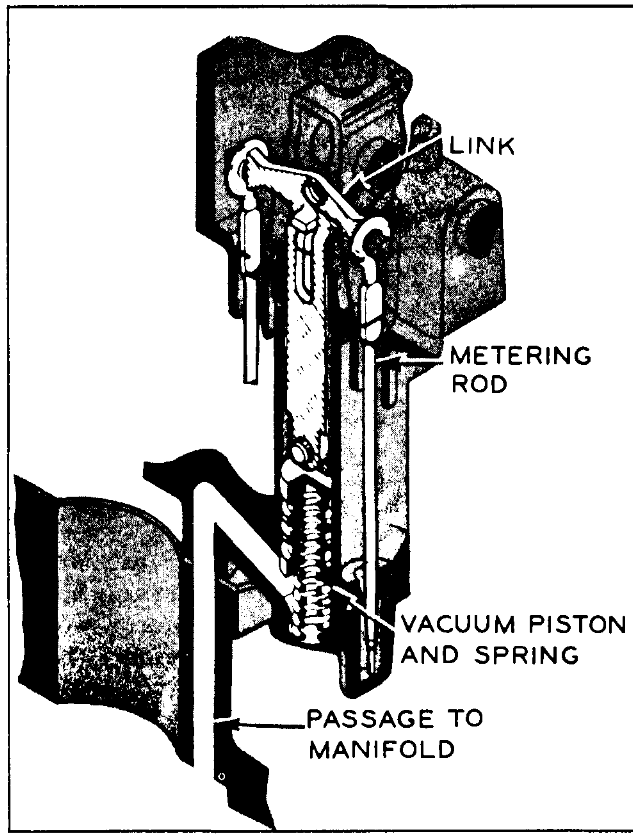


Fig. 6B-35 Power System

When the throttle is closed, the pump plunger moves up and draws a supply of fuel from the float chamber past the intake ball into the pump cylinder. When the throttle is opened, the pump plunger on its downward stroke exerts pressure on the fuel which presses the intake ball against its seat, raises the check needle off its seat and discharges a metered quantity of fuel through the pump jets into each barrel of carburetor. This occurs only momentarily during the accelerating period. The pump plunger spring provides a follow-up action so that the fuel discharge carries out over a brief period of time (Fig. 6B-36).

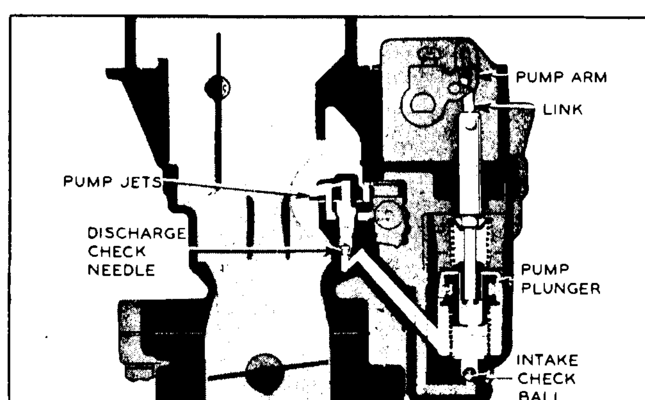


Fig. 6B-36 Accelerating System

When the desired speed is reached and the throttle is held in fixed position, the pressure on the fuel in pump cylinder decreases sufficiently so that fuel ceases to discharge from the pump jets. With the throttle held in a fixed position, the fuel flows only through the low speed or high speed systems as previously described.

At high speeds, pump discharge is no longer necessary to insure smooth acceleration. When the throttle valves are opened a pre-determined amount, the pump plunger bottoms in the pump cylinder, eliminating pump discharge due to pump plunger movement at high speeds.

DESCRIPTION AND OPERATION OF WGD AUTOMATIC CHOKE

GENERAL DESCRIPTION

The automatic choke consists of a choke valve, mounted on a shaft in the carburetor air horn, a vacuum diaphragm unit, fast idle cam, choke linkage and a thermostatic coil which is located on the engine manifold. The thermostatic coil is connected to the choke valve by a rod. The choke operation is controlled by a combination of intake manifold vacuum, the off-set choke valve and temperature (Fig. 6B-37).

The thermostatic coil located on the engine manifold is calibrated to hold the choke valve closed when the engine is cold. When starting the engine, air velocity against the off-set choke valve causes the valve to open slightly, against the torque of the thermostatic coil. When the engine is started, manifold vacuum applied to the vacuum diaphragm unit mounted on the carburetor air horn will open the choke valve to a point where the engine will operate without loading or stalling.

The vacuum break diaphragm unit has been changed in that a tension spring has been added to the choke vacuum break diaphragm plunger. The purpose of the tension or (bucking) spring is to off-set tension of the thermostatic coil in relation to atmospheric temperatures.

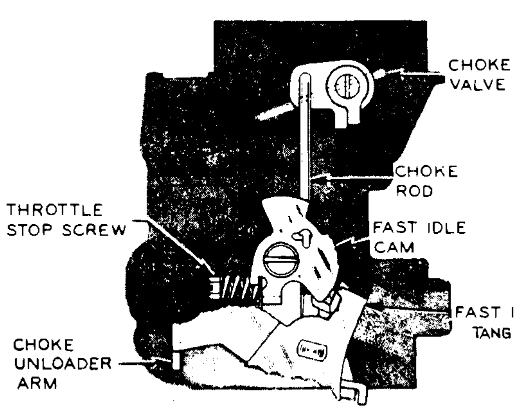


Fig. 6B-37 Choke System

With the addition of the bucking spring, the choke valve can be modulated through the thermostatic coil so that leaner mixtures are maintained during warmer temperatures and richer mixtures for colder temperature operation. This is accomplished in the following manner:

During extreme cold operation, the thermostatic coil has considerably more pressure than during warmer temperatures, consequently, the thermostatic coil operating against the spring on the vacuum diaphragm plunger compresses the plunger spring further and thus the choke valve does not open as far, allowing richer mixtures for the colder temperature. Conversely, during warmer temperatures, the thermostatic coil has less tension during the starting period so that the plunger spring is not compressed as much and consequently, the vacuum break diaphragm plunger opens the choke valve further supplying a leaner mixture for the warm up period. In this manner, choke valve opening through the vacuum break diaphragm can be varied to give the correct fuel mixtures, according to outside temperature.

The choke valve will remain in the vacuum break position until the engine begins to warm up and heat from the exhaust manifold warms the thermostatic coil to relax its tension and allows the choke valve to gradually open. Opening of the choke valve is controlled by air flow past the off-set choke valve and manifold heat acting upon the thermostatic coil.

If the engine is accelerated during warm-up, the corresponding drop in manifold vacuum to the vacuum diaphragm allows the thermostatic coil to momentarily close the choke providing a richer mixture.

During warm-up it is necessary to provide a fast idle to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke linkage. The fast idle tang on the throttle lever contacts the fast idle cam and prevents the throttle valves from returning to the idle position until the choke valve is fully open.

If the engine becomes flooded during the starting period, the choke valve can be partially opened to allow increased air flow through the carburetor. This is accomplished by depressing the accelerator pedal to the floor. The unloader projection on the throttle lever contacts the unloader lug on the fast idle cam and in turn partially opens the choke valve.

ADJUSTMENT OF FAST IDLE CAM, CHOKE UNLOADER AND FAST IDLE TANG

If the engine operates on fast idle too long after starting or else moves to slow idle too soon, or the choke unloader does not operate properly, check the following adjustments with the carburetor either on the engine or on the bench:

1. Remove air cleaner. Open throttle to clear fast idle cam and close choke valve. With choke valve held fully closed and stop on fast idle cam against the casting, there should be .005" minimum clearance between inner and outer choke levers (Fig. 6B-38).

2. If there is not enough clearance between levers, bend outer lever lug, using Tool J-4552 (or needle nose pliers) as required to obtain proper clearance (Fig. 6B-39).

   NOTE: *With choke fully closed, tang on fast idle cam must clear stop on throttle body flange.*

3. Hold choke closed lightly. Fully open throttle, forcing choke valve open.

4. Check clearance between upper edge of choke valve and wall of air horn, using a 3/16" drill (Fig. 6B-40).

5. If clearance is not correct, bend the unloader arm as required to obtain specified clearance.

6. With carburetor on engine, rotate fast idle cam so that fast idle tang contacts high step of cam. Then, adjust fast idle tang to obtain engine speed of 1500 R.P.M. with engine at normal operating temperatures (Fig. 6B-41).

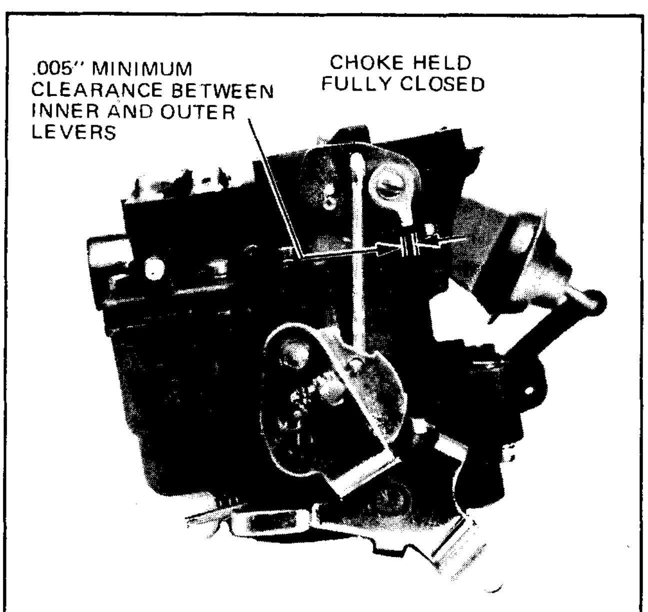


Fig. 6B-38 Checking Fast Idle Cam Position

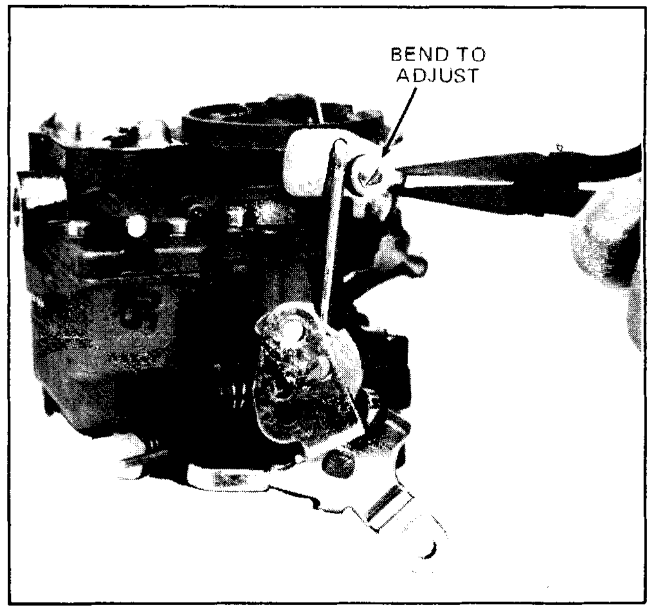


Fig. 6B-39 Adjusting Choke Lever Clearance

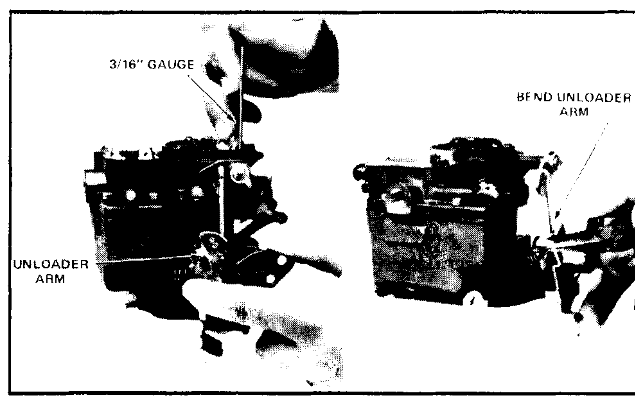


Fig. 6B-40 Choke Unloader Adjustment

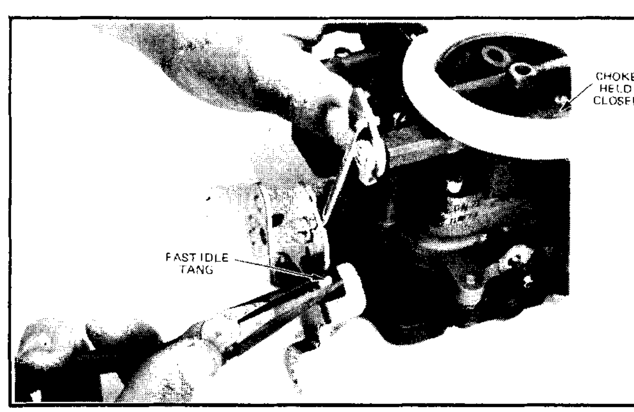


Fig. 6B-41 Adjusting Fast Idle Speed (On Engine)

DISASSEMBLY, CLEANING AND INSPECTION OF WGD 2-BARREL CARBURETOR

DISASSEMBLY OF CARBURETOR

1. Place carburetor on a suitable mounting fixture, such as J-5923. Remove hair-pin from upper end of fast idle rod.
2. Remove choke vacuum break diaphragm hose from the throttle body flange.
3. Remove hair-pin from lower end of choke break link and remove link.
4. Remove the vacuum break diaphragm unit from the air horn by removing two attaching screws.
5. Remove pump rod spring clips and pump rod. Remove dust cover and gasket. Rotate eyes of metering rods off pins on vacumeter piston link and lift rods out, using care to avoid bending them (Fig. 6B-42).
6. Loosen set screws in metering rod arm and pump arm. Pull countershaft and spring out, removing arms at the same time. Leave pump arm link attached to arm (Fig. 6B-44).
7. Remove eight (8) air horn screws. Remove air horn, using care to avoid damaging float. Swing vacumeter piston 1/4 turn to remove it from vacumeter link, then remove link from air horn. Leave metering rod spring in link (Fig. 6B-43).
8. Remove float lever pin and lift off float assembly. Shake float to see if it is "loaded" with gasoline due to a leak. Remove float needle seat and gasket. Remove air horn gasket (Fig. 6B-43).
9. Choke valve and shaft must be free of dirt and carbon accumulations. If necessary to disassemble, remove screen from end of choke shaft, then both levers and spacer. File ends of choke valve screws and remove. Remove choke valve and shaft.
10. Remove pump plunger assembly and lower pump spring from main body. Remove vacuum piston spring (Fig. 6B-43). assembly and lower pump spring. Remove vacuum piston spring. See Fig. 6B-45.
11. Check fuel in bowl for contamination by dirt, water, gum or other foreign matter. A magnet moved through the fuel will pick-up and identify any iron oxide dust that may have caused float needle and seat leakage. Then, empty fuel from bowl.
12. Remove pump inlet ball check retainer, using Remover T 109-56 or a stiff wire having a short hook on the end. Remove both metering rod jets. Remove pump jet screws, jet housing and gasket. Invert carburetor and catch pump inlet check ball and outlet check needle (Fig. 6B-43).
13. Remove four screws from bottom of carburetor, which connect the lower throttle body to the main body. Remove main body and gasket from throttle body.

   CAUTION: *Never attempt to remove main nozzles or anti-percolator vents from main body.*

14. Do not remove the idle mixture adjusting needles unless it is necessary to clean or replace the throttle body flange, or if the idle mixture needles are damaged. New red idle mixture limiter caps are provided in the repair kit. Before the new limiter caps are installed, it will be necessary to re-set the idle mixture according to the specifications outlined in Section 6D.

   NOTE: *The throttle body need not be disassembled further for normal cleaning and inspection.*

CLEANING CARBURETOR PARTS

Regardless of the number of new parts that are used in rebuilding a carburetor, the job in the end will not be satisfactory unless all metal parts are thoroughly cleaned. Because of the nature of carburetor parts, with numerous small passages subject to fouling with tenacious carbon and gum deposits, ordinary cleaning processes are entirely inadequate. The correct procedure is to use a cleaning bath in which metal parts can be immersed and "soaked" for sufficient time after dissassembly to thoroughly clean all surfaces and passages. Blow out all passages in castings with compressed air and blow off all parts so they are free of solvent.

Do not soak cork, plastic or leather parts in the cleaner. Wipe such parts with a clean cloth.

Remove all carbon from barrels of the body flange so that throttle valves may close properly. Be sure to clean all carbon out of idle ports.

INSPECTION OF CARBURETOR PARTS

After being thoroughly cleaned, all parts of the carburetor should be carefully inspected for wear or damage as follows:

1. Check choke shaft for free action in air horn. If shaft is worn so that excessive play in bearings exists, replace the shaft assembly.

2. Bowl Cover. Check for warped surfaces with a straight edge. Small nicks and burrs should be smoothed down to eliminate air or fuel leakage. Make sure that idle channels are clean and clear.

3. Float, Needle and Seat. Because of the wear that normally occurs in these parts and the necessity of having a tight seating needle, it is advisable to replace these parts if the carburetor has been used for considerable mileage. Even if mileage is low, replace these parts if needle is grooved or seat is damaged.

4. Low Speed Jets. Test jets by blowing or sucking to make sure that metering holes are clear. Inspect small ends for damage which might deform the metering holes.

5. Metering Rods, Jets and Spring. Metering rods and jets are subject to wear in normal use. If carburetor has been used for considerable mileage, it is advisable to replace these parts since wear cannot readily be detected by inspection. If metering rod spring in vacumeter piston link is distorted or damaged, it should be replaced since it performs an important function in keeping wear of metering rods and jets at a minimum.

6. Vacumeter Piston. Inspect vacumeter piston and its cylinder for scoring or roughness. Piston and cylinder must be clean and smooth. If piston spring is distorted, it should be replaced.

7. Accelerating Pump Parts. Inspect countershaft assembly for wear of shaft and make sure that lever is tight on countershaft. Inspect throttle connector rod and holes in throttle shaft arm and pump operating lever for excessive wear. Inspect pump plunger leather washer for cracks, creases, turned edges or other damage. Check holes in plunger shaft and pump arm, also pump arm link, for excessive wear.

   Inspect pump intake ball for corrosion and the retainer for distortion.

   Inspect pump check needle and replace it if tapered end is grooved or scored. Make sure that needle seat in main body is clean. Blow through each pump jet to make sure it is clean.

8. Main Body. If passages in main body appear to be clogged with carbon and gum to such an extend that penetration of cleaning solution is doubtful, remove both nozzle passage rivet plugs using Rivet Extractor. Do not attempt to remove nozzles or anti-percolator plugs from main body under any circumstances.

   After passages are thoroughly cleaned, drive new rivet plugs securely into body openings, using care to avoid distortion of plugs or openings.

9. Throttle Body Parts. Be sure that the idle discharge

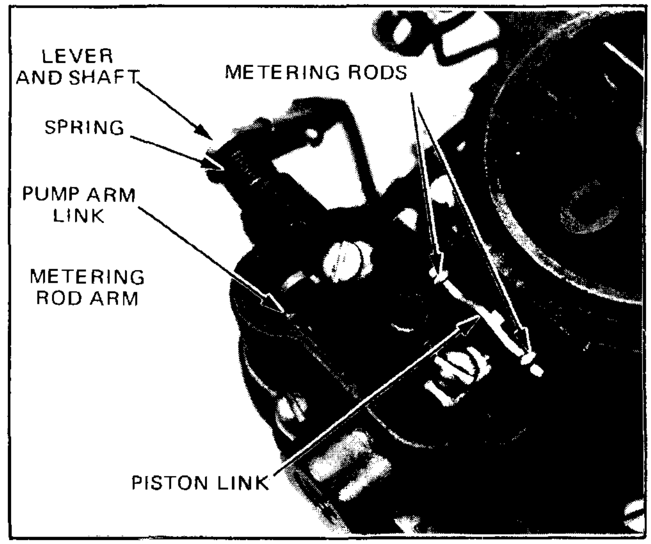


Fig. 6B-42 Metering Rod and Pump Operating Parts

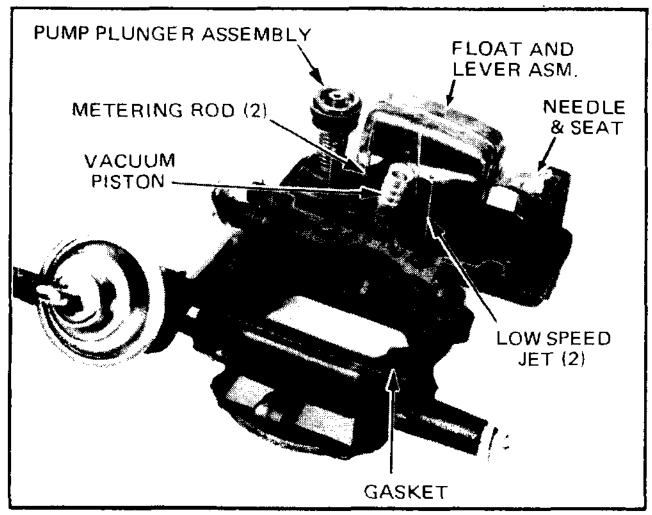


Fig. 6B-43 Air Horn Parts

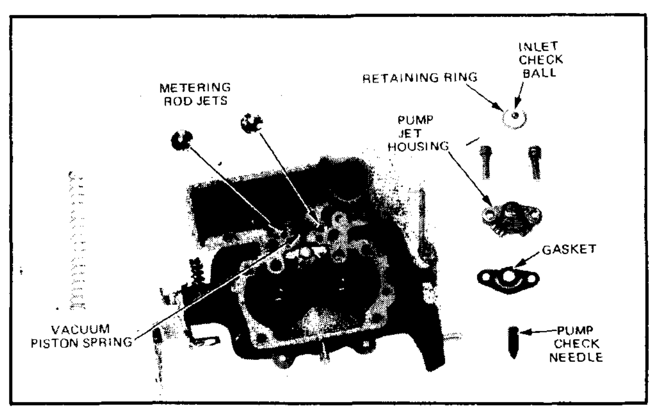


Fig. 6B-44 Main Body Parts

ports are clean of all carbon deposits and that the seats for idle adjustment screws are not damaged. If ends of adjustment screws are grooved or bent, they should be replaced.

Check wear of throttle shaft bearing and throttle shaft. There should not be more than about .005" play between shaft and bearings, otherwise air leaks will interfere with performance. Make sure that throttle valves are not bent and do not have burrs or sharp edges.

ASSEMBLY AND ADJUSTMENT OF WGD 2-BARREL CARBURETOR

During assembly of carburetor, use all new gaskets and any additional new parts found to be necessary during inspection.

1. Mount throttle body on fixture. If it was necessary to remove the idle mixture needles, install the idle mixture needles and springs into the throttle body until finger tight. Back out screws 1 1/4 turns as a preliminary idle adjustment.

   NOTE: *Do not install the plastic idle limiter caps furnished until after the idle mixture has been adjusted on the engine. Refer to Section 6D for setting procedure.*

2. Place new gasket on throttle body and install main body.

3. Place a new pump inlet check ball in inlet hole and install retainer firmly in seat.

4. Install pump outlet check needle point downward in pump outlet well, then install a new gasket, the discharge jet housing and screw. Install both metering rod jets (no gaskets used).

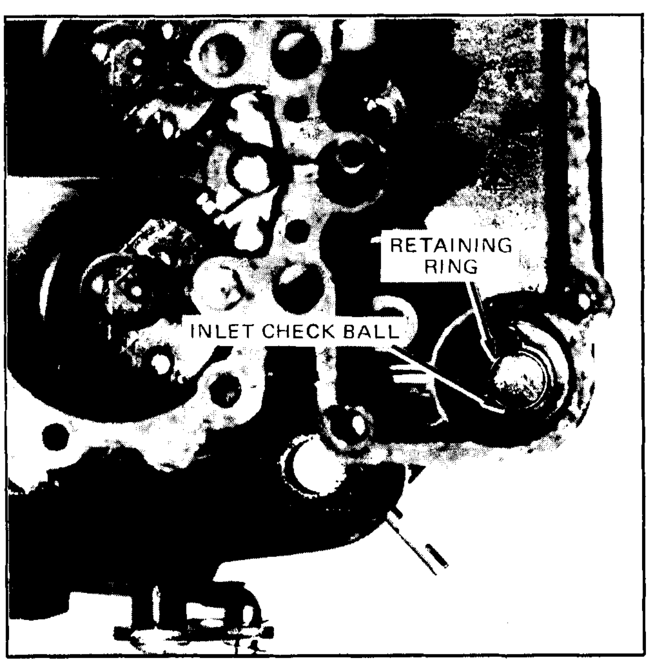


Fig. 6B-45 Installing Inlet Check Ball Retainer

5. Install vacuum piston spring. Install lower pump spring and pump plunger assembly, using care to avoid curling edges of plunger leather washer.

6. Install choke shaft assembly. Install choke valve with markings up; use new screws. With screws slightly loosened, close choke valve tightly to center it, then tighten screws. Check for uniform clearance and freedom from sticking in all positions. Choke mechanism is free if choke valve will fall open from its own weight. If valve fits properly, support heads of screws on a suitable steel block and stake opposite ends.

7. Install float needle seat and gasket. Use a large enough screw driver to completely fill slot so as to avoid damage to it. Install float needle, float and float pin, leaving gasket off.

8. With air horn inverted, adjust float as follows:

   (a) Check to see that float is parallel with outer edge of air horn casting. Adjust, if necessary, by bending float arm.

   (b) Place 5/16" Gauge between air horn and **center** of float. If necessary, adjust float level by bending float arm until float just touches gauge.

   NOTE: *When adjusting float, care must be exercised to avoid pressing the flared tip needle into the needle seat as a false setting may result.*

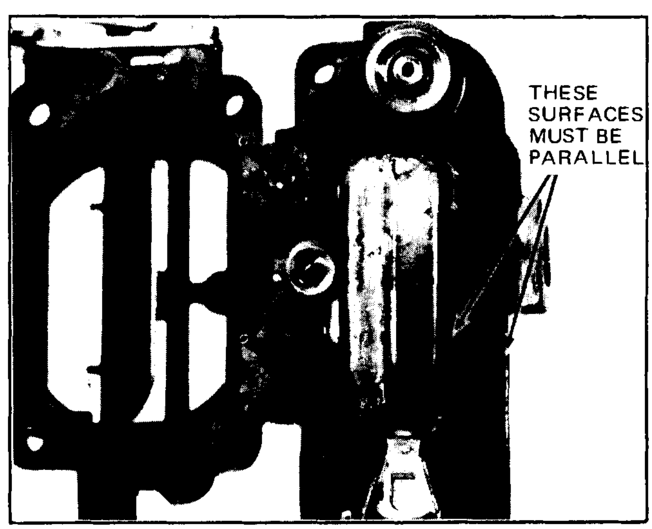


Fig. 6B-46 Checking Float Alignment

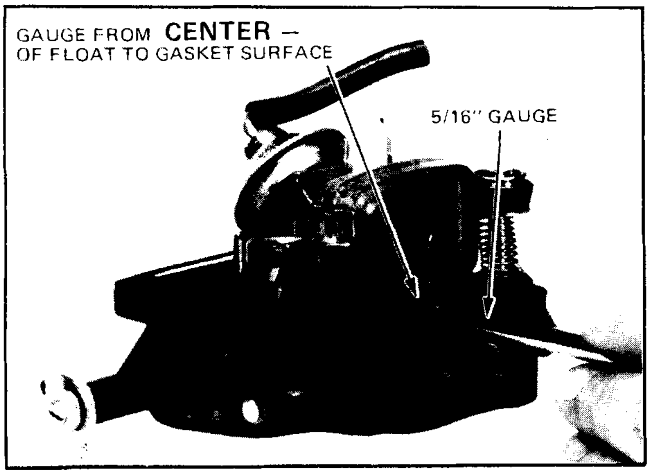


Fig. 6B-47 Checking Float Level

Allow weight of float only to seat needle when gauging.

Float must not have excess clearance at hinge pin and muust operate freely (Fig. 6B-47).

9. Install vacumeter link and metering rod spring assembly with protruding lip in guide slot toward air horn. Place gasket on main body. Install vacumeter piston on link.

10. Carefully install air horn assembly, guiding vacumeter piston and pump plunger shaft into their respective bores. Use care to avoid pressure against the float which would change its adjustment. Install air horn screws evenly and securely, starting from the center.

11. Position pump countershaft arm and link assembly through hole in pump plunger shaft. Position vacumeter link arm with finger through hole in vacumeter link. Install countershaft return spring on countershaft and coat countershaft with light graphite grease. Then, push countershaft through both arms as far as possible and tighten pump arm locking screw.

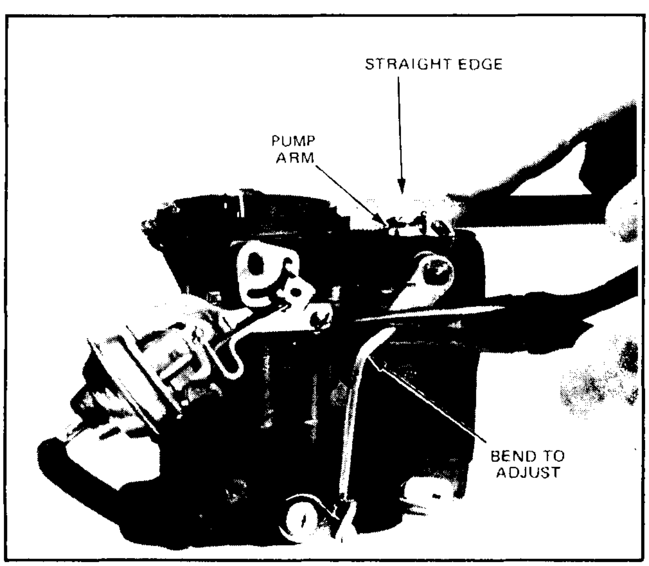


Fig. 6B-48 Checking and Adjusting Pump

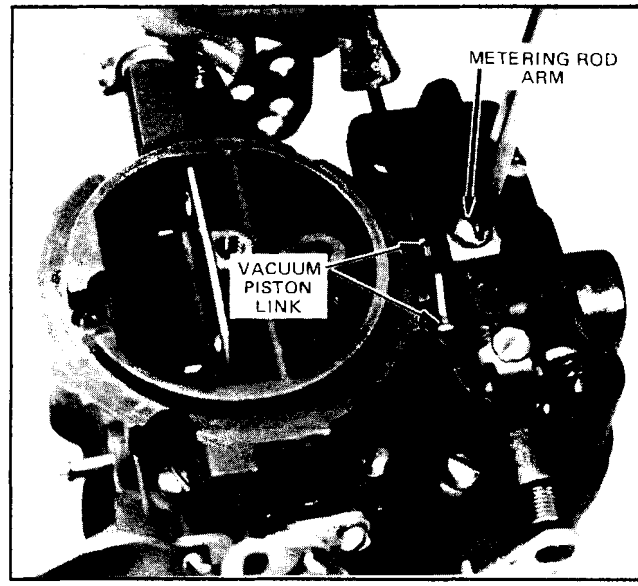


Fig. 6B-49 Adjusting Metering Rods

12. Using a wire hook, wind countershaft return spring 1/2 turn and hook on boss on casting. Install pump rod and two spring clips with offset end of rod up.

13. To adjust pump plunger, back out throttle stop screw, turn fast idle cam to "hot" position and fully close throttle valves. Place 1/4" Gauge or a similar straight edge across dust cover boss; it should be parallel with top surface of pump arm. If arm is not parallel, adjust by bending pump rod at offset, (Fig. 6B-48).

14. Insert end of each metering rod in hooked end of metering rod spring, carefully push rod down to enter metering rod jet, then rotate eye of rod over pin on vacumeter link. Use care to avoid bending metering rod.

15. To adjust metering rods, back out throttle stop screw, fully close throttle valves and press down on vacuum piston link until metering rods bottom. While holding rods down and metering arm tongue against lip of vacuum piston link, carefully tighten metering arm set screw (Fig. 6B-49).

16. While holding throttle valves in fully closed, turn throttle stop screw IN (Clockwise) until it just contacts, then turn screw IN exactly one turn. This setting should give an approximate idle speed for initial warm-up.

17. Install large choke shaft lever with collar inward and counterweight toward bowl. Then install washer, outer choke lever and screw.

18. Install fast idle rod and hair-pin retainer.
19. Adjust fast idle cam, choke unloader and fast idle screw as described previously.
20. Pack two countershaft lubrication holes with light graphite grease. Install dust cover, gasket and screws.
21. Make final idle speed and mixture adjustments on car in the normal manner as described previously.
22. Make final fast idle speed adjustment as described previously.

2GV CARBURETOR

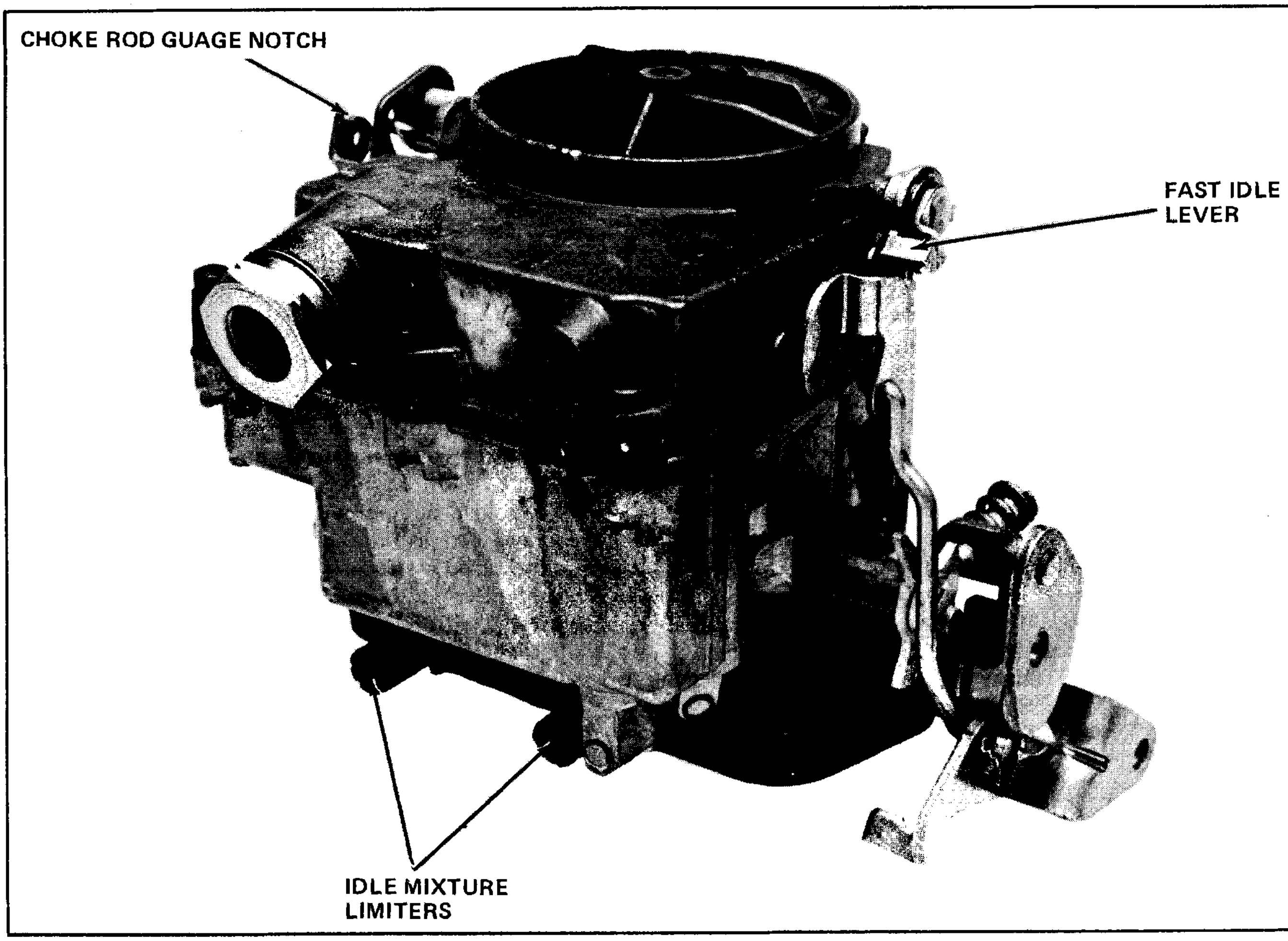
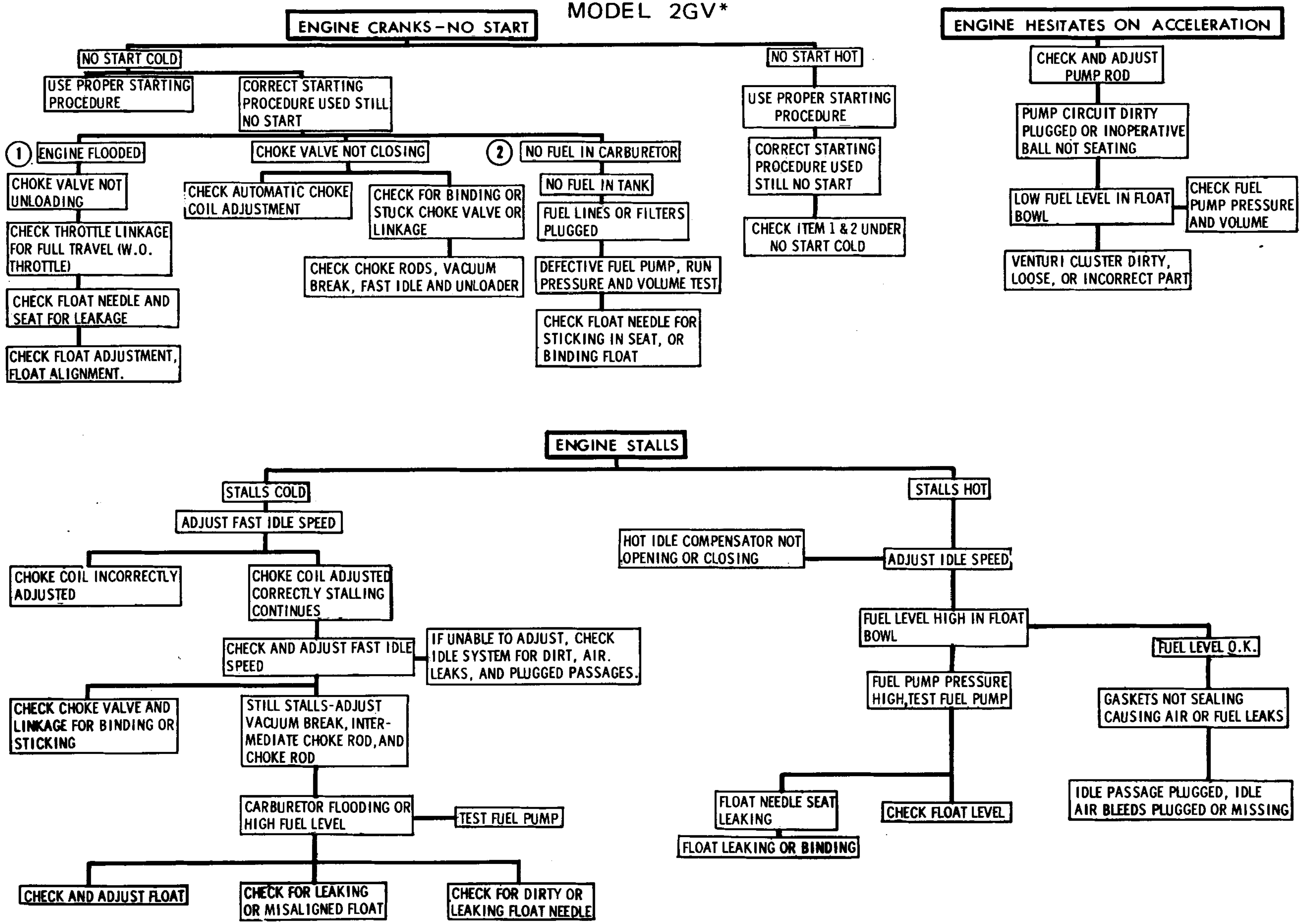


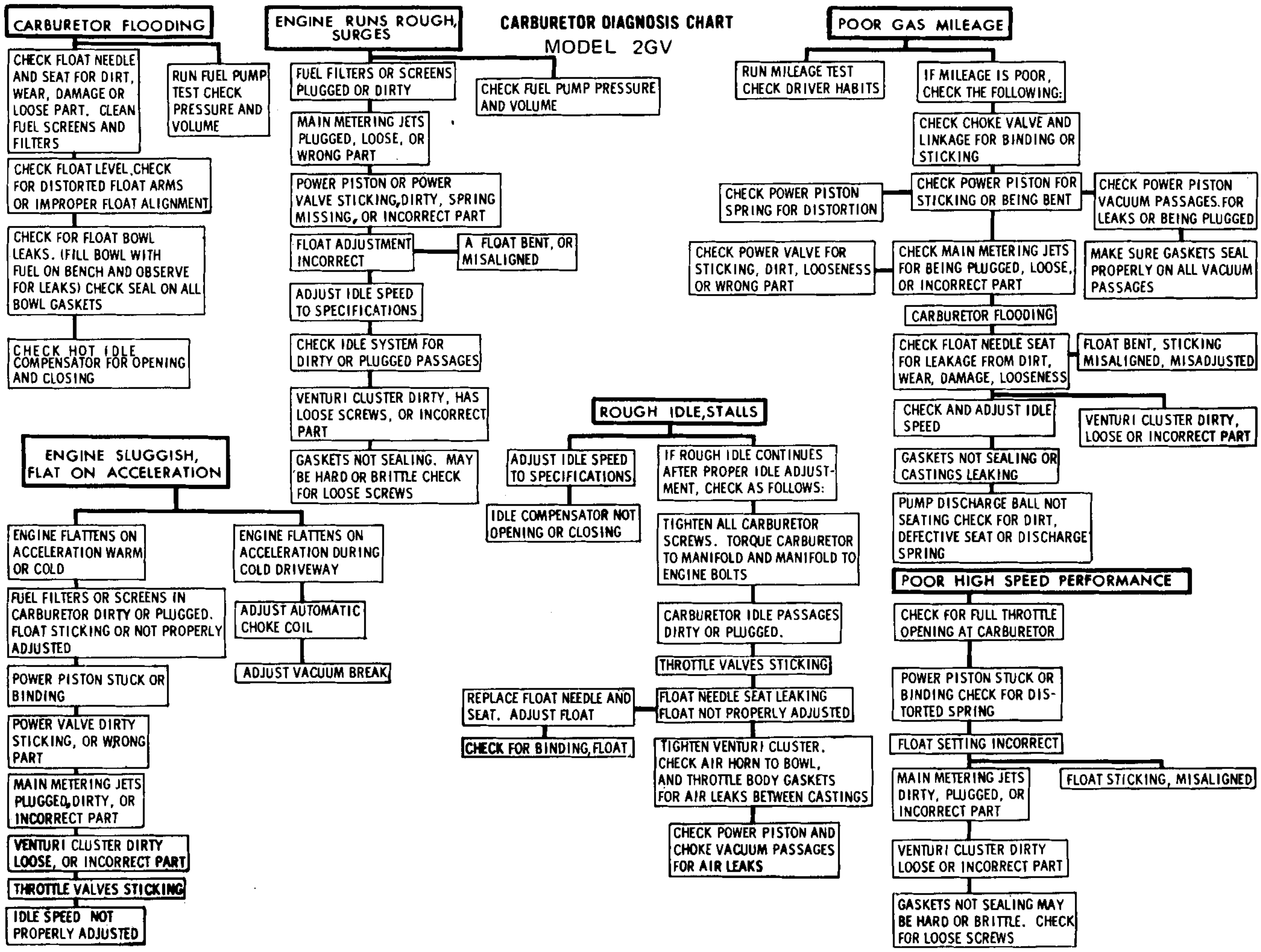
Fig. 6B-50 2GV Carburetor

CARBURETOR DIAGNOSIS CHART

MODEL 2GV*



*Although these charts are designed for diagnosing problems in the 2GV carburetor, these charts can also be helpful in diagnosing WGD carburetor problems.



GENERAL DESCRIPTION

The Rochester Model 2GV 1-1/4" carburetor used on the Ventura II is very similar in operation to the Model 2GV 1-1/2" carburetors used on the larger engines.

The following differences should be noted so that the Technician can become familiar with the correct service procedures:

1. The float assembly is made of hollow brass and is used in place of the solid plastic float.

2. The main fuel wells have metal inserts with perforated holes which surround the main discharge nozzles. The purpose of the main well inserts is to provide smooth fuel flow from the main wells during hot engine operation.

3. The pull-over enrichment circuit is not used in this particular carburetor application. However, there is an adjustable part throttle feature which is used in metering refinement during part throttle operation. The adjustable part throttle metering device is pre-set at the factory and plugged. No adjustment should be attempted in the field.

4. The combined emission control valve (C.E.C. valve) is not used and is replaced by the idle stop solenoid. Normal idle speed setting is made by adjusting the plunger screw in the idle stop solenoid. This setting should be made using information located on the decal in the engine compartment.

5. The choke system uses the delayed vacuum break diaphragm unit. When the engine is started, vacuum is applied to the choke vacuum diaphragm which opens the choke valve, against the choke coil tension to a point where the engine will run without loading or stalling lean. To delay the choke valve opening too fast, an internal check valve is used in the choke vacuum diaphragm unit. After the engine starts,

vacuum is applied through the check valve to the vacuum break diaphragm, causing the vacuum break diaphragm to move slowly inward. This gives sufficient time to overcome engine friction and allow the engine manifold to be wetted to prevent a lean stall.

A choke closing assist spring has been added to the vacuum break diaphragm plunger stem. The spring assists in closing the choke valve, along with tension from the remote choke thermostatic coil, for imporved cold starting. The choke closing assist spring only exerts pressure on the vacuum break link to assist in closing the choke valve during engine starting.

When the engine starts and the choke vacuum break diaphragm seats, the closing spring retainer hits a stop on the plunger stem and no longer exerts pressure on the vacuum break link.

The 1972 model 2GV for Pontiac is similar in operation to the 1971 models, except for the following design changes:

1. A new throttle lever is used to meet the 1972 engine design change requirements.
2. The pull over enrichment circuit is used on all model 2GV applications to provide the desired enrichment at higher engine speeds.
3. A variable choke vacuum break unit is used which has a tension spring mounted in the plunger head that works against the tension of the thermostatic coil. Incorporated in the variable vacuum break unit is a bleed check valve which delays opening of the choke valve to the vacuum break position a few seconds, until the engine will run at a slightly leaner mixture.
4. The carburetor has been completely recalibrated to meet the 1972 engine requirements.

The Model 2GV carburetor is of the side bowl design. The carburetor float bowl is located forward of the main bores of the carburetor. The carburetor is compact in design in that all fuel metering is centrally located. The carburetor uses a calibrated cluster design in which is placed the main well tubes, idle tubes, mixture passages, air bleeds and pump jets. The cluster can easily be removed for cleaning and inspection purposes. The venturi cluster fits on a flat portion of the carburetor bowl in front of the main venturi with a gasket underneath. The idle and main well tubes are installed in the cluster body by means of a precision press fit and, therefore, cannot be serviced separately. The main nozzles and idle tubes are suspended in the fuel in the main wells of the float bowl.

The main metering jets are of a fixed type. Metering calibration is accomplished through a system of calibrated air bleeds, which give the correct air/fuel mixtures throughout all operational ranges.

The model 2GV carburetor employs the use of a vacuum operated power system for extra power when needed. Power mixtures are controlled by a drop in engine manifold vacuum, regardless of the degree of throttle valve opening. Thereby, additional fuel can be supplied for power enrichment according to engine demands.

The pump system has a vented pump plunger. The pump cup is of a synthetic material with an expander spring located between the cup and the plunger head. This ensures proper seating of the pump plunger cup at all times. The pump well is vented through the pump plunger head by channels between the rubber cup and the plastic pump plunger head, which leads from the pump well through the center of the pump cup bore, up past the upper sealing surface and outward into the float bowl. By venting the pump plunger, any vapors which form in the pump well are vented to the float bowl during hot engine operation. This ensures that the pump well and passages will be primed with solid fuel at all times, thereby, improving accelerator pump action.

The carburetor is internally vented through a hole which leads from beneath the carburetor air cleaner, inside the air horn bore, to the fuel in the top of the float bowl.

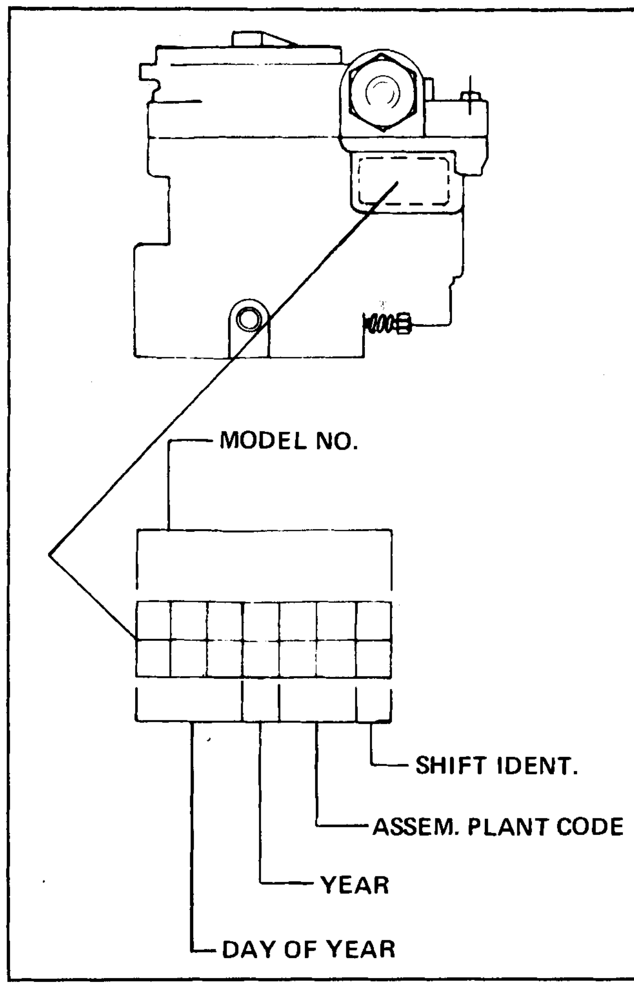


Fig. 6B-51 2GV Carburetor Identification Location

A center stud mounting provides for secure attachment of the carburetor air cleaner.

The carburetor part number is stamped on a horizontal section of the float bowl, near the fuel inlet nut (Fig. 6B-51). When replacing the float bowl assembly, follow the manufacturer's instructions contained in the service package so that the part number can be transferred to the new float bowl.

Plastic idle limiter caps are installed on all idle mixture needles. The idle mixture will be pre-set at the factory and no further fuel adjustment is required.

A variable vacuum break unit is used which has a tension spring mounted in the plunger head that works against the tension of the thermostatic choke coil. A bleed check valve is also incorporated to provide a slower choke opening for improved cold starts.

A fuel vapor collection canister is used in all models. The purpose of the vapor canister is to store raw fuel vapors from the fuel tank which is vented to the canister, as the fuel tank has no external vents.

In order to purge the canister of these raw fuel vapors, a constant purge system and a variable purge system are included in the carburetor throttle body.

Operation of the purge system is described in the "Idle System".

Six systems are utilized in the Rochester 2GV carburetor: float system, idle system, main metering system, power system, pump system and choke system. These systems are described and illustrated schematically in the following text:

OPERATING SYSTEMS

FLOAT SYSTEM

The float system (Fig. 6B-52) controls the level of fuel in the carburetor bowl. The float pontoon is solid and is made of a closed cell plastic material for added buoyancy.

Fuel level is very important because it must be maintained to provide proper metering through all operating ranges.

Fuel is supplied to the carburetor fuel bowl from the engine fuel pump. Fuel entering the carburetor must first pass through the inlet filter by the inlet needle seat, then pass the float needle into the float bowl; fuel flow continues until the fuel level raises the float to a position where it closes the float valve. As fuel is used from the carburetor bowl, the float drops, moving the float needle off its seat and replenishing the fuel in the float bowl, thereby, keeping the fuel level constant.

A float tang, located at the rear of the float arm between the float hanger posts, prevents the float assembly from moving too far downward, but also allows the float assembly to move down far enough for maximum fuel flow into the carburetor bowl. A float needle pull clip, connecting the float arm to the needle, keeps the float needle from sticking closed in the seat.

The fuel bowl is vented internally by a hole which leads from inside the air horn bore to the top of the fuel in the float bowl. The carburetor is internally balanced through the internal vent hole because the same pressure causing air to flow through the carburetor bores will be acting upon the top of the fuel in the float bowl, causing fuel to flow.

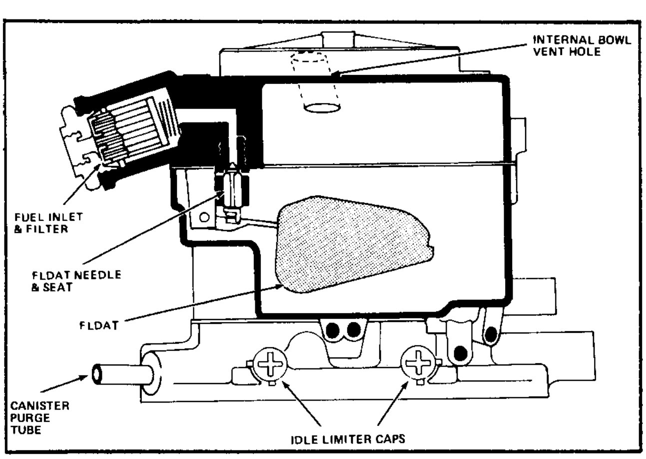


Fig. 6B-52 Float System

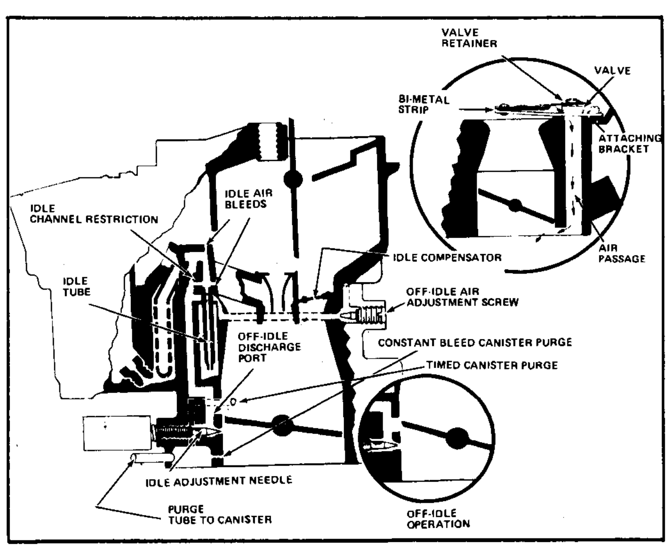


Fig. 6B-53 Idle System

IDLE SYSTEM

During engine idle operation, air flow through the carburetor venturi is very low and is not great enough to cause fuel to flow from the main discharge nozzles. Therefore, the idle system (Fig. 6B-53) is used to provide the proper mixture ratios required during idle and low speed operation of the engine.

The idle system consists of the idle tubes, idle passage idle air bleeds, idle mixture needles, off-idle discharg ports and the idle mixture needle holes.

In the idle position, the throttle valves are slightly open, allowing a small amount of air to pass between the wall of the carburetor bore and the edge of the throttle valves. Since there is not enough air flow for venturi action, the fuel is made to flow by the application of vacuum (low pressure) directly through the idle system to the fuel in the carburetor bowl.

Fuel from the float bowl passes through each main metering jet into the main fuel wells where it is metered by the orifice at the lower tip of the idle tubes. It then passes up the idle tubes and is mixed with air at the top of the idle tubes by calibrated idle air bleeds. The air/fuel mixture then passes downward through a calibrated restriction in the vertical passage, then past a second idle bleed just below the restriction and on downward past the off-idle discharge port to the idle mixture holes. The fuel mixture passes out the idle needle hole where it combines with air passing the slightly open throttle valves. The idle mixture needle controls the amount of fuel mixture which enters the carburetor bore at curb idle position of the throttle valves.

The idle mixture is pre-set at the factory and capped so that no adjustment will be required on the engine. If cleaning or mixture needle replacement is necessary during service operations, an adjustment procedure and new limiter caps will be provided in the repair kit.

A fuel vapor collection canister is used in all model vehicles. The purpose of the vapor canister is to store raw fuel vapors from the fuel tank which is vented to it, as the tank has no external vents.

In order to purge the canister of these raw fuel vapors, a constant purge system and a variable purge system are included in the carburetor throttle body. They operate as follows: The constand bleed and variable bleed ports are connected to a common tube located in the throttle body casting between the two idle mixture needles. The tube connects directly to the vapor canister through a hose. During normal engine idle, the constant bleed purge is in operation and is located below the throttle valve. This is a very small bleed hole which leads into the carburetor bore area and is used to pull vapors from the vapor canister during engine idle.

In order to provide additional purge to the vapor canister, two extra purge ports, located adjacent to the off-idle discharge slots, come in to operation during the off-idle and part throttle operation of the engine. This provides enough additional purge to the vapor canister for removing all vapors from it.

OFF-IDLE OPERATION

As the throttle valves are opened during acceleration, more fuel is needed and is supplied by the off-idle discharge port, which is gradually exposed to manifold vacuum. This port supplies additional fuel mixture for the increased engine speed requirements. Improved fuel control is achieved by an adjustable off-idle air bleed screw. The adjustment screw regulates air passing from a separate channel into the idle channel and adjustment is made at the factory. The adjusting screw is then sealed because this adjustment cannot be made in the field without adversely affecting carburetor calibration.

The hot idle compensator is used on air conditioned, F Series models (Auto. trans.) to offset enrichening effects caused by excessive fuel vapors from fuel percolation, during extreme hot engine operation. The compensator consists of a thermostatically controlled valve mounted in the area above the main venturi. The valve closes off an air channel which leads from above the carburetor venturi to a point below the throttle valves.

The compensator valve is operated by a bi-metal strip which senses temperature. During extreme hot engine operation, excessive fuel vapors entering the engine manifold cause richer than normally required mixtures, resulting in rough engine idle and stalling. At a certain pre-determined temperature, when extra air is needed to offset the enrichening effects of fuel vapors, the bi-metal strip bends and unseats a valve which uncovers the air channel leading from the carburetor venturi to below the throttle valves. At this time, just enough air is added to the engine to offset the richer mixtures and maintain a smooth engine idle. When the engine cools, the extra air is not needed, the bi-metal strip closes the valve and operation returns to normal mixtures.

In order to ensure proper idle adjustment, the valve should always be closed when setting engine idle speed and mixtures.

MAIN METERING SYSTEM

As the throttle valves continue to open, the edge of the throttle valves are gradually moving away from the wall of the carburetor bore, reducing the vacuum so that the discharge of the fuel mixture at the idle needle hole and off-idle port gradually diminishes.

With the increased throttle opening, there is increased velocity in the venturi system. This causes a drop in pressure in the large venturi which is increased many times in

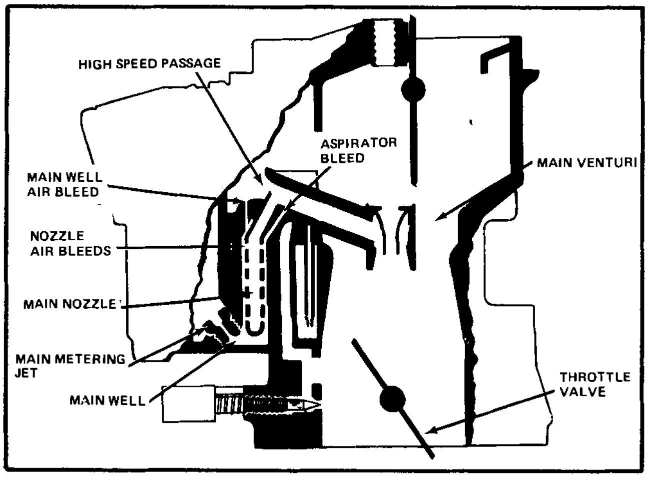


Fig. 6B-54 Main Metering System

the small venturi. Since the low pressure (high vacuum) is now in the small venturi, fuel will flow in the following manner:

Fuel from the float bowl passes through the main metering jets (Fig. 6B-54) into the main well and rises in the main well tubes. Air entering the main well through the main well air bleeds is mixed with fuel through calibrated holes in the main well tube. The mixture then moves up and out of the discharge nozzle into a channel where more air is added. The mixture then travels down the channel to the small venturi where it is delivered to the air stream passing through the venturi and then on into the intake manifold.

An additional fuel circuit has been provided which supplements the main metering system of the carburetor unit. In order to provide sufficient enrichment to the main metering system at higher air flows, two additional fuel feeds are located in the air horn just above the choke valve. They connect directly to the fuel in the float bowl, through channels which lead directly into a tube that extends into the fuel just above the main metering jets. At approximately 8 lbs. of air per minute and above, the extra fuel enrichment is added to supplement the main metering system.

With the addition of the pull over enrichment system, leaner mixtures can be maintained during the part throttle or cruising ranges and extra fuel supplied at higher air flows to meet engine demands.

POWER ENRICHMENT SYSTEM

To achieve the proper mixtures required when more power is desired or for extreme high speed driving, a vacuum operated power piston in the air horn and a power valve located in the bottom of the float bowl are used (Fig. 6B-55). Through a connecting vacuum passage from the base of the carburetor to the power piston cylinder in the air horn, the power piston is exposed to engine manifold vacuum at all times.

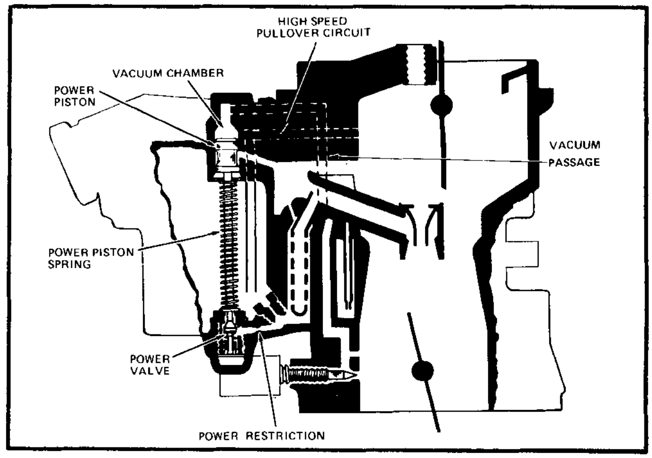


Fig. 6B-55 Power Enrichment System

During idle and part throttle operation, the relatively high vacuum holds the power piston up against spring tension and the power valve remains closed. Increase in engine load lowers the manifold vacuum. When it has dropped sufficiently, the power piston spring overcomes the upward vacuum flow and the power piston moves downward, opening the power valve to allow additional fuel to flow through calibrated restrictions into the main well.

As the engine load decreases, the resulting higher vacuum overcomes the spring tension on the power piston and raises the power piston, closing the power valve. It should be noted that the power piston cavity in the carburetor air horn is connected to the main air flow passage by a vacuum relief passage. The purpose of this passage is to prevent the transfer of vacuum acting on the piston from also acting on the top of the fuel in the float bowl. Any leakage of air past the upper grooves of the piston will be compensated for by this relief passage and will not affect carburetor metering.

PUMP SYSTEM

When the throttle valve is opened rapidly, air flow and

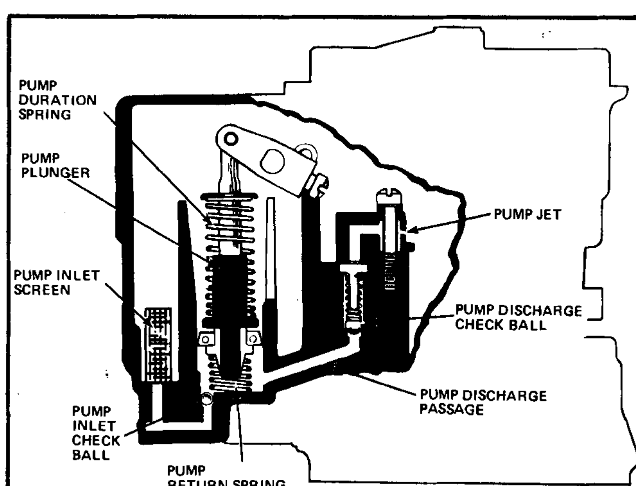


Fig. 6B-56 Pump System

manifold vacuum change almost instantaneously, while the heavier fuel tends to lag behind causing a momentary leanness. The accelerator pump (Fig. 6B-56) provides the fuel necessary for smooth operation on rapid acceleration.

Fuel for acceleration is supplied by a double spring loaded pump plunger. The top and bottom springs combine to move the plunger so that a smooth sustained charge of fuel is delivered for acceleration.

Fuel is drawn into the pump well through the inlet ball check on the upward stroke of the pump plunger.

Downward motion of the pump plunger, as on acceleration, seats the inlet ball check and forces the fuel through the pump discharge passage where it unseats the pump discharge ball and passes on through to the pump jets, where it sprays into the venturi area.

The expander spring located behind the pump cup ensures good contact between the lip of the pump cup and the pump well at all times. When the pump is not in operation, the pump cup unseats from the plunger head and acts as a vent for the pump well. If vapors form in the pump well during hot operation, they are vented between the head and the pump cup out into the fuel bowl. Without this pump vent, vapor pressure in the pump well might force fuel from the pump system into the engine manifold, causing hard starting when the engine is hot.

The pump discharge ball in the accelerator pump passage prevents any pump pullover or discharge of fuel from the pump nozzles when the accelerator pump is inoperative.

CHOKE SYSTEM

The purpose of the choke system is to supply richer fuel mixtures necessary during cold engine starting and warm up, plus maintain adequate fast idle to prevent engine stalling.

The choke system (Fig. 6B-57) consists of a choke valve located in the carburetor air horn, a vacuum diaphragm unit, fast idle cam, choke linkage and a thermostatic coil located on the engine manifold. The thermostatic coil located on the engine manifold is connected to the choke valve by a rod. Choke operation is controlled by a combination of intake manifold vacuum, the off-set choke valve and engine temperature.

The choke valve must be closed for cold engine starting. To close the choke valve, it is necessary that the accelerator pedal be depressed so that the fast idle screw attached to the throttle lever will clear the steps on the fast idle cam. This allows the choke valve to close through the tension of the thermostatic coil and places the fast idle screw on the top step of the fast idle cam.

When the engine is started, vacuum is applied to the choke vacuum diaphragm which opens the choke valve against coil tension to a point where the engine will run without loading or stalling. A bleed check valve internally located in the choke vacuum break diaphragm unit retards the action of the choke vacuum break diaphragm to provide slow opening of the choke valve after initial engine start. This allows sufficient time for fuel to wet engine manifold surfaces and reduce engine friction, to prevent the engine from stalling lean.

In addition to the delayed vacuum break unit, which retards the choke valve opening, a tension spring is used in the vacuum break diaphragm plunger to off-set tension of the thermostatic coil. With the addition of the tension (bucking) spring in the vacuum break diaphragm, the choke valve can be modulated through the thermostatic coil so that leaner mixtures are maintained during warmer temperatures and richer mixtures for colder temperature operation.

When the choke valve is moved to the correct opening position by the vacuum break diaphragm, it remains in this position until the engine begins to warm up and exhaust manifold heat warms up the automatic choke coil. This allows the choke valve to gradually open through air flow against the off-set choke valve and manifold heat acting of the choke coil. This action continues until the engine is warm and the choke valve is fully opened.

To prevent stalling during the warm up period, it is necessary to run the engine at a slightly higher idle speed than for a warm engine. This is accomplished through the fast idle screw which rests on steps of the fast idle cam and works directly off the throttle lever.

The fast idle cam is attached to the choke valve shaft through connecting linkage. The fast idle cam follows rotation of the choke valve and gradually reduces fast idle speed through graduated steps on the fast idle cam. This

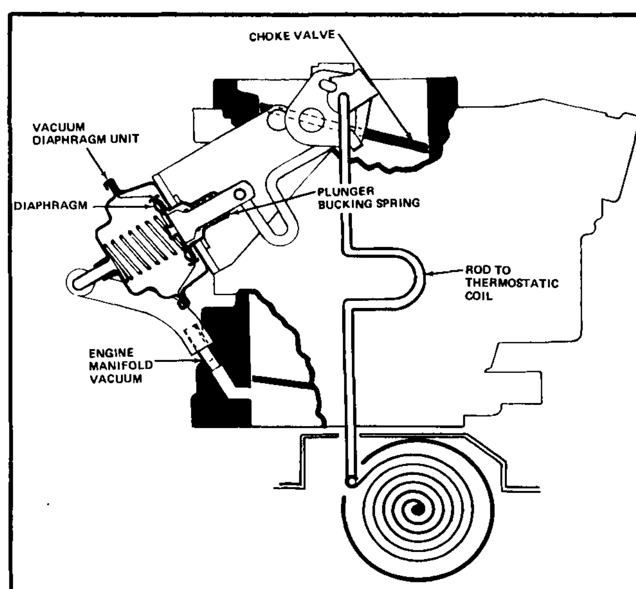


Fig. 6B-57 Choke System

continues until the choke valve is wide open. At this point the fast idle screw is on the lowest step of the fast idle cam and the engine is warm enough to run at normal idle speeds.

A choke unloader is provided should the engine become flooded during starting. The choke can be opened manually by depressing the accelerator pedal to the floor. This opens the choke valve sufficiently to lean out the mixtures so that the engine will start.

ADJUSTMENTS ON CAR

All Rochester 2GV adjustments can be performed on the car. With the exception of idle speed and mixture adjustment (outlined in Section 6D), all adjustments are included in the OVERHAUL AND ADJUSTMENTS procedure.

PERIODIC SERVICE

There are no periodic services required on the 2GV carburetor; however, choke linkage, choke valve and levers and pump linkage should be kept free of dirt and gum so that

2 GV			
Carburetor Model Number	A/C or Non A/C	Calif. or Non Calif.	Engine-Trans. Usage
7042060	Both	Non Calif.	400 2 Bbl. Auto.
7042061	Both	Calif.	400 2 Bbl. Auto.
7042062	Both	Non Calif.	350 2 Bbl. Auto.
7042064	Both	Both	455 2 Bbl. Auto.
2GV 1 1/4 (VENTURA II)			
7042100	Both	Non Calif.	307 Auto.
7042101	Both	Non Calif.	307 Man.
	WGD CARTER		
488062	Both	Both	350 Man.

they will operate freely. DO NOT OIL CHOKE VALVE SHAFT OR ANY PART OF THE LINKAGE.

The integral fuel filter in the carburetor air horn should be cleaned and replaced periodically. Normal recommendations are that it be cleaned or replaced during the normal engine tune-up or between approximately 10,000 to 12,000 miles. This will, of course, vary dependent upon fuel contamination.

OVERHAUL AND ADJUSTMENT

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 diagnosing the cause of complaint, the carburetor should be carefully removed from engine without draining fuel from bowl. The contents of fuel bowl may then be examined for contamination as carburetor is disassembled.

The following is a step-by-step sequence by which the 2GV carburetors may be completely disassembled and reassembled. Adjustments may be made and various parts of the carburetor may be serviced without completely disassembling the entire unit.

BOWL COVER

DISASSEMBLE

1. Remove fuel inlet filter retainer nut and gasket and remove filter (Fig. 6B-58).

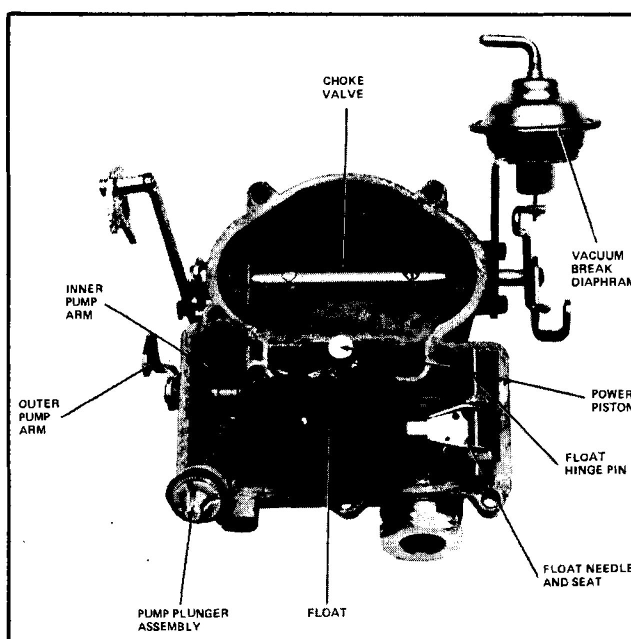


Fig. 6B-58 Air Horn Assembly

2. Disconnect pump rod from throttle lever by removing spring clip.
3. Remove upper end of pump rod from pump lever by rotating rod out of upper hole in lever.
4. Remove fast idle cam attaching screw from side of float bowl. The upper end of the choke link cannot be removed from the choke shaft until after air horn and choke valve are removed.
5. Remove choke vacuum break diaphragm hose from the choke vacuum break and throttle body assembly.
6. Remove vacuum break lever from end of choke shaft by removing retaining screw in end of shaft. Then, remove the vacuum break diaphragm unit from air horn by removing two attaching screws.
7. Remove eight air horn screws, then lift air horn from float bowl.
8. Place air horn on flat surface. Remove float hinge pin and lift float from cover. Float needle and pull clip may now be removed from float arm.
9. Remove float needle seat and gasket with a wide blade screw driver.
10. Remove power piston by depressing piston stem and allowing it to snap free. Use care not to bend the power piston stem.
11. A tang on the inner pump lever retains the pump plunger assembly in the inner pump lever hole. To remove the pump assembly from the inner pump lever, rotate the assembly until it clears the tang on the inner lever and then slide it out of the hole in the lever. The outer pump lever and shaft may be removed by loosening set screw on the inner lever and sliding outer lever and shaft assembly from the air horn.
12. The air horn gasket may now be removed.
13. 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 end on choke valve screws before removing.
14. Remove choke valve shaft from air horn.
15. Remove the fast idle cam and fast idle link and lever from the choke shaft.

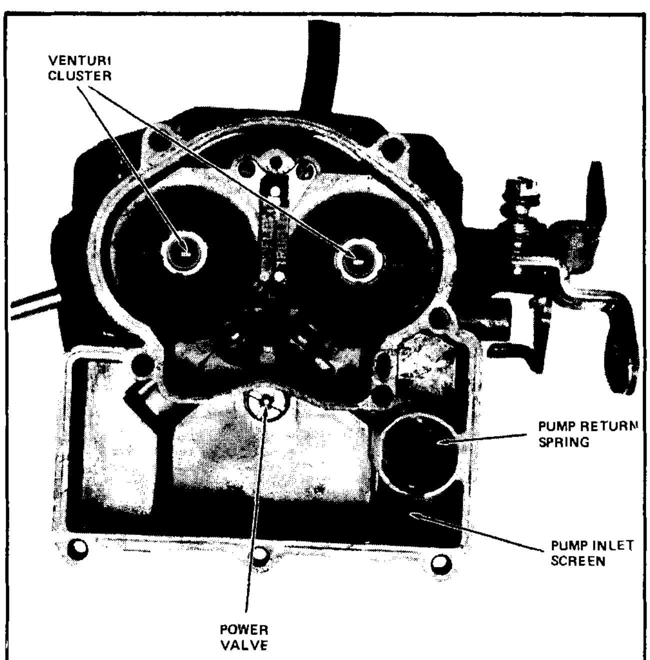


Fig. 6B-59 Float Bowl Assembly

FLOAT BOWL

DISASSEMBLE

1. Remove pump inlet filter screen and pump plunger

Fig. 6B-60 Removing Pump Discharge Spring Retainer return spring and remove aluminum check ball from bottom of pump well (Fig. 6B-59).

2. Remove main metering jets and power valve.

3. Remove three screws holding cluster to bowl and remove cluster and gasket (on 307 remove main well tubes).

4. Using a pair of long nose pliers, remove pump discharge spring retainer (Fig. 6B-60). Then, spring and check ball may also be removed.

5. Invert carburetor and remove three large bowl to throttle body attaching screws. Throttle body and gasket may now be removed.

THROTTLE BODY

DISASSEMBLE

1. Remove idle stop screw from throttle lever, if necessary to replace.

2. Do not remove the idle mixture adjusting needles unless it is necessary to clean or replace the throttle body assembly or if the idle mixture needles are damaged. New idle mixture limiter caps are provided in the repair kit. Before the new limiter caps are installed, it will be necessary to re-set the idle mixture according to specifications outlined in Section 6D.

NOTE: *No further disassembly of the throttle body is necessary. The throttle valves should not be removed from the throttle shaft as they are aligned at the factory and it may be difficult to align them properly.*

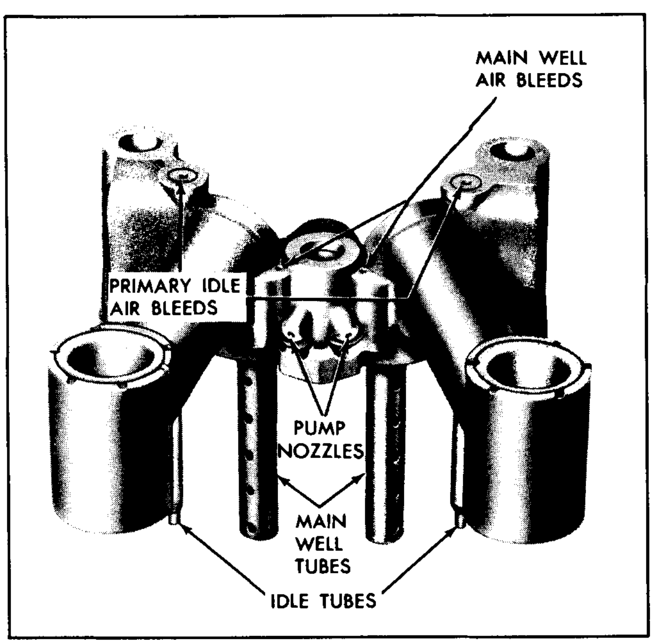


Fig. 6B-61 Venturi Cluster

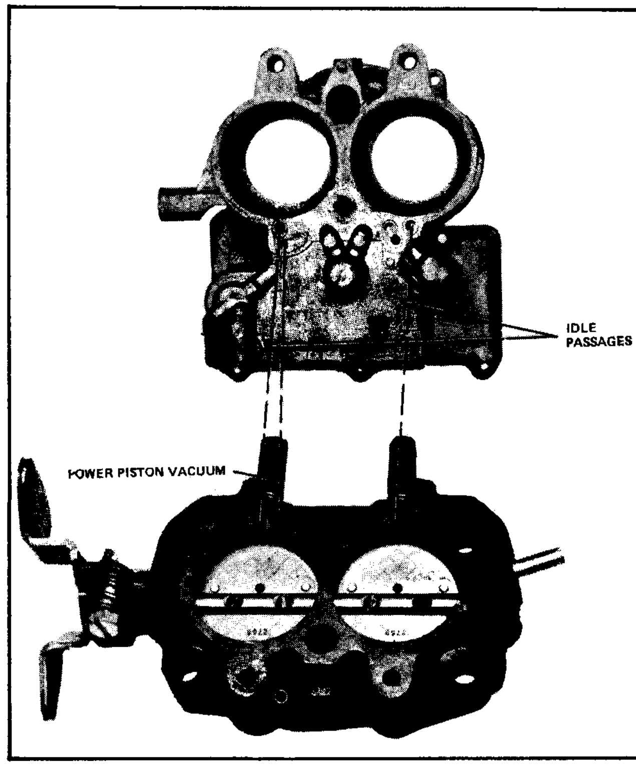


Fig. 6B-62 Throttle Body to Float Bowl Passages

CLEANING AND INSPECTION

Dirt, gum, water or carbon contamination in or on exterior moving parts of a carburetor are often responsible for unsatisfactory performance. For this reason, efficient carburetion depends upon careful cleaning and inspection while servicing.

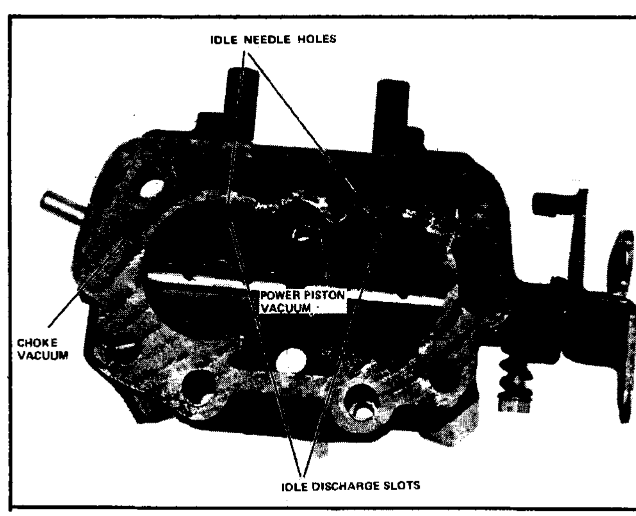


Fig. 6B-63 Throttle Body Passages

1. Thoroughly clean carburetor casting and metal parts in a clean cleaning solvent.

   CAUTION: *Vacuum break unit, gaskets and pump plunger should not be immersed in solvent. Clean pump plunger in clean gasoline only.*

2. Blow all passages in castings (Fig. 6B-61 through 6B-64) dry with compressed air and blow off all parts until they are dry.

   CAUTION: *Do not pass drills or wires through calibrated jets or passages as they may enlarge orifices and seriously affect carburetor calibration.*

3. Check all parts for wear. If wear is noted, defective parts must be replaced. Note especially the following:

   a. Check float needle and seat for wear. If wear is noted, the assembly must be replaced.

   b. Check float lip for wear and float for damage.

   c. Check throttle and choke shaft bores in throttle body and cover castings for wear or out of round.

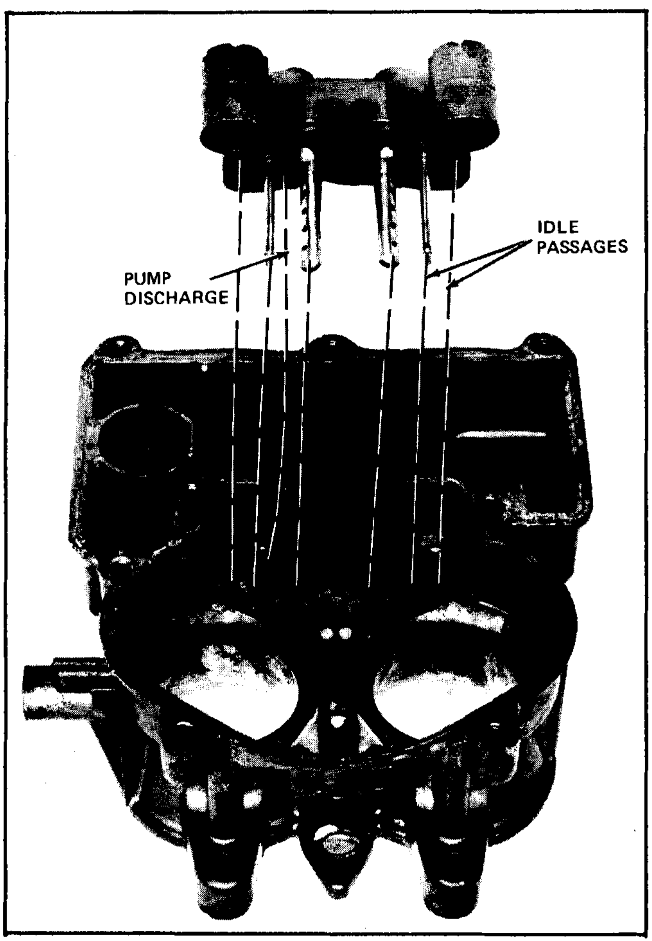


Fig. 6B-64 Float Bowl to Cluster Passages

   d. Inspect idle adjusting needles (if removed) for burrs or ridges. Such a condition requires replacement.

   e. Inspect fast idle cam. If wear is noted on steps of cam, it should be replaced as it may upset engine idle speed during the warm-up period.

   f. Inspect pump plunger cup. Replace plunger if cup is damaged.

   g. Inspect power piston and spring for burrs or distortion. Replace if necessary.

4. Check all filter screens for dirt or lint. Clean and, if they are distorted or plugged, replace with new parts.

5. Inspect cluster casting. If any parts in castings are loose or damaged, cluster assembly must be replaced.

6. Use new gaskets in reassembly.

ASSEMBLE

1. Install idle stop screw in throttle lever if removed.

2. If it was necessary to remove the idle mixture needles, install the idle mixture needles and springs into the throttle body until finger tight. Back out screws 4 turns as a preliminary idle adjustment.

   NOTE: *Do not install the plastic idle limiter caps furnished until after the idle mixture has been adjusted on the engine. Refer to Section 6D for setting procedure.*

3. Invert the float bowl, then place new throttle body gasket in position and attach the throttle body with three screws. Tighten the screws evenly and securely.

FLOAT BOWL

ASSEMBLE

1. Drop steel pump discharge check ball into pump discharge hole. Ball is 3/16" diameter (do not confuse with aluminum inlet ball). Install pump discharge spring and retainer.

2. Replace cluster main well tubes (307 only) and gasket, tighten screws evenly and securely. Make certain center screw is fitted with gasket to prevent pump discharge leakage.

3. Replace main metering jets and power valve.

4. Drop aluminum inlet ball check into hole in pump well. Install pump return spring, pressing with finger to center it in pump well.

5. Replace pump inlet strainer, pressing carefully into position.

AIR HORN

ASSEMBLE

1. Install upper choke lever onto choke shaft (link and cam assembly are permanently attached to the upper choke lever), with tang on upper lever facing outward away from air horn and above trip lever. Install choke shaft in air horn, then install choke valve on choke shaft, using two attaching screws. Letters RP on choke valve should face towards top of air horn. Center choke valve before tightening screws by maintaining approximately .020" clearance between the upper choke lever and air horn casting. Then, tighten choke valve screws and stake lightly in place. Choke valve should move freely in air horn bore.

FLOAT LEVEL ADJUSTMENT (Fig. 6B-65)

2. Install pump lever and shaft assembly into air horn casting. Then, install inner pump lever and tighten retaining screw securely.

   NOTE: *Be sure that choke link and fast idle cam assembly hangs straight down while installing pump lever and shaft (air horn right side up). Otherwise, choke link will not clear pump lever when final positioning of choke link is desired.*

3. Install pump plunger assembly into the hole on the inner pump arm by rotating pump assembly vertically until it passes the retaining tang. The end of the pump plunger shaft should point inwards towards center of air horn casting.

4. Install float needle seat and gasket, using wide blade screwdriver.

5. Install power piston assembly, if removed, and stake retaining washer lightly in place.

6. Install air horn gasket.

7. Install float needle pull clip and needle on float

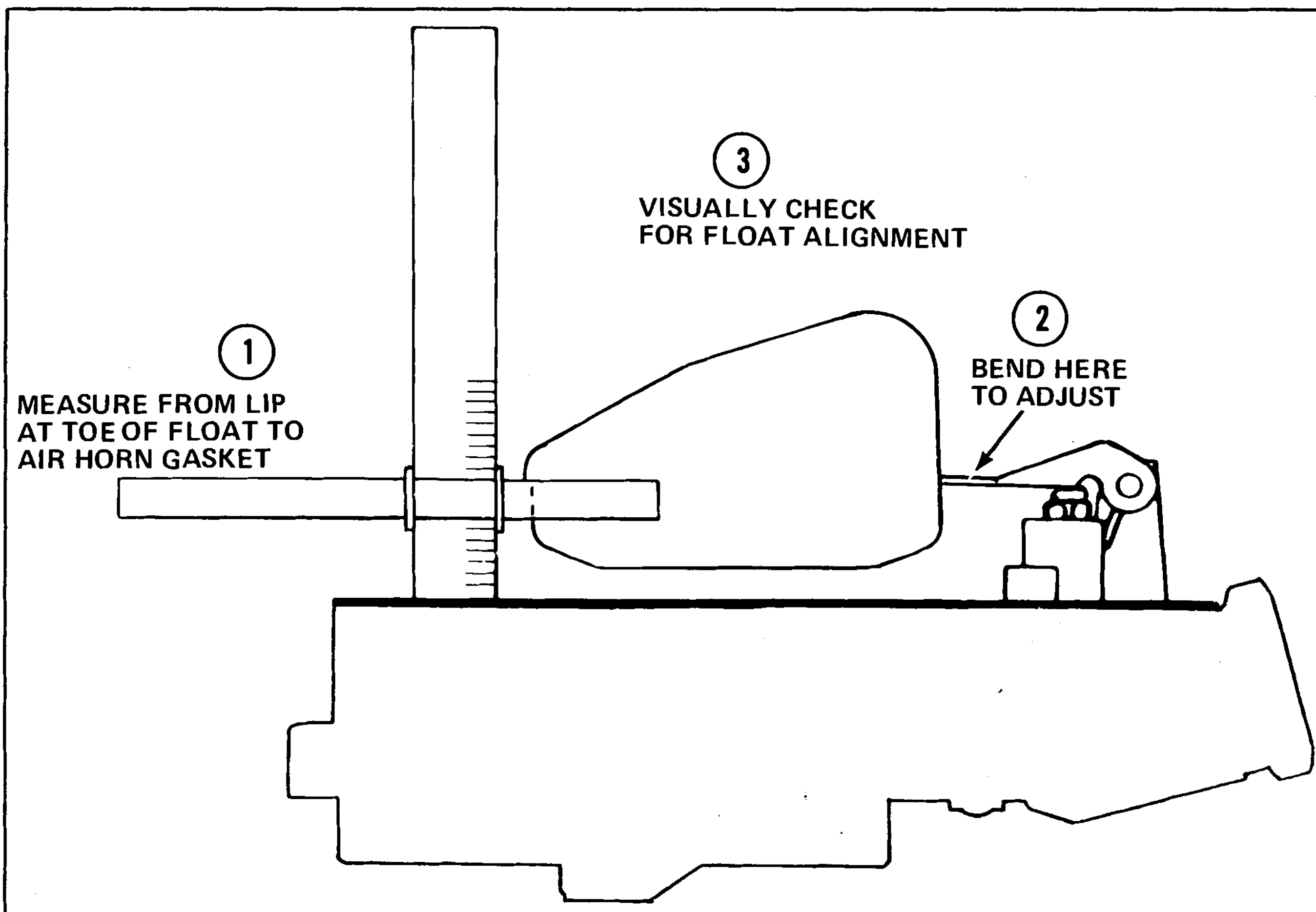


Fig. 6B-65 Float Level Adjustment

FLOAT DROP ADJUSTMENT (Fig. 6B-66)

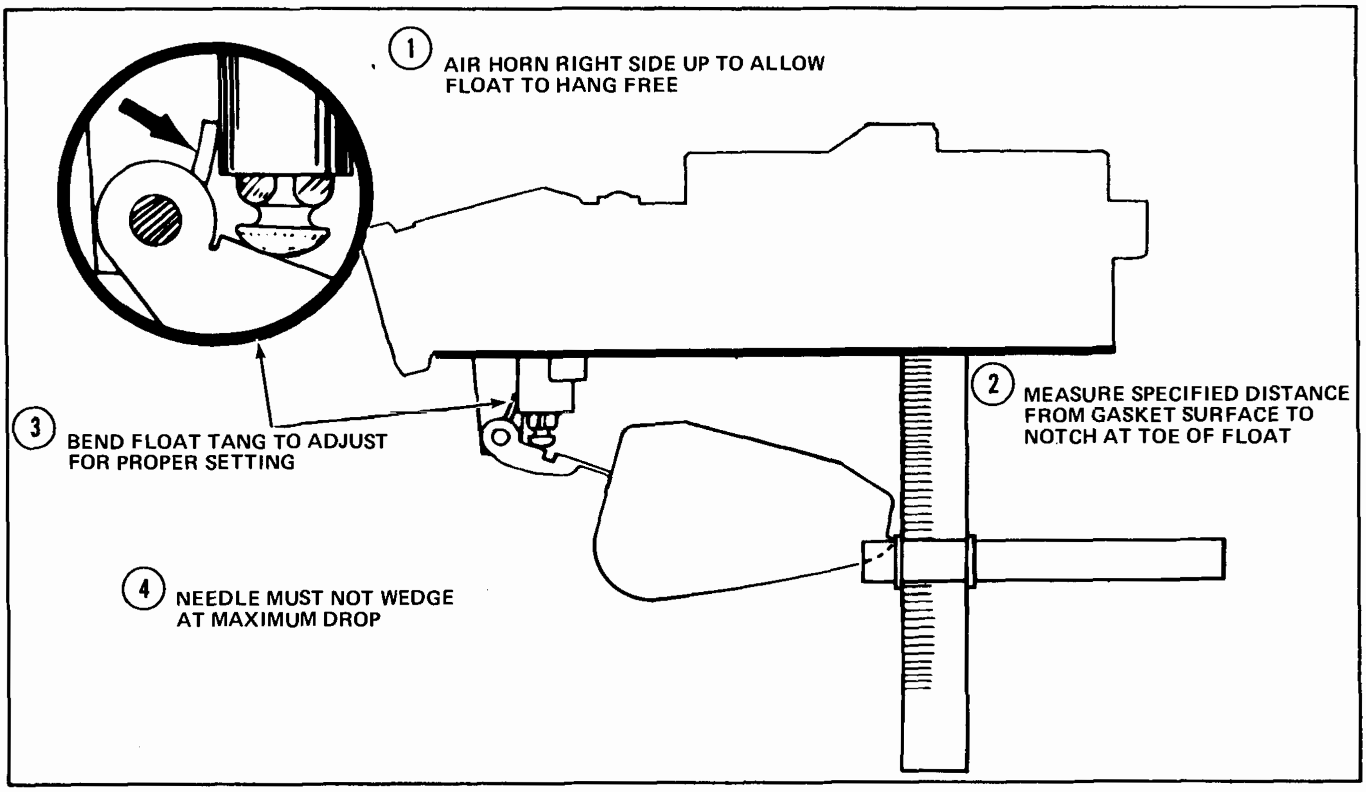


Fig. 6B-66 Float Drop Adjustment

hanger assembly, then install float assembly on air horn and insert hinge pin.

8. Check float level and drop adjustments.

ASSEMBLE AIR HORN TO FLOAT BOWL

1. Place cover on bowl, making certain that the accelerator pump plunger is correctly positioned into pump well and will move freely.

2. Install and tighten eight cover screws evenly and securely (Fig. 6B-67).

3. Install inlet filter, pressure relief spring and tighten nut to 25 lb. ft.

4. Install pump rod into upper pump lever by rotating off-set end into hole in lever and install lower end of pump rod to throttle lever and retain with spring clip.

5. Install vacuum break diaphragm assembly on to air horn with two screws. Tighten securely.

6. Install vacuum break link into diaphragm plunger and choke coil lever. Install choke coil lever to end of choke shaft. Install retaining screw and tighten securely.

Install fast idle cam to float bowl, using the fast idle cam attaching screw. Tighten securely.

Connect vacuum hose at throttle body and at vacuum break unit.

Check choke rod adjustment.

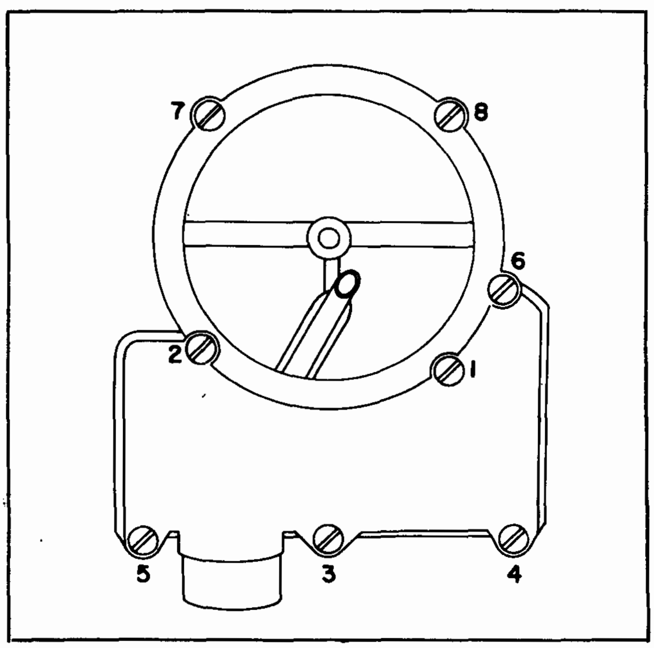


Fig. 6B-67 Air Horn Tightening Sequence

PUMP ROD ADJUSTMENT (Fig. 6B-68)

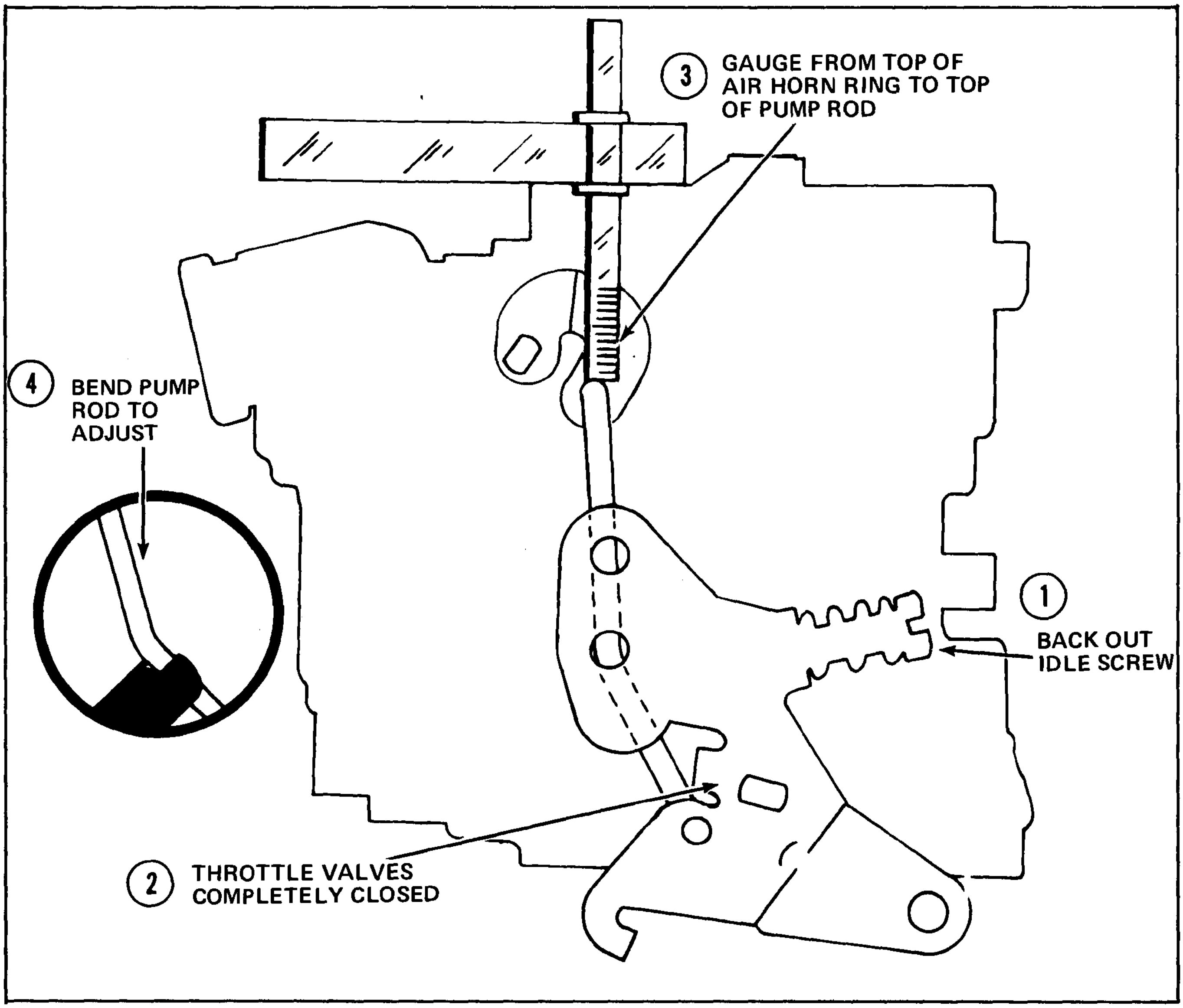


Fig. 6B-68 Pump Rod Adjustment

CHOKE ROD ADJUSTMENT (Fig. 6B-69)

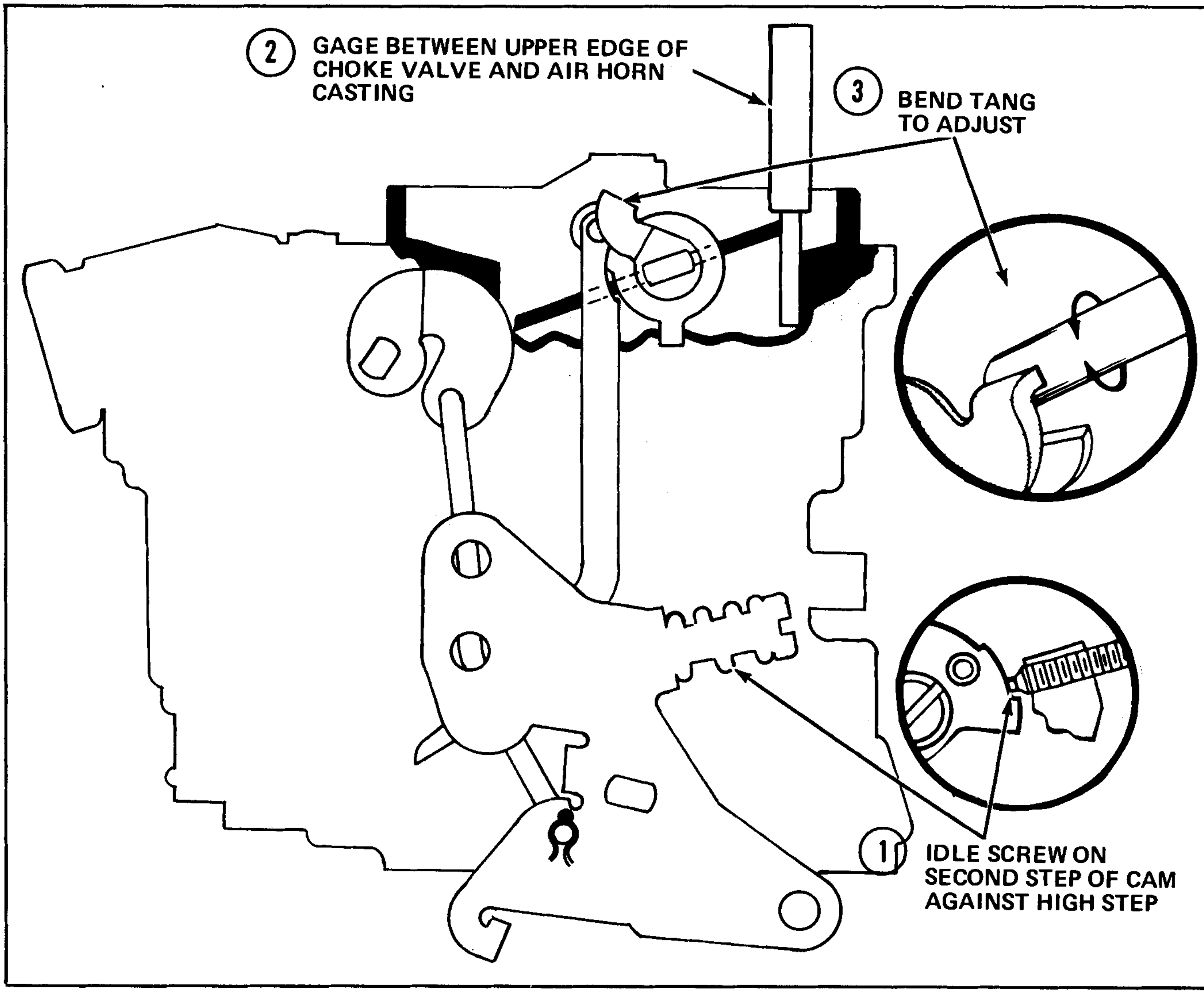


Fig. 6B-69 Choke Rod Adjustment

VACUUM BREAK ADJUSTMENT (Fig. 6B-70)

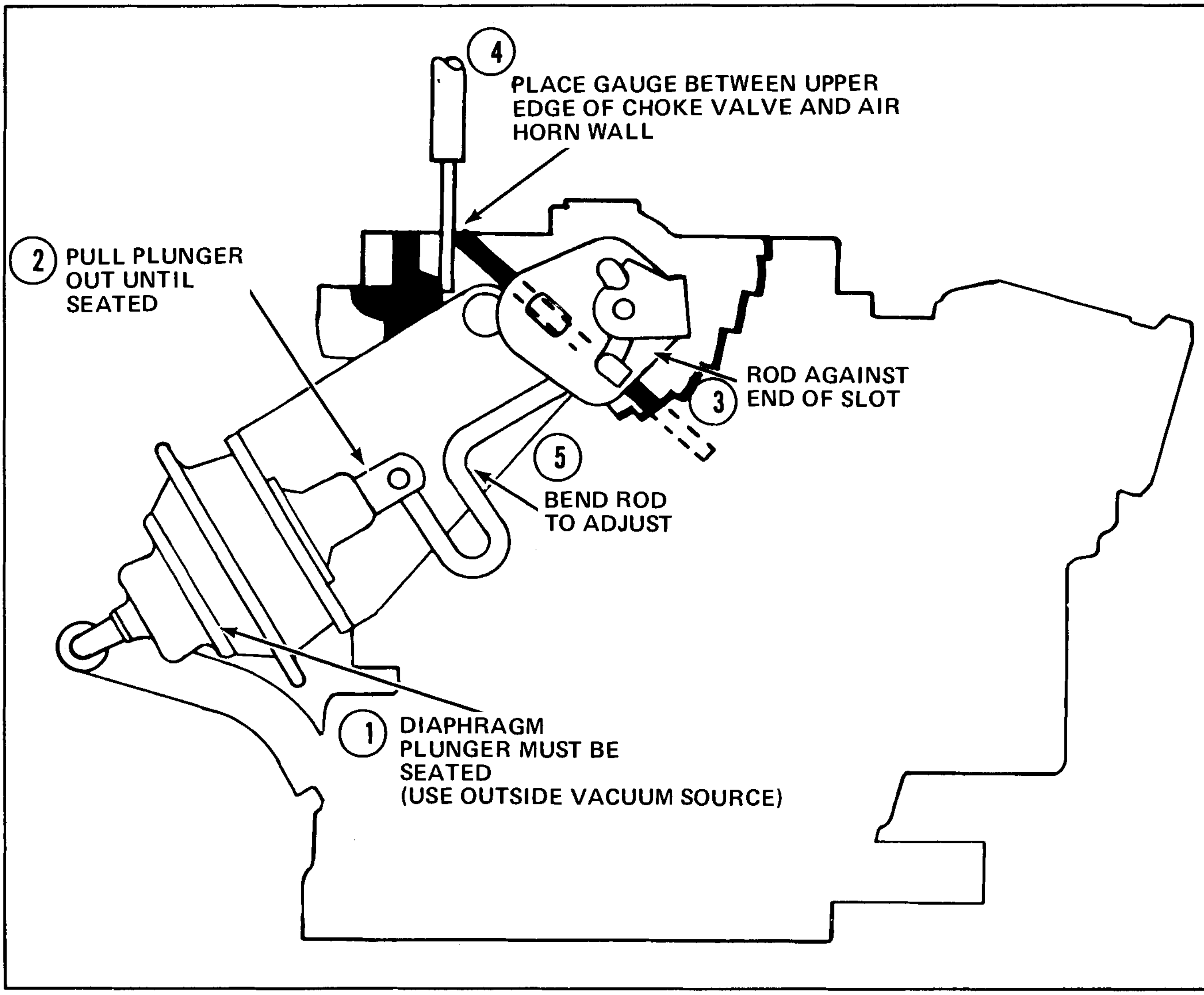


Fig. 6B-70 Vacuum Break Adjustment

UNLOADER ADJUSTMENT (Fig. 6B-71)

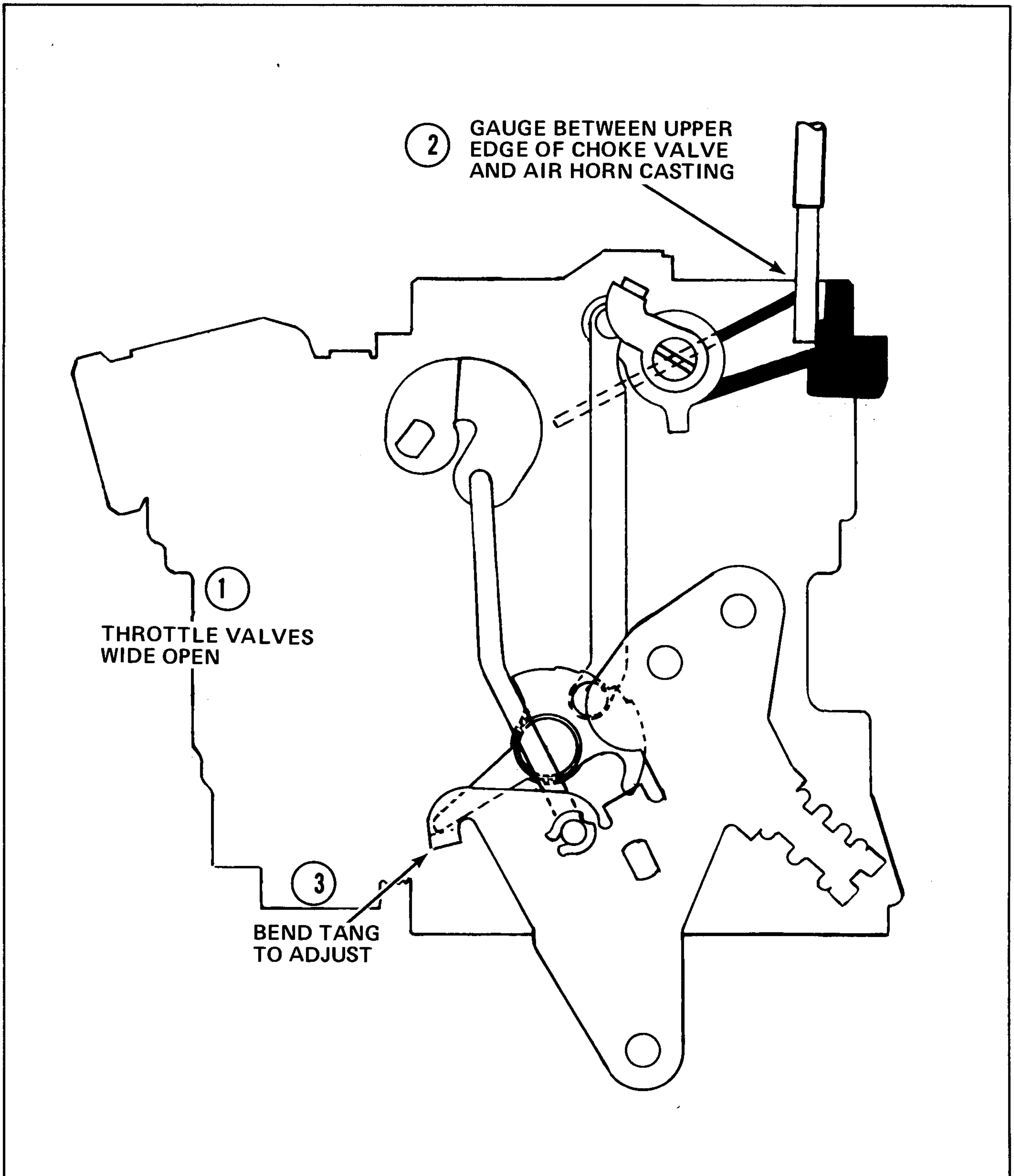


Fig. 6B-71 Unloader Adjustment

CHOKE COIL ROD ADJUSTMENT (Fig. 6B-72)

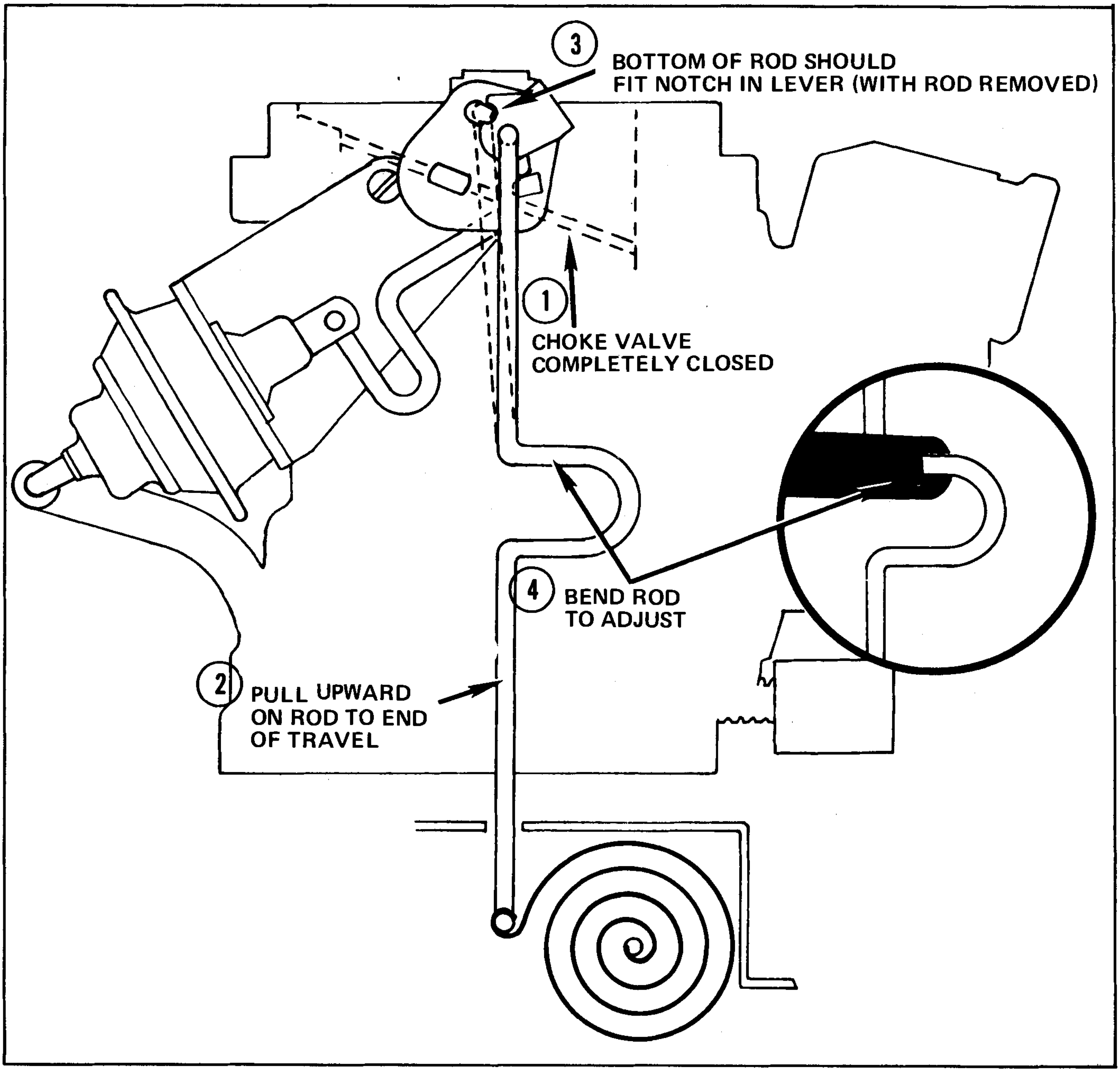


Fig. 6B-72 Choke Coil Rod Adjustment

4MV QUADRAJET CARBURETOR

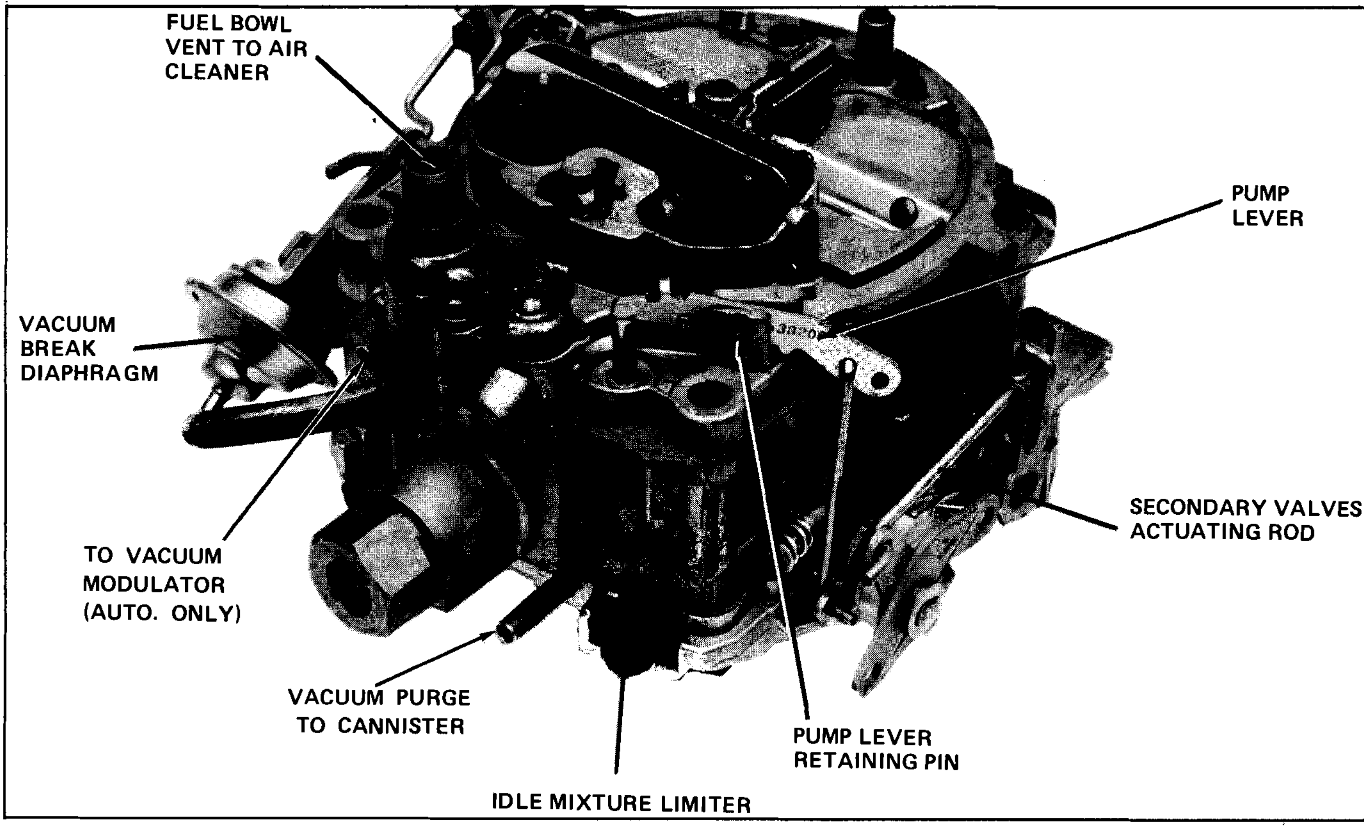


Fig. 6B-73 4MV Quadrajet Carburetor

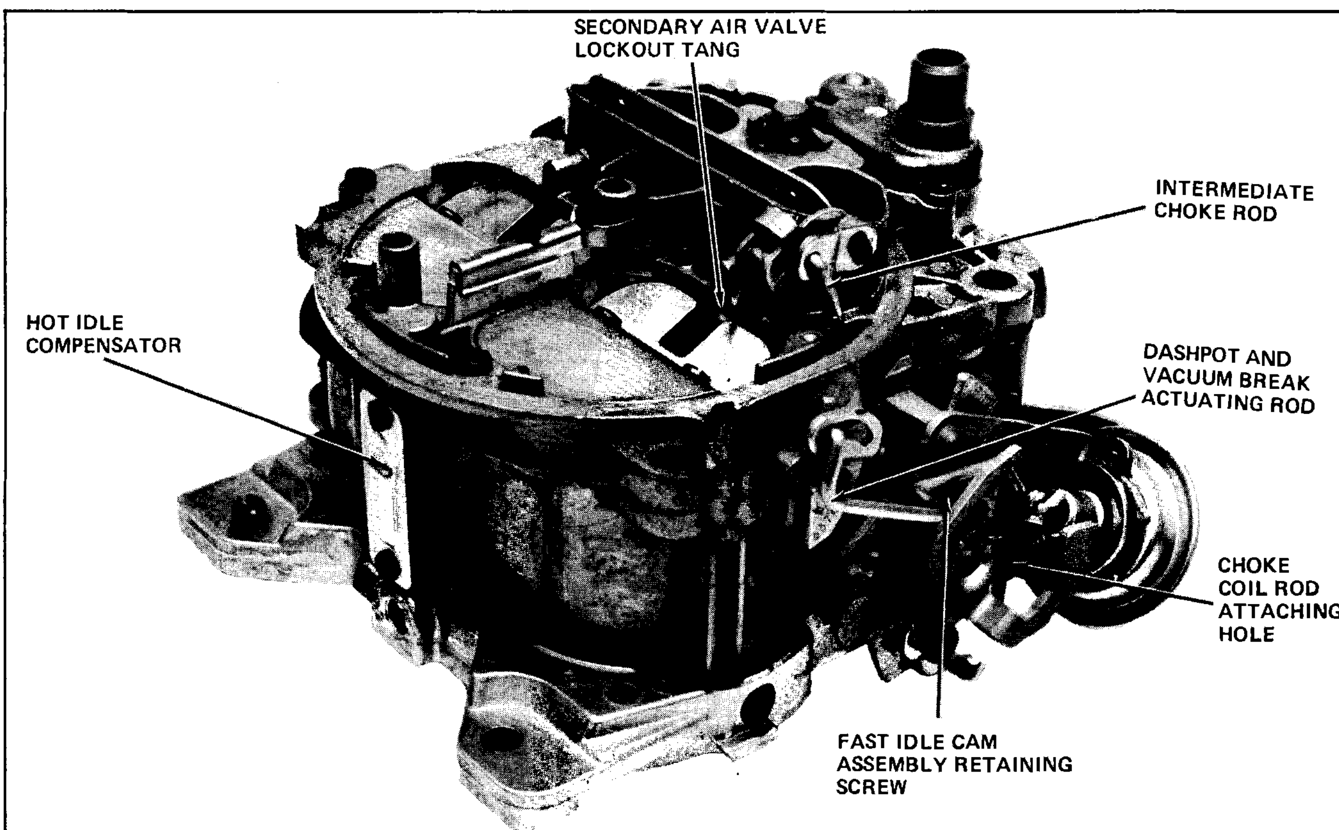
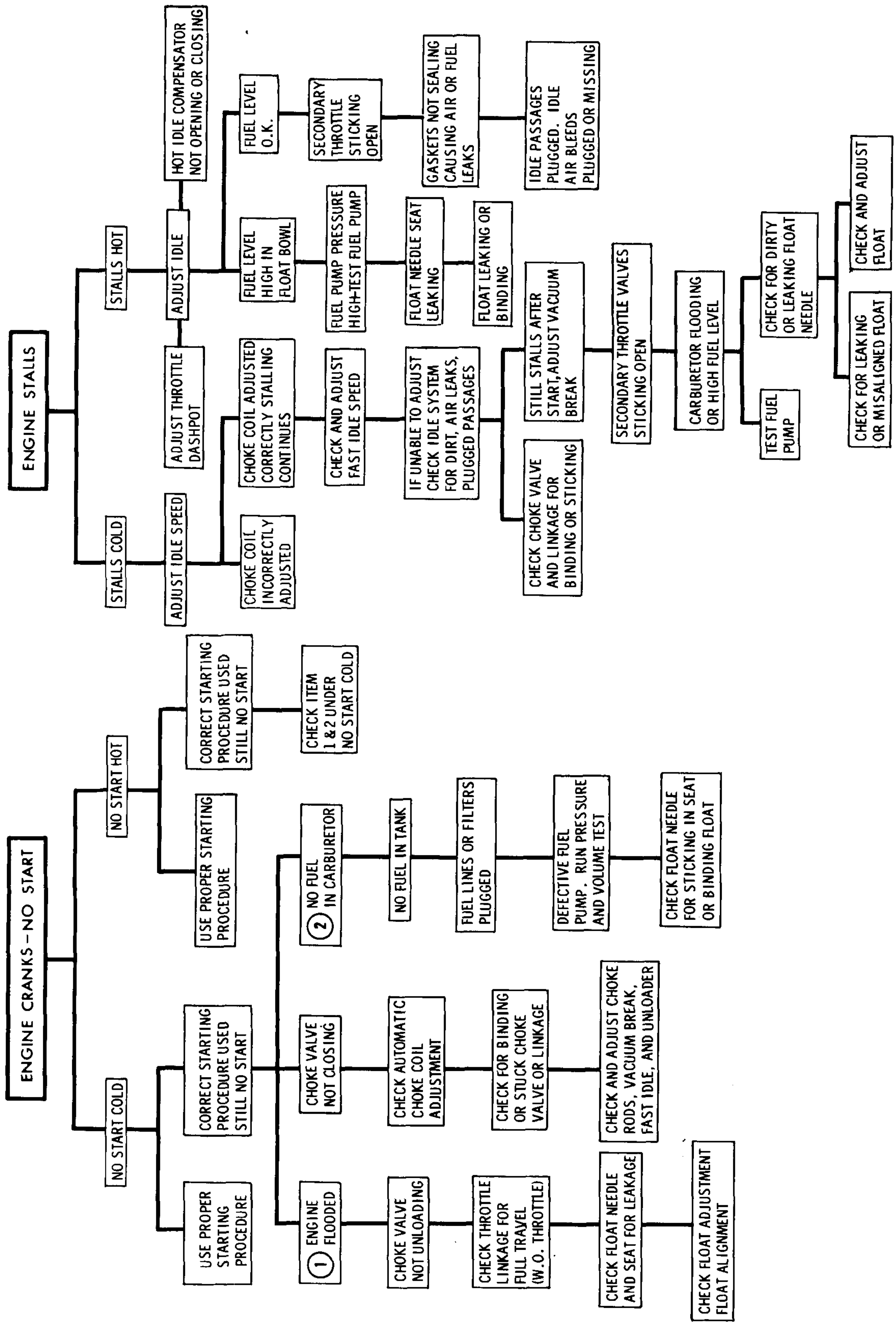


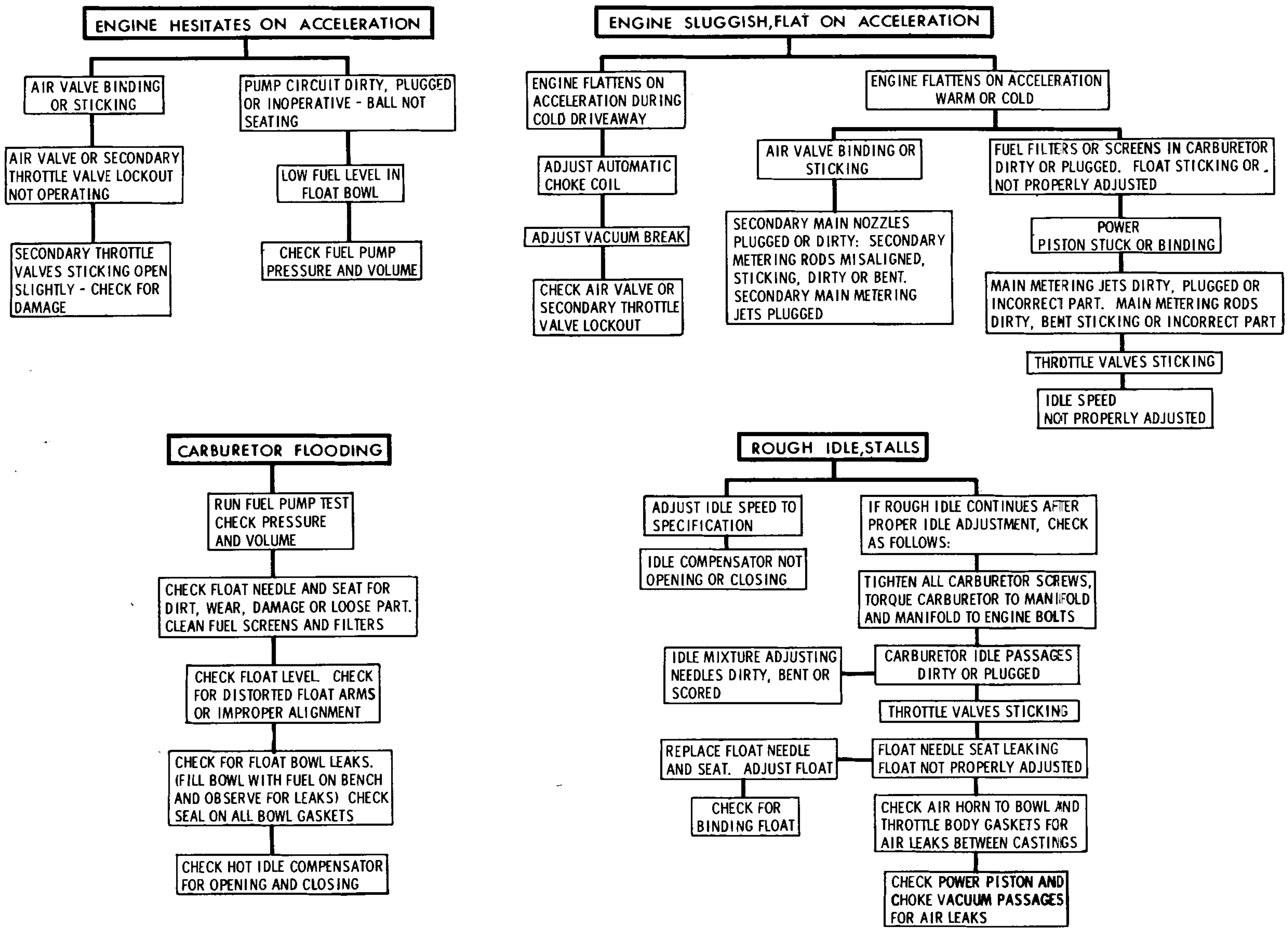
Fig. 6B-74 4MV Quadrajet Carburetor

CARBURETOR DIAGNOSIS CHART
MODEL 4MV

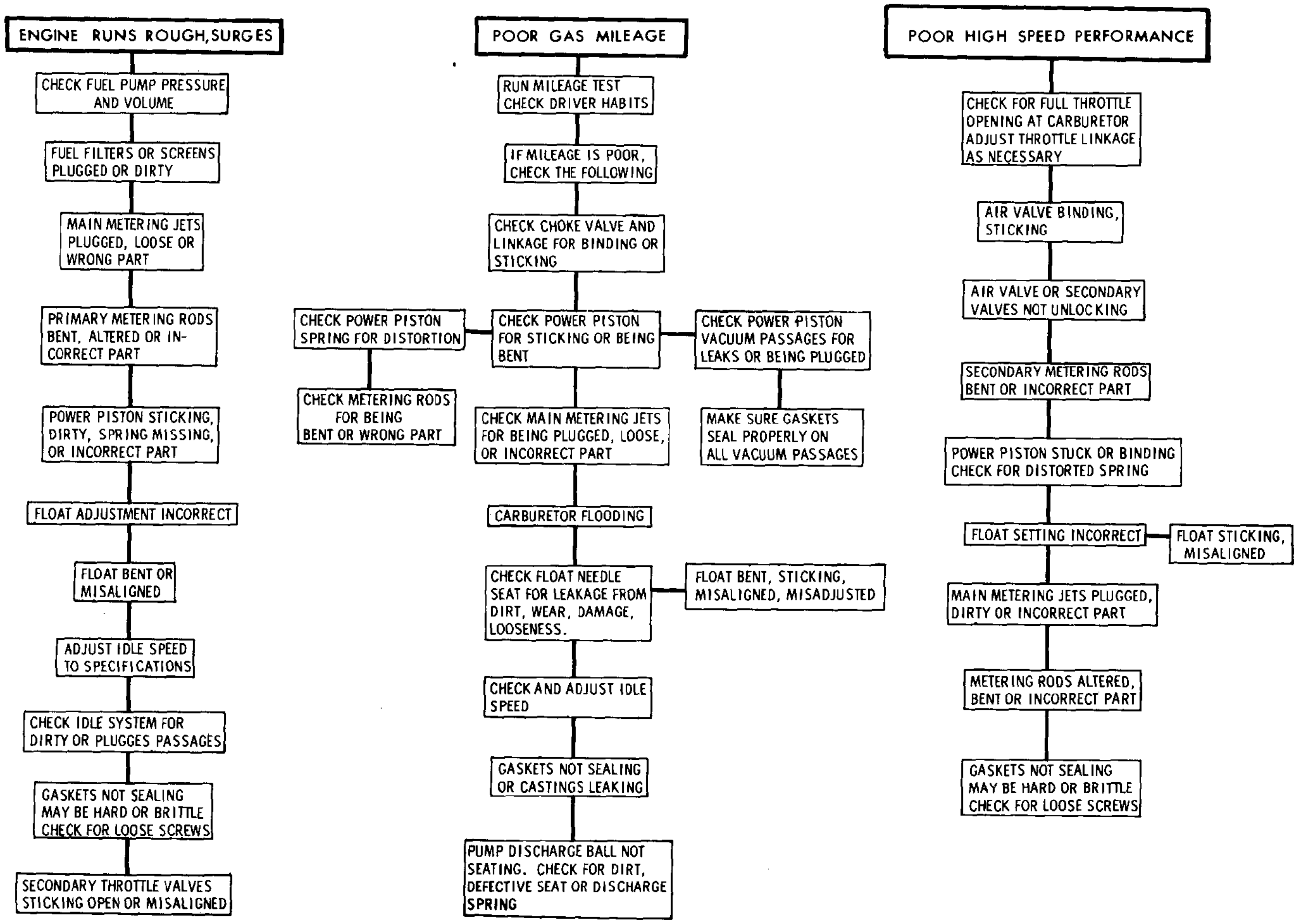


CARBURETOR DIAGNOSIS CHART

MODEL 4MV



CARBURETOR DIAGNOSIS CHART
MODEL 4MV



GENERAL DESCRIPTION

The Quadrajet carburetor has two stages in operation. The primary (fuel inlet) side has two small bores (1 3/8") with a triple venturi equipped with plain tube nozzles. The triple venturi stack up, plus the smaller primary bores, gives a more stable and finer fuel control in the idle and economy ranges of operation. Fuel metering in the primary side is accomplished with tapered metering rods positioned by a manifold vacuum responsive piston.

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.

The fuel reservoir is centrally located to avoid problems of fuel slosh, causing engine turn cut-out and delayed fuel flow to the carburetor bores. The float system uses a single float pontoon for ease in servicing the unit. The float needle has a synthetic tip which gives added insurance against flooding problems caused by dirt.

A pleated paper fuel inlet filter is mounted in the fuel inlet casting, which is an integral part of the float bowl and is easily removed for cleaning or replacement.

Idle mixture adjustment limiters are used on all models.

The idle mixture will be set at the factory and capped with a plastic cap. No adjustment should be required in the field unless complete overhaul of the carburetor is necessary.

Variable and constant bleed purge ports have been added to the carburetor base for use in purging fuel vapors from the vapor collection canister.

The large internal vent vents float bowl vapors to the air cleaner base.

To provide additional air capacity through the primary bores, the second boost venturi has been removed and the small boost venturi skirt lengthened (455 H.O. ONLY).

The choke vacuum break diaphragm has a varibale feature which includes a compression spring on the plunger stem. The internal check valve is replaced by an internal bleed restriction, which retards choke valve opening.

The carburetor part number is stamped on a vertical section of the float bowl, near the secondary throttle lever (Fig. 6B-75.) When replacing the float bowl assembly, follow the manufacturer's instructions contained in the service package so that the part number can be transferred to the new float bowl.

The primary side of the carburetor 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.

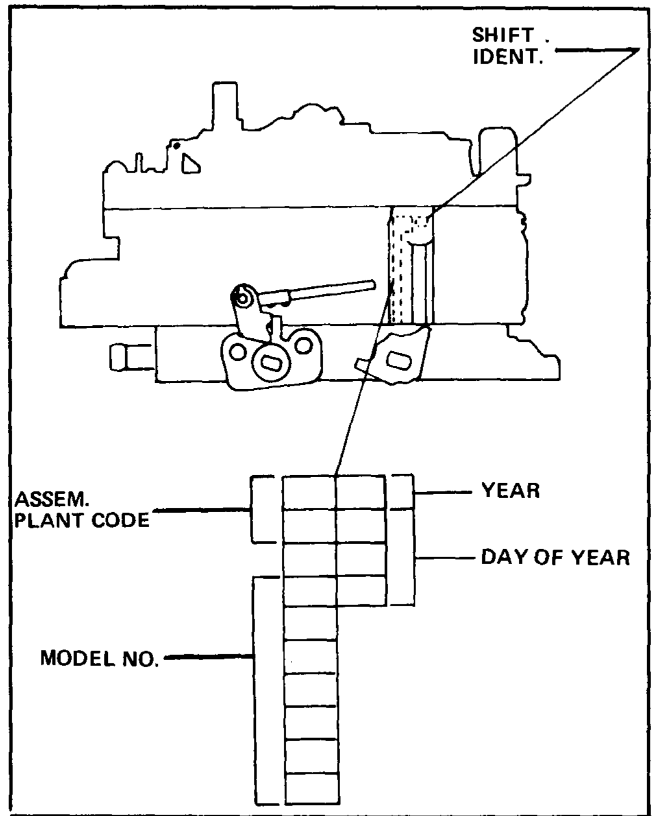


Fig. 6B-75 4MV Carburetor Identification Location

OPERATING SYSTEMS

FLOAT SYSTEM

The Quadrajet carburetor has a centrally located float chamber (Fig. 6B-76) with a single pontoon float and float needle valve. The fuel bowl is centered between the primary bores and is adjacent to the secondary bores. This type design assures adequate fuel supply to all carburetor bores, which gives excellent performance with respect to car inclination or severity of turns.

The float pontoon is solid and is made of a closed cell plastic material. It is lighter than a brass pontoon, which results in added buoyancy and allows the use of a smaller float to maintain constant fuel levels.

A pleated paper fuel inlet filter is used with a pressure relief spring. The relief spring allows fuel pump pressure to force the filter off its seat if for any reason it should become clogged and prevent fuel flow to the carburetor. A guide is cast into the filter housing to prevent the possibility of the filter being installed in the reverse position.

The float system consists of a float chamber, plastic float pontoon assembly, float hinge pin and retainer combination, a float needle valve and seat and a float valve pull clip. The float system operates as follows:

Fuel from the engine fuel pump enters the carburetor fuel inlet passage. It passes through the filter element and needle seat.

As incoming fuel fills the float bowl to the prescribed fuel level, the float pontoon rises and forces the fuel inlet valve closed, shutting off all fuel flow. As fuel is used from the float chamber, the float drops and allows more incoming fuel to enter the float bowl until the correct fuel level is reached. This cycle continues, constantly maintaining a positive fuel level in the float bowl.

A float needle pull clip, fastened to the float valve, hooks over the center of the float arm. Its purpose is to assist in lifting the float valve off its seat.

The fuel enters the float chamber at the top to prevent incoming fuel vapors from mixing with solid fuel in the bottom of the float bowl and disrupting good carburetor metering. A plastic filler block is located in the top of the float chamber in the area just above the float valve. This block prevents fuel slosh on severe brake applications. This maintains a more constant fuel level during this type maneuver, to prevent stalling.

The carburetor float chamber is internally vented through a large dome vent which leads to the base of the air

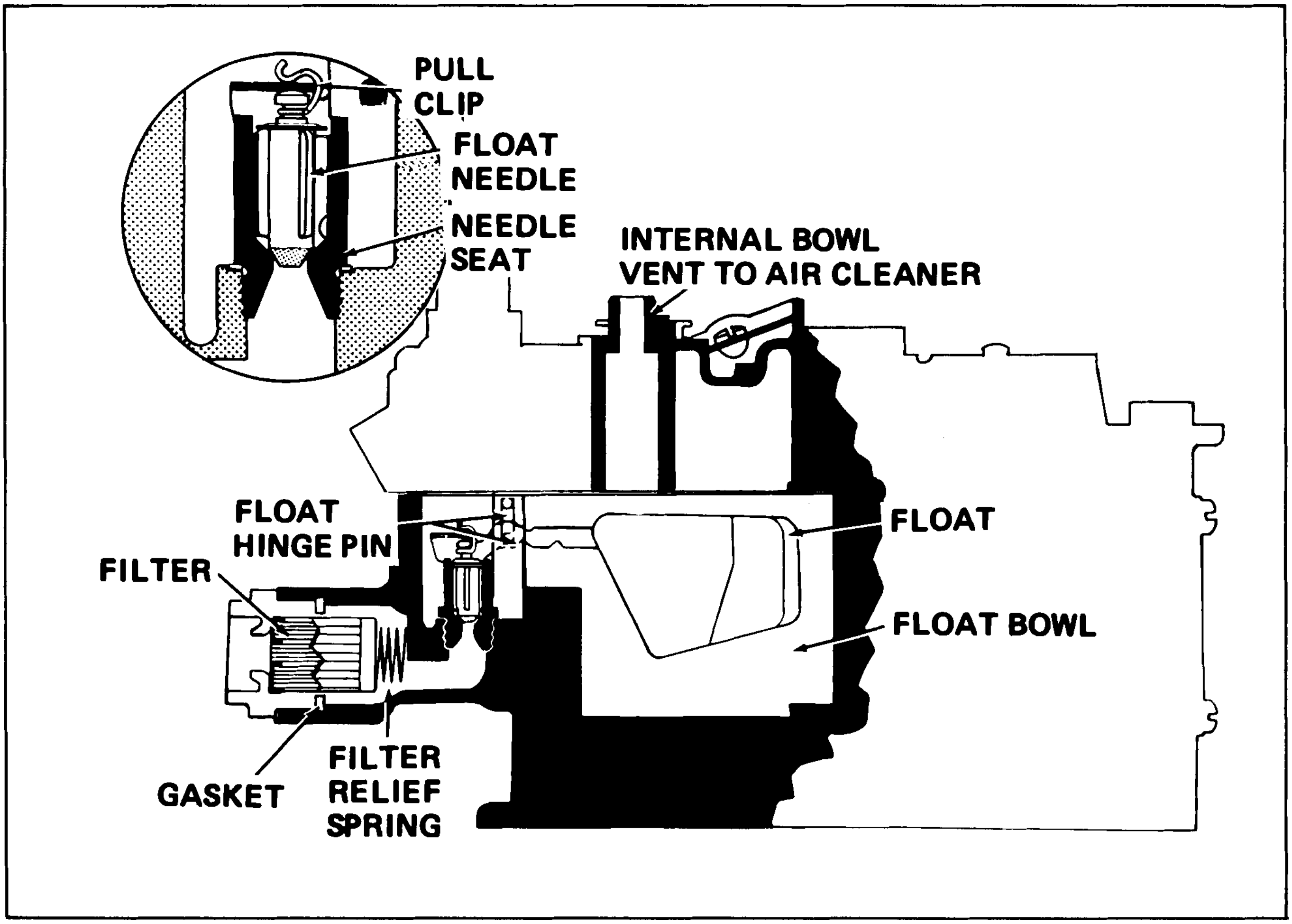


Fig. 6B-76 Float System

cleaner. The large internal dome vent will provide a completely internally balanced carburetor and yet allow the elimination of the external idle vent valve. Any fuel vapors which may form in the float chamber during hot engine operation will be condensed in the dome vent and allowed to drain back into the fuel bowl.

A completely internally balanced carburetor can be maintained with this feature because the pressure acting upon the fuel in the float bowl will be balanced with the air passing through the air cleaner.

IDLE SYSTEM

The idle system (Fig. 6B-77) is only used in the two primary bores of the carburetor. Each bore has a separate idle system. They consist of idle tubes, idle passages, idle air bleeds, idle channel restrictions, idle mixture needles and idle discharge holes.

During curb idle, the primary throttle valves are held slightly open by the throttle stop screw to give the engine the desired idle speed. Since the engine requires very little air for idle and low speeds, the idle discharge holes below the throttle valves are exposed directly to engine manifold vacuum. With the idle discharge holes in a very low pressure area and the fuel in the float bowl vented to atmosphere (high pressure), the idle system operates as follows:

Engine manifold vacuum at the idle discharge ports causes fuel to flow from the float bowl through the primary main metering jets into the main fuel wells. It passes from the main fuel well into the idle passages where it is picked up by the idle tubes. The fuel is metered at the tip of the idle tubes and passes up through the idle tubes. The fuel is mixed with air at the top of each idle tube through an idle air bleed. The fuel mixture then crosses over to the idle down channels where it passes through a calibrated idle channel restriction.

It then passes down the idle channel past the lower idle air bleed holes and off-idle discharge ports, just above the primary throttle valves, where it is mixed with more air. The air/fuel mixture then moves down to the idle needle discharge holes, where it enters the carburetor bores and finally mixes with air passing around the slightly open throttle valve. It then enters the intake manifold and is conducted to the engine cylinders as a combustible mixture.

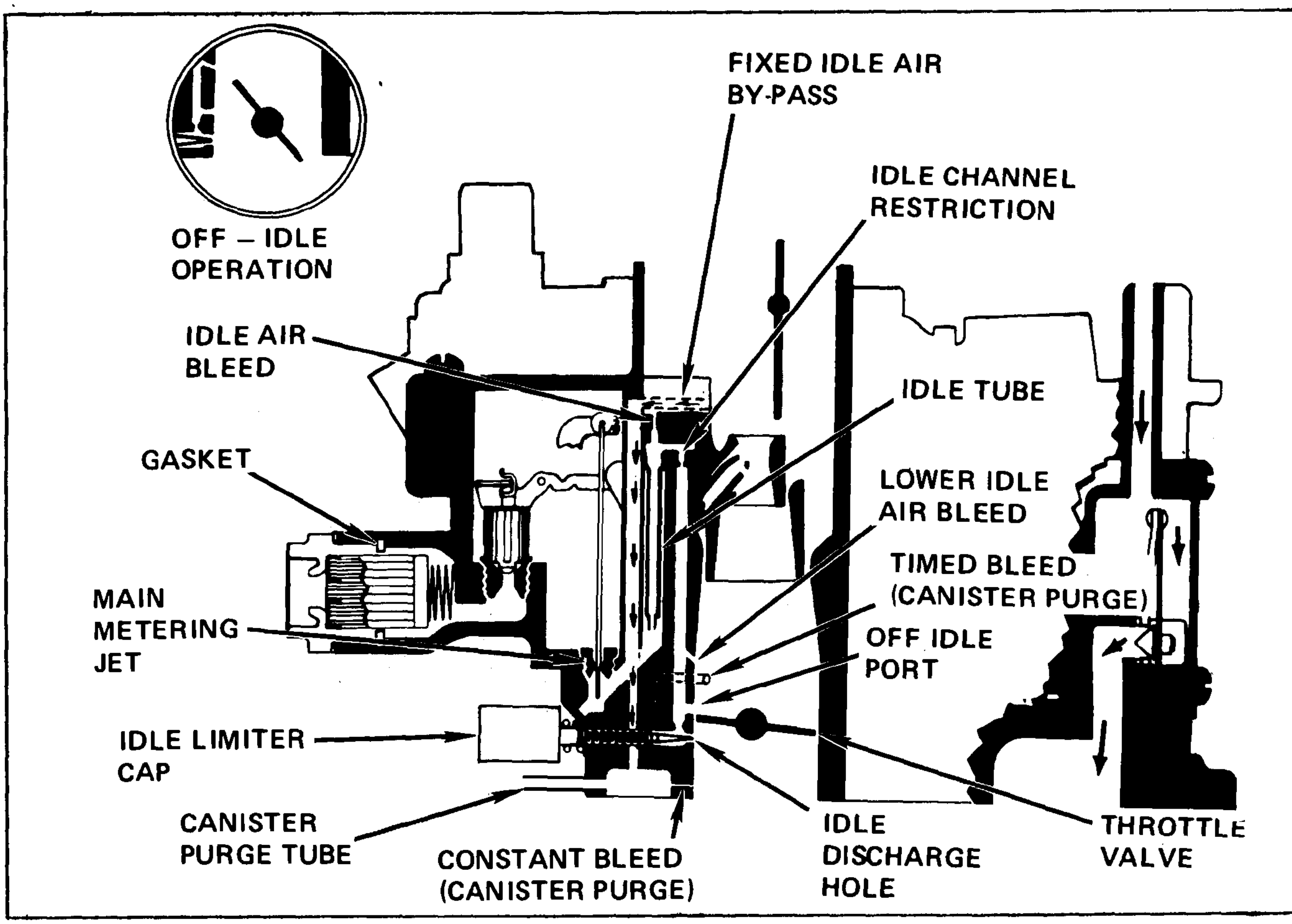


Fig. 6B-77 Idle System

In order to meet emission standards, the idle mixture needles will be pre-adjusted at the factory and capped so that they cannot be adjusted in the field. New limiter caps will be provided in the overhaul kits, should it be necessary to remove the idle mixture needles for overhaul or cleaning purposes.

A fixed idle air by-pass system is used to supplement the idle air passing by the slightly open throttle valves. The purpose of the idle air by-pass system is to reduce the amount of air going through the carburetor bores and still maintain sufficient air for the correct idle speed. This reduces the amount of air passing through the venturi system to prevent the main fuel nozzles from feeding at idle. The venturi system is very sensitive to air flow and where large amounts of air are needed to maintain idle speeds, the fixed idle air by-pass system is used.

Since the fuel tank is not normally vented to atmosphere, all fuel vapors are collected in a vapor collection canister. Purge ports for the canister are provided in the carburetor throttle body. They consist of a variable purge plus the constant bleed purge. The constant bleed purge is a small orifice and is used during idle operation to provide some removal of vapors from the collection canister.

The timed bleed purge is located above the throttle valves, adjacent to the off-idle discharge ports. The timed bleed purge holes provide sufficient purge to remove all vapors that will be collected in the vapor canister. They are designed to bleed constantly during the off-idle and part throttle operation of the engine.

OFF-IDLE OPERATION

As the primary throttle valves are opened from curb idle to increase engine speed, additional fuel is needed to combine with the extra air entering the engine. This is accomplished by the slotted off-idle discharge ports (Fig. 6B-77). As the primary throttle valves open, they pass by the off-idle ports, gradually exposing them to high engine vacuum below the throttle valves. The additional fuel added from the off-idle ports mixes with the increasing air flow past the opening throttle valves to meet increased engine air and fuel demands.

Further opening of the throttle valves increases the air velocity through the carburetor venturi sufficiently to cause low pressure at the lower idle air bleeds. As a result, fuel begins to discharge from the lower idle air bleed holes and continues to do so throughout operation of the part throttle to wide open throttle ranges, supplementing the main discharge nozzle delivery.

The idle needle holes and off-idle discharge ports continue to supply sufficient fuel for engine requirements until air velocity is high enough in the venturi area to obtain efficient fuel flow from the main metering system.

HOT IDLE COMPENSATOR

The hot idle compensator used on all V-8 automatic transmission models (except Ram Air) is located in a chamber at the rear of the carburetor float bowl, adjacent to the secondary bores. Its purpose is to offset enrichening effects caused by excessive fuel vapors during hot engine operation.

The compensator consists of a thermostatically controlled valve, a bi-metal strip which is heat sensitive, a valve holder and bracket. The valve closes off an air channel which leads from a hole in the top of the air horn, just beneath the air cleaner, to a point below the secondary throttle valves.

Normally the compensator valve is held closed by tension of the bi-metal strip. During extreme hot engine operation, excessive fuel vapors entering the engine manifold cause richer than normally required mixtures, resulting in rough engine idling and stalling. At a predetermined temperature, when extra air is needed to offset the enrichening effects of fuel vapors, the bi-metal strip bends and unseats the compensator valve. This uncovers the air channel leading from the valve chamber to the point below the throttle valves. This allows enough air to be drawn into the engine manifold to offset the richer mixtures and maintain a smooth engine idle. When the engine cools and the extra air is not needed, the bi-metal strip closes the valve and operation returns to normal mixtures.

The compensator valve assembly is held in place by the dust cover over the valve chamber. A seal is used between the compensator valve and the float bowl casting.

In order to insure proper idle adjustment when the engine is hot, the compensator valve must be closed. To check this, a finger may be held over the compensator air inlet channel located on top of the air horn. If no drop in engine RPM is noted on the tachometer, the valve is closed. If the valve is open, plug the hole or cool engine down to a point where the valve is closed for proper idle adjustment.

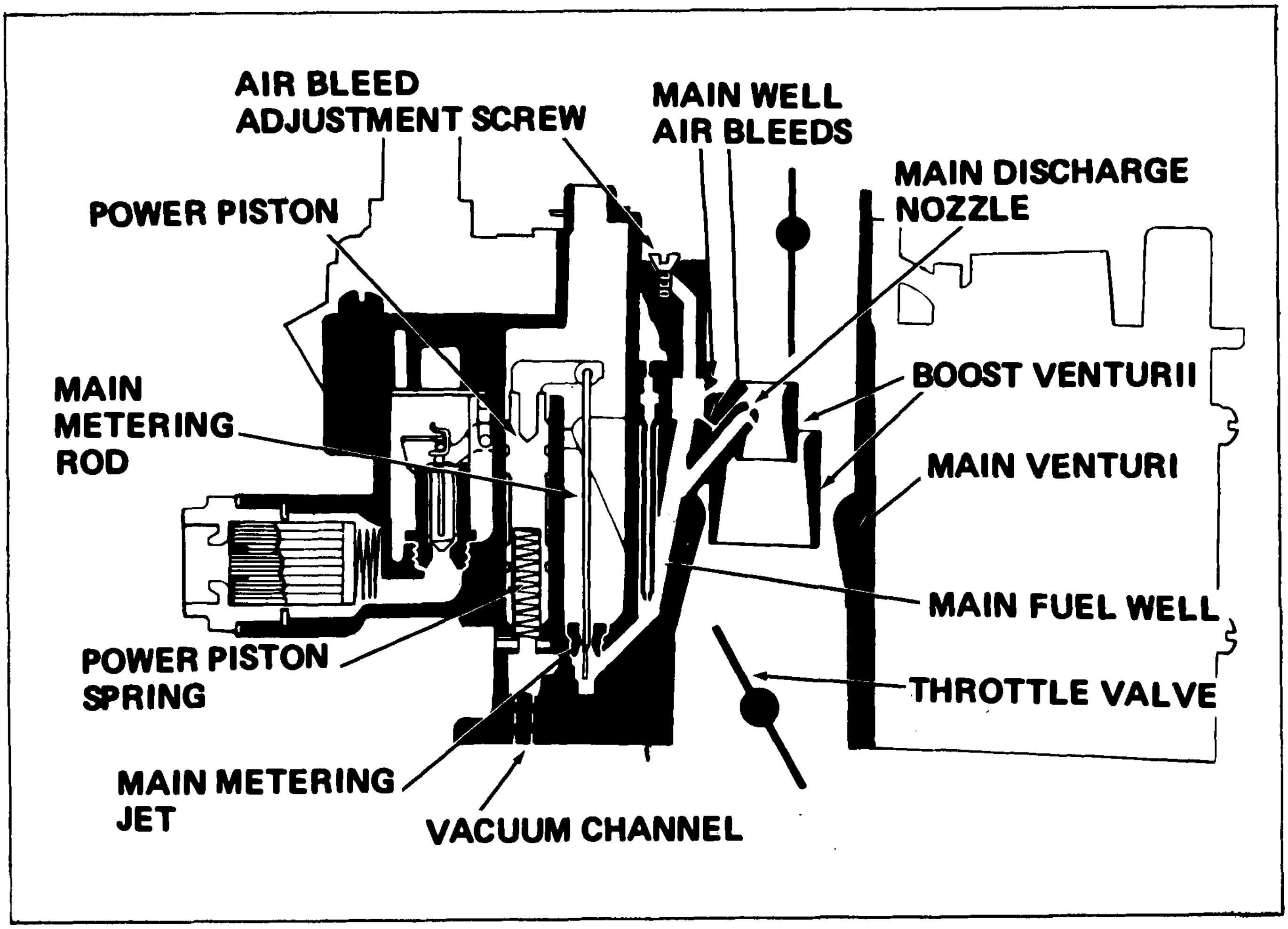


Fig. 6B-78 Main Metering System

NOTE: *Plug the compensator hole with something that will be seen, as the plug must be removed before the air cleaner is installed. Otherwise, the compensator will not function if the plug is left in the hole.*

MAIN METERING SYSTEM

The main metering system (Fig. 6B-78) supplies fuel to the engine from off-idle to wide open throttle operation. The two primary bores of the carburetor meter fuel through the venturi principle. This type design allows the use of multiple venturi for finer and more stable metering control during light engine loads.

The main metering system is in operation at all times when air flow through the venturi is high enough to maintain efficient fuel flow from the main fuel discharge nozzles. The main metering system begins to feed fuel when the idle system can no longer meet the engine requirements.

The main metering system consists of main metering jets, vacuum operated metering rods, main fuel well, main well air bleeds, fuel discharge nozzles and triple venturi. The system operates as follows:

During cruising speeds and light engine loads, engine manifold vacuum is high. Manifold vacuum holds the main metering rods down in the main metering jets against spring tension. Manifold vacuum is supplied through a channel to the vacuum operated power piston connected to the primary main metering rods. Fuel flow from the float bowl is metered between the metering rods and main metering jet orifice.

As the primary throttle valves are opened beyond the off-idle range allowing more air to enter the engine manifold, air velocity increases in the carburetor venturi. This causes a drop in pressure in the large venturi which is increased many times in the double boost venturi. Since the low pressure (vacuum) is now in the smallest boost venturi, fuel flows from the main discharge nozzles as follows:

Fuel flows from the float bowl through the main metering jets into the main fuel wells and is mixed with air from the adjustable air bleed at the top of the main well and also from side bleeds (one which leads from inside the bore area above the venturi and another from the cavity around the main fuel nozzle into the main fuel well). The fuel then passes through the main discharge nozzle into the boost venturi and on into the engine as a combustible mixture.

It should be noted that there is an adjustable part throttle air bleed system which supplements the other main well

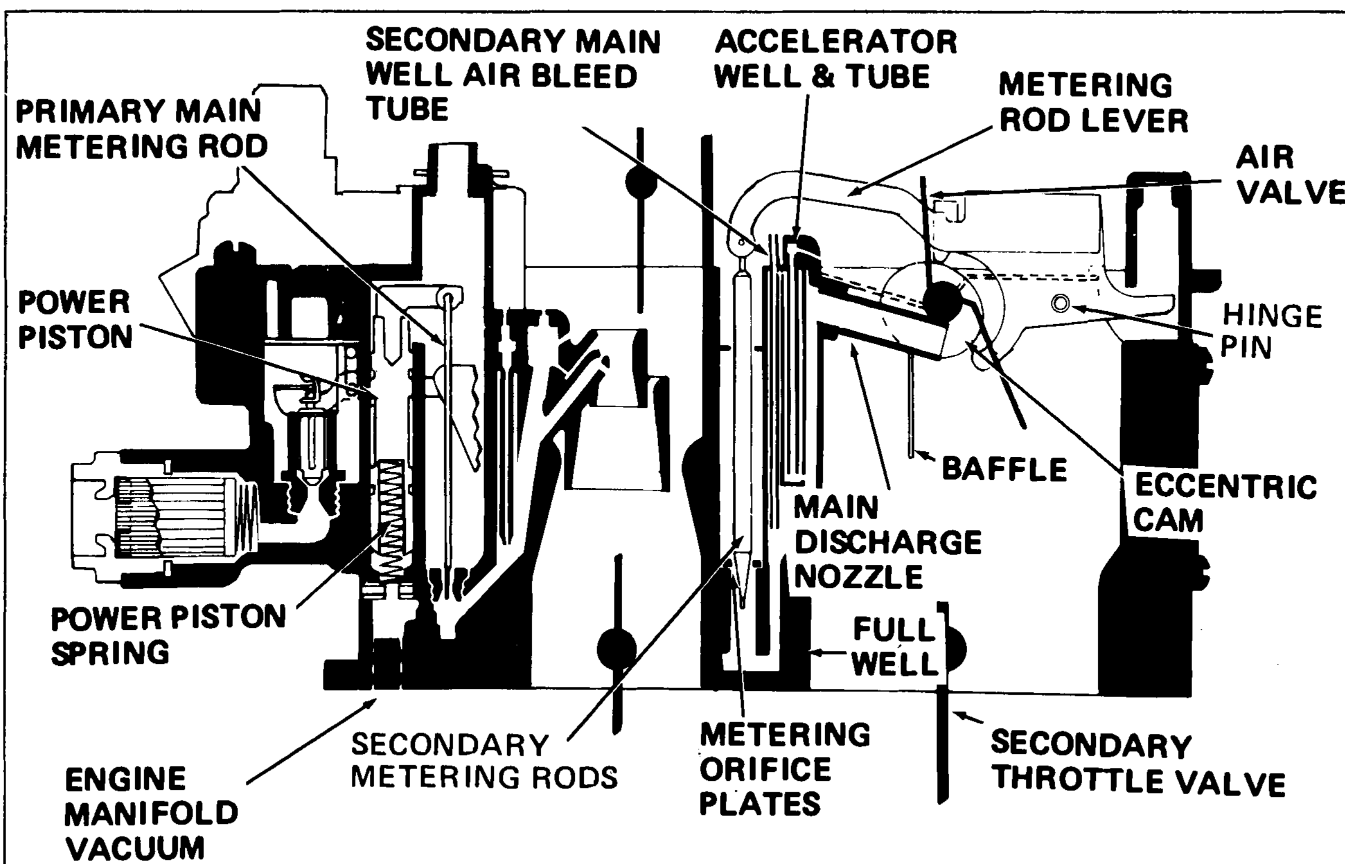


Fig. 6B-79 Power Enrichment System

air bleeds. The purpose of the adjustable bleed is to refine fuel mixtures to meet emission requirements. The bleed is adjusted at the factory and should not be re-adjusted in the field.

POWER ENRICHMENT SYSTEM

The power system (Fig. 6B-79) in the Quadrajet carburetor provides extra mixture enrichment for power requirements under heavy acceleration or high speed operation. The richer mixture is supplied through the main metering system in the primary and secondary sides of the carburetor.

The power system located in the primary side consists of a vacuum piston and spring, located in a cylinder connected by a passage to intake manifold vacuum. The spring located beneath the vacuum operated power piston tends to push the piston upward against manifold vacuum.

On part throttle and cruising ranges, manifold vacuums are sufficient to hold the power piston down against spring tension so that the larger diameter of the metering rod tip is held in the main metering jet orifice. Mixture enrichment is not necessary at this point. However, as engine load is increased to a point where extra mixture enrichment is required, the spring tension overcomes the vacuum pull on the power piston and the tapered primary metering rod tip moves upward in the main metering jet orifice. The smaller diameter of the metering rod tip allows more fuel to pass through the main metering jet and enrich the mixture flowing into the primary main wells and out the main discharge nozzles.

When manifold vacuum rises and mixture enrichment is no longer needed, the vacuum overcomes the power piston spring tension and returns the larger portion of the metering rod into the metering jet orifice and back to normal economy range. However, as the engine speed increases, the primary side of the carburetor can no longer meet the engine air and fuel requirements. To meet these demands, the secondary side of the carburetor is used. The secondary section contains throttle valves, spring loaded air valves, metering orifice discs, secondary metering rods, main fuel wells with air bleed tubes, fuel discharge nozzles and accelerating wells and tubes. The secondary side operates as follows:

When the engine reaches a point where the primary bores cannot meet engine air and fuel demands, the primary throttle lever (through connecting linkage to the secondary throttle shaft lever) begins to open the secondary throttle valves. As air flow through the secondary bores creates a low pressure (vacuum) beneath the air valve, atmospheric pressure on top of the air valve forces the air valve open against spring tension. This allows the required air for increased engine speed to flow past the air valve.

When the air valve begins to open, the upper edge of the air valve passes the accelerating well port. As the valve passes the port, it exposes the port to manifold vacuum. The port will immediately start to feed fuel from the accelerating wells.

The accelerating ports will prevent a momentary leanness as the valve opens and the secondary nozzles begin to feed fuel.

The secondary main discharge nozzles (one for each secondary bore) are located just below the air valve and above the secondary throttle valves. They, being in the area of lowest pressure, begin to feed fuel as follows:

When the air valve begins to open, it rotates a plastic cam attached to the center of the main air valve shaft. The cam pushes on a lever attached to the secondary main metering rods. The cam pushes the lever upward, raising the metering rods out of the secondary orifice discs. Fuel flows from the float chamber through the secondary orifice discs into secondary main wells, where it is mixed with air from the main well tubes. The air emulsified fuel mixture travels from the main wells to the secondary discharge nozzles and into the secondary bores. Here fuel mixture is mixed with air traveling through the secondary bores to supplement the air/fuel mixture delivered from the primary bores and then goes on into the engine manifold and on to the engine cylinders as a combustible mixture.

As the throttle valves are opened further and engine speeds increase, increased air flow through the secondary side of the carburetor opens the air valve to a greater degree which, in turn, lifts the secondary metering rods further out of the orifice discs. The metering rods are tapered so that fuel flow through the secondary metering orifice discs is directly proportional to air flow through the secondary carburetor bores. In this manner, correct air/fuel mixtures to the engine through the secondary bores can be maintained by the depths of the metering rods in the orifice discs.

There are three other features incorporated in the secondary metering system which are as follows:

1. The main well bleed tubes extend below the fuel level in the main well. These actually bleed air into the fuel in the well to quickly emulsify the fuel with air for good atomization as it leaves the secondary discharge nozzles.

2. The secondary metering rods have a slot milled in the side to ensure adequate fuel supply in the secondary fuel wells. These are necessary because, when the air valve is in the closed position, the secondary metering rods are nearly seated against the secondary metering orifice discs. During hot engine idle or hot soak, the fuel could boil away out of the fuel well. The milled slot allows enough fuel to by-pass the orifice disc to keep the main well filled during this period. This ensures immediate fuel delivery from the secondary fuel wells at all times.

3. A single baffle plate is used which extends into each secondary carburetor bore and seats into the float

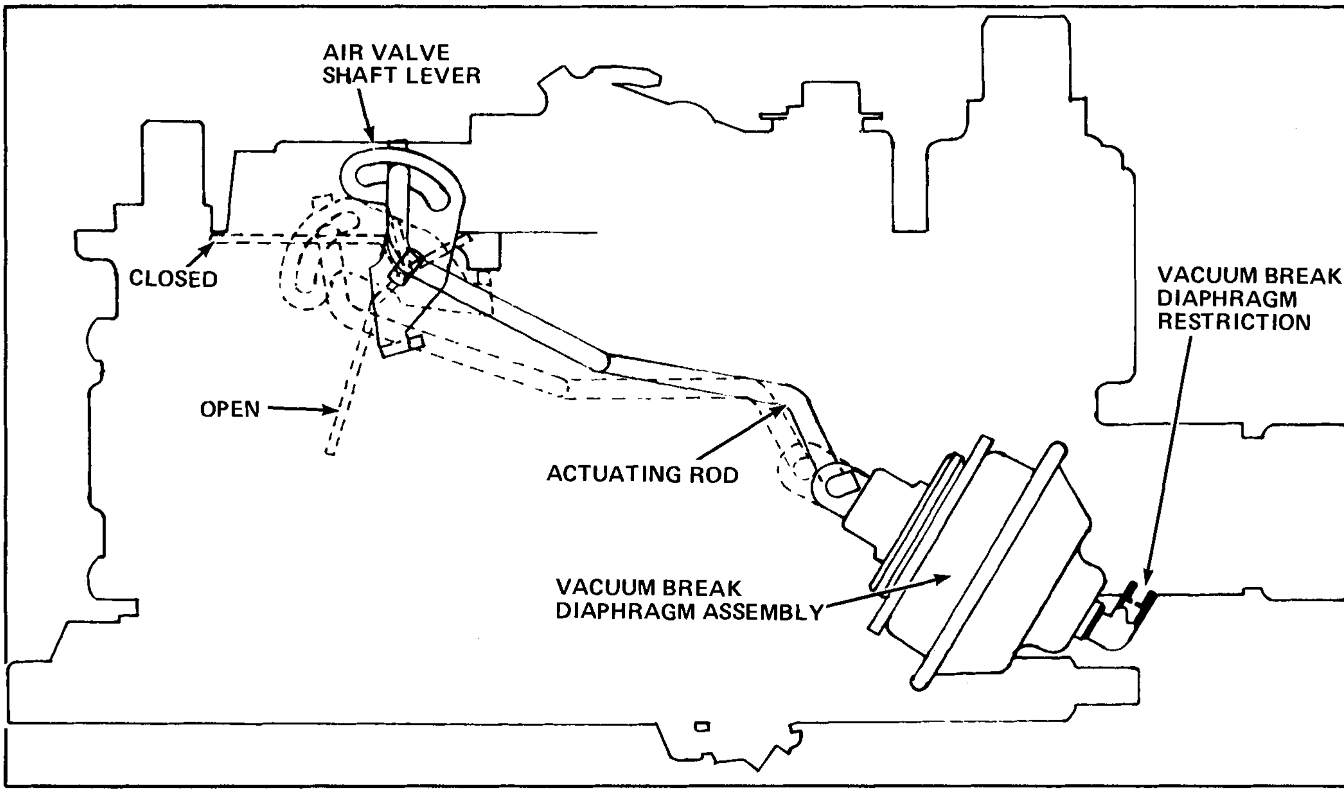


Fig. 6B-80 Air Valve Dashpot Operation

bowl casting. The upper edge of the secondary baffle fits around the secondary fuel discharge nozzles. The baffles are used to provide good fuel distribution by preventing too much fuel from going to the front of the engine.

AIR VALVE DASHPOT

The secondary air valve is connected to the vacuum break unit (Fig. 6B-80) by a rod, to control the opening rate of the air valve and prevent any secondary discharge nozzle lag.

Whenever manifold vacuum is above approximately 5" - 6" Hg, the vacuum break diaphragm stem is seated. However, when the secondary valves are opened and manifold vacuum drops below the 5" - 6" point, the spring in the vacuum break unit will force the diaphragm and stem off its seat. The rate of movement off the seat is controlled by a restriction in the cover of the vacuum break unit.

When the diaphragm is seated, it pulls the rod to the end of the slot in the air valve shaft lever. As the air valve starts to open, when the secondary valves are opened, the restriction in the cover will restrict the air movement to the back side of the diaphragm and slow down the opening of the air valve.

ACCELERATING PUMP SYSTEM

During quick acceleration, when the throttle is opened rapidly, the air flow and manifold vacuum change almost instantaneously. The fuel, which is heavier, tends to lag behind, causing a momentary leanness. The accelerator pump (Fig. 6B-81) is used to provide the extra fuel necessary for smooth operation during this time.

The accelerating pump system is located in the primary side of the carburetor. It consists of a spring loaded pump plunger and pump return spring, operating in a fuel well. The pump plunger is operated by a pump lever on the air horn which is connected directly to the throttle lever by a rod.

When the pump plunger moves upward in the pump well, as happens during throttle closing, fuel from the float bowl enters the pump well through a slot in the top of the pump well. It flows past the synthetic pump cup seal into the bottom of the pump well. The pump plunger is of a floating type (the cup moves up and down on the pump plunger head). When the pump plunger is moved upward, the flat on the top of the cup unseats from the flat on the plunger head and allows free movement of fuel through the inside of the cup into the bottom of the pump well. This also vents any vapors which may be in the bottom of the pump well so that a solid charge of fuel can be maintained in the fuel well beneath the plunger head. When the primary throttle valves are opened, the connecting linkage forces the pump plunger downward. The pump cup seats instantly and fuel is forced through the pump discharge passage, where it unseats the pump discharge check ball and passes on through the passage to the pump jets located in the air horn, where it sprays into the venturi area of each primary bore.

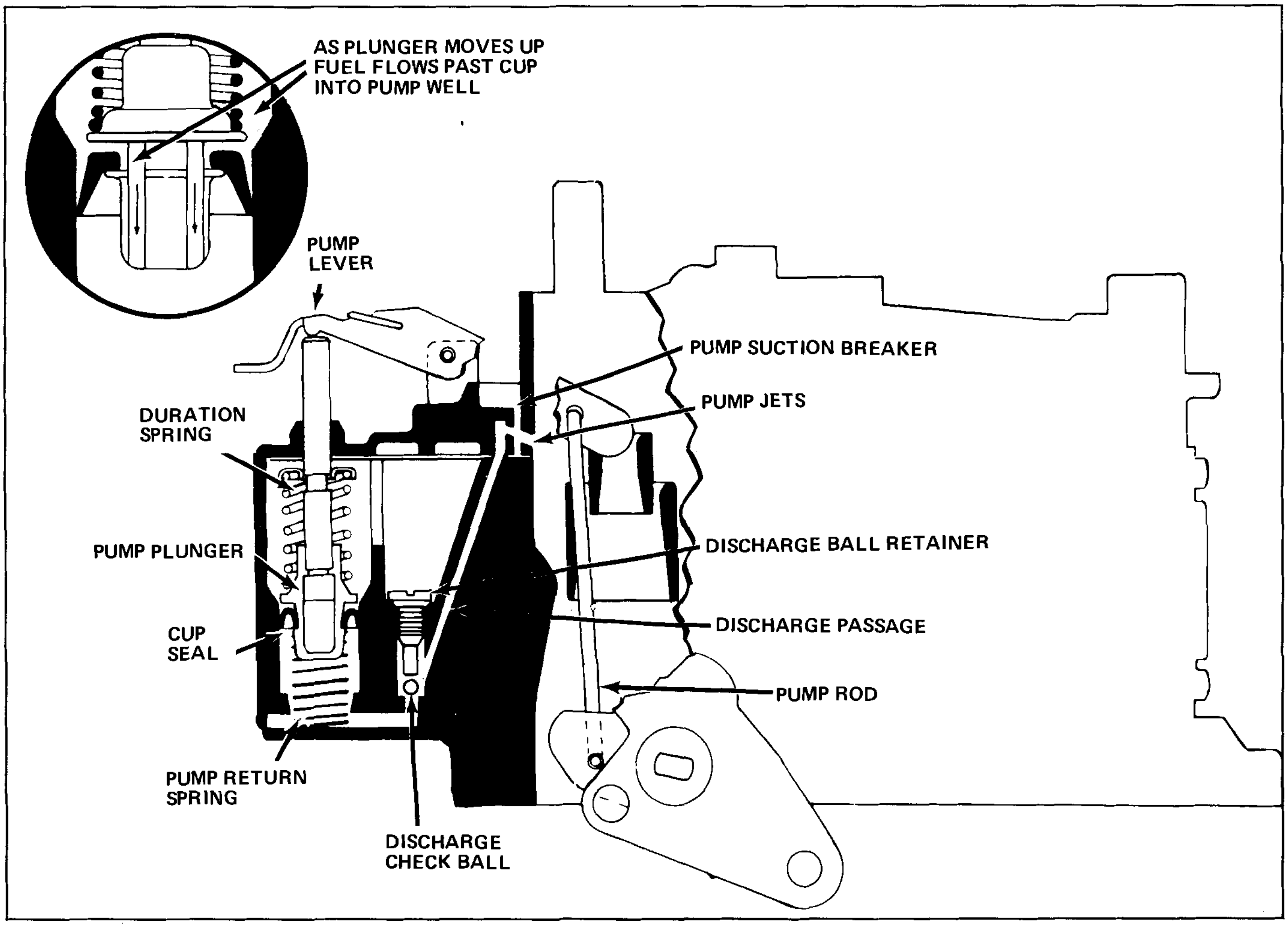


Fig. 6B-81 Pump System

It should be noted that the pump plunger is spring loaded. The top pump duration spring is balanced with the bottom pump return spring so that a smooth sustained charge of fuel is delivered during acceleration.

The pump discharge check ball seats in the pump discharge passage during upward motion of the pump plunger so that air will not be drawn into the passage; otherwise, a momentary acceleration lag could result.

During high speed operation, a vacuum exists at the pump jets. A cavity just beyond the pump jets is vented to the top of the air horn, outside the carburetor bores. This acts as a suction breaker so that when the pump is not in operation fuel will not be pulled out of the pump jets into the venturi area. This ensures a full pump stream when needed and prevents any fuel "pull over" from the pump discharge passage.

CHOKE SYSTEM

The Quadrajet choke valve (Fig. 6B-82) is located on the primary side of the carburetor. It provides the correct air/fuel mixture enrichment to the engine for quick cold engine starting and during the warm-up period. The air valve is locked closed until the engine is thoroughly warm and choke valve is wide open.

The choke system consists of a choke valve located in the primary air horn bore, a vacuum diaphragm unit, fast idle cam, connecting linkage, air valve lockout lever and a thermostatic coil. The thermostatic coil is located on the engine manifold and is connnected to the intermediate choke shaft and lever assembly. Choke operation is controlled by the combination of intake manifold vacuum, the off-set choke valve, temperature and throttle position.

The thermostatic coil, located on the engine manifold, is calibrated to hold the choke valve closed when the engine is cold.

NOTE: *To close the choke valve, the primary throttle valves have to be opened to allow the fast idle cam follower to by-pass the steps on the fast idle cam and come to rest on the highest step of the fast idle cam.*

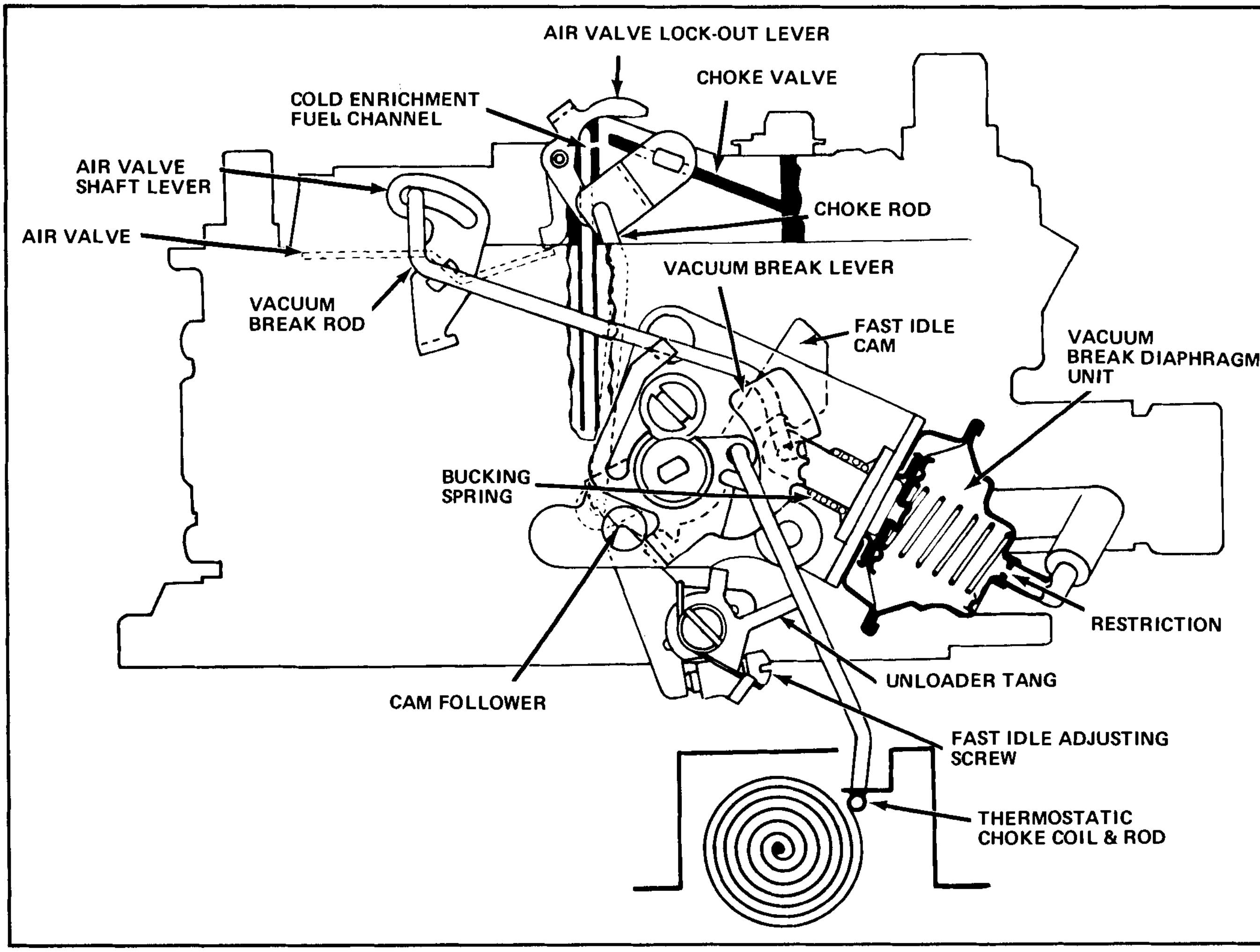


Fig. 6B-82 Choke Svstem

When the choke valve is closed, the air valve lock-out lever is weighted so that a tang on the lever catches the upper edge of the air valve and keeps the air valve closed.

During engine cranking, the choke valve is held closed by the tension of the thermostatic coil. Two fuel feed holes, located just beneath the choke valve, supply added fuel for cold enrichment during cranking. The additional fuel is supplied from tubes which lead from the bottom of the float bowl to the two fuel feed holes in the air horn bores. When the engine starts and is running, manifold vacuum is applied to the vacuum break diaphragm unit on the flat bowl and slowly opens the choke valve to a point where the engine will run without loading or stalling. A bleed check valve, located in the vacuum diaphragm unit, delays choke valve opening to allow the manifold to be wetted and prevent stalling due to leanness.

As the choke valve is opened to the vacuum break position, the cold enrichment feed holes, no longer in a low pressure area, cease to feed fuel.

Included in the vacuum break unit is a spring loaded plunger. The purpose of the spring is to off-set choke thermostatic coil tension and balance the greater opening of the choke valve with tension of the choke coil. This enables further refinement because the coil which senses engine and ambient temperatures will allow the choke valve to open gradually against spring tension in the diaphragm plunger head. In other words, in very cold temperatures the extra tension created by the thermostatic coil will overcome the tension of the diaphragm plunger spring and provide less choke valve opening with the results of slightly richer mixture. In warmer temperatures the thermostatic coil will have less tension and consequently will not press the spring as much, thereby, giving a greater choke valve opening for slightly leaner mixtures.

As the choke valve is opening, the fast idle cam follower on the end of the primary throttle shaft will drop from the highest step on the fast idle cam to the second step when the throttle valve is opened. This gives the engine sufficient fast idle and correct fuel mixtures for running until the engine begins to warm up and heat the thermostatic coil. As the thermostatic coil on the engine manifold becomes heated, it relaxes its tension and allows the choke valve to open further because of intake air pushing on the off-set choke valve. Choke valve opening continues until the thermostatic coil is completely relaxed, at which point the choke valve is wide open.

When the engine is thoroughly warm, the choke coil pulls the intermediate choke lever completely down and allows the fast idle cam to rotate so that the cam follower drops off the last step of the fast idle cam, allowing the engine to run at normal speeds. When the choke moves toward the up position, the end of the rod strikes a tang on the air valve lock-out lever. As the rod moves to the end of its travel, it pushes the lock-out tang upward and unlocks the air valve.

To reduce friction and alleviate choke binding, the choke shaft and intermediate choke shaft are teflon coated.

The choke system is equipped with an unloader mechanism which is designed to partially open the choke valve, should the engine become loaded or flooded during the starting period. To unload the engine, the accelerator pedal should be depressed so that the throttle valves are held wide open. A tang on a lever on the choke side of the primary throttle shaft contacts the fast idle cam and through the intermediate choke shaft forces the choke valve slightly open. This allows extra air to enter the carburetor bores and pass on into the engine manifold and engine cylinders to lean out the fuel mixture so that the engine will start.

ADJUSTMENTS ON CAR

All 4MV adjustments can be performed on the car. With the exception of the idle speed and mixture adjustment (See Section 6D), all adjustments are included in the OVERHAUL AND ADJUSTMENTS procedure.

4MV			
Carburetor Model Number	Calif. or Non Calif.	A/C or Non A/C	Engine-Trans. Usage
7042262	Both	Both	455 Auto. (Exc. H.O.)
7042263	Both	Both	400 Man.
7042264	Both	Both	400 Auto.
7042270	Both	Both	455 H.O. Auto.
7042273	Both	Both	455 H.O. Man.

PERIODIC SERVICE

There are no periodic services required on the 4MV carburetor; however, choke linkage, choke valve and levers and pump linkage should be kept free of dirt and gum so that they will operate freely. Do not oil any of the external linkage.

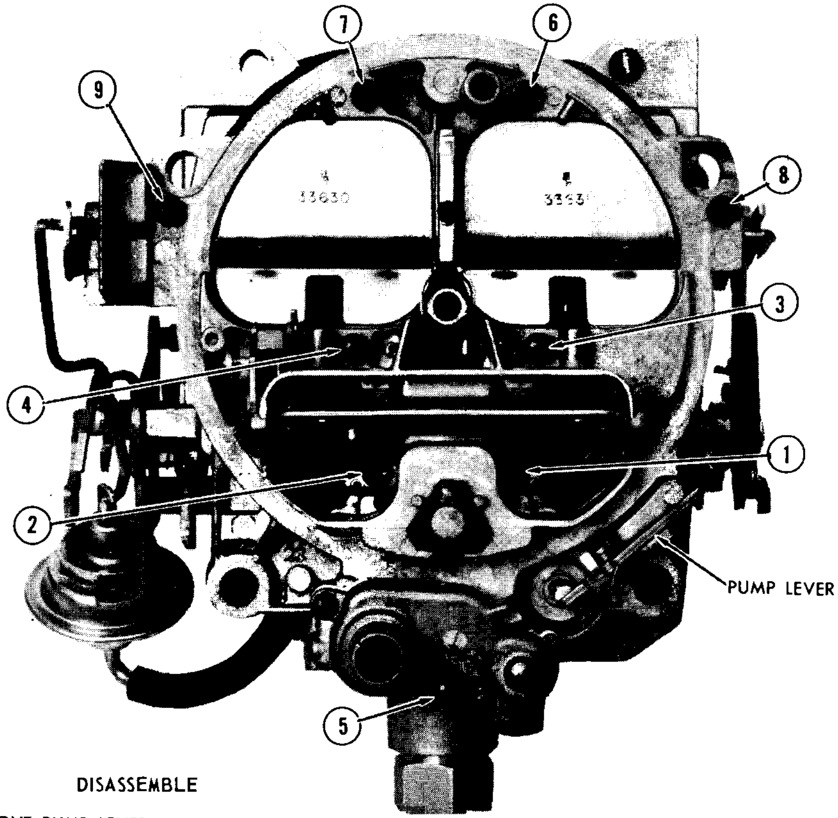
The integral fuel filter in the carburetor float bowl should be cleaned and replaced periodically. Normal recommendations are that it be cleaned or replaced during the normal engine tune-up or between approximately 10,000 to 12,000 miles. This will, of course, vary dependent upon fuel contamination.

OVERHAUL AND ADJUSTMENTS

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water or other foreign matter in the carburetor. To aid in diagnosing the cause of the complaint, the carburetor should be carefully removed from the engine without draining the fuel from the bowl. The contents of the fuel bowl may then be examined for contamination as the carburetor is disassembled.

The following is a step-by-step sequence by which the 4MV carburetor may be completely disassembled and reassembled. Adjustments may be made and various parts of the carburetor may be serviced without completely disassembling the entire unit.

NOTE: *Place carburetor on proper holding fixture.*



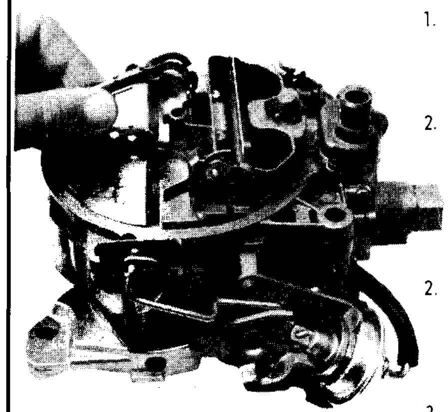
DISASSEMBLE

1. REMOVE PUMP LEVER & ROD ASS'Y. BY DRIVING THE PUMP HINGE PIN INWARD TOWARDS AIR HORN WITH A SMALL DRIFT PUNCH JUST FAR ENOUGH UNTIL PUMP LEVER IS FREE. THEN ROTATE PUMP LEVER FROM PUMP ROD AND PUMP ROD FROM LOWER THROTTLE LEVER.
2. REMOVE SECONDARY METERING RODS (INSERT A).
3. REMOVE NINE AIR HORN ATTACHING SCREWS (NUMBERED).
4. REMOVE INTERMEDIATE CHOKE ROD CLIP AND REMOVE ROD.
5. REMOVE IDLE VENT COVER & IDLE VENT ASS'Y.

REMOVE AIR HORN BY LIFTING STRAIGHT UP, UNTIL THE BLEED TUBES AND PUMP PLUNGER STEM CLEAR THE FLOAT BOWL, THEN ROTATE VERTICALLY TO REMOVE THE VACUUM BREAK ROD FROM THE AIR VALVE DASHPOT LEVER.

ASSEMBLE

REVERSE DISASSEMBLY STEPS.



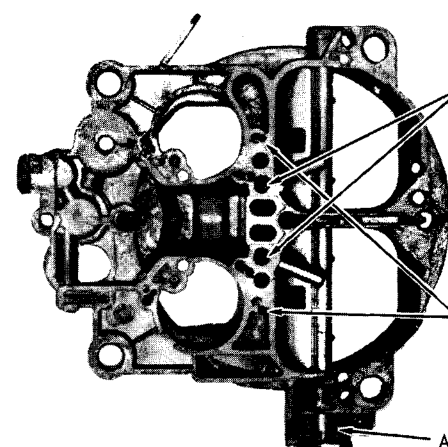
INSERT A

REMOVE

1. REMOVE RETAINING SCREW AND LIFT METERING RODS AND HANGER STRAIGHT UP
2. SLIDE RODS FROM HANGER.

REPLACE

1. INSERT RODS IN HANGER.
2. HOLD HANGER AS SHOWN. SLIDE RODS INTO LOCATING HOLES IN AIR HORN AND REPLACE SCREW.
3. CHECK FOR FREE OPERATION OF RODS IN METERING DISCS BY OPENING AND CLOSING AIR VALVE.



INSERT B

Fig. 6B-83 Air Horn R & R

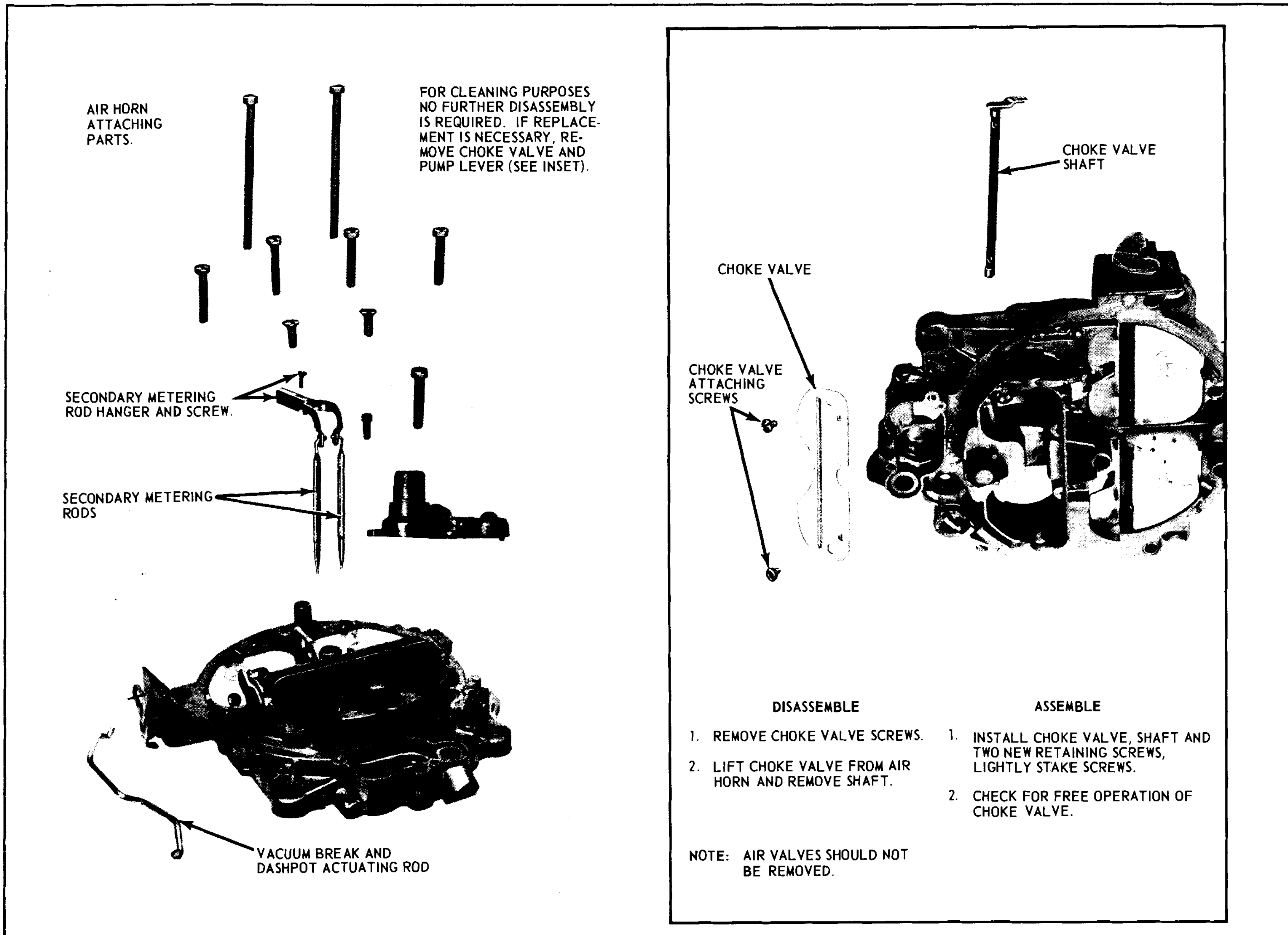
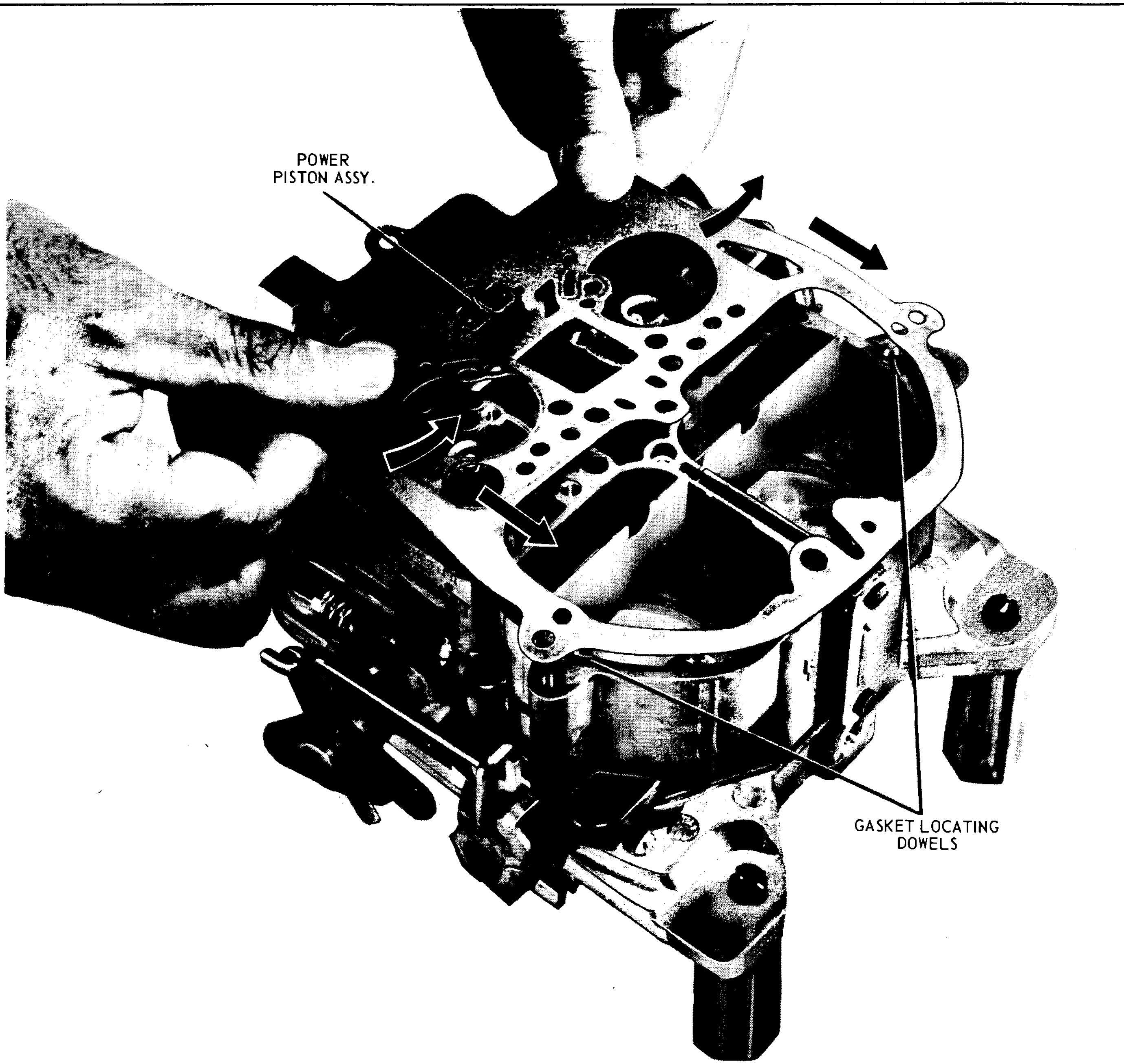


Fig. 6B-84 Air Horn Disassembly and Assembly



DISASSEMBLE

1. REMOVE ACCELERATOR PUMP
2. LIFT AIR HORN GASKET FROM LOCATING DOWELS.
3. SLIDE GASKET FORWARD TO CLEAR POWER PISTON AND LIFT OFF

NOTE: GASKET IS CUT AWAY IN AREA OF POWER PISTON FOR EASE OF REMOVAL AND REPLACEMENT

ASSEMBLE

1. INSTALL AIR HORN GASKET AROUND PRIMARY METERING RODS AND POWER PISTON. POSITION GASKET OVER DOWELS
2. REPLACE ACCELERATOR PUMP

Fig. 6B-85 Air Horn Gasket R & R

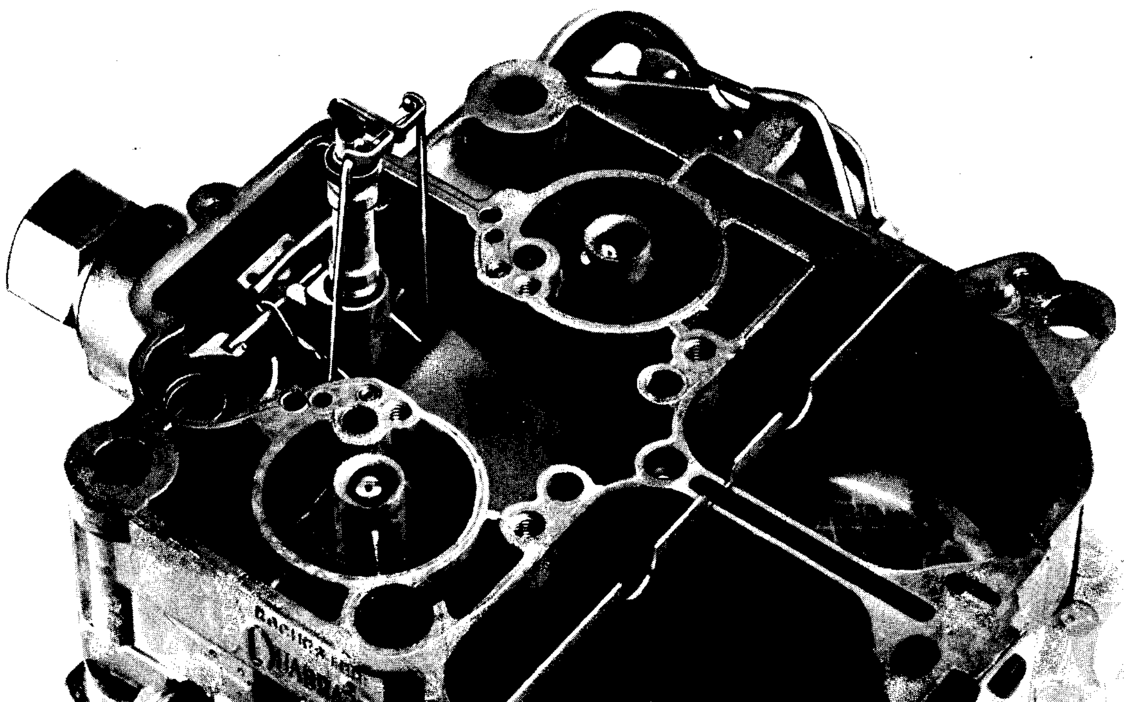
Fig. 6B-86 Plastic Filler & Pump Spring R & R

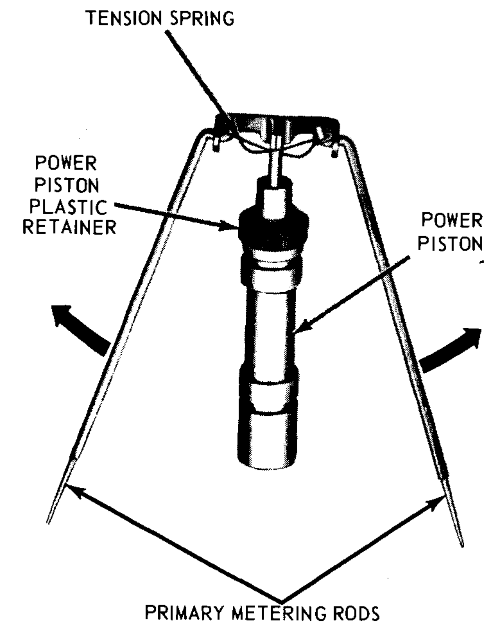
DISASSEMBLE

1. REMOVE POWER PISTON AND RODS FROM POWER PISTON WELL BY PRESSING DOWN ON HANGER AND ALLOWING ASSEMBLY TO "SNAP" FREE. DO NOT USE PLIERS TO REMOVE POWER PISTON ASSEMBLY.
2. REMOVE RODS, IF NECESSARY TO REPLACE, FROM HANGER. (SEE INSET)

ASSEMBLE

1. REPLACE RODS IN HANGER.
2. SLIDE POWER PISTON INTO BORE AND LINE UP METERING RODS WITH JETS.
3. WITH RODS IN PRIMARY JETS PUSH DOWN ON POWER PISTON TO LOCATE PLASTIC RETAINER PROPERLY IN BORE, THEN PRESS PLASTIC RETAINER INTO MACHINED RECESS IN BORE (USING BLADE OF SCREWDRIVER) EVENLY UNTIL RETAINER IS FLUSH WITH TOP OF CASTING.



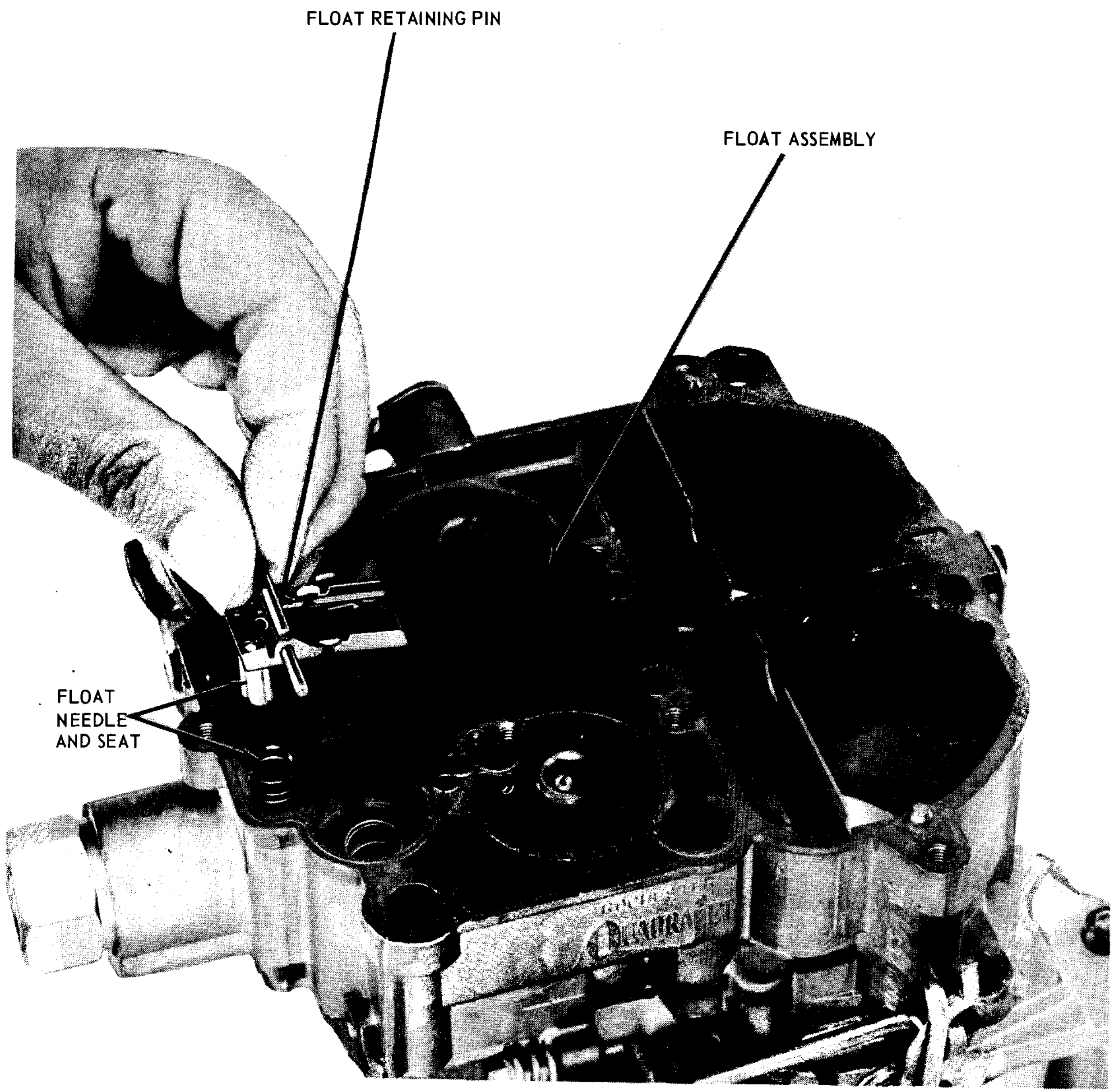


LIFT METERING RODS IN DIRECTION OF ARROWS TO DISCONNECT FROM HANGER AND TENSION SPRING. TO REPLACE REVERSE ABOVE PROCEDURE.

NOTE: RODS SHOULD NOT BE BENT OR DAMAGED.

Fig. 6B-67 Power Piston & Primary Rods R & R

Fig. 6B-87 Power Piston & Primary Rods R & R



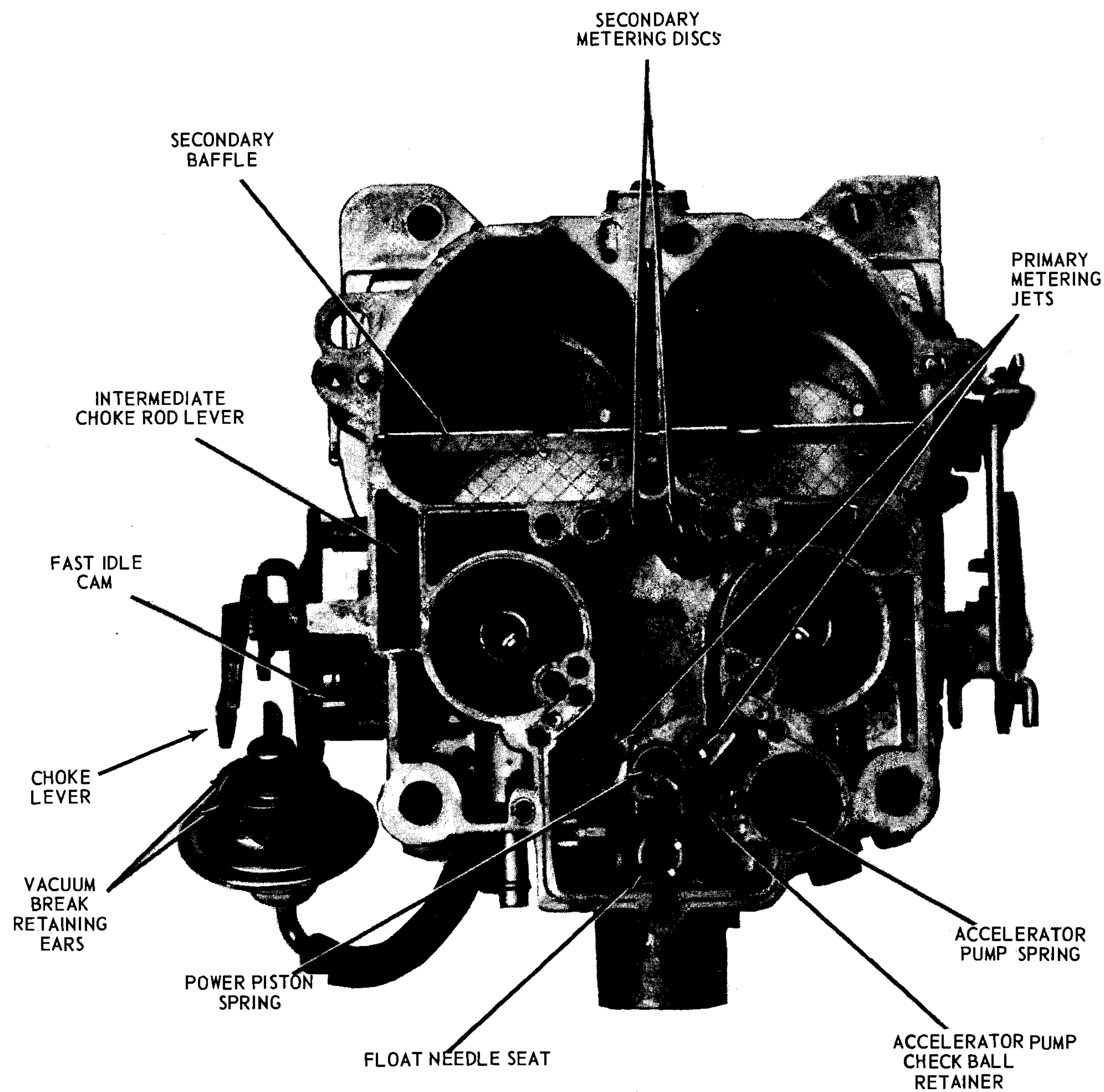
DISASSEMBLE

1. LIFT FLOAT AND NEEDLE FROM BOWL.
2. DISCONNECT NEEDLE PULL CLIP AND REMOVE NEEDLE

ASSEMBLE

1. INSERT NEW NEEDLE AND PULL CLIP IN FLOAT PIN.
2. INSTALL FLOAT BY HOLDING FLOAT AT TOE AND INSTALL RETAINING PIN FROM CHOKE SIDE.
3. ADJUST FLOAT LEVEL (FIG. 6B-73)

Fig. 6B-88 Float & Float Needle R & R



DISASSEMBLE

1. REMOVE PUMP PLUNGER SPRING
2. REMOVE POWER PISTON SPRING
3. REMOVE FLOAT NEEDLE SEAT
4. REMOVE PRIMARY METERING JETS.

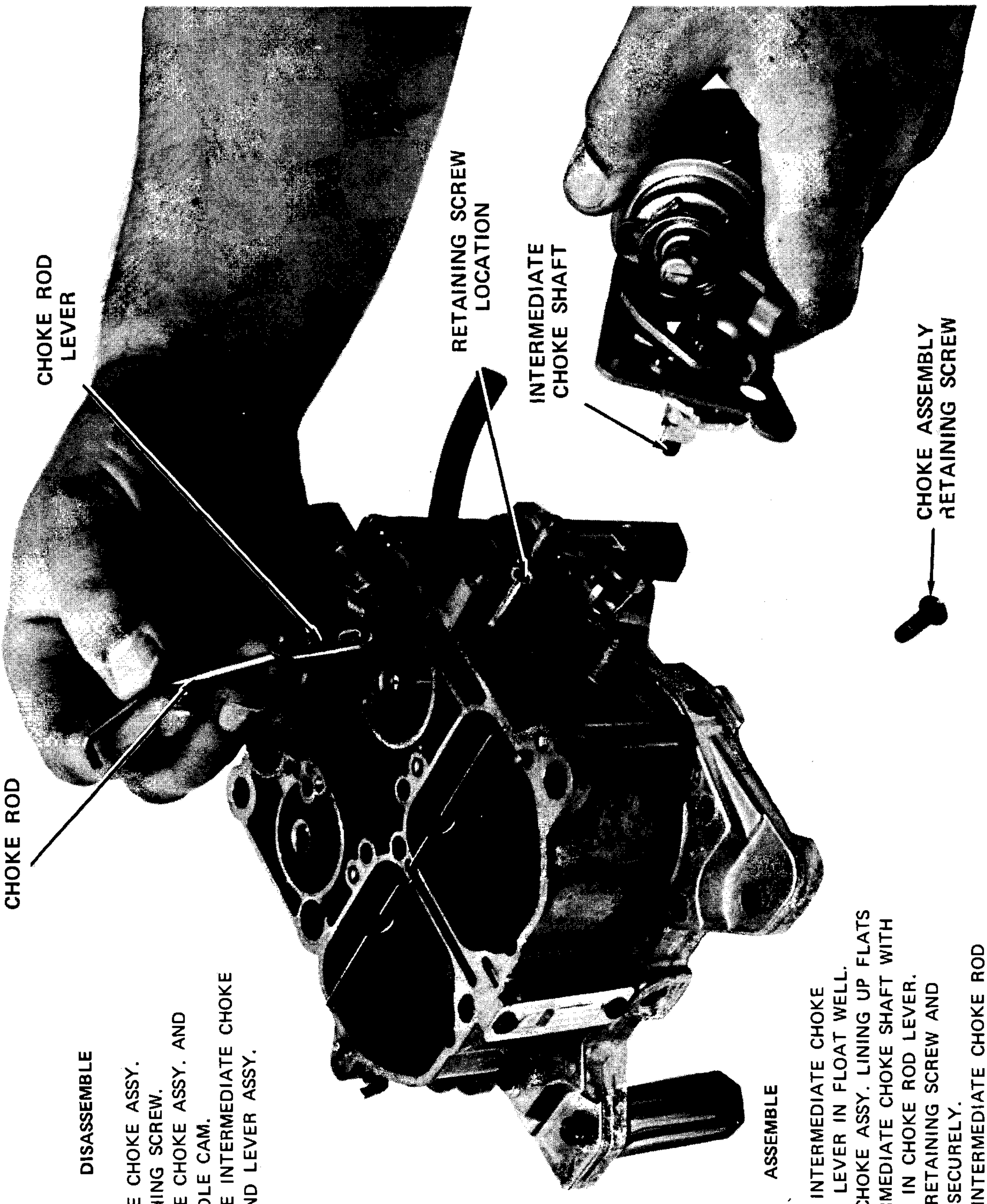
CAUTION: SECONDARY METERING DISCS ARE NOT REMOVABLE.

5. REMOVE ACCELERATOR PUMP CHECK BALL RETAINER AND BALL.
6. REMOVE SECONDARY BAFFLE.
7. SPREAD RETAINING EARS WITH PLIERS TO REMOVE VACUUM BREAK ASSEMBLY.

ASSEMBLE

1. REPLACE VACUUM BREAK UNIT. CLOSE EARS TO RETAIN.
2. REPLACE SECONDARY BAFFLE WITH NOTCHES TOWARD TOP.
3. REPLACE ACCELERATOR PUMP CHECK B AND RETAINER.
4. REPLACE PRIMARY JETS.
5. REPLACE FLOAT NEEDLE SEAT.
6. REPLACE POWER PISTON SPRING.
7. REPLACE PUMP RETURN SPRING.

Fig. 6B-89 Float Bowl Disassemble & Assemble



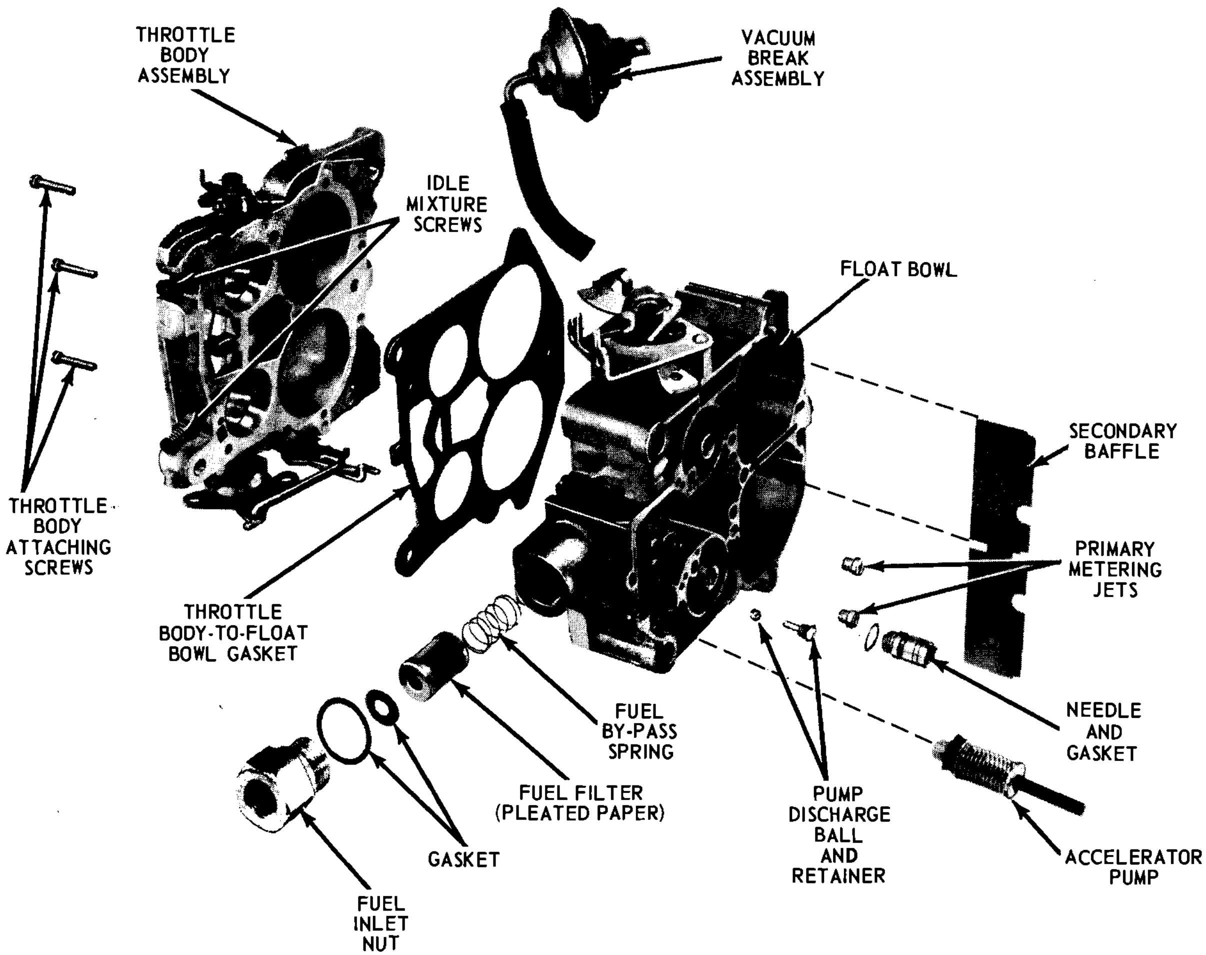
DISASSEMBLE

1. REMOVE CHOKE ASSY. ATTACHING SCREW.
2. REMOVE CHOKE ASSY. AND FAST IDLE CAM.
3. REMOVE INTERMEDIATE CHOKE ROD AND LEVER ASSY.

ASSEMBLE

1. POSITION INTERMEDIATE CHOKE ROD AND LEVER IN FLOAT WELL.
2. INSTALL CHOKE ASSY. LINING UP FLATS ON INTERMEDIATE CHOKE SHAFT WITH CUT-OUTS IN CHOKE ROD LEVER.
3. INSTALL RETAINING SCREW AND TIGHTEN SECURELY.
4. REMOVE INTERMEDIATE CHOKE ROD FOR INSTALLATION LATER.

Fig. 6B-90 Choke & Fast Idle Mechanism R & R



DISASSEMBLE

1. REMOVE FUEL INLET NUT, FILTER AND SPRING.
2. REMOVE THREE THROTTLE BODY-TO-FLOAT BOWL ATTACHING SCREWS.
3. REMOVE THROTTLE BODY AND GASKET.
4. REMOVE IDLE MIXTURE SCREWS AND SPRINGS.

NO FURTHER DISASSEMBLY OF THE THROTTLE BODY IS REQUIRED.

ASSEMBLE

1. INSTALL IDLE MIXTURE SCREWS AND SPRINGS. BACK OUT SCREWS FIVE TURNS FROM LIGHTLY SEATED POSITION AS A PRELIMINARY ADJUSTMENT.
2. INSTALL NEW THROTTLE BODY-TO-BOWL GASKET.
3. INSTALL THROTTLE BODY GASKET OVER DOWELS ON FLOAT BOWL, INSERT THREE ATTACHING SCREWS, TIGHTEN EVENLY AND SECURELY.
4. PLACE CARBURETOR ON HOLDING FIXTURE.
5. INSTALL FUEL INLET SPRING, NEW FUEL FILTER, GASKET AND RETAINING NUT.

Fig. 6B-91 Throttle Body & Float Bowl Disassemble & Assemble

CLEANING AND INSPECTION

NOTE: The carburetor should be cleaned in a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner such as Carbon-X (X-55) or its equivalent.

CAUTION: Any rubber parts, plastic parts, diaphragms, pump plungers, should not be immersed in carburetor cleaner. However, the delrin cam on the air valve shaft will withstand normal cleaning in carburetor cleaner.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.

3. Inspect idle mixture needles for damage.

4. Examine float needle and seat for wear. Replace if necessary with new float needle assembly.

5. Inspect upper and lower surfaces of carburetor castings for damage.

6. Inspect holes in levers for excessive wear or out-of-round conditions. If worn, levers should be replaced.

7. Examine fast idle cam for wear or damage.

8. Check air valve for binding conditions. If air valve is damaged, air horn assembly must be replaced.

9. Check all throttle levers and valves for binds or other damage.

Fig. 6B-92 Cleaning & Inspection Procedure

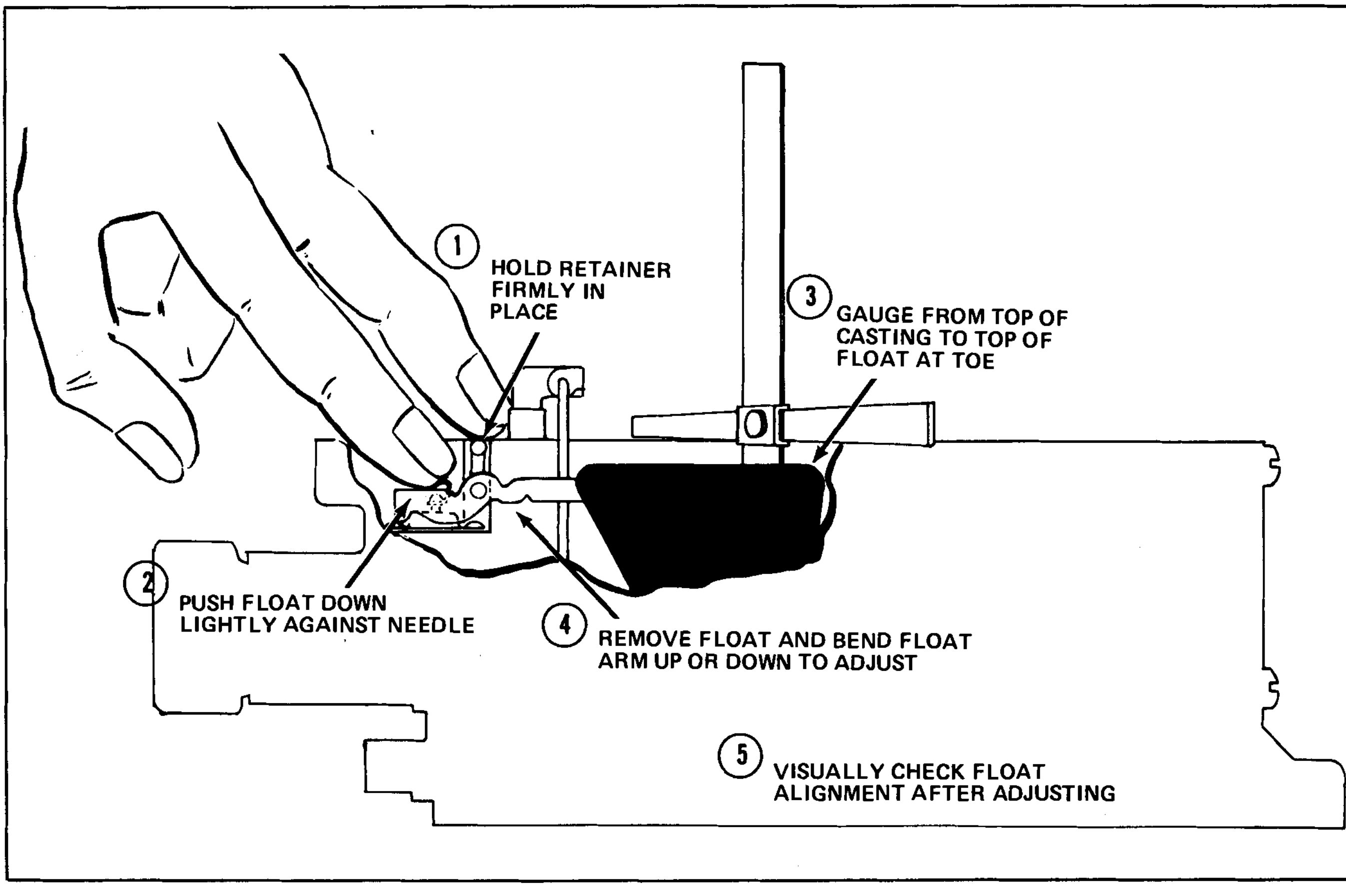


Fig. 6B-93 Float Level Adjustment

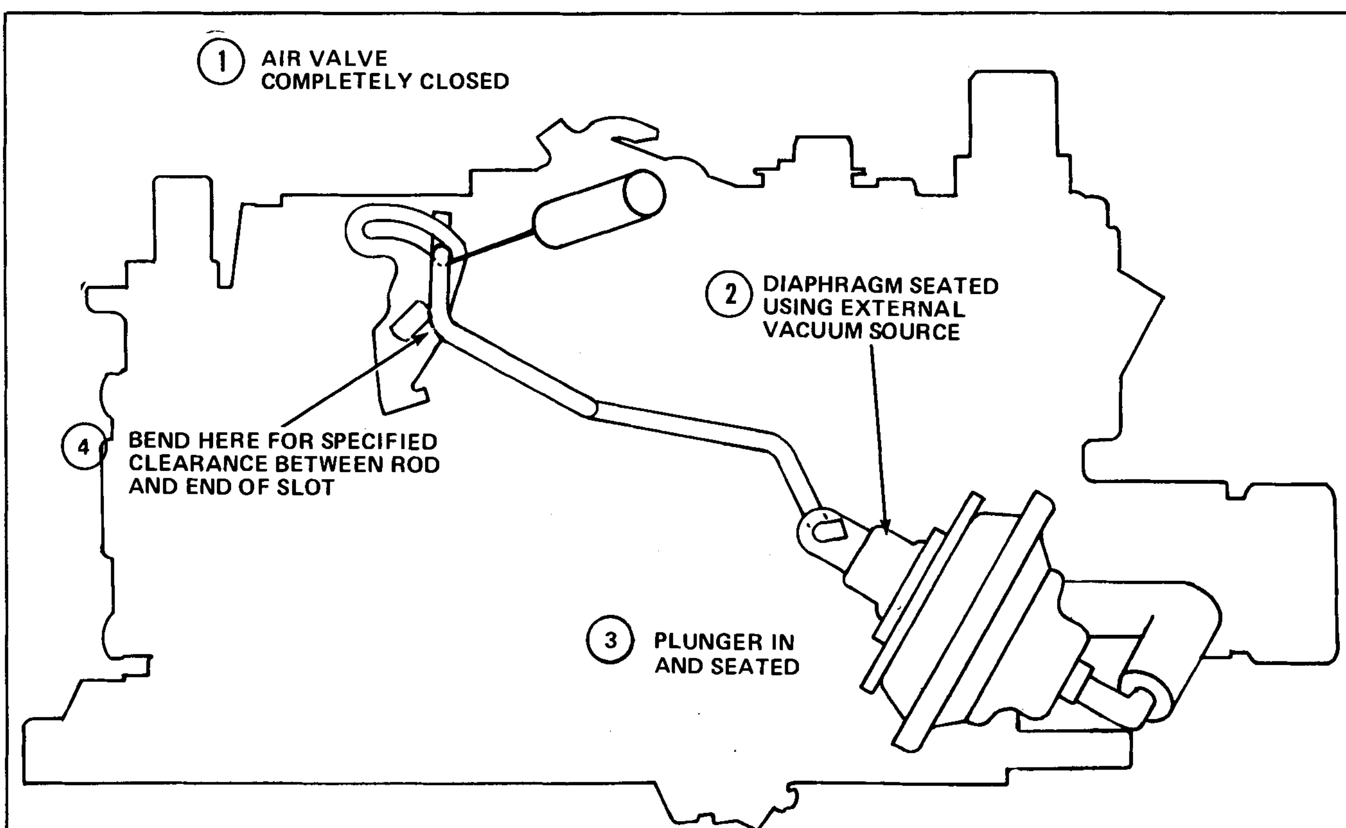


Fig. 6B-94 Air Valve Dashpot Adjustment

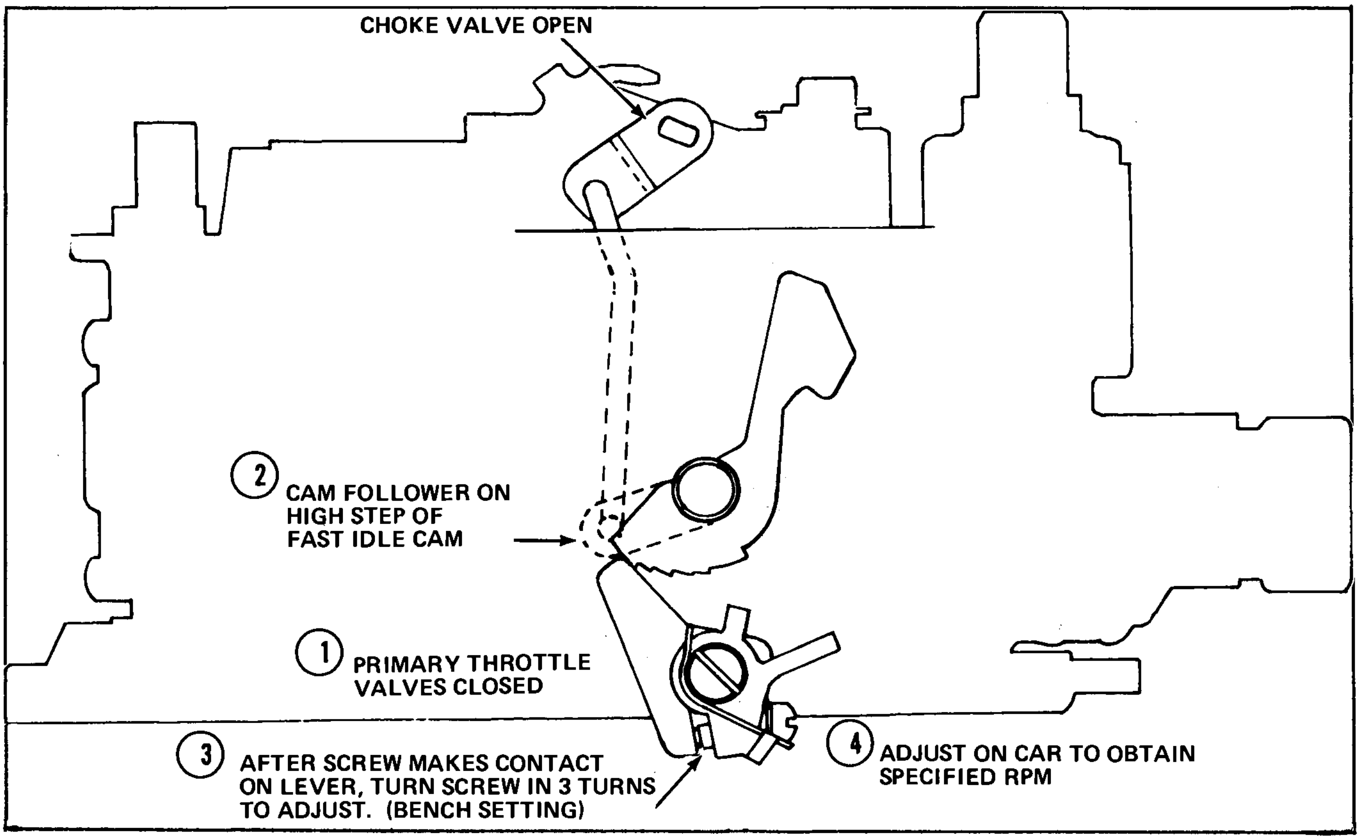


Fig. 6B-95 Fast Idle Adjustment

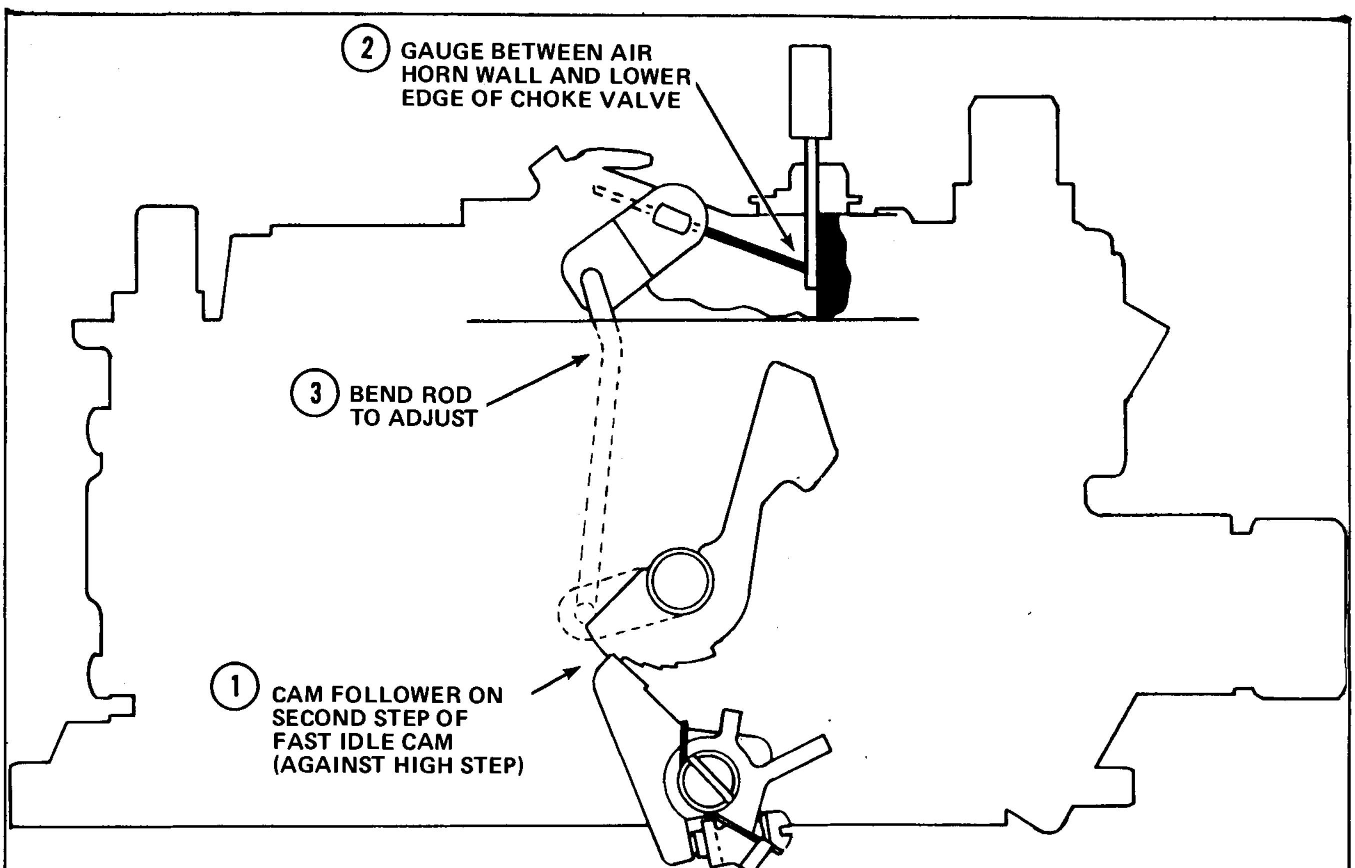


Fig. 6B-96 Choke Rod Adjustment

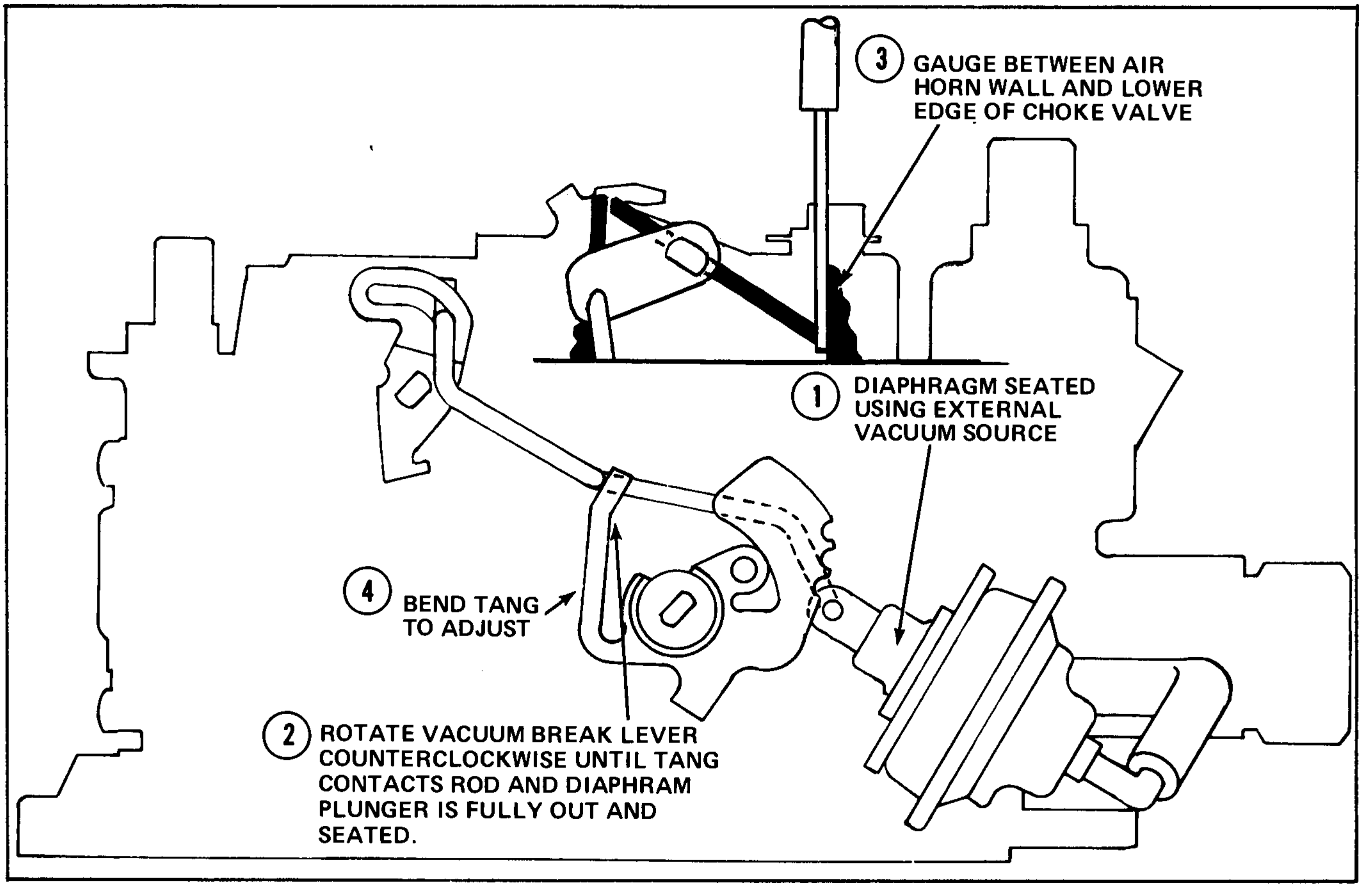


Fig. 6B-98 Vacuum Break Adjustment

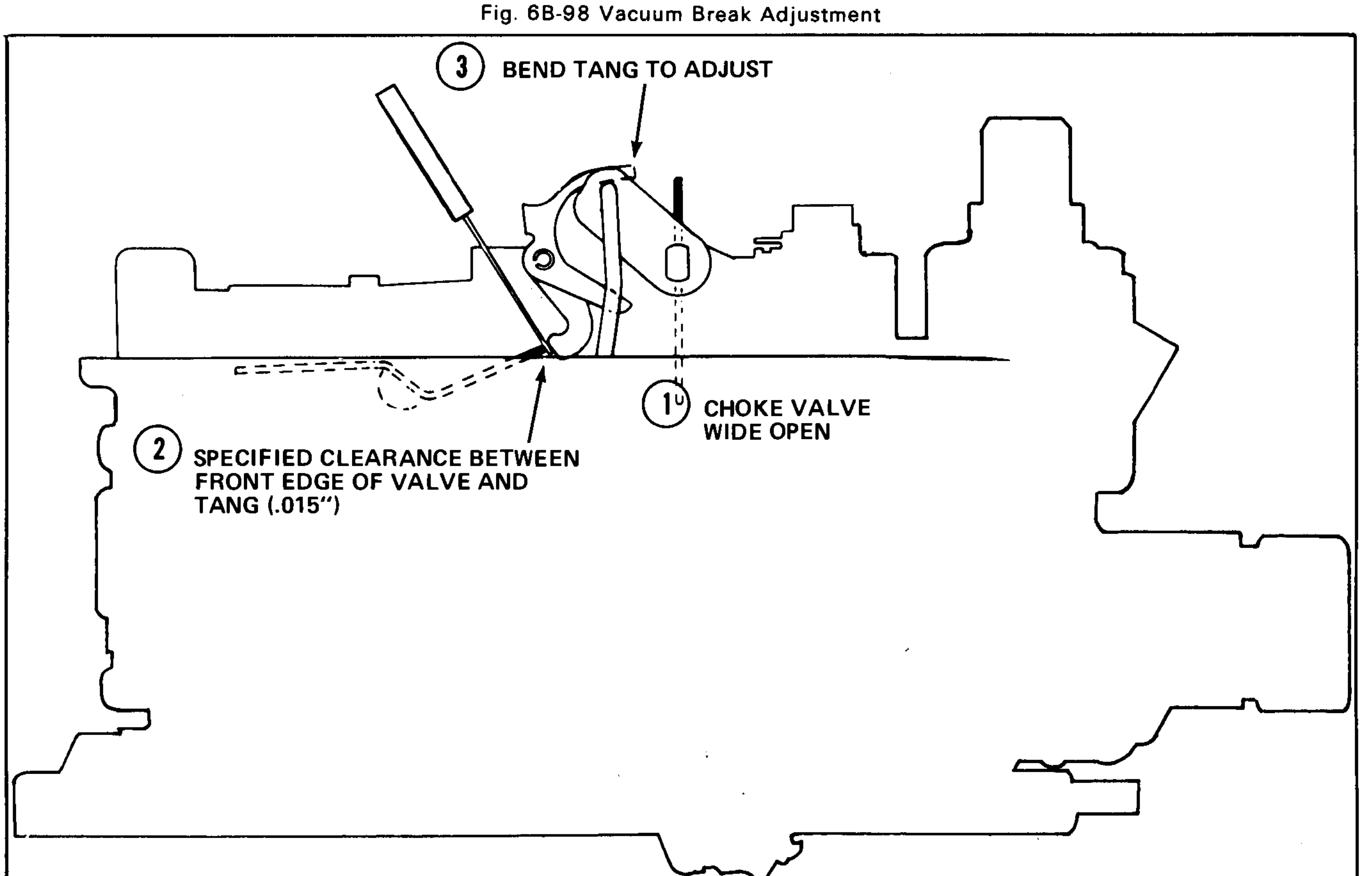


Fig. 6B-99 Air Valve Lockout Adjustment

CARBURETOR MODEL	USAGE	FLOAT SETTING	FLOAT DROP	PUMP ROD	CHOKE ROD	VACUUM BREAK	AIR VALVE LOCK-OUT	AIR VALVE DASH-POT	UN-LOAD-ER	METER-ING ROD	CHOKE COIL ROD
Rochester MV											
7042014	250 A.T. (non-Calif.)	1/4"	--	--	.160"	.200"	--	--	.500"	.080"	Refer To Choke Adjust-ment
7042017	250 M.T. (non-Calif.)				.180"	.230"					
7042984	250 A.T. (Calif.)				.160"	.200"					
7042987	250 M.T. (Calif.)				.180"	.230"					
Rochester 2 GV											
7042060	400 A.T.	5/8"				.122"					Refer To Choke Adjust-ment
7042061	400 A.T.					.122"					
7042062	350 A.T.	9/16"	1-9/32"	1-11/32"	.085"	.105"	--	--	.180"	--	
7042064	455 A.T.	5/8"				.150"					
7042100	307 A.T.	25/32"	1-31/32"	1-5/16"	.040"	.080"			.215"		
7042101	307 M.T.				.075"	.100"					
Rochester 4 MV											
7042262	455 A.T. (All exc. Ram-Air)	1/4"		13/32"	.100"	.290"	.015	.025	.310"	--	None
7042263	400 M.T. (All exc. Ram-Air)										
7042264	400 A.T. (All exc. Ram-Air)										
7042270	455 H.O. A.T. (Ram-Air)			7/16"							None
7042273	455 H.O. M.T. (Ram-Air)										
Carter WGD											
488062	350 M.T.	5/16"	--	--	--	--	--	--	--	--	Center Notch

Fig. 6B-100 Service Specifications

SECTION 6C

ENGINE TUNE-UP

TUNE-UP SEQUENCE INDEX

GENERAL INFORMATION

Engine tune-up can be described as diagnosis and preventative maintenance performed at regular intervals to restore maximum performance and economy in an engine.

It is advisable to follow a definite and thorough procedure of analysis and correction as suggested by the sequence-index above.

> **IMPORTANT:** *A quality tune-up is recommended every 12 months or 12,000 miles in order to assure proper engine performance and complete effectiveness of exhaust emission systems.*

SPARK PLUG REMOVAL

Remove any foreign matter from around spark plugs by blowing out with compressed air, then disconnect wires and remove plugs.

COMPRESSION TEST

Test compression with engine warm, all spark plugs removed and throttle and choke wide open. Crank engine through at least five compression strokes to obtain highest possible reading. No cylinder should be less than 80% of the highest cylinder (see examples). Excessive variation between cylinders, accompanied by low speed missing of the cylinder or cylinders which are low, usually indicates a valve not properly seating, a burned valve or broken piston ring. Low pressures, even though uniform, may indicate worn rings. This will usually be accompanied by excessive oil consumption.

6 CYL.

Example 1

CYLINDER	PRESSURE
1	139
2	137
3	140
4	131
5	126
6	110

80% of 140 (highest) is 112. Thus cylinder No. 6 is less than 80% of No. 3. This condition, accompanied by low speed missing, indicates a burned valve or broken piston ring.

Example 2

CYLINDER	PRESSURE
1	95
2	106
3	100
4	97
5	95
6	101

80% of 106 is 85. While all cylinders are well above 85, they are all excessively low. This may indicate poor valves in all cylinders or low cranking speed.

If compression is subnormal, tune-up will probably not be satisfactory.

V-8

Example 1

CYLINDER	PRESSURE
1	146
2	148
3	145
4	154
5	112
6	147
7	150
8	151

80% of 154 (highest) is 123. Thus cylinder No. 5 is less than 80% of No. 4. This condition, accompanied by low speed missing, indicates a burned valve or broken piston ring.

Example 2

CYLINDER	PRESSURE
1	95
2	101
3	100
4	97
5	106
6	103
7	97
8	99

80% of 106 is 85. While all cylinders are well above 85, they are all excessively low. This may indicate poor valves in all cylinders or, if accompanied by oil consumption, worn rings or low cranking speed. If compression is subnormal, tune-up will probably not be satisfactory. (See specifications at end of section 6 for correct compression pressures.)

> **NOTE:** *The compression check is important because an engine with low or uneven compression cannot be tuned successfully to give peak performance. Therefore, it is essential that improper compression be corrected before proceeding with an engine tune-up.*

CLEAN, TEST AND INSTALL SPARK PLUGS

1. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelains and replace plugs where necessary. For optimum engine performance and economy, it is recommended that spark plugs be replaced every 12,000 miles. Refer to the spark plug diagnosis information presented in Engine Electrical for an analysis of plug conditions.

2. Clean serviceable spark plugs thoroughly, using an abrasive-type cleaner. File the center electrode flat.

3. Inspect each spark plug for make and heat range. All plugs must be of the same make and number or heat range. (See section 6E for correct spark plug usage.)

4. Adjust spark plug gaps to .035" using a round feeler gauge.

   CAUTION: *Never bend the center electrode to adjust gap. Always adjust by bending ground (or side) electrode.*

5. If available, test plugs with a spark plug tester.

6. Inspect spark plug hole threads and clean before installing plugs. Corrosion deposits can be removed with a 14 mm. × 1.25 SAE spark plug tap (available through local jobbers) or by using a small wire brush in an electric drill. Use plenty of grease on the tap to catch any chips.

   CAUTION: *Use extreme care when using tap to prevent cross threading. Also crank engine several times to blow out any material dislodged during cleaning operation.*

7. Install spark plugs in engine and tighten to 15 lb. ft. (6-cyl. and V-8).

   Improper installation is one of the greatest single causes of unsatisfactory spark plug performance, and is the result of one or more of the following practices:

   - Installation of plugs with insufficient torque to fully seat the plug.
   - Installation of the plugs using excessive torque which changes gap settings.
   - Installation of plugs on dirty seal.
   - Installation of plugs to corroded spark plug hole threads.

Failure to install plugs properly will cause them to operate at excessively high temperatures and result in reduced operating life under mild operation or complete destruction under severe operation where the intense heat cannot be dissipated rapidly enough.

Always remove corrosion deposits in hole threads before installing plugs. When corrosion is present in threads, normal torque is not sufficient to compress the plug gasket and early failure from overheating will result.

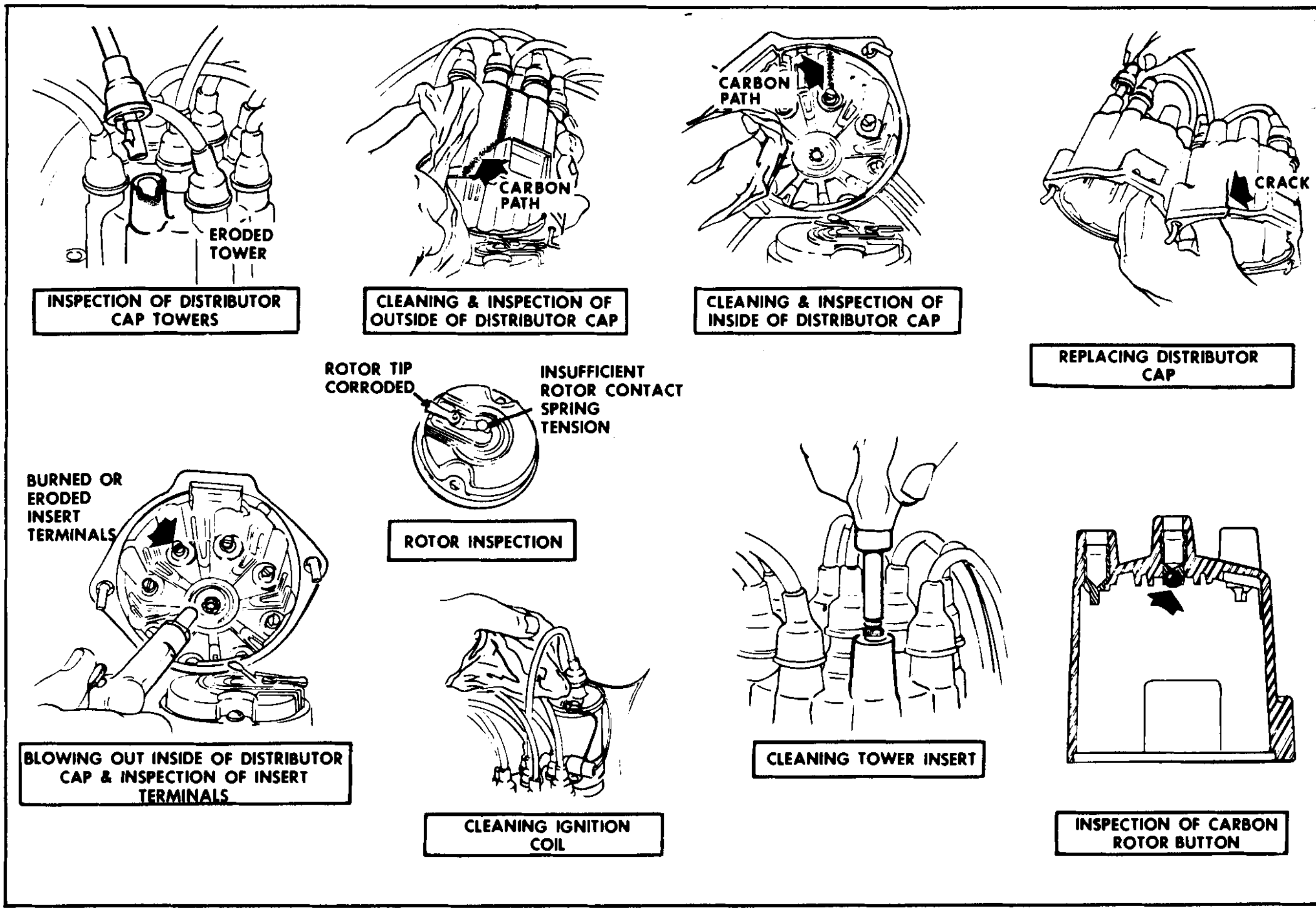


Fig. 6C-1 Inspecting Rotor and Distributor Cap

IGNITION SYSTEM SERVICE AND REPAIRS

1. Replace brittle or damaged spark plug wires. Install all wires to proper spark plug. Proper positioning of spark plug wires in wire supports is important on V-8 engines to prevent cross-firing.

2. Tighten all ignition system connections.

3. Replace or repair any wires that are frayed, loose or damaged.

4. Remove distributor cap, clean cap and inspect for cracks, carbon tracks and burned or corroded terminals. Replace cap where necessary.

5. Clean rotor and inspect for damage or deterioration. Replace rotor where necessary.

6. Check the distributor centrifugal advance mechanism by turning the distributor rotor as far as possible, then releasing the rotor to see if the springs return it to its original position. If the rotor does not return readily, the distributor must be disassembled and the cause of the trouble corrected.

7. Check to see that the vacuum advance control operates freely by turning the movable breaker plate to see if the spring returns to its original position. Any stiffness in the operation of the spark control will affect the ignition timing. Correct any interference or binding condition noted.

8. Examine distributor points and clean or replace if necessary.

   - Contact points with an overall gray color and only slight roughness or pitting need not be replaced.

   - Dirty points should be cleaned with a clean point file.

   - Use only a few strokes of a clean, fine-cut contact file. The file should not be used on other metals and should not be allowed to become greasy or dirty. Never use emery cloth or sandpaper to clean contact points since particles will embed and cause arcing and rapid burning of points. Do not attempt to remove all roughness or dress the point surfaces down smooth. Merely remove scale or dirt.

- Replace points that are burned or badly pitted.
- Where burned or badly pitted points are encountered, the ignition system and engine should be checked to determine the cause of trouble so it can be eliminated. Unless the condition causing point burning or pitting is corrected, new points will provide no better service than the old. See section 6E for condenser check.
- On 6 cyl. engines, adjust distributor point gap to .019" (new points) or .016" (used points), using a flat feeler gauge. Breaker arm rubbing block must be on high point of lobe during adjustment.

NOTE: *Used contact points should be cleaned before adjusting with feeler gauge.*

9. Lubricate distributor breaker cam sparingly with distributor cam lubricant. Rotate sponge lubricator (6-cyl) a few degrees to allow a new cam contact surface. A new wick-type lubricator should be installed on V-8 engines so equipped at 12 months or 12,000 miles. DO NOT LUBRICATE EITHER TYPE, ALWAYS REPLACE.
10. Install rotor and distributor cap. Press all wires firmly into cap towers.

SERVICE BATTERY AND BATTERY CABLES

State of Charge Test

1. Measure the specific gravity of the electrolyte in each cell. If it is below 1.230 (corrected to 80°F.), recharge with a slow rate charger, and recheck battery.
2. Connect a voltmeter across the battery terminals and measure the terminal voltage of the battery during cranking (remove the coil secondary lead during this check to prevent engine from firing). If the terminal voltage is less than 9.0 volts at room temperature, approximately 80°F.), the battery should be further checked. See section 12 for battery checking procedure using the "421" Tester.

Inspect for signs of corrosion on battery, cables and surrounding area, loose or broken carriers, cracked or bulged cases, dirt and acid, electrolyte leakage and low electrolyte level. Fill cells to proper level with distilled water or water passed through a demineralizer.

The top of the battery should be clean and the battery hold-down bolts properly tightened. Particular care should be taken to see that the top of the battery is kept clean of acid film and dirt because of the high voltage between the battery terminals. For best results when cleaning batteries, wash first with a dilute ammonia or soda solution to neutralize any acid present and then flush off with clean water. Care must be taken to keep vent plugs tight so that the neutralizing solution does not enter the cell. The hold-down clamp should be kept tight enough to prevent the battery from shaking around in its holder, but it should not be tightened to the point where the battery case will be placed under a severe strain.

To insure good contact, the battery cables should be tight on the battery posts. If the battery posts or cable terminals are corroded, the cables should be cleaned separately with a soda solution and a wire brush. A thin coating of petrolatum should be applied to the posts and cable clamps to help retard corrosion.

If the battery has remained undercharged, see Charging Circuit - Preliminary Checks, section 6E.

If the battery has been using too much water, the voltage regulator output is too high.

GENERATOR

Unsatisfactory results obtained during battery testing may indicate further tests of the generator as outlined in Engine Electrical (Section 6E).

FAN BELT

1. Inspect fan belt condition.
2. Check and adjust if necessary for correct tension of belt, as follows:
   a. Using a Belt Tension gauge, check the fan belt midway between the water pump pulley and generator pulley.
   b. Adjust generator on its mounting bracket to proper fan belt tension. See Section 6A.

CHECK OPERATION OF MANIFOLD HEAT VALVE

Check manifold heat control valve (6-cyl. engine only) for freedom of operation. If shaft is sticking, free it up with heat valve lubricant.

CHECK INTAKE MANIFOLD BOLTS

To check for a possible leak at the intake manifold, apply some heavy oil around the suspected area. If there is in fact a leak, oil will be sucked into engine when engine is running. Tighten all bolts to specification and sequence as outlined in Section 6. If gasket is bad, replace.

AIR CLEANER ELEMENT

Wash polyurethane element (heavy duty) in solvent and re-oil with SAE 30 engine oil. Paper element should be replaced at 24 months or 24,000 miles. Do not attempt to clean with an air hose.

> **NOTE:** *Air cleaner should be serviced after each occasion of driving under severe dust conditions, and inspected at 12 months, or 12,000 miles.*

CHECK FUEL LINES AND SERVICE FUEL FILTER

1. Inspect fuel lines for kinks, bends or leaks and correct any defects found. If necessary to replace fuel line, use copper double flared end lines.
2. Replace filter in carburetor inlet.

> **NOTE:** *If a complaint of poor high speed performance exists on the vehicle, fuel pump tests described in section 6B should be performed.*

INSPECT AND SERVICE COOLING SYSTEM

Inspect cooling system for leaks, weak hoses, loose hose clamps, correct coolant level, and service as required.

> **NOTE:** *A cooling system pressure test, as described in section 6A may be performed to detect internal or external leaks within the cooling system.*

CHECK LUBRICANT LEVEL AND INSPECT FOR OIL LEAKS

Check level of lubricant in crankcase and inspect engine for oil leaks.

CHECK CARBURETOR CHOKE AND UNLOADER OPERATION AND ADJUSTMENT

The specified choke setting provides ideal choke operation in all climates. No seasonal changes are necessary. For setting, see ENGINE FUEL, Section 6B.

> **CAUTION:** *Choke linkage and fast idle cam must operate freely. Do not lubricate linkage since this will collect dust and cause sticking.*

Check unloader adjustment, see Section 6B.

IDLE STOP SOLENOID

Idle stop solenoids are used on all 6 cylinder engines, as well as all 4 Bbl. V-8 engines.

See Section 6D for proper idle setting procedures.

CONNECT TUNE-UP EQUIPMENT

Follow manufacturer's recommendations for the use of testing equipment. Fig. 6C-2 shows a basic schematic for instrumentation which will apply to many types of test equipment and may be used as a rough guide if equipment manufacturer's instructions are not available.

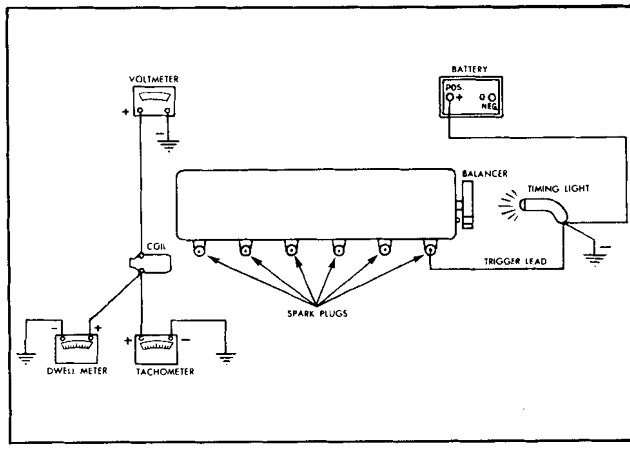


Fig. 6C-2 Schematic of Tune-Up Instrumentation

Connections shown in Fig. 6C-2 are made as follows:

1. Timing light
   a. Positive lead to positive battery terminal.
   b. Negative lead to ground.
   c. Trigger lead to number 1 spark plug.
2. Tachometer
   a. Positive lead to distributor side of coil.
   b. Negative lead to ground.
3. Dwell Meter
   a. Positive lead to distributor side of coil.
   b. Negative lead to ground.

TEST DWELL AND DWELL VARIATION

Two methods are offered for dwell or point gap adjustment on the vehicle. Whenever possible, a dwell meter should be used for better accuracy.

V-8

1. With engine running at idle, raise the adjusting screw window and insert an Allen wrench in the socket of the adjusting screw.

2. With dwell meter connected, adjust dwell angle to 30 degrees for all V-8 engines. A 2-degree variation is allowable for wear. If a dwell meter is not available, turn adjusting screw clockwise until engine starts to misfire, then turn screw one-half turn in the opposite direction to complete adjustment.

3. Close access cover fully to prevent the entry of dirt into the distributor.

6 CYL.

On 6 cyl. engines, adjust point gap with a flat feeler gauge to .019" (new) or .016" (used).

TEST IGNITION TIMING AND ADVANCE

1. Attach a timing light and tachometer as shown in Fig. 6C-1.

   NOTE: *Disconnect hose from distributor vacuum control unit.*

2. Set parking brake, start engine and run at idle speed.

3. Aim timing light at marks on lower timing chain cover and harmonic balancer.

4. Adjust timing as required by loosening clamp bolt and rotating distributor until correct timing is indicated, then tighten clamp bolt.

Engine	Set Timing To:
6 Cyl.	4°B.T.D.C.
V-8 Auto. Trans. (except 307)	10°B.T.D.C.
V-8 Manual Trans. (except 307)	8°B.T.D.C.
307 V-8 Manual Trans.	4°B.T.D.C.
307 V-8 Auto. Trans.	8°B.T.D.C.

5. Disconnect timing light.

6. Reconnect distributor spark advance hose, then perform idle speed and mixture adjustment. (See Section 6D.)

IDLE SPEED AND MIXTURE

1. Connect tachometer to engine. Set parking brake. Start engine, allow to idle.

2. With a thoroughly warmed-up engine, check to see that choke is fully open and carburetor is on slow idle.

3. Follow procedures outlined in Section 6D and adjust idle speeds to settings given in that section.

   NOTE: *Depress or plug hot idle compensator valve while adjusting all engines so equipped.*

POSITIVE CRANKCASE VENTILATION

All engines have the closed positive crankcase ventilation system utilizing manifold vacuum to draw fumes and contaminating vapors into the combustion chamber where they are burned. The crankcase ventilation system has an important function and should be understood and serviced properly.

In the closed crankcase ventilation system, air is drawn through the engine, through a regulating valve and into the manifold, drawing crankcase vapors and fumes with it to be burned. The closed positive ventilation system draws the clean air from the carburetor air cleaner and has a nonvented oil filler cap.

The P.C.V. valves are designed specifically for each engine to control the amount of flow from the crankcase to the manifold. VALVES SHOULD NEVER BE INTERCHANGED BETWEEN 6 AND 8 CYLINDER ENGINES.

The crankcase ventilation valve should be checked at regular intervals, otherwise it will become plugged and ineffective.

The P.C.V system should be serviced at 24,000 miles or 24 months, as follows:

1. Disconnect all hoses and blow them out with compressed air. If any hose cannot be freed of obstructions, replace with new hose.

2. Remove crankcase ventilation valve assembly from rubber grommet, and discard.

3. Clean crankcase and intake manifold connectors using care not to allow dirt to enter openings.

4. Replace ventilation filter in air cleaner.

5. Reinstall Crankcase Ventilation System, using a new P.C.V. valve.

6. Adjust carburetor idle to specifications as shown in Section 6D.

ROAD TEST

TEST PERFORMANCE OF CAR

Observe performance of engine at low speed, during acceleration, and at constant speed. Check for missing, stalling, surging, poor acceleration or flat spots on acceleration. If any irregularity is found, a complete diagnosis should be conducted to find and correct trouble. This diagnosis should also include carburetor checks outlined in Section 6B.

TEST OPERATION OF:

BRAKES - Pedal should not have excessive travel and car should not pull to either side. Fluid level in master cylinder should be as shown in Section 5.

PARKING BRAKE - Should hold the car without exceeding 8 notches of movement of parking brake pedal from released position.

AUTOMATIC TRANSMISSION - Observe shift pattern at minimum and full throttle and test forced downshifts. Watch for any indications of slipping or unusual shift characteristics that may indicate need for adjustment.

STEERING GEAR - See that steering operates normally and that steering wheel does not have excessive play. Also observe for alignment of steering wheel, pull, wander, or other irregularity that might indicate need for front end alignment.

WINDSHIELD WIPER - Wiper operation should be tested with windshield wet in order to properly judge the action.

CLUTCH - See that clutch engages smoothly and that lash is correct. Follow procedure for adjusting clutch pedal height and lash in Section 7.

Hard pedal or lack of pedal return may indicate need for return spring adjustment.

LIGHTS AND HORNS - Test operation of headlights, taillights, stop lights, parking lights, direction signals, hazard flasher and all other lights, as well as the horns.

INSTRUMENTS - Observe operation of all instruments. Observe especially for possible abnormal reading which may indicate trouble.

ACCESSORIES - Test operation of radio, heater, defroster, cigar lighter, other accessories.

SECTION 6D

EMISSION CONTROL SYSTEMS

CONTENTS OF THIS SECTION

INTRODUCTION

There are two types of emissions to be controlled: crankcase emissions and exhaust emissions. Crankcase emissions are controlled by use of the closed Positive Crankcase Ventilation (P.C.V.) system. Exhaust emissions are controlled by the use of the Engine Controlled Combustion System (C.C.S.).

Federal law requires that the emissions of unburned hydrocarbons and carbon monoxide in motor vehicle exhaust systems be controlled to certain prescribed maximums under specific test conditions. The law further requires that a closed crankcase ventilation system be used.

CLOSED POSITIVE CRANKCASE VENTILATION SYSTEM

The closed P.C.V. system which is standard on all models helps control air pollution caused by crankcase blow-by gases. With this system, blow-by gases are redirected into the engine for reburning.

Periodic inspection and required servicing of the P.C.V. system will assure a cleaner, better performing, longer lasting engine and will assure elimination of crankcase blow-by gases.

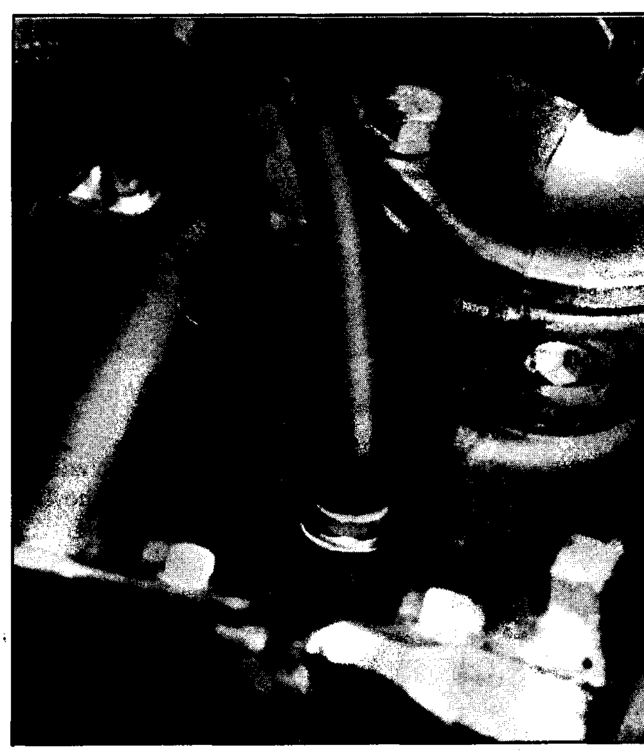


Fig. 6D-1 PCV Valve Location (V-8 except 307)

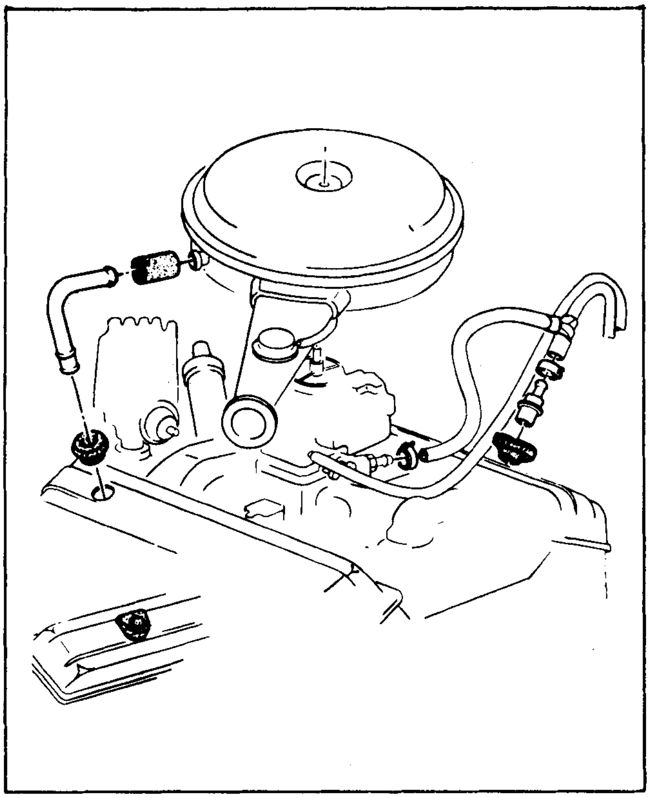


Fig. 6D-2 PCV Valve Location (307 V-8)

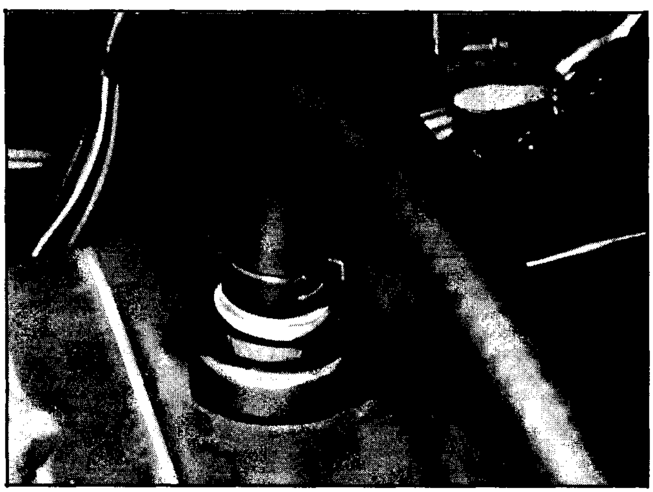


Fig. 6D-3 PCV Valve Location (6 Cyl.)

The components of the closed P.C.V. system include a P.C.V. valve, a sealed oil filler cap, and connecting hoses.

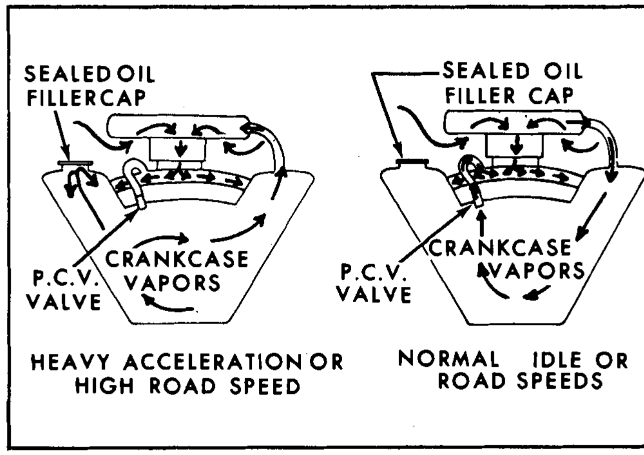


Fig. 6D-4 Schematic Flow Chart-P.C.V. System - Typical (V-8).

The P.C.V. valve is located in the front of the push rod cover (V-8 except 307), the front of the left rocker arm cover (307) and on the rear of the rocker arm cover (6-cyl.) and is connected to the intake manifold by a rubber hose (Fig. 6D-1, 6D-2, 6D-3). An additional hose from the air cleaner connects to the rocker arm cover.

At idle or normal road speeds, intake manifold vacuum causes fresh air to be drawn into the air cleaner, at the same time fresh air is routed from the air cleaner through the hose connecting it to the rocker arm cover and on into the crankcase where it joins with the crankcase vapors (Fig. 6D-4).

This mixture is drawn through the P.C.V. valve and into the intake manifold where it mixes with the normal fuel-/air charge and is later burned.

At high road speeds or heavy acceleration, engine blow-by is increased and, at the same time, intake manifold vacuum decreases. When this occurs, there is a reverse action as shown in Fig. 6D-5, and crankcase vapors are routed through the connecting hose from the rocker arm cover into the air cleaner. This mixture joins the normal air charge and passes through the carburetor and into the intake manifold for burning later in the cycle.

When the engine is not operating, or a manifold pressure condition such as a backfire exists, the P.C.V. valve is closed by spring tension to prevent fuel vapors from entering the crankcase.

PERIODIC SERVICE

CLOSED P.C.V. SYSTEM

Every two years or 24,000 miles, the Closed Positive Crankcase Ventilation System should be serviced as follows:

1. Disconnect all hoses and blow them out with compressed air. If any hose cannot be freed of obstructions, replace with new hose.

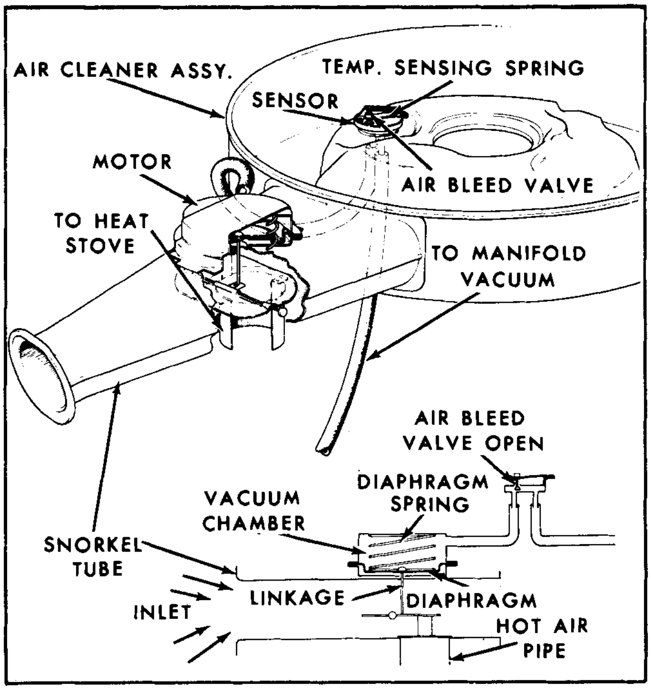


Fig. 6D-5 Auto-Therm Air Heater-Position During Hot Engine Operation

AUTO-THERM AIR CLEANER (Figs. 6D-6 and 6D-5)

The Auto-Therm air pre-heater consists of a special air cleaner and silencer assembly equipped with a temperature sensor and a vacuum operated valve in the air inlet snorkel. The vacuum at the valve is regulated by the temperature of the sensor.

When air temperatures are low with the engine running, the valve shuts off the flow of underhood air and inducts air via a stove mounted on the left bank exhaust manifold. When the carburetor air temperature reaches approximately 105°F. the sensor causes the valve to open partially, mixing the heated air with underhood air to maintain 105°F. (Fig. 6D-6). When underhood air exceeds 105°F., the valve is wide open shutting off the supply of heated air and allowing only underhood air to enter the carburetor (Fig. 6D-5). The valve also opens during heavy throttle operation so that full power is obtained when required.

This control of carburetor air temperatures allows leaner carburetor calibrations with accompanying reduced emissions than would normally be possible for acceptable cold weather operation and also eliminates carburetor icing.

2. Remove crankcase ventilation valve.
3. All engines are equipped with a crimped-type valve, thus no further disassembly is possible and a new valve should be installed.
4. Clean crankcase and intake manifold connectors using care not to allow dirt to enter openings.
5. Replace ventilation filter in air cleaner.

   NOTE: *The ventilation filter must be clean for proper engine operation and oil mileage.*

6. Inspect polyurethane or paper air filter element at 12 mo. or 12,000 miles; clean (polyurethane) or replace (paper) element at 24 mo. or 24,000 miles.
7. Reinstall positive crankcase ventilation system.
8. See IGNITION AND CURB IDLE SETTING PROCEDURES (this section).

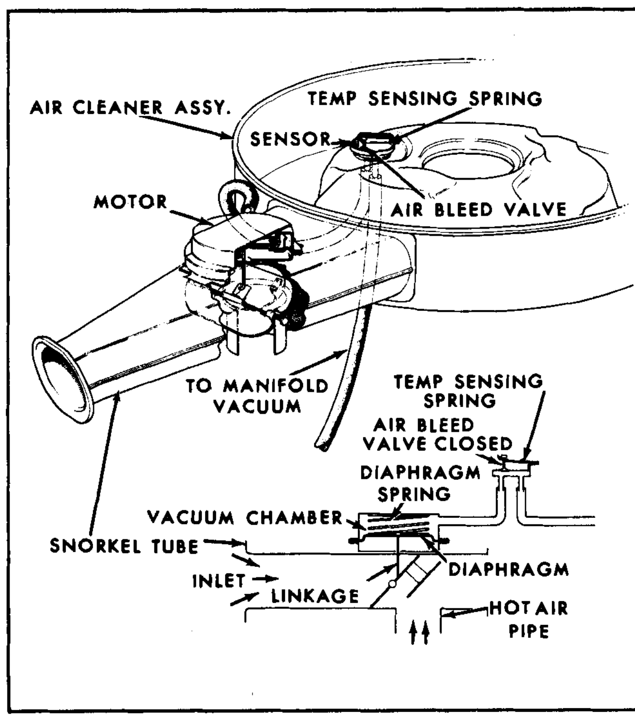


Fig. 6D-6 Auto-Therm Air Heater-Position During Cold Engine Operation

CHECK OUT AND SYSTEM SERVICING

1. Inspection check -

   Make a visual inspection of the system checking for loose, kinked, or deteriorated hoses. Repair or replace as required.

2. Operational System check -

   a. Start test with the air cleaner at a temperature below 85°F. If the engine has been in recent use - allow it to cool down.

b. With the air cleaner in position, secure a dial type temperature gage next to the sensor. Install air filter cover. Do not install wing nut.

c. Start engine. When the control valve begins to open (viewed through end of snorkel), remove air filter cover and observe temperature gage. It must read between 85°F. and 128°F.

CAUTION: *Do not accidentally touch moving parts such as the engine fan. When the snorkel tube is so positioned so as to make inspection difficult, the use of a mirror is recommended.*

d. If the system fails to operate the valve at the temperature indicated, proceed to the Motor Check.

3. Motor Check -

a. With the engine shut off, the position of the control valve should be open to outside air (Fig. 6D-5).

b. To determine if the motor is operable, apply at least nine inches of vacuum (either from the engine or from an independent source) to the vacuum fitting on the motor.

c. The control valve should close the cold air passage as long as vacuum is applied. The hot air pipe will be open.

d. If the vacuum motor fails to operate the control valve with the direct application of vacuum, first check to determine if the motor linkage is properly connected to the door or if a bind is present. If the linkage is found satisfactory, then motor replacement is indicated.

e. If the motor check is found to be satisfactory, then sensor replacement is indicated.

PERIODIC SERVICE

MOTOR

REMOVE

1. Drill out two spot welds initially with a 1/16" drill, then enlarge as required to remove the retaining strap. Do not damage snorkel tube. (Fig. 6D-7).

2. Raise motor strap retainer.

3. Lift motor, cocking it to one side to unhook linkage at the control damper.

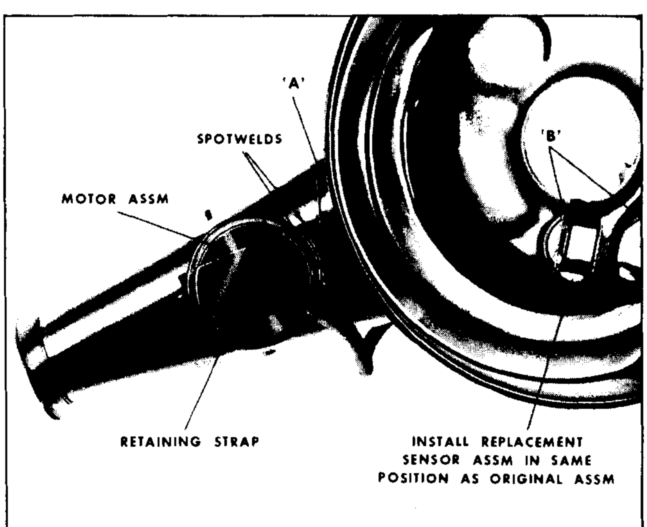


Fig. 6D-7 Auto-Therm Motor and Sensor

INSTALL

1. Assemble in reverse order adhering to the following notes.

a. Drill a 7/64" hole in snorkel tube at point A as shown in Fig. 6D-8.

b. Use motor strap retainer and sheet metal screw provided in the motor service package to secure the retainer and motor to snorkel tube.

c. If screw interferes with operation of the damper, shorten screw.

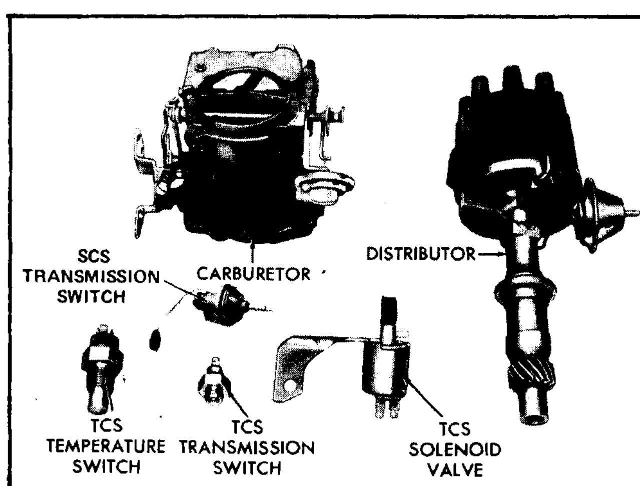


Fig. 6D-8 Components of Controlled Combustion Systems

SENSOR

REMOVE

1. Detach hoses at sensor.
2. Pry up tabs of sensor retaining clip.
3. Remove clip and sensor from air cleaner, after noting the installed position of the sensor.

INSTALL

1. Install sensor and gasket assembly in original holes in air cleaner.
2. Support sensor at position B as shown in Fig. 6D-8 and press clip on sensor being careful not to damage sensor.
3. Install hoses and connections.

CONTROLLED COMBUSTION SYSTEM

In order to provide efficient engine operation on cars equipped with the Controlled Combustion (S.C.S./C.E.C./T.C.S.) Systems (Fig. 6D-8), all normal tune-up items should receive careful and thorough attention every 12 months or 12,000 miles. Adherence to these items will assure that exhaust emissions are kept to the desired level.

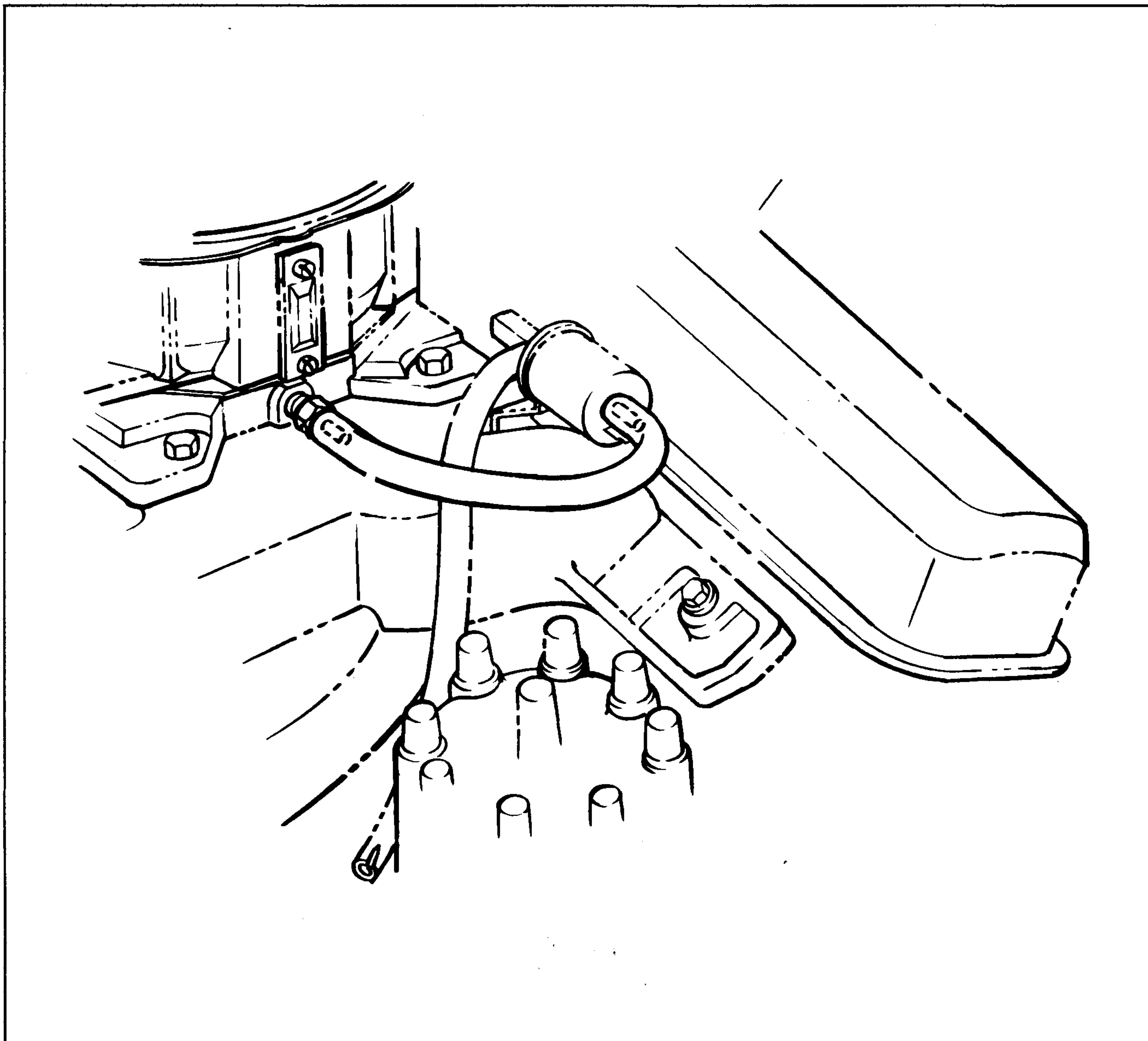


Fig. 6D-9 Vacuum Solenoid Location (V-8)

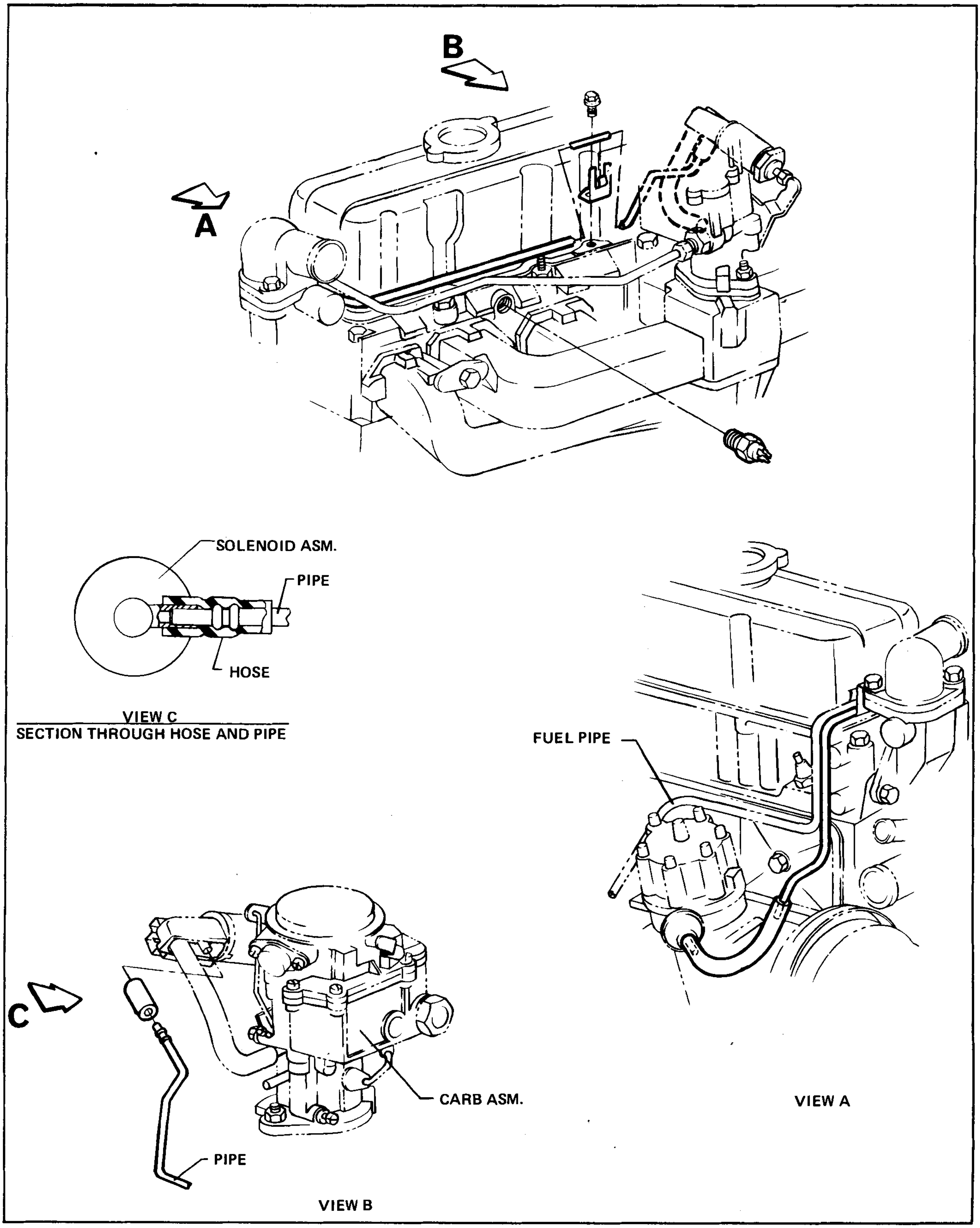


Fig. 6D-10 Vacuum Solenoid Location (6-cyl.)

Essential services included in the tune-up items are:

1. Check ignition timing (distributor advance hose disconnected and plugged and idle stop solenoid inactive).

2. Check engine idle speed.

3. Check operation of distributor T.C.S. or S.C.S. advance system.

The C.C.S. system has been redesigned to include a Controlled Spark System, which is used on all engines, on both manual and automatic transmissions (Fig. 6D-11 and 6D-12).

All six cylinder and 307 V-8 engines use the Combined Emission Control System (C.E.C.). All other engines except 4 speed manual transmission equipped V-8's use the Speed Control Spark Advance (S.C.S.). All V-8's equipped with 4 speed manual transmission, retain the Transmission Controlled Spark Advance (T.C.S.).

The T.C.S. and S.C.S. systems are composed of a vacuum advance solenoid valve, a temperature sensor switch and depending upon the system, either a T.C.S. transmission switch or a S.C.S. speed control spark switch. The temperature senser switch has been relocated from the top of the intake manifold to the rear of the right cylinder head between spark plugs 6 and 8.

The normal operation of the T.C.S. or S.C.S. systems allow vacuum controlled spark advance to the distributor in fourth gear ONLY (T.C.S.) or when the vehicle speed exceeds 38 m.p.h. (S.C.S.). There are two conditions where vacuum controlled spark advance will be available in all other modes of operation:

1. Cold engine operation - Engine temperature below 95°F.

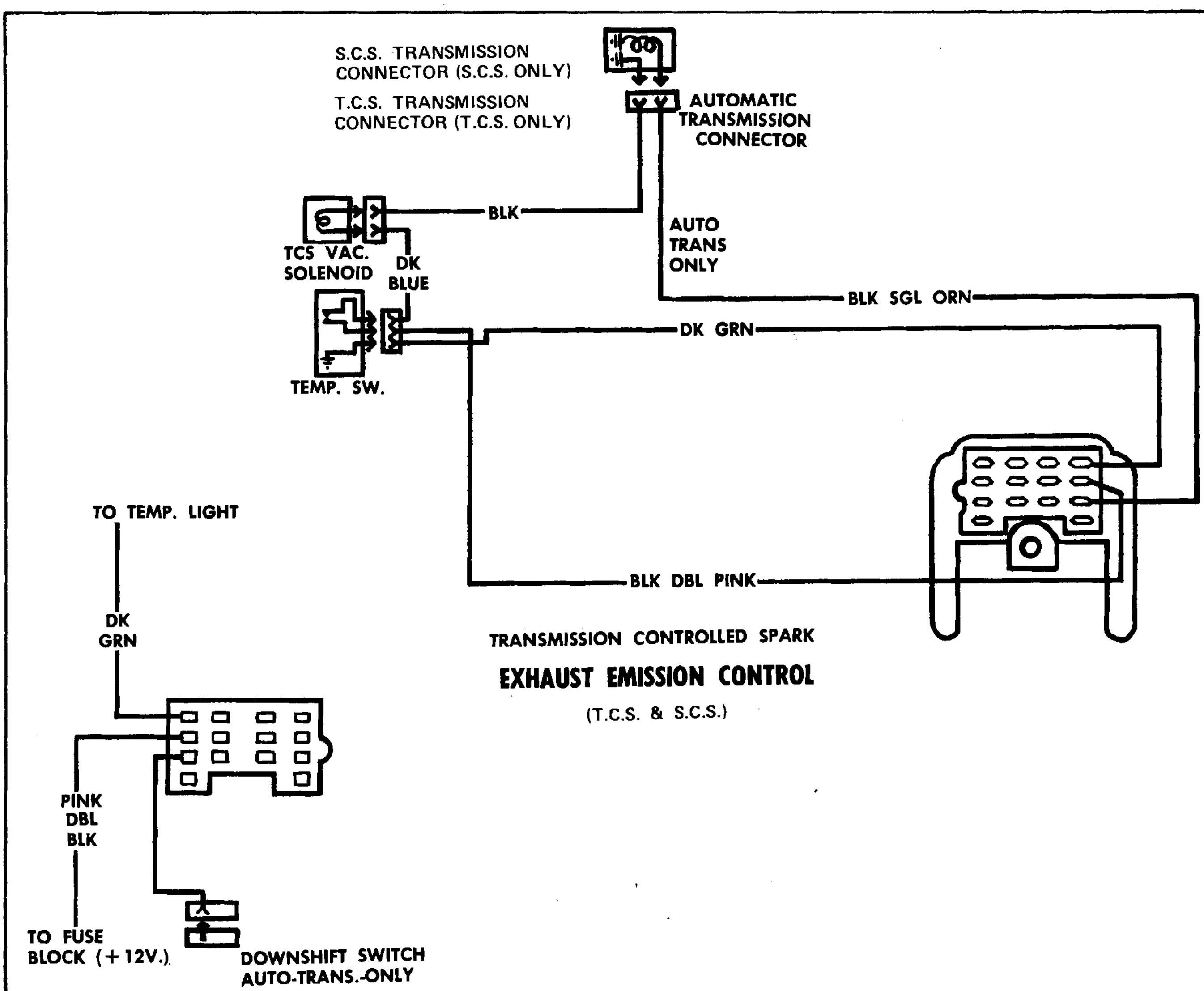


Fig. 6D-11 Controlled Spark Systems (S.C.S./T.C.S.) - Schematic

2. Hot engine operation - Engine temperature above 230°F.

The combined Emission Control System (C.E.C.) operates similarly to the T.C.S. system. Its purpose is to provide vacuum advance approximately 20 seconds after the transmission shifts into high gear (manual transmission) or Drive (high gear automatic transmission). The only other time where the vacuum controlled spark advance will be available in all other modes of transmission operation is with the engine temperature below 82°F.

C.C.S. SYSTEM CHECK

To check the system for proper operation, simply set timing (see dwell and ignition timing specifications) with vacuum hose disconnected as described.

Then, proceed as follows:

S.C.S. (All) and C.E.C. (Automatic Transmission)
With distributor vacuum hose connected and engine temperature between 95°F and 230°F (S.C.S. only), shift transmission into Drive (rear wheels raised) and accelerate car, observe timing mark on harmonic balancer. Timing should advance when the car shifts into high gear (T.C.S.) or approximately 20 seconds after the car shifts into high gear (C.E.C.) or after the car speed exceeds 38 m.p.h. (S.C.S.).

T.C.S. (Manual Transmission) and C.E.C. (Manual Transmission)

With distributor vacuum hose connected, engine temperature above 95°F and below 230°F (T.C.S. Only), and clutch pedal depressed, shift transmission into *high gear*, and observe timing mark on harmonic balancer. Timing should *advance*, as the Transmission is shifted into high gear (T.C.S.) or approximately 20 seconds after the transmission is shifted into high gear (C.E.C.).

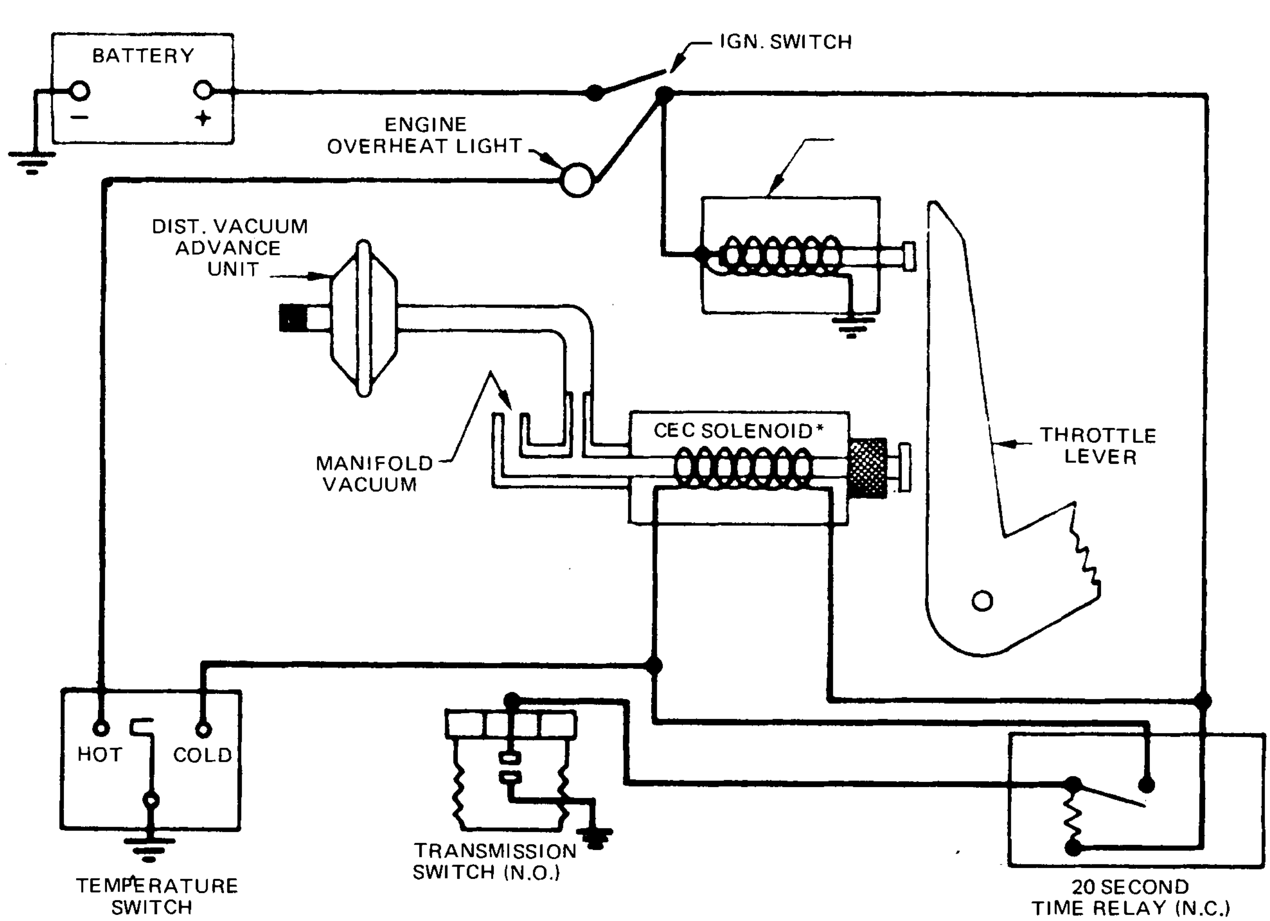


Fig. 6D-12 Controlled Spark System (CEC) - Schematic and Vacuum Routing

No maintenance is required of any components in the T.C.S./S.C.S./C.E.C. systems. If any component is not functioning properly, it should be replaced.

IGNITION TIMING

Set timing as specified with vacuum advance hose disconnected and plugged, and idle speed as specified (Fig. 6D-15).

ENGINE	DWELL	POINT GAP	IGNITION TIMING
6 Cyl.	32½°	All Engines .019" (New) .016" (Used)	4° B.T.D.C.
V-8 Manual (except 307)	30°		8° B.T.D.C.
V-8 Automatic (except 307)	30°		10° B.T.D.C.
307 Manual	30°		4° B.T.D.C.
307 Automatic	30°		8° B.T.D.C.

Fig. 6D-15 Dwell and Ignition Timing Specifications

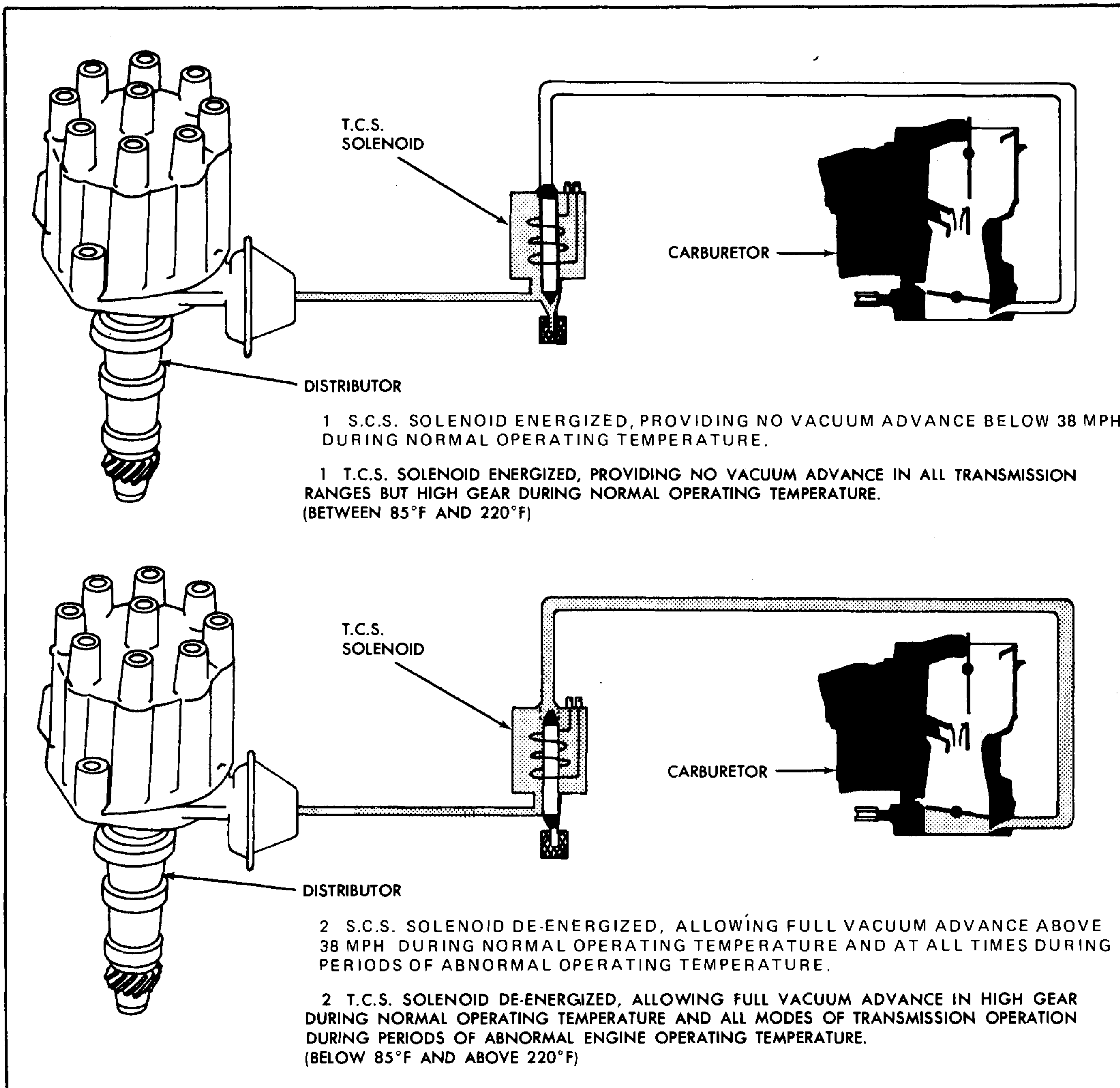


Fig. 6D-14 T.C.S/S.C.S. System - Vacuum Routing

IDLE SPEED CHART

CURB IDLE (RPM)				
ENGINE	Manual Transmission[1]	Automatic Transmission[1]	FAST IDLE	SOLENOID ACTIVE
250 1-Bbl.	700	600	2400	450 (A.T.)[3], 450 (M.T.)[3]
307 2-Bbl.	900	600	–	450 (A.T.), 450 (M.T.)
350 2-Bbl.	800	625	1500[2]	–
400 2-Bbl.	–	625	–	–
400 4-Bbl.	600	500	1500	700 (A.T.), 1000 (M.T.)
455 2-Bbl.	–	625	–	–
455 4-Bbl.	–	500	1500	650 (A.T.)
455 HO 4-Bbl.	600	500	1500	700 (A.T.), 1000 (M.T.)

[1] Solenoid Inactive
[2] Manual Transmission Only
[3] C.E.C. VALVE ENGINE SPEED (PLUNGER EXTENDED) 850 MAN. 650 AUTO.

REMARKS: Make adjustments with engine at normal operating temperature, choke open, A/C off, auto. trans. in drive, park brake on, disconnected vacuum hoses plugged.

Fig. 6D-16 Idle Speed Chart

CURB IDLE SETTING PROCEDURE (Fig. 6D-16)

IMPORTANT: *All carburetors are fitted with* **locked** *mixture screws. DO NOT TAMPER WITH SCREWS, or exhaust emission levels may be adversely affected.*

When service of the throttle body is necessary, follow the instructions presented below for optimum emissions control.

NOTE: *Make adjustments with engine at normal operating temperature, choke open, and A/C off. Plug disconnected vacuum fittings.*

CAUTION: *Set parking brake and block drive wheels.*

V-8 PROCEDURE

1. Disconnect carburetor "evap" hose from vapor canister.
2. Disconnect carburetor to vacuum solenoid hose at vacuum solenoid and plug hose. Disconnect throttle solenoid wire (4 Bbl.).
3. Set dwell and initial ignition timing (in that order) at specified Idle RPM (Fig. 6D-15, 6D-16).
4. a. Adjust carburetor speed screw to specified RPM (Fig. 6D-16) with automatic transmission in Drive.*
   b. On 4 Bbl. models, reconnect throttle solenoid wire. Manually extend solenoid screw and adjust to specified RPM (Fig. 6D-16).
5. With auto. trans. in Park (man. trans. in Neutral), check fast idle speed with fast idle speed screw (4 Bbl.) on top step of fast idle cam. Adjust to specified RPM (Fig. 6D-16) by turning fast idle speed screw (4 Bbl.). Refer to Section 6B for WGD fast idle adjustment.

NOTE: *2GV fast idle speed is non-adjustable.*

6. Reconnect distributor advance and vapor canister hoses.

6 CYL. PROCEDURE

1. Disconnect fuel tank "evap" hose from vapor canister.
2. Disconnect distributor vacuum hose at distributor and plug hose.
3. Set Dwell and Timing (in that order) at specified Idle RPM.
4. Adjust carburetor speed screw to specified RPM*. DO NOT ADJUST SOLENOID SCREW **.
5. With auto. trans. in Park (man. trans. in Neutral), check fast idle speed with fast idle tang on top step of fast idle cam. Adjust to specified RPM as shown in Fig. 6D-16.

IDLE MIXTURE ADJUSTMENT

NOTE: *The idle mixture should be reset only if the carburetor throttle body has been overhauled or replaced. The following procedure must be used to adjust idle speed and mixture:*

1. With mixture screws backed out approximately 3 1/2 turns from *lightly* seated position, adjust carb. speed screw to specified idle speed on all models.
2. Turn mixture screws IN an even amount until the idle speed shown in Fig. 6D-16 is attained.

IDLE MIXTURE ADJUSTMENT

ENGINE	MANUAL		AUTOMATIC	
	2 Bbl.	4 Bbl.[1]	2 Bbl.	4 Bbl.[1]
250 L-6	800[2]	––	630[2]	––
307 V-8	1000	––	650	––
350 V-8	875	––	700	––
400 V-8	––	1075	700	775
455 V-8	––	––	700	725
455 H.O.	––	1075	–––	775

[1] Solenoid Active [2] 1MV Carburetor

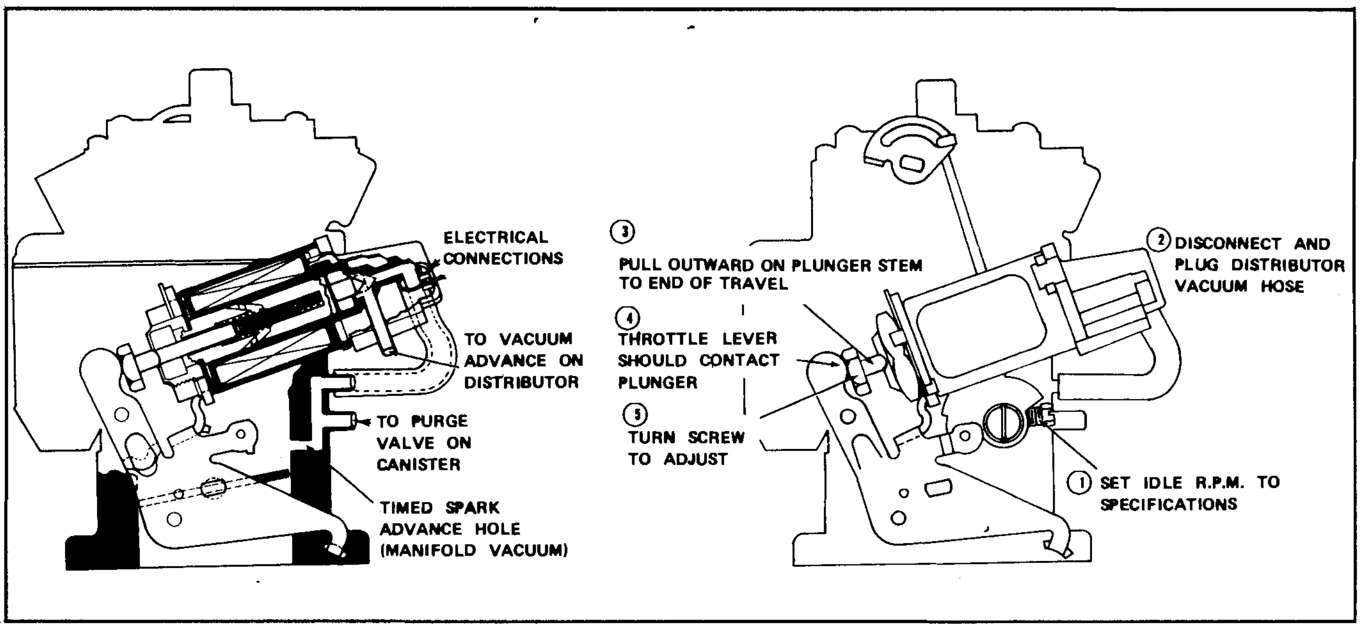


Fig. 6D-17 C.E.C. Solenoid Adjustment - 6 Cyl.

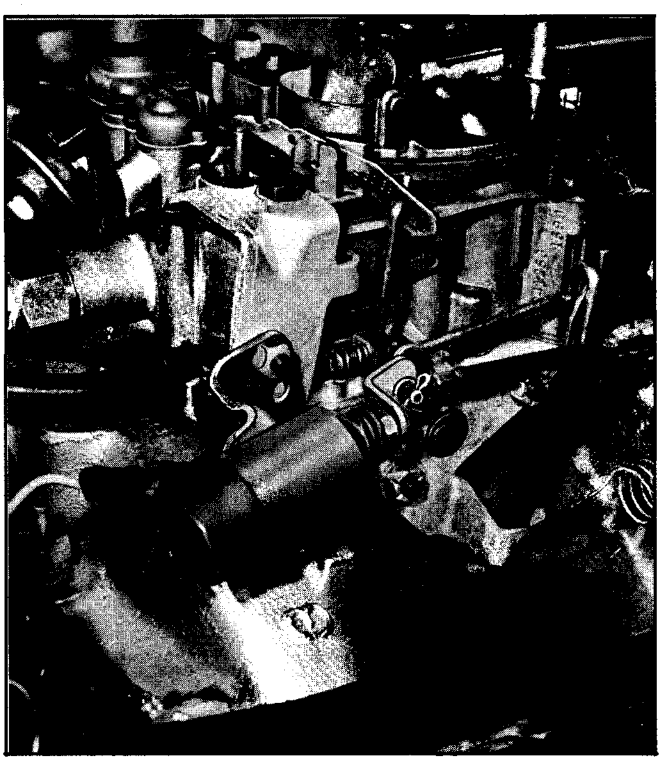


Fig. 6D-18 Idle Stop Solenoid (4 Bbl. V-8)

3. With engine shut off, drive new red plastic limiter caps in place on mixture screws with pin punch.
4. Refer back to step 4 above.

**C.E.C. (250 L-6 only) Valve adjustment is to be made only after (1) replacement of solenoid, (2) major carburetor overhaul, or (3) throttle body has been removed.

a. With slow idle speed set to specified RPM, manually extend C.E.C. Valve plunger to contact throttle lever (Fig. 6D-17).

NOTE: *C.E.C. valve on 307 V-8 does not have a deceleration plunger.*

b. Adjust plunger length to obtain specified RPM.

EVAPORATION CONTROL SYSTEM

In order to limit gasoline vapor discharge into the atmosphere, the following features are incorporated in the fuel system. The E.C.S. system (Fig. 6D-19) is designed to trap fuel vapors which normally escape from the fuel tank. Vapor arrest is accomplished through the use of a charcoal canister which adsorbs the fuel vapors and stores them until they can be removed to be burned in the engine. Removal of vapors from the canister to the engine is accomplished by a calibrated purge orifice in the carburetor. In addition to the carburetor modifications and the canister, the fuel tank requires a normally non-vented gas cap and extra vents to a liquid/vapor separator (standpipe design).* The standpipe prevents liquid gasoline from entering the vapor system to the canister. Thus, as vapors are generated in the fuel tank, they flow through the standpipe (except station wagon) through a restriction and to the canister where they are stored. From the canister the vapors are routed to the carburetor where they will be burned during normal combustion. A purge valve is located on the intake manifold. Its purpose is to prevent purge of the canister to the carburetor until the engine water temperature reaches approximately 170°F.

* *Station Wagon models do not require the use of a separator (standpipe design), due to fuel tank design. (See Section 8).*

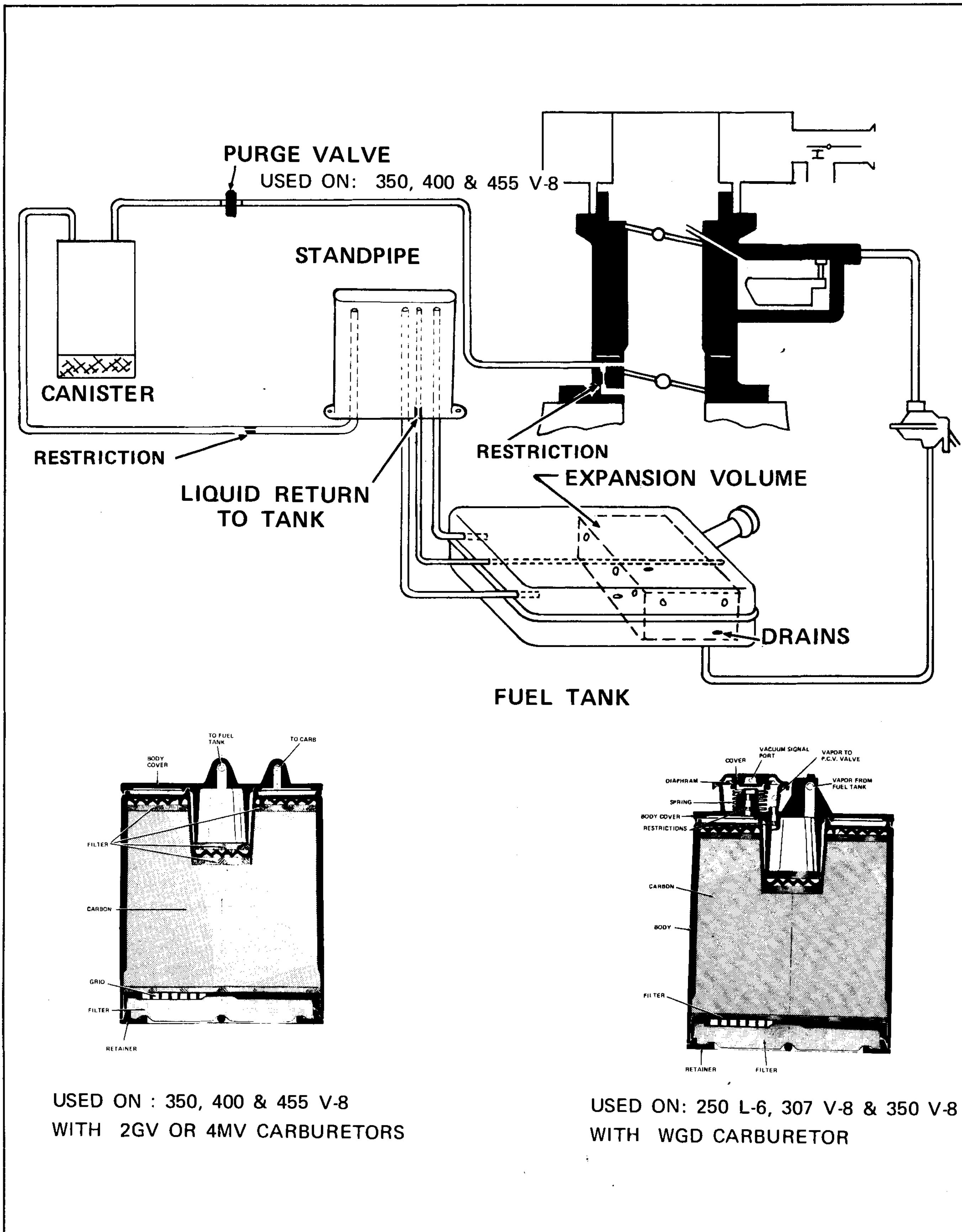


Fig. 6D-19 Evaporation Control System

Following is a breakdown of Evaporation Control System components, giving the functional description of each:

1. *Fuel Tank* - An evaporation control system (E.C.S.) which requires special features is included on all models. This is a closed system, therefore, no tank vents to the atmosphere are used. Fuel vapor normally escapes only through the evaporation control system. This also means that the only way for air to enter the tank as fuel is used by the engine is through a vacuum valve in the gas cap and by reverse flow through the canister at lower rates. Sedan and coupe tanks have a fuel limiter inside. This provides room for fuel expansion and prevents liquid fuel from being forced through the system. The sedan and coupe tank have three vents, one at each front corner and one at the rear top center which exists at the front of the tank. This three vent system always leaves one vent open no matter on what angle hill the vehicle is parked.

2. *Liquid-Vapor Separator* - An external steel liquid-vapor separator (standpipe design) is required with all sedan type fuel tanks (Fig. 6D-19). Its purpose is to stop fuel that has drained out of the tank through the front vents when the car is parked heading downhill. This is accomplished by four vertical tubes open at the upper end within a common chamber of the standpipe.

   If liquid fuel flows into the standpipe tubes from either front corner tank vent when the car points downhill, fuel will enter one or both of the tubes mentioned above, and seek the new level of the fuel in the tank. It will remain in the tubes until a normal angle is resumed, then the fuel will drain back into the tank.

   The rear tank vent (Fig. 6D-19) will be submerged when the car is pointed uphill, although no fuel will pass into the standpipe in this attitude. The standpipe tube connecting to the rear tank vent will act as a return line from the common chamber of the stand pipe if fuel overflows the corner vent tubes into the common chamber (two small holes are provided at the bottom of the rear vent tube in the common chamber). This draining back to the tank occurs after the car resumes level.

3. *Canister* - The plastic canister is filled with charcoal which adsorbs and stores fuel vapors (Fig. 6D-19). When fuel is drawn from the tank during engine operation, a fuel cap tank relief valve opens allowing air to be drawn into the tank. When the engine is running, air is drawn in through the bottom of the canister. This air picks up vapors which are being held in the charcoal and carries them through the carburetor into the engine where they are burned.

   The purge valve (three tube-6 cyl. and 307 V-8) canister operates basically the same as the two tube type. However, a purge valve is added which is an integral part of the canister. The purge valve controls the flow of vapor from the canister to the carburetor or intake manifold.

   The valve consists of a body (integral with the canister), a spring loaded diaphragm, a diaphragm cover and metered purge restrictions.

   The operation of the valve is such that it limits the flow of vapor to the carburetor or manifold at idle but allows maximum vapor purge during higher carburetor air flows. This action is accomplished through use of a vacuum signal from the carburetor spark port which unseats the spring loaded diaphragm.

   With this feature, a minimum amount of canister purge can be maintained at idle because of the smaller constant bleed restriction. At higher air flows where more fuel vapors can be tolerated, the spark port in the carburetor is uncovered and vacuum is applied to the purge valve diaphragm. This lifts the diaphragm off its seat and allows additional vapors to be pulled through the larger restriction, thereby, completely purging the vapor canister.

4. *Purge Valve* (all except L-6 and 307 V-8) - The purge valve is located on the intake manifold next to the water outlet housing. Its purpose is to prevent purge of the canister until the engine water temperature reaches 170°F. This is to improve exhaust emissions during cold starts.

5. *Carburetor* - Several modifications have been made to the carburetor for the evaporation control system. Vapor and idle vents are removed to seal the carburetor. A purge port is provided to draw vapors from the canister, and operates whenever the engine is running to handle any vapors previously stored in the charcoal canister. With the engine running, vapor from the bowl vents internally through a standpipe into the air cleaner where it is drawn through the carburetor into the engine. This standpipe also vents bowl vapors to the air cleaner with the engine off, allowing the air cleaner to store the vapors until the engine is started.

6. *Lines* - Conventional steel tubing, vapor resistant rubber hose and hose clamps are used to connect the various components of the system. It is extremely important that all pipes and hoses are not kinked, are properly connected, and that all connections are tight. This is necessary to assure a vent through the system for the fuel tank to prevent restriction of vapors to the canister. Thorough visual inspection is and will remain one of the most important checks of the system.

IMPORTANT: *Use only hose marked "EVAP" or "GM 6107M" if necessary to replace an evaporation control system (ECS) hose. Gasoline vapors will deteriorate other types of hose.*

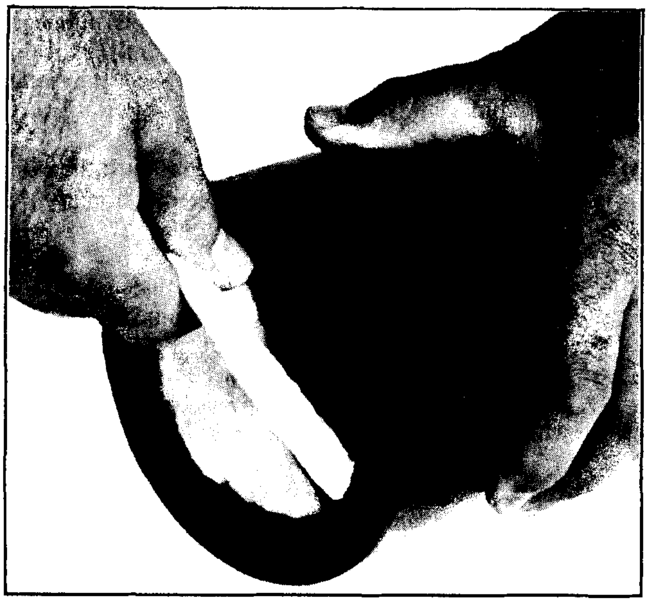


Fig. 6D-20 Replacing Canister Filter

PERIODIC SERVICE

All hoses, lines and connections should be visually inspected each time the car is lubricated.

Replace canister base filter every 12 months or 12,000 miles (Fig. 6D-20). The filter can be serviced by (1) replacing only the filler, or (2) replacing the filter and cap as an assembly. The procedure for the second method is to remove the original filter from the bottom of the canister and discard along with the original cap after removing the hose. Install the hose on the new filter and cap assembly. Snap the filter, cap and hose assembly into the bottom of the canister.

NOTE: *Second method is applicable only to X Series.*

AIR INJECTION REACTOR SYSTEM

GENERAL DESCRIPTION

The Air Injection Reactor (A.I.R.) System (Fig. 6D-21) used on 250 CID L-6 engines with automatic transmission consists of: the air injection pump (with necessary brackets and drive attachments), an air diverter valve, and check valve, and hoses necessary to connect the various components.

Carburetors and distributors for engines with the A.I.R. System are designed, particularly, for these engines; therefore, they should not be interchanged with or replaced by a carburetor or distributor designed for engines without the A.I.R. System.

The air injection pump (Fig. 6D-22) with an integral filter, compresses the air and injects it through hoses into a passage in the cylinder heads and into the exhaust system in the area of the exhaust valves. The fresh air helps burn the unburned portion of the exhaust gases in the exhaust system, thus minimizing exhaust contaminations.

The diverter valve (Fig. 6D-23) when triggered by a sharp increase in manifold vacuum, shuts off the injected air to the exhaust port areas and prevents backfiring during this richer period.

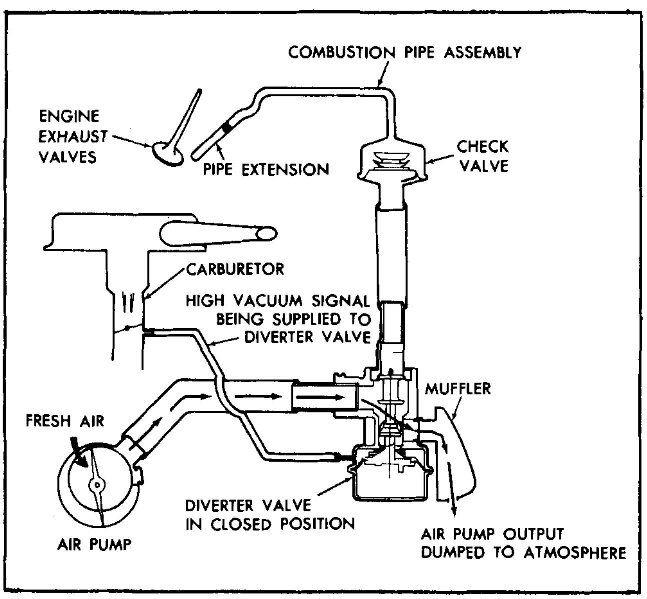


Fig. 6D-21 Schematic of A.I.R. System

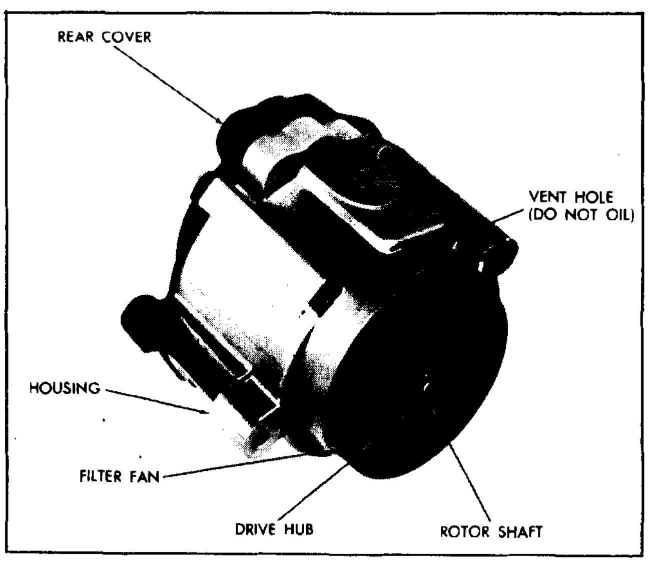


Fig. 6D-22 Air Injection Pump

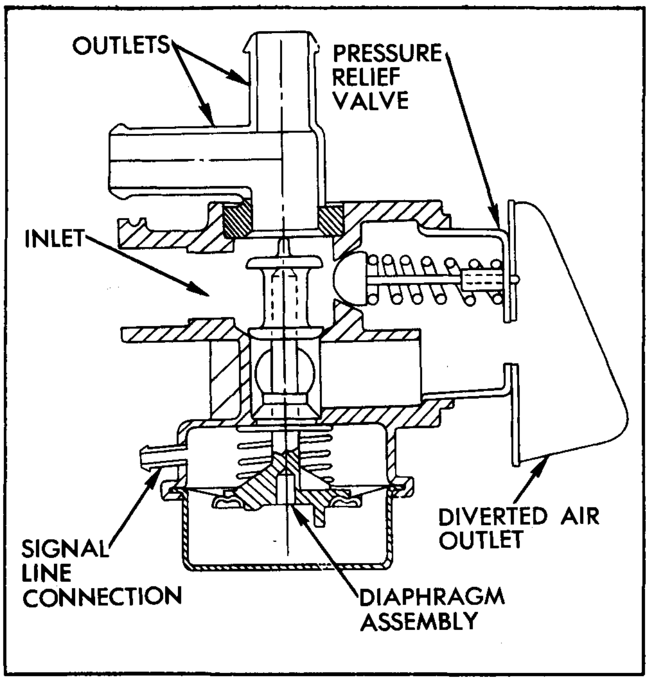


Fig. 6D-23 Diverter Valve (Typical)

On engine decelleration the total air supply is dumped through the muffler on the diverter valve. At high engine speeds the excess air is dumped through the pressure relief valve which is incorporated in the diverter valve.

The check valve prevents exhaust gases from entering and damaging the air injection pump, as back flow can occur even under normal operating conditions.

When properly installed and maintained, the A.I.R. System will effectively reduce exhaust emissions. However, if any A.I.R. component or any engine component that operates in conjunction with the A.I.R. System should malfunction, the exhaust emissions might be increased.

Because of the relationship between "Engine Tune UP" and "Unburned Exhaust Gases", the condition of the Engine Tune Up should be checked whenever the A.I.R. System seems to be malfunctioning. Particular care should be taken in checking items that affect fuel-air ratio such as the crankcase ventilation system, the carburetor and the carburetor air cleaner.

Because of the similarity of many parts, typical illustrations and procedures are used except where specific illustrations or procedures are necessary to clarify the operation.

MINOR SERVICE

DRIVE BELT

INSPECTION

1. Inspect drive belt for wear, cracks or deterioration and replace if required.

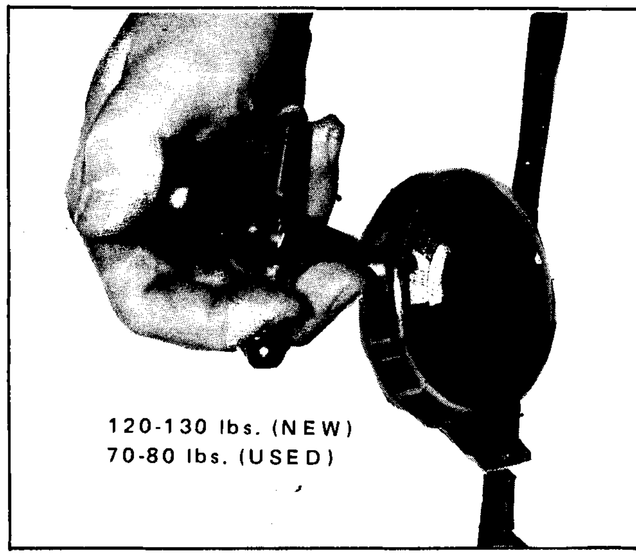


Fig. 6D-24 Checking A.I.R. Pump Belt Tension

2. Inspect belt tension and adjust if below 70 lbs. using a belt tension gauge.

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 gauge to check adjustment (Fig. 6D-24).

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.

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.

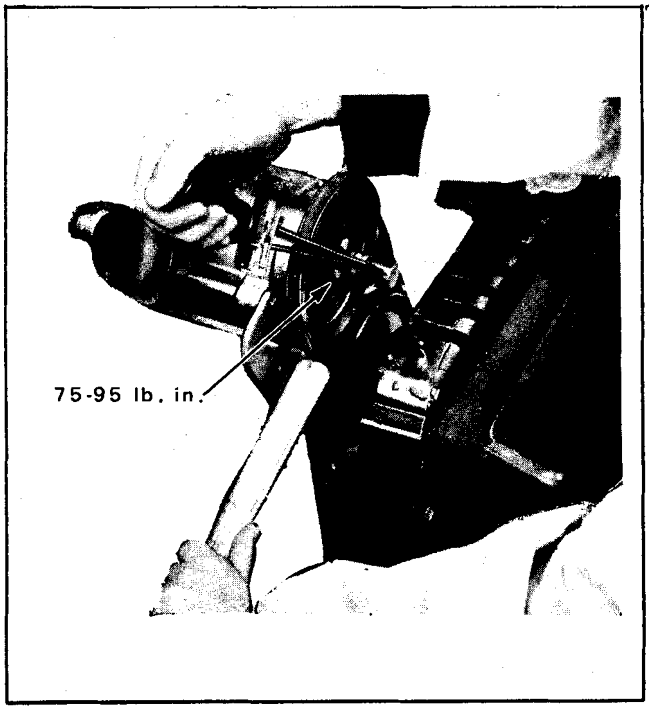


Fig. 6D-25 Tightening Pump Pulley Bolts

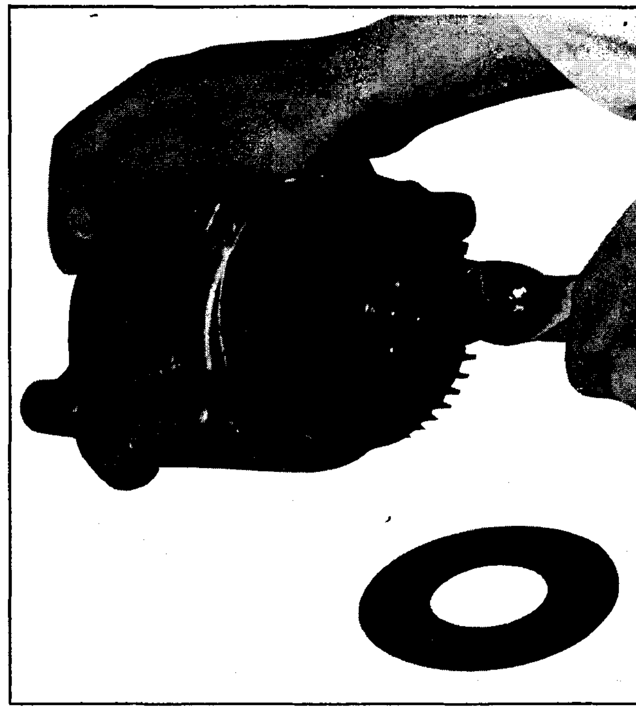


Fig. 6D-26 Removing Centrifugal Filter

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 25 lb. ft. (Fig. 6D-25).

3. Recheck drive belt tension and adjust if required.

PUMP FILTER

REMOVE

1. Remove drive belt and pump pulley as previously outlined.

2. Pry loose outer disc of filter fan.

3. Pull remaining portion of filter off with pliers (Fig. 6D-26).

   NOTE: *Care should be taken to prevent fragments from entering the air intake hole.*

INSTALL

1. Install the new filter by drawing it on with the pulley and pulley bolts (Fig. 6D-27). 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 its O.D. sealing lip has worn in.*

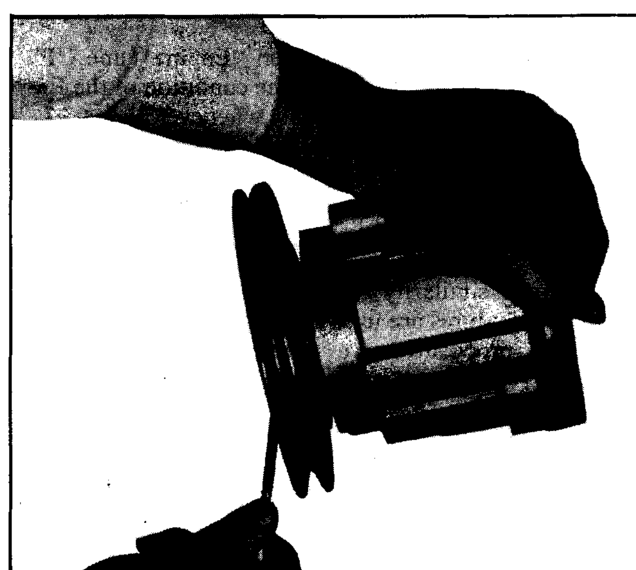


Fig. 6D-27 Installing Centrifugal Filter

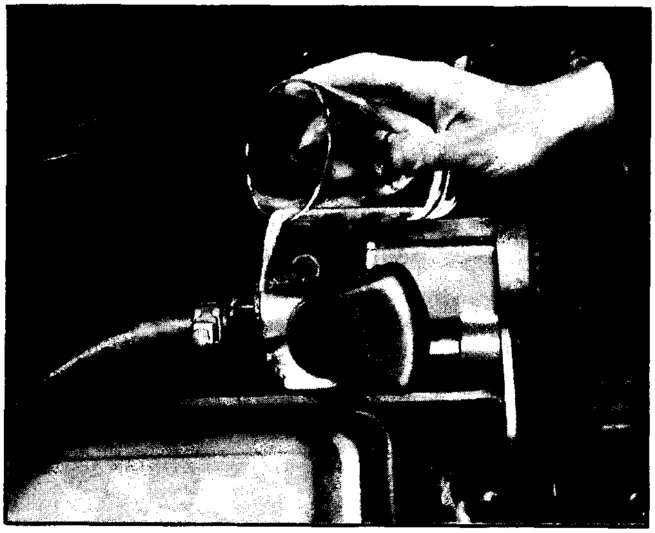


Fig. 6D-28 Checking for Leaks with a Soapy Water Solution

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. Check all tube and hose routing. Interference may cause wear.
5. 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.
6. With the pump running, bubbles will form if a leak exists (Fig. 6D-28).

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 air manifold) (Fig. 6D-29).

REMOVE

Disconnect pump outlet hose at check valve. Remove check valve from pipe assembly, being careful not to bend or twist the assembly (Fig. 6D-30).

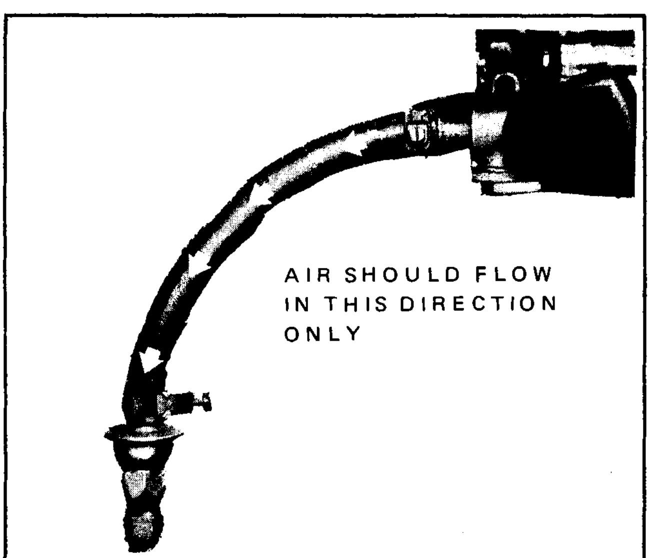


Fig. 6D-29 Air Flow Through Check Valve

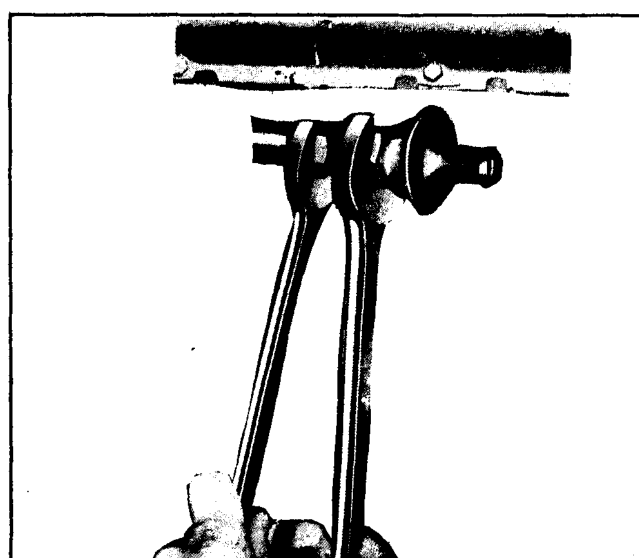


Fig. 6D-30 Removing Check Valve

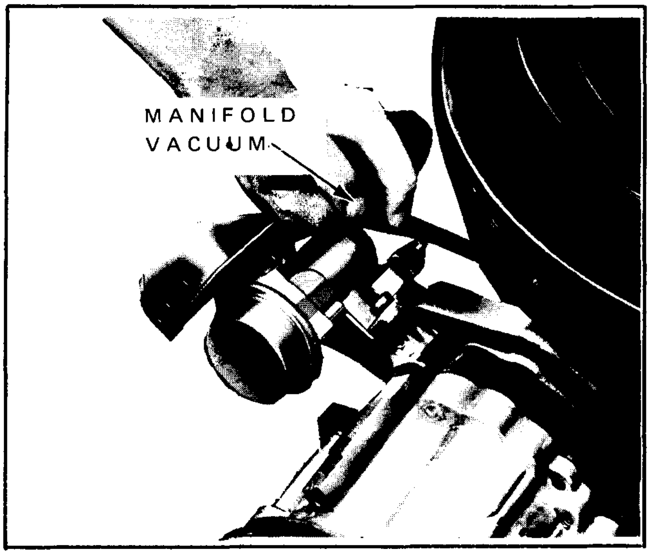


Fig. 6D-31 Checking for Vacuum Signal at Diverter Valve

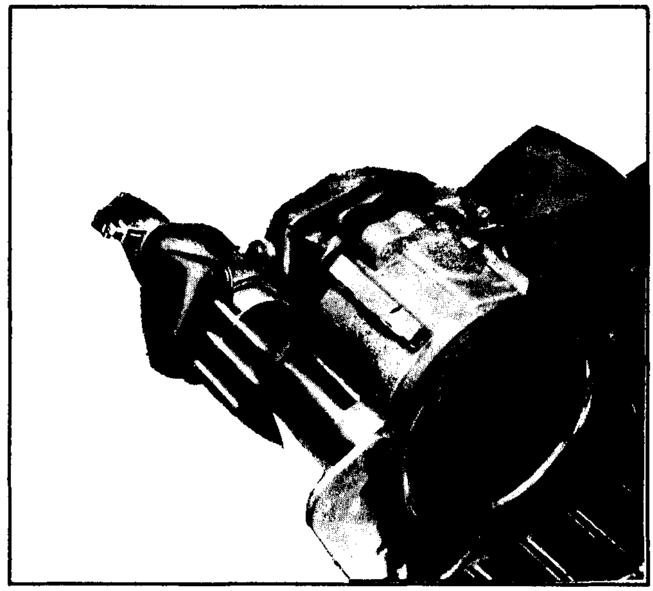


Fig. 6D-32 Momentary Blast of Air Through Diverter Valve During Engine Over-Run

DIVERTER VALVE

INSPECTION

1. Check condition and routing of all lines especially the signal line. All lines must be secure, without crimps and not leaking.

2. Disconnect signal line at valve. A vacuum signal must be available with engine running (Fig. 31).

3. With engine stabilized at idle speed, no air should be escaping through the muffler. Manually open and quickly close the throttle, a momentary blast of air should discharge through muffler for at least one second (Fig. 6D-32).

4. Defective valves should be replaced.

REMOVE

1. Disconnect vacuum signal line. Disconnect valve exhaust 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 lines and check system for leaks.

AIR INJECTION 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.

5. Check air injection pump for proper mounting.

6. If none of the above cónditons exist and the air injection pump has excessive noise remove and replace pump unit.

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 securely.

PRESSURE RELIEF VALVE REPLACEMENT

NOTE: *The pressure relief valve is incorporated in the diverter valve. The complete unit must be replaced to correct a malfunction of the relief valve.*

SECTION 6E

ENGINE ELECTRICAL

CONTENTS OF THIS SECTION

NOTE: *Information pertaining to Chassis Electrical will be found in Section 12.*

The engine electrical system can be divided into three basic sections.

1. The Cranking Circuit
2. The Charging Circuit
3. The Ignition Circuit

BATTERY

Since a 12-volt battery is a part of each of these three circuits, battery function, maintenance, and testing procedures are covered in section 12. The battery, however, should be considered as an integral part of each of the three circuits. When analyzing trouble in any one of the circuits, the battery should always be checked first.

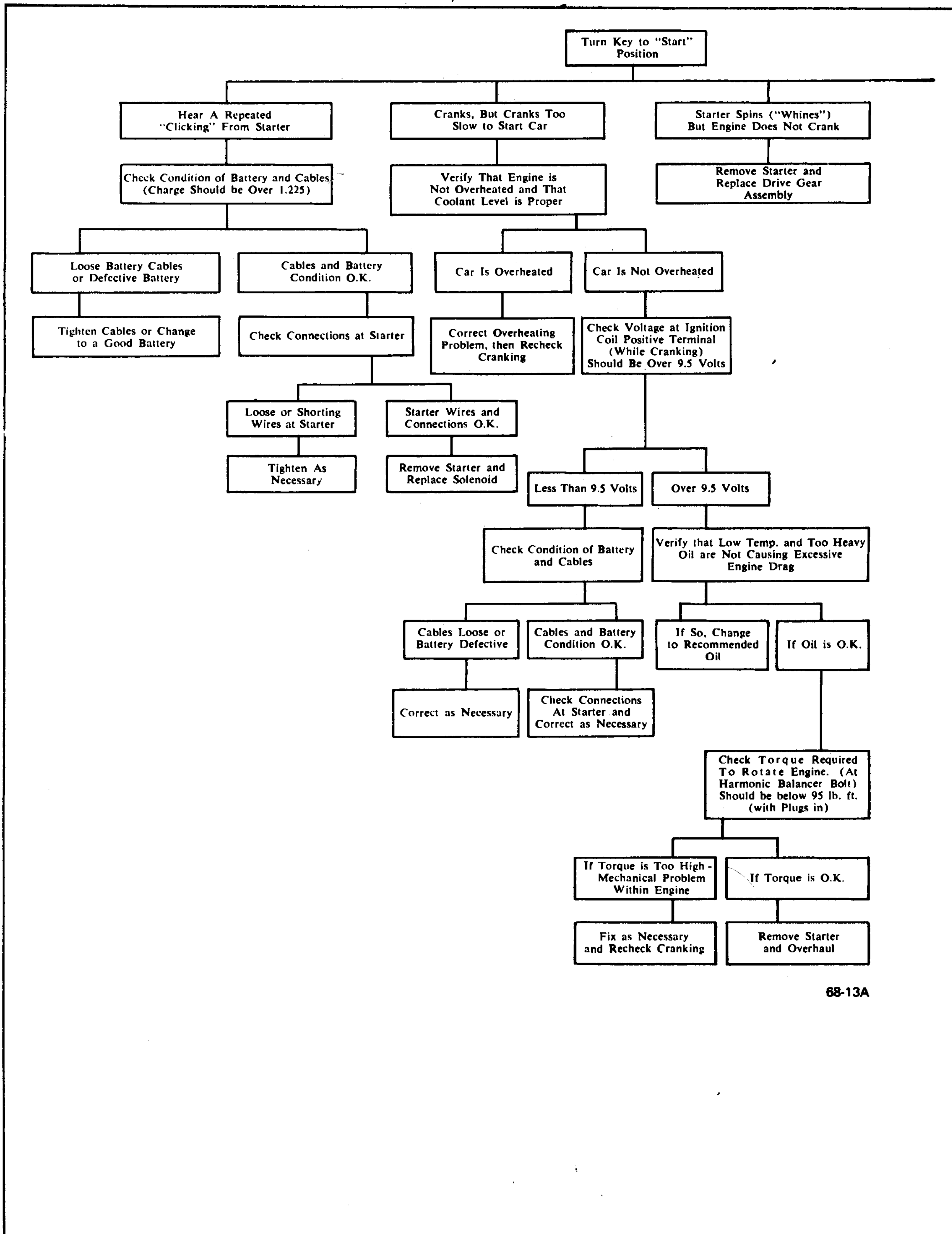


Fig. 6E-1 Cranking System - Trouble Diagnosis

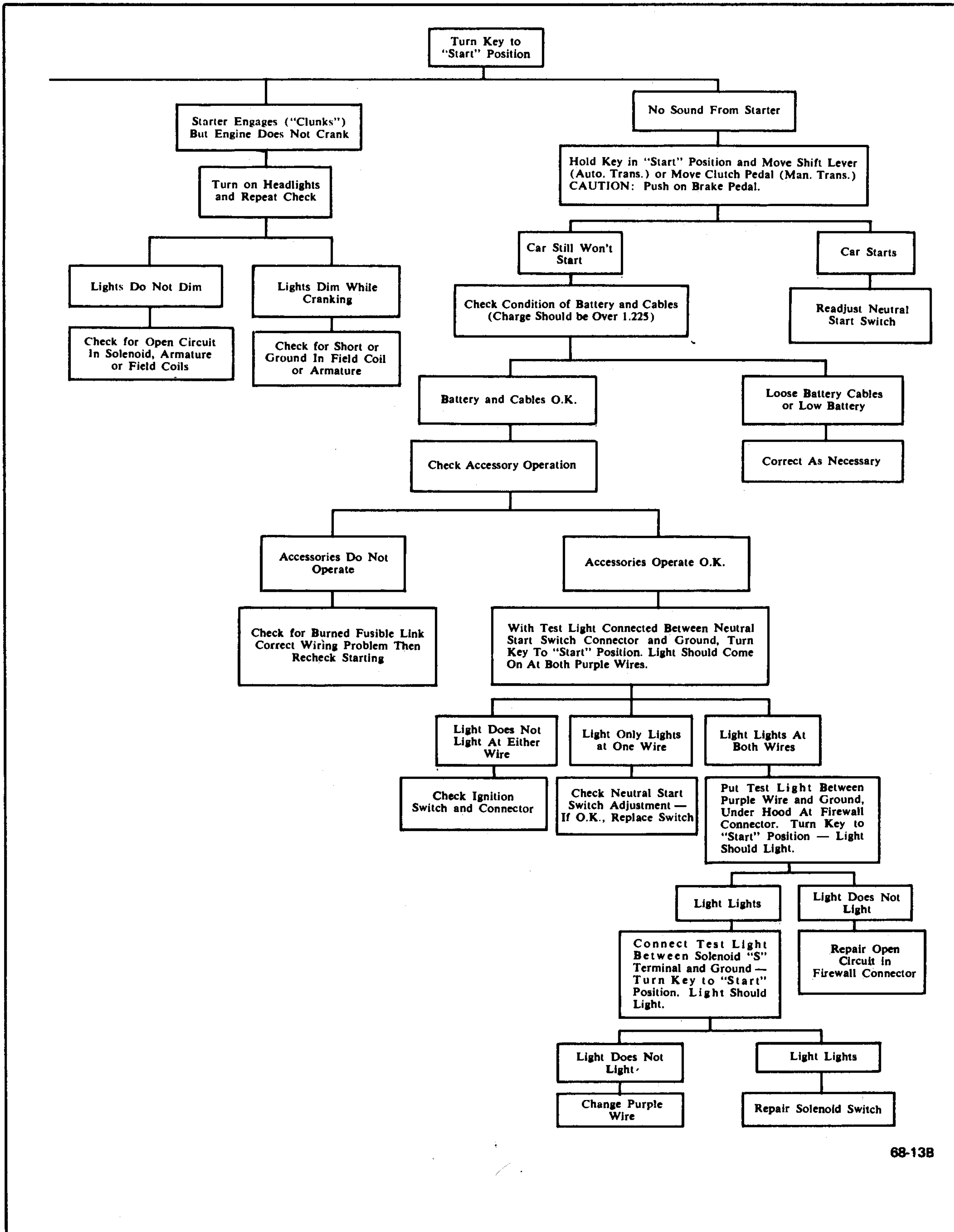


Fig. 6E-2 Cranking System - Trouble Diagnosis

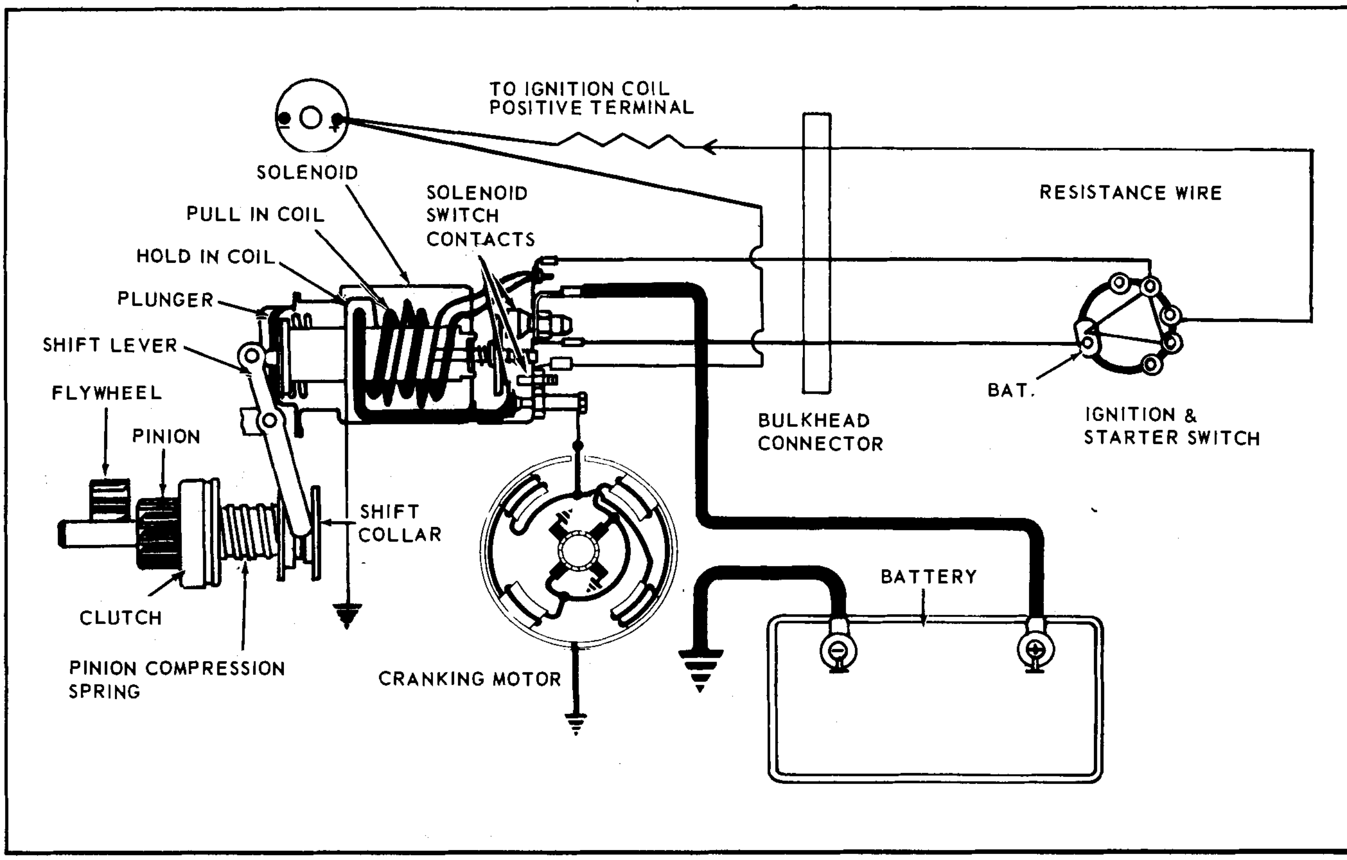


Fig. 6E-3 Cranking Circuit - All

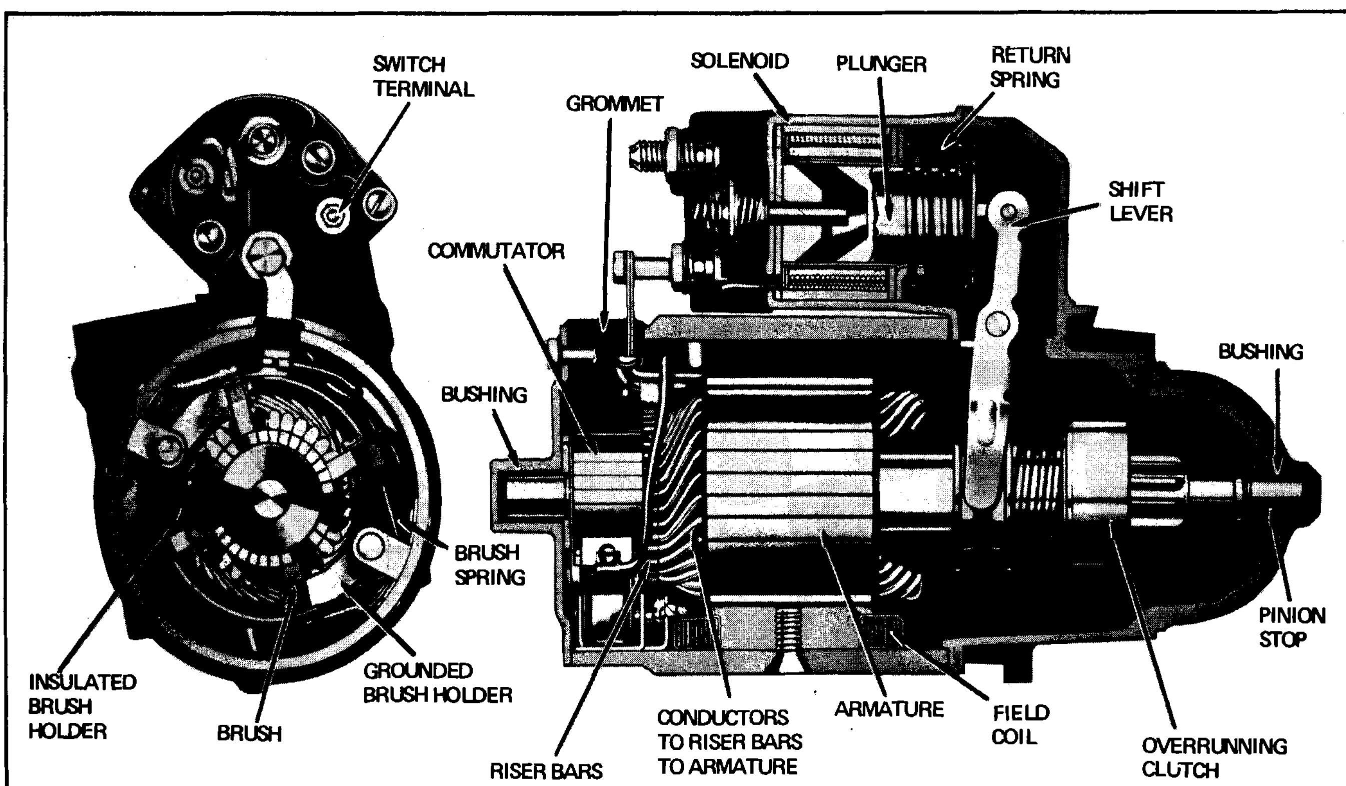


Fig. 6E-4 Cross Section of Starting Motor

DESCRIPTION AND OPERATION

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 Fig.

STARTING MOTOR

All starting motors are 12-volt extruded frame-type units of the enclosed shift lever design (Fig. 6E-4). This motor has the shift lever mechanism and solenoid plunger enclosed in the drive housing protecting them from exposure to dirt, icing conditions, and road splash.

The starting motors used on 6-cylinder and 307 V-8 engines have four poles and four field coils. The field circuit used in these motors is a "series" type. The starting motor used on 350 (V-8) engines has one shunt coil connected in series from the motor terminal directly to ground and three series coils connected in series from the motor terminal to the insulated brushes. The starter motor used on all 400 & 455 (V-8) applications consists of two series connected coils connected in parallel with a second set of two series connected coils from the motor terminal to the insulated brushes (Fig. 6E-5).

The brush rigging has brush arm supports attached directly to the extruded section of the field frame. One ground brush and one insulated brush are both pivoted from the same brush holder support, thus only two brush holder supports are required. A single ribbon-type spring applies tension to each pair of brushes.

An overrunning clutch type drive is used to engage the cranking motor pinion with the flywheel (Fig. 6E-6). Overrunning action of the clutch protects the cranking motor armature from excessive speed when the engine fires.

The armature shaft and clutch have mating spiral splines which aid in meshing of the gears and thus prevent transmission of cranking power until the clutch pinion is fully engaged in the flywheel ring gear. A special assist spring is located around the armature shaft between the end fiber of the armature and the collar of the clutch drive. This spring aids the solenoid in overcoming the return spring

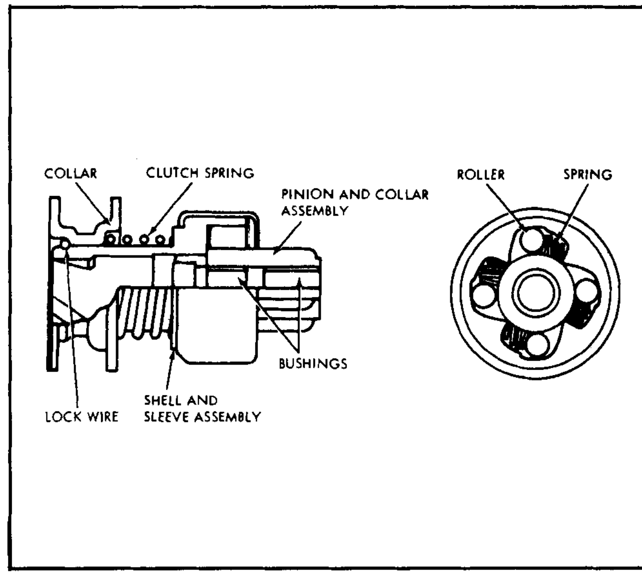


Fig. 6E-6 Overrunning Clutch

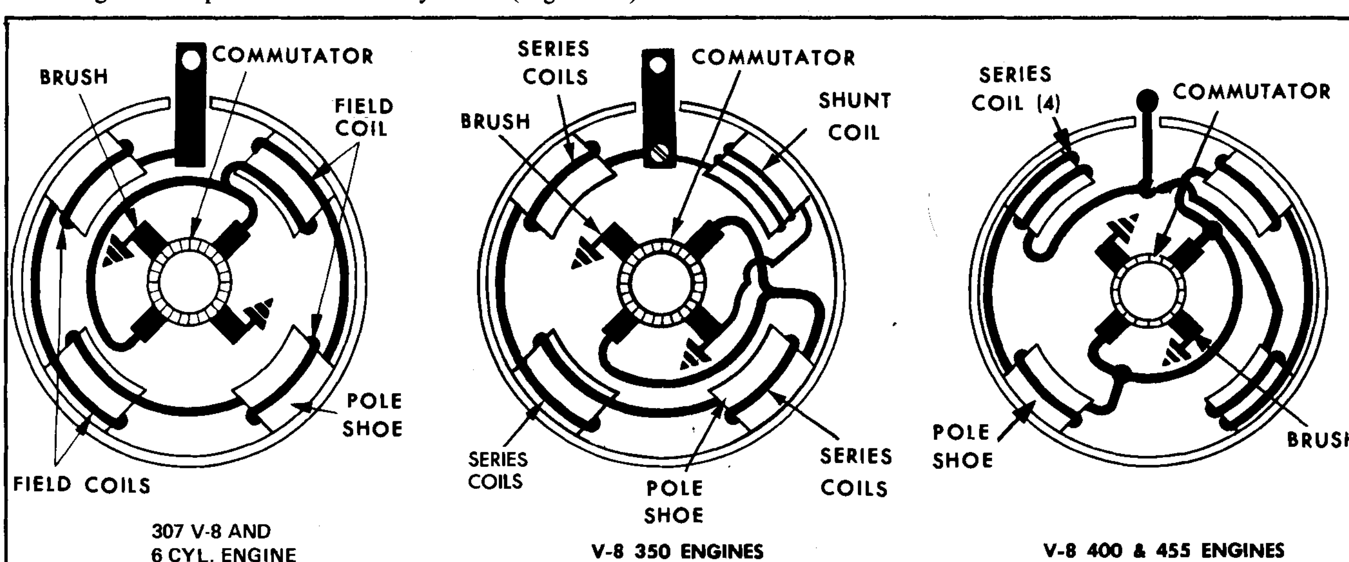


Fig. 6E-5 Starting Motor Internal Circuits force in the first movement of the clutch along the armature shaft. A pinion stop, consisting of a snap ring and retainer and a thrust collar assembled on the armature shaft, takes all the end thrust. The flange mounted solenoid switch operates the overrunning clutch drive by means of a linkage to the shift lever.

Following is a description of the operation of the solenoid used on all models. There are two coil windings in the solenoid: a pull-in winding and a hold-in winding (Fig. 6E-1). Both windings are energized when the ignition switch is closed. They produce a magnetic field which pulls the plunger in so that the drive pinion is shifted into mesh, and the main contacts in the solenoid switch are closed to connect the battery directly to the cranking motor. Closing of the main switch contacts shorts out the pull-in winding since this winding is connected across the main contacts. The magnetism produced by the hold-in winding is sufficient to hold the plunger in, and shorting out the pull-in winding reduces drain on the battery.

When the ignition switch is opened, it disconnects the hold-in winding from the battery; the shift lever spring withdraws the plunger from the solenoid, opening the solenoid switch contacts and at the same time withdrawing the drive pinion from mesh.

SERVICE PROCEDURES

PERIODIC 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.

CHECKS AND ADJUSTMENTS ON CAR

Although the starting motor cannot be checked against specifications on the car, a check can be made for excessive resistance in the cranking circuit by measuring:

1. The voltage drop, during cranking, between the positive battery post and battery terminal of solenoid.
2. The voltage drop, during cranking, between the battery terminal of solenoid and the motor terminal of solenoid.
3. The voltage drop, during cranking, between the negative battery post and the starting motor frame.

   CAUTION: *To prevent the engine from firing during the above checks, disconnect the primary lead to the distributor at the coil.*

   If the voltage drop for any one of the above three checks exceeds 0.2 volt, excessive resistance is indicated in that portion of the cranking circuit being checked. Locate and eliminate the cause for any excessive voltage drop in these circuits in order to obtain maximum efficiency of the cranking system.

   When the solenoid fails to pull in, the trouble may be due to excessive voltage drop in the solenoid control circuit. To check for this condition, close the starting switch and measure the voltage drop between the battery terminal of the solenoid and the switch terminal of the solenoid. Excessive resistance in the solenoid control circuit is indicated and should be corrected if the voltage drop exceeds 3.5 volts.

   If the voltage drop does not exceed 3.5 volts and the solenoid does not pull in, measure the voltage available at the switch terminal of the solenoid. If the solenoid does not feel warm, it should pull in whenever the voltage available at the switch terminal is 7.7 volts or more (when the solenoid feels warm, it will require a somewhat higher voltage to pull in).

OVERHAUL PROCEDURES

REMOVE FROM CAR - 6-CYL. ENGINE

1. Disconnect positive battery cable at battery terminal post.
2. Disconnect battery positive cable and wiring harness leads from starting motor solenoid.
3. Disconnect starter motor brace and swing out of way.
4. Remove starter motor to engine thru bolts and remove starter.

REMOVE FROM CAR - V-8 ENGINE

1. Disconnect positive battery cable from battery.
2. Raise car.
3. Disconnect starter motor brace and swing forward out of way.
4. Remove two starter motor thru bolts and let starter motor swing down and hang by wires.
5. Remove solenoid wires and battery cable and remove starter.

SOLENOID

REMOVE AND REPLACE

1. Disconnect field strap.
2. Remove solenoid to drive housing attaching screws, motor terminal bolt, and remove solenoid.
3. Remove solenoid return spring.
4. Remove shift lever pivot pin.
5. Remove starter thru bolts.
6. Separate starter end housing from motor frame.
7. Remove shift lever.
8. Replace by reversing above procedures.

CHECK CURRENT DRAW

Check current draw of hold-in winding by connecting a variable source of voltage (in series with an ammeter) to the switch terminal of solenoid and ground. Ammeter should read 14.5-16.5 amps. @ 10 volts. To check the current draw of both windings, ground the solenoid motor terminal and connect a source of voltage (in series with an ammeter) to the switch terminal of solenoid and ground. The ammeter should read 41-47 amps. @ 10 volts.

> **CAUTION:** *Either of the above checks must be completed in a minimum length of time to prevent overheating solenoid windings. Heating will cause the current draw readings to be below specifications which are based on a temperature of 80°F.*

DISASSEMBLE

1. Remove nuts from motor terminal (marked "B") and switch terminal.
2. Remove two screws securing cover and carefully remove cover.

> **CAUTION:** *Terminal studs have welded lead connections; therefore be extremely careful not to twist during removal of nuts.*

If solenoid contacts are slightly burned or dirty, contacts should be cleaned. When contacts are badly burned, burned parts should be replaced.

ASSEMBLE

1. When assembling cover on solenoid, make sure the terminal studs are properly positioned in cover. The cover gasket must be centered under cover to insure proper sealing.
2. Secure cover with screws and install nuts on motor and switch terminals.

> **CAUTION:** *Be sure to install all insulator washers under attaching screws and nuts.*

DISASSEMBLE STARTER

1. Disconnect field straps from terminal on solenoid.
2. Remove thru bolts.
3. Remove commutator end frame, field frame and armature from drive housing.
4. Remove overrunning clutch from armature shaft as follows:
   a. Slide thrust collar (Fig. 6E-7) off end of armature shaft.
   b. Slide a standard half-inch pipe coupling or other metal cylinder of suitable size (an old pinion of suitable size can be used if available) onto shaft so end of coupling or cylinder butts against edge of retainer (Fig. 6E-8).

      Tap end of coupling with hammer, driving retainer towards armature and off snap ring.
   c. Remove snap ring from groove in shaft, using pliers or other suitable tool. If snap ring is too badly distorted during removal, it will be necessary to use a new one when reassembling clutch.
   d. Slide retainer and clutch from armature shaft.

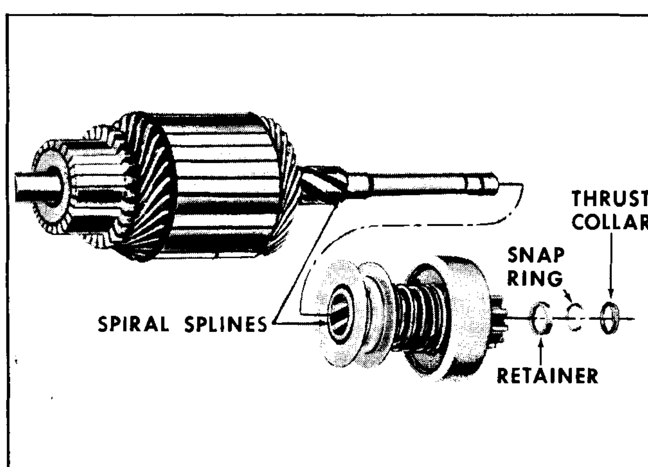


Fig. 6E-7 Armature and Overrunning Clutch Assembly

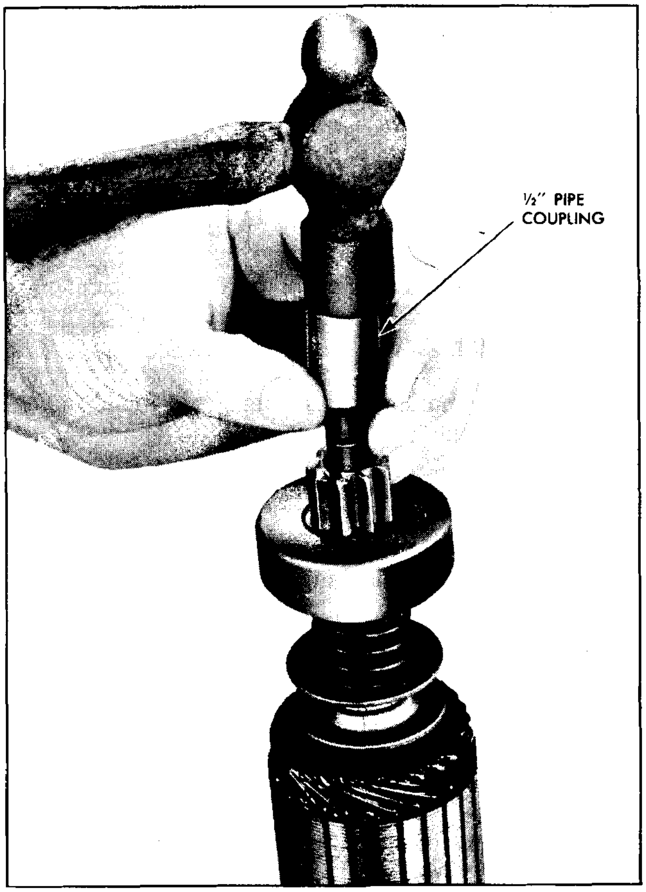


Fig. 6E-8 Driving Retainer Off Snap Ring

CLEAN AND INSPECT

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. Inspect brushes for wear. Replace if worn to one-half their original length. Check brush holders to see that they are not deformed or bent, but will properly hold brushes against the commutator.
3. Check fit of armature shaft in bushing of drive housing. Shaft should fit snugly in the bushing. If the bushing is worn, it should be replaced.
4. The overrunning clutch, armature and fields should not be cleaned in any degreasing tank, or with grease-dissolving solvents, since these would dissolve the lubricants in the clutch mechanism and would damage the insulation in the armature and field coils. It is suggested that all parts except the clutch be cleaned with oleum spirits and a brush. The clutch can be wiped with a clean cloth.

   If the commutator is dirty, it may be cleaned with No. 00 sandpaper. Never use emery cloth to clean commutator.

SERVICE

ARMATURE

If the armature commutator is worn, dirty, out of round or has high insulation, the armature should be put in a lathe so the commutator can be turned down. The starter motor commutator is of the molded type and should not be undercut, since undercutting will reduce the bonding of the molding material. When turning the molded commutator, only a very light clean-up cut should be made. The minimum diameter of the commutator after turning should not be less than 1.650 inches. As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper to remove any burrs left as a result of the undercutting procedure.

The armature should be checked for opens, short circuits and grounds as follows:

1. Open - The most likely place for an open to occur is at the commutator riser bars as a result of excessively long cranking periods. Inspect the points where the conductors are joined to the commutator bars for loose connections. The poor connections cause arcing and burning of the commutator bars as the starting motor is used. If the bars are not too badly burned, repair can often be effected by resoldering the leads in the riser bars (using rosin flux), and turning down the commutator in a lathe to remove the burned material.
2. Short Circuit - Short circuits in the armature are located by use of a growler. When the armature is rotated in the growler with a steel grip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eleminated by cleaning out the slots.
3. Ground - Grounds in the armature can be detected by the use of a 110-volt test lamp and test probes. If the lamp lights when one test probe is placed on the commutator with the other probe on the core or shaft (Fig. 6E-7), the armature is grounded. Grounds occur as a result of insulation failure which is often brought about by overheating of the starting motor produced by excessive long cranking periods or by accumulation of brush dust between the commutator bars and the steel commutator ring.

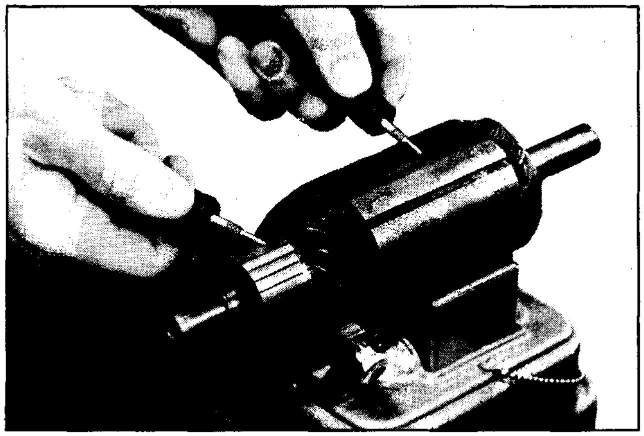


Fig. 6E-9 Testing Armature For Ground

FRAME AND FIELD

The field winding can be checked for an open or a ground by using a test lamp as follows:

1. Using a 110-volt test lamp, place one lead on each end of the field coils connected in series (Fig. 6E-8). If lamp does not light, the field coils are open and must be repaired or replaced.
2. Using a 110-volt test lamp, place one lead on the connector strap and the other on the field frame (Fig. 6E-9). Disconnect the shunt coil ground before check is made. If lamp lights, the field coils are grounded and defective coils must be repaired or replaced.
3. Using a 110-volt test lamp, place one lead on each end of shunt coil (Fig. 6E-10). Disconnect shunt coil ground before check is made. If lamp does not light, the shunt coil is open and must be replaced.

FIELD COIL

Field coils can be removed from the field frame easily by use of a pole shoe screwdriver. A pole shoe spreader should also be used since this prevents distortion of the field frame. Careful installation of field coils is necessary to prevent shorting or grounding of field coils as the pole shoes are tightened into place. Formed insulators are used to protect the field leads from grounding to frame. These must be replaced with assembly.

REPLACE BRUSHES

1. Remove brush holder pivot pin which positions one insulated and one grounded brush.
2. Remove brush spring.
3. Replace brushes as necessary.

ASSEMBLE STARTER

1. Assemble overrunning clutch to armature shaft as follows:
   a. Lubricate drive end of armature shaft with high melting point grease.

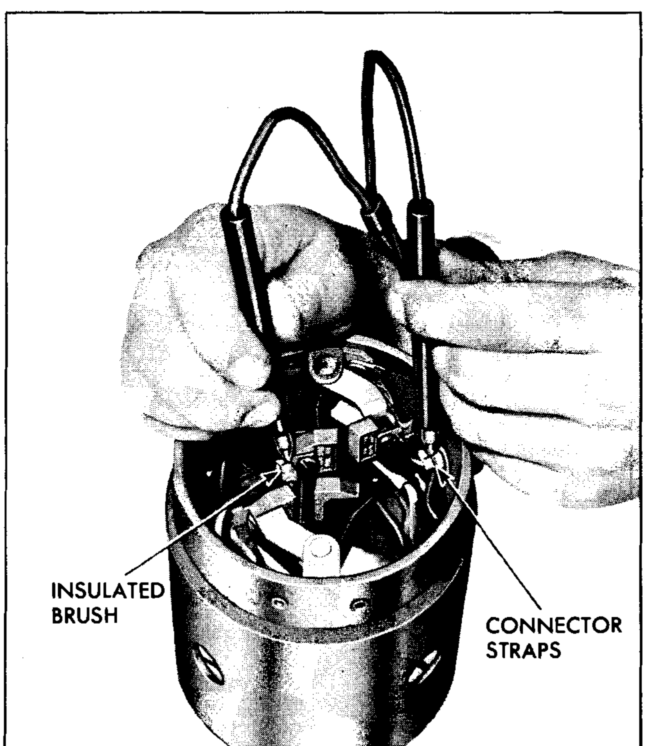


Fig. 6E-10 Testing Field Coils For Open

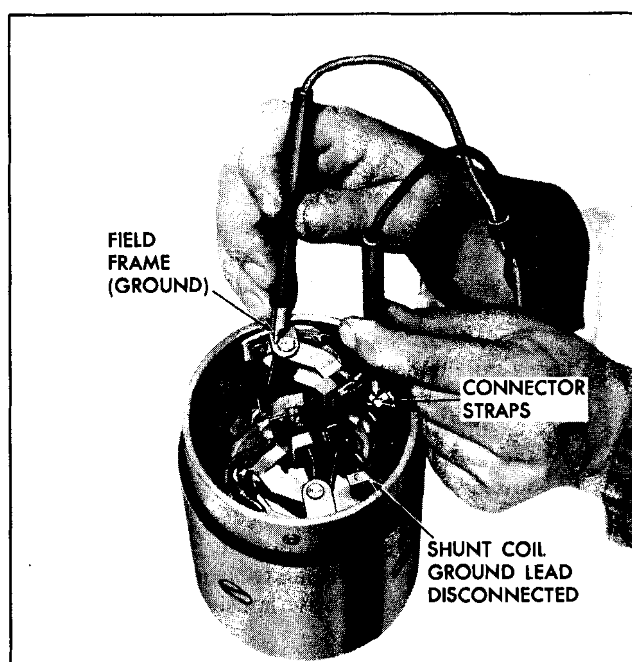


Fig. 6E-11 Testing Field Coils For Ground

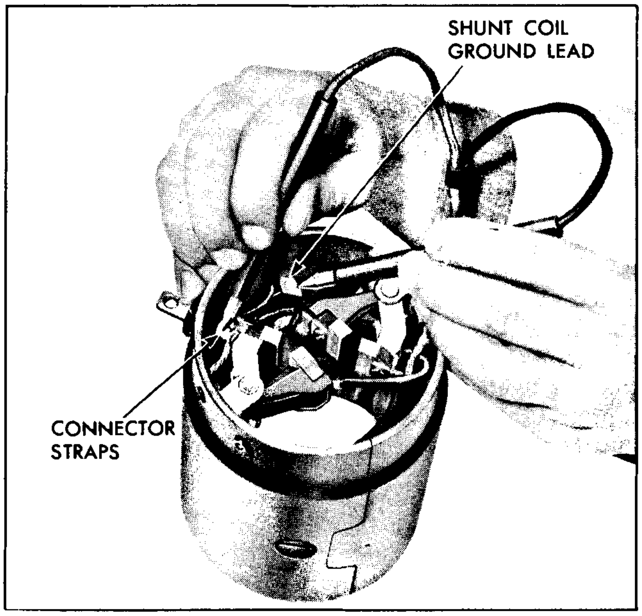


Fig. 6E-12 Testing Shunt Coil For Open

b. Slide clutch onto armature shaft with pinion outward.

c. Slide retainer onto shaft with cupped surface facing end of shaft.

d. Stand armature on end on wood surface with commutator down. Position snap ring on upper end of shaft and hold in place with a block of wood. Hit wood block a blow with hammer, forcing snap ring over end of shaft. Slide snap ring past the grease groove to the snap ring groove (Fig. 6E-11).

e. Assemble thrust collar on shaft with shoulder next to snap ring (Fig. 6E-12).

f. Place armature flat on work bench, and position retainer and thrust collar next to snap ring. Then, using two pairs of pliers at same time (one pair on either side of shaft), grip retainer and thrust collar and squeeze until retainer is forced over snap ring (Fig. 6E-12).

2. Place a small amount of high melting point grease in drive housing bushing. Make sure thrust collar is in place against snap ring and retainer and slide armature and clutch into place in drive housing, engaging shift lever with clutch.

3. Position field frame over armature, and apply sealing compound between frame and solenoid case. Position frame carefully against drive housing to prevent damage to brushes.

4. Place a small amount of high melting point grease in bushing in commutator end frame. Place leather

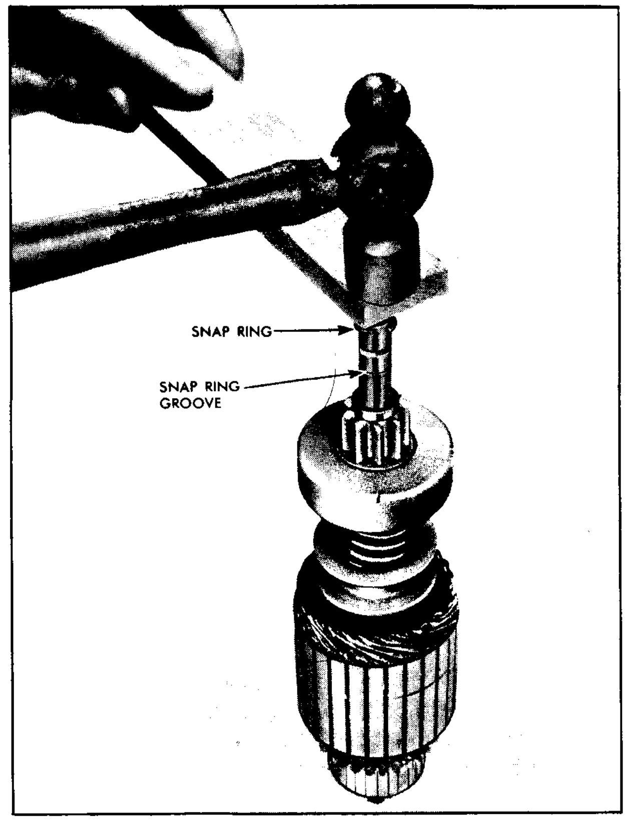


Fig. 6E-13 Forcing Snap Ring onto Armature Shaft

thrust washer on armature shaft and slide commutator end frame onto shaft.

5. Install thru bolts and tighten securely.

6. Reconnect field coil leads to solenoid terminal.

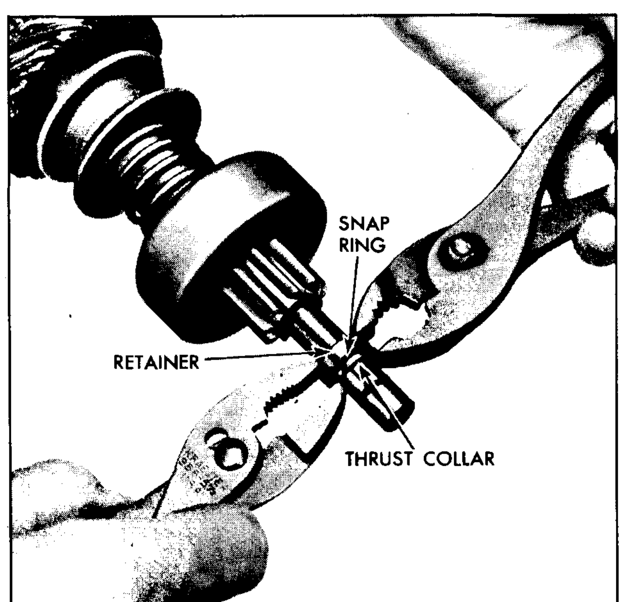


Fig. 6E-14 Forcing Retainer Over Snap Ring

PINION CLEARANCE CHECK

There is no provision for adjusting pinion clearance on the enclosed shift lever cranking motor. When the shift lever mechanism is correctly assembled, the pinion clearance should fall within the specified limits (.010"-.040"). When clearance exceeds these limits, it may indicate excessive wear of solenoid linkage or shift lever yoke buttons.

Pinion clearance should be checked after motor has been disassembled and reassembled.

Check pinion clearance in following manner:

1. Disconnect the motor field coil connector from the solenoid motor terminal and insulate it carefully.
2. Connect one battery lead to the solenoid switch terminal and the other to the solenoid frame (Fig. 6E-15).
3. Flash a jumper lead momentarily 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.
4. Push pinion back towards the commutator end to eliminate slack movement.
5. Measure the distance between pinion and pinion stop (Fig. 6E-16).

INSTALL IN CAR - 6-CYL. ENGINE

1. Position starter motor to engine and attach with thru bolts.
2. Swing starter motor brace into position and fasten securely.
3. Connect battery positive cable and wiring harness leads to starting motor solenoid.
4. Connect battery ground cable at battery terminal post.

INSTALL IN CAR - V-8 ENGINE

1. Position starter motor on engine.
2. Connect battery cable and solenoid wires to solenoid and fasten securely.

   NOTE: *Connect purple (or violet) wire to terminal marked "S", yellow wire to terminal marked "R".*

3. Attach starting motor to engine thru bolts and fasten securely.

   NOTE: *Make sure that the shims have been installed if car is equipped with an automatic transmission.*

4. Swing brace into position and fasten securely.

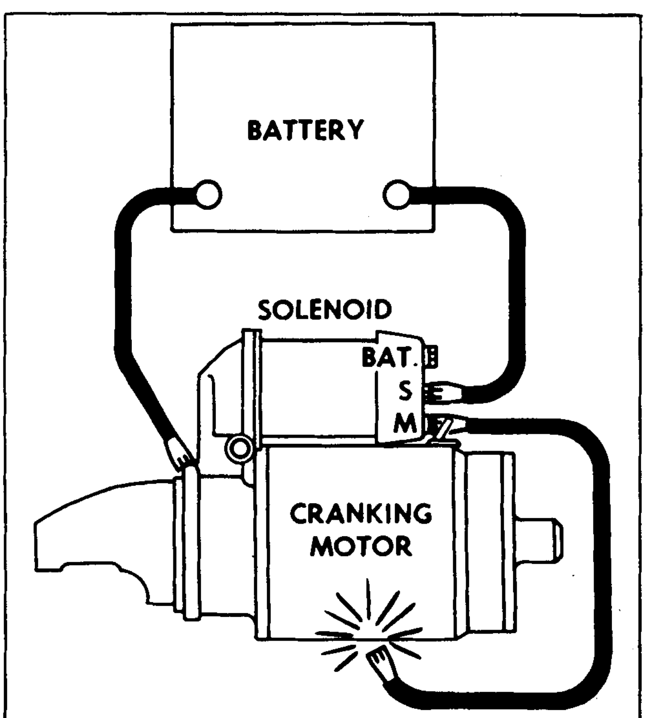


Fig. 6E-15 Circuit For Checking Pinion Clearance

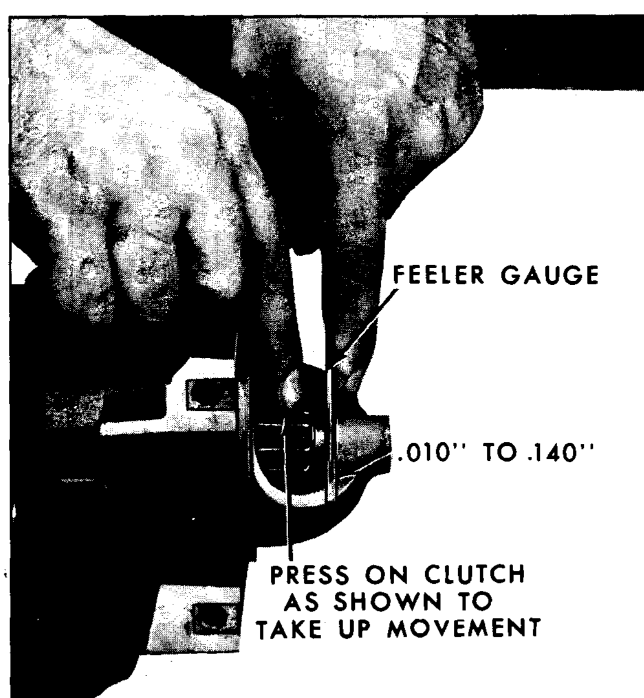


Fig. 6E-16 Measuring Pinion Clearance

TROUBLE DIAGNOSIS CRANKING CIRCUIT

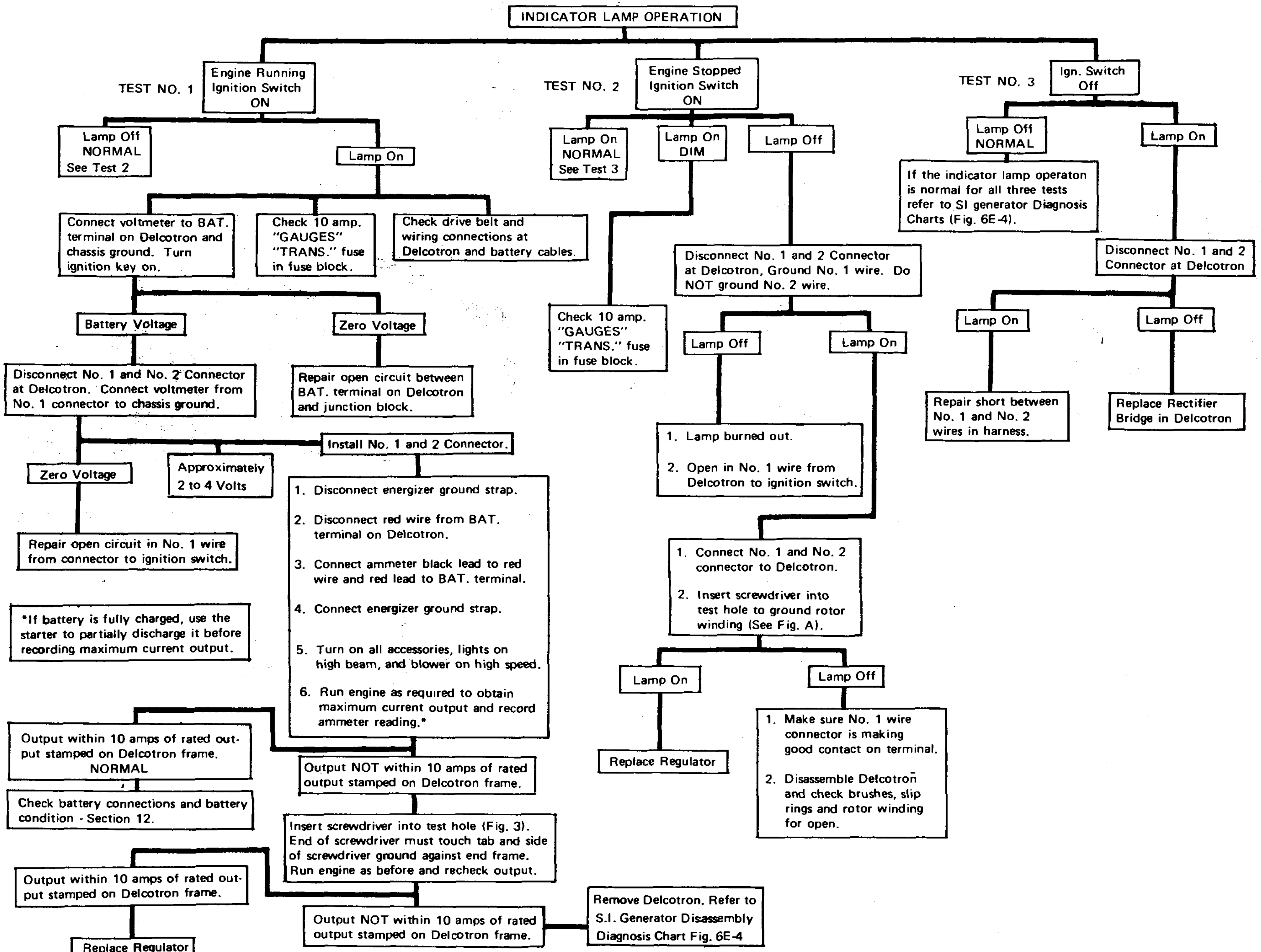


Fig. 6E-17 Charging System Diagnosis (SI)

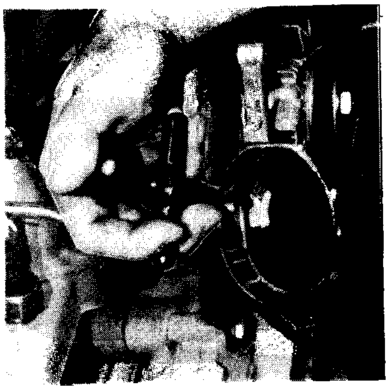


FIG. A

1. Check fan belt for proper tension (Fig. A) as described in Pontiac Service Manual Section 6A.

2. Use a SerCon voltmeter or a similar one with a wide accurate scale (Fig. B), and take a voltage reading (with engine and all accessories "OFF") between the two battery posts. This voltage is system battery voltage. Record this reading for later reference.

   NOTE: Battery must be in good condition to test charging system (Section 12, Pontiac Service Manual).

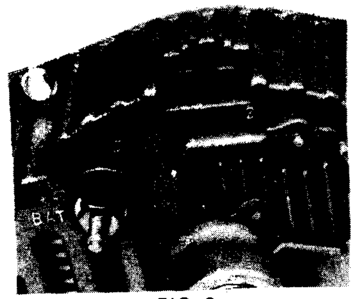


FIG. C

3. Ignition switch on, engine and accessories off, check the voltage reading at the No. 1 (brown wire) connection and No. 2 (red wire) connection at the generator (Fig. C and D). Connection may be made with awl or similar instrument as shown in Fig. D.

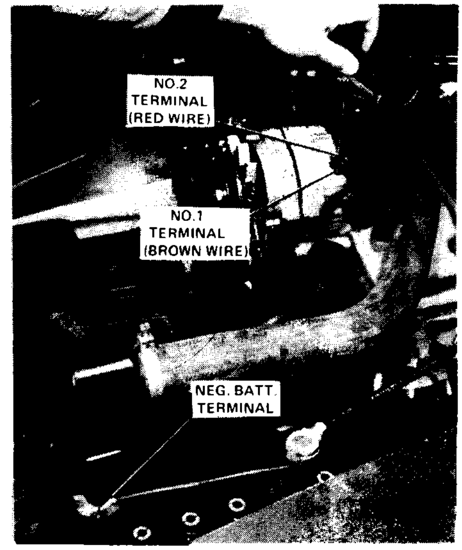


FIG. D

Low or no voltage - recheck battery voltage check voltage between alternator battery terminal and ground. Check starter solenoid (B terminal) for loose or bad connections - check for bad splice in engine harness (splice located in engine harness on left side of engine next to rocker cover approximately 6" from front of engine). (Fig. G). These three voltage readings should be the same.

Low or no voltage at any of these two locations indicates bad connection between that connection and battery.

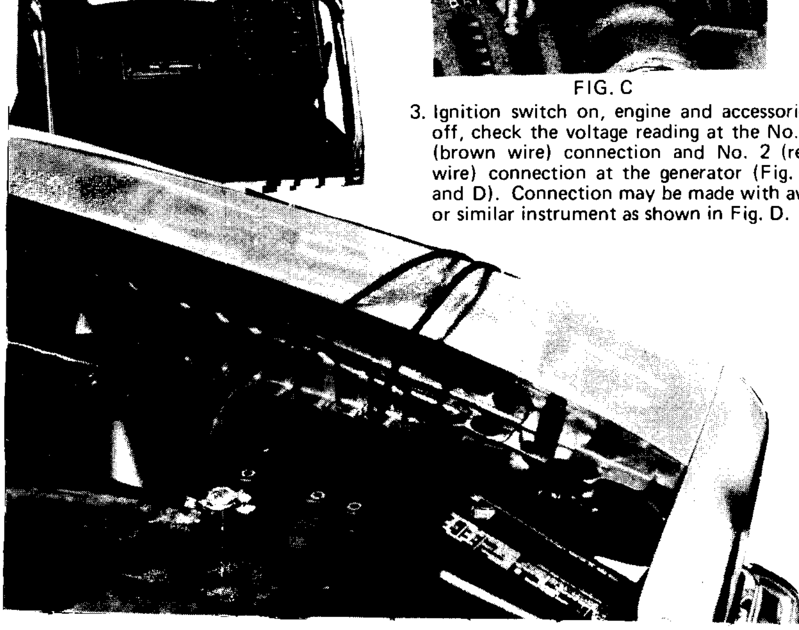


FIG. B

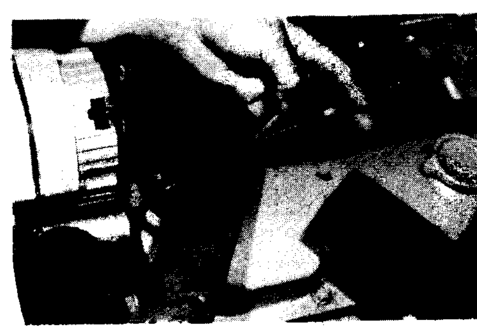


FIG. G

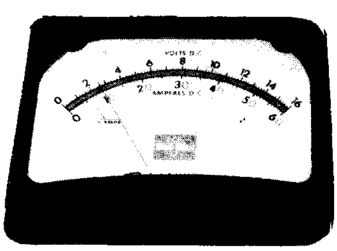


FIG. E

No. 1 terminal (brown wire) should register approximately 2 to 4 volts (Fig. E). No voltage condition open between terminal and ignition switch (71 cars with generator "warning light" - check for burned out bulb).

If reading is system battery voltage check for short between No. 1 and No. 2 wires.

No. 2 Generator connector (red wire) should read same as battery voltage recorded in Step 2 (Fig. F).

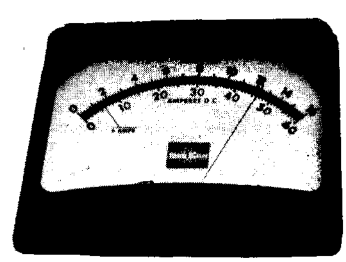


FIG. F

Fig. 6E-18 SI Diagnosis (A)

4. Connect the voltmeter to either one of the following locations:

   a. To the number 2 terminal on the generator and to ground (Fig. D).

   b. To cigar lighter outlet using a cigar lighter adapter (System battery voltage should appear on the voltmeter).

   With the voltmeter connected as in (a) or (b) above, perform the following checks:

5. Start engine and let it warm up, set idle (in "Park") at 1000 rpm for test. During cranking the voltage will drop below System Battery Voltage - this is normal.

6. Observe voltmeter.

7. If voltmeter reading is:

   a. The same or less than System Battery Voltage noted in step 2, regulator is possibly open (Fig. H). Check generator. Proceed to Step 8.

   b. Above system battery voltage but less than 15.5 volts (Fig. I) - regulator is functioning normally - proceed to step 8.

   c. Greater than 15.5 volts (Fig. J) - Regulator shorted - proceed to SI Generator disassembly diagnosis chart (Fig. 6E-20).

NOTE: It will be necessary to correct generator malfunction before determining the condition of the voltage regulator.

Refer to SI generator disassembly diagnosis chart (Fig. 6E-20).

Having determined by the above procedure that one or more areas of the generator are defective, proceed with disassembly and checking as described in Fig. 6E-20..

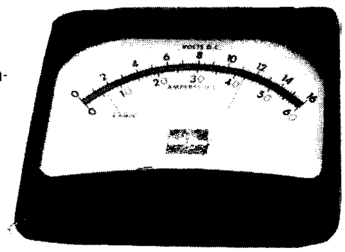


FIG. H

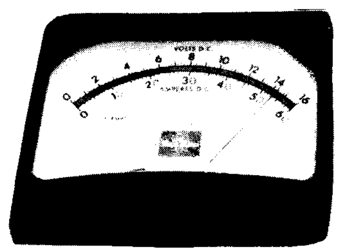


FIG. I

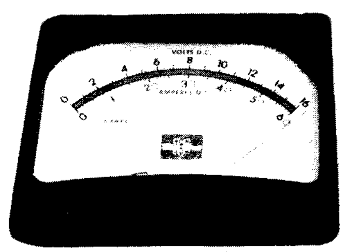


FIG. J

8. a. Disconnect energizer ground strap.

   b. Disconnect red wire from BAT. terminal on Delcotron.

   c. Connect ammeter black lead to red wire and red lead to BAT. terminal, Fig. K.

   d. Connect energizer ground strap.

   e. Turn on all accessories, lights on high beam, and blower on high speed.

   f. Run engine as required to obtain maximum current output and record ammeter reading. *If battery if fully charged, use the starter to partially discharge it before recording maximum current output.

      1) Output within 10 amps of rated output stamped on Delcotron frame.

      Replace Regulator

      2) Output NOT within 10 amps of rated output stamped on Delcotron frame.

   g. Insert screwdriver into test hole (Fig. L). End of screwdriver must touch tab and side of screwdriver ground against end frame. Run engine as before and recheck output.

      1) Output within 10 amps of rated output stamped on Delcotron frame.
      NORMAL

      Recheck battery to make sure it is in good condition.

      2) Output NOT within 10 amps of rated output stamped on Delcotron frame.
      GENERATOR DEFECTIVE

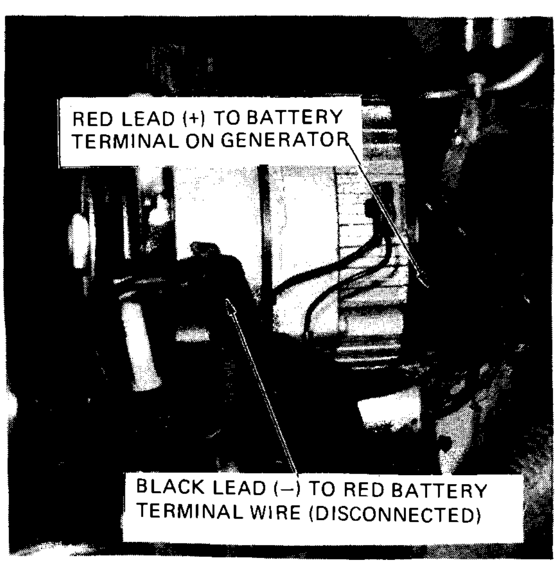


FIG. K

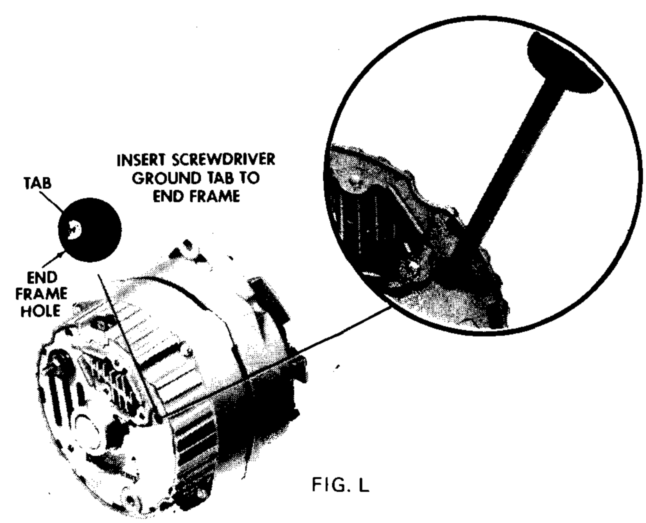


FIG. L

Fig. 6E-19 SI Diagnosis (B)

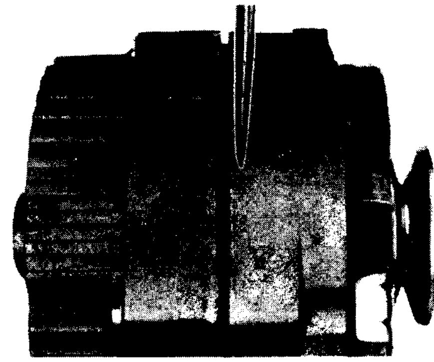


FIG. M

DISASSEMBLY

9. Stop engine, remove generator, mark end frames with punch (Fig. M) and separate end frames.

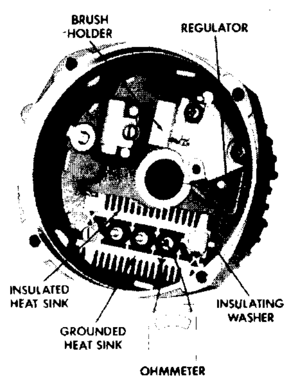


FIG. N

10. Check rectifier bridge (Fig. N). See 1971 Pontiac Service Manual, Section 6E for procedure.

NOTE: Rectifier bridge must be checked while installed in end frame.

As generator is disassembled, observe location of two insulating washers and screws that attach voltage regulator and brush holder to end frame (Fig. O).

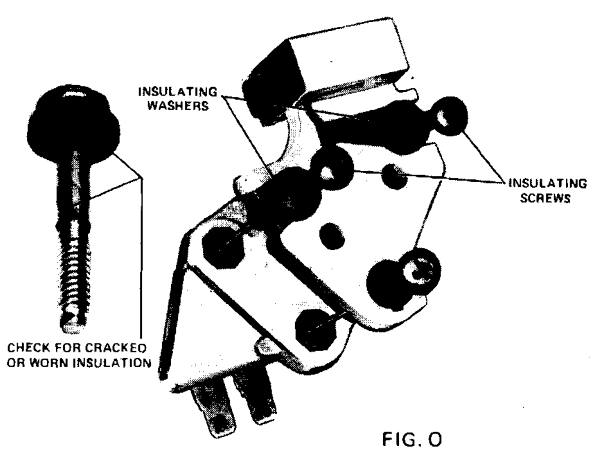


FIG. O

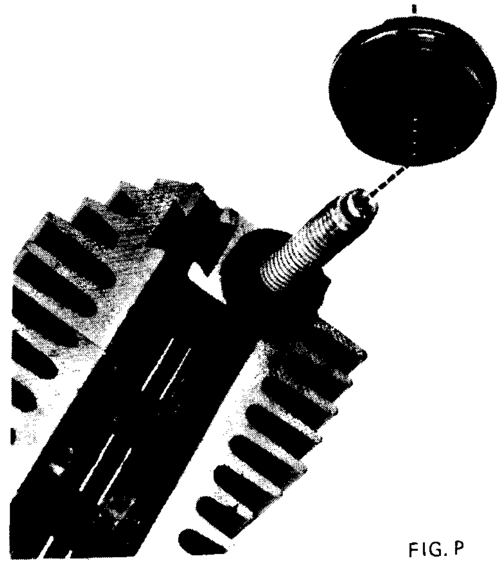


FIG. P

Also observe insulating washer under "rectifier bridge". Check for cracked or broken insulators (Fig. P).

Visually inspect brushes and holder for cracks, dirt or worn brushes.

Check for good contact between diodes and contacts.

11. Check diode trio (Fig. Q). See 1971 Pontiac Service Manual, Section 6E, for procedure.

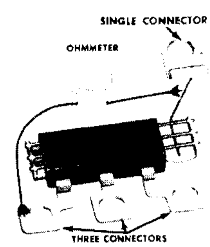


FIG. Q

12. Visually check stator for discoloration of "enamel coating" on copper wire. Color should be constant. Excessive heat or short between turns will tend to turn enamel coating "black" and will be easy to rub off. If enamel can be easily rubbed off, replace stator (Fig. R).

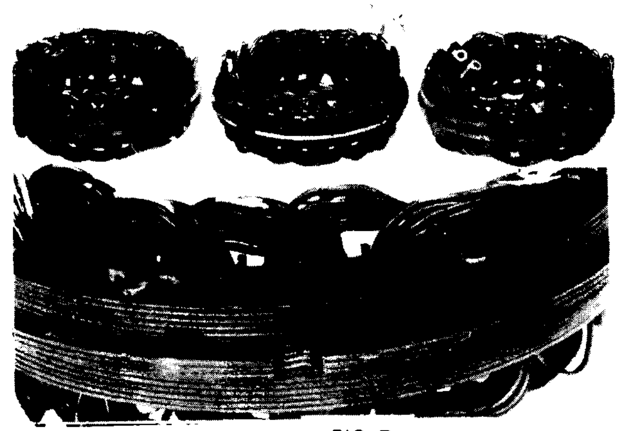


FIG. R

Fig. 6E-20 SI Diagnosis (C)

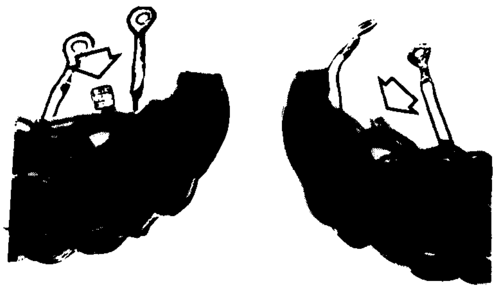


FIG. S

13. Inspect "Y" connection (on "10SI" only) for good connection plus discoloration of wires at/or near the joint. Excessive discoloration usually indicates poor welding of this connector. Check for a short between coil windings and frame laminations (Fig. S).

Check stator for opens or grounds (Fig. T).

14. Check rotor (Fig. U).

15. Use a wooden plastic toothpick to retain brushes and reinstall regulator and brush assembly in end frame, fitting toothpick through slot in end frame. Reassemble generator carefully observing proper location of the two insulating washers and screws at the voltage regulator and insulating washer under rectifier bridge (Fig. V).

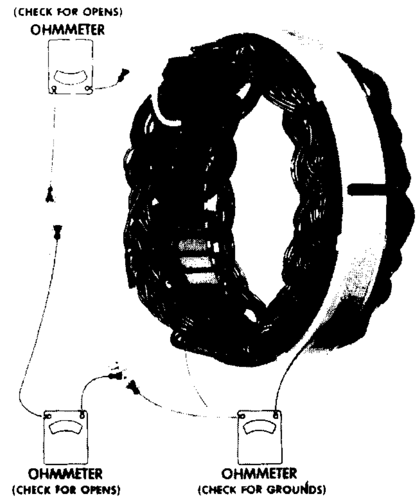


FIG. T

16. Reinstall on car, adjust belt tension and start engine.

17. With car running slightly above idle, repeat test 7 and 8 to ensure a normal functioning charging system.

NOTE: If both the alternator and regulator are defective simultaneously, it will be necessary to rebuild the alternator and rerun the preceding tests.

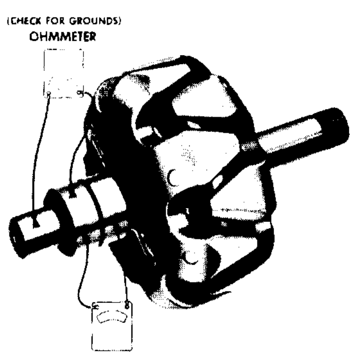


FIG. U

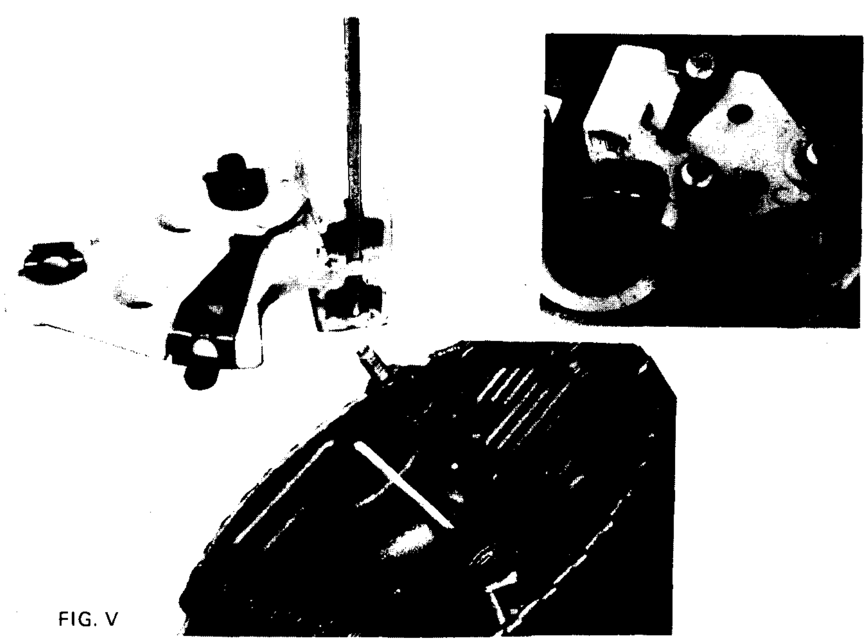


FIG. V

Fig. 6E-20A SI Diagnosis (D)

Do not make this test before making preliminary checks unless battery is being overcharged as evidenced by excessive water usage.

1. Insert 1/4 ohm resistor (J 22087) at battery negative terminal.
2. Insert test probe into No. 3 terminal of voltage regulator connector.
3. Connect voltmeter from test probe to ground.
4. Start engine and run at 2000 r.p.m.
5. Press on 1/4 ohm resistor to engage.
6. Observe voltage.

LESS THAN 13.5 VOLTS

Indicates low setting or defective regulator.

1. Shut off engine and remove regulator cover (disconnect connector while removing cover).
2. Turn adjusting screw clockwise to raise setting (see Fig. 6E-26).
3. Replace cover and repeat test. If regulator cannot be set within range, replace.

13.5 TO 16.0 VOLTS

Charging circuit is functioning properly.

Undercharged battery condition could be result of unnoticed accessory operation or intermittent ground causing battery drain.

NOTE: Voltage setting may be adjusted to owner's requirements within this range.

MORE THAN 16.0 VOLTS

Indicates high setting or defective regulator.

1. Shut off engine and remove regulator cover (disconnect connector while removing cover).
2. Turn adjusting screw counterclockwise, pry springholder up against screw head, and then turn screw clockwise to lower setting (Fig. 6E-26).
3. Replace cover and repeat test. If regulator cannot be set within range, replace.

NOTE: To adjust transistor voltage regulator:
1. Remove pipe plug
2. Insert small screwdriver into slot.
3. Turn clockwise to raise setting (0.3 volt for each notch moved).

Fig. 6E-20B 10DN Regulator Diagnosis

DESCRIPTION AND OPERATION

CHARGING CIRCUIT

The two basic types of charging systems are the SI integral regulator charging system (Fig. 6E-24 and 6E-25) and the 10 DN mechanical regulator charging system (Fig. 6E-23). The SI system is standard on all B, G A and F Series cars. The 10 DN system is standard on the X Series. These components are connected electrically as shown in Fig. 6E-26 and 6E-27.

SERIES SI- GENERATOR

GENERAL DESCRIPTION

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 rec-

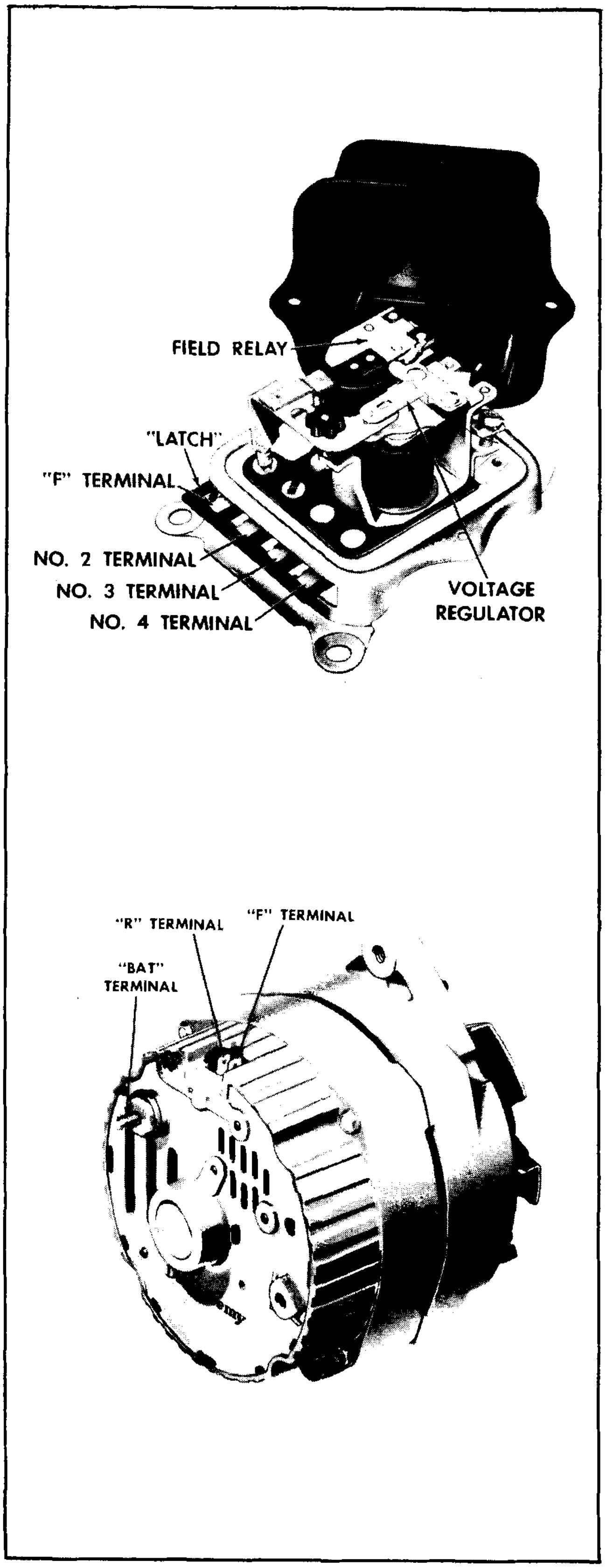


Fig. 6E23 10 DN Generator

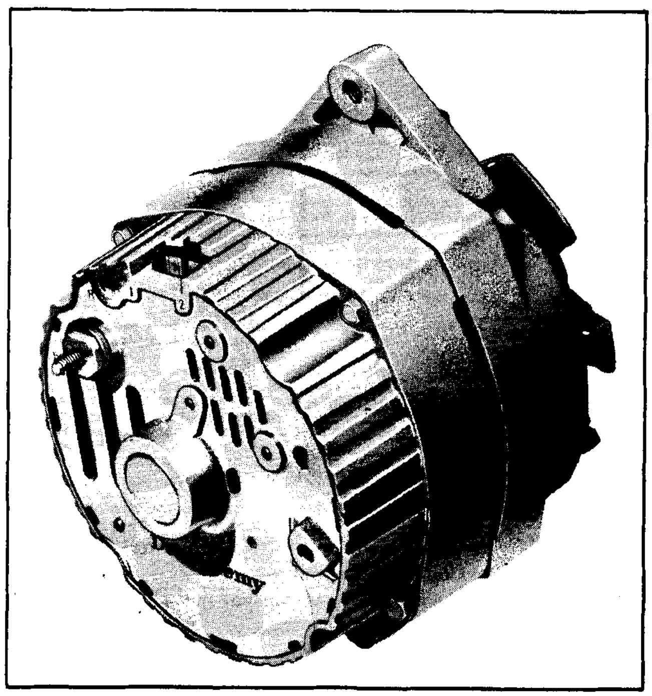


Fig. 6E-24 10 SI Generator

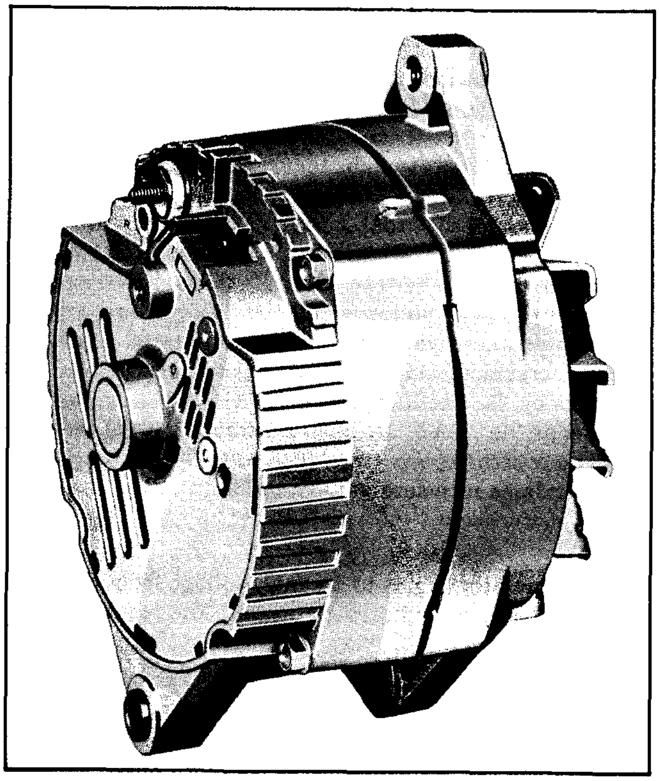


Fig. 6E-25 27 SI Generator

tifier 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.

OPERATION

A typical wiring diagram is illustrated in Figure 6E-26. The basic operating principles are explained as follows:

When the switch is closed, current from the Energizer flows through the indicator lamp to the generator No. 1 terminal, through resistor R1, transistor TR3 (collector-emitter) and the base-emitter of transistor TR1 to ground, and then back to the Energizer. This turns on transistor TR1, and current flows through the generator field coil and TR1 back to the Energizer.

With the generator operating, a.c. voltages are generated in the stator windings, and the stator supplies d.c. field current through the diode trio, the field, TR1, and then through the grounded diodes in the rectifier bridge back to the stator. Also, the six diodes in the rectifier bridge change the stator a.c. voltages to a d.c. voltage which appears between ground and the generator "BAT" terminal. As generator speed increases, current is provided for charging the Energizer and operating electrical accessories. Also, with the generator operating, the same voltage appears at the "BAT" and No. 1 terminals, and the indicator lamp goes out to indicate the generator is producing voltage.

The No. 2 terminal on the generator is always connected to the Energizer, but the discharge current is limited to a negligible value by the high resistances of R2 and R3. As the generator speed and voltage increase, the voltage between R2 and R3 increases to the point where zener diode D-1 conducts. Transistor TR2 then turns on and TR1 turns off. With TR1 off, the field current and system voltage decrease, and D-1 then blocks current flow, causing TR2 to turn back off and TR1 to turn back on. The field current and system voltage increase, and this cycle then repeats many times per second to limit the generator voltage to a preset value.

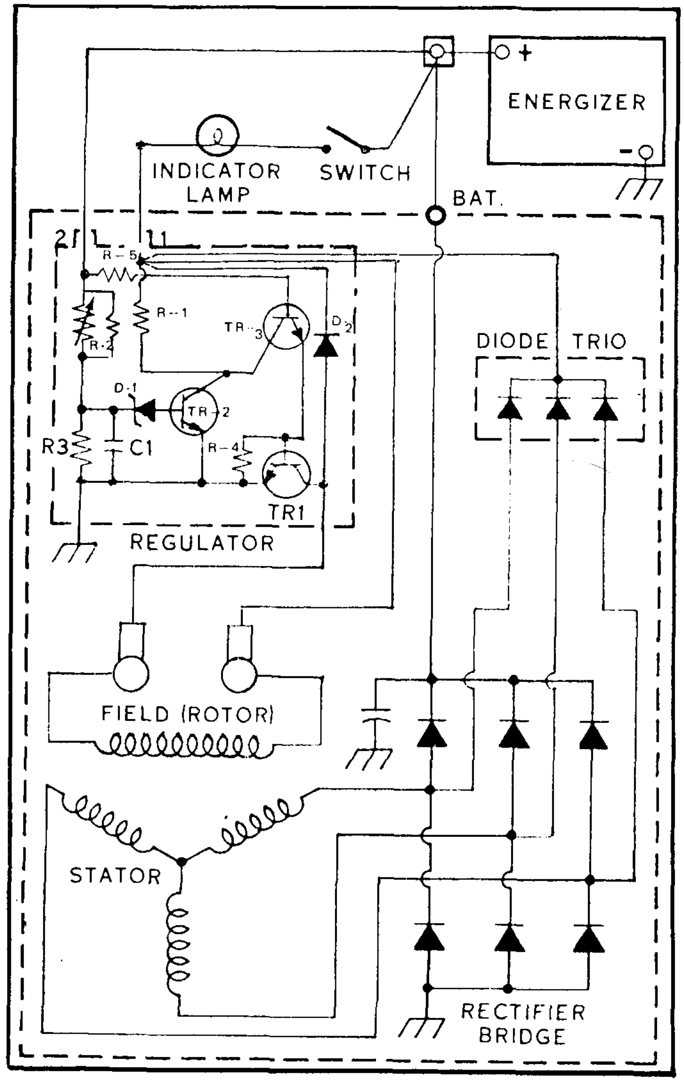


Fig. 6E-26 SI- Regulator in Charging Circuit

Capacitor C1 smooths out the voltage across R3, resistor R4 prevents excessive current through TR1 at high temperatures, and diode D-2 prevents high-induced- voltages in the field windings when TR1 turns off. Resistor R2 is a thermistor which causes the regulated voltage to vary with temperature, thus providing the optimum voltage for charging the Energizer.

Transistor TR3 provides circuit protection in the event the circuit to terminal No. 2 becomes open. TR3 will turn off and block the flow of current from terminal No. 1 and TR1.

10 DN GENERATOR REGULATOR

DESCRIPTION

A double contact voltage regulator unit and field relay unit make up the regulator assembly (Fig. 6E-27). The voltage regulator unit operates to limit generator voltage to a pre-set value whereas the field relay connects generator field winding to the battery through the regulator contacts. When the ignition switch is first turned on the charge indicator lamp lights. Then, when generator begins to charge, the indicator lamp goes out, indicating system is operating normally. If lamp should come on when the generator is in operation, trouble in system is indicated.

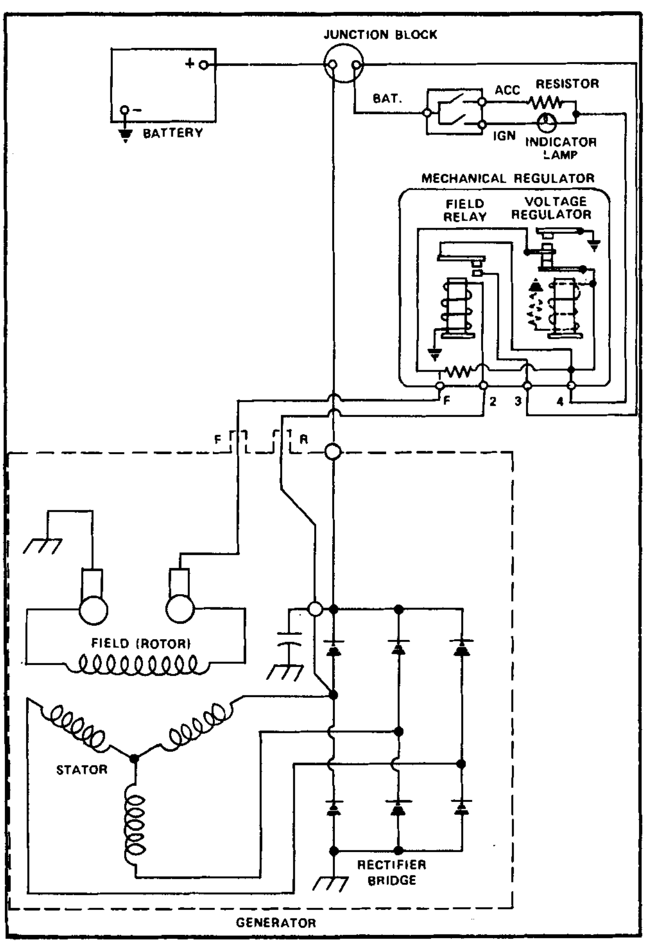


Fig. 6E-27 10 DN Regulator in Charging Circuit

OPERATING PRINCIPLES

When ignition switch is closed, before engine has started, the indicator lamp lights to indicate generator is not charging. The current flow can be traced from battery to "BAT" terminal on switch, through indicator lamp and resistor which is in parallel, and then through voltage regulator contacts. From here it continues to flow on through generator field winding to ground, completing the circuit back to battery. Current through this circuit energizes the field windings sufficiently to insure voltage build-up in stator windings when engine starts. The voltages generated in stator windings are then changed or rectified by the rectifier bridge to a d.c. voltage which appears at the "BAT" or output terminal on the generator. The resistor allows more current to flow through the field windings to insure voltage build-up in stator windings.

As the generator begins to operate, voltage from the "R" or relay terminal is impressed through the regulator No. 2 terminal across field relay winding, causing relay contacts to close. This connects the regulator No. 4 terminal directly to battery through the field relay contacts, causing the indicator lamp to go out. Generator field current then flows from battery to regulator No. 3 terminal, and then through field relay contacts and voltage regulator lower or series contacts to field winding.

As the speed of generator increases, the voltage at "BAT" terminal of generator also increases. This impresses a higher voltage through the field relay contacts and across the voltage regulator shunt windings. The increased magnetism created by this higher voltage across winding causes the lower or series contacts of relay to separate. The field current then flows through a resistor which reduces field current. This reduced field current causes generator voltage to decrease thereby decreasing the magnetic pull of voltage regulator shunt winding. Consequently, the spring causes the contacts to reclose. This cycle repeats many times per second to limit the generator voltage to a pre-set value.

As the generator speed increases even further, the resistor, connected across contacts, is not sufficiently high value to maintain voltage control with lower contacts. Therefore, as the voltage increases the upper or "shorting" contacts close. When this happens, the generator field winding is shorted and no current passes through the winding. With no current in the field winding, the generator voltage decreases, which also decreases the magnetism in the shunt winding and upper contact points open. With these points open, field current flows through the resistor and field winding. As the voltage increases, the contacts reclose. This cycle then repeats many times per second to limit the generator voltage to a pre-set value at high generator speeds. The voltage regulator unit thus operates to limit the value of generator voltage throughout the generator speed range. Consequently the electrical accessories are protected from excessive voltage which could cause damage.

NOISY GENERATOR

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode, out-of-round or rough slip rings, hardened brushes or defective stator.

SERVICE PROCEDURES

PERIODIC 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 belt for proper alignment, wear and tension.

CAUTION: *When adjusting belt tension, apply pressure at center of generator, never against either end frame (See Section 6A).*

CHECK IN CAR

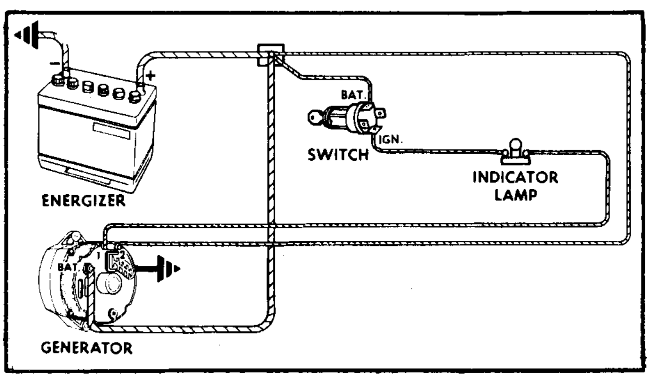


Fig. 6E-28 Charging Circuit - SI System

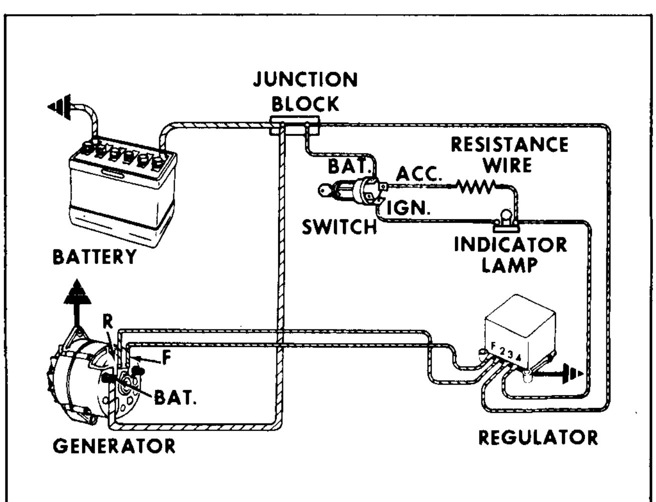


Fig. 6E-29 Charging Circuit - 10 DN System

SI GENERATOR

A basic wiring diagram showing lead connections is shown in Figures 6E-28 and 6E-29. To avoid damage to the electrical equipment, always observe the following precautions:

- Do not polarize the generator.
- Do not short across or ground any of the terminals in the charging circuit except as specifically instructed herein.
- NEVER operate the generator with the output terminal open-circuited.
- Make sure the generator and Energizer have the same ground polarity.
- When connecting a charger or a booster Energizer to the vehicle Energizer, connect negative to negative and positive to positive.

NOTE: *In some circuits 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 trouble-shooting 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 Energizer as evidenced by slow cranking and low specific gravity readings.

C. An overcharged Energizer as evidenced by excessive water usage.

REMOVE FROM CAR (SI AND 10 DN)

1. Disconnect positive 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 at generator.

3. Loosen adjusting bolts.
4. Remove generator drive belt.
5. Remove thru bolt which retains generator.
6. Remove generator from car.

DISASSEMBLE GENERATOR (SI AND 10 DN)

1. If rotor, drive end frame bearings or pulley and fan need replacement, remove and replace shaft nut using hex type wrench.
2. Scribe a mark between two halves of generator to help locate parts in same position during assembly.
3. Remove four through bolts.
4. Separate drive end frame and rotor assembly from stator assembly by prying apart with screwdriver at stator slot. The fit between the two is not tight and the two can be separated easily.

NOTE: *The separation is to be made between stator assembly and drive end frame.*

CAUTION: *As rotor and drive end frame assembly is separated from slip ring frame assembly, the brushes will fall down onto shaft and come in contact with lubricant. Brushes which come in contact with shaft should be cleaned immediately to avoid contamination by oil, or they will have to be replaced.*

INSPECTION AND REPAIR (SI AND 10 DN)

ROTOR (SI AND 10 DN)

The rotor may be checked electrically for grounded, open or short-circuited field coils as follows:

1. To check for grounds, connect a 110-volt test lamp or ohmmeter from either slip ring to rotor shaft, or to rotor poles. If lamp lights or ohmmeter reading is low, the field winding is grounded (Fig. 6E-30).
2. To check for opens, connect test lamp or ohmmeter to each slip ring. If lamp fails to light or if the ohmmeter reading is high (infinite), winding is open (Fig. 6E-30).
3. The winding is checked for short circuits by connecting a battery and ammeter in series with two slip rings. The field current at 12 volts and 80°F should be between 4.0 - 4.5 amperes. Any ammeter reading above these values indicates shorted windings.

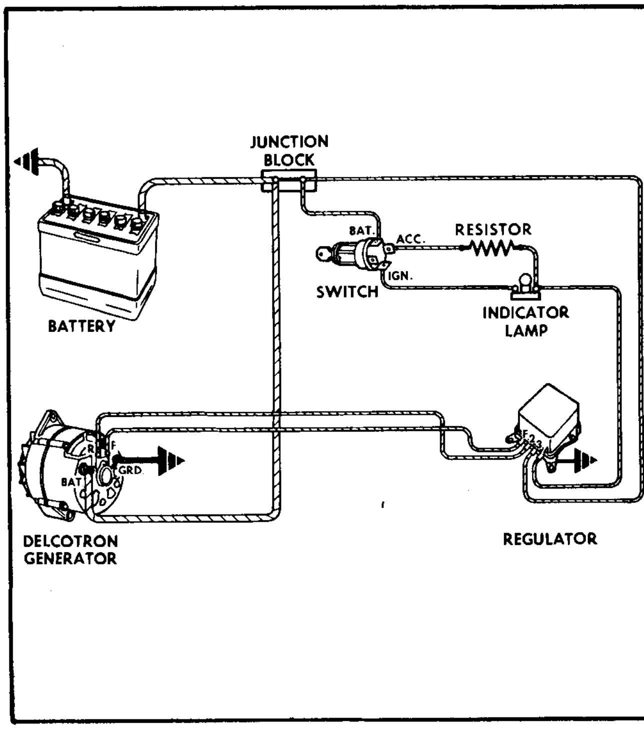


Fig. 6E-30 Checking Rotor

4. Rotor assemblies which fail above test should be replaced.

The rotor may be cleaned and inspected as follows:

a. If magnetic poles or rotor need cleaning, they may be cleaned by brushing with oleum spirits.

CAUTION: *Do not clean with degreasing solvent.*

b. Inspect slip rings for dirt and roughness. These may be cleaned with solvent, if necessary. They may also be cleaned and finished with 400 grain or finer polishing cloth. Do not use sandpaper. Spin rotor in lathe or otherwise spin rotor, and hold polishing cloth against rings until they are clean.

CAUTION: *The rotor must be rotated in order that slip rings will be cleaned evenly. Cleaning slip rings by hand, without spinning rotor, may result in flat spots on slip rings, causing brush noise.*

Slip rings which are rough or out of round should be trued in lathe to .002" maximum indicator reading. Remove only enough material to make rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

DRIVE END FRAME BEARING (SI AND 10 DN)

1. Remove three screws from retainer plate and remove retainer plate inner collar and gasket.
2. Press out bearing and oil slinger.
3. The bearings in the generator are permanently lubricated and require no lubrication during life of bearing. If a dry bearing is encountered, do not attempt to lubricate, as an improper lubricant or excessive amount of lubricant may burn bearing, or be thrown off and contaminate inside of generator. Replace dry, worn or rough bearings with new bearings, which are prepacked with proper amount and type of lubricant.
4. To install, press in bearing and grease slinger with tube or collar that just fits over outer race. Install bearing and slinger as shown in Fig. 6E-31.
5. Install retainer plate gasket and inner collar with three screws. It is recommended that new retainer plate be installed if felt seal is hardened or excessively worn.

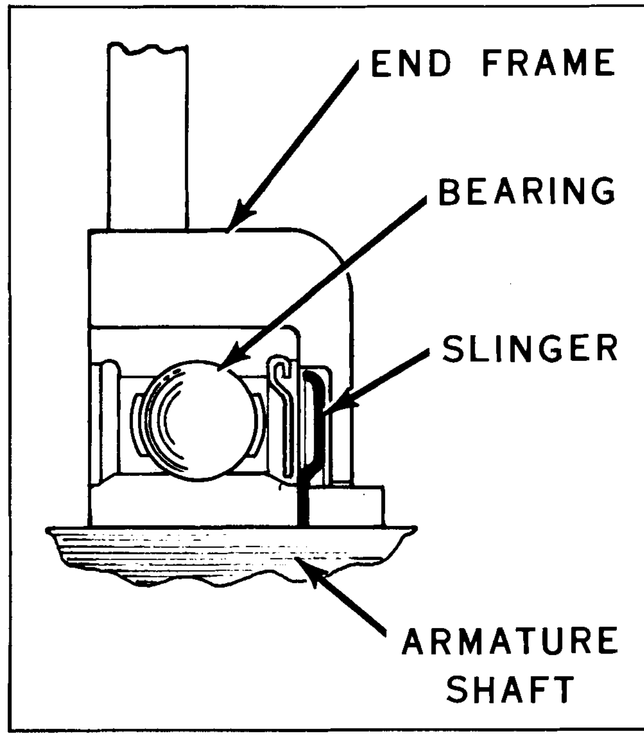


Fig. 6E-31 Drive End Frame Bearing Assembly

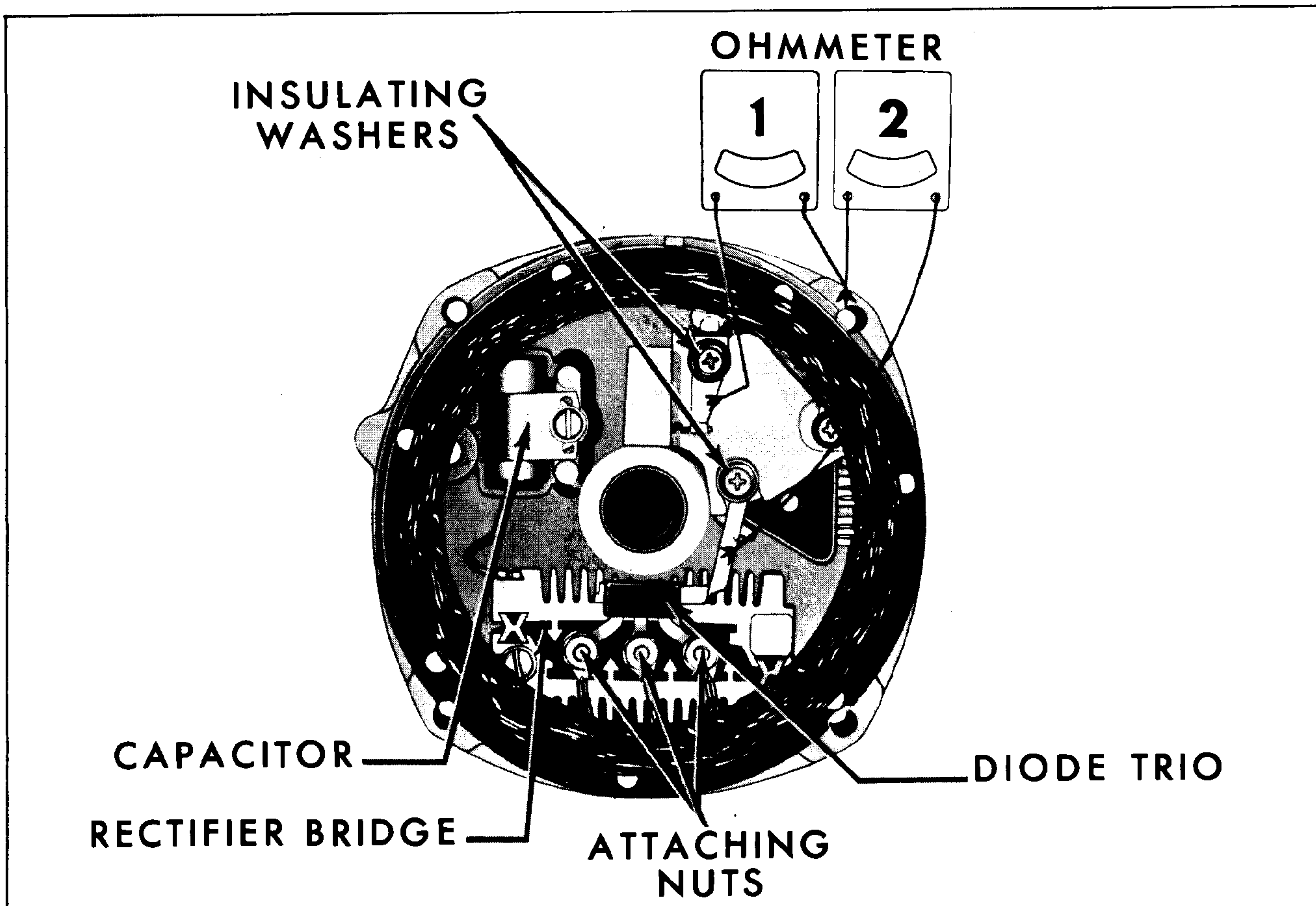


Fig. 6E-32 SI Slip Ring End Frame Assembly

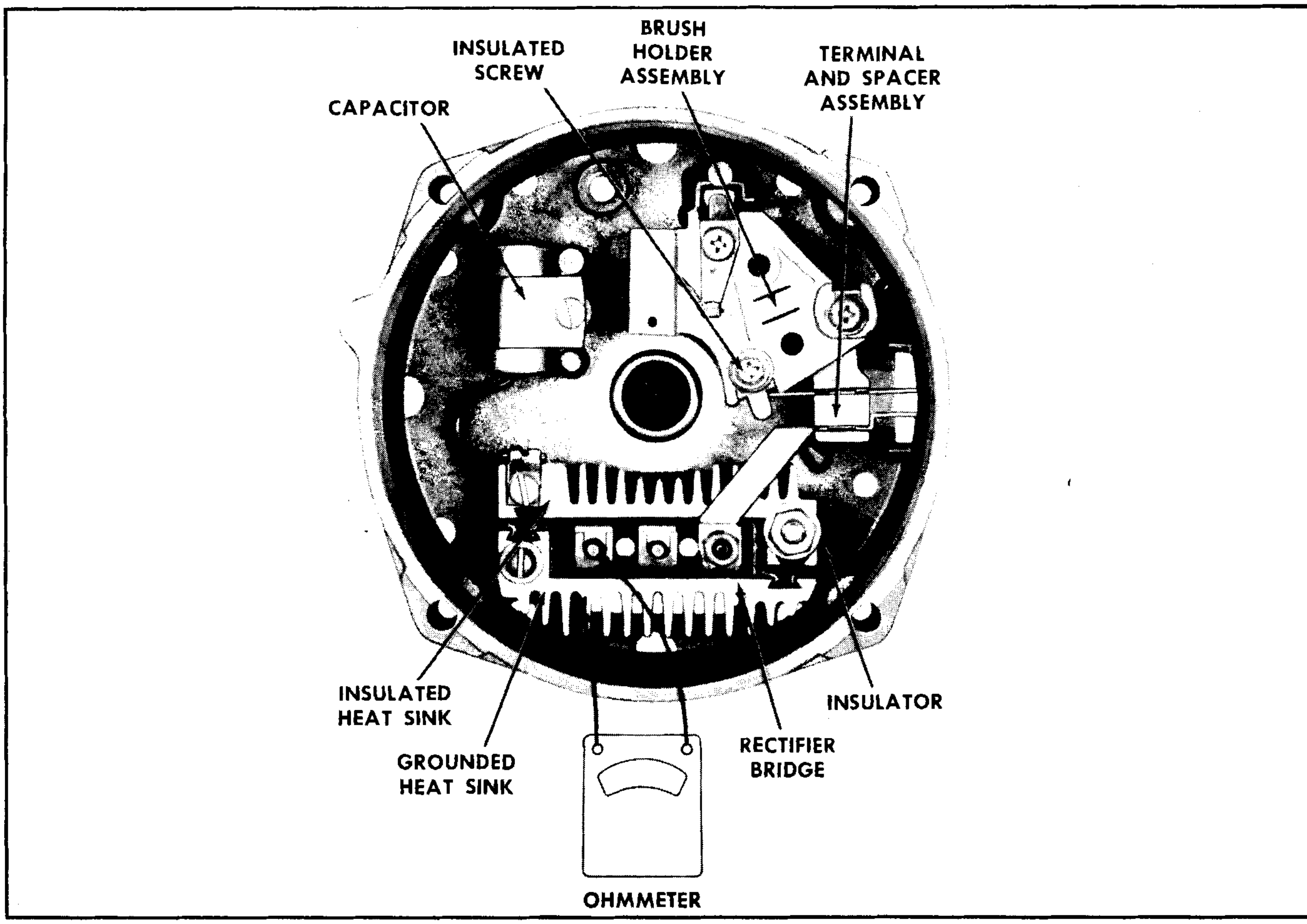


Fig. 6E-33 10 DN Slip Ring End Frame Assembly

STATOR

If stator is to be checked and/or replaced:

1. Remove 3 stator lead attaching nuts and washers (Fig. 6E-23).
2. Separate stator from end frame. The fit between stator frame and end frame is not tight, and the two can be separated easily.
3. The stator windings may be checked with test lamp or ohmmeter as follows:
   a. To check for grounded windings, connect lamp or ohmmeter from any stator lead to frame. If lamp lights or ohmmeter reading is low the stator is grounded (see Fig. 6E-26).
   b. To test for opens, successively connect test lamp or ohmmeter between stator leads. If lamp fails to light and if ohmmeter reading is high, there is an open in stator windings (see Fig. 6E-26).
   c. A short circuit in stator windings is difficult to locate without laboratory test equipment, due to low resistance of windings. However, if all other electrical checks are normal and alternator fails to supply rated output, shorted stator windings are indicated.

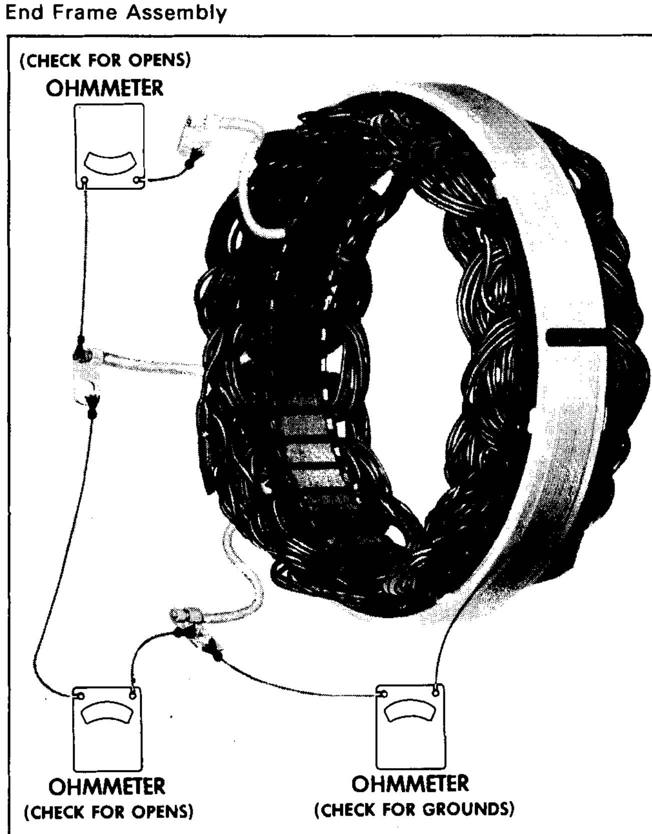


Fig. 6E-34 Checking Stator

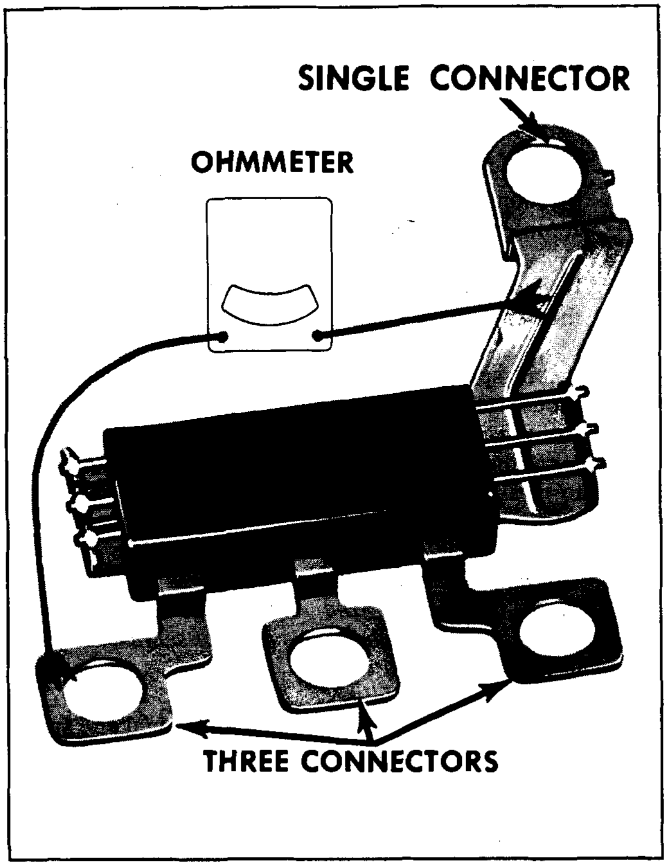


Fig. 6E-35 Checking Diode Trio (SI)

d. Stator which fails above test should be replaced.

4. If necessary, stator may be cleaned by brushing with oleum spirits.

CAUTION: *Do not clean in solvent.*

5. The stator can be installed by reversing steps 1 and 2.

DIODE TRIO (SI ONLY)

The diode trio is identified in Fig. 6E-23. Before removing the diode trio, connect an ohmmeter, using lowest range scale, from brush lead clip to end frame as shown in Fig. 6E-32, then reverse lead connections. If both readings are zero, check for grounded brush lead clip caused by omission of insulating washer (Fig. 6E-32), omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve.

To remove diode trio, proceed as follows:

1. Remove three stator attaching nuts.

2. Remove stator.

3. Remove diode trio lead clip attaching screw and remove diode trio. Note that the insulating washer on the screw is assembled over the top of the diode trio connector.

To check the diode trio, after removing it from the end frame assembly, connect an ohmmeter having a 1 1/2 volt cell to the single brush connector and one of the stator lead connectors (Fig. 6E-27). Observe the reading on the lowest range scale. Then reverse the leads to the same two connectors. Repeat this test with each of the other two stator lead connectors. If any or all give readings when reversing connections which are the same, replace the diode trio. A good diode trio will give one high and one low reading.

CAUTION: *Do not use high voltage, such as a 110 volt test lamp, to check this unit.*

RECTIFIER BRIDGE (SI AND 10 DN)

The rectifier bridge contains all of the diodes found in the heat sink and slip ring end frame of the generator. If one diode is defective, the entire rectifier bridge must be replaced.

To check the rectifier bridge, connect an ohmmeter to the ground heat sink and base of one of the three terminals (Fig. 6E-36). Then reverse the connections to the

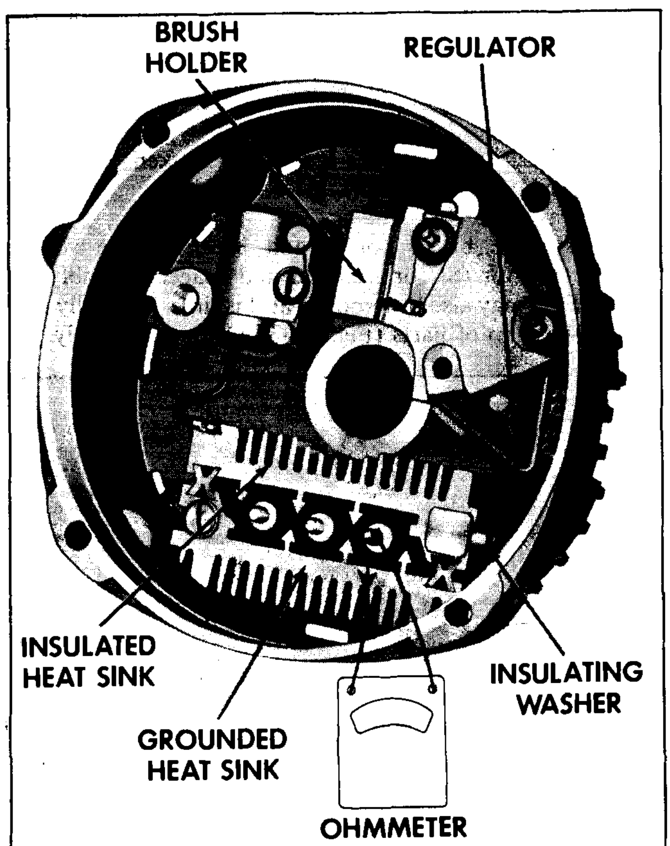


Fig. 6E-36 Checking Rectifier Bridge Diodes grounded heat sink and base of the same terminal. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading.

Repeat this same procedure between the grounded heat sink and the other two terminals, and between the insulated heat sink and each of the three terminals. If at least one pair of readings is the same, the rectifier bridge must be replaced.

NOTE: *It is important that the rectifier bridge be completely insulated to perform the above test.*

CAUTION: *Do not use high voltage, such as a 110 volt test lamp, to check this unit.*

To replace the rectifier bridge, proceed as follows:

1. Remove the attaching screw and the "BAT" terminal screw.
2. Disconnect the capacitor lead.
3. Remove rectifier bridge. Note the insulator between the insulated heat sink and end frame (Fig. 6E-36).

BRUSHES AND/OR VOLTAGE REGULATOR (SI AND 10 DN)

1. Remove two brush holder screws and one diode trio lead strap attaching screw. Note the position of all insulator washers for reassembly (Fig. 6E-32 and 6E-33).
2. Inspect brush holder screws for broken or cracked insulation.
3. Remove brush holder and brushes. The voltage regulator (SI) or terminal and spacer assembly (10 DN) may also be removed at this time. Carefully note stack-up of parts (Fig. 6E-36A) for reassembly.

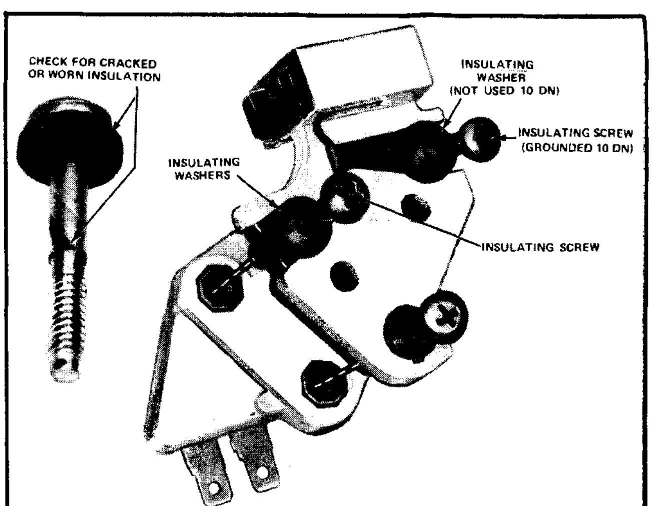


Fig. 6E-36A Brush Holders

4. Inspect brush springs for evidence of damage or corrosion.
5. Inspect brushes for wear or contamination.
6. If old brushes are to be reused, they must be thoroughly cleaned with soft dry cloth and must be completely free of oil.
7. If there is any doubt about condition of brush springs, they should be replaced.
8. Install springs and brushes into brush holder (they should slide in and out without binding). Insert straight wood or plastic toothpick (to prevent scratching brush face) into hole at bottom of holder to retain brushes.

   NOTE: *Should any of the brush holder assembly parts require replacement, it will be necessary to replace the entire brush holder assembly. Individual parts are not serviced for this particular assembly.*

9. Replace voltage regulator (SI) or terminal and spacer assembly (10 DN).
10. Attach brush holder into end frame, noting carefully stack-up of parts as shown in Fig. 6E-36. Allow wood or toothpick to protrude through hole in end frame and install stator or diode trio lead strap attaching screw and washer.
11. Tighten remaining two screws securely.

VOLTAGE REGULATOR (SI ONLY)

For removal and replacement of voltage regulator in the integrated circuit generator, see BRUSHES AND/OR VOLTAGE REGULATOR.

The voltage regulator test must be made before the generator is removed from the car. (Refer to SI Diagnosis Figs. 6E-17, 6E-18, 6E-19 and 6E-20.)

SLIP RING END FRAME BEARING AND SEAL (SI and 10 DN)

1. With stator removed, press out bearing and seal with tube or collar that just fits inside end frame housing. Press from outside of housing toward inside. Support inside of frame with hollow cylinder to allow seal and bearing to pass through.
2. The bearings in the generator are permanently lubricated and require no lubrication during life of bearing. If a dry bearing is encountered, do not attempt to lubricate, as improper lubricant or excessive amount of lubricant may burn bearing, or be thrown off and contaminate inside of generator. Replace dry,

worn or rough bearings with a new bearing which will be prepacked with proper amount and type of lubricant.

3. Place flat plate over bearing and press in from outside toward inside of frame until bearing is flush with outside of end frame. Support inside of frame with hollow cylinder to prevent breakage of end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on bearing.

4. From inside of frame, insert seal flush against bearing.

5. Install stator and connect leads.

ASSEMBLE GENERATOR (SI and 10 DN)

1. Before assembling rotor and drive end frame to slip ring end frame, make sure bearing surfaces of shaft are perfectly clean.

2. Join together two end frames, matching scribe marks.

3. Install four thru bolts.

4. Remove wood or toothpick from brush holder assembly.

INSTALL IN CAR (SI and 10 DN)

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 Section 6A 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 lead to generator.

6. Connect positive battery terminal.

CAUTION: *Take care not to reverse polarity.*

BATTERY CONDITION

Most charging system troubles show up as an undercharged or overcharged battery. Since the battery itself may be defective, it should be checked first to determine its condition. Second, the generator drive belt should be checked for proper tension, and all wiring should be visually inspected for loose or corroded connections. Also, in the case of an undercharged battery, check for battery drain caused by grounds or by accessories being turned on at all times.

CAUTION: *Do not short between or ground any of the terminals on the generator. Do not attempt to polarize the generator.*

To check for an undercharged battery condition, as evidenced by slow cranking, follow Charging Circuit Preliminary Checks, Fig. 6E-17 (SI) or Fig. 6E-21 (10 DN). For an overcharged battery, as evidenced by excessive water usage, refer to Trouble Charts, Figs. 6E-17 thru 6E-21.

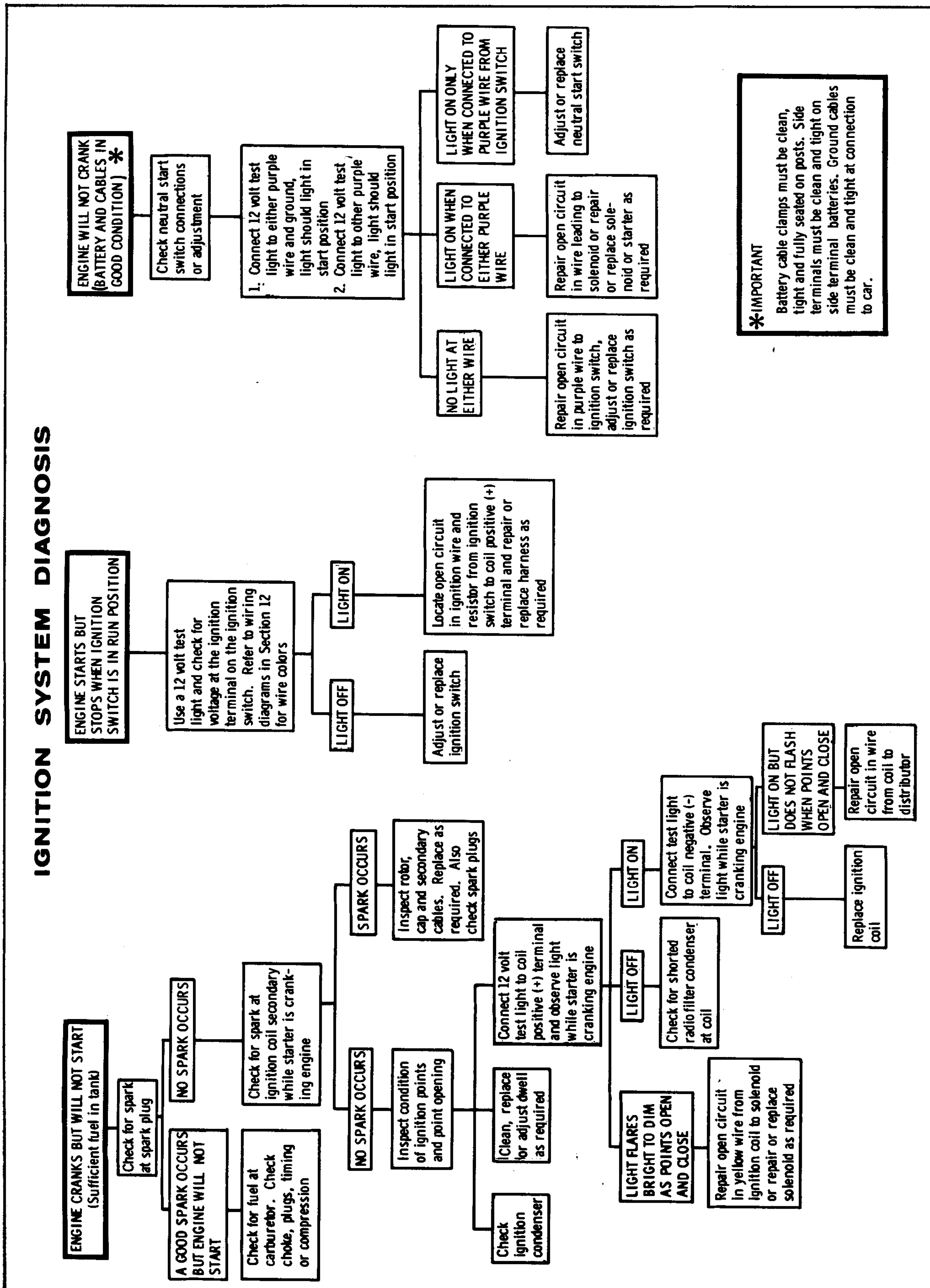


Fig. 6E-37 Ignition System Diagnosis

SPARK PLUG TROUBLE DIAGNOSIS

PLUG FLASH OVER

(Firing from upper terminal to base of plug)

CAUSE	CORRECTION
Dirty insulator tops--oil, dirt and moisture on insulator will shunt current to base of plug. The above condition can be caused by failure of spark plug boot.	Keep plugs wiped clean with cloth moistened with cleaning solvent. Check spark plug boot and replace if necessary.

OIL OR CARBON FOULING

Wet, black deposits on firing end of plug indicate oil pumping condition. Usually caused by worn piston rings, pistons, cylinders or valve guides.	Correct engine condition. In most cases plugs in this condition will be servicable after proper cleaning and regapping.
Soft, fluffy, dry carbon deposits usually indicate a rich mixture operation, excessive idling, improper operation of automatic choke or faulty adjustment of carburetor.	If troubles are not eliminated, use hotter type plug.
Hard baked-on, black carbon deposits result from use of too cold a plug.	Use hotter type plug.

LEAD FOULING

(Light and powdery or shiny glazed coating on firing end)

By-products of combustion and fuel additives, deposited as a powder which may later melt and glaze on insulator tip.	See page 6E-35

NORMAL ELECTRODE WEAR

Due to intense heat, pressure and corrosive gases together with spark discharge, electrode wears and gap widens.	See page 6E-35
May be caused by (1) burned valves, (2) gas leakage past threads and seat gaskets, due to insufficient installation torque or damaged gasket, (3) too lean a mixture or (4) plug too hot for operating speeds and loads.	Correct engine condition. Install plugs to specified torque. Use a new spark plug seat gasket each time a new or cleaned spark plug is installed. Used colder type plug if condition persists.

BROKEN UPPER INSULATOR

(Firing around shell crimp under load conditions)

Careless removal or installation of spark plug.	Replace with new spark plug.

BROKEN LOWER INSULATOR

(Firing tip)

Cause is usually carlessness in regapping by either bending of center wire to adjust gap, or permitting gapping tool to exert pressure against tip of center electrode or insulator, when bending side electrode to adjust gap.	Replace with new spark plug.
Fracture or breakage of lower insulator may also occur occasionally if engine has been operated under conditions causing severe and prolonged detonation or preignition.	Use colder type plug for particular type of operation.

DAMAGED SHELL

Very seldom occurs but cause is almost always due to mishandling by applying excessive torque during installation. Failure is usually in form of crack in Vee of thread next to seat gasket or at groove below hex.	Replace with new spark plug.

DESCRIPTION AND OPERATION

IGNITION CIRCUIT

The ignition circuit consists of the battery, distributor, ignition coil, spark plugs and primary and secondary wiring. These components are connected electrically as in Fig. 6E-38.

PERIODIC SERVICE

The distributor and spark plugs are the only components of the ignition circuit that require periodic service. The remainder of the ignition circuit requires only periodic inspection to check operation of units, tightness of electrical connections, and condition of wiring.

WIRING

The low and high tension cables should be examined carefully for brittle or cracked insulation and broken strands. Defective insulation will permit missing or cross firing of engine. Connections should be clean and tight to reduce resistance. Poor or high resistance connections in primary wiring can reduce available voltage for firing spark plugs. All leads located in either the coil tower or distributor cap should be checked to make sure they are pressed all the way down in their inserts. The rubber boots used at these connections should be tightly in place over connections.

CAUTION: *Lead from distributor must be connected to coil negative terminal and lead from ignition switch to coil positive terminal.*

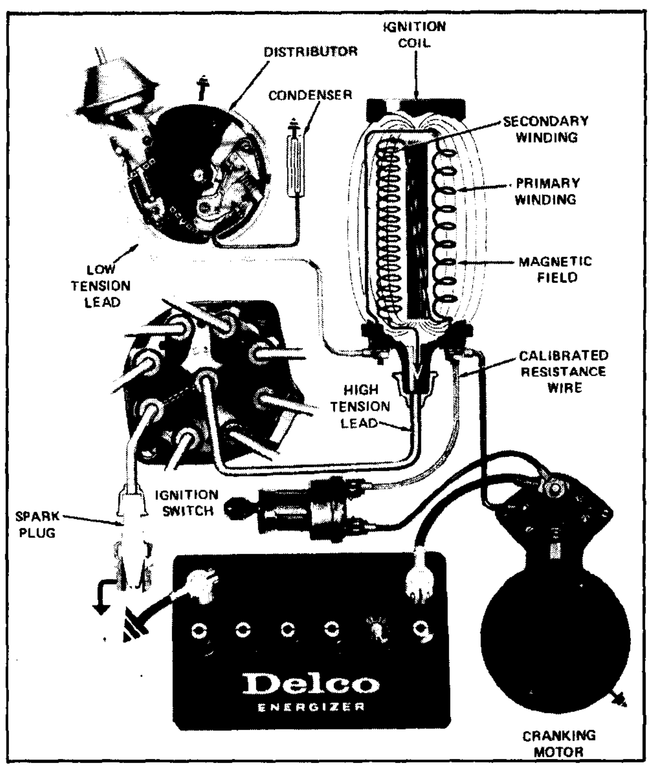


Fig. 6E-38 Ignition Circuit - Typical

TIMING

Periodically the ignition timing should be checked. If out of adjustment, set to specifications with distributor vacuum hose disconnected to insure most efficient engine performance.

> **NOTE:** *Always ascertain that distributor dwell is set to specification BEFORE setting timing, as a change in point gap will cause a change in ignition timing.*

SPARK PLUGS

Periodically (the actual time depending on operating conditions) the plugs should be removed for cleaning, inspection, and regapping.

DISTRIBUTOR

Three types of distributors are used: (1) A 12 volt aluminum internal adjustment distributor on 6 cylinder engines, (2) A 12-volt aluminum external adjustment distributor on 8-cylinder engines and (3) A 12-volt aluminum unitized ignition distributor.

All function in much the same manner to (1) cause a high voltage surge from coil (2) time these surges with regard to engine requirements through use of centrifugal and vacuum advance mechanisms (3) direct high voltage surges through distributor rotor, cap, and high tension wiring to spark plugs.

MAINTENANCE

CAP AND ROTOR

The cap and rotor should be checked for chips or cracks and carbonized paths which would allow high tension leakage to ground. The rotor spring should be checked to insure it has good positive contact against cap button.

CONTACT SET OR BREAKER POINTS

Under most normal operating conditions, distributor contact points will provide many thousands of miles of service. Points which have undergone several thousand miles of operation will have a rough surface or slight transfer of material, but this should not be interpreted as meaning that points are worn out.

Rough contacts which are greyish in color have a greater area of contact than new contacts and will provide satisfactory service until most of tungsten is worn off.

Pitted or transferred contacts is a normal condition and points should not necessarily be replaced unless transfer has exceeced .020" (Fig. 6E-39).

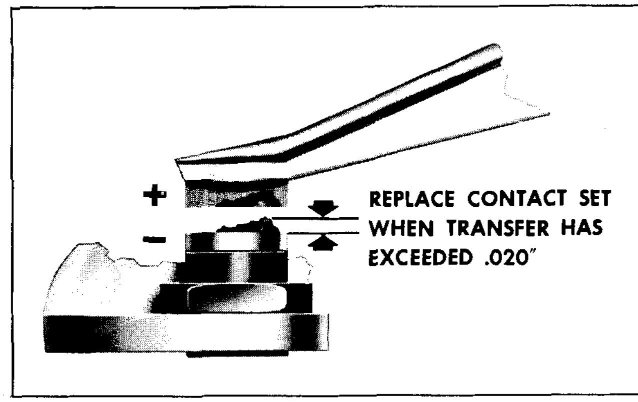


Fig. 6E-39 Allowable Contact Material Transfer

CONDENSER

Under normal operating conditions, the condenser should not require replacement. Do not change condenser when changing points unless there is evidence of failure, such as arcing and severe pitting of points.

If the condenser is suspected, check on a condenser tester for the following properties:

1. Insulation resistance (or leakage) (over 2 megohms).

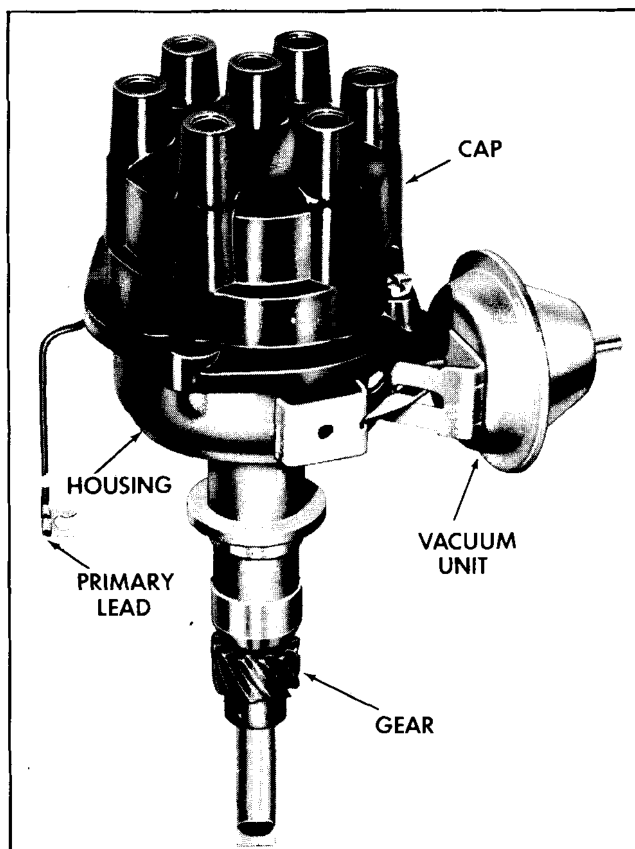


Fig. 6E-40 6-Cyl. Distributor

2. Series resistance. (Up to .5 ohms)
3. Capacity (mfd.) (.18-.23)

6 CYLINDER ENGINE DISTRIBUTOR

DESCRIPTION

The lightweight-high performance-type distributor shown in Fig. 6E-40 and Fig. 6E-41 is constructed with a diecast aluminum housing that provides a unit of light over-all weight.

The circuit breaker plate assembly is mounted onto the main housing with two attaching screws (Fig. 6E-42). The movable plate is pivoted on the base plate and rides on three nylon bearings. All distributors use a vacuum advance control unit which is mounted onto the side of the distributor housing. It consists of an enclosed, calibrated, spring-loaded diaphragm and is linked mechanically to the movable plate. The centrifugal advance mechanism is located under the breaker plate assembly, and is a part of the shaft assembly. It consists of an automatic cam actuated by two centrifugal weights controlled by springs. For complete description of vacuum advance unit and it's operation, see section 6-D.

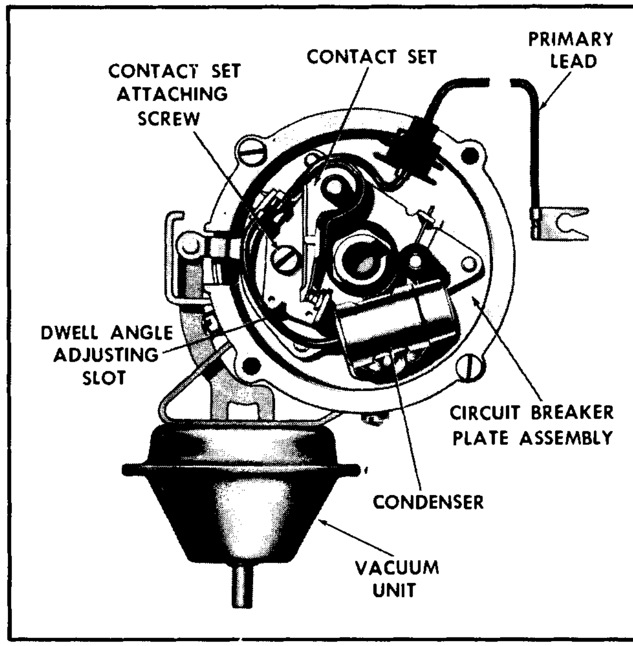


Fig. 6E-42 Top View of Distributor (Cap and Rotor Removed)

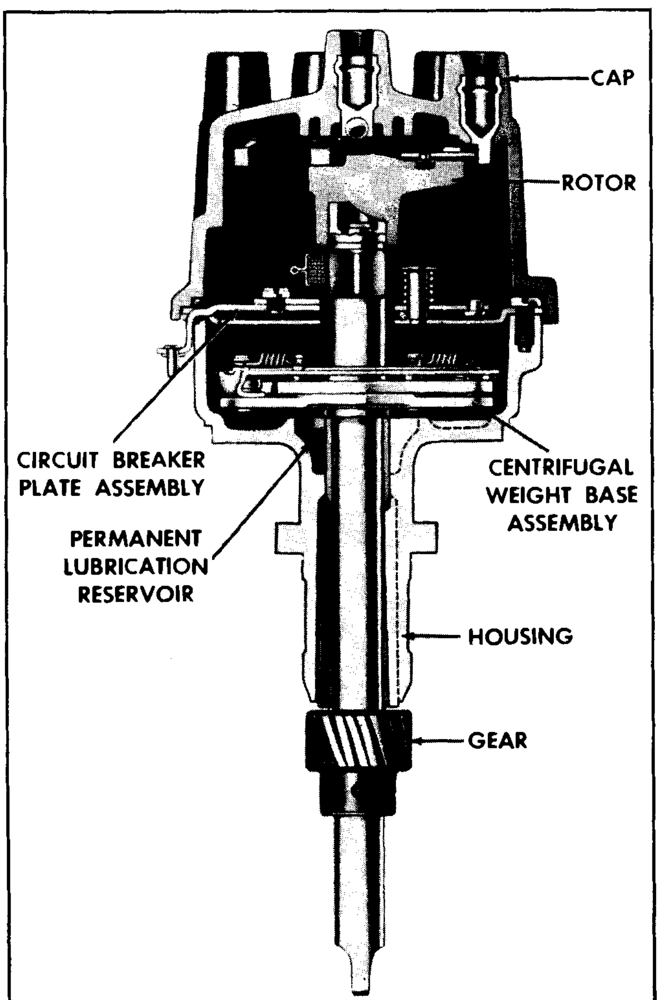


Fig. 6E-41 Cross Section of 6-Cyl. Distributor

LUBRICATION

No periodic lubrication to the main shaft is required, since bushings are lubricated by engine crankcase oil. The crankcase oil reaches the upper bushing through channels cut in housing next to shaft, and normal splash lubricates lower bushing. A seal at top of housing seals oil from reaching inside distributor.

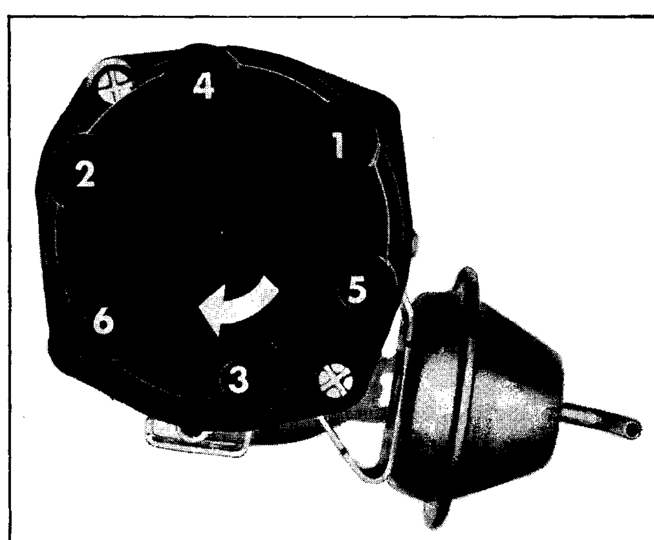


Fig. 6E-43 Position of Secondary Wires - 6 Cyl.

8 CYLINDER ENGINE DISTRIBUTOR

DESCRIPTION

The external adjustment type distributor is shown in Fig. 6E-44 and 6E-57. The cap has a window for adjusting dwell angle with cap in place (Fig. 6E-52). Adjustment of dwell can be made on car while engine is operating or while distributor is being operated on a distributor tester. The centrifugal advance components are located above the breaker plate and cam. This arrangement allows cam and breaker lever to be located directly adjacent to upper bearing for increased stability.

The breaker plate is of a one-piece construction and rotates on the outer diameter of the upper bearing. The plate is held in position by a retainer clip in the upper shaft bushing. The molded rotor serves as a cover for the centrifugal advance mechanism. The vacuum advance control unit is mounted under the movable breaker plate to the distributor housing. The contact set is attached to the movable breaker plate. The service replacement contact set has breaker lever spring tension and point alignment pre-adjusted at the factory and is serviced as one complete assembly.

Due to the location of the radio antenna, the radio is more sensitive to interference originating in the distributor. For this reason, all distributors contain a new Radio Frequency Interference Shield (RFI) to suppress radio noise interference. This two-piece shield covers the circuit breaker plate assembly (Fig. 6E-57).

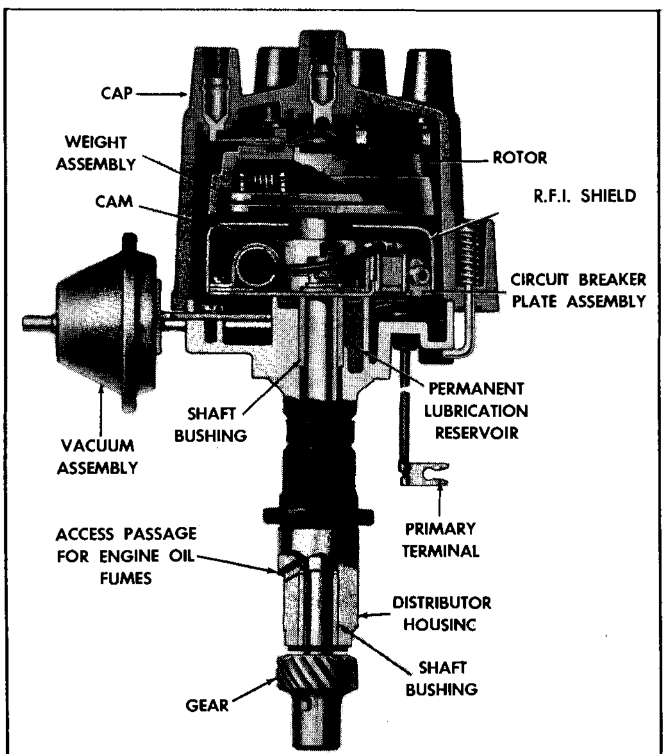


Fig. 6E-44 Cross Section of V-8 Distributor - Std.

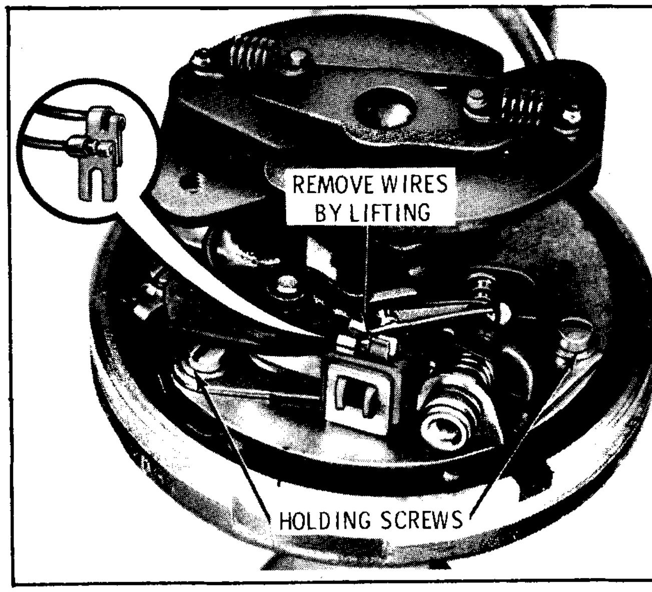


Fig. 6E-45 Condenser Point Assembly - V-8

Only point opening (dwell angle) requires adjustment after replacement.

For complete description of advance unit and it's operation, see Section 6D.

The centrifugal advance mechanism consists of a centrifugal advance cam actuated by two centrifugal weights controlled by springs. As the speed of the distributor shaft increases with engine speed, weights are thrown outward against pull of springs. This advances the breaker cam causing contact points to open earlier and thus advancing spark.

IGNITION TIMING

Correct timing of the spark, with relation to engine piston position, is made in the shop by use of a power timing light and timing marks on the front covers and harmonic balancer (Fig. 6E-49, 6E-54 and 6E-55).

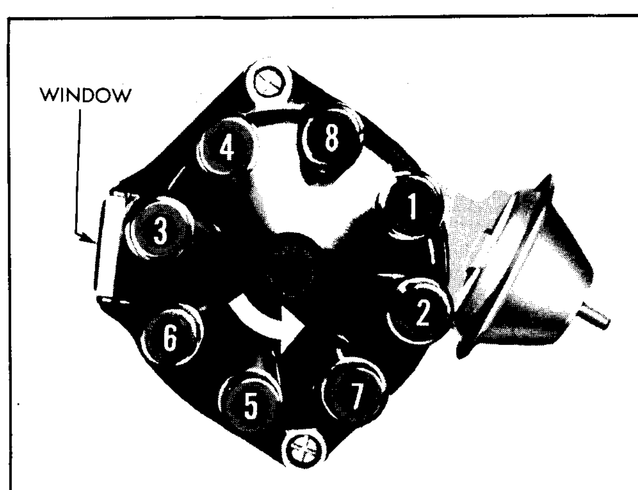


Fig. 6E-46 Position of Secondary Wires - V-8

At time spark is adjusted, the general appearance of breaker points should be observed. If smudge line appears on point support and breaker plate just beneath points, burned points (from oil or crankcase vapor between points) are very probable. Points which have gone several thousand miles will have a rough surface, but this does not mean that points are worn out. The roughness between points matches so that a large contact area is maintained and points will continue to provide satisfactory service. If dirt or scale is present, points should be cleaned with a few strokes of a clean, fine-cut, contact file. Do not attempt to remove all roughness or dress point surfaces down smooth. Never use emery cloth or sandpaper to clean points. If points are burned or badly pitted, they should be replaced and cause of this condition found and corrected. If this is not done new points will also burn and pit in a short time.

IGNITION COIL AND RESISTOR

The 6 and 8-cylinder 12 volt coil (Fig. 6E-47) is an oil filled, hermetically sealed unit designed specifically for use with an external resistance. The number of turns in the primary winding results in a higher inductance in this winding, which makes it possible for the coil to provide a higher secondary voltage output throughout the speed range.

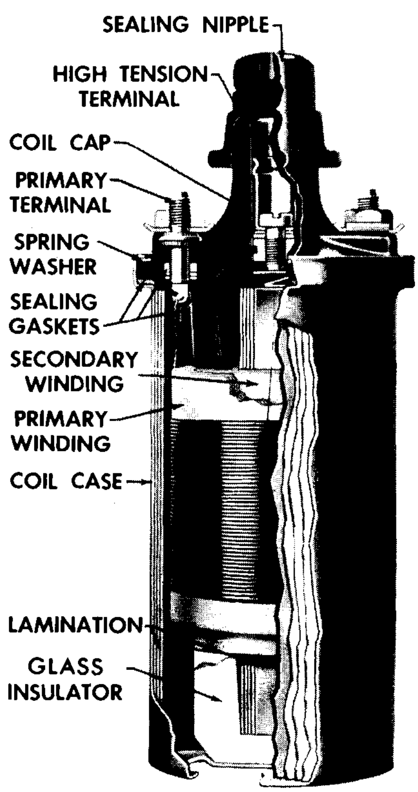


Fig. 6E-47 Ignition Coil - 6 & 8 Cyl.

The primary current from the ignition switch passes through a resistance wire which lowers the voltage to 7 or 8 volts. This lower voltage provides for longer ignition contact life.

For optimum starting performance, the resistance is bypassed during cranking, thereby connecting the ignition coil directly to the battery. This provides full battery voltage available at the coil and thus keeps ignition voltage as high as possible during cranking. The resistance is bypassed automatically through the ignition and starting switch when switch is in the START position.

SECONDARY IGNITION CABLES

All ignition cables in the secondary or high-tension system (coil to distributor and distributor to plugs) are neoprene jacketed. This cable is resistant to action of oil, grease, battery acid and road salt, and offers resistance to Corona breakdown. Ignition cables have a multiple cloth thread core impregnated with a graphite solution to give the correct conductivity. These cables give proper resistance for suppression of radio and television interference.

SPARK PLUGS

DESCRIPTION

R45TS, R46TS resistor type, tapered seat plugs with long reach are used in V-8 engines (except 307). The R44T and R46T are used in the 307 and 250 L-6 engines respectively. All plugs have tapered seats.

See Engine Electrical Specifications for normal usages.

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-and-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.

> **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 a 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 AC 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 AC 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.

INSPECT

Use of leaded fuels results in lead deposits on spark plugs and can cause misfiring at mileages less than 12,000 miles. Spark plugs must be replaced at 6,000 miles when operating with leaded fuels. Where misfiring occurs prior to 6,000 miles, spark plugs in good condition can often be cleaned, tested and reinstalled in an engine with acceptable results.

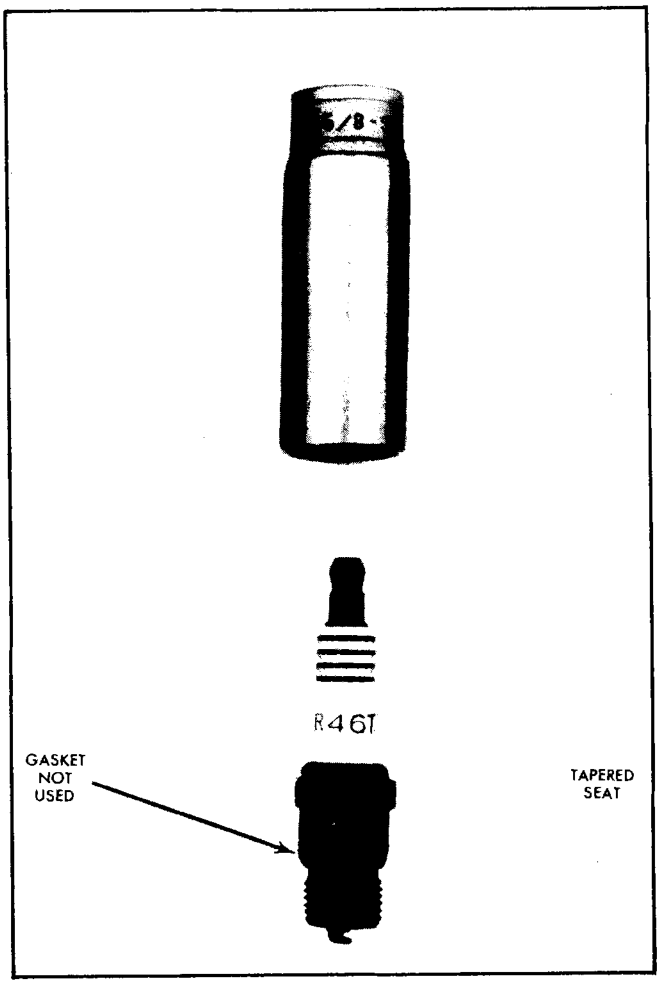


Fig. 6E-48 Spark Plug

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, such as: 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 or lead fouled plugs, excessive gap or broken insulator.

Fouled plugs may be indicated by checking for black carbon deposits, or red, brown, yellow or blistered oxide deposits on the plugs. 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. Red, brown, etc., oxide deposits, a consequence of the use of leaded fuel, usually result in spark plug failure under severe operating conditions. The oxides have no adverse effect on plug operation as long as they remain in a powdery state. But, under high speed or hard pull, the powder oxide deposits melt and form a heavy glaze coating on the insulator which, when hot, acts as a good electrical conductor, allowing current to follow the deposits and short out the plug.

Excessive gap wear, on plugs of low mileage, usually indicates the engine is operating at high speeds or loads that 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, cuased by combusiton gases leaking past the threads and gasket, due to insufficient compression of the spark plug gasket (V-8 only), dirt under the gasket seat, or use of old gaskets. 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.

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.

SERVICE PROCEDURES

DISTRIBUTOR - 6 CYLINDER ENGINE

CHECKS AND ADJUSTMENTS ON VEHICLE

REPLACING CONTACT SET

The contact set is replaced as a complete assembly. To remove contact set, merely lift condenser lead clip and primary lead clip from between breaker lever spring and insulator, and then remove the contact set attaching screw (Fig. 6E-42). The service replacement contact set has breaker lever spring and point alignment preadjusted at factory. Only point opening requires adjusting after replacement.

NOTE: *Always rotate sponge lubricator a few degrees to provide cam with new contact face. Apply a trace of petrolatum to the cam. Do not lubricate sponge - always replace, if necessary.*

ADJUSTING POINT OPENING

Loosen distributor clamp bolt and turn distributor until point set fiber block is on high point of cam. Measure point opening with feeler gauge. To change setting, loosen contact set attaching screw (Fig. 6E-42), insert screwdriver in adjusting screw slot, and pry to adjust to .016" with used points and .019" with new. Retighten screw securely after setting is made. Reset timing and tighten distributor clamp bolt.

CHECKS AND ADJUSTMENTS OFF VEHICLE

REMOVE

1. Disconnect distributor-to-coil primary wire.
2. Remove distributor cap.
3. Crank engine so rotor is in position to fire No. 1 cylinder and timing mark on harmonic balancer is indexed with 0° mark on the timing chain cover (Fig. 6E-49).
4. Remove vacuum hose from distributor.
5. Remove distributor clamping nut and hold-down clamp from stud.
6. Remove distributor.

   It will be noted that rotor will rotate as distributor is pulled out of block. Note relationship of rotor and distributor housing after removal so that rotor can be set in the same position when distributor is being installed.

Fig. 6E-49 Timing Marks on 6 Cylinder Engine

NOTE: *It is NOT necessary to remove compressor mounting bracket in engines equipped with air conditioning.*

CAUTION: *Always set distributor in upright position so oil from distributor shaft will not run out onto breaker plate and points.*

The distributor may be placed in a distributor testing machine or synchroscope to check for variation of spark and centrifugal and vacuum advance.

IMPORTANT: *When checking dwell angle, the vacuum advance must be in full retard or no vacuum advance position, since the dwell angle may vary with vacuum advance on these types of distributors.*

The procedure for replacing contact set, and adjusting point opening is covered under CHECKS AND ADJUSTMENTS OF DISTRIBUTOR ON VEHICLE.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLE (Fig. 6E-50)

1. Remove rotor.
2. Disconnect primary and condenser leads from between plastic retainer and breaker set spring. Remove breaker points adjusting hold-down screw and remove breaker points assembly.
3. Remove primary lead and retainer.
4. Remove condenser and bracket.

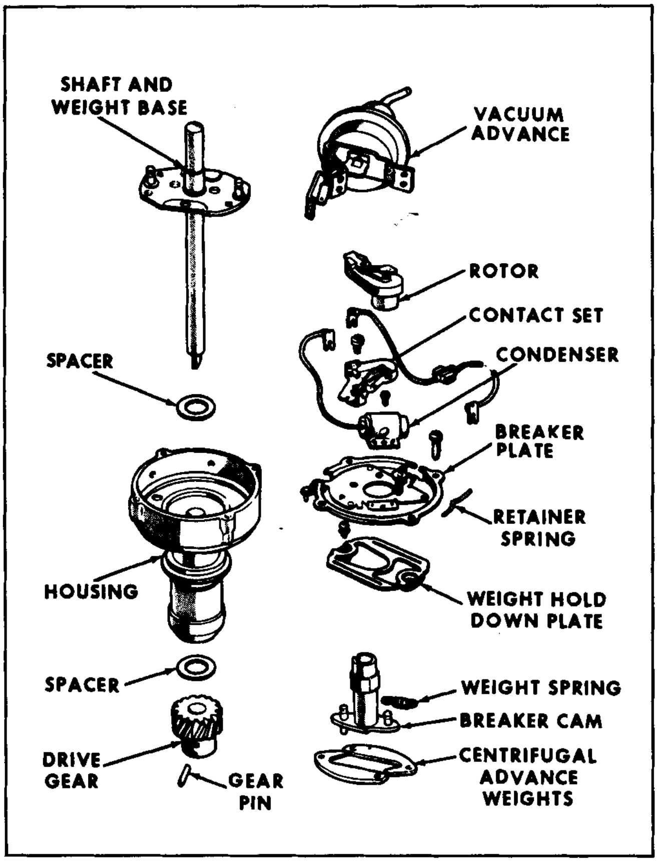


Fig. 6E-50 Exploded View of 6 Cyl. Distributor

5. Remove screws from vacuum advance diaphragm bracket. With slight downward pressure to disengage lever, remove vacuum advance assembly.
6. Remove screws securing breaker plate and remove breaker plate.
7. Remove roll pin from driven gear and remove driven gear and washer.

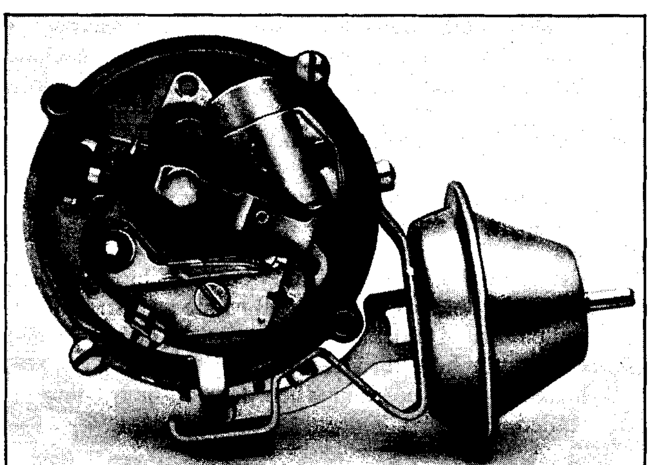


Fig. 6E-51 Rotor in No. 1 Firing Position - 6 Cylinder

8. Pull shaft and weight base assembly and washer out of distributor housing and remove screws and washers securing centrifugal advance upper plate.
9. Remove weight control springs, weights from base plate and pull breaker cam assembly from main shaft.

ASSEMBLE

Assembly of the distributor is the reverse of the disassembly procedure outlined above. Coat upper end of shaft with grease before installing breaker cam. When installing the gear on shaft, use a new roll pin. The pin must be tight in hole to prevent any movement between gear and shaft.

INSTALL

1. Check to see that engine is at firing position for No. 1 cylinder (No. 1 piston at top of compression stroke) and timing mark on harmonic balancer is indexed with the 0° mark on the timing chain cover (Fig. 6E-49).
2. Position new distributor to block gasket on block.
3. Before installing distributor, index rotor with housing as noted when distributor was removed, Fig. 6E-44. This will simplify indexing the distributor shaft and gear with oil pump drive shaft and distributor drive gear. Distributor and rotor will be positioned properly when installed with No. 1 piston in firing position.
4. Replace distributor clamp leaving nut loose enough to allow distributor to be turned for timing adjustment.
5. Attach distributor to coil primary wire.
6. Adjust points as described under ADJUSTING POINT OPENING.
7. Replace distributor cap.
8. Adjust timing and then tighten distributor clamp nut.
9. Attach vacuum hose to distributor.

DISTRIBUTOR - 8 CYLINDER ENGINE

PERIODIC SERVICE

A permanent lubricant reservoir is built into the distributor housing to lubricate upper end of shaft. No periodic lubrication is required.

When replacing contact set assembly, apply a trace of petrolatum to breaker cam. No other lubrication is required. The movable breaker plate is lubricated by lubricant from the upper shaft bushing. The lubricator wick (used on models equipped with 60p.s.i. oil pump) is not to be re-oiled. Recommended replacement of wick is 12 months, or 12,000 miles.

This distributor also requires periodic inspection of cap and rotor, wiring, and point condition, and a check for correct spark timing. This should be done at each tune-up and at least every spring and fall.

ADJUSTMENT

1. With engine operating, raise window provided in cap.
2. Insert hex type wrench into head of adjusting screw as shown in Fig. 6E-52.
3. Turn screw to adjust point opening by one of the following methods:

   Preferred Method

   Turn adjusting screw until 30° dwell is obtained as measured by dwell meter. (When using dwell meter, be sure to test distributor resistance and "zero" meter before testing dwell angle).

   Alternate Method

   Turn adjusting screw (clockwise) until engine begins to misfire. Then turn screw one-half turn in opposite direction (counterclockwise). This will give proper dwell angle.

REMOVE

1. Disconnect distributor-to-coil primary wire.
2. Remove distributor cap.

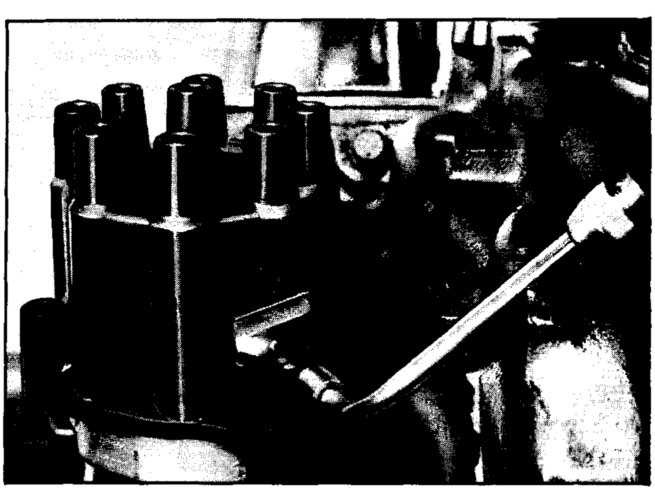


Fig. 6E-52 Adjusting Dwell Angle

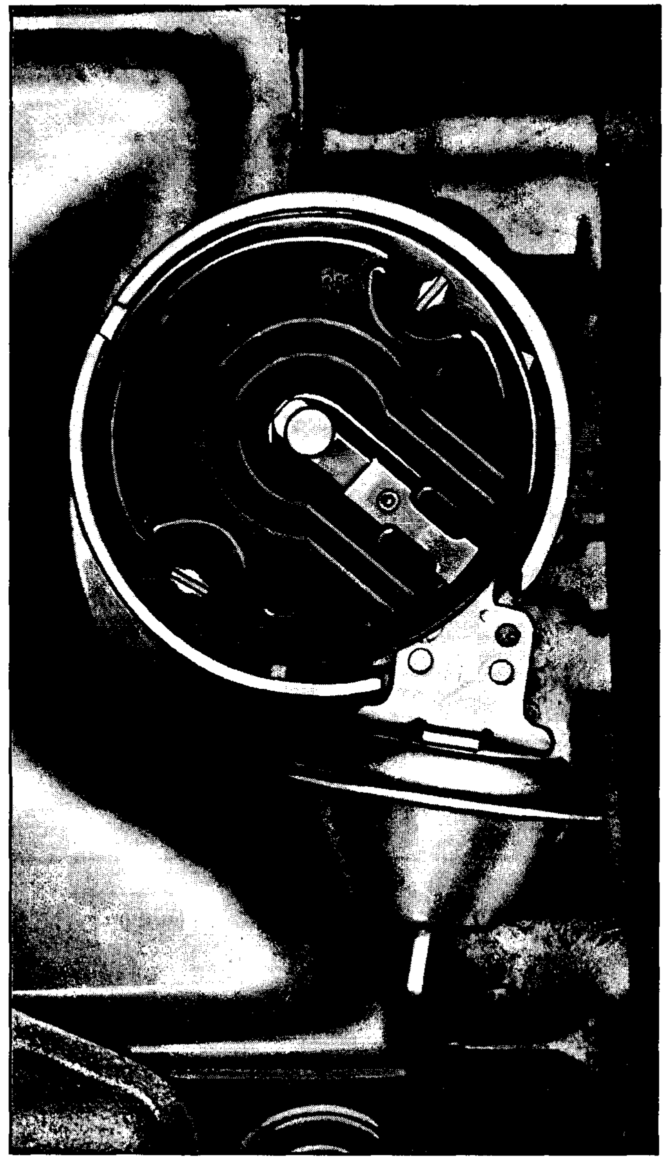


Fig. 6E-53 Rotor in No. 1 Firing Position - V-8

3. Crank engine so rotor is in position to fire No. 1 cylinder and timing mark on harmonic balancer is indexed with the proper mark on the timing chain cover, Fig. 6E-53, 6E-54 and 6E-55.
4. Remove vacuum hose from distributor.
5. Remove distributor clamping screw and hold-down clamp.
6. Remove distributor and distributor to block gasket. It will be noted that rotor will rotate as distributor is pulled out of block. Note relationship of rotor and distributor housing after removal, so that rotor can be set in same position when distributor is being installed.

NOTE: *Always set distributor in upright position so oil from distributor shaft will not run out onto breaker plate and points.*

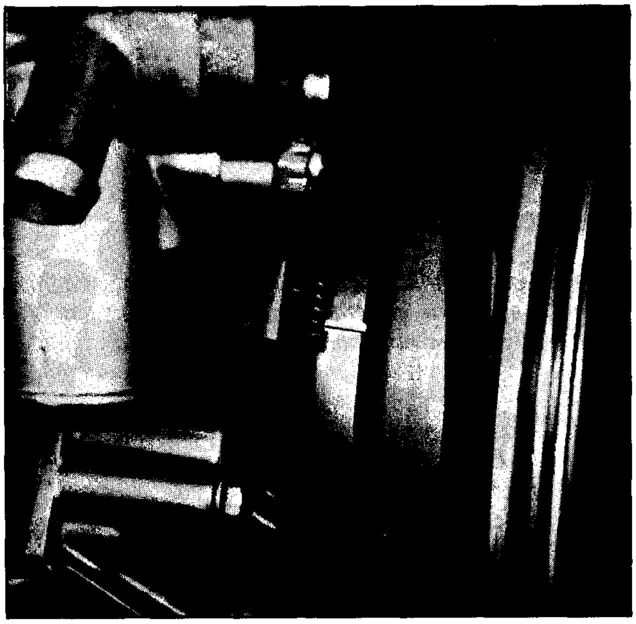


Fig. 6E-54 Timing Marks on V-8 Engine

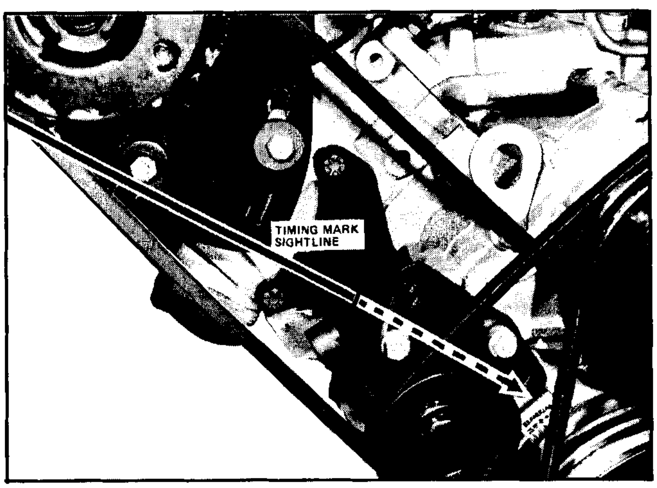


Fig. 6E-55 Sighting Timing Marks on "F" Cars With A/C

INSPECT

With distributor removed from vehicle it is advisable to place distributor in a distributor testing machine or synchroscope. When mounting distributor in tester, first secure gear in drive mechanism, then push distributor housing down toward gear to take up end play between gear and housing, and finally secure housing in tester. Test distributor for variation of spark, correct centrifugal and vacuum advance, and condition of contacts. This test will give valuable information on distributor condition and indicate parts replacement which may be necessary.

REPLACE CONTACT SET

The contact point set and condenser are replaced as one complete assembly. The breaker lever spring tension and point alignment of service contact set have been preadjusted at factory. Only point opening requires adjusting after replacement.

Distributors are designed to use ONLY snap-lock (push-in) contact sets which provide clearance between the lead clips and the new R.F.I. shield. For replacement, snap-lock type contact sets MUST be used to maintain this clearance.

Screw-type contact sets will not provide the necessary clearance to avoid the possibility of the lead clips or the screw touching either the shield or the insulating tape. Touching the shield grounds the primary circuit preventing the engine from starting. Due to vibration of parts, lead clips or screws may intermittently touch the shield or wear through the tape causing erratic vehicle operation and possible total loss of ignition.

Replace contact set as follows:

1. Remove rotor.
2. Remove R.F.I. shield (Fig. 6E-56A).
3. Remove two attaching screws which hold base of contact set assembly in place.

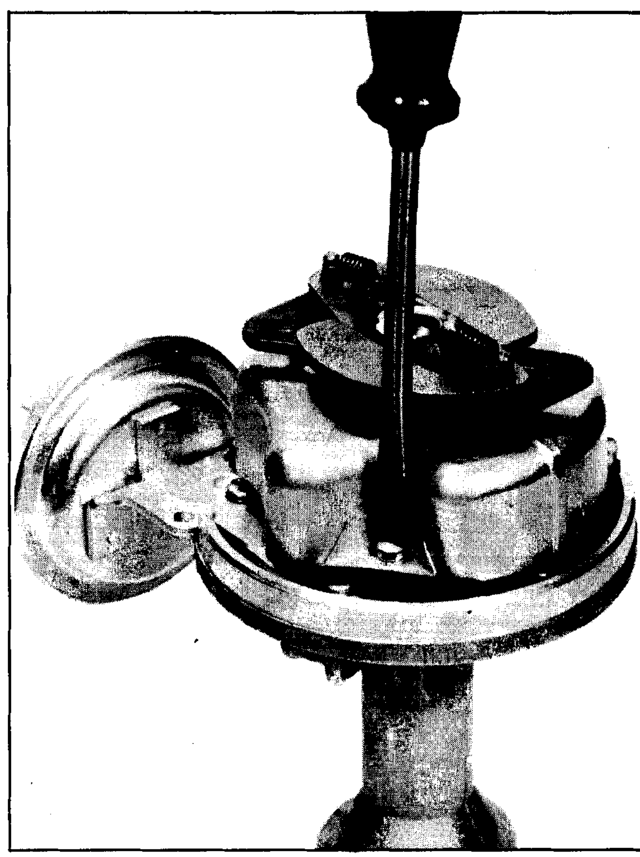


Fig. 6E-56A Removing R.F.I. Shield

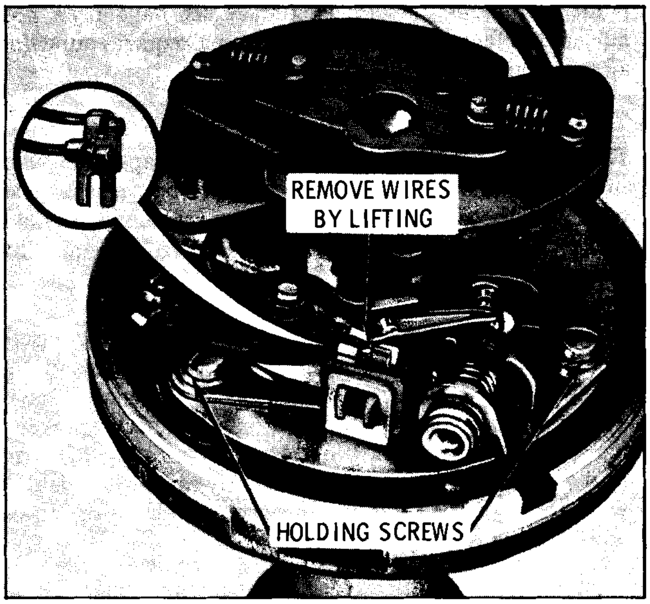


Fig. 6E-56B Arrangement of Lead Terminals

4. Remove condenser lead and primary lead fron nylon insulated connection (Fig. 6E-56B) in contact set.

5. Install new contact set. Tighten two attaching screws.

6. Insert lead clips as in Fig. 6E-56B and push all the way down to prevent them from touching the insulating tape inside the R.F.I. shield.

7. Apply a trace of petrolatum to breaker cam.

NOTE: *Close attention must be given to the following when replacing the shield:*

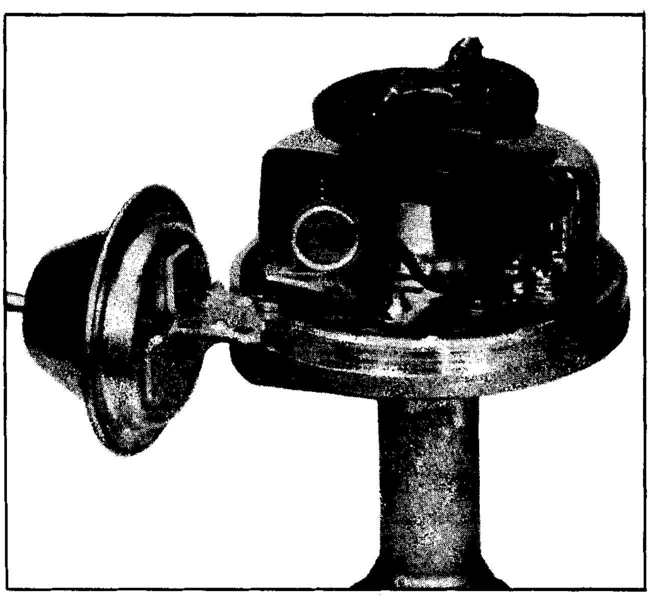


Fig. 6E-56C Correct Lead Routing

a. *First, place the half of the shield that covers the contact points into position on circuit breaker plate. Insert screw and tighten securely. Be sure shield is tight against breaker plate and two register identations are resting on top of the plate.*

DO NOT CROSS-THREAD SCREW.

b. *Look to make sure lead clips are pushed all the way down into the "snap-lock" point set. The clips must not touch the R.F.I. shield.*

c. *Arrange primary and condenser leads, as shown in Fig. 6E-56B, to clear the second half of the R.F.I. shield when it is installed.*

d. *Install the second half of the R.F.I. shield, making sure the mating flange rests on the outside of the first half (Fig. 6E-56D). Insert screw and tighten securely.*

SCREW MUST NOT BE CROSS-THREADED

The R.F.I. shield must never be omitted from the distributor. Radio interference and owner annoyance will result if the shield is removed.

8. Replace rotor and cap.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLE (Fig. 6E-57)

1. Remove rotor by removing two attaching screws, lockwashers, and flatwashers.

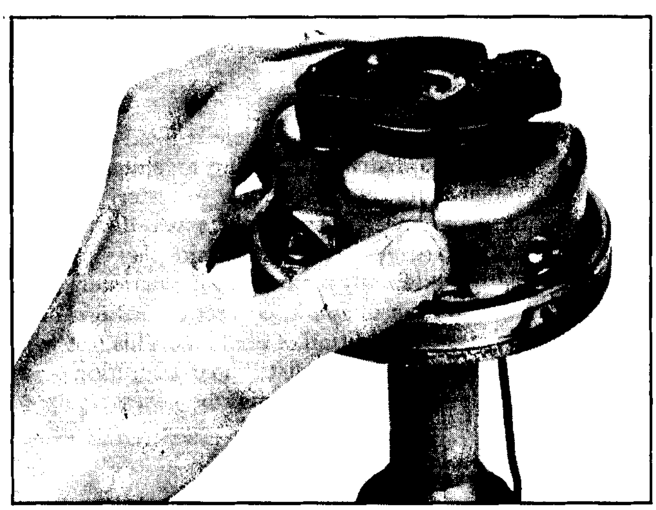


Fig. 6E-56D Installing R.F.I. Shield

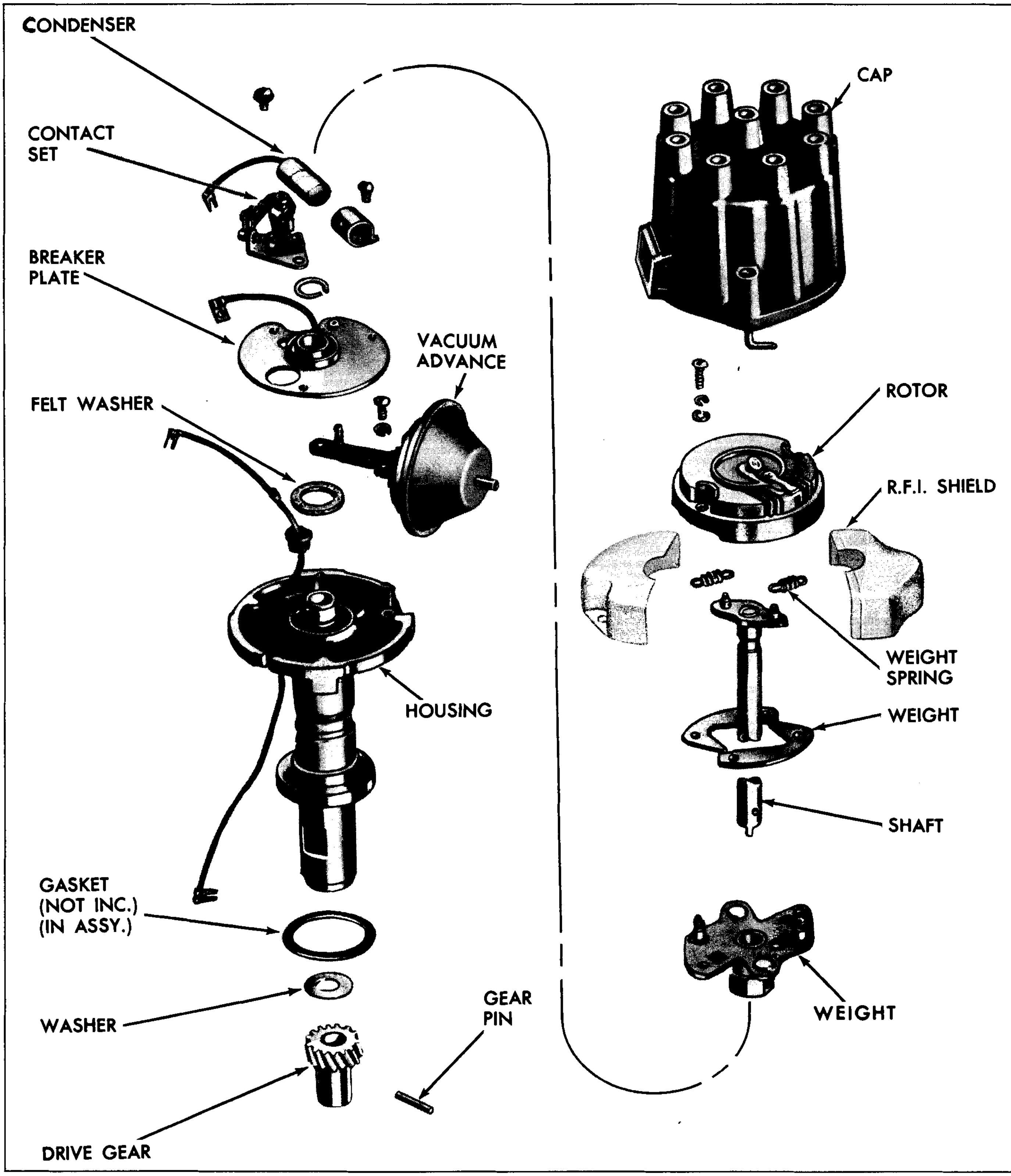


Fig. 6E-57 Exploded View of V-8 Distributor

NOTE: *It will be observed that rotor is doweled to weight base so that it can be installed in only one position.*

2. Remove both weight springs and both advance weights.
3. Remove R.F.I. shield.
4. Remove retaining pin from gear by driving it out of gear with a drift and hammer.

CAUTION: *Distributor should be supported in such a way that distributor shaft will not be damaged when driving pin out.*

5. Slide gear and washer off shaft.
6. Pull shaft and cam-weight base assembly from the housing.
7. Remove contact set assembly.
8. Remove condenser hold-down screw, condenser and bracket from the breaker plate.
9. Remove spring retainer and raise plate from housing.
10. Remove two attaching screws and lock washers and plate ground lead, and remove vacuum advance unit.
11. Remove felt washer from around bushing in housing.

ASSEMBLE

Assembly of the distributor is reverse of disassembly procedure outlined above. When installing gear on shaft, use a new retaining pin. The pin must be tight in hole to prevent any movement between gear and shaft.

Note that rotor can be installed in only one position. It will be broken if an attempt is made to install it backwards.

NOTE: *All engines with 60 p.s.i. oil pump incorporate distributors with phosphate coated, hardened drive gears. Whenever one of these distributors or gears is replaced, an identical replacement part must be used.*

INSTALL

1. Check to see that engine is at firing position for No. 1 cylinder (No. 1 piston at top of compression stroke) and timing mark on harmonic balancer is indexed with the proper mark on the timing chain cover (Fig. 6E-54).
2. Position new distributor to block gasket on block.
3. Install distributor in block so that vacuum diaphragm faces left side of engine and rotor points toward contact in cap for No. 1 cylinder. Before installing distributor, index rotor with housing as noted when distributor was removed. This will simplify indexing distributor shaft and gear with oil pump drive shaft and drive gear on camshaft. Distributor and rotor will be positioned as shown in Fig. 6E-53 when properly installed with No. 1 piston in firing position.
4. Replace distributor hold-down clamp, leaving screw loose enough to allow distributor to be turned for timing adjustment.
5. Attach distributor to coil primary wire.
6. Replace distributor cap.
7. Adjust dwell and timing and then tighten distributor clamp screw.
8. Attach vacuum hose to distributor.

If engine was cranked with distributor removed and/or position of rotor was not noted during removal of distributor, it may be installed by the following method.

1. Remove No. 1 spark plug (forward plug of left bank on V-8).
2. Place finger in spark plug hole and turn engine over manually until timing mark is at index (see Fig. 6E-54).

NOTE: *As engine approaches timing mark, a pressure should be felt with the finger in the spark plug hole. If no pressure is felt, it will be necessary to turn the engine one complete revolution and again index with timing marks.*

3. Install distributor in position as shown in Fig. 6E-53. It will be necessary to rotate rotor slightly to the right when attempting installation so that final position will be correct.

NOTE: *If distributor does not drop into position fully, hold down on housing and rotate engine until distributor drops into position.*

IGNITION TIMING

Timing marks are located on the front engine cover and harmonic balancer (Figs. 6E-49, 6E-54 and 6E-55).

It is mandatory to disconnect distributor vacuum advance hose before setting ignition timing.

At time spark is adjusted, the general appearance of breaker points should be observed. If smudge line appears on point support and breaker plate just beneath points, burned points (from oil or crankcase vapor between points) are very probable. Points which have gone several thousand miles will have a rough surface, but this does not mean points are worn out. The roughness between points matches so that a large contact area is maintained and points will continue to provide satisfactory service. If dirt or scale is present, points should be cleaned with a few strokes of a clean, fine-cut, contact file. Do not attempt to remove all roughness or dress point surfaces down smooth. Never use emery cloth or sandpaper to clean points. If points are burned or badly pitted, they should be replaced and cause of this condition found and corrected. If this is not done, new points will also burn and pit in a short time.

Adjust ignition timing as follows:

1. Adjust breaker point gap.
2. Connect power timing light.
3. Loosen distributor clamp screw and rotate distributor until power timing light shows that the proper mark on the cover lines up with the mark on the harmonic balancer. Tighten distributor clamp screw. The timing specifications for various engines are listed below:

6 Cyl. - All	4° B.T.D.C.
307 V-8 - Manual Transmission	4° B.T.D.C.
307 V-8 - Automatic Transmission	8° B.T.D.C.
350, 400 and 455 - Manual Trans.	8° B.T.D.C.
350, 400 and 455 - Automatic Trans.	10° B.T.D.C.

SPARK PLUGS

PERIODIC SERVICE

Periodically (actual time depending on operating conditions), plugs should be removed for cleaning, inspection and regapping.

REMOVE

1. Remove spark plug wires.
2. Remove any foreign matter from around spark plugs by blowing out with compressed air.
3. Using a 5/8" spark plug socket remove the spark plugs.

INSPECT

Spark plug life is governed to a large extent by operating conditions, and plug life varies accordingly. To insure peak performance, spark plugs should be checked, cleaned, regapped or replaced every 12 months or 12,000 miles.

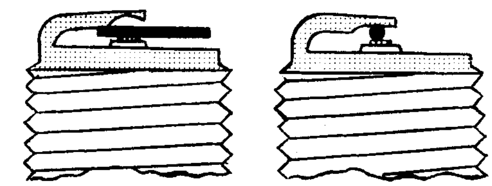


Fig. 6E-58 Measuring Spark Plug Gap

CLEAN AND REGAP

Clean spark plugs thoroughly using an abrasive-type cleaner. All spark plugs must be of the same make and number or heat range. Use a round feeler gauge to adjust the spark plug gaps to .035" (Fig. 6E-58).

> **CAUTION:** *Before adjusting gap, file center electrode flat. In adjusting spark plug gap, never bend center electrode which extends through porcelain center. Always make adjustments by bending ground (side) electrode.*

INSTALL

1. Inspect spark plug hole threads and clean before installing plugs. Corrosion deposits can be removed with a 14 mm. x 1.25 SAE spark plug tap (available through local jobbers) or by using a small, soft wire brush in an electric drill. If a tap is used, coat it with plenty of grease to catch any chips.

   CAUTION: *Use extreme care when using tap to prevent cross threading. Also, crank engine several times to blow out any material dislodged during cleaning operation.*

2. Install spark plugs in engine, and tighten to 15 lb. ft.

UNIT DISTRIBUTOR

The main features of the Unit Ignition System are shown in Figures 6E-60 and 6E-61. A basic wiring diagram is shown in Figure 6E-62.

A magnetic pickup assembly located over the shaft contains a permanent magnet, a pole piece with internal teeth, and a pickup 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 pickup coil signals the all-electronic module to open the ignition 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 high voltage leads to fire the spark plugs.

TROUBLESHOOTING PROCEDURES

(CAUTION: Do not operate system with exposed sparks from disconnected spark plug leads that might cause electrical shock, fire, or explosion).

Insure that black and pink leads are connected as shown in Fig. 1. Tighten both bolts, Fig. 1. Loose bolts may cause poor performance and radio interference.

ON THE VEHICLE

ENGINE WILL NOT RUN AT ALL.

1. Check ignition switch connector, Fig. 1.
2. Connect voltmeter from ignition switch connector to ground.
3. Turn on ignition switch.
4. If reading is zero, circuit is open between connector and ignition switch. Repair if needed.
5. If reading is Energizer voltage, hold one spark lead with insulating pliers about 1/4" from dry area of engine block while cranking engine.

If sparking occurs, trouble most likely is not ignition. Check fuel system.

If no spark, follow procedure under "On the Test Bench", with Unit Ignition System initially either on or off the engine.

ENGINE WILL START BUT NOT RUN, AND ENGINE MISS OR SURGE.

1. Insure that fuel system is satisfactory.
2. Check spark plug leads for arc-over or leakage to ground.
3. Check spark plugs.

If no defects are found, follow procedure under "On the Test Bench" with Unit Ignition System initially either on or off the vehicle.

ON THE TEST BENCH

1. Disassemble unit (Fig. 2).
2. Inspect coil, eight inserts, shell and rotor for arc-over or leakage.

1. Connect ohmmeter, Fig. 4.
2. Parts A and B each should be practically zero. If infinite on either reading, replace coil.
3. Part C should be 6000-9000 ohms. If outside range, replace coil.
4. Part D should be infinite. If not, replace coil.

1. Connect test stand vacuum source to vacuum unit.
2. Connect ohmmeter Parts A and B, Fig. 5.
3. Observe ohmmeter throughout vacuum range.
4. If Part A reads less than 650 ohms, or more than 850 ohms at any time, replace pickup coil, per Step 7 below.
5. If Part B reads other than infinite at any time, replace pickup coil, per step 7 below.
6. If vacuum unit is inoperative, replace per Step 7 below.
7. Remove unit from engine, drive pin from gear, remove rotor and shaft assembly from housing, remove shim and then "C" washer to replace pickup coil or vacuum unit (Fig. 6).

1. If no defects have been found, remove two attaching screws and replace module.

Fig. 6E-59 Unit Distributor - Trouble Diagnosis

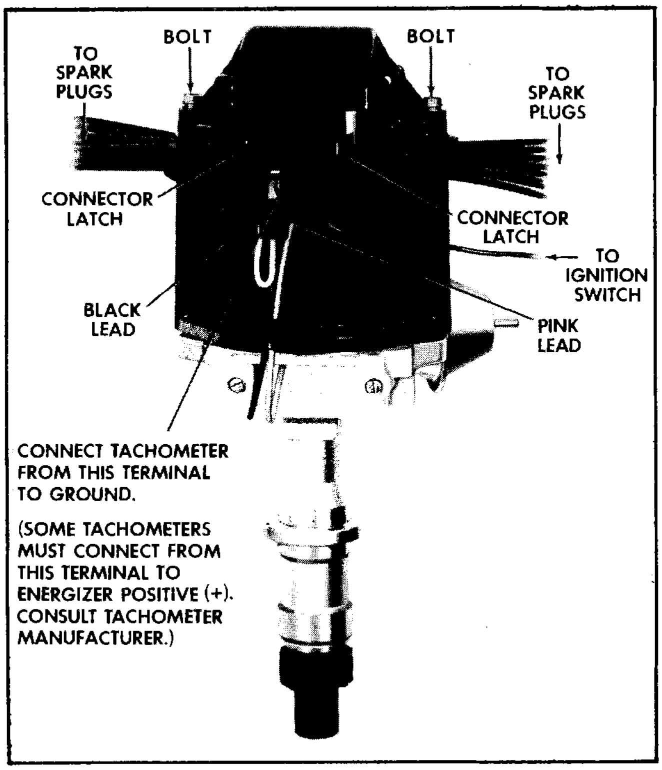


Fig. 6E-60 Unit Distributor - Typical

The magnetic pickup 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 centrifgual advance.

> **IMPORTANT:** *When making compression checks, disconnect ignition switch connector from Unit Ignition System.*

No periodic lubrication is required. Engine oil lubricates the lower bushing, and an oil-filled reservoir provides lubrication for the upper bushing.

IGNITION AND STARTING 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 9.

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.

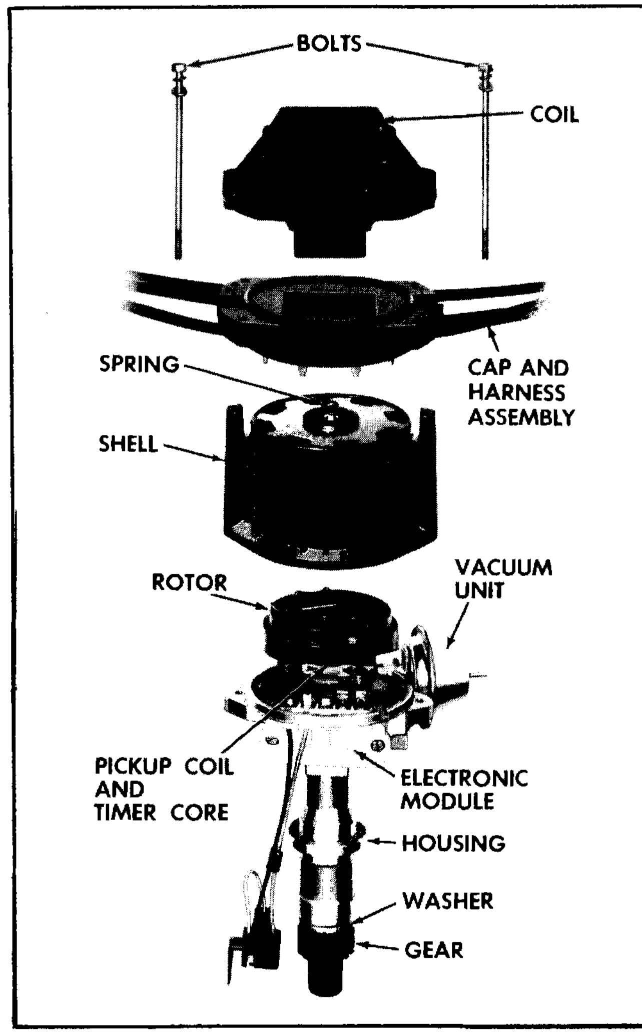


Fig. 6E-61 Unit Distributor - Exploded View

The ignition switch used on all cars has five positions: Two "OFF" positions; (one being the familiar "OFF" position found on previous model switches, and a new position known as the "OFF-LOCKED" position), "ACCESSORY", "RUN" and "START" "OFF" is the center po-

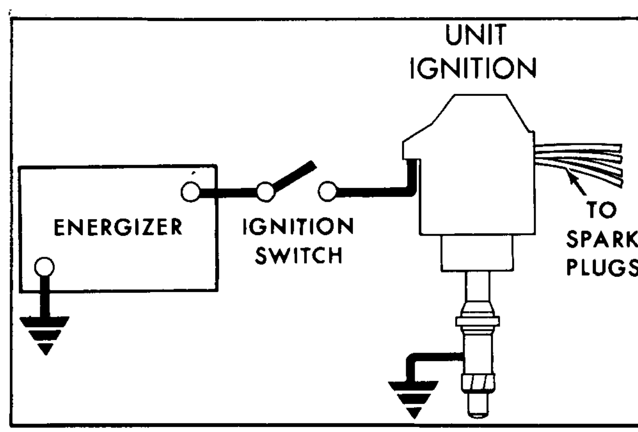


Fig. 6E-62 Unit Distributor - Basic Wiring Diagram

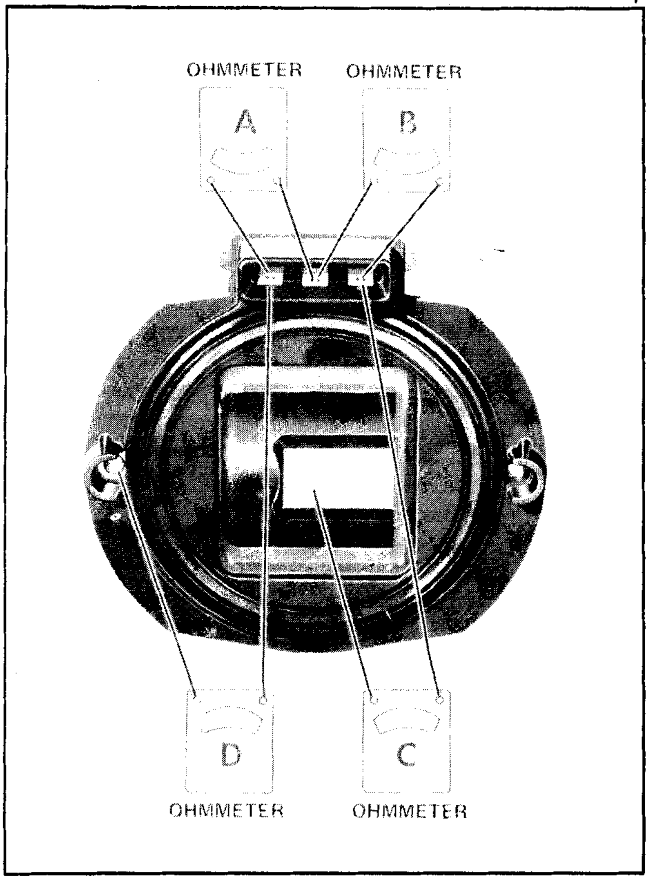


Fig. 6E-63 Unit Distributor - Coil Check

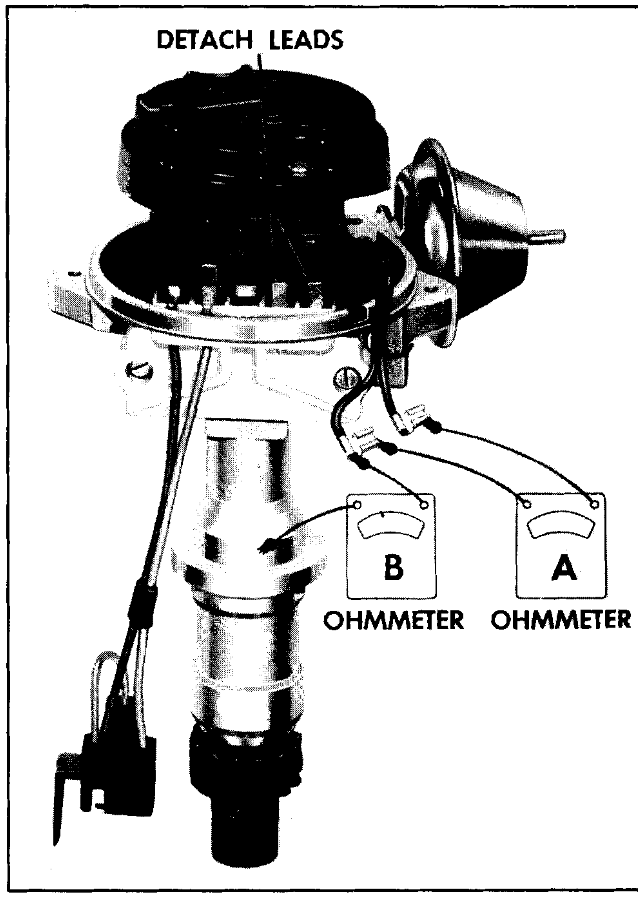


Fig. 6E-64 Unit Distributor - Pickup Coil Check

sition 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 switch will be in the "START" position.

With the switch in the "ACCESSORY" (A) position, the following electrical circuits are activated: stop lights, directional signals, parking brake warning light, radio, power windows and seats, back-up lights, and windshield wipers. In the "RUN" position, the ignition primary circuit is activated through the resistance wire and the air conditioning, heater and defroster circuits are activated.

There are six terminals on the back of the switch (Fig. 5E-66). The "BAT" terminals (B1, B2 and B3), which are connected to form one common terminal, are connected to the battery and supply power to the switch. The "ACCESSORY" terminal "A" supplies power to all of the accessories except air conditioning, heater and defroster when the switch is in the "ACCESSORY" position. The "SOLENOID" terminal "S" supplies power to the solenoid to activate the starter in the start position. This terminal also bypasses the resistance wire to the coil for improved starting. The "GROUND" terminal "G" completes the test circuit for the temperature "HOT" indicator bulb when the switch is turned to the start position.

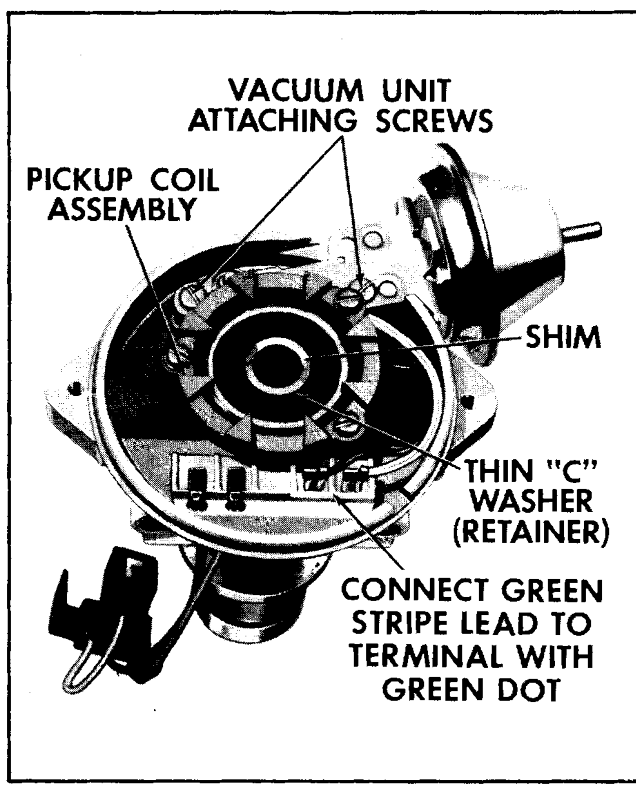


Fig. 6E-65 Unit Distributor - Unit With Shaft Assembly Removed

The "A" terminal is activated only when the ignition switch is in the "ACCESSORY" position, and the "S" and "G" terminals are activated only in the "START" position. All circuits are cut off in either the "OFF" or "OFF-LOCKED" positions.

When the ignition switch is turned to the "START" position, the ignition primary circuit is activated by the starter solenoid, which by-passes the resistance wire to the coil, and the starting motor circuit is activated to crank the engine.

Two IGNITION terminals, marked "I1" and "I3", will be found on the back of the switch. The "I1" and "I3" terminals are energized when the ignition switch is in the normal operating position ("RUN" position). The "I1" directs current to the ignition coil through the resistance wire. "I3" energizes the air conditioning, heater and defroster circuits.

When the ignition switch is in the "RUN" position, current can be traced from the battery through the battery terminals (B1, B2 and B3), through the voltage regulator to the field terminal of the generator, and finally through the rotor field coil windings to ground.

REPLACE SWITCH, LOCK CYLINDER OR FREE UP LOCK CYLINDER

Refer to GENERAL INFORMATION (Section 0), and for ignition switch and lock cylinder repair procedures.

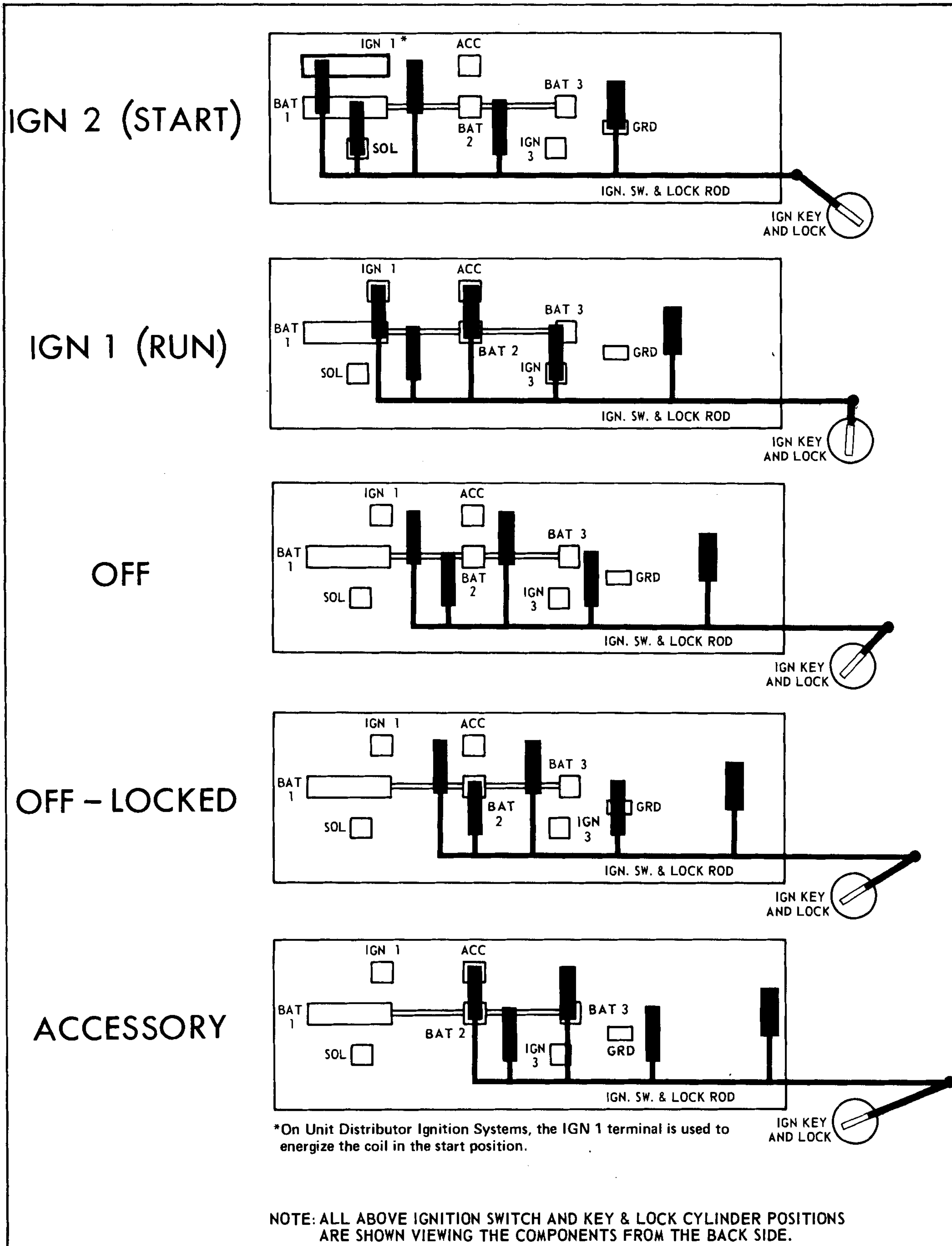


Fig. 6E-66 Ignition Switch

1972 ENGINE ELECTRICAL SPECIFICATIONS

	L-6 w/o Power Steering		250 L-6 With Power Steering		V-350			V-400			V-455			G Series Model SJ		
	STD.	A/C or H.O.	STD.	A/C	STD.	A/C or Rear Window Defog	A/C with Rear Window Defog or H.D.	STD.	A/C or Rear Window Defog	A/C with Rear Window Defog or H.D.	STD.	A/C or Rear Window Defog	A/C with Rear Window Defog or H.D.	STD.	A/C or Rear Window Defog	A/C with Rear Window Defog or H.D.
GENERATOR	1100927	1100928	1100927	1100928	1100927	1100928	1101015	1100927	1100928	1101015	1100927	1100928	1101015	1100927	1100928	1101015
Amps-Hot Rating	37	55	37	55	37	55	80	37	55	80	37	55	80	37	55	80
Output (Cold) @ Eng.	32	50	32	50	32	50	74	32	50	74	32	50	74	32	50	74
	@	@	@	@	@	@	@	@	@	@	@	@	@	@	@	@
R.P.M.	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Field Current Draw	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5	4-4.5
STARTER MOTOR	1108365				1108445			1108446			1108446[1]			1108446		
No. of shunt winds	0				0			0			0			0		
SOLENOID	1114362							1114364								
Hold-in winding amps @ 10V	14.5-16.5							14.5-16.5								
Both windings amps @ 10V	14.5-16.5 / 41-47							41-47								
IGNITION COIL	1115208							1115424								
Pri. Resistance	1.40-1.65 OHMS (75°)							1.77-2.01 OHMS (75°)								
Sec. Resistance	3000-2000 OHMS (75°)							3000-2000 OHMS(75°)								

[1] 455 HO (LS-5) Starter 1108436
No. of shunt winds 0
Solenoid 1114366
Hold in winds @ 10V 14-16.5
Pull in winds @ 10V 13-15.5

VENTURA II		
250 L-6	307 V-8	
W/O A/C	W/O A/C	WITH A/C
1100566 37 32 @ 5000	1102440 37 32 @ 5000	1102463 61 55 @ 5000
1119515 13.8-14.8 @ 85°F		
1108365 0	1108367 0	
1114362 14.5-16.5		
41-47		
1115208 See L-6 Above	1115424 1.77-2.01 OHMS (75°) 3000-2000 OHMS (75°)	

A SERIES	250 L-6		350 V-8			400 V-8		455 V-8		
	STD.	A/C OR H.D.	STD.	A/C	H.D.	STD. OR A/C	H.D.	STD. OR A/C	H.D.	MAINT. FREE
Battery	Y54	R58	Y58	R58	R58S	R58	R58S	R58S	R88X*	C89**
Watts @ 0°F.	2300	2900	2350	2900	3250	2900	3250	3250	3750	3750
Amp-Hrs.	45	61	53	61	62	61	62	62	62	80

B, G & F SERIES	250 L-6 F Series		350 V-8 F Series			400 V-8		455 V-8			455 V-8 (SJ) G Series Only
	STD.	H.D.	STD.	A/C	H.O.	STD. OR A/C	H.D.	STD. OR A/C	H.D.	MAINT. FREE	STD. OR A/C
Battery	Y54	R58	Y88*	R88*	R88S*	R88*	R88S*	R88S*	R88X*	C89**	C89**
Watts @ 0°F.	2300	2900	2350	2900	3250	2900	3250	3250	3750	3750	3750
Amp-Hrs.	45	61	53	61	62	61	62	62	62	80	80

X SERIES	250 L-6		307 V-8		350 V-8	
	STD.	H.D.	STD. OR A/C	H.D.	STD. OR A/C	H.D.
Battery	Y86*	R88W*	R88*	R88W*	Y58	R58S
Watts @ 0°F.	2300	3750	2900	3750	2350	3250
Amp-Hrs.	45	76	61	76	53	62

* Side Terminal Battery
** Side Terminal & Sealed Case

SPARK PLUG USAGE	Normal Driving	Trailer Provision or Extended High Speed Driving
6 Cyl. (All)	R46T	R46T
8 Cyl. 2 Bbl. (307)	R44T	R44T
8 Cyl. 2 Bbl. (350 & 400)	R46TS	R45TS
8 Cyl. 455 2 Bbl. & 4 Bbl. – All	R45TS	R45TS

Fig. 6E-67 Engine Electrical Specifications

MODEL	Rotation viewed from top	Dwell set to	Condenser capacity (MFD)	CENTRIFUGAL ADVANCE*						VACUUM CONTROL MODEL	In. Hg. to start advance	In. Hg. for full advance	Max. advance (Dist. Deg.)
				Start (Dist. Deg.)		Intermediate (Dist. Deg.)		Maximum (Dist. Deg.)					
				DEG.	RPM	DEG.	RPM	DEG.	RPM				
1110489	CW	32½°	.18–.23	0-2°	1300	7°	2300	12°	4100	1973434	7"–9"	15"-17"	11½°
1112005	CW	30°	.18–.23	0-2°	1200	6°	2200	12°	4300	1115357	7"–9"	16.5"–17.8"	10.3°
1112039	CW	30°	.18–.23	0-2°	1300			9–11°	4200	1973436	7"–9"	16.5"–18"	10½°
1112140	CCW	30°	.18–.23	0-1°	1600	4.5-6.5°	2000	10–12°	4600	1115364	6"–8"	13"–15"	10°
1112118	CCW	30°	.18–.23	0-1°	1600	2.5-4.5°	2000	8–10°	4600	1115364	6"–8"	13"–15"	10°
1112119	CCW	30°	.18–.23	0-1°	1600	3-5°	2000	11–13°	4600	1115365	8"-10"	15"–17"	10°
1112121	CCW	30°	.18–.23	0-1°	1400	4–6°	2400	11–13°	4600	1115364	6"–8"	13"–15"	10°
1112122	CCW	30°	.18–.23	0-1°	1600	–	–	11–13°	4600	1115365	8"–10"	15"–17"	10°
1112145	CCW	30°	.18–.23	0-1°	1400	3-5°	2000	9-11°	4600	1115365	8"–10"	15"–17"	10°
1112127	CCW	30°	.18–.23	0-1°	1400	3-5°	2000	9-11°	4600	1115365	8"–10"	15"–17"	10°
1112133	CCW	30°	.18–.23	0-1°	1150	4.5-6.5°	2000	13-15°	4600	1115364	6"–8"	13"–15"	10°

* Distributor Degrees shown @ ENGINE RPM

Fig. 6E-68 Distributor Specifications

SECTION 7

CLUTCH, MANUAL TRANSMISSIONS

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

THROW-OUT BEARING NOISE WITH CLUTCH FULLY ENGAGED

1. Clutch linkage improperly adjusted.
2. Throw-out bearing binding on transmission bearing retainer.
3. Insufficient tension between clutch fork spring and ball stud.
4. Fork improperly installed.
5. Weak linkage return spring.

NOISY

1. Worn throw-out bearing.
2. Fork came off ball stud (heavy clicking).

PEDAL STAYS ON FLOOR WHEN DISENGAGED

1. Bind in clutch linkage.
2. Springs weak in pressure plate.
3. Weak pedal return spring.

   NOTE: *Weak spring alone won't leave pedal on floor.*

HIGH PEDAL EFFORT

1. Bind in clutch linkage.
2. Driven plate worn.

FAILS TO RELEASE (WITH PEDAL PRESSED TO FLOOR-SHIFT LEVER WILL NOT MOVE FREELY IN AND OUT OF REVERSE GEAR)

1. Improper clutch linkage adjustment.
2. Improper pedal travel.
3. Loose clutch linkage.
4. Faulty pilot bearing.
5. Faulty driven plate.
6. Fork comes off ball stud.
7. Clutch driven plate hub binding on clutch (main drive) gear spline.

SLIPPING

1. Improper clutch adjustment (no lash).
2. Oil soaked driven plate.

3. Worn facing or facing torn from driven plate.

4. Warped pressure plate or flywheel.

5. Weak diaphragm spring.

6. Driven plate not seated in - make 20-40 normal starts.

7. Driven plate overheated - allow to cool and check lash.

GRABBING

1. Oil on facing or burned or glazed facings.

2. Worn splines on clutch (main drive) gear.

3. Loose engine mountings.

4. Warped pressure plate or flywheel.

5. Burned or smeared resin on flywheel or pressure plate.

RATTLING - TRANSMISSION CLICK

1. Clutch fork loose on ball stud or in bearing groove.

2. Oil in driven plate damper - replace driven plate.

3. Driven plate damper spring failure - replace driven plate.

GENERAL DESCRIPTION

A single plate, dry friction disc, diaphragm-spring type clutch is used on all cars with manual transmissions. The clutch assembly consists of the clutch driven plate, cover-pressure plate and clutch release mechanism.

The clutch driven plate has a spring damper hub to reduce the transmitting of torsional vibrations from the engine to the transmission.

Grooves on both sides of the clutch driven plate lining prevent sticking of the plate to the flywheel and the pressure plate due to vacuum between the members on disengaging.

The clutch cover and pressure plate of all clutch assemblies is of the diaphragm-spring type that not only provides the spring pressure required to hold the friction disc against the flywheel, but also acts as the release levers that take up the spring pressure when the clutch is disengaged.

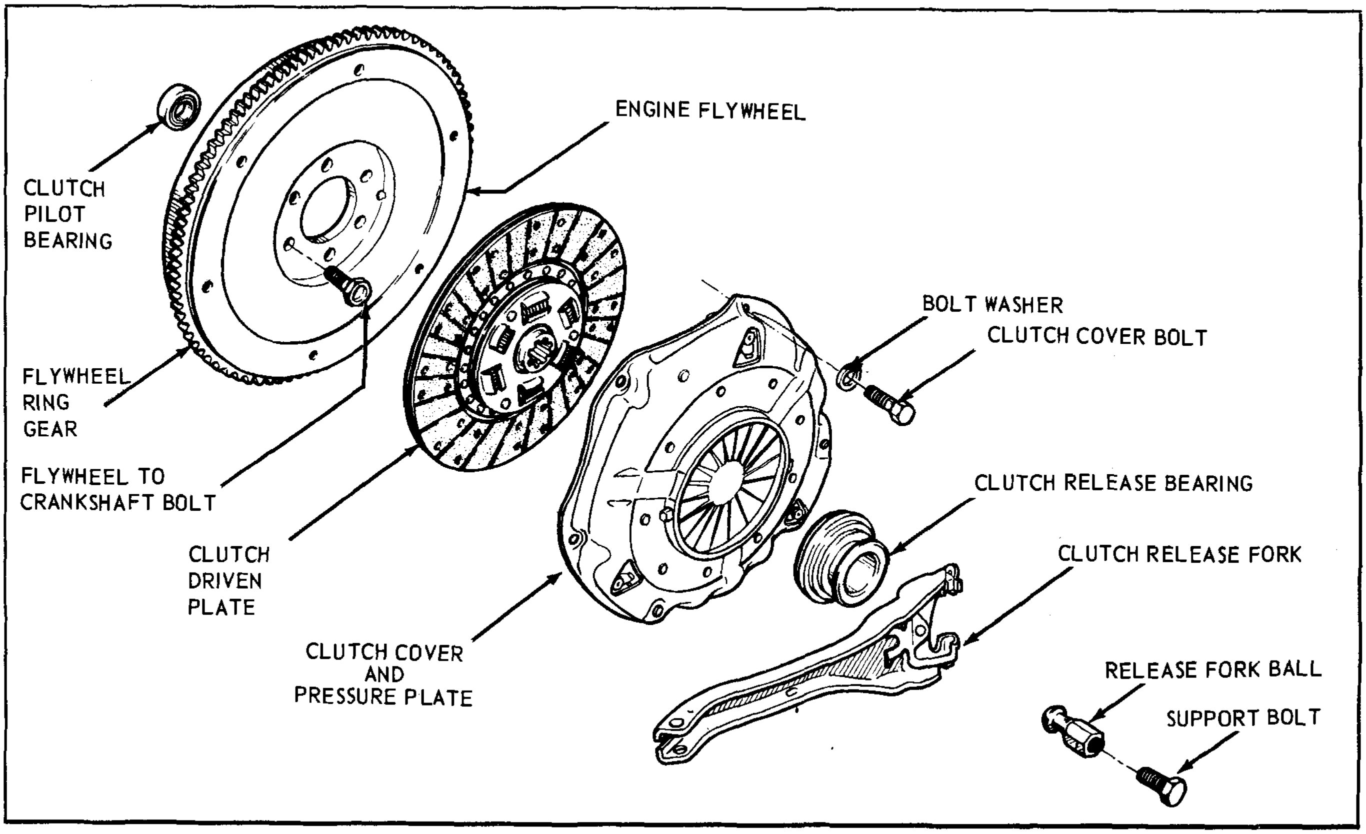


Fig. 7-1 Exploded View of Typical Clutch and Flywheel

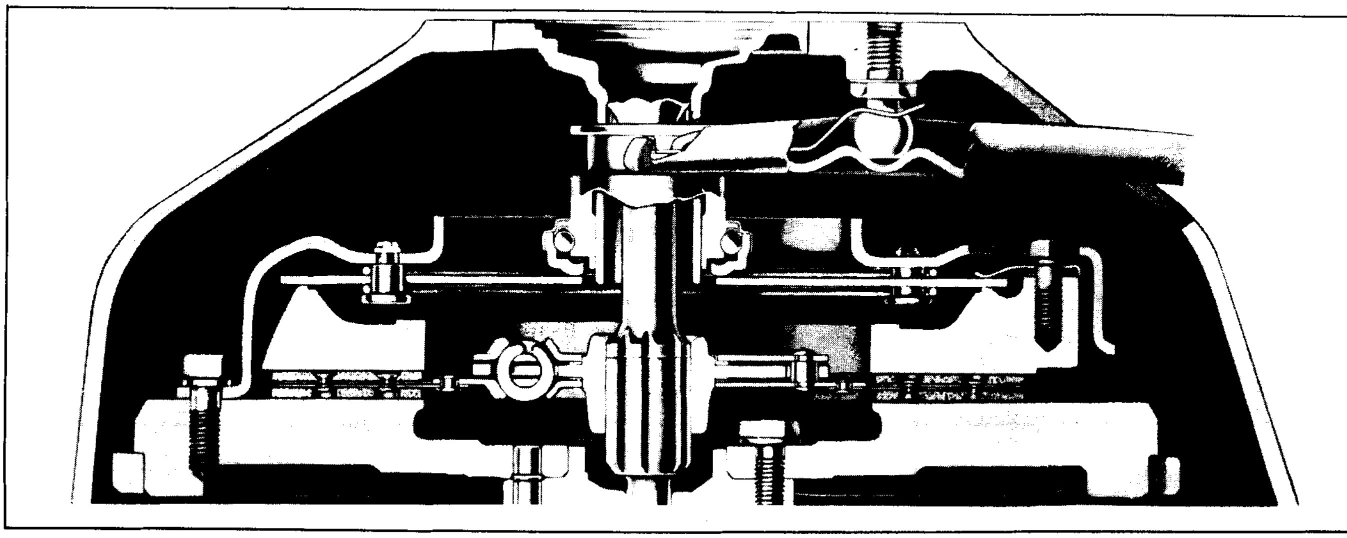


Fig. 7-2 Cross Section of Typical Flat-Finger Clutch

Two variations of this design are the flat-finger type (Fig. 7-2) and the bent-finger type (Fig. 7-3). These diaphragm spring clutches feature rate decreasing pedal effort, which eliminates the need of an over-center spring assist. Pressure plate spring pressure forces the driven plate against the flywheel, thereby coupling the engine to the transmission.

The clutch release mechanism consists of a ball thrust bearing, appropriate levers and linkage to manually control the action of the bearing. The ball thrust bearing (clutch release bearing) is piloted on a tubular support which is concentric with and enclosing the transmission main drive (clutch) gear. When pressure is applied to the clutch pedal to release the clutch, the clutch fork pivots on its ball socket. The inner end of the fork then pushes the release bearing forward so that it presses against the inner ends of the clutch release levers, releasing the clutch (Fig. 7-1). Pedal effort is transmitted by the pedal through the countershaft and lever assembly to the clutch fork.

Several clutches are being used, depending on the engine option. The clutches differ in diaphragm spring design, damper spring calibration and driven disc diameter. Clutch usages are shown in Fig. 7-4.

A clutch safety switch is standard on all models with manual transmission. Designed to prevent cranking "in gear", this switch will not permit the starter to operate unless the clutch pedal is depressed far enough to completely disengage the clutch.

While the steering column lock requires that manual transmission be in "Reverse" gear before removing the ignition key, the clutch safety switch prevents engine cranking "in gear" when the steering column is unlocked while starting.

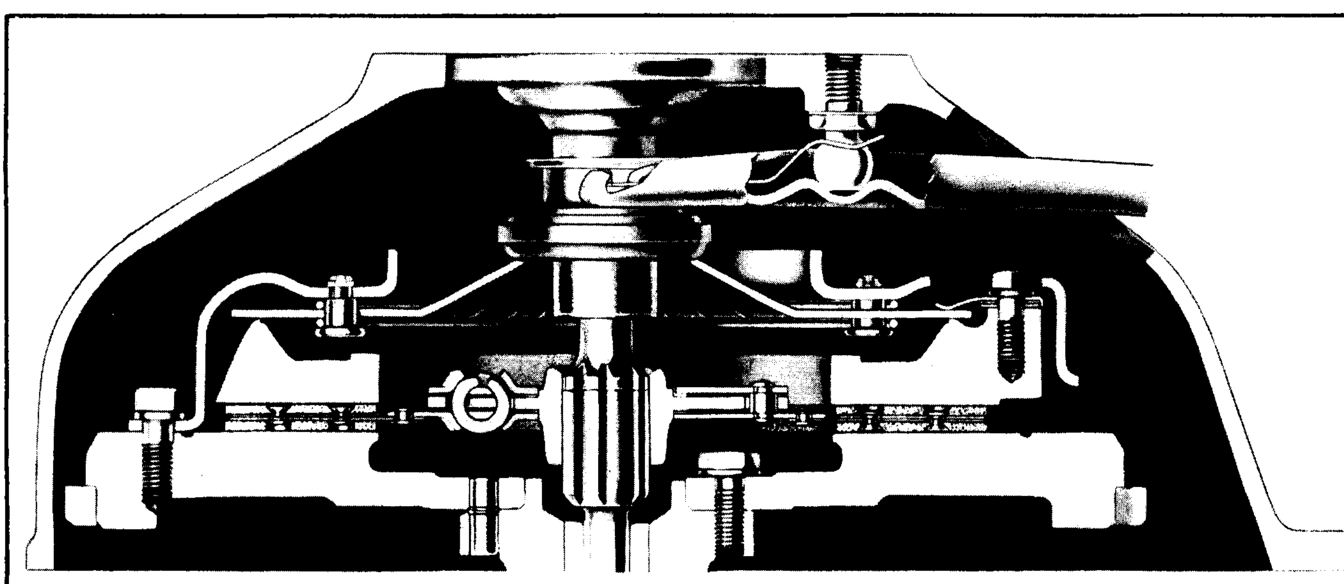


Fig. 7-3 Cross Section of Typical Bent-Finger Clutch

ENGINE	Carburetor	Series A	Series F	Series X	TRANSMISSION	CLUTCH COVER ASSEMBLY Paint Code Identification	CLUTCH COVER ASSEMBLY Pressure Plate Finger Design	CLUTCH DRIVEN PLATE No. of Splines	CLUTCH DRIVEN PLATE Diameter	CLUTCH DRIVEN PLATE Number & Color of Damper Springs
250 cu. in.	1 Bbl.	X	X	X	Saginaw 3X	Blue	Flat Finger	10	9.12"	6 Outer & 3 Inner
307 cu. in.	2 Bbl.			X	Saginaw 3X	Orange & Blue	Flat Finger	10	10.4"	6 Red
350 cu. in.	2 Bbl.	X	X		Saginaw 3X	Orange & Blue	Flat Finger	10	10.4"	6 Red
350 cu. in.	2 Bbl.	X			Muncie 3X	Orange & Blue	Flat Finger	10	10.4"	6 Red
350 cu. in.	2 Bbl.	X	X		Saginaw 4X	Orange & Blue	Flat Finger	10	10.4"	6 Red
400 cu. in.	4 Bbl.	X			Muncie 3X	Yellow	Bent Finger	10	10.4"	5 Black & 5 Yellow
400 cu. in.	4 Bbl.	X	X		Muncie 4X	Yellow	Bent Finger	26	10.4"	5 Black & 5 Yellow
455 cu. in.	H.O.	X	X		Muncie 4X	Yellow & White	Bent Finger	26	11.0"	5 Pink & 5 Blue

Fig. 7-4 Clutch Usage

PERIODIC SERVICE RECOMMENDATIONS

LUBRICATION

Every 6,000 miles, lubricate all pivot points with engine oil. Use light grease at push rod-to-clutch fork pin joint and chassis grease at high pressure lubrication fitting. The ball-type release bearing is lubricated and sealed for life and requires no lubrication.

ON CAR ADJUSTMENTS

CLUTCH PEDAL ADJUSTMENT (Figs. 7-5 thru 7-7)

INSPECTION

Since there are several things that can affect good clutch operation, it is necessary to make a preliminary inspection to determine whether trouble is actually in the clutch before performing any major clutch operations. Check clutch linkage to be sure that the clutch releases fully as follows:

1. With engine idling, depress the clutch pedal to within 1/2" of the floor mat and move the gearshift control lever between first and reverse several times:
   a. If shift can be made smoothly, the clutch is fully releasing.
   b. If shift is **NOT** smooth, clutch is not fully releasing and adjustment is necessary.
2. Check clutch pedal bushing for sticking or excessive wear.
3. Check clutch release fork for proper installation on its release fork ball. Lack of lubrication on the fork can cause fork to be pulled off the fork ball.
4. Check for bent, cracked or damaged countershaft levers and/or frame bracket.
5. Loose or damaged motor mounts may allow engine to shift position, causing a bind in clutch linkage at the countershaft. Check to make sure that there is some clearance between the countershaft and the engine boss ball and the frame bracket.
6. Check for clearance between the end of clutch release bearing, pressure plate flat-fingers and the bearing retainer on the transmission. If no clearance exists, the clutch release fork may be improperly installed on the fork ball or the clutch disc may be worn out.

ADJUSTMENT

Lash adjustment should be made as follows:

1. Disconnect the return spring at the clutch release fork.
2. With clutch pedal against stop, loosen jam nut sufficiently to allow the clutch fork push rod to be turned out of swivel (or rod end out of push rod) and rearward against the clutch fork until the release bearing contacts pressure plate fingers lightly.

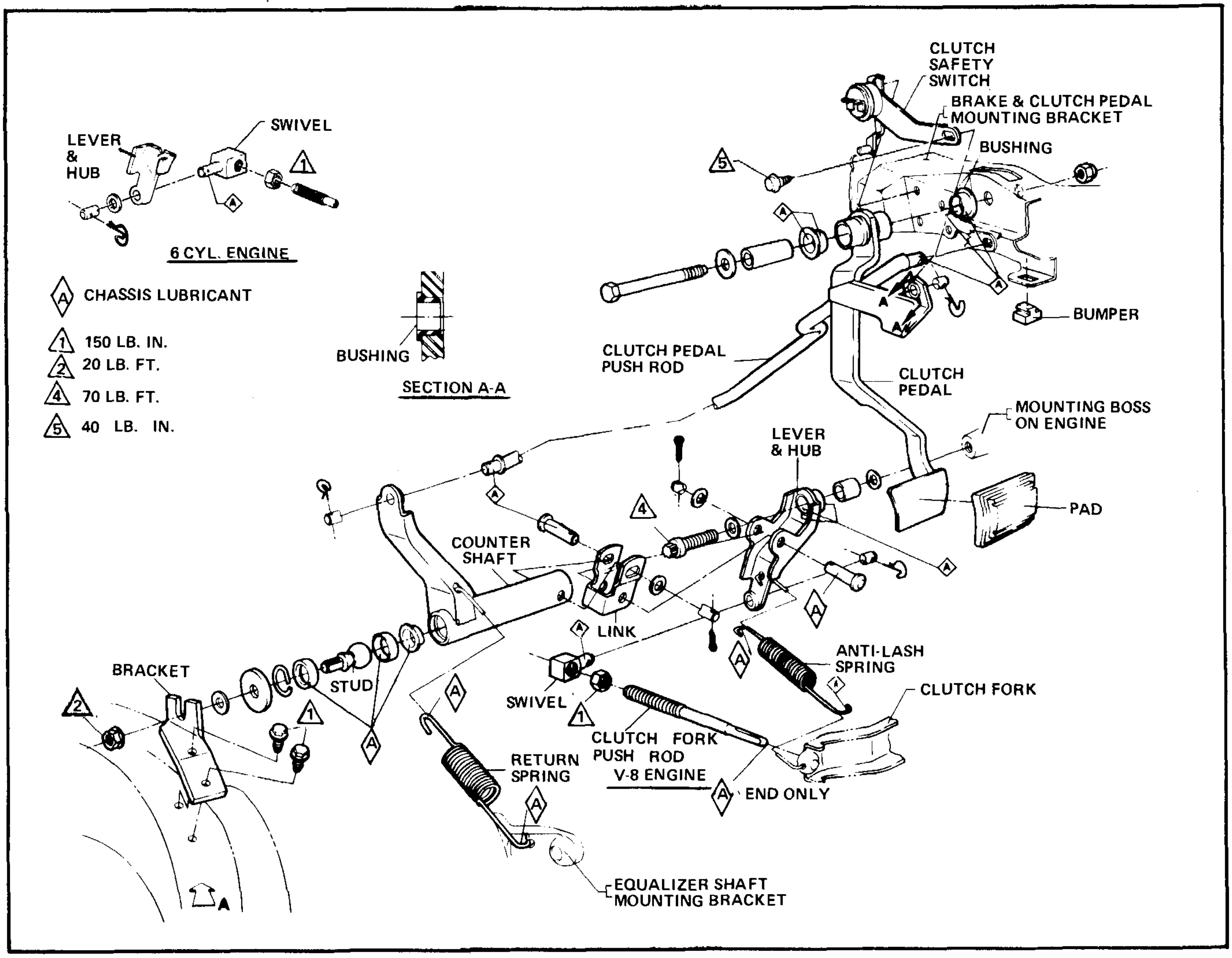


Fig. 7-5 Clutch Controls - A Series

3. Rotate clutch fork push rod into swivel (or rod end into push rod) by 3 1/2 turns and tighten jam nut to 30 lb. ft. torque.

4. Reinstall return spring and check pedal free travel. Approximately 1" to 1 1/2" of lash should be at the pedal.

MAJOR REPAIRS

CLUTCH CONTROL LINKAGE

REMOVE

1. Remove return spring and anti-lash spring.
2. Disconnect clutch pedal push rod and clutch fork push rod from their respective countershaft levers.
3. A Series - Remove bolt, retaining lever and hub to mounting boss on engine, loosen outboard ball stud nut and slide stud out of bracket slot.

   F and X Series - Loosen outboard ball stud nut and slide stud out of bracket slot.
4. Move countershaft outboard and lift out to remove from vehicle.

CLEANING AND INSPECTION

The countershaft assembly contains nylon ball stud seats which should be inspected for wear and/or damage. Also check condition of engine boss ball stud assembly (on F and X Series only) and special anti-rattle "O" ring.

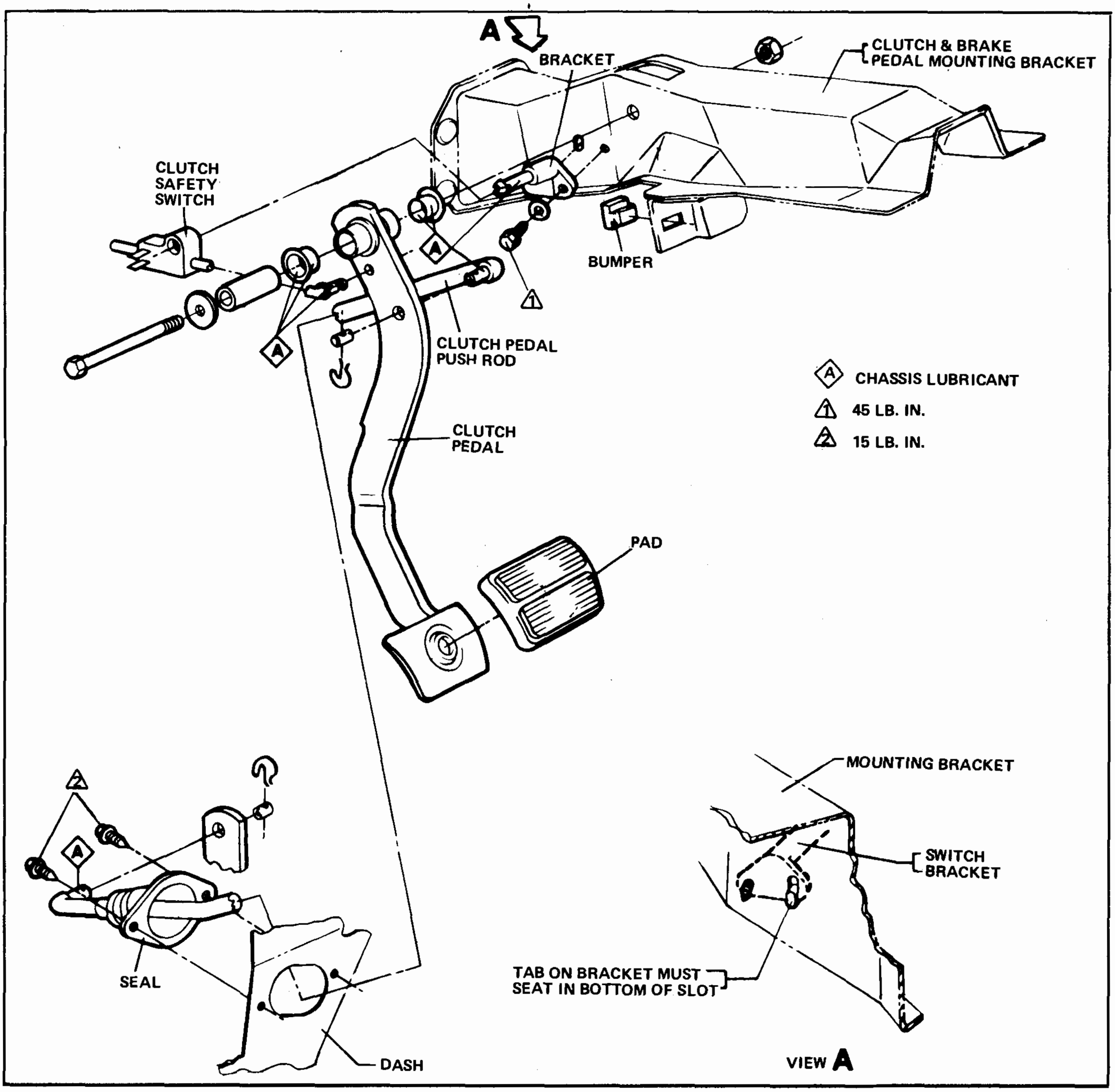


Fig. 7-6 Clutch Pedal and Push Rod - F and X Series

Figures 7-5 thru 7-7 show the component parts of the countershaft. Replace parts as necessary, based on wear and/or damage. Lubricate ball studs and seats with graphite grease before reassembly.

REPLACE

1. Reverse the removal steps. Tighten outboard ball stud nut to 21 lb. ft. torque.
2. Adjust lash. See Clutch Pedal Adjustment under ON CAR ADJUSTMENTS.

CLUTCH

REMOVE

1. Disconnect battery-to-starter lead at battery.
2. Remove propeller shaft and transmission. See applicable TRANSMISSION SECTION. Exercise care to avoid damaging transmission front bearing retainer (release bearing support) when transmission is pulled back to free the main drive (clutch) gear from the flywheel housing.

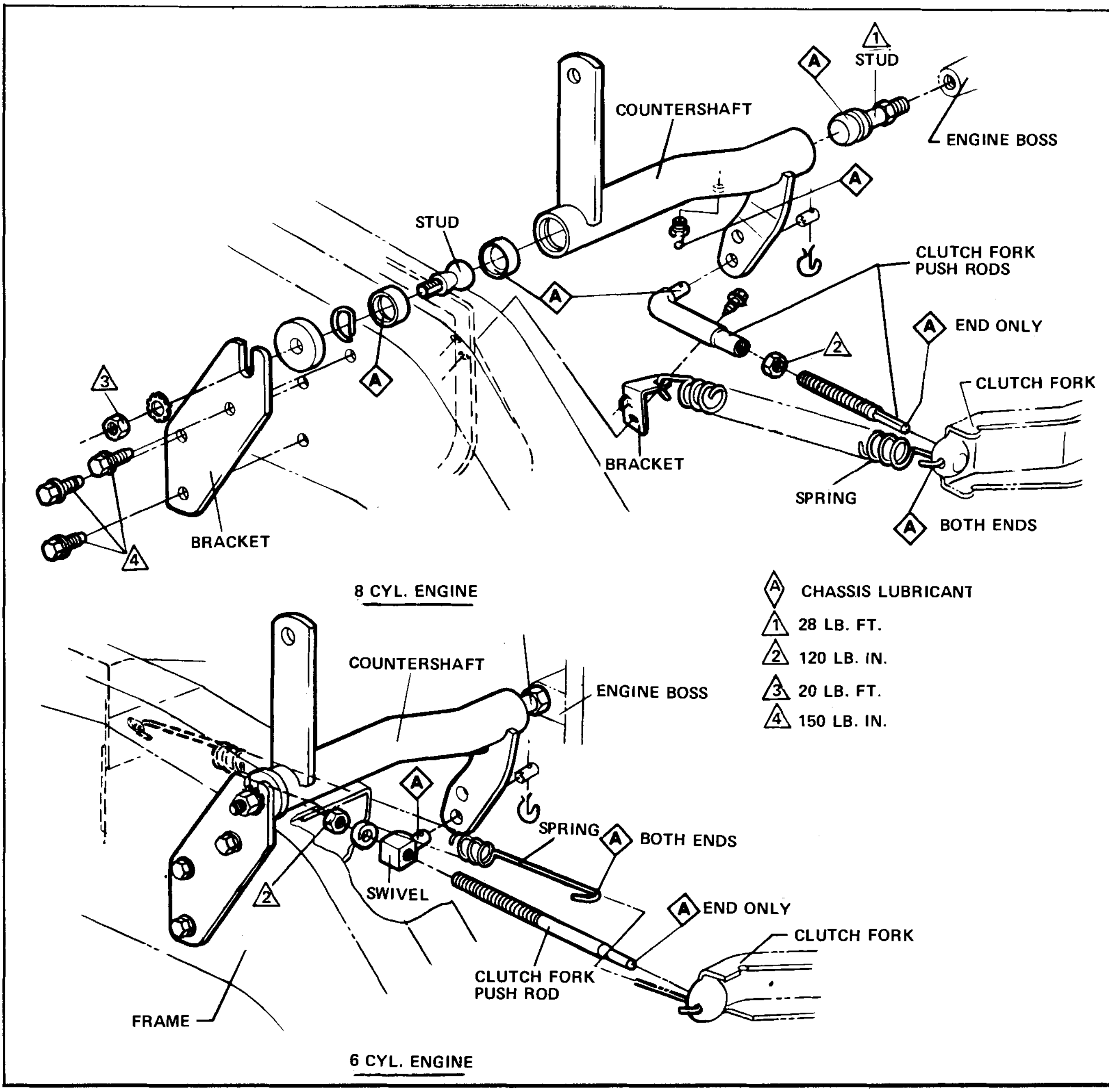


Fig. 7-7 Countershaft and Clutch Fork Push Rod - F and X Series

3. Remove clutch release bearing through rear opening in clutch housing. Do not place bearing in any degreasing or cleaning solvent.

4. Remove return spring.

5. Remove starter.

6. Remove front flywheel housing shield.

7. Remove flywheel housing bolts and pull housing off of dowels.

8. Remove flywheel housing.

9. Disconnect clutch release fork from ball stud by forcing it toward the center of the vehicle. Remove fork through inside of flywheel housing.

10. Mark the clutch cover-pressure plate assembly and the flywheel to insure reassembly in the same position as balanced at factory.

11. Loosen bolts holding clutch cover to flywheel one turn at a time until tension if relieved.

12. Remove all but top bolt and move clutch assembly away from flywheel at bottom so as to permit removal of clutch driven plate.

13. Remove remaining bolt to remove clutch cover-pressure plate assembly.

INSPECTION

1. Inspect clutch driven plate for broken or distorted torsion springs, worn or loose facings, oil on facings or damaged spline which could cause binding. If any of the above defects are present, replace driven plate with new assembly.

2. Inspect clutch cover-pressure plate assembly to see that it is free of oil and grease. Check pressure plate for scores or cracked surface.

   NOTE: *Servicing of clutch driven plate or clutch cover-pressure plate assembly must be made by replacement of assemblies only.*

3. Examine transmission bearing retainer carefully to be certain there are no burrs on outer surface which pilots the clutch release bearing.

4. Try clutch release bearing on transmission bearing retainer to make sure that no binding exists.

5. Check clutch release bearing by placing thrust load on bearing by hand and turning bearing race. Replace if bearing feels rough or seems noisy when turning.

6. Clean flywheel face with cleaning solvent, sandpaper or steel wool. Inspect pilot bearing in crankshaft for roughness.

REPLACE

1. Position clutch driven plate so that long end of hub is in flywheel and install clutch driven plate and clutch cover assembly on flywheel but do **not** tighten bolts (install lock washer under each cover-to-flywheel bolt).

   NOTE: *Align marks placed on flywheel and on cover during disassembly.*

2. Use a spare transmission main drive gear, inserted in spline of clutch driven disc, to move disc into correct alignment so pilot on end of drive gear will enter clutch pilot bearing. Tighten clutch cover and pressure plate-to-flywheel bolts one at a time until snug, then tighten to 25 lb. ft. torque. Remove spare main drive gear used to align clutch disc.

3. Lubricate surface of release fork fingers which contact release bearing, sides of pressure plate lugs protruding through cover plate stamping and release fork ball fulcrum with high melting point wheel bearing lubricant and install release fork.

4. Apply a light coat of grease to inner diameter of clutch release bearing and fill recess in inner diameter of bearing.

5. Install clutch release bearing to fork in flywheel housing.

   NOTE: *When installing a new bearing, be sure the same length bearing is installed as was removed.*

6. Apply a light coat of high melting point wheel bearing lubricant to full length of outer diameter of transmission release bearing support (retainer).

   CAUTION: *Do* **not** *over lubricate.*

7. Install flywheel housing and tighten bolts to 40 lb. ft. torque.

8. Install transmission. See applicable TRANSMISSION SECTION.

   CAUTION: *Use two transmission guide pins in upper holes in clutch housing.*

9. Connect clutch linkage to release fork.

10. Adjust pedal lash. See Clutch Pedal Adjustment under ON CAR ADJUSTMENTS.

    NOTE: *If interference is encountered with the clutch fully engaging, the transmission shift linkage should be adjusted as outlined in Sections 7A thru 7D, because the shift linkage interlock mechanism is controlled by clutch action.*

FLYWHEEL OR CLUTCH PILOT BEARING

REMOVE AND REPLACE

1. Remove transmission.

2. Remove clutch assembly.

3. If clutch pilot bearing is to be replaced, use cold chisel to remove staking in end of crankshaft which keeps bearing in place when transmission is removed (Fig. 7-9). Remove clutch pilot bearing from hole in crankshaft.

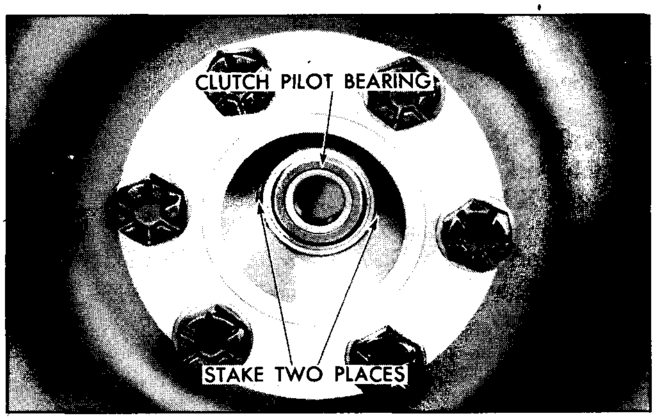


Fig. 7-8 Clutch Pilot Bearing Staked

4. If bearing is a snug fit in crankshaft, use Puller J 4383 and Slide Hammer J 2619-A to remove bearing. When installing new bearing, see that hole in crankshaft is thoroughly clean. Install new bearing with shielded side toward transmission. Start bearing into hole and tap into place. Stake slightly, as shown in Fig. 7-8, to keep bearing in place in case the transmission is removed in the future.

5. If flywheel is to be removed and reinstalled, scribe marks on flywheel and crankshaft flange, remove flywheel-to-crankshaft bolts and remove flywheel.

6. When reinstalling, clean the mating flanges of flywheel and crankshaft carefully, making sure there are no burrs on either mounting face. Position flywheel on crankshaft flange with scribe marks in alignment and install flywheel-to-crankshaft bolts and tighten evenly to 95 lb. ft. torque.

   NOTE: *Flywheel bolts do not require lock washers.*

7. Install clutch and transmission.

STARTER RING GEAR

REMOVE

1. With flywheel removed from vehicle, place the flywheel, crankshaft side down, on a solid flat surface or block which is slightly smaller in diameter than the flywheel.

2. Drive the ring gear off the flywheel, using a suitable drift and hammer.

   NOTE: *Keep working around the circumference of the ring gear to avoid binding the ring gear on the flywheel.*

3. Remove all burrs and rough spots from flywheel.

REPLACE

1. Support flywheel in a level position with cylinder block side facing up.

2. Support ring gear on metal surface and, using a blowtorch or acetylene torch, heat ring gear uniformly on the inside diameter, keeping the torch moving around the circumference of the ring gear to avoid localizing hot spots.

   CAUTION: *Under no circumstances should the ring gear be heated* **over** *400°F., as excessive heating may destroy the original heat treatment.*

3. Pick ring gear up with tongs and place it in position on flywheel, with ring gear facing the same direction as the one just removed.

4. Tap ring gear down into place against shoulder on flywheel. If the ring gear can not be tapped into place readily, it may be necessary to remove it and apply additional heat, heeding the caution about overheating given in step 2.

5. Reinstall flywheel in vehicle.

SPECIFICATIONS

CLUTCH

Pedal Lash	3 1/2 turns of adjusting rod from zero position.
Type Disc Facings	Single Plate Dry
Diameter of Disc:	
250 L-6	9.12"
350 V-8	10.4"
400 V-8	10.4"
455 V-8	11.0"
Release Bearing	Sealed Ball Bearing
Diaphragm Springs:	
6 cyl. and 350-2 Bbl., V-8	Flat Finger Design
400 and 455 V-8	Bent Finger Design

TORQUE

APPLICATION	LB. FT.
Clutch Pressure Plate-to-Flywheel Bolts	
All except X Series	25
X Series	35
Flywheel Housing-to-Engine Block Bolts	
All except X Series	40
X Series	30
Clutch Fork Ball Stud	40
Transmission-to-Flywheel Housing Bolts	55
Flywheel-to-Crankshaft Bolts	95
Countershaft Stud-to-Engine Boss	
F and X Series	28
Countershaft Stud-to-Frame Bracket Lock Nut	20
Lever & Hub-to-Engine Boss Bolt	
A Series	70

APPLICATION	LB. IN.
Clutch Fork Push Rod Lock Nut	
F and X Series	120
Countershaft Bracket-to-Frame Bolts	150
Clutch Fork Return Spring Bracket-to-Frame Screw	
F and X Series	72
Clutch Safety Switch Attaching Screw	
A Series	40

SECTION 7A

THREE SPEED SAGINAW TRANSMISSION

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

NOISY IN FORWARD SPEEDS

1. Incorrect lubricant or low lubricant level.
2. Transmission misaligned or loose.
3. Main drive gear bearing worn or damaged.
4. Countershaft gear or its roller bearings worn or damaged.
5. Main drive gear or its roller bearings worn or damaged.
6. Synchronizer assemblies worn or damaged.
7. Failure of operator to fully engage gears on every shift before engaging clutch and applying engine power (could cause scored or broken gear teeth).

NOISY IN REVERSE

1. Reverse idler gear or shaft worn or damaged.
2. Reverse gear worn or damaged.

HARD SHIFTING

1. Loose bolts at transmission outer shifter levers.
2. Bent gearshift control rods, loose swivel clamps or linkage interference.
3. Lack of lubricant on shift linkage.
4. Clutch improperly adjusted.
5. Shifter levers, shifter shafts or shift forks worn.
6. Incorrect lubricant.
7. Synchronizer assemblies worn or damaged.

STICKING IN GEAR

1. Clutch improperly adjusted.
2. Incorrect lubricant or low lubricant level.
3. Corroded transmission levers (shifter shaft).
4. Defective (tight) main drive gear roller bearings.

5. Frozen 3rd speed blocker ring on main drive gear cone.
6. Burred or battered clutching teeth on synchronizer sleeve and/or main drive gear.

JUMPING OUT OF GEAR

1. Shift linkage out of adjustment, bent, worn or loose.
2. Lack of lubrication on shift linkage.
3. Transmission misaligned or loose.
4. Shifter lever, shifter shaft and/or shift fork bent or worn.
5. Worn pilot bearing.
6. End play in main drive gear (bearing retainer loose or broken, loose or worn bearings on main drive gear and main shafts).
7. Detent cam spring weak or detent cam notches worn.
8. Worn clutch teeth on respective speed gear and/or worn clutch teeth on synchronizer sleeve.
9. Worn or damaged synchronizer assembly.
10. Bent main shaft.

FORWARD GEARS CLASH

1. Excessive engine idle speed.
2. Clutch not fully releasing.
3. Weak or broken synchronizer springs.
4. Worn blocker rings and/or cone surfaces.
5. Broken blocker rings.
6. Excessive rock of synchronizer assembly on mainshaft.

REVERSE GEAR CLASHES

Allow approximately three seconds after depressing clutch pedal before shifting into reverse gear. If gear clash is still present:

a. Check clutch adjustments.
b. Check for dragging or distorted clutch driven plate.
c. Check for tight or frozen main drive gear bearing.

LEAKS LUBRICANT

1. Excessive lubricant.
2. Main drive gear bearing retainer loose or cracked, oil seal or gasket damaged.
3. Worn or damaged rear extension oil seal.
4. Worn or damaged shifter shaft seals.
5. Rear extension-to-case gasket damaged.
6. Case cover or gasket damaged.

GENERAL DESCRIPTION

This transmission incorporates helical drive gears throughout with all forward gears synchronized, these gear changes being accomplished with synchronizer sleeves. The synchronizers permit quicker shifts, greatly reduced gear clash and permit downshifting from third to second between 40-20 mph and from second to first below 20 mph.

The Saginaw three speed transmission is used as the standard equipment transmission on all A, F and X Series equipped with 250 cu. in., 1 Bbl., 307 cu. in., 2 Bbl. (X Series Only) and 350 cu. in., 2 Bbl. engines (A and F Series only).

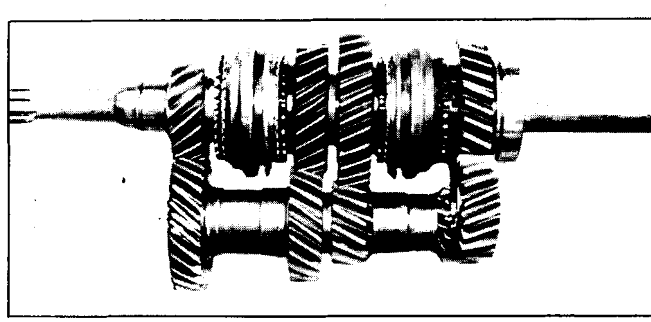


Fig. 7A-1 Gear Train - Neutral

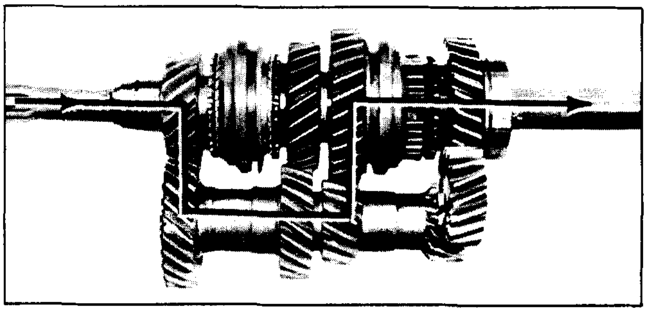


Fig. 7A-2 Power Flow - First Speed

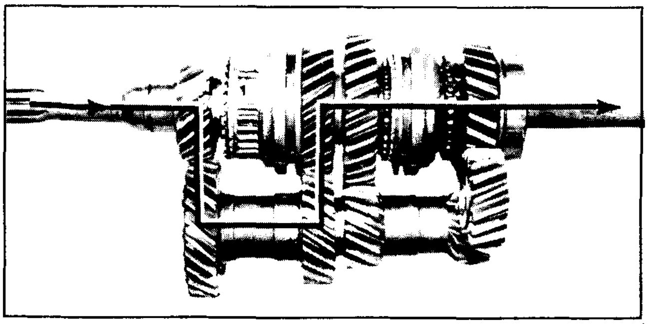


Fig. 7A-3 Power Flow - Second Speed

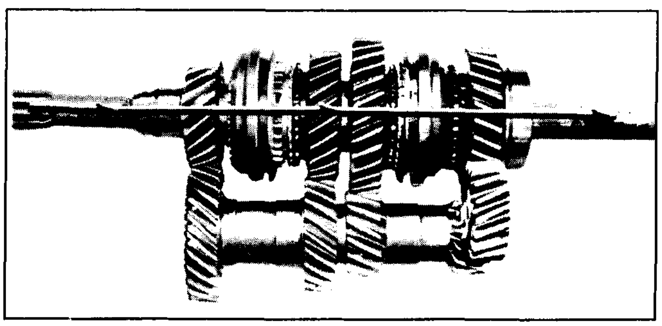


Fig. 7A-4 Power Flow - Third Speed

Gear ratios for the column shift (and optional floor shift - F Series and Sprint X Series only), 6-cylinder engine are 2.85:1 in first, 1.68:1 in second, 1:00:1 in high and 2.95:1 in reverse. The 8-cylinder engine gear ratios are 2.54:1 in first, 1.50:1 in second, 1.00:1 in high and 2.63:1 in reverse for both column shift (A and X Series) and floor shift (F and X Series) Saginaw manual transmissions.

For all models, the steering column lock requires that the transmission be in "Reverse" gear before the ignition key may be removed. Also, the clutch safety switch will not

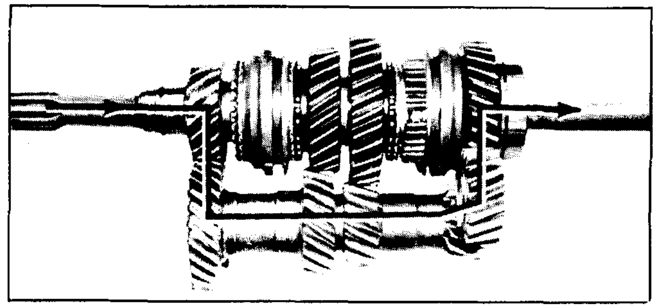


Fig. 7A-5 Power Flow - Reverse

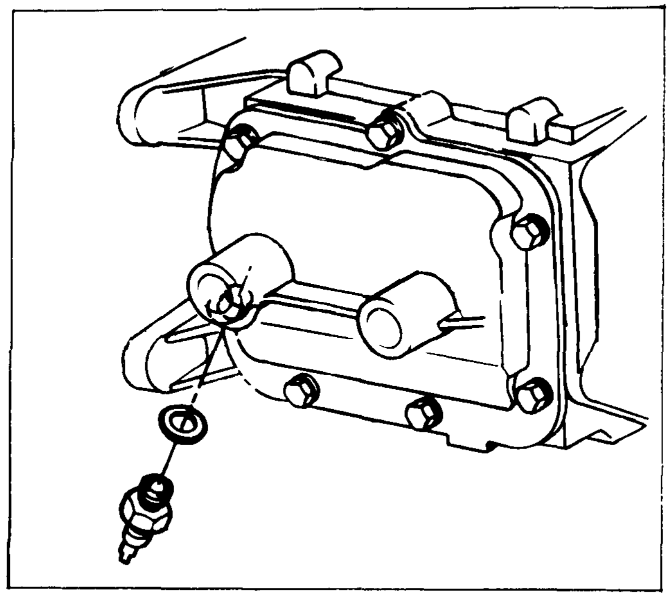


Fig. 7A-6 Transmission Controlled Spark Switch

permit engine cranking unless the clutch pedal is depressed far enough to completely disengage the clutch.

On 6 cylinder engine, column shift equipped vehicles only, a transmission controlled spark (TCS) switch is screwed into the boss of the 2nd & 3rd shifter shaft opening of the side cover (Fig. 7A-6).

This TCS switch is closed in all but high gear, grounding an electrical circuit from the distributor and engine thermo switch through a solenoid valve. This closing or grounding of the TCS switch will retard the spark. When the transmission is shifted into high gear, the pivoting of the 2nd & 3rd shifter shaft will cause the TCS switch to open, so that the transmission will no longer affect the vacuum advance of the distributor.

See Section 6D for further details.

PERIODIC SERVICE RECOMMENDATIONS

TRANSMISSION

No periodic service of the transmission is required except checking for leaks and proper lubrication level every 6000 miles. If there is evidence of leakage, leak should be corrected and lubrication added as needed.

Refill capacity is 56 fluid ounces (3-1/2 pints) (Use SAE 90 multi-purpose Gear Lubricant. No special additive to this lubrication is required or recommended).

SHIFT CONTROL

No periodic service of the shift control is required. Certain parts are lubricated on assembly and require further lubrication only when parts become dry and sticky.

ON CAR ADJUSTMENTS

COLUMN SHIFT LINKAGE (Figs. 7A-7 and 7A-8)

1. Set gearshift lever in Reverse and lock ignition.
2. A Series - Loosen swivel clamp screw "C" at rear transmission shifter lever (1st & Rev.) and screw "D" at cross shaft assembly (view B).

   F and X Series - Loosen swivel clamp nuts at both shifter levers.
3. Position front transmission shifter lever (2nd & 3rd) in Neutral position and rear transmission shifter lever (1st & Rev.) in Reverse position.
4. A Series - Tighten swivel clamp screw "C" to 20 lb. ft., unlock steering column and shift into Neutral.

   F Series - Tighten both swivel clamp nuts to 20 lb.ft. torque, unlock steering column and check complete shift pattern.

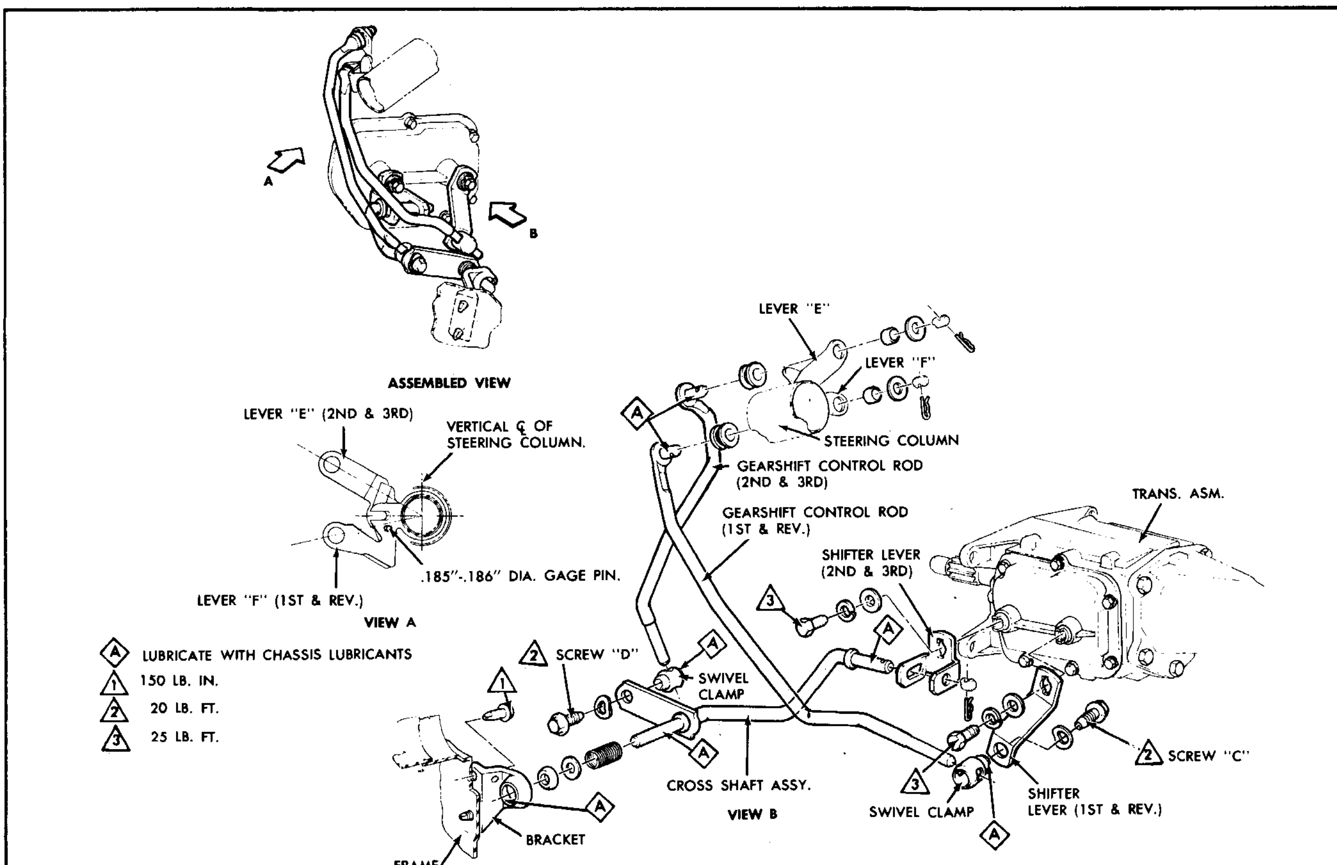


Fig. 7A-7 Column Shift Controls - A Series

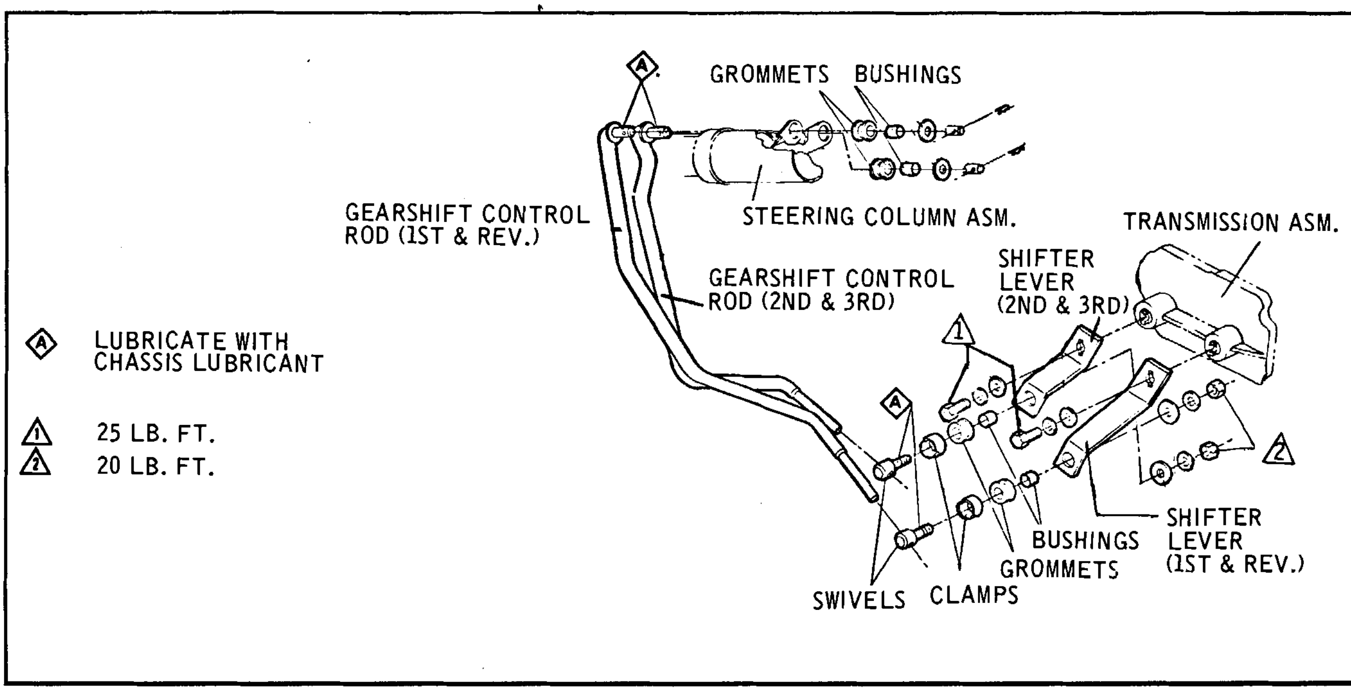


Fig. 7A-8 Column Shift Controls - F and X Series

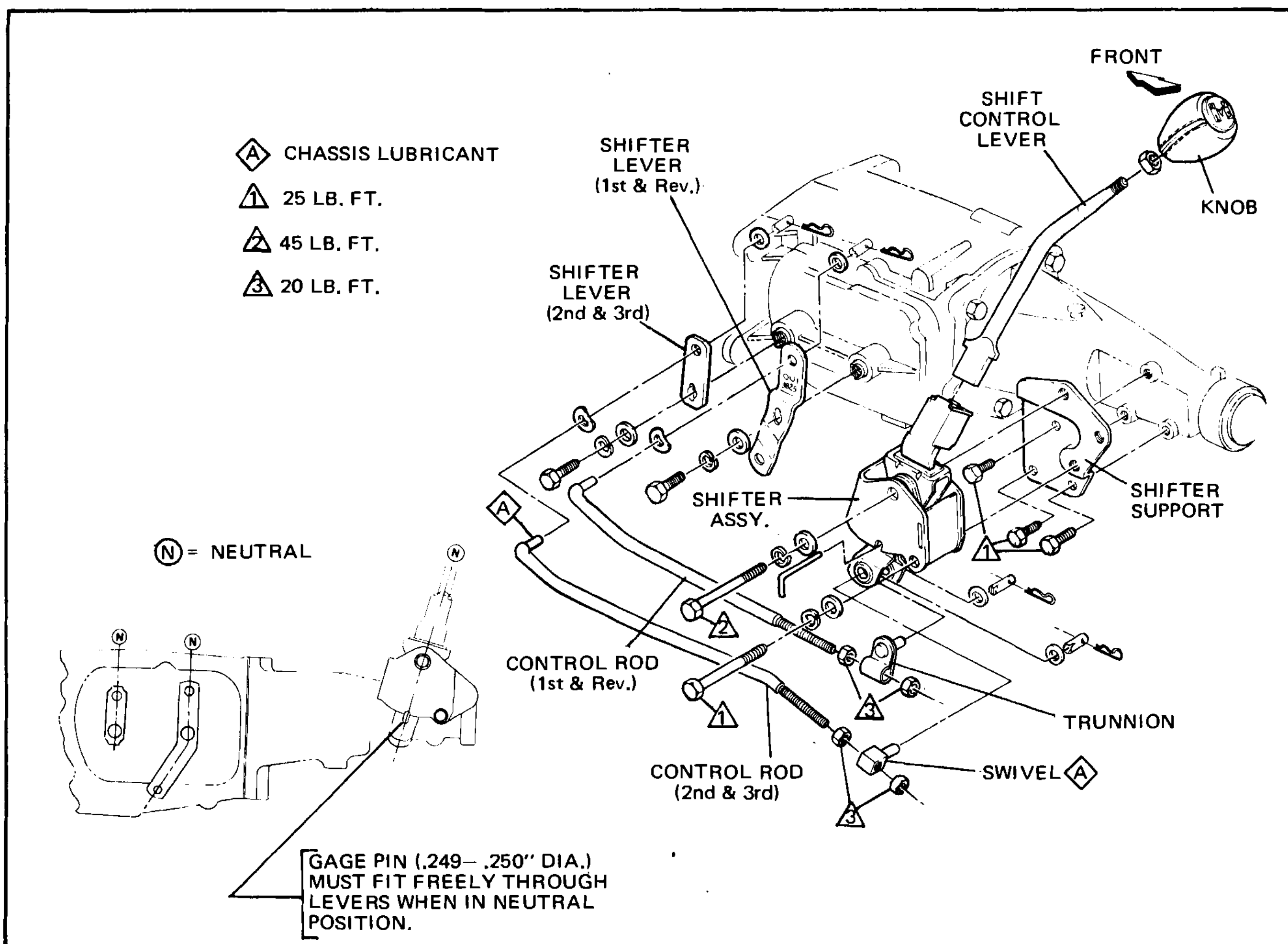


Fig. 7A-9 Floor Shift Controls - F Series

X Series -- Pull down slightly on 1st & Rev. control rod to remove any slack in column mechanism. Then tighten swivel clamp nut at the 1st & Rev. shifter lever to 20 lb. ft. torque.

5. A Series - Align gearshift lower control levers "E" and "F" in Neutral position and insert a .186-.185" diameter gage pin through hole in lower control levers (view A).

   X Series -- Unlock steering column and shift into Neutral. Align column lower levers in Neutral position and insert a .186-.185" diameter gage pin through hole in lower column levers.

6. A Series - Tighten swivel clamp screw "D" to 20 lb. ft., remove gage pin and check complete shift pattern.

   X Series -- Position front transmission shifter lever (2nd & 3rd) in Neutral position and and tighten swivel clamp nut at the 2nd & 3rd shifter lever to 20 lb. ft. torque.

7. X Series -- Remove gage pin and check complete shift pattern.

FLOOR SHIFT AND BACK DRIVE LINKAGE (Figs. 7A-9 and 7A-10)

1. With steering column unlocked, position the floor shift control lever into its Neutral position.
2. Loosen the swivel clamp nut, retaining the gearshift control rod to the idler lever (Fig. 7A-10).
3. Loosen trunnion jam nuts on 1st & Rev. control rod, loosen swivel jam nuts on 2nd & 3rd control rod and insert a .250/.249" diameter gage pin into shifter assembly (see Fig. 7A-9).

   NOTE: *With gage pin in place, the shifter assembly levers will be maintained in Neutral position.*

4. Manually position both transmission shifter levers in Neutral and torque the jam nuts to 20 lb.ft.
5. Remove gage pin from shifter assembly and check complete shift pattern.
6. Shift transmission into Reverse gear, set gearshift control rod (Fig. 7A-10) in Lock position and lock the steering column.
7. Push up on the gearshift control rod to take up clearance in the steering column lock mechanism and torque the adjusting swivel clamp nut to 20 lb.ft.

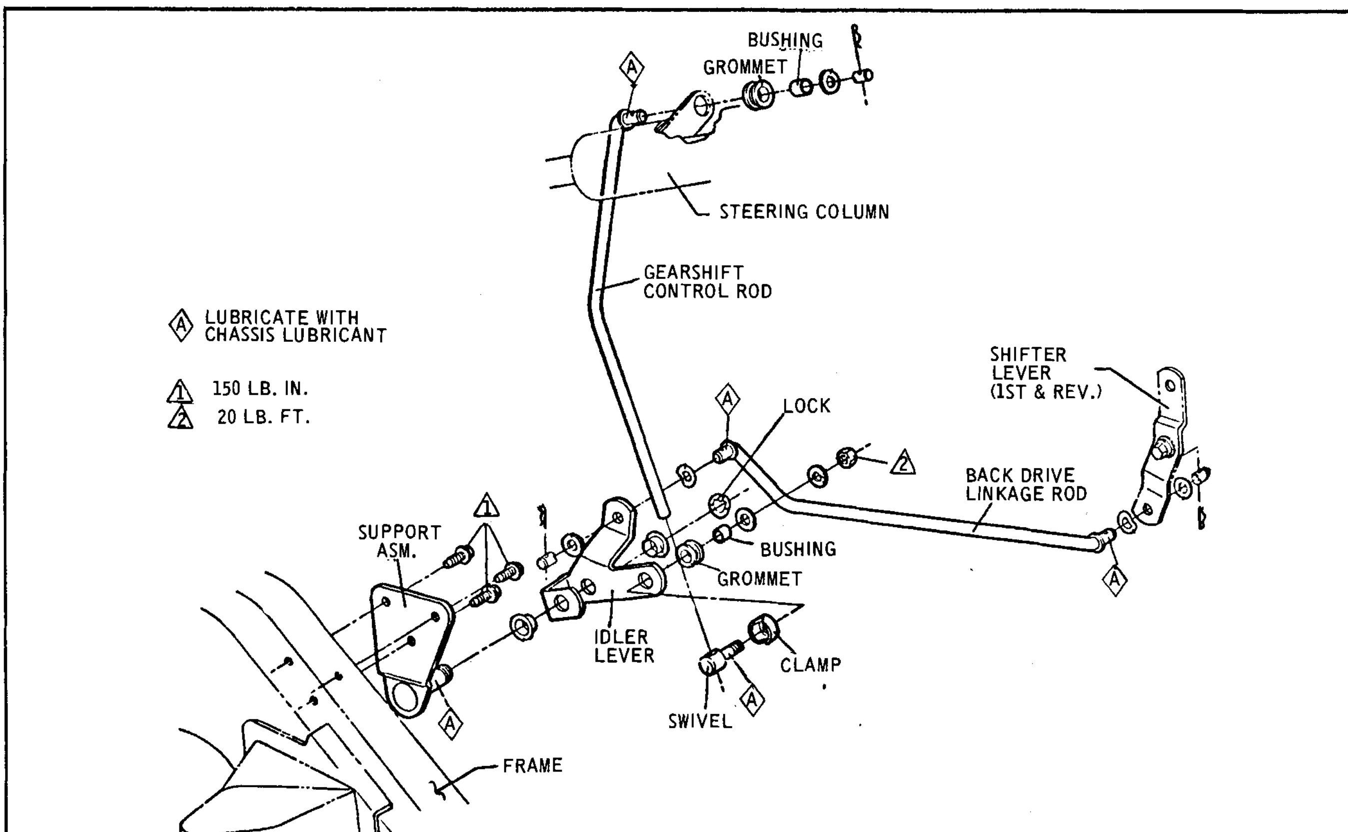


Fig. 7A-10 Back Drive Linkage - F and X Series

MINOR REPAIRS

REAR EXTENSION OIL SEAL

REMOVE AND REPLACE

Before raising the car, disconnect the battery and release the parking brake.

1. Remove propeller shaft as outlined in Section 4E.
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 would cut new seal or cause seal to leak or damage bushing.
5. Coat new oil seal with sealing compound and start new seal in opening.
6. Place Collar J 6403-2 onto Tool J 6403-1 (Fig. 7A-11).

   NOTE: *Flat side of J 6403-2 must be toward rear of J 6403-1.*

7. Place Tool J 6403-1 over end of mainshaft.
8. Tap end of tool with soft hammer to seat oil seal.
9. Reinstall propeller shaft.

REAR EXTENSION OIL SEAL AND BUSHING

REMOVE AND REPLACE

Before raising car, disconnect the battery and release the parking brake.

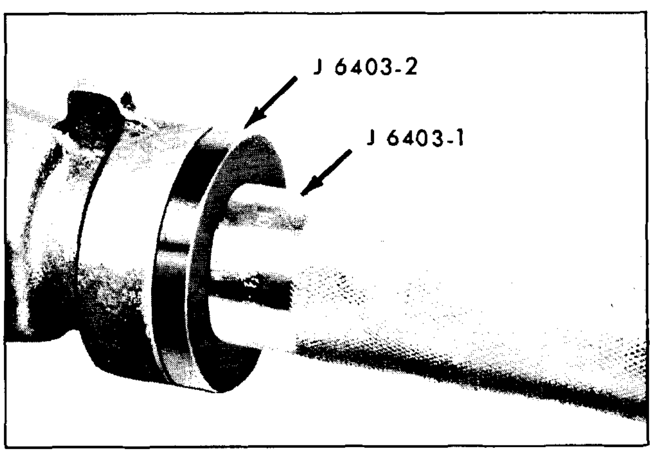


Fig. 7A-11 Installing Rear Extension Oil Seal

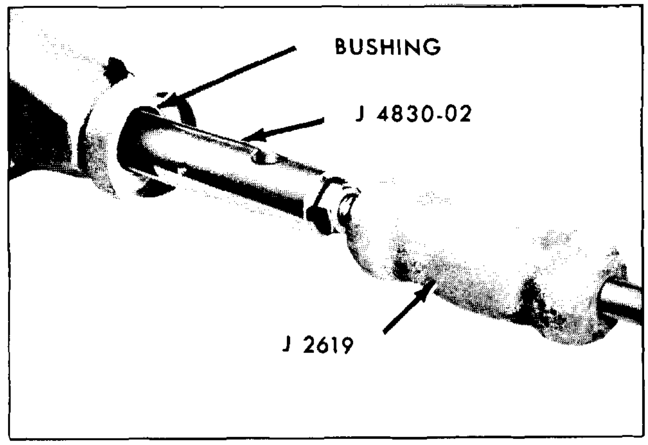


Fig. 7A-12 Removing Rear Extension Bushing

1. Remove propeller shaft.
2. Insert Tool J 4830-02 over mainshaft and tighten screw.
3. Attach Slide Hammer J 2619. Using hammer, pull bushing and seal from rear extension (Fig. 7A-12).
4. Start new bushing into rear extension.
5. Using Tool J 6403-1 and a soft hammer, tap bushing into place (Fig. 7A-13).
6. Install new oil seal, using Tool J 6403-1 and Collar J 6403-2 (Fig. 7A-11) and tap end of tool with a soft hammer to seat the oil seal.
7. Reinstall propeller shaft.

TRANSMISSION CASE COVER

REMOVE

It is not necessary to remove transmission from vehicle for inspection or replacement of parts in transmission case

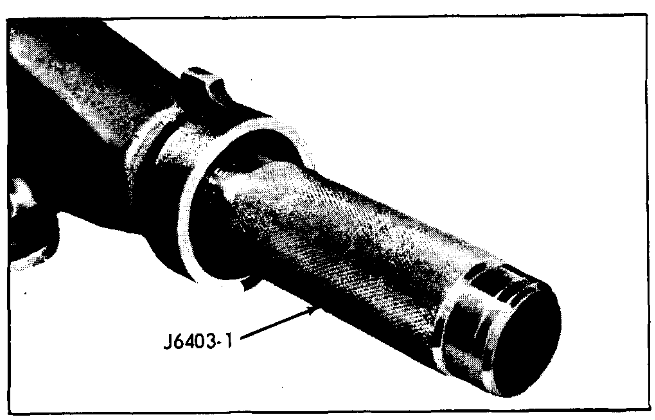


Fig. 7A-13 Installing Rear Extension Bushing cover assembly, but cover itself must be removed from transmission case (Fig. 7A-14).

1. Loosen case cover bolts to allow transmission fluid to drain.
2. Disconnect control rods from levers (on 6 cylinder engine vehicles, disconnect electrical lead from T.C.S. switch).
3. Remove case cover from transmission case.
4. Disassemble case cover by removing detent cam spring, shift forks, shifter shafts, detent cam retainer ring and detent cams.
5. Inspect and replace necessary parts.
6. Inspect shifter shaft seals and replace if necessary.

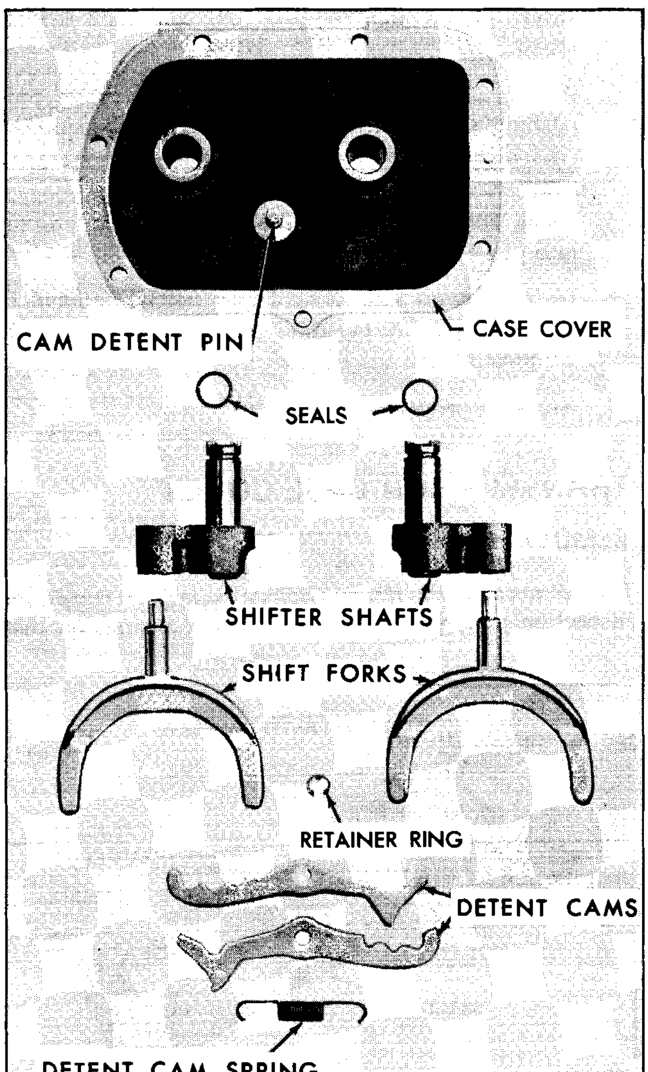


Fig. 7A-14 Exploded View of Transmission Case Cover

REPLACE

1. Install shifter shaft seals if removed.
2. Install detent cams, detent cam retainer ring, shifter shafts, shift forks and detent cam spring.
3. Attach case cover to transmission case.
4. Connect control rods to levers (on 6 cylinder engine vehicles, connect lead to T.C.S. switch).
5. Refill transmission.

NOTE: *Detent cams, shifter shafts and shift forks are interchangeable.*

FLOOR SHIFT CONTROL ASSEMBLY (X SERIES)

REPLACE (Fig. 7A-15)

1. Remove shifter knob from control lever.
2. Remove console or floor trim plate assembly.
3. Raise vehicle on hoist.
4. Remove retaining nuts and disconnect stabilizer rod from control lever assembly and transmission.
5. Remove shifter lever attaching bolts at transmission side cover and disconnect shifter levers and control rods from transmission.

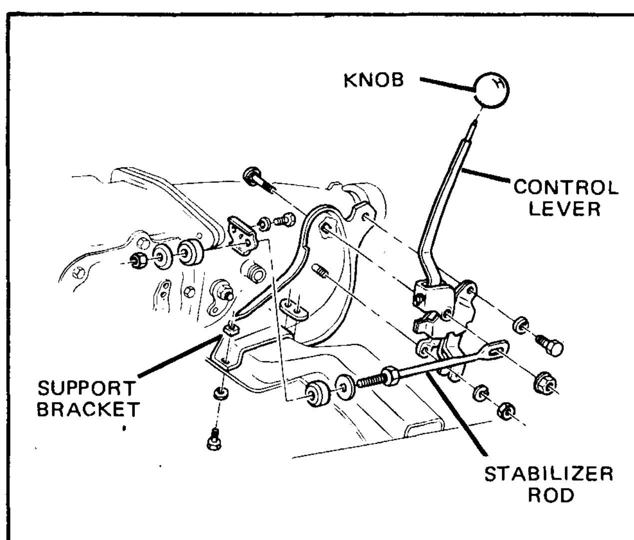


Fig. 7A-15 Floor Shift Control Lever and Bracket Assembly (X Series)

6. Remove crossmember-to-support bracket attaching bolts.

7. Pull control lever-bracket assembly down and to the rear to disengage control lever from the floor seal and remove assembly from the vehicle.

8. Remove control lever assembly from the support bracket and disconnect control rods from the control lever assembly.

9. To install, reverse the removal procedure and adjust linkage as outlined previously.

REPAIR (Fig. 7A-16)

1. Remove floor shift control assembly as outlined above.

2. Remove shift lever shaft retainer from the shift lever shaft and remove shaft from the control lever bracket.

3. Disengage control lever-bracket assembly, gearshift levers and shifter lever spacer from the shifter lever bracket.

4. Remove control lever pin retainer, pin washer and control lever pin from the control lever-bracket assembly. Then, disengage control lever, control lever spring and spring retainer from the control lever bracket.

5. Clean and inspect all parts for wear, cracks or other defects.

6. Install control lever spring and spring retainer into the control lever bracket.

7. Install control lever, control lever pin, pin washer and pin retainer into the control lever bracket.

NOTE: *Lubricate all parts with water repellent-type lubricant.*

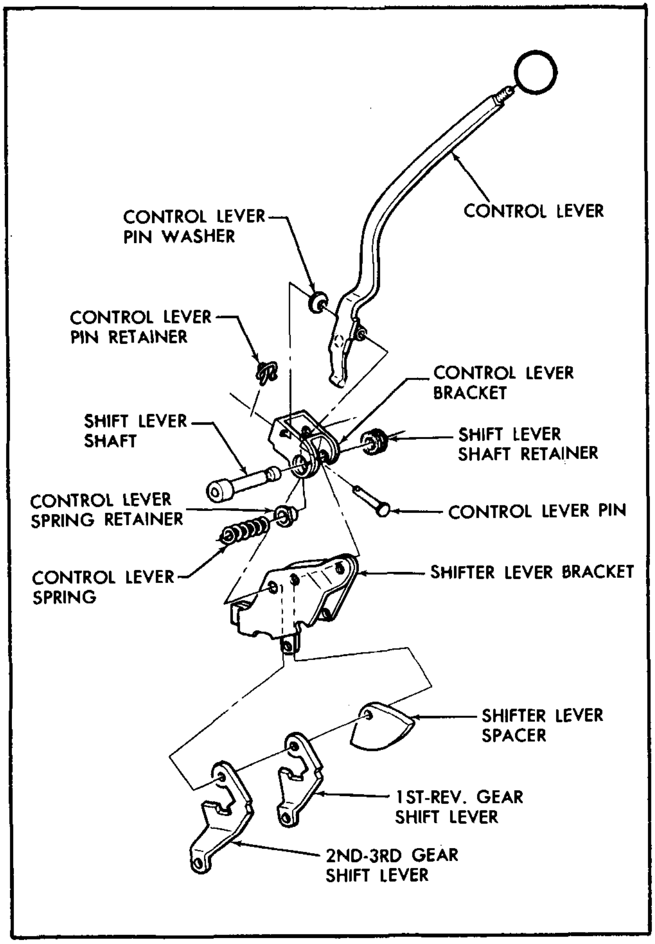


Fig. 7A-16 Exploded View of Floor Shift Control Assembly (X Series)

8. Assemble gear shift levers and lever spacer into the shifter lever bracket and lubricate thoroughly.

9. Position control lever-bracket assembly into the shifter lever bracket. Then, install shift lever shaft and shaft retainer.

10. To install control assembly, reverse the removal procedure.

MAJOR REPAIRS

TRANSMISSION

REMOVE

Before raising car, disconnect the battery and release the parking brake.

1. Disconnect speedometer cable.

2. Disconnect transmission shifter levers (1st & Rev. and 2nd & 3rd) from transmission shifter shafts (Fig. 7A-7, 7A-8 and 7A-9).

On 6 cylinder engine vehicles, disconnect electrical lead from T.C.S. switch.

On floor shift controlled cars (Fig. 7A-9), it will also

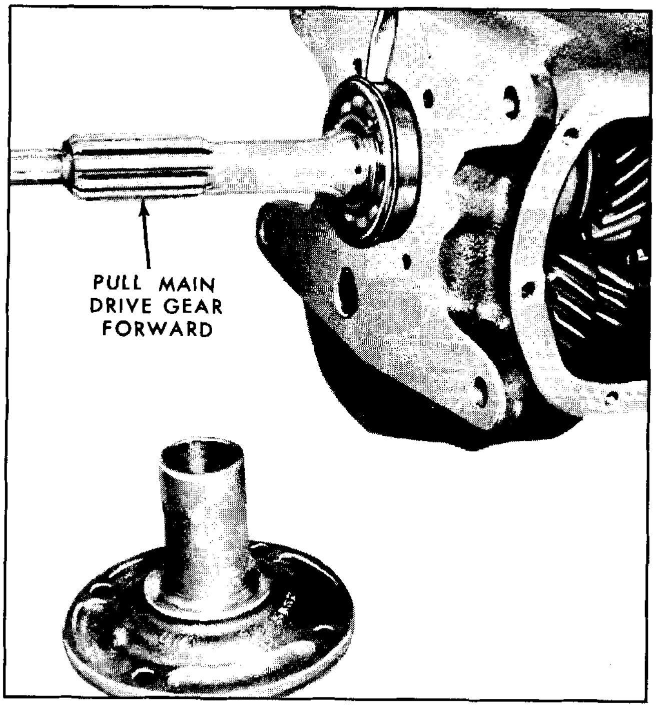


Fig. 7A-17 Removing Main Drive Gear Bearing

be necessary to remove the two (2) shifter assembly-to-shifter support bolts and remove shifter assembly from the transmission. If shifter assembly removal is not required, it may be left hanging from its floor seal while the transmission is removed.

3. Scribe a mark on companion flange and shaft yoke to assure proper reassembly and remove propeller shaft.

4. Support rear of engine and remove transmission mount.

5. Remove four (4) crossmember bolts and slide member rearward.

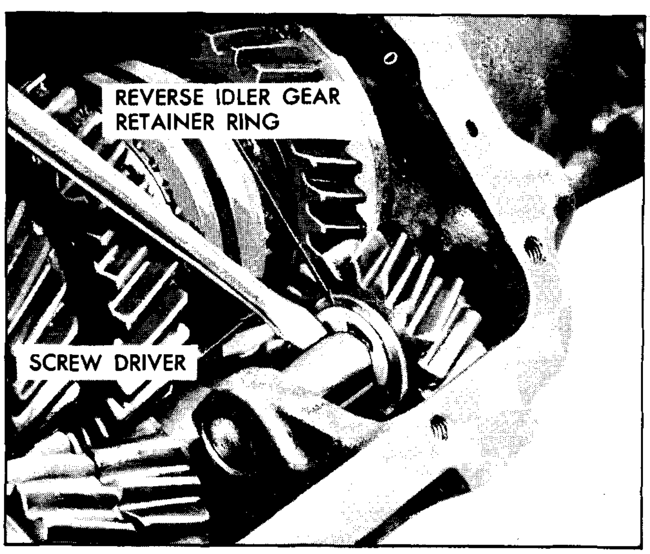


Fig. 7A-18 Removing Reverse Idler Gear Retainer Ring

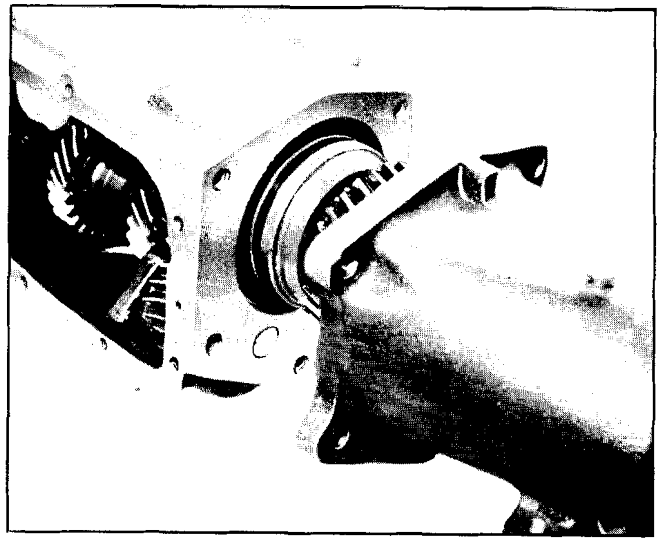


Fig. 7A-19 Removing Mainshaft Assembly

6. Remove two (2) upper transmission-to-clutch housing bolts and insert Guide Pins J 1126.

7. Remove two (2) lower transmission-to-clutch housing bolts.

8. Slide transmission straight back on guide pins until main drive gear splines are free of splines in clutch friction plate.

9. Remove transmission.

DISASSEMBLE

1. Remove case cover attaching bolts, drain lubricant and remove case cover and gasket.

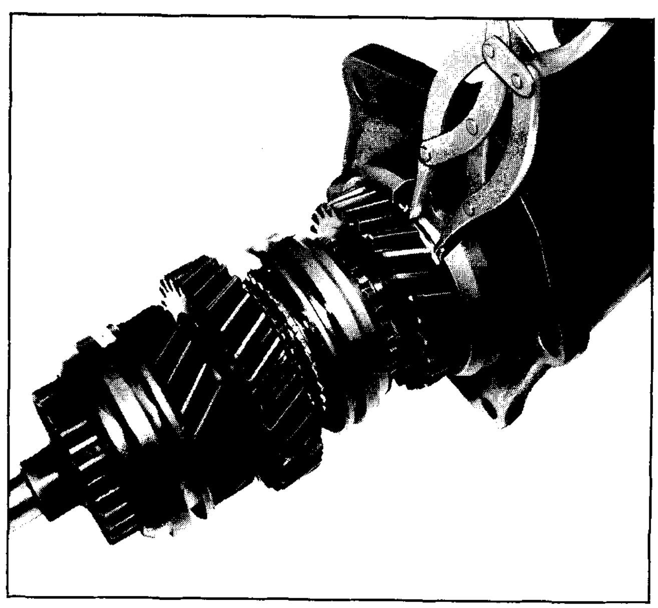


Fig. 7A-20 Expanding Rear Extension Snap Ring

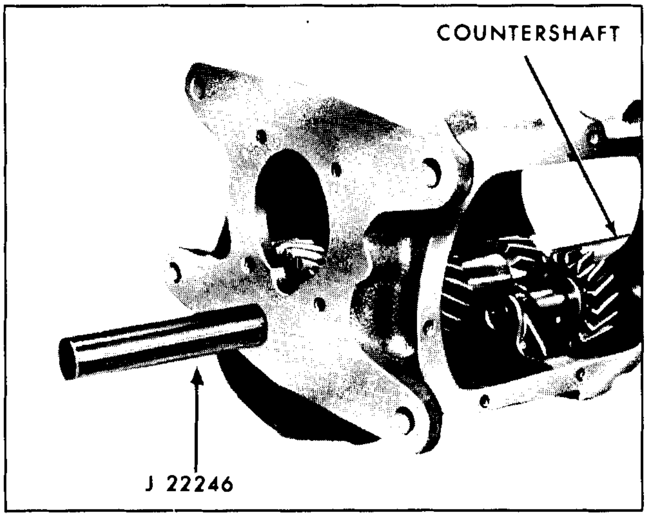


Fig. 7A-21 Removing Countershaft

2. Remove main drive gear bearing retainer and gasket.
3. Remove bearing-to-main drive gear snap ring.
4. Pull main drive gear out of case as far as possible and remove bearing (Fig. 7A-17).

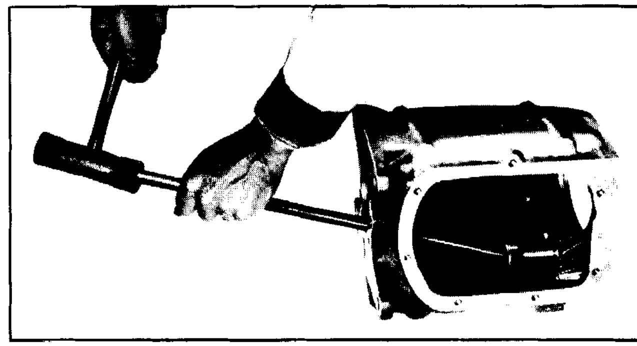


Fig. 7A-22 Removing Reverse Idler Gear Shaft

NOTE: *Although bearing is a slip fit on main drive gear, it may be necessary to aid removal with screwdriver.*

5. Remove S.C.S. ground wire from rear extension (V-8 engines only), speedometer driven gear and rear extension-to-case attaching bolts.
6. Remove reverse idler gear retainer ring (Fig. 7A-18). Slide reverse idler gear forward on shaft.

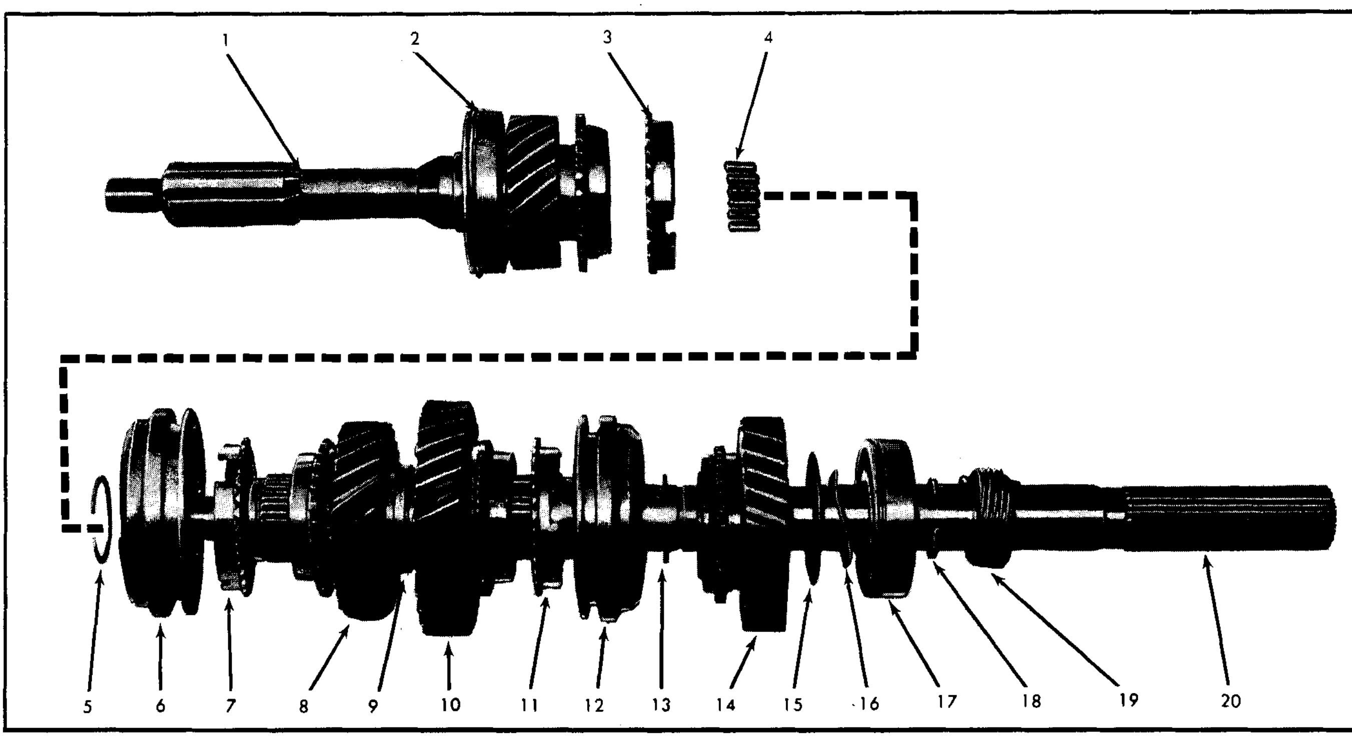


Fig. 7A-23 Exploded View of Mainshaft Assembly

1. Main Drive Gear
2. Front Bearing
3. 3rd Speed Blocker Ring
4. Main Drive Gear Bearing Rollers (14)
5. 2nd & 3rd Speed Synchronizer Snap Ring
6. 2nd & 3rd Speed Synchronizer Assembly
7. 2nd Speed Blocker Ring
8. 2nd Speed Gear
9. Shoulder (Part of Mainshaft)
10. 1st Speed Gear
11. 1st Speed Blocker Ring
12. 1st Speed Synchronizer Assembly
13. 1st Speed Synchronizer Snap Ring
14. Reverse Gear
15. Thrust Washer - Reverse Gear
16. Spring Washer - Reverse Gear
17. Rear Bearing
18. Rear Bearing Snap Ring
19. Speedometer Drive Gear and Retaining Clip
20. Mainshaft

7. From rear of case, remove extension and mainshaft assembly (Fig. 7A-19).

8. Remove main drive gear and 3rd speed blocker ring from inside of case and remove 14 roller bearings from main drive gear.

9. Using snap ring pliers, expand snap ring at front of rear extension, which retains extension to rear bearing (Fig. 7A-20), and remove extension.

10. Using Countershaft Alignment Tool J 22246, tap out countershaft and its woodruff key through rear of case (Fig. 7A-21). Remove countershaft gear and two (2) tanged thrust washers.

11. Remove Countershaft Alignment Tool J 22246.

12. From each end of countershaft gear, remove bearing washer and 27 bearing rollers.

13. Using a long brass drift or punch, drive reverse idler gear shaft and woodruff key through rear of case (Fig. 7A-22).

14. Remove reverse idler gear.

15. Remove 2nd & 3rd synchronizer sleeve (Fig. 7A-23).

16. Depress speedometer retaining clip and slide gear from mainshaft.

17. Remove rear bearing snap ring.

18. Using hydraulic or arbor press, press off rear bearing, spring washer, thrust washer and reverse gear (Fig. 7A-24).

CAUTION: *When pressing rear bearing, be careful to center the gear, washers and bearing on the mainshaft.*

19. Remove 1st speed synchronizer snap ring (Fig. 7A-23).

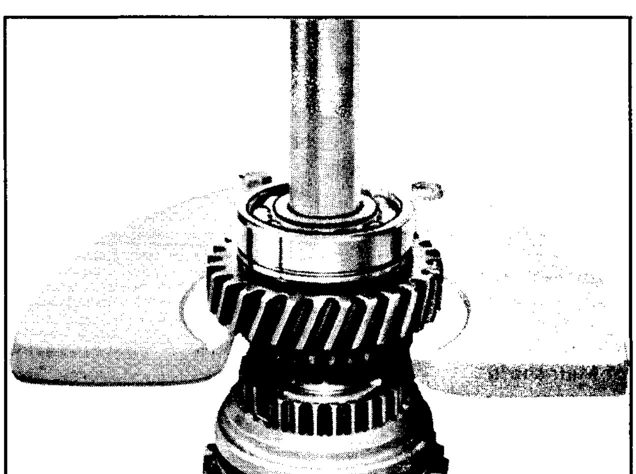


Fig. 7A-24 Removing Rear Bearing and Reverse Gear

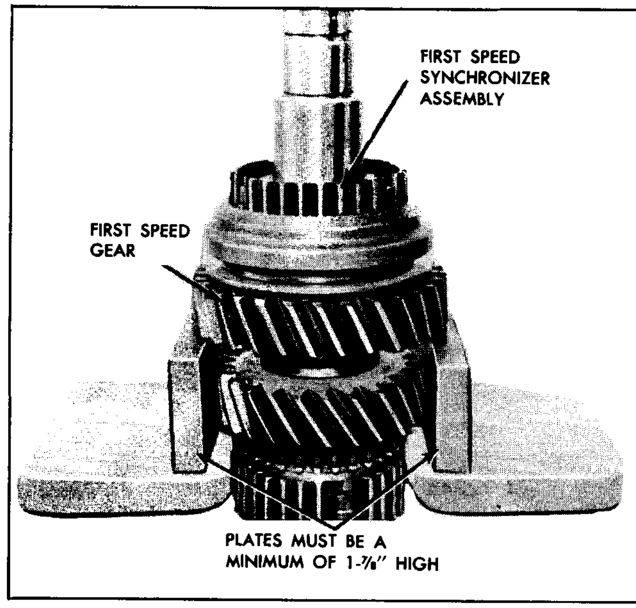


Fig. 7A-25 Removing 1st Speed Synchronizer and Gear

20. Support 1st speed gear on press plate, using two (2) pieces of stock 6" x 1 7/8" x 1/4" (Fig. 7A-25). Remove 1st speed synchronizer assembly and 1st speed gear.

21. Remove 2nd & 3rd speed synchronizer snap ring (Fig. 7A-23).

22. Support 2nd speed gear on press plate, using two (2) pieces of stock 6" x 1 7/8" x 1/4" (Fig. 7A-26). Remove 2nd & 3rd speed synchronizer clutch hub and 2nd speed gear.

CLEANING AND INSPECTION

1. Check synchronizer clutch hubs, sleeves, keys and springs and, if necessary, replace (Fig. 7A-27):

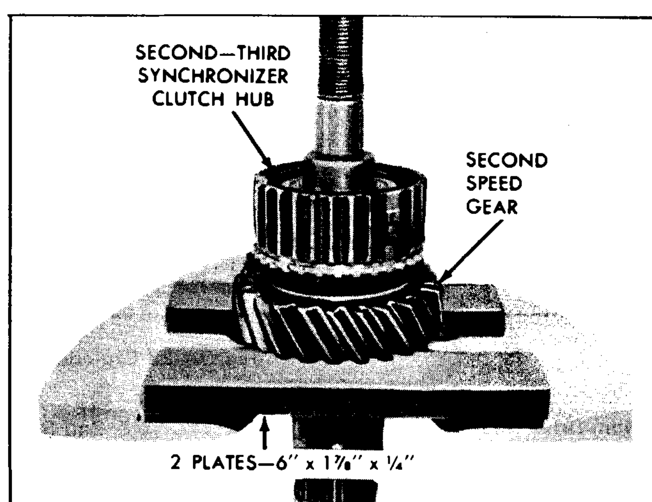


Fig. 7A-26 Removing 2nd & 3rd Speed Synchronizer Clutch Hub and 2nd Speed Gear

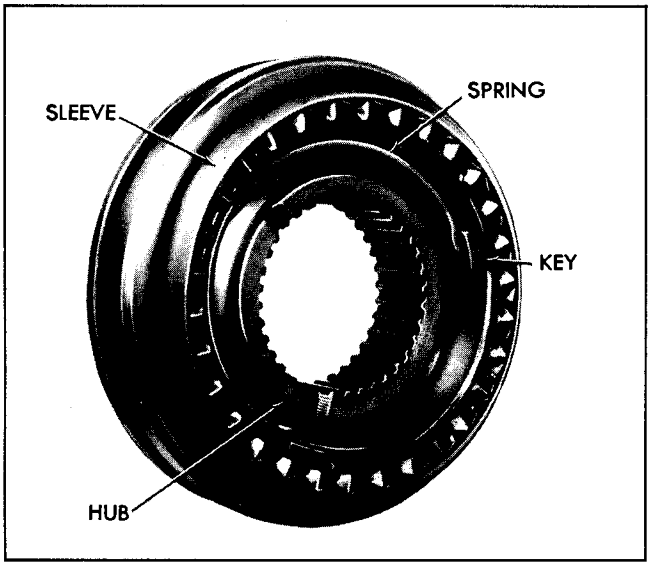


Fig. 7A-27 Typical Synchronizer Assembly

NOTE: *The synchronizer clutch hubs and sleeves are a selected assembly and should be kept together as originally assembled.*

a. Mark clutch hub and sleeve so they can be reassembled in same position.

b. Remove sliding sleeve from synchronizer clutch hub. Remove keys and springs from hub.

c. Replace the three (3) keys and two (2) springs in position (one on each side of clutch hub) so all three keys are engaged by both springs.

d. The tanged end of each synchronizer spring should be installed in different key cavities on either side of clutch hub. Slide sleeve onto hub, aligning marks made before disassembly.

NOTE: *A groove around the outside of synchronizer clutch hub identifies the end that must be opposite fork slot in sleeve when assembled. This groove indicates the clutch end of the hub with a greater recess.*

2. Wash main drive gear bearing and rear bearing thoroughly in cleaning solvent. Blow out bearing with compressed air.

CAUTION: *Do not allow bearings to spin; turn them slowly by hand. Spinning bearings will damage race and balls. Make certain bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning race by hand.*

3. Check for cracks in blocker rings.

4. Wash transmission case thoroughly inside and outside with suitable cleaning solvent; then inspect case for cracks.

   a. Check front and rear case faces for burrs and, if present, remove with a fine mill file.

   b. Check and clean magnet in bottom of transmission case.

5. All main drive gear and countershaft gear bearing rollers should be inspected closely and replaced if they show wear.

6. Inspect all gears for excessive wear, chips or cracks.

7. Inspect reverse gear bushing and, if worn or damaged, replace entire gear.

   NOTE: *Reverse gear bushing is not serviced separately.*

8. Inspect reverse idler gear bushing and, if worn or damaged, replace entire gear.

9. Check for broken bearing rollers in countershaft gear assembly:

   a. Inspect anti-rattle plate teeth for wear or other damage.

   b. Check for broken anti-rattle springs.

   NOTE: *The anti-rattle plate is riveted to the countergear in three (3) places. Disassembly is not recommended.*

10. If oil seal in main drive gear bearing retainer needs replacement, pry out oil seal with screwdriver. Replace with new oil seal, using flat plate, and tap until seal is seated in its bore (Fig. 7A-28).

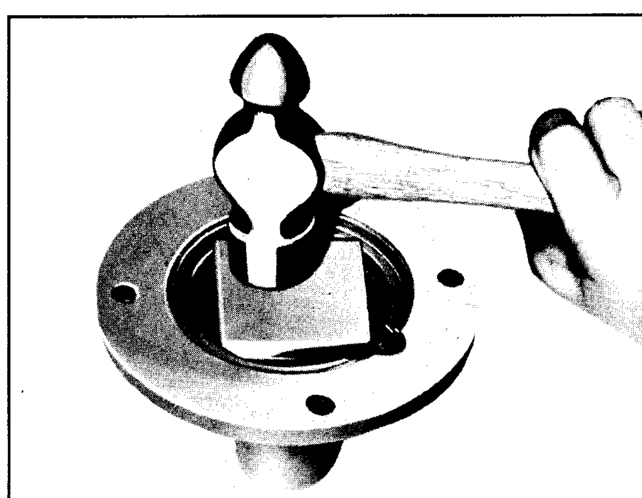


Fig. 7A-28 Installing Main Drive Gear Bearing Retainer Oil Seal

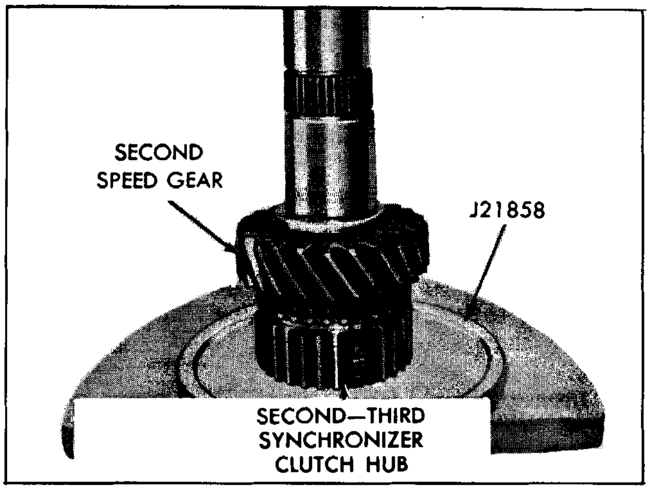


Fig. 7A-29 Installing 2nd & 3rd Speed Synchronizer Clutch Hub and 2nd Speed Gear

NOTE: *Lip of oil seal must face rear of bearing retainer.*

ASSEMBLE

1. Turn the front of the mainshaft upward and install 2nd speed gear, 2nd speed blocking ring and synchronizer. Using hydraulic or arbor press and Press Plate J 21858, press 2nd & 3rd speed synchronizer clutch hub (with chamfer toward rear of transmission) onto mainshaft (Fig. 7A-29). Install retaining snap ring.

   CAUTION: *Make certain notches in blocker ring align with keys in synchronizer hub.*

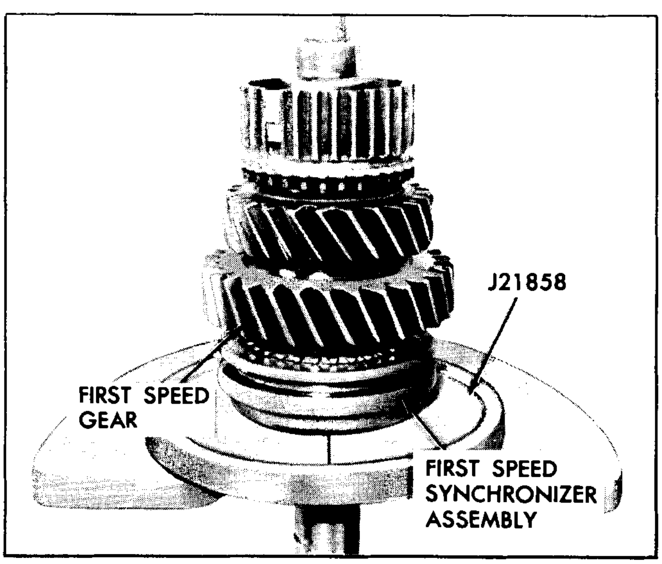


Fig. 7A-30 Installing 1st Speed Gear and Synchronizer Assembly

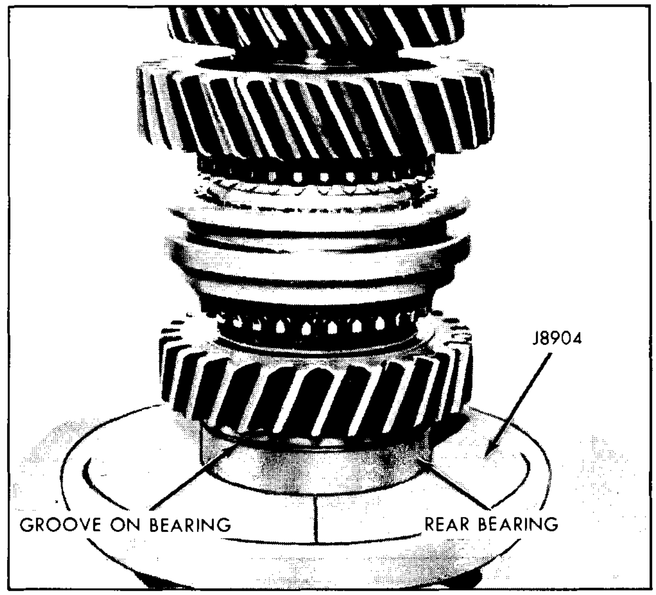


Fig. 7A-31 Installing Rear Bearing

2. Install 1st speed gear, 1st speed blocker ring and synchronizer assembly on mainshaft (Fig. 7A-30). Using hydraulic or arbor press and Press Plate J 21858, press 1st speed gear and synchronizer assembly onto mainshaft. Install retaining snap ring.

   CAUTION: *Make certain notches in blocker ring align with keys in 1st speed synchronizer assembly.*

3. Turn the rear of the mainshaft upward and install reverse gear, thrust washer, spring washer and rear bearing (Fig. 7A-20).

   NOTE: *Groove on bearing must be toward reverse gear.*

4. Using hydraulic or arbor press and Press Plate J 8904, press rear bearing into position (Fig. 7A-31). Install retaining snap ring.

5. Install the speedometer drive gear and retaining clip onto mainshaft.

6. Install 2nd & 3rd speed synchronizer sleeve (Fig. 7A-23).

7. Install Countershaft Alignment Tool J 22246.

8. From each end of countershaft gear, install 27 bearing rollers and bearing washer (Fig. 7A-32).

   NOTE: *Coat bearing rollers with heavy grease before installing.*

9. Install countershaft gear-to-case bronze thrust washers.

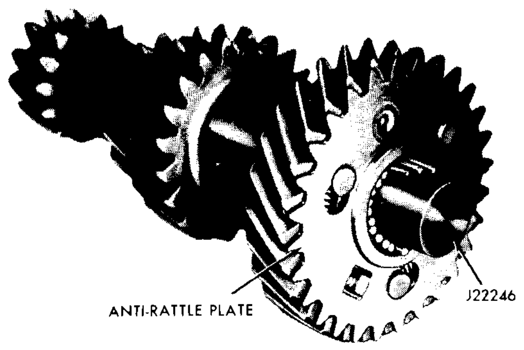


Fig. 7A-32 Loading Bearing Rollers into Countershaft Gear

10. Install countershaft gear assembly into case. Install countershaft from rear of case. Make certain woodruff key is in position.

11. Install reverse idler gear, shaft and woodruff key.

NOTE: *Reverse idler gear retainer ring will be installed after installation of mainshaft.*

12. Install rear extension. Spread snap ring in rear extension to allow snap ring to drop around rear bearing (Fig. 7A-20). Press on end of mainshaft until snap ring engages groove in rear bearing.

13. Install fourteen (14) bearing rollers in the main drive gear, using heavy grease to hold rollers in place (Fig. 7A-33).

Fig. 7A-33 Loading Rollers Into Main Drive Gear

14. Assemble 3rd speed blocker ring on main drive gear.

15. Pilot main drive gear and 3rd speed blocker ring over front of mainshaft.

16. Using heavy grease, install rear extension-to-case gasket.

17. Install rear extension and mainshaft assembly into case. Install rear extension-to -case bolts. Torque to 45 lb. ft.

CAUTION: *Make certain that notches in 3rd speed blocker ring align with keys in 2nd & 3rd synchronizer clutch hub.*

18. Install bearing onto main drive gear. Outer snap ring groove must be toward front of gear.

19. Install bearing-to-main drive gear snap ring.

20. Install main drive gear bearing retainer, gasket and four attaching bolts, torquing bolts to 10 lb. ft.

NOTE: *The retainer oil return hole must be at bottom of case.*

21. Install reverse idler gear retainer ring.

22. Install new case cover gasket. Place transmission in neutral and install case cover. Secure with attaching bolts and torque evenly to 10 lb. ft. to avoid case cover distortion.

23. Install speedometer driven gear in rear extension and attach S.C.S. ground wire (V-8 engines only).

INSTALL

1. Install guide pin in upper right transmission- -to-flywheel housing bolt hole for alignment and place transmission on guide pin. Rotate transmission as necessary to start main drive gear splines into clutch friction plate. Slide transmission forward.

NOTE: *Make certain splines of clutch friction plate are concentric with pilot bearing in crankshaft and that the release bearing is properly installed.*

2. Install two (2) lower transmission mounting bolts. Remove guide pin and install two (2) upper bolts. Torque bolts to 55 lb. ft.

3. Slide crossmember forward and install four (4) bolts. Torque to 25 lb. ft.

4. Install transmission mount and lower engine. Torque mount bolts to 30 lb. ft.

5. Install propeller shaft.

6. Connect linkage, connect lead to T.C.S. switch (6 cyl. only) and adjust linkage as described in ON CAR ADJUSTMENTS.

   On floor shift controlled cars, install shifter assembly to the 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.

7. Connect speedometer cable.

8. Refill transmission with recommended lubricant.

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

An identifying code is marked in yellow paint on all three speed manual transmissions. This code consists of a letter and a number, 2 inches high, on R.H. side of the transmission case.

The letter and number "R3" identifies the Saginaw three-speed manual transmission used on A, F and X Series equipped with the 250 cu. in. 6-cylinder engine.

The letter and number "R4" identifies the Saginaw three speed manual transmission used on X Series equipped with the 307 cu. in. V-8 engine and the Saginaw transmission used on A and F Series equipped with the 350 cu. in. V-8 engine.

A number derived from the vehicle identification number is also stamped on the transmission case as shown in Fig. 7A-34.

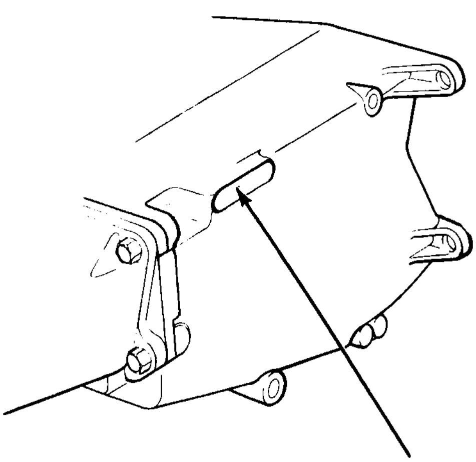


Fig. 7A-34 Vehicle Identification Number Location

GEAR RATIOS

	6-Cyl.	V-8
First Speed	2.85:1	2.54:1
Second Speed	1.68:1	1.50:1
Third Speed	1.00:1	1.00:1
Reverse	2.95:1	2.63:1

LUBRICANT

Capacity........................... 56 fluid ounces (3 1/2 pints)

TORQUE

APPLICATION	LB. FT.
Main Drive Gear Bearing-to-Case Bolts	10
Case Cover-to-Case Bolts	10
Rear Extension-to-Case Bolts	45
Shifter Lever-to-Shifter Shaft Bolts	25
Lubrication Filler Plug	15
Transmission Case-to-Flywheel Housing Bolts	55
Control Rod Swivel Screws (Nuts)	20
Shifter Assembly-to-Shifter Support (Upper) Bolt	45
Shifter Assembly-to-Shifter Support (Lower) Bolt	25
Shifter Support-to-Rear Extension Bolts	30
Frame-to-Crossmember Bolts (4)	35
Crossmember-to-Rear Mount Bolts (2)	40
Rear Mount-to-Rear Extension Bolts (2)	40

APPLICATION	LB. IN.
Idler Lever Support-to-Frame Bolts	150
Cross Shaft Bracket-to-Frame Bolts	150

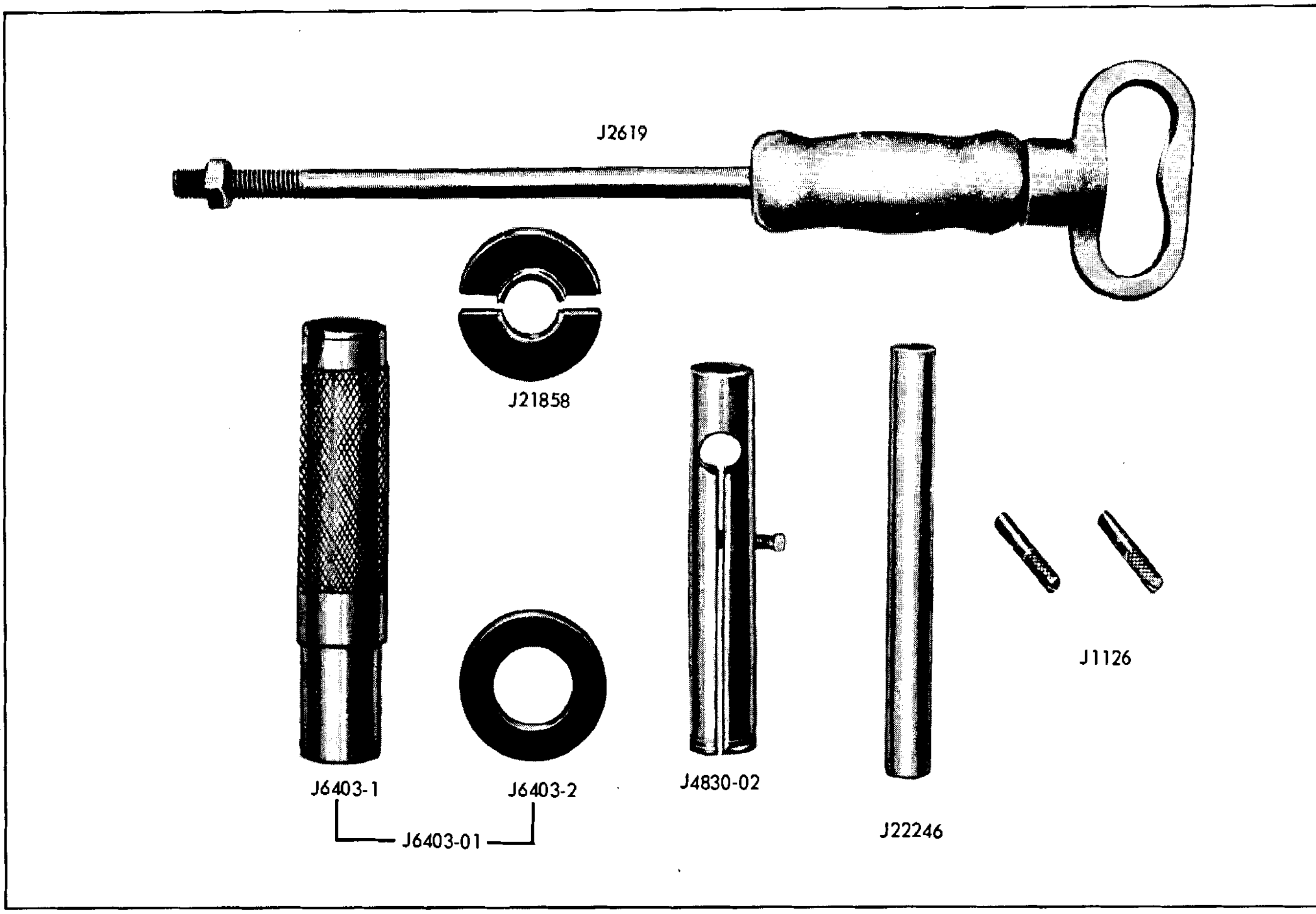


Fig. 7A-35 Special Tools

J 1126	Transmission Aligning Studs
J 2619	Slide Hammer
J 4830-02	Extension Bushing and Oil Seal Remover
J 6403-01	Extension Bushing and Oil Seal Installer
J 8904	Press Plate (Not Shown)
J 21858	Press Plates
J 22246	Countershaft Alignment Tool

6" x 1 7/8" x 1/4" - Pieces (2) of stock (Not Shown)

SECTION 7B

THREE SPEED MUNCIE TRANSMISSION

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

NOISY OPERATION

Noise is an elusive element and is generally not the fault of the transmission. Therefore, it is essential that the vehicle be road tested to determine if driver's complaint of noise is actually caused by the transmission.

NOISES FROM OUTSIDE TRANSMISSION

In some instances, drivers have insisted that noise was coming from transmission when further investigation has revealed the noise to be caused by one of the following conditions:

1. Fan out-of-balance or blades bent.
2. Defective harmonic balancer.
3. Crankshaft out-of-balance.
4. Flywheel out-of-balance.
5. Flywheel mounting bolts loose.
6. Engine rough at idle, causing rattle in gear train.
7. Clutch assembly out-of-balance.
8. Engine mounts loose or broken.
9. Universal joints worn or loose.
10. Propeller shaft out-of-balance.
11. Universal joint angles.
12. Wheels out-of-balance.
13. Tire treads humming or vibrating at certain speeds.
14. Loose or grounded floor shifter assembly.

NOISES FROM WITHIN TRANSMISSION

Determine what position the gearshift lever is in when noise occurs. If noise is evident in only one gear position, the cause of this noise is generally traceable to the gears in operation in that range. Moreover, if noise appears to originate from within the transmission, try to break it down into one of the following classifications:

1. Improper or lack of lubricant - can cause noises. Low fluid level will sometimes cause transmission to run hotter than normal, as there is insufficient lubricant to cool and cover the gears.
2. Vibration - in power train can cause gear seizures on thrust faces or fluted diameters in the transmission.

And power train encompasses engine, propeller shaft, universal joint angle, rear axle, differential, extension bearing, etc.

a. Improved highways encourage sustained high speed. Engines and entire power trains now cruising at high rpm can introduce vibration frequencies that weren't critical in the past. At slower speeds these items would get by unnoticed or only pass through brief critical periods while accelerating or decelerating through the gears.

b. In the past, drive line vibrations such as bent tubes, joints out-of- alignment, clutch out-of-balance, or gears and shafts in transmission out- of-balance were fairly obvious. These items are more critical in vehicles running at sustained high speeds.

c. Critical vibrations associated with higher speed are high frequency vibrations that could cause gear seizures, damaged synchronizers, bearing failure due to retainer bolt failures, promote brinelling, etc.

3. Gear whine - is usually caused by lack of backlash between mating gears.
4. Metallic rattles - from within transmission are usually caused by engine torsional vibrations being transmitted to the transmission through the clutch.
5. Growl, humming or grinding noise - are caused by worn, chipped, rough or cracked gears. As gears continue to wear, grinding noise is more evident, especially in the gear position that throws the greatest load on the worn gear.
6. Hissing, thumping or bumping noise - hissing noises could be caused by bad bearings. As bearings wear and retainers start to break up, etc., the noise could change to a thumping or bumping noise.

NOISE IN NEUTRAL

1. Improper lubricant or lack of lubrication.
2. Incorrect clutch linkage adjustment.
3. Misalignment of transmission.
4. Worn or scored main drive gear and/or countershaft bearing rollers.
5. Worn mainshaft pilot bearings.
6. Scuffed gear tooth contact surfaces on gears; worn or rough reverse idler gear.
7. Excessive back lash or unmatched constant mesh gears.
8. Sprung, worn or excessive end play in countershaft.
9. Excessive end play in reverse idler gear.

NOISE IN FORWARD SPEEDS

1. Noisy speedometer drive and/or driven gears.
2. Worn or rough mainshaft rear bearing.
3. Excessive end play of mainshaft gears.

WALKING OR SLIPPING OUT OF GEAR

1. If transmission is walking out of gear, it could be caused by:

   a. Shift linkage out of adjustment, worn or loose to prevent full engagement of the synchronizer sleeve.

   b. Interference or resistance in side cover shift mechanism to prevent full engagement of the synchronizer sleeve, such as bent or worn shift fork, lever and/or shaft, damaged detent cams, spring, etc.

   c. If synchronizer sleeve is engaging fully, look for some other malfunction which could move sleeve out of engagement, such as worn clutching teeth on gears, synchronizer sleeve, blocker ring, etc.

2. Items which could also cause gear walk-out are:

   a. Worn pads on shift fork or sleeve worn excessively.

   b. Worn taper on clutch gear teeth or gears.

   c. Transmission and engine misaligned vertically or horizontally.

3. Other items which could cause gear walk-out, especially on rough roads, are:

   a. Detent cam spring in side cover broken.

   b. Detent cam notches worn.

   c. If holding gearshift lever will prevent jump-out, detent cam modification or replacement will often correct it. However, when a gear has been allowed to jump-out for a long period, the cause must be corrected plus replacement generally of the affected gears.

d. Excessive end play in main drive gear, mainshaft or counter gear caused by worn bearings, retainers, etc.

e. Thrust washer or faces worn excessively, missing, etc.

HARD SHIFTING

1. Low level or wrong lubricant, especially if extreme pressure-type lubricants are added.
2. Incorrect clutch linkage adjustment.
3. Improper adjustment of shift linkage, excessively worn or damaged.
4. Shifter assembly mounting bolts too tight.
5. Worn, sprung shifter forks or worn shifter shafts.
6. Damaged synchronizer assemblies.
7. Burred or misaligned mainshaft.

STICKING IN GEAR

1. Wrong or low level of lubricant.
2. Clutch not releasing fully.
3. Worn chamfer on detent cam notches.
4. Damaged blocker ring or teeth of synchronizer sleeve.
5. Misaligned mainshaft and/or countershaft.

CLASHING OR RAKING OF GEARS

1. Raking of gears during shift duration is usually caused by a defective synchronizer or improper shifting technique:

   a. Broken synchronizer components will sometimes prevent proper movement of synchronizer sleeve, resulting in clashing shifts.

   b. Worn synchronizer components, with loss of clutching action, are usually caused by poor driver technique. Failure to control engine speed drop-off during upshift, or failure to bring engine speed nearly up to output shaft speed when downshifting, causes overwork of synchronizer and failure to shift. Also, shifting without using clutch will burn or wear out synchronizer at relatively low mileage.

2. When shift lever moves directly into gear position without resistance, raking of gears will be audible and felt through the gearshift lever. This condition does not always mean that synchronizer is worn out or broken. The following may cause this condition:

   a. Often, small chips may lodge temporarily in a synchronizer which would prevent proper synchronization and cause a raking shift. Continued operation may either embed the chip below the surface of the bronze blocker ring or reject it and the synchronizer will return to normal functioning.

   b. Use of improper lubricants often causes raking of synchronizers. Heavy oil prevents synchronizer from breaking through oil film and doing the job properly. This raking noise usually occurs with cold and heavy oil, but synchronizer begins to function properly when normal operating temperature of transmission oil is reached.

   CAUTION: *Use of extreme pressure-type lubricants is not recommended. Glazing of synchronizer blocker ring, due to breakdown of oil, is especially common because of additives found in extreme pressure lubricants.*

ROUGH NEUTRAL CROSS-OVER

1. Improper adjustment of shift linkage.
2. Bent or damaged shift control rod (1st & Rev. or 2nd & 3rd rod).

LOCKS IN TWO GEARS AT SAME TIME

1. Improper adjustment of shift linkage.
2. Bent or damaged shift control rod (1st & Rev. or 2nd & 3rd rod).

OIL LEAKS

1. Wrong lubricant or level too high.

2. Drain plug loose.
3. Welch plugs loose or missing from machined openings in case.
4. Seals at side cover or extension housing omitted or defective.
5. Extension housing bushing worn, resulting in repetitive oil seal failures.
6. Attaching bolts loose or omitted from bearing retainers, side cover, etc.
7. Oil drain-back openings in bearing retainer or case plugged with varnish or dirt, covered with gasket material, etc.
8. Broken gaskets, gaskets shifted or squeezed out of position, pieces still under bearing retainer, cover, etc.
9. Cracks or holes in castings.

GENERAL DESCRIPTION

The Muncie three-speed transmission is the optional heavy duty, floor shift, three-speed manual transmission used only on the 350 and 400 cu. in. V-8 equipped A Series.

It is fully synchronized in all forward gears and incorporates helical drive gears throughout (Fig. 7B-1). Reverse gear is not synchronized; however, it is a helical gear to insure quiet operation. While this transmission is very similar to the present Saginaw three-speed, it has a 3 1/4 inch center distance instead of 3 inches for Saginaw, has an iron case and has larger bearings, input shaft, mainshaft and gears. The main drive gear (input shaft) is supported by a ball bearing at the front end in an oil impregnated bushing mounted in the engine crankshaft. The front end of the mainshaft is piloted in a row of bearing rollers, set into the hollow end of the main drive gear and is carried at the rear by a bearing mounted in the front face of the extension housing. The countergear is carried on a double row of bearing rollers at both ends and thrust is taken on thrust washers located between the ends of 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 reverse idler gear is carried on a bushing finish, bored in place and thrust is taken on the thrust bosses of the case.

Gear shifting is manual through a floor mounted shifter assembly from a control rod to the outer rear shifter lever of the side cover assembly for first and reverse gear; and from a control rod to the outer forward shifter lever of the side cover assembly for second and third gear. All three forward gears are fully synchronized and each of these two synchronizer assemblies consists of a hub, sleeve, two key springs and three synchronizer keys. The synchronizer hubs are spliced to the mainshaft and are retained by snap rings. The transmission may be used as an aid in slowing vehicle speed in decelleration by downshifting in sequence without double-clutching or any gear clashing.

OPERATION

The main drive gear (input shaft), 2nd speed gear, 1st speed gear and reverse idler gear are in constant mesh with the countergear and the reverse idler gear is in constant mesh with the reverse gear. With the engine running and the engine clutch engaged, torque is imparted through the main drive gear to the countergear. From the countergear, torque is then imparted to the 2nd speed gear, the 1st speed gear and the reverse idler gear. The reverse idler gear imparts torque to the reverse gear.

NEUTRAL

With the engine running and clutch engaged, the main drive gear turns the countergear. The countergear, in turn, rotates the 2nd, 1st and reverse idler gears. The reverse idler gear turns the reverse gear.

In neutral, both synchronizer assemblies are neutrally positioned and no power will be imparted to the mainshaft.

FIRST GEAR

With the engine running and clutch engaged, the main drive gear turns the countergear. The countergear, in turn, rotates the 2nd, 1st and reverse idler gears. The reverse idler gear turns the reverse gear.

In first speed, the 1st & Rev. synchronizer sleeve is moved forward on its hub to engage the rotating 1st speed gear and the 2nd & 3rd synchronizer assembly remains positioned in neutral. Since the 1st & Reverse synchronizer sleeve is keyed to its hub, and the hub is splined to the mainshaft, torque is imparted from the rotating 1st speed gear through the synchronizer sleeve to its hub and hence to the mainshaft, causing it to rotate in first gear.

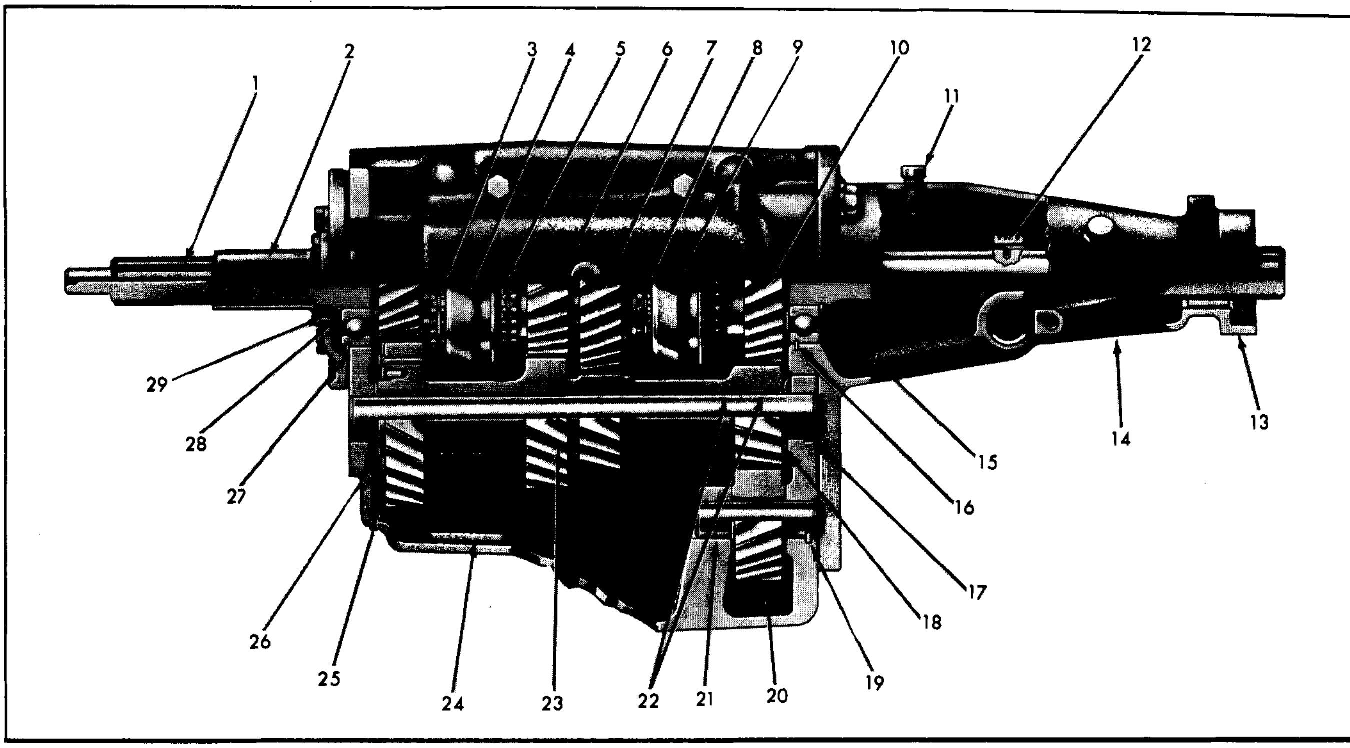


Fig. 7B-1 Cross Section of Transmission

1. Clutch Gear (Main Drive Gear)
2. Bearing Retainer
3. 3rd Speed Blocker Ring
4. 2nd & 3rd Speed Synchronizer Assembly
5. 2nd Speed Blocker Ring
6. 2nd Speed Gear
7. 1st Speed Gear
8. 1st Speed Blocker Ring
9. 1st & Reverse Synchronizer Assembly
10. Reverse Gear
11. Vent
12. Speedometer Drive Gear and Clip
13. Rear Oil Seal
14. Extension Housing
15. Rear Bearing-to-Shaft Snap Ring
16. Rear Bearing-to-Housing Snap Ring
17. Countershaft Woodruff Key
18. Thrust Washer
19. Reverse Idler Shaft Woodruff Key
20. Reverse Idler Gear
21. Reverse Idler Shaft
22. Countershaft Bearing Rollers
23. Countergear
24. Case Magnet
25. Anti-Lash Plate
26. Thrust Washer
27. Clutch Gear (Main Drive Gear) Bearing
28. Bearing-to-Gear Snap Ring
29. Retainer Lip Seal

SECOND GEAR

With the engine running and clutch engaged, the main drive gear turns the countergear. The countergear, in turn, rotates the 2nd, 1st and reverse idler gears. The reverse idler gear turns the reverse gear.

In second speed, the 1st & Rev. synchronizer assembly assumes a neutral position and the 2nd & 3rd synchronizer sleeve is moved rearward on its hub to engage the rotating 2nd speed gear. Since the 2nd & 3rd synchronizer sleeve is keyed to its hub, and the hub is splined to the mainshaft, torque is imparted from the rotating 2nd speed gear through the synchronizer sleeve to its hub and hence to the mainshaft, causing it to rotate in second gear.

THIRD GEAR

With the engine running and clutch engaged, the main drive gear turns the countergear. The countergear, in turn, rotates the 2nd, 1st and reverse idler gears. The reverse idler gear turns the reverse gear.

In third speed (or direct drive), the 2nd & 3rd synchronizer sleeve is moved forward on its hub to engage the rotating main drive gear and the 1st & Rev. synchronizer assembly remains in a neutral position. Since the 2nd & 3rd synchronizer sleeve is keyed to its hub, and the hub is splined to the mainshaft, torque from the rotating main drive gear is imparted directly through the 2nd & 3rd synchronizer sleeve to its hub and hence to the mainshaft, causing the mainshaft to rotate at the same speed as the main drive gear. Thus, the vehicle is in direct drive.

REVERSE

With the engine running and clutch engaged, the main drive gear turns the countergear. The countergear, in turn, rotates the 2nd, 1st and reverse idler gears. The reverse idler gear turns the reverse gear.

In reverse, the 2nd & 3rd synchronizer assembly assumes a neutral position and the 1st & Rev. synchronizer sleeve is moved rearward on its hub to engage the rotating reverse gear. Since the 1st & Rev. synchronizer sleeve is keyed to its hub and the hub is splined to the mainshaft, the engagement causes the mainshaft to rotate in a reverse direction. Since power flows from the main drive gear to countergear and through the reverse idler gear to the reverse gear, the mainshaft is now rotating in a direction that is opposite of main drive gear rotation and the vehicle is now in reverse.

PERIODIC SERVICE RECOMMENDATIONS

TRANSMISSION

No periodic service of the transmission is required except checking for leaks and checking for proper lubricant level every 6,000 miles. If there is evidence of leakage, leak should be corrected and lubricant added as needed. It is recommended that any additions required to bring up lubricant level should be made using the same type lubricant already in the transmission.

When checking lubricant level in transmission, it should be checked at operating temperature. When at operating temperature, lubricant should be level with bottom of filter plug hole. If unit is cold, lubricant level should be 1/2 inch below the filler plug hole. Refill capacity is 44 fluid ounces (2-3/4 pints). Use SAE 90 "Multi-Purpose" gear lubricant. The SAE 90 viscosity grade is recommended for year around use. However, when extremely low temperatures are encountered for protracted periods during winter months only, the SAE 80 viscosity grade may be used. No special additive to these lubricants is required or recommended.

FLOOR SHIFT CONTROLS

Every 6,000 miles or 4 months, lubricate shift linkage and

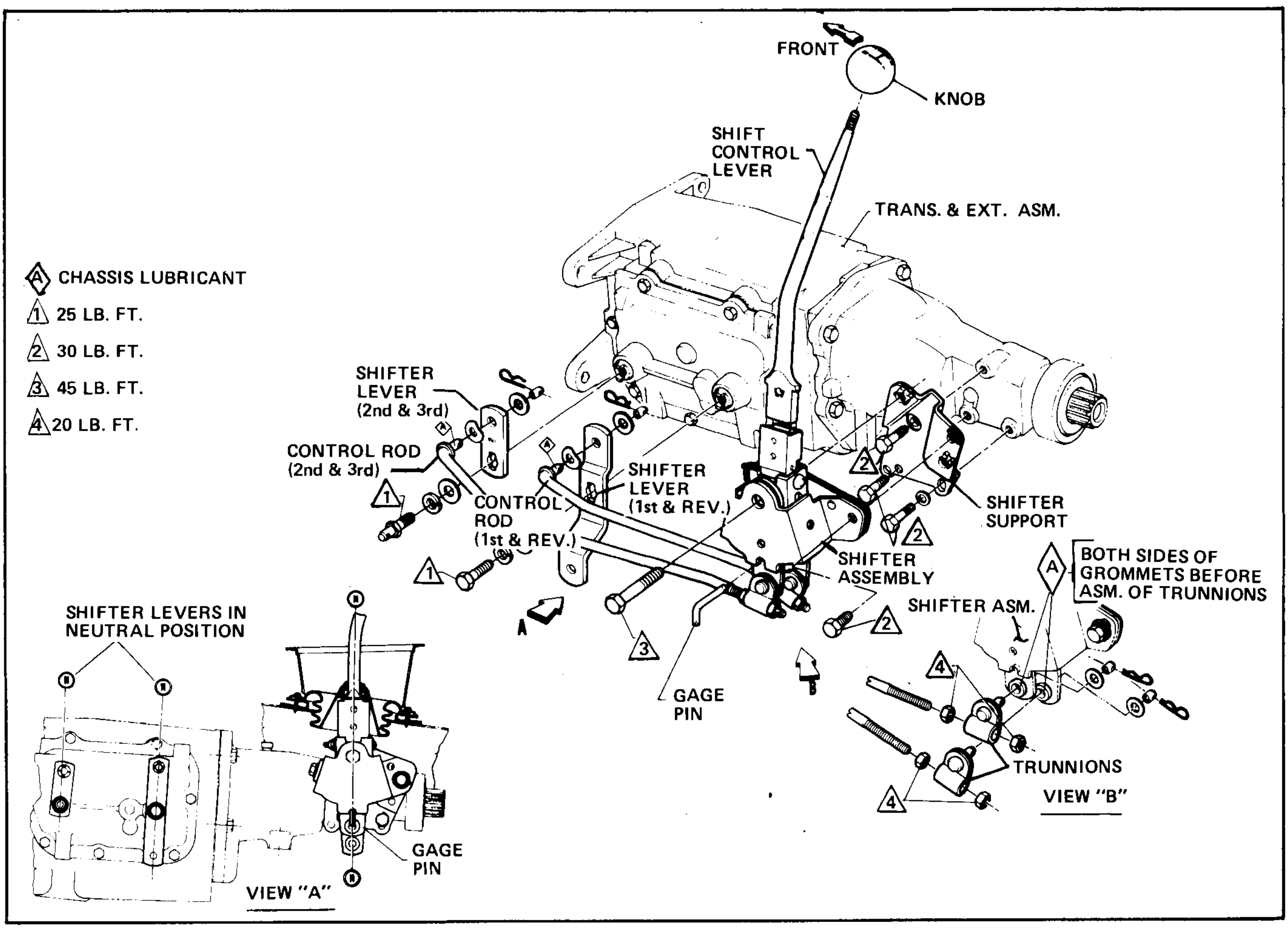


Fig. 7B-2 Floor Shift Controls - A Series floor shift control lever contacting faces with water resistant EP chassis lubricant. To lubricate the floor shifter assembly, use a needle fitting adapter on grease gun nozzle and direct grease liberally into vital areas as follows:

1. Pry dust cover off with a screwdriver blade.
2. Move gearshift control lever into 3rd gear (2nd & 3rd linkage moved forward), inject grease onto contact surfaces behind 2nd & 3rd lever, move control lever into 2nd gear (2nd & 3rd linkage moved rearward) and inject grease into contact surface ahead of 2nd & 3rd lever. Use grease liberally.
3. Repeat step 2 with 1st & Rev. lever and, after all areas have been greased, replace dust cover.

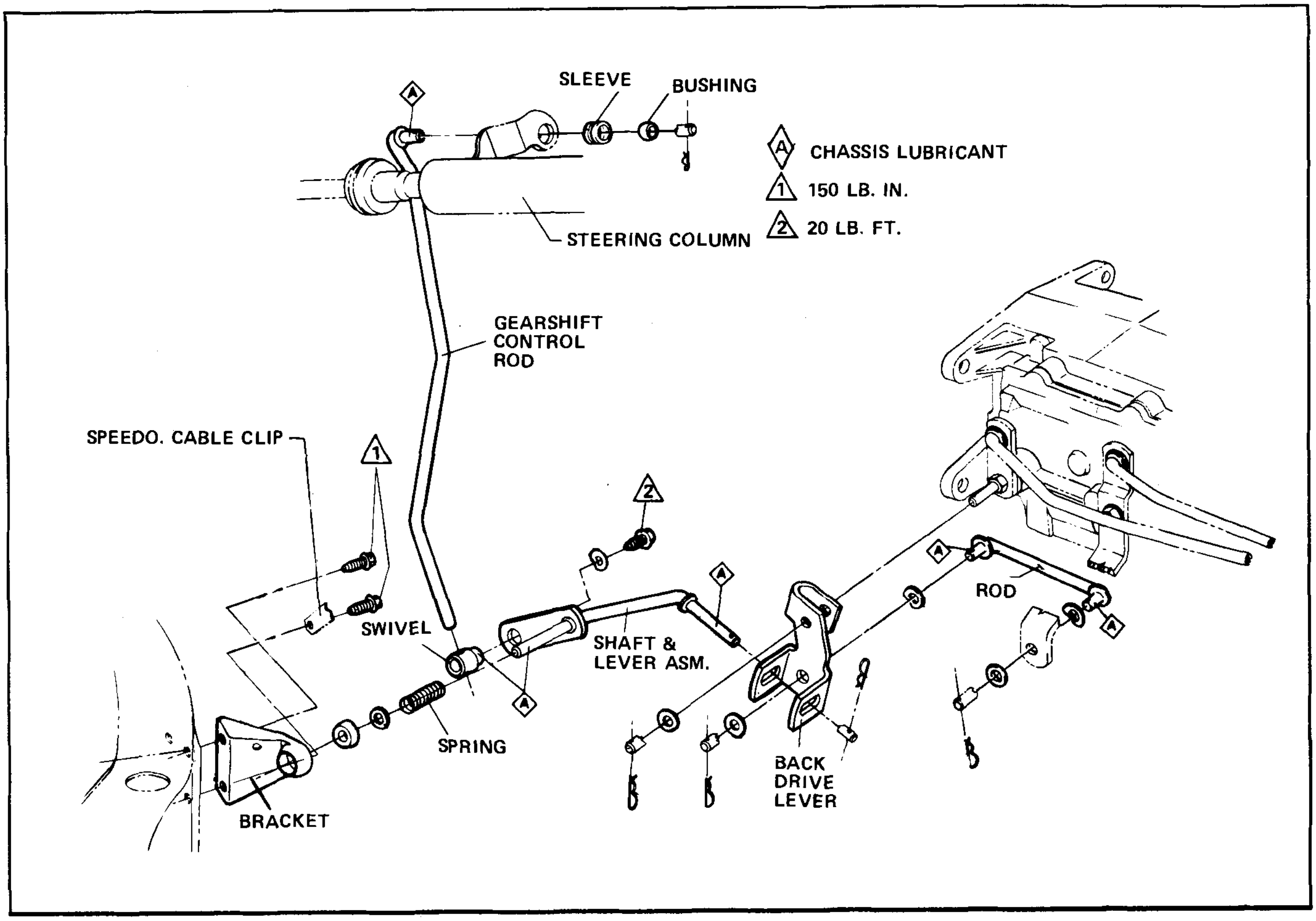


Fig. 7B-3 Back Drive Linkage - A Series

ON CAR ADJUSTMENTS

FLOOR SHIFT AND BACK DRIVE LINKAGE (Figs. 7B-2 and 7B-3)

1. Position floor shift control lever in Neutral position ("neutral" position is the mid-position of travel of shifter levers) and insert alignment tool (or suitable 1/4" diameter rod) into shifter alignment holes. Be sure that tool engages notch in far side of shifter housing.
2. Loosen jam nuts at gearshift control rod trunnions and disconnect 2nd & 3rd and 1st & Rev. trunnion and pin assemblies from both shifter assembly levers.
3. With 2nd & 3rd control rod and 1st & Rev. control rod disconnected from the shifter assembly, manually move them to ascertain that transmission gears are in neutral.
4. With transmission gears in neutral and shifter assembly locked in neutral by its alignment tool, adjust trunnion and pin assemblies on their control rods so they align with and enter freely into their holes in

shifter levers. Retain each with a plain washer and retainer clip and tighten jam nuts to 20 lb. ft. torque.

5. Remove alignment tool and check complete shift pattern for freeness of operation.

6. Position shift control lever in Reverse position, set steering column lower lever in lock position and lock the ignition.

7. Push up on gearshift control rod to take up clearance in steering column lock mechanism and torque nut (or screw) of adjusting swivel clamp to 20 lb. ft. torque.

MINOR REPAIRS

SPEEDOMETER DRIVEN GEAR ASSEMBLY

REMOVE

1. Raise vehicle on hoist.

2. Disconnect speedometer cable, remove retainer-to-extension housing bolt and remove retainer.

3. Insert screwdriver blade in retainer slot of gear fitting, pry speedometer fitting, gear and shaft from extension housing and remove "O" ring seal from its groove in fitting.

INSTALL

1. Install new "O" ring seal into groove in fitting and coat "O" ring seal and driven gear shaft with transmission lubricant.

2. Insert driven gear shaft into fitting.

3. Hold assembly so that slot in fitting is toward retainer boss on extension housing and insert assembly into extension housing.

4. Push fitting in until retainer can be inserted into its groove, install bolt, torquing to 4 lb. ft., connect speedometer cable and lower and remove vehicle from hoist.

EXTENSION HOUSING OIL SEAL

REMOVE

1. Raise vehicle on hoist and remove propeller shaft as outlined in Section 4E.

2. Remove oil seal by prying out with screwdriver and discard seal.

CLEANING AND INSPECTION

1. Wash housing counterbore with cleaning solvent and inspect for damage.

2. Inspect propeller shaft yoke for nicks, burrs or scratches which could cut new seal, cause seal to leak or damage extension housing bushing.

INSTALL

1. Prelubricate between sealing lips and coat new seal O.D. with sealing compound and start seal straight into extension housing bore.

2. With flat side of collar out, place Collar J 6403-2 onto Tool J 6403-1 and place over end of output shaft (Fig. 7B-4).

3. Tap end of tool with soft hammer to seat the seal.

4. Reinstall propeller shaft, lower and remove vehicle from hoist.

EXTENSION HOUSING BUSHING

REMOVE

1. Raise vehicle on hoist and remove propeller shaft as outlined in Section 4E.

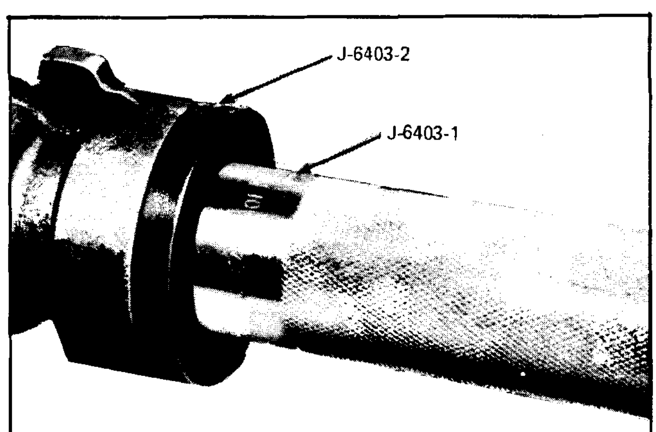


Fig. 7B-4 Installing Extension Housing Oil Seal

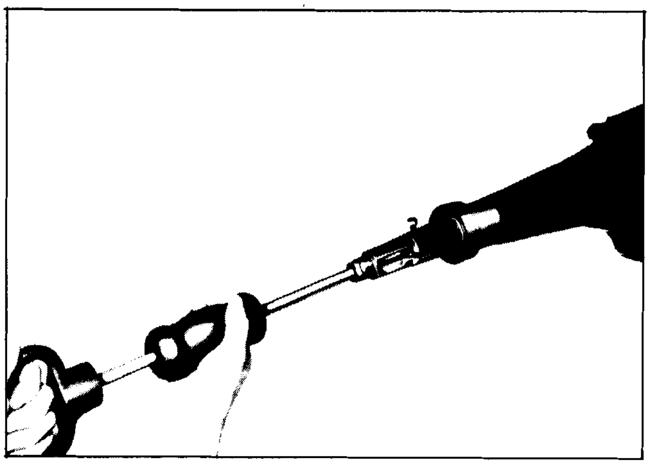


Fig. 7B-5 Removing Extension Housing Oil Seal and Bushing

2. Insert Tool J 4830-02 over output shaft and through extension housing bushing and tighten its screw.

3. Attach Slide Hammer J 2619. Using hammer, pull bushing and seal from extension housing (Fig. 7B-5).

INSTALL

1. Start new bushing into extension housing and, using Tool J 6403-1 and soft hammer, tap bushing into place (Fig. 7B-6).

2. Prelubricate between sealing lips and coat new seal O.D. with sealing compound and, using Collar J6403-2 on Tool J6403-1 and a soft hammer, seat the seal in its counterbore.

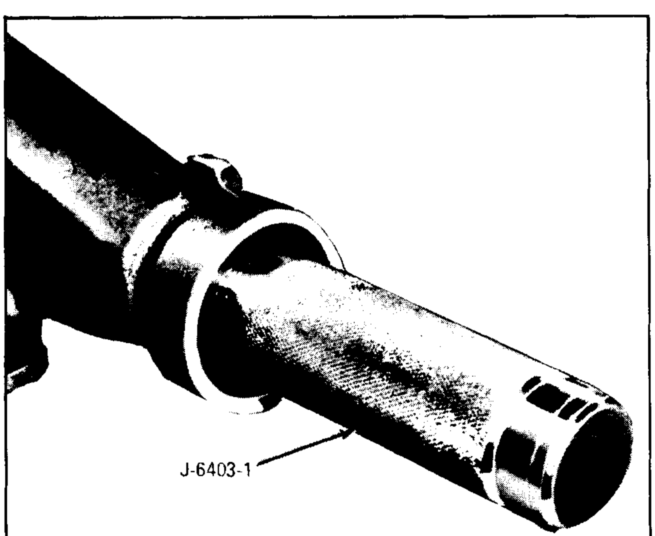


Fig. 7B-6 Installing Extension Housing Bushing

3. Attach Slide Hammer J 2619. Using hammer, pull bushing and seal from extension housing (Fig. 7B-5).

TRANSMISSION SIDE COVER ASSEMBLY

REMOVE

1. Raise vehicle on hoist and disconnect linkage from outer shifter levers on transmission, leaving it in neutral.

2. Loosen side cover bolts, allow transmission to drain and remove side cover assembly from transmission.

DISASSEMBLE

1. Remove outer shifter levers and both shifter forks from shifter shaft assemblies.

2. Remove both shifter shaft assemblies from side cover, removing "O" ring seals from around shifter shafts if replacement is required because of damage (Fig. 7B-7).

3. Remove detent spring, pivot retainer "E" ring and both detent cams from side cover.

4. Inspect and replace necessary parts.

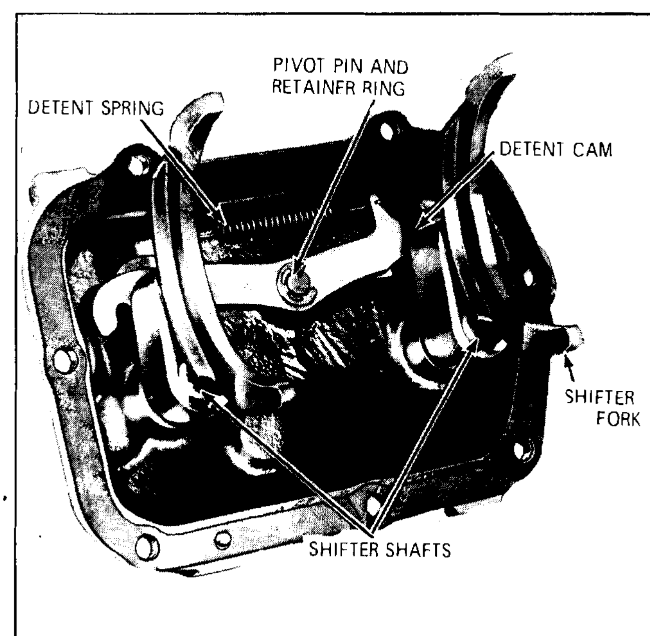


Fig. 7B-7 Transmission Side Cover Assembly

ASSEMBLE

1. Install 1st & Rev. detent cam onto the detent cam pivot pin and then 2nd & 3rd detent cam so that spring tangs of cams are facing up over their shifter shaft holes in the side cover.

2. Install detent cam retainer "E" ring to pivot shaft and hook detent spring over detent cam tangs.

3. Install both shifter shaft assemblies in cover, being careful not to damage "O" ring seals, and install both shifter forks to shifter shaft assemblies, lifting up on detent cams to allow forks to fully seat into position.

4. Install outer shifter levers, flat washers and bolts. Torque bolts to 25 lb. ft. and shift the outer shifter levers into neutral (center position).

INSTALL

1. Position side cover gasket on case and carefully position side cover into place, making sure that shifter forks are aligned with their respective synchronizer sleeves.

2. Install side cover bolts, tighten to 20 lb. ft. torque and connect control rods to shifter levers.

3. Remove filler plug from case and add SAE 90 "Multi Purpose" gear lubricant so that lubricant level is approximately level with bottom of filler plug hole when unit is at operating temperature. With unit cold, lubricant level should be 1/2 inch below the filler plug hole.

4. Install and tighten filler plug to 15 lb. ft. torque, lower and remove vehicle from hoist.

GEARSHIFT CONTROL LEVER

REMOVE

1. Release control lever by inserting a thin rule or a piece of .015" to .020" thick shim stock into the socket alongside the base of the floor gearshift lever on the driver's side.

2. Insert rule or stock to a depth of at least one inch to unlock its bayonet retainer.

3. Lift the control lever and tool up out of the shifter socket.

INSTALL

Replace lever. When inserting into the shifter socket, the bayonet will lock control lever automatically into position.

MAJOR REPAIRS

TRANSMISSION

REMOVE

1. Raise vehicle on hoist.

2. Replace propeller shaft as outlined in Section 4E.

3. Disconnect speedometer cable from its driven gear fitting and disconnect electrical leads from transmission.

4. Remove frame-to-crossmember attaching bolts and nuts and crossmember-to-rear mounting assembly bolts.

5. Support engine, raise slightly and slide crossmember rearward or remove.

6. Remove shifter levers at transmission shifter shafts and remove shifter assembly-to-shifter support attaching bolts. If shifter assembly removal is not required, it may be left hanging from its floor seal.

7. Remove two (2) upper transmission-to-clutch housing retaining bolts, install two (2) Transmission Aligning Studs J 1126 in their place and then remove the two (2) lower retaining bolts.

8. Slide transmission rearward and remove from vehicle.

DISASSEMBLE (Fig. 7B-8)

1. With transmission shifter shafts in neutral, remove side cover attaching bolts (7), cover assembly, shifter forks (2) and drain lubricant.

2. Remove extension housing-to-case attaching bolts (5).

3. Rotate extension housing 1/4 counterclockwise and, using drift or other suitable tool, drive reverse idler

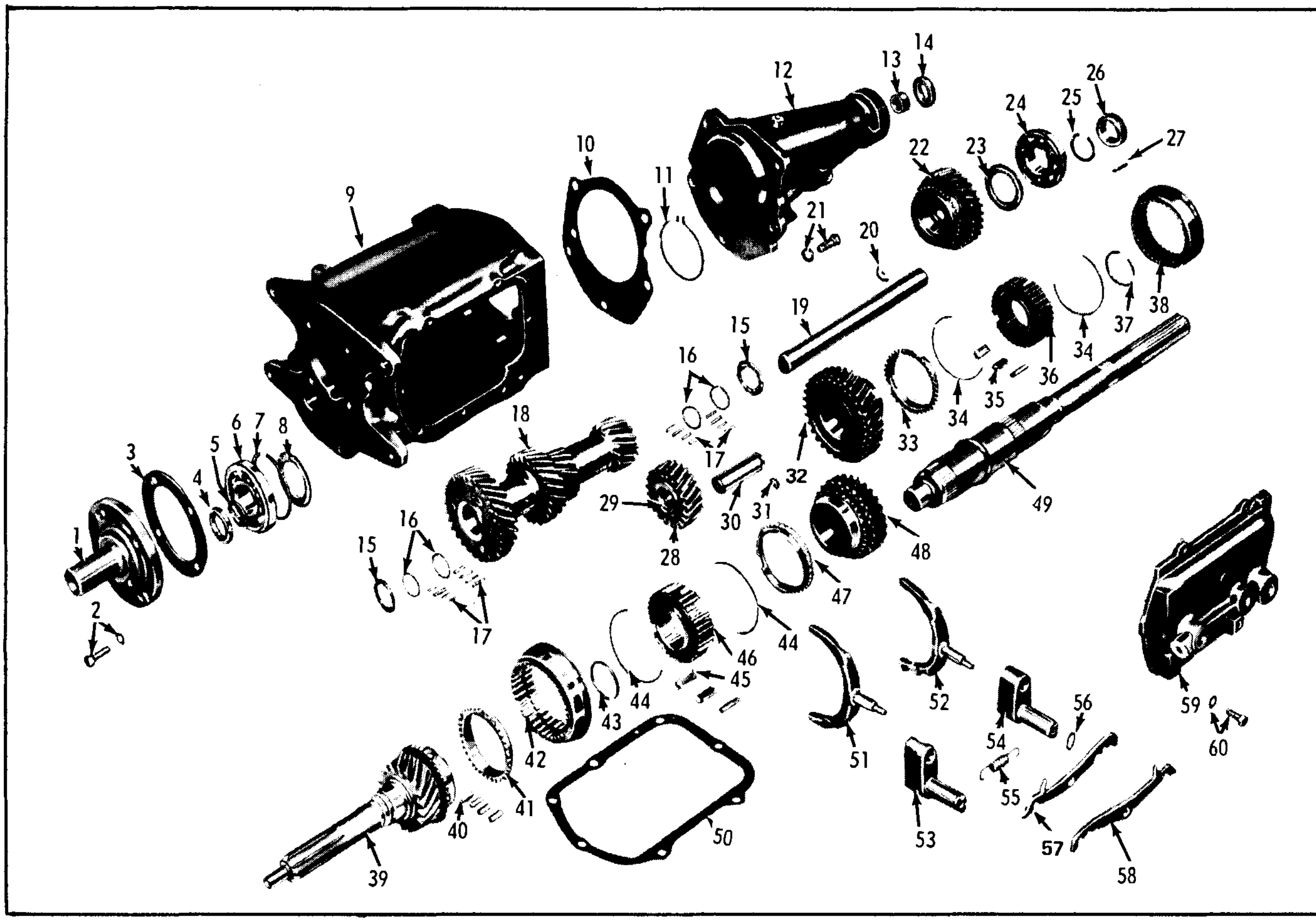


Fig. 7B-8 Exploded View of Transmission

1. Bearing Retainer
2. Bolts and Lock Washers (4)
3. Bearing Retainer Gasket
4. Retainer Oil Seal
5. Bearing-To-Gear Snap Ring
6. Main Drive Gear Bearing
7. Bearing-To-Case Snap Ring
8. Oil Slinger
9. Transmission Case
10. Extension Housing Gasket
11. Bearing-To-Housing Snap Ring
12. Extension Housing
13. Extension Housing Bushing
14. Rear Oil Seal
15. Countergear Thrust Washers (2)
16. Bearing Washers (4)
17. Countershaft Bearing Rollers (116)
18. Countergear
19. Countershaft
20. Woodruff Key
21. Bolts and Lock Washers (5)
22. Reverse Gear
23. Thrust Washer
24. Rear Mainshaft Bearing
25. Bearing-To-Shaft Snap Ring
26. Speedometer Drive Gear
27. Retaining Clip
28. Reverse Idler Gear
29. Reverse Idler Bushing
30. Reverse Idler Shaft
31. Woodruff Key
32. 1st Speed Gear
33. Ist Speed Blocker Ring
34. Synchronizer Key Springs (2)
35. Synchronizer Keys (3)
36. 1st & Rev. Synchronizer Hub
37. Hub-To-Mainshaft Snap Ring
38. 1st & Rev. Synchronizer Sleeve
39. Main Drive Gear
40. Mainshaft Pilot Bearings (16)
41. 3rd Speed Blocker Ring
42. 2nd & 3rd Synchronizer Sleeve
43. Hub-To-Mainshaft Snap Ring
44. Synchronizer Key Springs (2)
45. Synchronizer Keys (3)
46. 2nd & 3rd Synchronizer Hub
47. 2nd Speed Blocker Ring
48. 2nd Speed Gear
49. Mainshaft
50. Side Cover Gasket
51. 2nd & 3rd Shifter Fork
52. 1st & Rev. Shifter Fork
52. 2nd & 3rd Shifter Shaft
54. 1st & Rev. Shifter Shaft
55. Detent Spring
56. "O" Ring Seals (2)
57. 1st & Rev. Detent Cam
58. 2nd & 3rd Detent Cam
59. Side Cover
60. Bolts and Lock Washers (7)
62. "O" Ring Seal

shaft and its woodruff key out rear of case (Fig. 7B-9).

4. Move 2nd & 3rd synchronizer sleeve forward and, from rear of case, remove extension housing and mainshaft assemblies. Remove reverse idler gear from case and 3rd speed blocker ring from main drive gear.

5. Using snap ring pliers, expand snap ring at front of extension housing that retains mainshaft rear bearing and remove extension housing from mainshaft assembly (Fig. 7B-10).

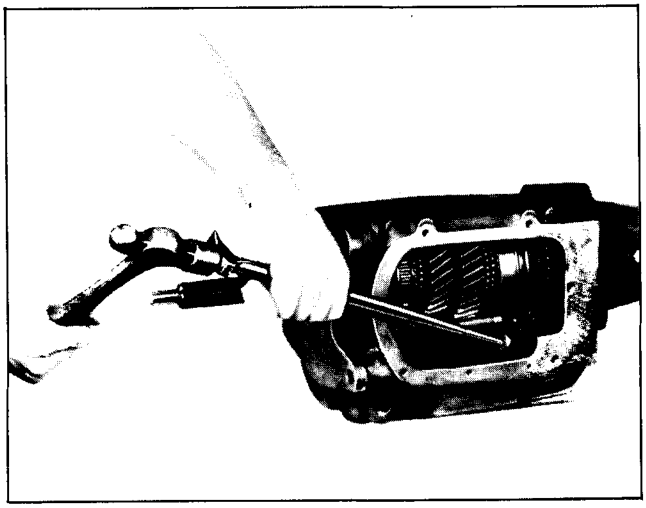


Fig. 7B-9 Removing Reverse Idler Shaft

6. Remove main drive gear bearing retainer bolts and lock washers (4), bearing retainer and gasket.
7. Remove bearing-to-main drive gear stem snap ring and remove main drive gear from inside of case by gently tapping on pilot end of main drive gear.
8. Remove oil slinger from main drive gear stem and unload sixteen (16) mainshaft pilot bearings from main drive gear cavity.
9. Slip main drive gear bearing out front of case. Since bearing is a slip fit on main drive gear stem and in case bore, it may be necessary to aid removal with a screwdriver between case and bearing outer snap ring.
10. Using drift or other suitable tool, drive countershaft and its woodruff key out rear of case.

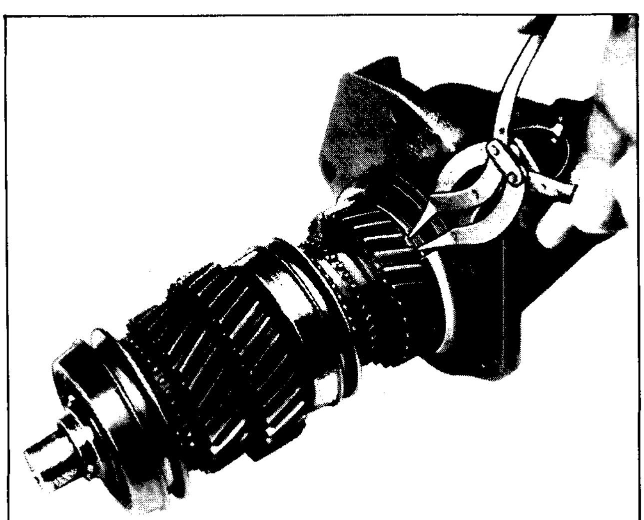


Fig. 7B-10 Separating Extension Housing From Mainshaft Assembly

11. Remove countergear and its two (2) tanged thrust washers from each end of the countergear.
12. If transmission side cover requires disassembly, proceed as outlined under MINOR REPAIRS.

MAINSHAFT

DISASSEMBLE (Fig. 7B-11)

1. Depress speedometer drive gear retaining clip and slide gear from mainshaft.
2. With front of mainshaft upward, remove 3rd speed blocker ring and, using snap ring pliers, remove 2nd & 3rd synchronizer hub snap ring from mainshaft.
3. Support 2nd speed gear with press plates and press on front of mainshaft to remove 2nd & 3rd synchronizer assembly, 2nd speed blocker ring and 2nd speed gear from mainshaft.
4. From other end of mainshaft remove rear bearing snap ring from mainshaft groove and, supporting reverse gear with press plates, press on rear of mainshaft to remove reverse gear, thrust washer and rear bearing from mainshaft. Use care when pressing so that reverse gear, thrust washer and rear bearing are centered on mainshaft.
5. Remove 1st & Rev. synchronizer hub snap ring from mainshaft.
6. Support 1st speed gear with press plates and press on rear of mainshaft to remove 1st & Rev. synchronizer assembly, 1st speed blocker ring and 1st speed gear from mainshaft.

TRANSMISSION

CLEANING

1. During overhaul procedures, all components of transmission (except bearing assemblies) should be thoroughly cleaned with cleaning solvent and dried with air pressure prior to inspection and reassembly of transmission.
2. Remove all portions of old gaskets from parts by using a stiff brush or scraper.
3. Clean bearing assemblies as follows:
   a. Since careful and proper cleaning of bearings is very important, they should always be cleaned separately from other parts.

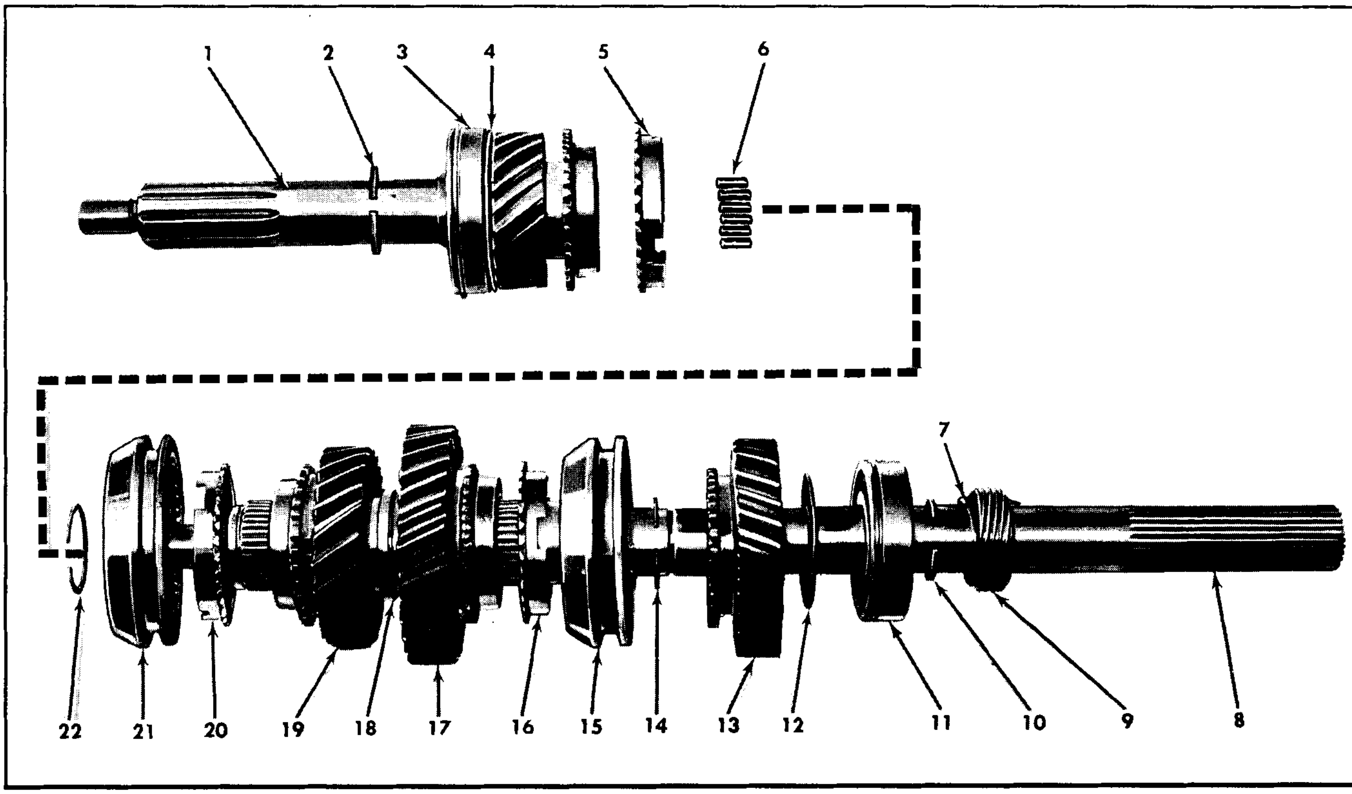


Fig. 7B-11 Main Drive Gear and Mainshaft Assembly

1. Main Drive Gear
2. Bearing-To-Gear Snap Ring
3. Main Drive Gear Bearing
4. Oil Slinger
5. 3rd Speed Blocker Ring
6. Mainshaft Pilot Bearings (16)
7. Retaining Clip
8. Mainshaft
9. Speedometer Drive Gear
10. Bearing-To-Shaft Snap Ring
11. Rear Mainshaft Bearing
12. Thrust Washer
13. Reverse Gear
14. Hub-To-Mainshaft Snap Ring
15. 1st & Rev. Synchronizer Assembly
16. Ist Speed Blocker Ring
17. 1st Speed Gear
18. Shoulder of Mainshaft
19. 2nd Speed Gear
20. 2nd Speed Blocker Ring
21. 2nd & 3rd Synchronizer Assembly
22. Hub-To-Mainshaft Snap Ring

b. Soak bearing assemblies in **clean** cleaning solvent. Gasoline is **not** recommended. Bearings should never be cleaned in a hot solution tank.

c. Slush bearings in solvent until all lubricant is loosened. Hold bearing races so bearings will not rotate; then brush bearings with soft bristled brush until all dirt has been removed. Remove loose particles of dirt by striking bearing flat against a block of wood.

d. Rinse in clean solvent; then blow bearings dry with air pressure. DO NOT SPIN BEARINGS WHILE DRYING.

e. Rotate each bearing slowly while examining balls or rollers for roughness, excessive wear or other damage. Replace all bearings not in first class condition.

f. Wrap each bearing in clean cloth or paper until ready to reinstall in transmission.

INSPECTION

1. Transmission case and extension housing:

   a. Examine case and housing for cracks or other damage. Since repairs by welding, brazing, etc. are not recommended, replace damaged parts.

   b. Check front and rear faces of case for burrs and, if present, dress them off with a fine mill file.

   c. Check bearing bores in case and extension housing and, if damaged, replace case and/or housing.

   d. Inspect vent assembly in extension housing to see that it is open and not damaged.

2. Main drive gear bearing and rear bearing:

   a. Slowly turning race by hand, check for roughness. Replace bearing if rough.

b. Check fit of bearings on their respective shafts and in their bores.

3. Bearing rollers, shafts and washers:

a. Examine mainshaft pilot bearings and countergear bearing rollers and replace if they show wear, pitting or galling.

b. Inspect countershaft and reverse idler shaft for wear or other damage. Check woodruff keys and keyways for condition and fit.

c. Inspect thrust washers and blocker rings for wear or damage.

4. Gears and synchronizer assemblies:

a. Examine all gear teeth and splines for chipped, worn, broken, or nicked teeth or splines. Small nicks or burrs may be removed with a fine abrasive stone.

b. Check both synchronizer sleeves to insure they slide freely on their hubs. The sleeve and hub are **not** serviced separately; only as an assembly.

c. Inspect bushings in reverse gear and reverse idler gear. If worn or damaged, replace the gear. Their bushings are **not** serviced separately.

5. Side cover assembly:

a. Inspect shift forks for wear, distortion or other damage.

b. Check detent cam spring for free length, compressed length, distortion or collapsed coils.

c. Examine detent cams for wear. If shift lever shafts or cams show signs of wear, replace them.

6. Countergear anti-lash plate:

a. Inspect plate teeth for wear or other damage.

b. Plate and two damper springs are retained to countergear by three rivets; disassembly is **not** recommended.

7. Inspect all parts for discoloration or warpage due to heat. Check all threaded parts for damage, stripped or crossed threads.

8. Replace all gaskets, oil seals and snap rings.

9. When assembling transmission, coat all moving parts with lubricant.

REPAIRS

1. Replacement of extension housing bushing - if bushing in rear of extension housing needs replacement, proceed as follows:

a. Remove oil seal from rear of extension housing and discard seal.

b. Using Tool J-6399, drive bushing into extension housing and discard bushing.

c. Using Tool J-6403-1, drive new bushing in from rear until end of bushing is slightly below counterbore for oil seal (Fig. 7B-7). Coat bushing with transmission lubricant.

d. Coat O.D. of new oil seal with sealing compound and lubricate lips of seal with transmission lubricant.

e. Using Collar J 6403-2 and Tool J 6403-1, tap seal into counterbore until its flange bottoms against extension housing (Fig. 7B-4).

2. Replacement of main drive gear bearing retainer oil seal - if lip seal in bearing retainer needs replacement, proceed as follows:

a. Pry old seal out of bearing retainer.

b. Center new seal in opening. Place a suitable size socket or a flat plate on seal and, using a soft hammer, tap seal into its bore.

3. Replacement of synchronizer keys and springs (Fig. 7B-12):

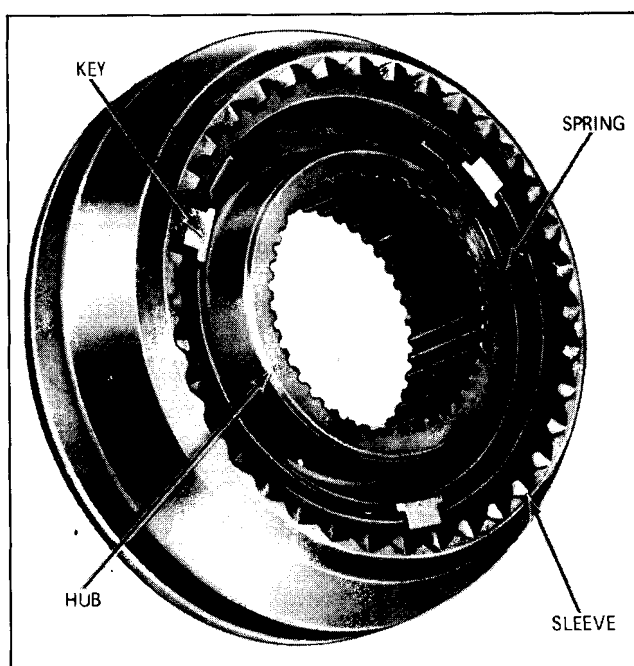


Fig. 7B-12 Synchronizer Assembly

NOTE: *Synchronizer hubs and 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.*

a. Mark hub and sleeve so they can be matched upon reassembly.

b. Push hub from sliding sleeve; keys and springs may be easily removed.

c. Reassemble by placing three (3) keys and two (2) springs into position (one spring on each side of hub), so that all three keys are engaged by both springs.

d. Slide sleeve onto hub, aligning marks made before disassembly.

MAINSHAFT (Fig. 7B-11)

ASSEMBLE

1. With rear of mainshaft upward, install 1st speed gear with its clutching teeth upward. Face of gear will butt against shoulder of mainshaft.
2. Install blocker ring (all three blocker rings are identical) with its clutching teeth downward over synchronizing surface of 1st speed gear.
3. Install 1st & Rev. synchronizer assembly with fork slot up (Fig. 7B-13) and, making sure that notches of blocker ring align with keys of synchronizer assembly, press assembly onto splines of mainshaft until it bottoms out.
4. Install synchronizer hub-to-mainshaft snap ring, making sure that snap ring is seated fully in its mainshaft groove. Both synchronizer hub snap rings are identical.
5. Install reverse gear with its clutching teeth downward and install its bronze thrust washer, aligning its flats onto the mainshaft.

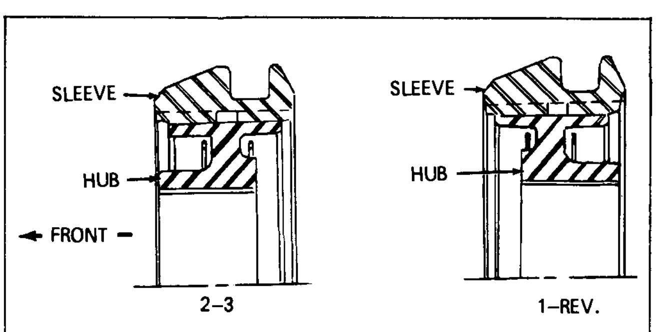


Fig. 7B-13 Synchronizer Sleeve and Hub Assembly

6. Install rear bearing with its snap ring slot downward and press it onto the mainshaft.
7. Install rear bearing snap ring into its mainshaft groove.
8. Install speedometer drive gear and retaining clip on mainshaft.
9. With front of mainshaft upward, install 2nd speed gear with its clutching teeth upward. Rear face of gear will butt against shoulder of mainshaft.
10. Install blocker ring with its clutching teeth downward over synchronizing surface of 2nd speed gear.
11. Install 2nd & 3rd synchronizer assembly with fork slot downward (Fig. 7B-13) and, making sure that notches of blocker ring align with keys in synchronizer assembly, press it onto splines of mainshaft until it bottoms out.
12. Install synchronizer hub-to-mainshaft snap ring.
13. If side cover was disassembled, reassemble as outlined under MINOR REPAIRS.

TRANSMISSION

ASSEMBLE

NOTE: *For ease in assembling and installing countergear, a tool may be fabricated using a 1" diameter dowel stock, cut to length of 9 5/8".*

1. Load a row of bearing rollers (29), a bearing washer, a second row of bearing rollers (29) and a second bearing washer at each end of the countergear. Use fabricated tool or heavy grease to hold them in place.
2. Place countergear assembly, along with a tanged thrust washer (tang away from gear) at each end, through rear opening of case and install countershaft and woodruff key from rear of case. Make sure that thrust washer tangs are aligned with their notches in case and that end flat of countershaft is flush with rear face of case.
3. Lay reverse idler gear in case. Do *not* install reverse idler shaft yet.
4. Using snap ring pliers, expand snap ring in extension housing and position extension housing over rear of mainshaft and onto rear bearing. Seat snap ring into groove of rear bearing.
5. With heavy grease holding them in place, load mainshaft pilot bearings (16) into main drive gear cavity

Fig. 7B-14 Loading Bearing Rollers into Main Drive Gear

and install blocker ring over synchronizing surface of main drive gear with its clutching teeth toward gear (Fig. 7B-14).

6. Pilot main drive gear assembly (minus front bearing) over front of mainshaft, making sure that notches of blocker ring align with keys in 2nd & 3rd synchronizer assembly.

7. Place gasket on extension housing, holding in place with grease and, from rear of case, assemble main drive gear, mainshaft and extension housing to the case as an assembly, make sure that main drive gear teeth engage the teeth of the countergear anti-lash plate.

8. Rotate extension housing and install reverse idler shaft and its woodruff key so that end flat of shaft is flush with rear face of case.

9. Align extension housing, install housing-to-case bolts (5) and torque them to 45 lb. ft.

10. Position oil slinger, inner lip facing forward, on main drive gear stem, install front bearing outer snap ring to bearing and slide bearing onto stem of main drive gear and into case bore.

11. Install snap ring to main drive gear stem and install main drive gear bearing retainer and its gasket to case. Install and torque retainer bolts and lock washers (4) to 20 lb. ft.

    NOTE: *Retainer oil return hole should be at 6 o'clock.*

12. Shift both synchronizer sleeves to neutral position and install side cover assembly and its gasket to case. While installing cover, be sure that shifter forks align with their synchronizer sleeve grooves.

13. Install and torque all side cover attaching bolts (7) to 20 lb. ft.

INSTALL

1. Raise transmission into position and slide forward, piloting main drive gear bearing retainer into clutch housing and index transmission with Transmission Aligning Studs J 1126, which were installed to facilitate removal.

2. Install lower transmission-to-clutch housing bolts, remove J 1126 studs and install two upper transmission-to-clutch housing bolts. Torque bolts to 55 lb. ft.

3. Position shifter assembly-to-extension housing shifter support and retain with its two (2) attaching bolts. Torque upper bolt to 45 lb. ft.; lower bolt to 30 lb. ft.

4. Support engine and raise slightly until crossmember may be repositioned. Then, install frame-to-crossmember attaching bolts and nuts, torque to 35 lb. ft. and remove engine support.

5. Install crossmember-to-rear mounting assembly bolts, torque to 55 lb. ft., connect speedometer cable to driven gear fitting and connect electrical leads.

6. Install propeller shaft assembly as outlined in Section 4E.

7. Fill transmission with lubricant (level should be 1/2 inch below filler plug hole), install and tighten filler plug to 15 lb. ft. torque and remove vehicle from hoist.

8. Check operation of transmission.

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

Transmission identification code letters are stamped approximately 1" high on the right front, upper side of the transmission case.

The letters "RM" identify the Muncie three-speed manual transmission used on A Series equipped with either the 350 cu. in., 2 barrel or the 400 cu. in., 4 barrel engine.

The vehicle identification number is also stamped on a pad on the right upper side of the transmission case.

Source identification is stamped on a flat surface of case just below the rear lower corner of the side cover.

EXAMPLE: **H2D03B**

H represents Muncie Built Three-Speed H.D.
2 represents model year produced (1972).
D represents month built.
03 represents day produced.
B represents first gear ratio.

MONTH CODE

A	January
B	February
C	March
D	April
E	May
H	June
K	July
M	August
P	September
R	October
S	November
T	December

GEAR RATIO CODE

A	3.03 first gear
B	2.42 first gear

GEAR RATIOS

	A	B
First Speed	3.03:1	2.42:1
Second Speed	1.75:1	1.58:1
Third Speed	1.00:1	1.00:1
Reverse	3.02:1	2.41:1

LUBRICANT

Capacity........................... 44 fluid ounces (2-3/4 pints)

TORQUE

APPLICATION	LB. FT.
Control Rod Swivel Clamp Screw	20
Trunnion Jam Nuts - A Series	20
Speedometer Gear Retainer Bolt	4
Shifter Lever-to-Shifter Shaft Bolts	25
Side Cover-to-Case Bolts	20
Filler Plug	15
Extension Housing-to-Case Bolts	45
Bearing Retainer-to-Case Bolts	20
Transmission Case-to-Clutch Housing Bolts	55
Shifter Assembly-to-Shifter Support (Upper) Bolt	45
Shifter Assembly-to-Shifter Support (Lower) Bolt	30
Frame-to-Crossmember Bolts (4)	35
Crossmember-to-Rear Mount Bolts (2)	40
Shifter Support-to-Extension Housing Bolts	30
Rear Mount-to-Extension Housing Bolts (2)	40
Drain Plug	30

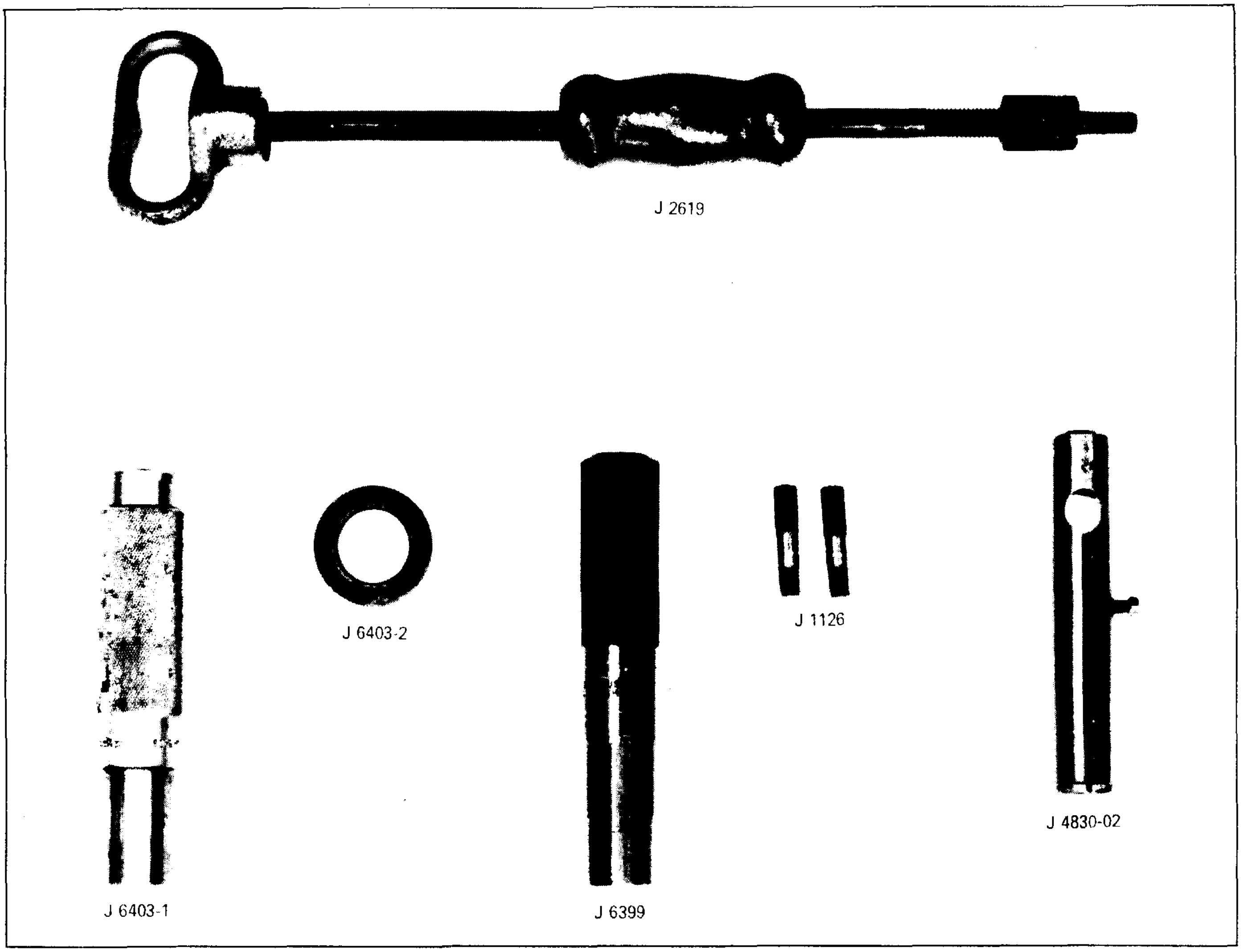


Fig. 7B-15 Special Tools

J 1126	Transmission Aligning Studs (2)
J 2619	Slide Hammer
J 4830-02	Bushing and Seal Remover
J 6399	Bushing Remover
J 6403-1	Bushing Installer
J 6403-2	Oil Seal Installer

1" dia. × 9 5/8" Countergear Shaft Aligner made of dowel stock (Not Shown)

1/4" Shifter Aligner Rod (Not Shown)

SECTION 7C
FOUR SPEED SAGINAW TRANSMISSION

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

Refer to Section 7A.

GENERAL DESCRIPTION

The Saginaw four-speed transmission is an optional floor shift, manual transmission used with the 350 cu. in., two barrel carburetor-equipped engine on A and F Series models. It has all forward gears fully synchronized with a constant mesh reverse idler (Fig. 7C-1).

The main drive gear is supported by a ball bearing at the front end of the transmission case and is piloted at its front end in an oil impregnated bushing mounted in the engine crankshaft. The front end of the mainshaft is piloted in a row of roller bearings set into the hollow end of the main drive gear and the rear end is carried by a ball bearing mounted in the front of the extension housing.

The countergear is carried on a single row of rollers at both ends while thrust is taken on thrust washers located between the ends of the gear and the thrust bosses in the case. An anti-rattle plate assembly at the front of the countergear provides a constant spring tension between the counter and clutch gears to reduce torsional vibrations.

The reverse idler gear is held in constant mesh with the 1st and 2nd synchronizer gear regardless of its position. The idler gear is carried on a bushing finish bored in place and rotates on a short idler shaft retained by a Woodruff key.

The synchronizer assemblies consist of a clutch hub, sliding sleeve, three keys, two springs and are retained as an assembly on the main shaft by a snap ring.

A great deal of similarity and interchangeability now exists between the new 3 and 4-speed Saginaw transmissions.

The cover on the new four-speed transmission is located on the left-hand side of the case. It is similar to the three-speed cover with the addition of a reverse shifter shaft assembly, detent ball and detent spring.

A transmission controlled spark (TCS) switch is screwed into the boss of the 3rd and 4th shifter shaft opening of the transmission side cover. This TCS switch is closed in all but high gear, grounding an electrical circuit from the distributor and engine thermo-switch through a solenoid valve. This closing, or grounding, of the TCS switch will retard the spark.

When the transmission is shifted into high gear, the pivoting of the 3rd and 4th shifter shaft will cause the TCS switch to open, so that the transmission will no longer affect the vacuum advance of the distributor. See Section 6D for further details.

PERIODIC SERVICE RECOMMENDATIONS

Refer to Section 7A.

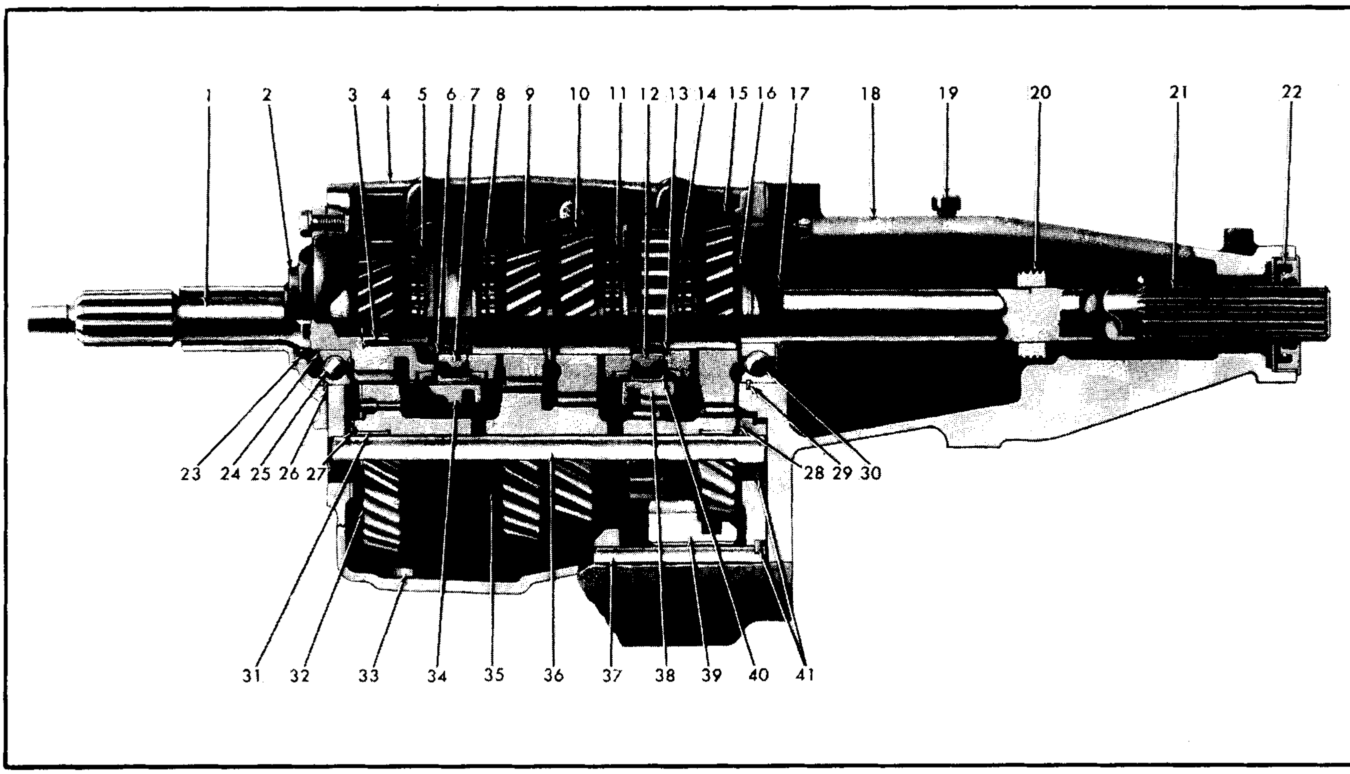


Fig. 7C-1 Cross Section of Transmission

1. Main Drive Gear
2. Front Bearing Retainer
3. Bearing Rollers
4. Transmission Case
5. 4th Speed Blocker Ring
6. 3rd & 4th Synchronizer Snap Ring
7. 3rd & 4th Synchronizer Hub
8. 3rd Speed Blocker Ring
9. 3rd Speed Gear
10. 2nd Speed Gear
11. 2nd Speed Blocker Ring
13. 1st & 2nd Synchronizer Snap Ring
14. 1st Speed Blocker Ring
15. 1st Speed Gear
16. Reverse Gear Thrust and Spring Washers
17. Bearing-to-Mainshaft Snap Ring
18. Extension Housing
19. Vent
20. Speedometer Drive Gear and Clip
21. Mainshaft
22. Rear Oil Seal
23. Bearing Retainer Oil Seal
24. Bearing-to-Gear Snap Ring
25. Front Bearing
26. Bearing-to-Case Snap Ring
27. Front Thrust Washer (Tanged)
28. Rear Thrust Washer (Tanged)
29. Bearing-to-Extension Snap Ring
30. Rear Bearing
31. Countergear Bearing Rollers
32. Anti-Rattle Plate
33. Magnet
34. 3rd & 4th Synchronizer Sleeve
35. Countergear Assembly
36. Countershaft
37. Reverse Idler Shaft
38. 1st & 2nd Synchronizer Sleeve and Reverse Gear
39. Reverse Idler Gear
40. Clutch Key
41. Woodruff Keys

ON CAR ADJUSTMENTS

FLOOR SHIFT AND BACK DRIVE LINKAGE (Figs. 7C-2 thru 7C-5)

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 locating gauge into lever alignment slot.
5. Tighten locknuts at shift rod swivels and remove locating gauge. Discard gauge.

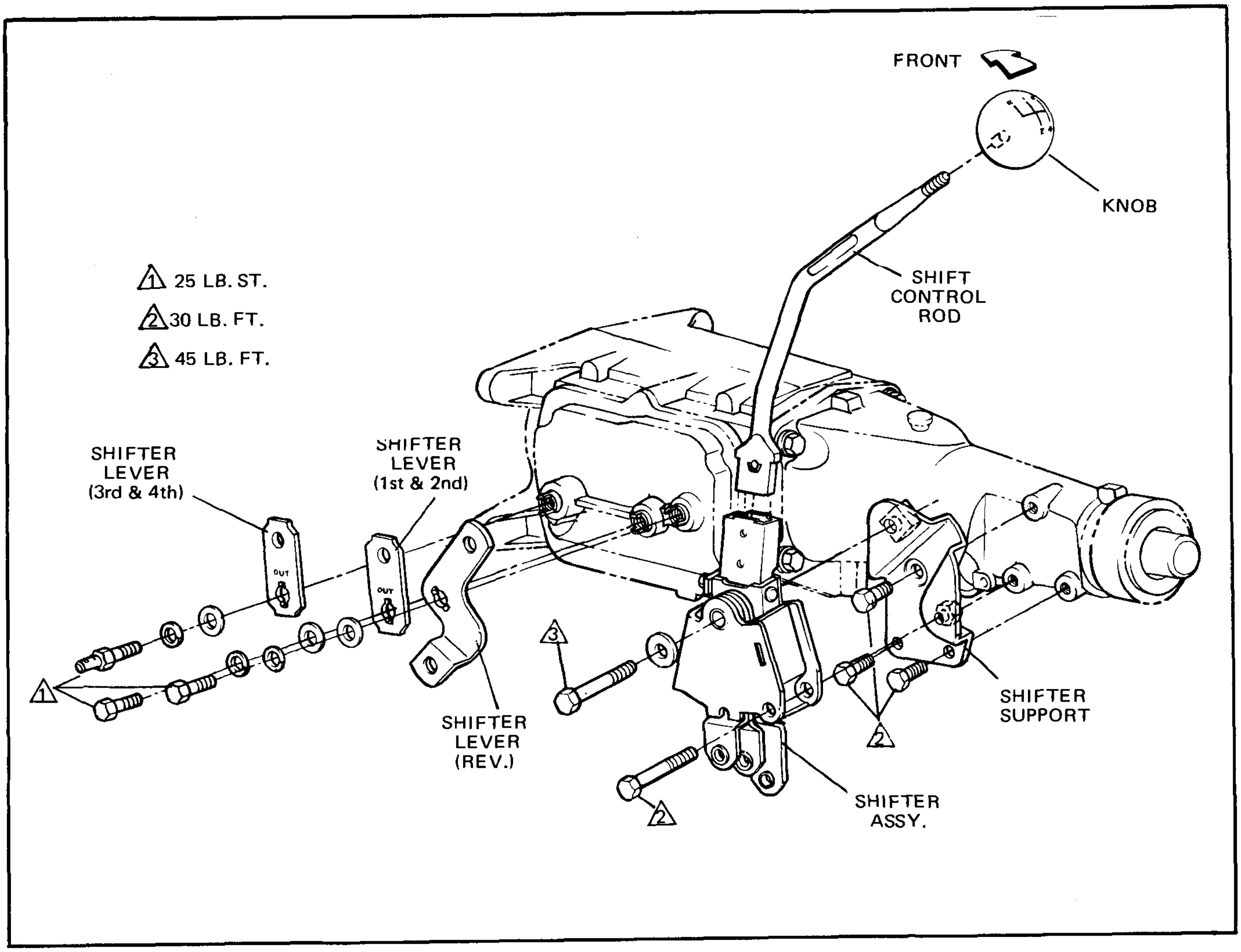


Fig. 7C-2 Floor Shift Controls (A Series Shown)

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 and 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.

MINOR REPAIRS

REAR EXTENSION OIL SEAL

1. Raise vehicle on hoist and remove propeller shaft.
2. Pry out the extension oil seal with screwdriver.
3. Coat new oil seal with sealing compound and press seal carefully into place in extension by using Seal Installer J 5154 or similar tool.

CAUTION: *Do not excessively force the seal against its seat in the extension.*

4. Lower and remove vehicle from hoist.

REAR EXTENSION OIL SEAL AND BUSHING

Refer to Section 7A.

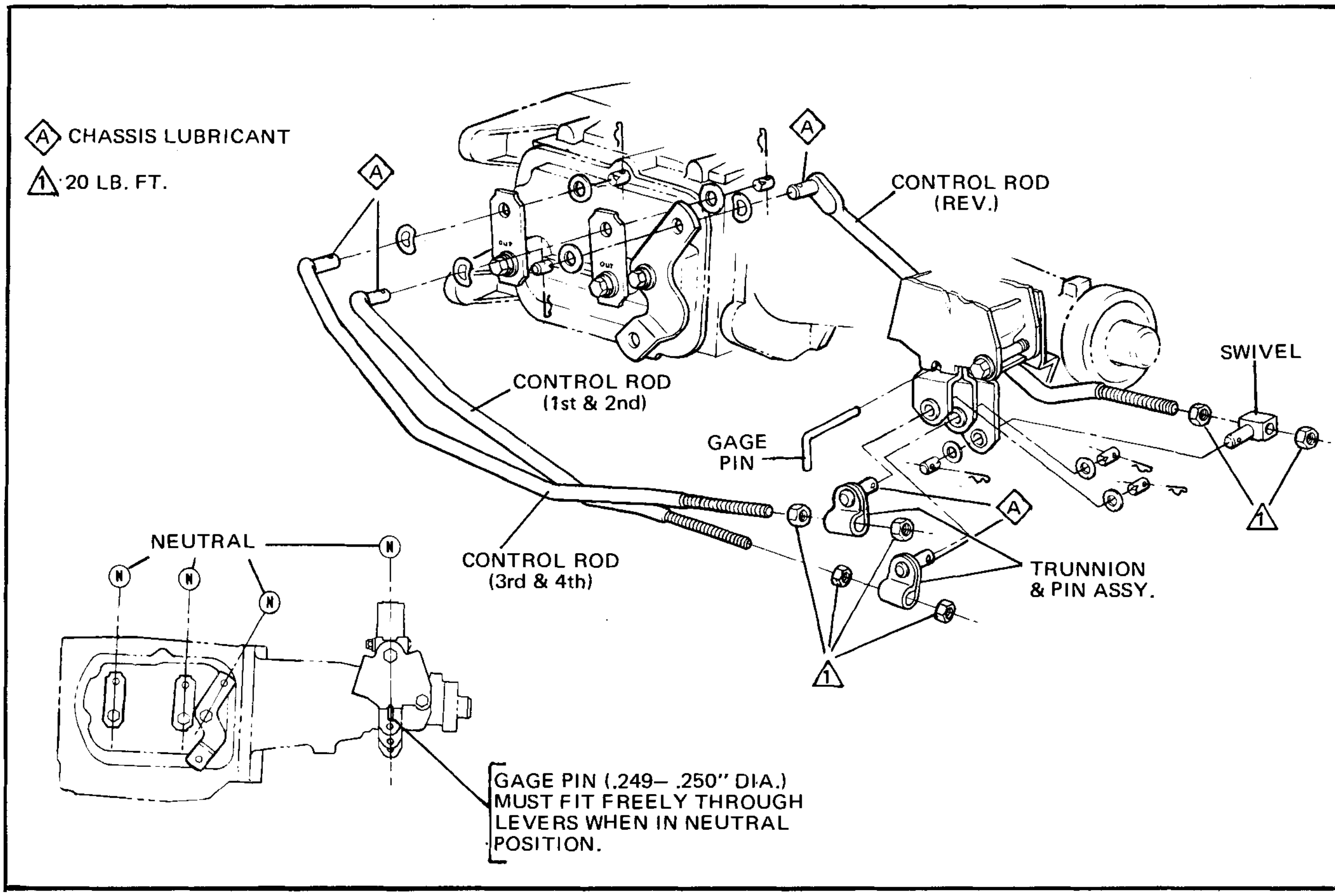


Fig. 7C-3 Floor Shift Linkage (A Series Shown)

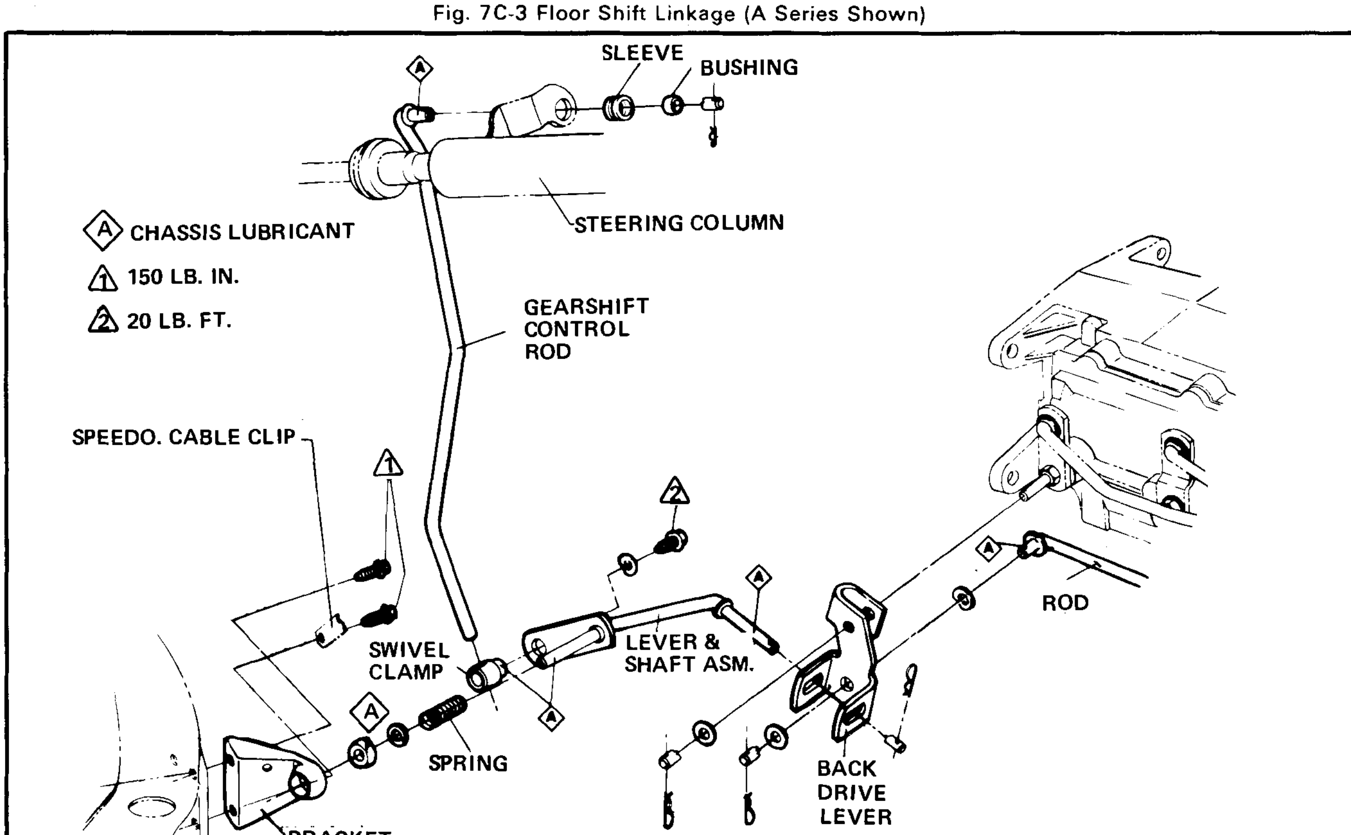


Fig. 7C-4 Back Drive Linkage - A Series

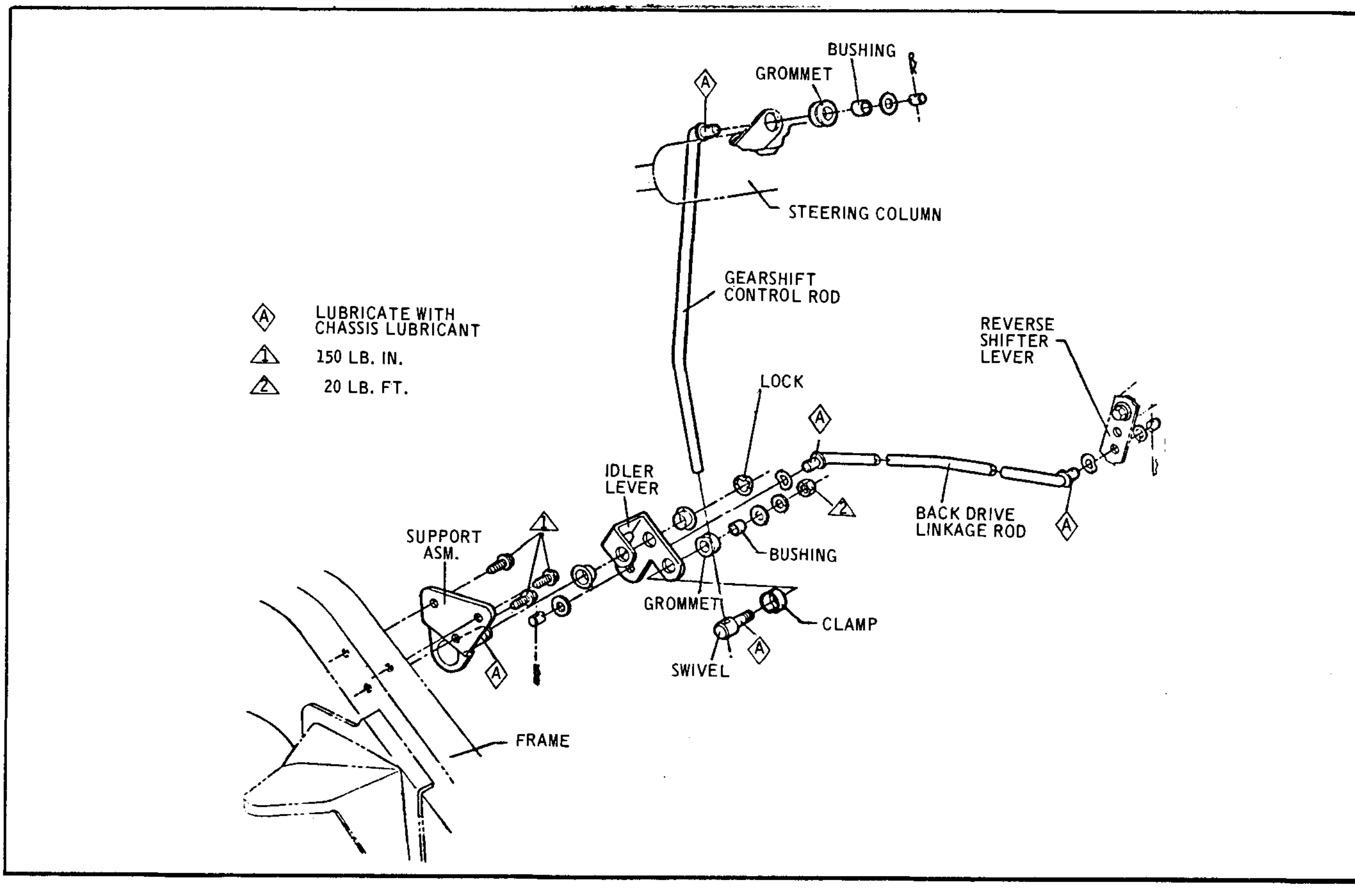


Fig. 7C-5 Back Drive Linkage - F Series

TRANSMISSION CASE COVER

REMOVE

1. Raise vehicle on hoist.
2. Disconnect control rods from levers. Disconnect back-up lamp and TCS switch at cover.
3. Shift transmission into neutral detent positions before removing cover.
4. Remove cover assembly from transmission case carefully and allow to drain.

DISASSEMBLE

1. Remove the outer shifter levers and TCS switch.
2. Remove both shift forks from shifter shaft assemblies. Remove all three shifter shaft assemblies from cover. The lip seal in the cover and "O" ring seal on the 1-2 and reverse shafts may now be pryed out if required because of damage. Remove reverse shifter shaft detent ball and spring (Fig. 7C-6).
3. Remove detent cam spring and pivot retainer "C" ring. Mark to identify for reassembly, then remove both detent cams.
4. Replace damaged parts.

ASSEMBLE

1. With detent spring tang projecting up over the 3rd and 4th shifter shaft cover opening, install the first

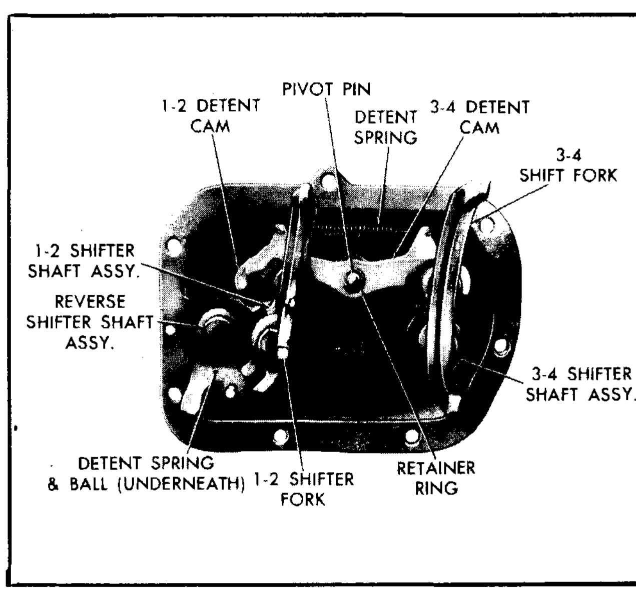


Fig. 7C-6 Side Cover Assembly

and second detent cam onto the detent cam pivot pin. With the detent spring tang projecting up over the first and second shifter shaft cover hole, install the 3rd and 4th detent cam.

NOTE: *The 1-2 detent cam has .090" greater contour on the inside detent notch.*

2. Install detent cam retaining "C" ring to pivot shaft and hook spring into detent cam notches.
3. Install 1-2 and 3-4 shifter shaft assemblies in cover, being careful not to damage seals. Install both shift forks to shifter shaft assemblies, lifting up on detent cam to allow forks to fully seat into position.
4. Install reverse detent ball and spring to cover, then install reverse shifter shaft assembly to cover.
5. Install TCS switch in cover.
6. Install outer shifter levers, flat washers, lock washers and bolts.

INSTALL

1. Shift shifter levers into neutral detent (center) position. Position cover gasket on case.
2. Carefully position side cover into place, making sure the shift forks are aligned with their respective mainshaft clutch sliding sleeves.
3. Install cover attaching bolts and tighten evenly to 22 lb. ft. torque.
4. Connect shift rods to levers at side cover.
5. Connect TCS switch wiring.
6. Remove filler plug and add lubricant specified in Section 0, to level of filler plug hole. Lower and remove vehicle from hoist.

MAJOR REPAIRS

TRANSMISSION

REMOVE

Refer to Section 7A.

DISASSEMBLE

1. Remove side cover attaching bolts, drain lubricant and remove side cover, gasket and shift forks.
2. Remove front bearing retainer and gasket.
3. Remove front bearing-to-main drive gear snap ring.
4. Pull main drive gear out of case as far as possible and remove front bearing (Fig. 7C-7).

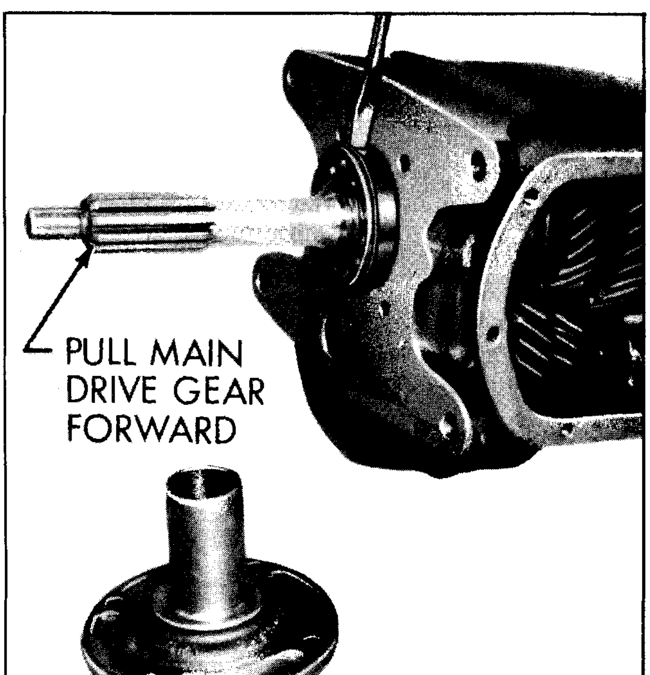


Fig. 7C-7 Removing Front Bearing

NOTE: *Although front bearing is a slip fit on main drive gear, it may be necessary to aid removal with screw driver.*

5. Remove extension housing-to-case attaching bolts.
6. From rear of case, remove extension housing and mainshaft assembly (Fig. 7C-8).
7. Separate main drive gear and 4th speed blocker ring from mainshaft assembly and remove 14 bearing rollers from main drive gear.
8. Using snap ring pliers, expand snap ring in extension housing which retains the mainshaft rear bearing and remove the extension housing (Fig. 7C-9).
9. Using Countershaft Alignment Tool J 22246, tap out countergear shaft and its woodruff key out through rear of case (Fig. 7C-10) and remove countergear and 2 tanged thrust washer.

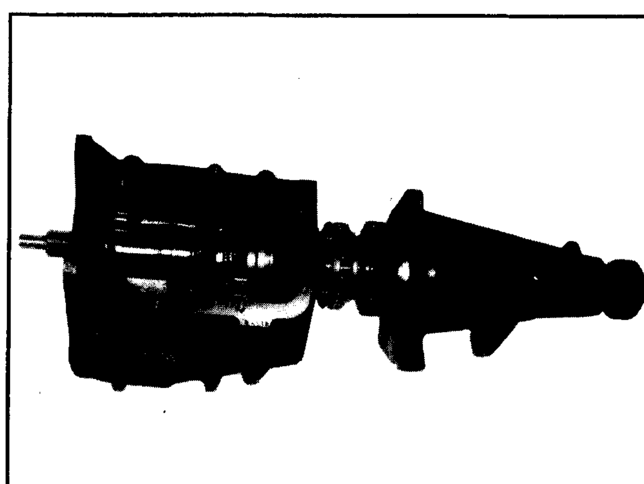


Fig. 7C-8 Removing or Installing Mainshaft Assembly

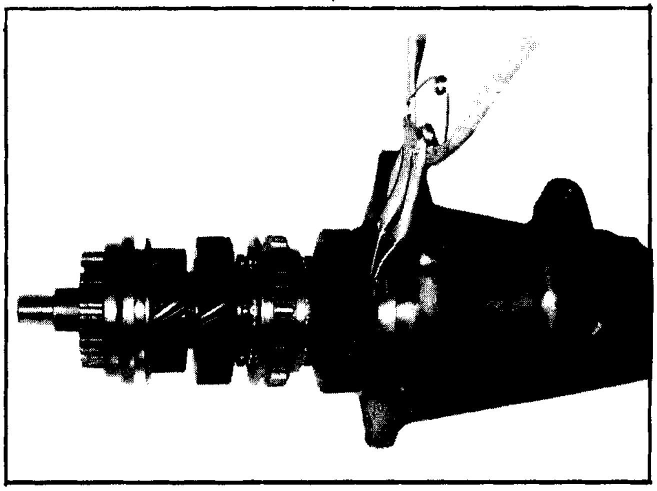


Fig. 7C-9 Expanding Snap Ring in Extension Housing

NOTE: *At this point, Tool J 22246 may be left in to hold the bearing rollers in place or be taken out, in which case 27 bearing rollers and a bearing thrust washer must be removed from each end of the shaft.*

10. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and its woodruff key through rear of the case (Fig. 7C-11).
11. Remove 3rd and 4th synchronizer snap ring and remove 3rd and 4th synchronizer sleeve from the mainshaft assembly (Fig. 7C-12).
12. Support 3rd speed gear with press plates and press on front of mainshaft to remove 3rd and 4th synchronizer hub, 3rd speed blocker ring and 3rd speed gear from front of mainshaft (Fig. 7C-13).
13. Depress speedometer retaining clip and slide gear from mainshaft.

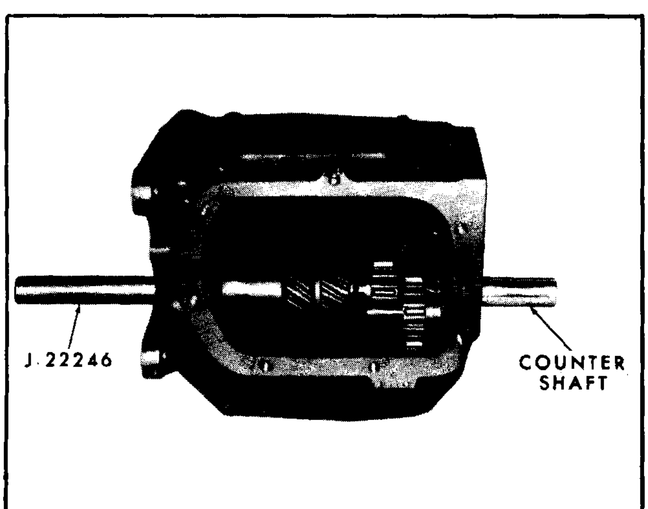


Fig. 7C-10 Removing Countershaft

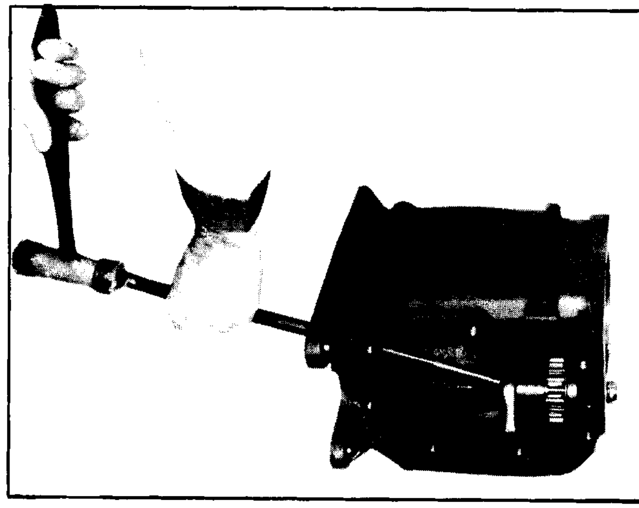


Fig. 7C-11 Removing Reverse Idler Shaft

14. Remove rear bearing snap ring from mainshaft groove (Fig. 7C-14).
15. Support 1st speed gear with press plates and press on rear of main shaft to remove 1st speed gear, thrust washer, spring washer, rear bearing and snap ring from rear of mainshaft (Fig. 7C-15).

CAUTION: *When pressing the rear bearing, be careful to center the gear, washers, bearings and snap ring on the mainshaft.*

16. Remove the 1st and 2nd synchronizer snap ring from mainshaft and press 1st and 2nd synchronizer assembly, 2nd speed blocker ring and 2nd speed gear from the rear of the mainshaft (Fig. 7C-16 and 17). This completes the disassembly of the mainshaft.

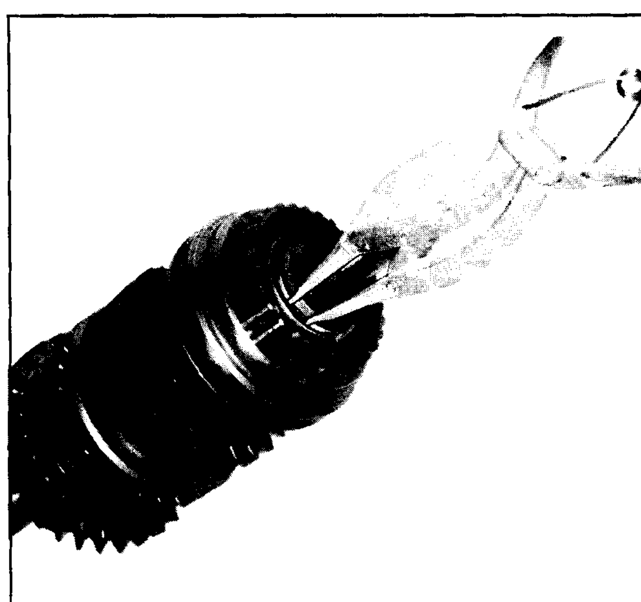


Fig. 7C-12 Removing 3rd and 4th Synchronizer Snap Ring

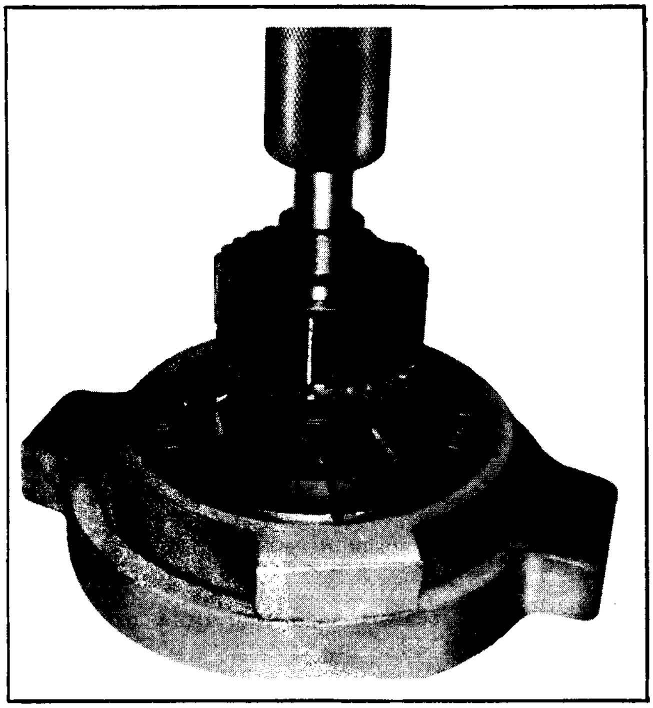


Fig. 7C-13 Removing 3rd and 4th Synchronizer and 3rd Speed Gear

CLEANING AND INSPECTION

TRANSMISSION CASE

1. Wash transmission case thoroughly inside and outside with cleaning solvent, then inspect for cracks.
2. Check front and rear faces of case for burrs and, if present, remove them with a fine mill file.

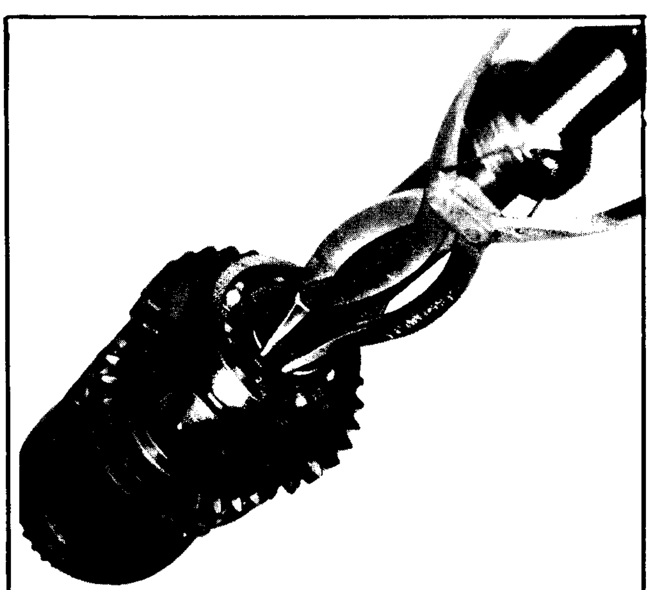


Fig. 7C-14 Removing Rear Bearing Snap Ring

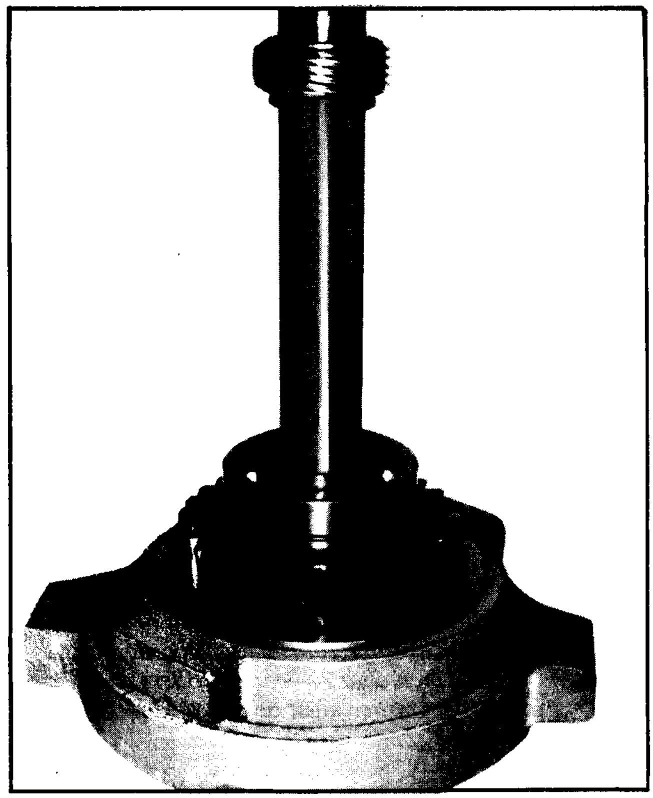


Fig. 7C-15 Removing Rear Bearing and 1st Speed Gear

FRONT AND REAR BEARINGS

1. Wash front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

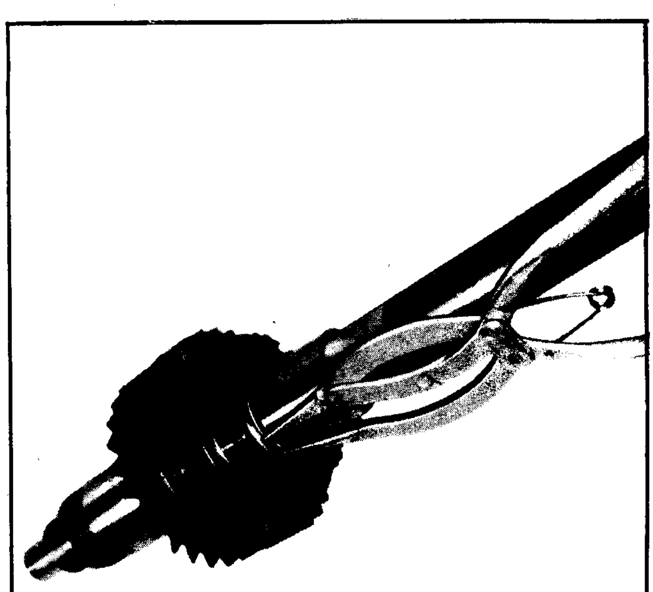


Fig. 7C-16 Removing 1st and 2nd Synchronizer Snap Ring

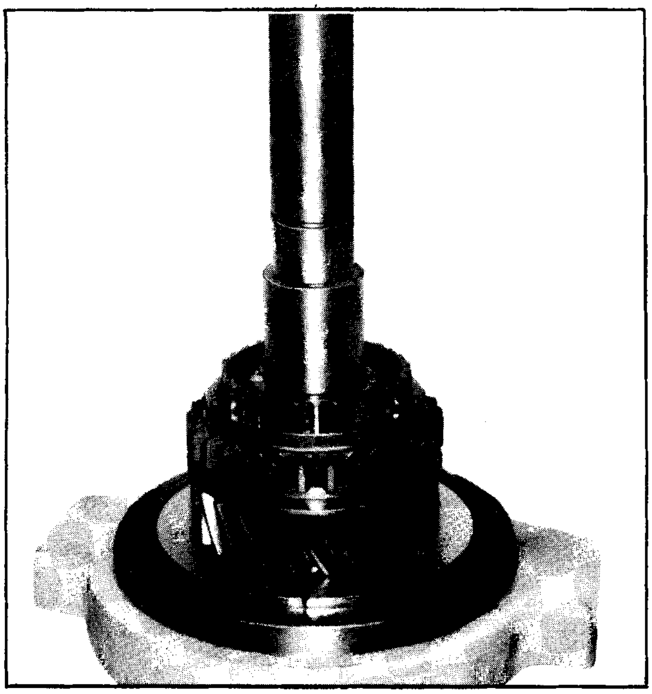


Fig. 7C-17 Removing 1st and 2nd Synchronizer and 2nd Speed Gear

CAUTION: *Do not allow bearings to spin, turn them slowly by hand. Spinning bearings will damage the rear and balls.*

3. Make sure that bearings are clean. Then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

BEARING ROLLERS

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect the countergear shaft and reverse idler shaft at the same time and 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 synchronizer clutch sleeves to see that they slide freely on their hubs.

   NOTE: *The synchronizer 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.*

   a. Mark hub and sleeve so they can be matched upon reassembly.

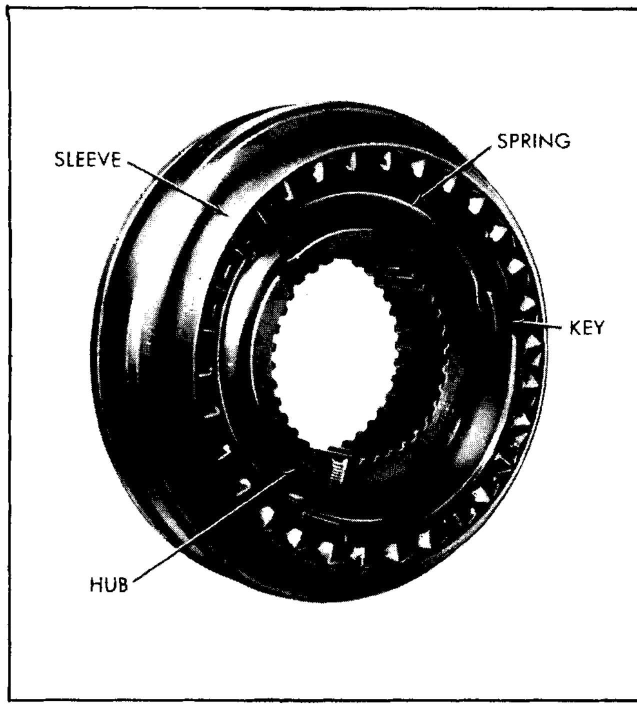


Fig. 7C-18 Typical Synchronizer Assembly

   b. Push hub from sliding sleeve and remove keys and springs from the hub (Fig. 7C-18).

TRANSMISSION

ASSEMBLE

Turn the front of the mainshaft upward and install the following components:

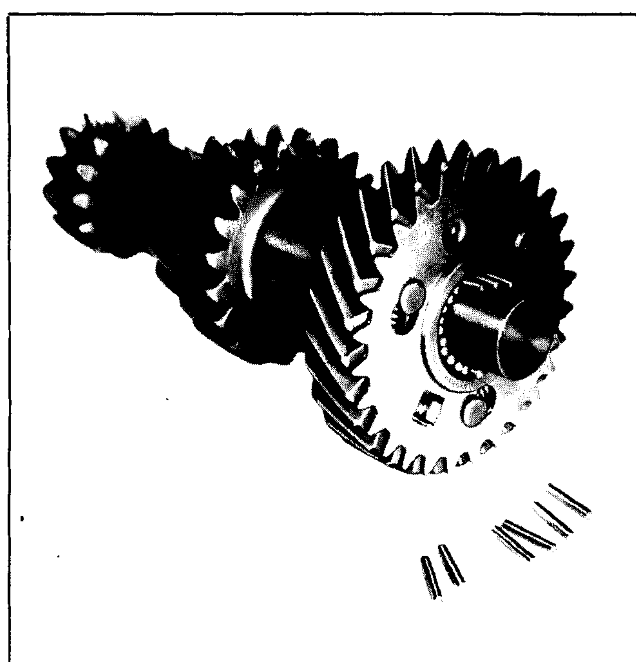


Fig. 7C-19 Anti-lash Plate on Countergear

1. Install 3rd speed gear with clutching teeth upward; rear face of gear will butt against the flange on the mainshaft.

2. Install a blocker ring with clutching teeth downward over synchronizing surface of the 3rd speed gear.

NOTE: *All 4 blocker rings in the transmission are the same and interchangeable.*

3. Install 3rd and 4th synchronizer assembly with the fork slot downward, pressing it onto splines on the mainshaft until it bottoms out (Fig. 7C-20).

CAUTION: *Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.*

4. Install 3rd and 4th synchronizer snap ring. Both synchronizer snap rings are the same.

5. Turn the rear of the mainshaft upward and install 2nd speed gear with clutching teeth upward; front face of gear will butt against the flange on the mainshaft.

6. Install blocker ring with clutching teeth downward over synchronizing surface of the 2nd speed gear.

7. With fork slot downward, press 1st and 2nd synchronizer assembly onto splines of mainshaft (Fig. 7C-21).

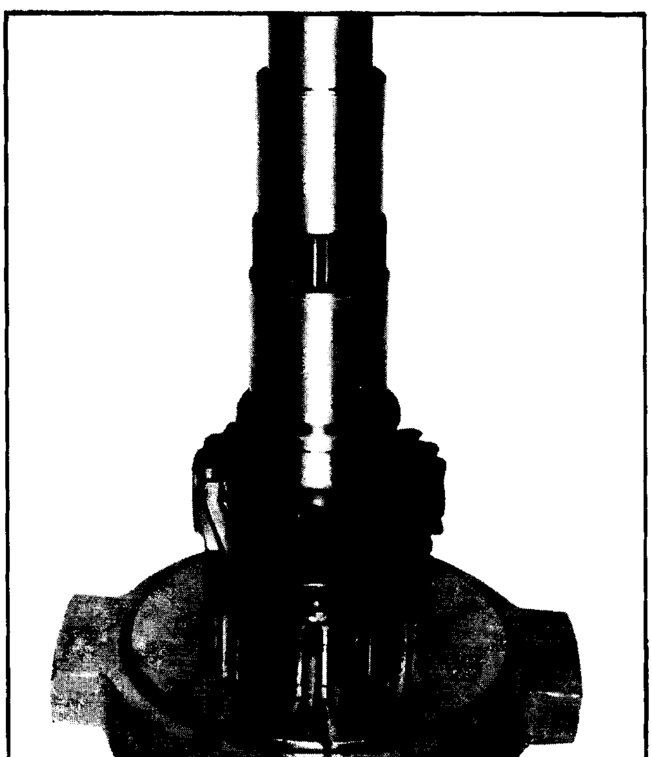


Fig. 7C-20 Installing 3rd and 4th Synchronizer and 3rd Speed Gear

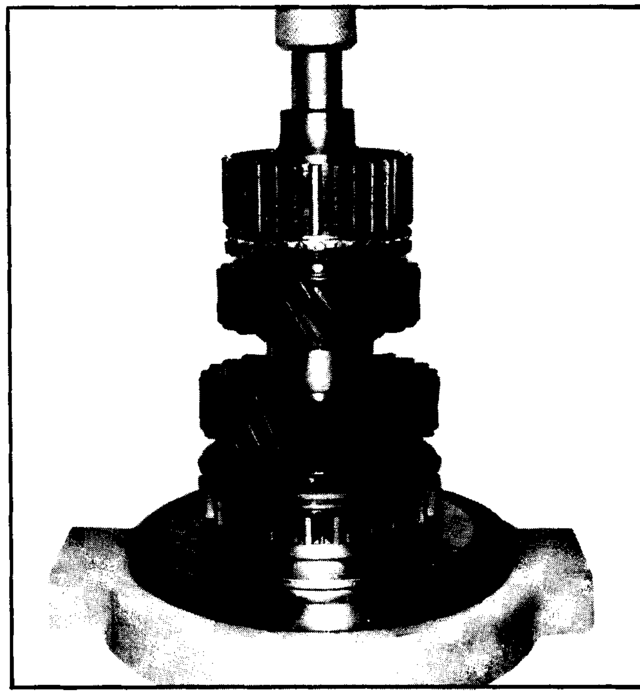


Fig. 7C-21 Installing 1st and 2nd Synchronizer and 2nd Speed Gear

CAUTION: *Be sure notches of blocker ring align with keys of synchronizer assembly.*

8. Install 1st and 2nd synchronizer snap ring.

9. Install blocker ring with notches downward so they align with keys of 1st and 2nd synchronizer assembly.

10. Install 1st speed gear with clutching teeth downward.

11. Install 1st speed gear thrust washer (steel) and spring washer.

12. With snap ring slot upward, press rear bearing onto mainshaft (Fig. 7C-22).

13. Install rear bearing snap ring (Fig. 7C-14).

14. Place speedometer gear retainer in output shaft.

15. Align slot in speedometer drive gear with retainer clip and slide gear into place.

16. Install Countershaft Alignment Tool J 22246 into countergear.

17. From each end of countergear, install 27 bearing rollers and a bearing thrust washer (Fig. 7C-19).

NOTE: *Coat bearing rollers with heavy grease before installing.*

18. Install countergear-to-case tanged thrust washer (tang away from gear) at each end of countergear.

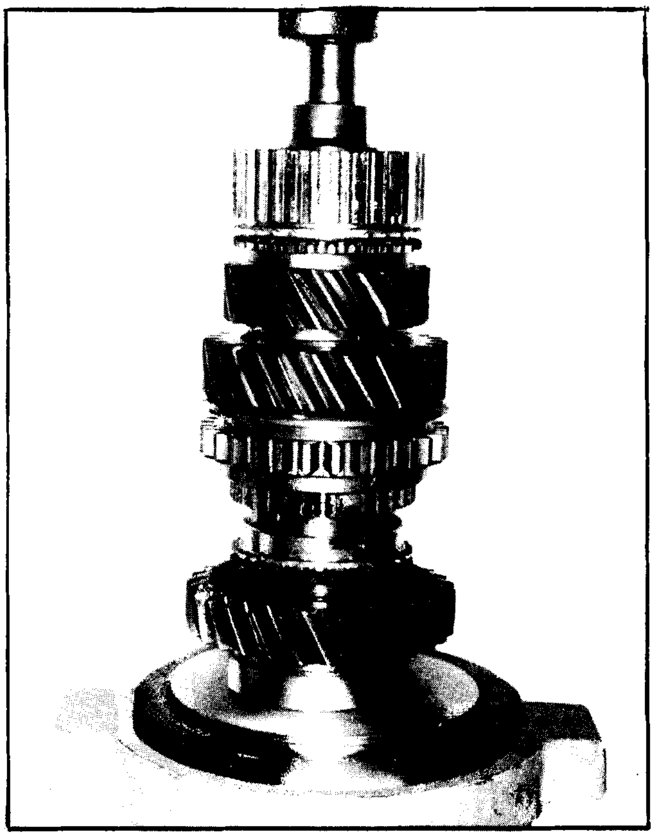


Fig. 7C-22 Installing Rear Bearing

19. Install countergear assembly into case. Install countergear shaft and woodruff key from rear of case.

CAUTION: *Be sure that countershaft picks up both thrust washers and that tangs of the thrust washers are aligned with their notches in the case.*

20. Install reverse idler gear, shaft and woodruff key from rear of case.

21. Install extension housing. Spread snap ring in housing to allow snap ring to drop around rear bearing (Fig. 7C-9). Press on end of mainshaft until snap ring engages groove in rear bearing.

22. Install fourteen (14) bearing rollers in main drive gear, using heavy grease to hold bearings in place (Fig. 7C-23).

23. Assemble 4th speed blocker ring on main drive gear.

24. Pilot main drive gear and 4th speed blocker ring over front of mainshaft.

CAUTION: *Make certain notches in blocker ring align with keys in 3rd and 4th synchronizer.*

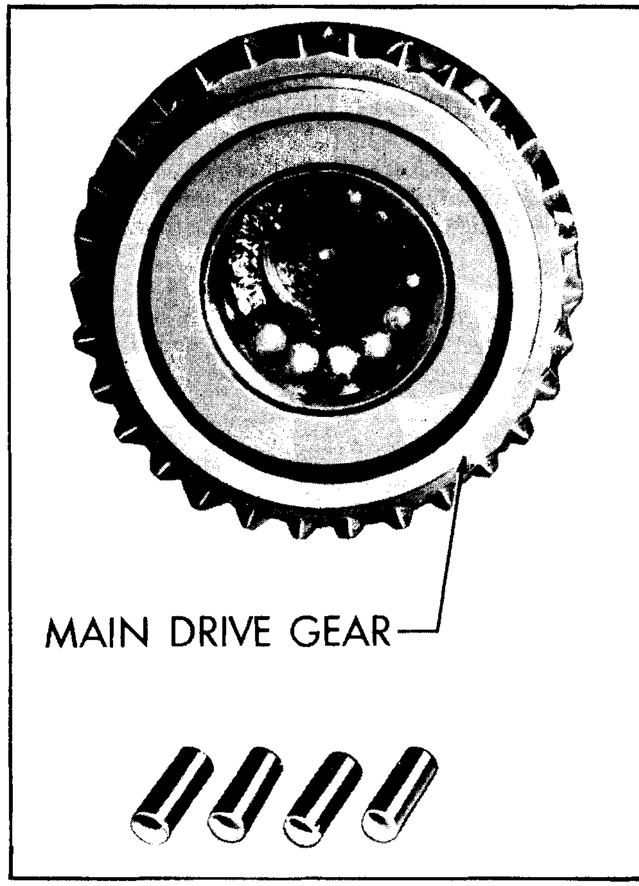


Fig. 7C-23 Loading Bearing Rollers in Main Drive Gear

25. Using heavy grease, install extension housing-to-case gasket.

26. Install extension housing and mainshaft assembly into case (Fig. 7C-8). Install extension housing-to-case bolts, torquing to 45 lb. ft.

27. Install front bearing onto main drive gear. Outer snap ring groove must be toward front of gear.

28. Install retaining snap ring.

29. Install front bearing retainer, gasket and four attaching bolts, torquing bolts to 22 lb. ft.

NOTE: *The retainer oil return hole must be at the bottom.*

30. Install new side cover gasket, place transmission synchronizer sleeves in neutral and install side cover. Secure with attaching bolts and torque evenly to 22 lb. ft. to avoid side cover distortion.

INSTALL

Refer to Section 7A.

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

An identifying code is marked in yellow paint on all four speed manual transmissions. This code consists of two letters, one inch high, on the RH side of the transmission case.

The letters "WC" identify the floor-shift, Saginaw four-speed manual transmission used on A and F Series equipped with the 350 cu. in. V-8 engine.

GEAR RATIOS

First Speed	2.54:1
Second Speed	1.80:1
Third Speed	1.44:1
Fourth Speed	1.00:1
Reverse	2.54:1

LUBRICANT

Capacity............................ .56 fluid ounces (3 1/2 pints)

TORQUE

APPLICATION	LB. FT.
Front Bearing Retainer-to-Case Bolts	22
Side Cover-to-Case Bolts	22
Extension Housing-to-Case Bolts	45
Shifter Lever-to-Shifter Shaft Bolts	25
Lubrication Filler Plug	15
Transmission Case-to-Flywheel Housing Bolts	55

SPECIAL TOOLS

Refer to Sections 7A and 7D.

SECTION 7D

FOUR-SPEED MUNCIE TRANSMISSION

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

NOISY IN ALL GEARS

1. Incorrect lubricant or low lubricant level.
2. Clutch gear bearing or mainshaft rear bearing worn or damaged.
3. Main drive gear and/or countershaft gear worn or damaged.
4. Countershaft bearing rollers and/or shaft worn or damaged.
5. Transmission misaligned or loose.

NOISY IN HIGH GEAR

1. Clutch gear bearing damaged.
2. Mainshaft front and/or rear bearing damaged.

NOISY IN THIRD GEAR

1. 3rd speed gear and/or countershaft gear worn or damaged.
2. Countershaft roller bearings and/or countershaft worn or damaged.

NOISY IN SECOND GEAR

1. 2nd speed gear and/or countershaft gear worn or damaged.
2. Countershaft rear roller bearings and/or countershaft worn or damaged.

NOISY IN FIRST GEAR

1. 1st speed gear and/or countershaft gear worn or damaged.
2. Countershaft rear roller bearings and/or countershaft worn or damaged.

NOISY IN REVERSE GEAR

1. Front and/or rear reverse idler gears worn or damaged.

2. Rear reverse idler gear bushings and/or idler shaft worn or damaged.
3. Reverse speed gear worn or damaged.

NOISY IN NEUTRAL

Clutch gear bearing or pilot bearing damaged.

HARD SHIFTING

1. Loose bolts at transmission outer shifter levers.
2. Bent shift control rods, loose trunnions or linkage interference.
3. Clutch improperly adjusted.
4. Shifter levers, shifter shafts or shift forks worn or damaged.
5. Incorrect lubricant.
6. Synchronizer assemblies worn or damaged.

EXCESSIVE BACKLASH IN SECOND GEAR ONLY

1. Mainshaft rear bearing and/or locating ring and/or rear bearing retainer not properly installed.
2. Countershaft rear bearing rollers and/or countershaft worn or damaged.

EXCESSIVE BACKLASH IN ALL REDUCTION GEARS

1. Countershaft gear bushings worn.
2. Excessive end play in countershaft gear because of worn countershaft thrust washers.

STICKS IN GEAR

1. Clutch improperly adjusted.
2. Incorrect lubricant or low lubricant level.
3. Defective (tight) mainshaft front bearing rollers.
4. 4th speed synchronizer blocker ring frozen on main drive gear cone.
5. Burred or battered clutching teeth on synchronizer sleeve and/or main drive gear.

SLIPS OUT OF HIGH GEAR

1. Shift control rods out of adjustment, bent worn or loose.
2. Transmission misaligned, loose or dirt between transmission case and clutch housing.
3. Damaged pilot bearing.
4. Clutch gear bearing retainer broken or loose.

SLIPS OUT OF REVERSE GEAR

1. Shift control rods out of adjustment, bent, worn or loose.
2. Reverse gear damaged because of worn or damaged reverse shifter fork or shifter shaft lever, reverse control rod bent or interference, etc.

FORWARD GEARS CLASH

1. Excessive engine idle speed.
2. Clutch not fully releasing.
3. Weak or broken synchronizer springs.
4. Worn synchronizer blocker rings and/or cone surfaces.
5. Broken synchronizer blocker rings.
6. Excessive rock of synchronizer assembly on mainshaft.

REVERSE GEAR CLASHES

Allow approximately three seconds after depressing clutch pedal before shifting into reverse gear. If gear clash is still present:

a. Check clutch adjustments.

b. Check for dragging or distorted clutch driven plate.

c. Check for tight or frozen clutch gear bearing.

LEAKS LUBRICANT

1. Excessive lubricant.
2. Clutch gear bearing retainer loose or cracked and/or gasket damaged.
3. Worn or damaged shifter shaft seals.
4. Case cover loose or gasket damaged.
5. Rear extension-to-rear bearing retainer gasket damaged.
6. Rear bearing retainer-to-case gasket damaged.
7. Rear extension oil seal worn or damaged.
8. Countershaft loose in case.

GENERAL DESCRIPTION

The Muncie four-speed transmission is an optional, heavy-duty, floor shift, four-speed manual transmission used on 400 and 455 cu. in. engine, A and F Series.

This four-speed transmission (Fig. 7D-1) consists of two basic sections: the transmission case, or forward section, and the case rear extension, or rear section. The forward section contains the four forward speed gear assemblies and their synchronizing mechanisms; the rear section 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. For 400 cu. in. engine models, gear ratios of 2.52 (first), 1.88 (second), 1.46 (third), 1.00 (fourth) and 2.59 (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.

Special close ratio transmissions are also available for 400 and 455 cu. in. engine models. These are gear ratios of 2.20 (first), 1.64 (second), 1.28 (third), 1.00 (fourth) and 2.27 (reverse).

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.

For all models, the steering column lock requires that the transmission be in "Reverse" gear before the ignition key may be removed.

Also, the clutch safety switch will not permit engine cranking unless the clutch pedal is depressed far enough to completely disengage the clutch.

A transmission controlled spark (TCS) switch is screwed into the boss of the 3rd & 4th shifter shaft opening of the transmission side cover (Fig. 7D-2). This TCS switch is closed in all but high gear, grounding an electrical circuit from the distributor and engine thermo-switch through a solenoid valve. This closing or grounding of the TCS switch will retard the spark.

When the transmission is shifted into high gear, the pivoting of the 3rd & 4th shifter shaft will cause the TCS switch to open, so that the transmission will no longer affect the vacuum advance of the distributor. See Section 6D for further details.

DESIGN

The four-speed transmission incorporates helical gears specially designed to provide high torque capacity without additional weight and gear teeth proportioned to operate at high speeds with neither excessive heat generation nor excessive frictional losses. Shafts, bearings, high capacity synchronizers and other precision parts are held to close limits, providing proper clearances necessary for durability during extended heavy usage.

Seven basic gears are utilized in this transmission. They are: main drive gear, 3rd speed gear, 2nd speed gear, 1st speed gear, reverse gear, countershaft gear and reverse idler gears (front and rear) (Fig. 7D-1).

The front end of the main drive gear is piloted in a single row, prepacked and shielded ball bearing mounted in the engine crankshaft, while the rear end is supported by a heavy-duty ball bearing located at the front end of the transmission case.

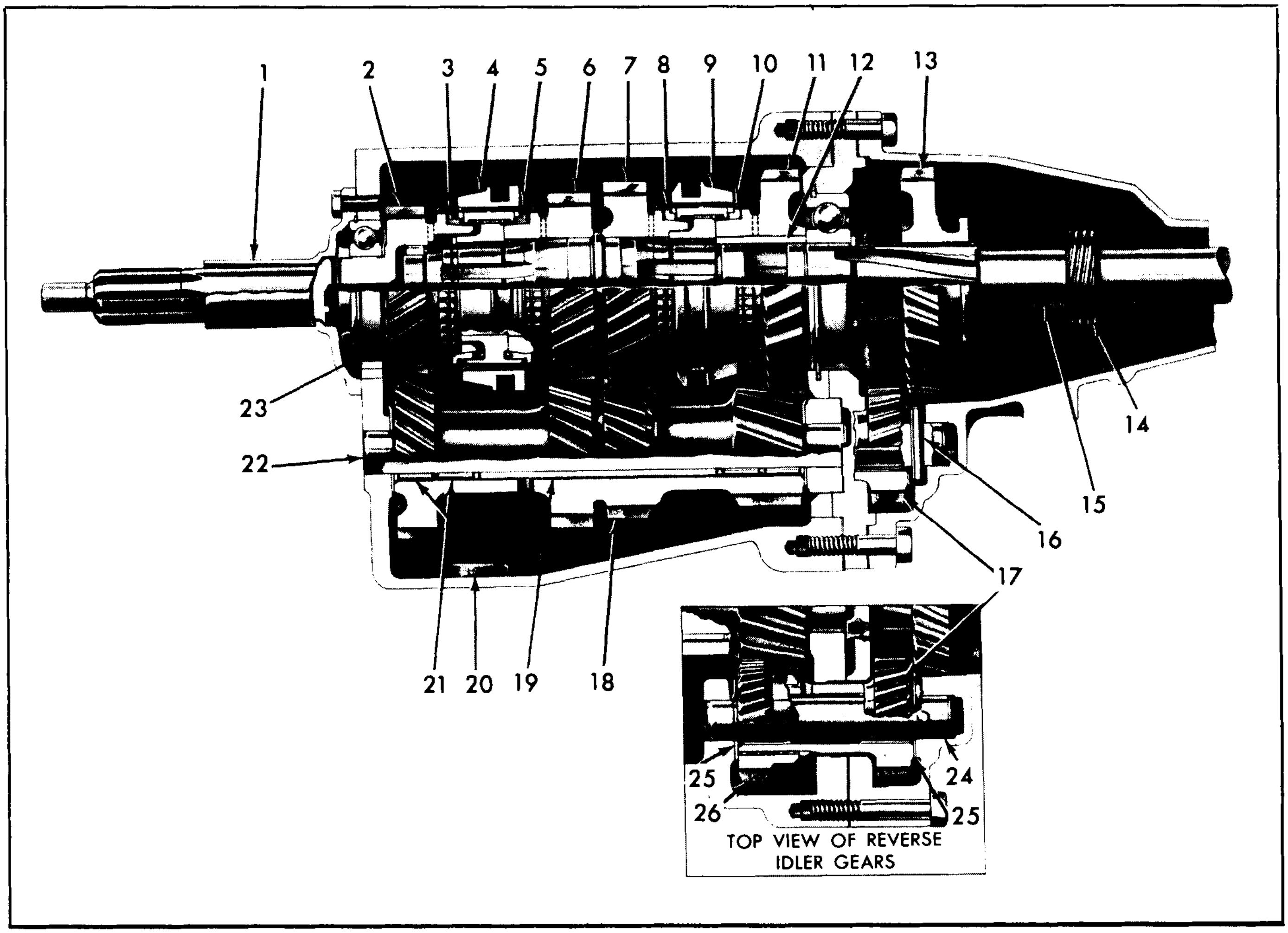


Fig. 7D-1 Cross Section of Transmission

1. Bearing Retainer
2. Main Drive Gear
3. 4th Speed Blocking Ring
4. 3rd & 4th Speed Synchronizer Sleeve
5. 3rd Speed Synchronizer Blocker Ring
6. 3rd Speed Gear
7. 2nd Speed Gear
8. 2nd Speed Blocker Ring
9. 1st & 2nd Speed Synchronizer Sleeve
10. 1st Speed Synchronizer Blocker Ring
11. 1st Speed Gear
12. 1st Speed Gear Sleeve
13. Reverse Gear
14. Speedometer Drive Gear
15. Mainshaft
16. Reverse Idler Shaft Lock Pin
17. Reverse Idler Gear (Rear)
18. Countergear
19. Countershaft Bearing Spacer
20. Magnet
21. Countershaft Bearing Rollers (112)
22. Countershaft
23. Oil Slinger
24. Reverse Idler Gear Shaft
25. Thrust Washer
26. Reverse Idler Gear (Front)

The front end of mainshaft is piloted in bearing rollers set into the hollow end of the main drive gear and the rear end is carried by a heavy-duty ball bearing located at the rear end of the transmission case.

The countershaft gear is carried on a double row of bearing rollers positioned at both ends of the gear, while thrust is taken on thrust washers located at front and rear of the gear.

The two-piece reverse idler gear is carried on press-fit bronze bushings and thrust is taken on thrust washers located between the front of the gear and the back of the reverse idler thrust boss and the rear of the gear and the reverse idler gear shaft boss in the rear extension.

The 1st speed gear has a loose fit sleeve, lining its inner bore, which enables the gear to float freely on the mainshaft, while the reverse speed gear has splines on its inner bore to prevent the gear from rotating on the mainshaft but allow forward and rearward movement of this gear.

The two synchronizer assemblies are splined to the mainshaft so that they can impart torque to the mainshaft whenever they engage a rotating gear.

OPERATION

The main drive gear, 3rd speed gear, 2nd speed gear, 1st speed gear and reverse idler gears are in constant mesh

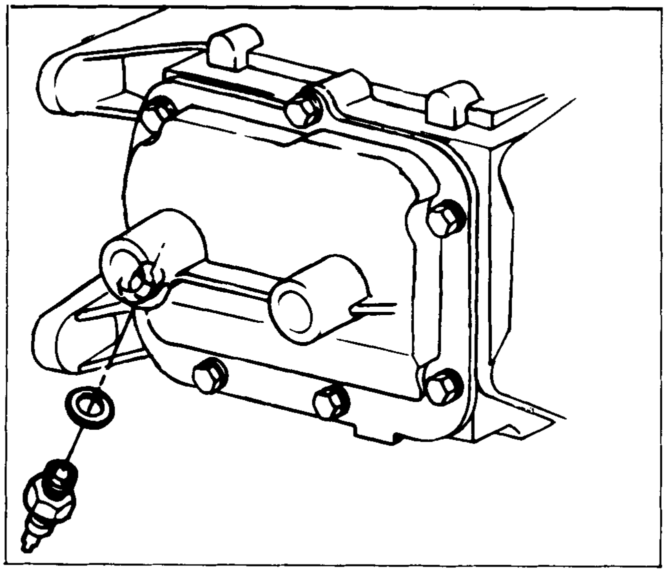


Fig. 7D-2 Transmission Controlled Spark Switch

with the countershaft gear; therefore, with the engine running and the engine clutch engaged, torque is imparted to the main drive gear and through the countershaft gear to the 3rd, 2nd, 1st and reverse idler gears at all times.

NEUTRAL (Fig. 7D-3)

In neutral, with engine clutch engaged, the main drive gear turns the countershaft gear. The countershaft gear then turns the 3rd, 2nd, 1st and reverse idler gears. But, because the 3rd & 4th and 1st & 2nd speed synchronizer sleeves are neutrally positioned and the reverse speed gear is positioned at the rear away from the reverse idler gear, power will not flow through the mainshaft.

FIRST (Fig. 7D-4)

In first speed, the 1st & 2nd speed synchronizer sleeve is moved rearward to engage the 1st speed gear, which is being turned by the countershaft gear. Because the 1st & 2nd speed clutch hub is splined to the mainshaft, torque

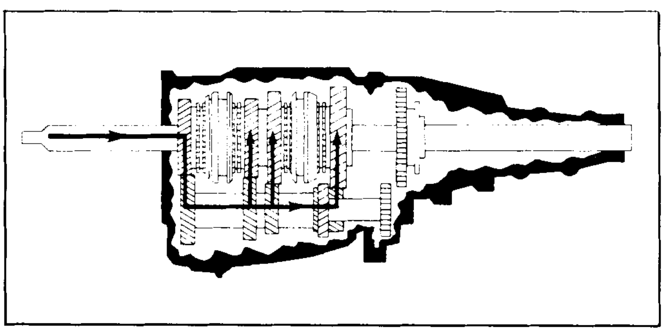


Fig. 7D-3 Power Flow - Neutral

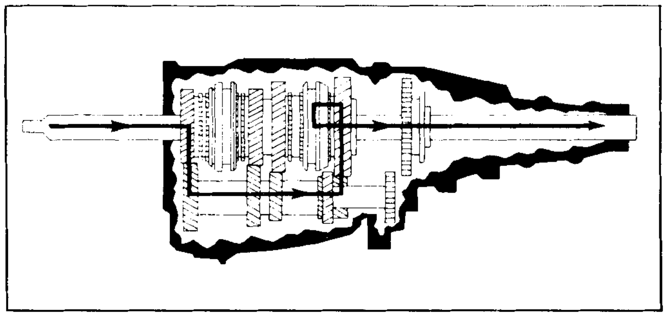


Fig. 7D-4 Power Flow - First Speed

is imparted to the mainshaft from the 1st speed gear through the 1st & 2nd speed synchronizer assembly.

SECOND (Fig. 7D-5)

In second speed, the 1st & 2nd speed synchronizer sleeve is moved forward to engage the 2nd speed gear, which is being turned by the countershaft gear. This engagement of the synchronizer sleeve with the 2nd speed gear imparts torque to the mainshaft because the 1st & 2nd speed clutch hub is splined to the mainshaft.

THIRD (Fig. 7D-6)

In third speed, the 1st & 2nd speed synchronizer sleeve assumes a neutral position. The 3rd & 4th speed synchronizer sleeve moves rearward to engage the 3rd speed gear, which is being turned by the countershaft gear. Because the 3rd & 4th speed clutch hub is splined to the mainshaft, torque is imparted to the mainshaft from the 3rd speed gear through the 3rd & 4th speed synchronizer assembly.

FOURTH (Fig. 7D-7)

In fourth speed, or direct drive, the 3rd & 4th speed synchronizer sleeve is moved forward to engage the main drive gear and the 1st & 2nd speed synchronizer sleeve

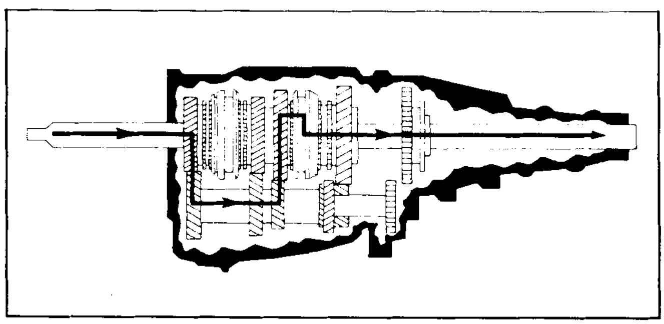


Fig. 7D-5 Power Flow - Second Speed

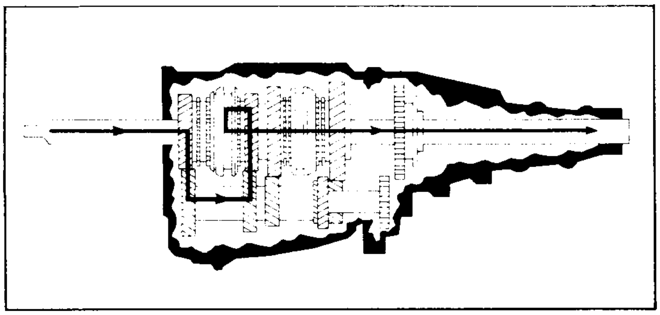


Fig. 7D-6 Power Flow - Third Speed

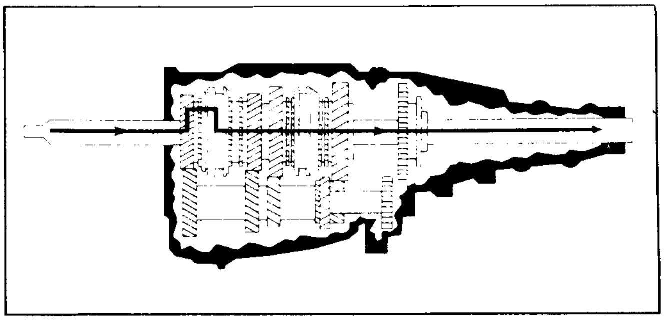


Fig. 7D-7 Power Flow - Fourth Speed

remains in a neutral position. This engagement of the main drive gear with the 3rd & 4th speed synchronizer sleeve imparts torque directly to the mainshaft.

REVERSE (Fig. 7D-8)

In reverse speed, both synchronizer sleeves assume a neutral position. The reverse speed gear is moved forward to engage the rear reverse idler gear, which is being turned by the countershaft gear. Because the reverse speed gear is splined to the mainshaft, this engagement causes the mainshaft to turn; however, because power flows from main drive gear to countershaft gear and through reverse idler gear to reverse speed gear, the direction of rotation will be opposite that of the engine.

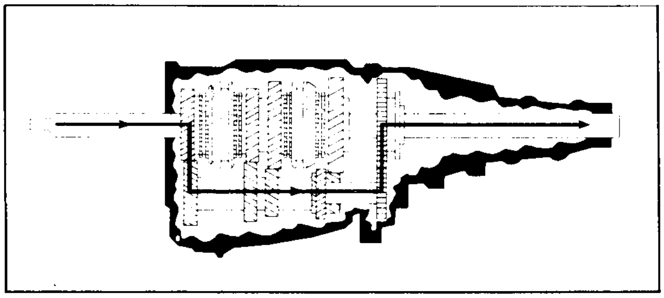


Fig. 7D-8 Power Flow - Reverse

PERIODIC SERVICE RECOMMENDATIONS

TRANSMISSION

No periodic service of the transmission is required except checking for leaks and proper lubricant level every 60 days. If there is evidence of leakage, the leak should be corrected and lubricant added, if needed.

Refill capacity is 39 fluid ounces (approx. 2-1/2 pints). Remove filler plug at side of case and add SAE 90 multipurpose gear lubricant. Lubricant level should be approximately level with bottom of filler plug hole. Install plug.

FLOOR SHIFT CONTROLS

Every 6,000 miles or 4 months, lubricate shift linkage and floor shift control lever contacting faces with water resistent EP chassis lubricant. To lubricate the floor shifter assembly, use a needle-fitting adaptor on a grease gun nozzle and direct grease liberally into vital areas as follows:

1. Pry dust cover off with a screwdriver blade.
2. Perform the following operation on each lever, one at a time:
   a. Move lever all the way forward and inject grease **behind** lever.
   b. Move lever all the way to the rear and inject grease **ahead** of lever.
3. After all lever areas have been greased, replace dust cover.

CAUTION: *Do not overbend dust cover.*

ON CAR ADJUSTMENTS

FLOOR SHIFT AND BACK DRIVE LINKAGE (Figs. 7D-9 thru 7D-11)

1. Position floor shift control lever in Neutral position.
2. Loosen adjusting swivel clamp on gearshift control rod (Figs. 7D-10 or 7D-11).
3. Loosen trunnion jam nuts on all three transmission control rods (Fig. 7D-9).

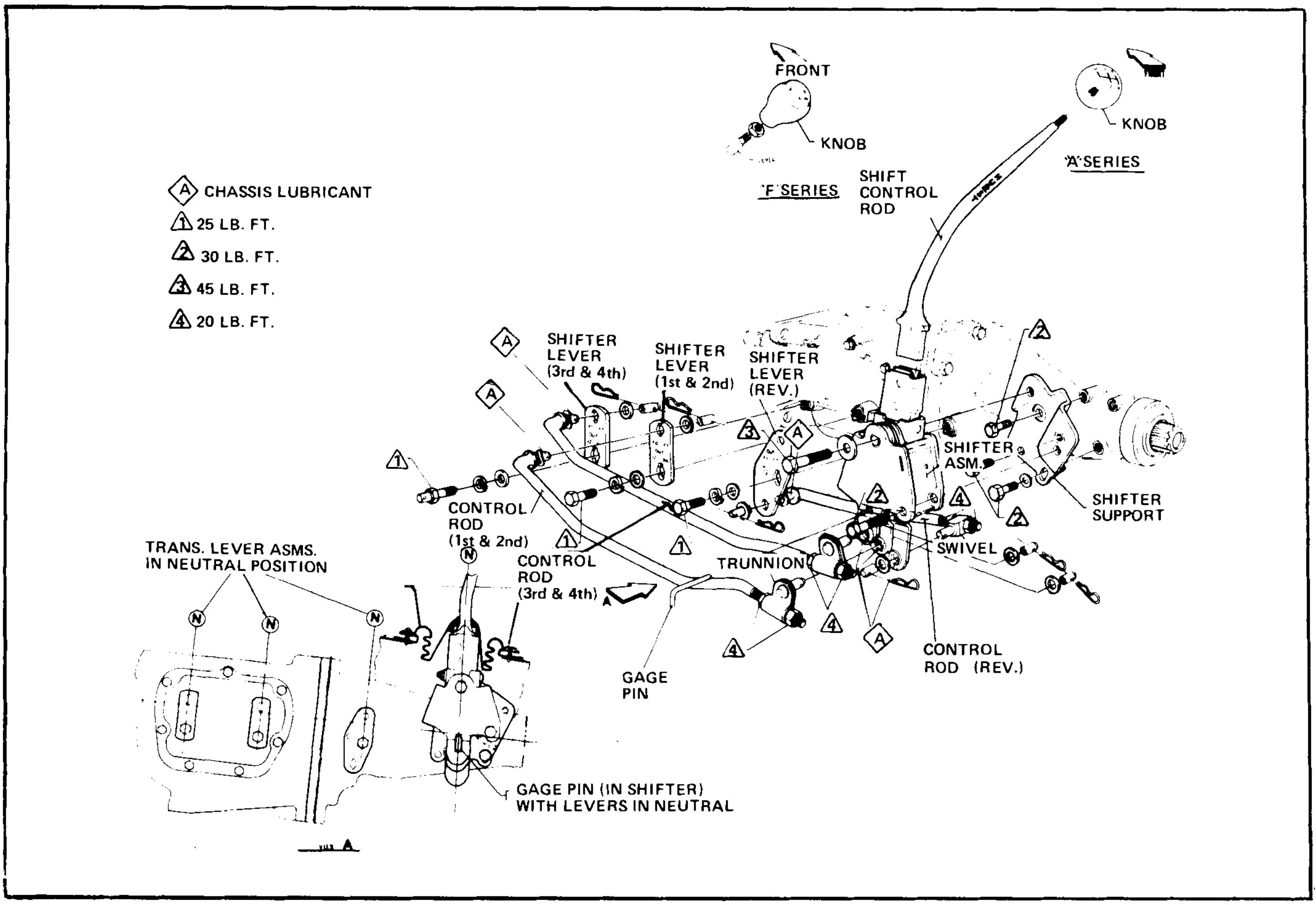


Fig. 7D-9 Floor Shift Controls (A Series Shown)

4. Insert a .250-249" diameter gage pin into shifter assembly (view "A" of Fig. 7D-9).

5. If shift control lever is misaligned to its floor pan (console) opening:

   a. With console - Loosen attaching bolts, shifter assembly-to- shifter support, align shifter assembly as shown in View "A" and tighten attaching bolts to specified torque.

   b. Except console - Loosen attaching bolts, shifter assembly-to-shifter support, align shifter assembly centrally in its floor boot and tighten attaching bolts to specified torque.

6. Position transmission shifter levers (1st & 2nd, 3rd & 4th and Reverse) in Neutral position and tighten jam nuts to 20 lb. ft.

7. Remove gage pin and check complete shift pattern for freeness of operation.

8. Position floor shift control lever in Reverse position, set steering column lower lever in Lock position and lock ignition.

9. Push up on gearshift control rod (Figs. 7D-10 or 7D-11) to take up clearance in steering column lock mechanism and tighten screw of adjusting swivel clamp to 20 lb. ft.

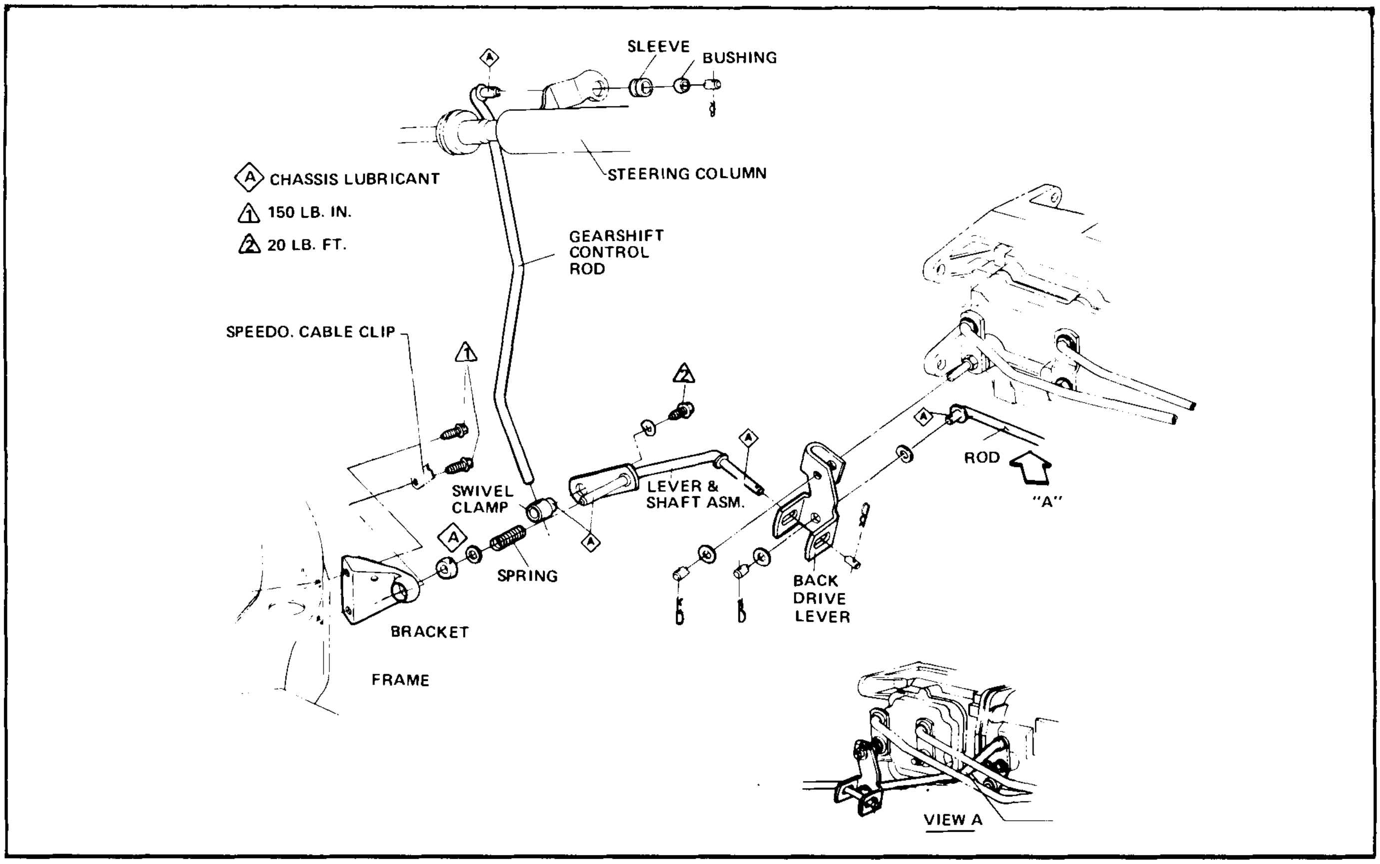


Fig. 7D-10 Back Drive Linkage - A Series

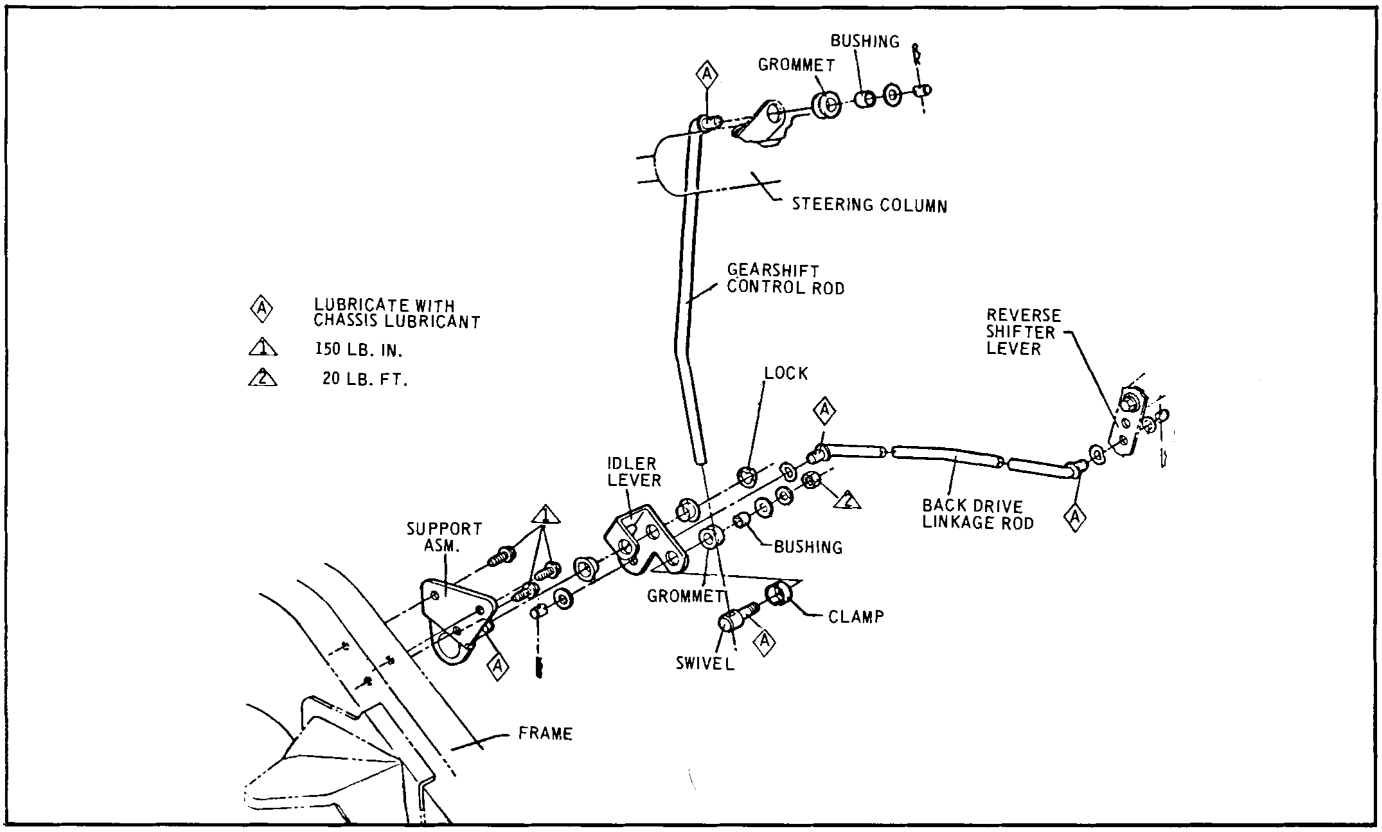


Fig. 7D-11 Back Drive Linkage - F Series

MINOR REPAIRS

SPEEDOMETER DRIVEN GEAR

REMOVE

1. Disconnect speedometer cable.
2. Remove retainer-to-rear extension bolt and lockwasher and remove retainer.
3. Insert screwdriver in slot in fitting and pry fitting, gear and shaft from rear extension.
4. Pry O-ring seal from groove in fitting and discard.
5. Check gear, shaft and fitting for wear and replace, if necessary.

REPLACE

1. Install new O-ring seal in groove and insert shaft.
2. Hold the assembly so slot in fitting is toward boss on rear extension and install in extension.
3. Push fitting into rear extension until retainer can be inserted into slot.
4. Install retainer bolt and lockwasher and tighten to 4 lb. ft. torque.
5. Connect speedometer cable to speedometer driven gear and sleeve assembly.

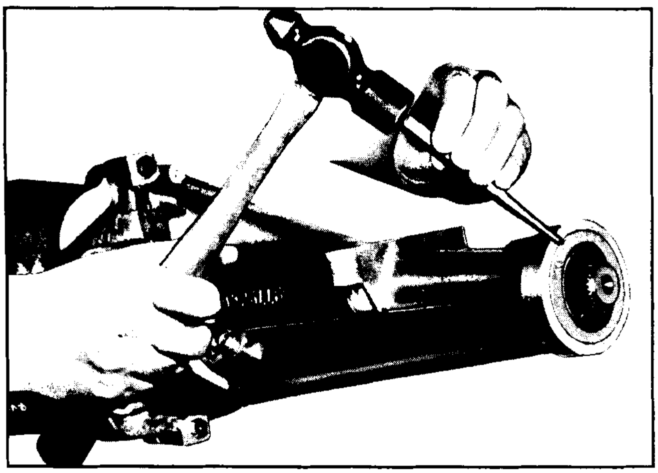


Fig. 7D-12 Removing Rear Extension Oil Seal

TRANSMISSION REAR EXTENSION OIL SEAL

REMOVE AND REPLACE

1. Remove propeller shaft as outlined in Section 4E.
2. Use punch or other suitable tool to loosen oil seal from rear extension, remove and discard (Fig. 7D-12).
3. Wash counterbore with cleaning solvent and inspect for damage.
4. Inspect propeller shaft yoke for nicks, burrs or scratches which would cut new seal or cause seal to leak or damage bushing.
5. Coat new seal with sealing compound and press straight into bore of rear extension with J 5154-A (Fig. 7D-13).

   CAUTION: *Do not excessively force the seal against the seat in the extension.*

6. Reinstall propeller shaft assembly.

TRANSMISSION CASE COVER

REMOVE

1. Disconnect control rods from shifter levers (Fig. 7D-9) and disconnect electrical lead to T.C.S. switch.
2. Shift transmission into second speed, before removing case cover, by moving 1st & 2nd shifter lever into forward detent position.

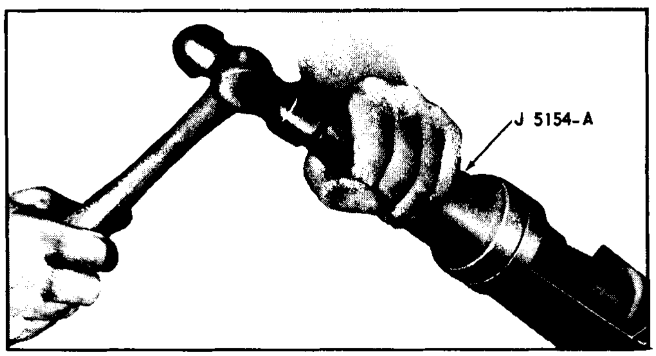


Fig. 7D-13 Installing Rear Extension Oil Seal

3. Remove T.C.S. switch and gasket from case cover, loosen case cover bolts and allow transmission to drain.

4. Remove case cover assembly from transmission case (Fig. 7D-14).

5. Remove shifter lever bolts, lockwashers and flat washers. Pull levers from shafts.

6. Remove both shift forks from the shifter shafts. Remove both shifter shaft assemblies from cover. Lip seals in case cover may now be pryed out if replacement is required because of damage (Fig. 7D-15).

7. Remove detent cam spring and detent cam retainer ring. Remove both detent cams.

8. Inspect and replace necessary parts.

REPLACE

1. Install 1st & 2nd detent cam to detent cam pin first, then install 3rd & 4th detent cam so that the detent cam spring notches are offset or opposite each other. Detent cam notches must be facing downward.

2. Install detent cam retainer ring to detent cam pin and hook spring into detent cam notches.

3. Install both shifter shaft assemblies in case cover, being careful not to damage lip seals. Install both shift forks to shifter shafts, lifting up on detent cams to allow forks to fully seat into position.

4. Install shifter levers, flat washers, lockwashers and bolts, torquing to 25 lb. ft.

5. Move 1st & 2nd shifter lever into 2nd speed (forward) position and position cover gasket on case.

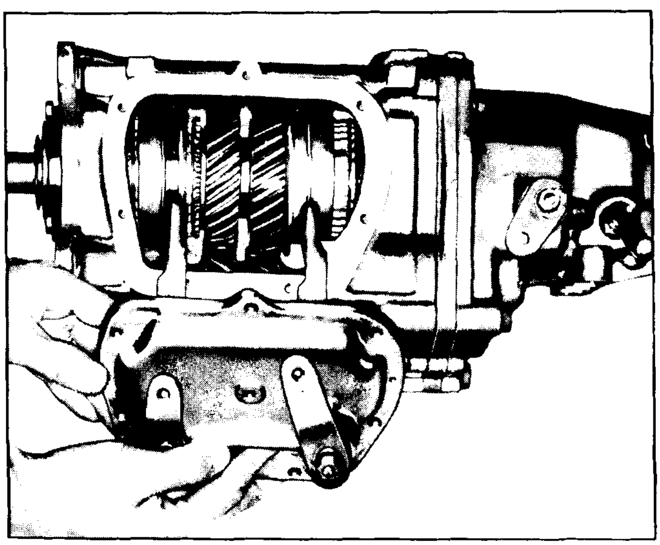


Fig. 7D-14 Removing or Installing Case Cover

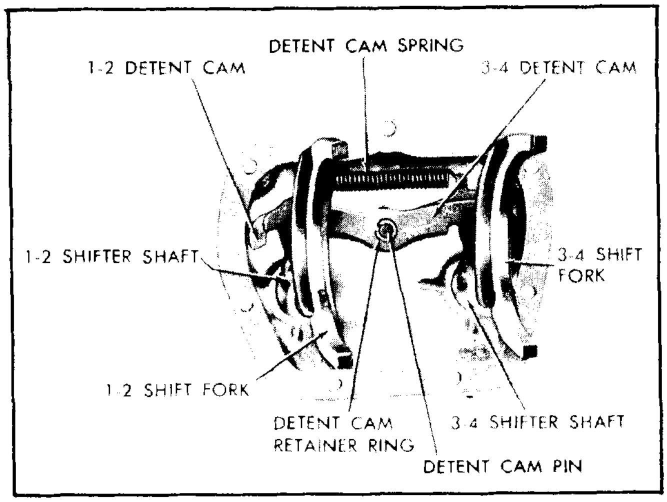


Fig. 7D-15 Case Cover Assembly

NOTE: *When installing new gasket, do not coat with grease.*

6. Carefully position case cover into place, making sure the shift forks aligned with their respective mainshaft synchronizer sleeves (Fig. 7D-14).

7. Install case cover attaching bolts, tighten evenly to 18 lb. ft. torque, install T.C.S. switch with new gasket and tighten to 10 lb. ft. torque and connect control rods to levers. Connect lead to T.C.S. switch.

8. Remove filler plug at side of transmission and check lubricant level. Lubricant level should be approximately level with bottom of filler hole. If necessary to add lubricant, use only SAE 90 multi-purpose gear lubricant. Install and tighten plug to 30 lb. ft. torque.

GEARSHIFT CONTROL LEVER

REMOVE

1. Release control lever by inserting a thin rule or a piece of .015" to .020" thick shim stock into the socket alongside the base of the floor gearshift lever on the driver's side.

2. Insert rule or stock to a depth of at least one inch to unlock its bayonet retainer.

3. Lift the control lever and tool up out of the shifter socket.

INSTALL

Replace lever by inserting into the shifter socket. This bayonet will lock the control lever automatically into its proper position.

MAJOR REPAIRS

TRANSMISSION

REMOVE

1. Disconnect the speedometer cable from speedometer driven gear fitting and disconnect leads from back-up light switch and TCS switch.

2. Disconnect transmission shifter levers (1st & 2nd, 3rd & 4th and Reverse) from transmission shifter shafts (Fig. 7D-9). Remove two (2) shifter assembly-to-extension support bolts and, if shifter assembly removal is not required, it may be left hanging in its floor seal.

3. Remove propeller shaft assembly as outlined in Section 4E.

4. Support rear of engine and remove two transmission extension insulator-to-cross member support retaining bolts (see Section 6).

5. Remove the two top transmission-to-clutch housing bolts and insert two Transmission Aligning Studs J 1126 in these holes.

   NOTE: *The use of two aligning studs during this operation will support the transmission and prevent damage to the clutch disc through springing.*

6. Remove the two lower transmission-to-clutch housing bolts.

7. Tilt rear of extension upward to disengage bracket studs from cross member support and withdraw transmission from clutch housing.

8. Remove the transmission.

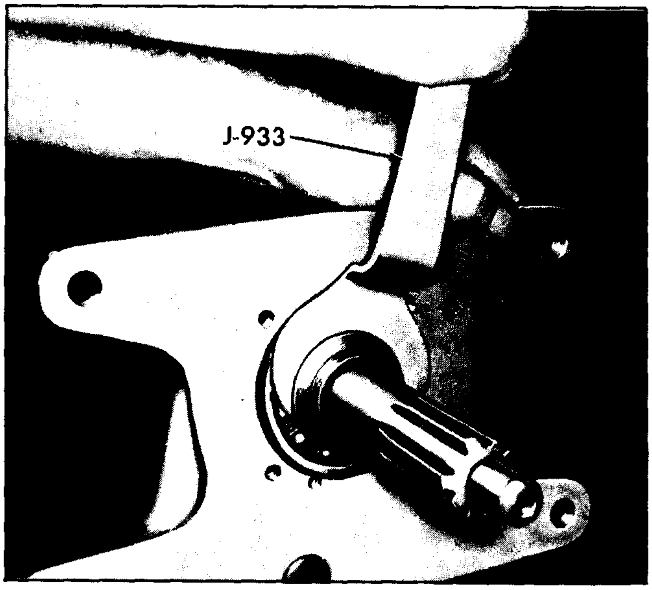


Fig. 7D-16 Removing Clutch Gear Bearing Retainer Nut

DISASSEMBLE

1. Remove transmission case cover assembly from transmission case and drain lubricant.

   NOTE: *If cover assembly is to be overhauled for inspection or replacement of worn parts, follow procedures 5 through 8 above under TRANSMISSION CASE COVER - REMOVE.*

2. Remove insulator assembly from transmission rear extension.

3. Remove four bolts from clutch gear bearing retainer and remove bolt locks, retainer and gasket.

4. Remove the clutch gear bearing retainer nut (Fig. 7D-16), using Tool J 933 after locking up transmission by shifting into two gears.

   NOTE: *Nut has left hand threads.*

5. With transmission gears in neutral, drive lock pin from bottom side of reverse shifter shaft boss and pull shaft out about 1/2". This disengages the reverse shift fork from reverse gear (Fig. 7D-17).

6. Remove bolt, lockwasher, retainer and speedometer driven gear from rear extension.

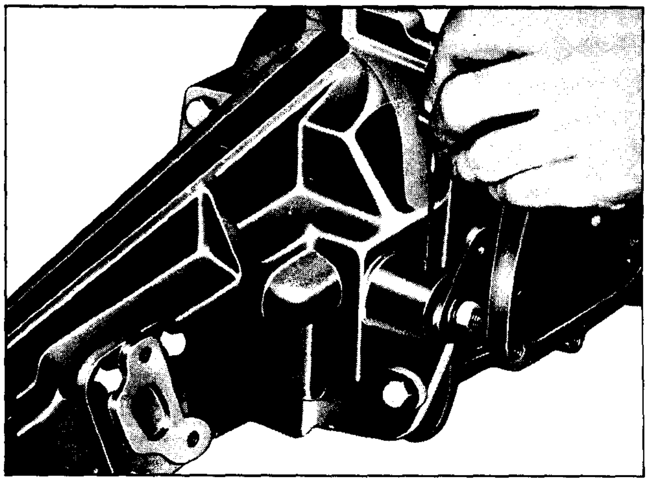


Fig. 7D-17 Removing Reverse Shifter Shaft Lock Pin

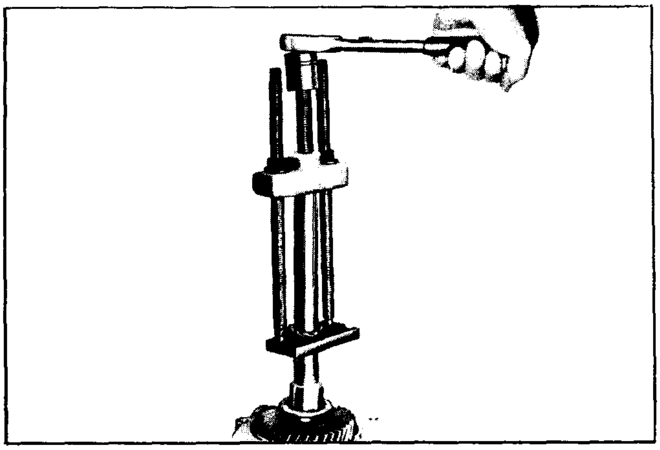


Fig. 7D-18 Removing Speedometer Drive Gear

7. Remove six bolts attaching the rear extension to the rear bearing retainer and case. Tap extension with soft hammer in a rearward direction to start. When the reverse idler shaft is out as far as it will go, move extension to left so reverse shift fork clears reverse gear and remove extension and gasket.

8. Remove the rear reverse idler gear, idler shaft (with lock pin) and flat thrust washer from the extension.

9. Remove the speedometer drive gear with Gear Remover J 5814-A, as shown in Fig. 7D-18, and remove the reverse gear.

10. Slide 3rd & 4th synchronizer clutch sleeve to 4th gear position (forward) before trying to remove mainshaft assembly from case (Fig. 7D-19).

11. Carefully remove the rear bearing retainer and mainshaft assembly from the case by tapping bearing retainer with a soft hammer.

12. Unload 17 bearing rollers and cage from main drive gear and remove fourth speed synchronizer blocker ring.

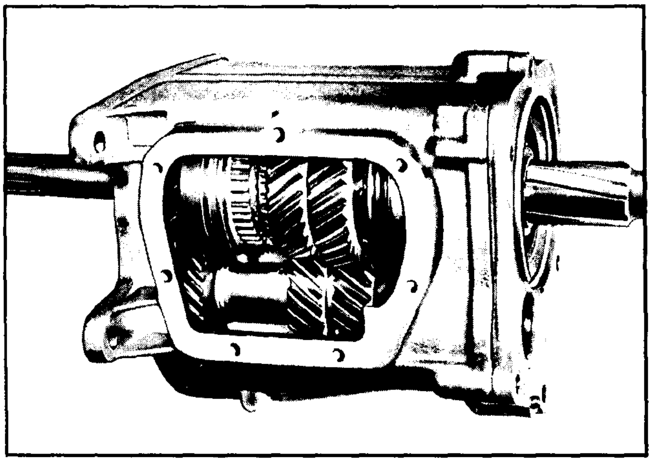


Fig. 7D-19 3rd & 4th Speed Synchronizer Sleeve in 4th Gear Position

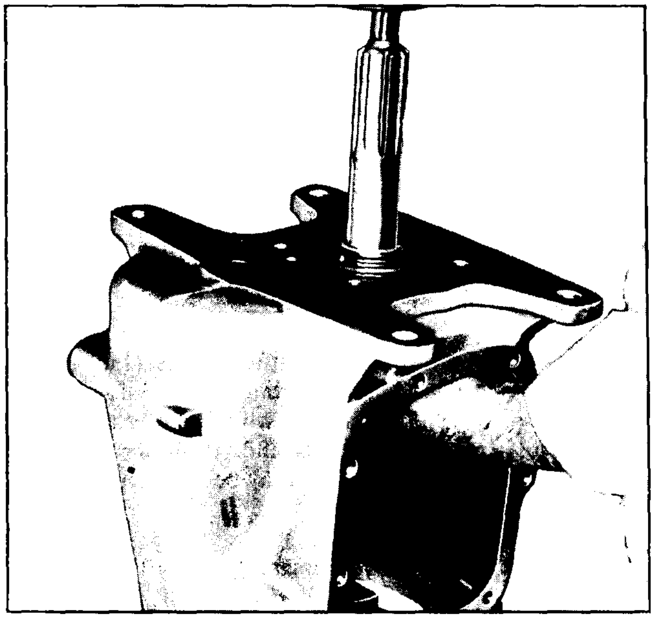


Fig. 7D-20 Removing Main Drive Gear

13. Lift the front reverse idler gear and thrust washer from case.

14. With soft hammer, tap main drive gear down from clutch gear bearing (Fig. 7D-20).

15. From inside case, tap out clutch gear bearing and its locating ring.

16. From the front of the case, tap out the countershaft, using Loader J 22379 (Fig. 7D-21). Remove the countershaft gear and both tanged washers. Remove Loader J 22379 from countershaft gear.

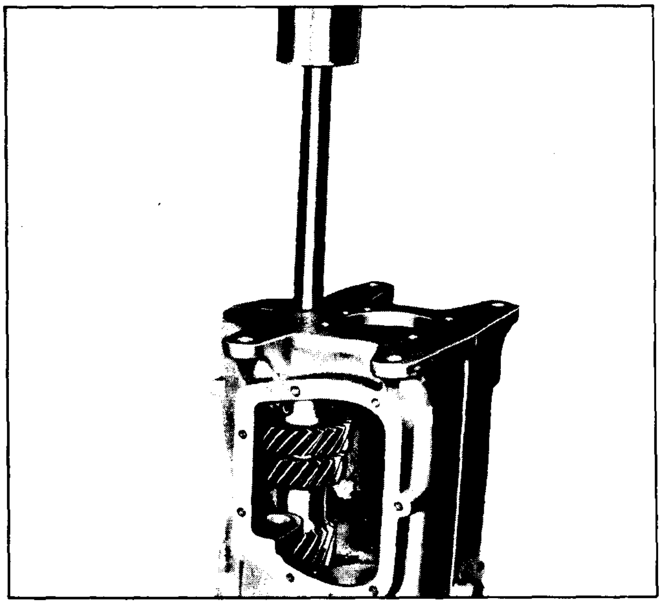


Fig. 7D-21 Removing Countershaft

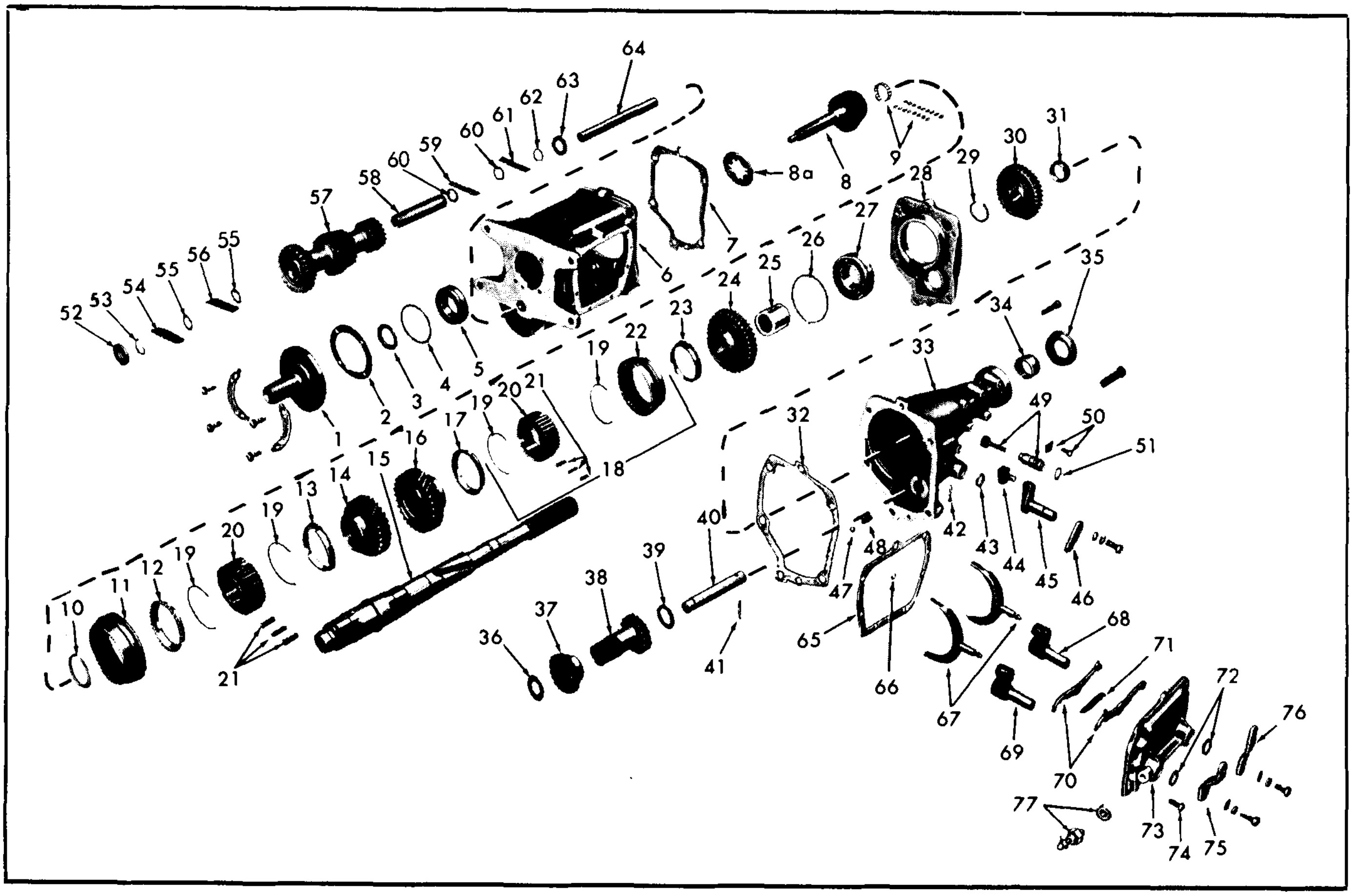


Fig. 7D-22 Exploded View of Transmission

1. Clutch Gear Bearing Retainer
2. Gasket
3. Bearing Retainer Nut
4. Locating Ring
5. Clutch Gear Bearing
6. Transmission Case
7. Gasket
8 .Main Drive Gear
8a. Oil Slinger
9. Bearing Rollers and Cage
10. Retainer Ring
11. 3rd & 4th Speed Synchronizer Sleeve
12. 4th Speed Synchronizer Blocker Ring
13. 3rd Speed Synchronizer Blocker Ring
14. 3rd Speed Gear
15. Mainshaft
16. 2nd Speed Gear
17. 2nd Speed Synchronizer Blocker Ring
18. 1st & 2nd Speed Synchronizer Assembly
19. Springs (4)
20. Synchronizer Hubs (2)
21. Shifting Plates(6)
22. 1st & 2nd Speed Synchronizer Sleeve
23. 1st Speed Synchronizer Blocker Ring
24. 1st Speed Gear
25. 1st Speed Gear Sleeve
26. Rear Bearing Locating Ring
27. Rear Bearing
28. Rear Bearing Retainer
29. Bearing Retainer Snap Ring
30. Reverse Gear
31. Speedometer Drive Gear
32. Gasket
33. Rear Extension
34. Extension Bushing
35. Extension Oil Seal
36. Reverse Idler Front Thrust Washer (Tanged)
37. Reverse Idler Gear (Front)
38. Reverse Idler Gear (Rear)
39. Reverse Idler Rear Thrust Washer (Flat)
40. Reverse Idler Shaft
41. Reverse Idler Shaft Lock Pin
42. Reverse Shifter Shaft Lock Pin
43. Lip Seal
44. Reverse Shift Fork
45. Reverse Shifter Shaft
46. Reverse Shifter Lever
47. Reverse Shifter Shaft Detent Ball
48. Reverse Shifter Shaft Detent Spring
49. Speedometer Driven Gear and Fitting
50. Retainer and Bolt
51. O-Ring Seal
52. Tanged Washer
53. Bearing Washer
54. Bearing Rollers
55. Bearing Washers
56. Bearing Rollers
57. Countershaft Gear
58. Bearing Spacer
59. Bearing Rollers
60. Bearing Washers
61. Bearing Rollers
62. Bearing Washer
63. Tanged Washer
64. Countershaft
65. Gasket
66. Detent Cam Retainer Ring
67. Forward Speed Shift Forks
68. 1st & 2nd Speed Shifter Shaft
69. 3rd & 4th Speed Shifter Shaft
70. Detent Cams
71. Detent Cam Spring
72. Lip Seals
73. Transmission Case Cover
74. Headed Cam Pin
75. 3rd & 4th Speed Shifter Lever
76. 1st & 2nd Speed Shifter Lever
77. T.C.S. Switch and Gasket

17. Remove the 112 bearing rollers, six .050" bearing washers and bearing spacer from countershaft gear (Fig. 7D-22).

18. Remove 3rd & 4th speed synchronizer retainer ring, using J 932 (Fig. 7D-23), and slide 3rd & 4th speed synchronizer assembly, 3rd speed gear and 3rd speed synchronizer blocker ring from front of mainshaft.

19. Spread rear bearing locating ring and press mainshaft out of the retainer (Fig. 7D-24).

20. Remove rear bearing retainer snap ring. Support 2nd speed gear and press on rear of mainshaft to remove rear bearings, 1st speed gear and sleeve, 1st speed synchronizer blocker ring, 1st & 2nd speed synchronizer assembly, 2nd speed synchronizer blocker ring and 2nd speed gear from the mainshaft (Fig. 7D-25).

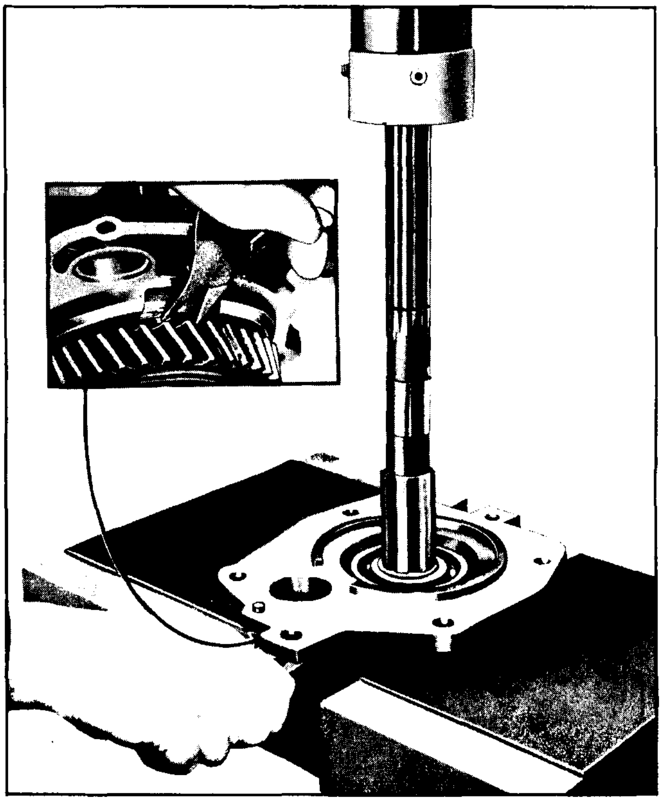


Fig. 7D-24 Pressing Mainshaft from Rear Bearing Retainer

REVERSE SHIFTER SHAFT AND SEAL

REMOVE AND REPLACE

1. With rear extension removed from transmission, the reverse shifter shaft lock pin will already be removed (see step 5 under TRANSMISSION - DISASSEMBLE).

2. Remove reverse shift fork.

3. Carefully drive the shifter shaft into rear extension, allowing detent ball to drop into case. Remove shaft, detent spring and detent ball.

4. Place detent spring into detent spring hole and, from inside of extension, install shifter shaft fully into its opening until its detent plate is butted against inside of rear extension.

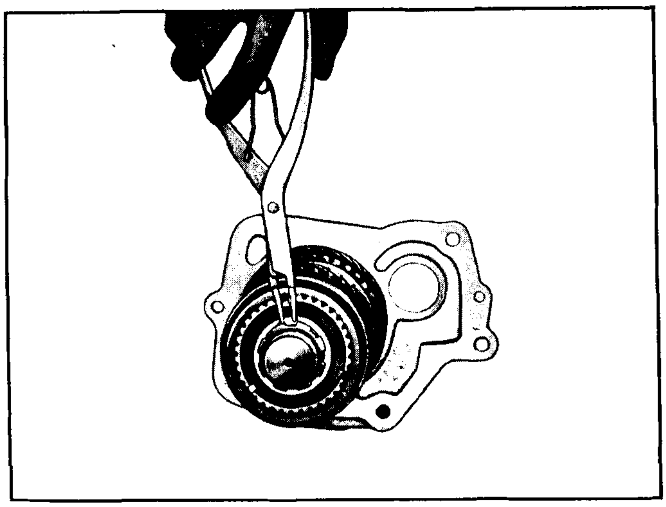


Fig. 7D-23 Removing 3rd & 4th Speed Synchronizer Retainer Ring

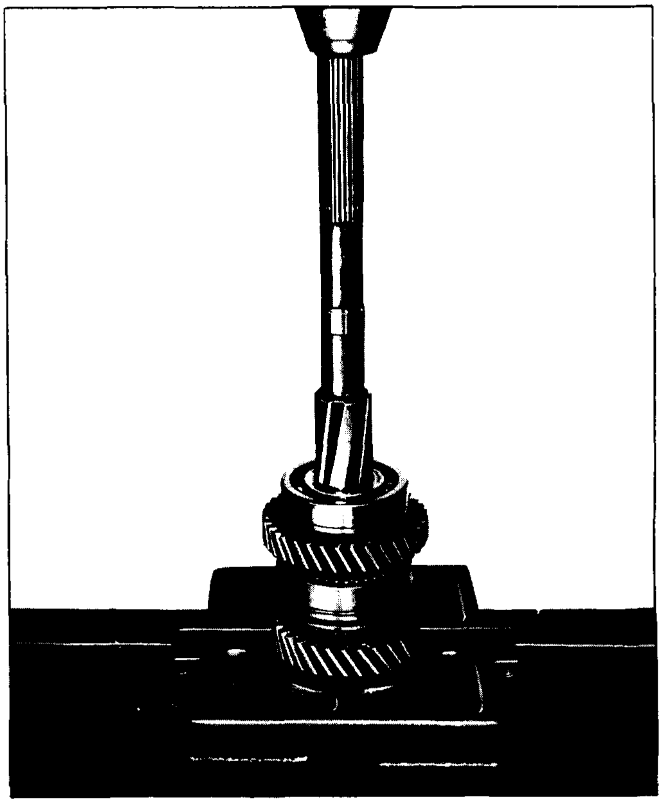


Fig. 7D-25 Pressing Mainshaft from Rear Bearing, 1st Speed Gear, 1st & 2nd Speed Synchronizer Assembly and 2nd Speed Gear

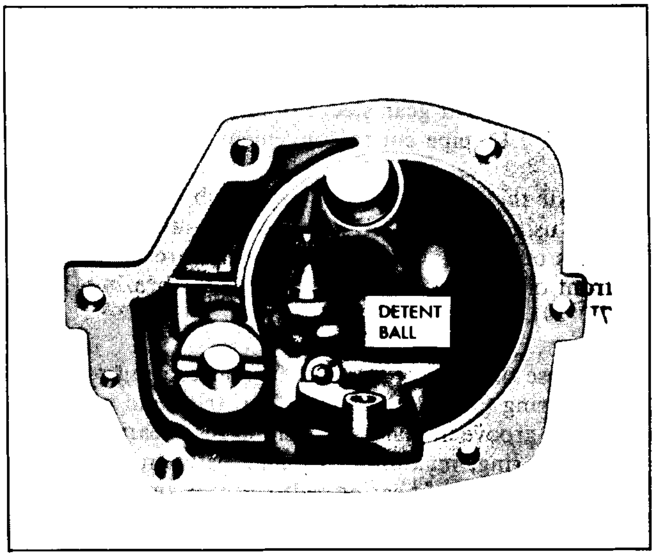


Fig. 7D-26 Installing Reverse Shifter Shaft and Detent Ball

5. Place detent ball on spring and, holding ball down with a suitable tool, push shifter shaft into place and turn until ball drops into place in detent on the shifter shaft (Fig. 7D-26).

6. Install reverse shift fork.

NOTE: *Do not drive the shifter shaft lock pin into place until the rear extension has been installed on the transmission case.*

REAR EXTENSION BUSHING AND OIL SEAL

REMOVE AND REPLACE

1. Remove oil seal with punch or other suitable tool and discard seal (Fig. 7D-12).

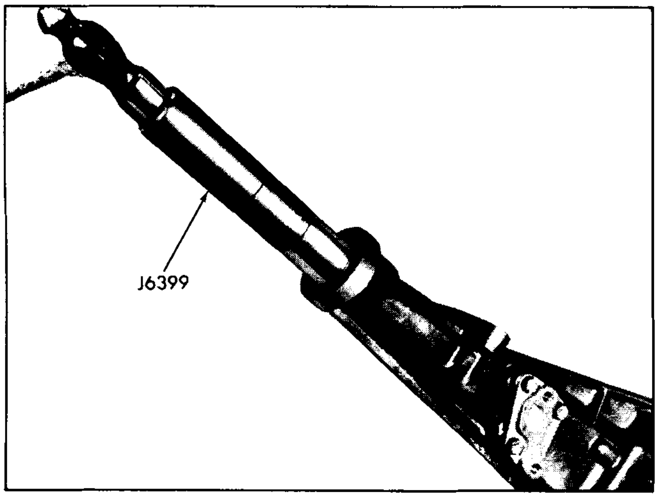


Fig. 7D-27 Removing or Installing Rear Extension Bushing

2. Using Tool J 6399, drive bushing forward into rear extension (Fig. 7D-27).

3. Drive new bushing in from rear of extension with same tool (J 6399), until end of bushing is slightly below counterbore for oil seal.

4. Coat I.D. of bushing with transmission oil, new seal with sealing compound and start straight into bore of extension. Using Installer J 5154-A, tap seal into extension (Fig. 7D-13).

CAUTION: *Do not excessively force the seal against the seat in the extension.*

SYNCHRONIZER ASSEMBLIES

DISASSEMBLE AND ASSEMBLE

NOTE: *The synchronizer hubs and their sleeves are a selected assembly and should be kept together as originally assembled, but the three shifting plates and two springs may be replaced if worn or broken.*

1. Mark synchronizer hub and sleeve so they can be reassembled in the same position.

2. Push the hub from its sleeve. The shifting plates will fall free and their springs may be easily removed.

3. Place the two springs in position (one on each side of the hub), so a tanged end of each spring falls into the same keyway in the hub. Place the shifting plates in position and, holding them in place, slide the hub into the sleeve.

TRANSMISSION

CLEANING AND INSPECTION

1. Wash the transmission case inside and out with a cleaning solvent and inspect for cracks. Inspect the front face, which fits against clutch housing, for burrs. If any are present, dress them off with a fine cut mill file.

2. Wash the clutch gear bearing and the rear bearing thoroughly in cleaning solvent and 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 the bearings are clean, then lubricate them with light engine oil and check them for roughness.

Roughness may be determined by slowly turning the outer race by hand.

4. All main drive gear and countershaft gear bearing rollers should be inspected closely and replaced if they show wear.

   Inspect countershaft at the same time and replace if necessary. Replace all worn bearing washers.

5. Inspect all gears and 1st speed gear sleeve and, if necessary, replace all that are worn or damaged.

6. The bushings used in the rear reverse idler gear are pressed into the gear, then peened into holes in the bores and are bored in place. This insures the positive alignment of the bushings and their shaft, as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushings are **not** serviced separately.

   Check bushings for excessive wear by using a narrow feeler gauge between the shaft and bushing or use a micrometer. The proper clearance is from .003" to .005".

ASSEMBLE

1. From the rear of mainshaft, assemble the 2nd speed gear (with hub of gear toward rear of shaft).

2. Install 1st & 2nd speed synchronizer assembly to mainshaft (synchronizer sleeve taper toward the rear of the transmission), together with a synchronizer blocker ring on either side so their keyways line up with the shifting plates (Fig. 7D-28).

3. Press 1st speed gear sleeve onto mainshaft, using a 1-3/4" I.D. pipe cut to convenient length.

4. Install the 1st speed gear (with hub toward front) and, using a 1-5/8" I.D. pipe cut to a suitable length, press on the rear bearing (snap ring groove toward front of transmission). Firmly seat the bearing (Fig. 7D-29).

5. Choose the correct selective fit rear bearing retainer snap ring (.087", .090", .093" or .096) and install it in the groove in mainshaft behind rear bearing. With proper ring, maximum distance between snap ring and rear face of bearing will be from zero to .005".

   NOTE: *Always use new rings when reassembling transmission and do* **not** *expand the rings further than is necessary for assembly.*

6. Install the 3rd speed gear (hub to front of transmission) and the 3rd speed gear synchronizer blocker ring (notches to front of transmission).

7. Install the 3rd & 4th speed synchronizer assembly with synchronizer sleeve taper toward front, making sure shifting plates in hub correspond to notches in the 3rd speed gear synchronizer blocker ring.

8. Install retainer ring in groove in mainshaft in front of the 3rd & 4th speed synchronizer assembly, with ends of ring seated behind spline teeth.

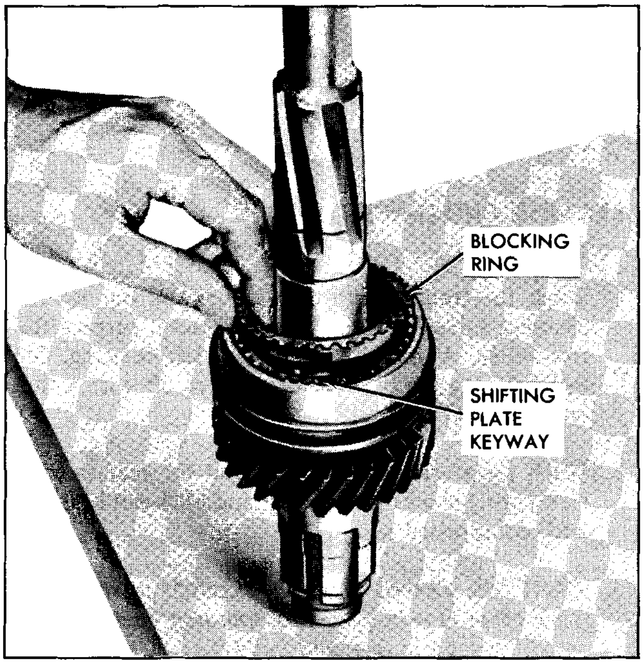


Fig. 7D-28 Installing 1st Speed Synchronizer Blocker Ring

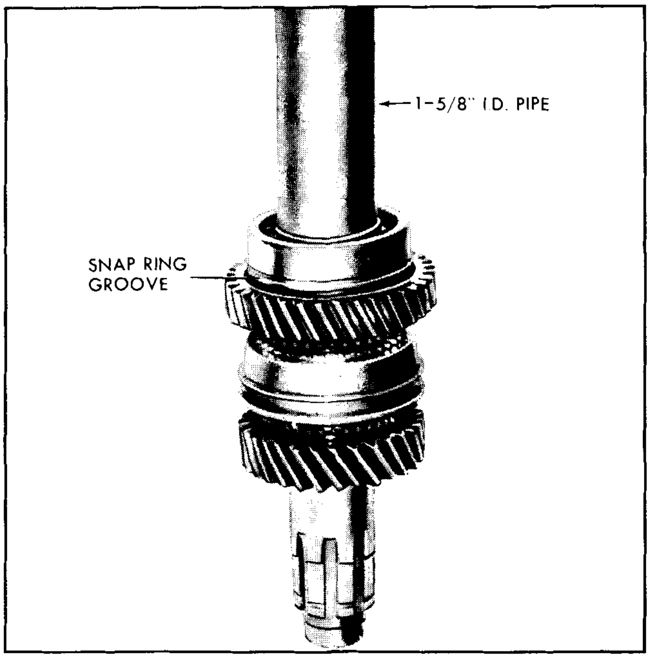


Fig. 7D-29 Installing Rear Bearing

9. Install the rear bearing retainer (Fig. 7D-30). Spread the locating ring in the retainer to allow the ring to drop around the rear bearing. Press on the end of the mainshaft until locating ring engages groove in the ring bearing.

10. Install the reverse gear (shift collar to rear) and two (2) anti-rattle springs (except close ratio).

11. Press or drive the speedometer drive gear onto the mainshaft until its rear face is 6.147 inches from the rear end of the mainshaft.

CAUTION: *Make certain correct speedometer drive gear is installed.*

12. Install seam-type spacer in countershaft gear and insert Tool J 22379 into countershaft gear.

13. Using heavy grease to retain the bearing rollers, install a .050" bearing washer and 28 bearing rollers in either end of the countershaft gear, a .050" bearing washer, 28 more bearing rollers and another .050" bearing washer (Fig. 7D-31).

14. Follow the same procedure for the opposite end of the countershaft gear.

15. Rest the transmission case on its side, with the case cover opening toward the assembler. Put countershaft gear tanged thrust washers in place, retaining them with heavy grease and making sure the tangs are resting in the notches of the case.

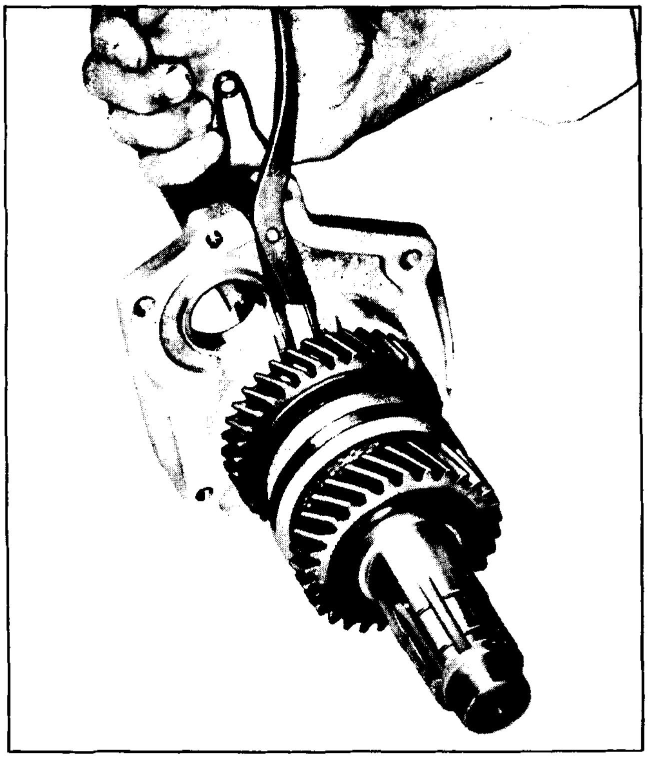


Fig. 7D-30 Installing Rear Bearing Retainer

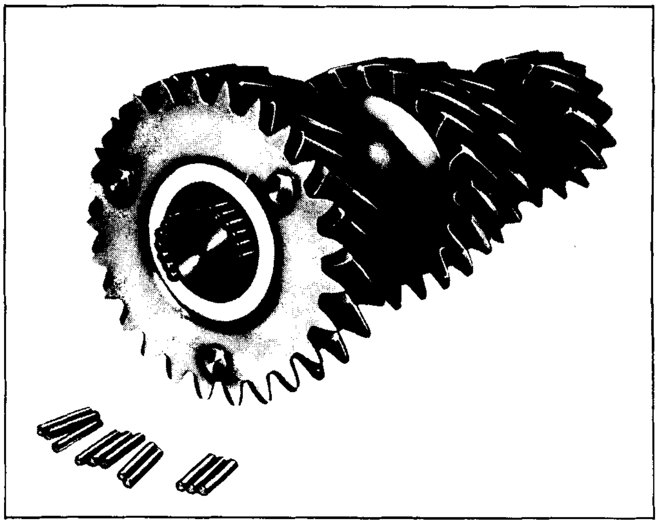


Fig. 7D-31 Loading Bearing Rollers into Countershaft Gear

16. Set countershaft gear in place in bottom of transmission case, making sure that tanged thrust washers are not knocked out of place and position the transmission case so that it is resting on its front face.

17. Lubricate and insert countershaft in rear of case. Turn countershaft so flat on end of shaft is horizontal and facing bottom of case.

NOTE: *The flat on shaft must be horizontal and toward the bottom to mate with rear bearing retainer when installed.*

18. Align countershaft gear with the shaft in rear and the hole in front of case and press countershaft into case (pushing Tool J 22379 out front of case) until flat on shaft is flush with rear of case. Be sure thrust washers remain in place (Fig. 7D-32).

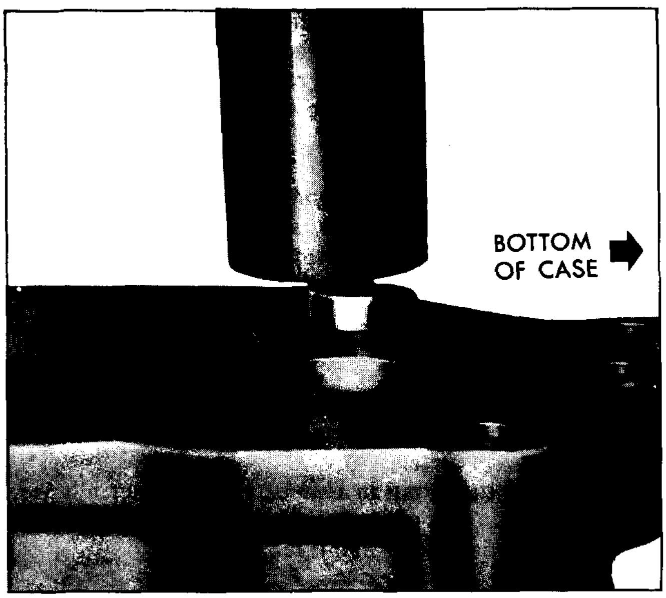


Fig. 7D-32 Installing Countershaft

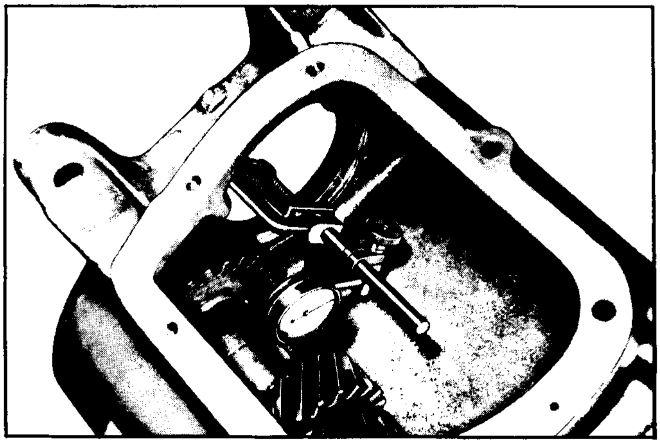


Fig. 7D-33 Checking Countershaft Gear End Play

19. Attach a dial indicator (Fig. 7D-33) and check end play of the countershaft gear. If end play is greater than .025", new thrust washers **must** be installed.

20. Install cage and the seventeen (17) bearing rollers into main drive gear cavity, using heavy grease to hold the rollers and cage in place.

21. Install main drive gear assembly through the case cover opening and into position in transmission front bore.

22. Install the 4th speed synchronizer blocker ring on main drive gear with the notches toward the rear of the transmission.

23. Place gasket in position on front face of rear bearing retainer.

24. Position the front reverse idler gear thrust washer (tanged) on the machined face of the ear cast in the case for the reverse idler shaft and hold with heavy grease. Position the front reverse idler gear next to the thrust washer, with the hub facing toward rear of the case.

CAUTION: *Before attempting to install mainshaft assembly into case, slide the 3rd & 4th synchronizer sleeve forward into 4th speed detent position (Fig. 7D-19).*

25. Lower the mainshaft assembly into case, making certain that notches on the 4th speed synchronizer blocker ring correspond to shifting plates in the 3rd & 4th synchronizer assembly (Fig. 7D-34).

26. With the guide pin in rear bearing retainer aligned with hole in rear of case, tap rear bearing retainer into position with a soft hammer.

27. From rear of the case, insert the rear reverse idler gear, engaging the splines with the portion of the front gear inside the case.

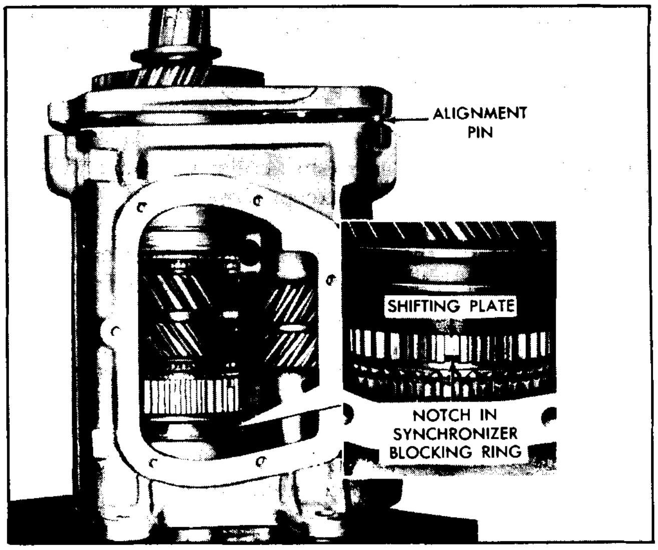


Fig. 7D-34 Installing Mainshaft Assembly

28. Using heavy grease, place gasket in position on rear face of rear bearing retainer.

29. Install the remaining flat thrust washer on reverse idler shaft. If new idler shaft is being used, drive out the lock pin and press it into new shaft.

30. Install reverse idler shaft (with lock pin) and thrust washer into idler gears and boss of case. Make sure to pick up front tanged thrust washer.

NOTE: *Lock pin should be in a vertical position.*

31. Position reverse gear at rear of spline, pull reverse shifter shaft to left side of extension and rotate shaft to bring reverse shift fork forward in extension (reverse detent position). Start the extension onto the transmission case (Fig. 7D-35), while slowly pushing in on the shifter shaft to engage the shift fork with the reverse gear shift collar. Then pilot the reverse idler shaft into the extension, permitting the extension to slide into the transmission case.

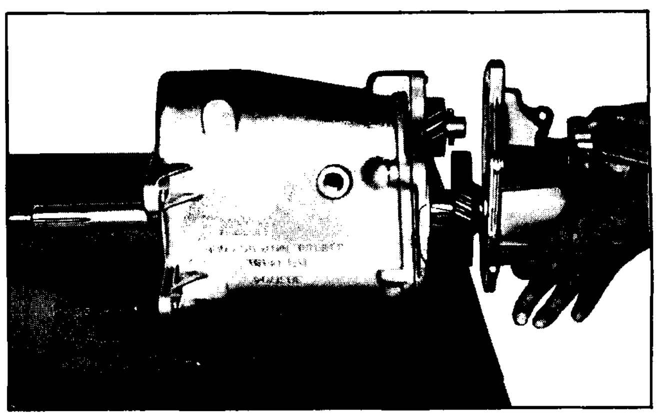


Fig. 7D-35 Installing Rear Extension To Case

32. Install six (6) extension-to-case attaching bolts. Torque the upper 3 bolts to 20 lb. ft.; lower 3 bolts to 30 lb. ft.

33. Push or pull reverse shifter shaft to line up groove in the shaft with holes · · the boss and drive in the lock pin. Install shifter lever, washers and bolt, torquing to 30 lb. ft.

34. Press clutch gear bearing onto main drive gear shaft (snap ring groove to front) and into case, until several main drive gear retaining threads are exposed.

35. Lock transmission up by shifting into two gears. Install clutch gear bearing retainer nut on the gear shaft and draw it up tight, using Tool J 933. Be sure bearing fully seats against shoulder on gear, torque retaining nut to 40 lb. ft. and lock in place by staking securely into main drive gear shaft hole with a center punch. Care must be used to avoid damaging the threads on the shaft.

36. Install the clutch gear bearing retainer, gasket, two bolt locks and four attaching bolts, using a suitable sealer on bolts. Torque to 20 lb. ft.

37. Shift 3rd & 4th synchronizer sleeve into neutral position and 1st & 2nd synchronizer sleeve into 2nd gear (forward) detent position. Shift case cover 3rd & 4th shifter lever into neutral detent and 1st & 2nd shifter lever into 2nd gear (forward) detent position.

38. Install case cover gasket and carefully position case cover into place. There is a dowel pin in cover to assure proper alignment with case. Install seven (7) attaching bolts and tighten evenly to avoid case cover distortion. Torque to 20 lb. ft.

    NOTE: *When installing new gasket, do* **not** *coat with grease.*

39. Install speedometer driven gear assembly, retainer, bolt and lockwasher to rear extension. Torque to 4 lb. ft.

40. Install insulator assembly on rear extension, if removed. Torque bolts to 30 lb. ft.

41. If shifter support to rear extension was removed, reinstall, tightening 3 bolts to 30 lb. ft. torque.

INSTALL

1. Raise transmission until rear extension can be moved rearwards over center cross member support.

   NOTE: *If it was necessary to remove cross member support before removing transmission, install support while transmission is held in a raised position.*

2. Move transmission forward until extension bracket studs engage holes in cross member support and main drive gear shaft enters clutch housing. Care should be taken to make certain clutch release bearing remains seated.

3. Install Aligning Stud J 1126 in lower right transmission-to-clutch housing bolt hole for alignment.

4. Install two upper transmission-to-clutch housing mounting bolts and washers and tighten securely to 55 lb. ft. torque. Remove aligning stud and install two lower mounting bolts and washers and tighten to 55 lb. ft. torque.

5. Install rear extension insulator-to-cross member support bolts and tighten to 30 lb. ft. torque.

6. Install propeller shaft assembly.

7. Install shifter assembly and secure it to transmission rear extension support with two shifter-to-extension support bolts. Tighten upper bolt to 45 lb. ft. torque. Tighten lower bolt to 30 lb. ft. torque.

8. Connect linkage and adjust as described in ON CAR ADJUSTMENTS.

9. Connect speedometer cable to speedometer driven gear and tighten securely.

10. Connect back-up light leads to back-up light switch leads and connect lead to TCS switch on case cover.

11. Remove filler plug at side of transmission and add 2 1/2 pints of SAE 90 multi-purpose gear lubricant. Lubricant level should be approximately level with bottom of filler plug hole. Install plug and tighten plug to 30 lb. ft. torque.

12. Check shift pattern and adjust as required.

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

An identifying code is marked in yellow paint on all four-speed manual transmissions. This code consists of two letters, one inch high, on the top of the case:

Wide Ratio (400 engine) .... WD
Close Ratio (400 & 455 engines) .... WJ

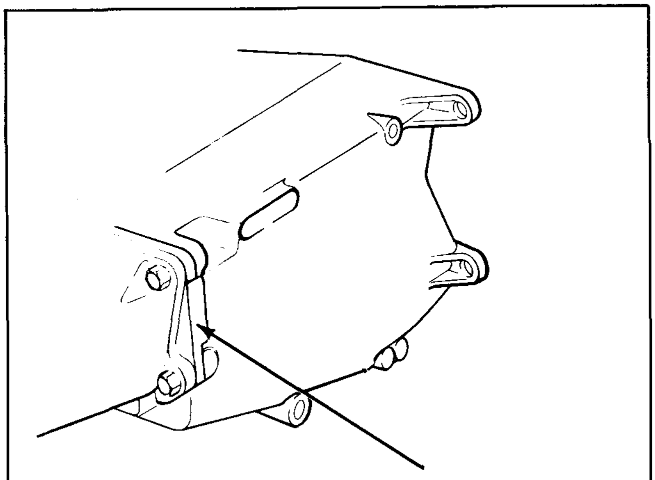


Fig. 7D-36 Vehicle Identification Number Location

The vehicle identification number is also stamped on the transmission case, as shown in Fig. 7D-36.

GEAR RATIOS

	WIDE	CLOSE
First	2.52	2.20
Second	1.88	1.64
Third	1.46	1.28
Fourth	1.00	1.00
Reverse	2.59	2.27

LUBRICANT

Capacity............. 39 fluid ounces (approx. 2 1/2 pints)

TORQUE

APPLICATION	LB. FT.
Clutch Gear Bearing Retainer Nut	40
Main Drive (Clutch) Gear Bearing Retainer Bolts	20
Case Cover Bolts	20
Extension-to-Case Bolts (Upper)	20
Extension-to-Case Bolts (Lower)	30
Shifter Lever-to-Shifter Shaft Bolts	25
Transmission Filler Plug	30
Shifter Support-to-Extension Bolts	30
Shifter Assembly-to-Support (Upper) Bolt	45
Shifter Assembly-to-Support (Lower) Bolt	30
Rear Mount to Extension and to Crossmember Bolts	40
Frame-to-Crossmember Bolts (4)	35
Transmission-to-Clutch Housing Bolts	55
Trunnion Jam Nuts	20
Speedometer Gear Retainer Bolt	4
T.C.S. Switch-To-Case Cover	10

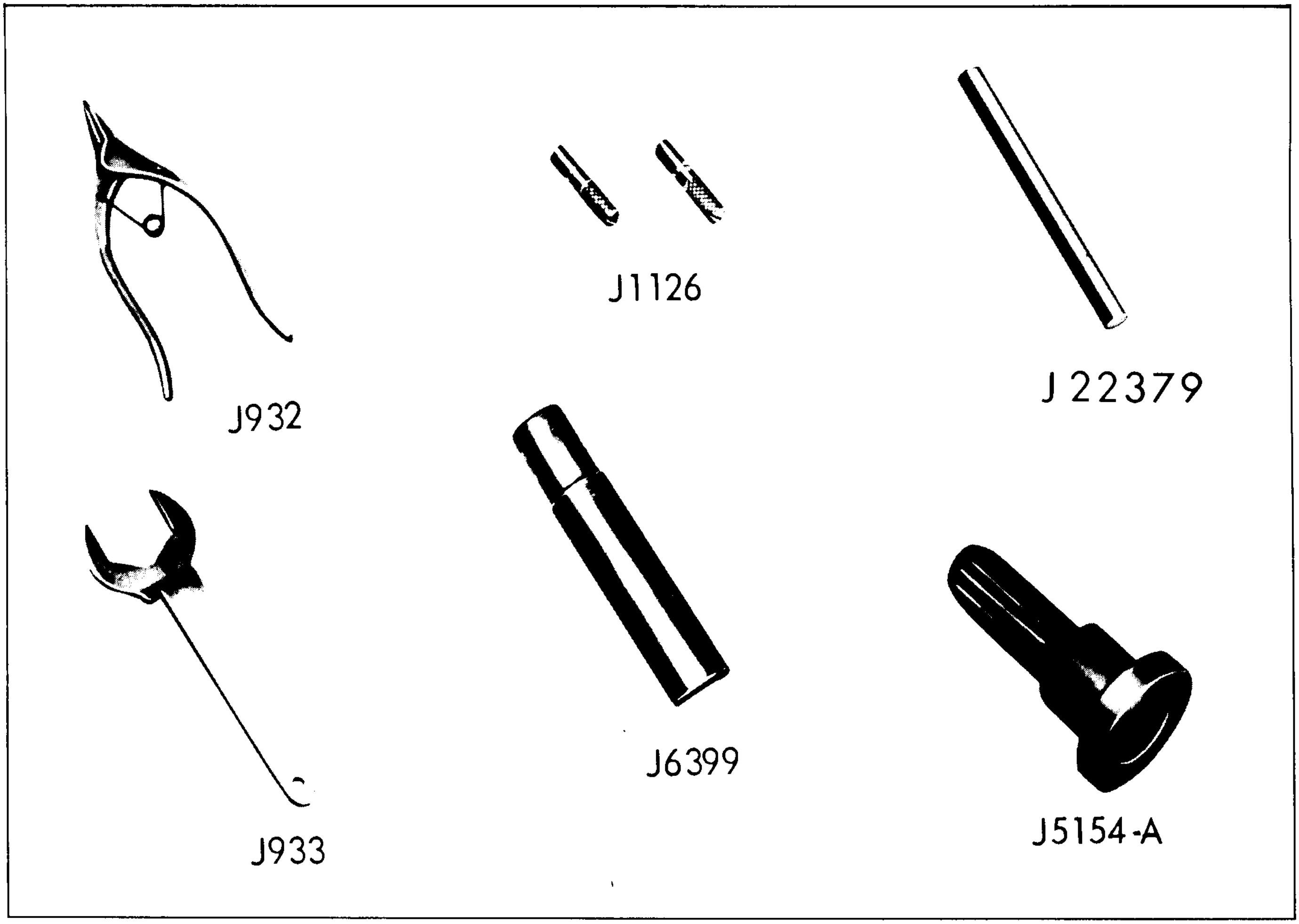


Fig. 7D-37 Special Tools

J 932 Snap Ring Pliers
J 933 Clutch Gear Retainer Nut Wrench
J 1126 Aligning Studs
J 5154-A Extension Oil Seal Installer
J 5814-A Speedometer Drive Gear Remover (Not Shown)
J 6399 Extension Bushing Remover and Installer
J 22379 Countershaft Bearing Loader

SECTION 7E

TURBO HYDRA-MATIC (M-40) TRANSMISSION

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

Accurate diagnosis of transmission problems begins with a thorough understanding of normal transmission operation. In particular, knowing which units are involved in the various speeds or shifts so that the specific units or circuits involved in the problem can be isolated and investigated further. Analytical diagnosis will protect the technician from comebacks and certainly will improve owner satisfaction.

An important and often overlooked aspect of diagnosis is finding out specifically what the customer is complaining of. For this purpose, a short ride with the customer will often prove beneficial. It may be found that the condition the customer wants corrected is standard and should not be altered.

The following sequence, based on field experience, provides the desired information quickly and in most cases actually corrects the malfunction without requiring the removal of the transmission. Details of the items listed in this sequence are covered further in the text.

SEQUENCE FOR TURBO HYDRA-MATIC (M-40) DIAGNOSIS

1. Check and correct oil level (refer to Fluid Level under Periodic Service Recommendations). Always check and correct the fluid level before road testing as erractic shifting, pump noise or other malfunctions can often be traced to improper fluid level.
2. Check and correct detent switch operation and adjustment.
3. Check and correct vacuum line and fittings.
4. Check and correct manual linkage operation and adjustment.
5. Road Test. Install line pressure gauge and road test (correcting items 1, 2, 3 and 4 above may have eliminated the complaint):
   a. Road test, using all selective ranges, noting when discrepancies 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.
   d. If the malfunction or complaint is determined during road test, check list of transmission problems and related causes as detailed in this section to assist your diagnosis.

After having used the above sequence to find the source of the problem, the cause of the problem can be corrected. A good mechanic will not stop at this point and consider the job done. A road test after repair could indicate that secondary effects or problems could have resulted as a side effect of the original problem.

ROAD TEST (ATTACH PRESSURE GAUGE TO TRANSMISSION)

The car owner should accompany the tester and the complaint analyzed under the same or simulated conditions. Check all the shifts in the following manner:

DRIVE RANGE:

Position selector lever in Drive range, accelerating the vehicle from 0 mph. A 1-2 and 2-3 shift should occur at all throttle openings (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.

LO RANGE:

Position the selector lever in Lo range. No upshift should occur in this range, regardless of throttle opening.

2ND GEAR - OVERRUN BRAKING:

Position the selector lever in the Drive range and, with the car speed at approximately 35 mph, 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 60 psi to approximately 150 psi in 2nd.

Super Range		Minimum	Maximum
2nd Gear - Steady road load at approximately 25 mph		145 psi	155 psi
Gear	Selector Lever Position	Minimum	Maximum
1st 2nd 3rd	Drive (Zero to full throttle)	60	150
3rd	Drive (Zero Throttle at 30 mph)	60	
Reverse	Reverse (Zero to full throttle).	95	260

Fig. 7E-1 Oil Pressure Check - Road or Normal Operating Conditions

1ST GEAR - OVERRUN BRAKING:

With the selector lever in Super at approximately 30 mph at constant throttle, reposition the selector lever into Lo range. An increase in engine rpm and a braking effect should be noticed. Line pressure should be approximately 150 psi.

OIL PRESSURE CHECKS

ROAD OR NORMAL OPERATING CONDITIONS

While road testing with the transmission oil pressure gauge attached and the vacuum modulator tube connected, the transmission pressures should check approximately as shown in Fig. 7E-1.

VEHICLE STATIONARY AND ENGINE AT 1200 RPM

With the transmission oil pressure gauge attached and the vacuum modulator tube disconnected, the transmission pressures should check approximately as shown in Fig. 7E-2.

VEHICLE STATIONARY AND ENGINE AT 1000 RPM

With the transmission oil pressure gauge attached and the vacuum modulator tube connected for normal modulator operation, the transmission pressure should check approximately as shown in Fig. 7E-3.

> **NOTE:** *Pressures are not significantly affected by altitude or barometric pressure when the vacuum modulator tube is connected.*

CONTROL VALVE ASSEMBLY - GOVERNOR LINE PRESSURE CHECK

1. With car on hoist (rear wheels off ground), disconnect the vacuum line to the vacuum modulator, install a line pressure gauge to the transmission and a tachometer to the engine.
2. Start engine, keep foot off brake, move selector lever to Drive range and check line pressure with engine speed at 1,000 rpm's.
3. Slowly increase engine rpm to 3,000 rpm and determine if a line pressure drop occurs (7psi or more).

Approximate Altitude (Ft. above sea level)	D,N,P	S or L	R
0	150	150	244
2,000	150	150	233
4,000	145	150	222
6,000	138	150	212
8,000	132	150	203
10,000	126	150	194
12,000	121	150	186
14,000	116	150	178

Fig. 7E-2 Oil Pressure Check - Vehicle Stationary, Vacuum Tube Disconnected

Drive, Neutral, Park	Super or Lo	Reverse
60	150	107

Fig. 7E-3 Oil Pressure Check - Vehicle Stationary, Vacuum Tube Connected

4. If no oil pressure drop occurs (and transmission is malfunctioning), inspect:

   a. Governor Assembly -

      (1) Stuck governor valve.

      (2) Stuck governor weight(s).

      (3) Restricted orifice in governor valve.

   b. Governor Feed System -

      (1) Check governor screen in transmission case.

      (2) Check for restrictions in governor pipe.

      (3) Scored governor bore.

5. If a pressure drop of 7 psi or more occurs (and transmission is malfunctioning), disassemble, clean and inspect the control valve assembly.

TURBO HYDRA-MATIC (M-40) TROUBLE DIAGNOSIS GUIDE

NO DRIVE IN DRIVE RANGE - (INSTALL PRESSURE GAUGE)

1. Low oil level - check for external leaks or defective vacuum modulator (leaking diaphragm will evacuate oil from unit).
2. Manual linkage maladjusted (correct alignment in manual lever shift quadrant is essential); manual valve disconnected from manual lever pin.
3. Low oil pressure - refer to LOW LINE PRESSURE below.
4. Forward clutch:

   a. Clutch does not apply - piston cracked; seals missing, damaged; clutch plates burnt (see BURNED CLUTCH PLATES below).

   b. Pump feed circuit-to-forward clutch oil seal rings missing or broken on pump cover; leak or restriction in feed circuits; pump-to-case gasket mispositioned or damaged. Clutch drum ball check stuck or missing.
5. Roller Clutch - broken springs, damaged cage or installed backwards.

HIGH OR LOW OIL PRESSURE

(Refer to OIL PRESSURE CHECKS)

HIGH LINE PRESSURE

1. Vacuum Leak:

   a. Vacuum line disconnected.

   b. Leak on line from engine to modulator.

   c. Improper engine vacuum.

   d. Leak in vacuum-operated accessory (hoses, vacuum advance, etc.).
2. Modulator:

   a. Stuck modulator valve.

   b. Water in modulator.

   c. Damaged, 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 or restricted.

   e. Detent solenoid loose.

   f. Detent valve bore plug damaged.

   g. Detent regulator valve pin short.
4. Oil Pump:

   a. Pressure regulator and/or boost valve stuck.

   b. Incorrect pressure regulator valve spring.

c. Too many pressure regulator valve spacers.

d. Pressure boost valve installed backwards or defective.

e. Pressure boost bushing broken or defective.

f. Pump casting bad.

LOW LINE PRESSURE

1. Low transmission oil level.
2. Defective vacuum modulator assembly.
3. Filter Assembly:
   a. Blocked or restricted.
   b. "O" Ring seal on intake pipe and/or grommet omitted or damaged.
   c. Split or leaking intake pipe.
   d. Wrong filter assembly.
4. Oil Pump:
   a. Pressure regulator and/or boost valve stuck.
   b. Pressure regulator valve spring too weak.
   c. Not enough spacers in pressure regulator.
   d. Gear clearance, damaged, worn, drive gear installed backwards.
   e. Pump-to-case gasket mispositioned.
   f. Defective or mismatched pump body/pump cover.
5. Internal Circuit Leaks:
   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 all other ranges) -
      (1) Check center support oil seal rings.
      (2) Check direct clutch outer seal.
      (3) Check rear servo and front accumulator pistons and rings for damage or missing.
6. Case Assembly:
   a. Porosity in intake bore area.
   b. Check case for intermediate clutch cup plug leak or blown out.

   NOTE: *See Fig. 7E-158 for location of intermediate clutch cup plug.*

   c. Lo-reverse check ball mispositioned or missing (this will cause no reverse and no overrun braking in Lo range).

1-2 SHIFT-FULL THROTTLE ONLY

1. Detent switch sticking or defective (may stick in cold or wet weather). Can be detected by pulling connection at transmission and obtaining normal upshifts.
2. Detent solenoid:
   a. Loose.
   b. Gasket leaking.
   c. Sticks open.
3. Control valve:
   a. Valve body gaskets - leaking, damaged, incorrectly installed.
   b. Detent valve train stuck.
   c. 3-2 valve stuck.
4. Case - porosity.

FIRST SPEED ONLY, NO 1-2 SHIFT

1. Governor:
   a. 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:
   a. 1-2 shift valve train stuck closed.
   b. Governor feed channels blocked, leaking, pipes out of position, governor screen plugged.

c. Valve body gaskets leaking, damaged, incorrectly installed.

3. Case:

a. Intermediate clutch cup plug leaking or blown out.

b. Porosity between channels.

c. Governor feed channel blocked; governor bore scored or worn, allowing cross pressure leak.

4. Intermediate clutch:

a. Case center support - oil rings missing, broken, defective; orifice plug missing.

b. Clutch piston seals missing, improperly assembled, cut.

FIRST AND SECOND SPEEDS ONLY, NO 2-3 SHIFT

1. Detent solenoid - stuck open (detent shifts only - the 2-3 shift would occur at very high speeds, being interpreted as no 2-3 shift).

2. Detent switch

3. Control valve:

a. 2-3 valve train stuck.

b. Valve body gaskets leaking, damaged, incorrectly installed.

4. Direct clutch:

a. Center support oil rings missing, broken, defective.

b. Clutch piston seals missing, improperly assembled, cut; piston ball check stuck or missing.

DRIVE IN NEUTRAL

1. Manual linkage maladjusted.

2. Internal Linkage:

a. Manual valve disconnected or end broken.

b. Inside detent lever pin broken.

3. Pump Assembly - transmission lube pressure leaking into forward clutch apply passage.

4. Forward Clutch:

a. Burned plates - check cause.

b. Clutch doesn't release - will also cause no drive in Reverse.

NO DRIVE IN REVERSE OR SLIPS IN REVERSE - (INSTALL PRESSURE GAUGE)

1. Low fluid level.

2. Manual linkage maladjusted.

3. Oil pressure - refer to LOW LINE PRESSURE above.

4. Control valve:

a. Valve body gaskets leaking, damaged, incorrectly installed (Other malfunctions may also be indicated).

b. Low reverse ball check missing from case (this will also cause no overrun braking in Lo Range).

c. 2-3 valve train stuck open (this will also cause 1-3 upshift in Drive range).

d. Reverse feed passage restricted; also check case passages.

5. Rear servo and accumulator:

a. Servo piston seal ring damaged or missing.

b. Short band apply pin (this may also cause no overrun braking or slips in overrun braking - Lo range). Refer to INSTALLATION OF REAR SERVO ASSEMBLY for pin selection procedure.

c. Defective rear servo piston or bore.

6. Reverse or low band burnt, loose lining; apply pin or anchor pins not engaged; band broken.

7. Direct clutch:

a. Outer seal damaged or missing.

b. Clutch plates burnt (see BURNED CLUTCH PLATES below).

8. Forward clutch - clutch does not release (will also cause Drive in Neutral).

9. Center support - oil seal rings or grooves damaged or worn.

SLIPS IN ALL RANGES, SLIPS ON START - (INSTALL PRESSURE GAUGE)

1. Low fluid level.
2. Oil pressure - refer to LOW LINE PRESSURE above.
3. Case - cross leaks, porosity.
4. Forward and direct clutches slipping (if burnt, see BURNED CLUTCH PLATE below); oil seal rings on pump cover broken or worn.

SLIPS 1-2 SHIFT - (INSTALL PRESSURE GAUGE)

1. Low fluid level.
2. Oil pressure - refer to LOW LINE PRESSURE above.
3. Front accumulator piston oil ring damaged or missing.
4. Control valve:
   a. 1-2 accumulator valve train sticking.
   b. Porosity in valve body or case.
   c. Valve body attaching bolts not properly torqued.
5. Rear accumulator oil ring missing or damaged; case bore damaged.
6. Pump-to-case gasket mispositioned.
7. Case:
   a. Intermediate clutch cup plug leaks excessively.
   b. Porosity between channels.
   c. Raised ridge around case center support bolt (does not allow control valve assembly to seat properly).
8. Intermediate clutch:
   a. Piston seals missing or damaged; clutch plates burnt (see BURNED CLUTCH PLATES below).
   b. Center support - leak in feed circuit (oil rings damaged or grooves defective), excessive leak between tower and bushing, orifice bleed plug hole (.020 dia.) blocked, center support bolt not seated properly in case.

ROUGH 1-2 SHIFT - (INSTALL PRESSURE GAUGE)

1. Oil pressure - refer to HIGH LINE PRESSURE above.
2. Control valve:
   a. 1-2 accumulator valve train.
   b. Valve body-to-case bolts loose.
   c. Wrong gaskets or off location, damaged.
3. Case:
   a. Intermediate clutch ball missing or not sealing.
   b. Porosity between channels.
4. Rear servo accumulator:
   a. Oil rings damaged.
   b. Piston stuck.
   c. Broken or missing spring.
   d. Bore damaged.
5. Intermediate clutch - clutch plates burnt (see BURNED CLUTCH PLATES below).

SLIPS 2-3 SHIFT - (INSTALL PRESSURE GAUGE)

1. Low fluid level.
2. Oil pressure - refer to LOW LINE PRESSURE above.
3. Control valve - accumulator piston pin (leak at swedge end).
4. Case porosity.
5. Direct clutch:
   a. Piston seals leaking or ball check leaks.
   b. Center support oil seal rings damaged; excessive leak between tower and bushing.

ROUGH 2-3 SHIFT - (INSTALL PRESSURE GAUGE)

1. Oil pressure - refer to HIGH LINE PRESSURE above.
2. Front servo accumulator:
   a. Front accumulator spring missing, broken.
   b. Accumulator piston stuck.
3. Direct clutch - air check for leak to outer area of clutch piston or center piston seal.
4. Damaged center support.

NO ENGINE BRAKING IN SUPER RANGE - 2ND GEAR

1. Front servo accumulator:
   a. Servo or accumulator oil rings or bores leaking.
   b. Servo piston cocked or stuck.
2. Front band broken, burnt (check for cause), not engaged on anchor pin and/or servo pin.

NO ENGINE BRAKING IN LO RANGE - 1ST GEAR

1. Case assembly - lo-reverse check ball mispositioned or missing from case; case damaged at lo-reverse check ball area.
2. Rear servo:
   a. Oil seal ring, bore or piston damaged; leaking apply pressure.
   b. Rear band apply pin short, improperly assembled.
3. Rear band broken, burnt (check for cause), not engaged on anchor pins or servo pin.

NOTE: *Items 1, 2 and 3 will also cause slips in Reverse or no Reverse.*

NO PART THROTTLE DOWNSHIFT - (INSTALL PRESSURE GAUGE)

1. Oil pressure - refer to HIGH OR LOW OIL PRESSURE above.
2. Control valve - 3-2 valve stuck spring missing or broken.

NO DETENT DOWNSHIFTS

1. Detent switch adjustments, connection (switch plunger activated approx. 7/8" at full throttle opening).
2. Solenoid inoperative, connections.
3. Control valve-detent valve train sticking.

LOW OR HIGH SHIFT POINTS - (INSTALL PRESSURE GAUGE)

1. Oil Pressure - refer to HIGH OR LOW OIL PRESSURE above.
2. Governor:
   a. Valve sticking.
   b. Feed holes restricted or leaking; pipes damaged or mispositioned.
   c. Feed line screen plugged.
2. Detent switch.
3. Detent solenoid stuck open, loose, etc. (will cause late shifts).
4. Control valve:
   a. Detent valve train.
   b. 3-2 valve train (detent upshifts possible).
   c. 1-2 shift valve train - 1-2 regulator valve stuck (this would cause a constant 1-2 shift point, regardless of throttle opening).
   d. Spacer plate gaskets mispositioned; spacer plate orifice holes missing or blocked.
5. Case porosity; intermediate clutch cup plug leaking, missing.

WON'T HOLD IN PARK

1. Manual linkage maladjusted.
2. Internal linkage:
   a. Parking brake lever and actuator defective (Check for chamfer on actuator rod sleeve).

b. Parking pawl broken.

c. Parking pawl bracket loose, burned, rough edges or incorrectly installed.

d. Parking pawl return spring missing, broken or incorrectly hooked.

TRANSMISSION NOISY

CAUTION: *Before checking transmission for what is believed to be "transmission noise", make sure that the noise is not from the water pump, alternator, power steering, etc. These components can be isolated by removing the proper belt and running the engine no more than two minutes at one time.*

PARK, NEUTRAL AND ALL DRIVING RANGES

1. Pump Cavitation:
   a. Oil level low.
   b. Plugged or restricted filter.
   c. Intake pipe "O" ring damaged.
   d. Intake pipe split, porosity in case intake pipe bore.
   e. Water in oil.
   f. Porosity or voids at transmission case (pump face) intake port.
   g. Pump-to-case gasket off location.
2. Pump Assembly:
   a. Gears damaged or defective; driving gear installed backwards.
   b. Crecent interference.
   c. Oil seal rings damaged or worn.
3. Converter:
   a. Loose flywheel-to-converter bolts.
   b. Damaged converter.

FIRST, SECOND AND/OR REVERSE GEARS

Planetary Gear Set:

a. Gears or thrust bearings damaged.

b. Front internal gear ring damaged.

DURING ACCELERATION - ANY GEAR

1. Transmission or cooler lines grounded to underbody.
2. Motor mounts loose or broken.

SQUEAL AT LOW VEHICLE SPEED

Speedometer driven gear shaft seal - requires lubrication or replacement.

BURNED CLUTCH PLATES

1. Forward clutch:
   a. Check ball in clutch drum damaged, stuck or missing.
   b. Clutch piston cracked, seals damaged or missing.
   c. Low line pressure (see LOW LINE PRESSURE above).
   d. Manual valve mispositioned (may also cause front band failure).
   e. Restricted oil feed to forward clutch (clutch housing to inner and outer areas not drilled, restricted, porosity in pump, etc.).
   f. Transmission case valve body face not flat or porosity between channels.
   g. Manual valve bent and center land not ground properly.
   h. Pump cover oil seal rings missing, broken or undersize, ring groove oversize.
2. Intermediate Clutch:
   a. Constant bleed orifice in center support missing.
   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 (see LOW LINE PRESSURE above).

g. Intermediate clutch cup plug in case missing.

h. Transmission 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 clutch piston damaged, stuck or missing.

c. Defective modulator bellows.

d. Center support bolt loose (bolt may be tight in support but not holding support tight to the case).

e. Center support oil rings or grooves damaged or missing.

f. Clutch piston cracked, seals damaged or missing.

g. Front and rear servo pistons and/or seals damaged.

h. 3-2 valve, 3-2 valve spring or 3-2 spacer pin installed in wrong location in 3-2 valve train bore.

i. Manual valve bent and center land not ground properly.

j. Transmission case valve body not flat or porosity between channels.

k. Intermediate sprag installed backwards.

4. In addition, 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 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.

POSSIBLE POINTS OF OIL LEAKS

TRANSMISSION OIL PAN

1. Attaching bolts not correctly torqued.
2. Improperly installed or damaged pan gasket.
3. Oil pan gasket mounting face not flat.

CASE EXTENSION

1. Attaching bolts not correctly torqued.
2. Rear seal damaged or improperly installed.
3. Extension-to-case gasket damaged or improperly installed.
4. Porous casting *.

CASE

1. Filler pipe O-ring seal damaged or missing; misposition of filler pipe bracket to engine - loading one side of O-ring.
2. Modulator O-ring seal damaged or improperly installed.
3. Governor cover, gasket and bolts damaged, loose; case face leak.
4. Speedometer gear O-ring damaged.
5. Manual shaft seal damaged, improperly installed.
6. Line pressure tap plug stripped, shy sealer compound.
7. Parking pawl shaft cup plug damaged, improperly installed.

8. Vent pipe (refer to OIL COMES OUT VENT PIPE below).
9. Porous case* or cracked at pressure plug boss.

FRONT END

1. Front seal damaged (check converter neck for nicks, etc., also for pump bushing moved forward); garter spring missing from pump-to-converter hub oil seal.
2. Pump attaching bolts and seals damaged, missing, bolts loose.
3. Converter - leak in weld.
4. Pump O-ring seal damaged (also check pump oil ring groove and case bore).
5. Porous casting (pump or case)*.
6. Pump - drain back hole restricted.

OIL COMES OUT VENT PIPE

1. Transmission over-filled.
2. Water in oil.
3. Pump-to-case gasket mispositioned.
4. Foreign material between pump and case, or between pump cover and body.
5. Case porous*, pump face improperly machined
6. Pump shy of stock on mounting faces, porous casting.
7. Incorrect dipstick.
8. Cut O-ring or grommet on filter.
9. Breather hole in pump cover blocked or missing.
10. Hole in intake pipe.

OIL COOLER LINES

1. Connections at radiator loose or stripped.
2. Connections at transmission case loose or stripped.

MODULATOR ASSEMBLY

Diaphragm defective (transmission oil may be lost through the diaphragm and be burned in the engine).

*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" and "SUPER" 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 (Z), 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 (Z) 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.

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. 7E-4). Three multiple-disc clutches, one sprag, one roller clutch and two bands provide the friction elements required to obtain the desired function of the compound planetary gear set.

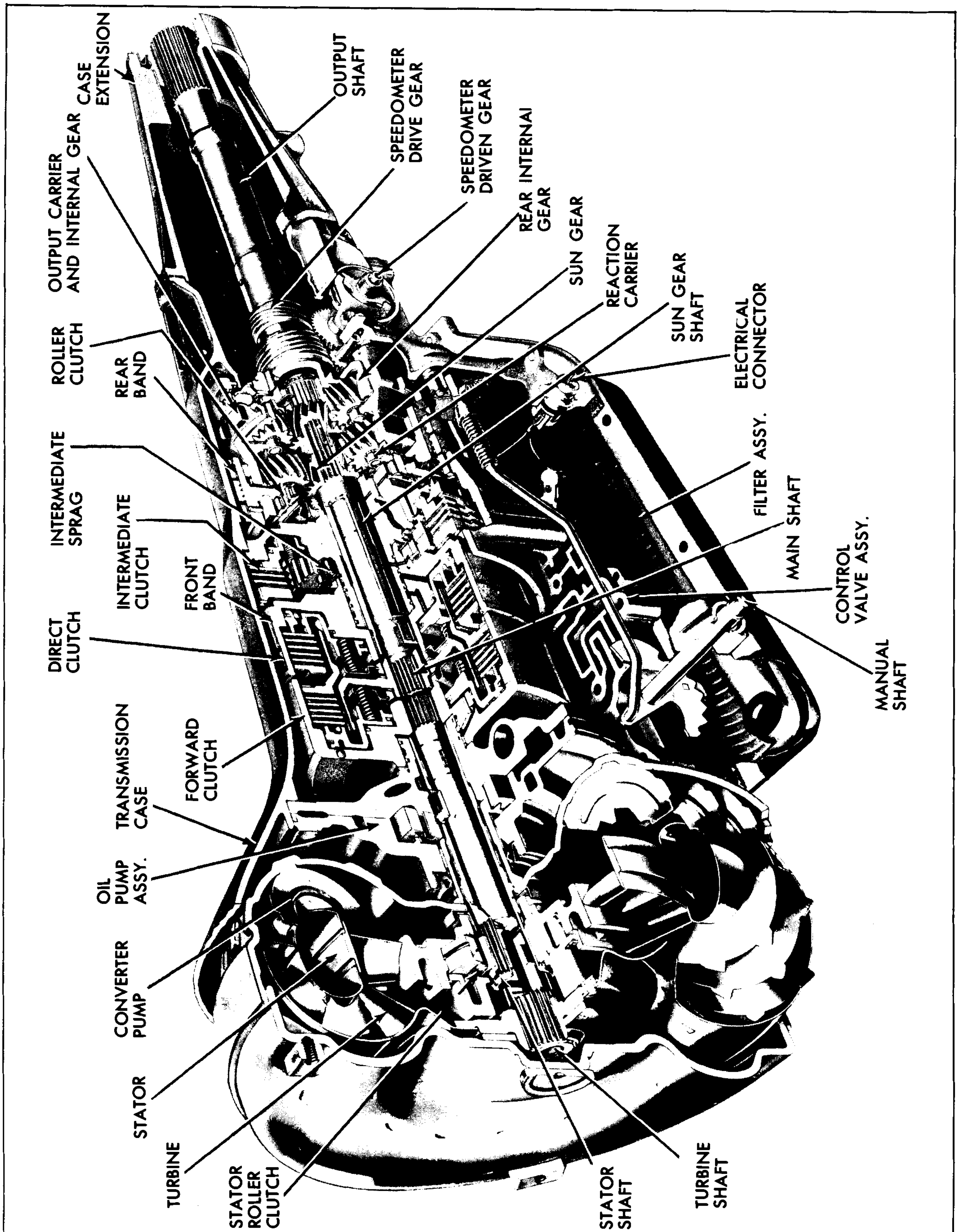


Fig. 7E-4 Cross Section of Transmission

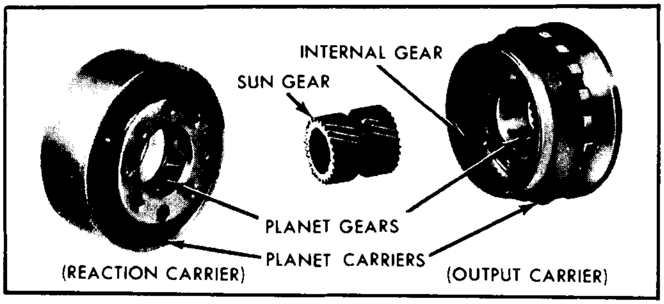


Fig. 7E-5 Compound Planetary Gear Set

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. 7E-5).

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. 7E-6).

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.

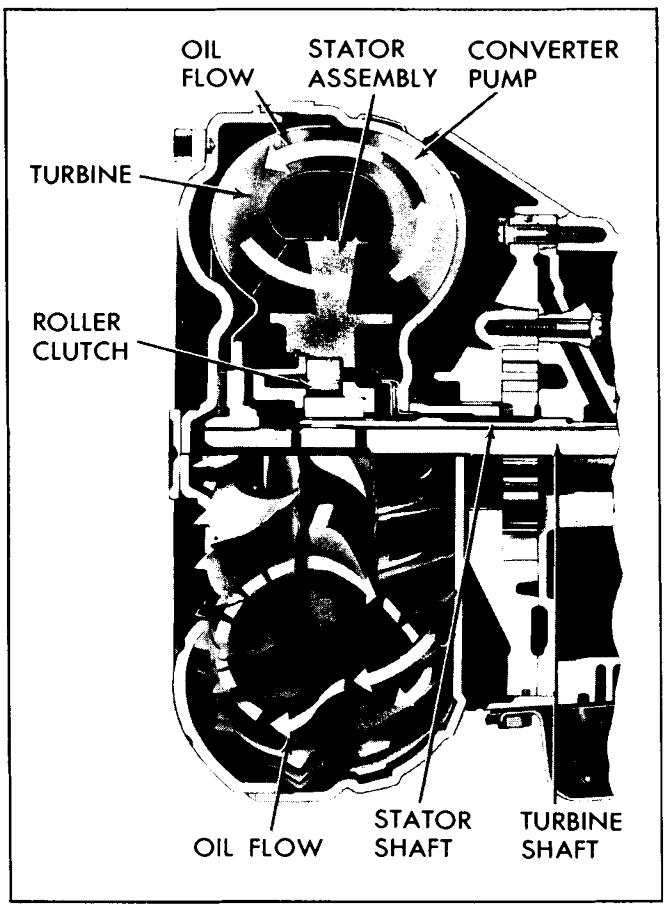


Fig. 7E-6 Converter Operation

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.

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. 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.

Approximate gear or torque ratios of the transmission are as follows:

First - 2.5 gear ratio × 2 converter stall ratio 5:1
*Second - 1.5 gear ratio 1.5:1
*Third 1:1
Reverse - 2:1 gear ratio × 2 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. 7E-5) 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.

ADVANTAGES OF A PLANETARY GEAR TRAIN

1. A planetary gear train is compact and sturdy because the load is distributed over several gears instead of only two as in the sliding gear-type of gear train. Planetary gears are smaller and occupy less space. They can transmit more load because there is more tooth area in contact at all times.
2. Planetary gears are always completely in mesh, thus there is no possibility of tooth damage due to gear clash or partial engagement.
3. The common axis for all members of the planetary train makes the unit more compact and facilitates its use as a coupling when any two of its members are locked together.

OPERATION OF A PLANETARY GEAR TRAIN

1. A planetary gear train can be used to increase power and decrease speed in either of two ways:
   a. One method of obtaining speed reduction (torque multiplication) is to hold the internal gear stationary while power is applied to the sun gear. As the sun gear turns, the planet pinion gears, which are in mesh with it, rotate on their respective pins. Since they are also in mesh with the held internal gear, they must rotate around inside the internal gear, carrying the planet carrier with them in the same direction of rotation as the sun gear. The planet carrier then rotates at a speed less than that of the sun gear and the planetary gear train functions as a torque increasing, speed-reducing unit.
   b. The same result can be obtained by holding the sun gear stationary and applying power to the internal gear. In this case, rotation of the internal gear causes the planet pinion gears to rotate on their respective pins and at the same time rotate around the sun gear, thus rotating the planet carrier at a speed less than that of the internal gear. The gear train then functions as a torque-increasing, speed-reducing unit.
2. A planetary gear train can be used to reverse direction of rotation when the planet carrier is held stationary. In this instance, if power is applied to the sun gear, the planet pinion gears rotate on their respective pins; but since the carrier is stationary, they act merely as idlers, transmitting power to the internal gear and causing it to rotate in the opposite direction.

In all of the examples described, one member has been held stationary, the power applied to another member and taken off the third member.

3. A planetary gear train can be used as a coupling for direct mechanical drive when any two members are locked together. Under this condition, movement cannot take place between the gears and the entire gear train will rotate as a unit.
4. When none of the members are held or locked together, the planetary gear train will not transmit power; therefore, it is in neutral.

OPERATION

STARTING ENGINE

1. Place control lever in P or N position. Starter is inoperative in any other position.
2. a. Engine Cold-Depress accelerator pedal to floor once and release (this presets automatic choke and throttle).
   b. Engine Warm-Hold accelerator pedal down about half way.
3. Turn ignition key clockwise to engage starter, release as soon as engine starts.

   NOTE: *At temperatures below 0°F., it may be necessary to hold the accelerator pedal down slightly while starting.*

Do not pump the accelerator at any time. Avoid racing the engine during the warm-up period. Should the engine

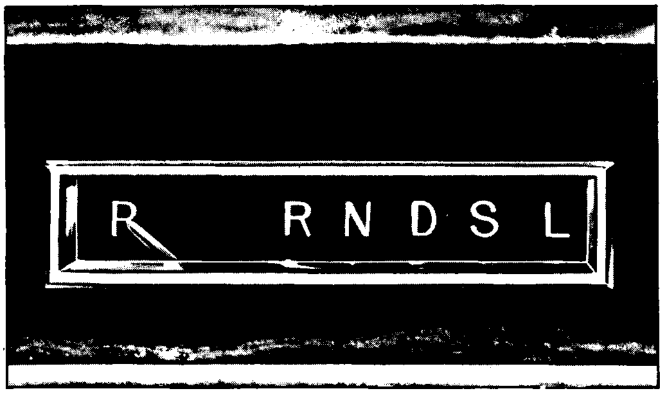


Fig. 7E-7 Typical Selector Indicator

flood, hold the accelerator pedal to the floor forcibly while starting the engine.

RANGE SELECTION

The selector quadrant has six selector positions: P, R, N, D, S, L (Fig. 7E-7).

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. This position should be selected whenever the driver leaves the vehicle. The engine may be started in Park position.

R Reverse enables the vehicle 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 for safe passing by depressing the accelerator to the floor.

S Super Range adds new performance for congested traffic or hilly terrain. Super Range has the same starting ratio as Drive Range, but prevents the transmission from shifting above second speed to retain second speed acceleration when extra performance is desired. Super Range can also be used for engine braking. Super Range can be selected at any vehicle speed and the transmission will shift to second gear and remain in second until the vehicle speed or the throttle are changed to obtain first gear operation in the same manner as in Drive Range.

L Lo Range can be selected at any vehicle speed and the transmission will shift to second gear and remain in second until vehicle speed is reduced to approximately 45 mph, depending on axle ratio. Lo Range position prevents the transmission from shifting out of first gear. This is particularly beneficial for maintaining maximum engine braking when continuous first gear operation is desirable.

HYDRAULIC SYSTEM DESCRIPTION

PRESSURE CONTROL

The transmission is automatically controlled by a hydraulic system. Hydraulic pressure is supplied by the transmission gear type oil pump, which is engine driven. Main line pressure is controlled by a pressure regulator valve train located in the pump. This regulator controls line pressure automatically in response to a pressure signal from a modulator valve, in such a way that the torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

To control line pressure properly, a modulator pressure is used which varies in the same manner as torque input to the transmission. Since the converter torque output is the product of engine torque and converter ratio, modulator pressure must compensate for changes in either or both of these.

To meet these requirements, modulator pressure is regulated by engine vacuum, which is an indicator of engine torque and carburetor opening. It is decreased by governor pressure with an increase in vehicle speed because converter torque ratio does the same.

VACUUM MODULATOR

The engine vacuum signal is provided by the vacuum modulator which consists of an evacuated metal bellows, a diaphragm and springs. These are so arranged that, when installed, the bellows and one spring apply a force which acts on the modulator valve. This force acts on the modulator valve so that it increases modulator pressure. Engine vacuum and the other spring act in the opposite direction to decrease modulator pressure; or low engine vacuum, high modulator pressure; high engine vacuum, low modulator pressure.

GOVERNOR

The vehicle speed signal to the modulator valve is supplied by the transmission governor, which is driven by the output shaft. The governor consists of two sets of flyweights, two springs and a regulator valve. Centrifugal force on the flyweights is imposed on the regulator valve, causing it to regulate a pressure signal that increases with increasing speed.

Centrifugal force is proportional to the square of vehicle speed. This means that a given change in vehicle speed results in a smaller change in governor pressure at low speeds than at high speeds. Because of this characteristic, a governor with a single set of weights has less pressure change at low speed than at high speed. To increase the pressure change of the governor signal at low speeds, the flyweights are so designed that their effective mass is greater at speeds below approximately 720 rpm than it is above this speed.

This is done by arranging the primary weights so that they act through preloaded springs on the secondary weights which, in turn, act on the valve. At approximately 720 rpm, the centrifugal force on each primary weight exceeds the spring force and the primary weights move to a grounded stop. With the primary weights grounded, the force on the governor regulator valve is equal to the spring forces plus the centrifugal force on the secondary weights.

FUNCTIONS OF VALVES AND HYDRAULIC CONTROL UNITS

1. Pressure Regulator:

   a. Regulates line pressure according to a fixed spring force and forces controlled by modulator and reverse pressures (Fig. 7E-8).

   b. Controls the flow of oil that charges the torque converter, feeds the oil cooler and provides lubrication for the transmission.

2. Manual valve establishes the range of transmission operation, i.e. P, R, N, D, S, L, as selected by the vehicle operator through the manual selector lever (Fig. 7E-9).

3. Governor generates a speed sensitive oil pressure that increases with output shaft or vehicle speed. Gover-

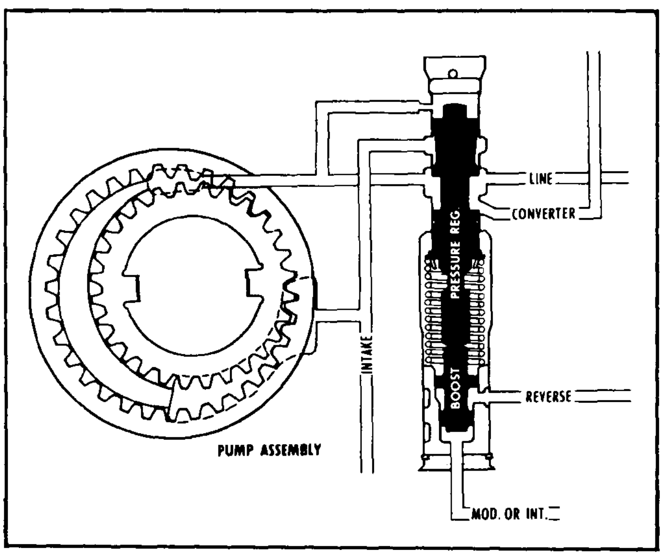


Fig. 7E-8 Pressure Regulator Valve

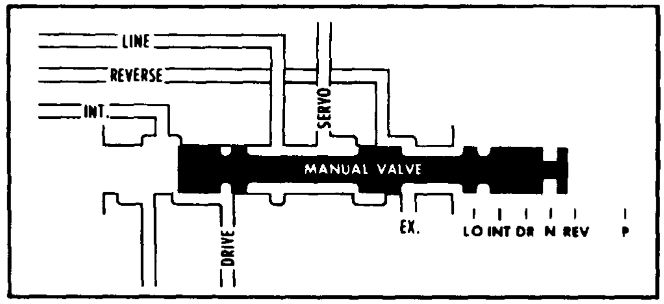


Fig. 7E-9 Manual Valve

nor pressure is used to vary the shift points and modulator pressure regulation (Fig. 7E-10).

4. Modulator valve regulates line pressure to a modulator pressure that varies with torque to the transmission (Fig. 7E-11). It senses force created by:

   a. The vacuum modulator bellows that increases modulator pressure.

   b. Engine vacuum acting on a diaphragm to decrease modulator pressure.

   c. Governor pressure which is generated by the governor assembly. Governor pressure tends to decrease modulator pressure.

5. 1-2 Shift valve controls the oil pressure that causes the transmission to shift from 1-2 or 2-1. Its operation is controlled by governor pressure, detent pressure, modulator pressure and a spring force (Fig. 7E-12).

6. 1-2 Regulator valve regulates modulator pressure to a lesser pressure that is proportional to modulator pressure, tending to keep the 1-2 shift valve in the downshift position.

7. 1-2 Detent valve senses regulated modulator pressure tending to hold the 1-2 shift valve in the downshift position and provides an area for detent pressure for detent 2-1 shifts.

8. 2-3 Shift valve controls the oil pressure that causes the transmission to shift from 2-3 or 3-2. Its operation is controlled by modulator, intermediate, governor and detent pressure as well as a spring force (Fig. 7E-13).

9. 2-3 Modulator valve senses modulator pressure to apply a variable force proportional to modulator pressure which tends to hold the 2-3 shift valve downshifted.

10. 3-2 Valve shuts off modulator pressure from acting on the shift valve trains after the direct clutch has been applied. This allows fairly heavy throttle operation in third speed without downshifting. In third

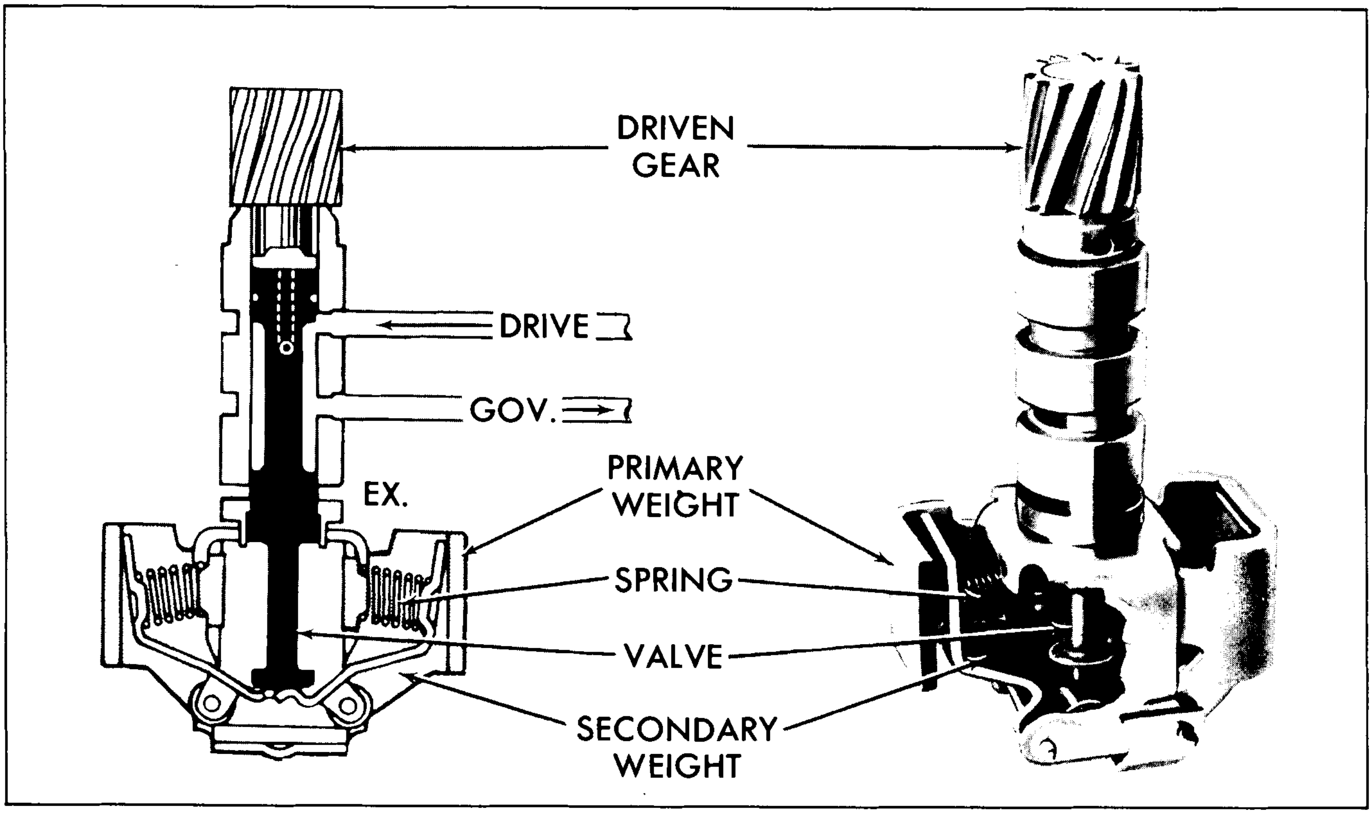


Fig. 7E-10 Governor Assembly

speed, modulator oil above 105 psi or detent oil is directed to the shift valves to provide the downshift forces (Fig. 7E-14).

11. 1-2 Accumulator valve regulates drive pressure to a 1-2 accumulator pressure which increases as modulator pressure increases to control the intermediate clutch pressure during the 1-2 shift. Detent and Lo oil pressures increase 1-2 accumulator pressure.

12. Detent valve shifts when line oil is exhausted at the end of the valve when the detent solenoid is energized. This directs detent pressure to the 1-2 and 2-3 modulator valves and also allows the detent regulator valve to regulate.

13. Detent Regulator Valve. When the detent valve shifts, the detent regulator valve is freed to allow drive oil to enter the detent passage and thus becomes regulated to a value of approximately 70 psi. Detent pressure will also flow into the modulator passage which flows to the shift valves. Lo oil moves the detent regulator valve open to drive oil, allowing drive oil to enter the modulator and detent passages

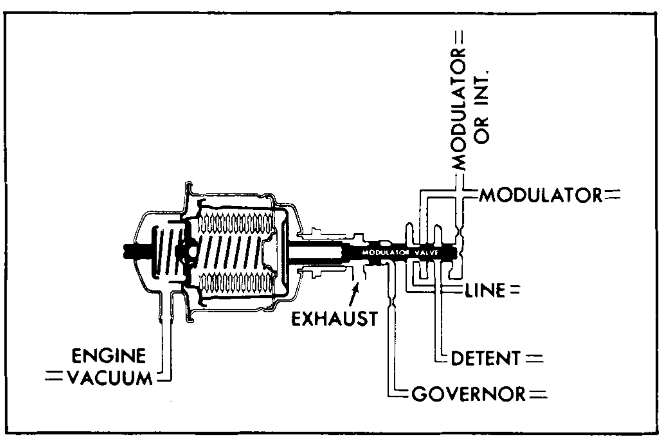


Fig. 7E-11 Modulator and Valve

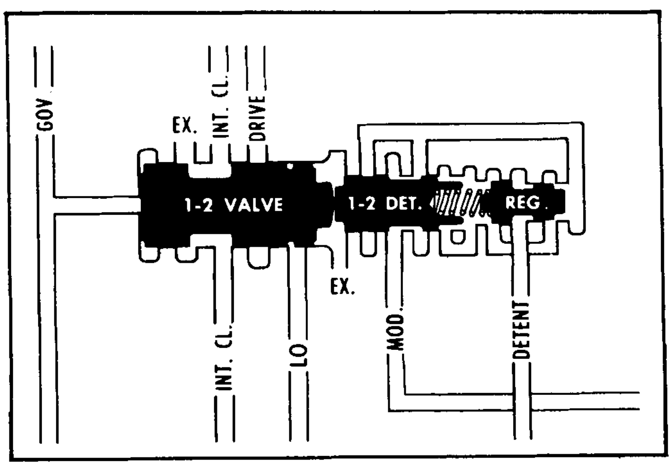


Fig. 7E-12 1-2 Shift Valve

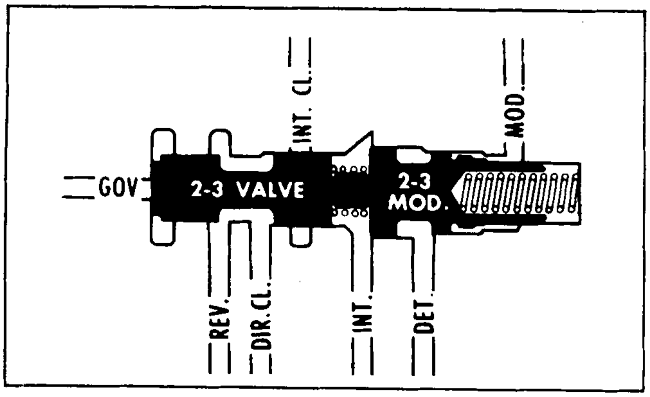


Fig. 7E-13 2-3 Shift Valve

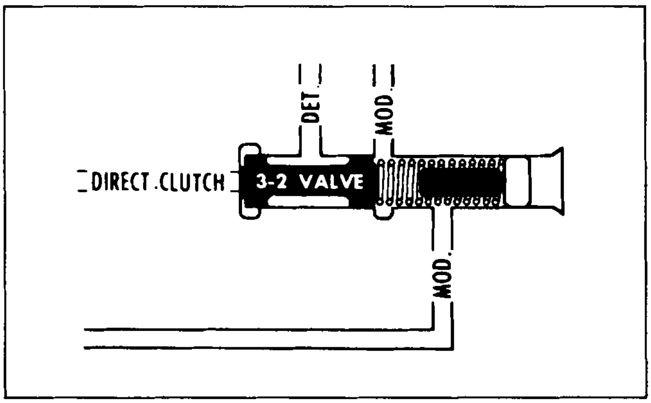


Fig. 7E-14 3-2 Shift Valve

14. Rear Servo and Accumulator. The rear servo and accumulator assembly serves three functions:

    a. The band apply piston provides the band apply force to hold the rear band in reverse.

    b. The band apply piston provides the band apply force for overrun band apply in Lo range, 1st gear.

    c. The accumulator piston, in conjunction with 1-2 accumulator oil, provides the accumulator function for the apply of the intermediate clutch.

15. Front Servo. The front servo serves two functions:

    a. Intermediate clutch oil applies the front servo to apply the front band in second gear in Super and Lo Range.

    b. During a 2-3 shift, direct clutch oil utilizes the servo and accumulator pistons as the accumulator for direct clutch apply.

FRONT SERVO

OPERATION

The front servo applies the front band to provide engine braking in 2nd gear in Super and Lo ranges. It is also used as an accumulator for the apply of the direct or 3rd clutch and in conjunction with a series of check balls and controlling orifices as a part of the timing for the release of the direct or 3rd clutch.

To prevent the apply of the front band in Neutral, Drive and Reverse ranges, oil is directed from the manual valve to the release side of the servo piston.

In Drive range, the servo release oil from the manual valve is used to charge the servo in preparation for the apply of the direct clutch.

Direct clutch oil is directed to the front servo accumulator piston where spring force, plus 3rd clutch pressure, strokes the piston up against the force of servo release oil. This lowers the clutch apply pressure for a smooth engagement.

The release of the direct clutch and the exhausting of the front servo accumulator is slowed down by three check balls and three orifices which permits a soft return of the drive load to the intermediate sprag and also allows engine rpm to increase during a detent 3-2 downshift in preparation for the lower gear ration, which results in a smooth shift.

DRIVE RANGE - FIRST GEAR

Servo oil from the manual valve in Drive range charges the accumulator by stroking the servo and accumulator pistons against the accumulator spring (Fig. 7E-15). This prepares the accumulator for the controlled apply of the direct clutch on a 2-3 shift. The charging of the accumulator in Drive range, first gear, also makes it possible to have a controlled 1-3 let up shift as the accumulator is prepared in first gear for direct clutch apply.

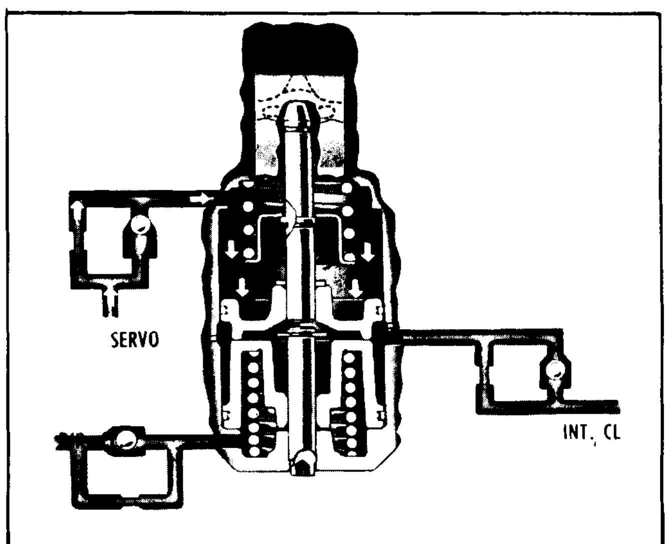


Fig. 7E-15 Drive Range - First Gear

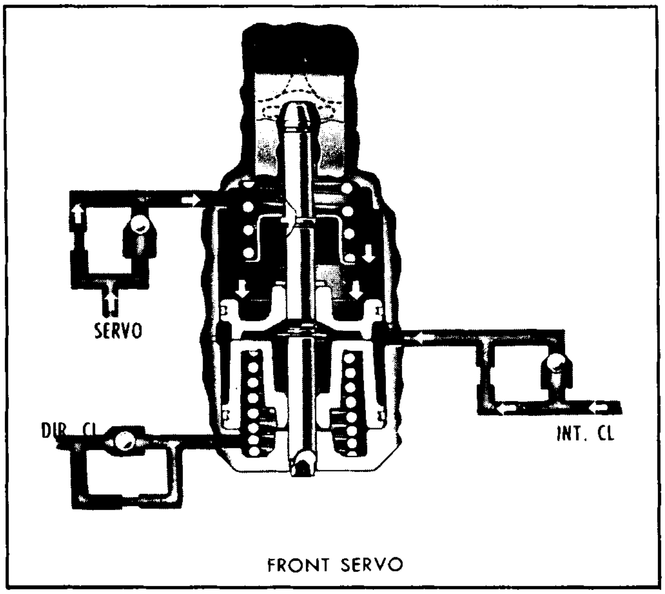


Fig. 7E-16 Drive Range - Second Gear

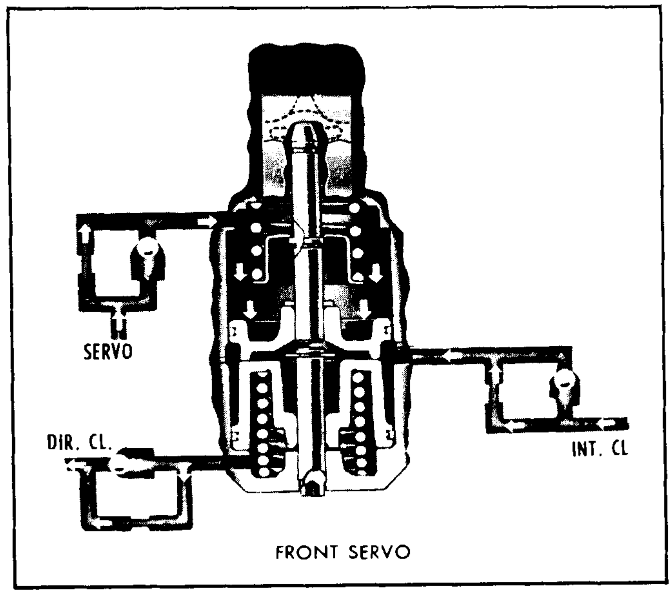


Fig. 7E-17 Drive Range - 3-2 Shift

Servo oil and the servo release spring prevents the apply of the band in second gear, Drive range, when intermediate clutch apply oil is directed between the servo and accumulator pistons. Servo oil is also present in Neutral and Reverse ranges.

DRIVE RANGE - SECOND GEAR

Servo oil charging the accumulator is present in first and second gears and has the servo and accumulator pistons stroked down against the accumulator spring (Fig. 7E-16). In second gear, intermediate clutch oil is directed between the servo and accumulator pistons but does not separate the pistons, as the force of servo oil holding the piston down is equal to the force of intermediate clutch oil attempting to stroke the servo piston up.

DRIVE RANGE - THIRD GEAR

Direct clutch pressure rises to a value such that the force from it, plus the accumulator spring force, overcomes the force from the servo pressure and moves the accumulator piston to the stop on the accumulator piston pin. This, in turn, strokes the servo piston the same amount of travel which allows it to just contact the band apply retainer ring on the servo pin, but it will not move the pin to apply the band.

The stroking of the accumulator piston absorbs some direct clutch oil and permits the direct clutch to apply at a controlled rate for a smooth 2-3 shift.

DRIVE RANGE - 3-2 SHIFT

The release of the direct clutch is controlled by the front servo, three orifices and three check balls to allow a smooth transfer of the drive load to the intermediate sprag (Fig. 7E-17). The controlled release pressure lets the engine increase its rpm for the lower gear ratio of second gear during detent downshifts, resulting in a shift and better acceleration.

Servo oil seats a check ball, intermediate clutch oil seats another check ball and oil must pass through the two orifices which slows the stroking of the servo and accumulator pistons. The exhausting direct clutch oil from the accumulator seats a third check ball and the exhausting direct clutch oil passes through an orifice which controls the clutch pressure during the direct clutch release.

SUPER RANGE - SECOND GEAR

Intermediate clutch oil from the 1-2 shift valve seats the check ball and passes through an orifice to apply the front band. The pressure applying the band is also controlled by the stroking of the accumulator piston which is moved by orificed flow of intermediate clutch oil and resisted by the accumulator spring and exhausting orificed direct clutch oil in a manual downshift 3-2 for a smooth apply of the band for Super range engine braking.

The rear servo applies the rear band for overrun engine braking in Lo range, first gear. It applies the band in Reverse to hold the reaction carrier to provide the reverse gear ratio.

On the 1-2 shift in Drive and Super ranges, it serves as an accumulator for the intermediate clutch to provide a smooth shift.

DRIVE AND SUPER RANGE-FIRST GEAR

In first gear, Drive and Super ranges, 1-2 accumulator oil

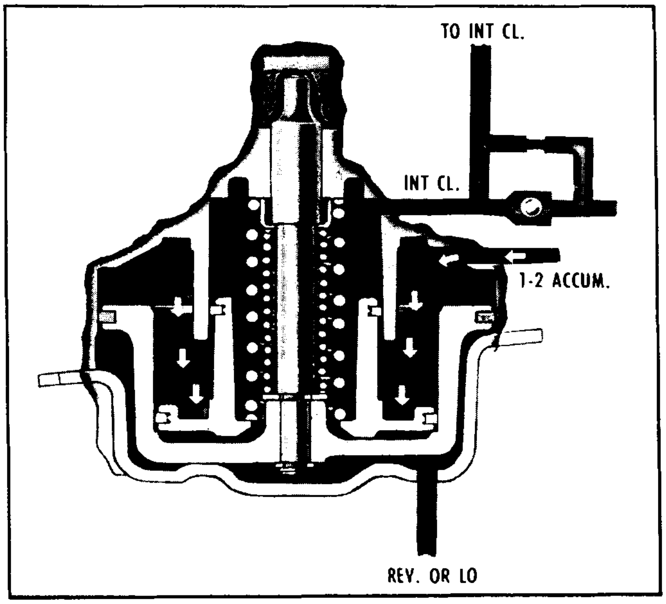


Fig. 7E-18 Drive and Super Range - First Gear

is directed to the rear servo accumulator piston in preparation for the 1-2 shift (Fig. 7E-18).

DRIVE AND SUPER RANGE-SECOND GEAR

Intermediate clutch apply oil is directed to the rear servo accumulator piston, stroking the piston against 1-2 accumulator oil and the accumulator spring (Fig. 7E-19). This action absorbs some intermediate clutch apply oil and permits the intermediate clutch to apply at reduced pressure for a smooth 1-2 shift.

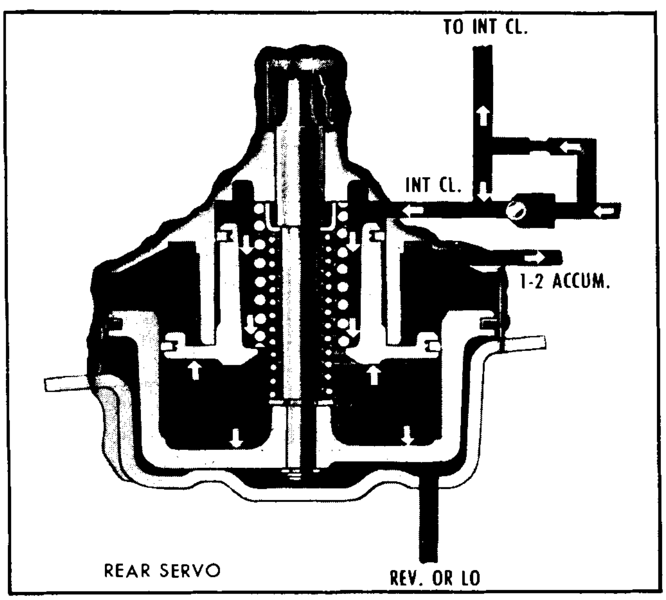


Fig. 7E-19 Drive and Super Range - Second Gear

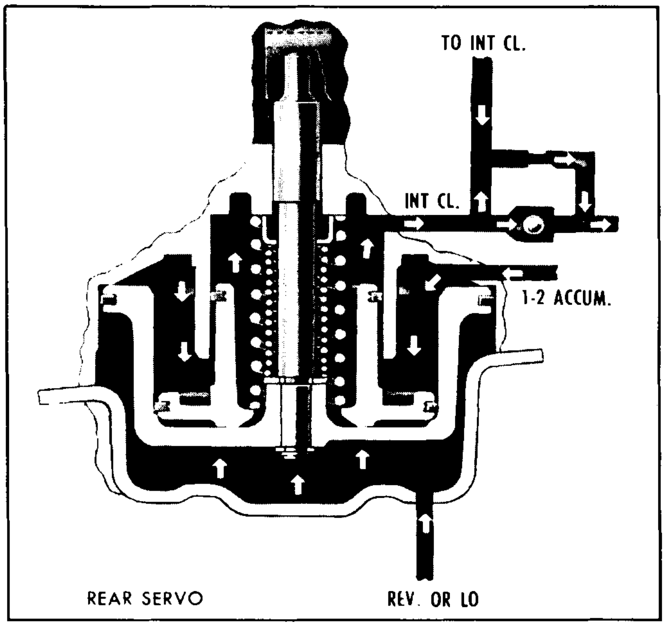


Fig. 7E-20 Lo Range - First Gear

LO RANGE - FIRST GEAR

Overrun engine braking in Lo range, first gear, is provided by the rear servo applying the band to hold the reaction carrier from clockwise rotation, viewed from front of car (Fig. 7E-20).

1-2 accumulator oil is directed to the accumulator piston which attempts to prevent the servo from applying. Lo range oil, directed to the servo piston which has the larger area, applies the band. Because 1-2 accumulator is present, the force applying the band is lowered. This provides a smooth apply.

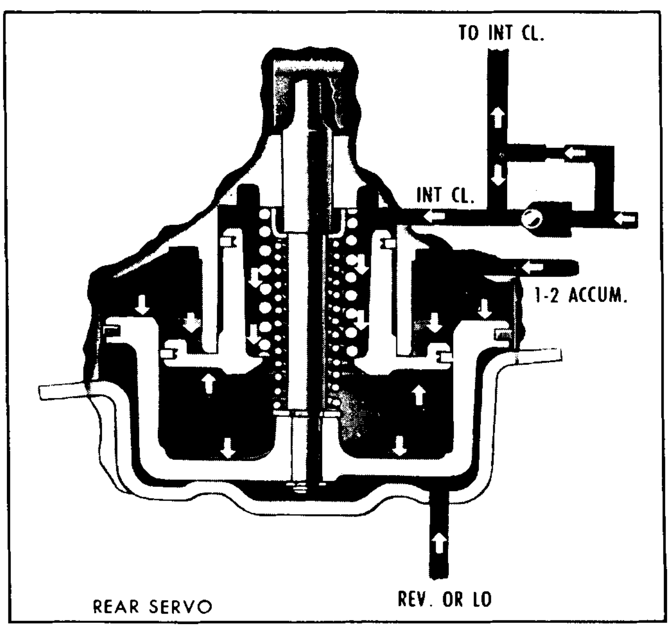


Fig. 7E-21 Lo Range - Second Gear

LO RANGE - SECOND GEAR

In second gear, the rear band is released (Fig. 7E-21). Intermediate clutch oil is directed to the release side of the servo piston which, with line oil in the 1-2 accumulator passage, balances out the Lo range oil on the apply side of the servo piston and the servo release spring strokes the servo piston to the released position.

REVERSE

In Reverse, the rear band is applied to hold the reaction carrier. Reverse oil is directed to the servo piston to apply the band. To insure the band holding the reaction carrier for the reverse gear ratio, line pressure is increased in Reverse and no other oil pressures are present in the servo to resist the apply of the servo piston.

1-2 ACCUMULATOR

1-2 Accumulator oil charges the rear servo accumulator in first gear in preparation for the apply of the intermediate clutch on the 1-2 shift.

The valve train consists of a 1-2 accumulator valve, a 1-2 accumulator primary valve and two springs.

1-2 Accumulator oil pressure is used to obtain greater flexibility in attaining the desired curve for various engine requirements.

Drive oil is directed to the 1-2 accumulator valve and is regulated by the valve train to 1-2 accumulator oil. Modulator pressure is directed to the 1-2 accumulator primary valve and the 1-2 accumulator valve. This results in 1-2 accumulator pressure being engine torque conscious and adjusts for smooth, durable shifts according to engine torque output.

For clutch durability, detent oil is directed to the 1-2 accumulator primary valve to raise 1-2 accumulator pressure during detent 1-2 shifts. Lo range oil is directed to the 1-2 accumulator valve, during Lo range operation, to raise 1-2 accumulator pressure to line pressure. This increased pressure, directed to the rear servo accumulator piston, resists servo apply pressure and slows down the apply of the rear band for a smooth manual shift to Lo range, first gear.

DETENT AND DETENT REGULATOR VALVES

When the accelerator pedal is fully depressed, the detent valve train replaces the modulator as a controller of shift points.

Line pressure is fed through a small orifice to one end of

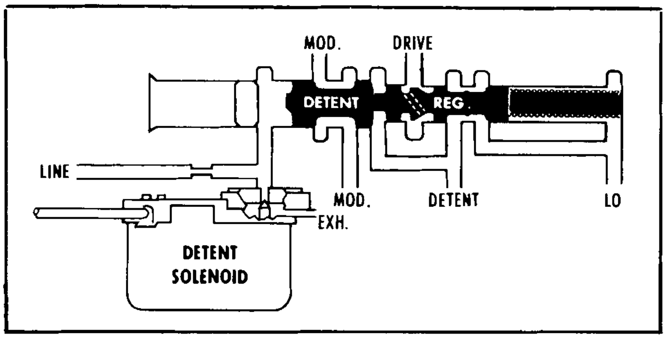


Fig. 7E-22 Detent Solenoid Needle Valve Closed - Normal Operation

the detent valve (Fig. 7E-22). In normal throttle operation, the cavity at this end of the valve is sealed by the needle valve in the detent solenoid assembly. This line pressure holds the detent valve train in an inoperative or normal position.

When the throttle is opened wide, an electric switch on throttle linkage is closed which energizes the detent solenoid (Fig. 7E-23). The needle valve is opened by the solenoid, causing a pressure drop on the end of the detent valve.

The detent regulator valve spring then shifts the detent valve and allows the detent regulator to regulate detent oil to a fixed pressure of approximately 70 psi. When the detent valve shifts, it routes this fixed or detent pressure

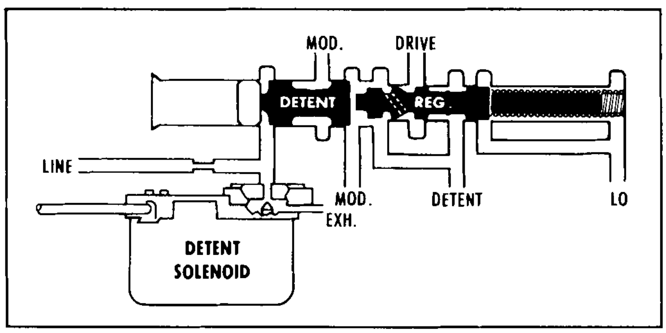


Fig. 7E-23 Detent Solenoid Needle Valve Open - Solenoid Energized

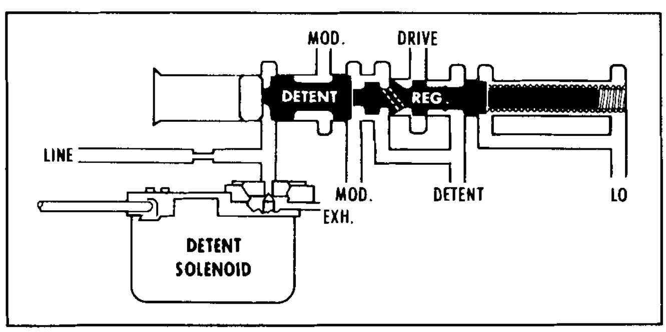


Fig. 7E-24 Detent Solenoid Needle Valve Closed - Lo Range Operation into the modulator passages. The detent valve train also routes detent pressure into the detent passages to the shift valve trains. The upshift points are then controlled by detent pressure in the modulator passages and the detent downshifts by detent pressure in the detent passages. These shift points are fixed at relatively high speeds by the constant pressure.

Detent pressure is directed to the 1-2 accumulator primary valve to increase 1-2 accumulator pressure for clutch durability during detent shifting. Detent pressure is directed to the modulator valve to prevent modulator pressure from dropping below approximately 70 psi which, in turn, prevents line pressure from dropping below approximately 105 psi.

In Lo range operation, Lo oil is directed to the detent regulator valve and spacer. The spring then moves the detent and regulator valves to the opposite end of the valve bore (Fig. 7E-24). Lo oil is also directed to the detent regulator valve to a passage which is used as an exhaust when the valve is regulating. Lo oil in these two areas prevents the detent valve from regulating and drive oil passes through the detent regulator valve into the detent and modulator passages at Lo range pressure of 150 psi. This increase in detent and modulator pressures will downshift the 1-2 valve at speeds below approximately 40 mph and will prevent the transmission from upshifting out of first gear, regardless of vehicle speed.

NEUTRAL RANGE-ENGINE IDLING

POWER FLOW

Forward Clutch - Released
Roller Clutch - Ineffective
Direct Clutch - Released
Front Band - Released
Rear Band - Released
Intermediate Clutch - Released
Intermediate Sprag - Ineffective
Detent Solenoid - De-energized

In Neutral or Park, no bands or clutches are applied. Therefore no power is transmitted.

OIL FLOW

Whenever the engine is running at idle with the selector lever in P or N, oil from the pump is directed to the:

1. Pressure Regulator Valve
2. Converter:
   a. Oil Cooler
   b. Lubrication System
3. Manual Valve
4. Detent Valve
5. Detent Solenoid
6. Vacuum Modulator Valve
7. Front Servo (Neutral only)

BASIC CONTROL

Oil flows from the pump to the pressure regulator valve which regulates pump pressure. When the pump output exceeds the demand of line pressure, oil from the pressure regulator is directed to the converter feed passage to fill the converter. Oil from the converter is directed to the transmission cooler. Oil from the cooler is directed to the transmission lubrication system.

Line pressure acts on the:

1. Manual Valve
2. Detent Valve
3. Detent Solenoid
4. Modulator Valve
5. Front Servo Piston (Neutral Only)

Line pressure at the modulator valve is re-regulated to modulator oil, which acts on the pressure boost valve and 1-2 accumulator valve train and passes through the detent valve and 3-2 valve to the 1-2 and 2-3 valve trains.

SUMMARY

The converter is filled and all clutches and bands are released. The transmission is in Neutral or Park.

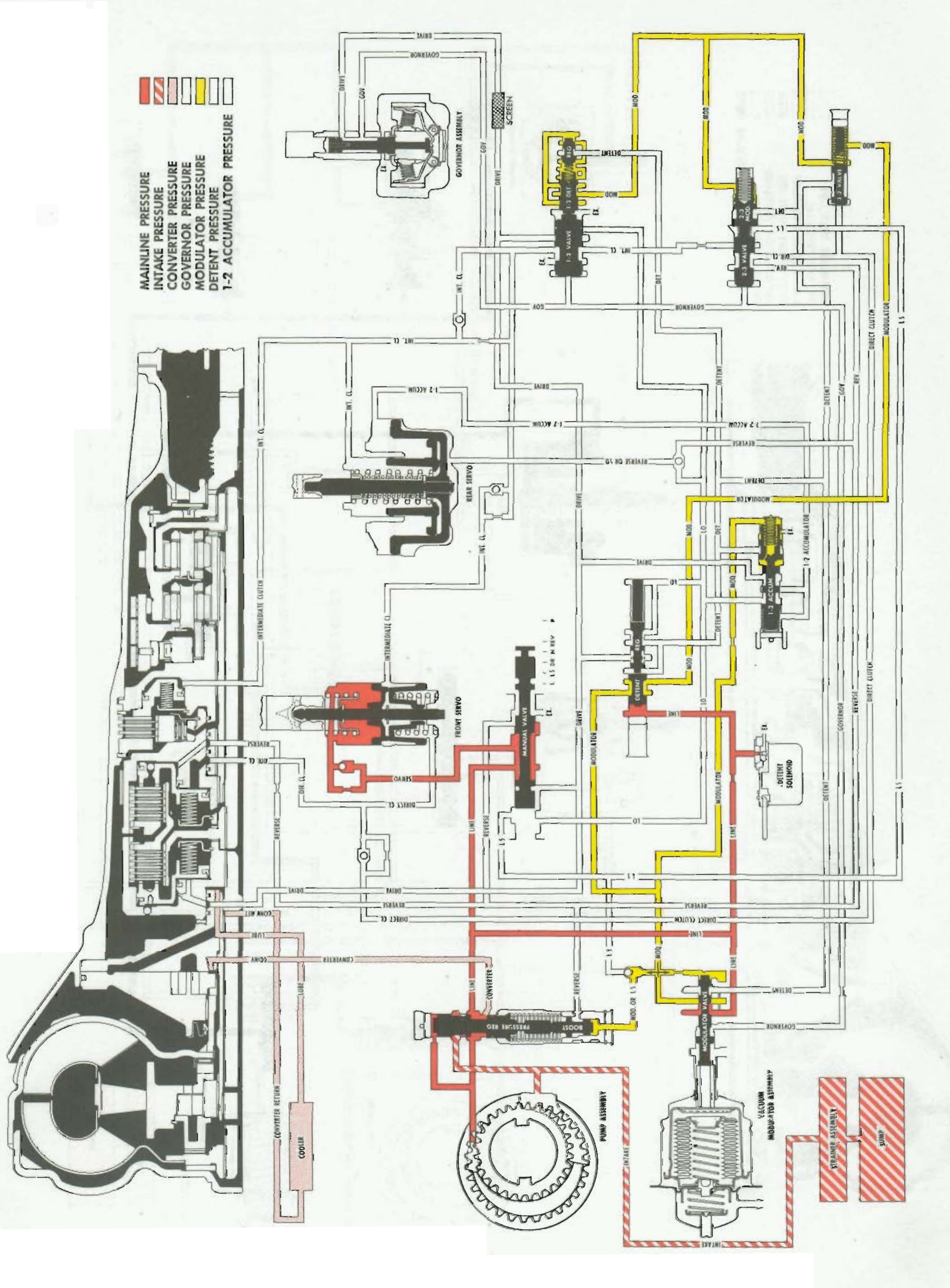


Fig. 7E-25 Neutral Range-Engine Idling

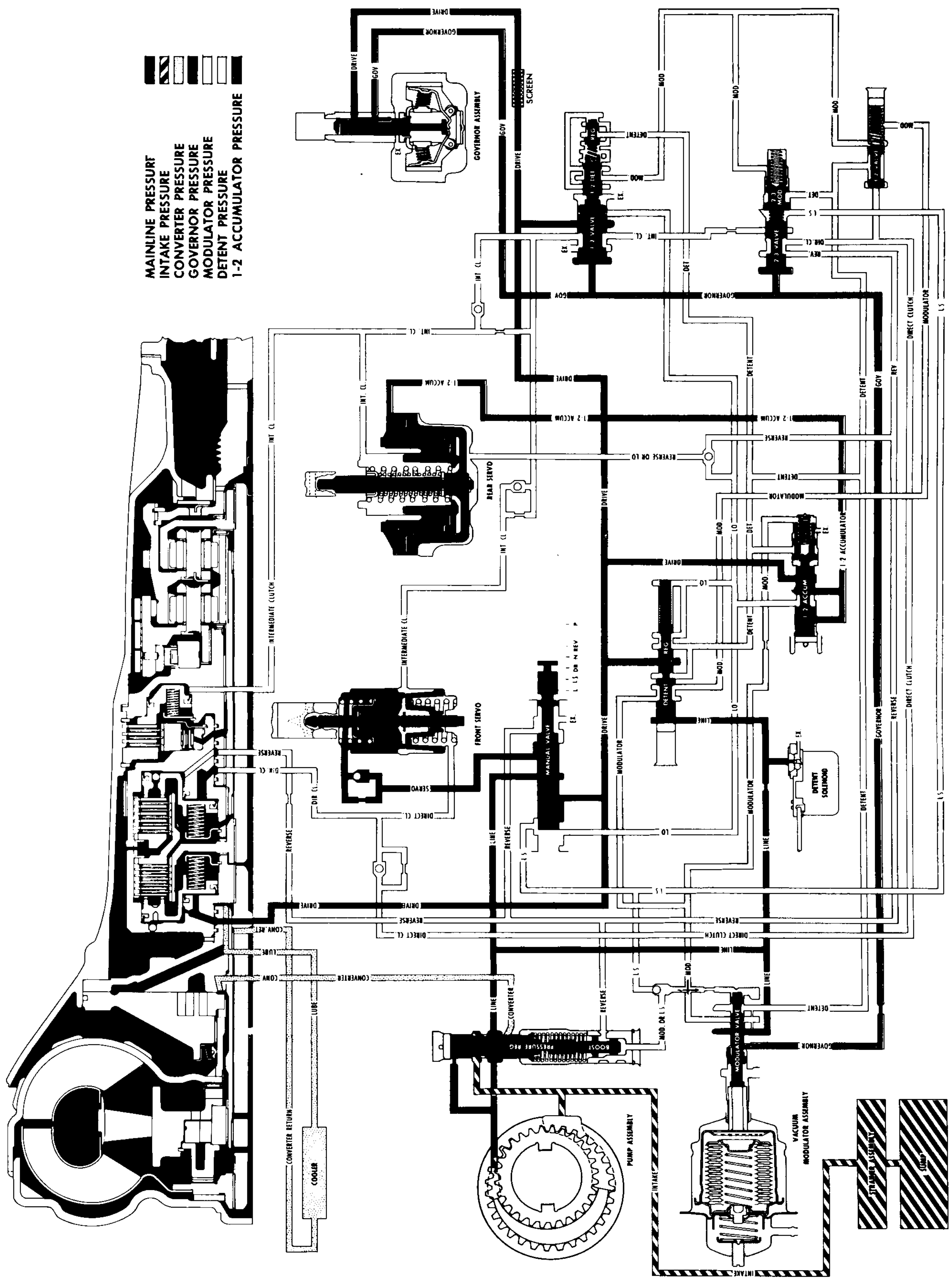


Fig. 7E-26 Drive Range-First Gear

DRIVE RANGE-FIRST GEAR

POWER FLOW

Forward Clutch - Applied
Roller Clutch - Effective
Direct Clutch - Released
Front Band - Released
Rear Band - Released
Intermediate Clutch - Released
Intermediate Sprag - Ineffective
Detent Solenoid - De-energized

With the selector lever in any forward range, the forward clutch is applied. This delivers turbine torque to the mainshaft and turns the rear internal gear in a clockwise direction, viewed from front (Converter torque ratio equals approximately 2:1 at stall).

Clockwise motion of the rear internal gear causes the rear pinions to turn clockwise, driving the sun gear counterclockwise. In turn, the sun gear drives the front pinions clockwise, thus turning the front internal gear, output carrier and output shaft clockwise in a reduction ratio of approximately 2.5:1.

Reaction of the front pinions against the front internal gear is taken by reaction carrier and roller clutch assembly to the transmission case (Approximate stall ratio equals 5:1).

OIL FLOW

When the selector lever is moved to Drive position, the manual lever is repositioned to allow line pressure to enter the drive circuit. Drive oil then flows to the:

1. Forward Clutch
2. 1-2 Shift Valve
3. Governor Assembly
4. 1-2 Accumulator Valve
5. Detent Regulator Valve

BASIC CONTROL

Drive oil is directed to the forward clutch where it acts on two areas of the clutch piston to apply the forward clutch. The inner area is fed through an unrestricted passage. The outer area is fed through an orifice to insure a smooth shift from Park, Neutral and Reverse to Drive.

Drive oil at the governor assembly is regulated to a variable pressure. This pressure increases with vehicle speed and acts against the ends of the 1-2 and 2-3 shift valves and an area on the modulator valve. This variable pressure is called governor pressure.

Drive oil is also regulated to another variable pressure at the 1-2 accumulator valve. This pressure, called 1-2 accumulator oil, is controlled by modulator oil and is directed to the rear servo. 1-2 accumulator oil at the rear servo acts on the accumulator piston.

SUMMARY

The converter is filled and the forward clutch is applied. The transmission is in Drive range - first gear.

DRIVE RANGE-SECOND GEAR

POWER FLOW

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Released
Front Band - Released
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Effective
Detent Solenoid - De-energized

In second gear, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against counterclockwise rotation. Turbine torque, through the forward clutch, is applied through the mainshaft to the rear internal gear in a clockwise direction.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.5:1.

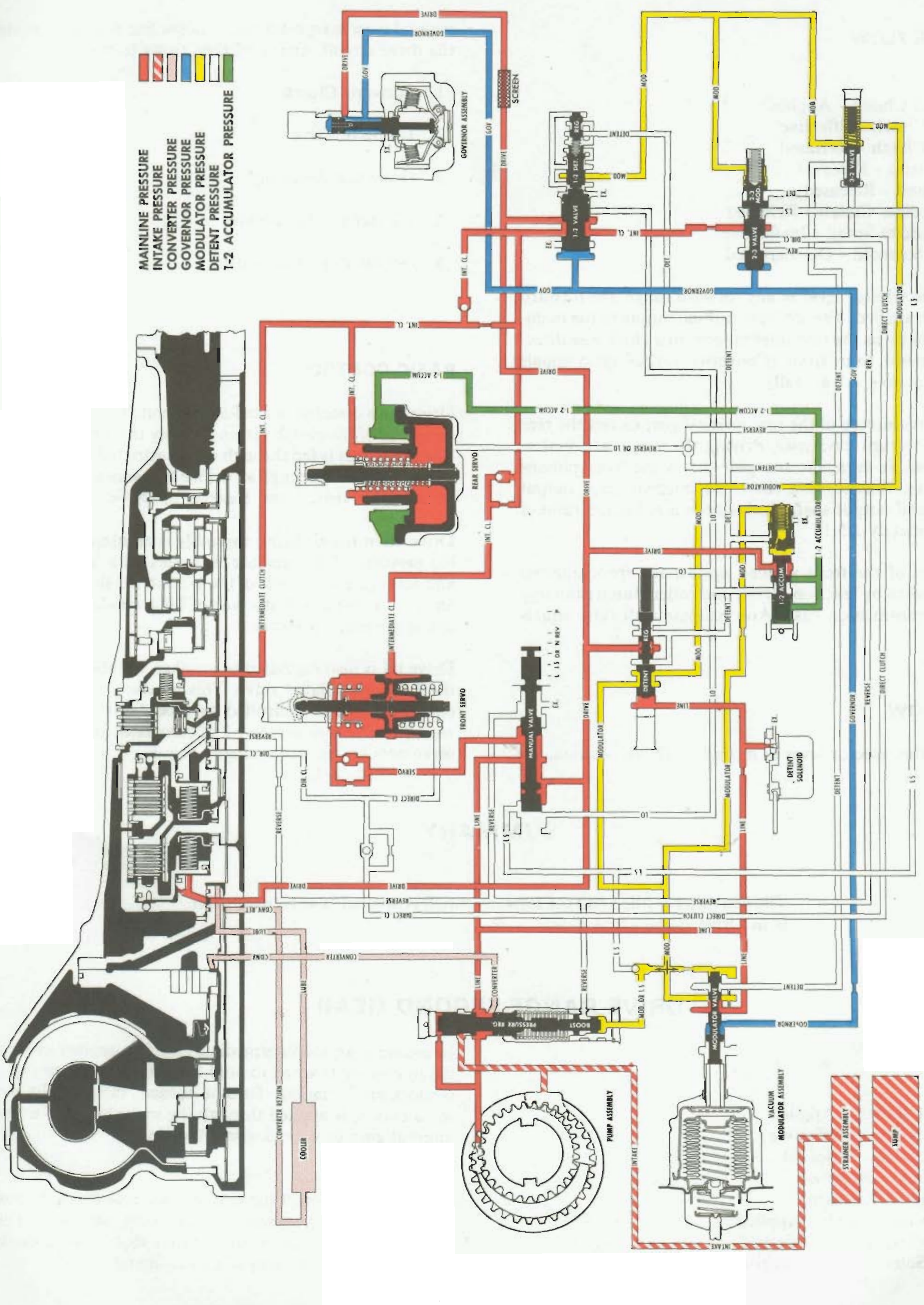


Fig. 7E-27 Drive Range - Second Gear

OIL FLOW

As both vehicle speed and governor pressure increase, the force of governor oil acting on the 1-2 shift valve will overcome the force of re-regulated modulator oil pressure. This allows the 1-2 shift valve to open, permitting drive oil to enter the intermediate clutch passage.

Intermediate clutch oil from the 1-2 shift valve is directed to the:

1. Intermediate Clutch
2. Rear Servo
3. Front Servo and Accumulator Pistons
4. 2-3 Shift Valve

BASIC CONTROL

Intermediate clutch oil from the 1-2 shift valve seats a one-way check ball and flows through an orifice to the intermediate clutch piston to apply the intermediate clutch. At the same time, intermediate clutch oil moves the accumulator piston against the 1-2 accumulator oil. The accumulator spring maintains controlled pressure in the clutch during a 1-2 shift for a smooth clutch apply. Intermediate clutch oil seats a second one-way check ball and flows to the front servo and accumulator pistons. Intermediate clutch oil is also directed to a land of the 2-3 shift valve.

SUMMARY

The forward and intermediate clutches are applied. The transmission is in Drive range-second gear.

DRIVE RANGE-THIRD GEAR

POWER FLOW

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Applied
Front Band - Released
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Ineffective
Detent Solenoid - De-energized

In direct drive, engine torque is transmitted to the converter through the forward clutch to the mainshaft and rear internal gear. Because the direct clutch is applied, torque is also transmitted to sun gear shaft and sun gear. Since both sun gear and internal gears are now turning at the same speed, the planetary gear set is essentially locked and turns as one unit in direct drive or a ratio of 1:1.

OIL FLOW

As vehicle speed and governor pressure increase, force of governor oil acting on the 2-3 shift valve overcomes the force of 2-3 shift valve spring and modulator oil. This allows the 2-3 shift valve to move, feeding intermediate clutch oil to the direct clutch passage.

Direct clutch oil from the 2-3 shift valve is directed to the:

1. Direct Clutch
2. Front Accumulator Piston
3. 3-2 Valve

BASIC CONTROL

Direct clutch oil from the 2-3 shift valve flows past a one-way check valve to the inner area of the direct clutch piston to apply the direct clutch. Simultaneously, direct clutch oil is fed to the front accumulator piston. Pressure of the direct clutch oil, combined with the accumulator spring, moves the accumulator and servo pistons against servo oil. This acts as an accumulator for a smooth direct clutch apply.

Direct clutch oil is also supplied to the 3-2 valve to move the valve against modulator pressure. This cuts off modulator oil to the 1-2 and 2-3 shift valve trains and allows the transmission to utilize the torque multiplying characteristics of the converter during medium throttle operation without downshifting.

SUMMARY

The forward, intermediate and direct clutches are applied. The transmission is in Drive range-third gear (direct drive).

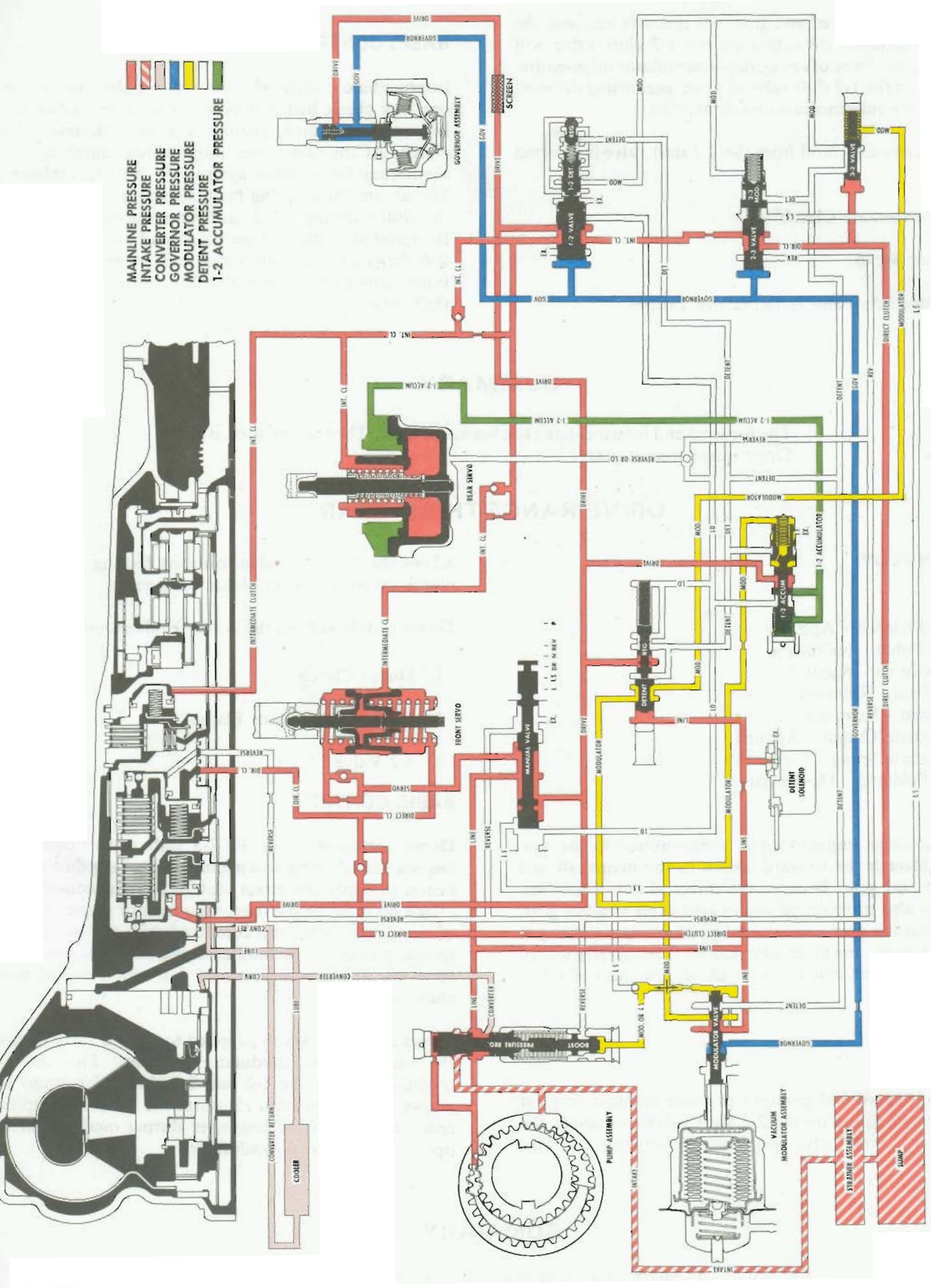


Fig. 7E-28 Drive Range-Third Gear

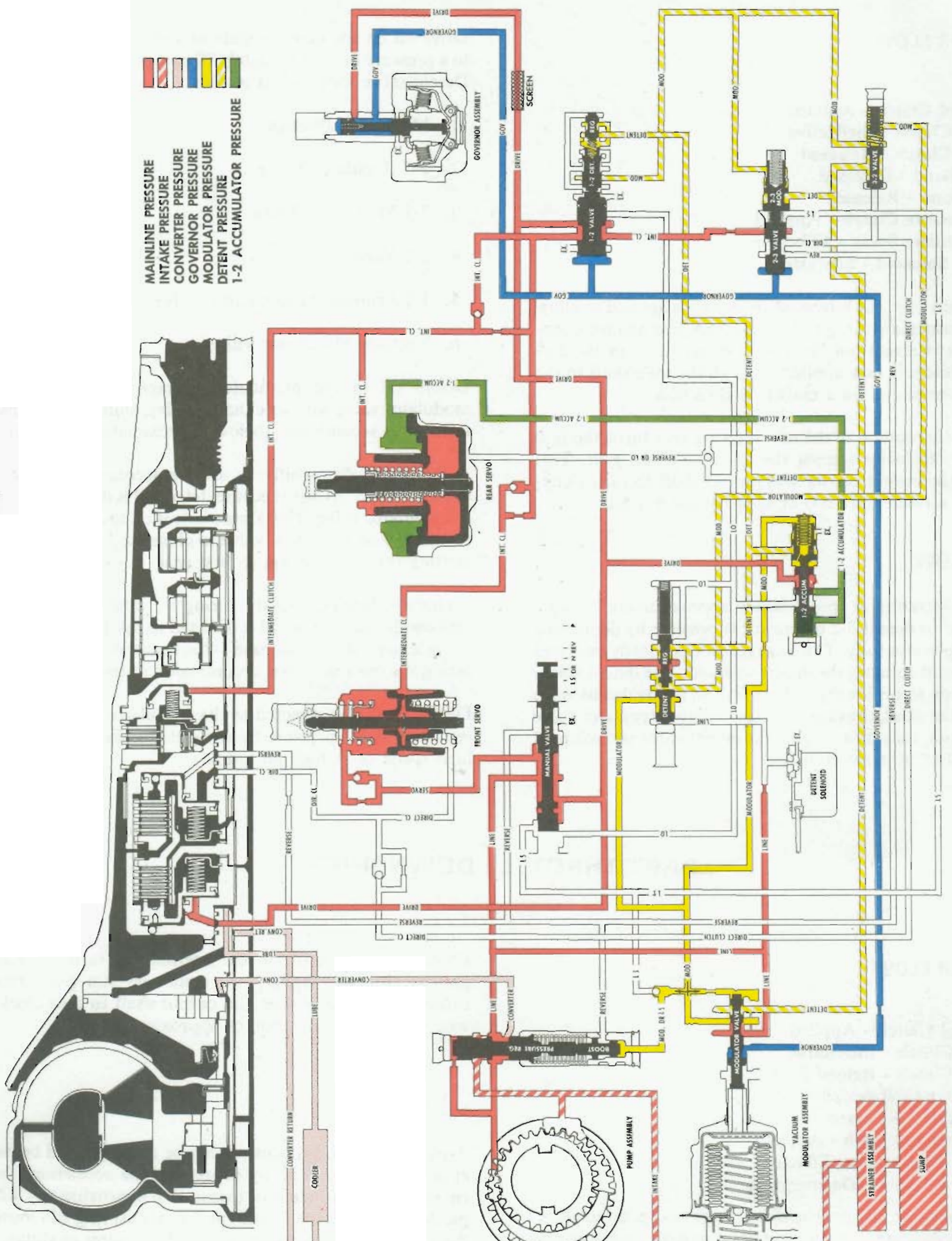


Fig. 7E-29 Detent Downshift - Valves in Second Gear Position

DETENT DOWNSHIFT

POWER FLOW

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Released
Front Band - Released
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Effective
Detent Solenoid - Energized

In second gear, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against counterclockwise rotation. Turbine torque, through the forward clutch, is now applied through the mainshaft to the rear internal gear in a clockwise direction.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.5:1.

OIL FLOW

While operating at speeds below approximately 70 mph, a forced or detent 3-2 downshift is possible by depressing the accelerator fully. This engages an electrically operated switch and actuates the detent solenoid. The detent solenoid opens an orifice that allows line oil at the detent valve to be exhausted, thus permitting the detent regulator valve to operate. Line oil acting on the detent valve and solenoid is supplied by a small orifice.

Drive oil on the detent regulator valve is then regulated to a pressure of approximately 70 psi and called detent oil. Detent oil is then routed to the:

1. Modulator Passage
2. 1-2 Regulator Valve
3. 2-3 Modulator Valve
4. 3-2 Valve
5. 1-2 Primary Accumulator Valve
6. Vacuum Modulator Valve

Detent oil in the modulator passage and at the 2-3 modulator valve will close the 2-3 valve, shifting the transmission to second gear (below approximately 70 mph).

A detent 2-1 downshift can also be accomplished below approximately 20 mph because detent oil is directed to the 1-2 regulator valve. This allows detent oil to act on the 1-2 regulator and 1-2 detent valve to close the 1-2 shift valve, shifting the transmission to first gear.

To insure clutch durability during 1-2 upshifts under detent conditions, detent oil is directed to the 1-2 accumulator primary valve to increase 1-2 accumulator oil pressure acting on the rear servo accumulator piston.

Detent oil is also directed to the modulator valve to prevent modulator pressure from regulating below 70 psi at high speed or at high altitudes.

PART THROTTLE DOWNSHIFT

POWER FLOW

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Released
Front Band - Released
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Effective
Detent Solenoid - De-energized

In second gear, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against counterclockwise rotation. Turbine torque, through the forward clutch, is now applied through the mainshaft to the rear internal gear in a clockwise direction.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ration of approximately 1.5:1.

OIL FLOW

A part throttle 3-2 downshift can be accomplished below approximately 33 mph by depressing the accelerator far enough to raise modulator pressure to approximately 105 psi. Modulator pressure and the 3-2 valve spring will move the 3-2 valve against direct clutch oil and allow modulator oil to act on the 2-3 modulator valve. This moves the 2-3 valve train against governor oil and shifts the transmission to second gear.

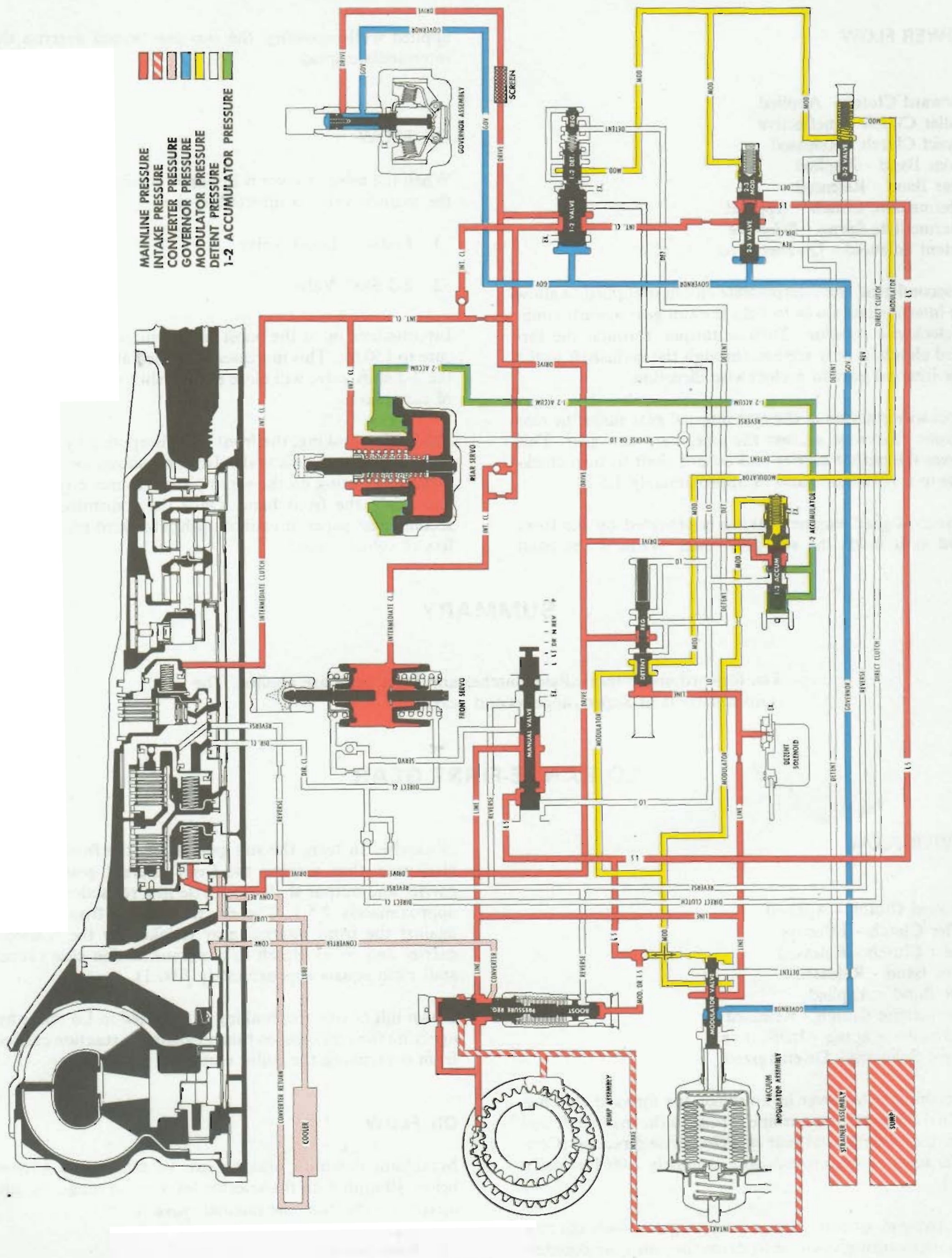


Fig. 7E-31 Super Range-Second Gear

SUPER RANGE-SECOND GEAR

POWER FLOW

Forward Clutch - Applied
Roller Clutch - Ineffective
Direct Clutch - Released
Front Band - Applied
Rear Band - Released
Intermediate Clutch - Applied
Intermediate Sprag - Effective
Detent Solenoid - De-energized

In second gear, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against counterclockwise rotation. Turbine torque, through the forward clutch, is now applied through the mainshaft to the rear internal gear in a clockwise direction.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.5:1.

In second gear, engine braking is provided by the front band as it holds the sun gear fixed. Without the band applied while coasting, the sun gear would overrun the intermediate sprag.

OIL FLOW

When the selector lever is in Super, intermediate oil from the manual valve is directed to the:

1. Pressure Boost Valve
2. 2-3 Shift Valve

Intermediate oil at the boost valve will increase line pressure to 150 psi. This increased intermediate oil pressure at the 2-3 shift valve will close the 2-3 shift valve, regardless of car speed.

For engine braking, the front band is applied by exhausting servo oil at the manual valve. This allows intermediate clutch oil, acting on the servo piston, to move the piston and apply the front band. Once the transmission is in second gear-Super, it cannot upshift to third gear regardless of vehicle speed.

SUMMARY

The forward and intermediate clutches and front band are applied. The transmission is in Super range-second gear.

LO RANGE-FIRST GEAR

POWER FLOW

Forward Clutch - Applied
Roller Clutch - Effective
Direct Clutch - Released
Front Band - Released
Rear Band - Applied
Intermediate Clutch - Released
Intermediate Sprag - Ineffective
Detent Solenoid - De-energized

With the selector lever in Lo range, the forward clutch is applied. This delivers turbine torque to the mainshaft and turns the rear internal gear in a clockwise direction (Converter torque ration equals approximately 2.00:1 at stall).

Clockwise motion of the rear internal gear causes the rear pinions to turn clockwise to drive the sun gear counterclockwise. In turn, the sun gear drives the front pinions clockwise, thus turning the front internal gear, output carrier and output shaft clockwise in a reduction ratio of approximately 2.5:1. The reaction of the front pinions against the front internal gear is taken by the reaction carrier and roller clutch to the transmission case (Total stall ratio equals approximately 5.00:1).

Down hill or overrun braking is provided in Lo range by applying the rear band as this prevents the reaction carrier from overruning the roller clutch.

OIL FLOW

Maximum downhill braking can be attained at speeds below 40 mph with the selector lever in Lo range, as this directs Lo oil from the manual valve to the:

1. Rear Servo

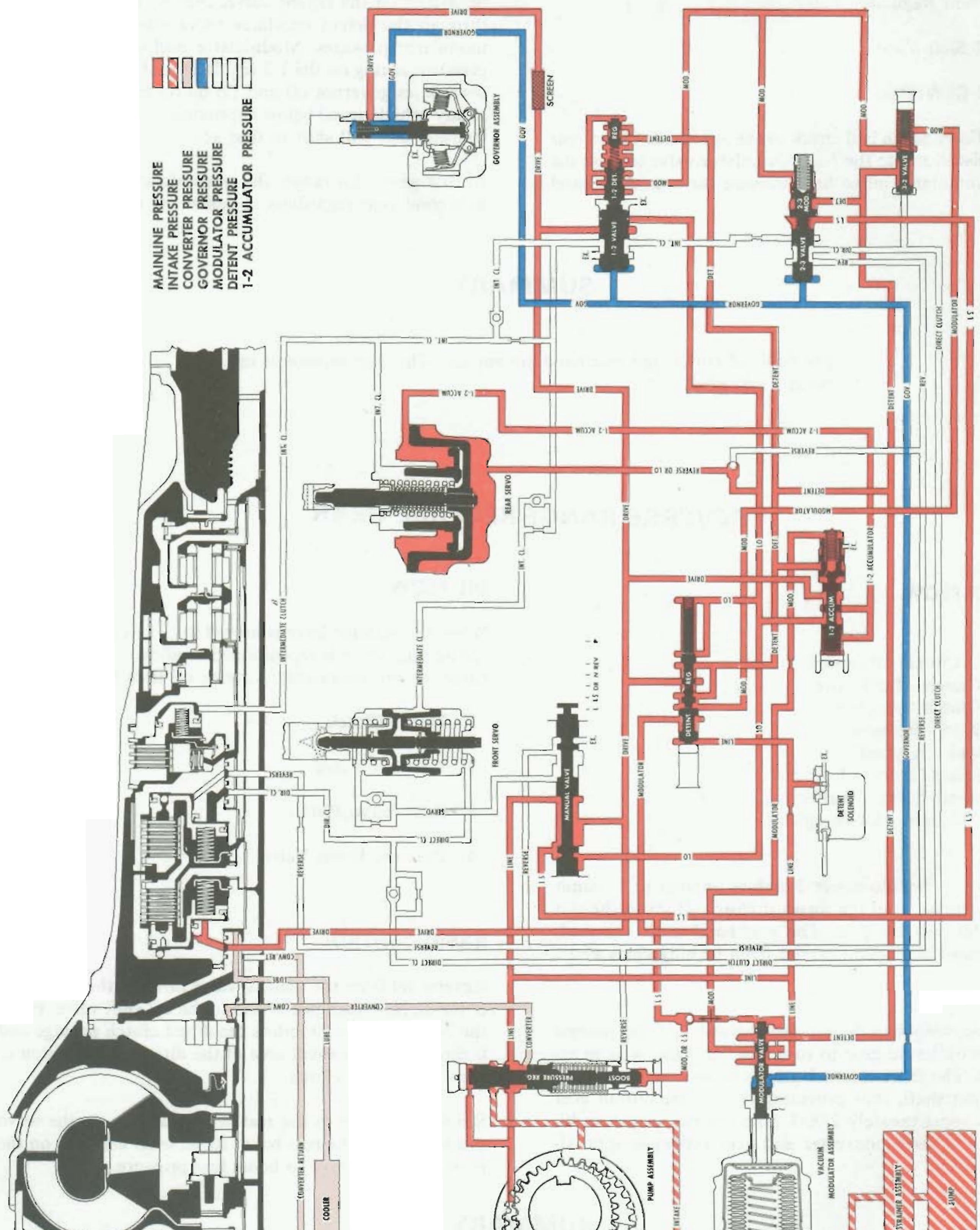


Fig. 7E-32 Lo Range-First Gear

2. 1-2 Accumulator Valve

3. Detent Regulator Valve

4. 1-2 Shift Valve

BASIC CONTROL

Lo oil flows past a ball check to the apply side of the rear servo piston and to the 1-2 accumulator valve to raise the 1-2 accumulator oil to line pressure for a smooth band apply.

Lo oil acts on the detent regulator valve. Combined with the detent spring, Lo oil holds the detent valve against line oil acting on the detent valve, causing drive oil to flow through the detent regulator valve into the detent and modulator passages. Modulalator and detent oil at line pressure, acting on the 1-2 regulator and 1-2 detent valve, overcomes governor oil and Lo oil on the 1-2 shift valve at any vehicle speed below approximately 40 mph and the transmission will shift to first gear.

In first gear - Lo range, the transmission cannot upshift to second gear regardless of vehicle or engine speed.

SUMMARY

The forward clutch and rear band are applied. The transmission is in Lo range - first gear.

REVERSE RANGE-REVERSE GEAR

POWER FLOW

Forward Clutch - Released
Roller Clutch - Ineffective
Direct Clutch - Applied
Front Band - Released
Rear Band - Applied
Intermediate Clutch - Released
Intermediate Sprag - Ineffective
Detent Solenoid - De-energized

In reverse gear, the direct clutch is applied to transmit turbine torque from the forward clutch drum to the sun gear shaft and sun gear. The rear band is also applied, preventing the reaction carrier from turning clockwise.

Clockwise torque to the sun gear causes the front pinions and front internal gear to turn counterclock- wise in re- duction. The front internal gear is connected directly to the output shaft, thus providing the reverse output gear ratio of approximately 2.00:1. The reverse torque multi- plication at stall (converter and gear ratios) is approxi- mately 4.00:1.

OIL FLOW

When the selector lever is moved to the Reverse position, the manual valve is repositioned to allow line pressure to enter the reverse circuit. Reverse oil then flows to the:

1. Direct Clutch

2. 2-3 Shift Valve

3. Rear Servo Piston

4. Pressure Boost Valve

BASIC CONTROL

Reverse oil from the manual valve flows to the large area of the direct clutch piston and to the 2-3 shift valve. From the 2-3 shift valve, it enters the direct clutch passage and is directed to the small area of the direct clutch piston to apply the direct clutch.

Reverse oil flows to the rear servo and acts on the servo piston to apply the rear band. Reverse oil also acts on the pressure boost valve to boost line pressure.

SUMMARY

The direct clutch and the rear band are applied. The transmission is in Reverse range - reverse gear.

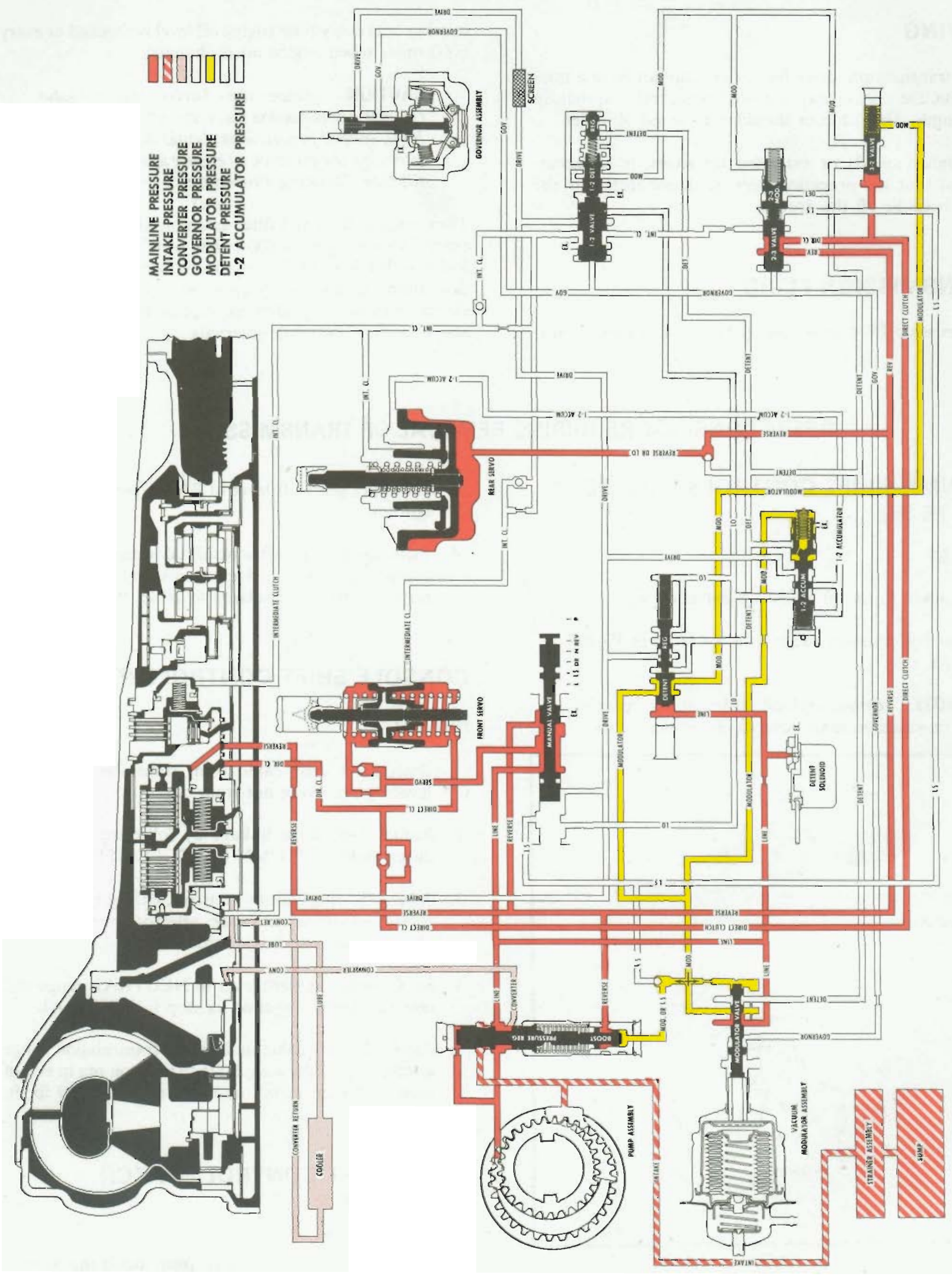


Fig. 7E-33 Reverse Range - Reverse Gear

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 6000 miles when engine oil is changed.

CAUTION: *Since the Turbo Hydra-Matic (M-40) 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 24,000 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 12,000 mile intervals.

OPERATIONS NOT REQUIRING REMOVAL OF TRANSMISSION

COLUMN SHIFT CONTROLS (Figs. 7E-34 thru 7E-36)

ADJUST

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.*

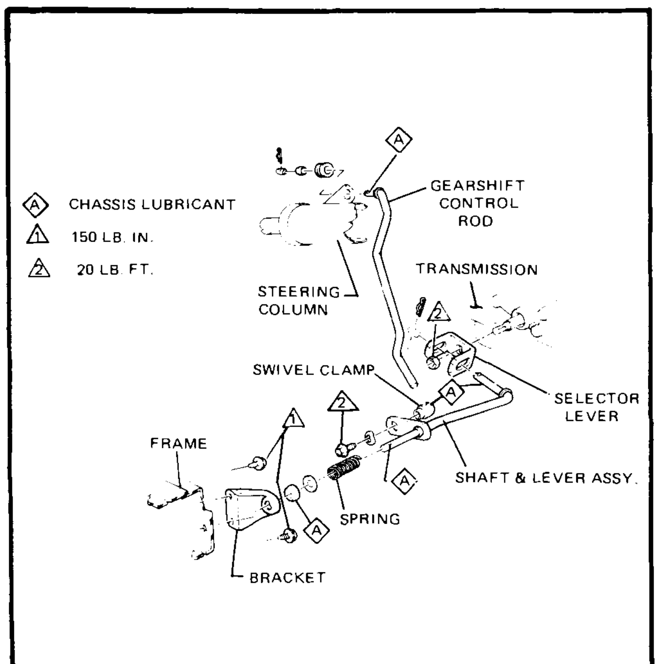


Fig. 7E-34 Column Shift Controls - B Series

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 (Fig. 7E-37)

ADJUST

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:

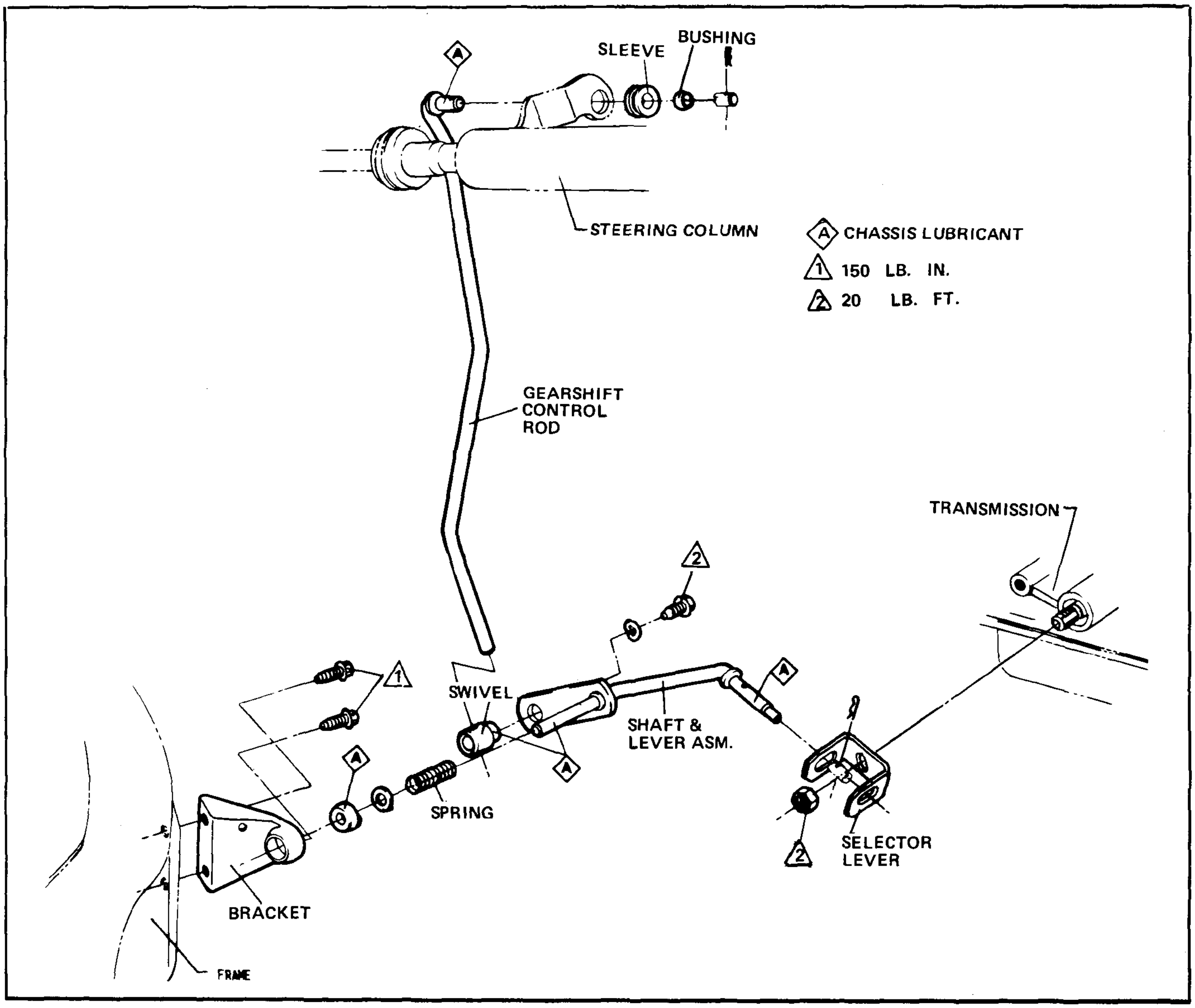


Fig. 7E-35 Column Shift Controls - A Series

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 Fig. 6B-7 thru 6B-9 in Section 6B).
2. Then, fully depress the accelerator pedal to properly "set" the downshift control switch.

NEUTRALIZER SWITCH

ADJUST

Refer to Chassis Electrical Service, Section 12.

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 mark with transmission at normal operating temperature (180-190°F). With warm fluid (room temperature 70°F.), the level should be approximately 1/4" **below** the ADD mark.

NOTE: *In checking the oil, insert the dipstick in the filter tube with the markings up (toward center of car).*

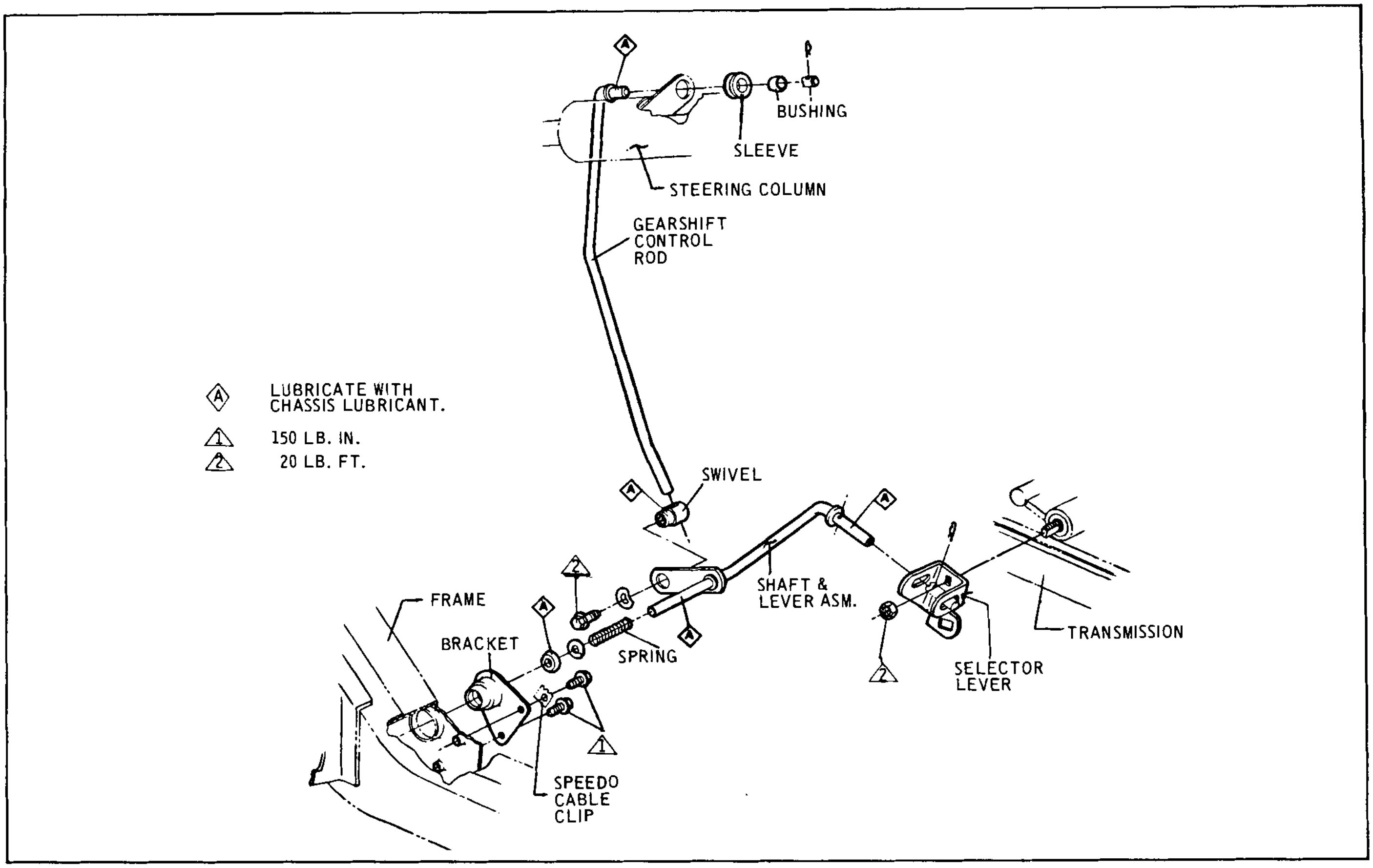


Fig. 7E-36 Column Shift Controls - F Series

CHECKING PROCEDURE

To determine proper fluid level, proceed as follows:

> **CAUTION:** *The full mark on the dipstick is an indication of transmission fluid at normal operating temperature of 180°F. This temperature is only obtained after at least 15 miles of highway driving or equivalent of city driving.*

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 mark.

3. If additional fluid is required, add enough fluid to bring level to the FULL 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 (70°F).

With fluid at room temperature (70°F), follow steps 1, 2 and 3 below:

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 1/4" **below** the ADD mark.

> **NOTE:** *If transmission fluid level is correctly established at 70°F, it will appear at the FULL mark on the dipstick when the transmission reaches normal operating temperature (180°F).*

3. If additional fluid is required, add fluid to bring level to 1/4" **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 transmission failure.*

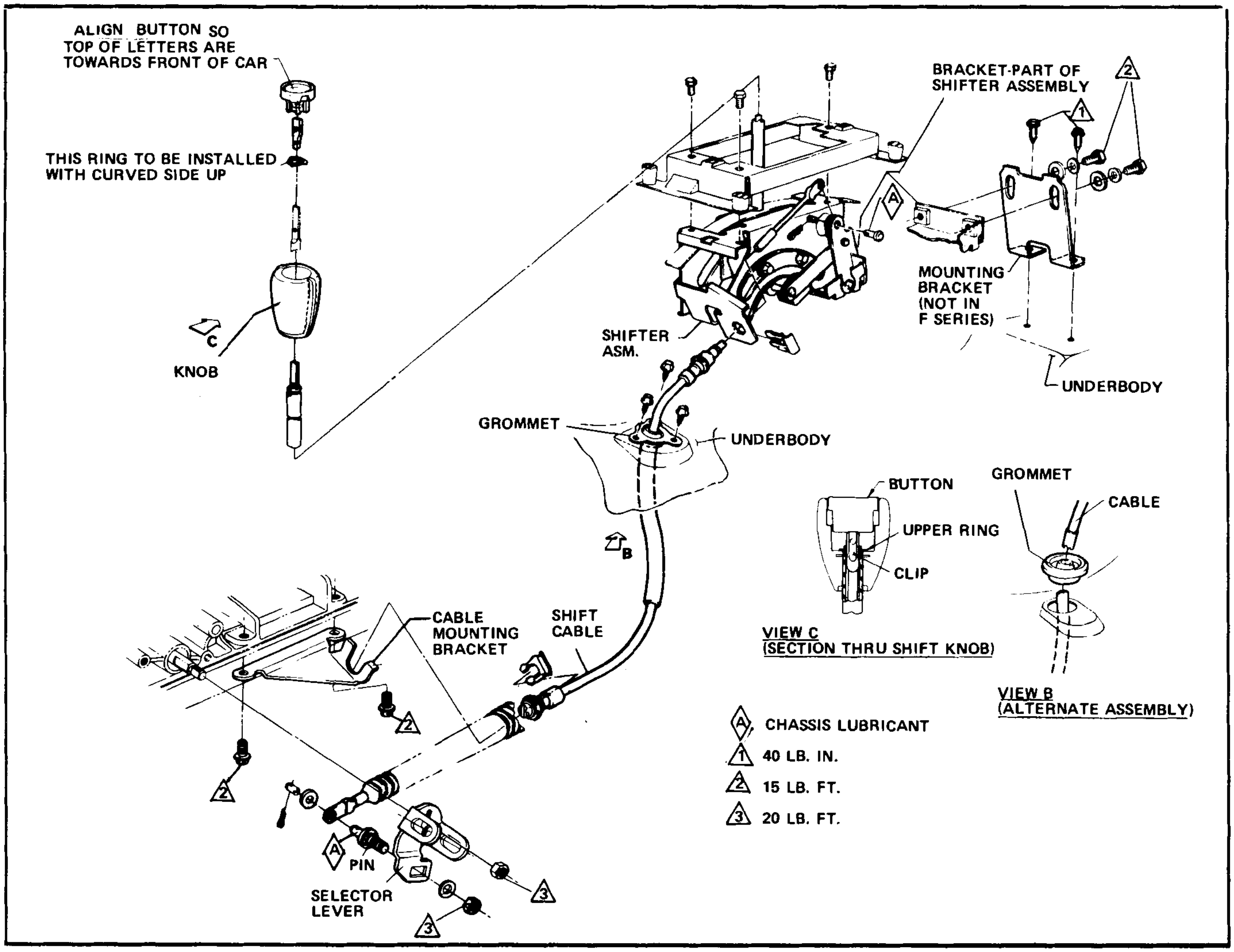


Fig. 7E-37 Console Shift Controls - A, F and G Series

IMPORTANT: *When adding fluid, use only DEXRON or equivalent automatic transmission fluid. The difference in oil level between ADD and FULL is one pint.*

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 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 180-190°F), add fluid to bring level to FULL mark on indicator.

With transmission at room temperature (70°F), add fluid to bring level to 1/4" below the ADD mark.

CAUTION: *Do not overfill. Foaming will result.*

PRESSURE REGULATOR VALVE

REMOVAL

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. 7E-38.

3. Remove regulator boost valve bushing and valve.

4. Remove pressure regulator spring.

5. Remove regulator valve, spring retainer and spacer(s) if present.

NOTE: *The 1972 solid-type pressure regulator valve does not contain oil holes and an orifice cup plug like previous pressure regulator valves. The solid-type valve must* **only** *be used in the pump cover with the squared-off pressure regulator boss (pressure boost bushing end). The previous pressure regulator valve with the oil holes and orifice cup plug will be used to service either type pump cover.*

INSTALLATION

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 THE 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-speed control switch and speedometer drive gear.

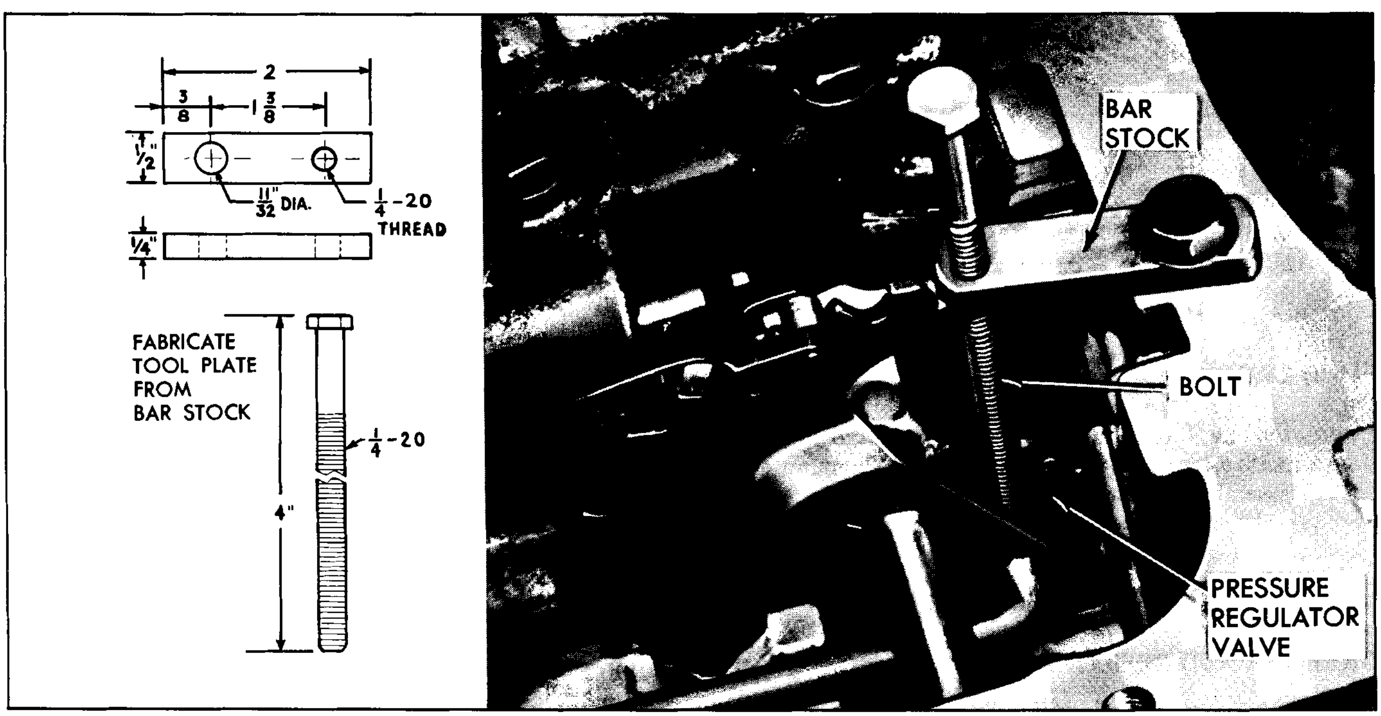


Fig. 7E-38 Removing Pressure Regulator Valve

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.

REMOVAL AND DISASSEMBLY OF TRANSMISSION

TRANSMISSION ASSEMBLY

REMOVE

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, speed control switch electrical lead from engine wire harness, vacuum line at modulator 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.
8. Remove converter-to-flex plate 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 Converter Holding Clamp J 21366.*

12. The installation of the transmission is the reverse of the removal.

CONVERTER AND MODULATOR

REMOVE

1. With transmission in cradle on portable jack, remove J 21366 and remove converter assembly by pulling straight out.

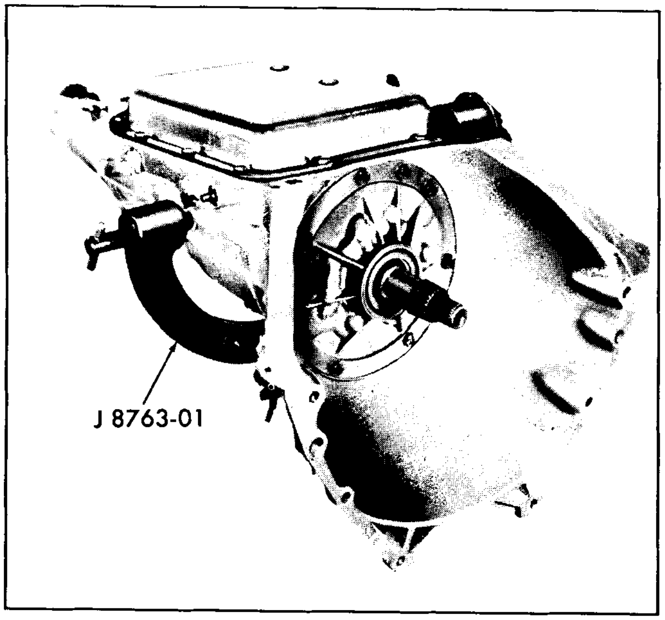


Fig. 7E-39 Transmission In Holding Fixture

Fig. 7E-40 Removing Modulator Retainer

NOTE: *Converter contains a large amount of oil.*

2. Install Holding Fixture J 8763 on transmission so that modulator will be located on side of holding fixture nearest bench (Fig. 7E-39).

   NOTE: *Do not over-torque holding screw. This will bind center support.*

3. Install fixture and transmission into Holding Tool Base J 3289-20 with bottom pan facing up.
4. Remove modulator attaching screw and retainer (Fig. 7E-40).
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-SPEED CONTROL SWITCH, PAN, FILTER AND INTAKE PIPE

REMOVE

1. Remove attaching screws, governor cover and gasket. Discard gasket (Fig. 7E-41).
2. Withdraw governor assembly from case.
3. Remove speedometer driven gear-speed control switch attaching screw and retainer.

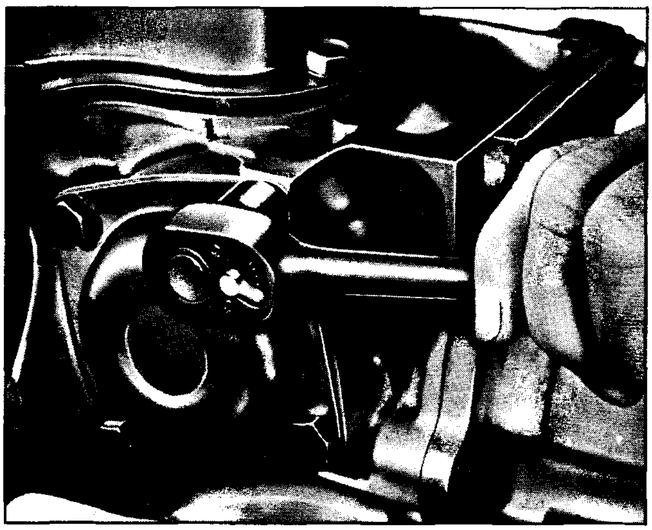


Fig. 7E-41 Removing Governor Cover Attaching Screws

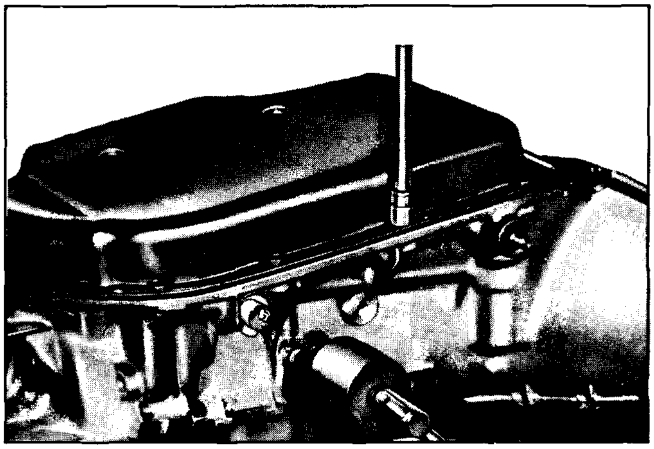


Fig. 7E-43 Removing Oil Pan Attaching Screws

4. Withdraw speedometer driven gear-speed control switch assembly from case.
5. Remove bottom pan attaching screws, bottom pan and bottom pan gasket. Discard gasket (Fig. 7E-43).
6. Remove the filter retainer bolt (Fig. 7E-44).
7. Remove the filter and intake pipe assembly and discard filter (Fig. 7E-45).
8. Remove intake pipe-to-case O-ring seal from intake pipe or case and discard.

CONTROL VALVE ASSEMBLY, GOVERNOR SCREEN ASSEMBLY, ELECTRICAL CONNECTOR, GOVERNOR PIPES AND DETENT SPRING ASSEMBLY

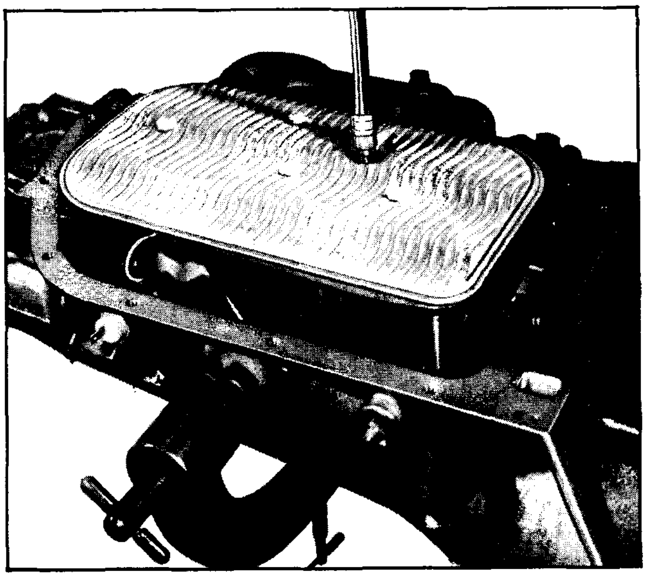


Fig. 7E-44 Removing Filter Retainer Bolt

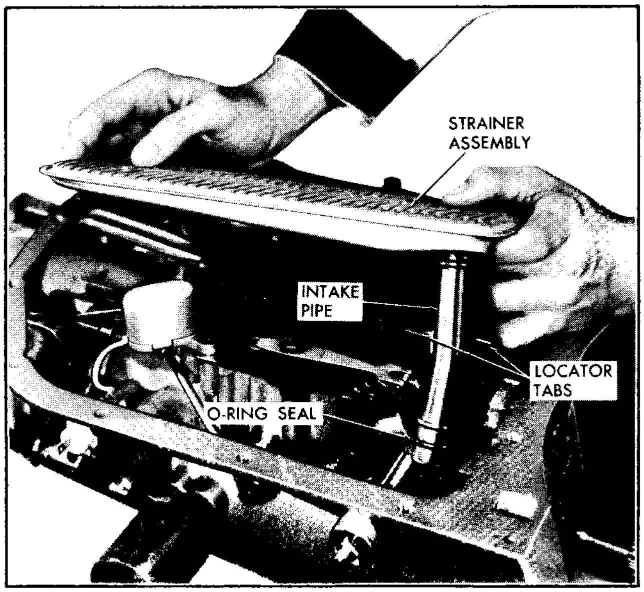


Fig. 7E-45 Removing Filter and Intake Pipe Assembly

REMOVE

1. Remove control valve body attaching screws and detent roller spring assembly (Fig. 7E-46).

   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. 7E-47).

   CAUTION: *Do not drop manual valve.*

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. 7E-48).

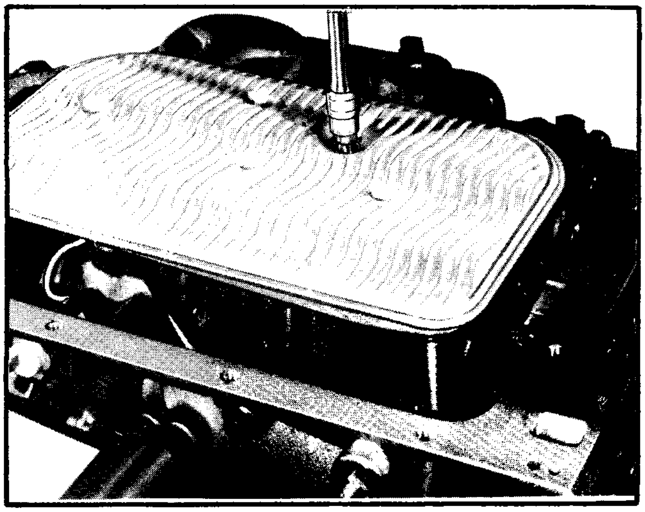


Fig. 7E-46 Removing Detent Roller Spring Assembly

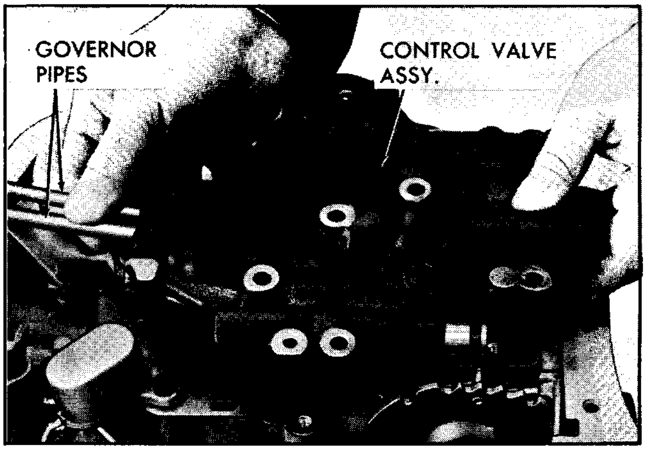


Fig. 7E-47 Removing Control Valve Assembly and Governor Pipes

4. Disconnect solenoid wire and lead wire from connector terminal.

5. Remove governor pipes from control valve assembly.

6. Remove valve body-to-spacer gasket.

REAR SERVO, VALVE BODY SPACER, GASKET AND FRONT SERVO

REMOVE

1. Remove rear servo cover attaching screws, servo cover and gasket. Discard gasket (Fig. 7E-49).

2. Remove rear servo from case (Fig. 7E-50).

3. Remove rear servo accumulator spring.

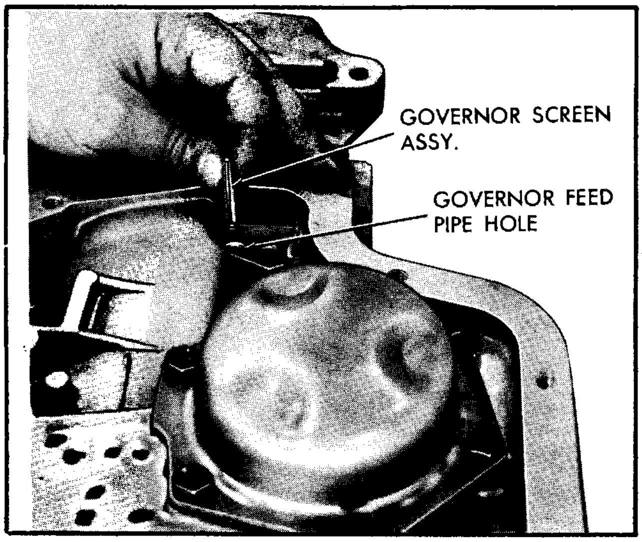


Fig. 7E-48 Removing Governor Screen Assembly

Fig. 7E-53 Removing Electrical Connector and O-Ring Seal

6. Withdraw electrical connector and O-ring seal (Fig. 7E-53).

7. Remove control valve assembly spacer plate and gasket.

8. Remove six (6) check balls from cored passages in transmission case (Fig. 7E-54).

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. 7E-55).

REAR OIL SEAL AND CASE EXTENSION

REMOVE

1. If necessary to replace, pry rear oil seal from case extension (Fig. 7E-56).

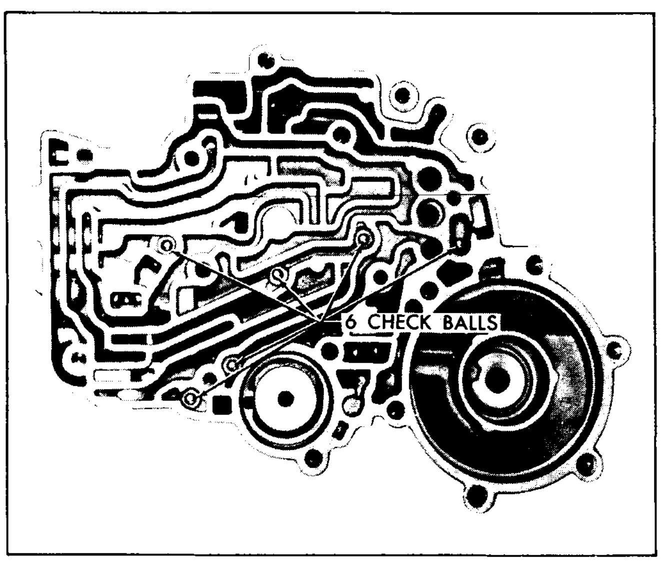


Fig. 7E-54 Location of Check Balls

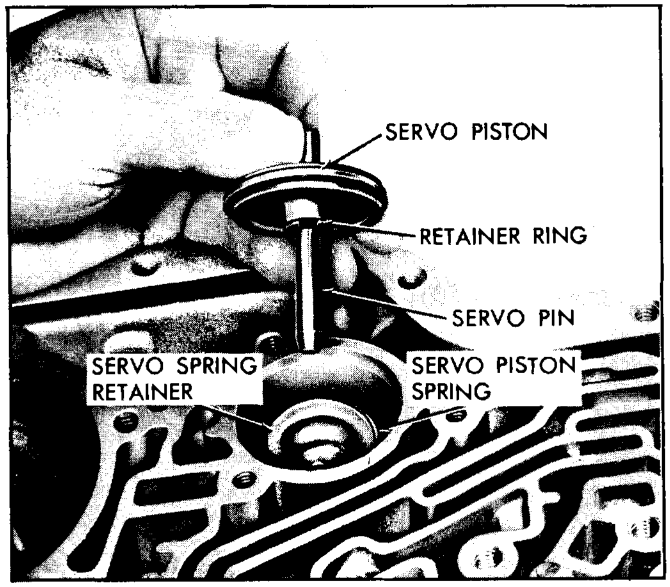


Fig. 7E-55 Removing Front Servo Assembly

2. Remove case extension-to-case attaching bolts.

3. Remove case extension and case extension-to-case gasket (Fig. 7E-57).

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 J 21904-1 into bolt hole (see Fig. 7E-58 for location).

3. Mount Dial Indicator J 8001 on rod and index indicator to register with end of turbine shaft.

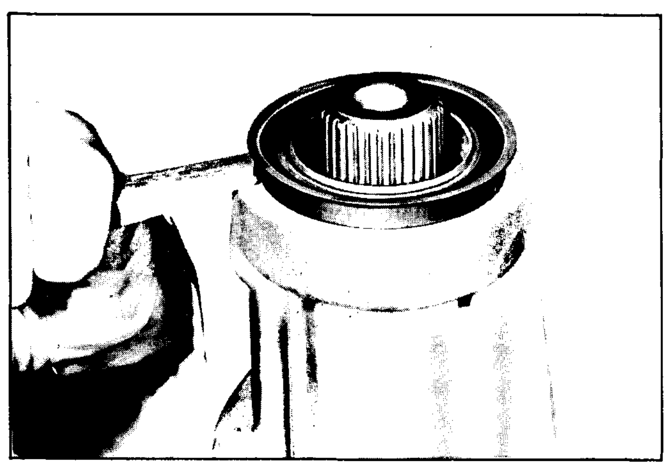


Fig. 7E-56 Removing Rear Oil Seal

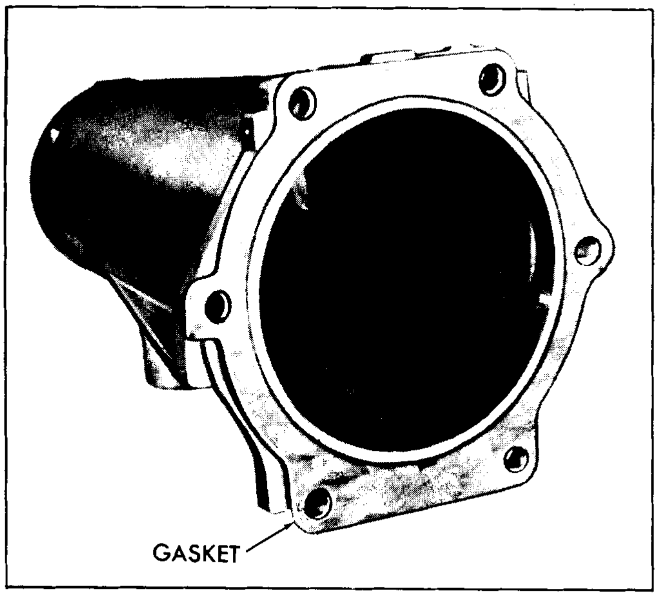


Fig. 7E-57 Case Extension and Gasket

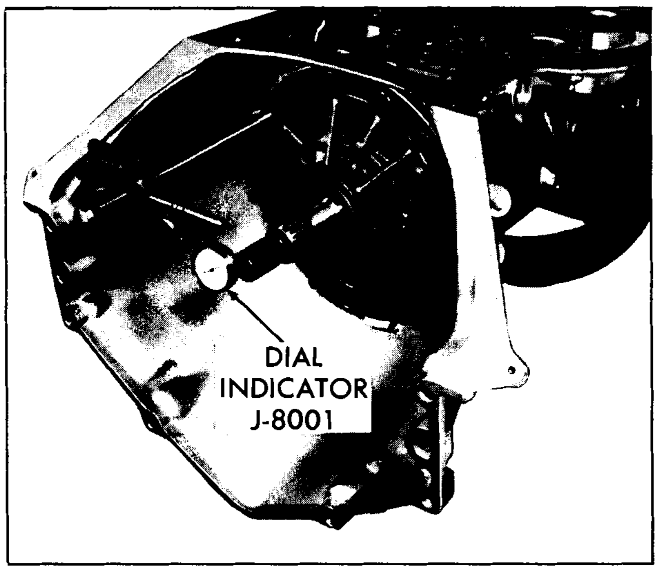


Fig. 7E-58 Checking Front End Play

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

REMOVE

1. If necessary to replace, pry front seal from pump (Fig. 7E-59).
2. Remove pump attaching bolts.
3. Install 3/8"-16 threaded Slide Hammer Adapters J 6125-2 into bolt holes in pump body, attach Slide Hammers J 6125-1 and remove pump assembly from case (See Fig. 7E-60 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. 7E-61).

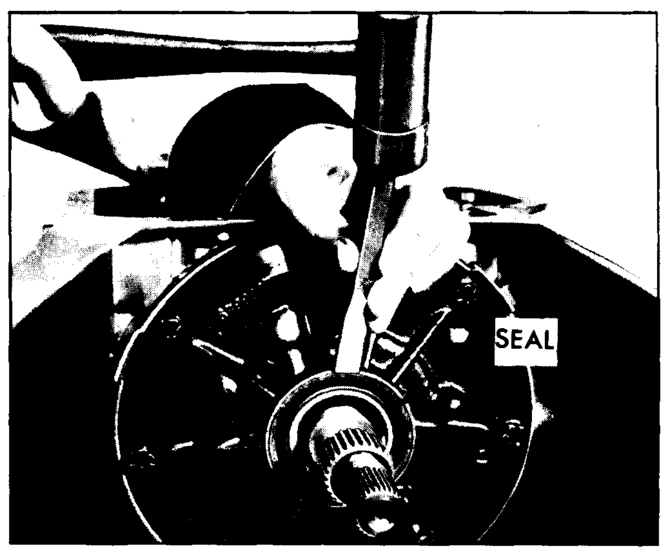


Fig. 7E-59 Removing Front Seal

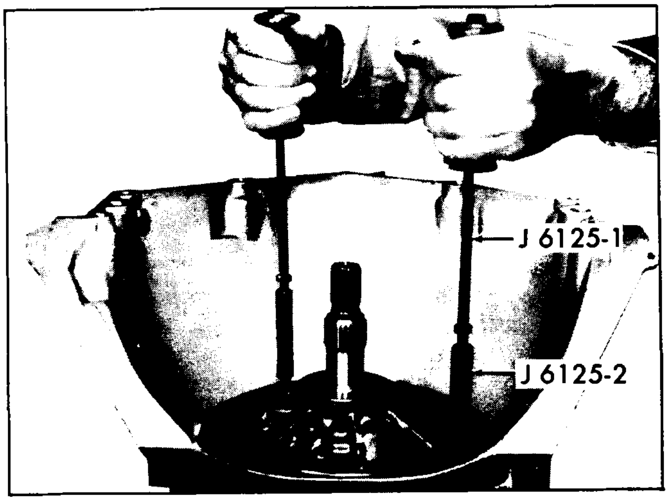


Fig. 7E-60 Removing Pump Assembly

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. 7E-62).

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. 7E-63).

   c. Remove manual shaft and jam nut from case (Fig. 7E-64).

CAUTION: *Do not lose jam nut as it becomes free from manual shaft.*

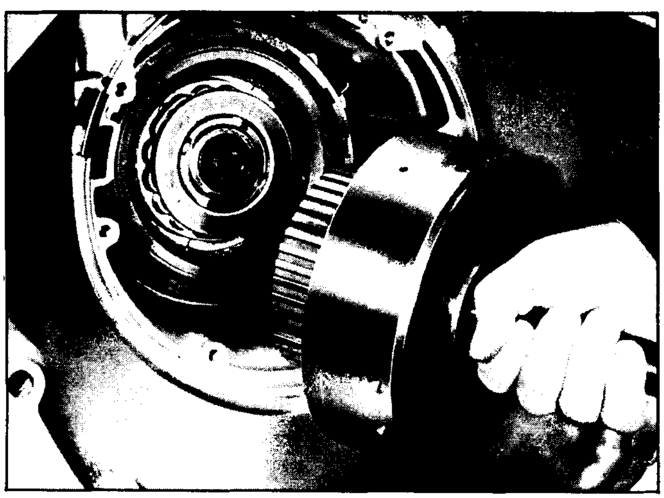


Fig. 7E-61 Removing Turbine Shaft and Forward Clutch Assembly

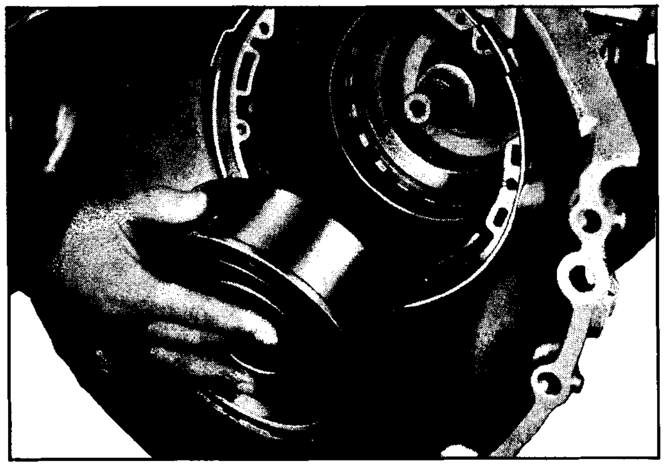


Fig. 7E-62 Removing Direct Clutch Assembly

   d. Remove parking actuator rod and detent lever assembly.

   e. Remove attaching screws and parking bracket (Fig. 7E-65).

   f. Remove parking pawl return spring (Fig. 7E-66).

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. 7E-67).

   h. Remove parking pawl shaft cup plug by inserting a screwdriver between the parking pawl shaft and the transmission case rib (Fig. 7E-68).

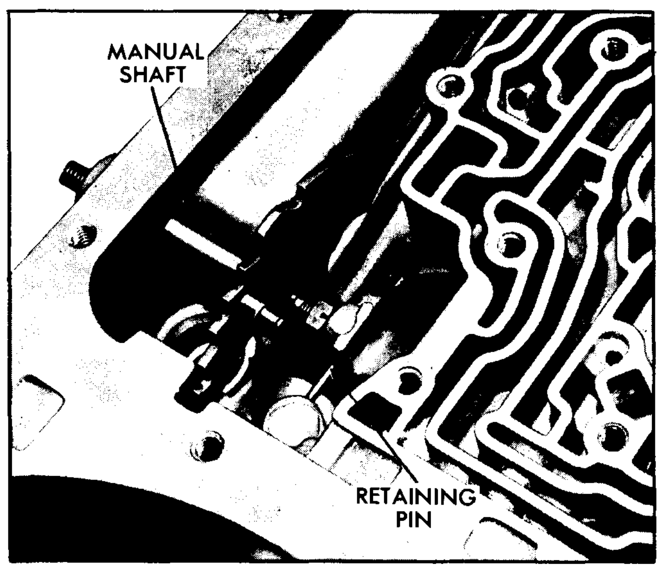


Fig. 7E-63 Location of Manual Shaft Retaining Pin

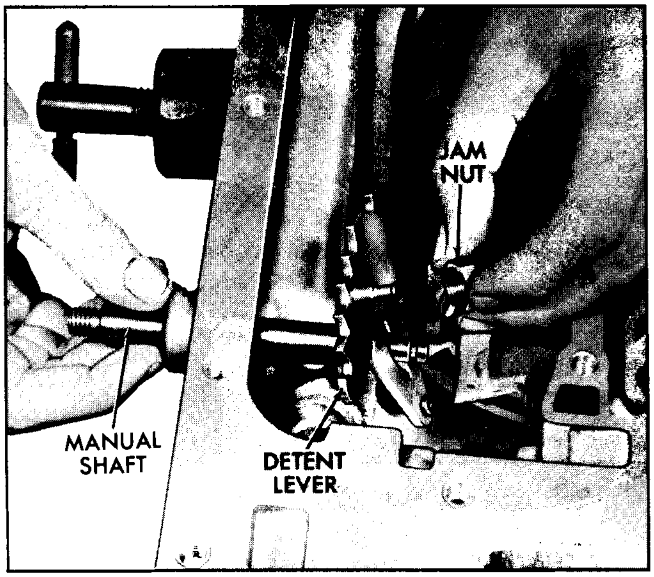


Fig. 7E-64 Removing Jam Nut and Manual Shaft

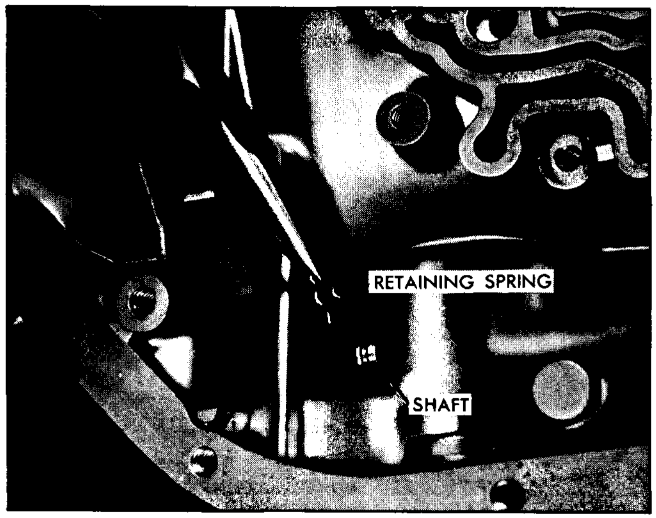


Fig. 7E-67 Removing Retaining Spring from Parking Pawl Shaft

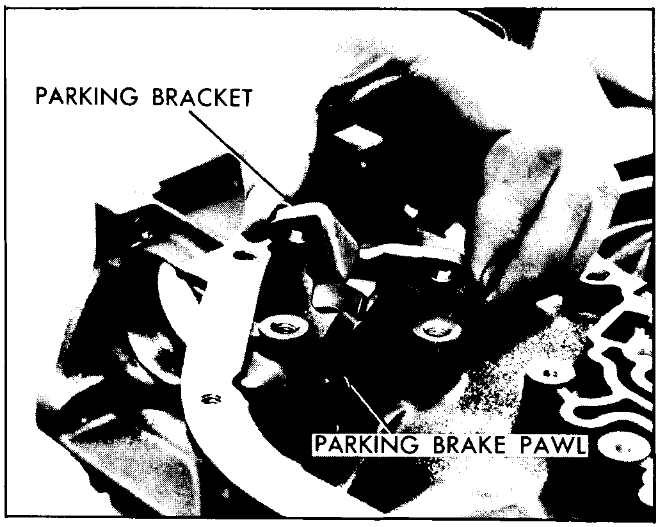


Fig. 7E-65 Removing Parking Bracket

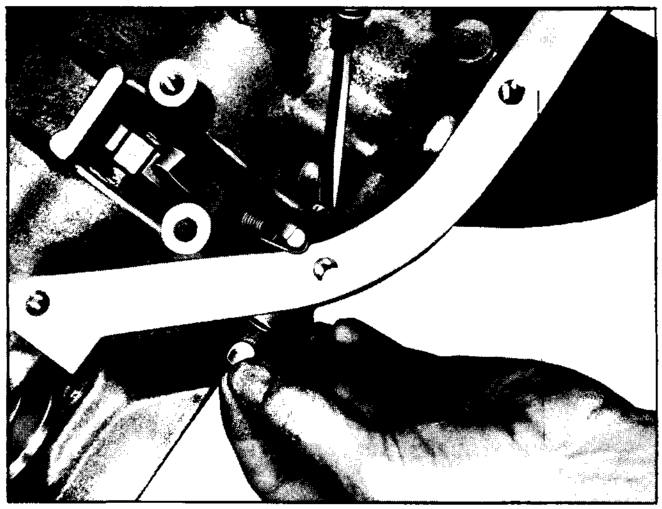


Fig. 7E-68 Removing Cup Plug from Case

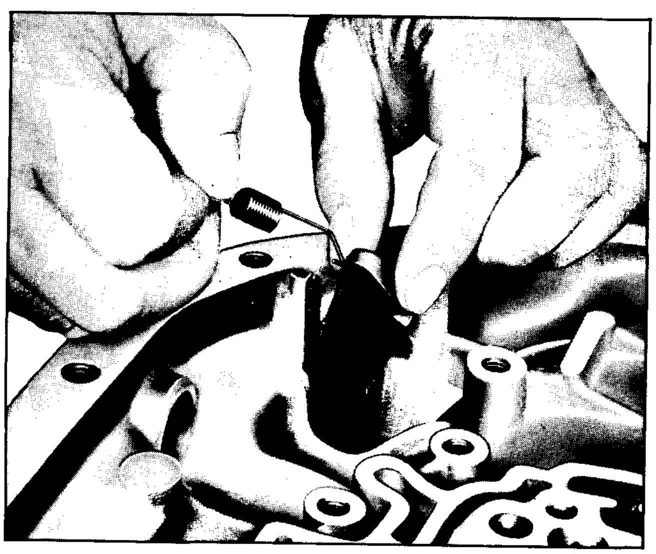


Fig. 7E-66 Removing Parking Pawl Return Spring

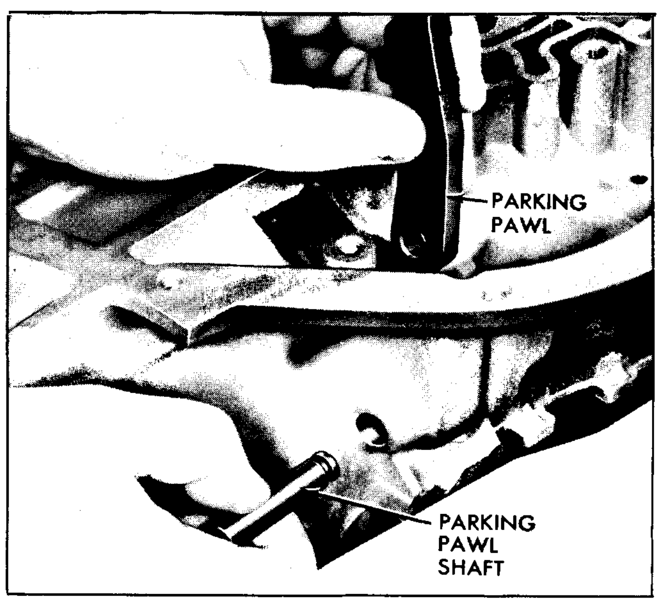


Fig. 7E-69 Removing Parking Pawl and Shaft

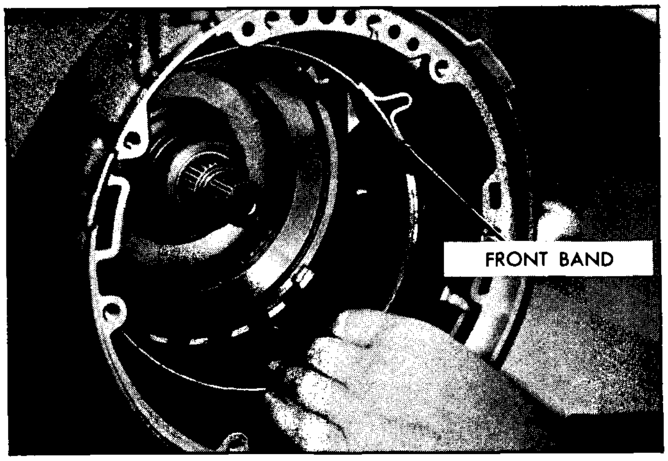


Fig. 7E-70 Removing Front Band

i. Remove parking pawl shaft and parking pawl (Fig. 7E-69).

9. Remove front band (Fig. 7E-70).

10. Remove sun gear shaft (Fig. 7E-71).

11. Check end play as follows:

a. Install J 21904 into an extension housing attaching bolt hole.

b. Mount Dial Indicator J 8001 on rod and index with end of output shaft (Fig. 7E-72).

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.

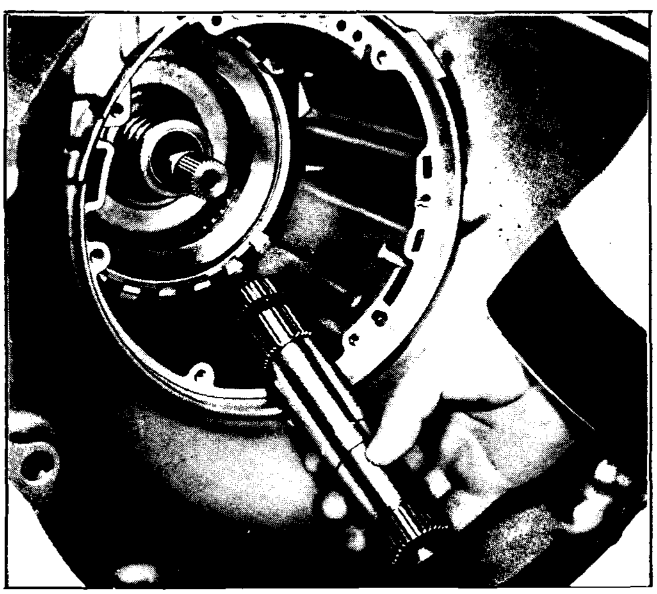


Fig. 7E-71 Removing Sun Gear Shaft

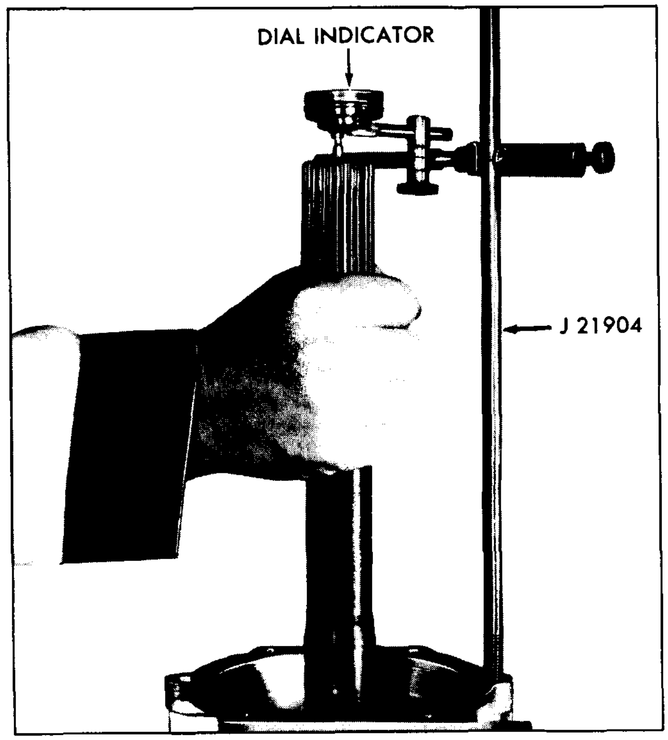


Fig. 7E-72 Checking Rear End Play

d. If a different washer thickness is required to bring end play within specification, it can be selected from the following chart:

THICKNESS IN INCHES	NOTCHES	AND/OR NUMERAL
.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. 7E-73).

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. 7E-74).

15. Remove center support-to-case retaining snap ring (Fig. 7E-75).

16. Remove entire gear unit assembly by lifting with Gear Assembly Installing and Removing Tool J 21765 with J 6125-1 Slide Hammer (Fig. 7E-76).

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 Fixtures J 6116 and J 21364.

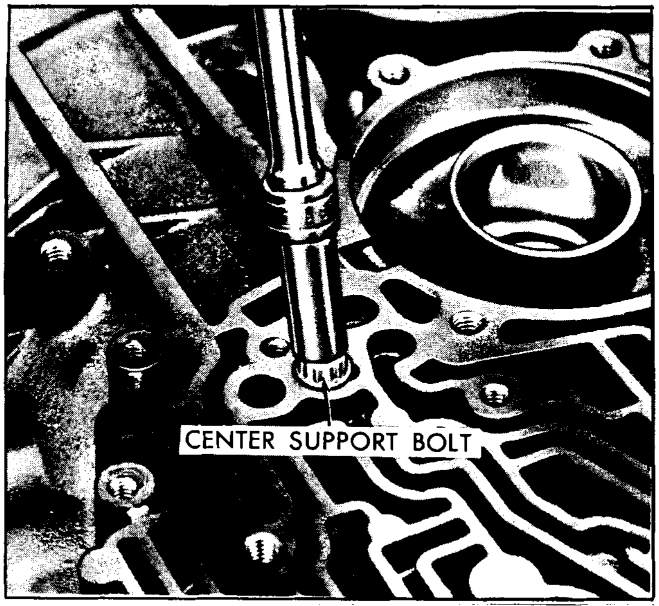


Fig. 7E-73 Removing Center Support Bolt

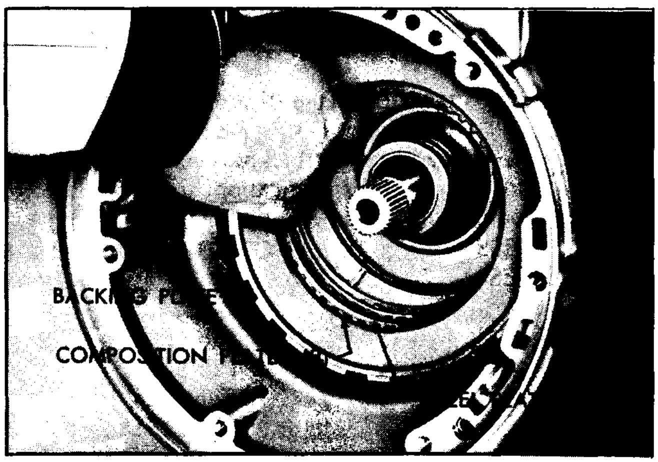


Fig. 7E-74 Removing Intermediate Clutch Pack

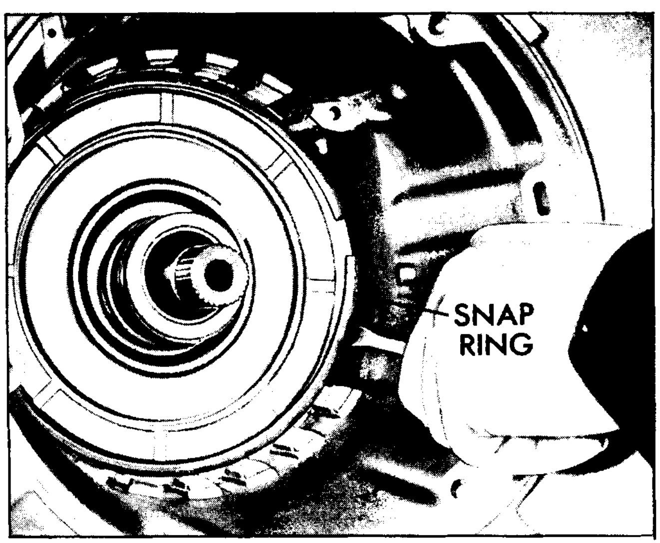


Fig. 7E-75 Removing Support-to-Case Snap Ring

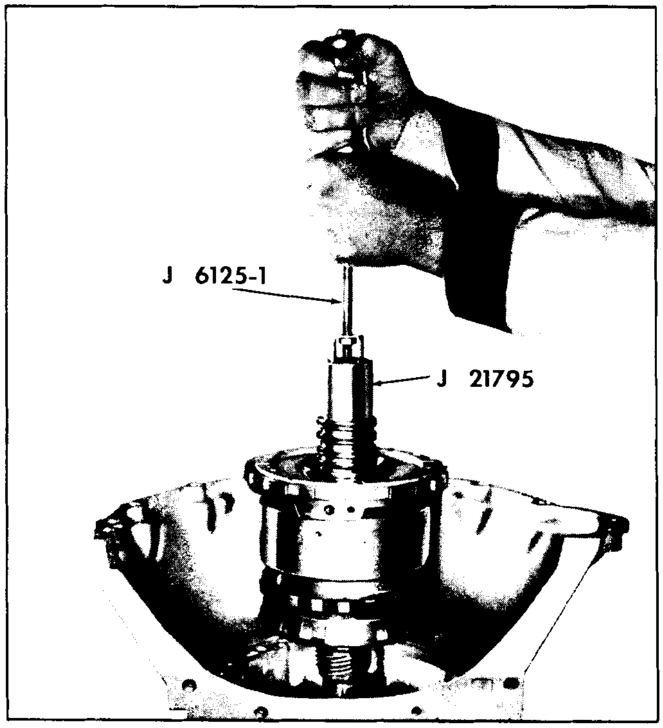


Fig. 7E-76 Removing Entire Gear Unit Assembly

19. Remove rear unit selective washer from transmission case (Fig. 7E-77).
20. Remove support-to-case spacer from inside of case (Fig. 7E-78).
21. Remove rear band assembly (Fig. 7E-79).

GEAR UNIT

DISASSEMBLE

1. Remove center support assembly (Fig. 7E-80).

Fig. 7E-77 Location of Rear Unit Selective Washer

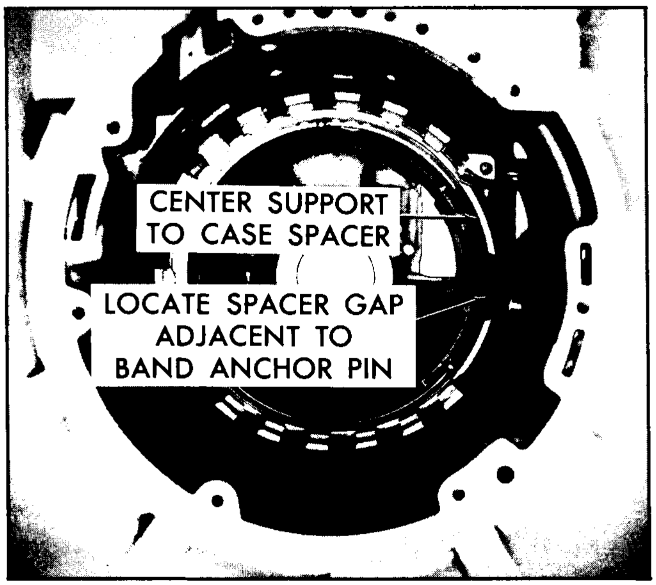


Fig. 7E-78 Location of Support-to-Case Spacer

2. Remove center support-to-reaction carrier thrust washer (Fig. 7E-81).

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. 7E-82).

5. Remove front internal (plastic) gear ring from output carrier assembly.

6. Remove sun gear (Fig. 7E-83).

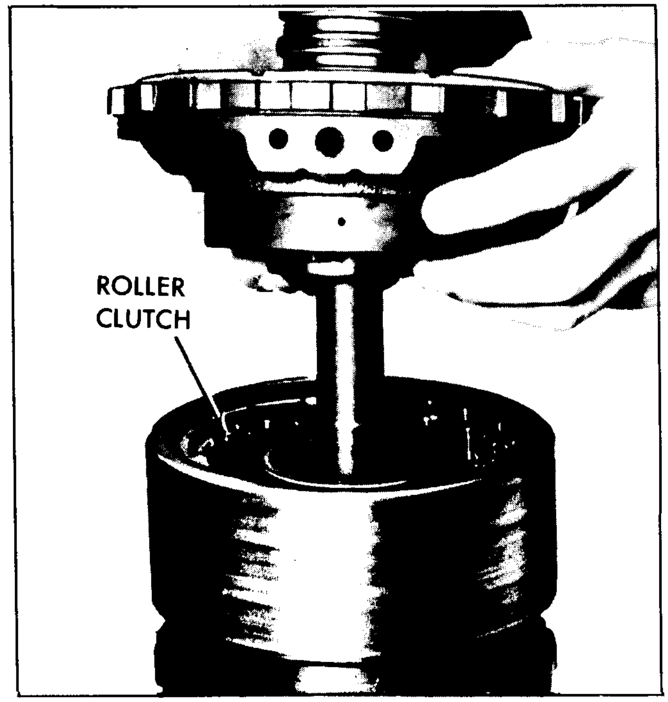


Fig. 7E-80 Removing Center Support Assembly

7. Remove reaction carrier-to-output carrier thrust washer.

8. Turn carrier assembly over.

9. Remove output shaft-to-output carrier snap ring (Fig. 7E-84).

10. Remove output shaft.

11. If removal and installation or replacement of the speedometer drive gear is necessary, proceed as follows:

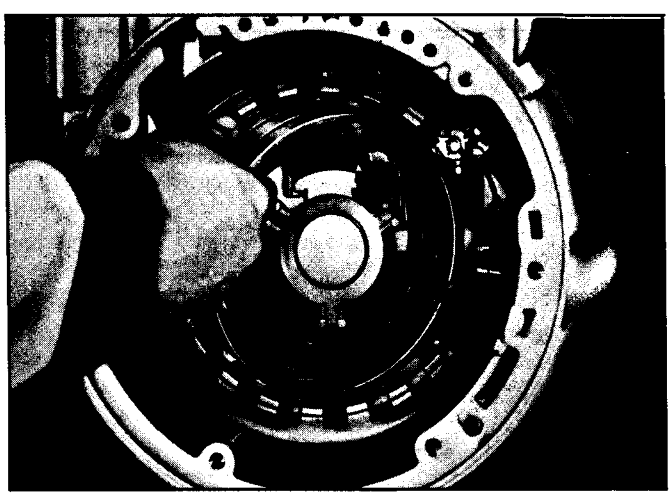


Fig. 7E-79 Removing Rear Band

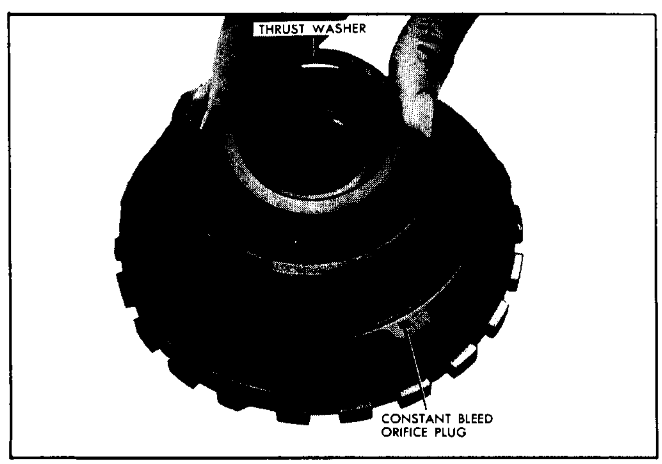


Fig. 7E-81 Removing Center Support Thrust Washer

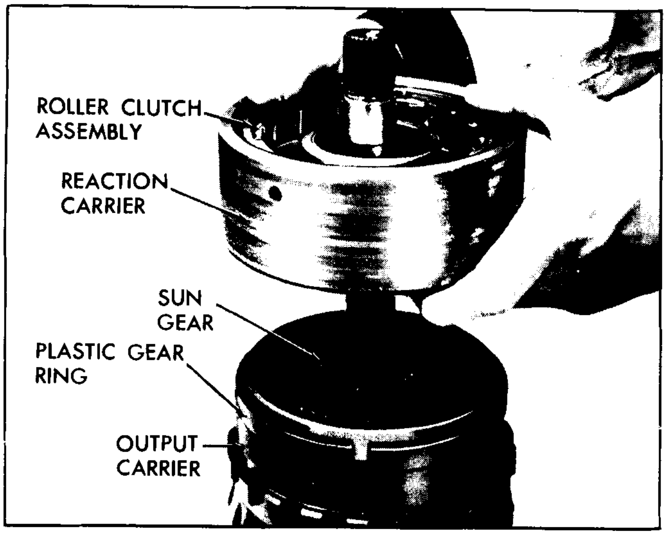


Fig. 7E-82 Removing Reaction Carrier Assembly

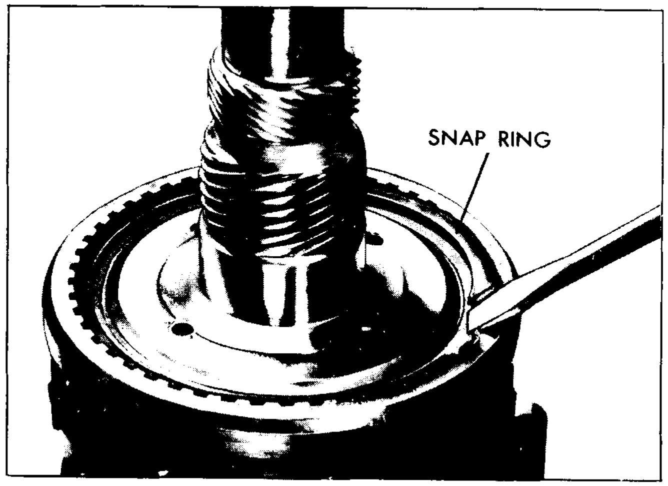


Fig. 7E-84 Disengaging Snap Ring from Output Carrier

TRANSMISSIONS WITH NYLON SPEEDOMETER DRIVE GEAR

a. Depress retaining clip and slide gear off the output shaft (Fig. 7E-85).

b. To install, place retaining clip (square end toward flange of shaft) into hole in output shaft (Fig. 7E-86). 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*

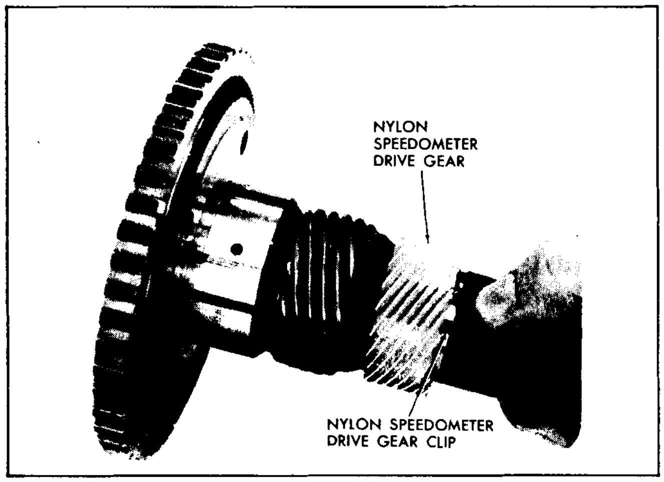


Fig. 7E-85 Removing Retaining Clip

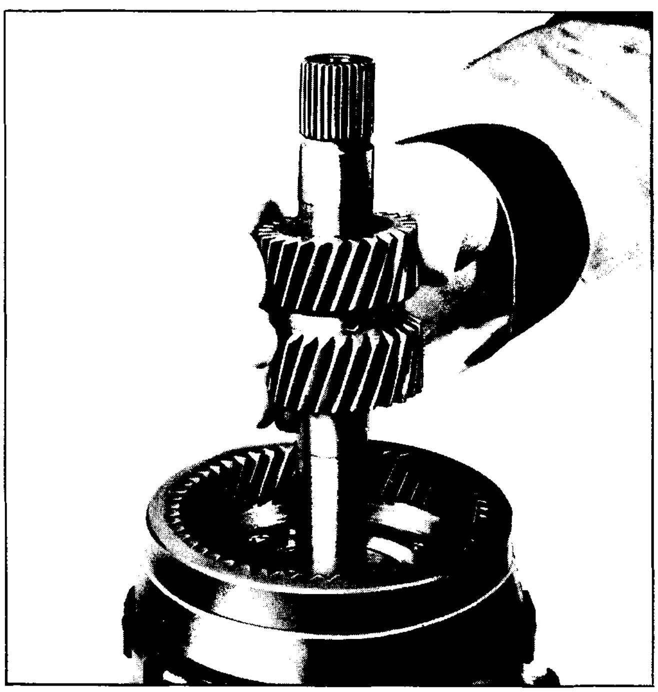


Fig. 7E-83 Removing Sun Gear

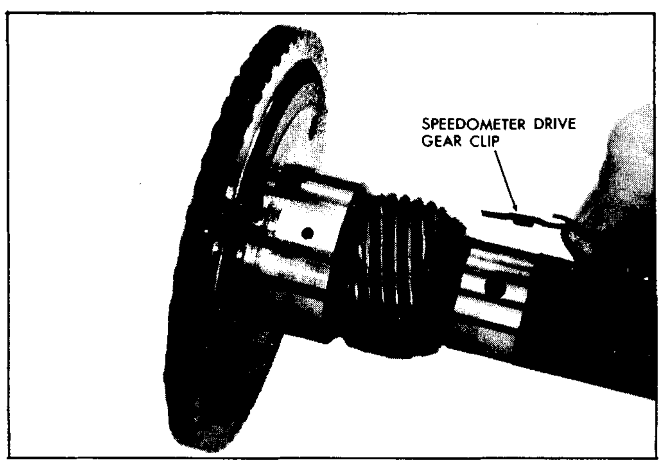


Fig. 7E-86 Installing Retaining Clip

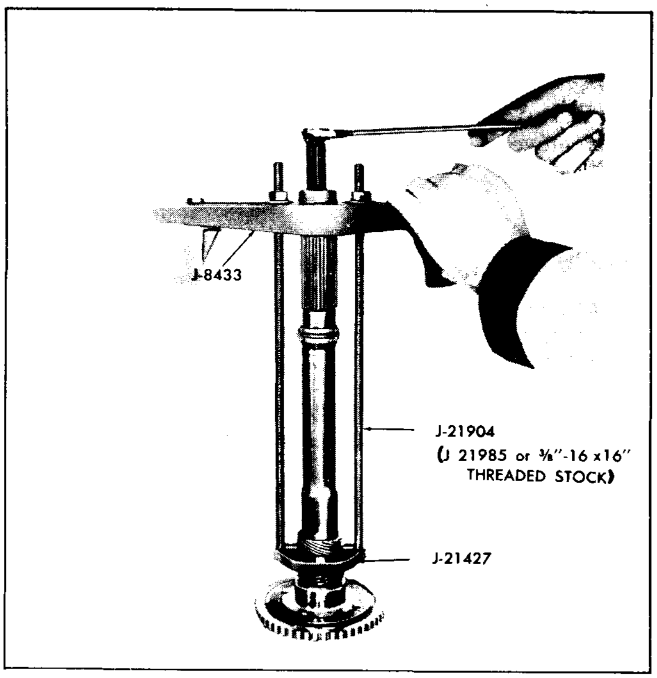


Fig. 7E-87 Removing Steel Speedometer Drive Gear

replacing the nylon speedometer drive gear with a steel gear, discard the retaining clip and proceed as indicated in step "d" below.

TRANSMISSIONS WITH STEEL SPEEDOMETER DRIVE GEAR

c. Installing Speedo Gear Removing Tools J 21427 and J 8433 and Bolts J 21904 on the output shaft, remove the speedometer drive gear (Fig. 7E-87).

d. Install a new **steel** speedometer drive gear and drive to location approximately 11 15/32" from end of output shaft to rear face of gear for models PA, PB, PC, PG and PH, to location 11 15/64" from end of output shaft to rear face of gear for model PD and to location 5 21/32" from end of output shaft to rear face of gear for models PQ, PR, PT and PX, using Spacer J 21028 (cup side up) and Installer J 6133 (Fig. 7E-88).

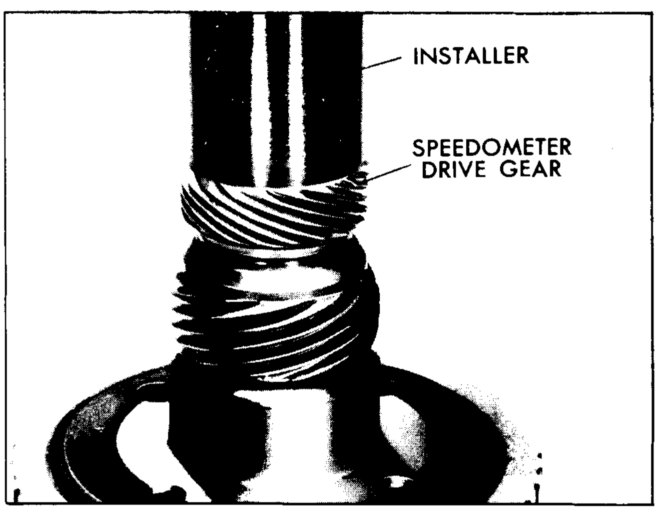


Fig. 7E-88 Installing Steel Speedometer Drive Gear

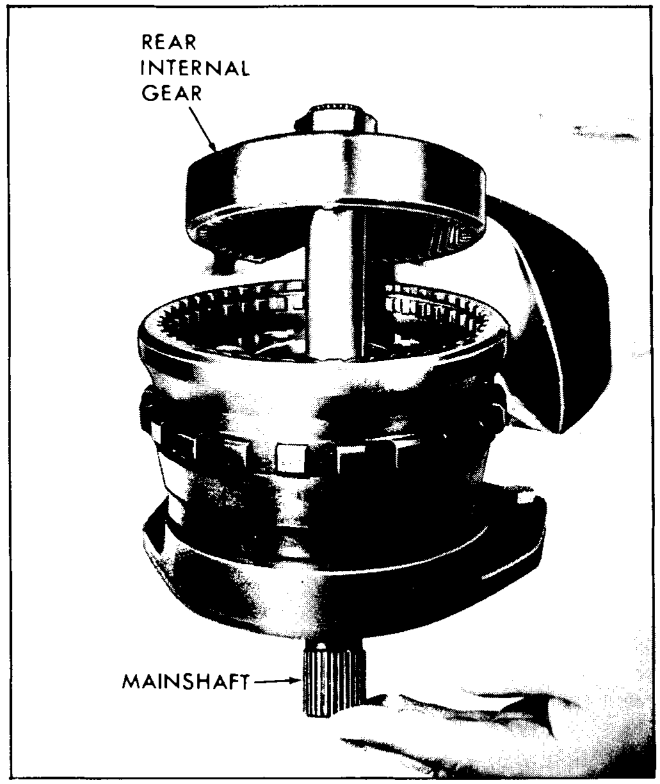


Fig. 7E-89 Removing Rear Internal Gear - Mainshaft

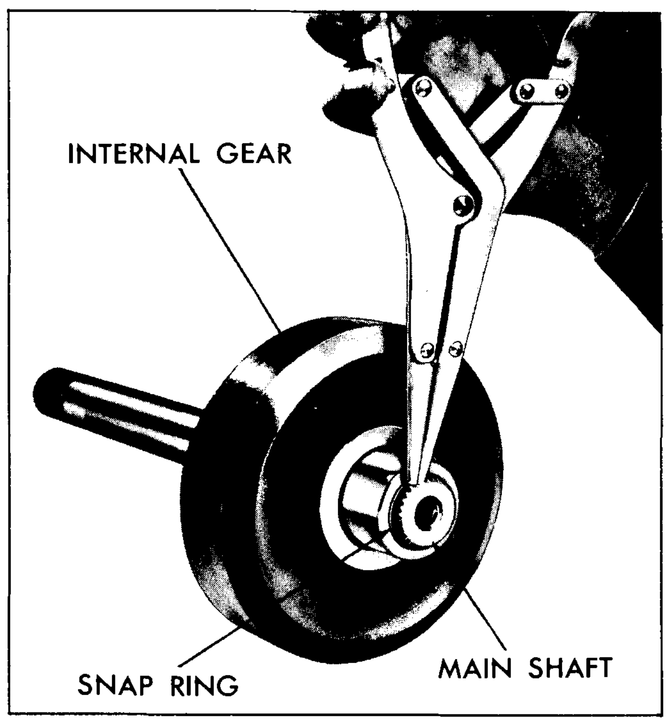


Fig. 7E-90 Removing Mainshaft Snap Ring

12. Remove output shaft-to-rear internal gear thrust bearing and two (2) races.

13. Remove rear internal gear and mainshaft (Fig. 7E-89).

NOTE: *Do not drop bearings.*

14. Remove rear internal gear-to-sun gear thrust bearing and two (2) races.

15. Remove rear internal gear-to-mainshaft snap ring to remove mainshaft (Fig. 7E-90).

OVERHAUL OF MAJOR UNITS

GOVERNOR ASSEMBLY

OVERHAUL

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

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. 7E-91).
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

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.

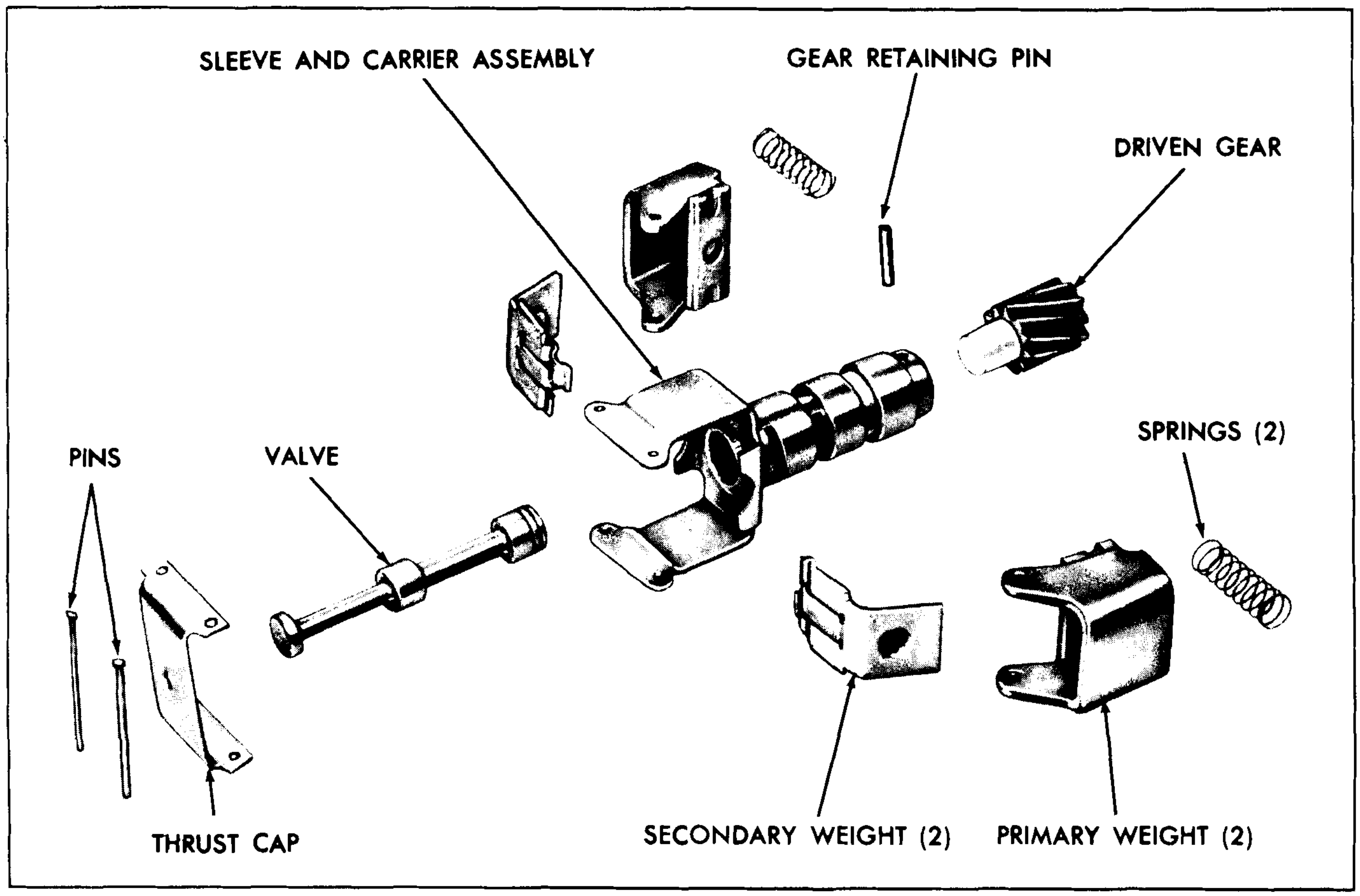


Fig. 7E-91 Exploded View of Governor

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.

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. 7E-92).

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.

GOVERNOR - ASSEMBLE

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 gauge as shown with governor weights extended completely **outward** (Fig. 7E-93).

   b. Check valve opening at exhaust port with a feeler

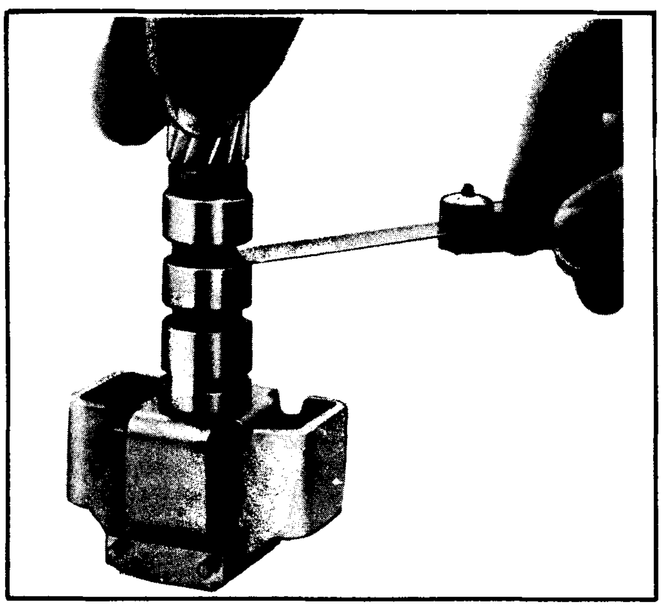


Fig. 7E-92 Checking Feed Port

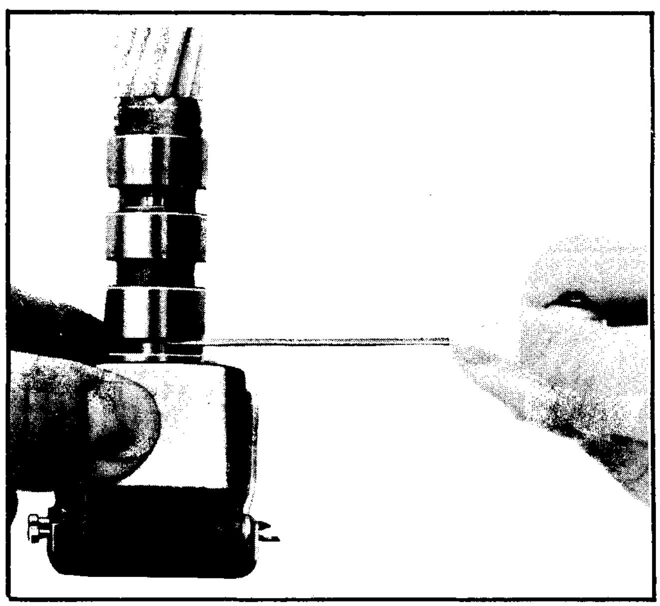


Fig. 7E-93 Checking Exhaust Port

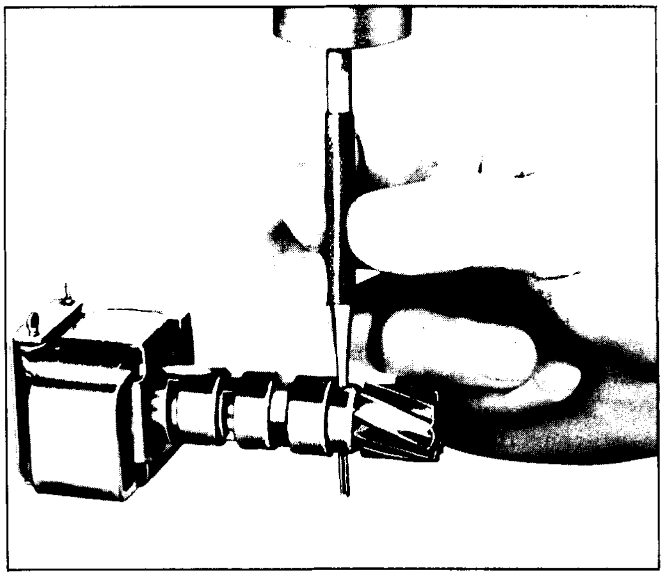


Fig. 7E-94 Driving Pin From Governor

gauge as shown by holding the governor weights completely **inward** (Fig. 7E-94).

c. If less than .020" minimum opening is found, governor assembly **must** be replaced.

FRONT SERVO

INSPECT (Fig. 7E-95)

1. Inspect servo pin for damage.
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. 7E-96).
2. Remove E-ring, retaining rear servo piston to band apply pin (Fig. 7E-97).

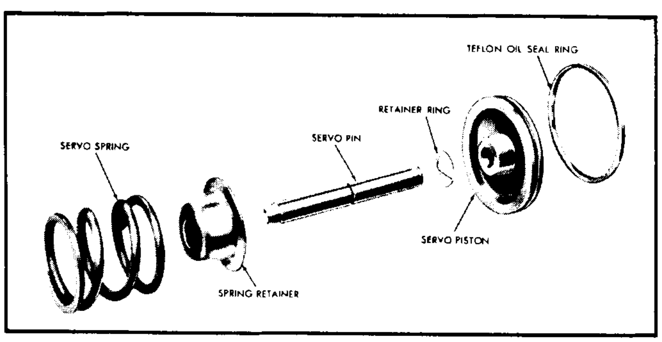


Fig. 7E-95 Exploded View of Front Servo

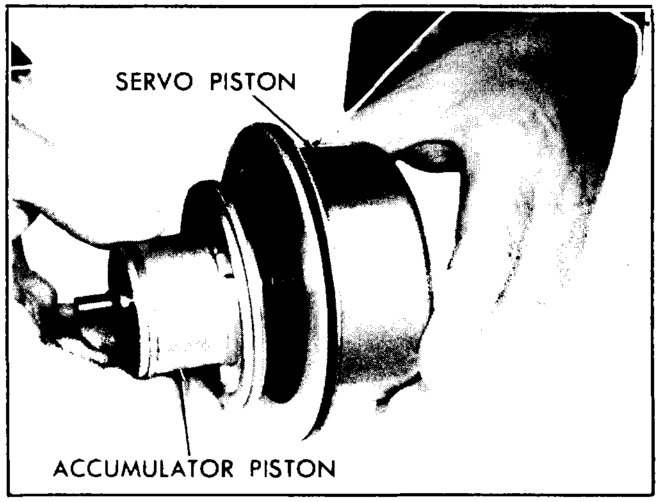


Fig. 7E-96 Removing Accumulator Piston From Rear Servo Piston

3. Remove rear servo piston and seal from band apply (servo) pin (Fig. 7E-98).
4. Remove washer, spring and retainer.

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. 7E-98. Do* **not** *remove the teflon oil seal rings from the accummulator piston unless the oil seal rings require replacement.*

If the teflon inner (small diameter) oil seal ring re-

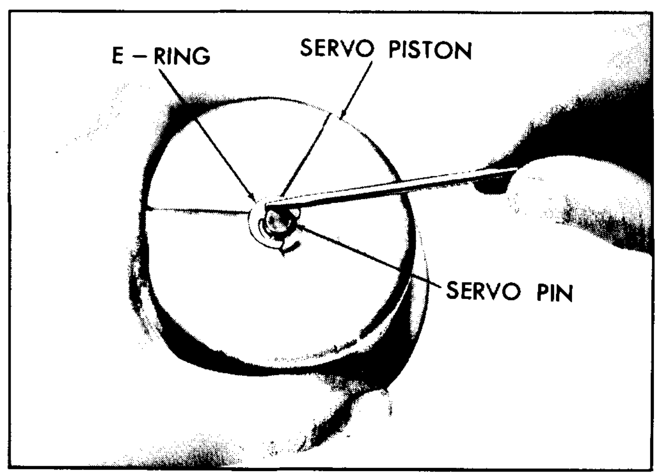


Fig. 7E-97 Removing E-Ring From Servo Pin

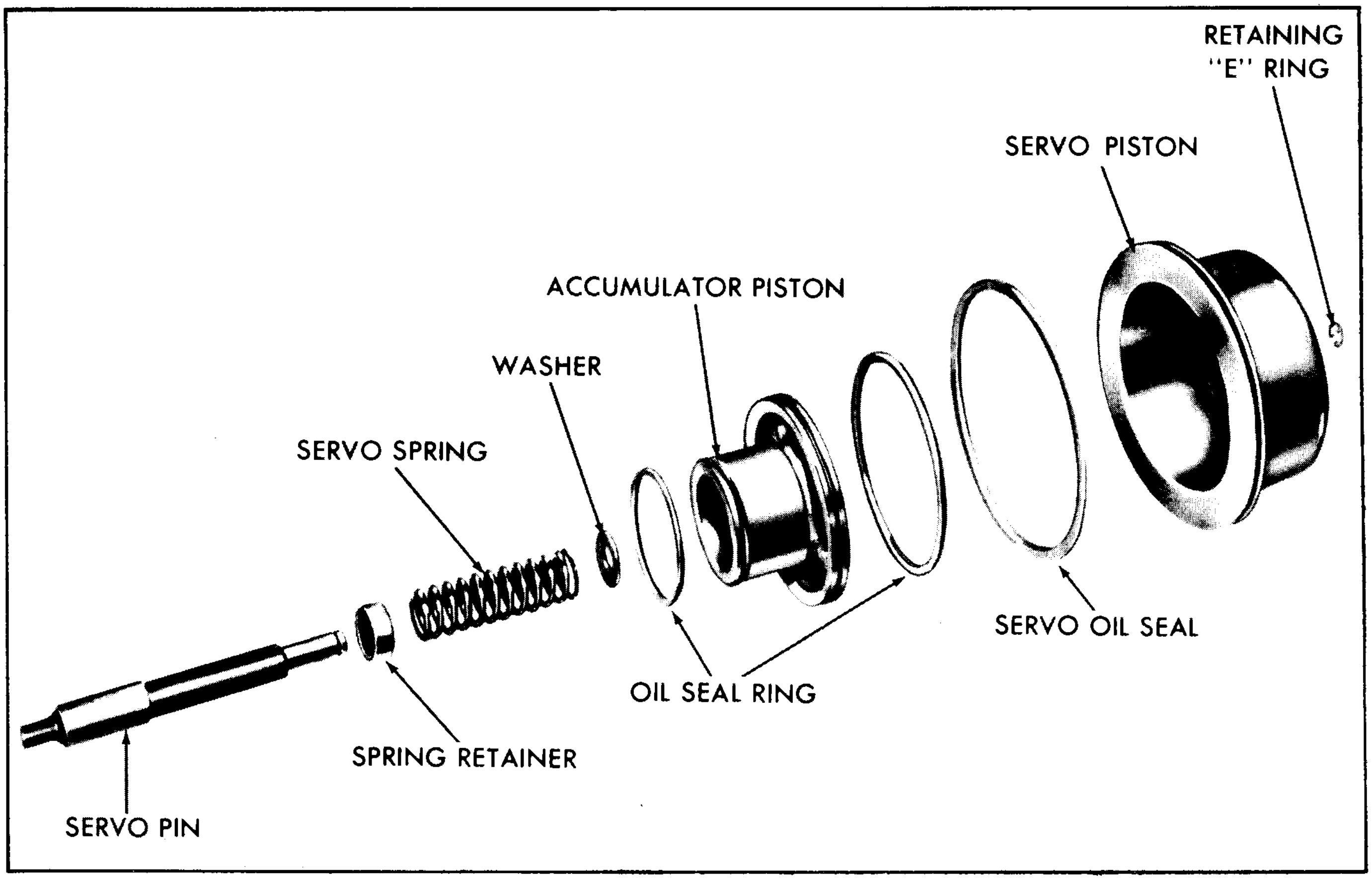


Fig. 7E-98 Exploded View of Rear Servo

quires replacement, use the aluminum oil seal ring, Group No. 4.242, Part No. 8623671.

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.*

ASSEMBLE

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 assembly 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 Special Tool J 21885 on accumulator piston valve and remove retaining ring (Fig. 7E-99).

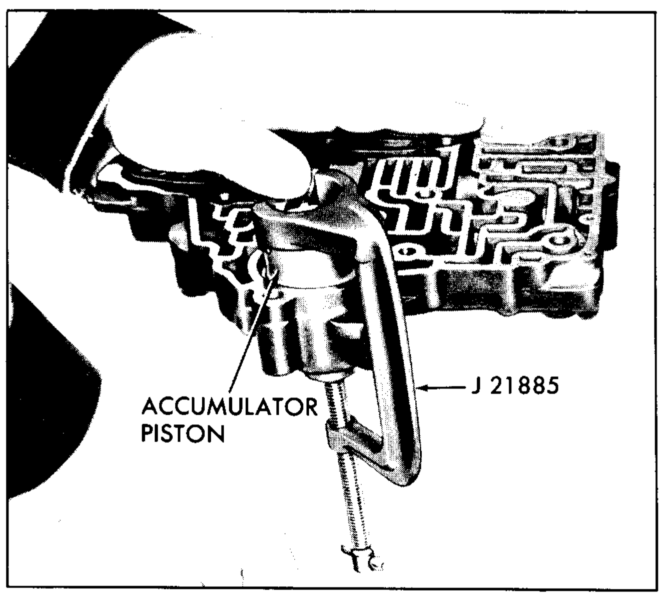


Fig. 7E-99 Compressing Accumulator Piston and Spring

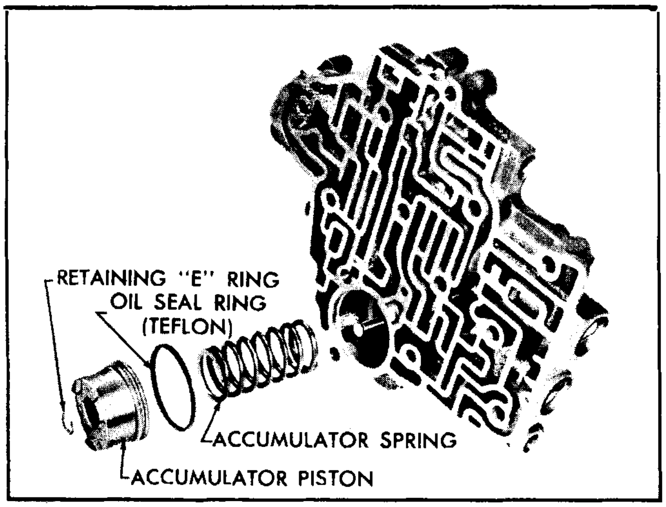


Fig. 7E-100 Exploded View of Front Accumulator Piston

4. Remove front accumulator piston and spring (Fig. 7E-100).

5. From the top right hand bore, remove roll pin, 1-2 modulator bushing, 1-2 regulator valve, 1-2 regulator spring, 1-2 detent valve and 1-2 shift valve (Fig. 7E-101).

6. From next bore down, remove roll pin, 2-3 primary spring, modulator valve bushing, 2-3 modulator valve, 2-3 secondary spring and 2-3 shift valve.

7. From next bore down, remove roll pin, bore plug, spring, spacer and 3-2 valve.

8. At other end of assembly, top bore, remove roll pin and bore plug, detent valve, detent regulator valve, spring and spacer.

9. Remove the grooved retaining pin from the next bore down, the bore plug, 1-2 accumulator secondary spring, 1-2 accumulator valve, 1-2 accumulator bushing, 1-2 accumulator primary valve and the 1-2 accumulator primary spring (bushing, primary valve and primary spring are not used in PG or PR models).

INSPECT

NOTE: *See Fig. 7E-100. 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.*

CAUTION: *The front accumulator piston was new for 1971 and it is* **not** *interchangeable with previous model pistons.*

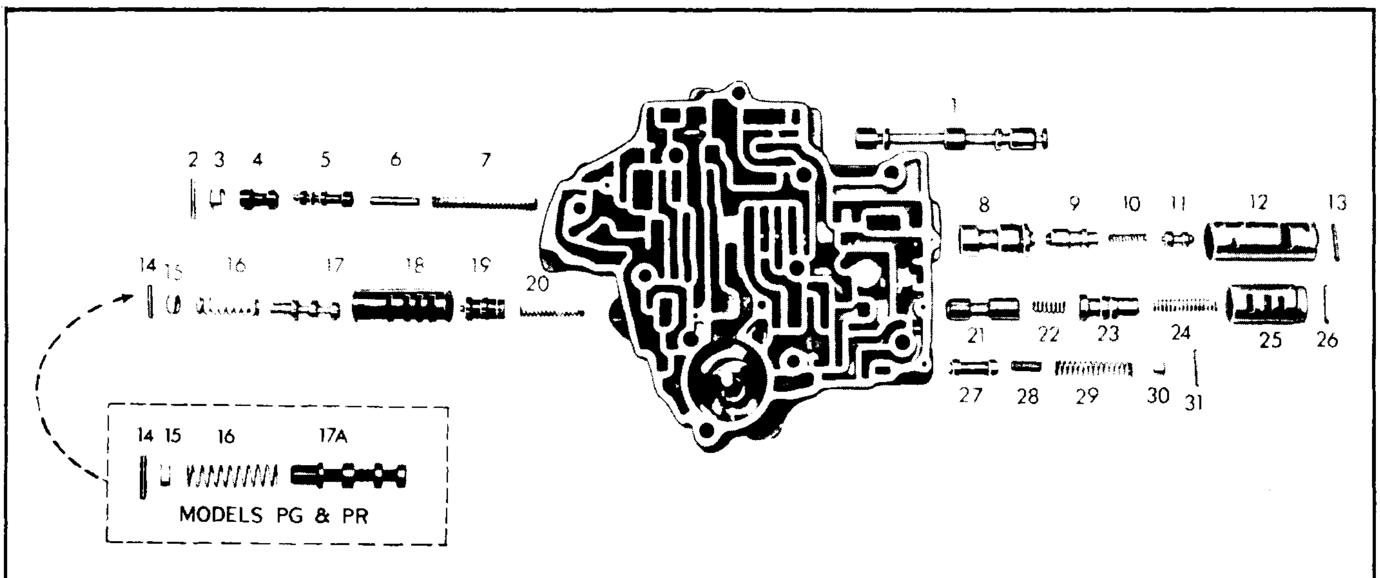


Fig. 7E-101 Exploded View of Control Valve Assembly

1. Manual Valve
2. Roll Pin
3. Bore Plug
4. Detent Valve
5. Detent Regulator Valve
6. Spacer
7. Detent Regulator Valve Spring
8. 1-2 Shift Valve
9. 1-2 Detent Valve
10. 1-2 Regulator Spring
11. 1-2 Regulator Valve
12. 1-2 Modulator Bushing
13. Roll Pin
14. Grooved Retaining Pin
15. Bore Plug
16. 1-2 Accumulator Secondary Spring (Not Used in PQ Model)
17. 1-2 Accumulator Valve
17a. 1-2 Accumulator Valve
18. 1-2 Accumulator Bushing (Not Used in PG and PR Models)
19. 1-2 Accumulator Primary Valve (Not Used in PG and PR Models)
20. 1-2 Accumulator Primary Spring (Not Used in PG and PR Models)
21. 2-3 Shift Valve
22. 2-3 Secondary Spring
23. 2-3 Modulator Valve
24. 2-3 Primary Spring
25. Modulator Valve Bushing
26. Roll Pin
27. 3-2 Valve
28. Spacer
29. 3-2 Valve Spring
30. Bore Plug
31. Roll Pin

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

1. Install front accumulator spring and piston into valve body.
2. Install special tool J 21885, compress spring and piston and secure with retaining E-ring (Fig. 7E-99).
3. Install 1-2 accumulator primary spring in lower left bore (not used in PG or PR models).
4. Install 1-2 accumulator primary valve, using a retaining pin as a temporary retainer to hold the spring and its valve in their operating position (not used in PG or PR models).
5. Install the 1-2 accumulator bushing and 1-2 accumulator valve, stem end out, into the bore (bushing not used in PG or PR models).
6. Install 1-2 accumulator secondary spring and bore plug. Compress plug and install 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. Remove temporary retainer.
7. In next bore up, install detent spring and spacer. Compress spring and secure with small screwdriver (Fig. 7E-102).

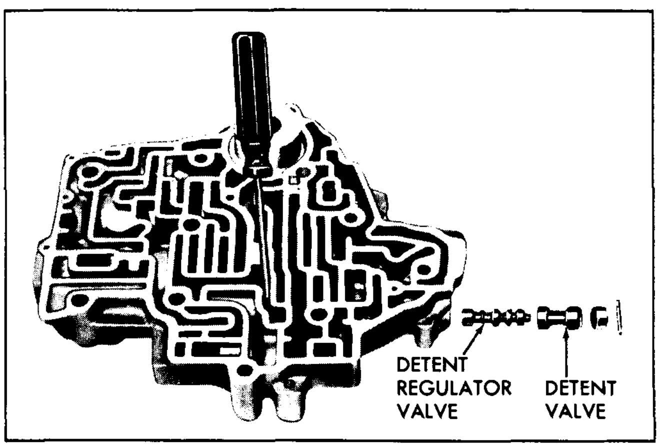


Fig. 7E-102 Installing Detent Regulator Valve and Detent Valve

8. Install detent regulator valve, wide land first.
9. Install detent valve, narrow land first.
10. Install bore plug (hole out), depress spring by pressing in on plug and install roll pin. Remove screwdriver.
11. In lower right hand bore, install 3-2 valve.
12. Install 3-2 valve spring, spacer, bore plug (hole out) and roll pin.
13. In next bore up, install 2-3 shift valve, open end out and install 2-3 secondary spring into its open end.
14. Install 2-3 modulator valve into its bushing and install both parts into valve body bore.
15. Install 2-3 primary spring and roll pin.
16. In next bore up, install 1-2 valve, stem end out.
17. 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.
18. Compress bushing against spring and install roll pin.
19. Install manual valve with detent pin groove to the right.

OIL PUMP

DISASSEMBLE

1. Place oil pump assembly in hole in bench or Holding Fixture J 6116 and J 21364 Adapter.

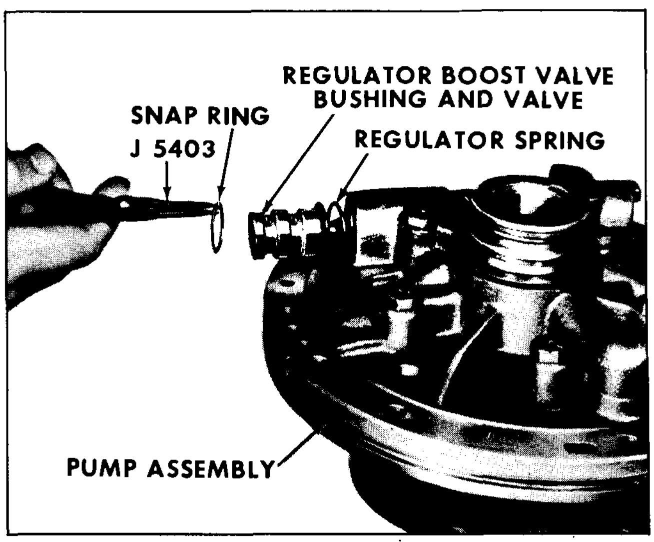


Fig. 7E-103 Removing Snap Ring From Boost Valve Bushing

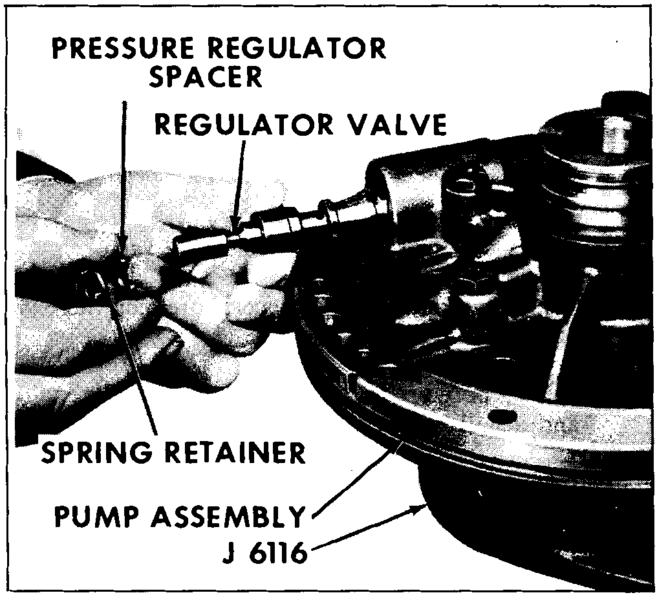


Fig. 7E-104 Removing Pressure Regulator Valve

2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using snap ring pliers (Fig. 7E-103).

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. 7E-104).

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. 7E-105).

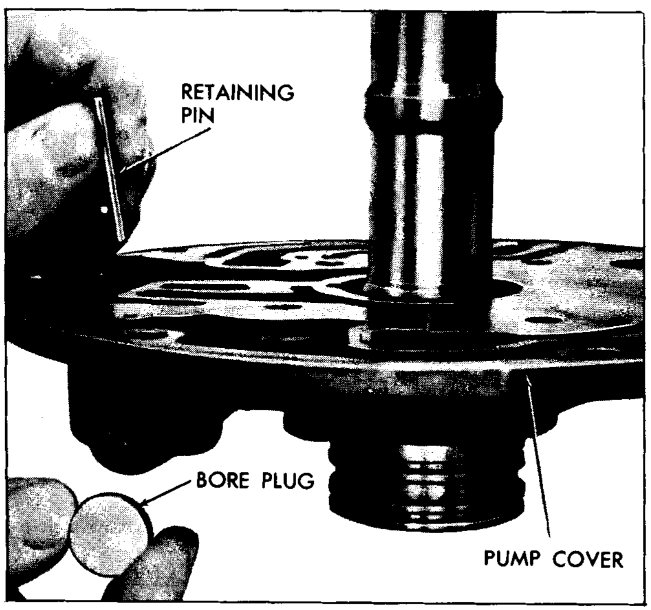


Fig. 7E-105 Removing Retaining Pin and Bore Plug

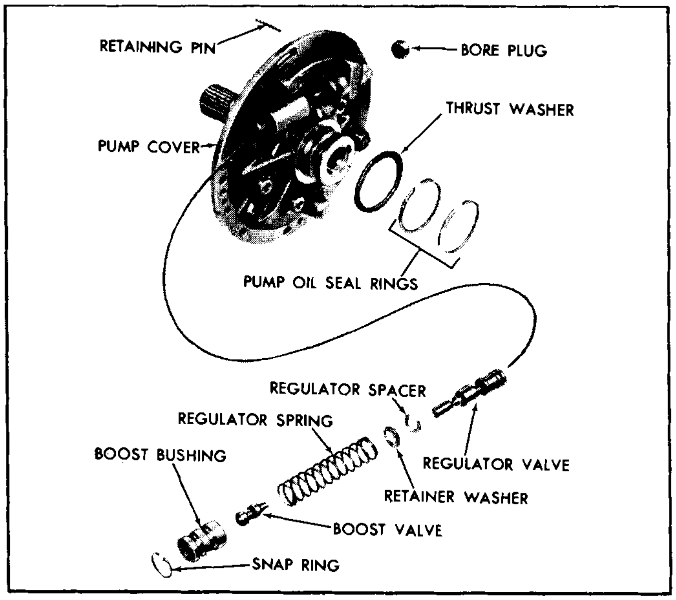


Fig. 7E-106 Exploded View of Pump Cover

8. Remove hook-type oil seal rings from pump cover (Fig. 7E-106).

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. 7E-107).

INSPECT

NOTE: *The 1972 solid-type pressure regulator valve does not contain oil holes and an orifice cup plug like previous valves. The solid- type valve must* **only** *be used in the pump cover with the squared-off pressure regulator boss (Fig. 7E-108). The previous pressure regulator valve*

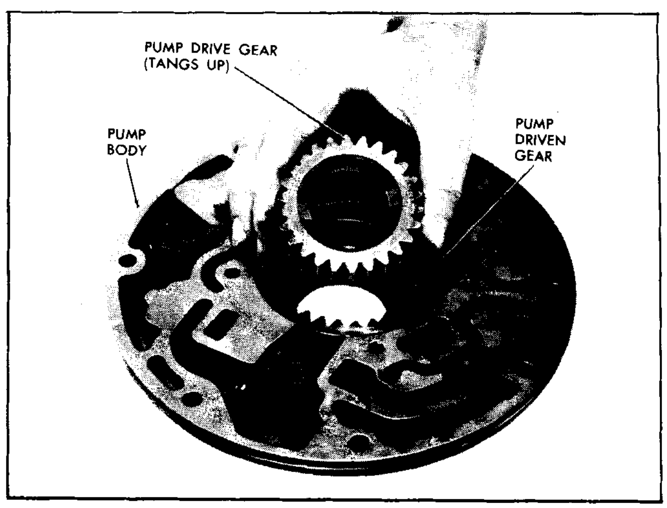


Fig. 7E-107 Removing or Installing Pump Gears

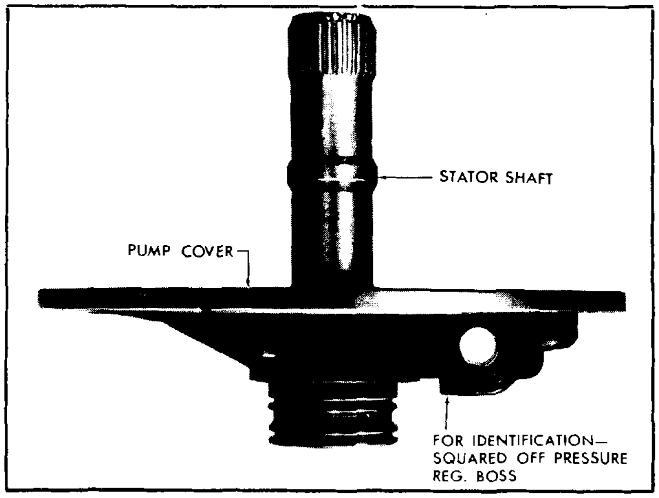


Fig. 7E-108 Pump Cover with Squared-Off Boss

with the oil holes and orifice cup plug will 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. 7E-109).
3. Check face of pump body for scores or nicks.
4. Check oil passages in pump body (Fig. 7E-110).
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:
   a. Using Tool J 21465-17 with Driver Handle J 8092, remove bushing.

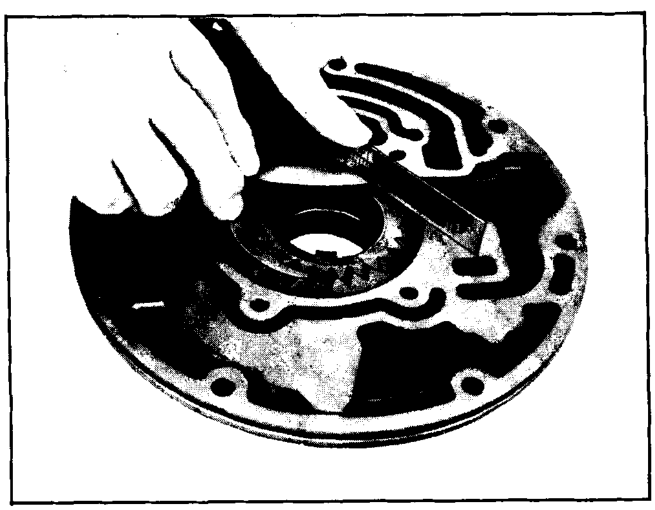


Fig. 7E-109 Checking Body Face-To-Gear Face Clearance

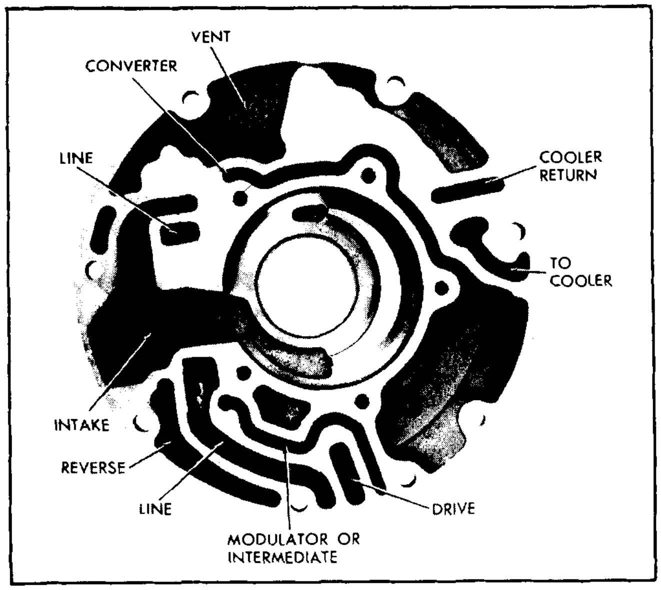


Fig. 7E-110 Pump Body Oil Passages

   b. From gear pocket side of pump and using J 21465-17 with Driver 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 inter-connected in pump cover (Fig. 7E-111).
12. Check for scoring and damage at pump gear face.

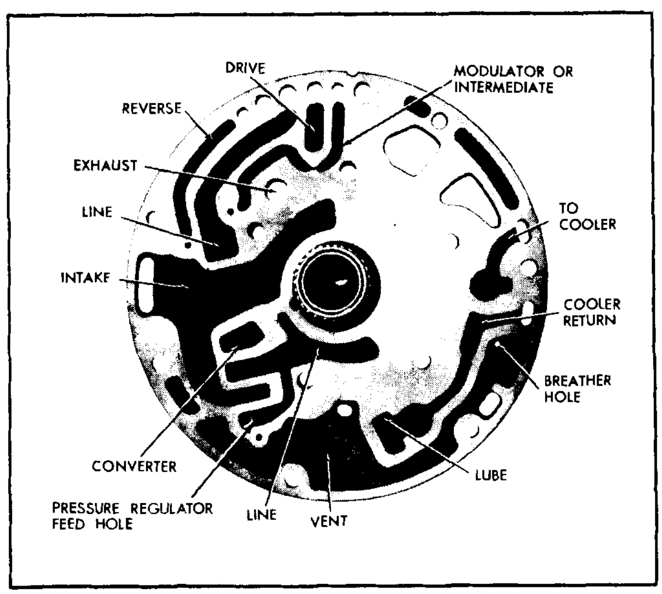


Fig. 7E-111 Pump Cover Oil Passages

13. Inspect stator shaft for damaged splines or scored bushings. If replacement of bushings is necessary, proceed as follows:

    a. Thread J 21465-15 into stator shaft bushing. Thread Slide 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 Driver 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. 7E-114).

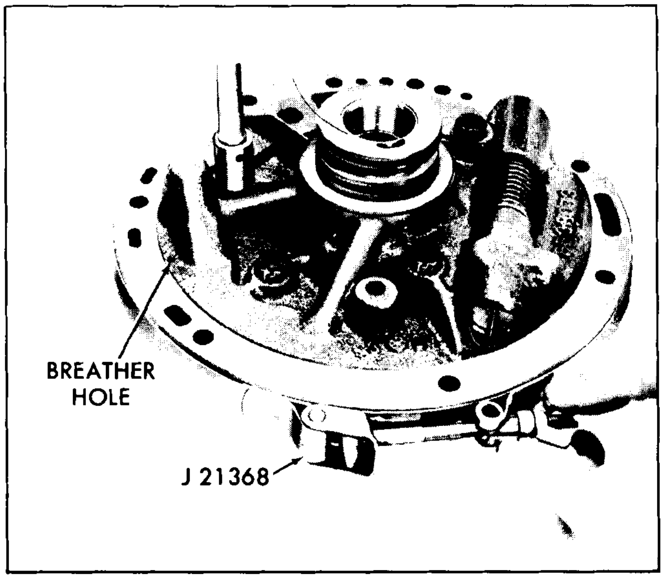


Fig. 7E-112 Aligning Pump Cover to Pump Body

ASSEMBLE

1. Install drive and driven pump gears into pump body with alignment marks up (Fig. 7E-110).

NOTE: *Install drive gear with drive tangs up.*

2. Protect stator shaft and install pump in vise.

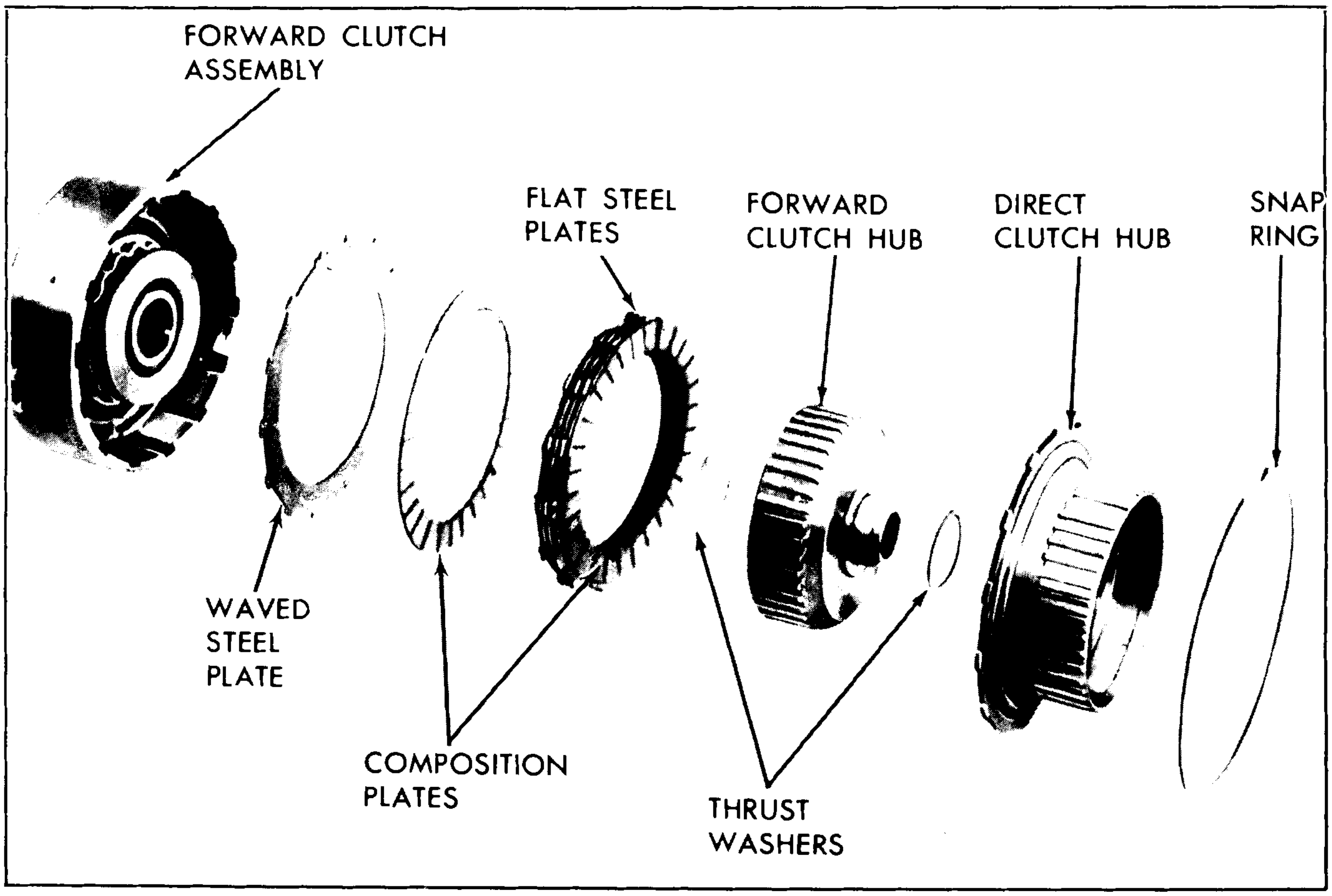


Fig. 7E-113 Exploded View of Forward Clutch

3. Install spacer(s) if used, retainer and spring into pressure regulator bore (Fig. 7E-108).

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 two (2) hook-type oil seal rings.

10. Assembly pump cover to pump body with attaching bolts.

NOTE: *Leave bolts one turn loose at this time.*

11. Place Pump Aligning Strap J 21368 over pump body and cover and tighten tool (Fig. 7E-112).

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

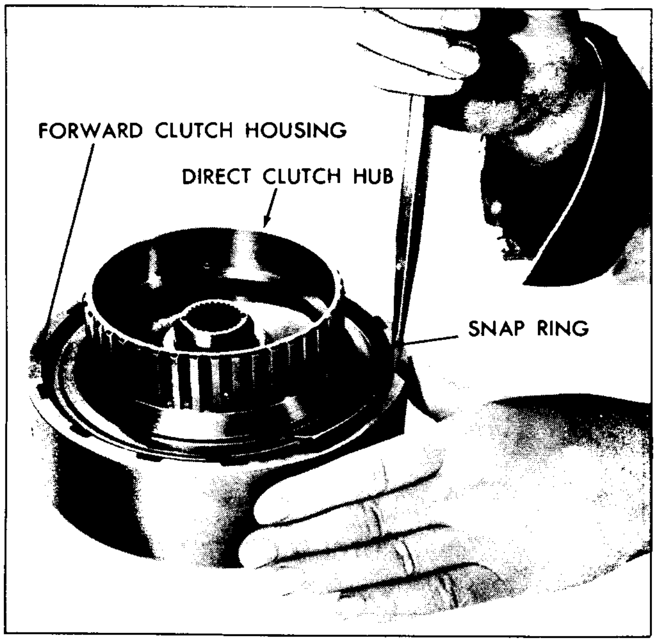


Fig. 7E-114 Removing or Installing Clutch Hub Retaining Snap Ring

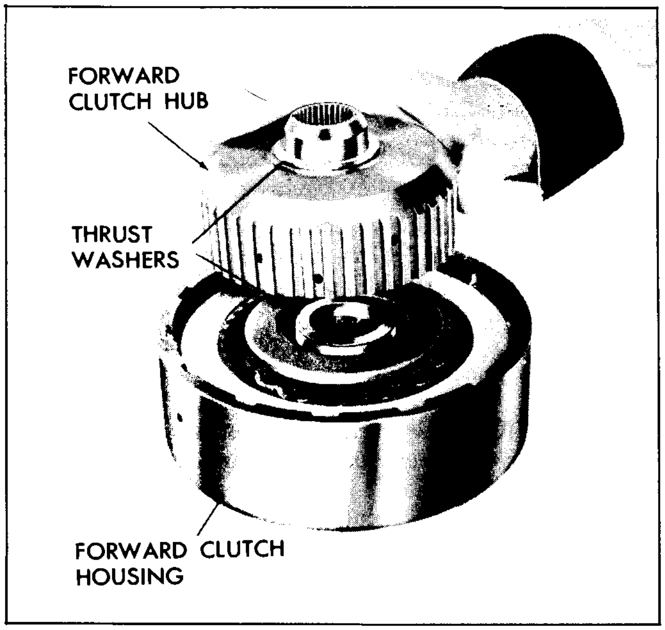


Fig. 7E-115 Removing or Installing Forward Clutch Hub

1. Place forward clutch and turbine shaft in hole in bench or Holding Fixture J 6116 and remove forward clutch housing-to-direct clutch hub snap ring (Fig. 7E-114).

2. Remove direct clutch hub.

3. Remove forward clutch hub and thrust washers (Fig. 7E-115).

4. Remove composition and steel clutch plates from the forward clutch housing.

5. Place forward clutch and turbine shaft in arbor press and press out turbine shaft (Fig. 7E-116).

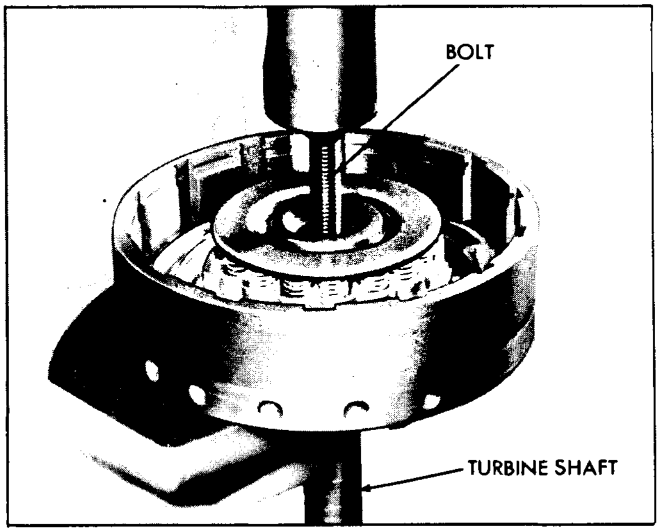


Fig. 7E-116 Pressing Turbine Shaft From Clutch Housing

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 Clutch Spring Compressor J 23327-1 in an arbor press to compress the spring retainer and remove its snap ring.*

6. Using Clutch Spring Compressor J 4670 with Adapters J 6129 and J 8765, compress spring retainer and remove snap ring (Fig. 7E-117).

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.

9. Remove inner and outer clutch piston seals from clutch piston (Fig. 7E-118).

10. Remove center piston seal from forward clutch housing (Fig. 7E-119).

INSPECT

1. Inspect composition and steel clutch plates for signs of burning, scoring or wear.

2. Inspect sixteen (16) springs for collapsed coils or sings of distortion.

3. Inspect clutch hubs for worn splines, proper lubrication holes and thrust faces.

4. Inspect piston for cracks.

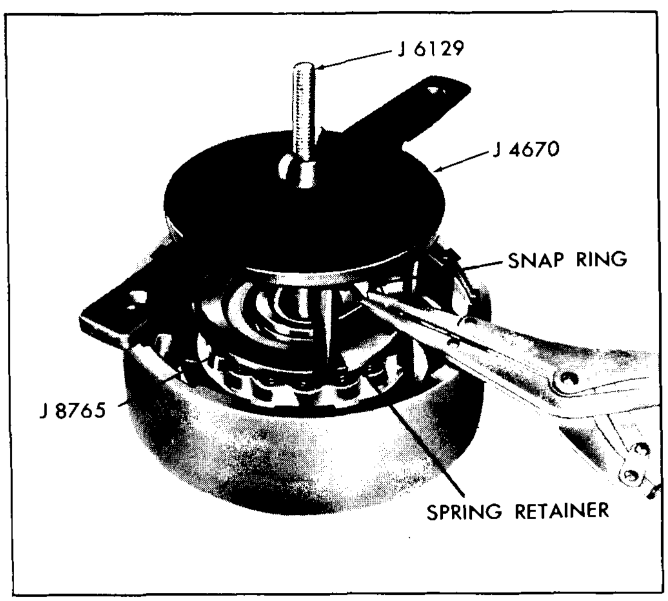


Fig. 7E-117 Removing or Installing Spring Retainer Snap Ring

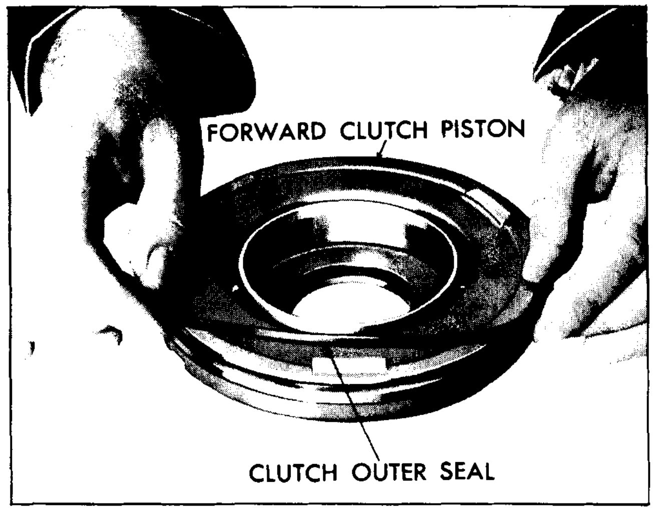


Fig. 7E-118 Removing or Installing Clutch Piston Seals

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.

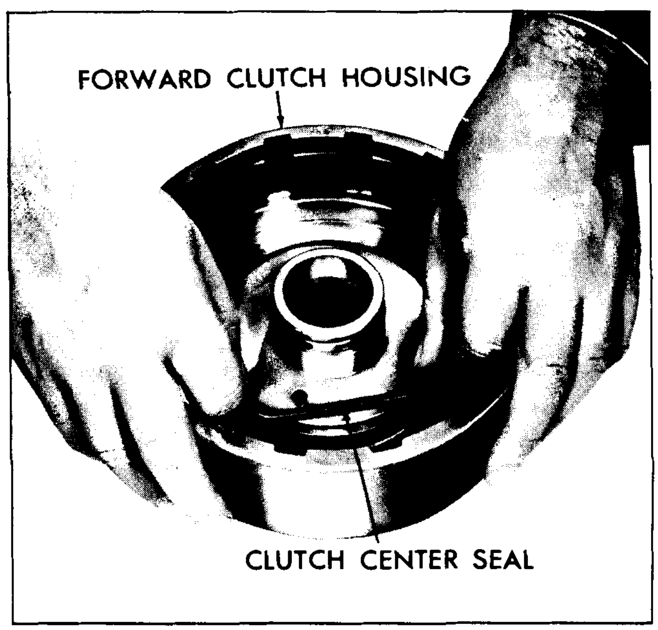


Fig. 7E-119 Removing or Installing Clutch Housing Center Seal

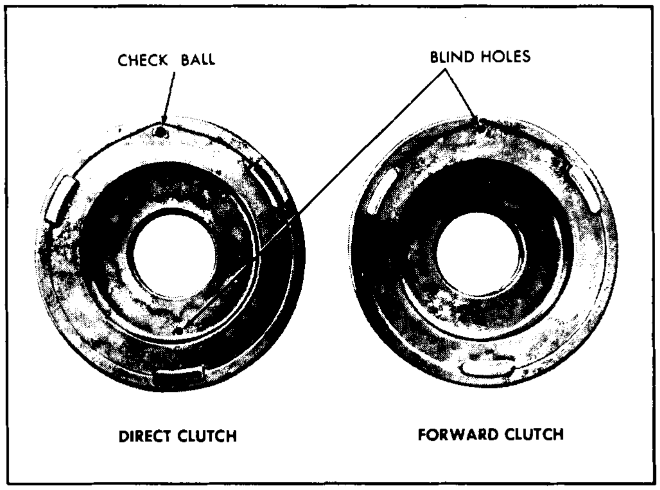


Fig. 7E-120 Identification of Clutch Pistons (Except Model PH)

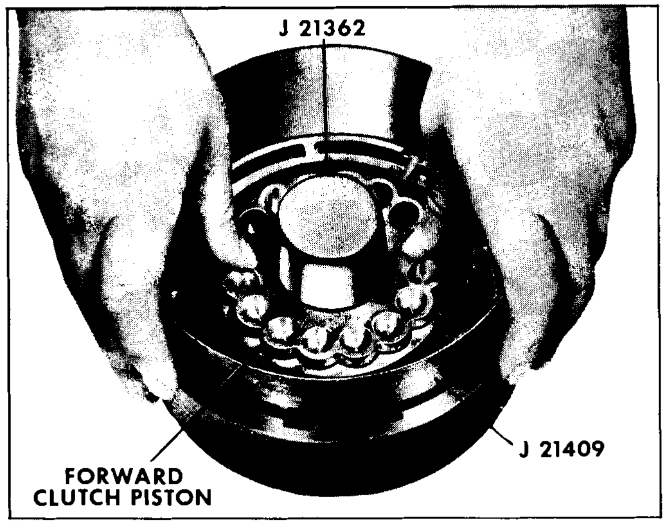


Fig. 7E-121 Installing Forward Clutch Piston

ASSEMBLE

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. 7E-118).

   NOTE: *The forward and direct clutch pistons * have identical inside and outside diameters. It is possible to reverse the pistons during reassembly, therefore care should be exercised to make certain the proper piston be installed in the clutch assemblies.*

   ** As shown in Fig. 7E-120, the forward clutch piston can be identified by the blind hole in the clutch apply face of the piston.*

2. Place a new center seal on clutch housing, lip faces up (Fig. 7E-119).
3. Place Seal Protector Tool J 21362 over clutch hub and install outer clutch piston Seal Protector J 21409 into clutch drum and install piston, rotating piston on drum until seated (Fig. 7E-121).
4. Install sixteen (16) clutch release springs into pockets in piston.
5. Place spring retainer and snap ring on springs.
6. Compress springs, using Clutch Compressor Tools J 4670, J 6129 and J 8765 and install snap ring (Fig. 7E-117).
7. Install turbine shaft in forward clutch housing, using arbor press.
8. Install forward clutch hub washers on forward clutch hub. Retain with petrolatum.
9. Place forward clutch hub into forward clutch housing (Fig. 7E-115).
10. a. (Models PA, PB, PC, PG, PQ, PR, PT and PX) Oil and install five (5) composition, four (4) flat steel and one (1) waved steel (plate with "U" notches) clutch plates, starting with the waved steel and alternating composition and flat steel clutch plates (Fig. 7E-122).

    b. (Model PH only) Oil and install six (6) composition, five (5) flat steel and one (1) waved steel

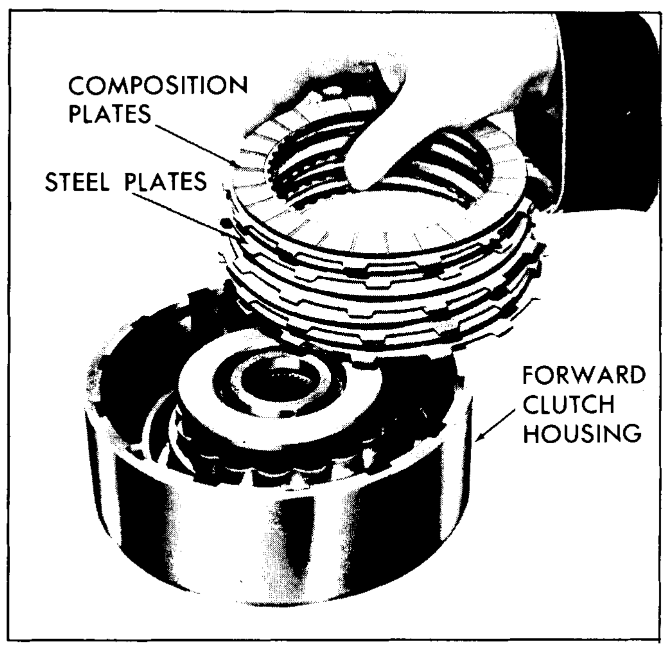


Fig. 7E-122 Installing Forward Clutch Pack

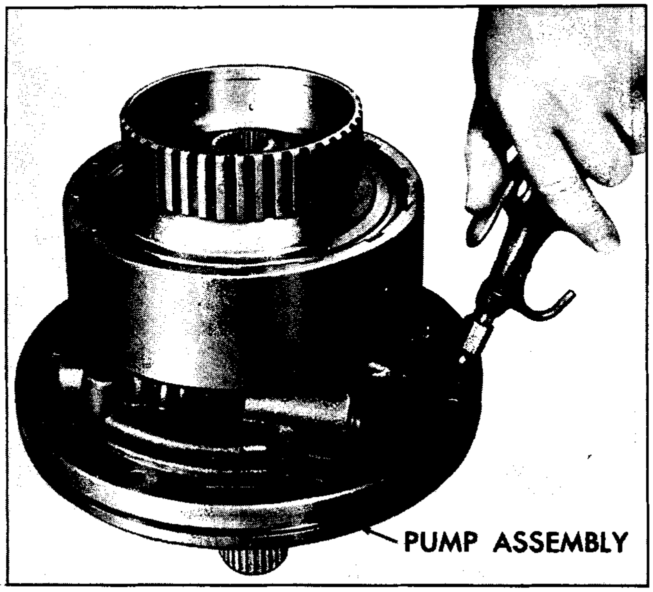


Fig. 7E-123 Air Checking Forward Clutch

clutch plates, starting with the waved steel and alternating composition and flat steel clutch plates (Fig. 7E-122).

c. (Model PD Only) Oil and install four (4) composition, three (3) flat steel and one (1) waved steel clutch plates, starting with the waved steel and alternating composition and flat steel clutch plates (Fig. 7E-122).

NOTE: *Radially grooved composition clutch plates are installed at the factory only. All service composition plates have the smooth surface configuration.*

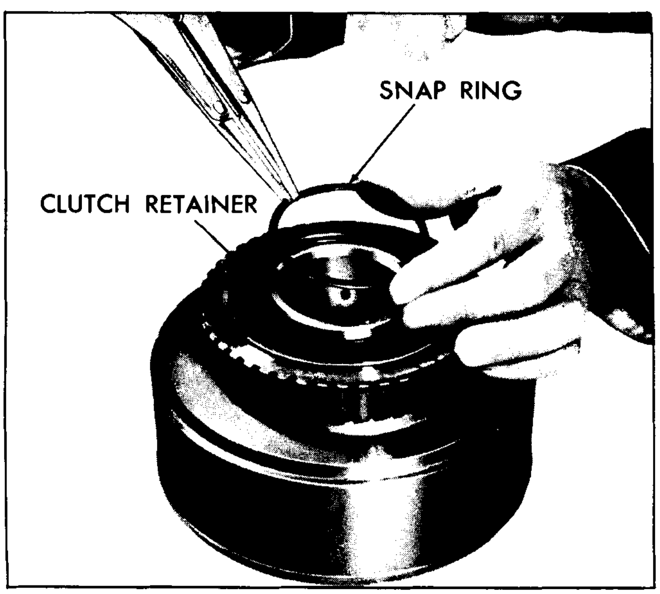


Fig. 7E-124 Removing or Installing Clutch Retainer Snap Ring

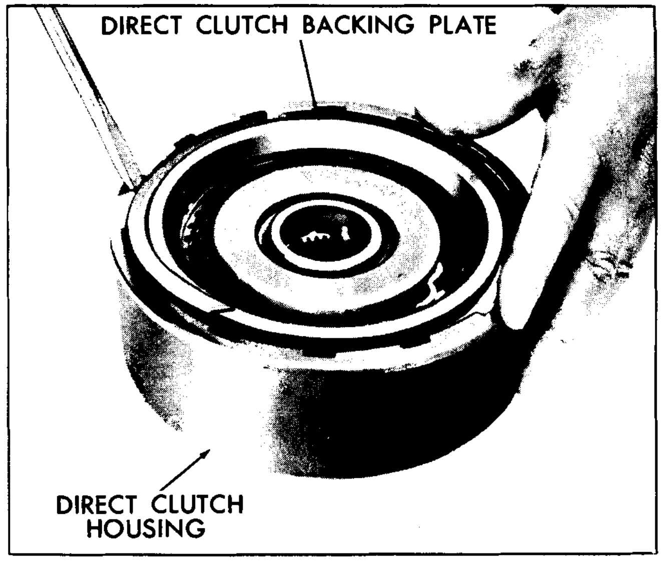


Fig. 7E-125 Removing or Installing Backing Plate Snap Ring

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. 7E-114).

12. Place forward clutch housing on pump delivery sleeve and air check clutch operation (Fig. 7E-123).

DIRECT CLUTCH AND INTERMEDIATE SPRAG

DISASSEMBLE

1. Remove intermediate clutch retainer snap ring and retainer (Fig. 7E-124).

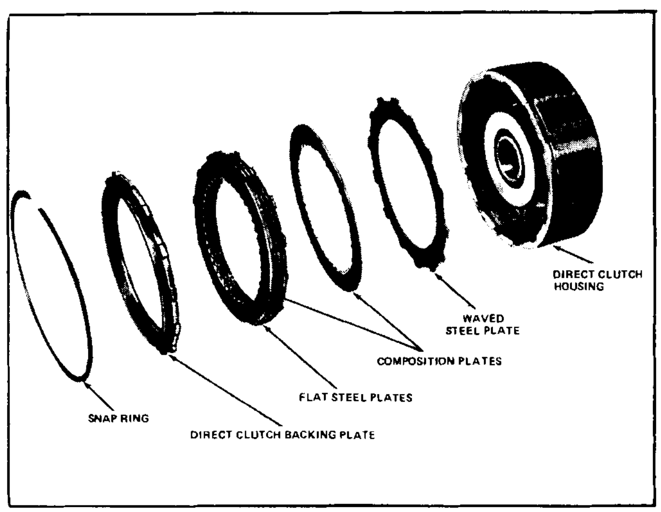


Fig. 7E-126 Exploded View of Direct Clutch Pack

2. Remove clutch outer race, bushings and sprag assembly.
3. Turn unit over and remove backing plate-to-direct clutch housing snap ring (Fig. 7E-125).
4. Remove the direct clutch backing plate, the composition and the steel clutch plates from the direct clutch housing.
5. Using Clutch Compressor Tools J 4670, J 6129 and J 8765, compress spring retainer and remove snap ring (Fig. 7E-127).
6. Remove retainer and fourteen (14) piston release springs.

   CAUTION: *Keep piston release springs separate from forward clutch release springs.*

7. Remove direct clutch piston (Fig. 7E-128).
8. Remove outer seal from piston.
9. Remove inner seal from piston.
10. Remove center piston seal from direct clutch housing.

INSPECT

1. Inspect roller assembly for popped or loose rollers.
2. Inspect inner and outer races for scratches or wear.

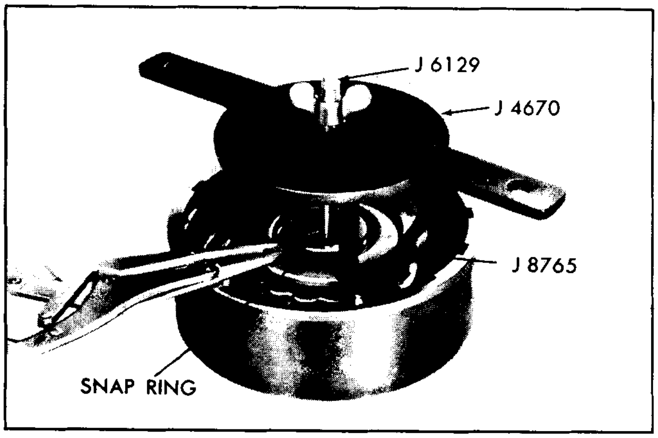


Fig. 7E-127 Removing or Installing Clutch Piston Snap Ring

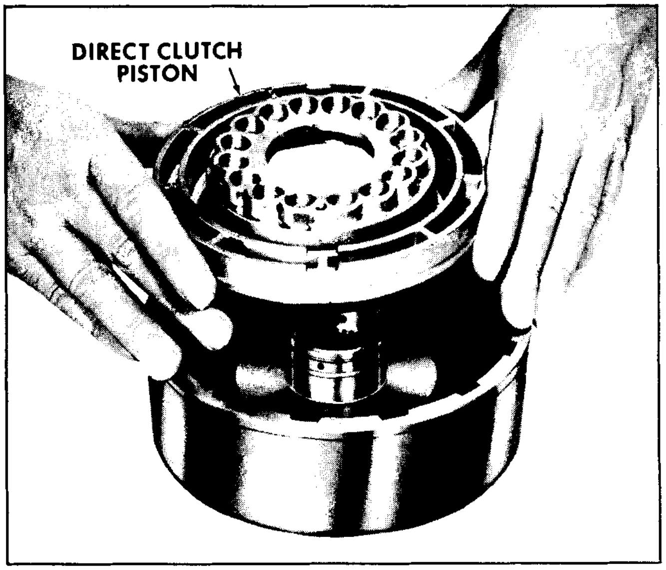


Fig. 7E-128 Removing Direct Clutch Piston

3. Inspect clutch housing for cracks, wear, proper opening of oil passages or wear on clutch plate drive lugs.
4. Inspect composition 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 and free operation of check balls.

   NOTE: *The direct clutch piston contains two (2) check balls for model PH transmissions while other models contain only one (1) check ball.*

7. Inspect springs for collapsed coils or signs of distortion.

   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

1. Install a new inner clutch piston seal on piston, with lip facing away from spring pockets (Fig. 7E-130).

   NOTE: *Apply Hydra-Matic oil to all seals.*

2. Install a new outer clutch piston seal with lip facing away from spring pockets (Fig. 7E-131).

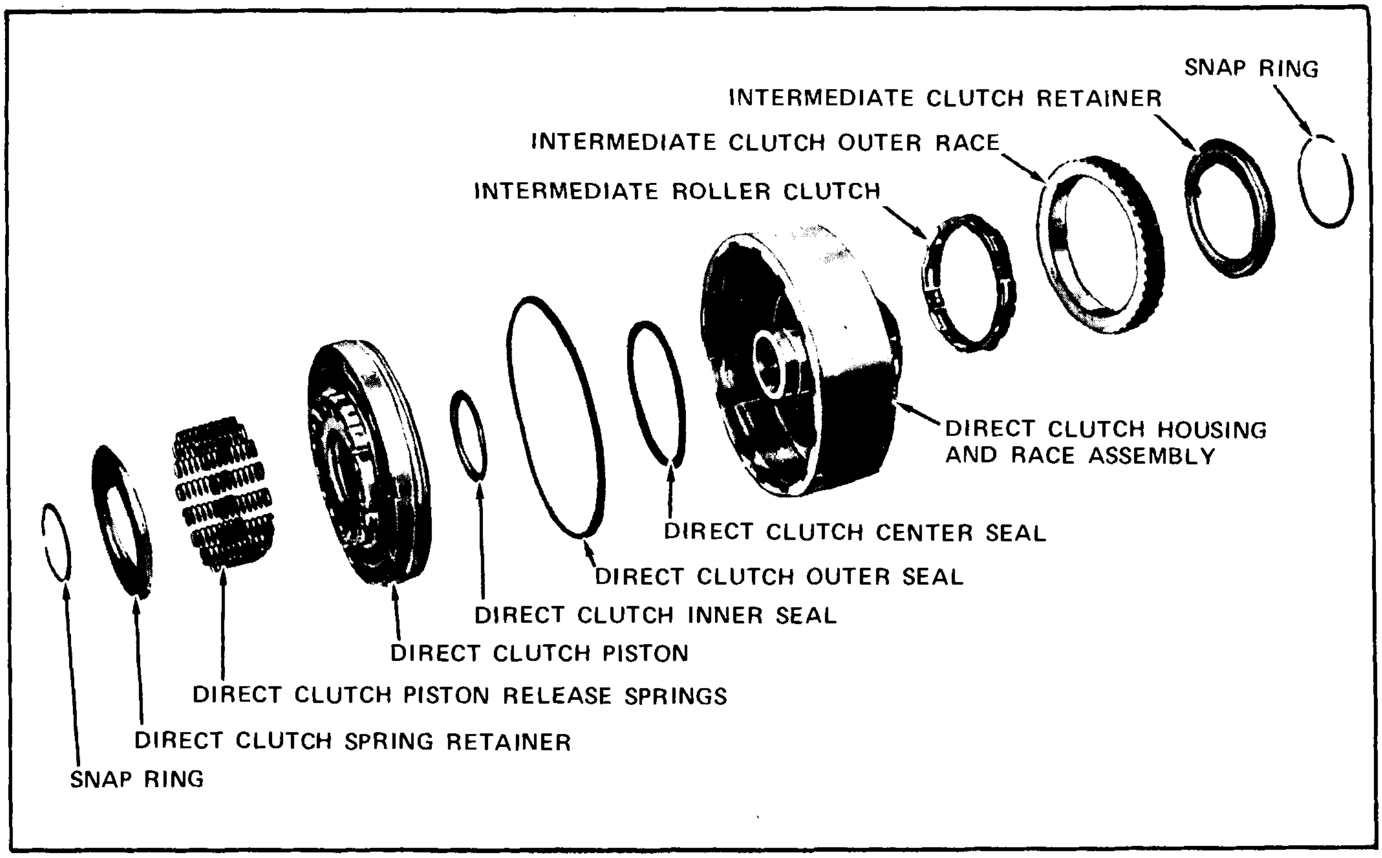


Fig. 7E-129 Exploded View of Direct Clutch Piston and Intermediate Roller Assembly

3. Install a new clutch center seal on hub of direct clutch housing with lip of seal facing up (Fig. 7E-132).

NOTE: *When installing the piston, make certain that the proper piston is used. The direct clutch piston can be identified by the check ball installed in the casting (Fig. 7E-120).*

4. Place seal protectors, Tools J 21362 Inner and J 21409 Outer, over hub and clutch housing and install clutch piston with a rotating motion (Fig. 7E-133)

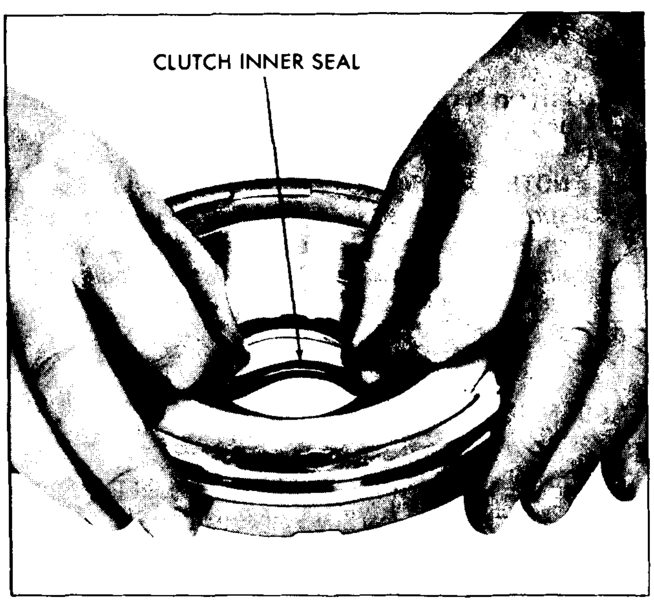


Fig. 7E-130 Installing Clutch Piston Inner Seal

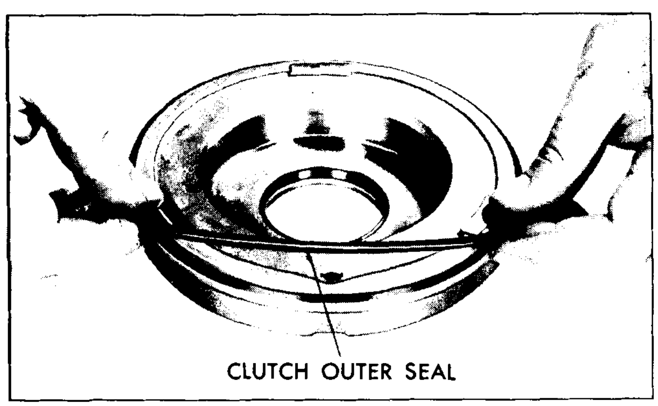


Fig. 7E-131 Installing Clutch Piston Outer Seal

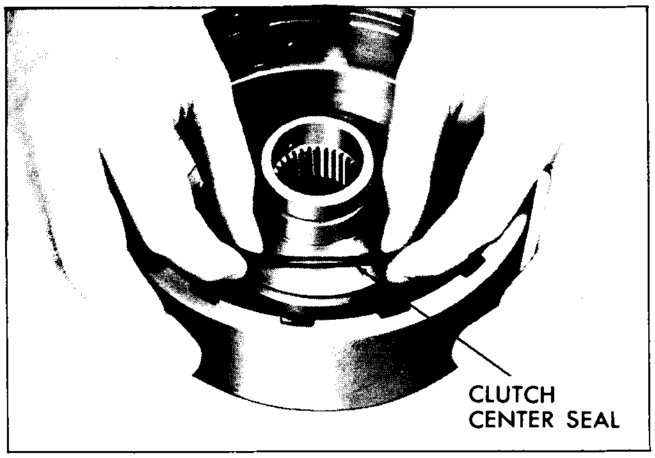


Fig. 7E-132 Installing Direct Clutch Center Seal

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.*

6. Place spring retainer and snap ring on retainer.

7. Using Clutch Compressor Tool J 4670, J 6129 and J 8765, install snap ring (Fig. 7E-127).

8. a. (Models PA, PB, PC, PT and PX) Lubricate with transmission fluid and install five (5) composition, four (4) flat steel and one (1) waved steel (plate with "U" notch) clutch plates, starting with the waved steel plate and alternating composition and flat steel clutch plates (Fig. 7E-126).

   b. (Model PD Only) Lubricate with transmission fluid and install four (4) composition, three (3) flat steel and one (1) waved steel clutch plates, starting with the waved steel plate and alternating composition and flat steel clutch plates (Fig. 7E-126).

   c. (Models PG, PQ and PR) Lubricate with transmission fluid and install five (5) composition and five (5) flat steel clutch plates, starting with a flat steel and alternating composition and flat steel clutch plates.

   d. (Model PH only) Lubricate with transmission fluid and install six (6) composition and six (6) flat steel clutch plates, starting with a flat steel and alternating composition and flat steel clutch plates.

CAUTION: *Do not use radial groove composition plates here.*

9. Install direct clutch backing plate.

10. Install backing plate snap ring (Fig. 7E-128).

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.

12. Turn until over and install the roller clutch assembly onto the intermediate clutch inner cam (Fig. 7E-134).

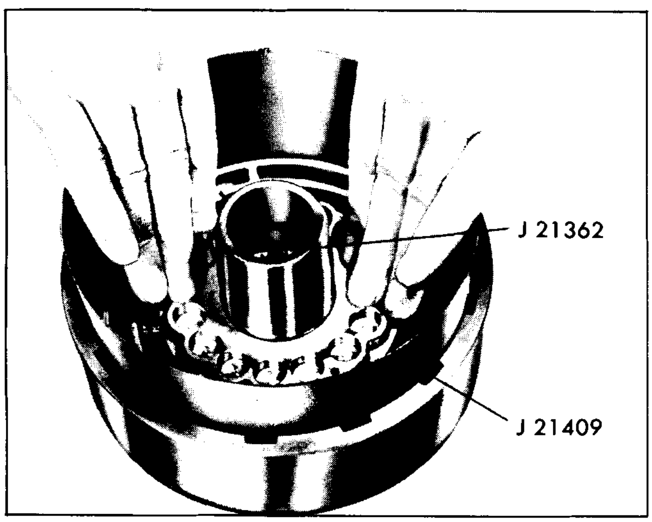


Fig. 7E-133 Installing Direct Clutch Piston

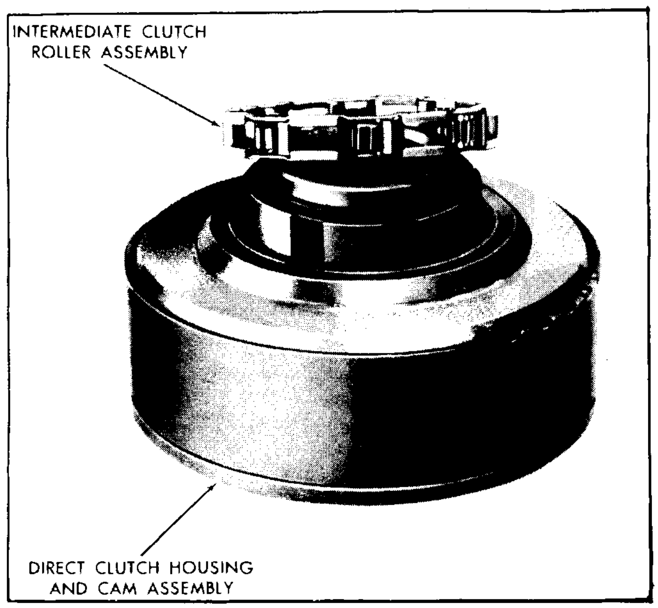


Fig. 7E-134 Installing Intermediate Roller Assembly

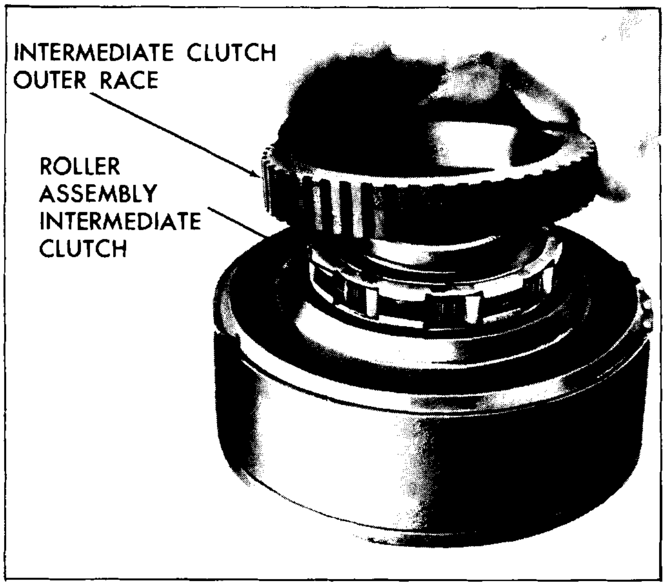


Fig. 7E-135 Installing Outer Race

13. Install the intermediate clutch outer race with a clockwise turning motion (Fig. 7E-135).

14. Install clutch retainer (Fig. 7E-136) and snap ring (Fig. 7E-124).

15. Place direct clutch assembly over center support and air check operation of direct clutch (Fig. 7E-137).

    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.*

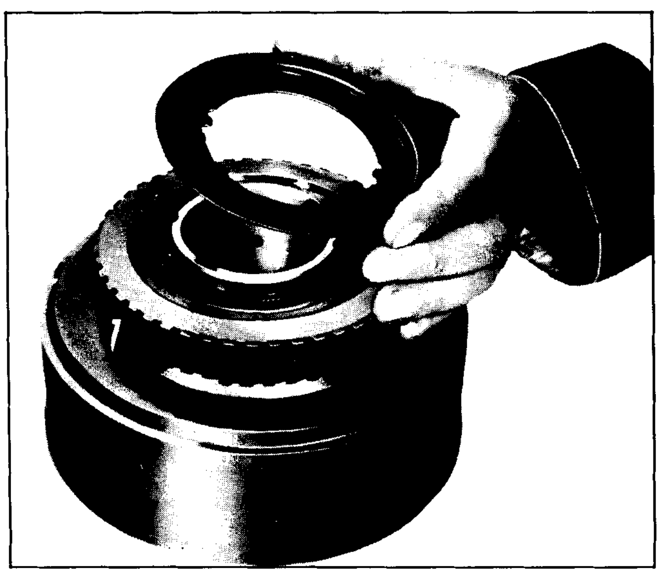


Fig. 7E-136 Installing Clutch Retainer

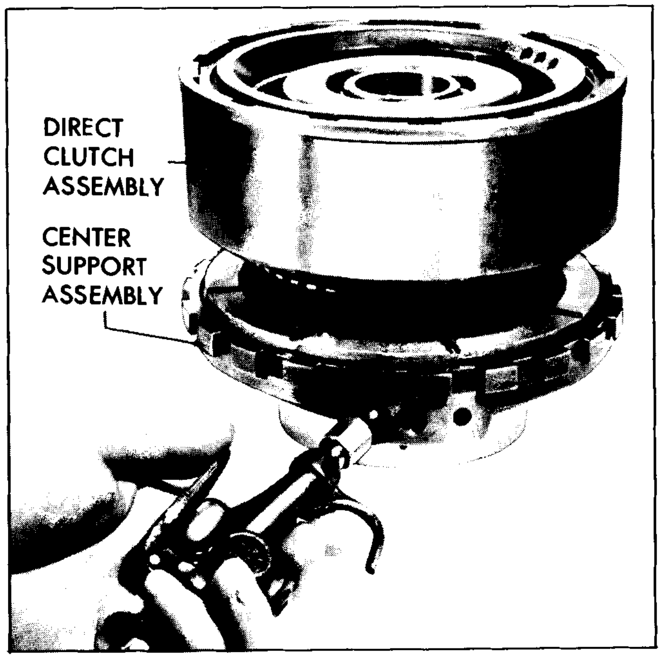


Fig. 7E-137 Air Checking Direct Clutch

CENTER SUPPORT

DISASSEMBLE (Fig. 7E-138)

1. Remove three (3) hook-type cast iron oil seal rings from the center support. Do not remove the teflon oil seal ring unless replacement is required. All service center support oil seal rings are hook-type cast iron.

2. Using your fingers, compress spring retainer and remove snap ring.

3. Remove spring retainer and three (3) clutch release springs.

4. Remove intermediate clutch piston.

5. Remove inner and outer piston seal.

   NOTE: *Do not remove three (3) screws retaining roller clutch inner race to center support.*

INSPECT

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. 7E-84).*

2. Inspect bushing for scoring, wear or galling. If replacement is necessary, proceed as follows:

   a. Using Tool J 21465-6 with Driver Handle J 8092, remove bushing.

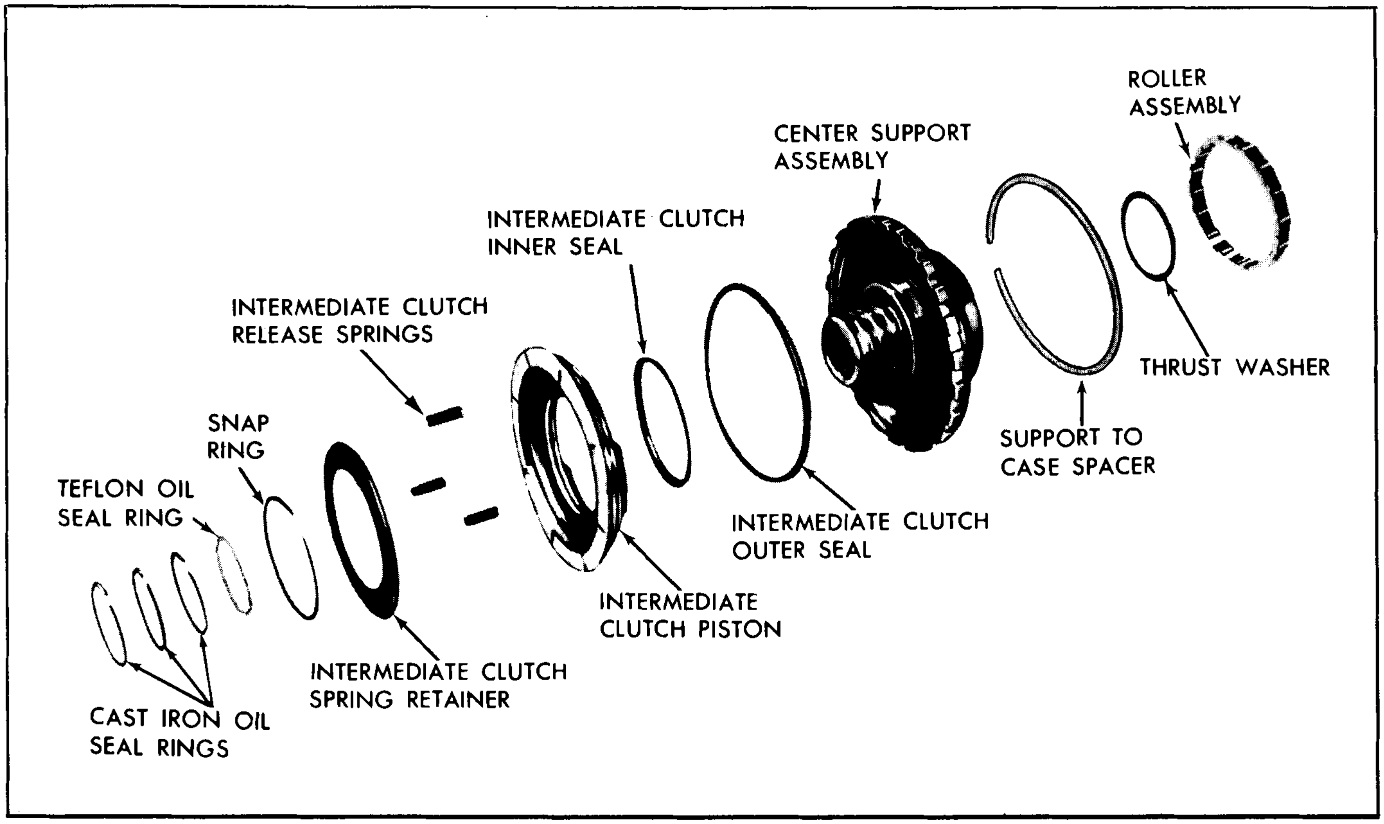


Fig. 7E-138 Exploded View of Center Support

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 Driver 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.

   NOTE: *All service center support oil seal rings are hook-type case iron.*

4. Air check oil passages to be sure they are not interconnected.

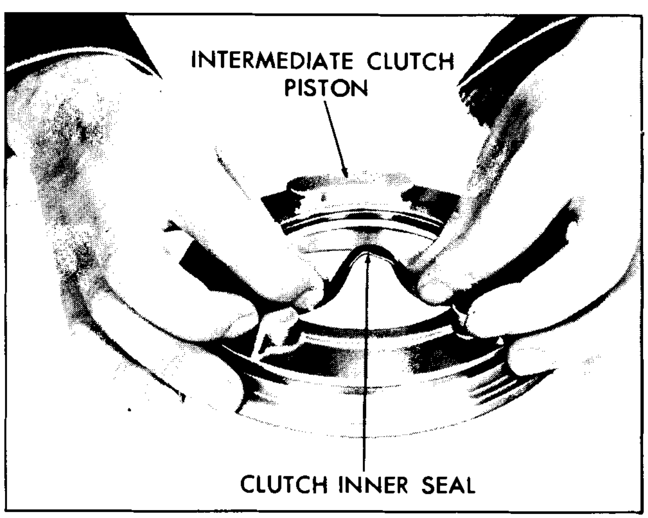


Fig. 7E-139 Installing Clutch Piston Inner Seal

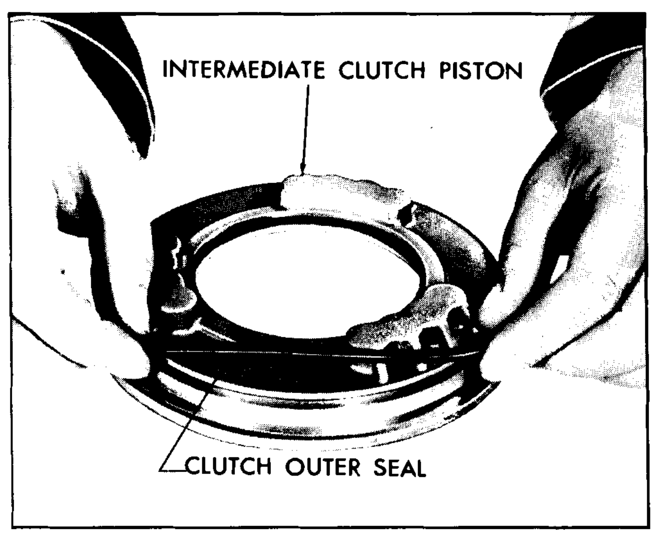


Fig. 7E-140 Installing Clutch Piston Outer Seal

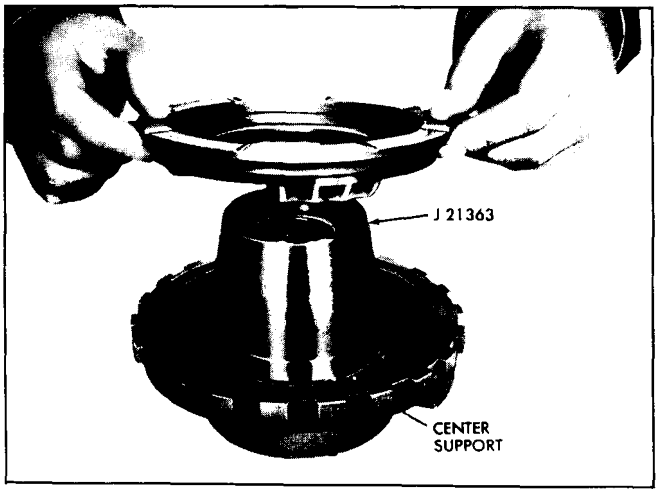


Fig. 7E-141 Installing Intermediate Clutch Piston

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

1. Install new inner and outer seals on piston with lip of seal facing away from spring pocket (Fig. 7E-139 and 7E-140).

2. Install Inner Seal Protector Tool J 21363 on center support hub and install piston, indexing spring pockets of piston into cored areas of center support (Fig. 7E-141).

3. Install three (3) release springs into counterbores of piston. Space equally during assembly.

4. Place spring retainer and snap ring over springs.

5. Compress springs and install snap ring (Fig. 7E-142).

6. Install three (3) hook-type cast iron oil seal rings on

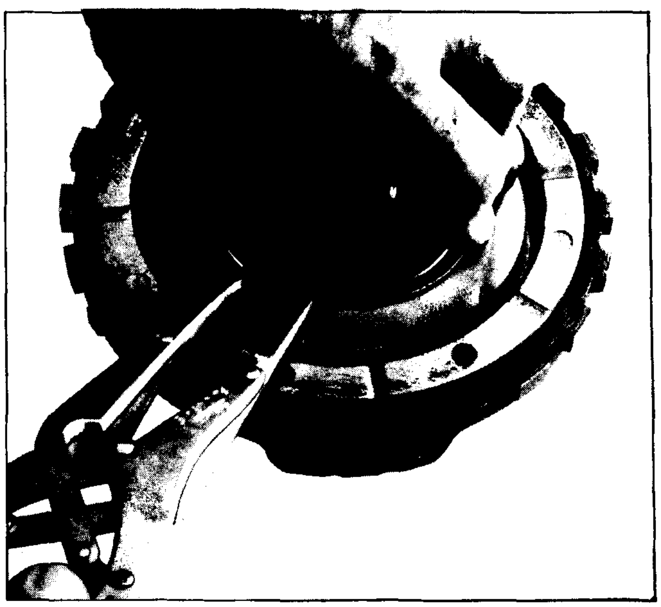


Fig. 7E-142 Installing Clutch Piston Snap Ring

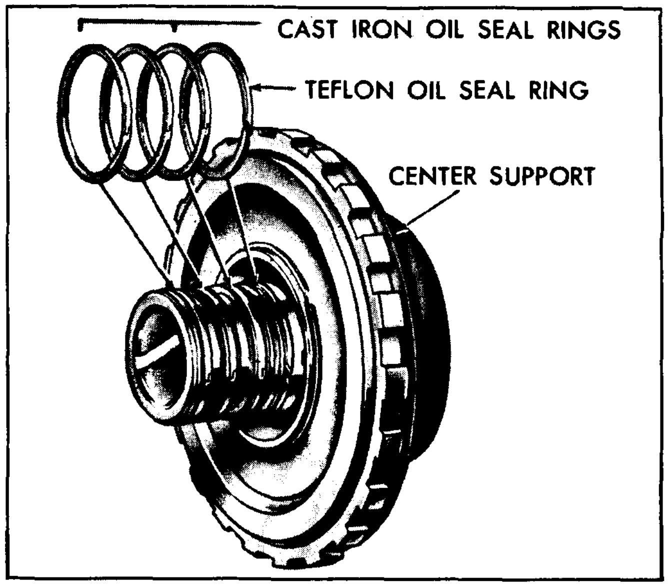


Fig. 7E-143 Oil Seal Rings on Center Support

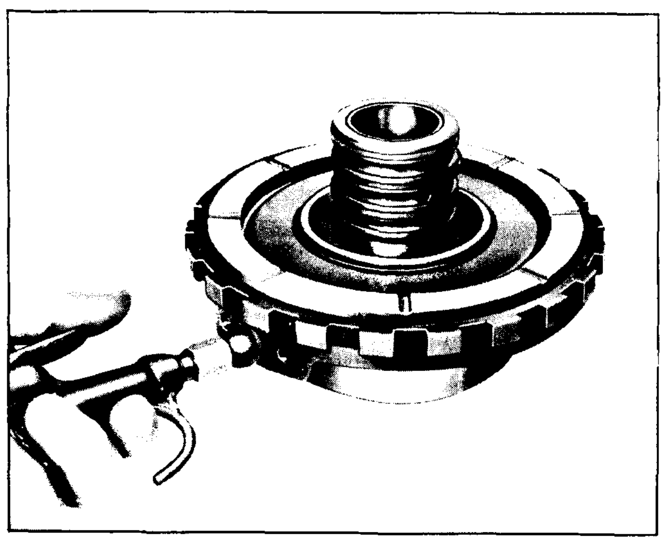


Fig. 7E-144 Air Checking Intermediate Clutch Piston the center support if the teflon ring was not removed. If the teflon ring was removed, install four (4) hook-type cast iron oil seal rings (Fig. 7E-143).

7. Air check operation of intermediate clutch piston (Fig. 7E-144).

INSPECTION OF MAJOR UNITS

REACTION CARRIER, ROLLER CLUTCH AND OUTPUT CARRIER ASSEMBLY

INSPECT

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. 7E-145).
7. Inspect roller clutch for damaged members.
8. Inspect roller clutch cage for damage.
9. Inspect front internal gear (output carrier) for damaged teeth.
10. Inspect output carrier pinions for damage, rough bearings or excessive tilt.

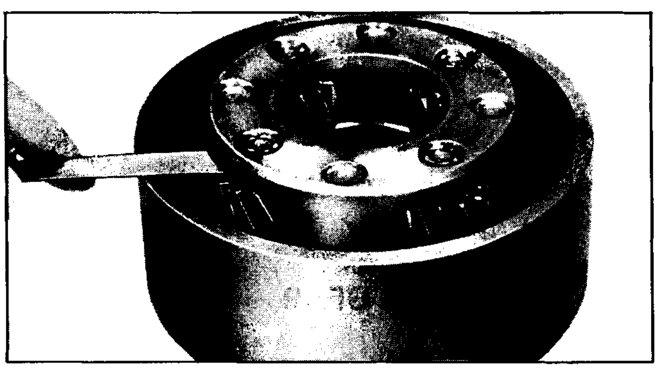


Fig. 7E-145 Checking Reaction Carrier Pinion End Play

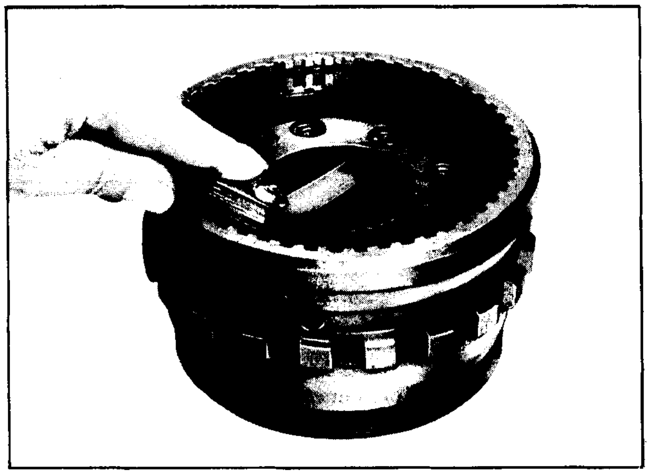


Fig. 7E-146 Checking Output Carrier Pinion End Play

11. Check output carrier pinion end play. Should be .009"-.024" (Fig. 7E-146).
12. Inspect parking pawl lugs for cracks or damage.
13. Inspect output locating splines for damage.
14. Inspect front internal gear ring for flaking.

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 and future failure would be probable.*

3. Using a tapered punch, drive or press pinion pins out of carrier (Fig. 7E-147).
4. Remove pinions, thrust washers and roller needle bearings.

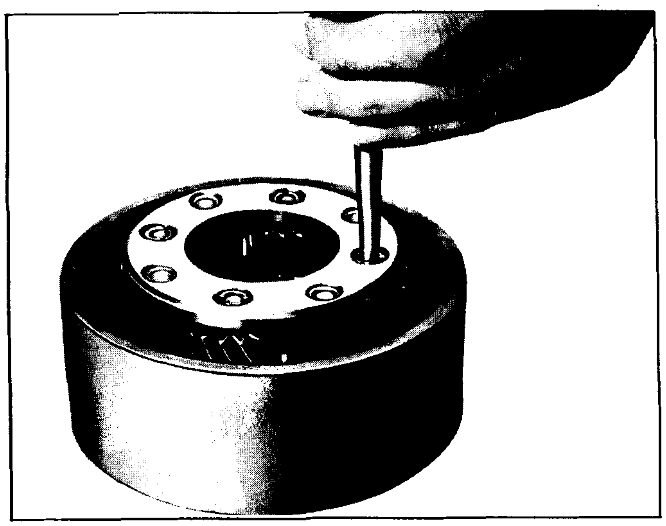


Fig. 7E-147 Driving Pinion Pin from Carrier (Reaction Carrier Shown)

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. 7E-148).
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. 7E-149).
10. Place a large punch in a bench vise to be used as an

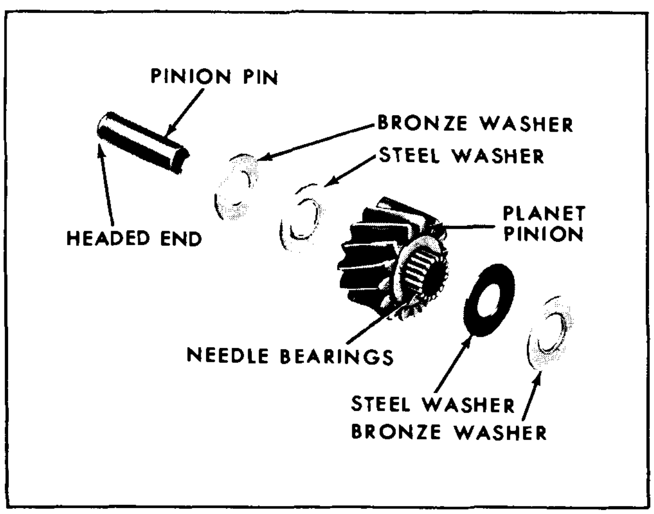


Fig. 7E-148 Exploded View of Planet Pinion

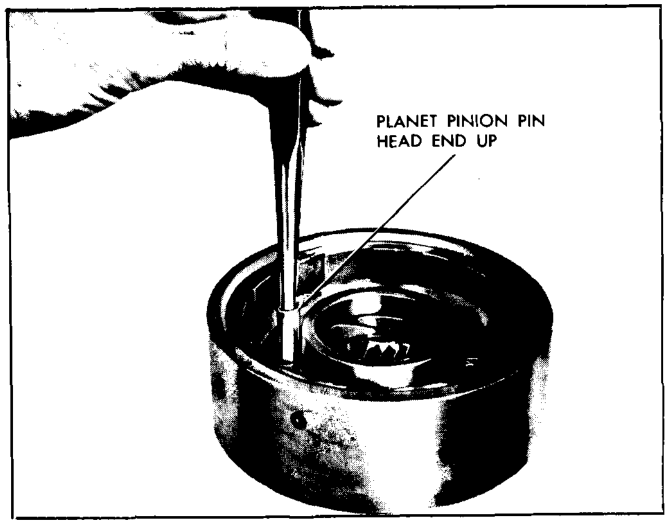


Fig. 7E-149 Driving Pinion Pin Into Carrier (Reaction Carrier Shown)

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

INSPECT

1. Inspect bushing for wear or galling. If replacement is necessary, proceed as follows:
   a. Thread Tool J 21465-16 into bushing and, using Slide Hammer J 2619 and Adapter J 2619-4, remove bushing.
   b. Using Tool J 21465-1 with Driver 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 orificed cup plug in lubrication passage.
6. Inspect drive lugs for damage.

REAR INTERNAL GEAR

INSPECT

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Inspect gear for cracks.

SUN GEAR

INSPECT

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Be sure oil lubrication hole is open.

SUN GEAR SHAFT

INSPECT

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 Tool J 21465-14 into bushing and, using Slide Hammer J 2619 and Adaptor J 2619-4, remove bushing.

   Replace:

   Using Tool J 21465-5 with Drive 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 Tool J 21465-15 with Slide Hammer J 2619, remove bushing.

   Replace:

   Using Tool J 21465-5 with Drive 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

INSPECT

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

INSPECT

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

INSPECT

1. Inspect bushing for excessive wear or damage. If replacement is necessary, proceed as follows:

   On all models **except** PD -

   a. Install Tool J 21465-17 and remove bushing.

   b. Using Tool J 21465-17 with Drive Handle J 8092, install new bushing flush to .010" below oil seal counterbore.

   c. Stake bushing in place, using Tool J 21465-10 in diamond area of bushing lube groove.

   On PD models only, perform the above operation by using Tool J 21424-9.

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.

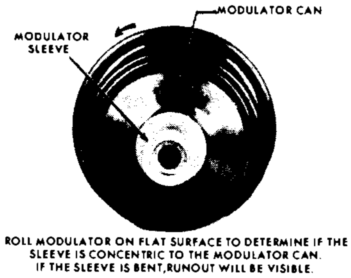


Fig. 7E-150 Checking Concentricity of Sleeve

MODULATOR AND VALVE

INSPECT

1. Inspect modulator assembly for any signs of bending or distortion (Fig. 7E-150):

   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. Check modulator for atmospheric leakage as follows (Fig. 7E-151):

   a. Apply a liberal coating of soap bubble solution (available at 5 & 10 cent store) to vacuum connector pipe seam, crimped upper-to-lower housing seam and to the threaded screw seal.

   b. Using a short piece of rubber tubing, apply air pressure to the vacuum pipe by blowing into tubing and observe for leak bubbles.

   c. If bubbles appear, replace the modulator.

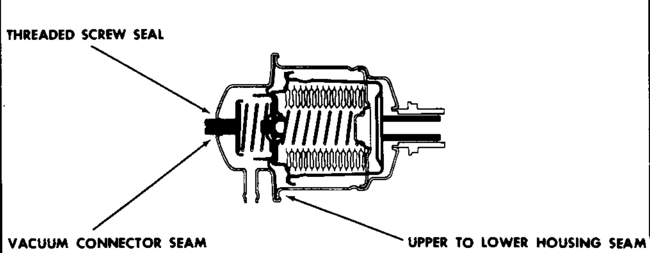


Fig. 7E-151 Vacuum Modulator Seams and Seals

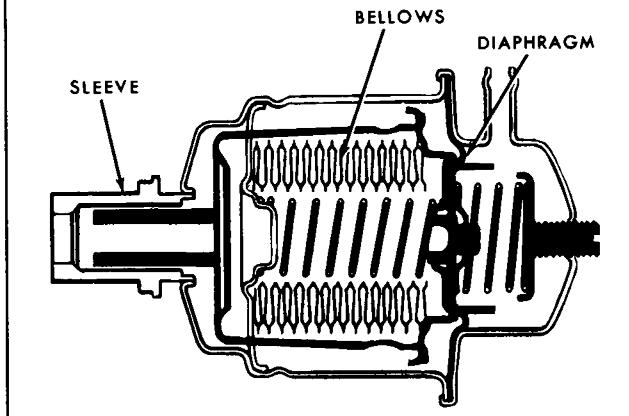


Fig. 7E-152 Cross Section of Vacuum Modulator

CAUTION: *Do* **not** *use any method other than human lung power for applying air pressure as pressures over 6 psi may damage the modulator.*

3. Inspect O-ring seal seat for damage.

4. Check for vacuum diaphragm leakage as follows (Fig. 7E-152):

   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.*

5. Make a bellows comparison check by using a comparison gauge (Fig. 7E-153) and compare the load of a known good modulator of the same part number with the modulator in question, as follows:

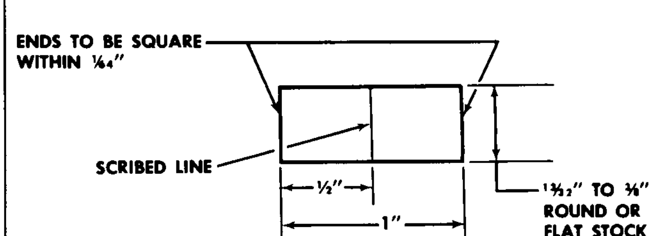


Fig. 7E-153 Comparison Gauge

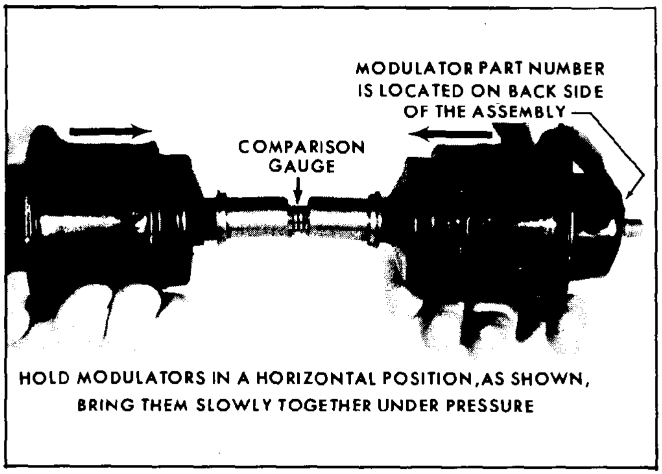


Fig. 7E-154 Bringing Modulators Together

a. Install known good modulator on either end of the gauge.

b. Install modulator in question on opposite end of the gauge.

c. Holding modulators in a horizontal position, bring them together under pressure until either modulator sleeve just touches the line in the center of the gauge (Fig. 7E-154).

d. The gap between the opposite modulator sleeve ends and gauge line should be 1/16" or less (Fig. 7E-155). If gap is greater than 1/16", the modulator in question should be replaced (Fig. 7E-156).

6. Inspect modulator valve for nicks or damage.

7. 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.

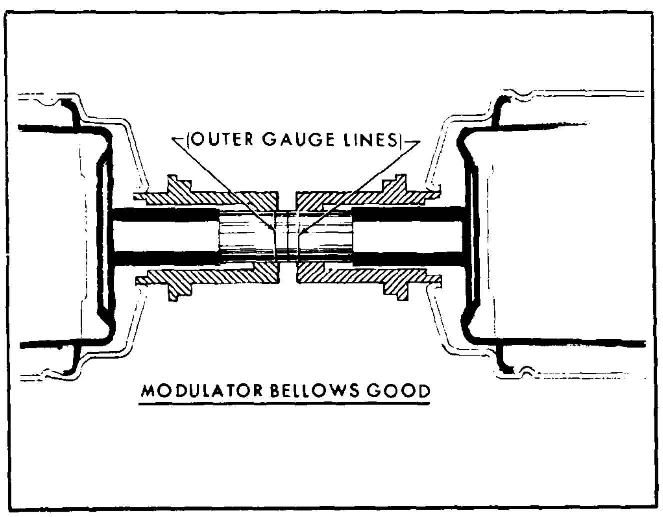


Fig. 7E-155 Modulator Bellows Good

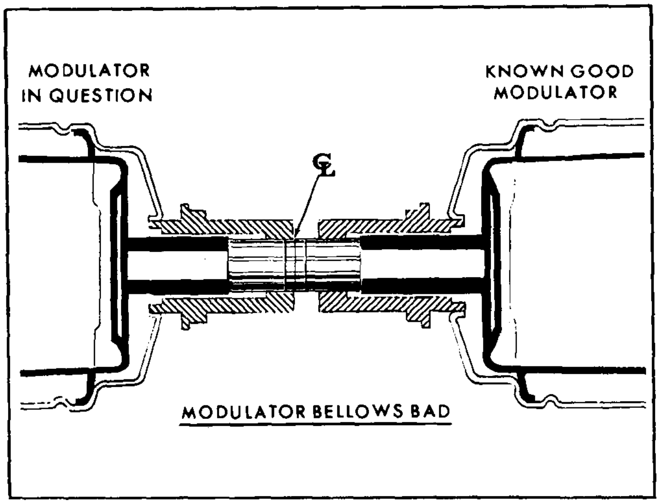


Fig. 7E-156 Modulator Bellows Bad

MANUAL AND PARKING LINKAGE

INSPECT

1. Inspect parking actuator rod for cracks or broken spring retainer lugs (Fig. 7E-157).

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, rough oil seal surface or loose lever.

6. Inspect inside detent lever for cracks or a loose pin.

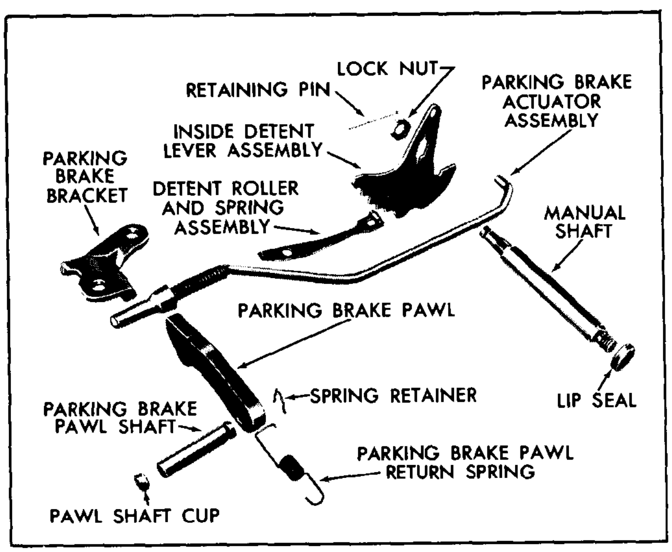


Fig. 7E-157 Exploded View of Manual and Parking Linkage

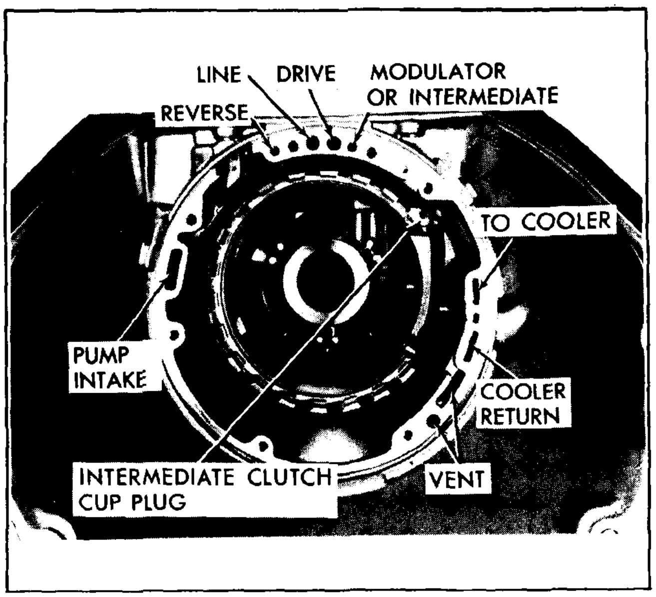


Fig. 7E-158 Case Passages - Front View

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

INSPECT

1. Inspect case for cracks, porosity or inter-connected passages (Fig. 7E-158 and 7E-159).

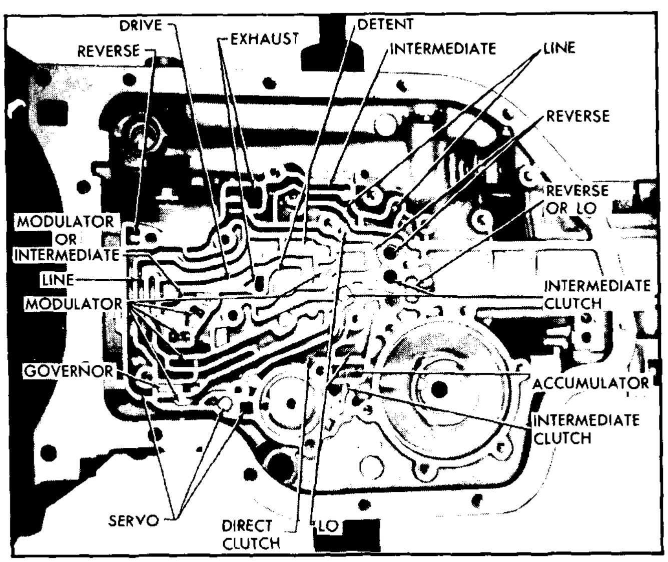


Fig. 7E-159 Case Passages - Bottom View

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.*

2. Check for good retention of band anchor pins.

3. Inspect all threaded holes for thread damage.

4. Inspect intermediate clutch driven 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. 7E-158 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) 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 Tool J 21465-8 with Handle J 8092, remove bushing.

   b. Replace - Use Tool J 21465-8, Adapter Ring J 21465-9, Drive 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.

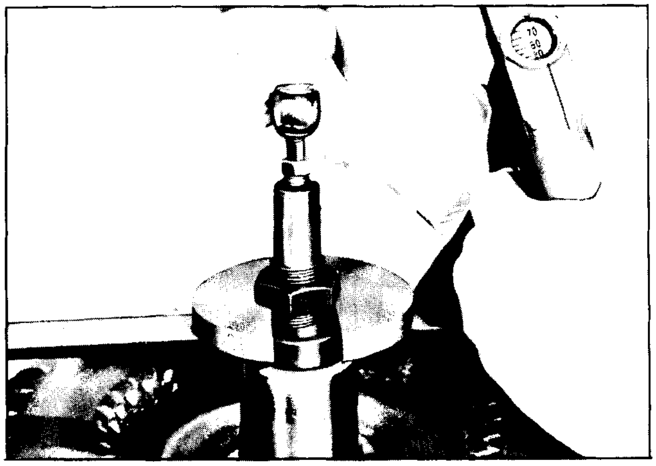


Fig. 7E-160 Pressurizing Converter

CONVERTER

INSPECT

1. Check converter for leaks as follows:
   a. Install Tool J 21369 and tighten.
   b. Fill converter with 80 psi of air (Fig. 7E-160).
   c. Submerge in water and check for leaks.
2. Check converter hub surfaces for signs of scoring or wear that could damage the oil pump front seal.
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:

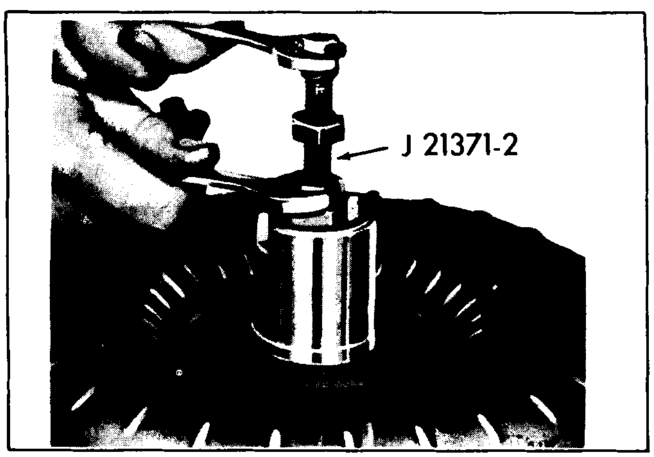


Fig. 7E-161 Installing Tool J 21371-2

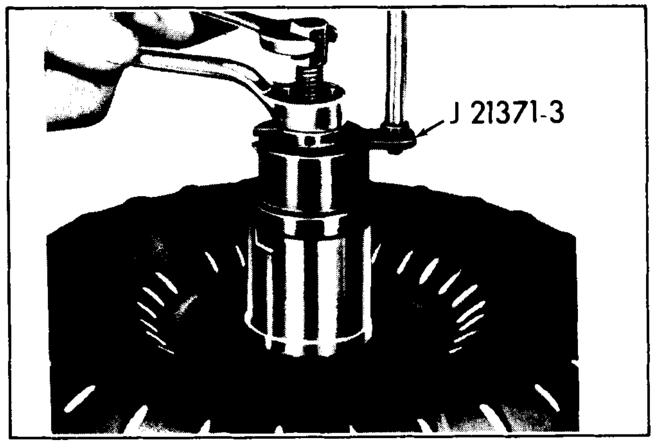


Fig. 7E-162 Installing Tool J 21371-3

a. Fully release collet end of Tool J 21371-2 by turning its brass nut clockwise.
b. Install collet end of Tool J 21371-2 into converter hub until it bottoms, then tighten its brass nut to 5 lb. ft. (Fig. 7E-161).
c. Install Tool J 21371-3 and tighten the hex nut to 3 lb. ft. (Fig. 7E-162).
d. Install Dial Indicator J 8001 and set it for "zero" while its plunger rests on the brass nut of Tool J 21371-2.
e. Loosen hex nut while holding brass nut stationary, allowing converter internal assembly to lower, until dial indicator shows that internal assembly has bottomed (Fig. 7E-163).
f. The reading obtained on dial indicator represents converter end clearance. If clearance is UNDER .050", the converter is acceptable. If clearance is .050" or OVER, replace the converter.

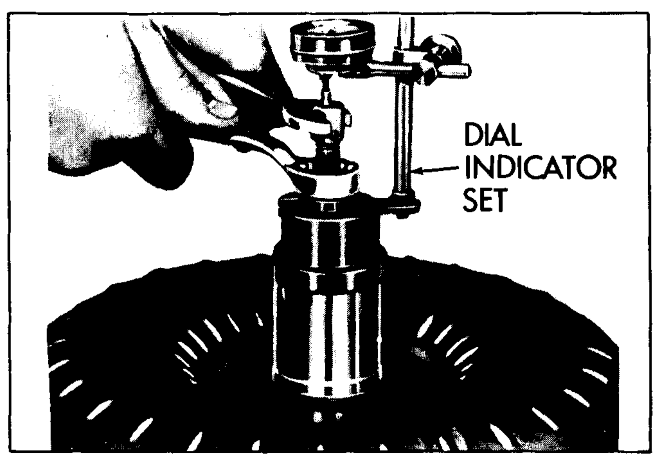


Fig. 7E-163 Checking Converter End Play

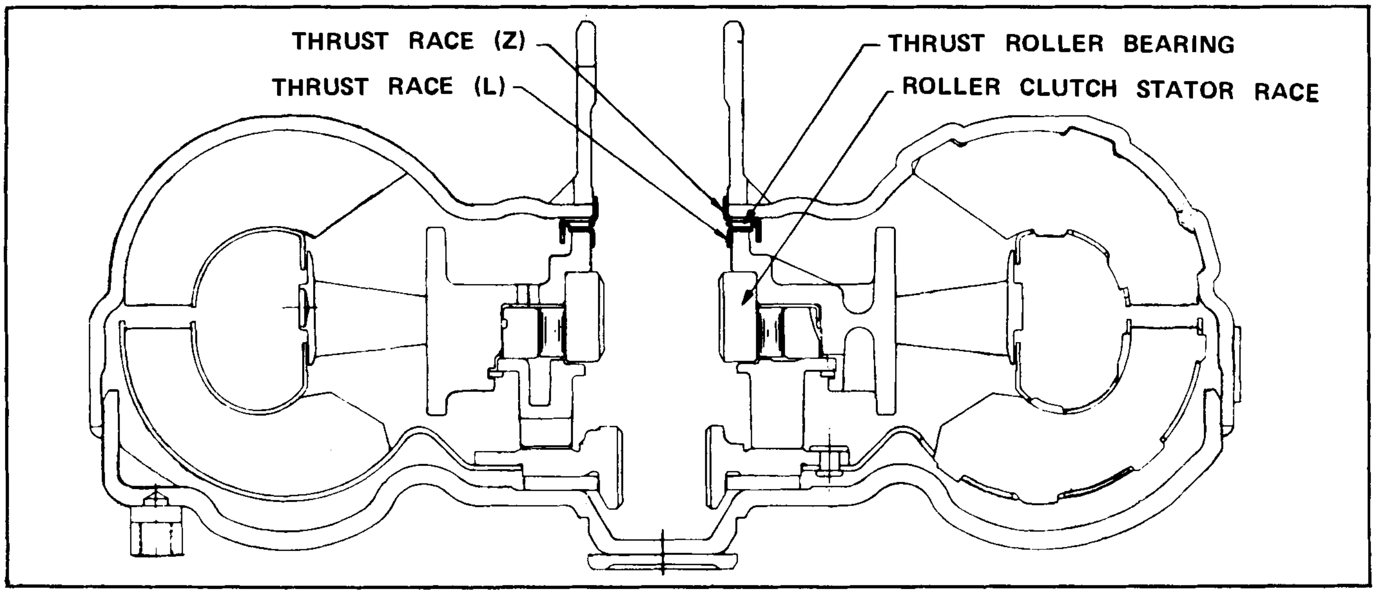


Fig. 7E-164 Cross Section of Converter

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 a failure in some other part of the transmission has resulted in the converter containing dark, discolored fluid. The full flow filter, used in the Hydra-Matic unit since late 1967, is designed to remove all harmful residue from failures, other than converter and/or pump failures, 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. 7E-164):

   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 function of the stator roller clutch can be checked by placing a finger into the converter neck and, with side pressure against splines of the stator race, turning the stator race. The race should turn fairly freely in a clockwise direction and not turn in a counterclockwise direction.

TRANSMISSION REASSEMBLY

REAR UNIT

ASSEMBLE (Fig. 7E-165)

1. Install rear internal gear on end of main shaft.
2. Install internal gear retaining snap ring (Fig. 7E-166).
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. 7E-167).

   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. 7E-168):

   a. Place small diameter race against internal gear, with center flange facing up.

   b. Place bearing on race.

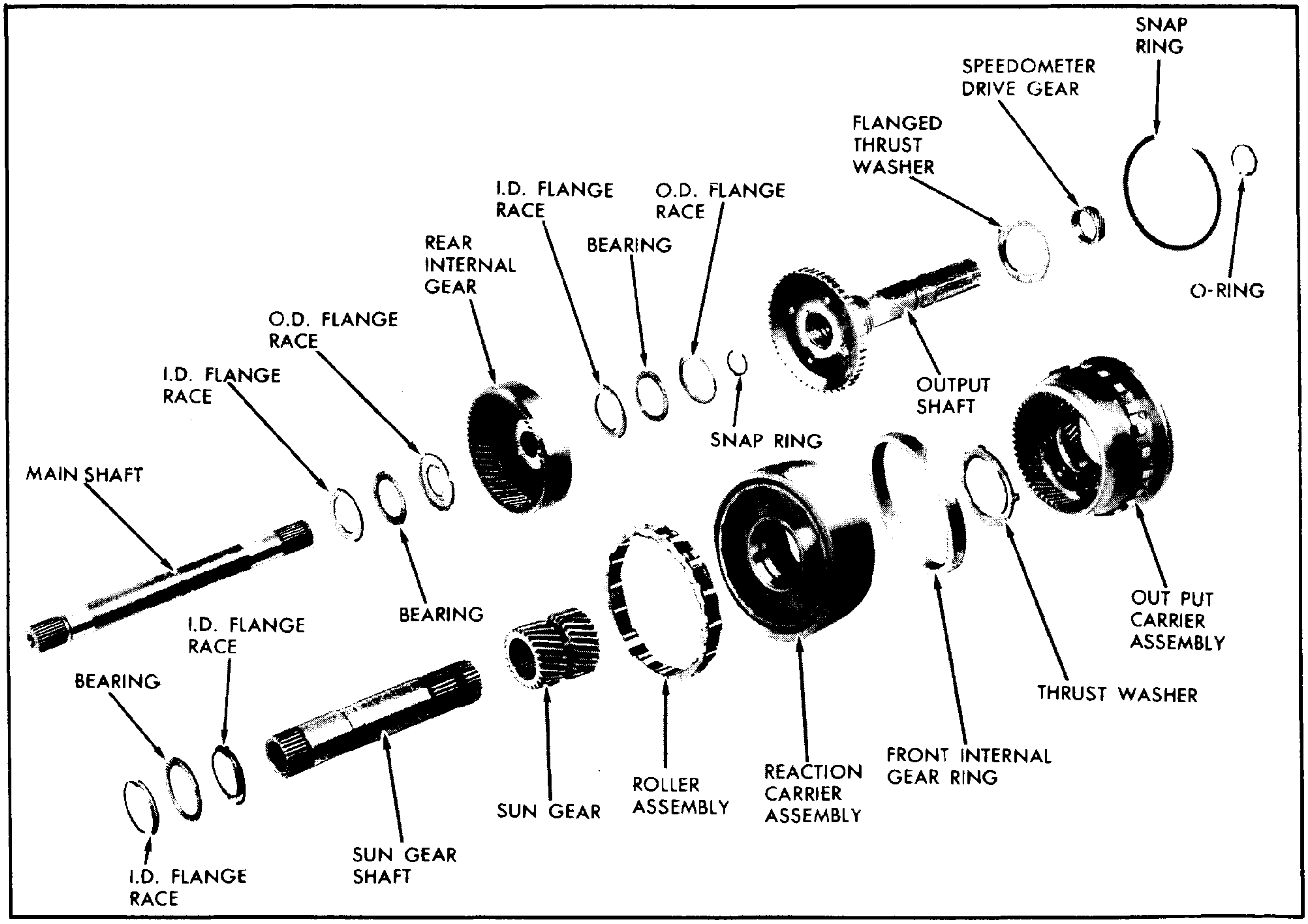


Fig. 7E-165 Exploded View of Rear Unit

c. Place second race on bearing, with outer flange

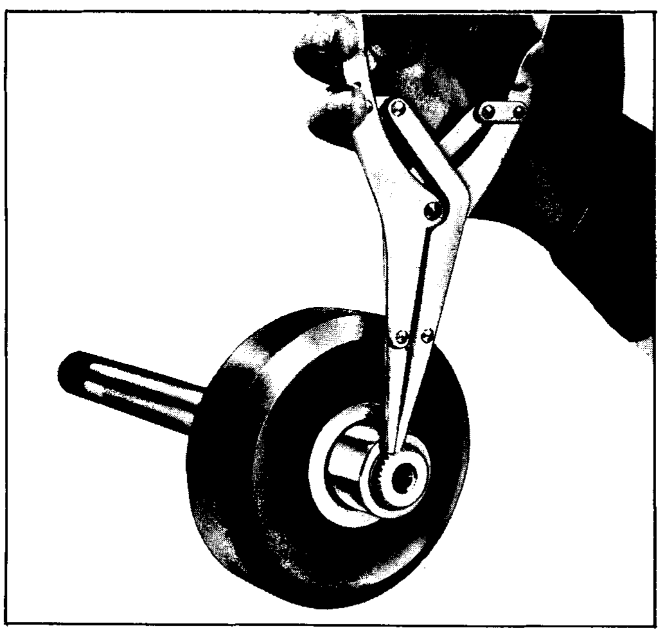


Fig. 7E-166 Installing Mainshaft Snap Ring

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 thrust washer, with tabs facing down in pockets and retain with petrolatum.

11. Install sun gear, splines with chamfer down.

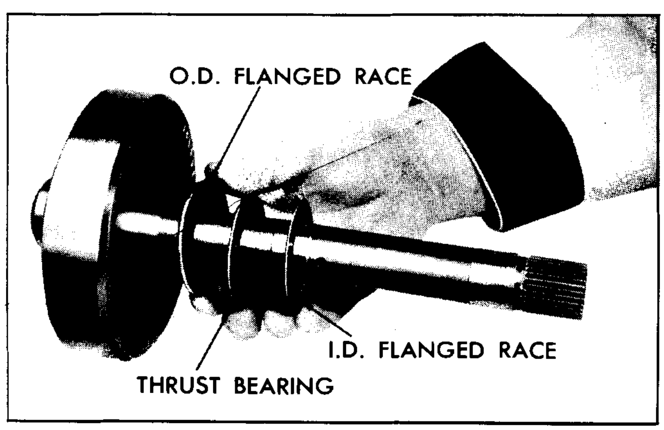


Fig. 7E-167 Installing Bearing and Races

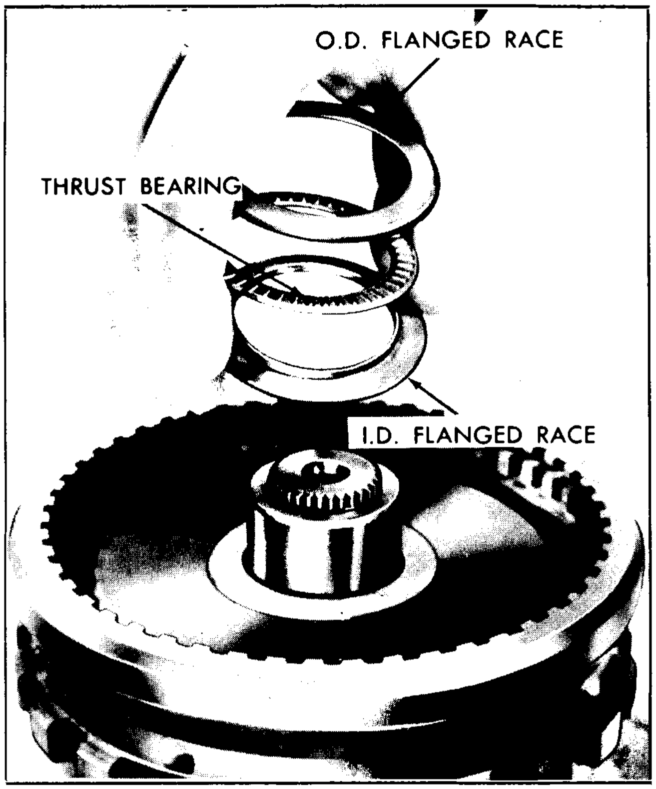


Fig. 7E-168 Installing Bearing and Races on Rear Internal Gear

12. Install composition gear ring over output carrier (Fig. 7E-170).

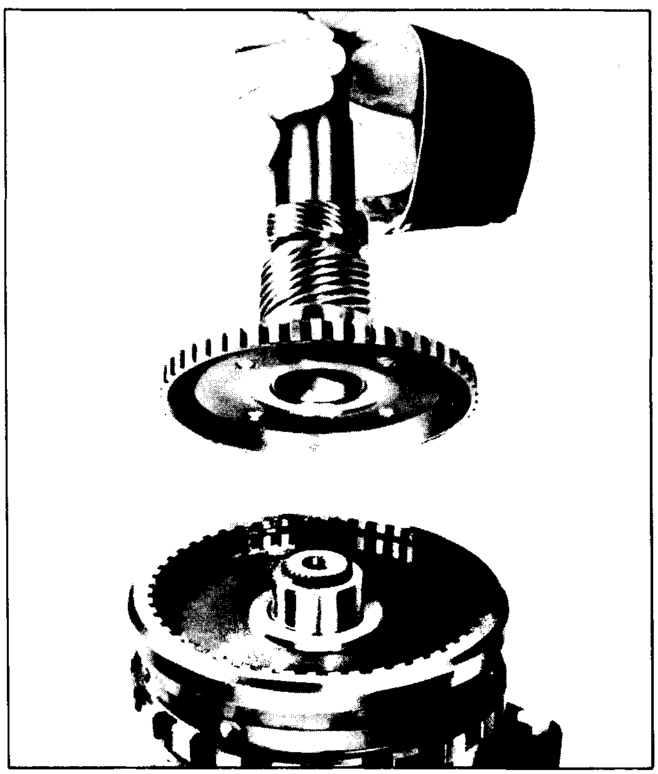


Fig. 7E-169 Installing Output Shaft

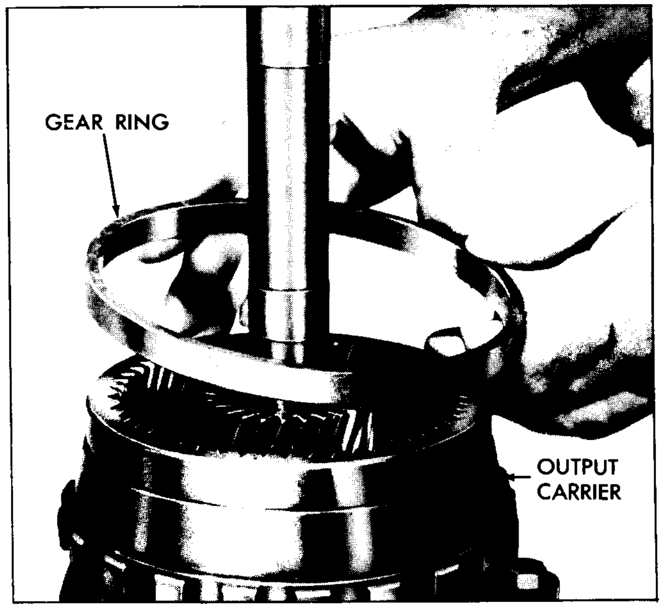


Fig. 7E-170 Installing Gear Ring to Output Carrier

13. Install sun gear shaft, with long splined end down.
14. Install reaction carrier (Fig. 7E-171).

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.*

Fig. 7E-171 Installing Reaction Carrier

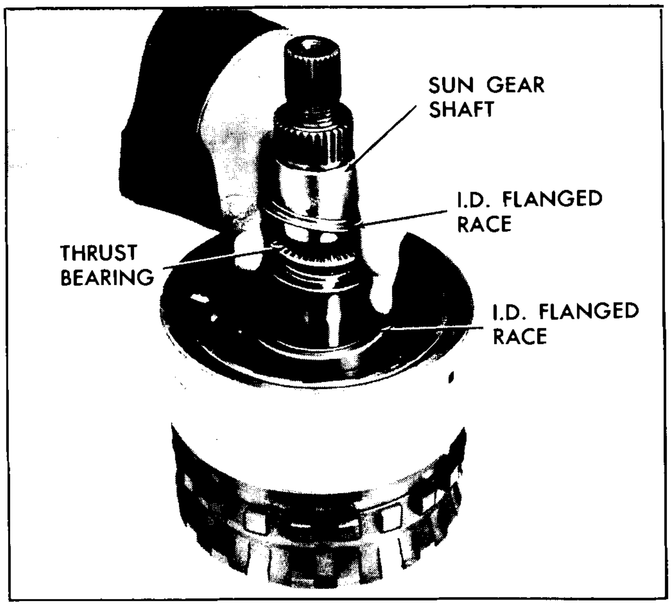


Fig. 7E-172 Installing Bearing and Races on Sun Gear Shaft

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. 7E-172).

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. 7E-173).

17. Install roller clutch into reaction carrier outer race (Fig. 7E-174).

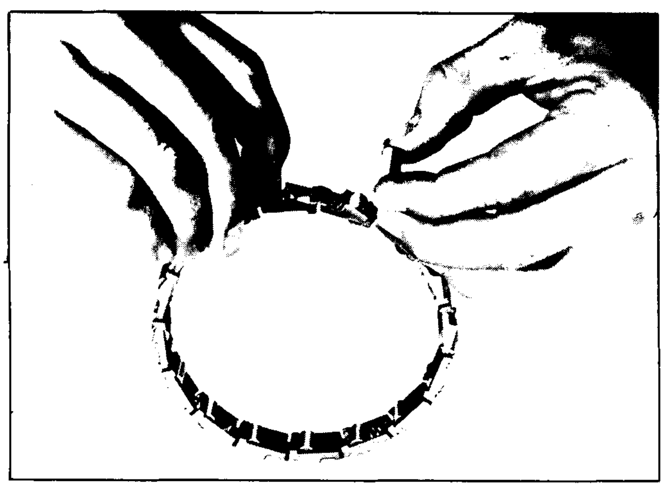


Fig. 7E-173 Installing Roller into Roller Clutch

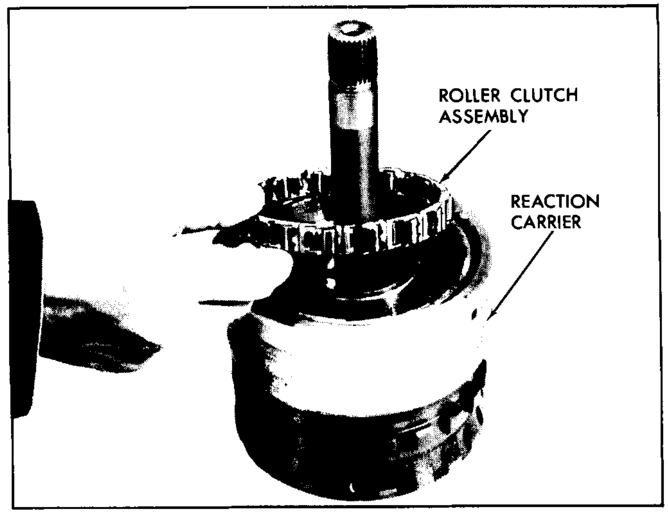


Fig. 7E-174 Installing Roller Clutch Assembly

18. Install center support-to-reaction carrier thrust washer into recess in center support. Retain with petrolatum (Fig. 7E-175).

19. Install center support into reaction carrier and roller clutch assembly (Fig. 7E-176).

    NOTE: *With reaction carrier held, center support should only turn counterclockwise.*

20. Install J 21795 on gear unit to hold units in place.

21. Install output shaft-to-case thrust washer tabs in pockets and retain with petrolatum (Fig. 7E-177).

ASSEMBLY OF UNITS INTO TRANSMISSION CASE

NOTE: *The first 3 steps can be omitted if the*

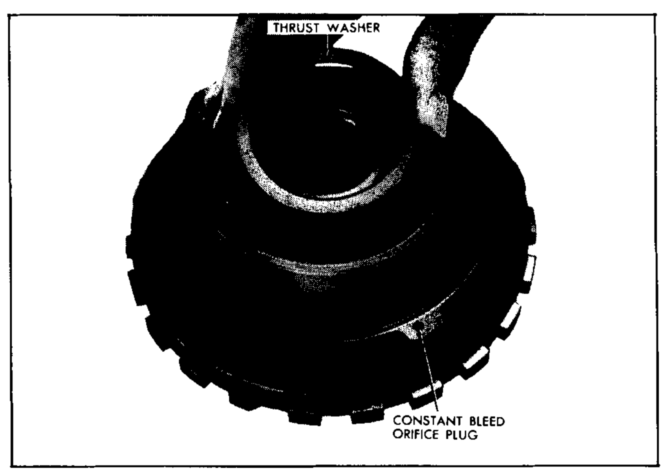


Fig. 7E-175 Installing Center Support Thrust Washer

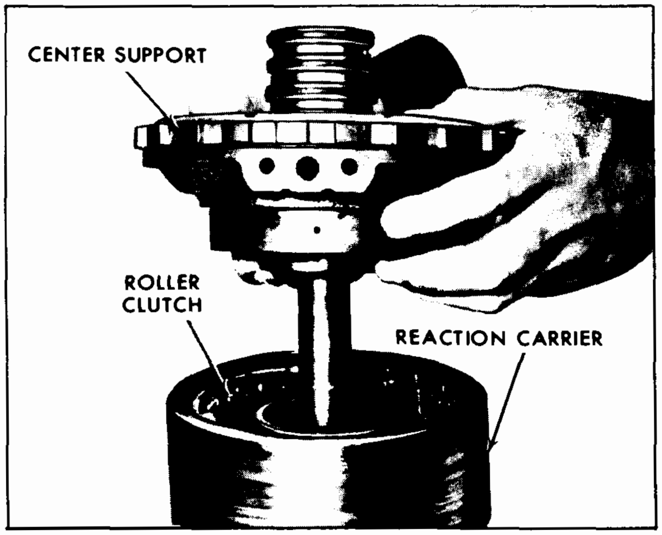


Fig. 7E-176 Installing Center Support Assembly

parts involved were not removed on disassembly.

1. Install parking pawl, tooth toward inside of case, and parking pawl shaft (Fig. 7E-178).
2. Install parking pawl shaft retaining spring (Fig. 7E-179).
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. 7E-180).
4. Install parking pawl return spring, square end hooked on pawl and other end on case (Fig. 7E-181).
5. Install parking brake bracket guides over parking pawl, using two attaching bolts. Torque to 18 lb. ft.

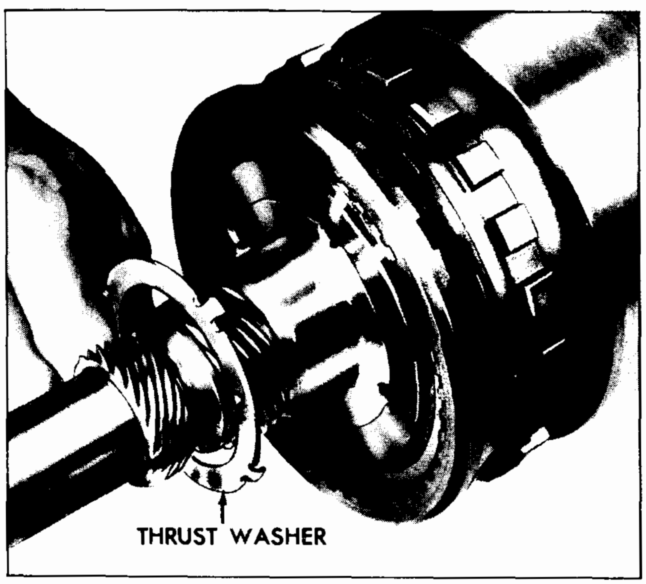


Fig. 7E-177 Installing Output-to-Case Thrust Washer

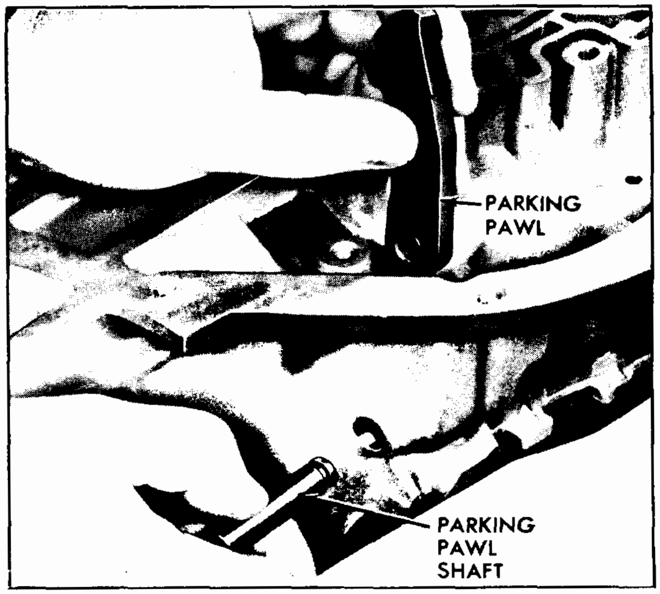


Fig. 7E-178 Installing Parking Pawl and Shaft

6. Install rear band so that two lugs index with two anchor pins. Check to make sure band is seated on lugs (Fig. 7E-182).
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. 7E-183).

   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.

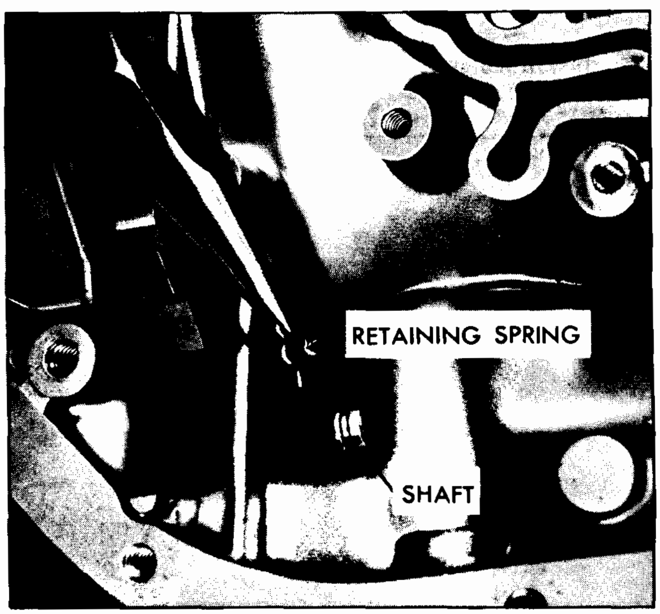


Fig. 7E-179 Installing Retaining Spring onto Pawl Shaft

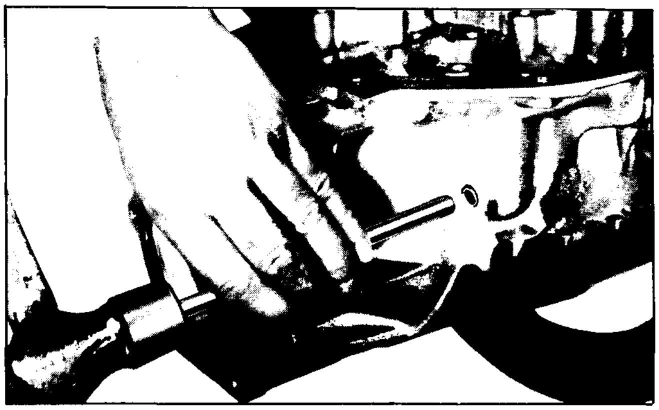


Fig. 7E-180 Driving Cup Plug into Case

Fig. 7E-181 Installing Parking Pawl Return Spring

NOTE: *Dip washer in transmission oil before installation.*

9. Install complete gear unit assembly into case, using Tool J 21795 (Fig. 7E-184) and making certain center

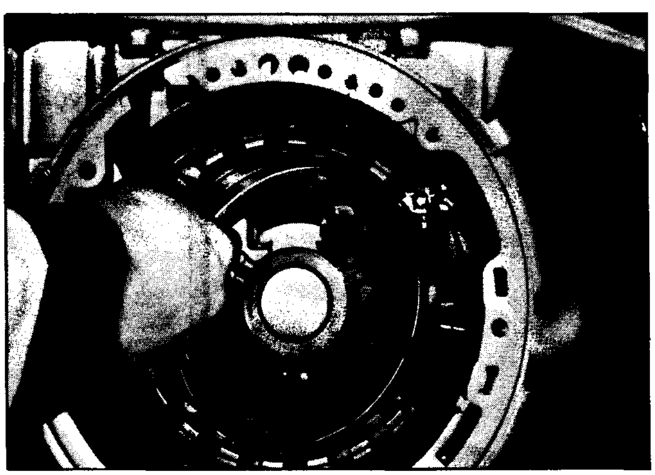


Fig. 7E-182 Installing Rear Band

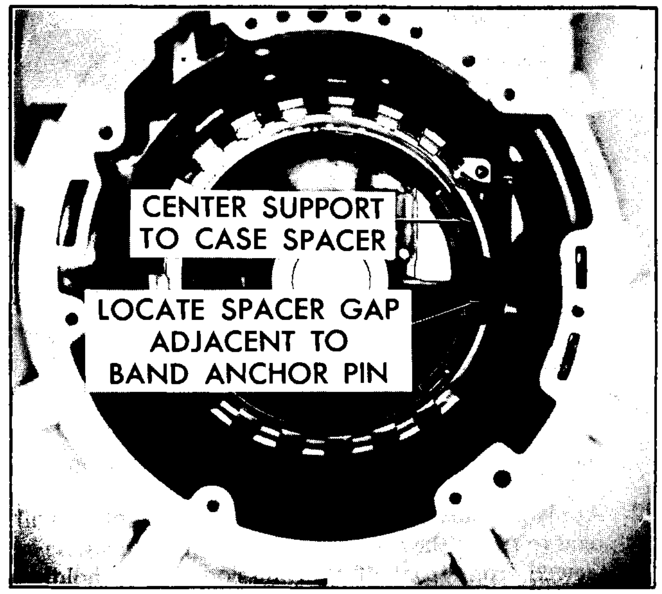


Fig. 7E-183 Proper Location of Support-To-Case Spacer

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. 7E-185).

IMPORTANT: *When properly installed, flat side of ring is against the center support.*

11. Install the case to center support bolt by placing the Center Support 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. 7E-186).

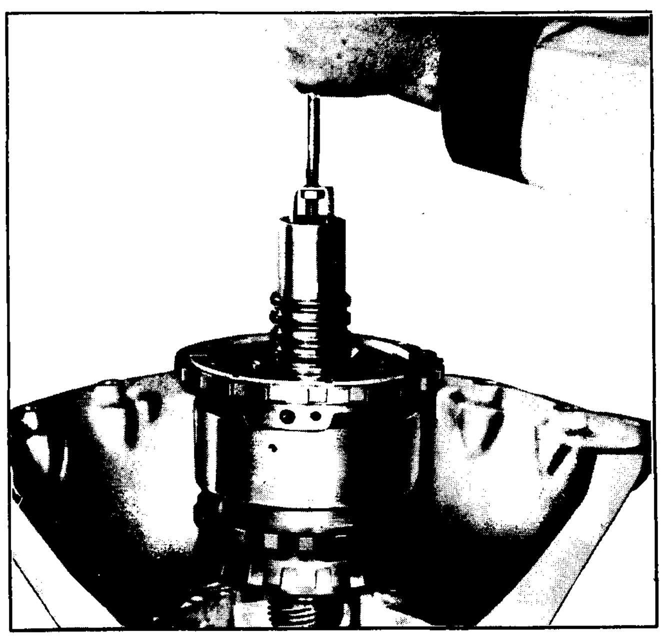


Fig. 7E-184 Installing Complete Gear Unit

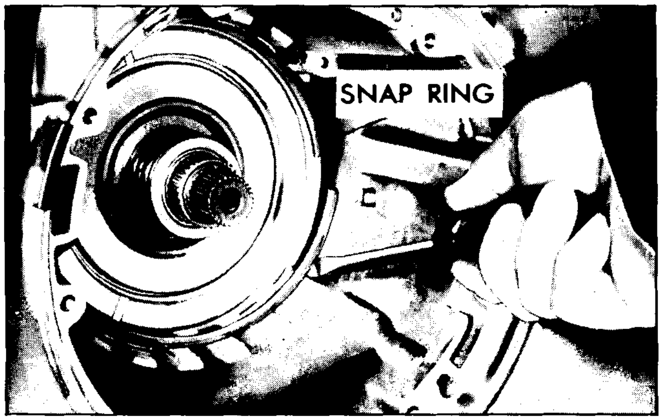


Fig. 7E-185 Installing Support-to-Case Snap Ring

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 and install three (3) steel and three (3) composition intermediate clutch plates. Start with the waved steel and alternate composition and steel clutch plates (Fig. 7E-187).

14. Install intermediate clutch backing plate, ridge up.

15. Install backing plate-to-case snap ring, locating gap opposite the band anchor pin.

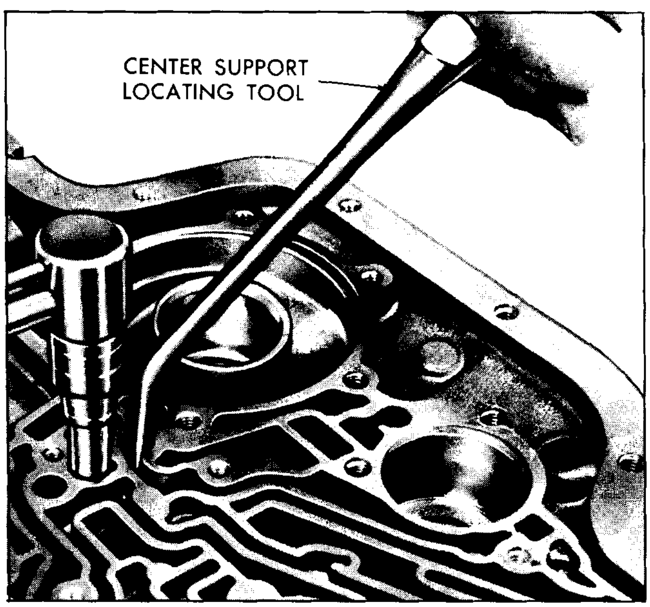


Fig. 7E-186 Installing Center Support Bolt

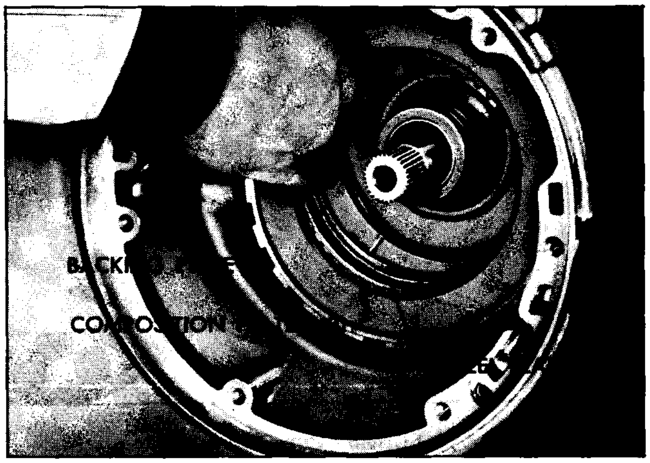


Fig. 7E-187 Installing Intermediate Clutch Pack

NOTE: *Both sides of this snap ring are flat and ring is .093" thick.*

16. Check rear end play as follows:

a. Install J 21884 with 3/8" adapter into an extension housing attaching bolt hole (Fig. 7E-188).

b. Mount Dial Indicator J 8001 on rod and index with end of output shaft.

c. Move output shaft in and out to read end play.

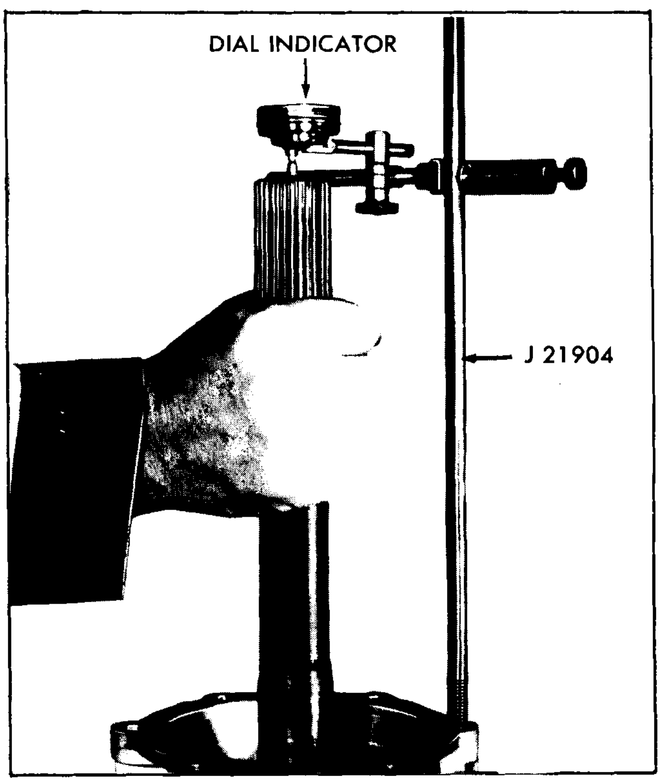


Fig. 7E-188 Checking Rear End Play

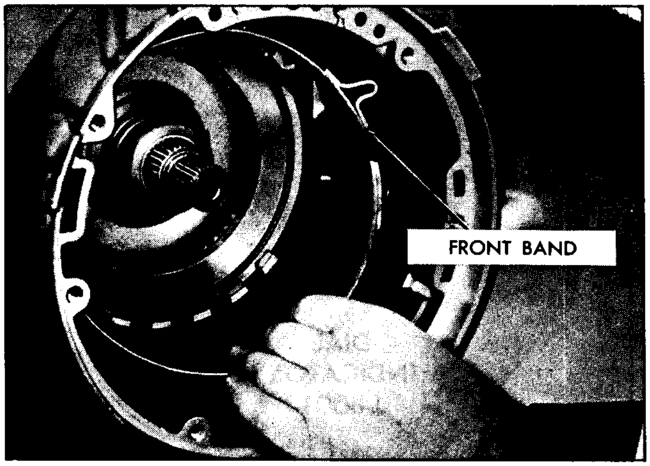


Fig. 7E-189 Installing Front Band

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. 7E-189).

Fig. 7E-190 Positioning Actuator Rod Plunger

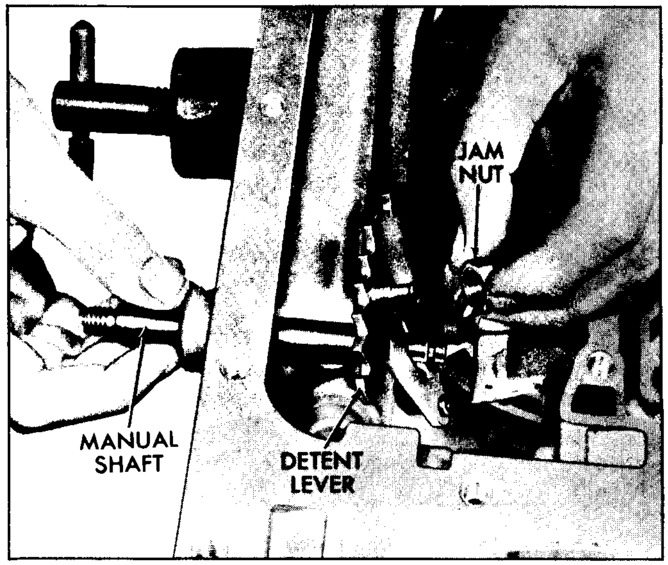


Fig. 7E-191 Installing Jam Nut onto Manual Shaft

18. Install manual linkage as follows:

    a. If necessary, install a new manual shaft seal into transmission case, using a 3/4" dia. 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. 7E-190).

    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. 7E-191).

    f. Install retaining pin, indexing with groove in

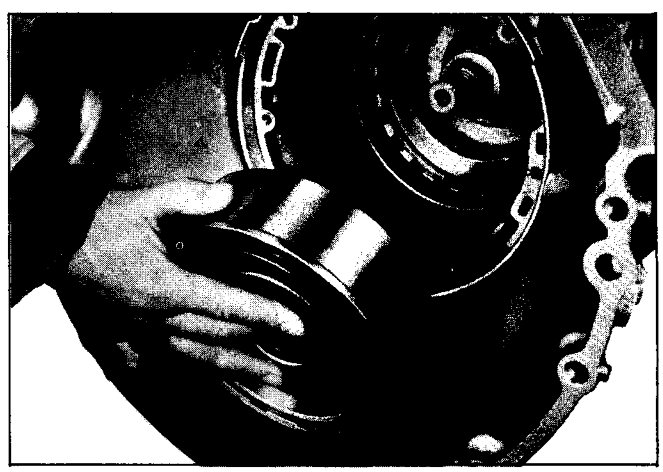


Fig. 7E-192 Installing Direct Clutch Assembly

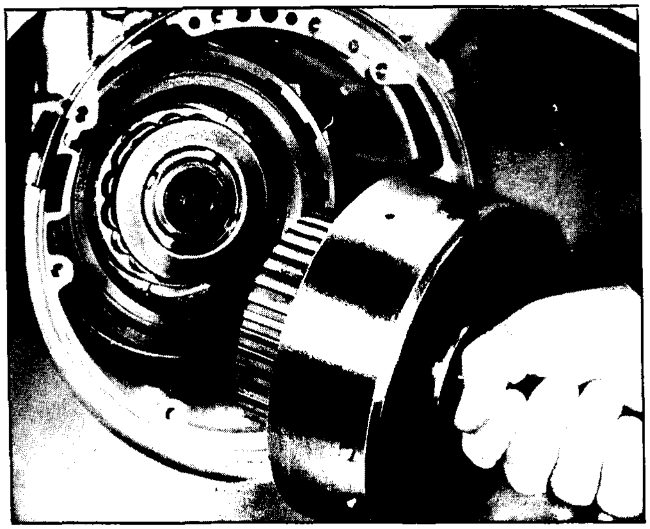


Fig. 7E-193 Installing Forward Clutch Assembly

manual shaft. Rotate transmission to vertical position and remove J 21795.

19. Install direct clutch and intermediate sprag 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. 7E-192).

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. Retain with petrolatum.

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. 7E-193).

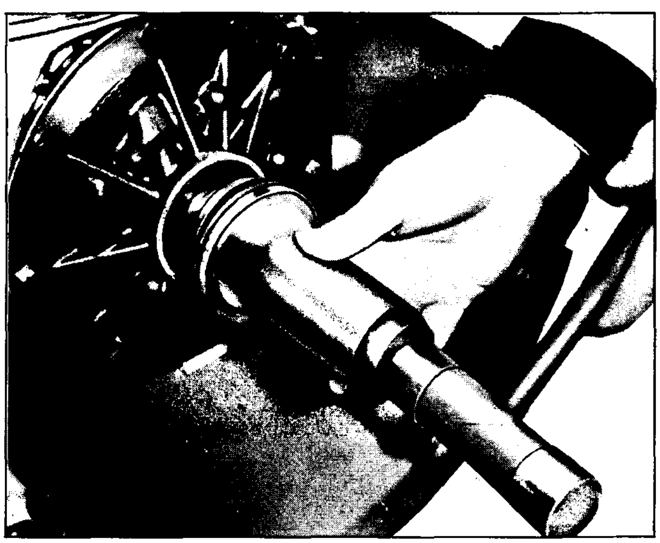


Fig. 7E-194 Installing Front Seal

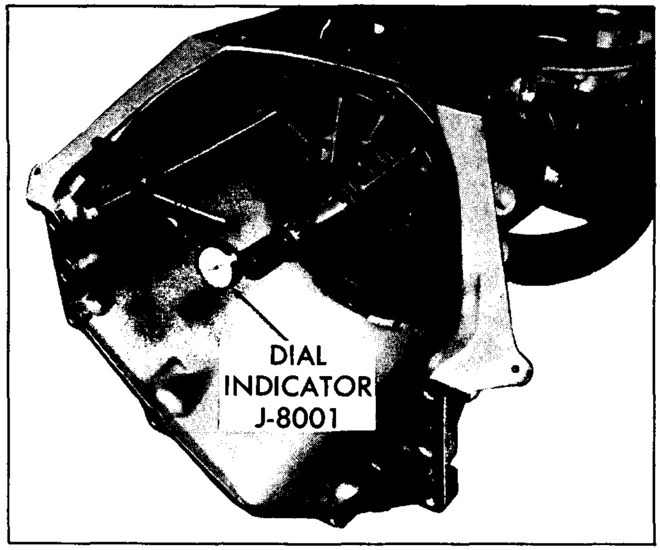


Fig. 7E-195 Checking Front End Play

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 Tool J 21359, drive seal in place (Fig. 7E-194).

25. Check front unit end play as follows (Fig. 7E-195):

    a. Install a 5/16"-18 threaded slide hammer or J 6125 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

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.

CASE EXTENSION ASSEMBLY

INSTALL

1. Install case extension-to-case gasket on extension.
2. Attach case extension to case, using attaching bolts. Torque bolts to 22 lb. ft.
3. a. (All models except PD) If necessary to install a new rear seal, use non-hardening sealer on outside of seal body and, using Oil Seal Installer J 21359, drive seat into place (Fig. 7E-196).

   b. (PD model only) If necessary to install a new rear seal, use non-hardening sealer on outside of seal body and, using Oil Seal Installer J 21426, drive seat into place (Fig. 7E-196).

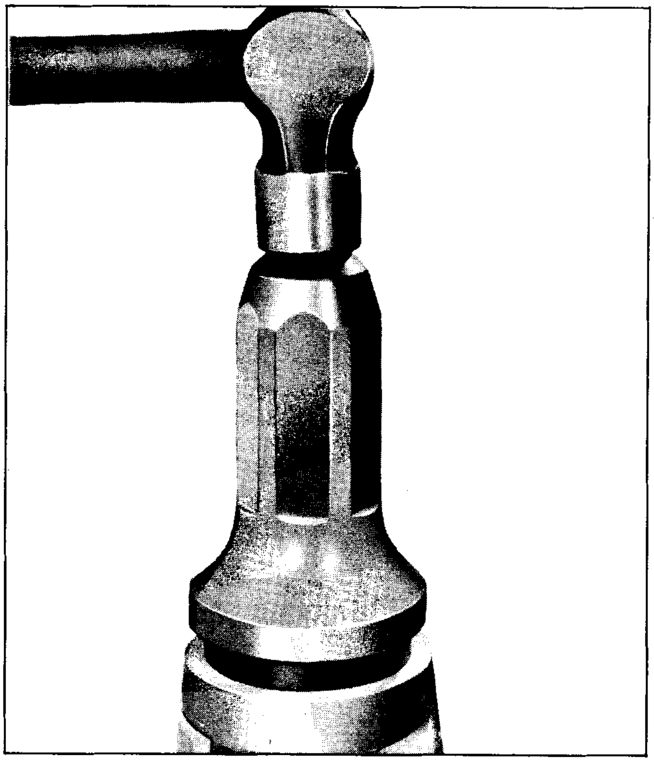


Fig. 7E-196 Installing Rear Oil Seal

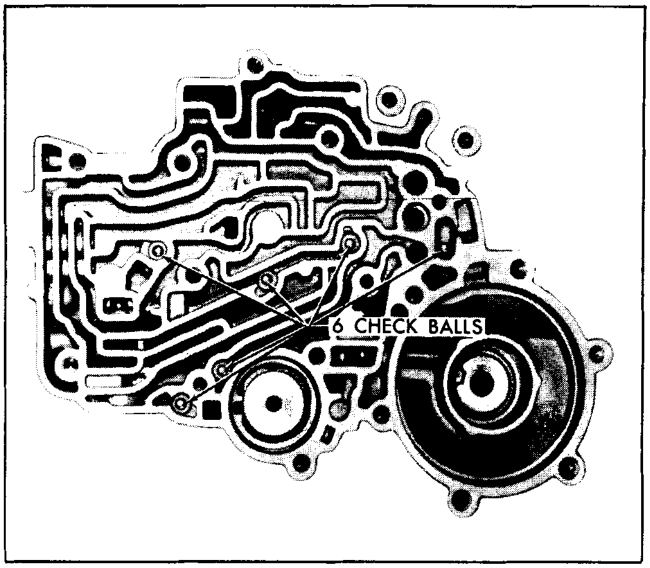


Fig. 7E-197 Location of Check Balls in Case Valve Body Face

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 six (6) check balls into ball seat pockets in the transmission case valve body face (Fig. 7E-197).

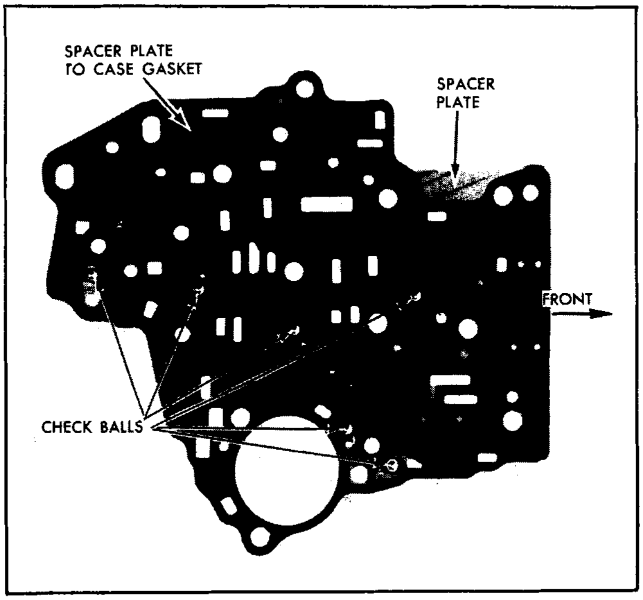


Fig. 7E-198 Location of Check Balls in Spacer Plate

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. It will be necessary to measure washer for its actual thickness.*

26. Install remaining front pump attaching bolt and seal. Torque 18 lb. ft.

CASE EXTENSION ASSEMBLY

INSTALL

1. Install case extension-to-case gasket on extension.
2. Attach case extension to case, using attaching bolts. Torque bolts to 22 lb. ft.
3. a. (All models except PD) If necessary to install a new rear seal, use non-hardening sealer on outside of seal body and, using Oil Seal Installer J 21359, drive seat into place (Fig. 7E-196).

   b. (PD model only) If necessary to install a new rear seal, use non-hardening sealer on outside of seal body and, using Oil Seal Installer J 21426, drive seat into place (Fig. 7E-196).

Fig. 7E-196 Installing Rear Oil Seal

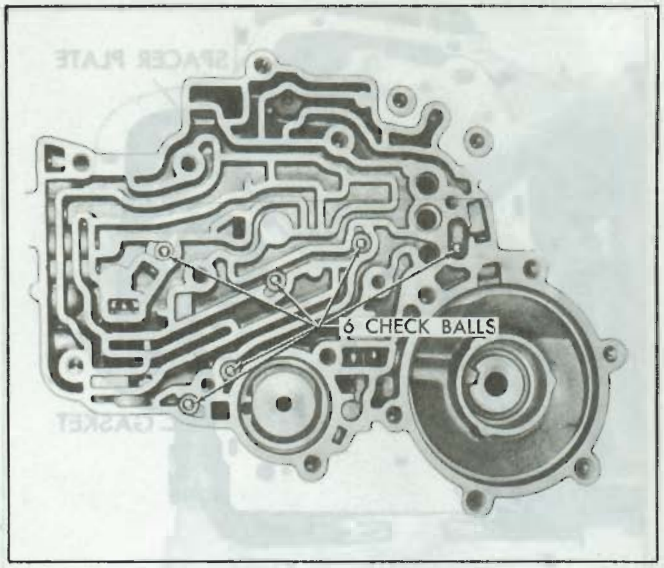


Fig. 7E-197 Location of Check Balls in Case Valve Body Face

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 six (6) check balls into ball seat pockets in the transmission case valve body face (Fig. 7E-197).

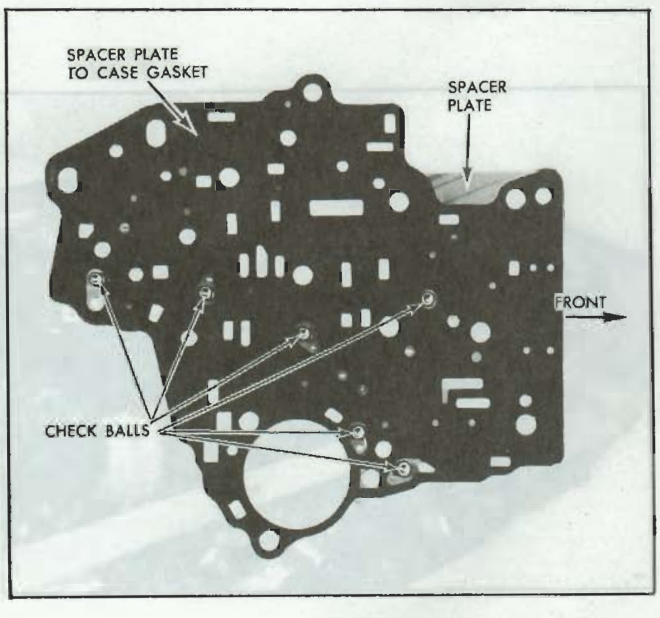


Fig. 7E-198 Location of Check Balls in Spacer Plate

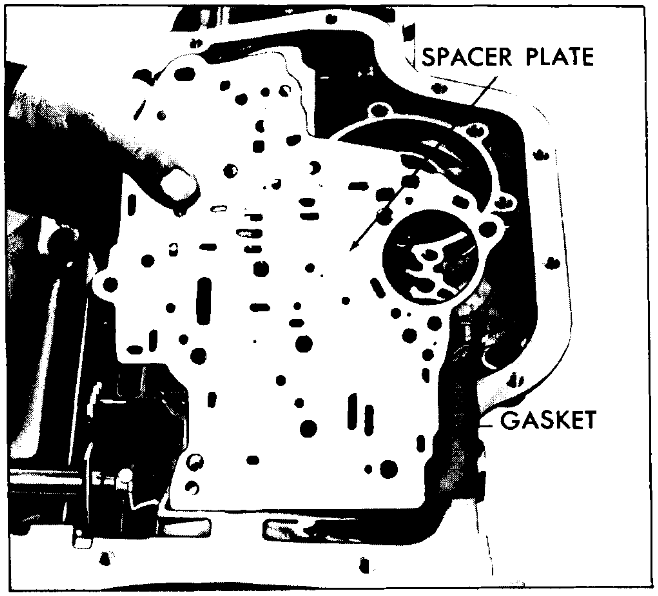


Fig. 7E-199 Installing Gasket and Spacer Plate

NOTE: *If transmission is in car, install check balls into ball seat pockets on the spacer plate (Fig. 7E-198).*

3. Install control valve spacer plate-to-case gasket (gasket with the extension for the detent solenoid).
4. Install control valve spacer plate (Fig. 7E-199).
5. Install detent solenoid gasket and solenoid, with connector facing the outer edge of the case (Fig. 7E-200).

NOTE: *Do not tighten bolts at this time.*

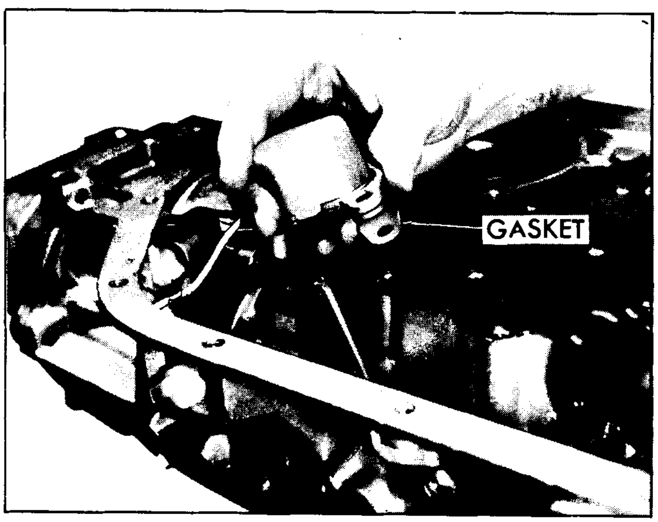


Fig. 7E-200 Installing Detent Solenoid and Gasket

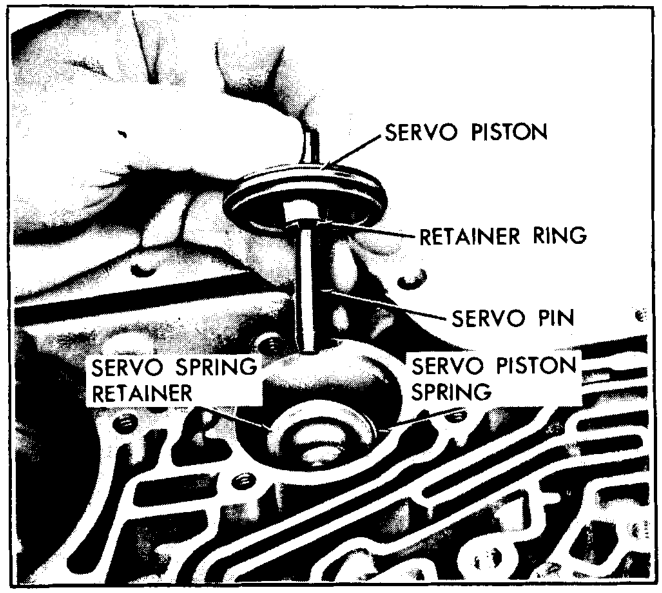


Fig. 7E-201 Installing Front Servo Assembly

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. 7E-201).

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

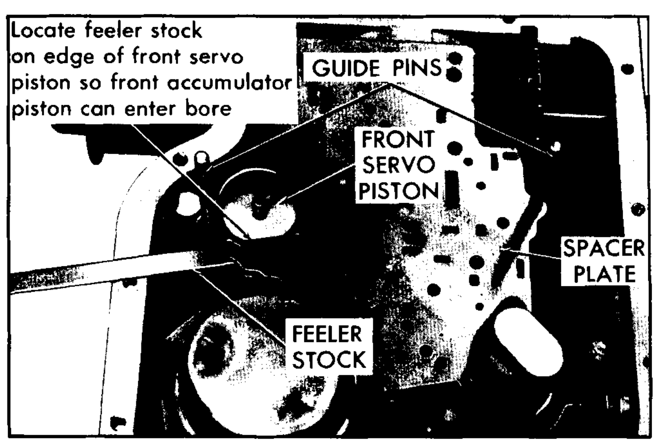


Fig. 7E-202 Retaining Front Servo Group in Case Bore

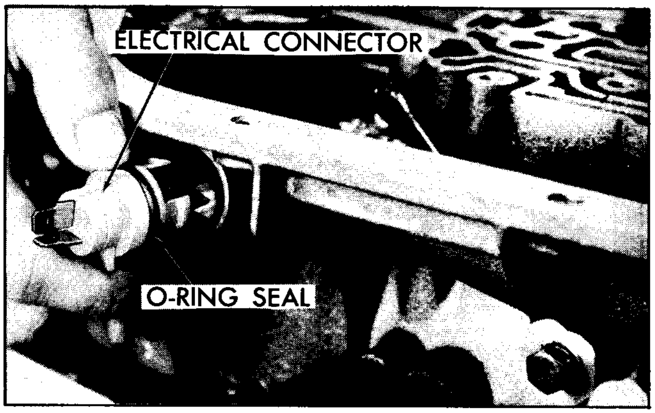


Fig. 7E-203 Installing Electrical Connector

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 7E-98 and install this group of parts into the front servo bore in the case and hold. Slip a length of straight, smooth, clean feeler gauge or shim stock (about .020") between the spacer plate and the front servo piston to temporarily retain the front servo group in its base as shown in Fig. 7E-202.*

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. 7E-203).

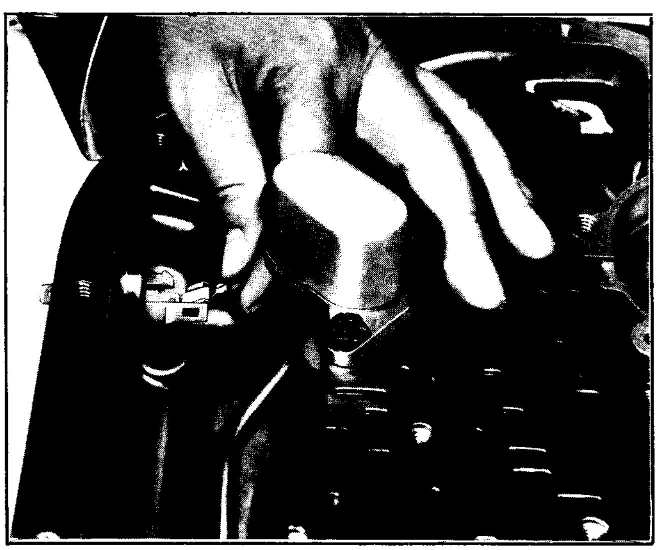


Fig. 7E-204 Connecting Leads to Connector

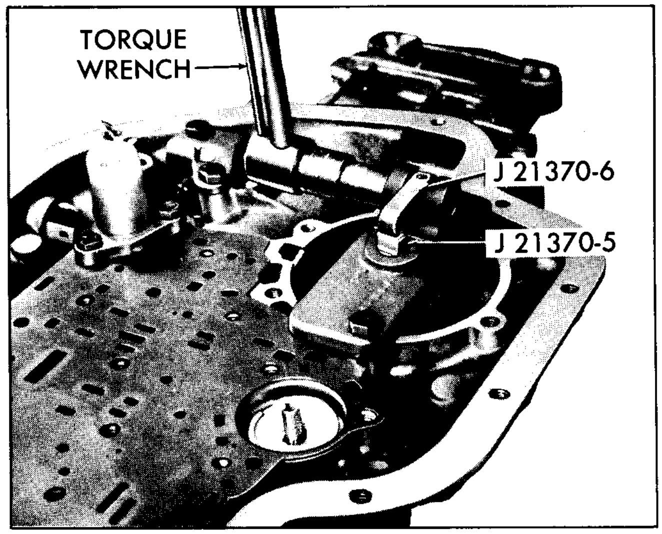


Fig. 7E-205 Checking for Proper Band Apply Pin

11. Connect detent wire and lead wire to electrical connector (Fig. 7E-204).

REAR SERVO ASSEMBLY

INSTALL

1. Before installing rear servo, check band apply (Servo) pin, using Tools J 21370-5 and 6 as follows (Fig. 7E-205):

   a. Attach Band Apply Pin Selection Gage J 21370-6 and 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.

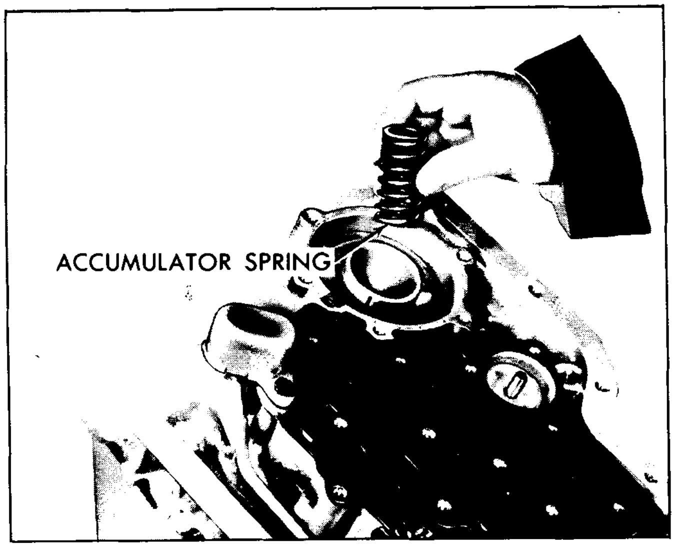


Fig. 7E-206 Installing Rear Accumulator Spring

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. 7E-206).

3. Lubricate and install rear servo assembly into case (Fig. 7E-207).

4. Install rear servo gasket and cover (Fig. 7E-208).

5. Install attaching screws. Torque bolts to 18 lb. ft.

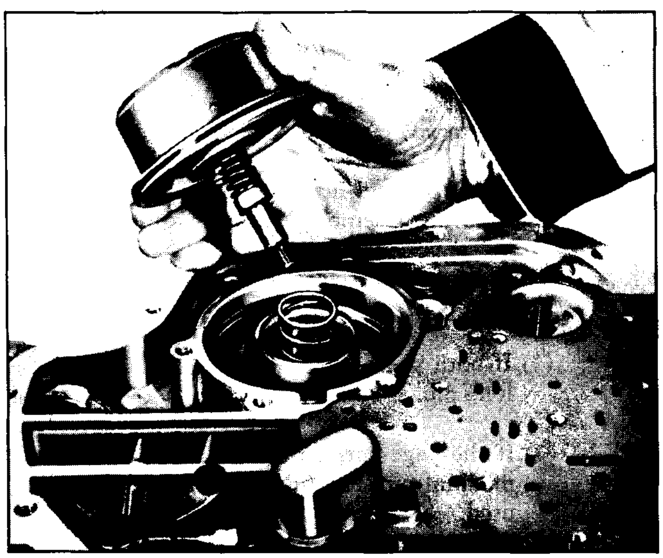


Fig. 7E-207 Installing Rear Servo Piston

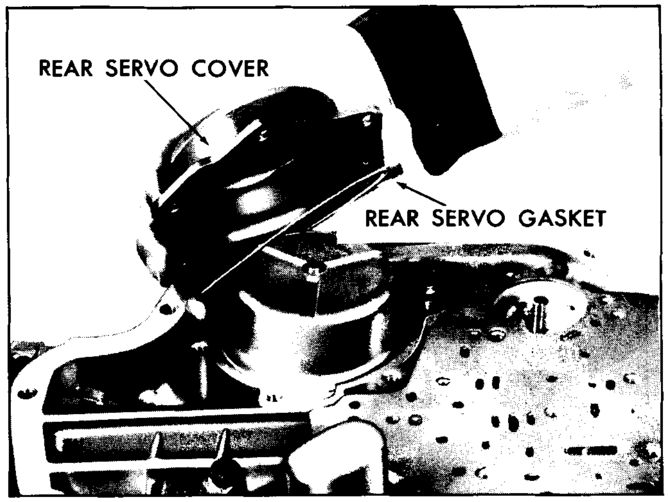


Fig. 7E-208 Installing Rear Servo Cover

@1-3.0

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. 7E-209).

   NOTE: *If transmission is in car, before installing the control valve assembly and governor pipes as outlined in Step 3 below, insert the*

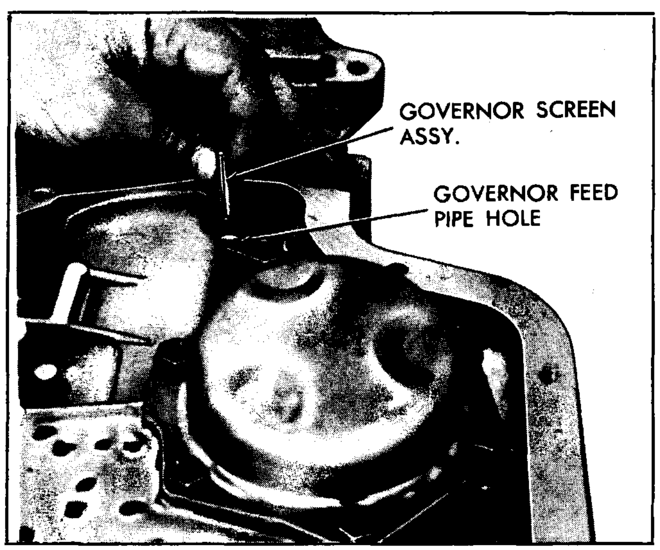


Fig. 7E-209 Installing Governor Screen Assembly

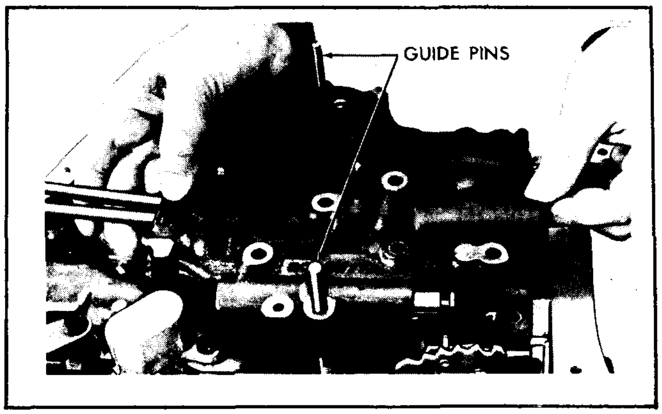


Fig. 7E-210 Installing Control Valve Assembly and Governor Pipes

governor screen (closed end 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, control valve assembly and governor pipes on transmission while carefully aligning the governor feed pipe over the governor screen (Fig. 7E-210). 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 and make certain that lead wire assembly clip is installed.

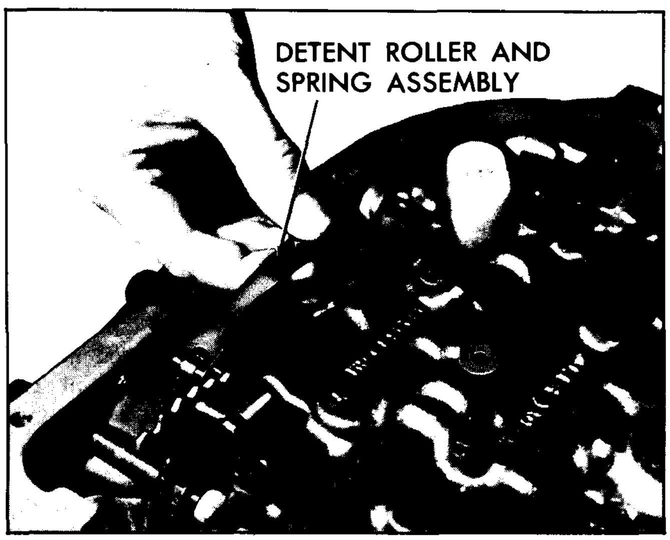


Fig. 7E-211 Installing Detent Roller and Spring Assembly

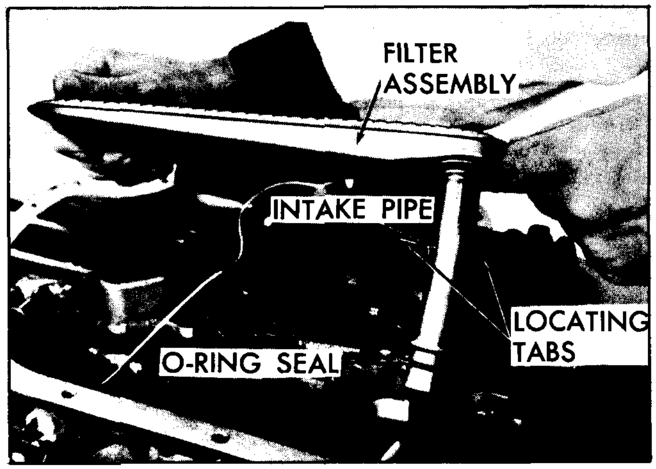


Fig. 7E-212 Installing Filter and Intake Pipe Assembly

NOTE: *If transmission is in car, remove shim stock (or feeler gauge) from between spacer plate and front servo piston before tightening any control valve bolts.*

5. Remove guide pins, install detent roller and spring assembly, remaining attaching bolts and torque all attaching bolts to 8 lb. ft. (Fig. 7E-211).

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. 7E-212).

2. Attach filter to the control valve assembly with the retainer bolt (Fig. 7E-213).

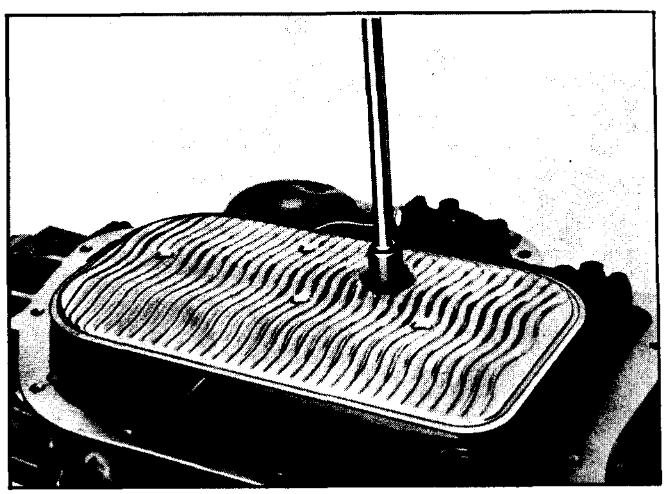


Fig. 7E-213 Installing Filter Retainer Bolt

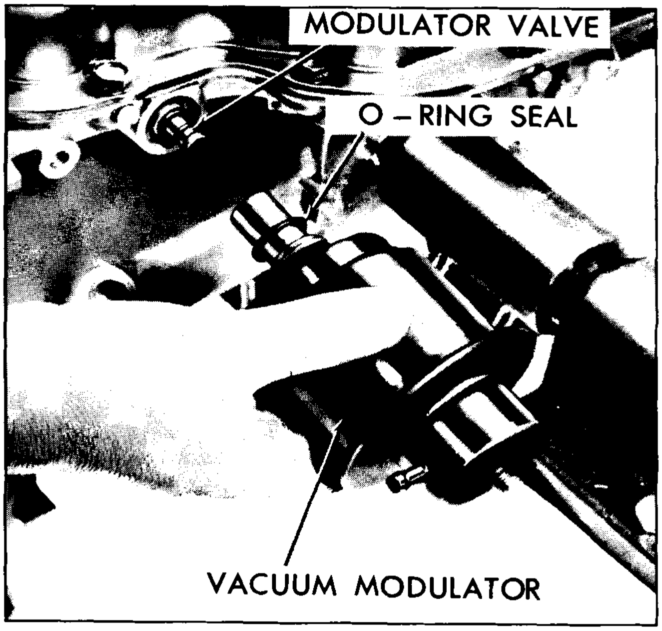


Fig. 7E-214 Installing Vacuum Modulator

NOTE: *After any major repair, the filter must be replaced and oil cooler and cooler lines must be flushed.*

3. Install new bottom pan gasket and bottom pan with attaching screws. Torque to 12 lb. ft.

MODULATOR VALVE AND VACUUM MODULATOR

INSTALL

1. Install modulator valve into case, stem end out.
2. Install O-ring seal on vacuum modulator.

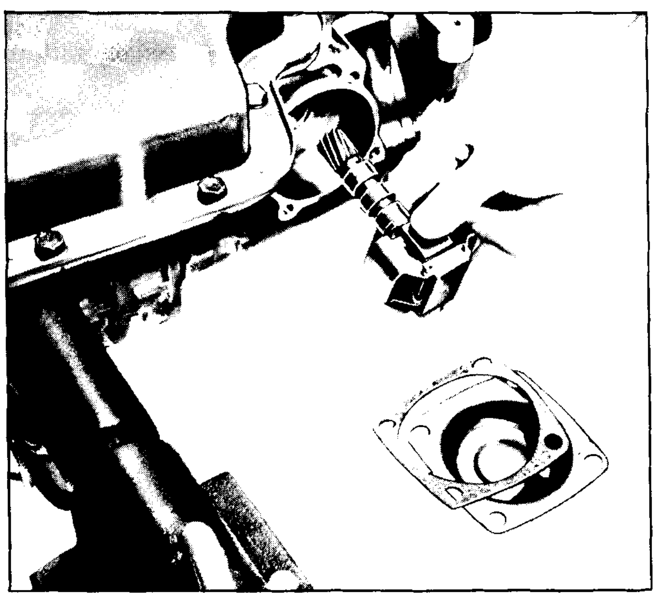


Fig. 7E-215 Installing Governor

3. Install vacuum modulator into case (Fig. 7E-214).
4. Install modulator retainer and attaching bolt. Torque bolt to 18 lb. ft.

GOVERNOR

INSTALL

1. Install governor into case (Fig. 7E-215).
2. Attach governor cover and new gasket with four (4) attaching bolts. Torque bolts to 18 lb. ft.

SPEEDOMETER DRIVEN GEAR-SPEED CONTROL SWITCH

INSTALL

1. Install speedometer driven gear-speed control switch assembly into case extension.
2. Install speedometer driven gear-speed control switch 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.

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

An identifying code is found on the serial number plate of the Turbo Hydra-Matic (M-40) 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, PG, PH, PQ, PR, PT or PX. The application of each transmission code is as follows:

PA 400 cu. in., 2 and 4 bbl. (Wagons Only) and 455 cu. in., 2 bbl. engines (B Series).

PB 400 cu. in., 4 bbl. (Except Wagons) engine (B Series).

PC 455 cu. in., 4 bbl. engine (B Series).

PD 400 cu. in., 2 bbl. (Except Wagons) engine (B Series).

PG 400 cu. in., 4 bbl. engine (A and F Series).

PH Police and Heavy Duty Requirements (B Series).

PQ 455 cu. in. H.O. engine (A and F Series).

PR 455 cu. in., 4 bbl. engine (A and G Series).

PT 400 cu. in., 2 bbl. engine (A and F Series).

PX 400 cu. in., 4 bbl. engine (G Series).

It is very important that any communications concerning the Turbo Hydra-Matic (M-40) 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

APPLICATION	LB. FT.
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	16
Filter Retainer Bolt	10

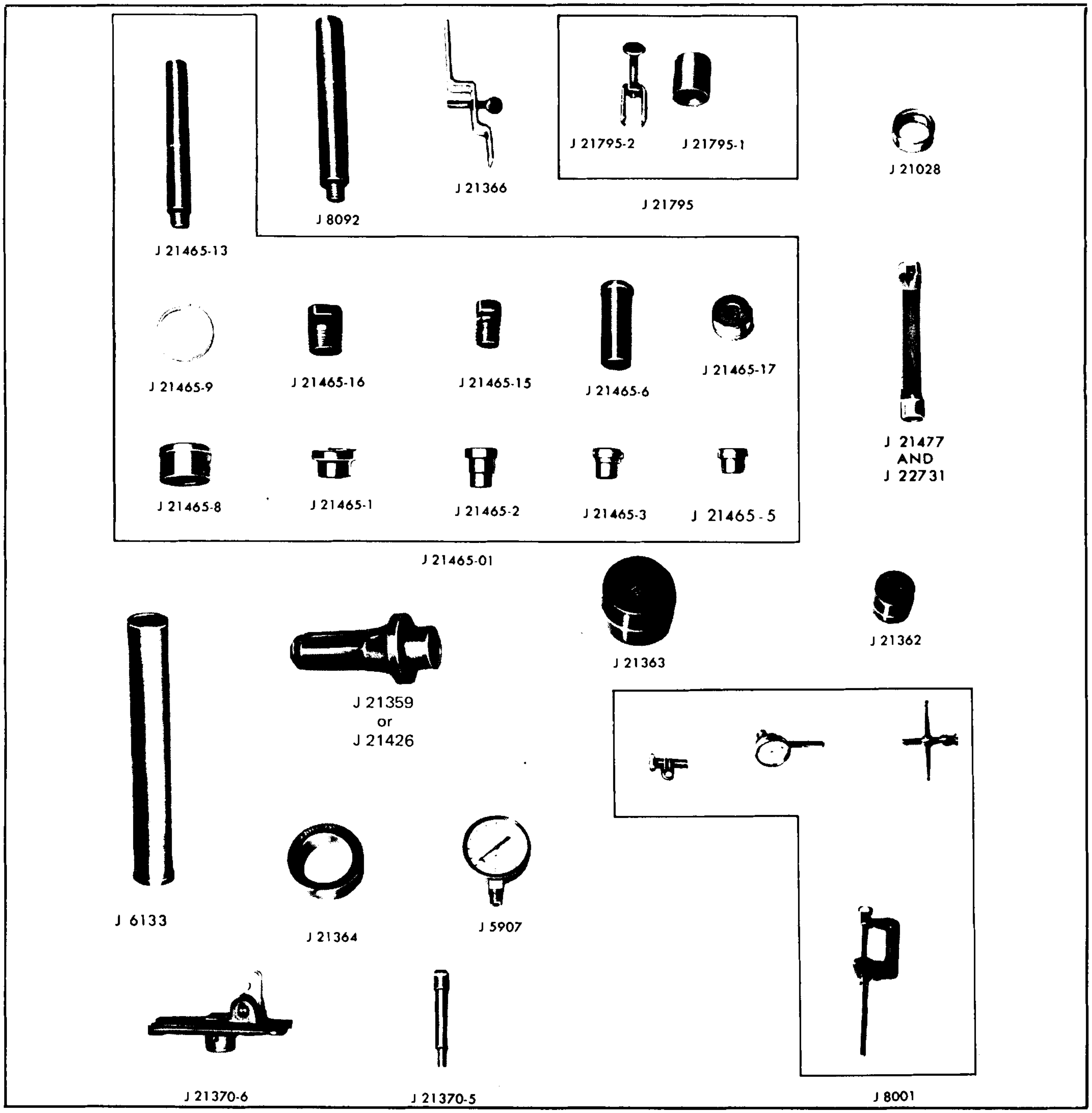


Fig. 7E-216 Special Tools

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 (Except Model PD)
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 21426	Oil Seal Installer (Model PD Only)
J 21465-01	Bushing Tool Set
J 21477	Cooler Pipe Wrench - B Series Only
J 21795	Gear Unit Assembly Holding Tool
J 22731	Cooler Pipe Wrench-Except B Series
J 23093	Center Support Locating Tool (Not Shown)

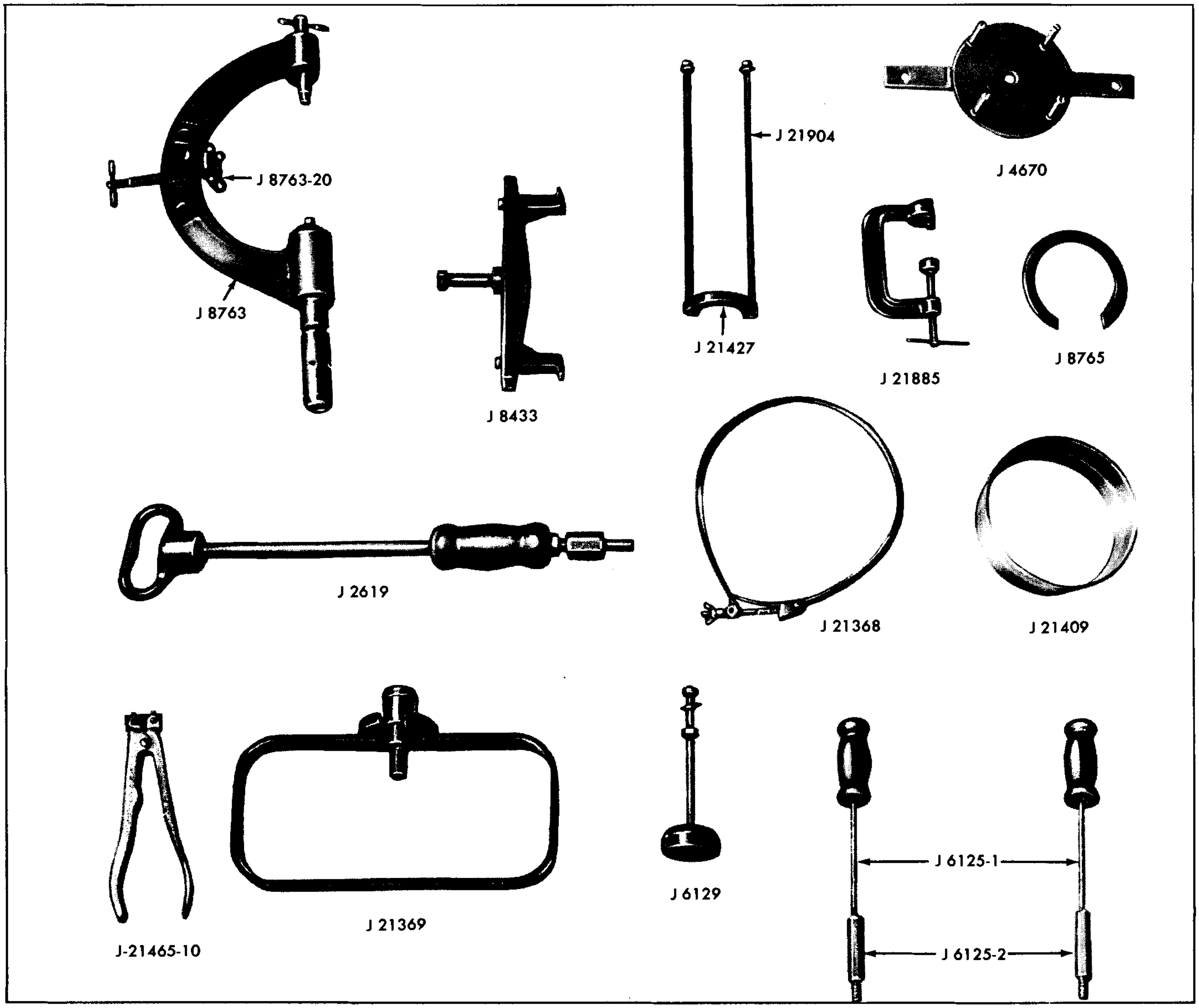


Fig. 7E-217 Special Tools

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&-3	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

SECTION 7F

TWO SPEED AUTOMATIC (M-35) TRANSMISSION

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

Four basic pressure checks are used for trouble diagnosis and operational checks for the two speed automatic (M-35) transmission:

I. Wide Open Throttle Upshift Pressure Check

II. "Drive" Range Overrun (Coast) Pressure Check

III. "Drive" Range Idle Pressure Check

IV. "Low" Range Pressure Check

All checks should be made only after thoroughly warming up the transmission.

Make pressure gauge hose connection at low servo apply pressure (mainline) test point, run hose into driver's compartment by pushing aside lower steering column jacket seal (hose out of way of the driver's feet) and connect to Pressure Gauge J5907. With pressure gauge installed, perform the following preliminary steps:

1. Establish pressure gauge indicator needle rest position at "zero" pressure.

<table>
<tr><th rowspan="2">ENGINE</th><th rowspan="2">I
Drive Range–Wide Open Throttle Upshift</th><th rowspan="2">II
Drive Range–Overrun (Coast) @25-20 mph. (20" Hg. Approx.)</th><th colspan="2">III
Drive Range–Idle Pressure</th><th rowspan="2">IV
Low Range–@1000 rpm.</th></tr>
<tr><th>16" Hg.</th><th>10" Hg.</th></tr>
<tr><td>6 Cylinder</td><td>87–104</td><td>48–53</td><td>52–72</td><td>79–97</td><td>106–117</td></tr>
<tr><td>8 Cylinder</td><td>99–117</td><td>48–53</td><td>53–73</td><td>81–100</td><td>115–128</td></tr>
</table>

Fig. 7F-1 Mainline Pressure Check Chart

2. Check transmission oil level.
3. Make sure vacuum line connections are tight.
4. Check linkage adjustment.

I. Wide Open Throttle Upshift Pressure Check

Road test the car to determine its wide open throttle upshift pressure point and compare it to the pressure check chart (Fig. 7F-1) for upshift pressure points as indicated.

II. "Drive" Range Overrun (Coast) Pressure Check

In addition to the oil pressure gauge, a vacuum gauge should be installed for this check. With the vehicle coasting in "Drive" range at 25 - 20 m.p.h., with engine vacuum at approximately 20" Hg., low servo apply (Mainline) pressure should be as shown on the pressure check chart (Fig. 7F-1).

III. "Drive" Range Idle Pressure Check

With pressure gauge and vacuum gauge installed, with vehicle at a stop and parking brake applied, shift selector lever in "Drive" range and engine idling, low servo apply (Mainline) pressure should be as shown on the pressure check chart (Fig. 7F-1).

If pressures are not within these ranges, the following items should be checked for oil circuit leakage:

1. Pressure regulator valve stuck.
2. Vacuum modulator valve stuck.
3. Boost valve stuck.
4. Leak at low servo piston ring (between ring and bore).
5. Leak at low servo piston rod (between rod and bore).
6. Leak at valve body-to-case gasket.
7. Leak at valve body gaskets.
8. Oil pump clearances.
9. Check passages in transmission case for porosity.

IV. "Low" Range Pressure Check

In addition to the pressure gauge, connect a tachometer, apply the parking brake, place shift selector lever in "Low" range and adjust the engine speed to 1,000 r.p.m. Low servo apply (Mainline) pressure should be as shown on the pressure check chart (Fig. 7F-1).

If pressures are not within these ranges, check the following possibilities:

1. Partially plugged oil suction screen.
2. Broken or damaged low servo ring.
3. Pressure regulator valve stuck.
4. Leak at valve body-to-case gasket.
5. Leak between valve body gaskets.
6. Leak at servo center.
7. Oil pump clearance.

SHIFT POINTS (Fig. 7F-2)

With a tachometer installed, road test the vehicle for its shift from low to high gear as follows:

ENGINE	THROTTLE POSITION	R.P.M. IN DRIVE RANGE			
		UPSHIFT		DOWNSHIFT	
		Min.	Max.	Min.	Max.
L-6 250 cu. in.	Closed Throttle	1390	1690	1602	1285
	Detent Touch	3133	3837	3001	2014
	Wide Open Throttle	3758	4374	4162	3476
V-8 350 cu. in.	Closed Throttle	1126	1496	1320	1047
	Detent Touch	3406	4215	3344	2429
	Wide Open Throttle	4083	4646	4435	3802

Fig. 7F-2 Shift Points (in Engine rpm's)

1. Position the selector lever in Drive range and accelerate the vehicle from 0 mph. The low to high gear shift points (in rpm's) will vary with the throttle opening.
2. As the vehicle decreases in speed to 0 mph, the high to low gear shifts (in rpm's) will occur, varying with the throttle opening.

TWO SPEED AUTOMATIC (M-35) TROUBLE DIAGNOSIS GUIDE

NO DRIVE IN ANY SELECTOR POSITION

1. Low oil level.
2. Clogged oil suction screen.
3. Defective pressure regulator valve.
4. Defective oil pump.
5. Broken input shaft.
6. Sticking oil pump priming valve.

ENGINE FLARES ON STANDSTILL STARTS BUT ACCELERATION LAGS.

1. Low oil level.
2. Clogged oil suction screen.
3. Improper band adjustment.
4. Disengaged or broken band apply linkage.
5. Worn band facing.
6. Blocked servo apply passage.
7. Broken or leaking servo piston ring.
8. Stator in converter not holding (rare).

ENGINE FLARES ON UPSHIFT

1. Low oil level.
2. Improper band adjustment.
3. Plugged vacuum modulator line.
4. Clogged oil suction screen.
5. Blocked high clutch feed orifice.
6. Leaking high clutch seals.
7. Worn high clutch plates.
8. Sticking or hung up high clutch piston.
9. Relief ball not sealing in high clutch drum.

NO UPSHIFT

Low band not releasing, probably due to:

1. Stuck low and drive valve.
2. Defective governor.
3. Stuck or maladjusted throttle valve.
4. Maladjusted manual valve lever.

NO DOWNSHIFT

1. Low TV pressure.
2. High governor pressure.
3. Sticking low and drive shift plug.
4. Sticking low and drive shift valve.

HARSH UPSHIFT

1. Improper carburetor-to-transmission TV rod adjustment.
2. Improper band adjustment.
3. Broken or disconnected vacuum modulator line.
4. Leaking vacuum modulator diaphragm.
5. Sticking vacuum modulator valve.
6. Sticking booster valve in valve body.

HARSH CLOSED THROTTLE (COAST) DOWNSHIFT

1. High engine idle speed.
2. Improper band adjustment.
3. Malfunction of downshift timing valve.
4. High mainline pressure, probably due to:
   a. Vacuum modulator line broken or disconnected.
   b. Modulator diaphragm ruptured.
   c. Sticking vacuum modulator valve, pressure regulator valve or booster valve.

NO DRIVE IN REVERSE

1. Improper manual valve lever adjustment.
2. Stuck reverse clutch piston.
3. Worn out reverse clutch plates.
4. Reverse clutch leaking excessively.
5. Blocked reverse clutch apply orifice.

IMPROPER SHIFT POINTS

1. Improper carburetor-to-transmission linkage adjustment.
2. Improper throttle valve (TV) adjustment.
3. Defective governor.

BURNED CLUTCH PLATES

1. Band adjusting screw backed off more than specified.
2. Improper order of clutch plate assembly.
3. Extended operation with low oil level.
4. Stuck relief ball in clutch drum.
5. Abnormally high speed upshift, probably due to:
   a. Improper governor action.
   b. Transmission operated at high speed in manual "low".

CAR CREEPS EXCESSIVELY IN DRIVE RANGE

Idle speed set too high.

CAR CREEPS IN NEUTRAL RANGE

1. Improper manual valve lever adjustment.
2. High clutch or low band not released.

OIL LEAKS

1. Transmission case and extension housing:

a. Extension housing oil seal.

b. Shifter shaft oil seal.

c. Speedometer driven gear fitting.

d. Pressure taps.

e. Oil cooler pipe connections.

f. Porosity in case and/or housing.

g. Vacuum modulator assembly (a very smoky exhaust indicates a ruptured vacuum modulator diaphragm).

2. Transmission oil pan gasket.

3. Converter cover pan:

a. Oil pump attaching bolts.

b. Oil pump seal ring.

c. Oil pump oil seal.

d. Plugged oil drain in oil pump.

e. Porosity in transmission case.

4. Oil forced out filler tube:

a. Oil level too high with aeration and foaming caused by planet carrier running in oil.

b. Water in oil.

c. Leak in oil pump suction circuits.

GENERAL DESCRIPTION

The case and converter housing of the two-speed automatic (M-35) transmission is a single case aluminum unit. When the manual control is placed into the drive position, the transmission automatically shifts to low gear for initial vehicle movement. As the car gains speed, depending upon load and throttle position, an automatic shift is made to high gear. A forced downshift feature provides a passing gear by returning the transmission to low gear.

The oil pump assembly is a conventional gear-type pump and the pump housing is of the large diameter type, acting as the front bulkhead of the transmission. The torque converter is a conventional three-element welded design converter, bolted to the engine flywheel, which drives a two-speed planetary gear set. The high clutch assembly is typical of the designs used in this type transmission. This transmission uses an output shaft- mounted governor, which requires a hole through the output shaft to accept the governor shaft. The reverse clutch assembly is a multiple disc-type clutch, with steel plates splined directly to the case while the face plates are splined to the internal (ring) gear. The internal diameter of the piston is sealed to an internal hub portion of the case rear bulkhead; the outside diameter is sealed to a machined portion of the case. The valve body assembly is bolted to the bottom of the transmission case and is accessible for service by removing the oil pan assembly. The valve body consists of an upper and lower body located on either side of a transfer plate. The vacuum modulator is located on the left rear face of the transmission case. The modulator valve bore is located in the upper valve body.

TORQUE CONVERTER (Fig. 7F-4)

The converter assembly is a conventional three-element welded design that consists of a pump (driving member), a turbine (driven or output member) and a stator (reaction member). The torque converter is designed to multiply torque and to eliminate or reduce the number of gears required to give the desired vehicle performance.

The vanes of the torque converter turbine (driven member) are curved in a manner that causes the oil to be discharged from the center of the turbine in a direction opposite to rotation of the turbine. As the oil leaves the turbine blades at the center, it still has a lot of energy of motion left unused and, due to the curvature of the turbine blades, it would drive the energy against the blades of the pump (driving member) and hinder its operation unless some means were provided for turning the flow.

In order to give directional control to the oil as it leaves the turbine and enters the pump, a stator (reaction member) is installed between the pump and turbine and the vanes of the stator are so curved that they will change the direction of the oil discharged from the turbine and cause it to flow in the same direction as the rotation of the pump (Fig. 7F-4). With this arrangement, the oil does not interfere with, or "buck", the operation of the pump. Actually, the oil flow from the stator will assist pump rotation. The stator thus becomes a reaction member, redirecting oil flow and permitting the design of turbine blades for torque multiplication.

As the rotational speed of the turbine increases, the direction of the oil flow from the turbine changes so that it exerts a force on the back of the stator vanes. This condition could cause turbulence, resulting in increased friction and power loss. Therefore, the stator is mounted on a free wheeling clutch (Fig. 7F-5) which locks in a direction opposite to that of pump and turbine rotation. As turbine speed approaches pump speed, creating a coupling condition, the stator free wheels and is carried along with the rotating oil mass.

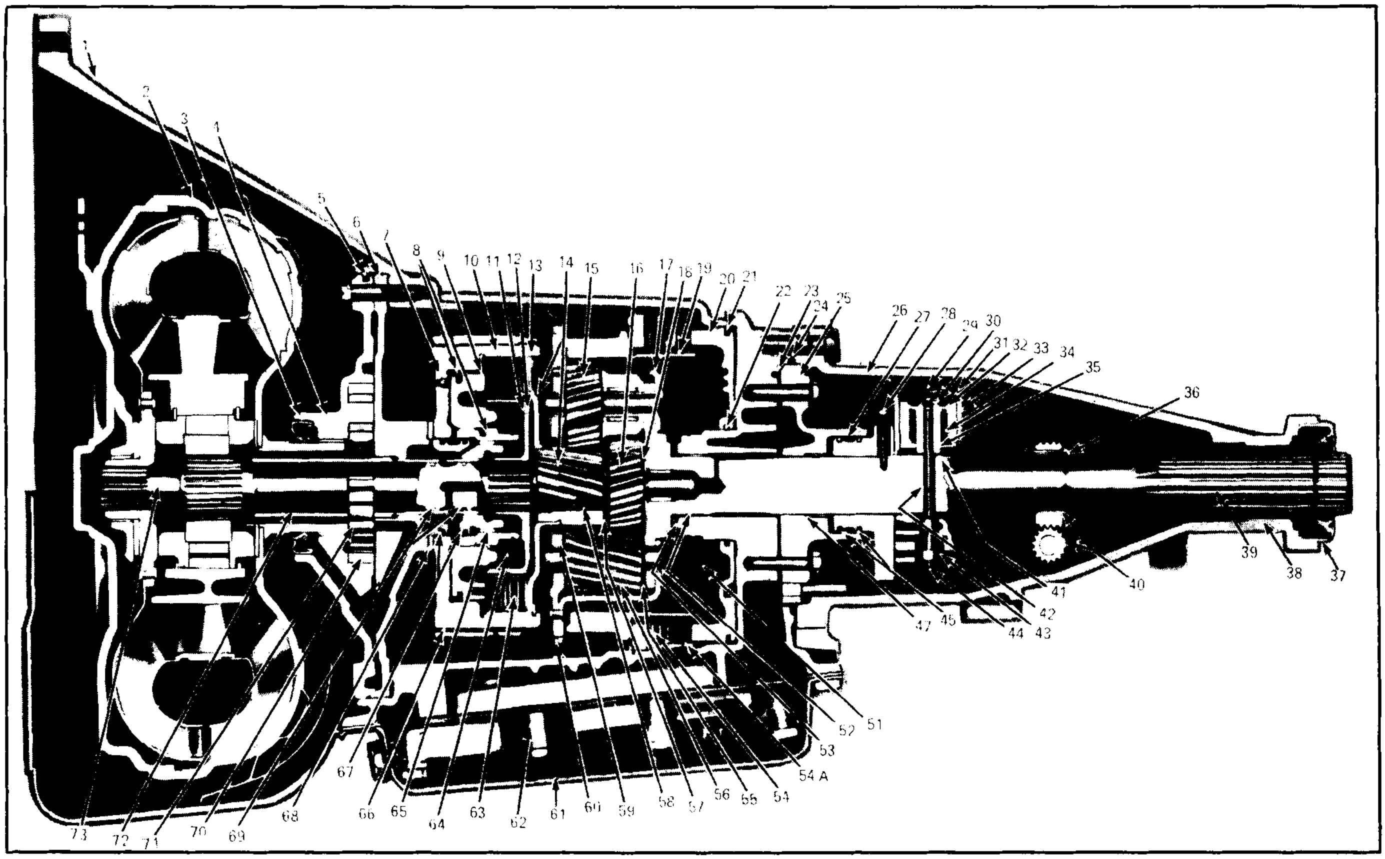


Fig. 7F-3 Cross Section of Transmission

1. Transmission Case
2. Converter Assembly
3. Oil Pump Oil Seal
4. Oil Pump Body
5. Oil Pump Body Rubber Oil Seal Ring
6. Oil Pump Cover
7. Clutch Relief Valve Ball
8. Clutch Piston Inner and Outer Seal
9. Clutch Piston
10. Clutch Drum
11. Clutch Hub
12. Clutch Hub Rear Thrust Washer
13. Clutch Flange Retainer Ring
14. Low Sun Gear and Clutch Flange Assembly
15. Planet Short Pinion
16. Input Sun Gear
17. Planet Carrier
18. Input Sun Gear Rear Thrust Washer
19. Reverse Ring Gear
20. Reverse Clutch Piston
21. Reverse Piston Outer Seal
22. Reverse Piston Inner Seal
23. Governor Support Gasket
24. Extension Housing Seal Ring
25. Governor Support
26. Extension Housing
27. Governor Hub
28. Governor Hub Drive Screw
29. Governor Body
30. Governor Shaft Retainer "E" Clip
31. Governor Outer Weight Retainer Ring
32. Governor Inner Weight Retainer Ring
33. Governor Outer Weight
34. Governor Spring
35. Governor Inner Weight
36. Speedometer Drive Gear Retaining Clip
37. Extension Housing Rear Oil Seal
38. Extension Housing Rear Bushing
39. Output Shaft
40. Speedometer Drive and Driven Gear
41. Governor Shaft Urethane Washer
42. Governor Shaft
43. Governor Valve
44. Governor Valve Retainer Clip
45. Governor Hub Oil Seal Rings
47. Governor Support Bushing
51. Reverse Piston Return Springs
52. Transmission Case Rear Bushing
53. Output Shaft Caged Thrust Bearing
54. Reverse Clutch Pack
54A. Reverse Clutch (Waved) Cushion Spring
55. Pinion Thrust Washer
56. Pinion Long Pinion
57. Low Sun Gear Needle Thrust Bearing
58. Low Sun Gear Splined Bushing
59. Pinion Thrust Washer
60. Parking Lock Gear
61. Transmission Oil Pan
62. Valve Body Assembly
63. High Clutch Pack
64. Clutch Piston Return Spring
65. Clutch Drum Bushing
66. Low Brake Band
67. High Clutch Oil Seal Rings
68. Clutch Drum Selective Thrust Washer
69. Input Shaft Oil Seal Rings
70. Oil Pump Driven Gear
71. Oil Pump Drive Gear
72. Stator Shaft
73. Input Shaft

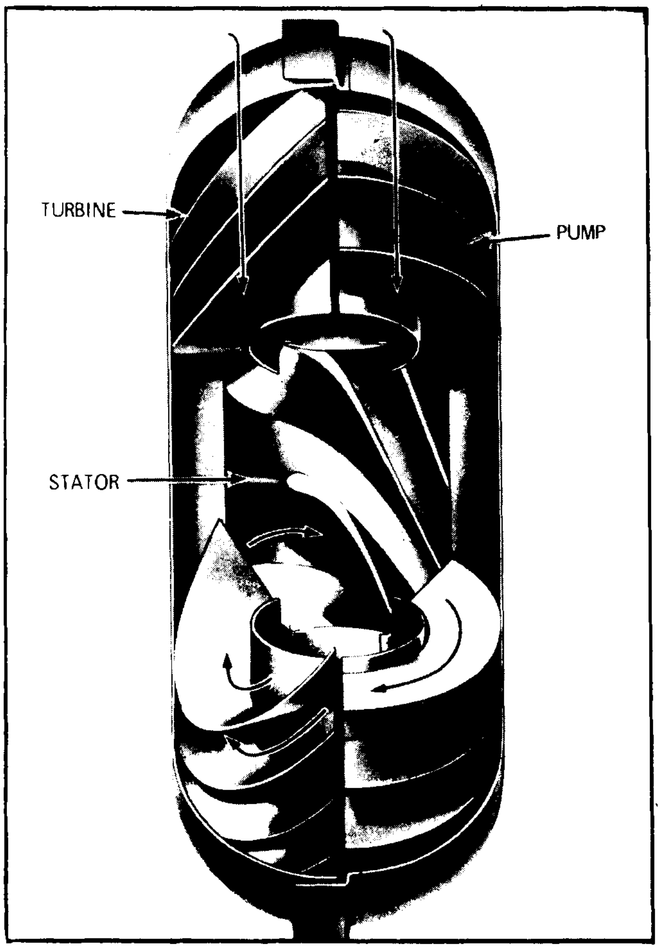


Fig. 7F-4 Cross Section of Converter

OIL PUMP

The oil pump assembly is a conventional gear-type pump. The stator support is a pressed member of the pump cover. If the stator support requires replacement, the stator support and oil pump cover assembly is supplied as a unit. A hub section of the oil pump extends rearward to serve both as the high clutch support and as an oil distribution member for the clutch assembly (Fig. 7F-6). Oil sealing is accomplished between the hub and clutch by two cast iron oil seal rings.

The oil pump is used to supply oil to fill the converter, for application of forward and reverse clutches, for application and release of the low band and to circulate oil for lubrication and heat transfer.

OIL COOLER

The externally cooled Two-Speed Automatic (M-35) Transmission uses a heat exchanger in the radiator tank to cool the oil. Cooler lines attach to the transmission case at a point just above the servo cover and oil is transported through these lines along the right side of the engine.

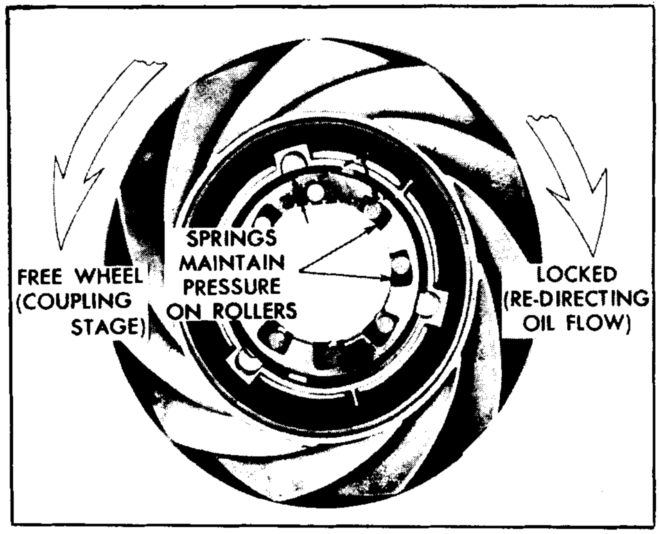


Fig. 7F-5 Stator Action

HIGH CLUTCH

The high clutch assembly consists of a clutch drum, cushion spring, clutch piston, twenty-four (24) piston return springs, piston seals and a clutch pack. These parts are retained inside the clutch drum by the low sun gear and clutch flange assembly and a retainer ring (Fig. 7F-7). When oil pressure is applied to the piston, the clutch plates are pressed together and connect the clutch drum to the input shaft through the clutch hub. This engagement of the high clutch causes the low sun gear to rotate at the same speed as the input shaft.

LOW BAND

The low band assembly is of the double-wrap type and surrounds the high clutch drum. The actuating servo extends through the right side of the transmission case and is retained by a servo cover. The band adjusting screw and lock nut extend through the left side of the case at a point directly above the external control levers.

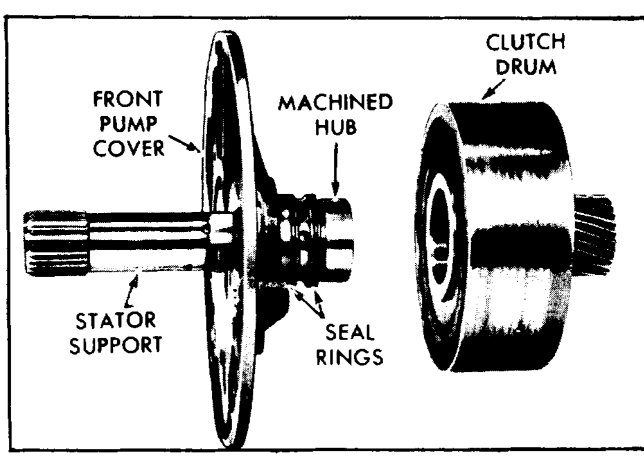


Fig. 7F-6 Oil Pump - High Clutch Relationship

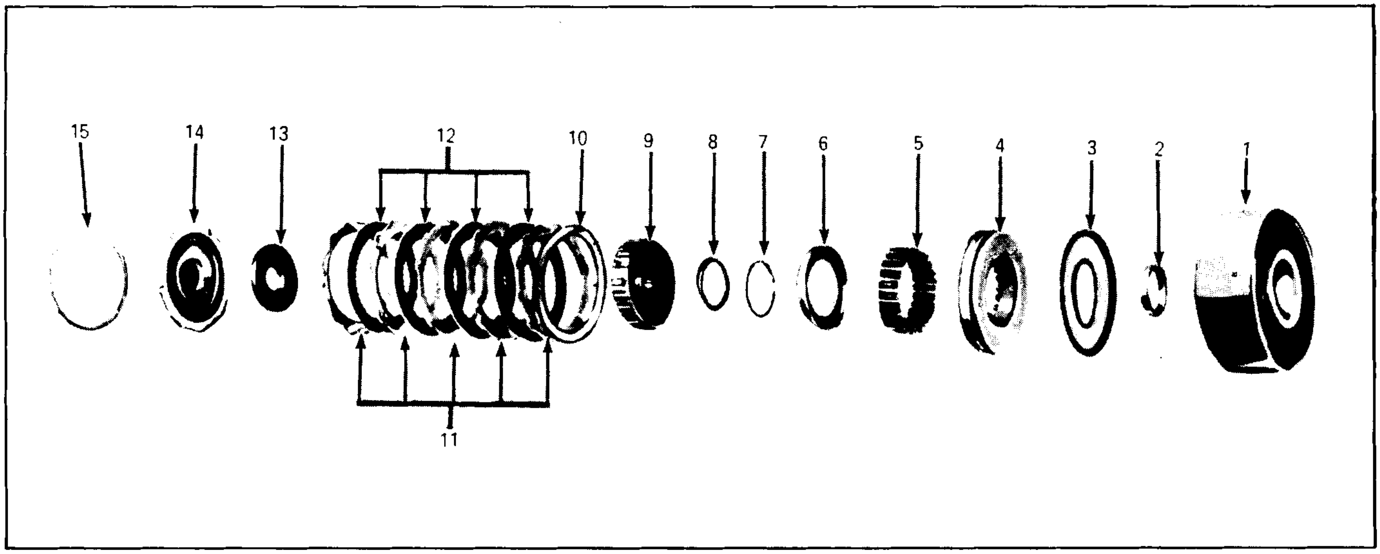


Fig. 7F-7 Exploded View of Clutch Drum

1. Clutch Drum
2. Clutch Drum Bushing
3. Clutch Piston Outer and Inner Seals
4. Clutch Piston
5. Clutch Return Springs
6. Spring Retainer
7. Spring Retainer Snap Ring
8. Clutch Hub Front Thrust Washer
9. Clutch Hub
10. Clutch Cushion Spring (Waved)
11. Clutch Driven Plates (Steel)
12. Clutch Drive Plates (Faced)
13. Clutch Hub Rear Thrust Washer
14. Low Sun Gear and Clutch Flange Assembly
15. Flange Retainer Snap Ring

PLANET CARRIER

The planetary gear set consists of an input sun gear, low sun gear, short and long pinions, reverse ring gear and a planet carrier - output shaft (Fig. 7F-8). The input shaft is splined to the input sun gear. The low sun gear, which is part of the high clutch assembly, rotates freely until the low band on the high clutch is applied. The input sun gear is meshed with three long pinions which, in turn, are meshed with the three short pinions. The short pinions are meshed with the low sun gear and with the reverse ring gear. The input sun gear and the short pinions always rotate in the same direction. Application of either the low band or the reverse clutch determines whether the planet carrier-output shaft rotates clockwise or counterclockwise.

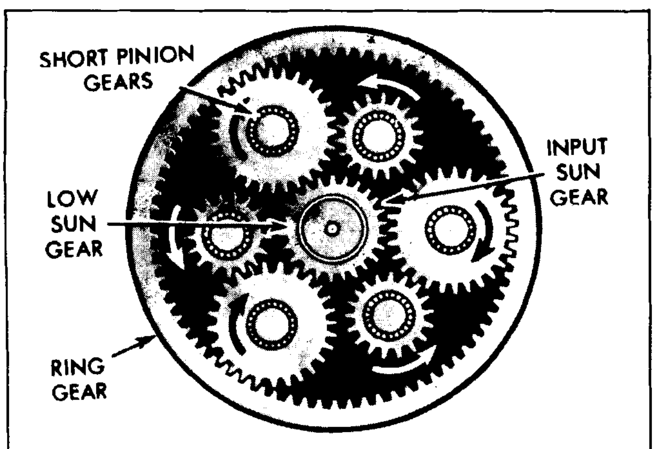


Fig. 7F-8 Typical Planet Carrier Gear Set

REVERSE CLUTCH

The reverse clutch assembly is a multiple-disc type clutch pack (Fig. 7F-9). The clutch piston operates within the rear portion of the case and the internal diameter of the piston is sealed to an integral hub portion of the case rear bulk head. The outside diameter is sealed to a machined portion of the case. The piston is hydraulically applied and is released by seventeen (17) separate piston return springs. The reaction (steel) plates are splined directly to the case while the drive (faced) plates are splined to the reverse ring gear.

GOVERNOR

The output shaft type governor consists of a governor body and a governor hub bolted together at a gasket surface with the output shaft passing through each piece (Fig. 7F-10).

The governor hub is the oil delivery unit and is mounted within the governor support counterbore. Two cast iron sealing rings are used on the governor hub and both are seated in the counterbore of the governor support. The hub also contains a set screw that correctly positions the governor assembly to the output shaft. A pilot hole is machined into the output shaft to receive this set screw.

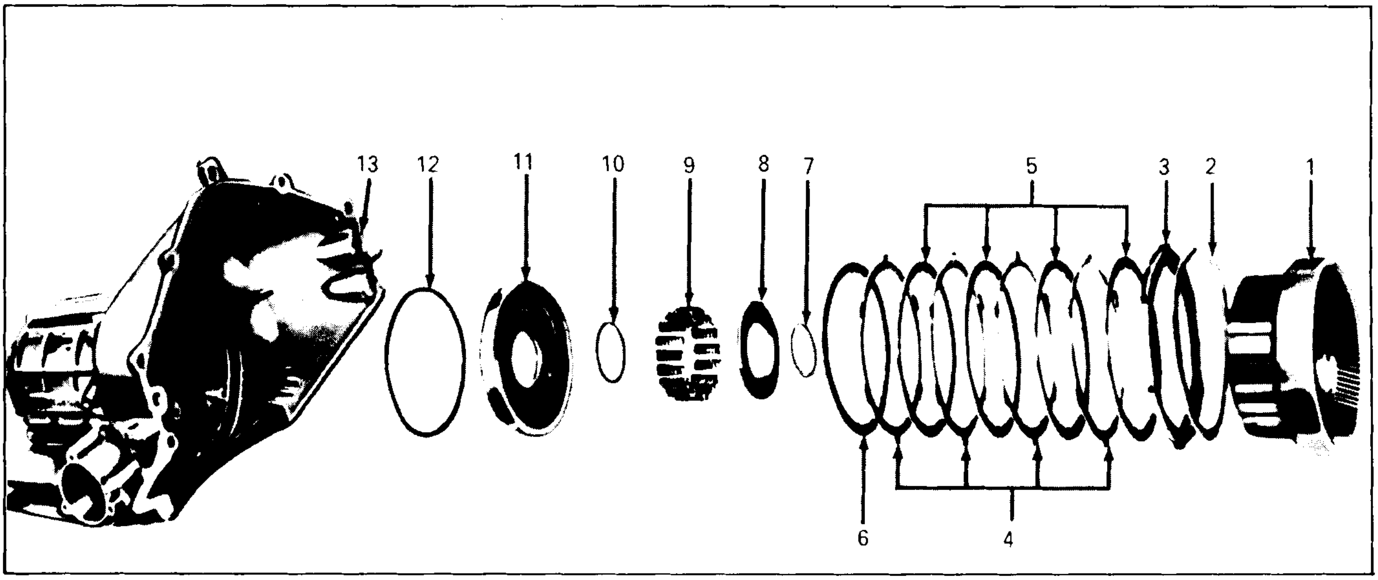


Fig. 7F-9 Exploded View of Reverse Clutch

1. Reverse Ring Gear
2. Clutch Pack Snap Ring
3. Reverse Clutch Pressure Plate
4. Clutch Reaction (steel) Plates
5. Clutch Drive (faced) Plates
6. Clutch Cushion (waved) Spring
7. Spring Retainer Snap Ring
8. Piston Return Spring Retainer
9. Clutch Piston Return Springs
10. Clutch Piston Inner Seal
11. Reverse Clutch Piston
12. Clutch Piston Outer Seal
13. Transmission Case

The governor body contains the valve and the weight assembly. The valve and the weight assembly are located on opposite sides of the output shaft and are connected by a small diameter shaft. The shaft passes through the center of the valve and weight assembly, which are each retained to the shaft by an "E" clip at each end. A hole is drilled through the output shaft to facilitate use of this type governor shaft. The weight assembly consists of the large diameter outer weight, a coil spring and an inner weight. The spring and inner weight are retained in the outer weight by an internal snap ring. A urethane washer is located between the outer weight and the output shaft. It serves as a governor damper to eliminate noise at low or non-governed speeds.

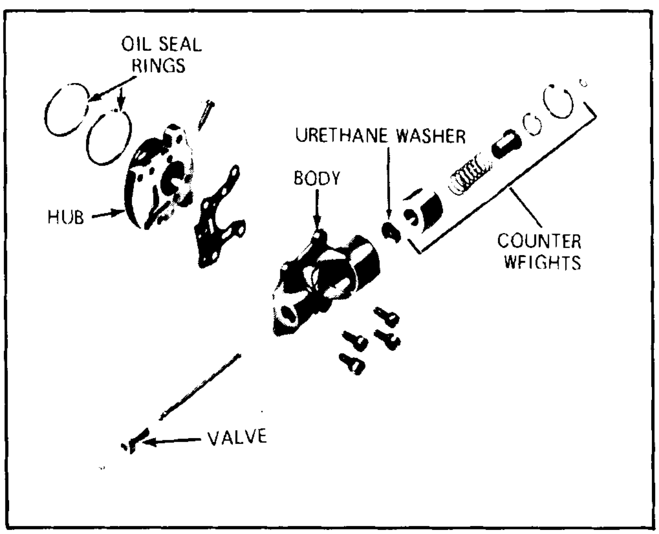


Fig. 7F-10 Exploded View of Governor

VALVE BODY

The valve body assembly is bolted to the bottom of the transmission case and is accessible for service by removing the oil pan. This valve body assembly consists of an upper and lower body, located on either side of a transfer plate (Fig. 7F-11). The function of the valve body assembly is to control the application of clutches and low band in response to governor, throttle valve and modulator pressures.

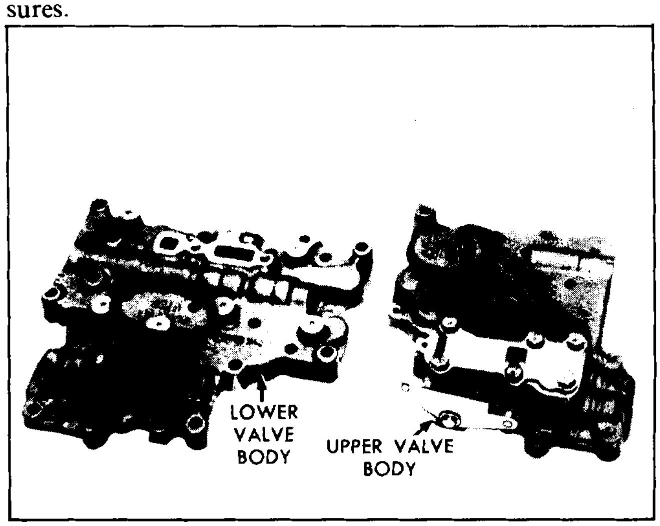


Fig. 7F-11 Upper and Lower Valve Bodies

OIL FILL

An oil filler tube is located on the right side of the transmission and is accessible for checking and filling in the engine compartment. The lower end of the filler tube is sealed to the case by an "O" ring.

POWER FLOW

GEAR TRAIN

In the automatic transmission gearset, all the gears are in constant mesh and the output ratio is changed merely by holding or driving various components of the planetary set. Three distinct advantages of the automatic transmission are:

1. The various shifts are automatic and are accomplished by hydraulic pressure.
2. The gearset is always in mesh so that there is no time lag or possible gear clash when shifting ratios.
3. All planetary power flow is based on one axis. This can be seen by a cross section view of the planetary set taken 90° to the output shaft axis (Fig. 7F-12). This view shows how all gears revolve about a common axis, resulting in a more compact unit or assembly.

NEUTRAL RANGE

When the selector lever is placed in the (Neutral) "N" range, the output shaft remains stationary, the clutches and low band are released and there is no reaction member to provide positive drive. All gears are free to spin around their own axis and no motion is imparted to the planet carrier in any direction.

PARK RANGE

In (Park) "P" range, all reaction members are released as they are in neutral. A positive planet carrier lock is provided when the park pawl is engaged between the heavy teeth spaced around the front face of the planet carrier. The linkage is activated by direct manual action, but the pawl is activated by spring action. If the pawl is in line with a tooth of the planet carrier rather than in a space between the teeth, the linkage remains in the park position with the spring holding pressure against the pawl. Slight rotation of the carrier will then immediately seat the pawl and lock the output shaft to the transmission case.

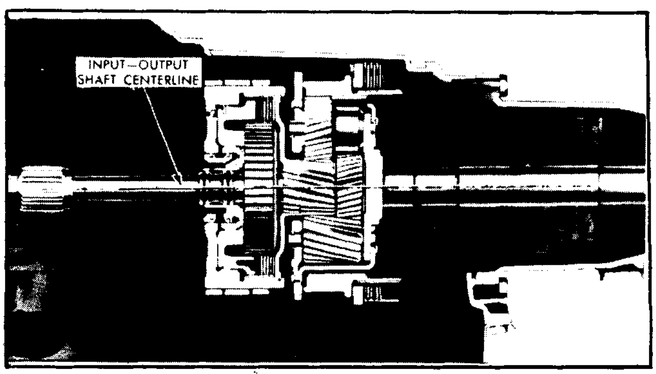


Fig. 7F-12 Cross Section of Planetary Set

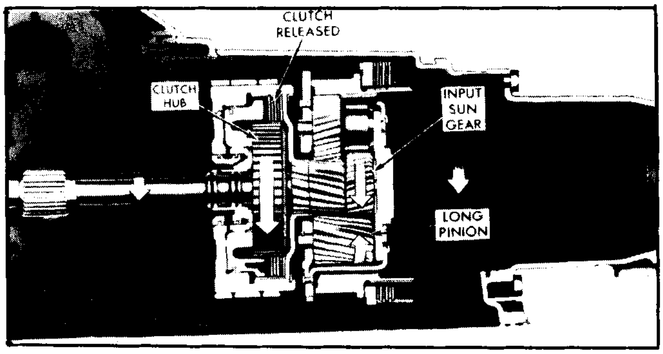


Fig. 7F-13 Operation in Drive Range - Low Gear

> **CAUTION:** *Severe damage may occur if the unit is shifted to park when the vehicle is in motion.*

DRIVE RANGE

When the selector lever is placed in the (Drive) "D" range, which is the normal driving range, the transmission is automatically shifted into its low gear (Fig. 7F-13). The clutches are released and the low band is applied to the outside diameter of the clutch drum. With the low band applied, the clutch drum is held stationary which, in turn, holds the clutch flange and low sun gear stationary. Drive is then from the converter pump to the converter turbine and through the input shaft to the input sun gear in the planetary gear set. The input sun gear drives the long pinions which, in turn, drive the short pinions. The short pinions are in mesh with the low sun gear. Since the low sun gear is held stationary with the low band applied, the short pinions will walk around the low sun gear and, as they walk, they carry the planet carrier and output shaft with them at a reduction of 1.76 to 1.

The transmission will automatically upshift to the high gear (direct drive) at between 10 and 68 mph, depending upon throttle position (Fig. 7F-14). When this shift occurs, the low band is released and the high clutch is applied as a unit. This lock-up occurs in the following manner: With the high clutch applied, the clutch hub (which is splined to the input shaft) is locked to the clutch flange and low sun gear through the medium of the applied clutch plates. The low sun gear is meshed the short pinions, the short pinions are meshed with the long pinions and the long pinions are meshed with the input sun gear, which is also splined to the input shaft. Since both

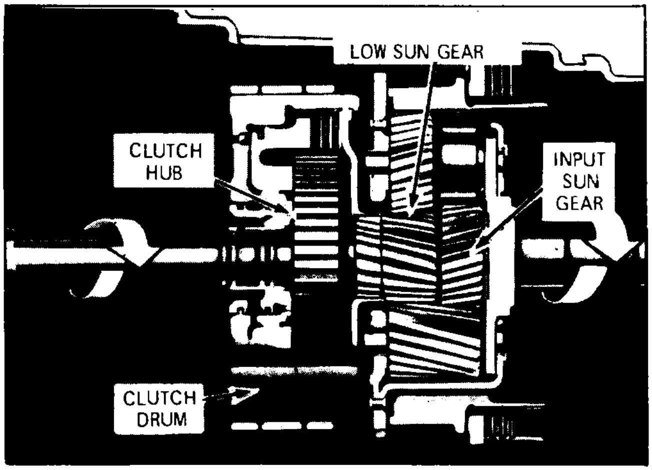


Fig. 7F-14 Operation in Drive Range - High Gear

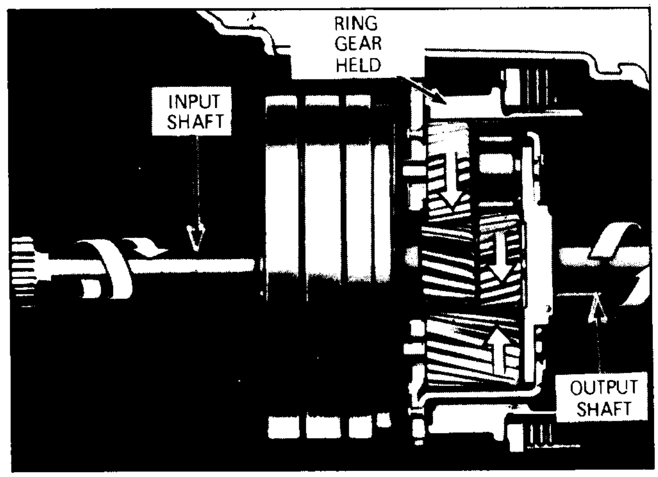


Fig. 7F-15 Operation in Reverse Range - Reverse Gear

the low sun gear and the input sun gear are now locked to the input shaft, the entire planetary unit will revolve at input shaft speed, a direct drive ration of 1 to 1.

LOW RANGE

In (Low) "L" range, as in starting forward in (Drive) "D" range, the clutches are released and the low band is applied to the outside diameter of the clutch drum (Fig. 7F-13). Therefore, the same mechanical action takes place as when starting in (Drive) "D" range. However, hydraulic action differs in that the manual valve in the valve body is so positioned that it blocks off the passages leading to the low-drive shift valve, preventing an upshift from low to high gear. In addition, it supplies pressure to the modulator exhaust which has the effect of increasing mainline pressure.

REVERSE RANGE

In (Reverse) "R" range, it is necessary to turn the planet carrier (which is part of the output shaft) in a direction opposite to that of the input shaft (Fig. 7F-15). With the selector lever in the reverse position, the high clutch and the low band are released and the reverse clutch is applied, holding the reverse ring gear in a stationary position. Drive then is through the input shaft and input sun gear to the long pinions and to the short pinions. The short pinions are meshed with the reverse ring gear, which is now held stationary by the applied reverse clutch pack. The short pinions will walk around inside the internal gear in a reverse direction, carrying with them the output shaft to which they are attached at a reverse reduction of 1.76 to 1.

HYDRAULIC COMPONENTS AND OPERATION

The hydraulic systems have been separated into three groups to aid their understanding. These groups are - General Information; Pressure Development and Control; Hydraulic Unit Operation.

GENERAL INFORMATION

The valve body assembly (Fig. 7F-16) is bolted to the lower surface of the transmission case. It is enclosed by the oil pan assembly and is completely accessible with the transmission in the vehicle. All control valves are located in the valve body with the exception of two valves located in the oil pump (a third valve, cooler by-pass valve, is used on V-8 engine equipped vehicles) and the governor valve.

The valve body assembly consists of two cast iron bodies joined at a transfer plate. The upper valve body contains a manual valve, detent valve, throttle valve, high speed downshift timing valve and a vacuum modulator valve. The vacuum modulator is threaded into the rear face of the transmission case and aligns to the valve bore in the upper valve body.

The lower valve body contains a pressure regulator valve, booster valve, low-drive shift valve and a low-drive regulator valve.

The downshift timing valve and an oil pump priming valve are contained in the oil pump (Fig. 7F-17). Also, on units equipped with a V-8 engine, a cooler by-pass valve is located in the oil pump which can open a path to the lubrication circuit in case of a restriction in the cooler system.

The governor is mounted on the output shaft. This unit is entirely different than the gear driven centrifugal governor of previous two speed transmissions (Fig. 7F-10).

Driving requirements are signalled by the driver and the engine through three means:

1. Manual valve, which is connected by linkage to the selector lever on the steering column.

2. Throttle and detent valves, which are connected through linkage to the accelerator pedal.

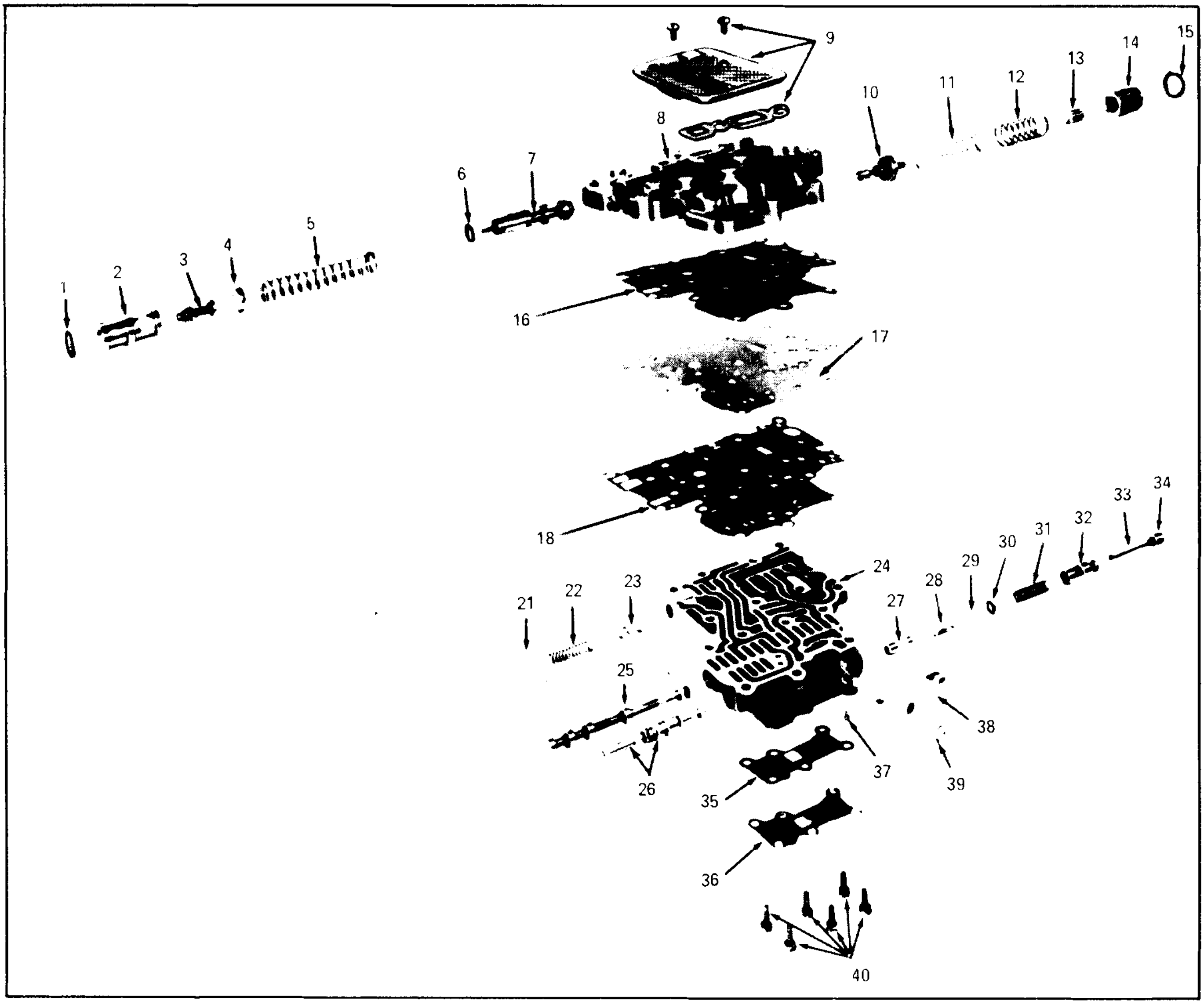


Fig. 7F-16 Exploded View of Valve Body

1. Snap Ring
2. Booster Valve Sleeve
3. Booster Valve
4. Pressure Regulator Spring Retainer
5. Pressure Regulator Spring
6. Pressure Regulator Spring Seat
7. Pressure Regulator Valve
8.
9. Suction Screen, Screws (2) and Gasket
10. Low and Drive Valve
11. Drive Valve Inner Spring
12. Drive Valve Outer Spring
13. Low and Drive Regulator Valve
14. Low and Drive Regulator Valve Sleeve
15. Snap Ring
16. Transfer Plate-To-Valve Body Gasket
17. Transfer Plate
18. Transfer Plate-To-Valve Body Gasket
21. Roll Pin
22. Downshift Timing Valve Spring
23. High Speed Downshift Timing Valve
24. Upper Valve Body
25. Manual Control Valve
26. Vacuum Modulator Valve, Spring and Plunger
27. Throttle Valve
28. Throttle Valve Spring
29. Retainer "E" Clip
30. T.V. Spring Regulator Guide Washer
31. Detent Valve Spring
32. Detent Valve
33. T.V. Spring Regulator
34. T.V. Spring Regulator Nut
35. Upper Valve Body Plate Gasket
36. Upper Valve Body Plate
37. Retaining Stud
38. Range Selector Detent Lever
39. Retainer "E" Clip
40. Upper Valve Body Plate-To-Upper Valve Body Bolts and Washers (6)

3. Vacuum modulator, which senses engine manifold vacuum as supplied by a vacuum line.

The remainder of the hydraulic system is controlled by internal factors.

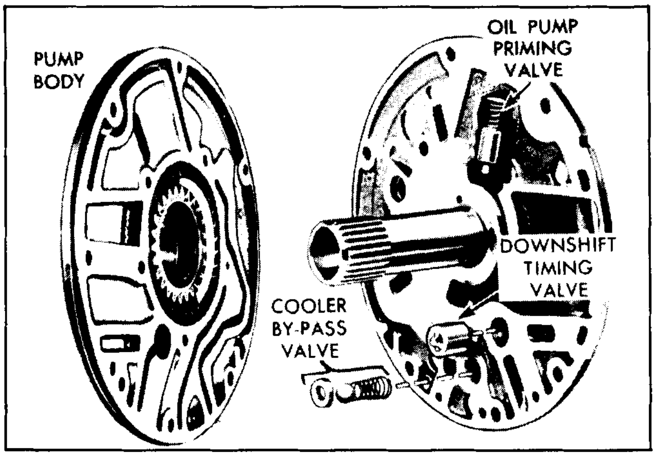


Fig. 7F-17 Exploded View of Oil Pump

PRESSURE DEVELOPMENT AND CONTROL

Most of the valves and control members of the hydraulic system are interconnected in some manner and usually several events are occurring at the same time. In order to avoid confusion, each components operation will be treated in a step by step manner.

OIL PUMP CIRCUIT

The internal-external gear type oil pump is driven by the converter hub. Pump drive is accomplished by two concentric tangs machined on the I.D. of the small gear which engage two matching slots in the converter hub. Since the converter is bolted to the engine flywheel, the oil pump operates and provides pressure any time the engine is running.

As the engine is started and the oil pump begins operating, fluid is drawn from the sump (oil pan) through a fine mesh screen and into the suction side of the pump. Output fluid under pressure enters a passage leading to the area between two spools of the pressure regulator valve and to the cavity at the extreme left of the pressure regulator valve (Fig. 7F-18). Pressure in this cavity causes the valve to move to the right against spring pressure.

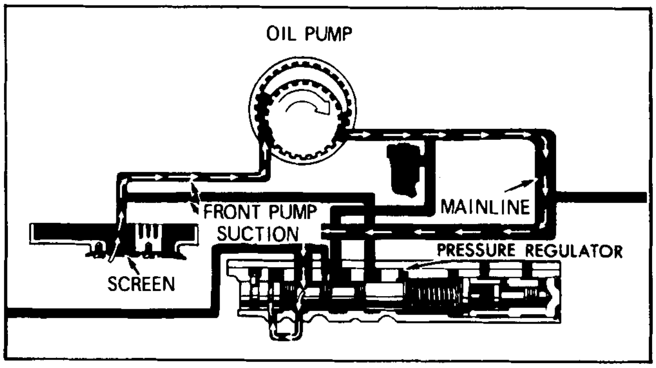


Fig. 7F-18 Oil Pump Circuitry

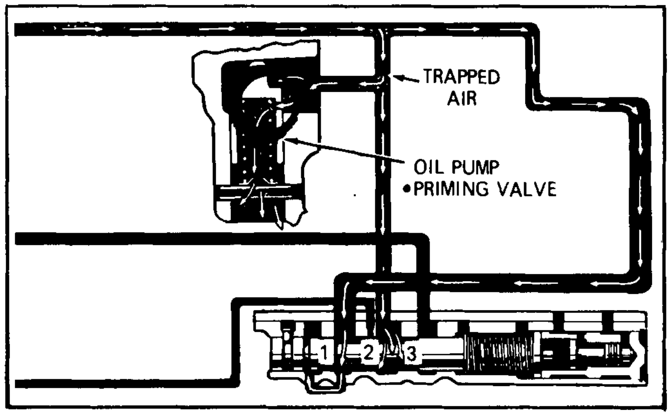


Fig. 7F-19 Oil Pump Priming Valve Circuitry

As oil pump output is being delivered, it is directed through a passage to an area between spools 2 and 3 of the pressure regulator valve. This same passage also delivers oil to the oil pump priming valve (Fig. 7F-19). The priming valve provides an exhaust for any air that may be trapped in the system. The priming valve spring holds the valve in an open position, allowing any trapped air to exhaust. As the hydraulic pressure builds up in the oil pump circuit, the valve is forced to seat in its bore, closing the exhaust bleed hole.

CONVERTER CHARGING CIRCUIT

As soon as sufficient hydraulic pressure is developed, the force acting on the left end of the pressure regulator valve moves the valves to the right against opposing spring force (Fig. 7F-20). This movement causes the number 2 spool to uncover the converter feed passage. Fluid in the area between spools 1 and 2 then fill the converter. The converter is kept fully charged in this way any time the oil pump is operating and supplying pressure. The converter is filled through the area between the converter hub and the stator support by a passage drilled in the oil pump cover.

Since the converter is continually turning when the engine is running, the oil is thrown outward and the return location is in the area between the input shaft and the inside

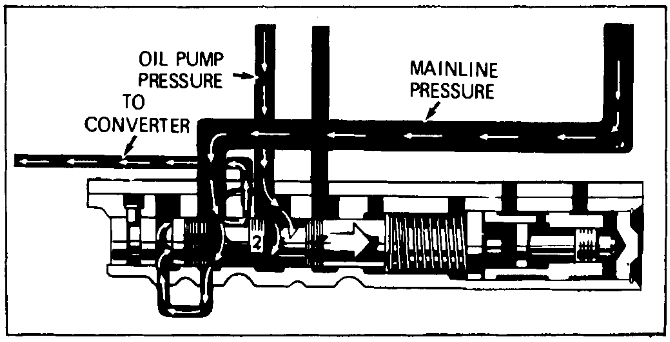


Fig. 7F-20 Converter Charging Circuitry

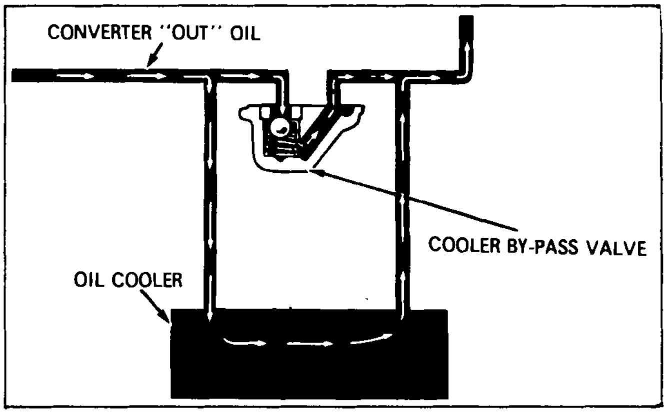


Fig. 7F-21 Oil Cooler and Lubrication Circuitry

diameter of the stator support. This converter "out" oil then enters the oil cooler passage of the oil pump.

LUBRICATION CIRCUIT

On units equipped with a V-8 engine, the converter "out" oil passes over the opening of a cooler by-pass valve, which is preset to open at approximately 45 psi, and is directed to the oil cooler supply line. If converter "out" oil pressure where to exceed 45 psi, the by-pass valve would open and this oil would by-pass the cooler and directly enter the lubrication circuit (Fig. 7F-21).

On units equipped with a 6 cylinder engine, converter "out" oil is directed through the oil cooler and through the by-pass passage to exit as lubrication circuit oil.

Beginning at the rear end of the cooler by-pass port, the lubrication circuit is identical on both the 6-cylinder and the V-8 engine models of the Two-Speed Automatic (M-35) transmission. Lubrication oil is supplied to the input shaft between two metal seal rings where it enters a main oil gallery, drilled from the rear of the input shaft. This oil gallery supplies lubrication oil to the high clutch and reverse clutch plates, the planetary components and the various bushing and thrust washer surfaces.

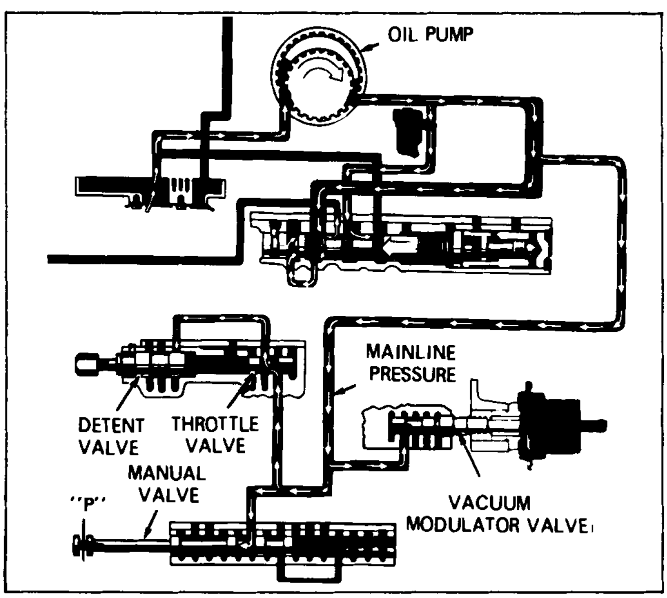


Fig. 7F-22 Mainline Pressure Circuitry

MAINLINE PRESSURE CIRCUIT

As the converter and lubrication circuits are charged, mainline pressure continues to increase. This increased pressure places more force on the left end of the pressure regulator valve, moving it further to the right against spring pressure until the number 3 spool of the valve uncovers a port which leads to exhaust through an oil pump suction passage (Fig. 7F-22).

Any drop in mainline pressure, such as this exhaust, permits spring force to overcome the decreased hydraulic pressure and return the valve to the left. This closes the exhaust passage and allows mainline pressure to again increase. The continual opening and closing of this exhaust port, which occurs rapidly, regulates mainline pressure at the desired level.

The regulated mainline pressure is then delivered to the throttle valve, the detent valve, the vacuum modulator valve and the manual valve. These valves then regulate or direct the mainline pressure to perform their various operational functions.

VACUUM MODULATOR AND BOOSTER VALVE CIRCUIT

The vacuum modulator will vary to modulate mainline pressure to meet the needs of changing engine loads. This modulation of pressure is controlled by hydraulic pressure (mainline and governor), spring pressure and engine vacuum (Fig. 7F-23). High manifold vacuum, such as that created at idle, will cause low modulator pressure and will result in lower mainline pressure. During periods of low engine vacuum, such as occurs on acceleration, high modulator pressure is produced resulting in the higher mainline pressure that is needed to control the increased planetary torque.

In all ranges, mainline pressure is supplied to the area between spools 1 and 2 of the modulator valve. The spring in the sealed vacuum unit of the modulator tends to keep the modulator valve bottomed in its bore. In this position, oil is delivered through a drilled passage in the valve to the

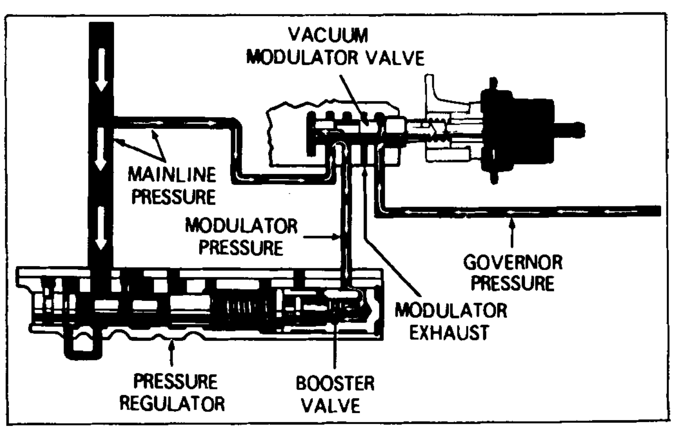


Fig. 7F-23 Modulator and Booster Valve Circuitry blind cavity at the left end of the valve. Oil pressure in this area tends to oppose spring pressure and tries to move the modulator valve to the right. At the same time, mainline pressure flows from the area between spools 1 and 2 of the modulator valve into the booster valve passage where this mainline pressure is directed to the right end of the booster valve. Mainline pressure applies force to the left on the small spool rear face of the booster valve. This modulator pressure force, combined with the normal spring force on the pressure regulator valve, results in a higher mainline pressure.

Higher vacuum moves the modulator valve further to the right which shuts off the source of mainline pressure to the booster valve. Continued motion to the right uncovers a modulator exhaust passage for the booster valve oil. The exhaust port of this passage is located in the manual valve bore of the valve body. This will be covered in detail later.

The modulator valve is supplied with governor pressure in the area between spools 2 and 3. Since spool 3 is larger than spool 2, governor pressure tends to move the modulator valve to the right, reducing modulator pressure to the booster valve. This application of governor pressure results in smoother part-throttle upshifts by reducing mainline pressure.

The action of the vacuum modulator helps tailor mainline pressure to meet changing requirements. It does this by varying booster pressure in relation to modulator spring pressure, engine vacuum, governor pressure and mainline pressure itself.

GOVERNOR CIRCUIT

With the vehicle moving and increasing in speed, mainline pressure is directed to the governor where it is re-regulated and delivered to the low-drive shift valve, the vacuum modulator valve and the rear face of the downshift timing valve (Fig. 7F-24). As the governor rotates with the output shaft, the inner and outer weights are thrown outward due to centrifugal force. The governor valve, which is connected by a small through-shaft to the weights, is pulled inward to open the mainline delivery port. Mainline pressure enters the open port and becomes

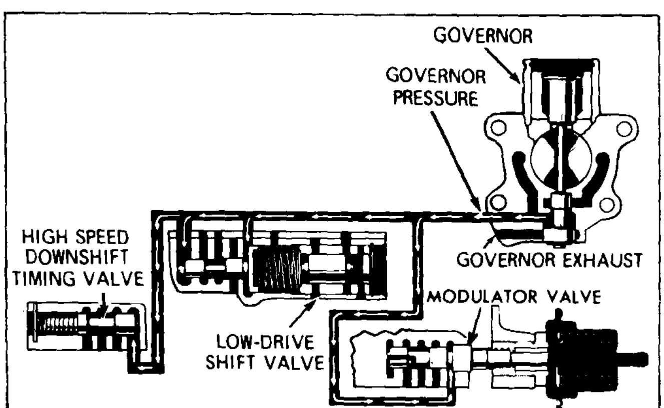


Fig. 7F-24 Governor Circuitry

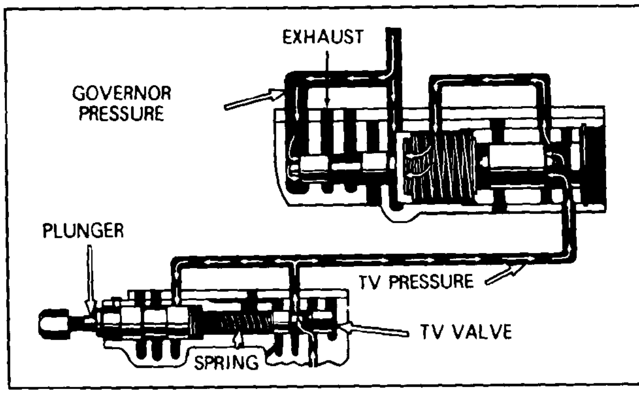


Fig. 7F-25 Throttle Valve Circuitry

governor pressure. This pressure, while acting on the various control valves, applies an outward force on the flat area of the large spool of the governor valve. When this governor pressure overcomes the centrifugal force of the weights, the governor weight is moved outward and closes the mainline feed to the governor circuit.

At lower speeds, when centrifugal force is reduced, governor pressure moves the governor valve further outward, opposing the pull of the weights, to open this governor pressure to exhaust. As governor pressure drops, the pull of the weights returns the valve inward and regulates governor pressure in direct relation to road speed.

THROTTLE VALVE CIRCUIT

With the selector lever in Drive range, throttle valve (TV) pressure is used to provide a wide range of automatic shift points to match the transmission ratio to varying driving conditions. Throttle valve (TV) pressure aids spring pressure to oppose governor pressure acting on the low-drive shift valve (Fig. 7F-25). If there was no throttle pressure acting on the low-drive shift valve, the upshift would always occur at the same road speed, that is, when governor pressure overcomes spring pressure on the low-drive shift valve.

Because the throttle (TV) valve and the detent valve are connected by linkage to the accelerator, the effect of different accelerator positions directly controls TV and detent pressure. Depressing the accelerator pedal causes the throttle valve plunger to increase the spring force on the TV valve, moving it to the right. This opens mainline pressure to the area between the spools of the TV valve. At this point, the pressure enters the TV pressure passage and also passes through a small hole drilled in the TV valve and fills the blind cavity at the right end of the valve.

The pressure in the TV passage is delivered to the detent valve and to the low-drive shift valve. TV pressure aids spring pressure to oppose governor pressure acting on the low-drive shift valve. As hydraulic force builds in the TV circuit, the pressure acting on the right end of the TV valve equals or overcomes spring pressure and the TV valve moves to the left, closing the mainline pressure port.

The opening and closing of the mainline port regulates TV pressure at a given plunger position.

Release of the accelerator reduces the plunger spring force and the hydraulic pressure on the right end of the TV valve moves the valve to the left, opening the TV pressure to exhaust. Thus, TV pressure varies in direct proportion to plunger spring force.

Later it will be shown how the TV valve and the low-drive shift valve work together to provide minimum, to detent and through detent throttle upshifts.

HYDRAULIC UNIT OPERATION

Now that we have seen how mainline pressure is developed and regulated, the next step in hydraulics is the operation and control of the various valves and shift units.

MANUAL VALVE - NEUTRAL OR PARK RANGE

The manual control valve in the valve body routes oil to the controlling devices that govern transmission operation in Drive, Low and Reverse ranges. In Neutral or Park ranges, this manual control valve cuts off oil pressure to the low band and clutches and exhausts it back into the sump (Fig. 7F-26). The manual valve is moved into position for the desired range by the driver, using the selector lever on the steering column.

DRIVE RANGE - LOW GEAR

When the manual control valve is moved into the "D" position, it opens passages to direct mainline pressure to the low-drive shift valve (as shift valve oil), to the high speed downshift timing valve (as low servo oil) and as low servo apply oil (Fig. 7F-27). Low servo (mainline) pressure enters the timing valve bore between the spools and passes through both the opening and the restricting orifice to charge the low servo apply circuit. Spring pressure holds the low-drive shift valve in the full left position, which blocks the high clutch apply passage and thus allows the low servo to apply the low band.

The transmission is now in automatic low gear with the low sun gear being held stationary by the applied low band.

DRIVE RANGE - HIGH GEAR

As the vehicle is moving in automatic low gear, spring pressure plus throttle valve pressure on the low-drive shift valve holds the valve in a position that blocks shift valve (mainline) pressure to the high clutch apply circuit (Fig. 7F-28). To provide an automatic upshift, governor pressure is delivered to the low-drive shift valve, opposing spring pressure (Fig. 7F-29).

As governor pressure overcomes the spring force (vehicle speed increases), the low-drive shift valve moves to the right and allows mainline (shift valve) pressure to enter the high clutch apply circuit.

Throttle valve pressure acts on the shift valve and its regulator valve to oppose governor pressure, as discussed previously.

Oil pressure in the high clutch apply circuit is routed to passages in the oil pump (Fig. 7F-30). The high clutch apply oil is delivered to the clutch drum in the area between two seal rings on the pump cover hub. This pressure acts on the high clutch piston, causing it to engage the clutch plates which, in turn, lock the clutch to the input shaft. Since one sun gear is driven by the input shaft and the other is a part of the clutch assembly, the planetary carrier assembly is driven at a 1 to 1 ration when the two sun gears are locked together.

At the same time the clutch is being applied, the high clutch apply pressure acts on the downshift timing valve, unseating the ball and entering the low servo release circuit. The servo release pressure, plus force from the servo release springs, overcomes the low servo apply pressure acting on the other side of the servo piston and releases the band. Thus, with the band released and the high clutch applied, the transmission makes the shift from low to high gear. Since a common passage supplies pressure to high clutch apply and low servo release, the shift from low to high gear is fast and smooth.

A pressure-sensitive switch is screwed through the front face of the low servo boss of the transmission case and into the low servo release oil passage. This pressure switch is closed (grounded) in all but high gear, since there is no low servo release oil pressure in this circuit in neutral, low or reverse gear. When the pressure switch is closed, it grounds an electrical circuit from the distributor and engine thermo-switch through a solenoid valve. This closing or grounding of the pressure switch will retard the spark at the distributor.

When the transmission is shifted into high gear, oil pressure in the low servo release circuit will open the pressure switch so that the transmission will no longer affect the vacuum advance of the distributor. See Section 6D for further details.

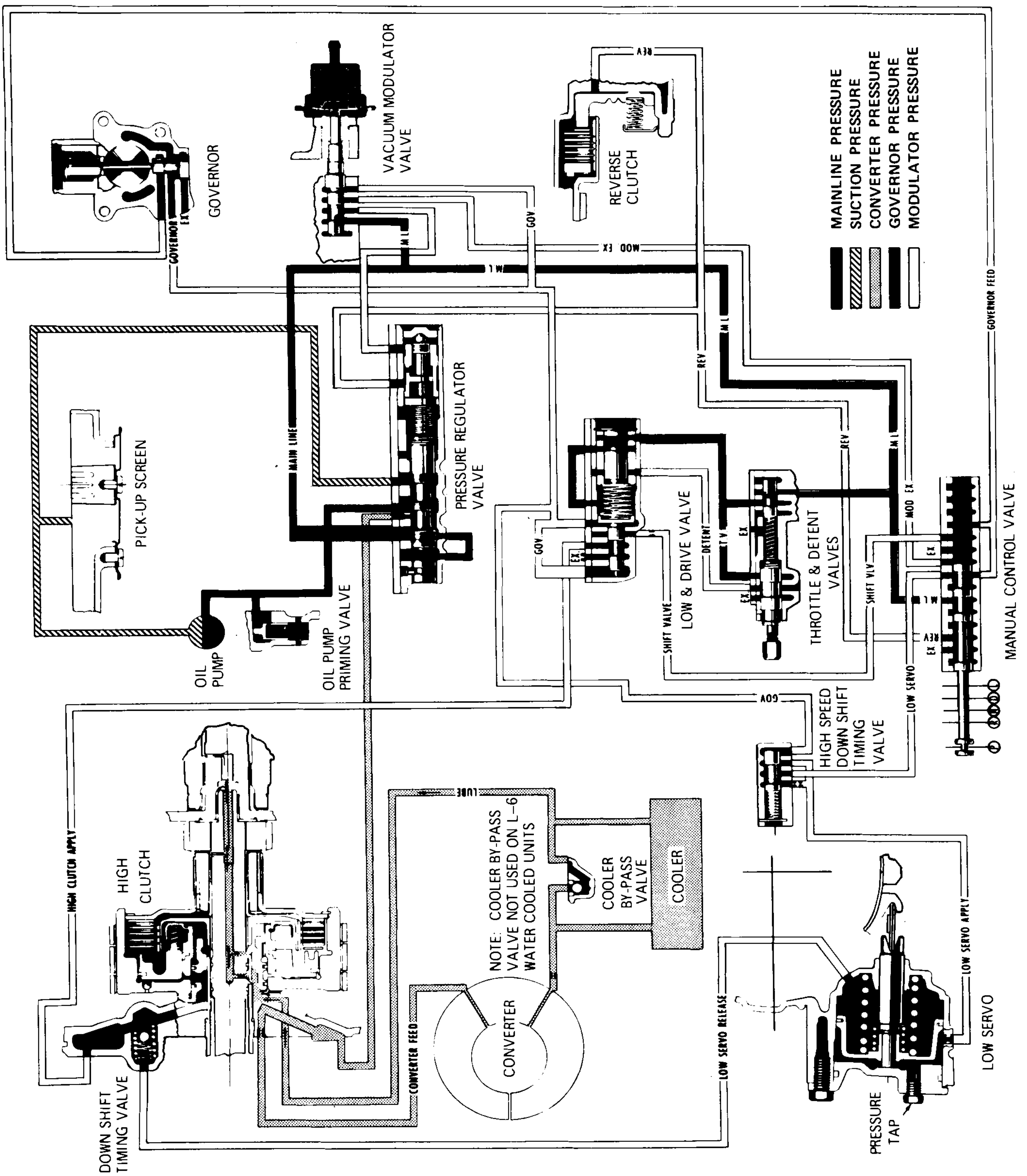


Fig. 7F-26 Park or Neutral Range - Engine Idling

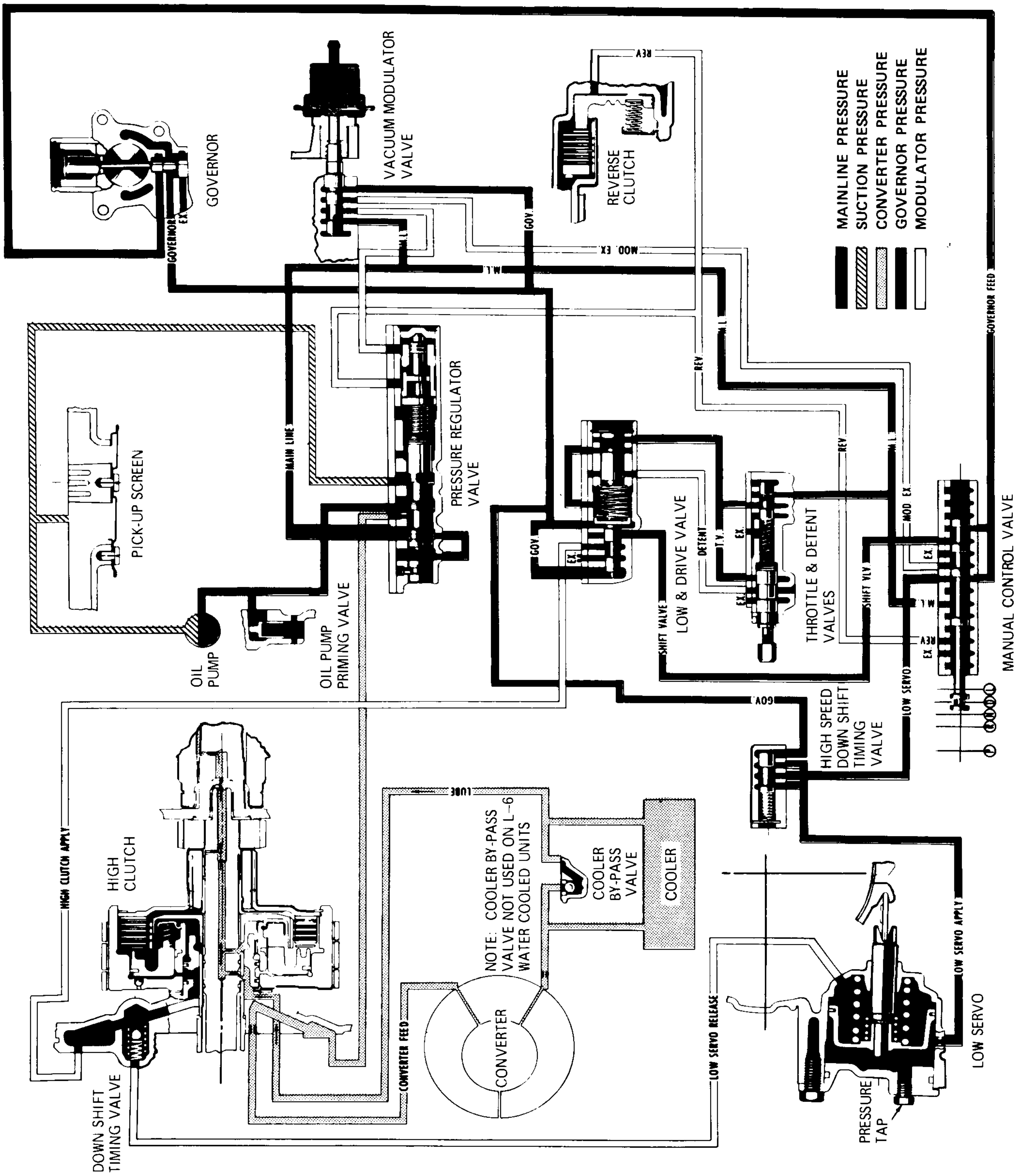


Fig. 7F-27 Drive Range - Low Gear

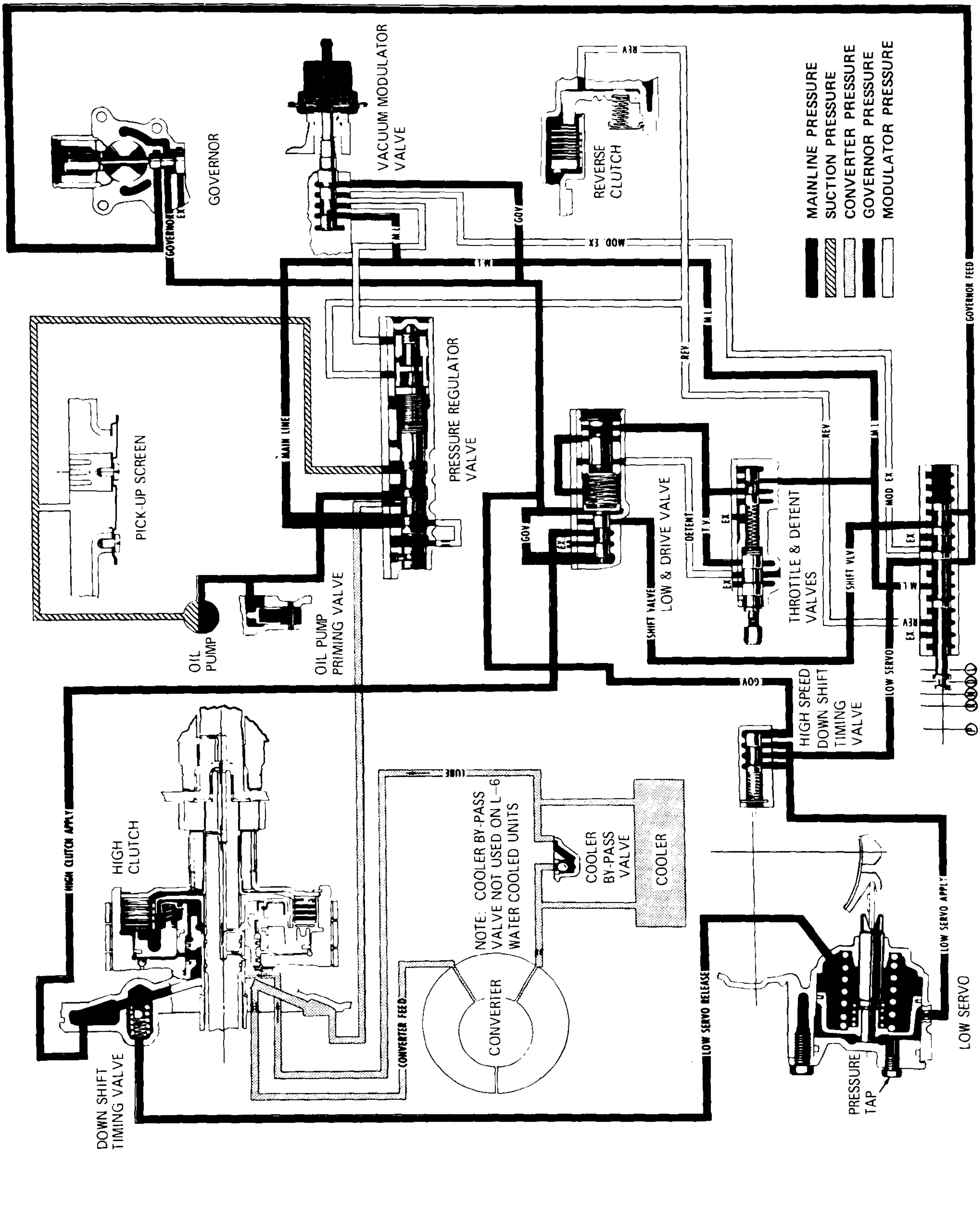


Fig. 7F-28 Drive Range - High Gear

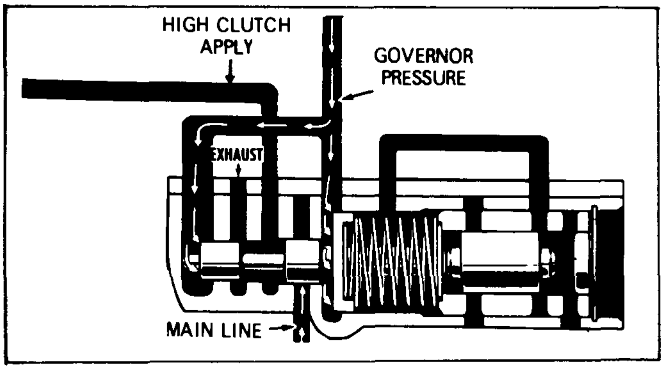


Fig. 7F-29 Low-Drive Shift Valve

AUTOMATIC UPSHIFTS

Minimum throttle upshifts occur when TV pressure is regulated to a minimum. The TV pressure is delivered to the right side of the low-drive regulator valve, causing the regulator valve to move to the left and contact the stem of the low-drive shift valve. With the regulator valve moved to the left, a by-pass port is opened which directs TV pressure to the spring side of the large diameter low-drive shift valve spool (Fig. 7F-31).

TV pressure in this area balances the pressure on the right of the regulator valve. This balanced condition allows the regulator valve to be moved by the shift valve without offering additional resistance.

As the vehicle reaches its minimum throttle shift point, governor pressure moves the low-drive shift valve to the right with its valve stem causing the regulator valve to move back to the right, blocking TV pressure flow through the by-pass (Fig. 7F-31). As the regulator valve moves to the right, it opens an exhaust port for relieving the TV pressure in the area between the low-drive shift valve and the regulator valve.

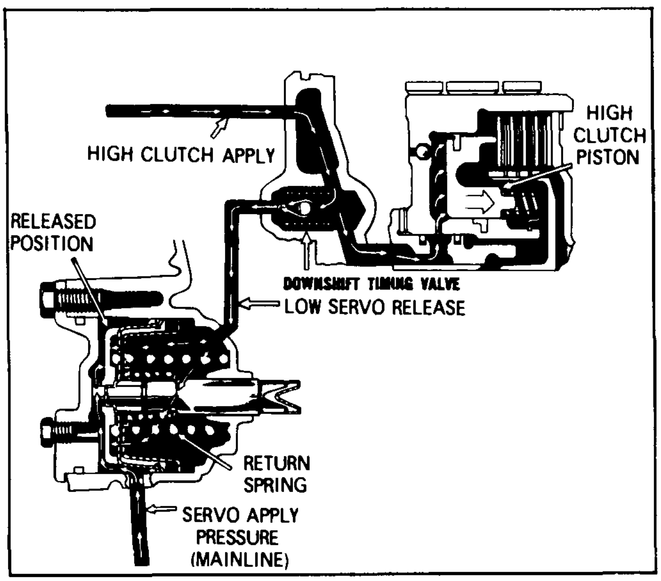


Fig. 7F-30 Clutch Apply - Servo Release Circuitry

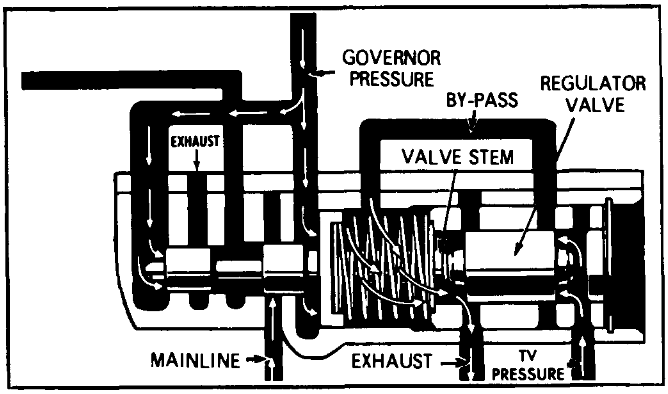


Fig. 7F-31 Minimum Throttle Upshift

This sudden exhaust of TV pressure allows the low-drive shift valve to snap to the right, allowing shift valve (mainline) pressure to enter the high clutch apply passage. This snap action of the low-drive shift valve is aided by mainline pressure acting on the difference in area between spools 1 and 2 of the low-drive shift valve (Fig. 7F-32). The overall design of the low-drive shift valve (with different spool areas) and the regulator valve eliminates any "hunt", that is, moving back and forth when the transmission is at a shifting point.

Medium throttle (to detent) upshifts are all controlled in the manner just described. However, since the TV pressure is regulated at higher pressures (Fig. 7F-31), the shift point will occur at higher road speeds.

Full throttle (through-detent) upshifts occur when the TV plunger causes full TV pressure to develop and also forces the detent valve to bottom in its bore. With the detent valve bottomed, the regulator valve exhaust port is blocked and TV pressure now occupies the area between the detent valve spools. This TV pressure enters the detent passage and supplies detent (TV) pressure to the spring side of the low-drive shift valve, after the regulator valve moves to close the by-pass port (Fig. 7F-33). In this way, the full throttle (through detent) upshift is delayed to the highest possible road speed. At this high road speed, high governor pressure snaps the low-drive shift valve to the right and accomplishes the shift to high gear.

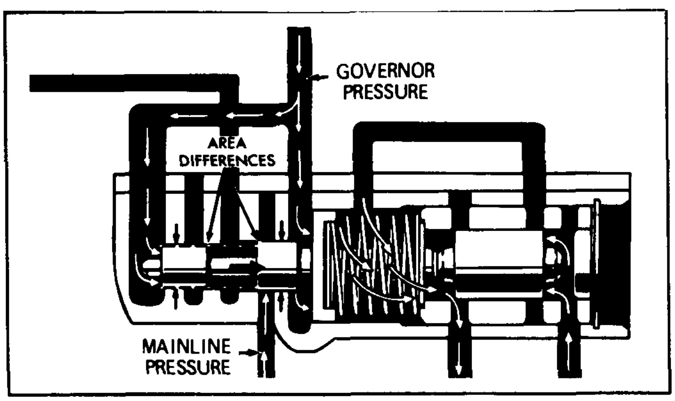
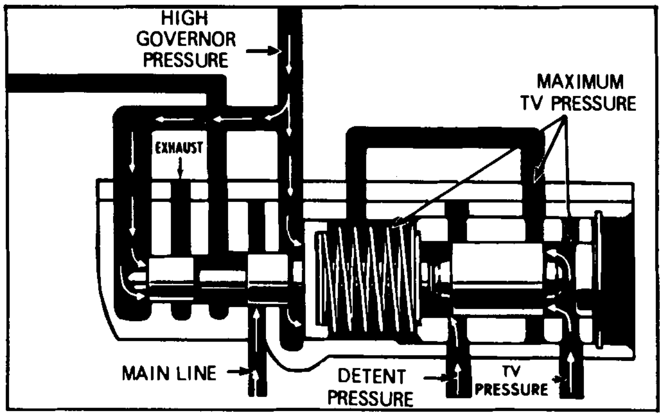


Fig. 7F-32 Low-Drive Shift Valve "Snap Action"



7F-33 Full Throttle Upshift

AUTOMATIC DOWNSHIFTS

Automatic downshifts to low range are divided into three types: Coast Downshift, To-Detent Forced Downshift and Through-Detent Forced Downshift. The control for these downshifts is provided by pressure differentials acting on the low-drive shift valve and the regulator valve. These pressures (governor, TV and detent) are the same ones previously discussed. In the case of the various downshift conditions, the low-drive shift valve is moved to the left, closing shift valve (mainline) pressure to the high clutch apply passage. The conditions that cause these shifts are: reduced road speed, increased pressure on the accelerator (raising TV pressure) or both.

Coast Downshift - As the vehicle slows down, governor pressure (holding low-drive shaft valve to the right) is being reduced. At approximately 18 to 14 mph, governor pressure is less than the opposing spring force of the low-drive shift valve springs. When this occurs, the springs snap the shift valve to the left, shutting off shift valve (mainline) pressure and opening the high clutch apply oil to exhaust (Fig. 7F-34).

To provide a smooth downshift when high clutch apply pressure is exhausted, low servo release pressure, which is returning to exhaust, is metered through two small openings in the pump cover. Because of this metered restriction in the servo release path to exhaust, the application of the low band is slightly delayed and this allows time for the high clutch to begin releasing and thus avoids a severe downshift or a "lock-up" condition. This coast downshift places the transmission in low gear, ready for instant response and acceleration.

To-Detent Forced Downshift - At low to moderate road speeds, increased pressure on the accelerator will result in regulating TV pressure high enough to move the low-drive shift valve to the left, overcoming governor pressure. TV pressure holds the low-drive shift valve in its low gear position (to the left) until vehicle speed and resultant governor pressure will cause an upshift.

Through-Detent Forced Downshift - At all road speeds below approximately 70 to 62 mph, the transmission can be automatically shifted to low gear by depressing the accelerator linkage "through-detent". This causes the detent valve to bottom in its bore, allowing maximum TV pressure to enter the detent passage to the low-drive shift valve. The resulting full TV pressure on the regulator valve and detent pressure on the low-drive shift valve overcomes governor pressure acting on the low-drive shift valve. This causes the low-drive shift valve to move to the left, closing the shift valve (mainline) pressure port and shifting the transmission to low gear (Fig. 7F-35).

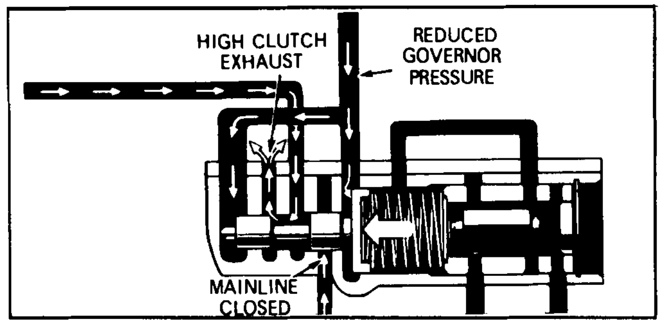


Fig. 7F-34 Coast Downshift

The transmission will remain in low gear until either the accelerator is released (decreasing TV pressure) or vehicle speed reaches the maximum upshift point of 68 to 74 mph (increasing governor pressure). At road speeds above approximately 63 pmh, governor pressure acting on the low-drive shift valve is usually high enough to prevent TV pressure from moving the low-drive shift valve to the left. Therefore, regardless of accelerator position, the transmission will remain in high gear at all road speeds above approximately 70 mph.

HIGH SPEED DOWNSHIFT TIMING VALVE

The high speed downshift timing valve is a spring loaded

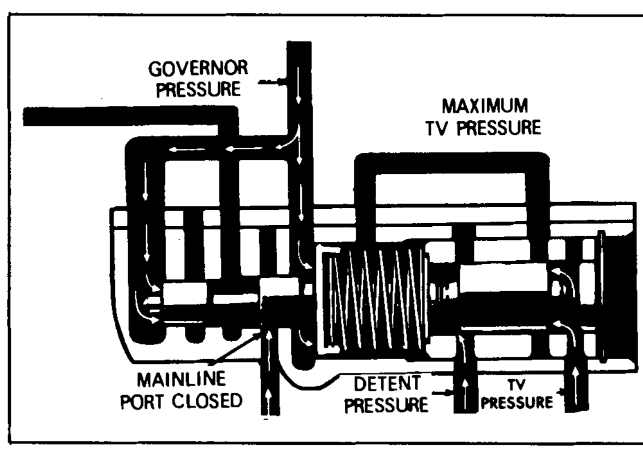


Fig. 7F-35 Through-Detent Forced Downshift

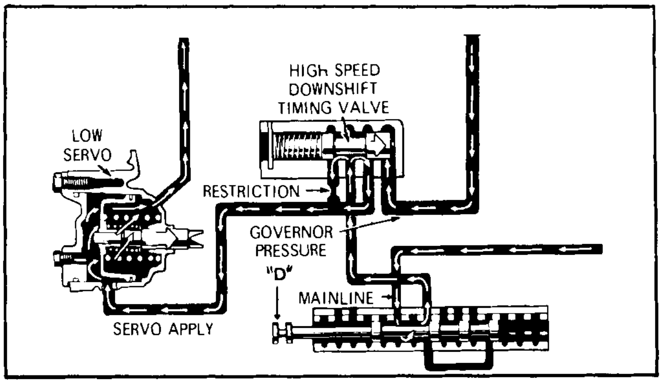


Fig. 7F-36 High Speed Downshift Timing Valve

spool valve located in the upper valve body. The function of this valve is to control low servo apply pressure at high road speeds. The actions of this valve are affected by spring pressure on the left end and by governor pressure on the right end. At low speeds (30 mph or less) with resultant lower governor pressure, the valve is held to the right by spring pressure. In this position, the valve offers two paths of flow for low servo apply pressure (Fig. 7F-36). The passage on the right offers a non-restricted path, for low servo oil, whereas the passage on the left includes a restricted orifice. At low road speeds, the valve is held to the right and does not offer any resistance to low servo apply.

As road speed increases, the resultant higher governor pressure acts on the right end of the valve until, at approximately 30 mph, governor pressure overcomes spring pressure and moves the valve to the left. This movement blocks the non-restricted path, routing all low servo apply oil through the restricted orifice of the left passage. This restriction of oil flow causes band apply to be delayed slightly and is thus timed with the high clutch release for a smooth downshift.

LOW RANGE

When the manual control valve is moved into the "L" position, mainline pressure is directed into the low servo apply circuit and the modulator exhaust circuit, but is now prevented from entering the shift valve and hence the high clutch apply circuits (Fig. 7F-37). Since the high clutch apply circuit is no longer subjected to mainline pressure, the position of the low-drive shift valve will not affect the transmission and it will remain in low gear, regardless of road speed or governor pressure.

The vacuum modulator valve receives mainline pressure through its normal passage and through the modulator exhaust passage from the manual control valve (Fig. 7F-38). Mainline pressure at the modulator valve prevents the vacuum modulator valve from regulating and applies full mainline pressure to the booster valve on the right end of the pressure regulator valve train. This pressure on the end of the booster valve causes mainline pressure to be regulated to a higher value. The increased mainline pressure offsets the higher torque reactions associated with low range operation.

DRIVE TO LOW RANGE DOWNSHIFT

With the vehicle moving at any speed in high gear, Drive Range, a forced downshift may be made by moving the selector lever into Low Range.

> **CAUTION:** *Do* **not** *force a downshift at speeds above approximately 70 mph.*

Since the transmission was in high gear, Drive Range, governor pressure was holding the low-drive shift valve in the full right position and the high clutch circuit exhaust port in the manual control valve bore was blocked. Thus, when shifting the transmission from drive range to low range, the normal low range circuits are changed and the high clutch oil will exhaust through the now open exhaust port at the manual valve (Fig. 7F-39). As this high clutch pressure exhausts, the transmission downshifts to low gear.

REVERSE RANGE

When the manual control valve is moved into the "R" position, mainline pressure is directed only to the reverse circuit (Fig. 7F-40). The low servo and high clutch apply (shift valve) circuits are all open to exhaust at the manual control valve.

Mainline oil leaves the manual control valve as reverse circuit oil and is fed to the reverse clutch assembly to apply the reverse clutch piston and plates (Fig. 7F-41). Reverse circuit oil is also routed to the pressure regulator valve train where it passes through the booster valve sleeve to act against the large spool end of the booster valve. Vacuum modulator pressure acts on the right end of the small spool of the booster valve.

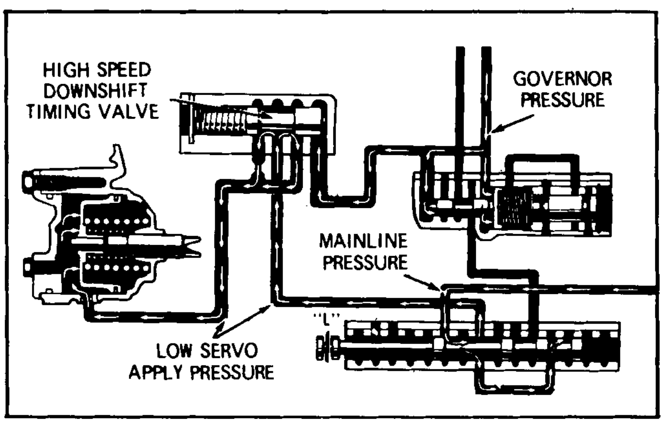


Fig. 7F-37 Manual Low Circuitry

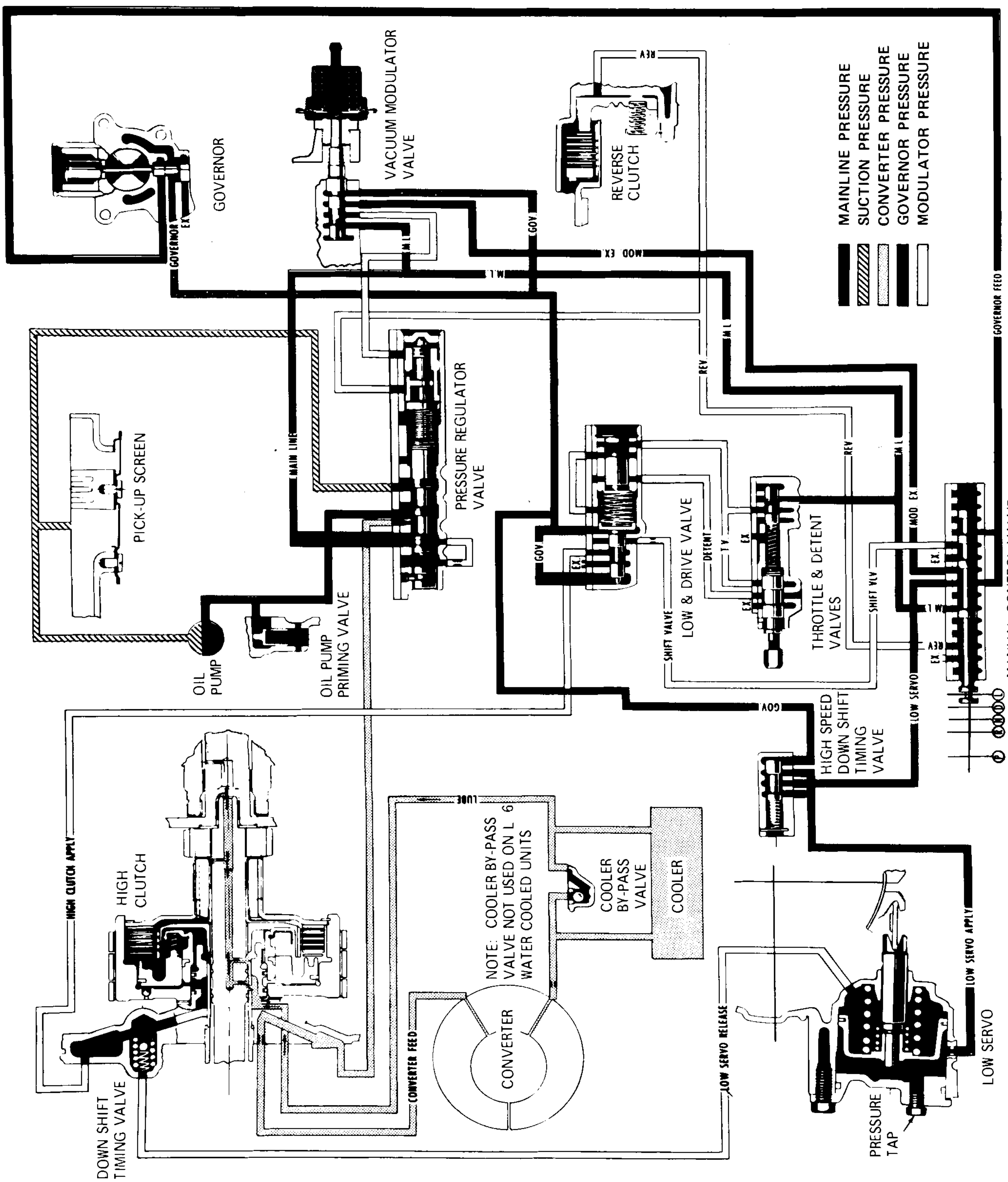


Fig. 7F-38 Low Range - Low Gear

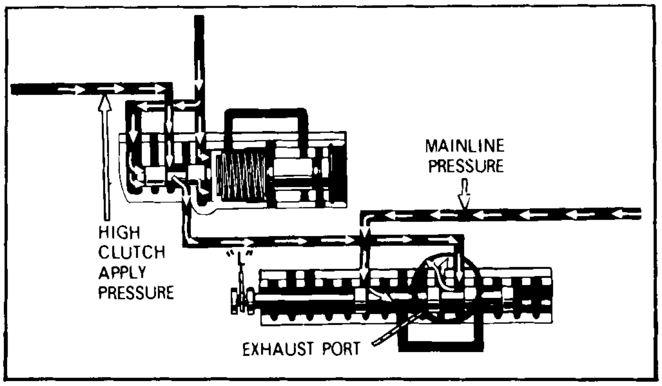


Fig. 7F-39 Downshift to Low Range

The combined pressure of mainline pressure between the spools and of modulator pressure on the small spool causes the pressure regulator to increase mainline operating pressure to its maximum.

PERIODIC SERVICE RECOMMENDATIONS

TOWING

If the transmission, drive line or axle do *not* have a malfunction, the vehicle may be towed in neutral, with steering column unlocked, at speeds up to 35 m.p.h. 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

FLUID LEVEL CHECK

Transmission fluid level should be checked every time engine oil level is checked or every 6,000 miles, whichever comes first. Check fluid level with engine idling, selector lever in neutral, parking brake set and transmission at operating temperature (180°F). The fluid level indicator is located in the filler tube at the right rear of the engine compartment.

Fluid should be added only when level is on or below the "ADD" mark on the indicator with fluid at operating temperature (180°F). The "FULL" mark on the indicator is an indication of transmission fluid at its normal operating temperature of 180°F. This temperature is only obtained after at least 15 miles of highway driving or its equivalent of city driving. It is important that fluid level be maintained no higher than the "FULL" mark on the indicator. **Do not overfill** for when fluid level is at the full mark it is just slightly below the planetary gear unit. If additional fluid were added to bring the level above the full mark, the planetary gear train would run in the fluid, causing foaming and aerating of fluid. This aerated fluid, carried through the various oil pressure passages, could cause malfunction of the transmission, resulting in cavitation noise in the converter, improper band or clutch application and/or overheating of the transmission.

If the transmission is found consistently low on fluid, a thorough inspection should be made to find and correct all external oil leaks.

FLUID CAPACITY

The fluid capacity of the Two Speed Automatic (M-35) transmission and converter assembly is approximately 20 pints for V-8 engine models (**TS**) and approximately 18 1/4 pints for the 6 cylinder engine model (**RB**). However, the correct fluid level is determined by the mark on the dipstick rather than by the amount added. Use only DEXRON, or equivalent, automatic transmission fluid.

DRAINING AND REFILLING

Drain fluid immediately after operation, before it has an opportunity to cool. If car has been parked for any length of time, run engine with transmission in Neutral for at least one minute prior to changing:

1. Raise vehicle on hoist or place on jack stands and place container beneath transmission to collect draining fluid. Be sure vehicle is level.
2. Remove oil pan plug and allow fluid to drain thoroughly into container.
3. Re-install drain plug, torque to 20 lb. ft. and lower vehicle.
4. Remove indicator from filler tube and refill the transmission with approximately 3 pints of DEXRON, or equivalent, transmission fluid.

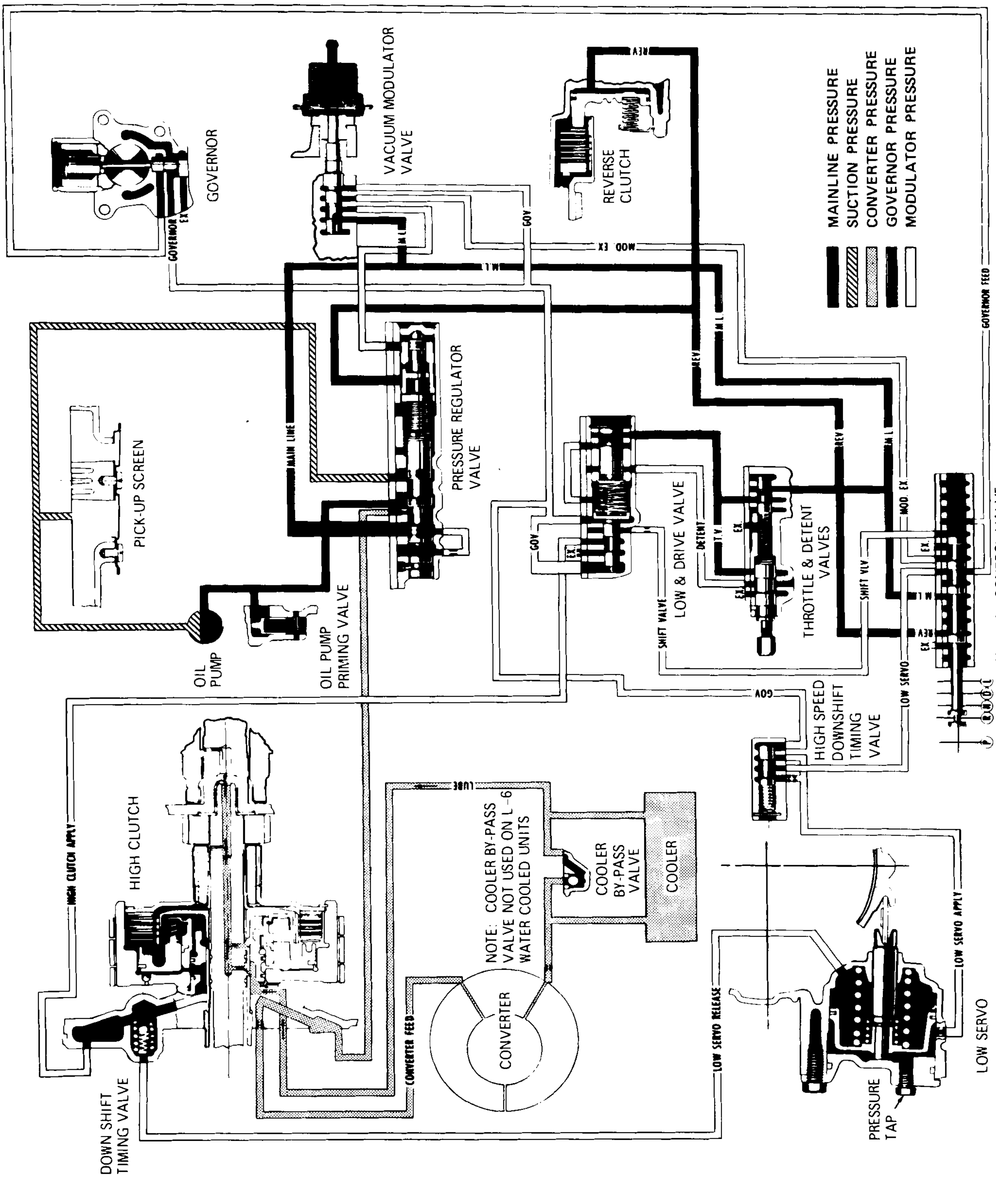


Fig. 7F-40 Reverse Range - Reverse Gear

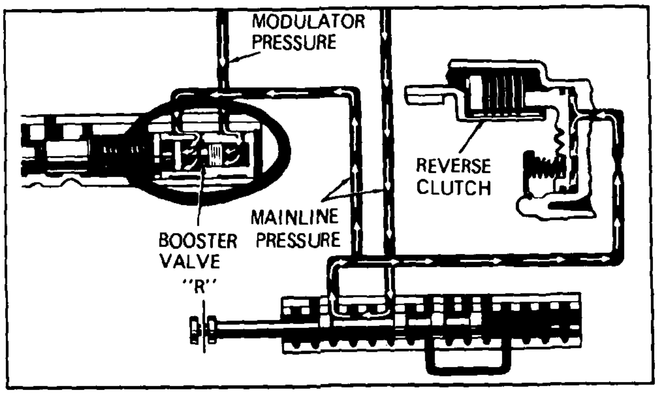


Fig. 7F-41 Reverse Circuitry

5. After shifting into all ranges with engine at idle speed to fill all oil passages, engine should be at 800 - 1000 rpm with transmission in Neutral until fluid warms up. Add additional fluid, as required, to raise fluid level to the "FULL" mark on the indicator.

   CAUTION: Do not overfill. *Foaming will result if overfull.*

OPERATIONS NOT REQUIRING REMOVAL OF TRANSMISSION

LOW BAND

ADJUST

Low band adjustment should be performed at first transmission fluid change or sooner if operating performance indicates slippage of the low band. Perform as follows:

1. Place selector lever in neutral and raise vehicle on hoist.
2. Remove protective cap from transmission adjusting screw.
3. Loosen adjusting screw lock nut 1/4 turn and hold in this position with wrench.

   CAUTION: *Be sure to hold adjusting screw lock nut at 1/4 turn loose during this adjusting procedure.*

4. Using Band Adjusting Tool J21848 (Fig. 7F-42), adjust band to 70 lb. in. and back off exactly four (4) complete turns for a band which has been in operation for 6,000 miles or more; or three (3) turns for one in use less than 6,000 miles.
5. Tighten adjusting screw lock nut to 15 lb. ft. torque and install protective cap.

COLUMN SHIFT CONTROLS (Figs. 7F-43 and 7F-44)

ADJUST

1. Place steering column selector lever in Park (P) position and lock ignition.
2. Loosen screw on adjusting swivel clamp at shaft and lever assembly.
3. Make sure that transmission range selector lever is in PARK detent. PARK position is obtained by rotating transmission range selector lever fully clockwise.
4. Push up on gearshift control rod to take up clearance in steering column lock mechanism and tighten screw on adjusting swivel clamp to 20 lb. ft. torque.
5. Unlock ignition, readjust indicator needle if necessary to agree with transmission detent positions and readjust transmission neutralizer switch if necessary.

CONSOLE SHIFT CONTROLS (Figs. 7F-45 and 7F-46)

ADJUST

1. Place console gearshift lever in Part (P) position and lock ignition.

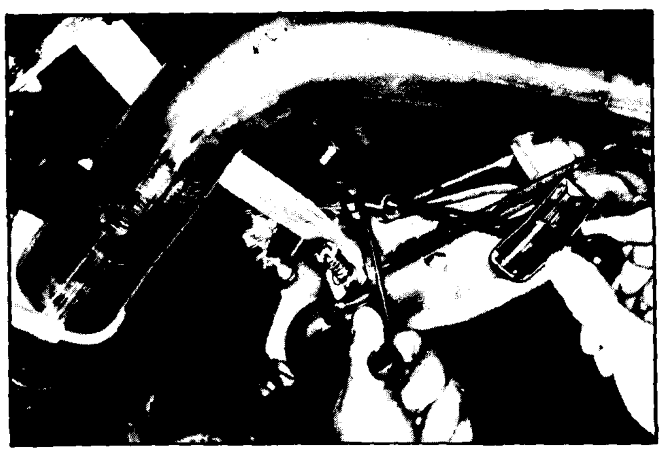


Fig. 7F-42 Low Band Adjustment

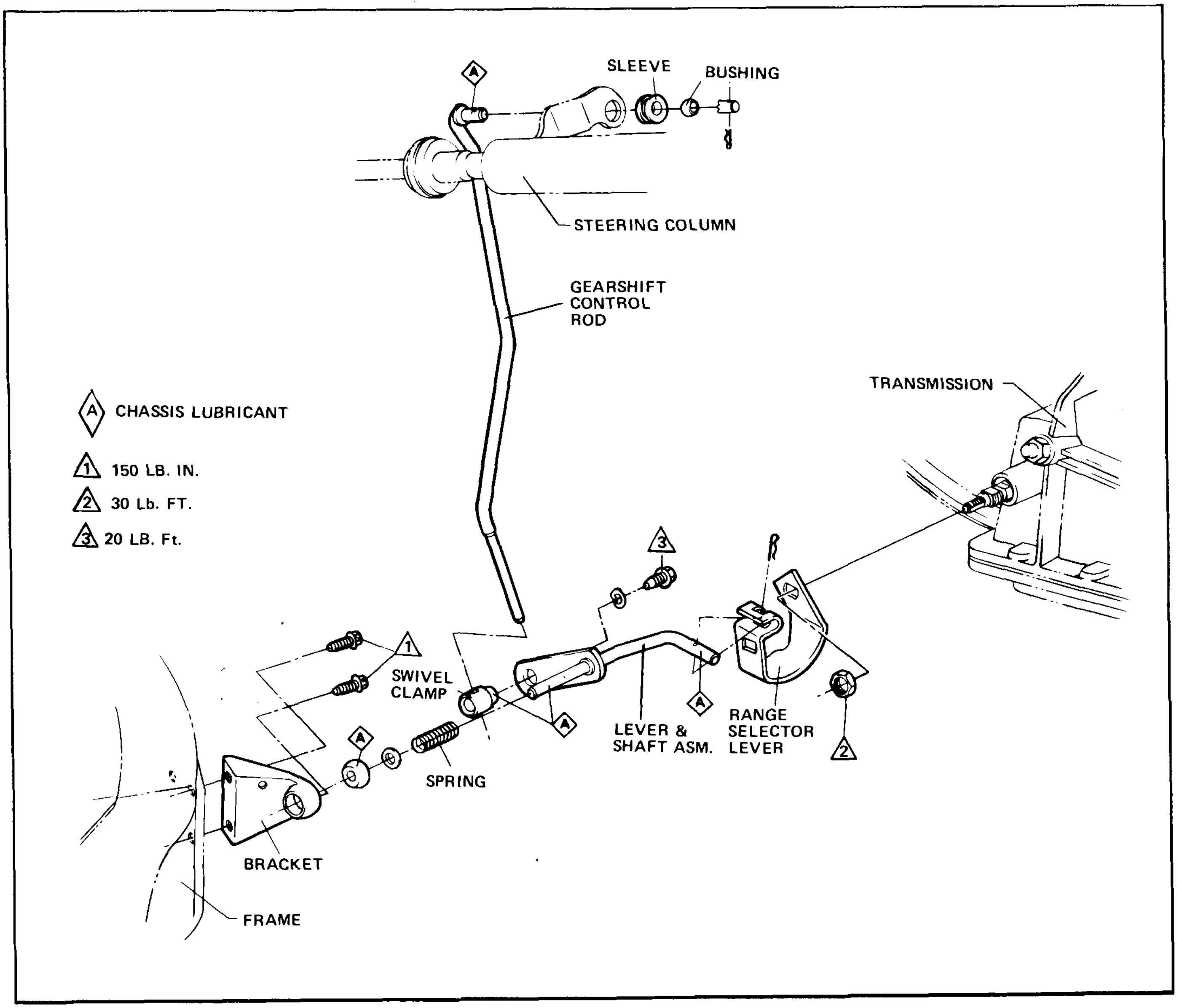


Fig. 7F-43 Column Shift Controls - A Series

2. Disconnect shift cable from transmission range selector lever by removing nut from pin (Fig. 7F-45).

3. Loosen screw on adjusting swivel at the shaft lever assembly (Fig. 7F-44).

4. Make sure that the transmission range selector lever is in PARK detent (Fig. 7F-46). Park position is obtained by rotating the transmission range selector lever fully clockwise.

5. Push up on the gearshift control rod to take up clearance in steering column lock mechanism and tighten screw on adjusting swivel to 20 lb. ft. torque.

6. Unlock ignition and rotate the transmission range selector lever counterclockwise by two (2) detent positions.

7. Set the console gearshift lever in NEUTRAL range and move it forward against its stop in neutral.

8. Assemble the shift cable and pin to the transmission range selector lever, allowing the shift cable to position its pin in the slot of the selector lever and then install and tighten the nut to 20 lb. ft. torque.

9. Readjust transmission neutralizer switch if necessary.

THROTTLE VALVE LINKAGE

ADJUST

6 CYLINDER ENGINE MODELS (Fig. 7F-47)

1. Remove air cleaner.

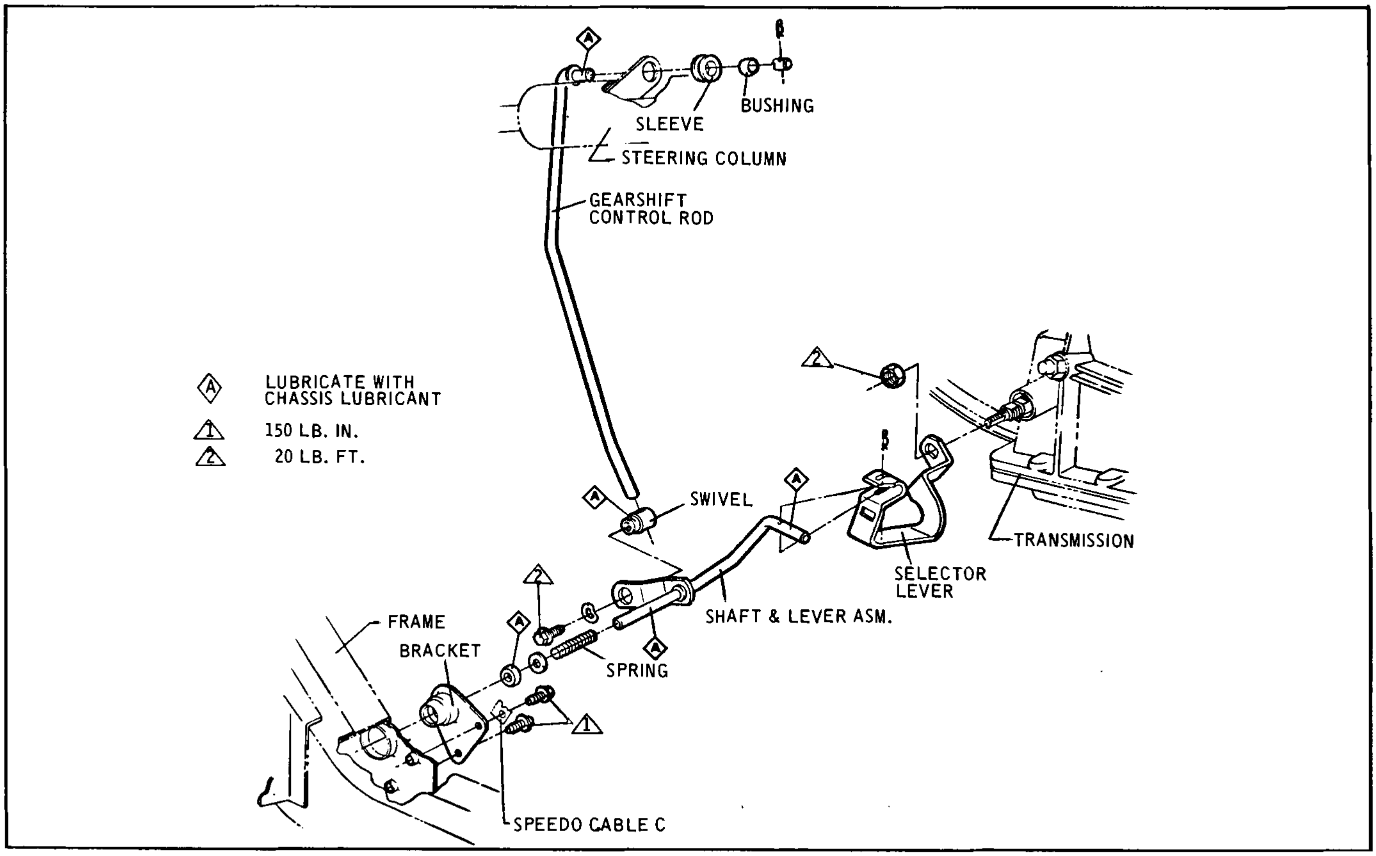


Fig. 7F-44 Column Shift Controls - F Series

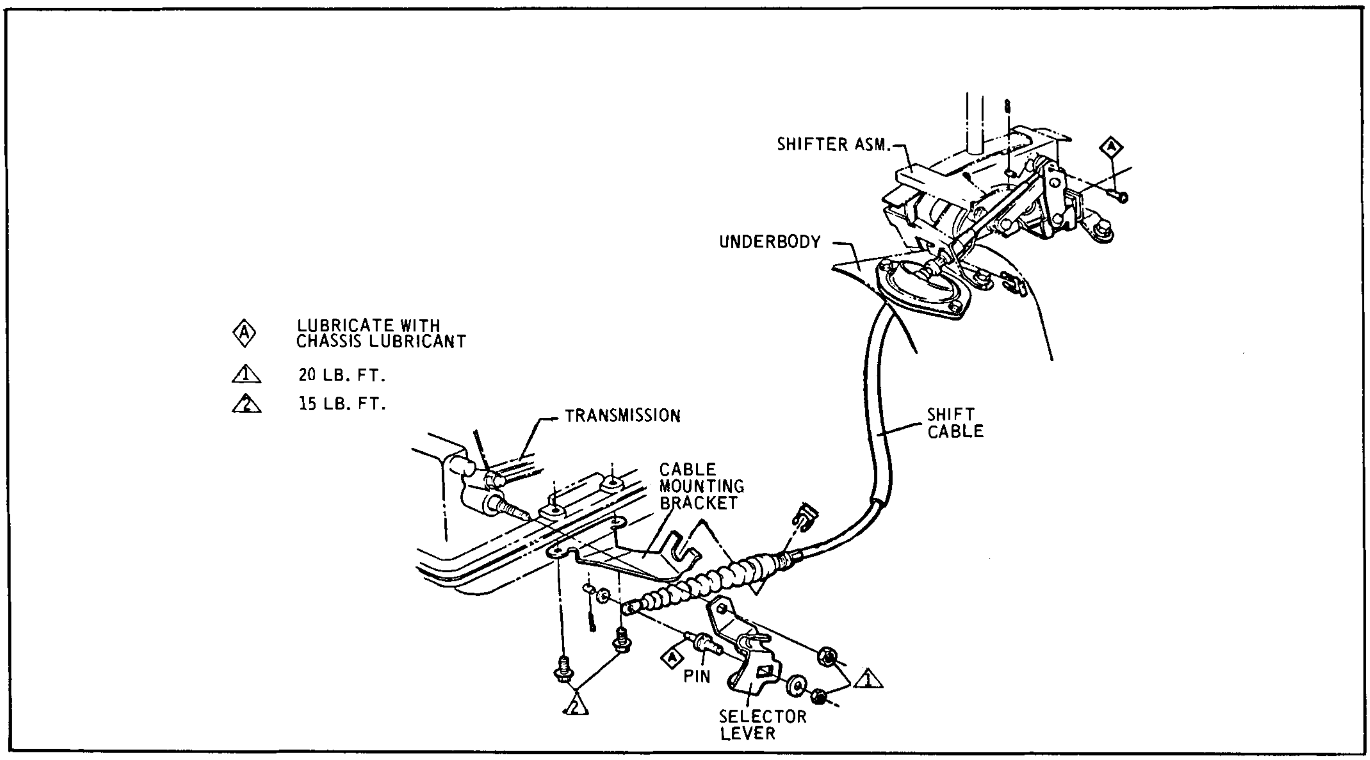


Fig. 7F-45 Shift Cable Routing - F Series

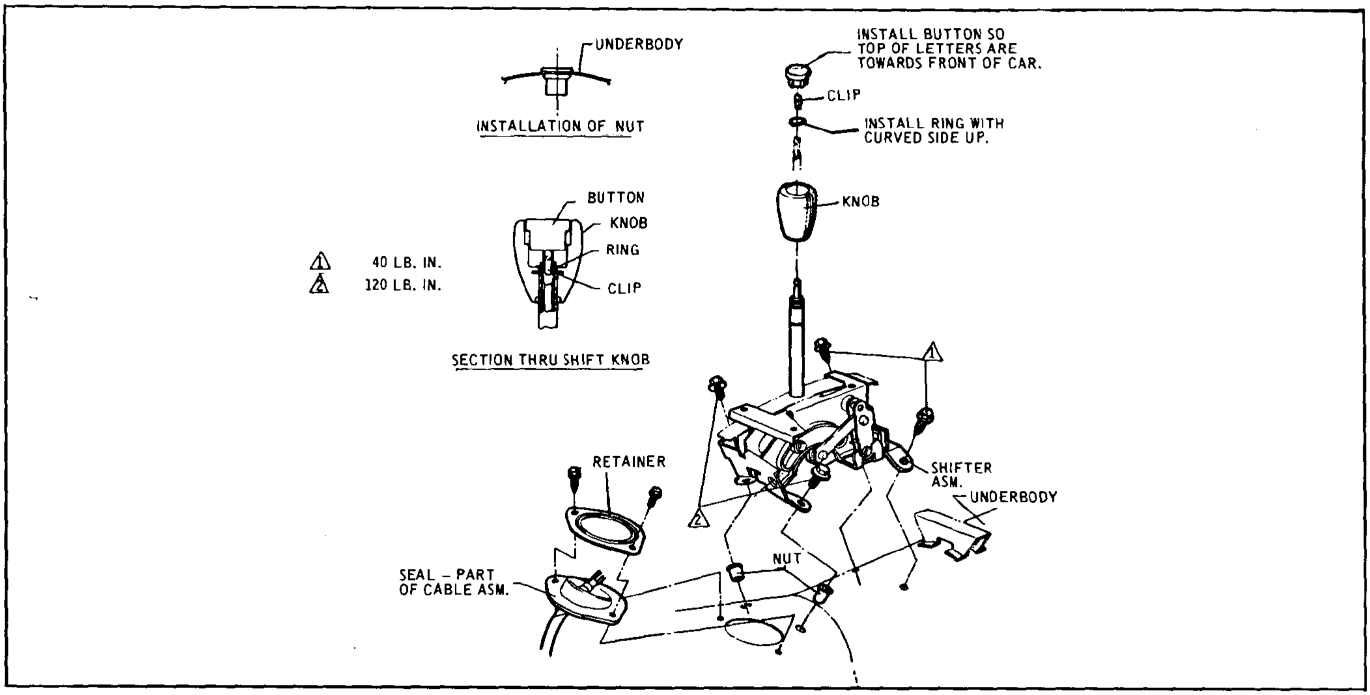


Fig. 7F-46 Console Shifter Mounting - F Series

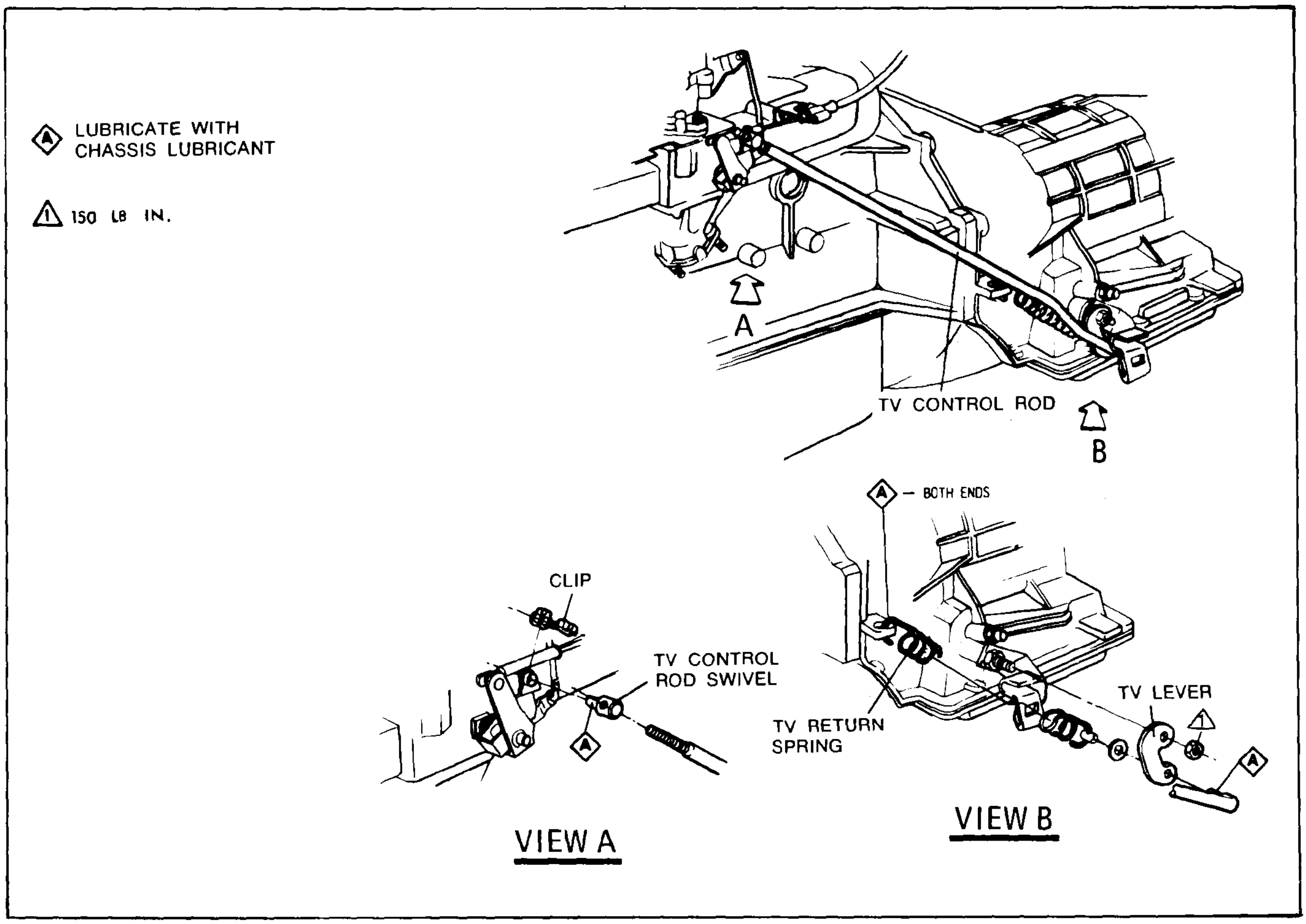


Fig. 7F-47 6 Cylinder T.V. Linkage

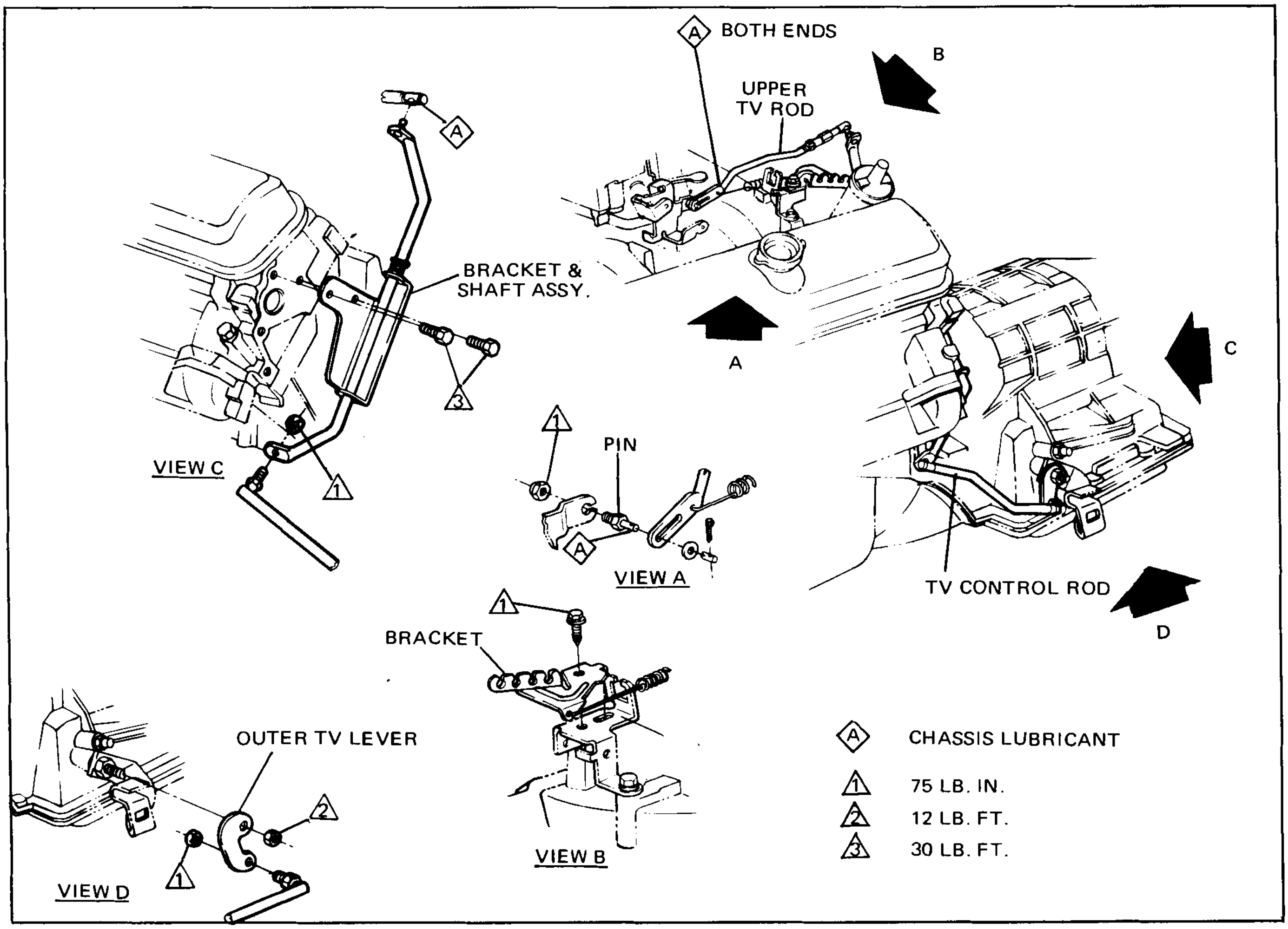


Fig. 7F-48 V-8 T.V. Linkage

2. Disconnect TV control rod swivel and clip from carburetor lever and TV return spring from flywheel housing.
3. With right hand, push TV control rod rearward until transmission TV lever is against internal stop of transmission.
4. With left hand, hold carburetor lever in wide-open throttle position.
5. Adjust TV control rod swivel so that swivel pin freely enters hole in carburetor lever.
6. Secure swivel and control rod to carburetor lever with clip, connect TV return spring and check for throttle valve linkage freeness.
7. Install air cleaner.

V-8 ENGINE MODELS (Fig. 7F-48)

1. Remove air cleaner.
2. Disconnect accelerator linkage at carburetor.
3. Disconnect accelerator return spring and T.V. rod return spring.
4. With right hand, pull T.V. upper rod forward until transmission is through detent. With left hand, open carburetor to wide-open throttle position. Carburetor must reach wide-open throttle position at the same time that the ball stud contacts end of slot in the upper T.V. rod.
5. If necessary, adjust swivel on end of upper T.V. rod to obtain the setting in previous step (step 4). Allowable tolerance is approximately 1/32".
6. Connect accelerator linkage and springs and check for throttle valve linkage freedom.
7. Install air cleaner.

NEUTRALIZER SWITCH

ADJUST

Refer to CHASSIS ELECTRICAL SERVICE, Section 12.

OTHER SERVICE OPERATIONS

Certain service operations, such as oil pan and gasket, manual levers, valve body, governor, filler pipe "O" ring, speedometer drive and driven gears, extension housing, "O" ring and rear oil seal, vacuum modulator and servo cover or gasket may be performed from underneath vehicle without removing the transmission. Their service procedure is covered later in this section and is not detailed here.

REMOVAL AND DISASSEMBLY OF TRANSMISSION

TRANSMISSION ASSEMBLY

REMOVE

1. Before raising vehicle, disconnect battery and release parking brake.
2. Raise vehicle on hoist and remove oil pan drain plug to drain lubricant.

   NOTE: *If desired, fluid may be drained after transmission is removed.*

3. Disconnect oil cooler lines, electrical lead to pressure switch, vacuum modulator line and speedometer cable fitting from transmission. Tie lines out of way.
4. Disconnect manual and TV control lever rods from transmission outer levers.
5. Remove propeller shaft as outlined in Section 4E.
6. With suitable transmission lifting equipment installed on jack, support the transmission with jack.
7. Disconnect engine rear mount from extension housing and transmission support rear crossmember from frame. Slide crossmember rearward or remove.
8. Remove flywheel housing bottom cover, scribe flywheel and converter relationship (to maintain balance re-assembly) and remove flywheel-to-converter bolts.
9. Support engine at oil pan rail with a jack or suitable brace, lower rear of transmission slightly so that upper transmission-to-engine bolts can be reached and remove upper attaching bolts.
10. Disconnect transmission filler pipe from engine, remove from transmission and remove remainder of transmission-to-engine bolts.
11. Making sure that converter moves with transmission, move transmission slightly rearward and install Converter Holding Strap J 21366 to hold converter in place on transmission.
12. Lower transmission assembly from vehicle and transfer to work bench

CONVERTER

REMOVE

1. Place transmission in Holding Fixture J 8763-01 and position it horizontally at work bench with a drain pan on floor beneath it. Remove oil pan drain plug.
2. Remove Converter Holding Strap J 21366 and pull converter straight out from transmission.

SPEEDOMETER DRIVE AND DRIVEN GEARS, EXTENSION HOUSING, GOVERNOR AND GOVERNOR SUPPORT

REMOVE

1. Remove bolt, retainer and speedometer driven gear from side of extension housing.
2. Remove five (5) extension housing-to-case attaching bolts, extension housing and its square-cut seal ring from transmission case.

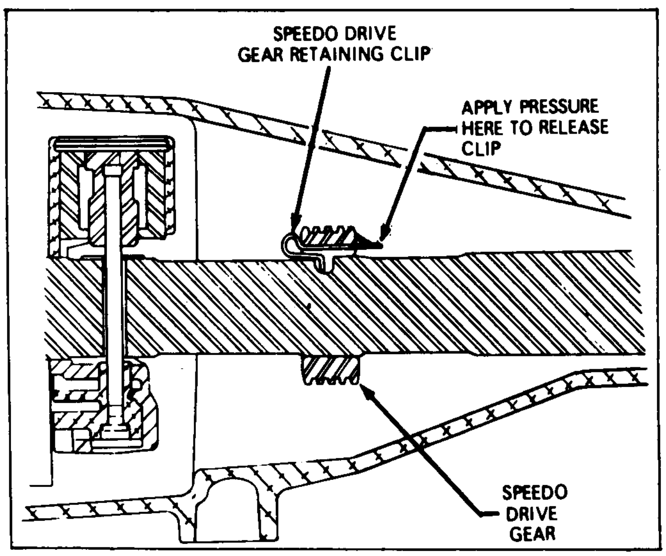


Fig. 7F-49 Removing Speedometer Drive Gear

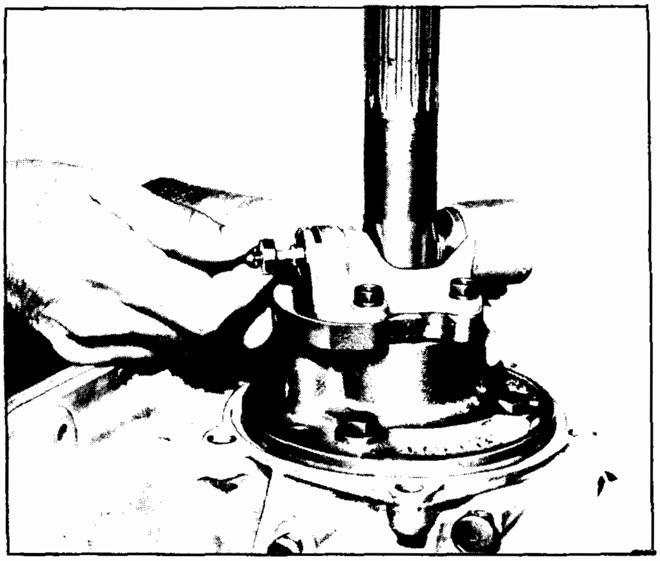


Fig. 7F-50 Removing Governor Valve and Shaft

3. If necessary to replace, pry rear oil seal from extension housing.

4. Depress retaining clip and slide speedometer drive gear from clip and output shaft (Fig. 7F-49).

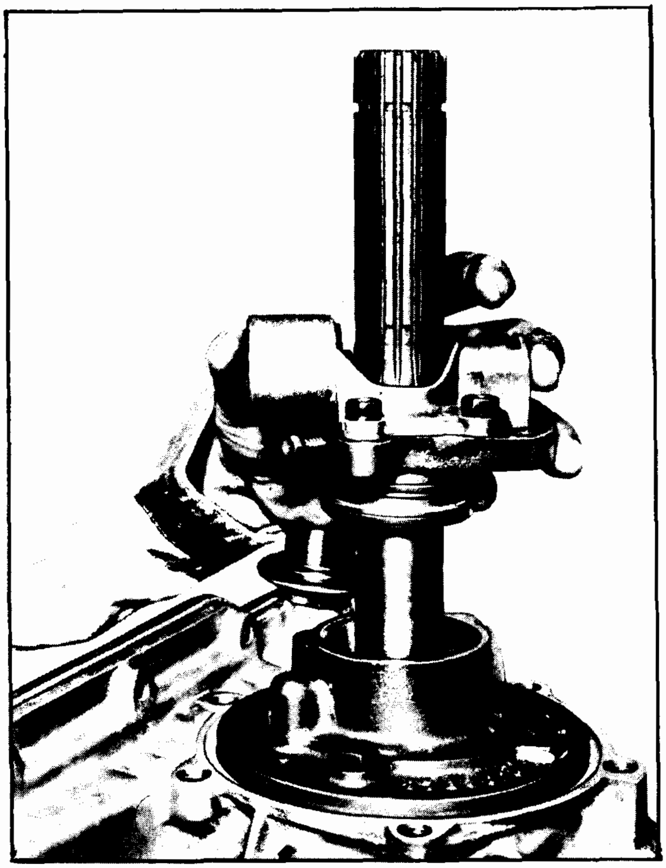


Fig. 7F-51 Removing Governor Assembly

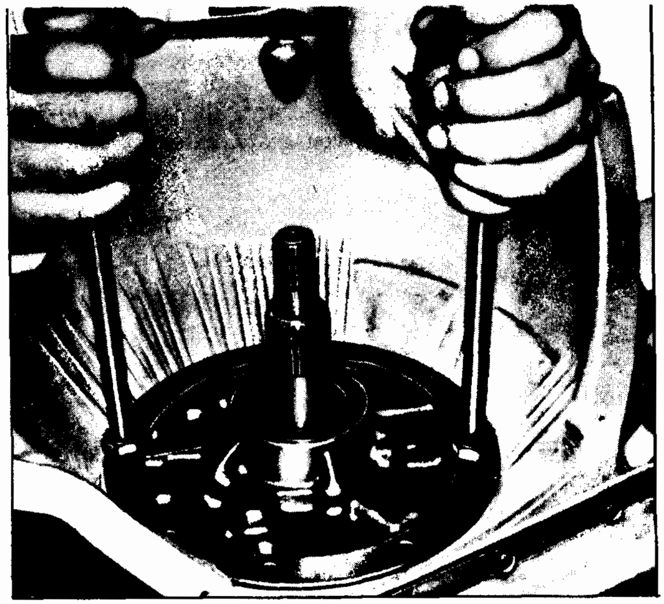


Fig. 7F-52 Removing Oil Pump Assembly

5. On the weight side of governor, remove "E" clip from governor shaft and remove governor shaft and valve from opposite side of governor (Fig. 7F-50).

6. Remove urethane washer (located between governor weight and output shaft) from governor body.

7. Loosen drive screw from governor hub and remove governor assembly from output shaft (Fig. 7F-51).

8. Remove four (4) governor support-to-case bolts, drain-back baffle, governor support and its gasket from transmission case and output shaft.

9. If necessary, unscrew pressure switch from side of servo boss on transmission case.

INTERNAL COMPONENTS

REMOVE

1. Remove seven (7) oil pump attaching bolts. The bolt holes are offset to facilitate proper location of pump upon installation.

2. Install Slide Hammers J 6125 with Adapters J 6125-2 into two (2) threaded bolt holes of the pump body (at 4 and 10 o'clock), loosen and remove oil pump and stator shaft assembly from case (Fig. 7F-52).

3. Remove oil pump gasket from case (or pump) and remove tanged selective fit thrust washer from pump cover.

4. Back off band anchor adjusting screw to release tension on low brake band. Grasp input shaft and carefully work it and clutch assembly out of transmission

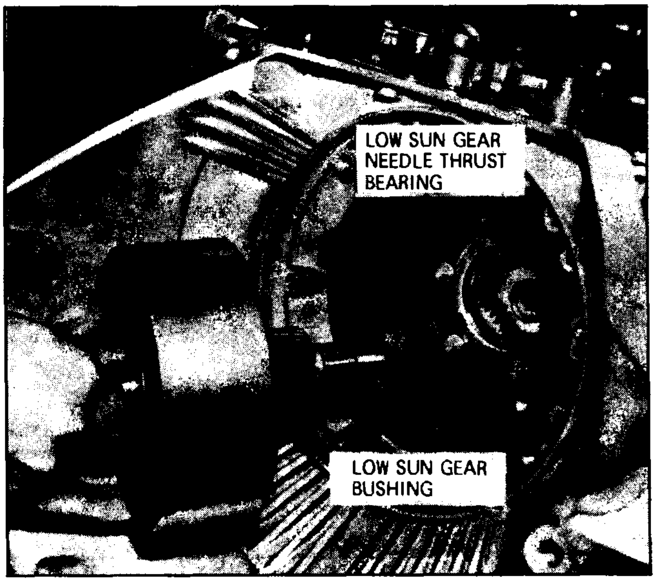


Fig. 7F-53 Removing Input Shaft and Clutch Assembly

case (Fig. 7F-53). Use care so as *not* to lose low sun gear splined bushing from end of input shaft nor damage the machined face of the clutch drum.

5. Remove low brake band, apply and anchor struts and adjusting screw from case.

6. Remove planet carrier - output shaft assembly from case and remove output shaft caged thrust bearing from output shaft or case. From inside of carrier, remove low sun gear needle thrust bearing.

7. If not removed with planet carrier - output shaft assembly, remove reverse ring gear.

8. Using large screwdriver, remove reverse clutch pack

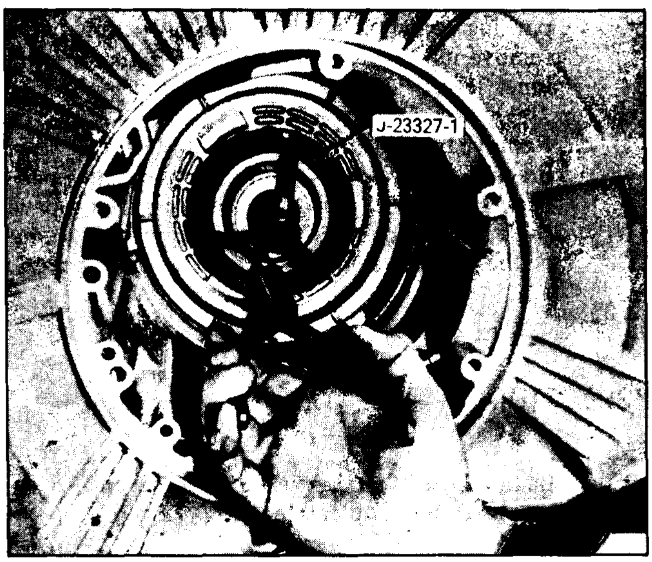


Fig. 7F-54 Removing Reverse Piston Spring Retainer Snap Ring

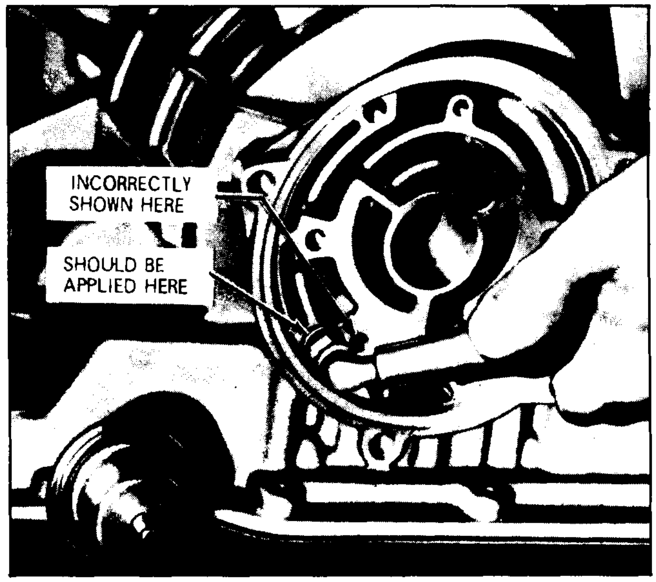


Fig. 7F-55 Applying Air to Remove Reverse Piston

snap ring and lift pressure plate, clutch pack and waved cushion spring from case.

9. Install Compressor J 23327-1 and -2 through inside rear base of case and, with Pilot J 9542-4 on outside rear face of case, turn down wing nut to compress reverse piston return springs and retainer (Fig. 7F-54).

10. With return springs compressed, remove retainer snap ring, compressor tools, spring retainer and seventeen (17) piston return springs.

11. Apply compressed air to reverse piston port to force out the reverse clutch piston. If necessary, remove inner and outer oil seals from piston (Fig. 7F-55).

12. Remove three (3) servo cover-to-case attaching bolts, servo cover, seal and its gasket from case.

13. Remove servo piston assembly and return spring from its case bore.

OIL PAN, VACUUM MODULATOR AND VALVE BODY

REMOVE

1. Rotate transmission so that oil pan is up and remove fourteen (14) oil pan-to-case attaching bolts, oil pan and its gasket.

2. Remove two (2) attaching screws, transmission suction screen and its gasket from valve body assembly.

3. Unscrew vacuum modulator assembly from end of transmission case, using Wrench J 9543 (or any thin 1" tappet-type wrench), and remove vacuum

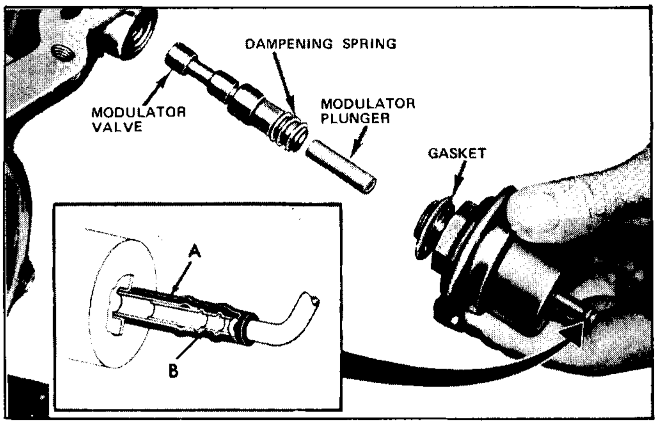


Fig. 7F-56 Vacuum Modulator Assembly

modulator and gasket, plunger, dampening spring and modulator valve from case (Fig. 7F-56).

4. Remove two (2) attaching bolts and detent guide plate from valve body and case.

5. Remove six (6) remaining valve body-to-case attaching bolts and carefully lift out valve body and gasket, disengaging servo apply line from case as valve body is removed (Fig. 7F-57).

6. Remove manual control valve from valve body and transmission case screen from its bore in valve body

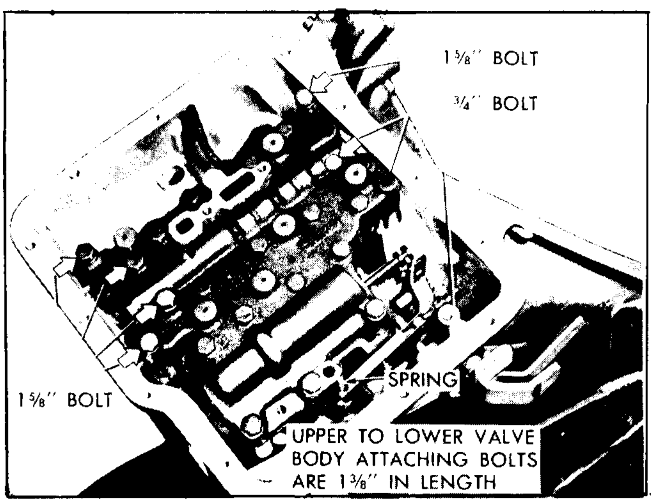


Fig. 7F-57 Valve Body Attaching Bolts

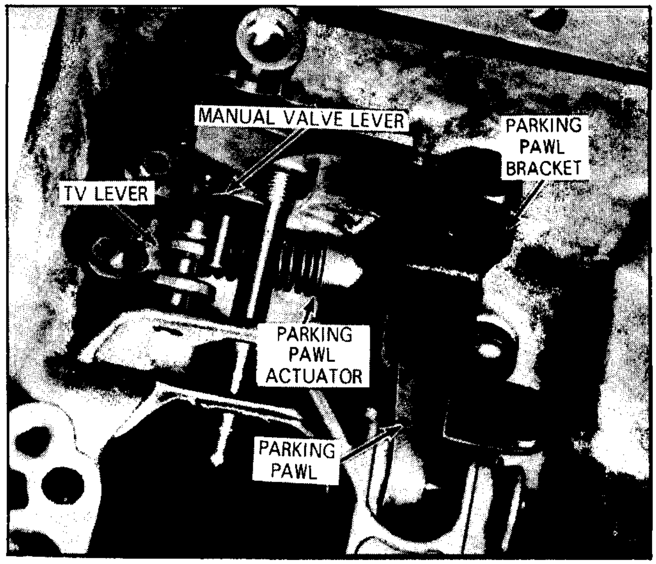


Fig. 7F-58 Inner Control Levers, Parking Pawl and Bracket

face of the case. Note its location for reassembly purposes.

7. If necessary, remove TV, shift and parking actuator levers, parking pawl and its bracket from case (Fig. 7F-58) as follows:

   a. Loosen allen head screw on inner TV lever and remove outer TV lever and shaft from its inner TV lever. Remove "O" ring seal and special washer from outer TV lever shaft and remove inner TV lever from case.

   b. Loosen allen head screw on selector inner lever and remove selector outer lever and shaft from selector inner lever. Remove selector inner lever parking pawl actuator assembly from case, remove its "E" clip and separate actuator from inner lever.

   c. Remove two (2) attaching bolts and parking pawl bracket from case. Remove parking pawl pull-back spring, "E" clip from end of parking pawl shaft and remove shaft by driving it forward out of the transmission case. Remove parking pawl.

OVERHAUL AND INSPECTION

CONVERTER ASSEMBLY

INSPECT

1. Check converter for leaks as follows:

   a. Install Leak Test Fixture J 21369-2 and -6 on converter hub and tighten (Fig. 7F-59).

   b. Fill converter with 80 p.s.i. of air, submerge in water and check for leaks.

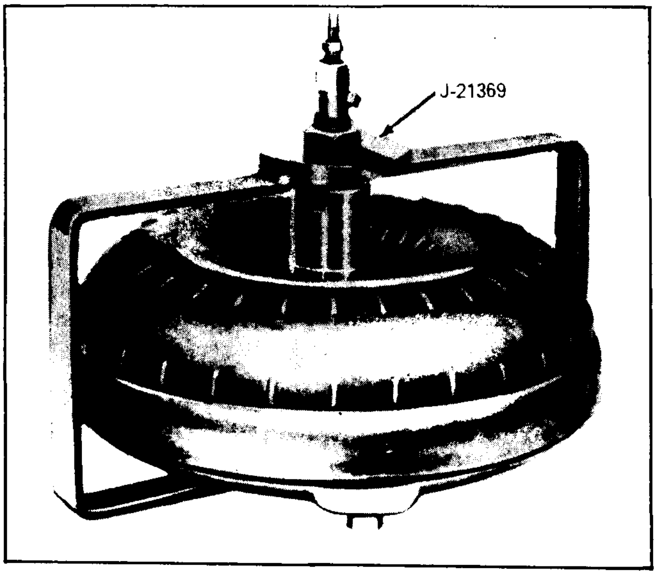


Fig. 7F-59 Air Checking Converter

c. Remove leak test fixture.

2. Check converter hub surfaces for signs of scoring or wear.

3. Check seams of converter for stress or breaks and replace converter if necessary. The converter is a welded assembly and no internal repairs are possible.

VACUUM MODULATOR ASSEMBLY

INSPECT

1. Inspect modulator-to-case gasket. Discard if nicked, cut or deteriorated.

2. Check vacuum modulator plunger and valve for nicks or burs. If such minor imperfections cannot be repaired with a slip stone, replace the part.

3. Check vacuum modulator diaphragm with a vacuum source for leakage. However, diaphragm leakage normally results in transmission oil pull-over, which is evident in a smoky exhaust and continually low transmission fluid. No vacuum modulator repairs are possible; replace as an assembly.

SPEEDOMETER DRIVEN GEAR ASSEMBLY

INSPECT

1. Inspect oil seals for nicks, cuts or deterioration. Discard damaged seals.

2. Check driven gear and shaft for wear or damage. Replace if necessary.

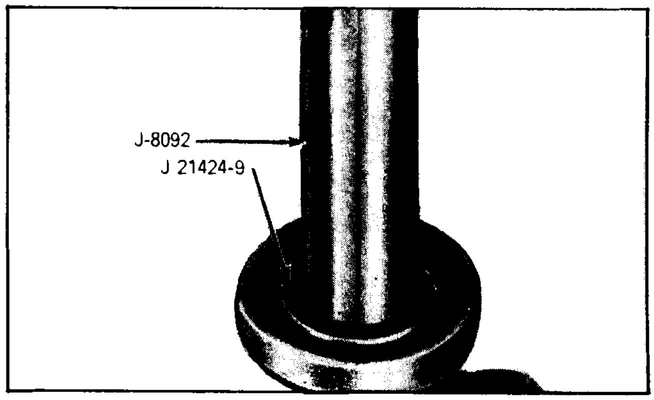


Fig. 7F-60 Removing or Installing Extension Housing Bushing

EXTENSION HOUSING ASSEMBLY

INSPECT

1. Wash extension housing thoroughly with cleaning solvent and air dry.

2. Inspect housing for cracks that may contribute to leakage.

3. Inspect rear oil seal and remove if damaged or worn.

4. Inspect rear bushing for damage or excessive wear. If necessary to replace, remove rear oil seal and:

   a. Using Drive Handle J 8092 and Bushing Tool J 21424-9, drive bushing into housing and remove (Fig. 7F-60).

   b. With new bushing in pilot end of Tool J 21424-9, drive it into place in housing bore.

5. If rear oil seal were removed in steps 3 or 4, coat outer casing of new seal with sealing compound and drive it into place, using Seal Installer J 5154. Prelubricate between lips of seal with cup grease.

GOVERNOR ASSEMBLY

DISASSEMBLE

NOTE: *Governor valve and shaft were already removed during transmission disassembly.*

1. Remove outer weight assembly by sliding toward center of governor body, remove large snap ring and remove weight assembly from governor body (Fig. 7F-61).

2. Remove smaller inner weight retaining snap ring, inner weight and its spring from outer weight.

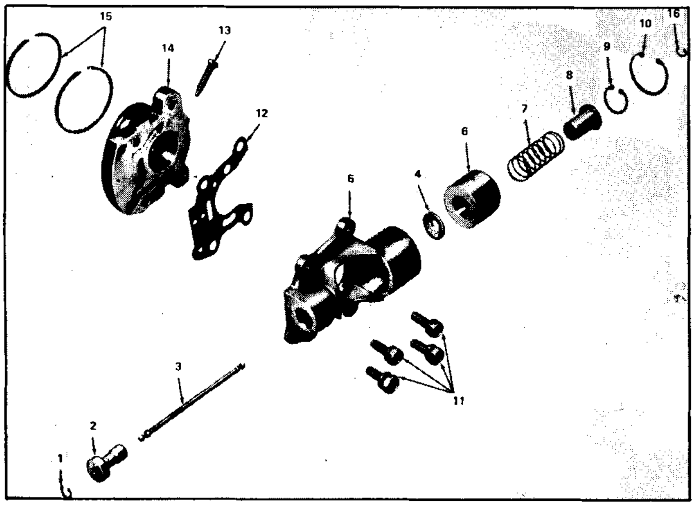


Fig. 7F-61 Exploded View of Governor

1. Valve-To-Shaft Snap Ring
2. Governor Valve
3. Governor Shaft
4. Urethane Washer
5. Governor Body
6. Governor Outer Weight
7. Governor Spring
8. Governor Inner Weight
9. Inner Weight Retainer Snap Ring
10. Outer Weight Retainer Snap Ring
11. Body-To-Hub Bolts and Lock Washers
12. Body-To-Hub Gasket
13. Governor Hub Drive Screw
14. Governor Hub
15. Hub Oil Seal Rings
16. Governor Shaft Retainer "E" Clip

3. Remove four (4) body-to-hub bolts and lock washers and separate body and gasket from the hub.
4. Remove two (2) oil seal rings from the hub.

INSPECT

1. Clean all parts thoroughly in cleaning solvent and air dry.
2. Check condition of all component parts of governor assembly and replace any bent, damaged or scored parts; body and hub must be replaced as a unit.

ASSEMBLE

1. Install oil seal rings onto governor hub.
2. Reassemble inner weight and its spring in outer weight, retain with its snap ring and install outer weight assembly into governor body bore, retaining it with its large snap ring.
3. Slide governor hub into place on the output shaft and lock it in place with the hub drive screw.
4. Install gasket and governor body over output shaft against hub, install governor shaft and valve, line up governor body properly with hub, install four (4) body-to-hub bolts and lock washers and torque to 7 lb. ft.
5. Check governor weight assembly for free fit in governor body. If weight sticks or binds, loosen body-to-hub bolts and retorque.
6. Loosen hub drive screw, remove governor shaft and valve from body and remove governor assembly from output shaft.

GOVERNOR SUPPORT ASSEMBLY

INSPECT

1. Wash support thoroughly in cleaning solvent and air dry.
2. Inspect for nicks, burns or other damage.
3. Inspect governor support bushing for wear or damage. To replace bushing, proceed as follows:
   a. Using Drive Handle J 8092 and Bushing Tool J 23465 from rear of support, drive bushing out.
   b. Using Tool J 23465, press or drive new bushing in from front of support.

VALVE BODY ASSEMBLY

DISASSEMBLE (Fig. 7F-62)

1. Remove roller spring and "E" clip from range selector detent lever and remove detent lever from side of valve body assembly.
2. Remove fifteen (15) lower-to-upper valve body bolts and spring retainer and carefully separate lower valve body, transfer plate and two (2) gaskets from upper valve body. Discard gaskets.
3. Noting its location for reassembly, remove filter from face of upper valve body.
4. From upper valve body, remove throttle, detent and downshift timing valves as follows:

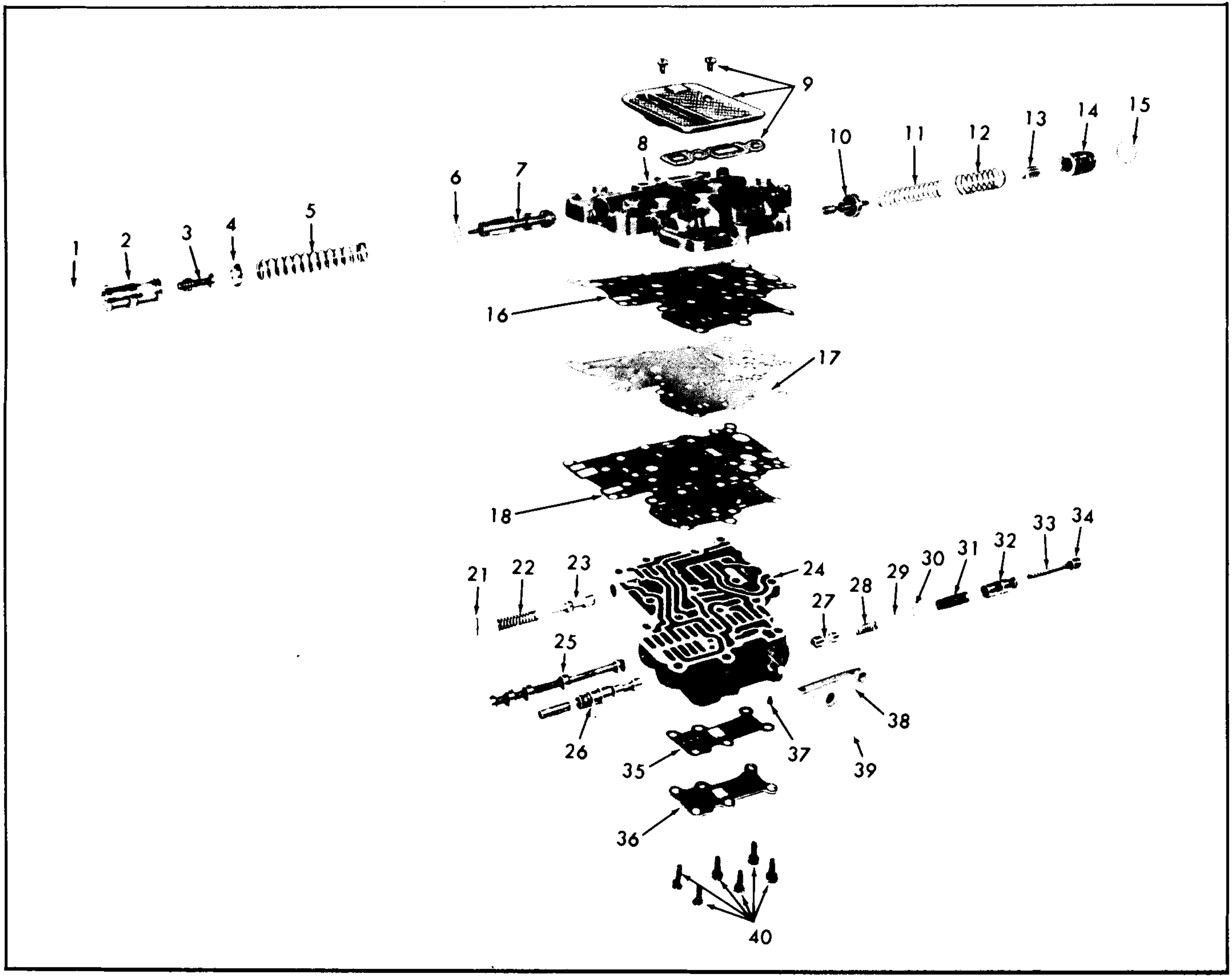


Fig. 7F-62 Exploded View of Valve Body

1. Snap Ring
2. Booster Valve Sleeve
3. Booster Valve
4. Pressure Regulator Spring Retainer
5. Pressure Regulator Spring
6. Pressure Regulator Spring Seat
7. Pressure Regulator Valve
8. Lower Valve Body
9. Suction Screen, Screws and Gasket
10. Low and Drive Valve
11. Low-Drive Valve Inner Spring
12. Low-Drive Valve Outer Spring
13. Low-Drive Regulator Valve
14. Low-Drive Regulator Valve Sleeve
15. Snap Ring
16. Transfer Plate-To-Valve Body Gasket
17. Transfer Plate
18. Transfer Plate-To-Valve Body Gasket
21. Roll Pin
22. Downshift Timing Valve Spring
23. High Speed Downshift Timing Valve
24. Upper Valve Body
25. Manual Control Valve
26. Vacuum Modulator Valve, Spring and Plunger
27. Throttle Valve
28. Throttle Valve Spring
29. Retainer "E" Clip
30. T.V. Spring Regulator Guide Washer
31. Detent Valve Spring
32. Detent Valve
33. T. V. Spring Regulator
34. T.V. Spring Regulator Nut
35. Upper Valve Body Plate Gasket
36. Upper Valve Body Plate
37. Retaining Stud
38. Range Selector Detent Lever
39. Retainer "E" Clip
40. Upper Valve Body Plate-To-Upper Valve Body Bolts and Washers

CAUTION: *Do not disturb setting of TV adjustment jam nut at end of detent valve train. This is a factory adjustment and should not normally be changed. However, if some adjustment is needed, see "THROTTLE VALVE ADJUSTMENT".*

a. Throttle valve and detent valve train - remove six

(6) attaching bolts and washers, upper valve body plate and its gasket from upper valve body. Remove retaining stud from face of valve body by wedging a thin bladed screwdriver between head of stud and valve body. Then, remove detent valve assembly and throttle valve spring. If necessary, remove "E" clip and tilt valve body to allow throttle valve to fall out. If necessary, remove "E" clip, guide washer, detent valve spring and detent valve from TV spring regulator and nut.

b. Downshift timing valve train - drive out roll pin, remove valve spring and high speed downshift timing valve.

5. From lower valve body, remove low and drive shift valve and pressure regulator valve as follows:

   a. Low and drive shift valve train - remove snap ring and tilt valve body to remove low and drive regulator valve sleeve and valve, inner and outer springs and low and drive valve.

   b. Pressure regulator valve train - remove snap ring and tilt valve body to remove booster valve sleeve and valve, pressure regulator spring retainer, spring and pressure regulator valve. If necessary, remove spring seat from pressure regulator valve.

INSPECT

1. Wash all parts thoroughly in cleaning solvent and air dry.
2. Check all valves and their bores in valve bodies for burrs or other deformities which could result in valve hang up.
3. Inspect both valve bodies for cracks, interconnected oil passages and flatness of their mounting faces.
4. Check all springs for distortion or collapsed coils.

ASSEMBLE

1. Into lower valve body, install low and drive shift valve and pressure regulator valve as follows:

   a. Pressure regulator valve train - if removed, install pressure regulator spring seat onto stem end of pressure regulator valve and install valve (stem end out) and spring into its bore of lower valve body. Install spring retainer onto spring. Install booster valve (stem end in) into booster valve sleeve, insert sleeve assembly into bore, compress sleeve and retain with snap ring.

   b. Low and drive shift valve train - on other end of lower valve body, install low and drive shift valve (stem end out) into its bore and install inner and outer springs. Install low and drive regulator valve into low and drive regulator valve sleeve, install sleeve assembly (cap end out) into bore, compress sleeve and retain with snap ring.

2. Into upper valve body, install throttle, detent and downshift timing valves as follows:

   a. Downshift timing valve train - install high speed downshift timing valve (stem end out) and spring into its bore. Compress timing valve spring and install its retaining roll pin below flush with machined face of upper valve body.

   b. Throttle valve and detent valve train - on other end of upper valve body, if removed, install throttle valve (stem end out) into its bore and retain it with its "E" clip. Install throttle valve spring. If disassembled, install detent valve onto stem of TV spring regulator and nut, then detent valve spring, guide washer, compress it and retain with "E" clip. Install detent valve assembly into bore and contain it with its retaining stud in face of valve body. Install gasket and upper valve body plate to the upper valve body, align and install six (6) attaching bolts and washers and torque evenly to 5 lb. ft.

3. Install filter into its proper bore in face of upper valve body.

   NOTE: *Upper and lower valve body gaskets are identical.*

4. Install valve body gasket to upper valve body, then install transfer plate, second valve body gasket and lower valve body carefully to the upper valve body.
5. Noting location of spring retainer as shown in Fig. 7F-57, install spring retainer and fifteen (15) lower-to-upper attaching bolts, torquing to 15 lb. ft. These bolts are 1 3/8" long.
6. Install range selector detent lever on stud at side of valve body and retain with "E" clip.
7. Install manual control valve in upper valve body.

OIL PUMP OIL SEAL

REPLACE

1. If pump oil seal requires replacement, pry out old seal from pump body and discard.
2. Coat O.D. of new seal with non-hardening sealer and, using Seal Installer J 21359, drive seal into place so that it is fully seated in its counterbore.

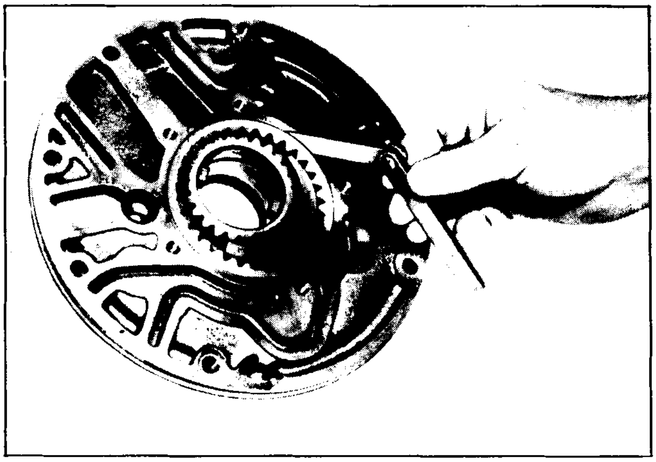


Fig. 7F-63 Checking Driven Gear-To-Pump Body Clearance

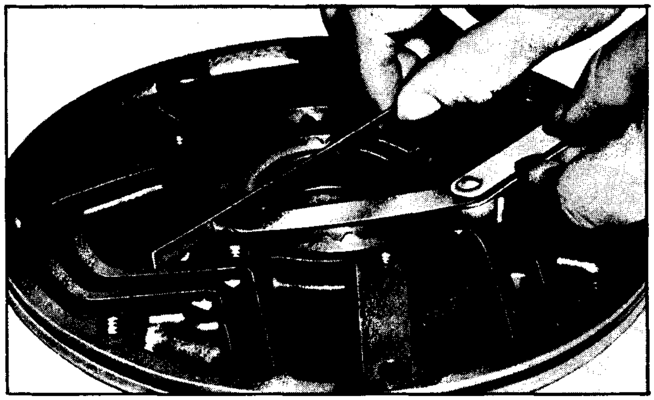


Fig. 7F-65 Checking Pump Gear End Clearance

OIL PUMP ASSEMBLY

DISASSEMBLE

1. Remove five (5) pump cover-to-body bolts and pump cover from pump body.
2. Remove two (2) high clutch oil seal rings from hub of pump cover.
3. With slight twist of pliers, remove downshift timing valve from pump cover.

   CAUTION: *Do not drop or nick gears. These gears are* **not** *heat-treated.*

4. Remove rubber oil seal ring, mark gear faces for reassembly and remove pump gears from pump body.

INSPECT

1. Wash all parts thoroughly in cleaning solvent, blow out all oil passages and air dry. DO NOT USE RAGS TO DRY PARTS.
2. Inspect pump gears for nicks or other damage. With parts clean and dry, install gears into pump body and check:

Fig. 7F-64 Checking Driven Gear-To-Pump Crescent Clearance

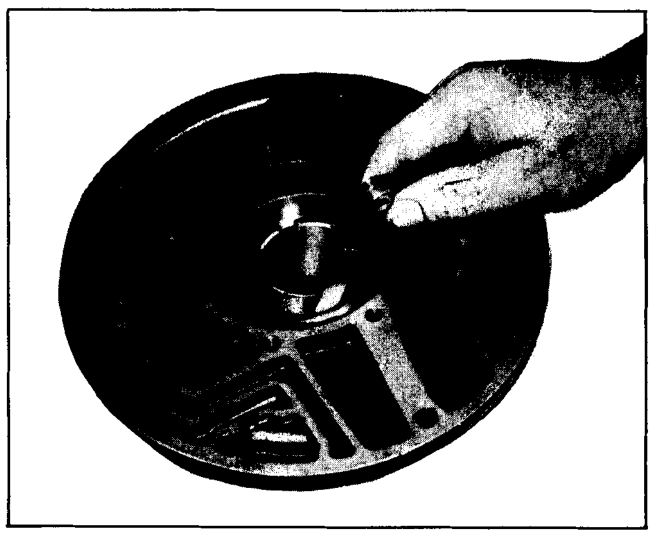


Fig. 7F-66 Checking Pump Body Bushing-To-Converter Pump Hub Clearance

a. Clearance between O.D. of driven gear and pump body should be .0035" to .0065" (Fig. 7F-63).

b. Clearance between I.D. of driven gear and pump crescent should be .003" to .009" (Fig. 7F-64).

c. Gear end clearance should be .0005" to .0015" (Fig. 7F-65).

3. Inspect pump body bushing for galling or scoring. If bushing is damaged, replace pump body (bushing is not serviced). Also, check clearance between bushing and converter pump hub. Maximum allowable clearance is .005" (Fig. 7F-66).

4. Inspect O.D. of converter pump hub for nicks or burrs that might damage pump body seal or bushing. Repair or replace as necessary.

5. Inspect pump body and cover faces for nicks or scoring.

6. Inspect O.D. of pump cover hub for nicks or burrs that could damage the clutch drum bushing journal.

7. Check for free operation of priming valve in pump cover and replace as necessary.

8. Check condition of oil cooler by-pass valve and replace if it leaks excessively, as follows:

a. To remove, use an "Easy-Out" or its equivalent.

b. To install, tap into place with soft hammer or brass drift so that it is flush to .010" below face of pump cover.

ASSEMBLE

1. Lubricate pump drive and driven gears generously and install in pump body, assembling gears with marked faces up (recessed side of drive gear lugs downward, facing the converter).

2. Install downshift timing valve (conical end out) into place in pump cover to a height of 17/32". Height is measured from shoulder of valve to face of pump cover.

3. Carefully set pump cover into place over pump body and loosely install two (2) attaching bolts.

4. Place pump assembly, minus rubber oil seal ring, upside down into pump bore of emptied transmission case. Install remaining three (3) cover-to-body bolts and torque all five (5) bolts to 20 lb. ft.

5. Remove pump assembly from case, install rubber oil seal ring into its groove in pump body and install two (2) high clutch seal oil rings onto hub of pump cover.

CLUTCH DRUM ASSEMBLY (Fig. 7F-67)

DISASSEMBLE

CAUTION: *When working with clutch drum, use extreme care that machine face on front of drum is not scratched, scored, nicked or otherwise damaged during any service operation.*

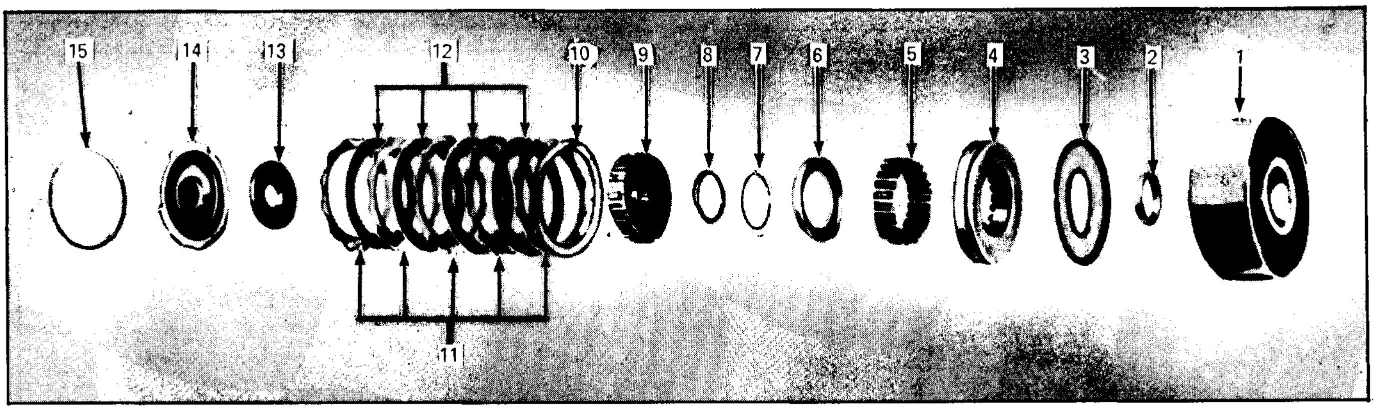


Fig. 7F-67 Exploded View of Clutch Drum

1. Clutch Drum
2. Clutch Drum Bushing
3. Inner and Outer Seals
4. Clutch Piston
5. Clutch Piston Return Springs
6. Piston Return Spring Retainer
7. Spring Retainer Snap Ring
8. Clutch Hub Front Thrust Washer
9. Clutch Hub
10. Clutch Cushion (Waved) Spring
11. Clutch Driven (Steel) Plates
12. Clutch Drive (Faced) Plates
13. Clutch Hub Rear Thrust Washer
14. Low Sun Gear and Clutch Flange
15. Clutch Flange Snap Ring

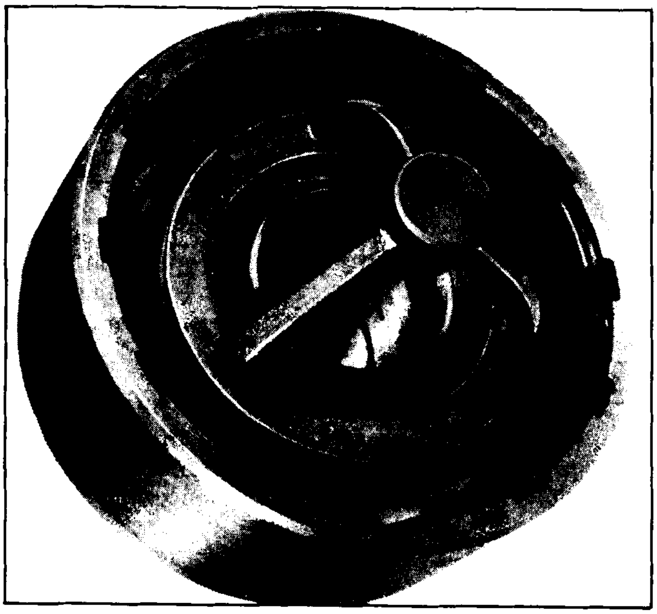


Fig. 7F-68 Compressing Piston Return Springs

This machined face must be protected whenever it must be brought to bear on a press or tool of any sort.

1. Remove clutch flange snap ring from clutch drum.
2. Remove low sun gear and clutch flange assembly and clutch hub rear thrust washer from clutch drum.
3. Lift out clutch hub, clutch pack and clutch hub front thrust washer.
4. Using Spring Compressor J 23327 -1 and -2, Adapter Ring J 23466 and Pilot J 9542-4, compress piston return springs and retainer to remove the retainer snap ring (Fig. 7F-68).

   CAUTION: *When using compressor tools, be careful not to mark or score front machined face of clutch drum.*

5. Carefully release pressure, remove tools, retainer snap ring, spring retainer and twenty-four (24) piston return springs.
6. Remove clutch piston with a twisting motion from drum and separate inner seal from clutch drum and outer seal from piston. Discard seals.

INSPECT

1. Wash all parts in cleaning solvent and air dry. DO NOT USE RAGS TO DRY PARTS.
2. Check bushing in clutch drum for scoring or excessive wear. If replacement is necessary, proceed as follows:

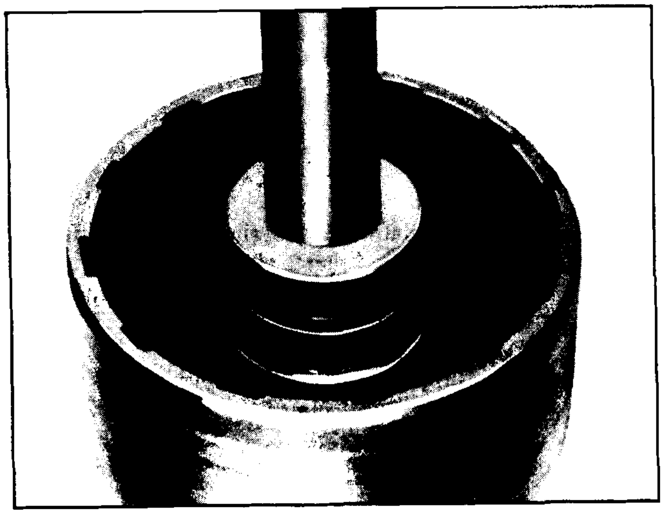


Fig. 7F-69 Removing Clutch Drum Bushing

a. Remove old bushing, using Drive Handle J 8092 with Bushing Tool J 21424-5 (Fig. 7F-69). Avoid damaging bushing bore at machined front face of clutch drum.

b. Using same tools, install new bushing into face side of drum (Fig. 7F-70). Press bushing in only until Bushing Tool J 21424-5 touches front face of drum.

3. Check steel ball in clutch drum. Ball acts as a relief valve. Be sure that it is free to move and that orifice in front face of drum is open. If ball is loose enough to come out, or not loose enough to rattle, replace clutch drum. Do not attempt replacement or restaking of ball.

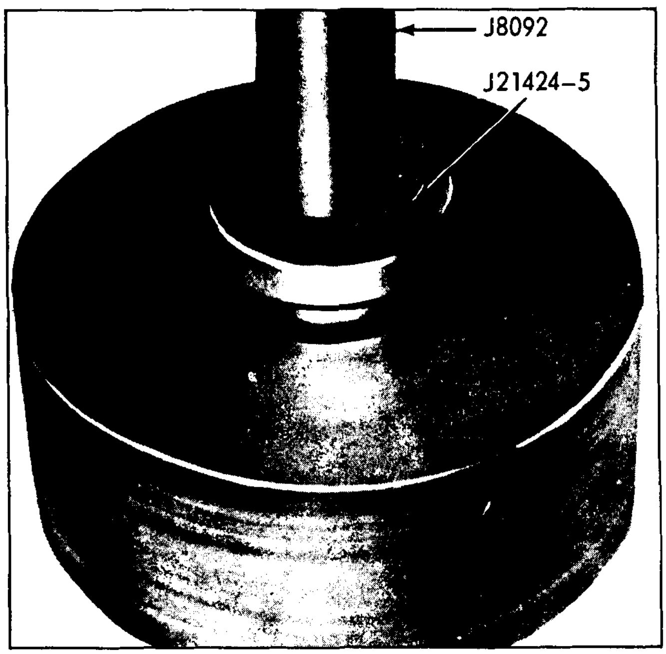


Fig. 7F-70 Installing Clutch Drum Bushing

4. Check fit of low sun gear and clutch flange assembly in clutch drum slots. There should be no appreciable radial play.

5. Check low sun gear for nicks or burrs and check its bore for wear.

6. Check clutch plates for burring, wear, pitting or metal pick-up. Faced plates should be a free fit over clutch hub; steel plates should be a free fit in clutch drum slots.

7. Check condition of clutch hub splines and mating splines of clutch faced plates.

8. Check clutch piston for cracks or distortion.

ASSEMBLE

1. Lubricate new inner and outer piston seals with transmission fluid.

2. Install piston inner seal in clutch drum hub groove with seal lip down (toward front of transmission); install piston outer seal in clutch piston groove with seal lip down (toward front of transmisssion).

3. Install clutch piston into clutch drum with a twisting motion until bottomed in drum (wire loop may be used to start lip of seal into bore of drum).

4. Position twenty-four (24) piston return springs and spring retainer in place and lay snap ring on top of retainer.

5. Using Spring Compressor J 23327-1 and-2, Adapter Ring J 23466 and Pilot J 9542-4, compress piston return springs and retainer to expose groove in clutch hub. Install retainer snap ring and remove tools.

6. Install clutch hub front thrust washer (its lip toward clutch drum) and position clutch hub into clutch drum.

7. Install clutch cushion (waved) spring into clutch drum.

8. **V-8 Engine Model (TS)** - The first steel driven plate to the rear of the cushion spring is a selective fit driven plate. To correctly install clutch pack, proceed as follows:

   a. Before installing the clutch pack into the clutch drum, stack the five (5) steel driven (except the selective fit plate) and five (5) faced drive plates and measure this stack height.

   b. If stock height measures .872" to .903", install steel selective driven plate, Part No. 3883903 (.060" thick), into clutch drum on top of the cushion spring.

   c. If stock height measures .798" to .872", install steel selective driven plate, Part No. 3883904 (.090" thick), into clutch drum on top of the cushion spring.

   d. Then, install five (5) faced drive plates and five (5) steel driven plates alternately (beginning with a faced drive plate) into clutch drum on top of the selective fit driven plate.

   6 Cylinder Engine Model (RB) - Install five (5) steel driven plates and four (4) faced drive plates alternately (beginning with a steel driven plate) into clutch drum on top of the cushion spring (Fig. 7F-68).

9. Install clutch hub rear thrust washer into low sun gear and clutch flange assembly (retain with petrolatum), position low sun gear and clutch flange assembly into clutch drum and install its snap ring. Position snap ring so that opening in ring is adjacent to one of the lands of the clutch drum.

10. Check clutch pack assembly by turning the clutch hub. It must be free to rotate.

LOW BRAKE BAND ASSEMBLY

INSPECT

The brake band used in this transmission has bonded linings which, due to transmission characteristics and band usage, requres very little attention. However, whenever transmission is disassembled, low brake band assembly should be cleaned of metal particles and inspected:

1. Check lining for evidence of scoring or burring.

2. Check band and lining for cracks.

3. Check all band linkage for excessive wear.

PLANET CARRIER ASSEMBLY AND INPUT SHAFT

INSPECT

1. Wash planet carrier assembly and input shaft in cleaning solvent, blow out all oil passages and air dry. DO NOT USE RAGS TO DRY PARTS.

2. Inspect planet pinion gears for nicks or other tooth damage.

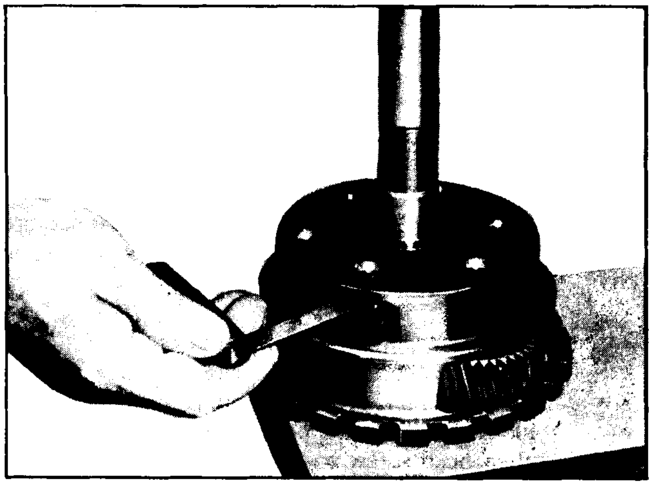


Fig. 7F-71 Checking Pinion Gear End Clearance

3. Check end clearance of pinion gears; should be .006" to 030" (Fig. 7F-71).

4. Inspect output shaft bearing surface for nicks or scoring; inspect input shaft pilot bushing in planet carrier.

5. Check input sun gear for tooth damage and input sun gear front thrust for damage.

6. Inspect splines of input shaft for nicks or damage and check fit of splines in clutch hub, in input sun gear and in turbine hub of converter assembly.

7. Check oil seal rings on input shaft for damage; rings must be free in their ring grooves:

   a. Remove rings from input shaft.

   b. Insert rings into stator shaft bore of oil pump and make sure that hooked ring ends have clearance.

   c. Reinstall rings on input shaft.

8. If it is found that planet pinion gears, input sun gear, thrust washers and/or output shaft show signs of excessive wear or damage, the planet carrier assembly must be replaced.

TRANSMISSION CASE

INSPECT

1. Wash case thoroughly in cleaning solvent, air dry and blow out all oil passages. DO NOT USE RAGS TO DRY PARTS.

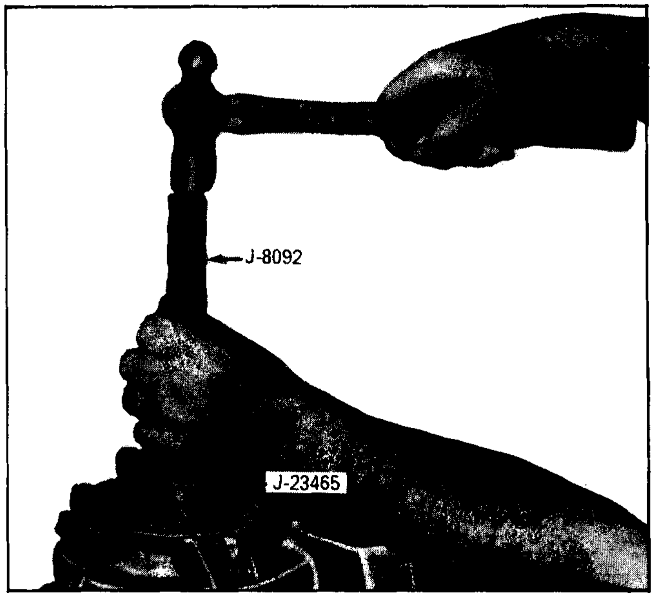


Fig. 7F-72 Installing Case Rear Bushing

2. Inspect case for cracks which might contribute to leakage and check for interconnected oil passages by using air gun or smoke.

3. Check all bolt hole threads for cross-threading or stripped condition.

4. Check shifter shaft oil seal for signs of leakage or damage. If necessary to replace:

   a. Pry out oil seal.

   b. Install new seal, seating seal firmly in its case counterbore.

5. Inspect case rear bushing for excessive wear or damage. This is a precision bushing and, if damaged or worn, can be replaced as follows:

   a. Using Drive Handle J 8092 and Bushing Tool J 23465, drive bushing out from within case.

   b. Install new bushing by driving or pressing bushing into place from rear of case by using same tools (Fig. 7F-72). Install bushing only until it is flush with bottom of chamfer in front rear face of case. Use caution as excessive force may crack or otherwise damage aluminum case.

TRANSMISSION REASSEMBLY

INTERNAL COMPONENTS

INSTALL

CAUTION: *Use only transmission fluid or petroleum jelly as lubricants to retain bearings or races during assembly. Lubricate all bearings, seal rings and clutch plates prior to assembly. Thrust washers may be held in place with petrolatum sparingly applied.*

1. If manual linkage was removed from case, assemble as follows (Fig. 7F-73):

   a. Install parking pawl and shaft in case and retain with new "E" clip.

   b. Install parking pawl pull-back spring over its boss located to rear of pawl. Short leg of spring should locate in hole in parking pawl.

   c. Install parking pawl bracket and retain to case with its two (2) attaching bolts, torquing to 10 lb. ft.

   d. Using new "E" clip, connect park lock actuator to selector inner lever and fit park lock actuator between parking pawl and bracket.

   e. Lubricate shaft and seal and insert selector outer lever and shaft into case, being careful of shaft oil seal, and pick up selector inner lever (with park lock actuator attached) and tighten its 3/16" allen head screw to 2 1/2 lb. ft. torque.

   f. Lubricate and insert TV outer lever and shaft, with its special washer and "O" ring seal, into case and pick up TV inner lever. Seat inner lever on splines of TV lever shaft and tighten its 3/16" allen head screw to 2 1/2 lb. ft. torque. To prevent binding between TV and range selector controls,

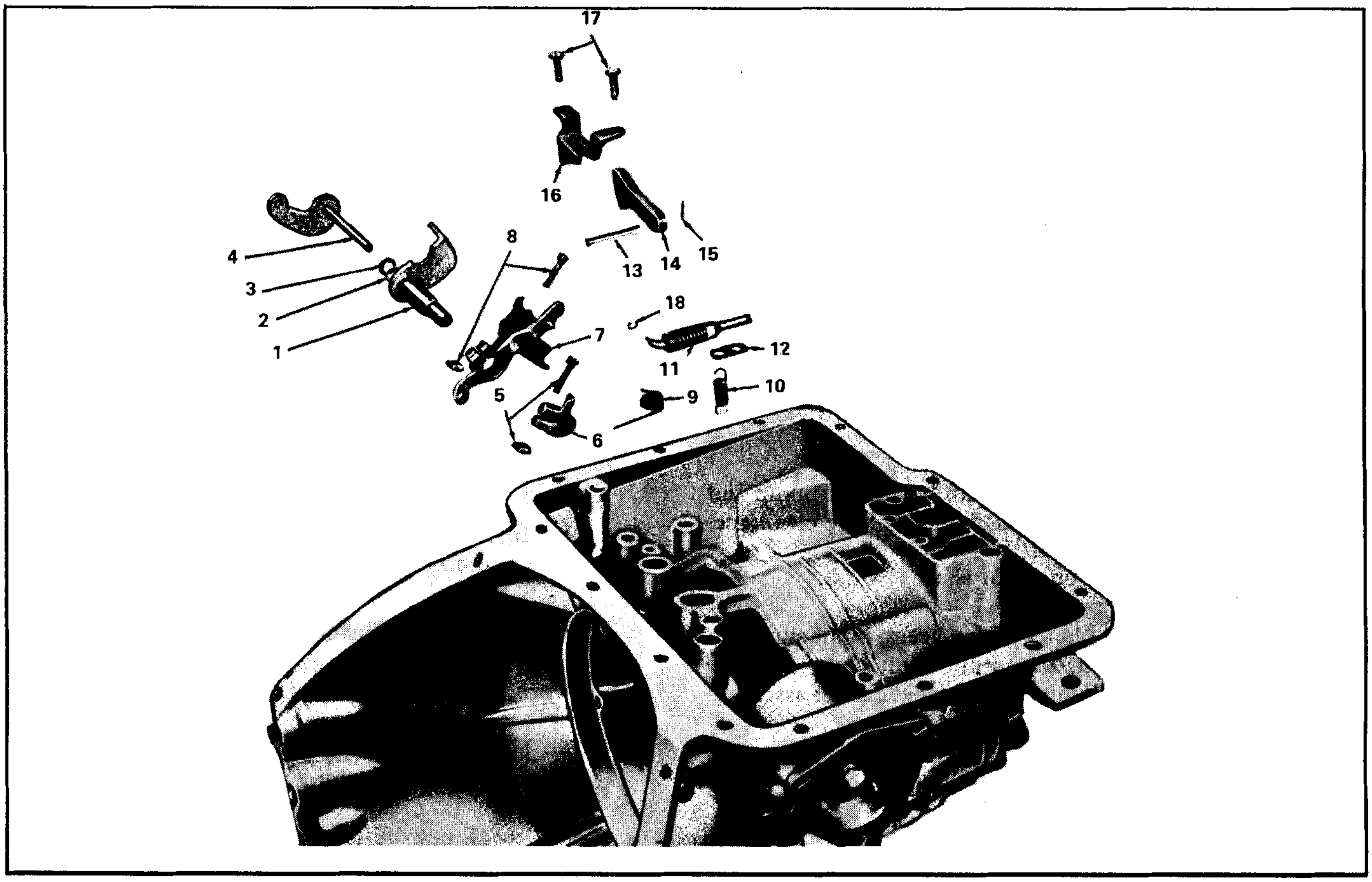


Fig. 7F-73 Exploded View of Manual Levers

1. Selector Outer Lever and Shaft
2. TV Shaft Oil Seal
3. TV Shaft Washer
4. TV Outer Lever and Shaft
5. TV Levers Attaching Screw and Nut
6. TV Inner Lever
7. Selector Inner Lever
8. Selector Lever Attaching Screw and Nut
9. Parking Pawl Pull-Back Spring
10. Range Selector Roller Spring
11. Park Lock Actuator
12. Roller Spring Retainer
13. Parking Pawl Shaft
14. Parking Pawl
15. Pawl Shaft "E" Clip
16. Parking Pawl Bracket
17. Bracket Attaching Nuts
18. Actuator-To-Inner Lever "E" Clip

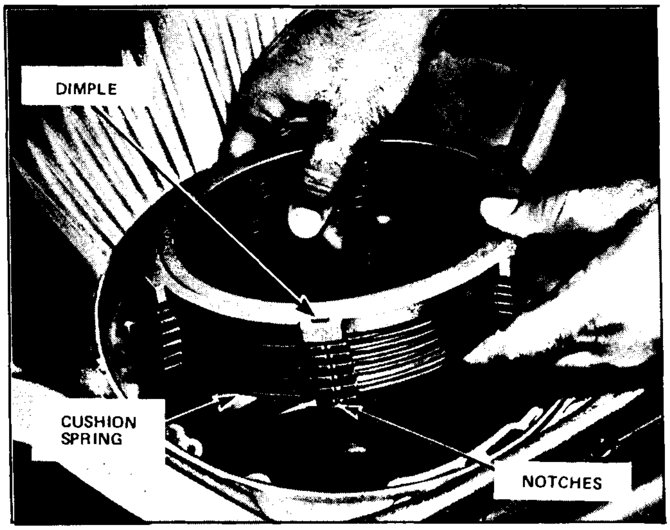


Fig. 7F-74 Installing Clutch Plates

maintain .010" to .020" clearance between TV inner lever and selector inner lever after assembly.

2. Thread low band adjusting screw part way into case.

3. Lubricate and install inner and outer seals on reverse piston (lips of seals facing rear of case); lubricate reverse piston bore in transmission case with transmission fluid.

4. With transmission case in holding fixture, position it vertically (front of transmission facing up) and install reverse piston into case with a twisting motion until it bottoms in case (wire loop or feeler gauge may be used to start lip of seal into bore of case).

5. Install seventeen (17) reverse piston return springs, spring retainer and snap ring into position on reverse piston.

6. Install Compressor Tools J 23327-1 and 2 through snap ring and retainer and through rear bore of case. With Pilot J 9542-4 on rear face of case, turn down wing nut to compress return springs and expose snap ring groove. Use care when compressing springs and retainer over case hub so that spring retainer is not damaged by catching on edge of case hub or in snap ring groove of hub. Install snap ring and remove tools.

7. Install large (waved) cushion spring, lubricate and install reverse clutch pack into its case bore. Begin pack by installing a reaction (spacer) plate and alternating with a drive (faced) plates until all plates are in place (Fig. 7F-74).

NOTE: *When installed properly, the single notched lug of each reaction plate is aligned in the 7 o'clock groove of case.*

8. Install pressure plate ("dimple" in one lug to align with 7 o'clock groove of case) and install clutch pack snap ring.

9. Align internal lands and grooves of reverse clutch drive (faced) plates and then engage reverse ring gear with these plates. Engagement can be made by "feel" while jiggling and turning reverse ring gear until all clutch plates are engaged and ring gear has bottomed in the transmission case.

10. Place output shaft caged thrust washer over output shaft, install low sun gear needle thrust bearing (with lip of bearing up) into carrier assembly and install planetary carrier and output shaft into transmission case.

11. Install input shaft into machined face of clutch drum and install low sun gear splined bushing on and against shoulder of input shaft.

12. Install input shaft-clutch drum assembly into case, aligning end of input shaft with low sun gear needle thrust bearing in carrier and indexing low sun gear on clutch drum flange with short pinions of the planet carrier.

13. Remove rubber oil seal ring from oil pump body and install clutch drum selective thrust washer, gasket and oil pump assembly into case. Install and tighten two (2) pump-to-case attaching bolts to 15 lb. ft. torque.

14. Check for correct thickness of clutch drum selective thrust washer as follows:

    a. Install a 5/16" - 18 threaded bolt (or Slide Hammer Bolt J 21904-1) into a threaded bolt hole in pump. Mount a dial indicator on bolt so that plunger of indicator is resting on end of input shaft and "zero" indicator (Fig. 7F-77).

    b. Push up on output shaft and observe total indicator movement. Indicator movement should read .028" to .059".

    c. If reading is within limits, the correct selective fit washer is being used.

    d. If reading is not within limits, remove oil pump and selective thrust washer. Change to thicken or thinner selective thrust washer, as the case may be, to obtain a .028" to .059" movement and repeat steps a and b. Clutch drum selective thrust washers are available in thicknesses of .061", .078", .092" and .106".

    e. If movement is above .059" with a .106" selective thrust washer installed, check for excessive wear on assembled parts or omitted thrust washers or bearings in or behind planet carrier.

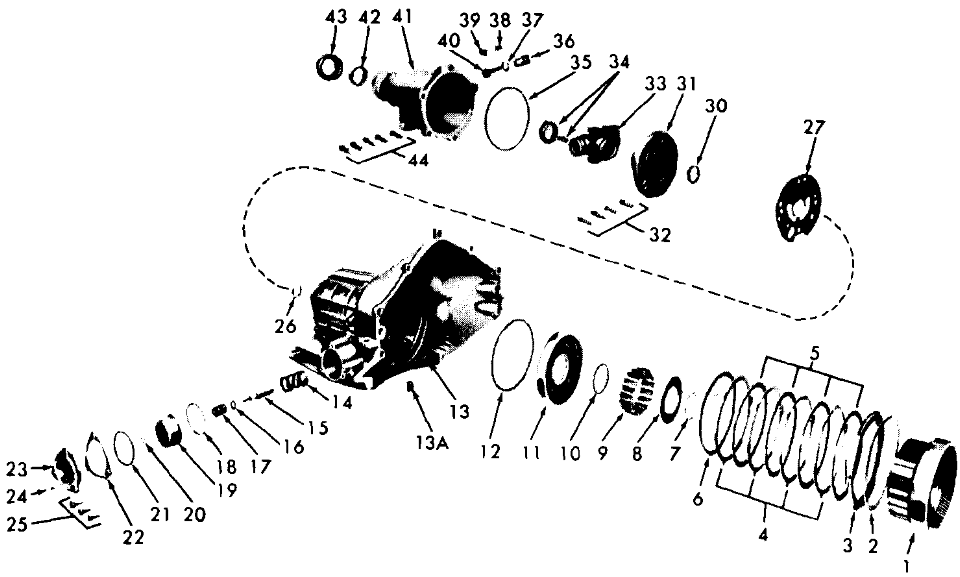


Fig. 7F-75 Exploded View of Transmission Case

1. Reverse Ring Gear
2. Clutch Pack Snap Ring
3. Reverse Clutch Pressure Plate
4. Clutch Reaction (Steel) Plates
5. Clutch Drive (Faced) Plates
6. Clutch Cushion (Waved) Spring
7. Spring Retainer Snap Ring
8. Piston Return Spring Retainer
9. Clutch Piston Return Springs
10. Clutch Piston Inner Seal
11. Reverse Clutch Piston
12. Clutch Piston Outer Seal
13. Transmission Case
13A. Transmission Case Spring
14. Servo Piston Return Spring
15. Servo Piston Rod
16. Piston Apply Spring Seat
17. Piston Apply Spring
18. Servo Piston Seal Ring
19. Servo Piston
20. Piston Rod Retainer
21. Servo Cover Seal
22. Servo Cover Gasket
23. Servo Cover
24. Servo Cover Plug
25. Servo Cover Bolts
26. Transmission Case Bushing
27. Governor Support Gasket
30. Governor Support Bushing
31. Governor Support
32. Governor Support Bolts
33. Governor Assembly
34. Speedometer Drive Gear and Clip
35. Extension-to-Case Seal Ring
36. Speedometer Shaft Fitting
37. Fitting Oil Seal
38. Retainer Plate Bolt
39. Retainer Plate
40. Speedometer Driven Gear and Shaft
41. Transmission Extension
42. Extension Bushing
43. Extension Oil Seal
44. Extension-to-Case Bolts

15. After obtaining proper output shaft movement, remove oil pump and proper selective thrust washer from case.

SERVO, LOW BAND AND OIL PUMP

INSTALL

1. Turn transmission horizontally so that oil pan face is up and install low brake band into position around clutch drum in case.
2. Install servo piston return spring into servo bore of case and, while installing servo piston (with its seal ring installed) into case, position band anchor strut between band and adjusting screw and band apply strut between servo piston rod and band.
3. Seat servo piston in case and, if necessary, turn low band adjusting screw in far enough to prevent struts from falling out of position.
4. Using new cover oil seal and gasket, install servo cover. Make sure that gasket is properly aligned with three (3) bolt holes and one (1) drain-back passage in case. Install three (3) servo cover-to-case bolts and torque to 20 lb. ft.

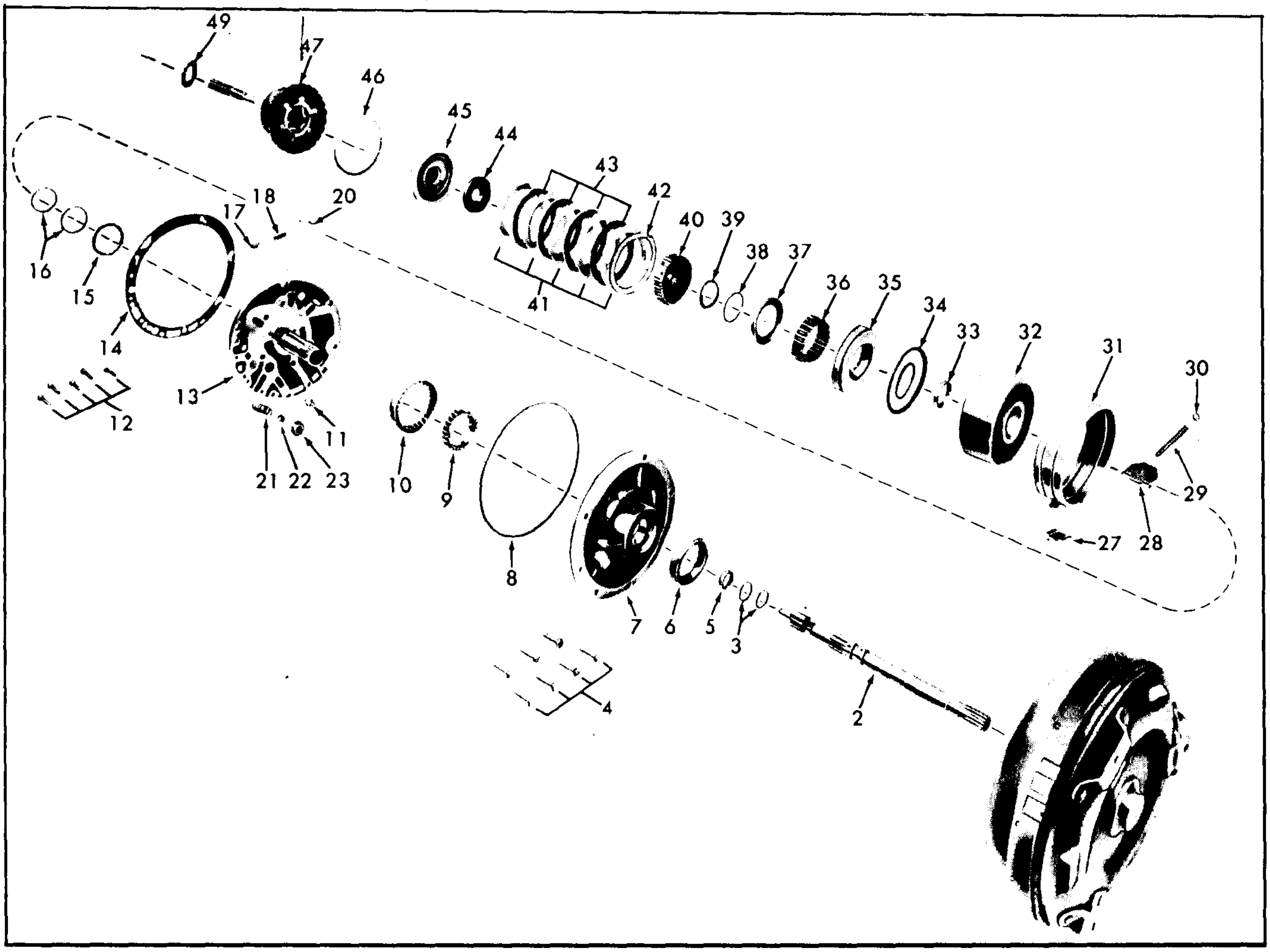


Fig. 7F-76 Exploded View of Internal Mechanism

1. Convertor Assembly
2. Input Shaft
3. Shaft Oil Seal Rings
4. Pump-to-Case Bolts and Washers
5. Sun Gear Splined Bushing
6. Pump Oil Seal
7. Oil Pump Body
8. Body-to-Case Oil Seal Ring
9. Oil Pump Drive Gear
10. Oil Pump Driven Gear
11. Downshift Timing Valve
12. Cover-to-Body Attaching Bolts
13. Pump Cover and Stator Shaft
14. Cover-to-Case Gasket
15. Clutch Drum Thrust (Selective) Washer
16. Clutch Oil Seal Rings
17. Pump Priming Valve
18. Priming Valve Spring
20. Valve Spring Retaining Pin
21. By-Pass Valve Spring
22. Oil Cooler By-Pass Valve
23. Oil Cooler By-Pass Valve Seat
27. Band Apply Strut
28. Band Anchor Strut
29. Band Anchor Adjusting Screw
30. Adjusting Screw Lock Nut
31. Low Brake Band
32. Clutch Drum
33. Clutch Drum Bushing
34. Piston Outer and Inner Seals
35. Clutch Piston
36. Piston Return Springs
37. Return Spring Retainer
38. Spring Retainer Snap Ring
39. Clutch Hub Front Thrust Washer
40. Clutch Hub
41. Clutch Driven (Steel) Plates
42. Clutch Cushion (Waved) Spring
43. Clutch Drive (Faced) Plates
44. Clutch Hub Rear Thrust Washer
45. Low Sun Gear and Clutch Flange Assembly
46. Clutch Flange Snap Ring
47. Planet Carrier and Output Shaft Assembly
49. Output Shaft (Caged) Thrust Washer

5. Place rubber oil seal ring in groove around oil pump body, position clutch drum selective thrust washer over pump cover oil delivery sleeve and install oil pump gasket to its face of transmission case.

6. Align and position oil pump assembly to case, install seven (7) oil pump-to-case attaching bolts (replacing any damaged bolt sealing washers) and torque to 15 lb. ft.

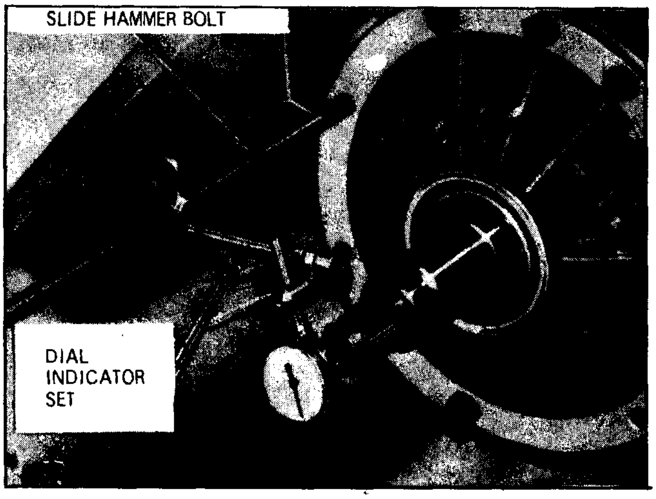


Fig. 7F-77 Checking For Proper End Play

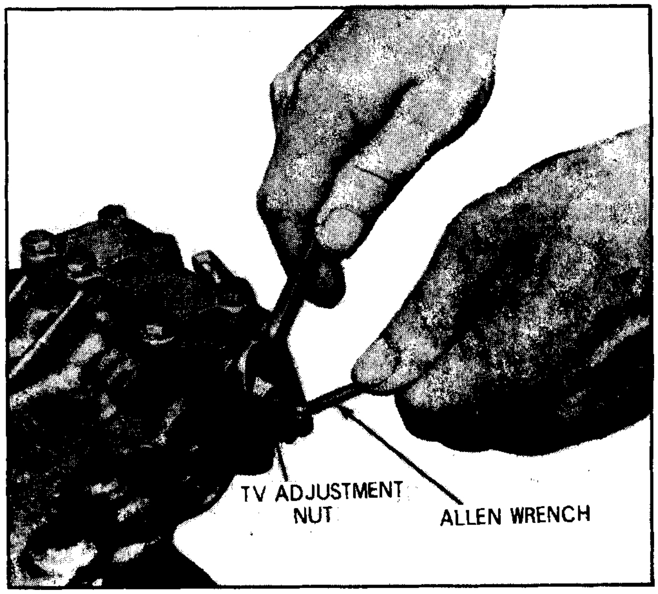


Fig. 7F-78 Adjustment of TV Pressure

GOVERNOR AND SUPPORT, SPEEDO DRIVE AND DRIVEN GEAR AND EXTENSION HOUSING

INSTALL

1. Install gasket and governor support, drain-back baffle (at 6 o'clock position) and four (4) support-to-case bolts. Torque bolts to 10 lb. ft. Bolt holes are positioned in case so that governor support may be assembled only in correct position.
2. Remove drive screw from hub of governor and install governor over output shaft and into governor support.
3. Align hole in governor hub with hole in output shaft and reinstall drive screw into governor hub. Torque screw to 8 lb. ft.
4. Place urethane washer in governor (between outer weight and output shaft) and install governor shaft and valve through governor and output shaft. Retain in position with its "E" clip.
5. Position speedometer drive gear retainer clip into its hole in output shaft, align slot in drive gear with retainer clip and slide speedometer drive gear into place on output shaft.
6. Position square-cut seal ring on governor support and install extension housing into place. Install five (5) housing-to-case attaching bolts and torque to 25 lb. ft.
7. Install speedometer driven gear assembly, retainer and bolt to extension housing. Torque to 4 lb. ft.
8. If removed, install pressure switch into servo boss of case and torque to 9 lb. ft.

THROTTLE VALVE ADJUSTMENT (Fig. 7F-78)

No provision has been made for checking TV pressure. However, if operation of transmission was such that some adjustment of TV pressure is indicated, pressure may be raised or lowered by adjusting position of TV adjustment jam nut on the throttle valve of the valve body assembly as follows:

1. To raise TV pressure by 3 p.s.i., back off TV adjustment nut by one (1) full turn. This increases dimension from jam nut to throttle valve assembly stop.
2. To lower TV pressure by 3 p.s.i., tighten TV adjustment nut by one (1) full turn. This decreases dimension from jam nut to throttle valve assembly stop.

A difference of 3 p.s.i. in TV pressure will cause a change of approximately 2 to 3 MPH in wide-open throttle upshifts. Smaller pressure changes are made by partial turns of the jam nut. The end of TV adjusting screw has a 1/8" allen head so that the adjusting screw may be held stationery while the TV adjustment jam nut is moved.

VALVE BODY, VACUUM MODULATOR AND OIL PAN

INSTALL

1. Install transmission case screen in its bore in front surface of valve body face of the transmission case.

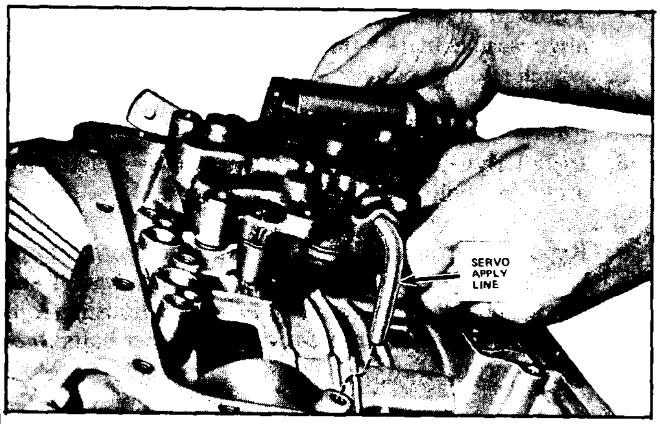


Fig. 7F-79 Installing Valve Body

2. Position new gasket on case and install valve body assembly while carefully guiding servo apply line into its boss in case as valve body is being set into place (Fig. 7F-79). Also, make sure that range selector inner lever properly picks up the manual control lever.

3. Install six (6) valve body-to-case attaching bolts and evenly torque to 15 lb. ft.

4. Install range selector roller spring to spring retainer and range selector detent lever.

5. Install new gasket and suction screen to valve body, torquing its two (2) attaching screws to 2 1/2 lb. ft.

6. Install detent guide plate to valve body and torque its two (2) attaching bolts to 15 lb. ft. (Fig. 7F-80).

7. Install vacuum modulator valve and dampening spring (spring end out) into case bore and valve body, insert modulator plunger into modulator body and screw vacuum modulator body and gasket into case bore. Torque to 15 lb. ft., using Wrench J 9543 (or thin 1" tappet type wrench).

8. Install new gasket and oil pan to case with fourteen (14) oil pan attaching bolts. Torque bolts evenly to 8 lb. ft.

9. Adjust low brake band as follows (Fig. 7F-81):

   a. Hold adjusting screw lock nut 1/4 turn loose and, using Band Adjusting Tool J 21848, tighten adjusting screw to 70 lb. in torque.

   b. Then, back off adjusting screw by exactly four (4) complete turns for a used band (in operation for 6,000 miles or above) or by exactly three (3) complete turns for a new brake band (less than 6,000 miles usage).

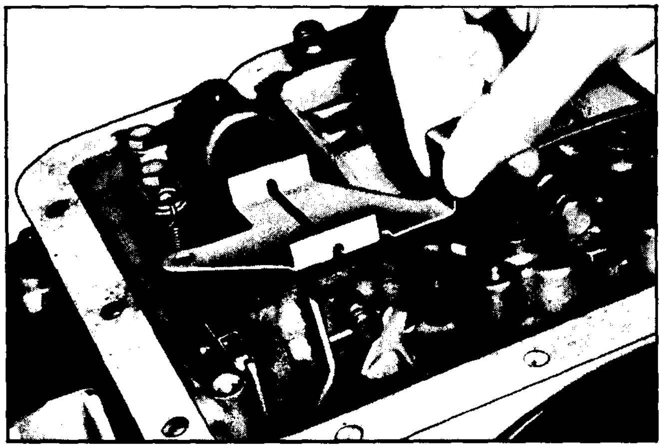


Fig. 7F-80 Installing Detent Guide Plate

   c. Holding adjusting screw stationery, tighten the adjusting screw lock nut to 15 lb. ft. torque.

   d. Remove tools and install protective cap on adjusting screw.

CONVERTER

INSTALL

1. Install converter into transmission, rotating converter so that it engages into drive lugs of oil pump drive gear.

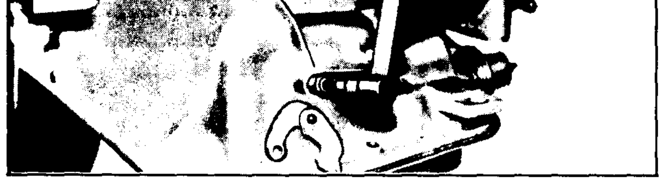


Fig. 7F-81 Adjustment of Low Brake Band

2. Install Converter Holding Strap J 21366 or a suitable substitute.

TRANSMISSION

INSTALL

1. Mount transmission assembly on transmission lifting equipment installed on a jack or other suitable lifting device.

2. Remove Converter Holding Strap J 21366.

   CAUTION: *Do* **not** *allow converter to move forward after removal of holding strap.*

3. Raise transmission into position at rear of engine and install transmission case-to-engine upper attaching bolts. Torque to 35 lb. ft.

4. Install seal and filler pipe into transmission and connect to engine.

5. Install transmission case-to-engine lower attaching bolts and torque to 35 lb. ft.

6. Remove support from beneath engine and raise rear of transmission slightly.

7. Through flywheel housing bottom cover opening, align scribe marks (made during removal) on flywheel and on converter cover. Install flywheel-to-converter attaching bolts and tighten to 35 lb. ft. torque.
8. Install flywheel housing bottom cover and tighten attaching bolts to 7 1/2 lb. ft. torque.

9. Reposition transmission support rear crossmember to transmission assembly and to frame. Install and tighten engine rear mount-to-extension housing bolts to 40 lb. ft. torque; frame-to-crossmember bolts to 25 lb. ft. torque.

10. Remove transmission lift equipment.

11. Reinstall propeller shaft.

12. Connect oil cooler lines, electrical lead to pressure switch, vacuum modulator line and speedometer cable to transmission.

13. If removed, reinstall and tighten oil pan drain plug to 20 lb. ft. torque, lower vehicle and refill transmission through filler tube, following recommendations provided for earlier under "DRAINING AND REFILLING".

14. Check transmission for leakage, proper operation and, if necessary, adjust linkage.

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

Transmission Model **RB** is used with 6 cylinder engine A, F and X Series.

Transmission Model **RK** is used with V-8 307 cu. in. engine X Series.

Transmission Model **TS** is used with V-8 350 cu. in. engine A and F Series.

TORQUE

APPLICATION	LB. FT.
Transmission Case-to-Engine Bolts (6)	35
Flywheel-to-Converter Bolts (3)	35
Flywheel Housing Bottom Cover-to-Case Bolts (4)	7 1/2
Extension Housing-to-Case Bolts (5)	25
Oil Pan-to-Case Bolts (14)	8
Oil Pan Drain Plug	20
Vacuum Modulator to Case	15
Band Adjusting Screw Lock Nut	15
Speedometer Driven Gear Retainer Bolt	4
Engine Rear Mount-to-Extension Housing Bolts (2)	40
Frame-to-Crossmember Bolts (4)	35
Detent Guide Plate-to-Case Bolts (2)	15
Suction Screen-to-Valve Body Screws (2)	2 1/2
Upper Valve Body Plate-to-Valve Body Bolts (6)	5
Valve Body-to-Case Bolts (6)	15
Lower-to-Upper Valve Body Bolts (15)	15
Outer Shift-to-Inner TV Lever Screw	2 1/2
Outer TV-to-Inner TV Lever Screw	2 1/2
Servo Cover-to-Case Bolts (3)	20
Oil Pump-to-Case Bolts (7)	15
Oil Pump Cover-to-Body Bolts (5)	20
Parking Pawl Bracket-to-Case Bolts (2)	10
Governor Support-to-Case Bolts (4)	10
Governor Hub Drive Screw	8
Governor Body-to-Hub Screws (4)	7
T.C.S. Pressure Switch (6 cylinder engine only)	9

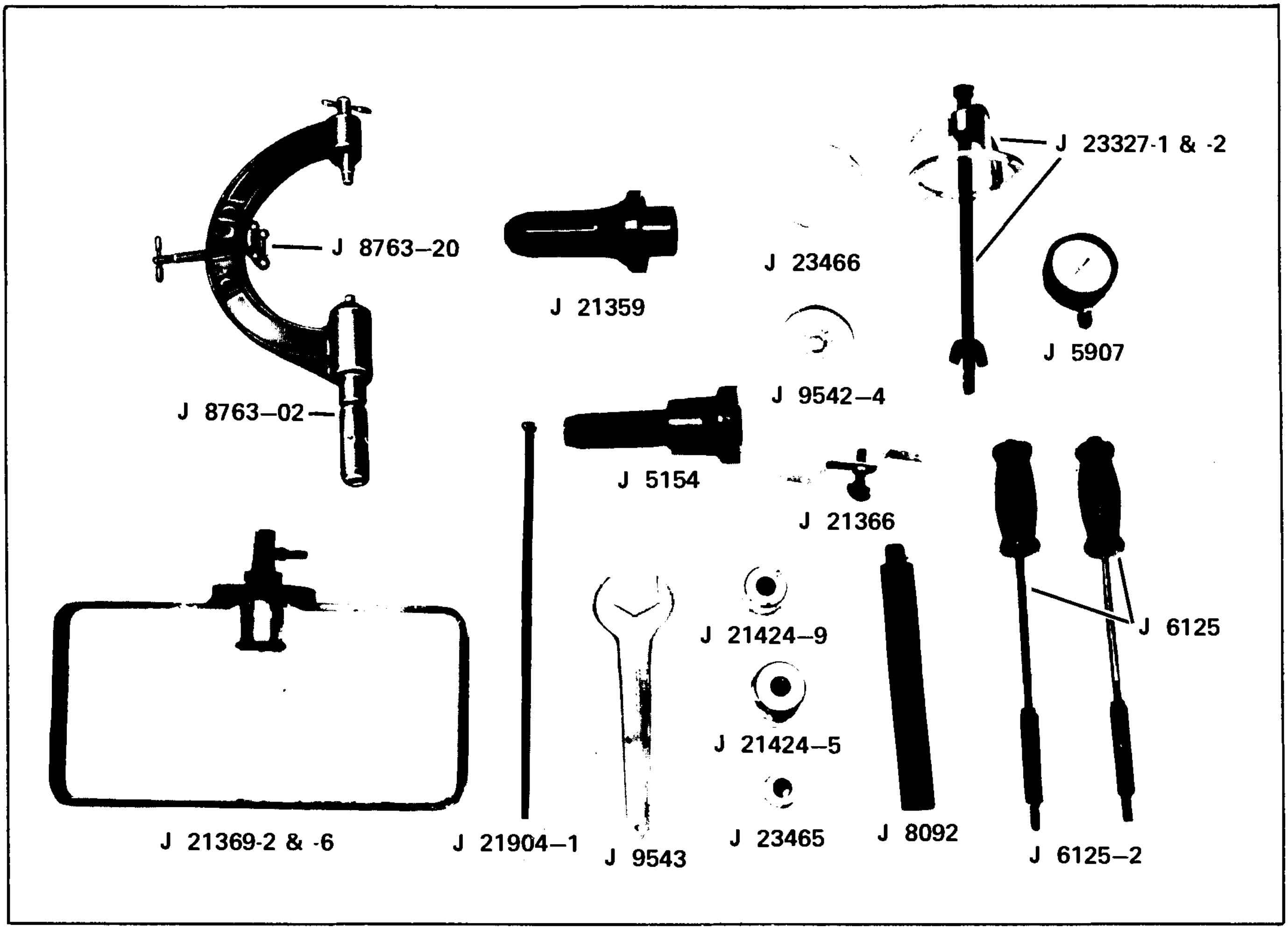


Fig. 7F-82 Special Tools

J5154	Oil Seal Installer
J5907	Pressure Gauge
J6125	Slide Hammers (2)
J6125-2	Slide Hammer Adapters (2)
J8092	Drive Handle
J8763-02	Holding Fixture
J 8763-20	Holding Fixture Adapter
J9542-4	Spring Compressor Pilot
J9543	Modulator Wrench
J21359	Oil Seal Installer
J21366	Converter Holding Strap
J21369-2 & -6	Leak Test Fixture
J21424-5	Bushing Tool
J21424-9	Bushing Tool
J21848	Band Adjusting Tool (Not Shown)
J21904-1	Slide Hammer Bolt
J23327-1 & -2	Clutch Spring Compressor
J23465	Bushing Tool
J23466	Compressor Adapter Ring

SECTION 7G

TURBO HYDRA-MATIC (M-38) TRANSMISSION

CONTENTS OF THIS SECTION

TROUBLE DIAGNOSIS

SEQUENCE FOR TURBO HYDRA-MATIC (M-38) 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 gauge.
   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 road testing is completed or transmission correction attempted. Poor engine performance can result in rough shifting or other malfunctions.

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, improper reading of dipstick, or oil appearance; therefore, a careful analysis of the condition of oil and the level may eliminate needless repairs.

When checking oil level, the procedure outlined under FLUID LEVEL, CHECKING PROCEDURE, should be followed to obtain the most accurate reading.

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.

ROAD TEST

When road testing vehicle, a reliable pressure gauge should be attached to the line pressure port on the right side of the transmission case, behind and adjacent to the intermediate clutch accumulator cover. Observe and record results of pressure checks, comparing results with transmission pressures shown under OIL PRESSURE CHECKS.

Check all the shifts in the following manner:

DRIVE RANGE:

Position selector lever in DRIVE range, accelerating vehicle from 0 mph. A 1-2 and 2-3 shift should occur at all throttle openings, shift points varying with the throttle opening. As vehicle speed decreases to 0 mph, a 3-2 and 2-1 shift should occur (Fig. 7G-1).

SUPER RANGE:

Position selector lever in SUPER range, accelerating vehicle from 0 mph. A 1-2 shift should occur at all throttle openings, the shift point varying with the throttle opening. No 2-3 shift should be obtained in this range. As vehicle speed decrease to 0 mph, a 2-1 shift should occur (Fig. 7G-1).

LOW RANGE

Position selector lever in LOW range. No upshift should occur in this range, regardless of throttle opening (Fig. 7G-1).

2nd GEAR-OVERRUN BRAKING

Position selector lever in DRIVE range and, with vehicle speed at approximately 30 mph and foot off accelerator, move selector lever to SUPER range. Transmission should immediately downshift to second gear. An increase in engine rpm and an engine braking effect should be noted. Line pressure should change from 55 psi to approximately 85 psi in second gear.

Shift points indicated are approximate and should be obtained as follows, providing engine tune-up is satisfactory:

Selector Lever In -	Upshifts (MPH)		Downshifts (MPH)	
	1-2	2-3	3-2	3 or 2-1
DRIVE				
Full Throttle	50	85	75	40
Part Throttle	12-49	22-84	50	-
Minimum Throttle	10	22	-	-
Coasting	-	-	22	9
SUPER	Engine Braking @ Any Speed			
LOW	Engine Braking @ 46 MPH or Below			

Fig. 7G-1 Shift Point Information

With vacuum line CONNECTED and pressure gage installed:		
Selector Lever In -	Minimum PSI	Maximum PSI
Drive - 1st Gear (0 to WOT)	60	153
- 2nd Gear (0 to WOT)	60	153
- 3rd Gear (Coast @ 30 mph)	60	-
Super (Coast @ 30 mph)	85	-
Low (Coast @ 30 mph)	85	-
Reverse (0 to WOT)	86	239
WOT = Wide Open Throttle	Pressures are approximate ($\pm$5 psi)	

Fig. 7G-2 Oil Pressure Check - Road or Normal Operating Conditions

1st GEAR-OVERRUN BRAKING

With selector lever in SUPER range and, with vehicle speed at approximately 30 mph at constant throttle, move selector lever to LOW range. Transmission should downshift to first gear. An increase in engine rpm and an engine braking effect should be noted. Line pressure should remain constant (approximately 85 psi).

OIL PRESSURE CHECKS

ROAD OR NORMAL OPERATING CONDITIONS

While road testing vehicle with the transmission oil pressure gage attached and the vacuum modulator tube CONNECTED, the transmission line pressures should check approximately as shown in Fig. 7G-2.

VEHICLE COASTING AT 25 MPH

While vehicle is coasting at 25 mph (foot off throttle), transmission oil pressure gage attached and the vacuum modulator tube CONNECTED, the transmission line pressures should check approximately as shown in Fig. 7G-3.

Vehicle coasting @25 mph, Vacuum line CONNECTED, pressure gage installed and foot off throttle:	
Selector Lever In -	Pressure (PSI)
Neutral	60
Drive	60
Super	85
Low	85
Pressures are approximate ($\pm$5 psi)	

Fig. 7G-3 Oil Pressure Check - Vehicle Coasting

VEHICLE STATIONARY AND ENGINE AT 1200 RPM

While vehicle is stationary (service brake on), engine speed set to 1200 rpm, with transmission oil pressure gage attached and the vacuum modulator tube DISCONNECTED, the transmission line pressure should check approximately as shown in Fig. 7G-4.

GOVERNOR PRESSURE CHECK

1. With car on hoist (rear wheels off ground), disconnect the vacuum line to the modulator, install a line pressure gauge to the transmission and a tachometer to the engine.
2. Start engine, keep foot off brake, move selector lever to DRIVE range and check line pressure with engine speed at 1,000 rpm's.
3. Slowly increase engine speed to 3,000 rpm's and determine if a line pressure drop occurs (7 psi or more).
4. If no pressure drop takes place:

   a. Inspect governor

      (1) Stuck governor valve.

      (2) Stuck governor weight.

      (3) Restricted orifice in governor valve.

   b. Check governor feed system

      (1) Plugged or restricted screen in control valve assembly.

      (2) Restrictions in feed line.

      (3) Scored governor bore.

Oil pressures indicated are at zero output speed, vacuum line DISCONNECTED and with engine speed set to 1200 rpm (service brake on):

Approximate Altitude (Feet above Sea Level)	Park Neutral Drive	Super or Low	Reverse
0	153	153	239
2,000	153	153	224
4,000	145	147	206
6,000	134	139	191
8,000	124	132	176
10,000	116	125	164
12,000	106	118	151
14,000	98	112	139
Pressures are approximate ($\pm$5 psi)			

Fig. 7G-4 Oil Pressure Check - Vehicle Stationary

TURBO HYDRA-MATIC (M-38) TROUBLE DIAGNOSIS GUIDE

NO DRIVE IN DRIVE RANGE

(Install pressure gauge)

1. Low Oil Level - correct level and check for external leaks or defective vacuum modulator (leaking diaphragm will evacuate oil from unit).
2. Manual Linkage - misadjusted, correct alignment to manual lever shift quadrant is essential.
3. Low Oil Pressure - refer to LOW LINE PRESSURE below.
4. Forward Clutch:
   a. Forward clutch does not apply - piston cracked; seals missing or damaged; clutch plates burned (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.
5. Low & Reverse Roller Clutch Assembly- broken spring, damaged cage or installed backwards.

HIGH OR LOW OIL PRESSURE

(Refer to OIL PRESSURE CHECKS)

HIGH LINE PRESSURE

1. 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.).
2. Modulator:
   a. Stuck modulator valve.
   b. Water in modulator.
   c. Damaged, not operating properly.
3. Detent System - detent valve or cable stuck in detent position.
4. 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

1. Low transmission oil level.
2. Defective vacuum modulator assembly.
3. Strainer Assembly:
   a. Blocked or restricted.
   b. Gasket omitted or damaged.
4. Oil Pump:
   a. Gear clearance, damaged, worn, gear installed backwards.
   b. Pump-to-case gasket mispositioned.
   c. Defective pump body and/or cover.
5. Valve Body:
   a. Pressure regulator or boost valve stuck.
   b. Pressure regulator valve spring, too weak.
6. Internal Circuit Leaks:
   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 and 2-3 accumulator pistons and rings for damage or missing.
7. Case Assembly - check ball missing from cored passage in case face.

1-2 SHIFT - FULL THROTTLE ONLY

1. Detent Valve - sticking or linkage misadjusted.
2. Vacuum Leak - vacuum line or fittings leaking.
3. 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).
4. Case Assembly - porosity*.

FIRST SPEED ONLY-NO 1-2 SHIFT

1. Detent (downshift) cable - binding.
2. 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).
3. 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).
4. Intermediate Clutch:
   a. Clutch piston seals - missing, improperly installed or cut.
   b. Intermediate roller clutch - broken spring or damaged cage.
5. 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

1. Control Valve Assembly:
   a. Valve body gaskets - leaking, damaged or incorrectly installed.
   b. 2-3 shift valve train stuck closed (in downshifted position).
2. 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 below).

NO FIRST SPEED - STARTS IN SECOND SPEED

(Locks up in Lo Range)

Intermediate Clutch:

a. Too many plates in intermediate clutch pack.

b. Incorrect intermediate clutch piston.

DRIVE IN NEUTRAL

1. Manual Linkage - misadjusted, (correct alignment in manual lever shift quadrant is essential).
2. Internal Linkage - manual valve disconnected or end broken.
3. Oil Pump - line pressure leaking into forward clutch apply passage.
4. Forward Clutch - incorrect clutch plate usage or burned clutches (see BURNED CLUTCH PLATES below).

NO MOTION IN REVERSE OR SLIPS IN REVERSE

(Install pressure gauge)

1. Low Oil Level - add oil.
2. Manual Linkage - misadjusted (correct alignment in manual lever shift quadrant is essential).
3. Low Oil Pressure - refer to LOW LINE PRESSURE above.
4. Control Valve Assembly:
   a. Valve body gaskets - leaking, damaged or incorrectly installed.
   b. 2-3 shift valve train stuck open (in upshifted position).
5. Intermediate Servo - piston or pin stuck so intermediate overrun band is applied.
6. Low and Reverse Clutch - piston outer seal damaged or missing.
7. Direct Clutch:
   a. Outer seal damaged or missing.
   b. Clutch plates burned (see BURNED CLUTCH PLATES below).
8. Forward Clutch - clutch does not release (will cause DRIVE in NEUTRAL).

SLIPS IN ALL RANGES OR SLIPS ON START

(Install pressure gauge)

1. Low Oil Level - add oil.
2. Low Oil Pressure - refer to LOW LINE PRESSURE above.
3. Forward clutch:
   a. Clutch plates burned (see BURNED CLUTCH PLATES below).
   b. Pump cover oil seal rings broken or worn.
4. Case - cross leaks or porosity*.

SLIPPING 1-2 SHIFT

(Install pressure gauge)

1. Low Oil Level - add oil.
2. Low Oil Pressure - refer to LOW LINE PRESSURE above.
3. 2-3 Accumulator - oil ring damaged or missing.
4. 1-2 Accumulator - oil ring damaged, missing or case bore damaged.
5. Pump-to-Case Gasket - mispositioned or damaged.
6. Intermediate Clutch:
   a. Piston seals damaged or missing.
   b. Clutch plates burned (See BURNED CLUTCH PLATES below).
7. Case - porosity* between channels.

SLIPPING 2-3 SHIFT

(Install pressure gauge)

1. Low Oil Level - add oil.
2. Low Oil Pressure - refer to LOW LINE PRESSURE above.
3. Direct Clutch:
   a. Piston seals leaks, damaged or missing.

b. Clutch plates burned (see BURNED CLUTCH PLATES below).

c. Inspect for proper number and type of clutch plates.

4. Case - porosity*.

ROUGH 1-2 SHIFT

(Install pressure gauge)

1. High Oil Pressure - refer to HIGH LINE PRESSURE above.

2. 1-2 Accumulator:

   a. Oil rings damaged.

   b. Piston stuck.

   c. Broken or missing spring.

   d. Bore damaged.

3. Intermediate Clutch - check for burned and number (type) of plates.

4. Case:

   a. Check for correct number and location of check balls.

   b. Porosity * between channels.

ROUGH 2-3 SHIFT

(Install pressure gauge)

1. High Oil Pressure - refer to HIGH LINE PRESSURE above.

2. 2-3 Accumulator:

   a. Oil ring damaged.

   b. Piston stuck.

   c. Broken or missing spring.

   d. Piston bore damaged.

NO ENGINE BRAKING IN SUPER RANGE

(Install pressure gauge)

1. Low Oil Pressure - pressure regulator and/or boost valve stuck.

2. Intermediate Servo and 2-3 Accumulator:

   a. Servo or accumulator oil rings or bores leaking or damaged.

   b. Servo piston stuck or cocked.

3. Intermediate Overrun Band - intermediate overrun band broken or burned (look for cause), not engaged or servo pin.

NO ENGINE BRAKING IN LO RANGE

(Install pressure gauge)

1. Low Oil Pressure - pressure regulator and/or boost valves stuck.

2. Manual Low Control Valve Assembly - stuck.

3. Low and Reverse Clutch - piston inner seal damaged or missing.

NO PART THROTTLE DOWNSHIFT

(Install pressure gauge)

1. Oil Pressure - vacuum modulator assembly, modulator valve or pressure regulator valve train (other malfunctions may also be noticed).

2. Detent Valve and Linkage - sticks, disconnected or broken.

3. 2-3 shift valve - stuck.

NO DETENT (WIDE-OPEN THROTTLE) DOWNSHIFT

1. Detent cable or retainer not adjusted properly.

2. Detent cable disconnected at transmission or throttle linkage.

3. Valve Body:

   a. Detent valve sticks.

   b. Detent regulator valve sticks.

   c. Incorrect spacer plate or gasket.

HIGH OR LOW SHIFT POINTS

(Install pressure gauge)

1. Oil 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.

2. Governor:

a. Valve sticking.

b. Feed holes restricted or leaking.

3. Detent Valve and Linkage - stuck open (will cause high shift points).

4. Control Valve Assembly:

a. 1-2 shift valve train sticking.

b. 2-3 shift valve train sticking.

5. Case - porosity*.

WON'T HOLD IN PARK

1. Manual Linkage - misadjusted (correct alignment in manual lever shift quadrant is essential).

2. 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 for noise, make certain that the noise is not coming from the water pump, alternator, 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.*

PARK, NEUTRAL AND ALL DRIVING RANGES

1. Pump Cavitation:

a. Low oil level.

b. Plugged or restricted strainer.

c. Strainer-to-valve body gasket damaged.

d. Porosity in valve body intake area.

e. Water in oil.

f. Porosity or voids at transmission case (pump face) intake port.

g. Pump-to-case gasket off location.

2. Pump Assembly:

a. Gears damaged.

b. Driving gear assembled backwards.

c. Crescent interference.

d. Oil seal rings damaged or worn.

3. Converter:

a. Loose flexplate-to-converter bolts.

b. Converter damage.

c. Water in oil (causes whine).

FIRST, SECOND AND/OR REVERSE GEAR

Planetary Gear Set:

a. Gears or thrust bearings damaged.

b. Input or output ring gear damaged.

DURING ACCELERATION - ANY GEAR

1. Transmission or cooler lines grounded to underbody.

2. Motor mounts loose or broken.

SQUEAL AT LOW VEHICLE SPEED

Speedometer driven gear shaft seal - requires lubrication or replacement.

BURNED CLUTCH PLATES

1. Forward Clutch:

a. Check ball in clutch drum damaged, stuck or missing.

b. Clutch piston cracked, seals damaged or missing.

c. Low line pressure (see LOW LINE PRESSURE above).

d. Pump cover oil seal rings missing, broken or undersize; ring groove oversize.

e. Transmission case valve body face not flat or porosity between channels.

2. Intermediate Clutch:
   a. Intermediate clutch piston seals damaged or missing.
   b. Low line pressure (see LOW LINE PRESSURE above).
   c. Transmission case valve body face not flat or porosity between channels.
3. Direct Clutch:
   a. Restricted orifice on vacuum line to modulator (poor vacuum response).
   b. Check ball in clutch drum damaged, stuck or missing.
   c. Defective modulator bellows.
   d. Clutch piston cracked, seals damaged or missing.
   e. Transmission case valve body face not flat or porosity between channels.
   f. Intermediate overrun roller clutch installed backwards.
   g. In addition, 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 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 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

TRANSMISSION OIL PAN LEAK

1. Attaching bolts not correctly torqued.
2. Improperly installed or damaged pan gasket.
3. Oil pan gasket mounting face not flat.

EXTENSION HOUSING LEAK

1. Attaching bolts not correctly torqued.
2. Rear seal assembly damaged or improperly installed.
3. Square seal, extension-to-case, damaged or improperly installed.
4. Porous casting*.

CASE LEAK

1. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine.
2. Modulator assembly "O" ring seal damaged or improperly installed.
3. Detent cable connector O-ring seal damaged or improperly installed.
4. Governor cover not tight, gasket damaged or leak between case face and gasket.
5. Speedometer gear "O" ring damaged.
6. Manual shaft seal damaged or improperly installed.
7. Line pressure tap plug loose.
8. Vent pipe (refer to OIL COMES OUT VENT PIPE below).
9. Porous casting*.

FRONT END LEAK

1. Front pump seal leaks.
   a. Seal lip cut. Check converter hub, etc.
   b. Bushing moved and damaged. Oil return hole plugged.

c. No oil return hole.

2. Front pump attaching bolts loose or bolt washer-type seals damaged or missing.

3. Front pump housing "O" ring damaged or cut.

4. Converter leak in weld area.

5. Porous casting (pump).

OIL COMES OUT VENT PIPE

1. Transmission over-filled.

2. Water in oil.

3. Foreign material between pump and case or between pump cover and body.

4. Case - porous near converter bosses*. Front pump cover or housing oil channels shy of stock near breather.

5. Pump-to-case gasket mis-positioned.

*CASE POROSITY REPAIR

Turbo Hydra-Matic (M-38) transmission external oil leaks caused by case porosity can be repaired with the transmission in the car by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 180°F.

2. Raise car on a hoist or jack stand, engine running and locate source of oil leak. Check for oil leaks in LOW, DRIVE and REVERSE ranges.

3. Shut engine off and thoroughly clean area to be repaired with a suitable cleaning solvent and a brush, then air dry.

   NOTE: *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, Group 0.423, Part No. 1360016, or equivalent, to make the repair.

   NOTE: *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.

GENERAL DESCRIPTION

The Turbo Hydra-Matic (M-38) transmission (Fig. 7G-5) is a fully automatic unit consisting primarily of a 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.

The 3-element torque converter consists of a pump, turbine 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.

NOTE: *References to clockwise and counterclockwise are determined by looking toward the rear of the car.*

The torque converter is of welded construction and is serviced as a complete assembly. The unit is filled with oil and is attached to the engine crankshaft by a flywheel, 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 throughout the turbine, it is traveling in such a direction that, if it were not redirected by the stator, it would hit the rear of the converter pump blades and impede its pumping action. So, at low turbine speeds, oil is redirected 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 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.

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.

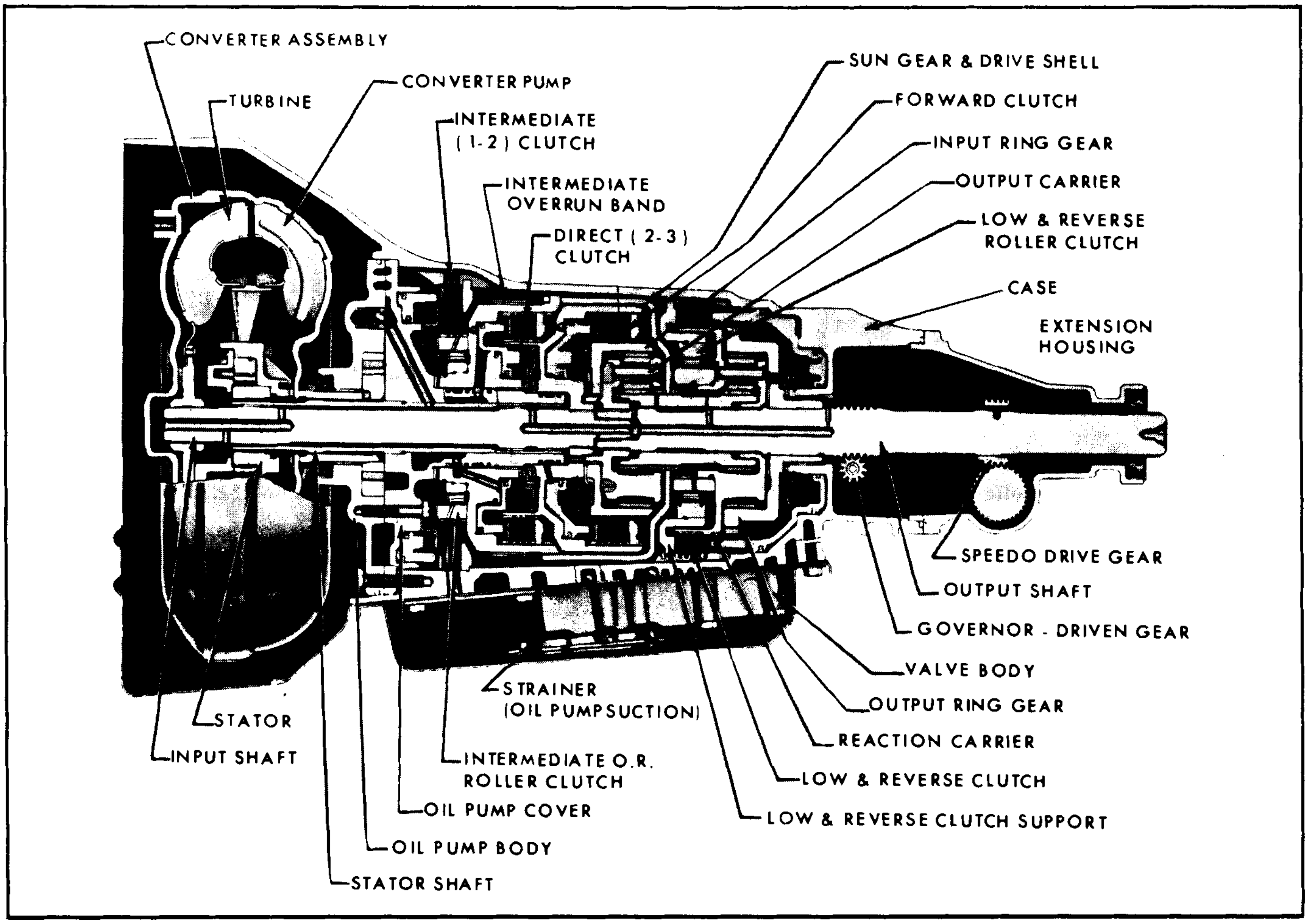


Fig. 7G-5 Cross Section of Transmission

2. Engine Vacuum - To operate the vacuum modulator.
3. Cable Control - To operate the detent valve.

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, which controls line pressure, so that all torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

The detent valve is activated by a cable that is connected to the accelerator lever assembly. When the throttle is half open, the valve is actuated causing throttle downshift at speeds below 50 mph. When the throttle is fully open, the detent valve is actuated causing the transmission to downshift from 3-1 at speeds below 40 mph and 3-2 below 75 mph.

POWER FLOW

In neutral or park, all clutches and the intermediate overrun band are released. Also, in park range the parking pawl is engaged, preventing movement of the vehicle. Therefore, no power is transmitted from the torque converter turbine to the planetary gear sets or output shaft (Fig. 7G-6).

With the range selector lever in Drive (D) range, the forward clutch is applied. This delivers turbine torque from the input shaft through the forward clutch to the input ring gear in a clockwise direction (converter torque ratio equals approximately 2.25 to 1 at stall).

Clockwise rotation of the input ring gear causes the output planet pinions to rotate in a clockwise direction, driving the sun gear (and shaft) counterclockwise. In turn, the sun gear turning counterclockwise will cause the output ring gear and output shaft to turn in a clockwise direction (in a reduction ratio of approximately 2.52 to 1). The reaction of the reaction carrier planet pinions against the output ring gear is taken by the low and reverse roller clutch, which is grounded to the case (Fig. 7G-7).

To prepare the transmission for the shift into second gear, the intermediate roller clutch is locked. Therefore, the sun gear, sun gear drive shell, direct clutch housing, intermediate roller clutch and the intermediate clutch faced plates are all turning in a counterclockwise direction.

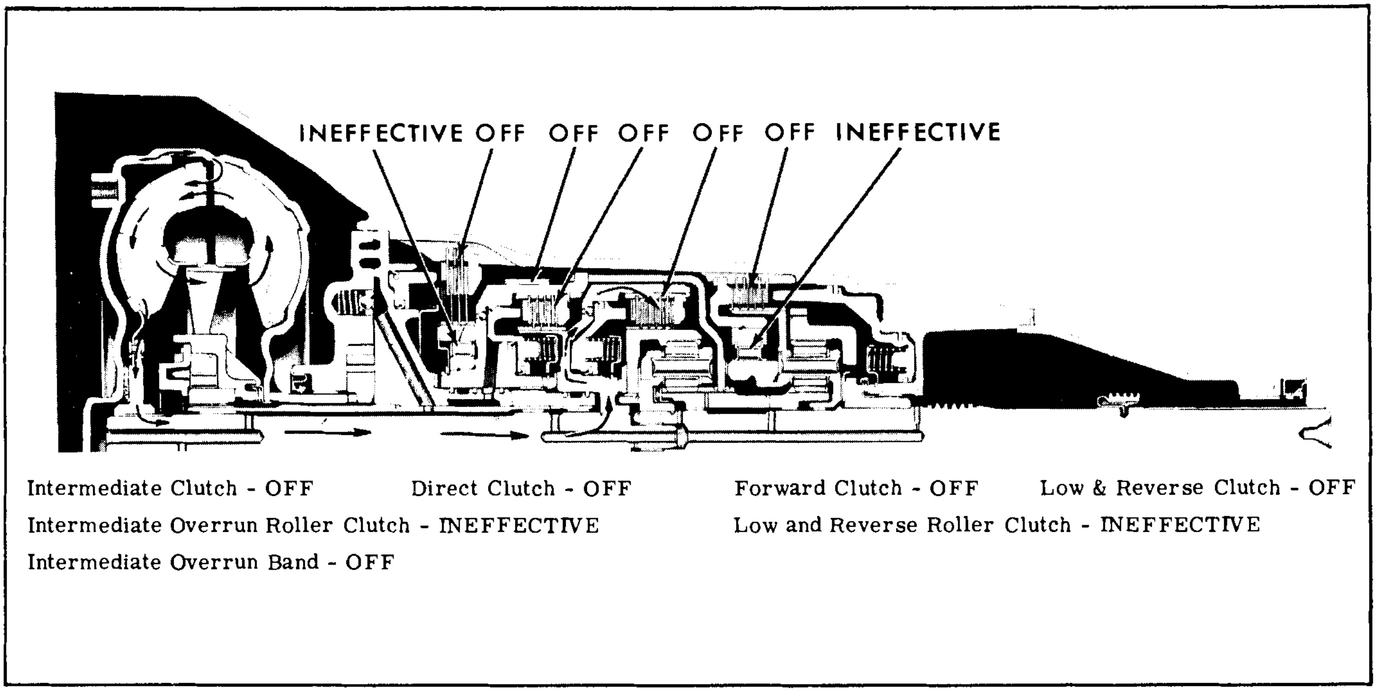


Fig. 7G-6 Operation in Neutral or Park Range

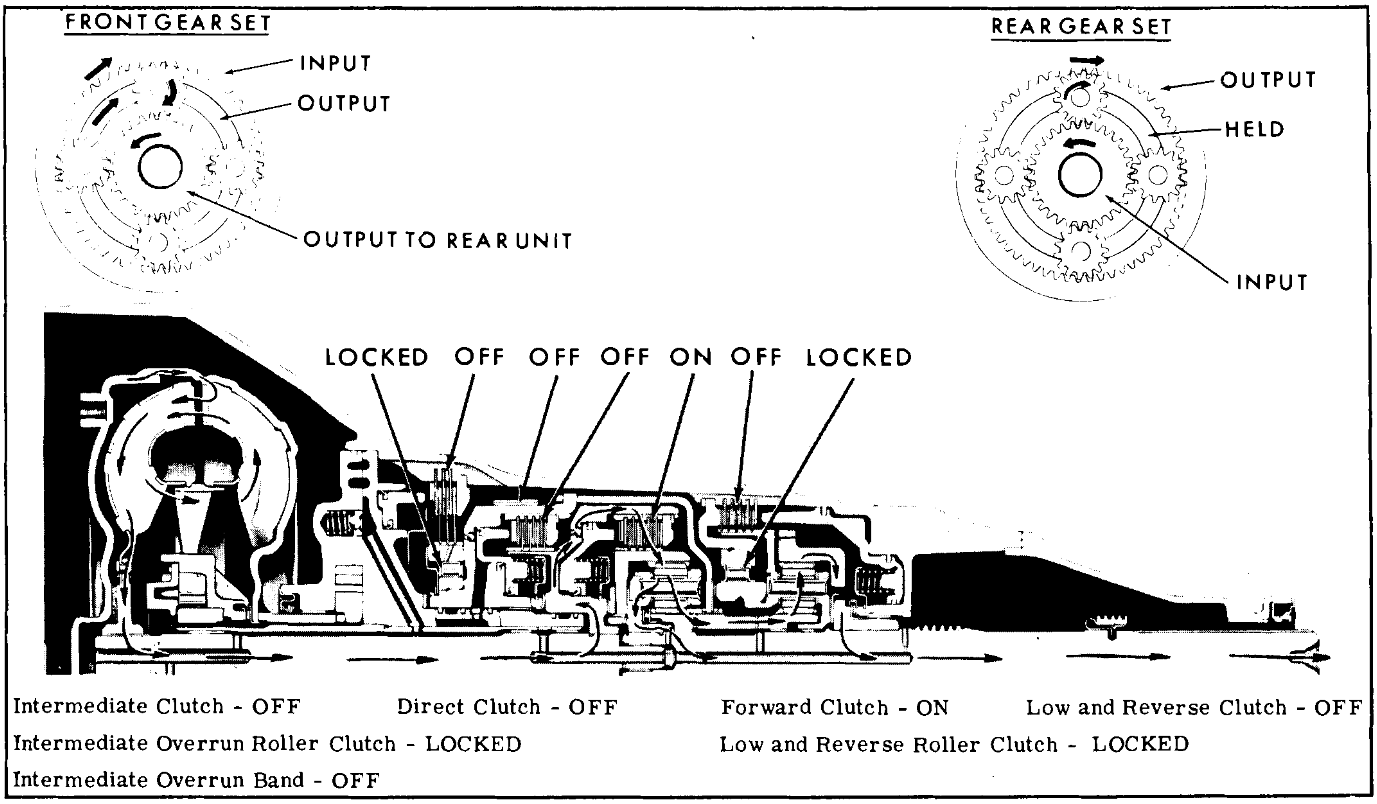


Fig. 7G-7 Operation in Drive Range - First Gear

In Drive (D) range, second gear, the intermediate clutch is applied to allow the intermediate overrun roller clutch to hold the drive shell and sun gear stationary (against counterclockwise rotation). Turbine torque, through the applied forward clutch, is delivered to the input ring gear in a clockwise direction (Fig. 7G-8).

Clockwise rotation of the input ring gear causes the output planet pinions to walk around the now stationary sun gear in a clockwise direction. This causes the output ring gear and output shaft to turn in a clockwise direction (in a reduction ratio of approximately 1.52 to 1).

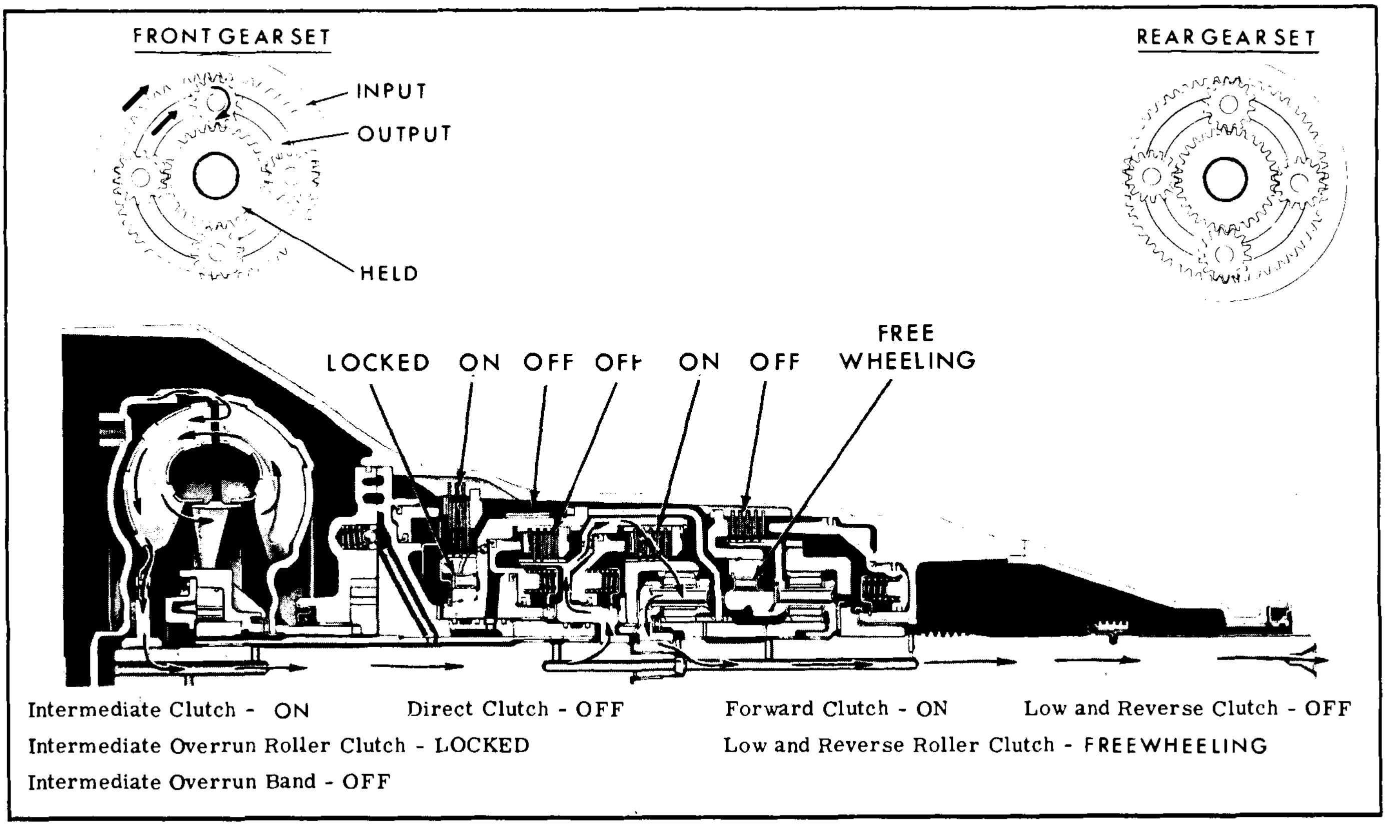


Fig. 7G-8 Operation in Drive Range - Second Gear

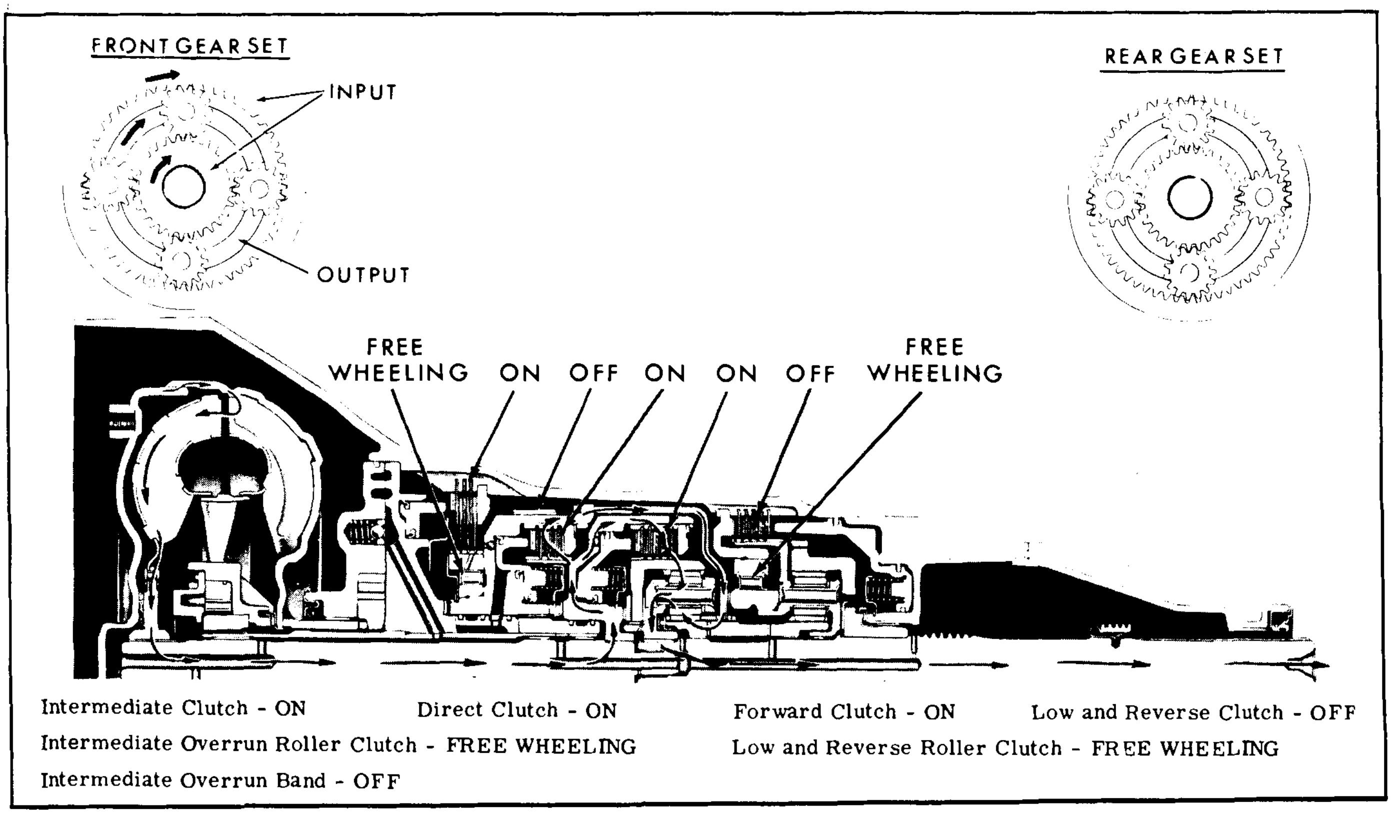


Fig. 7G-9 Operation in Drive Range - Third Gear

In direct drive, third gear, engine torque is transmitted through the converter assembly and through the applied forward clutch to the input ring gear in a clockwise direction. The direct clutch is now applied, transmitting torque through the sun gear drive shell to the sun gear in a clockwise direction also (Fig. 7G-9).

Since both the input ring gear and the sun gear are turning in a clockwise direction at the same speed, the planetary gear sets are locked and turn as one unit in direct drive (third gear) or at a ratio of 1 to 1.

In Super (S) range, second gear, the intermediate clutch is applied to allow the intermediate overrun roller clutch to hold the drive shell and sun gear stationary (against counterclockwise rotation). Turbine torque, through the applied forward clutch, is delivered to the input ring gear in a clockwise direction (Fig. 7G-10).

Clockwise rotation of the input ring gear causes the output planet pinions to walk around the stationary sun gear in a clockwise direction. This causes the output ring gear and output shaft to turn in a clockwise direction (in a reduction ratio of approximately 1.52 to 1).

When the transmission is shifted into Super range, the intermediate overrun band is applied in addition to the forward and the intermediate clutches. The intermediate overrun band provides overrun braking, during deceleration or coast, as it holds the sun gear fixed.

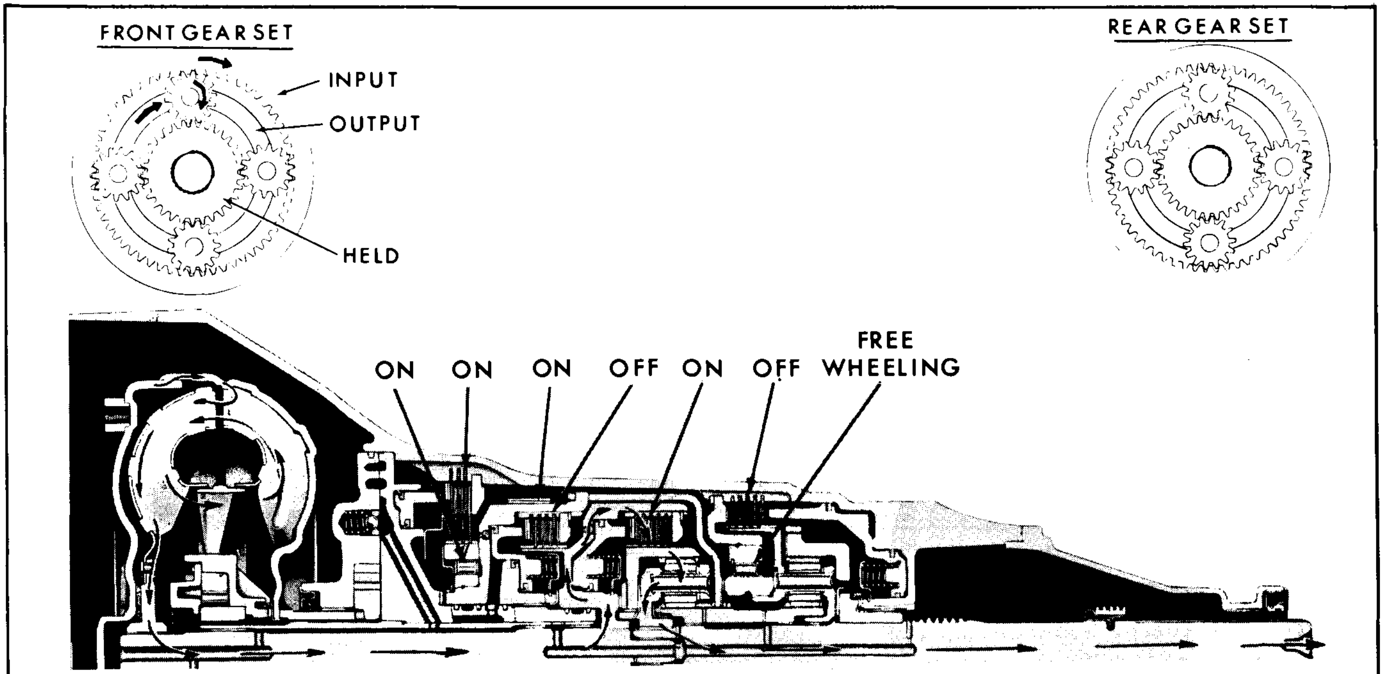
With the range selector lever in Low (L) range, the forward clutch is applied (Fig. 7G-11). This delivers turbine torque from the input shaft through the forward clutch to the input ring gear in a clockwise direction (converter torque ratio equals approximately 2.25 to 1 at stall).

Clockwise rotation of the input ring gear causes the output planet pinions to rotate in a clockwise direction, driving the sun gear counterclockwise. In turn, the sun gear turning counterclockwise will cause the output ring gear and output shaft to turn in a clockwise direction (in a reduction ratio of approximately 2.52 to 1). The reaction of the reaction carrier planet pinions against the output ring gear is taken by the low and reverse roller clutch, which is grounded to the case, and/or the low and reverse clutch, which is applied in Low range.

When the selector lever is moved in Low range, the low and reverse clutch is applied, below a preset controlled car speed, in addition to the forward clutch which is on for all forward ranges. The low and reverse clutch provides overrun braking as it holds the reaction carrier fixed.

With the range selector lever in Reverse (R) range, the forward clutch is off and the direct clutch is applied to transmit torque from the forward clutch housing to the sun gear drive shell and the sun gear. The low and reverse clutch is applied, preventing the output carrier from turning (Fig. 7G-12).

Clockwise rotation of the sun gear causes the reaction carrier planet pinions to turn counterclockwise, turning the output ring gear and output shaft in a counterclockwise direction (in a reduction ratio of approximately 1.92 to 1).



Intermediate Clutch - ON
Direct Clutch - OFF
Forward Clutch - ON
Low and Reverse Clutch - OFF
Intermediate Overrun Roller Clutch - LOCKED
Low and Reverse Roller Clutch - FREE WHEELING
Intermediate Overrun Band - ON

Fig. 7G-10 Operation in Super Range - Second Gear

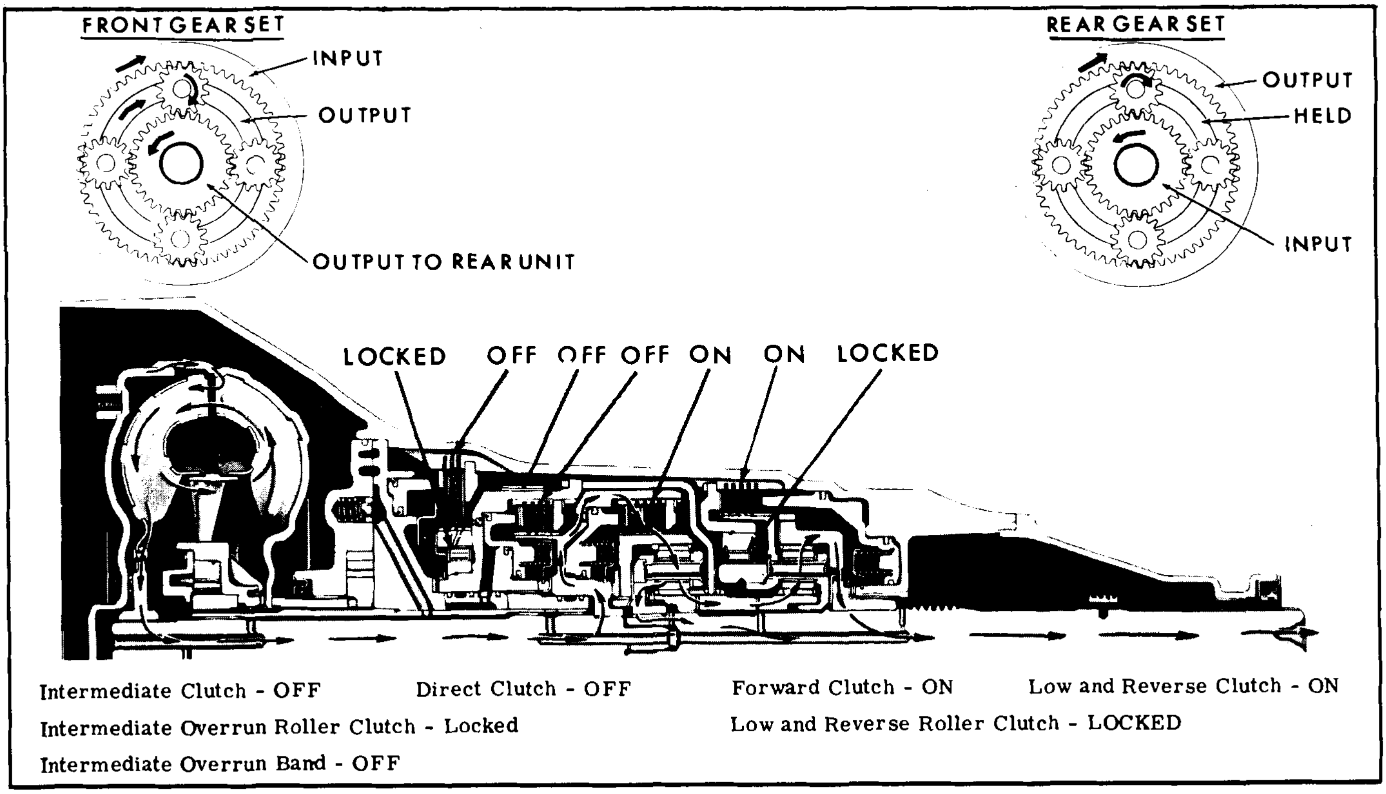


Fig. 7G-11 Operation in Low Range - First Gear

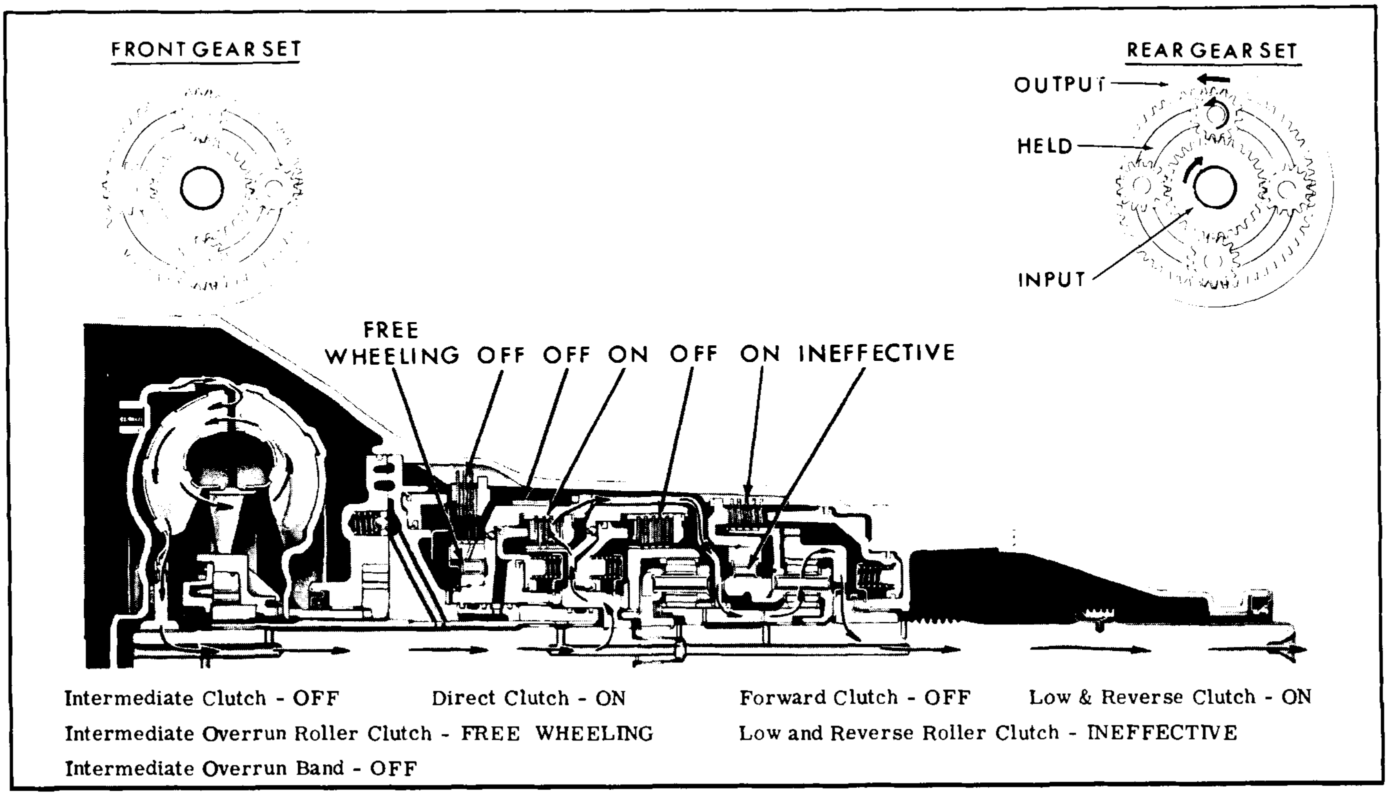


Fig. 7G-12 Operation in Reverse Range - Reverse Gear

FUNCTIONS OF VALVES AND HYDRAULIC CONTROL UNITS

PRESSURE CONTROL

The transmission is controlled automatically by a hydraulic system. Hydraulic pressure is supplied by the transmission oil pump, (Fig. 7G-13) which is engine driven. Main line pressure is controlled by a pressure regulator valve train and by the vacuum modulator which is connected to engine vacuum. The pressure regulator valve train controls line pressure automatically, in response to a pressure signal from a modulator valve, in such a way that the torque requirements of the transmission clutches are met and proper shift spacing is obtained at all throttle openings. To control line pressure properly, a modulator pressure is used which varies in the same manner as torque input to the transmission. Modulator pressure is regulated by engine vacuum which is an indicator of engine torque and carburetor opening.

VACUUM MODULATOR ASSEMBLY

The engine vacuum signal is provided by the vacuum modulator, which consists of an evacuated metal bellows, a diaphragm and two springs (Fig. 7G-14). These are so arranged that, when installed, the bellows and its external spring apply a force which acts on the modulator valve. This force acts on the modulator valve so that it increases modulator pressure. Engine vacuum and the other spring acts in the opposite direction to decrease modulator. That is, low engine vacuum creates high modulator pressure; high engine vacuum, low modulator pressure. To reduce the effect of engine power loss at high altitudes on shift points, the effective area of the diaphragm is made somewhat larger than that of the bellows. Atmospheric pressure then acts on the resulting differential area to reduce modulator pressure.

GOVERNOR ASSEMBLY

The vehicle speed signal to the modulator valve is supplied by the transmission governor, which is driven by the output shaft. The governor consists of a pair of dual weights and a regulator valve (Fig. 7G-15).

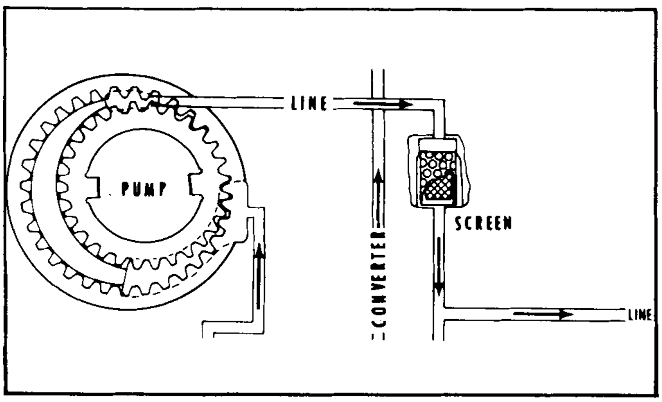


Fig. 7G-13 Transmission Oil Pump

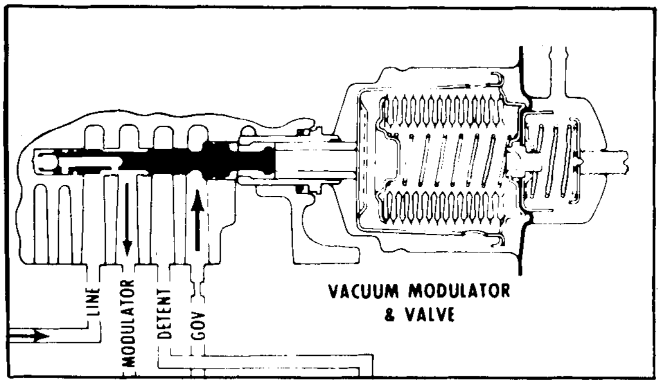


Fig. 7G-14 Vacuum Modulator Assembly

As the car begins to move, the weight assemblies move outward to provide a regulating force against the valve through the springs between the primary and secondary weights. As car speed is further increased, regulating force against the valve is provided by the secondary weights moving outward. At approximately 22 MPH, the primary weights have reached the limit of their travel and the force against the valve is then entirely through the secondary weights.

Thus, governor valve pressure is determined at very low speeds by the primary and secondary weights and at higher speeds by the secondary weights plus the force of the springs between the weights. In this manner, governor pressure is increased rapidly but smoother from very low speeds to approximately 22 MPH, where it increases at a slower rate.

PRESSURE REGULATOR VALVE

The pressure regulator valve regulates line pressure according to a fixed spring force and forces controlled by

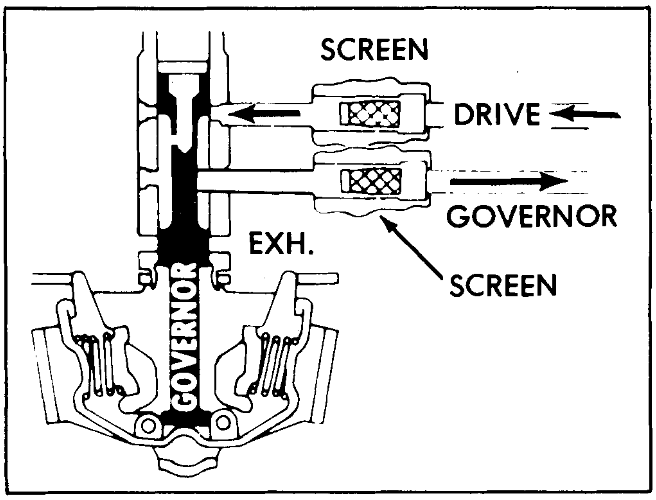


Fig. 7G-15 Governor Assembly

modulator, intermediate and reverse pressure (Fig. 7G-16). It also controls the flow of oil that charges the torque converter, feeds the oil cooler and provides lubrication and oil for clutch applications.

MANUAL VALVE

Establishes the range of transmission operation, i.e., P, R, N, D, S and L as selected by the vehicle operator through the manual selector lever (Fig. 7G-17).

MODULATOR VALVE

The modulator valve regulates line pressure to modulator pressure that varies with torque to the transmission (Fig. 7G-14). It senses forces created by:

1. The vacuum modulator bellows that increases modulator pressure.
2. Engine vacuum acting on a diaphragm to decrease modulator pressure.
3. Governor pressure which is generated by the governor assembly. Governor pressure tends to decrease modulator pressure.

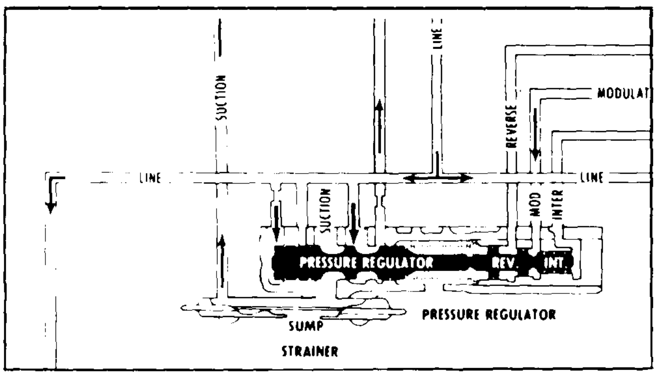


Fig. 7G-16 Pressure Regulator Valve

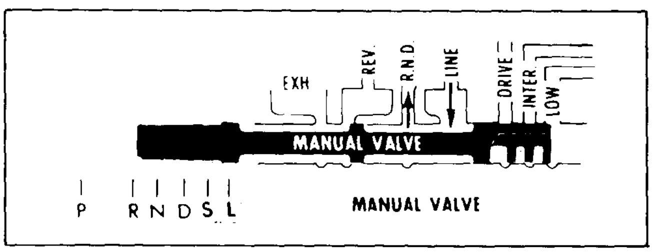


Fig. 7G-17 Manual Valve (In Neutral)

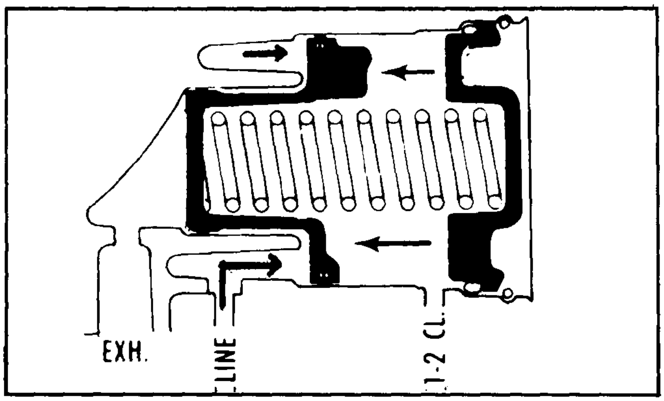


Fig. 7G-18 1-2 Accumulator

1-2 ACCUMULATOR

Line pressure routed to the 1-2 accumulator causes the piston to cushion application of the intermediate clutch. The spring within the accumulator acts against the piston. The force of the spring and the pressure of the 1-2 clutch oil push the 1-2 accumulator piston back towards the line oil to allow a gradual build up of the 1-2 clutch pressure (Fig. 7G-18).

2-3 ACCUMULATOR

Oil routed to the 2-3 accumulator cushions the application of the direct clutch. The spring within the accumulator acts against the piston. The force of the spring and the pressure of the 2-3 clutch oil push the 2-3 accumulator piston back towards the R, D, N oil to allow a gradual build up of the 2-3 clutch pressure (Fig. 7G-19).

1-2 SHIFT VALVE

Routes oil pressure that causes the transmission to shift from 1-2 or 2-1. Its operation is controlled by governor pressure, detent pressure, modulator pressure and spring force (Fig. 7G-20).

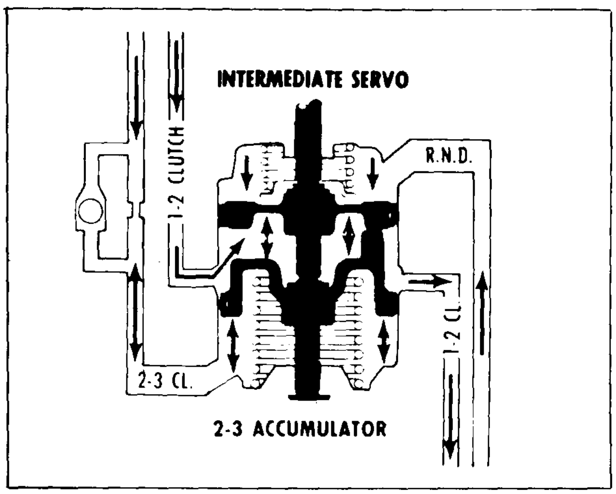


Fig. 7G-19 2-3 Accumulator

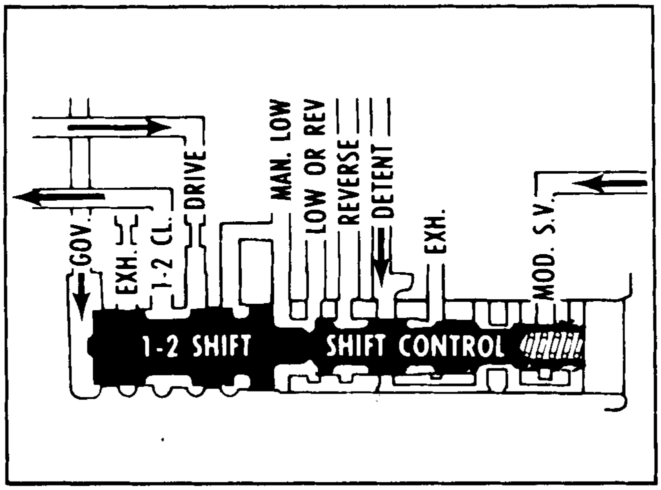


Figure 7G-20 1-2 Shift Valve

2-3 SHIFT VALVE

Routes oil pressure that causes the transmission to shift from 2-3 or 3-2. Its operation is controlled by governor, detent and modulator shift valve pressures as well as a spring force (Fig. 7G-21).

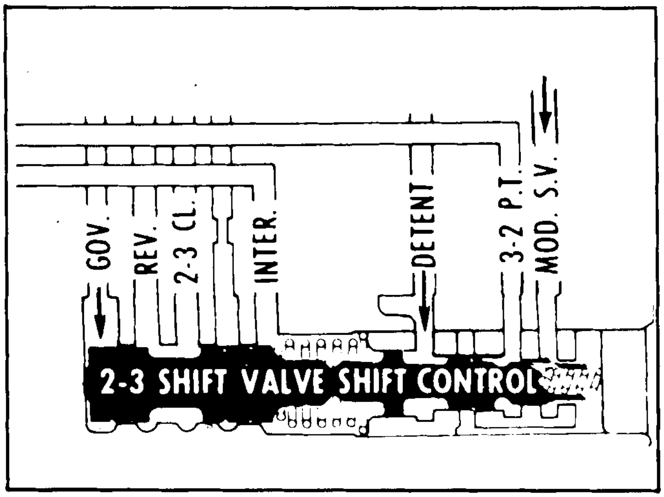


Fig. 7G-21 2-3 Shift Valve

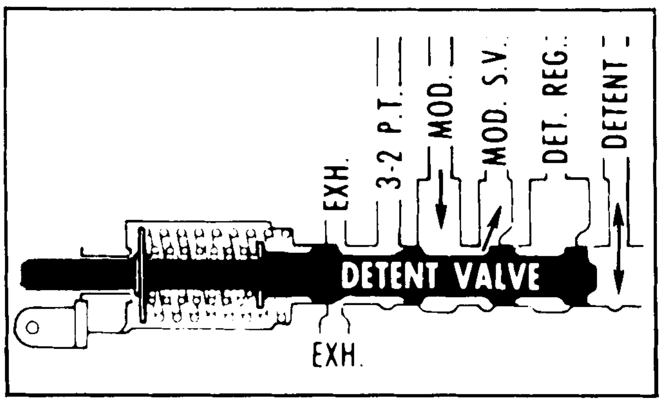


Fig. 7G-22 Detent Valve

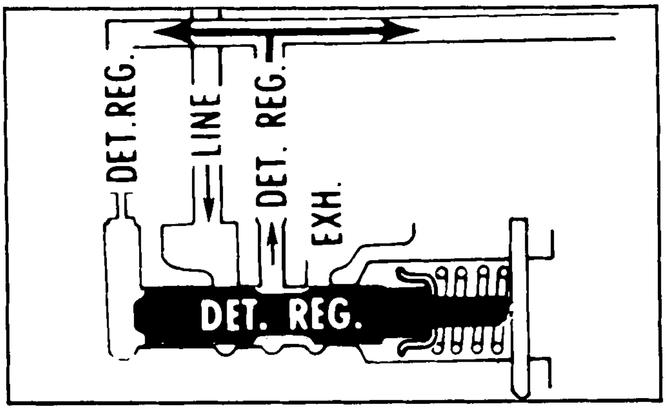


Fig. 7G-23 Detent Regulator Valve

DETENT VALVE

The detent valve, actuated by a cable connected to the accelerator lever assembly, directs the regulated modulator pressure tending to hold the 1-2 shift and 2-3 shift valves in the downshift position and provides areas for modulator and detent regulated pressures for detent 2-1, 3-1 and 3-2 downshifts (Fig. 7G-22).

DETENT REGULATOR VALVE

The detent regulator valve and spring regulate line pressure into detent regulator oil which is used to control the car speed at which the 1-2 and 2-3 upshifts occur (Fig. 7G-23).

COOLER BY-PASS VALVE

The cooler by-pass valve permits oil to be fed directly from the converter to the lubrication circuit when the oil is very cold or if the cooler or lines should become restricted. (Fig. 7G-24).

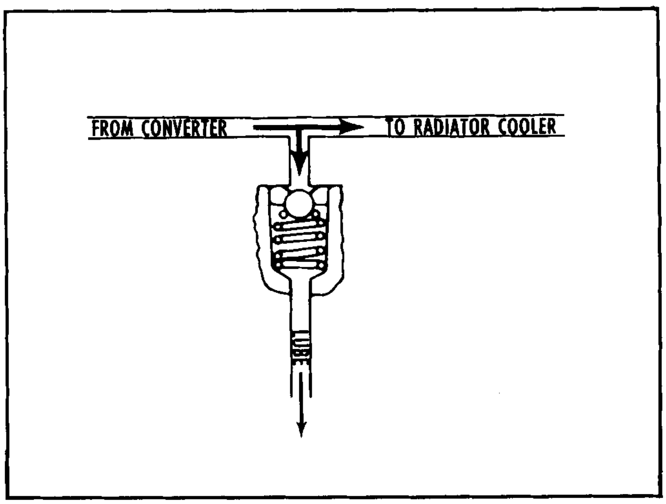


Fig. 7G-24 Cooler By-Pass Valve

MANUAL LOW CONTROL VALVE

The manual low control valve is positioned to exhaust the manual low apply line when the manual valve is placed in the manual low (L) position above approximately 50 MPH. At speeds below 50 MPH, low oil is fed into the manual low apply line which moves the 1-2 shift valve to the downshifted position (exhausting the 1-2 clutch) and moves the 1-2 shift control valve to the upshifted position which sends low apply oil to the low and reverse clutch, which engages this clutch. Once the manual low control valve is in the downshifted position, its spring plus low apply oil acting on it will keep it in this position; therefore, with the transmission in manual low (L range), the transmission cannot upshift to second gear regardless of vehicle or engine speed once low gear has been engaged. (Fig. 7G-25).

The manual low control valve is used also to protect the engine by preventing low range engagement (indicated by high car speed which is sensed by high governor pressure) at car speeds over 50 MPH.

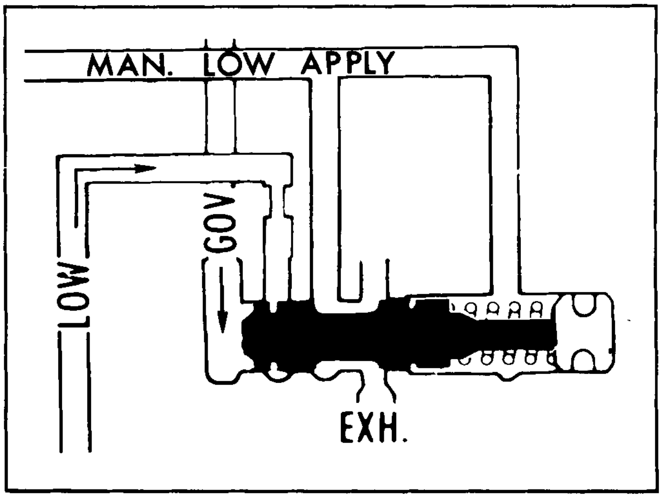


Fig. 7G-25 Manual Low Control Valve

NEUTRAL - ENGINE IDLING

POWER FLOW

Intermediate Clutch	Off
Direct Clutch	Off
Forward Clutch	Off
Low and Reverse Clutch	Off
Intermediate Overrun Roller Clutch	Free Wheeling
Low and Reverse Roller Clutch	Free Wheeling
Intermediate Overrun Band	Off

OIL FLOW

Whenever the pump is running at idle speed with the range selector lever in Neutral (N), oil from the sump is picked up by the pump and is directed to:

1. Pressure Regulator Valve.
2. Converter (with Pressure Regulator Valve regulating)
   a. Cooler By-Pass Valve
   b. Oil Cooler
   c. Lubrication System
3. Manual Valve
4. Modulator Valve
5. Intermediate Servo (In Neutral range - not in Park)
6. Detent Pressure Regulator Valve
7. 1-2 Accumulator

Oil flowing from the pump is directed to the pressure regulator valve, which regulates the pump (line) pressure. When pump output exceeds the demand of line pressure, oil from the pressure regulator valve is directed through converter feed passage to fill the converter. Converter return oil is directed to the cooler by-pass valve and transmission cooler. Oil from the cooler is directed to the transmission lubrication system and, hence, back to sump. The cooler by-pass valve permits oil to be fed directly from the converter to the lubrication circuit if the cooler should be restricted.

Line pressure oil at the modulator valve is regulated to modulator oil, which acts on the reverse and modulator boost valve and the detent valve.

Modulator oil at the detent valve is regulated to modulator shift valve oil which acts on the 2-3 shift valve and the 1-2 shift valve.

From the pressure regulator valve, line oil is routed to:

1. Manual Valve and, as R.N.D. oil, to the 2-3 Accumulator.
2. Detent Pressure Regulator
3. 1-2 Accumulator
4. Vacuum Modulator Valve

SUMMARY

The converter is filled, and all clutches and the intermediate band are released. The transmission is in Neutral.

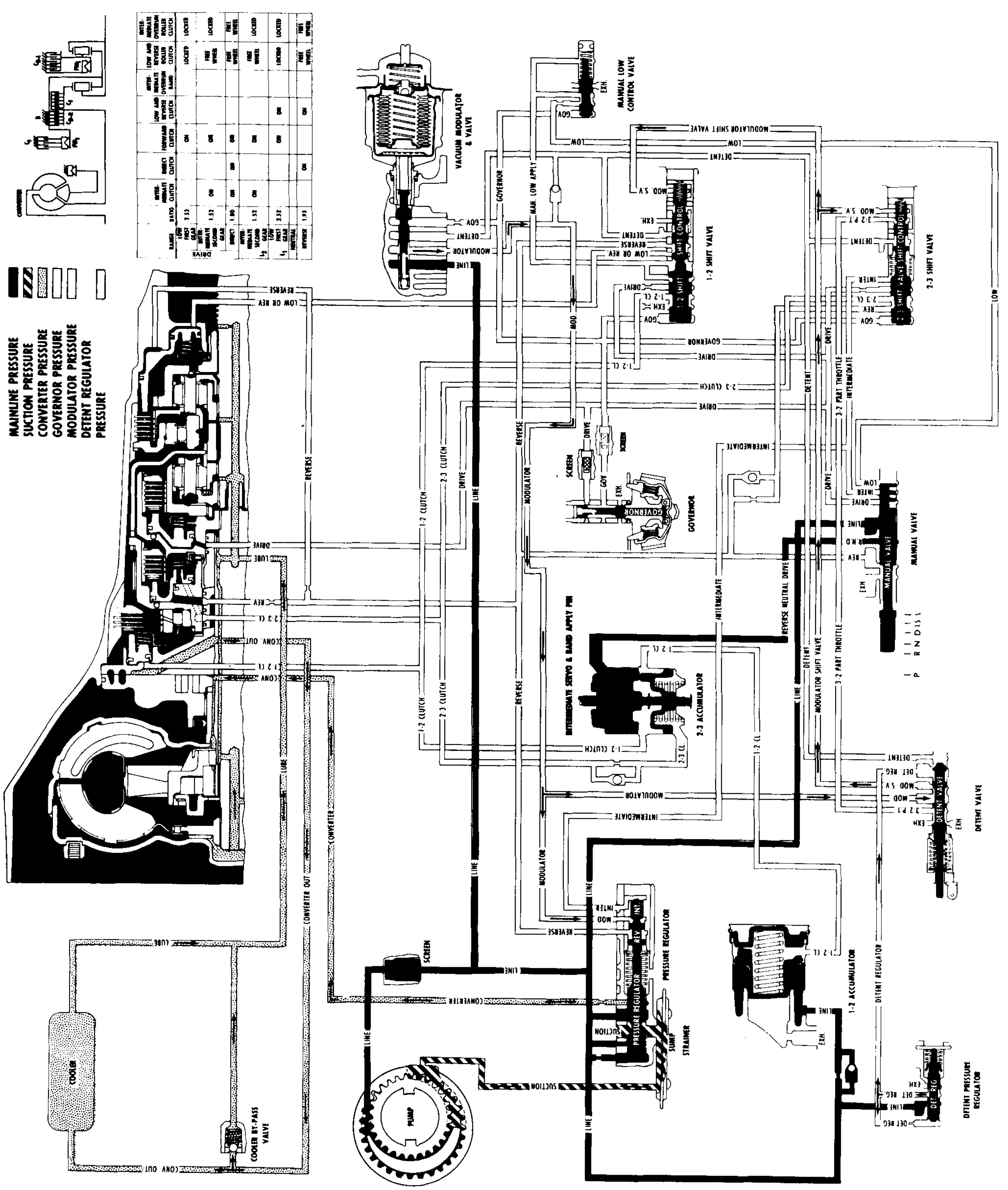


Fig. 7G-26 - Neutral Range - Engine Idling

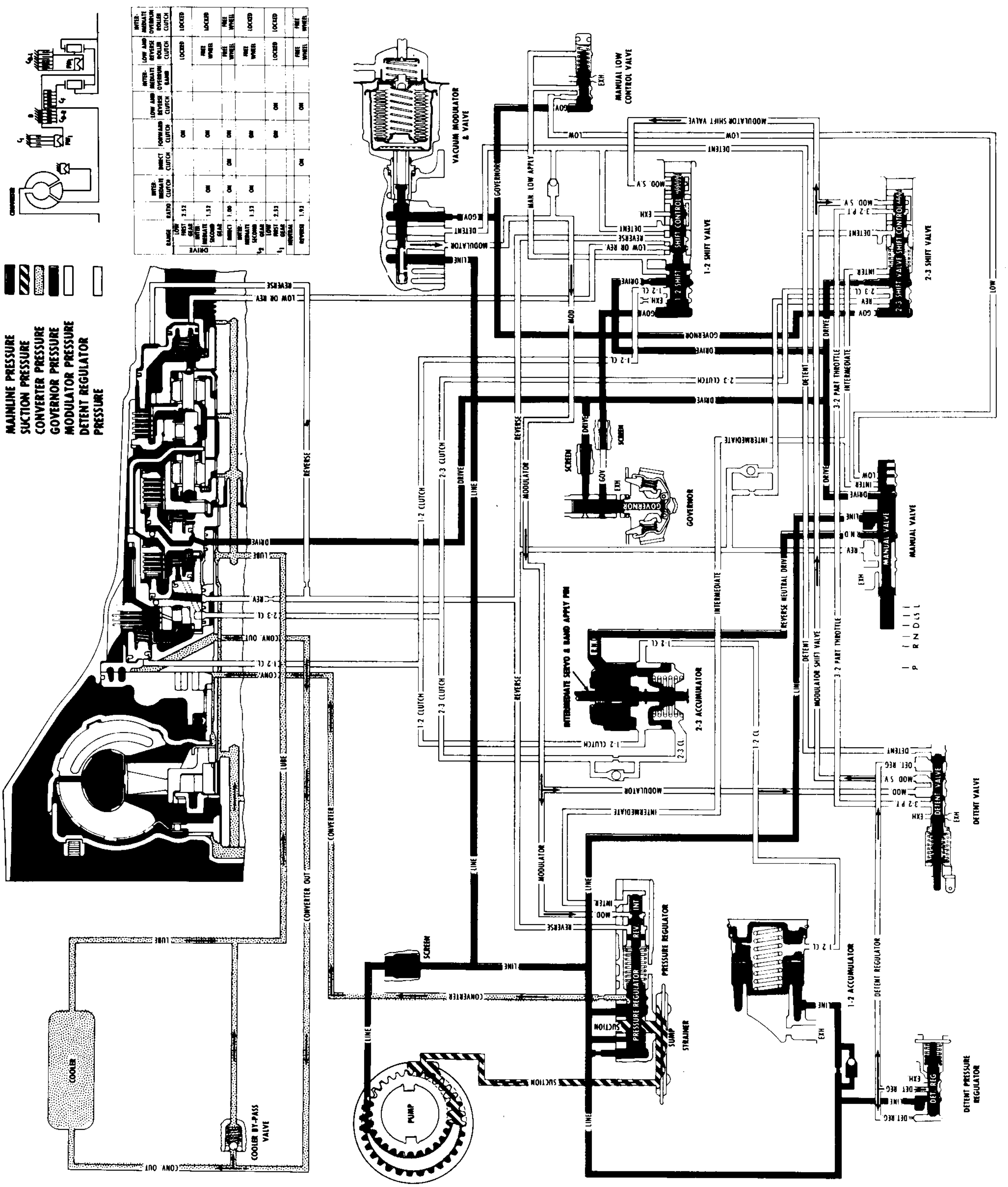


Fig. 7G-27 Drive Range - First Gear

DRIVE RANGE - FIRST GEAR

POWER FLOW

Intermediate Clutch	Off
Direct Clutch	Off
Forward Clutch	On
Low and Reverse Clutch	Off
Intermediate Overrun Roller Clutch	Locked
Low and Reverse Roller Clutch	Free Wheeling
Intermediate Overrun Band	Off

OIL FLOW

Line pressure is fed to:

1. Modulator Valve.
2. Manual Valve.
3. Pressure Regulator Valve.
4. Detent Pressure Regulator Valve.
5. 1-2 Accumulator.

From the manual control valve, line pressure becomes drive oil and is fed to:

1. Forward Clutch (to apply the clutch).
2. Governor
3. 1-2 Shift Valve
4. 2-3 Shift Valve

Also, from the manual control valve, line pressure becomes R.N.D. oil and is fed to the intermediate servo.

When the range selector lever is moved to Drive (D) position, the manual valve directs line pressure to the R.N.D. and drive ports. R.N.D. oil strokes the intermediate servo so that it is prepared to cushion the 2-3 clutch for an upshift. The 1-2 accumulator has already been stroked with line oil to prepare it to cushion the 1-2 clutch for an upshift.

Drive oil is directed to and applies the forward clutch and is directed to the governor assembly, where it is regulated to variable governor oil. Governor oil (which increases with car speed) is directed to the ends of the 1-2 and 2-3 shift valves, to the manual control valve and to the modulator valve.

SUMMARY

The forward clutch is applied and the transmission is in first gear.

DRIVE RANGE - SECOND GEAR

POWER FLOW

Intermediate Clutch	On
Direct Clutch	Off
Forward Clutch	On
Low and Reverse Clutch	Off
Intermediate Overrun Roller Clutch	Locked
Low and Reverse Roller Clutch	Free Wheeling
Intermediate Overrun Band	Off

OIL FLOW

As both vehicle speed and governor oil pressure increase, the force of the governor oil pressure (46 p.s.i. at W.O.T.), acting as the end of the 1-2 shift valve, overcomes the force of the 1-2 shift valve spring and modulator shift valve oil regulated by the detent valve. This allows the 1-2 shift valve to move to the upshifted position, which allows drive oil to pass through the valve and leave as 1-2 clutch oil.

1-2 (intermediate) clutch oil is directed to:

1. Intermediate clutch (to apply the clutch).
2. 2-3 Accumulator
3. 1-2 Accumulator

1-2 clutch oil flows from the 1-2 shift valve, through the 2-3 accumulator and then to the 1-2 accumulator which, with line oil already stroking it, cushions the intermediate clutch application.

SUMMARY

Both the forward and the intermediate clutches are applied and the transmission is in second gear.

When in Drive range, the full throttle 1-2 upshift will occur at approximately 42-49 m.p.h. and the mimimum throttle upshift will occur at approximately 9-12 m.p.h.

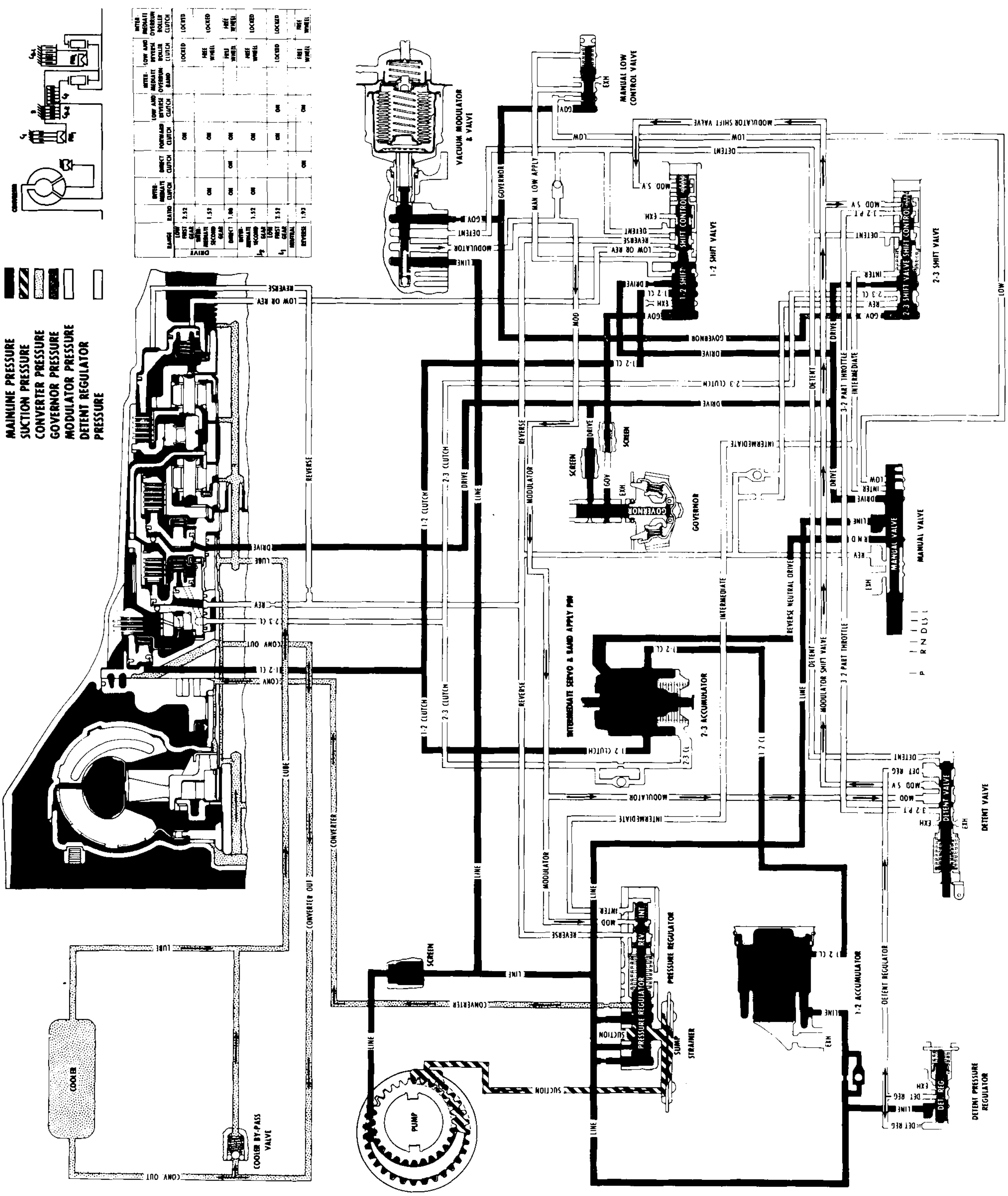
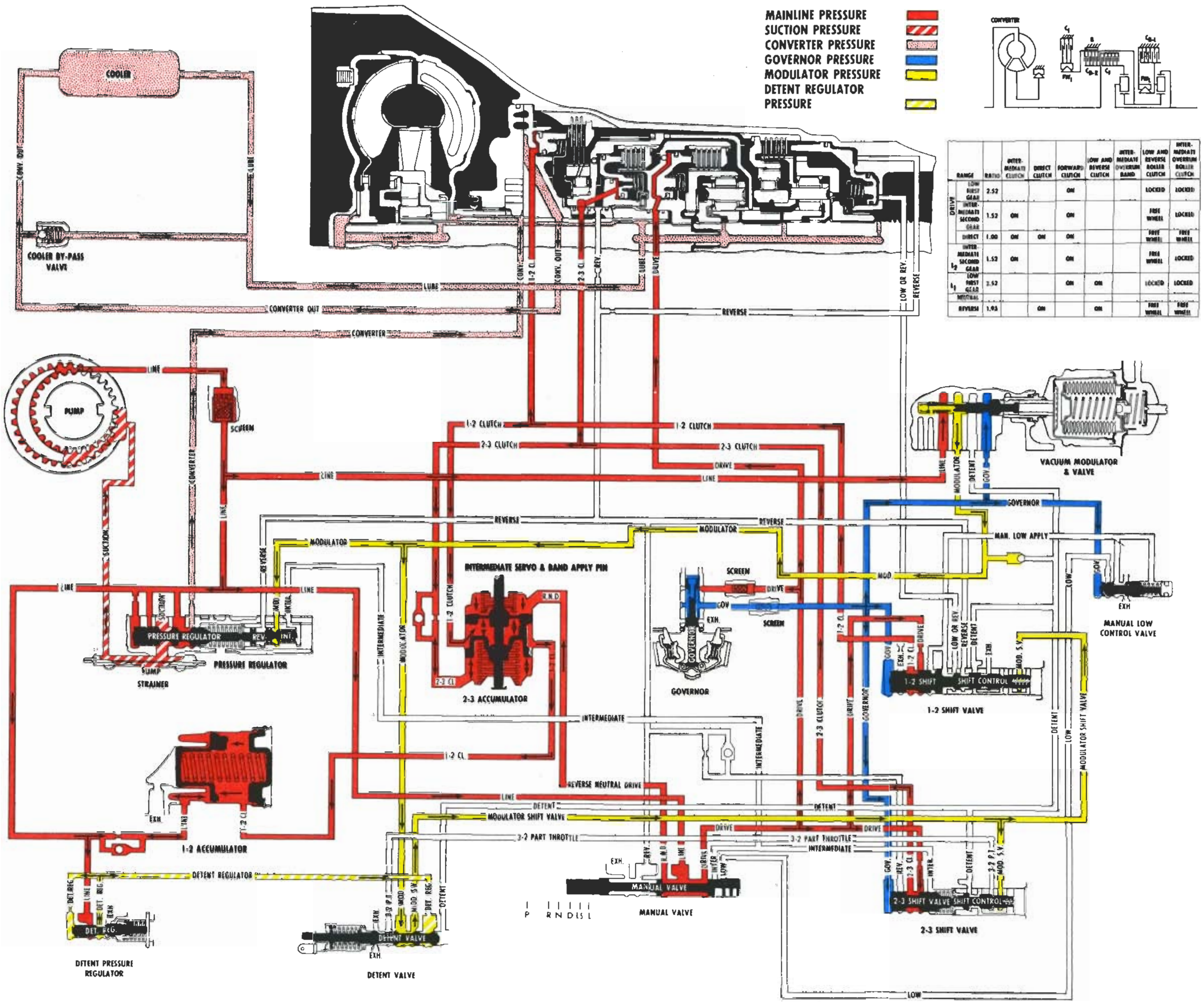


Fig. 7G-28 - Drive Range - Second Gear



RANGE		RATIO	INTERMEDIATE CLUTCH	DIRECT CLUTCH	FORWARD CLUTCH	LOW AND REVERSE CLUTCH	INTERMEDIATE OVERRUN BAND	LOW AND REVERSE ROLLER CLUTCH	INTERMEDIATE OVERRUN ROLLER CLUTCH
DRIVE	LOW FIRST GEAR	2.52			ON			LOCKED	LOCKED
DRIVE	INTERMEDIATE SECOND GEAR	1.52	ON		ON			FREE WHEEL	LOCKED
DRIVE	DIRECT	1.00	ON	ON	ON			FREE WHEEL	FREE WHEEL
L2	INTERMEDIATE SECOND GEAR	1.52	ON		ON			FREE WHEEL	LOCKED
L1	LOW FIRST GEAR	2.52			ON	ON		LOCKED	LOCKED
NEUTRAL									
REVERSE		1.93		ON		ON		FREE WHEEL	FREE WHEEL

Fig. 7G-29 - Drive Range - Third Gear

DRIVE RANGE - THIRD GEAR

POWER FLOW

Intermediate Clutch .... On
Direct Clutch .... On
Forward Clutch .... On
Low and Reverse Clutch .... Off
Intermediate Overrun Roller Clutch .... Free Wheeling
Low and Reverse Roller Clutch .... Free Wheeling
Intermediate Overrun Band .... Off

OIL FLOW

As vehicle speed and governor oil pressure further increase, the force of the governor oil pressure (77 p.s.i. at W.O.T.), acting on the end of the 2-3 shift valve, overcomes the force of the 2-3 shift valve spring and the modulator shift valve oil. This allows the 2-3 shift valve to move to the upshifted position, which allows drive oil to pass through the valve and leave as 2-3 clutch oil.

2-3 (direct) clutch oil is directed to:

1. Direct clutch (to apply the clutch).
2. 2-3 Accumulator

2-3 clutch oil flows from the 2-3 shift valve to the direct clutch and to the underside of the 2-3 accumulator piston. The direct clutch application is cushioned by the R.N.D. and 1-2 clutch oil forces already present on the other side of the intermediate servo and 2-3 accumulator pistons.

SUMMARY

The forward, intermediate and direct clutches are all applied and the transmission is in third gear (direct drive).

When in Drive range, the full throttle upshift will occur at approximately 70-79 m.p.h. and the minimum throttle upshift will occur at approximately 20 m.p.h.

LOW RANGE - FIRST GEAR

POWER FLOW

Intermediate Clutch .... Off
Direct Clutch .... Off
Forward Clutch .... On
Low and Reverse Clutch .... On
Intermediate Overrun Roller Clutch .... Locked
Low and Reverse Roller Clutch .... Locked
Intermediate Overrun Band .... Off

OIL FLOW

With the range selector lever in Low (L), line oil leaves the manual valve as low oil and is directed to the manual low control valve which, in turn, directs it through the 1-2 shift valve train to the low and reverse clutch piston (inner area only).

At speeds above approximately 42 m.p.h., governor oil pressure holds the manual low control valve in a position that exhausts the manual low apply line. At speeds below 42 m.p.h., low oil is fed into the manual low apply line which moves the 1-2 shift valve to its downshifted position, exhausting the 1-2 clutch oil and moves the 1-2 shift control valve to its upshifted position, sending low or reverse oil to the low and reverse clutch.

Once the manaul low control valve is in its downshifted position, its spring, plus low apply oil acting on it, will keep it in this position. Also, intermediate oil is being directed into the 2-3 shift valve train, moving the 2-3 shift valve to its downshifted position, exhausting the 2-3 clutch oil. Therefore, with the transmission in Low (L) range, it cannot be upshifted to second gear regardless of vehicle or engine speed, once first gear has been engaged.

SUMMARY

The forward clutch and the low and reverse clutch are applied. The transmission is in first gear, Low range.

Maximum downhill braking can be attained at speeds below approximately 42 m.p.h. by moving th range selector lever into Low (L) range position. The manual low control valve is used also to protect the engine by preventing Low (L) range engagement at car speeds over approximately 42 m.p.h. or 3600 engine r.p.m.

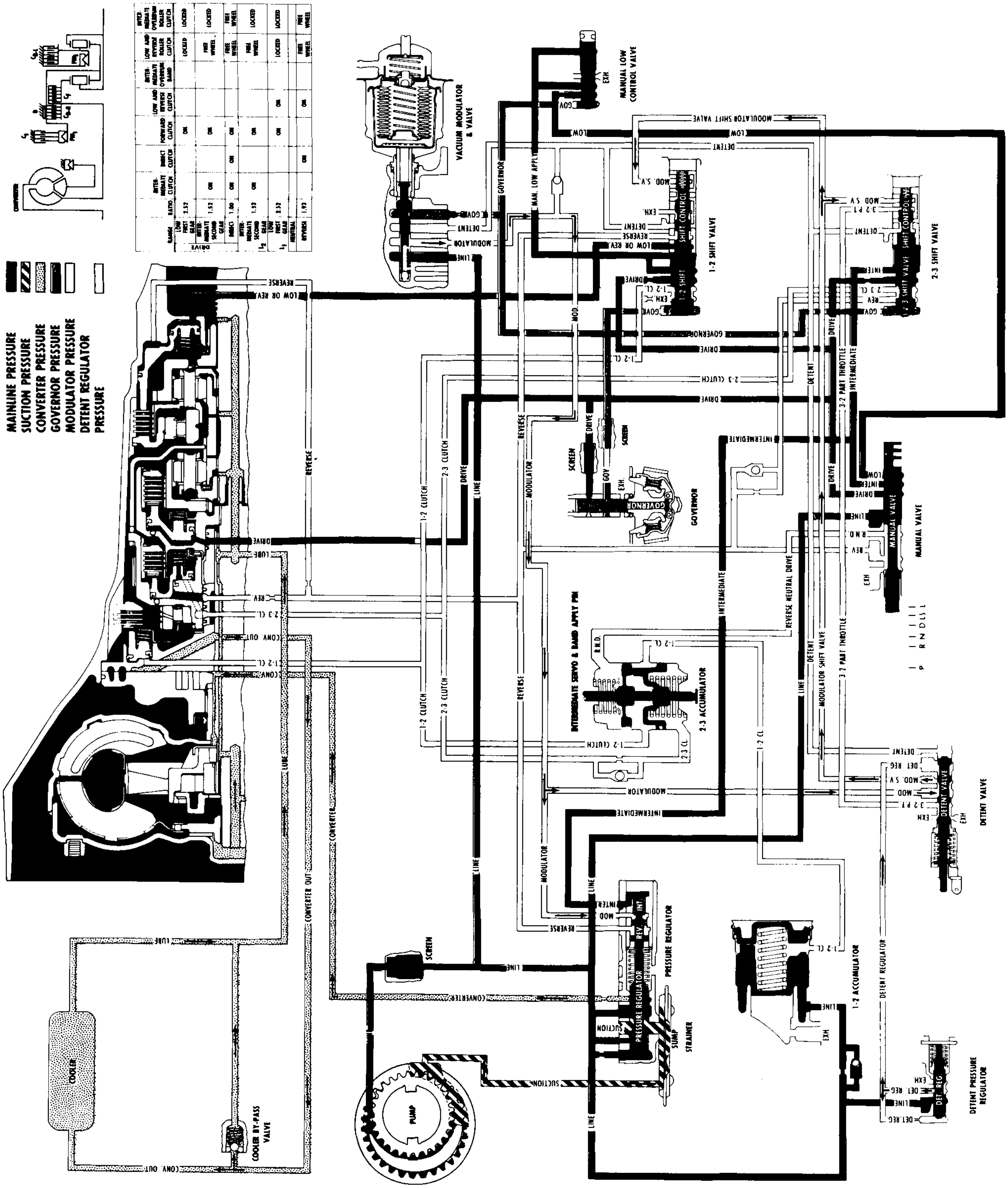


Fig. 7G-30 Low Range - First Gear

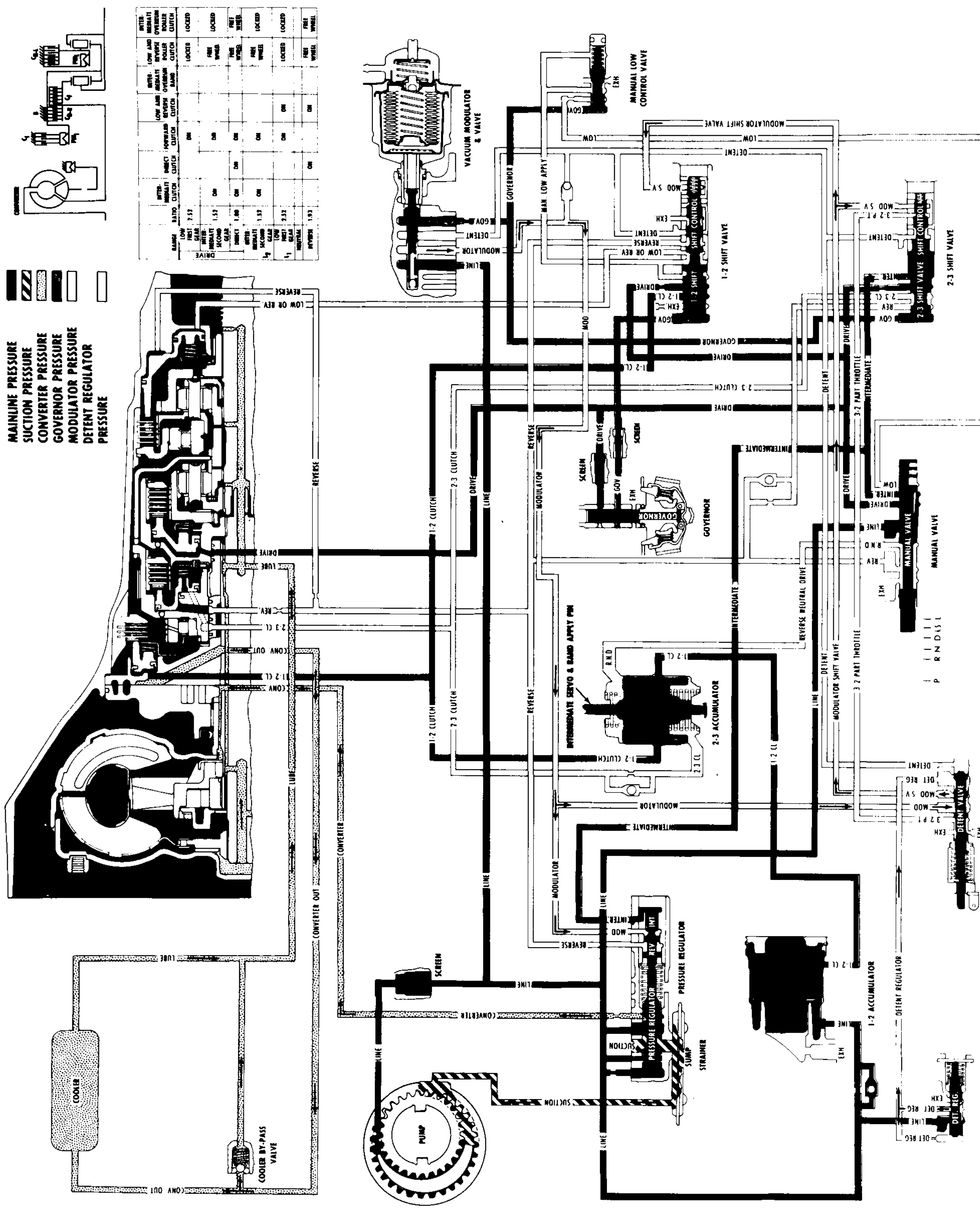


Fig. 7G-31 - Super Range - Second Gear

SUPER RANGE - SECOND GEAR

POWER FLOW

Intermediate Clutch	On
Direct Clutch	Off
Forward Clutch	On
Low and Reverse Clutch	Off
Intermediate Overrun Roller Clutch	Locked
Low and Reverse Roller Clutch	Free Wheeling
Intermediate Overrun Band	On

OIL FLOW

With the range selector lever in Super (S), line oil leaves the manual valve as intermediate oil and is directed to:

1. 2-3 Shift Valve Train.
2. Intermediate Boost Valve.

Intermediate oil at the pressure regulator intermediate boost valve will increase minimum line pressure to 80 p.s.i. It will also move the 2-3 shift valve to its downshifted position, regardless of car speed, to exhaust the 2-3 clutch oil and releasing the direct clutch.

With the manual valve in its Super (S) range position, R.N.D. oil is exhausted. The 1-2 clutch oil, acting between the intermediate servo piston and the 2-3 accumulator piston, then overcomes spring force and moves the intermediate servo piston and band apply pin to apply the intermediate overrun band, placing the transmission in second gear.

Band application in Super (S) range provides engine braking by preventing counter clockwise rotation of the direct clutch drum, sun gear drive shell and sun gear. Once the transmission is in second gear, Super (S) range, it cannot be upshifted to third gear, regardless of car or engine speed.

SUMMARY

The forward and intermediate clutches and the intermediate overrun band are applied and the transmission is in second gear, Super range, and allows engine braking.

A manual 3-2 downshift can be accomplished, at any car speed, by simply moving the range selector lever from Drive (D) to Super (S) range. When the car slows down to approximately 9 m.p.h., a 2-1 shift will occur when the 1-2 shift control spring overcomes the decreased governor oil pressure, moving the 1-2 shift valve to its downshifted position and exhausting the 1-2 clutch oil.

DRIVE RANGE - DETENT DOWNSHIFT (SHIFT VALVES IN SECOND GEAR POSITION)

POWER FLOW

Intermediate Clutch	On
Direct Clutch	Off
Forward Clutch	On
Low and Reverse Clutch	Off
Intermediate Overrun Roller Clutch	Locked
Low and Reverse Roller Clutch	Free Wheeling
Intermediate Overrun Band	Off

OIL FLOW

While operating at speeds below approximately 65-75 m.p.h., a forced or detent 3-2 downshift is possible by depressing the accelerater pedal fully to the floor. The detent valve is moved by cable linkage to its extreme inner position, allowng modulator oil to pass through the detent valve and be regulated to 3-2 part throttle oil. Detent regulator oil also passes through the detent valve and is regulated to detent oil.

3-2 part throttle oil is directed to the 2-3 shift control valve and detent oil is directed to the 2-3 shift control valve, 1-2 shift control valve and the modulator valve. Modulator shift valve oil, 3-2 part throttle oil and detent oil, plus the force of the 2-3 shift control valve spring, will move the 2-3 shift valve to its downshift position below approximately 65-75 m.p.h., shifting the transmission to second gear.

While operating at speeds below approximately 40 m.p.h., a detent 2-1 or 3-1 downshift is also possible because of detent oil directed to the 1-2 shift control valve. This detent oil, plus the force of the 1-2 shift control valve spring, will move the 1-2 shift valve to its downshifted position, shifting the transmission to first gear.

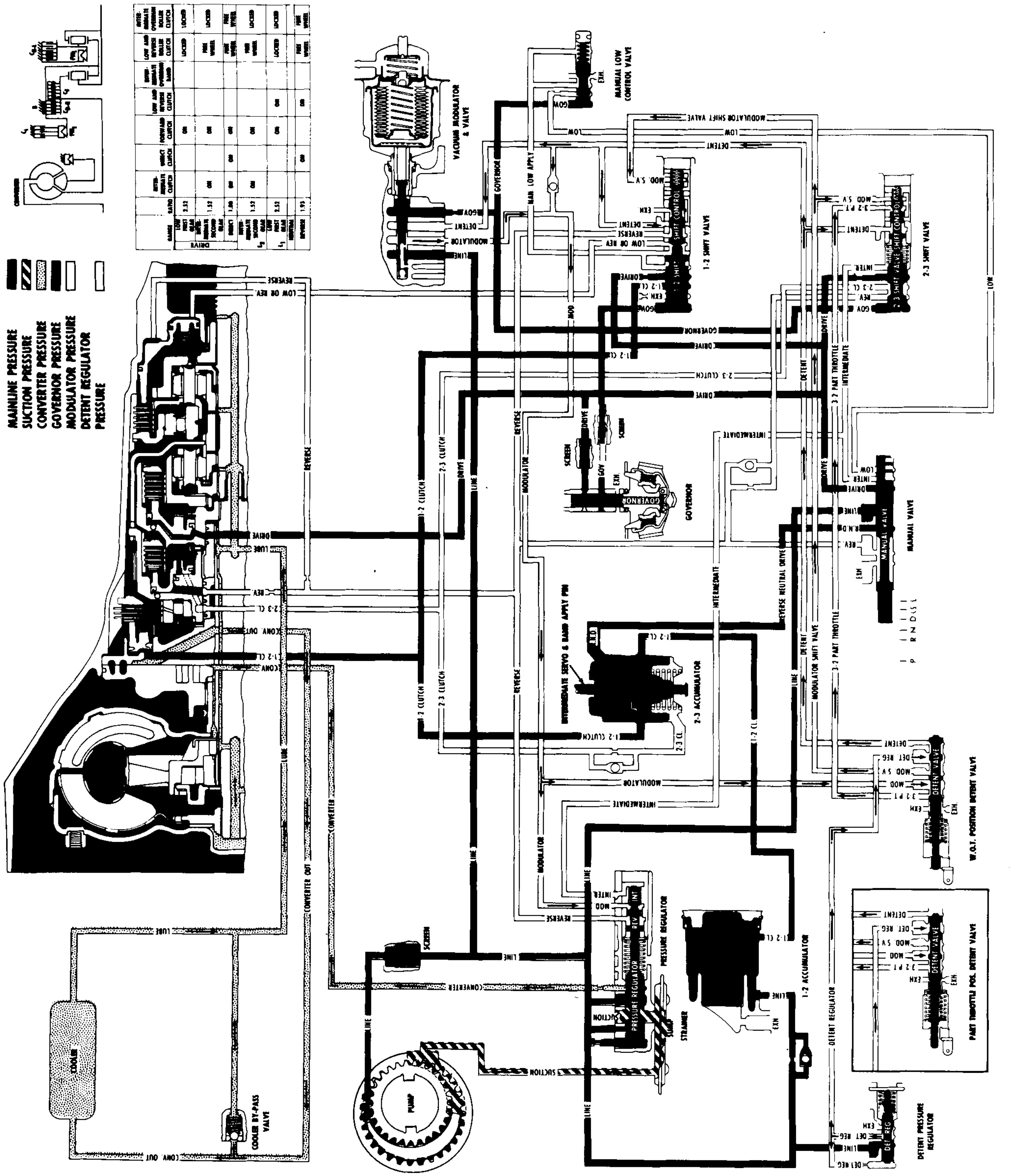


Fig. 7G-32 Detent Downshift-Valves in Second Gear Position

DRIVE RANGE - PART THROTTLE DOWNSHIFT

A 3-2 part throttle downshift can be made below approximately 42 m.p.h. At a light throttle opening, the 3-2 part throttle oil passage is exhausted, however, at a moderate throttle opening, the detent valve is moved enough to allow modulator oil to enter the 3-2 part throttle passage. If the modulator pressure in the 3-2 part throttle oil passage, plus the 2-3 shift valve spring, is sufficient to move the 2-3 shift valve against governor pressure to its downshifted position, the transmission will be in second gear.

REVERSE - ENGINE IDLING

POWER FLOW

Intermediate Clutch	Off
Direct Clutch	On
Forward Clutch	Off
Low and Reverse Clutch	On
Intermediate Overrun Roller Clutch	Free Wheeling
Low and Reverse Roller Clutch	Free Wheeling
Intermediate Overrun Band	Off

OIL FLOW

When the range selector lever is moved to the reverse (R) range position, the manual valve is repositioned to allow line oil pressure to enter the reverse oil circuit. Reverse oil then is directed to:

1. Direct Clutch.
2. Low and Reverse Clutch.
3. 1-2 Shift Control Valve.
4. 2-3 Shift Valve.
5. Reverse Boost Valve.

Reverse oil from the manual valve flows to the outer area of the direct clutch piston, to the outer area of the low and reverse clutch piston, to the 1-2 shift control valve and to the 2-3 shift piston. Reverse oil comes out of the 1-2 shift control valve as low or reverse oil and is directed to the inner area of the low and reverse piston. Reverse oil at the 2-3 shift valve is regulated to 2-3 clutch oil and applies the direct clutch. Reverse oil also acts on the reverse boost valve to increase the line oil pressure to a maximum of 250 p.s.i. at stall.

SUMMARY

The direct clutch and the low and reverse clutch are applied, line pressure is boosted and the transmission is in reverse gear.

PERIODIC SERVICE RECOMMENDATIONS

TOWING

If the transmission, drive line or axle do not have a malfunction, the vehicle may be towed in neutral, with steering column unlocked, at speeds up to 35 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 6,000 miles when engine oil is changed.

> **CAUTION:** *Since the Turbo Hydra-Matic (M-38) 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, under MINOR SERVICE).*

Transmission fluid should be changed and the strainer cleaned every 24,000 miles or 24 months. When the car is in heavy duty service (police, taxi, fleet service or for cars subjected to heavy city traffic during hot weather), it is recommended that the fluid be changed and the strainer cleaned at 12,000 mile intervals.

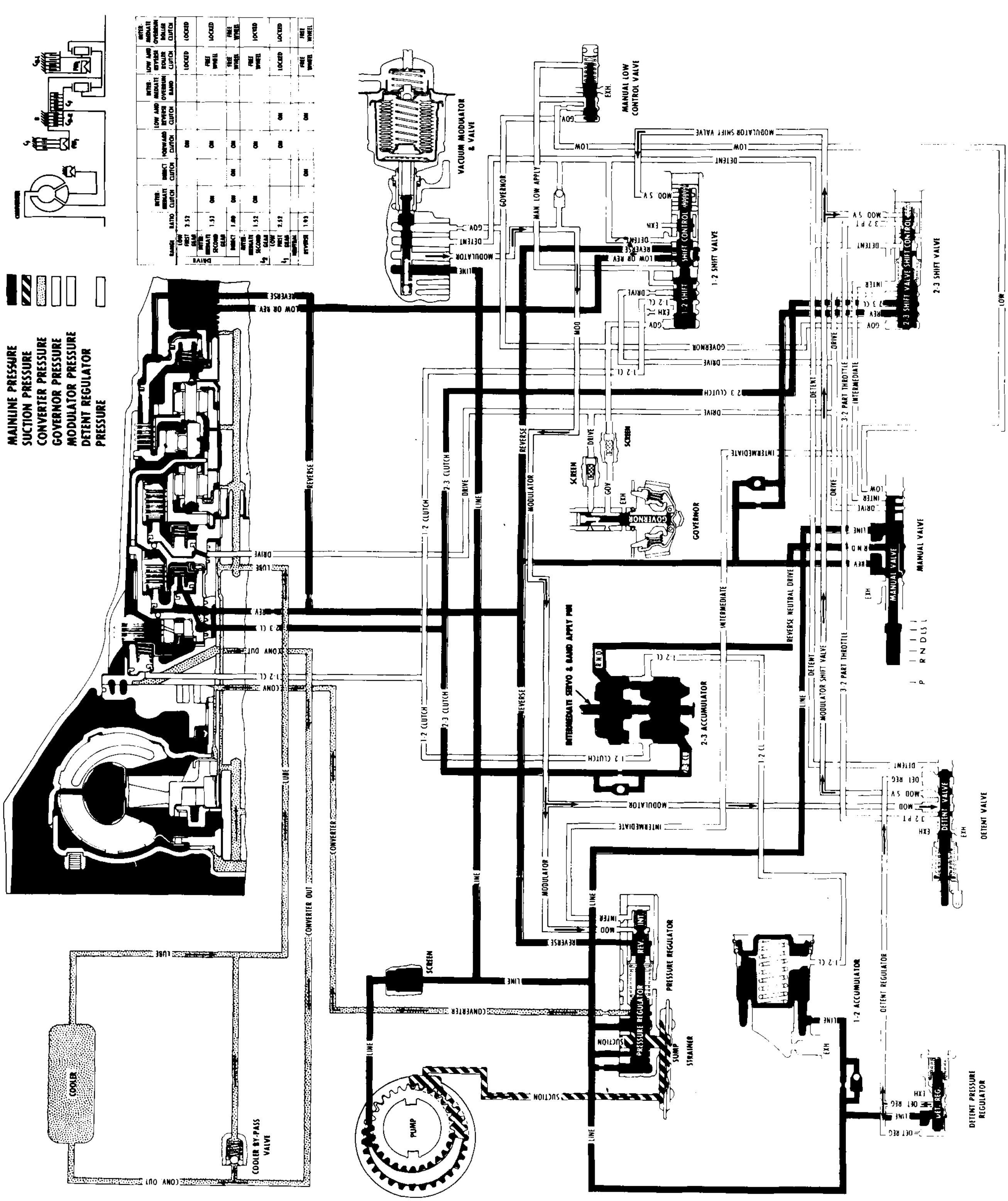


Fig. 7G-33 Reverse Range - Reverse Gear

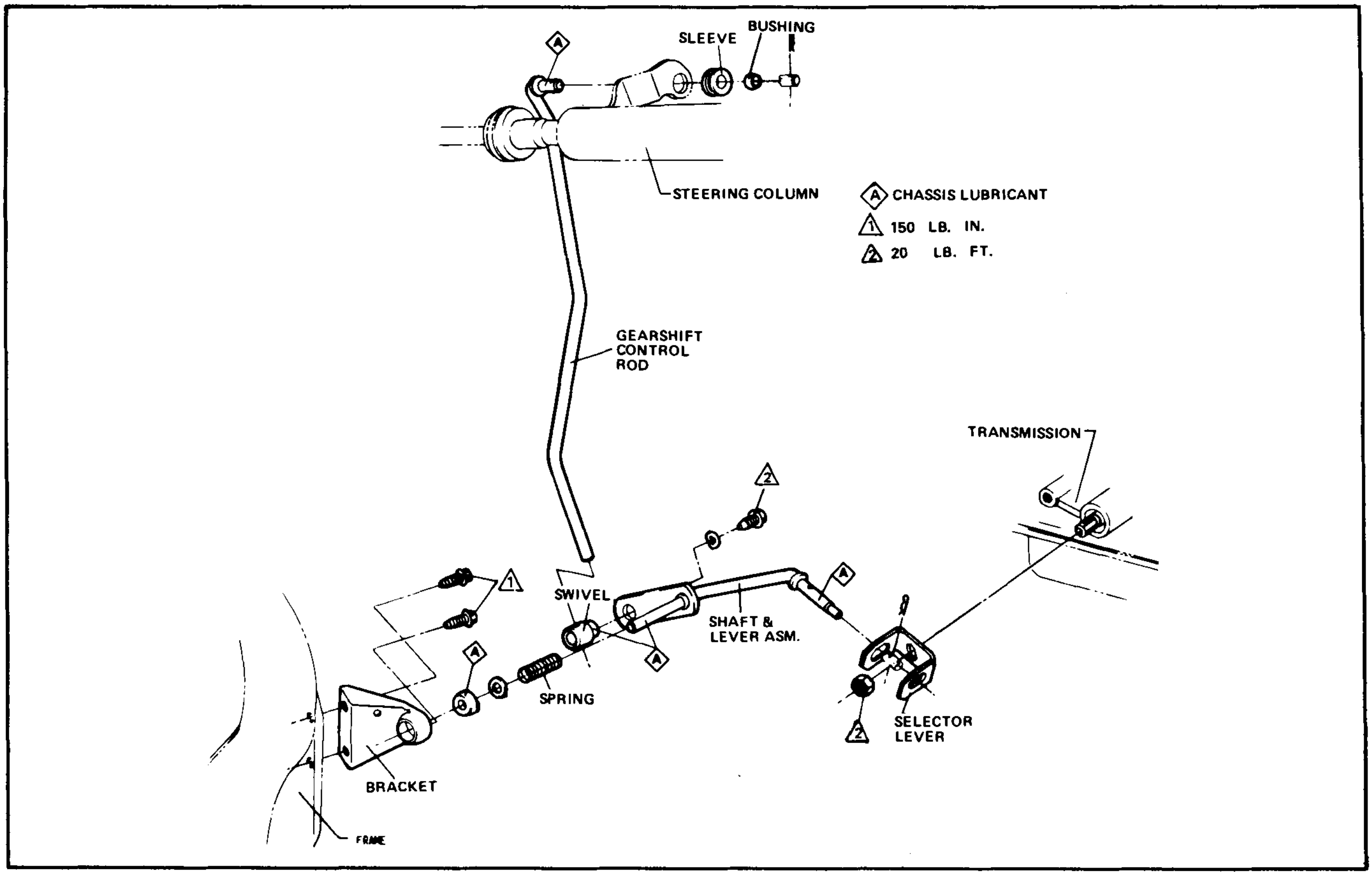


Fig. 7G-34 Column Shift Controls - A Series Shown

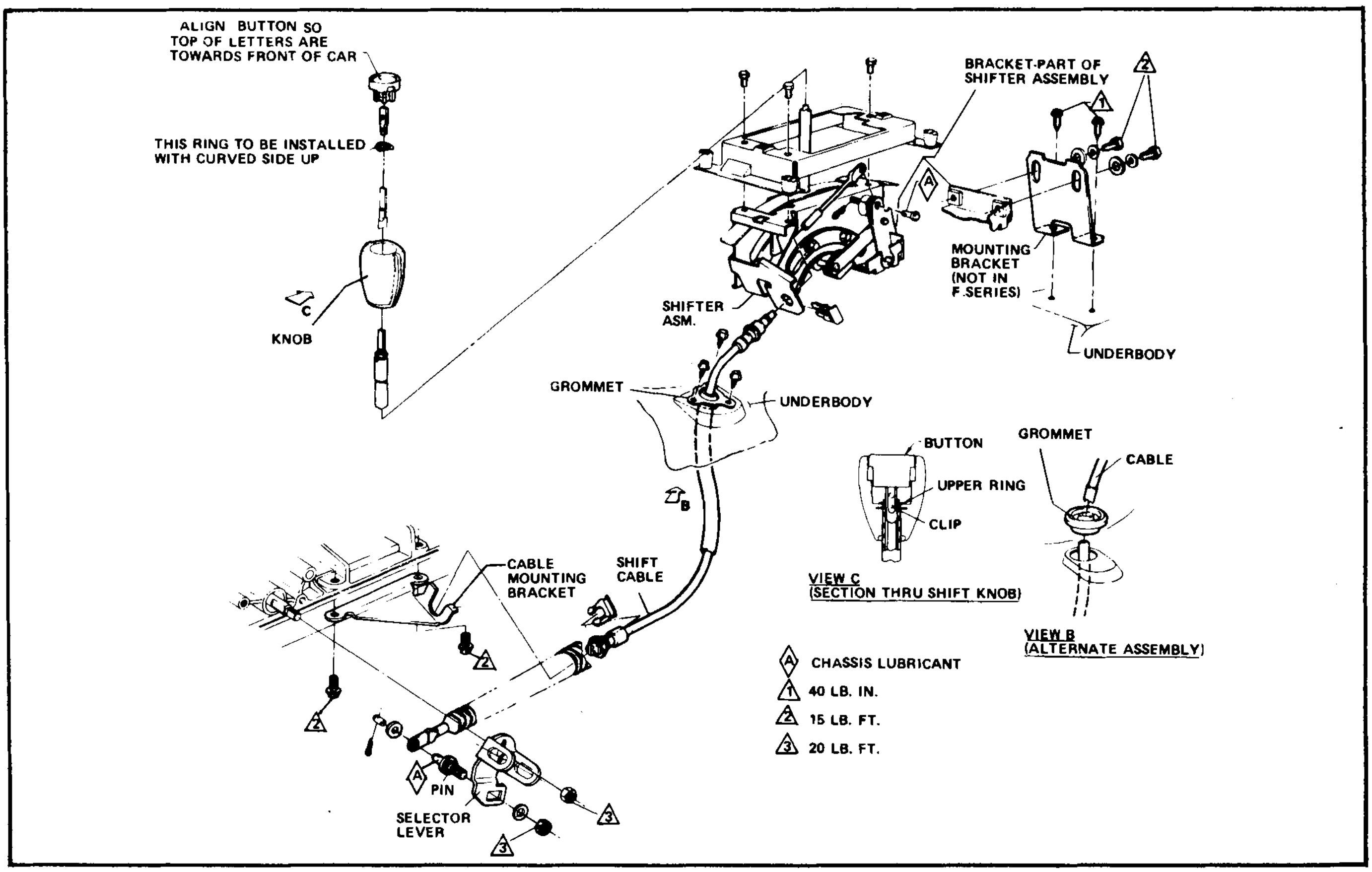


Fig. 7G-35 Console Shift Controls - A and F Series (Typical)

OPERATIONS NOT REQUIRING REMOVAL OF TRANSMISSION

COLUMN SHIFT CONTROLS

ADJUST (Fig. 7G-34)

1. Loosen screw on adjusting swivel clamp.
2. Set transmission range selector lever in PARK detent. Obtain PARK position by rotating transmission range selector lever clockwise.
3. Set upper gearshift lever in PARK position and lock ignition.
4. Tighten screw on adjusting swivel clamp to 20 lb. ft.

CONSOLE SHIFT CONTROLS

ADJUST

A AND F SERIES (Fig. 7G-35)

1. Disconnect shift cable from transmission range 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.

X SERIES (Fig. 7G-36)

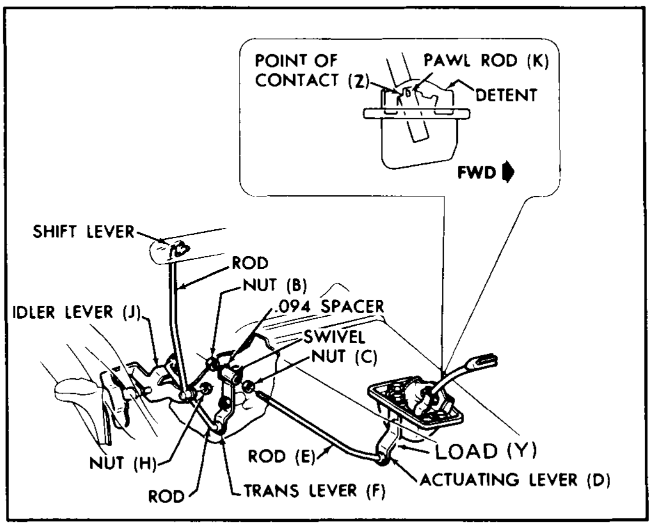


Fig. 7G-36 Floor Shifts Controls - X Series

1. Loosen both swivel nuts (B and C) on lower control rod (E).
2. Set transmission lever (F) in DRIVE position.

   NOTE: *Obtain DRIVE position by moving transmission lever counterclockwise to LOW, then clockwise two detent positions to DRIVE.*

3. Set pawl rod (K) into the DRIVE notch of the detent.
4. Apply a load (Y) on actuating lever (D) until the pawl rod (K) contacts the detent at point of contact (Z).
5. Place a .094" spacer between nut (B) and swivel and run nut (B) until it touches the spacer. Release load (Y), remove the .094" spacer and tighten nut (C) to a maximum of 40 lb. in. torque.
6. Set transmission lever (F) into PARK position and turn the ignition switch to LOCK.
7. Loosen nut (H) at the idler lever (J).
8. Remove column "Lash" by rotating shift lever in a downward direction and secure with attaching nut (H) to 20 lb. ft. torque.

   NOTE: *The foregoing will provide a .05" over travel gap in the notches of the detent.*

NEUTRALIZER SWITCH

ADJUST

Refer to CHASSIS ELECTRICAL SERVICE, Section 12.

DETENT CABLE

ADJUST

A SERIES (Fig. 7G-37)

The detent (downshift) cable is adjusted from inside the driver's compartment in the following manner:

1. With engine off and throttle valves closed (carburetor off fast idle), position the retainer (see view C) against the insert on the detent cable.
2. To adjust the retainer, grasp the accelerator pedal lever adjacent to the detent cable and pull the throttle cable to the wide open throttle position.

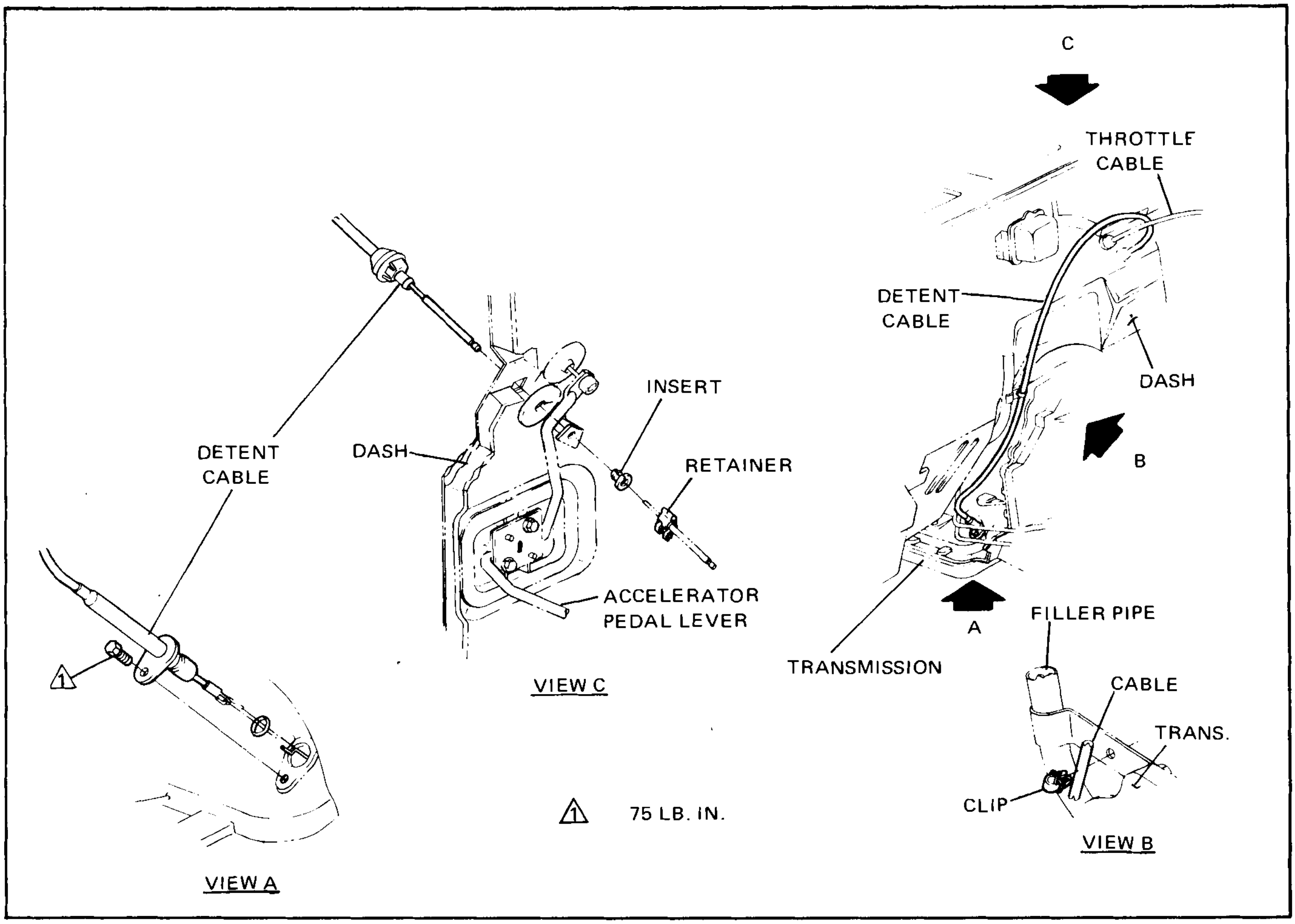


Fig. 7G-37 Detent Cable Adjustment - A Series

F AND X SERIES (Fig. 7G-38)

The detent cable is adjusted under the hood at the carburetor in the following manner:

1. With engine off and throttle valves closed (carburetor off fast idle), position the "snap lock" button in its released (up) position.

2. Rotate and hold the carburetor lever against the wide open throttle stop.

3. Push the "snap lock" into its engaged (down) position and release the carburetor lever.

TRANSMISSION FLUID

FLUID LEVEL

The fluid level indicator is located in the filler tube at the right rear of the engine. To bring the fluid lever from the ADD mark to the FULL mark requires one pint of fluid.

Fluid level should be to the FULL mark with the transmission fluid at normal operating temperature (180-190°F). With warm fluid (room temperature - 70°F), the level will be as 1/4" below the ADD mark on the dipstick.

NOTE: *In checking the oil, insert the dipstick in the fuller tube with the markings toward center of car.*

CHECKING PROCEDURE

To determine the proper fluid level, proceed as follows:

CAUTION: *The* **full** *mark on the dipstick is an indication of transmission fluid at its normal operating temperature of 180°F. This temperature is only obtained after at least 15 miles of highway type driving or the equivalent of city driving.*

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 idling and vehicle on LEVEL surface.

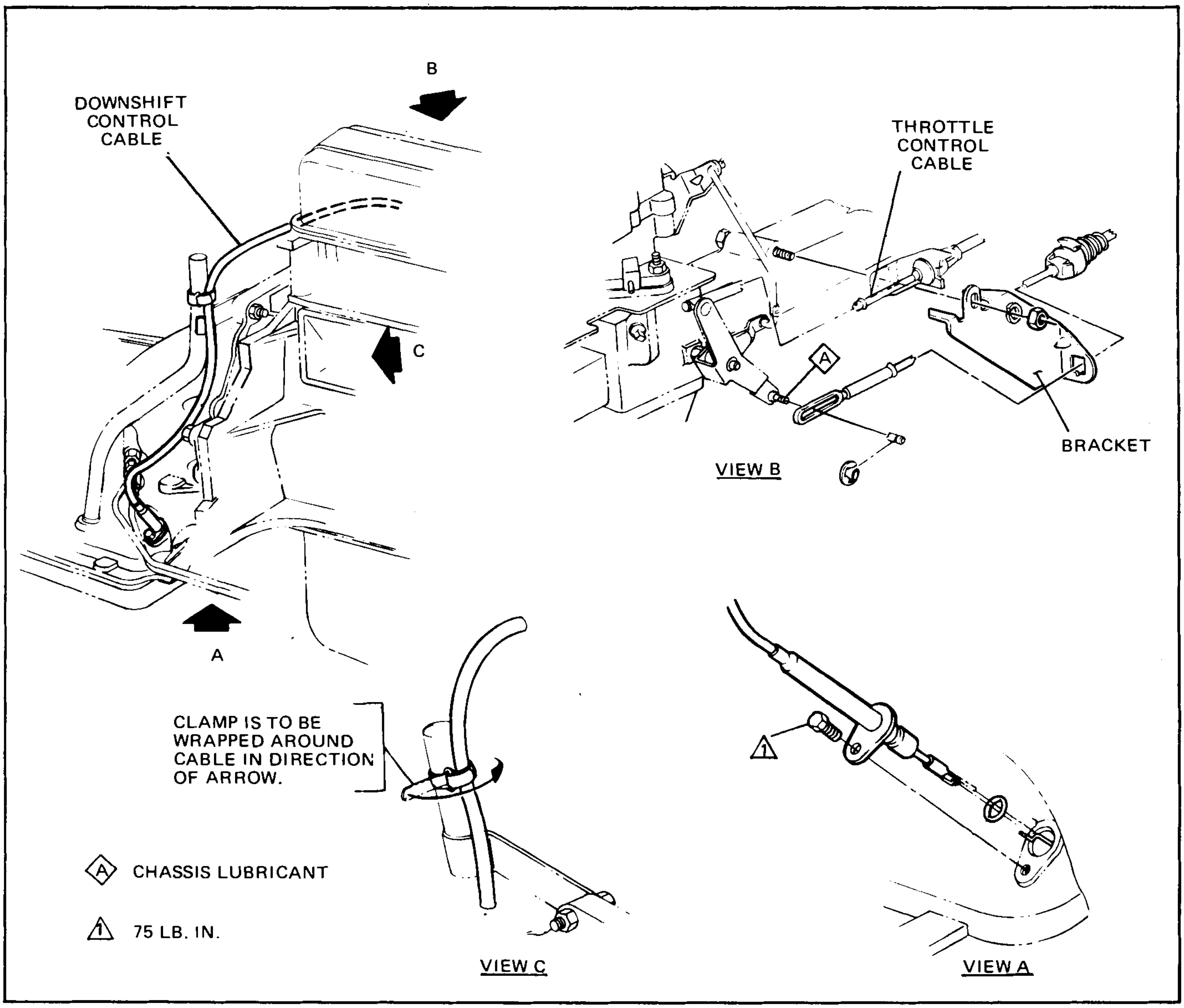


Fig. 7G-38 Detent Cable Adjustment, 6 cyl. Engine - F and X Series (Typical)

At this point, when a reading is made, fluid level on the dipstick should be at the FULL mark.

3. If additional fluid is required, add enough fluid to bring level to the FULL mark on the dipstick.

If vehicle is not driven 15 miles of highway type driving, or its equivalent, and it becomes necessary to check the fluid level, the transmission fluid may be at room temperature (70°F).

With the fluid at room temperature (70°F), follow steps 1 2 and 3 below:

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 idling and vehicle on LEVEL surface.

   At this point, when a reading is made, fluid level on the dipstick will be as 1/4" **below** the ADD mark on the dipstick.

3. If additional fluid is required, add enough fluid to bring level to 1/4" **below** the ADD mark on the dipstick. If transmission fluid level is correctly established at 70°F, it will appear at the FULL mark on the dipstick when the transmission reaches its normal operating temperature of 180°F.

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, especially when cold, complete loss of drive may result which can cause transmission failure.

IMPORTANT: *When adding fluid use only* **DEXRON** *automatic transmission fluid or equivalent. The difference in oil level between ADD and FULL is one pint.*

FLUID CAPACITY

The fluid capacity of the Turbo Hydra-Matic (M-38) transmission and converter assembly is approximately 21 pints for the V-8 engine model (MA) and approximately 19 1/4 pints for the 6-cylinder engine model (JE). However, the correct fluid level is determined by the mark on the dipstick rather than by the amount added.

Use only **DEXRON**, or equivalent, automatic transmission fluid.

DRAINING AND REFILLING TRANSMISSION

Drain oil immediately after operation before it has had an opportunity to cool. To drain oil, proceed as follows:

1. Raise car on hoist or place on jack stands and place container beneath transmission to collect draining fluid.
2. Remove thirteen (13) oil pan attaching bolt and washer assemblies, oil pan and gasket. Discard gasket.
3. Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.
4. Remove two (2) strainer-to-valve body screws, strainer and gasket (Fig. 7G-39). Discard gasket.
5. Thoroughly clean strainer assembly in solvent and dry thoroughly with clean compressed air.
6. Install new strainer-to-valve body gasket, strainer and two (2) screws.
7. Install new gasket on oil pan and install oil pan. Tighten its thirteen (13) attaching bolt and washer assemblies to 12 lb. ft. torque.
8. Lower car and add approximately 3 pints of transmission fluid through filler tube.
9. With selector lever in PARK position, apply hand brake, start engine and let idle (carburetor off fast idle step). DO NOT RACE ENGINE.
10. Move selector lever through each range and, with selector lever in PARK range, check the fluid level.

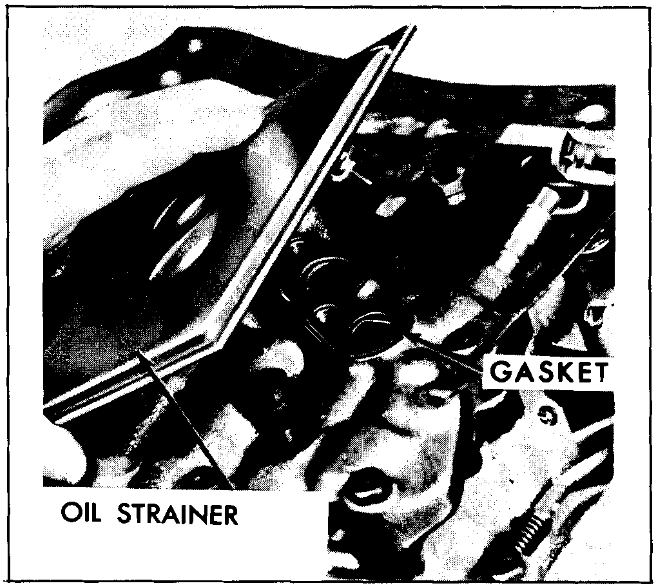


Fig. 7G-39 Removing Strainer and Gasket

11. Add additional fluid to bring level to 1/4" below the ADD mark on the dipstick.

CAUTION: *Do not overfill. Foaming will result if overfull.*

ADDING FLUID TO FILL DRY TRANSMISSION AND CONVERTER ASSEMBLY

The fluid capacity of the Turbo Hydra-Matic (M-38) transmission and converter assembly is approximately 20 pints, but correct level is determined by the mark on the dipstick rather than by amount added. In cases of transmission overhaul, when a complete fill is required, **including a new converter**, proceed as follows:

1. Add 8 pints of transmission fluid through filler tube.

   NOTE: *The converter should be replaced* **only** *if the converter itself fails. On any major failure, such as a clutch or gearset, the strainer* **must** *be cleaned.*

   If installation of a new converter is **not** required, add only 5 pints of transmission fluid.

2. With manual control lever in PARK 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, engine running and vehicle on LEVEL surface.
4. Add additional fluid to bring level to 1/4" below the "ADD" mark on the dipstick. **Do not overfill.**

VALVE BODY ASSEMBLY

REMOVAL

1. Remove oil pan and strainer. Discard gaskets.
2. Remove detent spring and roller assembly from valve body and remove valve body-to-case bolts (Fig. 7G-40).
3. 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.

   CAUTION: *While removing valve body assembly, the intermediate servo piston and related parts are apt to drop from the case bore because of the normal freeness of the teflon ring on the intermediate servo piston.* **Do not drop manual valve.**

4. Remove manual valve and link assembly from valve body assembly.

INSTALLATION

Installation of the valve body assembly is the reverse of REMOVAL. Install new gaskets to strainer and oil pan and adjust the fluid level.

GOVERNOR ASSEMBLY

REMOVAL

1. Remove governor cover retaining clip, governor cover and O-ring seal from case.
2. Withdraw governor assembly from case.

INSTALLATION

Installation of the governor assembly is the reverse of REMOVAL. Install a new O-ring seal and retaining clip on governor cover and adjust the fluid level.

MANUAL SHAFT, RANGE SELECTOR INNER LEVER AND PARKING LINKAGE ASSEMBLIES

REMOVAL

1. Remove oil pan, strainer and valve body assembly. Discard gaskets.

   CAUTION: *The intermediate servo piston and related parts are apt to drop from the case bore because of the normal freeness of the teflon ring.*

2. Remove manual shaft-to-case retainer and unthread jam nut holding range selector inner lever to manual shaft (Fig. 7G-41).
3. Remove jam nut and remove manual shaft from range selector inner lever and case.

   NOTE: *Do not remove manual shaft lip oil seal unless replacement is required.*

4. Remove parking pawl actuating rod and range selector inner lever from case (Fig. 7G-42).
5. Remove bolts and parking lock bracket.
6. 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 (Fig. 7G-43).

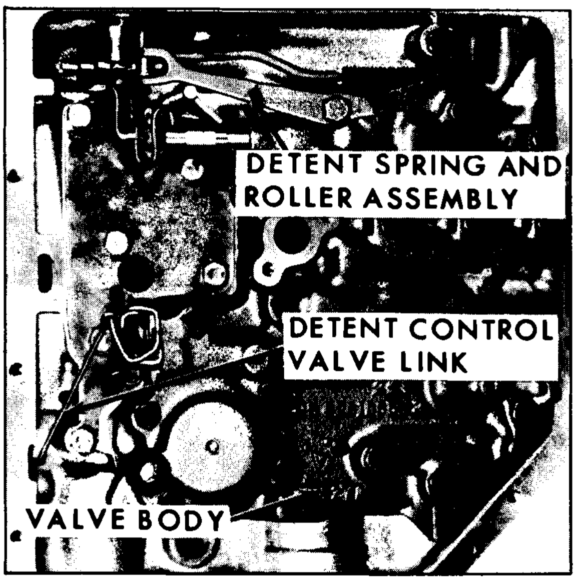


Fig. 7G-40 Removing Valve Body

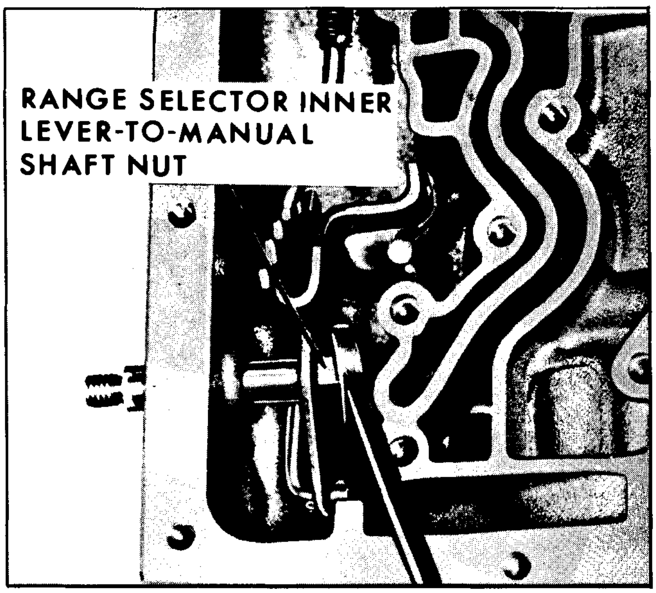


Fig. 7G-41 Removing Jam Nut

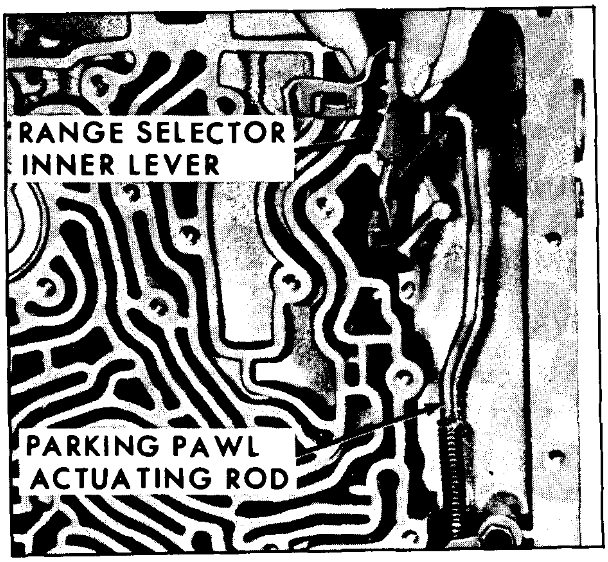


Fig. 7G-42 Removing Inner Lever and Actuating Rod

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 the fluid level.

INTERMEDIATE CLUTCH ACCUMULATOR PISTON ASSEMBLY

REMOVAL

1. Remove two (2) oil pan bolts adjacent to accumulator piston cover, install Compressor J 23069 on oil pan lip and retain with these two (2) bolts.

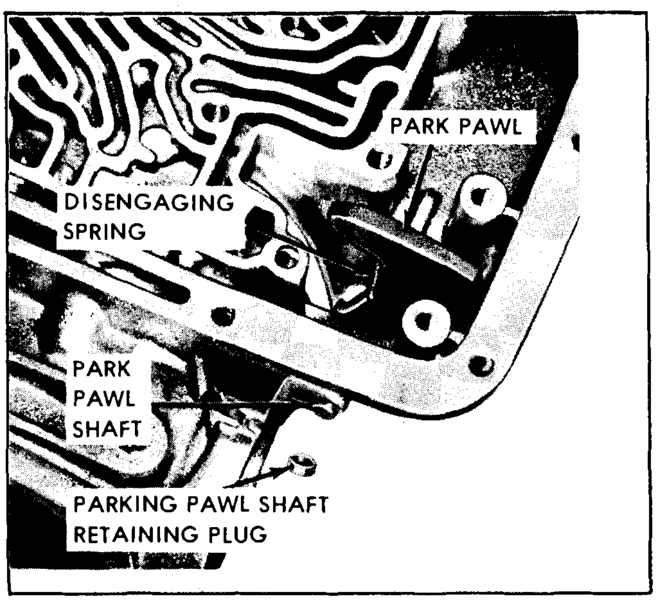


Fig. 7G-43 Parking Pawl Assembly

2. Compress intermediate clutch accumulator piston cover and remove its retaining ring and piston cover from case.
3. Remove spring and intermediate clutch accumulator piston.

INSTALLATION

Installation of the intermediate clutch accumulator piston assembly is the reverse of REMOVAL. Adjust the fluid level.

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 (Fig. 7E-44).
3. Remove modulator valve from case.

INSTALLATION

Installation of the modulator and modulator valve is the reverse of REMOVAL. Install a new O-ring seal and adjust the fluid level.

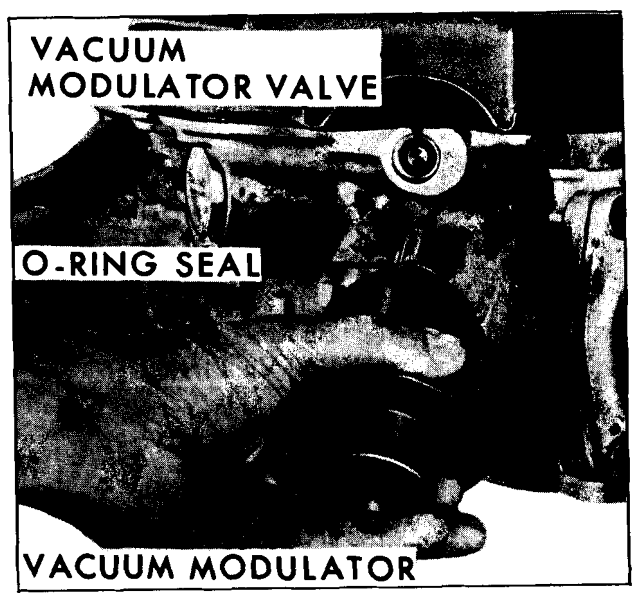


Fig. 7G-44 Removing Vacuum Modulator

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 of new lip oil seal with a non-hardening sealer and drive it into place with Seal Installer J 21426.
2. Install propeller shaft and adjust fluid level.

SPEEDOMETER DRIVEN GEAR-SPEED CONTROL SWITCH ASSEMBLY

REMOVAL

1. Disconnect speedometer cable and disconnect SCS electrical lead from engine wire harness.
2. Remove retainer bolt, retainer, speedometer driven gear-speed control switch assembly 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 the fluid level.

REMOVAL AND DISASSEMBLY OF TRANSMISSION

TRANSMISSION ASSEMBLY

REMOVE

1. Remove detent (downshift) cable from accelerator pedal lever (Fig. 7G-37, A Series) or from carburetor lever (Fig. 7G-38, F and X Series).
2. Before raising the car, disconnect the battery and release the parking brake.
3. Remove the propeller shaft.
4. Disconnect speedometer cable, speed control switch electrical lead from engine wire harness, vacuum hose at modulator, detent (downshift) cable and shift control linkage from transmission.

   CAUTION: *When removing detent (downshift) cable from detent link, do* **not** *bend cable.*

5. Support transmission with jack.
6. Disconnect rear mount and frame crossmember and remove crossmember.
7. Remove converter dust pan, mark flywheel and converter for reassembly in same position and remove flywheel-to-converter bolts. After bolts are removed, make certain converter hub is free of crankshaft.
8. Disconnect transmission filler pipe at engine and remove pipe from transmission.
9. Lower transmission and engine assembly to gain access to cooler line fitting nuts and disconnect cooler lines. On some cars, it may be necessary to loosen the exhaust system.
10. With transmission in lowered position, remove transmission-to-engine bolts.
11. Raise transmission to its normal position, slide rearward from engine and lower it away from car. When lowering transmission, keep rear of transmission lower than front so as to not lose the converter.

    NOTE: *Converter can be held in position until transmission is to be disassembled by using Converter Holding Clamp J 21366.*

DISASSEMBLE

1. Before starting disassembly of the transmission, it should be thoroughly cleaned externally to avoid getting dirt inside.
2. Place transmission on a **clean** work bench and use **clean** tools during disassembly. Provide clean storage space for parts and units moved from transmission. An excellent working arrangement is provided by assembling the transmission to Holding Fixture J 8763-01.
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 old 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 should require forcing when disassembling or assembling transmission. Use a rawhide or plastic mallet to separate tight fitting cases - do not use a hard hammer.

CONVERTER AND MODULATOR

REMOVE

1. With transmission in portable jack, remove Converter Holding Clamp J 21366 (if installed) and remove converter assembly by pulling straight out.
2. Install Holding Fixture J 8763-01 and Adaptor J 8763-19 onto transmission and place transmission into Holding Tool Base J 3289-14 on bench. Position transmission vertically, with extension housing down and a drain pan on floor beneath transmission.

   NOTE: *Before installing Holding Fixture J 8763-01 onto transmission, it must be modified so that the intermediate accumulator will clear the fixture.*

3. Remove vacuum modulator attaching screw and retainer clip, modulator, O-ring seal and modulator valve from case (Fig. 7G-44). Discard O-ring seal.

EXTENSION HOUSING, SPEEDO DRIVE GEAR AND GOVERNOR

REMOVE

1. Remove bolt, retainer and speedometer driven gear-speed control switch from side of extension housing.
2. Remove four (4) extension housing-to-case attaching bolts, extension housing and its square cut oil seal from case or housing (Fig. 7G-45).
3. If necessary to replace, pry lip oil seal from extension housing, using a screwdriver (Fig. 7G-46).

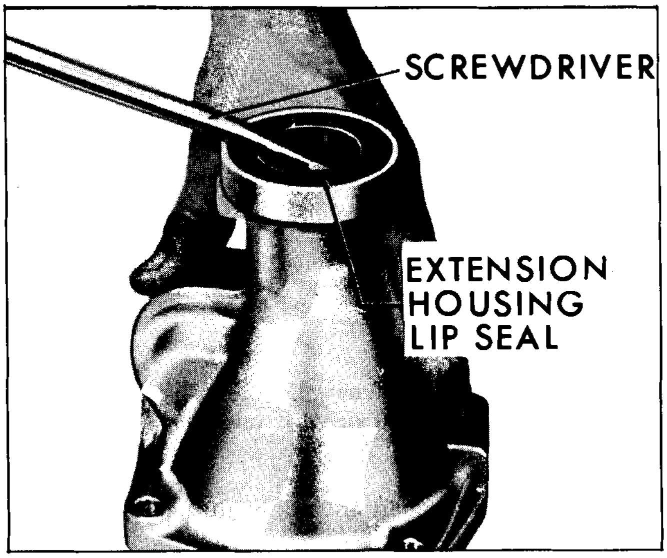


Fig. 7G-46 Removing Lip Oil Seal

4. Depress speedometer drive gear retaining clip and slide speedometer drive gear off output shaft (Fig. 7G-47).
5. Remove governor cover retaining clip, if present, with a screwdriver.
6. Pry governor cover and O-ring seal from case and withdraw governor assembly. Discard O-ring seal (Fig. 7G-48).

   CAUTION: *Use extreme care so as not to damage cover. If cover is damaged, it* **must** *be replaced.*

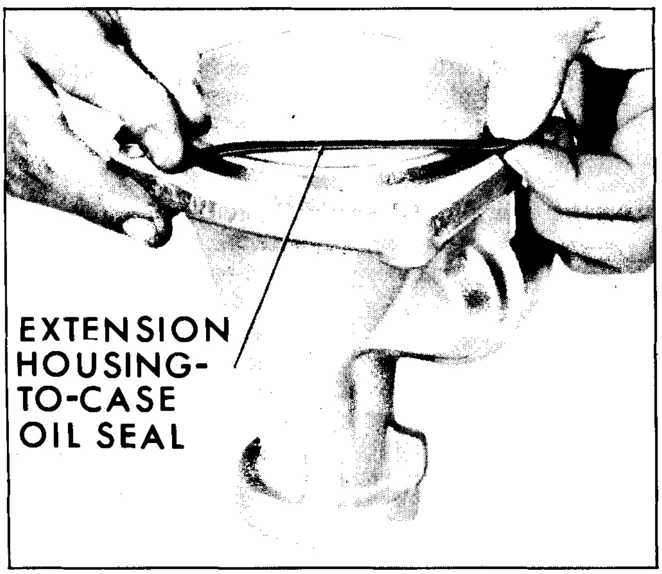


Fig. 7G-45 Removing Extension Housing Oil Seal

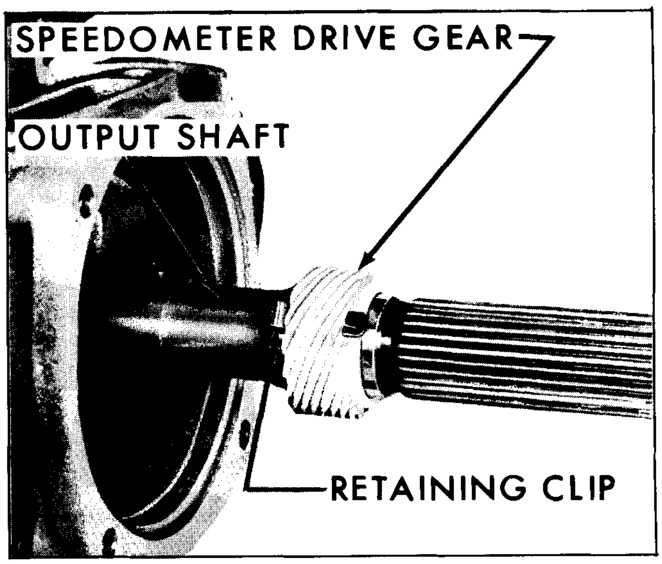


Fig. 7G-47 Speedometer Drive Gear

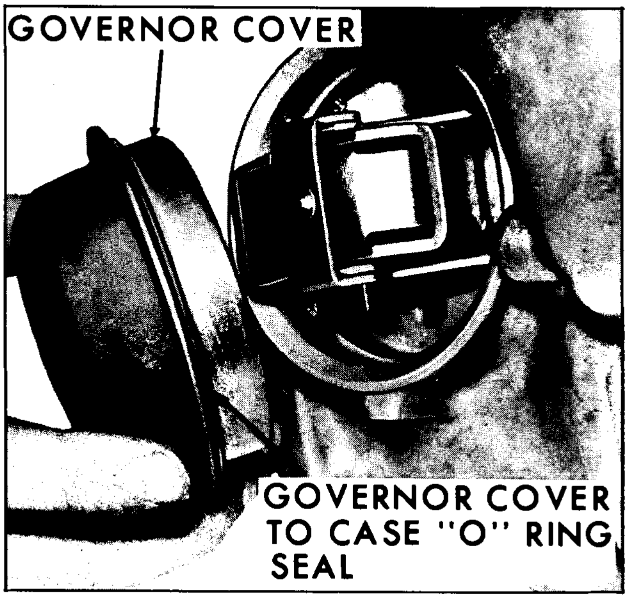


Fig. 7G-48 Removing Governor Cover

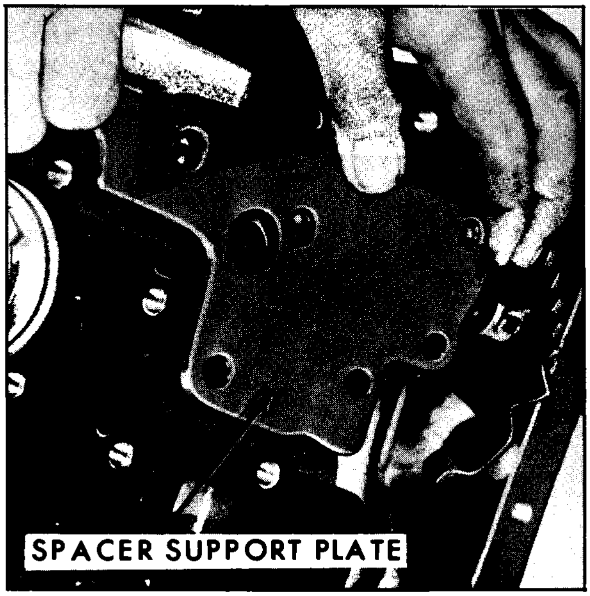


Fig. 7G-50 Removing Support Plate

VALVE BODY ASSEMBLY

REMOVE

1. Remove oil pan attaching bolt and washer assemblies (13), oil pan and oil pan gasket. Discard gasket.
2. Remove oil pump strainer-to-valve body attaching screws (2) and remove oil pump strainer and gasket (Fig. 7G-49).
3. Remove retaining bolt and detent roller and spring assembly from valve body.

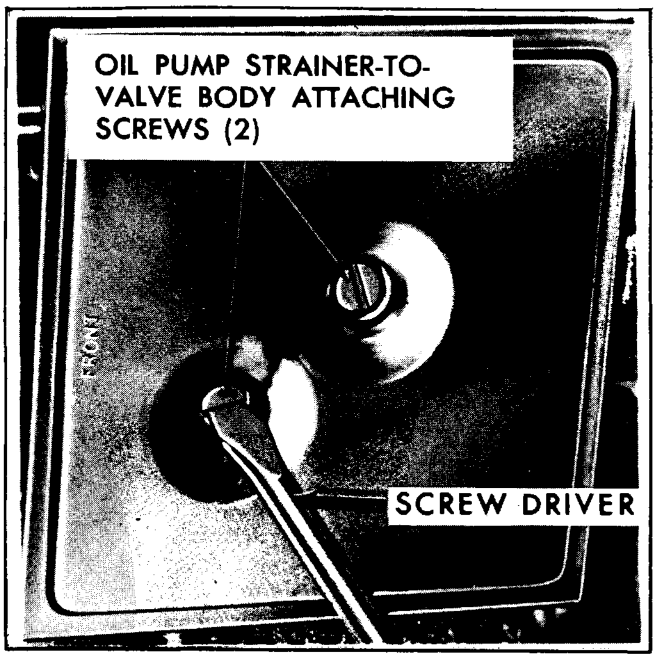


Fig. 7G-49 Removing Strainer Attaching Screws

4. Remove sixteen (16) of remaining seventeen (17) valve body-to-case attaching bolts, complete draining fluid from transmission, move transmission to horizontal position and remove last body-to-case bolt.
5. While removing valve body assembly, disconnect manual control valve link from range selector inner lever and remove detent control valve link from detent actuating lever on valve body (Fig. 7G-45).
6. Remove valve body-to-spacer plate gasket.
7. Remove seven (7) spacer support plate bolts and remove spacer support plate from case (Fig. 7G-50).

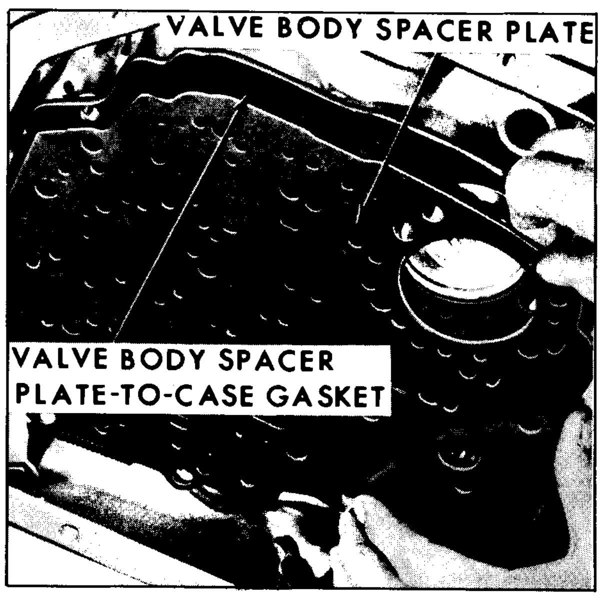


Fig. 7G-51 Removing Spacer Plate and Gasket

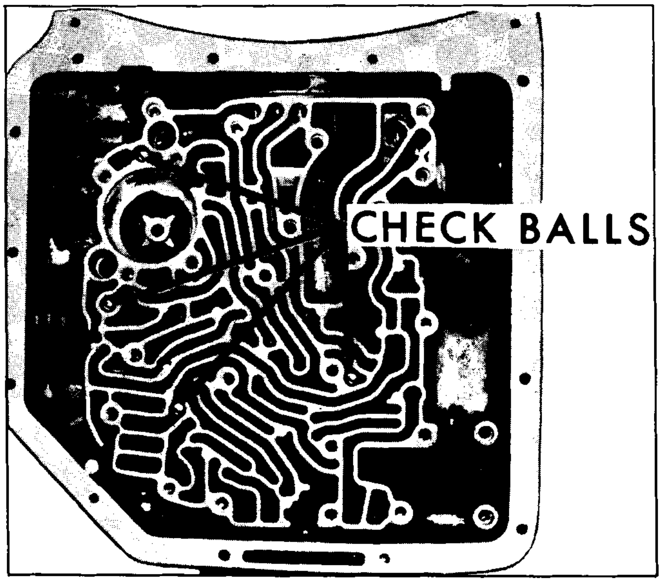


Fig. 7G-52 Location of Check Balls

8. Remove valve body spacer plate and valve body spacer plate-to-case gasket (Fig. 7G-51).

9. Remove four (4) check balls from cored passages in case face (Fig. 7G-52).

10. Remove oil pump pressure screen from oil pump pressure passage in case and clean (Fig 7G-53).

11. Remove governor feed screens from passages in case and clean (7G-54).

12. Remove manual shaft-to-case retainer with a screw-driver (7G-55).

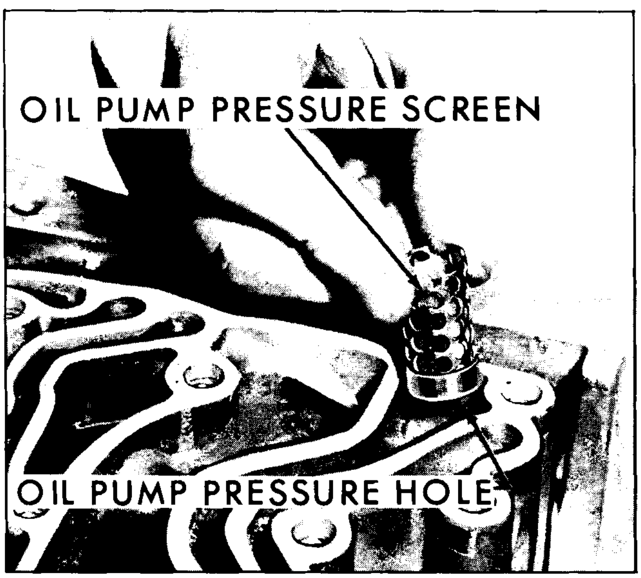


Fig. 7G-53 Removing Pump Pressure Screen

Fig. 7G-54 Removing Governor Screens

13. Loosen jam nut that holds range selector inner lever to manual shaft.

14. Remove jam nut and remove manual shaft from range selector inner lever and case.

15. Disconnect parking pawl actuating rod from range selector inner lever and remove both from case (Fig. 7G-42).

16. If necessary to replace, remove manual shaft-to-case lip oil seal, using a screwdriver (Fig. 7G-56).

17. Remove two (2) bolts and parking lock bracket.

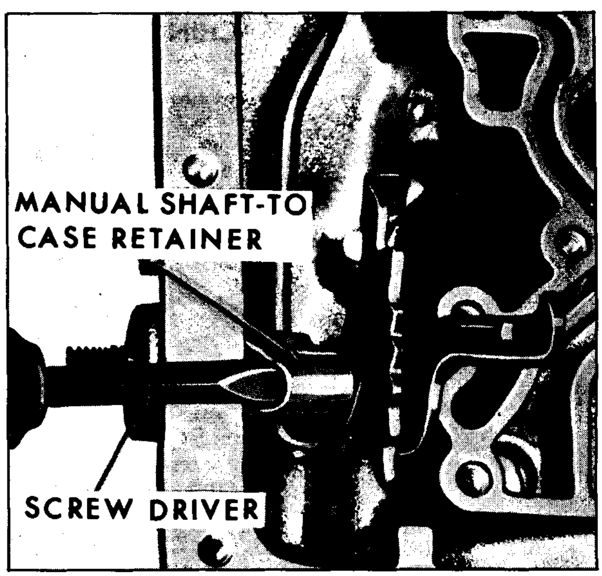


Fig. 7G-55 Removing Manual Shaft Retainer

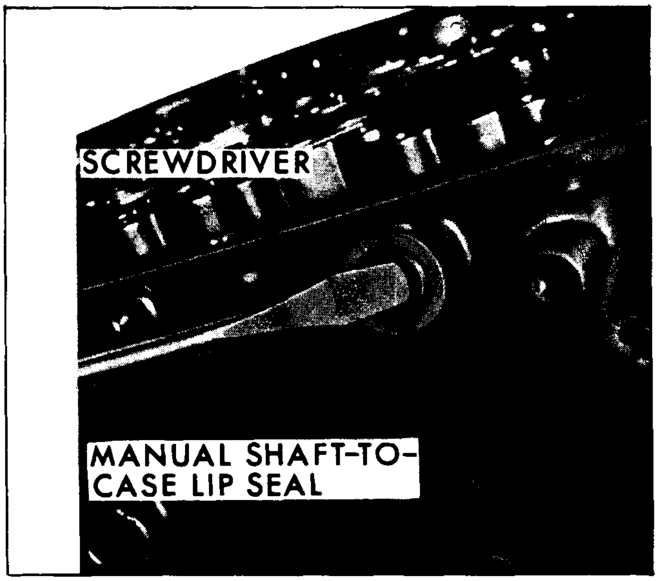


Fig. 7G-56 Removing Manual Shaft Oil Seal

18. If necessary to replace the disengaging spring, parking pawl shaft and/or parking pawl, remove the parking pawl shaft retaining plug stake marks, plug, shaft, parking pawl and disengaging spring from the transmission case (Fig. 7G-43).

19. From valve body case face, remove intermediate servo piston with its teflon ring, apply pin, washer, spring seat and spring (Fig. 7G-57). Note that the teflon ring allows the intermediate servo piston to slide very freely in its bore. This free fit is a normal characteristic and does not indicate leakage during operation.

    To remove, carefully cut teflon ring and remove both the ring and the restrictors from the piston groove.

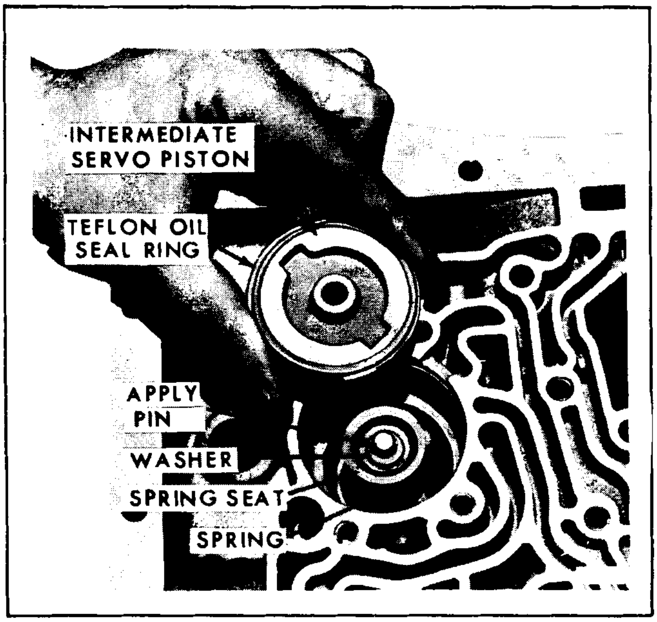


Fig. 7G-57 Removing Intermediate Servo Piston

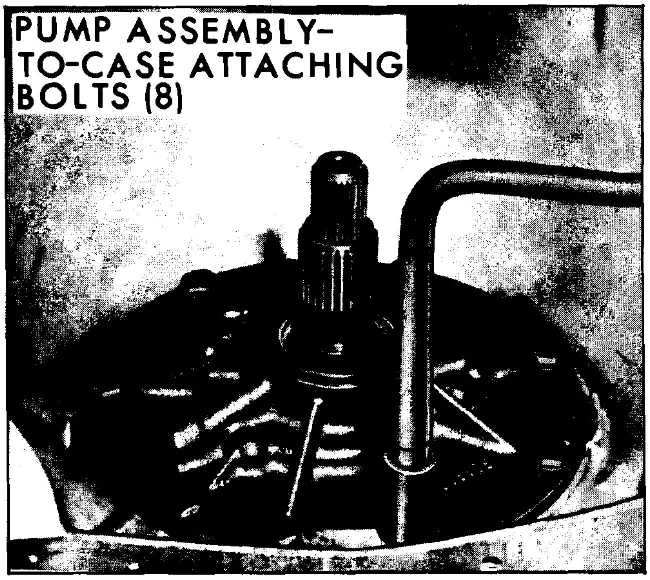


Fig. 7G-58 Removing Pump Attaching Bolts

OIL PUMP AND INTERNAL COMPONENTS

REMOVE

1. Move transmission to vertical position (oil pump face up), scribe a mark on pump body and transmission case face, for aid in alignment on reinstallation, and remove eight (8) pump attaching bolts with washer-type seals (Fig. 7G-58). Discard washer-type seals.

2. Install two (2) Slide Hammers J 6125-1 and Adapters J 6125-2 into threaded bolt holes in pump body (at approximately 4 and 11 o'clock) and remove pump assembly from case.

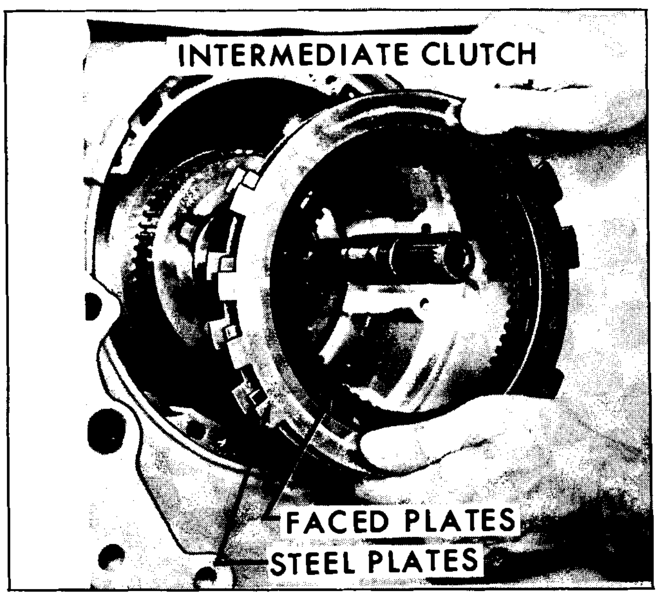


Fig. 7G-59 Removing Intermediate Clutch Plates

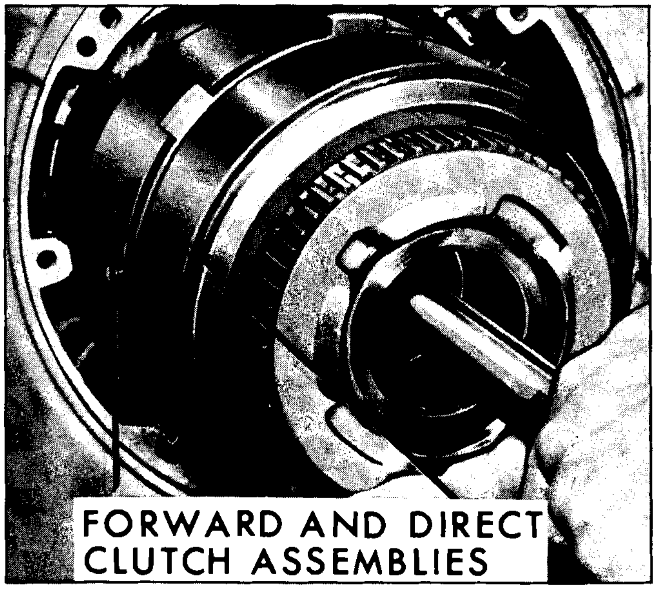


Fig. 7G-60 Removing Clutch Assemblies

3. Remove pump-to-case gasket and tools from pump. Discard gasket.

4. On **V-8 models**, remove intermediate clutch cushion spring, three (3) intermediate clutch faced plates and three (3) steel separator plates: (Fig. 7G-59).

   On **6 cylinder models**, remove cushion spring, two (2) faced plates and two (2) separator plates (Fig. 7G-59).

   Inspect condition of plates as follows:

   a. Dry the faced (lined) plates with compressed air and inspect the faced plates for - pitting and flaking, wear, glazing, cracking, charring and/or chips (metal particles) imbedded in lining.

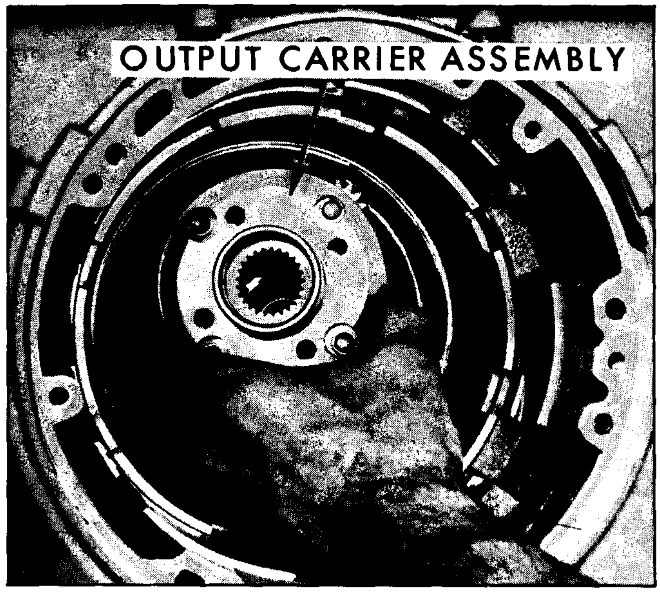


Fig. 7G-62 Removing Output Carrier

   b. If a faced plate exhibits any of the above conditions, replacement is required.

   c. Wipe the steel (separator) plates dry and check for heat discoloration. If the surface is smooth and an even color smear is observed, plates should be re-used. If surface is scuffed or shows severe heat discoloration, the plates must be replaced.

5. Remove intermediate clutch pressure plate.

6. Remove intermediate overrun brake band, direct and forward clutch assemblies from case (Fig. 7G-60).

7. Remove forward clutch housing-to-input ring gear thrust washer from ring gear (or clutch housing). This washer has three (3) wide external tangs.

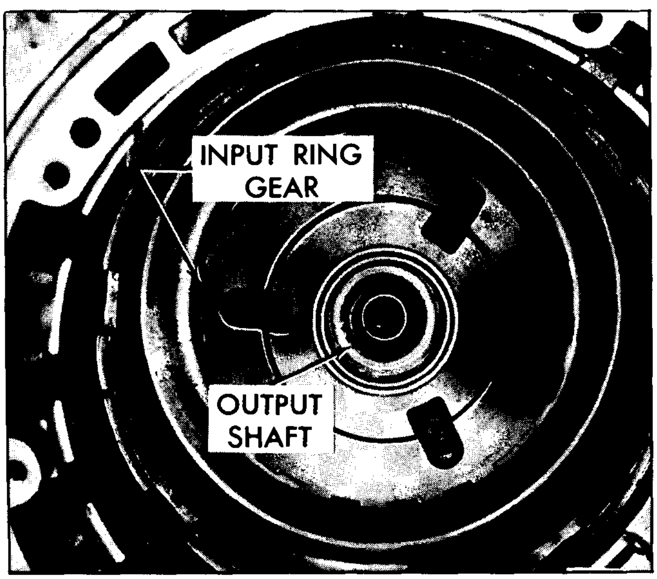


Fig. 7G-61 Removing Input Ring Gear

Fig. 7G-63 Removing Drive Shell

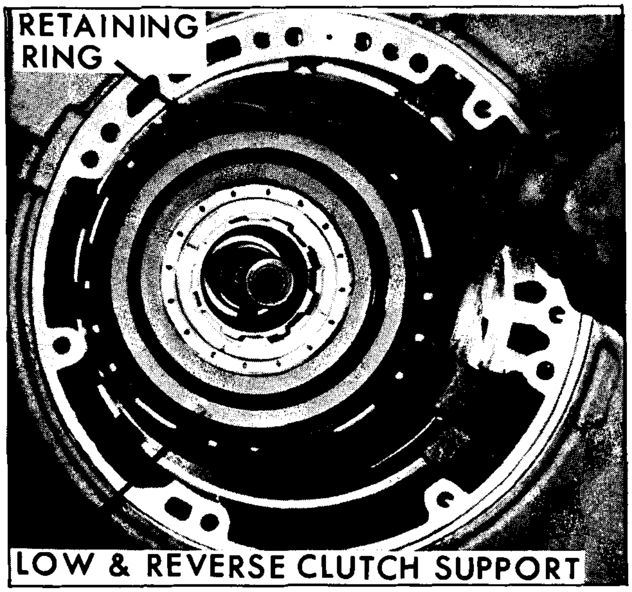


Fig. 7G-64 Removing Case-to-Support Retaining Ring

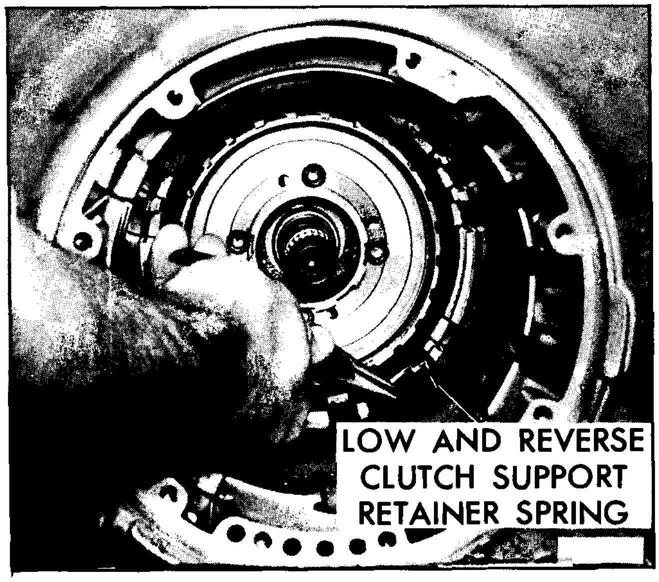


Fig. 7G-66 Removing Retainer Spring

8. Remove input ring gear (Fig. 7G-61).
9. Remove input ring gear-to-output carrier thrust washer from ring gear (or output carrier). This washer has four (4) external tangs.
10. Using a finely pointed awl and a small screwdriver, remove output carrier-to-output shaft snap ring. Discard ring.
11. Remove output carrier assembly (Fig. 7G-62).
12. Remove sun gear drive shell assembly (Fig. 7G-63).
13. Remove sun gear drive shell-to-low and reverse roller clutch inner race thrust washer from drive shell (or inner race). This washer has four (4) wide internal tangs.
14. Remove low and reverse roller clutch support-to-case retaining ring (Fig. 7G-64).
15. Push up on end of output shaft until the low and reverse clutch support assembly clears the low and reverse clutch support retainer spring. Then, remove the low and reverse clutch support assembly from the case (Fig. 7G-65).
16. Remove low and reverse clutch support retainer spring (Fig. 7G-66), push up on end of output shaft and remove output shaft assembly from case.

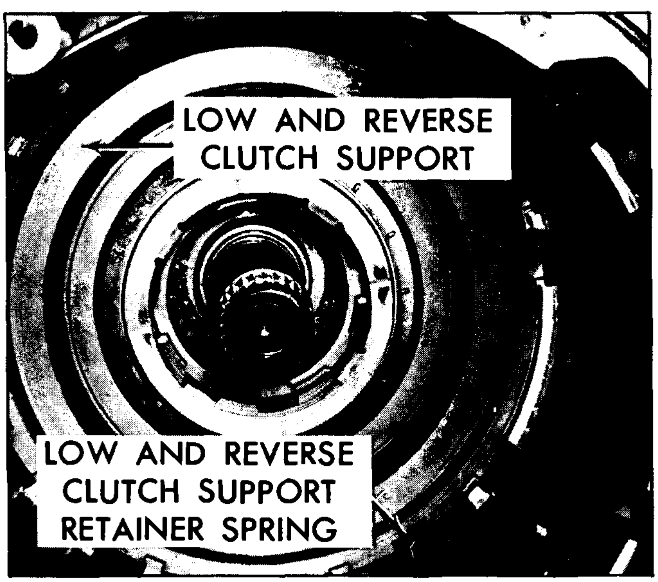


Fig. 7G-65 Location of Retainer Spring

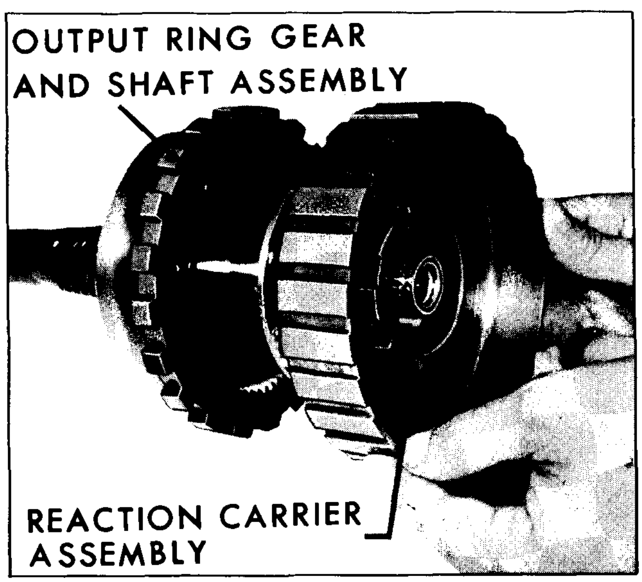


Fig. 7G-67 Removing Carrier from Shaft

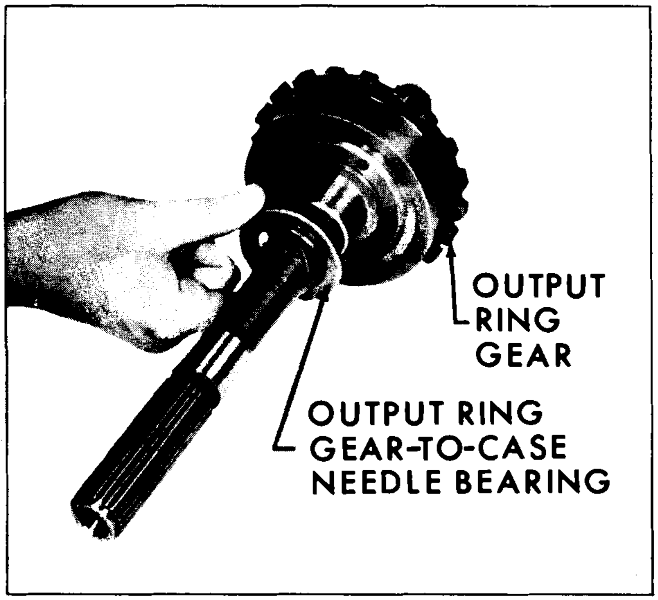


Fig. 7G-68 Removing Needle Bearing

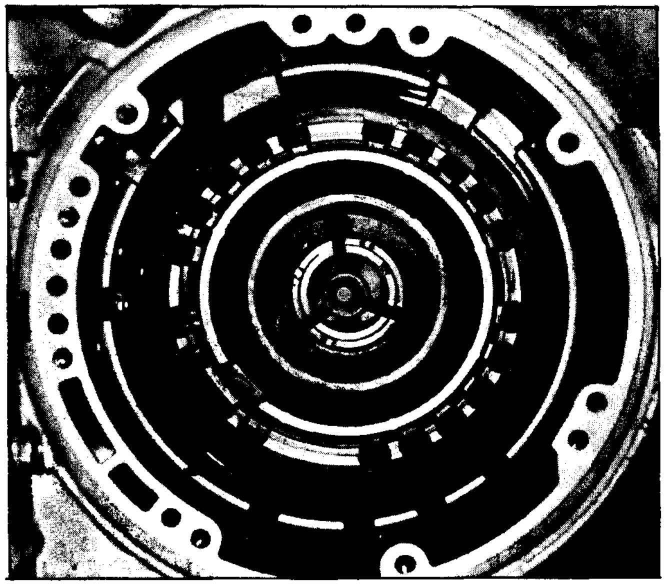


Fig. 7G-70 Compressing Low and Reverse Clutch Piston

17. On **V-8 models**, remove five (5) low and reverse clutch faced plates and five (5) steel separator plates from reaction carrier assembly or case.

    On **6 cylinder models**, remove four (4) faced plates and four (4) separator plates.

18. Remove reaction carrier assembly from output ring gear and shaft assembly (Fig. 7G-67).

19. Remove reaction carrier-to-output ring gear tanged thrust washer from ring gear (or reaction carrier). This washer has three (3) narrow external tangs.

20. Remove output ring gear-to-case needle bearing from output shaft assembly or case (Fig. 7G-68).

21. If it is necessary to separate ring gear from output shaft, remove output ring gear-to-output shaft snap ring by using a finely pointed awl and a small screwdriver. Discard snap ring (Fig. 7G-69).

22. Using Clutch Spring Compressor Tools J 23327-1 and J 23327-2 and Pilot J 21420-2 in end of case, compress low and reverse clutch piston spring retainer and remove piston retaining ring (Fig. 7G-70).

23. Remove tools, spring retainer and seventeen (17) piston return springs from low and reverse clutch piston.

24. Remove low and reverse clutch piston assembly by applying compressed air to the passage shown in Fig. 7G-71.

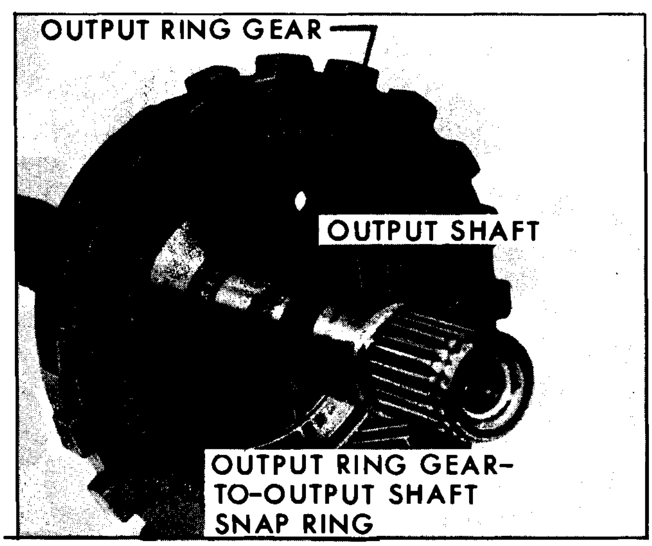


Fig. 7E-69 Output Ring Gear and Output Shaft

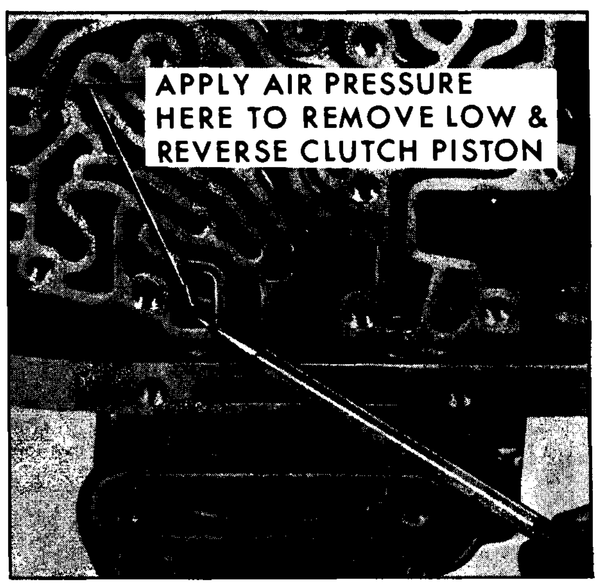


Fig. 7G-71 Using Air to Remove Piston

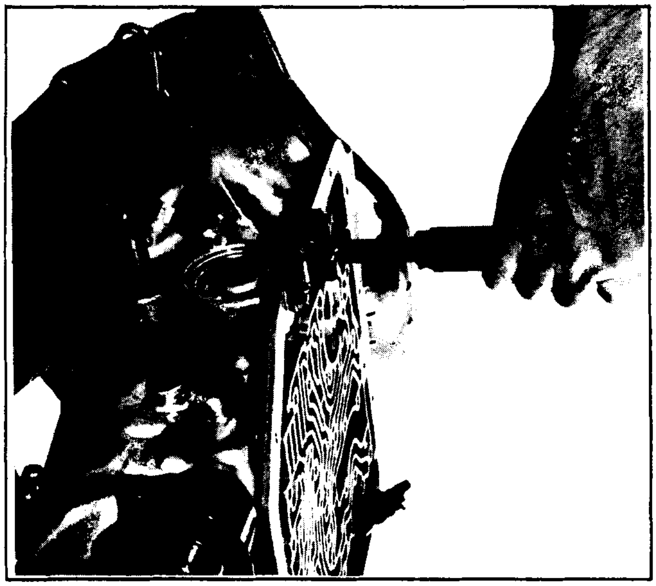


Fig. 7G-72 Compressing Accumulator Cover

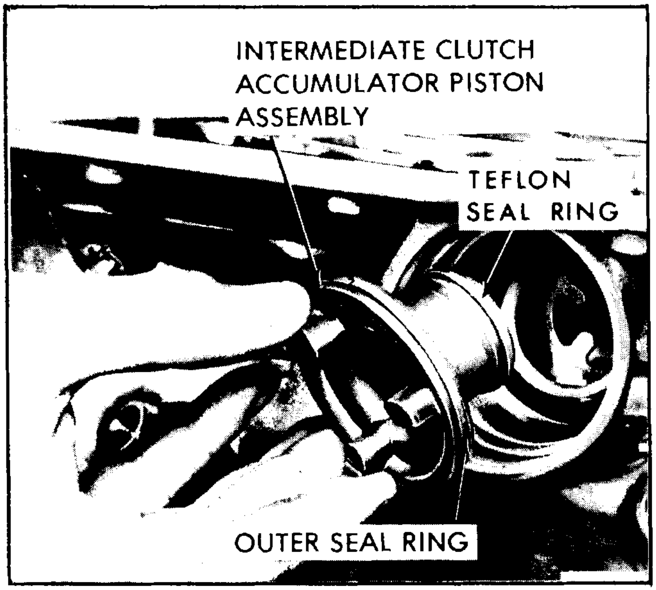


Fig. 7G-73 Removing Accumulator Piston

25. Remove outer, center and inner flat seals from low and reverse clutch piston.

26. Move transmission to horizontal position and, using two (2) oil pan bolts, install Compressor J 23069 on oil pan face, compress intermediate clutch accumulator piston cover and remove its retaining ring. Remove tool (Fig. 7G-72).

27. Remove intermediate clutch accumulator piston cover, O-ring seal from cover, intermediate clutch accumulator piston spring, intermediate clutch accumulator piston assembly (Fig. 7G-73) and remove outer hook-type oil seal ring from piston. Replace ring if nicked or worn. **Do not** remove the inner teflon oil seal ring **unless** replacement is required. All service inner accumulator piston oil seal rings are metal hook-type.

OVERHAUL OF MAJOR UNITS

GOVERNOR

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. However, the driven gear can be serviced separately.

While it is necessary to disassemble governor assembly in order to replace the driven gear, disassembly may also be necessary due to foreign material causing improper operation. To disassemble governor assembly, proceed as follows:

DISASSEMBLE

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights and springs.

   NOTE: *Governor weights are interchangeable from side to side and need not be identified.*

2. Remove governor valve from governor sleeve. Use care in not damaging valve.

INSPECT

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. Inspect governor valve for free operation in bore of governor sleeve.
6. Inspect governor weights for free operation in their retainers.
7. Check governor weight springs for distortion or damage.
8. Check governor driven gear for looseness of governor sleeve, for nicks, burrs or damage. If replacement is necessary, follow replacement below.

GOVERNOR DRIVEN GEAR - REPLACE

To facilitate governor repair in the field, a governor driven gear and weight pin are available for service use. The service package consists of a driven gear, governor weight retaining pins (2) and a governor gear retaining split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin, using a small punch.
2. Support governor on 3/16" 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 (Fig. 7G-74).
5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch and, while supporting governor, drill new hole through sleeve and gear, using a standard (1/8") drill.
6. Install new retaining split pin.
7. Wash governor assembly thoroughly to remove any chips that may have collected.

GOVERNOR ASSEMBLE

1. Install governor valve in bore of governor sleeve, large end first.
2. Install governor weights, springs and thrust cap on governor.

   NOTE: *Lip of secondary weight must be* **over** *end of valve.*

3. Align pin holes in thrust cap, governor weights, governor sleeve and install new pins. After installing, crimp both ends of pins to prevent their falling out.
4. Check governor weight assemblies for free movement on pins.
5. Check governor valve for free movement in governor sleeve.
6. Suspending governor assembly by its driven gear (weights out), check valve opening at feed port. Opening must be .020" minimum (Fig. 7G-75).
7. Check governor valve opening at exhaust port while holding weights completely inward. Opening **must** be .020" minimum. If **less** than .020" minimum feed port or exhaust port is found, governor assembly must be replaced.

VALVE BODY

DISASSEMBLE (Fig. 7G-76)

1. Position valve body assembly with cored face up and accumulator piston assembly at upper left corner.
2. Remove manual valve from lower left hand bore.
3. From next bore up, remove retaining pin, detent

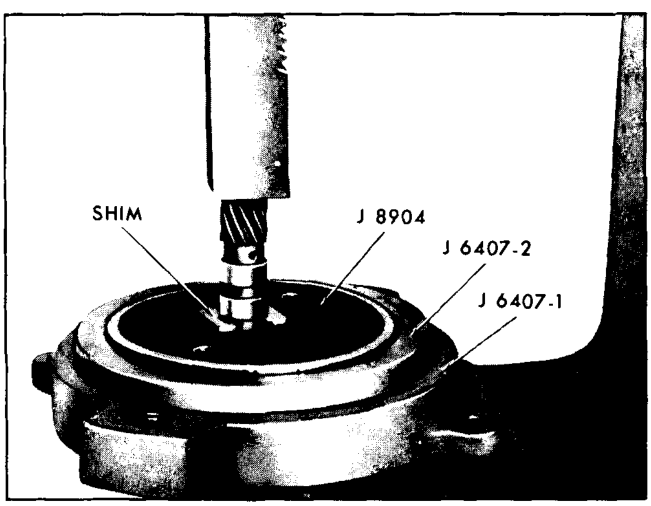


Fig. 7G-74 Pressing Governor Driven Gear into Sleeve

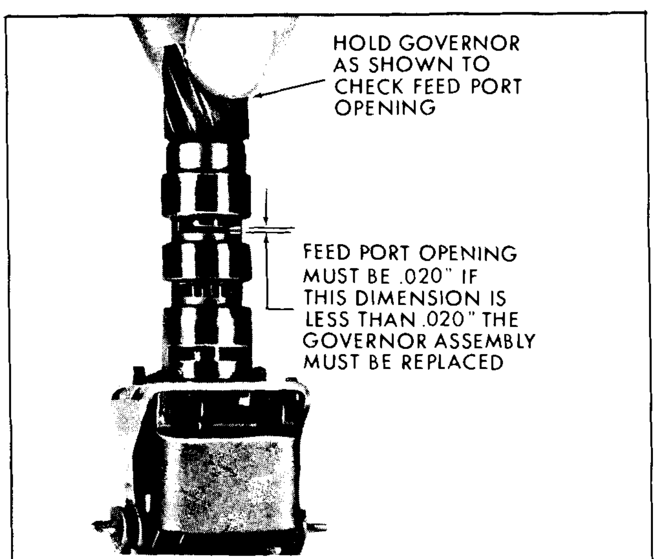
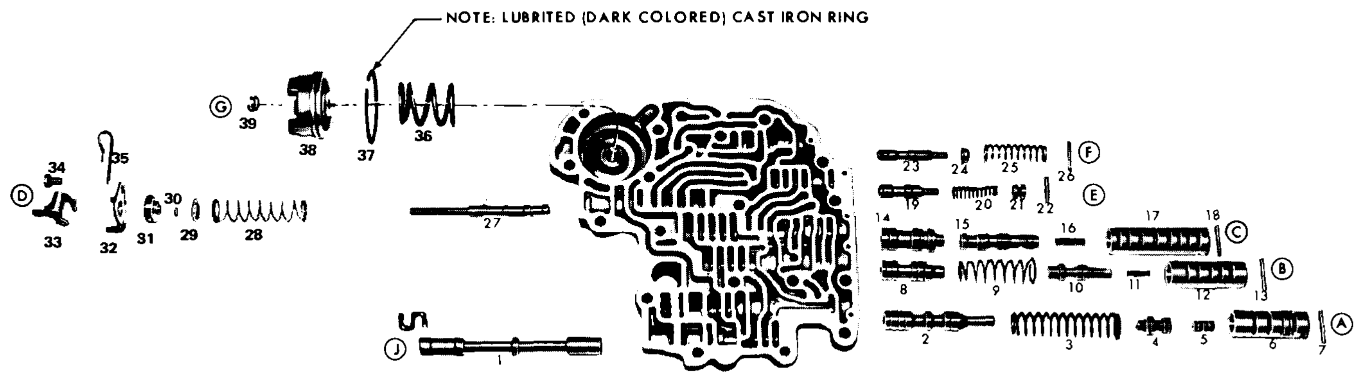


Fig. 7G-75 Checking Feed Port Opening



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 DETENT VALVE SPRING
29 DETENT VALVE SPRING SEAT
30 DETENT VALVE SPRING RETAINER
31 DETENT VALVE STOP
32 DETENT VALVE ACTUATING LEVER BRACKET
33 DETENT VALVE ACTUATING LEVER
34 RETAINING BOLT
35 RETAINING PIN

G:
36 DIRECT CLUTCH ACCUMULATOR SPRING
37 OIL SEAL RING
38 DIRECT CLUTCH ACCUMULATOR PISTON
39 RETAINER RING

Fig. 7G-76 Exploded View of Valve Body

valve actuating lever, bolt, detent actuating lever bracket, detent valve stop, spring seat retainer, spring seat, spring and detent valve.

4. Place Accumulator Compressor J 21885 on top of piston lugs of the direct clutch accumulator piston, compress piston evenly and remove retainer "E" ring.

5. Remove tool, direct clutch accumulator piston, metal oil seal ring and direct clutch accumulator spring.

6. From lower right hand bore, compress boost valve sleeve and, turning valve body over, remove retaining pin, boost valve sleeve assembly, pressure regulator valve spring and pressure regulator valve. Then, remove reverse and modulator boost valve and intermediate boost valve from boost valve sleeve.

7. From next bore up, compress 2-3 shift control valve sleeve and remove retaining pin, 2-3 shift control valve sleeve assembly, 2-3 shift valve spring and 2-3 shift valve. Then, remove 2-3 shift control valve and control valve spring from 2-3 shift control valve sleeve.

8. From next bore up, compress 1-2 shift control valve sleeve and remove retaining pin, 1-2 shift control valve sleeve assembly and 1-2 shift valve. Then, remove 1-2 shift control valve and control valve spring from 1-2 shift control valve sleeve.

9. From next bore up, compress manual low control valve plug and remove retaining pin, plug, manual low control valve spring and manual low control valve.

10. From top bore, remove retaining pin, detent regulator valve spring, valve spring seat and detent regulator valve.

INSPECT

1. Wash all parts in cleaning solvent, air dry and blow out all passages.

2. Inspect all valves for scoring, cracks and free movement in their respective bores.

3. Inspect sleeves for cracks, scratches or distortion.

4. Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face (Fig. 7G-77).

5. Check all springs for distortion or collapsed coils.

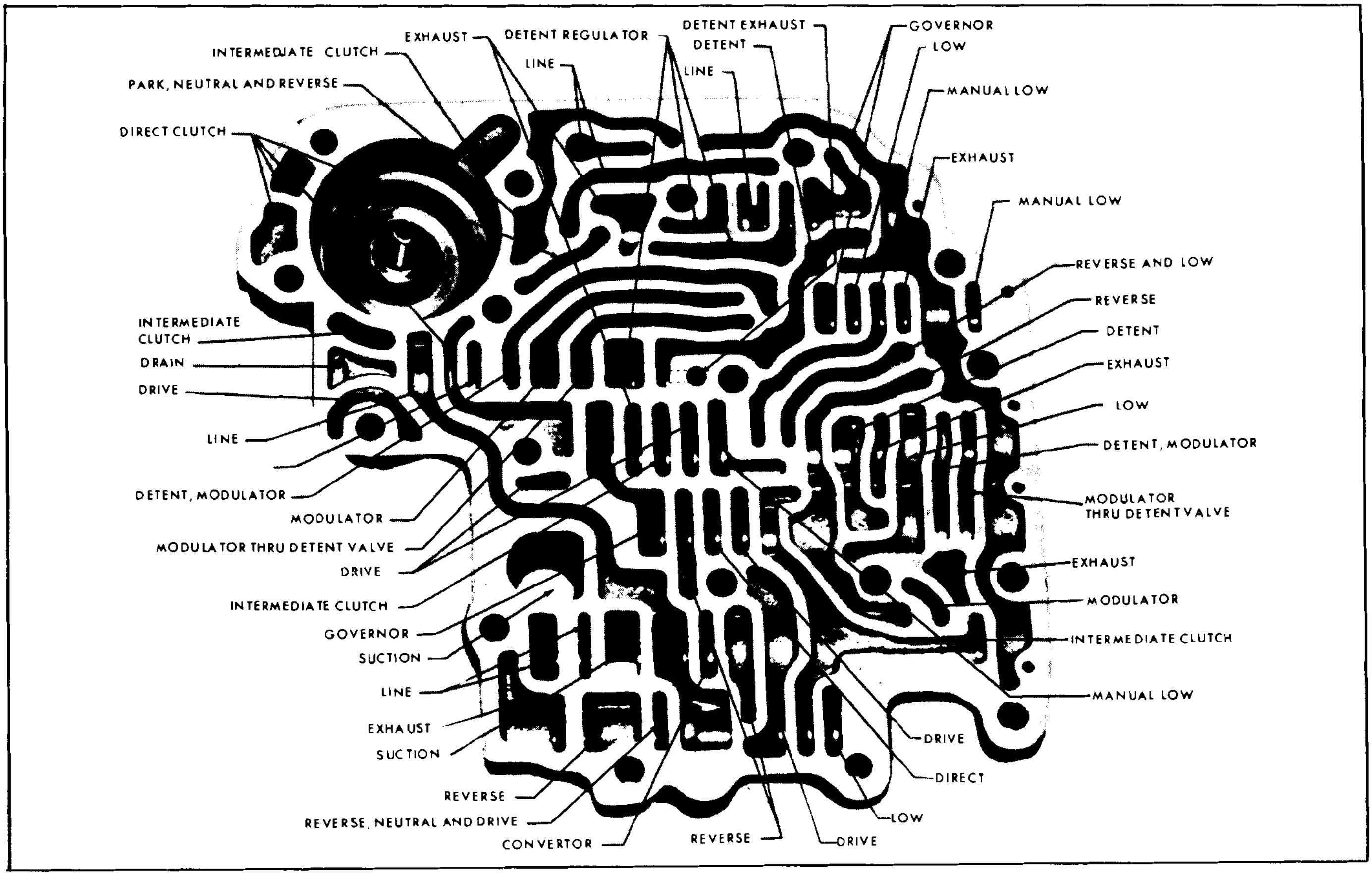


Fig. 7G-77 Valve Body Oil Passages

ASSEMBLE

1. Position valve body with cored face up and accumulator piston bore at upper left corner.

2. Beginning at top right hand bore, install detent regulator valve spring seat onto stem end of valve and install detent regulator valve, seat and detent regulator valve spring into bore. Compress spring and install retaining pin below flush with machined face.

   NOTE: *Free length of spring is 1 7/8" by 9/16" diameter.*

3. In next bore down, install manual low control valve with stem end out, manual low control valve spring and plug. Compress plug and install retaining pin below flush with machined face.

   NOTE: *Free length of spring is 1 1/2" by 7/16" diameter.*

4. In next bore down, install 1-2 shift valve with stem end out, install control valve spring into its bore in 1-2 shift control valve and both into 1-2 shift control valve sleeve. Install control valve sleeve assembly into bore, compress sleeve and install retaining pin below flush with machined face.

   NOTE: *Free length of spring is 1 15/16" by 1/4" diameter.*

5. In next bore down, install 2-3 shift valve with stem end out and 2-3 shift valve spring with narrow end in. Install control valve spring into 2-3 shift control valve and install both into 2-3 shift control valve sleeve. Install sleeve assembly into bore, compress sleeve and install retaining pin below flush with machined face.

   NOTE: *Free length of shift valve spring is 2 1/16" by 7/8" diameter; free length of control valve spring is 11/16" by 3/16" diameter.*

6. In last bore down, install pressure regulator valve with stem end out and pressure regulator valve spring with narrow end in. Install intermediate boost valve, then reverse and modulator boost valve with stem end out into boost valve sleeve. Install sleeve assembly into bore, compress sleeve and install retaining pin below flush with machined face.

   NOTE: *Free length of spring is 1 11/16" by 17/32" diameter.*

7. If removed, install metal oil seal ring to direct clutch accumulator piston.

8. At upper left corner, install direct clutch accumulator spring and direct clutch accumulator piston into its core in valve body face.

   NOTE: *Free length of spring is 1 3/4" by 1 1/2" diameter.*

9. Using Accumulator Compressor J 21885, compress spring and piston into body, install retainer "E" ring and remove tool.

   CAUTION: *Compressor tool must be centered on piston.*

10. On stem end of detent valve, install spring seat, seat retainer and detent valve stop.

11. In upper left bore, install detent valve spring, detent valve assembly, detent actuating lever bracket and its retaining bolt. Torque bolt to 52 lbs. in.

    NOTE: *Free length of spring is 1 7/8" by 3/4" diameter.*

12. Install manual valve into lower left hand bore.

OIL PUMP

DISASSEMBLE

1. Remove pump body-to-case O-ring seal (square cut) from pump body. Discard seal.

2. Continue scribe mark, made earlier before removal of pump from case, down side of body and cover for aid in re-assembly.

3. Place pump assembly, stator shaft down, through hole in bench and remove five (5) pump cover-to-body attaching bolts (Fig. 7G-78).

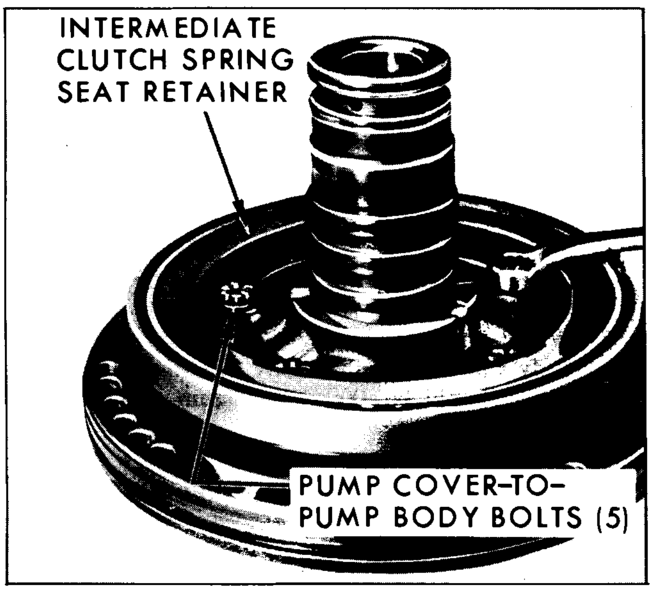


Fig. 7G-78 Removing Pump Cover Attaching Bolts

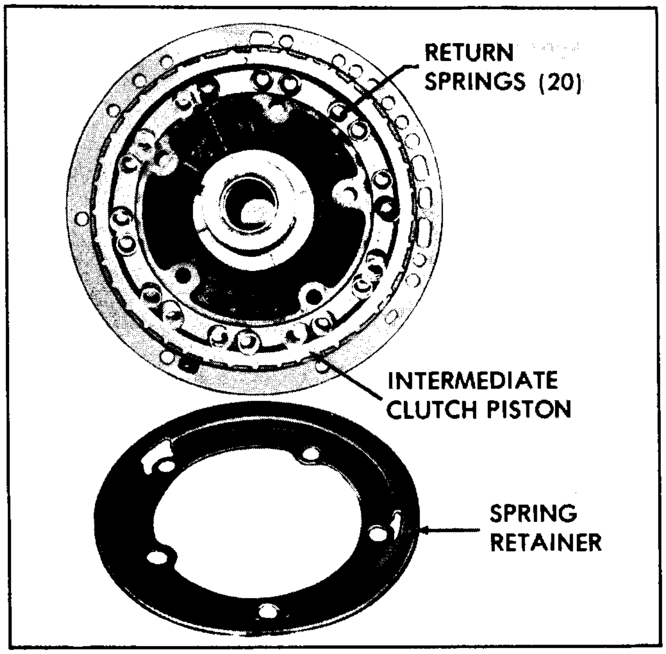


Fig. 7G-79 Removing Retainer, Springs and Piston

4. Remove intermediate clutch spring seat retainer, twenty (20) clutch return springs and intermediate clutch piston assembly (Fig. 7G-79).

5. Remove intermediate clutch piston inner and outer seals from piston.

6. Remove three (3) direct clutch-to-pump hub hook-type oil seal rings from pump cover hub (Fig. 7G-80). Do not remove the teflon oil seal rings from the pump cover hub unless replacement is required.

7. Remove pump cover-to-direct clutch drum selective thrust washer.

Fig. 7G-80 Removing O-Rings and Thrust Washer

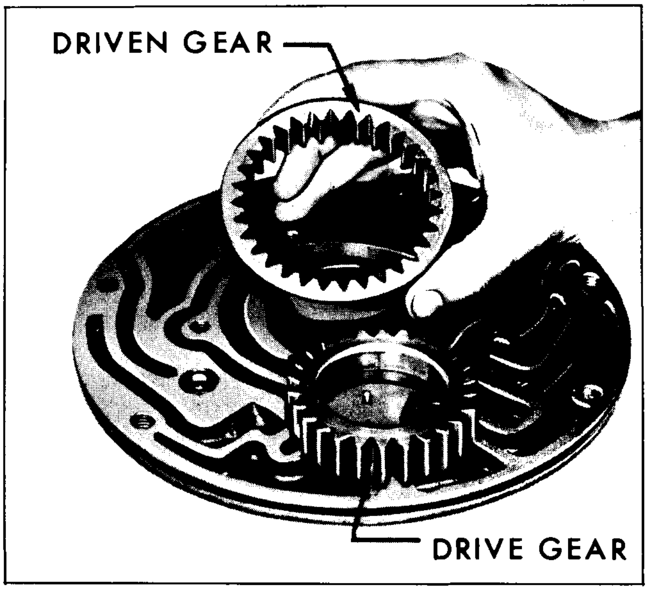


Fig. 7G-81 Removing Drive and Driven Gears

NOTE: *Washer has one (1) large tang and controls end play of transmission.*

8. Lift pump cover and stator shaft assembly from pump body.
9. Mark drive and driven gears for aid in re-assembly and remove gears from pump body (Fig. 7G-81).
10. If necessary to replace the cooler by-pass valve, fill the cooler by-pass passage with grease, insert Tool J 23071 into passageway and force the by-pass valve seat, check ball and spring from the pump body (Fig. 7G-82).
11. If necessary to replace oil pump body oil seal, place pump body on wood blocks so machined face surface

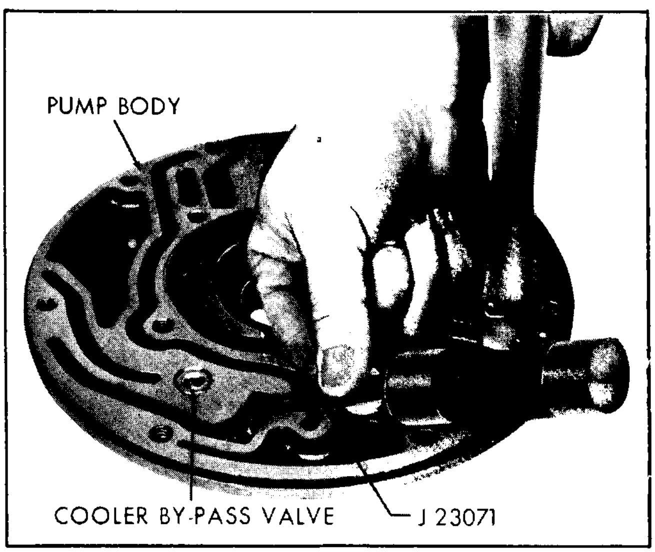


Fig. 7G-82 Removing By-Pass Valve Seat

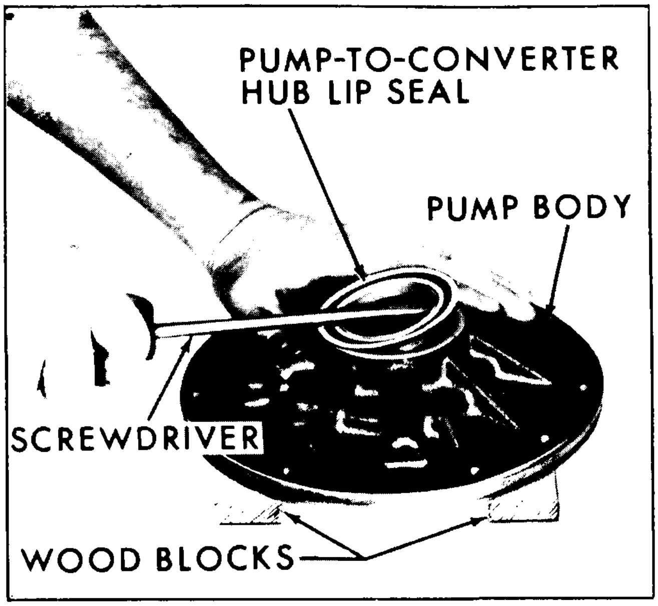


Fig. 7G-83 Removing Pump Body Lip Oil Seal

is not damaged and remove pump body-to-converter hub lip oil seal with screwdriver or a small pry bar. Discard seal (Fig. 7G-83).

INSPECT (Fig. 7G-84)

1. Wash all parts in cleaning solvent, blow out all oil passages and air dry.
2. Inspect pump drive and driven gears, gear pocket and crescent for nicks, galling or damage.
3. Inspect pump body and pump cover faces for nicks or scoring.
4. Inspect pump cover hub outer diameter for nicks or burrs which might damage direct clutch drum bushing.
5. Check three (3) pump cover and hub lubrication holes to make certain they are NOT restricted.
6. Inspect pump body bushing for galling or scoring. Check clearance between pump body bushing and converter hub - maximum clearance is .005". If bushing is damaged, pump body should be replaced.
7. With parts clean and dry, install pump gears in pump body and check pump body face-to-gear face clearance. Should be .0008" minimum to .0035" maximum.
8. Inspect pump body-to-converter hub lip oil seal. If it was replaced as above, inspect converter hub for nicks or burrs which might have damaged pump lip oil seal or pump body bushing.
9. Check condition of cooler by-pass valve and replace

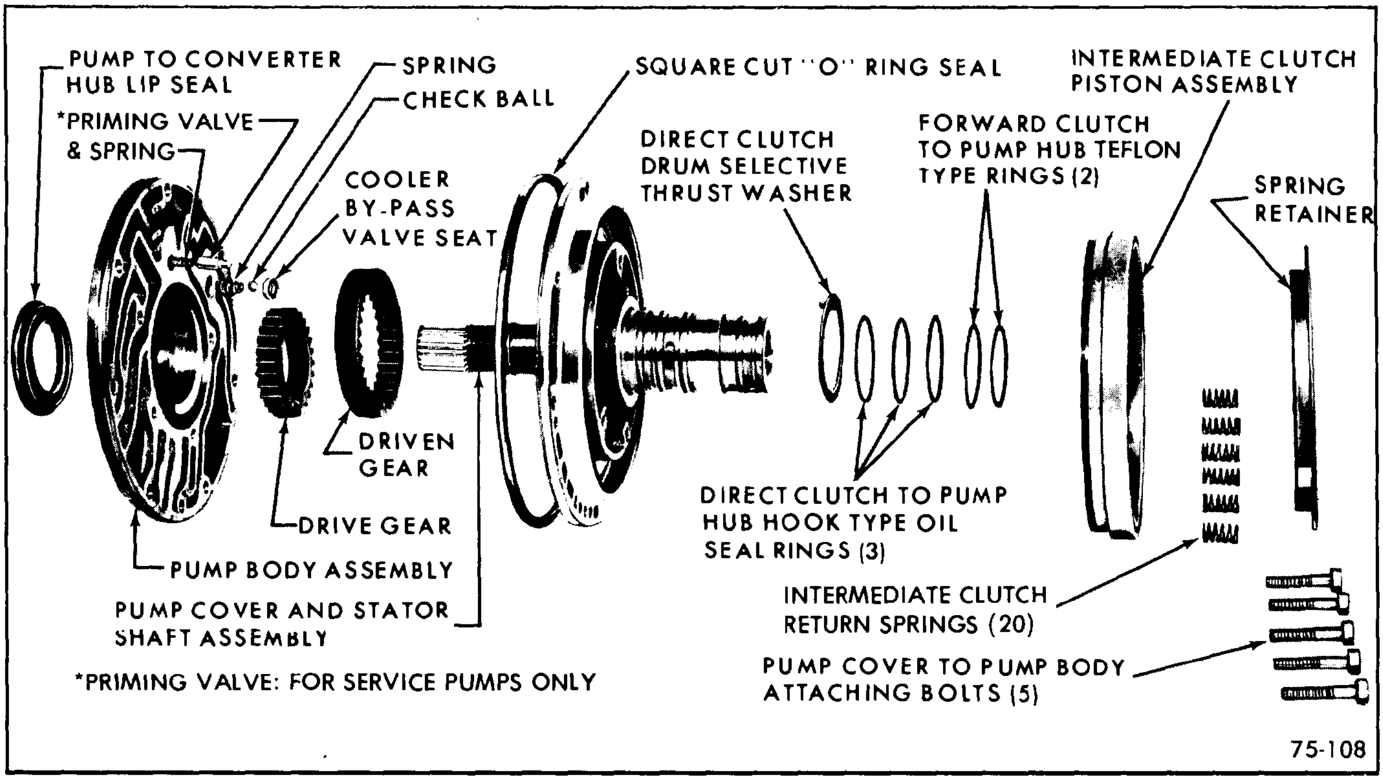


Fig. 7G-84 Exploded View of Oil Pump

if valve leaks excessively.

10. Check all springs for distortion or collapsed coils.

11. Check oil passages in pump body (Fig. 7G-85) and in pump cover (Figs. 7G-86 and 7G-87).

12. Inspect three (3) pump cover stator shaft bushings for galling or scoring. If any of these bushings is damaged, replace bushing(s) as follows:

STATOR SHAFT FRONT BUSHING - REPLACE

1. Thread Bushing Tool J 21465-15 into stator shaft front bushing, thread Slide Hammer J 2619 and Adapter J 2619-4 into Bushing Tool and clamp Slide Hammer handle into vise. Grasp pump cover hub and remove bushing. Discard bushing (Fig. 7G-88).

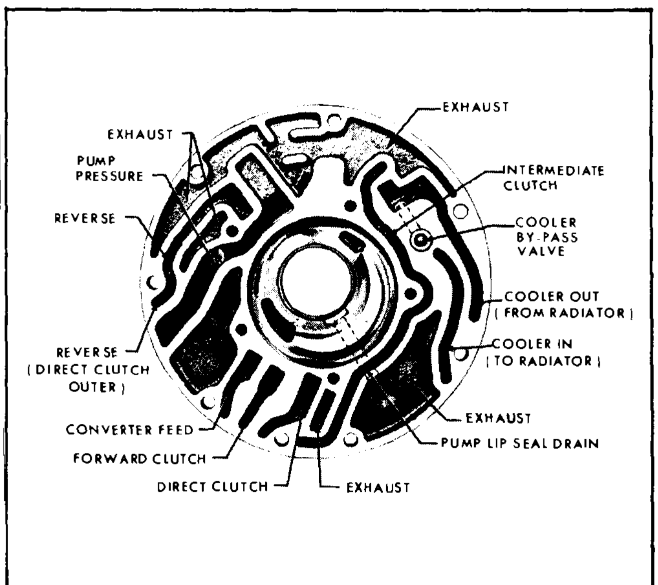


Fig. 7G-85 Pump Body Oil Passages

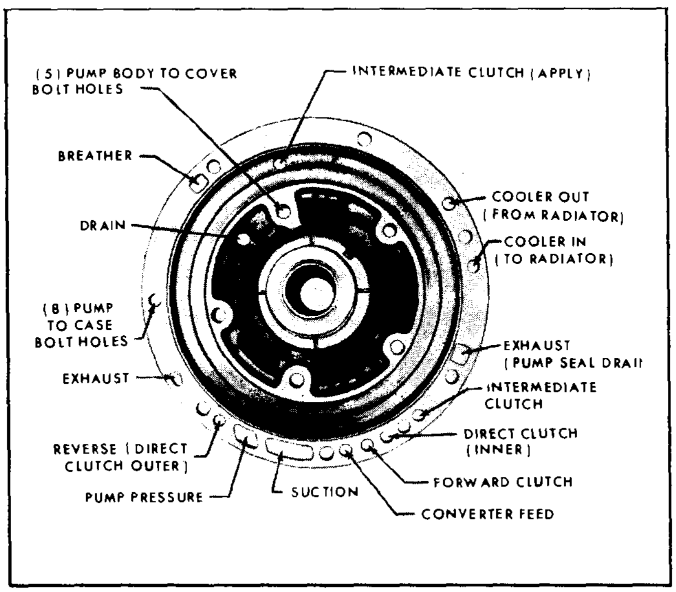


Fig. 7G-86 Pump Cover (Case Face) Oil Passages

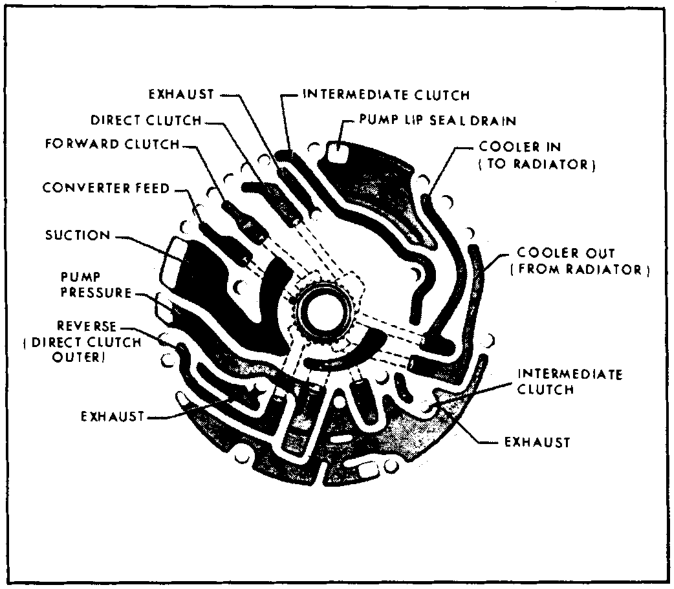


Fig. 7G-87 Pump Cover (Body Face) Oil Passages

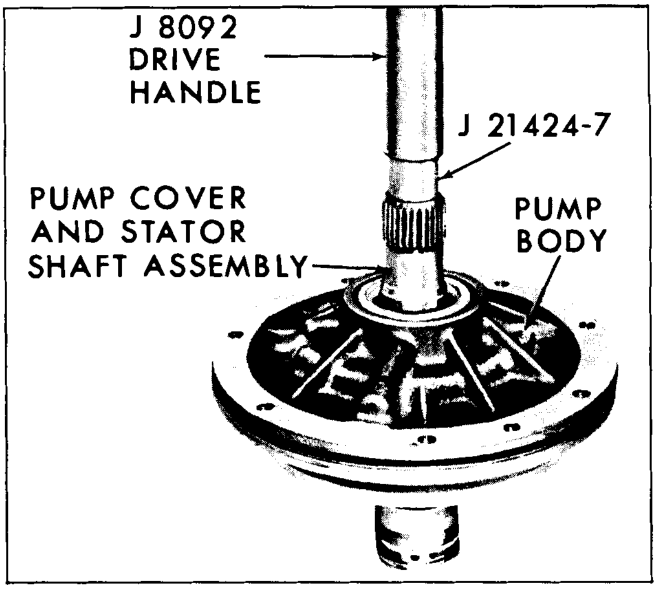


Fig. 7G-89 Installing Shaft Front Bushing

2. Install new bushing into front end of stator shaft by using Bushing Tool J 21424-7 and Drive Handle J 8092. Tap bushing into shaft to .250" below front face of shaft (Fig. 7G-89).

CAUTION: *Extreme care must be taken so bushing is not driven past shoulder.*

STATOR SHAFT REAR BUSHINGS - REPLACE

1. Remove front bushing as described above. Then, thread Bushing Tool J 21424-7 into Extension J 21465-13 and Drive Handle J 8092. Place tool assembly through front of stator shaft and drive out center and rear bushings.

2. Install new center bushing into hub end of pump cover by using Bushing Tool J 23062-2, Extension J 21465-13, Drive Handle J 8092 and drive bushing to approximately 1 1/32" below face of pump cover hub. Then, install new rear bushing in same manner flush to .010" below face of pump cover hub (Fig. 7G-90).

ASSEMBLE

1. If oil pump body oil seal was removed, place pump body on wood blocks and install new pump body-to-converter hub lip oil seal, using Seal Installer J 21359 to fully seat seal in its counterbore (Fig. 7G-91).

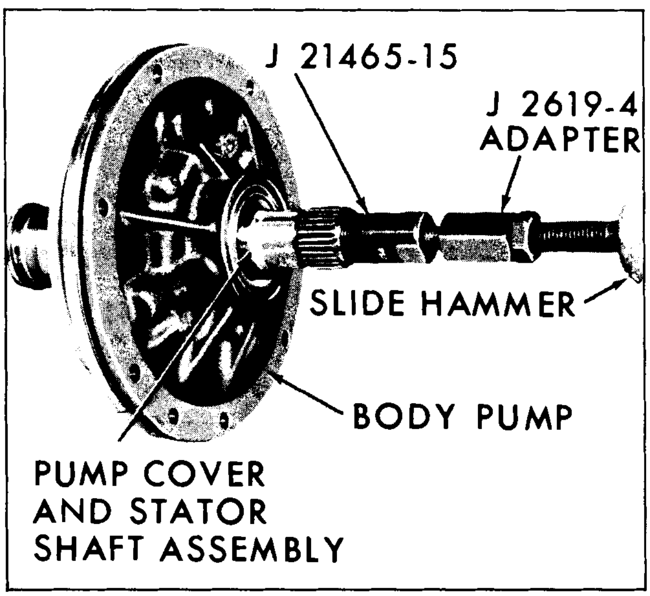


Fig. 7G-88 Removing Shaft Front Bushing

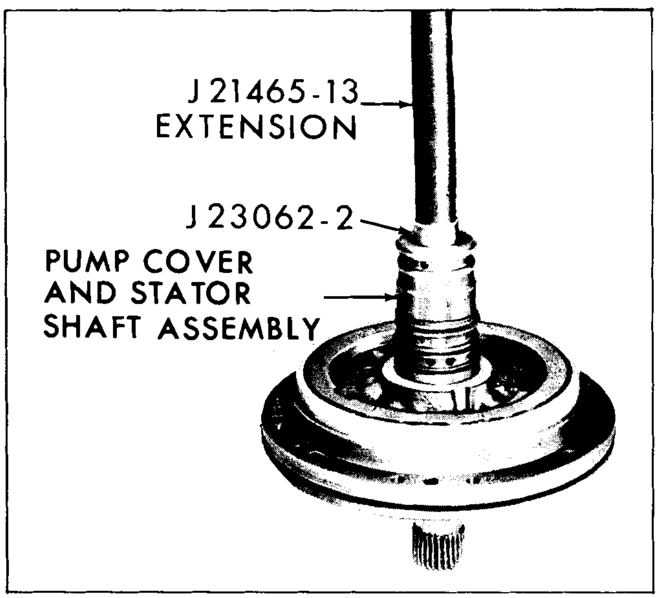


Fig. 7G-90 Installing Shaft Rear Bushings

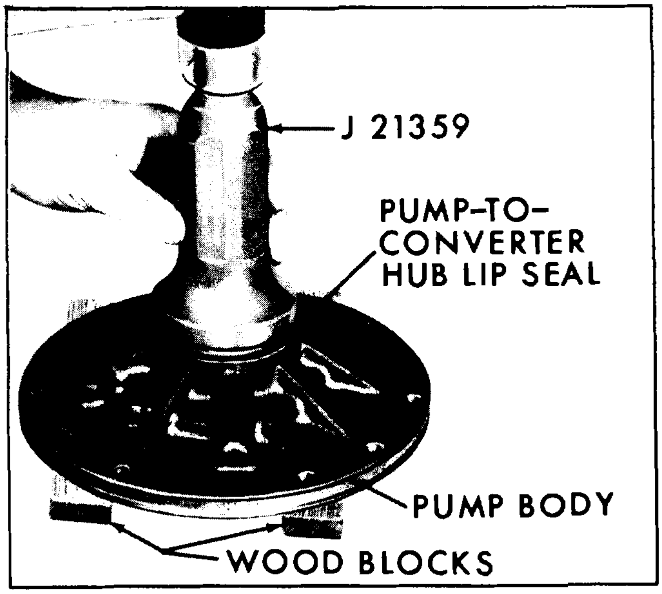


Fig. 7G-91 Installing Pump Body Oil Seal

NOTE: *Outer diameter of seal should be coated with a non-hardening sealer prior to installation.*

2. If cooler by-pass valve was removed, install new cooler by-pass spring, check valve and valve seat by tapping seat into place with a soft hammer or brass drift so it is flush to .010" below face of pump body (Fig. 7G-92).

3. If a new oil pump body is installed, it is **essential** that a priming valve and spring (Fig. 7G-84) be installed in this new pump body.

CAUTION: *The production oil pump body does* **not** *include, nor use, this primary valve and spring. However, if a service pump body were installed* **without** *this priming valve and spring, serious transmission malfunction would occur.*

4. Install drive and driven gears into pump body with alignment marks up (Fig. 7G-86).

NOTE: *Tang face of drive gear is up to prevent damage by converter.*

5. Install pump cover to pump body, aligning marks made earlier.
6. Install pump cover-to-direct clutch drum selective thrust washer over pump cover oil delivery sleeve (hub). This washer has one (1) external tang.
7. Install and engage three (3) direct clutch-to-pump hub hook-type oil seal rings on pump cover oil delivery sleeve (Fig. 7G-80). If the teflon forward clutch rings were removed, install two (2) hook-type metal oil seal rings and make certain that rings are free to move in grooves.
8. Install intermediate clutch piston inner and outer seals on clutch piston and install intermediate clutch piston assembly into pump cover (Fig. 7G-93).

NOTE: *Lips of seals should be facing into pump cover when piston is installed. For aiding installation of piston into pump cover, use a piece of .020" music wire crimped into short section of copper tubing.*

9. Install twenty (20) clutch return springs into piston and install spring seat retainer and five (5) attaching bolts, finger tight.

10. Place oil pump assembly upside down in transmission case, tighten five (5) pump cover-to-pump body bolts to 18 lb. ft. and remove pump from case.

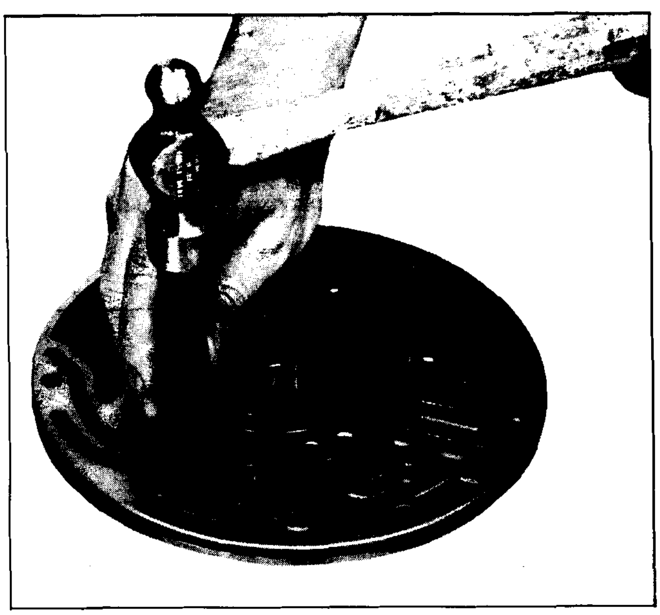


Fig. 7G-92 Installing New By-Pass Valve Seat

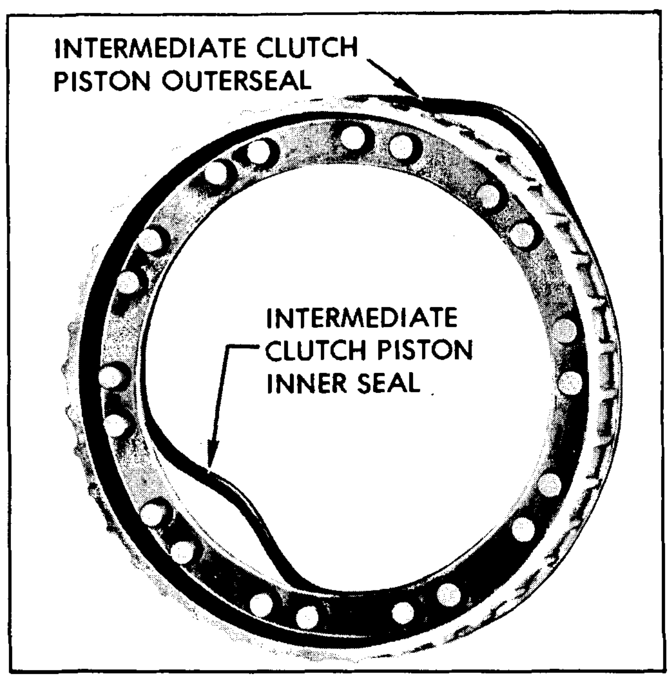


Fig. 7G-93 Installing Seals onto Clutch Piston

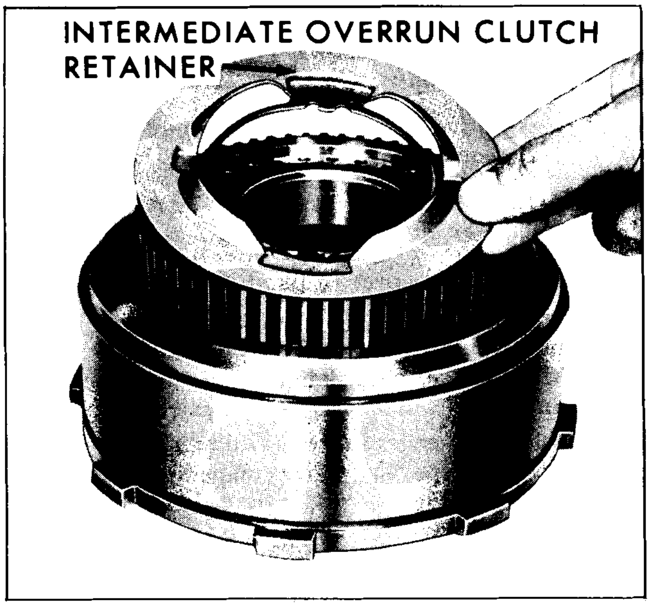


Fig. 7G-94 Removing Clutch Retainer

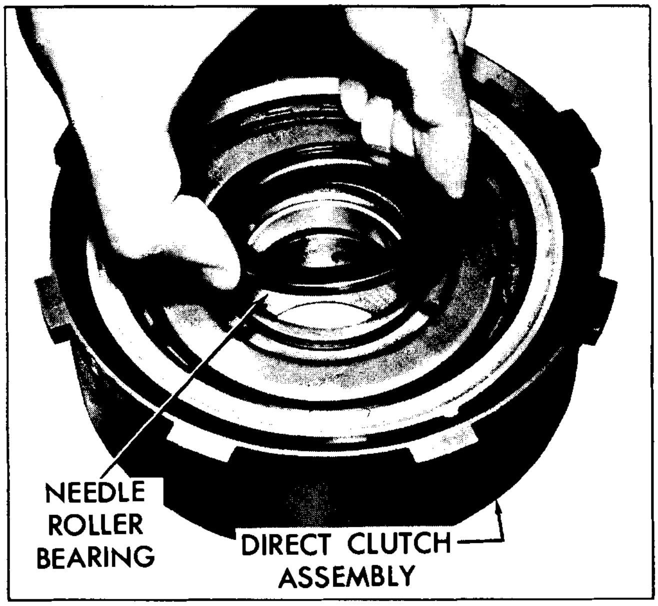


Fig. 7G-96 Removing Roller Bearing

DIRECT CLUTCH

DISASSEMBLE

1. Separate direct clutch assembly from forward clutch assembly and remove intermediate overrun clutch retaining ring and retainer from direct clutch assembly (Fig. 7G-94).

2. Remove intermediate overrun clutch outer race.

   NOTE: *Before removal, check for correct assembly. Outer race should free wheel counterclockwise only.*

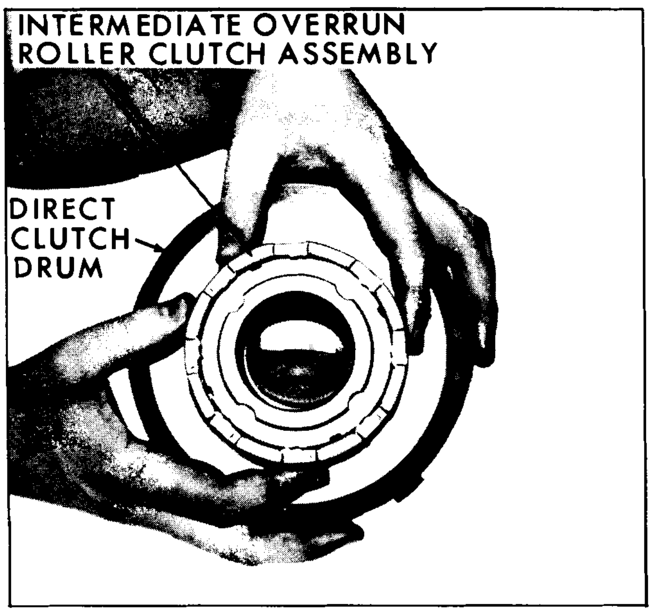


Fig. 7G-95 Removing Roller Clutch

3. Remove intermediate overrun roller clutch assembly from direct clutch drum (Fig. 7G-95).

4. Turn over and remove direct clutch drum-to-forward clutch drum needle roller bearing (Fig. 7G-96).

5. Remove direct clutch pressure plate-to-clutch drum retaining ring and remove pressure plate (Fig. 7G-97).

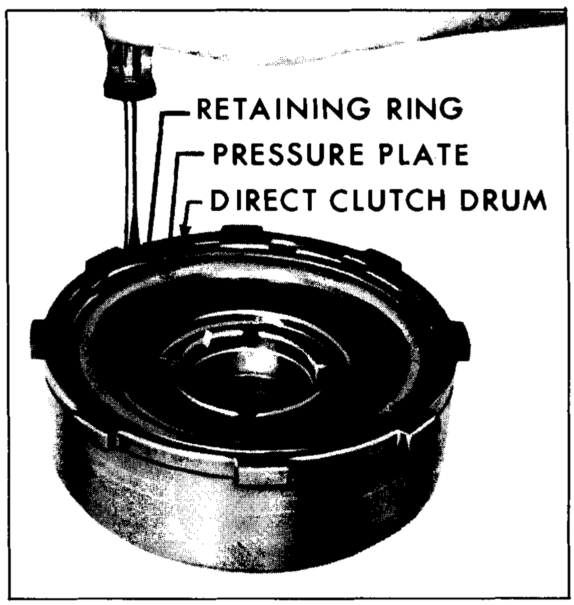


Fig. 7G-97 Removing Retaining Ring

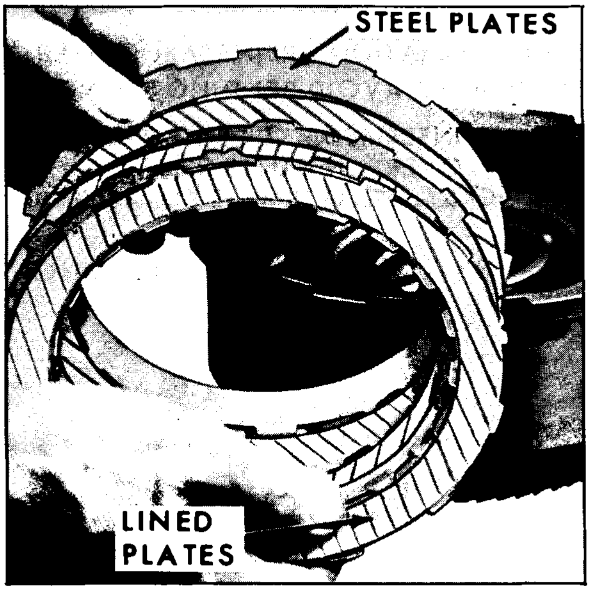


Fig. 7G-98 Removing Direct Clutch Plates

6. On **V-8 models**, remove four (4) faced (lined) plates and four (4) steel separator plates (Fig. 7G-98).

   On **6 cylinder models**, remove three (3) faced (lined) plates and three (3) steel separator plates (7G-98).

7. Using Clutch Spring Compressor J 23327-1 in an arbor press, compress direct clutch piston return spring seat and remove piston retaining ring.

8. Remove tools, spring seat, seventeen (17) piston return springs and direct clutch piston assembly.

9. Remove outer and inner seals from direct clutch piston and center seal from direct clutch drum hub (Figs. 7G-99 and 7G-100).

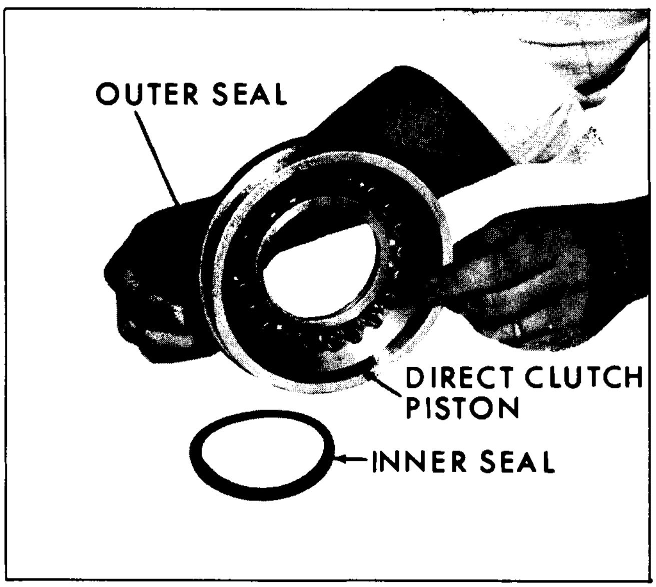


Fig. 7G-99 Removing Piston Inner and Outer Seals

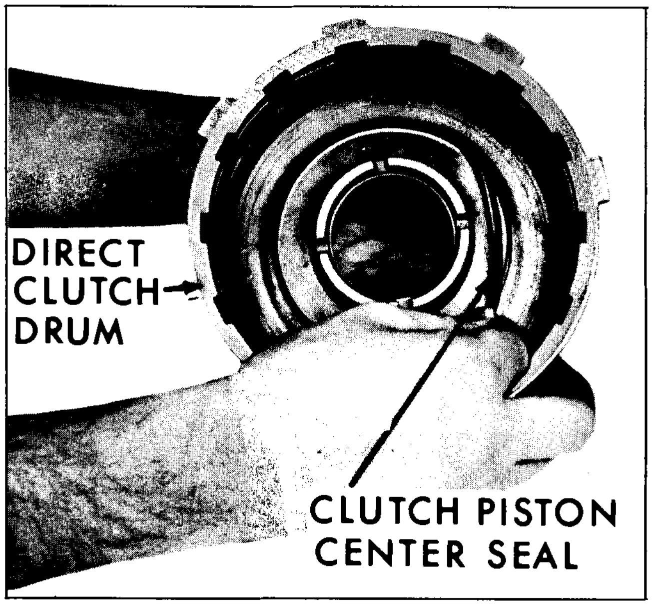


Fig. 7G-100 Removing Drum Hub Center Seal

INSPECT

1. Wash all parts in cleaning solvent, blow out all oil passages and air dry.

2. Inspect drive and driven clutch plates as follows:

   a. Dry the faced (lined) plates with compressed air and inspect for - pitting and flaking, wear, glazing, cracking, charring, and/or chips (metal particles) imbedded in lining. If faced plate exhibits any of these conditions, replacement is required.

   b. Wipe the steel (separator) plates dry and check for heat discolorations. If the surface is smooth and an even color smear is observed, plates should be re-used. If surface is scuffed or shows severe heat discoloration, the plates must be replaced.

3. Check all springs for collapsed coils or signs of distortion.

4. Inspect piston for cracks.

5. Inspect overrun clutch inner cam and outer race for scratches, wear or indentations (Fig. 7G-101).

6. Inspect overrun roller clutch assembly rollers for wear and roller springs for distortion.

7. Inspect clutch drum for wear, scoring, cracks, proper opening of oil passages, wear on clutch plate drive lugs and free operation of ball check (Fig. 7G-102).

8. Inspect direct clutch drum bushing for galling or scoring. If bushing is damaged, replace as follows:

   a. With direct clutch drum properly supported, remove bushing (Fig. 7G-103), using care not to score inner surface of direct clutch drum.

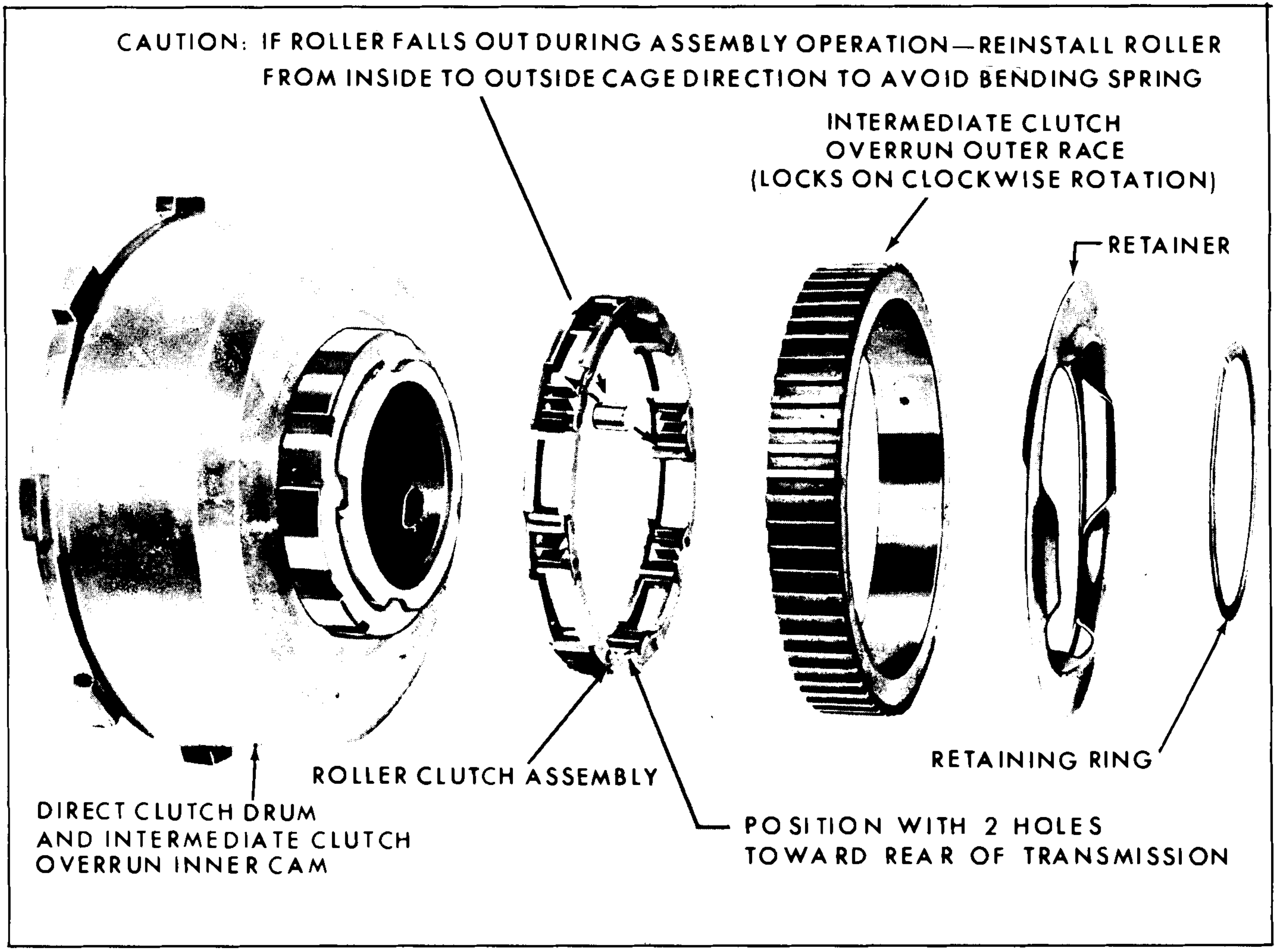


Fig. 7G-101 Exploded View of Intermediate Overrun Clutch

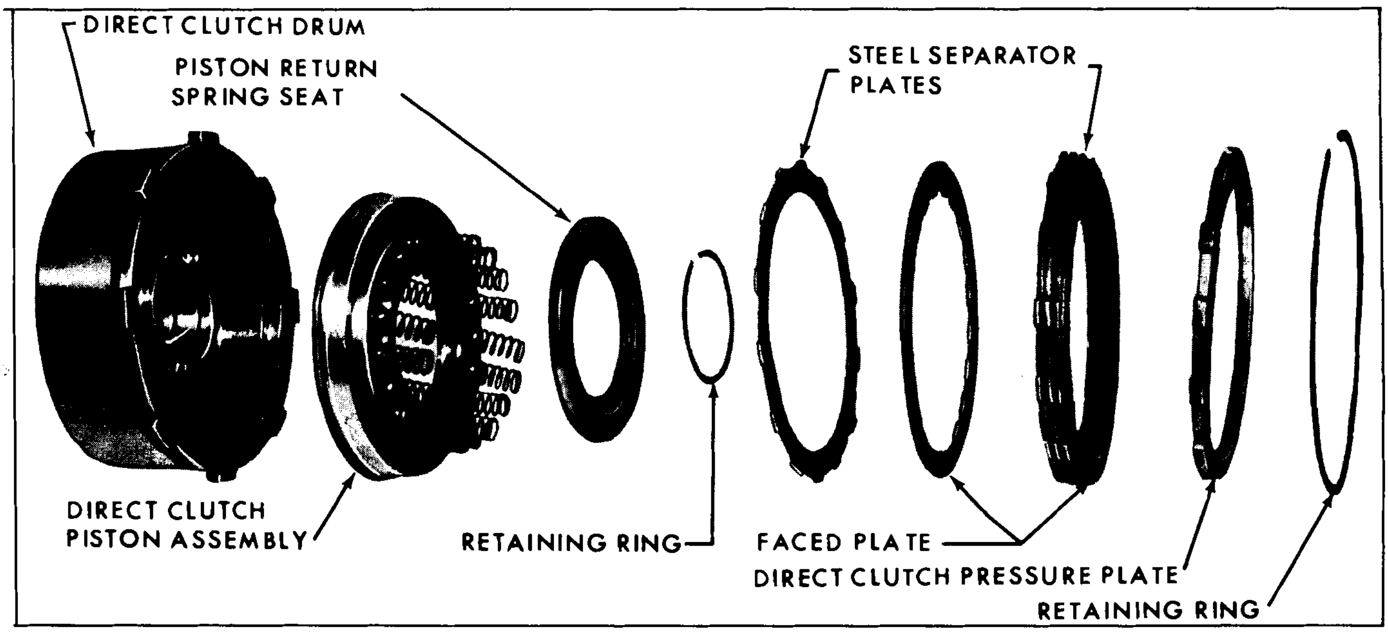


Fig. 7G-102 Exploded View of Direct Clutch

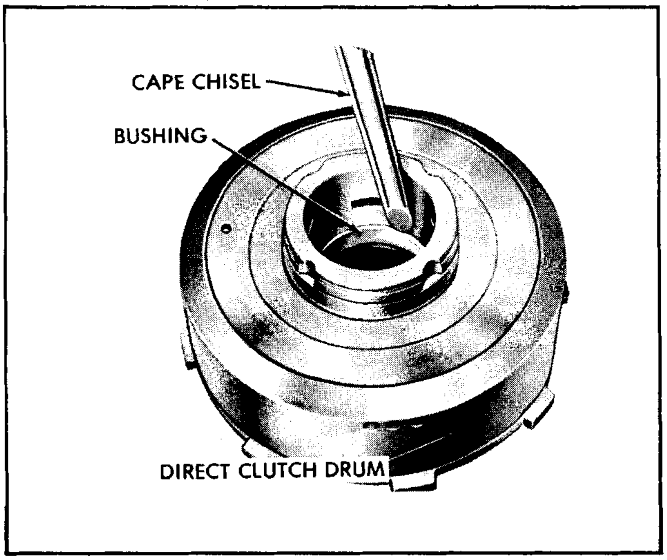


Fig. 7G-103 Removing Clutch Drum Bushing

b. Using Bushing Tool J 23062-4 and Drive Handle J 8092, install new bushing 9/32" below clutch plate side of hub face (Fig. 7G-104).

NOTE: *Bushing should be .010" below slot in hub face.*

ASSEMBLE

1. Install direct clutch piston outer and inner seals (lips down) in clutch piston and direct clutch piston center seal (lip up) in clutch drum hub.

2. Install direct clutch piston assembly into clutch drum by using a piece of .020" music wire crimped into short section of copper tubing (Fig. 7G-105).

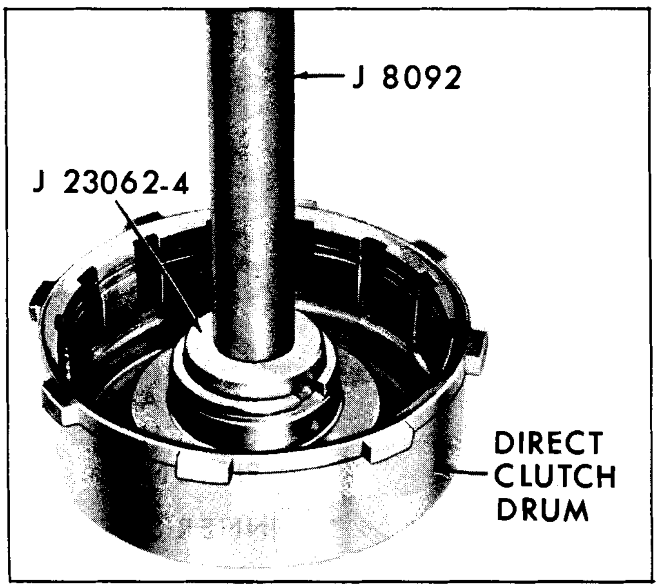


Fig. 7G-104 Installing Clutch Drum Bushing

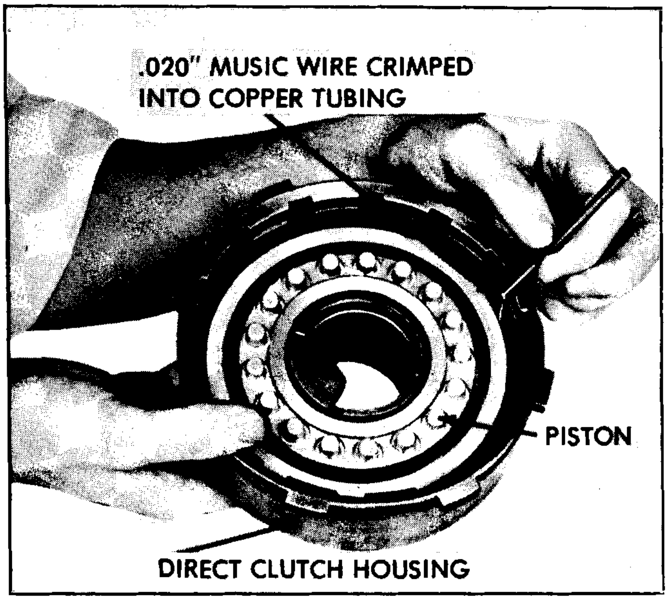


Fig. 7G-105 Installing Direct Clutch Piston

3. Install seventeen (17) piston return springs and spring seat into piston.

   NOTE: *Free length of springs is 1 1/16" by 1/2" diameter and springs are violet in color.*

4. Using Clutch Spring Compressor J 23327-1 in an arbor press, compress spring seat and install piston retaining ring.

5. Remove tools and lubricate plates with transmission fluid.

6. On **V-8 models**, install four (4) faced plates and four (4) steel separator plates, starting with a steel plate and alternating with faced and steel plates.

   On **6 cylinder models**, install three (3) faced plates and three (3) steel separator plates, starting with a steel plates and alternating with faced and steel plates.

7. Install direct clutch pressure plate and retaining ring (Fig. 7G-97).

8. Install intermediate overrun roller clutch assembly, with paint daub up (Fig. 7G-95).

   IMPORTANT: *Roller clutch assembly must be installed with the two (2) holes in cage down (facing rearward).*

9. Install intermediate overrun clutch outer race, retainer and front retaining ring (Fig. 7G-94).

   NOTE: *When overrun roller clutch assembly is properly installed, outer race will free wheel counterclockwise only.*

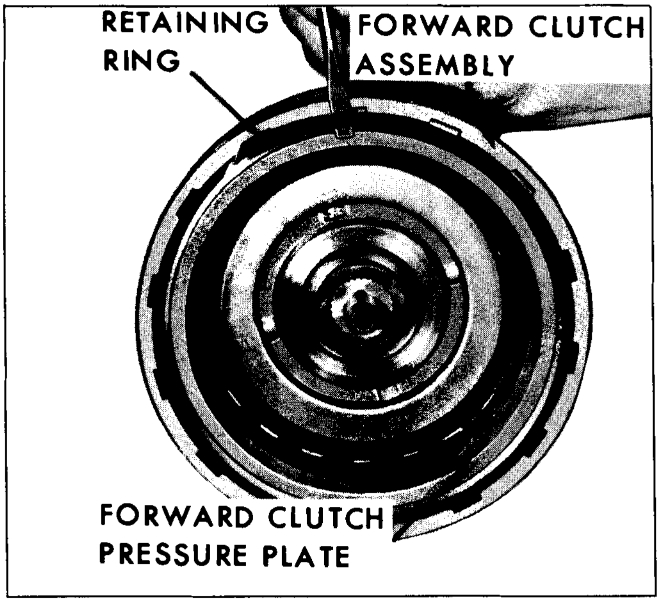


Fig. 7G-106 Removing or Installing Retaining Ring

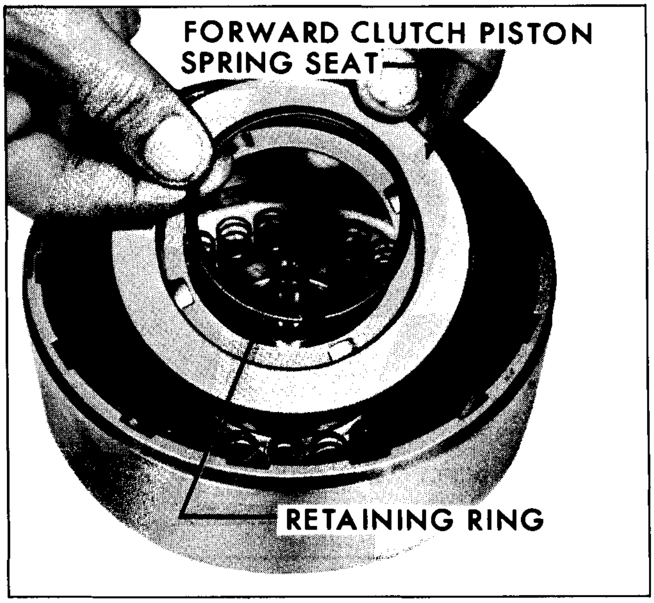


Fig. 7G-108 Removing Retaining Ring and Seat

FORWARD CLUTCH

DISASSEMBLE

1. Place forward clutch assembly in hole in bench, with input shaft down, and remove forward clutch drum-to-pressure plate retaining ring and forward clutch pressure plate (Fig. 7G-106).
2. On **V-8 models**, remove five (5) faced plates, five (5) steel separator plates and the forward clutch housing cushion spring (Fig. 7G-107).

   On **6 cylinder models**, remove four (4) faced plates, four (4) steel separator plates and the forward clutch housing cushion spring (Fig. 7G-107).
3. Using Clutch Spring Compressor J 23327-1 in arbor press, compress forward clutch piston return spring seat and remove retaining ring.
4. Remove tool, spring seat, twenty-one (21) piston return springs and forward clutch piston assembly (Fig. 7G-108).
5. Remove inner and outer seals from forward clutch piston (Fig. 7G-109).
6. If required, remove input shaft from forward clutch drum, using a ram press or arbor press.

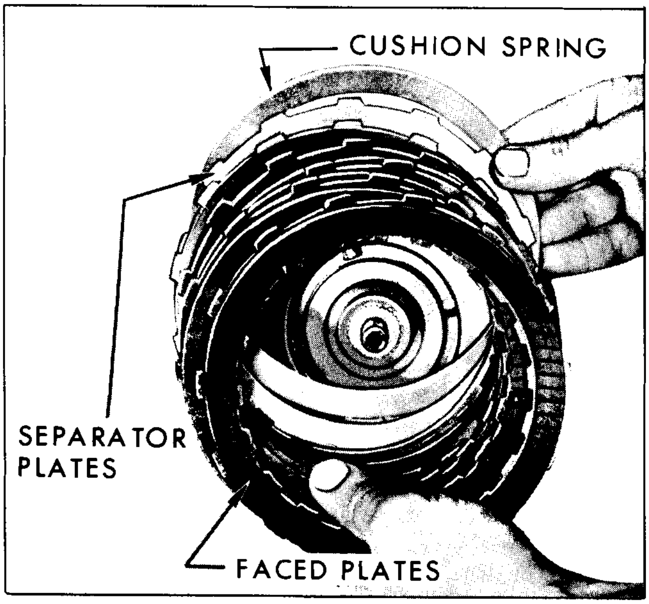


Fig. 7G-107 Removing or Installing Forward Clutch Plates

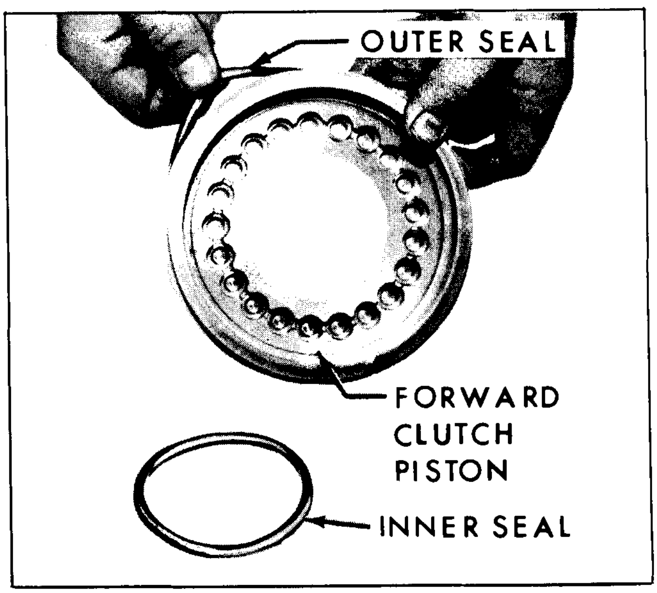


Fig. 7G-109 Removing Piston Inner and Outer Seals

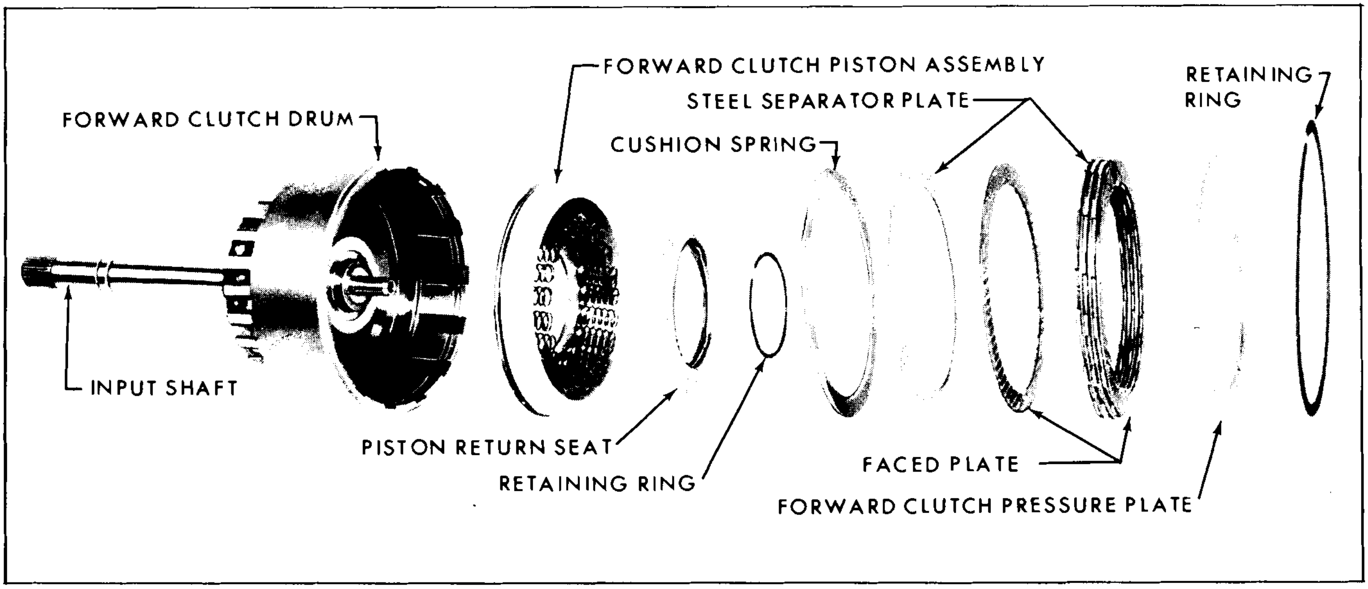


Fig. 7G-110 Exploded View of Forward Clutch

INSPECT (Fig. 7G-110)

1. Wash all parts in cleaning solvent, blow out all oil passages and air dry.

2. Inspect drive and driven clutch plates as follows:

    a. Dry the faced (lined) plates with compressed air and inspect for - pitting and flaking, wear, glazing, cracking, charring and/or chips (metal particles) imbedded in lining. If faced plate exhibits any of these conditions, replacement is required.

    b. Wipe the steel (separator) plates dry and check for heat discoloration. If the surface is smooth and an even color smear is observed, plates should be re-used. If surface is scuffed or shows severe heat discoloration, the plates must be replaced.

3. Inspect all springs for collapsed coils or signs of distortion.

4. Inspect piston for cracks.

5. Inspect clutch drum for wear, scoring, cracks, proper opening of oil passages and free operation of ball check (Fig. 7G-111).

6. Inspect input shaft for:

    a. open lubrication passages at each end.

    b. damage to splines or shaft.

    c. damage to ground bushing journals.

    d. cracks or distortion of shaft.

NOTE: *Input shaft and clutch drum are* **not** *serviced separately.*

ASSEMBLE

1. If input shaft was removed from clutch drum, reinstall, using a ram press or arbor press.

2. Install forward clutch piston outer and inner seals (lips down) in clutch piston (Fig. 7G-109).

3. Install forward clutch piston assembly into drum by using a piece of .020" music wire crimped into short section of copper tubing (Fig. 7G-112).

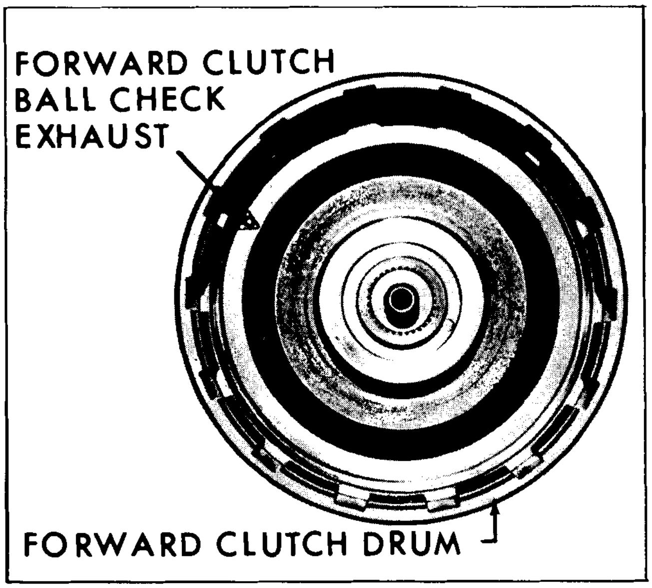


Fig. 7G-111 Location of Ball Check Exhaust

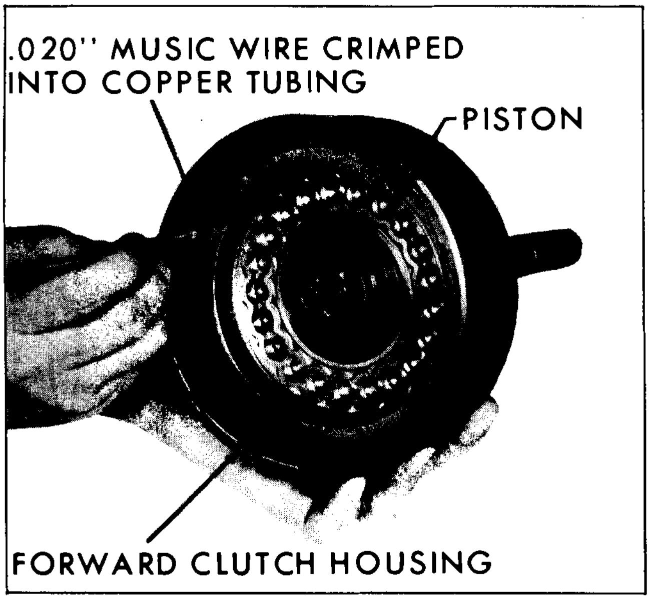


Fig. 7G-112 Installing Forward Clutch Piston

4. Install twenty-one (21) piston return springs and spring seat into piston.

   NOTE: *Free length of springs is 1 1/16" by 1/2" diameter and springs are violet in color.*

5. Using Clutch Spring Compressor J 23327-1 in a press, compress spring seat and install piston retaining ring.

6. Remove tool and lubricate plates with transmission fluid.

7. On **V-8 models,** install cushion spring and, starting with a steel plate, alternately install five (5) steel and five (5) faced plates into the forward clutch drum (Fig. 7G-107).

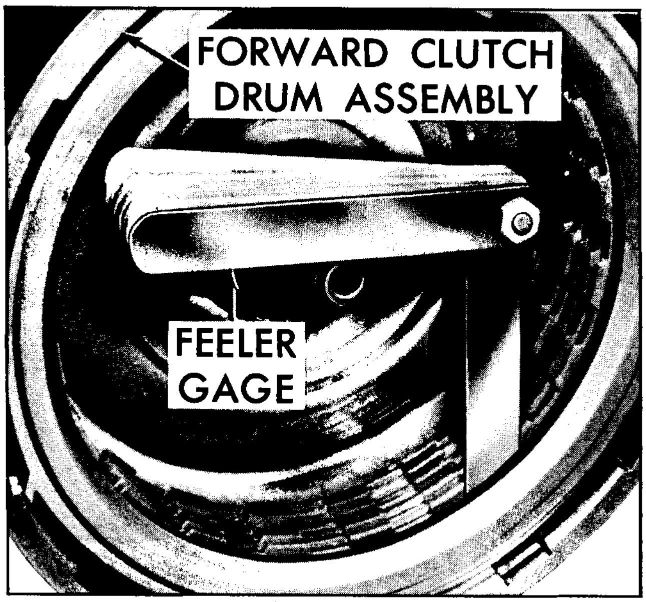


Fig. 7G-113 Checking Free Back Height

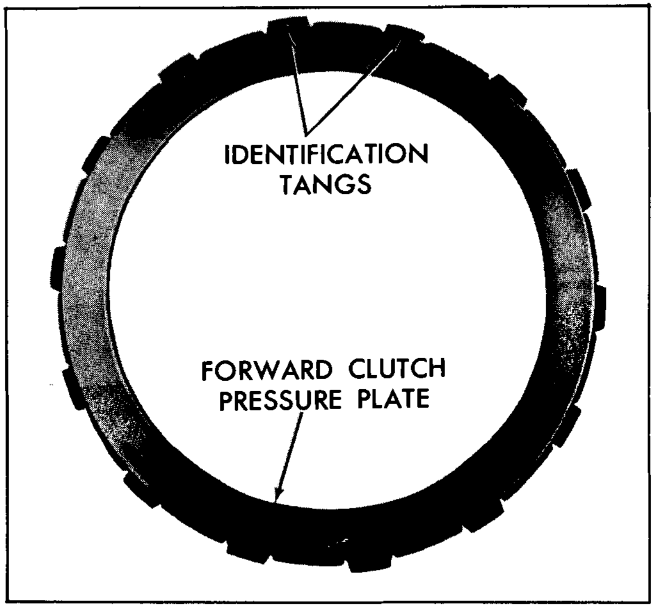


Fig. 7G-114 Pressure Plate Identification

On **6 cylinder models,** install cushion spring and, starting with a steel plate, alternately install four (4) steel and four (4) faced plates into the forward clutch drum (Fig. 7G-107).

8. Install forward clutch pressure plate and its retaining ring (Fig. 7G-108).

9. Using a feeler gage, check the free back height between the forward clutch pressure plate and faced plate (Fig. 7G-113).

The specifications of the transmission call for a free back height of no less than .0105" and no more than .0820".

NOTE: *There are three pressure plates of different thickness that are available for service and are identified by tangs adjacent to the source identification mark (Fig. 7G-114):*

a. Pressure plate with no tangs is .245" to .255" thick.

b. Pressure plate with 1 tang is .275" to .285" thick.

c. Pressure plate with 2 tangs is .306" to .316" thick.

10. a. If free back height checks out to be between .0105" and .0820", no change of pressure plate is needed.

    b. If free back height checks out to be less than .0105", remove the pressure plate, check for thickness of pressure plate (use absence of or number of tangs as indicated by NOTE above) and install a thinner pressure plate that will a clearance of .0105" to .0820".

c. If free back height checks out to be greater than .0820", remove the pressure plate, check for thickness of pressure plate (use absence of or number of tangs as indicated by NOTE above) and install a thicker pressure plate that will give a clearance of .0105" to .0820".

SUN GEAR AND SUN GEAR DRIVE SHELL

DISASSEMBLE

1. Remove sun gear-to-sun gear drive shell rear retaining ring. Discard ring (Fig. 7G-115).
2. Remove sun gear-to-drive shell rear flat thrust washer (Fig. 7G-116).
3. Remove sun gear from drive shell and remove front retaining ring from sun gear. Discard ring (Fig. 7G-117).

INSPECT

1. Wash all parts in cleaning solvent and air dry.
2. Inspect sun gear and sun gear drive shell for wear or damage.
3. Inspect sun gear bushings for galling or scoring. If bushing(s) is damaged, replace as follows:
   a. Using Bushing Tool J 23062-3, Extension J 21465-13 and Drive Handle J 8092 and with sun gear properly supported, drive out bushings (2).
   b. Using Bushing Tool J 23062-3 and Drive Handle J 8092, install each new bushing flush to .010" below surface of each counterbore (Fig. 7G-118).

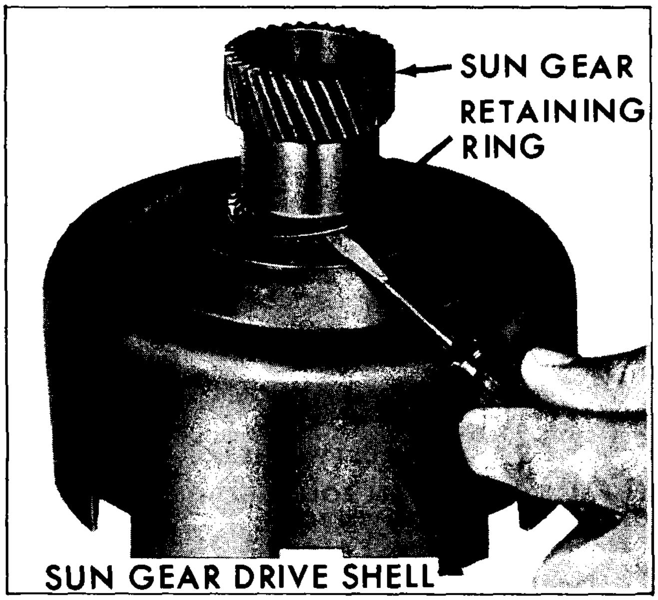


Fig. 7G-115 Removing Rear Retaining Ring

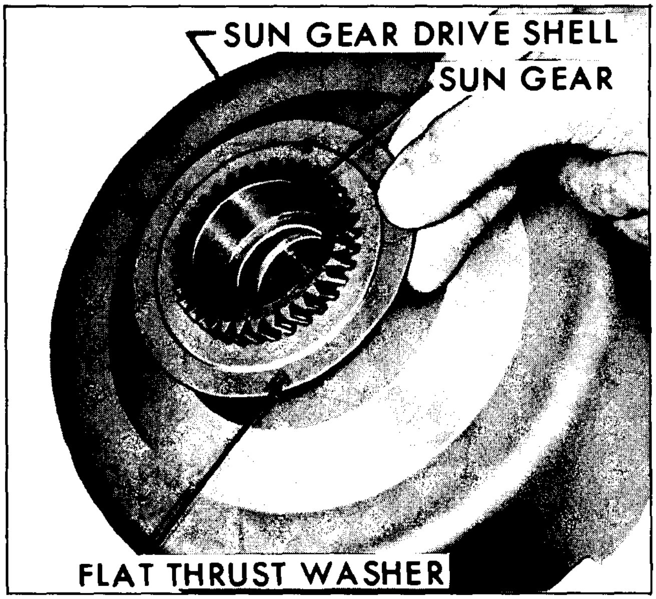


Fig. 7G-116 Removing or Installing Rear Thrust Washer

ASSEMBLE

1. Install new front retaining ring on sun gear.
2. Install sun gear into sun gear drive shell (Fig. 7E-117).
3. Install sun gear-to-drive shell rear flat thrust washer (Fig. 7G-116).
4. Retain sun gear to drive shell with new rear retaining ring.

NOTE: *Do* **not** *over stress front and rear retaining rings on installation.*

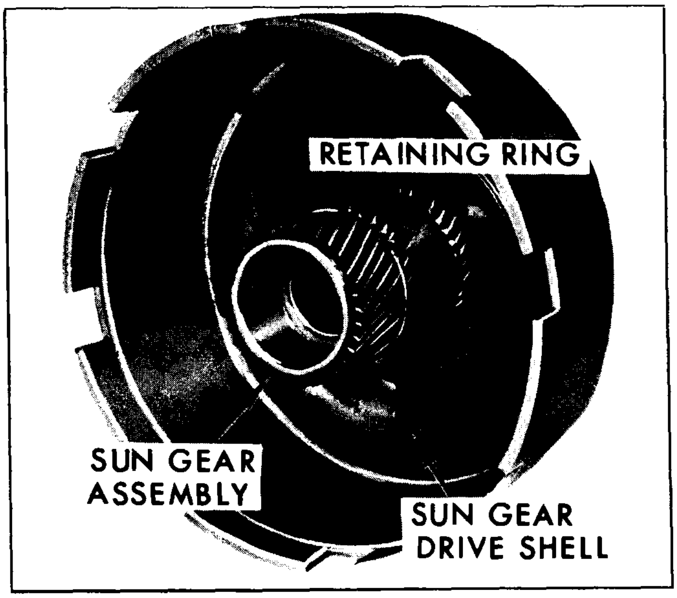


Fig. 7G-117 Removing or Installing Sun Gear

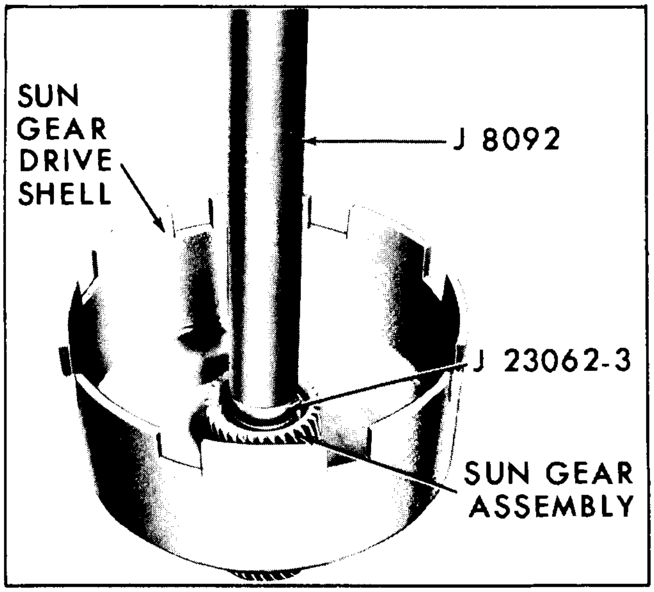


Fig. 7G-118 Installing Sun Gear Bushings

LOW AND REVERSE ROLLER CLUTCH (Fig. 7G-119)

DISASSEMBLE

1. Remove low and reverse overrun clutch inner race from support assembly.

CAUTION: *Before removal, check for correct assembly. Inner race should free wheel clockwise only.*

2. Remove low and reverse roller clutch front retaining ring and low and reverse roller clutch assembly from support.

INSPECT

1. Wash parts in cleaning solvent and air dry.
2. Inspect roller clutch inner and outer races for scratches, wear or indentations.
3. Inspect roller clutch assembly rollers for wear and roller springs for distortion.

NOTE: *If rollers are removed from assembly, install rollers from outside in to avoid bending springs.*

ASSEMBLE

1. Install low and reverse roller clutch assembly in support.

NOTE: *Install roller clutch assembly with four (4) oil holes facing rear of transmission.*

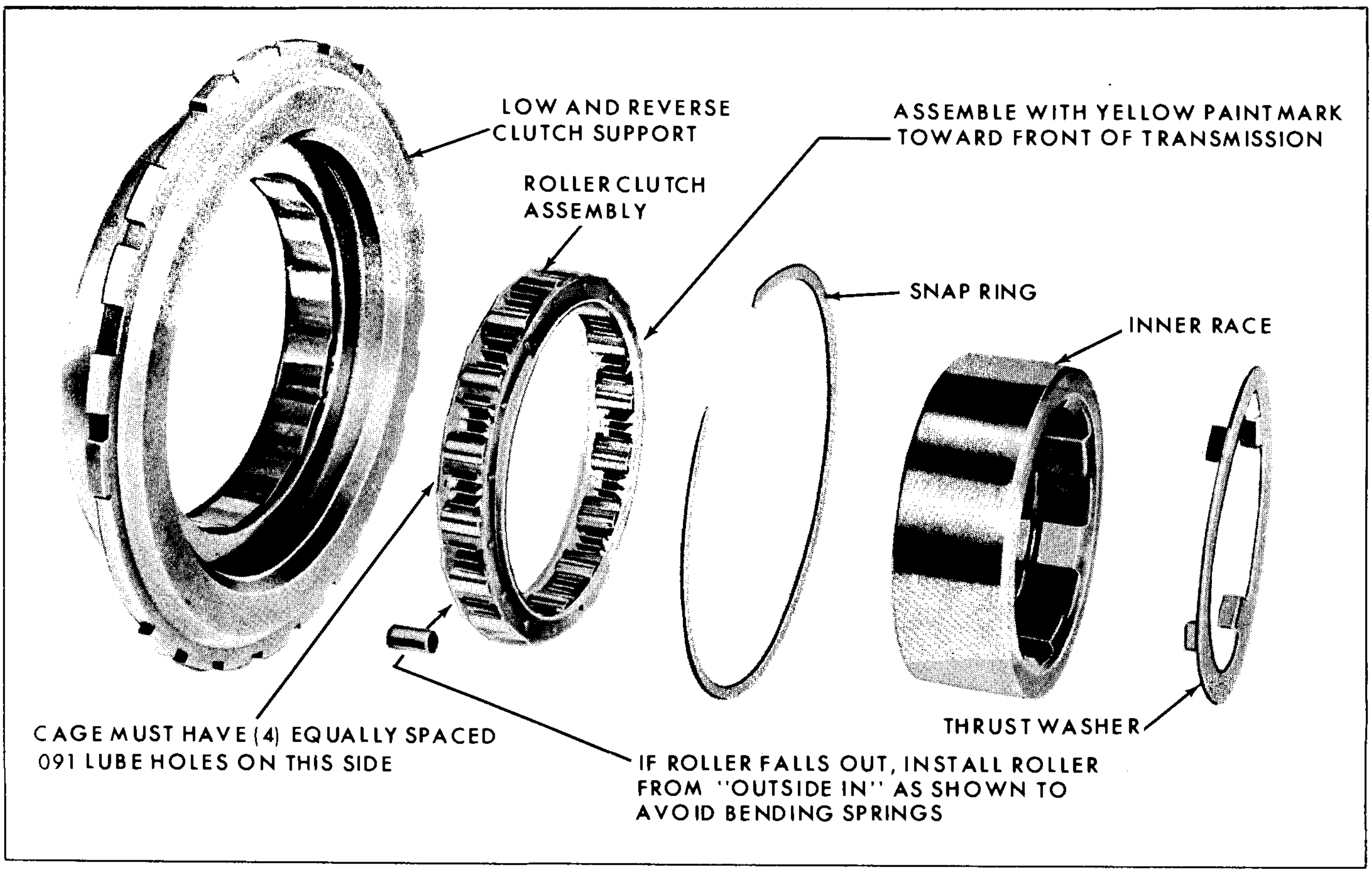


Fig. 7G-119 Exploded View of Low and Reverse Roller Clutch

2. Install low and reverse roller clutch front retaining ring.

3. Install low and reverse overrun clutch inner race.

NOTE: *When roller clutch assembly is properly installed, inner race will free wheel clockwise only.*

INPUT RING GEAR

INSPECT

1. Wash in cleaning solvent and air dry.

2. Check to see that forward clutch faced plates are a free fit over input ring gear hub.

3. Examine condition of hub splines and mating splines of forward clutch faced plates.

4. Inspect thrust washer surface for signs of scoring or wear.

5. Inspect input ring gear bushing for galling or scoring. If bushing is damaged, replace as follows:

   a. Using Bushing Tool J 23062-5 and Drive Handle J 8092 and with input ring gear properly supported, drive out bushing (Fig. 7G-120).

   b. Using Bushing Tool J 23062-5 and Drive Handle J 8092, install new bushing to .050"-.060" below rear face, inside gear end (Fig. 7G-120).

OUTPUT CARRIER

INSPECT

1. Wash in cleaning solvent and air dry.

2. Inspect output carrier internal splines for nicks or damage.

3. Inspect thrust washer surface for signs of scoring or wear.

4. Inspect planet pinions for damage, rough bearings or excessive tilt.

5. Check output carrier pinion end play. Should be .009" to .024".

REACTION CARRIER

INSPECT

1. Wash in cleaning solvent and air dry.

2. Check to see that low and reverse clutch faced plates are a free fit over reaction carrier hub.

3. Examine condition of carrier hub splines and mating splines of low and reverse clutch faced plates.

4. Inspect thrust washer surface for signs of scoring or wear.

5. Inspect planet pinions for damage, rough bearings or excessive tilt.

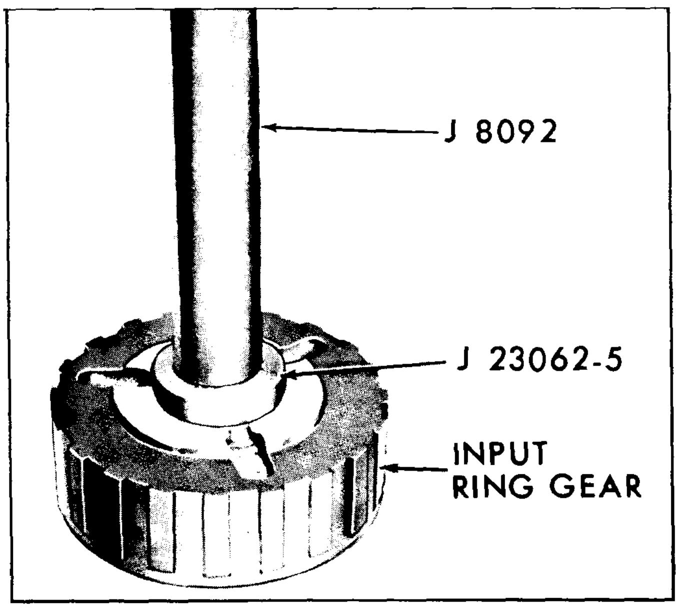


Fig. 7G-120 Removing or Installing Input Ring Gear Bushing

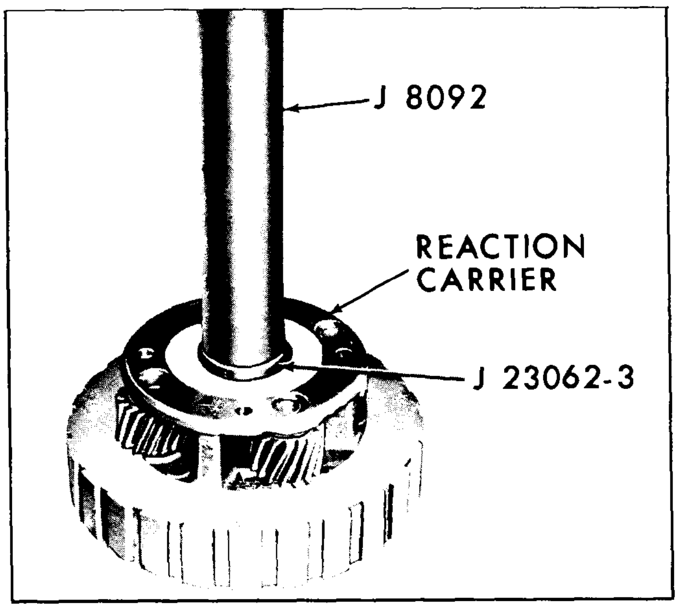


Fig. 7G-121 Removing or Installing Reaction Carrier Bushing

b. Using Bushing Tool J 23062-3 and Drive Handle J 8092, install new bushing flush to .010" below inside face (Fig. 7G-121).

6. Check reaction carrier pinion end play. Should be .009" to .024".

7. Inspect reaction carrier bushing for nicks, scoring or wear. If bushing is damaged, replace as follows:

   a. Using Bushing Tool J 23062-3 and Drive Handle J 8092 and with reaction carrier properly supported, drive out bushing (Fig. 7G-121).

OUTPUT RING GEAR AND OUTPUT SHAFT

INSPECT

1. Wash in cleaning solvent and air dry.

2. Check output ring gear for tooth damage.

3. Inspect output ring gear and output shaft splines for nicks or damage.

4. Check output shaft bearing surface for nicks or scoring.

5. Check output shaft bushing for nicks, scoring or wear. If bushing is damaged, replace as follows:

   a. Thread Bushing Tool J 9534 into output shaft bushing, thread Adapter J 2619-4 and Slide Hammer J 2619 into Bushing Tool and remove bushing (Fig. 7G-122).

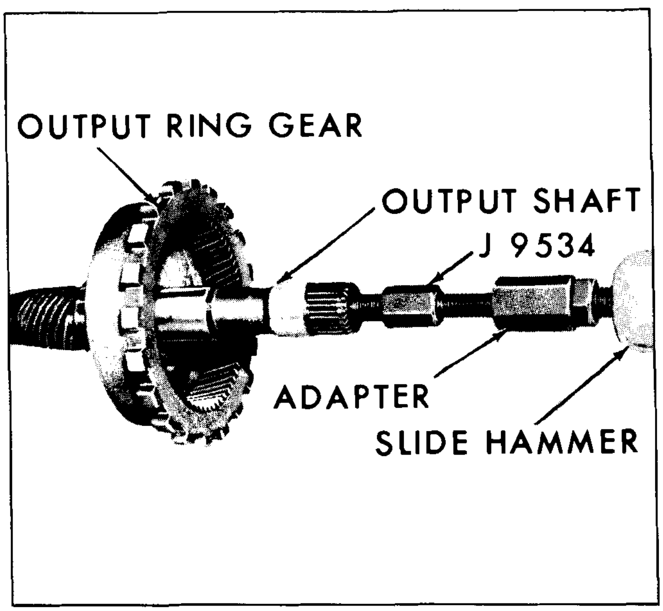


Fig. 7G-122 Removing Output Shaft Bushing

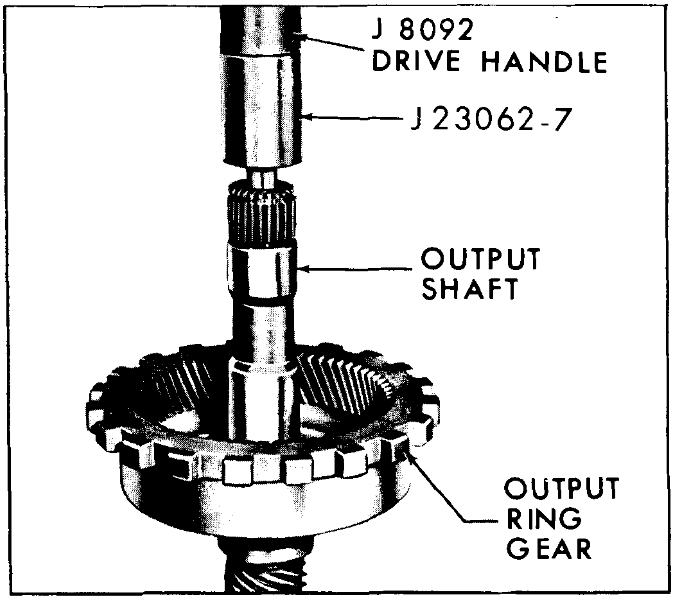


Fig. 7G-123 Installing Output Shaft Bushing

b. Install new bushing into front end of output shaft by using Bushing Tool J 23062-7 and Drive Handle J 8092.

c. Press in bushing .140" below end surface of shaft (Fig. 7G-123).

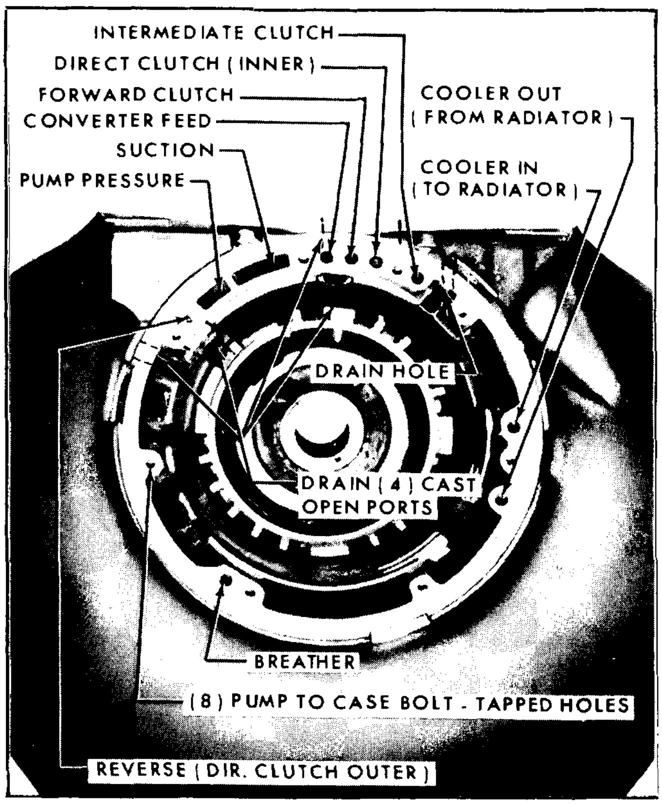


Fig. 7G-124 Front View of Case Oil Passages

TRANSMISSION CASE

INSPECT

1. Wash in cleaning solvent, blow out all oil passages and air dry.
2. Inspect case for cracks, porosity or interconnected passages, using air gun or smoke (Figs. 7G-124 and 7G-125).
3. Inspect threaded holes for thread damage.
4. Inspect ring grooves for damage.
5. Inspect governor bore for scoring or damage. If bore is damaged, see INSTALLATION OF GOVERNOR BUSHING IN CASE below.
6. Inspect intermediate clutch accumulator bore for scoring or damage.
7. Check case bushing for nicks, scoring or wear. If bushing is damaged, see REPLACEMENT OF CASE BUSHING.

INSTALLATION OF GOVERNOR BUSHING IN CASE

1. Position transmission case in Fixture J 8763-01 into a vise with the case governor face up (Fig. 7G-126).

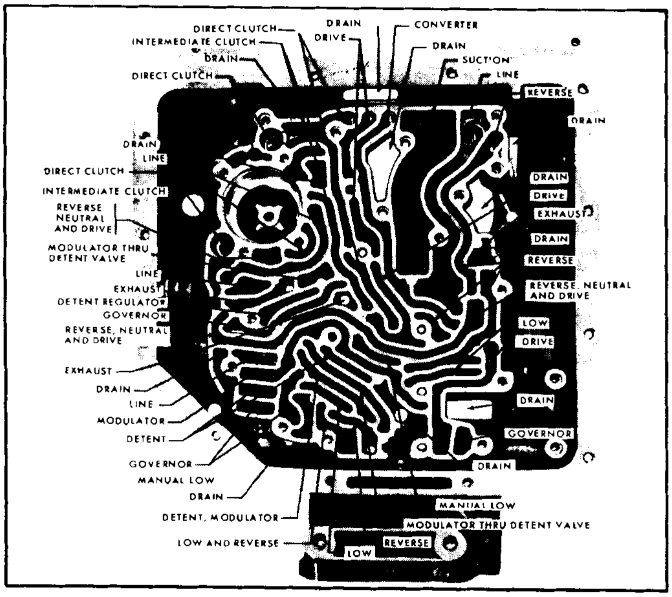


Fig. 7G-125 Bottom View of Case Oil Passages

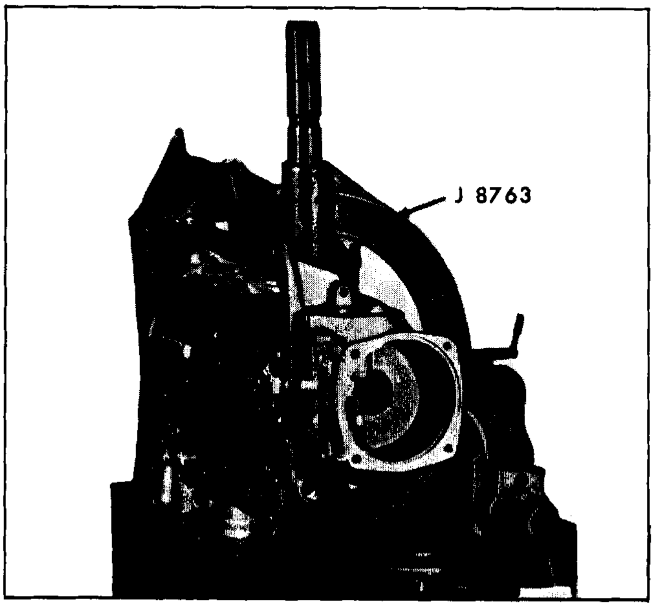


Fig. 7G-126 Transmission Fixture in Vise

2. Clean off excess stock from the governor o-ring seal-to-case mating surface with a file (Fig. 7G-127).
3. Loosely bolt the Drill Bushing Fixture J 22976-1 to the case and place Alignment Arbor J 22976-3 into the fixture and down into the governor bore until it bottoms on the dowel pin (Fig. 7G-128).
4. Torque the bolts on the bushing fixture to 10 ft. lbs.

CAUTION: *Do not over torque and strip the threads. The alignment arbor should rotate freely after the bolts are properly torqued. If*

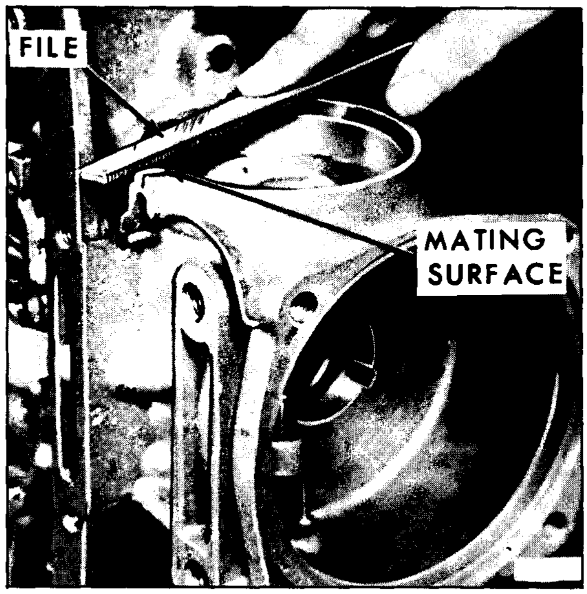


Fig. 7G-127 Filing Excessive Stock from Case.

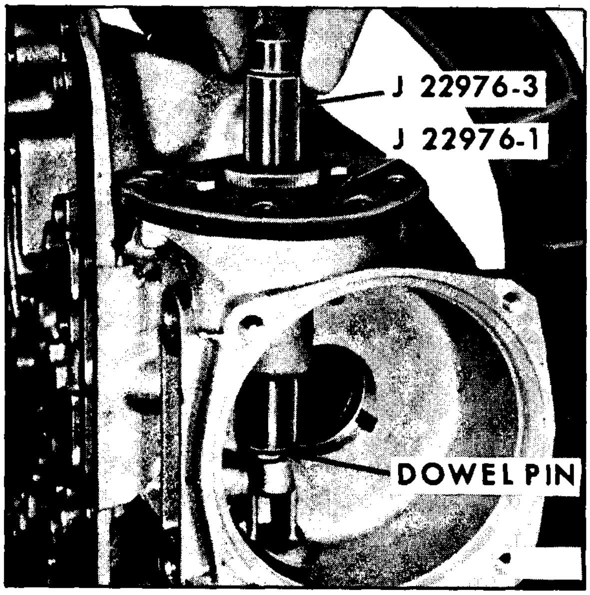


Fig. 7G-128 Installing Tools to Governor Bore

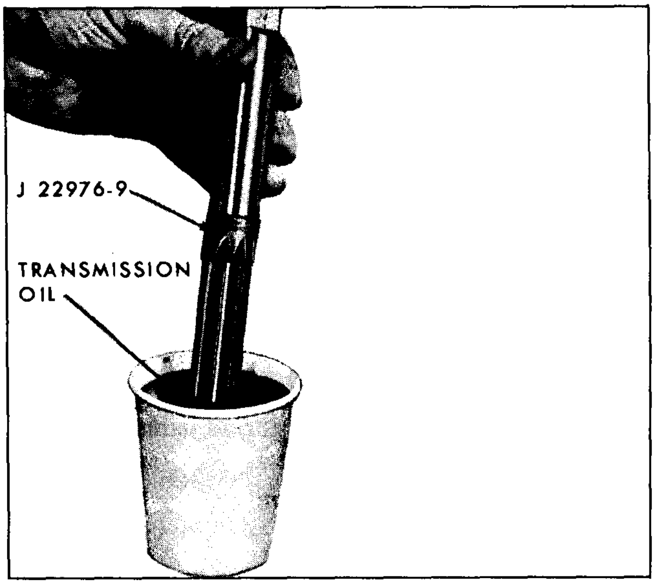


Fig. 7G-130 Cleaning and Lubricating Reamer

arbor cannot be rotated by hand, recheck work done in step 2.

5. Remove the alignment arbor and, using Reamer J 22976-9 and a drive ratchet, hand ream the governor bore by using the following procedure:

CAUTION: Hand Ream Only!

a. Lubricate the reamer, the bushing fixture and the governor bored the case.

b. Using 5 to 10 pounds of feeding force on the reamer, begin to ream out the bore (Fig. 7G-129).

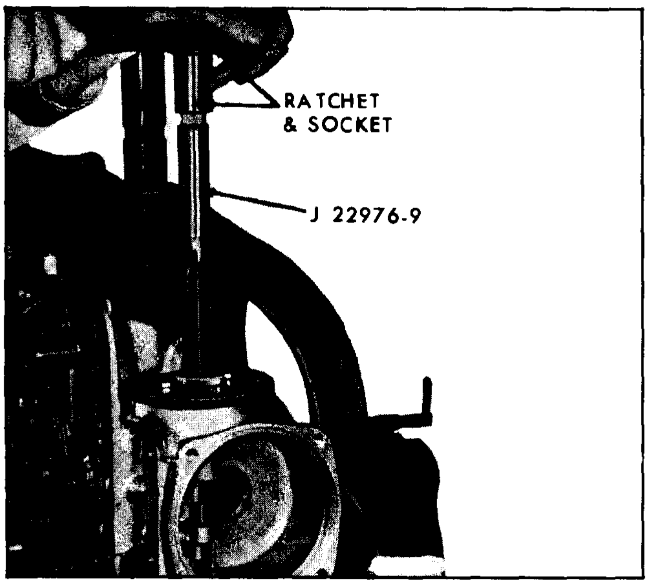


Fig. 7G-129 Reaming Out Governor Bore

c. After each 10 revolutions, remove reamer and dip it in a cup full of transmission fluid to clean the chips from the reamer and lubricate it (Fig. 7G-130).

d. When reamer reaches end of the bore, continue reaming until the reamer bottoms out on the dowel pin in the case, shown in Fig. 7G-129.

e. Remove the reamer by rotating clockwise and using 5 to 10 pounds of upward force.

CAUTION: *Pulling reamer without rotating can score the bore, resulting in a leak between the case and the bushing.*

6. Remove Drill Bushing Fixture J 22976-1 and thoroughly clean all chips from the case, visually check the governor feed holes in the case to insure that they are free of chips.

7. Install the service bushing, using the following procedure:

a. Note the two (2) notches at one end of the bushing.

b. Position bushing into governor bore with notched end up so that one notch is toward the front of the case and the other notch toward the bottom of the case (Fig. 7G-131).

c. Using Alignment Arbor J 22976-3, drive the bushing into the case until it is flush with the top of its bore (Fig. 7G-132).

CAUTION: *A brass hammer should be used to strike the hardened steel alignment arbor tool.*

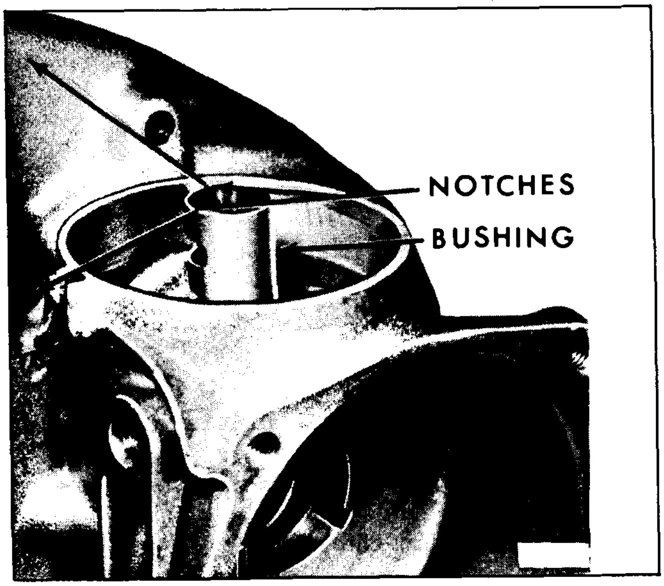


Fig. 7G-131 Alignment of Governor Bushing

8. Lubricate a new governor and insert it into the installed bushing. The governor should spin freely. If a slight honing of the bushing is necessary, use crocus or fine emery cloth and move in a circular direction only.

REPLACEMENT OF CASE BUSHING

1. Collapse bushing by using screwdriver in bore slot and remove bushing.
2. Using Bushing Tool J 23062-1, Extension J 21465-13 and Drive Handle J 8092, drive new bushing in from front of case to .195" below front surface of bore (Fig. 7G-133).

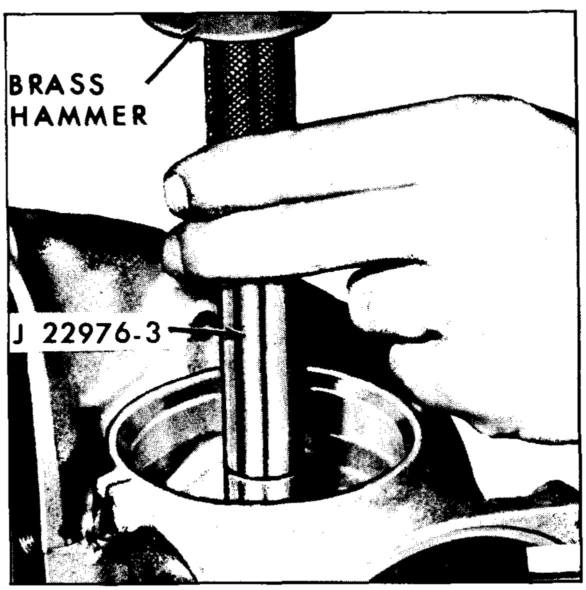


Fig. 7G-132 Installing Governor Bushing

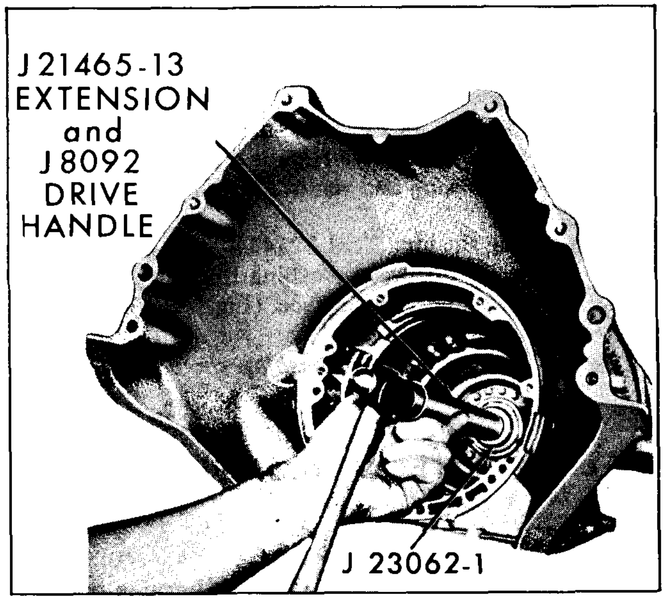


Fig. 7G-133 Installing Case Bushing

NOTE: *Make certain that split in bushing is opposite notch in case.*

EXTENSION HOUSING

INSPECT

1. Wash in cleaning solvent and air dry.
2. Inspect housing for cracks or porosity.
3. Inspect housing-to-case seal mounting face for damage.
4. Be sure that rear seal drain back port is not obstructed.

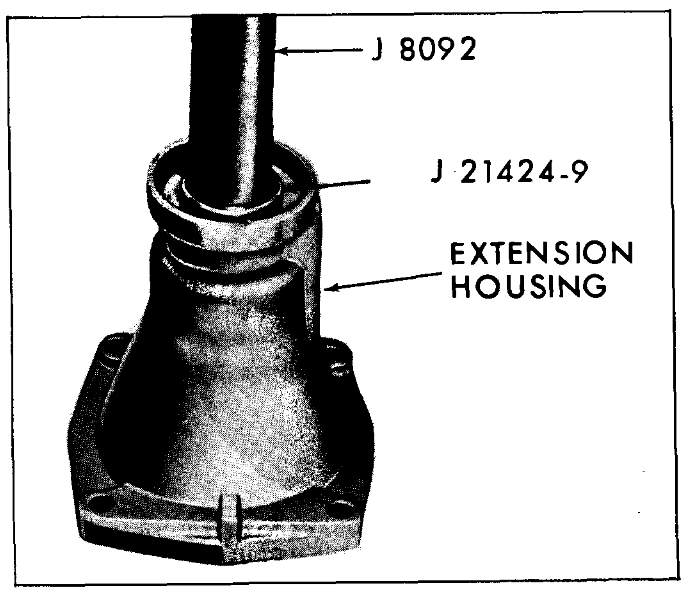


Fig. 7G-134 Removing or Installing Extension Housing Bushing

5. Inspect extension housing bushing for nicks, scoring or wear. If bushing is damaged, replace as follows:

   a. Remove lip oil seal from extension housing if not done previously and, using Bushing Tool J 21424-9 and Drive Handle J 8092, drive bushing into housing and remove bushing (Fig. 7G-134).

   b. Using Bushing Tool J 21424-9 and Drive Handle J 8092, drive new bushing flush to .010" below seal counterbore surface. (Fig. 7G-134).

   NOTE: *Notches in bushing should be toward front of extension.*

INTERMEDIATE OVERRUN BRAKE BAND

INSPECT

1. Inspect lining for cracks, flaking, burning or looseness.

2. Inspect band for cracks or distortion.

3. Inspect ends of band for damage at anchor lug or apply lug.

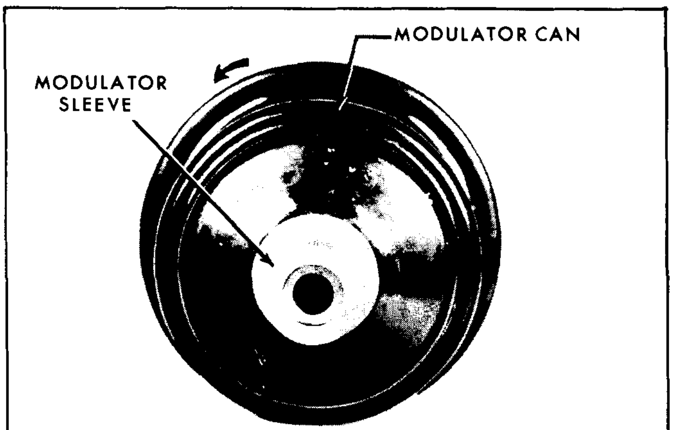
VACUUM MODULATOR

INSPECT

1. Inspect modulator assembly for any signs of bending or distortion -

   a. Roll main body of modulator on a flat surface and observe sleeve for concentricity to body (Fig. 7G-135).

   b. If sleeve is concentric and modulator valve is free within sleeve, modulator is acceptable.



ROLL MODULATOR ON FLAT SURFACE TO DETERMINE IF THE SLEEVE IS CONCENTRIC TO THE MODULATOR CAN. IF THE SLEEVE IS BENT,RUNOUT WILL BE VISIBLE.

Fig. 7G-135 Checking Concentricity of Sleeve

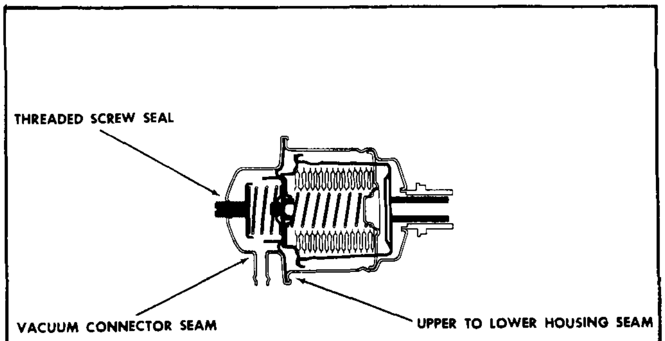


Fig. 7G-136 Vacuum Modulator Seams and Seal

2. Atmospheric leak check -

   a. Apply liberal coating of soap bubble solution (available at 5-10 cent store) to vacuum connector pipe seam, crimped upper-to-lower housing seam and to threaded screw seal (Fig. 7G-136).

   b. Using a short piece of rubber tubing, apply air pressure to vacuum pipe by blowing into tubing and observe for leak bubbles.

   c. If bubbles appear, replace modulator.

   CAUTION: *Do* **not** *use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage modulator.*

3. Inspect O-ring seal seat for damage.

4. Vacuum diaphragm leak check (Fig. 7G-137) -

   a. Insert 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 modulator.

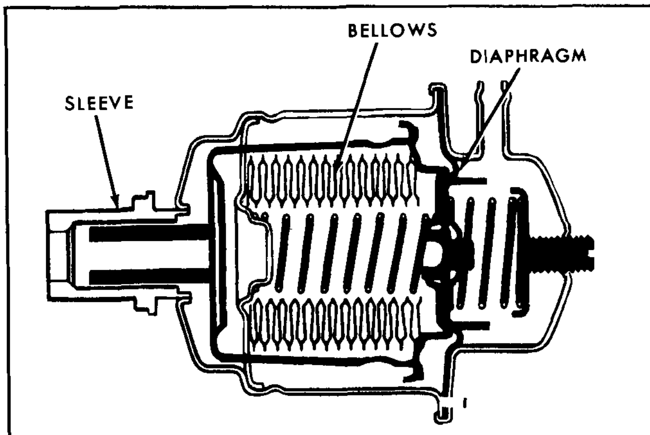


Fig. 7G-137 Cross Section of Vacuum Modulator

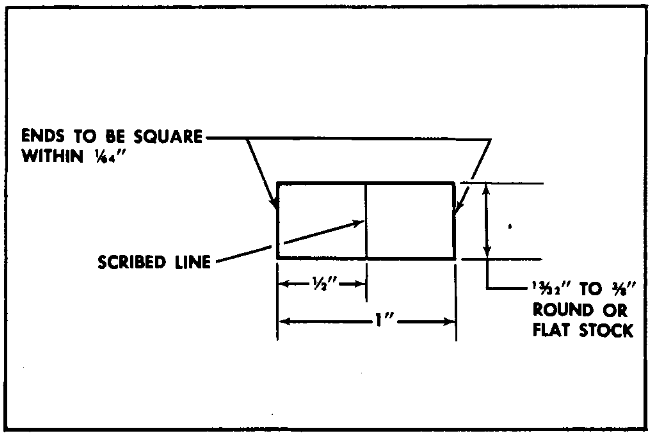


Fig. 7G-138 Comparison Gauge

NOTE: *Gasoline or water vapor may settle in vacuum side of diaphram. If this is found* **without** *presence of transmission fluid, modulator should* **not** *be replaced.*

5. Bellows comparison check -
   a. Install known good modulator on either end of a comparison gage (Fig. 7G-138) and install modulator in question on opposite end.
   b. Holding modulator in horizontal position, bring them together under pressure until either modulator sleeve just touches line in center of gage (Fig. 7G-139).
   c. Gap between opposite modulator sleeve ends and center line of gage should be 1/16" or less (Fig. 7G-140). If gap is greater than 1/16", modulator in question should be replaced (Fig. 7G-141).
6. Inspect modulator valve for nicks or damage.
7. Check freeness of valve operation in case bore.
8. If modulator assembly passes all of above checks, it is an acceptable part and should be re-used.

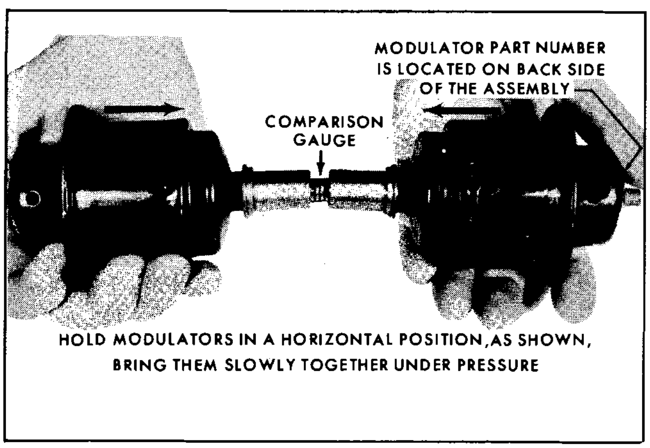


Fig. 7G-139 Bringing Modulators Together

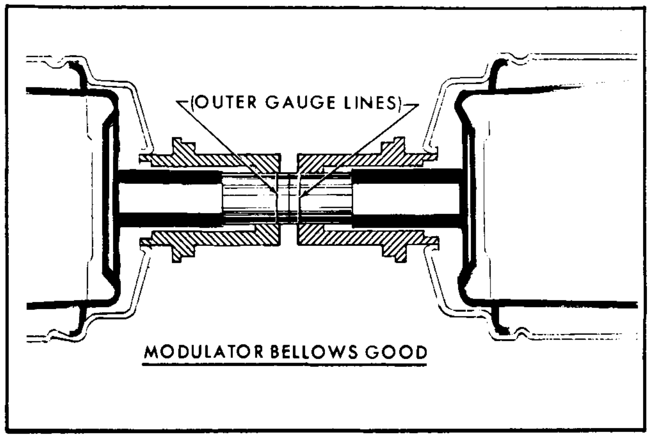


Fig. 7G-140 Modulator Bellows Good

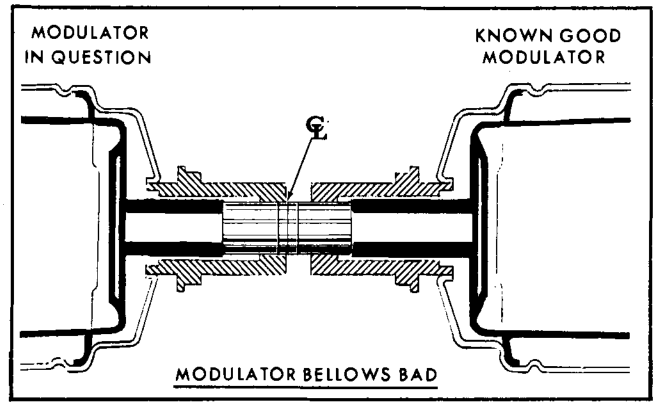


Fig. 7G-141 Modulator Bellows Bad

MANUAL AND PARKING LINKAGE

INSPECT

1. Inspect manual shaft for damaged threads, rough oil seal surface or looseness of shaft on range selector inner lever.
2. Inspect range selector inner lever for cracks, looseness on manual shaft or other damage.
3. Inspect detent roller and spring assembly for damage.
4. Inspect parking pawl actuating rod for cracks or broken retainer lugs.
5. Inspect actuator for free fit on parking actuator rod.
6. Inspect parking pawl disengaging spring for deformed coils or ends.
7. Inspect parking lock bracket for cracks or wear.
8. If removed, inspect parking pawl and parking pawl shaft for cracks, wear or other damage.

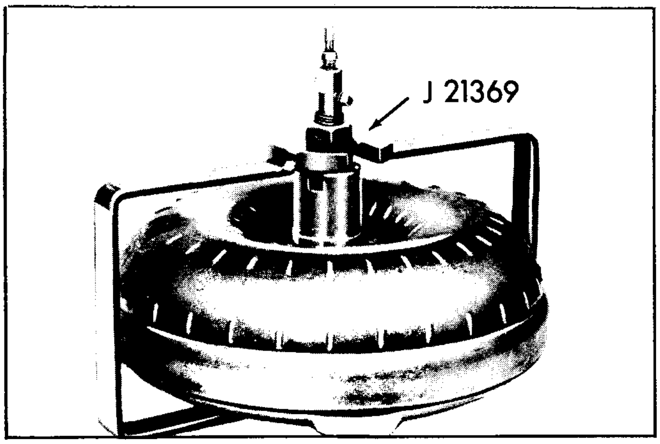


Fig. 7G-142 Air Checking Converter

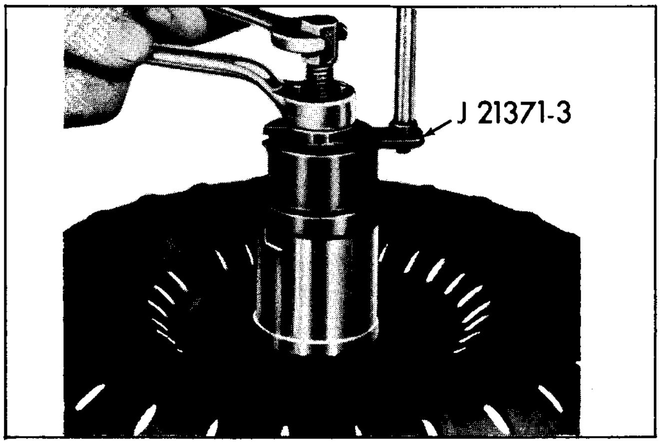


Fig. 7G-144 Tightening Hex Nut

CONVERTER

INSPECT

1. Check converter assembly for leaks:

   a. Install Leak Test Fixture J 21369 on converter hub and tighten.

   b. Fill converter assembly with 80 psi. of air, submerge in water and check for leaks (Fig. 7G-142).

2. Check converter hub surfaces for signs of scoring or wear.

3. Check converter assembly end play:

   a. Fully release collet end of End Play Tool J 21371-2 by turning its brass nut clockwise.

   b. Install collet end of End Play Tool J 21371-2 into converter hub until it bottoms, then tighten its brass nut counterclockwise to 5 lb. ft. torque (Fig. 7G-143).

   c. Install Tool J 21771-3 and, while preventing brass nut from turning, tighten hex nut to 3 lb. ft. torque (Fig. 7G-144).

   d. Install Dial Indicator J 8001 and set it for "zero", while its plunger rests on brass nut

   e. While holding brass nut stationary, loosen hex nut, allowing converter internal assembly to lower, until dial indicator shows that internal assembly has bottomed (Fig. 7G-145).

   f. Reading obtained on dial indicator will represent converter end clearance. If clearance is UNDER .050", converter is acceptable; if clearance is .050" or OVER, replace converter.

4. If fluid in the converter has the appearance of having been mixed with "aluminum paint", the converter is damaged internally and must be replaced.

NOTE: *Do not change the converter if a failure in some other part of the transmission has resulted in the converter containing dark, discolored fluid.*

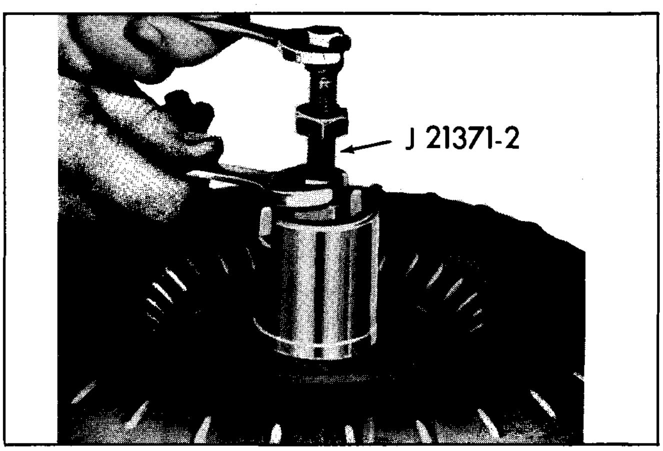


Fig. 7G-143 Installing End Play Tool J 21371-2

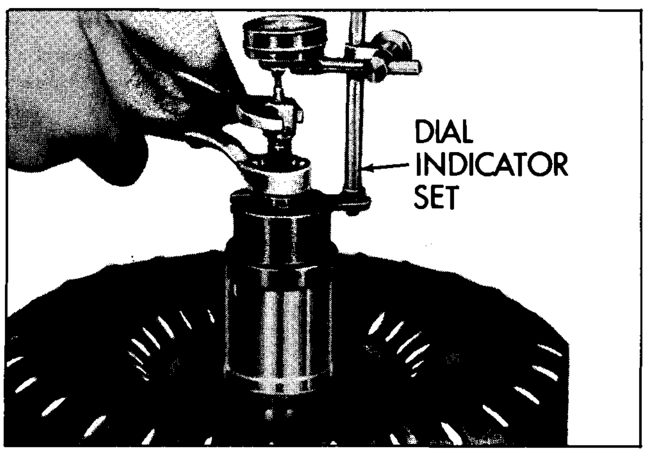


Fig. 7G-145 Checking Converter End Play

TRANSMISSION REASSEMBLY

Before starting to assemble the transmission, make certain that all parts are absolutely clean. Keep hands and tools clean to avoid getting dirt into the assembly. If work is stopped before assembly is completed, cover all openings with clean cloths.

Lubricate all bearings, seal rings, clutch plates and other moving parts with transmission fluid prior to re-assembly. Thrust washers may be held in place with petroleum jelly, sparingly applied.

Do not take chances on used gaskets and seals - use new ones to avoid oil leaks.

Use care to avoid making nicks or burrs on parts, particularly at bearing surfaces and surfaces where gaskets are used.

It is extremely important to tighten all parts evenly 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.

INSTALLATION OF INTERNAL COMPONENTS AND OIL PUMP

1. Install the outer hook-type oil seal ring to the intermediate clutch accumulator piston. If the teflon inner ring was removed, install a hook-type metal oil seal ring.
2. Install piston assembly into its bore in case (Fig. 7G-146).
3. Install piston spring into case and install O-ring seal to piston cover.

NOTE: *Free length of spring is 3 3/16" by 15/16" diameter.*

4. Install accumulator cover to its bore in case by installing compressor J 23069 on oil pan face with two (2) oil pan bolts, compress intermediate accumulator cover and install its retaining ring. Remove bolts and tool (Fig. 7G-147).

NOTE: *A production day and shift built number, transmission model and model year are stamped on the intermediate clutch accumulator piston cover. If cover is replaced, this information* **must** *be stamped on new cover.*

5. Install outer, center and inner flat seals to low and reverse clutch piston and install piston assembly into case.

NOTE: *Notch in low and reverse clutch piston must be installed adjacent to parking pawl and lug on back of piston aligned with its cavity in case.*

6. Install seventeen (17) piston return springs and spring retainer in case.

NOTE: *Free length of springs is 1 1/4" by 1/2" diameter and springs are orange in color.*

7. Using Compressor Tools J 23327-1, J 23327-2 and Pilot J 21420-2 in end of case, compress low and reverse clutch piston and spring retainer, install retaining ring and remove tools (Fig. 7G-148).

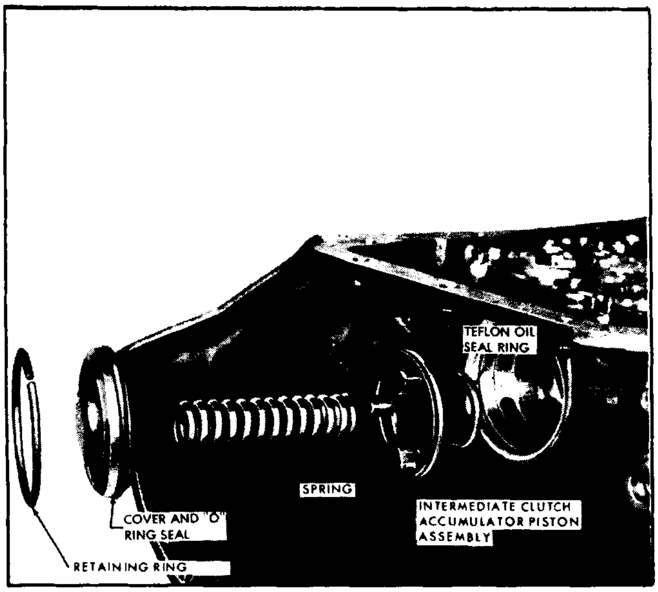


Fig. 7G-146 Exploded View of Intermediate Clutch Accumulator

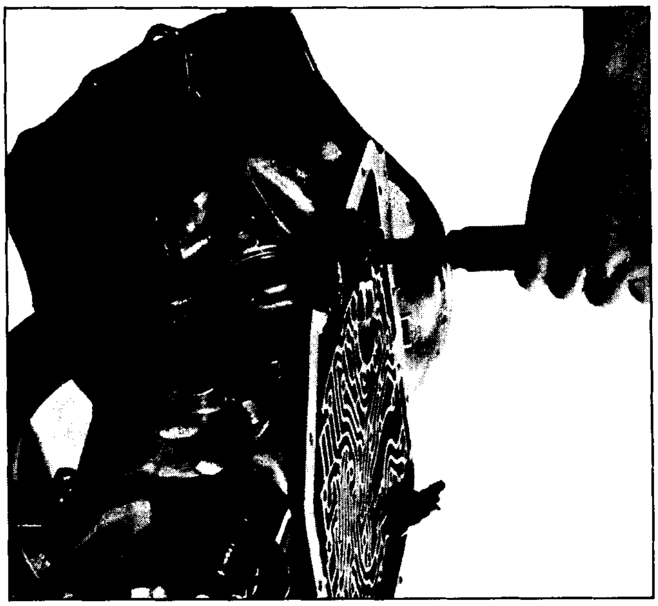


Fig. 7G-147 Compressing Accumulator Cover

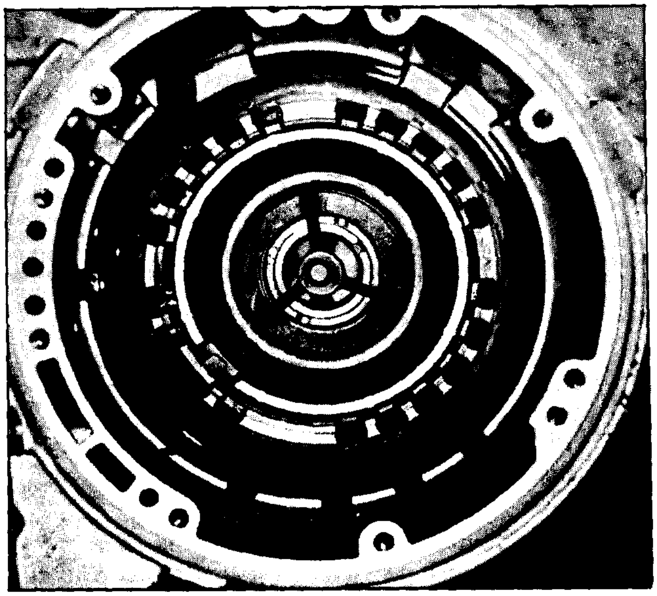


Fig. 7G-148 Compressing Low and Reverse Clutch Piston

NOTE: *If clearance for installing snap ring is not available, low and reverse clutch piston is probably not aligned properly in case.*

8. If output ring gear was separated from output shaft, install ring gear to output shaft, retaining with a new snap ring.
9. Install reaction carrier-to-output ring gear thrust washer into output ring gear face (Fig. 7G-149).

   NOTE: *Washer has three (3) narrow external tangs.*

10. Install output ring gear-to-case needle bearing onto output shaft and install output shaft assembly into case.

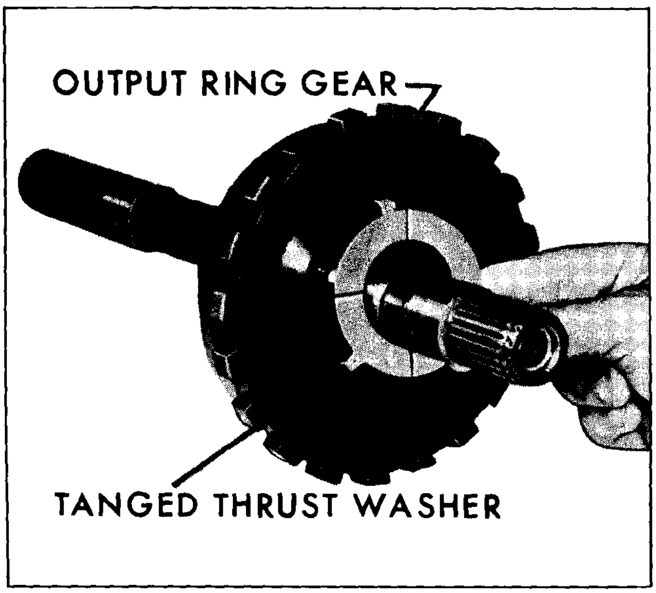


Fig. 7G-149 Installing Output Ring Gear Thrust Washer

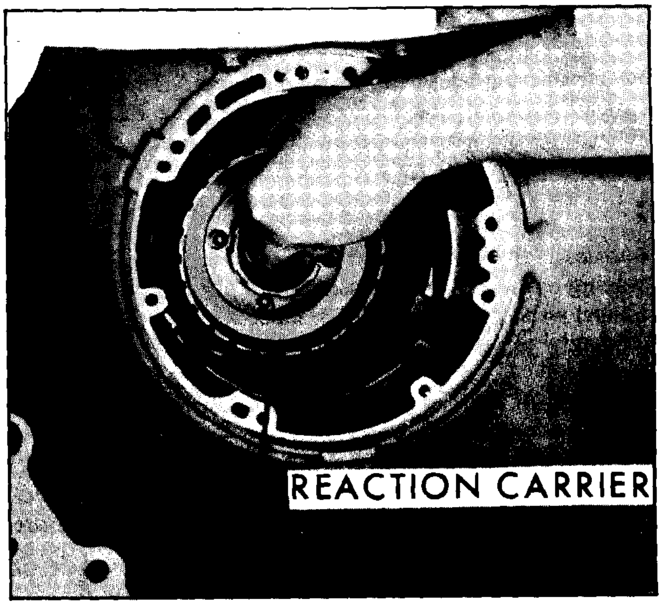


Fig. 7G-150 Installing Carrier onto Output Shaft

NOTE: *Lip on inner race of needle bearing faces rear of case.*

11. Install reaction carrier assembly onto output shaft assembly (Fig. 7G-150).
12. Lubricate plates with transmission fluid and:

    On **V-8 models**, install five (5) low and reverse clutch faced plates and five (5) steel separator plates into reaction carrier assembly, starting with a steel separator plate and alternating with faced plates (Fig. 7G-151).

    On **6 cylinder models**, install four (4) faced and four (4) separator plates into reaction carrier, starting with a steel separator plate (Fig. 7G-151).

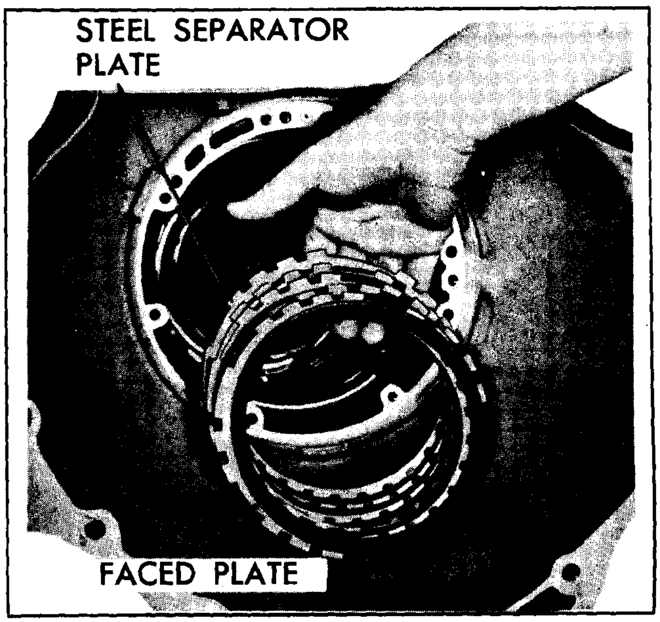


Fig. 7G-151 Installing Low and Reverse Clutch Pack

NOTE: *Notch in steel separator plates should be placed in bottom notch (5:30 o'clock position) of case.*

13. Install low and reverse clutch support retainer spring (Fig. 7G-66).

14. Install low and reverse roller clutch and support assembly into case, pushing firmly until support assembly is seated past the top of low and reverse clutch support retainer spring (Fig. 7G-65).

IMPORTANT: *Make certain splines on inner race of roller clutch align with splines on reaction carrier.*

15. Install low and reverse roller clutch support-to-case retaining ring (Fig. 7G-64).

16. Install low and reverse roller clutch inner race-to-sun gear drive shell thrust washer into roller clutch inner race (Fig. 7G-152). This washer has four (4) wide internal tangs.

17. Install sun gear drive shell assembly into low and reverse roller clutch and support assembly (Fig. 7G-63).

18. Install output carrier assembly into drive shell (Fig. 7G-62).

19. Install new output carrier-to-output shaft snap ring.

CAUTION: *Do* **not** *overstress snap ring.*

20. Install input ring gear-to-output carrier thrust washer. This washer has four (4) external tangs.

21. Install input ring gear (Fig. 7G-61).

22. Install forward clutch housing-to-input ring gear thrust washer into input ring gear face. This washer has three (3) wide external tangs.

23. Install direct clutch drum-to-forward clutch drum needle roller bearing and install forward clutch assembly into direct clutch assembly.

24. Holding by input shaft, install clutch assemblies onto input ring gear (Fig. 7G-60).

CAUTION: *Make certain that forward clutch faced plates are positioned over input ring gear and that tangs on direct clutch housing are installed into slots on sun gear drive shell. Make certain that clutch plates are indexed with their respective parts* **before** *going further.*

25. Install intermediate overrun brake band with anchor lug and apply lug positioned properly.

26. Install intermediate clutch pressure plate (Fig. 7G-153), lubricate with transmission fluid and:

On *V-8 models*, install three (3) intermediate clutch faced plates and three (3) steel separator plates, starting with a faced plate and alternating steel separator plates (Fig. 7G-59).

On **6 cylinder models**, install two (2) faced and two (2) separator plates, starting with a faced plate (Fig. 7G-59).

NOTE: *Notch in steel separator plates should be placed in case notch adjacent to selector lever inner bracket (4:00 o'clock position).*

27. Install intermediate clutch cushion spring.

28. Install new pump-to-case gasket on face of case and

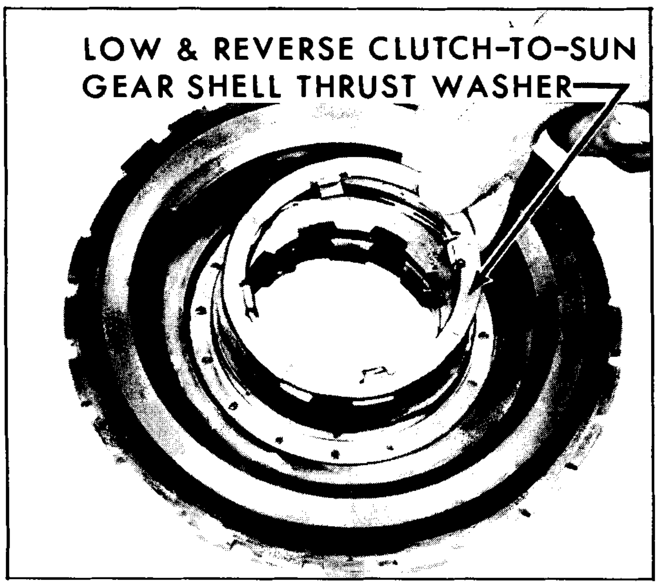


Fig. 7G-152 Installing Shell Thrust Washer

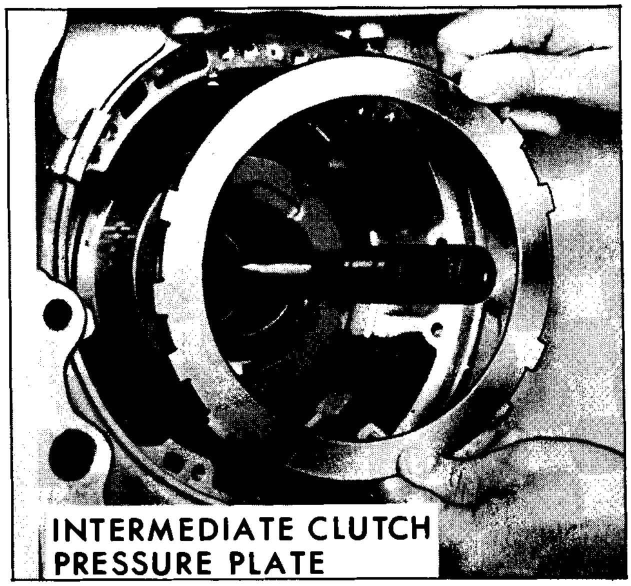


Fig. 7G-153 Installing Pressure Plate

install new pump body-to-case O-ring seal (square cut) on pump cover.

29. Aligning marks made on disassembly, install oil pump to case.

30. Install all but one (at 4 o'clock position) pump attaching bolts and tighten alternately to 20 lb. ft. torque.

NOTE: *Use new washer-type seals on pump bolts.*

IMPORTANT: *If the input shaft can* **not** *be rotated as the pump is being pulled into place or the pump can* **not** *be pulled down properly, the direct and forward clutch housings have not been installed properly to index the faced plates with their respective parts. This condition* **must** *be corrected* **before** *pump is pulled into place.*

31. Check front unit end play as follows:
    a. Move transmission so that output shaft points down and install a 5/16"-18 threaded slide hammer bolt (or J 21904-1) into threaded bolt hole in pump body (at 4 o'clock position).
    b. With flat of hand, move input shaft rearward and mount dial indicator J 8001 on bolt and index plunger of indicator on end of input shaft. "Zero" the indicator (Fig. 7G-154).
    c. Push up on output shaft and record the amount of end play registered by the dial indicator.
    d. Indicator should read from .033" to .064". If reading is within these limits, proper selective thrust washer is being used.

NOTE: *Front unit end play is controlled by thickness of pump cover-to-direct clutch drum selective thrust washer. This is the washer having one (1) tang (Fig. 7G-155).*

Fig. 7G-154 Checking Front Unit End Play

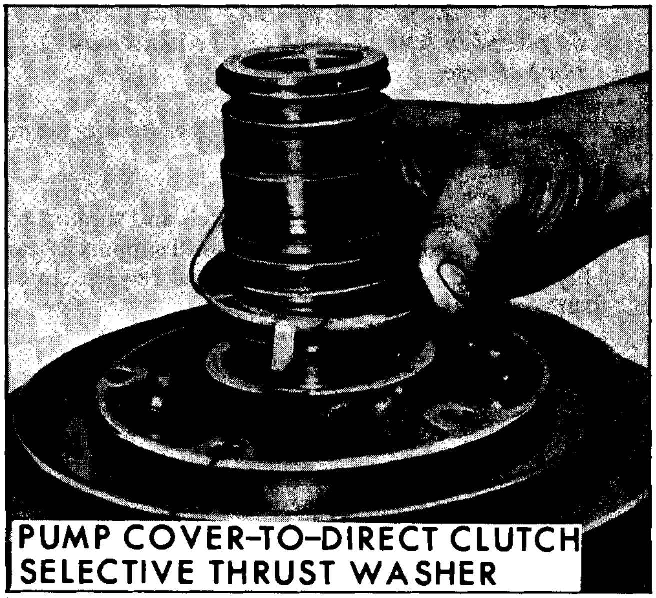


Fig. 7G-155 Clutch Drum Selective Thrust Washer

    e. If reading is not within these limits, it is necessary to remove pump, change to a thicker or thinner selective thrust washer as required to obtain specified clearance, re-install pump and repeat the above checking procedure.

NOTE: *There are three (3) selective washers available, .065-.067, .082-.084 and .099-.101".*

32. When end play is within specifications, remove tools, install remaining pump attaching bolt with its new washer-type seal and torque bolt to 20 lb. ft.

IMPORTANT: *Make sure input shaft* **can** *be rotated. It it cannot, this condition* **must** *be corrected!*

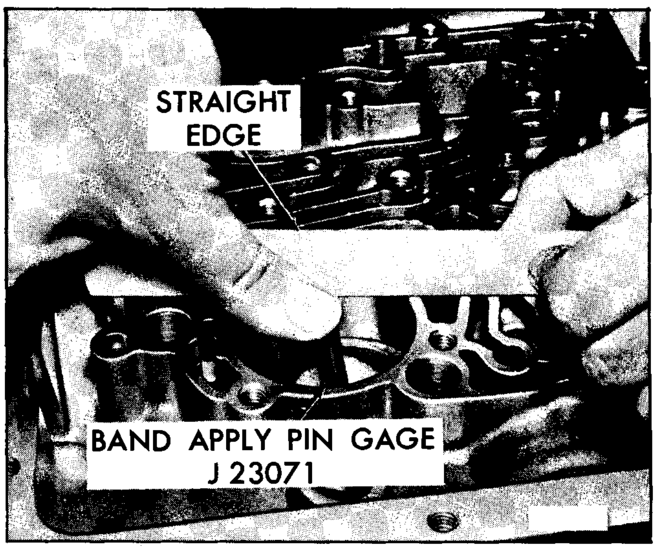


Fig. 7G-156 Selection of Proper Apply Pin

SELECTING PROPER BAND APPLY PIN

1. Check for proper band apply pin selection in the following manner:

   a. Using Band Apply Pin Gage J 23071 and a straight edge, apply firm downward pressure on the gage as shown in Fig. 7G-156.

   NOTE: *There are two (2) selective apply pins available for service. A longer pin is 2 31/32" in length and is identified by a groove located on the band lug end of the pin; whereas, the short pin is 2 27/32" in length and carries* **no** *identification.*

   b. If Gage J 23071 is **below** the straight edge surface, the long pin should be used.

   c. If Gage J 23071 is **above** the straight edge surface, the short pin should be used.

   d. Remove Gage J 23071 from transmission case.

   Selecting the proper pin is the equivalent of adjusting the band.

2. If teflon oil seal ring was removed from servo piston, replace it with the service aluminum intermediate servo piston oil seal ring.

3. Install spring, spring seat, washer and the correct band apply pin and intermediate servo piston with its oil seal ring into its case bore (Fig. 7G-157).

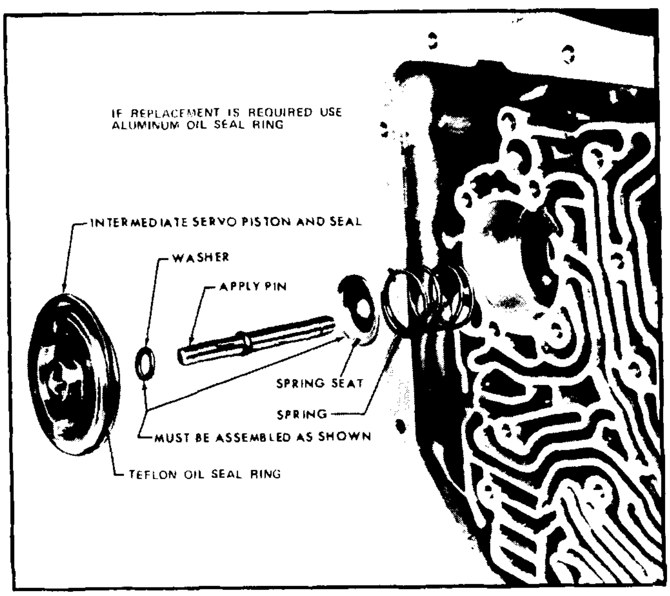


Fig. 7G-157 Exploded View of Intermediate Servo Piston and Pin

PARKING LINKAGE, VALVE BODY AND OIL PAN

INSTALL

1. If removed, install the park pawl into case with its tooth toward center of case. Install park pawl shaft into case bore and through disengaging spring and parking pawl. Install other end of disengaging spring on park pawl and drive a new retaining plug into the case, using a 3/8" diameter rod, until the plug is flush to .010" below the face of the case. Stake plug in three (3) places to the case (Fig. 7G-158).
2. Install parking lock bracket and its two (2) bolts, torquing to 29 lb. ft.
3. If removed, install a new manual shaft-to-case lip oil seal, using a 7/8" diameter rod to seat oil seal flush with case bore.
4. Connect range selector inner lever to parking pawl actuating rod and install actuating rod under parking lock bracket, between bracket and parking pawl.
5. Install manual shaft through case and range selector inner lever (Fig. 7G-159).
6. Install retaining jam nut on manual shaft and torque to 30 lb. ft.
7. Install manual shaft-to-case retainer.
8. Clean and insert governor screens into case (Fig. 7G-54).
9. Clean and insert oil pump pressure screen into its oil pump pressure passage in case, ring end facing in (Fig. 7G-53).

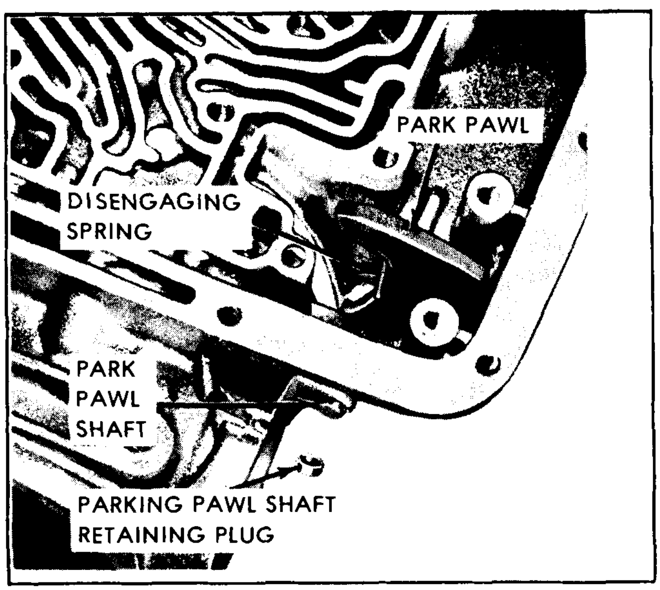


Fig. 7G-158 Park Pawl Assembly

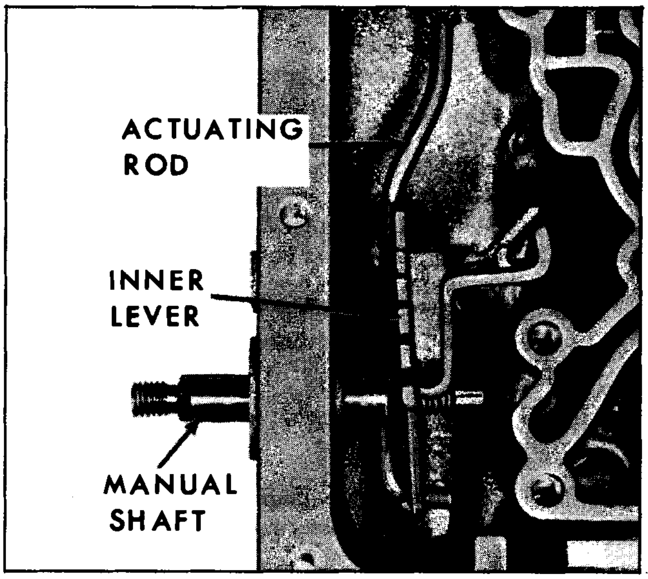


Fig. 7G-159 Installing Manual Shaft

10. Install four (4) check balls in case face (Fig. 7G-160).

    CAUTION: *If number one (#1) check ball is omitted or incorrectly placed, transmission failure will result due to minimum line pressure.*

11. Install valve body spacer plate-to-case gasket and valve body spacer plate.

12. Install spacer support plate and its seven (7) bolts loosely (Fig. 7G-50).

13. Install valve body-to-spacer plate gasket (Fig. 7G-161).

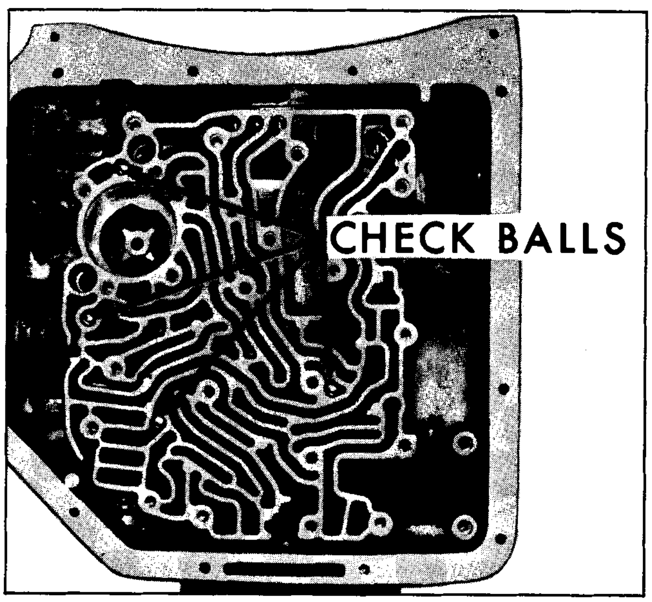


Fig. 7G-160 Location of Check Balls

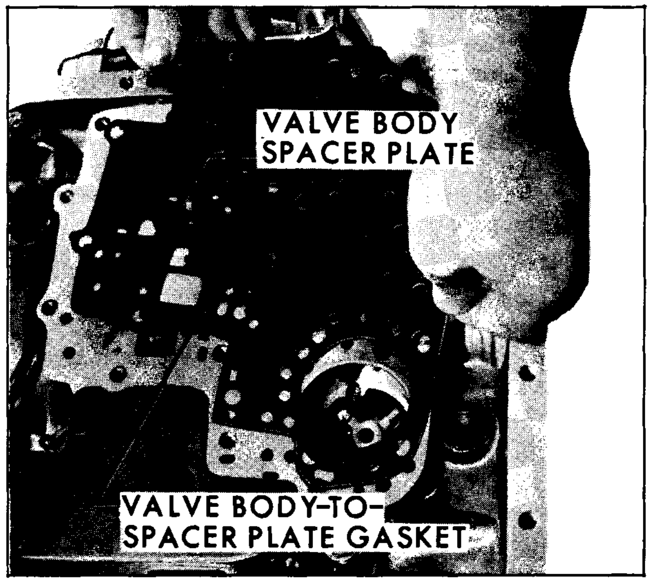


Fig. 7G-161 Installing Spacer Plate Gasket

14. Connect detent control valve link to detent valve actuating lever and, while connecting manual control valve link-to-range selector inner lever, install valve body assembly to its spacer plate gasket, install seventeen (17) valve body-to-case attaching bolts and torque these bolts and seven (7) spacer support plate bolts to 13 lb. ft. (Fig. 7G-162).

    CAUTION: *When handling valve body assembly, do* **not** *touch sleeves as retainer pins can fall into transmission.*

15. Install detent spring and roller assembly to valve body with the remaining valve body-to-case attaching bolt, torquing to 13 lb. ft. (Fig. 7G-163).

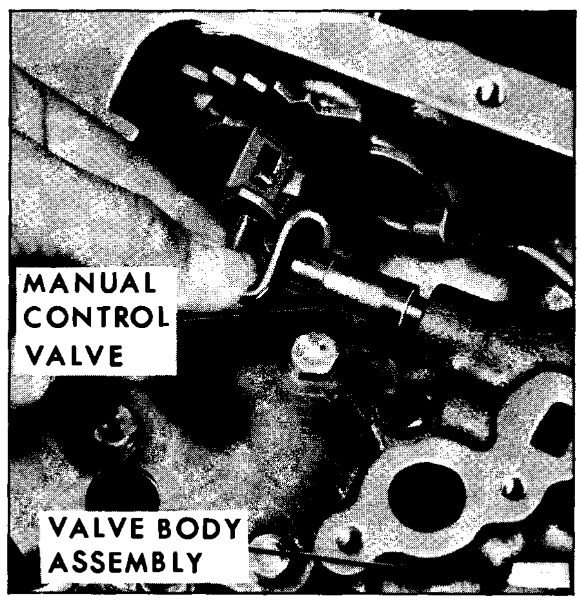


Fig. 7G-162 Connecting Control Valve Link

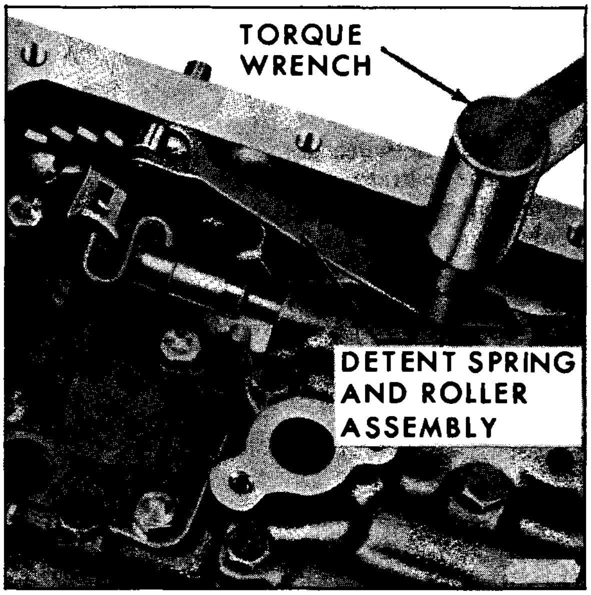


Fig. 7G-163 Installing Roller Assembly

16. Install strainer assembly and new gasket, retaining it with two (2) screws.

    NOTE: *Flush out strainer and check for foreign material.*

17. Install new oil pan gasket and oil pan. Install and torque its thirteen (13) bolt and washer assemblies to 12 lb. ft.

GOVERNOR, SPEEDO DRIVE GEAR AND EXTENSION HOUSING

INSTALL

1. Install governor assembly, new O-ring seal, governor cover and retaining clip.

   CAUTION: *Use extreme care so as not to damage governor cover. If cover is damaged, it must be replaced.*

2. Place speedometer drive gear retaining clip into hole in output shaft, align slot in speedometer drive gear with retaining clip, depress clip and install speedometer drive gear into position on output shaft (Fig. 7G-47).

3. Install extension housing-to-case square cut O-ring seal and attach extension housing to transmission case.

   NOTE: *Speedometer driven gear opening should be on L.H. side of housing.*

4. Install four (4) extension housing-to-case bolts, torquing to 35 lb. ft.

5. If extension housing lip oil seal was removed, install new extension housing lip oil seal by using Seal Installer J 21426.

   NOTE: *Outer diameter of seal should be coated with a non-hardening sealer prior to installation.*

6. Install speedometer driven gear, retainer and bolt. Torque bolt to 12 lb. ft.

MODULATOR AND CONVERTER

INSTALL

1. Install vacuum modulator valve into its case bore, lubricate new O-ring seal with transmission fluid and install on modulator.

2. Install vacuum modulator assembly, with stem pointing up, install retaining clip, with tangs of retainer pointing toward modulator and install its attaching bolt to transmission, torquing to 12 lb. ft.

3. Install converter assembly into transmission, making certain that converter hub drive slots are fully engaged with oil pump drive gear tangs and converter is installed fully towards rear of transmission (Fig. 7G-164).

4. Retain converter assembly to transmission with Converter Holding Clamp J 21366, remove transmission assembly from bench, place in portable jack and remove Transmission Holding Fixture and Adaptor J 8763-01.

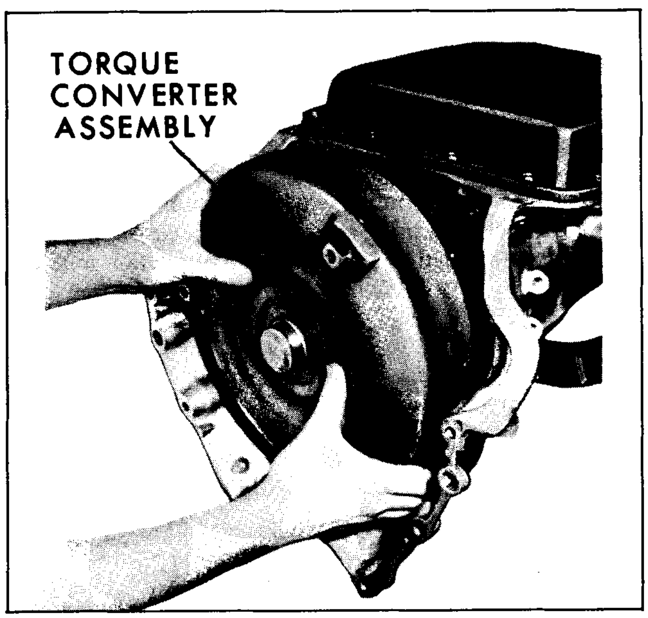


Fig. 7G-164 Installing Converter

TRANSMISSION ASSEMBLY

INSTALL

Installation of the transmission assembly is the reverse of the procedure for removing the transmission assembly. Reverse the procedure as stated under REMOVAL AND DISASSEMBLY OF TRANSMISSION.

After installing, adjust the detent cable and check and adjust the fluid level.

Manual and back drive linkage adjustments and the associated neutralizer switch are important from a safety standpoint. The neutralizer switch should be adjusted so that engine will start in the PARK and NEUTRAL positions only.

With the selector lever in PARK range, the parking pawl should freely engage and prevent vehicle from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

SPECIFICATIONS

TRANSMISSION IDENTIFICATION NUMBER AND VEHICLE IDENTIFICATION NUMBER

A production day and shift built number, transmission model and model year are stamped on the 1-2 accumulator cover, which is located on the middle lower right side of the transmission case. 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:

JE - 250 cu. in., 1Bbl. engine, A and F Series

SB - 307 cu. in., 2 Bbl. engine, X Series

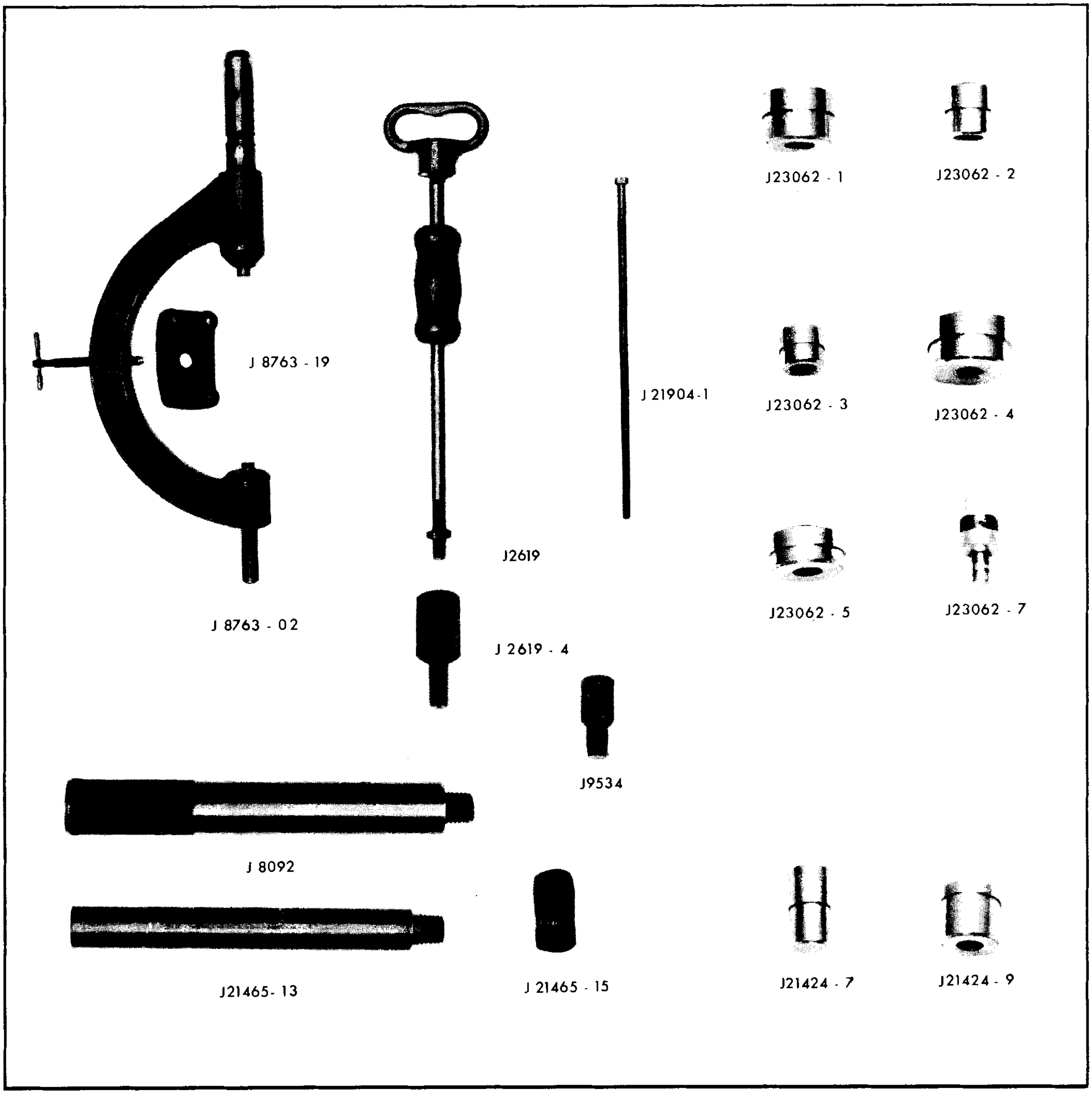
MA - 350 cu. in., 2Bbl. engine, A, F and X Series

Whenever the 1-2 accumulator cover is replaced, it will be necessary to stamp transmission identification number from original cover to the new cover. All transmission parts returned to Pontiac Motor Division, and any communications concerning same, must be identified by transmission identification and vehicle identification numbers.

TORQUE

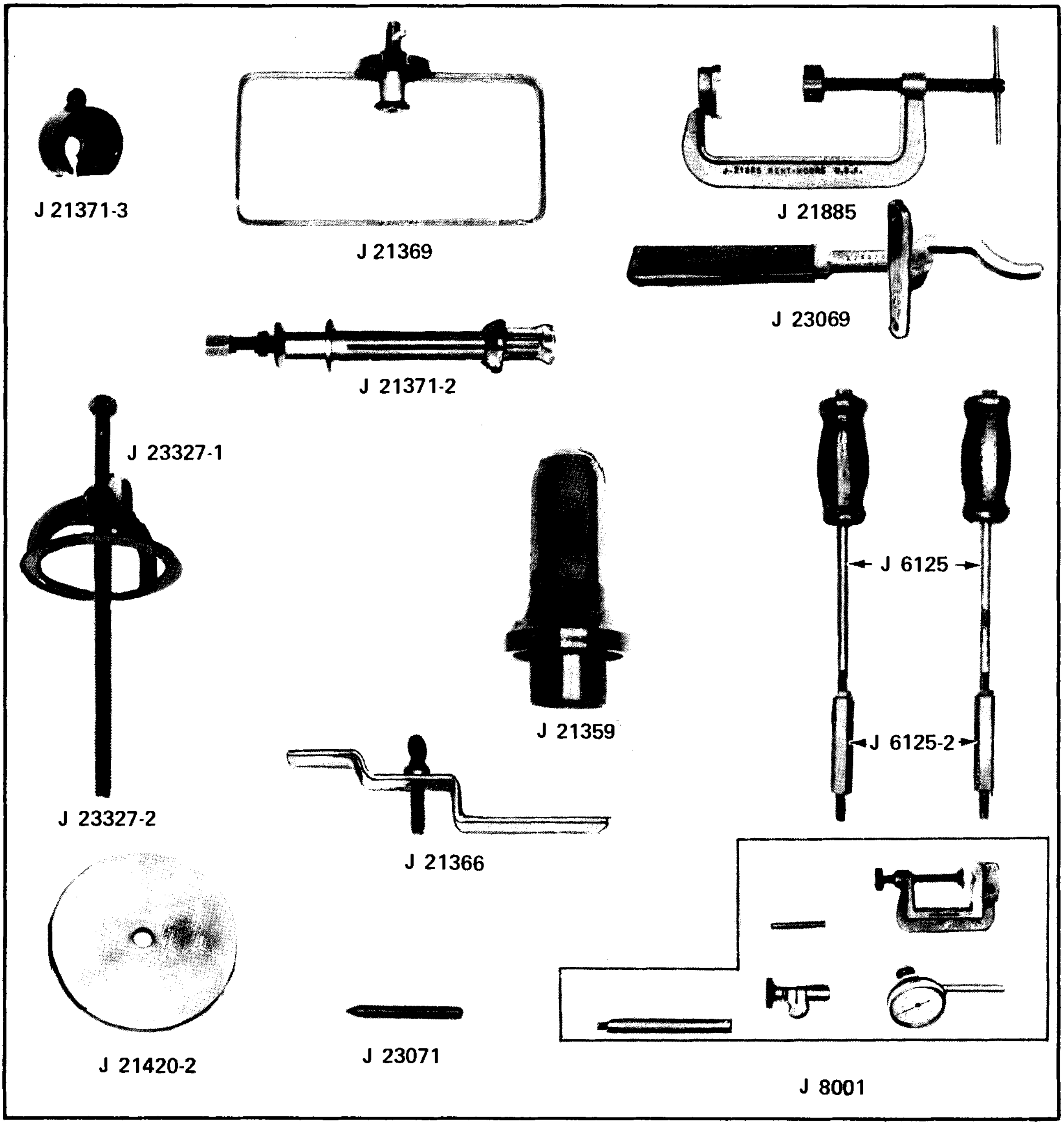
APPLICATION	LB. FT.
Transmission-to-Engine Bolts	40
Converter-to-Flexplate Bolts	30
Frame-to-Crossmember Bolts (4)	35
Rear Mount-to-Transmission Bolts	40
Crossmember-to-Rear Mount Bolts	40
Cooler Line Fitting Nuts	16
Range Selector Outer Lever-to-Manual Shaft Nut	20
Range Selector Outer Lever Pin Nut	20
Linkage Swivel Clamp Screw	20
Oil Pan-to-Case Bolts	12
Extensive Housing-to-Case Bolts	35
Vacuum Modulator Retainer Bolt	12
Speedo Driven Gear Retainer Bolt	12
Valve Body-to-Case Bolts	13
Spacer Support Plate-to-Case Bolts	13
Manual Shaft Jam Nut	30
Parking Lock Bracket Bolts	29
Oil Pump-to-Case Bolts	20
Oil Pump Cover-to-Pump Body Bolts	18

APPLICATION	LB. IN.
Case-to-Converter Dust Pan Bolts	25
Converter Dust Pan-to-Case Bolts	75
Downshift Cable-to-Case Bolt	75
Downshift Detent Lever Bracket-to-Valve Body Bolts	52



J 2619 Slide Hammer
J 2619-4 Slide Hammer Adapter
J 8092 Drive Handle
J 8763-02 Holding Fixture
J 8763-19 Holding Fixture Adapter
J 9534 Output Shaft Bushing Remover
J 21424-7 Stator Shaft Front Bushing Installer and Center and Rear Bushing Remover
J 21424-9 Extension Housing Bushing Remover and Installer
J 21465-13 Drive Handle Extension
J 21465-15 Stator Shaft Front Bushing Remover
J 21904-1 Slide Hammer Bolt
J 23062-1 Case Bushing Installer
J 23062-2 Stator Shaft Center and Rear Bushing Installer
J 23062-3 Sun Gear and Reaction Carrier Bushing Remover and Installer
J 23062-4 Direct Clutch Bushing Installer
J 23062-5 Input Ring Gear Bushing Remover and Installer
J 23062-7 Output Shaft Bushing Installer
J 3289-14 Holding Fixture Base (Not Shown)
J 22976-1 Drill Bushing Fixture (Not Shown)
J 22976-3 Alignment Arbor and Bushing Installer (Not Shown)
J 22976-9 Reamer (Not Shown)

Fig. 7G-165 Special Tools



J 5907	Pressure Gauge (Not Shown)
J 6125	Slide Hammer (2)
J 6125-2	Slide Hammer Adapter (2)
J 8001	Dial Indicator Set
J 21359	Pump Oil Seal Installer
J 21366	Converter Holding Strap
J 21369	Converter Leak Test Fixture
J 21371-2&3	Converter End Play Fixture
J 21420-2	Clutch Spring Compressor Pilot (Low & Reverse Clutches)
J 21426	Rear Oil Seal Installer (Not Shown)
J 21885	Direct Clutch Accumulator Compressor
J 23069	Intermediate Accumulator Cover Compressor
J 23071	Band Apply Pin Gauge
J 23327-1&2	Clutch Spring Compressor (Forward, Direct or Low & Reverse Clutches)

Fig. 7G-166 Special Tools

SECTION 8

FUEL TANK AND EXHAUST SYSTEM

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

FUEL SYSTEM

FUEL TANK (EXCEPT STATION WAGON)

The fuel tank is of center fill design and is located under the floor pan behind the rear axle. The fuel tank filler neck is located behind the rear license plate, which is attached to a spring loaded door in the center of the bumper (Fig. 8-2). The filler neck is soldered to the tank and is not serviced separately.

An evaporation control system (ECS) which requires special features is included on all models. This is a closed system, therefore, no tank vents to the atmosphere are used. Fuel vapor normally escapes only through the evaporation control system. This also means that the only way for air to enter the tank as fuel is used by the engine is through a vacuum valve in the gas cap and by reverse flow through the canister at lower rates. Sedan and coupe tanks have a fuel limiter inside. This provides room for fuel expansion and prevents liquid fuel from being forced through the system. The sedan and coupe tank has three vents, one at each front corner and one at the rear top center which exits at the front of the tank. This three vent system always leaves one vent open no matter on what angle hill the vehicle is parked (Fig. 8-3).

The fuel tank is retained by two metal straps, which hook and bolt into the floor pan at the rear edge of the tank and are retained with a nut and carriage bolt to the floor pan reinforcement at the forward edge of the tank (Fig. 8-4).

Refer to chart at end of this section for proper tank capacity.

FUEL TANK (STATION WAGON)

The station wagon fuel tank (Figs. 8-5 and 8-6) is located between the left rear fender outer panel and inner panel. The tank is retained at the front and bottom with wide metal straps. On the bottom strap, one end hooks into the inner side of the quarter panel and the other end is retained with a special hook which attaches to a bracket on the inner wheel well. One end of the two-piece front strap attaches to a bracket on the inner wheel well and the other end to a bracket on the inner side of the quarter panel.

All station wagons include an evaporation control system and are vented through one pipe in the top center of the tank. Because of the tank shape, this vent is open at extreme vehicle attitudes and it connects to a pipe routed directly to the fuel vapor collector (charcoal canister).

Fuel fill limiting is accomplished by extending the filler neck low enough within the tank to prevent complete fill. This assures room for fuel expansion.

FUEL GAUGE CHECKING PROCEDURE

DASH UNIT READS FULL WITH IGNITION SWITCH ON

1. DISCONNECT TANK UNIT FEED WIRE AT TANK UNIT.
2. WITH VOLTMETER CHECK FEED WIRE VOLTAGE. SHOULD READ APPROX. 9 VOLTS. WITH LOW FUEL WARNING 5-6 VOLTS.

NO VOLTAGE READING

CHECK FOR PROPER CONNECTIONS AT:

1. DASH UNIT CONNECTOR AT GAUGE.
2. BODY HARNESS CONNECTOR TO CHASSIS HARNESS CONNECTOR.
3. BODY HARNESS CONNECTOR AT BACK OF REAR SEAT CUSHION.

CORRECT VOLTAGE READING

1. CHECK GROUND WIRE FROM TANK TO TRUNK FLOOR PAN FOR CONTINUITY.
2. CONNECT SPARE TANK UNIT. RAISE AND LOWER FLOAT ARM OBSERVING DASH UNIT. IF DASH UNIT FOLLOWS ARM MOVEMENT, REPLACE TANK UNIT.

DASH UNIT READS EMPTY WITH IGNITION SWITCH ON

DISCONNECT TANK UNIT. DASH UNIT SHOULD NOW READ FULL.

GAUGE READS FULL

1. CONNECT SPARE TANK UNIT.
2. RAISE AND LOWER FLOAT ARM WHILE OBSERVING DASH UNIT. IF DASH UNIT FOLLOWS ARM MOVEMENT, REPLACE TANK UNIT.

GAUGE READS EMPTY

1. CONNECT SPARE DASH UNIT. IF FULL READING SHOWN. DASH UNIT SHORTED. REPLACE.
2. IF STILL READS EMPTY, SHORT IN HARNESS BETWEEN TANK UNIT AND DASH UNIT.

DASH UNIT NEVER READS FULL

1. FUEL TANK MUST BE FILLED TO CAPACITY.
2. NOTE DASH UNIT NEEDLE POSITION WITH ENGINE RUNNING.
3. DISCONNECT FEED WIRE TO TANK UNIT.
4. WITH OHMMETER CHECK RESISTANCE OF TANK UNIT. SHOULD READ APPROXIMATELY 88.0—93.0 OHMS WITH FULL FUEL TANK.

LOW RESISTANCE READING

1. FLOAT ARM BENT.
2. TANK MOUNTING AREA DEFORMED.

NORMAL RESISTANCE READING

REPLACE DASH UNIT.

ERRATIC FUEL GAUGE READINGS

NOTE: GAUGE FLUCTUATION DURING ACCELERATION OR DECELERATION IS NORMAL.

CHECK THE FOLLOWING:

1. DASH UNIT MOUNTING SCREWS.
2. DASH UNIT CONNECTOR.
3. BODY HARNESS CONNECTOR TO CHASSIS HARNESS.
4. GROUND CONNECTION FROM TANK UNIT TO TRUNK FLOOR PAN.
5. FEED WIRE CONNECTION AT TANK UNIT.

MANY FUEL GAUGE TANK UNITS ARE REPLACED BECAUSE OF POOR DIAGNOSIS OR LACK OF KNOWLEDGE OF THE VARIABLES IN THE SYSTEM. FOR EXAMPLE:

TYPICAL COMPLAINT—THE GAS GAUGE READS EMPTY AND ALL THAT WAS REQUIRED TO FILL THE TANK WAS 19 GALLONS.

REASON:
1. EMPTY FUEL RESERVE (1-2 GAL.)
2. HIGH VOLUME PUMP; STATION ATTENDANT DID NOT TAKE TIME TO TOP-OFF TANK AFTER PUMP "SHUT OFF" THE FIRST TIME. LOSS OF .5 TO 1.5 GAL.
3. POSITION IN WHICH CAR WAS FILLED. IF CAR IS EXCESSIVELY LOW ON EITHER SIDE, THIS MAY CAUSE AIR TO BE TRAPPED IN THE TANK THAT CANNOT BE VENTED, PREVENTING COMPLETE FILLING OF THE TANK.

Fig. 8-1 Fuel Gage Checking Procedure

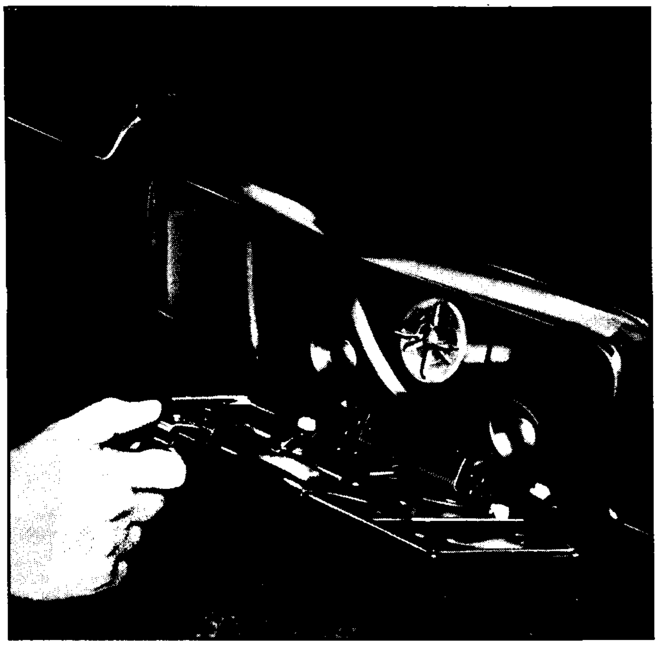


Fig. 8-2 Fuel Tank Fill Location (Sedan & Coupe)

The tank filler for all station wagons is at the outer side of the left rear fender. A spring hinge is used on the inner side of the door assembly to assure rattle-free retention when closed.

Refer to chart at end of this section for proper tank capacity.

LIQUID-VAPOR SEPARATOR

An external steel liquid-vapor separator (standpipe design) is required with all sedan and coupe type fuel tanks (Fig. 8-7). The standpipe mounts with screws to the underbody between the rear seat back and the cargo barrier. Its purpose is to stop liquid fuel that has drained out of the fuel tank through the front corner vents when the car is parked heading downhill. This is accomplished by four

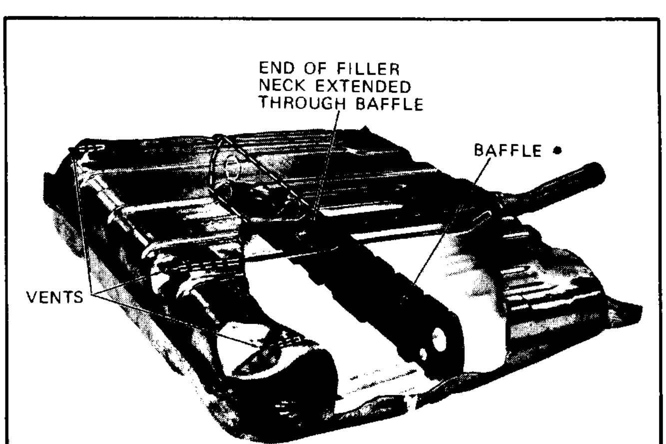


Fig. 8-3 Sedan and Coupe Fuel Tank

vertical tubes open at their upper ends within the common chamber of the standpipe which is positioned above the fuel tank vents.

If the car points downhill, fuel will enter one or both of the standpipe tubes connected to either front fuel tank corner vent and rise until equal with the fuel level in the fuel tank. This fuel will remain in the tubes until the car is level or points uphill and then the fuel will drain back into the fuel tank. When the car is level or points uphill the two front corner vents are above the fuel tank liquid level.

There are two small drain holes near the base of the pipe in the standpipe common chamber that connects to the fuel tank rear top center vent. These drain holes allow overflowed fuel from the fuel tank corner vents that has collected in the standpipe common chamber to drain back into the fuel tank through its rear top center vent when the car is level or pointing uphill. This vent is normally below the standpipe and submerged only when the car points uphill.

Station wagons do not require a separator because the fuel tank vent is always above the level of the fuel.

FUEL TANK FILLER CAP

A gas cap not normally vented to atmosphere is used. This cap has built-in spring loaded pressure-vacuum valves that allow inward air flow under negative pressure conditions or pressure relief if fuel or vapor pressure builds up to approximately 1 psi in the fuel tank. (Fig. 8-8). These valves are necessary to limit the operating pressures of the fuel tank, which are governed by the heating or cooling rate and the canister line restriction. An extended skirt is provided to deflect any escaping vapors downward while removing the cap. There is a double set of locking tangs included on the cap with two used for normal cap retention to the filler neck and two for holding the cap to the filler neck to provide adequate time for vapor pressure relief during cap removal.

NOTE: *If this 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 system malfunction.*

FUEL TANK GAGE UNIT

The fuel tank filter and tank gage unit are one assembly. By a specific combination of material and mesh size the tank filter prevents passage of water and assures that the particles passing through it are too small to interfere with valve operation in the fuel pump. The filter is of double plastic wrap construction with a heat-sealed end. Also, it offers a large filtering area and does not require cleaning. However, if neccesary, the filter can be serviced sepa-

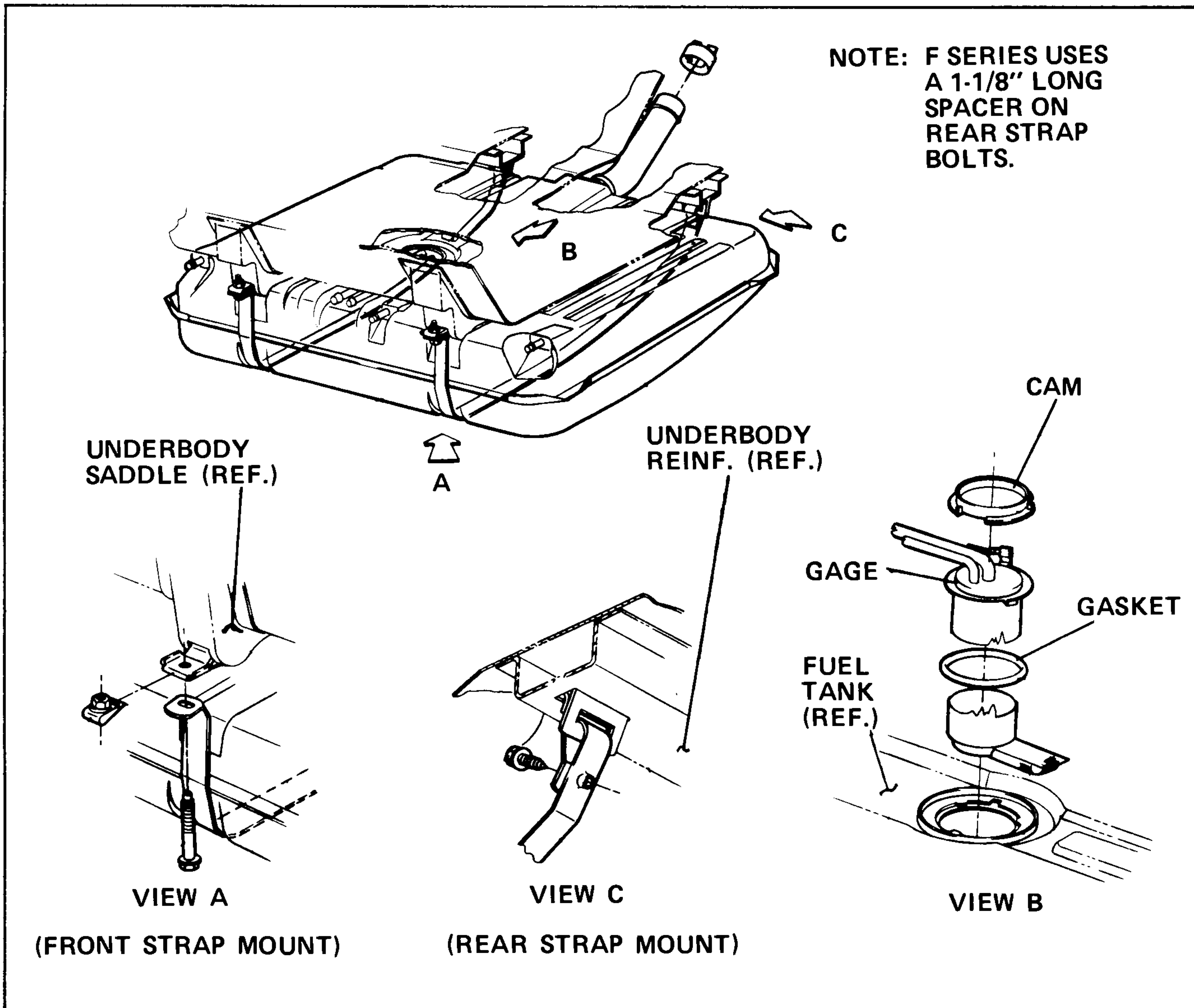


Fig. 8-4 Installation of Fuel Tank (Except Station Wagon)

rately. The filter is designed not to rattle on the bottom of the tank.

Because of the difference in construction and location of the fuel tanks, different fuel tank gage units are required for standard and station wagon models. All A, G and F Series V-8 engine cars with 4-barrel carburetors and B Series with air conditioning use a fuel tank gage unit which has an additional pipe attached to it for fuel vapor return from the fuel pump to the tank.

The fuel gage tank unit consists of a float with linkage connecting the float to a variable resistor. As the float raises or lowers according to the fuel level, the resistor varies the resistance for electrical current to flow through the tank unit and the amount of current flowing through the dash unit (see Section 12 for operation of the dash unit). When the fuel tank is empty, the float is positioned so the resistor has almost zero resistance. This causes the dash unit to register empty. As the fuel level increases, the float moves up and the resistance in the resistor increases to approximately 90 ohms. This causes the indicator on the dash unit to move toward the full mark.

FUEL PIPES, HOSES AND CLAMPS

The ECS vapor pipe is routed with the brake pipe along the left side frame rail of all B, F and X Series. On A Series with V-8 engines and all G Series the fuel pipe and brake pipe are routed alongside each other on the left side frame rail. There are no fuel system pipes routed on the left side frame rail of A Series models with 6-cylinder engines.

A fuel pipe and fuel vapor return pipe are routed on the right side frame rail of all B Series and F Series. The ECS vapor pipe and fuel vapor return pipe are routed on the right side frame rail of A Series with V-8 engines and all

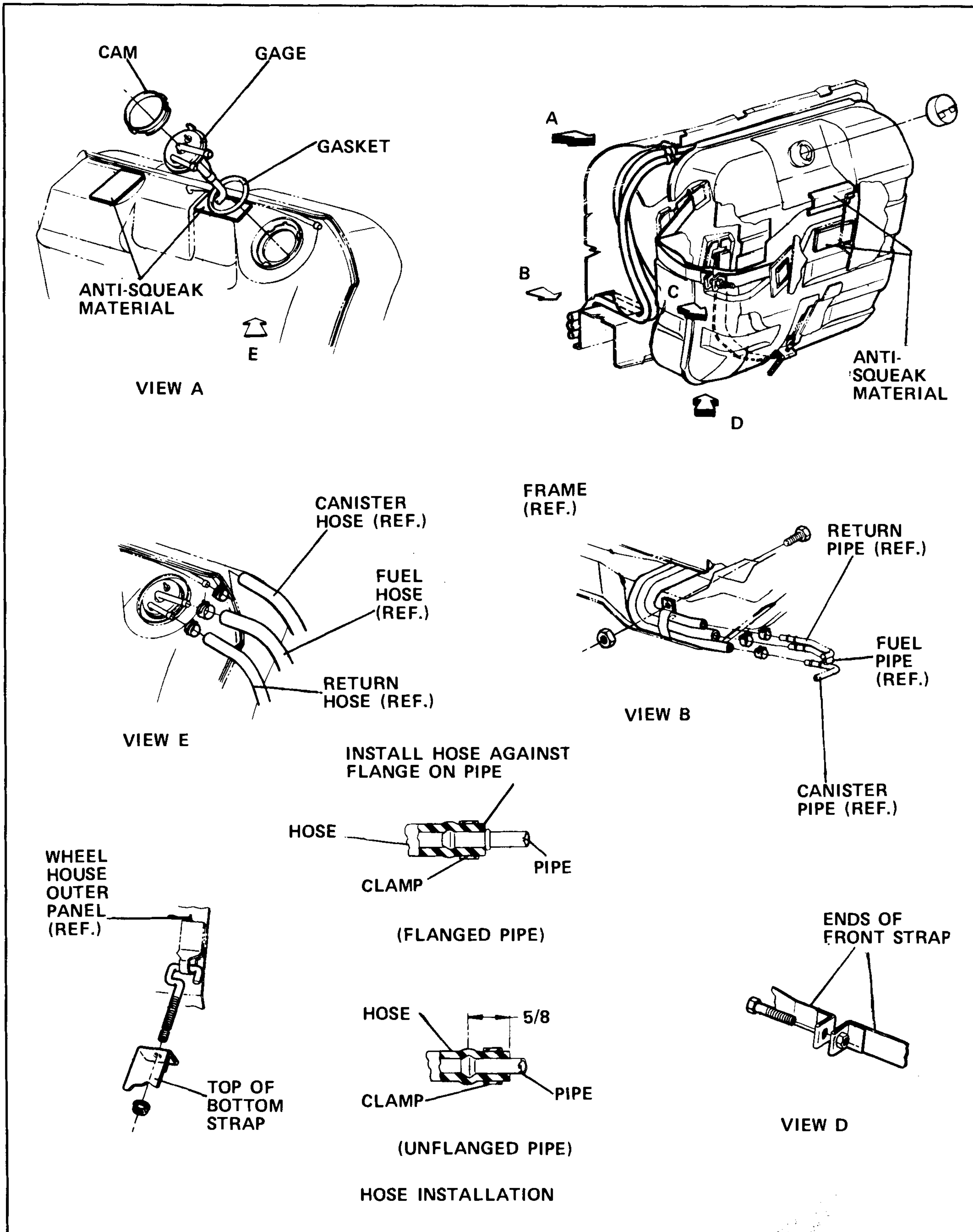


Fig. 8-5 Installation of Station Wagon Fuel Tank (B Series)

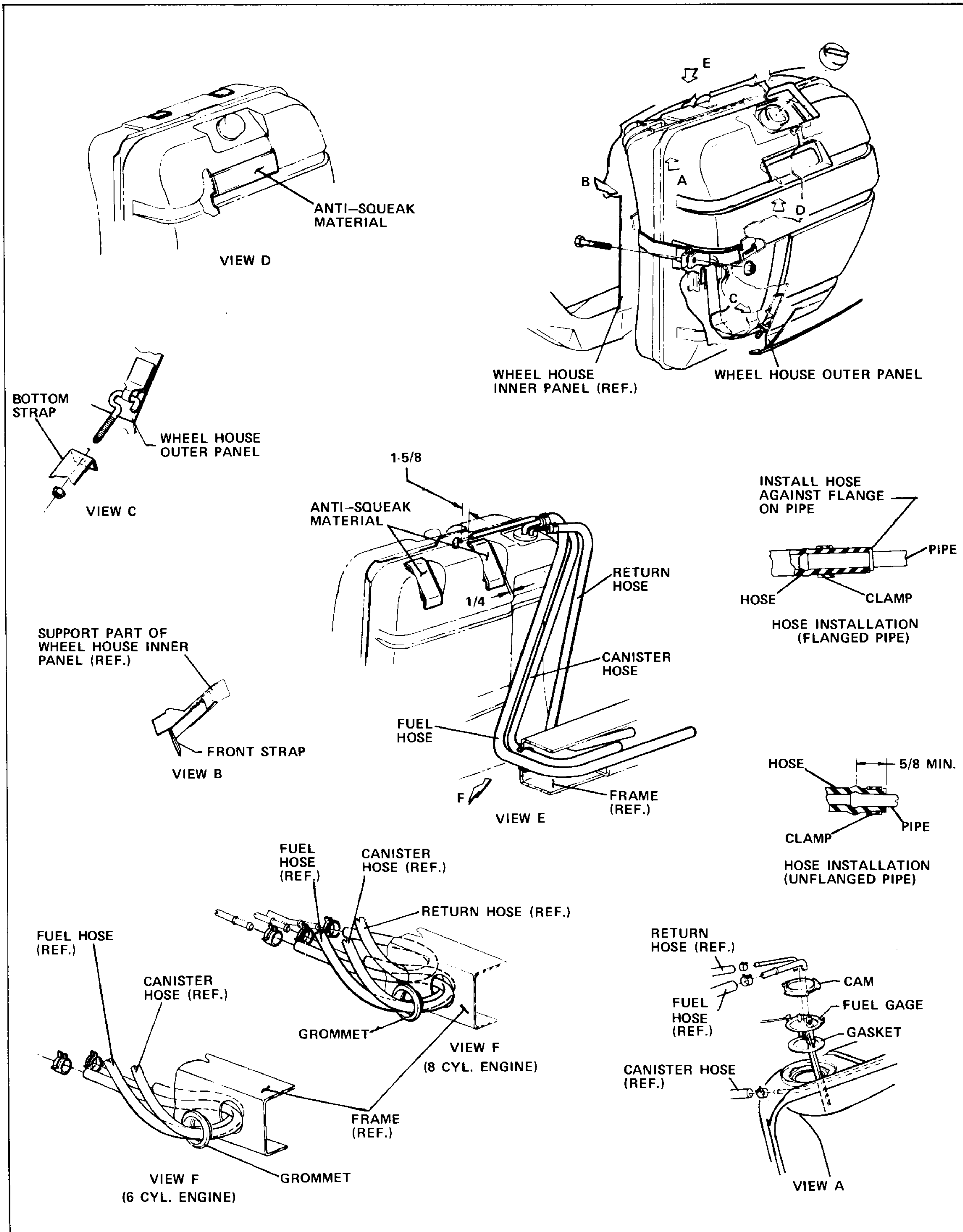


Fig. 8-6 Installation of Station Wagon Fuel Tank (A Series)

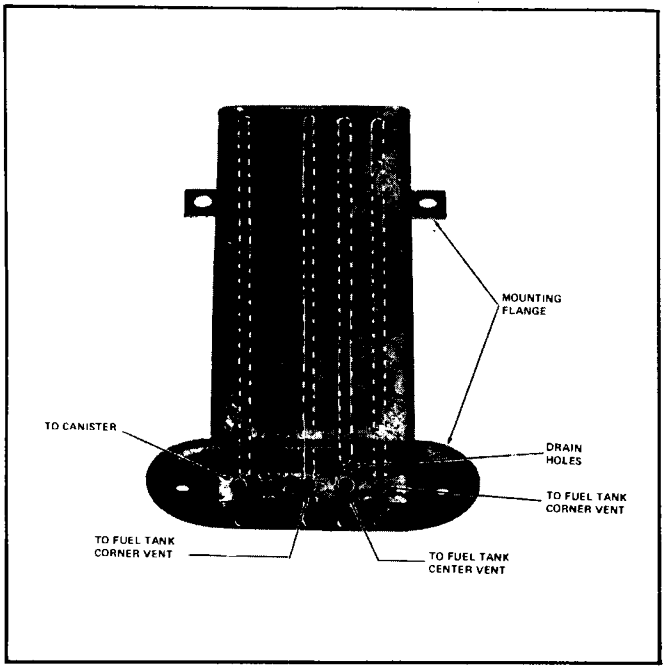


Fig. 8-7 Liquid-Vapor Separator

G Series. There is a fuel pipe and ECS vapor pipe routed on the right side frame rail of all A Series models with 6-cylinder engine.

The fuel vapor return pipe is used on all A, G and F Series V-8 engine cars with 4-barrel carburetors and B Series with air conditioning. This feature prevents vapor from entering the fuel pipe to the carburetor by bleeding off or separating the vapor from the liquid fuel and returning it to the fuel tank, greatly reducing the possibility of vapor lock.

The ECS vapor pipe connects the charcoal canister to the sedan and coupe liquid-vapor separator or fuel tank on station wagon models. The charcoal canister is mounted on the engine side of the radiator support baffle assembly and located on the side of the car opposite the battery (right side with V-8 engines and left side with 6-cylinder engines).

On all models except F Series, a crossover pipe and attachments are used with V-8 engines when a fuel pump vapor return pipe is required. A crossover pipe from the ECS vapor pipe is used to reach the canister mounted on the left side of 6-cylinder equipped A Series and on the right side of V-8 engine equipped F Series.

The connections between the ECS liquid-vapor separator inlet extensions and the fuel tank vent outlet extensions are by means of pipes with a short length of hose on each end (Fig. 8-9).

All fuel system pipe connections are made with short lengths of rubber hose.

> **IMPORTANT: IMPORTANT:** *Use only hose marked "EVAP " or "GM 6107M " if necessary to replace an evaporation control system (ECS) hose. Gasoline vapors will deteriorate other types of hose.*
>
> *The hose connecting the canister pipe to the standpipe has a restriction inserted in it, therefore, when replacing this hose the restriction must be removed and installed in the new hose. The restriction is necessary to control the rate of vapor flow to the canister.*

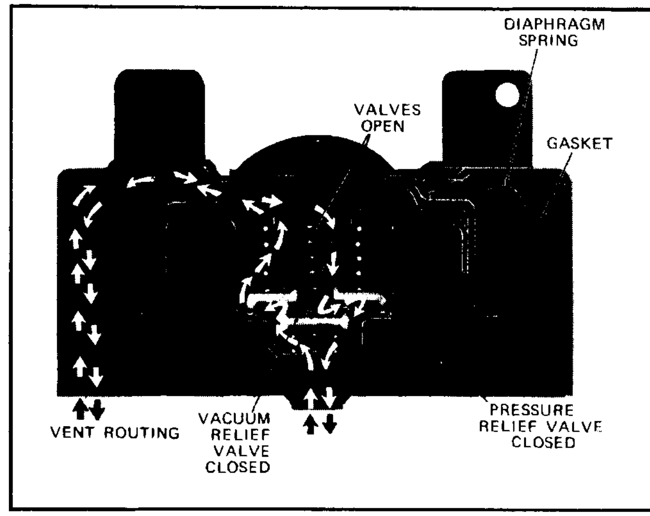


Fig. 8-8 Fuel Tank Filler Cap

The hose connecting the fuel pipe and vapor return pipe to the fuel pump (B & F Series) is routed along the timing chain cover behind the harmonic balancer.

All hose connections are clamped except the four connections at the standpipe and ECS vapor pipe from the standpipe to the canister. There are two types of clamps used; flat spring and screw.

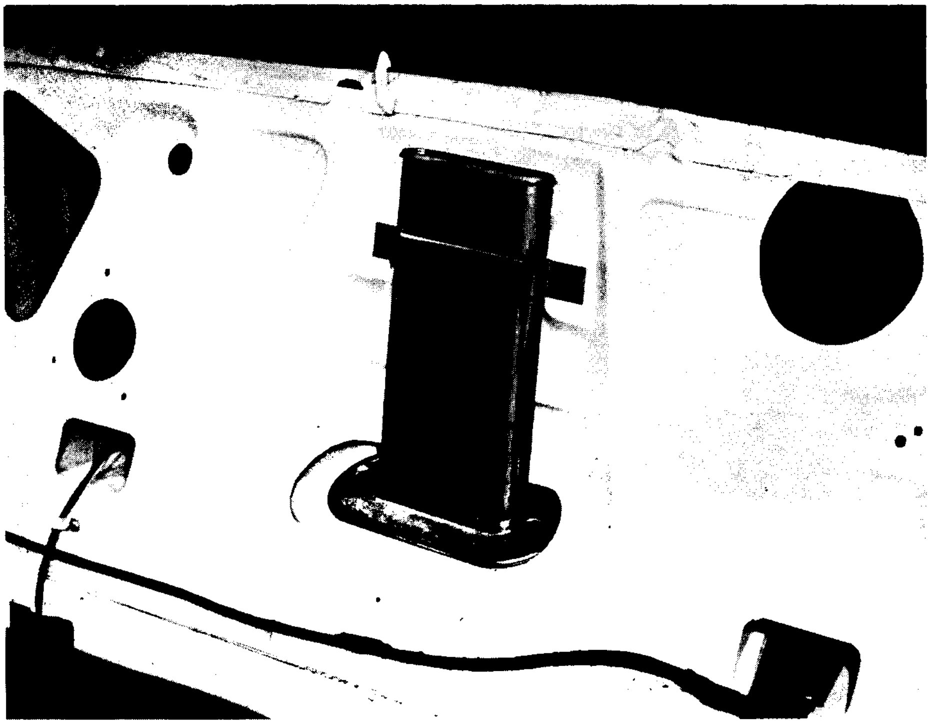
EXHAUST SYSTEM

B SERIES

Single and dual exhaust systems are used. However, station wagons do not use a dual exhaust system (Figs. 8-11, 8-12 and 8-13.

Exhaust manifold to crossover pipe (single systems) or exhaust pipe (dual systems) connections are of the ball type, thus eliminating the need for gaskets. The crossover pipe used with single exhaust systems passes under the engine oil pan from left bank to right bank and then connects to an intermediate exhaust pipe. The intermediate exhaust pipe runs along the right side to a tri-flow muffler. Exhaust pipes used on dual exhaust systems are one-piece and connect the exhaust manifolds to tri-flow mufflers.

Tail pipes used on 350 engines are one-piece. The 400 and 455 engines use a two-piece tail pipe consisting of a short pipe and a tail pipe with integral resonator. Sedan and coupe tail pipes "kick-up" over the axle tube. On the



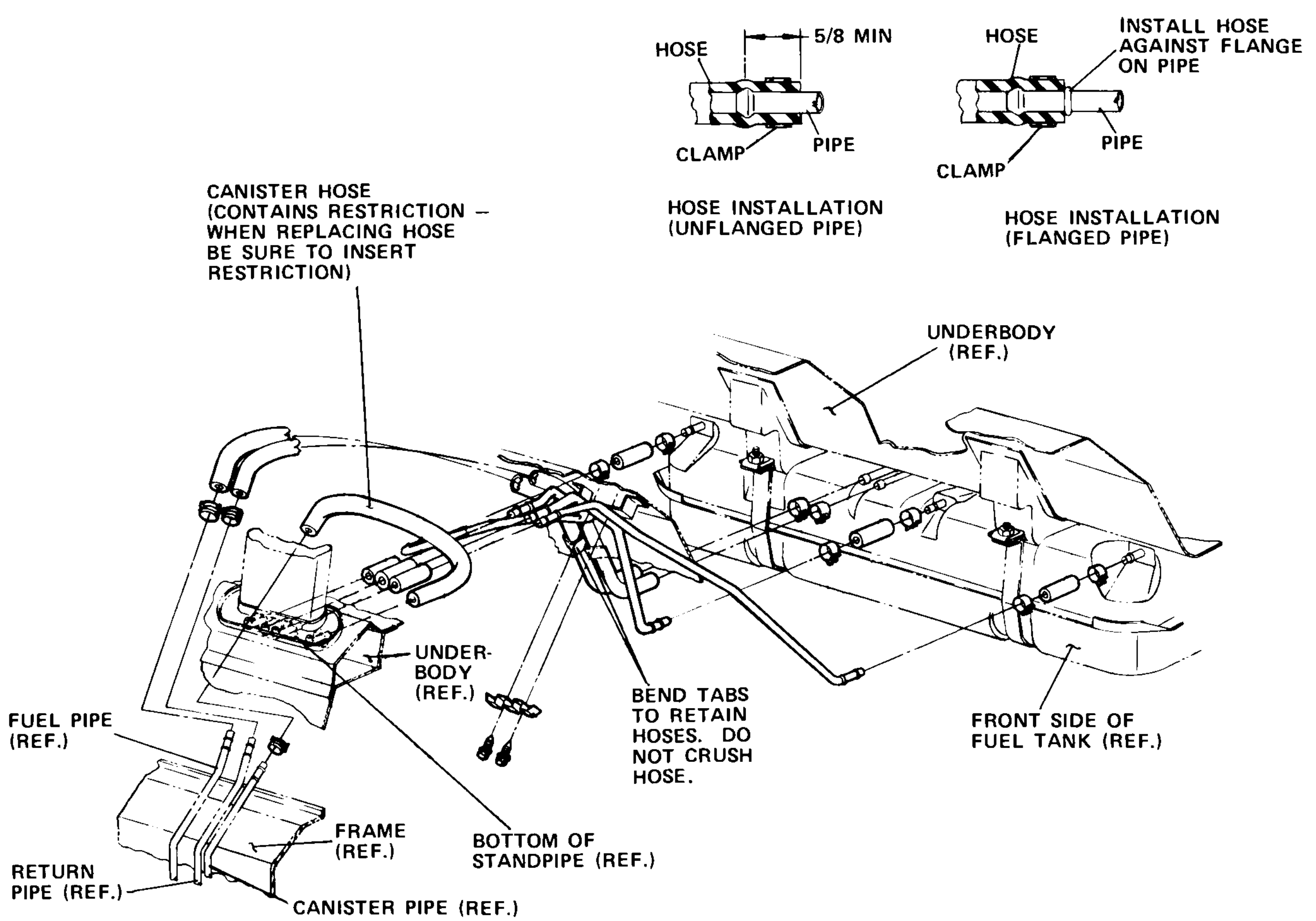


Fig. 8-9 Installation of Liquid-Vapor Separator (Except Station Wagon)

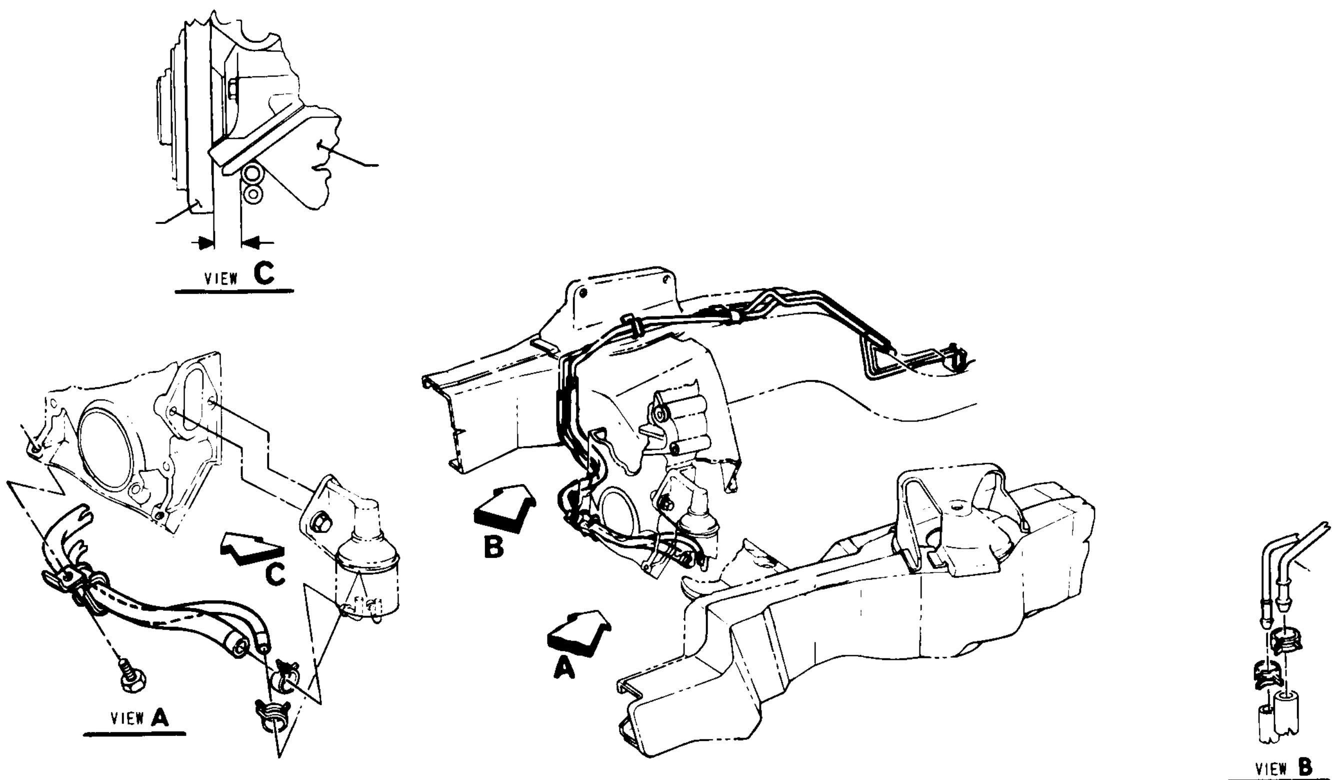


Fig. 8-10 Installation of Fuel and Vapor Return Hoses to Fuel Pump (B & F Series)

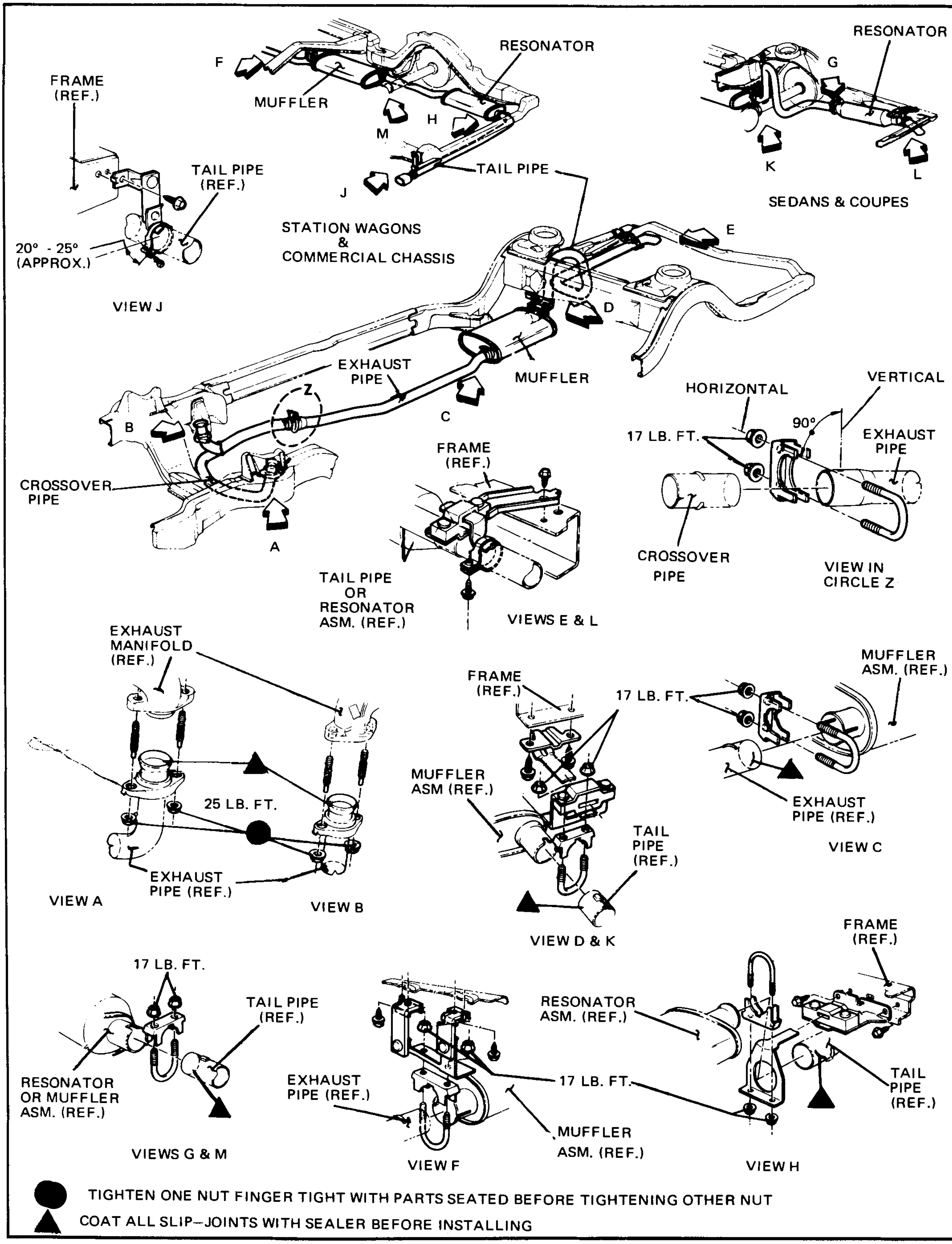


Fig. 8-11 Installation of Single Exhaust System (B Series)

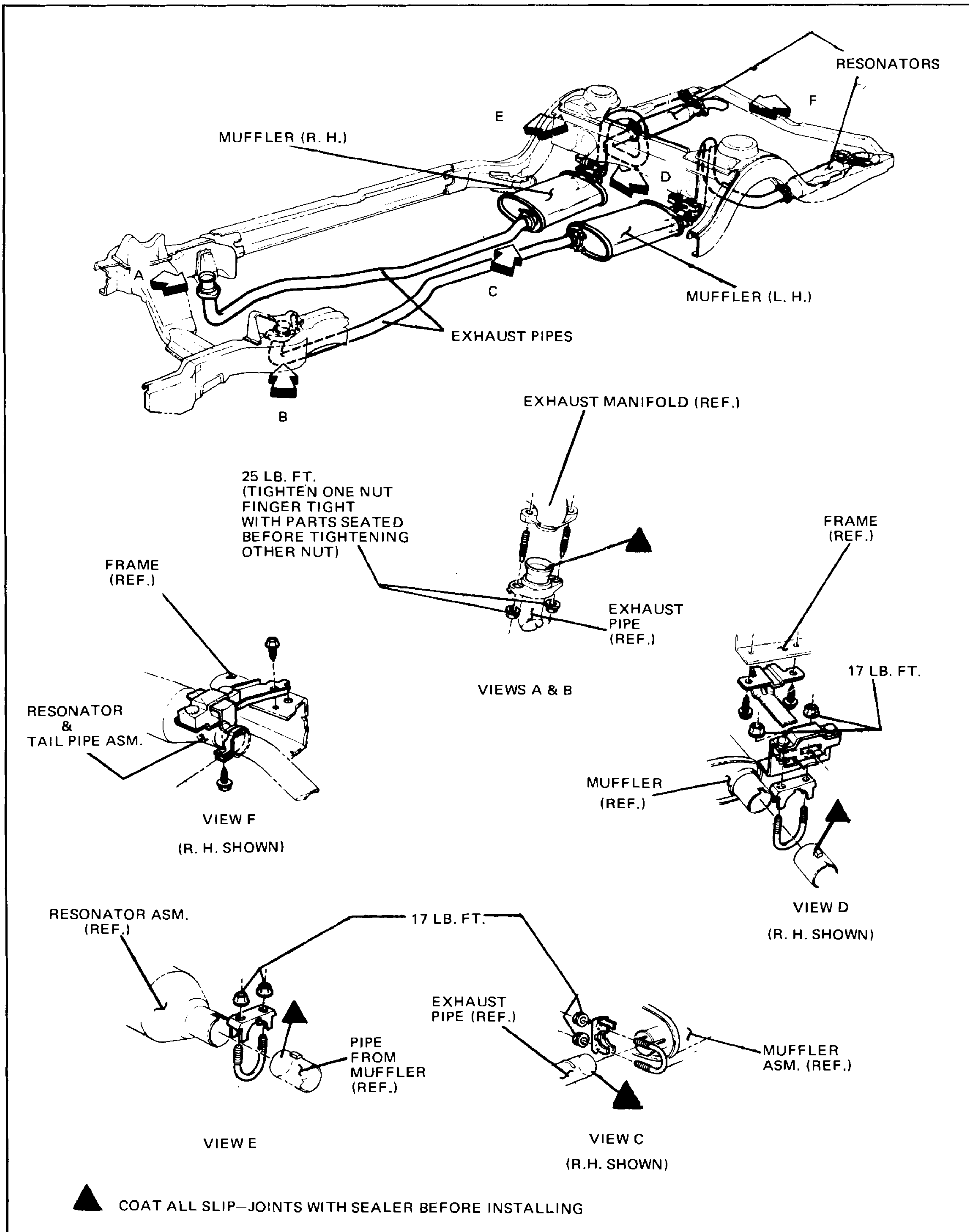


Fig. 8-12 Installation of Dual Exhaust System (B Series)

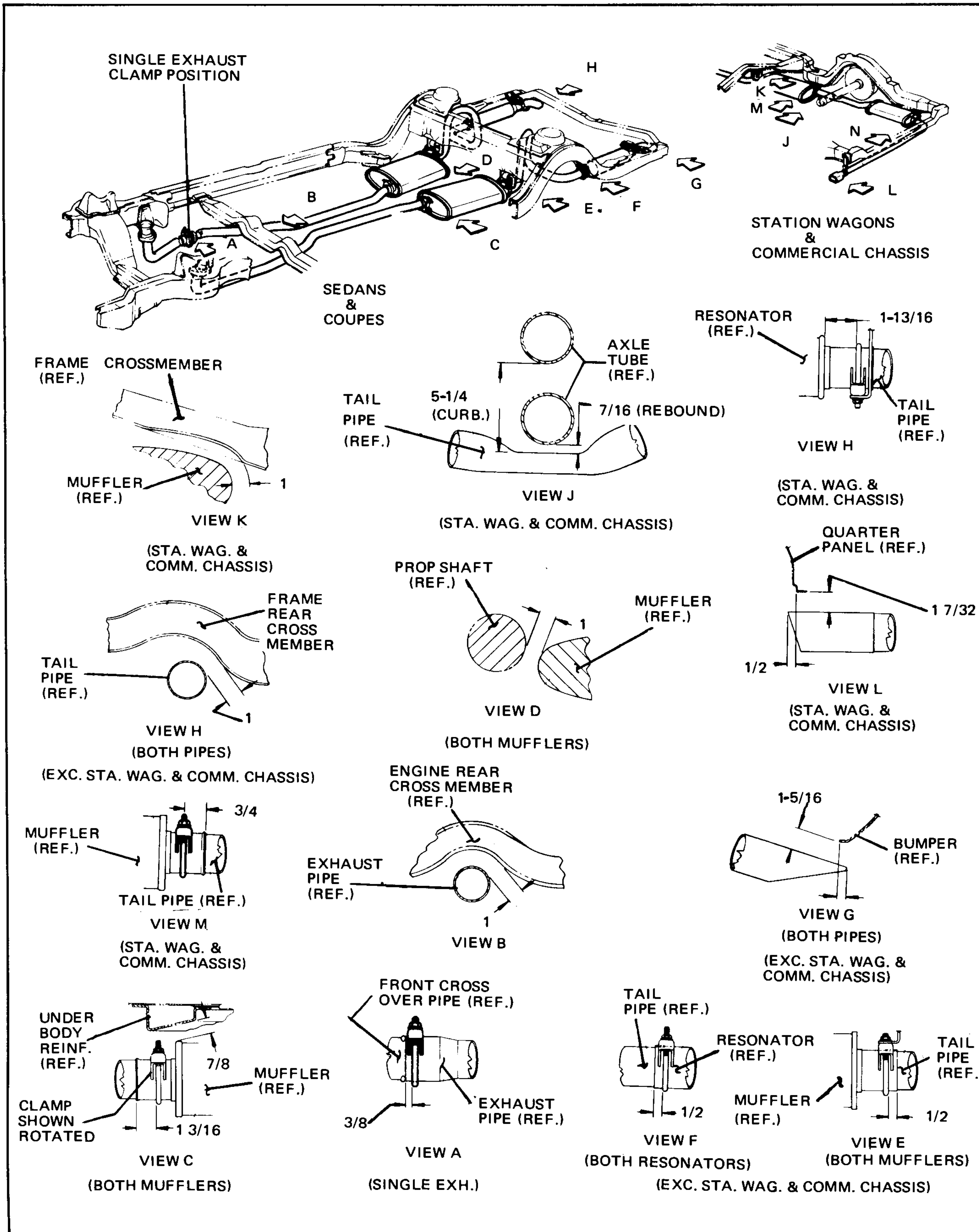


Fig. 8-13 Exhaust System Clearance Requirements (B Series)

station wagon, a "kick-under" pipe from the muffler passes under the axle tube to a resonator and then the tail pipe crosses from right side to left side in front of the rear frame crossmember. **CAUTION:** *Use care not to crush the "kick-under" pipe when using an axle engaging hoist.*

A resonator is used on all exhaust systems except the 350. It allows the use of mufflers with less back pressure and provides for optimum tuning characteristics of the exhaust system.

The clamp joints at the exit end of all mufflers and inlet of the resonators are indexed to the tail pipe or kick pipe by a key (tab) welded on the pipe and a slot in the muffler outlet pipe and resonator inlet pipe.

Conventional rubber strap type hangers are used with the exception of the sedan and coupe muffler and tail pipe plus rear of the station wagon and commercial chassis resonator which are a "rubber block" type (Fig. 8-14). The 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 hanger assembly is made up of a rubber insulator block placed in a stamped metal bracket which bolts to the frame. The supports holding components of the exhaust system in place have a strap (blade) formed on one end that slips into a slot in the hanger's rubber insulator block with no clamping of the support to hanger required. The installation of exhaust system supports is very important as improperly installed supports can cause annoying vibrations which are difficult to diagnose. When inspecting or replacing exhaust system components make sure there is at least 3/4" clearance from the floor pan to avoid possible overheating of the floor pan and possible damage to passenger compartment carpets.

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(s) and resonator rearward of the muffler must be replaced whenever a new muffler is installed.

A & G SERIES

6-CYLINDER ENGINE (A SERIES ONLY)

The 6-cylinder engine exhaust system (Figs. 8-15 and 8-16) has a single outlet exhaust manifold. A seal is installed between the manifold and exhaust pipe connection. There is a steel extension sleeve that fits into the seal inside diameter to provide support. The manifold is connected by a one-piece exhaust pipe welded to a tri-flow muffler clamped to the tailpipe. The exhaust pipe to muffler connection is clamped instead of welded when either the pipe or muffler are replaced. The muffler and tail pipe are indexed together by a key (tab) welded on the tail pipe and a slot in the muffler inlet pipe.

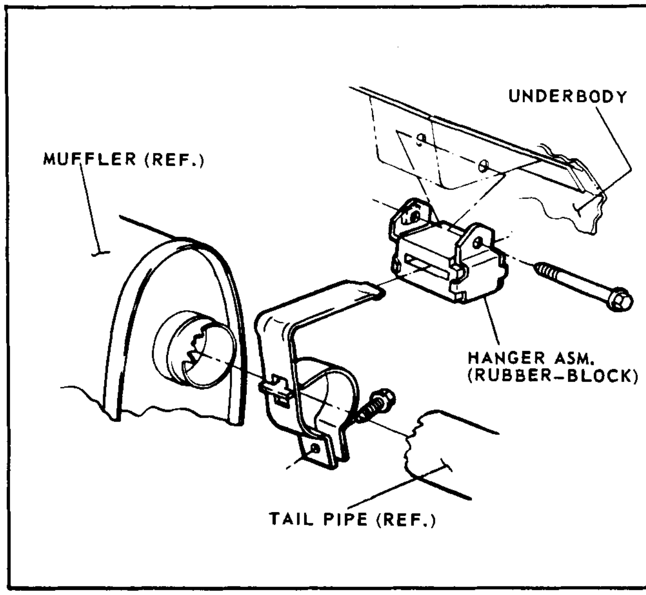


Fig. 8-14 Installation of Rubber Block Exhaust System Hanger (F Series Shown)

Resonators are not used.

The exhaust system is supported by conventional rubber strap type hangers and clamps attached to the frame and they keep the exhaust system in proper alignment. The installation of these supports is very important, as improperly installed supports can cause annoying vibrations which are difficult to diagnose. When inspecting or replacing exhaust system components make sure there is at least 3/4" clearance from the floor pan to avoid possible overheating of the floor pan and possible damage to the passenger compartment carpets.

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.

V-8 ENGINE

Two exhaust systems are used with V-8 engines - single and dual (Figs. 8-17, 8-18 and 8-19). Exhaust manifold to crossover pipe (single systems) or exhaust pipe (dual systems) connections are of the ball type, thus eliminating the need for gaskets.

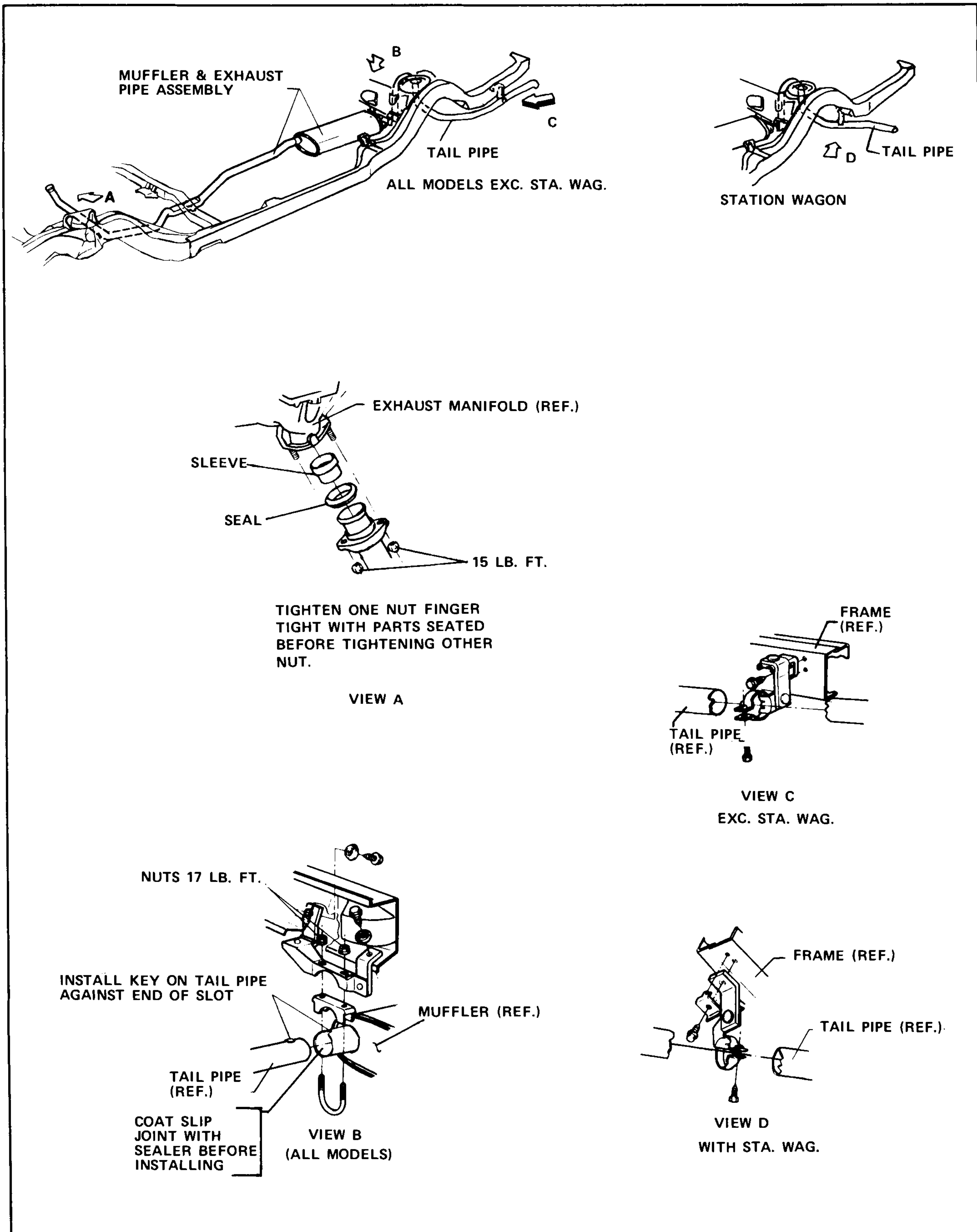


Fig. 8-15 Installation of 6-Cyl. Exhaust System (A Series)

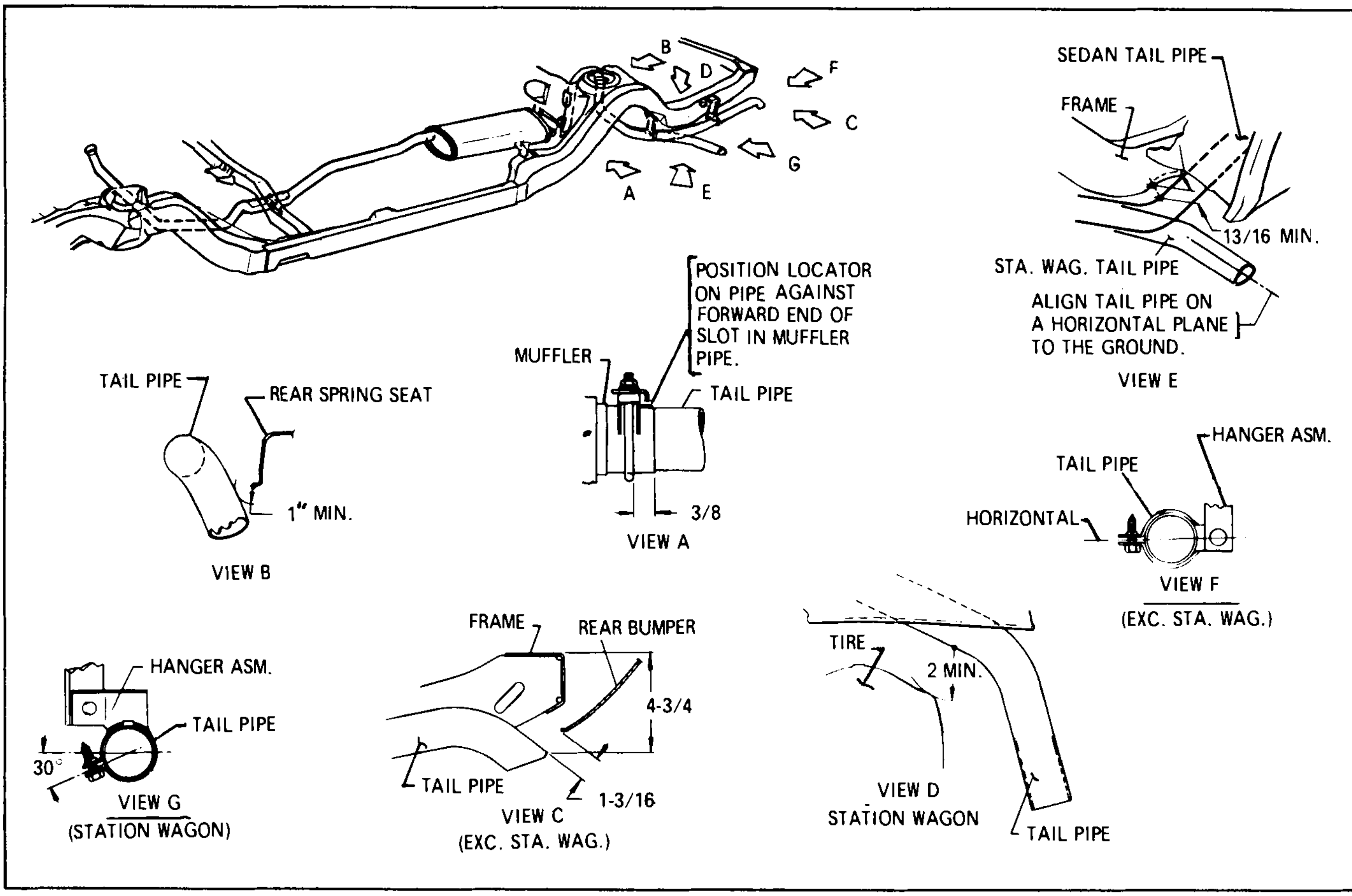


Fig. 8-16 Exhaust System Clearance Requirements (A Series 6-Cyl.)

In the single exhaust system, the crossover pipe passes under the engine oil pan from left bank to right bank and then connects to an intermediate exhaust pipe. The intermediate exhaust pipe runs along the right side to a tri-flow muffler which is attached to the tailpipe.

The dual exhaust system consists of two one-piece exhaust pipes, two tri-flow mufflers and two tailpipes. The dual exhaust system is standard equipment on G Series, GTO and GT options and optional on other models (except A Series station wagon).

Resonators are not used.

Exhaust extensions installed on the GTO and GT options have dual (split) outlets rather than single and they exit to the side behind the rear wheel (Fig. 8-20).

The exhaust system is supported by conventional rubber strap type hangers and clamps attached to the frame and they keep the exhaust system in proper alignment. The installation of these supports is very important, as improperly installed supports can cause annoying vibrations which are difficult to diagnose. When inspecting or replacing exhaust system components make sure there is at least 3/4" clearance from the floor pan to avoid possible overheating of the floor pan and possible damage to the passenger compartment carpets.

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.

F & X SERIES

6-CYLINDER ENGINE

The 6-cylinder engine exhaust system (Figs. 8-21, 8-22 and 8-23) has a single outlet exhaust manifold. A seal is installed between the manifold and exhaust pipe connection. There is a steel extension sleeve that fits into the seal inside diameter to provide support. The manifold is connected by a one-piece exhaust pipe clamped to a tri-flow muffler. The exhaust pipe and muffler are indexed together by a key (tab) welded on the exhaust pipe and a slot in the muffler inlet pipe. The muffler and tail pipe are welded together. This connection is clamped instead of welded when either the tail pipe or muffler are replaced.

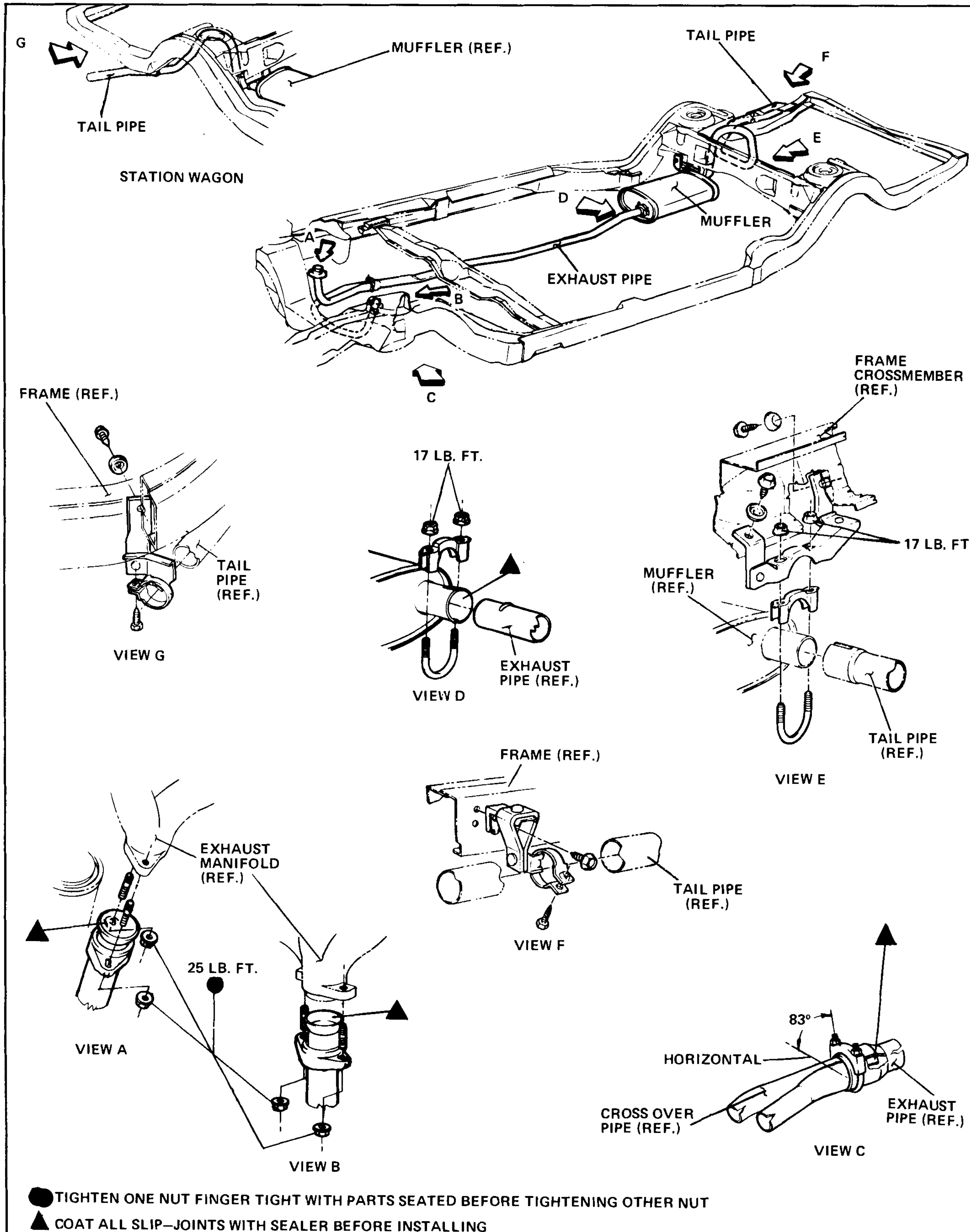


Fig. 8-17 Installation of V-8 Single Exhaust System (A Series)

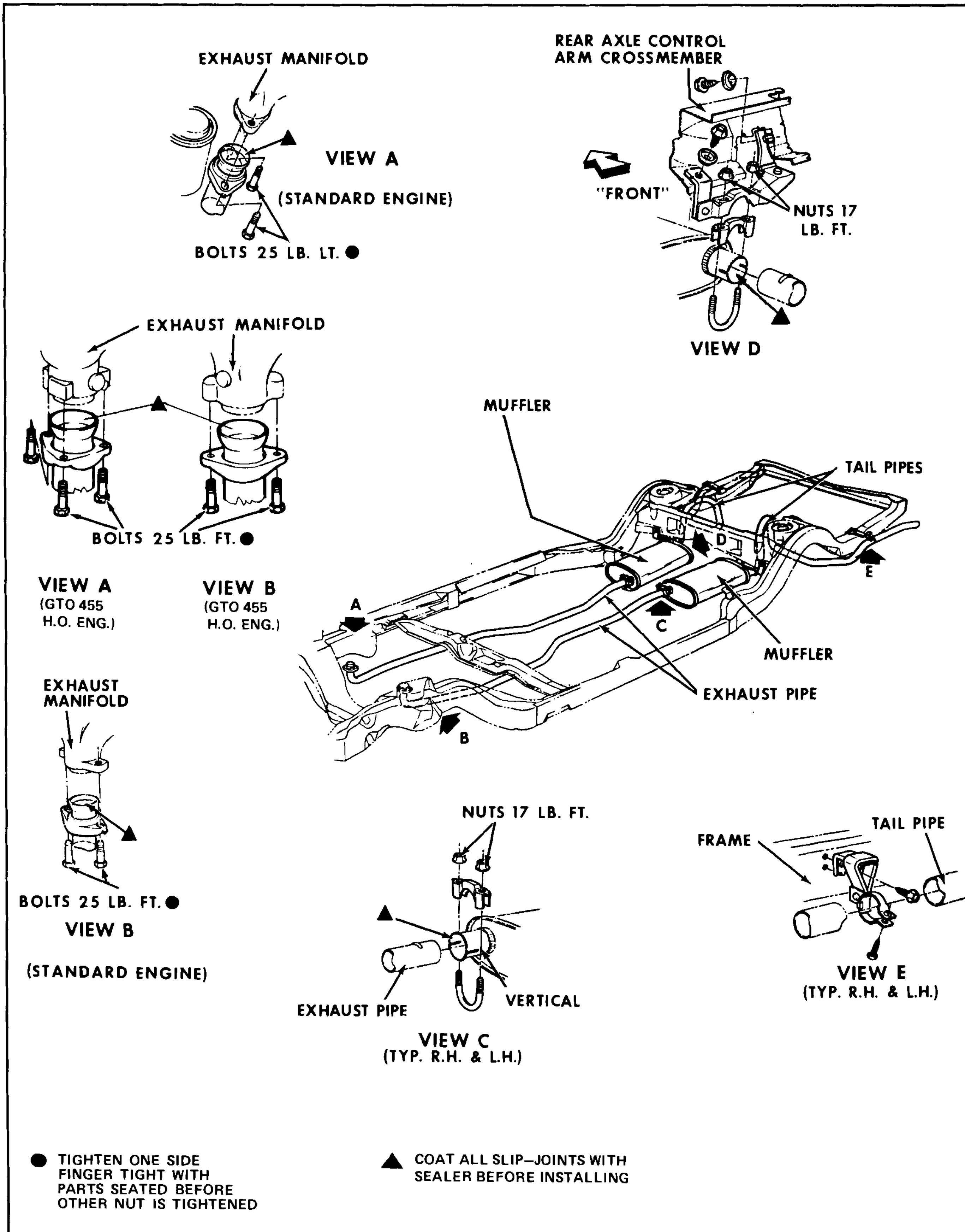


Fig. 8-18 Installation of V-8 Dual Exhaust System (A & G Series)

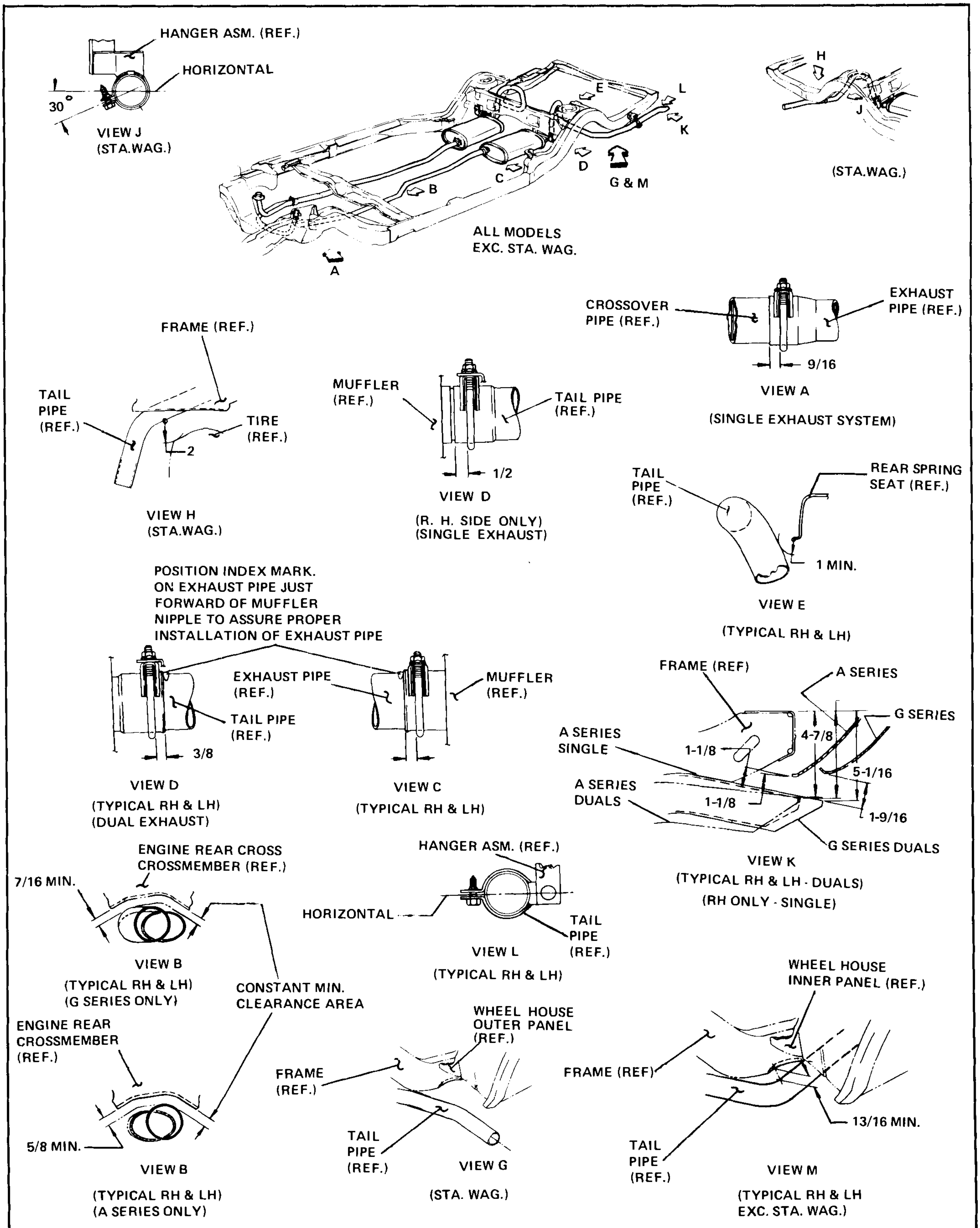


Fig. 8-19 Exhaust System Clearance Requirements (A & G Series V-8)

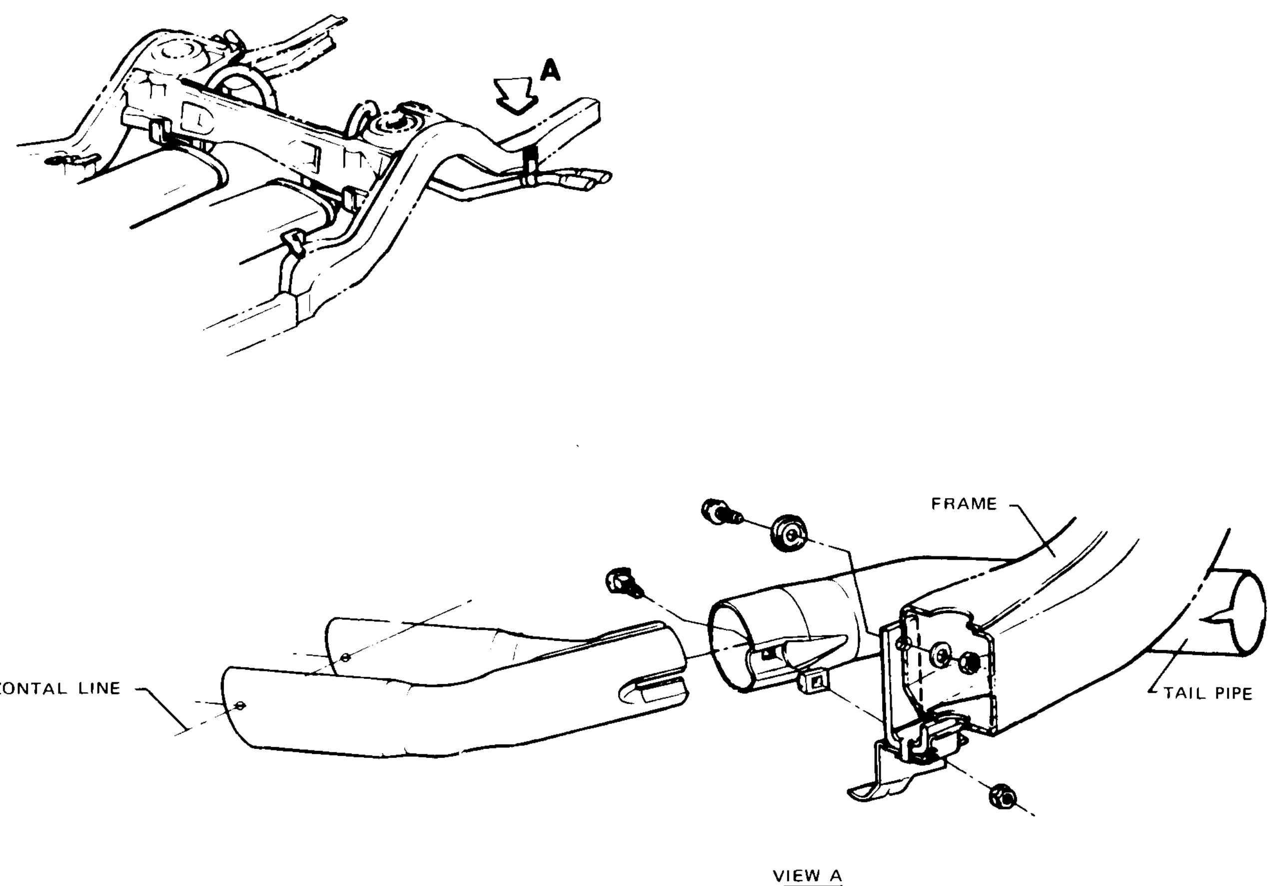


Fig. 8-20 Installation of GTO & GT Exhaust Extension

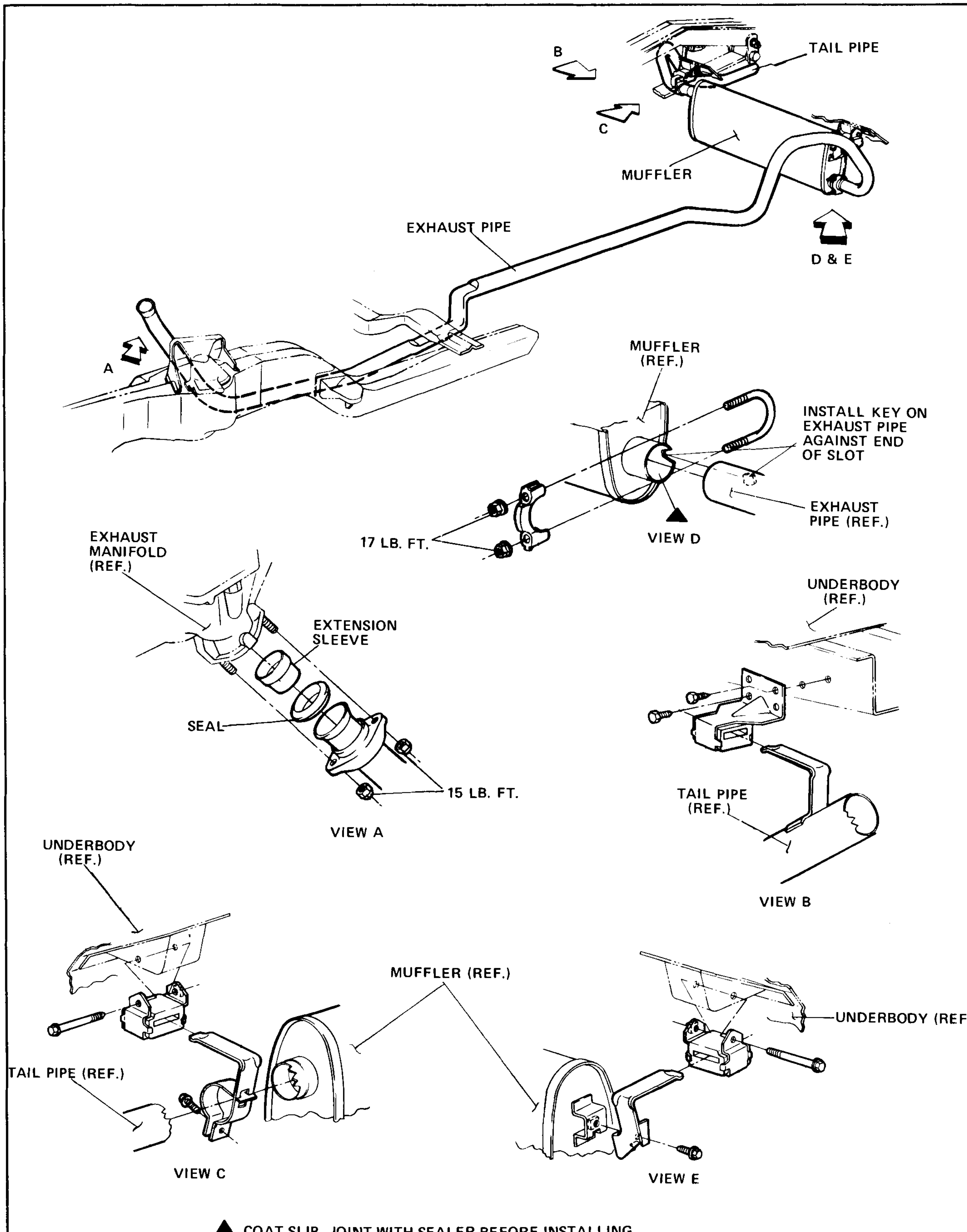


Fig. 8-21 Installation of 6-Cyl. Exhaust System (F Series)

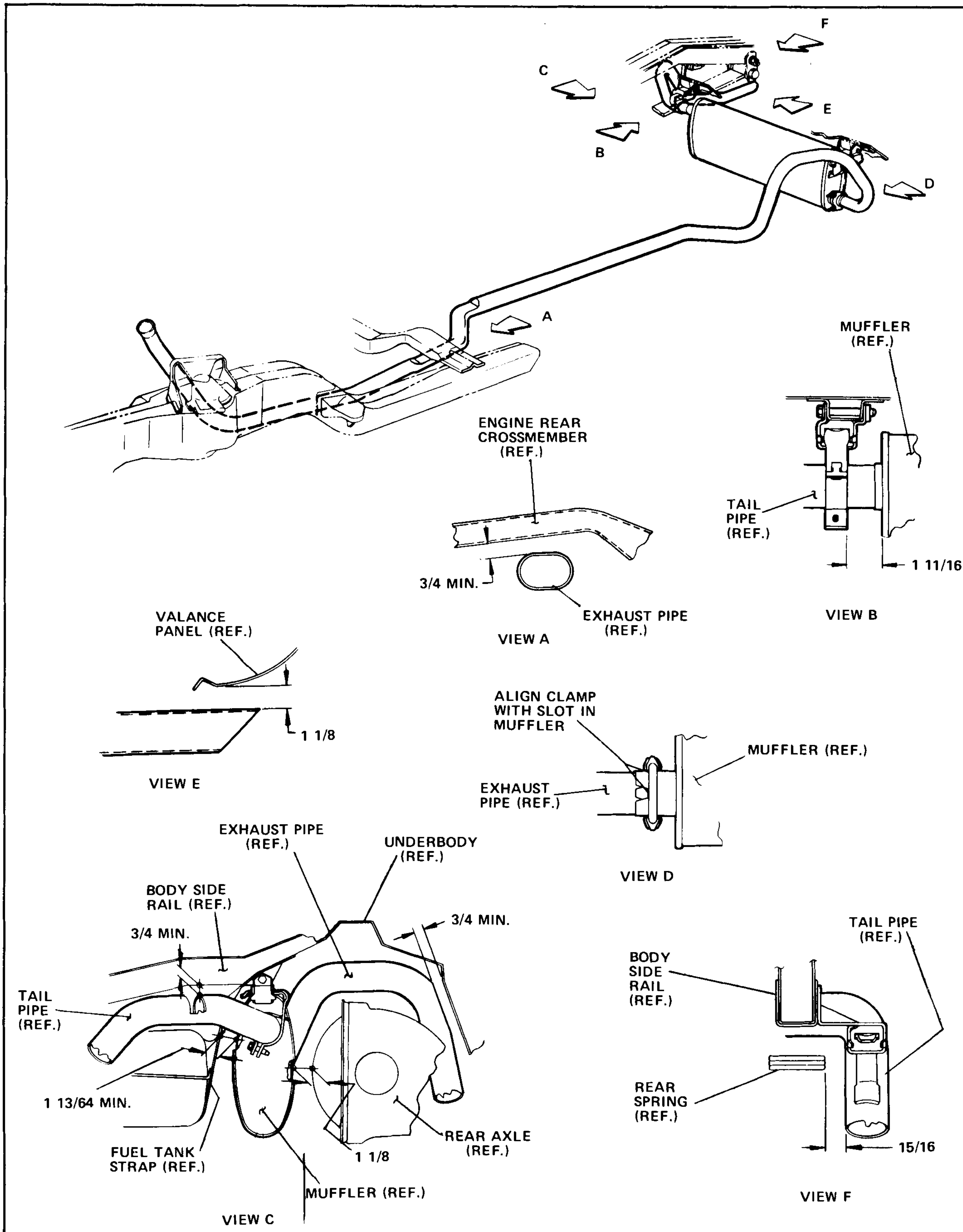


Fig. 8-22 Exhaust System Clearance Requirements (F Series 6-Cyl.)

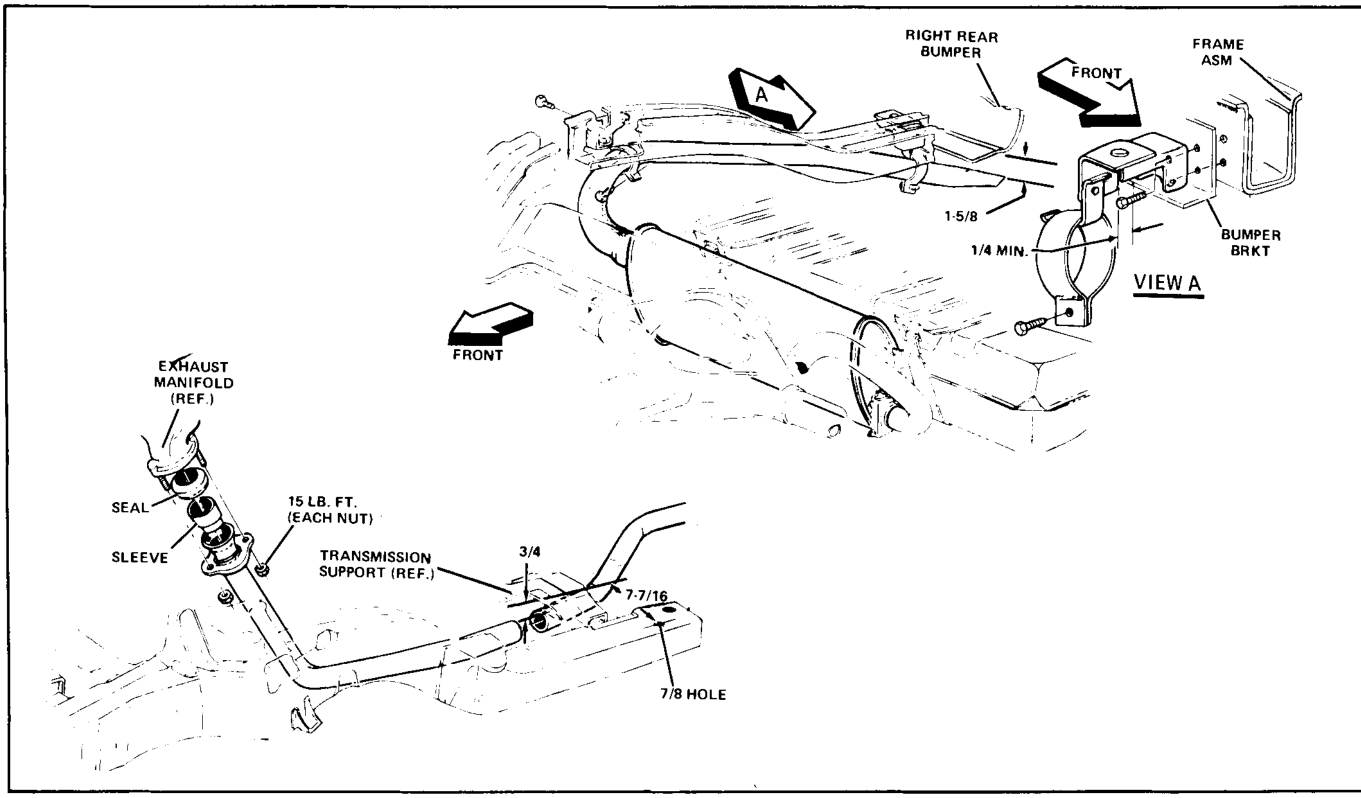


Fig. 8-23 Exhaust System Clearance Requirements (X Series 6-Cyl.)

Resonators are not used.

Pipe and muffler hanger assemblies are a "rubber block" type (Fig. 8-14). This 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 hanger assembly is made up of a rubber insulator block placed in a stamped metal bracket which bolts to the underbody. The supports holding components of the exhaust system in place have a strap (blade) formed on one end that slips into a slot in the hanger's rubber insulator block with no clamping of the support to hanger required. The installation of exhaust system supports is very important as improperly installed supports can cause annoying vibrations which are difficult to diagnose. When inspecting or replacing exhaust system components make sure there is at least 3/4" clearance from the floor pan to avoid possible overheating of the floor pan and possible damage to the passenger compartment carpets.

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.

V-8 ENGINE

Two exhaust systems are used with V-8 engines - single and dual (Figs. 8-24, 8-25, 8-26 and 8-27). Exhaust manifold to crossover pipe (single systems) or exhaust pipe (dual systems) connections are of the ball type, thus eliminating the need for gaskets.

The single exhaust system crossover pipe passes under the engine oil pan from left bank to right bank and then connects to an intermediate exhaust pipe. The intermediate exhaust pipe runs along the right side to a rear exhaust pipe connected to a tri-flow muffler mounted transversely between the rear axle and fuel tank. The muffler is welded to the tail pipe located on the left side which is connected to an extension passing under the rear valance panel. The muffler to tail pipe connection is clamped instead of welded when either the tail pipe or muffler are replaced.

The dual exhaust system consists of two exhaust pipes, one muffler and two tail pipes. The exhaust pipes are two-piece with a front and rear section clamped together forward of the rear axle. The rear section of each exhaust pipe clamps to a single tri-flow muffler mounted transversely between the rear axle and fuel tank. The muffler is welded to the tail pipes which are clamped to extensions passing under the rear valance panel. The muffler to tail pipe connection is clamped instead of welded when either of the tail pipes or muffler is replaced. The dual exhaust system is standard equipment on Formula and Trans Am models. A dual exhaust system is only used on X Series in conjunction with special performance suspension.

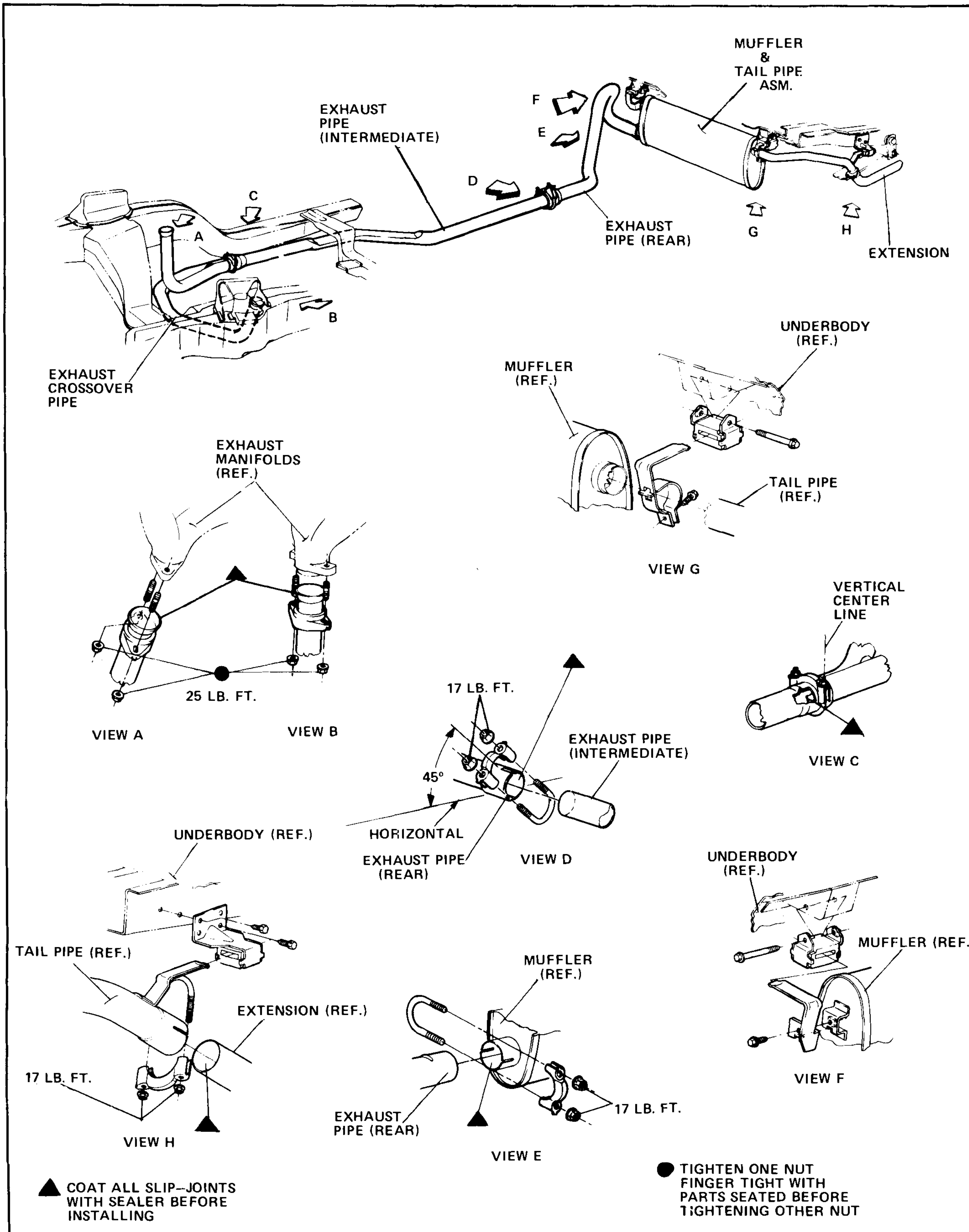


Fig. 8-24 Installation of V-8 Single Exhaust System (F Series)

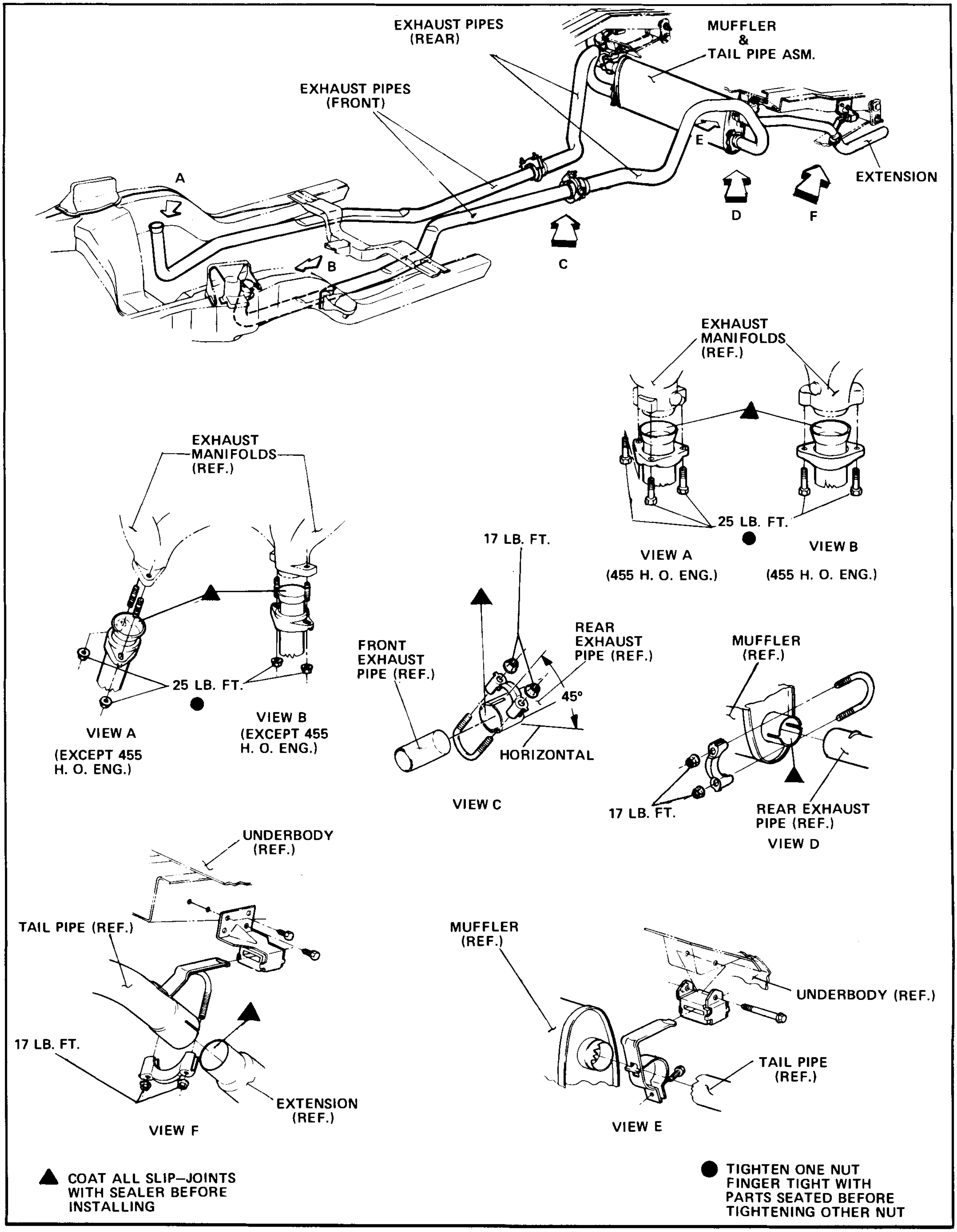


Fig. 8-25 Installation of V-8 Dual Exhaust System (F Series)

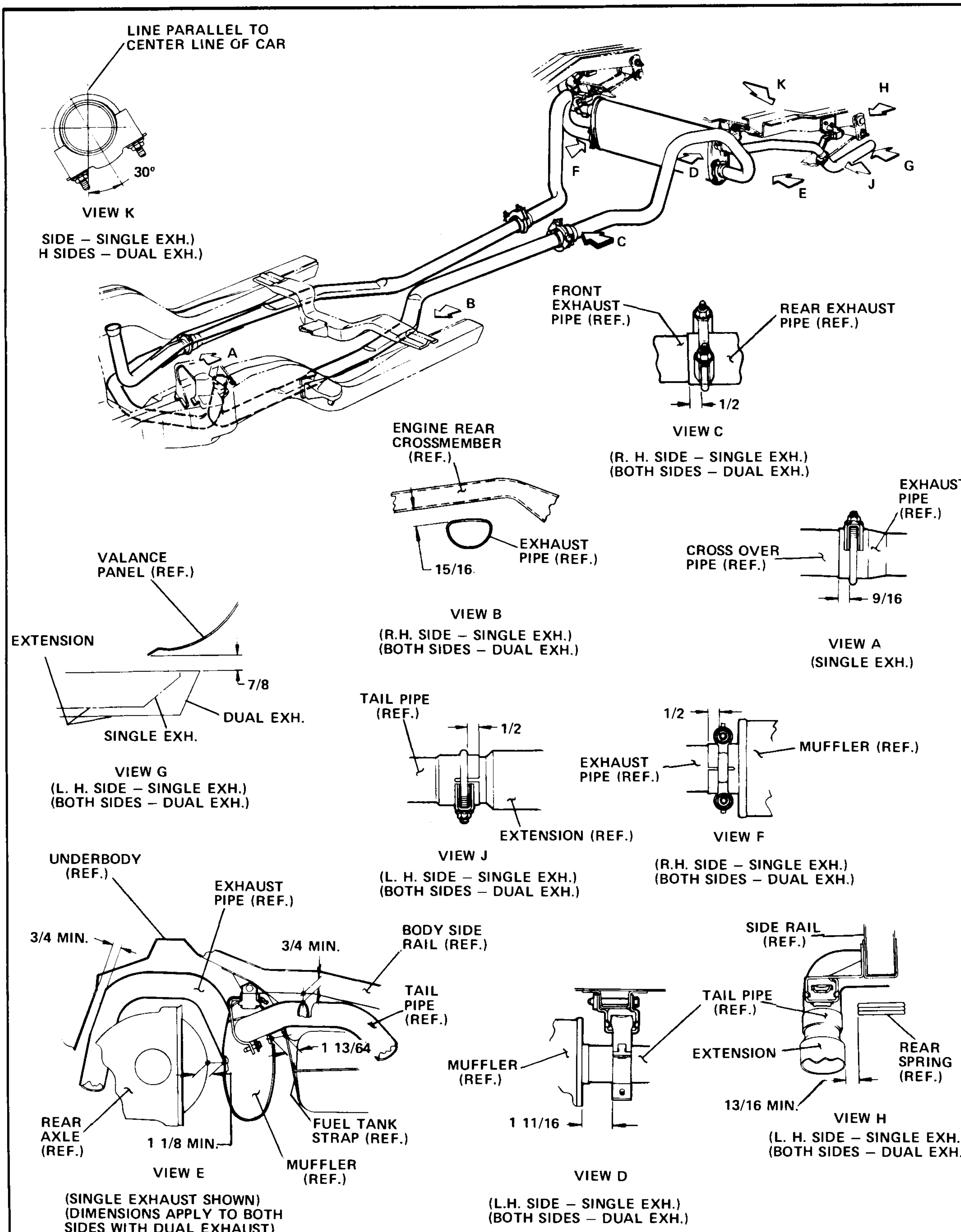


Fig. 8-26 Exhaust System Clearance Requirements (F Series V-8)

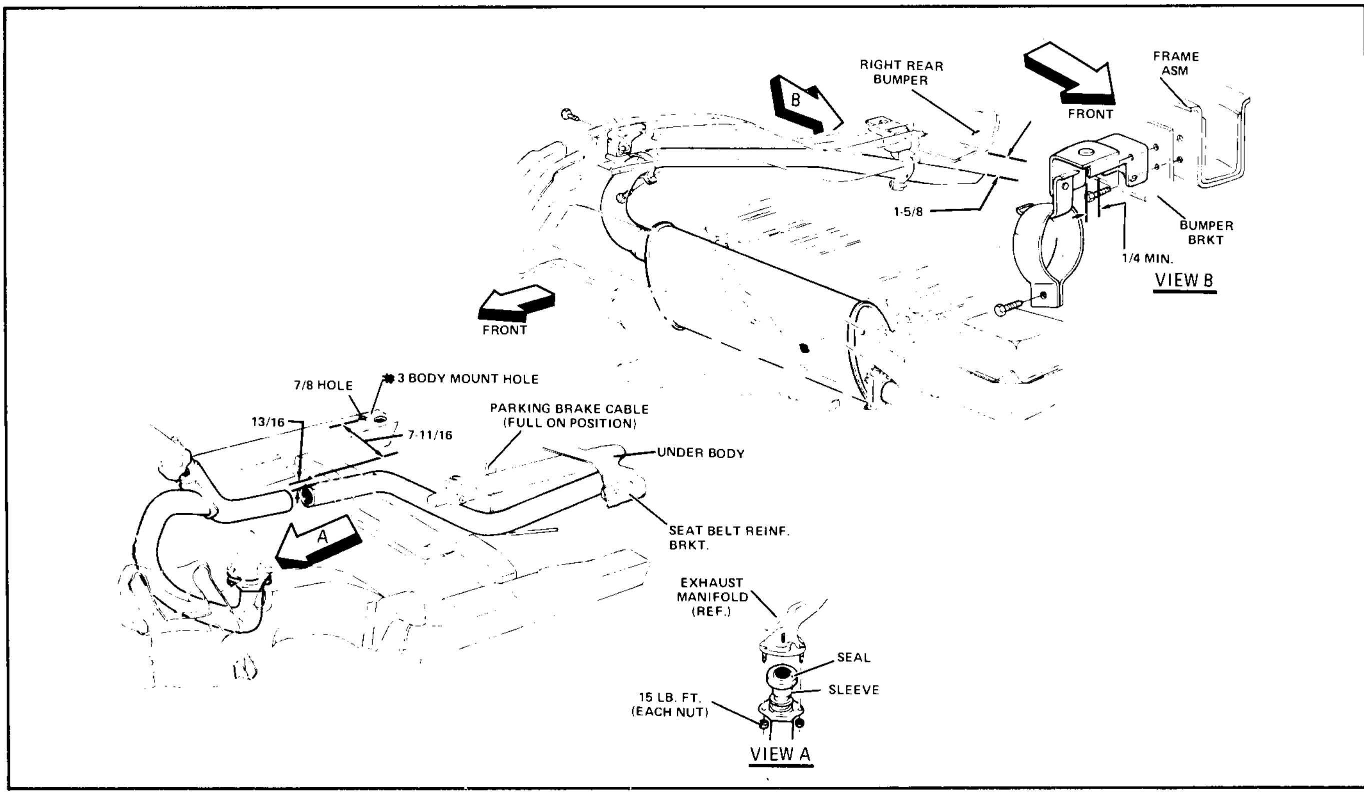


Fig. 8-27 Exhaust System Clearance Requirements (X Series V-8)

Resonators are not used.

Pipe and muffler hanger assemblies are a "rubber block" type (Fig. 8-14). This 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 hanger assembly is made up of a rubber insulator block placed in a stamped metal bracket which bolts to the underbody. The supports holding components of the exhaust system in place have a strap (blade) formed on one end that slips into a slot in the hanger rubber insulator block with no clamping of the support to hanger required. The installation of exhaust system supports is very important as improperly installed supports can cause annoying vibrations which are difficult to diagnose. When inspecting or replacing exhaust system components make sure there is at least 3/4" clearance from the floor pan to avoid possible overheating of the floor pan and possible damage to the passenger compartment carpets.

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(s) rearward of the muffler must be replaced whenever a new muffler is installed.

MINOR AND MAJOR SERVICE

FUEL TANK FILLER CAP

All series are equipped with a gas cap which has a double set of locking tangs. The use of these tangs requires a two step removal and installation procedure.

REMOVE

1. Rotate cap one-half turn counterclockwise to clear the first set of tangs from the slots inside the filler neck. This will allow any residual pressure to escape.
2. Pull the cap outward and rotate one-quarter turn counterclockwise to clear second set of tangs and remove the cap.

INSTALL

NOTE: *If this cap requires a replacement, only a cap with the same features should be used. Failure to use the correct cap can result in a serious malfunction.*

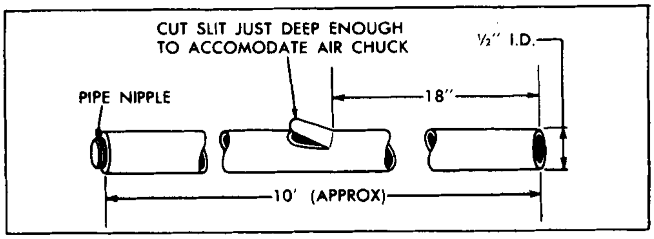


Fig. 8-28 Fuel Tank Drain Hose

Reverse removal procedure. Additional attention must be given to insure complete installation by the first set of tangs used to seat the cap tightly against the filler neck. Otherwise, the cap will be retained loosely to the filler neck by the second set of tangs encountered during removal and since this set of tangs is *not* intended for tight cap seating, there may be fuel spillage under some conditions.

FUEL TANK

DRAIN

1. Raise rear of car.

   NOTE: *End of hose will reach front bottom edge of tank easier if rear of car is raised above the front.*

2. Insert a length of hose (refer to Fig. 8-28 for details) into gas tank, pipe nipple end first, until weighted end of hose rests on bottom of tank.

3. With chuck of air hose inserted into hose slit, a short blast of air will cause gas to flow.

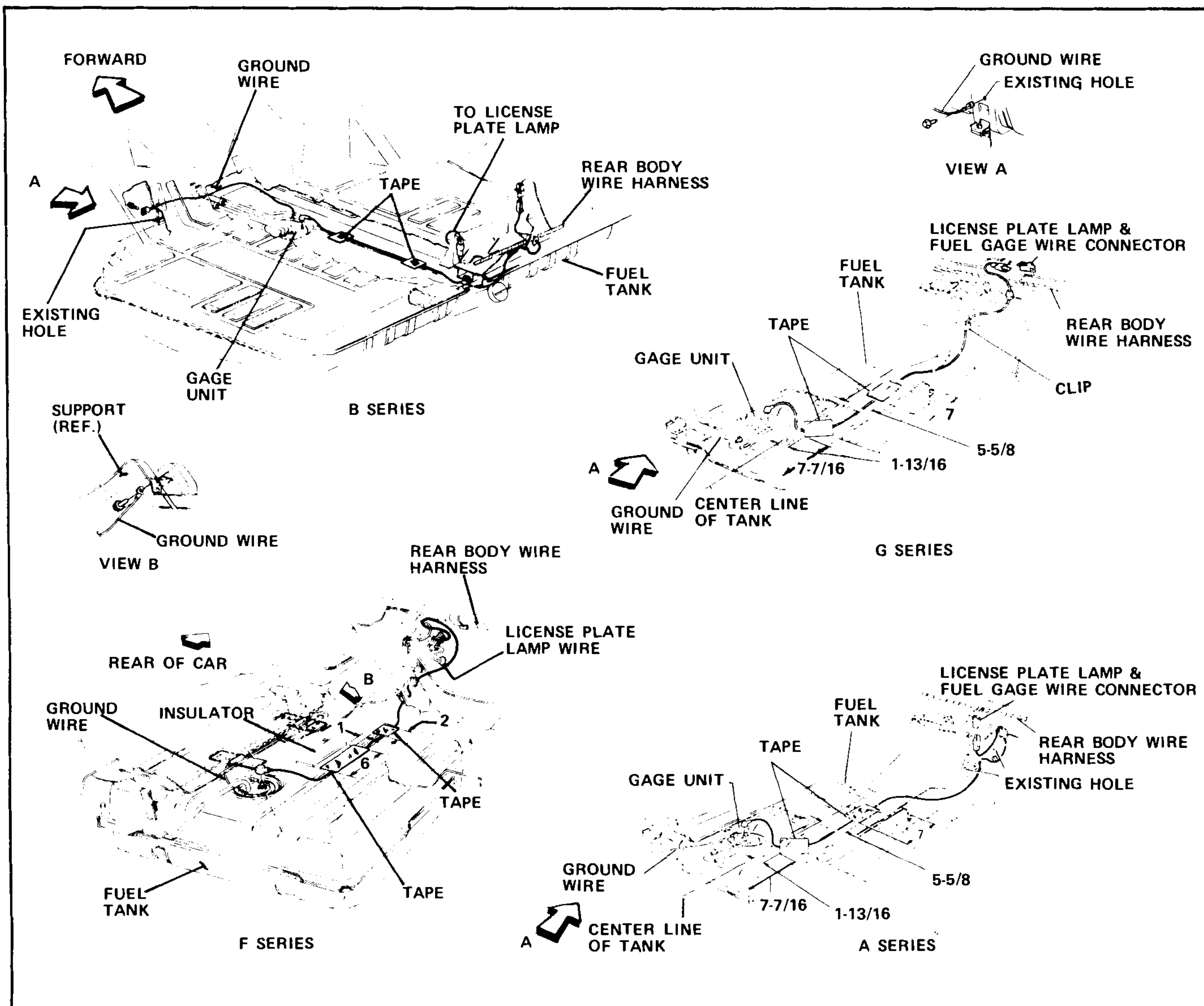


Fig. 8-29 Fuel Tank Gage Unit Wiring (Except Station Wagon & X Series)

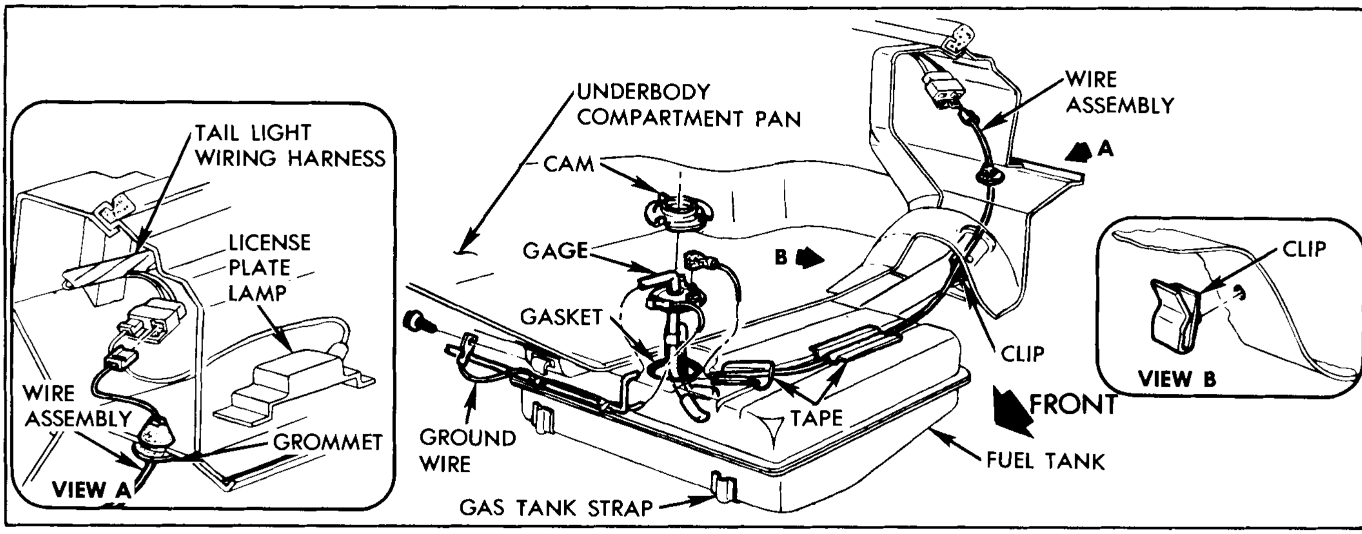


Fig. 8-30 Fuel Tank Gage Unit Wiring (X Series)

REMOVE (EXCEPT STATION WAGON)

1. Raise rear of car.
2. Drain tank.
3. Disconnect fuel hose and fuel vapor return hose at tank gage unit.
4. Remove screw retaining ground wire (Figs. 8-29 and 8-30).
5. Disconnect tank gage unit lead wire from clip on B Series.
6. Disconnect front vent hoses (Fig. 8-10).
7. Disconnect support straps and partially lower tank.
8. Disconnect waterproof wire connector at tank gage unit on B Series.
9. Complete tank removal.

INSTALL

1. Install tank by reversing the above steps.
2. Torque fuel tank support strap nuts and bolts as listed below.

APPLICATION	TORQUE
B Series (Except Wagon)	25 lbs. ft.
B Series Wagon	9 lbs. ft.
A Series (Except Wagon)	8 lbs. ft.
A Series Wagon	9 lbs. ft.
G Series	8 lbs. ft.
F Series	20 lbs. ft.
X Series	20 lbs. ft.

REMOVE (STATION WAGON)

1. Drain tank.
2. Raise car at axle housing.

   CAUTION: *Use care not to crush exhaust system "kick-under" pipe on B Series station wagons when using an axle engaging hoist.*

3. **A Series:**

   a. Disconnect lower end of left rear shock absorber.

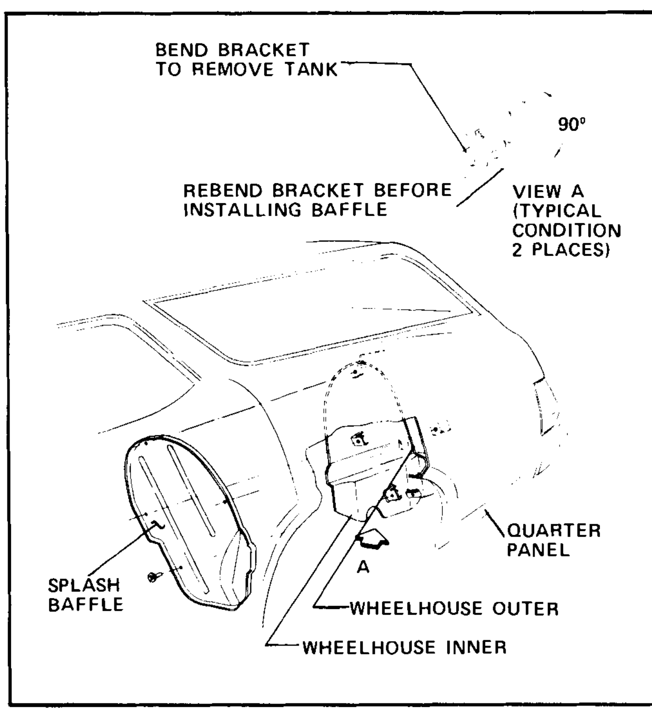


Fig. 8-31 Installation of Fuel Tank Wheel Opening Splash Baffle (Station Wagon)

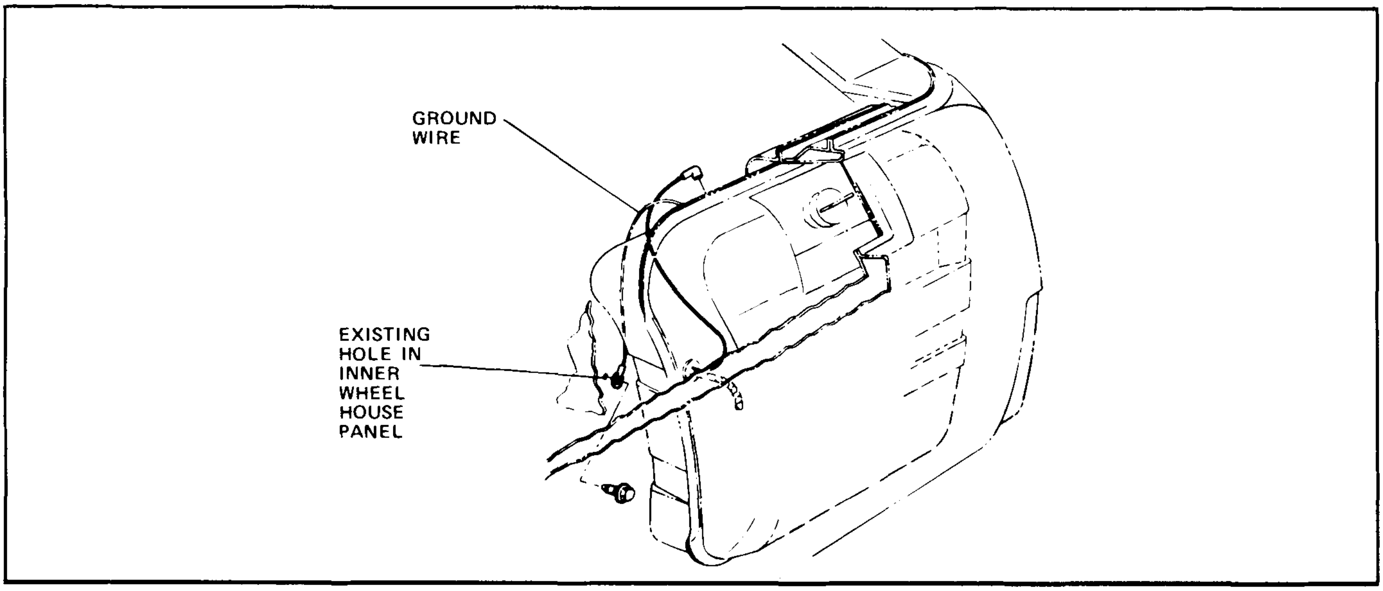


Fig. 8-32 Fuel Tank Gage Unit Wiring (B Series Station Wagon)

b. Place jack stand under right side axle tube near wheel and tire.

c. Place jack stand under left side frame rail just forward of frame kick-up.

d. Lower car onto jack stands and let left side of axle assembly extend down.

CAUTION: *Be careful not to let axle assembly hang on brake hose. Replace brake hose if weight of suspension is allowed to hang on hose. The suspension coil spring may be loose enough to be removed.*

4. Remove left rear wheel.

5. **B Series:** Remove left rear brake drum and cover brake backing plate assembly with clean cloth.

6. Remove screws retaining wheel opening splash baffle under left rear wheel well (Fig. 8-31).

7. Disconnect fuel hose and fuel vapor return hose at frame.

8. Disconnect vent hose at frame.

9. Remove screw retaining ground wire (Fig. 8-32 and 8-33).

10. Disconnect fuel gage wire connector at body wire harness.

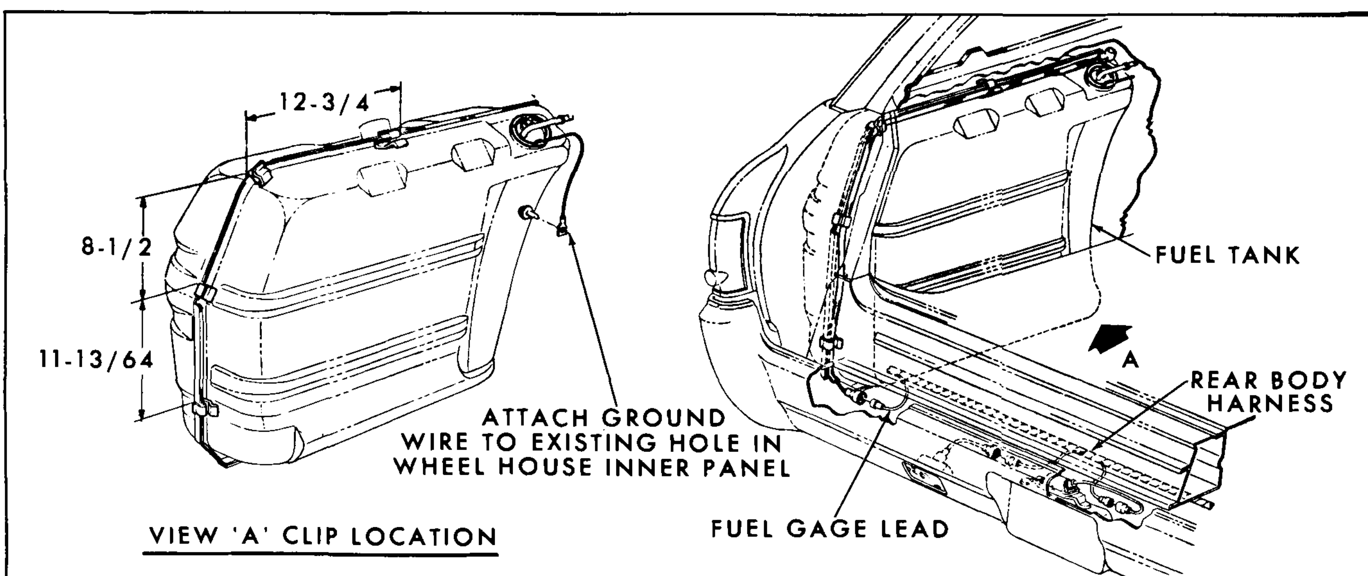


Fig. 8-33 Fuel Tank Gage Unit Wiring (A Series Station Wagon)

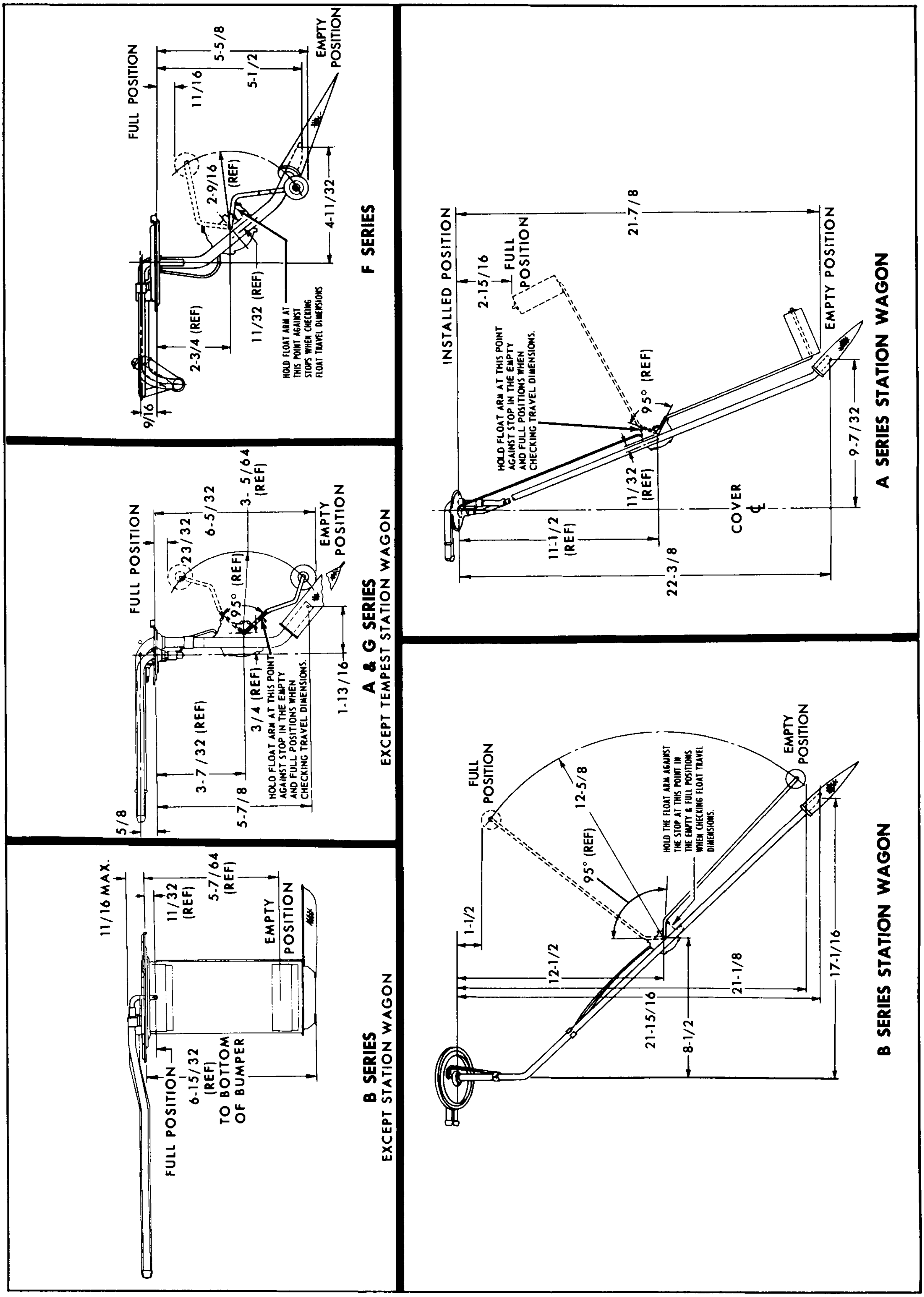


Fig. 8-34 Fuel Tank Gage Unit (Except X Series)

11. Remove nut on B Series or bolt on A Series holding front tank support strap to bracket.

12. Remove nut holding lower tank support strap to hook bolt.

13. Move fuel tank into wheel well opening and remove tank.

INSTALL

1. Install tank by reversing the above steps.

   CAUTION: *Be sure suspension coil spring on A Series is properly positioned.*

2. Tighten support strap nuts to 10 lb. ft. torque. Tighten splash baffle to wheel well screws to 17 lb. in. torque on B Series or 25 lb. in. torque on A Series. Tighten shock absorber lower nut to 65 lb. ft. torque.

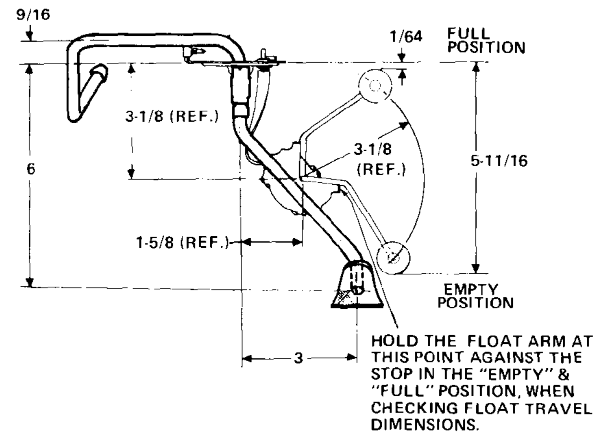


Fig. 8-35 Fuel Tank Gage Unit (X Series)

FUEL TANK GAGE UNIT

REMOVE (EXCEPT STATION WAGON)

NOTE: *Before removing tank gage unit, be sure it is actually inoperative (see diagnosis chart, Fig. 8-1 Fuel Gage Checking Procedure).*

1. Remove tank (see FUEL TANK - EXCEPT STATION WAGON - REMOVE).

2. Clean away any dirt that has collected around gage unit and terminal so it will not enter tank when gage unit is removed.

3. Remove tank gage unit by using tool J 22554 on B and F Series or tool J 23346 on A, G and X Series (Fig. 8-38).

INSTALL

1. Install by reversing the above steps, making sure a new tank gage unit gasket is installed.

   NOTE: *Before the new unit is installed in the tank, the float arm should be checked for freedom of movement by raising it to various positions and seeing if it will always fall to the "empty" position (Figs. 8-34 and 8-35).*

2. Install tank (see FUEL TANK - EXCEPT STATION WAGON - INSTALL).

REMOVE (STATION WAGON)

NOTE: *Before removing tank gage unit, be sure it is actually inoperative (see diagnosis chart, Fig. 8-1 Fuel Gage Checking Procedure).*

1. Remove tank (see FUEL TANK - STATION WAGON - REMOVE).

2. Clean away any dirt that has collected around gage unit and terminal so it will not enter tank when gage unit is removed.

3. Remove tank gage unit by using tool J 22554 on B Series or tool J 23346 on A Series (Fig. 8-38).

INSTALL

1. Install by reversing the above steps, making sure a new tank gage unit gasket is installed.

   NOTE: *Before the new unit is installed in the tank, the float arm should be checked for freedom of movement by raising it to various positions and seeing if it will always fall to the "empty" position (Fig. 8-34).*

2. Install tank (see FUEL TANK - STATION WAGON - INSTALL).

LIQUID-VAPOR SEPARATOR

REMOVE

1. Raise rear of car.
2. Disconnect hoses from separator (Fig. 8-9).

   CAUTION: *Disconnect hoses carefully to prevent damaging separator inlet extensions. Plug hoses to keep fuel from draining out of tank.*

3. Lower rear of car.
4. Remove rear seat back.
5. Remove screws retaining separator to underbody.
6. Remove separator.

INSTALL

1. Install by reversing the above steps.

   NOTE: *Install new gasket between mounting flange at base of separater and underbody.*

2. Tighten separator retaining screws to 40 lb. in. torque.

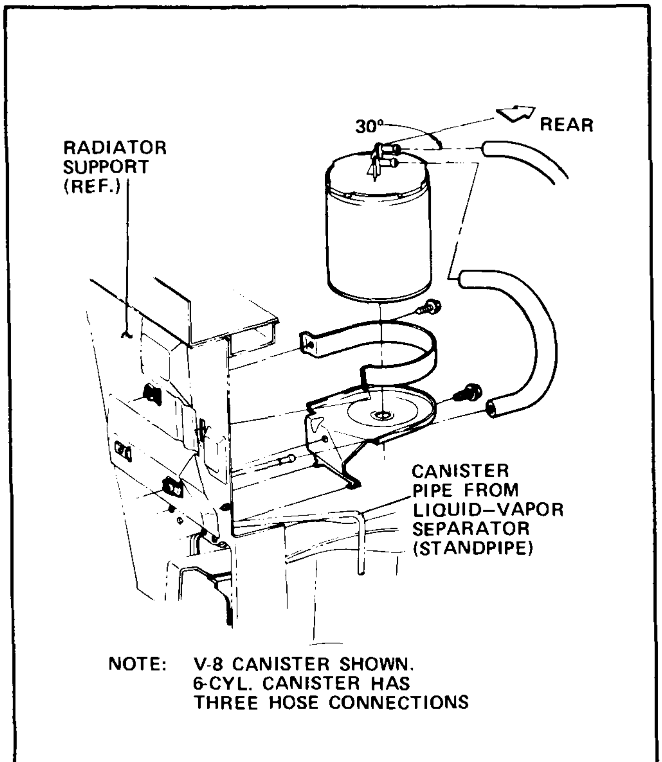


Fig. 8-36 Installation of Canister (Except X Series)

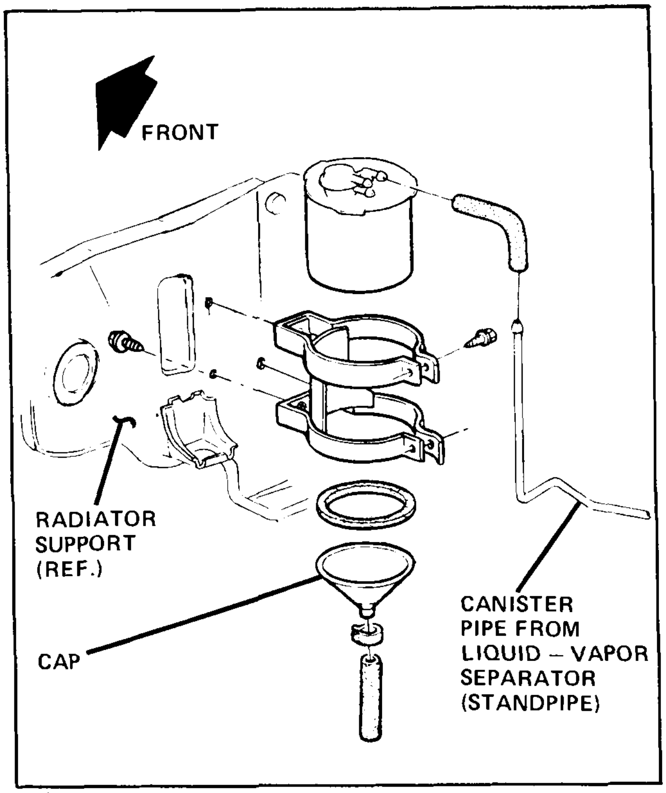


Fig. 8-37 Installation of Canister (X Series)

CANISTER

REMOVE

1. Disconnect hoses from canister (Figs. 8-36 and 8-37).

   CAUTION: *Disconnect hoses carefully to prevent damaging canister inlet extensions.*

2. Remove screw from strap(s) holding canister.
3. Remove canister.
4. **X Series:** Unsnap cap and length of hose from the opening at the bottom of the canister below the filter.

INSTALL

1. Install by reversing the above steps.
2. Tighten screw for strap holding canister to 75 lb. in. torque.

CANISTER MOUNTING BRACKET

REMOVE

1. Loosen screw(s) for strap holding canister (Figs. 8-36 and 8-37).

2. Slide canister with hoses attached up from mounting bracket.

3. Remove screw(s) attaching canister mounting bracket.

NOTE: *On some series it may be necessary to remove the headlamp on same side of car canister is mounted on and use hole behind headlamp in headlamp filler panel for access.*

INSTALL

1. Install by reversing the above steps.

2. Tighten canister mounting bracket screw(s) to 20 lb. ft. torque on B & X Series or to 75 lb. in. torque on A, G and F Series. Tighten screw for strap holding canister to 75 lb. in. torque.

GENERAL SPECIFICATIONS

FUEL TANK CAPACITY (U.S. GALS. - APPROX.)

B Series (except Station Wagon)	25
B Series Station Wagon	23
A Series (except Station Wagon)	20
A Series Station Wagon	23
G Series	26
F Series	18
X Series	16

NOTE: *Fuel pumping rate during refueling may cause tank capacities to vary due to fill limiter inside tank that fills slowly after fuel tank is filled.*

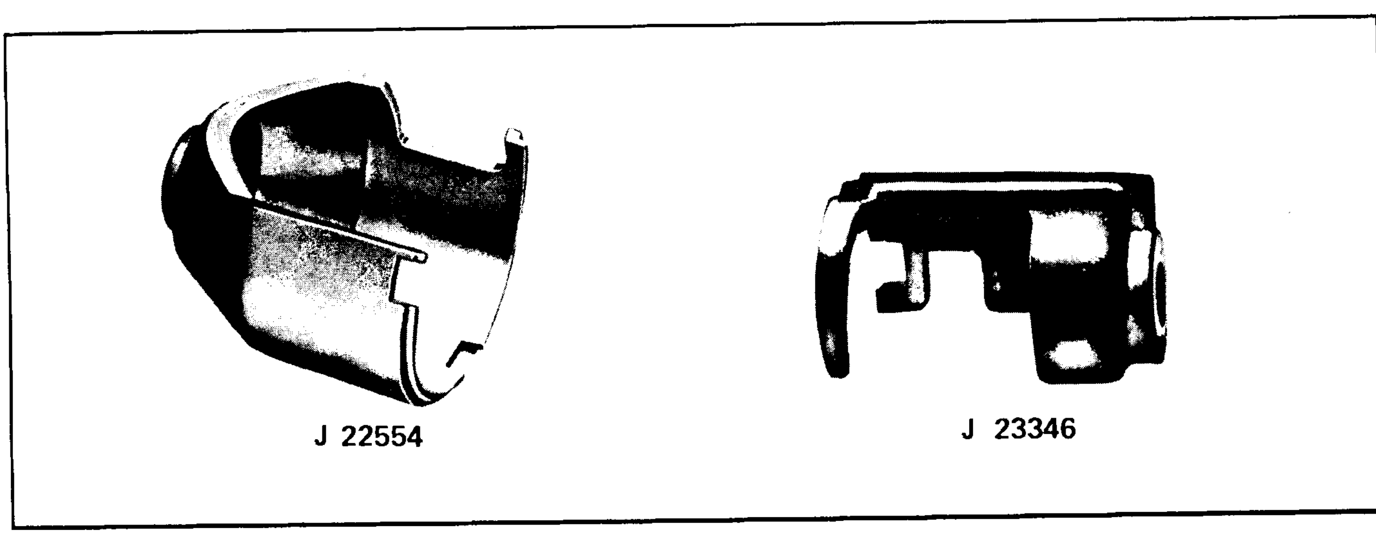


Fig. 8-38 Special Tools

Tool No.	Name
J-22554	Fuel Tank Sending Unit Spanner
J-23346	Fuel Tank Sending Unit Spanner

SECTION 9

STEERING

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

TROUBLE DIAGNOSIS AND TESTING

POWER STEERING SYSTEM HAS HISSING OR SWISHING NOISE

NOTE: *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.*

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Misaligned steering column causing metal to metal contact at steering shaft and flexible coupling.	a. Align steering column to obtain proper clearance.
b. Flexible coupling loose or torn.	b. Replace coupling.
c. Flow control valve in pump sticking or binding (P/S equipped cars only).	c. Replace flow control valve.

STEERING SYSTEM HAS RATTLE OR CHUCKING NOISE

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Gear loose on frame.	a. Check gear-to-frame mounting screws.
b. Pressure hose touches other parts of car.	b. Adjust hose position.
c. Loose pump pulley (P/S equipped cars only).	c. Tighten to specifications.
d. Steering linkage looseness or looseness present inside steering column.	d. Check linkage pivot points for wear. Replace if necessary. If linkage is OK, inspect for damage or wear of steering shaft, bearing or other internal parts of steering column.
e. Loose pitman shaft adjustment.	e. Adjust to specifications, if adjustment does not correct problem disassemble steering gear and inspect for excessive wear and replace worn parts.

TROUBLE DIAGNOSIS (Continued)

HARD STEERING OR LACK OF ASSIST

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Low oil level in pump. (**NOTE**: *This will also cause excessive pump noise*).	a. Fill to proper level. Check all lines and connections for evidence of external leakage.
b. Loose pump belt.	b. Tighten to specifications.
c. Steering gear adjusted too tight.	c. Test steering system for bind with front wheels off floor. Adjust as necessary, if bind is still present in steering gear inspect steering gear for worn or damaged internal parts.
d. Steering shaft binding.	d. Align steering column, if steering shaft is still binding disassemble steering column and inspect for bent or damaged parts.
e. Insufficient oil pressure.	e. If above checks do not reveal cause of hard steering, check pump pressure. If pressure check indicates power steering is operating normal, refer back to Section 3 for additional causes of hard steering.
f. Low oil pressure due to restriction in hoses.	
(1) Check for kinks in hoses.	(1) Remove kink.
(2) Foreign object stuck in hose.	(2) Remove hoses and remove restricting object or replace hose.
g. Low oil pressure due to steering gear.	
(1) Leakage at internal seals.	(1) Remove gear from car for disassembly and replace seals.
(2) Pressure loss in cylinder due to scored bore.	(2) Remove gear from car for disassembly and inspection of ring and housing bore.
h. Low oil pressure due to steering pump.	
(1) Flow control valve stuck or inoperative.	(1) Remove burrs or dirt or replace.
(2) Cracked or broken thrust or pressure plate.	(2) Replace part.
(3) Scored pressure plate, thrust plate or rotor.	(3) Lap away light scoring, replace heavily scored parts.
(4) Extreme wear of cam ring.	(4) Replace part.
(5) Vanes sticking in rotor slots.	(5) Free-up by removing burrs, varnish or dirt or improperly installed.

POOR RETURN OF STEERING

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Tires over-inflated.	a. Inflate to specified pressure.
b. Lack of lubricant in suspension joints and steering linkage.	b. Lubricate properly.
c. Steering linkage binding.	c. Inspect linkage for damage. Replace any damaged parts.
d. Steering wheel rubbing against directional signal housing.	d. Adjust steering mast jacket.

TROUBLE DIAGNOSIS (Continued)

POOR RETURN OF STEERING (Continued)

CAUSE	CORRECTION
e. Lower coupling flange rubbing against steering gear adjuster plug.	e. Loosen coupling and assemble properly.
f. Steering gear adjustments tight.	f. Check adjustment with pitman arm disconnected. Readjust if necessary.
g. Steering gear to column misalignment.	g. Realign steering column.
h. Rubber spacer in shift tube is rubbing steering shaft.	h. Make certain spacer is properly seated. Lubricate inside diameter with silicone.
i. Rough or broken steering shaft bearings.	i. Replace bearings.
j. Improper front wheel alignment.	j. Check and adjust as necessary.
k. Sticky steering gear valve spool (P/S equipped cars only).	k. Remove and clean or replace rotary valve.

STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING, ESPECIALLY DURING PARKING

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Fluid level low (P/S equipped cars only).	a. Fill fluid level to proper level and be sure air is not present in system.
b. Loose pump belt (P/S equipped cars only).	b. Adjust belt.
c. Steering linkage hitting engine oil pan at full turn.	c. Inspect linkage for damage and replace any damaged parts.
d. Sticky flow control valve (P/S equipped cars only).	d. Replace flow control valve.
e. Steering shaft upper or lower bearing rough or broken.	e. Replace bearing if noise is present in steering column.
f. Vanes sticking in rotor slots or improperly installed (P/S equipped cars only).	f. Free-up by removing burrs, varnish or dirt. Install properly.

POWER STEERING SYSTEM HAS SQUEAL OR SQUAWK WHEN TURNING STEERING WHEEL

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Loose belt.	a. Tighten belt.
b. Glazed belt.	b. Replace belt.
c. Power steering hose obstructed causing excessive pump pressures.	c. Reposition hose.
d. Flow control valve sticking or binding.	d. Replace control valve if pressure test indicates excessive pressures.
e. Cut or worn dampener "O" ring or valve spool.	e. Replace dampener "O" ring being careful not to cut new "O" ring at installation.
f. Loose or worn rotary valve parts.	f. Replace rotary valve.

TROUBLE DIAGNOSIS (Continued)

POWER STEERING SYSTEM HAS A GROAN OR GROWLING NOISE

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Low oil level.	a. Fill reservoir (make sure no air is in system since it contributes to noise).
b. Excessive back pressure caused by restriction in hoses or steering gear.	b. Locate restriction and correct. Replace parts if necessary.
c. Scored pressure plate, thrust plate or rotor inside pump.	c. Replace with new part.
d. Extreme wear of cam ring inside pump.	d. Replace parts.

POWER STEERING PUMP HAS WHINE NOISE

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Pump shaft bearing scored or rough.	a. Replace shaft bearing and damaged parts as needed.

POWER STEERING PUMP LEAKING OIL

NOTE: *Wipe parts thoroughly and make sure source of leakage is determined (Fig. 9-1).*

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Reservoir oil level too high.	a. Remove excess oil from reservoir.
b. Damaged reservoir cap (loose).	b. Replace cap.
c. Loose hose connections or hose cracked.	c. Tighten connection or replace hose as necessary.
d. Pressure union or cover screws loose or seals leaking.	d. Tighten loose fitting or replace seals if necessary.
e. Reservoir "O" ring leaking.	e. Replace seal also examine reservoir housing for damage.
f. Shaft seal leaking.	f. Replace seal and examine shaft. If shaft is scored, replace.

POWER STEERING GEAR LEAKING OIL EXTERNALLY

NOTE: *Wipe parts thoroughly and make sure source of leakage is determined (Fig. 9-2).*

TROUBLE DIAGNOSIS (Continued)

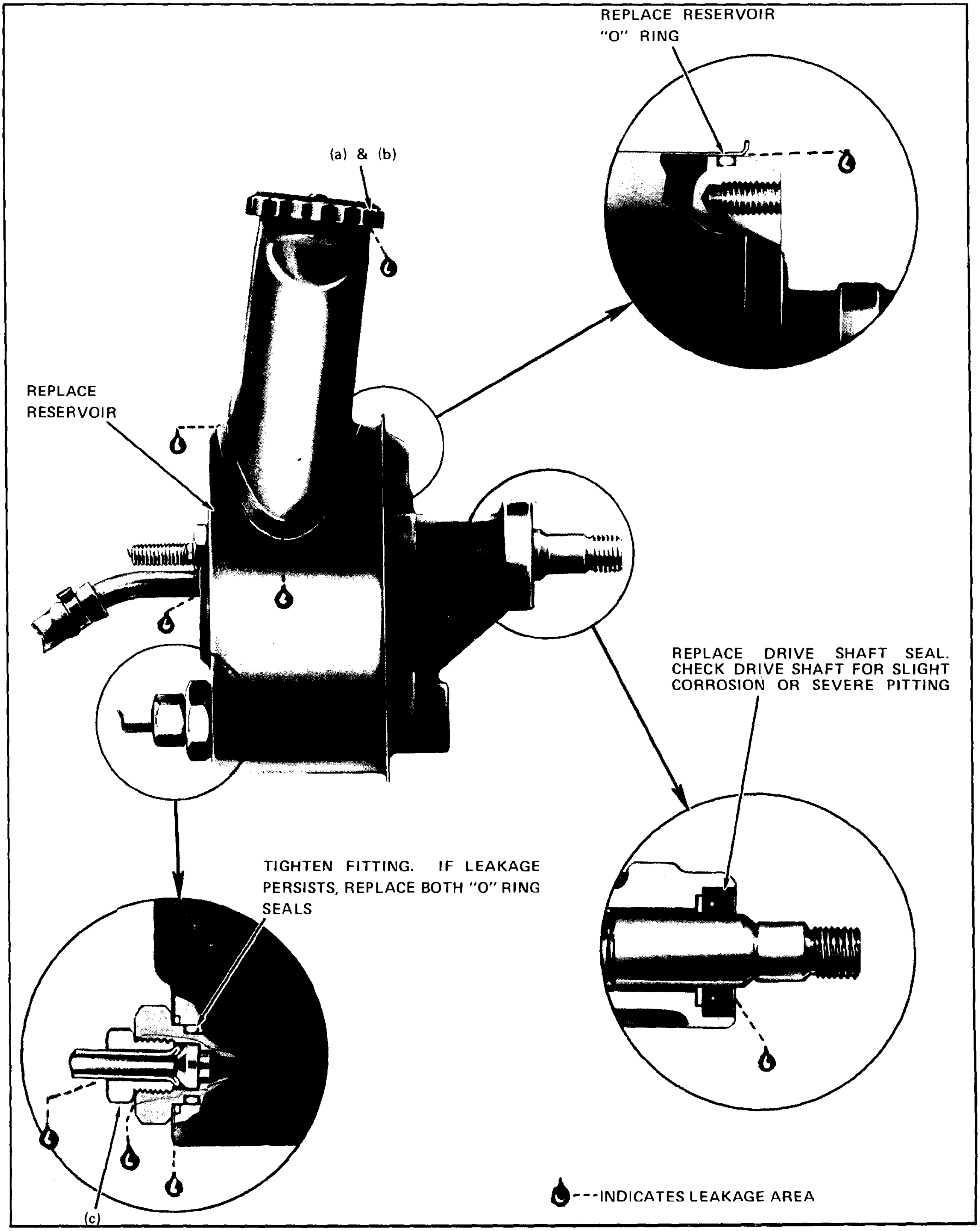


Fig. 9-1 Diagnosis of Power Steering Pump Leakage Areas

TROUBLE DIAGNOSIS (Continued)

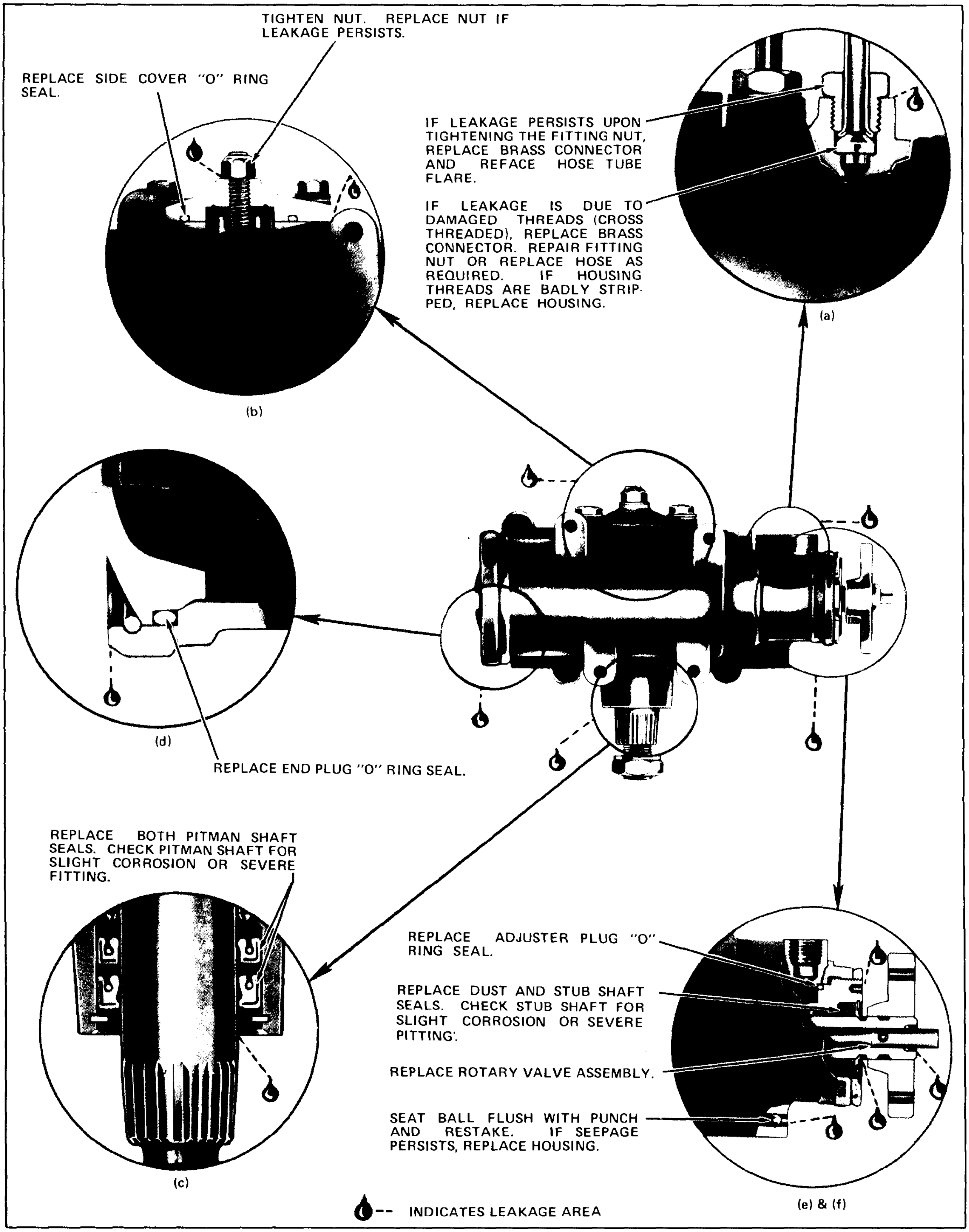


Fig. 9-2 Diagnosis of Power Steering Gear Leakage Areas

TROUBLE DIAGNOSIS (Continued)

POWER STEERING GEAR LEAKING OIL EXTERNALLY (Continued)

Follow steps below. If first step is O.K., proceed down list until problem is corrected.

CAUSE	CORRECTION
a. Hose connection loose or hose cracked.	a. Tighten connection or replace hose as necessary.
b. Side cover "O" ring seal.	b. Replace seal.
c. Pitman shaft seals.	c. Replace seals.
d. Housing end plug seal.	d. Replace seal.
e. Adjuster plug seals.	e. Replace seals.
f. Torsion bar seal.	f. Replace rotary valve assembly.
g. Defective housing.	g. Replace housing assembly.

ENERGY ABSORBING STEERING COLUMN

DESCRIPTION

All models incorporate a steering column mounted lock located on the right-hand side of the steering column immediately below the steering wheel. The system locks the steering wheel, ignition system, and the transmission shift linkage when the ignition key is removed from the lock.

Five key positions are provided, each with a positive detent. These positions are, in a clockwise direction, "accessory" - "lock" - "off" - "on" - "start" (Fig. 9-3). The "lock" position is indicated by a groove on the rotating lock faceplate which aligns with an arrow and embossed LOCK letters on the column mast jacket. In the "lock" position, movement of the steering wheel and the transmission shift linkage is restricted and the ignition key can be removed from the lock. The "off" position permits the steering wheel and the transmission shift linkage to be moved normally without having to have the engine running, but the ignition key cannot be removed from the lock.

The locking feature is incorporated in the two column applications available; regular energy-absorbing and tilt energy-absorbing. The regular column is standard on all models and the tilt column is optionally available on all models. The basic functioning of the locking mechanism, is the same for each column.

Two wing tabs on the lock and use of a large ignition key head provide operating leverage for turning the lock cylinder. A toothed sector on the end of the cylinder inside the column meshes with a rack such that the rack moves up or down the column as the lock cylinder is rotated. This movement is used to lock the steering wheel and transmission shift linkage (either floor or column mounted) when the cylinder is rotated to the "lock" position (Fig. 9-4).

A slotted lock plate is splined to the steering shaft upper end. As the lock cylinder is rotated to the "lock" position, the lock bolt moves up the column with the rack and into one of the 12 slots in the lock plate. The lock bolt is spring loaded so that the wheel will "lock" with any wheel movement if the lock bolt is unable to enter directly into one of the slots.

A slotted lock bracket moves with the steering column shifter bowl as the transmission is shifted. When the transmission is in the PARK position on automatic or REVERSE position on manual shift transmissions, the slot in the lock bracket is aligned such that a raised step on the rack moves into the slot when the lock cylinder is rotated to the "lock" position. This effectively prevents the shifter bowl from moving, thereby preventing the transmission from being shifted. This also prevents the lock cylinder

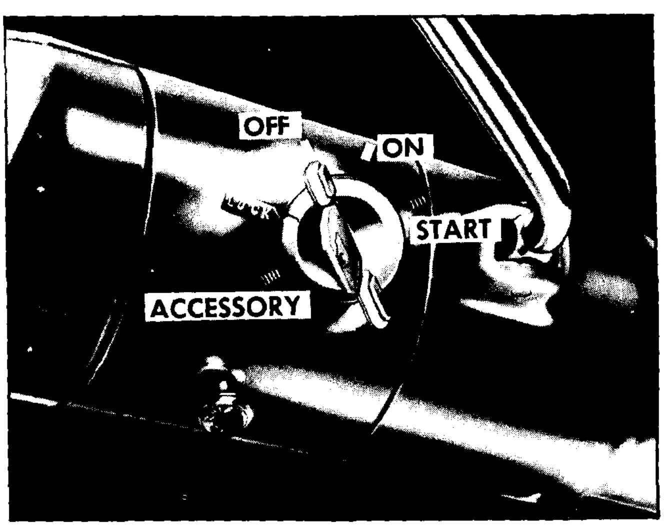


Fig. 9-3 Lock Cylinder Positions

from being rotated into the "lock" position unless the transmission shift linkage has been positioned in either the PARK or REVERSE position. Vehicles with floor mounted transmission shift linkage incorporate a shifter tube and lock bracket arrangement in the steering column which is very similar to that used in the column mounted shift linkage set-up. Interlock linkage between the transmission linkage and the column shift tube forms a "back-drive" arrangement to provide the same locking features for floor mounted as for column mounted transmission shift linkage.

When rotating the lock cylinder from the "lock" to the "off" position, the rack is moved down the column, releasing the transmission shift linkage and pulling the lock bolt from the steering shaft lock plate. This allows the transmission shift linkage and the steering wheel to be moved freely. Rotating the lock cylinder further, to the "start" position, causes the rack to move further down the column to energize the starter through the ignition switch, which is located on the steering column under the brake pedal support assembly. An actuator rod outside the column mast jacket connects the ignition switch contact carrier to the lower end of the lock rack assembly. Contact carrier

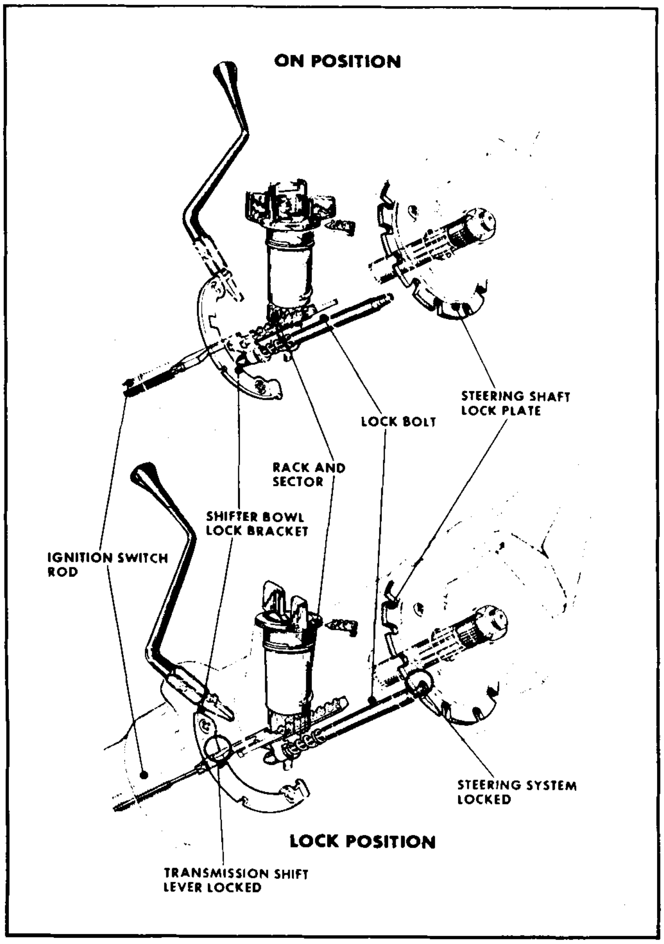


Fig. 9-4 Locking Mechanism

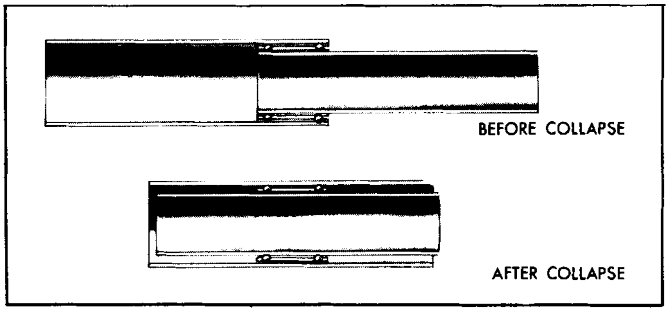


Fig. 9-5 Energy - Absorbing Steering Column Design

movement inside the switch housing establishes the various ignition system circuits. When the key is released from the "start" position, the lock cylinder automatically returns to the "on" position. For vehicles with manual transmission, a switch activated by the clutch linkage requires that the clutch pedal be fully depressed before the engine can be started. Operation is similar to that of the neutral safety switch used on vehicles equipped with automatic transmission.

The energy absorbing steering column is used on all series cars. This column is designed to compress under impact. Energy absorbing characteristics are provided by a "telescoping" action in the mast jacket (Fig. 9-5). Thirty-two balls, embedded in a plastic sleeve, are crimped between overlapping upper and lower mast jacket sections. As the column assembly is impacted, the upper mast jacket section is compressed over the lower, sliding along the ball bearings as they deform the tube to achieve a controlled rate of collapse. The steering shaft and the shifter tube are held rigid until impact by injected plastic shear pins.

When an automobile is being driven, the forward movement of the automobile and the forward movement of the driver both constitute a form of energy or force. When an automobile is involved in a frontal collision, the primary force (forward movement of the car) is suddenly halted, while the secondary force (the driver) continues its forward direction. A severe collision generally involves these two forces - the primary and the secondary forces. The secondary impact occurs when the driver is thrust forward onto the steering wheel and column.

The energy absorbing column is designed to absorb these primary and secondary forces to the extent that the severity of the secondary impact is reduced. During a collision the steering column compresses, thereby reducing its tendency to move rearward into the driver's compartment. A split second later when the driver is thrown forward (the secondary impact) his energy is also partially absorbed by the compression characteristics of the column.

The energy absorbing column may be easily disassembled and reassembled. It is important that only the specified screws, bolts and nuts be used as designated during reassembly, and that they are tightened to their specified torque. This precaution will insure the energy absorbing action of the assembly. Care should be exercised in using overlength bolts as they may prevent a portion of the assembly from compressing under impact. Equally as important is correct torque of the 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 energy absorbing column 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 levers, 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 this assembly.

TILT MECHANISM OPERATION

The tilt steering column is designed for driver comfort. It has six different steering wheel angle positions.

The tilt release lever is located on the left side of the steering column and below the directional lever. The tilt lever is pulled toward the steering wheel to disengage the lock and allow positioning of the wheel at the desired angle.

The tilt assembly consists of an upper and lower steering shaft assembly with a universal joint between them. A support assembly is held to the mast jacket by a lock plate, an actuator is positioned over the upper steering shaft and secured to the support by two pivot pins. Two lock shoes are pinned to the actuator and engage pins in the support assembly. When the release lever is pulled up and the lock shoes disengage the support pins, the steering wheel is pushed up by a spring compressed between the support and actuator assemblies. Releasing the lever will automatically reengage the lock shoes and hold the mechanism at the desired angle.

FLEXIBLE COUPLING

A steering gear flexible coupling known as a captured coupling is used on all models (Fig. 9-6). This coupling is basically the same as non-captured couplings except a bracket is included on the steering gear side of the coupling which provides an improved design. If at any time the bracket appears deformed, replace the coupling assembly and thoroughly inspect the steering column for damage. Plastic flexible coupling alignment spacers either orange or yellow in color are provided on service couplings The alignment spacers help obtain proper steering gear and column alignment during installation. The spacers must be installed all the way onto the coupling pins before placing the coupling to the steering shaft flange. Column instrument panel bracket nuts are then tightened with the steering shaft flange bottomed on the spacers. The spacers are split on the inside for easy removal after all steering gear and column alignment procedures have been completed and fasteners tightened. Remove the spacers by pulling them away from the locking pins with pliers or a hook fashioned out of heavy gage wire.

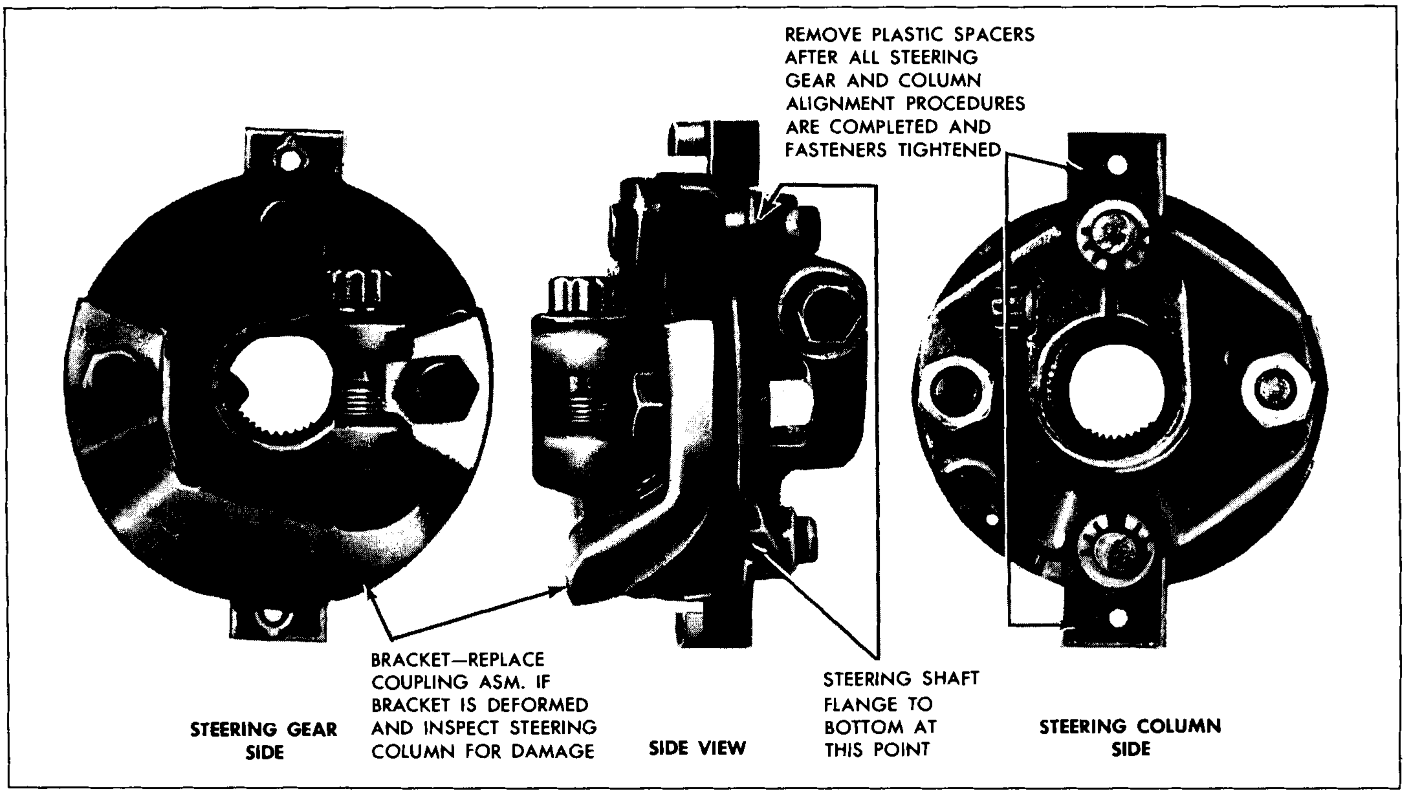


Fig. 9-6 Installation of Steering Shaft to Flexible Coupling

MANUAL STEERING GEAR

DESCRIPTION

The manual steering gear (Fig. 9-7) is of the recirculating ball nut type with the steering shaft, worm shaft and worm nut all in line, making a compact and easily serviced gear. The steering shaft and worm shaft are separated with a flexible coupling which permits removal of the gear assembly or steering shaft (and column) independent of each other.

The mechanical element of this steering gear is a low-friction, high-efficiency recirculating ball system in which steel balls act as a rolling thread between the steering worm and nut. The nut is one piece and is geared to the sector of the pitman shaft. Lash between the pitman shaft and rack piston nut is maintained by an adjusting screw which is retained in the end of the pitman shaft gear (Fig. 9-8).

The ball nut, mounted on the worm, is driven through steel balls which circulate in helical grooves in both the worm and nut. Ball return guides, attacned to the nut, serve to recirculate the two sets of twenty-five balls each in the grooves.

As the steering wheel is turned to the right, the nut moves upward. When the wheel is turned to the left the nut moves downward.

The teeth on the sector, which are forged as part of the pitman shaft, and the ball nut are so designed that a tighter fit exists between the two when the front wheels are straight ahead. Proper engagement between the sector and the ball nut is obtained by an adjusting screw which moves the pitman shaft endwise, permitting desired engagement of the tapered teeth of the ball nut and sector gear. The worm bearing adjuster can be turned to provide proper preloading of the upper and lower bearings.

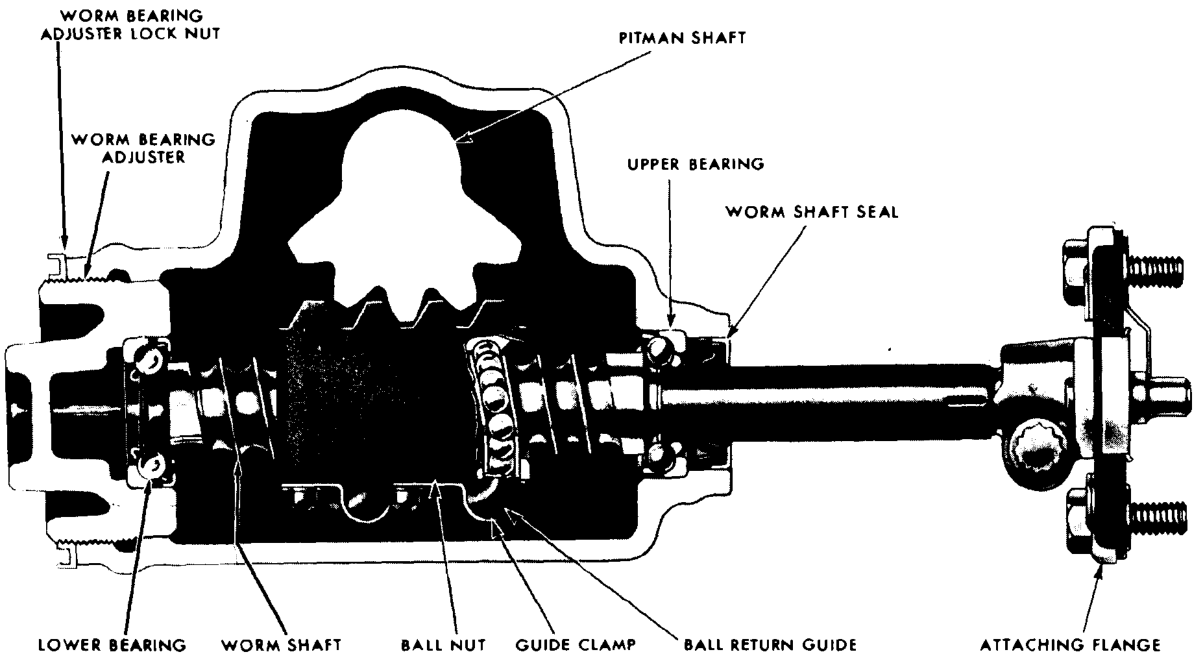


Fig. 9-7 Cross Section of Manual Steering Gear

POWER STEERING GEAR

DESCRIPTION

All series use a variable ratio power steering gear. Variable ratio steering is faster, requiring fewer turns of the steering wheel to move the front wheels from stop to stop, while steering effort is not increased. It also provides more precise control and better response in maneuvering, particularly in sharp rapid turns and in parking.

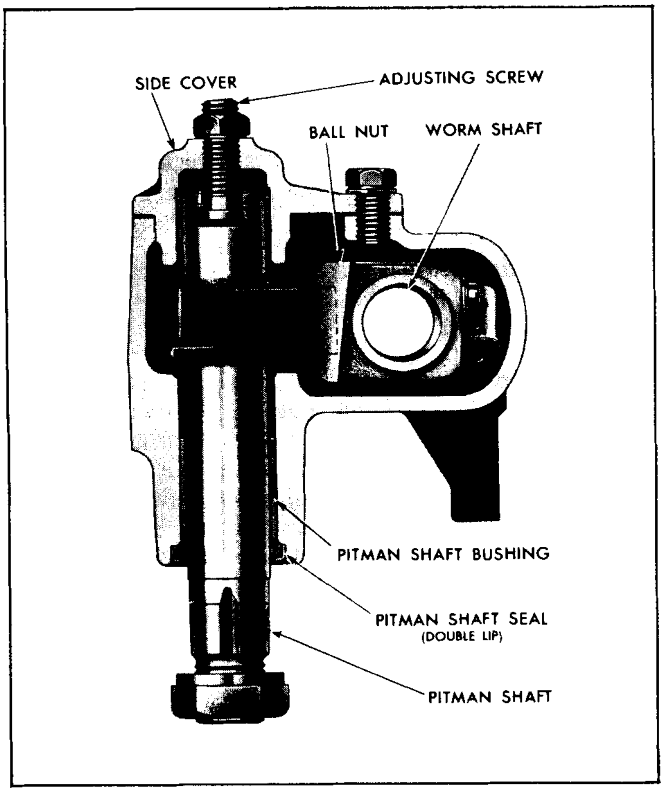


Fig. 9-8 Cross Section Through Pitman Shaft

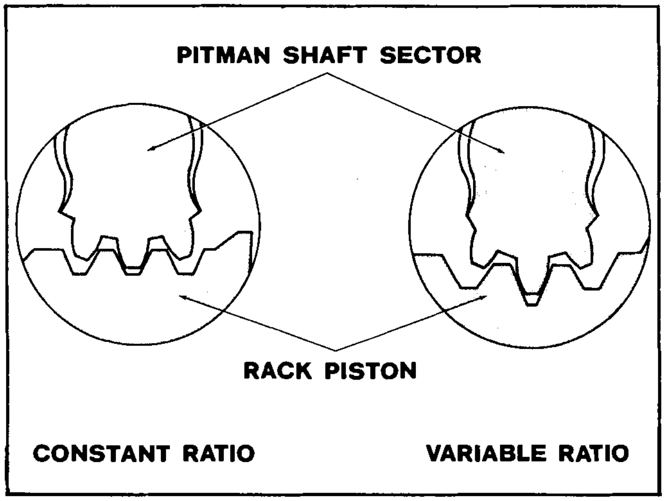


Fig. 9-9 Pitman Shaft Sector Teeth

The gear incorporates the recirculating ball system in which steel balls act as a rolling thread between the steering wormshaft and rack-piston. The rack-piston nut is geared to the sector of the pitman shaft. Lash between the pitman shaft and rack-piston nut is maintained by an adjusting screw which is retained in the end of the pitman shaft gear. The rotary valve is contained in the gear housing thus eliminating the need for separately mounted valve and cylinder assemblies.

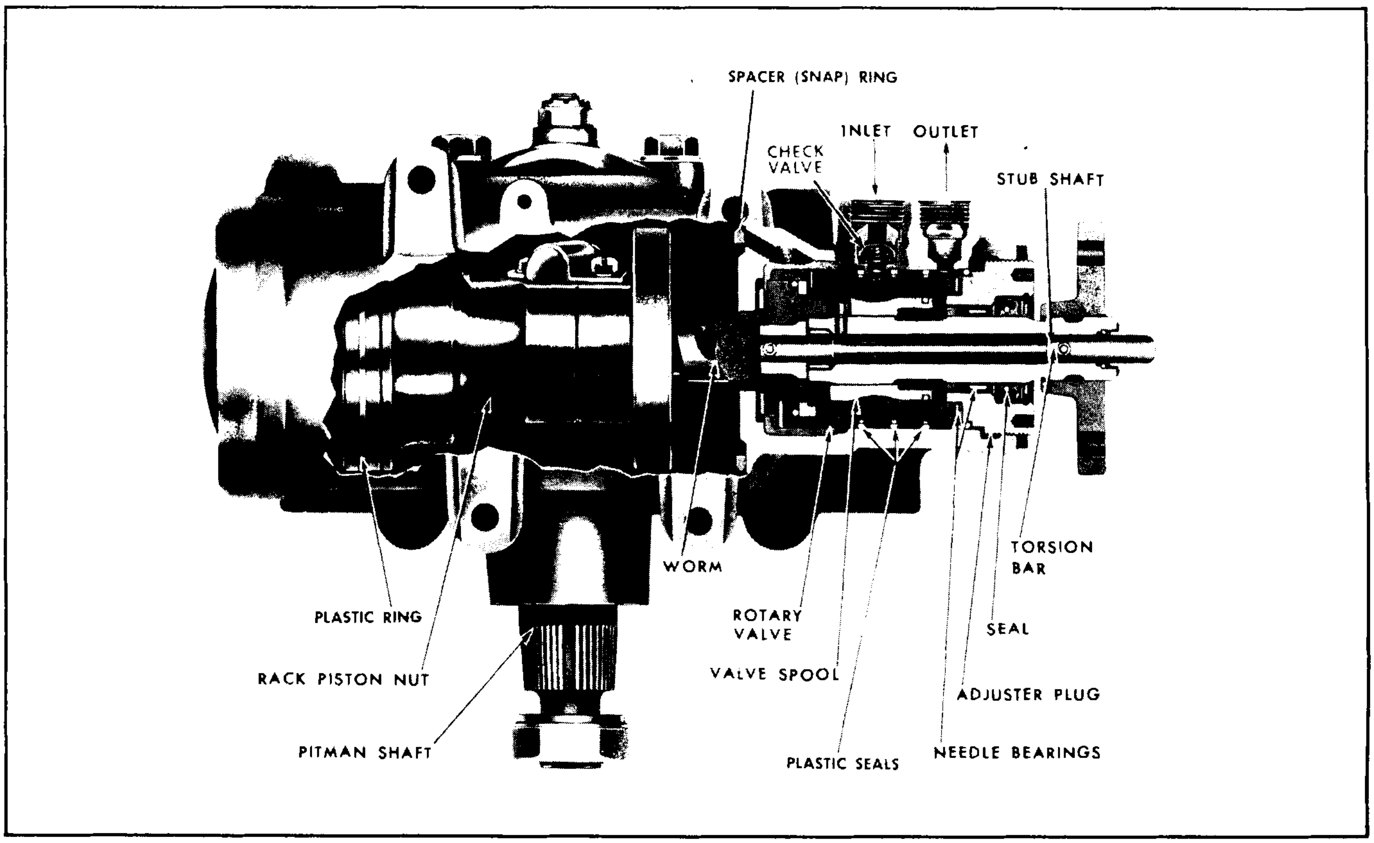


Fig. 9-10 Sectional View of Power Steering Gear

Variable ratio steering is accomplished by a pitman shaft sector incorporating a short tooth on either side of a long center tooth, rather than a sector with three teeth of equal length as in a constant ratio gear (Fig. 9-9). Companion changes are also made in the rack-piston teeth.

The rotary valve power steering gear assembly operates entirely on displacing oil to provide hydraulic oil pressure assists only when turning. As the entire gear assembly is always full of oil, all internal components of the gear are immersed in oil, making periodic lubrication unnecessary. In addition this oil acts as a cushion to absorb road shocks that may be transmitted to the driver.

The steering shaft, hydraulic valve, worm and the rack-piston nut are all in line making a compact and space-saving gear. All oil passages are internal except the pressure and return hoses between the gear and pump.

The rotary valve feature provides a smooth transmission through the driving range of steering wheel effort. A torsion bar transmits the road feel to the driver. Response of the steering gear to effort applied to the steering wheel is greatly increased. This increased response gives the driver greater control and minimizes over-steering.

The gear is designed to utilize a minimum number of parts to reduce over-all size and weight (Fig. 9-10). The simplicity of design also reduces the number of special tools required to service the unit. Being a self-bleeding unit the steering gear requires no external bleeding.

The rotary valve is shown schematically in Figs. 9-11, 9-12 and 9-13 and is an open-center, rotary-type valve. The valve spool is inside the valve body and is held in a neutral position by a torsion bar attached to one end of the valve body through the torsion bar cap and extends through this valve. The other end of the torsion bar is attached to a stub shaft which in turn is splined to the gear flange that bolts to the steering shaft flange.

Twisting of the torsion bar allows the valve spool to displace or move its position in relation to the valve body, thereby directing oil to the proper area in the gear to provide a hydraulic assist on turns. During the turn the steering worm turns in the same direction as the turn. This causes the rack-piston nut to move which in turn applies a turning effort to the pitman shaft gear.

OPERATION

OPERATING PRESSURES

Under normal driving conditions, the hydraulic oil pressure in the power cylinder should not exceed 40-100 psi. Pressure for turning corners should be approximately 100-600 psi. Parking pressure, the most difficult of turning conditions, should range from 600 psi to 1350 psi, depending upon roadbed conditions and the weight of the car.

OIL FLOW–STRAIGHT-AHEAD POSITION

The rotary valve contains a valve spool which is a selective slip fit inside the valve body and is positioned so the grooves and lands on the outside surface of the valve spool

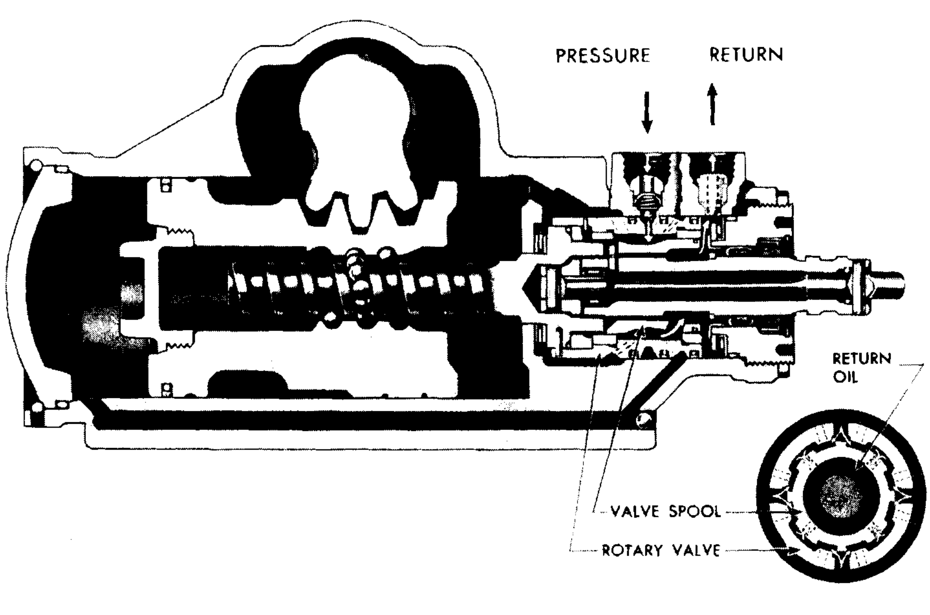


Fig. 9-11 Oil Flow - Straight Ahead Position

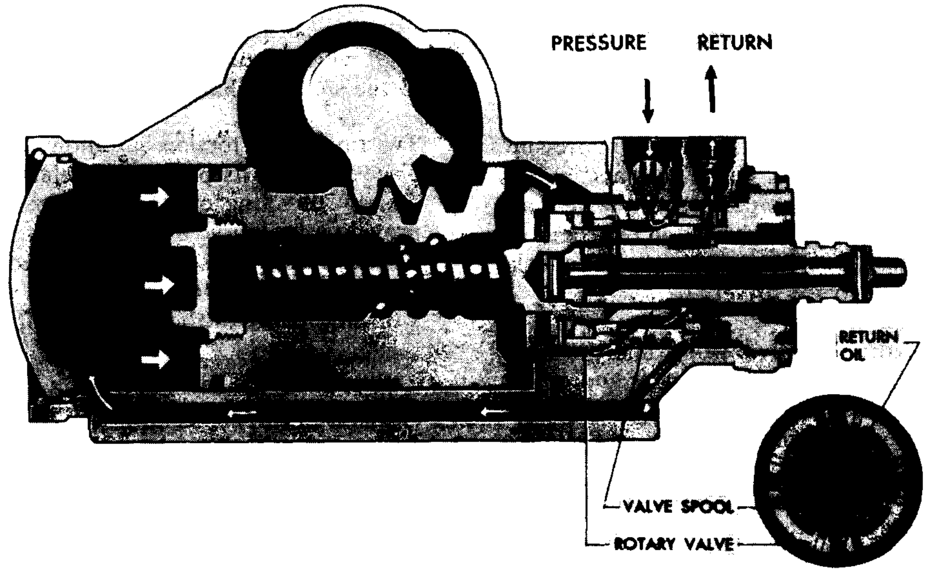


Fig. 9-12 Oil Flow - Right Turn Position

align with the lands and grooves on the inside surface of the valve body (Fig. 9-11). Grooves are slightly wider than their mating land and clearance on both sides of the land provides and open position. A stub shaft (stub shaft and a torsion bar pinned together at one end) extends through and is attached to one end of the rotary valve; a pin locks the stub shaft and the valve spool together and a pin in the valve body retains the torsion bar.

In the straight-ahead or neutral position, oil flows from

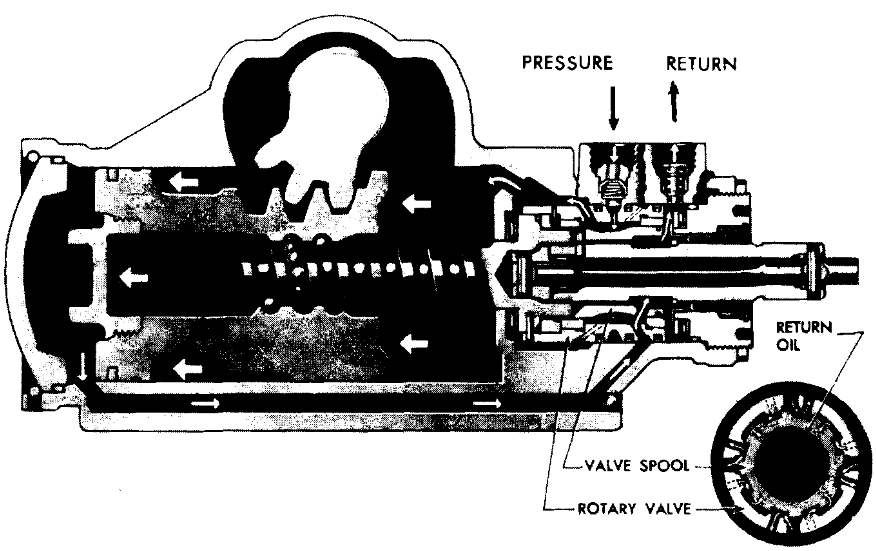


Fig. 9-13 Oil Flow - Left Turn Position

the power steering pump through the open position of the rotary valve (Fig. 9-11) and back to the power steering pump reservoir without circulating in the power cylinder in which the rack-piston is located. Since all passages are open, flow resistance is low in the neutral position at all times except when steering in turns, the power required to operate the pump is at the minimum.

The power cylinder is full of oil at all times, although in the straight-ahead position the pressure on both sides of the rack-piston is equal and very low.

Oil from the steering gear pump flows through a passage in the gear housing to an annular groove around the valve body. Four holes evenly spaced around the valve are drilled from the bottom of this groove inside surface of the valve body. Eight pressure holes evenly spaced around the valve body are also drilled through the valve body wall but these are through a land portion on the inside surface of the valve body with one hole on each side of the four inlet pressures holes.

When no twisting force is applied to the steering gear stub shaft from the steering wheel there is sufficient clearance between the land groove alignment of the valves to permit oil to flow between the valves. Oil flows back to the pump via four drilled holes through the valve spool wall that align with a groove on the stub shaft assembly. From here oil flows around the stub shaft to an area between the rotary valve and adjuster plug, through the return port to the pump.

OIL FLOW-RIGHT TURN POSITION

When a right turn is executed, oil from the power steering pump flows through the rotary valve, through the steering gear housing to an area between the housing end plug and the rack-piston nut to assist in forcing the rack to turn the pitman shaft and steering leakage for assist in the turn.

When the steering wheel is turned to the right, resistance to turning is encountered between the front wheels and the roadbed, tending to twist the stub shaft. Since the stub shaft is pin-locked to the torsion bar at one end and the opposite end indexes the valve spool by a pin on the stub shaft, the twisting action moves the valve spool to the right in relation to the valve body. This slight movement causes the land in the valve spool to restrict the right side opening between the valve spool land and valve body lands and opens the clearance on the left side of the spool lands (Fig. 9-12).

The right openings being restricted permit oil to flow through the unrestricted passages to the left (Fig. 9-12) to an annular groove around the valve body which aligns with an oil passage in the gear housing.

Oil is then directed to flow between the housing end plug and the rack-piston nut to force the rack upward permitting the steering worm to screw into the rack-piston nut. This forces the pitman shaft to turn and reduces driver turning effort in executing the right turn. The oil in the upper end of the cylinder is simultaneously forced out through the rotary valve and back to the pump reservoir.

The higher the resistance to turning between the roadbed and the front wheels, the more the valve spool is displaced, and the higher the oil pressure on the lower end of the rack-piston nut. Since the amount of valve displacement and, consequently, the amount of hydraulic pressure built in the cylinder is dependent upon the resistance to turning, the driver is assured of the proper amount of smooth hydraulic assistance at all times.

As the driver stops applying steering effort to the steering wheel and then relaxes the wheel, the spool valve is forced back into its neutral position by the untwisting of the torsion bar. The spool valve lands and grooves align themselves with the grooves and lands in the valve body, providing a balanced clearance between the land-groove alignment. When this happens, the oil pressure is again equal on both sides of the rack-piston nut and the steering geometry of the car causes the wheels to return to the straight-ahead position.

OIL FLOW-LEFT TURN POSITION

Executing a left turn causes oil to flow from the power steering pump through the rotary valve and to the area between the rotary valve and the rack-piston nut rack via a drilled passage in the steering gear housing. This is to assist in forcing the rack nut piston to turn the pitman shaft and linkage.

When the steering wheel is turned to the left, resistance to turning is encountered between the front wheels and the roadbed tending to twist the stub shaft. Since the stub shaft is pin-locked to the torsion bar at one end and the opposite end indexes the valve spool by means of a pin the the stub shaft, the twisting action moves the valve spool to the left in relation to the valve body. This slight movement causes the land on the valve spool to restrict the left side opening between valve spool lands and the valve body lands and opens the clearance on the right side of spool lands (Fig. 9-13).

The left openings being restricted permit oil to flow through the unrestricted passages to the right to an annular groove around the valve body which aligns with an oil passage in the gear housing.

Oil is then directed to flow between the rotary valve and the rack-piston nut via a drilled passage in the steering gear housing to force the rack- piston nut downward. This forces the pitman shaft to turn and reduces driver turning effort in executing the left turn. The oil in the lower end of the housing is simultaneously forced out through the rotary valve from a drilled passage in the housing and back to the pump reservoir.

The higher the resistance to turning between the roadbed and the front wheels, the more the valve spool is displaced, and the higher the oil pressure on the upper end of the rack-piston nut. Since the amount of valve displacement and, consequently, the amount of hydraulic pressure built in the cylinder is dependent upon the resistance to turning, the driver is assured of the proper amount of smooth hydraulic assistance at all times.

As the driver stops applying steering effort to the steering wheel and then relaxes the wheel, the spool valve is forced back into its neutral position by the untwisting of the torsion bar. The spool valve lands and grooves align themselves with the grooves and lands in the valve body, providing a balanced clearance between the land-groove alignment. When this happens, the oil pressure is again equal on both sides of the rack-piston nut and the steering geometry of the car causes the wheels to return to the straight-ahead position.

CHECK VALVE POPPET

The check valve is located in the pressure port of the housing under the connector. The valve consists of a poppet and a spring and its purpose is to reduce the possibility of steering wheel "kick-back". If when making a turn, the front tire hits a bump which forces it in a direction opposite the turn, the impact will be carried up to the rack-piston nut by the pitman shaft. If the force is great enough, the rack-piston nut will tend to move against the applied oil pressure and force oil back through the valve assembly and out through the pressure port where the poppet valve is now located. If the rack-piston moved in the opposite direction, the steering wheel would resist momentarily or would "kick-back". The poppet valve is designed to prevent the above action from occurring by trapping the oil inside the gear.

POWER STEERING PUMP

DESCRIPTION

Hydraulic pressure for the steering system is provided by a constant displacement vane type pump. It is attached to the left front of the engine by brackets and is belt driven from an engine crank shaft pulley.

The housing and internal parts of the pump are inside the reservoir (Fig. 9-14) so that the pump parts operate submerged in oil. The reservoir has a filler neck fitted with a vented cap. The reservoir is sealed against the pump housing, leaving only the housing face and shaft hub exposed. A shaft bushing (bronze on steel) and seal are pressed into the housing from the front. The drive shaft is inserted through this seal and bushing.

A large hole in the rear of the housing contains the functional parts; namely pump ring, rotor, vanes and plates (Fig. 9-15). A smaller hole contains the control valve assembly and spring.

THRUST PLATE

The thrust plate (Figs. 9-14 and 9-15) is located on the inner face of the housing by two dowel pins. This plate has four central blind cavities for undervane oil pressure. The two outer blind cavities direct discharge oil through the two cross-over holes in the pump ring (Fig. 9-16) through the pressure plate, and into cavity 1 (Figs. 9-17, 9-18 and 9-19). The two outside indentations in the thrust plate are for intake of the oil from the suction part of the pump.

PUMP RING

The pump ring (Fig. 9-16) is a plate having the mating surfaces ground flat and parallel. The center hole is two lobed cam in which the rotor and vanes operate. The ring is placed next to the thrust plate, and located with the same dowel pins.

PRESSURE PLATE

The pressure plate is fitted against the ring and located with the same two dowel pins. This plate has six through ports. The four central through ports connect from cavity 1 (Figs. 9-17, 9-18 and 9-19) to supply undervane oil pressure. The two outer ports pass oil under discharge pressure to cavity 7. The two indentations are for oil intake from the suction part of the pump, cavity 7 (Figs. 9-17, 9-18 and 9-19) into the rotor.

RESERVOIR AND OIL LEVEL INDICATOR

The reservoir is for oil storage. It receives and directs the return oil back to the make-up passage of the pump.

"Hot" and "cold" marks appear on the reservoir filler cap oil level indicator. Fluid level should be at the "cold" mark when the pump and fluid are at normal room temperature, or approximately *70°F.* If fluid level is checked with fluid at room temperature, the pump is underfilled when the fluid level is below the "cold" mark.

The proper fluid level must be maintained to prevent foaming conditions in the power steering hydraulic pump. This is especially important in the colder regions of the country when diagnosing noise due to oil foaming. In most cases, this condition is caused by low fluid level in the pump reservoir.

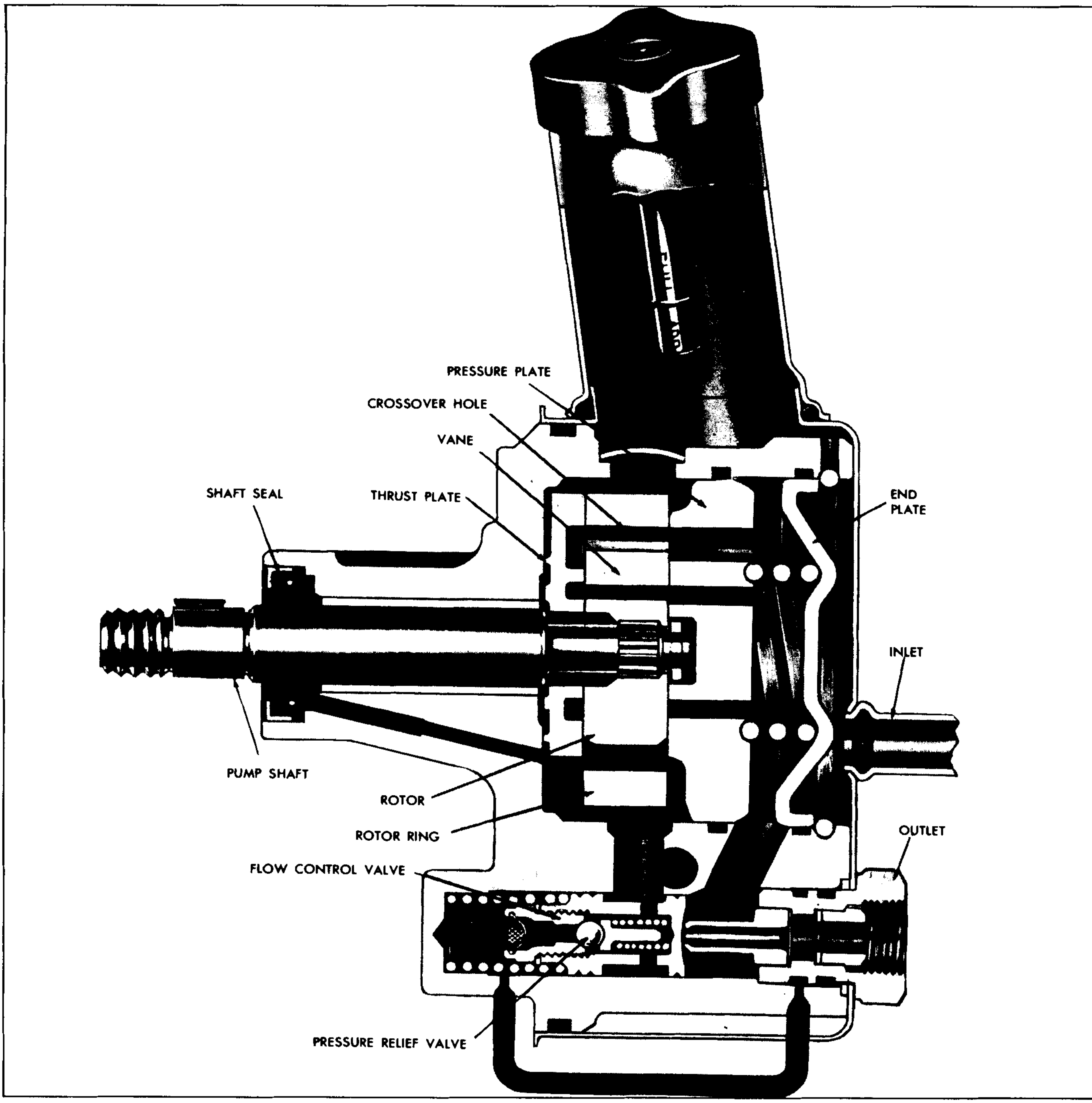


Fig. 9-14 Power Steering Pump

DRIVE SHAFT

The drive shaft is fitted with a pulley and is belt driven from the crankshaft. The rotor is loosely splined to the drive shaft and secured with a retaining ring. It is located centrally within the ring and between the thrust and pressure plates. The ten vanes are mounted in radial slots in the rotor (Fig. 9-16).

FLOW CONTROL VALVE

The purpose of the flow control valve is to control power steering system pressures and thereby oil flow to the gear as required under various operating conditions.

This valve assembly consists of a plunger, ball check, ball check guide and ball check guide spring. A screen in the

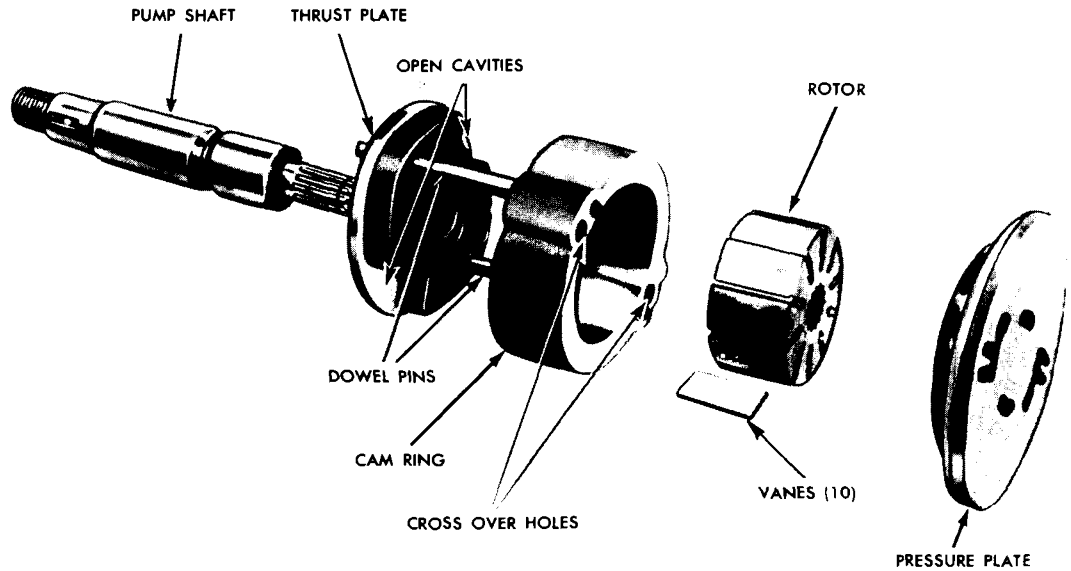


Fig. 9-15 Power Steering Pump Components

end of the plunger screw is designed to keep dirt and foreign material out of the ball check area. Due to selective parts controlling calibration of this valve, the flow control valve is only serviced as an assembly.

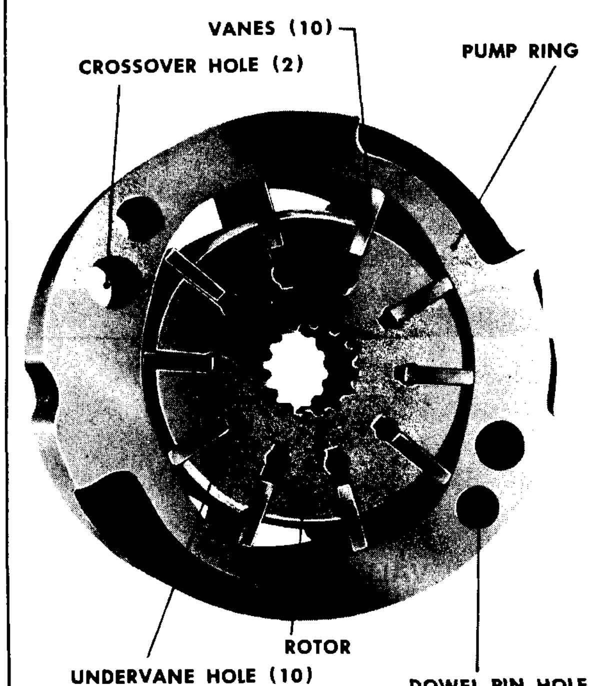


Fig. 9-16 Pump Ring, Rotor and Vanes

OPERATION

When the pump and power steering gear are completely void of oil, adding oil to the reservoir will completely envelope the pump housing assembly which is inside the reservoir (Fig. 9-14). Oil is drawn into the intake portion of the pump by suction (and weight of oil) causing it to flow through a drilled passage in the lower portion of the housing (4) to another drilled hole leading to a groove around the rotor ring (3) to tend to fill this area and also the two suction openings on the surface of the thrust plate and two suction openings in the pressure plate. Oil fills the lower opening in the thrust plate to feed the rising portion of the rotor ring. Air is pumped out of the pump through the gear oil circuit to the gear, then to return to the reservoir and out the vented cap.

The mode of operation of the power steering pump is based upon the demand of the power steering gear. The various major modes of operation are: (1) Slow cornering, (2) moderate to high speed straight ahead driving, and (3) cornering against the wheel stop. The pump is designed to recognize these conditions as required by the steering gear rotary valve and compensates for them internally.

As the pump drive shaft turns the rotor, the vane tips follow the inner cam surface of the pump ring, moving outward and inward twice during each revolution. This results in a complete pumping cycle every 180 degrees of rotation (Fig. 9-16). Oil is moved in the spaces between the vanes. As the vane tips move outward, oil is sucked into the intervane spaces through four suction ports in the pressure and thrust plates. The pressure of the oil is raised, and the oil is discharged from the pump ring, as the vane tips move inward. High pressure oil discharges into cavity 1, (Figs. 9-17, 9-18 and 9-19), through two open ports in the pressure plate, and through two blind ports in the thrust plate, which are connected to cavity 1 by the cross-over holes in the ring. A portion of this oil is circulated through the central port system in the pressure plate, forcing the vanes to follow the cam surface of the ring. The ring-rotor leakage oil (12) is used for drive shaft bushing lubrication and then bled to the reservoir.

SLOW CORNERING

During slow cornering maneuvers (Fig. 9-17), the oil pressure required will usually not exceed 400 p.s.i. The speed of the pump is not high enough to require internal bypassing of oil, therefore, the pump by-pass port to (5) remains closed. The high pressure discharge oil (7) is slightly lower in pressure than the internal high pressure oil (1). The drop in pressure occurs as oil flows through the flow

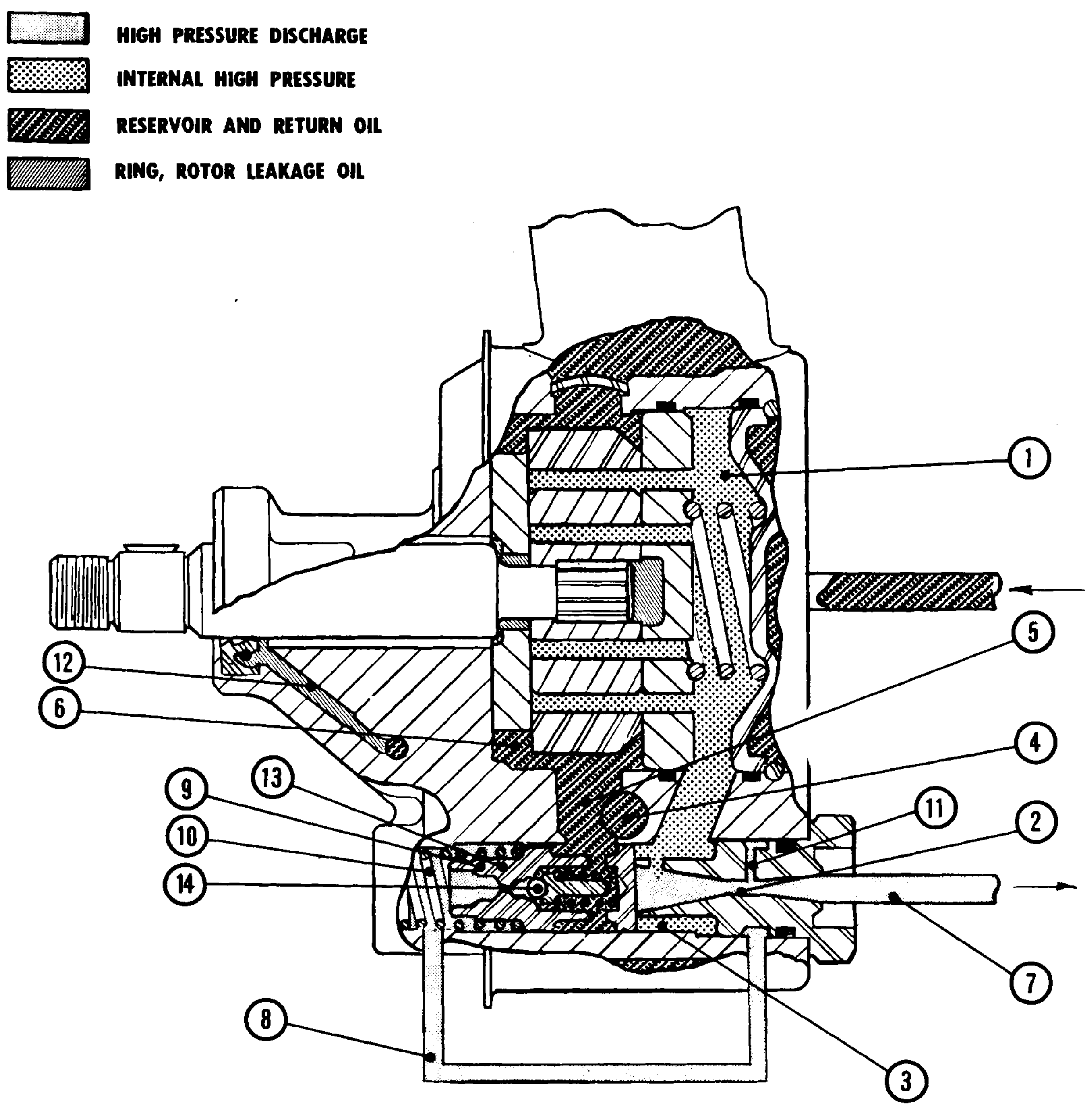


Fig. 9-17 Oil Flow - Slow Cornering

control orifice (2). This lower pressure is transmitted to the bottom end of the pump control valve (9) via orifice (11) and passage (8), resulting in a pressure unbalance on the valve itself. The flow control valve moves away from the discharge fitting, but due to the force of the flow control spring (10) the valve remains closed to the bypass hole (5). The oil pressure does not build up high enough to cause the pressure relief valve to actuate, because the external circuit through the steering gear allows oil to recirculate through the entire system.

MODERATE TO HIGH SPEED OPERATION

When operating at moderate to high speed (Fig. 9-18), it is desirable to limit the temperature rise of the oil. This is

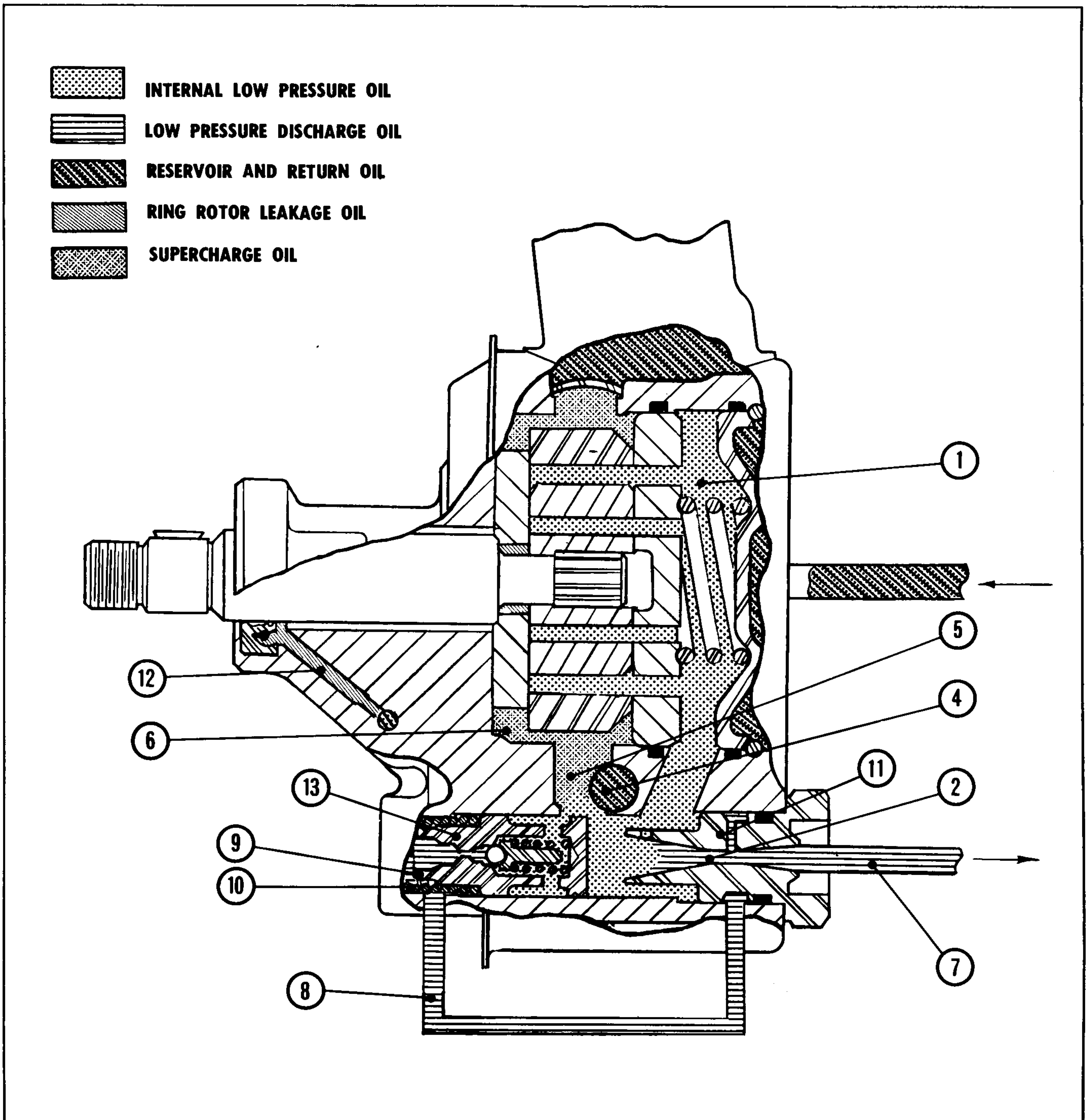


Fig. 9-18 Oil Flow - Moderate to High Speed (Flow Controlling)

done by flow controlling. The control valve in the steering gear is an open center rotary valve. When this valve is in the straight ahead position, oil flows from the pump through the open center valve and back to the pump reservoir without traveling through the power cylinder. When this flow exceeds the predetermined system requirements, oil is bypassed within the pump.

This is accomplished by the pressure drop which occurs across the flow control orifice (2). The pressure drop is transmitted to the bottom of the flow control valve (9) via orifice (11) and passage (8). The pressure unbalance on the valve is sufficient to overcome the force of the spring (10), allowing the valve to open the bypass hole (5), and diverting oil into the intake chamber (6). Supercharging of the intake chamber occurs under these conditions. Oil at high velocity discharging past the valve into the intake chamber picks up make-up oil at hole (4) from the reservoir on

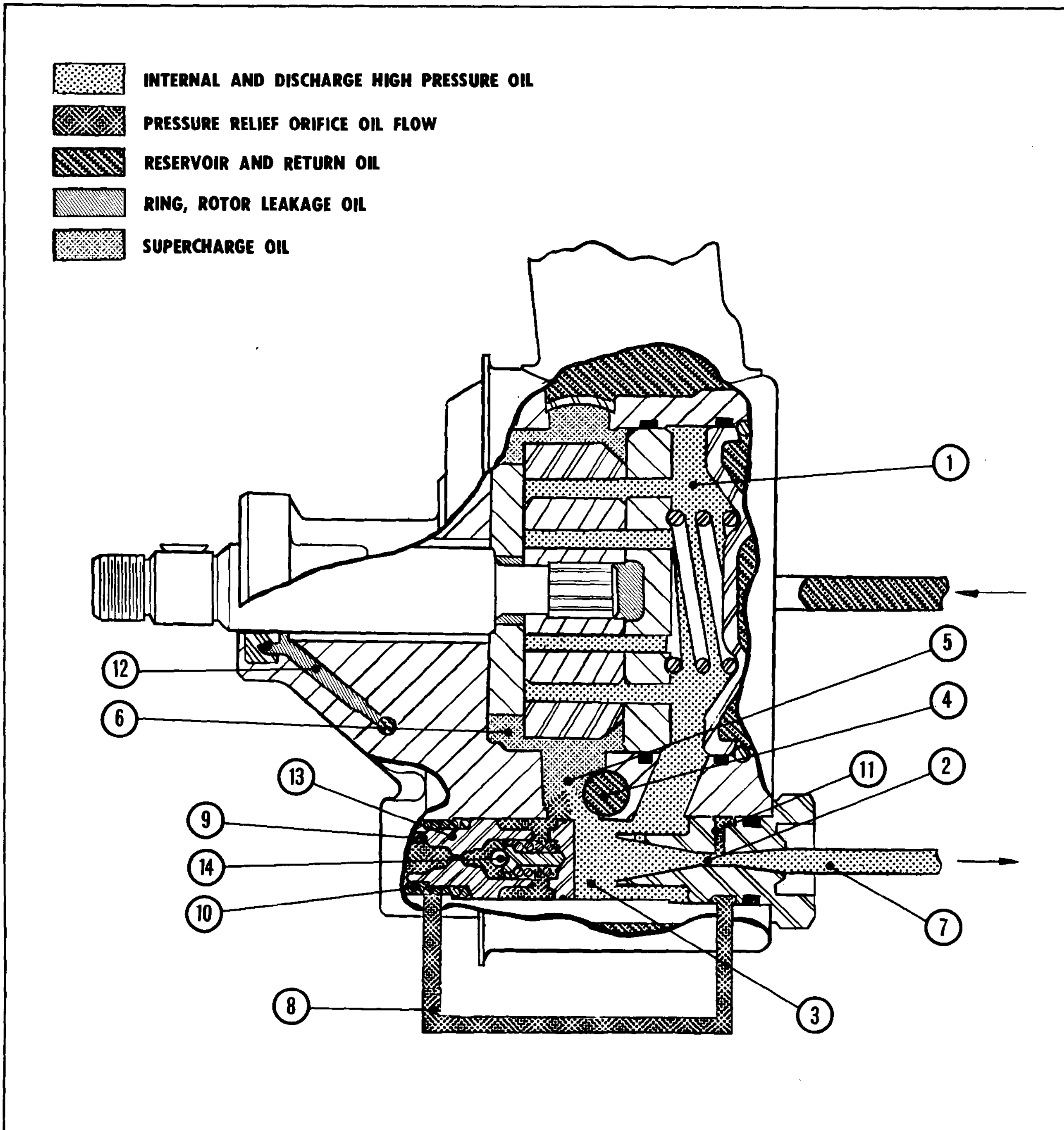


Fig. 9-19 Oil Flow - Cornering Against Wheel Stops (Pressure Relief)

the jet pump principle. By reduction of velocity, velocity energy is converted into supercharge pressure in cavity (6). During this straight ahead driving condition, the discharge pressure (pressure line) should not exceed 100 p.s.i.

CORNERING AGAINST WHEEL STOPS

When the steering gear control valve is actuated in either direction to the point of cut-off, the flow of oil from the pump is blocked. This condition occurs when the front wheels meet the wheel stop, or when the wheel movement is otherwise blocked by a curb or deep sand or mud. In order to keep pressures and temperatures at a minimum, the pump is equipped with a pressure relief valve. The relief valve is contained inside the flow control plunger (13). When the pressure exceeds a predetermined pressure, (greater than maximum system requirements) the pressure relief ball (14) opens, allowing a small amount of oil to flow into the bypass hole (5). This flow of oil passing through the pressure relief orifice (11) causes a pressure drop and resulting lower pressure on the bottom end of the control valve (9).

The pressure unbalance then causes the valve to compress the spring (10) allowing the major portion of the oil to bypass into the intake chamber (from 3 to 6) in the same manner as is accomplished by flow controlling. Relief pressures are limited between 900 and 1450 p.s.i. depending on the vehicle requirements.

GENERAL INFORMATION

The steering system consists of a steering wheel, steering column, universal joint (except X Series), intermediate steering shaft (except X Series), flexible coupling, manual or power steering gear and steering linkage.

On B, A, G and F Series, the steering linkage is positioned ahead of the front frame crossmember in accordance with the steering gear location ahead of the front wheels. The X Series steering gear and linkage is located behind the front wheels. The steering knuckle arm is part of the integral steering knuckle and brake caliper support on B and F Series, therefore, refer to procedure outlined in Section 3, Front Suspension, under STEERING KNUCKLE AND/OR STEERING KNUCKLE ARM (B & F SERIES) - REMOVE AND INSTALL when servicing.

The intermediate steering shaft and universal joint are used in conjunction with the steering gear location ahead of the front wheels. On the F Series, the steering column toe plate is welded to the column mast jacket.

If it becomes necessary to tow a car with the column locked and the key is not available, a dolly should be placed under the rear wheels and the car towed with the front end raised. If a dolly is not available, tow the car by lifting the rear end, providing the front wheels are locked in essentially the straight ahead position (the use of a steering clamp should be continued for this type of towing).

MINOR SERVICE

STEERING WHEEL

REMOVE

1. Remove screws attaching trim cover to wheel or on sport type wheel, remove horn button by lifting (Fig.9-20).

2. Remove nut from shaft.

3. Remove steering wheel using puller J 3044-1.

   CAUTION: *Do not hammer on end of steering shaft, as hammering could steering shaft or otherwise loosen plastic injections which maintain column rigidity.*

4. Disconnect horn wire insulator from canceling cam tower by rotating insulator counter-clockwise to unlock position and then pull up.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 1.*

1. Install by reversing above steps, making sure steering wheel is in straight ahead position (Fig. 9-21). Tighten steering wheel nut to 30 lb. ft. torque.

TURN SIGNAL SWITCH

REMOVE

1. Remove steering wheel (see STEERING WHEEL - REMOVE).

2. Remove the three cover screws and lift cover off the shaft.

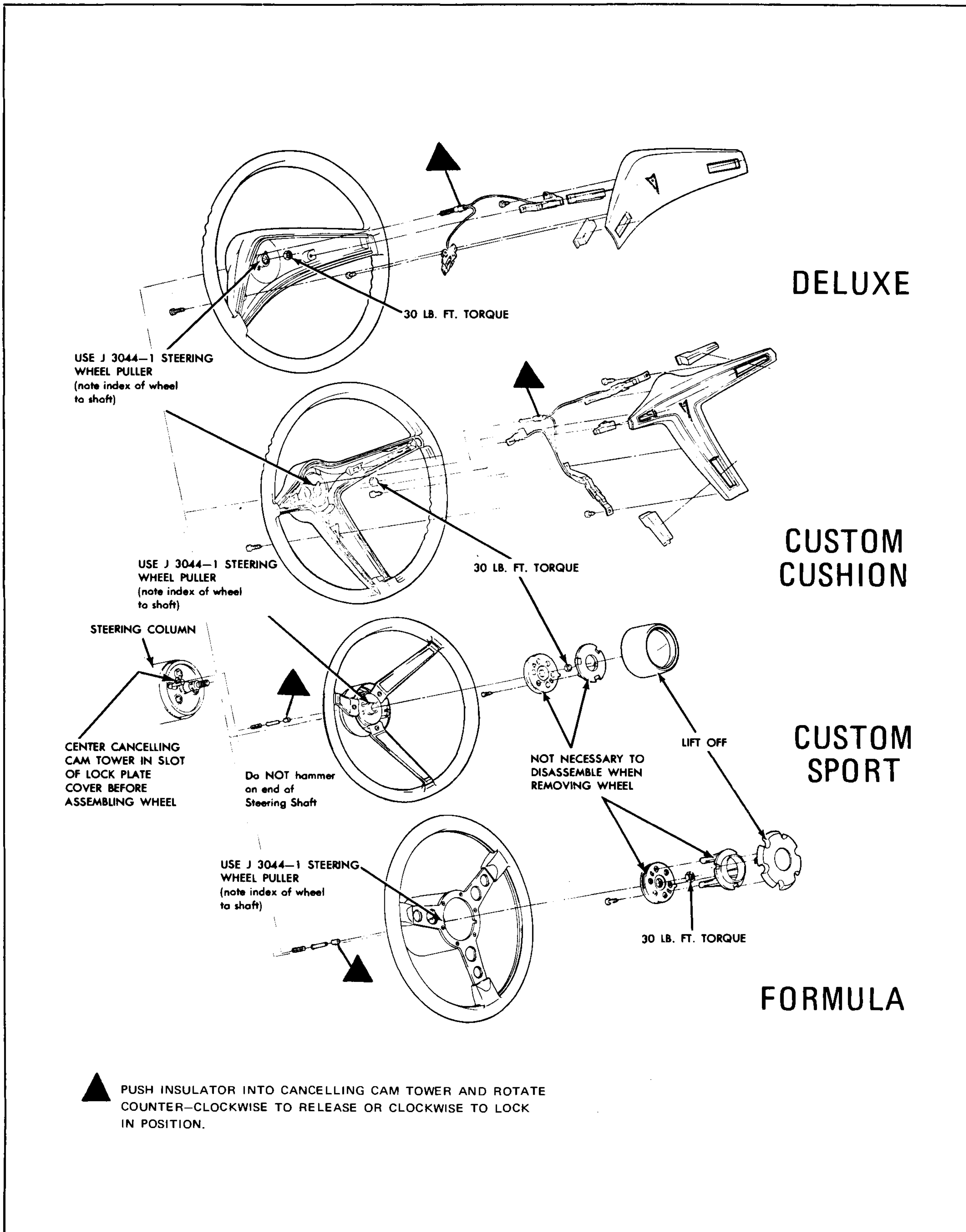


Fig. 9-20 Exploded View of Steering Wheel and Horn Button

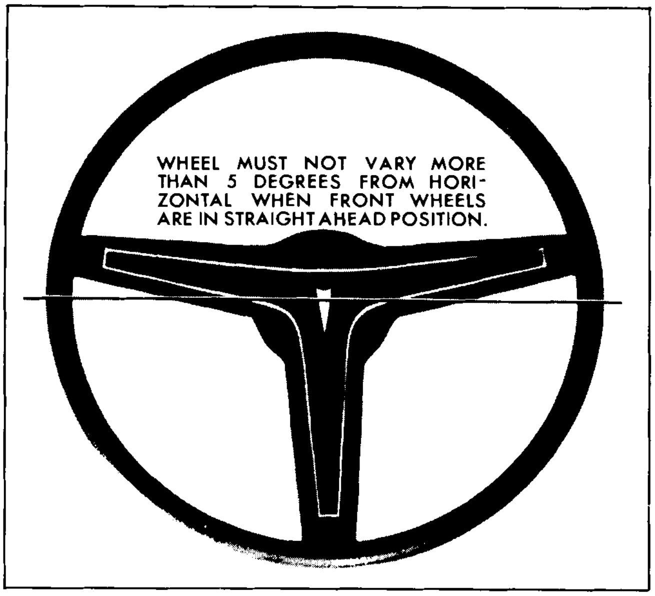


Fig. 9-21 Locating Steering Wheel Position

NOTE: *Screw retainers will be lost if screws are removed completely from cover.*

3. Depress lock plate downward as far as possible using J 23653. Pry the round wire snap ring out of the shaft groove (Fig. 9-22). Remove the snap ring and lock plate (Fig. 9-23). Discard snap ring.

CAUTION: *With ring removed, shaft could slide out bottom of column causing damage to shaft if column is removed from car.*

NOTE: *Use new snap ring when installing lock plate.*

4. Slide upper bearing preload spring and turn signal cancelling cam off upper steering shaft.
5. Slide thrust washer off upper steering shaft.

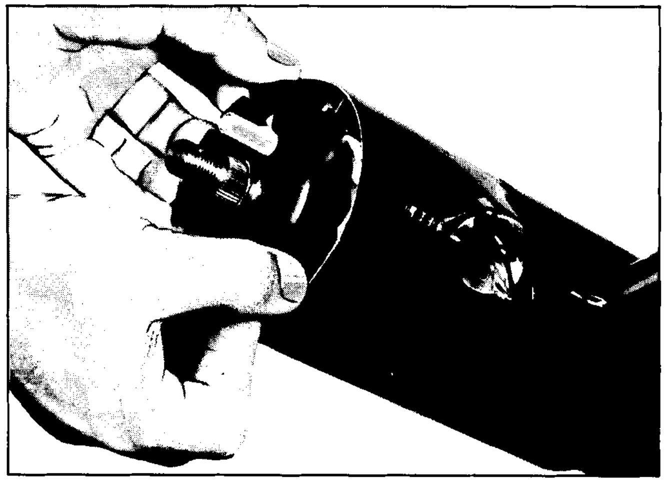


Fig. 9-23 Removing Snap Ring and Lock Plate

6. Remove turn signal lever screw and lever.
7. Push hazard warning switch in and unscrew knob.
8. Pull the turn signal wiring connector out of the bracket on the jacket and disconnect. Wrap a piece of tape around the upper part of the connector and wires to prevent snagging when removing switch (Fig. 9-24).
9. Remove three turn signal switch mounting screws
10. Pull the switch straight up with wire protector and remove from housing (Fig. 9-25).

NOTE: *The column must be lowered from instrument panel to remove wire protector (Fig. 9-26) before pulling switch (see STEERING COLUMN - REMOVE, steps 5 or 6 through 7 or 8). Never let column be unsupported when lowered from instrument panel.*

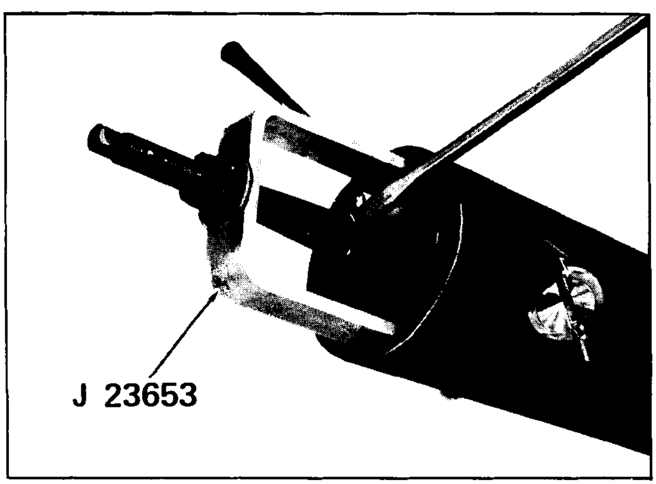


Fig. 9-22 Depressing Lock Plate and Removing Snap Ring

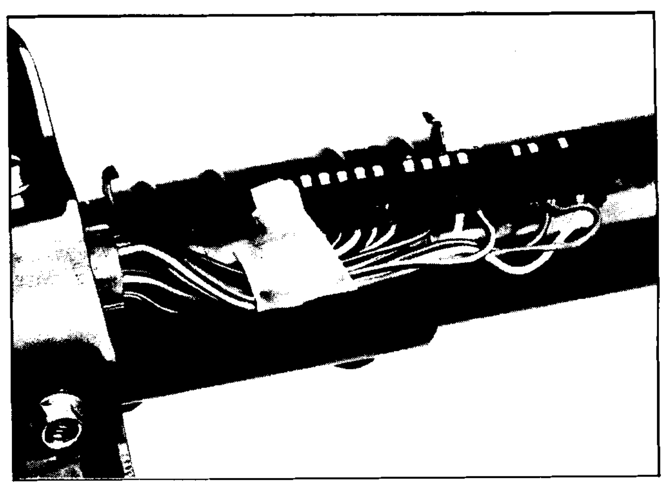


Fig. 9-24 Connector and Wires with Tape

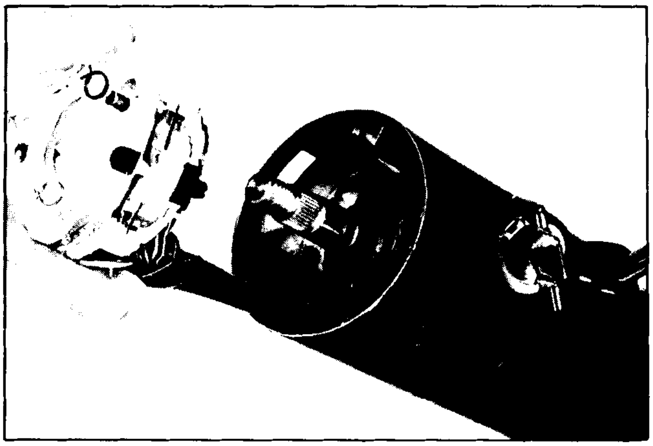


Fig. 9-25 Removing Turn Signal Switch

INSTALL

1. Install turn signal switch by reversing above steps.

   NOTE: *Be sure the hazard warning knob is pushed in to allow clearance for the cover and to avoid damage to switch.*

   CAUTION: *On tilt column, play or slack should be left in signal switch when installed in wire protector so that the column head is free to move in full "up" position. Install column to instrument panel and check alignment (see STEERING COLUMN - INSTALL, steps 1 through 12).*

2. Tighten three switch screws and three cover screws to 25 lb. in. torque.

3. Install steering wheel (see STEERING WHEEL - INSTALL).

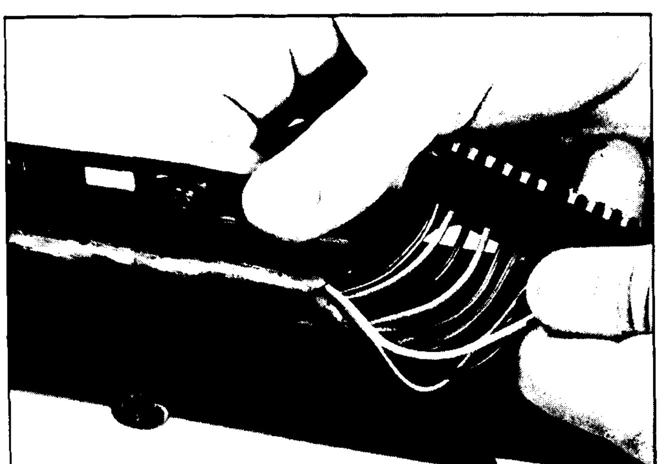


Fig. 9-26 Removing Wire Protector From Turn Signal Harness

LOCK CYLINDER

REMOVE

1. Remove steering wheel (see STEERING WHEEL - REMOVE).

2. Pull turn signal switch up far enough to allow access to lock cylinder spring latch slot (see TURN SIGNAL SWITCH - REMOVE, steps 2 through 9).

3. Remove lock cylinder in "RUN" position by inserting a thin tool (small screwdriver, 6" steel rule or knife blade) into the slot next to the switch mounting screw boss (right-hand slot) and depress spring latch at bottom of slot to release lock.

   NOTE: *If lock cylinder has never been removed before, the slot will be covered by thin casting "flash" which can easily be broken through when inserting thin tool.*

4. Remove lock by pulling out of housing (Fig. 9-27).

INSTALL

1. Hold lock cylinder sleeve and rotate knob clockwise against stop when viewed from key end (Fig. 9-28).

2. Lay a 1/16" drill on housing surface next to housing bore.

   CAUTION: *1/16" drill prevents forcing lock cylinder inward beyond its normal latched position. Buzzer switch and spring latch can hold lock cylinder inward too far. Complete disassembly of upper bearing housing is necessary to release inproperly installed lock cylinder.*

3. Insert cylinder into housing bore with key on lock

Fig. 9-27 Depressing Lock Cylinder Spring Latch

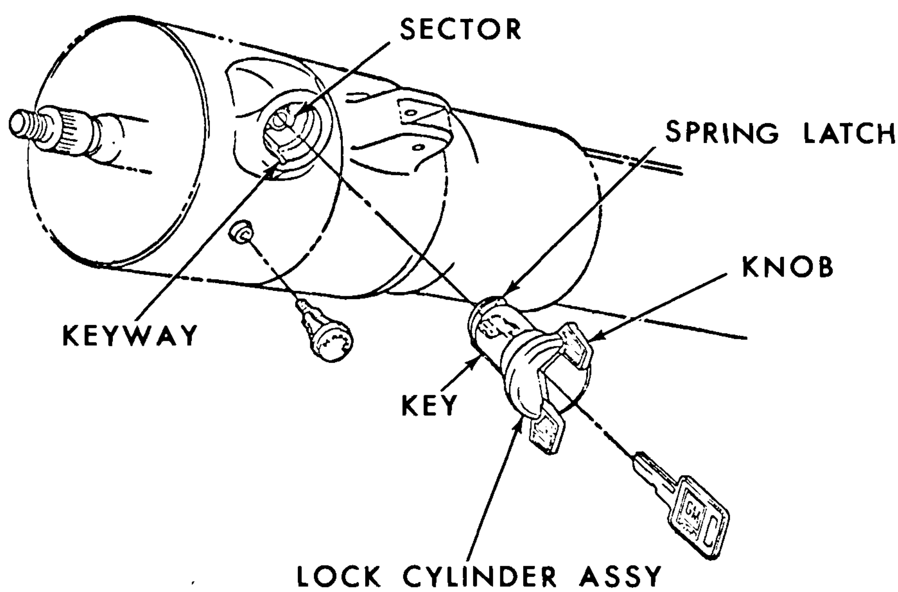


Fig. 9-28 Installation of Lock Cylinder

cylinder sleeve aligned to keyway in housing. Push into abutment of cylinder and lock sector.

4. Rotate lock knob counterclockwise. Maintaining a light push inward on lock cylinder until drive section of lock cylinder mates with sector.

5. Push in until spring latch pops into groove and lock cylinder is secured into the housing.

6. Remove 1/16" drill.

7. Check freedom of rotation of lock cylinder in housing. There must be a free spring return from "START" to "RUN" positions.

CAUTION: *If prior to assembly of back-up light and/or neutral-start switch, the lock should remain in the "RUN" position.*

8. Install turn signal switch (see TURN SIGNAL SWITCH - INSTALL).

9. Install steering wheel (see STEERING WHEEL - INSTALL).

BUZZER SWITCH

REMOVE

1. Remove steering wheel (see STEERING WHEEL - REMOVE).

2. Pull turn signal switch up far enough to allow access to buzzer switch (see TURN SIGNAL SWITCH - REMOVE, steps 2 through 9).

3. Pull buzzer switch straight out of the housing using a paper clip or similar tool. A flat spring wedges the switch toward the lock cylinder (Fig. 9-29).

NOTE: *This may be done without the removal of the lock cylinder. If the lock cylinder is in the housing, it must be in the "RUN" position.*

CAUTION: *Be careful not to let flat spring fall down into housing and do not pull on switch contacts or plastic material of switch when removing.*

INSTALL

1. Assemble buzzer switch to spring clip with formed

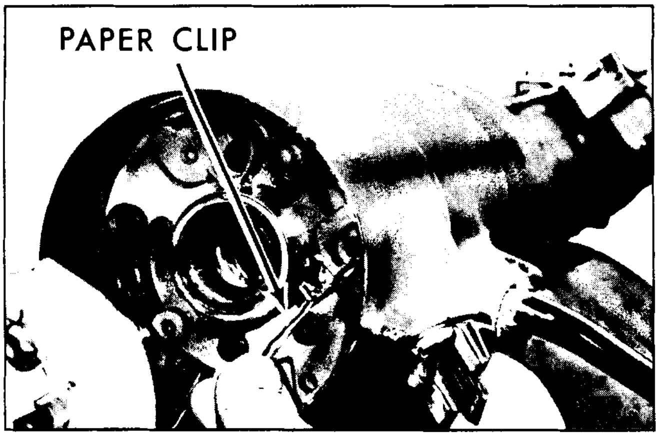


Fig. 9-29 Removing Buzzer Switch

end of clip around the lower end of switch and spring bowed away from switch.

CAUTION: *Spring should lay on the switch opposite the contacts.*

2. Push switch and spring into hole with contacts toward the lock cylinder bore (Fig. 9-30).
3. Install turn signal switch (see TURN SIGNAL SWITCH - INSTALL).
4. Install steering wheel (see STEERING WHEEL - INSTALL).

STEERING COLUMN (B SERIES)

REMOVE

CAUTION: *When the steering column is removed from the car, it 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 mast jacket could cause the jacket to bend or deform. Such damages could impair the column's collapsible design. If it is necessary to remove the steering wheel, use standard wheel puller J 3044-1. Do not hammer on end of shaft, as hammering could loosen plastic injections which maintain column rigidity.*

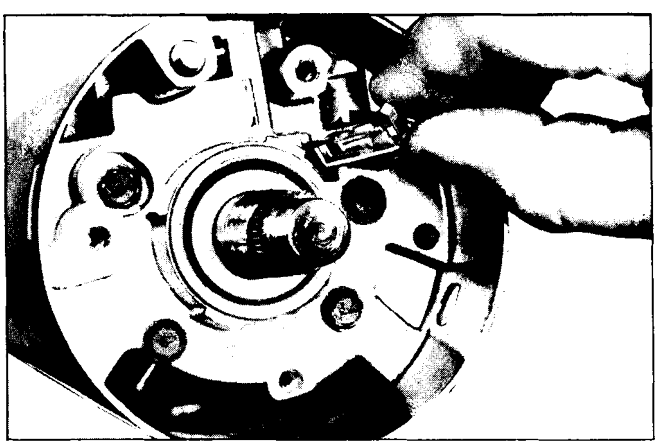


Fig. 9-30 Installing Buzzer Switch

1. Remove both attaching nuts securing flexible coupling to steering shaft.
2. On column shift, disconnect shift linkage from column shift lever(s).
3. Disconnect all electrical connectors from steering column.
4. Remove screws securing toe cover plate halves to dash panel and loosen cover clamping screw.
5. Remove instrument panel trim cover screws and remove cover.

   NOTE: *Remove lower air conditioning duct if so equipped.*

6. Remove shift indicator (pointer) cable attaching screw from shift bowl on models with automatic transmission (Fig. 9-31).
7. Remove two nuts securing mounting bracket to instrument panel and carefully withdraw column.

INSTALL

NOTE: *Make sure this procedure is followed in exactly this order.*

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in step 1.*

1. Position steering column in car and attach steering shaft flange to steering gear flexible coupling and tighten coupling nuts to 20 lb. ft. torque (Fig. 9-32).

   NOTE: *Align large flexible coupling attaching bolt in large hole of steering shaft flange. Metal-to-metal contact between flanges on steering gear stub shaft assembly and steering shaft assembly will transmit and amplify gear noise to the driver. (See FLEXIBLE COUPLING outlined at front of Section 9 and Fig. 9-6 for use of plastic alignment spacers).*

2. Position steering column with mounting bracket to instrument panel loosely with two nuts.

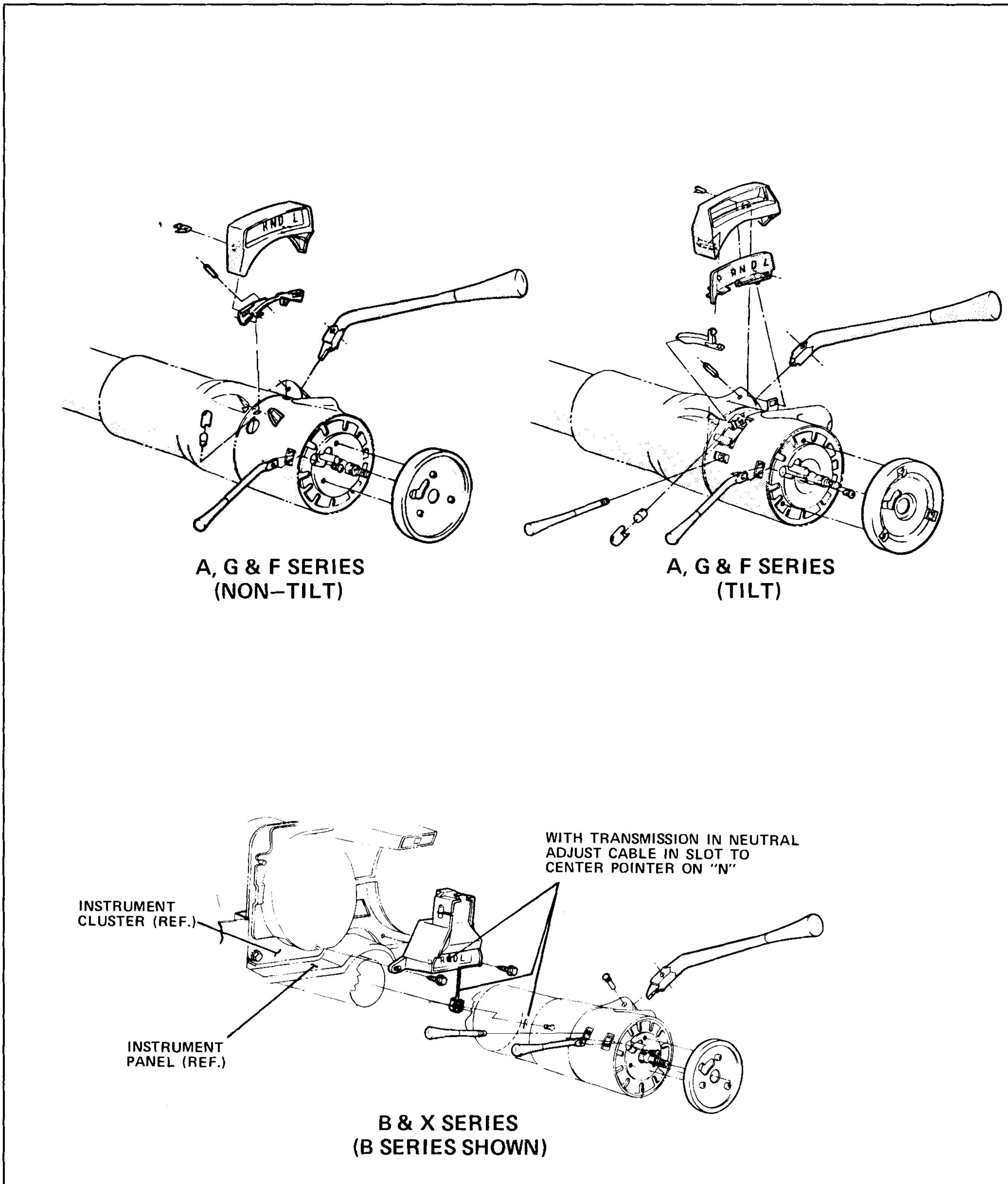


Fig. 9-31 Installation of Shift Indicator

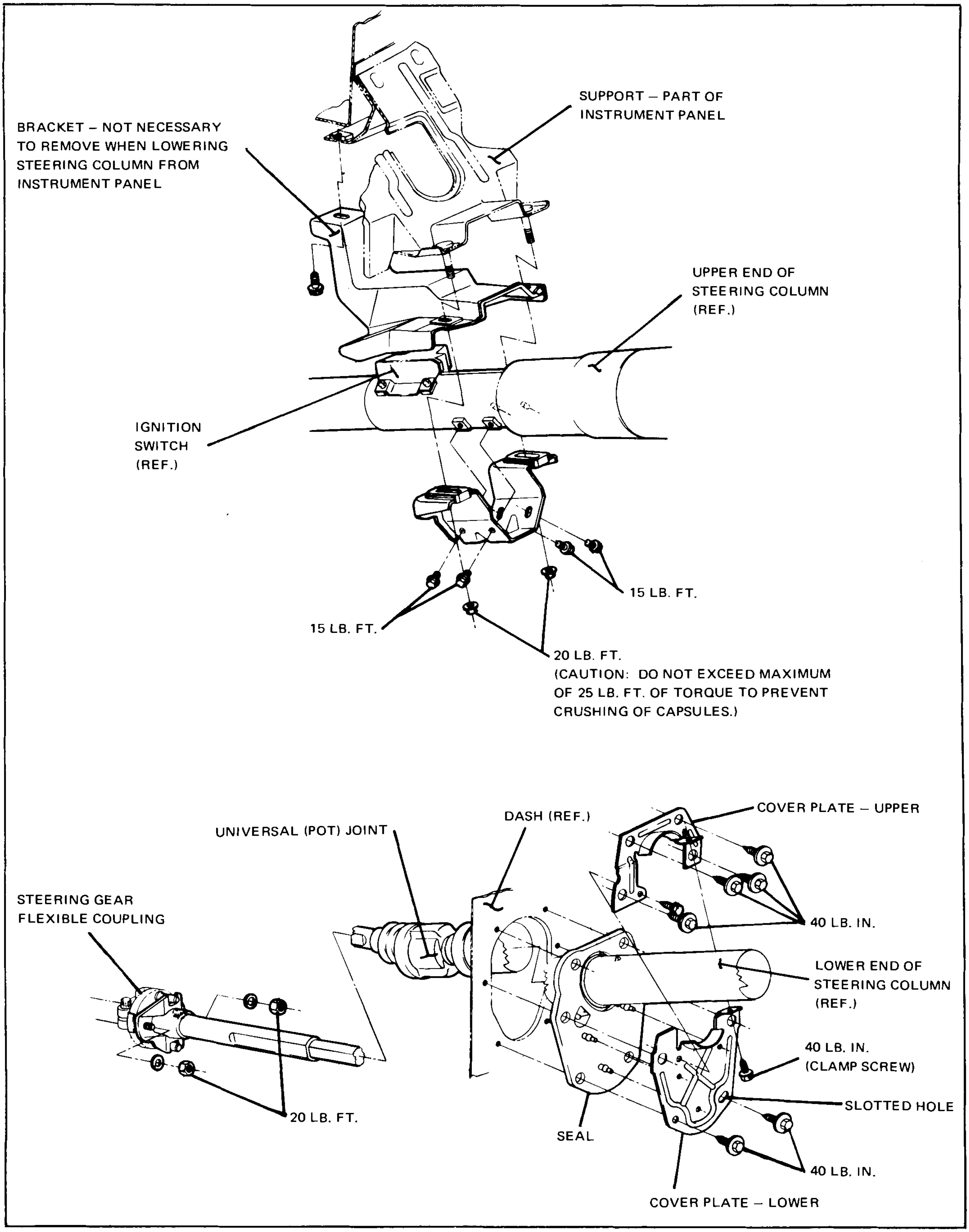


Fig. 9-32 Installation of Steering Column (B Series)

3. Position lower cover plate to dash panel and start screw through unslotted hole in cover.

4. Install second cover plate screw in lower slotted hole and tighten to 40 lb. in. torque thereby locating cover plates properly. Tighten unslotted hole screw to 40 lb. in. torque.

5. Tighten upper and lower cover attachment screw to 40 lb. in. torque. Tighten adjacent cover screw to dash to 40 lb. in. torque.

6. Tighten clamp screw to 40 lb. in. torque.

7. Install three remaining cover screws and tighten to 40 lb. in. torque.

8. With steering column thus positioned, tighten two steering column mounting bracket to instrument panel nuts to 20 lb. ft. torque.

   CAUTION: *Do not over-torque nuts because correct torque is necessary to ensure breakaway action of the bracket and capsules in the event of a collision.*

9. Install shift indicator (pointer) cable attaching screw to shift bowl on models with automatic transmission (Fig. 9-31).

10. Reconnect all electrical connections and install any trim which has been removed.

11. Connect all transmission linkage, if linkage requires adjusting, see Section 7 for the procedure.

12. Adjust back-up light or neutral-start switch (see Section 12 for adjustment procedure).

STEERING COLUMN (A & G SERIES)

REMOVE

CAUTION: *When the steering column is removed from the car, it 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 mast jacket could cause the jacket to bend or deform. Such damages could impair the column's collapsible design. If it is necessary to remove the steering wheel, use standard wheel puller J 3044-1. Do not hammer on end of shaft, as hammering could loosen plastic injections which maintain column rigidity.*

1. Remove both attaching nuts securing flexible coupling to steering shaft.

2. On column shift transmission and floor shift cars, disconnect shift linkage from column shift levers.

3. Disconnect all electrical connectors from steering column.

4. Remove floor pan trim and insulator cover.

5. Remove screws securing toe cover plate halves to dash panel and loosen cover clamping screws.

6. Remove instrument panel trim cover screws and remove cover.

   NOTE: *Remove lower air conditioning duct if so equipped.*

7. Remove two nuts securing mounting bracket to instrument panel and carefully withdraw column.

INSTALL

NOTE: *Make sure this procedure is followed in exactly this order.*

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in step 1.*

1. Position steering column in car and attach steering shaft flange to steering gear flexible coupling and tighten coupling nuts to 20 lb. ft. torque (Fig. 9-33).

   NOTE: *Align large flexible coupling attaching bolt in large hole of steering shaft flange. Metal-to-metal contact between flanges on steering gear stub shaft assembly and steering shaft assembly will transmit and amplify gear noise to the driver. (See FLEXIBLE COUPLING outlined at front of Section 9 and Fig. 9-6 for use of plastic alignment spacers).*

2. Position steering column with mounting bracket to instrument panel loosely with two nuts.

3. Position left (outboard) cover plate to dash panel and start screw through bottom hole in cover.

4. Install second cover plate screw in upper slotted hole and tighten to 40 lb. in. torque, thereby locating cover plates properly. Tighten previously installed bottom hole screw to 40 lb. in. torque. Install third screw in left (outboard) cover plate and tighten to 40 lb. in. torque.

   NOTE: *On cars with manual transmission also attach clutch push rod bellows and retainer plate assembly with cover plate retainer screws.*

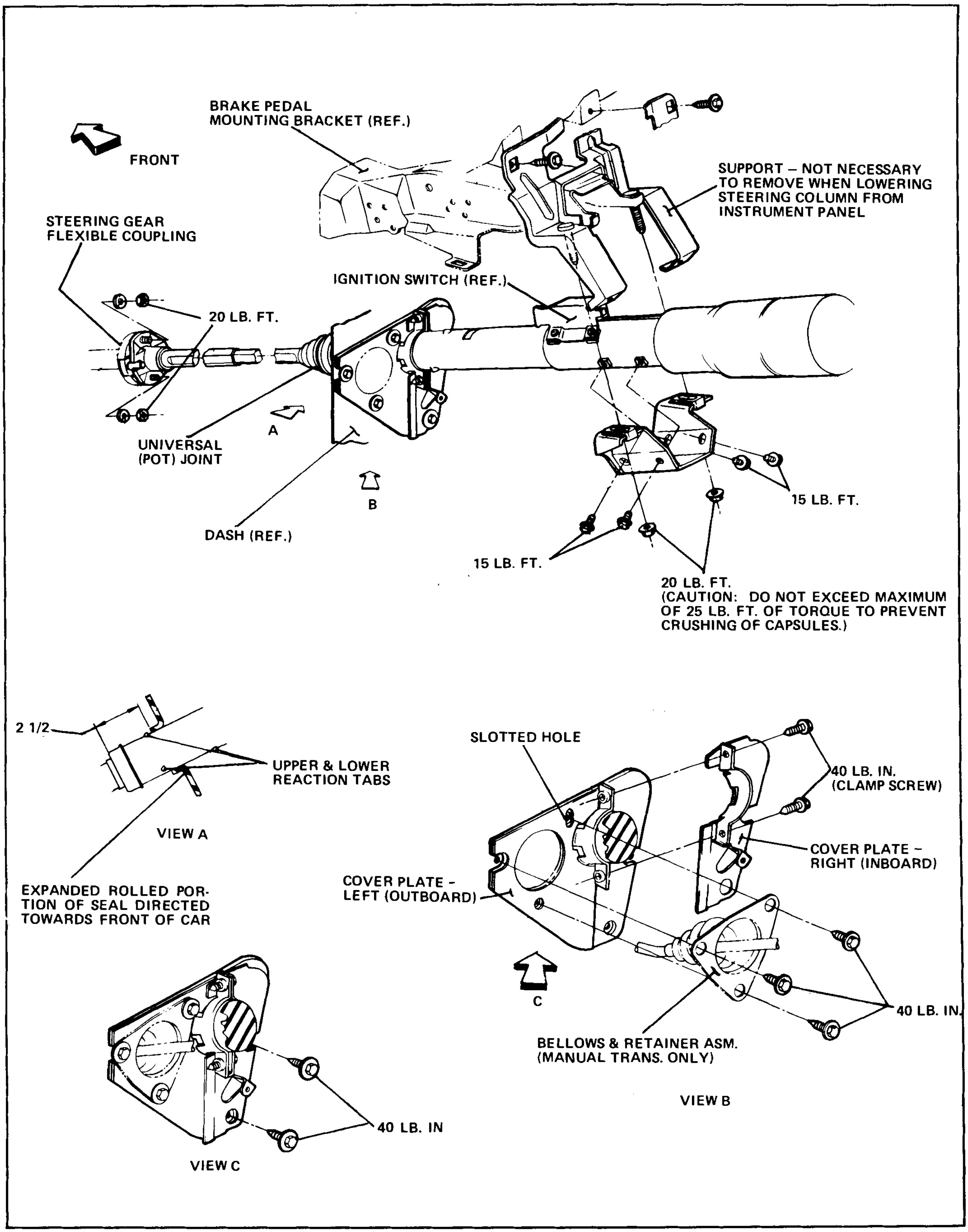


Fig. 9-33 Installation of Steering Column (A & G Series)

5. Hold right (inboard) cover plate tightly against dash panel and secure to left (outboard) cover plate with two clamp screws and tighten to 40 lb. in. torque.

   CAUTION: *Do not permit rolled section of the seal to reverse itself.*

6. Attach right (inboard) cover plate to dash panel with two cover plate screws and tighten to 40 lb. in torque.

7. Tighten two nuts attaching mounting bracket to instrument panel. Torque nuts to 20 lb. ft. torque.

   CAUTION: *Do not over-torque nuts because correct torque is necessary to insure breakaway action of the bracket and capsules in the event of a collision.*

8. Reconnect all electrical connections and install any trim which has been removed.

9. Connect all transmission linkage, if linkage requires adjusting, see Section 7 for the procedure.

10. Adjust back-up light or neutral-start switch (see Section 12 for adjustment procedure).

STEERING COLUMN (F SERIES)

REMOVE

CAUTION: *When the steering column is removed from the car, it 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 mast jacket could cause the jacket to bend or deform. Such damages could impair the column's collapsible design. If it is necessary to remove the steering wheel, use standard wheel puller J 3044-1. Do not hammer on end of shaft, as hammering could loosen plastic injections which maintain column rigidity.*

1. Remove both attaching nuts securing flexible coupling to steering shaft.

2. Disconnect transmission linkage from column shift levers.

3. Disconnect all electrical connectors from steering column.

4. Remove the floor pan trim and insulator cover.

5. Remove screws securing toe plate to dash panel.

6. Loosen instrument panel trim cover screws and remove cover.

   NOTE: *Remove lower air conditioning duct if so equipped.*

7. Remove instrument panel lower support bracket below steering column.

8. Remove two nuts securing mounting bracket to instrument panel and carefully withdraw column.

INSTALL

NOTE: *Make sure this procedure is followed in exactly this order.*

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in step 1.*

1. Position steering column in car and attach steering shaft flange to steering gear flexible coupling and tighten coupling nuts to 20 lb. ft. torque (Fig. 9-34).

   NOTE: *Align large flexible coupling attaching bolt in large hole of steering shaft flange. Metal-to-metal contact between flanges on steering gear stub shaft assembly and steering shaft assembly will transmit and amplify gear noise to the driver. (See FLEXIBLE COUPLING outlined at front of Section 9 and Fig. 9-6 for use of plastic alignment spacers).*

2. Loosely attach mounting bracket to instrument panel with two mounting nuts.

3. Position cover and seal to front of dash and install screw at unslotted hole location. Tighten to 40 lb. in. torque.

4. Tighten two nuts securing mounting bracket to instrument panel to 20 lb. ft. torque.

   CAUTION: *Do not over-torque nuts because correct torque is necessary to ensure breakaway action of the bracket and capsules in the event of a collision.*

5. Install screws at two slotted locations of cover and seal and tighten to 40 lb. in. torque.

6. Reconnect all electrical connections.

7. Install instrument panel lower support bracket below steering column.

8. Install instrument panel trim cover.

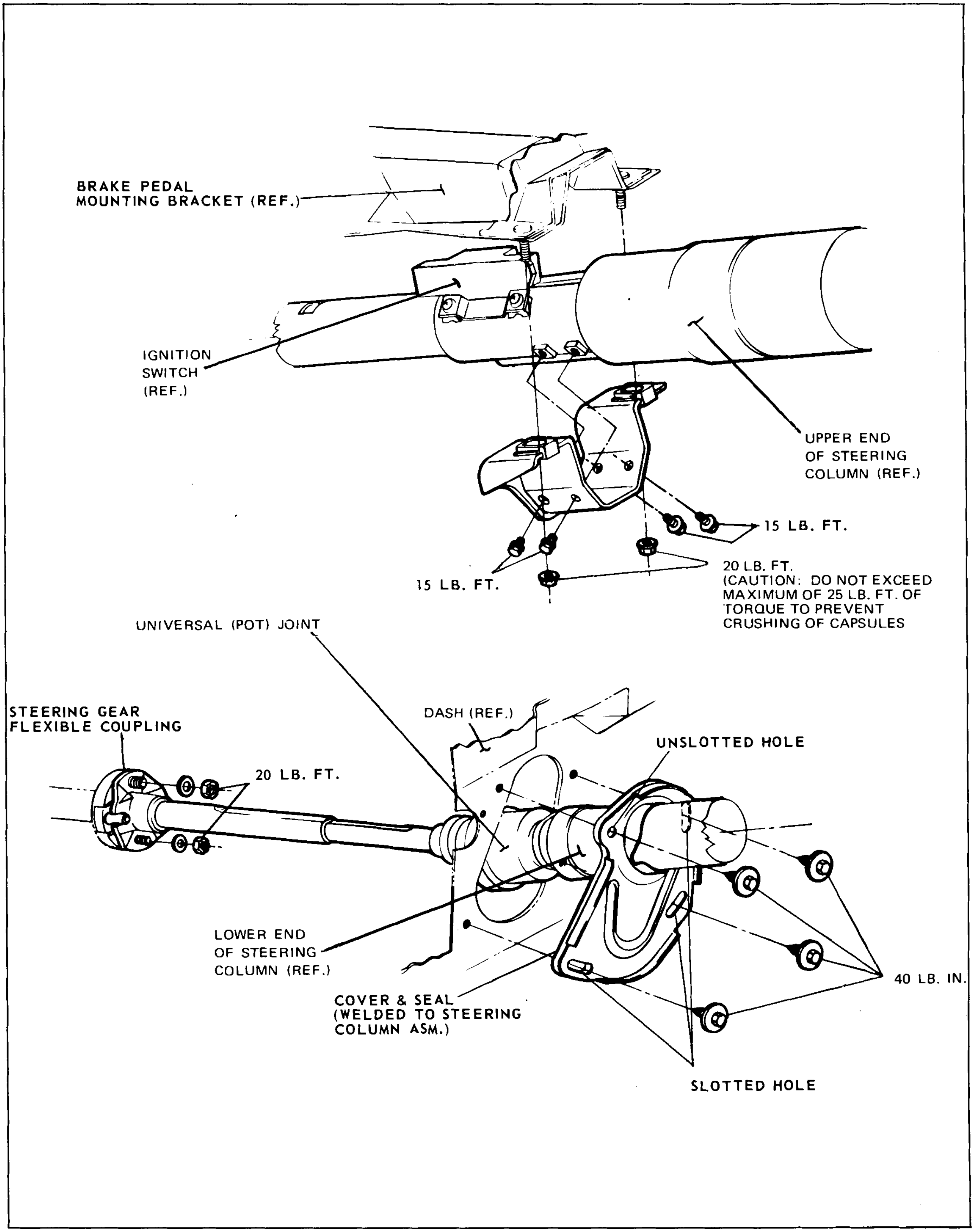


Fig. 9-34 Installation of Steering Column (F Series)

9. Install floor pan trim and insulator cover.

10. Connect all transmission linkage, if linkage requires adjusting, see Section 7 for the procedure.

11. Adjust back-up light or neutral-start switch (see Section 12 for adjustment procedure).

STEERING COLUMN (X SERIES)

REMOVE

NOTE: *When the steering column is removed from the car, it 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 mast jacket could cause the jacket to bend or deform. Such damages could impair the column's collapsible design. If it is necessary to remove the steering wheel, use standard wheel puller J 3044-1. Do not hammer on end of shaft, as hammering could loosen plastic injections which maintain column rigidity.*

1. Remove both attaching nuts securing flexible coupling to steering shaft.

2. On column shift transmission and floor shift cars, disconnect shift linkage from column shift levers.

3. Disconnect all electrical connectors from steering column.

4. Remove the floor pan trim and insulator cover.

5. Remove screws securing toe cover plate halves to dash panel and loosen cover clamping screws.

6. Remove instrument panel trim cover screws and remove cover.

   NOTE: *Remove lower air conditioning duct if so equipped.*

7. Remove two nuts securing mounting bracket to instrument panel and carefully withdraw column.

INSTALL

NOTE: *Make sure this procedure is followed in exactly this order.*

1. Install upper (A) and lower (B) steering column to dash covers on column and tighten two screws (C) so that cover assembly is snug on column but still will move with respect to column (Fig. 9-35).

2. Glue dash panel seal (D) to upper (A) and lower cover (B).

3. Position rolled portion of dash panel seal at the column lower reaction tab two inches from bottom of mast jacket.

   CAUTION: *Rolled portion of seal must be directed down column toward front of car and must remain in this position during and after column installation.*

   CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in step 4.*

4. Position steering column in car and attach steering shaft flange to steering gear flexible coupling and tighten coupling nuts to 20 lb. ft. torque.

   NOTE: *Align large flexible coupling attaching bolt in large hole of steering shaft flange. Metal-to-metal contact between flanges on steering gear stub shaft assembly and steering shaft assembly will transmit and amplify gear noise to the driver. (See FLEXIBLE COUPLING outlined at front of Section 9 and Fig. 9-6 for use of plastic alignment spacers).*

5. Tighten two rearward mast jacket bracket retaining nuts (H) to 20 lb. ft. torque while holding flexible coupling to flange clearance dimension shown (5/16").

   CAUTION: *Do not over-torque nuts because correct torque is necessary to insure breakaway action of the bracket and capsules in the event of a collision.*

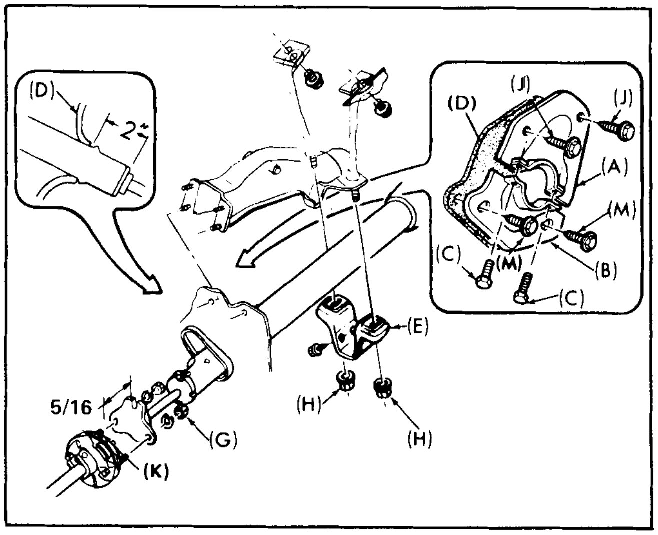


Fig. 9-35 Installation of Steering Column (X Series)

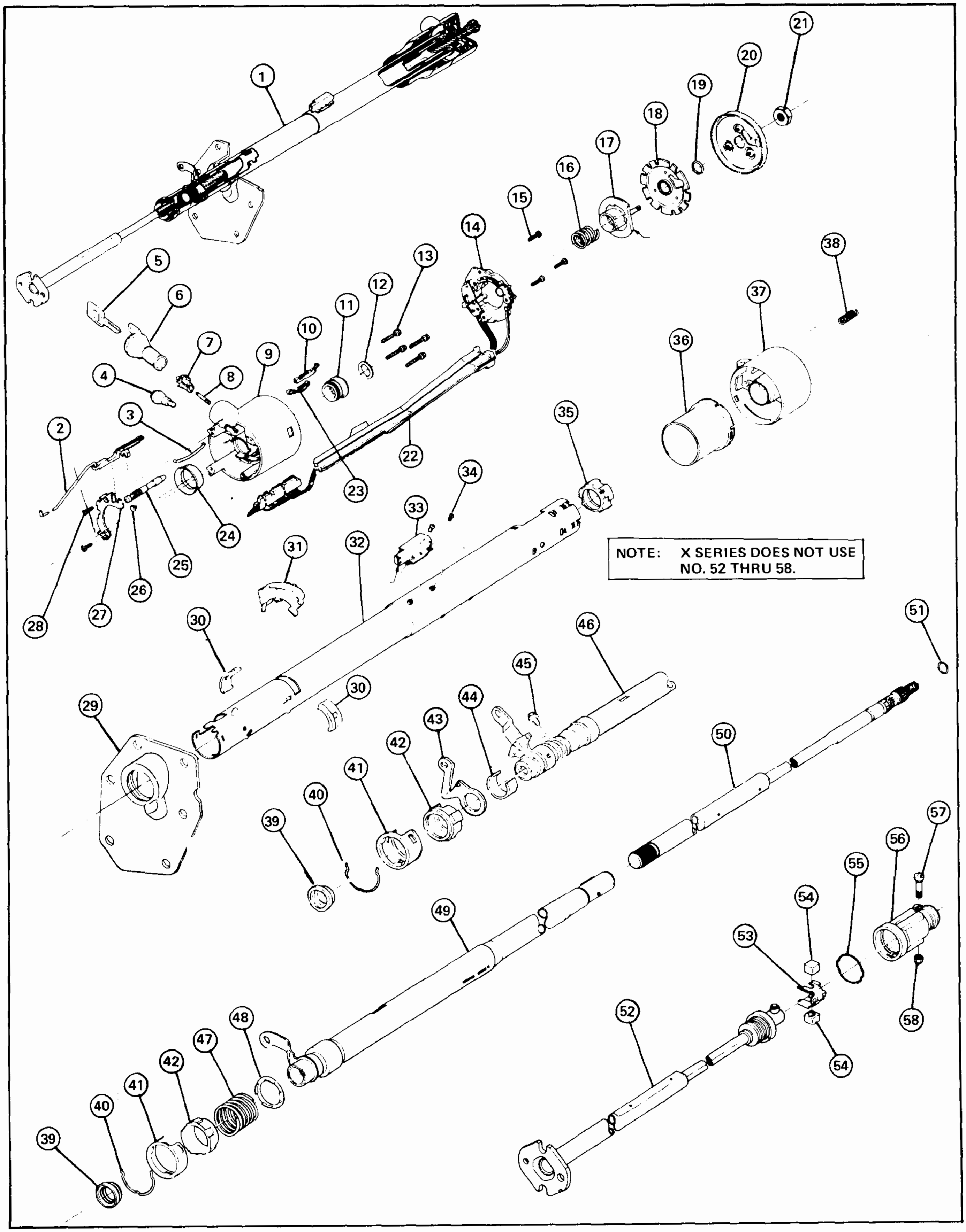


Fig. 9-36 Exploded View of Typical Regular Column - Automatic and Manual Transmission

1. COLUMN ASM., Steering
2. ROD and RACK ASM., Steering Column Housing
3. SPRING, Housing Rack Preload
4. SWITCH ASM., Hazard Flasher
5. KEY, Ignition
6. CYLINDER ASM., Ignition
7. SECTOR, Ignition Switch Actuator
8. SHAFT, Ignition Switch Actuator Sector
9. HOUSING, Steering Column
10. SWITCH ASM., Ignition Buzzer
11. BEARING ASM., Steering Shaft Upper
12. WASHER, Steering Shaft Upper Thrust
13. SCREW, Upper Brg. Housing Support
14. SWITCH ASM., Directional Signal
15. SCREW, Turn Signal Switch
16. SPRING, Steering Shaft Upper Bearing
17. CAM ASM., Turn Signal Canceling
18. LOCK, Steering Shaft
19. RING, Upper Steering Shaft Retaining
20. COVER and SCREW ASM., Steering Column Lock Plate
21. NUT, Steering Shaft to Wheel
22. PROTECTOR, Turn Signal Control Wire
23. CLIP, Ignition Buzzer Switch Retainer
24. CUP, Turn Signal Housing Thrust
25. SPRING and BOLT ASM., Steering Column Housing
26. WASHER, Housing Rack Spring Thrust
27. GATE, Turn Signal Housing Shift Lever
28. SCREW, Turn Signal Housing Shift Lever Gate
29. SEAL, Steering Column to Dash
30. GROMMET, Neutral-Start & Back-Up Lamp Retainer
31. SWITCH ASM., Trans. Neutral-Start and Back-Up Lamp
32. JACKET ASM., Steering Column
33. SWITCH ASM., Ignition
34. SCREW, Ignition Switch to Steering Column
35. BEARING, Steering Column Bowl Lower
36. SHROUD, Steering Column Bowl
37. BOWL, Gear Shift Lever
38. SPRING, Upper Gearshift Lever
39. BEARING, Steering Shaft Adapter-Lower
40. CLIP, Steering Column Lower Brg. Adapter
41. RETAINER, Steering Column Lower Brg. Adapter
42. ADAPTER, Steering Column Lower Brg.
43. LEVER, Steering Column Lower Shift
44. SPACER, Steering Column Shift Lever
45. SCREW and WASHER, To Shift Tube (1/4"-20 × 1/2")
46. TUBE ASM., Gearshift
47. SPRING, Steering Column Shift Tube Return
48. WASHER, Steering Column Shift Tube Return Spring Thrust
49. TUBE ASM., Gearshift
50. SHAFT ASM., Steering
51. RING, Upper Steering Shaft Retaining
52. SHAFT ASM., Steering
53. SPRING, Intermediate Steering Shaft Coupling
54. BEARING, Intermediate Steering Shaft Coupling
55. RING, Intermediate Shaft Seal Retainer
56. CLAMP, Plug and Coupling, Intermediate Shaft
57. BOLT, Coupling to Upper Shaft
58. NUT, Coupling to Upper Shaft

Fig. 9-36 Exploded View Of Typical Regular Column - Automatic And Manual Transmission

NOTE: *For remaining steps, upper cover (A) and lower cover (B) must move to established position of column which has been determined by flexible coupling and instrument panel attachment.*

6. Push upper (A) and lower (B) cover assembly to dash and line up all cover to dash attaching holes.

CAUTION: *Do not permit rolled section of seal (D) to reverse itself.*

7. Holding both upper and lower cover assemblies against dash and column, install and tighten two screws (M) to 40 lb. in. torque.
8. Tighten two screws (C) to 40 lb. in. torque.
9. Loosen two screws (M).
10. Tighten two screws (M) to 40 lb. in. torque.
11. Tighten two screws (J) to 40 lb. in. torque.
12. Install shift indicator (pointer) cable attaching screw to shift bowl on models with automatic transmission.
13. Reconnect all electrical connections and install any trim which has been removed.
14. Connect all transmission linkage, if linkage requires adjusting, see Section 7 for the procedure.
15. Adjust back-up light or neutral-start switch (see Section 12 for adjustment procedure).

MAJOR SERVICE

The following procedures cover the complete disassembly and assembly of steering columns after their removal from car and should only be used to the extent necessary for replacement of steering shaft, lower bearing, shift bowl bearing, shift tube, column jacket or other internal parts (Figs. 9-36 and 9-37).

NOTE: *The removal and disassembly of upper bearing housing can be performed with steering column installed in car.*

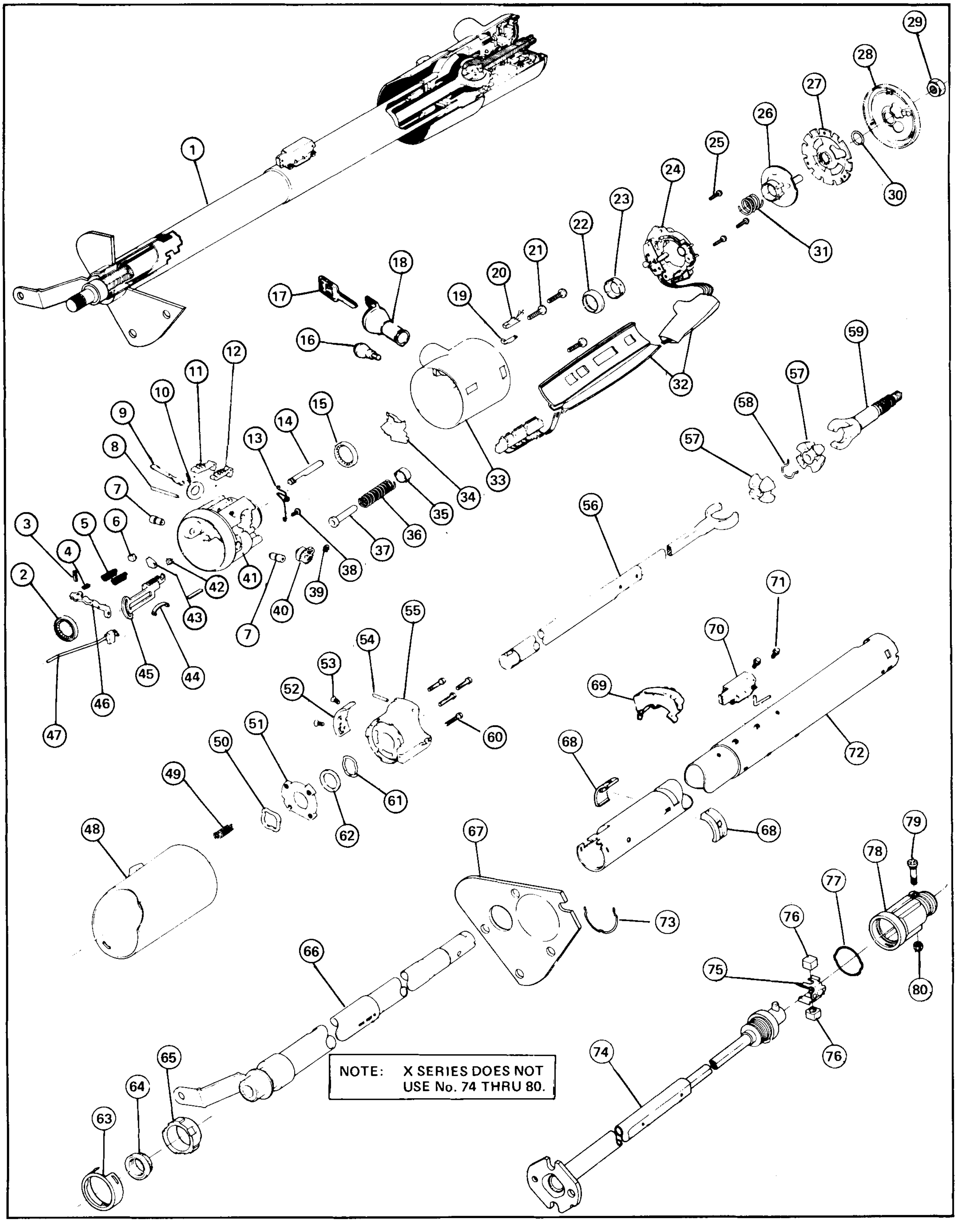


Fig. 9-37 Exploded View of Typical Tilt Column

1. COLUMN ASM., Steering
2. BEARING ASM., Steering Shaft Upper (1/32" I.D.)
3. PIN, Tilt Shoe Release Lever (3/16" × 3/4")
4. SPRING, Strg. Wheel Tilt Shoe
5. SPRING, Strg. Wheel Tilt Shoe
6. BUMPER, Bearing Housing
7. PIN, Bearing Housing Pivot
8. PIN, Bearing Housing Dowel (3/16" × 1-11/16")
9. SHAFT, Steering Column Housing Drive
10. WASHER, Steering Column Housing Drive Shear
11. SHOE, Steering Wheel Lock (3-Position)
12. SHOE, Steering Wheel Lock (4-Position)
13. SPRING, Steering Column Housing Lock Bolt
14. BOLT, Steering Column Housing Lock
15. BEARING ASM., Steering Shaft Upper
16. SWITCH ASM., Hazard Flasher
17. KEY, Ignition
18. CYLINDER ASM., Ignition
19. CLIP, Ignition Buzzer Switch Retainer
20. SWITCH ASM., Ignition Buzzer
21. SCREW, Upper Brg. Housing Support
22. RACE, Steering Shaft Upper Bearing-Inner
23. SEAT, Steering Shaft Upper Bearing Inner Race
24. SWITCH ASM., Directional Signal
25. SCREW, Directional Signal Switch
26. CAM ASM., Turn Signal Cancelling
27. LOCK, Steering Shaft
28. COVER and SCREW ASM., Steering Column Lock Plate
29. NUT, Steering Shaft to Wheel
30. RING, Upper Steering Shaft Retaining
31. SPRING, Turn Signal Cancelling Cam
32. PROTECTOR, Turn Signal Control Wire
33. COVER, Steering Housing
34. SHIELD, Tilt Lever Opening
35. RETAINER, Bearing Housing Spring
36. SPRING, Steering Column Housing Wheel Tilt
37. GUIDE, Bearing Housing Spring
38. SCREW, Steering Column Housing Lock Bolt
39. RING, Steering Column Housing Drive Shaft Ret.
40. SECTOR, Ignition Switch Actuator
41. HOUSING ASM., Steering Column (w/Bearings)
42. BUMPER, Bearing Housing
43. BUMPER, Bearing Housing
44. SPRING, Steering Column Housing Rack Preload
45. RACK, Steering Column Housing Switch Actuator
46. LEVER, Steering Shaft Shoe Release
47. ACTUATOR ASM., Steering Column Housing Switch
48. BOWL (Part of Cover)
49. SPRING, Gearshift Lever Bowl
50. WASHER, Steering Column Bowl-Wave
51. PLATE, Steering Column Lock
52. GATE, Steering Shaft Housing Support
53. SCREW, Steering Shaft Housing Support Gate or Detent Plate
54. PIN, Steering Column Housing Dowel
55. SUPPORT, Steering Column Housing
56. SHAFT ASM., Steering-Lower
57. SPHERE, Steering Shaft Centering
58. SPRING, Steering Shaft Joint Preload
59. SHAFT ASM., Steering-Upper
60. SCREW, Upper Bearing Housing Support
61. RING, Steering Column Shift Tube Retainer
62. WASHER, Steering Column Bowl Thrust
63. RETAINER, Steering Column Lower Brg. Adapter
64. BEARING, Steering Shaft Adapter - Lower
65. ADAPTER, Steering Column Lower Brg.
66. TUBE ASM., Steering Column Reaction and Shift
67. SEAL, Grommet to Toe Pan
68. GROMMET, Steering Column Toe Plate
69. GROMMET, Neutral-Start and Back-Up Lamp Switch Retaining
70. SWITCH ASM., Trans. Neutral-Start and Back-Up Lamp
71. SWITCH ASM., Ignition
72. SCREW, Ignition Swtich to Steering Column
73. JACKET ASM., Steering Column
74. CLIP, Steering Column Lower Brg. Adapter
75. SHAFT ASM., Steering
76. SPRING, Intermediate Steering Shaft Coupling
77. BEARING, Intermediate Steering Shaft Coupling
78. RING, Intermediate Shaft Seal Retainer
79. CLAMP, Plug and Coupling, Intermediate Shaft
80. BOLT, Coupling to Upper Shaft
81. NUT, Coupling to Upper Shaft

Fig. 9-37 Exploded View Of Typical Tilt Column

STEERING COLUMN (NON-TILTING)

DISASSEMBLE UPPER END

1. Remove four bolts attaching column mounting bracket. Set bracket aside to protect breakaway capsules (Fig. 9-38).

2. Mount column in vise by clamping two welded tapping nuts in vise (Fig. 9-39). Disconnect lower shaft with universal joint (pot joint) from steering column shaft by removing clamping bolt (Fig. 9-36) if pot joint is to be serviced.

CAUTION: *Never clamp on the jacket.*

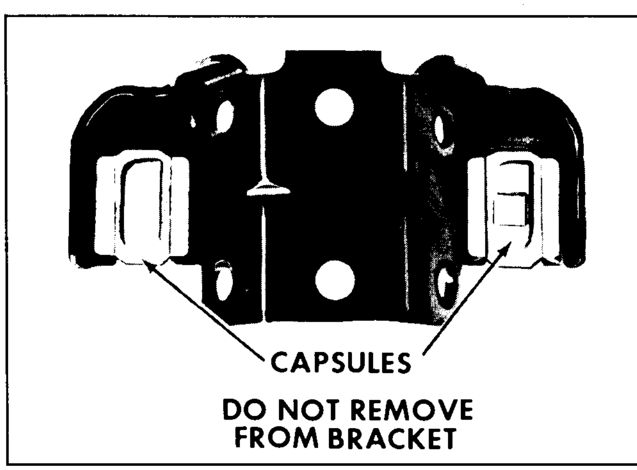


Fig. 9-38 Mounting Bracket Assembly

NOTE: *Steps 3 through 15 can be performed with column installed in car and lowered from instrument panel. Never let column be unsupported when lowered from instrument panel. Check alignment of column after attaching to instrument panel.*

3. Remove shift indicator assembly if it needs to be serviced by removing retaining spring(s) and lifting off assembly from upper bearing housing on all models except B Series (Fig. 9-31).

4. Remove steering wheel, if still attached (see STEERING WHEEL - REMOVE).

5. Remove turn signal switch (see TURN SIGNAL SWITCH - REMOVE, steps 2 through 10).

   NOTE: *It is recommended that the steering shaft be removed at this time to eliminate the possibility of it sliding out the lower end of the column and being damaged. Steps 6 through 16 are not required if steering shaft, lower bearing, and shift tube (step 9 is required on cars equipped with column shift manual transmission to remove shift tube) are the only parts to be replaced. (Remove back-up light and neutral-start switch on all cars before removing shift tube.)*

6. Remove lock cylinder if it needs to be serviced (see LOCK CYLINDER - REMOVE, steps 3 and 4).

   CAUTION: *Buzzer switch must be left in place until AFTER the lock cylinder is removed. The reason for removing in this order is to reduce the possibility of damage to the small plastic buzzer switch actuator protruding from the lock cylinder. The spring action of the buzzer switch holds this actuator up into the cylinder so that it will not catch on the column housing when the lock cylinder is removed.*

   NOTE: *Lock cylinder does not have to be removed to remove upper bearing housing.*

7. Remove buzzer switch if it needs to be serviced (see BUZZER SWITCH - REMOVE, step 3).

   NOTE: *Buzzer switch does not have to be removed to remove upper bearing housing.*

8. To remove any further parts from the upper end, the ignition switch should be removed. Remove the two attaching screws and the switch.

9. Drive out upper shift lever pivot pin and remove upper shift lever.

10. Remove the four screws attaching the upper bearing housing to the jacket. Remove the upper housing assembly (Fig. 9-40).

11. Remove thrust cup if still attached to housing (Fig. 9-41).

12. Remove the rack and lock bolt (Fig. 9-42).

13. Remove the rack load spring (Fig. 9-43).

14. Remove the sector through the lock cylinder hole by pushing firmly on the wide tooth of the sector with a blunt punch (Fig. 9-44).

15. Remove shift bowl and shroud from the jacket.

DISASSEMBLE LOWER END

Steering wheel, cover, shaft lock, snap ring, spring cancelling cam and flat washer must be removed prior to disassembly of the lower end. Follow instructions in steps 4 and 5 above.

1. Pull steering shaft assembly from bottom of column.

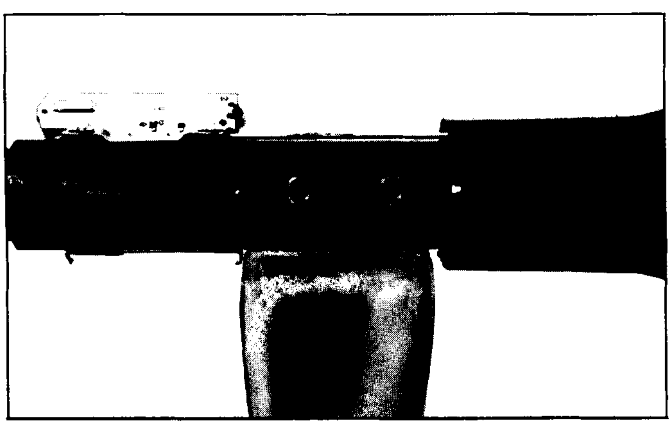


Fig. 9-39 Mounting Column In Vise By Welded Tapping Nuts

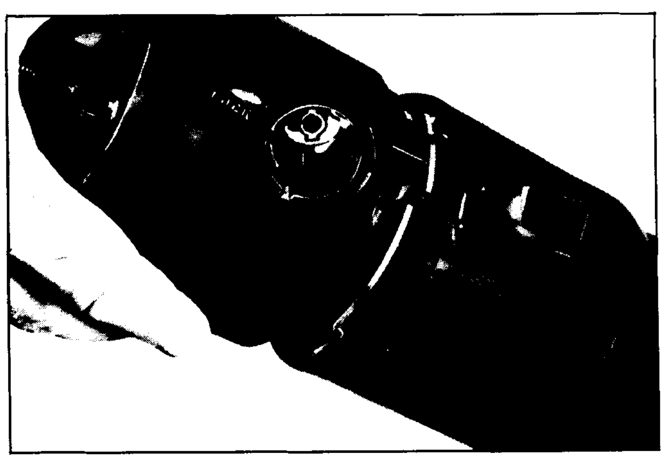


Fig. 9-40 Removing Upper Bearing Housing

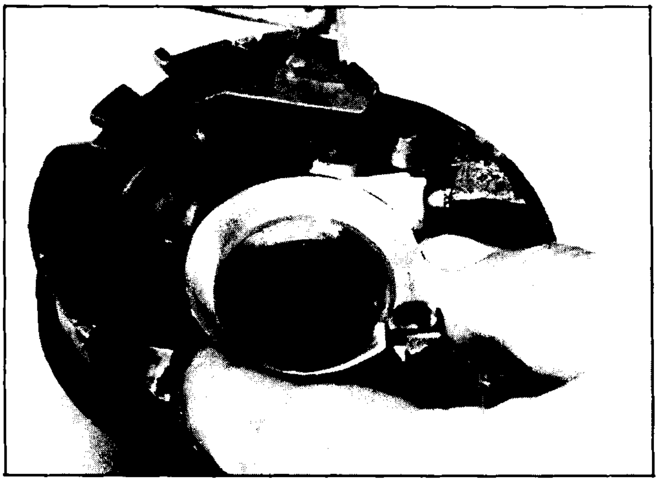


Fig. 9-41 Removing or Installing Thrust Cup

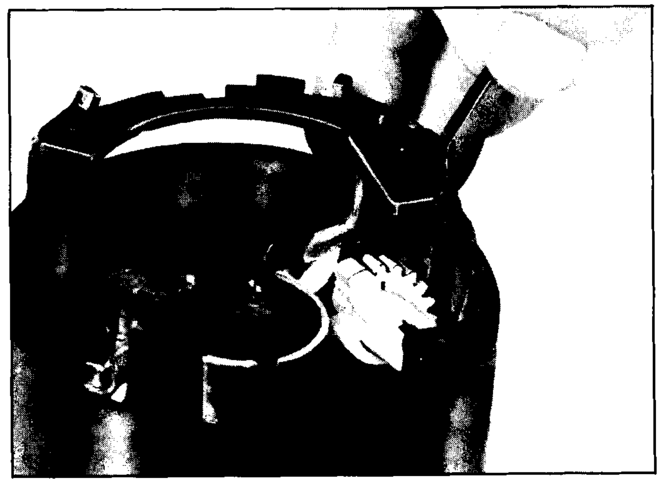


Fig. 9-43 Removing or Installing Rack Load Spring

2. Remove the two screws attaching the back-up light or neutral-start switch and remove switch (Fig. 9-45).

3. Remove bearing adapter retaining clip (Fig. 9-46).

Perform step 4 on all cars not equipped with column shift manual transmission.

4. Remove bearing adapter, bearing and shift tube spring (Fig. 9-47).

   NOTE: *Bearing may be removed from adapter by a light press-out operation on the outer race.*

Perform steps 5 and 6 on all cars equipped with column shift manual transmission.

5. Remove bearing adapter, bearing and FIRST-/REVERSE lever (Fig. 9-48).

   NOTE: *Bearing may be removed from adapter by a light press-out operation on the outer race.*

6. Remove three screws from shift tube support at lower end (Fig. 9-49).

7. Slide out shift tube assembly.

8. Remove lower shift bowl bearing from top of jacket (Fig. 9-50).

ASSEMBLE LOWER END

Apply a thin coat of chassis grease to all friction surfaces.

1. Press the lower bearing assembly into the adapter assembly if removed.

2. Insert the shift tube assembly into the lower end of the jacket and rotate until the upper shift tube key slides into the bowl keyway.

   NOTE: *The shift bowl should be in place on the mast jacket before the shift tube is assembled.*

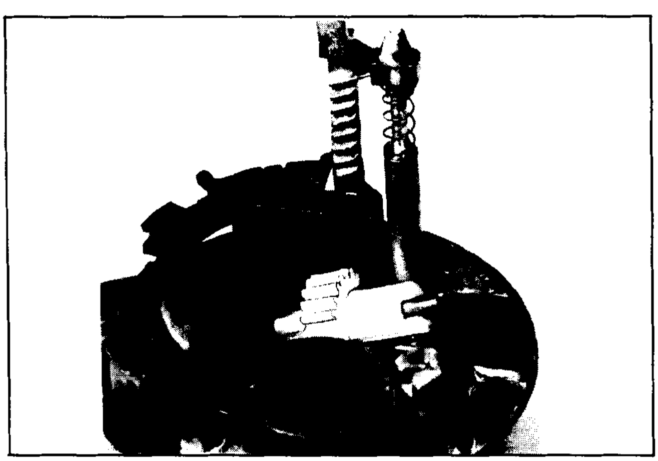


Fig. 9-42 Removing or Installing Rack and Lock Bolt

Fig. 9-44 Removing Sector

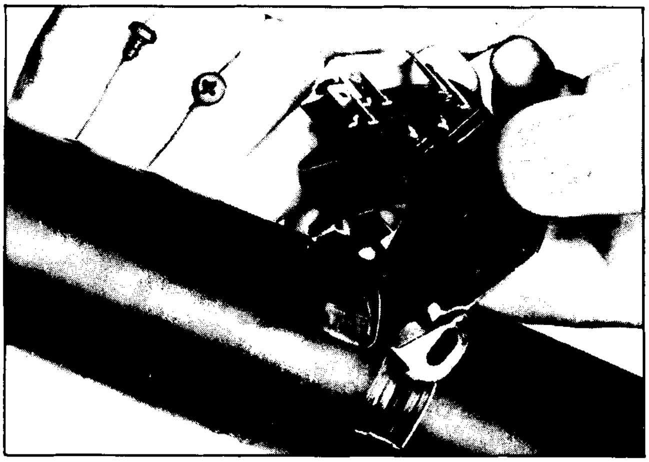


Fig. 9-45 Removing Back-Up Light or Neutral-Start Switch

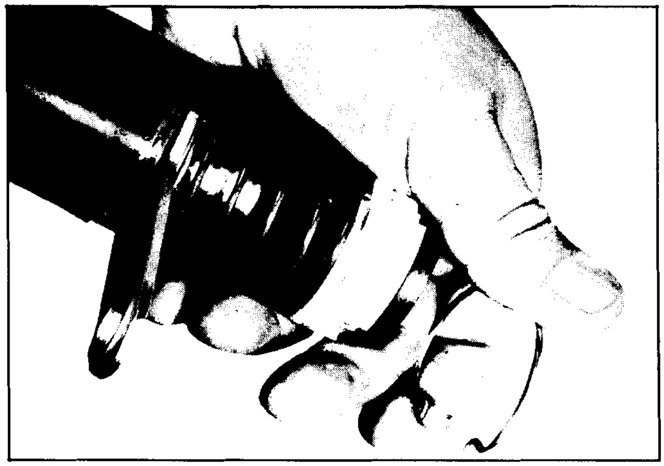


Fig. 9-47 Removing Bearing Adapter and Shift Tube Spring

Perform steps 3 through 9 on all cars equipped with column shift manual transmission.

3. Loosely attach three screws in jacket and shift tube support.

4. Assemble the FIRST/REVERSE lever and adapter assembly into the bottom of the jacket. Holding the adapter in place, insert the clip in the jacket slots.

CAUTION: *Friction surfaces of lower levers and mating bearing surfaces must be greased.*

5. Place a .005" maximum shim on each side of steering shaft between either lever and the spacer (Fig. 9-51). By using two shims, the possibility of cocking the lever is eliminated.

6. Turn shift tube support down until levers are bottomed out.

7. Tighten the three bolts to 10 lb. ft. torque.

8. Remove both .005" maximum shims.

Perform step 9 on all models except cars equipped with column shift manual transmission.

9. Assemble the spring and adapter assembly into the bottom of the jacket. Holding the adapter in place, insert the clip in the jacket slots.

10. Install the back-up light or neutral-start switch loosely to the jacket assembly. This will be tightened to the jacket after installing column in car and adjustment of switch.

CAUTION: *Use only the proper screws. Screws must not be longer than 1/4" or damage to the shift tube will occur.*

11. Slide steering shaft assembly into column.

NOTE: *The upper housing should be in place before the shaft is assembled.*

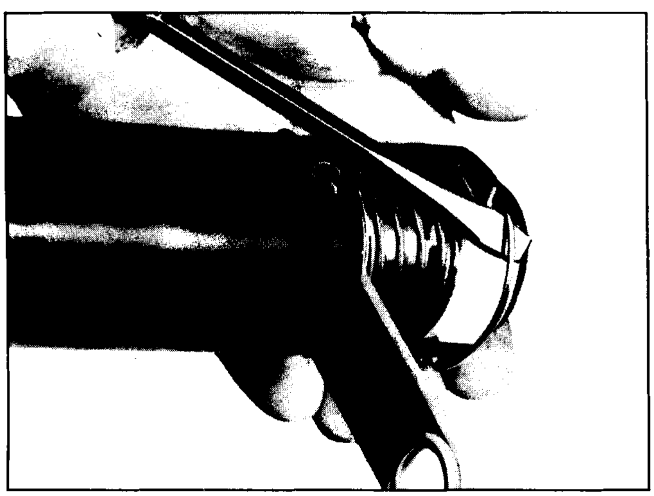


Fig. 9-46 Removing Bearing Adapter Retaining Clip

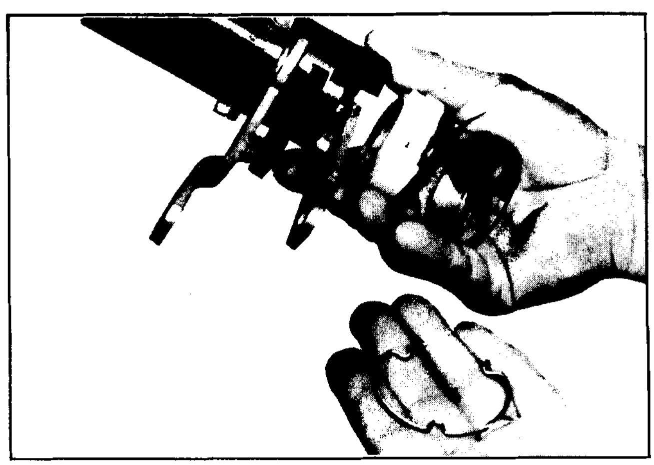


Fig. 9-48 Removing Bearing Adapter, Bearing and FIRST/REVERSE Lever - Manual Transmission

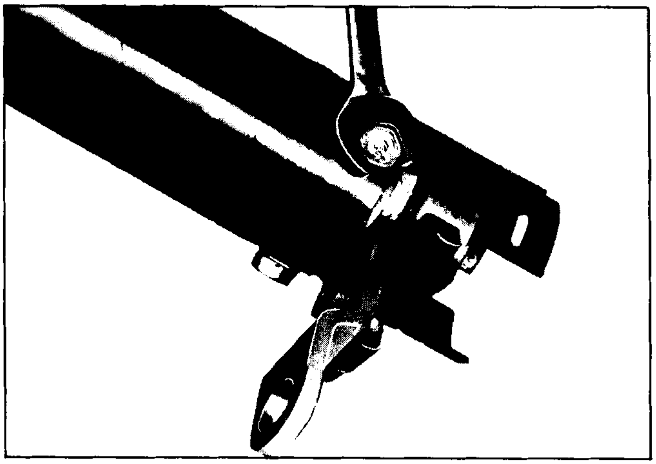


Fig. 9-49 Removing Lower Shift Tube Support Screws - Manual Transmission

ASSEMBLE UPPER END

Apply a thin coat of chassis grease to all friction surfaces.

1. Install the sector in the lock cylinder hole over the sector shaft with the tang end to the outside of the hole. Press the sector over the pin with a blunt tool (Fig. 9-52).
2. Insert the rack load spring in the housing from the bottom side. The long section should be toward the sector and hook on the edge of the housing (Fig. 9-42).
3. Assemble the bolt to the cross-over arm of the rack (Fig. 9-53).
4. Insert the rack and lock bolt into the housing from the bottom with the teeth up (toward sector) and toward the centerline of the column wide tooth on rack to engage wide tooth on sector (Fig. 9-42).
5. Install the thrust cup on the bottom hub of the housing (Fig. 9-41).

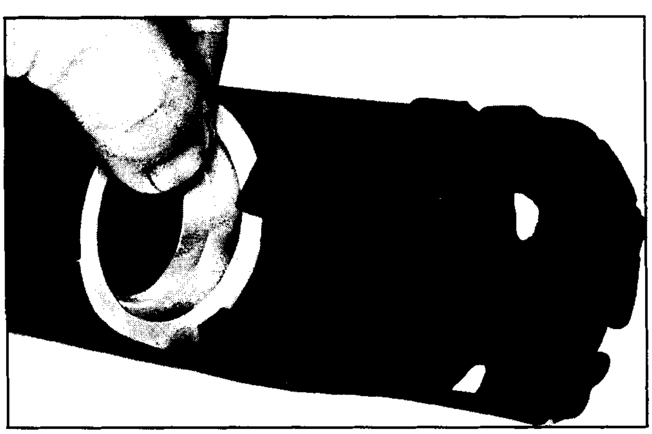


Fig. 9-50 Removing or Installing Lower Shift Bowl Bearing

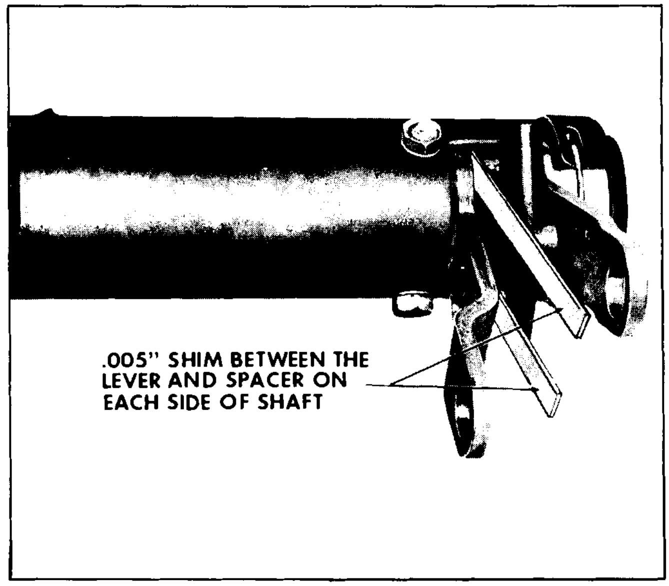


Fig. 9-51 Adjusting Lower Shift Lever Clearance

6. Install lower bowl bearing in jacket (Fig. 9-50).
7. Install bowl and rotate it to be sure it is seated in bearing.
8. Position shift indicator assembly, if removed, to upper bearing housing and install retaining spring(s) on all models except B Series (Fig. 9-31).
9. With the bowl in place, install the upper bearing housing assembly on the jacket. The bowl should be in the "PARK" position and the rack pulled downward. Be sure the housing is seated on the jacket and tighten the four screws to 60 lb. in torque.
10. Install buzzer switch if removed (see BUZZER SWITCH - INSTALL, steps 1 and 2).

CAUTION: *Buzzer switch should be installed BEFORE the lock cylinder. The reason for re-*

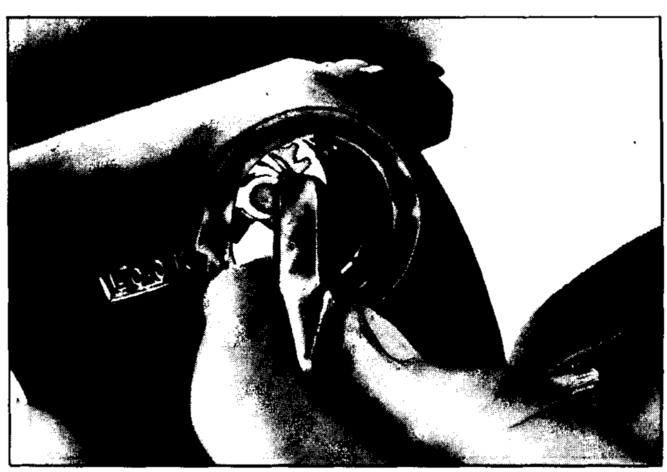


Fig. 9-52 Installing Sector

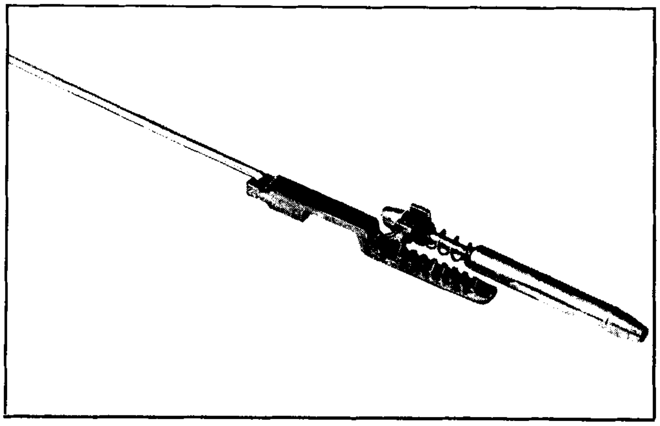


Fig. 9-53 Bolt and Rack Assembled

placing in this order is to reduce the possibility of damage to the small plastic buzzer switch actuator protruding from the lock cylinder. The spring action of the buzzer switch holds this actuator up into the cylinder so that it will not catch on the column housing when the lock cylinder is installed.

11. Install lock cylinder if removed (see LOCK CYLINDER - INSTALL, steps 1 through 5).
12. Install turn signal switch (see TURN SIGNAL SWITCH - INSTALL).
13. Install steering wheel (see STEERING WHEEL - INSTALL).
14. Reinstall column bracket with the four bolts previously removed. Do not use a different length bolt. Torque bolts to 15 lb. ft. torque.
15. Install lower steering shaft with pot joint to steering column shaft. Tighten clamping nut or bolt to 30 lb. ft. torque (Figs. 9-36 and 9-37).
16. Install ignition switch by inserting the actuator rod into the slider and assemble to the column with two screws. Tighten attaching screws to 35 lb. in. torque.

    CAUTION: *Use only the correct screws.*

    NOTE: *Before installing switch, place the lock cylinder in "OFF" position and position the ignition switch slider in "OFF" (see Section 12 for ignition switch adjustment).*

17. Install column in car (see STEERING COLUMN - INSTALL).

    CAUTION: *Make certain that column is never unsupported when either the toe plate, instrument panel mounting, or gear mounting is connected.*

18. Adjust back-up light or neutral-start switch (see Section 12 for adjustment procedure).

TILT STEERING COLUMN

DISASSEMBLE COLUMN

1. Remove four bolts attaching column mounting bracket. Set bracket aside to protect breakaway capsules (Fig. 9-38).
2. Mount column in vise by clamping two welded tapping nuts in vise (Fig. 9-39).

    CAUTION: *Never clamp on the jacket.*

3. Remove ignition switch by removing two attaching screws.
4. Remove two screws attaching back-up light or neutral-start switch and remove switch (Fig. 9-45).
5. Remove shift indicator assembly, if it needs to be serviced, by removing retaining spring(s) and lifting off assembly from upper bearing housing on all models except B Series (Fig. 9-31).
6. Remove steering wheel, if still attached (see STEERING WHEEL - REMOVE).
7. Remove turn signal switch (see TURN SIGNAL SWITCH - REMOVE, steps 2 through 10).
8. Remove lock cylinder (see LOCK CYLINDER - REMOVE, steps 3 and 4).

    CAUTION: *Buzzer switch must be left in place until AFTER the lock cylinder is removed. The reason for removing in this order is to reduce the possibility of damage to the small plastic buzzer switch actuator protruding from the lock cylinder. The spring action of the buzzer switch holds this actuator up into the cylinder so that it will not catch on the column housing when the lock cylinder is removed.*

9. Remove buzzer switch if it needs to be serviced (see BUZZER SWITCH - REMOVE, step 3).

    NOTE: *Buzzer switch does not have to be removed to remove upper bearing housing.*

10. Remove tilt release lever.
11. Remove three housing cover screws and remove housing cover.

    NOTE: *Use 5/32" hex key wrench to remove star drive type screws.*

12. Install tilt release lever and place column in full "UP" position. Remove tilt spring retainer using screwdriver blade that just fits into slot opening. Insert screwdriver in slit, press in approximately 3/16", turn approximately 1/8 turn counterclockwise until ears align with grooves in housing and remove spring and guide (Fig. 9-54).

WARNING: CARE SHOULD BE TAKEN WHEN RELEASING TILT SPRING DUE TO HIGH COMPRESSION RATE OF SPRING.

13. Push upper steering shaft in sufficiently to remove steering shaft inner race seat and inner race.
14. Remove two pivot pins with tool J 21854-1 (Fig. 9-55).
15. Install tilt release lever and disengage lock shoes. Remove bearing housing assembly by pulling upward to extend rack full down and moving housing assembly to the left to disengage rack from actuator.
16. Remove actuator rod assembly.
17. Remove lower steering shaft with pot joint.
18. Remove retaining clip, spacer, spring, and bearing adapter assembly at lower end of the mast jacket.
19. Remove steering shaft assembly from upper end.
20. Disassemble steering shaft assembly by removing center spheres and anti-lash spring (Fig. 9-36).
21. Remove four screws securing the support assembly to the lock plate and mast jacket and take off support assembly.

NOTE: *Use 1/4" 6-point deep socket to remove star drive type screws.*

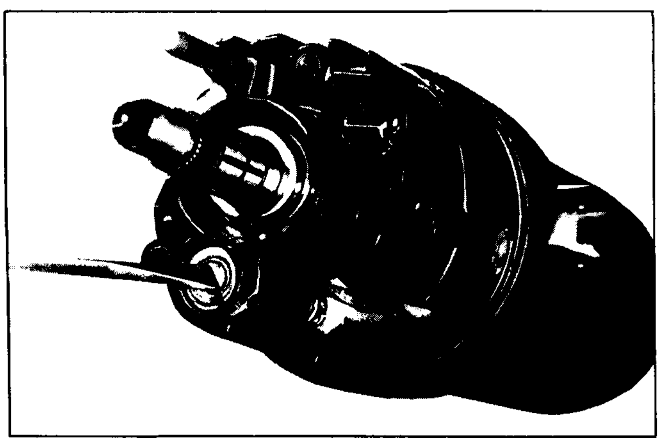


Fig. 9-54 Removing or Installing Tilt Spring Retainer

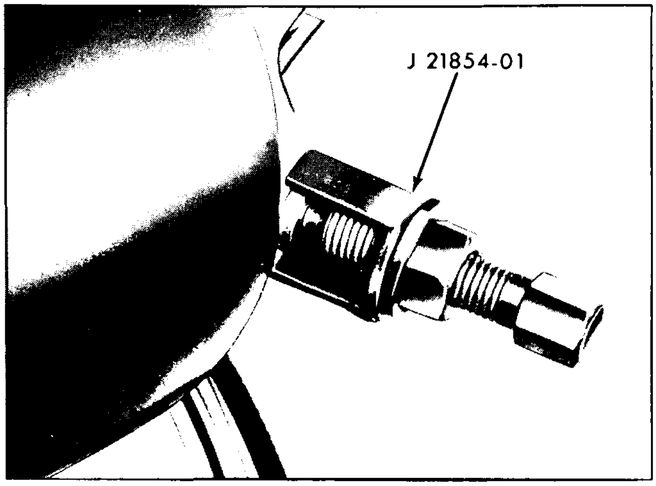


Fig. 9-55 Removing Pivot Pin

22. Remove shift tube retaining ring with screwdriver and remove thrust washer.
23. Remove shift tube from bowl using tool J 23072, (Fig. 9-56). Pilot sleeve in upper end of shift tube and force tube out of bowl.

CAUTION: *Care should be taken not to jam lower shift lever into "T" slot on lower end of mast jacket while forcing out shift tube.*

CAUTION: *Do not hammer or pull on lower or upper shift tube because plastic joint may be sheared.*

24. Remove shift tube assembly from mast jacket lower end.
25. Remove lock plate by sliding out of jacket notches and tipping down toward bowl hub and "12 o'clock" position and under jacket opening. Remove wave washer.

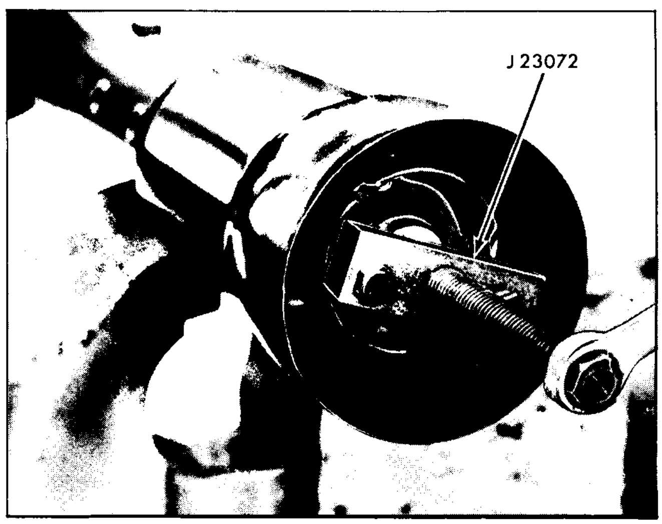


Fig. 9-56 Installation of Shift Tube Remover J 23072

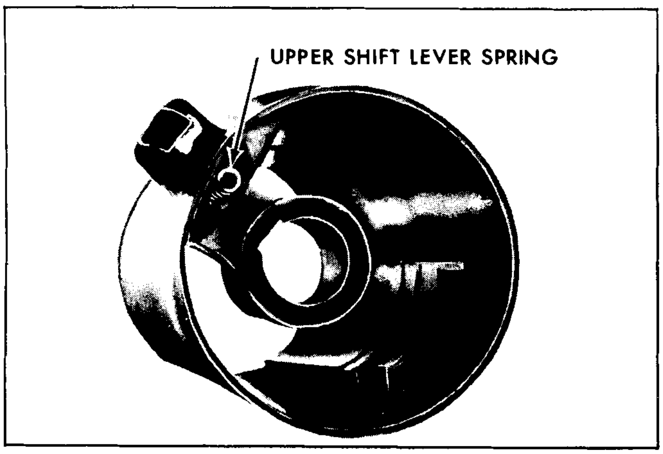


Fig. 9-57 Upper Shift Lever Spring

26. Remove shift bowl from mast jacket.

27. Remove upper shift lever spring from shift bowl by winding spring up with pliers and pulling out (Fig. 9-57).

DISASSEMBLE BEARING HOUSING

NOTE: *Housing can be removed with column installed in car and lowered from instrument panel. Check alignment of column after attaching to instrument panel. See steps 5 through 15 outlined above.*

1. Remove tilt lever opening shield from housing (Fig. 9-58).

2. Remove lock bolt spring by removing spring retaining screw and moving spring clockwise to remove from bolt (Fig. 9-59).

3. Remove snap ring from sector drive shaft. With small punch, lightly tap drive shaft from sector. Remove drive shaft, washer, sector and bolt (Fig. 9-60).

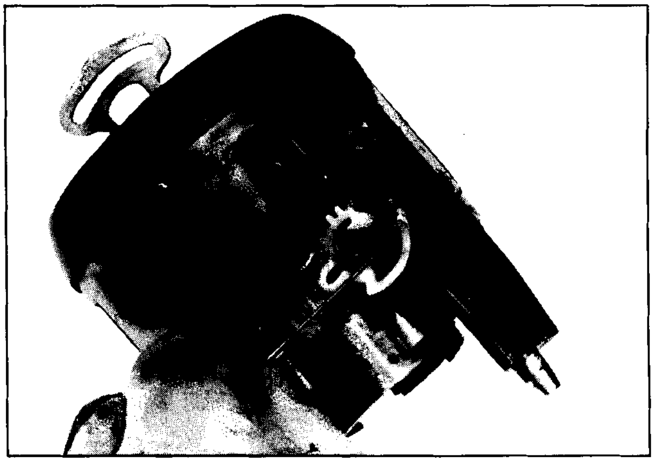


Fig. 9-59 Removing or Installing Lock Bolt Spring

4. Remove rack and rack spring.

5. Remove lock shoe release lever pin by driving out with J 22635. Remove lever and release lever spring (Fig. 9-61).

WARNING: TO RELIEVE LOAD ON RELEASE LEVER, HOLD SHOES INWARD AND WEDGE SCREWDRIVER BETWEEN TOP OF SHOES (OVER SLOTS) AND BEARING HOUSING.

6. Remove lock shoes and lock shoe springs by driving lock shoe pin out with J 22635.

7. Remove bearings from bearing housing only if they are to be replaced. Remove separator and balls from bearings. Place housing on work surface. With a pointed punch against back surface of race, carefully hammer race out of housing until bearing puller can be used. Repeat for other race.

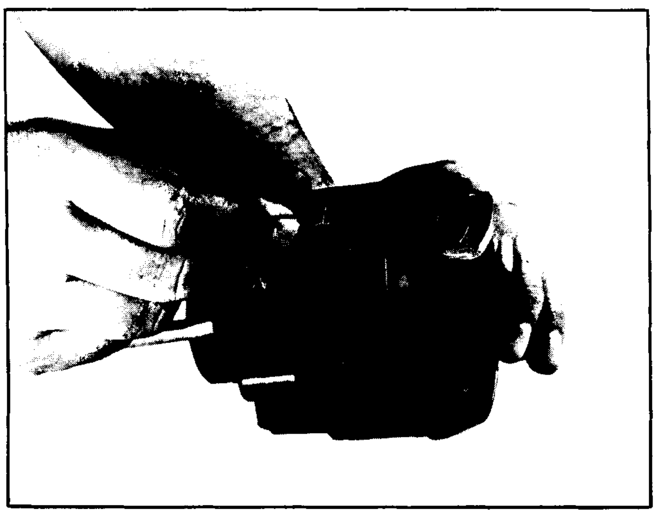


Fig. 9-58 Removing or Installing Tilt Lever Opening Shield

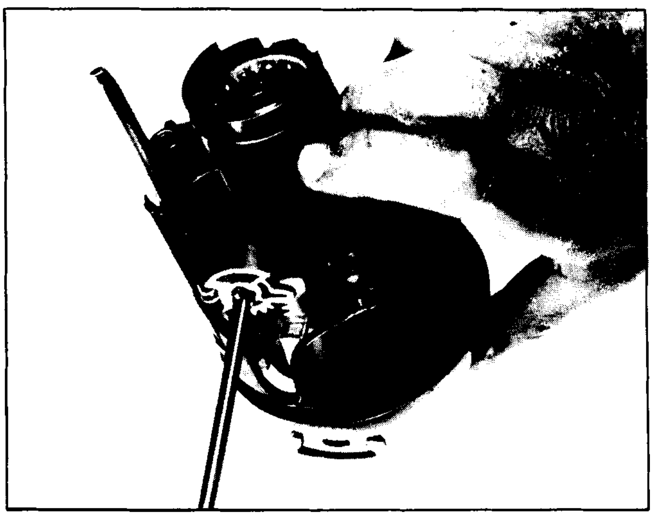


Fig. 9-60 Removing Sector Drive Shaft

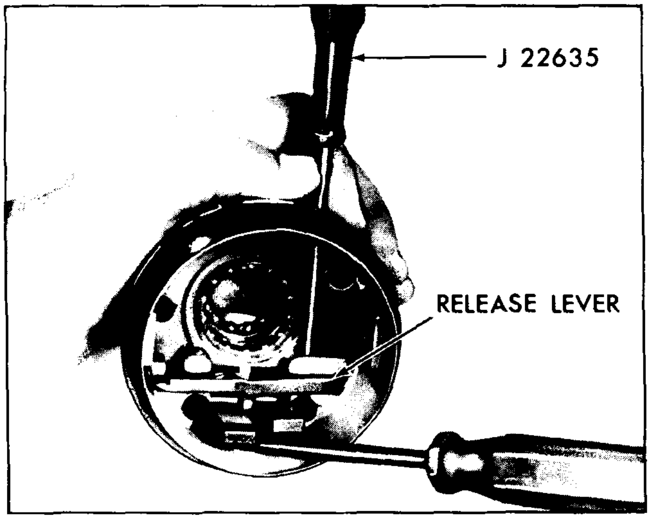


Fig. 9-61 Removing Tilt Release Lever Pin

ASSEMBLE BEARING HOUSING

Apply thin coat of chassis grease to all friction parts.

1. Install bearings in bearing housing, if removed.
2. Install lock shoe springs, lock shoes and shoe pin in bearing housing. Use J 22635 or .180" diameter rod (approx.) to line up shoes for pin installation.

   NOTE: *With tilt lever opening on the left side, shoes facing up, the four slot shoe is on the left.*

   NOTE: *Install shoe pin flush with housing face on release lever pin side.*

3. Install release lever spring, release lever and pin in bearing housing.

   NOTE: *Again, relieve load on release lever as in step 5 of disassembly procedure (Fig. 9-61).*

4. Install washer and sector drive shaft in housing. Lightly tap sector onto the shaft far enough to install snap ring.
5. Install lock bolt and engage with sector cam surface (Fig. 9-62).
6. Install rack and spring. Wide tooth on rack to engage wide tooth on sector (Fig. 9-62).
7. Install lock bolt spring and spring retaining screw. Tighten to 35 lb. in. torque (Fig. 9-59).

ASSEMBLE COLUMN

1. Install upper shift lever spring in bowl by winding up with pliers and pushing in.
2. Slide bowl into mast jacket.
3. Install wave washer and lock plate in place. Work lock plate into notches in jacket by tipping lock plate toward bowl hub and "12 o'clock" position and under jacket opening. Slide lock plate into notches in jacket.
4. Carefully install shift tube in lower end of mast jacket. Align keyway in tube with key in bowl and use tool J 23073 to pull shift tube into bowl (Fig. 9-63).

   CAUTION: *Do not push or tap on end of shift tube.*

5. Install thrust washer and retaining ring by pulling bowl up to compress wave washer.
6. Install support by aligning "V" in support with "V" notch in jacket. Insert screws through support and into lock plate. Tighten screws to 60 lb. in. torque.

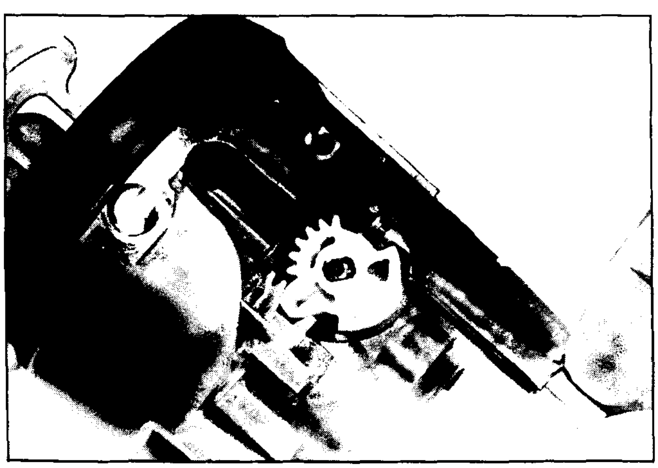


Fig. 9-62 Installing Lock Bolt to Sector

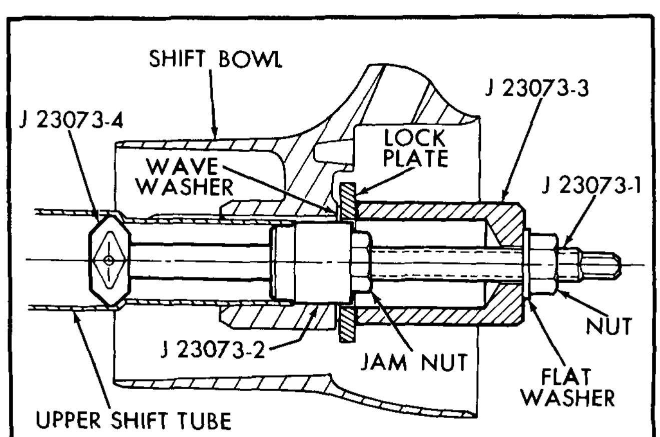


Fig. 9-63 Installation of Shift Tube Installer J 23073

7. Align lower bearing adapter notches in jacket and push in lower end of mast jacket. Shift tube should pilot in adapter while this is done. Install clip.

8. Install the back-up light or neutral-start switch loosely to the jacket assembly. This will be tightened to the jacket after installing column in car and adjustment of switch.

   CAUTION: *Use only the proper screws. Screws must not be longer than 1/4" or damage to the shift tube will occur.*

9. Install centering spheres and anti-lash spring in upper steering shaft. Install lower steering shaft from same side of spheres that spring ends protrude.

10. Install steering shaft assembly in shift tube from upper end. Carefully guide shaft through shift tube and bearing.

11. Install ignition switch actuator rod through bowl from bottom and insert in slot in support. Extend rack downward from bearing housing.

12. Install external tilt release lever and, holding lock shoes in disengaged position, assemble upper bearing housing over steering shaft, engage rack over end of actuator rod and line up the pivot pin holes (Fig. 9-64).

13. Install pivot pins.

14. Place housing in full "UP" position and install guide, tilt spring and tilt spring retainer using screwdriver in retainer slot. Turn retainer clockwise to engage (Fig. 9-54).

15. Install inner race, inner race seat on upper steering shaft.

16. Remove tilt release lever.

17. Install tilt lever opening shield in housing (Fig. 9-58).

Fig. 9-64 Installing Upper Bearing Housing - Tilt Column

18. Install housing cover and tighten three screws to 85 lb. in. torque.

19. Install tilt release lever.

20. Install buzzer switch, if removed (see BUZZER SWITCH - INSTALL, steps 1 through 3).

   CAUTION: *Buzzer switch should be installed BEFORE the lock cylinder. The reason for replacing in this order is to reduce the possibility of damage to the small plastic buzzer switch actuator protruding from the lock cylinder. The spring action of the buzzer switch holds this actuator up into the cylinder so that it will not catch on the column housing when the lock cylinder is installed.*

21. Install lock cylinder (see LOCK CYLINDER - INSTALL, steps 1 through 7).

22. Install the ignition switch by inserting the actuator rod into the slider hole and assemble to the column with two screws. Push the switch lightly down the column (away from the steering wheel), to take out lash in the actuator rod, and tighten attaching screws to 35 lb. in. torque.

   CAUTION: *Use only the correct screws.*

   NOTE: *Before installing switch, place the lock cylinder in "ACCESSORY" (full counterclockwise position) and position the ignition switch slider in "ACCESSORY" (see Section 12 for ignition switch adjustment).*

3. Position shift indicator assembly, if removed, to upper bearing housing and install retaining spring(s) on all models except B Series.

24. Install turn signal switch (see TURN SIGNAL SWITCH - INSTALL).

25. Install lower steering shaft with pot joint to steering column shaft. Tighten clamping nut or bolt to 30 lb. ft. torque (Figs. 9-36 and 9-37).

26. Reinstall column bracket with the four bolts previously removed. Do not use a different length bolt. Tighten bolts to 15 lb. ft. torque.

27. Install steering wheel (see STEERING WHEEL - INSTALL).

28. Install column in car (see STEERING COLUMN - INSTALL).

   CAUTION: *Make certain that column is never unsupported when either the toe plate, instrument panel mounting, or gear mounting is connected.*

29. Adjust back-up light or neutral-start switch (see Section 12 for adjustment procedure).

FLEXIBLE COUPLING

REMOVE

1. Remove flexible coupling flange attaching nuts and lock washers.
2. Remove steering gear mounting bolts and swing gear away from frame.
3. Remove flexible coupling clamping bolt and remove from steering gear stub shaft.

INSTALL

NOTE: *Metal-to-metal contact between flanges on stub shaft assembly and steering shaft assembly will transmit and amplify gear noise to the driver. (See FLEXIBLE COUPLING outlined at front of Section 9 and Fig. 9-6 for use of plastic alignment spacers).*

1. Install by reversing the above steps.

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in step 2.*

2. Tighten steering gear to frame bolts to 70 lb. ft. torque, flexible coupling clamping bolt to 35 lb. ft. torque and flexible coupling flange attaching nuts to 20 lb. ft. torque.

UNIVERSAL JOINT (POT JOINT) & LOWER STEERING SHAFT

NOTE: *The pot joint need only be disassembled if there is looseness or binding in the assembly (Figs. 9-36 and 9-37).*

DISASSEMBLE

1. Remove flexible coupling bolts, steering gear mounting bolts and swing gear away from frame.
2. Remove pot joint clamping bolt or nut and remove shaft assembly with joint from steering column shaft.
3. Scribe a mark on pot joint housing and lower steering shaft.
4. Remove wire retaining clip around inside of housing. Care must be taken not to cut rubber boot around lower shaft.
5. With slight pressure, pull on steering shaft; this will separate shaft from housing.
6. Remove bearing cups and clip from steering shaft.

NOTE: *If the rubber boot or cross shaft in lower steering shaft is damaged, do not attempt to remove these parts from the steering shaft. These parts are serviced with the lower steering shaft.*

ASSEMBLE

1. Assemble pot joint by reversing the above steps.

NOTE: *When assembling lower steering shaft into joint housing, be sure scribe marks are lined up. Also use care not to cut rubber boot when installing wire retaining clip.*

NOTE: *To provide proper lubrication of this assembly, coat all surfaces with lithium soap chassis grease. Do not over fill assembly with grease.*

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2 and 3.*

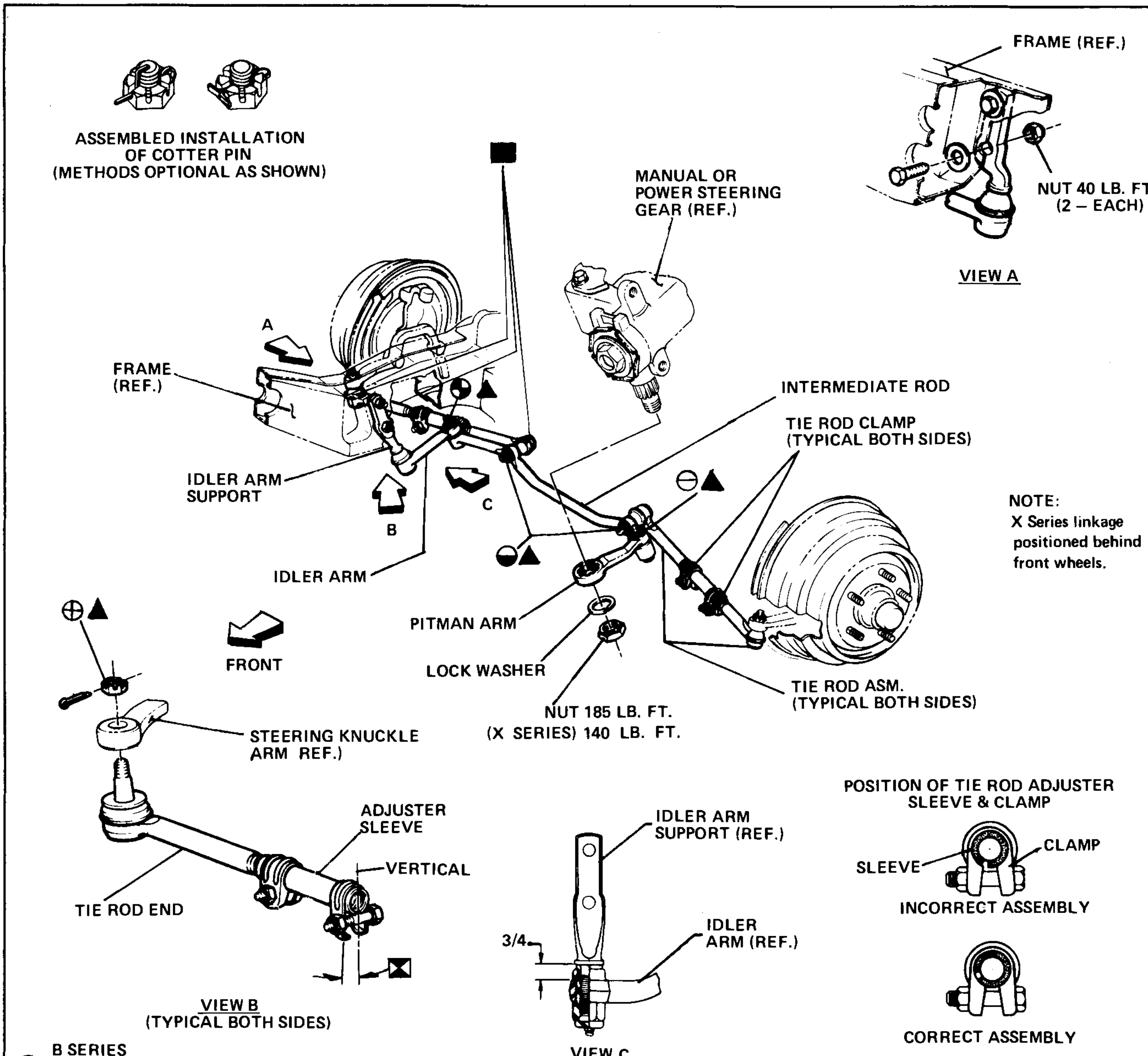
2. Install shaft assembly with joint onto steering column shaft. Tighten pot joint clamping bolt nut to 50 lb. ft. torque.
3. Install steering gear to frame and flexible coupling. Tighten steering gear to frame bolts to 70 lb. ft. torque and flexible coupling nuts to 20 lb. ft. torque.

NOTE: *Metal-to-metal contact between flanges on stub shaft assembly and steering shaft assembly will transmit and amplify gear noise to the driver. (See FLEXIBLE COUPLING outlined at front of Section 9 and Fig. 9-6 for use of plastic alignment spacers).*

STEERING LINKAGE

GENERAL INFORMATION

There are two tie rod assemblies used on all models. Each assembly is of three piece construction, consisting of a sleeve and two tie rod ends. The ends are threaded into the sleeve and locked with clamps. Right and left hand threads are provided to facilitate toe-in adjustment and steering gear centering (Fig. 9-65).



⊕ B SERIES
(70 lb. ft. max. to insert cotter pin) . . . . 30 lb. ft.
EXCEPT B SERIES
(50 lb. ft. max. to insert cotter pin) . . . . 30 lb. ft.

⊖ B & F SERIES
(55 lb. ft. max. to insert cotter pin) . . . . 40 lb. ft.
A & G SERIES
(45 lb. ft. max. to insert cotter pin) . . . . 30 lb. ft.
X SERIES
(Next notch 45 lb. ft. min.) . . . . 45 lb. ft.

◒ B & F SERIES
(85 lb. ft. max. to insert cotter pin) . . . . 50 lb. ft.
A & G SERIES
(55 lb. ft. max. to insert cotter pin) . . . . 30 lb. ft.
X SERIES
(50 lb. ft. max.) . . . . 30 lb. ft.

◕ B & F SERIES
(50 lb. ft. max. to insert cotter pin) . . . . 35 lb. ft.
A & G SERIES
(45 lb. ft. max. to insert cotter pin) . . . . 30 lb. ft.
X SERIES
(Next notch 45 lb. ft. min.) . . . . 45 lb. ft.

NOTE: SLOT IN TIE ROD ADJUSTER SLEEVE MAY BE IN ANY POSITION EXCEPT AT EDGES OF CLAMP JAWS.

◪ ASSEMBLE OPEN END TIE ROD CLAMPS FORWARD FROM A VERTICAL "DOWN" POSITION (EXCEPT X SERIES)
B & F SERIES . . . . 0° - 45°
A & G SERIES . . . . 0° - 15°

⧗ ASSEMBLE TIE ROD CLAMPS FORWARD OR REARWARD FROM A VERTICAL "UP" POSITION
X SERIES . . . . 0° - 30°

▲ Care should be taken to insure that hole, ball stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole to insert cotter pin. Do not back off nut.

■ When adjusting tie rod sleeve both inner & outer tie rod ends must rotate for full travel in the same direction. The position of each tie rod end must be maintained as the clamps are tightened to ensure free movement of each joint. (This procedure also applies to opposite side)

Fig. 9-65 Installation of Steering Linkage

The tie rod ends are self-adjusting for wear and require no attention in service other than periodic lubrication as outlined in Section 0 and occasional inspection to see that ball studs are tight. Replacement of tie rod ends should be made when excessive up and down motion is evident or if any lost motion or end play at ball end of stud exists.

Periodically inspect the complete steering linkage for damaged or worn components. Replace parts that are bent, cracked or broken and parts which are loose that cannot be tightened. Do not attempt to service parts which display these conditions by straightening or welding.

MAJOR SERVICE

TIE ROD END

REMOVE

1. Raise front of car.
2. Loosen tie rod adjuster sleeve clamp nuts.

   CAUTION: *Discard the nut and bolt of an adjuster sleeve clamp if rusted and after breakaway (nut starts to turn) the removal torque of the nut exceeds 7 lb. ft. (84 lb. in.). Install a new nut and bolt having the same part number to assure proper clamping at the specified nut torque.*

3. Remove tie rod stud nut cotter pin and nut.
4. Remove tie rod stud from steering arm or intermediate rod by prying on tie rod using a suitable pry bar and tapping sharply on arm or intermediate rod in area of stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 6627 can be used. Use care not to damage rubber seal around tie rod.*

5. Unthread tie rod end from adjuster sleeve.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2 and 3.*

1. Install by reversing the above steps.

   NOTE: *Check toe-in and adjust if necessary.*

2. If tie rod end was removed from steering arm, tighten tie rod stud nut at steering arm to 30 lb. ft. torque. Insert cotter pin.

   CAUTION: *Care should be taken to insure that steering arm hole, stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole in tie rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 70 lb. ft. on B Series or 50 lb. ft. on A, G, F and X Series.*

   b. If tie rod end was removed from intermediate rod, tighten tie rod stud nut at intermediate rod to 50 lb. ft. on B and F Series or to 30 lb. ft. on A, G and X Series. Insert cotter pin.

   CAUTION: *Care should be taken to insure that intermediate rod hole, stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align alot with hole in tie rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 85 lb. ft. on B and F Series or 55 lb. ft. on A and G Series or to 50 lb. ft. on X Series.*

3. Tighten tie rod adjuster sleeve clamp nuts to 20 lb. ft. torque on B, A, G and F Series or to 12 lb. ft. torque on X Series.

   CAUTION: *Before tightening, apply penetrating oil between each clamp and adjuster sleeve that is rusted. Rotate the clamps until they move freely. Open end of clamps should be 0°-45° forward from a vertical "down" position on B, A, G and F Series. Open end of clamps should be 0°-30° forward or rearward from a vertical "up" position on X Series.*

TIE ROD ADJUSTER SLEEVE

REMOVE

1. Raise front of car.
2. Loosen tie rod adjuster sleeve clamp nuts.

   CAUTION: *Discard the nut and bolt of an adjuster sleeve clamp if rusted and after breakaway (nut starts to turn) the removal torque of the nut exceeds 7 lb. ft. (84 lb. in.). Install a new nut and bolt having the same part number to assure proper clamping at the specified nut torque.*

3. Remove tie rod end stud nut cotter pin and nut.
4. Remove tie rod stud from steering arm by prying on tie rod using a suitable pry bar and tapping sharply on arm in area of stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 6627 can be* *used. Use care not to damge rubber seal around tie rod.*

5. Unthread tie rod end from adjuster sleeve.

6. Unthread adjuster sleeve from tie rod end still connected to intermediate rod.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2 and 3.*

1. Install by reversing the above steps.

NOTE: *Check toe-in and adjust if necessary.*

2. Tighten tie rod stud nut to 30 lb. ft. torque. Insert cotter pin.

CAUTION: *Care should be taken to insure that steering arm hole, stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole in tie rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 70 lb. ft. on B Series or 50 lb. ft. on A, G, F and X Series.*

3. Tighten tie rod adjuster sleeve clamp nuts to 20 lb. ft. torque. on B, A, G and F Series or to 12 lb. ft. torque on X Series.

CAUTION: *Before tightening, apply penetrating oil between each clamp and adjuster sleeve that is rusted. Rotate the clamps until they move freely. Open end of clamps should be 0°-45° forward from a vertical "down" position on B, A, G and F Series. Open end of clamps should be 0°-30° forward or rearward from a vertical "up" position on X Series.*

INTERMEDIATE ROD

REMOVE

1. Raise front of car.

2. Remove left and right side tie rod end stud nut cotter pins and nuts from intermediate rod.

3. Remove left and right side tie rod studs from intermediate rod by prying on tie rods using a suitable pry bar and tapping sharply on intermediate rod in area of studs.

NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 6627 can be used. Use care not to damage rubber seal around tie rod.*

4. Remove intermediate rod stud nut cotter pin and nut from idler and pitman arms.

5. Remove intermediate rod studs from idler and pitman arms by prying on intermediate rod using a suitable pry bar and tapping sharply on idler and pitman arms in area of studs.

NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 6627 can be used. Use care not to damage rubber seal around intermediate rod.*

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2, 3 and 4.*

1. Install by reversing the above steps.

2. Tighten intermediate rod stud nut at idler arm to 35 lb. ft. on B and F Series or to 30 lb. ft. on A and G Series or to 45 lb. ft. on X Series. Insert cotter pin.

CAUTION: *Care should be taken to insure that idler arm hole, stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole in intermediate rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 50 lb. ft. on B and F Series or 45 lb. ft. on A and G Series. Tighten to next slot on X Series.*

3. Tighten intermediate rod stud nut at pitman arm to 40 lb. ft. on B and F Series or to 30 lb. ft. on A and G Series or to 45 lb. ft. on X Series. Insert cotter pin.

CAUTION: *Care should be taken to insure that pitman arm hole, stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole in intermediate rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 55 lb. ft. on B and F Series or 45 lb. ft. on A and G Series. Tighten to next slot on X Series.*

4. Tighten left and right tie rod stud nuts at intermediate rod to 50 lb. ft. on B and F Series or to 30 lb. ft. on A, G and X Series. Insert cotter pin.

CAUTION: *Care should be taken to insure that intermediate rod hole, stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole in tie rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not the exceed 85 lb. ft. on B and F Series or 55 lb. ft. on A and G Series to 50 lb. ft. on X Series.*

PITMAN ARM

REMOVE

1. Raise front of car.
2. Remove intermediate rod stud nut cotter pin and nut from pitman arm.
3. Remove intermediate rod stud from pitman arm by prying on intermediate rod using a suitable pry bar and tapping sharply on pitman arm in area of stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 6627 can be used. Use care not to damage rubber seal around intermediate rod.*

4. Remove pitman arm nut and lock washer from pitman shaft.
5. Remove pitman arm from pitman shaft using tool J 5504.

   CAUTION: *Do not hammer on end of puller.*

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2 and 3.*

1. Install by reversing the above steps.
2. Tighten pitman shaft nut to 185 lb. ft. torque on B, A, G and F Series or to 140 lb. ft. torque on X Series.
3. Tighten intermediate rod stud nut to 40 lb. ft. on B and F Series or to 30 lb. ft. on A and G Series or to 45 lb. ft. on X Series. Insert cotter pin.

   CAUTION: *Care should be taken to insure that pitman arm hole, ball stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole in intermediate rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 55 lb. ft. on B and F Series or 45 lb. ft. on A and G Series. Tighten to next slot on X Series.*

IDLER ARM, SUPPORT, BUSHING AND SEAL

REMOVE

1. Raise front of car.
2. Remove intermediate rod stud nut cotter pin and nut from idler arm.
3. Remove intermediate rod stud from idler arm by prying on intermediate rod using a suitable pry bar and tapping sharply on arm in area of stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 6627 can be used. Use care not to damage rubber seal around intermediate rod.*

4. Remove two bolts attaching idler arm support to frame.
5. Unthread idler arm support from bushing nut.
6. Remove seal from idler arm support.
7. Unthread bushing nut from idler arm.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2 and 3.*

1. Install by reversing the above steps.
2. Tighten idler arm support to frame bolts to 40 lb. ft. torque.
3. Tighten intermediate rod stud nut to 35 lb. ft. on B and F Series or to 30 lb. ft. on A and G Series or to 45 lb. ft. on X Series. Insert cotter pin.

   CAUTION: *Care should be taken to insure that pitman arm hole, stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole in intermediate rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 50 lb. ft. on B and F Series or 45 lb. ft. on A and G Series. Tighten to next slot on X Series.*

STEERING KNUCKLE ARM (A, G & X SERIES)

REMOVE

1. Raise front of car.

2. Remove tie rod stud nut cotter pin and nut.

3. Remove tie rod stud from steering arm by prying on tie rod using a suitable pry bar and tapping sharply on arm in area of stud.

   NOTE: *Instead of using a pry bar, the PREFERRED METHOD using tool J 6627 can be used. Use care not to damage rubber seal around tie rod.*

4. Remove hub cap or wheel disc from wheel.

5. **Drum Brakes:** Remove dust cap from hub.

   Disc Brakes: Remove wheel and tire assembly before removing dust cap from hub.

6. **Drum Brakes:** Remove cotter pin, spindle nut and washer from spindle, then remove wheel with hub and drum assembly from spindle with a gentle rocking motion.

   CAUTION: *When hub and wheel assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.*

   NOTE: *In some cases it may be necessary to back off brake adjustment to remove hub and wheel assembly.*

   Disc Brakes: Remove brake caliper assembly before removing cotter pin, spindle nut and washer from spindle. Then remove hub and disc assembly from spindle.

   CAUTION: *When hub and disc assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.*

7. Remove two bolts attaching steering arm to steering knuckle.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2 and 3.*

1. Install by reversing the above steps.

2. Tighten steering knuckle to steering arm bolts to 80 lb. ft. torque.

3. Tighten tie rod stud nut to 30 lb. ft. torque. Insert cotter pin.

   CAUTION: *Care should be taken to insure that steering arm hole, stud and nut are free of dirt and grease before tightening nut. Turn nut in tightening direction only to align slot with hole in tie rod stud to insert cotter pin. DO NOT BACK OFF NUT. Maximum torque to align slot with hole not to exceed 70 lb. ft. on B Series or 50 lb. ft. on A, G, F and X Series.*

4. Adjust wheel bearings as outlined in Section 3 under ADJUSTMENT PROCEDURES.

STEERING GEAR

GENERAL INFORMATION

Manual steering is standard equipment on A Series, F Series except Trans Am and X Series. There is one manual ratio *28:1* gear used.

Power steering is standard equipment on B Series, G Series and F Series Trans Am. Power steering is optionally available on the other series and models. Variable ratios of *15:1-13:1* and *16:1-13:1* are utilized for all applications. F Series (Trans-Am & Formula) and B Series use the variable ratio of 15:1 on center and 13:1 at full turn. The variable ratio of 16:1 on center and 13:1 at full turn is used on all A Series, G Series F Series (except Trans-Am and Formula) and X Series.

STEERING GEAR

REMOVE

1. Disconnect pressure and return hose assemblies from housing on power steering equipped cars.

2. Raise front of car.

3. Disconnect pitman arm from pitman shaft, using tool J 5504.

   CAUTION: *Do not hammer on end of puller.*

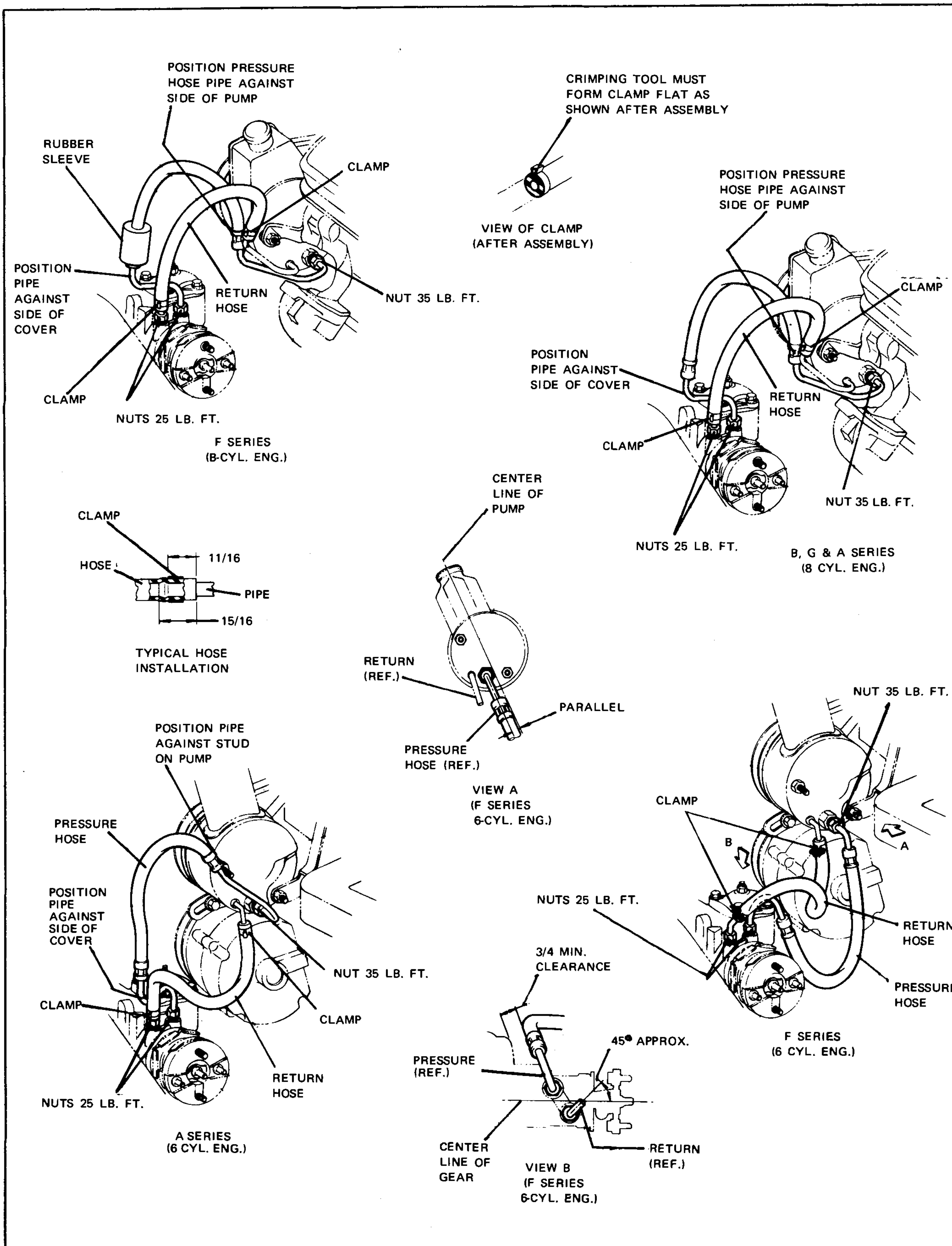


Fig. 9-66 Installation of Power Steering Hoses (Except X Series)

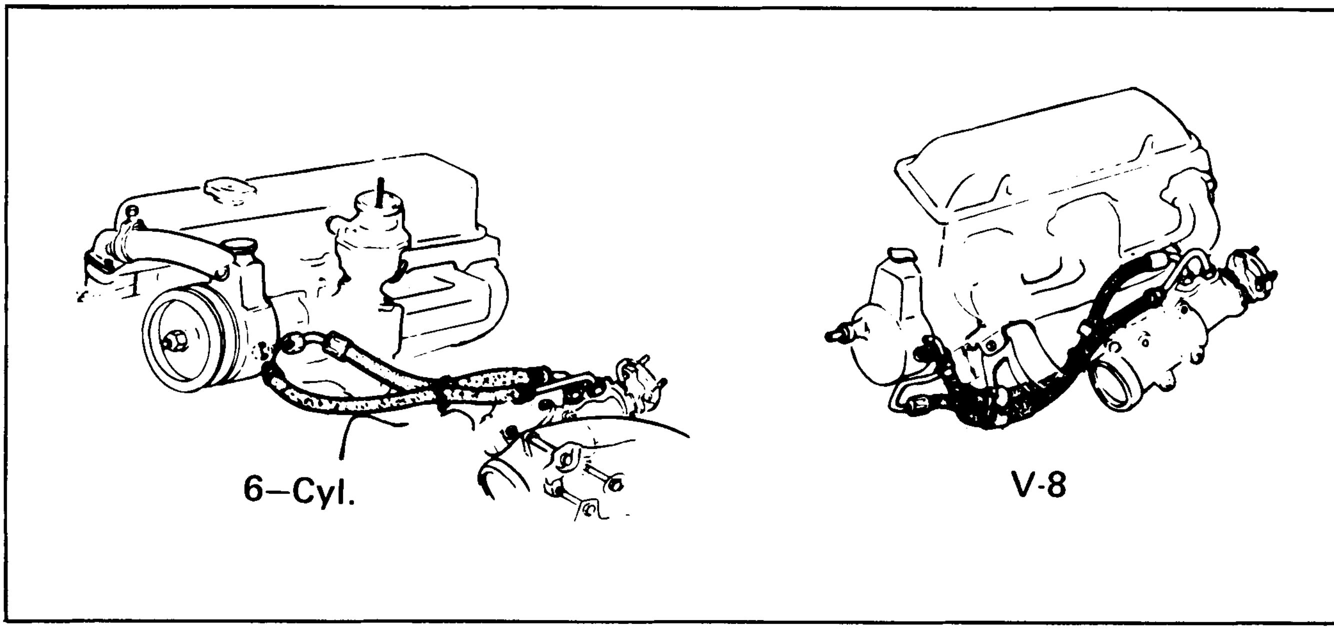


Fig. 9-67 Installation of Power Steering Hoses (X Series)

4. Remove flexible coupling flange attaching nuts and lock washers.

5. Remove gear housing to frame bolts.

NOTE: *On Pontiac models a brake hose bracket must be removed prior to removing frame bolts.*

6. Remove steering gear assembly.

INSTALL

CAUTION: *See CAUTION on page 1 of this Section regarding the fasteners referred to in steps 2, 3 and 5.*

1. Position steering gear assembly in car, aligning large head rivet in widest upper flange opening (Fig. 9-6).

NOTE: *Metal-to-metal contact between flanges on stub shaft assembly and steering shaft assembly will transmit and amplify gear noise to the driver. (See FLEXIBLE COUPLING outlined at front of Section 9 and Fig. 9-6 for use of plastic alignment spacers).*

2. Install steering housing to frame bolts finger-tight. Shift gear assembly to obtain best alignment with flange on steering shaft. Tighten housing to frame bolts to 70 lb. ft. torque.

3. Install pitman arm and secure with lock washer and nut. Tighten nut to 185 lb. ft. torque.

4. Connect pressure and return hose assemblies to gear assembly and tighten to 25 lb. ft. torque (Figs. 9-66 and 9-67).

5. Install flexible coupling flange attaching nuts and lock washers and tighten to 20 lb. ft. torque.

6. Be sure coupling pins are porperly positioned (Fig. 9-6). If pins are not positioned porperly, loosen flexible coupling at worn shaft and reposition or align steering column.

7. Check fluid level in pump reservoir on power steering equipped cars (see POWER STEERING PUMP DESCRIPTION). Add GM power steering fluid or equivalent as necessary. DO NOT use automatic transmission fluid, except in an emergency if power steering fluid is not available. With front wheels off floor, start engine and bleed hydraulic system by manually steering through cycle several times until there is no evidence of air bubbles in reservoir. Recheck fluid level and lower car.

MANUAL STEERING GEAR

GENERAL INFORMATION

Periodic service consists of lubrication as outlined in Section 0. Add lubricant by removing the center side cover bolt.

MAJOR SERVICE

ADJUSTMENT PROCEDURES (ON BENCH)

Correct adjustment of the steering gear is extremely important. Before any adjustments are made to the steering gear in an attempt to correct such conditions as shimmy, hard to loose steering and road shocks, a careful check should be made to determine that front end elignment, shock absorbers, wheel balance and tire pressure are correctly adjusted and/or operating satisfactorily.

There are two adjustments on the recirculating ball-type steering gear:

1. Worm bearing preload adjustment.
2. Overcenter or Pitman Shaft (Lash) Adjustment.

CAUTION: *It is very important that adjustments be made in above sequence to avoid steering gear damage.*

WORM BEARING PRELOAD

1. Tighten the adjuster plug until all end play has been removed and then loosen one-quarter turn.
2. Using an 11/16" 12-point socket and 25 pound inch torque wrench, carefully turn the wormshaft all the way to the right corner and then turn back about one-half turn.
3. Tighten the adjuster plug until the proper thrust bearing preload is obtained (5-8 lb. in.).
4. Tighten the adjuster plug locknut to 85 lb. ft. torque.

OVERCENTER OR PITMAN SHAFT (LASH)

1. Turn the wormshaft from one stop all the way to the other, counting the number of turns. Then turn the shaft back exactly half the number of turns to the center position.
2. Turn the pitman shaft lash adjuster screw clockwise to remove all lash between the ball nut and sector teeth. Tighten the locknut to 23 lb. ft. torque.
3. Again using the 11/16" 12-point socket and a 25 pound inch torque wrench, observe the highest reading while the gear is turned through center position. Reading should be 4-10 lb. in. in excess of worm bearing preload.

   NOTE: *Total worm bearing preload adjustment and pitman shaft adjustment should not exceed 16 lb. in.*

4. If necessary, readjust lash adjuster screw to obtain proper torque. Tighten the locknut to 23 lb. ft. torque and again check torque reading through center of travel.

DISASSEMBLY

As with any ball bearing unit the steering gear parts must be kept free of dirt (Fig. 9-68). Clean paper or rags should be spread on the workbench before starting disassembly of the steering gear.

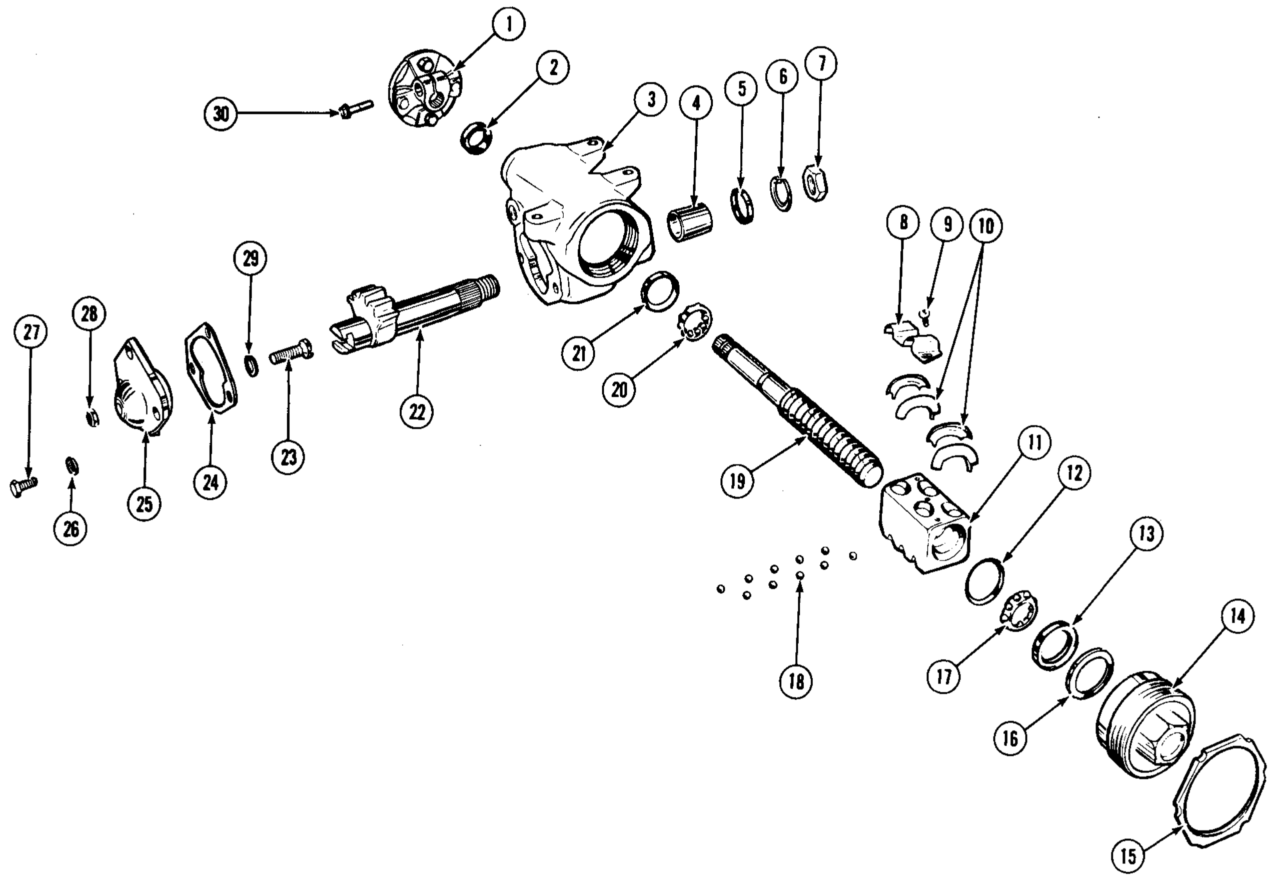
1. Place the steering gear in a vise, clamping onto one of the mounting tabs. The wormshaft should be in a horizontal position.
2. Rotate the wormshaft with flexible coupling from stop to stop, counting the total number of turns. Then turn back exactly halfway, placing the gear on center.
3. Remove the three self locking bolts attaching the side cover to the housing.
4. Tap lightly on the end of the pitman shaft with a pastic hammer and lift the side cover and pitman shaft assembly from the gear housing (Fig. 9-69).

   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. Scribe a mark on flexible coupling and worm shaft. Remove coupling form shaft.
6. Loosen worm bearing adjuster lock nut with brass drift.
7. Remove the adjuster plug assembly. This includes one wormshaft bearing and race.
8. Draw the wormshaft and ball nut assembly from housing (Fig. 9-70).

   CAUTION: *Use care that the ball nut does not run down to either end of the worm. Damage will be done to the ends of the ball guides if the nut is allowed to rotate until stopped at the end of the worm.*

9. Remove the remaining worm bearing from either the wormshaft or from inside the gear housing.
10. Where applicable use a suitable size screw driver to pry the lower bearing retainer from the adjuster plug housing and remove the bearing (Fig. 9-71).



1. COUPLING & LOWER FLANGE, Strg. Gear
2. SEAL, Strg. Shaft Oil
3. HOUSING ASM., Strg. Gear
4. BUSHING, Pitman Shaft
5. SEAL, Pitman Shaft
6. LOCKWASHER, Pitman Arm to Pitman Shaft (7/8")
7. NUT, Strg. Gear Pitman Arm (7/8"-14)
8. CLAMP, Worm Ball Return Guide
9. BOLT & WASHER ASM., Return Guide Clamp
10. GUIDE, Worm Ball Return
11. NUT, Steering Gear Worm Ball
12. RETAINER, Worm Thrust Adj. Lower Bearing
13. RACE, Strg. Gear Worm Thrust Bearing
14. ADJUSTER, Worm Thrust Bearing
15. NUT, Worm Bearing Adjusting
17. BEARING, Strg. Gear Thrust
18. BALL, Steering Gear Worm
19. SHAFT, Steering Gear (w/Balls & Nut)
20. BEARING, Strg. Gear Thrust
21. RACE, Strg. Gear Worm Thrust Bearing
22. SHAFT ASM., Pitman
23. SCREW, Lash Adjuster
24. GASKET, Housing Side Cover
25. COVER, Housing Side
26. LOCKWASHER, Cover to Housing (3/8")
27. BOLT, Cover to Housing (3/8"-16 × 3/4")
28. NUT, Sector Adjusting Screw (7/16"-20 Check)
29. SHIM, PKG., Lash Adjuster
30. BOLT, Shaft Flange to Shaft Clamping

Fig. 9-68 Exploded View of Manual Steering Gear

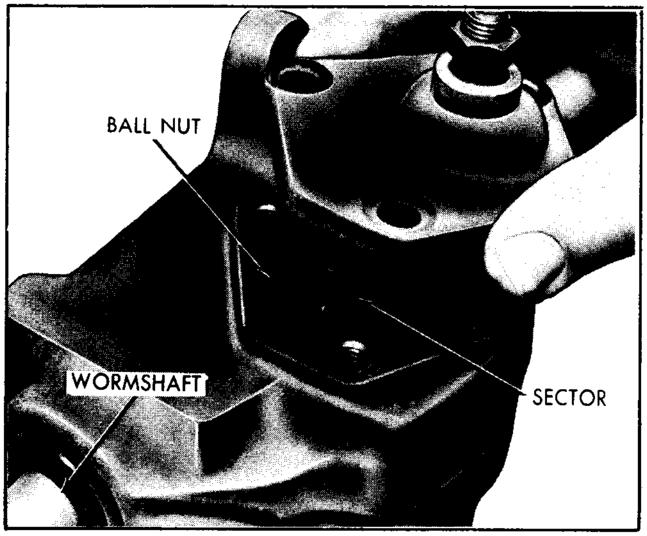


Fig. 9-69 Removing Pitman Shaft Assembly

11. Remove the locknut from the adjuster plug.

12. Remove the locknut from the pitman shaft lash adjuster screw in the side cover.

13. Remove the pitman shaft lash adjuster screw from the side cover by turning the screw clockwise.

14. Slide the adjuster screw and shim out of the slot in the end of the pitman shaft (Fig. 9-72).

15. Pry out and discard both the pitman shaft and wormshaft seals.

INSPECTION

1. With the steering gear completely disassembled, wash all parts in cleaning solvent. Dry them thoroughly with air.

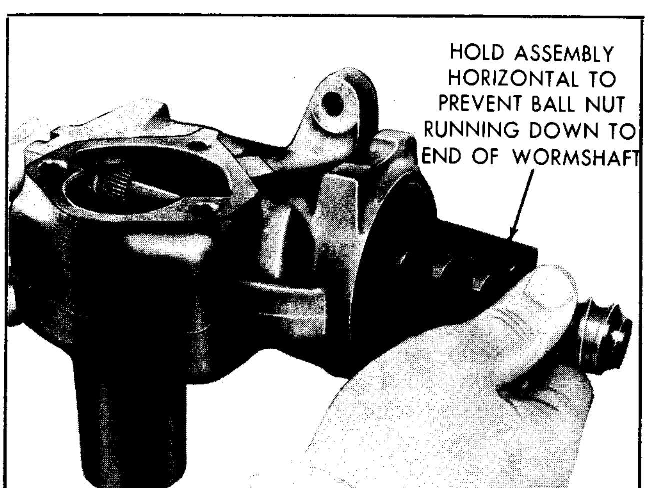


Fig. 9-70 Removing the Wormshaft and Ball Nut

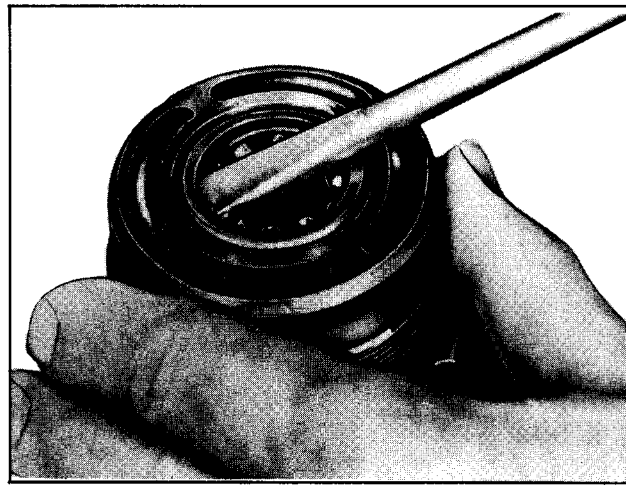


Fig. 9-71 Removing Lower Bearing Retainer from Adjuster Plug

2. 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.

3. Inspect all seals. Any seal that is worn or has been removed should be replaced.

4. Inspect the fit of the pitman shaft in its bushing in the side cover. If this bushing is worn, a new side cover and bushing assembly should be installed.

5. Check steering gear wormshaft assembly for being bent or damaged in any way.

NOTE: *Never attempt to salvage steering parts by welding or straightening.*

REPAIRS

PITMAN SHAFT AND WORMSHAFT SEALS

The double lipped pitman shaft and wormshaft seals should be replaced each time a defective seal is indicated or the steering gear is desassembled.

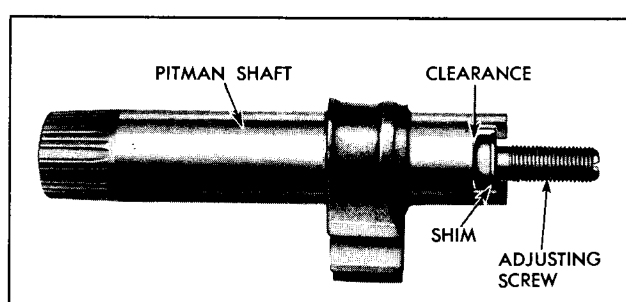


Fig. 9-72 Pitman Shaft and Adjusting Screw

REMOVE

Pry out the old seal using a suitable size screw driver.

CAUTION: *Before installing a new seal, check the condition of the pitman shaft bushing(s) and the wormshaft bearing race installed in the gear housing.*

INSTALL

A suitable size socket, pressing on the outer diameter of the seal, may be used to install a new seal(s). Make sure that socket is large enough to avoid injuring the external lip of the seal.

CAUTION: *Care should be taken to insure that the new seal is not assembled in a cocked position.*

PITMAN SHAFT BUSHING

REMOVE

Support the steering gear housing in an arbor press and press the pitman shaft bushing(s) from the housing using tool J 1614, inserted from the lower end of the housing (Fig. 9-73).

INSTALL

Press the new bushing(s) into position using tool J 1614. Position the bushings as shown in Figures 9-7 or 9-8.

NOTE: *Service bushings are diamond bored to size and require no further reaming.*

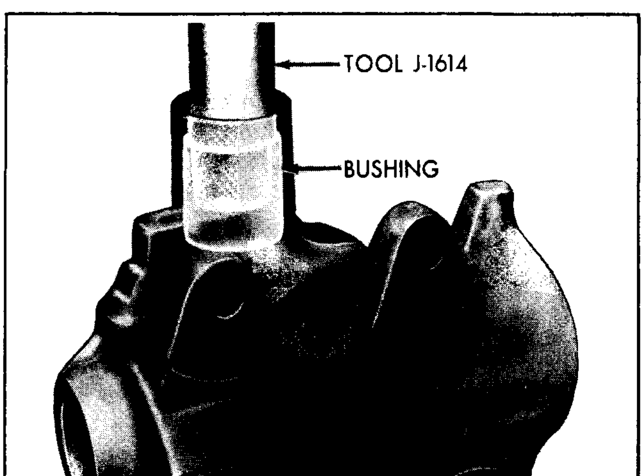


Fig. 9-73 Removing Pitman Shaft Bushing Using Tool J 1614

SIDE COVER BUSHING

The entire side cover assembly, including bushing, is serviced as a unit.

WORMSHAFT BEARING RACE ADJUSTER PLUG RACES

REMOVE

Remove the wormshaft bearing race with a slide hammer puller as shown in Figure 9-74.

INSTALL

Press the new bearing race into position using tool J 5755.

HOUSING RACES

REMOVE

Using a drift or punch, drive the bearing race out of the housing.

INSTALL

Press the new bearing race into position using tool J 5755 (Fig. 9-75).

BALL NUT

As a rule, disassembly of the ball bearing 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 indication of binding or tightness, the unit should be disassembled, cleaned and inspected as follows:

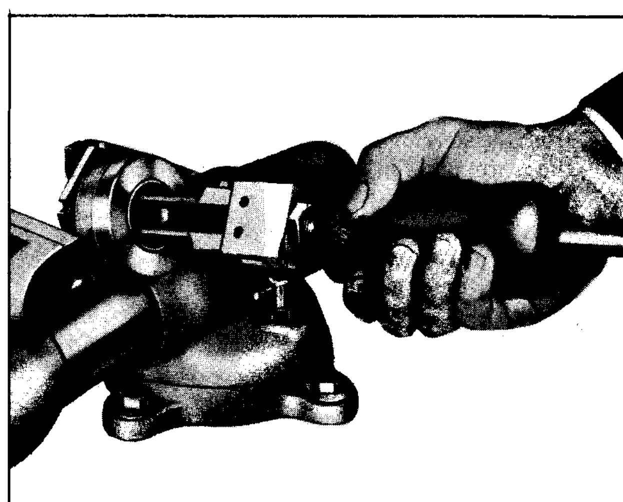


Fig. 9-74 Removing Adjuster Plug Bearing Race

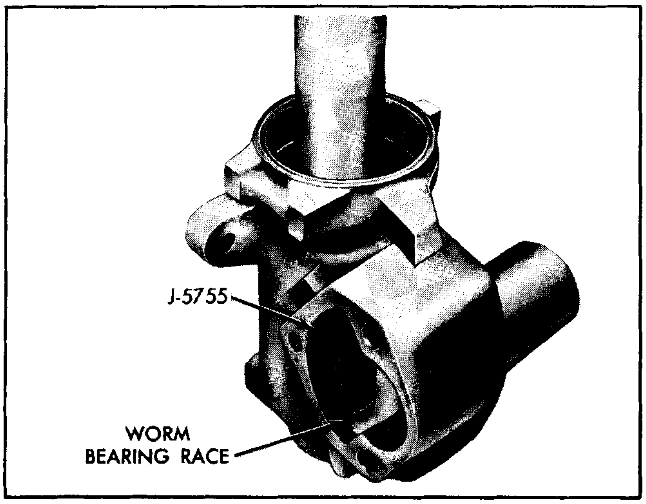


Fig. 9-75 Install Wormshaft Bearing Race in Housing Using Tool J 5755

DISASSEMBLE

1. Remove screws and clamp retaining the ball guides in nut. Draw guides out of nut.

2. Turn the nut upside down and rotate the wormshaft back and forth until all the balls have dropped out of the nut into a clean pan. With the balls removed, the nut can be pulled endwise off the worm.

3. Wash all parts in cleaning solvent and dry them thoroughly with air.

4. Using a magnifying glass inspect the worm and nut grooves and the surface of all balls for signs of indentation.

5. 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.

ASSEMBLE

1. Slip the 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 nut by sighting through the ball guide holes.

2. Place two ball guide halves together and insert them into the upper circuit in the ball nut.

3. Place the remaining two guides together and insert them in the lower circuit (Fig. 9-76).

4. Count 25 balls into a suitable container. This is the proper number of balls for one circuit.

5. Load the balls into one of the guide holes while turning the wormshaft gradually away from that hole.

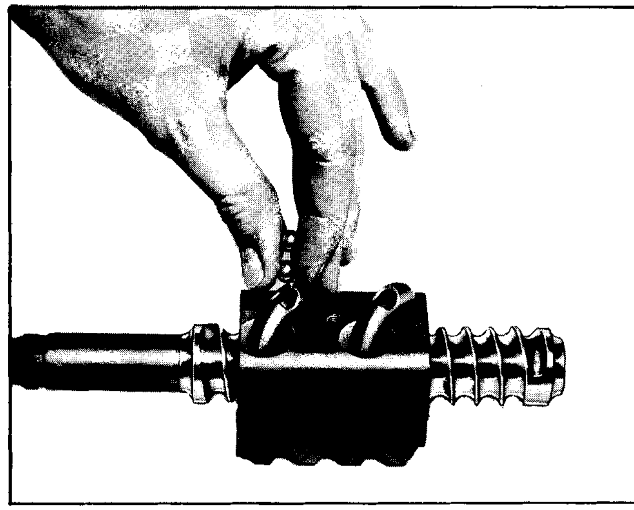


Fig. 9-76 Filling Ball Circuits

When all 25 of the balls have been installed, the circuit is complete.

6. Fill the remaining ball circuit in the same manner as described for the first circuit in steps 4 and 5 above.

7. Assemble the ball guide clamp to the ball nut and tighten the screws to 10 lb. ft. torque.

CAUTION: *Check the assembly by rotating the nut on the worm to see that it moves freely. Do not rotate the 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 nut, some slight damage to the ends of the ball guides or to other gear components may have been overlooked.*

STEERING GEAR

ASSEMBLE

NOTE: *After a major service 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. 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 (Part No. 1051052 or equivalent) meeting GM Specification GM 4673-M to the wormshaft bearings, pitman shaft bushings, and side cover bushing.*

1. Place the steering gear housing in a vise with the wormshaft bore horizontal and the side cover opening up.

2. With the pitman shaft and wormshaft 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 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 cup and press the stamped retainer into place with a suitable socket.

5. Install the adjuster 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 screw (with shim) in the slotted end of the pitman shaft. Check the end clearance, which should not be greater than .002" (Fig. 9-77). 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 (Part No. 1051052 or equivalent) meeting GM Specification GM 4673-M. 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 about in the center of travel.

   NOTE: *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.

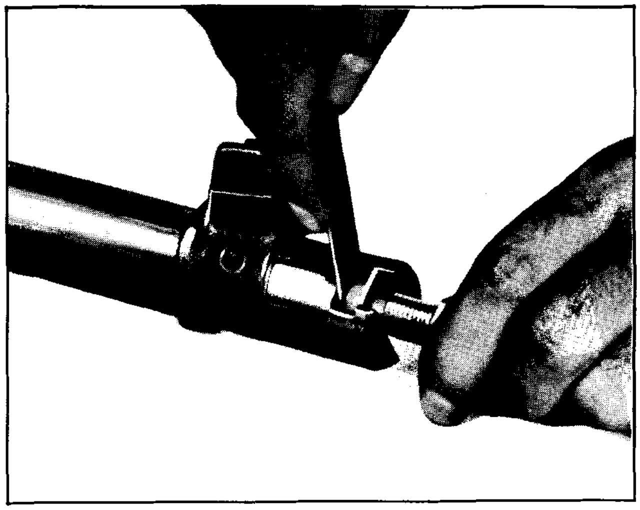


Fig. 9-77 Checking Lash Adjuster End Clearance

10. Pack the remaining portion of lubricant into the housing, and place a quantity in the side cover bushing hole.

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 screw driver 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 35 lb. ft. torque.

14. Adjust steering gear as outlined under ADJUSTMENT PROCEDURES (ON BENCH).

    CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 15.*

15. Install flexible coupling on worm shaft and tighten clamping bolt or nut to 35 lb. ft. torque. Be sure the scribe marks are aligned.

POWER STEERING

GENERAL INFORMATION

Since the steering gear is constantly lubricated, it is only necessary to periodically check the fluid level in the pump reservoir (see POWER STEERING PUMP DESCRIPTION). See SPECIFICATIONS at end of this section for system capacity.

MINOR SERVICE

PITMAN SHAFT SEAL (WITH 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 vehicle as follows:*

REMOVE

1. Remove pitman nut and lock washer.
2. Disconnect pitman arm from pitman shaft using puller J 5504.

   CAUTION: *Do not hammer on end of puller.*

3. 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.*

4. Remove pitman shaft seal retaining ring with snap ring pliers J 4245.
5. 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 eleminates the possibility of scoring the housing while attempting to pry seals out. If pressure of oil does not remove seals, turn off engine and remove seals in normal manner being careful not to score seal bore in housing.*

6. Inspect seals for damage to rubber covering on outside diameter (O.D.). If O.D. appears scored, inspect housing for burrs and remove before attempting new seal installation.
7. Clean the end of housing thoroughly so that dirt will not enter housing with the installation of the new seals.

INSTALL

1. Lubricate the seals thoroughly with power steering fluid to install seals with J 6219 (Fig. 9-78).
2. Install the inner single lip seal, then a back-up washer.

   NOTE: *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.*

3. Install the outer double lip seal and the second back-up washer in only far enough to provide clearance for the retaining ring.

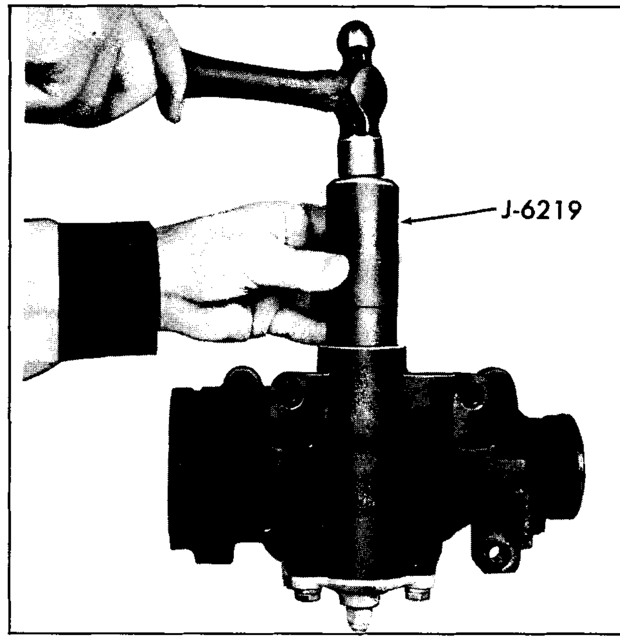


Fig. 9-78 Installing Pitman Shaft Seals Using Tool J 6219

4. Install retaining ring.
5. Fill pump reservoir to proper level with power steering fluid (see POWER STEERING PUMP DESCRIPTION).
6. Start engine and allow engine to idle for at least three minutes without turning steering wheel.
7. Turn wheel to left and check for leaks.

   CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 8.*

8. Remove tape and reconnect pitman arm. Tighten pitman arm nut to 185 lb. ft. torque.

MAJOR SERVICE

ADJUSTMENT PROCEDURES (ON BENCH)

Adjustment of the steering gear in the vehicle is discouraged 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 (pitman shaft lash) adjustment, it is necessary that the steering gear assembly be removed from the vehicle and both thrust bearing and over-center preload be checked and corrected as necessary. An in-vehicle check of the steering gear will not pin-point a thrust bearing adjustment error.

INITIAL CHECKS

1. Remove gear from vehicle (see STEERING GEAR - REMOVE).
2. Drain oil from gear by rotating through its travel several times.
3. Check gear adjustment torque as removed from car as follows:
   a. One-half turn off right and left stops.
   b. One-half turn off center-right and left.
   c. Over center (rotate through an arc 180 degress each side of center) - right and left.

WORM THRUST BEARING ADJUSTMENT

1. Loosen pitman shaft (lash) adjuster screw lock nut.
2. Back off pitman shaft lash adjuster screw 1-1/2 turns and retighten lock nut.
3. Loosen thrust bearing adjuster plug lock nut.

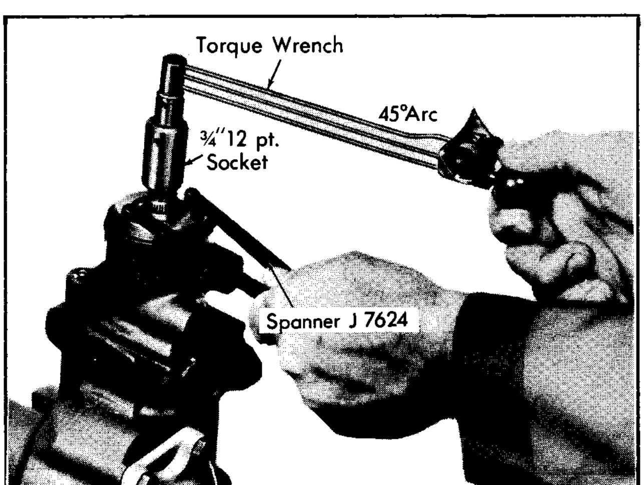


Fig. 9-79 Adjusting Thrust Bearing Preload

4. Back off thrust bearing adjuster plug 1/2 turn and retighten lock nut.
5. Turn gear stub shaft to right stop and then back 1/2 turn.
6. Using a 25 pound inch torque wrench on gear stub shaft, measure drag torque.
7. Tighten adjuster plug until torque to turn stub shaft is 3 to 4 lb. in. greater than drag torque (with lock nut tightened). See Fig. 9-79.

NOTE: *Preload torque tends to drop off when the lock nut is tightened. Therefore, torque reading must be taken with the lock nut tight.*

PITMAN SHAFT (LASH) OVER-CENTER ADJUSTMENT

1. With gear on center, loosen pitman shaft (lash) adjuster screw lock nut and tighten pitman shaft lash adjuster screw. Retighten lock nut (holding lash adjuster screw to keep it from turning) and measure gear over-center torque at stub shaft. When checking over-center torque, torque wrench should be rotated through a 180 degree arc either side of center and readings taken going over-center. Continue adjusting lash adjuster screw and checking over-center torque (with lock nut tightened) until correct over-center torque is obtained. See Fig. 9-80. Limits for new and old gears are different, as follows:
   a. **New Gear:** Over-center torque to be 4-8 lb. in. additional torque, but total over-center torque must not exceed 18 lb. in.

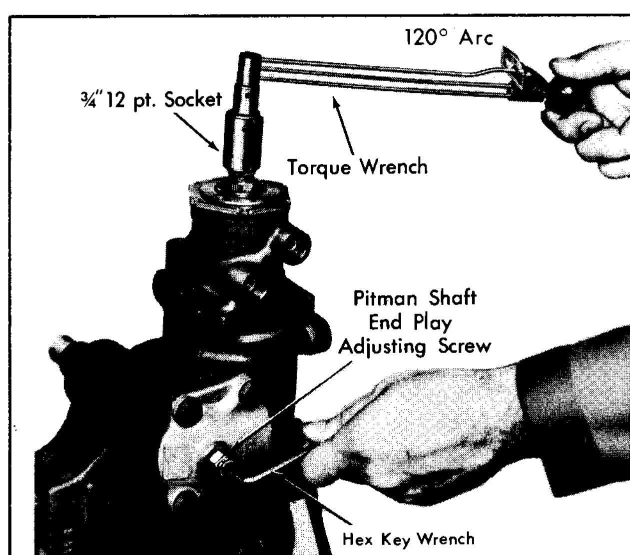


Fig. 9-80 Pitman Shaft Over-Center Adjustment

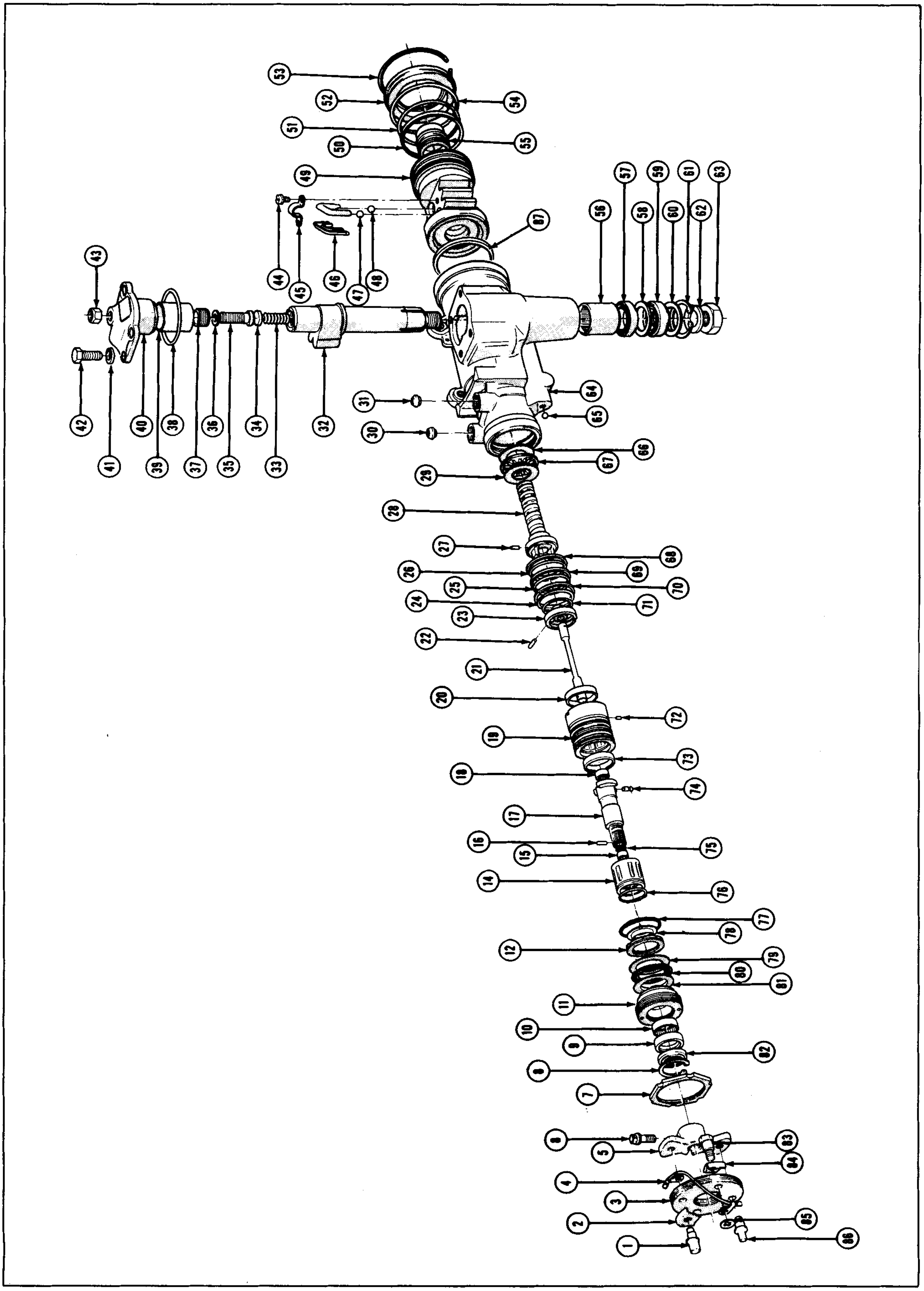


Fig. 9-81 Exploded View of Power Steering Gear Assembly

1. RIVET, Steering Shaft Coupling (Large)
2. REINFORCEMENT, Steering Gear Coupling
3. COUPLING, Steering Shaft Flange
4. CABLE ASM., Horn Ground Strip
5. FLANGE, Steering Gear Shaft Lower
6. BOLT, Steering Gear Flange to Shaft Coupling
7. NUT, Strg. Gear Worm Bearing Adjusting
8. RING, End Plug Oil Seal Retaining
9. SEAL, End Plug Stub Shaft Oil
10. BEARING, Steering Gear Housing End Cover
11. PLUG, Housing Upper End Adjuster
12. SPACER, Thrust Bearing
14. SPOOL, Valve
15. SLEEVE, Torsion Bar
16. PIN, Torsion Bar
17. SHAFT, Stub
18. BEARING, Torsion Bar
19. BODY, Valve
20. SLEEVE, Valve Body
21. BAR, Torsion
22. PIN, Cap to Torsion Bar
23. CAP, Valve Body
24. SEAL, Valve Asm. Oil Ring Back-Up "O" Ring
25. SEAL, Valve Asm. Oil Ring Back-Up "O" Ring
26. SEAL, Valve Asm. Oil Ring Back-Up "O" Ring
27. PIN, Valve Body Drive
28. WORM, Steering
29. RACE, Lower Thrust Bearing
30. CONNECTOR, Hose Fitting to Hsg. (1/4" I.D. × 17/32" O.D.)
31. CONNECTOR, Hose Fitting to Hsg. (9/32" I.D. × 39/64" O.D.)
32. GEAR, Pitman Shaft
33. SPRING, Lash Adjuster
34. WASHER, Lash Adjuster Spring
35. ADJUSTER, Lash
36. WASHER, Lash Adjuster Thrust
37. RETAINER, Lash Adjuster
38. SEAL, Side Cover to Housing "O" Ring
39. BUSHING, Housing Side Cover
40. COVER, Housing Side
41. LOCKWASHER, Cover to Housing (3/8" med.)
42. BOLT, Cover to Housing (3/8"-16 × 1)
43. NUT, Pitman Shaft Gear Lash Adjuster
44. SCREW & LOCKWASHER ASM., Clamp to Rack (1/4"-28 × 5/16").
45. CLAMP, Strg. Gear Ball Return Guide
46. GUIDE, Strg. Gear Ball Return
47. BALL PKG., Recirculating (Bright Finish) (Selective)
48. BALL PKG., Recirculating (Black Finish) (Selective)
49. RACK, Piston
50. RING, Strg. Gear Power Cylinder Piston
51. SEAL, Piston Ring Back-Up "O" Ring
52. COVER, Steering Gear Lower End
53. RING, Lower End Plug Retainer
54. SEAL, Steering Gear End Cover "O" Ring
55. PLUG, Rack Piston End
56. BEARING ASM., Pitman Shaft Needle
57. SEAL, Strg. Gear Pitman Shaft Oil
58. WASHER, Pitman Shaft Seal Back-Up
59. SEAL, Strg. Gear Pitman Shaft Oil - Double Lip
60. WASHER, Pitman Shaft Seal Back-Up
61. RING, Pitman Shaft Seal Retaining
62. LOCKWASHER, Pitman Arm (7/8")
63. NUT, Steering Gear Pitman Arm (7/8"-14)
64. HOUSING, Steering Gear
65. BALL, Oil Passage Plug (5/16" dia.)
66. RACE, Lower Thrust Bearing
67. BEARING, Lower Thrust
68. RING, Valve Asm. to Housing
69. RING, Valve Asm. to Housing
70. RING, Valve Asm. to Housing
71. SEAL, Torsion Bar Cap to Worm "O" Ring
72. PIN, Valve Body to Cap
73. SLEEVE, Valve Body
74. PIN, Spool Drive
75. SEAL, Torsion Bar to Stud Shaft "O" Ring
76. "O" RING, Strg. Gear Valve Spool Dampener
77. SEAL, Adjusting Plug to Housing "O" Ring
78. RETAINER, Upper Thrust Bearing
79. RACE, Upper Thrust Bearing - Lower
80. BEARING, Valve Asm., Upper Thrust
81. RACE, Upper Thrust Bearing - Upper
82. BEARING, Stud Shaft Needle
83. BOLT, Strg. Shaft Coupling to Upper Flange
84. REINFORCEMENT, Steering Gear Coupling
85. WASHER, Strg. Gear Shaft Flange Bolt
86. RIVET, Steering Shaft Coupling (Small)
87. SPACER, Snap Ring

Fig. 9-81 Exploded View of Power Steering Gear Assembly

b. **Used Gear (400 or more miles):** Over-center torque to be 4-5 lb. in. additional torque, but total over-center torque must not exceed 14 lb. in.

2. Record total over-center torque. This consists of over-center, thrust bearing, and drag torque.

STEERING GEAR OVERHAUL OPERATIONS

The following procedure outlines the disassembly of the gear, overhaul of the individual components, and assembly of the gear. Disassembly of the major components within the gear must be performed on a clean work bench. The work area, tools, and parts must be kept clean at all times. Refer to Figs. 9-10 and 9-81 for parts nomenclature and location.

GEAR DISASSEMBLY

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. 9-82).

2. Turn the flexible coupling flange counter-clockwise until the rack-piston just forces end cover out of housing. Remove cover and discard "O" ring.

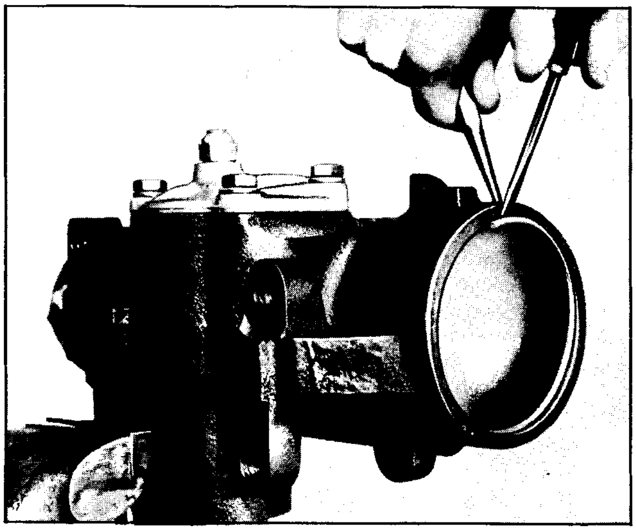


Fig. 9-82 Removing End Cover Retaining Ring

CAUTION: *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. 9-83.

NOTE: *To aid in loosening end plug, tap end plug with a brass drift.*

4. Remove the pitman shaft and side cover as follows:

a. Loosen the pitman shaft (lash) over-center adjusting screw locknut and remove the 4 side cover attaching bolts and lock washers.

b. Rotate the side cover until the rack-piston and pitman shaft teeth are visible.

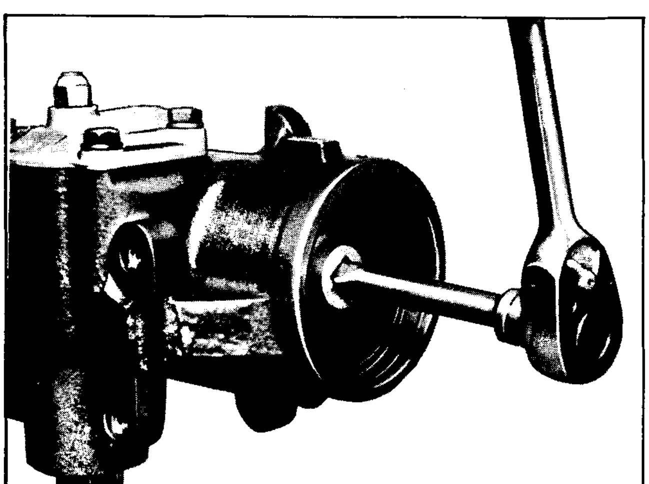


Fig. 9-83 Removing Rack-Piston End Plug

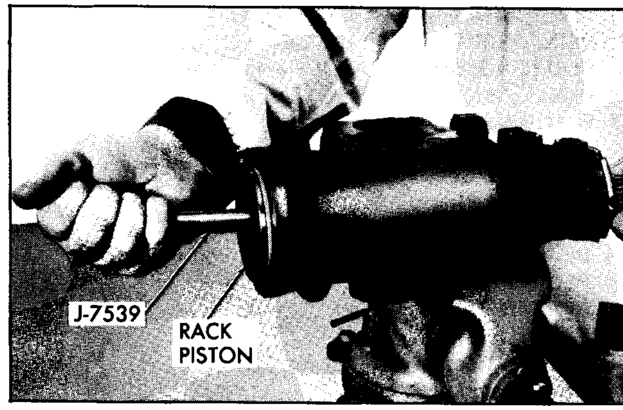


Fig. 9-84 Removing Rack-Piston

c. Turn the flexible coupling flange until the pitman shaft teeth are centered in the housing opening.

d. Tap the pitman shaft with a soft hammer and remove the pitman shaft and side cover from the housing.

e. Remove the side cover "O" ring and discard.

5. Remove the rack-piston as follows:

a. Insert ball retainer tool J 7539 into the rack-piston bore with pilot of tool seated in the end of the worm (Fig. 9-84).

b. Turn stub shaft counter-clockwise while holding tool tightly against worm. The rack-piston will be forced onto the tool.

c. Remove the rack-piston with ball retainer tool J 7539 from gear housing.

6. Remove the adjuster plug as follows:

a. Loosen the adjuster plug locknut and remove.

b. Remove adjuster plug assembly with spanner J 7624 (Fig. 9-85).

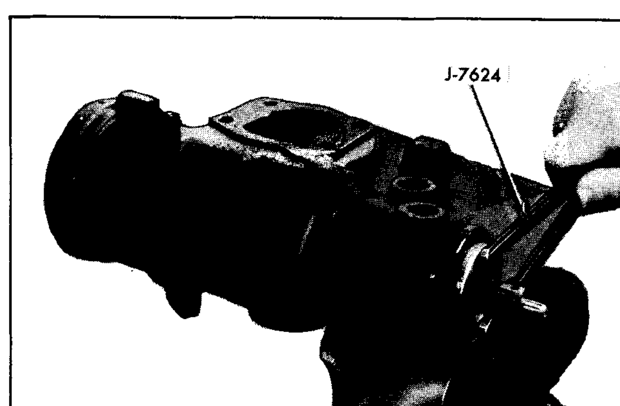


Fig. 9-85 Removing Adjuster Plug

c. Remove and discard the plug "O" ring.

7. Grasp the lower shaft and pull the valve and shaft assembly from the housing bore.

8. Separate worm and shaft and remove the lower shaft cap "O" ring and discard.

9. If the worm or the lower thrust bearing and race remained in the gear housing, remove them at this time.

OVERHAULING INDIVIDUAL UNITS

ADJUSTER PLUG ASSEMBLY

DISASSEMBLY

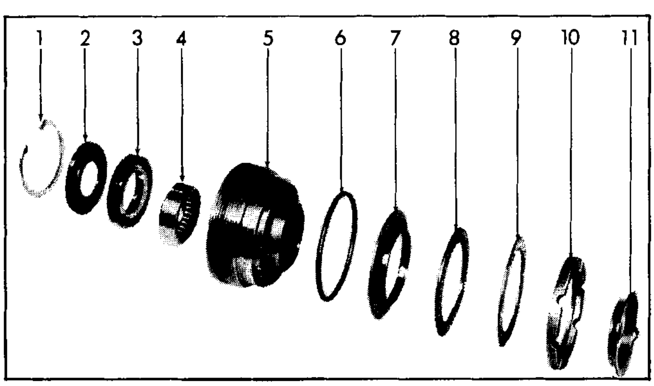
1. If the oil seal ONLY is to be replaced, and not the bearing, proceed as follows:

   a. Install the adjuster plug loosely in the gear housing.

   b. Remove the retaining ring with internal pliers J 4245.

   c. With a screw driver, pry the dust seal and oil seal from the bore of the adjuster plug being careful not to score the needle bearing bore (Fig. 9-86).

   d. Discard the oil seal.



1. RETAINING RING
2. DUST SEAL
3. OIL SEAL
4. NEEDLE BEARING
5. ADJUSTER PLUG
6. "O" RING
7. THRUST WASHER (Large)
8. THRUST BEARING
9. THRUST WASHER (Small)
10. SPACER
11. RETAINER

Fig. 9-86 Exploded View of Adjuster Plug

2. If the thrust bearing ONLY is to be removed, proceed as follows:

   a. Pry the thrust bearing retainer at the two raised areas with a small screw driver (Fig. 9-87).

   b. Remove the spacer, thrust bearing washer, thrust bearing and washer.

   c. Discard the retainer.

3. If the needle bearing is to be replaced, proceed as follows:

   a. Remove the retaining ring using internal pliers J 4245.

   b. Remove thrust bearing as outlined in Step 2 above.

   c. Drive needle bearing, dust seal and oil seal from adjuster plug using bearing remove J 8524-2 and driver J 7079-2 as shown in Fig. 9-88.

   d. Discard the oil seal.

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 washers for wear, putting or scoring. If any of these conditions exist, replace the bearing and washers.

ASSEMBLY

1. If the needle bearing was removed, place new needle bearing over tools J 8524-1 and J 7079-2, with the

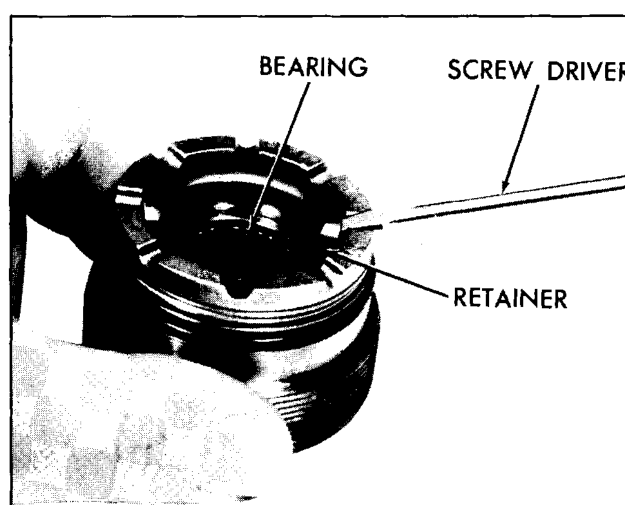


Fig. 9-87 Removing Retainer

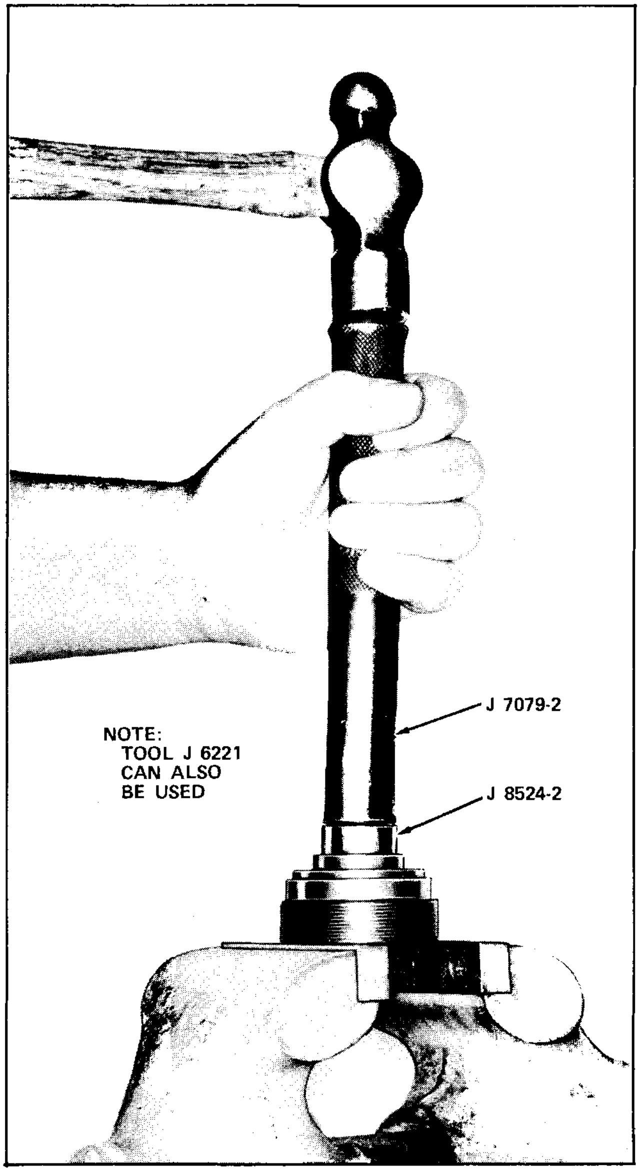


Fig. 9-88 Removing Bearing and Seal

bearing manufacturer's identification against the tool, and drive the bearing into the adjuster plug until the tool bottoms in the housing (Fig. 9-89).

CAUTION: *Place a block of wood under the adjuster plug to protect the thrust bearing surface.*

2. Temporarily install the adjuster plug in the gear housing and place dust seal and a new oil seal on tool J 8524-1 (lip of seal away from tool). Lubricate seal with power steering fluid and drive or press seals into adjuster plug until seated (Fig. 9-90).

3. Install retaining ring with internal pliers J 4245. Then remove the adjuster plug from the housing.

4. Lubricate the thrust bearing assembly with power steering fluid.

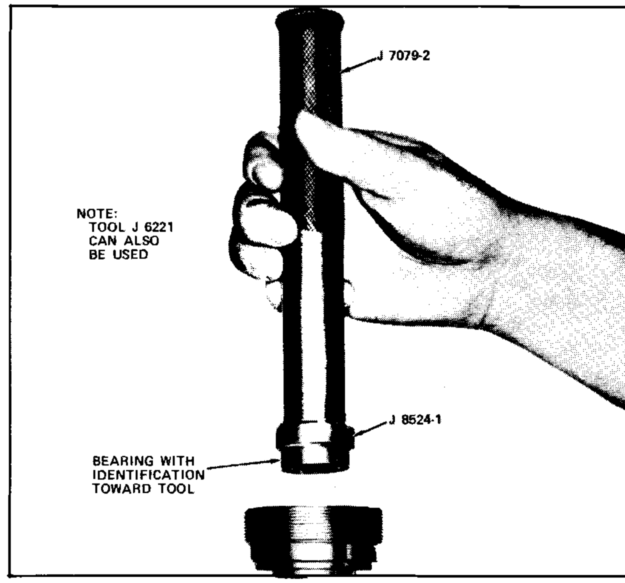


Fig. 9-89 Installing Bearing

5. Place the large thrust bearing washer on the adjuster plug hub then install the upper thrust bearing, small bearing washer and spacer (grooves of spacer away from bearing washer).

6. Install a new bearing retainer on the adjuster plug by carefully tapping on the flat surface of the retainer (Fig. 9-91).

CAUTION: *The projections must not extend beyond the spacer when the retainer is seated. The spacer must be free to rotate.*

VALVE AND LOWER SHAFT ASSEMBLY

DISASSEMBLY

1. Remove and discard the "O" ring in the shaft cap end of the valve assembly.

2. To remove the lower shaft assembly from the valve body, proceed as follows:

   a. While holding the assembly (lower shaft down), lightly tap the stub shaft against the bench until the shaft cap is free from the valve body (Fig. 9-92).

   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.*

   c. Carefully disengage the shaft pin from the valve spool and remove the shaft assembly (Fig. 9-92).

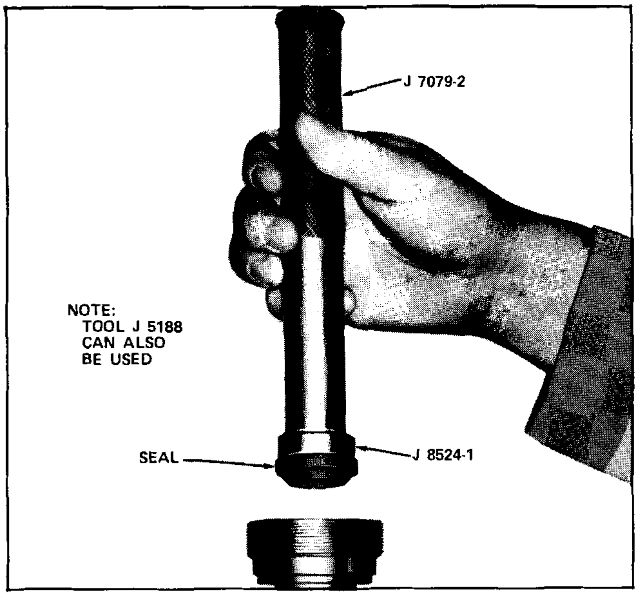


Fig. 9-90 Installing Adjuster Plug Seal

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. 9-93). 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 plastic oil rings are to be replaced, cut the 3 plastic oil rings and "O" rings from the valve body and discard.

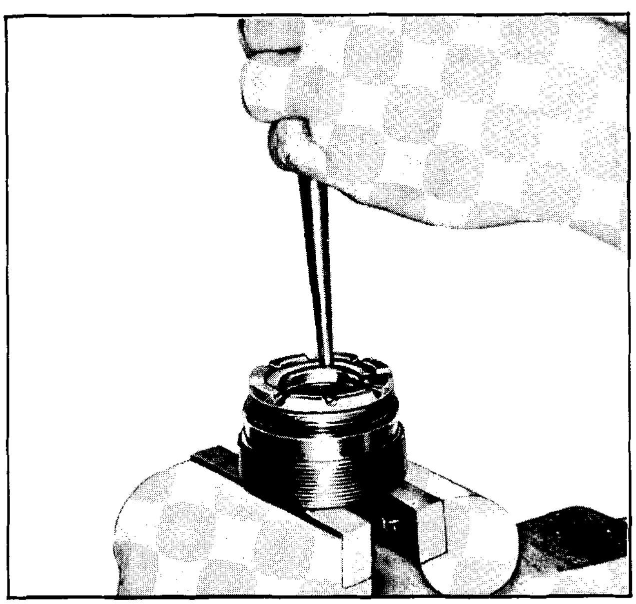


Fig. 9-91 Installing Retainer

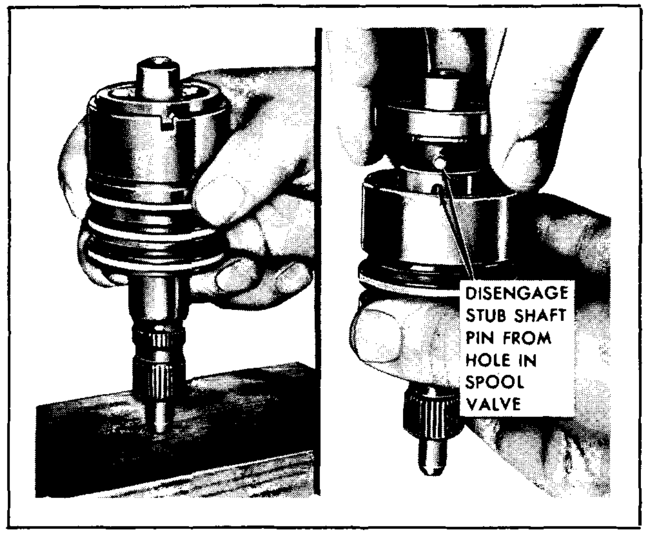


Fig. 9-92 Removing Stub Shaft Assembly

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 lower shaft or valve body is cracked, excessively worn or broken, replace the complete valve and shaft assembly.

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 sub shaft that cannot be cleaned up with crocus cloth, the entire valve and shaft 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 weat 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 and shaft assembly will have to be replaced.

6. Lubricate the spool valve with power steering fluid and check the fit of the spool valve in the valve body (with the spool valve dampener "O" ring removed).. If the 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 plastic rings were removed, install new "O" rings in the oil ring grooves and lubricate with power steering fluid (Fig. 9-94).

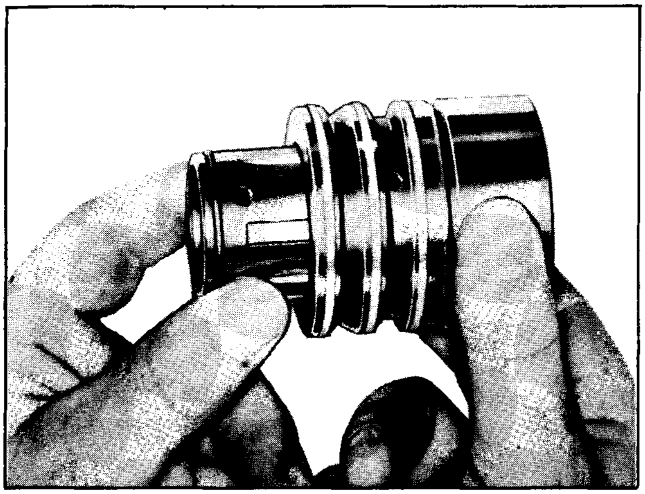


Fig. 9-93 Removing Spool Valve

2. Lubricate the 3 new plastic oil rings with power steering fluid and install in grooves over "O" rings.

   NOTE: *The plastic 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 and install over the spool valve.

4. a. Lubricate the spool valve and valve body with power steering fluid and slide the spool valve into the valve body.

   b. Rotate the spool valve while pushing it into the valve body.

   c. Push the spool valve on through the valve body until the shaft pin hole is visible from the opposite end (spool valve flush with shaft cap end of valve body).

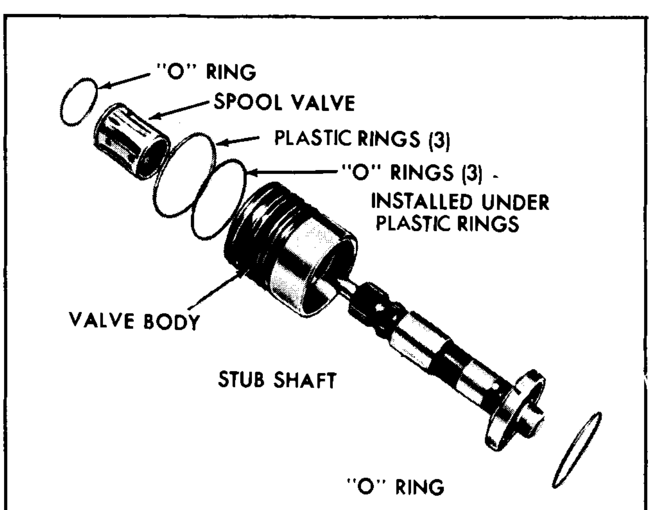


Fig. 9-94 Exploded View of Valve Body and Shaft Assembly

5. Lubricate the shaft assembly with power steering fluid and carefully install it into the spool valve until the shaft pin can be placed into the hole in 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. 9-95).

   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 "O" ring with power steering fluid and install it in the shaft cap end of the valve body assembly.

PITMAN SHAFT AND SIDE COVER

DISASSEMBLY

Remove the pitman shaft (lash) adjuster screw 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 parts with compressed air.

2. Check pitman shaft bearing surface in the side cover for scoring. If badly worn or scored, replace the side cover.

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.

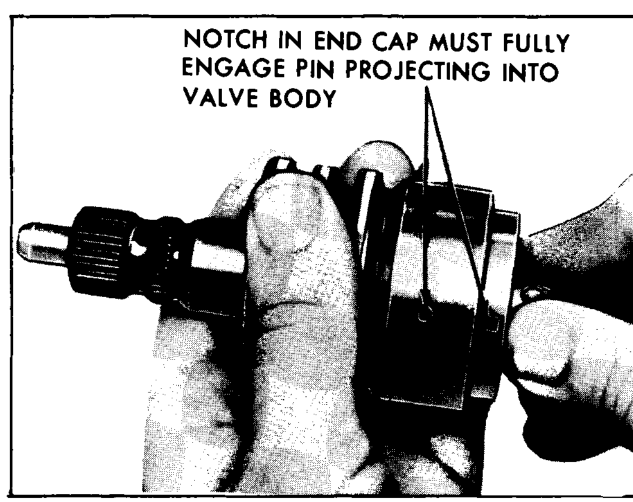


Fig. 9-95 Installing Stub Shaft Assembly

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.

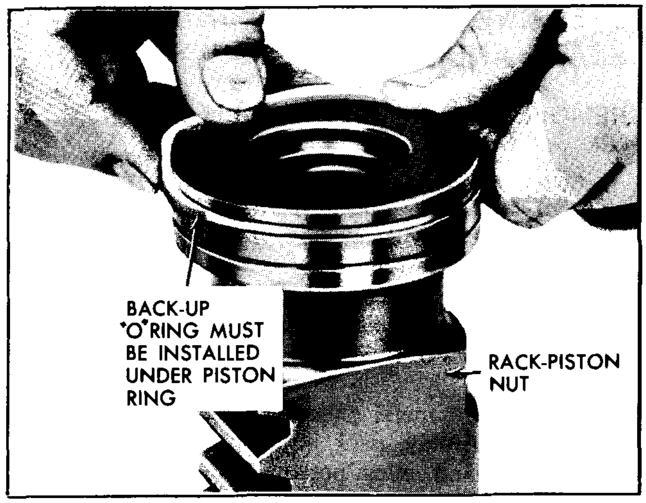


Fig. 9-96 Installing Plastic Ring on Rack-Piston

RACK-PISTON

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 scores or excessive wear. If any of these conditions are found, replace the thrust bearing and washer.

5. Inspect rack-piston teeth for scoring or excessive wear. Inspect the external ground surfaces for wear, scoring or burrs.

ASSEMBLY

1. If the plastic oil seal and "O" ring were removed, lubricate a new "O" ring and seal with power steering fluid and install in groove on rack-piston.

   NOTE: *The plastic ring may be slightly loose after assembly, but will tighten up when subjected to the hot oil in the system (Fig. 9-96).*

2. Slide the worm all the way into the rack-piston.

   NOTE: *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. 9-97).

4. Lubricate the balls with power steering fluid, then feed 17 balls into the rack-piston, while slowly rotating the worm counterclockwise.

   CAUTION: *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. Alternately install 7 balls (black and silver) into the return guide and retain with grease at each end of guide.

6. Install the return guide assembly onto the rack-piston.

7. Install the return guide clamp and tighten the 2 clamp screws to 10 lb. ft. torque.

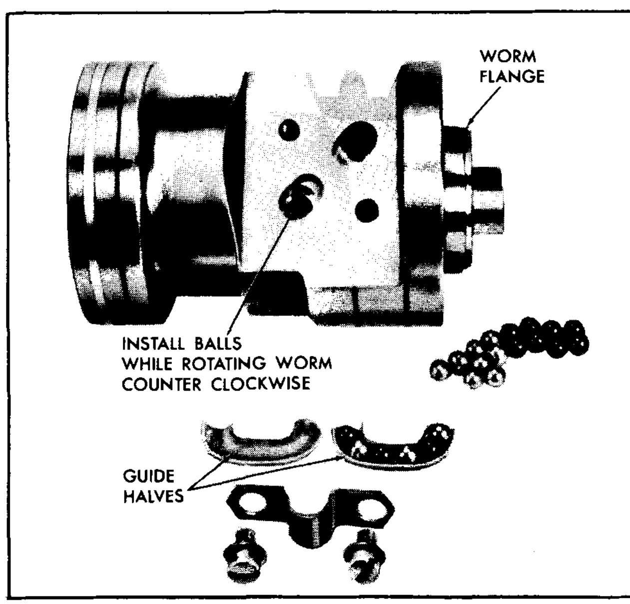


Fig. 9-97 Installing Balls in Rack-Piston

STEERING GEAR HOSE CONNECTOR SEATS AND POPPET CHECK VALVE

REMOVE

NOTE: *The following procedure can be performed on car as well as on bench.*

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 port housing 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. 9-98).
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. Remove poppet check valve and spring from pressure port and discard.

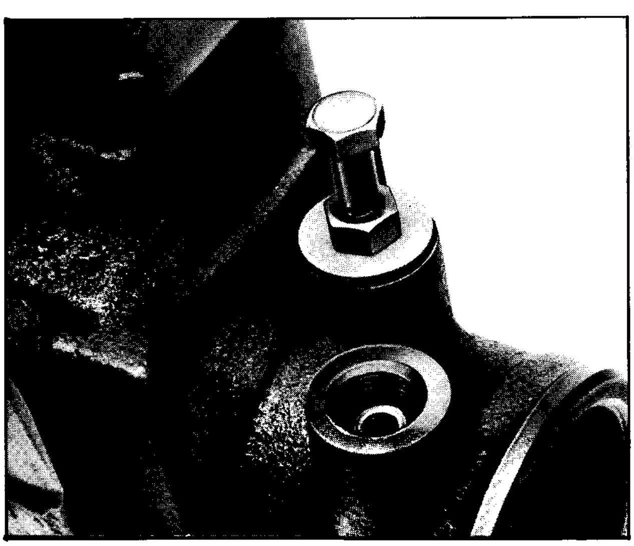


Fig. 9-98 Removing Hose Connector Seat

INSTALL

1. Install new check valve spring in pressure port with large end down. Make sure spring is seated in counterbore in pressure port.
2. Install new check valve over spring with tangs pointing down. Make sure valve is centered on small end of spring.
3. 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. 9-99).
4. 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.
5. Connect pressure and return line hoses on steering gear. Tighten hose fittings to 30 lb. ft.
6. Check fluid in pump reservoir and add if necessary (see POWER STEERING PUMP DESCRIPTION).

PITMAN SHAFT NEEDLE BEARING AND SEALS

REMOVE

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 J

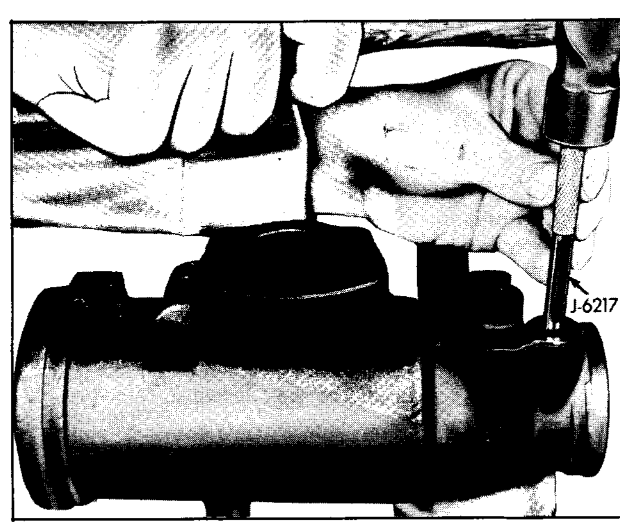


Fig. 9-99 Installing New Connector in Housing Using Tool J 6217

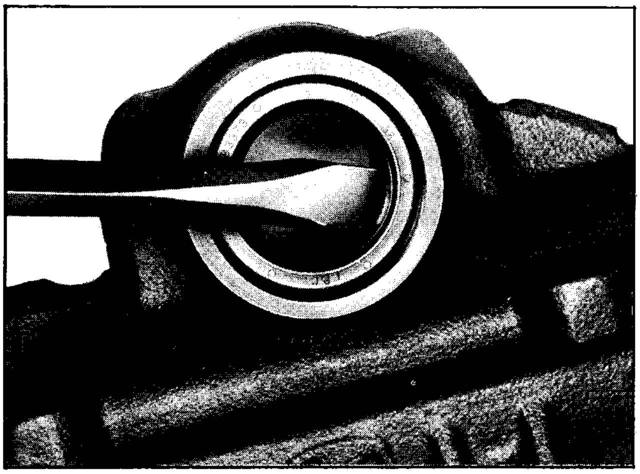


Fig. 9-100 Pry Out Inner Seal

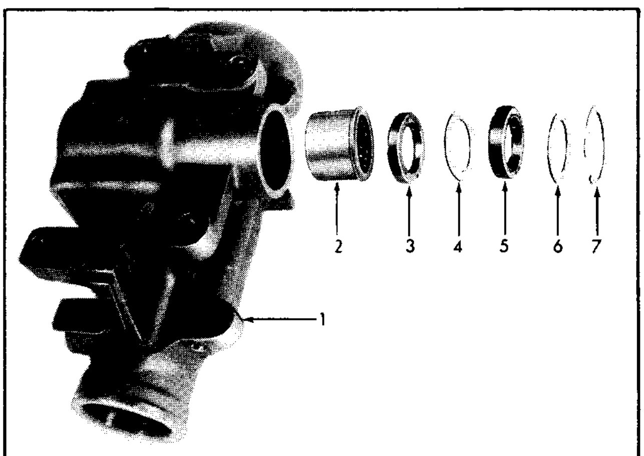
4245 and remove outer steel washer. Using screw driver under lip of seal pry out the outer seal. Remove the inner steel washer, then pry out the inner seal (Fig. 9-100). Discard seals.

CAUTION: *When prying out seals, be extremely careful not to score the housing bore.*

2. If pitman shaft needle bearing replacement is necessary, remove with tool J 6278. Since this bearing is shouldered (flanged), it must be pressed out the pitman arm end of the housing (Fig. 9-101).

ASSEMBLY

1. Thoroughly clean the parts and lubricate them with power steering fluid.



1. HOUSING
2. BEARING
3. OIL SEAL
4. STEEL WASHER
5. OIL SEAL (Double Lip)
6. STEEL WASHER
7. RETAINING RING

Fig. 9-101 Exploded View of Pitman Shaft Bearing and Seals

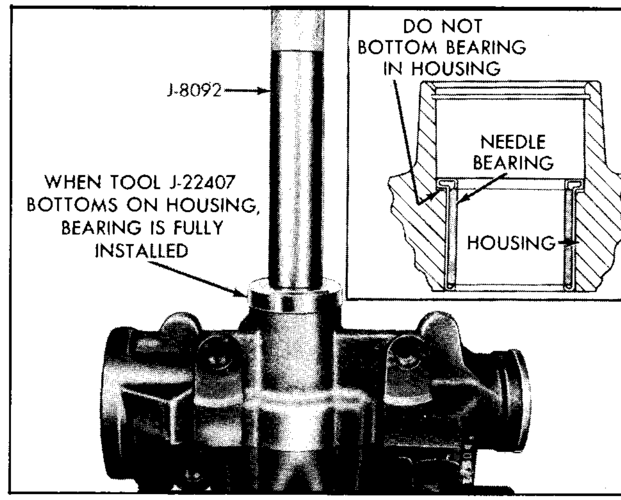


Fig. 9-102 Installing Pitman Shaft Bearing

2. Install pitman shaft needle bearing on bearing installer J 22407, with flange of bearing against tool.

3. Position bearing and tool in housing and press bearing into housing, until tool bottoms on housing (Fig. 9-102).

CAUTION: *Do not drive the bearing further into the housing after removing tool J 22407, since damage to the bearing would result.*

NOTE: *Bearing can be installed using adapter J 6278-3 with remover and replacer J 6278-1. Be careful flanged bearing is not driven into housing and bottomed out with too much force. Make sure needle bearings rotate freely.*

4. Lubricate the lips of the oil seals with power steering fluid.

5. 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), inner steel 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. 9-103).

   c. Remove the tool and adapter, then install the outer steel washer and seal retaining rings. The retaining ring will not seat in the groove at this time.

   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. 9-103), then remove the tool and adapter.

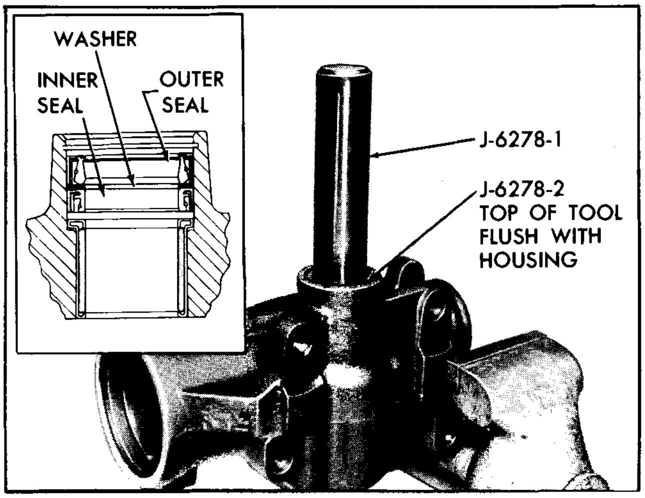


Fig. 9-103 Installing Pitman Shaft Seals

GEAR ASSEMBLY

1. Lubricate the worm, lower thrust bearing and the two thrust washers with power steering fluid, then install one thrust washer, the bearing, and the other thrust washer over the end of the worm (Fig. 9-104).

2. Lubricate the valve body plastic rings and a new lower shaft cap "O" ring with power steering fouid.

   b. Install the lower shaft cap "O" ring in the valve body so it is seated against the lower shaft cap.

   c. 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. 9-105).

   d. Apply pressure to the VALVE BODY when installing. If pressure is applied to the lower shaft during installation, the shaft may be forced out of the valve body (Fig. 9-106).

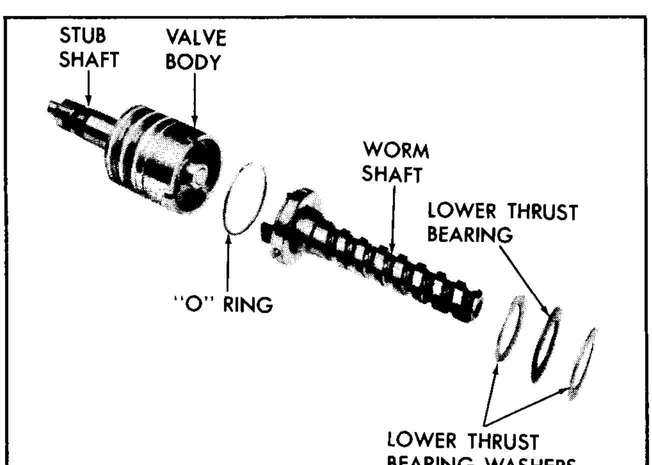


Fig. 9-104 Exploded View of Worm and Valve Body

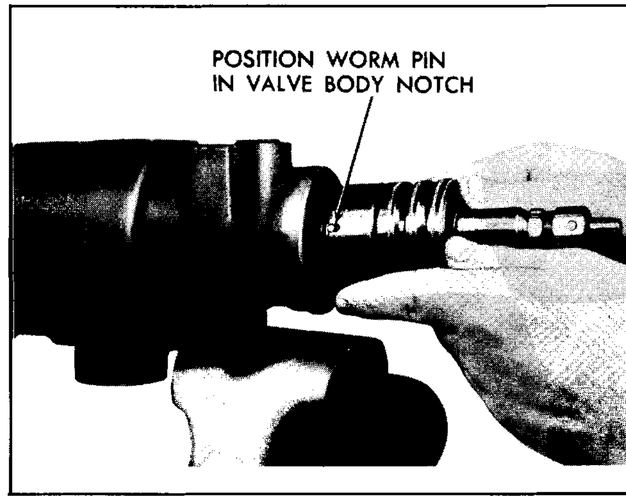


Fig. 9-105 Valve to Worm Alignment

NOTE: *The valve body is properly seated when the oil return hole in the housing is entirely uncovered (Fig. 9-107).*

3. a. Lubricate a new adjuster plug "O" ring with power steering fluid and install in groove on adjuster plug.

   b. Place seal protector J 6222 over stub shaft, then install the adjuster plug assembly in the housing until it seats against the valve body (Fig. 9-108).

   c. Remove seal protector.

   d. Do not adjust the thrust bearing preload at this time.

4. Install the rack-piston as follows:

   a. Lubricate the rack-piston plastic seal with power steering fluid.

Fig. 9-106 Installing Valve Body

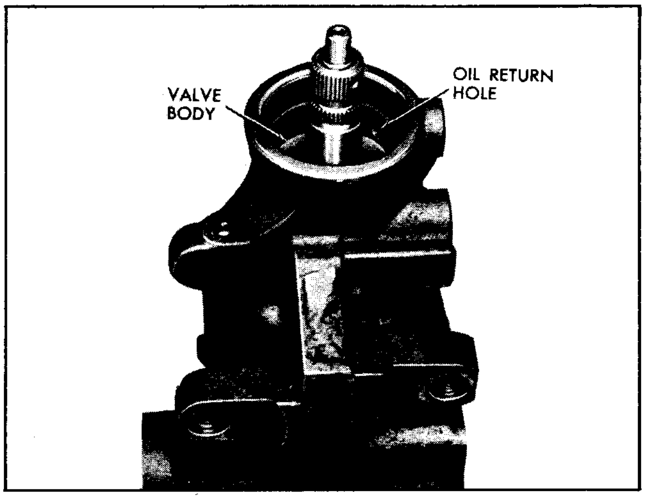


Fig. 9-107 Valve Body in Housing

b. Position seal compressor J 8947 of J 7576 against the shoulder in the housing.

c. With ball retainer J 7539 in place in the rack-piston, push the rack-piston (with teeth toward pitman shaft opening), into the housing until tool J 7539 contacts the center of worm (Fig. 9-109).

d. Turn the lower shaft clockwise with a 3/4" 12-point socket or box end wrench to thread the rack-piston onto the worm while holding tool J 7539 against the end of the worm.

e. When the rack-piston is completely threaded on the worm, remove ball retainer J 7539 and seal compressor J 8947.

5. Install the pitman shaft and side cover as follows:

a. Install a new "O" ring in the pitman shaft side cover and retain with heavy grease.

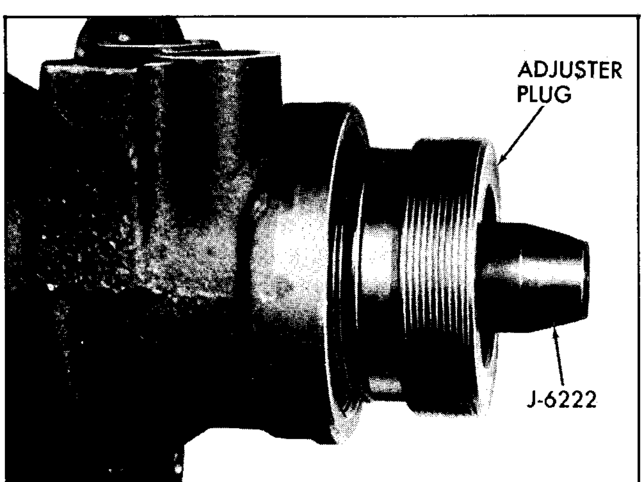


Fig. 9-108 Installing Adjuster Plug

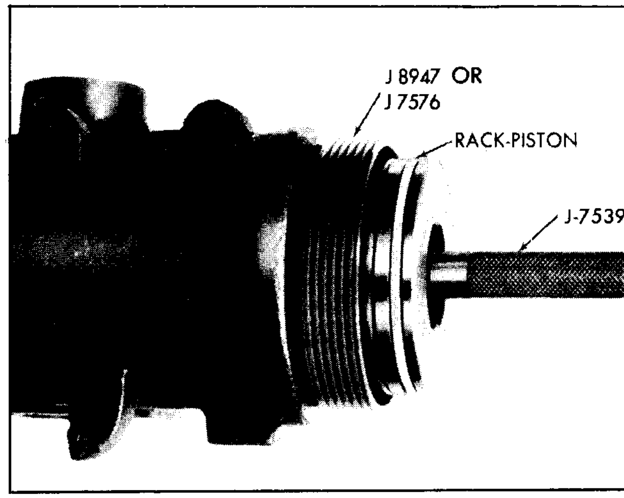


Fig. 9-109 Installing Rack-Piston

NOTE: *Some power steering gears are equipped with a side cover seal that has 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 lower 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. Install the side cover bolts and lock washers and tighten to 30 lb. ft. torque.

6. Install the rack-piston plug in the rack-piston and torque to 75 lb. ft.

7. Install a new housing end cover "O" ring and lubricate it with power steering fluid. Install the end cover and retaining ring.

8. Adjust steering gear (see ADJUSTMENT PROCEDURES - ON BENCH).

CAUTION: *See CAUTION on page 1 of this Section regarding the fastener referred to in step 9.*

9. Install flexible coupling on stub shaft and tighten clamping bolt or nut to 35 lb. ft. torque.

POWER STEERING PUMP

GENERAL INFORMATION

No periodic service of the pump is required except checking power steering fluid level in the reservoir as outlined in this section (see POWER STEERING PUMP DESCRIPTION).

ADJUSTMENT PROCEDURES

ADJUST PUMP BELT TENSION

1. Loosen pump plate (support) to bracket bolts two full turns.

2. Move pump until belt has 140 lbs. on V-8 engines or 125 lbs. on 6-cylinder engines as indicated on gage BT-3395 or equivalent for initial tension of a new belt. Tighten used belt to 115 lbs. on V-8 engines or 75 lbs. on 6-cylinder engines (Figs. 6A-22 and 6A-26).

3. Holding adjustment, tighten mounting bolts to 30 lb. ft. torque.

   CAUTION: *Do not pry against reservoir sheet metal.*

PUMP PRESSURE TEST

1. Disconnect pressure hose at union on 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 5176-1, adapter fitting J 22326, connect gage to both hoses.

4. Open hand valve on gage.

5. Start engine, allow system to reach operating temperatures and check fluid level adding any fluid if required.

6. Turn steering wheel slowly to left or right until wheel is at full turn position. Holding wheel in this position, read pressure on gage, presssure should be at least 1150 psi on all 6-cylinder models or 1300 psi on all 8-cylinder models. If pressure does not reach specification, there is either internal leakage in steering gear or pump is malfunctioning.

   CAUTION: *Vehicle's front wheels must be on ground and supporting weight of vehicle. Do not hold steering wheel at full turn for over 5 seconds, this will prevent damage to pump.*

7. To determine which problem exists, slowly close hand valve on gage, pressure should read 1200 to 1300 psi on all 6-cylinder models or 1350 to 1450 psi on all 8-cylinder models.

   CAUTION: *Do not hold hand valve on gage closed for over 5 seconds during this test to prevent damage to pump.*

8. If pressure does not reach specifications in step 7, the pump needs servicing.

9. If pressure is within specifications in step 7, pump is functioning properly, and fault is in steering gear or hoses.

10. Shut off engine, remove testing gage, spare hose, reconnect pressure, check fluid level or make needed repairs.

MINOR SERVICE

FLOW CONTROL VALVE

REPLACE (WITHOUT REMOVING PUMP FROM CAR)

1. Disconnect pressure hose from pump union and drain oil (Fig. 9-65).

2. Remove union from pump.

3. Using a magnet, withdraw flow control valve then spring from pump.

4. Install valve by reversing above steps, be sure that "O" ring seal on union is replaced and flow control valve is installed in the proper direction.

MAJOR SERVICE

PUMP

REMOVE

1. Disconnect hoses at pump. When hoses are disconnected, secure ends in raised position to prevent drainage of oil (Figs. 9-66 and 9-67).

2. Install two caps at pump fittings to prevent drainage of oil from pump.

3. Remove drive pulley attaching nut (Figs. 6A-22 and 6A-26).

4. Loosen bracket to pump mounting bolts.

5. Remove pump belt.

6. Slide pulley from shaft. Do not hammer on rim of pulley as this will damage pulley or pump.

7. Remove bracket to pump bolts.

8. Drain pump of oil.

9. Clean exterior of pump.

PUMP

DISASSEMBLE

CAUTION: *In clamping pump in vise, be careful not to exert excessive force on front hub of pump as this may distort bushing.*

1. Remove union and seal.

2. Remove pump rear mounting bolts.

3. Lift reservoir from housing by tapping reservoir at flange, rocking back and forth.

4. Remove mounting bolt and union "O" ring.

5. Remove end plate retaining ring. Push end plate retaining ring out of groove, using a punch through 1/8" diameter hole in pump housing (Fig. 9-110) and remove with screwdriver. End of retaining ring should be next to hole to ease removal.

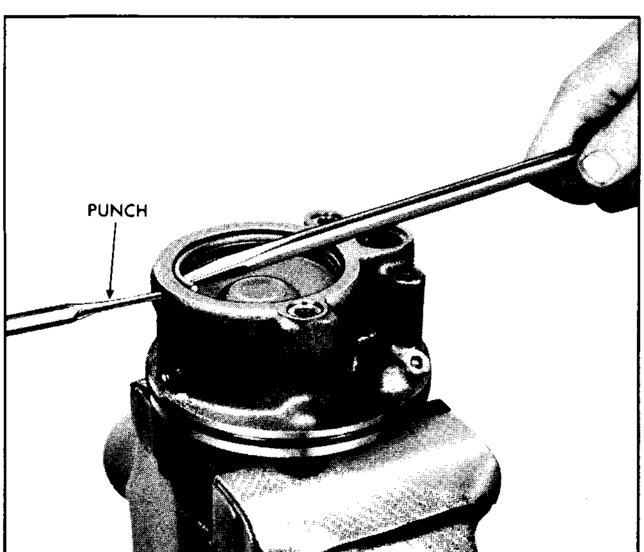


Fig. 9-110 Removing Retaining Ring

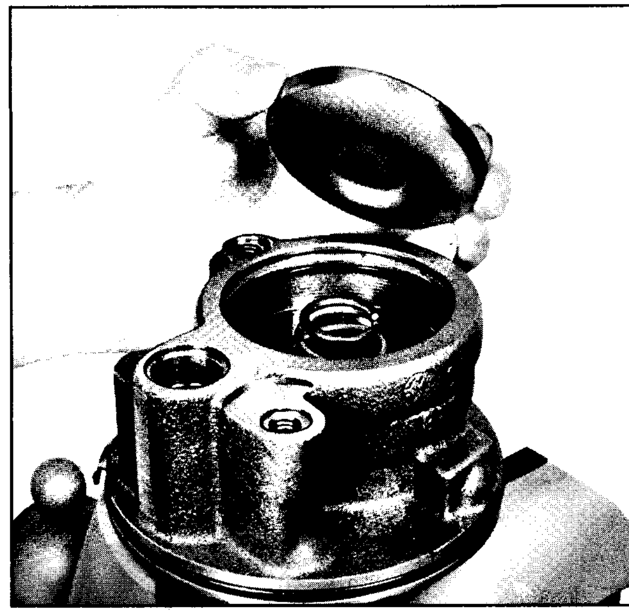


Fig. 9-111 Removing End Plate

6. Remove end plate and spring. End plate is spring-loaded and will generally sit above the housing level. If sticking should occur, a slight tapping action will free the plate (Fig. 9-111).

7. Remove end plate "O" ring.

8. With end cover "O" ring and shaft key removed, tap very lightly on end of shaft, only until pressure plate falls free.

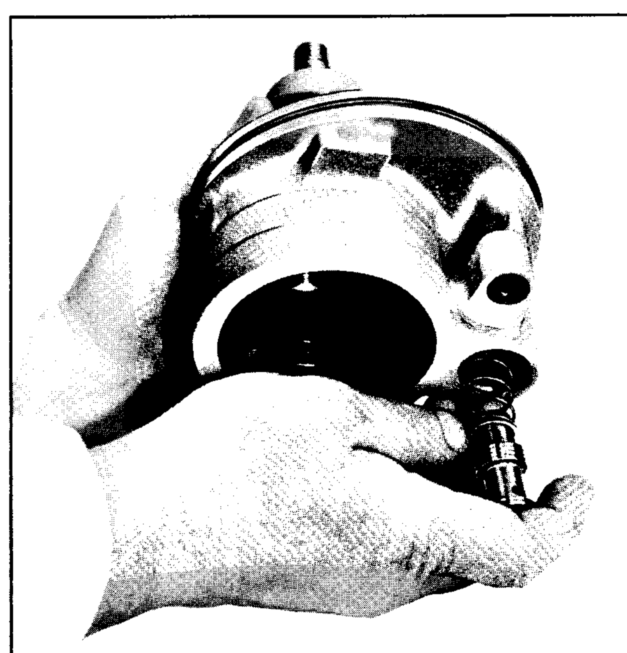


Fig. 9-112 Removing Flow Control Valve

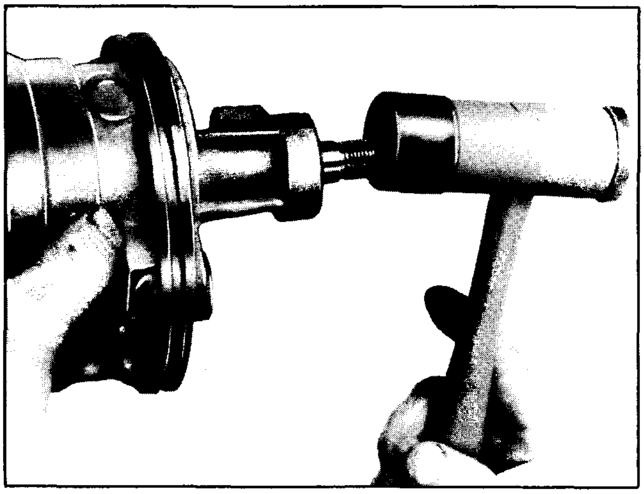


Fig. 9-113 Removing Pressure Plate

9. Remove pressure plate, pump ring and vanes, being careful not to drop parts (Fig. 9-114).
10. Remount housing in vise. Using a suitable tool, remove shaft retainer ring on end of drive shaft. DISCARD RING.
11. Remove rotor and thrust plate from shaft and both dowel pins from housing (Fig. 9-115).
12. Remove shaft through front of housing (Fig. 9-116).

CLEANING AND INSPECTION

Carefully clean all parts, except "O " rings which are to be replaced and should not be immersed in cleaning solvent. Lubricate all "O " rings and the drive shaft seal with power steering fluid and install in proper location. Be sure not to immerse drive shaft seal in cleaning solvent as this could damage it. Fig. 9-117 shows an exploded view of the pump.

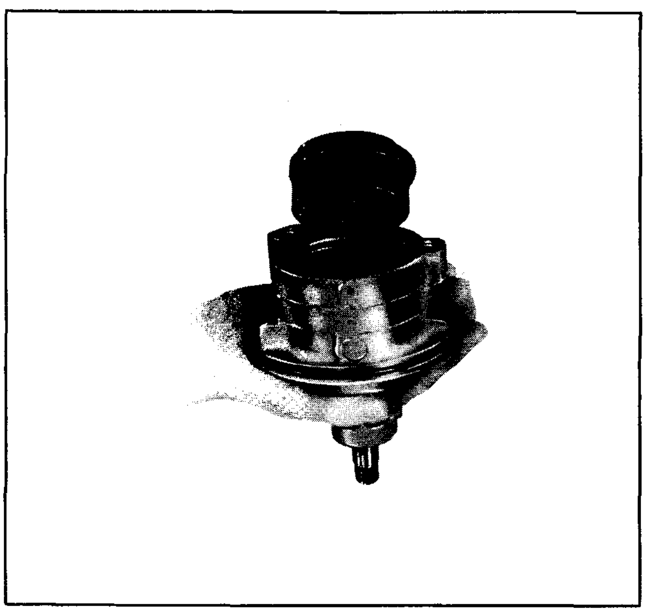


Fig. 9-114 Shaft, Pressure Plate, Plate Pump Ring, Vanes and Rotor Removed

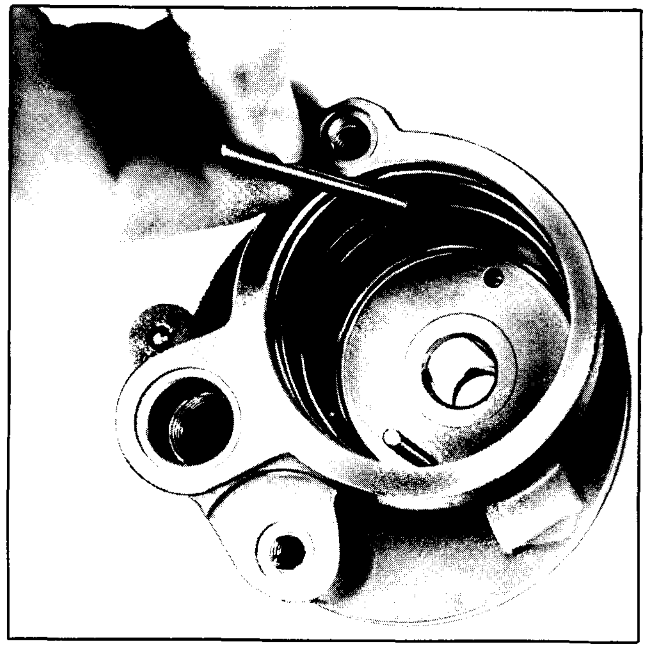


Fig. 9-115 Removing Dowel Pin

PUMP

ASSEMBLE

CAUTION: *Be sure all parts are clean during reassembly.*

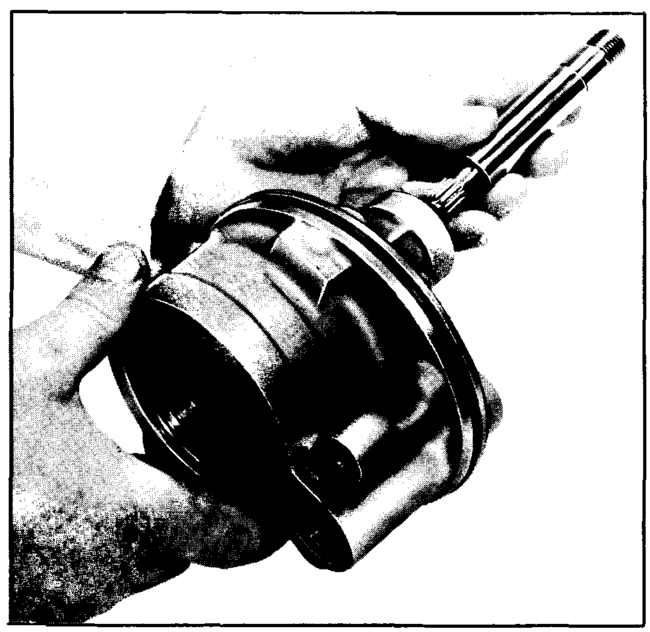
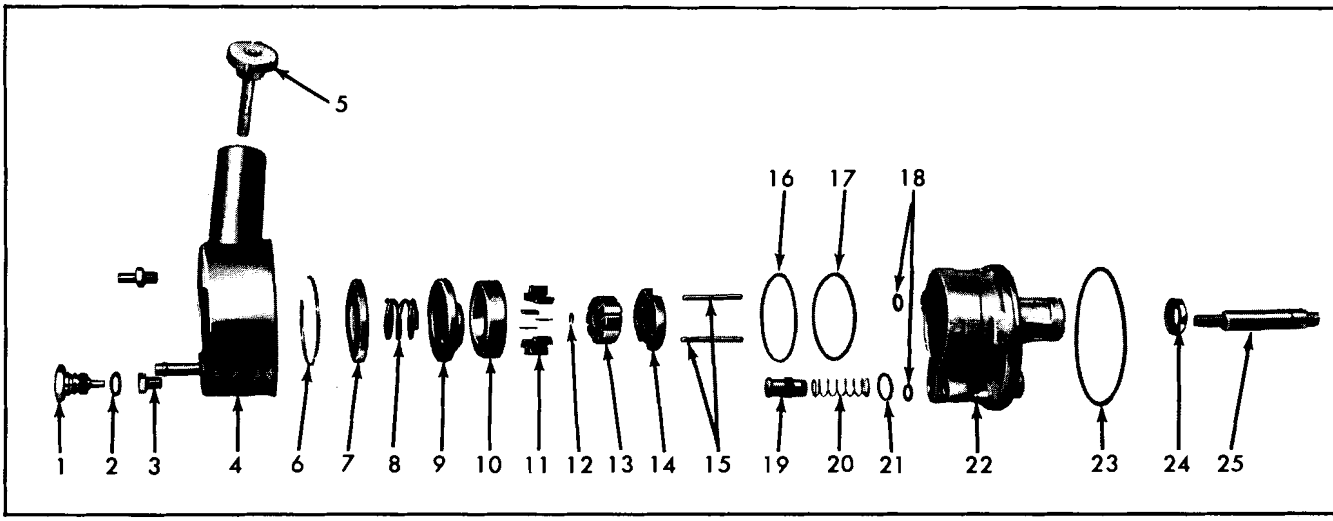


Fig. 9-116 Removing Pump Shaft



1. Union
2. Seal
3. Mounting Bolts
4. Reservoir
5. Dip Stick and Cover
6. End Plate Retaining Ring
7. End Plate
8. Spring
9. Pressure Plate
10. Pump Ring
11. Vanes
12. C-Washer
13. Rotor
14. Thrust Plate
15. Dowel Pins
16. End Plate O-Ring
17. Pressure Plate O-Ring
18. Mounting Bolt O-Ring Seals
19. Flow Control Valve
20. Flow Control Valve Spring
21. Flow Control Valve O-Ring Seal
22. Pump Housing
23. Reservoir O-Ring Seal
24. Shaft Seal
25. Drive Shaft

Fig. 9-117 Exploded View of Power Steering Pump

1. Insert shaft at hub end of housing, spline end entering mounting face side (Fig. 9-118).

2. Install thrust plate on dowel pins with ported face to rear of pump housing (Fig. 9-119).

3. Install rotor (must be free on splines) on pump shaft at splined end.

CAUTION: *Assemble rotor with flat side toward rear of pump (Fig. 9-120).*

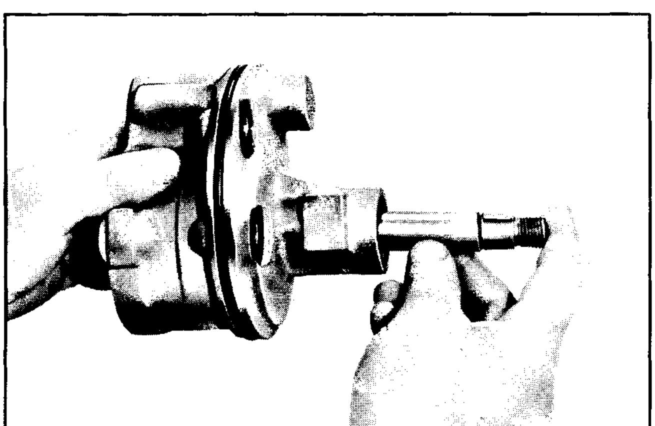


Fig. 9-118 Installing Pump Shaft

4. Using suitable tool, install new shaft retainer ring.

5. Install pump ring on dowel pins with rotation arrow facing to rear of pump housing (Fig. 9-121).

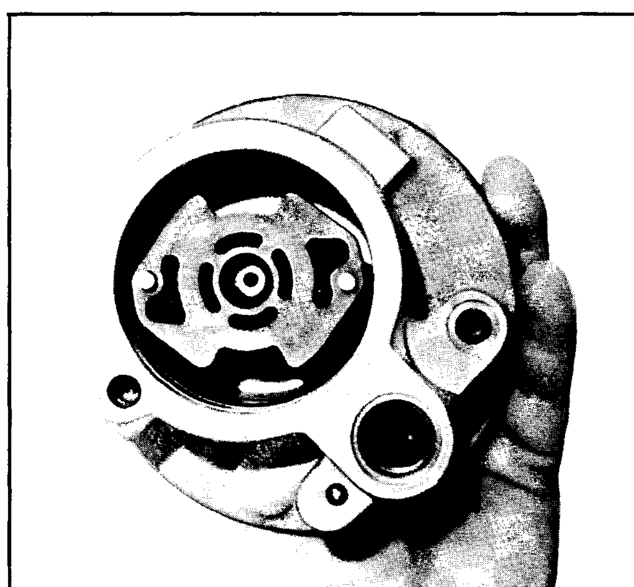


Fig. 9-119 Thrust Plate Installed

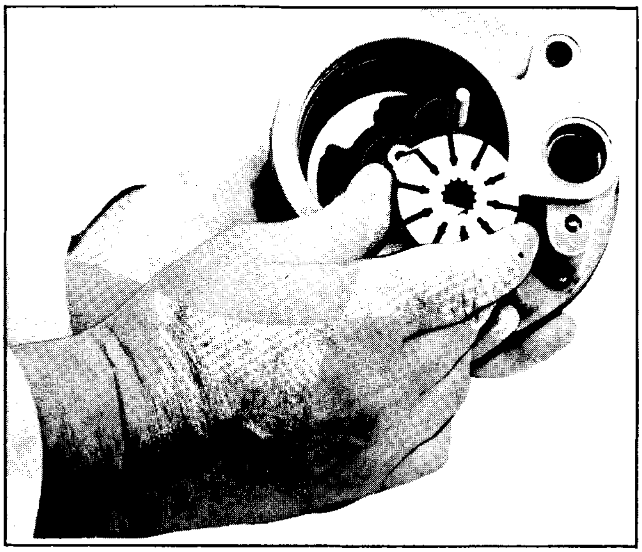


Fig. 9-120 Installing Rotor

6. Install vanes in rotor slots with radius edge towards outside (Figs. 9-122 and 9-123).

7. Lubricate outside diameter and chamber of pressure plate with power steering fluid to insure against damaging "O" ring and install on dowel pins with ported face toward pump ring. Applying pressure to outer edge only, seat pressure plate. Never press or hammer on the center of the pressure plate as this will cause permanent distortion with resulting pump failure. (Pressure plate will travel about 1/16" to seat.)

8. Install end plate "O" ring.

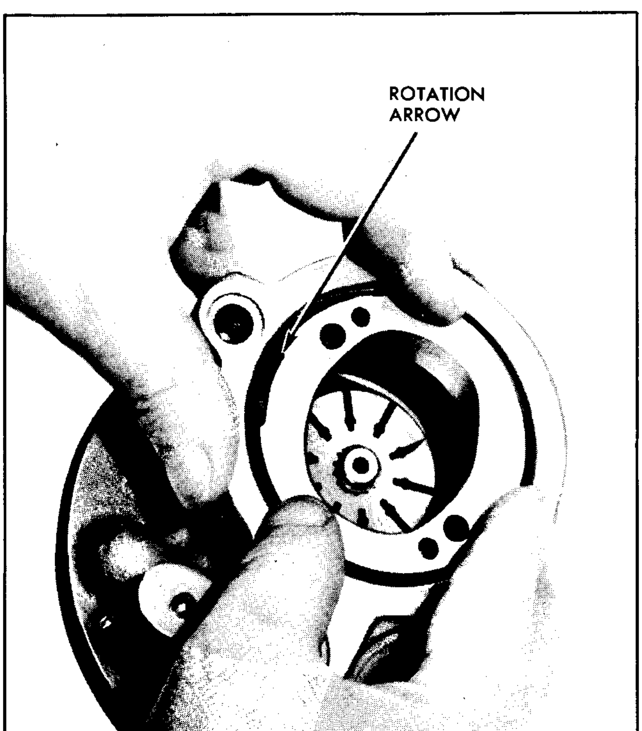


Fig. 9-121 Installing Pump Ring

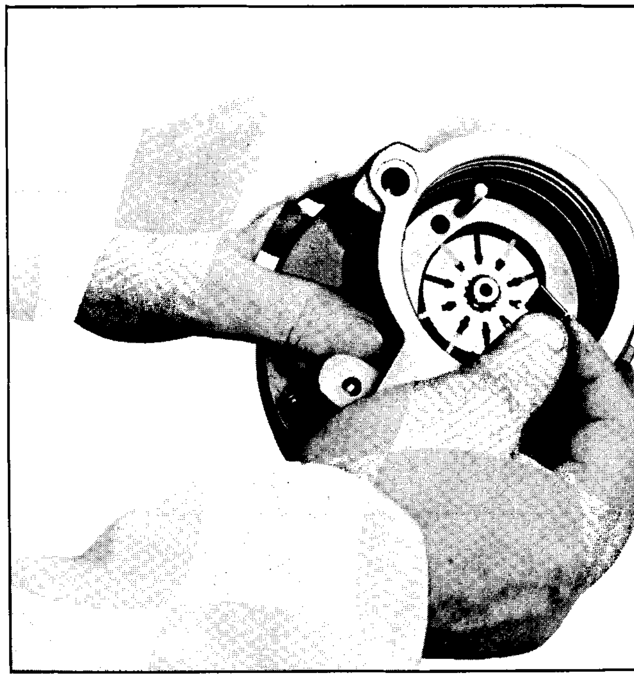


Fig. 9-122 Installing Pump Vanes

9. Install pressure plate spring in center groove of pressure plate (Fig. 9-124).

10. Lubricate outside diameter of end plate with power steering fluid to insure against damaging "O" ring and install in housing using an arbor press.

11. Install end plate retaining ring while pump is in arbor press. Be sure it is completely seated in the groove of the housing (Fig. 9-125).

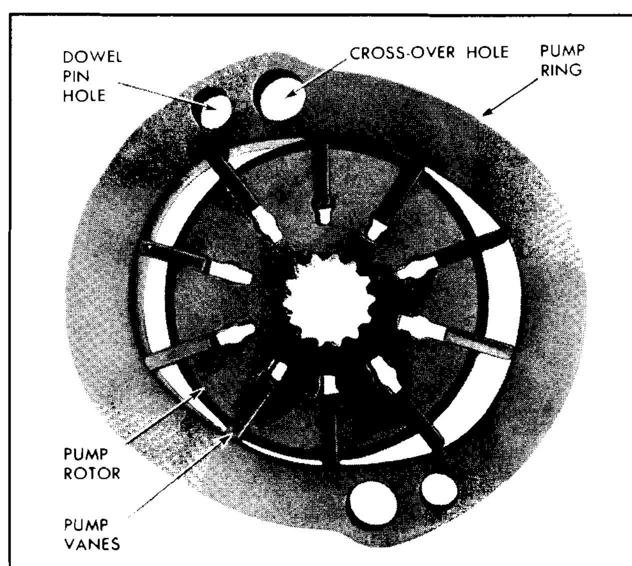


Fig. 9-123 Pump Vanes Installed

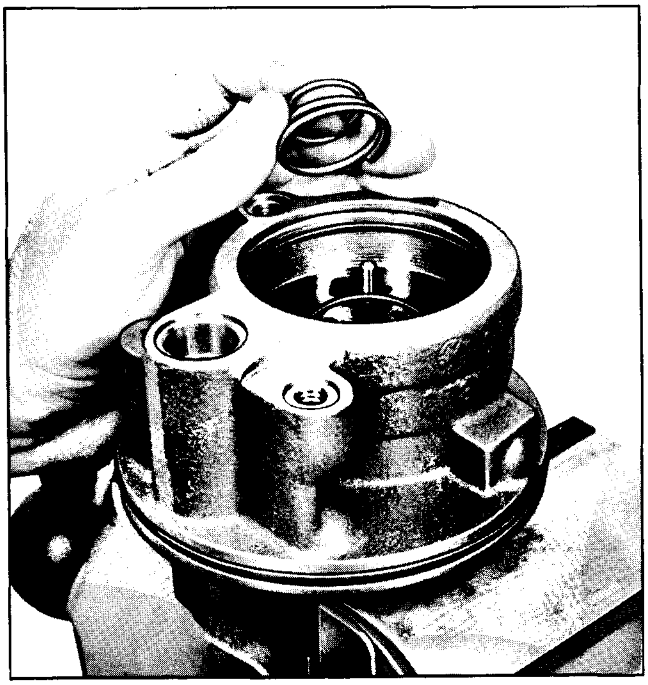


Fig. 9-124 Installing Pressure Plate Spring

12. Install flow control spring and flow control plunger. Be sure end with screen goes into bore first.

13. Install mounting bolt and union "O" rings.

14. Drop reservoir into place and press down until reservoir seats on housing.

15. Install studs and outlet union, and torque to 35 lb. ft.

16. Install drive shaft key. Support shaft on opposite side of key when installing key.

PUMP

INSTALL

1. Position pump assembly on mounting bracket with holes lined up and install bolts loosely (Figs. 6A-22 and 6A-26).

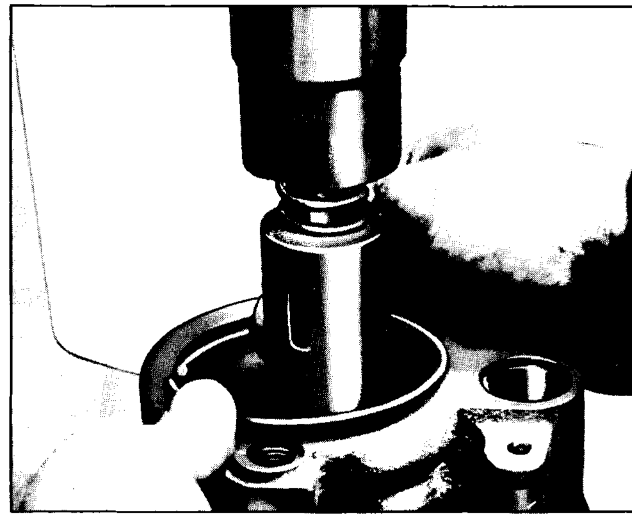


Fig. 9-125 Installing End Plate

2. Slide pulley on shaft.

3. Install pulley nut fingertight.

4. Connect and tighten hose fitting. Tighten outlet fitting to 35 lb. ft. torque (Fig. 9-66).

5. Fill reservoir with GM power steering fluid or equivalent (see POWER STEERING PUMP DESCRIPTION). Bleed pump by turning pulley backward (counterclockwise as viewed from front) until air bubbles cease to appear.

6. Install pump belt over pulley last to avoid damage to belt.

7. Move pump until belt has 140 lbs. on V-8 engines or 125 lbs. on 6-cylinder engines as indicated on gage BT-3395 or equavalent for initial tension of a new belt. Tighten used belt to 115 lbs. on V-8 engines or 75 lbs. on 6-cylinder engines. Tighten mounting bolts to 30 lb. ft. torque.

CAUTION: *Do not pry against reservoir sheet metal.*

8. Tighten pulley nut to 60 lb. ft. torque.

GENERAL SPECIFICATIONS

	ITEMS	MANUAL					POWER				
		B SERIES	G SERIES	A SERIES	F SERIES	X SERIES	B SERIES	G SERIES	A SERIES	F SERIES	X SERIES
STEERING GEAR	Type	RECIRCULATING BALL NUT					ROTARY VALVE				
	Ratio •	—	—	28:1	28:1	28:1	15:1-13:1	16:1-13:1	16:1-13:1	16:1-13:1	16:1-13:1
	Turns**	6.5 (APPROX.)					3.0 (APPROX.)				
	Recirculating Balls	50					24 (12 BLACK – 12 SILVER)				
	Lubricant Capacity	11 FLUID OUNCES					32 FLUID OUNCES				
LINKAGE	Type	PARALLELOGRAM					PARALLELOGRAM				
	Location	—	—	Front of Wheels	Front of Wheels	Rear of Wheels	Front of Wheels	Front of Wheels	Front of Wheels	Front of Wheels	Rear of Wheels
	Tie Rods	2					2				
PUMP	Type	–					VANE				
	Pressure	–					1300 PSI MIN.				

* *Handling Package Ratio 15:1–13:1 (F Series)*
** *Number of Turns of Steering Wheel Stop to Stop Pitman Arm Disconnected*

ADJUSTMENT SPECIFICATIONS

GEAR ADJUSTMENT		TORQUE TO TURN WORM SHAFT	
		MANUAL GEAR	POWER GEAR
Worm Bearing Preload		5 to 8 lb. in.	3 to 4 lb. in.
Over-center or Pitman Shaft	New	4 to 10 lb. in.	4 to 8 lb. in.
	Used*		4 to 5 lb. in.
Total Worm Bearing, Pitman Shaft & Drag not to exceed	New	16 lb. in.	18 lb. in.
	Used*		14 lb. in.

***400 or more miles**

		V-8	6 CYL.
Belt Tension*	New	135–150 Lbs.	100–130 Lbs.
	Used	100–105 Lbs.	70– 90 Lbs.

**Tension on Gage BT-3395 or equivalent*

TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise specified

APPLICATION	TORQUE
Nut, Tie Rod to Steering Knuckle	
B Series	
(70 lb. ft. max. to insert cotter pin)	30*
Except B Series	
(50 lb. ft. max. to insert cotter pin)	30*
Nut, Pitman Shaft to Pitman Arm	
Except X Series	185
X Series	140
Nut, Pitman Arm to Intermediate Rod	
B & F Series	
(55 lb. ft. max. to insert cotter pin)	40*
A & G Series	
(45 lb. ft. max. to insert cotter pin)	30*
X Series	
(Then tighten to next slot for cotter pin insertion)	45*
Nut, to Tie Rod Intermediate Rod	
B & F Series	
(85 lb. ft. max. to insert cotter pin)	50*
A & G Series	
(55 lb. ft. max. to insert cotter pin)	30*
X Series	
(50 lb. ft. max. to insert cotter pin)	30*
Nut, Idler Arm to Intermediate Rod	
B & F Series	
(50 lb. ft. max. to insert cotter pin)	35*
A & G Series	
(45 lb. ft. max. to insert cotter pin)	30*
X Series	
(Then tighten to next slot for cotter pin insertion)	45*
Nut, Tie Rod Adjuster Sleeve Clamp	
Except X Series	20
X Series	12
Nut, Idler Arm Support to Frame	40
Nut, Steering Wheel to Steering Shaft	30
Nut, Steering Column Mounting Bracket to Instrument Panel	20
Nut, Universal Joint (Pot Joint) Clamping Bolt to Steering Shaft	50
Bolt, Mounting Bracket to Steering Column	15
Bolt or Nut, Flexible Coupling Clamping to Steering Gear Stub Shaft	35
Bolt, Steering Gear to Frame	70
Screw, Toe Cover Plate to Dash Panel	40 (lb. in.)
Nut, Adjuster Plug Lock Nut	85
Nut, Pitman Shaft Adjusting Screw Lock Nut (Manual Gear)	23
Bolt, Side Cover to Housing (Manual Gear)	35

POWER STEERING ONLY:

APPLICATION	TORQUE
Nut, Hose Connector to Pump or Gear	25
Union, Pressure Hose Connector to Pump	35
Stud, Pump Mounting	35
Bolt, Pump Mounting Bracket to Engine	30
Bolt or Nut, Mounting Bracket to Pump or Bracket	30
Nut, Pump Pulley to Shaft	60
Bolt, Side Cover to Housing	30
Nut, Pitman Shaft Adjusting Screw Lock Nut	32

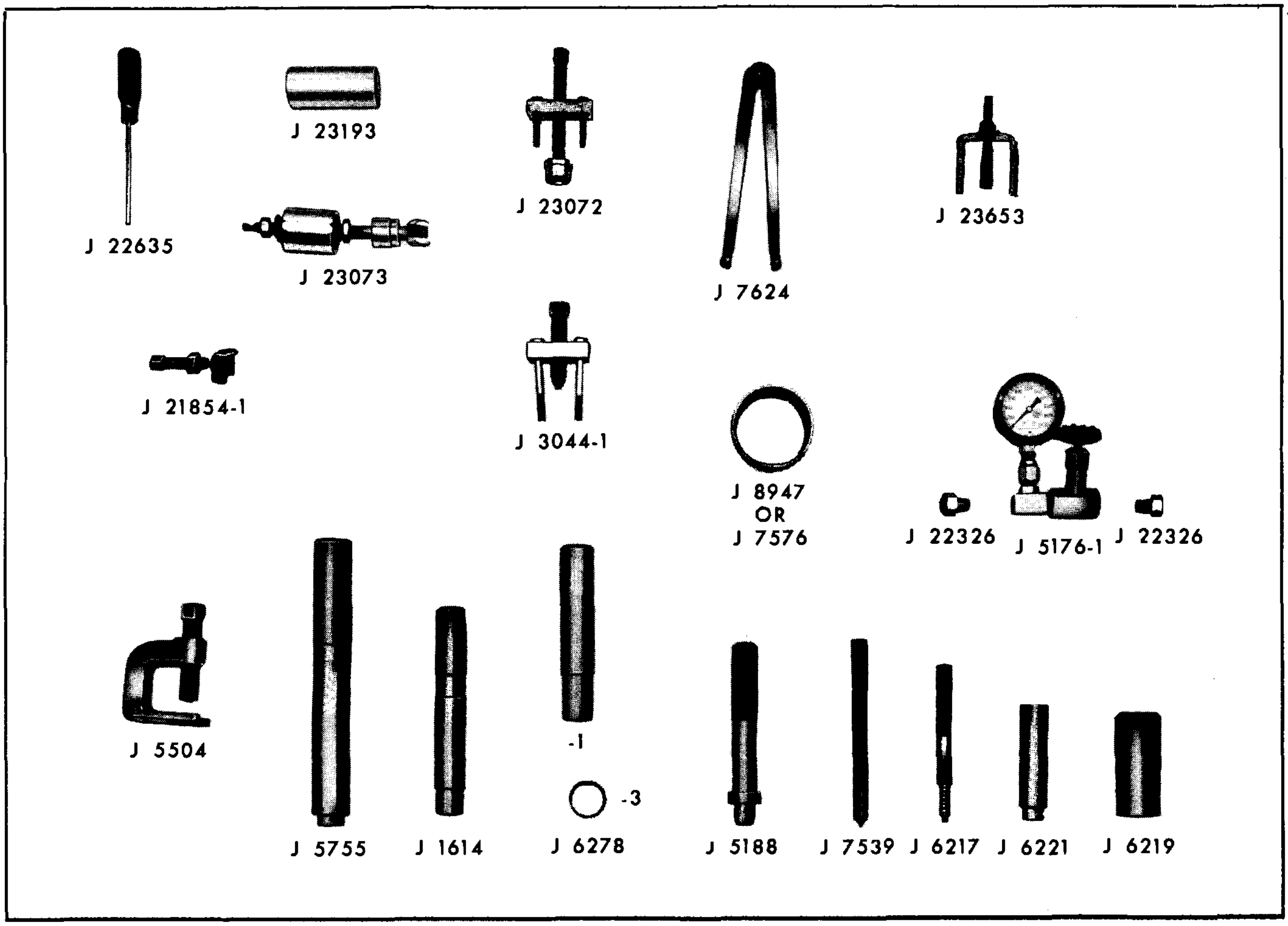


Fig. 9-126 Special Tools for Steering Columns and Steering Gears

Tool No.	Name
J 1614	Pitman Bushing Driver
J 3044-1	Steering Wheel Puller
J 5176-1	Power Steering Checking Gage 0 - 2,000 Lbs.
J 5188	Valve Cover Seal Installer
J 5504	Pitman Arm Puller
J 5755	Steering Shaft Worm Bearing Cup Installer
J 6217	Valve Connector Seat Installer
J 6219	Steering Gear Pitman Shaft Oil Seal Installer
J 6221	Adjuster Plug Bearing Remover & Installer

Tool No.	Name
J 6278	Pitman Shaft Bearing Remover & Installer
J 7539	Piston Rack Arbor
J 7576	Plastic Ring Seal Installer
J 7624	Bearing Pre-Load Spanner Wrench
J 8947	Plastic Ring Seal Installer
J 21854-1	Pivot Pin Remover
J 22326	Power Steering Checking Gage Adapter
J 22635	Lock Shoe & Release Lever Pin Remover & Replacer
J 23072	Tilt Column Shift Tube Remover
J 23073	Tilt Column Shift Tube Installer
J 23193	Tilt Column Pre-Load Nut Socket
J 23653	Lock Plate Compressor

SECTION 10

WHEELS AND TIRES

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

TROUBLE DIAGNOSIS AND TESTING

TIRE INSPECTION (Fig. 10-1)

It is characteristic of belted bias ply tires to display an apparent rapid but even wear of the second tread rows from the outer and inner shoulders. This condition is normal and does not decrease the tread life of the tire. Tire rotation at recommended intervals will assist in minimizing this type of wear (Fig. 10-2). Careful inspection of tires may show that improper wheel alignment, poorly adjusted brakes, poor driving habits, fast cornering or other conditions are the cause of wear. Listed below are common types of irregular tire wear and possible causes.

UNDERINFLATION

The result of underinflation is shown in Fig. 10-1. Car weight distorts the normal contour of the tire body and the tire bulges out. This wears the tread at the edges more than the center and generates excessive internal heat, weakening the cords and resulting in bruises, broken cords or ply separation. Underinflation also leads to rim bruises, as insufficient resistance is provided to prevent the tire from being jammed against the rim and crushed or cut when the tire strikes a curb, rock, or rut.

OVERINFLATION

When a tire is overinflated, increased tension caused by excessive pressure prevents proper deflection of the sidewalls. This results in wear in the center of the tread and the tire also loses its ability to absorb road shocks. Under this increased strain, cords in the belt or sidewall cords may snap under impact.

SIDE WEAR (CAMBER OR CORNERING WEAR)

There are three reasons why tires wear more rapidly on one side of the tread than on the other.

1. Wheel camber causes the tires to run at an angle from the perpendicular, resulting in side wear.

2. Side thrust when rounding turns causes wear on the

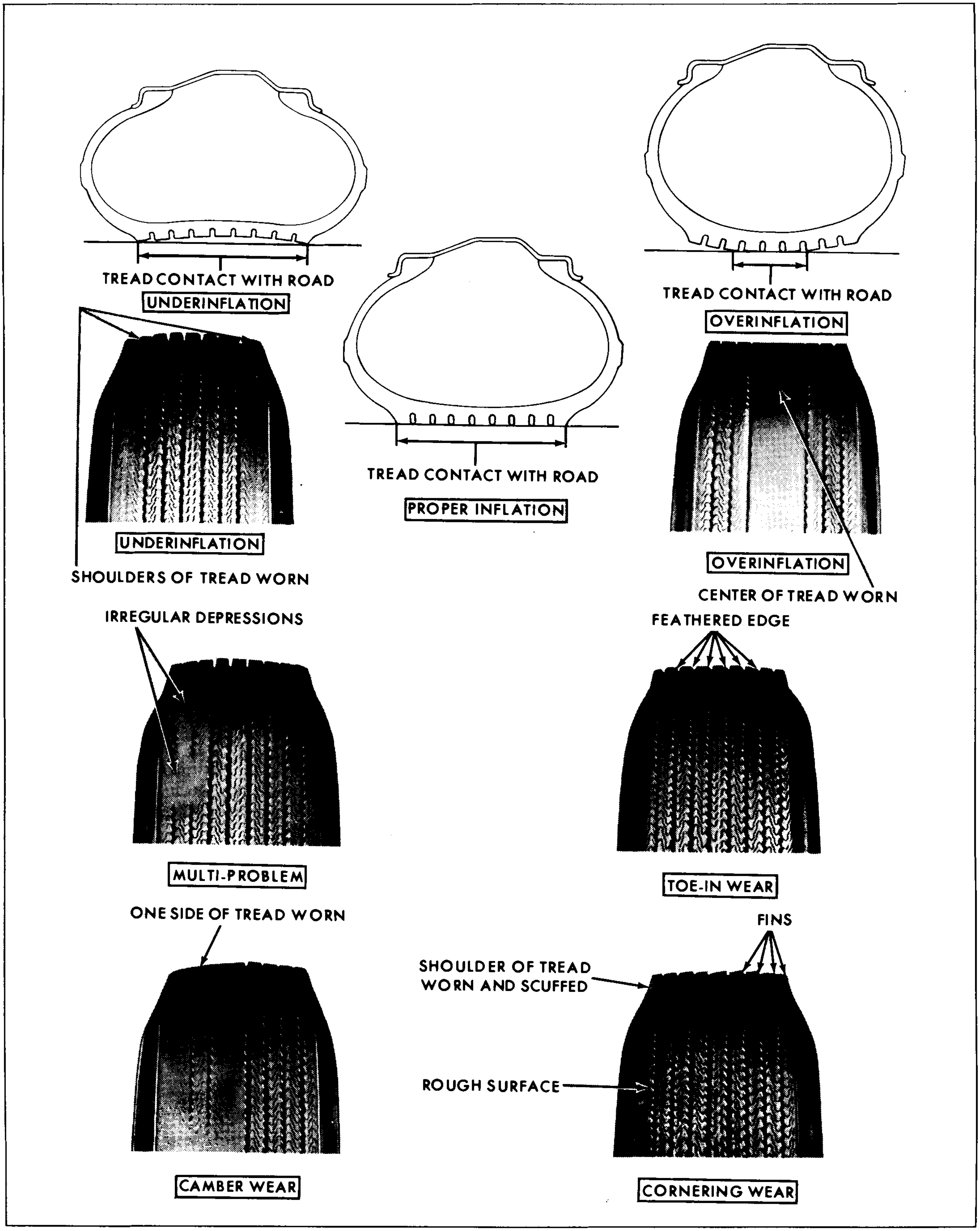


Fig. 10-1 Tire Wear Diagnosis

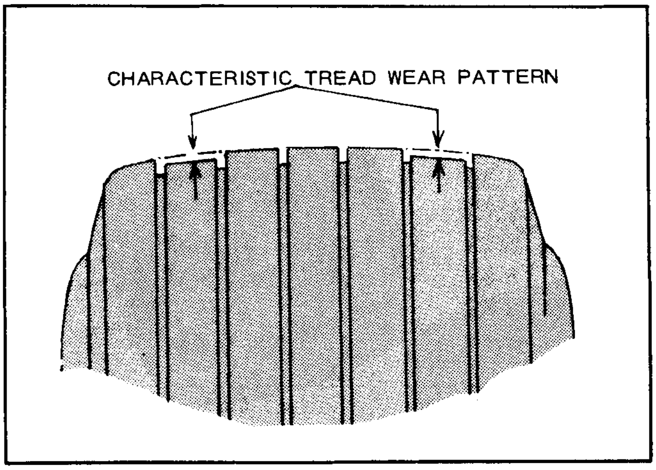


Fig. 10-2 Characteristic Tread Wear Pattern of Bias-Belted Tires

sides of front tire treads. In making a turn to the left, especially at high speeds, the outside shoulder of the right tire and the inside shoulder of the left tire take most of the wear. When making a right-hand turn, the opposite shoulders of the tires are worn.

3. High crowned roads cause increased wear on the side of the right front tire. This is particularly true when there is too much toe-in on front wheels or when positive camber of right front wheel is greater than the left.

Cornering wear can usually be differentiated from camber wear because cornering wear affects both sides of the tire, giving it a very round apperance. When camber is incorrect, it will cause excessive wear only on one side of the tire tread. Camber wear does not leave the tread rounded as cornering wear does.

When cornering wear is encountered, the owner should be shown, by the rough tire surface and rounded shoulders, that he is severely abrading his tires by fast or sharp turns, and told that he could greatly prolong the useful life of his tires by taking the turns a little slower. The tires and wheels should be rotated and continued in service the same as with normal camber wear.

TOE-IN OR TOE-OUT MISALIGNMENT WEAR

Front wheels should be straight ahead or toe-in slightly. When there is excessive toe-in or toe-out, tires will revolve with a side motion and scrape the tread rubber off. Front tires will show wear on the outside with a toe-in condition and on the inside with a toe-out condition. This wear pattern is reversed when considering toe for rear tires.

UNEVEN TIRE WEAR

Other types of uneven tread wear such as a single spot or series of cuppings around the tire circumference may also be noted on some tires. Such uneven wear may be due to excess toe-in or toe-out with underinflation, uneven camber, or such irregularities as bent or worn suspension, wobbly wheels, improper caster, out of round brake drums, and unequally adjusted brakes.

TREAD WEAR

Tread wear is affected by wheel alignment, cornering, and inflation pressure as mentioned previously. There are several factors which must be considered in analyzing tread wear.

A careful driver may obtain many times the mileage from his tires than would be obtained by a severe driver. Also, tires wear much faster in some localities depending on the type of road (some are more abrasive than others), condition of road (rain or snow), the number of sharp turns, hills or mountains the car must go up or down, and the prevailing temperature. Fast driving, quick starting, and hard stopping are generally recognized as a definite cause of rapid tread wear. By actual test, an increase of 40°F in temperature reduces tread mileage by 33%.

TESTING FOR TIRE NOISES

To determine if tires are causing a noise, use the following procedure:

Snow tires produce a noise which the owner will have to ignore or overlook. If not equipped with snow tires, drive the car at various speeds and note the effect of acceleration and deceleration on noise. Axle and exhaust noise show definite variations under these conditions while tire noise will remain constant. Tire noise generally is most pronounced on smooth black top roads at speeds between 15 and 40 miles per hour.

Tire thump is a periodic noise with each revolution of the wheel. It is prominent only on smooth black top pavement that is free of surface irregularities. Tire thump may be checked by driving the car over a smooth black top pavement with tires at recommended inflation pressure, and again over the same stretch of road with all tires inflated to 50 lbs. Drop the pressure in one tire at a time to normal until defective tire is found.

> **CAUTION:** *Striking any obstructions or rocks in road with tire at 50 psi can lead to tire casing rupture. Operate car with higher than recommended inflation only while testing. Do not operate car over 50 mph with high tire pressure.*

Carefully inspect the tire making the noise for bulges, irregular wear, low air pressure, toe and heel (saw tooth) wear, and unusual tread design (ribbed tread gives less noise than some all-weather treads; mud and snow treads are very noisy). Checking wheel alignment and rotating tires will usually cure tire noises unless caused by tire tread design, heavy irregular tread wear, or tire bulges.

GENERAL DESCRIPTION

All models except X Series have bias-belted tires as standard equipment. These tires have two polyester cord bias plies in the tire body, plus two glass fiber plies, or "belts", under the tread only (Fig. 10-3). The advantages of the bias-belted tire over the bias ply tire are increased tire life, greater traction, and better resistance to road hazards due to greater strength.

X Series models have bias-ply tires as standard equipment with bias-belted optional. The Sprint option also includes bias-belted tires.

Belted tires should not be mixed with conventional tires on any car as a brake pull or a drifting under acceleration will result.

All models use steel drop center rim wheels secured by right-hand threaded nuts on either side of the vehicle.

Wheel sizes are as follows: A, F and G Series - 14 × 6", 14 × 7" and 15 × 7"; B Series - 15 × 6"; X Series - 14×5" and 14×6". Various wheels can be identified by a letter code stamped on the rim near the valve hole (Fig. 10-13).

TIRE SIZE AND LOAD RATING

Tire sizes and load ratings are indicated by a combination of numbers and letters such as G78 × 14, load range B.

The first letter designates the load the tire will carry at a given inflation pressure. The "higher" the letter, the bigger the tire and so the greater the load capacity. Fig. 10-4 gives approximate size comparisons between conventional and wide tread tires.

The first set of numbers (78) denotes the ratio of tire height to width. Height divided by width equals section ratio. For example, a G78 tire is 78% as high as it is wide. The lower the number, the wider the tire.

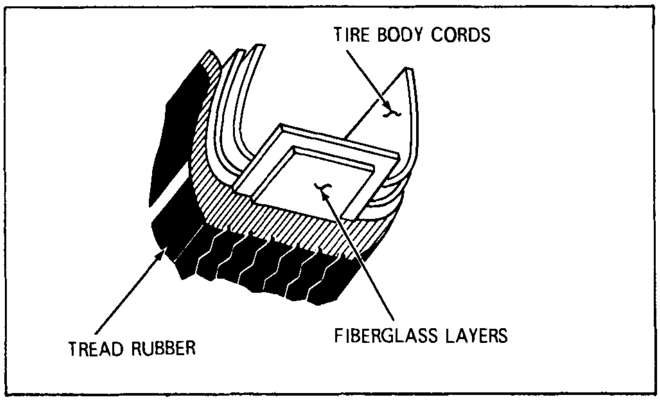


Fig. 10-3 Bias-Belted Tire Construction

Conventional	Wide Tread
7.35	E
7.75	F
8.25	G
8.55	H
8.85	J
9.15	L
2 Ply–4 Ply Rating	Load Range B
4 Ply–8 Ply Rating	Load Range D
7.35, 7.75, 8.25, etc.	83 (Section Ratio)

Fig. 10-4 Tire Size Comparisons

The second set of numbers (14) shows the inner diameter of the tire.

Load range replaces the ply-rating system (Fig. 10-4). Load range B and load range D tires will carry the same load at the same pressure. However, load range D tires may be inflated to higher pressures. At these higher pressures they will carry a greater load.

NOTE: *Use of optional, larger, or higher load range tires does not permit an increase in the maximum vehicle load.*

Normal passenger or cargo loads do not appreciably increase the load carried by the front tires. The rear tires carry most of this load. Rear tire pressures of load range B tires may be increased up to 32 psi and load range D tire pressures increased up to 40 psi for extra tire load capacity.

The ride quality of tires at increased pressures may be hard compared to normal pressures. It is important that tire pressures be maintained at recommended values when car is carrying normal loads.

NOTE: *White sidewall tires should have the protective coating washed off before being placed in service. This coating is not as flexible as rubber and therefore checks, which may introduce sidewall check if not removed.*

INFLATION OF TIRES

Correct inflation pressure is one of the most important elements of tire care. The inflation pressure recommended for any model of car is carefully calculated to give a correct balance of satisfactory ride, stability, steering, tread wear, cord life and resistance to stone bruises.

Tire pressure, with tires cold, should be checked monthly or more often depending on driving habits, and also before any extended trips. Pressures should be changed, if necessary, to conform to specifications.

NOTE: *Maintain 4 to 8 psi more in rear than in front tires of station wagons and heavily loaded sedans to prevent over-steer and rear end sway.*

Under average driving conditions, it is normal for tire pressure to increase approximately 6 psi due to increased tire temperature. Check tire pressure with an accurate gage under cold conditions.

NOTE: *High tire pressure may be incurred due to rapid accelerating and braking, high speeds or extended trips. This is normal under these conditions, and should not be reduced.*

Tire valve caps should always be reinstalled on the valve (push caps on tire valve extensions). They assist in keeping air in the tire in case of a valve leak, and keep dust and water out of the valve.

Higher than recommended inflation pressure can cause:

1. Hard ride.
2. Tire bruising or carcass damage directly under the tread.
3. Poor traction at rear wheels resulting in uneven wear.
4. Rapid tread wear at center of tire.

Lower inflation pressures than recommended can cause:

1. Tire squeal on turns.
2. Hard steering.
3. Rapid and uneven wear on the edges of tire tread.
4. Tire rim bruises and various types of rupture.
5. Tire cord fatigue or breakage.
6. Tramp and shimmy troubles.
7. High tire temperatures.
8. Car roll when turning a corner or making a sharp swerve in traffic.

TIRE ROTATION

NOTE: *Inspect disc brake linings for wear each time the tires are rotated. See Section 5E, Lining Inspection.*

Tire noises due to uneven tire wear are often improperly diagnosed as bearing, wheel or rear axle malfunctions resulting in unnecessary work. To minimize tire noise and equalize wear, it is recommended that tires be rotated approximately every 6,000 miles as shown in Fig. 10-5. This will prevent undue wear on any particular tire which might cause excessive noise. When rotating tires, do not neglect the spare since tires deteriorate through disuse. Wheels and tires should be balanced on car at time of rotation.

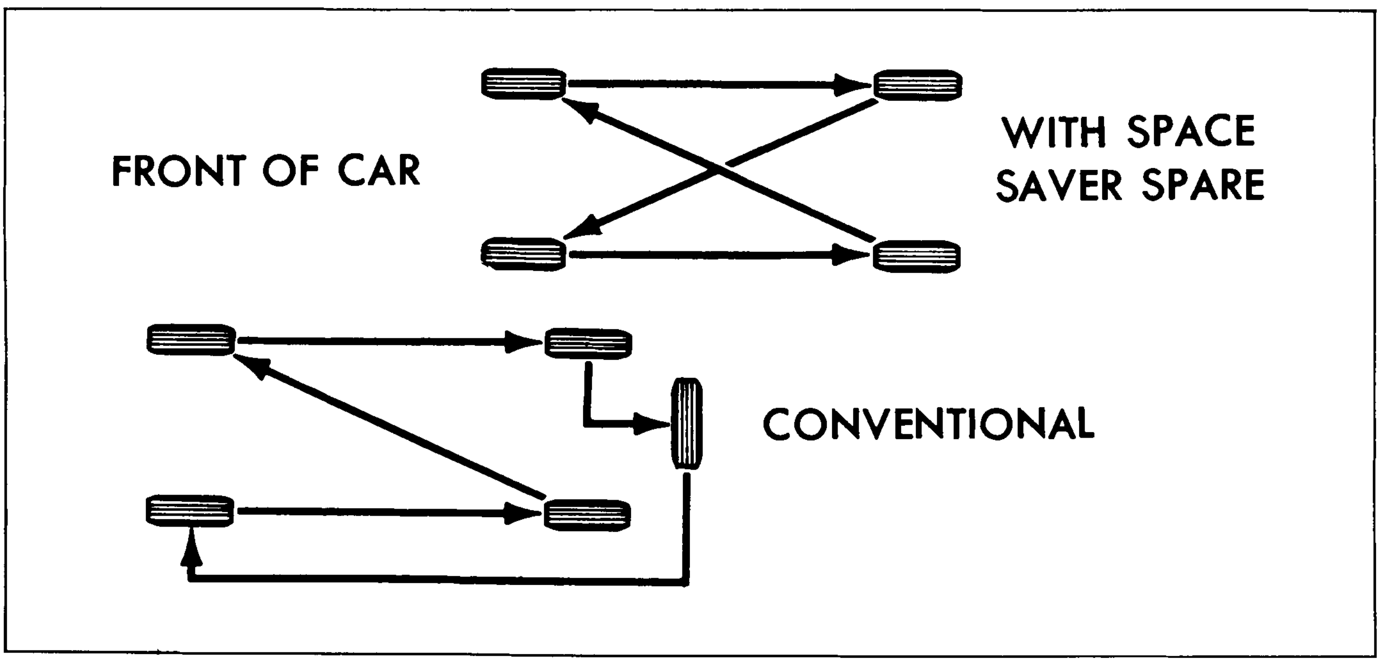


Fig. 10-5 Tire Rotation Diagram

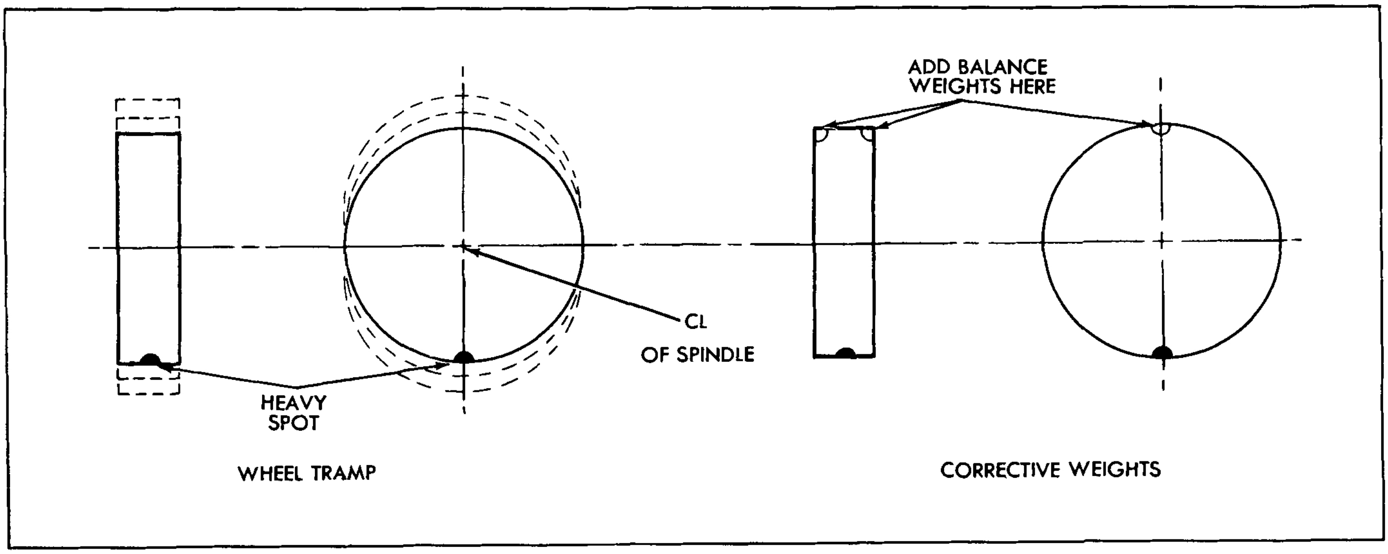


Fig. 10-6 Static Unbalance Correction

Each time tires are changed they should be inspected for signs of abnormal wear, bulging, stones, nails, glass, etc.

WHEEL AND TIRE BALANCE

There are two types of wheel and tire assembly balance-static and dynamic.

Static balance is the equal distribution of weight around the axis of rotation (spindle) such that the wheel and tire assembly has no tendency to rotate by itself, regardless of its position, Fig. 10-6. Wheels that are statically unbalanced cause a hopping or bouncing action called wheel tramp as the tire rolls along the highway and, if severe, will eventually cause wear and damage to the tire.

Dynamic balance is the equal distribution of weight about the plane of rotation, Fig. 10-7, such 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 a vibration to occur while the car is turning.

Improper balance will cause objectional vibrations or resonances in the vehicle and should always be checked and corrected as part of a vibration diagnosis procedure. Balance should also be checked when wheels, tires or brake drums are replaced in service. Under normal conditions, static unbalance has more adverse effect than dynamic unbalance.

Wheel and tire assemblies are balanced in production to a static balance specification of 3 1/2 inch ounces (approximately 1/2 ounce weight at wheel rim). In this procedure, balance weights totaling a maximum of six ounces are

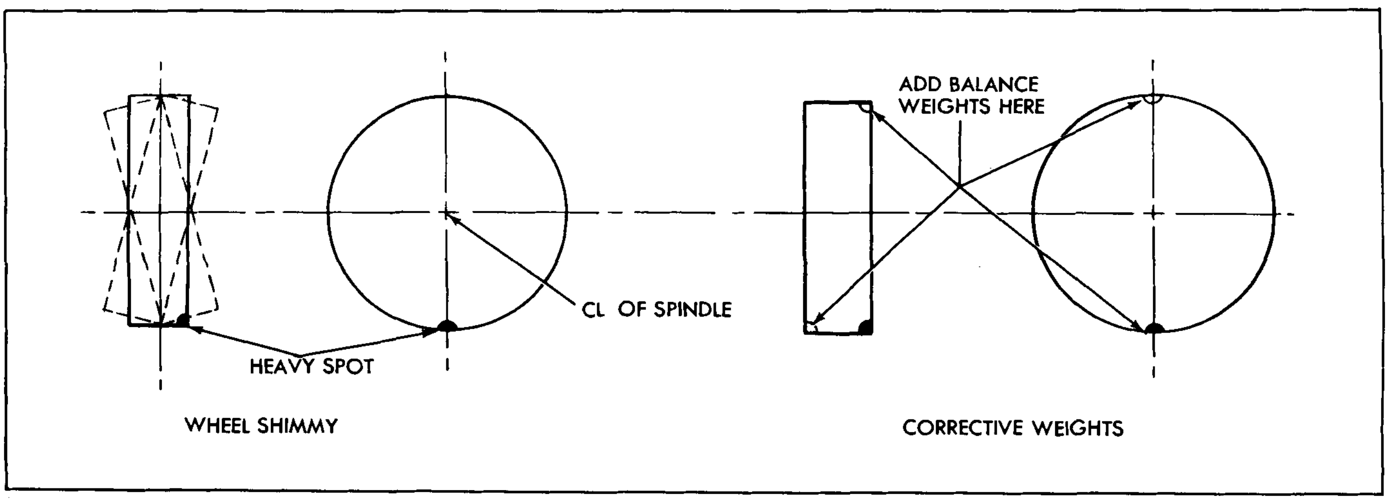


Fig. 10-7 Dynamic Unbalance Corrections

MODELS	STANDARD INFLATION FOR ALL LOADS INCLUDING FULL RATED (POUNDS PER SQUARE INCH COOL)		OPTIONAL INFLATION FOR REDUCED LOADS (750 LBS. MAX.)	
	Front	Rear	Front	Rear
CATALINA with G78 x 15 Tires	26	30	26	24
BONNEVILLE & GRANDVILLE 2-Door & 4-Door and Catalina with H78 x 15 Tires	24	28	24	24
B SERIES Station Wagons	24	32	24	28
A SERIES Station Wagons	24	32	24	28
F SERIES	26	26	26	24
G SERIES & G.T.O.	24	28	24	24
All Other Models	26	28	26	24
X Series (Pressure Depends on Vehicle Weight - Consult Placard On Left Front Door)	24 26	28 26	24 26	24 26

Load Limit: Sedans 1100 LBS., Station Wagons 1200 LBS., Cars with Bucket Seats 950 LBS., All F Series 800 LBS.

Fig. 10-8 Tire Inflation Pressures

applied to the wheel rim flanges 180° from the heavy spot. If total weight requirement is three ounces, the weights are split half inside and half outside the wheel to maintain a satisfactory dynamic balance. Wheel and tire assemblies requiring more than six ounces are replaced.

RECOMMENDED TIRE INFLATION PRESSURES

NOTES ON CHART:

1. Tire inflation pressures may increase as much as 6 pounds per square inch (psi) when hot.
2. For continuous high speed operation (over 75 mph) increase tire inflation pressures 4 p.s.i. over the recommended pressures up to a maximum of 32 pounds per square inch cold for B rated tires, or 40 pounds per square inch for D rated tires. Sustained speeds above 75 mph are not recommended when the 4 pounds per square inch adjustment would require pressures greater than maximum stated above.
3. Cold tire inflation pressure: after vehicle has been inoperative for 3 hours or more, or driven less than 1 mile. Hot tire inflation pressure: after vehicle has been driven 10 miles or more at 60-70 miles per hour.
4. Station Wagon loads should be distributed as far forward as possible.
5. Vehicles with luggage racks do not have a vehicle load limit greater than specified.
6. When towing trailers, the allowed passenger and cargo load must be reduced by an amount equal to the trailer tongue load on the trailer hitch.

MINOR REPAIRS

TEST FOR LEAKS

1. Use soapy water to check valve for leaks. In many cases air loss can be corrected by simply tightening the valve core.
2. If the reason for air loss is not obvious, submerge the complete wheel assembly in a tank of water.
3. Mark the tire and rim at the point where air is escaping.

TIRE MOUNTING AND DISMOUNTING INSTRUCTIONS:

Because of a tight wheel to tire design, it is necessary to use a vegetable oil soap solution as a lubricant, and mount and dismount with the outboard side of the wheel up. Use of a non-drying lubricant may cause tire to "walk" around the rim and effect tire balance.

RALLY II AND HONEYCOMB WHEELS

In order to mount this type of wheel on a tire changing machine it is necessary to first remove the center ornament.

The Rally II ornament is held in place by six tabs (three of which have teeth that snap against the wheel) and the honeycomb ornament by three tabs. Remove the ornament from the front after prying loose these three tabs from *inside* the wheel (Fig. 10-9).

WHEEL STUD - REMOVE AND REPLACE

CAUTION: *When replacing wheel studs, the car should be driven 10 miles with the new stud and the nut should then be re-torqued to take up initial stretch in new stud.*

FRONT:

1. Support the hub and drum or rotor assembly with approximately 1" diameter by 5" long pipe or other suitable tool directly under and surrounding the stud to be removed and press out the stud.

   CAUTION: *If hub and drum or rotor are not supported underneath, pressure from the press may distort the drum or rotor or push the hub assembly away from the drum.*

2. Clean out the existing hole in front drums by drilling through the hub and drum assembly. (A and X Series only). Use a 9/16" (.5625) drill.

3. Drums - Press in replacement stud. Rotor - Insert new stud and pull through with wheel nut (flat side of nut against rotor).

REAR:

1. Remove stud using J 5504 as shown in Fig. 10-10.

2. Insert new stud and pull through with wheel nut (flat side of nut against axle).

   CAUTION: *Stud must be pulled through with drum removed to prevent distortion.*

REMOVE TIRE FROM WHEEL

1. Remove valve cap and valve core, and let out all air.

2. With valve hole side of tire up, break beads away from rim. Use only conventional bead-breaker type machine.

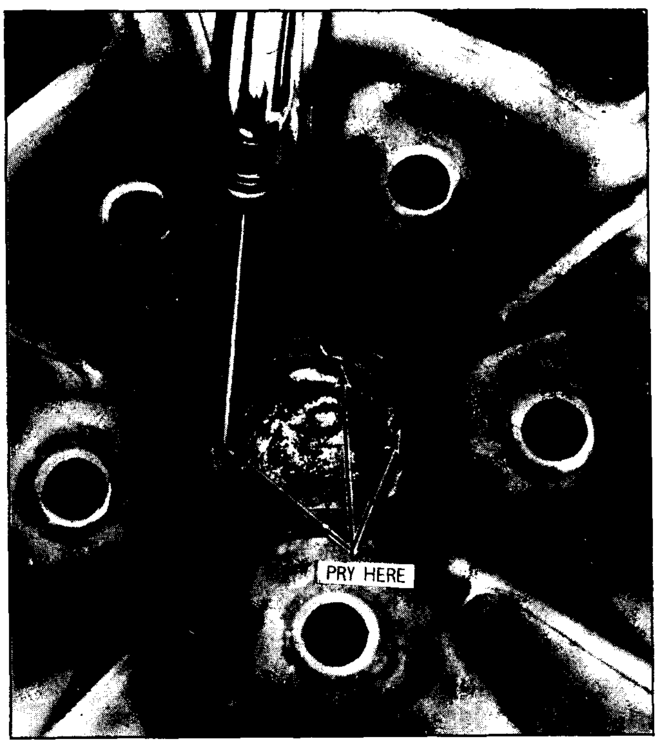


Fig. 10-9 Removing Ornament From Rally II Wheel

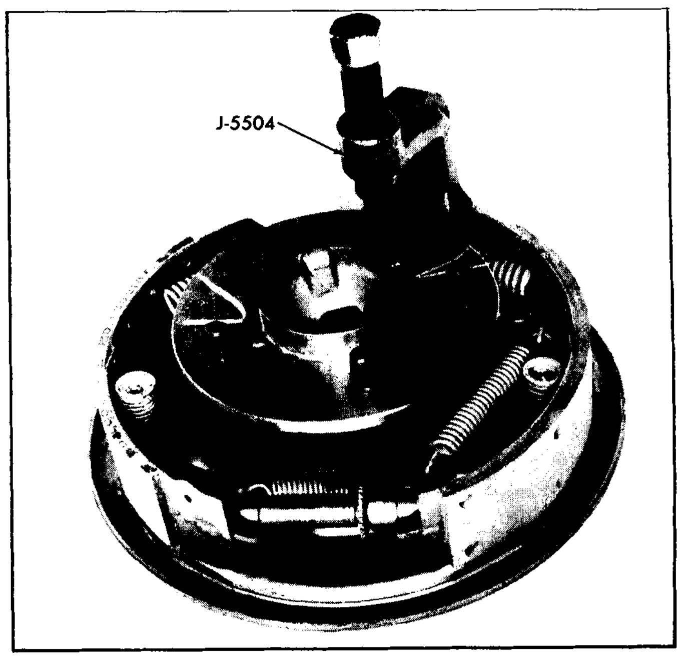


Fig. 10-10 Removing Rear Stud

CAUTION: *During the entire operation of breaking beads away from rim and removing tire from rim, special care should be taken not to damage the tire beads.*

3. Use standard tire-changing machine to remove tire.

PUNCTURE REPAIRS

Puncture repairs may be quickly and permanently performed, using one of several kits available through tire manufacturer's dealer outlets. "Hot patch" types are recommended for puncture repairs.

WHEEL LEAKS

Examine rim flanges for sharp dents. Any dent visible to the eye should be straightened. NEVER USE HEAT when straightening a wheel.

CAUTION: *Under no circumstances should wheels be brazed, welded or peened. In the event the wheel is severely damaged, it should be replaced.*

PREPARATION OF TIRE

Remove excess strings of rubber hanging from tire bead.

PREPARATION OF RIM

1. Clean rim flanges with small piece of No. 3 coarse steel wool or emery cloth to remove all oxidized rubber, soap solution or rust. If rim is badly pitted, use file to remove and PAINT WITH PRIMER.

2. Straighten or replace bent or damaged rim.

MOUNTING TIRE ON WHEEL

1. Install new valve if valve was removed. Always install type T.R. 413 valve or equivalent.

2. Apply liberal amounts of vegetable base soap solution.

   NOTE: *A non-drying type lubricant may cause the tire to walk around the rim in service.*

3. Mount tire on the wheel with valve hole side up, using the machine method.

4. Remove valve core from stem to increase flow of air.

5. With casing on the rim so that the beads are resting uniformly on the bead ledge, quickly apply a large volume of air. This forces the bead on the bead seat and against the flanges where the air seal for the tire is obtained. Inflate tire until beads are completely forced against rim flanges.

WARNING: DO NOT STAND OVER TIRE WHEN INFLATING. BEAD WIRE MAY BREAK WHEN BEAD SNAPS OVER SAFETY HUMP. DO NOT EXCEED 40 LB. AIR PRESSURE WHEN INFLATING. IF 40 LBS. PRESSURE WILL NOT SEAT BEADS PROPERLY, DEFLATE, LUBRICATE AND REINFLATE.

6. Once beads are seated against rim flanges, air pressure can be released.

7. Install valve core and inflate to proper specifications.

8. General precautions in mounting tires:

   a. Use tire mounting and dismounting machine.

   b. Do not use hammer or tire irons.

   c. Work over rim flange so that the section nearest the valve stem will be applied last.

INSPECTION BEFORE BALANCING WHEELS AND TIRES

1. Check and if necessary, adjust front wheel bearings as outlined in Section 3.

2. Set tire pressure to cold specifications and drive car until tires are hot.

3. Attach a dial indicator to the car body or stationary support and check runout as shown in Fig. 10-11.

Runout measurements for the whole assembly (Fig. 10-11 steps 1 and 4) are the most significant.

Excessive total lateral or radial runout of wheel and tire assemblies can sometimes be reduced within specifications by rotating the tire on the wheel until the high spot on the tire indexes with the low spot on the wheel. If this procedure fails to bring the total radial or lateral runout within specifications, check for damaged or improperly mounted tire, bent or distorted wheel, and variations in tread surface due to wear and correct as necessary.

BALANCE PROCEDURE

The preferred method of balancing wheels and tires is with on-the-car type equipment; but, whether on or off car-type

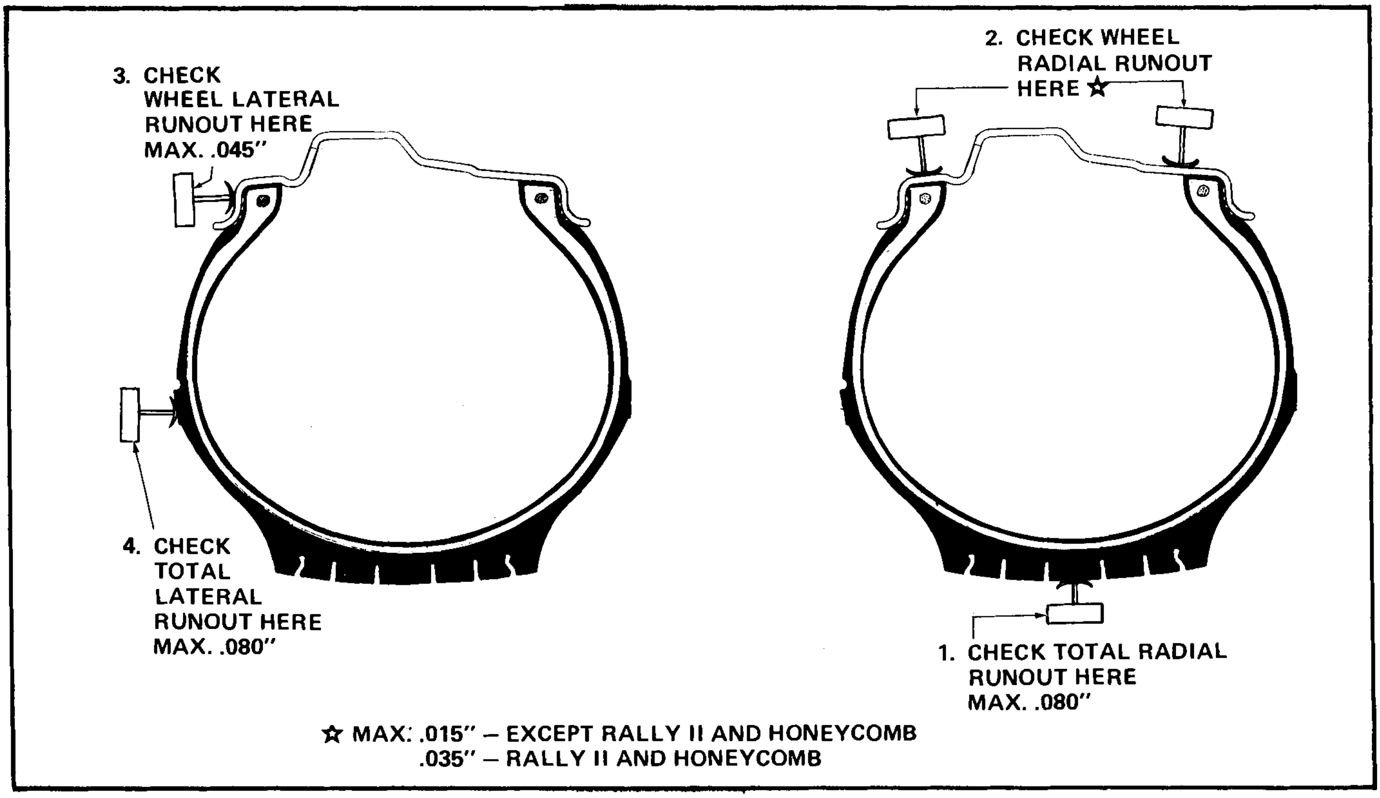


Fig. 10-11 Measuring Runout

equipment is used, always follow the manufacturer's instructions for the equipment being used. In addition, pay particular attention to the following points:

1. Be sure tires are free of stones or other foreign objects that may become wedged in the tread. Be sure wheels are free of mud and brake drums do not drag on brake shoes.

2. Be sure tires are at normal operating temperatures (hot).

   NOTE: *Always split weight evenly between inside and outside of wheel to avoid changing dynamic balance.*

3. Wheels and tires must be balanced statically before being balanced dynamically. Recheck static balance after dynamic balance.

   NOTE: *When using an on-car balancer to balance the the front wheels of any 1972 model with disc brakes, the following procedure should be used. Using a screw driver, pry with steady pressure against the back of the caliper (Fig. 10-12) to push the piston into its bore. Be careful not to pinch any lines, fittings or the bleeder valve. While prying, rotate wheel until drag is removed. If wheel does not rotate freely after piston is bottomed, pry gently as illustrated to free inboard shoe.*

4. Clean the master cylinder cover area, remove cover and siphon out enough fluid from front half of master

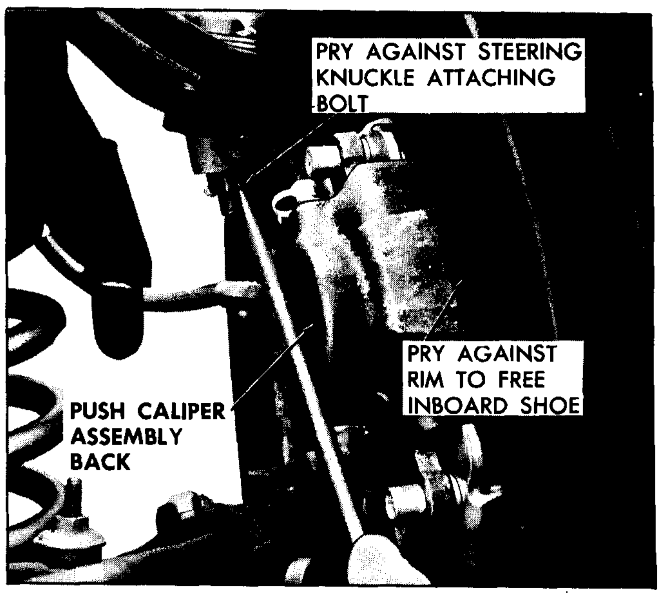


Fig. 10-12 Releasing Drag on Disc Brake Rotor

cylinder to bring the level down to 1/4-in. below the lowest edge of the filler opening. Replace the cover but do not clamp it into place.

5. Balance wheels.

6. After balancing, pump up brakes until the pedal returns to normal height.

7. Re-fill master cylinder (Fig. 5-6).

NOTE: *When balancing rear wheels on the car, always check to see if car is equipped with Safe-T-Track differential. Never balance Safe-T-Track-equipped car with one wheel on ground as car may move when engine is started and transmission is in drive gear.*

WARNING: WHEN BALANCING TIRES ON THE CAR, FOLLOW THE EQUIPMENT MANUFACTURER'S INSTRUCTIONS CAREFULLY. ON CARS WHICH DO NOT HAVE SAFE-T-TRACK, 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, RESULTING IN POSSIBLE TIRE DISINTEGRATION OR DIFFERENTIAL FAILURE, WHICH COULD CAUSE PERSONAL INJURY OR EXTENSIVE VEHICLE DAMAGE.

ON CARS WHICH DO HAVE SAFE-T-TRACK, DRIVE WHEEL PIN SHOULD BE LIMITED TO 70 MPH. ON SUCH CARS, DO NOT ATTEMPT TO BALANCE A TIRE ON A DRIVE WHEEL WITH THE OTHER DRIVE WHEEL ON THE GROUND SINCE THE CAR MAY DRIVE THROUGH THIS WHEEL.

If car is equipped with Safe-T-Track rear axle, the balancing of the rear wheels should be performed as follows:

a. Raise and block the rear of the vehicle with both wheels off the floor.

b. Remove one wheel.

c. Reinstall two (2) lug nuts and tighten securely to retain the brake drum.

d. Proceed with balancing operation on the remaining wheel using engine power to spin the wheel.

e. When proper balance has been achieved on first wheel, reinstall the second wheel and balance in the same manner.

8. When balancing rear wheels on the car, remember that: with one wheel on the ground, speedometer speed is one-half (1/2) rear wheel speed. With both wheels off the ground, speedometer speed is the same as rear wheel speed.

INSTALLING WHEELS

CAUTION: *See Caution on page 1 of this Section regarding the fasteners referred to below.*

Wheel lug nuts must be gradually and alternately torqued to 75 lb. ft. for B Series or 70 lb. ft. for A, F, X or G Series. Improper tightening will distort the wheel or the brake drum.

SPECIFICATIONS

WHEELS

Material	Steel
Type	Drop Center - with flat safety hump
Diameter	B Series 15"
	G and X Series 14"
	A and F Series 14" and 15"
Width	B Series 6"
	G Series 7"
	A Series 5", 6" and 7"
	F Series 6" and 7"
	X Series 5" and 6"

TORQUE

B Series Wheel to Drum Nut	
Front and Rear	75 Lb. Ft.
A, F, X and G Series Wheel to Drum Nut	
Front and Rear	70 Lb. Ft.

WHEEL CODES		
USAGE	SIZE	CODE
	B SERIES	
STANDARD	15x6"	BX
STATION WAGON	15x6"	AK
COMMERCIAL CHASSIS	15x6"	SB
	A SERIES	
STANDARD - 8 CYL. AND WAGON	14x6"	CZ, HF
STANDARD 6 CYL. NON-WAGON	14x5"	KL, YD, DD
OPTIONAL	15x7'	AH
RALLY II	14x6"	KT
RALLY II (OPTIONAL)	15x7"	KR
HONEY COMB	14x7"	JX
HONEY COMB	15x7"	KP
	G SERIES	
STANDARD	14x7"	CL or JZ
RALLY II	14x7"	KS
HONEY COMB	14x7"	JX
SPACE SAVER SPARE	14x6"	NONE
	F SERIES	
STANDARD (with E78 x 14 Tire)	14x6"	AM
STANDARD (exc. E78 x 14 Tire)	14x7"	CL
OPTIONAL	15x7"	AH
RALLY II	14x7"	KS
RALLY II (Optional)	15x7"	KR
HONEY COMB	15x7"	KP
SPACE SAVER SPARE	14x6"	NONE
	X SERIES	
STANDARD	14x5"	DD
SPRINT OPTION	14x6"	AM
RALLY II	14x6"	KU

Fig. 10-13 Wheel Code Chart

B SERIES				
Models	Standard	Optional	Trailer Provisions	Heavy Trailer Provisions
Catalina and Brougham Without A/C, H.D. Suspension or 455 Engine (H.O.)	G78x15*[1]	H78x15*[1] J78x15*[1]	H78x15†[2]	H78x15†[2]
All Other B Series Except as Listed Below	H78x15*[1]	J78x15*[1]	H78x15†[2]	H78x15†[1]
Station Wagons	L78x15*[1]	—	L78x15†[2]	—
Freeway Enforcer	H78x15*[2]	—		—
Light & Medium Duty Police	H78x15*[1]	J78x15*[1] H78x15*[2]	H78x15†[2]	H78x15†[2]
Stageway Coach	8.90x15†[5]	—	—	—
Ambulance	L78x15†[1]	—	—	—

A & G SERIES				
Models	Standard	Optional	Trailer Provisions	Space Saver Spare
G Series	G78x14*[1]	—	G78x14†[2]	G78x14*[4]
G.T.O. Option	G70x14*[1]	G60x15*[1]	—	—
Station Wagon	H78x14*[1]	—	—	—
6 Cyl. Except LeMans Sport Convertible	E78x14*[1]	G70x14*[1] G78x14*[1] F 78x14*[1]	—	—
6 Cylinder LeMans Sport Convertible, LeMans Luxury Except 4 Door Hardtop, 8 Cyl. LeMans (except 455) without Endura Front Bumper and A/C	F78x14*[1]	G70x14*[1] G78x14*[1]	G78x14†[2]	—
LeMans Luxury 4 Door Hardtop, LeMans with 455, LeMans with Endura Bumper and A/C	G78x14*[1]	—	G78x14†[2]	—

F SERIES				
Models	Standard	Optional	Trailer Provisions	Space Saver Spare
Firebird and Esprit	E78x14*[1]	F70x14*[1] F78x14*[1]	—	E78x14*[4] F78x14*[4]
Formula	F70x14*[1]	F60x15*[1]	—	F78x14*[4]
Trans Am	F60x15*[1]	—	—	F78x14*[4]

X SERIES				
Models	Standard	Optional	Trailer Provisions	Space Saver Spare
All Except Sprint	E78x14*[6]	E78x14*[1] E70x14*[2]	—	—
Sprint	E78x14*[1]	E70x14*[1]	—	—

* Load Range B
† Load Range D
1. 2 Body Plys & 2 Belted Plys
2. 4 Body Plys & 2 Belted Plys
3. 4 Body Plys
4. 2 Body Plys & 1 Belted Ply
5. 6 Body Plys
6. 2 Body Plys

Fig. 10-14 Tire Usage Chart

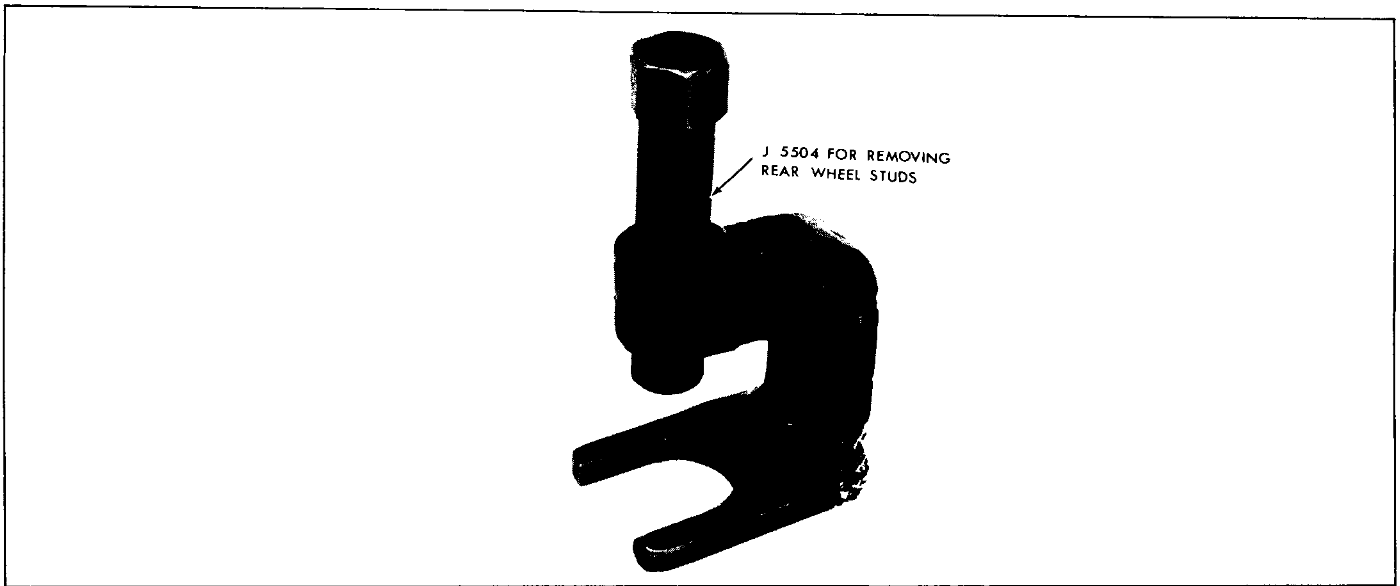


Fig. 10-15 Special Tool

SECTION 11

CHASSIS SHEET METAL

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. There are four types of hoods used on the 1972 models. All Series use the standard conventional hood. The GTO, GT and Formula 400 models have a hood that incorporates two hood scoops. The Formula 400 hood is constructed of fiberglass. The Trans-Am model uses a steel hood which incorporates an opening in the hood for the air cleaner to protrude through (Refer Section 6B).

ADJUST

Slotted holes are provided at all hood hinge attaching points (Fig. 11-1) for proper adjustment; both vertically and fore and aft.

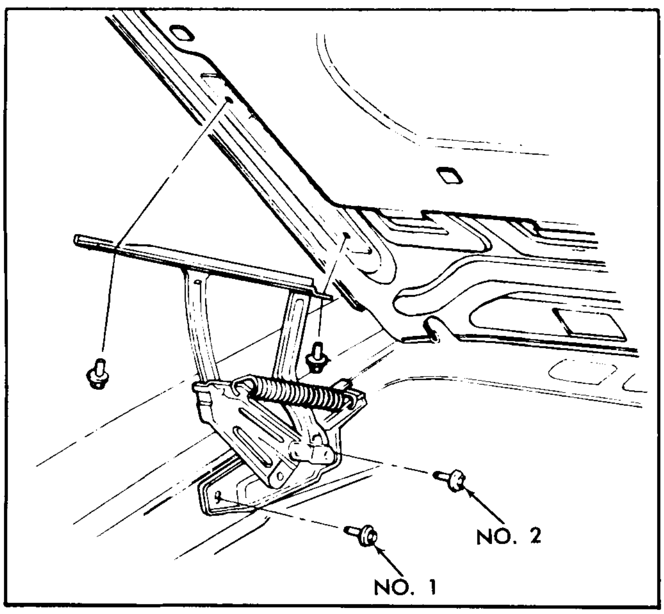


Fig. 11-1 Hood Attachment Typical

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 bolt no. 1 (Fig. 11-1).
2. Force hood open as high as possible to move front of hinge upward.
3. Tighten fender connection.
4. If further adjustment is required, loosen rear end of hinge mounting bracket to fenders at bolt no. 2 and repeat steps 2 and 3.
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 jam nut on adjustable hood bumper and raise or lower as required.
5. Tighten jam nut.

REMOVE

1. Open hood.
2. Scribe line on hood inner panel to indicate original hinge position.

3. Loosen hood hinge to hood attaching bolts.
4. With aid of a helper, hold hood securely and remove attaching bolts.
5. Lift hood assembly from sheet metal.

REPLACE

To replace simply reverse above procedure checking hood alignment. Adjust one hinge at a time as outlined in steps 4 and 5 under HOOD ADJUSTMENT.

HOOD LATCH

The G, A, F and X Series have a positive locking hood latch, which incorporates a safety catch with the pilot assembly. The hood latch being fastened to the radiator support and baffle assembly locks securely with the latch plate mounted in the hood (Fig. 11-2, 11-3, 11-4, 11-5 and 11-6).

The B Series has a cable release, positive locking two piece hood latch (Fig. 11-7 and 11-8) also located in the radiator support and baffle assembly. The cable is of a two piece construction. There is a hand released safety catch mounted on the underside of the hood.

After proper positioning of the hood bumpers, hood height is automatically controlled by the vertically self-adjusting hood latch. Proper hood alignment is essential for ease of latch operation.

To open the hood, pull the release handle under the center portion of the front bumper grille downward. A "pop-up" spring on the radiator support and baffle assembly provides initial opening of the hood upon release.

To fully open the hood, pull the release handle past the detent position pushing down on hood slightly (on B and X Series release safety catch), then lift hood.

> **NOTE:** *If the cable on the B Series fails to release the hood latch, release can be made by reaching up between the bumper and radiator support and manually releasing latch.*

> **NOTE:** *G Series and A Series Luxury LeMans have the release handle below the bumper. A Series except Luxury LeMans and F Series have the handle located in the grille.*

If hood latch binds severely, it may be adjusted laterally as follows:

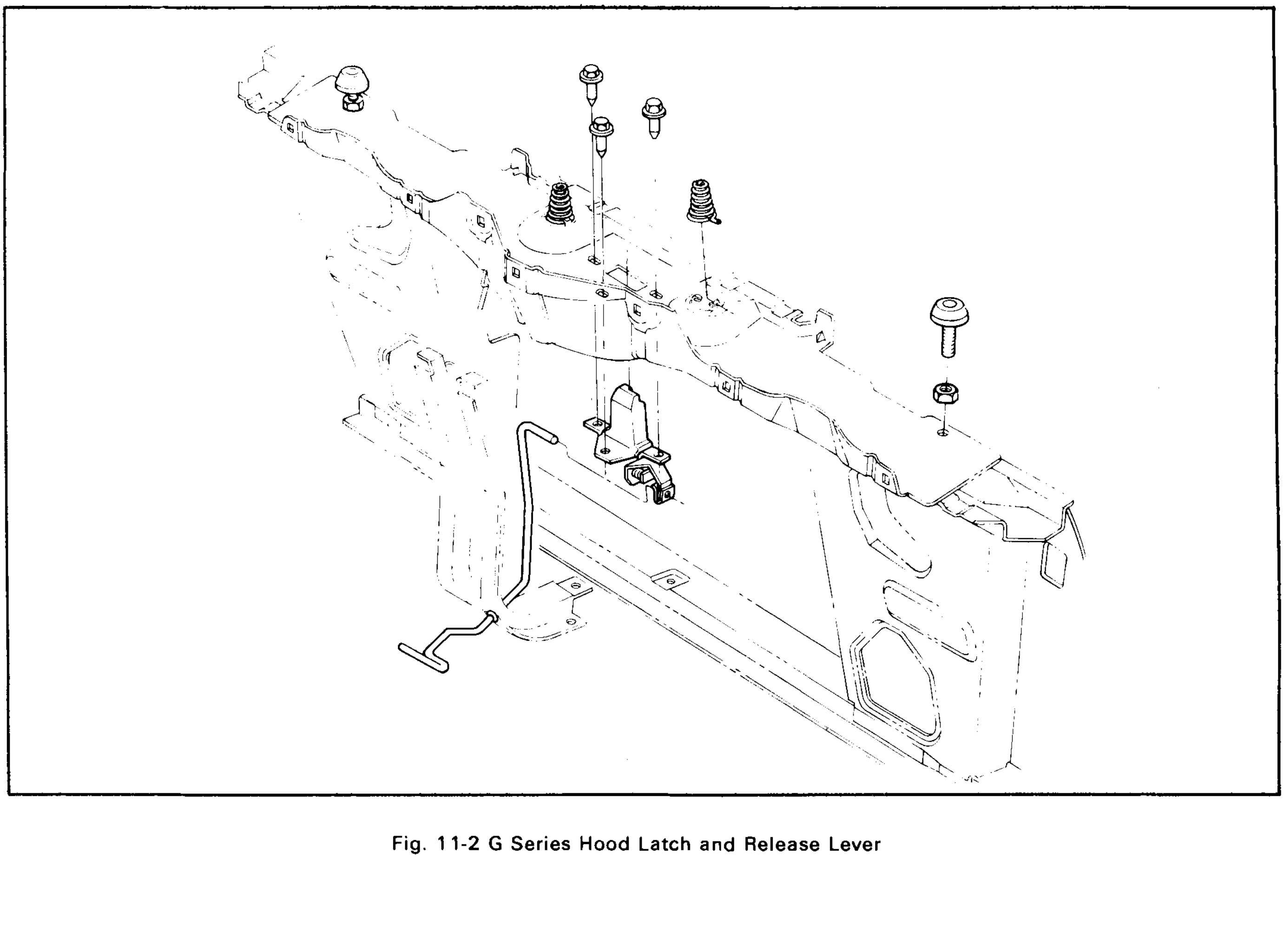


Fig. 11-2 G Series Hood Latch and Release Lever

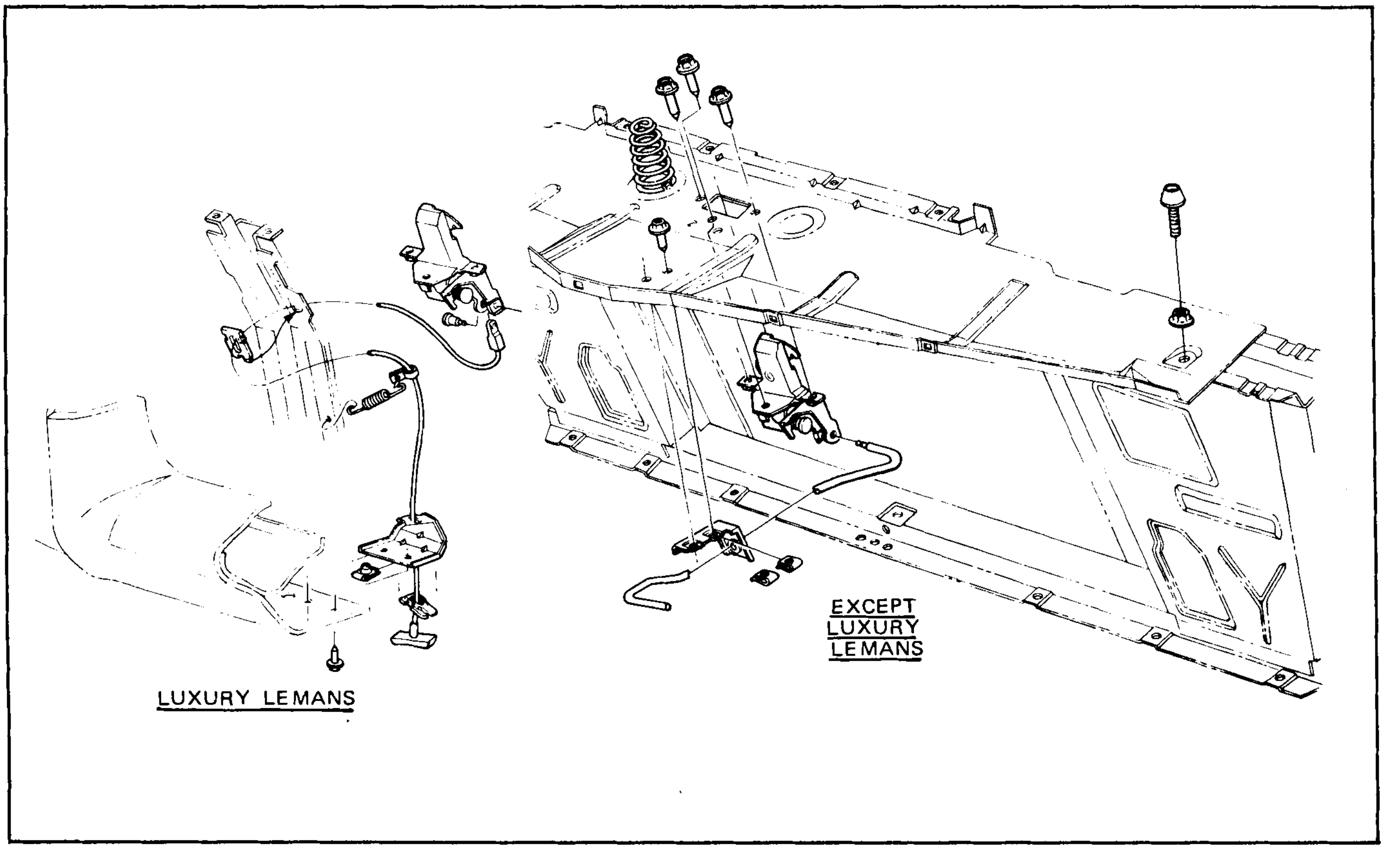


Fig. 11-3 A Series Hood Latch and Release Lever (Except GT and GTO)

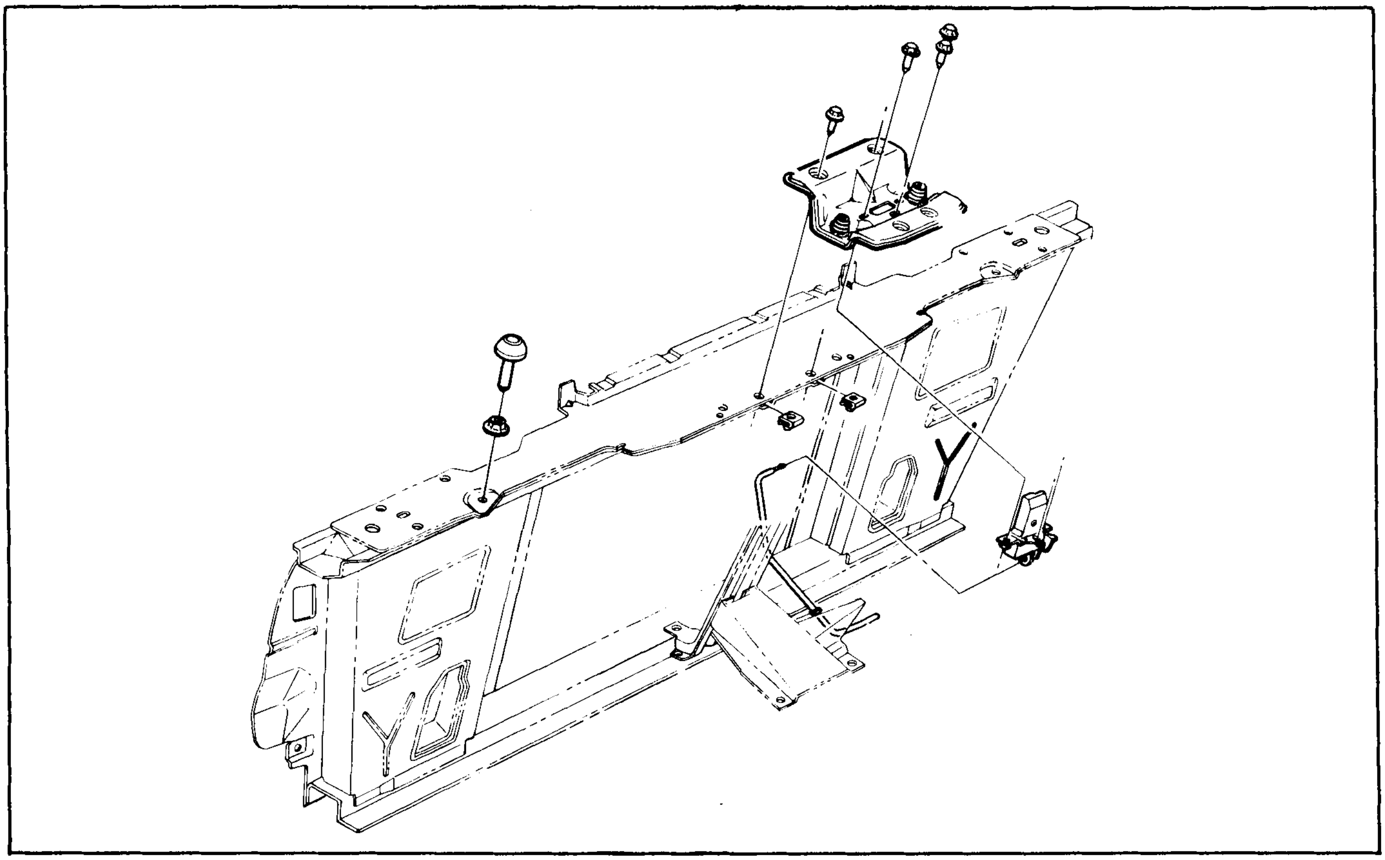


Fig. 11-4 GT and GTO Hood Latch and Release Lever

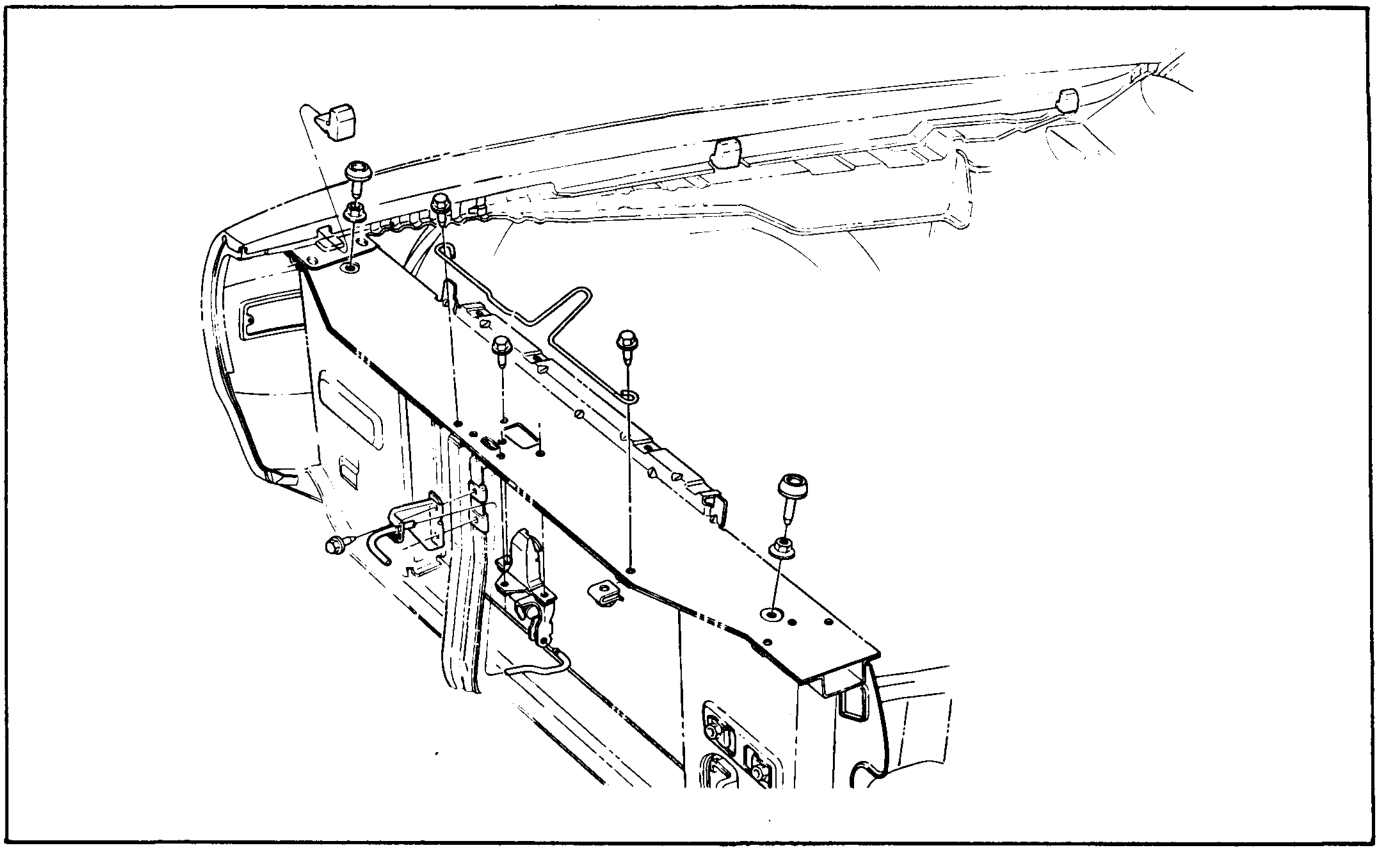


Fig. 11-5 F Series Hood Latch and Release Lever

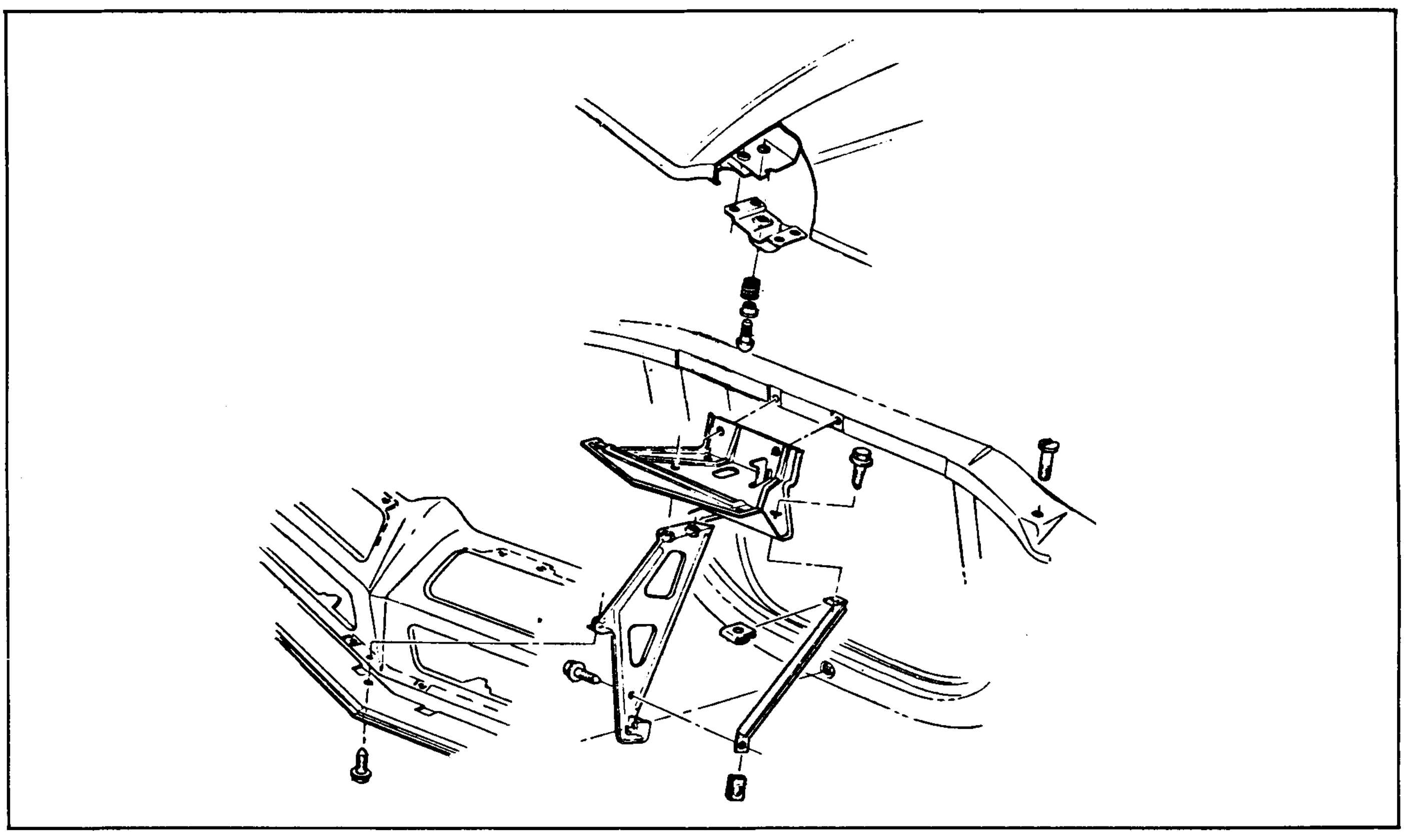


Fig. 11-6 X Series Hood Latch and Release Lever

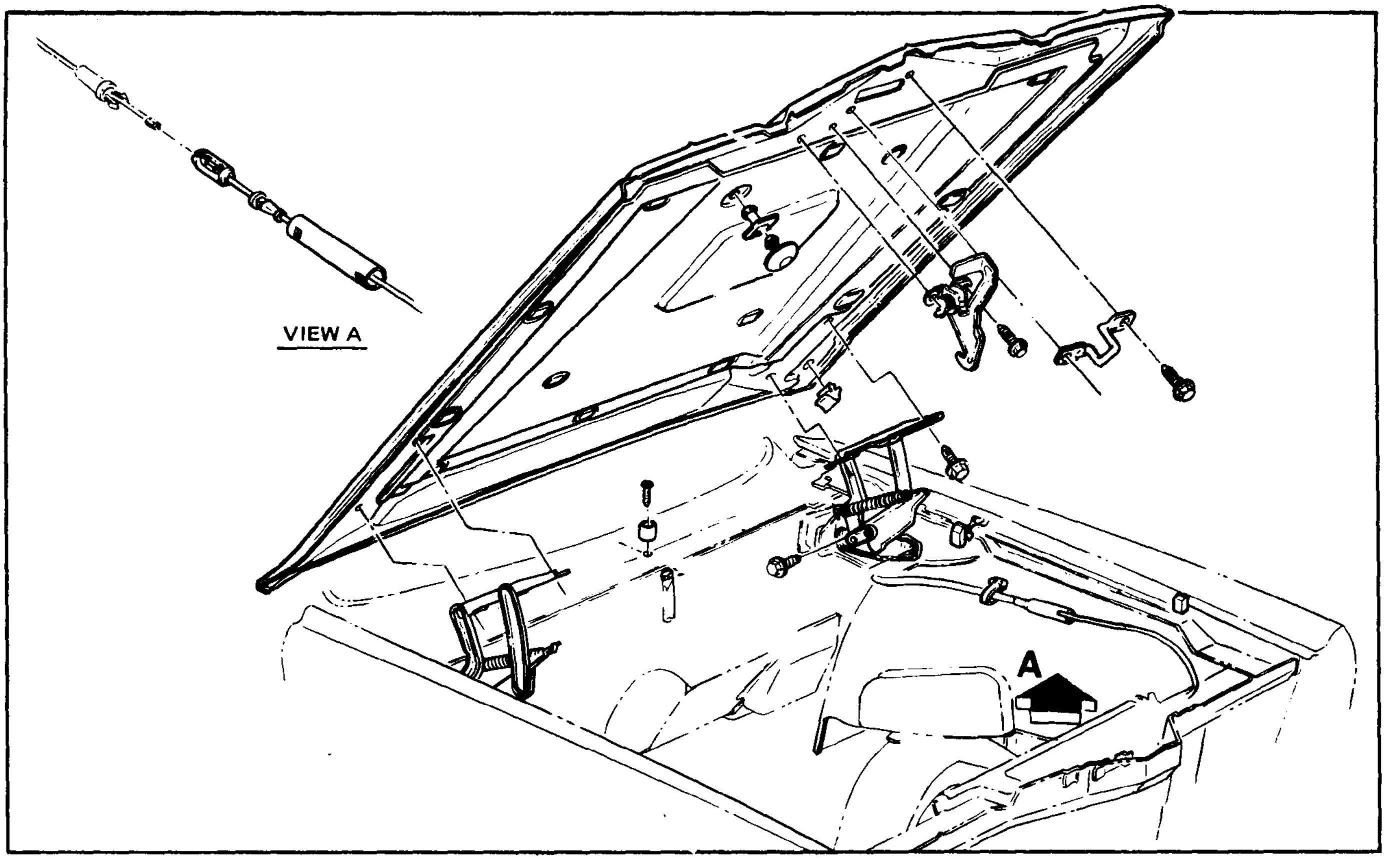


Fig. 11-7 B Series Hood Striker and Release Cable

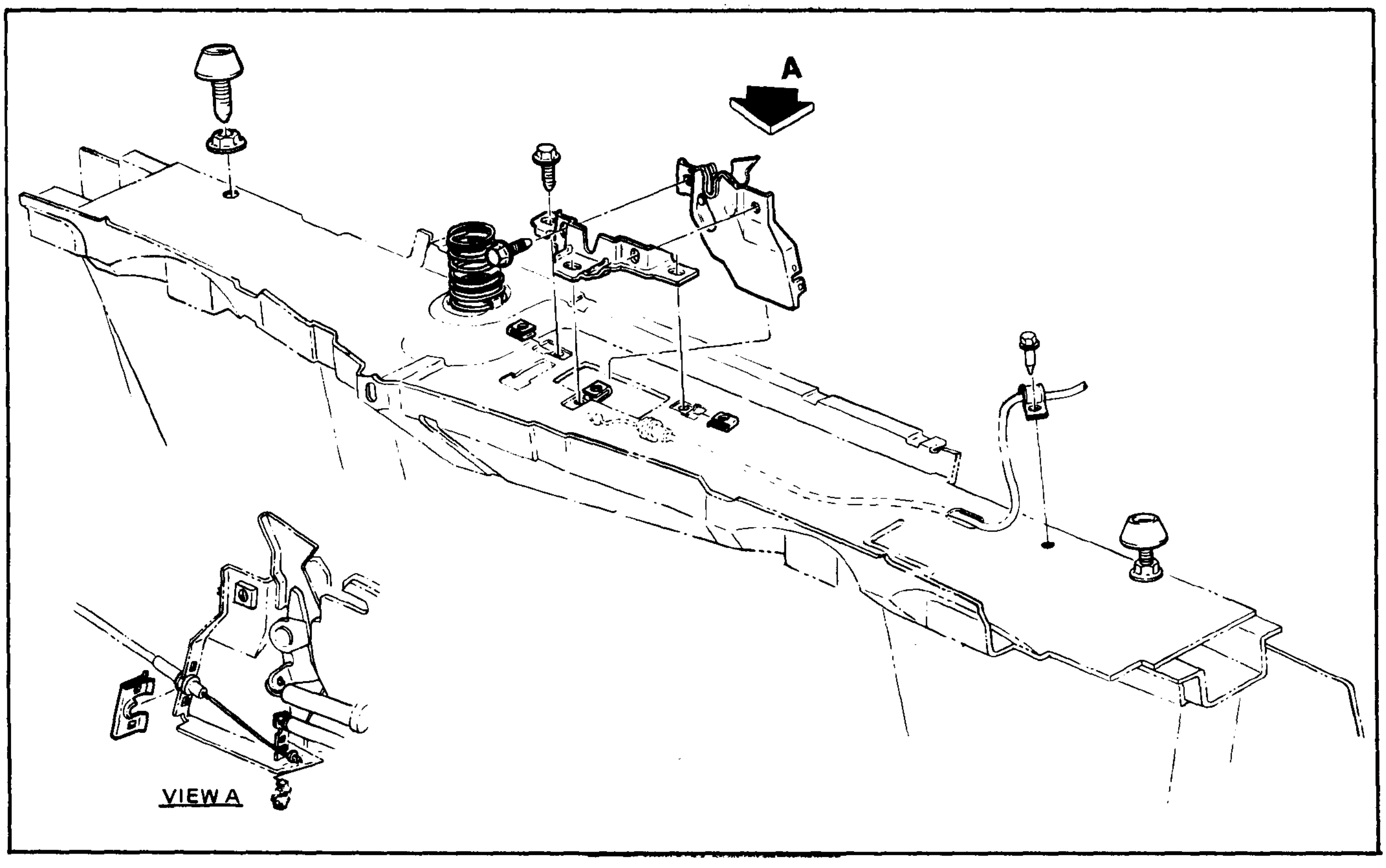


Fig. 11-8 B Series Hood Latch

1. Loosen latch attaching bolts, finger-tight.
2. Push down on hood, holding the hood closed while pulling the release lever.
3. Let hood open and tighten bolts in new location.

HOOD RELEASE CABLE (B SERIES)

The B Series Hood Latch Release Cable (Fig. 11-7) consists of two cables junctioned by means of a coupling which is mounted in the engine compartment on the left hand inner fender skirt. The inner cable (release handle to coupling) is mounted on the left hand kick panel and is routed through the firewall along the inner fender skirt. The outer cable (coupling to release assembly) routes along the inner fender, into and through the top channel of the radiator support to the release assembly.

REMOVE (INNER CABLE)

1. Disconnect cable at coupling.
2. Loosen sill plate, windshield garnish molding and remove kick panel.
3. Remove grommet and hood release cable from firewall.
4. Remove handle and cable assembly from kick panel.

REMOVE (OUTER CABLE)

1. Disconnect cable at coupling.
2. Remove bumper to radiator support filler (A/C only).
3. Remove hood latch attaching bolts.
4. Remove hood release cable clip on latch assembly.
5. Remove cable from radiator support.

REPLACE

To replace, reverse the above procedure taking precautions to prevent binding of the cable. Check function of the release cable assembly.

HOOD HINGES

Hood hinges (Fig. 11-1) 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 snug.
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 reposition to correct misalignment.
   c. Tighten securely and recheck (torque 20-30 lb. ft.).

FENDERS

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 (Figs. 11-9, 11-10, 11-11, 11-12 and 11-13).

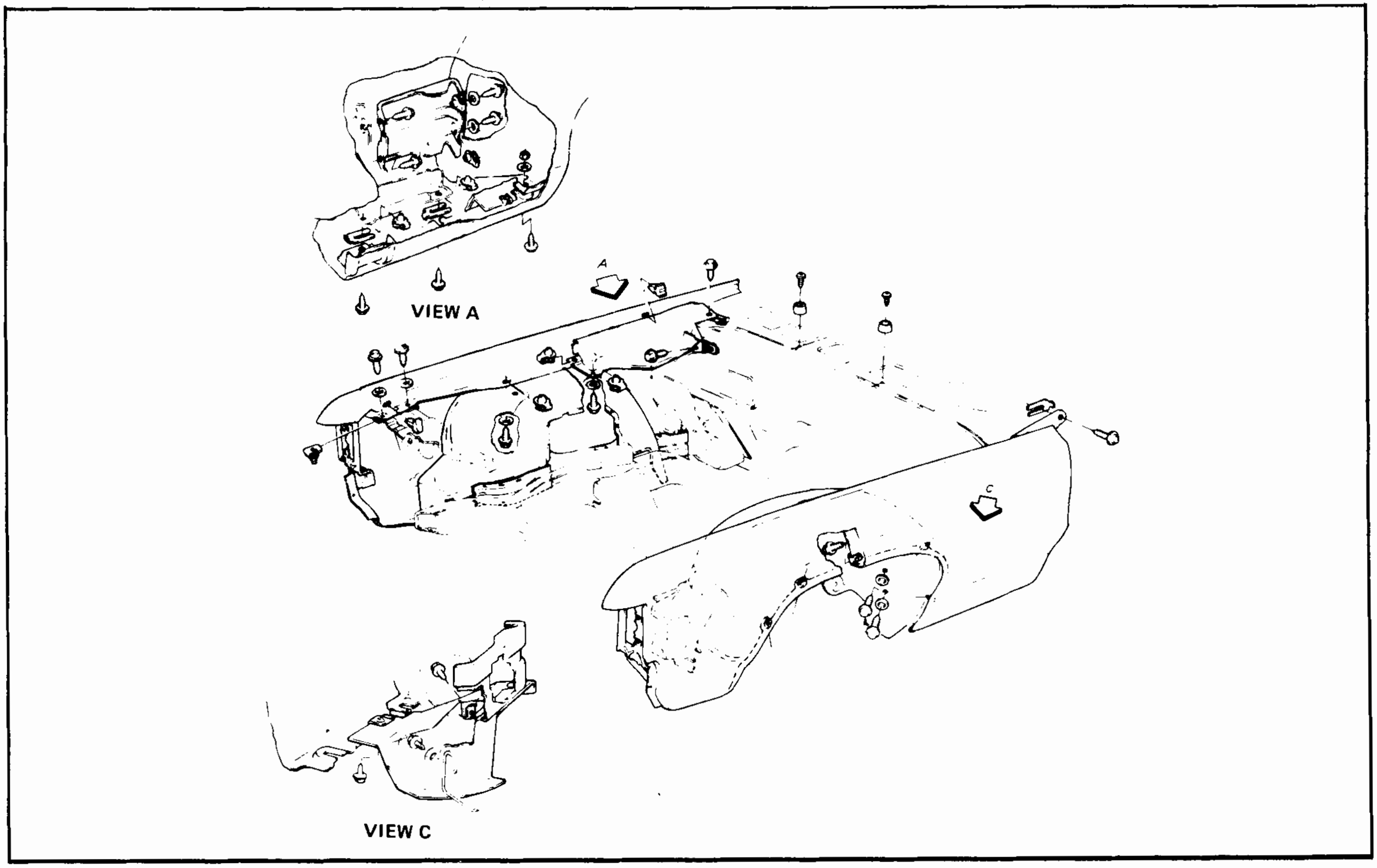


Fig. 11-9 G Series Front Fenders

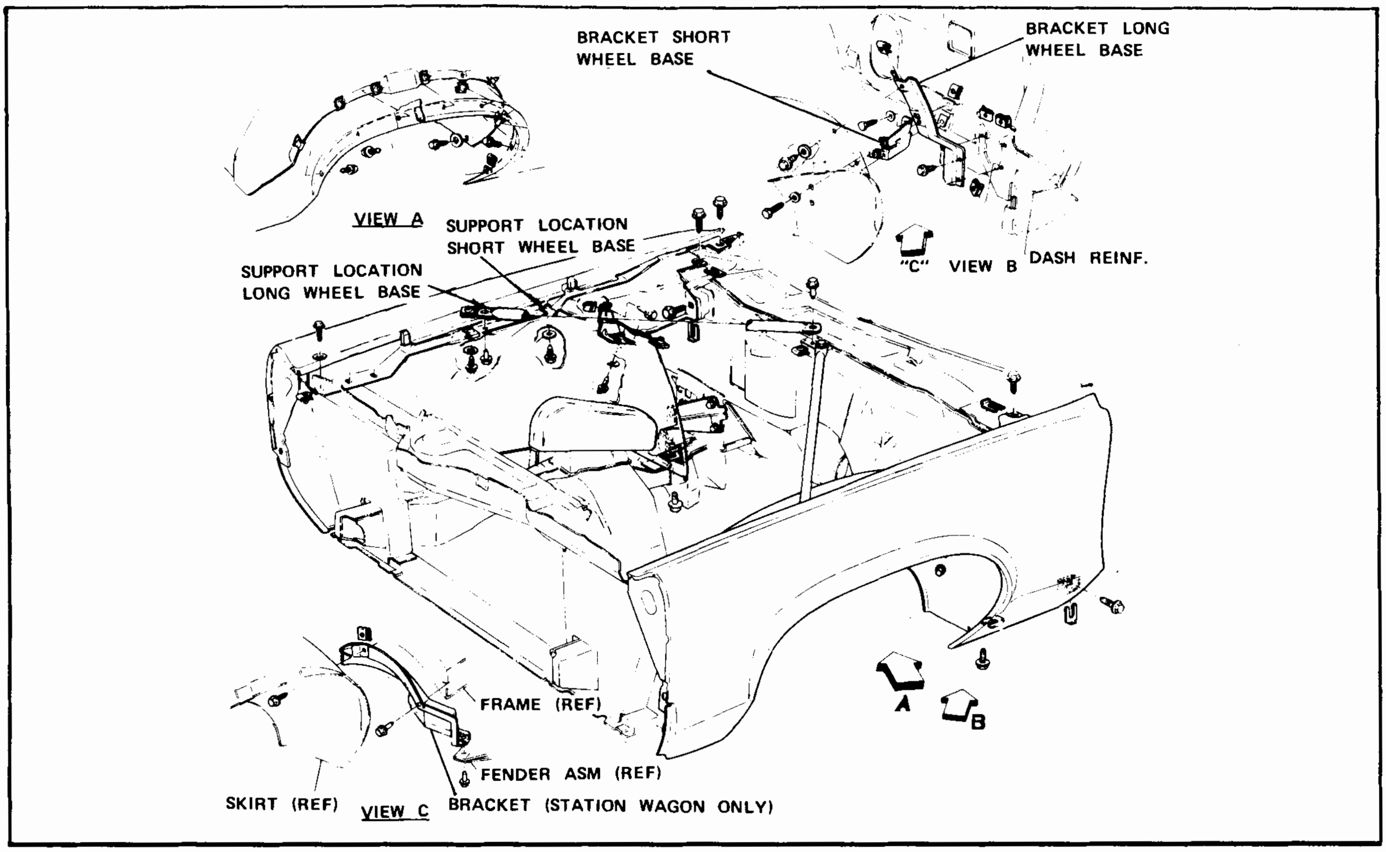


Fig. 11-10 B Series Front Fenders

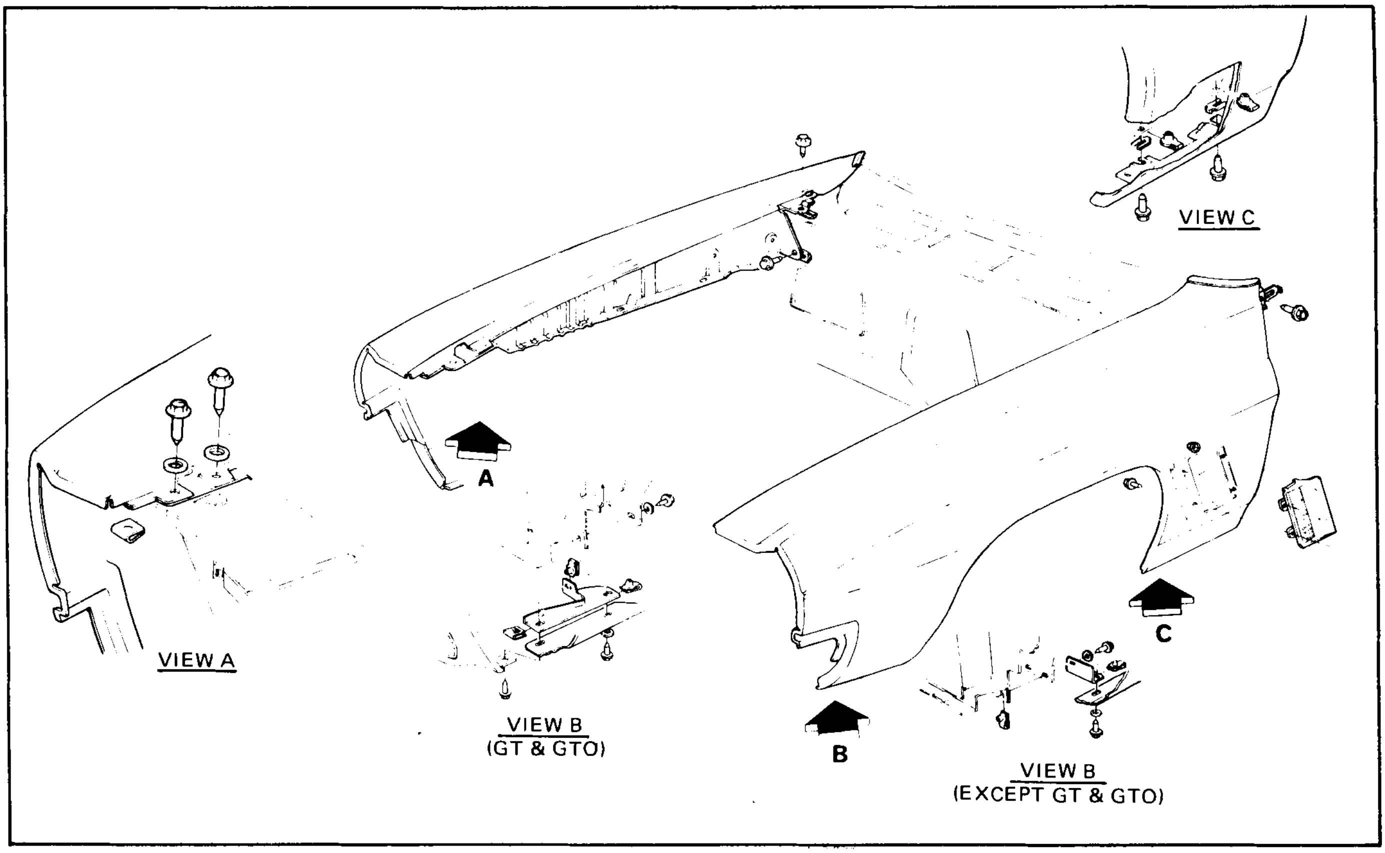


Fig. 11-11 A Series Front Fenders

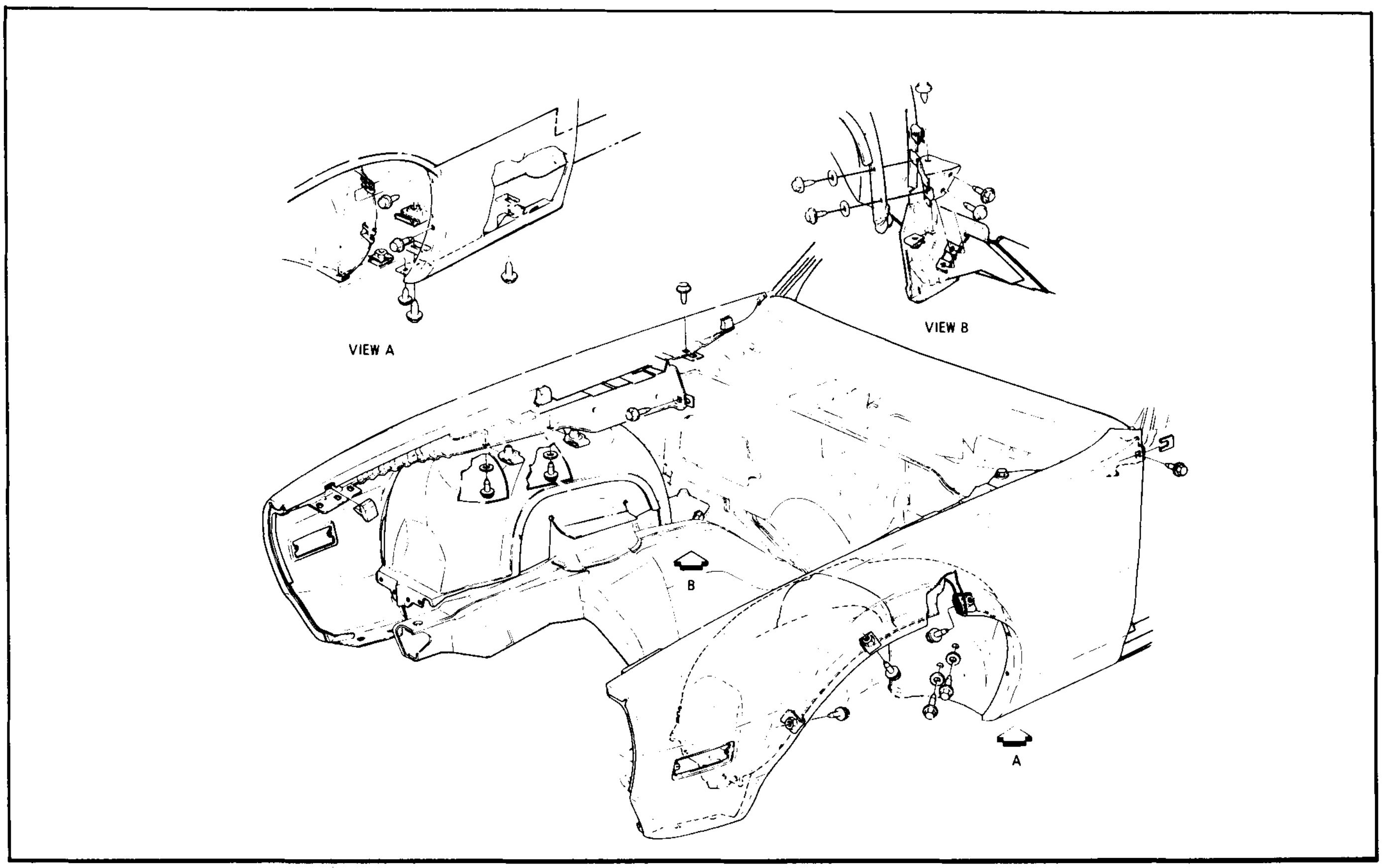


Fig. 11-12 F Series Front Fenders

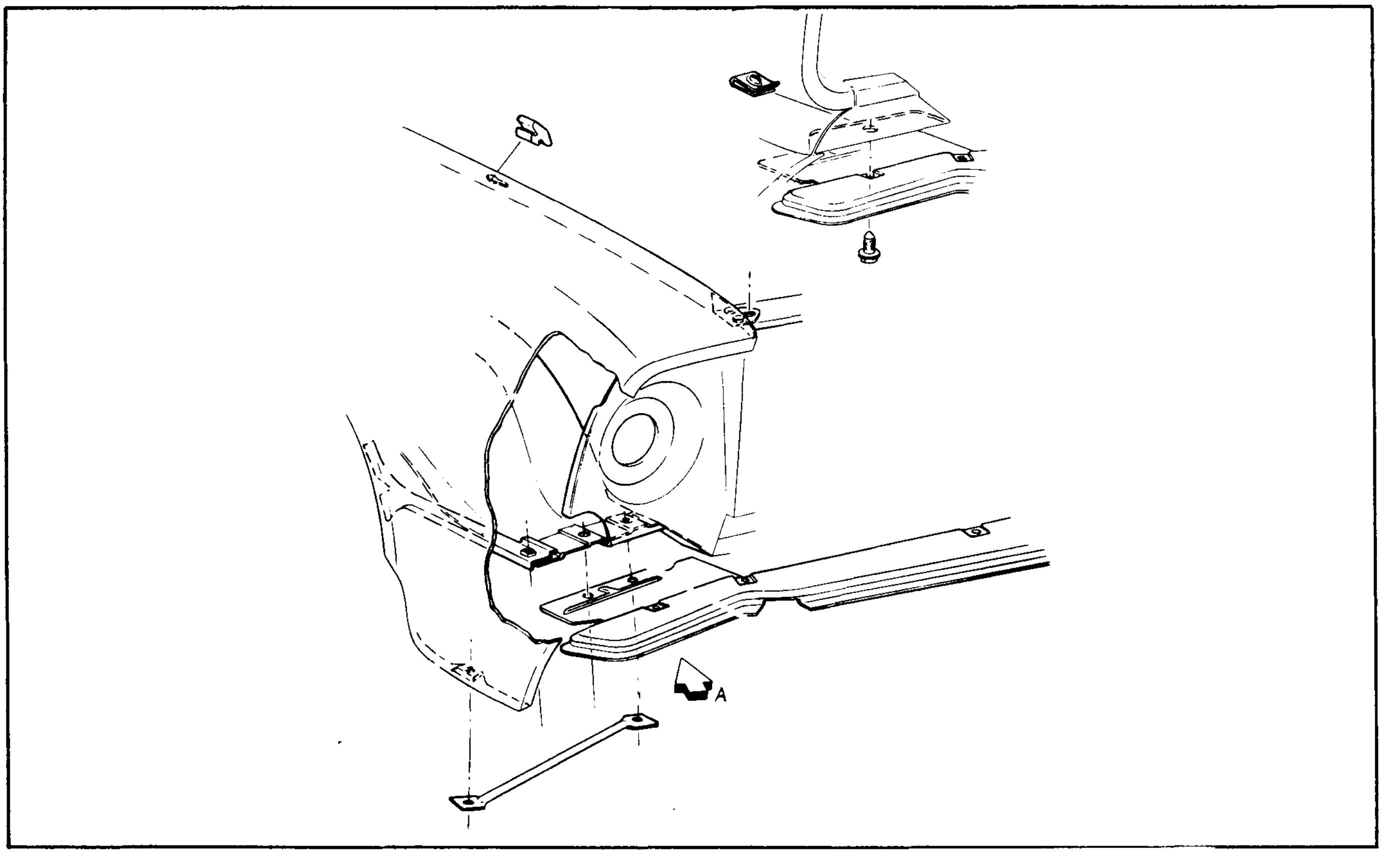


Fig. 11-13 X Series Front Fender

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.

FRONT FENDER

REMOVE

NOTE: *If the same fender is to be replaced, note position, location and number of alignment shims used.*

1. Remove rocker molding to fender attachments.
2. Remove valance panel attachments to fender.
3. Remove fender to support and baffle assembly attaching screws.
4. Remove headlamp filler and fender extension to fender attaching screws.
5. Remove hood hinge to fender attaching screws and block up hood.
6. Remove fender to inner skirt attaching screws at wheelhouse.
7. Disconnect fender from cowl at door opening and from rocker panel area.
8. Remove fender.

REPLACE

1. To install, reverse above procedure.
2. Align fender with other sheet metal and body parts.

Application	Torque
Fender to Skirt	15-22 lbs. ft.
Fender to Lower Body	24-32 lbs. ft.
Fender to Upper Body	30-40 lbs. ft.
Hood Hinge to Fender	20-30 lbs. ft.
Fender to Radiator Support	15-22 lbs. ft.
Fender to Fender Extension	15-22 lbs. ft.
Fender to Headlamp Panel	15-22 lbs. ft.

FRONT INNER FENDER (SKIRT)

REMOVE

1. Disconnect any components attached to fender skirt

such as battery tray, cruise control, hoses, electrical harnesses, etc.

2. Lift front end on frame allowing front suspension to hang free.
3. Install safety stand under frame.
4. Remove wheel assembly.
5. Remove front fender wheel opening molding (if so equipped).
6. Remove inner fender skirt retaining screws.
7. Remove lower fender attaching bolts and rocker panel molding.
8. Pry out and block fender away from frame.

   CAUTION: *Exercise care in pulling fender away from frame to avoid bending fender.*

9. Disengage inner fender skirt lip from outer fender panel by pulling out and down on inner edge of skirt.
10. Remove inner fender skirt by rotating rearward.

REPLACE

1. To replace, reverse above procedure checking fender alignment with other sheet metal and body parts.
2. Torque all fender inner skirt to fender attaching screws 15-22 lb. ft.

HEADLAMP FILLER PANEL OR FENDER EXTENSION

The headlamp filler panels and fender extensions on all series (except A Series) are constructed of fiberglass. The G and B Series panels consist of three separate units, two fender extensions and a headlamp filler panel. The GT and GTO models have a headlamp filler panel on either side of the endura bumper.

NOTE: *Minor cracks and pits can be repaired per the procedure listed below.*

REMOVE - G SERIES (Fig. 11-14)

1. Remove parking lamp lens.

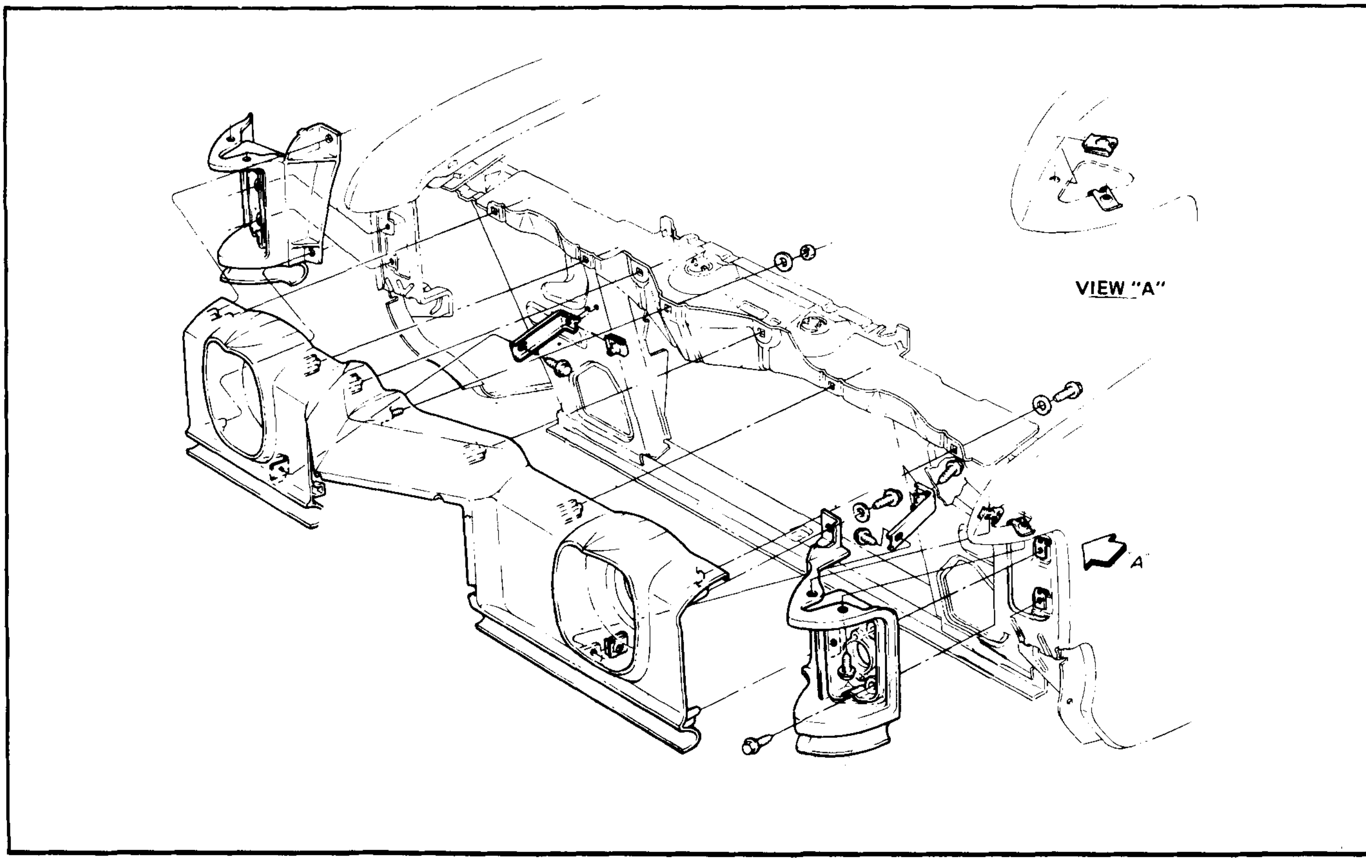


Fig. 11-14 G Series Headlamp Filler Panel and Front Fender Extensions

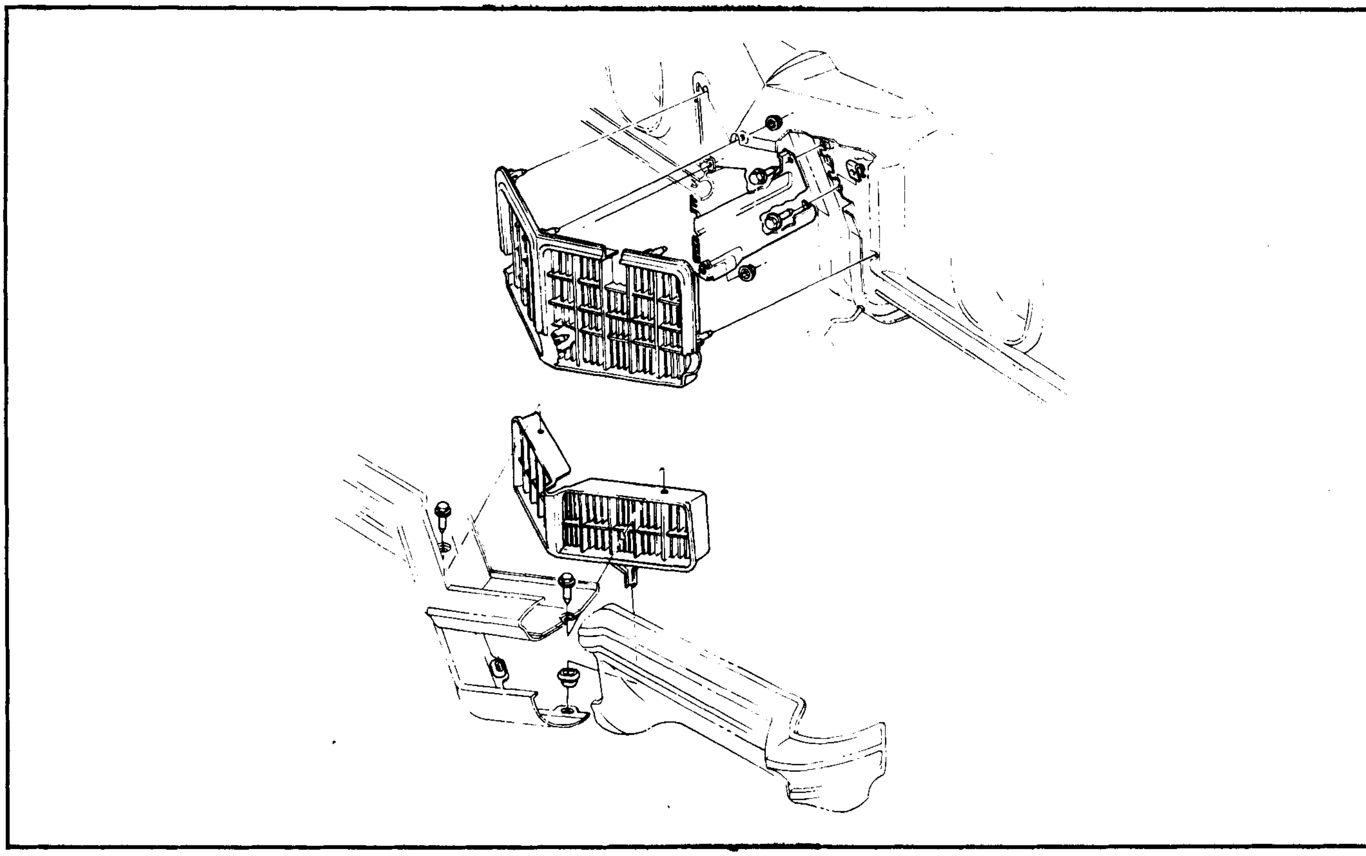


Fig. 11-15 G Series Grille Assembly

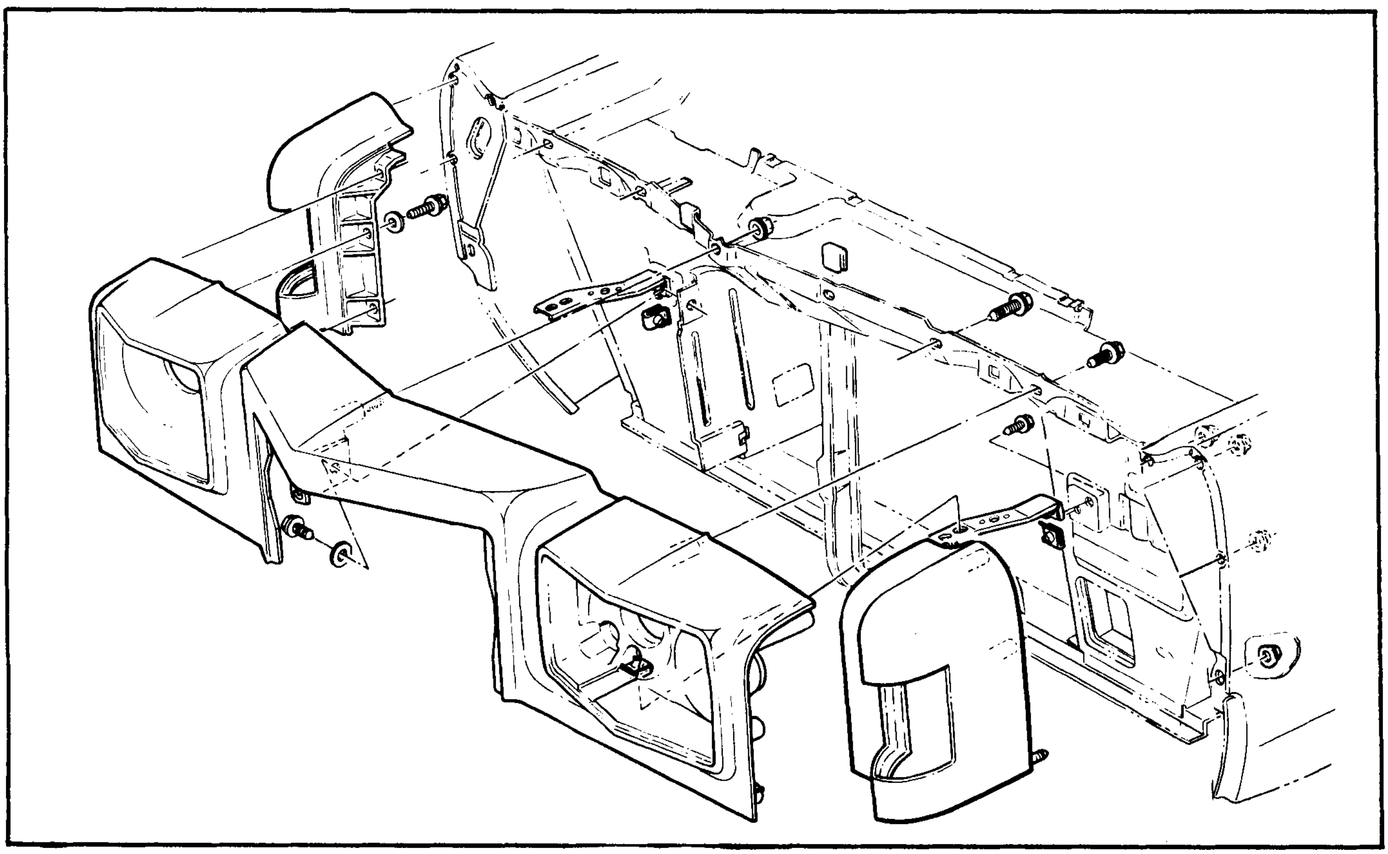


Fig.11-16 B Series Headlamp Filler Panel and Front Fender Extensions

2. Remove fender extension to fender attaching bolts.
3. Remove headlamp filler panel to radiator support attaching bolts.
4. Disconnect electric connectors and remove panel assembly.
5. Separate section and remove headlamp assembly.
6. Remove grille assembly.

REMOVE - B SERIES (Fig. 11-16)

1. Remove front bumper to frame attaching bolt and remove bumper for access.
2. Remove headlamp mounting panel to radiator support attaching screws.
3. Disconnect headlamp wires and remove complete panel assembly.
4. Separate sections and remove grille assembly.
5. Remove headlamp assembly, bumper close out panels and remaining parts.

REMOVE - A SERIES (Refer Fig. 11-18)

1. Remove valance panel.
2. Loosen bumper to frame attaching bolts and move bumper assembly for access.
3. Remove attaching bolts and disconnect headlamp wires.
4. Remove grille assembly.
5. Remove headlamps.

REMOVE - GTO (Fig. 11-18)

1. Remove valance panel.
2. Loosen bumper to frame attaching bolts.
3. Disconnect headlamps.
4. Remove headlamp filler panel attaching screws and remove panel.
5. Remove headlamp assembly.

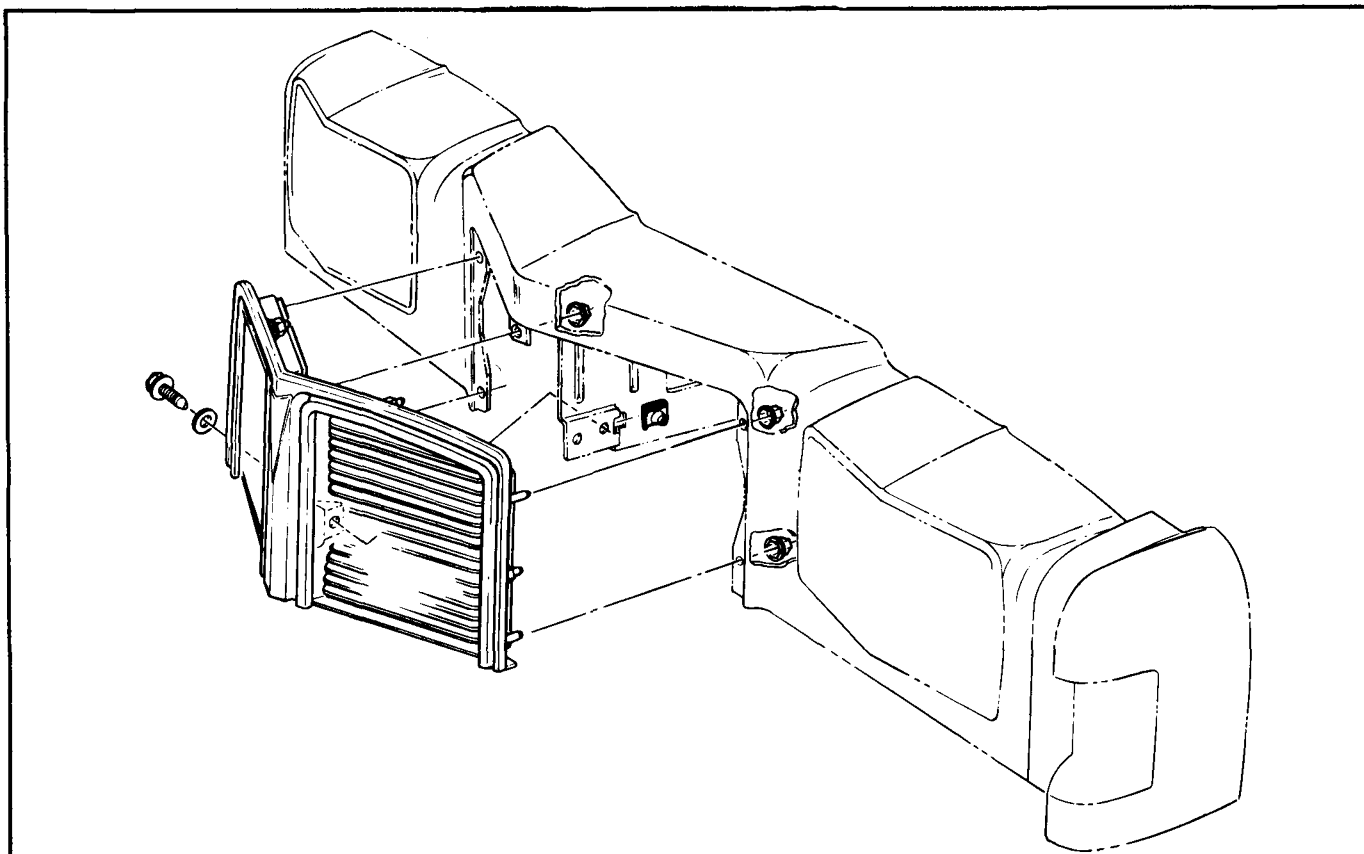


Fig. 11-17 B Series Center Grille Assembly

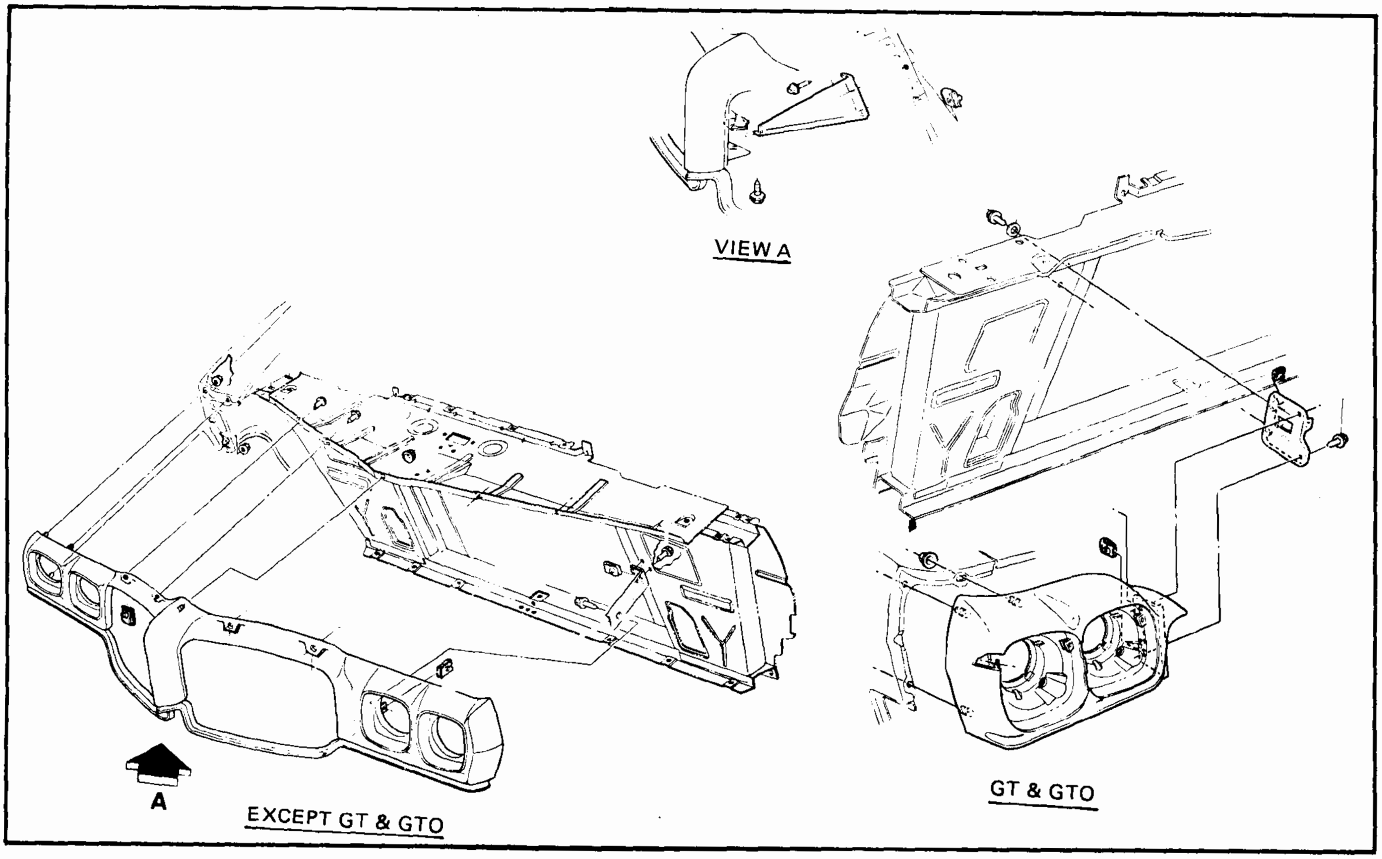


Fig. 11-18 A Series Headlamp Filler Panel

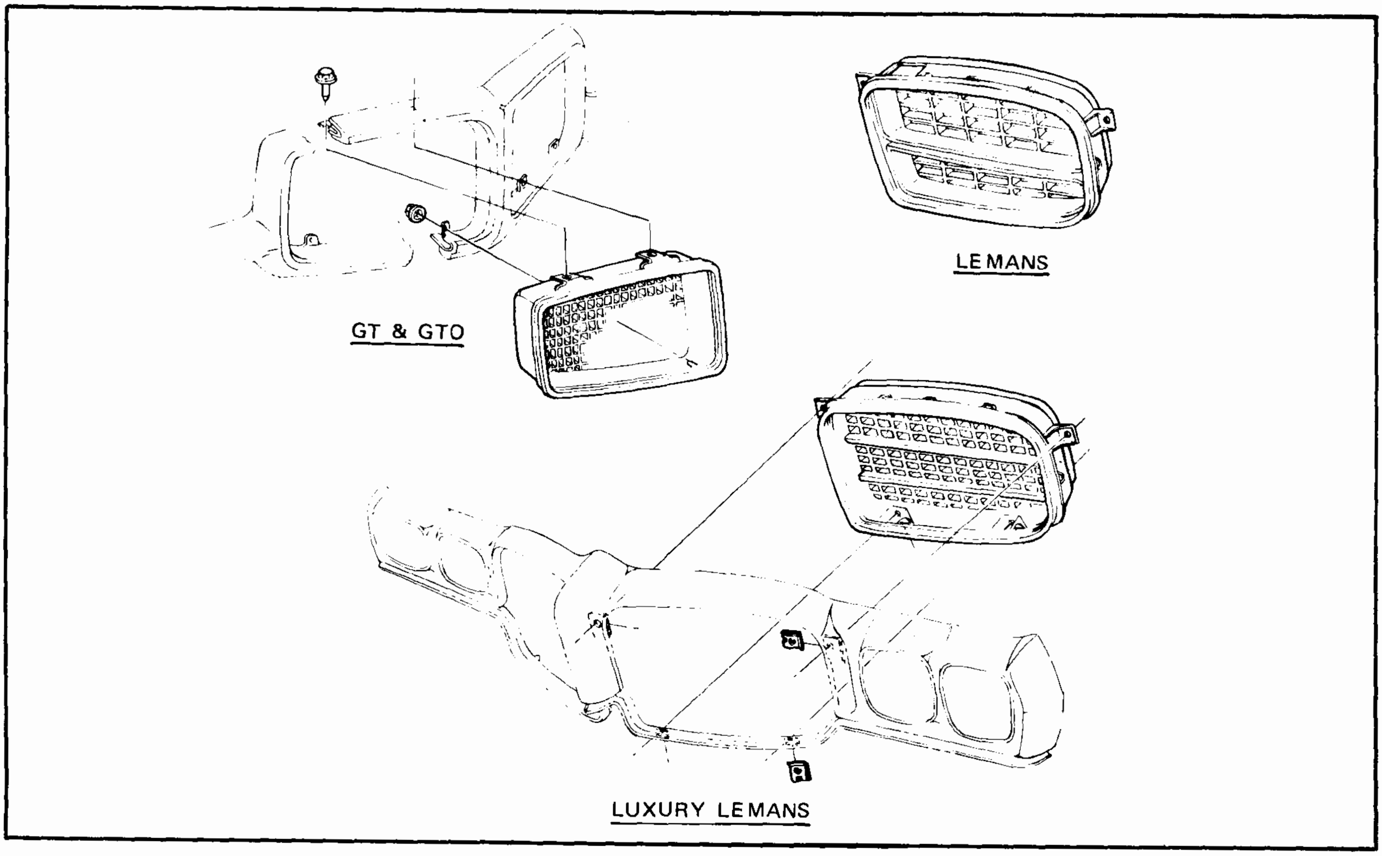


Fig. 11-19 A Series Grille Assembly

REMOVE - X SERIES (Fig. 11-20)

1. Remove both headlamp bezels.
2. Remove grille panel attaching screws and remove.
3. When replacing panel, transfer grille shells, emblem and attachment clips.

REPLACE

To replace, reverse above procedure and check alignment of headlamps.

FIBERGLASS PANEL REPAIR

A Plastic Solder Repair Kit can be used to repair cracks, dents, or pits in the fiberglass panels. A Glass Woven Cloth should be installed on the underside of a crack in panel to structurally reinforce the panel. The following procedure can be used to repair fiberglass panels.

1. With a lacquer removing solvent, remove paint from damaged area down to the fiberglass.
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 using a putty knife or rubber squeegee.
5. Work the material into the repair and build up to the desired contour. For deep filling and on vertical surfaces several layers may be used.
6. Feather sand damaged area with No. 200 sandpaper and finish sand with No. 320.
7. Prepare repaired area for refinishing. Refinish with acyrlic per normal procedure.

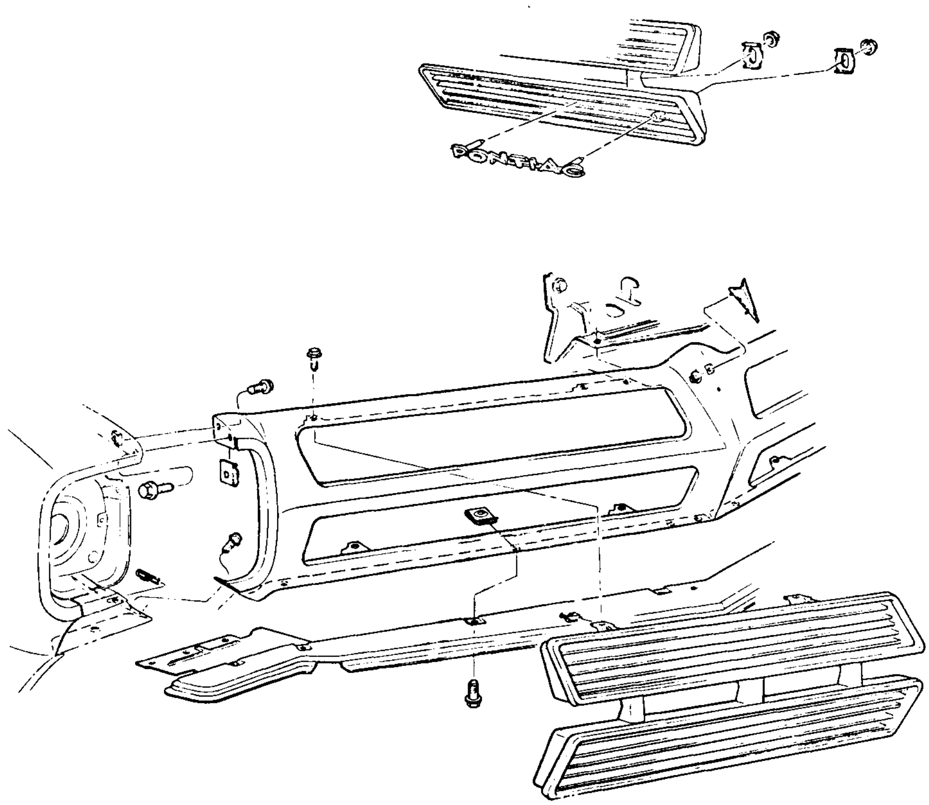


Fig. 11-20 X Series Grille Panel and Grille Assembly

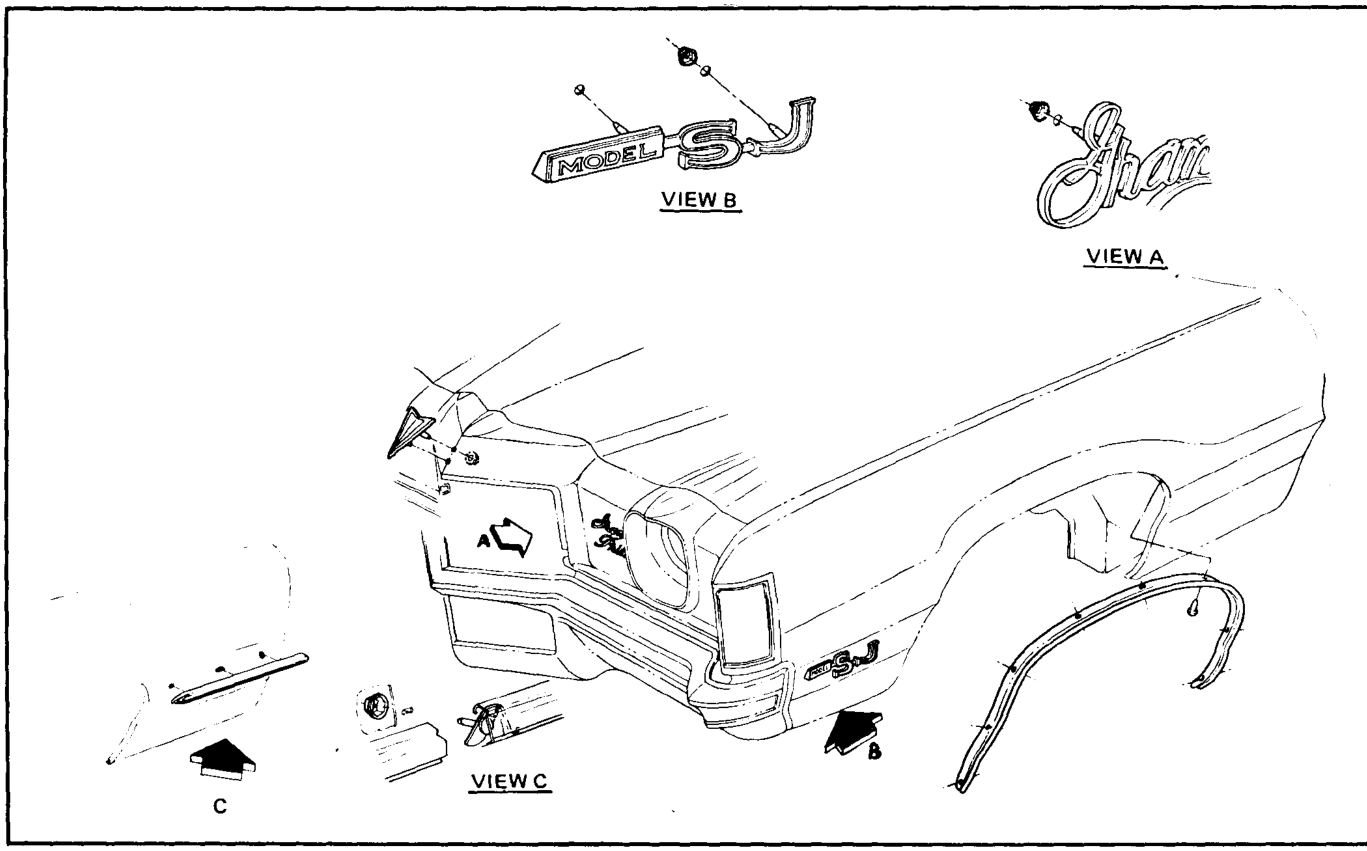


Fig. 11-21 G Series Moldings and Ornaments

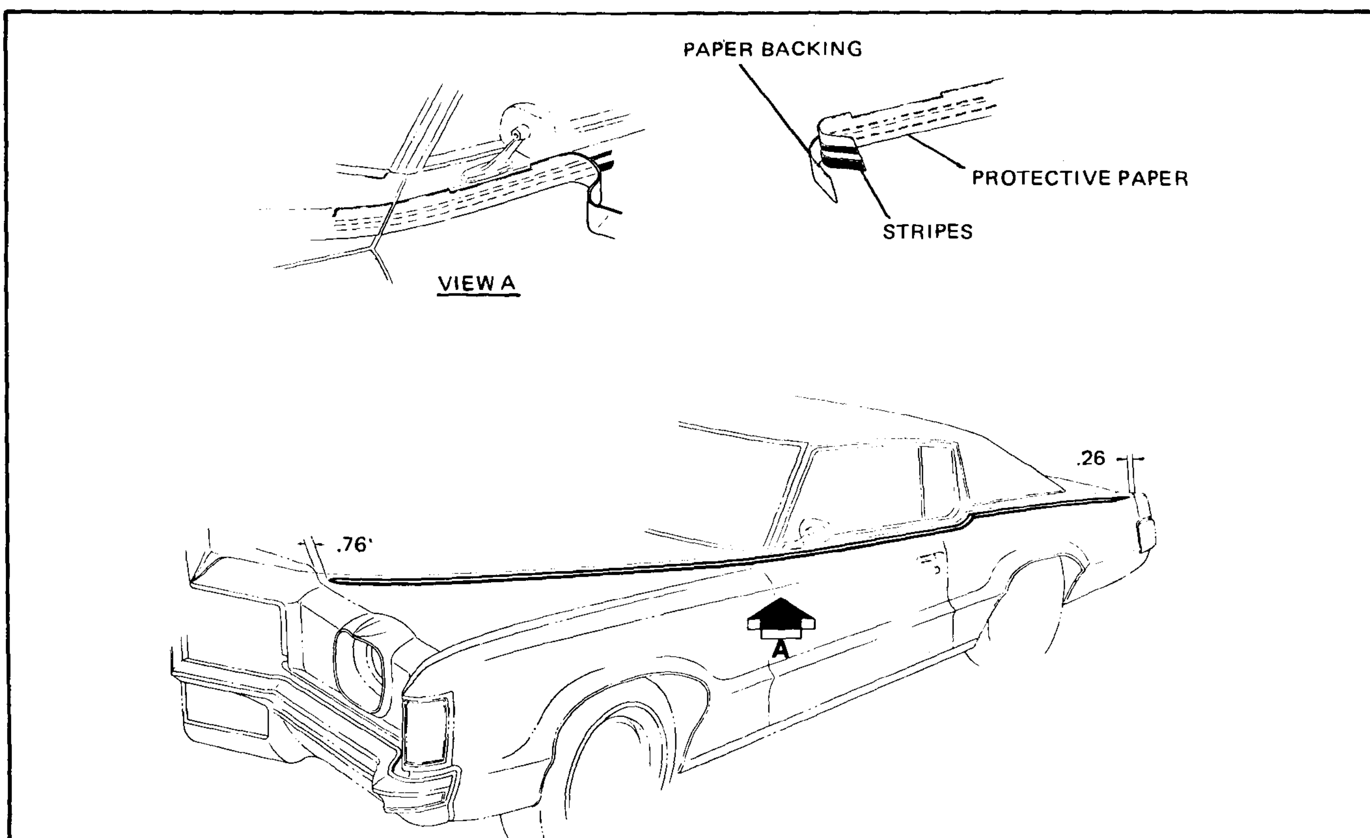


Fig. 11-22 G Series Paint Stripe Decals

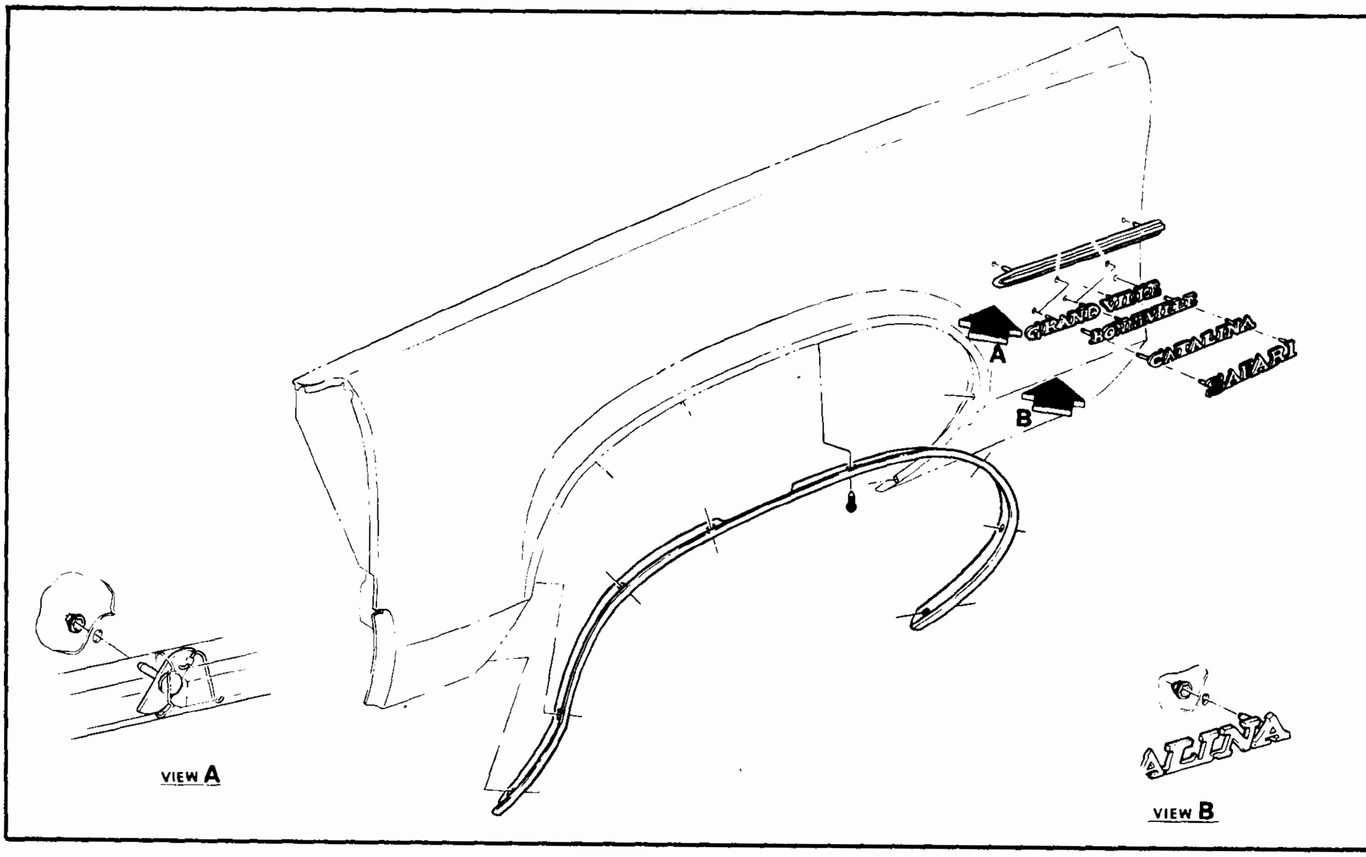


Fig. 11-23 B Series Molding and Ornaments

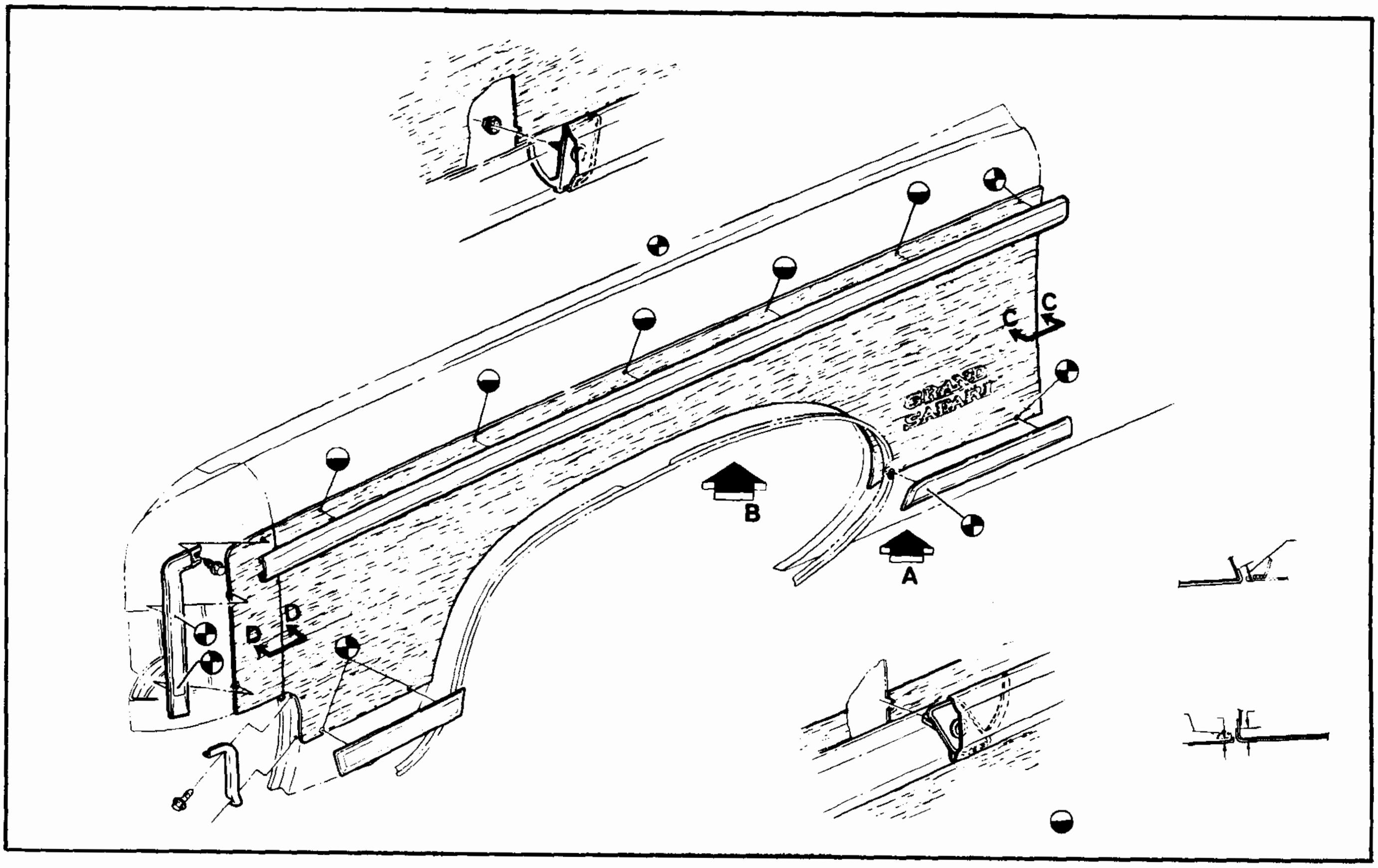


Fig. 11-24 B Series Wood Side Moldings

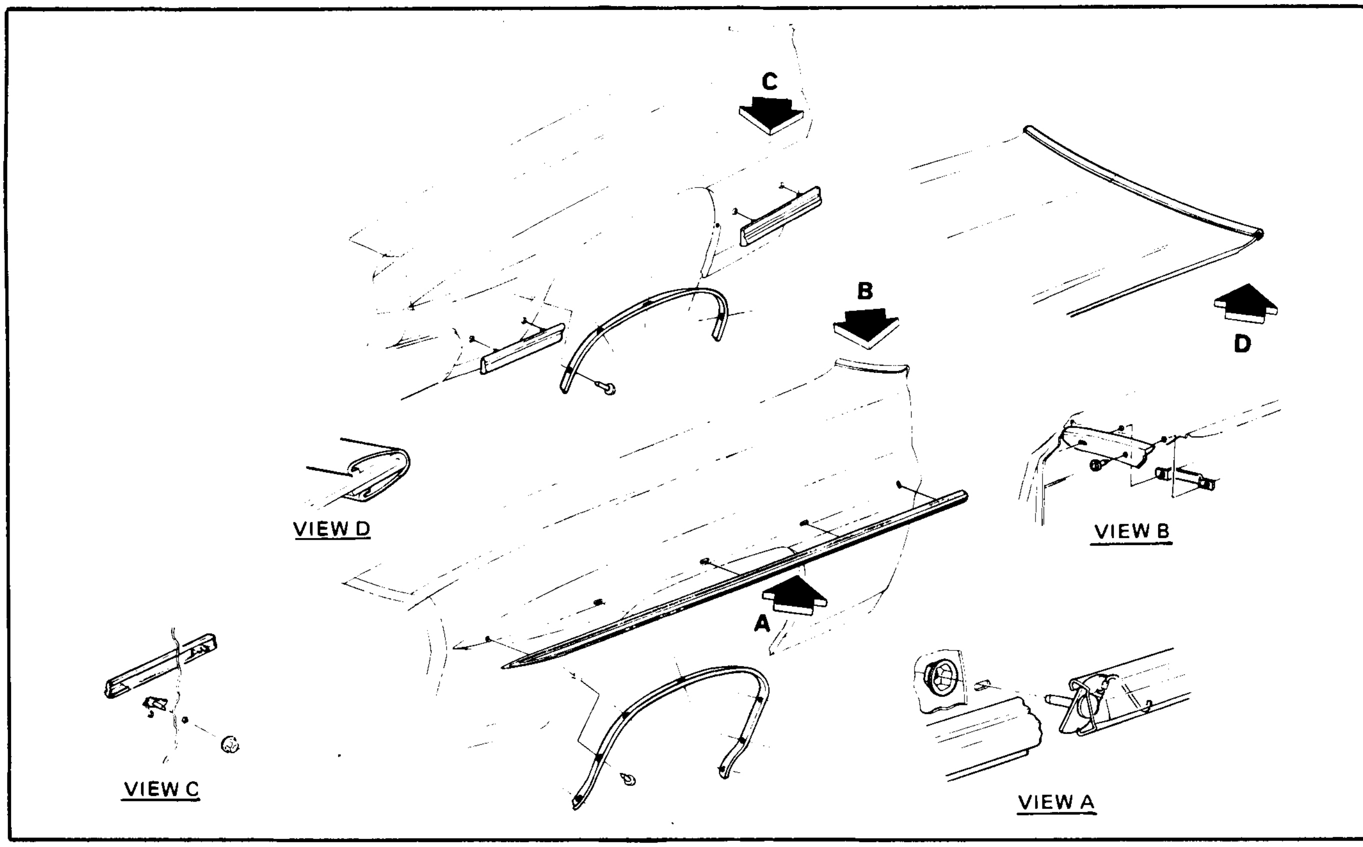


Fig. 11-25 A Series Moldings

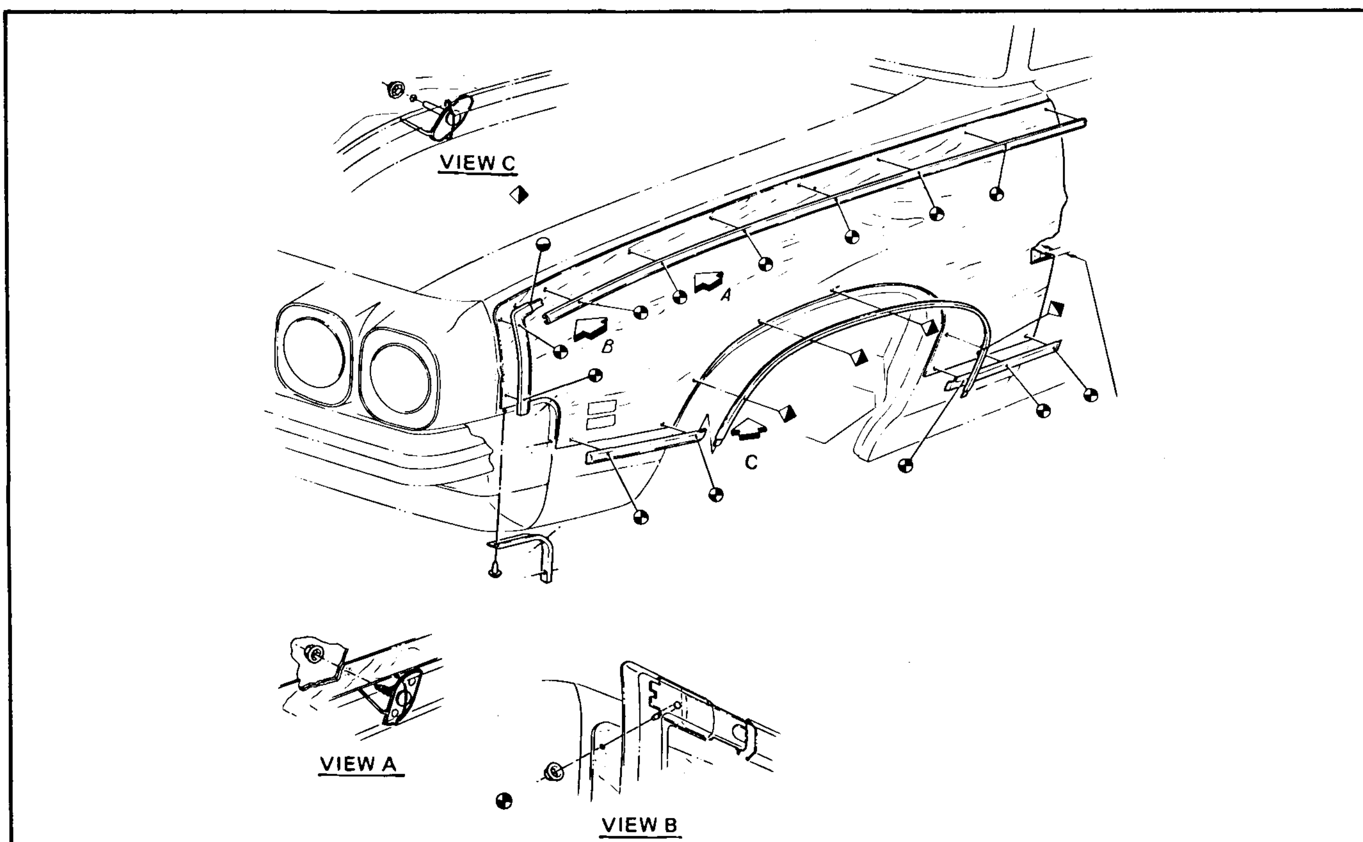


Fig. 11-26 A Series Wood Side Moldings

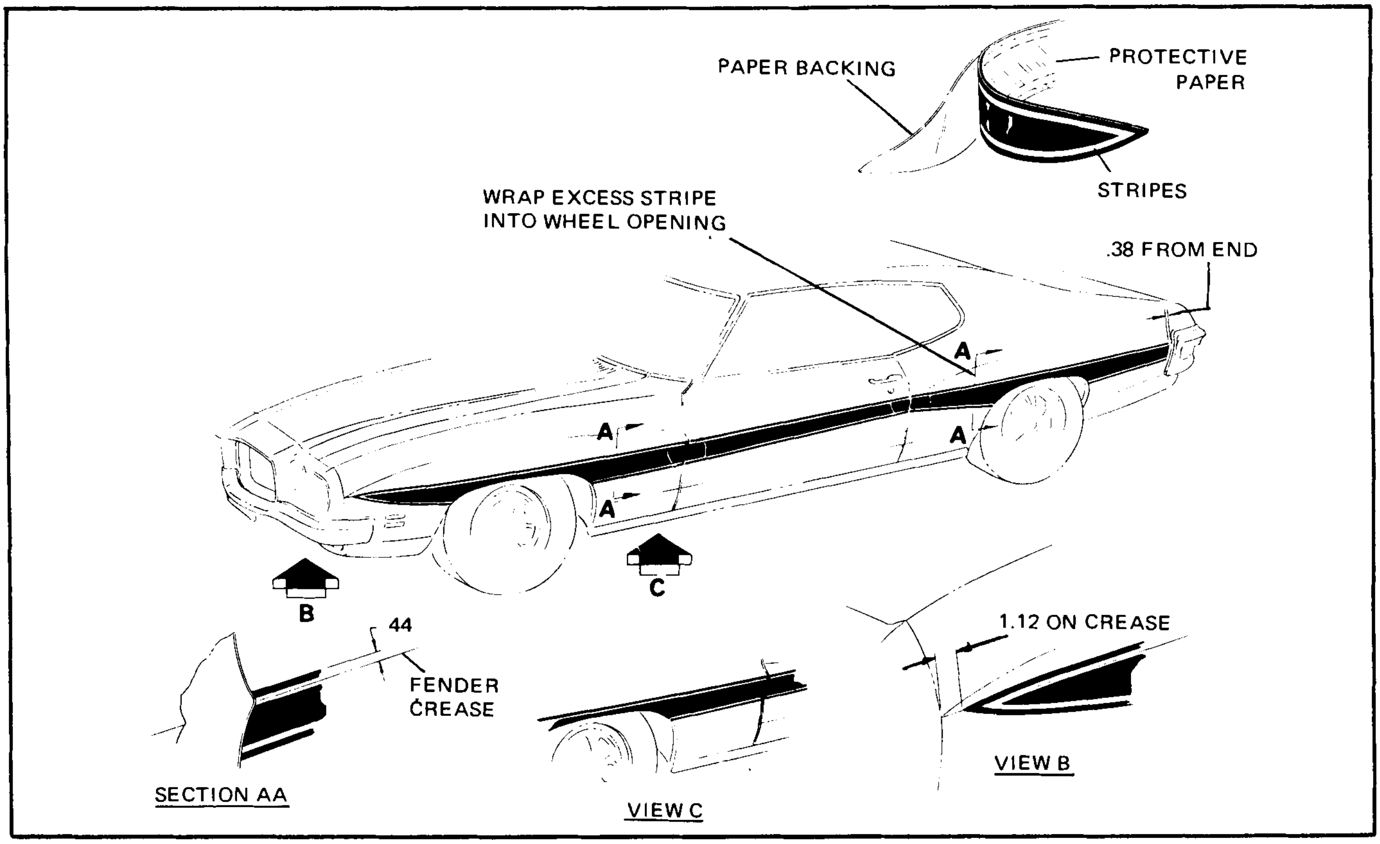


Fig. 11-27 A Series Paint Stripe Decals

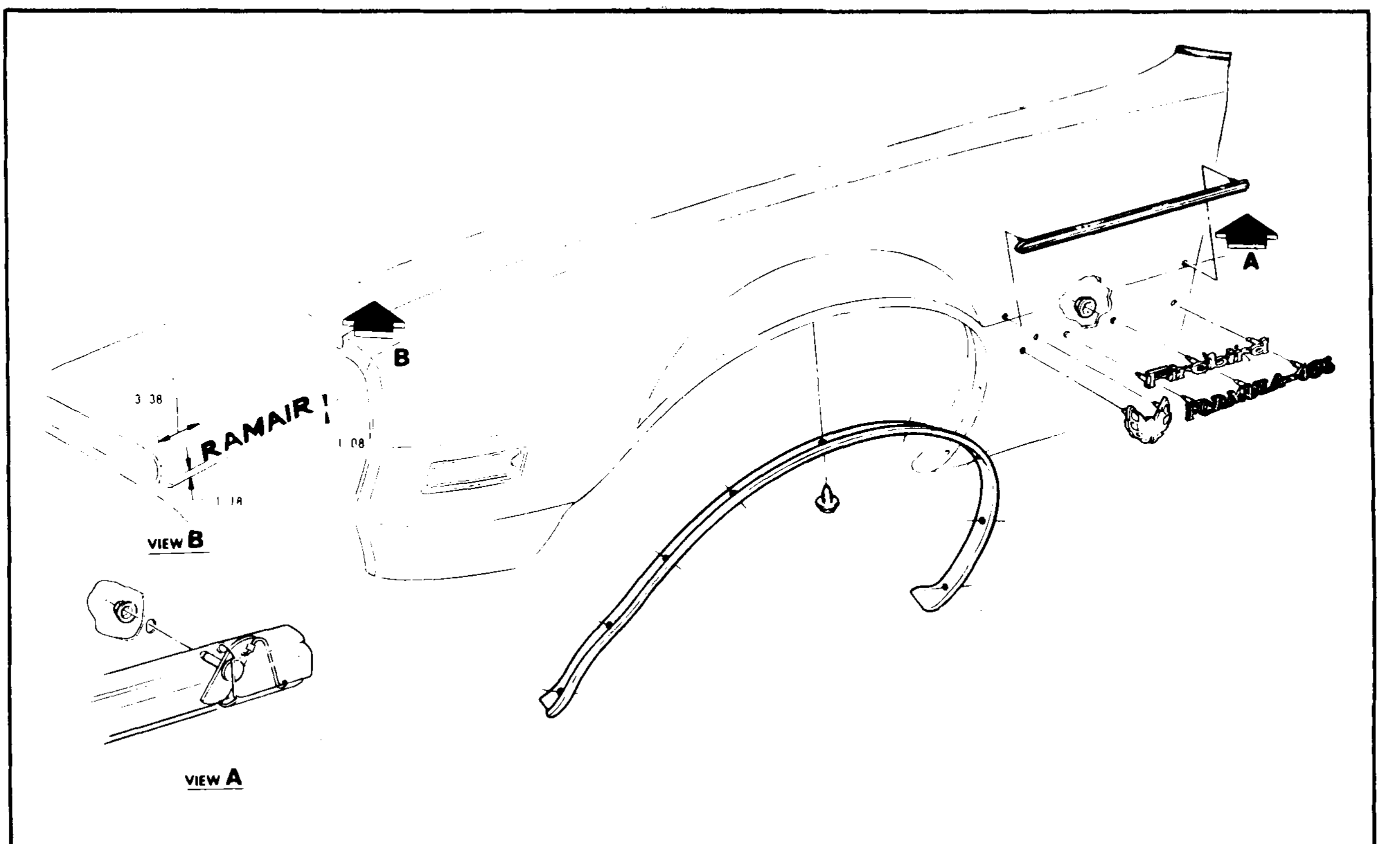


Fig. 11-28 F Series Moldings and Ornaments

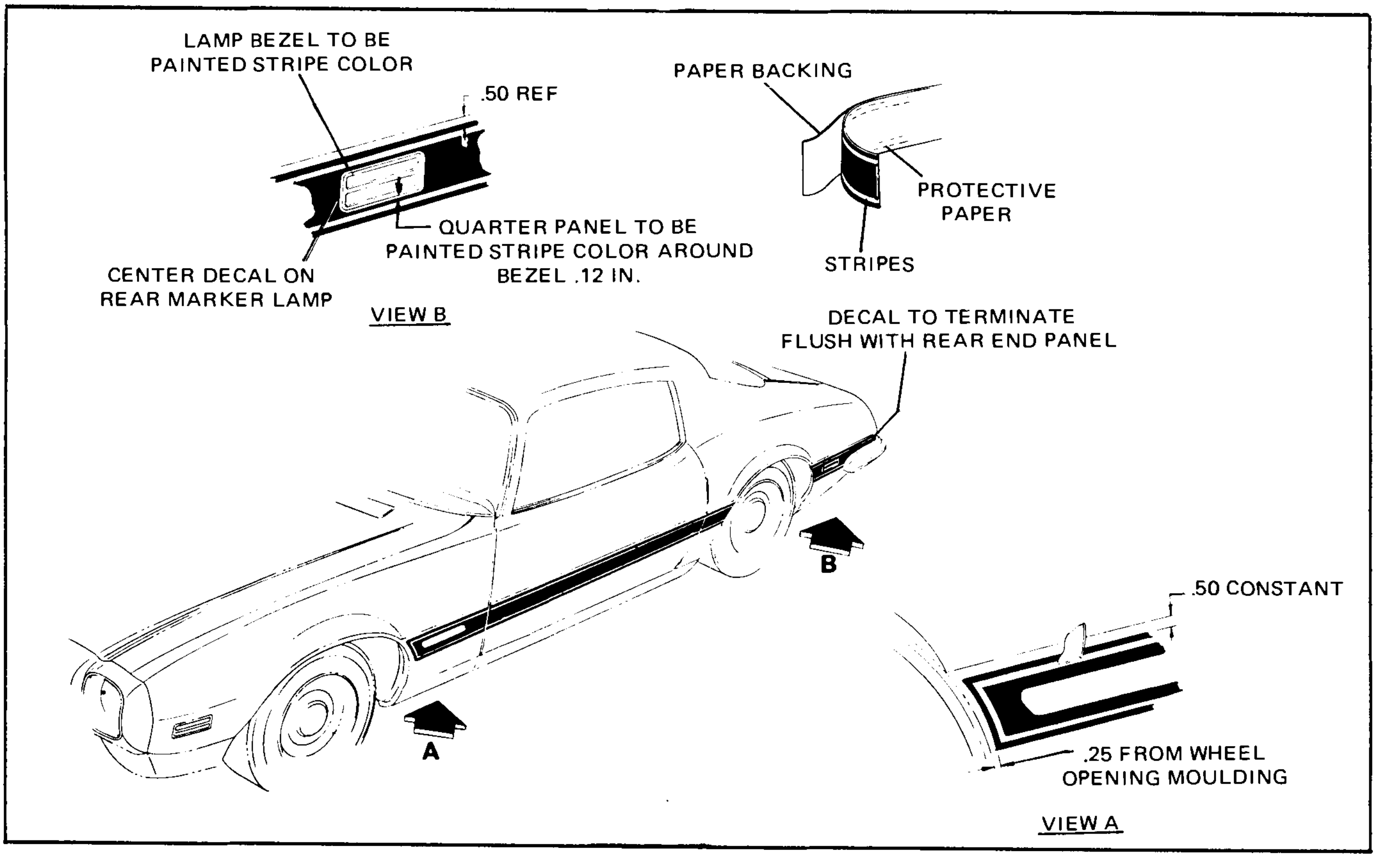


Fig. 11-29 F Series Paint Stripe Decals

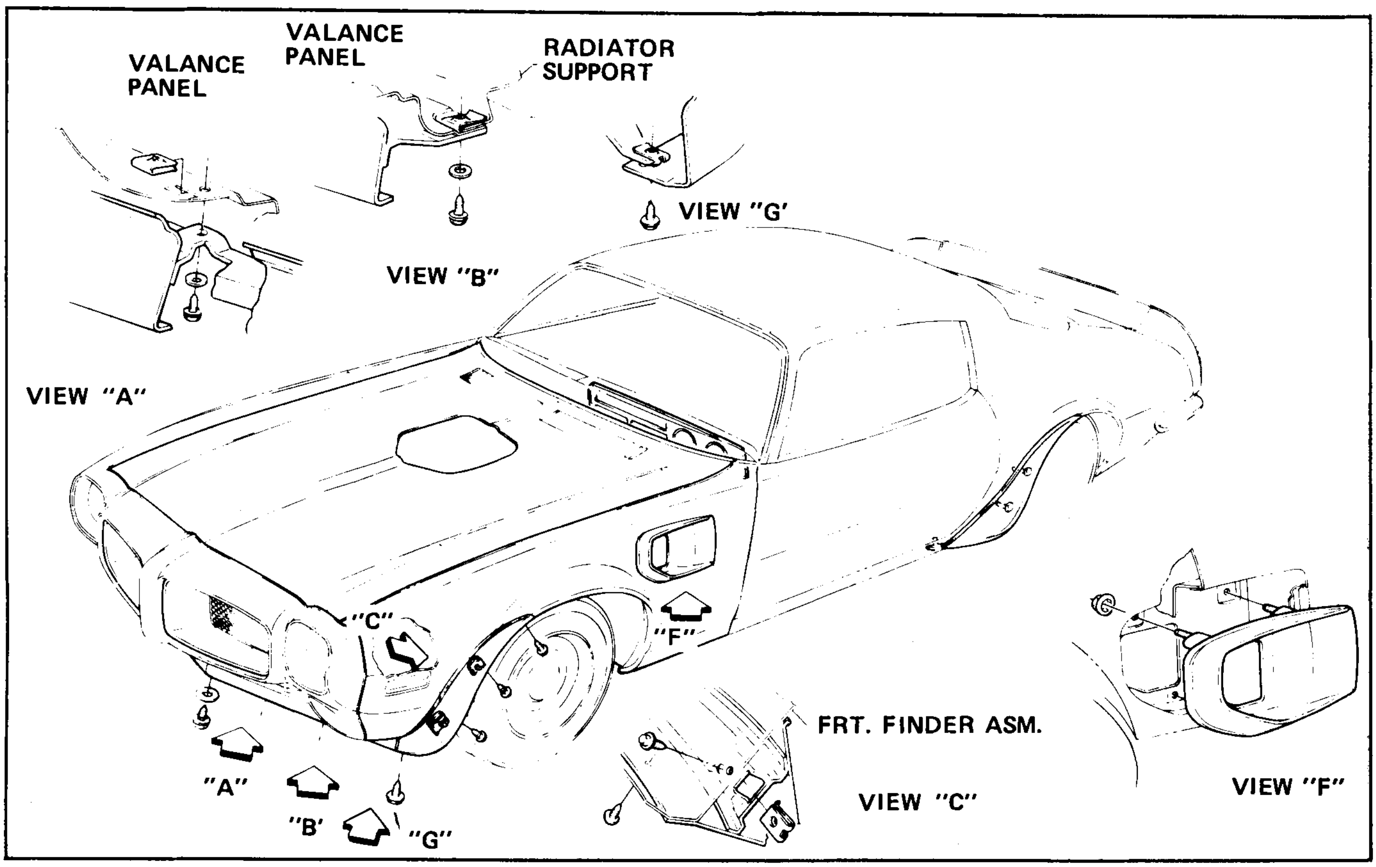


Fig. 11-30 Trans-Am Spoiler

SECTION 12

CHASSIS ELECTRICAL AND INSTRUMENTS

CONTENTS OF THIS SECTION

DIAGNOSIS

For more detailed diagnosis procedures consult "SER-CON Electrical Diagnosis Procedures".

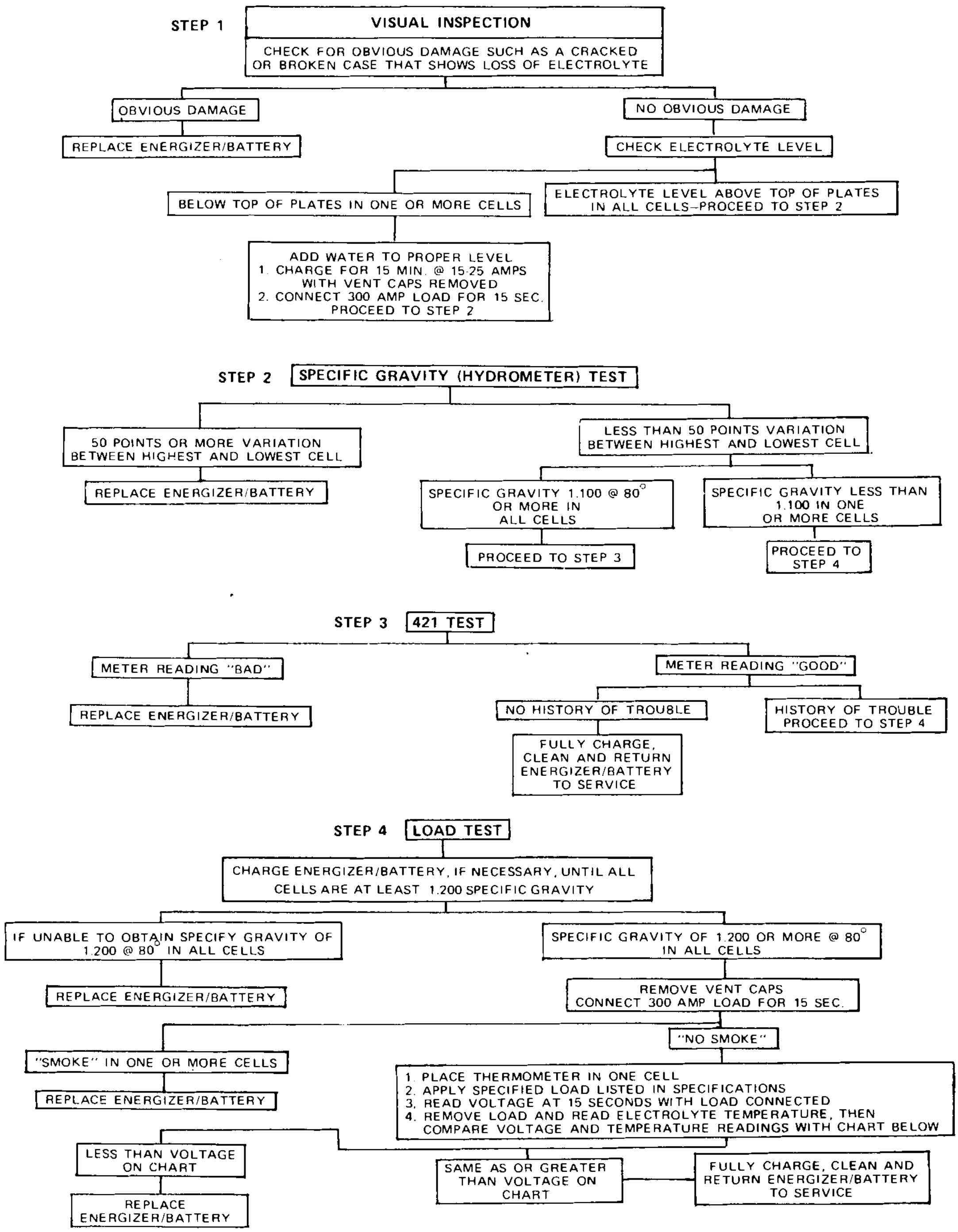
BATTERY (Fig. 12-1)

If battery remains undercharged, check for loose generator belt, defective generator, high resistance in charging circuit, oxidized regulator contact points, or a low voltage setting.

If battery uses an abnormal amount of water, voltage regulator setting may be too high.

Measure terminal voltage of battery during cranking.

Disconnect distributor to coil primary wire during this check to prevent engine firing. If terminal voltage is less than 9.0 volts, remove battery from service for further checking. See "Battery - General Description" for detailed battery tests.



VOLTAGE AND TEMPERATURE CHART

Voltage must not drop below minimum listed at given temperature when battery is subjected to the proper load for 15 seconds and is 1.200 specific gravity @ 80° or more.

	MINIMUM VOLTAGES								
	Electrolyte Temperature Down To								
Voltage	80°	70°	60°	50°	40°	30°	20°	10°	0°
12-Volt	9.6	9.6	9.5	9.4	9.3	9.1	8.9	8.7	8.5

Fig. 12-1 Battery Diagnosis

LIGHTING AND HORN POWER CIRCUITS

Troubles in the lighting and horn power circuits are caused by loose connections, open or shorted wiring, 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 in the end of Section 12.

HORNS WILL NOT OPERATE

NOTE: *To locate trouble, connect jumper lead to number 1 and 3 terminals of relay; terminal numbers are stamped on relay base. If horn blows, the trouble is in relay horn button or wiring. (To determine whether relay horn button or wiring is at fault, ground No. 2 terminal of relay. If horn blows, horn button or wiring is at fault.) If horn does not blow and wiring between battery and relay is not defective, connect voltmeter between horn terminal and horn mounting nut. Again connect jumper lead to number 1 and 3 terminals of relay and note voltmeter reading. If no voltmeter reading is obtained, wiring between relay and horn is open or horn is not grounded. If voltmeter reading is less than 7.0 volts, trouble is due to high resistance connections in wiring or faulty horn. If voltmeter reading is above 7.0 volts, trouble is due to faulty horn.*

CAUSE	CORRECTION
Loose connections in circuit.	Check and tighten connections. Be sure to check ground straps.
Defective horn switch.	Replace defective parts.
Defective horn relay.	Replace relay.
Defects within horn.	Replace horn.

1. Bench checks:

a. No current may indicate broken connection or open circuit due to broken lead or overheating. Most horn failures are caused by horns being operated continuously. This develops sufficient heat to melt wires in winding causing an open circuit. Overheating is accompanied by a characteristic odor which indicates that horn should be replaced.

b. No current can also indicate contact points are open and current adjustment is required. Turn adjusting screw counterclockwise.

c. High current (over 20 amperes) indicates an overheated winding or shorted horn which should be replaced.

d. A reading of approximately 18 amperes for 12 volt horn indicates condition in which contact points are not opening. A current adjustment is required by turning screw clockwise.

2. Current adjustment for "Type-C" horns:

Current adjustment is made by turning adjusting screw counterclockwise to increase current or clockwise to decrease current until specified current is reached. Care must be taken not to turn adjusting screw too far. Turn only 1/4 of turn at one time. If adjustment loosens screw excessively, it may be staked with prick punch.

The following adjustment of horn current should be made using an automotive type battery and wires that are No. 16 gauge or larger:

Voltage Supply	Adjust Horn Current To
11.5-12.5v	4.5-5.5 amps

HORNS HAVE POOR TONE

CAUSE	CORRECTION
Low available voltage at horn.	Check battery and charging circuit.
Defects within horn.	Although horn should blow at any voltage above 7.0 volts, a weak or poor tone may occur at operating voltages below 11.0 volts. If horn has weak or poor tone at operating voltage of 11.0 volts or higher, remove horn and replace.

HORNS OPERATE INTERMITTENTLY

CAUSE	CORRECTION
Loose or intermittent connections in horn relay or horn circuit.	Check and tighten connections.
Defective horn switch.	Replace switch.
Defective relay.	Replace relay.
Defects within horn.	Replace horn.

HORNS BLOW CONSTANTLY

CAUSE	CORRECTION
Sticking horn relay.	Replace relay.
Horn relay energized by grounded or shorted wiring.	Check and adjust wiring.
Horn button can be grounded by sticking closed.	Adjust or replace damaged parts.

NOTE: *Most horns with burned open windings are caused by one of above malfunctions. Before replacing horns with open windings with new horns check to make sure that none of above conditions exist which would again cause horn winding to burn open.*

IGNITION KEY BUZZER INOPERATIVE

CHASSIS CHECK

If the key buzzer does not operate with the key fully inserted in the lock cylinder, with the driver's door open:

1. Check the horn operation. This shows that the power is available to the horn relay. If the horn does not operate, consult the manual as to the method of repair.

2. Check the door jamb switch by opening and closing the driver's door and observing the dome light operation. If the light does not work, repair, replace, or adjust the switch as required.

3. Check the horn relay to insure that the buzzer wire is connected.

If the results of these three checks are normal, proceed to the harmonica (a multiple wire connector), which connects the column to the chassis. Separate it and connect jumper wire between the "E" and "F" female contacts (marked on connector body) on the chassis side (Fig. 12-3).

At this point, one of two things will occur; the buzzer will either sound or it will not. If it does not sound, the problem is in the chassis end of the harmonica connection. Even though the horn did sound, the buzzer part of the horn relay could be defective. By grounding the #4 terminal of the horn relay, the buzzer should function. If it does not, replace the horn relay.

If the buzzer sounds when the "E" and "F" contacts of the harmonica are connected, the fault is in the column part of the circuit.

COLUMN CHECK

1. Buzzer Switch and Lock Cylinder Check - Disassemble the upper end of the column until the buzzer switch leads are visible. With the key fully inserted in the lock cylinder, check the continuity of the buzzer switch. With a probe at each lead, the meter should light. If it does not, the fault has been isolated to the switch or lock cylinder.

2. Lock Cylinder Inspection - Remove the lock cylinder and check the actuator tip when the key is fully seated and removed (Fig. 12-4).

   If this tip will not protrude from the cylinder approximately 1/8" with the key fully inserted, replace the lock cylinder. If this cylinder is physically damaged, it should be replaced.

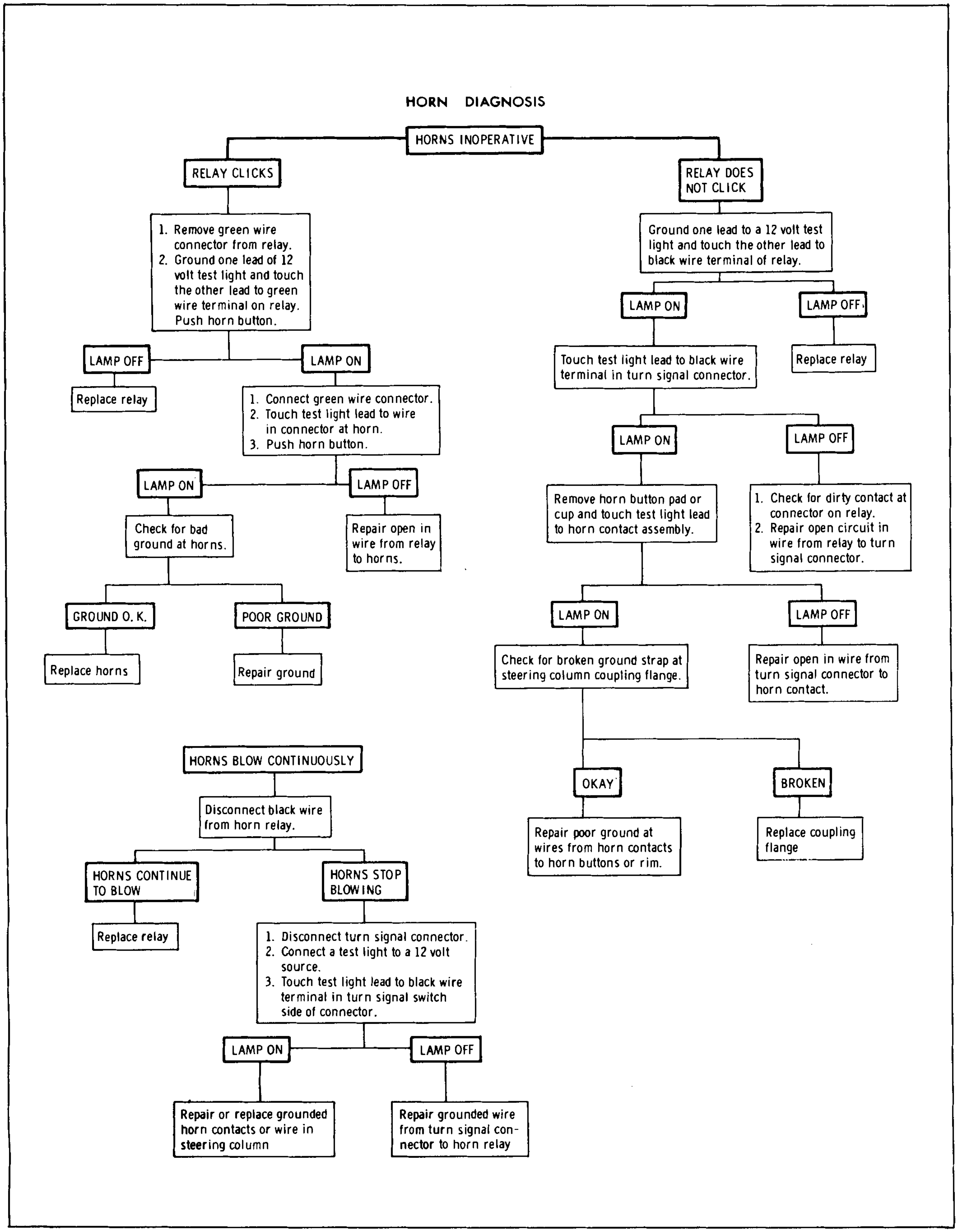


Fig. 12-2 Horn Diagnosis

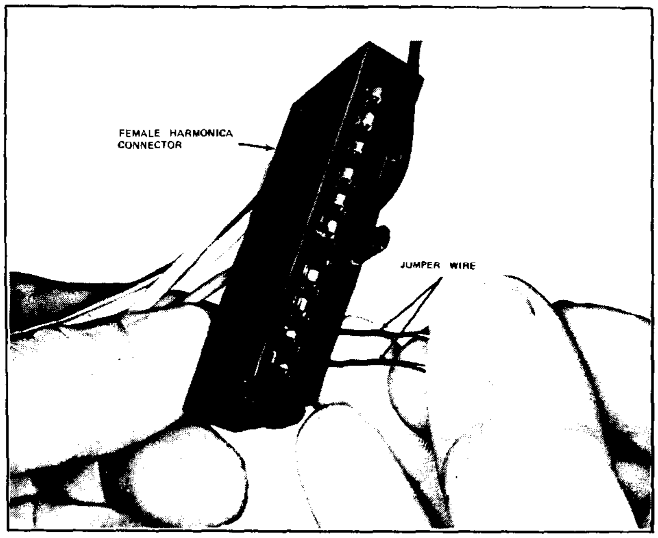


Fig. 12-3 Jumper Inserted to "E" and "F" Contacts

3. Buzzer Switch Check - Remove the buzzer switch and visually inspect it for physical damage. Should the switch be damaged, replace it. If it appears satisfactory, fasten the alligator clips from the continuity meter to the buzzer switch leads (one clip per one lead). Be careful not to bend the leads. Depress the actuator pad until the interior points contact (Fig. 12-5).

   The continuity check should light when the points close. If it does not, replace the buzzer switch.

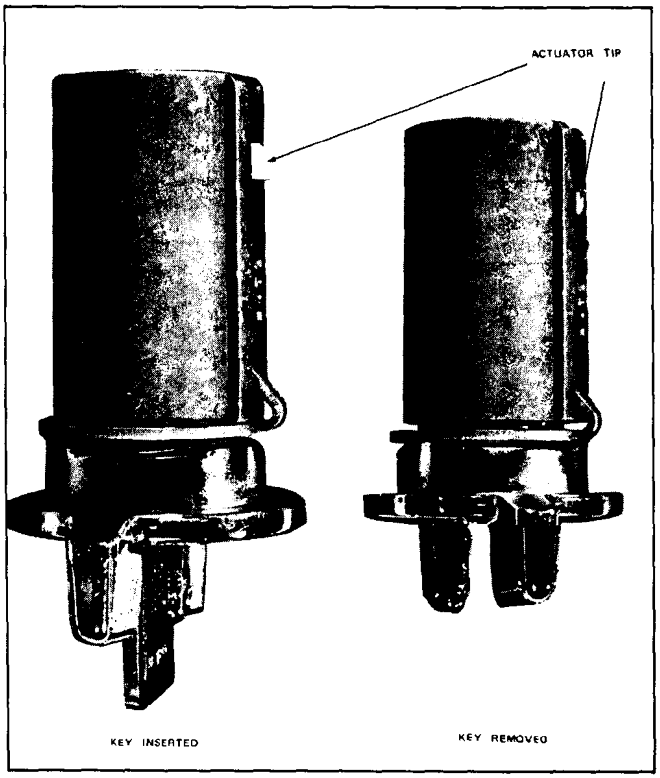


Fig. 12-4 Lock Cylinder Actuator Tip

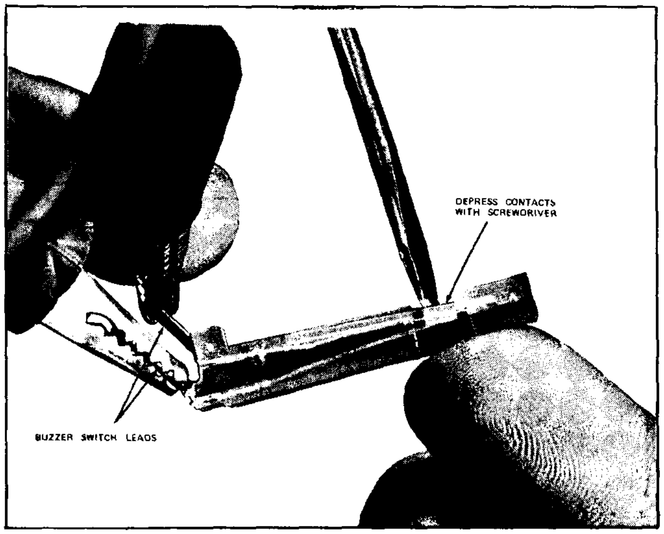


Fig. 12-5 Continuity of Buzzer Switch

4. Setting the Contact Gap - To set the switch to the low contact limit, insert a typical feeler gauge firmly onto the actuator pads.

   If contact is not made, adjust the switch by bending the moveable internal member with a small screwdriver. Adjust as shown in Fig. 12-6 to .031".

   Then check the switch with a feeler gage for the "no light" condition. If contact occurs here, bend blade as shown in Fig. 12-7 to .024".

   When the switch will make contact on the "light" and not on the "no light", the contact gap is set on the low limit.

   CAUTION: *Should the switch be used with the contact occurring in the "no light" step, the buzzer could then operate with or without the key in the lock cylinder.*

5. Recheck - With the switch properly adjusted, assemble it and the lock cylinder back into the column. Recheck continuity with the key in and out as before.

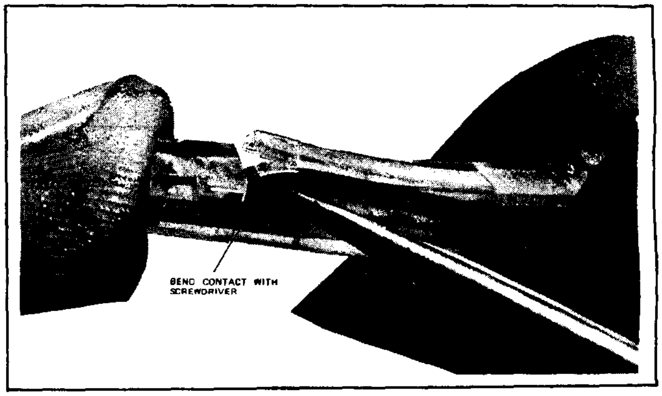


Fig. 12-6 Adjusting "Light" Position

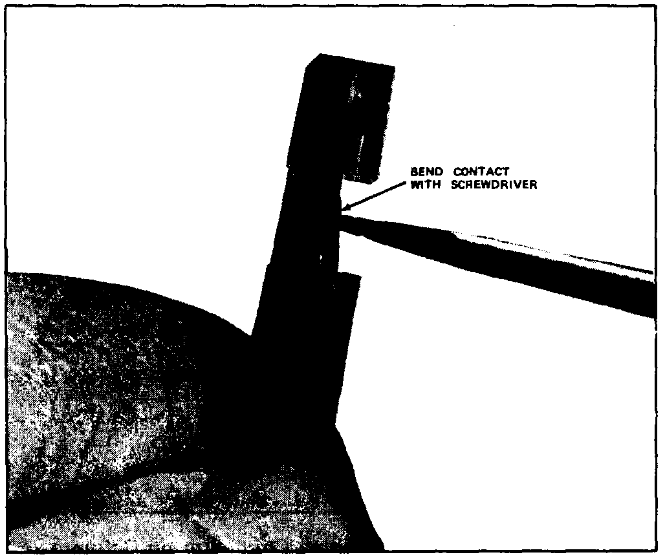


Fig. 12-7 Adjusting "No Light" Position

If positive contact is still not established, replace the lock cylinder.

6. Signal Switch Wiring Check - If, when checking the continuity of the buzzer switch the first time, contact was established, a jumper wire should be secured to the male "E" and "F" contacts of the harmonica (mounted on steering column). Check the buzzer switch contact pads with the continuity meter (Fig. 12-8).

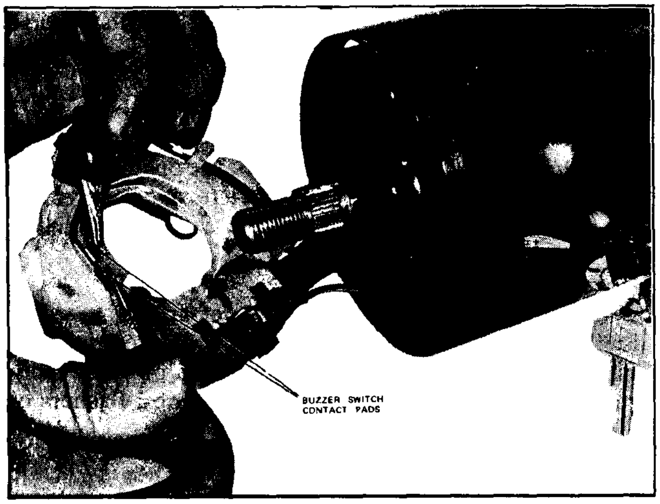


Fig. 12-8 Continuity of Buzzer Switch Contacts

If no contact is established during this check, inspect for loose connections, frayed wires, etc. As a last resort, replace the signal switch.

7. Buzzer Switch to Signal Switch Contact Check - If, during the initial continuity checks, both the switch and pad checks are positive, the indication is that poor or no contact is being made between the buzzer terminals and the switch pads. The switch may either be replaced or the terminals rebent to regain positive contact. If the switch is replaced, it is recommended that it be set to the minimum contact gap to insure reliable function.

CONTINUOUS IGNITION KEY BUZZER OPERATION

CHASSIS CHECK

Should the buzzer continue to operate with the key in the lock cylinder and the door either opened or closed, but would cease when the key is removed, the door jamb switch should be adjusted or possibly replaced.

COLUMN CHECK

If the buzzer sounds after the key has been removed from the lock cylinder with the driver' door open, and ceases when it is closed, the apparent fault is either in the buzzer switch or the lock cylinder. To verify, disconnect the harmomica and check the continuity of the "E" and "F" male contacts with the key removed from the lock cylinder. If contact is established, the fault is in the switch or lock cylinder.

Disassemble the column to the point where the buzzer switch and lock cylinder can be removed. Remove both and visually inspect. Also, check the lock cylinder bore for chips, etc. If the buzzer switch is damaged, replace it. If it is not, reset the contact gap opening, using the gage and procedure described previously.

Check the lock cylinder for positive plunger actuation. The plunger should retract with little effort when the key is removed from the lock cylinder. If it sticks or is difficult to retract, replace the lock cylinder.

With the switch reset and the lock cylinder checked, replace both and recheck the function using the continuity light. (Probes on buzzer leads inserting and removing key in lock cylinder.) If function is now correct, reassemble the column.

TURN SIGNAL SYSTEM DIAGNOSIS

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. (Figure 12-9) 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 is located on the fuse board, while the turn signal flasher is up under the instrument panel adjacent to the column).
2. Check for secure connection at the chassis switch connector. This is the harmonica connector on the column. (Figure 12-10) 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. (On fuse block, Figure 12-11)

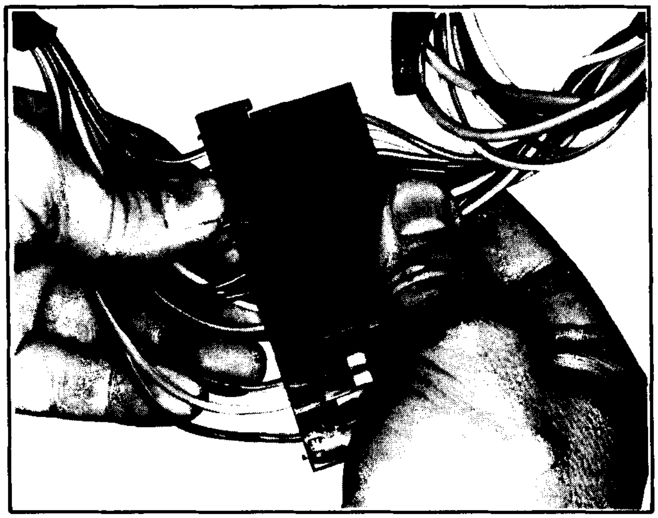


Fig. 12-10 Check Harmonica Connector on Column

4. If all directional lamps on the indicated side light when lane change or turn indicator is actuated, but no flashing occurs, replace the turn signal flasher. This flasher is located under the instrument panel near the steering column.

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.

Electrical Check of the Turn Signal Switch

To check the electrical function of the switch in the vehicle, a continuity checker is required.

1. Disconnect the chassis to column connector.

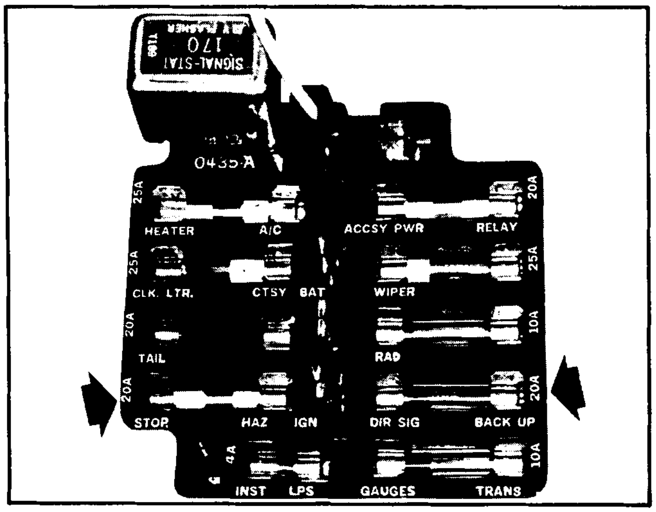


Fig. 12-9 Check Fuses in Fuse Block

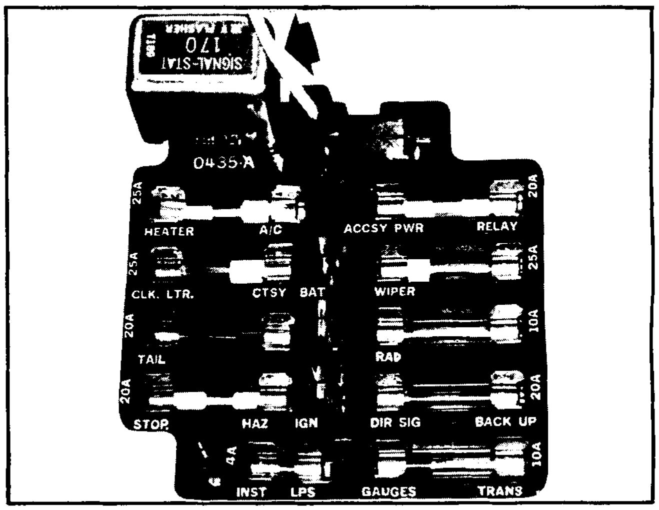


Fig. 12-11 Check Hazard Warning Flasher

2. Turn column connector so that the lettered terminals on its side are visible.
3. Put turn signal lever in center "Off" position.
4. Connect one end of continuity checker to terminal "P" (Figure 12-12).
5. Touch other end of checker to terminal "M" and check for continuity.
6. Move checker from "M" to "N" and check for continuity.
7. Put turn signal switch in "Right" turn.
8. Move continuity connection from "P" to "L".
9. Touch other end of checker to "J" and then to "N" and check for continuity at each terminal.
10. Move checker from "L" to "P". Touch other end to "M" and check for continuity.
11. Put turn signal switch in "Left" turn.
12. Touch checker to "N" and check for continuity.
13. Move checker from "P" to "L".
14. Touch other end to "H" and then to "M" and check for continuity at each terminal.
15. Put turn signal to "Off" and turn HAZARD SWITCH "On".
16. Move checker from "L" to "P".
17. Touch other end to J, K, H, M, N and check for continuity at each terminal.
18. Turn "Off" Hazard Switch.

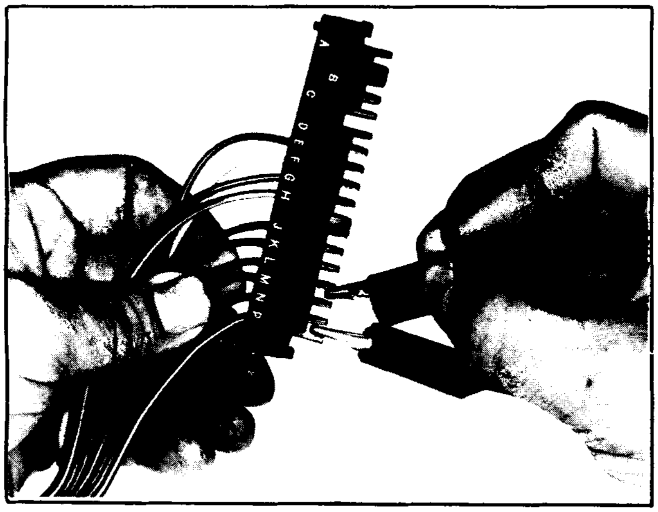


Fig. 12-12 Using Continuity Checker

If cornering lights do not operate:

1. Move checker from "P" to "A".
2. Move turn signal switch to "Right" turn.
3. Touch other end of checker to "C" and check for continuity.
4. Move turn signal switch to "Left" turn.
5. Touch other end of checker to "B" and check for continuity.

Alternate Method - Electrical Check of the Turn Signal Switch

Another method of checking the Turn Signal Switch System is to substitute a known good switch without removing the one in the vehicle. (Method previously described can be used to check switch out of vehicle.) Connect the connector of the new switch into the chassis connector and repeat the electrical function test. Lane change, turn (Figure 12-13) and hazard warning can all be actuated and the systems' function checked. The horn operation can also be checked by grounding the horn button to a grounded metallic part of the vehicle. Horn circuit problems are generally associated with the cancel cam or steering wheel switches.

If all above systems operate correctly, the switch in the vehicle is in need of repair or replacement.

Should part of the system still not function, that part will have to be checked for shorts and the lamp receptacles checked to insure proper grounding.

MECHANICAL CHECK

1. If diagnostic procedures indicate the problem is in the

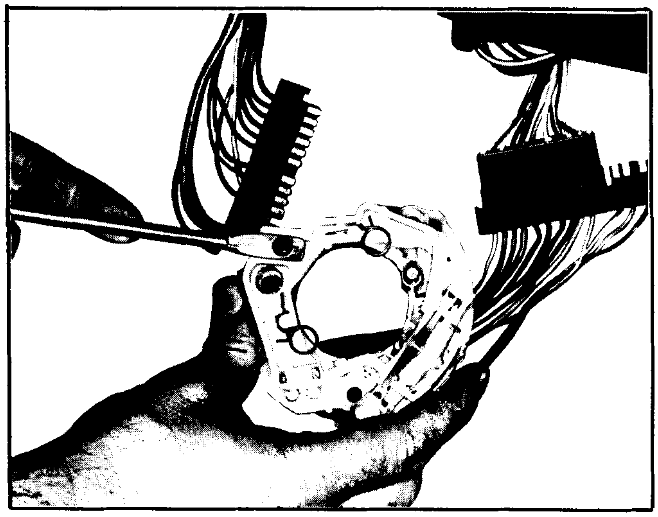


Fig. 12-13 Alternate Checking Method Using Known Good Switch

switch, function check as to return from full left and full right turns.

Actuate the turn lever into full turn position in either direction, then turn the steering wheel (motor on with power steering) at least 1/4 turn in the direction indicated and then back to center. Do this in both directions. If the lever does not return to the neutral position, disassemble the upper part of the column until the switch is visible.

2. Check the return from lane change by holding the lever in lane change and releasing (both left and right). If the lever does not return to neutral, disassemble the upper part of the column. An over sized wedge on the mounting end of the turn signal lever can cause this condition. Loosen attaching screw 1/2 turn and if the switch now returns replace lever or file wedge.

3. If the hazard warning button cannot be depressed or released, the switch must be replaced. The actuating lever may be bent on tilt and telescope columns.

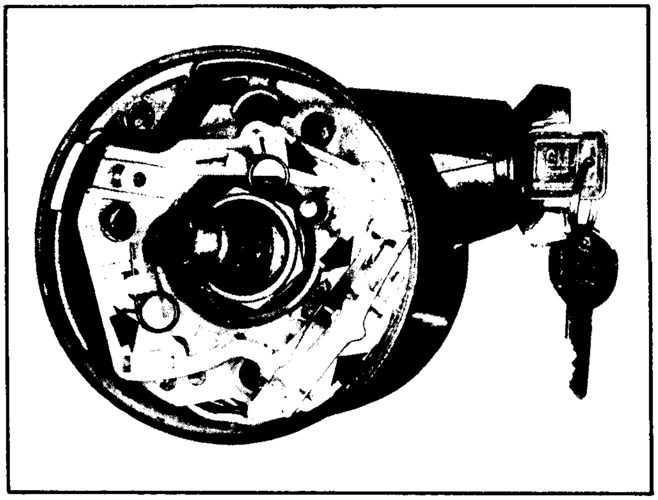


Fig. 12-14 Visual Check of Turn Signal Switch

Visual Inspection and Repair

1. With the upper part of the column disassembled so that the signal switch is visible (Figure 12-14) check for missing springs. Replace any spring that is missing, inspecting the molded pins which secure them. If these pins are broken, the switch must be replaced.

2. Check the position of the switch in the bowl. If it appears cocked or crooked, loosen the three mounting screws and inspect the switch. If any of the plastic is broken or badly deformed, the switch must be replaced.

3. With switch in neutral position, both cancel springs should be spaced equally from the steering shaft. Replace upper casting if mounting holes will not allow proper switch centering.

4. If the switch appears undamaged, replace it being careful to seat the pilot into the housing, tighten the screws to 25 in. lbs. of torque.

HEADLIGHT DIAGNOSIS

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

Open ground connection at headlight	Repair black wire connection between sealed beam and body ground.
Black ground wire mislocated in headlight Connector (type 2 sealed beam)	*Relocate as shown in Service Circuit.

ONE OR MORE HEADLIGHTS - SHORT LIFE

Voltage Regulator Misadjusted	Check and replace if necessary.

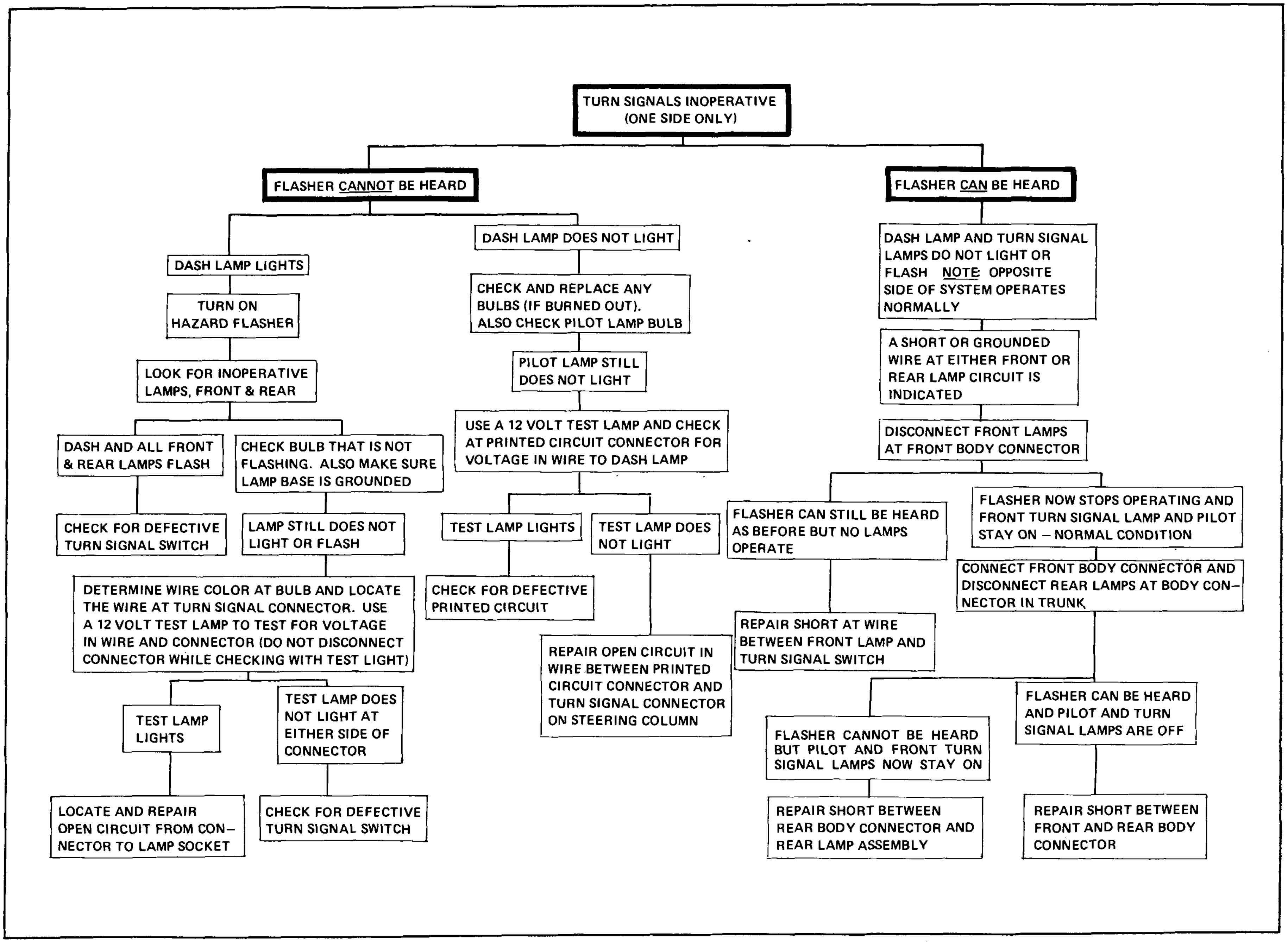


Fig. 12-15 Turn Signal Diagnosis Chart

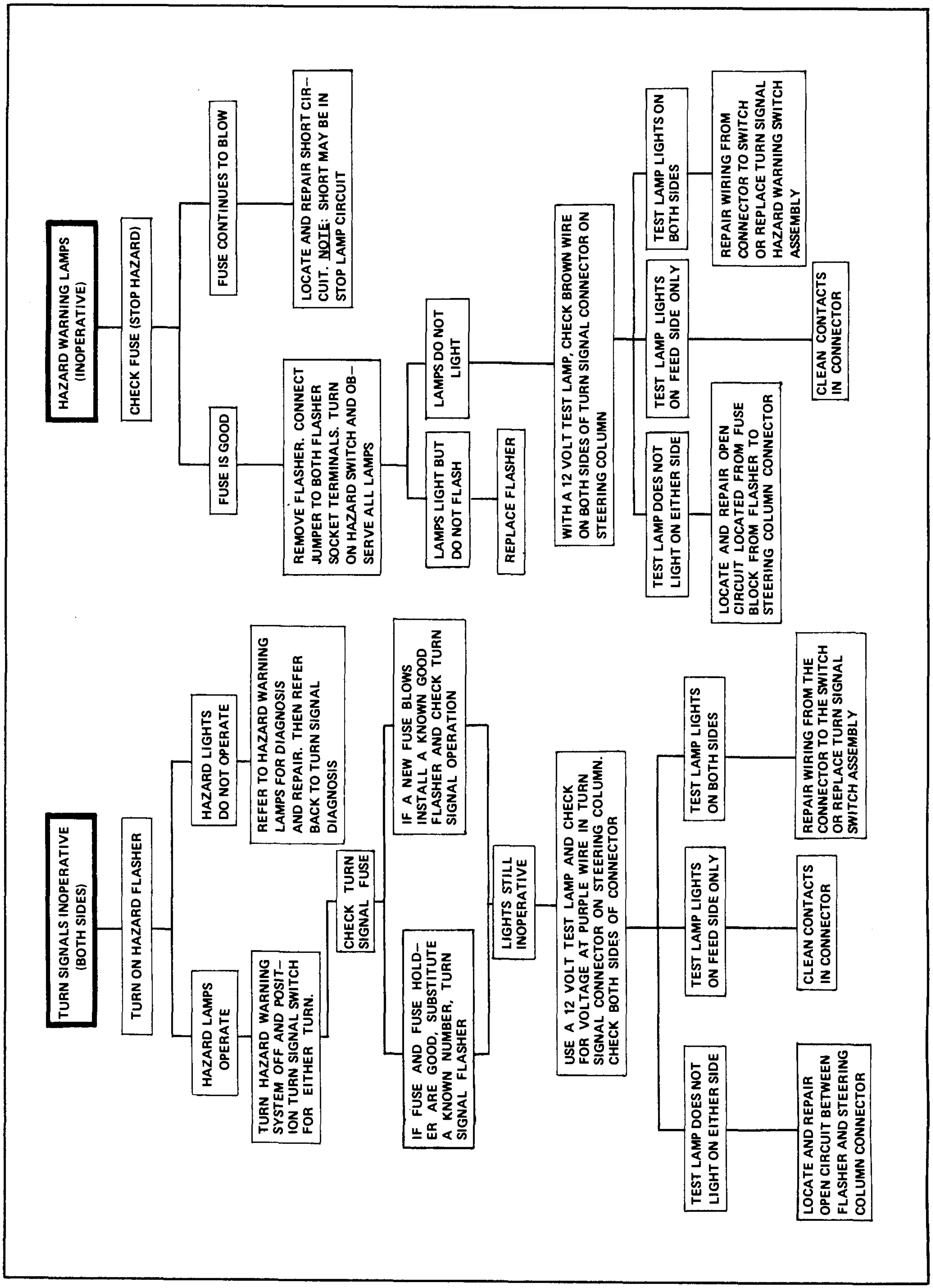


Fig. 12-16 Turn Signal and Hazard Flasher Diagnosis Chart

ALL HEADLIGHTS INOPERATIVE OR INTERMITTENT

Loose connection	Check and secure connections at foot switch and light switch.
Defective foot switch.	*Check voltage at foot switch with test bulb. If bulb lights only at light blue wire terminal, replace foot switch.
Open wiring - light switch to foot switch.	*Check voltage at light blue wire with test bulb. If bulb lights at light switch light blue wire terminal, but not at foot 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.

UPPER OR LOWER BEAM WILL NOT LIGHT OR INTERMITTENT

Open connection or defective foot switch.	*Check voltage at foot switch headlight terminals with test light. If bulb lights at headlight terminals (blk/lt. green - upper beam, blk/tan - low beam), repair open wiring between foot switch and headlights. If bulb will not light at one of the foot switch headlight terminals, replace foot switch.
Circuit shorted to ground.	*Follow diagnosis shown above under "All Headlights Inoperative or Intermittent".

*See headlight circuit (Fig. 12-17).

CORNERING LAMPS DIAGNOSIS

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.

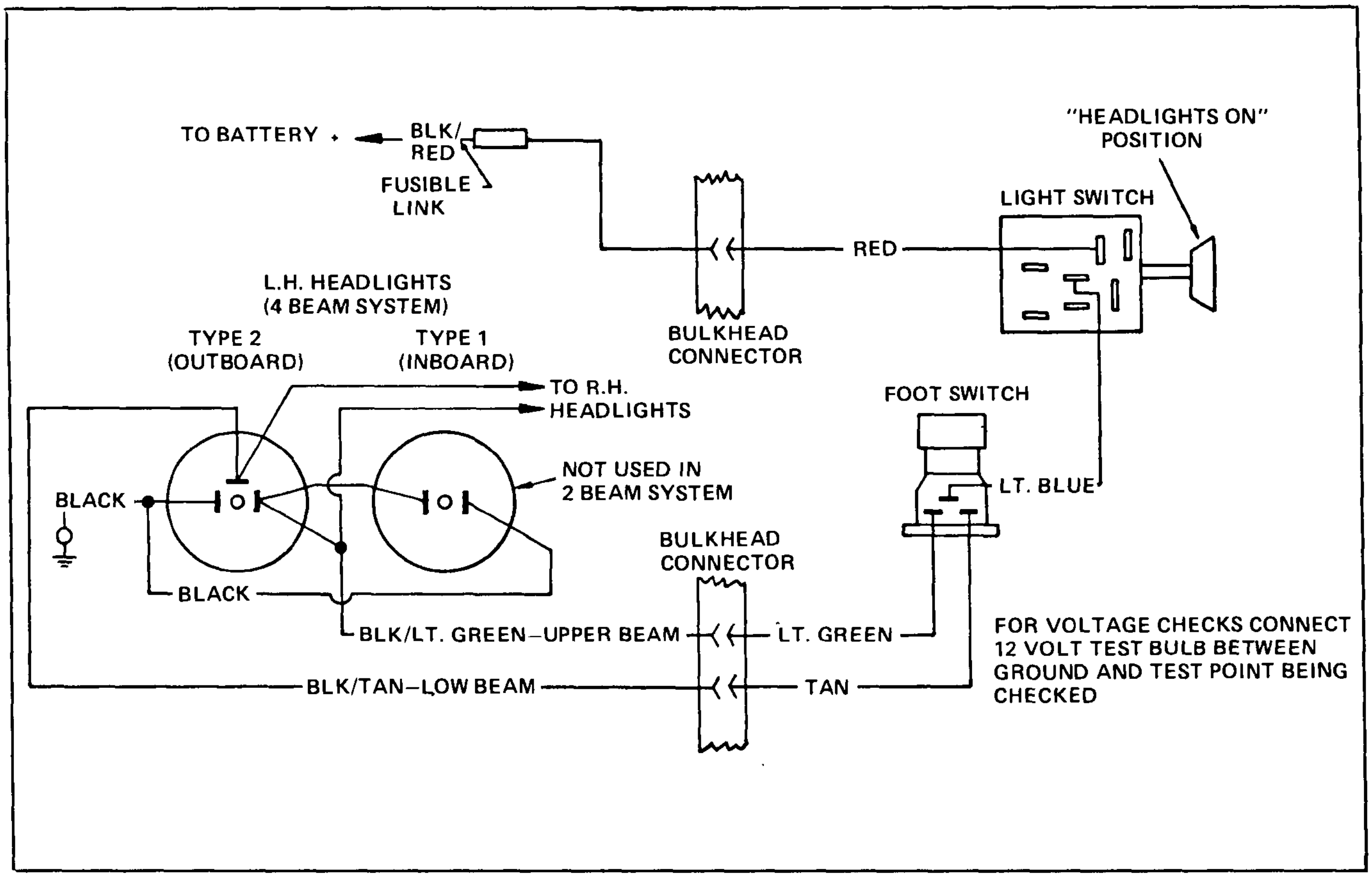


Fig. 12-17 Headlight Circuit

BOTH LAMPS INOPERATIVE

Tail fuse blown.	*If tail lamps do not light, replace tail 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. column.
Open wiring.	*If tail lamps light, check voltage at steering column connector brown wire. If test bulb lights on lamp side of connector only, repair terminal. If tail lamps do not light, check for open wiring between light switch and battery.
Defective directional signal switch	*If tail lamps light, and test bulb lights on both sides of steering column connector, replace directional signal switch.
Defective light switch	*If tail lamps do not light and test bulb lights at at light switch terminal #5 but not at #4, replace light switch.

*See cornering lamp circuit (Fig. 12-18).

TURN SIGNAL AND HAZARD WARNING LAMPS DIAGNOSIS

TURN SIGNAL INOPERATIVE - ONE SIDE

CAUSE	CORRECTION
Bulb out (flasher cannot be heard)	*Turn on hazard warning system. If one

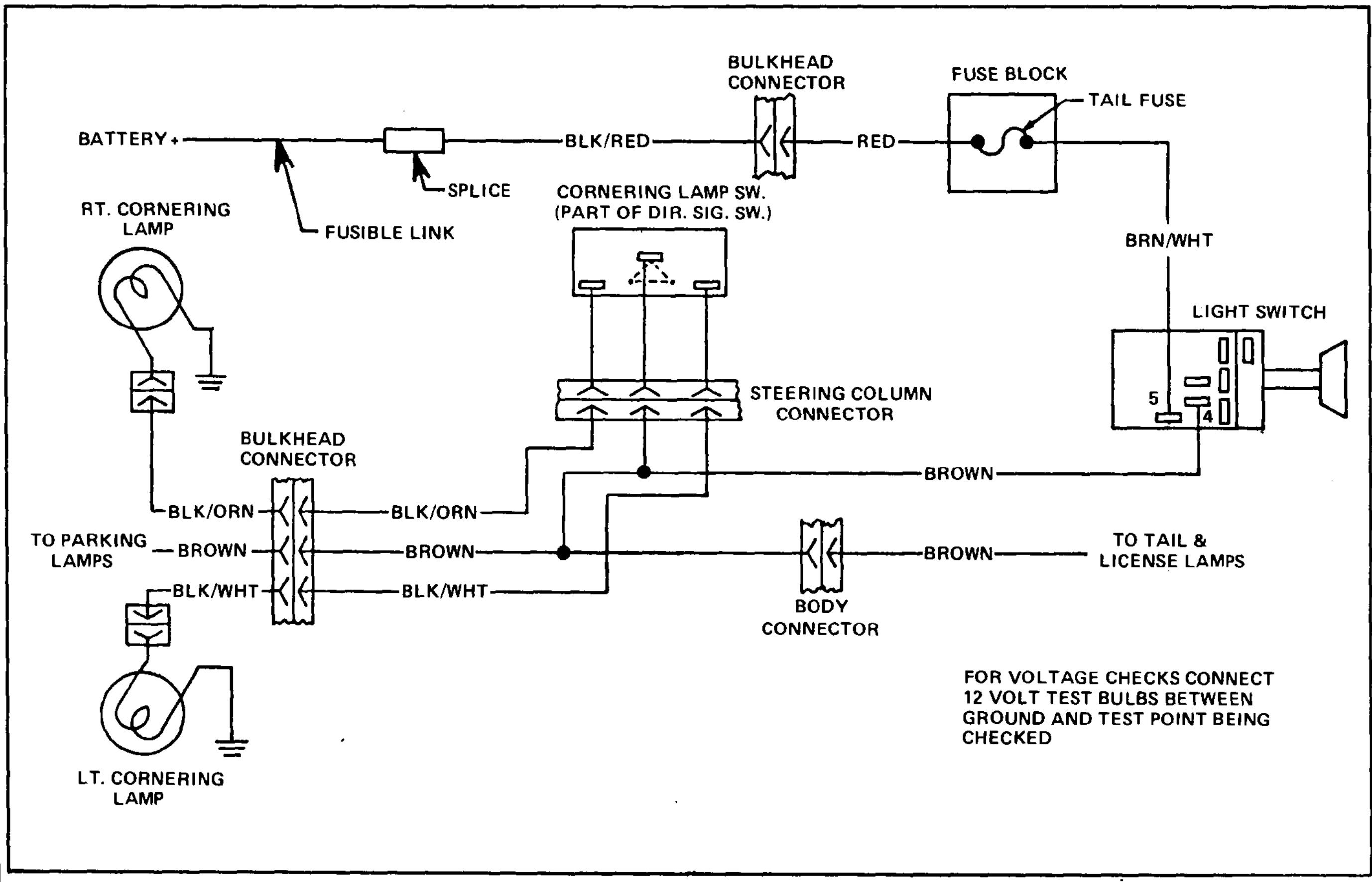


Fig. 12-18 Cornering Lamp Circuit

	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

Open fuse (turn signal)	*Turn on hazard warning system. If all lamps operate, replace 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).
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 switch	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

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 turn 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.

*See turn signal and hazard warning lamp circuit (Fig. 12-19).

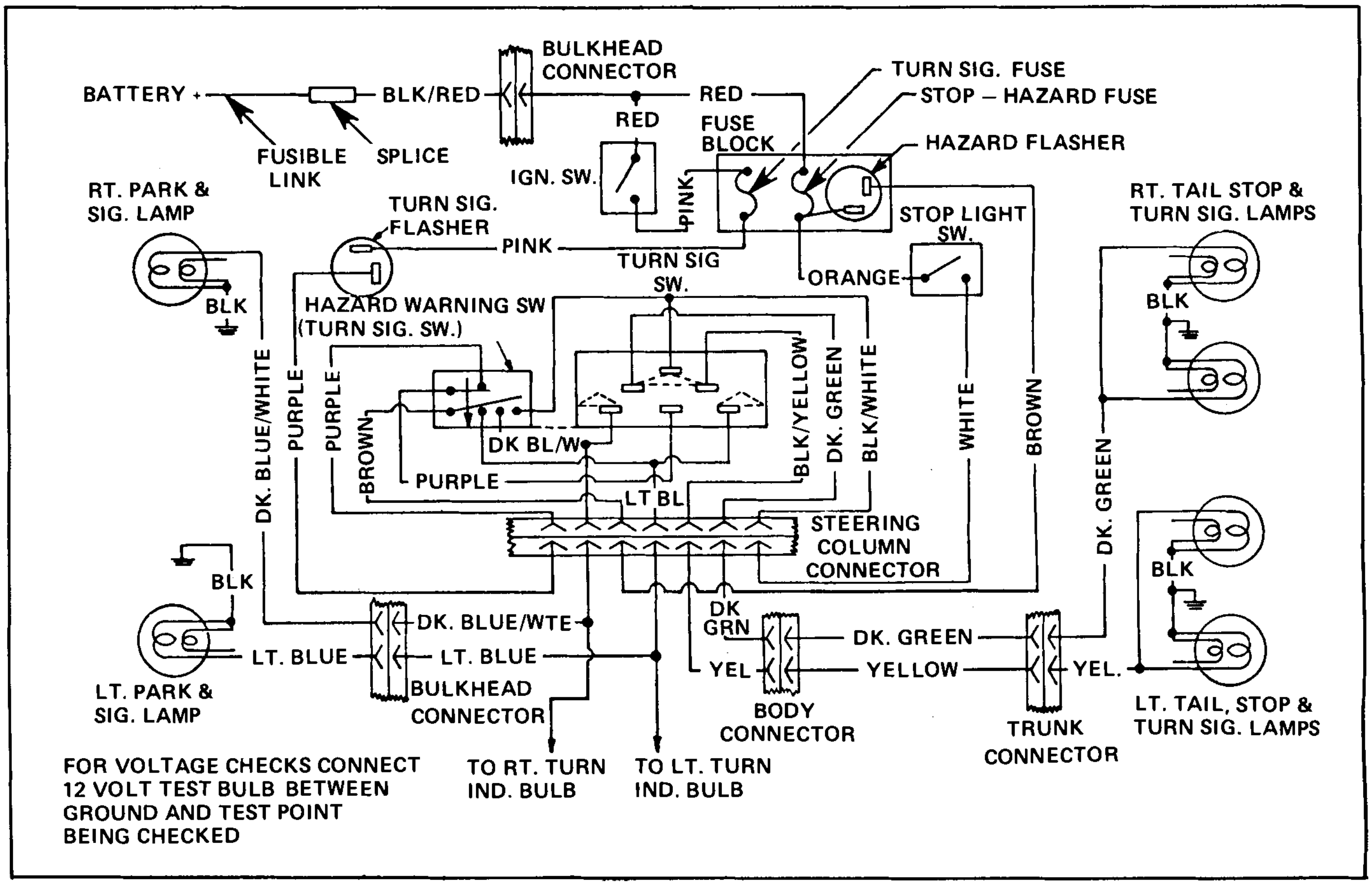


Fig. 12-19 Turn Signal and Hazard Warning Lamp Circuit

SIDE MARKER LAMPS DIAGNOSIS

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

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 tail lamps operate, repair open ground connections.
Multiple bulbs out.	Replace burned out bulbs.

ALL LAMPS INOPERATIVE

Fuse blown.	*If park and tail lamps 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 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.

*See side marker circuit (Fig. 12-20).

TAIL, PARK OR LICENSE LAMPS DIAGNOSIS

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.

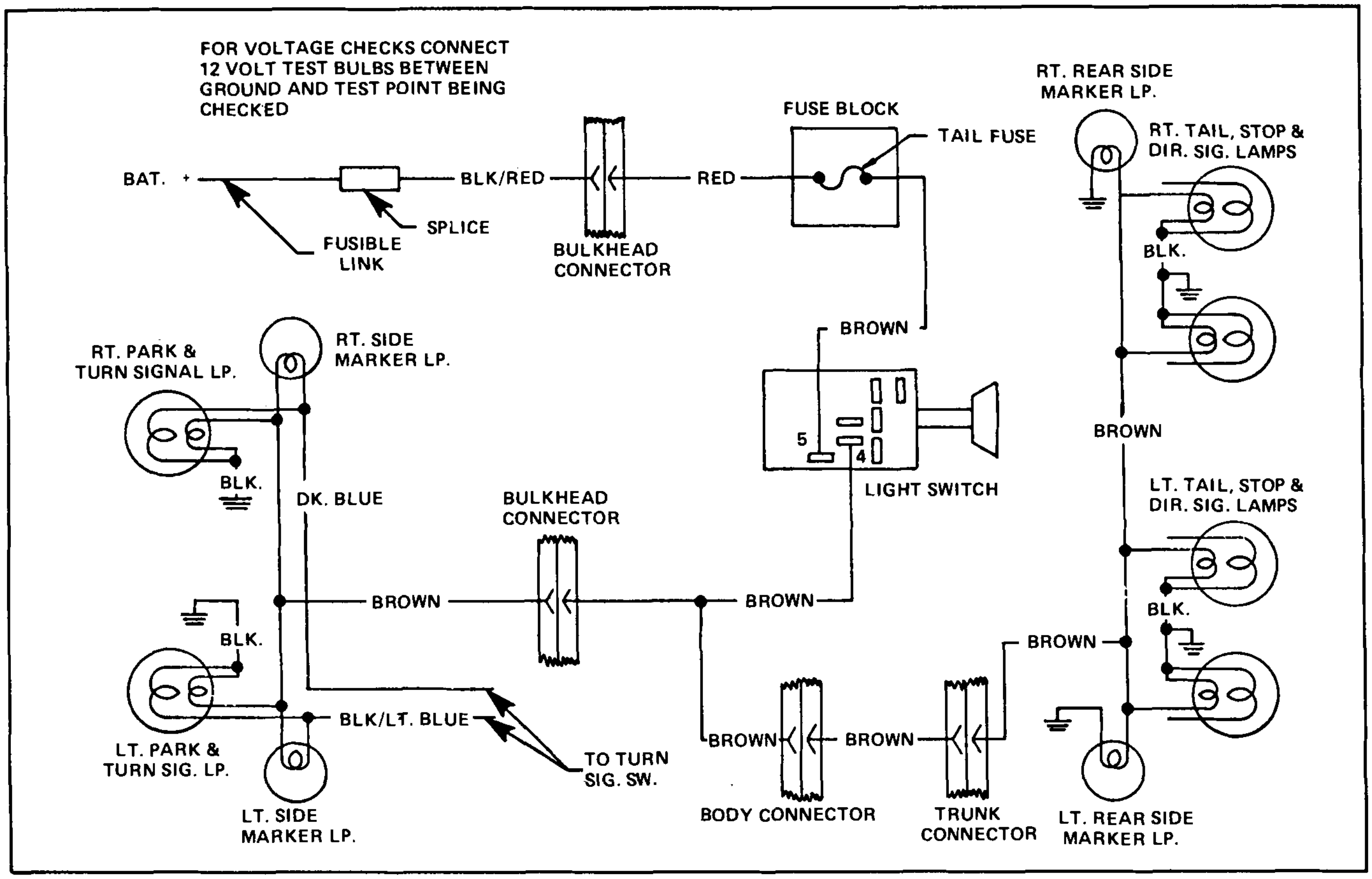


Fig. 12-20 Side Marker Lamp Circuit

BOTH SIDES INOPERATIVE

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.

*See tail lamp circuit (Fig. 12-21).

BACK-UP LAMPS DIAGNOSIS

ONE LAMP INOPERATIVE OR INTERMITTENT

CAUSE	CORRECTION
Open ground connection.	*Repair bulb ground circuit.
Loose connection.	*Tighten connectors.
Bulb out.	Replace bulb.

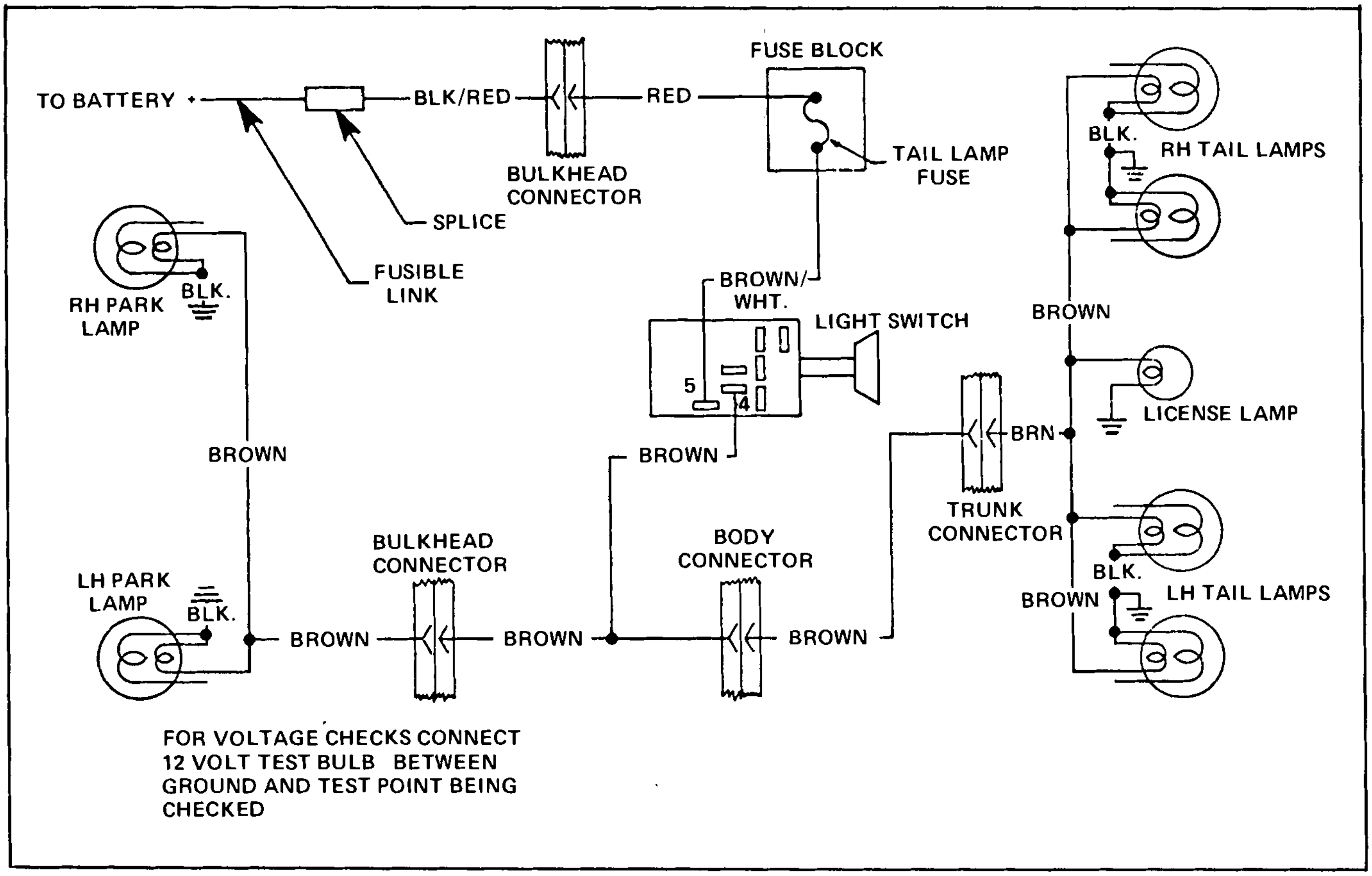


Fig. 12-21 Tail, Park or License Lamp Circuit

BOTH LAMPS INOPERATIVE OR INTERMITTENT

Fuse blown.	*Replace fuse. If new fuse blows, repair 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 either side of fuse, check open circuit from battery to fuse.
Neutral-safety switch misadjusted (open when shift lever is in reverse position).	Adjust
Defective neutral-safety switch.	*With ignition on, check voltage at terminals with switch in back-up position. If bulb lights at pink wire terminal but not at light green wire terminal, replace neutral-safety 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

Neutral-safety switch misadjusted (closed when shift lever is not in reverse position).	Adjust

*See back-up lamp circuit (Fig. 12-22).

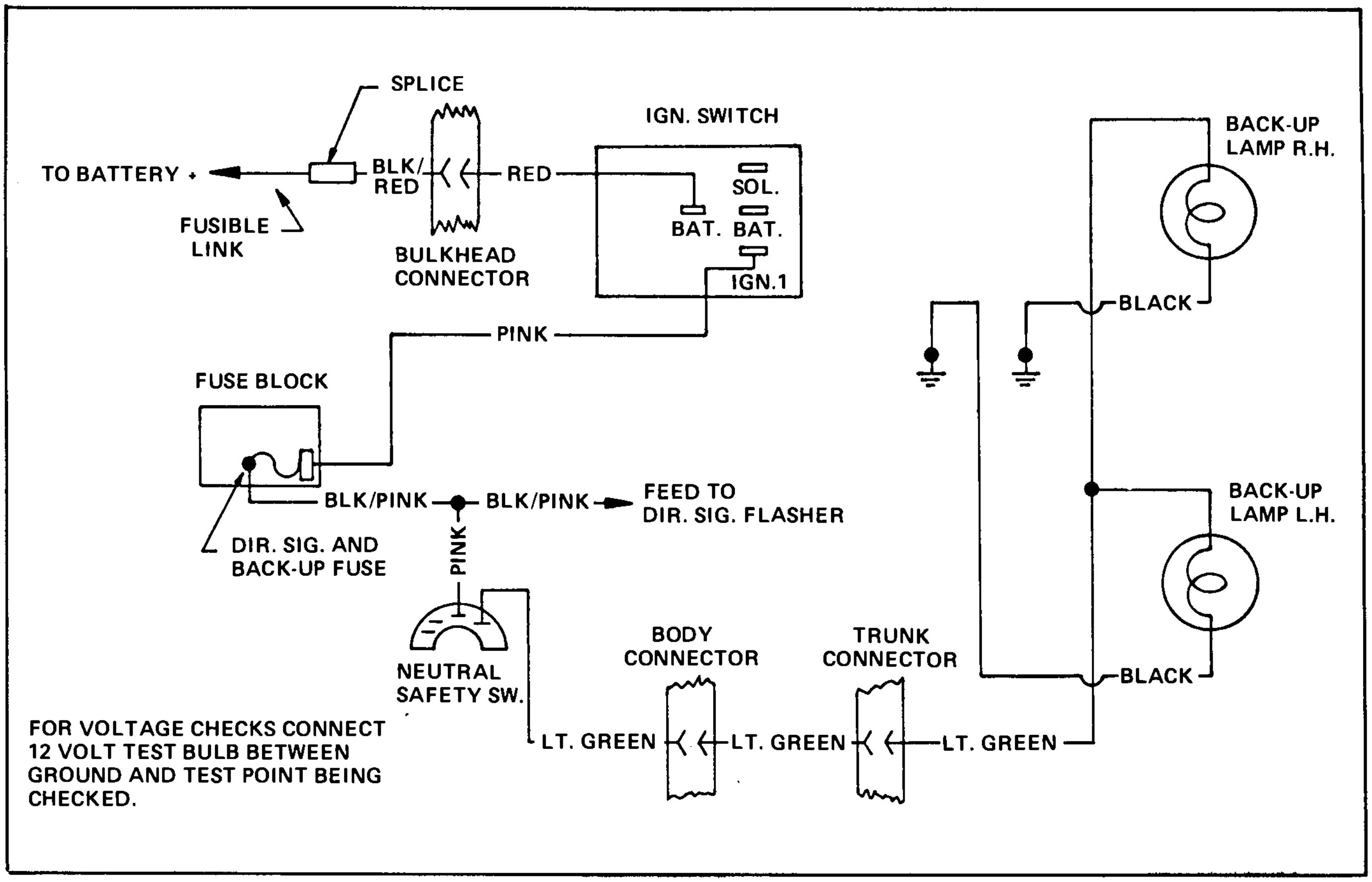


Fig. 12-22 Back-up Lamp Circuit

STOP LAMPS DIAGNOSIS

ONE BULB INOPERATIVE

CAUSE	CORRECTION
Bulb out.	Replace bulb.

ONE SIDE INOPERATIVE

Loose connection, open wiring or defective bulbs.	*Turn on direction 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

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

Stop switch misadjusted or defective. *See stop lamp circuit (Fig. 12-23).	Readjust properly. If switch still malfunctions, replace.

SPEEDOMETER

CAUSE	CORRECTION
Noisy speedometer cable.	Loosen over-tightened casing nuts and snap-on at speedometer head. Replace housing and core.
Pointer and odometer inoperative.	Replace broken cable.
Inaccurate reading.	Check tire size. Check for correct speedometer driven gear.
Kinked cable.	Replace cable. Reroute casing so that bends have no less than 6" radius.
Defective speedometer head.	Replace or have repaired at authorized service station.
Casing connector loose on speedometer case.	Tighten connector.

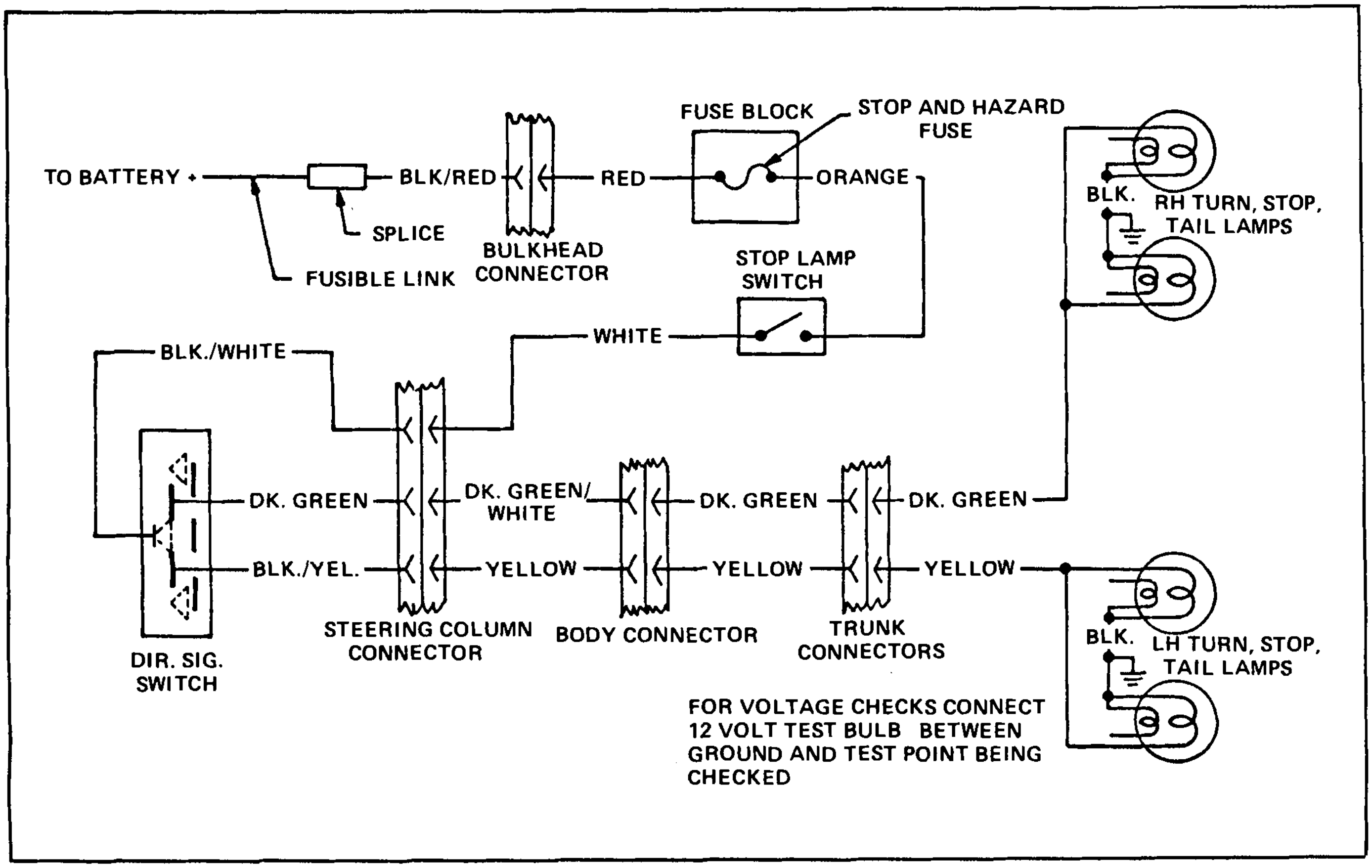


Fig. 12-23 Stop Lamp Circuit

OIL PRESSURE INDICATOR

CAUSE	CORRECTION
Oil light stays on run (if electrical failure).	Check sender unit for improper ground. Check connection at bulkhead connector. Check short from printed circuit to fuse block.
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

CAUSE	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.
Temperature warning lamp inoperative during crank.	Check bulb. Check fuse. Check for open in circuit.
Generator indicator.	See Engine Electrical.

TEST LAMP DIAGNOSIS

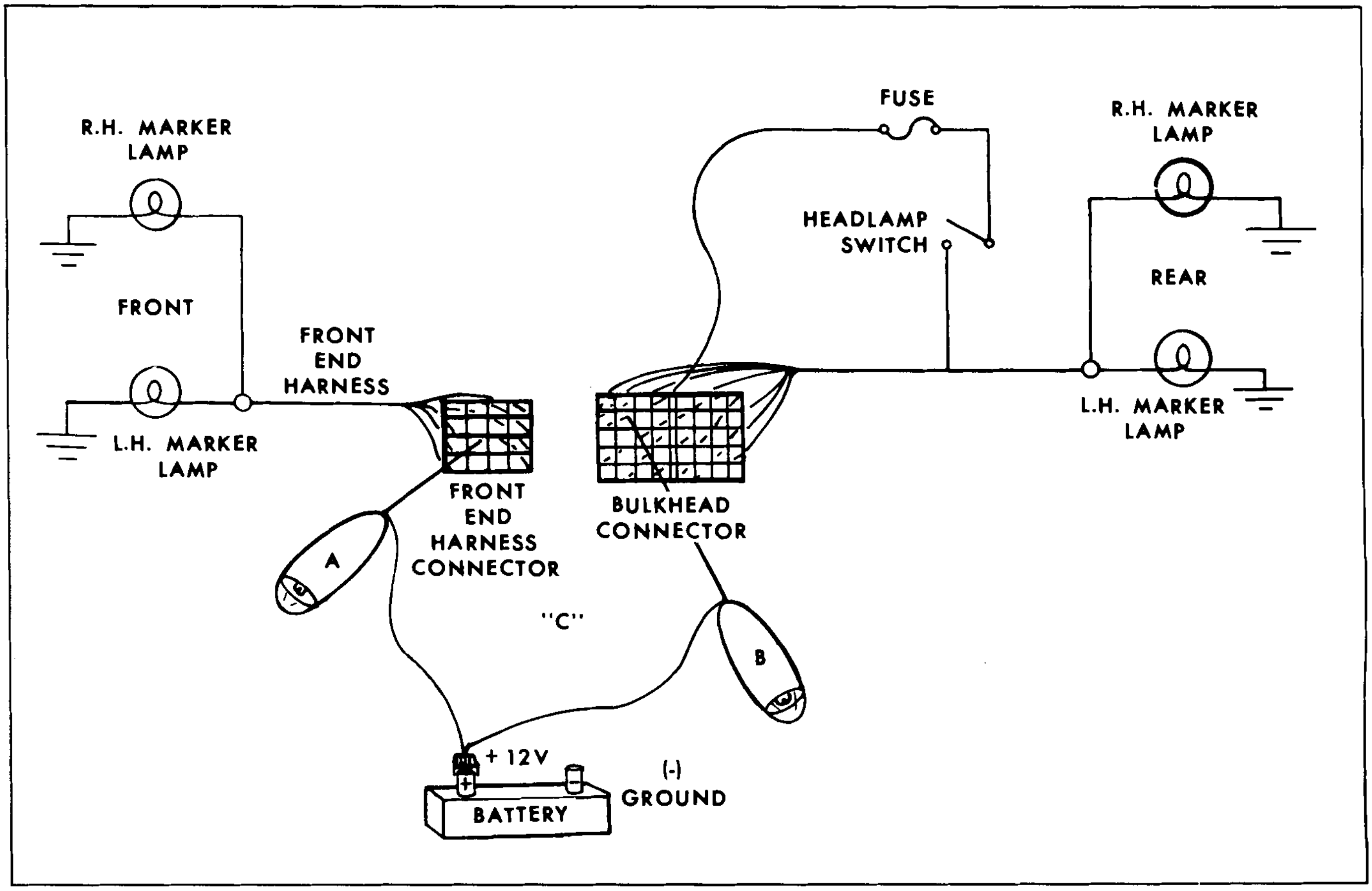


Fig. 12-24 Test Lamp Diagnosis

1. Test lamp connection "A" in Fig. 12-24 checks for continuity from the harness connectors through the front marker lamps to ground.

2. Test lamp connection "B" in Fig. 12-24 checks for continuity from the bulkhead connector through the fuse, headlamp switch and rear marker lamps to ground.

NOTE: *All circuits in the bulkhead, engine and front end connectors can be checked in a similar manner. Check wiring diagrams at end of section for specific circuit locations in the various connectors.*

GENERAL DESCRIPTION

NON-SEALED BATTERY

The Non-Sealed Battery is standard on most models (See Fig. 12-113 at end of Section 12 for battery usage).

It has unique thru the partition cell connection structure. Increased voltage due to this construction adds as much as 10% to cold cranking speeds, extends time before rundown under continuous cranking by 16%, and gives longer battery life. In addition this construction allows a weight reduction of approximately one pound.

The special electrolyte level indicator permits a direct visual check of battery fluid level without removing the caps. A transparent eye in the cap of the second cell from the positive post turns light when the fluid level is low (Fig. 12-25).

WARNING: Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.

Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. This battery has a specific gravity of 1.-250-1.280 at full charge at 80°F.

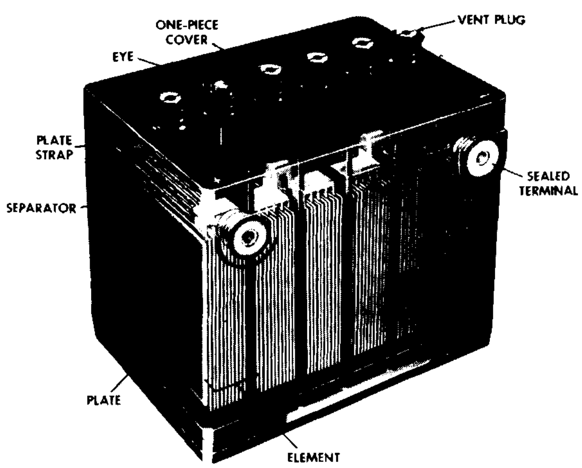


Fig. 12-25 Non-Sealed Battery

The battery date code is located between the first and second vent cap from the negative post. This date code should always be included on product information reports or battery correspondence.

JUMP STARTING WITH AUXILIARY (BOOSTER) BATTERY

WARNING: Never expose battery to open flame or electric spark - battery action generates hydrogen gas, which is flammable and explosive. Don't allow battery fluid to contact skin, eyes, fabrics or painted surfaces - fluid is a sulfuric acid solution which could cause serious personal injury or property damage. Wear eye protection when working with battery.

Both booster and discharged batteries should be treated carefully when using jumper cables. Follow **exactly** the procedure outlined below, being careful not to cause sparks:

1. Set parking brake and place transmission in "PARK". Turn off lights, heater and other electrical loads.

2. Remove vent caps from both the booster and the discharged batteries. Lay a cloth over the open vent wells of each battery. These two actions help reduce the explosion hazard always present in either battery when connecting "live" booster batteries to "dead" batteries.

3. Attach one end of jumper cable to the positive terminal of the **booster battery** (identified by a red color, "+" or "P" on the battery case, post or clamp) and the other end of same cable to positive terminal of **discharged battery.**Do NOT permit cars to touch each other, as this could establish a ground connection and counteract the benefits of this procedure.

4. Attach one end of the remaining negative cable to the negative terminal (black color, "–" or "N") of the **booster battery** and the other end to the negative cable attachment at front of engine of the vehicle (do

not connect circectly to negative post of dead battery) - taking care that clamps from one cable do not inadvertently touch the clamps on the other cable. Do not lean over the battery when making this connection.

Reverse this sequence exactly when removing the jumper cables. Reinstall vent caps and throw cloths away as the cloths may have corrosive acid on them.

WARNING: Any procedure other than the above could result in: (1) personal injury caused by electrolyte squirting out the battery vents, (2) personal injury or property damage due to battery explosion, (3) damage to the charging system of the booster vehicle or of the immobilized vehicle. Do not attempt to jump start a car having a frozen battery because the battery may rupture or explode. If a frozen battery is suspected examine all fill vents on the battery. If ice can be seen, or if the electrolyte fluid cannot be seen, do not attempt to start with jumper cables as long as the battery remains frozen.

PERIODIC SERVICE

Battery care is extremely important. It should receive the following attention:

1. Check the fluid level in each cell of battery every two months. If low, add distilled water to bring level to bottom of split ring in cell filler well.

   CAUTION: *Do not overfill battery and never add any substance to fluid except distilled water.*

2. Keep battery, battery cable clamps, and battery hold-down bracket clean. Cleaning should be done with a brush and a solution of ammonia and water or baking soda and water. Flush off with clear water. After cleaning, apply petroleum jelly or petrolatum to battery cable clamps and terminals to retard corrosion.

   NOTE: *Apply petrolatum or petroleum jelly AFTER connecting battery cables.*

3. If battery performance becomes questionable, check the battery.

INSPECT

Check outside of battery for damage or signs of serious abuse such as broken case or broken covers. Check inside of battery by removing vent caps and inspecting for signs of abuse such as electrolyte level too low or unusual odors. If battery shows signs of serious damage or abuse, it should be replaced.

SPECIFIC GRAVITY CELL COMPARISON TEST

The hydrometer test will indicate the state of charge of a battery unless water has recently been added to the battery or the battery has been recently fast charged. A good hydrometer reading does not necessarily indicate that the battery will perform its normal functions.

The specific gravity of the electrolyte, as measured by the hydrometer, must be corrected for temperature for a true specific gravity reading. The thermometer is used to measure the temperature of the electrolyte in the center cell of the battery. Based on this temperature reading, the specific gravity reading of each cell is corrected by adding .004 points for each 10° above 80°F. or subtracting .004 points for each 10° below 80°F.

Examples:

a. Hydrometer gravity reading.................1.235
   Electrolyte temperature ....110°F.
   Correction (4 x 3).................+.012
   Corrected gravity reading.................1.247

b. Hydrometer gravity reading.................1.250
   Electrolyte temperature ....0°F.
   Correction (4 x 8).................–.032
   Corrected gravity reading.................1.218

1. Visually inspect the battery for a broken or cracked case, broken or cracked cover, odor, leaks around damaged terminal posts, etc. If severe damage is found, replace the battery.

2. Measure the specific gravity of each cell in the battery and the temperature of one of the center cells. Interpret readings as shown in Fig. 12-26.

   NOTE: *If the electrolyte level is too low to be checked by a hydrometer, adjust electrolyte to the proper level by adding colorless, odorless, drinking water. After water addition, the specific gravity check cannot be made until the battery is charged at a rate high enough to cause vigorous gassing for a period of 15 minutes or more. This insures that added water is mixed with the electrolyte before a specific gravity reading is taken.*

3. Fully-charge and re-test those batteries which pass the specific gravity test but fail to perform satisfactorily. Any cell indicating a specific gravity reading (corrected for temperature) of less than 1.230 means that the battery is defective and should be replaced.

421 TEST

The 421 battery testers (Fig. 12-27) are available to test all solid-top batteries or other conventionally- constructed 12 volt batteries. These 421 testers, manufactured by various test equipment companies, will in 2 or 3 minutes deter-

Specific Gravity Difference Between Highest and Lowest Cells	Specific Gravity of Lowest Cell (Temp. Corrected)	Interpretation
Less than 50 points	More than 1.200	Good Battery - Satisfactorily Charged
Less than 50 points	Less than 1.200	Good Battery - Requires Charging
More than 50 points	--	Defective Battery - Replace

Fig. 12-26 Specific Gravity Chart

mine the condition of any 12-volt unit. The conditions, good, defective or amount of battery charge can quickly be determined. The tester can be used with the battery either in or out of the vehicle, regardless of size or temperature. Terminal adapters are readily available for side terminal battery hook-up (Fig. 12-28).

The 421 tester is based on an analysis of the difference between two voltage readings. One of these voltage readings is taken after the battery has been discharged at a given rate and time by the tester. The other reading is taken after the battery has been charged at a given rate and time by the tester. The difference between these two readings is then compared with a standard shown on the tester. The conditions of good or defective and the state-of-charge can quickly be determined.

421 testers which automatically charge and discharge the test battery at a given rate and time are manufactured and sold by a number of companies. The 421 designation is shown on the meter face indicating that the above described programmed test is followed. For particulars in the use of the test, follow the specific directions of the test equipment manufacturer.

If a 421 tester is not available for the solid-top batteries, a hydrometer and thermometer may be used as a preliminary check for this type battery. The accuracy of this check, described below, is not sufficient to be considered as a reliable battery test. All batteries passing the hydrometer check, would not necessarily pass the 421 test nor perform its normal function. General comments on overall 421 Tester operation follow:

Energizers or batteries should NOT be charged prior to making this test. Defects within the unit can be hidden by the charging and erroneous test results will be obtained.

Erratic or extremely low initial meter readings may indicate poor connections at the tester terminals. Obtain clean and tight connections before performing the 421 test.

All meter readings should be made immediately after the meter indicator light comes on even if the meter needle is still moving.

If additional discharges are required after the initial discharge, set meter indicator following the last discharge cycle.

Batteries designated as bad by the tester should be replaced.

Batteries designated as good, with no owner's complaint

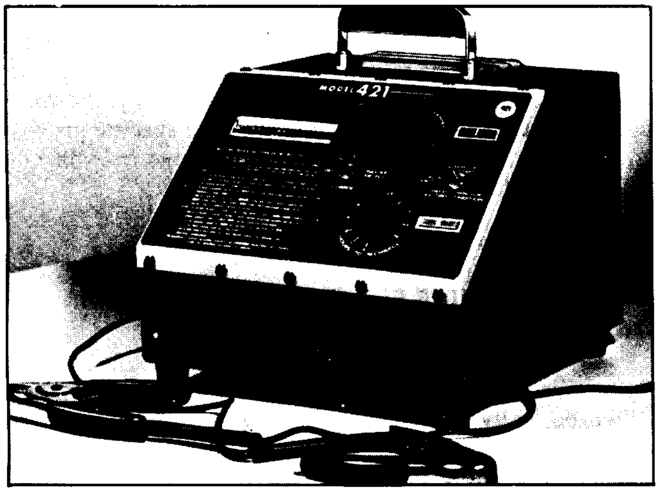


Fig. 12-27 421 Battery Tester

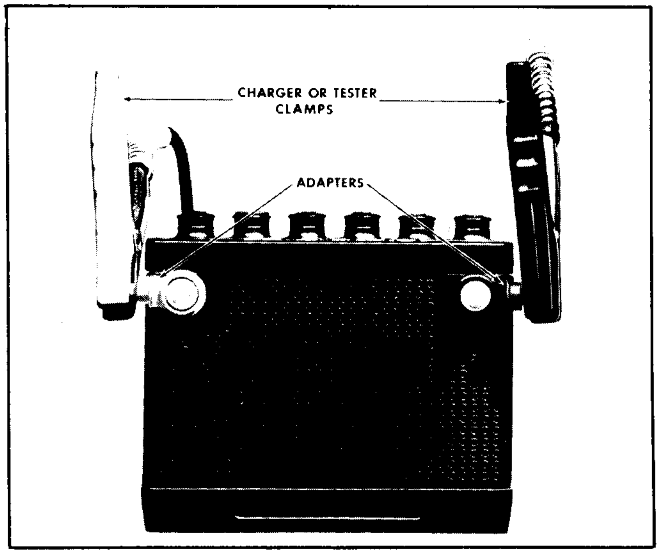


Fig. 12-28 Side Terminal Battery Adapters

or indication of poor performance, should be left in service. Posts, cable clamps, and top should be cleaned, water should be added and recharging should be performed, if required. For dependable and reliable battery service, the battery should be in at least a 75% state-of-charge.

Batteries designated as good that are suspected of being questionable because of owner complaint, or age of the battery, should be further tested by the hydrometer test.

LOAD TEST

Load test equipment is available to test the battery's capacity under a load. The test is as follows:

1. Charge battery, if necessary, until all cells are at least 1.200 specific gravity.

2. If unable to obtain 1.200 specific gravity @ 80° in all cells, replace the battery.

3. If specific gravity is 1.200 or more @ 80° in all cells, remove vent caps and connect 300 amp load for 15 seconds.

4. If "smoke" is visible in one or more cells after 300 amp load, replace the battery.

5. If no "smoke" is visible, place a thermometer in one cell:

   a. Apply specified load as shown in Fig. 12-29.

   b. Read voltage at 15 seconds with load connected.

   c. Remove load and read electrolyte temperature.

6. Compare temperature and voltage readings with those in Fig. 12-29.

7. If measured voltages are less than Fig. 12-30, replace battery.

8. If measured voltages are the same as or greater than Fig. 12-29, fully charge, clean and return battery to service.

BATTERY MODEL	AMP LOAD
R58 or R58S	180
R88 or R88S	180
R88W or R88X	230
Y54	130
Y58	160
Y88	160

Fig. 12-29 Battery Load Test Values

ELECTROLYTE TEMPERATURE	MINIMUM VOLTAGE*
80°F and higher	9.6
70°	9.6
60°	9.5
50°	9.4
40°	9.3
30°	9.1
20°	8.9
10°	8.7
0°	8.5

***Note:** *Voltage must not drop below minimum listed when battery is subjected to proper load for 15 seconds.*

Fig. 12-30 Voltage and Temperature Values

FULL CHARGE HYDROMETER TEST

This test should be used on energizers which test good by other tests, but which subsequently fail in service.

In order to perform the full charge hydrometer test, the energizer must first be fully charged by the slow charge method. This method consists of charging all 12-volt energizers at a 4-ampere rate until the energizer is fully charged. A fully charged condition is reached when cells are gassing freely and no change in specific gravity occurs over a one-hour period. Due to the low charge rate, a charge period of 24 hours or more may be required.

With the energizer fully charged, measure the specific gravity in each cell. If any cell reads less than 1.230, corrected for temperature, the energizer should be replaced.

If the specific gravity readings are between 1.230 and 1.310, the energizer is in good condition and may be returned to service.

If any cell reads above 1.310, corrected for temperature, the energizer may be returned to service, but its useful life has been shortened due to damage caused by the high specific gravity electrolyte. Adjusting the specific gravity to lower levels may not correct the damage that has already been done.

CHARGING GUIDE FOR TYPICAL PASSENGER CAR BATTERIES

There are three methods of recharging energizers. They differ basically in the length of time the energizer is charged and the rate at which charging current is supplied. One is the slow charge method, the second is the fast charge method, and the third is the emergency boost charge method.

Before recharging an energizer by any method, the electrolyte level must be checked and adjusted if necessary.

The slow charge method supplies the energizer with a relatively low current flow for a relatively long period of time. This is the only method that will bring the energizer to a full state of charge.

The slow charge method consists of charging at approximately a 4-ampere rate for 24 hours or more if necessary to bring the energizer to full charge. A fully charged condition is reached when the cells are gassing freely and three corrected specific gravity readings taken at hourly intervals show no increase.

The fast charge method supplies current to the energizer at a 40 to 50 ampere rate for a 1-1/2 hour period of time. If the electrolyte temperature reaches 125°F. before the 1-1/2 hour period is completed, the energizer must be taken off charge temporarily, or the charging rate reduced to avoid damage to the energizer.

In cases where the energizer is not sufficiently charged to crank the engine, an emergency boost charge may be applied as a temporary expedient in order to crank the engine. The emergency boost charge method consists of charging at a 40 to 50-ampere rate for a period of one-half hour.

It should be particularly noted that the emergency boost charge will not necessarily restore the energizer to a useful state of charge for continued service. After an emergency boost charge, failure to charge the energizer further, either by a long uninterrupted driving period or by the fast charge or slow charge method, may result in failure to crank the engine the next time cranking is attempted. An energizer should never be condemned on the basis of failure to crank the engine after an emergency boost charge. Although an emergency boost charge may put enough energy into the energizer to crank the engine once, further charging usually is necessary in order to create a sufficient reserve to crank a second and third time.

SEALED BATTERY

This sealed, maintenance-free battery (Fig. 12-31) is available on some models (See Fig. 12-113 at end of Section 12 for battery usage). Its new chemistry and construction methods give it the following advantages:

1. No water addition for the life of the battery. This is made possible by its new chemistry so that it never uses water. This feature, combined with its corrosion-proof side terminals, offer a battery that is completely maintenance-free.

2. 35% more power - compared to a conventional battery of the same size.

3. Higher performance level throughout its normal life. This means that, compared to an ordinary battery whose performance decreases steadily with age, the sealed battery delivers more available power at any time during its life.

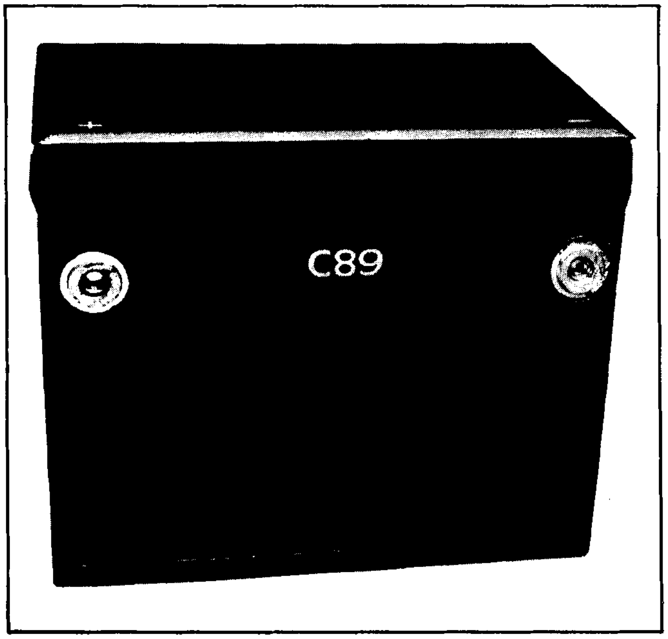


Fig. 12-31 Sealed Battery

4. Greatly reduced susceptibility to self-discharge as compared to an ordinary battery - which has a tendency to gradually discharge when left unused for long periods of time. This is a great advantage, for example, to people who go on winter vacations and leave their car parked at the airport.

VISUAL INSPECTION

Check for obvious damage, such as a cracked or broken case that could permit loss of electrolyte. If obvious physical damage is noted, replace energizer.

PREPARING ENERGIZER FOR SERVICE

1. If no physical damage is noted, charge energizer as noted below.

2. After charging, connect a 300 ampere load across terminals for 15 seconds to remove surface charge from energizer.

LOAD TEST

1. Connect voltmeter and 230 ampere load across terminals.

2. Read voltage after 15 seconds with load connected, then disconnect load.

3. If voltage is 9.6 or more, energizer is good and sufficiently charged to return to service.

4. If voltage is less than 9.6, replace energizer.

CHARGING INSTRUCTIONS

1. Charge at maximum setting of charger for the length of time required to obtain 50 ampere-hours of charge. Examples:

INITIAL CHARGE RATE	HRS. TO CHARGE*
75 Amps.	2/3
50 Amps.	1
25 Amps.	2
10 Amps.	5

* Initial charge rate is the current that the energizer will accept at the start of charging. As the energizer is charged, this rate will decrease.

When a charger does not have an ammeter, place a test ammeter in series with the charger to determine the initial charge rate.

If energizer temperature is 32°F or less, energizer should be charged for 1/2 hour at charger's highest setting before the charge rate is determined.

2. Do not exceed the calculated hours of charge, as overheating and spewing of acid might result. In case of spewing, shut off charger and proceed with testing.

BATTERY CABLE

REPLACE

When replacing battery ground cable, be sure the connections are clean and secure. Apply petroleum jelly or petrolatum to cable clamps and terminals to retard corrosion. On the heavy duty side - terminal battery, torque the terminal bolts to 60-90 lb. in.

BATTERY SUPPORT

REPLACE

When replacing the battery on B and F Series, first position the battery into the fixed tray. Then, position the retainer clamp on the battery top and onto the hold-down bolt. Torque the hold-down nut to 38-42 lb. in. On A, G and X Series, position the retainer clamp into the battery hold-down slot and torque the hold-down screw to 60-90 lb. in.

WIRING HARNESS

Engine, passenger compartment and rear end wire harness routings and connections are shown in Fig. 12-114 (B Series), Fig. 12-115 (A Series), Fig. 12-116 (G Series), Fig. 12-117 (F Series) and Fig. 12-118 (X Series) at end of section. The wiring harness routing is positioned to reduce possibility of damage to harness.

In addition the body harness is protected with a tough plastic conduit to prevent puncture and shorting. Particular attention should be given toward making sure wiring is not pinched, stretched or positioned so as to contact any movable parts under instrument panel. This includes hand brake, foot brake, ash trays, accelerator linkage, etc. All unfused circuits and the engine wiring harness have a .067" nylon jacket to improve resistance to heat, pinching and cutting.

FUSE BLOCK

The fuse block (Figs. 12-32 and 33) is located on the dash shroud at left side just above front edge of floor mat, and has replaceable fuse clips which are serviced separately. An efficient tool for fuse clip removal can be made from a cotter pin approximately 2-1/2" long. Cut off long leg even with short leg. File bevel on outside of both legs. Spread pin wide enough to span fuse clip.

The front end and engine harnesses are firmly attached to the bulkhead connector which is connected to the front of the fuse block by two bolts. 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.

FUSIBLE LINK

Added protection is provided in all battery feed circuits by a fusible link (Fig. 12-34). 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 gauges 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 X Series incorporates the following fusible links:

1. The pigtail lead at the battery positive cable is a 14 gauge, brown fusible link protecting the 10 gauge battery charging circuit. This wire is an integral part of the battery cable assembly and servicing requires replacing the complete battery cable assembly.

2. A 16 gauge black fusible link is located at horn relay to protect all unfused wiring of 12 gauge or larger. It is a serviceable piece with an in-line connector and is not integral with the wiring harness.

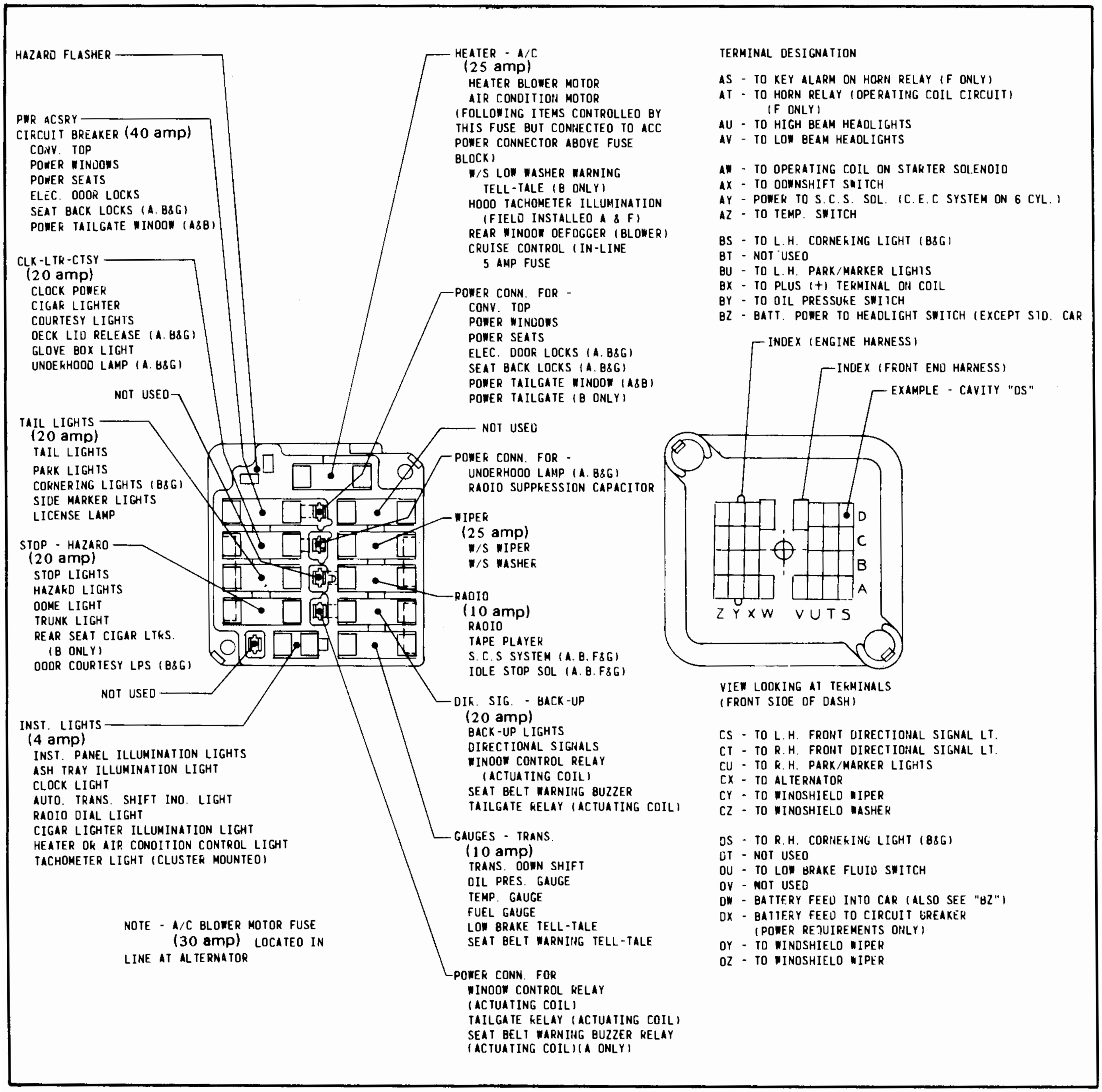


Fig. 12-32 Fuse Block Identification - Without Electric Rear Window Defogger

3. The generator warning light and field circuitry (16 gauge wire) is protected by a fusible link (20 gauge orange wire) used in the "battery feed to voltage regulator #3 terminal" wire. The link is installed as a molded splice in the circuit at the junction block and at the horn relay. Each link is serviced by splicing in a new 20 gauge wire as required.

4. The ammeter circuit is protected by two orange, 20 gauge wire fusible links installed as molded splices in the circuit at the junction block and at the horn relay. Each link is serviced by splicing in a new 20 gauge wire as required.

WIRING CONNECTORS

Wiring connectors have a locking design to insure tight fit to prevent them from separating.

Connectors are also designed to attach in only one manner which simplifies harness connection.

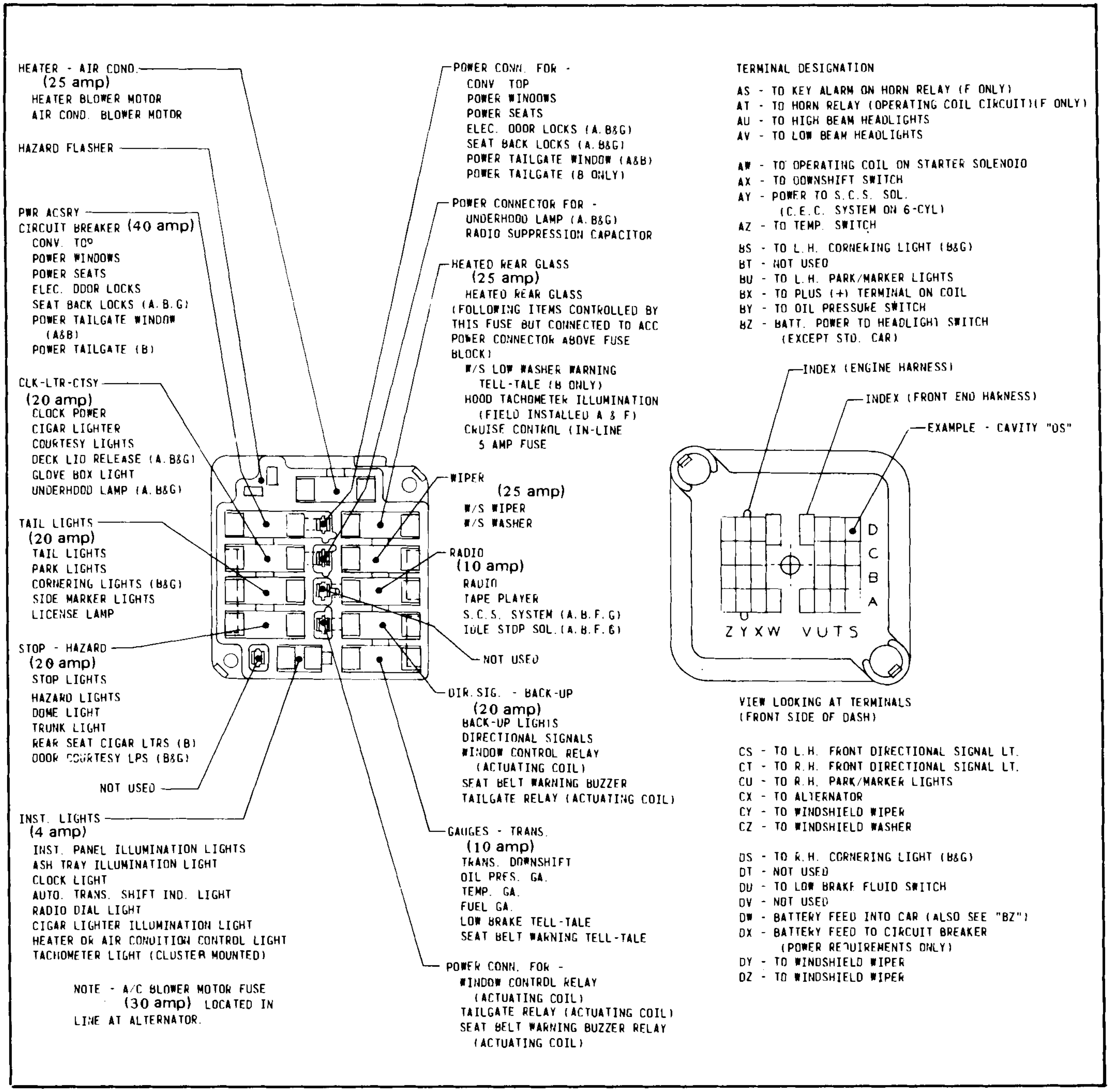


Fig. 12-33 Fuse Block Identification - With Electric Rear Window Defogger

CIRCUIT BREAKER

A circuit breaker is provided to protect power seat, power window and power tailgate windows from high current loads. A relay in the same circuit switches current of these various components and is energized by current from the accessory feed connectors.

LIGHTING

The headlamp system consists of two dual headlamp units (one on F, G and X Series) mounted in a horizontal arrangement on each side of car. In this installation the outside lamp is a dual filament seal beam unit. 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. First, 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 extreme 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

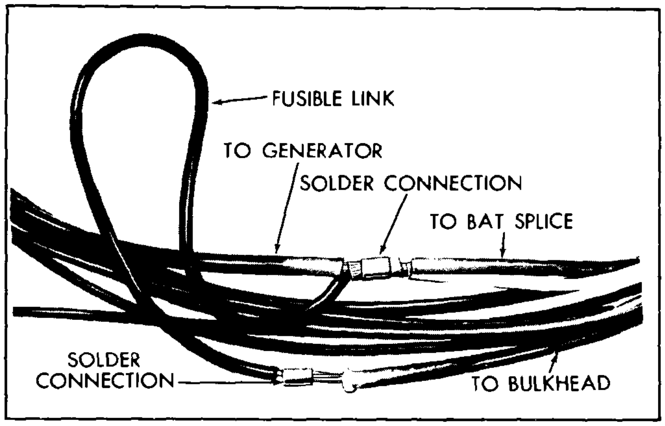


Fig. 12-34 Typical Fusible Link

the extreme counterclockwise position the instrument panel lights are completely off and the dome light is turned on. Second, the beam switch (foot operated) determines if the headlamp country (bright) beam or traffic (dim) beam is on when the main lighting switch is pulled out. A red indicator lamp (blue on B and F Series) on the instrument panel glows when the headlamp country 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 (rear) or double filament (front) 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 fragile, 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.

Regardless of method used for 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 Section 10). 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.

Horizontal aiming of each sealed beam is provided by adjusting screws which move mounting ring in body against tension of springs. There is no adjustment for focus since sealed beam unit is set for proper focus when it is manufactured.

Headlamp aiming equipment is commercially available. Follow manufacturers recommendations for use of this equipment.

Lighting for ash tray illumination on A, G and F Series comes from the instrument panel cluster. The light 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 tail lamp lens on B (except station wagons), G and F Series contain small circles of reflex (about 1/8" diameter) covering its entire surface. Thus, when lights are directed at the rear of the car, the entire tail lamp appears to light up. The A and X Series lens continues to have a small section of reflex in the tail lamp lens rather than the entire surface. This is a safety advantage for a driver following a a car which has a tail lamp burned out. The B Series station wagons have two separate reflectors mounted in the rear bumper.

The tail lamp bulb is a double filament bulb which acts as stop, tail and turn signal lamp. The bulb can be removed by removing the tail lamp lens on A, G and station wagon series or removing bulb and socket from inside trunk on B, F and X Series.

STOP LAMP SWITCH

The stop lamp switch must be checked whenever brake pedal height has been changed. Adjustment is made by positioning the switch and bracket in relation to pedal arm.

> **NOTE:** *Make sure that switch does not restrict pedal action.*

HORNS

The two horns installed on most cars (Fig. 12-35) are designed to give a blended tone when operated together. Each horn utilizes a solenoid-actuated diaphragm to develop a resonating air column in horn projector.

A relay is inserted in the horn circuit because of high current required to operate horns. The relay reduces length of heavy gauge 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.

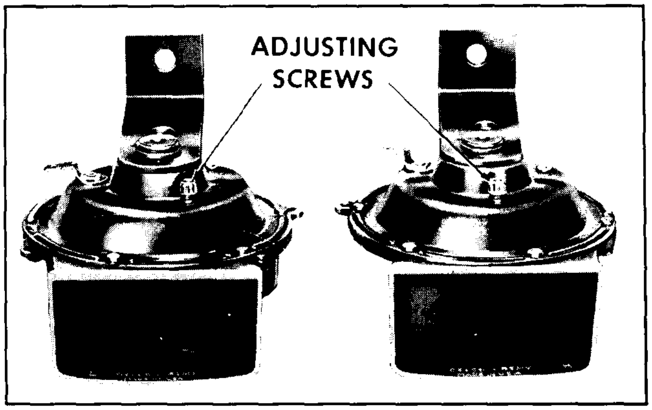


Fig. 12-35 Typical Horn Assemblies

NOTE: *Only one horn is standard equipment on some A, F and X Series.*

The horn relay-buzzer is constructed to incorporate both the horn relay and reminder buzzer into one assembly. A typical assembly is shown in Fig. 12-36.

The horn relay-buzzer operates when the driver's door is opened to remind him that the ignition key has been left in the switch. A typical circuit is shown in Fig. 12-37. The operation is explained as follows:

With the key fully inserted into the ignition switch, the No. 4 terminal on the horn relay-buzzer is connected to ground through the door switch when the driver's door is opened. Current then flows from the battery through the coil winding, the buzzer contacts, the ignition switch, and the door switch to ground. The winding magnetism causes the buzzer contacts to open, which opens the winding circuit, and the contacts then re-close. This cycle then repeats many times per second to give the buzzing sound. Closing the door, or removing the key, will stop the buzzer action.

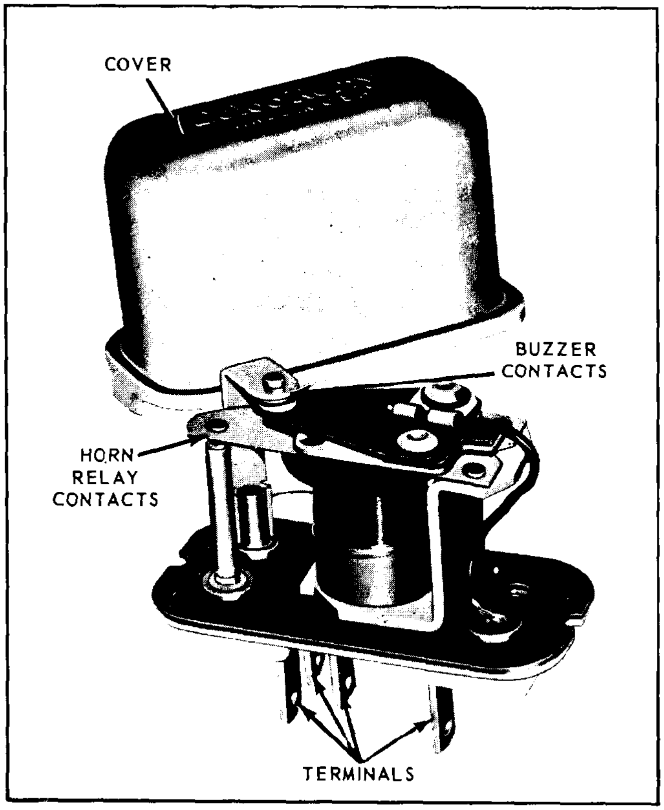


Fig. 12-36 Typical Horn Relay Buzzer

When the horn switch is closed, the coil winding is connected to ground, and the armature moves toward the core to close the horn relay contacts. The horns are then connected to the battery, and operate accordingly. With the horn switch closed, the buzzer contacts remain separated.

BACK-UP LAMPS

Back-up lamps are standard equipment on all models. On automatic transmission equipped cars the back-up lamp switch is incorporated in the neutral safety switch located on the steering column. On synchro-mesh transmission equipped cars, the back-up lamp switch is separately mounted on the steering column. 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.

CIGAR LIGHTER

The lighters release automatically (usual time for release is 10 to 14 seconds) which means that if plug is held in by

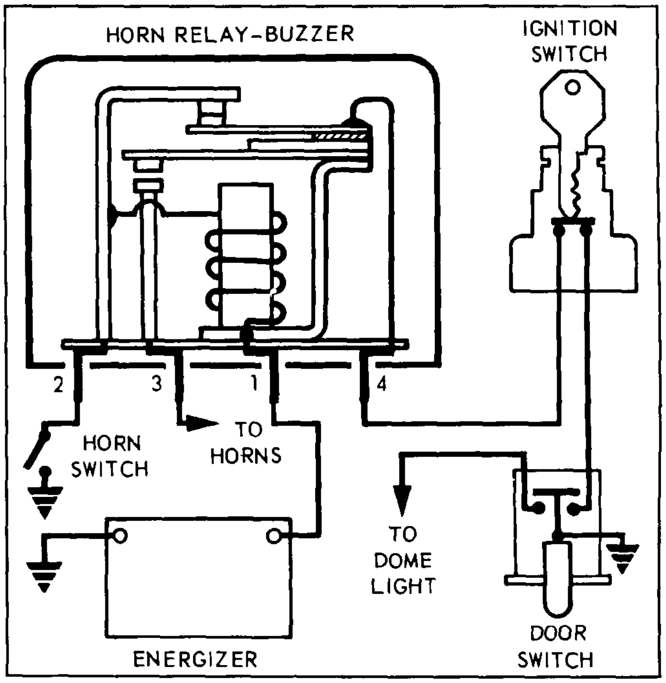


Fig. 12-37 Typical Horn Relay Buzzer Circuit

operator's hand a sufficient length of time (60 to 90 seconds) the fuse will blow. This may, in some cases, account for blown fuse when lighter is functioning perfectly.

If temperature of element shows indication of incorrect timing (too hot or too cold), the socket containing bimetal hold-in fingers must be replaced.

Lighters have a safety feature in the form of two retaining fingers which prevent knob and element from falling out or popping out of sockets onto floor. If these fingers do not keep knob and element from falling out, socket should be replaced.

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 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 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 remaining signal on that side of car to burn steadily.

The flasher, which is mounted on the lower instrument panel reinforcement brace, is a sealed unit and is non-adjustable. If flasher is inoperative, it must be replaced. The flasher makes an audible signal when it is properly positioned in its clamp. This audible signal serves as an additional warning when signal is operating.

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 vehicle side panel. The front side marker lamps (double filament) flash with the turn signals in operation while the rear side marker lamps (single filament) are illuminated only by the headlamp switch. The circuit is fused with the tail, cornering and park lamps.

INSTRUMENTS

Instruments consist of fuel gage, temperature indicator (thermo-gage), charge indicator, oil pressure indicator, and speedometer. 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.

The B and F Series instrument panel is designed so that any bulb can be changed in less than a minute from the face of the panel. Instruments have been designed for easy removal by elimination of separate ground straps. With the grounding provisions integrated with the instrument panel wiring, the instruments can be removed after removing a separate trim plate.

FUEL GAGE

An electric fuel gage is used at instrument panel (dash unit) and fuel tank on all models. The fuel gage indicates the quantity of fuel in tank only when ignition switch is turned on or to accessory position.

When ignition is turned off or to start, 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.

The dash unit is an electromagnetic instrument consisting of a permanent magnetic armature and spindle assembly mounted in a pocket in center of a plastic core with a quantity of silicone dampening fluid to restrict pointer movement due to car motion. A pointer is attached to spindle. Around the core, and surrounding magnet armature, are three coils that produce a magnetic field which attracts the armature. The direction of the magnetic field of coils is determined by resistance of the tank unit rheostat.

Coil No. 1 is connnected through the gage terminal to battery. The opposite end of coil No. 1 is a common point to coil No. 2 and rheostat. The common point is another gage terminal to which coils 1 and 2 are internally connected and rheostat is externally connected. A third coil is connected to opposite end of coil No. 2. The opposite end of coil No. 3 is connected to ground.

Coils 1 and 2 are wound in opposite directions so that in operation their magnetic fields oppose each other. A fixed calibration resistor is connected across coil No. 1.

When the fuel tank is empty, the tank unit rheostat resistance is approximately zero ohms. All current passes through coil No. 1 and the armature and pointer align themselves with the magnetic field of this coil. As the tank fills up, the rheostat resistance increases and current now flows in all three coils. The armature and pointer will align themselves with resultant magnetic field of all three coils. The exact position of armature and pointer depends on magnitude of each field produced by coils. The total angular travel of armature and pointer from empty to full is 90°.

The fuel gage tank unit consists of a float with linkage connecting it to a movable contact arm and rheostat. As the float rises with filling tank, the contact arm moves over the rheostat which increases resistance into the dash unit electrical circuit, and provides more current into coils 2 and 3, and causes greater dash unit pointer movement toward FULL position.

Air conditioned cars are equipped with a vapor separator system therefore, a special fuel tank gage unit is required to accept the vapor return line to tank.

TEMPERATURE INDICATOR LAMP

The engine temperature indicator lamp is controlled by a thermal switch which senses cylinder head temperatures.

When the ignition switch is turned to "start" position, a test circuit is closed to indicate whether the red lamp is functioning properly.

The engine thermostat is calibrated to control the coolant temperature within certain limits of atmospheric pressure. With installation of a 15 psi cap, the boiling point of engine coolant is raised approximately 2.5°F. for each increase in pressure. Thus, at atmospheric pressure, the boiling point of coolant (if only water) will increase from 212°F. to approximately 250°F. at sea level.

The coolant pressure and temperature will vary during car's operation. As engine warms up from cold start, heat energy absorbed by coolant (circulated by water pump) causes coolant to expand with resultant increase in cooling system pressure. When car is stopped, as at an intersection, the temperature of coolant will increase because coolant circulation is reduced and air flow through radiator is at minimum. When car moves forward again, the engine coolant is cooled due to recirculation through radiator and added air flow across radiator. This rising and lowering of temperature and pressure is a normal function of the cooling system.

The engine thermostat control temperature also varies as coolant mixture varies. All models specify the use of 195°F. thermostat with glycol type coolant.

Upon starting a cold engine there will be a period of time before coolant reaches its normal operating temperature and thermostat will remain closed until thermostat control temperature is exceeded; then the thermostat will open. If coolant temperature reaches 248°F. ± 20°, the circuit to red lamp will be closed, causing warning lamp to be illuminated.

If the cooling system should 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.

It is to be noted that a higher temperature thermostat (e.g., 195°F.) will not provide faster warm-up. Since either a 170°F. or 190°F. thermostat remains tightly closed until their control temperatures are reached, rate of warm-up is unaffected by thermostat. Heat is obtained from heater at about 113°F. water temperature at 0°F. ambient.

> **NOTE:** *Low boiling coolants 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.

ENGINE OIL PRESSURE INDICATOR LAMP

The engine oil pressure indicator lamp is controlled by a pressure-operated switch located on the oil filter support. 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 5 $\pm$ 1.5 psi on increasing pressure and makes contact at 5 $\pm$ 1.5 psi on decreasing pressure.

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.

The speed indicating portion of the speedometer operates on a magnetic principle. In the speedometer head is a permanent magnet which rotates at the same speed as the cable. This magnet exerts a pull on a speed cup causing it to move in direct ratio to revolving magnet speed. A pointer is attached to the speed cup spindle to indicate speed on the speedometer dial. A finely calibrated hair spring, also part of the speed cup assembly, opposes magnetic pull on the speed cup so pointer indicates true speed; it also pulls cup and pointer to zero when car stops.

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.

PRINTED CIRCUIT

All models are equipped with printed circuits which supply current to most instrument panel lights. These circuits are made of copper foil which are die cut and bonded to a polyester base film (usually mylar). The printed circuit is supplied current via a connector containing several wires as shown in Figs. 12-38 and 12-39 (B Series), Figs. 12-40 and 12-41 (A and G Series) and Figs. 12-42 and 12-43 (F Series).

The connector also helps retain the printed circuit to the instrument panel. The rest of the circuit is retained by screws and snap-in bulbs.

POWER ACCESSORY SCHEMATICS

Power accessory schematics for all series are shown in Section 15 of this manual.

ELECTRONIC ACCESSORY SCHEMATICS

Electronic accessory schematics (radio, stereo tape, etc.) for all series are shown in Section 15 of this manual.

INTERIOR LAMP SCHEMATICS

Interior lamp schematics for B Series are shown in Fig. 12-44. A and G Series schematics are shown in Fig. 12-45.

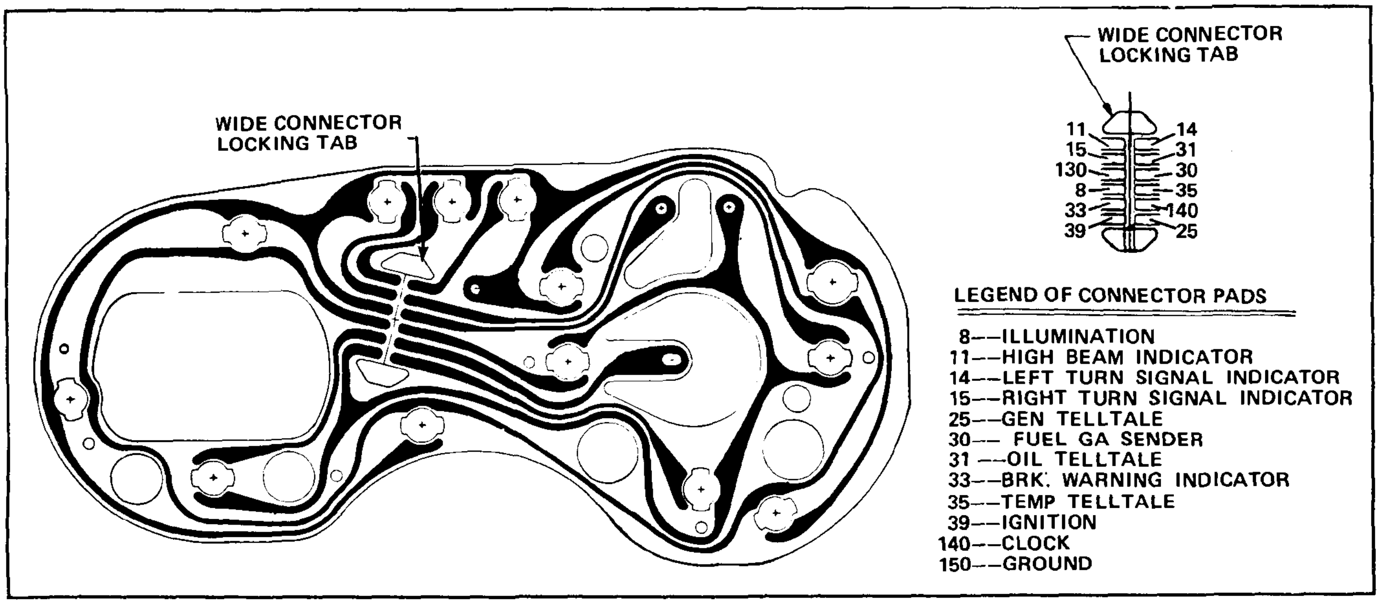


Fig. 12-38 B Series Printed Circuit Without Rally Gage

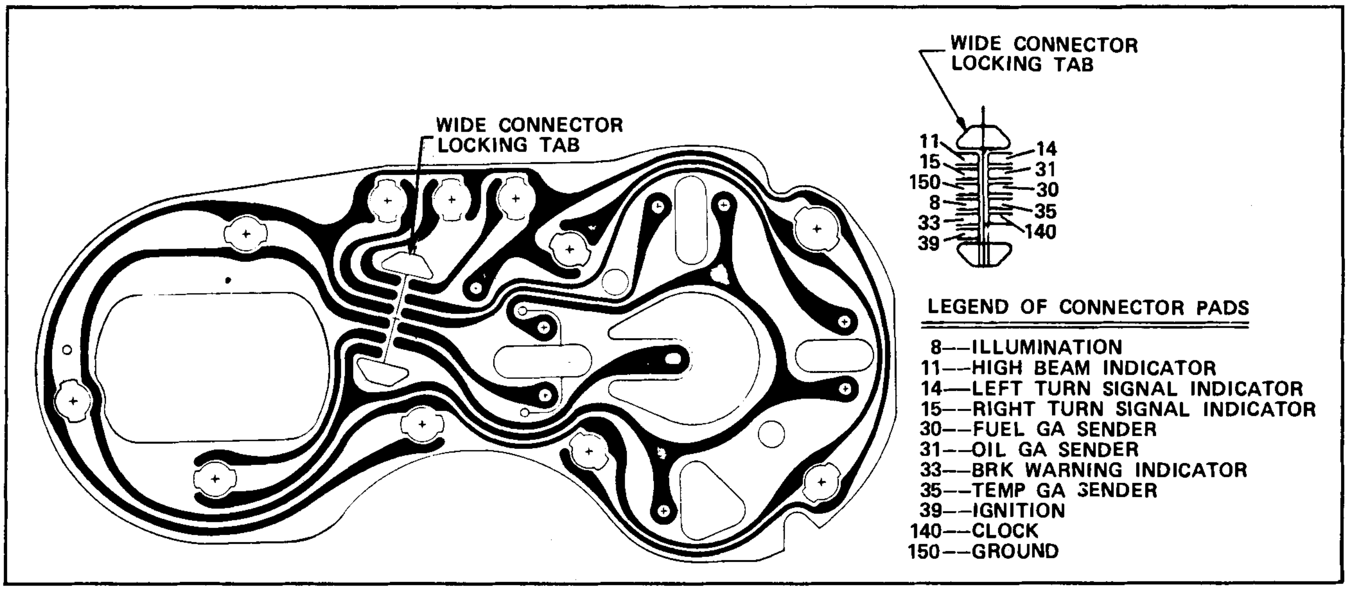


Fig. 12-39 B Series Printed Circuit With Rally Gage

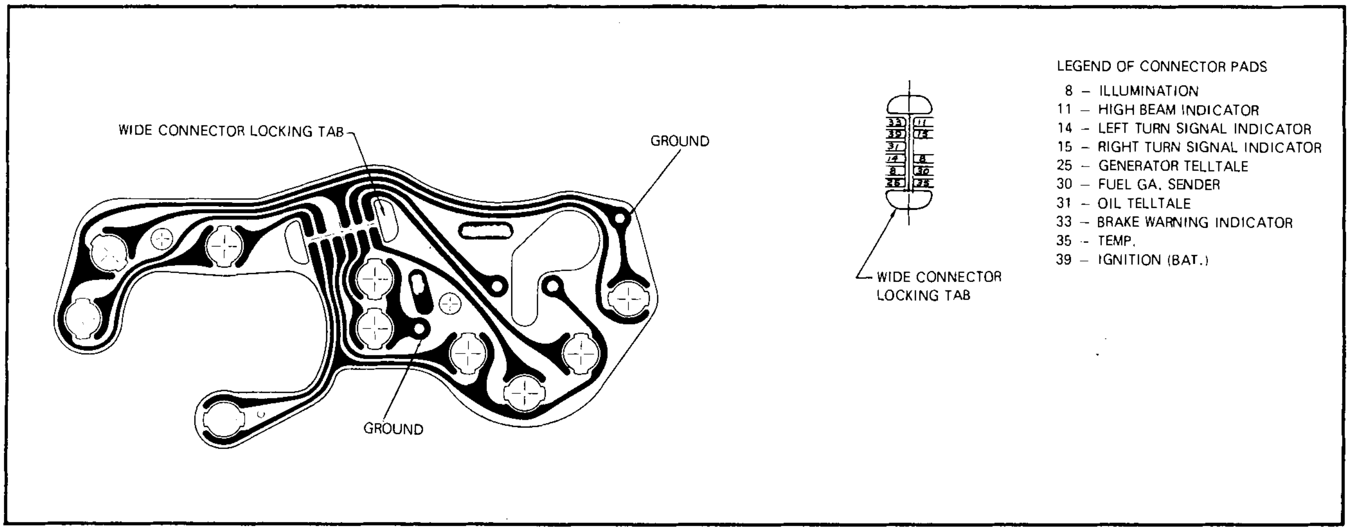


Fig. 12-40 A and G Series Printed Circuit Without Rally Gage

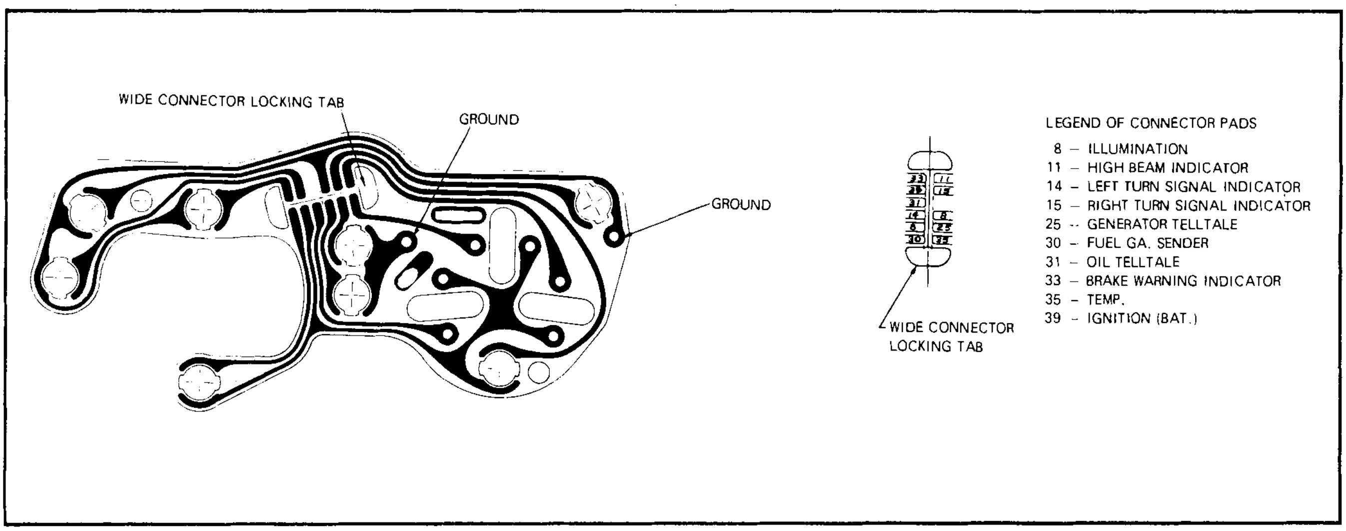


Fig. 12-41 A and G Series Printed Circuit With Rally Gage

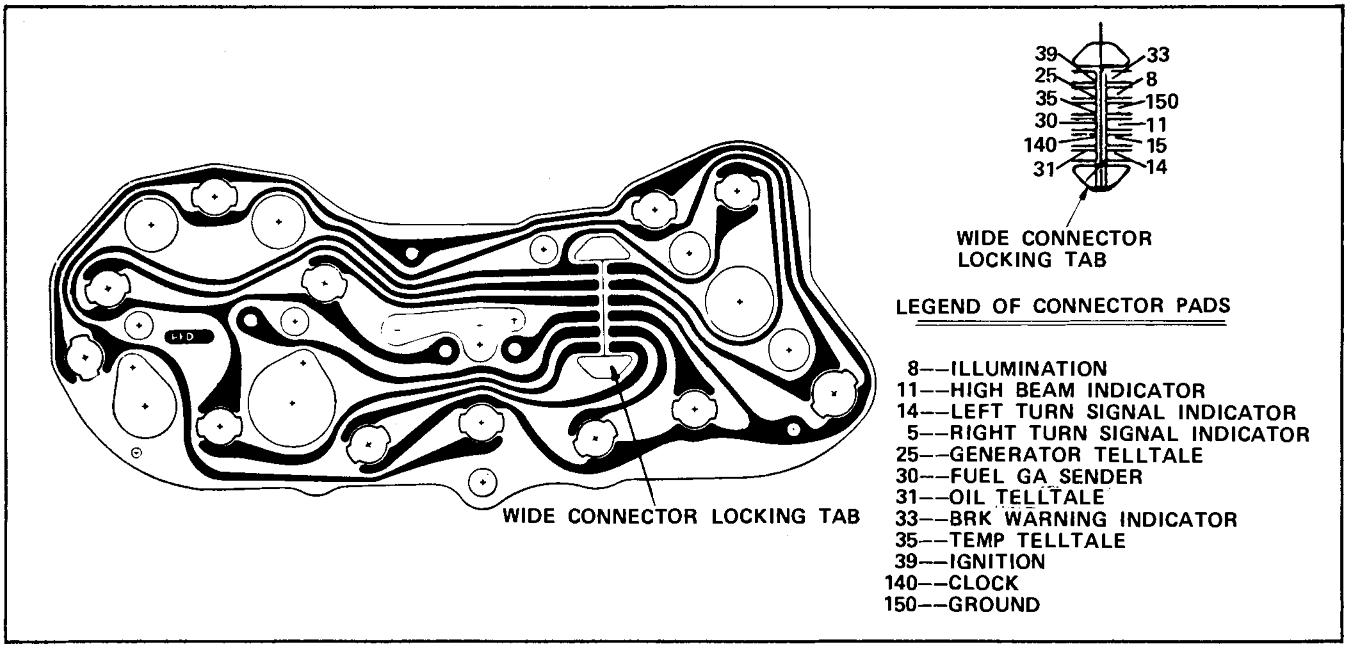


Fig. 12-42 F Series Printed Circuit Without Rally Gage

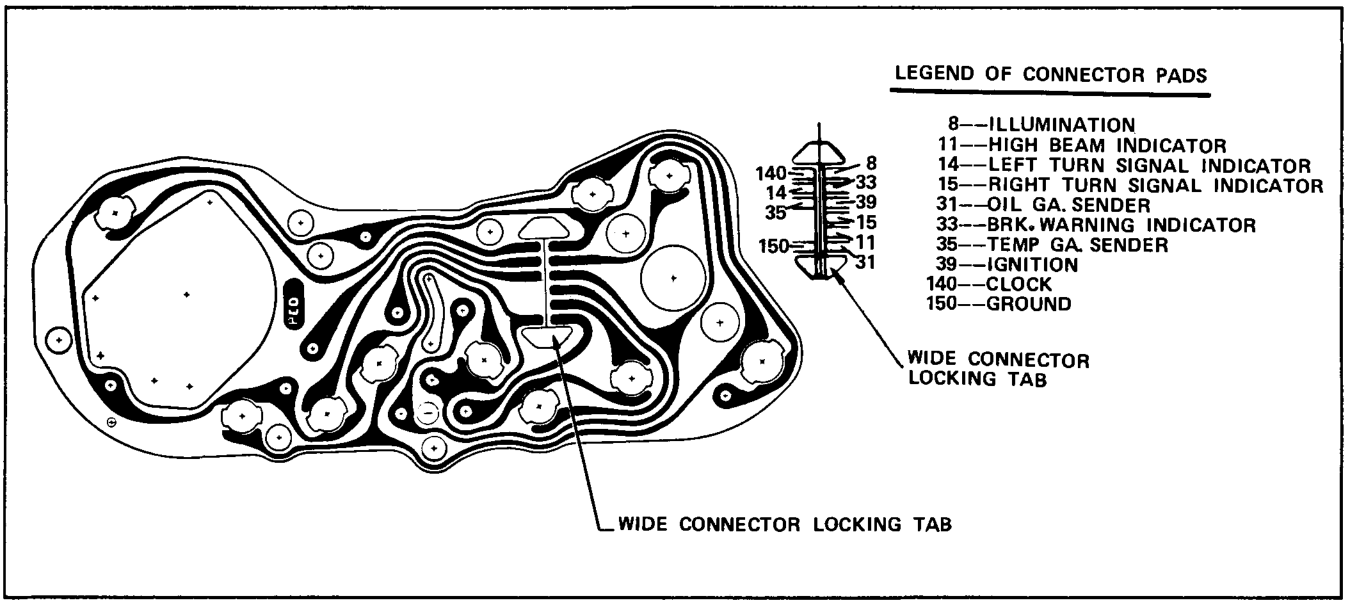


Fig. 12-43 F Series Printed Circuit With Rally Gage

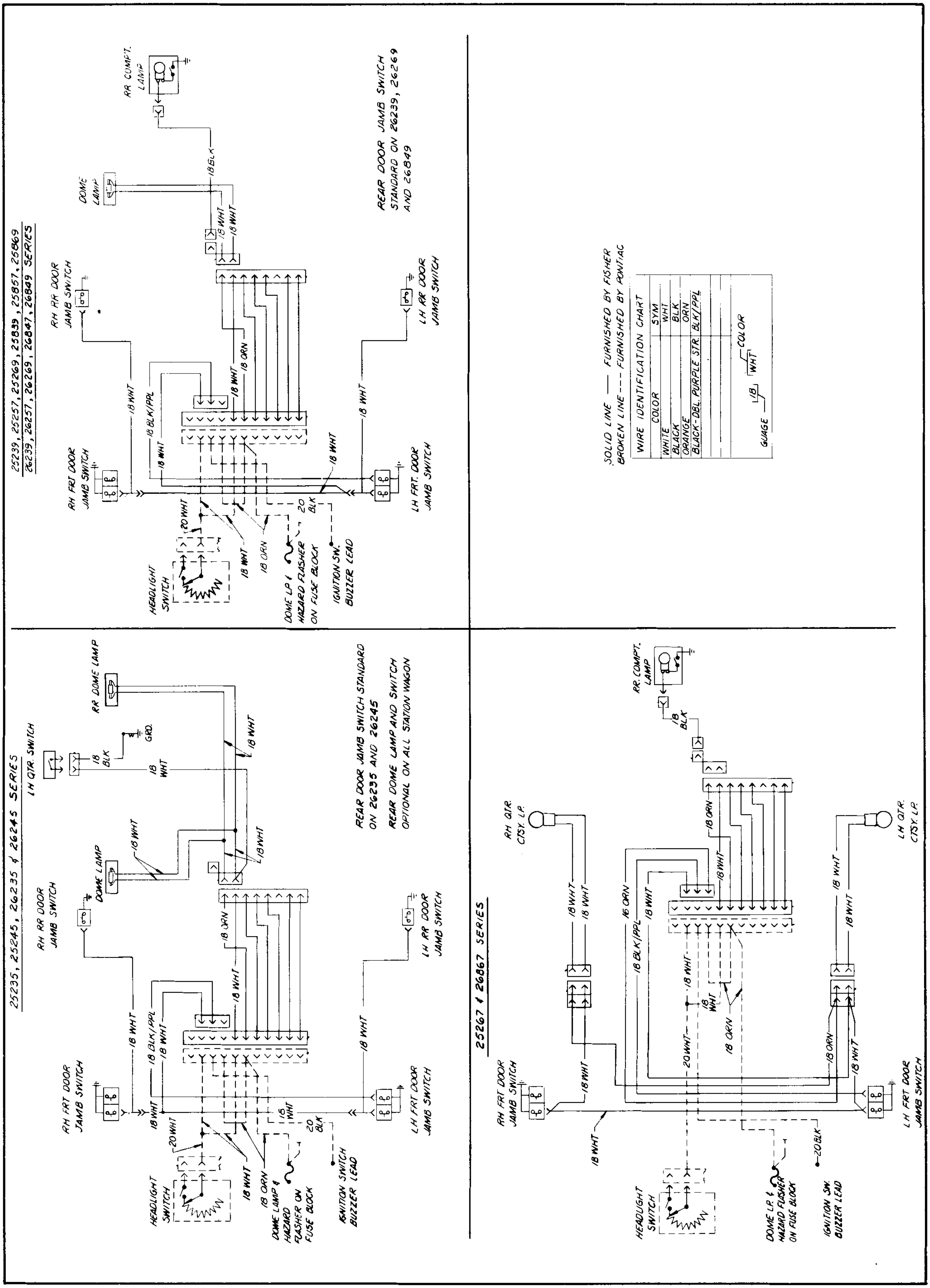


Fig. 12-44 B Series Interior Lamps Schematics

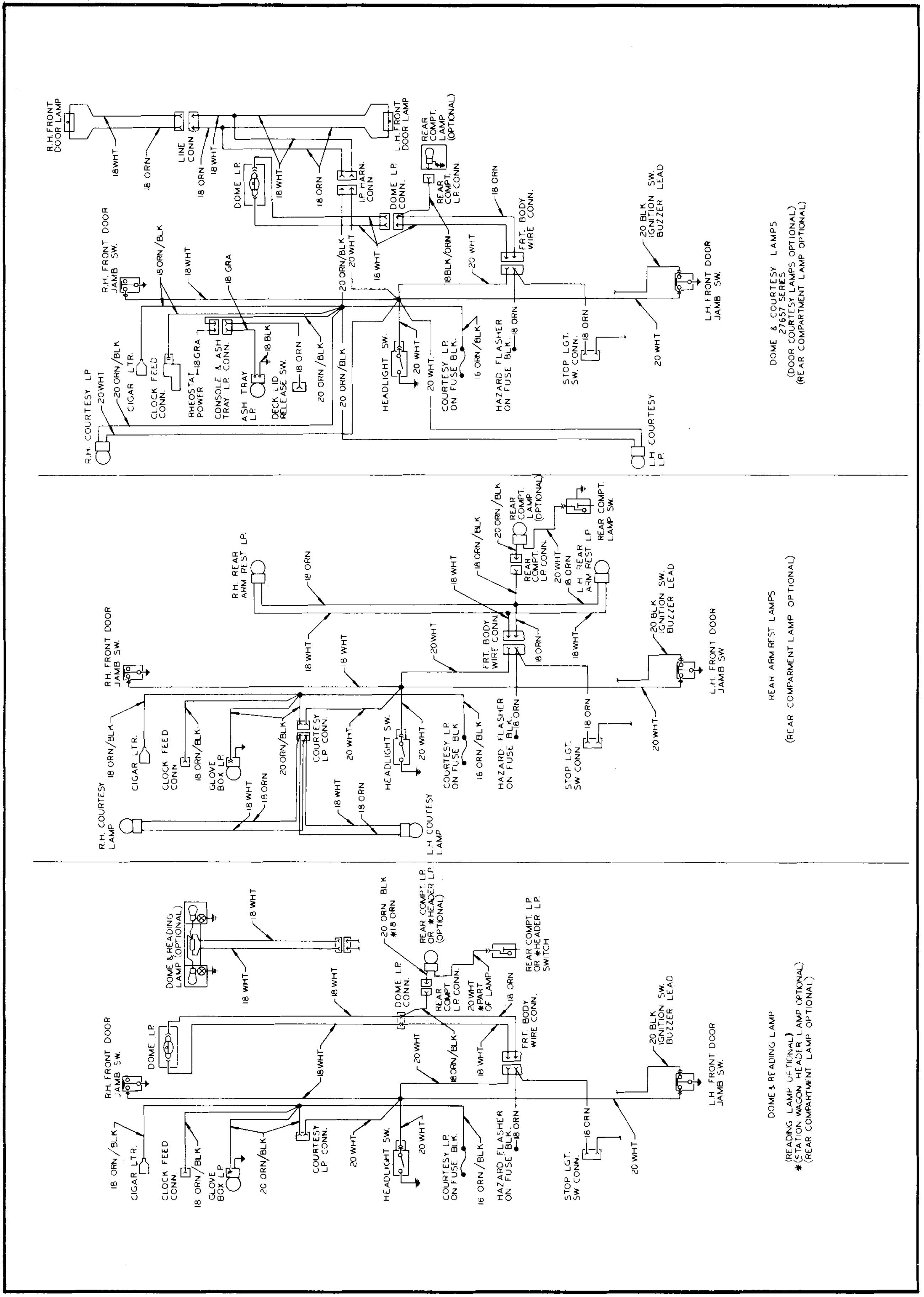


Fig. 12-45 A and G Series Interior Lamps Schematics

SERVICE PROCEDURES

BATTERY

REMOVE AND REPLACE

1. Remove positive and negative battery cables using pliers (wrench on side terminal type).
2. Remove battery clamp (on B Series, the hood latch cable attachment at radiator support may have to be removed for clearance).
3. Remove battery, keeping it in an upright position.
4. To replace, reverse removal procedure.

BATTERY CABLE

REMOVE AND REPLACE

Battery cable routing is shown in Fig. 12-46 (B Series), Fig. 12-47 (A Series), Fig. 12-48 (G Series), Fig. 12-49 (F Series) and Fig. 12-50 (X Series). Disconnect cables from battery using pliers (use wrench for side-terminal battery) and make sure connections are clean and tight when replacing.

FUSIBLE LINK

REMOVE AND REPLACE

1. Disconnect battery.
2. Locate burned out link.

   NOTE: *Link may be recognized on V-8 models as a loop of wire (approximately 5" in length) protruding from engine wiring harness along left rocker arm cover where harness breaks out for alternator. On 6-cylinder models loop will be located at breakout for voltage regulator from engine wiring harness.*

3. Strip away all melted harness insulation.
4. Cut burned link ends from circuit wire.
5. Strip (approximately 1/2") back circuit wire that new link is to be soldered to.
6. Using fusible link 4 gauges 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 of approximately 5" in length.
9. Reconnect battery.

FUSE BLOCK AND BULKHEAD CONNECTOR

REMOVE AND REPLACE

1. Remove bolt holding front end and engine harness to fuse block. Separate harnesses.
2. Inside car, remove two screws retaining fuse block to dash.
3. Remove remaining in-car wire connectors and note position for reinstallation.

   NOTE: *Chassis wiring schematics will aid in identifying wires.*

4. To replace, reverse removal procedure.

ENGINE WIRE HARNESS

REMOVE AND REPLACE

Engine wire harness routing and connection may be determined from Fig. 12-51 through 12-60.

FRONT END WIRE HARNESS

REMOVE AND REPLACE

Front end wire harness routing and connection may be determined from Figs. 12-61 through 12-64.

HEADLAMP

REMOVE AND REPLACE (Figs. 12-65 through 12-70)

1. Remove bezel.
2. Remove seal beam retaining spring.
3. Remove wire connector and remove seal beam.
4. Remove seal beam rim retaining screws.
5. To replace, reverse removal procedure.

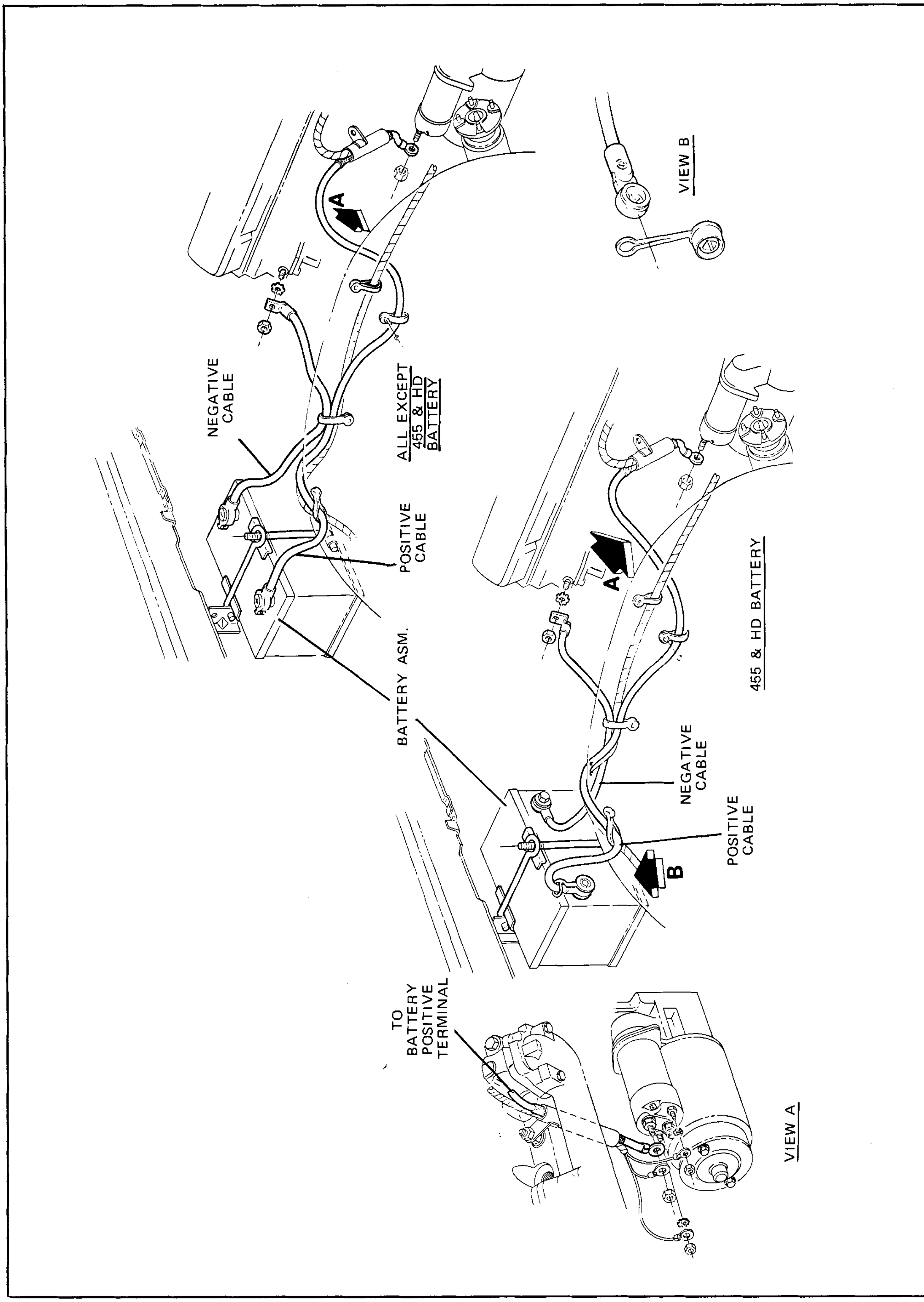


Fig. 12-46 B Series Battery Cable Routing

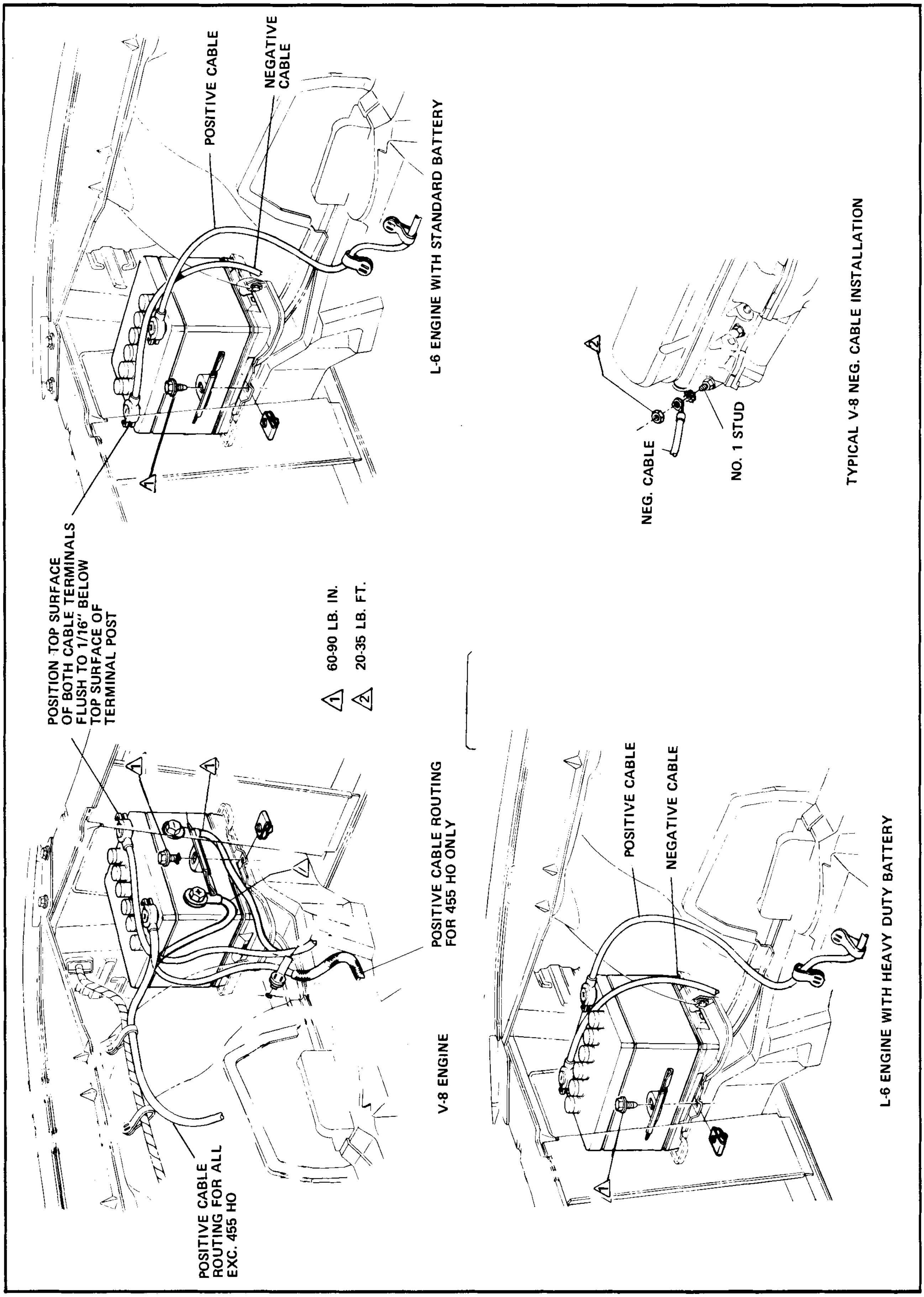


Fig. 12-47 A Series Battery Cable Routing

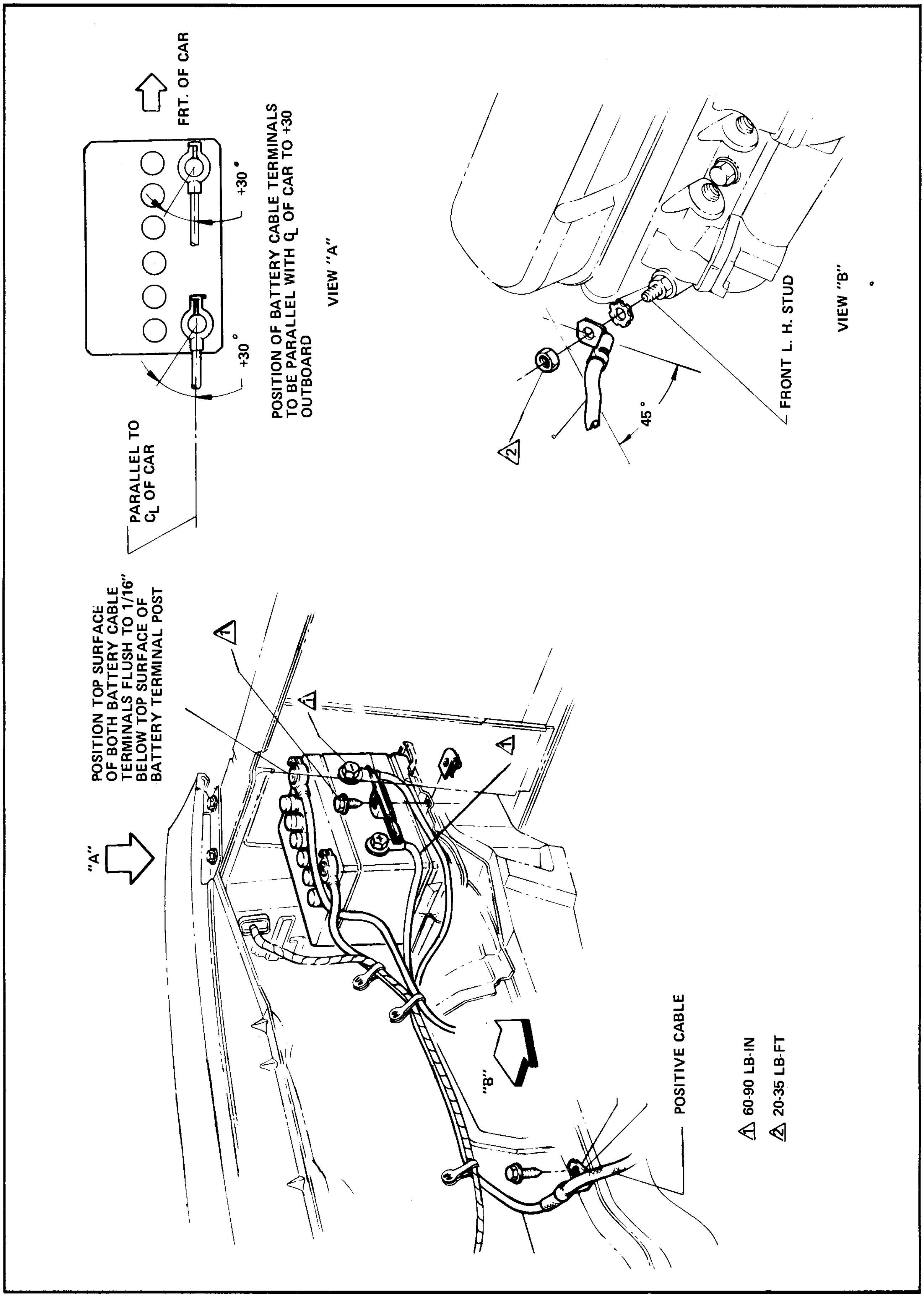


Fig. 12-48 G Series Battery Cable Routing

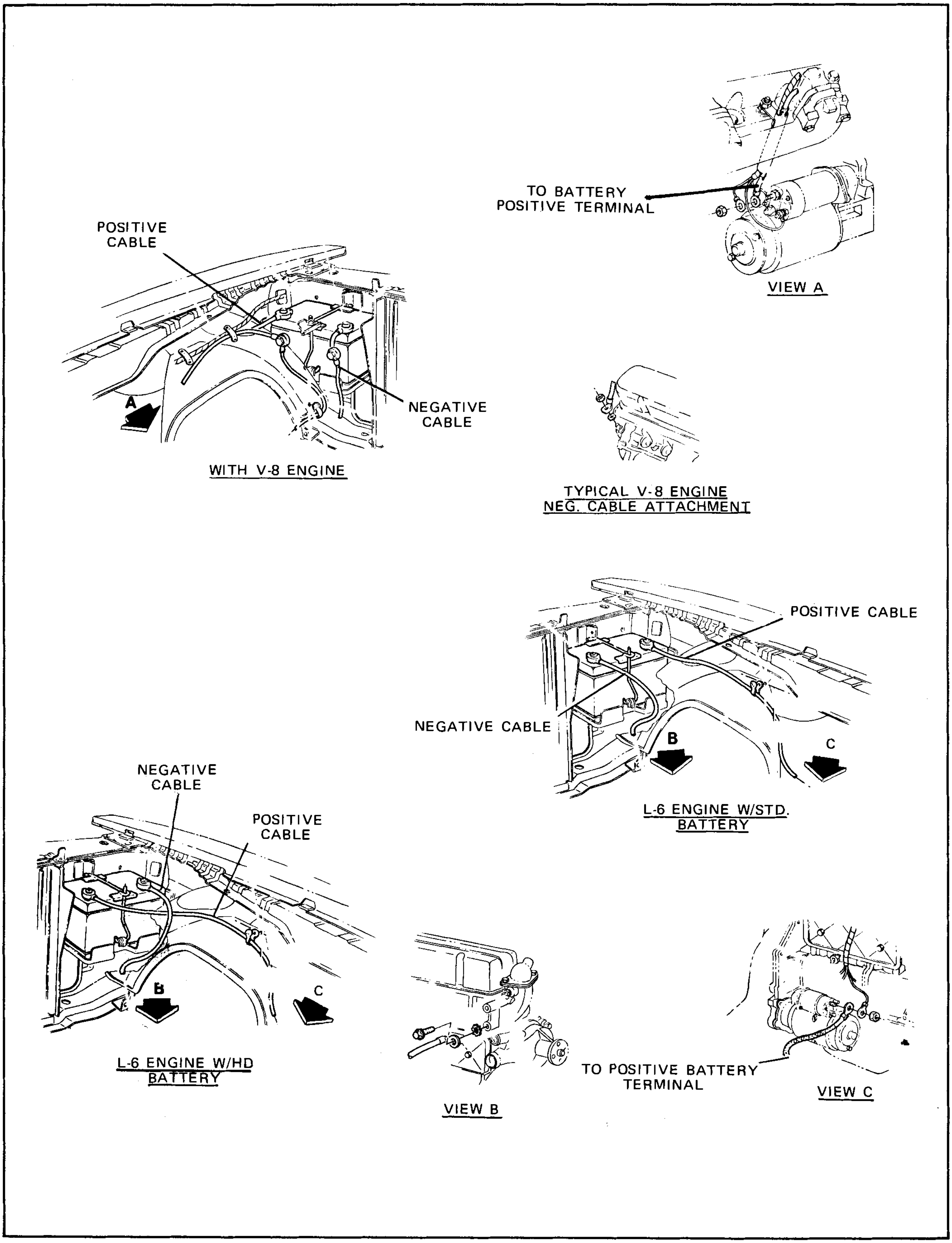


Fig. 12-49 F Series Battery Cable Routing

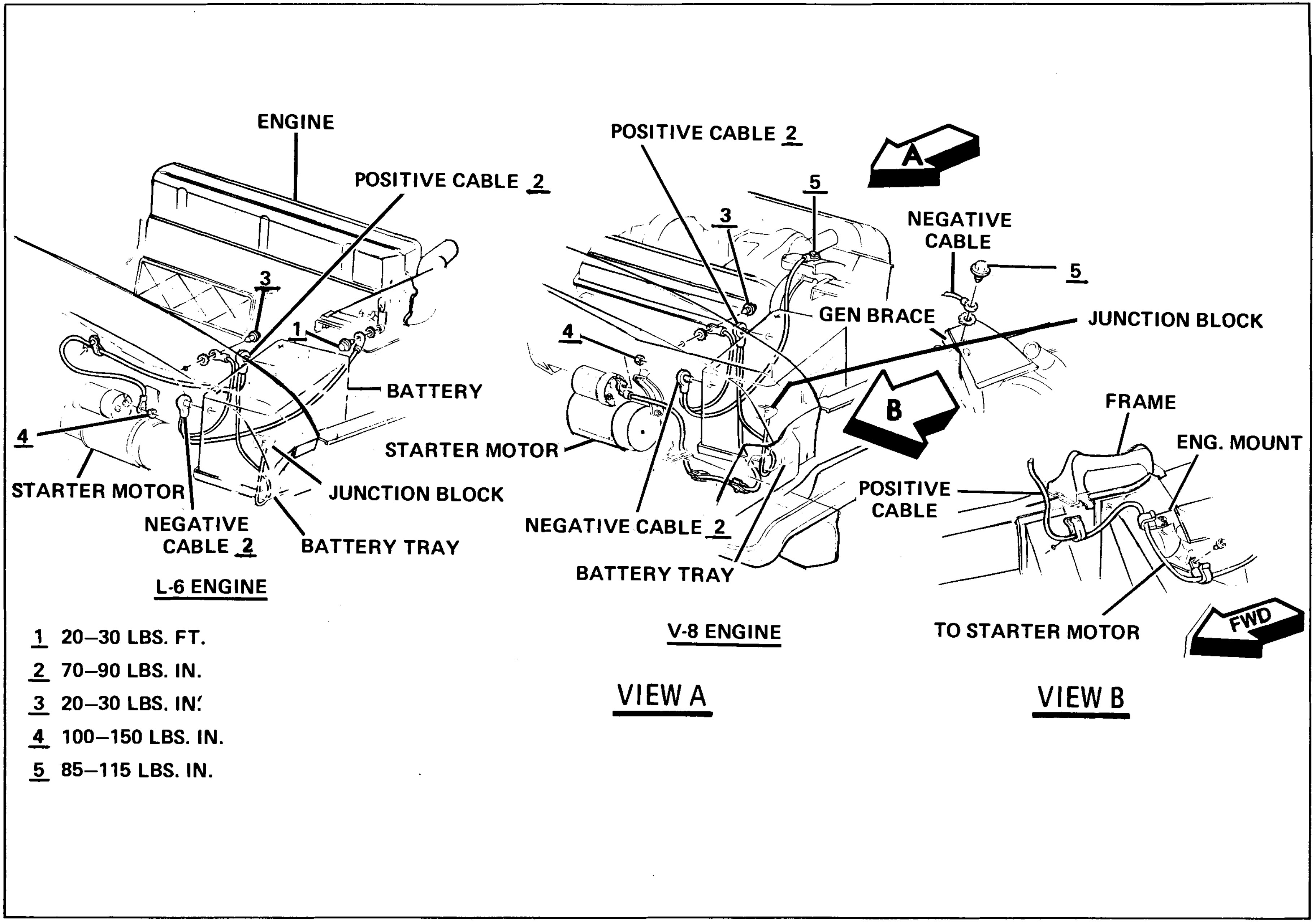


Fig. 12-50 X Series Battery Cable Routing

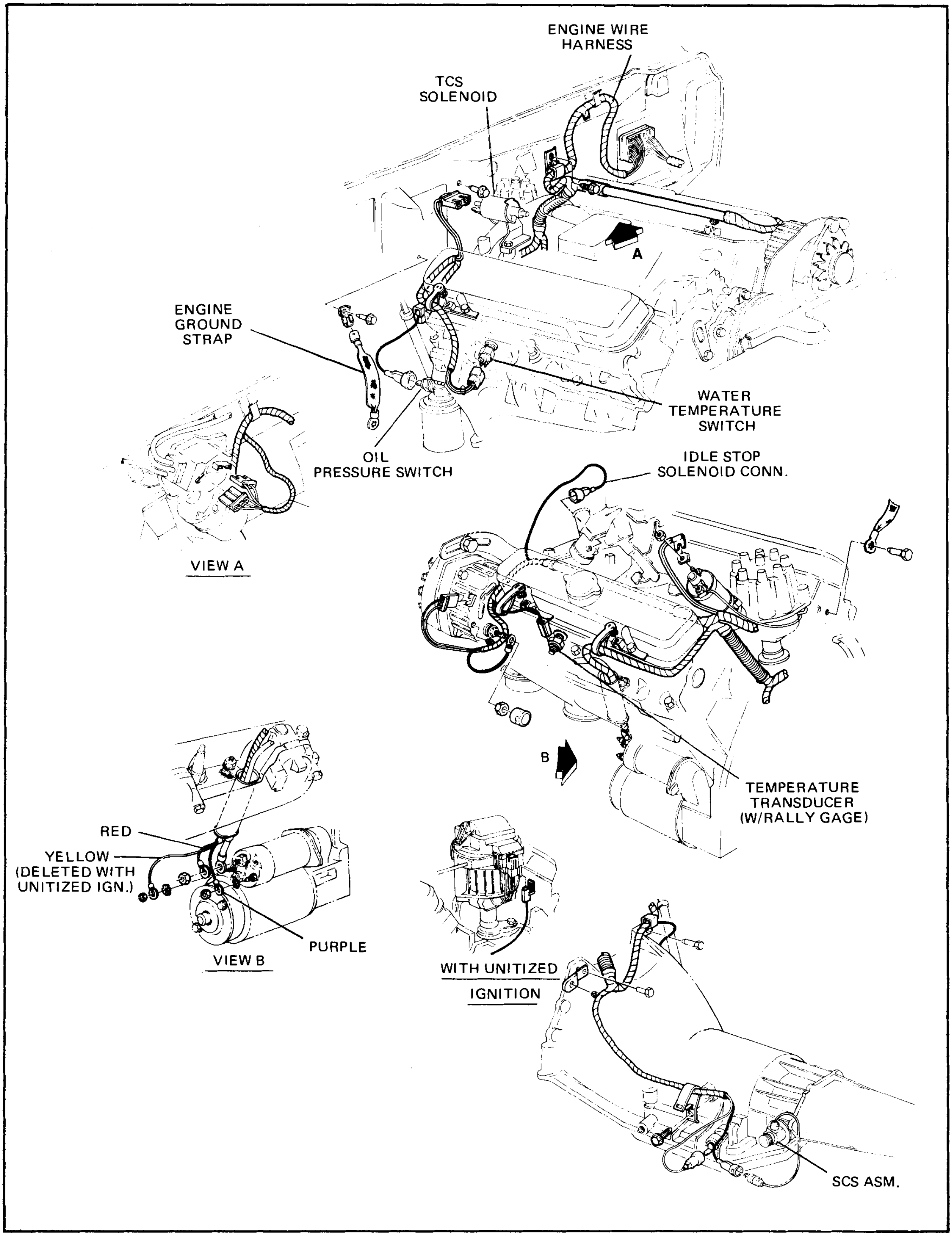


Fig. 12-51 B Series Engine and Transmission Wire Harness Installation

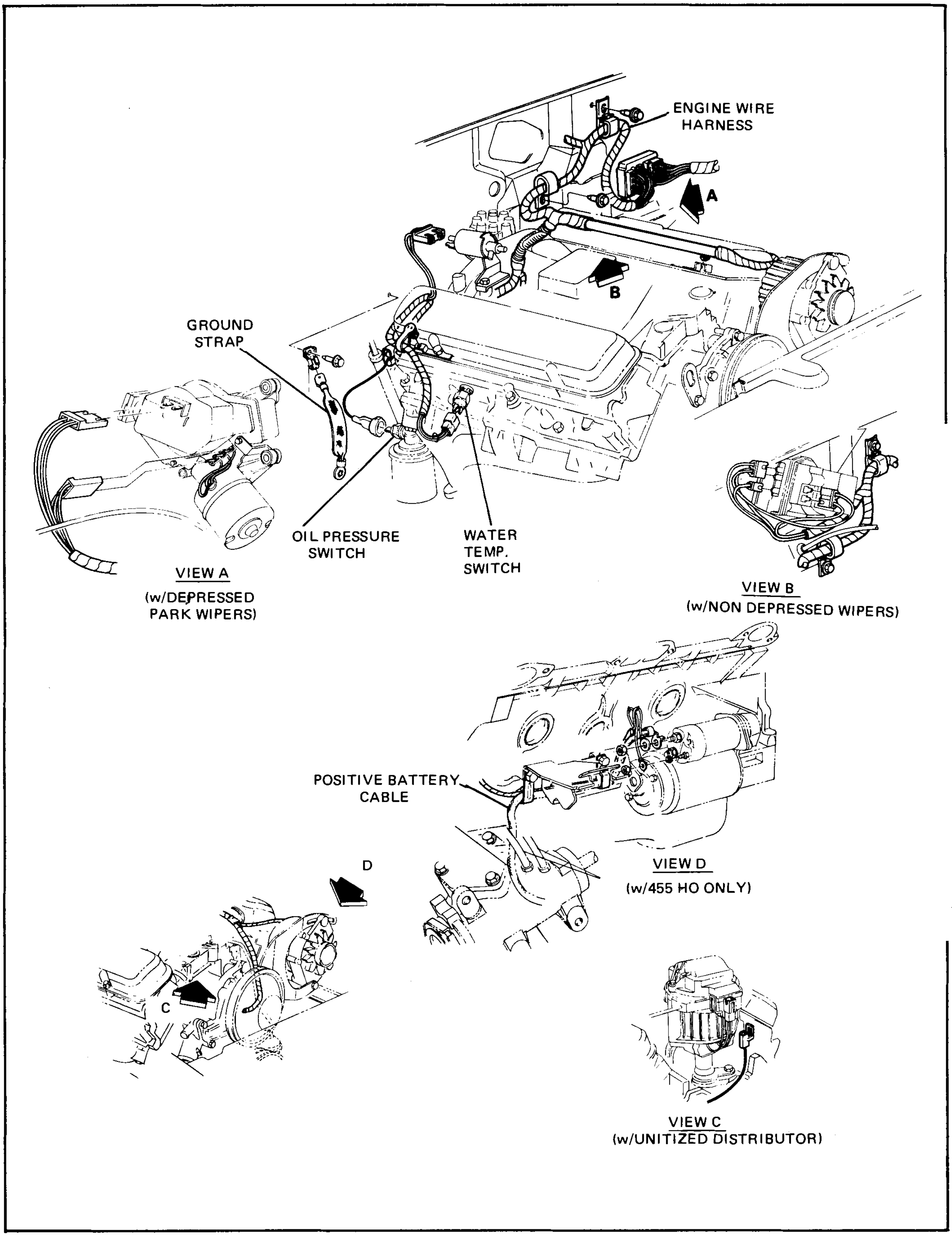


Fig. 12-52 A & G Series (V-8) Engine Wire Harness Installation

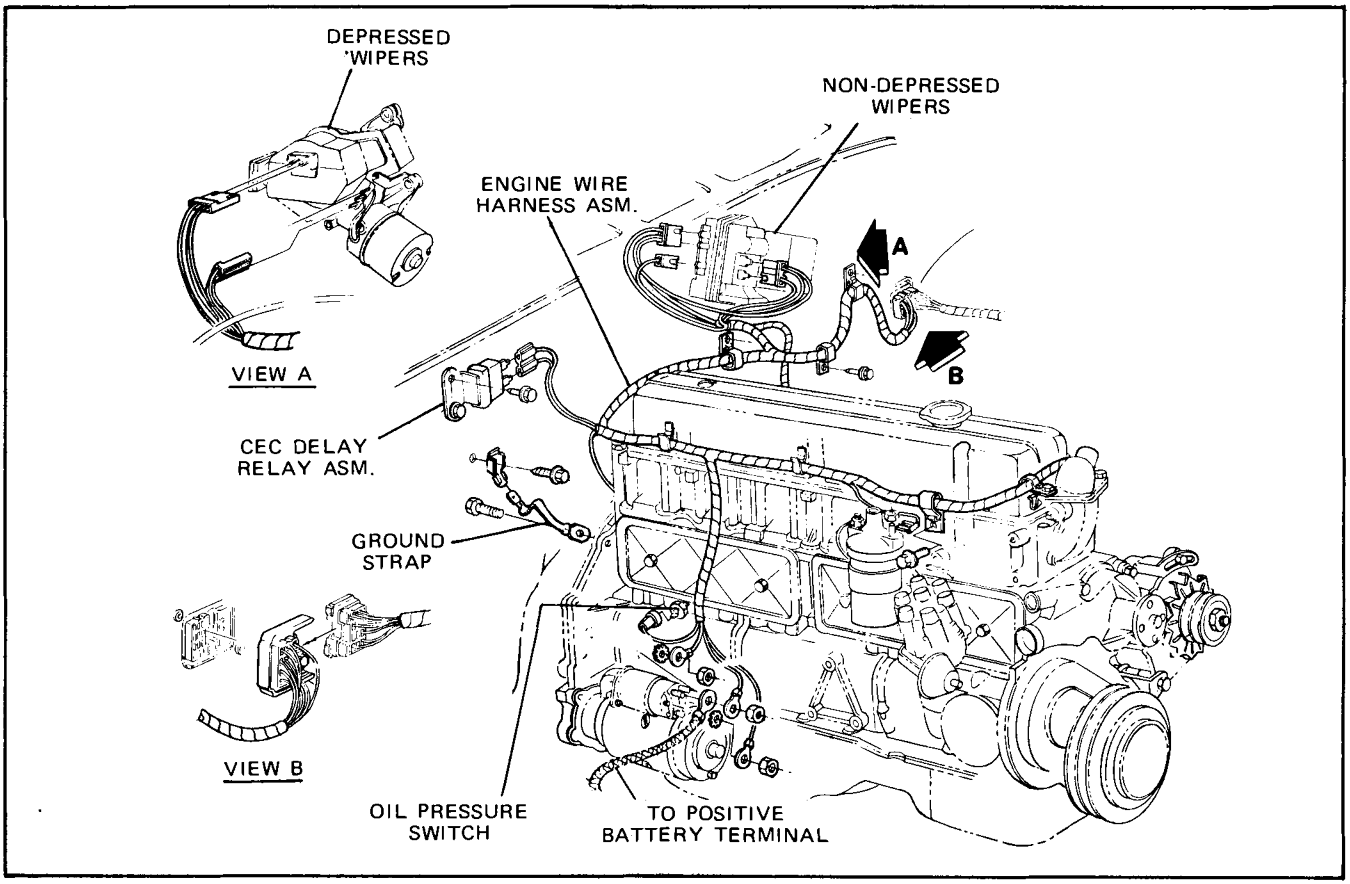


Fig. 12-53 A Series (L-6) Engine Wire Harness Installation

ADJUST

PRE-AIMING INSTRUCTIONS - MECHANICAL AIMER J 6878-01

1. Adjusting Aimer for Floor Level

   a. To obtain accurate headlamp aim, the vehicle must be placed on a flat surfaced floor area.

   b. Place transit Fig. 12-60 target on floor at center of rear wheel and place transit at center of front wheel on same side so target is visible in transit viewing port at top (Fig. 12-71).

   c. Adjust screw on back of transit until target split image merges into one unbroken line.

   d. Turn dial on side of transit until bubble in spirit level is centered.

   e. When bubble is centered note "plus" or "minus" reading on calibrating dial (Fig. 12-72). This figure indicates degree of floor slope and must be transferred to each aimer.

   f. With a screwdriver, turn adjusting slot of floor level compensator in each aimer until adjoining dial reads same as dial on transit (Fig. 12-73).

   g. **Aimers are now adjusted for use on this specific floor area. If operation is moved to a new location, aimers must be readjusted.**

2. Vehicle Preparation

   a. With vehicle in selected aiming area, turn on headlamps and make sure all are functioning.

   b. Tires should be properly inflated, gas tank at least half full, spare tire in trunk and no people in car. Rock vehicle sideways to equalize springs.

   c. Clean headlamp lenses thoroughly.

3. Installing Mechanical Aimers J 6878-01

   a. While holding aimer in alignment with lens of one outer headlamp, bring aimer up to and against the lens. The sealed beam guide points must engage smooth inner ring of aimer at alignment points and the sight opening on the side of the aimer must face toward center of vehicle (Fig. 12-74).

NOTE: *An adaptor is available for installing the mechanical aimers on 7 inch sealed beam units.*

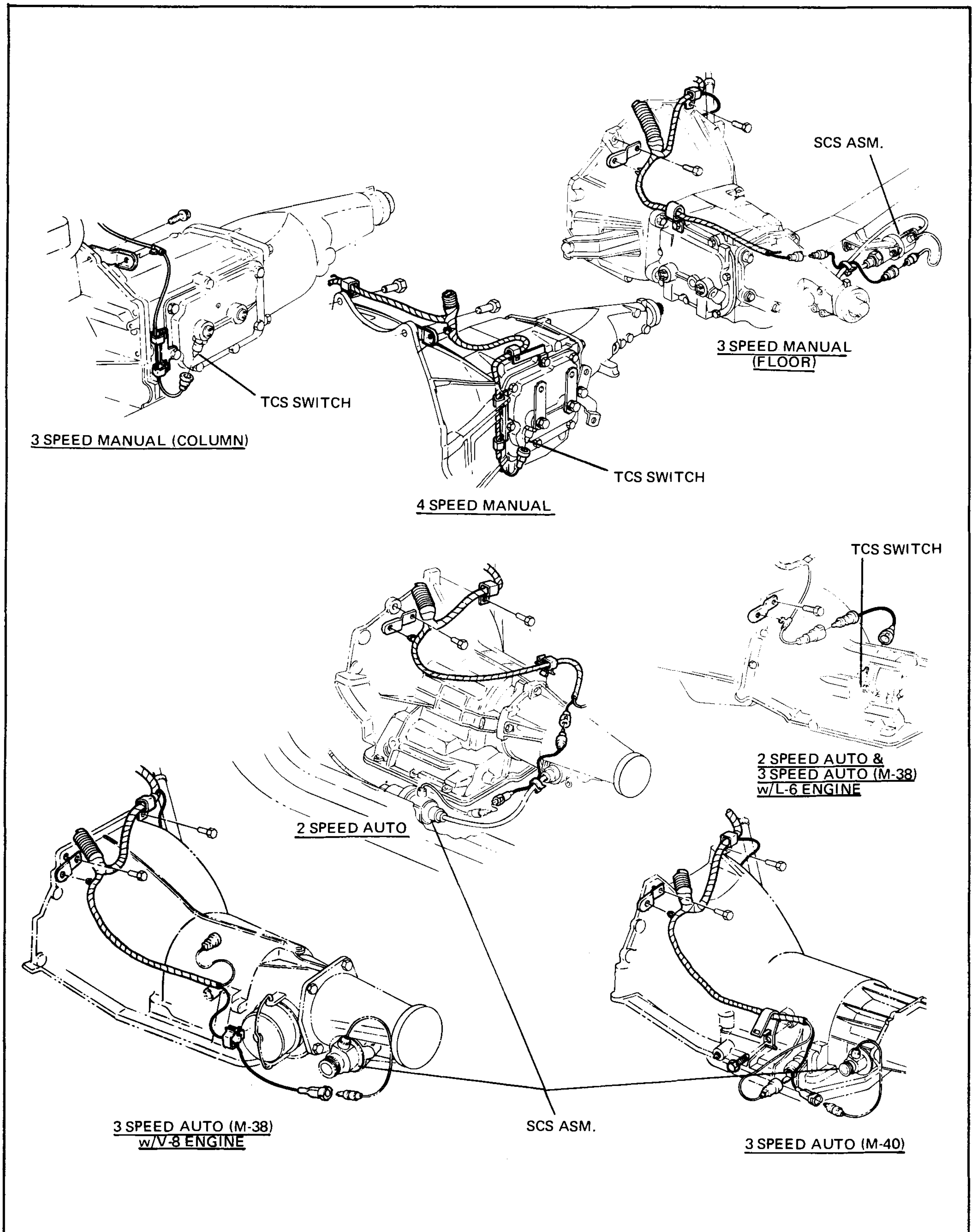


Fig. 12-54 A and G Series Transmission Wire Harness Installation

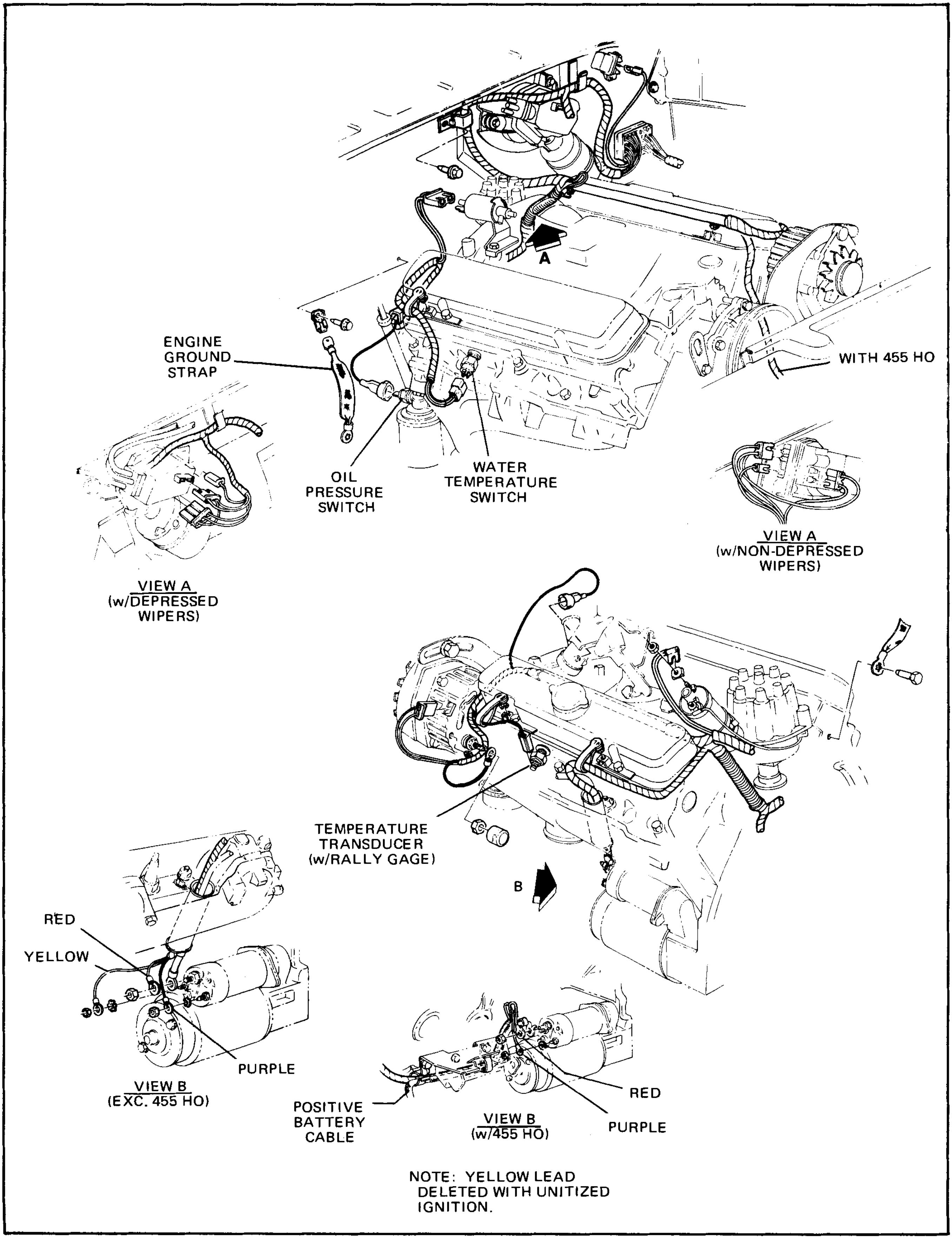


Fig. 12-55 F Series (V-8) Engine Wire Harness Installation

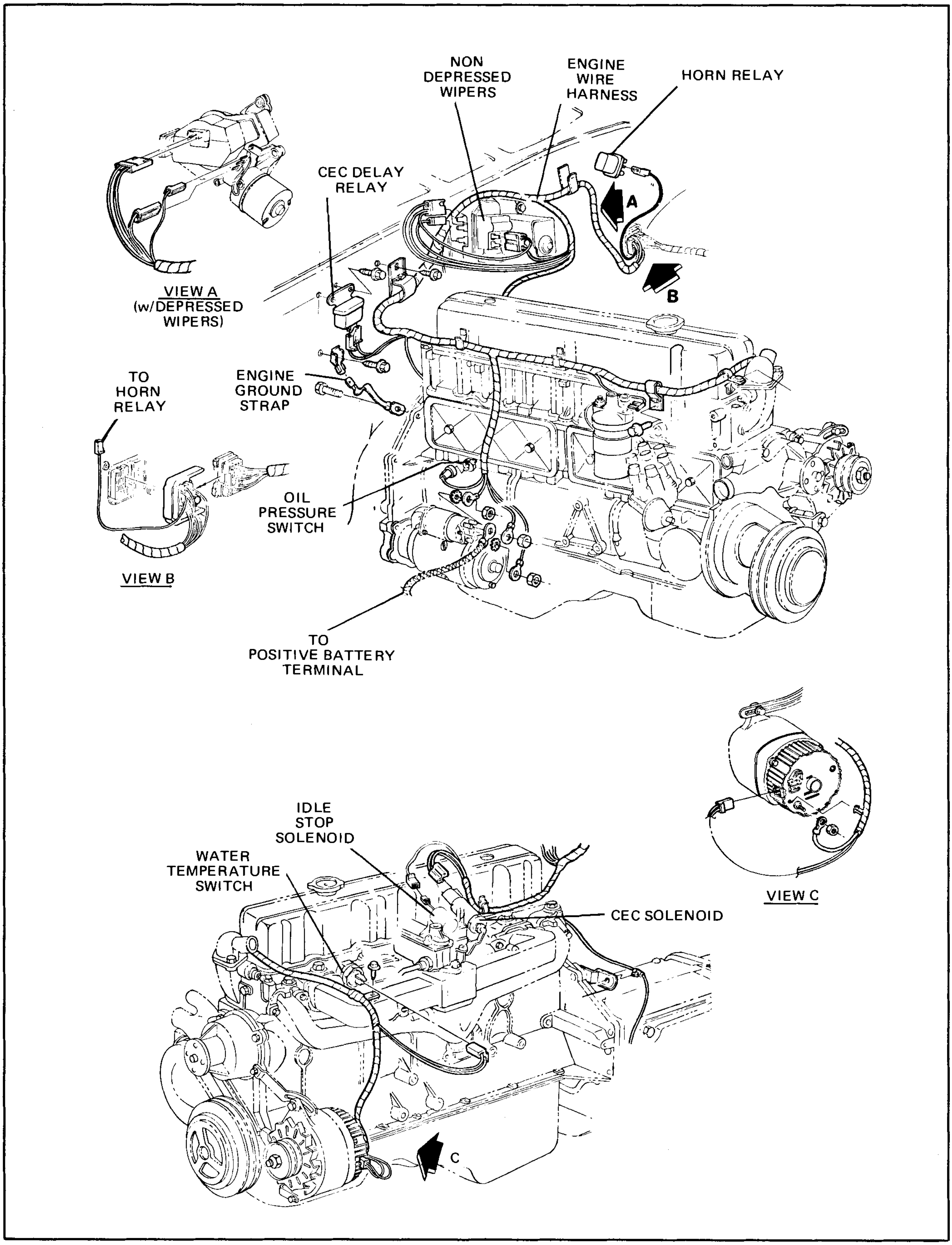


Fig. 12-56 F Series (L-6) Engine Wire Harness Installation

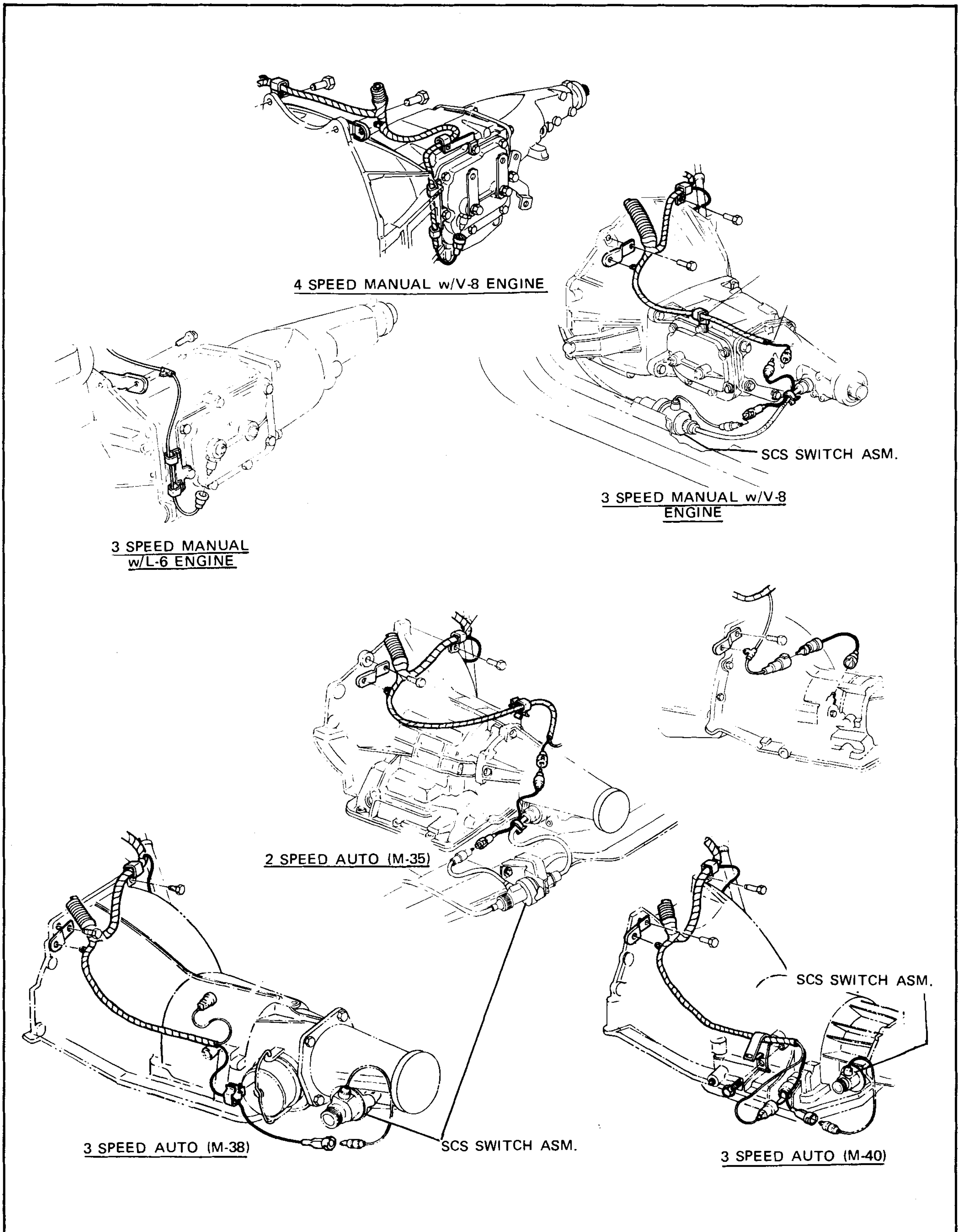


Fig. 12-57 F Series Transmission Wire Harness Installation

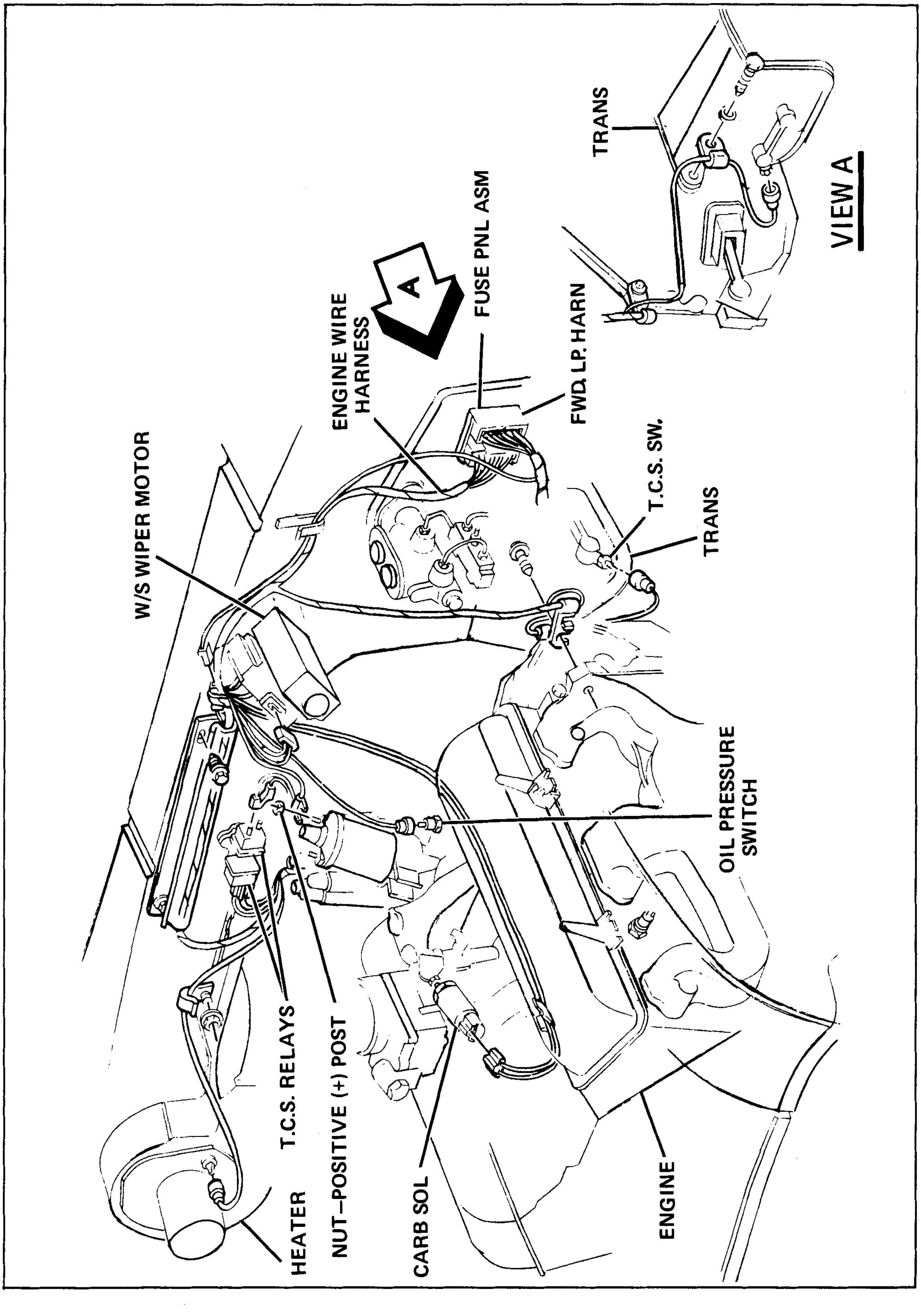


Fig. 12-58 X Series (V-8) Engine Wire Harness Installation

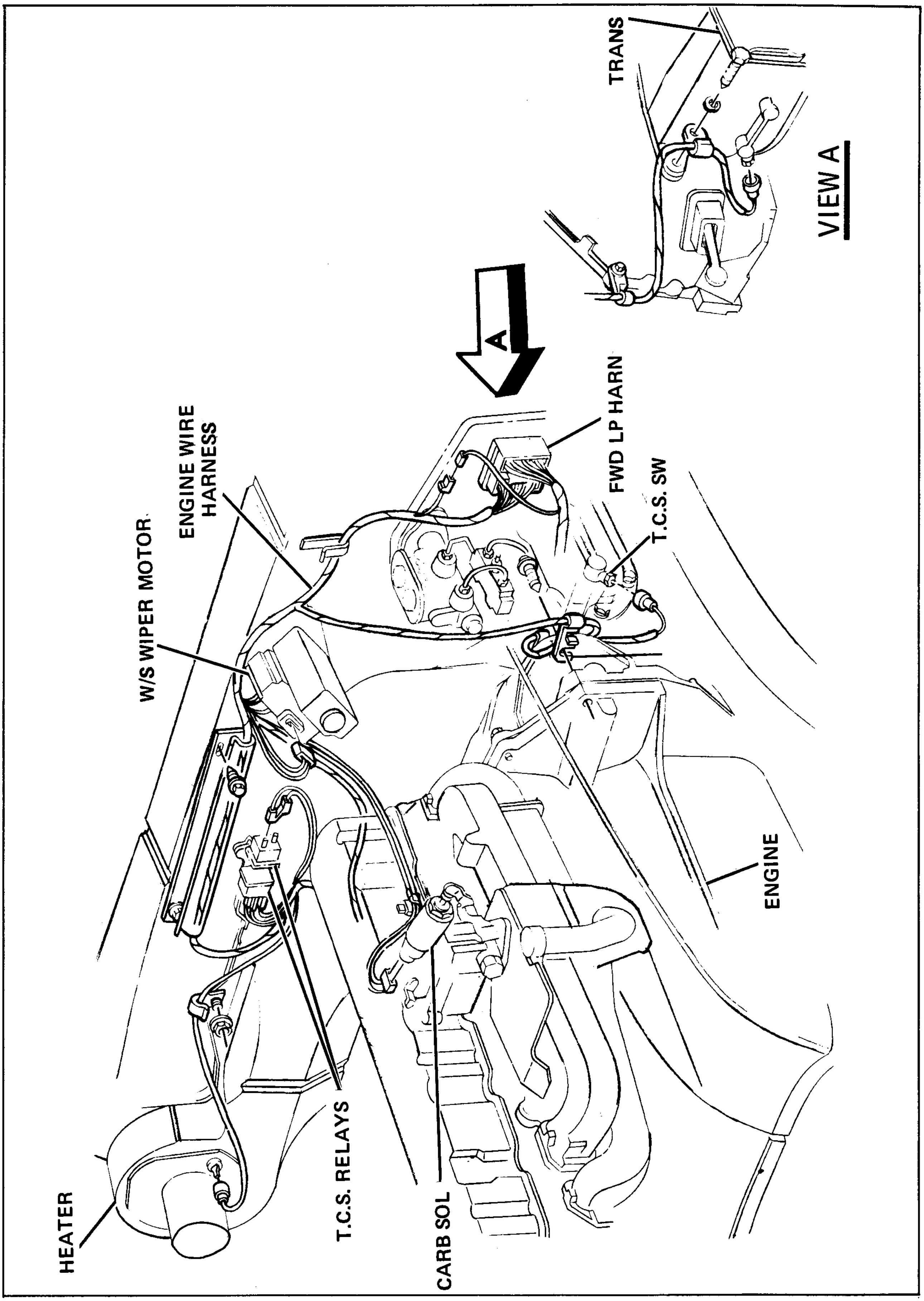


Fig. 12-59 X Series (L-6) Engine Wire Harness Installation

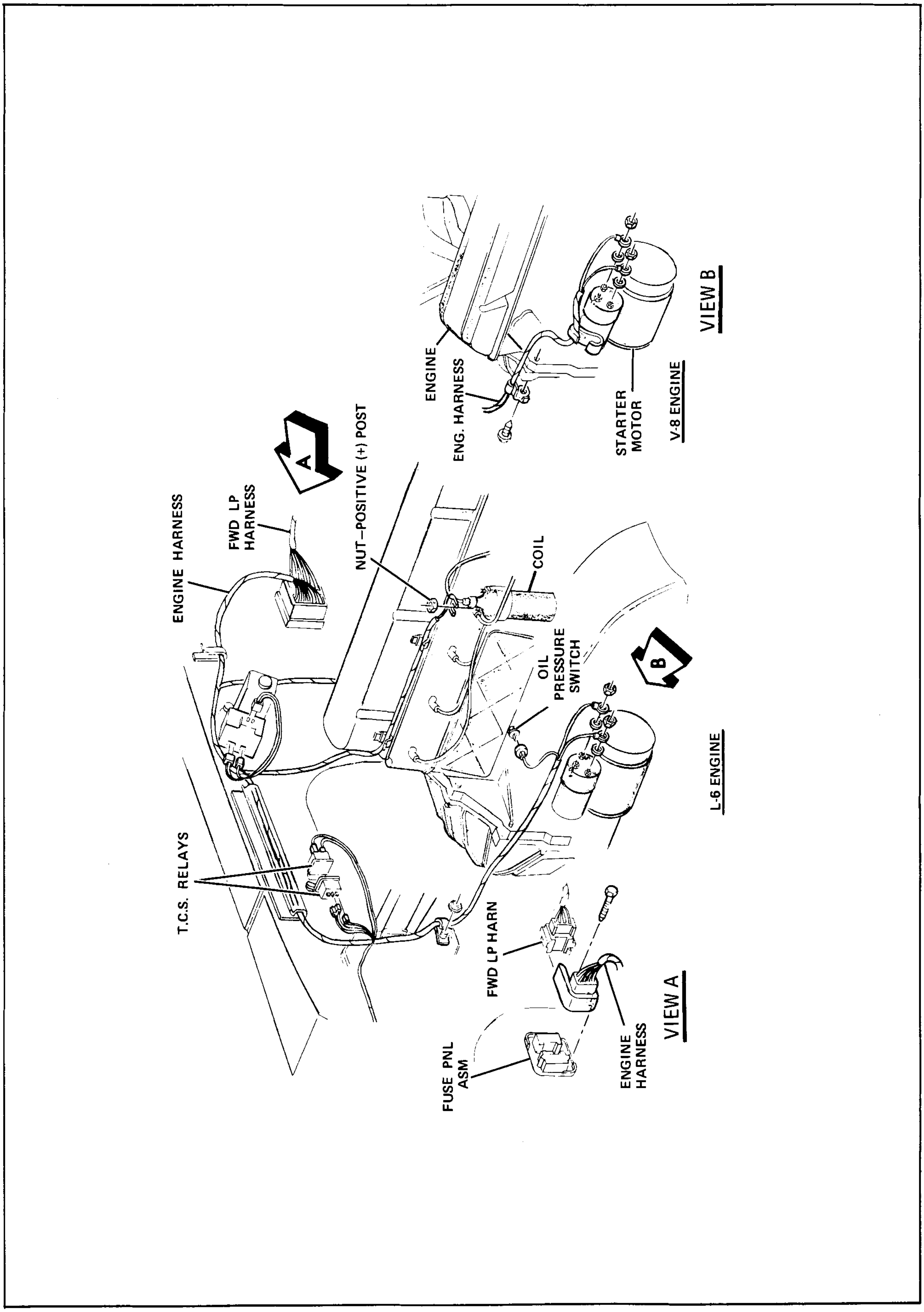


Fig. 12-60 X Series Engine Starter Wire Harness Installation

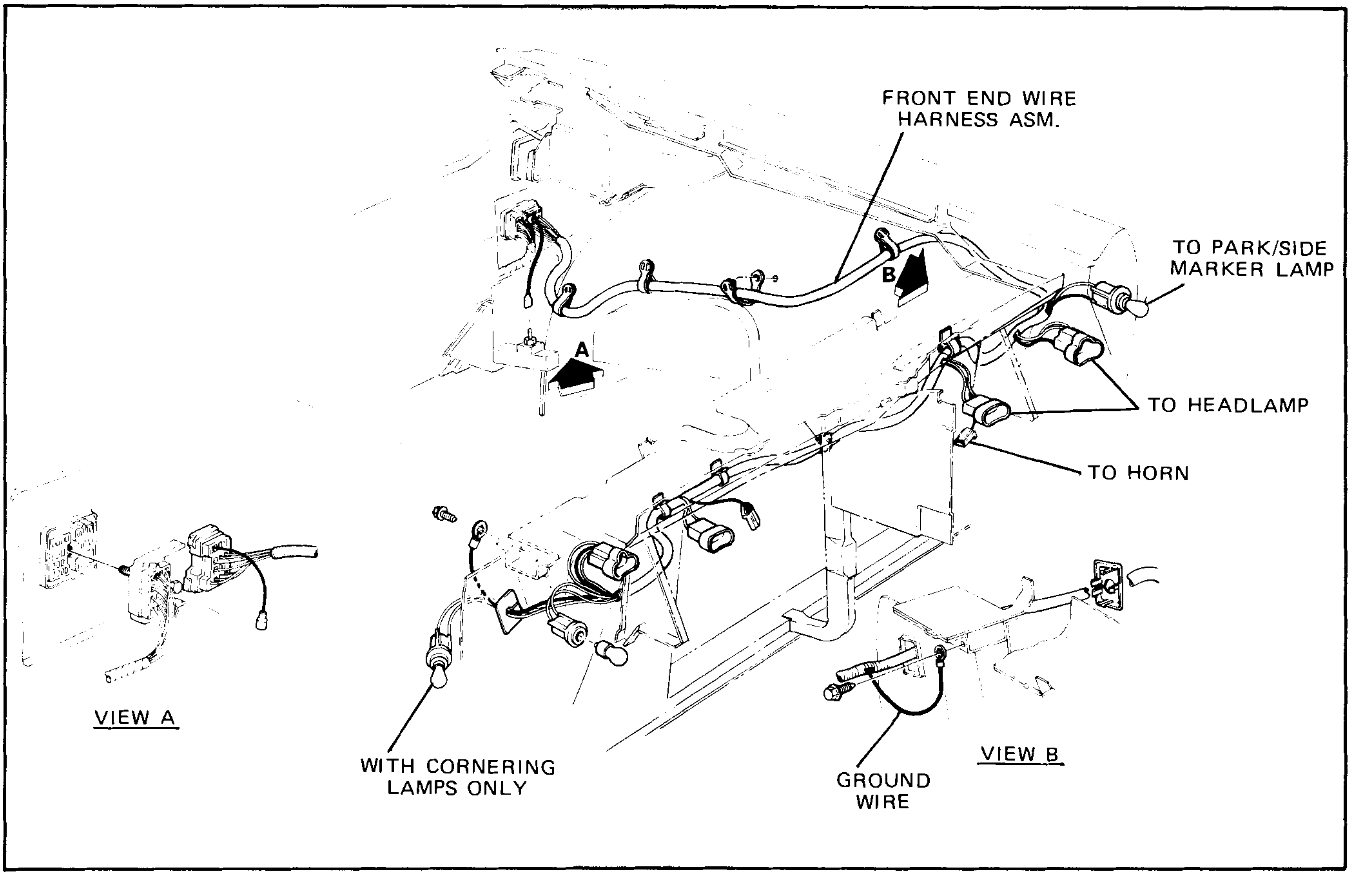


Fig. 12-61 B Series Front End Wire Harness Installation

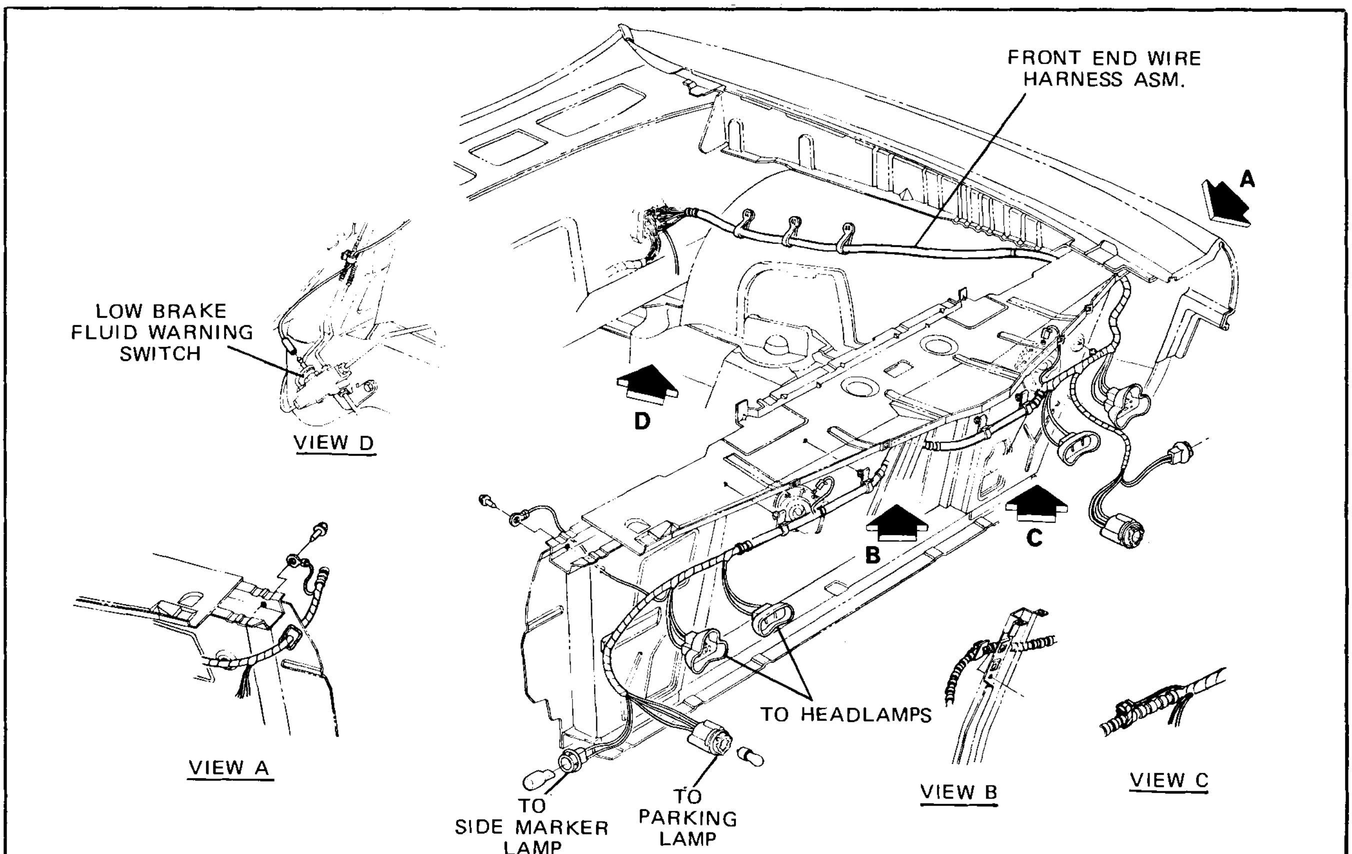


Fig. 12-62 A Series Front End Wire Harness Installation

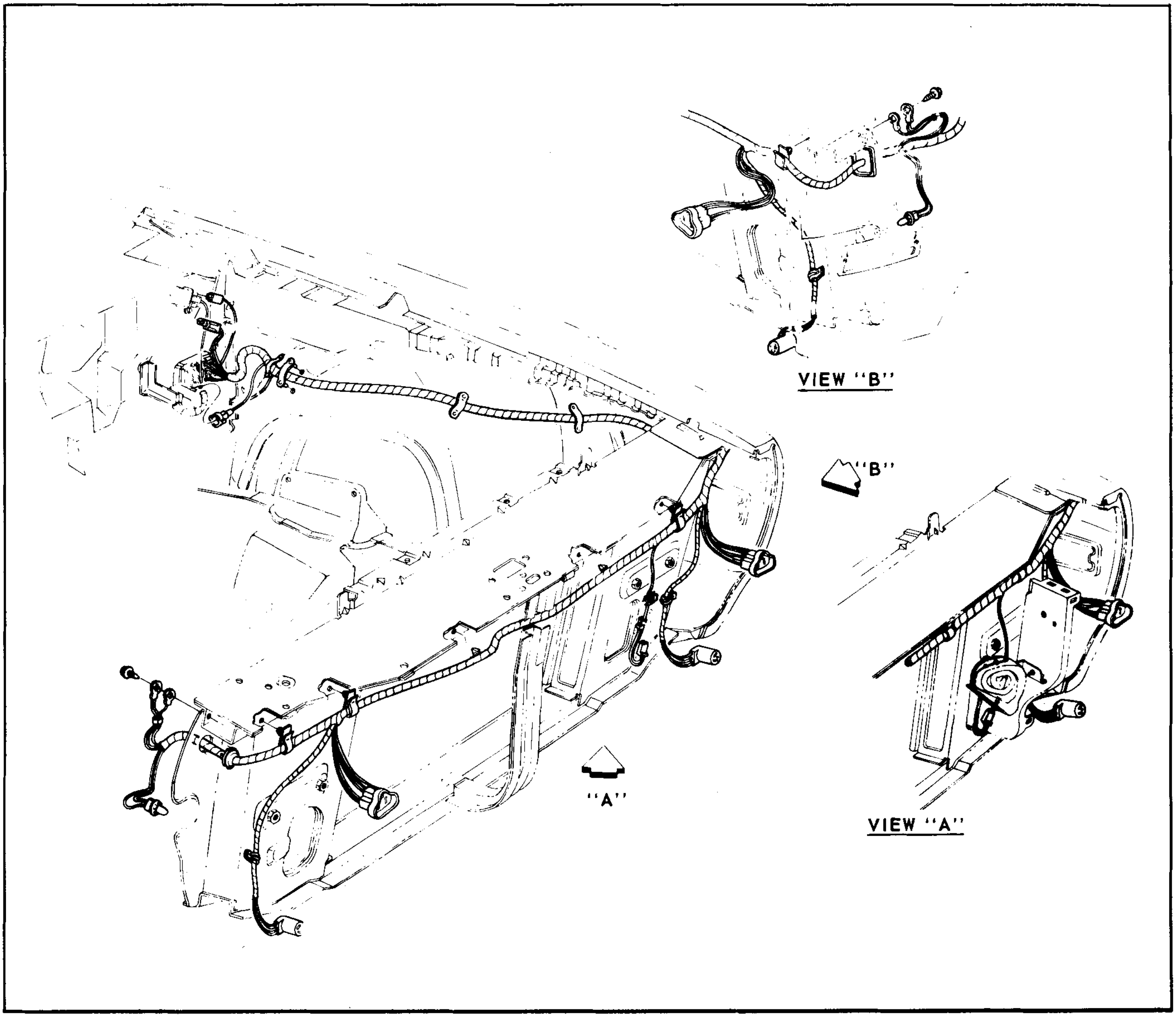


Fig. 12-63 F Series Front End Wire Harness Installation

b. Push handle "Y" forward (to expel air from suction cup) and while holding aimer firmly against the headlamp guide points, slowly pull handle "Y" back until spring catch engages and holds it in position (Fig. 12-63).

c. Install second aimer on other side of vehicle in the same manner. Rotate aimers until the "up-down" and "right-left" scales are facing straight up and the horizontal aiming target can be seen from the viewing port in top of the opposite aimer (Fig. 12-75). Aimers are now installed for checking the no. 2 units (low beam) on B and A Series or 7 inch units on G, F and X Series.

d. Install in same manner on inboard units to check No. 1 units (high beam) on B and A Series.

HEADLAMP AIM

1. Horizontal Aiming

   a. Set right-left scale on each aimer to "0".

   b. While sighting through viewing port on top of aimer, adjust headlamp horizontal adjusting screw until split target image merges into one unbroken line.

   NOTE: *To remove backlash, final adjustment should be made while turning screw clockwise.*

   c. Make horizontal adjustment on other side of vehicle in same manner.

2. Vertical Aiming

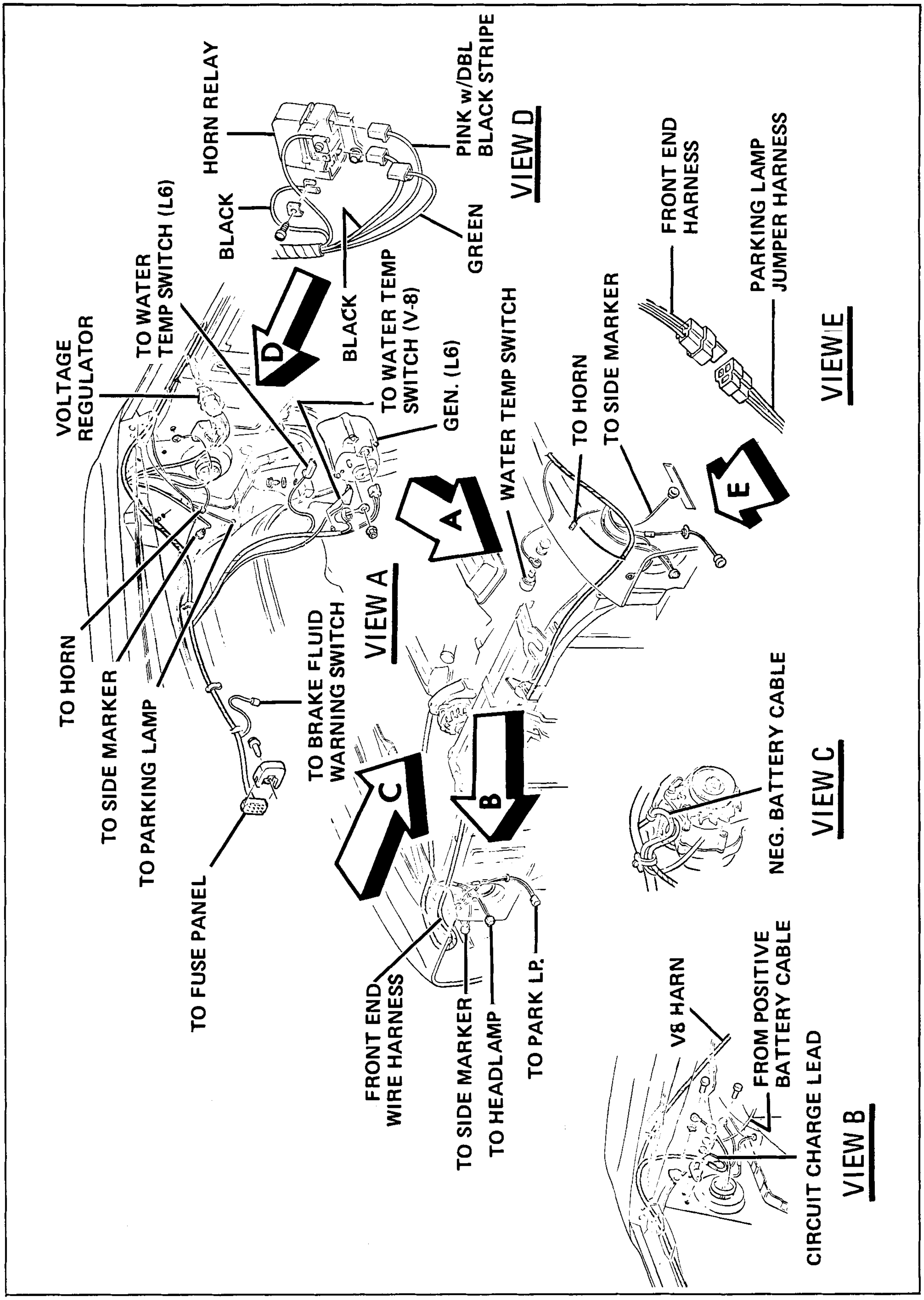


Fig. 12-64 X Series Generator and Front End Wire Harness Installation

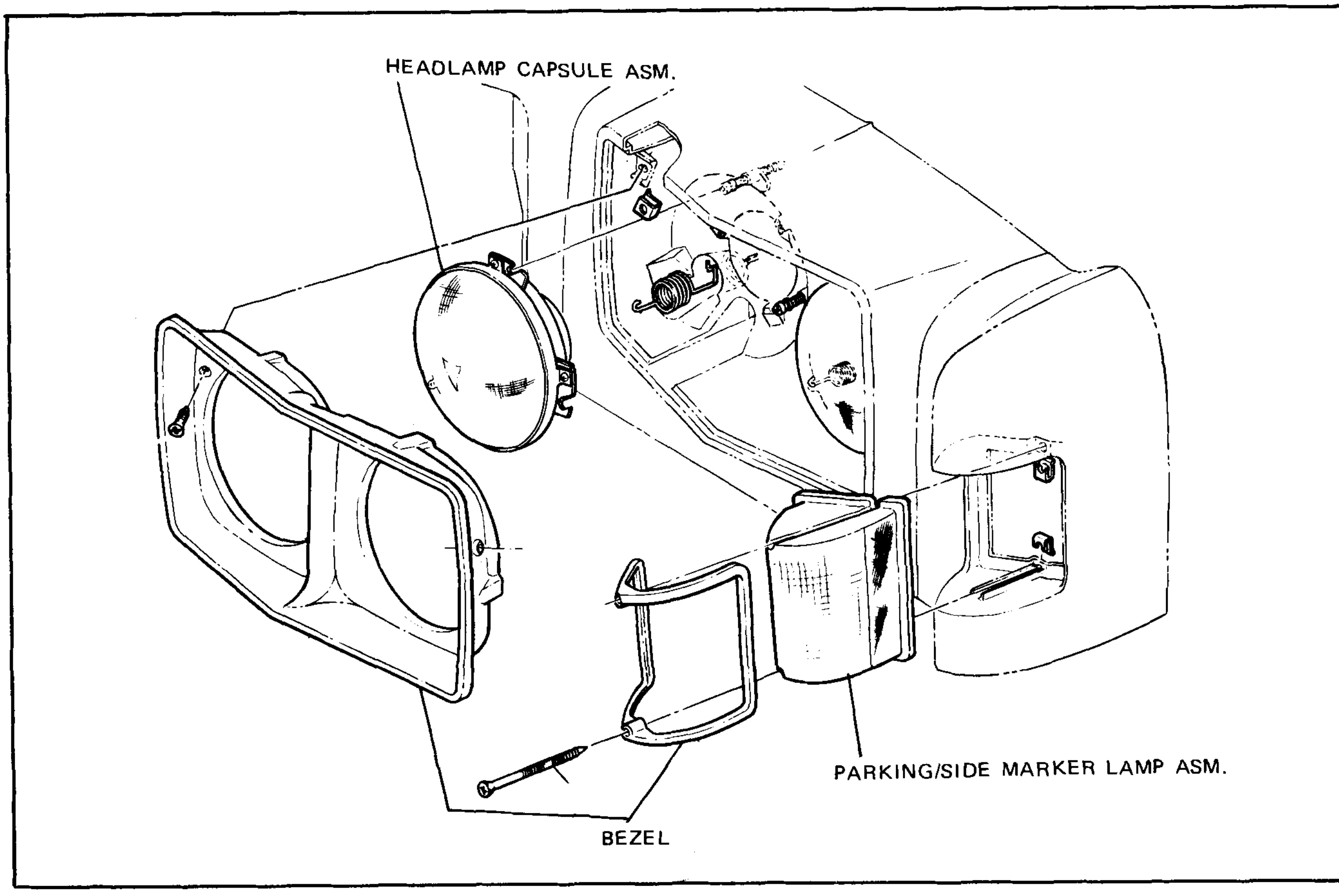


Fig. 12-65 B Series Front Lamps Installation

a. Set "down-up" scale to read "0" on both aimers.

b. Turn headlamp vertical aiming screw counter-clockwise until spirit level bubble is on car side of center.

c. Now turn aiming screw clockwise until spirit level bubble is centered.

d. Make vertical adjustment on other side of car in same manner.

On B and A Series proceed to adjust inboard units by repeating the above procedure.

Remove aimers by releasing the spring catch at rear (bottom) of aimer and push handle "Y" forward. Do not attempt to remove aimers by pulling them away from headlamp lens - slide suction cup downward and away from lens.

CALIBRATING AIMERS - J 6878-01

Aimer J 6878-01 is calibrated at the factory for use on a level floor. They require no readjustment of factory calibration unless they are dropped or damaged in some manner.

1. Using a carpenter or stone mason spirit level of known accuracy, locate a vertical plate glass window or smooth surface that aimer suction cups will adhere to (Fig. 12-76).

2. Set aimer "down-up" pointer to read "0".

3. Set aimer "right-left" pointer and floor compensator adjustment to read "0".

4. Secure aimers to glass or smooth surface three to five feet apart so split images can be located in viewing ports.

5. If spirit level bubble is centered, vertical calibration is correct. If not, turn level adjusting screw until bubble is centered (Fig. 12-77).

6. The horizontal calibration is correct if target split images on opposite aimers are aligned as one continuous line in the viewing port. If not, turn mirror adjusting screw until target split image becomes aligned (Fig. 12-77).

NOTE: *A calibration ring H-5 is now available for installing on aimer before mounting on glass window or smooth surface for calibration.*

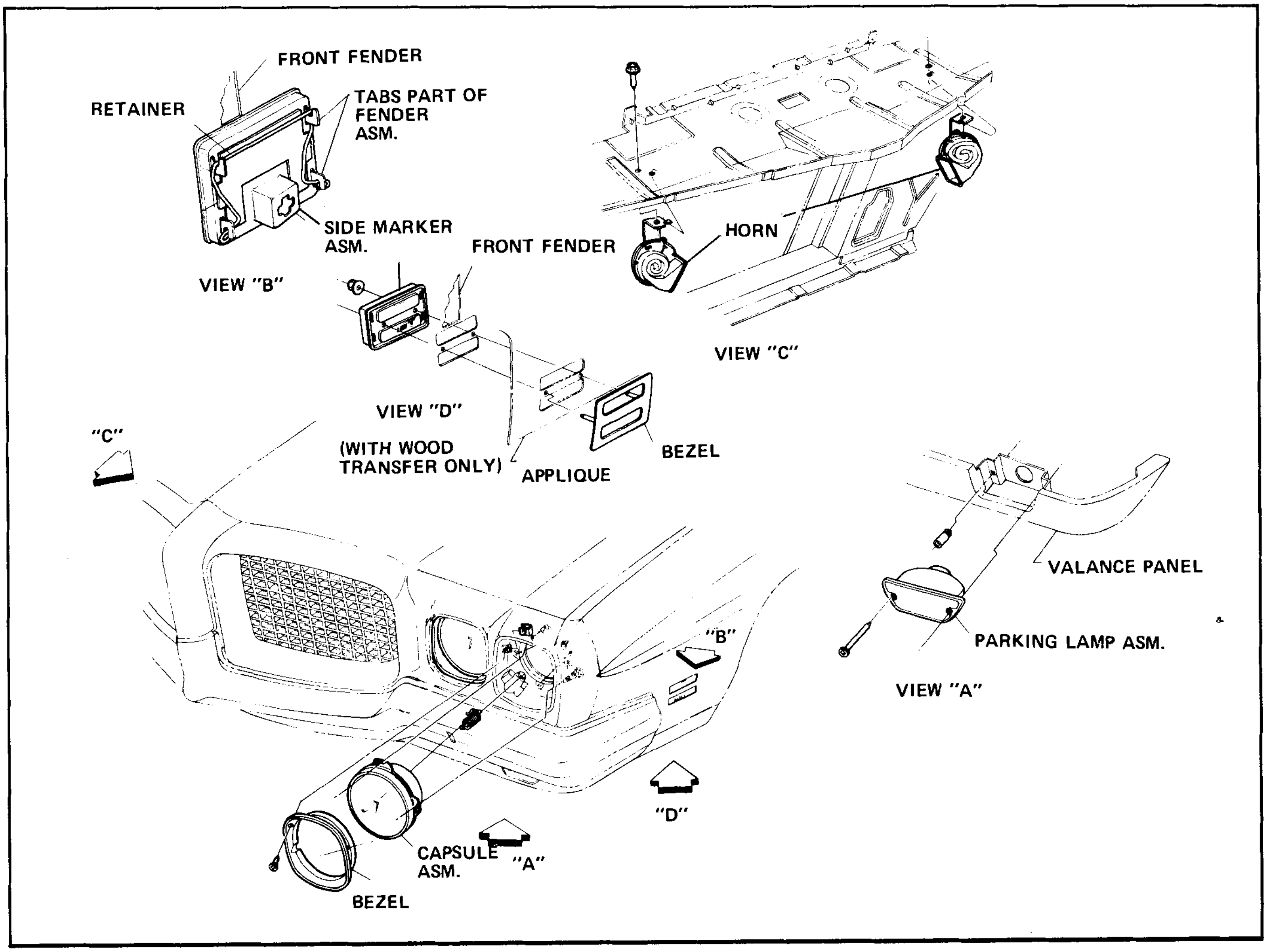


Fig. 12-66 A Series Front Lamps Installation

This device is equipped with an adjustment screw and spirit level for adjusting to a vertical plane, thus eliminating a need for a perfectly vertical surface to mount the aimers for calibration and a carpenter's level. In addition, calibration will probably be more accurate since the calibration ring seats 3 platforms on the face of the aimer where the sealed beam guide points rest (and any wear occurs) when aiming headlamp.

HEADLAMP AIMING - VISUAL - SCREEN METHOD

If it becomes necessary to aim headlights by the screen method, the following specifications are recommended. However, some states have special requirements for headlight aim adjustment and these requirements should be observed.

Low Beam

Place vehicle on a known level floor 25 feet from aiming screen or light colored wall.

Four lines are required on screen or wall (Figs. 12-78 and 79).

1. A horizontal line "2" at the level of centers of headlights.
2. A center vertical line "4" which must be lined up with vehicle center line. A good method is to sight through rear window and align center of rear window molding through mirror bracket or hood centerline.
3. A vertical line on left of screen or wall "3" in line with center line of left headlamp.
4. A vertical line on right of screen or wall "5" in line with center line of right headlamp.

   Adjust low beam pattern "1" of headlights as shown in Fig. 12-78.

High Beam (B and A Series)

Adjust high beam pattern "1" of headlights as shown in Fig. 12-79.

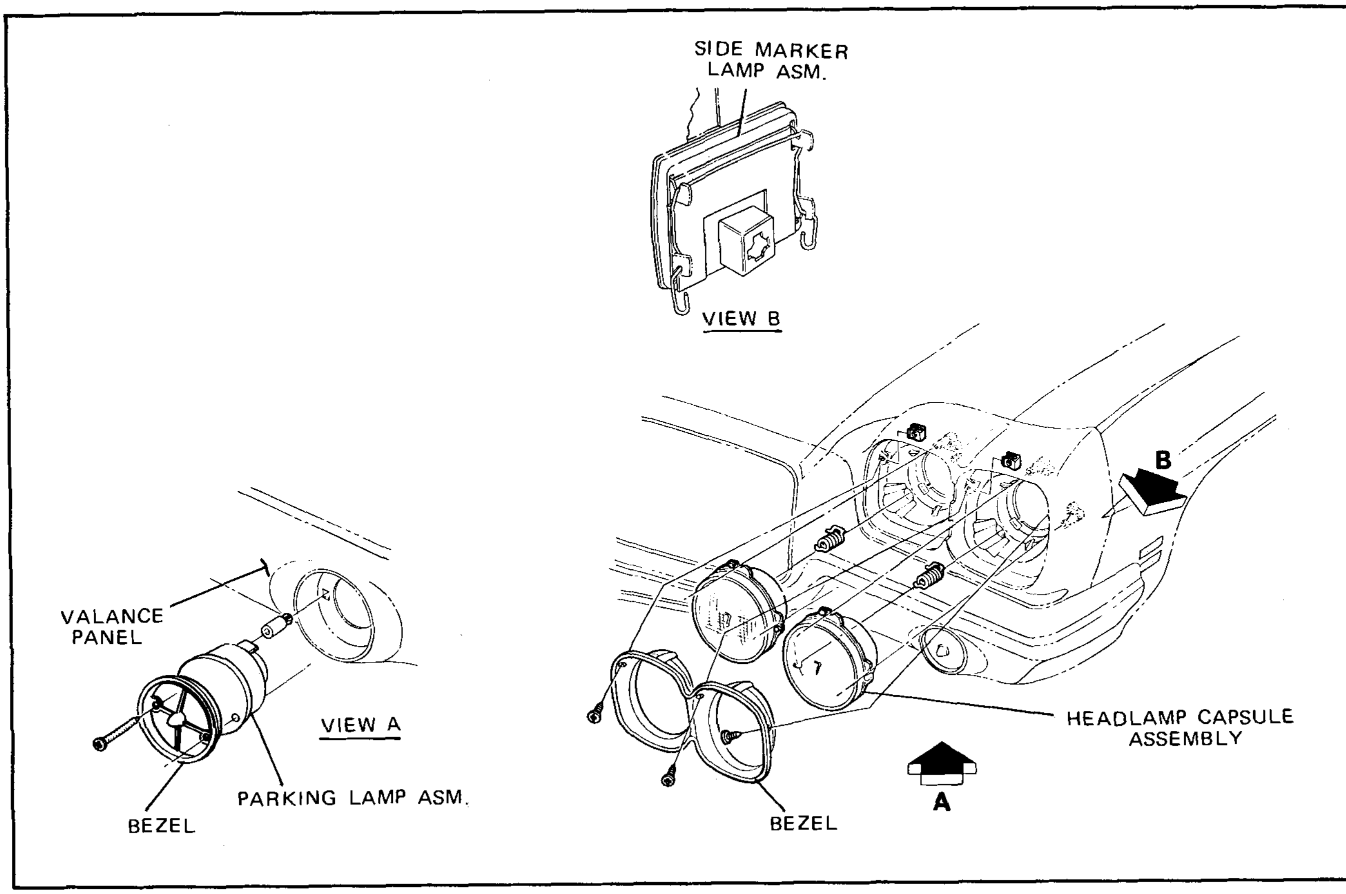


Fig. 12-67 Endura Bumper and GTO Front Lamps Installation

FRONT PARK/TURN SIGNAL LAMP HOUSING ASSEMBLY

REMOVE AND REPLACE

All except G Series (Figs. 12-65, 66, 67, 69 and 70)

1. Remove screws from lamp assembly to headlamp filler panel or valance panel.
2. Remove lamp assembly and twist bulb and socket from assembly.
3. To replace, reverse the removal procedure.

G SERIES (Fig. 12-68)

1. Remove lens.
2. Remove lamp retaining screws.
3. Pull lamp assembly and disconnect wires.
4. To replace reverse removal procedure.

FRONT PARK AND SIGNAL LAMP LENS

REMOVE AND REPLACE

G SERIES

1. Remove 2 retaining screws from lens and housing.

A, B, F AND X SERIES

Due to the construction of these lamps, lens is not serviced, therefore, lamp housing must be replaced.

HORNS

REMOVE AND REPLACE

1. **A, B and G Series** - Remove upper radiator shroud bolts, tilt radiator/shroud assembly toward engine for access.

   F Series - Reach thru opening between bumper and support.

   X Series - Remove windshield washer solvent container from left front fender.

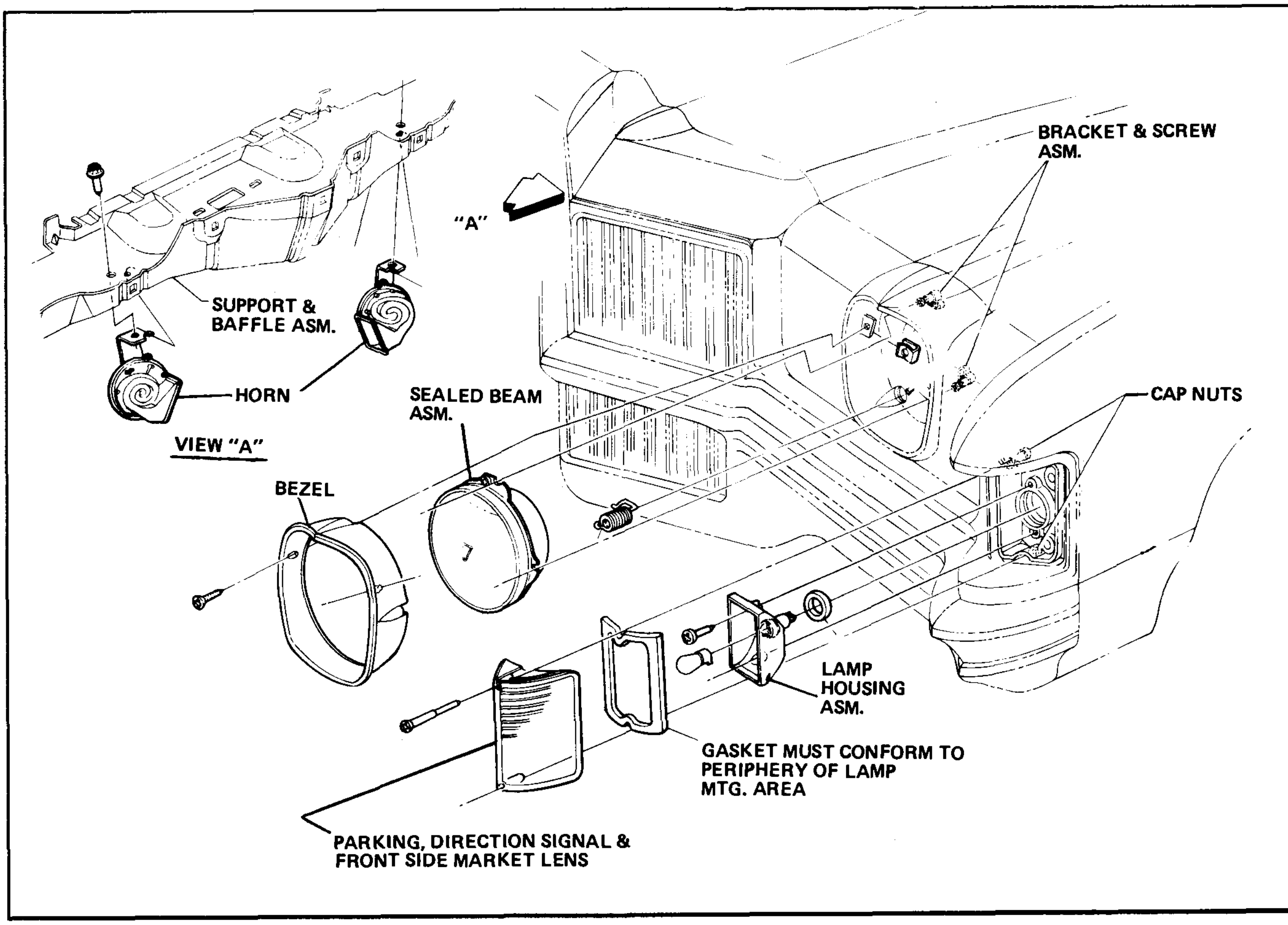


Fig. 12-68 G Series Front Lamps Installation

2. Disconnect horn wire, remove horn retaining screw and remove horn or horns.
3. To replace, reverse removal procedure.

HORN RELAY AND BUZZER ALARM

REMOVE AND REPLACE (Figs. 12-80 and 81)

1. From under dash near steering column, pull relay from IP harness connector.
2. To replace, install new relay in IP connector.

BRAKE WARNING LAMP SWITCH

REMOVE AND REPLACE

It is necessary to remove brake line distributor to replace brake warning lamp switch. Instructions for removal of the switch can be found in Section 5.

SIDE MARKER LAMP HOUSING

REMOVE AND REPLACE

FRONT

1. **B and G Series** - a reflecting surface is integral with park and turn signal lamp.
2. **F Series** - twist bulb and socket from lamp housing for bulb removal. Remove two (2) nuts from inside of fender for housing and bezel removal.
3. **A Series** - remove outboard headlamp capsule and twist bulb and socket from lamp housing. Remove housing retainer for housing removal.
4. **X Series** - on left side, remove windshield washer container from left fender. On right side, remove battery. Twist bulb and socket from housing. Remove two (2) retaining nuts from inside fender for housing removal.

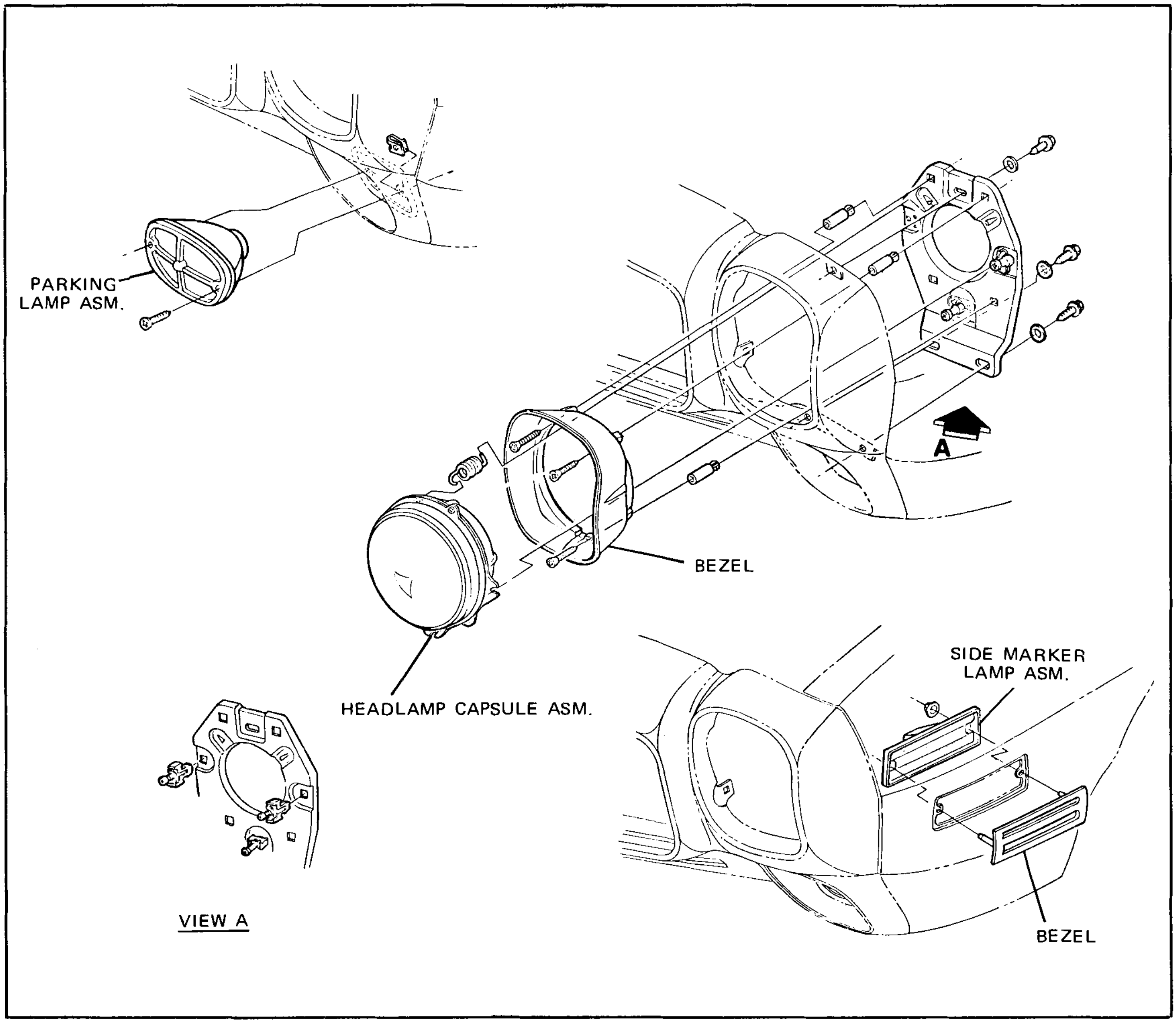


Fig. 12-69 F Series Front Lamps Installation

REAR

1. **B Series (except station wagons), G, F and X Series** - twist bulb and socket from assembly inside of trunk. Remove two (2) retaining nuts for housing removal.

2. **A Series (except station wagons)** - remove tail lamp lens for bulb removal.

3. **Station Wagon models** - remove lens assembly at rea quarter and twist bulb and socket from behind.

INSTRUMENT PANEL (SPEEDO) CLUSTER

Removal of these units can be accomplished by using the following installation diagrams, Figs. 12-82 through 12-86, and by referring to the procedures below.

REMOVE AND REPLACE

B SERIES

1. Disconnect battery and remove lower and upper IP trimplates.

2. Remove automatic transmission shift indicator and speedometer cluster bezel.

3. Remove cluster retaining screws, pull rearward, disconnect speedo cable and printed circuit connector.

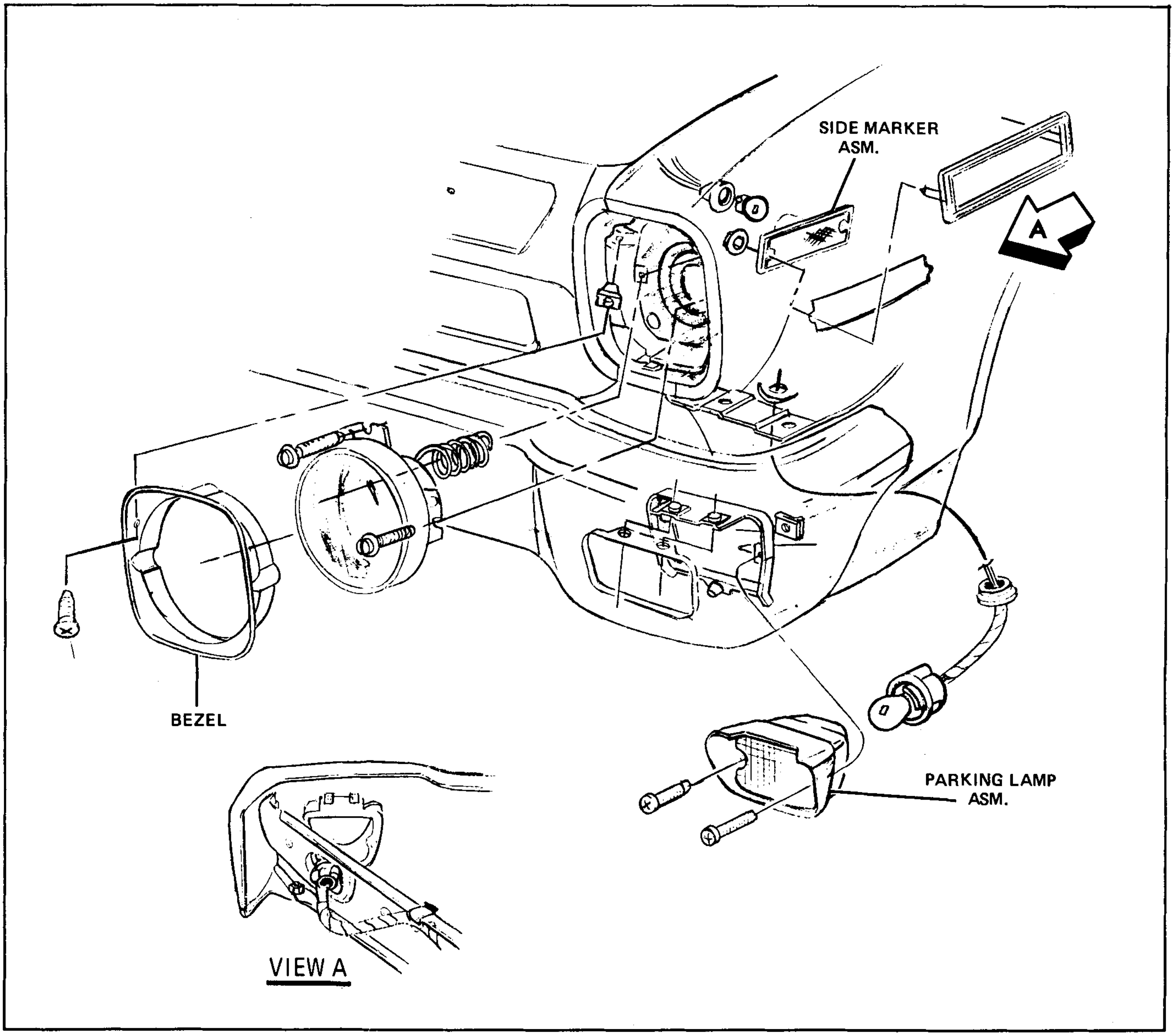


Fig. 12-70 X Series Front Lamps Installation

4. To replace, reverse removal procedure.

A SERIES

1. Disconnect battery and remove lower A/C duct if equipped.
2. Remove lower instrument panel trim and glove box.
3. Lower steering column.
4. Disconnect speedometer cable and heater cable at heater case.
5. Remove 3 instrument panel screws at gages.
6. Remove 3 right upper instrument panel nuts.
7. Remove lower instrument panel bolts at right and left ends and at steering column.
8. Position crash pad outward on steering column.
9. Disconnect printed circuit.
10. Remove instrument panel harness retaining screws.
11. Remove cluster retaining screws and cluster.
12. To replace, reverse removal procedure.

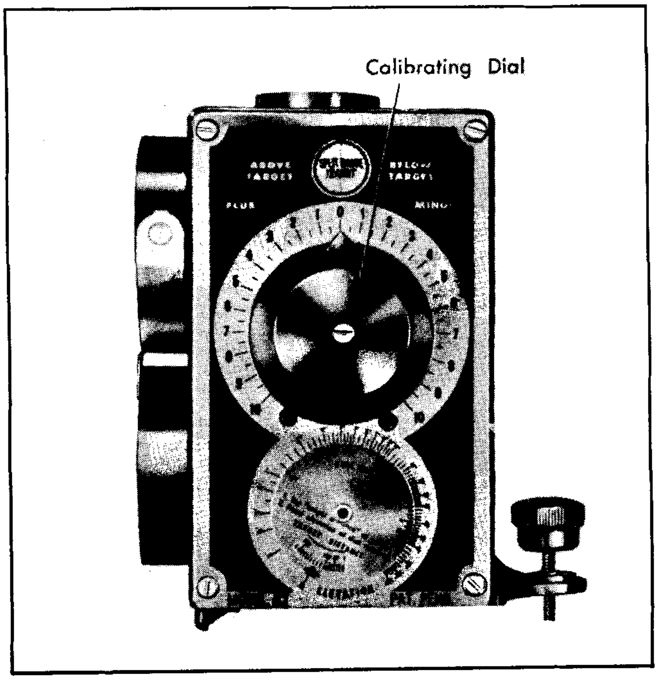


Fig. 12-71 Aiming Transit

G SERIES

1. Disconnect battery and remove lower A/C duct if equipped.
2. Remove pillar post moldings and filler plate at windshield.
3. Remove lower instrument panel trim at steering column.
4. Disconnect speedometer cable and radio antenna lead.
5. Lower steering column.

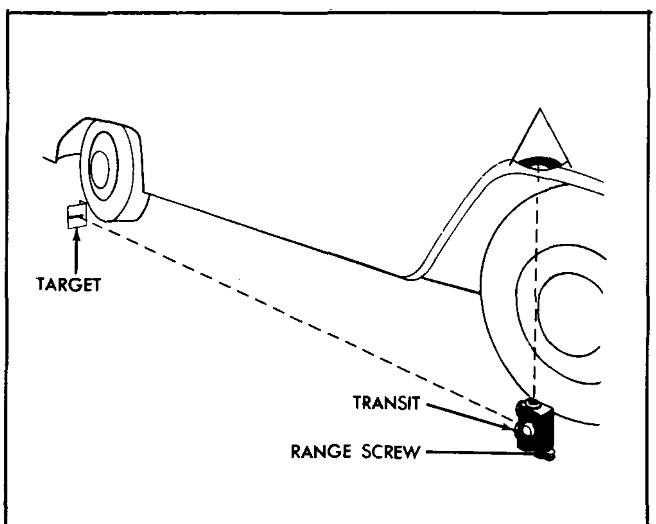


Fig. 12-72 Checking Slope of Floor

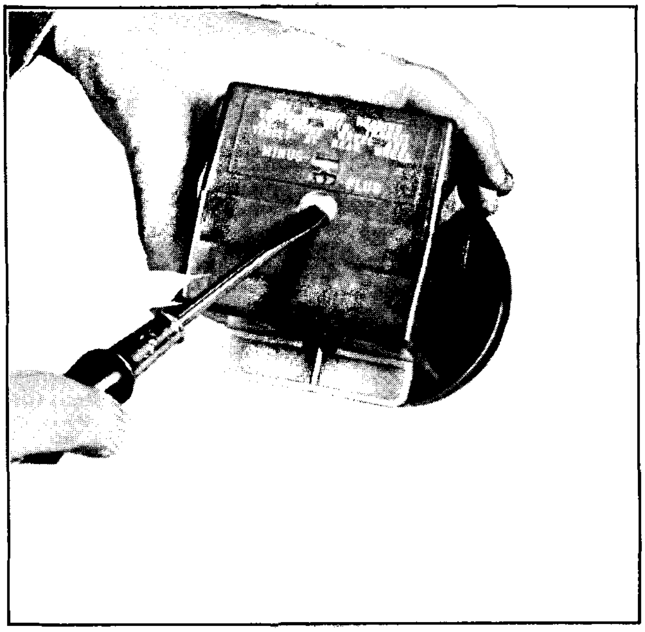


Fig. 12-73 Adjusting Aimer to Compensate for Floor Slope

6. Remove upper air outlet vents and instrument panel attaching screws at steering column, console, ends and upper center.
7. Remove lower defroster duct screw at heater case.
8. Position instrument pad outward on steering column.
9. Disconnect printed circuit.
10. Remove wire harness retaining screws and cluster ground screw.

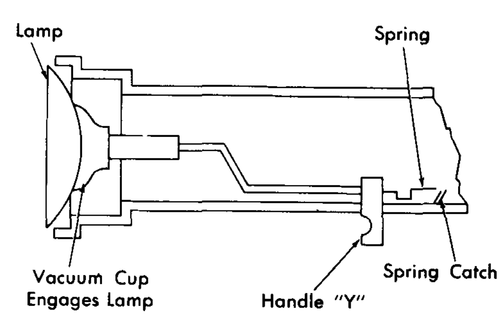


Fig. 12-74 Securing Aimers on Sealed Beams

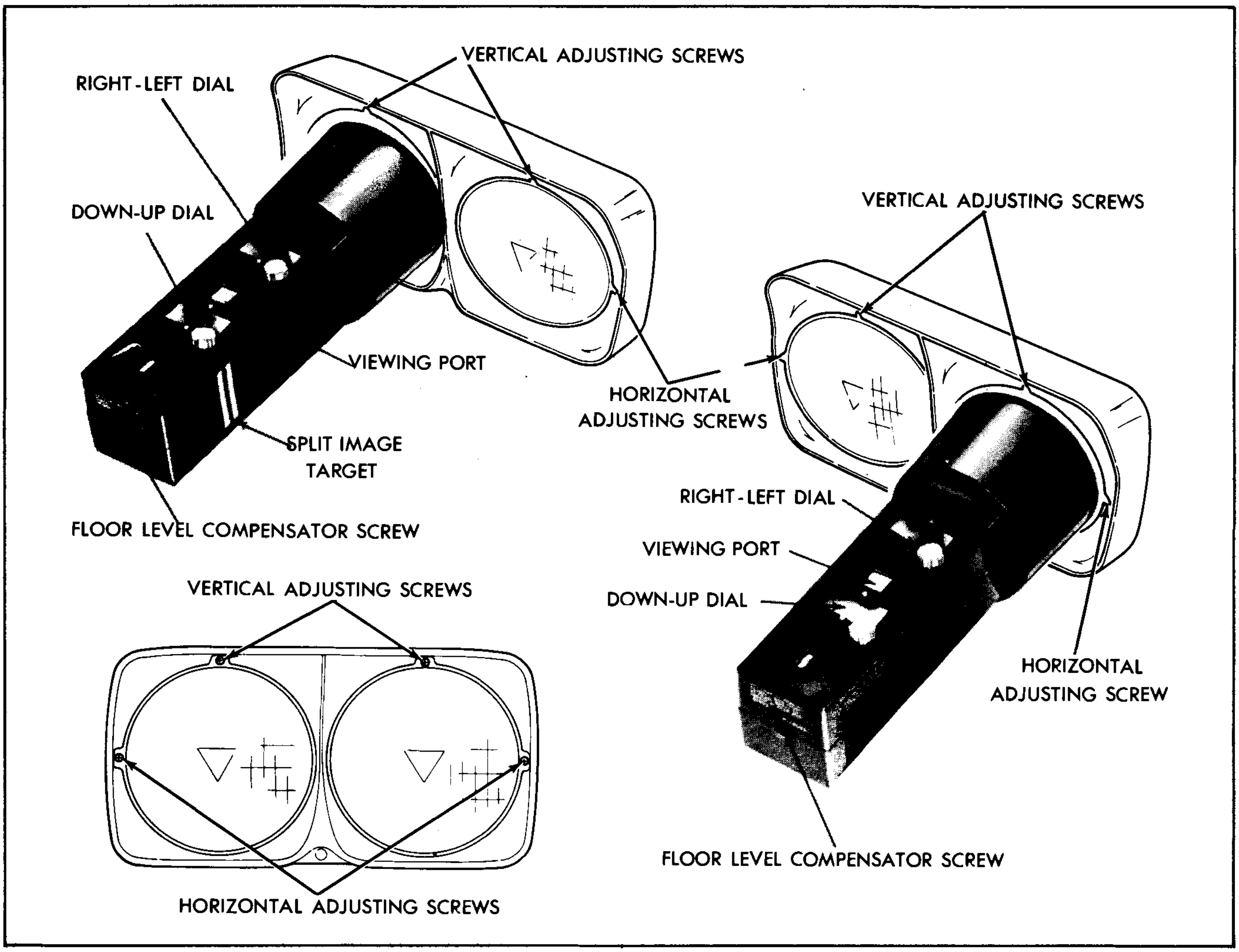


Fig. 12-75 Installing Aimers and Aiming Headlamps

11. Remove cluster mounting screws and cluster.

12. To replace, reverse removal procedure.

F SERIES

1. Disconnect battery and remove upper IP trim plate.

2. Remove lower IP trim and bracket at steering column.

3. Loosen 2 steering column nuts to lower column.

4. Remove cluster screws, pull rearward, disconnect speedo cable and printed circuit connector.

5. To replace, reverse removal procedure.

X SERIES

1. Disconnect battery and remove steering column cover trim.

2. Remove three (3) screws retaining heater or A/C control panel to IP carrier.

3. Remove radio control knobs, bezels and nuts.

   NOTE: *This allows the radio to remain attached to the IP reinforcement.*

4. Remove screws at top, bottom and side of carrier securing it to the IP pad.

5. Disconnect shift quadrant indicator cable at shift bowl (if automatic transmission), remove two (2) steering column to IP nuts.

6. Remove toe plate cover and five (5) toe plate to cowl screws, lower steering column from IP and protect with shop towel or tape.

7. Remove ground wire screw under left side of IP pad above kick pad and disconnect speedometer cable from under dash.

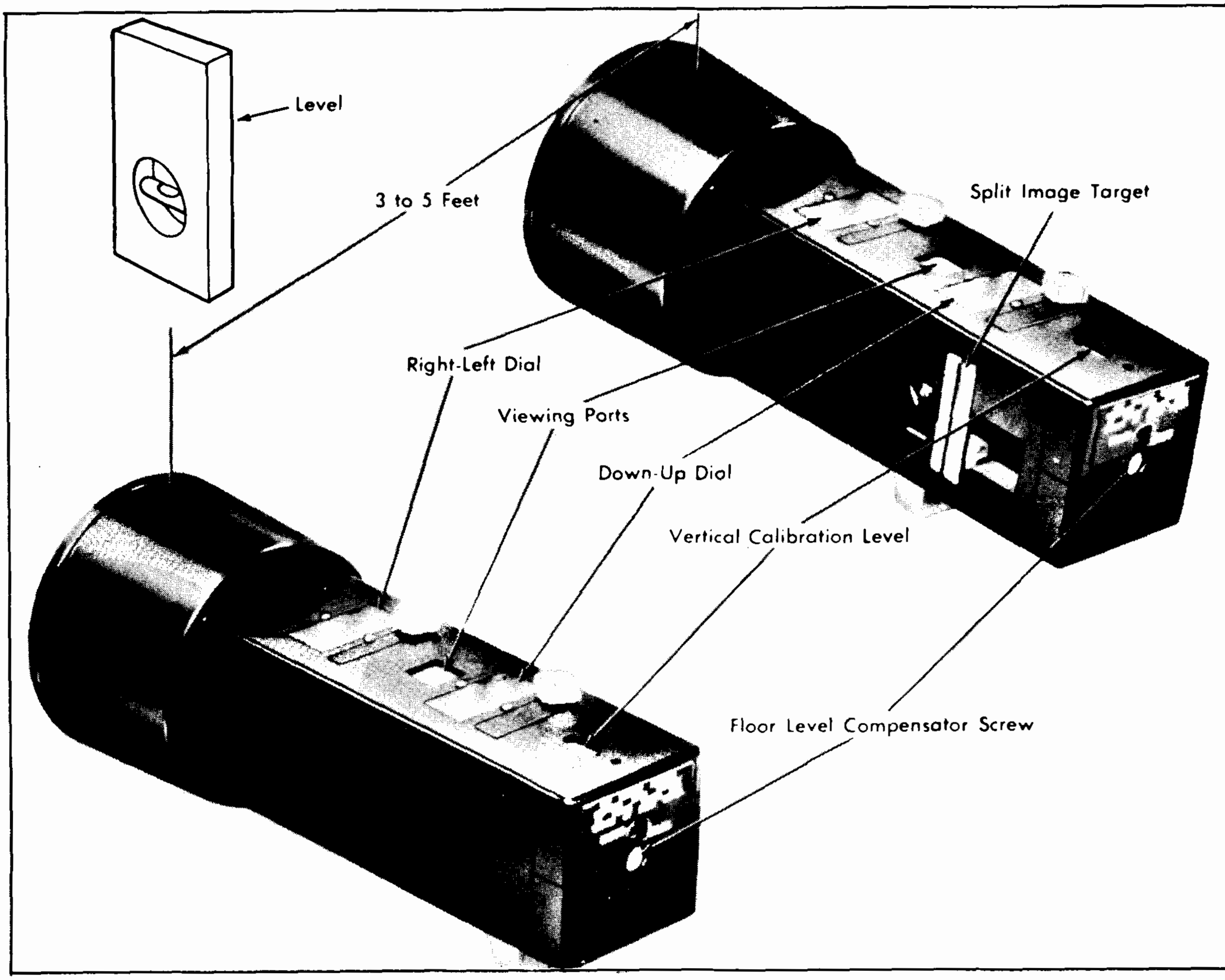


Fig. 12-76 Calibrating Aimers

8. Tilt carrier and cluster assembly rearward, disconnect printed circuit and cluster ground connectors, and rest assembly on top of column.

9. Remove screws from cluster to carrier assembly and remove cluster.

10. To replace, reverse removal procedure.

NOTE: *Refer to Section 9 - "Steering Column-Reinstall" for proper alignment of column.*

PRINTED CIRCUIT

NOTE: *Tool J 22746, Carburetor Adjusting Tool, is handy for removing nuts and screws from back of cluster.*

REMOVE AND REPLACE

B AND F SERIES (Figs. 12-82 and 12-85)

1. Remove speedo cluster as previously described.

2. Remove cluster bulbs, nuts and printed circuit.

3. To replace, reverse removal procedure.

A SERIES (Figs. 12-83)

1. Disconnect battery and remove lower A/C duct if equipped.

2. Disconnect wire connector to printed circuit.

3. Remove bulbs, ground screws and gage terminal nuts retaining printed circuit to instrument panel cluster.

4. Remove printed circuit.

5. To replace, reverse removal procedure.

G SERIES (Fig. 12-84)

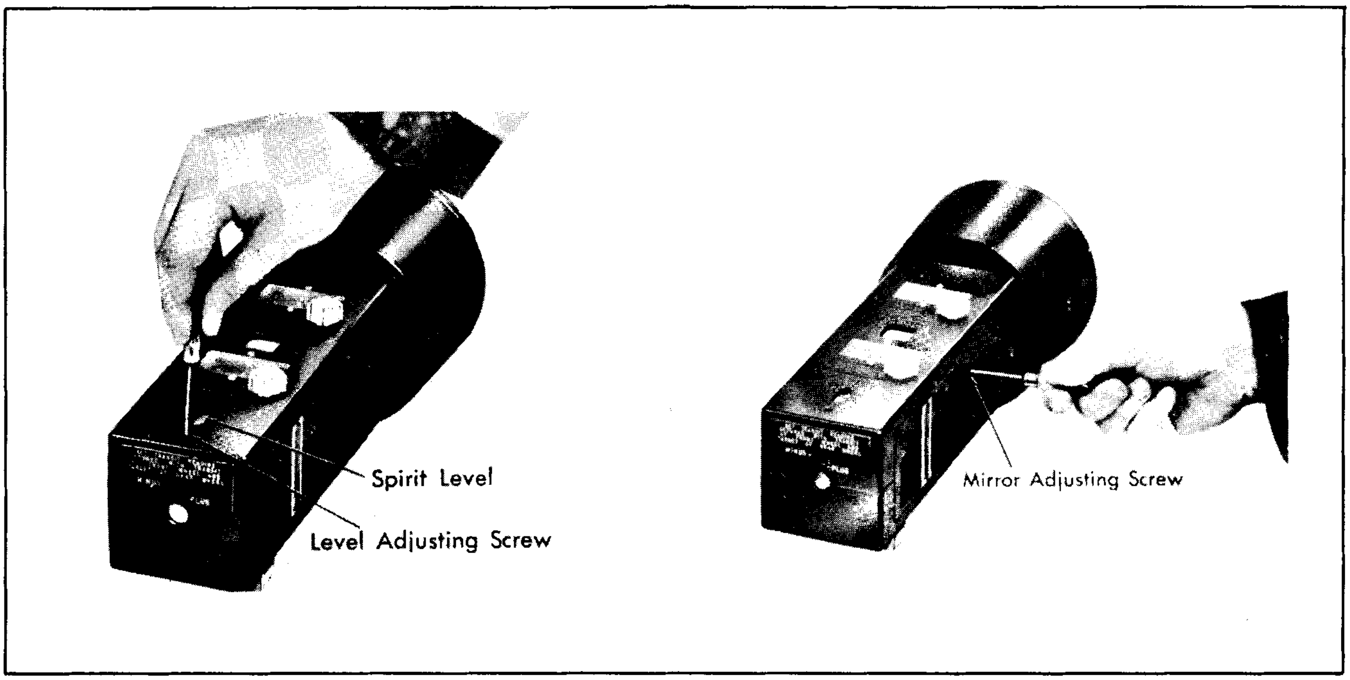


Fig. 12-77 Adjusting Vertical and Horizontal Calibration

1. Disconnect battery and remove lower A/C duct if equipped.
2. Remove pillar post moldings and filler plate at windshield.
3. Remove lower instrument panel trim at steering column.
4. Disconnect speedometer cable.
5. Lower steering column.
6. Remove upper air outlet vents and instrument panel attaching screws at steering column, console, ends and upper center.
7. Remove lower defroster duct screw.
8. Position crash pad rearward on steering column.
9. Disconnect wire connector to printed circuit.
10. Remove bulbs, ground screws, gage terminal nuts retaining printed circuit to cluster.
11. Remove printed circuit.
12. To replace, reverse removal procedure.

X SERIES (Fig. 12-87)

1. Tilt instrument carrier and cluster assembly rearward as previously described under "INSTRUMENT PANEL (SPEEDO) CLUSTER - REMOVE AND REPLACE".
2. From back of cluster, twist and remove all bulb sock-

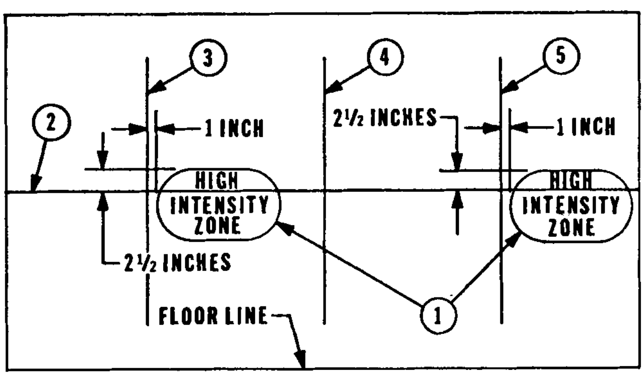


Fig. 12-78 Low Beam Adjustment Pattern (Visual Aim at 25 Feet)

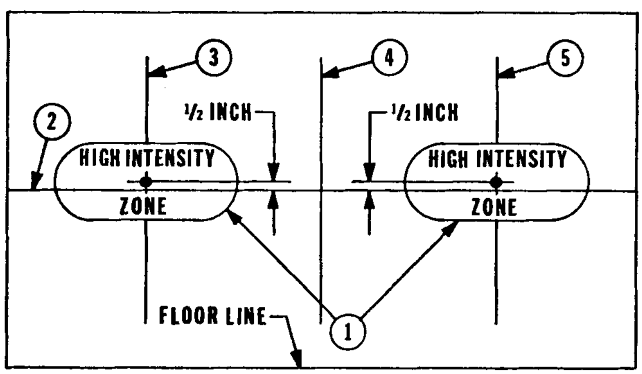


Fig. 12-79 High Beam Adjustment Pattern (Visual Aim at 25 Feet)

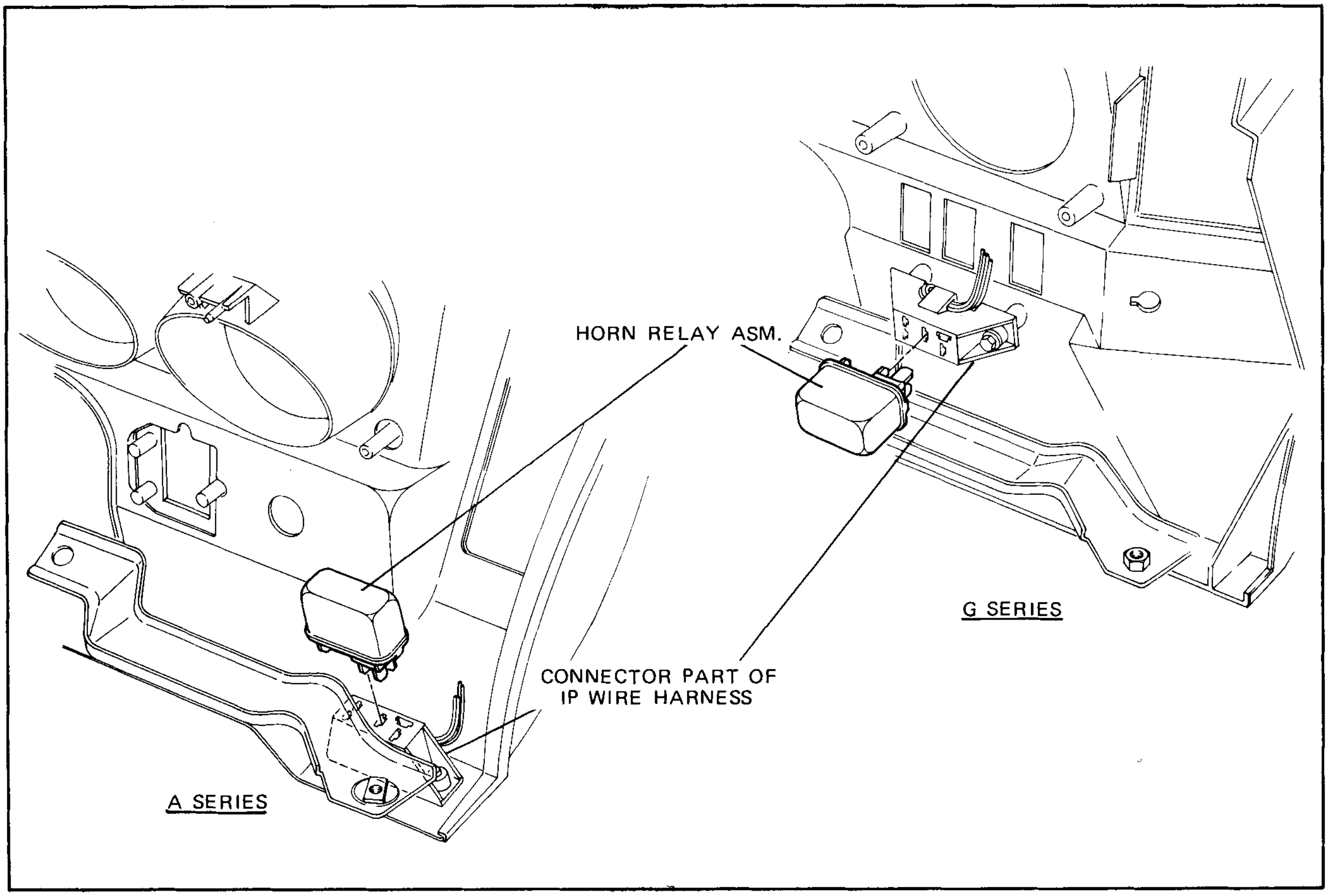


Fig. 12-80 A and G Series Horn Relay Mounting

ets, remove gage nuts and screws retaining printed circuit to cluster.

3. To replace, reverse removal procedure.

NOTE: *The retaining screws must be adequately secured to provide ground circuits for printed circuit.*

SPEEDOMETER CABLE

Speedometer cable connection at speedometer cluster is of quick disconnect design. Fig. 12-88 shows detail. Fig. 12-89 shows attachment of transmission.

REMOVE AND REPLACE

1. Remove lower A/C duct if equipped on A and G Series or lower IP trimplates on B and F Series.
2. Disconnect speedometer cable casing from speedometer head.
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 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

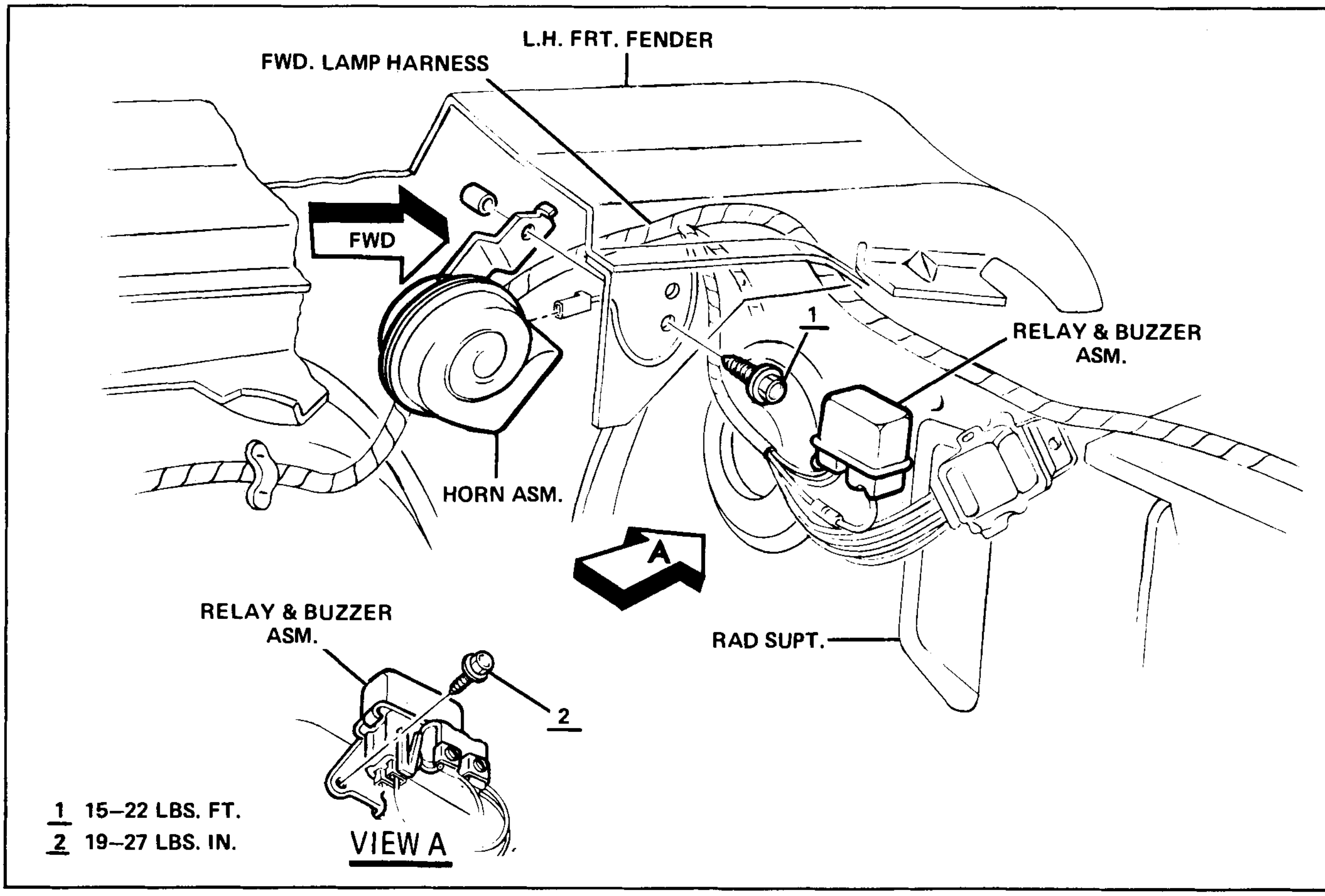


Fig. 12-81 X Series Horn and Horn Relay Installation

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.

INSTRUMENT PANEL PAD

Refer to Figs. 12-90 through 12-99 for applicable models and the following procedures.

REMOVE AND REPLACE

B SERIES

1. Disconnect battery and remove upper and lower IP trimplates.
2. Remove wiper/headlamp switch bezel and disconnect connectors.
3. Remove heater or A/C control and bezel.
4. Remove cluster bezel and speedometer cluster (includes removing automatic shift quadrant).
5. Remove glove box and radio if equipped.
6. Remove plastic upper panel and remove six (6) upper IP to steel extension screws.
7. Remove left and right pillar post moldings.
8. Remove three (3) left hand upper IP pad screws, steering column brace and center IP support.
9. Disconnect park brake cable at foot pedal bracket and remove IP wire harness clips.

   NOTE: *IP wire harness remains in car.*

10. Remove right and left lower IP bolts.
11. Remove A/C duct extension under steering column if so equipped and lower steering column.
12. Place rag on column, tilt pad rearward and disconnect any miscellaneous connectors, remove IP pad from car.
13. Transfer of parts on bench includes lower A/C duct if so equipped, outlet ducts and nozzles, brackets, clips, brake park handle assy., nameplate and miscellaneous parts.
14. To replace, reverse removal procedure.

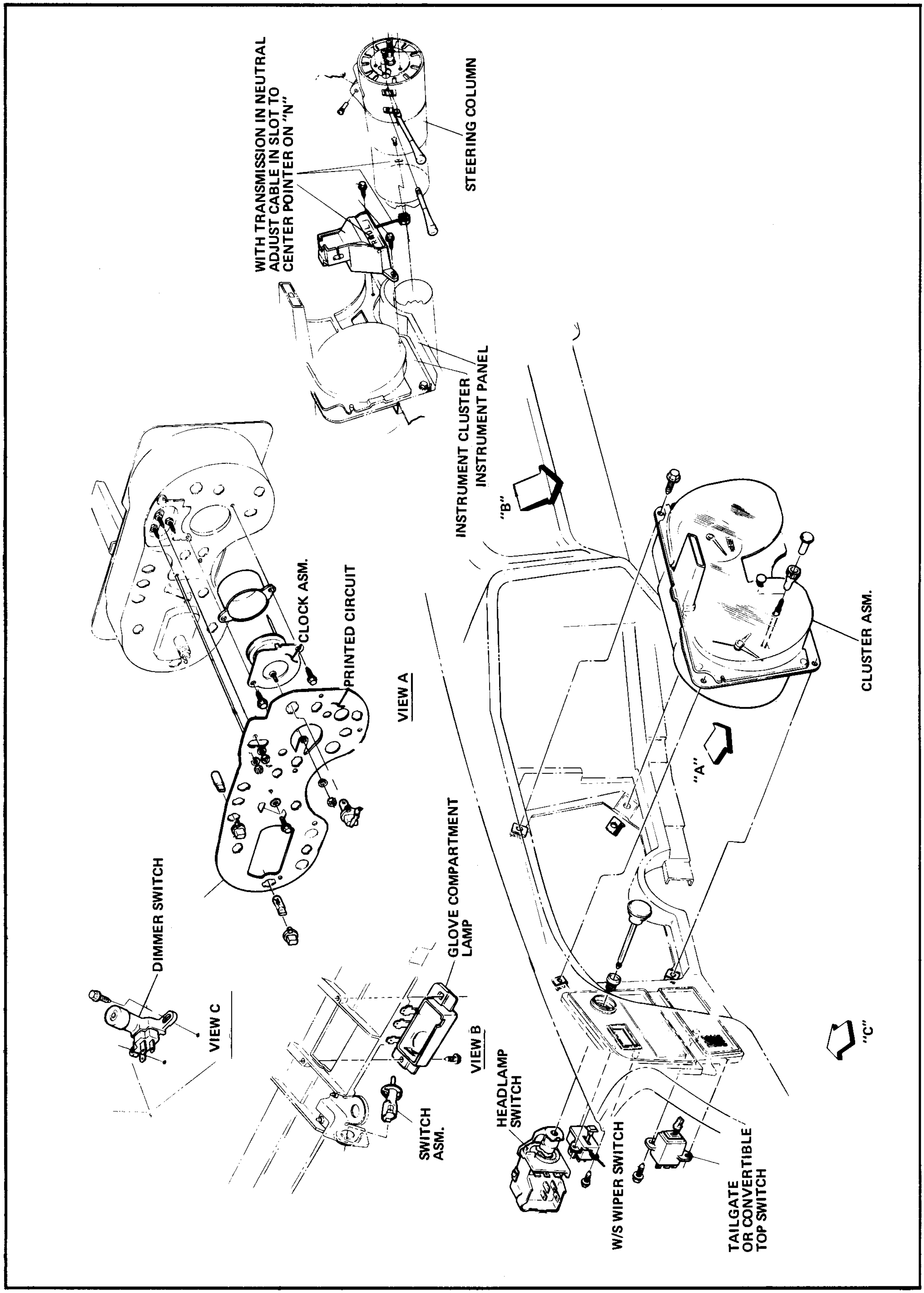


Fig. 12-82 B Series Speedometer Cluster and Printed Circuit Installation

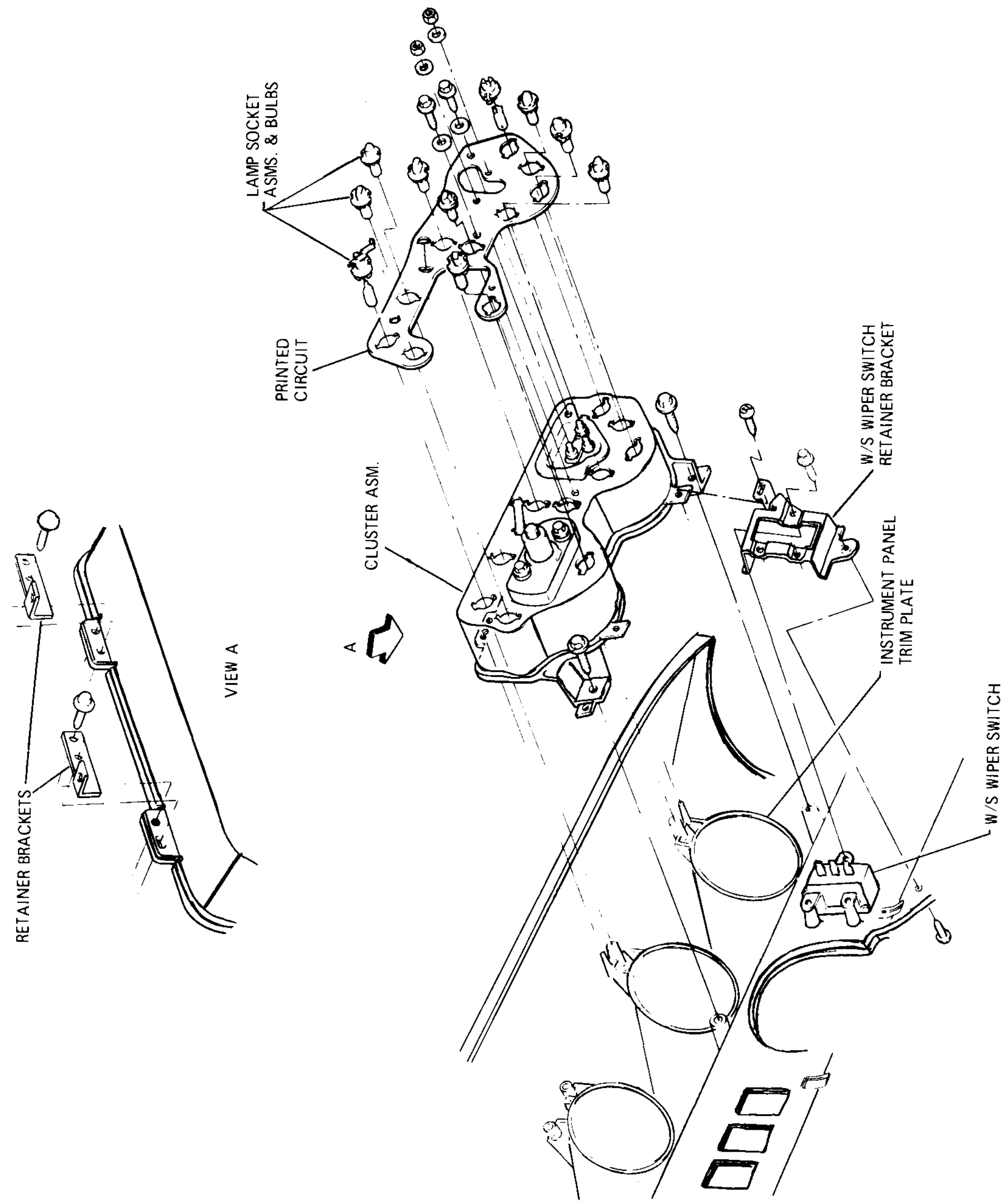


Fig. 12-83 A Series Speedometer Cluster and Printed Circuit Installation

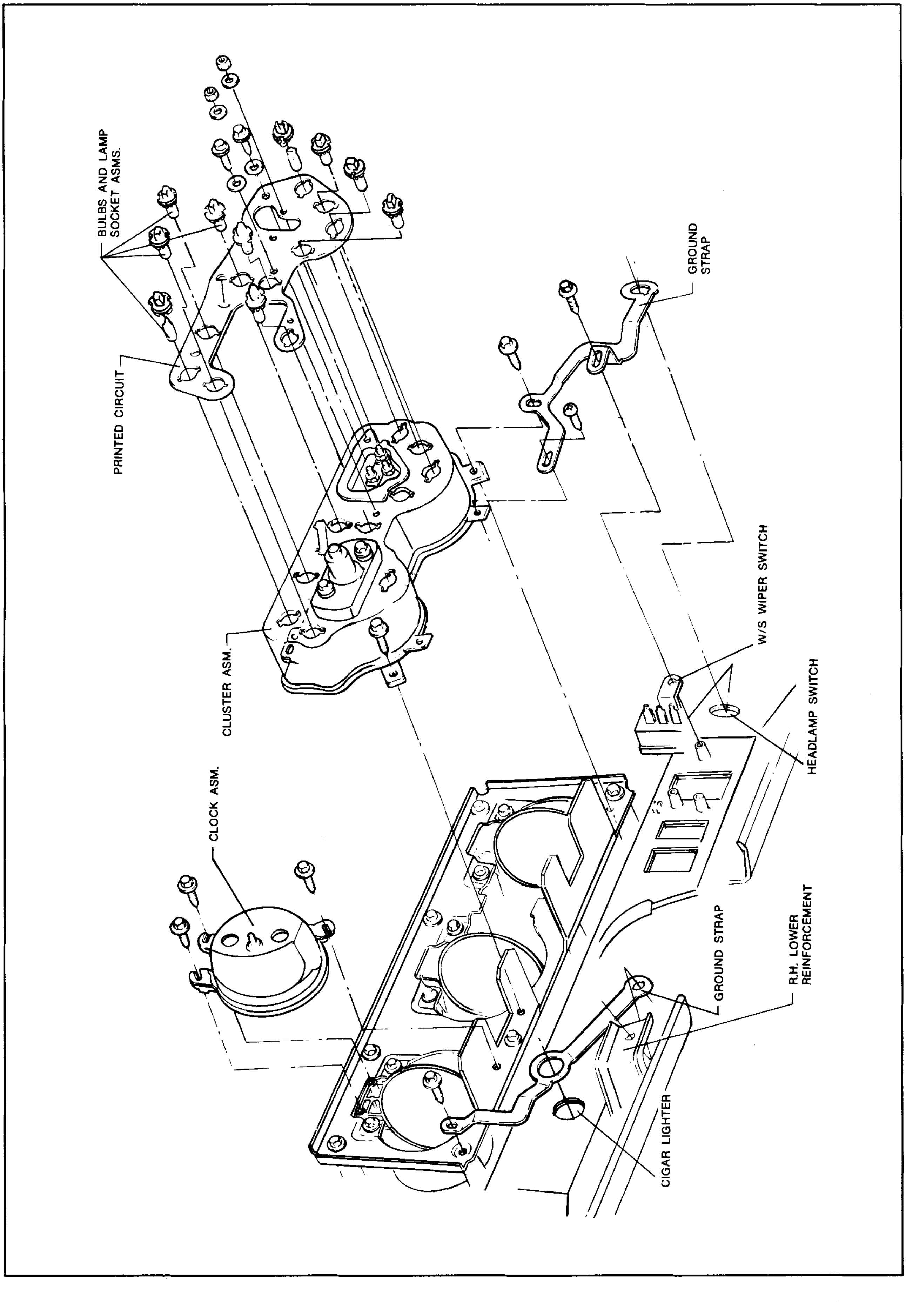


Fig. 12-84 G Series Speedometer Cluster and Printed Circuit Installation

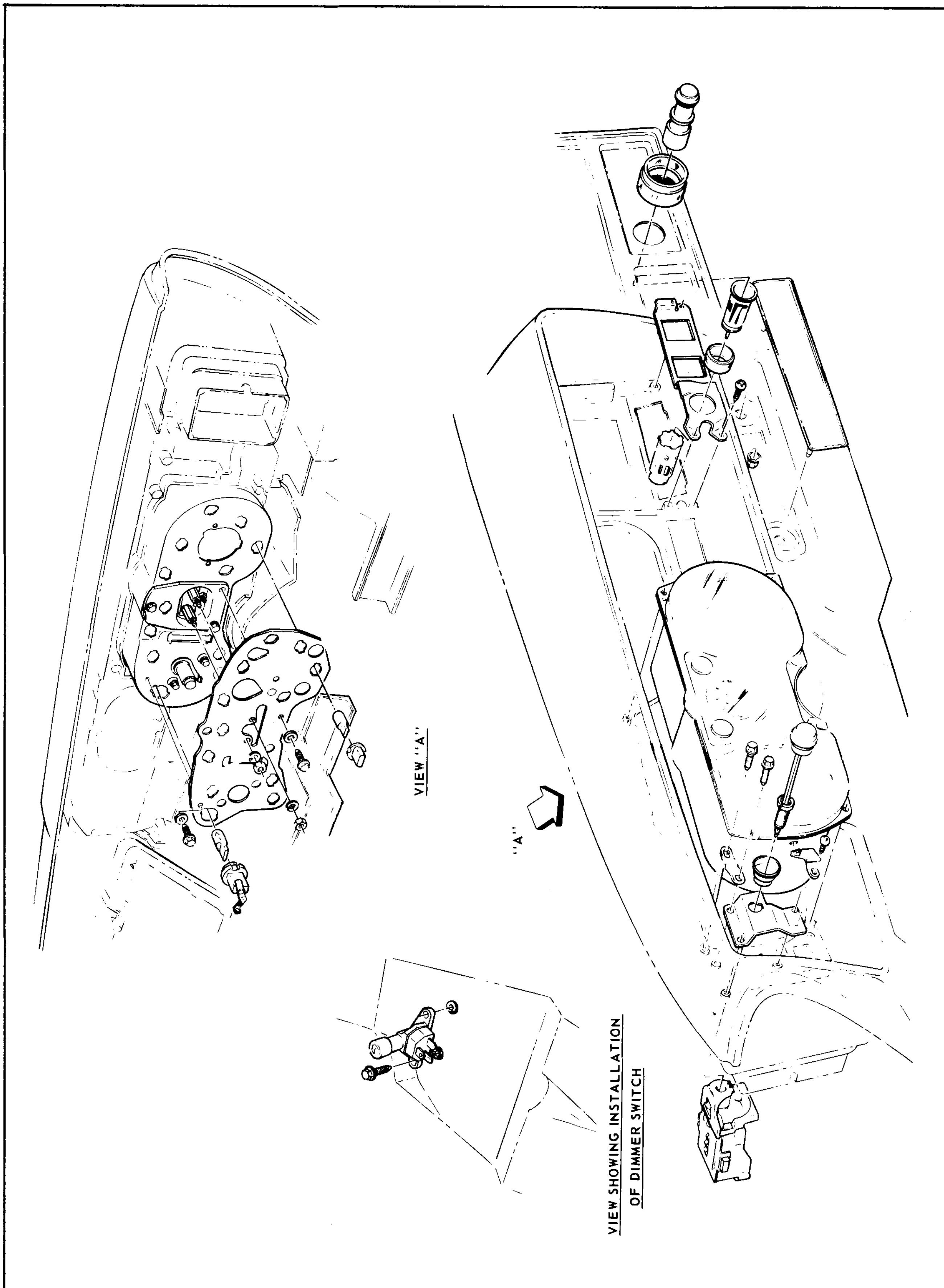


Fig. 12-85 F Series Speedometer Cluster and Printed Circuit Installation

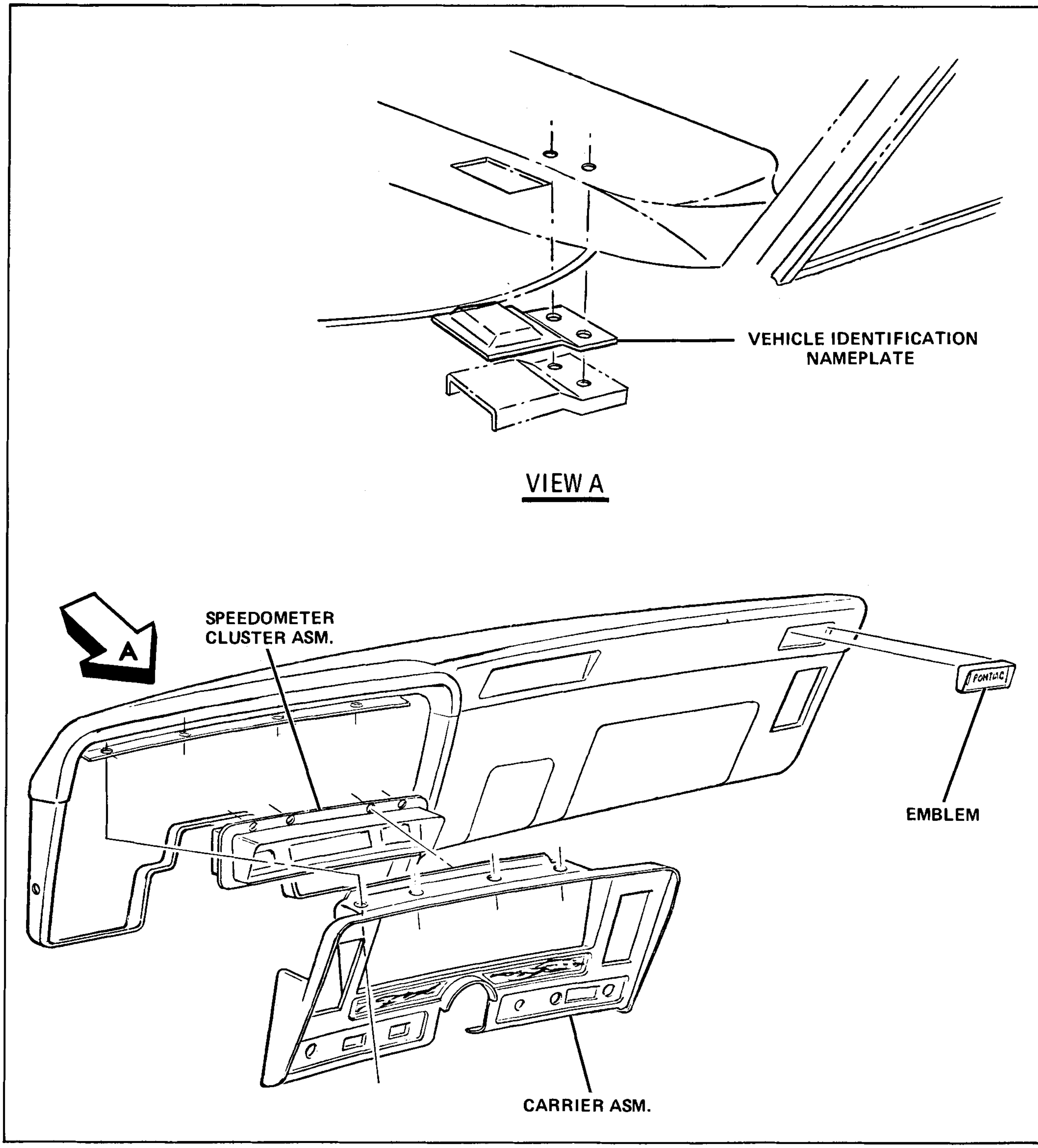


Fig. 12-86 X Series Speedometer Cluster and IP Carrier Installation

A SERIES

1. Disconnect battery and remove lower air conditioning ducts if equipped.
2. Remove lower instrument panel trim.
3. Remove glove box and radio.
4. Separate fuse block.
5. Remove plastic trim at floor around steering column and toe plate screws.

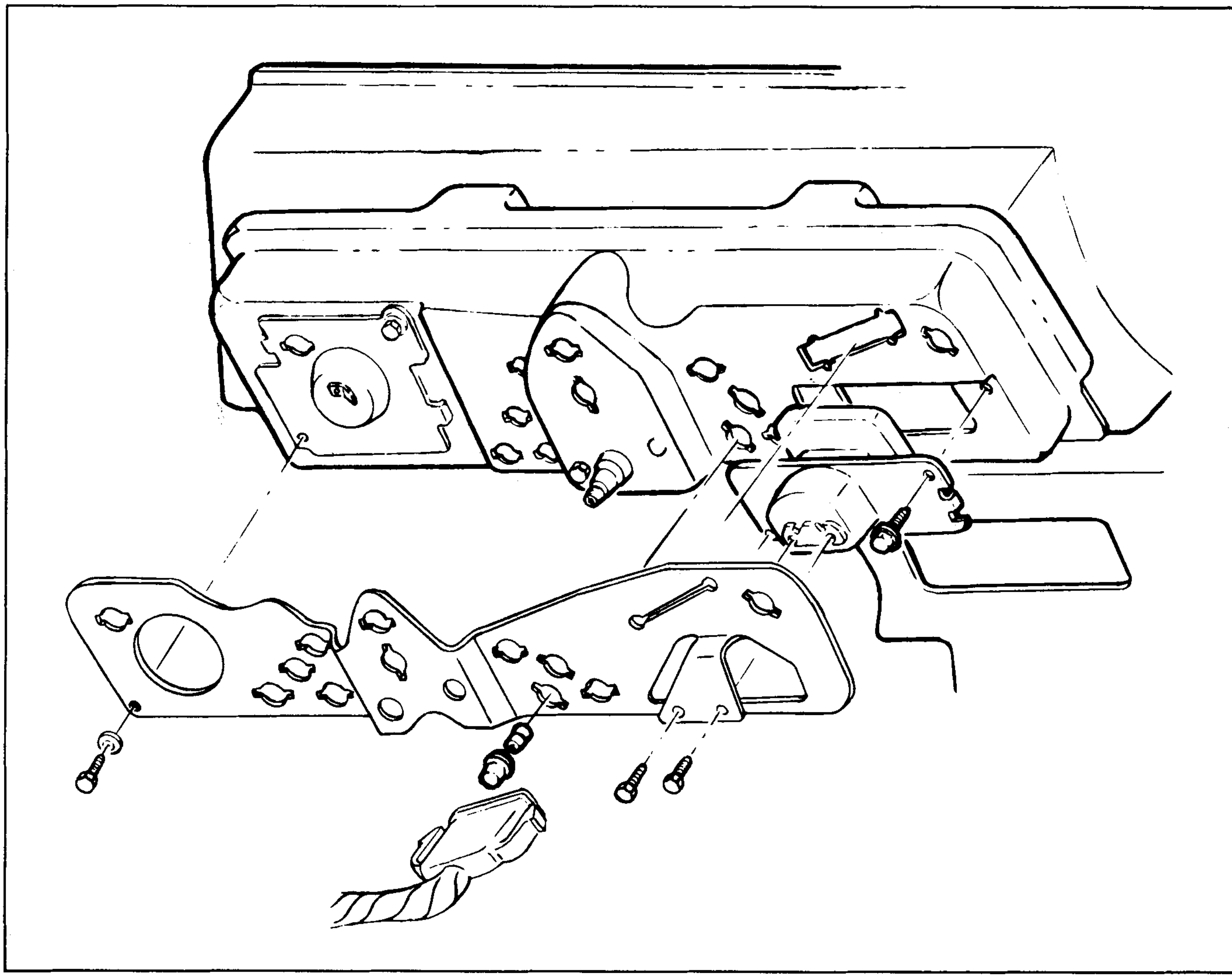


Fig. 12-87 X Series Printed Circuit and Fuel Gage Installation

6. Disconnect dimmer switch, door jamb switch, parking brake switch, stop lamp switch, neutral safety switch, back-up lamp switch, body harness, ignition switch and air conditioning harness.

7. Disconnect vacuum harness and temperature control cable at control panel.

8. Lower steering column and disconnect speedometer cable.

9. Remove upper screws at gages, nuts at upper right end and lower attaching screws.

10. Remove complete assembly from car and transfer remaining parts while at bench.

11. Transfer of parts at bench includes clock, 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.

G SERIES

1. Disconnect battery.

2. Remove lower air conditioning ducts if so equipped.

3. Separate bulkhead connector and disconnect necessary wires at horn relay.

4. Remove plastic toe plate at steering column and remove two fuse block screws.

5. Remove left air outlet nozzle and air conditioning duct extension.

6. Disconnect the following - dimmer switch, park brake switch, stop lamp switch, neutral safety switch, transmission downshift switch, left door jamb switch,

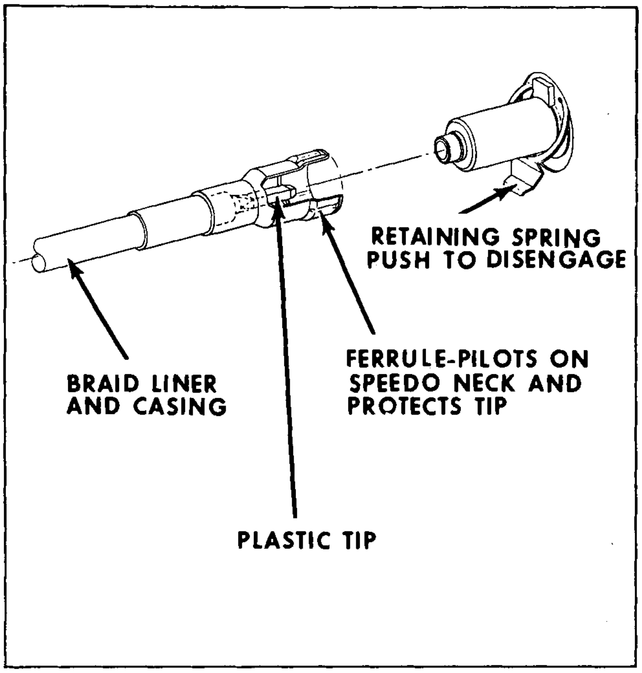


Fig. 12-88 Speedometer Cable Attachment at Cluster

turn signal, body harness and all accessory connectors.

7. Remove lower instrument panel trim at steering column.

8. Remove two bolts from lower instrument panel at steering column.

9. Lower steering column, position on seat and disconnect ignition switch connector.

10. Remove left pillar post molding and two instrument panel retaining bolts at left end.

11. Remove right pillar post molding, right air outlet nozzle and two instrument panel retaining bolts at right end.

12. Remove plastic filler panel at windshield.

13. Disconnect right door jamb switch.

14. Remove defroster duct retaining screw at heater case.

15. Disconnect temperature control cable at heater case and radio antenna lead-in at radio.

16. Remove two lower instrument panel retaining screws at console and disconnect console wiring harness.

17. Remove two upper center instrument panel retaining bolts and position complete instrument panel assembly rearward onto steering column.

18. Disconnect speedometer cable, air conditioning vacuum hoses and any remaining connectors.

19. Remove complete assembly from car.

20. Transfer of parts on bench includes defroster and air conditioning duct extensions and outlets, instrument panel wire harness, radio and speaker, heater or air conditioning control panel, switches, cluster, clock and miscellaneous trim and retention parts.

21. To replace instrument panel pad, reverse removal procedure.

F SERIES

1. Disconnect battery and separate bulkhead from fuseblock.

2. Remove upper and lower left IP trim plates and lower A/C duct extensions if so equipped.

3. Remove left garnish molding, left lower IP brace (under steering column) and toe plate.

4. Remove left IP pad bolts (1 lower and 3 upper) and fuseblock screws.

5. Disconnect body connectors, dimmer, brake, and left door jamb switches and speedo cable.

6. Lower steering column and disconnect ignition, neutralizer, turn signal and back-up switches.

7. Remove glove box and door, right garnish molding and right lower A/C duct at case if so equipped.

8. Remove right lower IP bolt, upper IP nuts and disconnect right door jamb switch connector, temperature cable and miscellaneous connectors.

9. With rag on column, position complete pad rearward on column and disconnect any miscellaneous connectors remaining.

Remove complete pad with components from car, transfer following parts at bench:

10. Remove all upper A/C ducts and nozzles.

11. Remove complete wire harness.

12. Remove speedo cluster, windshield wiper and headlamp switches, rally gage unit if so equipped.

13. Remove heater or A/C control panel, cigar lighter and accessory plate, ash tray and bracket.

14. Remove glove box latch, radio and brake release lever.

15. To replace, reverse removal procedure.

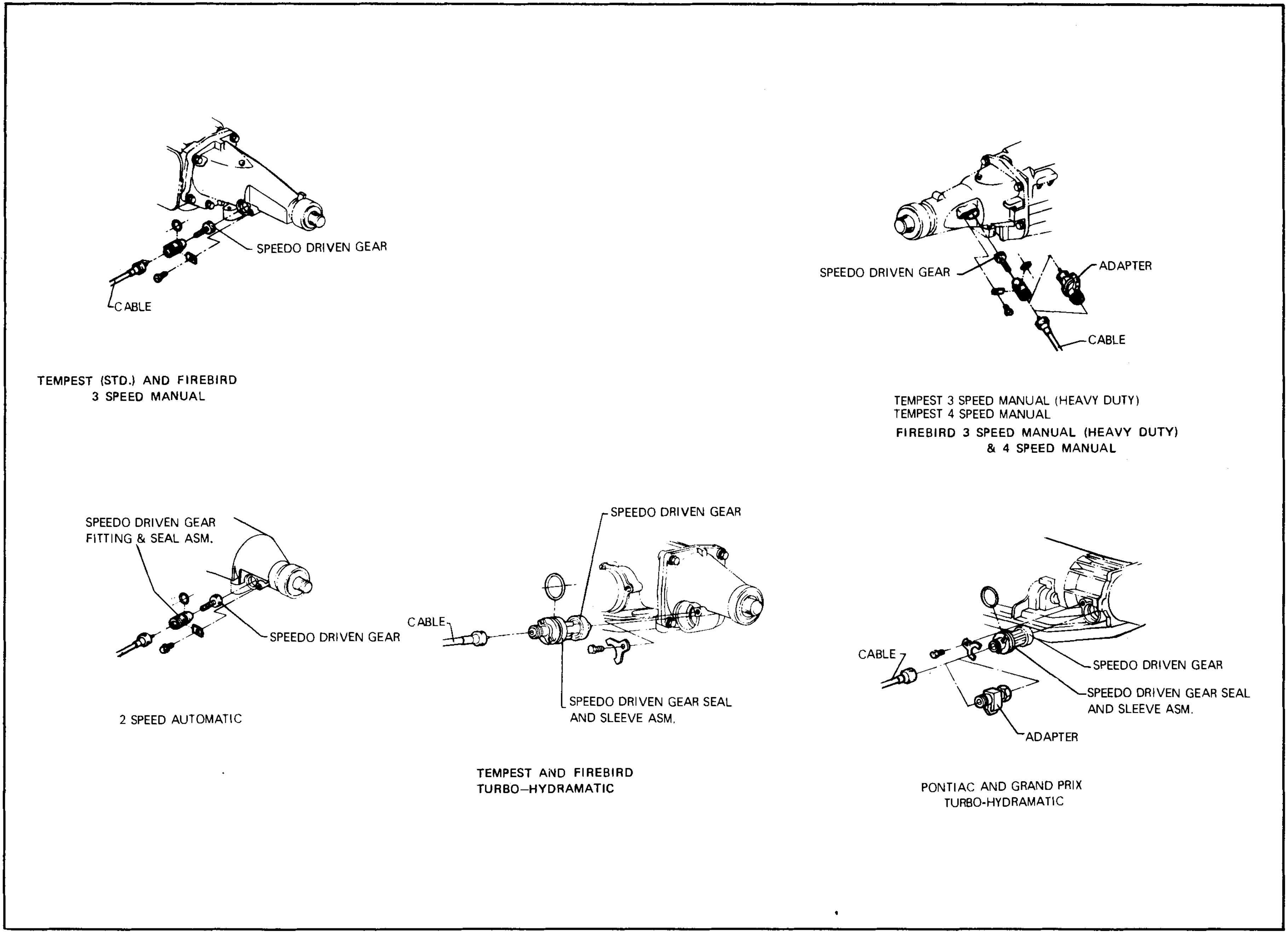


Fig. 12-89 Speedometer Cable Attachment at Transmission

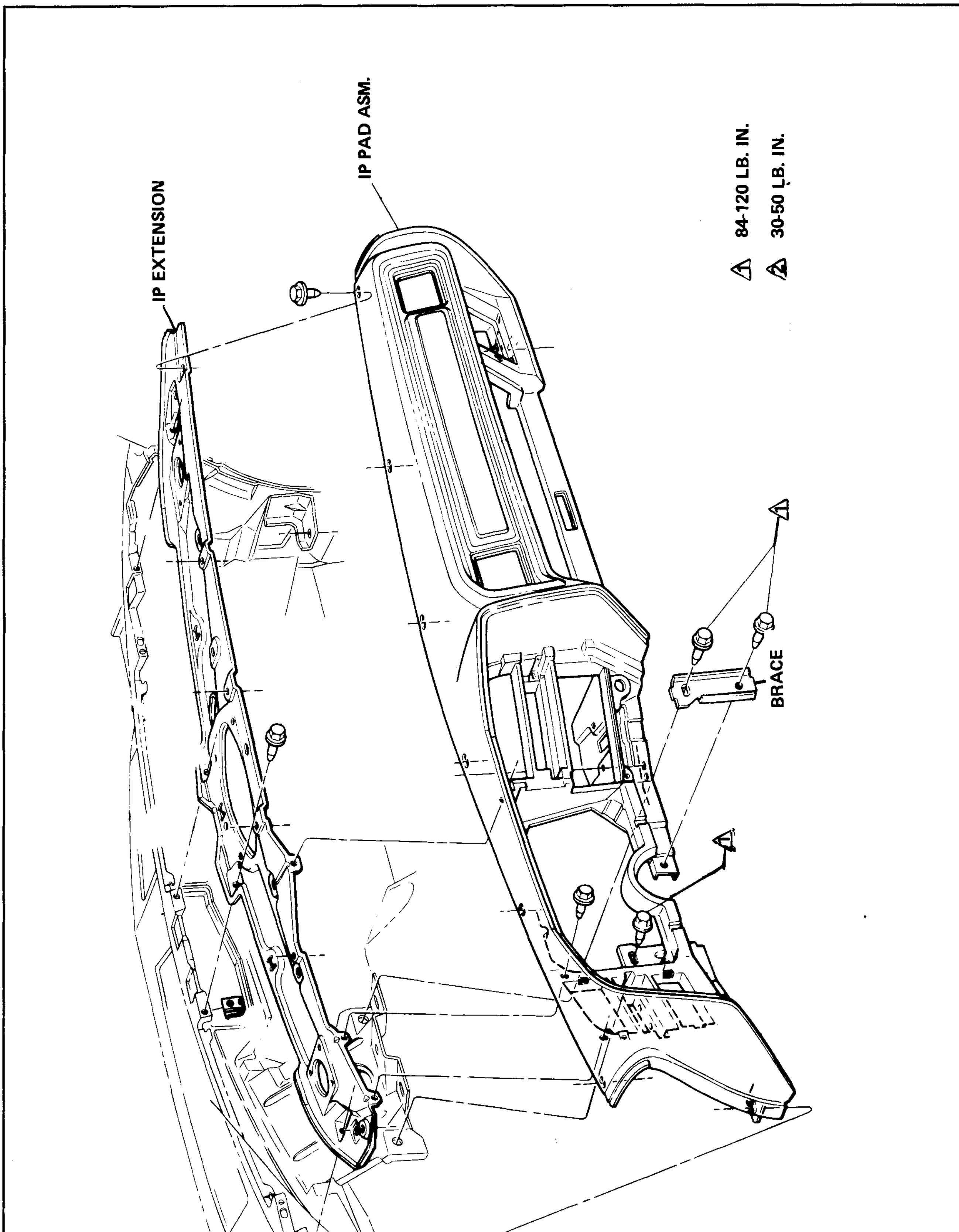


Fig. 12-90 B Series Instrument Panel Pad Installation

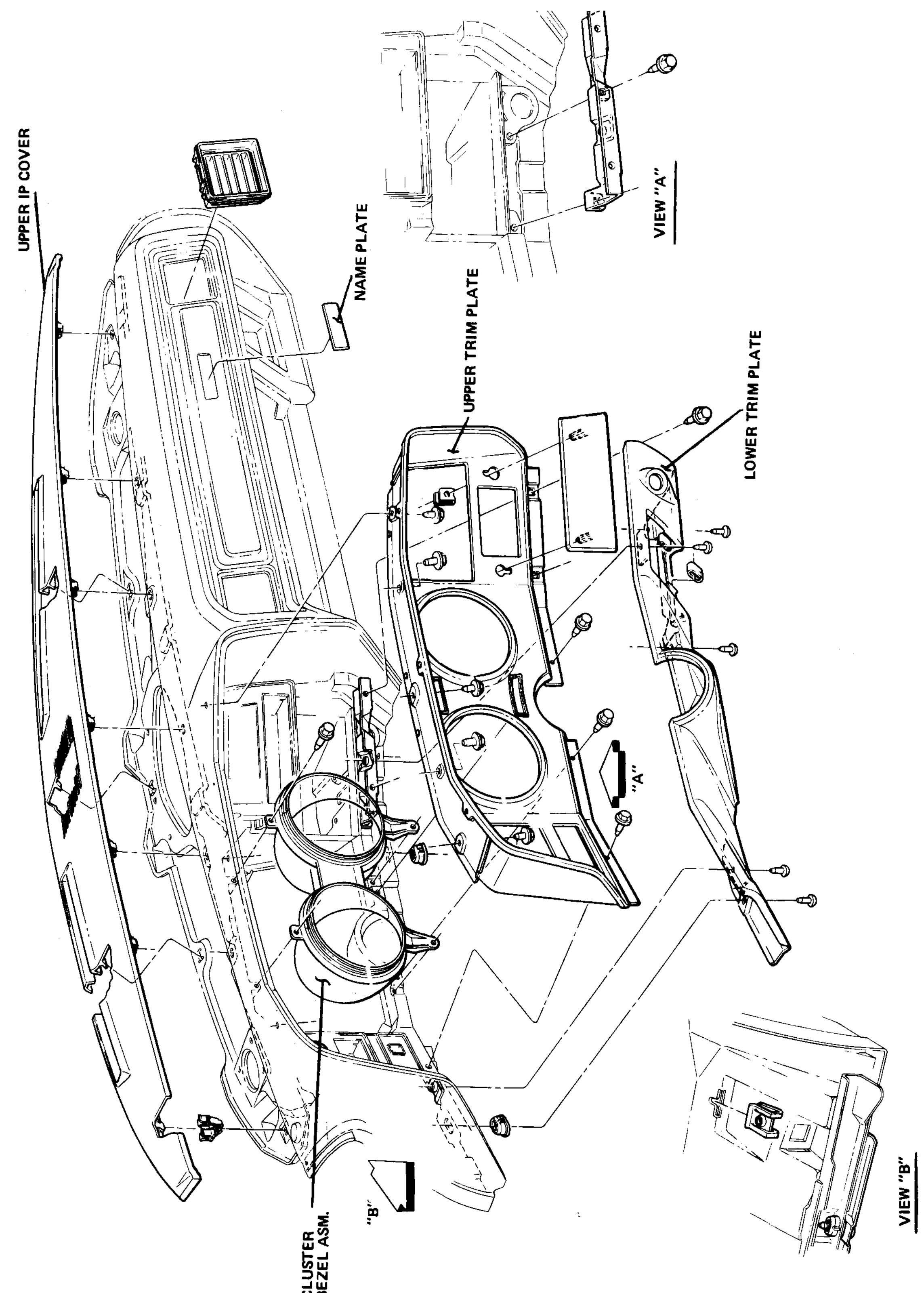


Fig. 12-91 B Series Instrument Panel Pad Attaching Parts

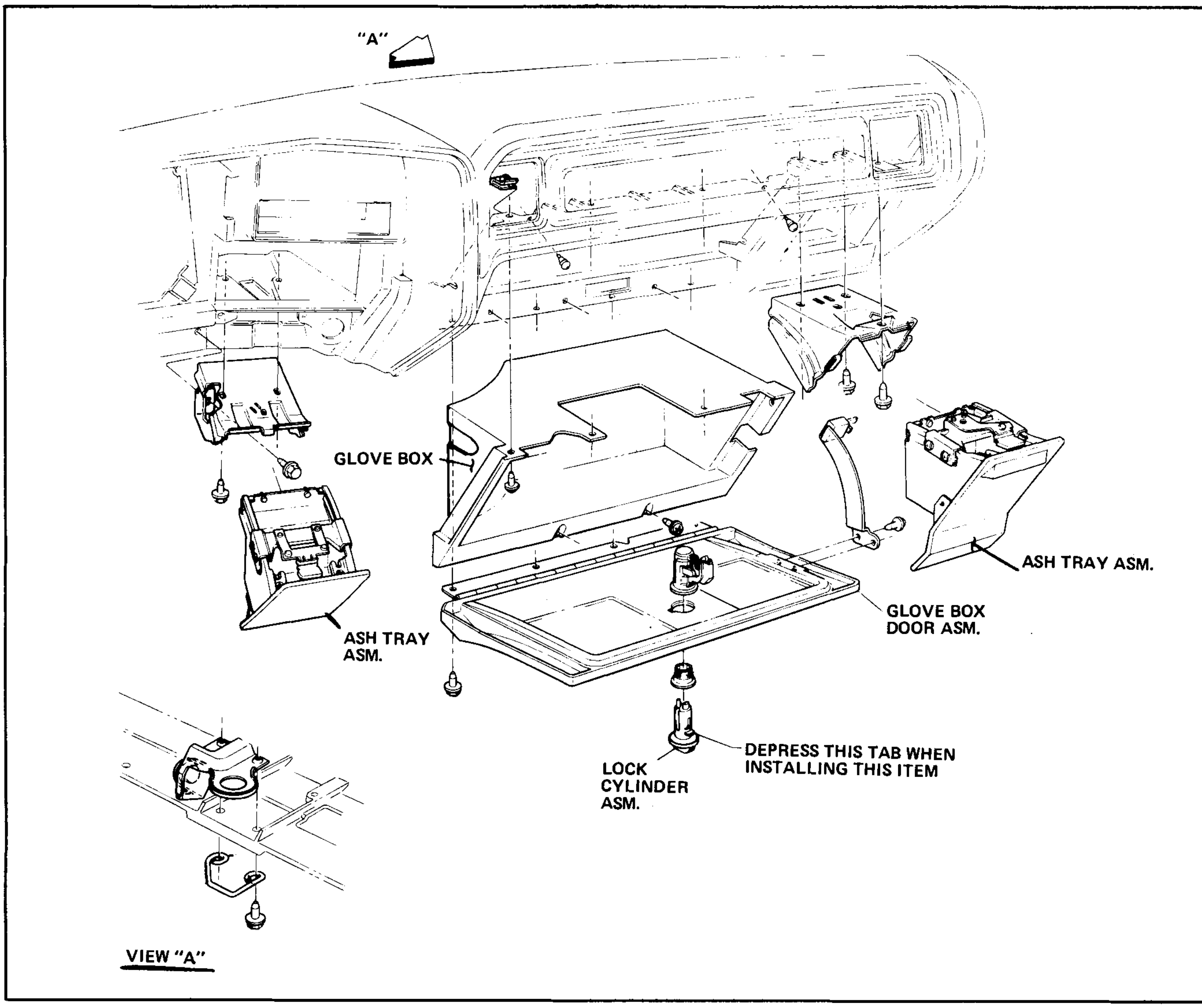


Fig. 12-92 B Series Instrument Panel Pad Attaching Parts

X SERIES

1. Disconnect battery and remove glove box.

2. On A/C equipped cars, remove upper A/C extension and lower A/C outlet at center of IP. Remove upper center outlet nozzle, adapter and flex hose to right side outlet.

3. Remove four (4) IP pad nuts above glove box and ash tray, remove right side pad screw near pillar post.

4. Remove five (5) upper carrier screws and left side carrier screw near left pillar post.

5. Remove steering column cover, disconnect shift quadrant indicator cable at shift bowl (if automatic transmission).

6. Remove two (2) steering column nuts at IP, remove four (4) lower carrier screws.

7. Remove radio knobs, bezels and nuts, remove two (2) lower heater or A/C control screws.

8. Remove toe plate cover and five (5) toe plate to cowl screws, lower steering column.

9. Disconnect speedo cable, protect column with shop towel or tape, tilt carrier assembly rearward and rest on column.

10. Remove upper left hand IP pad screw and nut, remove IP pad from car. Transfer clips and name-plate to replacement pad.

11. To replace, reverse removal procedure.

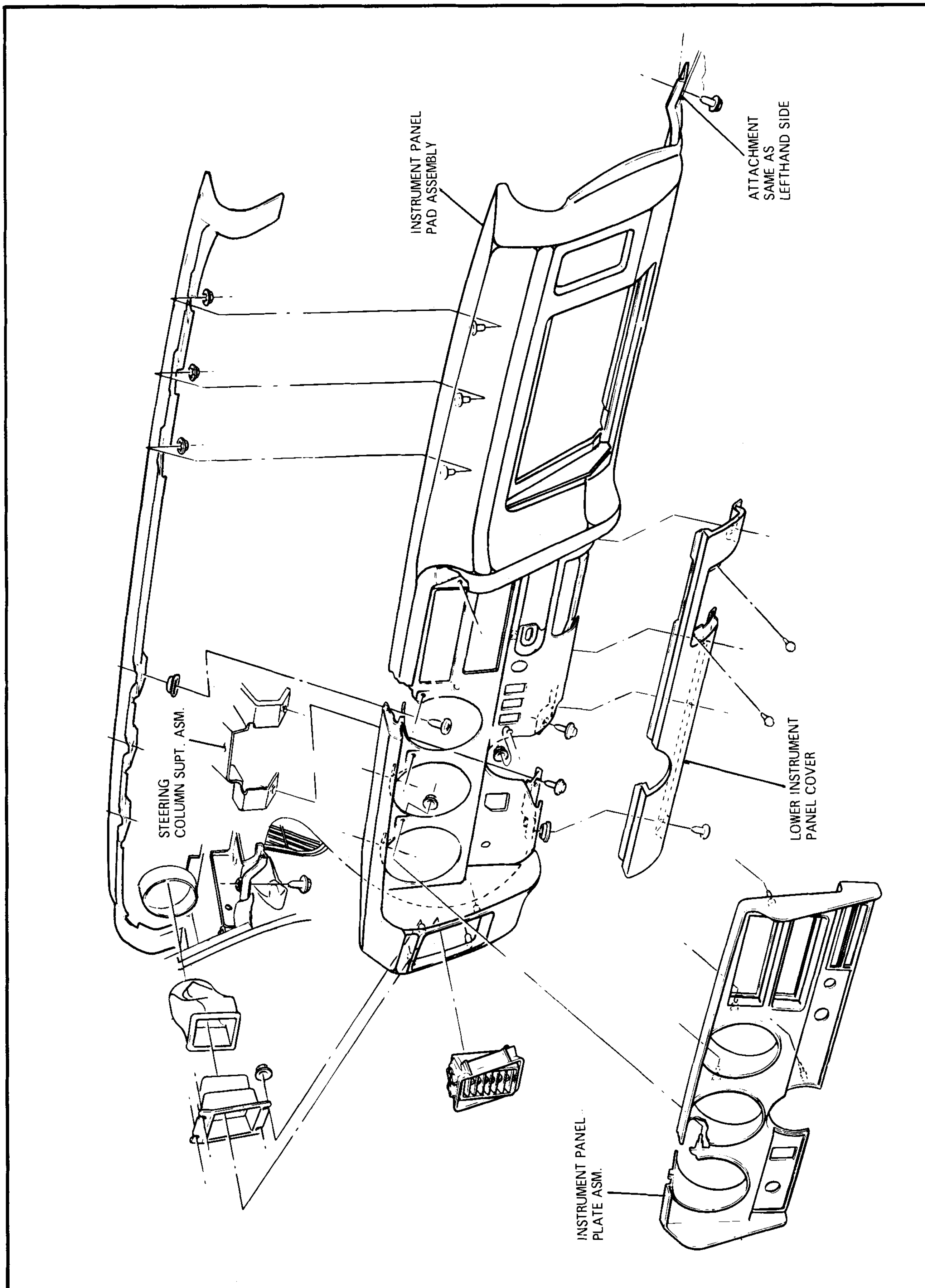


Fig. 12-93 A Series Instrument Panel Pad Installation

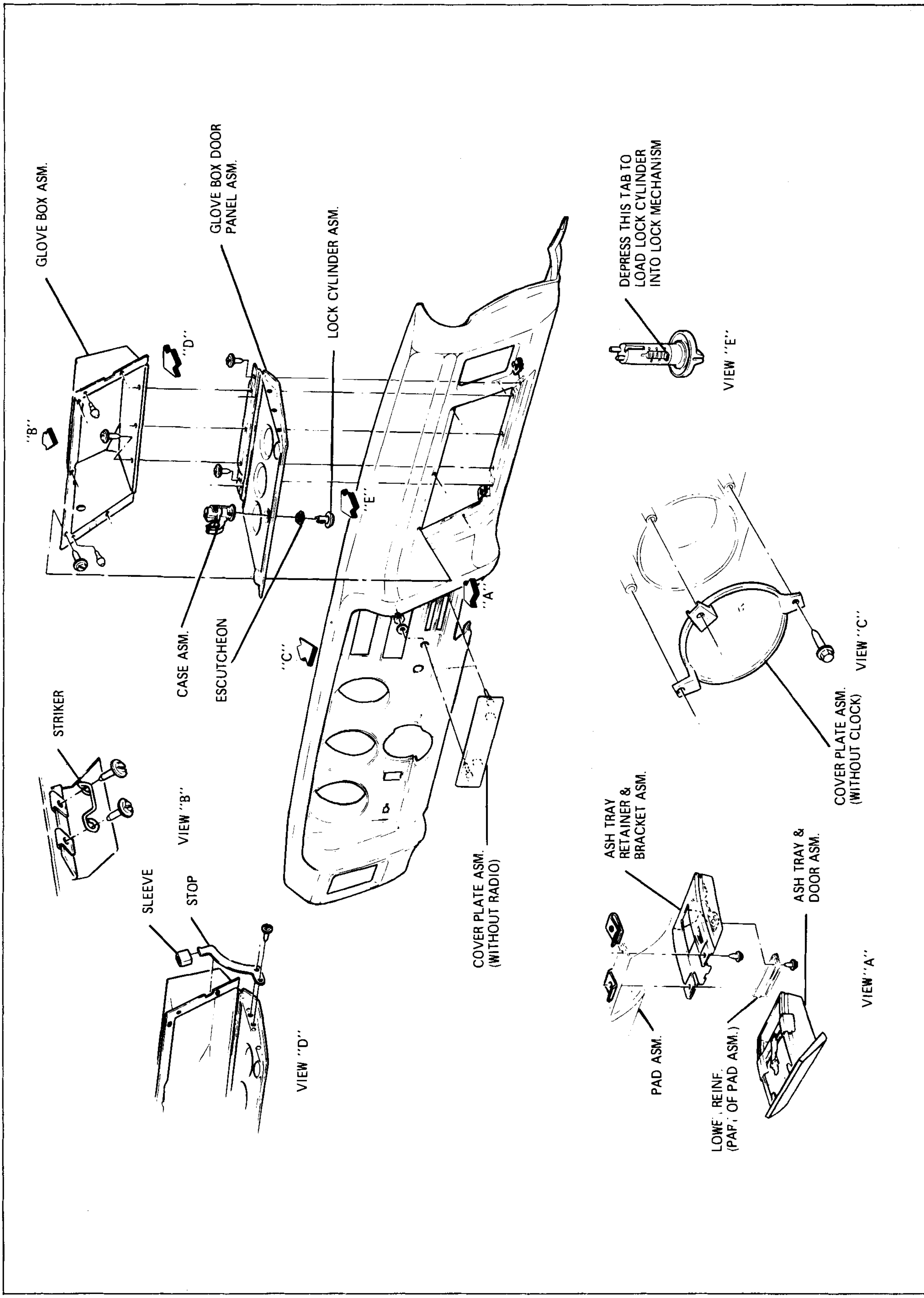


Fig. 12-94 A Series Instrument Panel Pad Attaching Parts

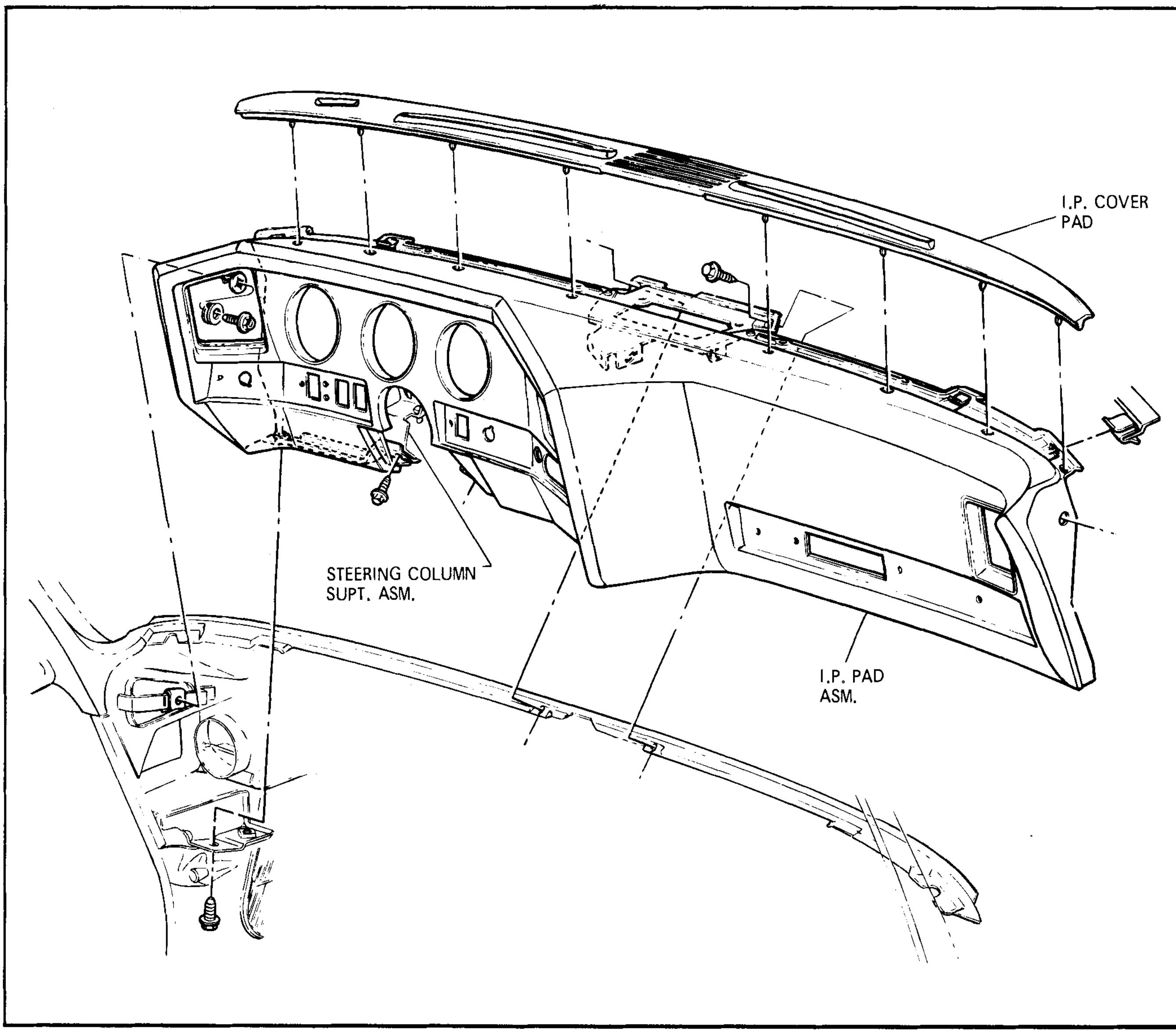


Fig. 12-95 G Series Instrument Panel Pad Installation

NOTE: *Refer to Section 9 - "Steering Column - Reinstall" for proper alignment of column.*

FUEL GAGE

NOTE: *Tool J 22646, Carburetor Adjusting Tool, is handy for removing nuts and screws from back of cluster.*

REMOVE AND REPLACE

B SERIES

1. Remove speedo cluster and printed circuit as previously described under B Series.
2. Remove fuel gage nuts and gage.
3. To replace, reverse removal procedure.

A SERIES

1. Disconnect battery and remove lower air conditioning duct if equipped.
2. Remove bulb socket(s).
3. Remove gage terminal nuts and attaching screws.
4. Gently lift end of printed circuit and remove gage.
5. To replace, reverse removal procedure.

G SERIES

1. Disconnect battery and lower A/C duct if equipped.

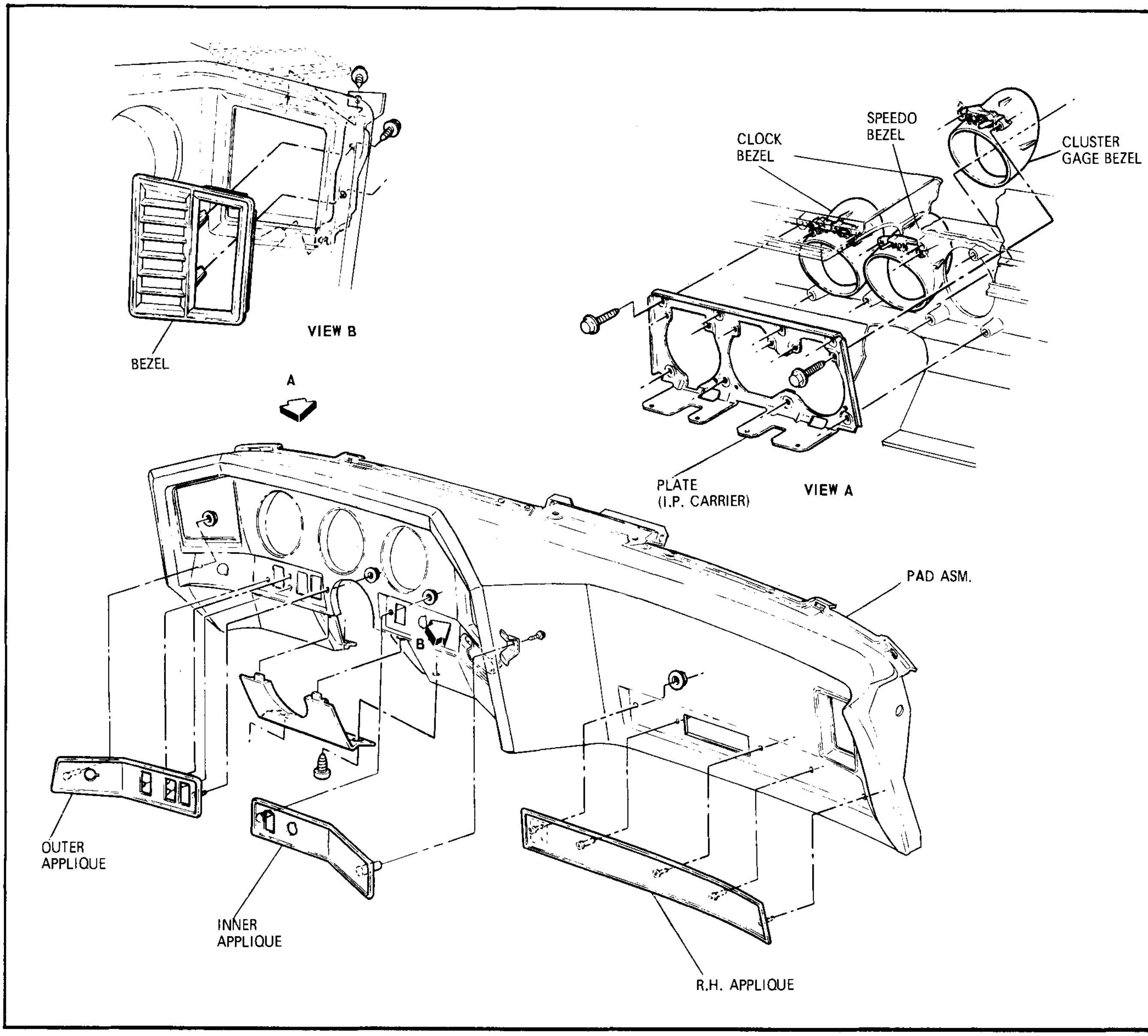


Fig. 12-96 G Series Instrument Panel Pad Attaching Parts

2. Remove pillar post moldings and filler plate at windshield.
3. Remove lower instrument panel trim at steering column.
4. Disconnect speedometer cable.
5. Lower steering column.
6. Remove upper air outlet vents and instrument panel attaching screws at steering column, console, ends and upper center.
7. Remove lower defroster duct screw.
8. Position crash pad rearward on steering column.
9. Remove instrument panel bulbs at left end.
10. Remove gage terminal nuts and fuel gage attaching screws.
11. Lift end of printed circuit carefully and remove gage.
12. To replace, reverse removal procedure.

F SERIES - STANDARD CLUSTER

1. Remove speedo cluster and printed circuit as previously described under F Series.
2. Remove fuel gage nuts and gage.

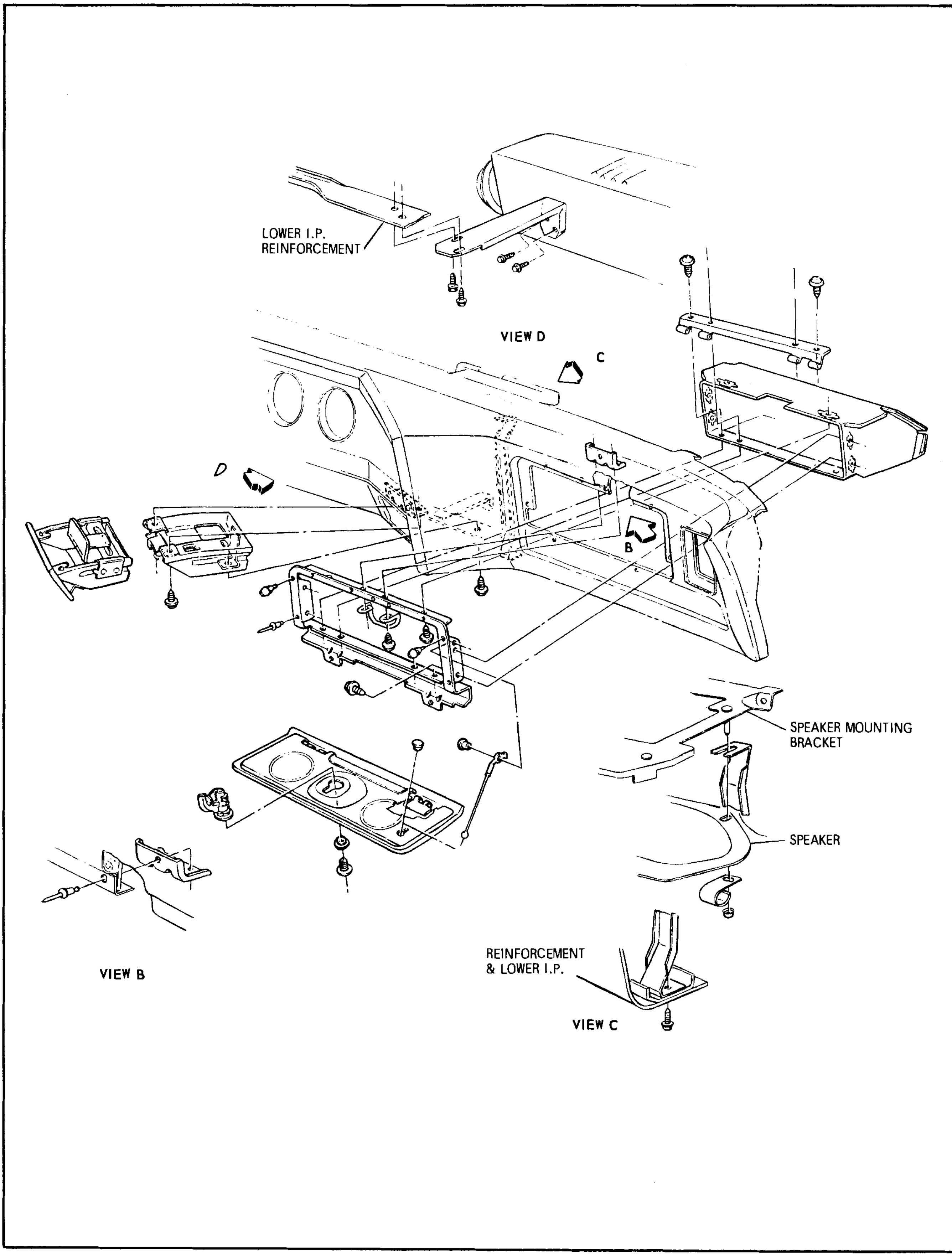


Fig. 12-97 G Series Glove Box and Ash Tray with Bench Seat

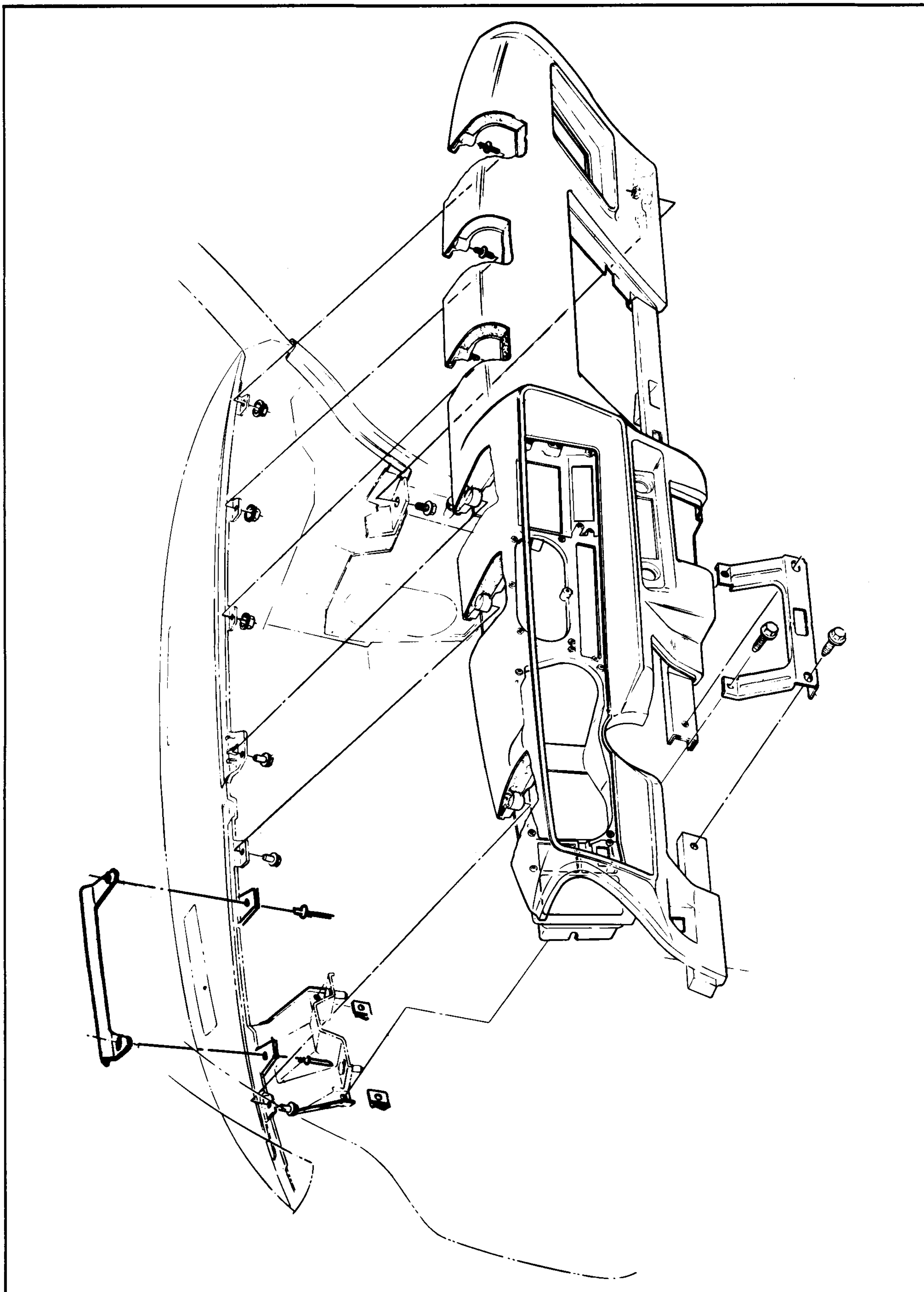


Fig. 12-98 F Series Instrument Panel Pad Installation

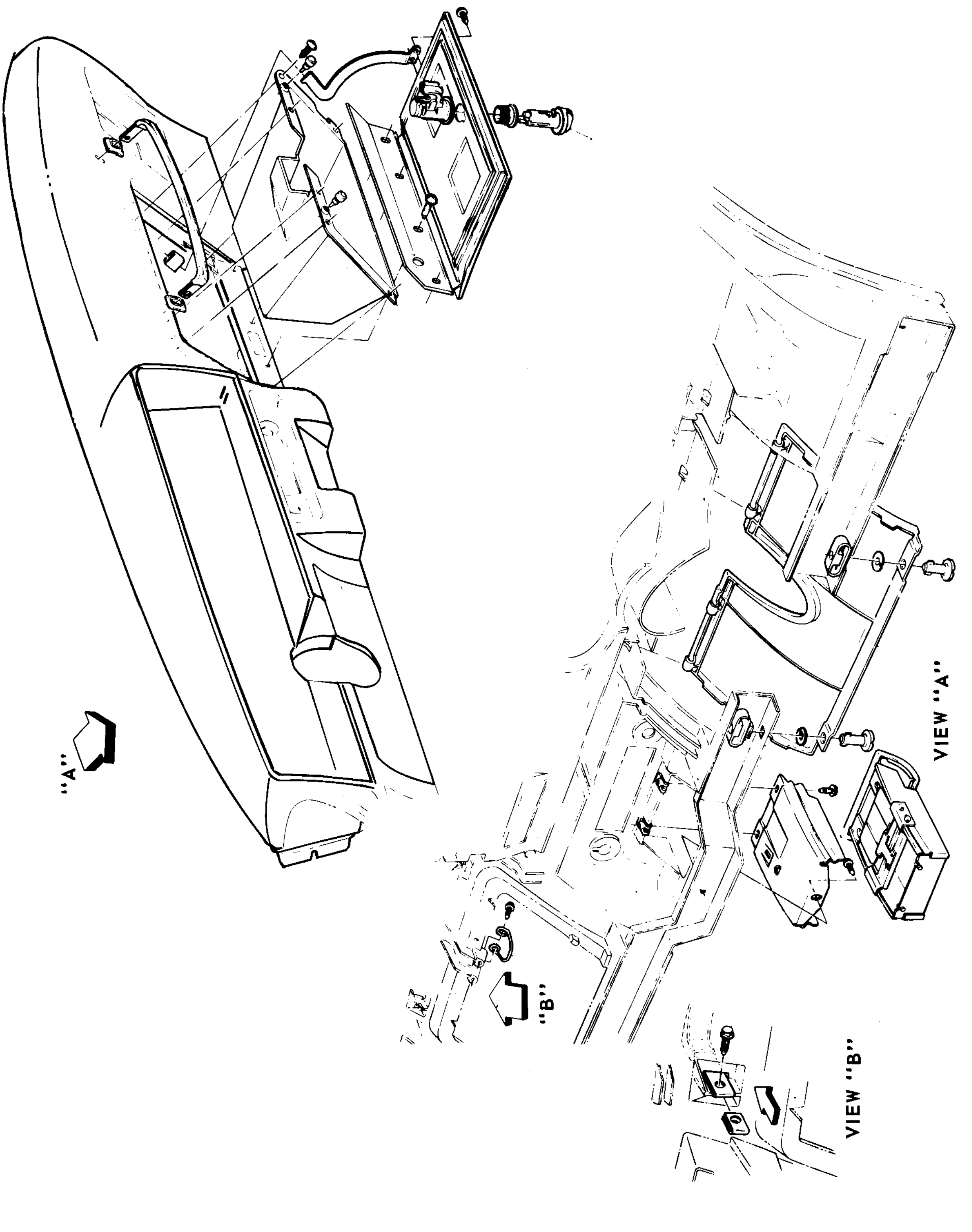


Fig. 12-99 F Series Instrument Panel Pad Attaching Parts

3. To replace, reverse removal procedure.

F SERIES - RALLY GAGE CLUSTER

1. Disconnect battery and remove lower and upper IP trimplates.
2. Remove rally gage unit rearward and disconnect leads.
3. Remove fuel gage from unit.
4. To replace, reverse removal procedure.

X SERIES

1. Disconnect battery.
2. On A/C equipped cars, remove left A/C duct attachment screw above kick pad. Push duct toward front of car.
3. From under dash, twist and remove bulb sockets from left side of cluster, disconnect cluster ground connector.
4. Remove fuel gage terminal nuts from printed circuit and "fold" printed circuit away from gage.
5. Remove gage attachment screws and remove gage from rear of cluster.
6. To replace, reverse removal procedure.

WINDSHIELD WIPER SWITCH

REMOVE AND REPLACE

B SERIES

1. Disconnect battery and remove upper and lower IP trimplates.
2. Remove speedometer bezel and cluster.
3. Disconnect headlamp, windshield wiper and accessory switch connectors.
4. Remove left IP bezel assembly screws, pull rearward and disconnect vent control cable if equipped.
5. Remove windshield wiper switch from backside of bezel assembly.
6. To replace, reverse removal procedure.

A, G AND F SERIES

1. Disconnect battery and remove lower A/C duct if equipped (except F Series).
2. Remove upper and lower IP trimplates (F Series only).
3. Disconnect wire connector.
4. Remove ground strap screw (A and G Series only).
5. Remove switch retaining screws.
6. To replace, reverse removal procedure.

X SERIES (Fig. 12-100)

1. Disconnect battery.
2. From under dash, disconnect connector from switch.
3. Remove three (3) screws retaining switch to lower IP, and remove switch form IP.
4. To replace, reverse removal procedure.

HEADLAMP SWITCH

REMOVE AND REPLACE

1. Disconnect battery.
2. Pull control knob to full "ON" position.
3. From under dash, depress switch shaft retainer and remove knob and shaft from switch.
4. Disconnect connector from the switch, remove ferrule nut and switch from IP.
5. To replace, reverse removal procedure.

CIGAR LIGHTER

REMOVE AND REPLACE

1. Remove lighter.
2. Remove upper IP trim plate and accessory switch bracket (F Series only) or lower IP trim plate (B Series only). Remove ash tray and retainer (X Series).
3. Remove bezel and case by unscrewing.
4. Remove wire connector.
5. To replace, reverse removal procedure.

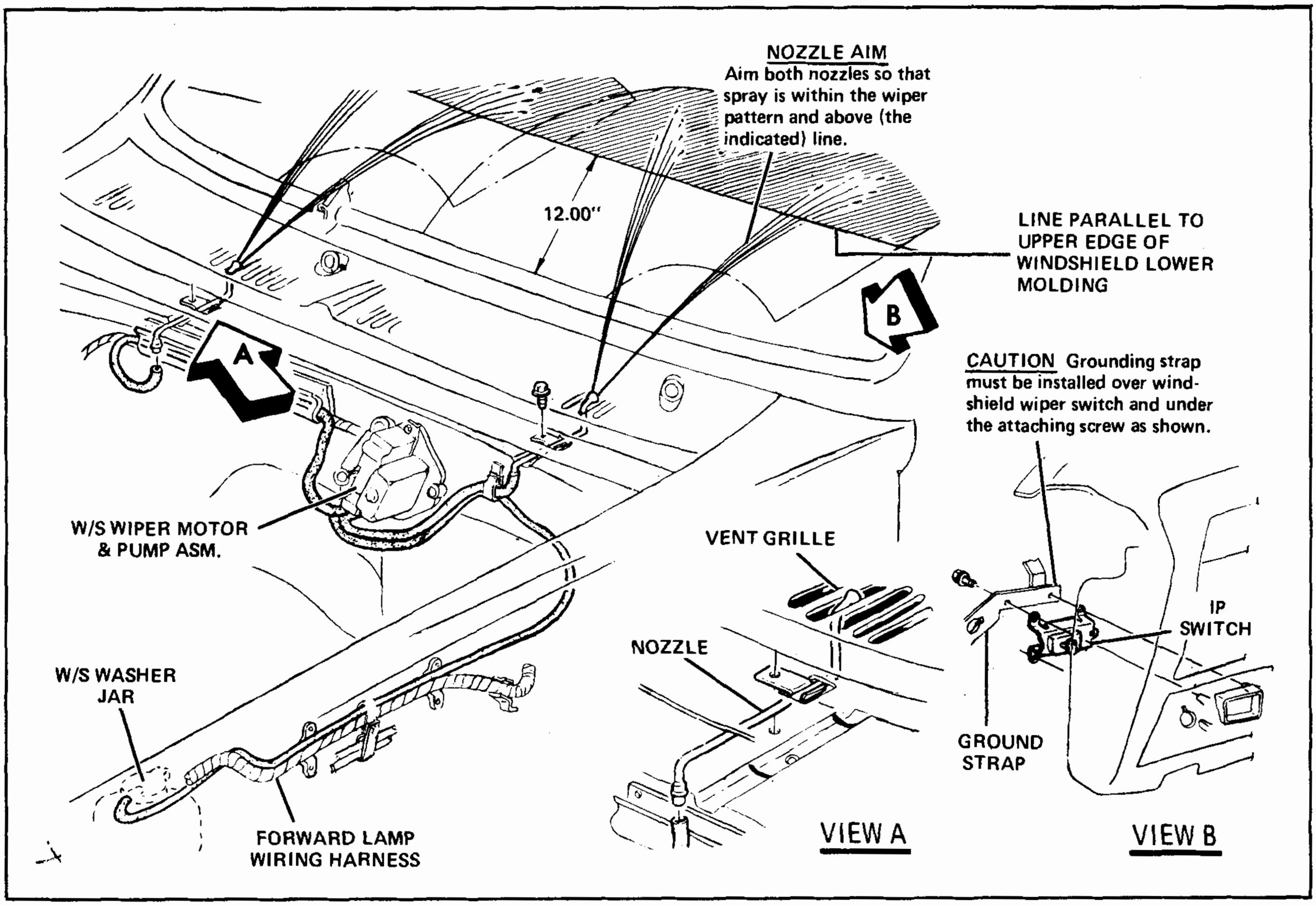


Fig. 12-100 X Series Windshield Wiper Switch and Washer Nozzle Pattern

IGNITION SWITCH

REMOVE AND REPLACE

1. Disconnect battery.
2. Loosen toe pan screws.
3. Remove column to instrument panel trim plates and attaching nuts.
4. Lower column and disconnect switch wire connectors.
5. Remove switch attaching screws and remove switch.
6. To replace move key lock to LOCK position.
7. Move actuator rod hole in switch to LOCK position (Fig. 12-101 and 102).
8. Install switch with rod in hole.
9. Reverse remaining procedure referring to section 9 for column alignment instructions.

ADJUST - STANDARD STEERING COLUMN

When replacing the ignition switch, place the switch in "off" by following procedure:

1. Position the switch as it is shown in Figure 12-101.
2. Move the slider to the extreme left (toward steering wheel).
3. Move the slider back two positions to the right of the "accessory" position.

Then place the lock in a run position (any position other than "accessory" or "lock") and shift the transmission lever to any position except "park" ("reverse" for manual transmissions), then position the lock toward "accessory" with a very light load.

ADJUST - TILT STEERING COLUMN

1. Turn ignition lock to "accessory" position (full counterclockwise position), leave key in lock (Fig. 12-102).

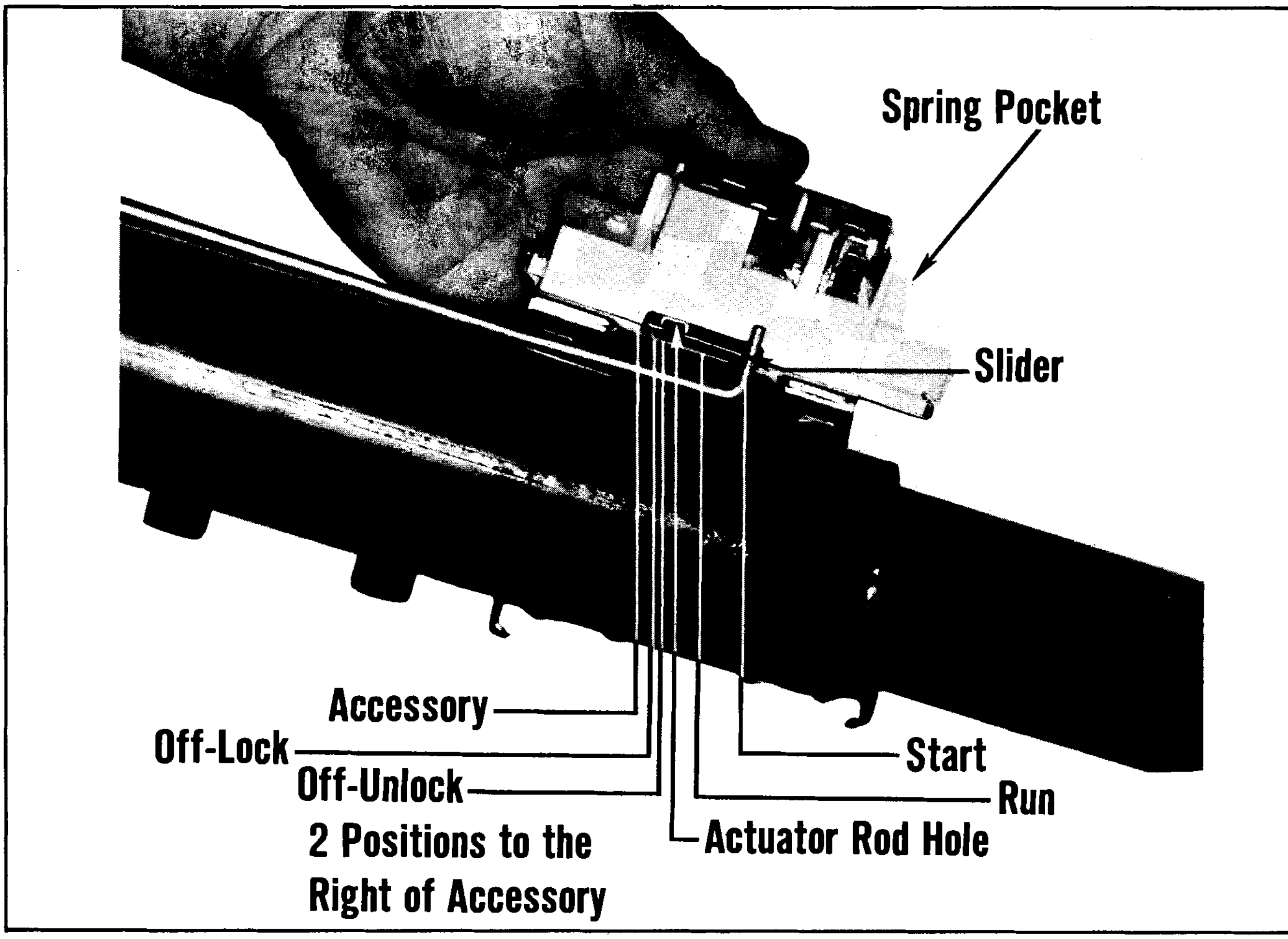


Fig. 12-101 Installing Ignition Switch (Standard Column)

2. Loosen ignition switch mounting screws.

3. Push ignition switch upward toward steering wheel to make certain switch is in "accessory" detent. This position is at full travel of the switch carrier block at the square end of the switch.

4. Hold ignition lock in full counterclockwise "accessory" position and tighten ignition switch mounting screws.

5. Check lock for proper operation:

   a. Ability to operate into "accessory".

   b. Key removal in lock detent.

   c. Travel into "start" position. Approximately one-third of the total travel between "run" and "start" should be available after contact is made to the cranking circuit.

DIMMER SWITCH

REMOVE AND REPLACE

1. Fold back carpet in area of switch.

2. Remove wire connector.

3. Remove screws retaining switch to toe pan.

4. To replace, reverse removal procedure.

BACK UP LAMP AND NEUTRAL START SWITCH

REMOVE AND REPLACE-MANUAL TRANSMISSION

1. Remove wire connector.

2. Remove retaining screws.

3. Remove switch.

4. To replace, position gear selector in reverse, insert switch drive tang in shifter tube slot and assemble switch to steering column jacket.

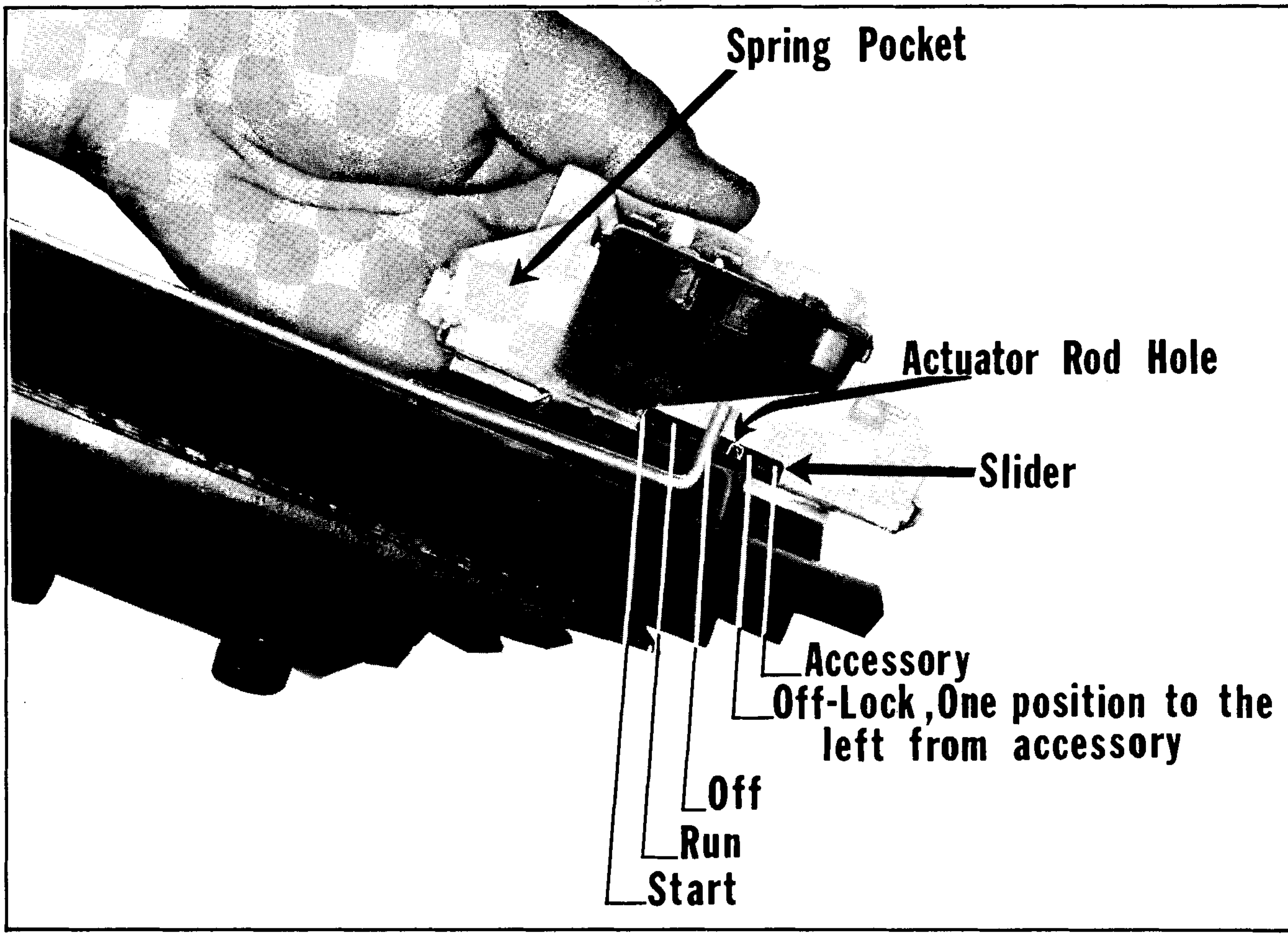


Fig. 12-102 Installing Ignition Switch (Tilt Column)

5. Move gear selector out of reverse position to shear pin.

ADJUST-MANUAL TRANSMISSION

1. Loosen switch retaining screws and move lever to **Reverse** position.
2. Align hole in drive tang with slot in switch and insert a .092 diameter pin.
3. Tighten screws and remove pin.

REMOVE AND REPLACE - AUTOMATIC TRANSMISSION - CONSOLE SHIFT ONLY

1. Remove wire connector.
2. Remove retaining screws.
3. Remove switch.
4. To replace, position shift tube in drive position.
5. Insert switch drive tang in shifter tube slot and assemble switch to steering column jacket with retaining screws and adjust.

ADJUST - AUTOMATIC TRANSMISSION - CONSOLE SHIFT ONLY (FIG. 12-103)

All except X Series

1. Loosen switch retaining screws and move shift tube to **Park** position.
2. Align hole with slot in back of switch and insert a .092" diameter pin.
3. Tighten screws and remove pin.
4. Check starter operation in all ranges.
5. If starter operates in either reverse or drive, repeat steps 1 through 4.

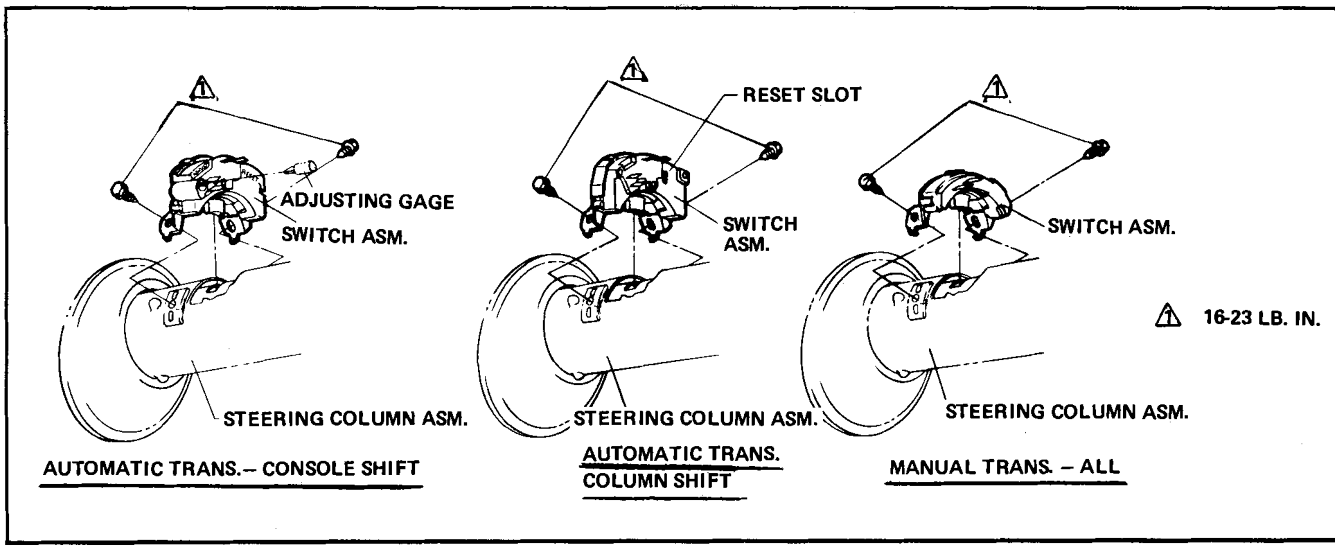


Fig. 12-103 Adjusting Back-up and Neutralizer Switch

X Series

1. Remove console trim plate retaining screws and trim plate.
2. Remove switch retaining nuts and remove switch from the control assembly.
3. To replace, position shift lever in **Drive** position, align hole in contact support with hole in switch and insert a .092" diameter pin to hold support in place.
4. Place the contact support drive slot over the drive tang and tighten switch mounting screws. Remove pin.
5. Reconnect switch connectors and check operation of switch. Replace trim plate assembly.

REMOVE AND REPLACE - AUTOMATIC TRANSMISSION - COLUMN SHIFT ONLY

All except X Series

1. Remove wire connector.
2. Remove retaining screws and switch.
3. To replace, position shift tube in **Neutral** position.
4. Insert switch drive tang in shifter rube slot and assemble switch to steering column jacket.
5. Move gear selector out of neutral position to shear pin.

X Series

1. Disconnect connectors from neutral start switch.
2. Remove switch retaining screws and remove switch.
3. To replace, position shift lever in **Neutral** position and locate lever tang against transmission selector plate.
4. Align slot in contact support with hole in switch and inset a .092" diameter pin to hold support in place. Switch is now in drive position.
5. Place contact support drive slot over shifter tube drive tang and tighten screws. Remove clamp and pin.
6. Reconnect switch connectors and check operation of switch.

ADJUST - AUTOMATIC TRANSMISSION - COLUMN SHIFT ONLY (FIG. 12-87)

1. Loosen switch retaining screws and move shift tube to **Neutral** position.
2. Align hole with slot in back of switch and insert a .092" diameter pin.
3. Tighten screws and remove pin.
4. Check starter operation in all ranges.
5. If starter operates in either reverse or drive, repeat steps 1 through 4.

CLUTCH START SWITCH

REMOVE AND REPLACE

1. Remove wire connector.

2. Remove bracket retaining screw.

3. Remove switch

4. To replace, reverse removal procedure. No adjustment is necessary.

INSTRUMENT PANEL WIRE HARNESS

Instrument panel harness installation is shown in Figs. 12-104 through 12-110.

REMOVE AND REPLACE

All except X Series

1. Disconnect battery.

2. Disconnect bulkhead and fuse block from under dash.

3. Disconnect all harness connectors.

4. **On B and F Series**, remove wire harness clips retaining wire harness.

5. **On A and G Series** it is necessary to disconnect instrument panel pad and position on steering column (see instrument cluster removal) in order to remove harness from protective conduit.

6. To replace, reverse removal procedure.

X Series (Fig. 12-110)

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, 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.

TAIL LAMP HOUSING ASSEMBLY

REMOVE AND REPLACE

B, G and F Series - Fig. 12-111

From inside trunk, remove retaining nuts or screws and remove housing.

A Series (Fig. 12-112)

1. Remove rear valance panel.

2. Disconnect tail lamp bulbs.

3. Remove housing retaining screws.

4. To replace, reverse removal procedure.

X Series

1. On right side, remove jack handle and stand from its mounting position.

2. Twist and remove three (3) bulbs and sockets from housing, remove six (6) housing nuts inside trunk and remove housing assembly from rear end panel.

3. Separate gasket from housing assembly.

4. To replace, reverse removal procedure.

TAIL LAMP LENS

REMOVE AND REPLACE

B, F AND X SERIES

Remove tail lamp housing from inside trunk as previously described and separate lens from housing.

A AND G SERIES

Remove lens retaining screws and lens.

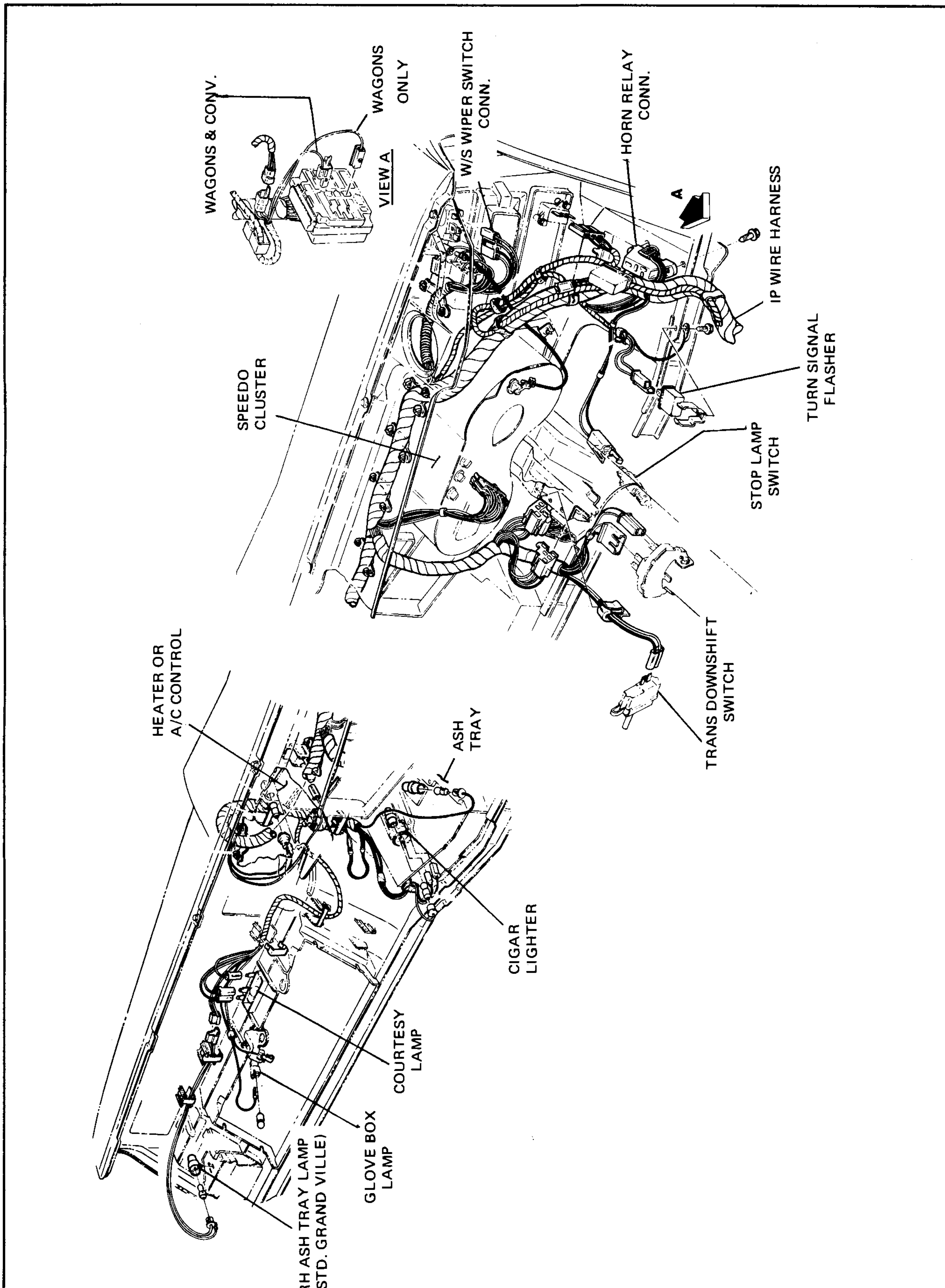


Fig. 12-104 B Series Instrument Panel Wire Harness Installation

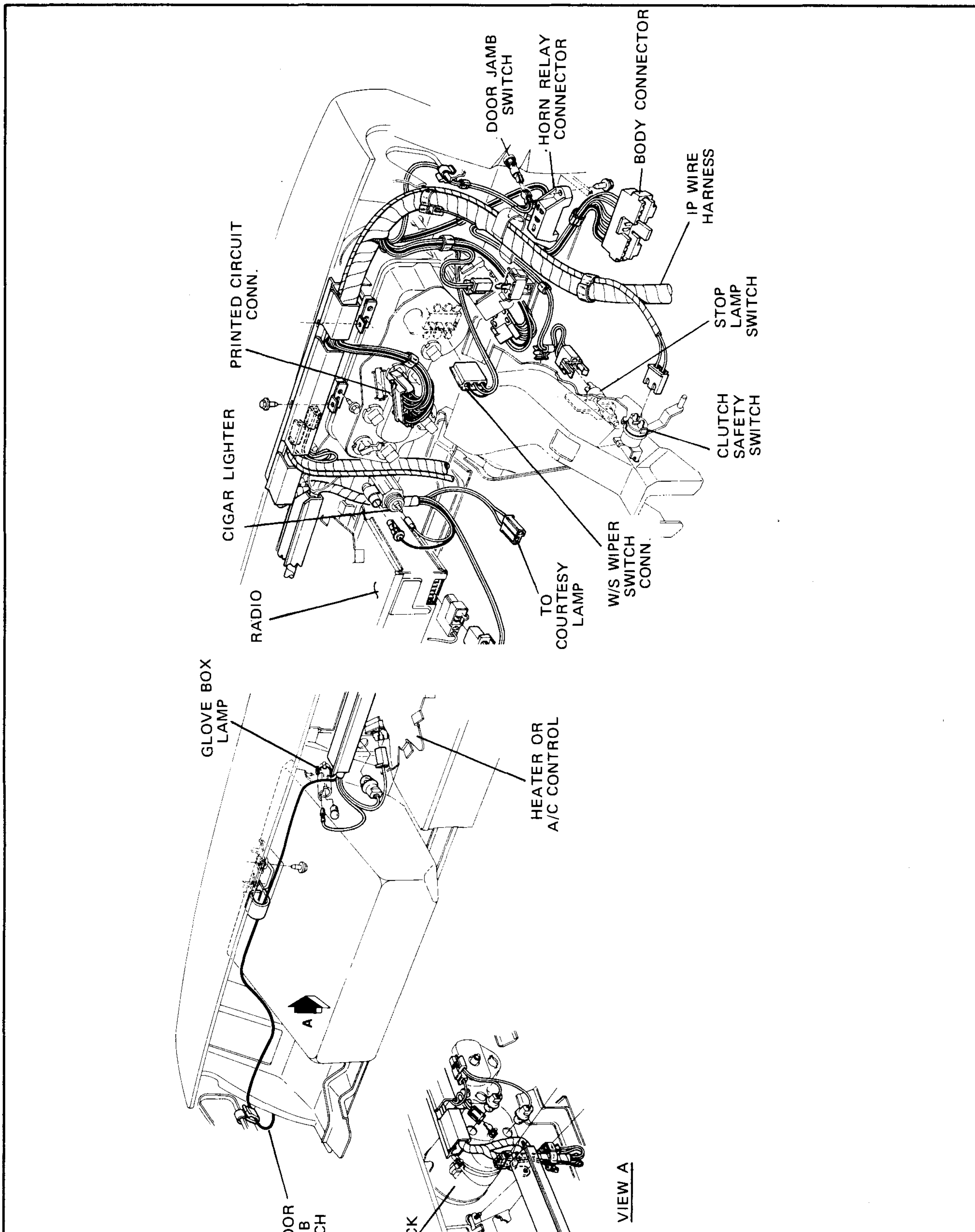


Fig. 12-105 A Series Instrument Panel Wire Harness Installation

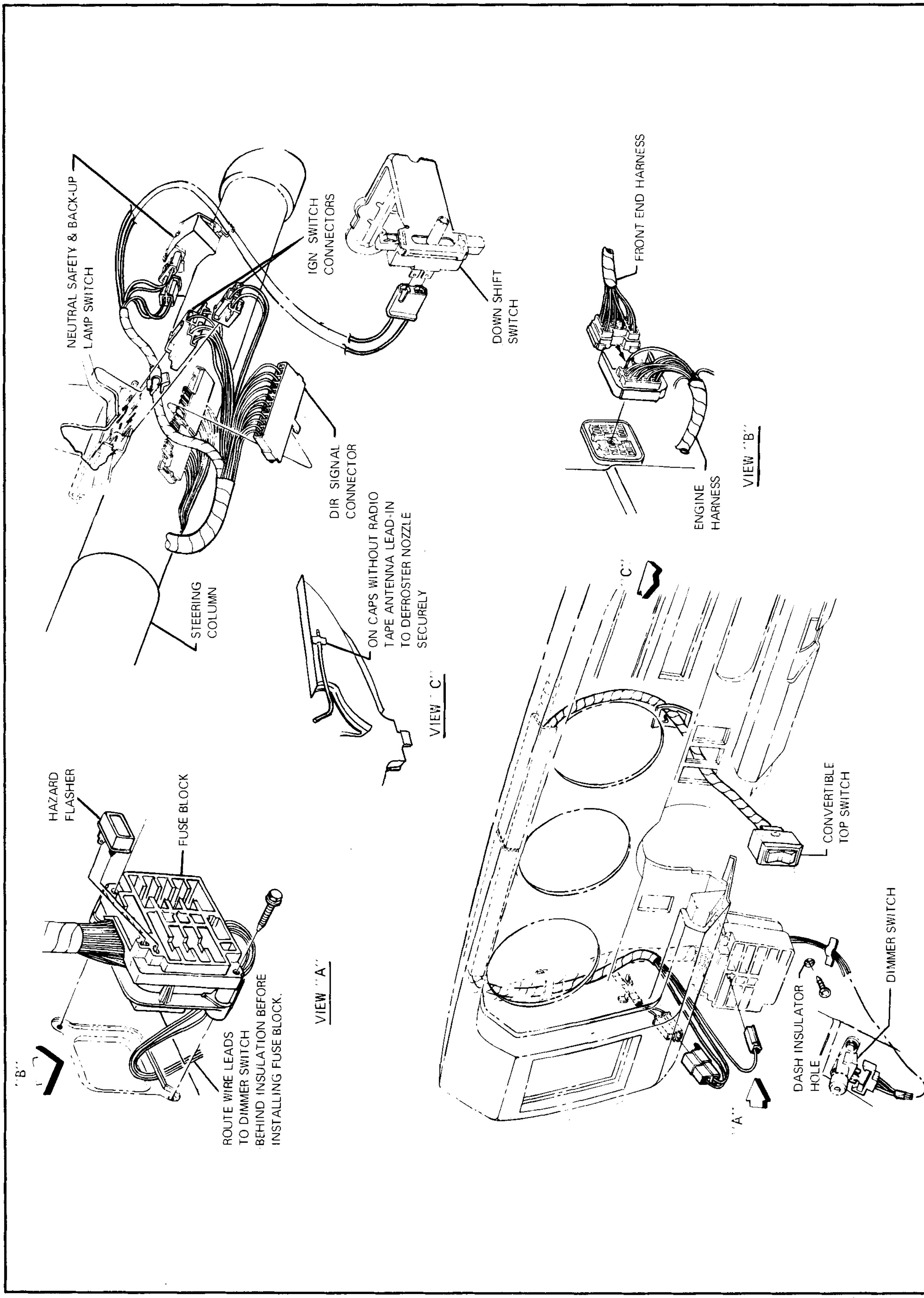


Fig. 12-106 A Series Instrument Panel Wire Harness Connections

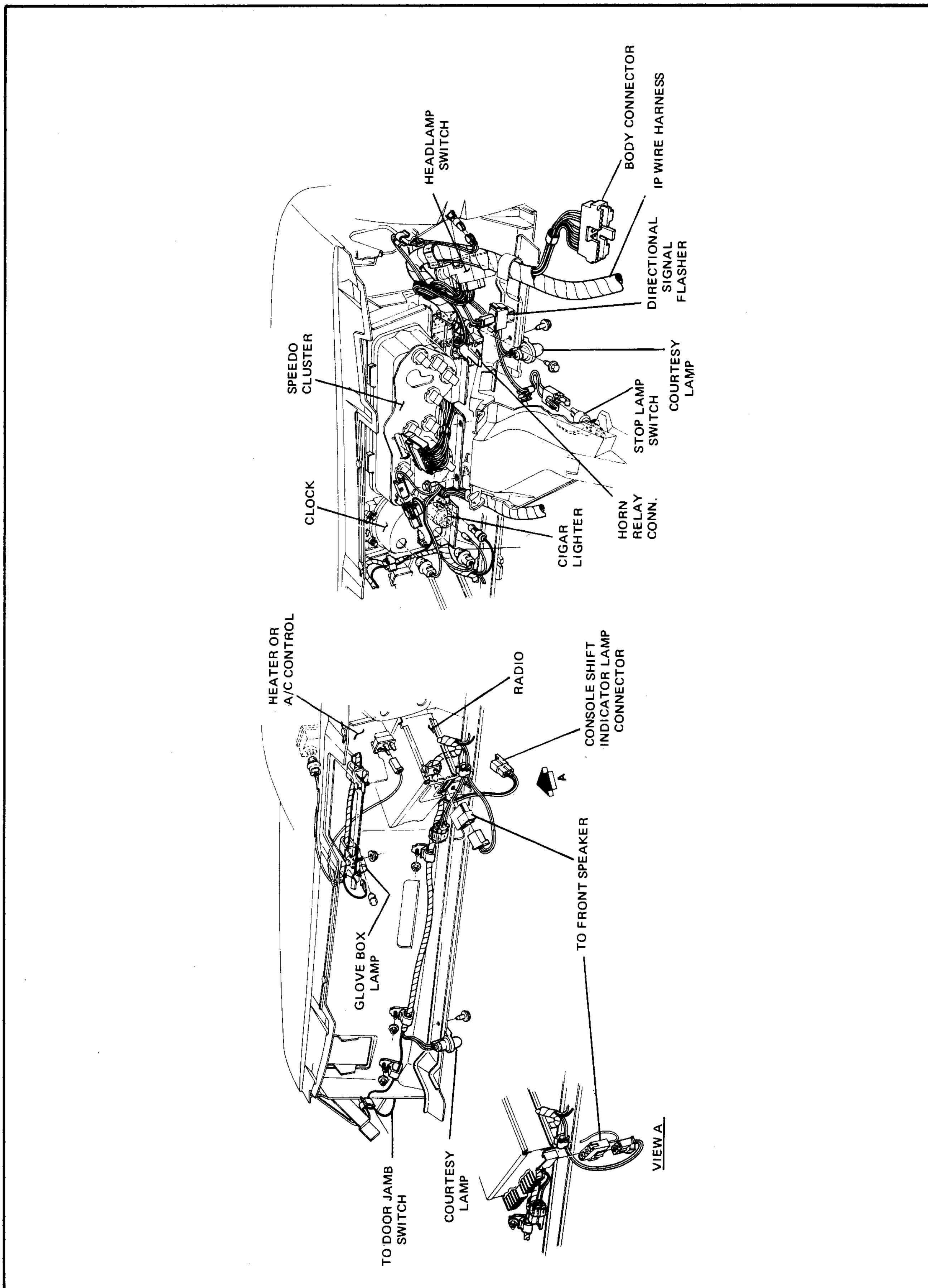


Fig. 12-107 G Series Instrument Panel Wire Harness Installation

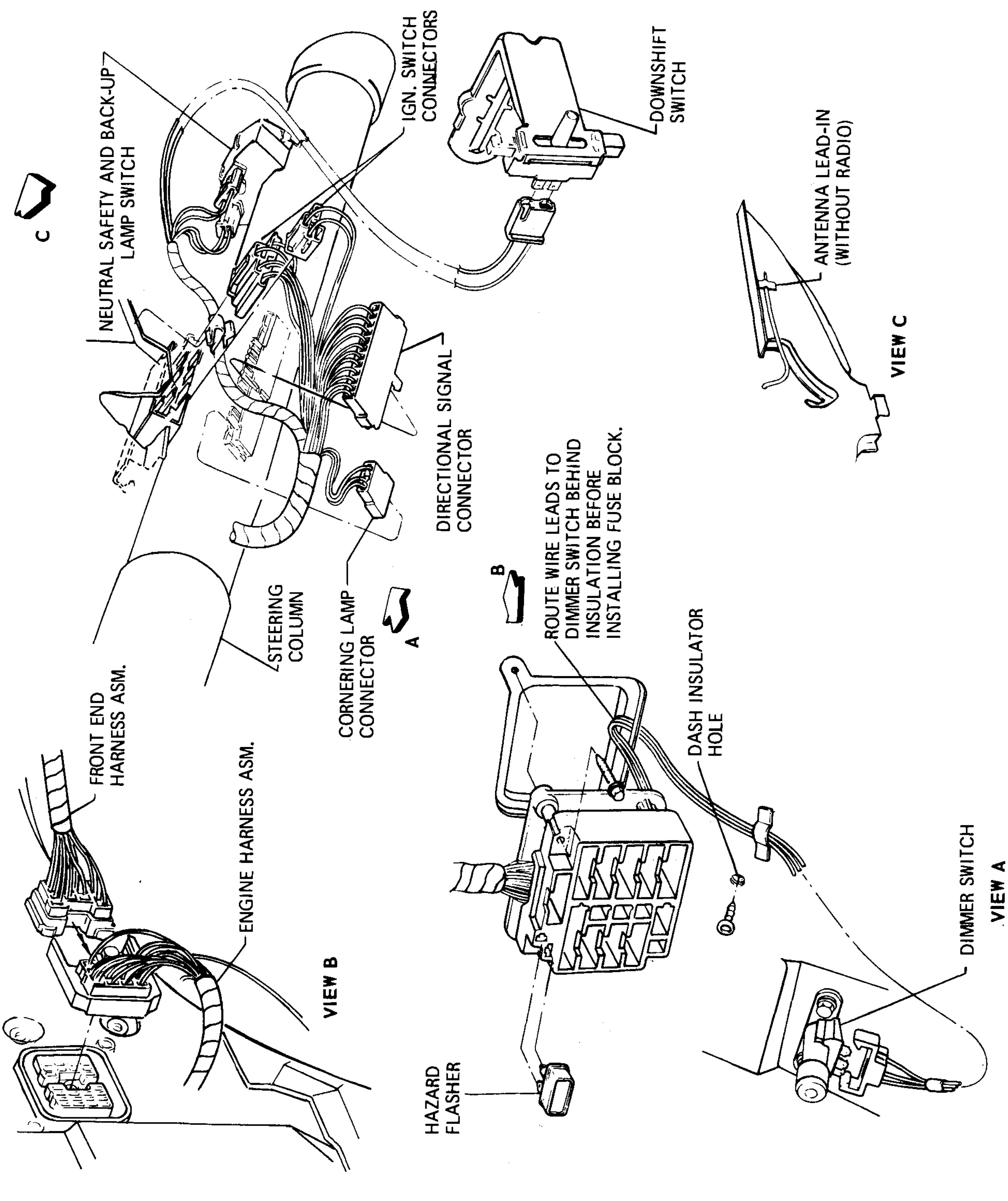


Fig. 12-108 G Series Instrument Panel Wire Harness Connections

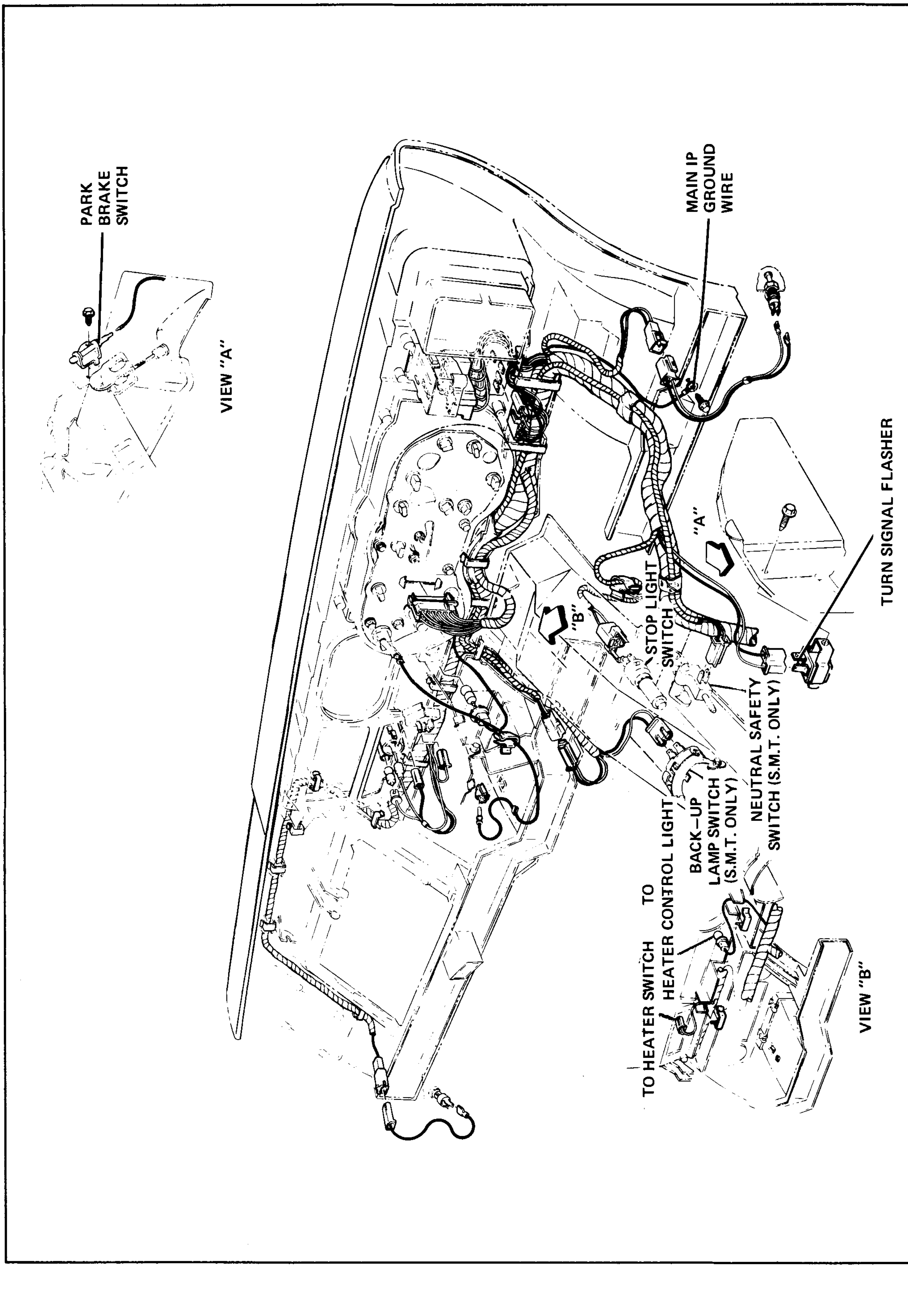


Fig. 12-109 F Series Instrument Panel Wire Harness Installation

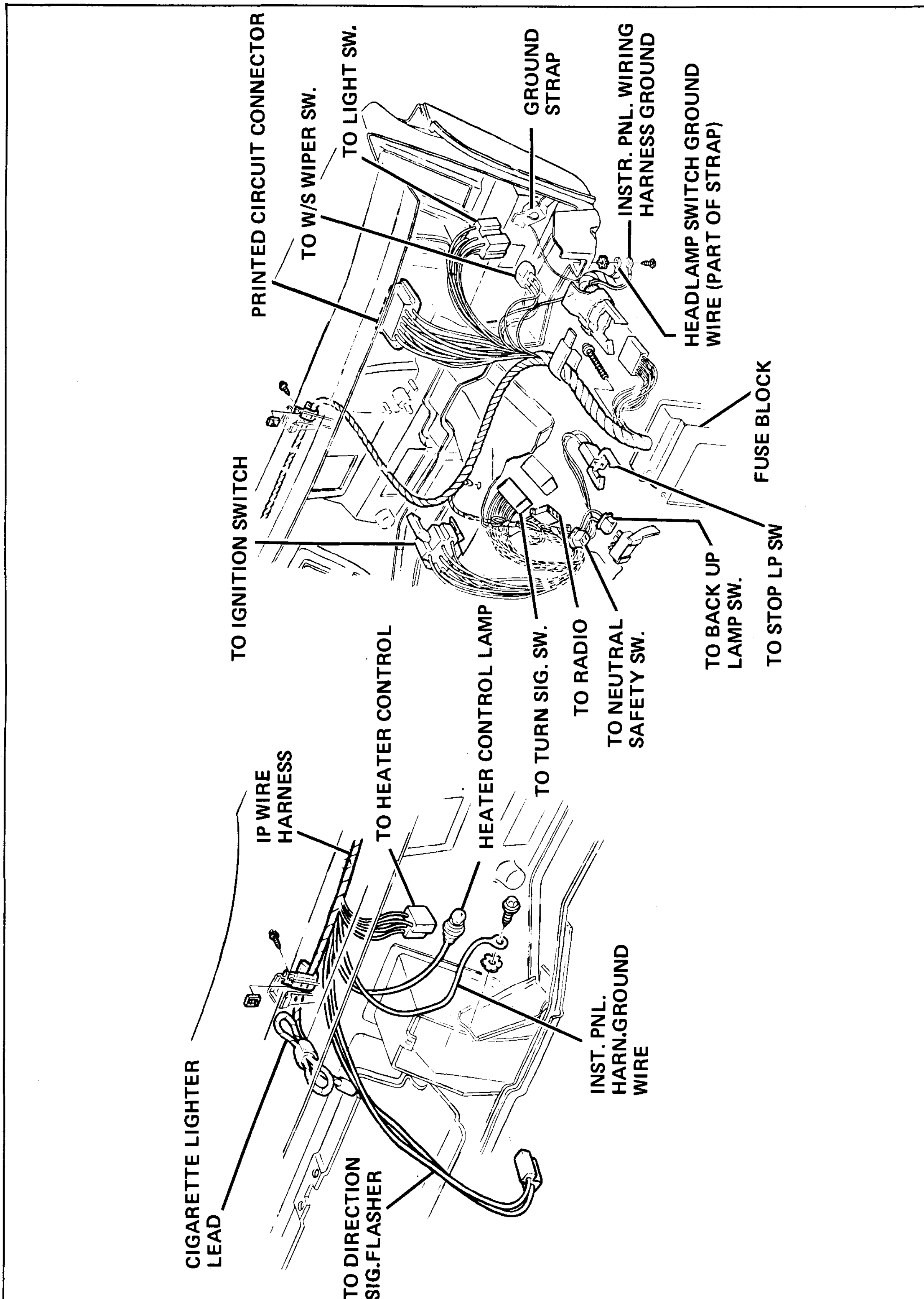


Fig. 12-110 Instrument Panel Wire Harness Installation

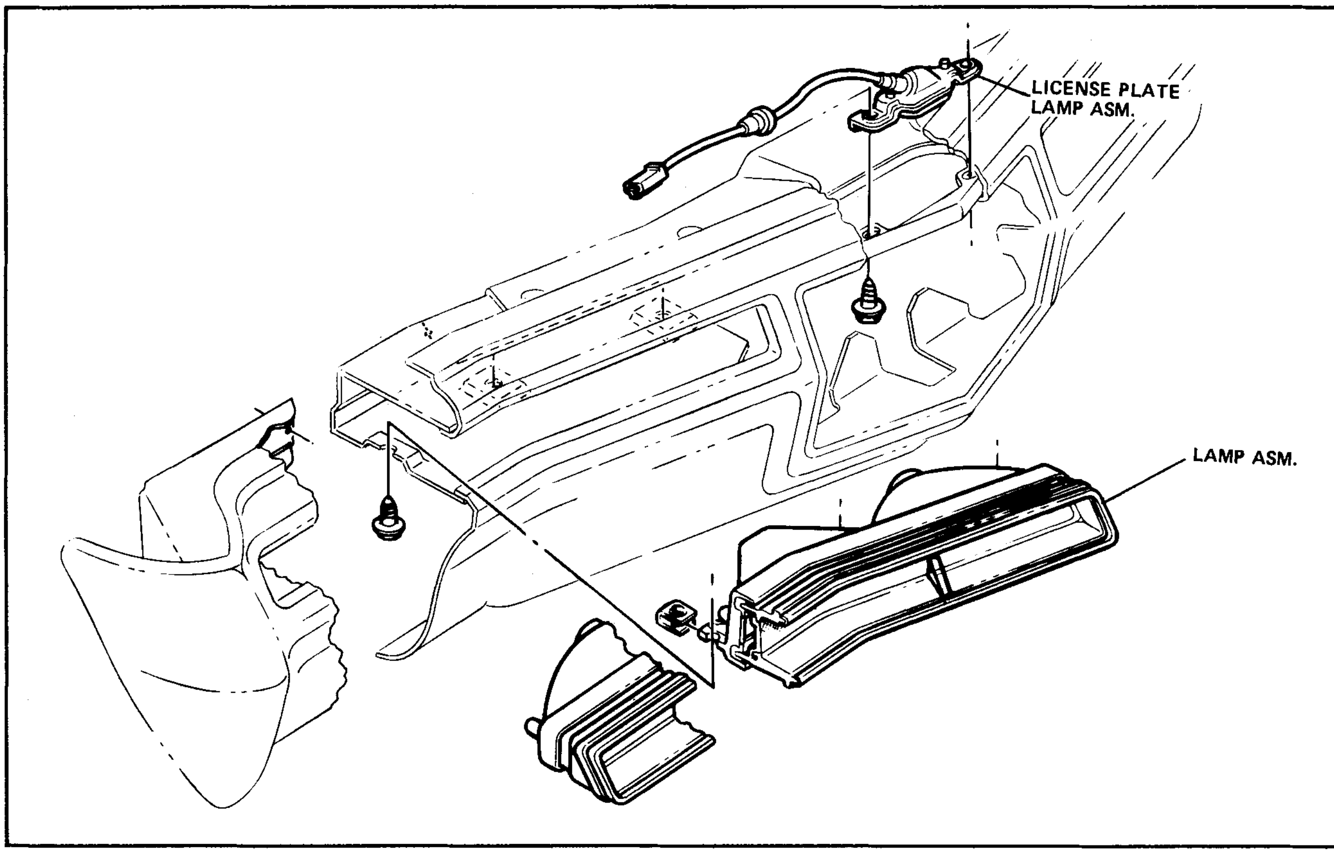


Fig. 12-111 G Series Rear Lamps Installation

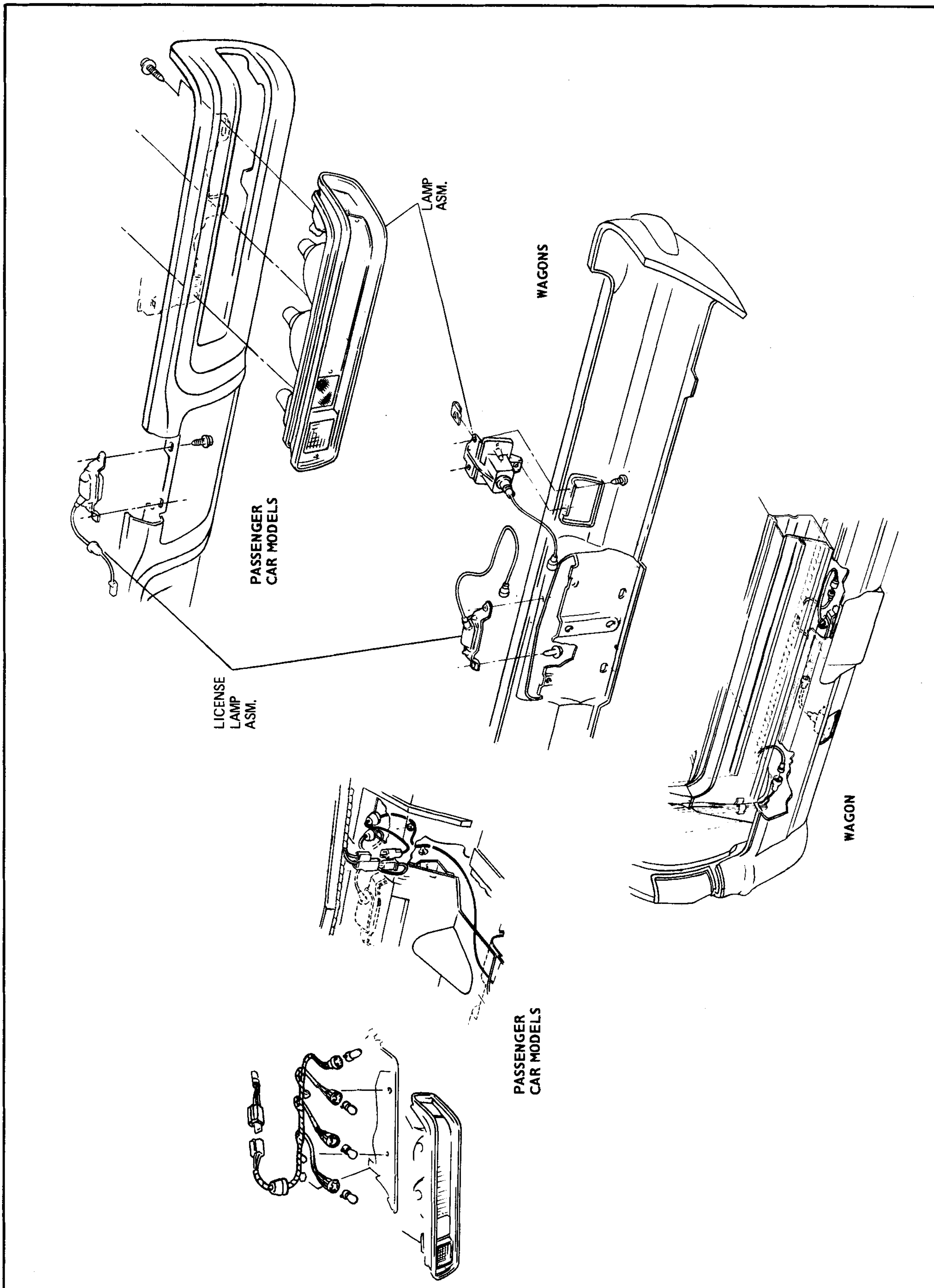


Fig. 12-112 A Series Rear Lamps Installation

B SERIES

	400 V-8		455 V-8		
	STD. OR A/C	H.O.	STD. OR A/C	H.D.	MAINT. FREE
Battery	R88*	R88S*	R88S*	R88X*	C89**
Watts @ 0°F.	2900	3250	3250	3750	3750
Amp-Hrs.	61	62	62	62	80

A SERIES

	250 L-6		350 V-8			400 V-8		455 V-8		
	STD.	A/C OR H.D.	STD.	A/C	H.D.	STD. OR A/C	H.D.	STD. OR A/C	H.D.	MAINT. FREE
Battery	Y54	R58	Y58	R58	R58S	R58	R58S	R58S	R88X*	C89**
Watts @ 0° F.	2300	2900	2350	2900	3250	2900	3250	3250	3750	3750
Amp-Hrs.	45	61	53	61	62	61	62	62	62	80

G SERIES

	400 V-8		455 V-8 (Exc. SJ)			455 V-8 (SJ)
	STD. OR A/C	H.D.	STD. OR A/C	H.D.	MAINT. FREE	STD. OR A/C
Battery	R88*	R88S*	R88S*	R88X*	C89**	C89**
Watts @ 0° F.	2900	3250	3250	3750	3750	3750
Amp-Hrs.	61	62	62	62	80	80

F SERIES

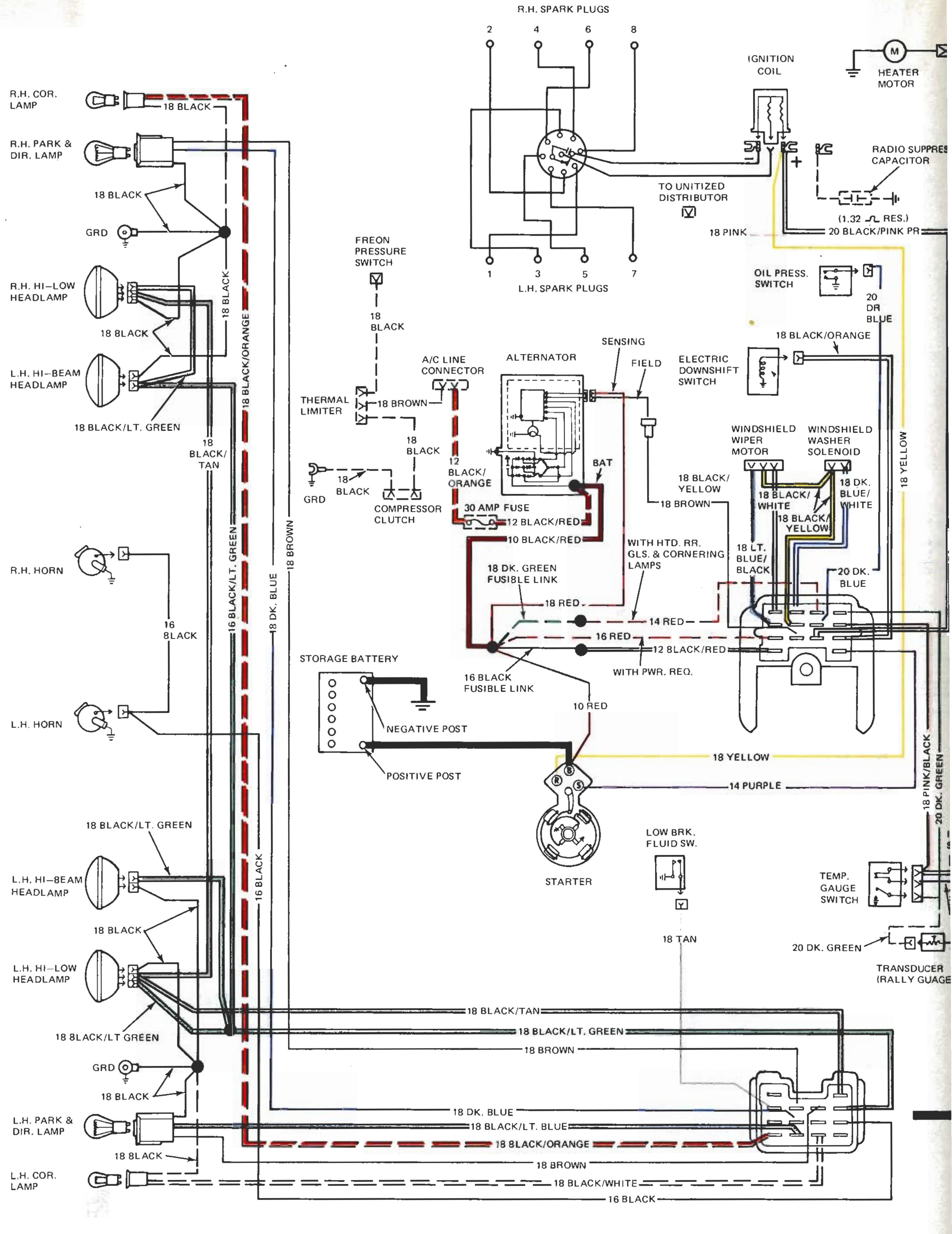
	250 L-6		350 V-8			400 V-8		455 V-8		
	STD.	H.D.	STD.	A/C	H.D.	STD. OR A/C	H.D.	STD. OR A/C	H.D.	MAINT. FREE
Battery	Y54	R58	Y88*	R88*	R88S*	R88*	R88S*	R88S*	R88X*	C89**
Watts @ 0° F.	2300	2900	2350	2900	3250	2900	3250	3250	3750	3750
Amp-Hrs.	45	61	53	61	62	61	62	62	62	80

X SERIES

	250 L-6		307 V-8		350 V-8	
	STD.	H.D.	STD. OR A/C	H.D.	STD. OR A/C	H.D.
Battery	Y86*	R88W*	R88*	R88W*	Y58	R58S
Watts @ 0°F.	2300	3750	2900	3750	2350	3250
Amp-Hrs.	45	76	61	76	53	62

* Side Terminal Battery
** Side Terminal & Sealed Case

Fig. 12-113 Battery Usage Chart



R.H. SPARK PLUGS
2 4 6 8
1 3 5 7
L.H. SPARK PLUGS
IGNITION COIL
HEATER MOTOR
RADIO SUPPRES CAPACITOR
TO UNITIZED DISTRIBUTOR
(1.32 RES.)
18 PINK
20 BLACK/PINK PR
OIL PRESS. SWITCH
20 DK BLUE
R.H. COR. LAMP
18 BLACK
R.H. PARK & DIR. LAMP
GRD
R.H. HI-LOW HEADLAMP
L.H. HI-BEAM HEADLAMP
18 BLACK/LT. GREEN
18 BLACK/TAN
18 BLACK/ORANGE
16 BLACK/LT. GREEN
18 DK. BLUE
18 BROWN
FREON PRESSURE SWITCH
THERMAL LIMITER
18 BROWN
A/C LINE CONNECTOR
ALTERNATOR
SENSING
FIELD
ELECTRIC DOWNSHIFT SWITCH
18 BLACK/ORANGE
COMPRESSOR CLUTCH
12 BLACK/ORANGE
30 AMP FUSE
12 BLACK/RED
10 BLACK/RED
BAT
18 BLACK/YELLOW
18 BROWN
WINDSHIELD WIPER MOTOR
WINDSHIELD WASHER SOLENOID
18 BLACK/WHITE
18 BLACK/YELLOW
18 DK. BLUE/WHITE
18 YELLOW
18 LT. BLUE/BLACK
20 DK. BLUE
WITH HTD. RR. GLS. & CORNERING LAMPS
18 DK. GREEN FUSIBLE LINK
18 RED
14 RED
16 RED
12 BLACK/RED
WITH PWR. REQ.
16 BLACK FUSIBLE LINK
10 RED
R.H. HORN
16 BLACK
L.H. HORN
STORAGE BATTERY
NEGATIVE POST
POSITIVE POST
18 YELLOW
14 PURPLE
STARTER
18 PINK/BLACK
20 DK. GREEN
LOW BRK. FLUID SW.
18 TAN
TEMP. GAUGE SWITCH
20 DK. GREEN
TRANSDUCER (RALLY GUAGE
L.H. HI-BEAM HEADLAMP
16 BLACK
L.H. HI-LOW HEADLAMP
18 BLACK/LT GREEN
18 BLACK/TAN
18 BLACK/LT. GREEN
18 BROWN
18 DK. BLUE
18 BLACK/LT. BLUE
18 BLACK/ORANGE
L.H. PARK & DIR. LAMP
18 BROWN
18 BLACK/WHITE
16 BLACK
L.H. COR. LAMP

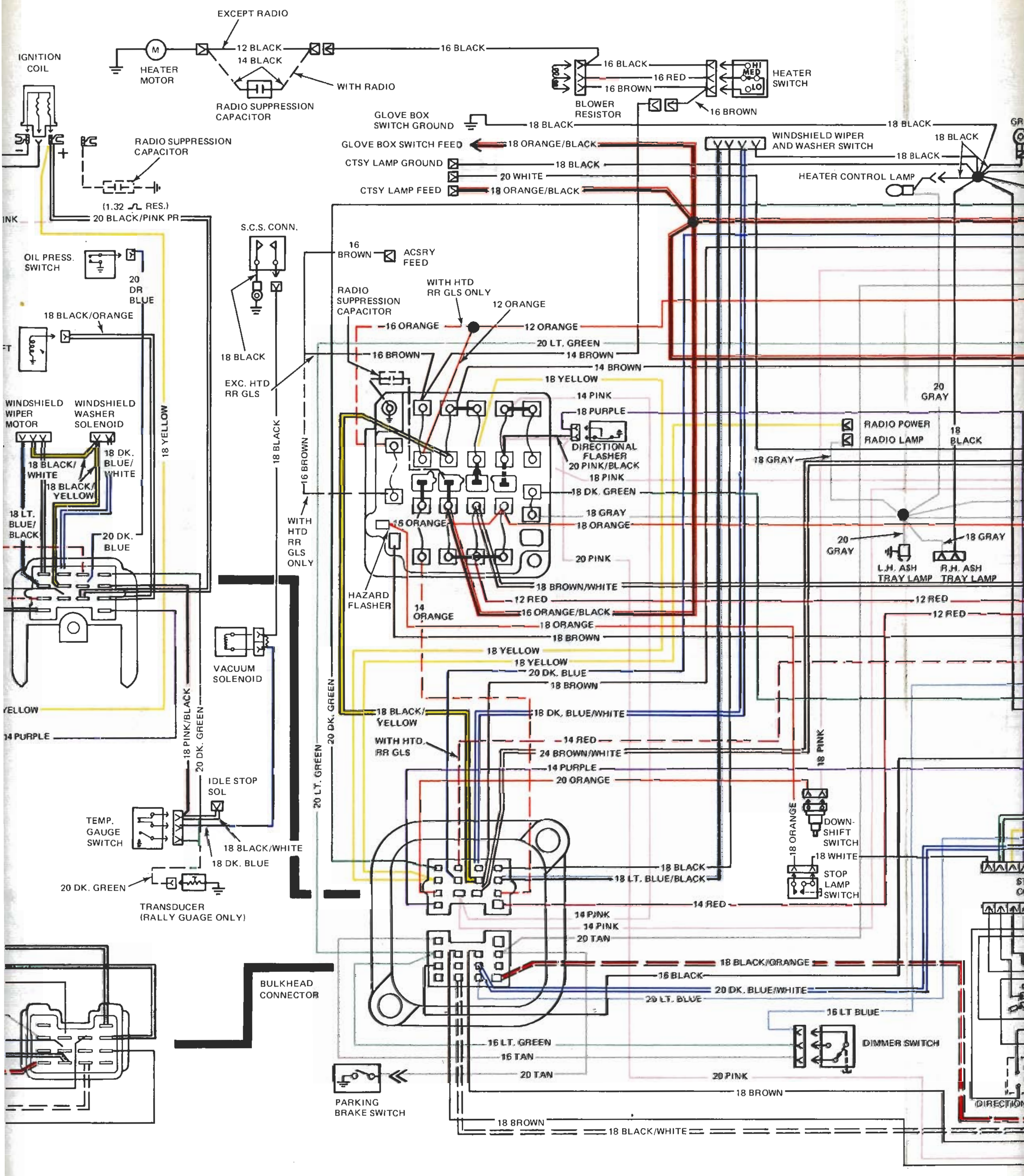

EXCEPT RADIO
IGNITION COIL
HEATER MOTOR
12 BLACK
14 BLACK
16 BLACK
WITH RADIO
RADIO SUPPRESSION CAPACITOR
16 BLACK
16 RED
16 BROWN
HEATER SWITCH
HI
MED
LO
BLOWER RESISTOR
16 BROWN
GLOVE BOX SWITCH GROUND
18 BLACK
GLOVE BOX SWITCH FEED
18 ORANGE/BLACK
WINDSHIELD WIPER AND WASHER SWITCH
18 BLACK
CTSY LAMP GROUND
20 WHITE
CTSY LAMP FEED
18 ORANGE/BLACK
HEATER CONTROL LAMP
RADIO SUPPRESSION CAPACITOR
(1.32 RES.)
20 BLACK/PINK PR
S.C.S. CONN.
16 BROWN
ACSRY FEED
OIL PRESS. SWITCH
20 DR BLUE
RADIO SUPPRESSION CAPACITOR
WITH HTD RR GLS ONLY
12 ORANGE
18 BLACK/ORANGE
16 ORANGE
12 ORANGE
20 LT. GREEN
18 BLACK
16 BROWN
14 BROWN
14 BROWN
EXC. HTD RR GLS
18 YELLOW
14 PINK
18 PURPLE
20 GRAY
WINDSHIELD WIPER MOTOR
WINDSHIELD WASHER SOLENOID
18 YELLOW
18 BLACK
16 BROWN
DIRECTIONAL FLASHER
20 PINK/BLACK
18 PINK
RADIO POWER
RADIO LAMP
18 BLACK
18 BLACK/WHITE
18 DK. BLUE/WHITE
18 BLACK/YELLOW
18 GRAY
18 DK. GREEN
18 LT. BLUE/BLACK
WITH HTD RR GLS ONLY
16 ORANGE
18 GRAY
18 ORANGE
20 DK. BLUE
20 GRAY
18 GRAY
20 PINK
L.H. ASH TRAY LAMP
R.H. ASH TRAY LAMP
18 BROWN/WHITE
HAZARD FLASHER
12 RED
12 RED
14 ORANGE
16 ORANGE/BLACK
12 RED
18 ORANGE
18 BROWN
YELLOW
14 PURPLE
VACUUM SOLENOID
18 YELLOW
18 YELLOW
20 DK. BLUE
18 BROWN
18 BLACK/YELLOW
18 DK. BLUE/WHITE
WITH HTD. RR GLS
14 RED
24 BROWN/WHITE
18 PINK/BLACK
20 DK. GREEN
20 DK. GREEN
20 LT. GREEN
14 PURPLE
20 ORANGE
18 PINK
IDLE STOP SOL
TEMP. GAUGE SWITCH
18 BLACK/WHITE
18 DK. BLUE
18 ORANGE
DOWN-SHIFT SWITCH
18 WHITE
STOP LAMP SWITCH
18 BLACK
18 LT. BLUE/BLACK
20 DK. GREEN
TRANSDUCER (RALLY GUAGE ONLY)
14 RED
14 PINK
14 PINK
20 TAN
18 BLACK/ORANGE
16 BLACK
BULKHEAD CONNECTOR
20 DK. BLUE/WHITE
20 LT. BLUE
16 LT BLUE
DIMMER SWITCH
16 LT. GREEN
16 TAN
20 TAN
PARKING BRAKE SWITCH
20 PINK
18 BROWN
18 BROWN
18 BLACK/WHITE
DIRECTION

Fig. 1

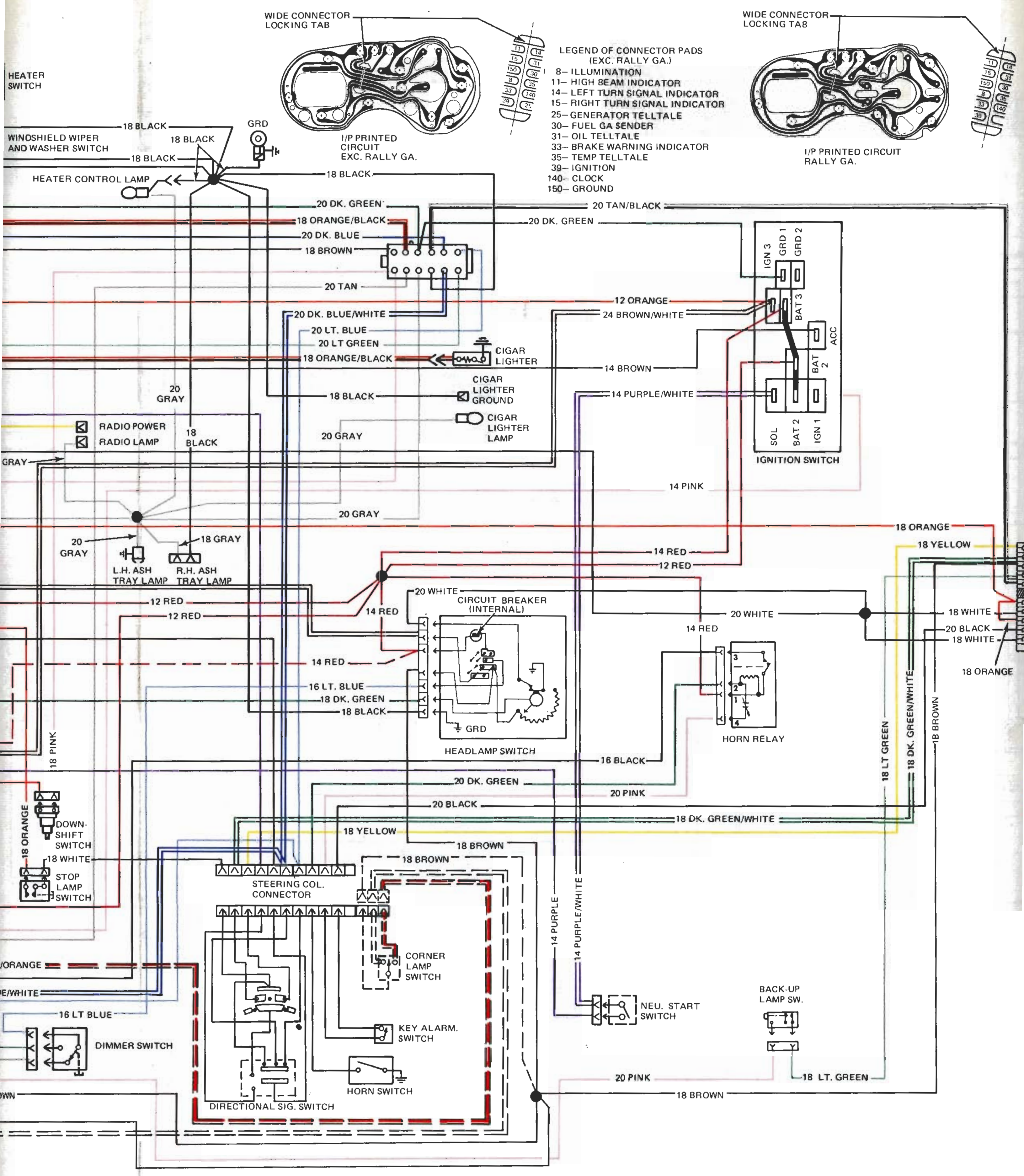
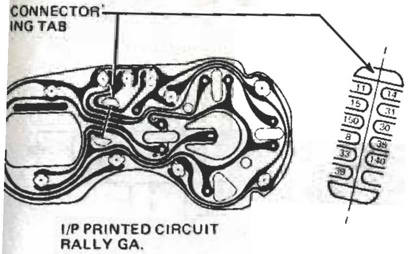


Fig. 12-114 B Series Chassis Electrical Wiring Diagram

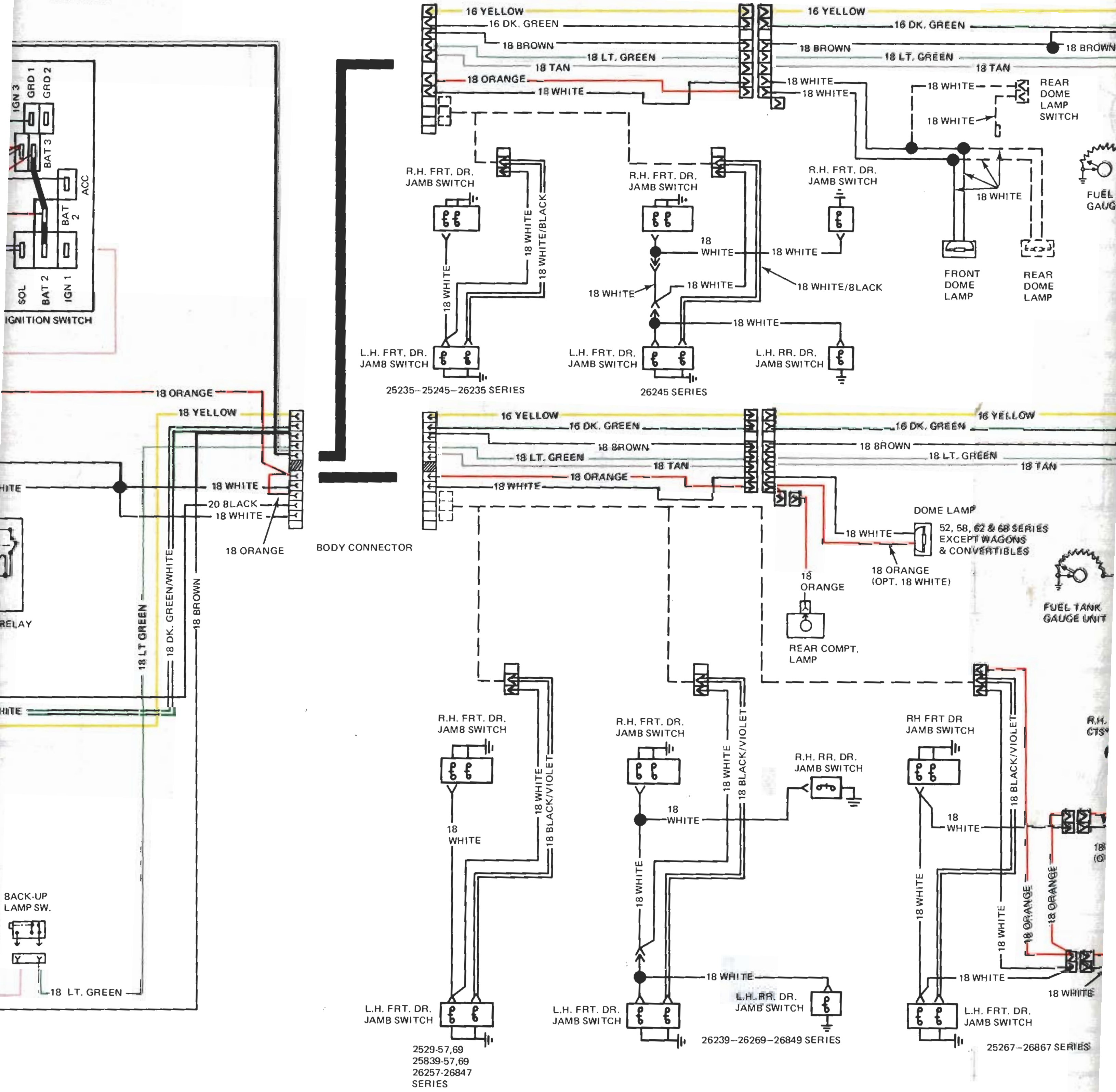


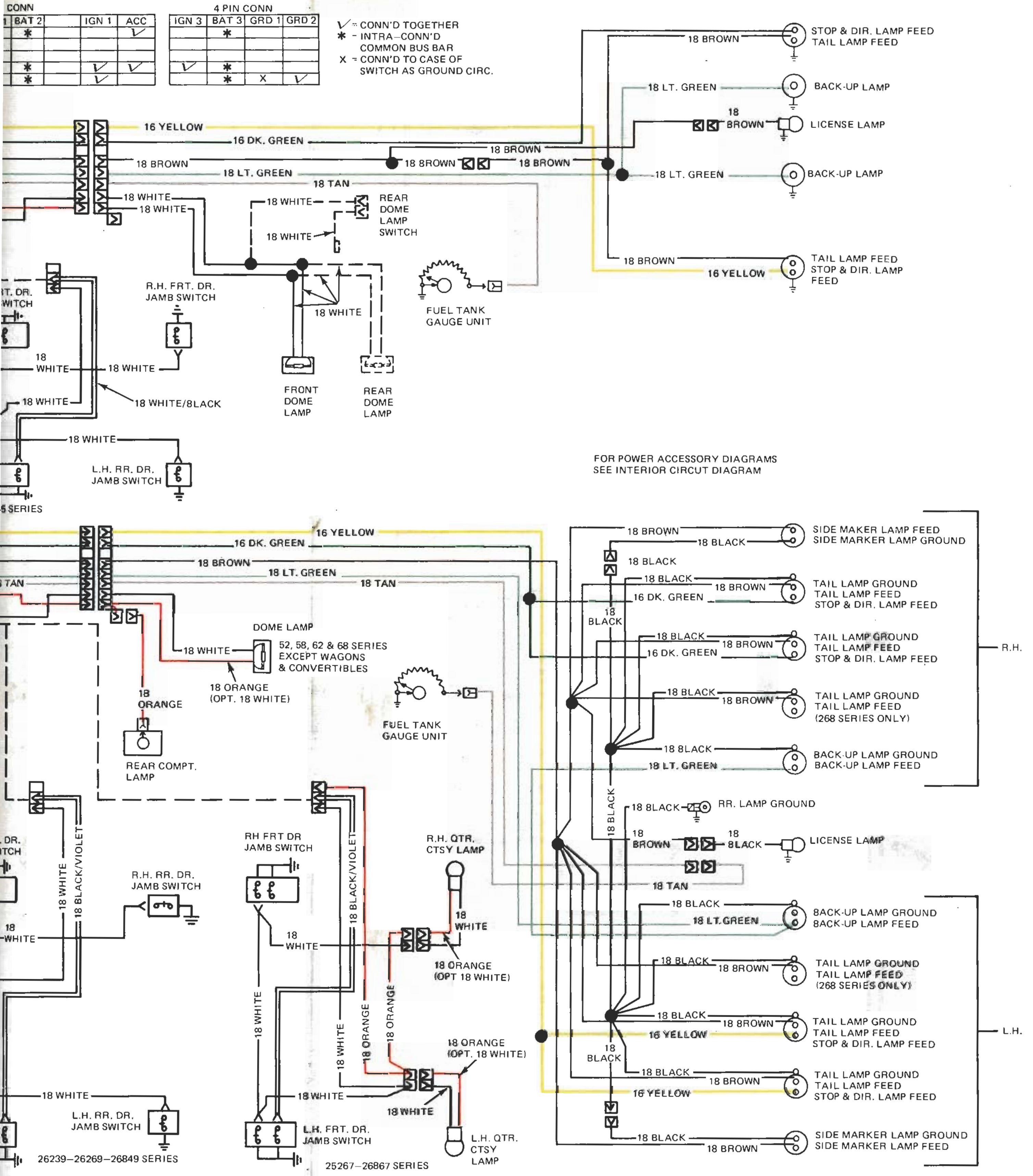
LEGEND OF CONNECTOR PADS
(RALLY GA.)

8– ILLUMINATION
11– HIGH BEAM INDICATOR
14– LEFT TURN SIGNAL INDICATOR
15– RIGHT TURN SIGNAL INDICATOR
30– FUEL GA SENDER
31– OIL GA SENDER
33– BRAKE WARNING INDICATOR
35– TEMP GA SENDER
39– IGNITION
140– CLOCK
150– GROUND

	5 PIN CONN						4 PIN CONN			
	SOL	BAT 1	BAT 2		IGN 1	ACC	IGN 3	BAT 3	GRD 1	GRD 2
ACC		*	*			✓		*		
OFF–LOCK										
OFF–UNLOCK										
RUN		*	*		✓	✓	✓	*		
START	✓	*	*		✓			*	X	✓

✓ – CONN'D TOGETHEF
* – INTRA–CONN'D COMMON BUS BAR
X – CONN'D TO CASE O SWITCH AS GROUN

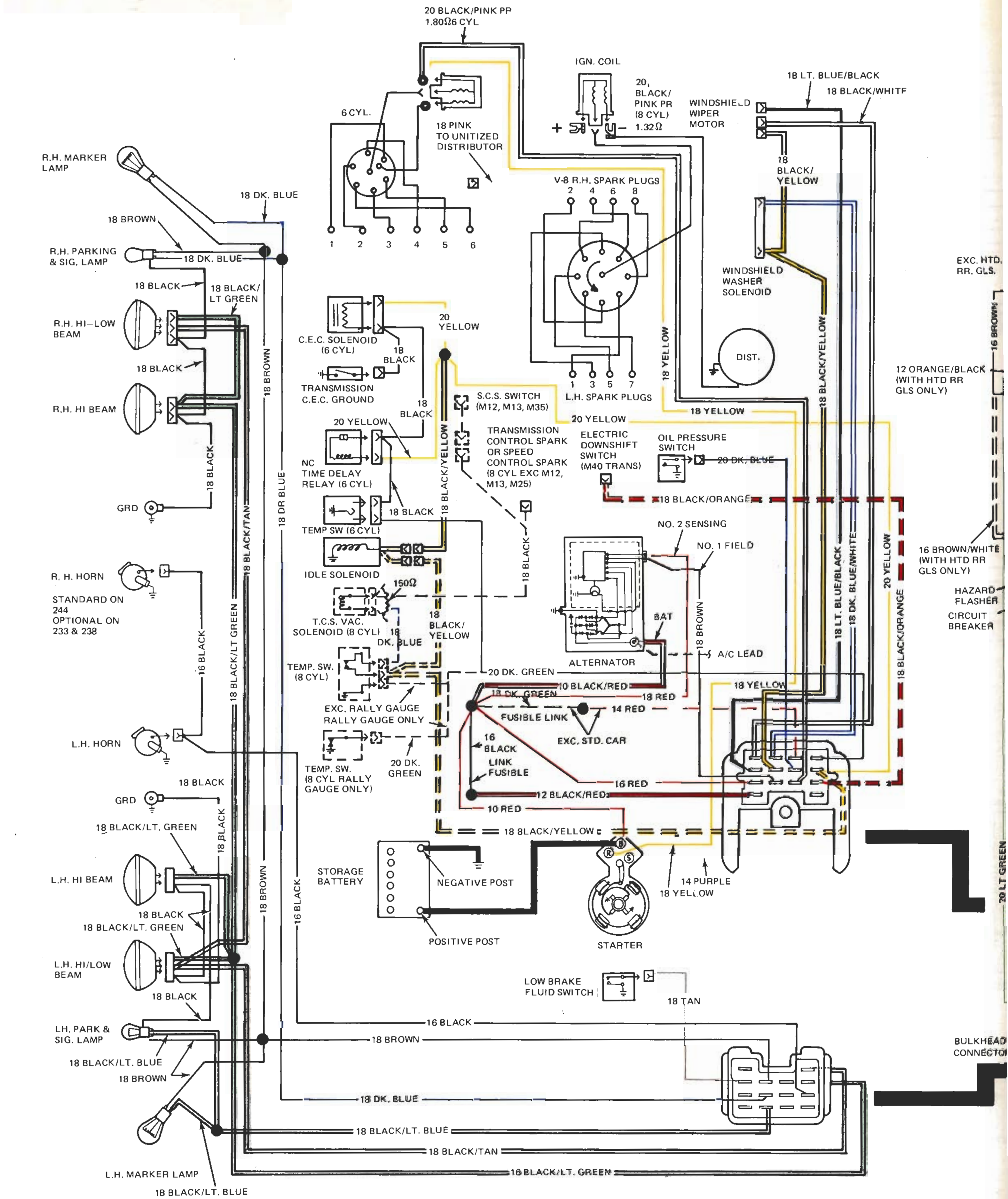




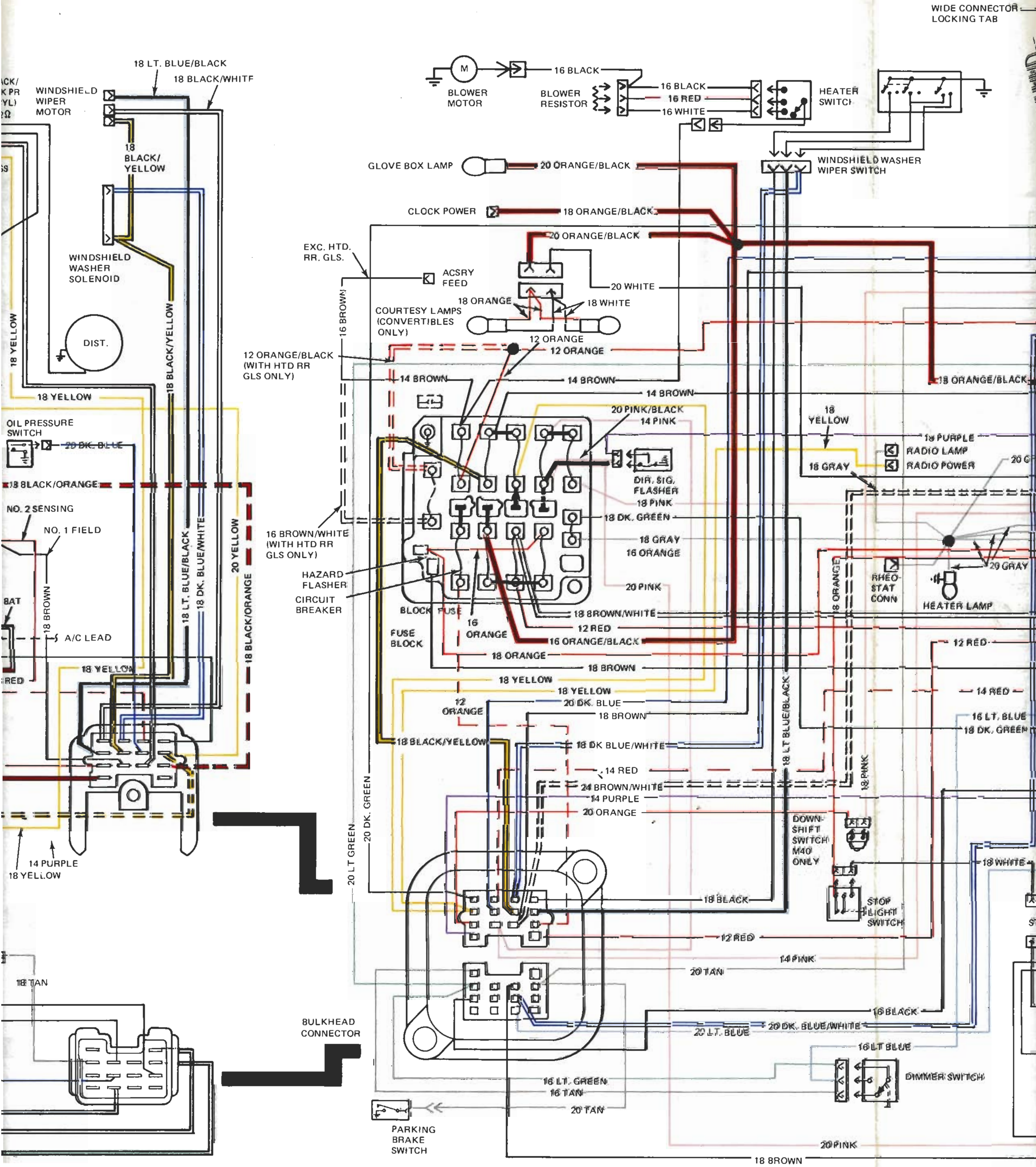
LEGEND

SOLID LINE ——————— STANDARD CAR

BROKEN LINE — — — — EXCEPT STD. CAR



20 BLACK/PINK PR
1.80Ω 6 CYL
IGN. COIL
20 BLACK/PINK PR (8 CYL) 1.32Ω
18 LT. BLUE/BLACK
18 BLACK/WHITE
WINDSHIELD WIPER MOTOR
6 CYL.
18 PINK TO UNITIZED DISTRIBUTOR
18 BLACK/YELLOW
V-8 R.H. SPARK PLUGS
2 4 6 8
R.H. MARKER LAMP
18 DK. BLUE
18 BROWN
R.H. PARKING & SIG. LAMP
18 DK. BLUE
1 2 3 4 5 6
WINDSHIELD WASHER SOLENOID
EXC. HTD. RR. GLS.
18 BLACK
18 BLACK/LT GREEN
R.H. HI-LOW BEAM
C.E.C. SOLENOID (6 CYL)
20 YELLOW
18 BLACK
16 BROWN
18 BLACK
TRANSMISSION C.E.C. GROUND
DIST.
12 ORANGE/BLACK (WITH HTD RR GLS ONLY)
18 YELLOW
18 BLACK/YELLOW
R.H. HI BEAM
18 BLACK
S.C.S. SWITCH (M12, M13, M35)
1 3 5 7
L.H. SPARK PLUGS
18 YELLOW
20 YELLOW
20 YELLOW
TRANSMISSION CONTROL SPARK OR SPEED CONTROL SPARK (8 CYL EXC M12, M13, M25)
ELECTRIC DOWNSHIFT SWITCH (M40 TRANS)
OIL PRESSURE SWITCH
20 DK. BLUE
NC TIME DELAY RELAY (6 CYL)
18 BLACK
18 BLACK/YELLOW
18 BLACK
18 BROWN
18 DR BLUE
GRD
18 BLACK
18 BLACK/ORANGE
TEMP SW (6 CYL)
18 BLACK/TAN
NO. 2 SENSING
NO. 1 FIELD
IDLE SOLENOID
18 BLACK
16 BROWN/WHITE (WITH HTD RR GLS ONLY)
R. H. HORN
150Ω
STANDARD ON 244
OPTIONAL ON 233 & 238
T.C.S. VAC. SOLENOID (8 CYL)
18 DK. BLUE
18 BLACK/YELLOW
BAT
18 BROWN
18 LT. BLUE/BLACK
18 DK. BLUE/WHITE
20 YELLOW
HAZARD FLASHER
CIRCUIT BREAKER
16 BLACK
18 BLACK/LT GREEN
A/C LEAD
18 BLACK/ORANGE
TEMP. SW. (8 CYL)
ALTERNATOR
20 DK. GREEN
10 BLACK/RED
18 YELLOW
18 DK. GREEN
18 RED
EXC. RALLY GAUGE
RALLY GAUGE ONLY
FUSIBLE LINK
14 RED
L.H. HORN
EXC. STD. CAR
16 BLACK
LINK FUSIBLE
TEMP. SW. (8 CYL RALLY GAUGE ONLY)
20 DK. GREEN
18 BLACK
16 RED
GRD
12 BLACK/RED
10 RED
18 BLACK/LT. GREEN
18 BLACK
18 BLACK/YELLOW
L.H. HI BEAM
STORAGE BATTERY
NEGATIVE POST
14 PURPLE
18 YELLOW
20 LT GREEN
18 BROWN
16 BLACK
18 BLACK
18 BLACK/LT. GREEN
L.H. HI/LOW BEAM
POSITIVE POST
STARTER
LOW BRAKE FLUID SWITCH
18 TAN
18 BLACK
LH. PARK & SIG. LAMP
16 BLACK
18 BROWN
BULKHEAD CONNECTOR
18 BLACK/LT. BLUE
18 BROWN
18 DK. BLUE
18 BLACK/LT. BLUE
18 BLACK/TAN
L.H. MARKER LAMP
18 BLACK/LT. GREEN
18 BLACK/LT. BLUE



WIDE CONNECTOR LOCKING TAB
18 LT. BLUE/BLACK
18 BLACK/WHITE
WINDSHIELD WIPER MOTOR
18 BLACK/ YELLOW
WINDSHIELD WASHER SOLENOID
DIST.
18 YELLOW
18 BLACK/YELLOW
OIL PRESSURE SWITCH
20 DK. BLUE
18 BLACK/ORANGE
NO. 2 SENSING
NO. 1 FIELD
BAT
18 BROWN
A/C LEAD
18 LT. BLUE/BLACK
18 DK. BLUE/WHITE
20 YELLOW
18 BLACK/ORANGE
RED
14 PURPLE
18 YELLOW
18 TAN
M
BLOWER MOTOR
16 BLACK
BLOWER RESISTOR
16 RED
16 WHITE
HEATER SWITCH
WINDSHIELD WASHER WIPER SWITCH
GLOVE BOX LAMP
20 ORANGE/BLACK
CLOCK POWER
18 ORANGE/BLACK
EXC. HTD. RR. GLS.
ACSRY FEED
20 WHITE
18 ORANGE
18 WHITE
COURTESY LAMPS (CONVERTIBLES ONLY)
16 BROWN
12 ORANGE
12 ORANGE/BLACK (WITH HTD RR GLS ONLY)
14 BROWN
20 PINK/BLACK
14 PINK
DIR. SIG. FLASHER
18 PINK
18 DK. GREEN
16 BROWN/WHITE (WITH HTD RR GLS ONLY)
18 GRAY
16 ORANGE
HAZARD FLASHER
CIRCUIT BREAKER
20 PINK
FUSE BLOCK
16 ORANGE
18 BROWN/WHITE
12 RED
16 ORANGE/BLACK
18 ORANGE
18 BROWN
18 YELLOW
20 DK. BLUE
12 ORANGE
18 BLACK/YELLOW
18 DK BLUE/WHITE
14 RED
24 BROWN/WHITE
14 PURPLE
20 ORANGE
20 LT GREEN
20 DK. GREEN
18 LT BLUE/BLACK
18 YELLOW
18 PURPLE
RADIO LAMP
RADIO POWER
18 GRAY
18 ORANGE
RHEO-STAT CONN
20 GRAY
HEATER LAMP
12 RED
14 RED
16 LT. BLUE
18 DK. GREEN
18 PINK
DOWN-SHIFT SWITCH M40 ONLY
18 WHITE
STOP LIGHT SWITCH
18 BLACK
12 RED
14 PINK
20 TAN
16 BLACK
20 LT. BLUE
20 DK. BLUE/WHITE
16 LT BLUE
DIMMER SWITCH
BULKHEAD CONNECTOR
16 LT. GREEN
16 TAN
20 TAN
PARKING BRAKE SWITCH
20 PINK
18 BROWN

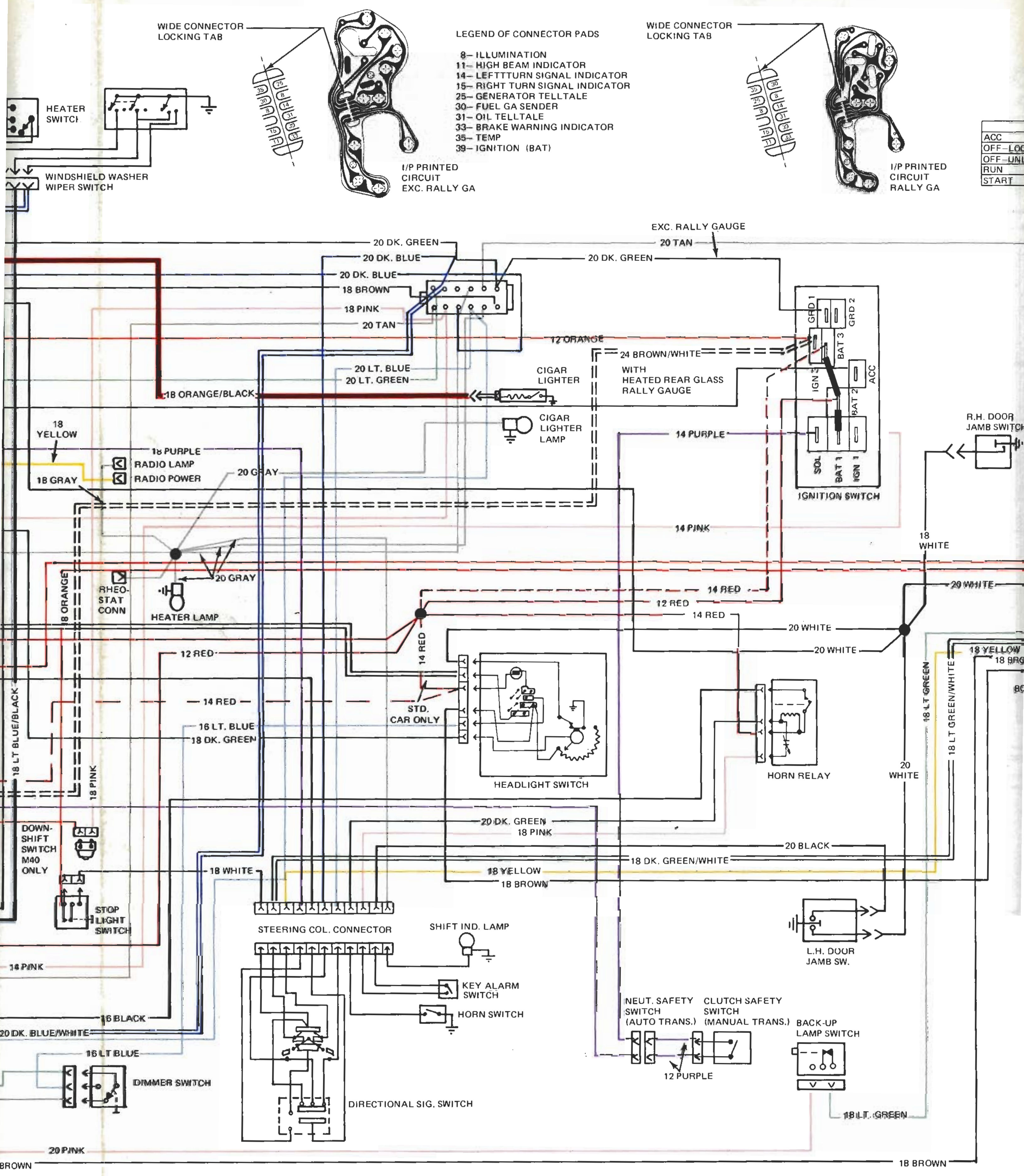
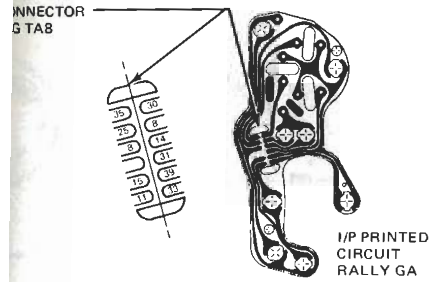
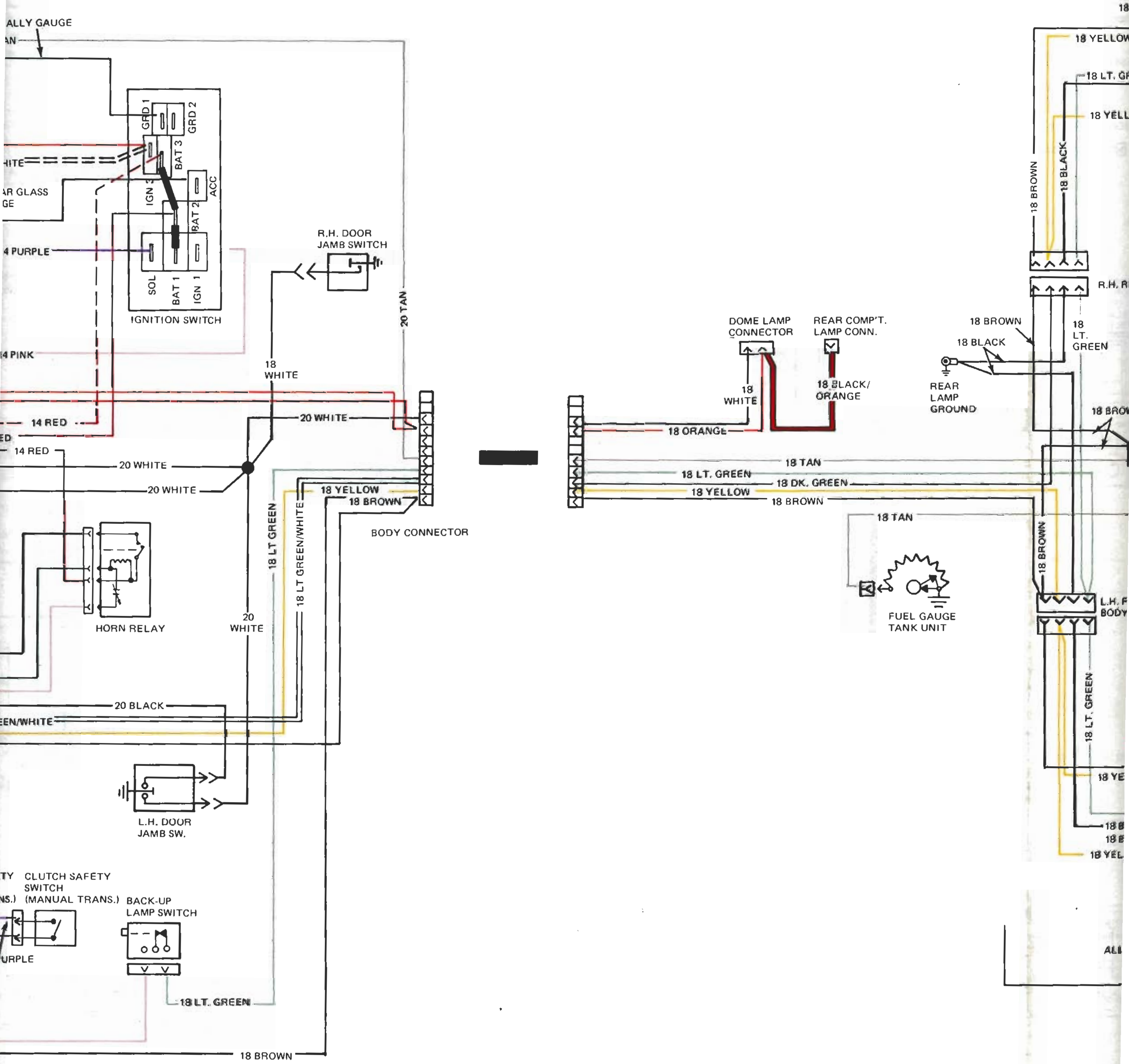


Fig. 12-115 A Series Chassis Electrical Wiring Diagram

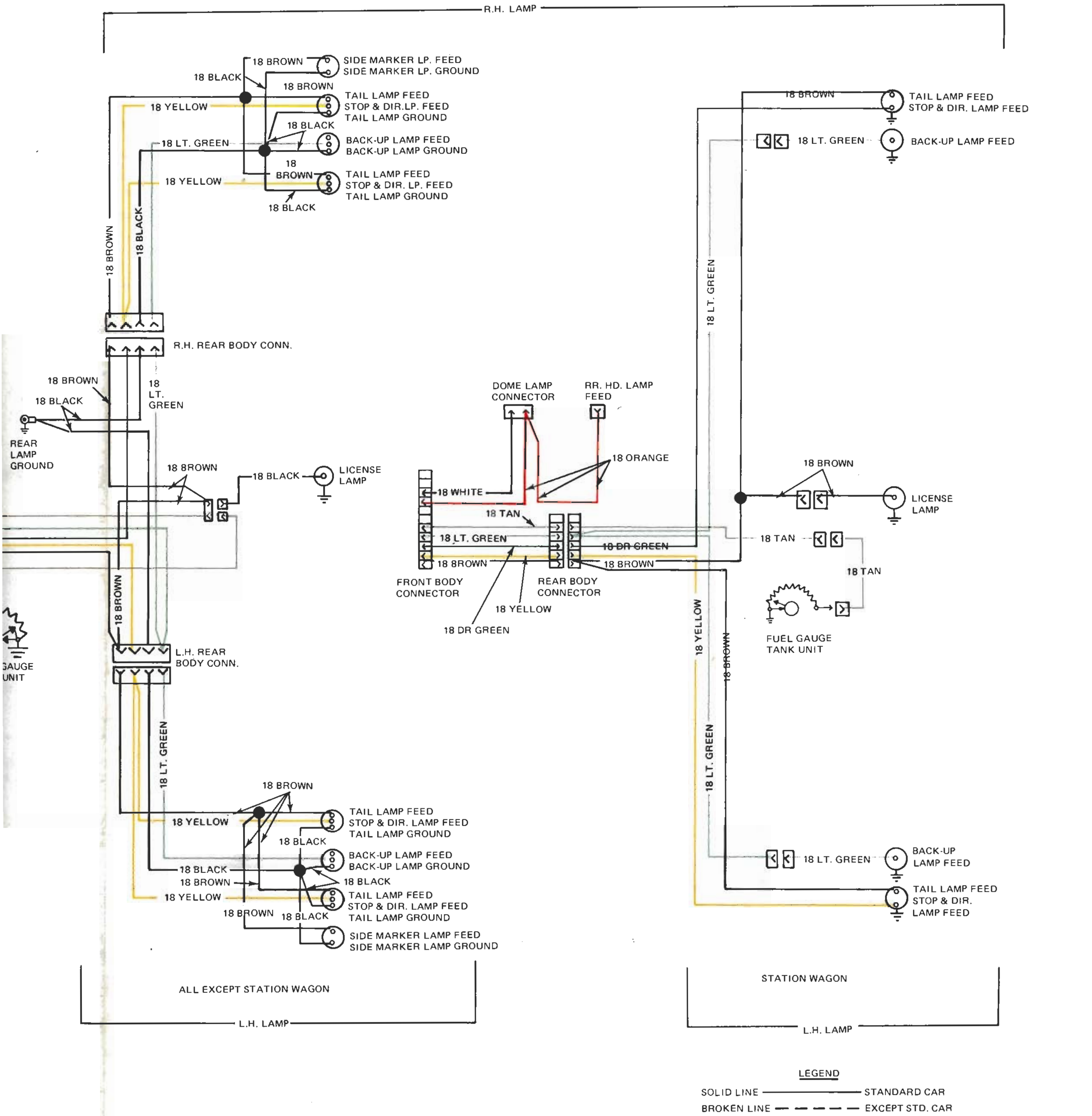


√ - CONN'D TOGETHER
✱ - INTRA-CONN'D COMMON BUS BAR
X - CONN'D TO CASE OF SWITCH AS GROUND CIRC.

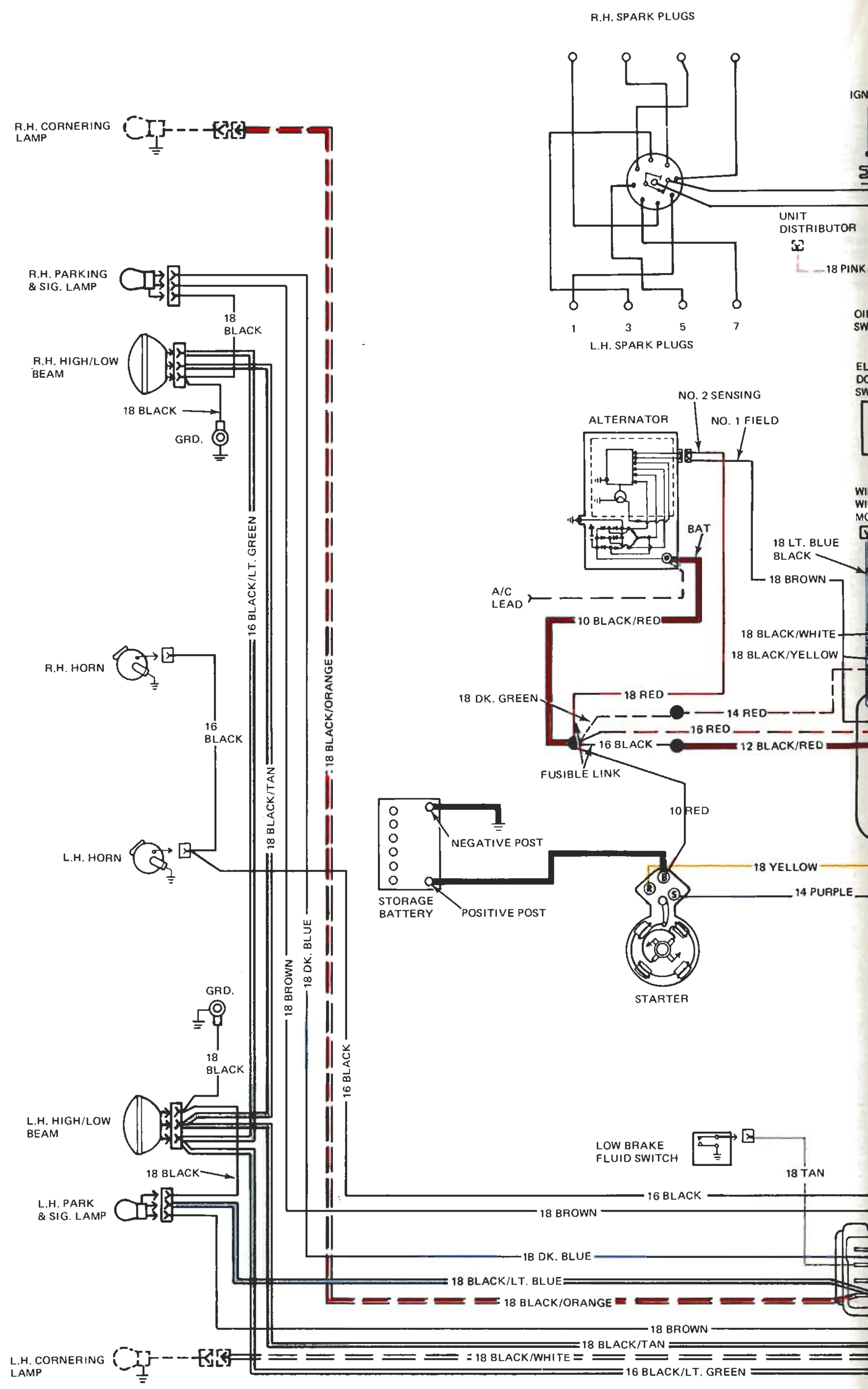
	5 PIN CONN						4 PIN CONN			
	SOL	BAT 1	BAT 2		IGN 1	ACC	IGN 3	BAT 3	GRD 1	GRD 2
ACC		✱	✱			√		✱		
OFF-LOCK										
OFF-UNLOCK										
RUN		✱	✱		√	√	√	✱		
START	√	✱	✱		√			✱	X	√



Wiring Diagram



R.H. LAMP
18 BROWN
SIDE MARKER LP. FEED
SIDE MARKER LP. GROUND
18 BLACK
18 BROWN
TAIL LAMP FEED
STOP & DIR.LP. FEED
TAIL LAMP GROUND
18 YELLOW
18 BLACK
18 LT. GREEN
BACK-UP LAMP FEED
BACK-UP LAMP GROUND
18 BROWN
18 YELLOW
TAIL LAMP FEED
STOP & DIR. LP. FEED
TAIL LAMP GROUND
18 BLACK
18 BROWN
18 BLACK
R.H. REAR BODY CONN.
18 BROWN
18 BLACK
18 LT. GREEN
REAR LAMP GROUND
18 BROWN
18 BLACK
LICENSE LAMP
GAUGE UNIT
18 BROWN
L.H. REAR BODY CONN.
18 LT. GREEN
18 BROWN
18 YELLOW
TAIL LAMP FEED
STOP & DIR. LAMP FEED
TAIL LAMP GROUND
18 BLACK
BACK-UP LAMP FEED
BACK-UP LAMP GROUND
18 BLACK
18 BROWN
18 BLACK
18 YELLOW
TAIL LAMP FEED
STOP & DIR. LAMP FEED
TAIL LAMP GROUND
18 BROWN
18 BLACK
SIDE MARKER LAMP FEED
SIDE MARKER LAMP GROUND
ALL EXCEPT STATION WAGON
L.H. LAMP
DOME LAMP CONNECTOR
RR. HD. LAMP FEED
18 ORANGE
18 WHITE
18 TAN
18 LT. GREEN
18 DR GREEN
18 BROWN
18 BROWN
FRONT BODY CONNECTOR
REAR BODY CONNECTOR
18 YELLOW
18 DR GREEN
18 BROWN
TAIL LAMP FEED
STOP & DIR. LAMP FEED
18 LT. GREEN
BACK-UP LAMP FEED
18 LT. GREEN
18 BROWN
LICENSE LAMP
18 TAN
18 TAN
FUEL GAUGE TANK UNIT
18 YELLOW
18 BROWN
18 LT. GREEN
18 LT. GREEN
BACK-UP LAMP FEED
TAIL LAMP FEED
STOP & DIR. LAMP FEED
STATION WAGON
L.H. LAMP
LEGEND
SOLID LINE — STANDARD CAR
BROKEN LINE — EXCEPT STD. CAR



R.H. SPARK PLUGS
1
3
5
7
L.H. SPARK PLUGS
UNIT DISTRIBUTOR
18 PINK
R.H. CORNERING LAMP
R.H. PARKING & SIG. LAMP
18 BLACK
R.H. HIGH/LOW BEAM
18 BLACK
GRD.
NO. 2 SENSING
NO. 1 FIELD
ALTERNATOR
BAT
18 LT. BLUE BLACK
18 BROWN
A/C LEAD
10 BLACK/RED
18 BLACK/WHITE
18 BLACK/YELLOW
18 RED
18 DK. GREEN
14 RED
16 RED
16 BLACK
12 BLACK/RED
FUSIBLE LINK
10 RED
R.H. HORN
16 BLACK
L.H. HORN
NEGATIVE POST
STORAGE BATTERY
POSITIVE POST
18 YELLOW
14 PURPLE
STARTER
16 BLACK/LT. GREEN
18 BLACK/TAN
18 BLACK/ORANGE
18 BROWN
18 DK. BLUE
16 BLACK
GRD.
18 BLACK
L.H. HIGH/LOW BEAM
18 BLACK
L.H. PARK & SIG. LAMP
LOW BRAKE FLUID SWITCH
18 TAN
16 BLACK
18 BROWN
18 DK. BLUE
18 BLACK/LT. BLUE
18 BLACK/ORANGE
18 BROWN
18 BLACK/TAN
L.H. CORNERING LAMP
18 BLACK/WHITE
16 BLACK/LT. GREEN

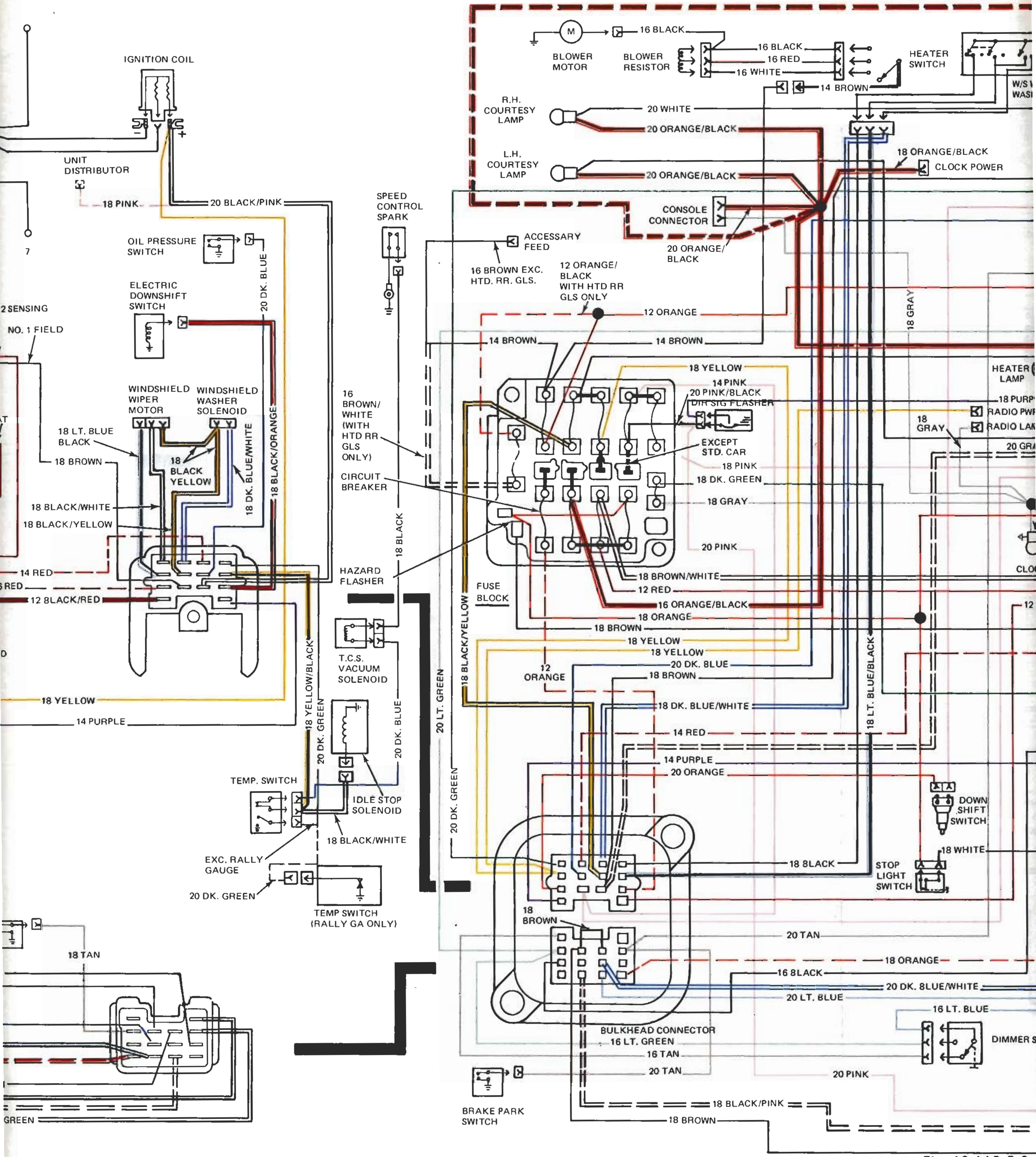


Fig. 12-116 G Se

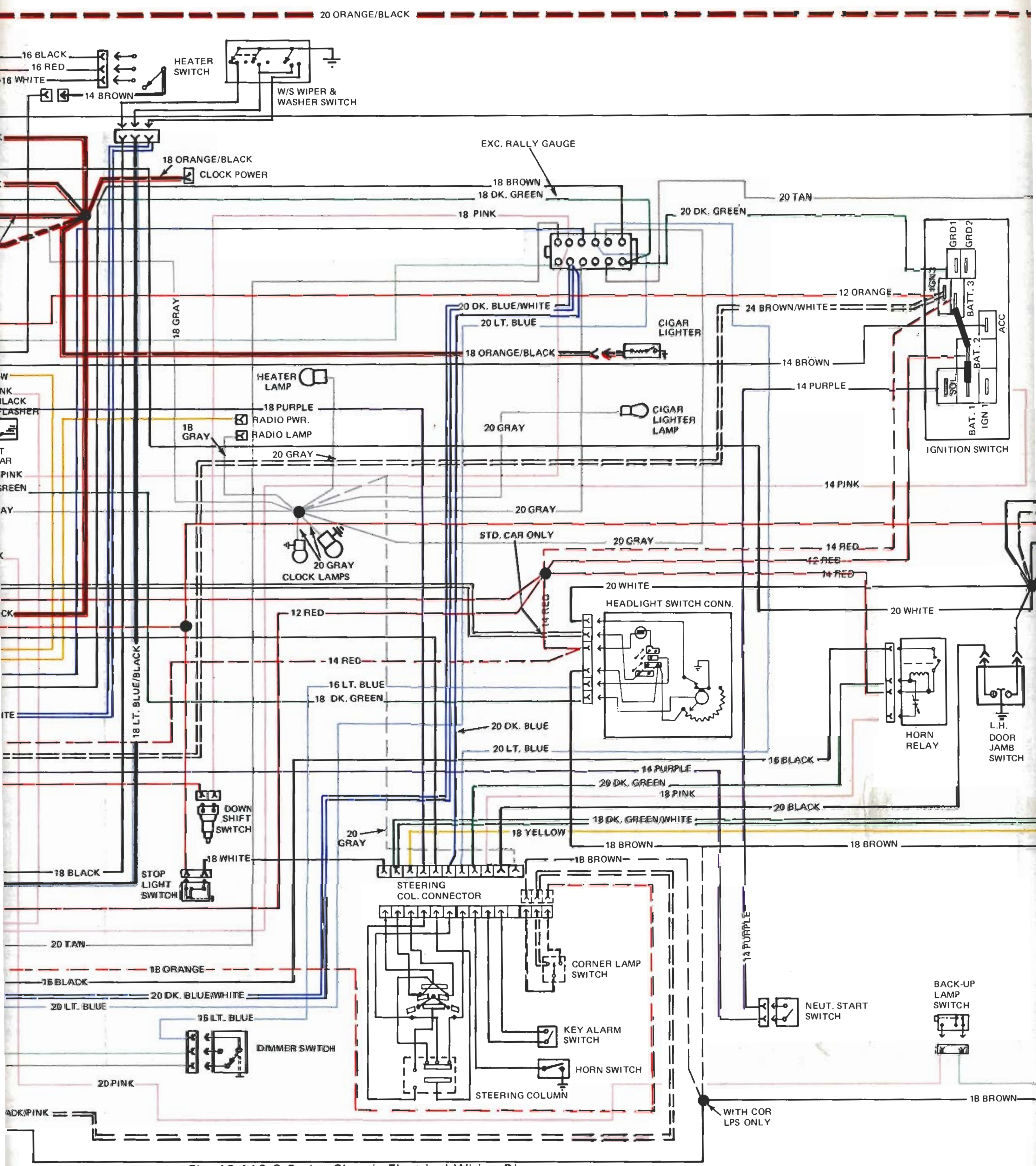
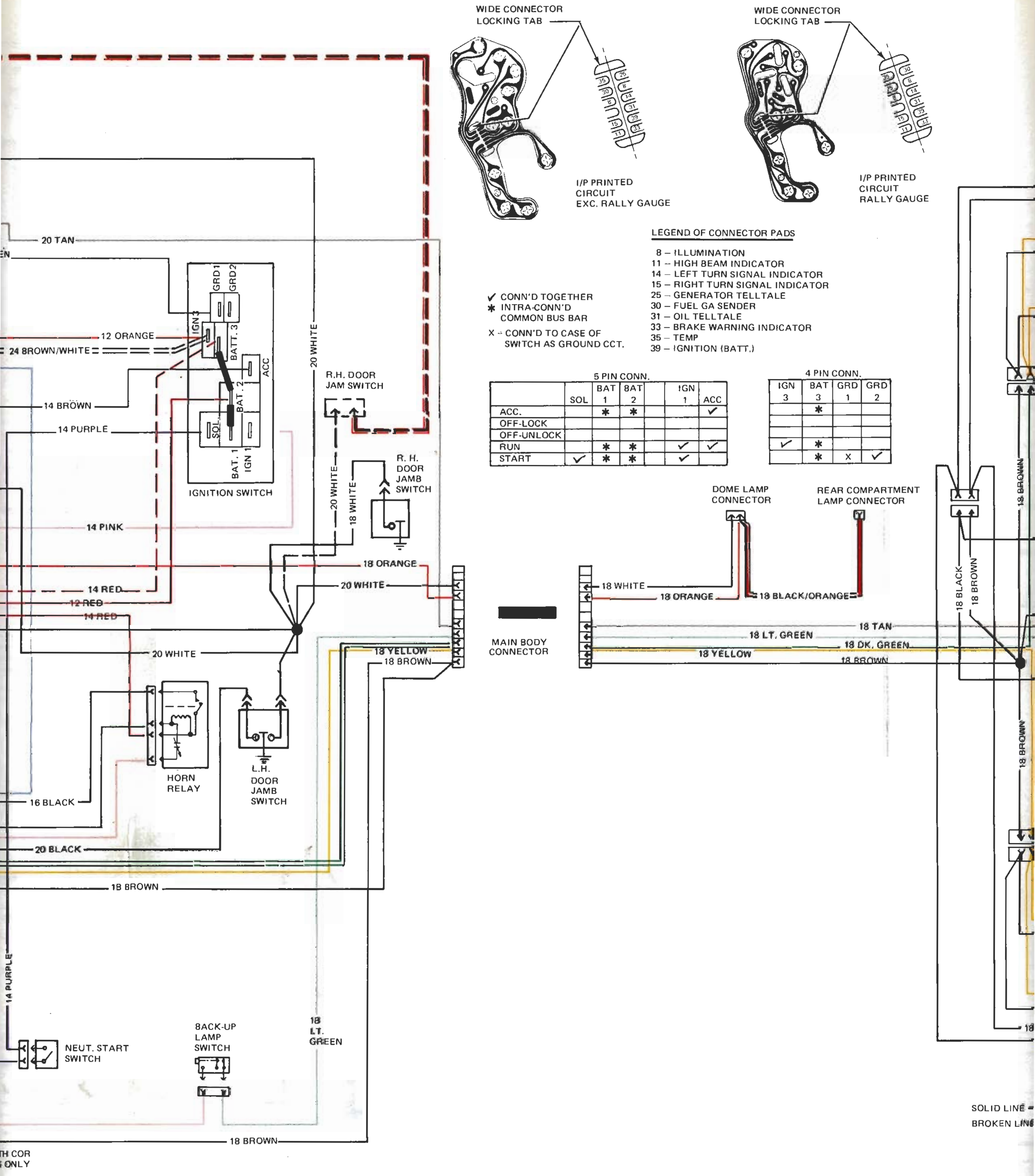


Fig. 12-116 G Series Chassis Electrical Wiring Diagram



✔ CONN'D TOGETHER
✱ INTRA-CONN'D COMMON BUS BAR
X – CONN'D TO CASE OF SWITCH AS GROUND CCT.

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 – BRAKE WARNING INDICATOR
35 – TEMP
39 – IGNITION (BATT.)

5 PIN CONN.

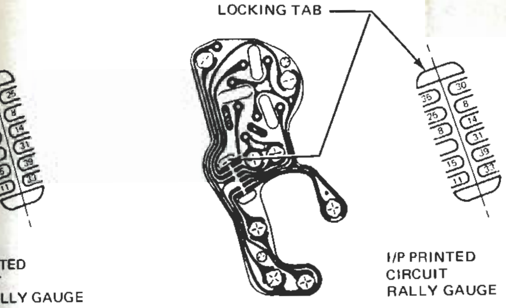
	SOL	BAT 1	BAT 2		IGN 1	ACC
ACC.		✱	✱			✔
OFF-LOCK						
OFF-UNLOCK						
RUN		✱	✱		✔	✔
START	✔	✱	✱		✔	

4 PIN CONN.

IGN 3	BAT 3	GRD 1	GRD 2
	✱		
✔	✱		
	✱	X	✔

TH COR
ONLY

SOLID LINE
BROKEN LINE



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 – BRAKE WARNING INDICATOR
35 – TEMP
39 – IGNITION (BATT.)

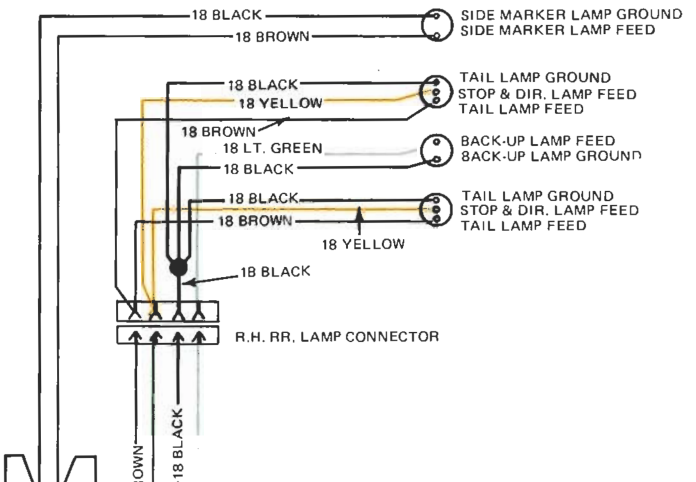
T.

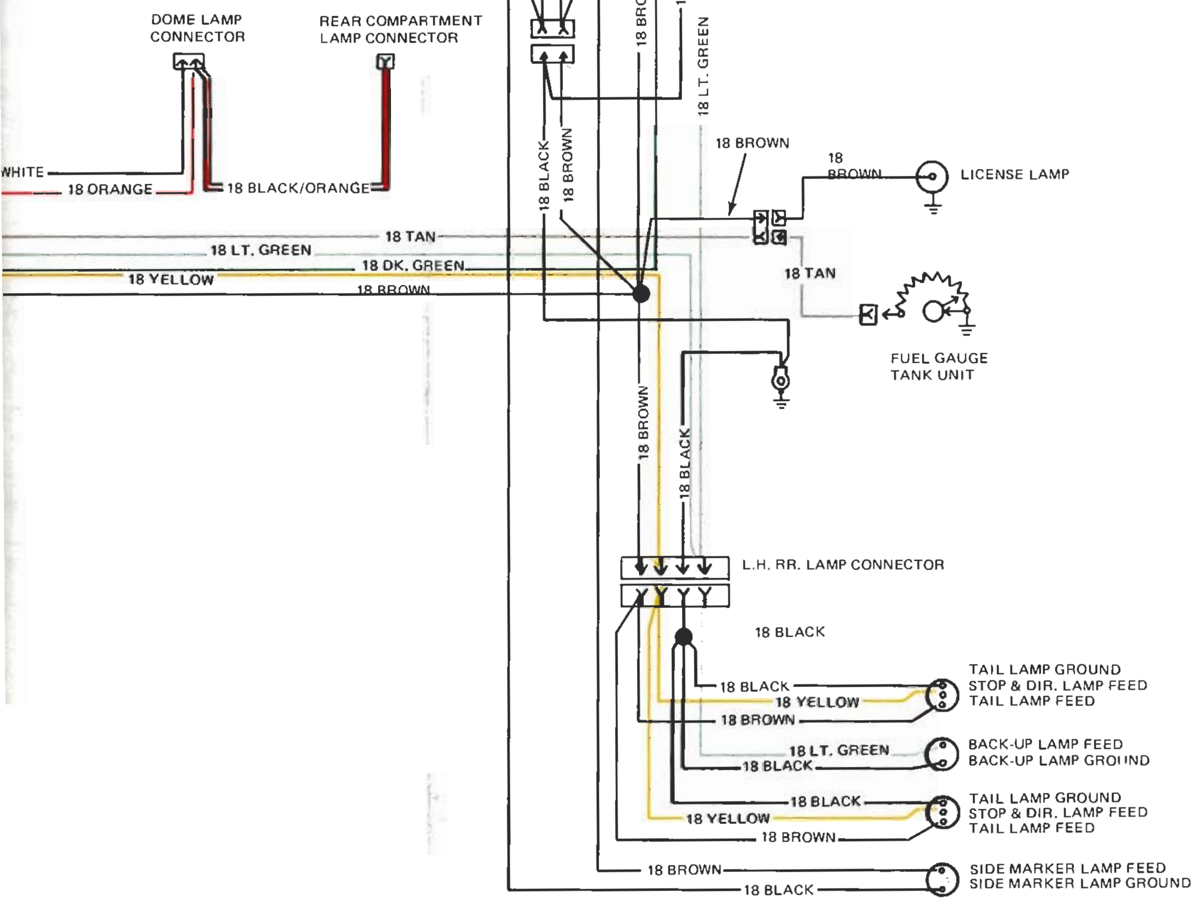
CONN.

BAT 2	IGN 1	ACC
*		✓
*	✓	✓
*	✓	

4 PIN CONN.

IGN 3	BAT 3	GRD 1	GRD 2
	*		
✓	*		
	*	X	✓

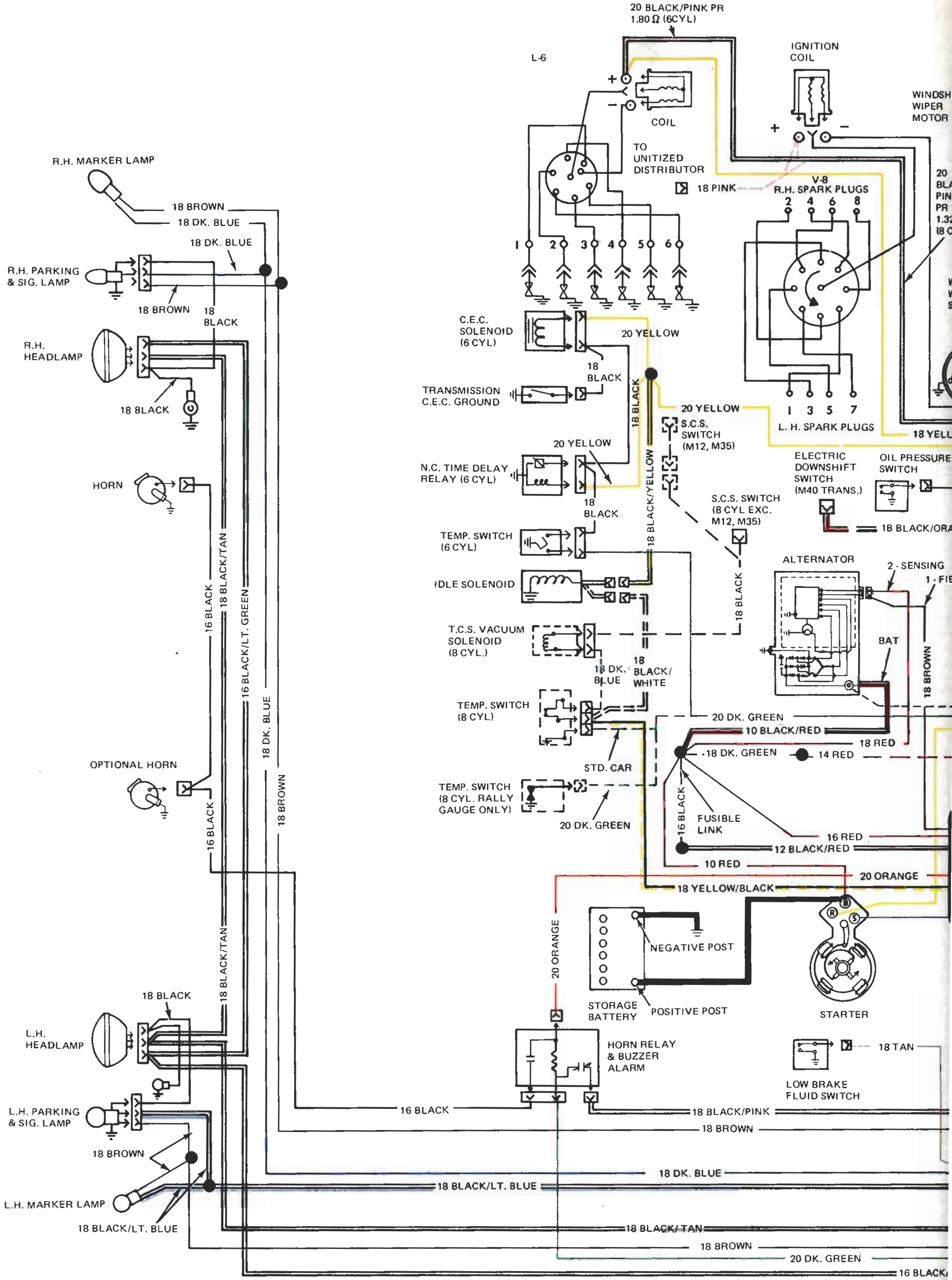




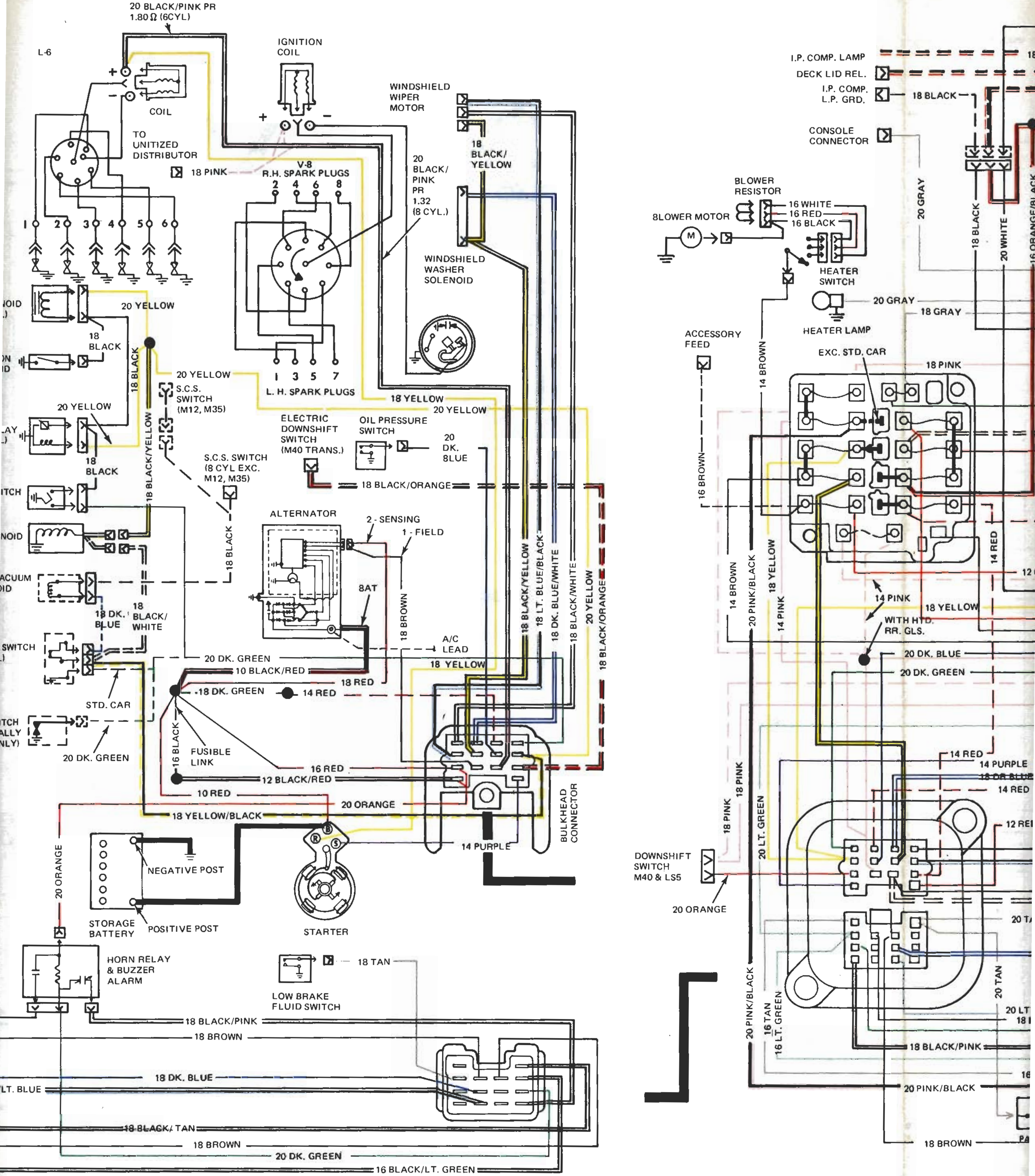
LEGEND

SOLID LINE ——— STANDARD CAR

BROKEN LINE — — — — EXCEPT STD. CAR



20 BLACK/PINK PR
1.80 Ω (6CYL)
L-6
IGNITION
COIL
COIL
WINDSH
WIPER
MOTOR
TO
UNITIZED
DISTRIBUTOR
18 PINK
V-8
R.H. SPARK PLUGS
2 4 6 8
R.H. MARKER LAMP
18 BROWN
18 DK. BLUE
18 DK. BLUE
R.H. PARKING
& SIG. LAMP
18 BROWN
18
BLACK
R.H.
HEADLAMP
18 BLACK
C.E.C.
SOLENOID
(6 CYL)
20 YELLOW
18
BLACK
TRANSMISSION
C.E.C. GROUND
18 BLACK
20 YELLOW
S.C.S.
SWITCH
(M12, M35)
1 3 5 7
L. H. SPARK PLUGS
18 YELL
20 YELLOW
N.C. TIME DELAY
RELAY (6 CYL)
18
BLACK
18 BLACK/YELLOW
ELECTRIC
DOWNSHIFT
SWITCH
(M40 TRANS.)
OIL PRESSURE
SWITCH
S.C.S. SWITCH
(8 CYL EXC.
M12, M35)
18 BLACK/ORA
HORN
TEMP. SWITCH
(6 CYL)
ALTERNATOR
2 - SENSING
1 - FIE
IDLE SOLENOID
18 BLACK
16 BLACK
18 BLACK/TAN
16 BLACK/LT. GREEN
18 DK. BLUE
T.C.S. VACUUM
SOLENOID
(8 CYL.)
18 DK.
BLUE
18
BLACK/
WHITE
BAT
18 BROWN
TEMP. SWITCH
(8 CYL)
20 DK. GREEN
10 BLACK/RED
18 RED
18 DK. GREEN
14 RED
STD. CAR
OPTIONAL HORN
TEMP. SWITCH
(8 CYL. RALLY
GAUGE ONLY)
20 DK. GREEN
16 BLACK
FUSIBLE
LINK
16 RED
12 BLACK/RED
18 BROWN
10 RED
20 ORANGE
18 YELLOW/BLACK
20 ORANGE
NEGATIVE POST
STORAGE
BATTERY
POSITIVE POST
STARTER
18 BLACK
18 BLACK/TAN
L.H.
HEADLAMP
HORN RELAY
& BUZZER
ALARM
18 TAN
LOW BRAKE
FLUID SWITCH
L.H. PARKING
& SIG. LAMP
16 BLACK
18 BLACK/PINK
18 BROWN
18 BROWN
18 DK. BLUE
L.H. MARKER LAMP
18 BLACK/LT. BLUE
18 BLACK/LT. BLUE
18 BLACK/TAN
18 BROWN
20 DK. GREEN
16 BLACK


20 BLACK/PINK PR
1.80 Ω (6CYL)
L-6
IGNITION
COIL
COIL
TO
UNITIZED
DISTRIBUTOR
18 PINK
V-8
R.H. SPARK PLUGS
2 4 6 8
1 3 5 7
L. H. SPARK PLUGS
WINDSHIELD
WIPER
MOTOR
18
BLACK/
YELLOW
20
BLACK/
PINK
PR
1.32
(8 CYL.)
WINDSHIELD
WASHER
SOLENOID
20 YELLOW
18
BLACK
18 BLACK
20 YELLOW
S.C.S.
SWITCH
(M12, M35)
20 YELLOW
18
BLACK
18 BLACK/YELLOW
S.C.S. SWITCH
(8 CYL EXC.
M12, M35)
18 BLACK
18 YELLOW
20 YELLOW
ELECTRIC
DOWNSHIFT
SWITCH
(M40 TRANS.)
OIL PRESSURE
SWITCH
20
DK.
BLUE
18 BLACK/ORANGE
ALTERNATOR
2 - SENSING
1 - FIELD
8AT
18 BROWN
A/C
LEAD
18 DK.
BLUE
18
BLACK/
WHITE
20 DK. GREEN
10 BLACK/RED
18 RED
18 YELLOW
18 DK. GREEN
14 RED
STD. CAR
20 DK. GREEN
16 BLACK
FUSIBLE
LINK
16 RED
12 BLACK/RED
10 RED
20 ORANGE
18 YELLOW/BLACK
18 BLACK/YELLOW
18 LT. BLUE/BLACK
18 DK. BLUE/WHITE
18 BLACK/WHITE
20 YELLOW
18 BLACK/ORANGE
BULKHEAD
CONNECTOR
14 PURPLE
NEGATIVE POST
STORAGE
BATTERY
POSITIVE POST
STARTER
20 ORANGE
HORN RELAY
& BUZZER
ALARM
18 TAN
LOW BRAKE
FLUID SWITCH
18 BLACK/PINK
18 BROWN
18 DK. BLUE
LT. BLUE
18 BLACK/TAN
18 BROWN
20 DK. GREEN
16 BLACK/LT. GREEN
I.P. COMP. LAMP
DECK LID REL.
I.P. COMP.
L.P. GRD.
18 BLACK
CONSOLE
CONNECTOR
20 GRAY
18 BLACK
20 WHITE
BLOWER
RESISTOR
BLOWER MOTOR
16 WHITE
16 RED
16 BLACK
HEATER
SWITCH
20 GRAY
18 GRAY
HEATER LAMP
ACCESSORY
FEED
14 BROWN
EXC. STD. CAR
18 PINK
16 BROWN
14 RED
14 BROWN
20 PINK/BLACK
18 YELLOW
14 PINK
14 PINK
18 YELLOW
WITH HTD.
RR. GLS.
20 DK. BLUE
20 DK. GREEN
14 RED
14 PURPLE
14 RED
12 RED
18 PINK
18 PINK
20 LT. GREEN
DOWNSHIFT
SWITCH
M40 & LS5
20 ORANGE
20 TAN
20 PINK/BLACK
16 TAN
16 LT. GREEN
18 BLACK/PINK
20 PINK/BLACK
18 BROWN

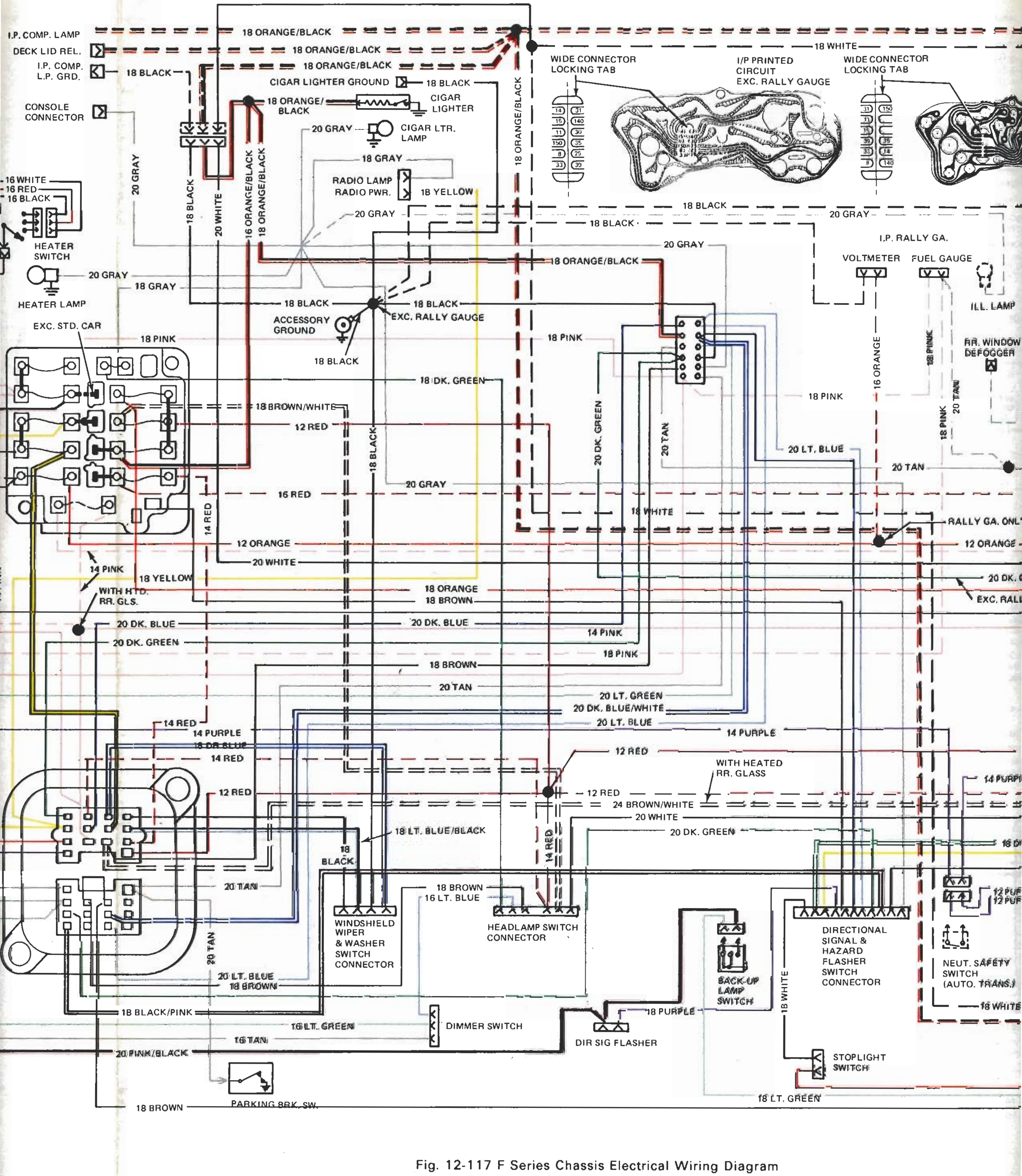
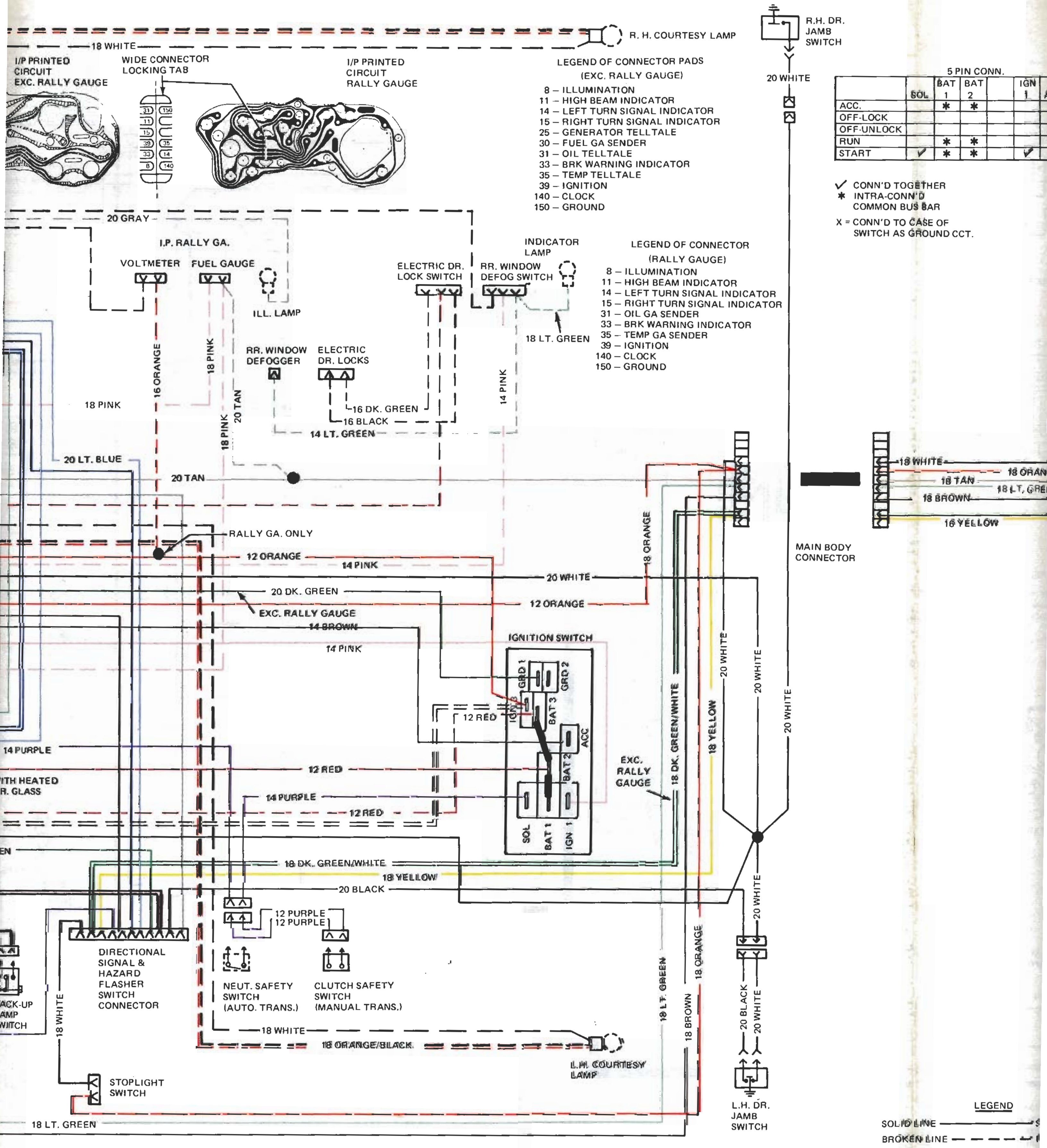


Fig. 12-117 F Series Chassis Electrical Wiring Diagram


R. H. COURTESY LAMP
R.H. DR. JAMB SWITCH
18 WHITE
I/P PRINTED CIRCUIT EXC. RALLY GAUGE
WIDE CONNECTOR LOCKING TAB
I/P PRINTED CIRCUIT RALLY GAUGE
LEGEND OF CONNECTOR PADS
(EXC. RALLY GAUGE)
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
20 WHITE
5 PIN CONN.
SOL
BAT 1
BAT 2
IGN 1
ACC.
OFF-LOCK
OFF-UNLOCK
RUN
START
CONN'D TOGETHER
INTRA-CONN'D COMMON BUS BAR
X = CONN'D TO CASE OF SWITCH AS GROUND CCT.
20 GRAY
I.P. RALLY GA.
VOLTMETER
FUEL GAUGE
ILL. LAMP
INDICATOR LAMP
ELECTRIC DR. LOCK SWITCH
RR. WINDOW DEFOG SWITCH
LEGEND OF CONNECTOR
(RALLY GAUGE)
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
18 LT. GREEN
RR. WINDOW DEFOGGER
ELECTRIC DR. LOCKS
16 ORANGE
18 PINK
18 PINK
20 TAN
18 PINK
16 DK. GREEN
16 BLACK
14 LT. GREEN
14 PINK
20 LT. BLUE
20 TAN
18 WHITE
18 ORANGE
18 TAN
18 LT. GREEN
18 BROWN
16 YELLOW
MAIN BODY CONNECTOR
RALLY GA. ONLY
12 ORANGE
14 PINK
18 ORANGE
20 WHITE
20 DK. GREEN
12 ORANGE
EXC. RALLY GAUGE
14 BROWN
14 PINK
IGNITION SWITCH
GRD 1
GRD 2
IGN 3
BAT 3
12 RED
ACC
BAT 2
SOL
BAT 1
IGN 1
EXC. RALLY GAUGE
18 DK. GREEN/WHITE
18 YELLOW
20 WHITE
20 WHITE
20 WHITE
14 PURPLE
12 RED
ITH HEATED
R. GLASS
14 PURPLE
12 RED
EN
18 DK. GREEN/WHITE
18 YELLOW
20 BLACK
12 PURPLE
12 PURPLE
20 WHITE
DIRECTIONAL SIGNAL & HAZARD FLASHER SWITCH CONNECTOR
NEUT. SAFETY SWITCH (AUTO. TRANS.)
CLUTCH SAFETY SWITCH (MANUAL TRANS.)
ACK-UP
AMP
WITCH
18 WHITE
18 WHITE
18 ORANGE/BLACK
18 LT. GREEN
18 BROWN
18 ORANGE
20 BLACK
20 WHITE
L.H. COURTESY LAMP
STOPLIGHT SWITCH
18 LT. GREEN
L.H. DR. JAMB SWITCH
LEGEND
SOLID LINE
BROKEN LINE

Diagram

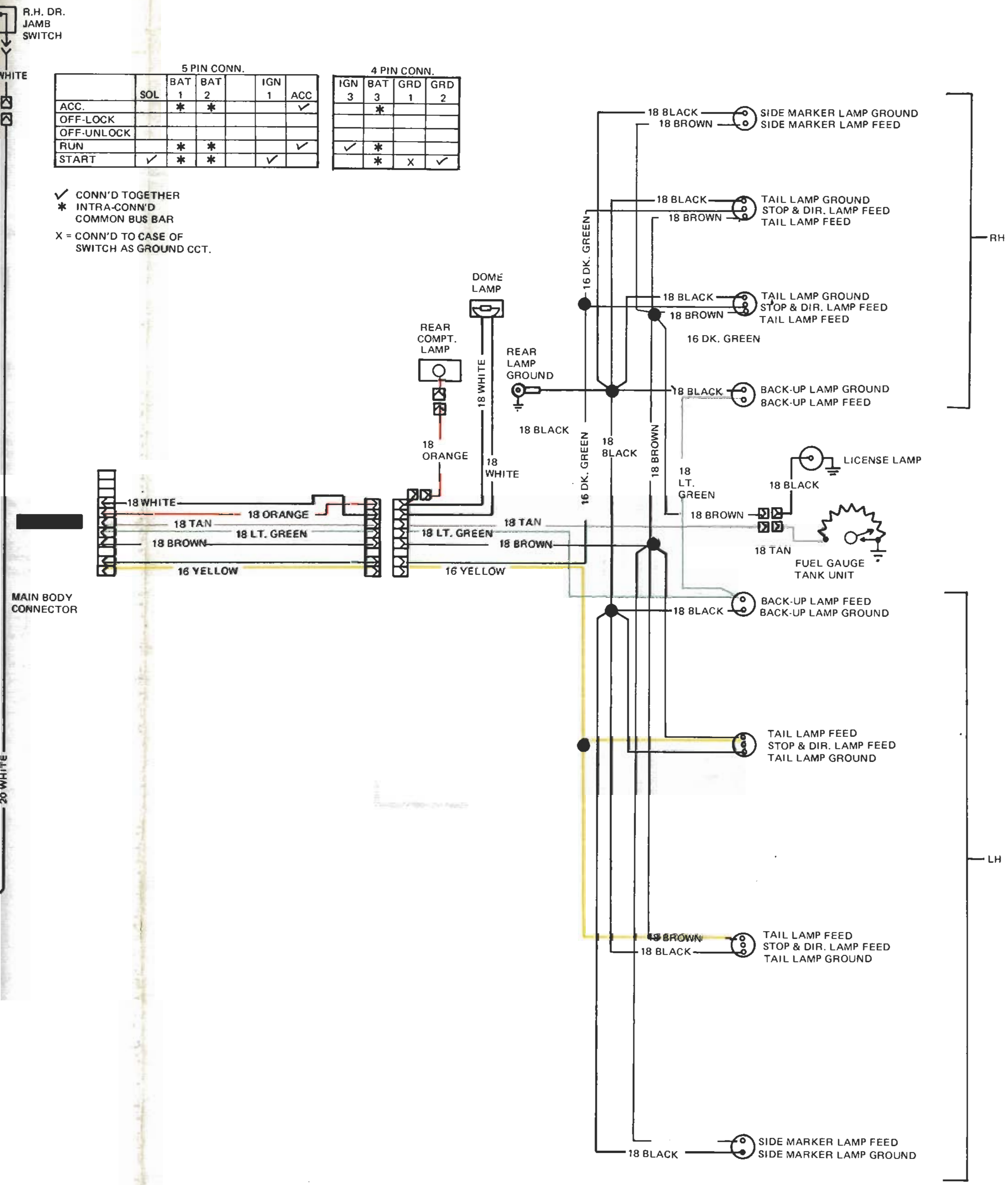
5 PIN CONN.

	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	✓

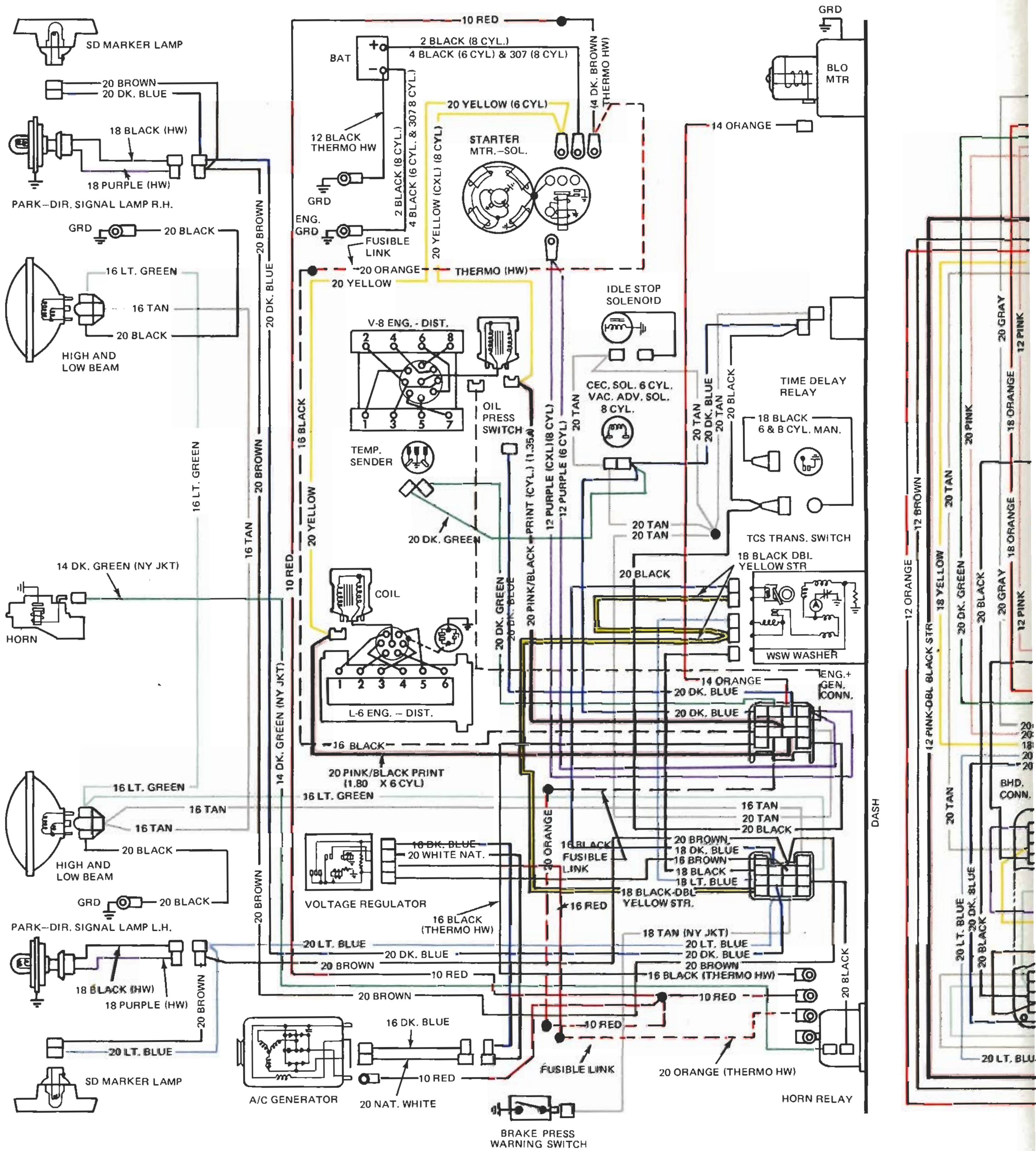
✓ CONN'D TOGETHER
✱ INTRA-CONN'D COMMON BUS BAR
X = CONN'D TO CASE OF SWITCH AS GROUND CCT.



LEGEND

SOLID LINE ——— STANDARD CAR

BROKEN LINE – – – – EXCEPT STD. CAR


SD MARKER LAMP
20 BROWN
20 DK. BLUE
18 BLACK (HW)
18 PURPLE (HW)
PARK–DIR. SIGNAL LAMP R.H.
GRD
20 BLACK
16 LT. GREEN
16 TAN
20 BLACK
HIGH AND LOW BEAM
14 DK. GREEN (NY JKT)
HORN
16 LT. GREEN
16 TAN
16 TAN
20 BLACK
HIGH AND LOW BEAM
GRD
20 BLACK
PARK–DIR. SIGNAL LAMP L.H.
18 BLACK (HW)
18 PURPLE (HW)
20 BROWN
20 LT. BLUE
SD MARKER LAMP
10 RED
BAT
2 BLACK (8 CYL.)
4 BLACK (6 CYL) & 307 (8 CYL)
20 YELLOW (6 CYL)
4 DK. BROWN THERMO HW
12 BLACK THERMO HW
GRD
ENG. GRD
FUSIBLE LINK
20 ORANGE
THERMO (HW)
20 YELLOW
STARTER MTR.–SOL.
2 BLACK (8 CYL.)
4 BLACK (6 CYL. & 307 8 CYL.)
20 YELLOW (CXL) (8 CYL)
V-8 ENG. - DIST.
OIL PRESS SWITCH
TEMP. SENDER
20 DK. GREEN
COIL
L-6 ENG. – DIST.
16 BLACK
20 YELLOW
10 RED
16 BLACK
20 PINK/BLACK PRINT (1.80 X 6 CYL)
16 LT. GREEN
VOLTAGE REGULATOR
18 DK. BLUE
20 WHITE NAT.
16 BLACK (THERMO HW)
20 LT. BLUE
20 DK. BLUE
20 BROWN
10 RED
20 BROWN
16 DK. BLUE
10 RED
A/C GENERATOR
20 NAT. WHITE
FUSIBLE LINK
BRAKE PRESS WARNING SWITCH
GRD
BLO MTR
14 ORANGE
IDLE STOP SOLENOID
CEC. SOL. 6 CYL. VAC. ADV. SOL. 8 CYL.
TIME DELAY RELAY
18 BLACK 6 & 8 CYL. MAN.
20 TAN
20 DK. BLUE
20 TAN
20 BLACK
20 TAN
20 TAN
TCS TRANS. SWITCH
18 BLACK DBL. YELLOW STR
20 BLACK
WSW WASHER
14 ORANGE
20 DK. BLUE
20 DK. BLUE
ENG.+ GEN. CONN.
12 PURPLE (CXL) (8 CYL)
12 PURPLE (6 CYL)
20 PINK/BLACK PRINT (CYL.) (1.35A)
20 DK. GREEN
20 DK. BLUE
14 DK. GREEN (NY JKT)
20 ORANGE
16 BLACK
FUSIBLE LINK
16 RED
18 BLACK-DBL YELLOW STR.
16 TAN
20 TAN
20 BLACK
20 BROWN
18 DK. BLUE
16 BROWN
18 BLACK
18 LT. BLUE
18 TAN (NY JKT)
20 LT. BLUE
20 DK. BLUE
20 BROWN
16 BLACK (THERMO HW)
10 RED
10 RED
20 ORANGE (THERMO HW)
20 BLACK
HORN RELAY
DASH
12 ORANGE
12 BROWN
12 PINK-DBL BLACK STR
18 YELLOW
20 DK. GREEN
20 BLACK
20 GRAY
18 ORANGE
12 PINK
20 PINK
20 TAN
20 TAN
20 LT. BLUE
20 DK. BLUE
20 BLACK
BHD. CONN.
20 LT. BLU

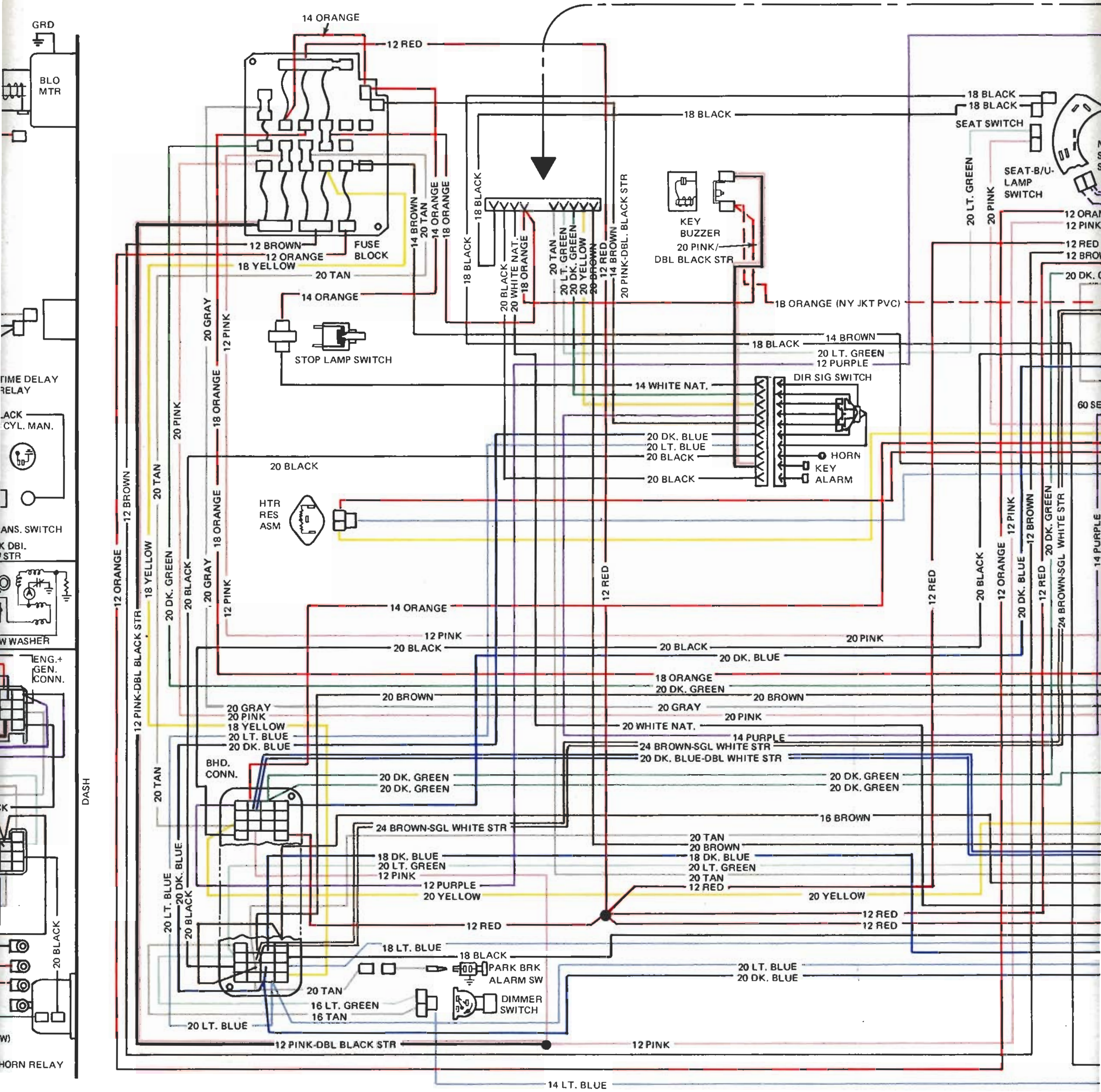


Fig. 12-118 X Series Chassis Electrical

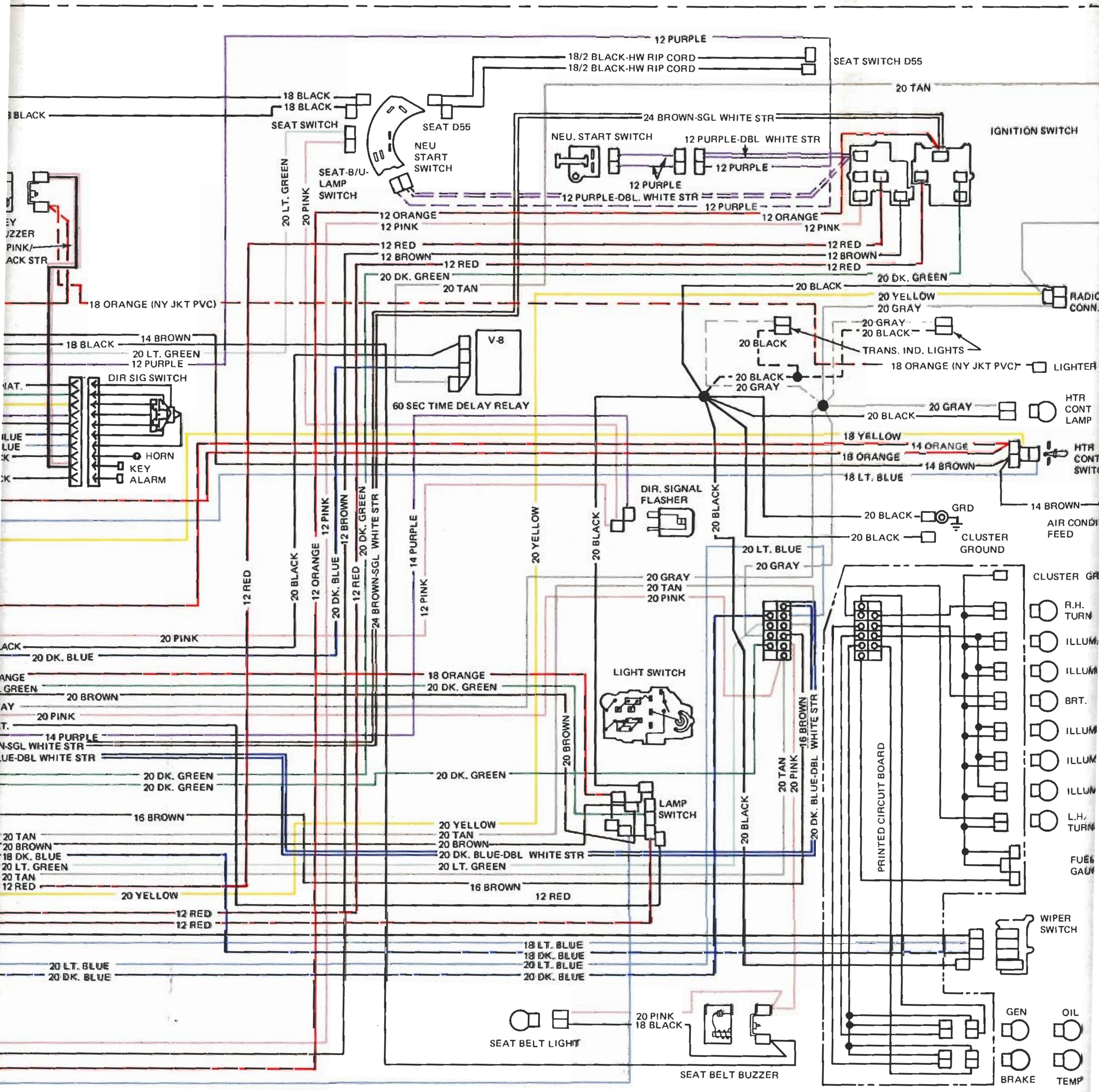
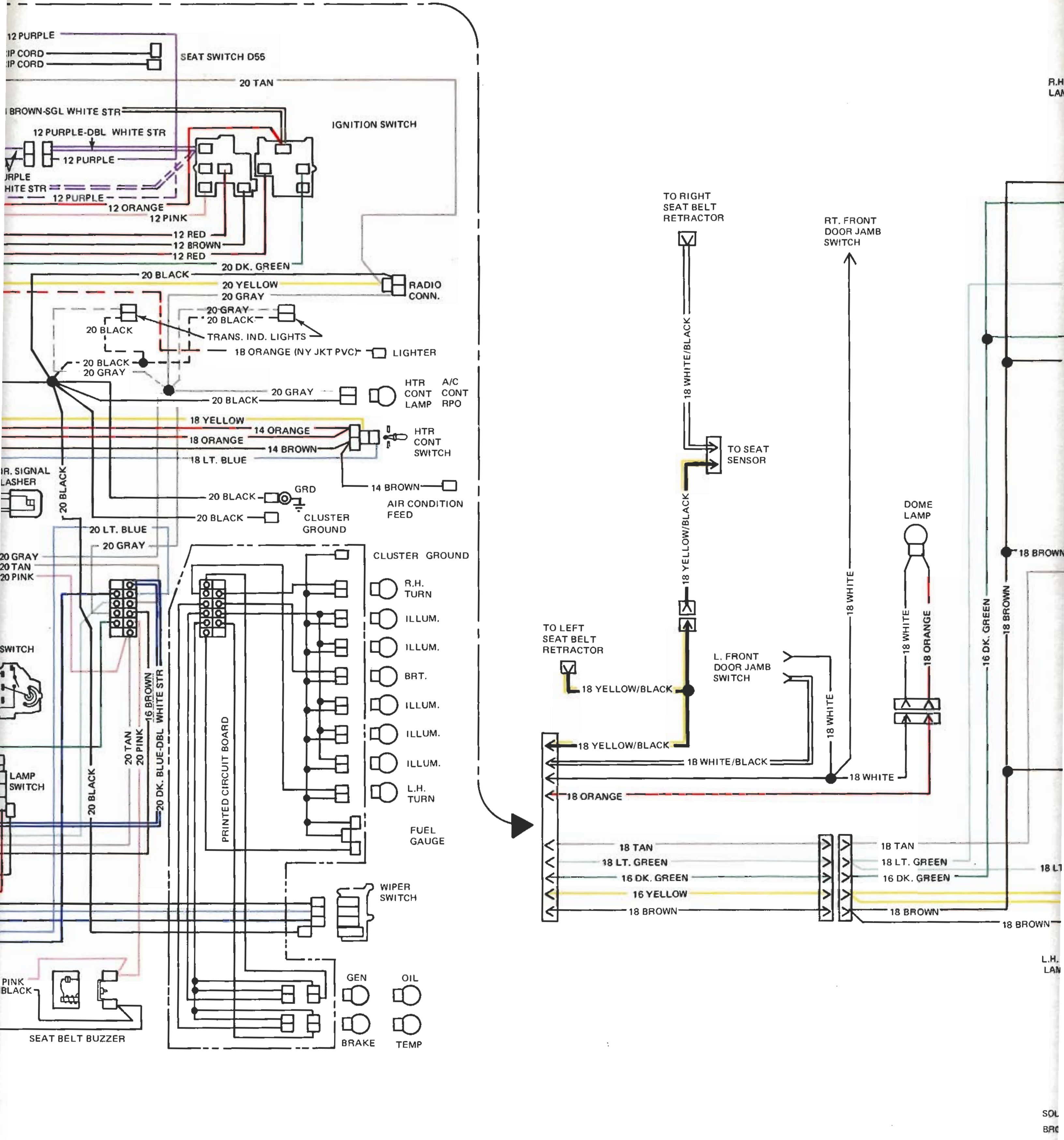
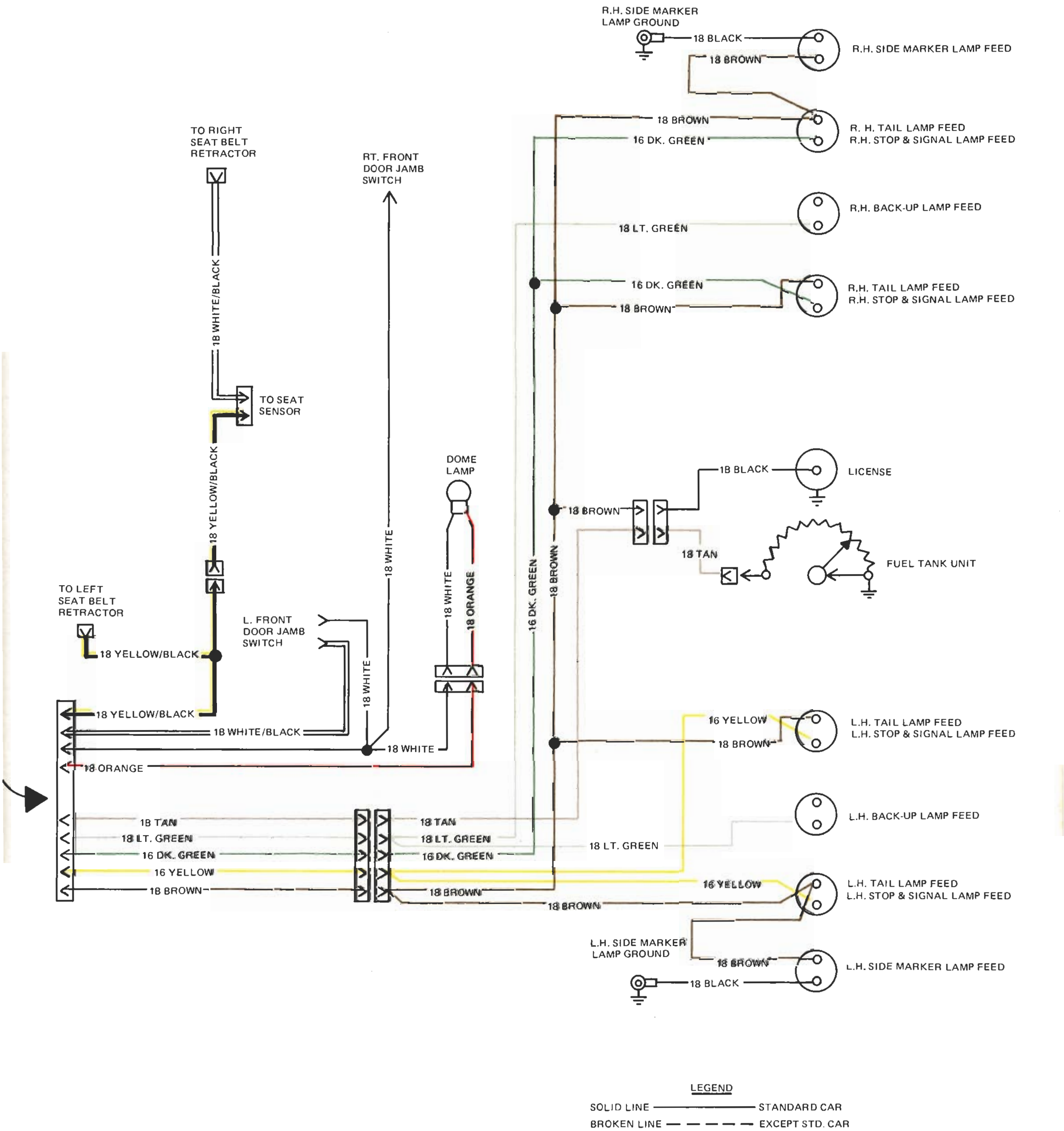


Fig. 12-118 X Series Chassis Electrical Wiring Diagram



12 PURPLE
SEAT SWITCH D55
20 TAN
BROWN-SGL WHITE STR
12 PURPLE-DBL WHITE STR
IGNITION SWITCH
12 PURPLE
12 ORANGE
12 PINK
12 RED
12 BROWN
12 RED
20 DK. GREEN
20 BLACK
20 YELLOW
20 GRAY
RADIO CONN.
20 GRAY
20 BLACK
20 BLACK
TRANS. IND. LIGHTS
18 ORANGE (NY JKT PVC)
LIGHTER
20 BLACK
20 GRAY
20 GRAY
20 BLACK
HTR CONT LAMP
A/C CONT RPO
18 YELLOW
14 ORANGE
18 ORANGE
14 BROWN
18 LT. BLUE
HTR CONT SWITCH
14 BROWN
AIR CONDITION FEED
20 BLACK
GRD
20 BLACK
CLUSTER GROUND
20 LT. BLUE
20 GRAY
20 GRAY
20 TAN
20 PINK
SWITCH
LAMP SWITCH
20 BLACK
20 TAN
20 PINK
16 BROWN
WHITE STR
20 DK. BLUE-DBL
PRINTED CIRCUIT BOARD
CLUSTER GROUND
R.H. TURN
ILLUM.
ILLUM.
BRT.
ILLUM.
ILLUM.
ILLUM.
L.H. TURN
FUEL GAUGE
WIPER SWITCH
PINK
BLACK
SEAT BELT BUZZER
GEN
OIL
BRAKE
TEMP
TO RIGHT SEAT BELT RETRACTOR
18 WHITE/BLACK
TO SEAT SENSOR
18 YELLOW/BLACK
RT. FRONT DOOR JAMB SWITCH
18 WHITE
TO LEFT SEAT BELT RETRACTOR
18 YELLOW/BLACK
L. FRONT DOOR JAMB SWITCH
18 WHITE
18 YELLOW/BLACK
18 WHITE/BLACK
18 WHITE
18 ORANGE
DOME LAMP
18 WHITE
18 ORANGE
16 DK. GREEN
18 BROWN
18 BROWN
18 TAN
18 LT. GREEN
16 DK. GREEN
16 YELLOW
18 BROWN
18 TAN
18 LT. GREEN
16 DK. GREEN
18 BROWN
18 BROWN


R.H. SIDE MARKER LAMP GROUND
18 BLACK
18 BROWN
R.H. SIDE MARKER LAMP FEED
18 BROWN
16 DK. GREEN
R. H. TAIL LAMP FEED
R.H. STOP & SIGNAL LAMP FEED
18 LT. GREEN
R.H. BACK-UP LAMP FEED
16 DK. GREEN
18 BROWN
R.H. TAIL LAMP FEED
R.H. STOP & SIGNAL LAMP FEED
TO RIGHT SEAT BELT RETRACTOR
18 WHITE/BLACK
TO SEAT SENSOR
18 YELLOW/BLACK
RT. FRONT DOOR JAMB SWITCH
18 WHITE
DOME LAMP
18 WHITE
18 ORANGE
16 DK. GREEN
18 BROWN
18 BLACK
LICENSE
18 BROWN
18 TAN
FUEL TANK UNIT
TO LEFT SEAT BELT RETRACTOR
18 YELLOW/BLACK
L. FRONT DOOR JAMB SWITCH
18 WHITE
18 YELLOW/BLACK
18 WHITE/BLACK
18 WHITE
18 ORANGE
16 YELLOW
18 BROWN
L.H. TAIL LAMP FEED
L.H. STOP & SIGNAL LAMP FEED
L.H. BACK-UP LAMP FEED
18 TAN
18 LT. GREEN
16 DK. GREEN
16 YELLOW
18 BROWN
18 TAN
18 LT. GREEN
16 DK. GREEN
18 BROWN
18 LT. GREEN
16 YELLOW
18 BROWN
L.H. TAIL LAMP FEED
L.H. STOP & SIGNAL LAMP FEED
L.H. SIDE MARKER LAMP GROUND
18 BROWN
18 BLACK
L.H. SIDE MARKER LAMP FEED
LEGEND
SOLID LINE — STANDARD CAR
BROKEN LINE — — — — EXCEPT STD. CAR

SECTION 13

RADIATOR

GENERAL DESCRIPTION

All models are equipped with cross-flow radiators, which provide horizontal coolant flow for improved cooling characteristics. For specifications and usage, refer to the radiator charts in Section 6A.

All V-8 radiators are supported by insulators which are cradled in the fan shroud. The fan shroud is firmly attached to the support and baffle assembly (Refer to Section 6A).

A Series 6 cylinder radiators are supported by insulated cradle type brackets, which retain both the lower and upper ends of the radiator tanks.

The two upper cradles are attached to the bottomside of the upper panel mounting assembly which, in turn, is fastened to the front end support and baffle assembly, for radiator removal and replace refer to Section 6A.

RADIATOR SUPPORT

REMOVE

1. Disconnect and remove battery and battery tray.
2. Drain and remove radiator and shroud assembly. For radiator removal see Section 6A.
3. Remove valance panel (if so equipped).
4. Remove front bumper assembly.
5. On all models except F Series remove headlamp filler panel.
6. Remove front end wire harness from radiator support.
7. Remove radiator support mounts, and attaching screws.
8. Remove radiator support assembly.

REPLACE

1. Replace radiator support assembly by reversing the previous procedure.
2. Check operation of all lights and adjust headlamp aim.

SECTION 14

FRONT AND REAR BUMPERS

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

FRONT BUMPERS

ADJUST

Attachment of bumpers is such that slotted holes in the frame and bumper to frame attachment bars provide fore and aft, lateral, as well as vertical adjustment.

REMOVE - G SERIES (Fig. 14-1)

1. Support bumper - remove bumper hanger bar to frame attaching bolts.
2. Remove bumper from vehicle.
3. Remove grille assembly.
4. Remove bumper reinforcement.

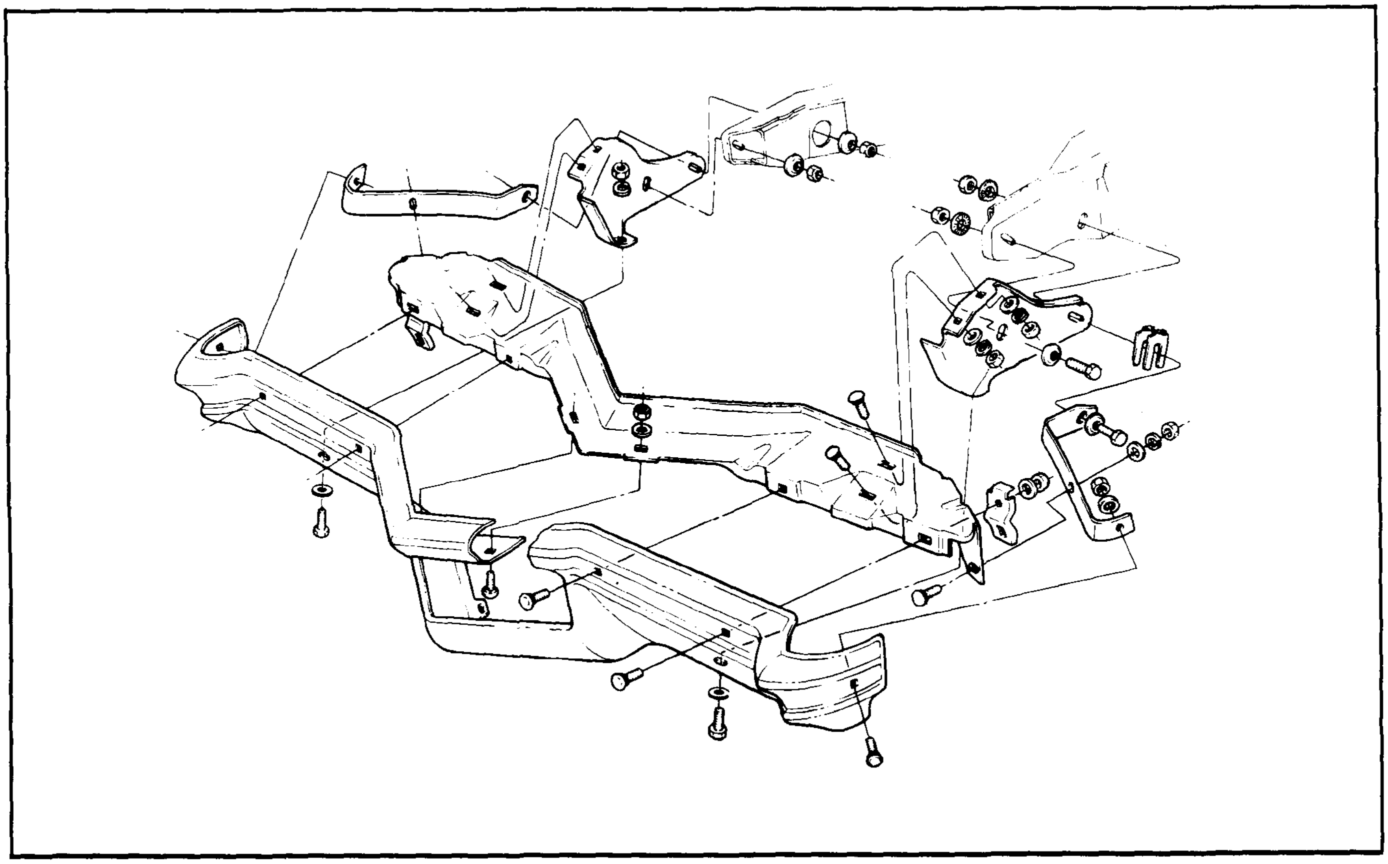


Fig. 14-1 G Series Front Bumper Assembly

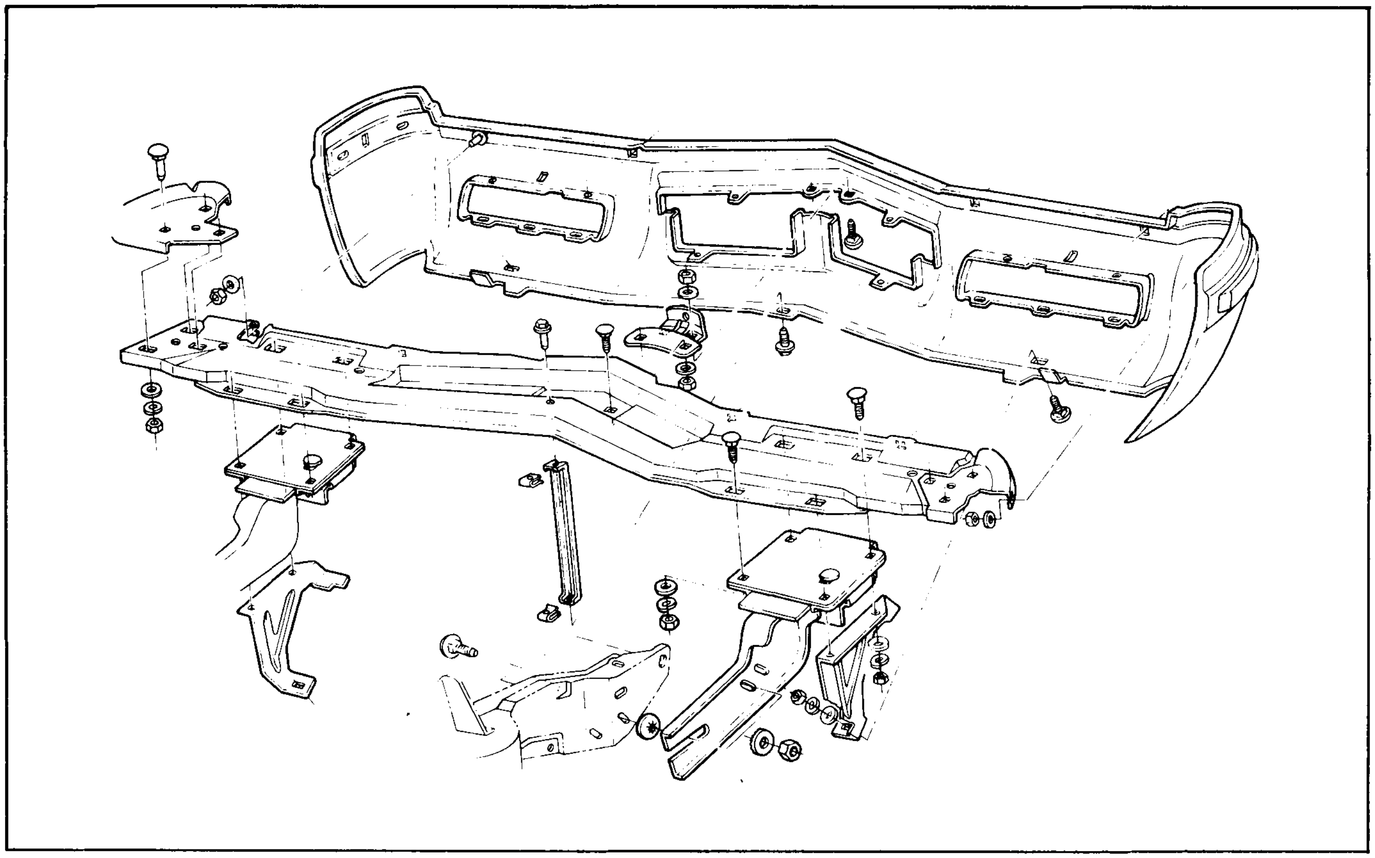


Fig. 14-2 B Series Front Bumper Assembly

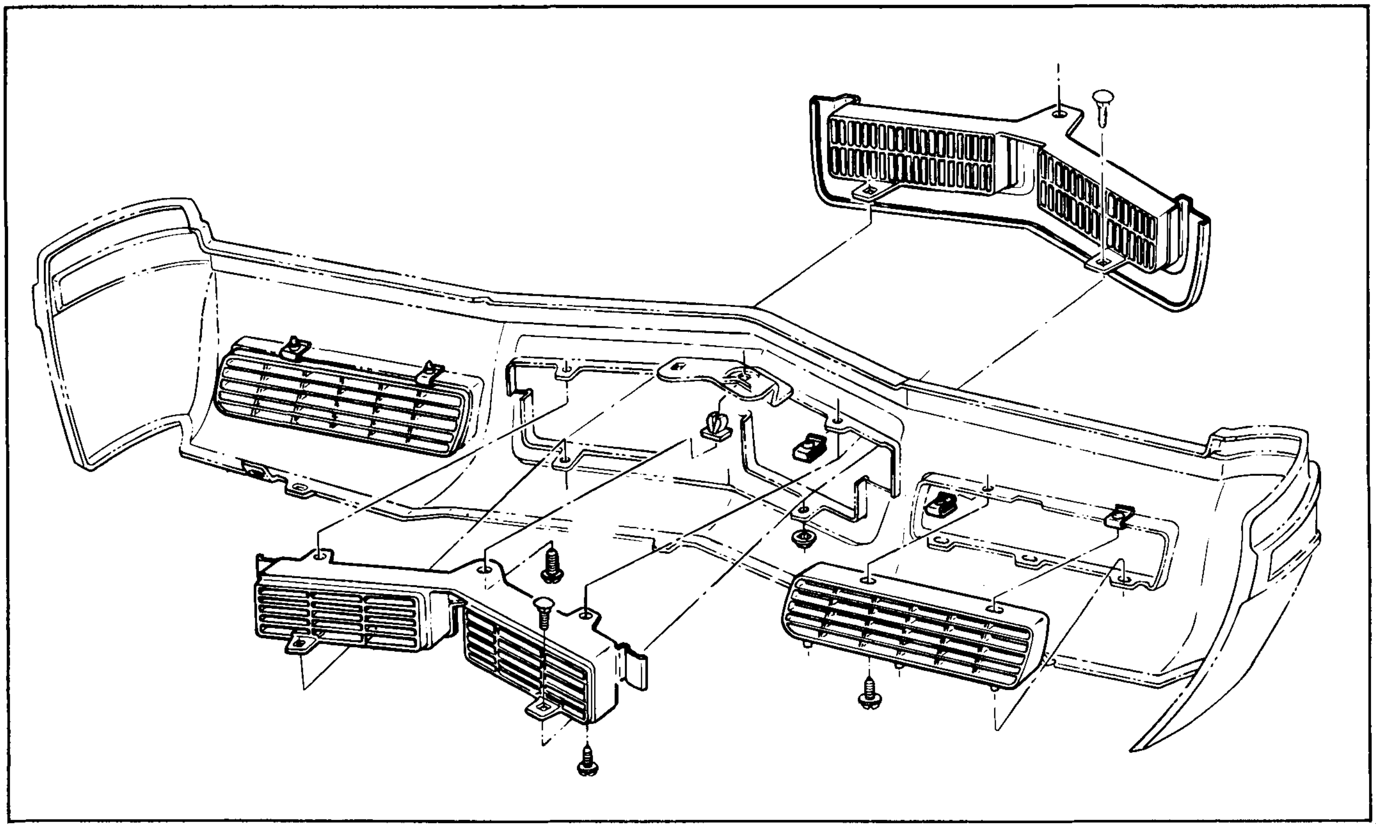


Fig. 14-3 B Series Lower Grille Assemblies

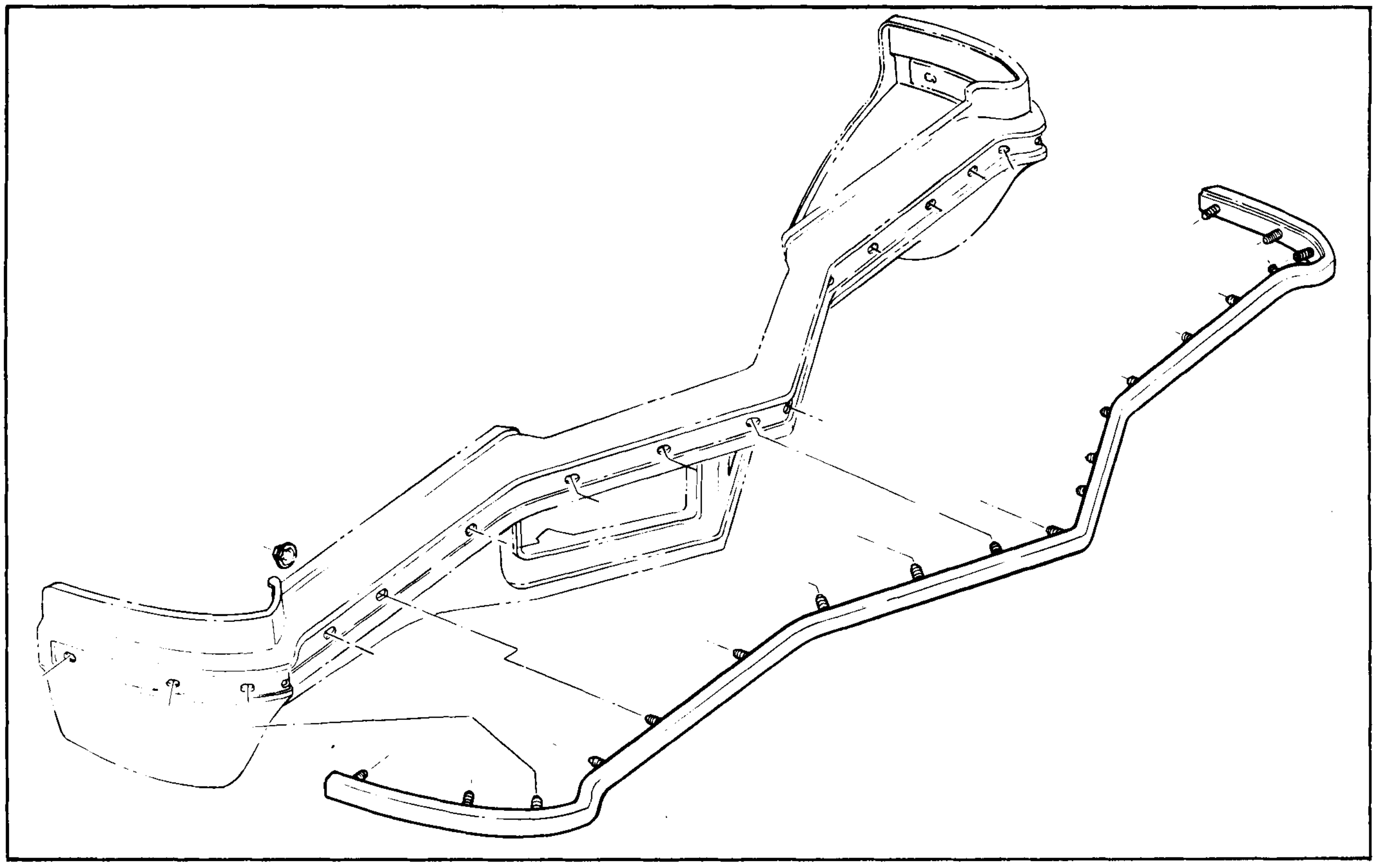


Fig. 14-4 B Series Front Bumper Rub Strip

REMOVE - B SERIES (Fig. 14-3, 4)

1. Support bumper - remove bumper hanger to frame attaching bolts.
2. With aid of helper remove bumper assembly.
3. Remove bumper reinforcement.
4. Remove grille assemblies.
5. Remove bumper rub strip.

REMOVE A SERIES (Fig. 14-6, 7)

1. Remove valance panel.
2. Support bumper - remove bumper hanger to bumper reinforcement bolts.
3. Remove bumper assembly.
4. Remove bumper reinforcement.

REMOVE GT and G.T.O. (Fig. 14-8)

1. Remove parking lamp assembly.
2. Remove valance panel.
3. Remove upper support bolts.
4. Support bumper - remove bumper hanger to bumper reinforcement bolts.
5. Remove bumper assembly.
6. Remove bumper reinforcement.
7. Remove grille assembly (Fig. 14-9)

REMOVE F SERIES FRONT BUMPER (Fig. 14-11)

1. Remove radiator support to bumper plastic filler.
2. Remove valance panel (Fig. 14-10).
3. Disconnect headlamp connectors.
4. Remove bumper to hanger brackets attaching bolts.
5. Remove bumper assembly (Fig. 14-11).
6. Remove grille assembly (Fig. 14-12).

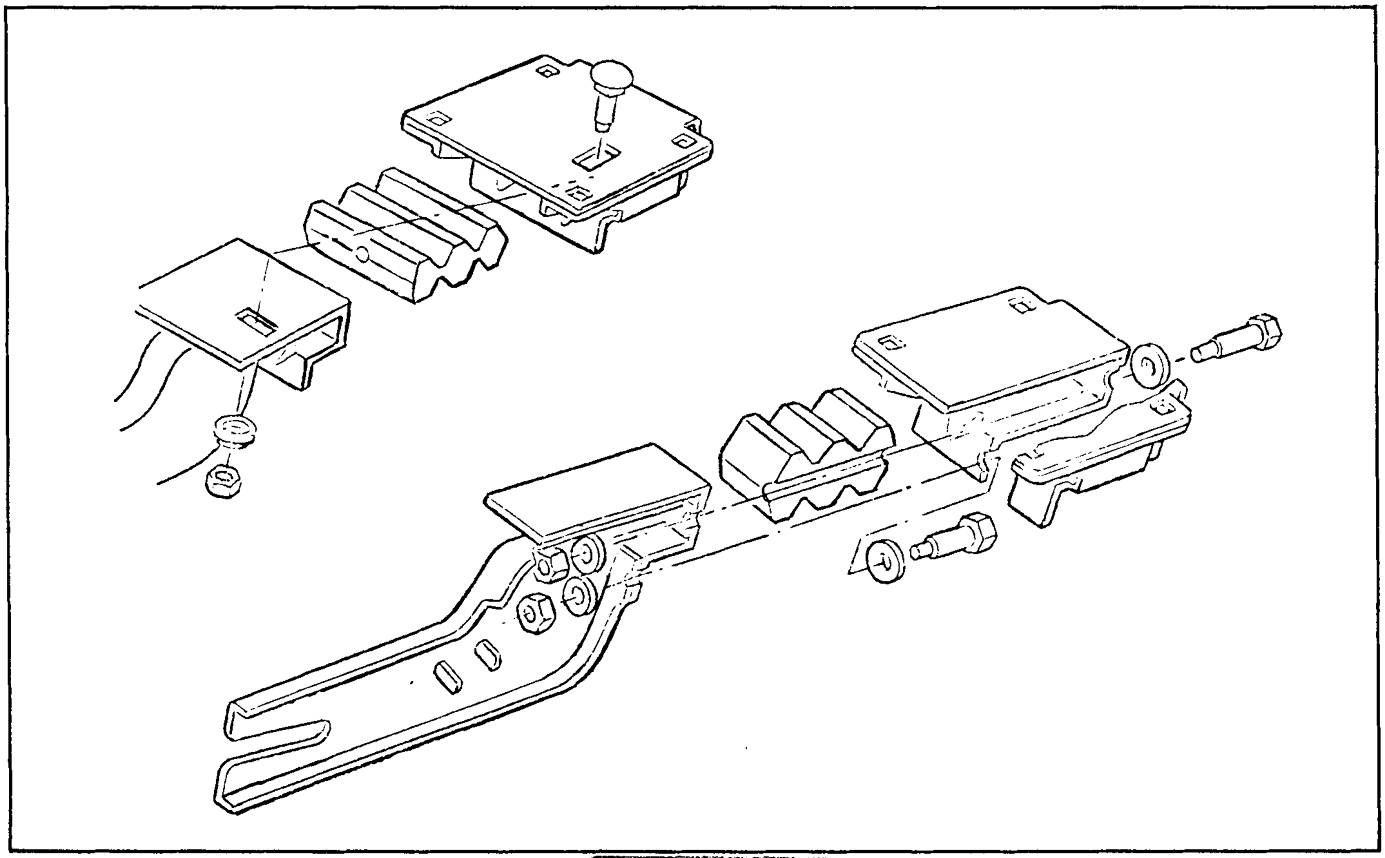


Fig. 14-5 B Series Front Bumper Hanger Assembly

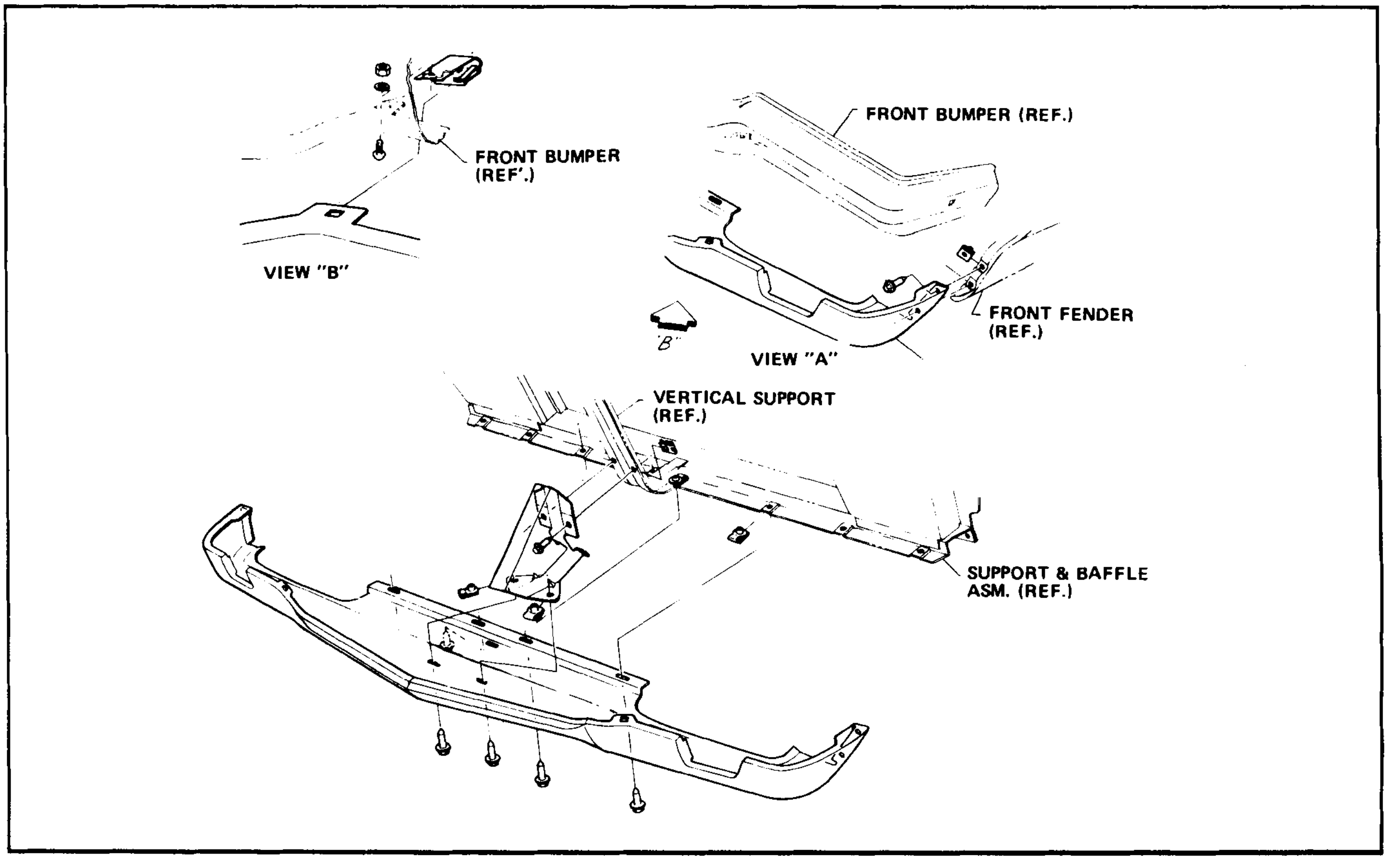


Fig. 14-6 A Series Valance Panel

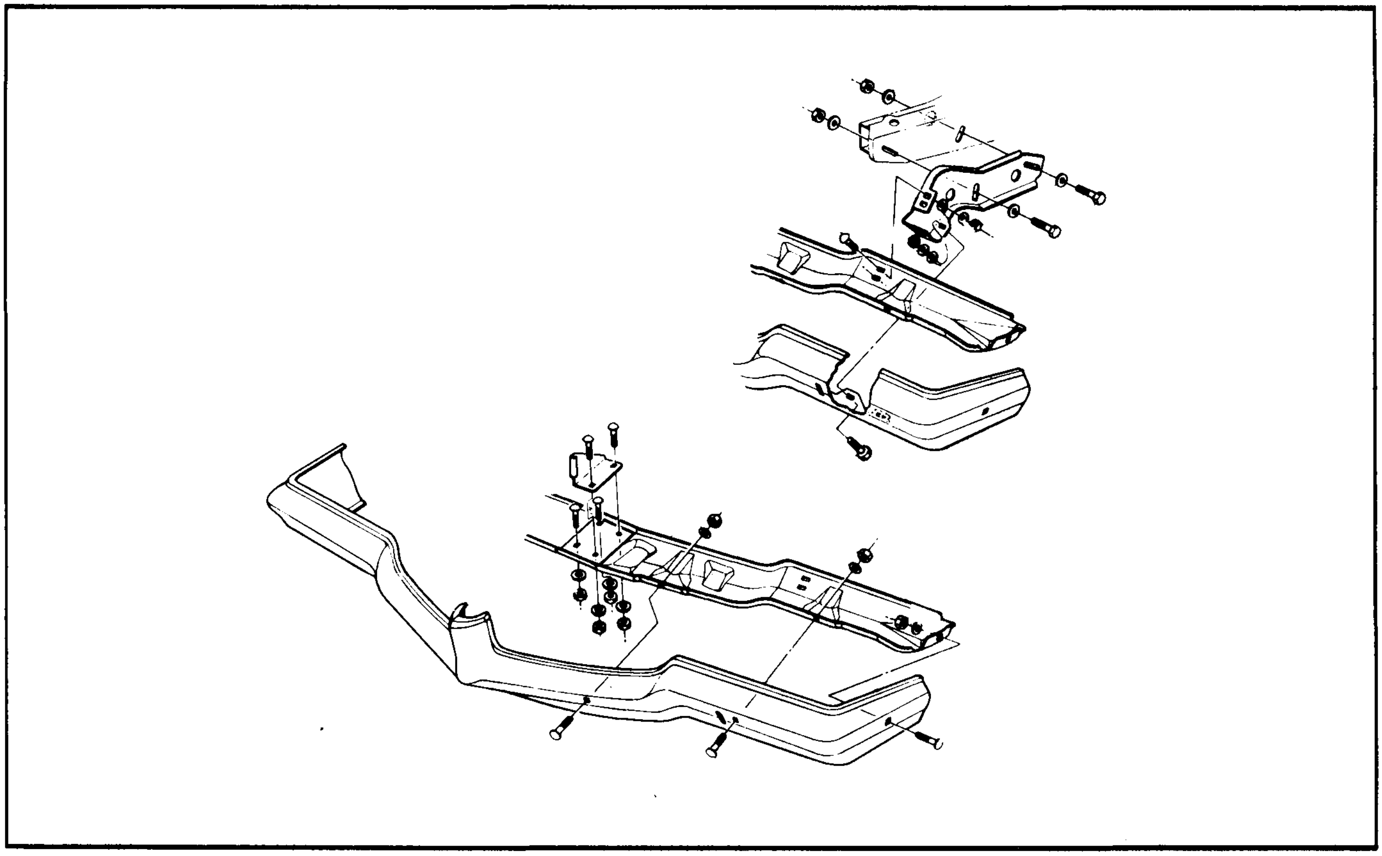


Fig. 14-7 A Series Front Bumper Assembly

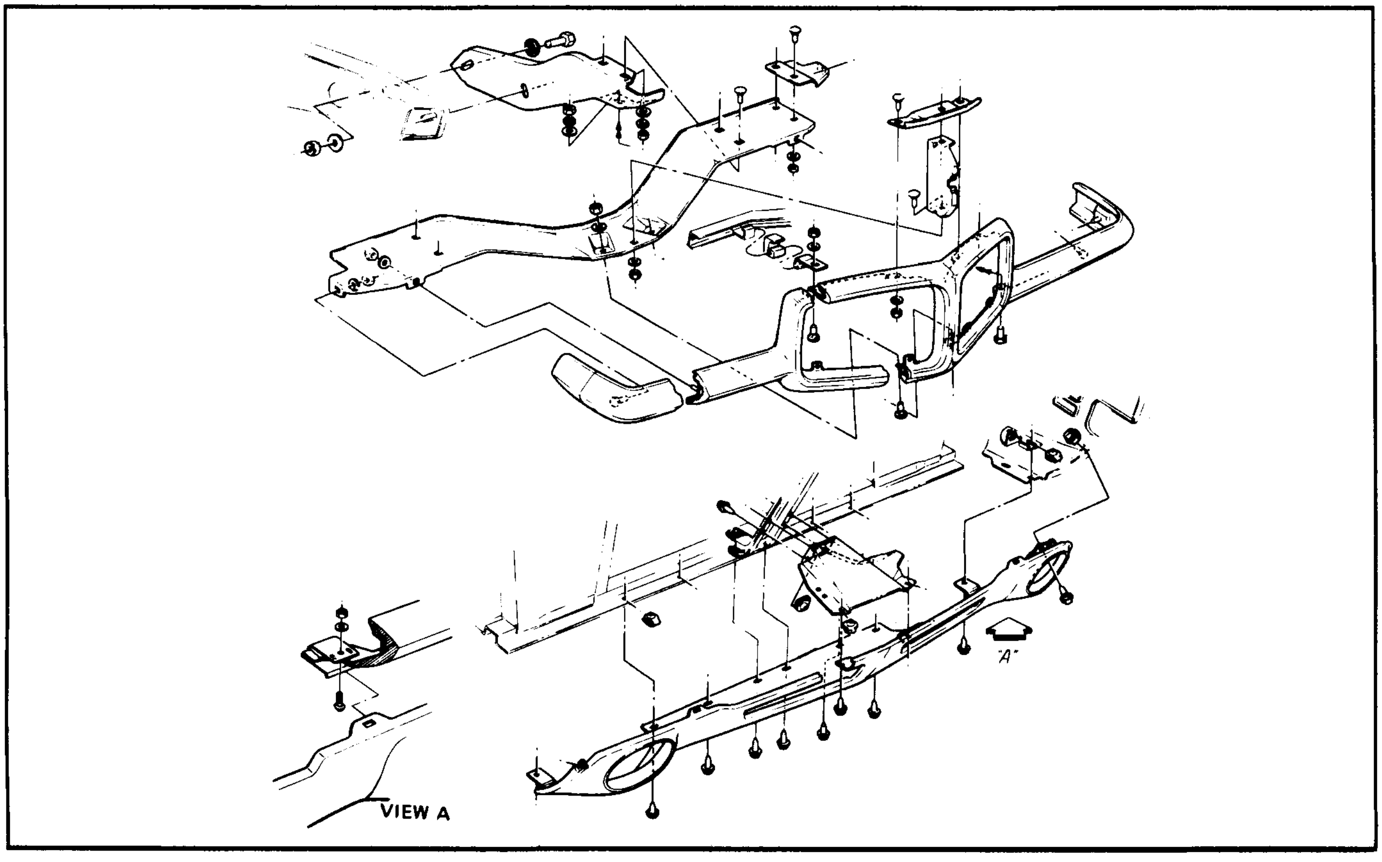


Fig. 14-8 GT and G.T.O. Front Bumper and Valance Panel

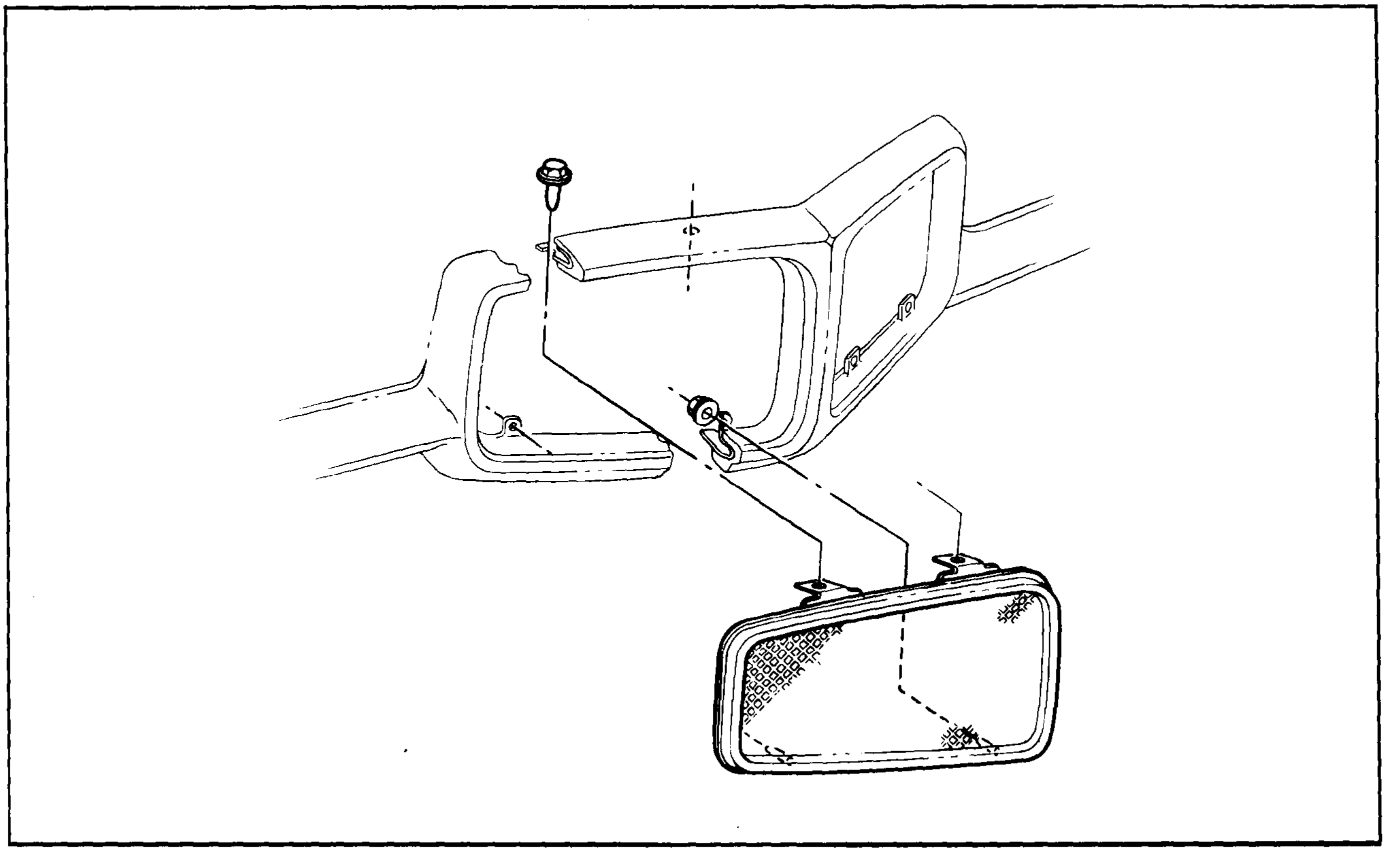


Fig. 14-9 GT and G.T.O. Grille Assembly

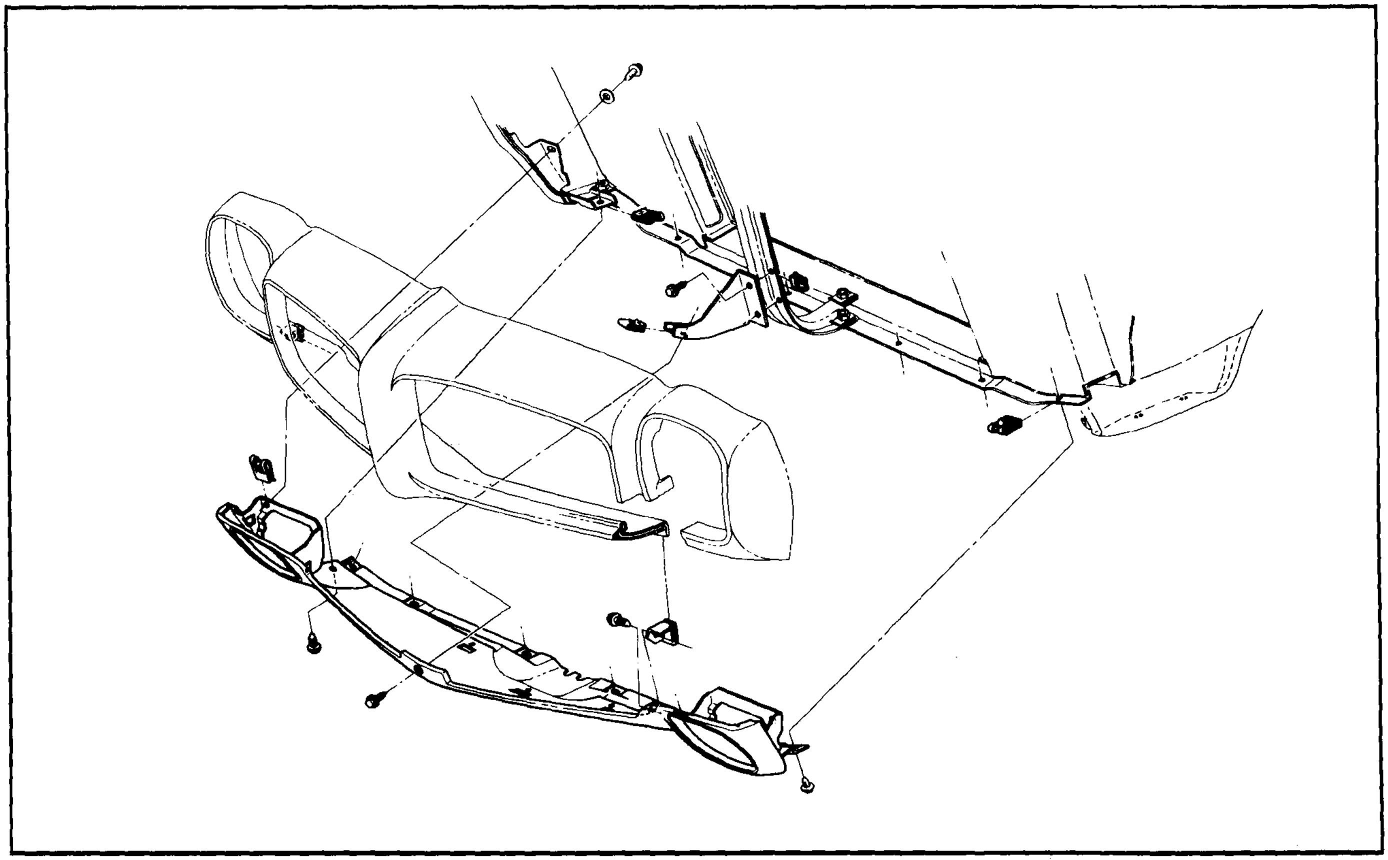


Fig. 14-10 F Series Valance Panel

7. Transfer headlamp assemblies and attaching brackets.

NOTE: *Always check headlight aim whenever any F Series bumper is removed or readjusted.*

REMOVE - X SERIES (Fig. 14-13)

1. Disconnect parking lamps.
2. Remove bumper hanger to frame attaching bolts.
3. Remove bumper assembly.
4. Transfer parts if replacing bumper.
5. Remove hanger bars from bumper.
6. Remove parking lamps.

REPLACE

1. To install, reverse above procedures making sure the front bumper is properly aligned with the front end sheet metal. Adjust front bumper stabilizers to contact sheet metal.
2. Torque all face bar to attachment bar bolts 20-30 lb. ft. and all attachment bar to frame bolts 60-80 lb. ft.

BUMPER CLOSE OUT PANEL

REMOVE - B SERIES (Fig. 14-14)

1. Support bumper - remove bumper hanger bar to frame attaching bolts.
2. Remove bumper from vehicle.
3. Remove bumper close-out panels.

REMOVE - X SERIES (Fig. 14-15)

1. Support bumper - remove bumper hanger bar to frame attaching bolts.
2. Remove bumper from vehicle.
3. Remove bumper close-out panels.

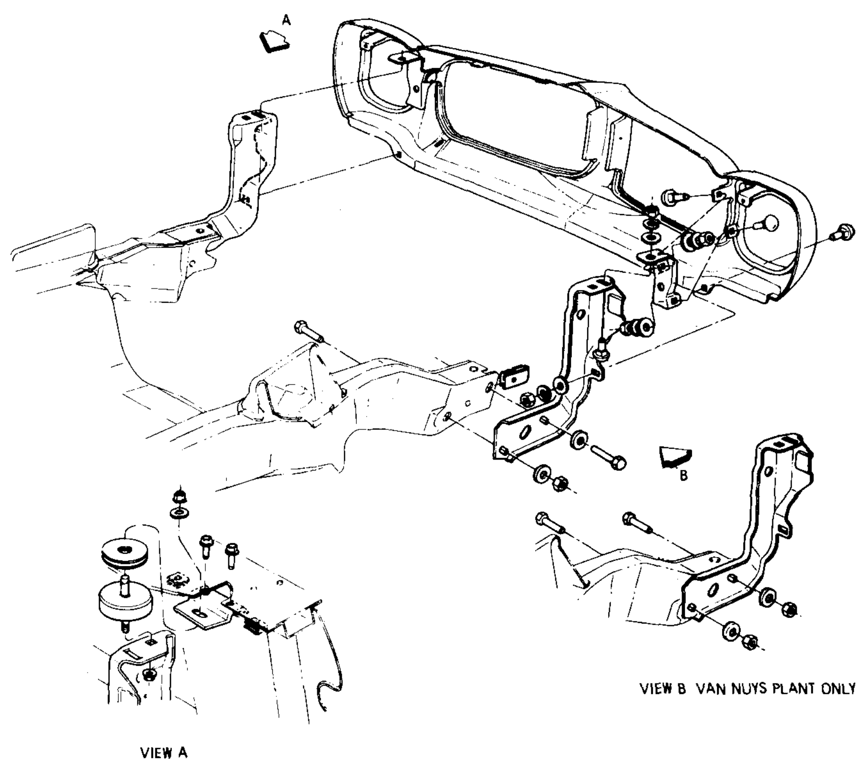


Fig. 14-11 F Series Front Bumper Assembly

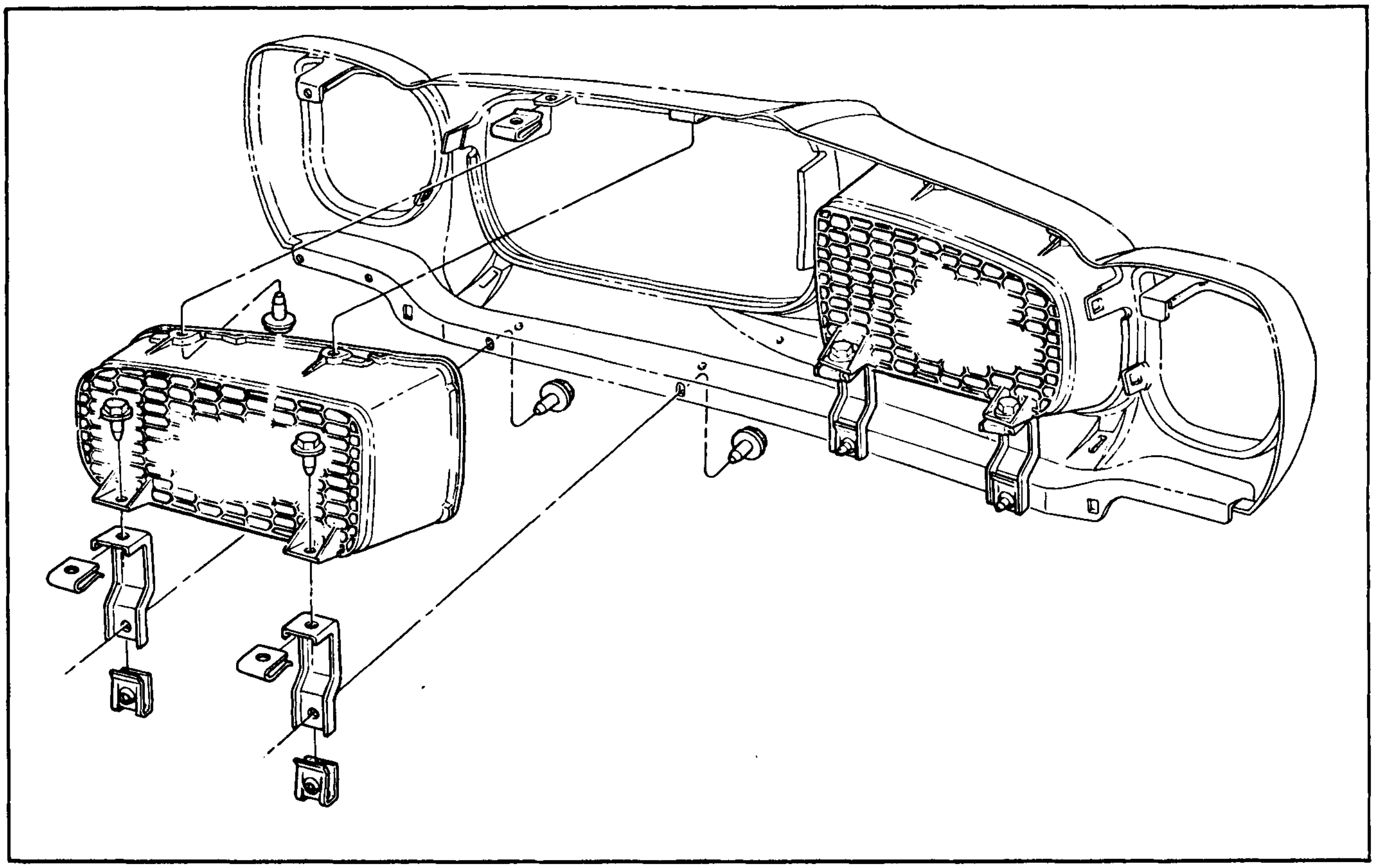


Fig. 14-12 F Series Grille Assembly

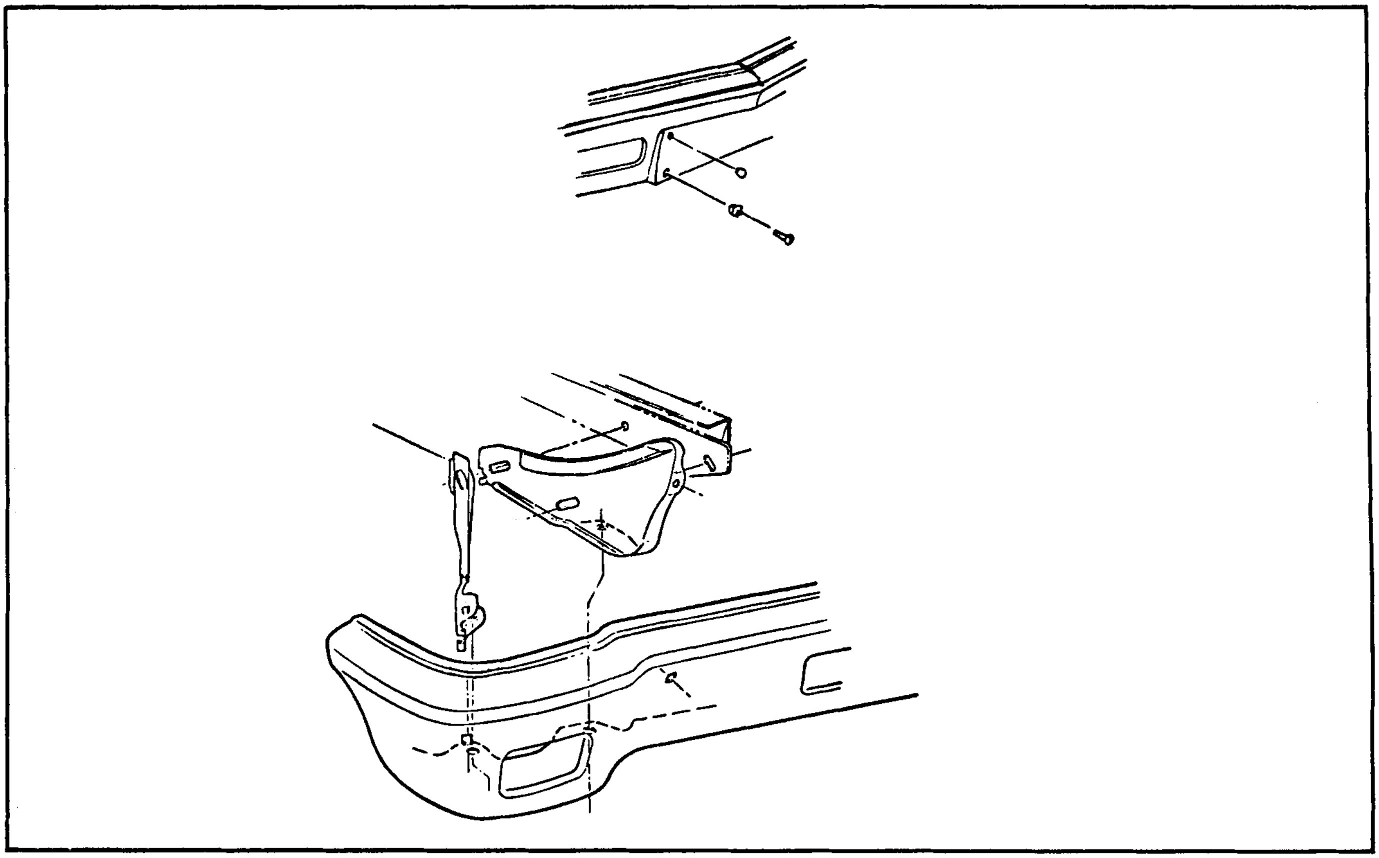


Fig. 14-13 X Series Front Bumper Assembly

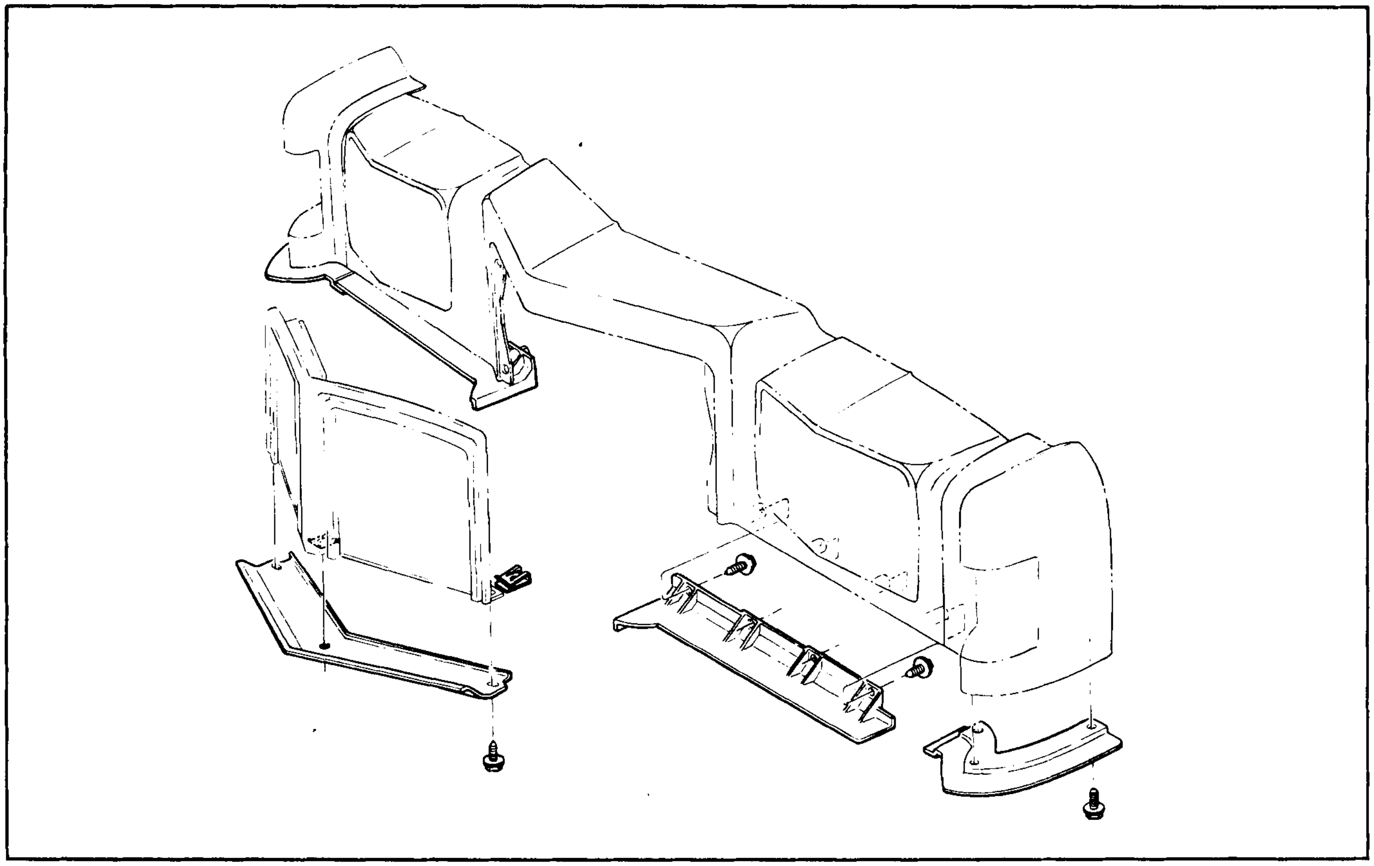


Fig. 14-14 B Series Front Bumper Close Out Panels

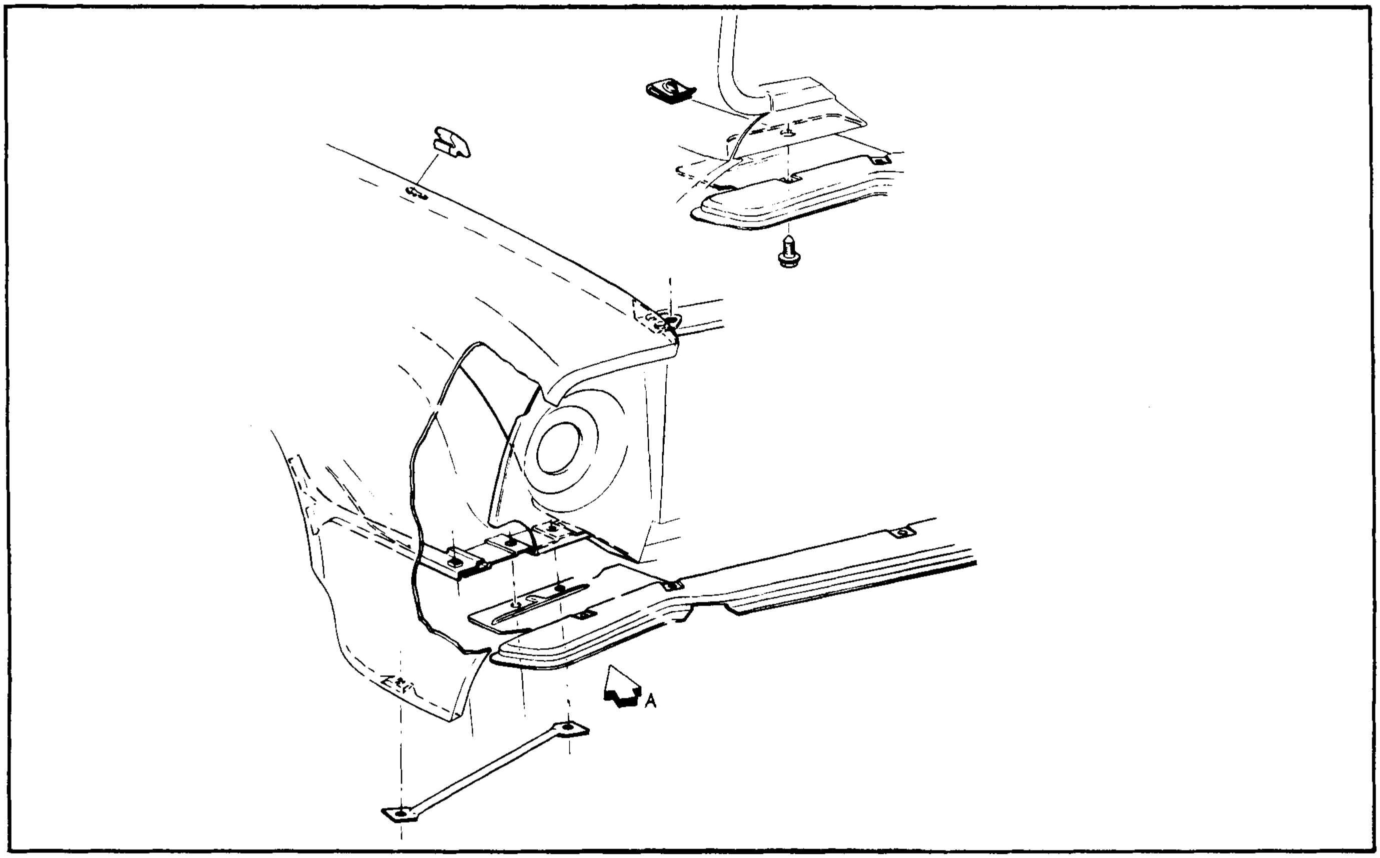


Fig. 14-15 X Series Front Bumper Close Out Panel

REPLACE

To replace, reverse the above procedure making sure the front bumper is properly aligned with the front end sheet metal.

REAR BUMPERS

All rear bumpers except on station wagons contain a center opening for access to the gasoline filler. The A Series station wagon bumpers have a step built in (dual acting tailgate only) for easier access to the rear compartment.

Shims may be required at the center hanger bar bracket where the face bar is mounted to prevent possible rattles.

REMOVE - G SERIES (Fig. 14-16)

1. Remove license lamp assembly.
2. Disconnect tail lamps.
3. From below bumper, remove bumper hanger to body attaching bolts.
4. Support bumper - remove bumper bracket attaching nuts.
5. Remove all bumper brackets and license door.
6. Remove tail lamp assemblies.

REMOVE - B SERIES (EXCEPT STATION WAGON) (Fig. 14-17)

1. Remove center bracket to frame attaching bolts.
2. Disconnect license plate lamp.
3. Support bumper and remove bumper hanger bracket to frame attaching bolts.
4. Remove bumper hanger brackets and license door.
5. Remove rub strips.

REMOVE - B SERIES STATION WAGON (Fig. 14-18)

1. Disconnect license plate lamp.

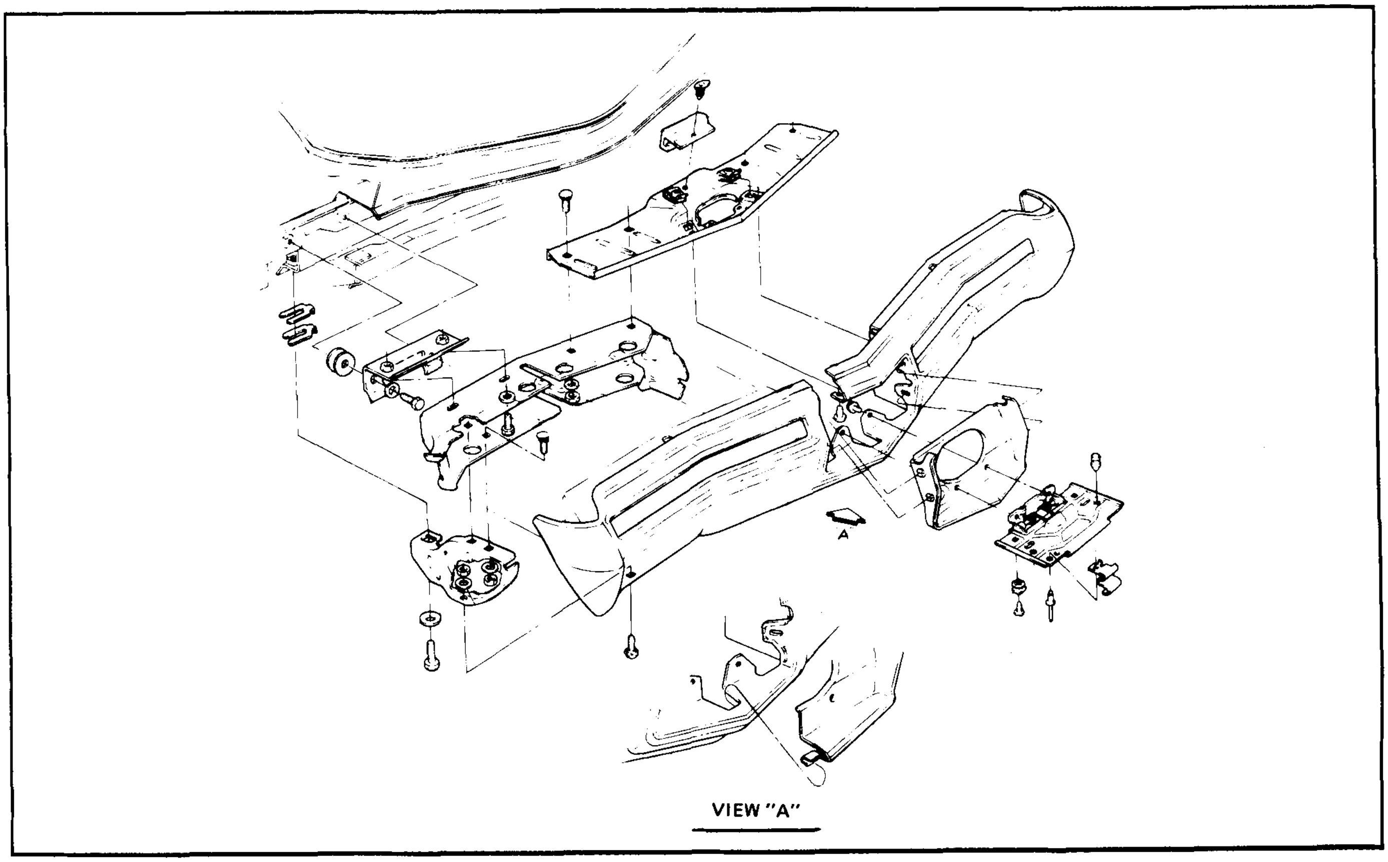


Fig. 14-16 G Series Rear Bumper Assembly

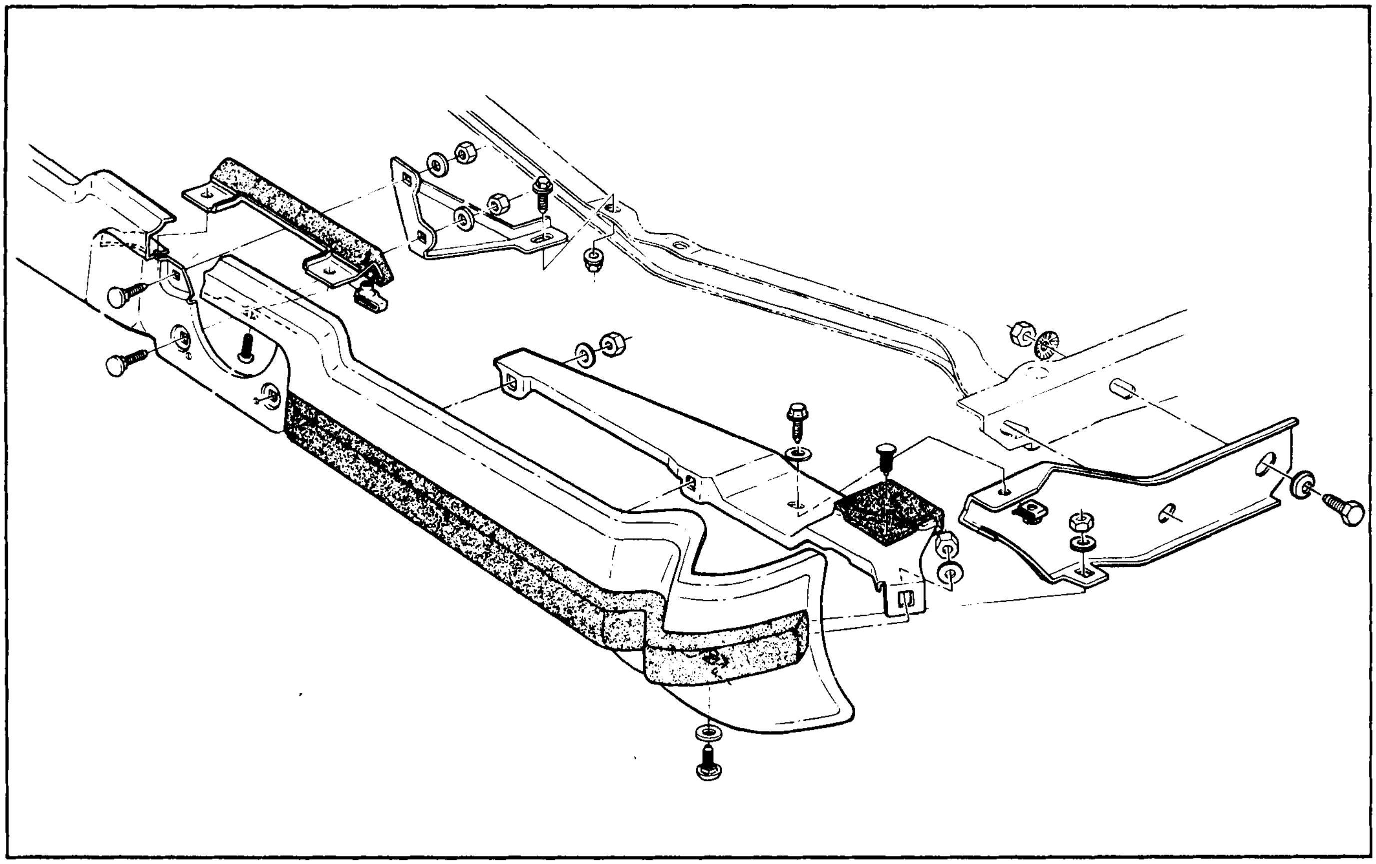


Fig. 14-17 B Series Rear Bumper Assembly

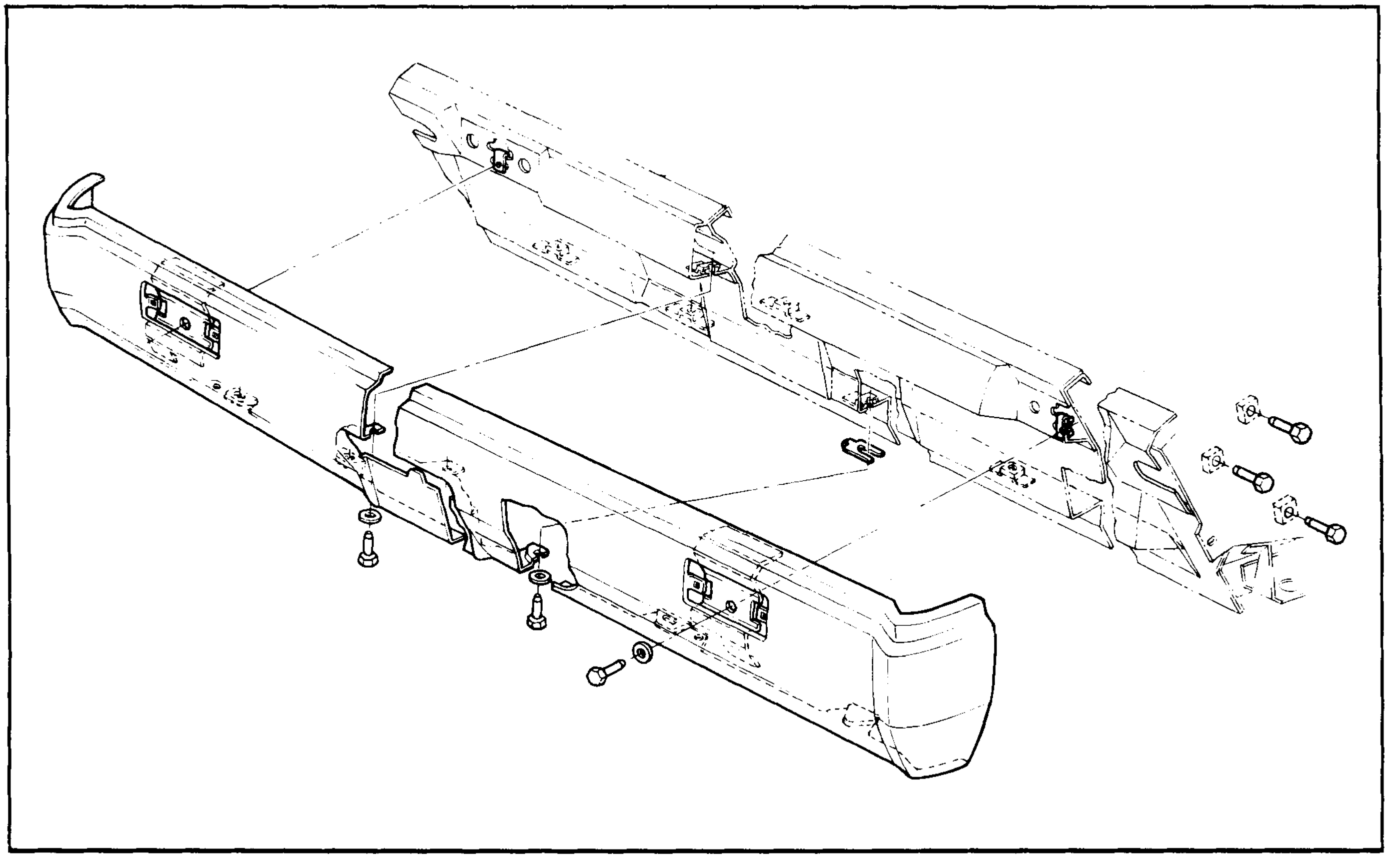


Fig. 14-18 B Series Station Wagon Rear Bumper Assembly

2. Support bumper and disconnect bumper hanger to body bolts.

3. Remove bumper reflectors and hanger brackets.

REMOVE - A SERIES (EXCEPT STATION WAGONS) (Fig. 14-19)

1. Remove valance panel.

2. Remove license lamp assembly.

3. Disconnect tail lamps.

4. Support bumper-remove bumper hanger to body bolts.

5. Remove brackets from bumper.

REMOVE - A SERIES STATION WAGON (FIG. 14-20)

1. Disconnect all lights contained in or attached to the bumper.

2. Remove step and tread assembly.

3. Support bumper-remove hanger bracket to frame attaching bolts.

4. Remove brackets from bumper.

5. To remove the latch cover assembly from the station wagon tailgate, proceed as follows:

   a. Open tailgate.

   b. Remove inner cover to expose outer latch cover bolts.

   c. Remove outer latch cover.

   NOTE: *The bumper is fully adjustable to permit aligning the step opening with the striker on body.*

REMOVE-F SERIES (Fig. 14-21)

1. Remove body to bumper hanger bracket bolts from inside trunk.

2. Remove bumper assembly.

3. Remove bumper hanger brackets.

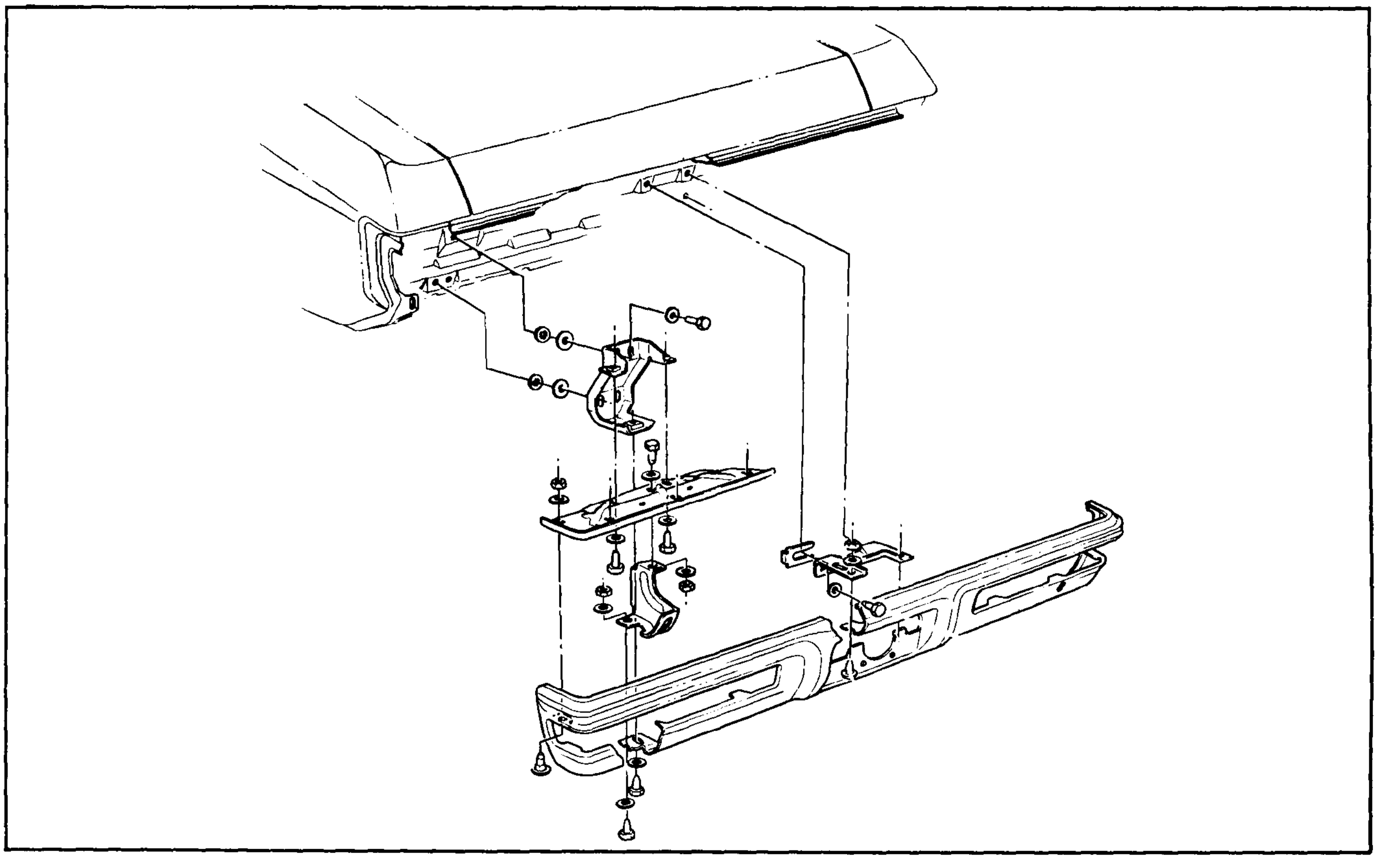


Fig. 14-19 A Series Rear Bumper Assembly

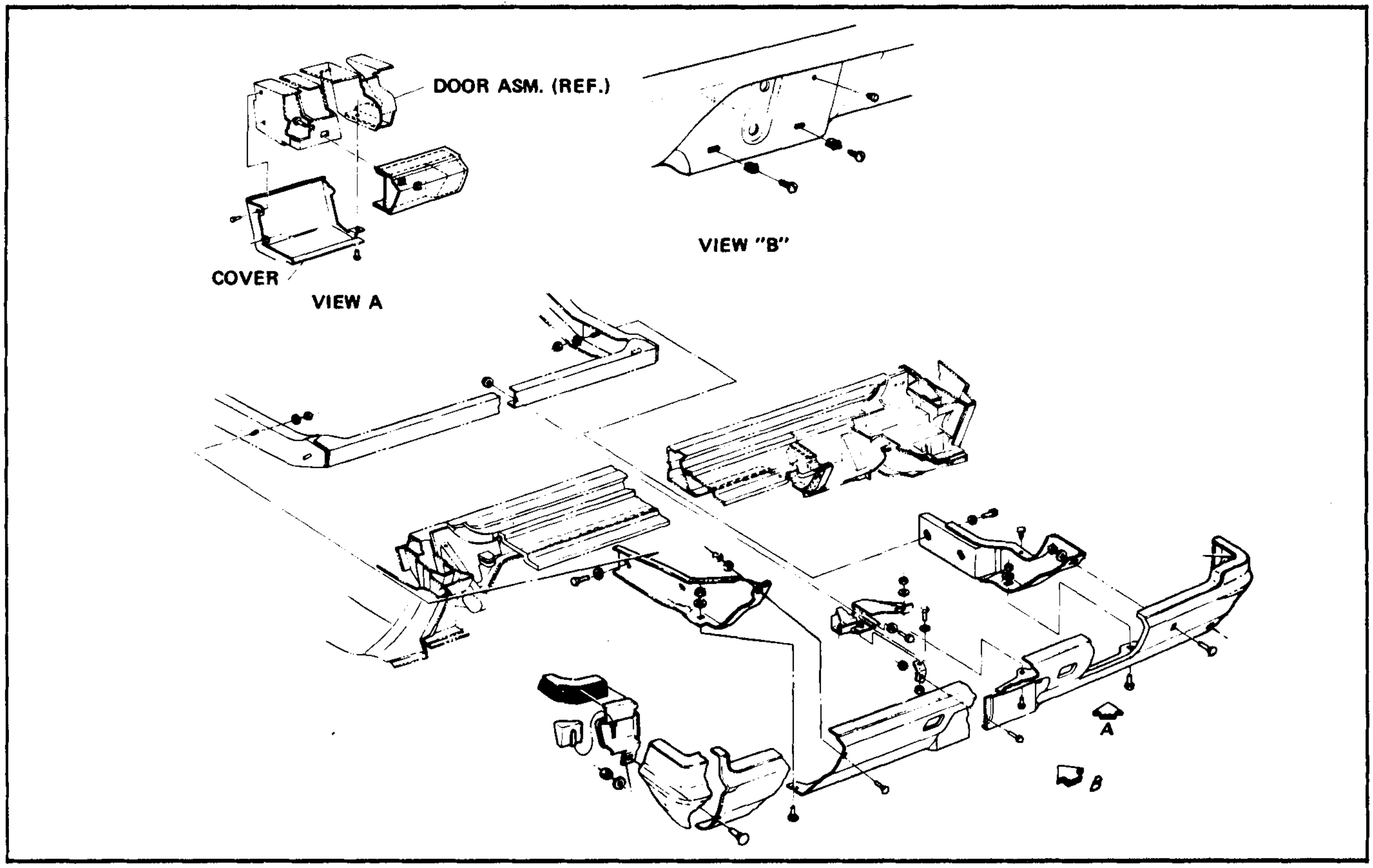


Fig. 14-20 A Series Station Wagon Rear Bumper Assembly

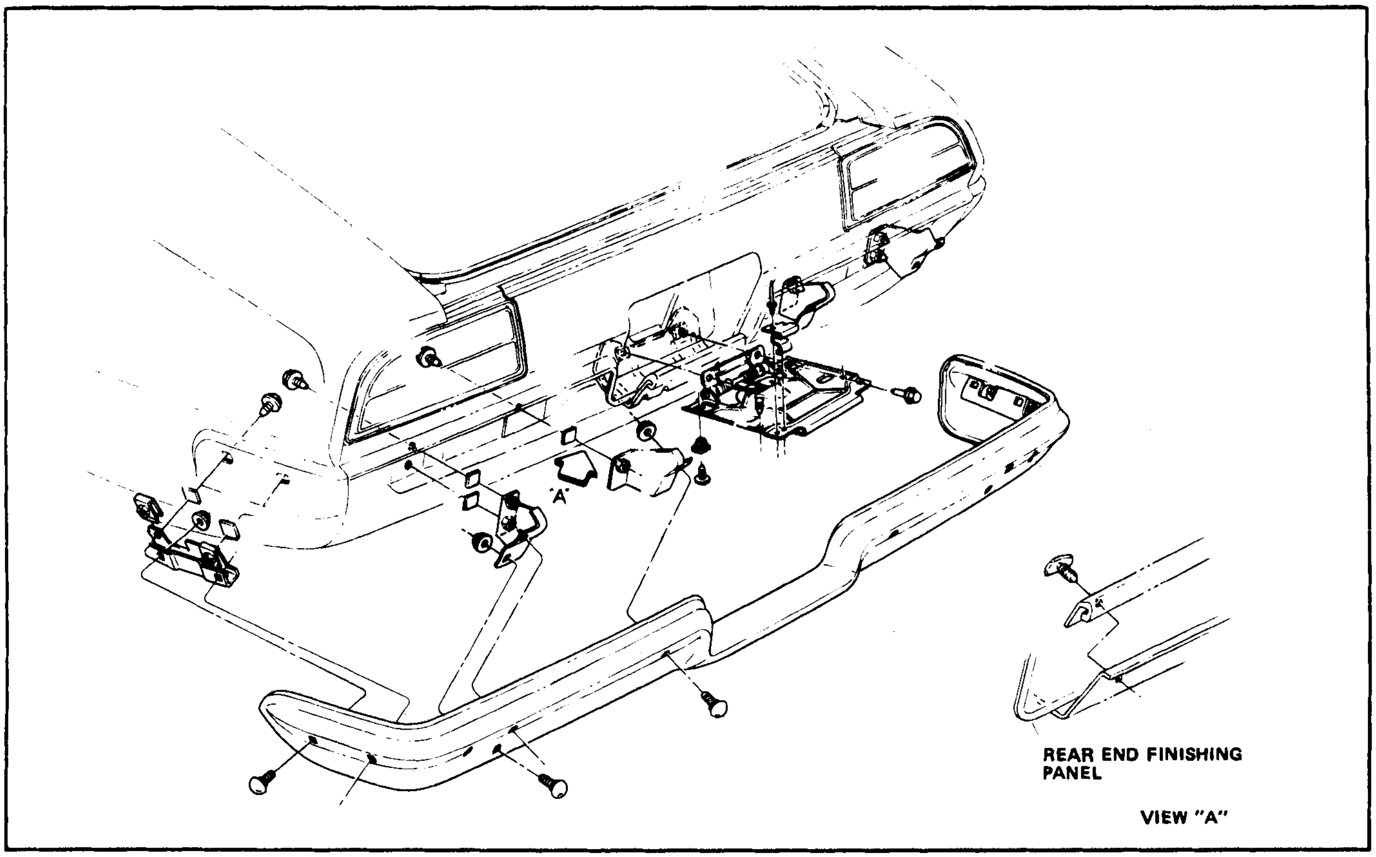


Fig. 14-21 F Series Rear Bumper Assembly

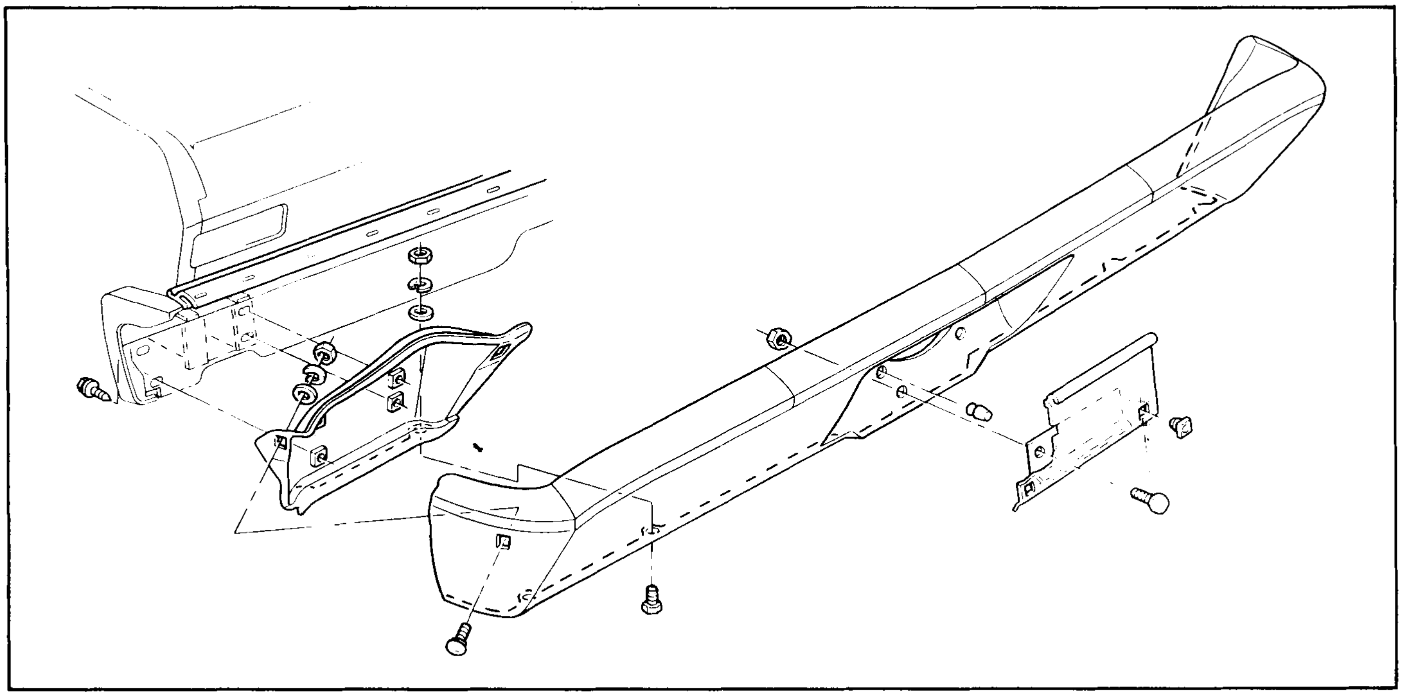


Fig. 14-22 X Series Rear Bumper Assembly

REMOVE - X SERIES (Fig. 14-22)

1. Disconnect license lamp from inside trunk.
2. Remove bumper hanger to body bolts (4 bolts each side).
3. Remove bumper assembly.
4. Transfer parts when replacing face bar.
5. Remove hanger to bumper bolts and remove hanger.
6. Remove fuel tank door assembly.
7. Remove license lamp from bumper face bar.

REPLACE

1. To install, reverse the above procedures making sure rear bumper assembly is properly aligned.

NOTE: *If splash shields were removed at any time during the above operations, they must be replaced before installing bumper.*

2. Torque the attachment bolts as follows:

	LB. FT.
Face bar to attachment bar bolts	20-30
Attachment bar to frame bolts	60-80
Attachment bracket to body bolts	45-60

POLYURETHANE REPAIR

DESCRIPTION

The endura bumper material will withstand minor impact and the resultant damage such as occurs in parking lots by recovering its original shape. The paint film responds to impact in a similar manner without cracking or splitting. If, however, an area of damage in the bumper 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 endura base material.

FILLING

Material:
Part A - Flexible Resin
Part B - Resin Hardener
Equipment:
Putty Knife
Squeegee
Heat Lamp(s)
#220 & #400 Sandpaper
DA Sander w/ #80 Discs
Body File w/Holder

1. Clean the repair area with a wax, grease and silicone removing solvent. With a DA sander adjusted to a feathering action and fitted with a #80 grit disc, remove the paint film in and surrounding the area to be filled. This is necessary because the patching compound will adhere only to the foam base material.

2. If the surface to be repaired is cut or gouged, use the DA sander and a clean disc to enlarge the cut or gouged area(s). This must be done to ensure removal of grease, oil, or dirt from the area to be contacted by the repair material. This action should also taper the edges of the cut to minimize the possibility of highlighting the repair.

3. Mix the patching compound and hardening agent at the prescribed portion as outlined in the procedure enclosed in the package. The patching compound and hardening agent should be mixed until a uniform color is achieved.

4. Fill the repair area with the mixed compound to a height slightly above the surrounding contour. Work out air bubbles, if present.

5. Dress the patch to contour with a curved-tooth body file, followed by sanding with #220 sandpaper and block.

6. If the patch is uneven or porous, repeat steps 4 and 5.

REFINISHING

The factory paint is of an enamel base and requires sealing prior to the application of the service endura paint which is of a laquer base. Therefore, the polyurethane bumper cannot be spot refinished. The complete bumper has to be completely refinished using a Primer (sealer) prior to the Color Coat and Clear Top Coat. Under no circumstances, however, should acrylic paint materials be used in refinishing this bumper. Although it may appear satisfactory, it will crack from physical contact. As mentioned earlier, the Primer (sealer) coat, Color Coats and Clear Top Coats that are to be used are specially formulated with an elastomer vehicle so that the cured film may bend under impact without cracking or splitting.

Material:
Sealer
Primer Surfacer
Color
Top Coat Clear
Thinner
220 and # 400 Sandpaper
Equipment:
Suction Spray Gun with same nozzle and air cap combination used for acrylic application.

1. Featheredge the repair area by dry-sanding with #220 sandpaper followed by #400 grit sandpaper.

2. Apply a coat of Primer (sealer) over the entire bumper as well as the repaired area.

3. Apply Primer Surfacer to build up the repair area as required.

4. Apply a coat of Primer (sealer) over the repaired area, overlapping onto the non repaired area to assure complete sealing of the entire bumper.

5. Thoroughly stir the color and apply in sufficient quantity to achieve hiding only--one dry coat followed by a wet coat.

   NOTE: *If mottling occurs, the metallic color control method of color application corrects this problem.*

6. Allow the color to dry 5 to 10 minutes at room temperature.

7. Thoroughly mix and apply the top coat clear, using two coats as done previously with the color.

   CAUTION: *Wet application of clear coats causes considerable darkening of the color.*

8. Air-dry of the clear coats require 8 hours at room temperature. Force-dry is recommended for 1/2 hour at 150° - 170°F.

9. Compounding reduces the gloss, for this reason, rubbing compound should be used only if a reduction of gloss is desired.

   NOTE: *In using this material, the following cautions should be noted:*

All the bumper refinishing materials are packaged at spraying viscosity. Only if "veiling" occurs during application will additional reduction be necessary.

Reduce these refinish materials with the special Endura Thinner only--never use acrylic thinner.

The top coat clear material has a tendency to yellow if subjected to prolonged, elevated temperatures (300°F).

The clear coat tends to soften the color over which it is applied. For this reason, premature featuring (within 24 hours) of air-dried film, as in overlap of a previously repaired area, will TEAR and PEEL the color off the surface.

SECTION 15

ACCESSORIES

CONTENTS OF THIS SECTION

DIAGNOSIS

CRUISE CONTROL

All electrical and vacuum connections and other obvious items, such as cruise release brake switch adjustment, are to be checked and corrected prior to any type of testing.

BLOWING FUSES

CAUSE	CORRECTION
Short or ground in wiring circuit.	Perform electrical checks (Fig. 15-1).

CRUISE CONTROL DOES NOT ENGAGE

CAUSE	CORRECTION
Fuse blown.	Replace fuse.
Brake switch out of adjustment.	Adjust brake switch.
No current to terminal No. 2.	Repair wiring harness.
Engaging switch inoperative.	Replace engaging switch.
Faulty valve body and magnet assembly.	Replace valve body and magnet assembly.
Faulty low speed switch.	Replace low speed switch.

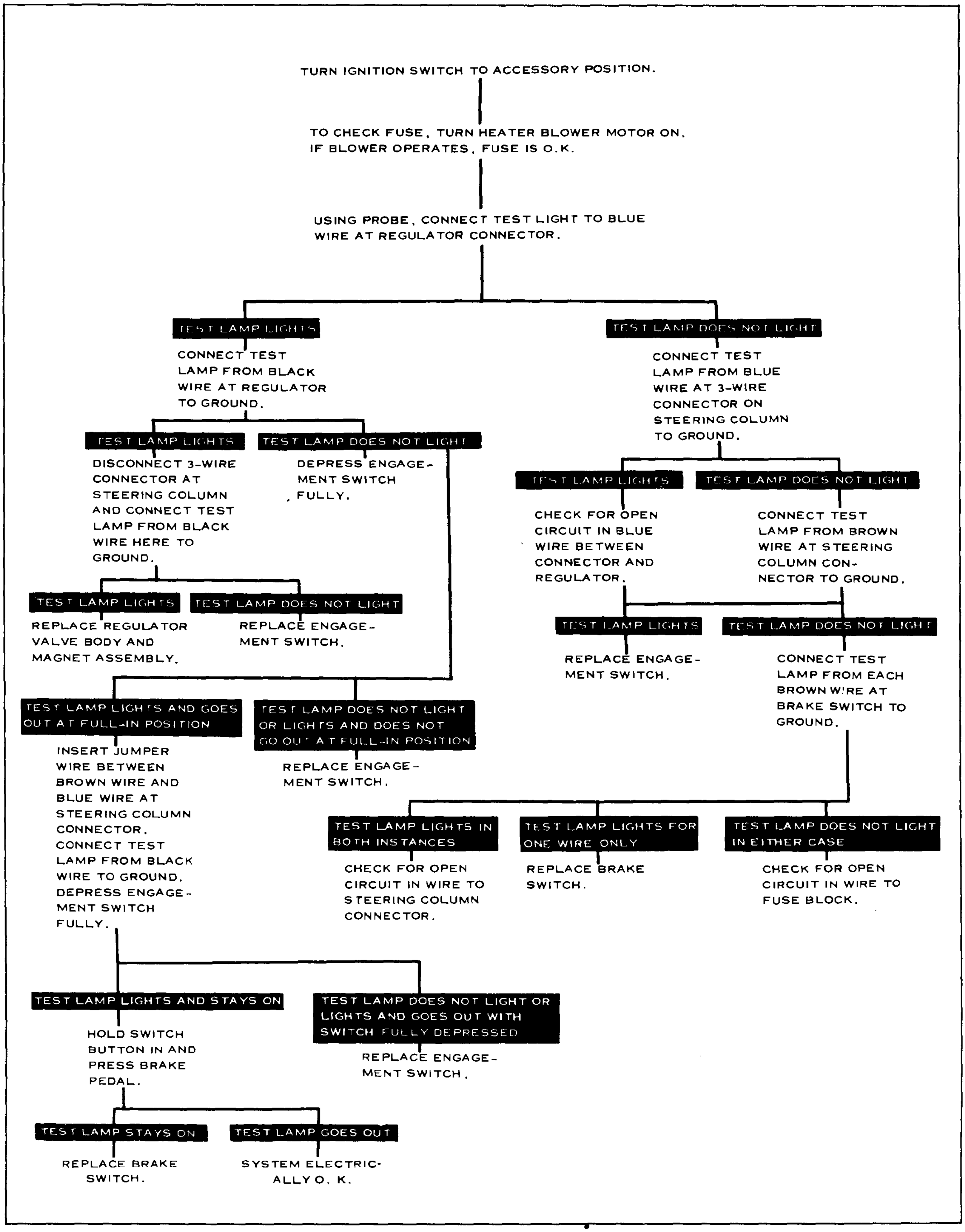


Fig. 15-1 Cruise Control Electrical Check-Out Procedure

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 valve body and magnet assembly.	Replace low speed switch.

CRUISE CONTROL RE-ENGAGES WHEN BRAKE IS RELEASED

CAUSE	CORRECTION
Faulty engaging switch.	Replace engaging switch.
Terminal No. 1 grounded.	Replace or repair wiring 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 governor assembly.	Replace governor assembly.

CRUISE CONTROL CONTROLS SPEED 3 OR MORE MPH ABOVE SELECTED SPEED

CAUSE	CORRECTION
Improper centering spring adjustment.	Adjust centering spring (C).

CRUISE CONTROL CONTROLS SPEED 3 OR MORE MPH BELOW SELECTED SPEED

CAUSE	CORRECTION
Improper centering spring adjustment.	Adjust centering spring (C).

RADIO (Fig.15-2)

Because radio problems are most often repaired at United Delco 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 cause 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 Station can frequently be avoided if the following quick checks are used to eliminate external radio system problems before removing the radio for repair.

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.

The radio trouble diagnosis guide (Fig. 15-2) is intended as an aid in locating minor faults which can be corrected without a specialized knowledge of radio and without special radio test equipment. If the suggestions given here do not effect a correction, further testing should be done only by a trained radio technician having proper test equipment.

RADIO/TAPE (Fig. 15-3)

In diagnosing radio/tape problems, the main point to remember is that you now have both a radio **and** a tape player to diagnose as part of the Stereo system. By inserting test tape, J22683-01, you can quickly determine whether the tape speed is proper. Since only the pre-amps and audio are common to both radio and tape, by listening for distortion with the tape playing and comparing it to the radio signal you can further isolate the problem to either radio or tape.

EIGHT TRACK STEREO TAPE PLAYER (Fig. 15-3)

The tape player trouble diagnosis guide is intended as an aid in locating minor faults which can be corrected without a specialized knowledge of electronics and without special test equipment. If the suggestions given here do not effect a correction, further testing should be done only by a trained radio technician having proper test equipment. **It should first be determined if the owner's tape and not the player is at fault.** Substituting a known good tape cartridge for the owner's is a simple check.

CASSETTE STEREO TAPE PLAYER (Fig. 15-4)

Unlike the stereo eight track tape player, the Cassette stereo player turns off automatically at the end of each type. An inexperienced owner, or an owner accustomed to the continuous-playing, eight track tape, may suggest that a malfunction has occurred. By merely turning the tape over, it will play through the program on the opposite side. The diagnostic guide will assist in isolating the problem to a defective component in the system -- radio-to-tape harness, player, or speakers.

NOISE SUPPRESSION (Fig. 15-5)

If you are attempting to correct an interference or electrical noise problem which is "**abnormal**", first check to see that all of the proper suppression equipment is present and that all of the suppression items are making good electrical connections.

If all of the proper suppression equipment is present and making **good electrical connection,** then the procedure in Fig. 15-5 can be used to solve the more stubborn noise problems. Also, review "IGNITION SUPPRESSION EQUIPMENT" in General Description Section of this section for description of normal noises.

WINDSHIELD ANTENNA (Fig. 15-6)

The following guide will aid in further diagnosing the radio system, using the Windshield Antenna Tester J-23520.

The spring shield must be on the Tester J-23520 at all times to direct the signal only to the area being tested. Always check the tester on a known good car to make sure it is operating properly and that the battery is not weak or dead.

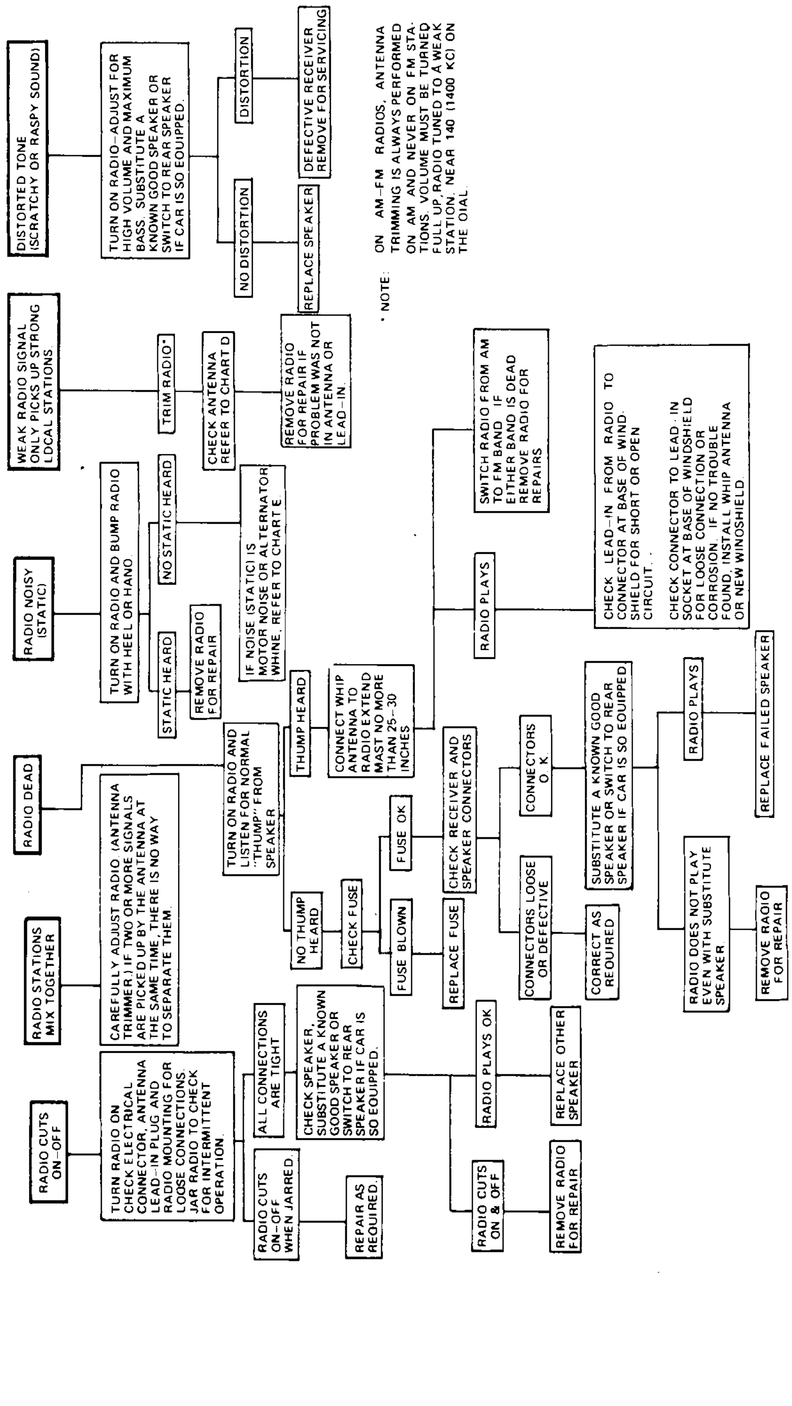


Fig. 15-2 Radio Diagnosis

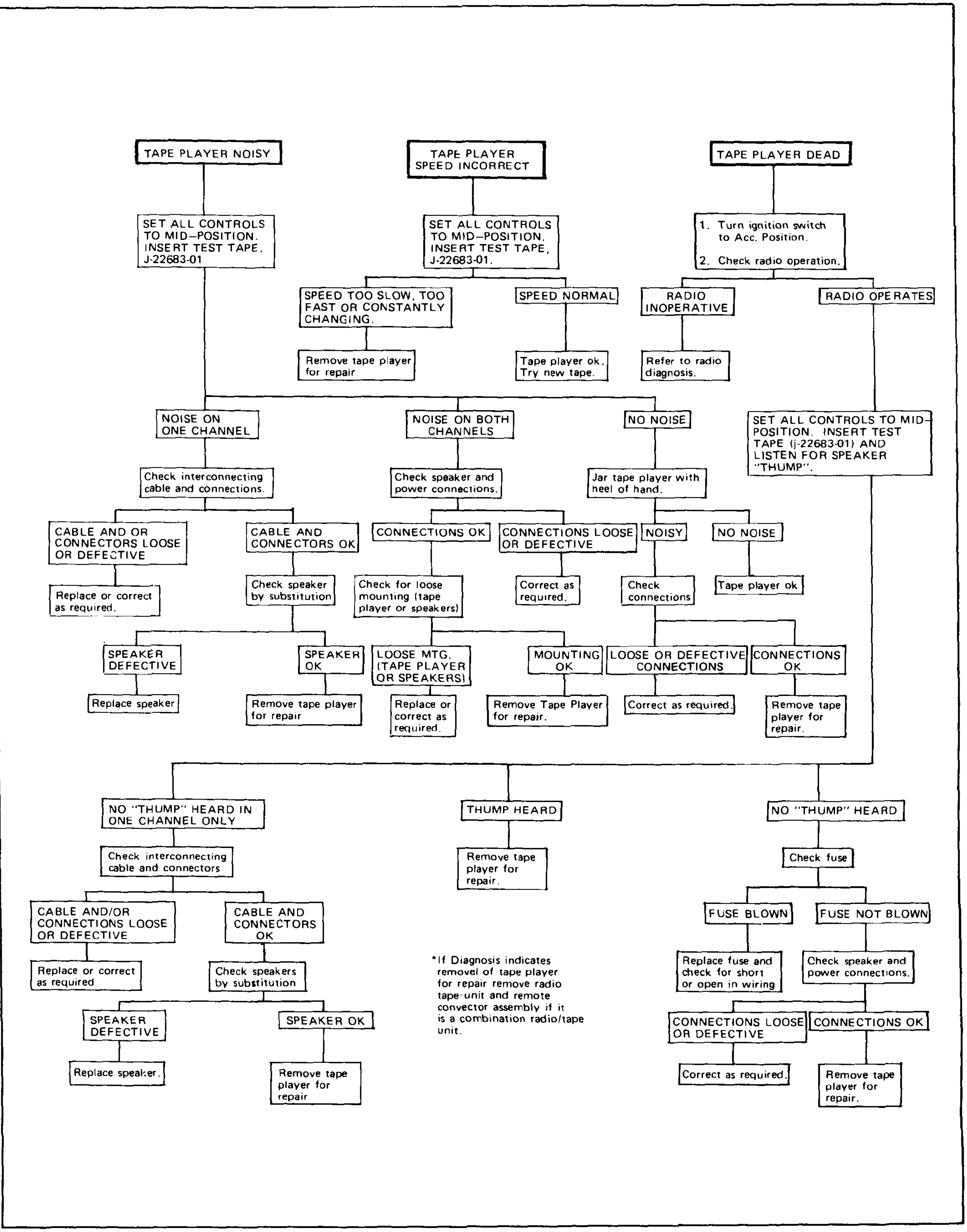


Fig. 15-3 Radio/Tape and Stereo Eight Track Tape Player Diagnosis

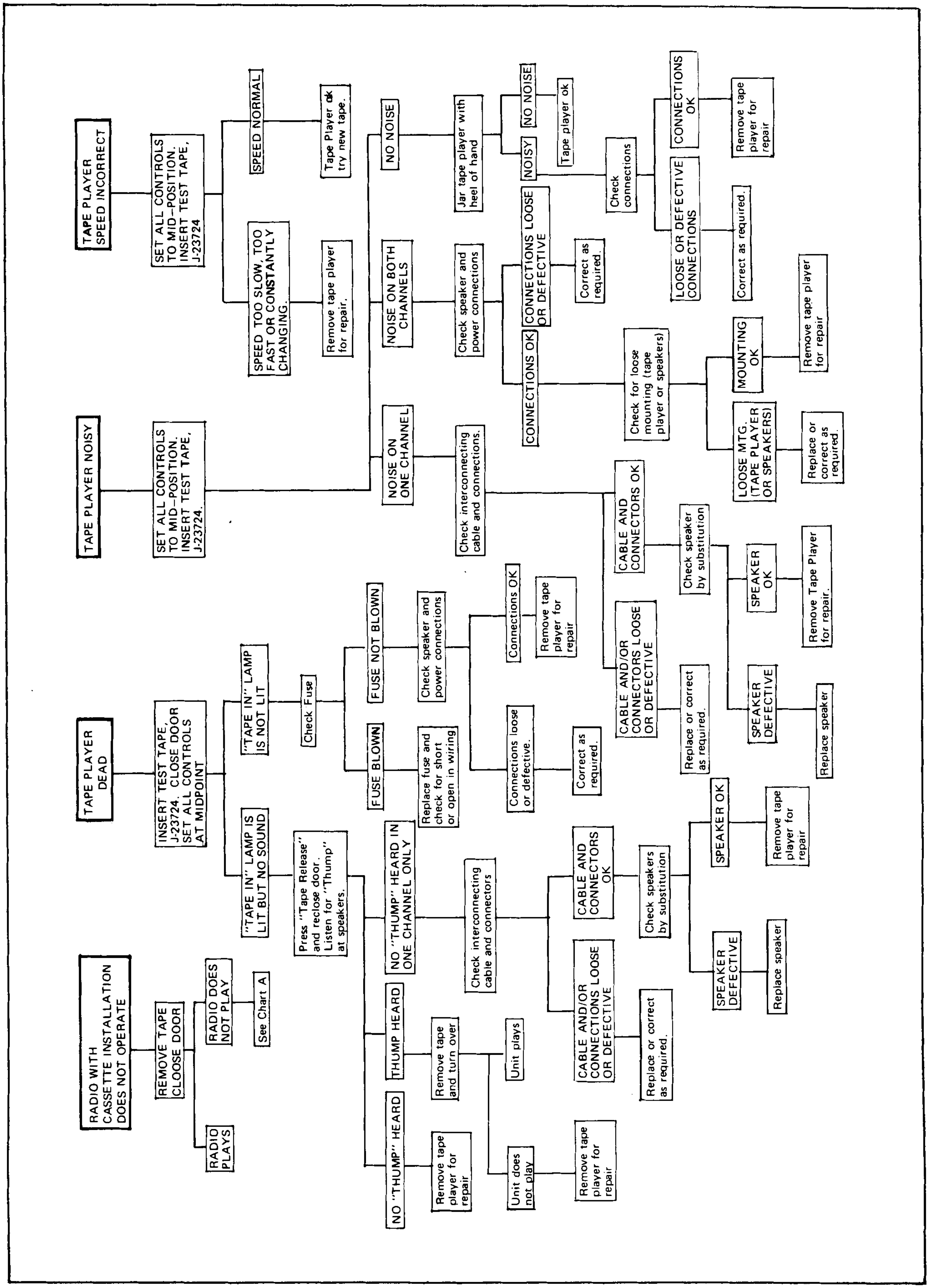


Fig. 15-4 Cassette Stereo Tape Player Diagnosis

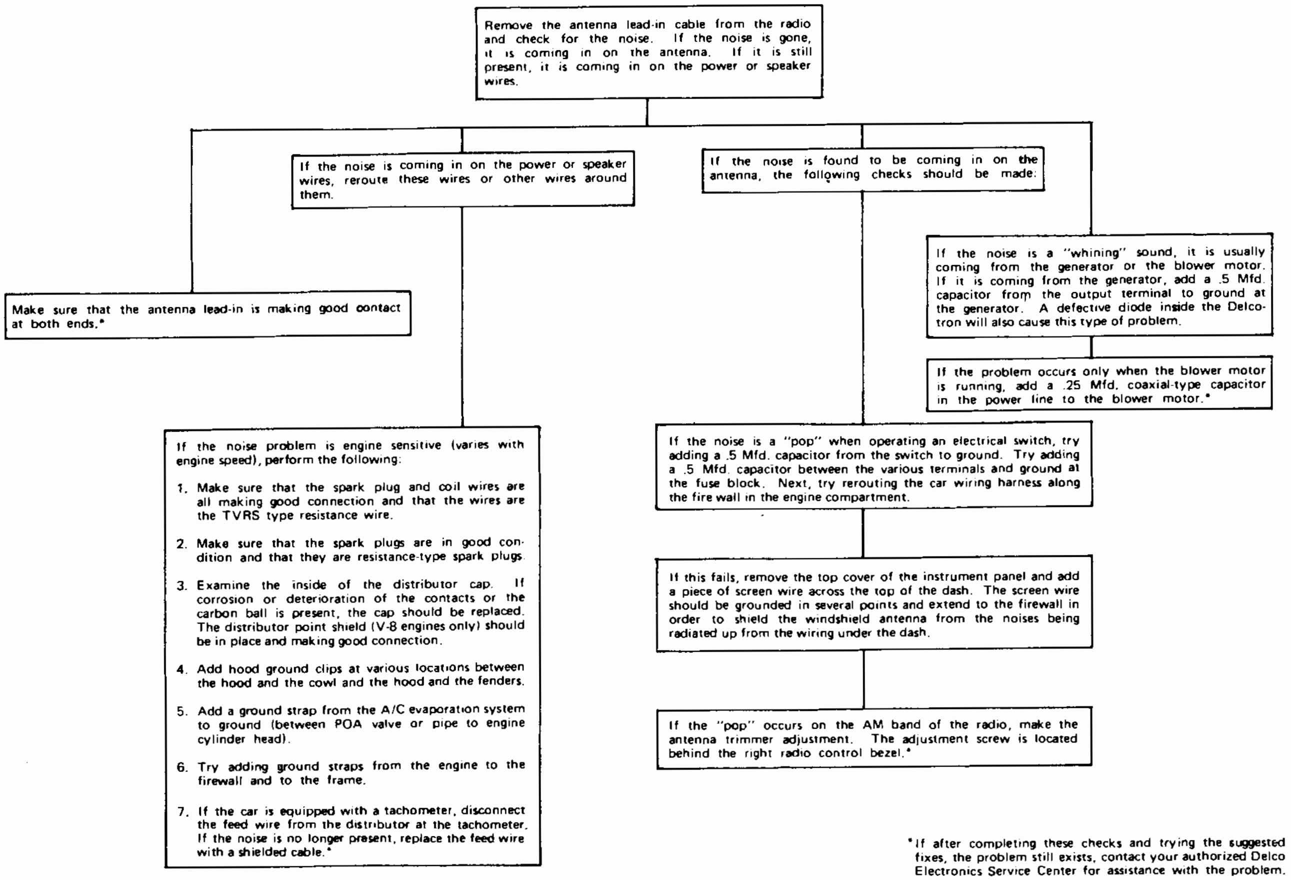
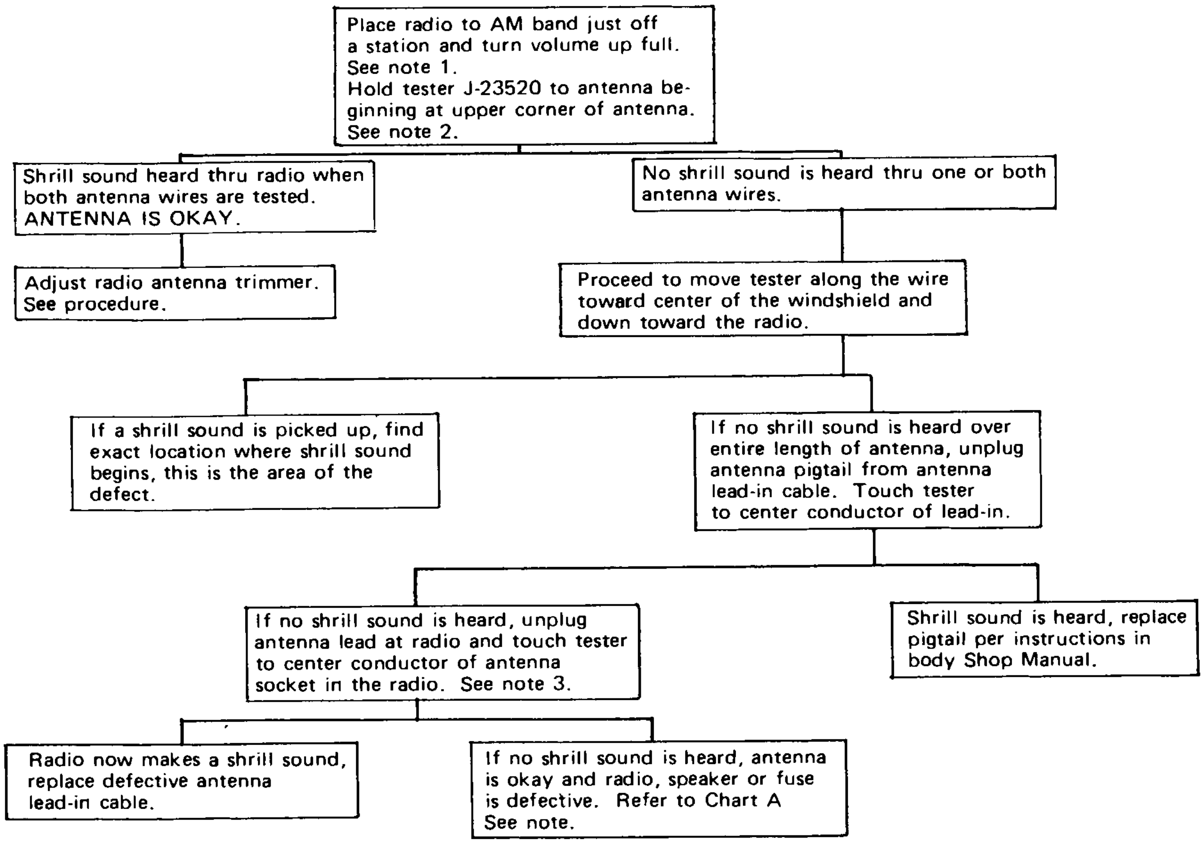


Fig. 15-5 Radio Noise Diagnosis



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.

Fig. 15-6 Windshield Antenna Diagnosis

GENERAL DESCRIPTION

CRUISE CONTROL

Cruise Control is an easy-to-use, driver-operated speed control system. It may be either factory or dealer installed on all V-8 engines except F and X Series.

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)

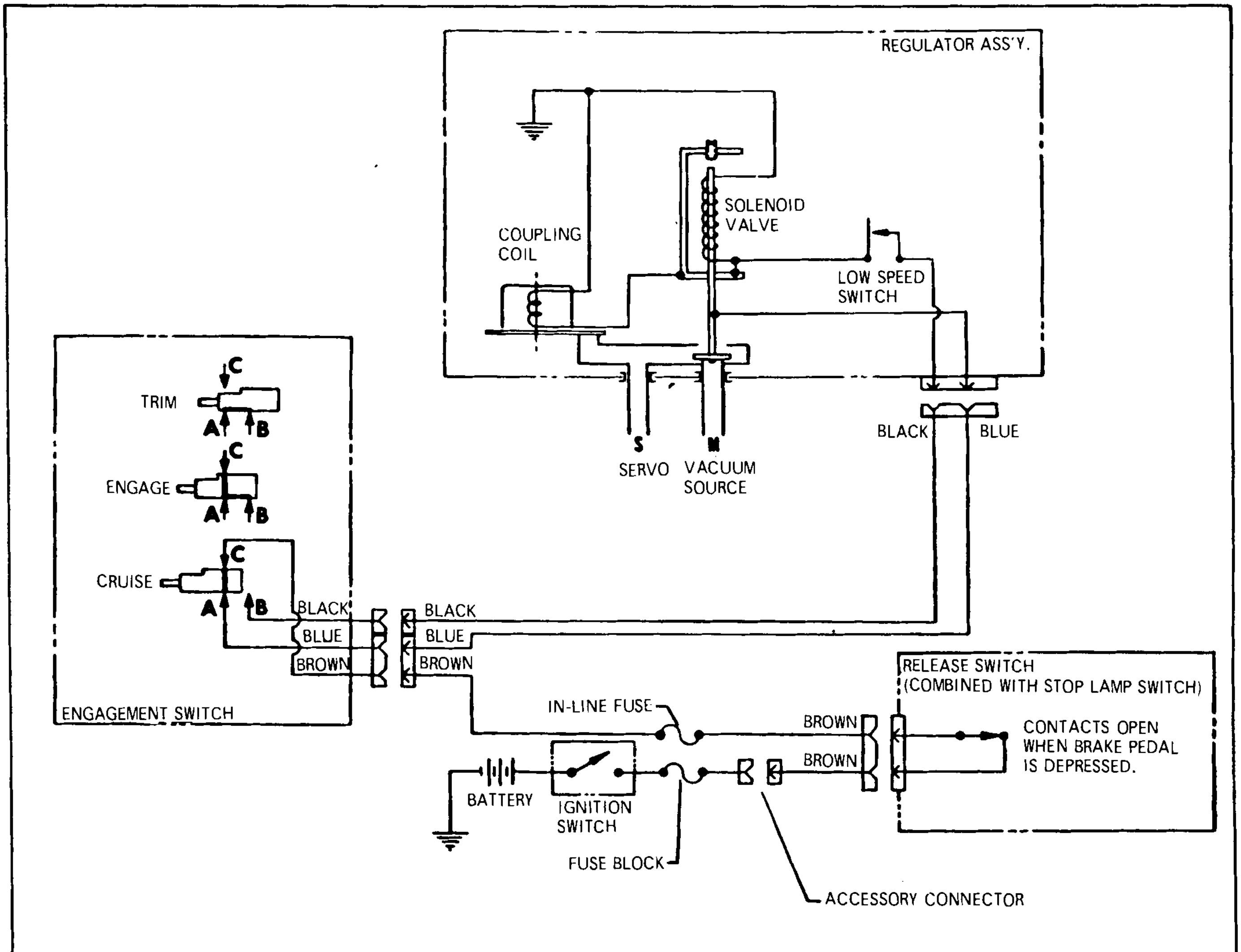
OPERATION

ELECTRICAL CIRCUIT (Fig. 15-7)

Battery current is supplied to contact C in the engagement switch through the underdash accessory power circuit. A release switch is inserted in this circuit to break the connection whenever the brake pedal is depressed.

When the engagement button in the turn signal lever (Fig. 15-8) is depressed to the engage position, a circuit is made between contacts A & B, and the power source - contact C. Current will now be supplied to the regulator assembly at both terminals 1 & 2.

Current passes from terminal 1 (black wire) through the winding in the solenoid valve to ground. A low speed switch is inserted in this circuit to break contact at low speeds (below approx. 30 mph).



SWITCH SEQUENCE CHART			
BUTTON POSITION	CONTACT C TO A	CONTACT C TO B	CONTACT A TO B
CRUISE (NORMAL)	CLOSED	OPEN	OPEN
ENGAGE (DEPRESSED MIDWAY)	CLOSED	CLOSED	CLOSED
TRIM (DEPRESSED FULLY)	OPEN	OPEN	CLOSED

Fig. 15-7 Cruise Control Circuit Diagram

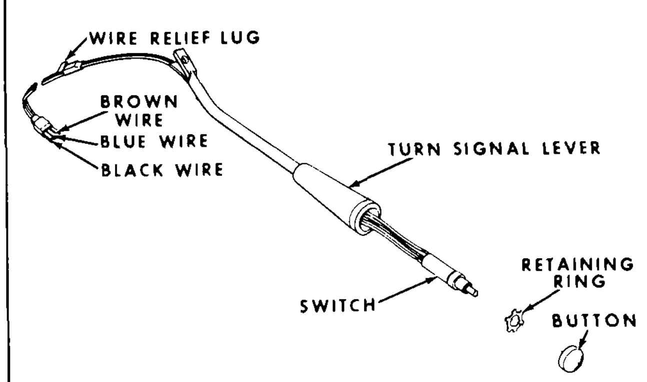


Fig. 15-8 Turn Signal Lever and Engagement Switch

With the solenoid valve winding energized, the valve will pull up off its seal allowing engine vacuum to enter the regulator passage and be passed to the servo.

In this position, current also passes to the solenoid valve frame and through the coupling coil winding to ground. With the coupling coil energized, the vacuum regulator plate is engaged. The regulator plate is now mechanically connected to the governor, regulating the size of the vent opening.

Now when the engaging switch is released, the contact at B is broken but A remains complete through the switch, thus keeping the coupling coil and solenoid valve energized. Current now flows from the ignition switch through the fuse block and brake switch to the No. 2 terminal of the connector at the regulator. In the full up position, the solenoid valve makes contact with its frame, passing current through the frame and through the coupling coil. Enough current passes from the solenoid frame through the solenoid winding to hold the valve up, although not enough to pull it up once it is released. The driver's speed is now automatically regulated.

The electrical circuit can be broken by the driver in three different ways. He may turn off the ignition switch or step on the brake (open the brake switch), thus the feed circuit to the engagement switch would be broken. It is also possible for the driver to disengage the Cruise Control by pressing in and holding the engaging switch. This will open both circuits at A and B. The only time the button

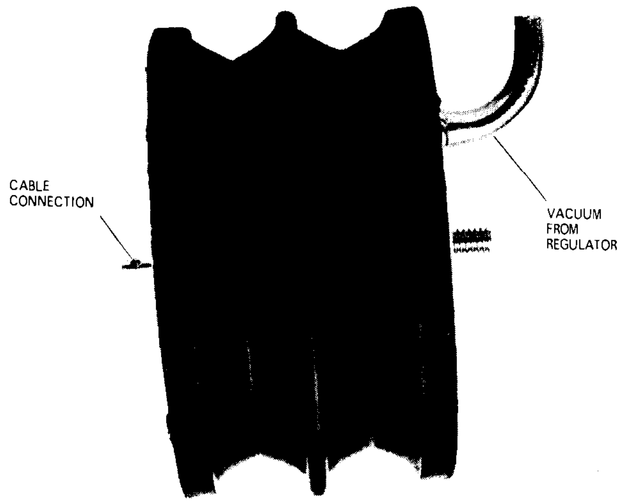


Fig. 15-9 Vacuum Servo

would be held in this position is when the driver wants to change the speed setting of the Cruise Control downward. Release of the button once again gives the driver automatic speed control at his new speed.

When the brake pedal is depressed, the vacuum release switch immediately vents the vacuum hose to the servo. This renders the system inoperative independently of the electrical circuit.

VACUUM SERVO

The vacuum servo (Fig. 15-9) is located on the left hand fender skirt. It is connected through a cable to the throttle lever and varies throttle opening in relation to vacuum supplied by the regulator.

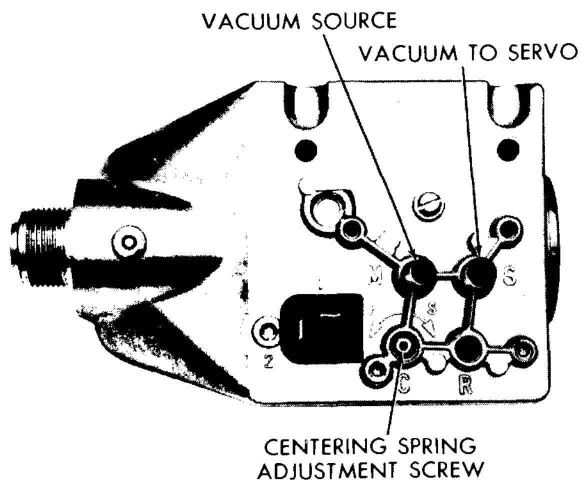


Fig. 15-10 Regulator Assembly

REGULATOR ASSEMBLY

The regulator (Fig. 15-10) 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.

The following are the main operating components of the regulator:

SOLENOID VALVE AND COUPLING COIL

The solenoid valve (Fig. 15-11) blocks the vacuum supply to the Cruise Control when the unit is not in operation. When its magnetic field is energized (Cruise Control operating), the vacuum source to the regulator is completed.

When the coupling coil is not energized, the coil itself moves in relation to governor speed. When the coil is energized, a vacuum regulator plate moves with the coupling coil.

The drive cable from the transmission connects directly to the regulator drive assembly to turn the governor shaft and weights, including the cable to the speedometer.

VALVE BODY AND MAGNET ASSEMBLY

As the governor weights move in or out with varying car speed, the actuator cup assembly causes the coupling coil to move. This portion of the Cruise Control is always operating regardless of whether the system is engaged or not.

When the driver pushes the engaging switch, the vacuum plate is held to the coupling valve by the coupling valve coil magnetic field. The position in which the vacuum plate is held to the coupling coil is dependent upon the car speed when the system was engaged. This position does not change as car speed is increased (system over-ridden), and hence acts as a memory device for when cruise is resumed.

When the switch is engaged, the solenoid valve coil is also energized pulling the valve off its seat and opening port "M" to port "S". As car speed increases or decreases, causing the governor weights to go out or in, the actuator will move the coupling coil and vacuum plate. The vacuum plate will now regulate engine vacuum by opening the vacuum port to atmosphere. This regulated vacuum is delivered from the vacuum plate to the "S" outlet on the bottom of the regulator, then through a hose to the vacuum servo. The servo then moves in proportion to the vacuum applied from the regulator and thus varies throttle opening through the cable to the throttle lever.

VACUUM CHECKS

The vacuum servo is a sealed unit; therefore, a leaky or defective bellows requires replacement of the assembly.

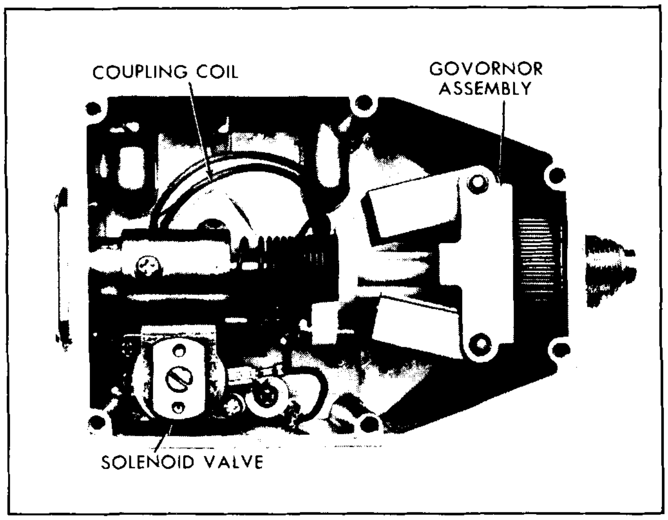


Fig. 15-11 Regulator-Internal View

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.

ELECTRIC CLOCK

DESCRIPTION

The electric clock 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.

SETTING CLOCK

When setting 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.

RALLY GAGES

The rally gage option consits of an engine water temperature gage, an oil pressure gage, and a voltmeter (B and F Series only).

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.

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.

The tachometer is available as a dash mounted unit on A and F Series. This dash unit is mounted in the IP clock location. On F Series, a combination tachometer-clock unit is the only tachometer available.

ELECTRIC DECK LID RELEASE

With this option, the deck lid latch can be operated from a switch located in the glove box. This switch operates a solenoid which opens the deck lid.

The trunk can also be operated in the normal manner using a key.

ELECTRIC REAR WINDOW DEFOGGER

The electric rear window defogger option, available on all series, consists of grid lines bonded on the inner surface of the rear window. The grid lines complete a circuit and develop high current as voltage is applied to the resistance of the grids.

The power developed raises the temperature of the glass to a point sufficient to defog the window.

> **NOTE:** *The rear window temperature is not raised to a level that would cause the grid lines to be warm to the touch. Do not touch the grid lines to determine proper operation.*

The electric rear window defogger switch (ON-OFF) features an indicator lamp which glows when the defogger is in operation.

BLOWER REAR WINDOW DEFOGGER

The rear window defogger mounted under the rear package shelf provides rapid defogging of the rear window. The blower control switch, located on the instrument panel, may be operated on either "HI" or "LO" speed as required. Lo speed is provided by means of a resistor mounted on the control switch.

WARNING LAMP OPTION

A warning lamp option consists of two (2) indicator lamps in the cluster assembly. The lamps serve as a warning for the following:

LOW FUEL - Refuel before too long. This lamp glows when fuel level drops to approximately one-eighth of full tank and will remain glowing until fuel level is increased.

WASHER - Add windshield washer solution. This lamp glows whenever washer solution level drops to one-third full.

CONSOLE

A seat separator console is available on all models with bucket seats and floorshift transmission.

The console includes a shift lever opening (with indicator on automatic transmission models) and compartment box (except X Series).

On F Series a rear seat console is available with or without front console. This console includes an ashtray and seat belt buckle compartment.

AM, AM-FM RADIO

The pushbutton radio provides manual tuning, pushbutton tuning, and a tone control which enables the owner to select a high fidelity tone on either AM or FM stations. AM and FM operation on A, G and F Series is controlled by extreme lefthand (AM) and righthand (FM) buttons.

The left radio knob turns the radio ON and OFF and controls the volume. The tone control bezel (behind the left knob) is turned counterclockwise for bass tones and clockwise for treble tones. When indexed at the detent, it provides a balanced normal tone.

The right knob is used to tune stations manually. The bezel behind the knob is the front-rear speaker control (if so equipped).

On B Series an AM-FM selector bar is located directly above the dial face. Movement of the bar to the left exposes the letters "FM" and switches the radio to FM band. Movement of the bar to the right provides AM band. An automatic frequency control circuit is incorporated in the radio and automatically keeps the receiver on frequency. This eliminates any station detuning due to temperature changes around the radio.

Due to the higher frequencies involved in the FM band, reception is generally limited to an average of about 25 miles. Beyond this point station flutter or fading may become apparent. FM reception is noise-free, provided sufficient signal is present to allow the noise-limiting features of the radio to operate.

ADJUST ANTENNA TRIMMER

The proper adjustment of antenna trimmer is extremely important to the operation of an auto radio.

> **NOTE:** *On AM-FM radios, adjustment must be made on AM band only. Trimmer adjustment on FM band is internal to the radio and is independent of the antenna being used.*

1. Tune radio to a weak station near 1400 KHz which can barely be heard with volume turned fully clockwise.
2. Remove right-side control knobs.
3. On cars equipped with monaural radios that have a rear speaker, there are three small holes (electrical connection points) in the receiver which are located directly behind right knob. The rear speaker control has three prongs which interconnect these points. When the control is removed to gain access to the trimmer screw behind it, two of the holes (the center and an outside hole) must be interconnected by a short piece of jumper wire to channel the audio signal to a speaker. It is generally desirable to trim the radio while using the front speaker.
4. Adjust antenna trimmer screw until maximum volume is achieved.
5. Reinstall both right knobs.

The antenna trimmer adjustment should be made after a set has been removed from car and worked on by a radio repair man. The reason for trimming antenna after service work has been performed is that the radio repair man will undoubtedly have adjusted trimmer to match his antenna so it no longer matches the antenna in the car from which it was removed. Trimming the antenna is especially important with the all-transistor radio as this will directly affect sensitivity and selectivity. Complaints of station mixing on all-transistor radios can be eliminated by this adjustment.

SET RADIO PUSHBUTTONS

1. Turn radio on.
2. Pull out pushbutton until it stops.
3. Manually tune to desired station.
4. **Fully** depress pushbutton.

To set the radio for AM or FM reception on B Series radios move the selector bar to "AM" position and perform the four (4) steps above. Then move selector to "FM" position and repeat. In this manner five separate AM and FM stations (total of ten) can be selected.

If the AM-FM selector bar does not move from one band to the other, fully depress each pushbutton one at a time to make sure that the pushbutton slide mechanism is fully engaged.

DO NOT ATTEMPT TO MOVE SELECTOR BAR WHILE A PUSHBUTTON IS PULLED OUT.

> **NOTE:** *On pushbutton selection, if the program sounds shrill or distorted, it is probably caused by improper tuning and can be corrected by adjusting the tuning knob slightly. Since the low notes are more affected by tuning than the high ones, it is preferable to tune the receiver to a point where the low notes are heard best and high notes are clear but not shrill. This point may be most readily found by listening to the background noise of a station and tuning for the lowest noise level of the station. Turning the control knob back and forth until the station is almost lost on either side will enable the operator to hear the difference in reception and select the intermediate position giving the best results.*

AM-FM STEREO RADIO

On all series the multiplex adapter is incorporated in the radio receiver. AM and FM operation is identical to that described under "AM, AM-FM Radio". The volume and tone control varies the volume and tone respectively in both channels simultaneously. AM, FM, or stereo reception through the speakers is governed by the fader control which is operated by turning the bezel behind the tuning knob. If the bezel is in a complete clockwise position, the volume of the rear speaker(s) will be loudest. Likewise, complete counterclockwise position gives full front speaker(s) volume. This control has no effect on the balance of stereo channels.

The stereo system on B Series includes four speakers, two front and two rear. The right rear and left front speakers are one channel and the left rear and right front are the other channel. This gives a criss-cross or surrounding sound effect. On G Series the front speaker plays one channel while the two rear speakers play the other channel.

Speaker location is shown in Fig. 15-12.

When an FM station is capable of transmitting in stereo, the stereo indicator lamp will light (the word "STEREO" on B Series will light). This indication of stereo, however, does not always mean the station is transmitting stereo at that particular moment. The perimeter of good FM stereo reception will be generally less than 25 miles.

WINDSHIELD RADIO ANTENNA

All models are equipped with a windshield radio antenna including models without radio (X Series only have a windshield antenna with a radio or no radio with tinted glass). This antenna is the only available antenna on 1972 models. The windshield is installed and the antenna lead-in is provided under the instrument panel. For installation details, see the body manual for 1972.

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. All FM signals are transmitted and received in a horizontal plane. The top segment of each antenna conductive element is mounted horizontally and measures 31 inches, resulting in ideal FM reception.
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".

TESTING: The antenna can easily be checked using tester J-23520 as shown on the chart in Diagnosis Section.

RADIO/TAPE PLAYER COMBINATION

Two integral radio/tape player units are available on B Series only; AM, or AM-FM Stereo Radio/Tape player. This unit uses a standard eight-track tape cartridge that is inserted through the spring loaded radio dial. Track selection is made by pushing the left hand (volume) control knob, while cartridge ejection is controlled by the "EJECT" pushbutton. If there is no cartridge in the tape player, the eject button is also an AM or FM station. Front-rear speaker volume is controlled by the right-hand control bezel.

This integral design offers several advantages over a separate tape player unit:

1. Neater appearance.

		F SERIES	A SERIES WGNS.	A SERIES CONV.	A SERIES OTHERS	B SERIES WGNS.	B SERIES CONV.	B SERIES OTHERS	G SERIES	X SERIES
EITHER AM RADIO OR AM/FM RADIO	FRONT	1 in center of I.P.								
EITHER OF ABOVE 2 RADIOS PLUS REAR SEAT SPEAKER	FRONT	1 in center of I.P.								
	REAR	1 PKG. SHELF	1 WHEEL HSG.	1 TOP COMPT.	1 PKG. SHELF	1 WHEEL HSG.	1 TOP COMPT.	1 PKG. SHELF	1 PKG. SHELF	1 PKG. SHELF
STEREO RADIO OR ANY STEREO TAPE PLAYERS	FRONT	1 in center of I.P.				2 on ends of I.P.			1 in I.P. Center	1 in I.P. Center
	REAR	1 PKG. SHELF	1 WHEEL HSG.	1 TOP COMPT.	1 PKG. SHELF	2 WHEEL HSG.	2 TOP COMPT.	2 PKG. SHELF	2 PKG. SHELF	1 PKG. SHELF

Fig. 15-12 Front and Rear Speaker Location

2. More foot room for the center passenger since the unit no longer sits on the tunnel.

3. Theft deterrent - with the tape cartridge removed, the unit looks like an ordinary radio.

EIGHT-TRACK STEREO TAPE PLAYER

NOTE: *When removing tape player knobs on F Series, insert a small allen wrench (Fig. 15-51), pointed tool or wire (awl, etc.) in slot on side of knob and release inner retainer by prying outward (away from dash). While releasing retainer, pull knob off.*

The Stereo Tape Player allows the owner to make his own selection of pre-recorded music. It uses a standard eight-track cartridge and may only be ordered with a radio. The tape player is turned on by **completely** inserting a cartridge into the unit. The insertion of a tape cartridge automatically removes power from the radio and switches the speakers from the radio to the tape player. This feature prevents accidental damage to the radio should the owner attempt to operate it while the tape player is in use. After the tape player is in operation, the front panel controls of the player are then adjusted for the most pleasant stereo listening.

The unit is equipped with a cartridge locking arm to hold the cartridge in a rigid position against the capstan drive for minimum "wow" and "flutter". As the cartridge is withdrawn from the player, the on/off switch at the other side of the cartridge is not completely disengaged when the lock arm reaches a detent point on the cartridge.

CAUTION: *Always pull cartridge approximately one inch out of tape player when not in use. If this is not done, the tape may be pulled out of the cartridge and wound around the capstan when player is re-started.*

The tape player speaker system is the same as described under "AM-FM Stereo Radio.".

MAINTENANCE AND CAUTIONS

The only required maintenance on tape players is periodic cleaning of the tape player head. This service should be performed 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 alcohol.

No lubricants should be used since they will cause the player to operate improperly, especially at extreme temperatures.

Do not bring any magnetized tools near the tape head. If the head becomes magnetized, every cartridge played in the player will be degraded.

CASSETTE STEREO TAPE PLAYER

A cassette tape player is available in conjunction with a radio. Mounted on a transmission tunnel pod or the top of console, this unit uses standard cassette tape cartridges. To operate the tape player, insert the cartridge and close the tape door. This automatically transfers power and speaker connections from the radio to the tape player.

TO INSERT TAPE CARTRIDGE-Push "TAPE RELEASE" button firmly. Tape door will pop up. Insert Cassette cartridge with tape facing toward you.

TO START PLAYER-Press tape door down until it locks in place. Player will start within a few seconds. If no tape is inserted, player will remain OFF.

TO REMOVE TAPE CARTRIDGE-Push "TAPE RELEASE" button firmly and tape door will pop up.

TO PLAY OTHER SIDE-Player automatically turns off when tape reaches end of program. Push "TAPE RELEASE" button, remove cartridge, turn it over, and re-insert to hear Side Two.

TO REWIND TAPE-Side One is automatically re-wound when Side Two is played. However, you may re-wind Side One without playing Side Two by pressing the "REVERSE" button. When you reach the beginning, tape will stop.

TO SKIP PORTIONS OF TAPE-Simply hold in the "Forward" button and the tape runs forward rapidly. Release to play.

NOTE: *If you reach end of tape while running fast forward, it may not be possible to re-wind by pressing the "REVERSE" button. If this happens, turn tape over and play other side.*

TO OPERATE RADIO- Radio will not operate while tape cartridge is inserted in player. (The Tape-In light comes ON to indicate that a tape cartridge is in the player.) Press "TAPE RELEASE" button, remove tape cartridge, and close door.

REAR SEAT SPEAKER

The rear speaker system with AM or AM-FM radios employs a single rear speaker which, together with the front speaker, is controlled by a switch incorporated into the righthand bezel on the radio receiver.

The speaker control features a "Fader" operation which provides a variable volume control for both front and rear speakers. Extreme counterclockwise switch position is front speaker only; while extreme clockwise position is rear speaker only. Positions between these extremes give varying amounts of front or rear volume.

IGNITION SUPPRESSION EQUIPMENT

Various types of ignition suppressors are used to prevent spark noise from interfering with radio reception. Failure of any of these parts to function properly is accompanied by a popping noise. The noise increases as the engine is accelerated and varies with engine speed.

Interference or electrical noises which are amplified by the radio fall into two basic classifications: "normal" and "abnormal". Interference or an electrical noise is **considered "normal"** if it occurs when the customer manually operates a switch or accessory in the car. Interference or an electrical noise that occurs without the customer manually operating a switch is **considered "abnormal"**. (e.g., alternator whine, transmission switch pop, etc.)

Some types of interference and electrical noises that are considered **"normal"** are:

1. Blower switch
2. Power window motor
3. Ignition key door buzzer
4. Brake warning light
5. Turn signal
6. Cruise control
7. Cigar lighter
8. Power seat switch
9. Windshield wiper switch
10. Headlight switch

The following is a list of suppression equipment which is installed on 1972 Pontiac models:

1. Ground strap from the rear of engine to firewall (All).
2. 0.3 Mfd. capacitor on ignition coil ("+" terminal, V-8 engines only).
3. 0.25 Mfd. coaxial capacitor in blower motor feed (FM radio only).
4. 0.5 Mfd. capacitor in fuse block "BAT" terminal (except A Series).
5. Hood ground clip (All).
6. 0.5 Mfd. capacitor on A/C master relay (B Series only).
7. Distributor point shield (V-8 engines only).

SLIDING SUNROOF (X SERIES)

The sun roof consists of two (2) layers of fabric; an outside water repellent material bonded to a grained vinyl coating and an inner layer of vinyl headlining. Roof bows fitted between the two (2) layers shape the sunroof to the contour of the roof panel.

Nylon caps on the ends of the front header and on two roof bows slide in the side channels when the sunroof is opened or closed.

To unlock the sunroof, pull the release handle down, and turn counterclockwise (180°). While holding the handle, pull the panel back to full open and return forward to the desired position, then turn handle clockwise (180°) and fold handle flush. **Do not pull on either side of roof to open or close.** The closing action secures the sunroof in any open position, and protects against possible head impact (by folding handle flush). To reduce air turbulence at highway speeds, do not open beyond the mid position, and fold handle flush to close. To lock, move sunroof fully forward with handle to engage lock-catch, then turn handle clockwise (180°) and fold handle flush.

During the latching operation, the initial rotation of the handle moves the latch hook left to engage the front retainer and then continued rotation pulls the sun roof forward for a tight cover over the opening. The last few degrees of handle rotation cause an internal cam to force the front edge of the header down for a tight seal to the roof panel.

No maintenance is required except to periodically wipe slide rails with a clean cloth. Cleaning of the inside or outside surfaces should be done with soap and water. Use of detergents is not advisable.

CRUISE CONTROL TEST PROCEDURE

ROAD OR ROLL TEST AS FOLLOWS:

1. DRIVE AT SPEED OF 50 M.P.H.
2. CHECK ENGAGE AND CRUISE:
   PUSH ENGAGE BUTTON APPROX. 1/2 TRAVEL
   CRUISE CONTROL SHOULD ENGAGE AT 50 M.P.H. ± 1 M.P.H.
3. CHECK ENGAGE BUTTON DISENGAGE:

   PUSH BUTTON TO FULL TRAVEL AND ALLOW CAR TO DROP TO 40 M.P.H. AND RELEASE BUTTON SLOWLY. CRUISE CONTROL SHOULD LOCK IN AT 40 M.P.H.
4. CHECK FOR THROTTLE RELEASE:
   SLOWLY DEPRESS BRAKE PEDAL. THROTTLE RELEASE MUST BE ACHIEVED PRIOR TO BRAKE ENGAGEMENT

IN THE EVENT THAT LIMITS IN STEP 2 ABOVE ARE EXCEEDED, AN ALLEN WRENCH ADJUSTMENT IS PROVIDED ON THE REGULATOR ASSEMBLY. (SEE ILLUSTRATION) THIS ADJUSTMENT SCREW IS LOCATED NEXT TO THE ELECTRICAL TERMINALS AND IS MARKED "C" WITH "F" (FAST) AND "S" (SLOW) ARROWS INDICATING CLOCKWISE ROTATION TO BRING CONTROL SPEED DOWN TO ENGAGE SPEED AND COUNTERCLOCKWISE ROTATION TO BRING CONTROL SPEED UP TO ENGAGE SPEED.

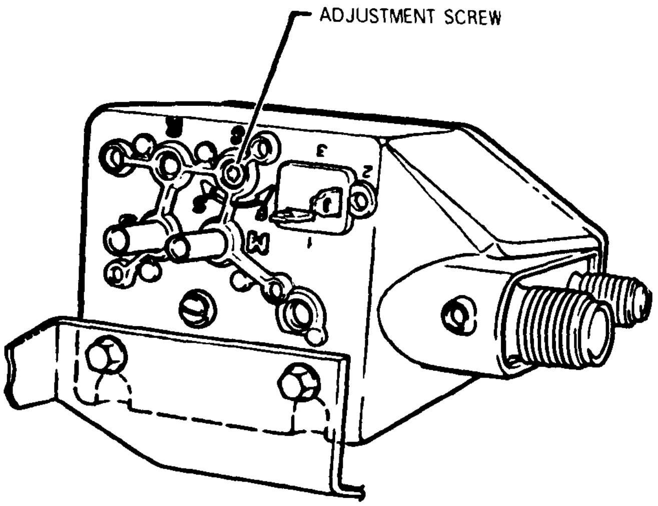


Fig. 15-13 Cruise Control Regulator Adjustment

SERVICE PROCEDURES

CRUISE CONTROL

ADJUST REGULATOR (Fig. 15-13)

1. If Cruise Control holds speed three or more mph higher than selected speed, turn centering spring adjusting screw (C) clockwise 1/8" turn or less.
2. If Cruise Control holds speed three or more mph below selected speed, turn centering spring adjusting screw (C) counterclockwise 1/8" turn or less.

ADJUST BRAKE RELEASE SWITCH (Figs. 15-14 and 15-15)

Apply brake pedal and push both switches forward as far as possible. Pull pedal forcibly rearward to adjust switches.

CHECKING FOR DAMAGED CABLES AND GEARS

1. Raise rear of car and place on jack stands.
2. Start engine and move transmission shift lever to "Drive" range.
3. Remove input cable at regulator to determine if cable from transmission to regulator is turning. If cable is not turning, check for broken cable or stripped transmission speedometer gear.
4. If input cable is turning and speedometer was inoperative, cable to speedometer or regulator transfer gear is broken.

REGULATOR

REMOVE AND REPLACE (Figs. 15-16 and 15-17)

1. Disconnect vacuum hoses and electrical connector.
2. Disconnect both speedometer cables.
3. Remove screws holding regulator to fender skirt and remove regulator.
4. To replace, reverse above steps.

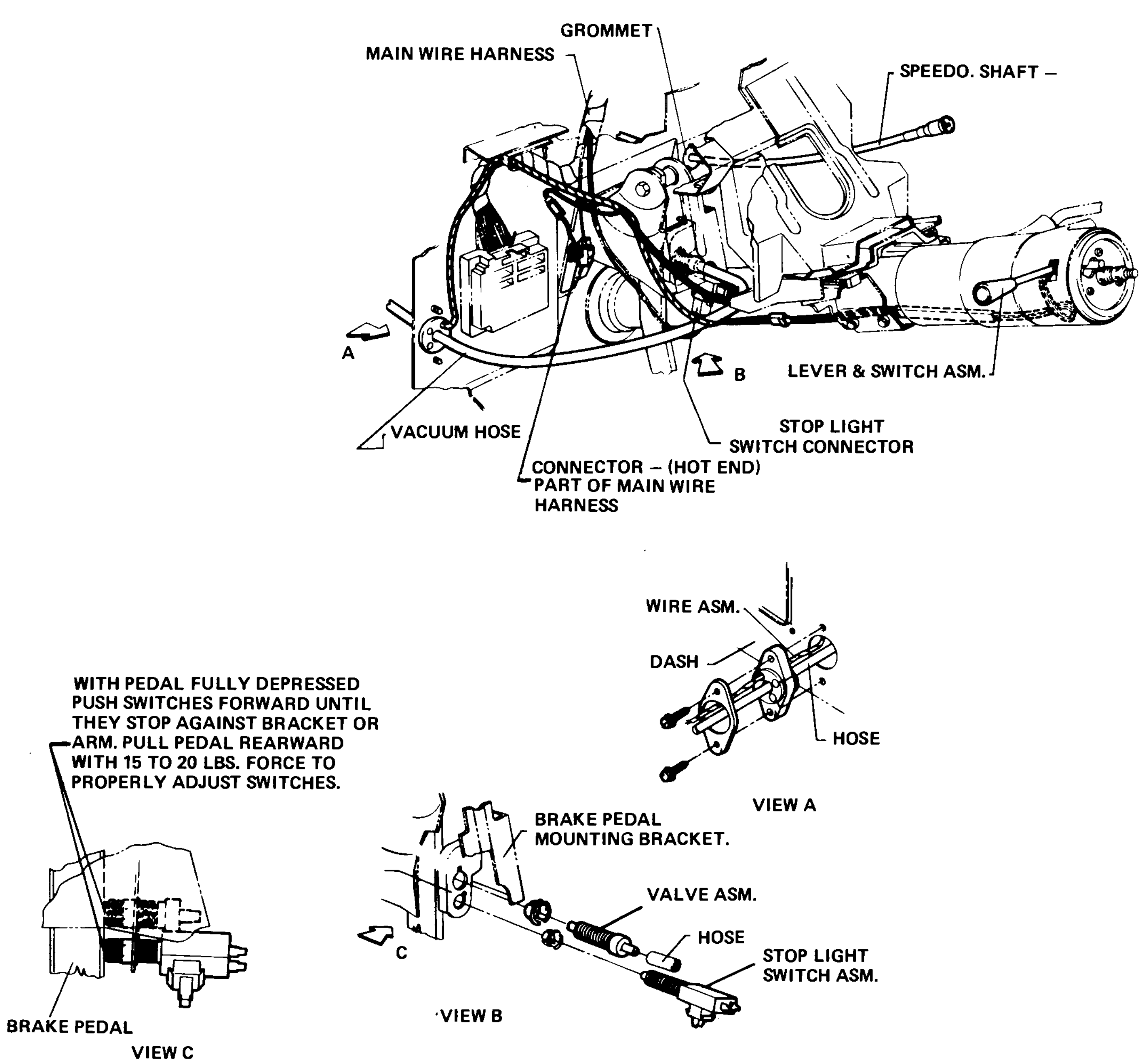


Fig. 15-14 B Series Cruise Control Wiring and Vacuum Switch Installation

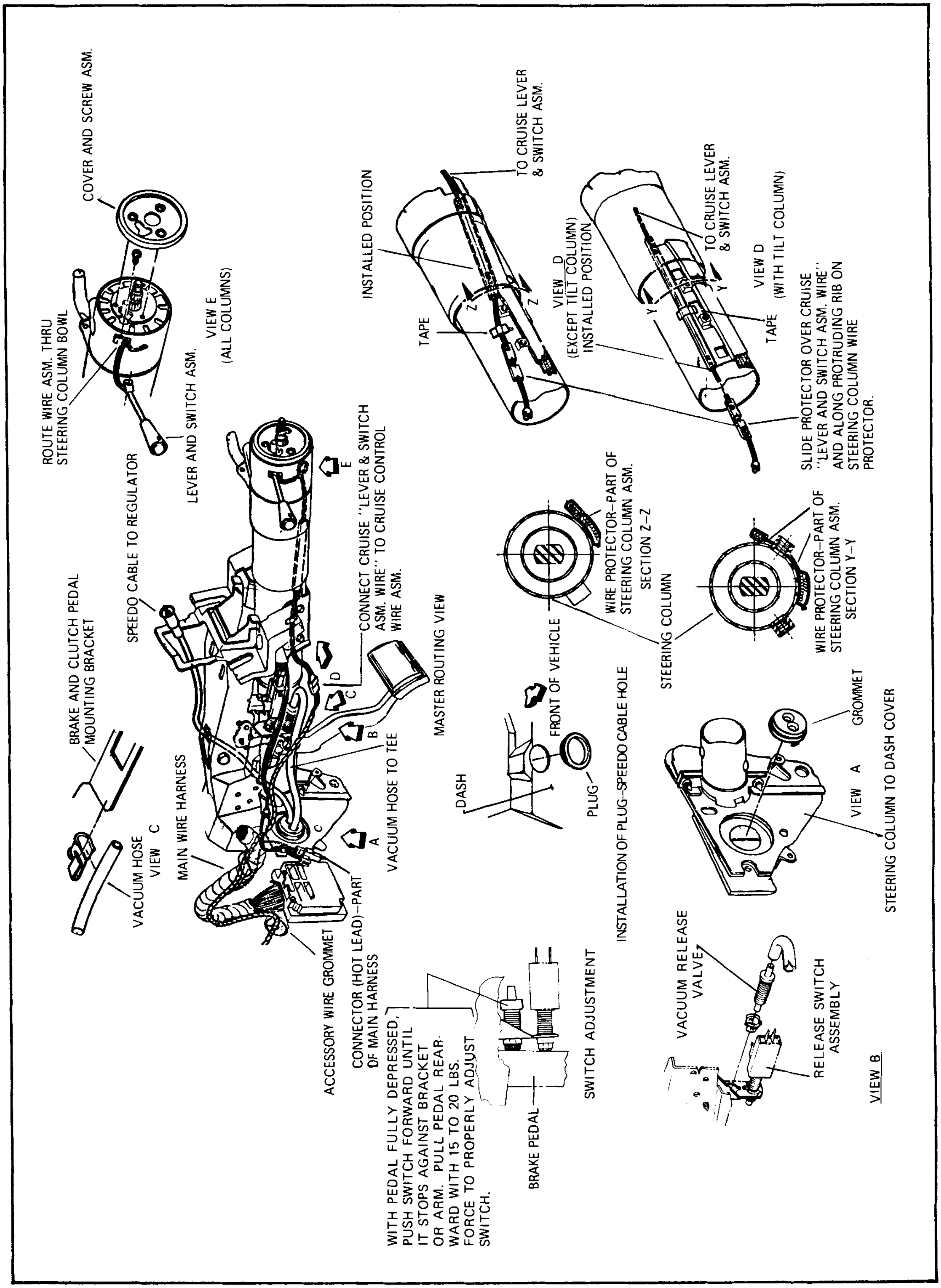


Fig. 15-15 A and G Series Cruise Control Wiring and Vacuum Switch Installation

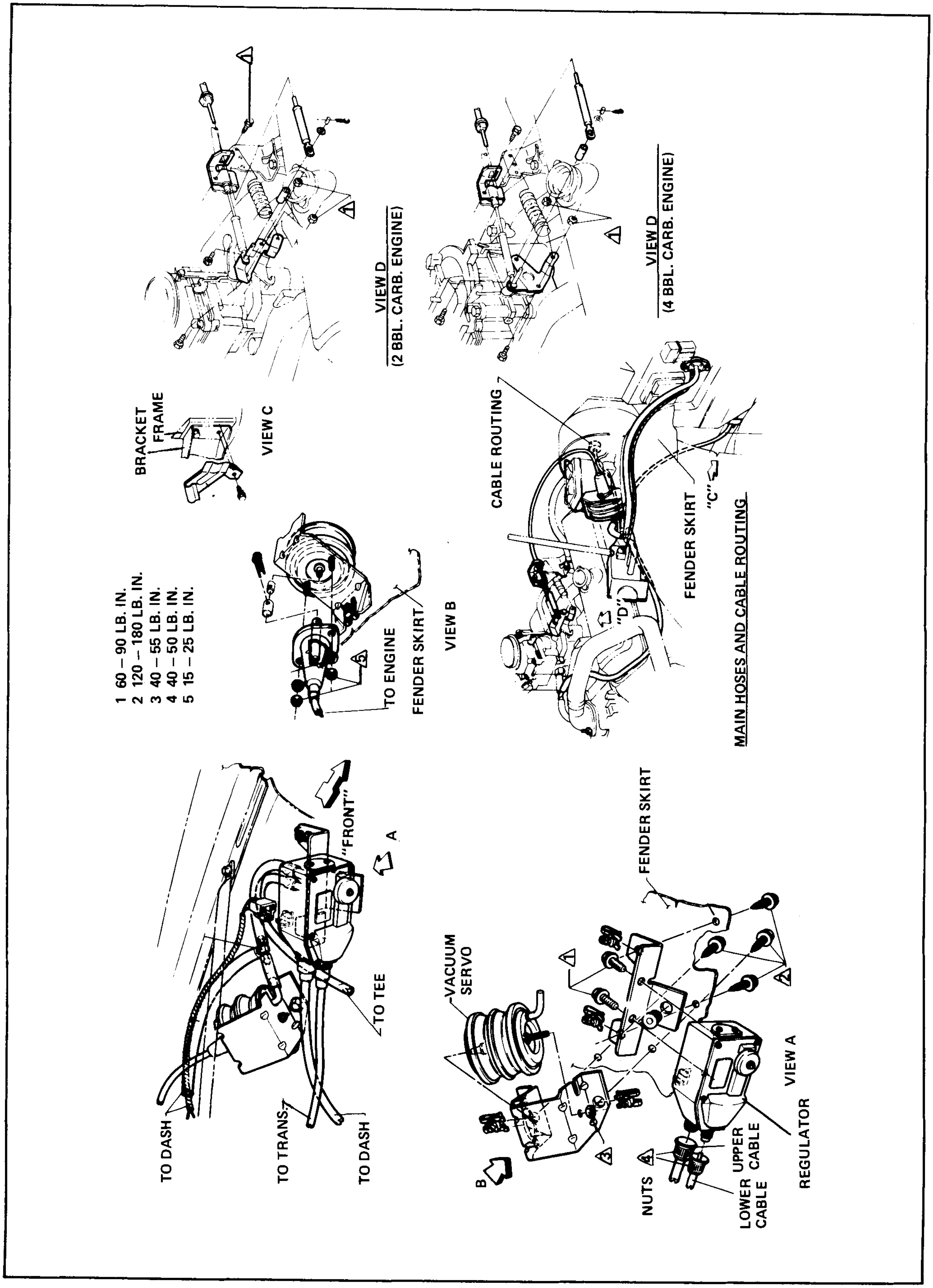


Fig. 15-16 B Series Cruise Control Installation

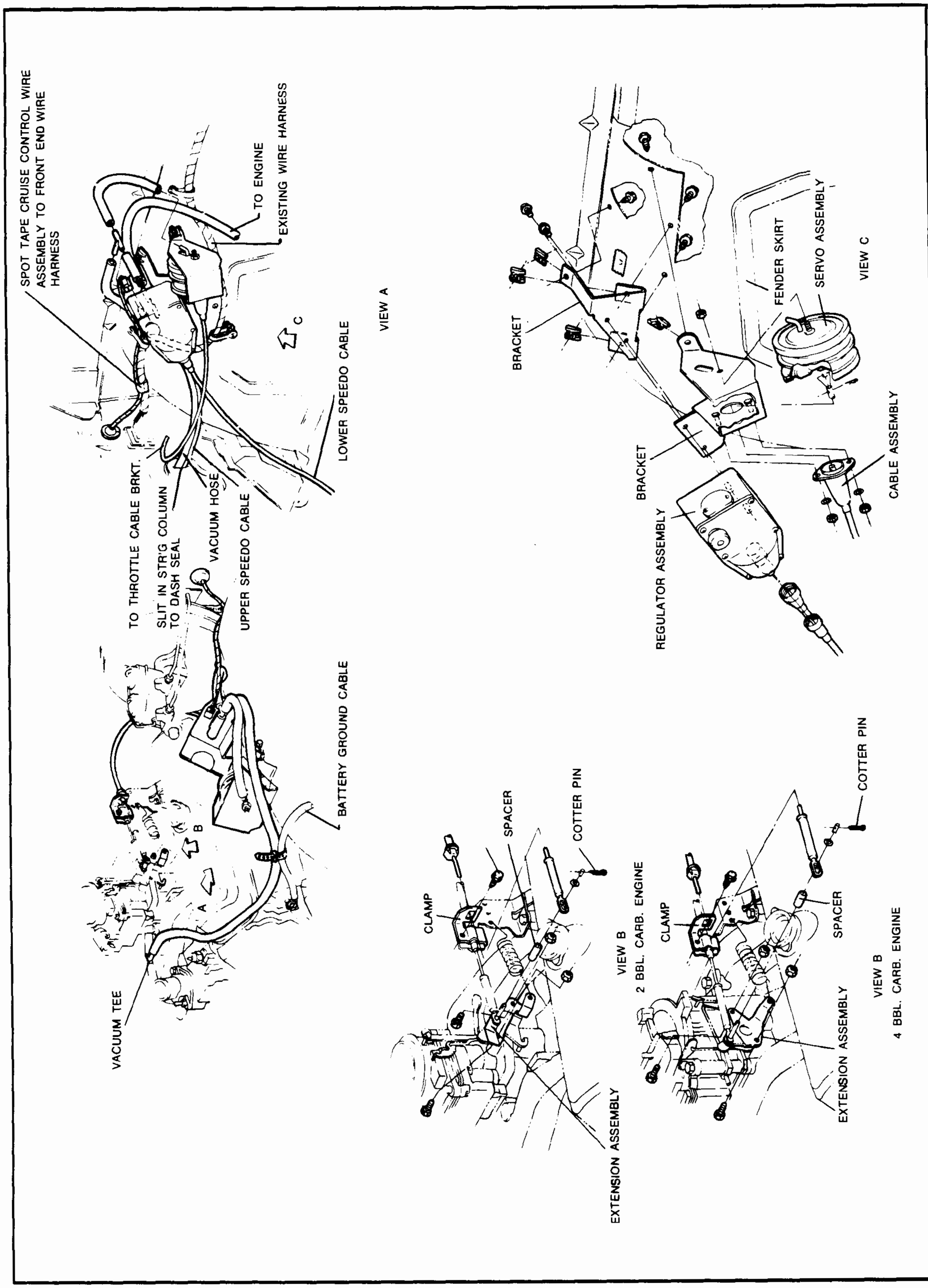


Fig. 15-17 A and G Series Cruise Control Installation

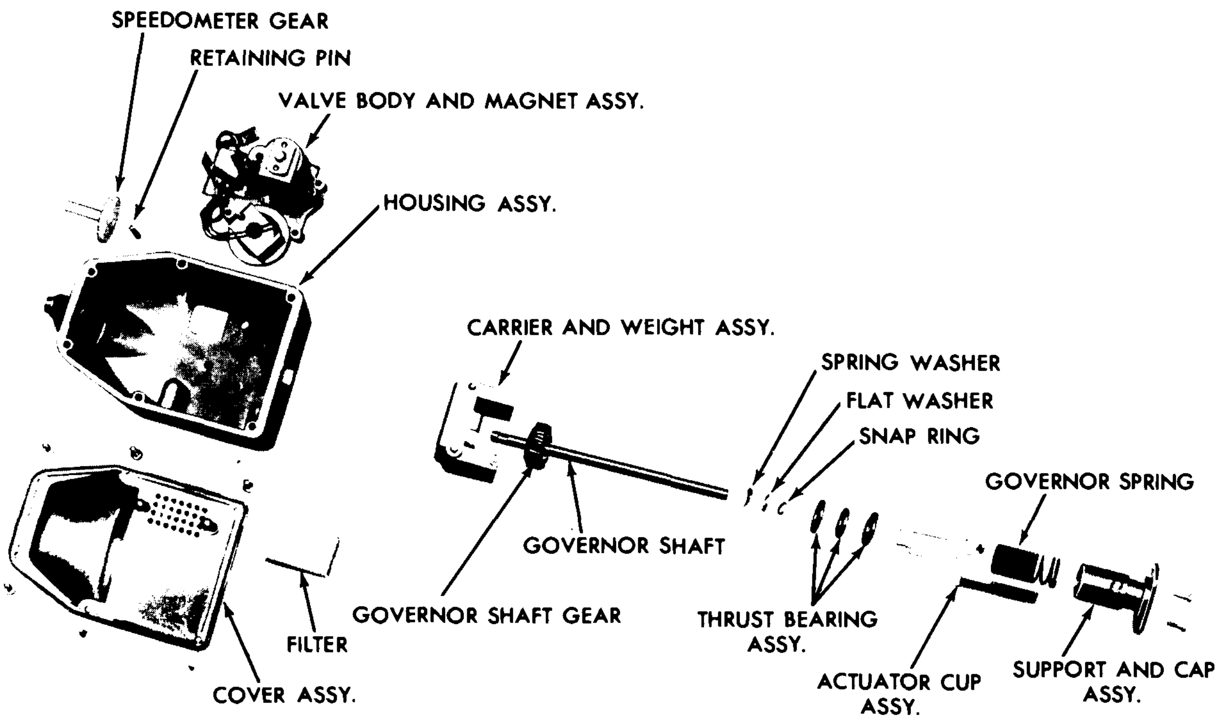


Fig. 15-18 Regulator - Exploded View

DISASSEMBLE (Fig. 15-18)

NOTE: *Do not tamper with the following screws (Fig. 15-19):*

a. The screw in the bearing support assembly.

b. The screw on top of the solenoid coil.

These screws are pre-adjusted at the factory.

1. Remove screws and cover. To replace air filter in cover, push filter out from under filter plate (Fig. 15-20).
2. Remove two screws securing bearing support, rotate support 180° and slide out (Fig. 15-21).

   NOTE: *Do not tamper with screw on bearing support. This screw positions the governor spring and is pre-set at the factory.*

3. Remove governor spring.
4. Spread governor weights in an up and down position and pry up on actuator coupling with a screwdriver until pin is disengaged from magnet assembly and can be rotated clockwise (Fig. 15-21). Rotate actuator cup 180° and hook the actuator coupling over the top of regulator housing (Fig. 15-22).

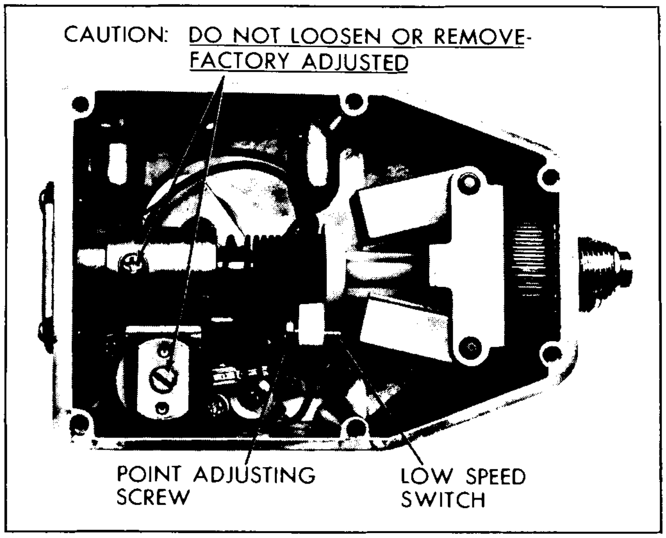


Fig. 15-19 Adjusting Low Speed Switch

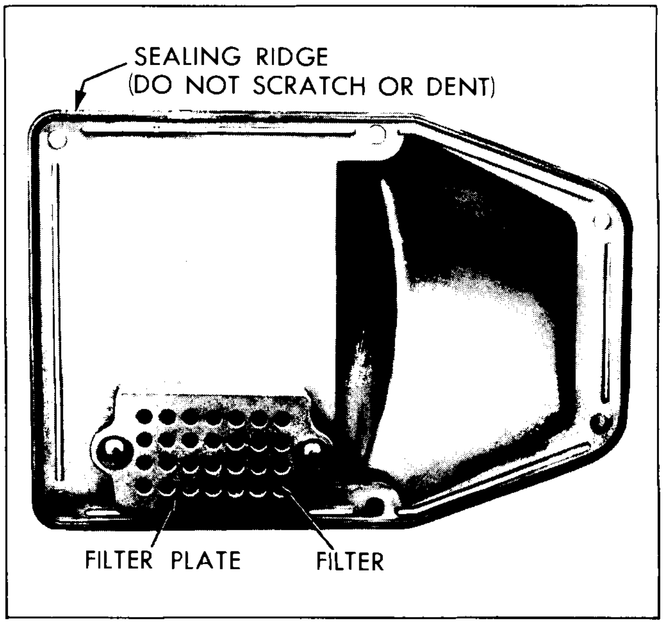


Fig. 15-20 Cover and Intake Filter Assembly

5. Slide the governor assembly away from the speedometer drive adapter end until the shaft is free of bearing. This will allow the governor assembly to be removed from the regulator. For further disassembly of governor, see Fig. 15-18.

6. Remove four screws (2 internal, 2 external) holding the valve body and magnet assembly. Remove valve body and magnet assembly from the regulator housing. (Fig. 15-23).

7. Remove driven gear from regulator by pressing retaining pin out of regulator body.

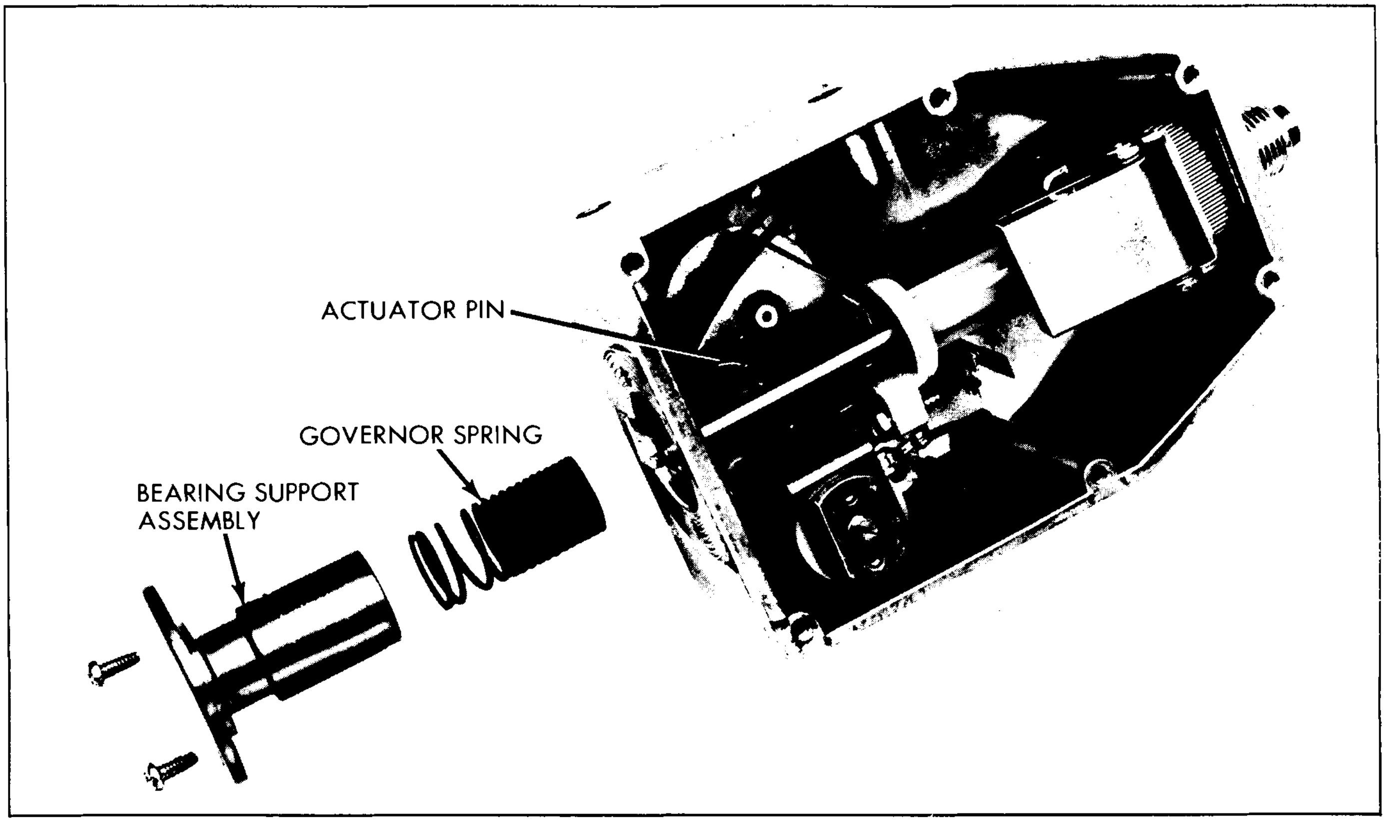


Fig. 15-21 Bearing Support Removal

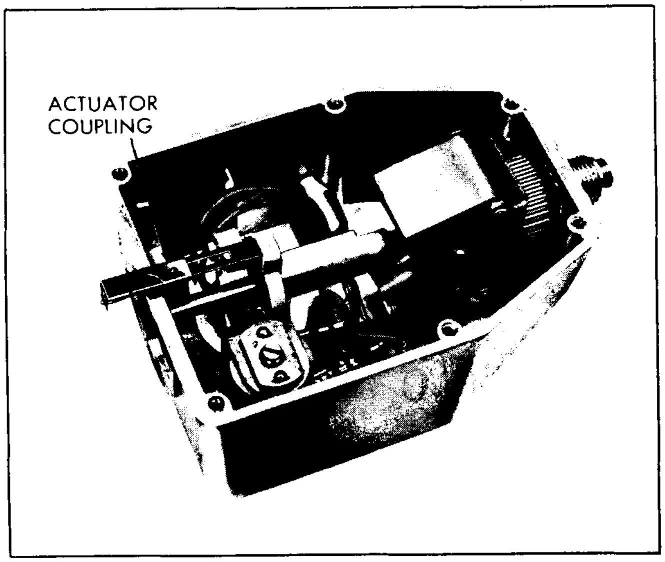


Fig. 15-22 Governor Assembly Removal

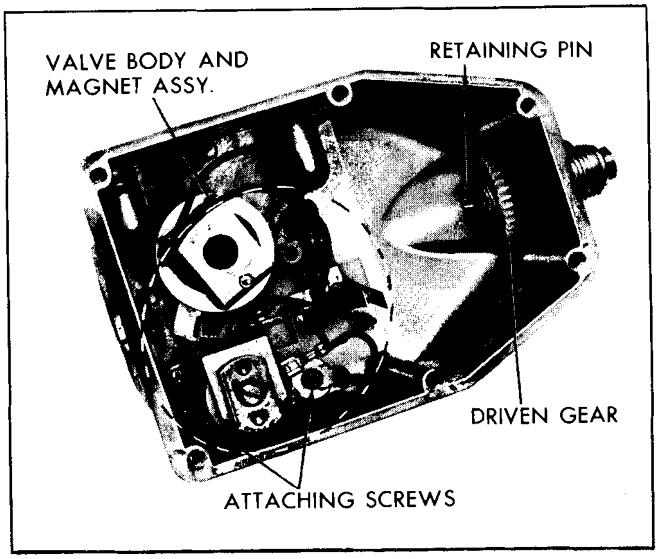


Fig. 15-23 Valve Body and Magnet Assembly Removal

ASSEMBLE

1. Install driven gear and retaining pin in housing.

2. Insert valve body and magnet assembly into the regulator housing and install four screws.

   NOTE: *Make sure the foam-paper back gasket on the bottom of the valve body and magnet assembly lies flat against the regulator housing. Under no circumstances should this gasket be glued to the valve body and magnet assembly.*

3. With weights in an up and down position, insert the long end of the governor shaft through the bearing support mounting hole keeping the actuator coupling hooked over the regulator housing. Insert the shaft far enough to allow the short end of the governor to be inserted into its bearing. Slide the governor assembly into the bearing until it bottoms.

4. Move the actuator cup down the shaft until it bottoms and rotate 180°.. Using a screwdriver, pry the actuator coupling up and rotate the magnet counterclockwise until the pin engages the actuator coupling hole.

5. Install governor spring over governor shaft with closed end of spring toward the actuator cup.

6. Install bearing support in regulator. Rotate 180° and secure with two (2) screws.

7. Secure cover with six (6) screws.

   NOTE: *When the valve body and magnet assembly or the governor assembly is replaced, the low speed switch must be adjusted. With the actuator cup held in the lowest speed position (governor weights in) turn point adjusting screw until the gap between the switch points is .025".*

Refer to Section 9 of this manual for service of the engagement switch.

ELECTRIC CLOCK

REMOVE AND REPLACE

A Series (Fig. 15-24)

1. Disconnect battery.

2. Remove cold air duct if equipped with air conditioning.

3. Remove radio and support bracket.

4. Disconnect bulbs and power feed connector from clock.

5. Loosen clock retaining screws (3), rotate clock assembly in a clockwise direction (as viewed from passenger side of dash) and remove.

6. To replace, reverse removal procedure.

G Series (Fig. 15-24)

1. Disconnect battery.

2. Remove lower A/C duct if equipped.

3. Remove radio.

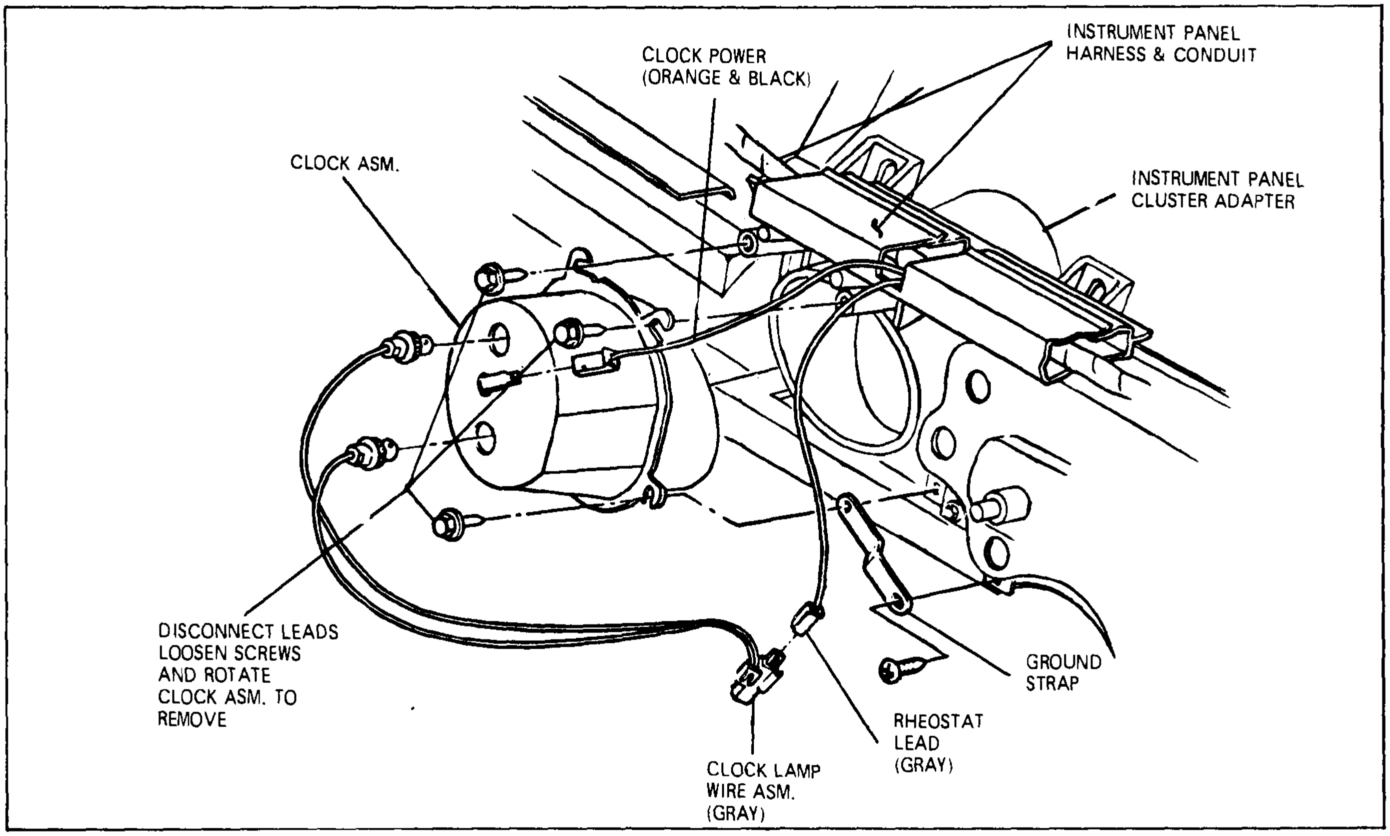


Fig. 15-24 A and G Series Clock Installation

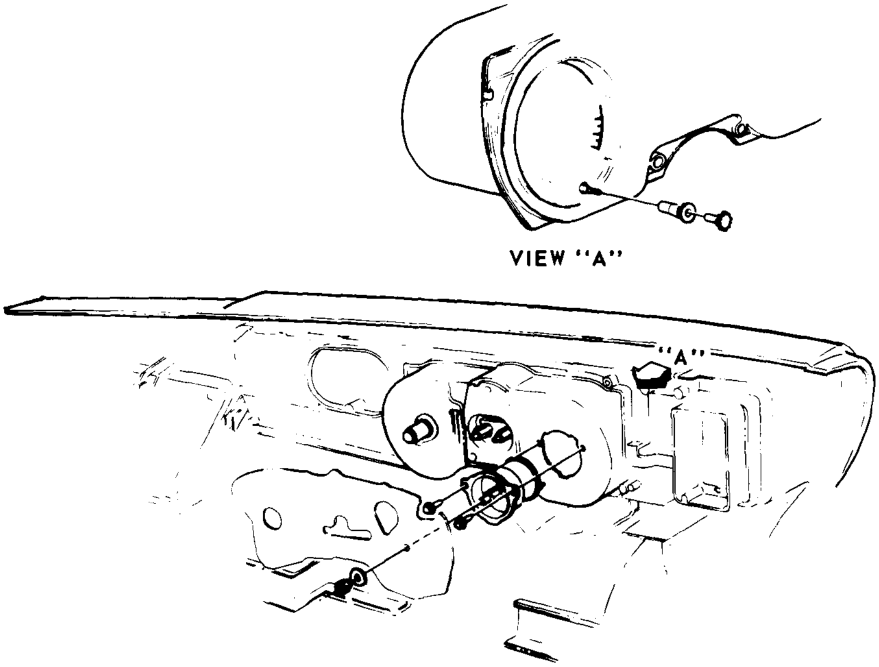


Fig. 15-25 F Series Clock Installation

4. Remove upper A/C duct if equipped.

5. Disconnect bulbs and power feed from clock.

6. Loosen clock retaining screws (3) and rotate clock in a clockwise direction (as viewed from passenger side). Remove clock.

7. To replace, reverse removal procedure.

B and F Series (Fig. 15-25)

Remove instrument panel speedo cluster as outlined in Section 12 and remove clock from cluster.

X Series (Fig. 15-26)

1. Disconnect battery and remove radio (includes remove knobs, bezels, nuts and side brace screw, disconnect antenna lead-in and connectors).

2. Remove clock stem knob, disconnect clock lead, twist and remove four (4) cluster bulbs near clock.

3. Remove two (2) screws from printed circuit and clock, "fold" back printed circuit and remove clock.

4. To replace, reverse removal procedure.

DASH-MOUNTED TACHOMETER

REMOVE AND REPLACE

For removal of dash-mounted tachometer on A and F Series use procedure for clock removal.

DECK LID RELEASE SWITCH

REMOVE AND REPLACE

All except G Series with Console

1. Remove ash tray and bracket on models with air conditioning to gain access to switch.

2. Disconnect wires from switch.

3. Depress retaining clips and remove switch.

4. To replace, reverse removal procedure.

See Figs. 15-27 (B Series), 15-28 (A Series) and 15-29 (G Series).

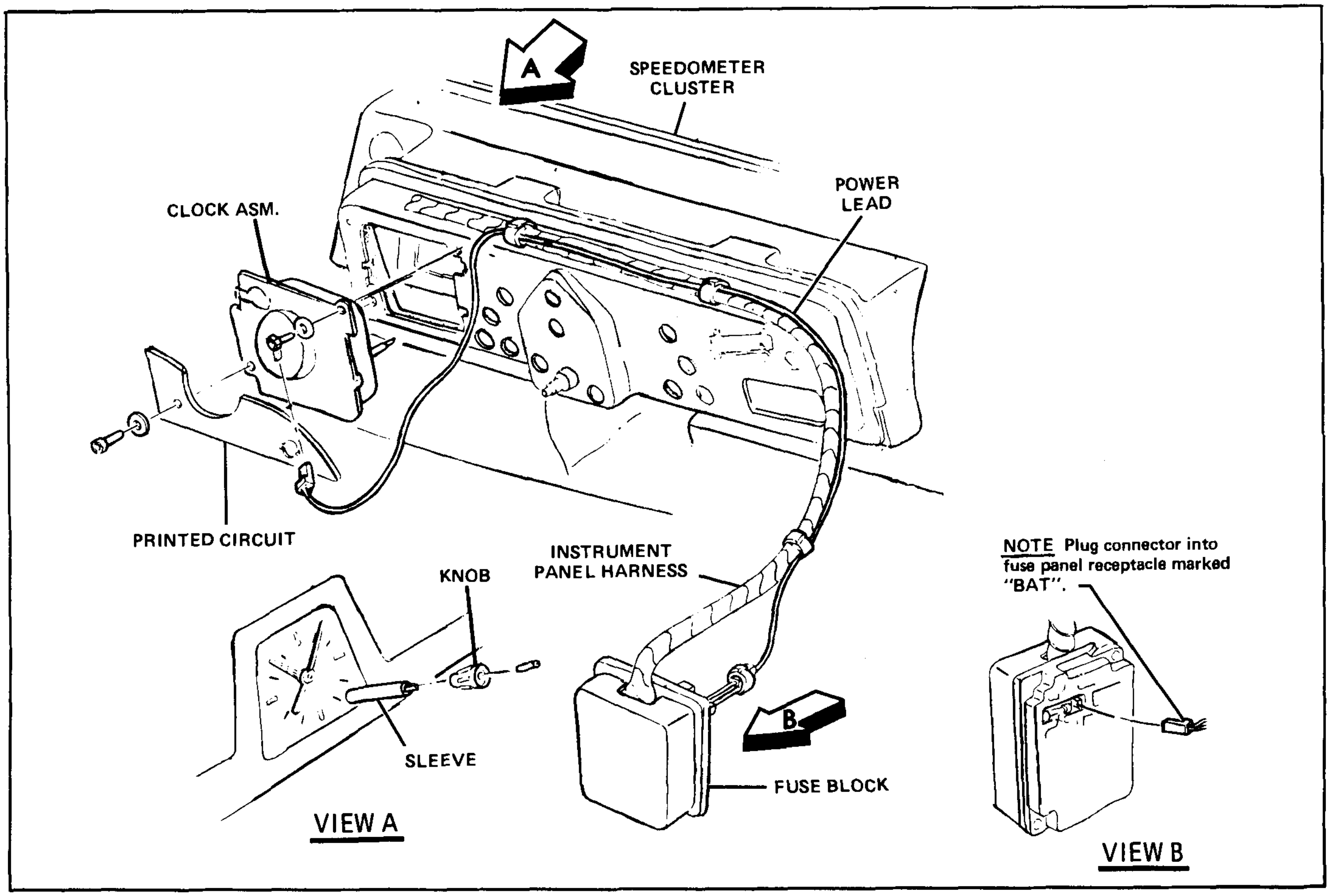


Fig. 15-26 Clock Installation

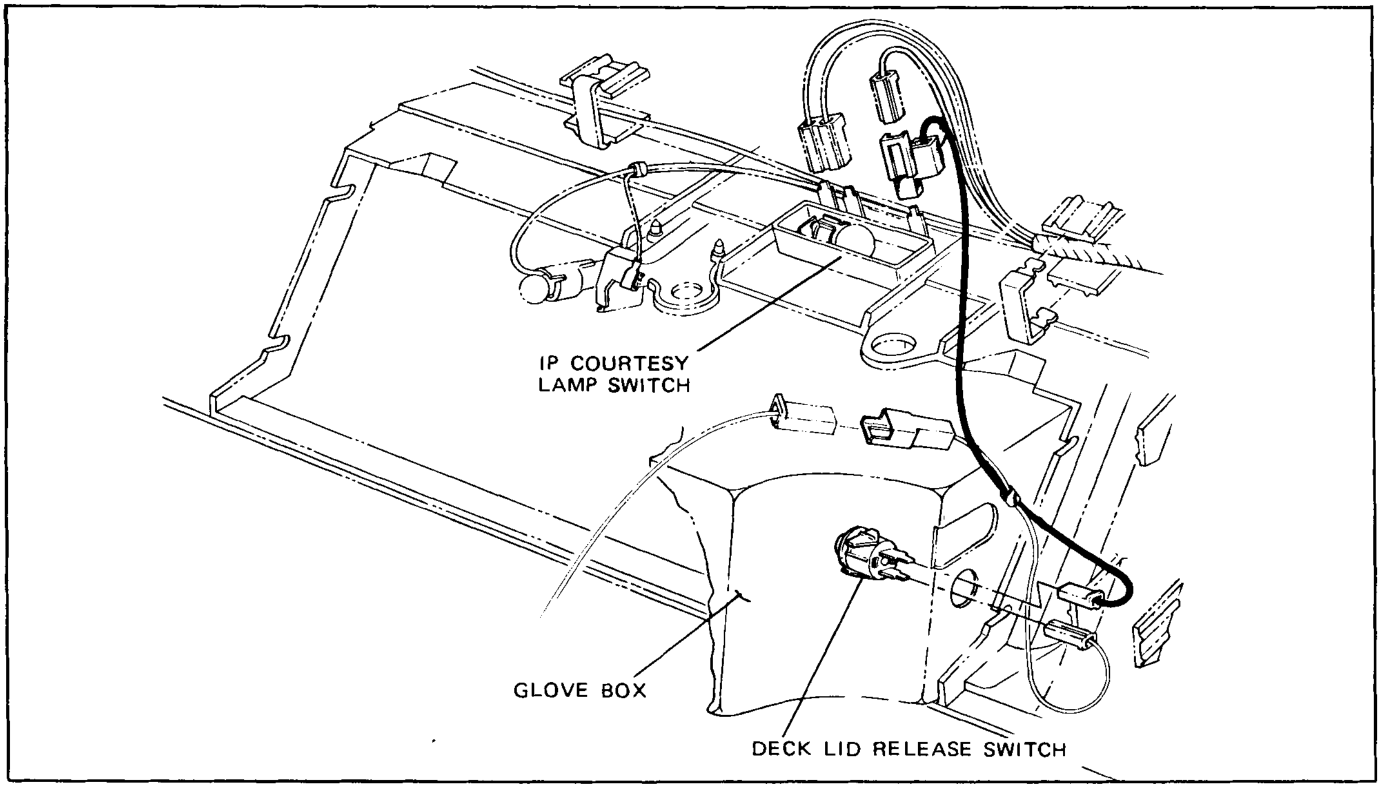


Fig. 15-27 B Series Deck Lid Release Switch

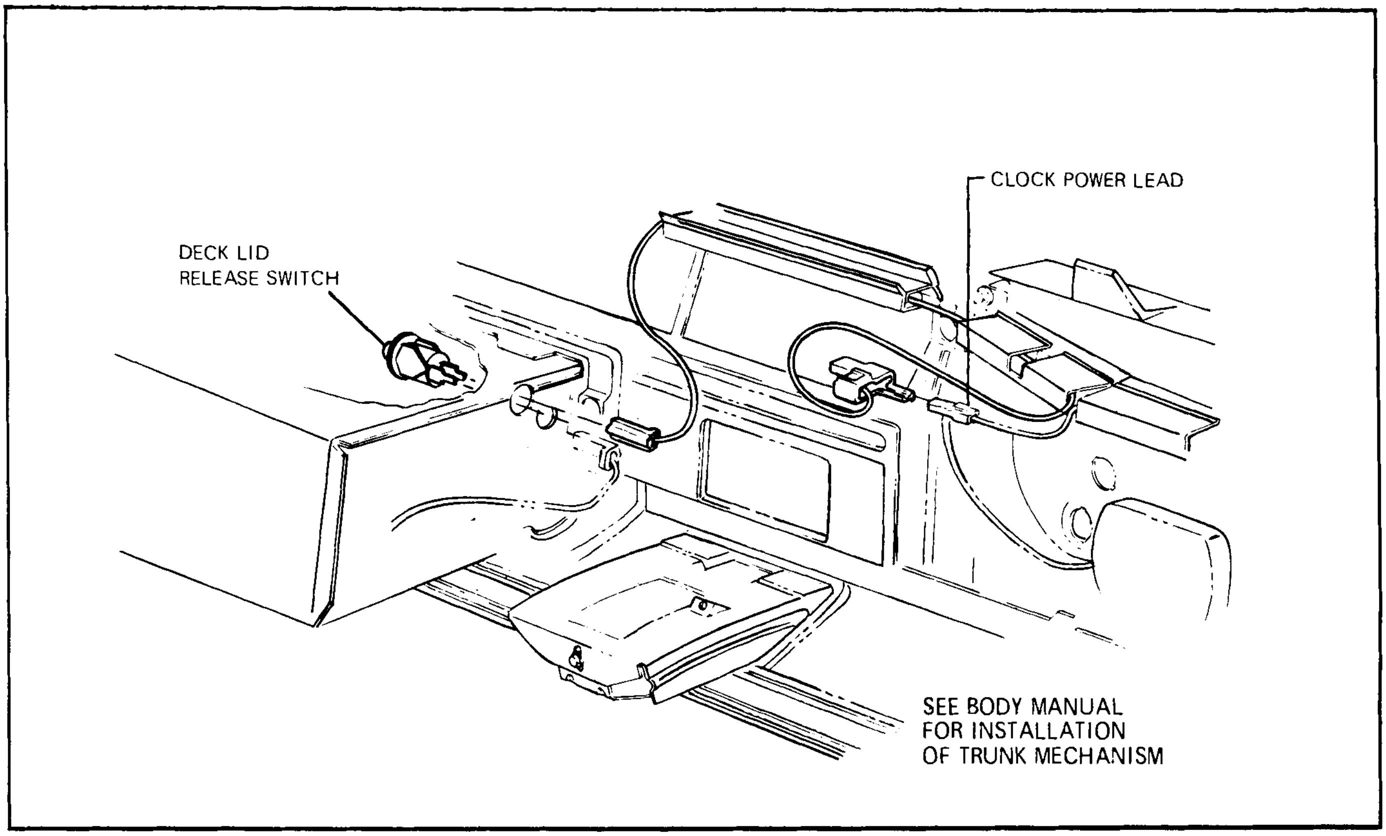


Fig. 15-28 A Series Deck Lid Release Switch

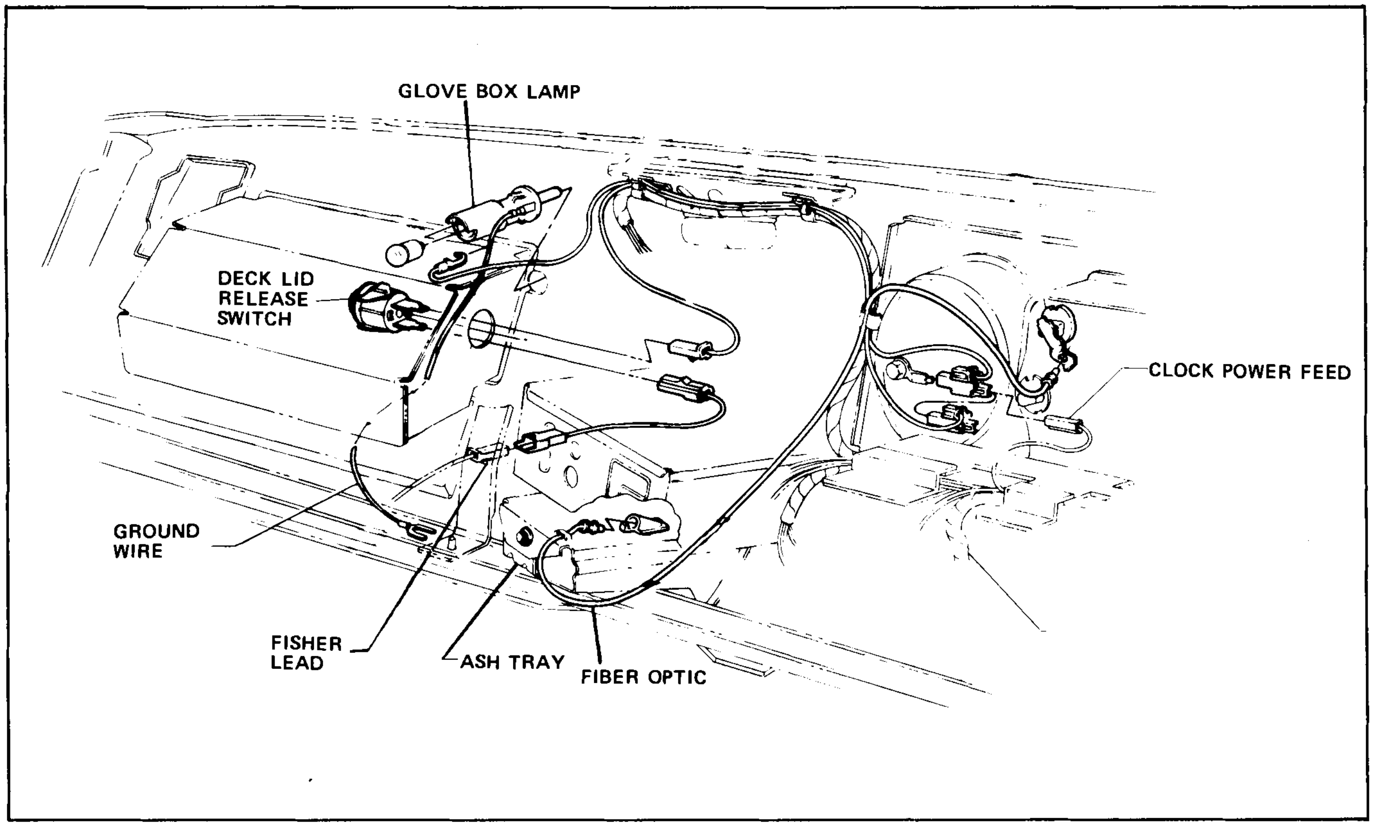


Fig. 15-29 G Series Deck Lid Release Switch (Bench Seat)

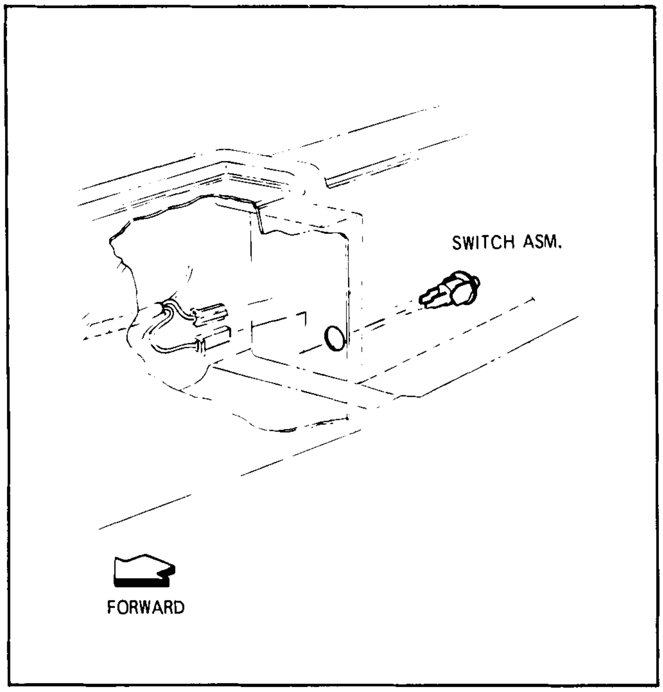


Fig. 15-30 G Series Deck Lid Release Switch (Console)

G Series with Console

1. Remove console compartment box.
2. Disconnect wires from switch.
3. Remove switch (Fig. 15-30).
4. To replace, reverse removal procedure.

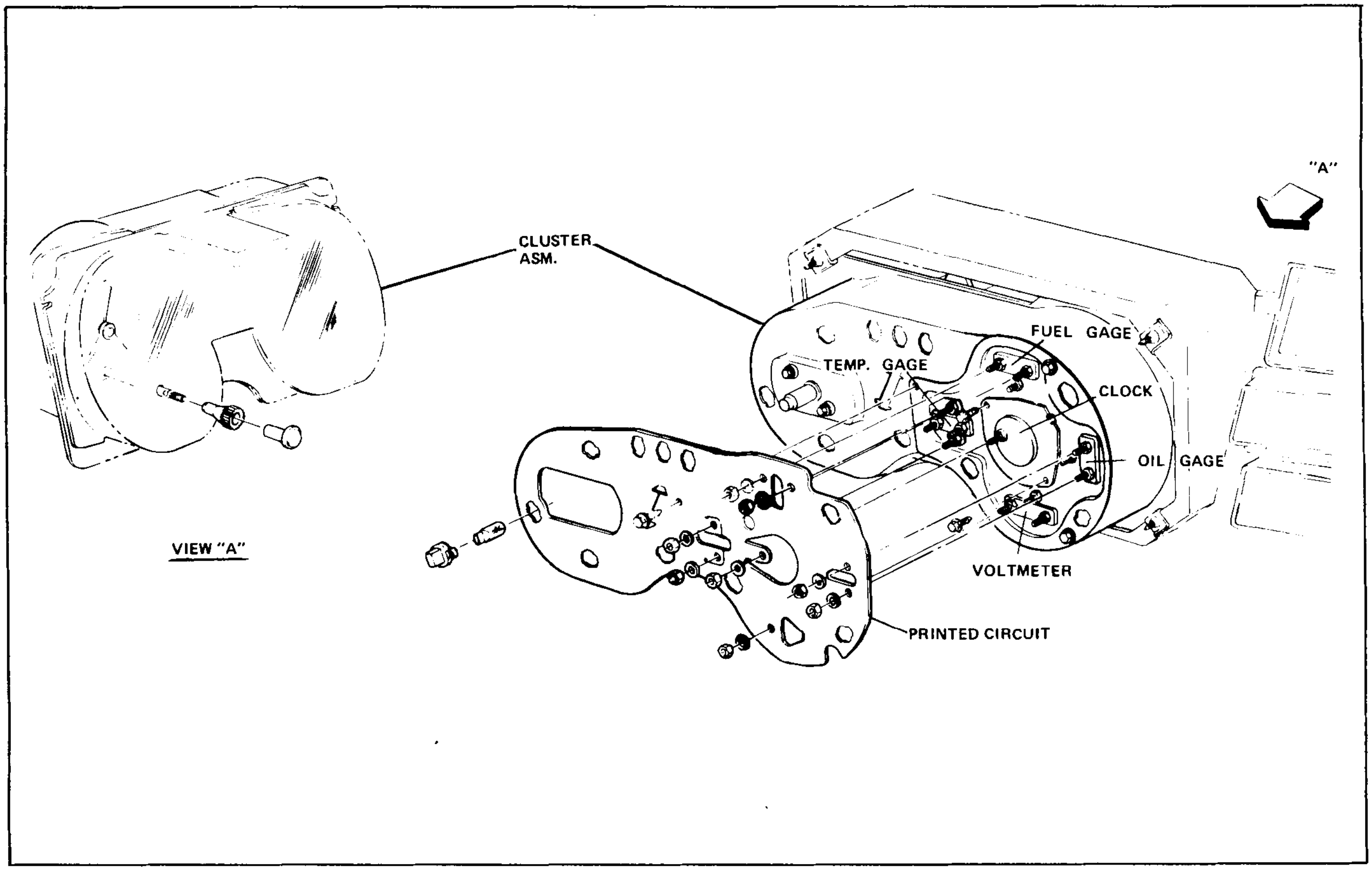


Fig. 15-31 B Series Rally Gage and Clock Installation

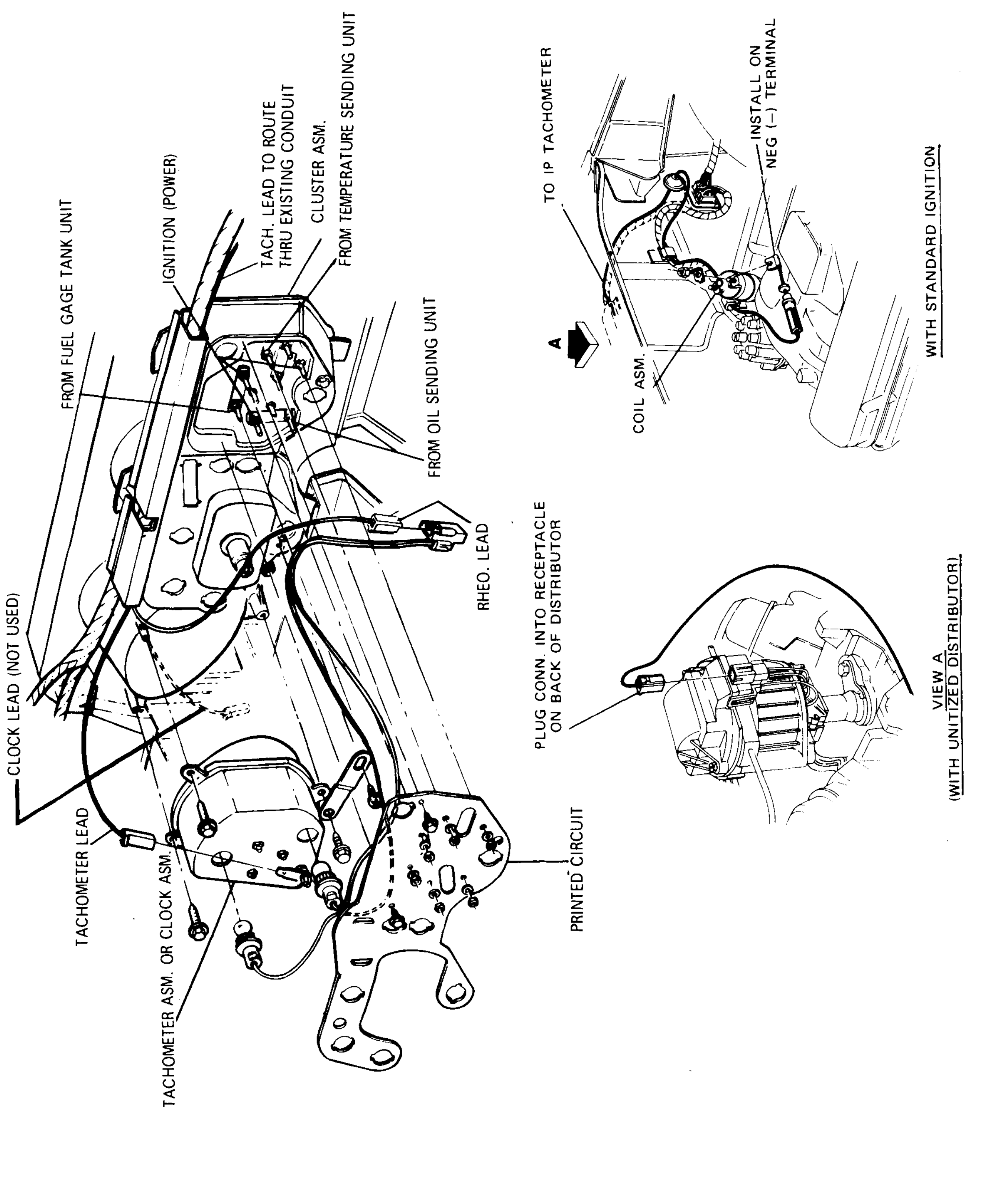


Fig. 15-32 A Series Rally Gage Installation

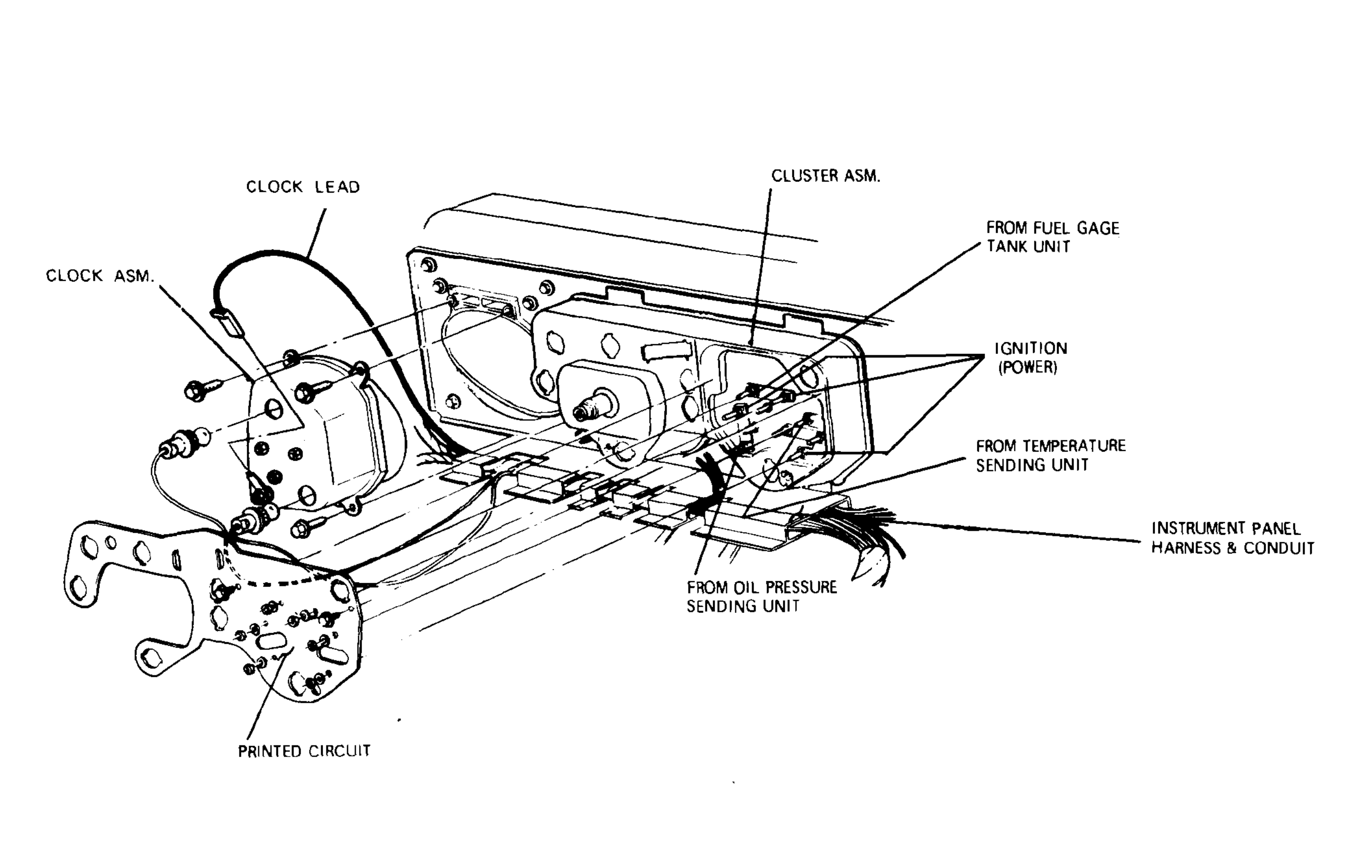


Fig. 15-33 G Series Rally Gage Installation

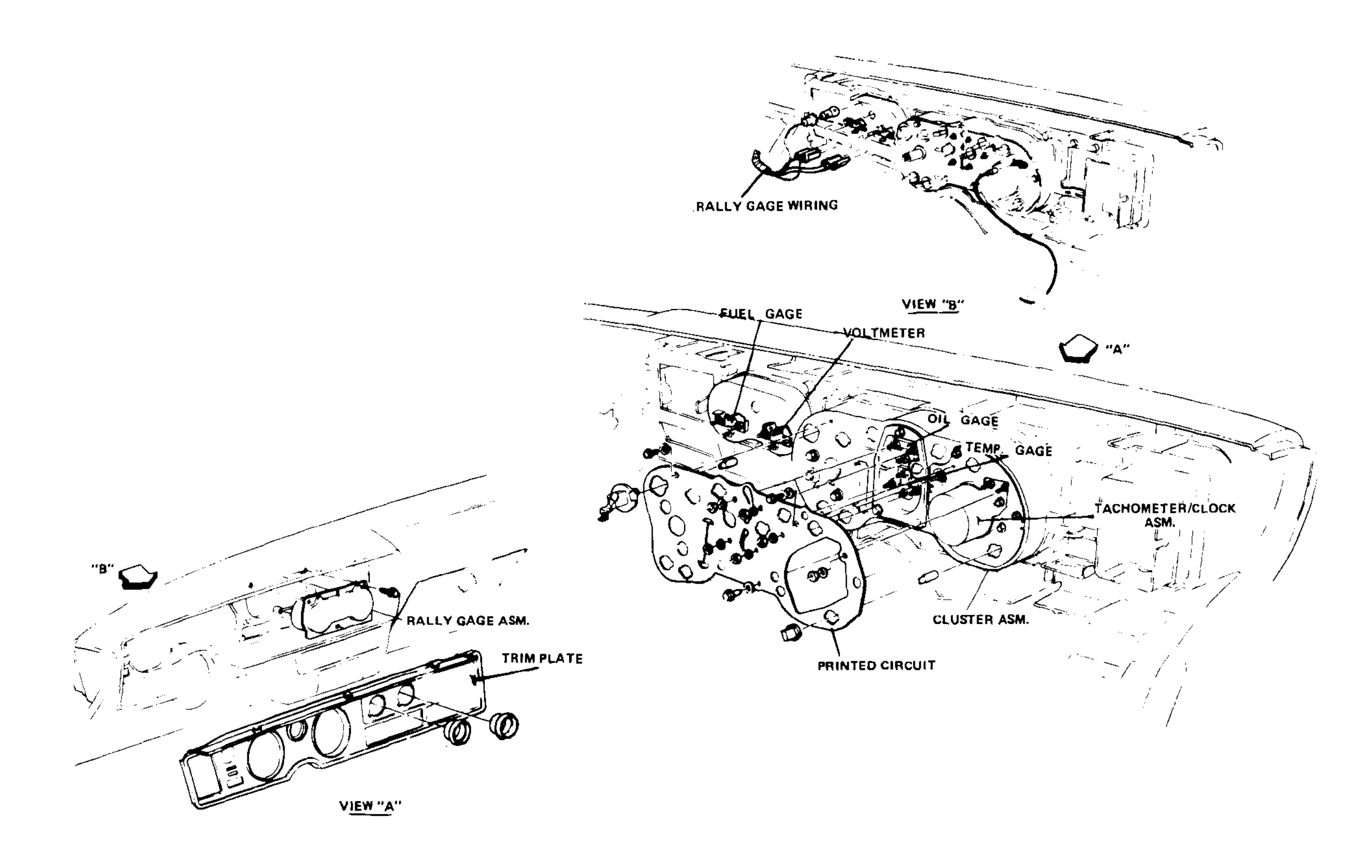


Fig. 15-34 F Series Rally Gage Installation

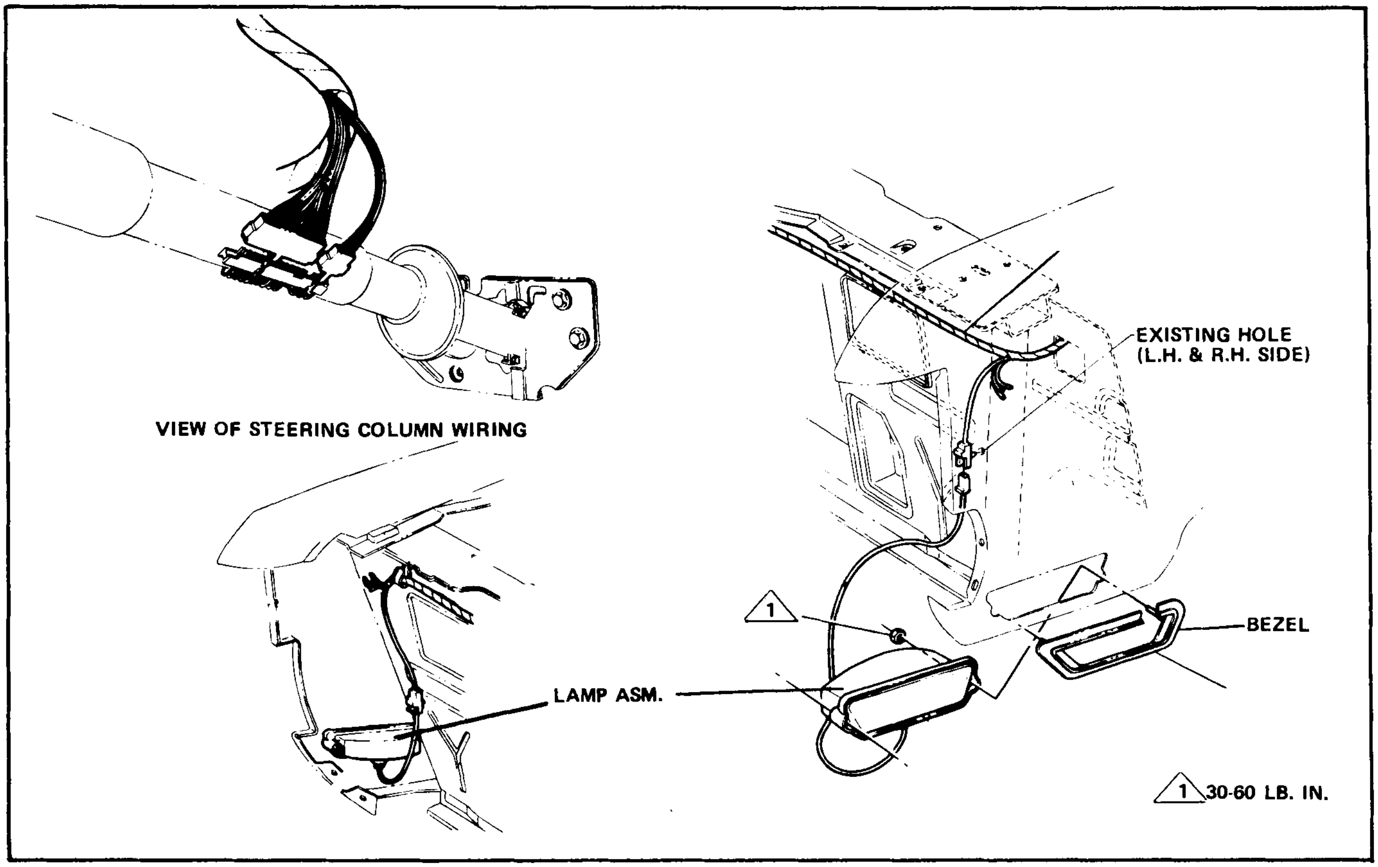


Fig. 15-35 G Series Cornering Lamp Installation

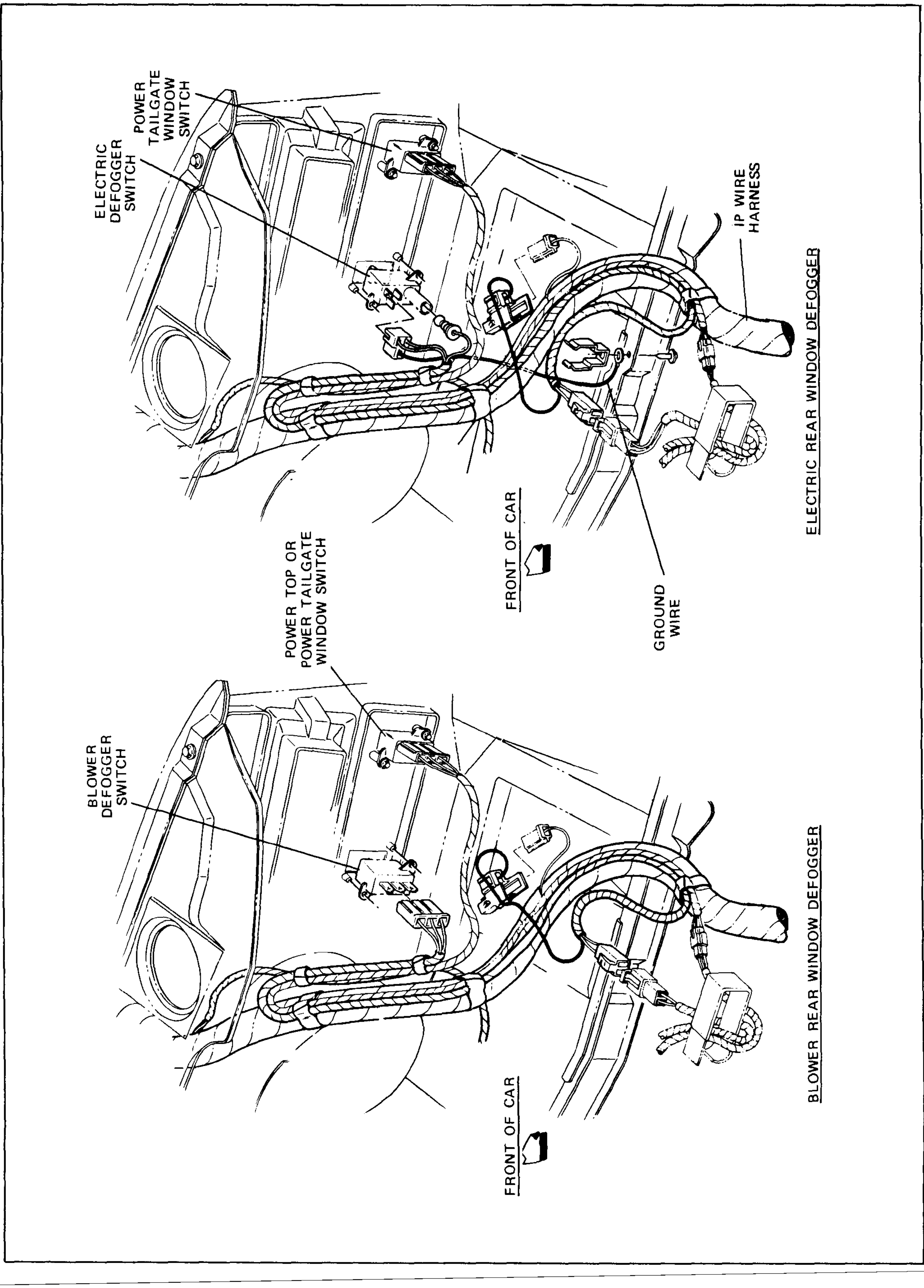


Fig. 15-36 B Series Electric and Blower Rear Window Defogger

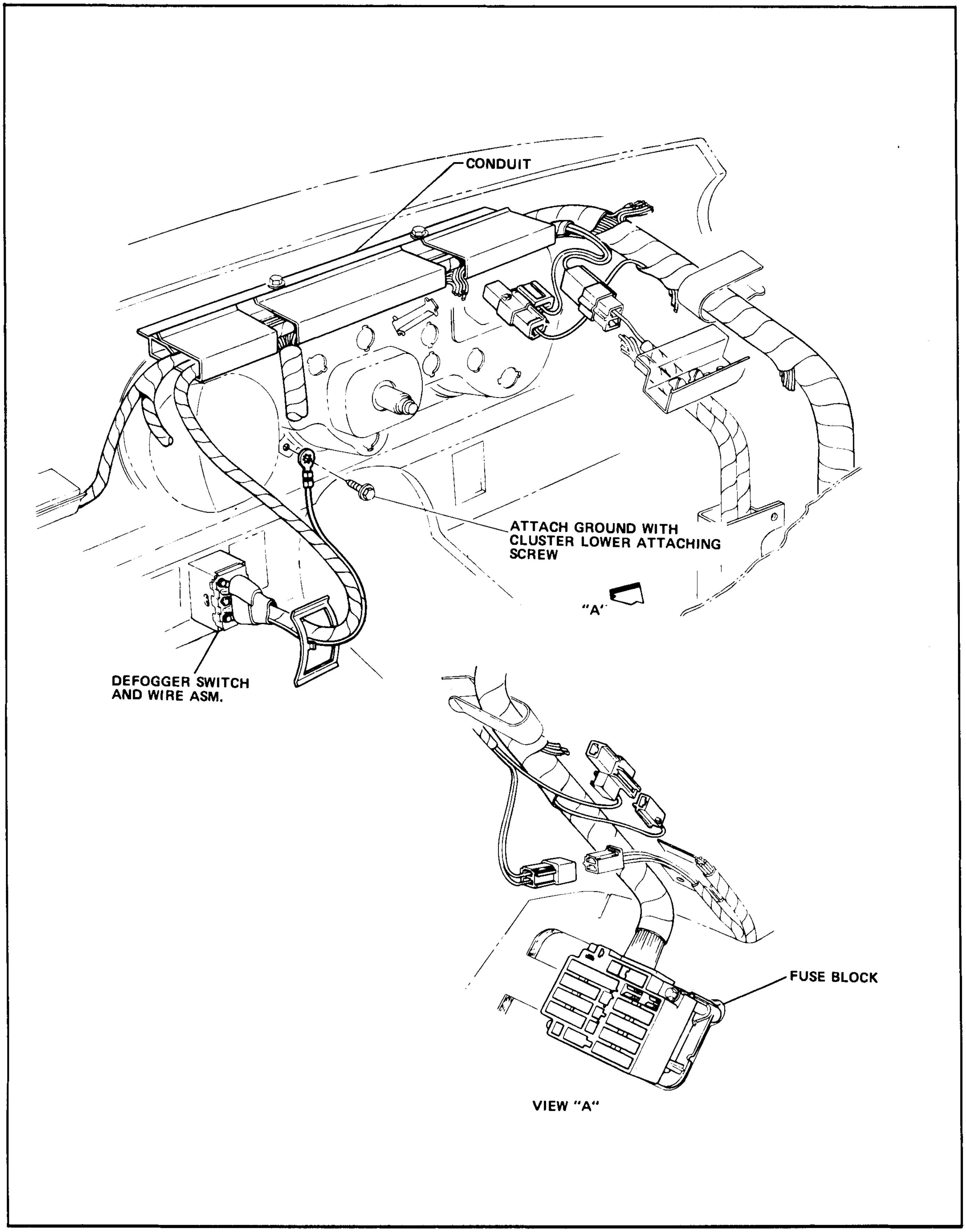


Fig. 15-37 A Series Electric Rear Window Defogger

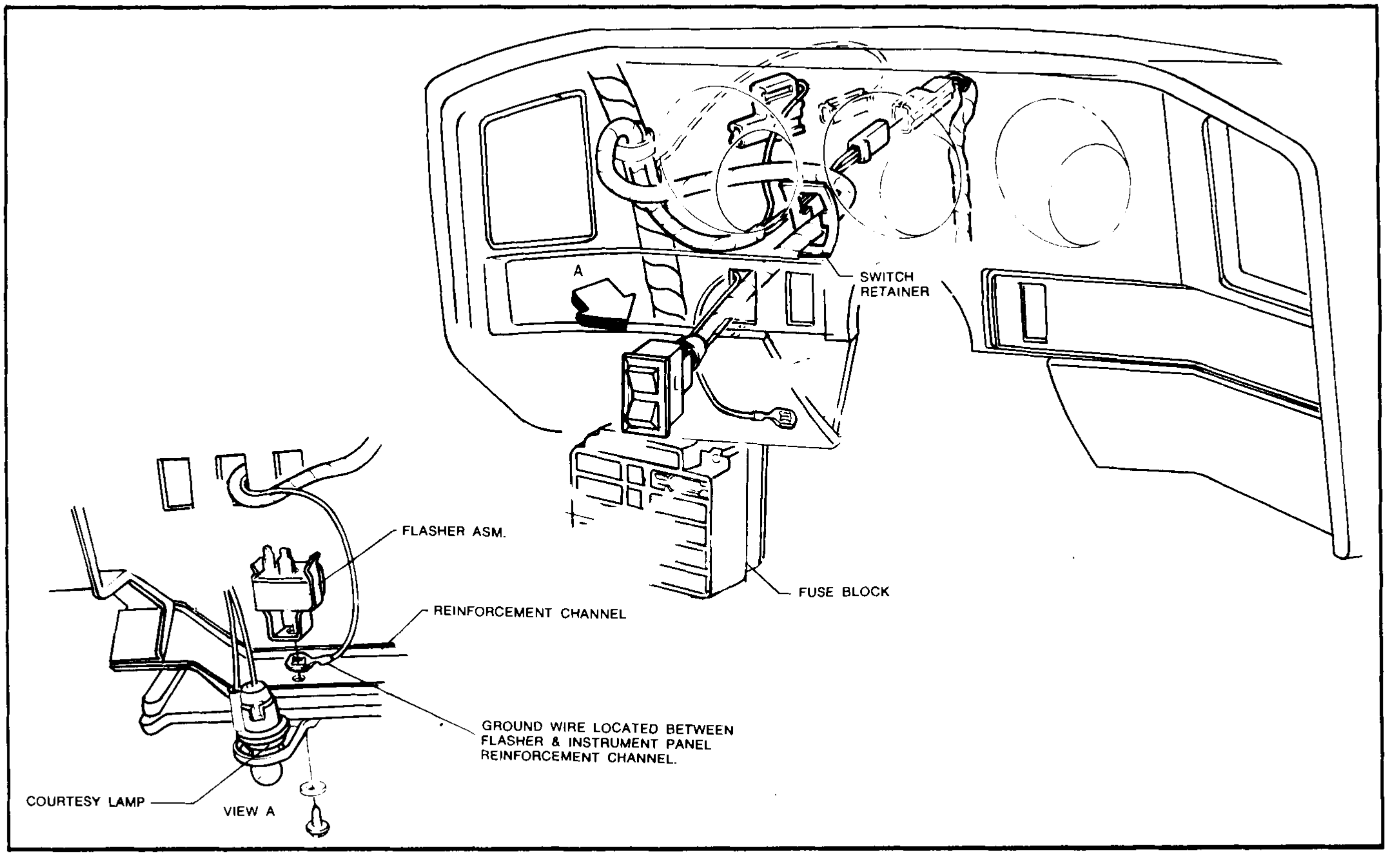


Fig. 15-38 G Series Electric Rear Window Defogger

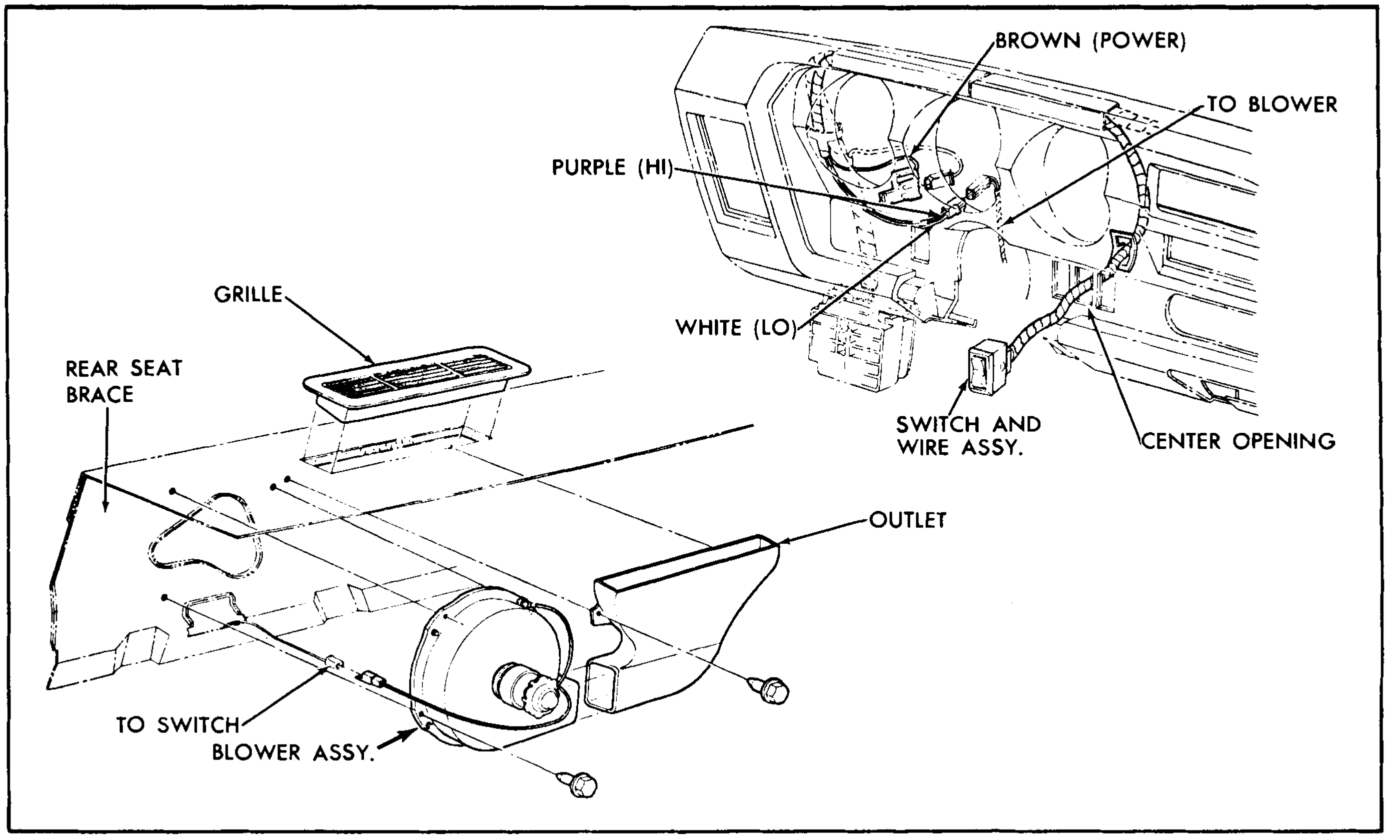


Fig. 15-39 A Series Blower Rear Window Defogger

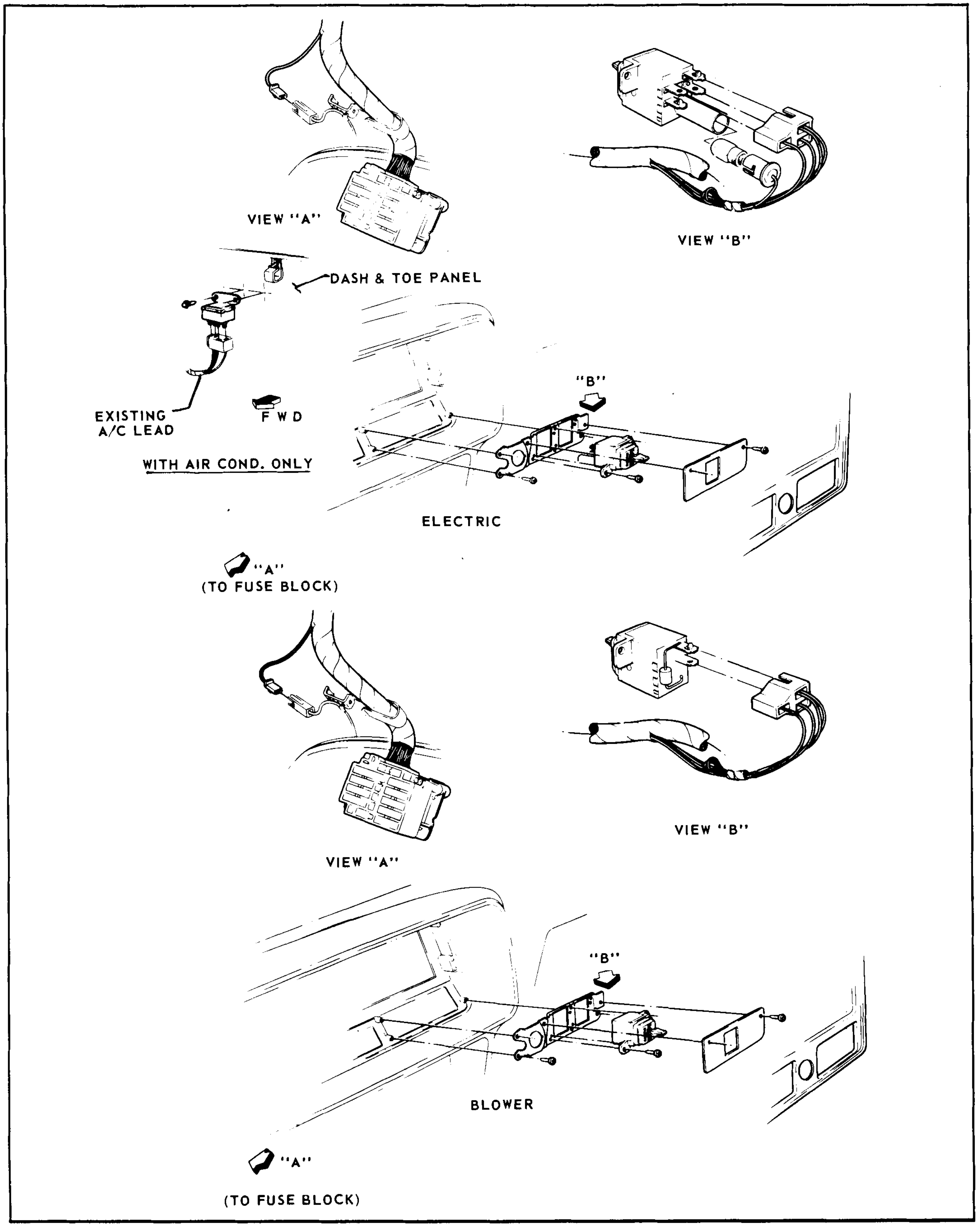


Fig. 15-40 F Series Electric and Blower Rear Window Defogger

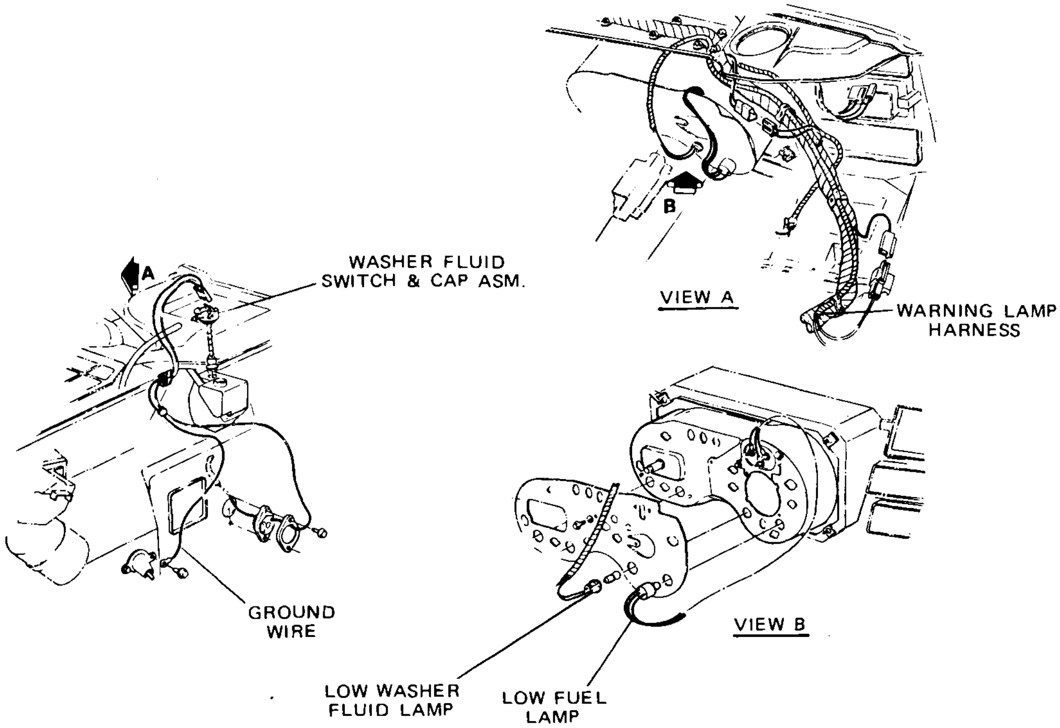


Fig. 15-41 B Series Warning Lamp Option

ACCESSORY SWITCHES

REMOVE AND REPLACE

1. Disconnect battery.
2. On B Series, remove lower I.P. trim at steering column.
3. On F Series, remove upper IP trimplate and remove switch.
4. Disconnect switch harness connections.
5. Remove retainer clip (A and G Series only) and remove switch.

When installing an accessory package or replacing the instrument panel, refer to Fig. 15-42 for locating and punching holes for accessory switches.

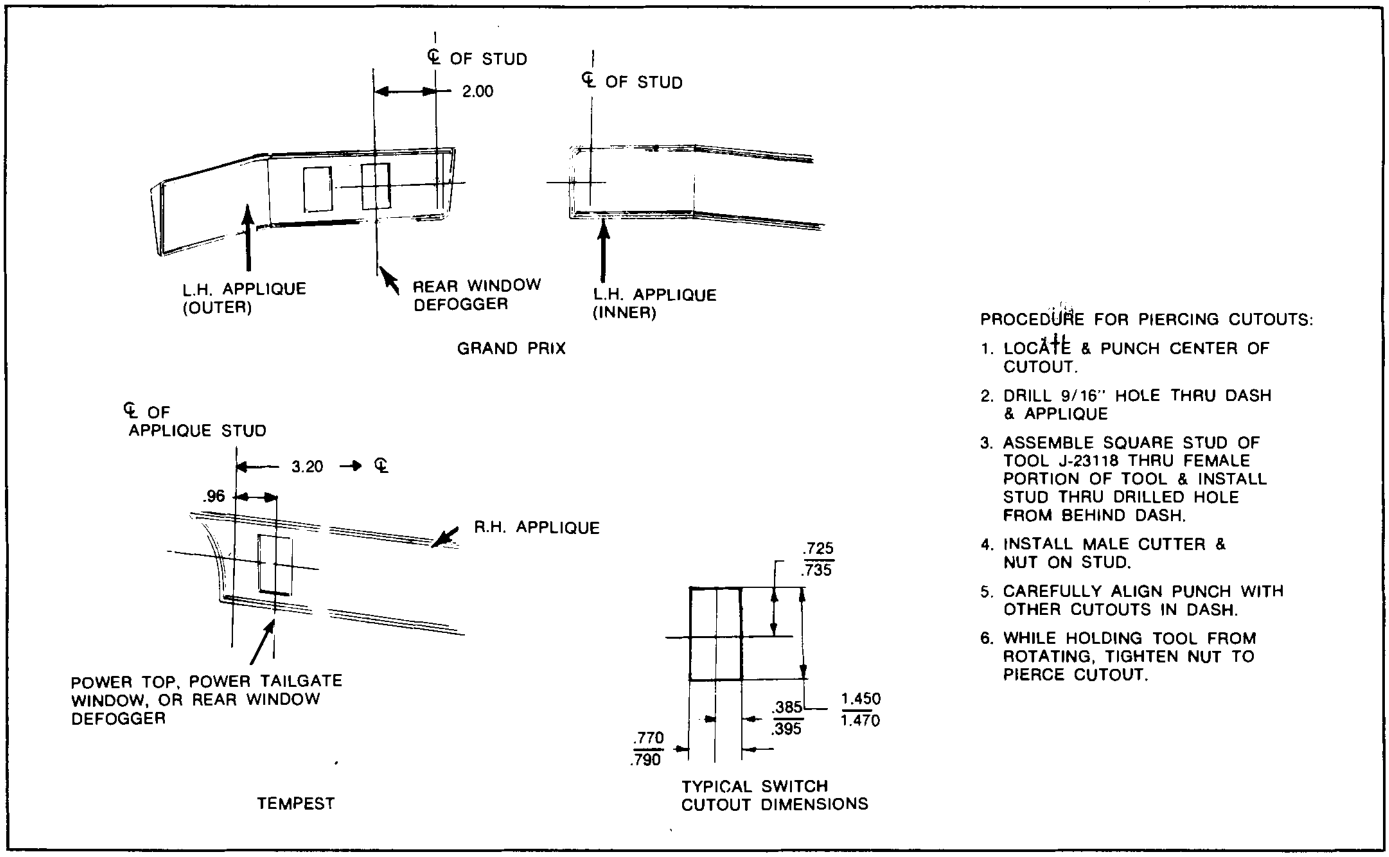


Fig. 15-42 Accessory Switch Cutouts

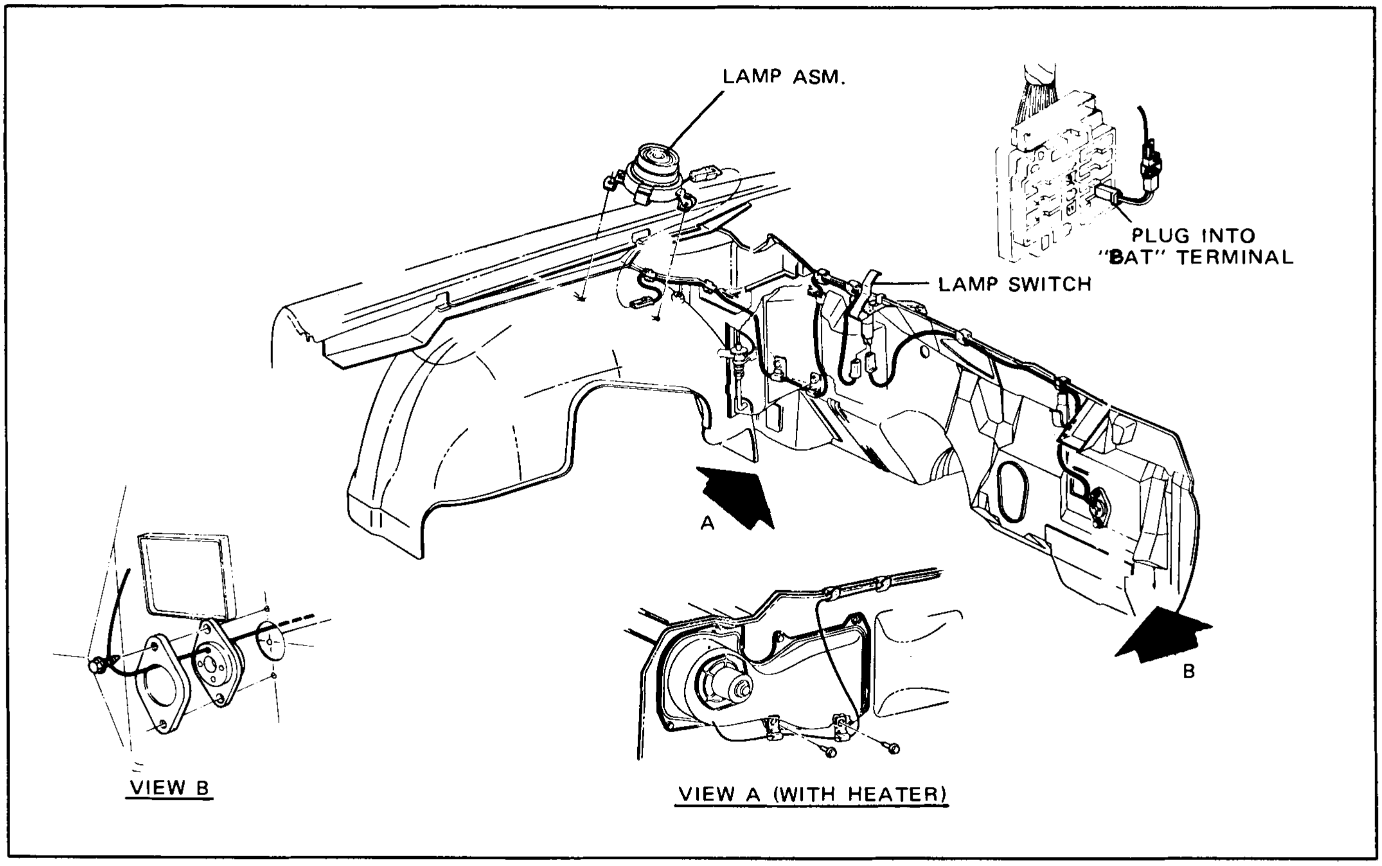


Fig. 15-43 B Series Underhood Lamp

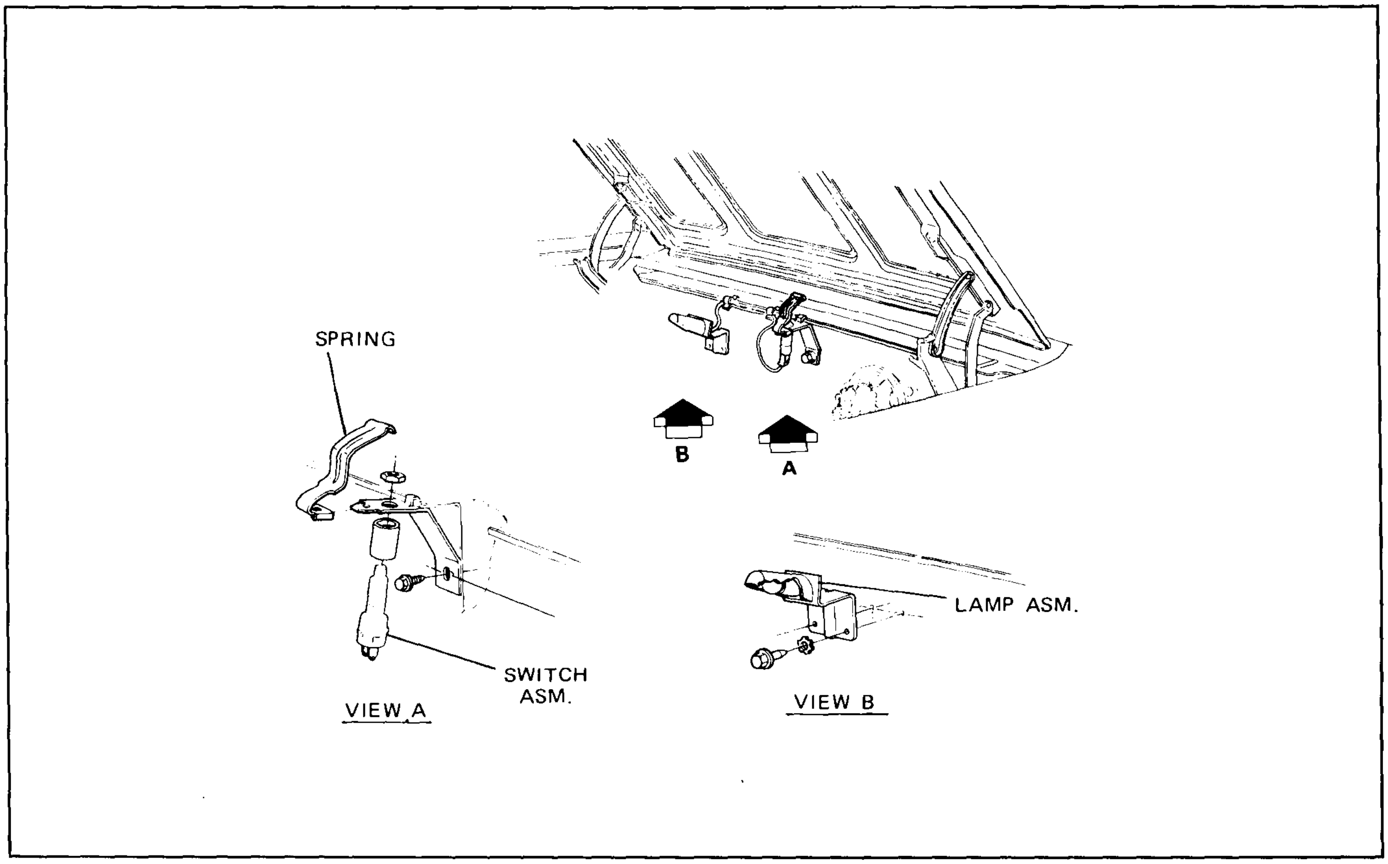


Fig. 15-44 A Series Underhood Lamp

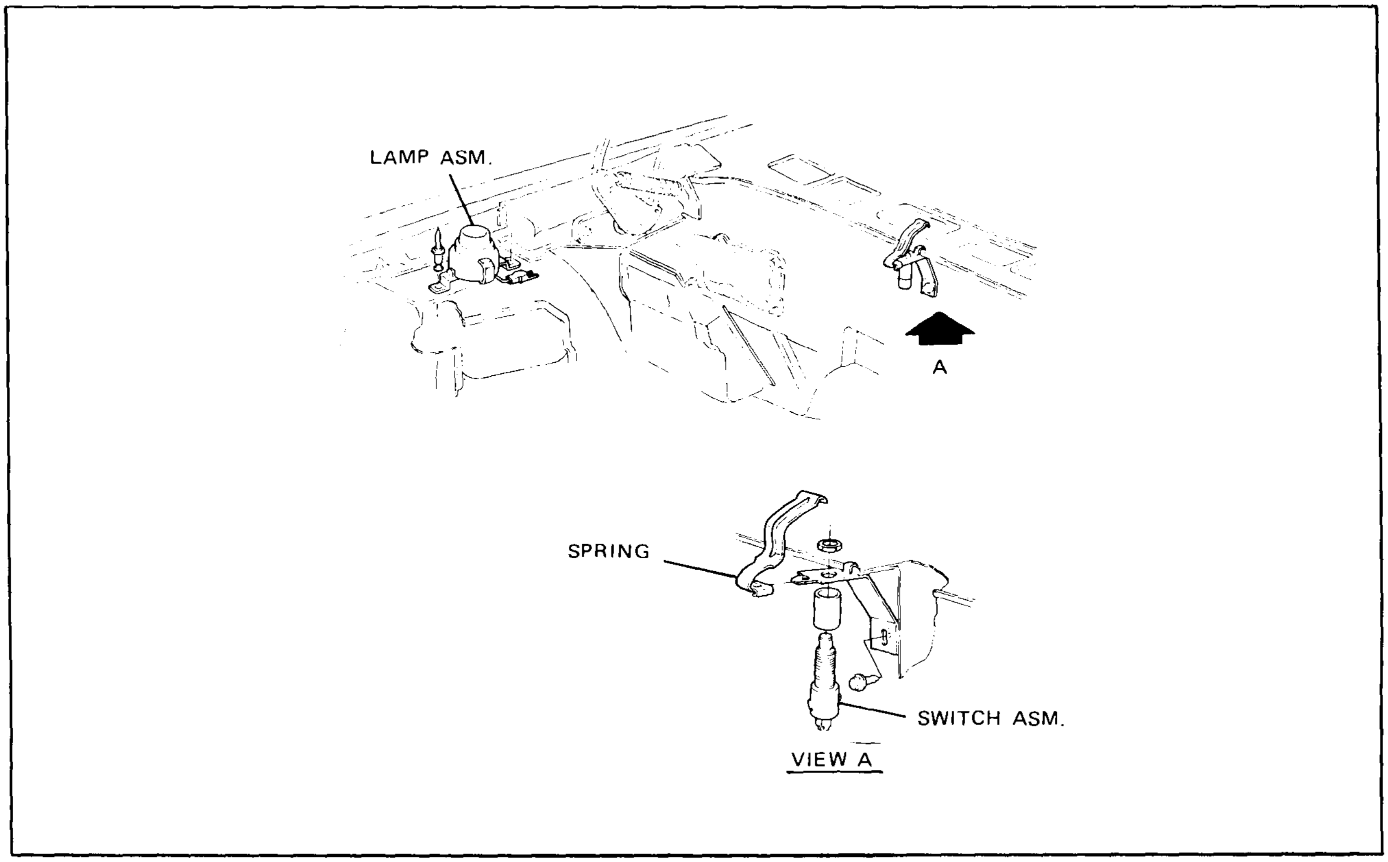


Fig. 15-45 G Series Underhood Lamp

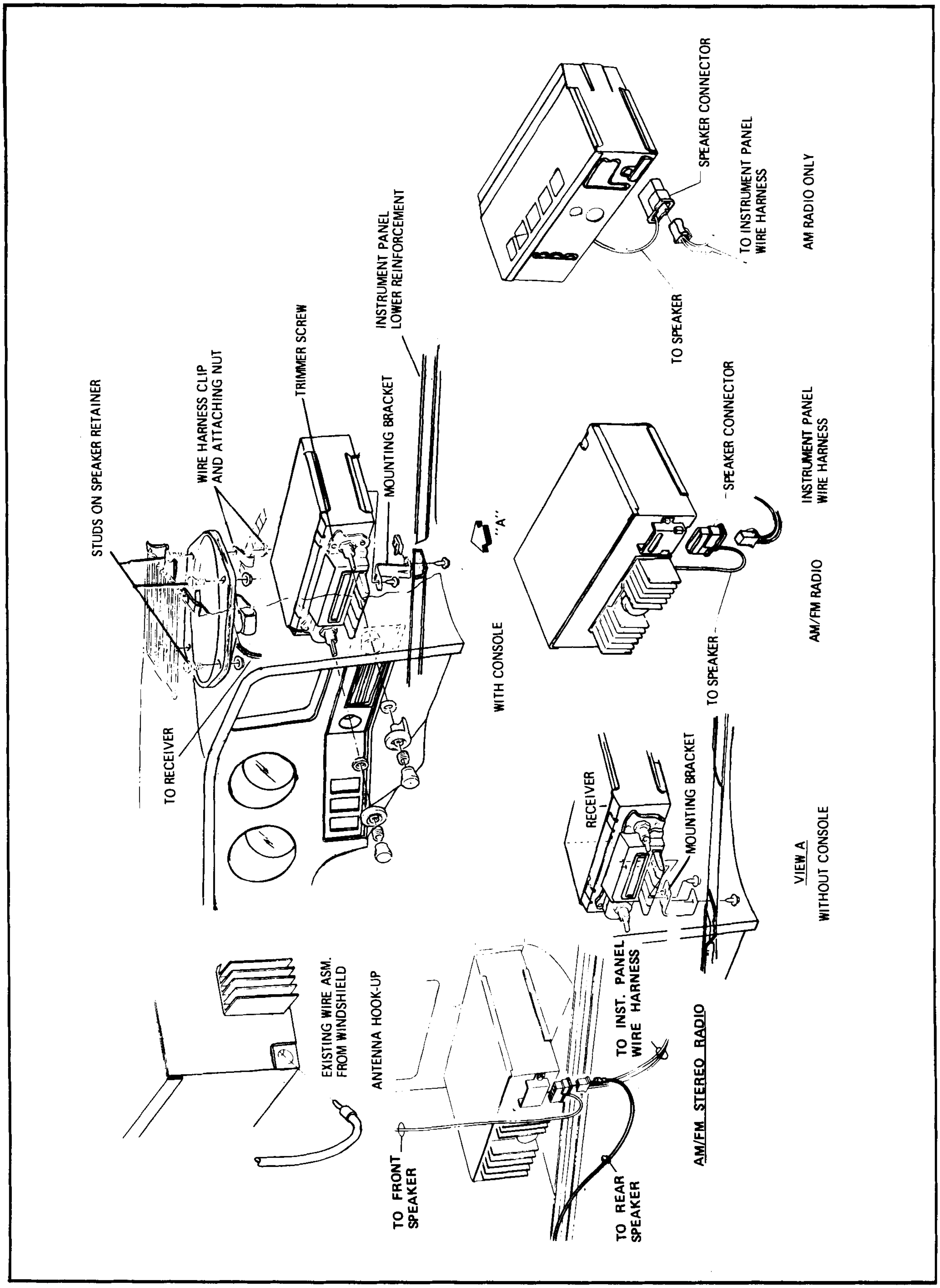


Fig. 15-54 G Series Radio and Front Speaker Installation

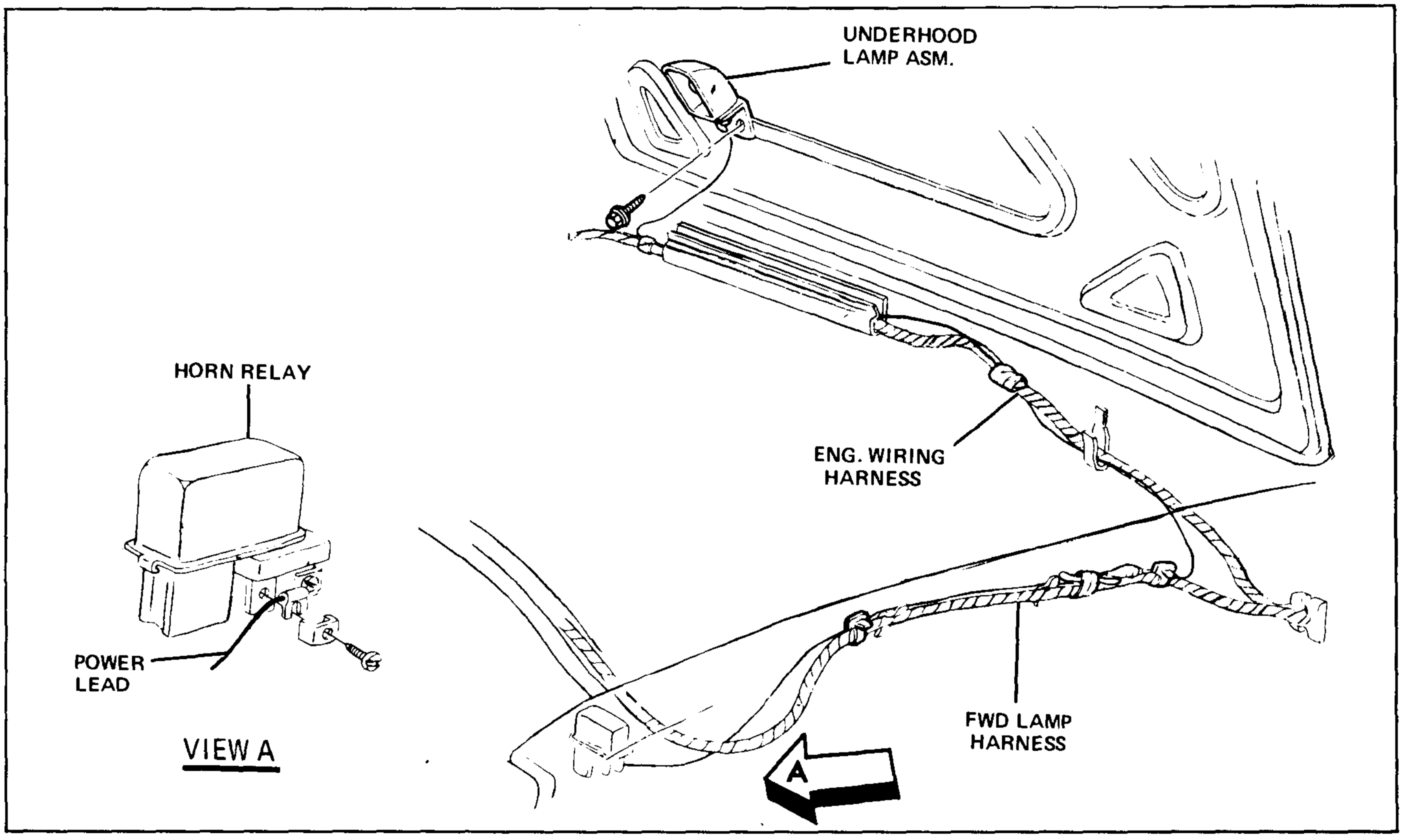


Fig. 15-47 X Series Underhood Lamp Installation

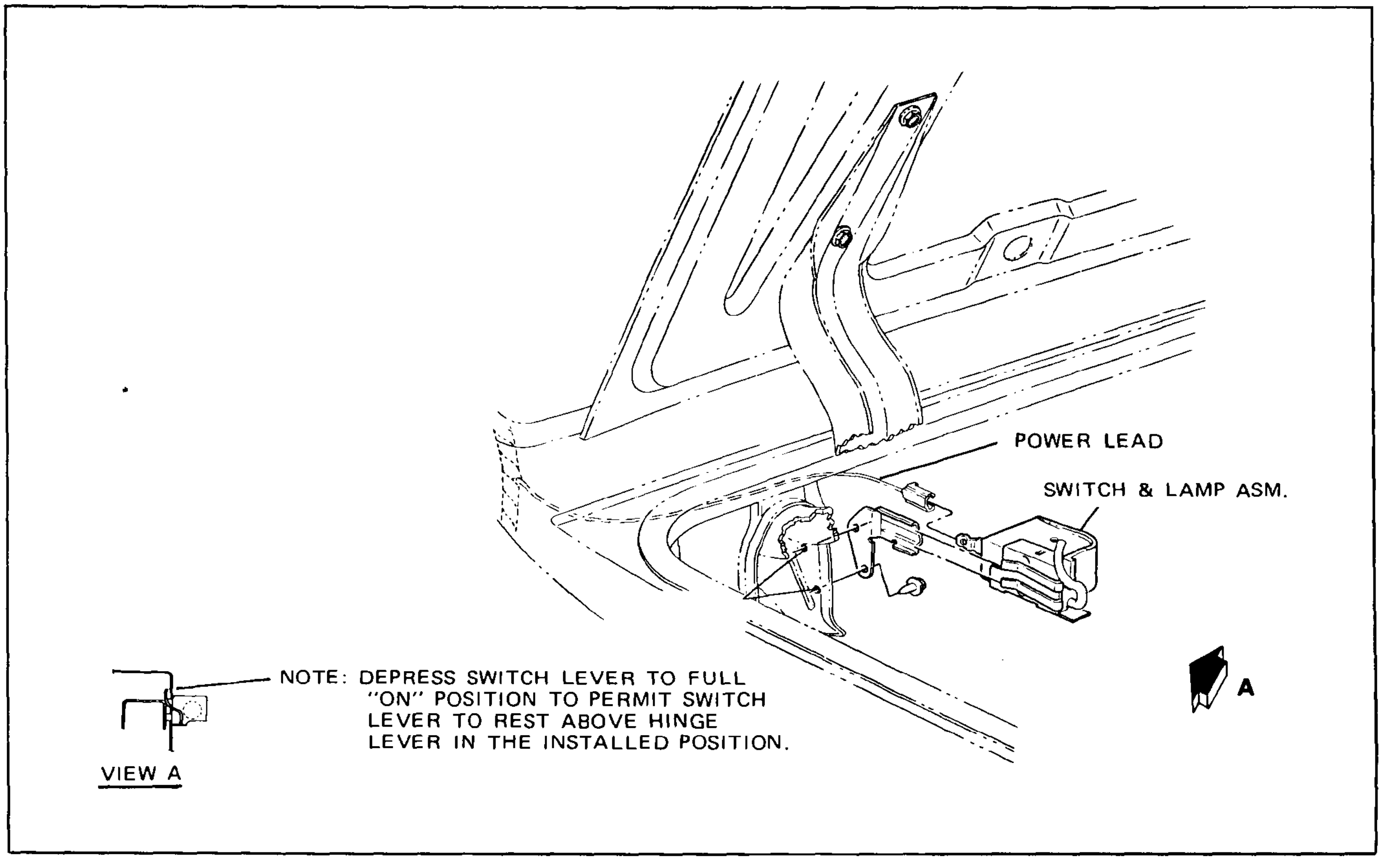


Fig. 15-48 A and G Series Luggage Compartment Lamp

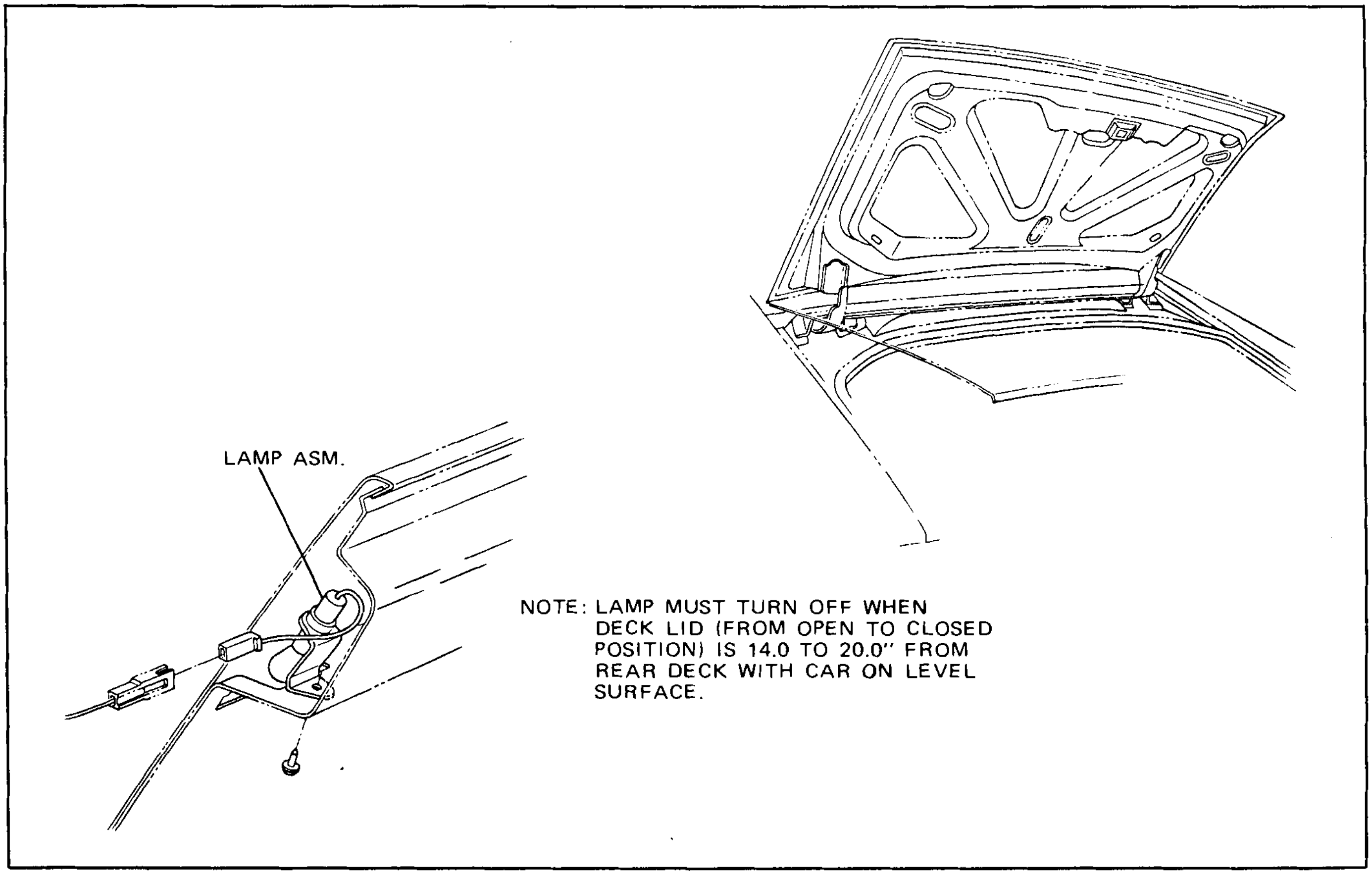


Fig. 15-49 F Series Luggage Compartment Lamp

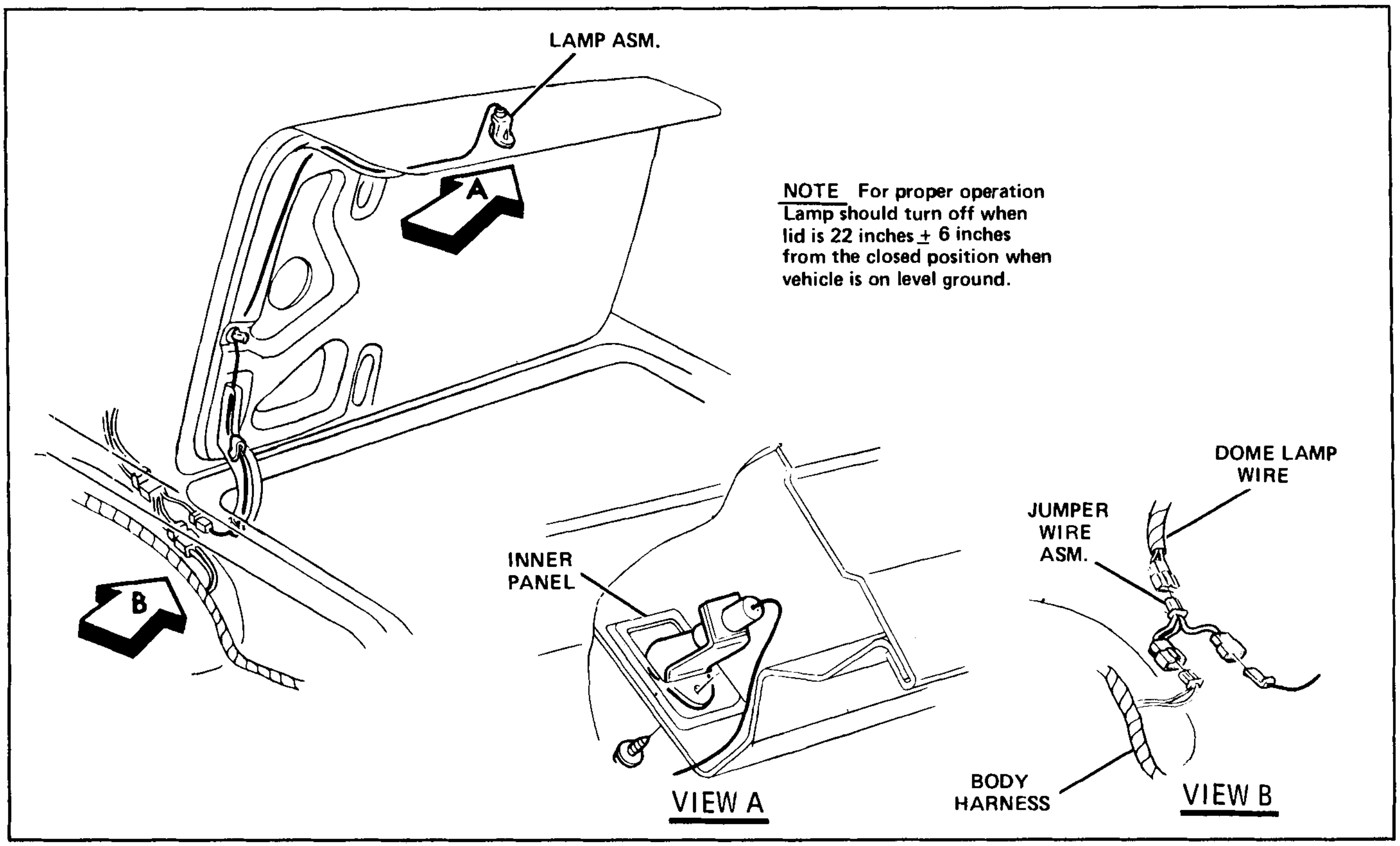


Fig. 15-50 X Series Luggage Compartment Lamp Installation

RADIO (AM, AM-FM, AND AM-FM STEREO)

NOTE: *When removing knobs on B and F Series, insert a small allen wrench (Fig. 15-51), pointed tool or wire (awl, etc.) in slot on side of knob and release inner retainer by prying outward (away from dash). While releasing retainer, pull knob off.*

REMOVE AND REPLACE

B Series (Fig. 15-52)

1. Disconnect battery.
2. Remove radio control knobs and hex nuts.
3. Remove upper and lower IP trimplates and front lower radio bracket.
4. Remove glove box (if equipped with A/C) and disconnect all connections and antenna lead-in to radio.
5. Loosen screw holding radio brace to side of radio and slide radio toward front seat.
6. To replace, reverse removal procedure.

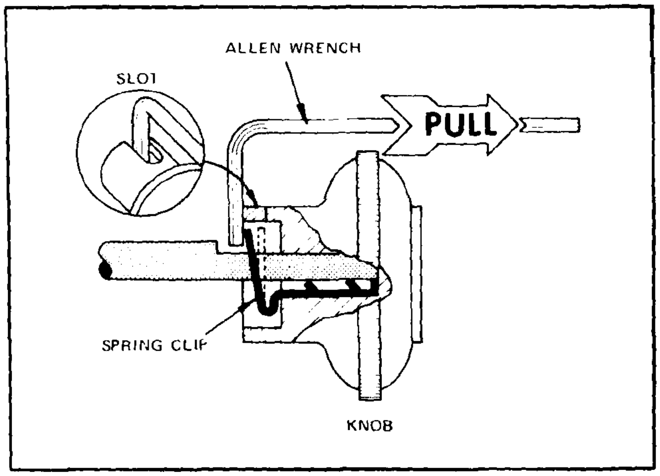


Fig. 15-51 B and F Series Knob Removal

A and G Series (Figs. 15-53 and 15-54)

1. Disconnect battery and remove lower A/C duct if equipped.
2. Remove radio control knobs and hex nuts.
3. Remove radio support bracket bolt.
4. Disconnect all electrical leads and antenna lead at radio and remove radio.
5. To replace, reverse removal procedure.

F Series (Fig. 15-55)

1. Disconnect battery.
2. Remove glove box and door and right lower A/C duct on A/C equipped cars only.
3. Remove radio knobs, nuts and lower and upper trimplates.
4. Disconnect antenna lead-in and radio connectors.
5. Remove radio bracket and radio from passenger side of IP.
6. To replace, reverse removal procedure.

X Series (Fig. 15-56)

1. Disconnect battery.
2. Remove radio knobs, bezels, nuts and side brace screw, disconnect antenna lead-in and connectors.
3. Remove radio from under dash.
4. To replace, reverse removal procedure.

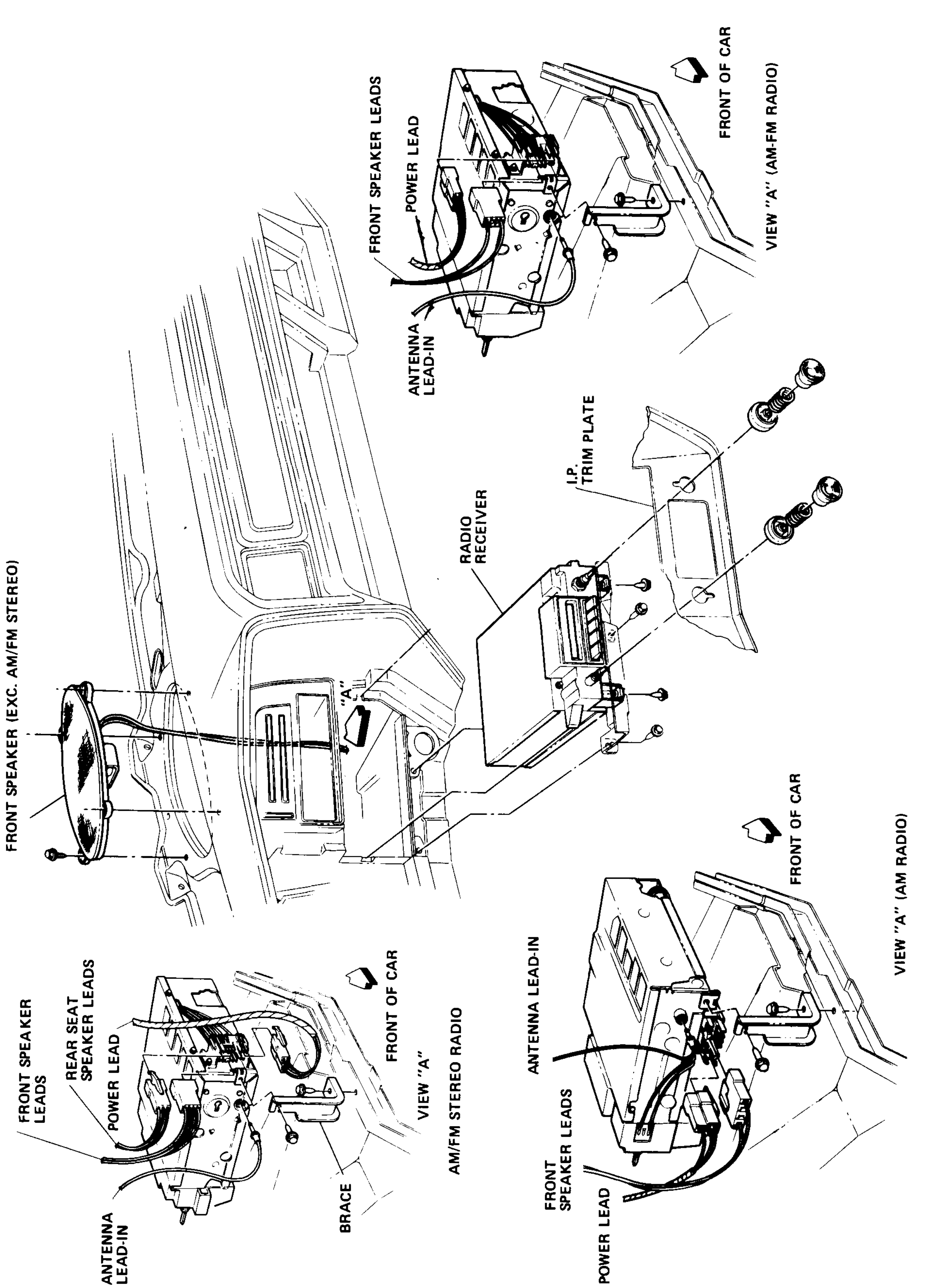


Fig. 15-52 B Series Radio and Front Speaker Installation

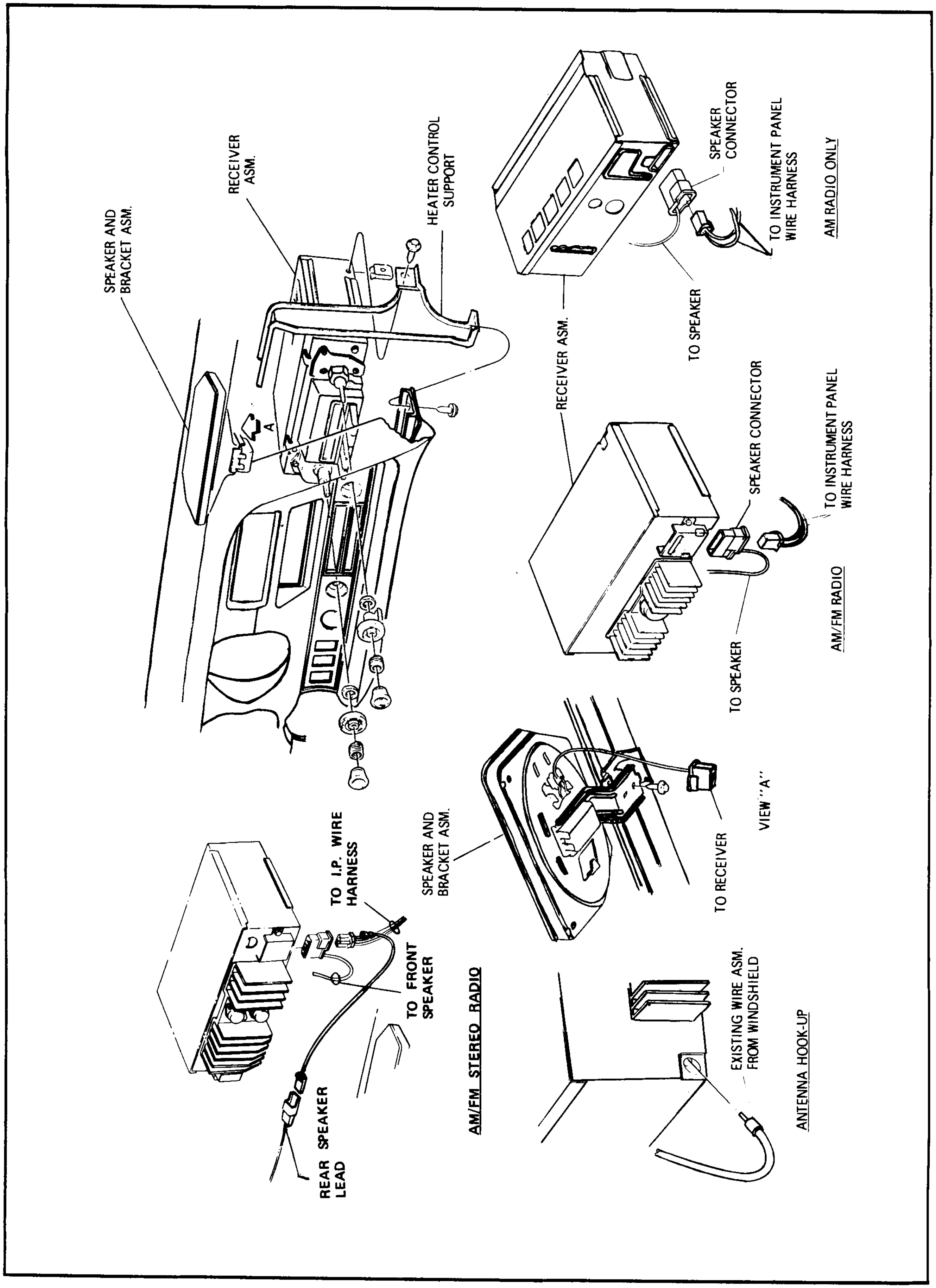


Fig. 15-53 A Series Radio and Front Speaker Installation

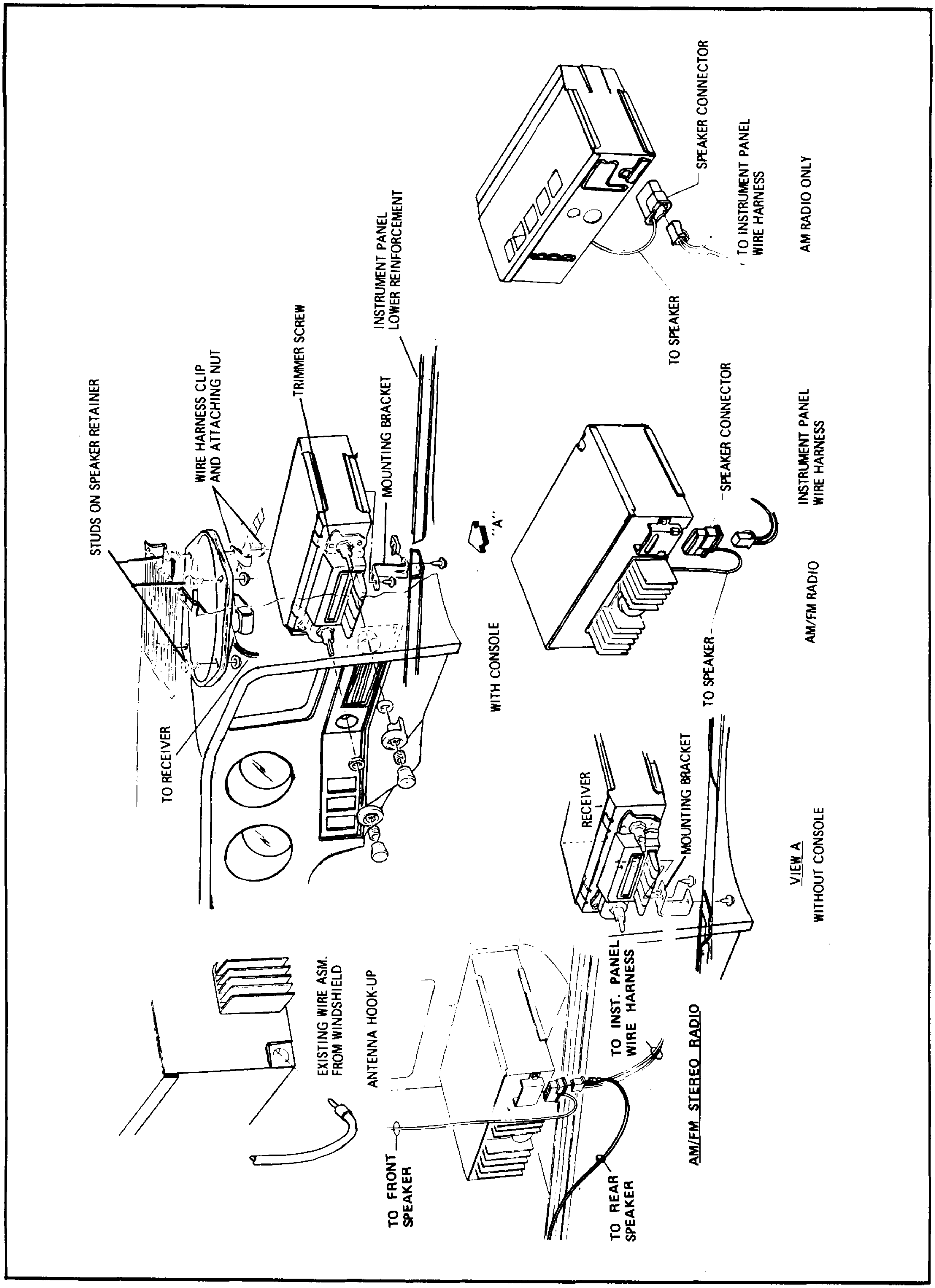


Fig. 15-54 G Series Radio and Front Speaker Installation

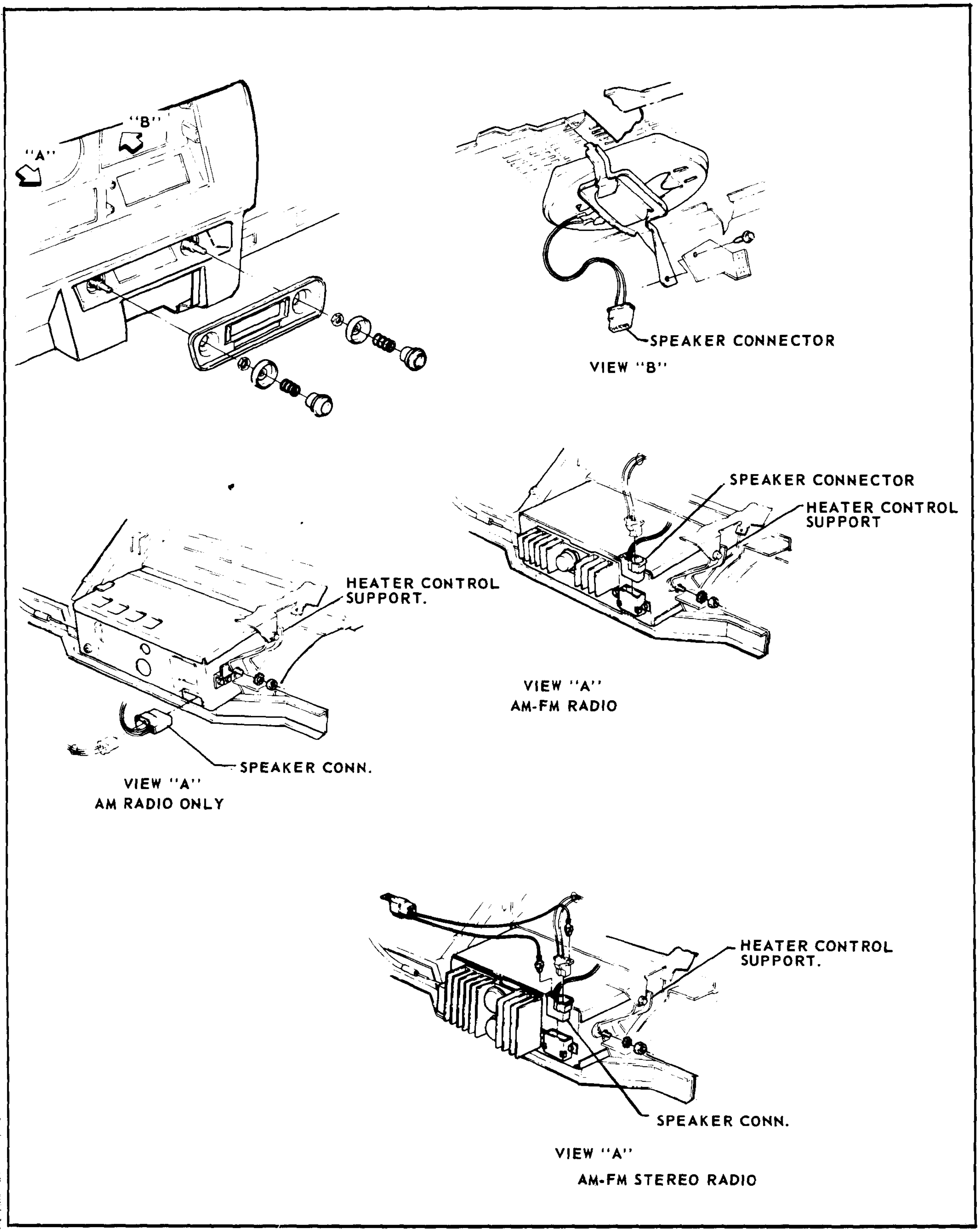


Fig. 15-55 F Series Radio and Front Speaker Installation

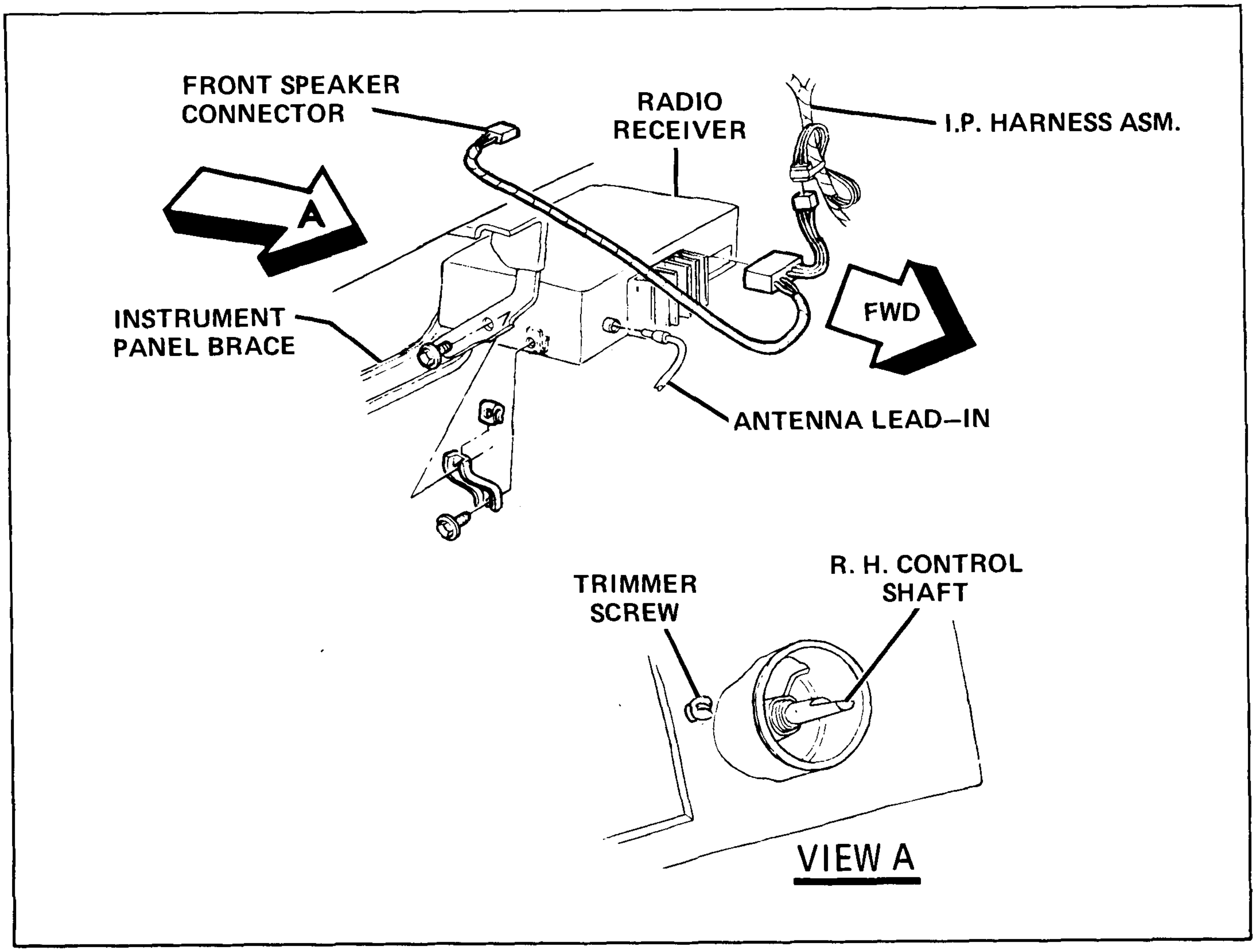


Fig. 15-56 X Series Radio Installation

RADIO DIAL AND STEREO LIGHT

REMOVE AND REPLACE

All except B Series

1. Remove radio as outlined under "Radio (AM, AM-FM and AM-FM STEREO) - Remove and Replace".
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.

B Series

1. Tune radio dial pointer to high end of band.
2. Press the dial plate down (Fig. 15-57) and tilt out at top to remove.
3. **For dial light removal,** remove dial light bracket by pulling it forward and unclip from radio.
4. **For stereo light removal,** turn stereo light counter-clockwise from socket (located in lower right corner of radio).

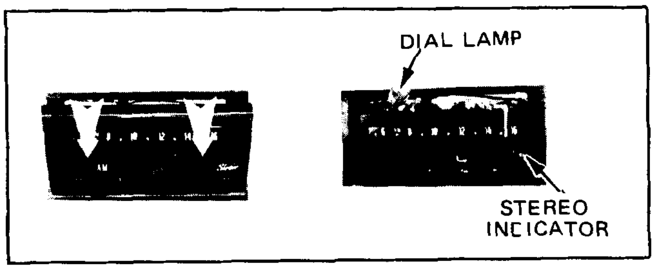


Fig. 15-57 Radio Dial and Stereo Light Removal

SUNROOF TOP ASSEMBLY (X SERIES)

REMOVAL

1. Unlock and partially open the sunroof. Hold the left side (driver's side) of the front header and force the right side toward the rear until the nylon capped end is out of the side slide channel. Then pull the left side out of the channel. Repeat this procedure to remove the remaining roof bows from the slide channel.
2. Remove the hole plugs from the rear inner retainer and remove the screws which are visible in the access holes (Fig. 15-57A).
3. Remove the top assembly from the vehicle.

   CAUTION: *Do not allow sealing compound from the rear retainer memory sealer tape to smear on the headliner material. The sealer cannot be removed without damaging headliner.*

INSTALLATION

1. Place the top assembly over the roof opening. Install the rear retainer screws through the access holes. Do not install the hold plugs at this time - the adjustment for fore and aft tighteness of the top is made by the positioning of this rear retainer. (Refer to adjustments).
2. Starting with the rear roof bow, install one end into the slide channel. Move the opposite side forward until it can be installed into the slide channel.
3. Repeat this procedure with the front roof bow and the front header.
4. Adjust the rear retainer fore or aft to obtain the desired fit of the top in the opening. (Refer to Adjustments). Tighten the screws and install the hole plugs.

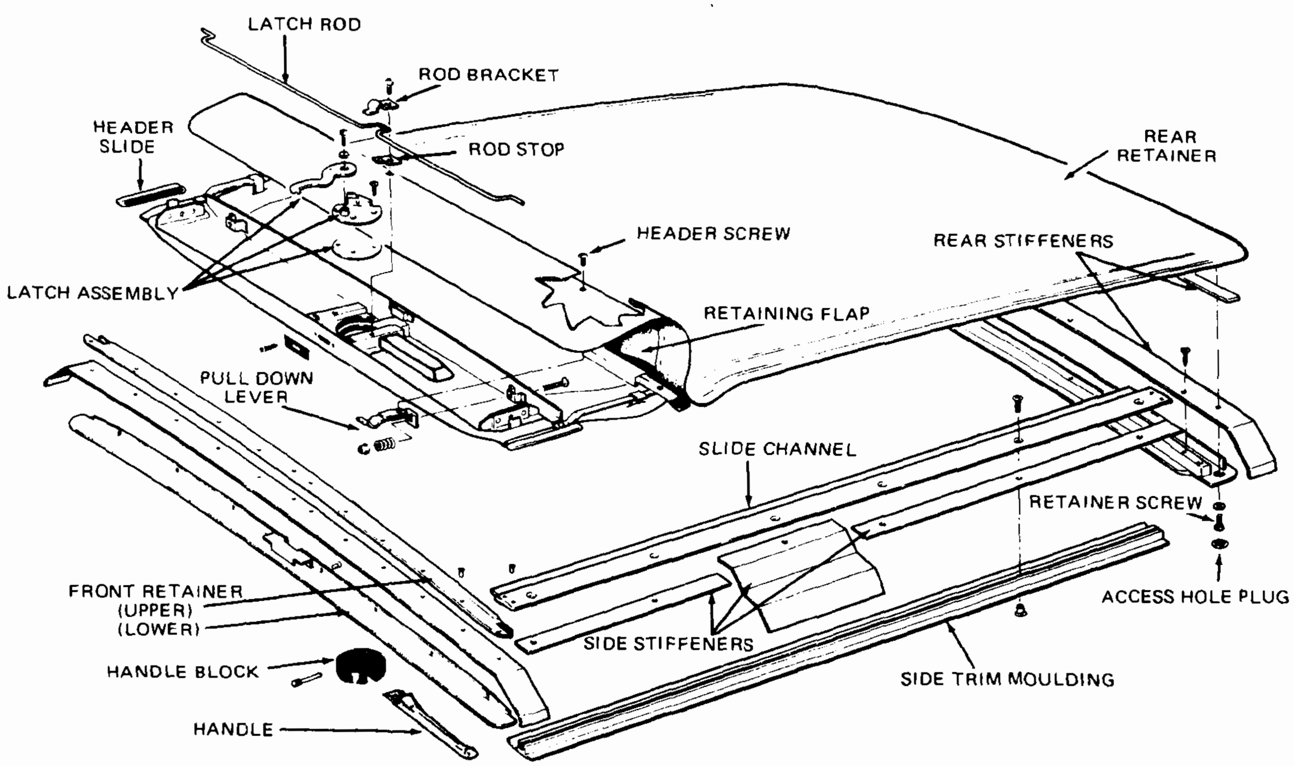


Fig. 15-57A Sunroof Top Assembly Components

ADJUSTMENTS

Rear Retainer

1. For a waterproof assembly, the top must be stretched tightly over the roof opening when in the closed and latched position. Being stretched too tightly, however, can create high closing effort.

2. Adjustments can be made to obtain the desired degree of tightness by moving the rear retainer fore or aft as required.

3. Remove the four (4) hole plugs from the rear inner retainer and loosen the screws.

4. Move the retainer to the rear to tighten the top or move it forward to ease the closing effort.

5. If additional fore or aft movement is required, remove the rear retainer and the inner moulding and elongate the four (4) holes in the roof panel.

Side Slide Channels

A thin film of a non-staining lubricant can be applied to the side channels to to reduce the effort of pulling the top open or closed. If a bind exists after lubrication, use a tapered hard wood block to increase the width of the opening in the side slide channel.

Front Header Contour

To provide adequate sealing when required, minor adjustment of reshaping the header to the contour of the roof panel can be performed. Use glaziers pliers to bend the header to obtain the desired contour (these pliers can be found at most glass supply shops). Caution must be taken not to cut the vinyl top material during this operation.

INTERIOR TRIM SIDE MOULDINGS

REMOVAL

1. To remove interior trim side mouldings, it is necessary to first either remove the rear inner retainer or drop the end of the wind deflector assembly toward the side moulding to be removed. See instructions for "REAR RETAINER" or "WIND DEFLECTOR ASSY.".

2. Remove the six (6) countersunk screws and trim nuts from the side trim moulding and slide rails. Remove the trim moulding.

INSTALLATION

1. Remove any sealer residue from the inner surface of the moulding.

2. Install the moulding and attaching screws and nuts.

SIDE SLIDE CHANNEL

REMOVAL

Remove the six (6) countersunk screws and trim nuts from the side trim moulding and slide rail. Drill out the two (2) rivets at each end of the channel using a 1/8" diameter drill. Separate the slide channel from the trim moulding.

CAUTION: *Channels are bonded to the roof panel with adhesive. To prevent damage, use a fiber stick tool to pry the slide channel from the roof panel.*

INSTALLATION

1. Remove any sealer residue from the inner surface of the slide channel and roof top.

2. Apply a bead of fresh sealer (Dow Corning "Silastic" or equivalent) on the inner surface along the full length of the slide channel and around each screw and rivet hole.

3. Install the channel on the edge of the opening.

4. Install the trim moulding, screws and nuts. Do not tighten. Install two (2) rivets at each end of the channel. Tighten the screws.

5. Wipe off any excess sealer which may have been squeezed out from under the channel.

REAR RETAINERS, INNER AND OUTER

REMOVAL

1. Remove the hole plugs from the rear inner retainer and remove the screws which are visible in the access hole.

2. Move the rear of the top assembly forward and remove the four (4) roof panel to inner retainer screws.

INSTALLATION

1. Hold the inner retainer in position and install the roof panel to inner retainer screws.

2. Move the rear of the top assembly into position and install the screws through the access holes in the inner retainer.

3. Check for correct location of the sunroof in the opening. Adjust if necessary. (Refer to Adjustments).

4. Install the access hole plugs.

WIND DEFLECTOR ASSEMBLY, DEFLECTOR AND HINGE UNIT

REMOVAL

1. To remove the deflector from the hinge unit, remove the left and right deflector to hinge mounting screws and the center mounting bolt. Slip deflector out of hinges.

2. To remove the entire deflector assembly, remove the eight (8) deflector hinge strap to front inner retainer mounting screws. To allow clearance to remove an interior trim side moulding, remove the four (4) deflector assembly mounting screws on the side toward the trim moulding. This will allow the end of the hinge strap to be pulled down to give clearance for removal of the side moulding.

INSTALLATION

1. To remount the hinge assembly, locate the assembly on the front inner retainer, and install the eight (8) mounting screws.

2. If the deflector was removed from the hinge strap, insert the deflector between the hinge straps and install the right and left mounting screws. Then install the center hinge mounting bolt. The tightness of this bolt determines the force required to move the deflector panel up and down.

FRONT RETAINERS, INNER AND OUTER

REMOVAL

1. Remove eight (8) deflector retaining screws.

2. To remove the front lower retainer, drill out the rivets on the latch side of the opening.

3. To remove the front upper retainer, drill out the rivets on the latch side and the top side of the opening.

   NOTE: *Drill out rivets using a 1/8" diameter drill.*

4. Remove the retainers.

   CAUTION: *Channels are bonded to the roof panel with an adhesive sealer. To prevent damage, use a fiber stick tool to pry the slide channel from the roof panel.*

INSTALLATION

1. Remove any sealer residue from the retainer and the roof top panel.

2. Apply a bead of fresh sealer (Dow Corning "Silastic" or equivalent) on the inner surface along the full length of the retainer and around each rivet hole.

3. Install the retainer on the edge of the opening.

4. Insert several rivets to position the retainer and hold it in alignment to the opening and the rivet holes.

5. Install the rivets.

6. Wipe off any excess sealer which may have been squeezed out from under the retainer.

7. Locate the wind deflector on the inner retainer and install 8 retaining screws.

FRONT HEADER AND LATCHING HANDLE MECHANISM

The front header can be disassembled for lubrication or for repair of the latching mechanism.

DISASSEMBLY

1. Unlock and partially open the sunroof. Hold the left side of the front header and force the right side to the rear until the nylon capped end is out of the side slide channel. Place the header on the rear half of the sun roof.

   NOTE: *The handle must be rotated to the unlatched position for disassembly or assembly of the header.*

2. Separate the two (2) layers of top material between the header and the first sliding roof bow. Carefully remove the staples from the small retaining flaps. Pull ends of first non-sliding roof bow out of pockets in outer top material.

3. Remove the two (2) flat head screws from the upper surface of the header panel using a flat blade stubby screwdriver. The screws are located 6" from each end of the header.

4. Separate the header and fold back the top half to expose the latching mechanism (Fig. 15-57B).

5. Apply a non-staining lubricant to the lube point indicated.

ASSEMBLY

1. When assembling the header, the pull down levers must engage the slots in the upper half of the header.

2. Install the two (2) screws through the top surface of the header.

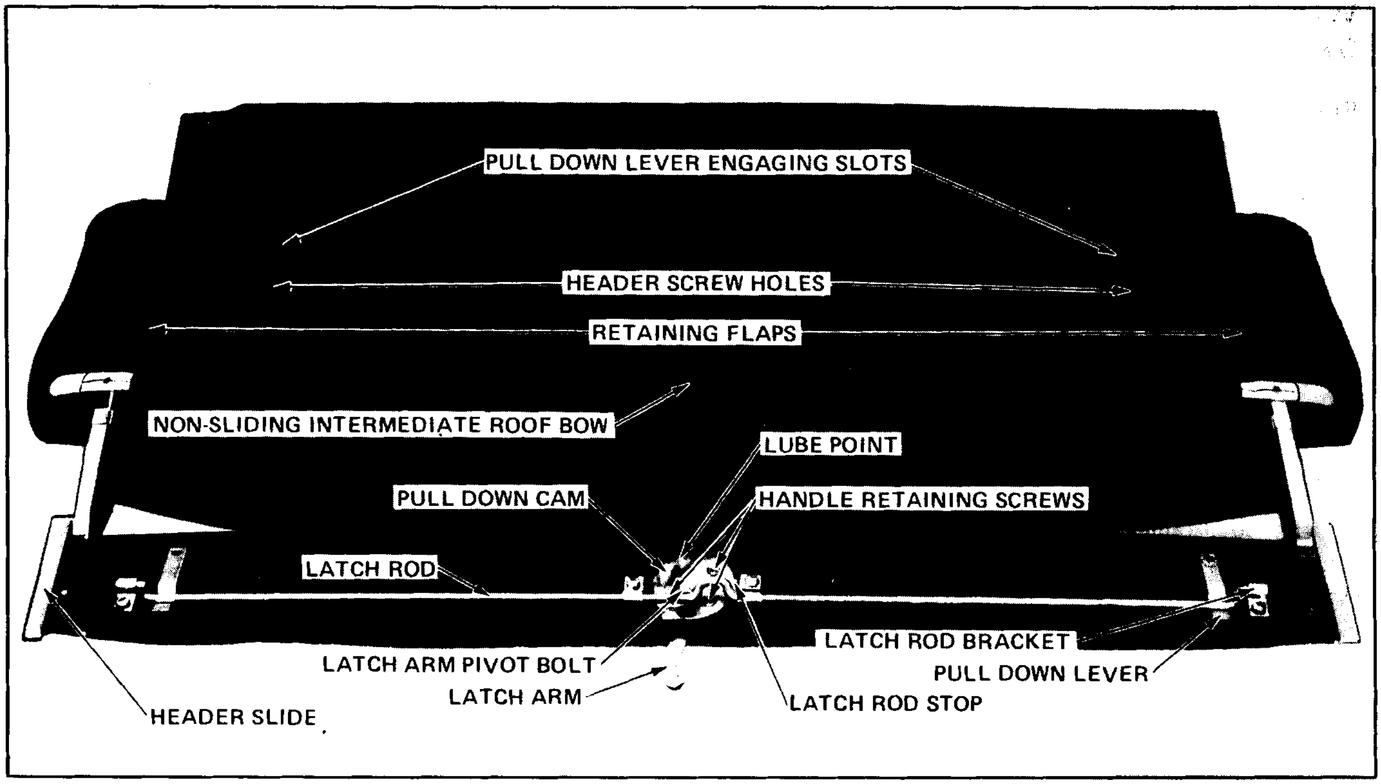


Fig. 15-57B Latching Mechanism

3. Assemble the top material to the roof bows. Staple the small retaining flaps to the top material.
4. Install the left end of the front header into the slide channel. Move the opposite side forward until it can be installed into the slide channel. Check for proper sliding action of the sunroof.

HANDLE

REMOVAL

1. Disassemble the front header.
2. Remove the handle retaining screws and the handle assembly.
3. Unscrew the handle retaining pin and pull out of handle block to separate the handle from the handle block.

INSTALLATION

1. With the return spring in place, install the handle in the handle block and install the pin.
2. Using the three (3) handle retaining screws, install the handle assembly to the latch mechanism with both the cut-out in the handle block and the latch hook forward.
3. Assemble the front header and install into the side slide channels.

LATCH

REMOVAL

1. Disassemble the front header.
2. Remove the two (2) rod brackets and the rod stop. Remove latch arm pivot bolt.
3. Remove the handle retaining screws and the handle assembly.
4. Raise the latch rod in the center and remove the latch assembly.

INSTALLATION

1. Raise the latch rod and insert the latch assembly.
2. Using the three (3) handle retaining screws, install the handle assembly to the latch mechanism with both the cut-out in the handle block and the latch hook forward.
3. Install the rod brackets and the rod stop. Press down on the pull down levers to ease rod bracket screw installation.
4. Assemble the front header.

LATCH ROD

REMOVAL

1. Disassemble the front header.
2. Remove the two (2) rod brackets and the rod stop.
3. Carefully raise the latch rod, bowing it in the center and at the same time forcing one end of the rod out of its retainer.

INSTALLATION

Refer to Figure 15-57B

1. Prior to installing the latch rod, place it on the header to be certain that the "U" bend will be to the left of the header center line.
2. Install the left end of the rod into the rod retainer. Hold the right end of the rod at the retainer and carefully bow the center of the rod up until the right end can be installed into its retainer.
3. Install the rod brackets and the rod stop. Press down on the pull down levers to ease screw installation.
4. Assemble the front header.

HEADLINING

REMOVAL

1. Remove the sunroof top assembly and the wind deflector assembly (Refer to R & R procedures.)
2. Remove the rear and side inner trim mouldings. (Refer to R & R procedures.)
3. Drill out the two (2) rivets at each end of the two side slide channels (use 1/8" diameter drill). Drill out the twenty (20) rivets on the latch side and the top side of the front outer retainer. Remove the side slide channels and the front inner and outer retainers.

   CAUTION: *Channels are bonded to the roof with sealer adhesive. To prevent damage, use a fiber stick tool to pry the channels and outer retainer from the roof panel.*

4. The headliner is attached to the edge of the opening with adhesive. Carefully remove the headliner from around the sunroof opening.
5. Carefully complete removal of the headliner as outlined in the 1971 Body Service Manual, Section 10, Headlining.

INSTALLATION

1. Remove any sealer residue from the sunroof opening and retainers. Carefully install the headliner as outlined in Section 10 of the body manual. Note that listing wires are not used.
2. When installing a new headlining, cut an opening for the sunroof in the headliner. Cut a rectangular opening in the headliner, leaving a six to eight inch margin of material inside the opening. From each corner of the opening in the headliner, cut diagonally to the respective corner of the roof opening.
3. Cement the headliner at the sunroof opening with a contact type cement. Cemented area should be on the inner and outer side of the roof panel in a less than 1/2 inch wide strip along the edge of the opening.
4. When cemented in place, trim the headliner to extend not more than 1/2 inch beyond the outside of the roof opening.
5. Install front retainers, side rails, rear retainers and deflector assembly (Refer to installation procedures.)
6. Install and adjust the top assembly (Refer to installation procedures.)

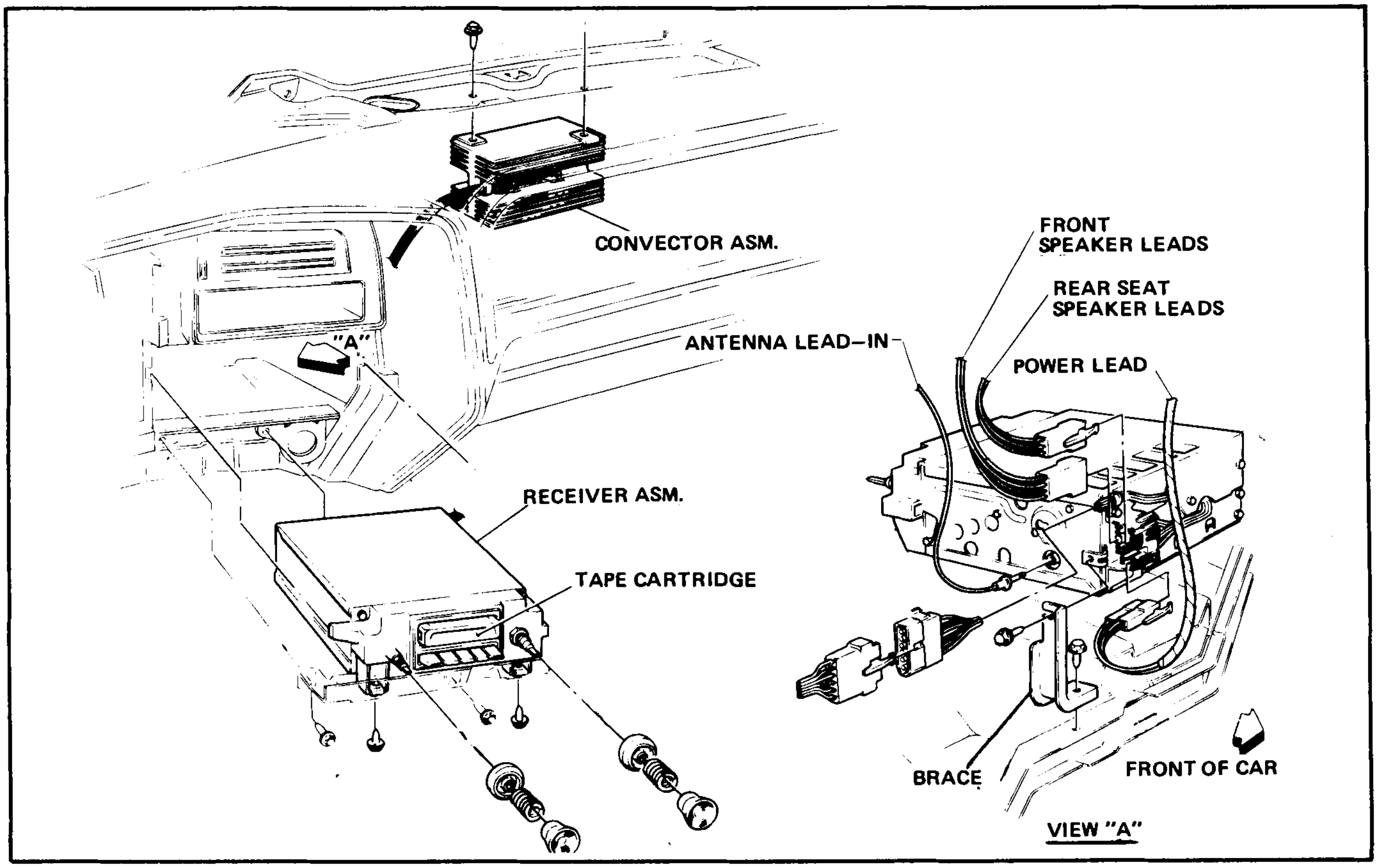


Fig. 15-58 B Series Stereo Radio/Tape Player

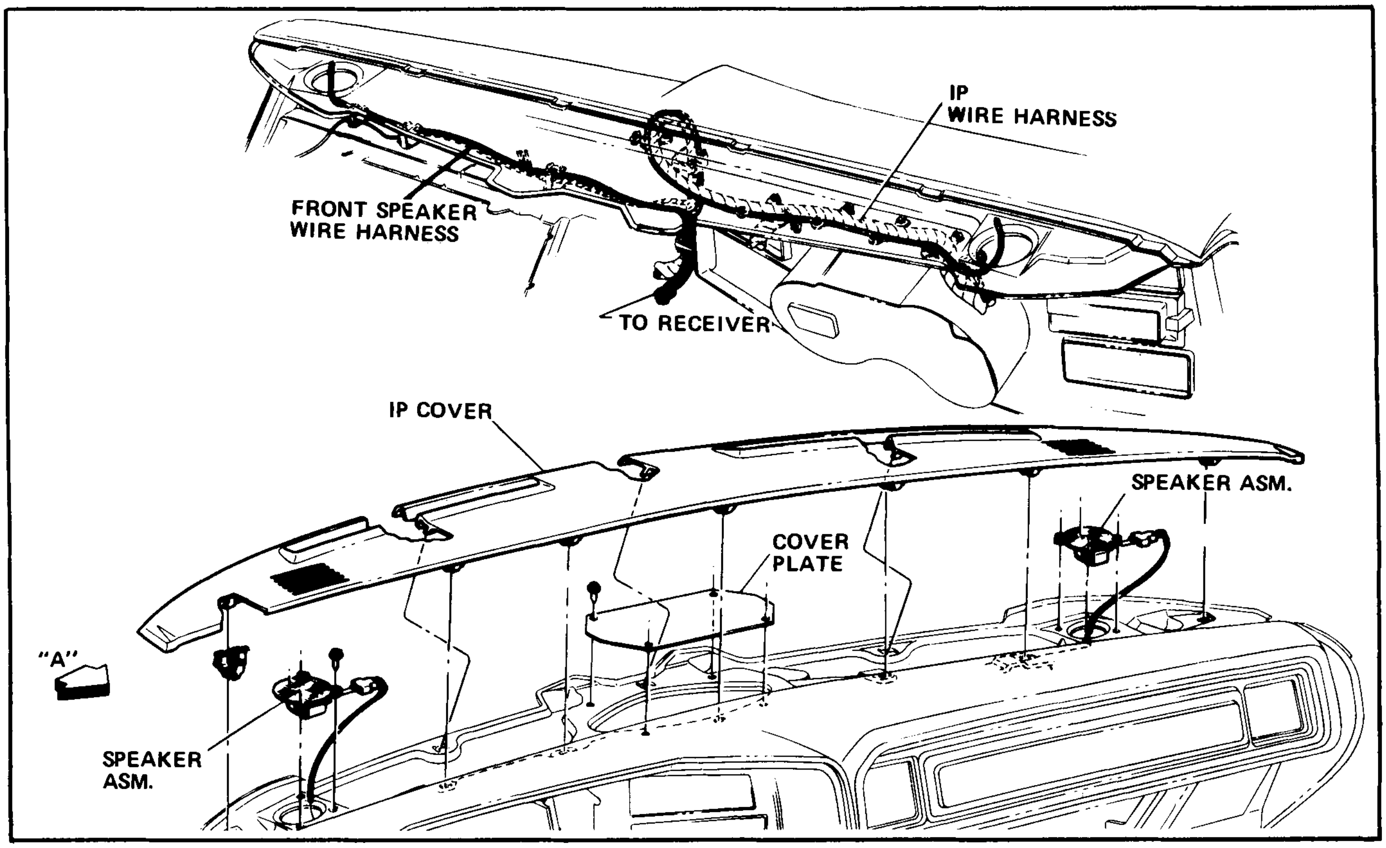


Fig. 15-59 B Series Front Stereo Speakers

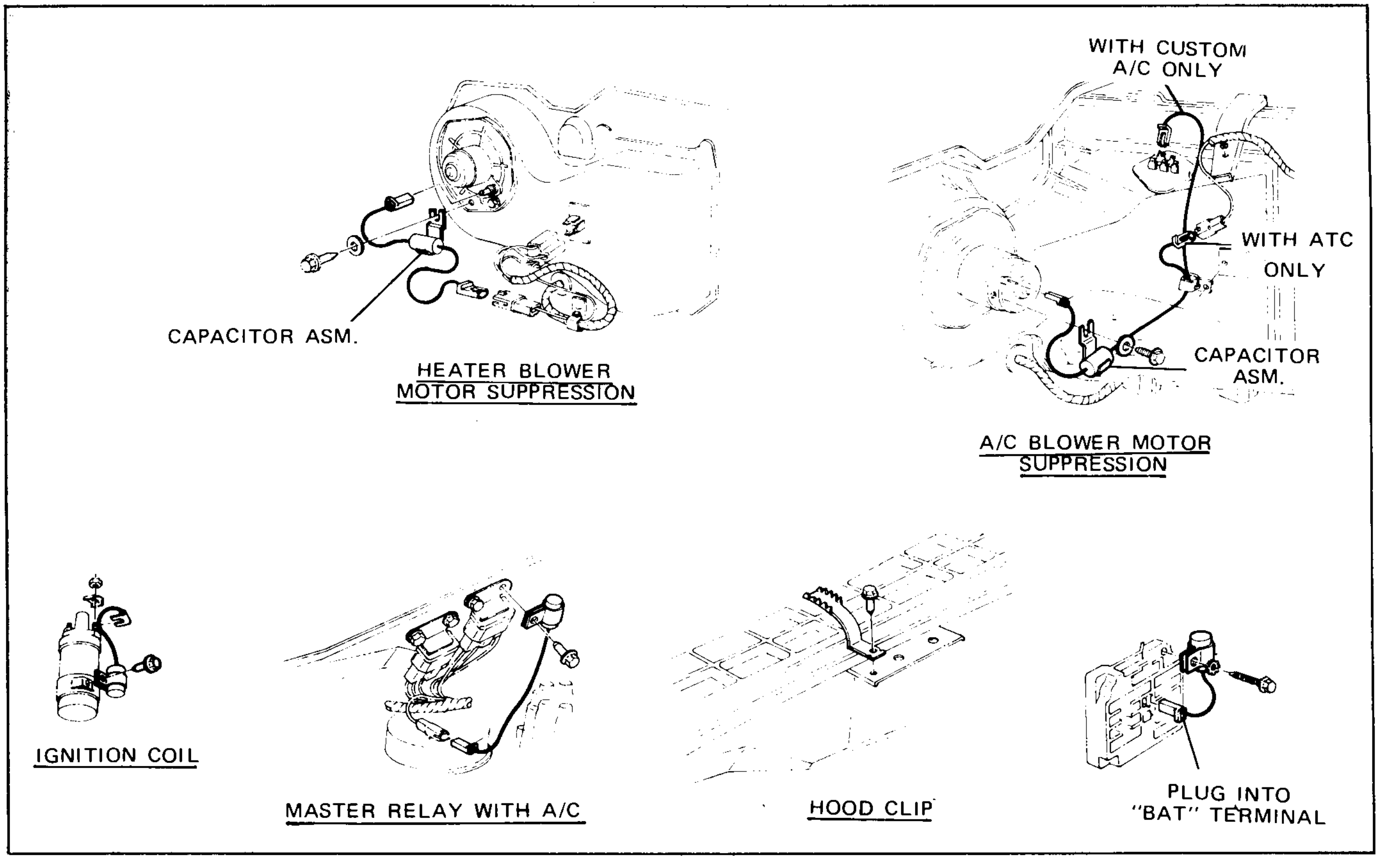


Fig. 15-60 B Series Radio Suppression Equipment

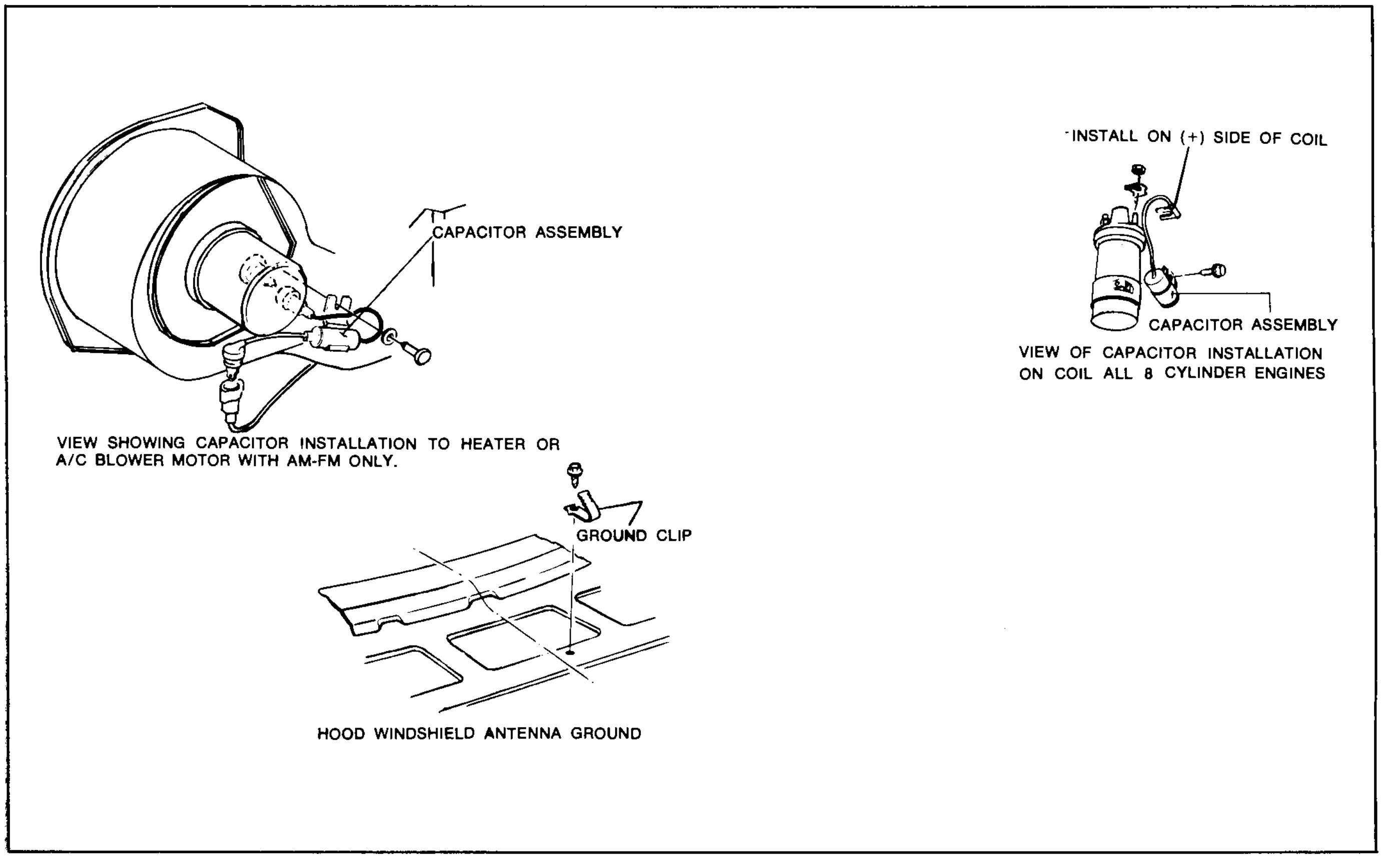


Fig. 15-61 A Series Radio Suppression Equipment

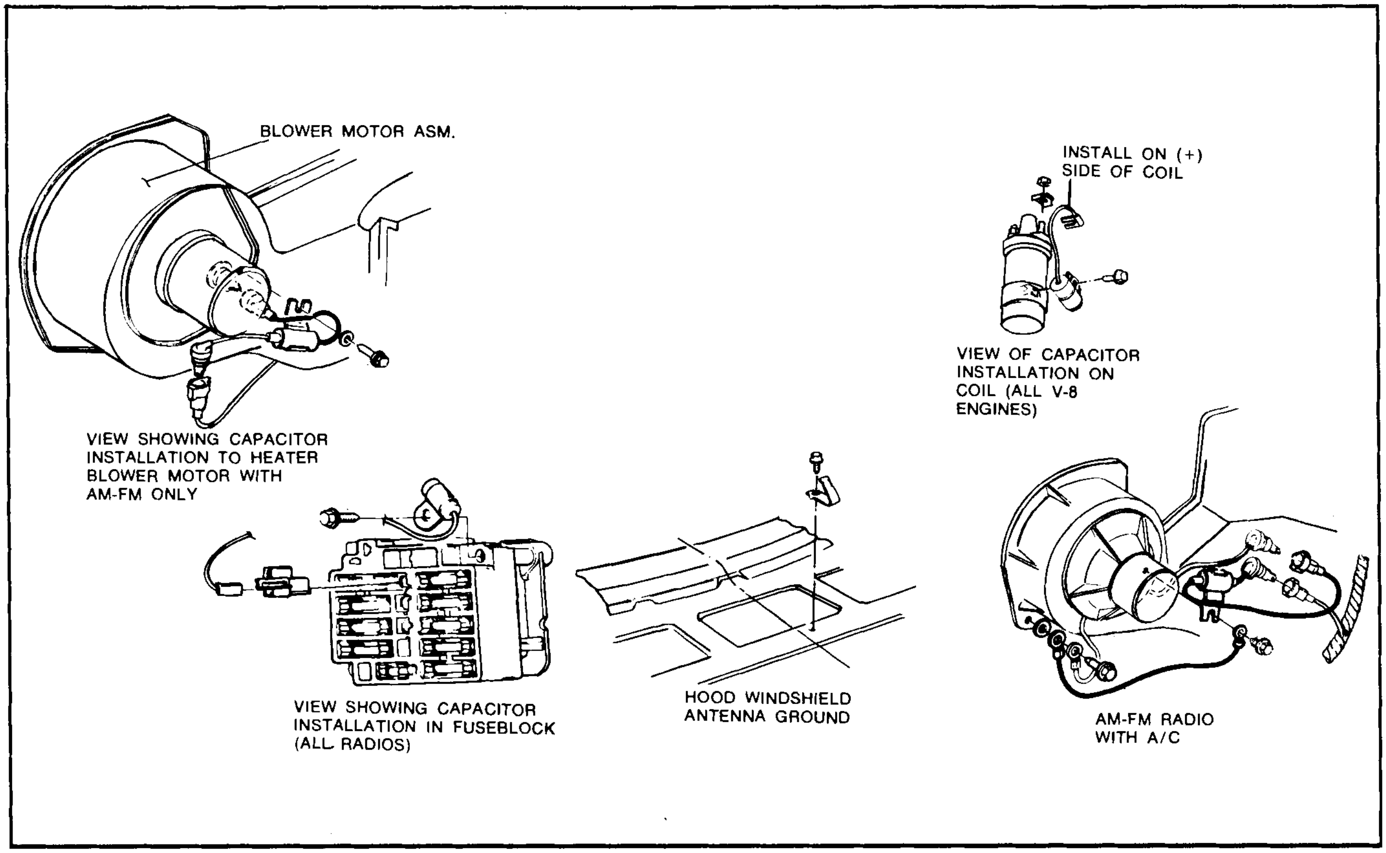


Fig. 15-62 G Series Radio Suppression Equipment

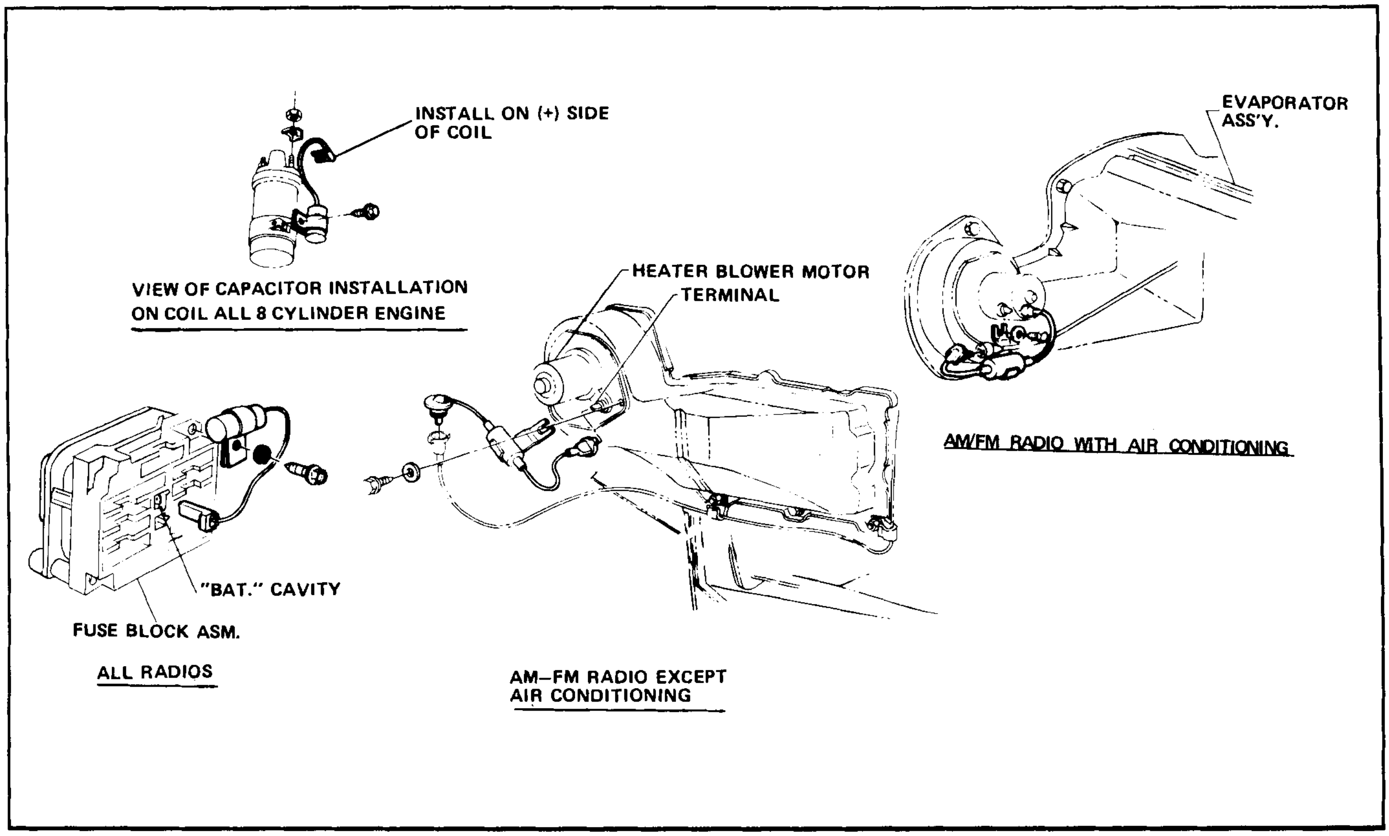


Fig. 15-63 F Series Radio Suppression Equipment

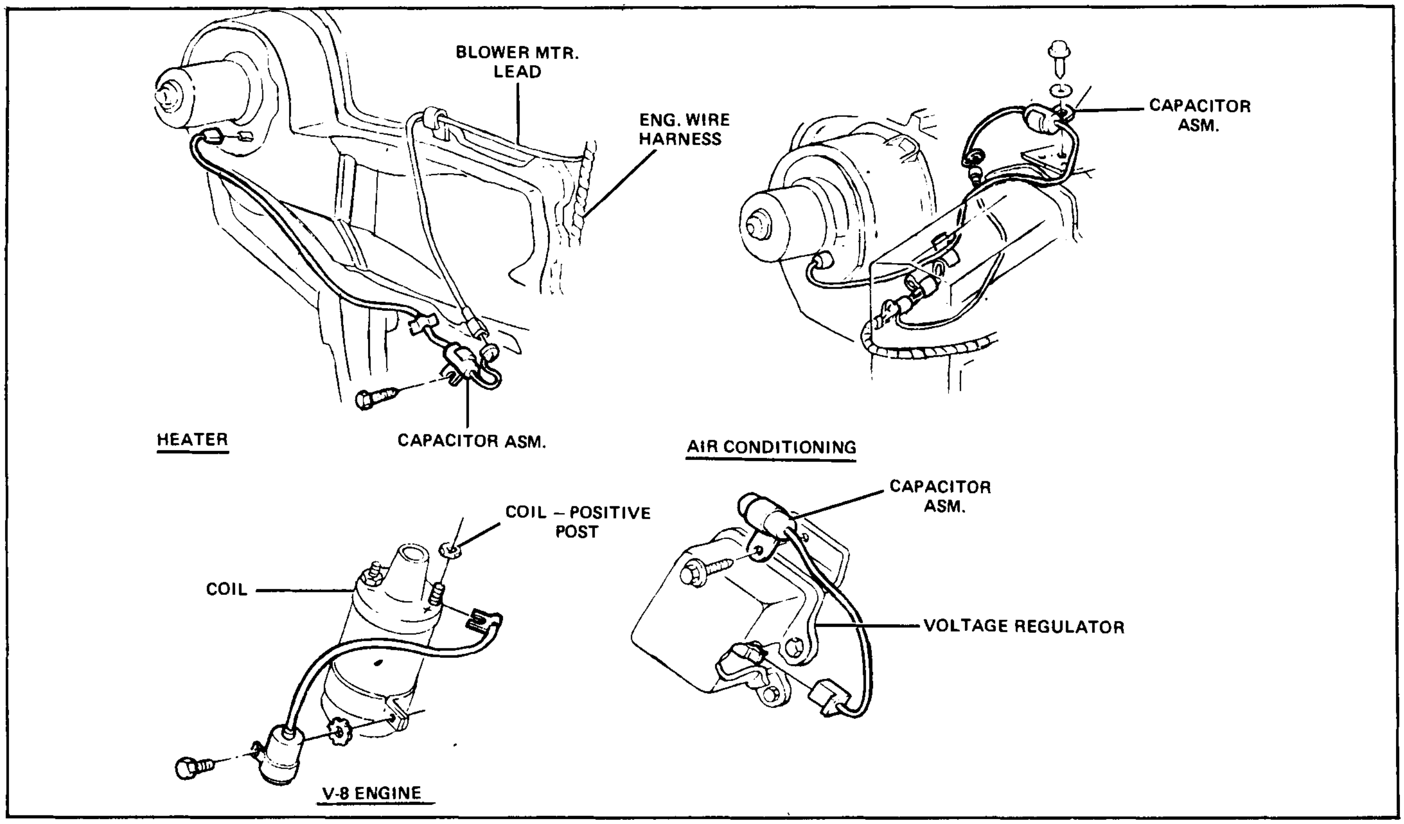


Fig. 15-64 X Series Radio Suppression Equipment

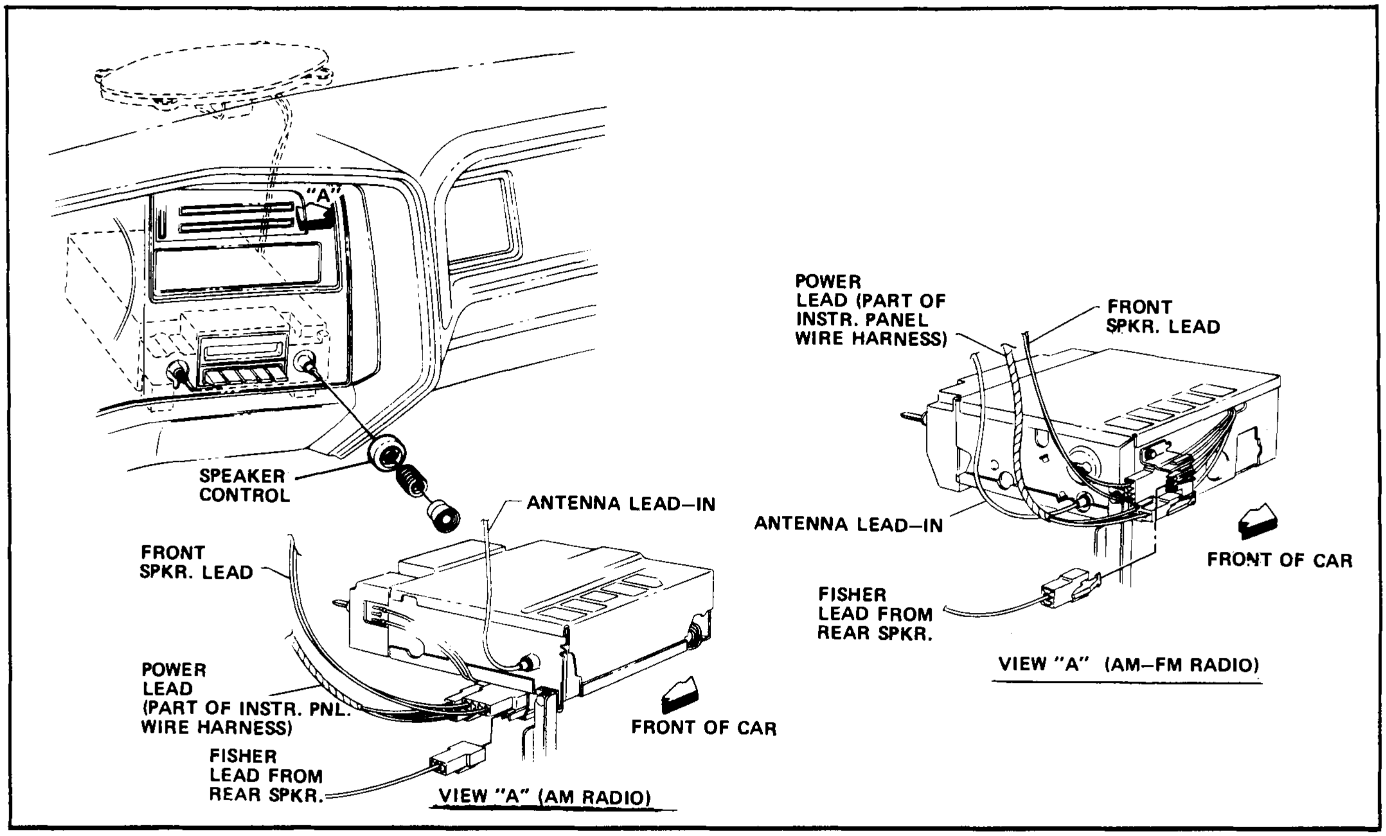


Fig. 15-65 B Series Rear Seat Speaker Installation

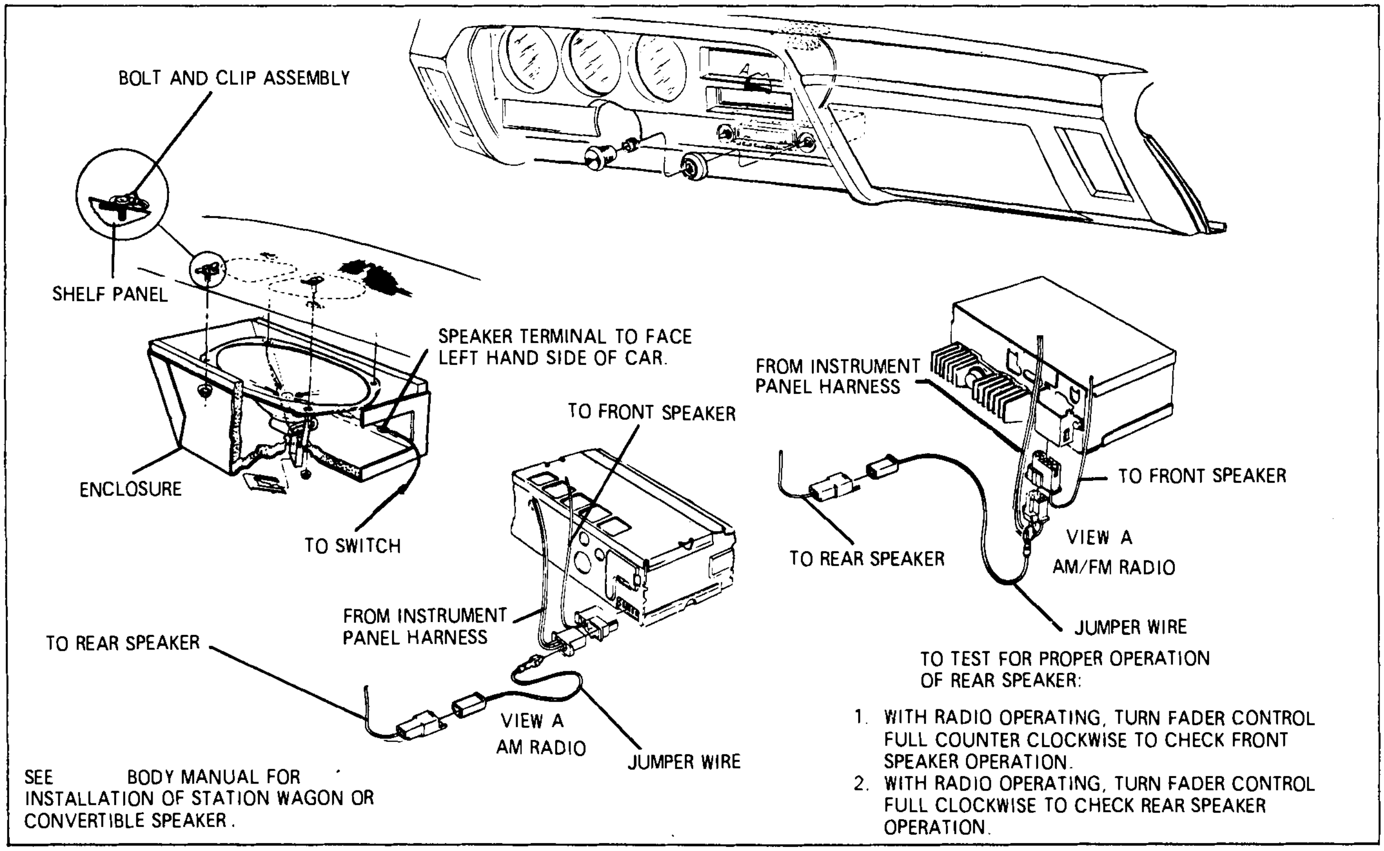


Fig. 15-66 A Series Rear Seat Speaker Installation

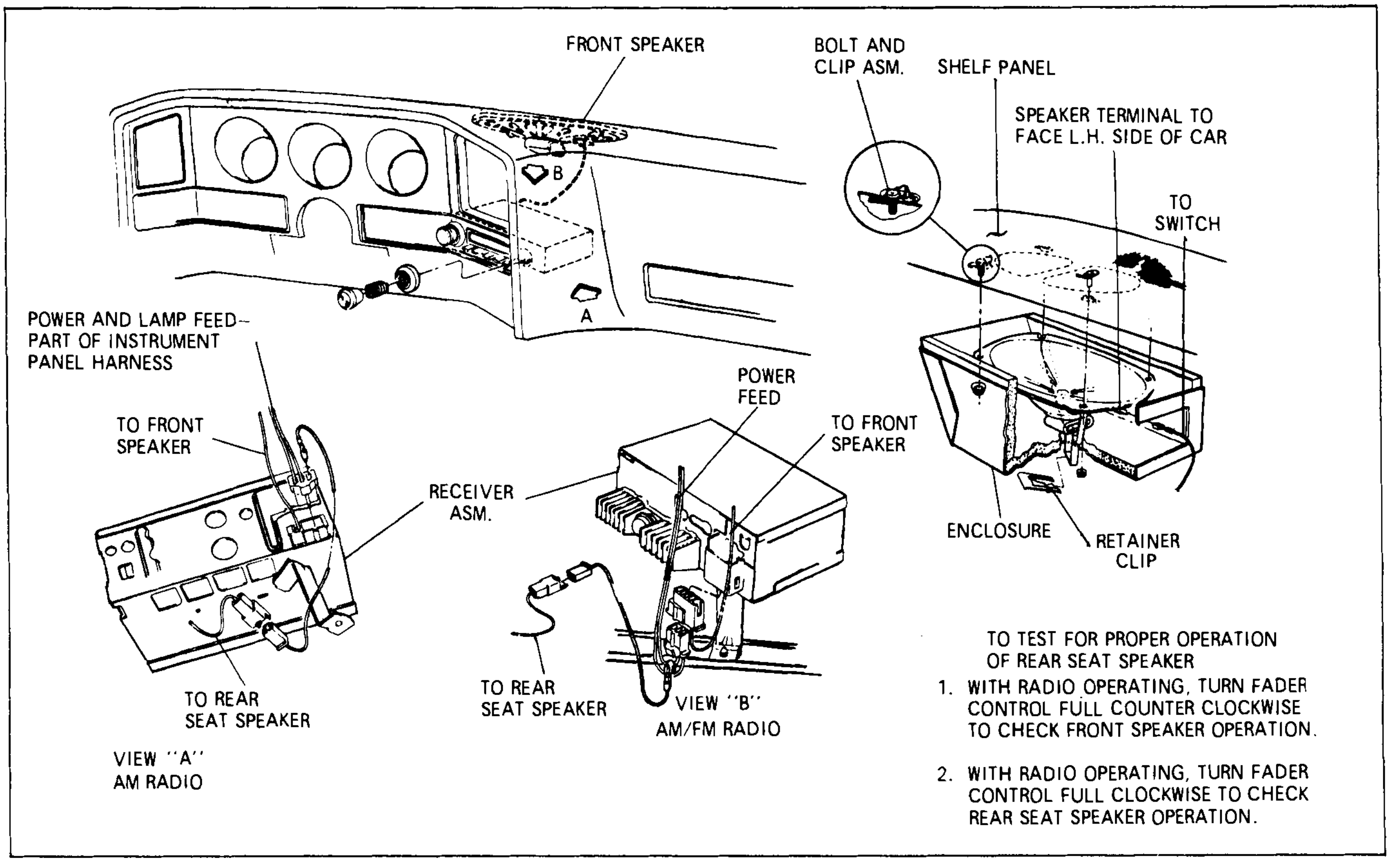


Fig. 15-67 G Series Rear Seat Speaker Installation

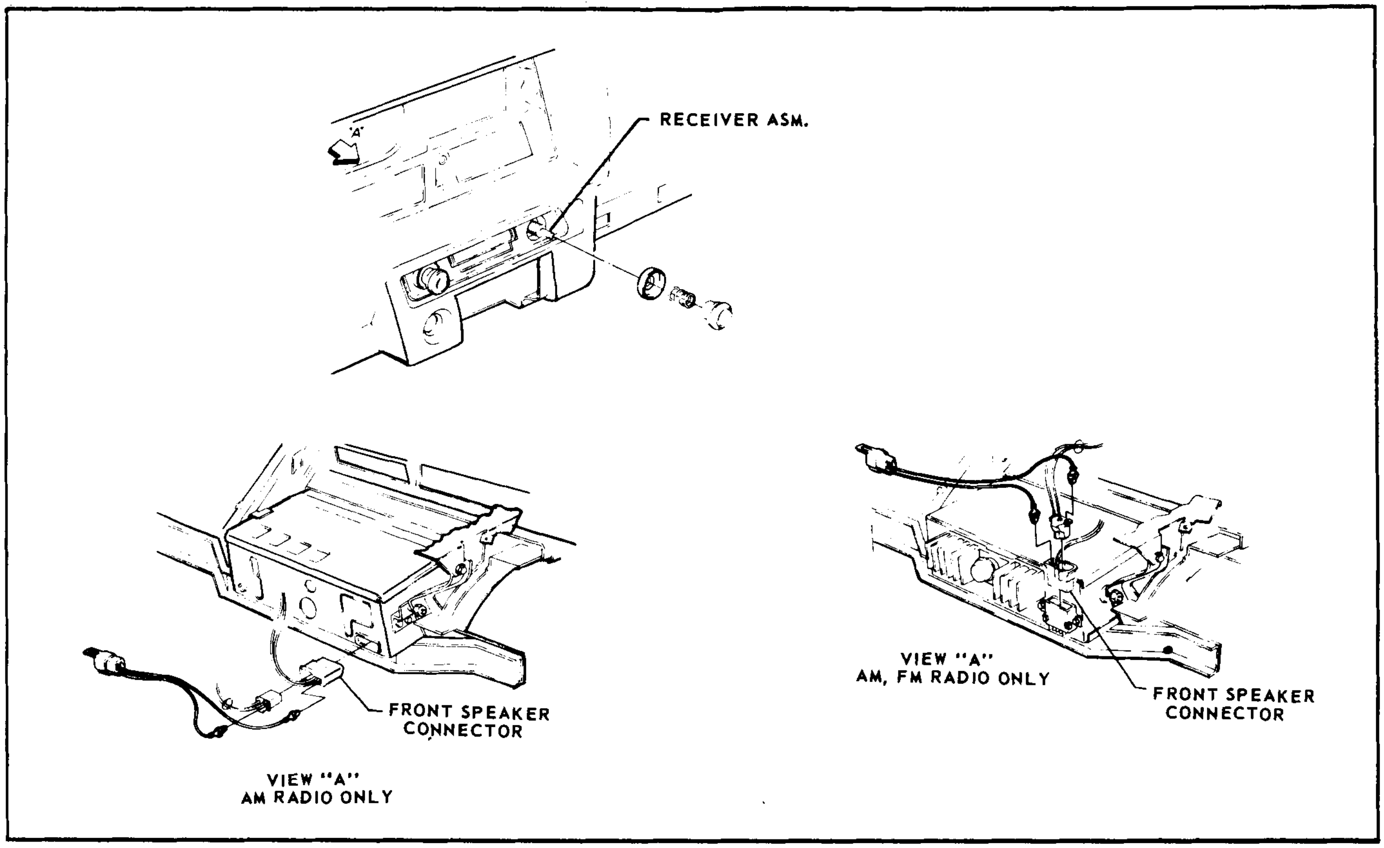


Fig. 15-68 F Series Rear Seat Speaker Installation

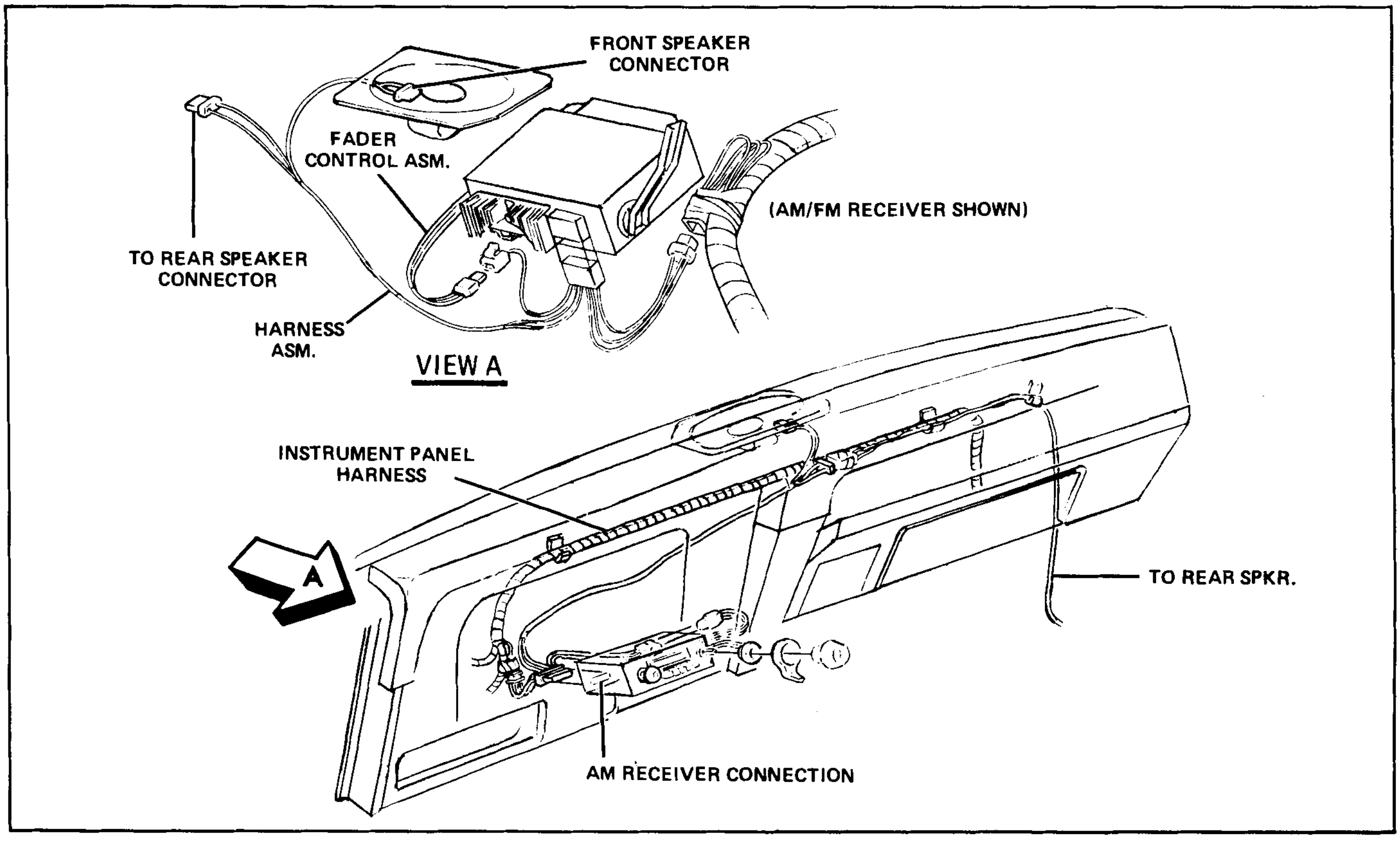


Fig. 15-69 X Series Rear Seat Speaker Installation

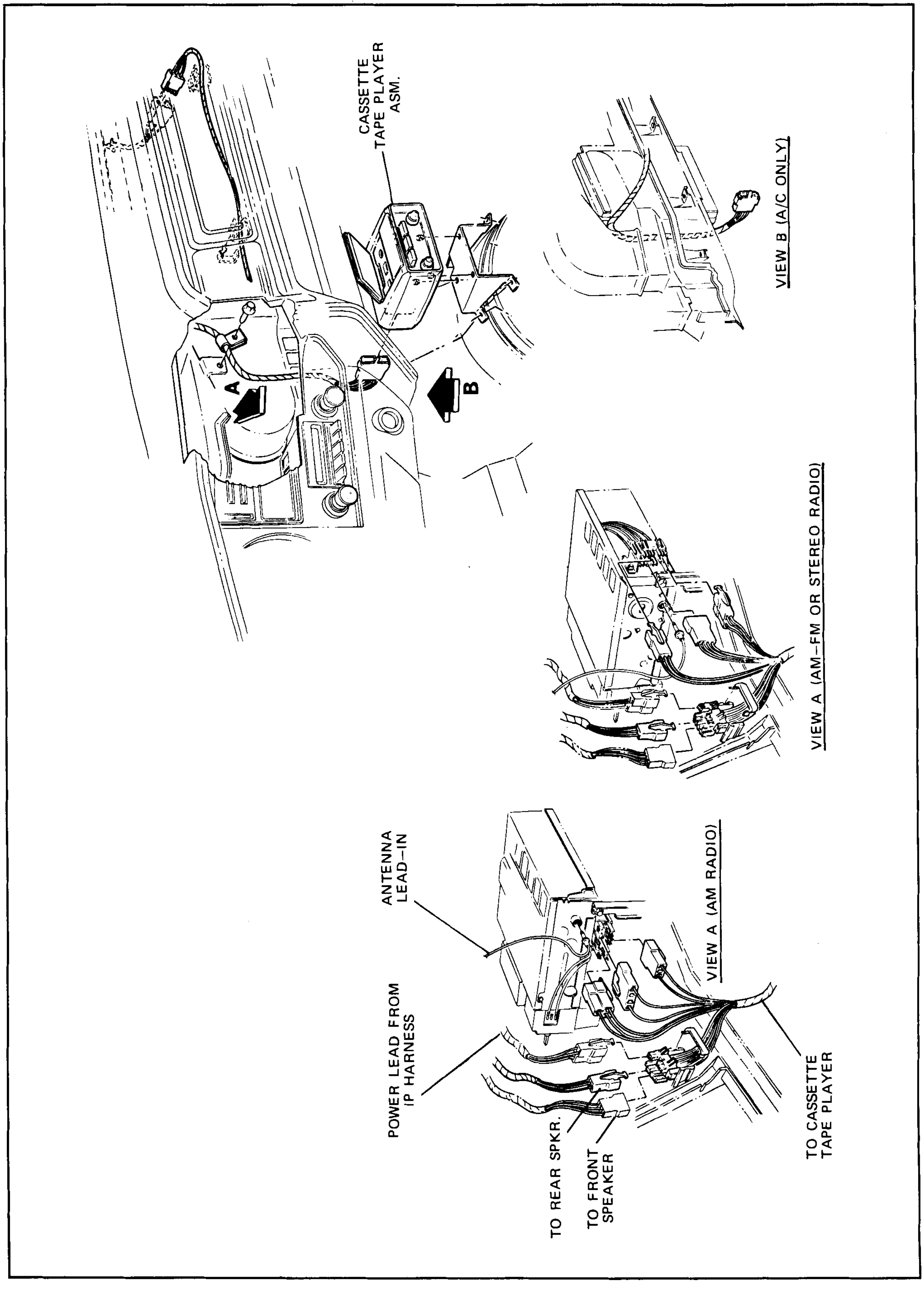


Fig. 15-70 B Series Cassette Tape Player Installation

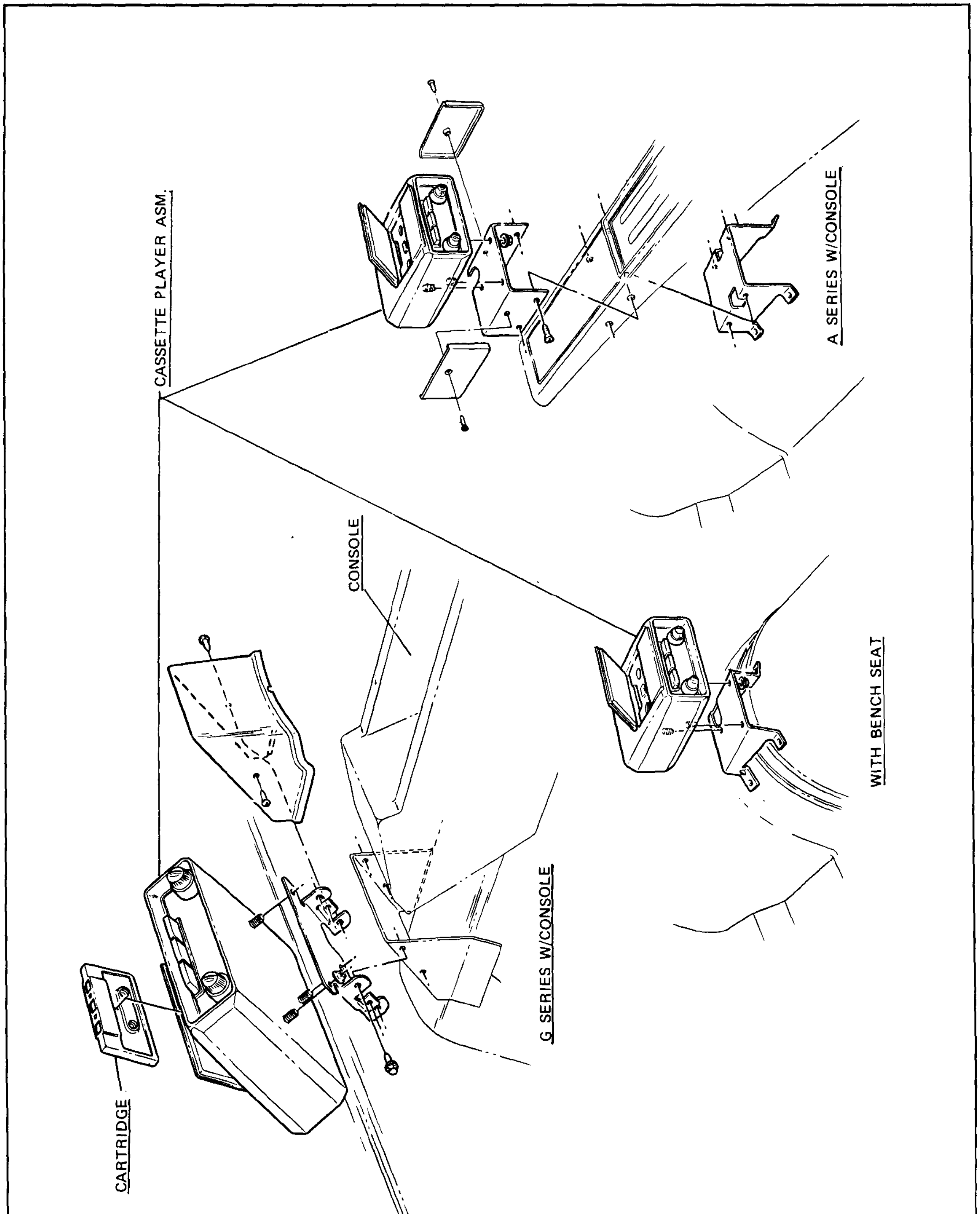


Fig. 15-71 A and G Series Cassette Tape Player Installation

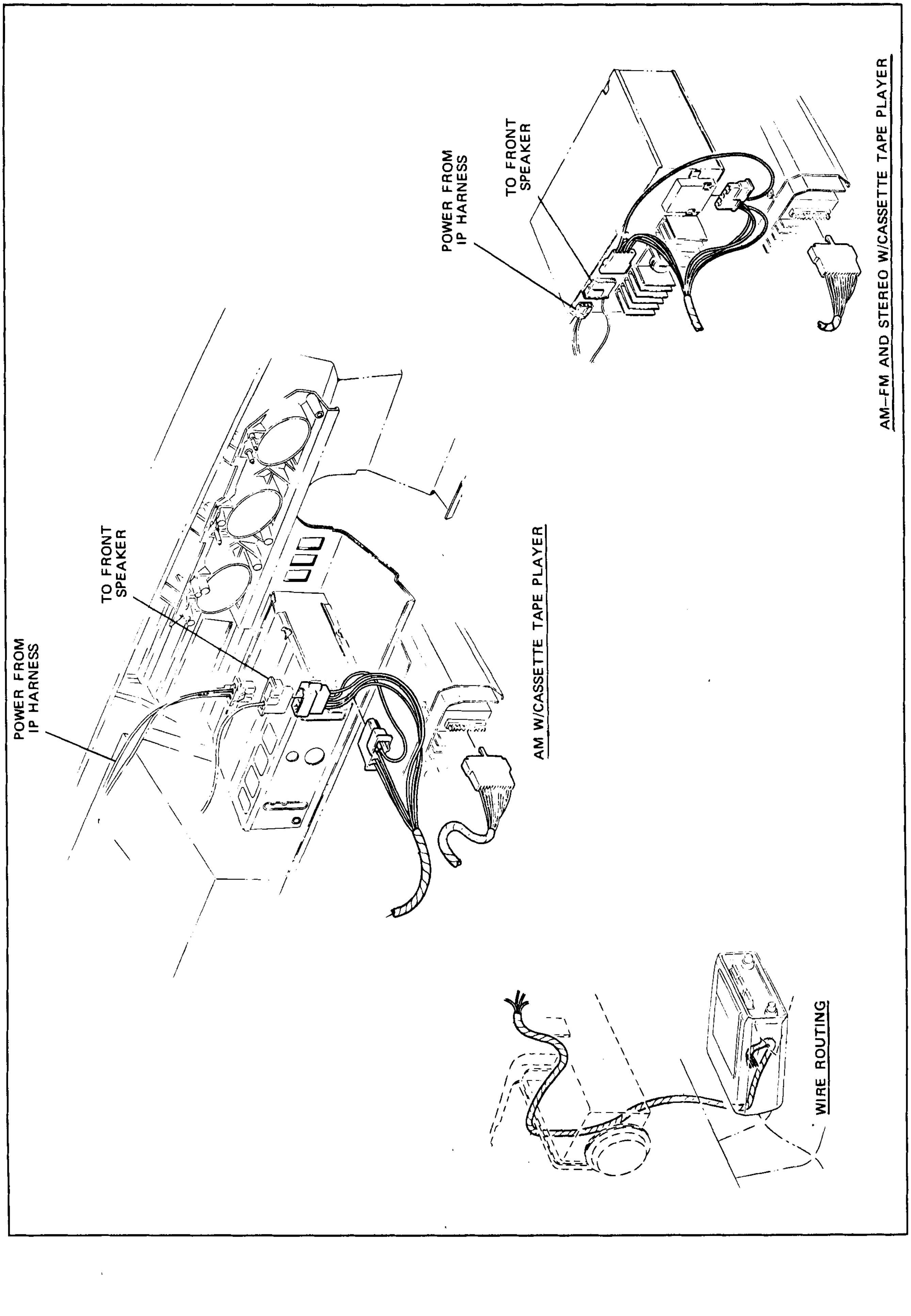


Fig. 15-72 A Series Cassette Tape Player Wiring

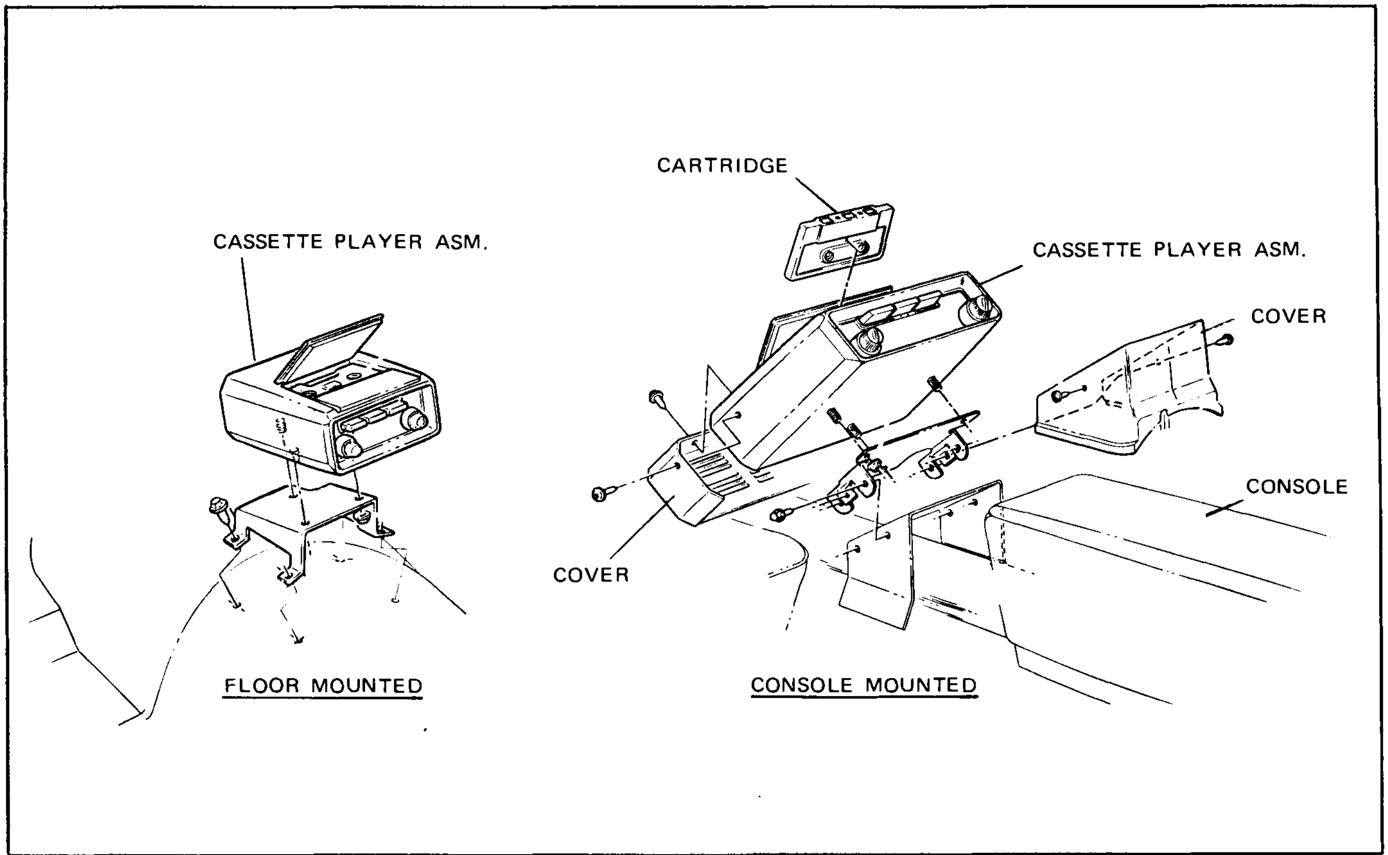


Fig. 15-73 F Series Cassette Tape Player Installation

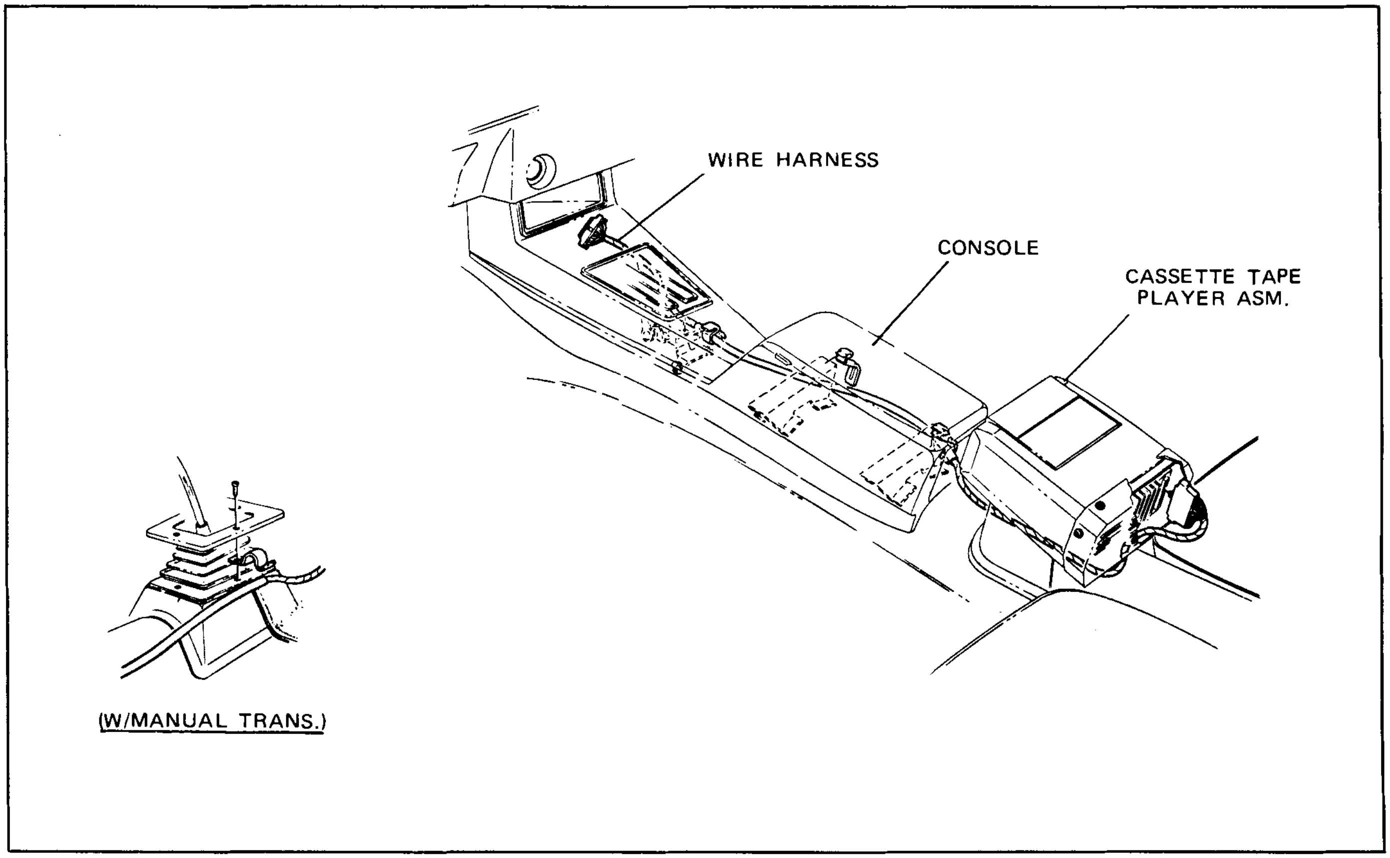


Fig. 15-74 F Series Cassette Tape Player Wiring (With Console)

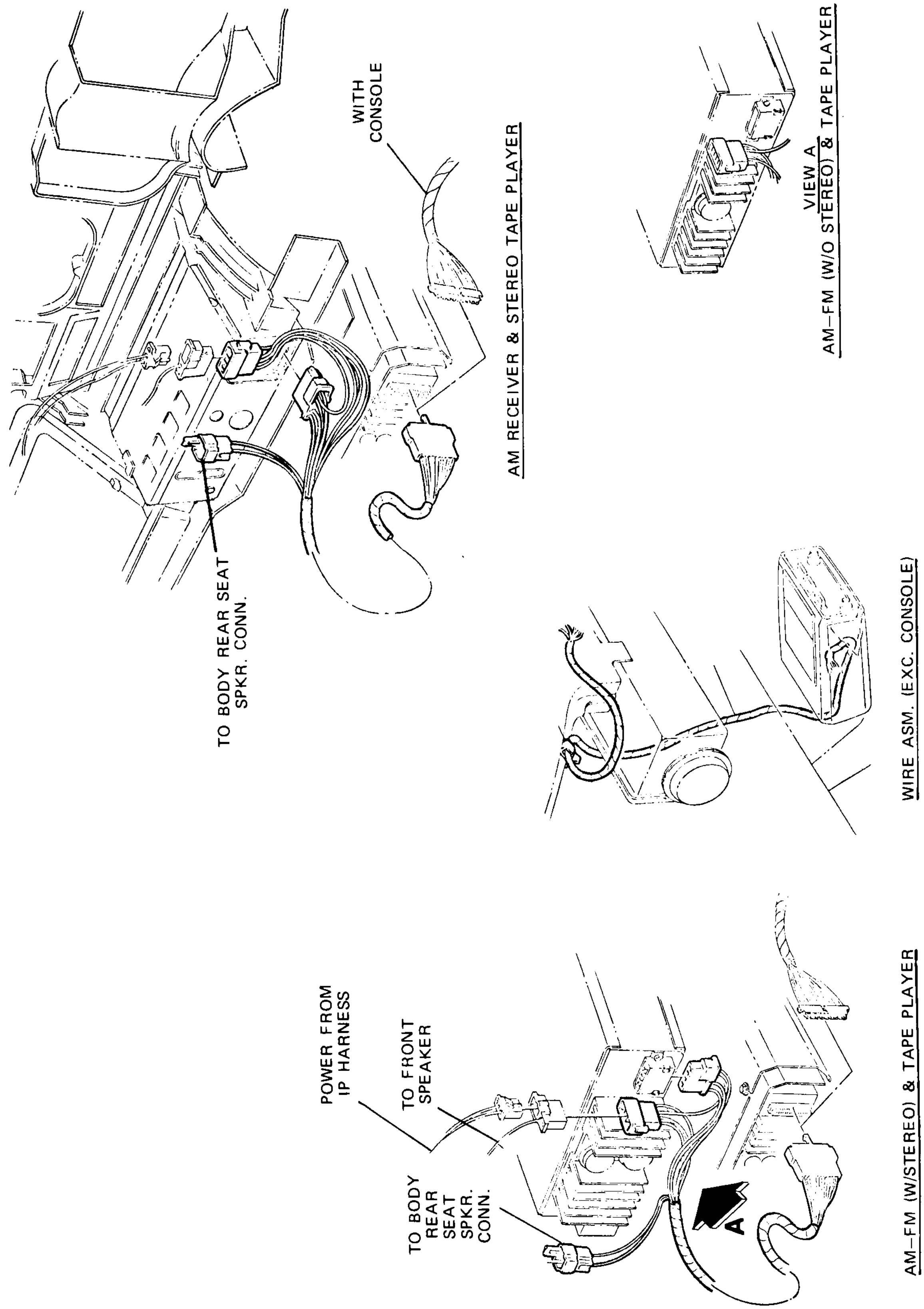


Fig. 15-75 F Series Cassette Tape Player Wiring (Without Console)

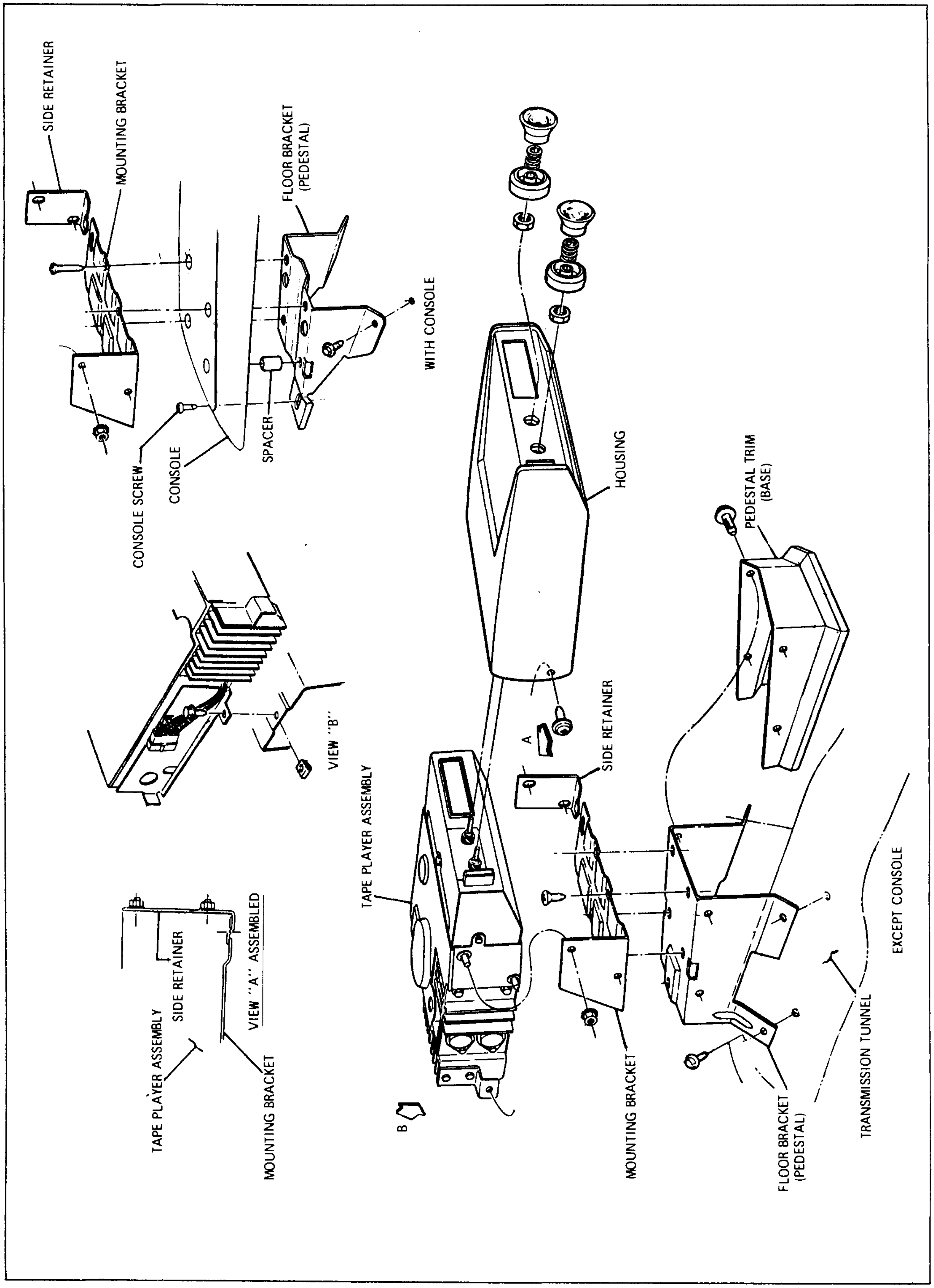


Fig. 15-76 A Series Eight Track Tape Player Installation

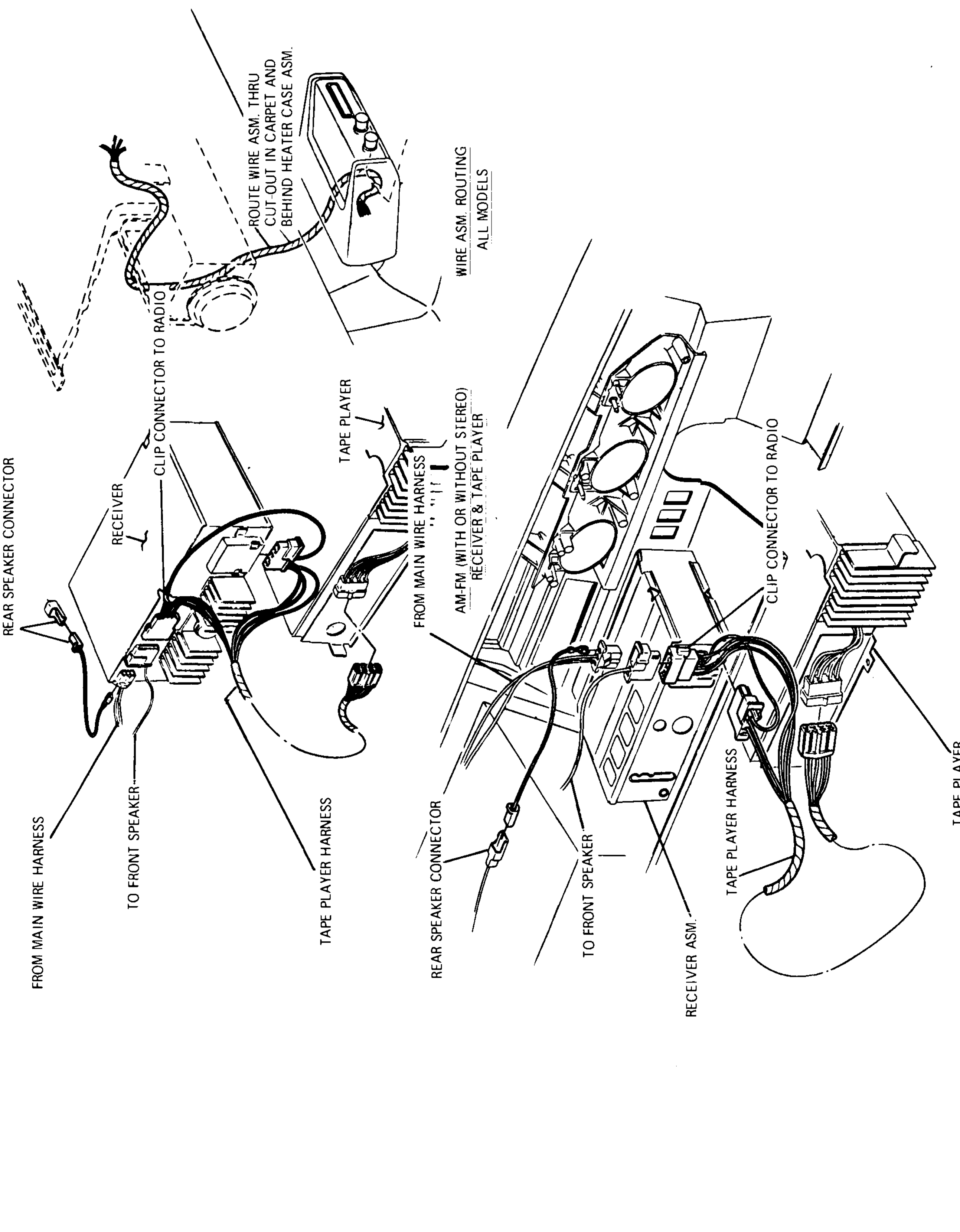


Fig. 15-77 A Series Eight Track Tape Player Wiring

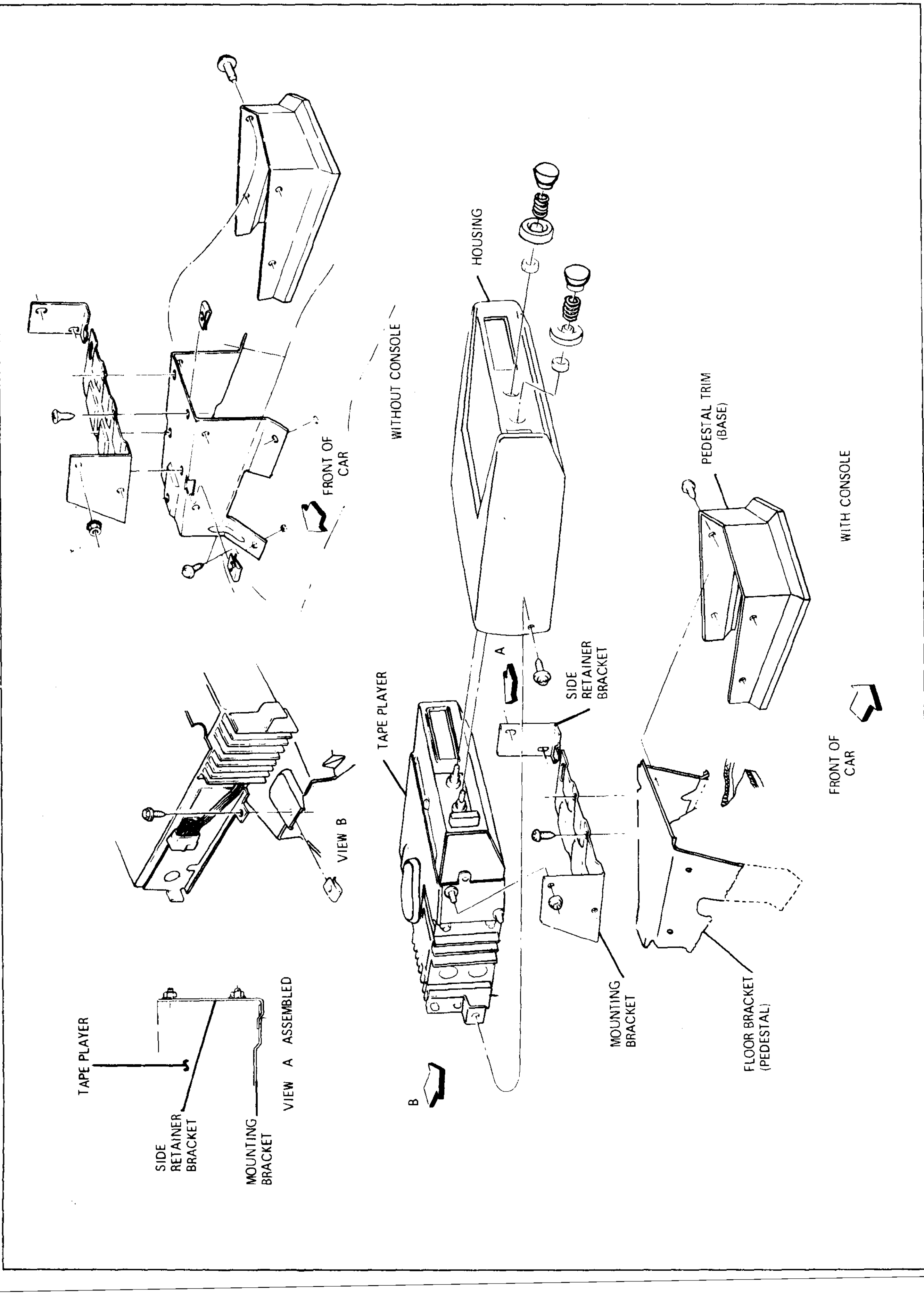


Fig. 15-78 G Series Eight Track Stereo Tape Player Installation

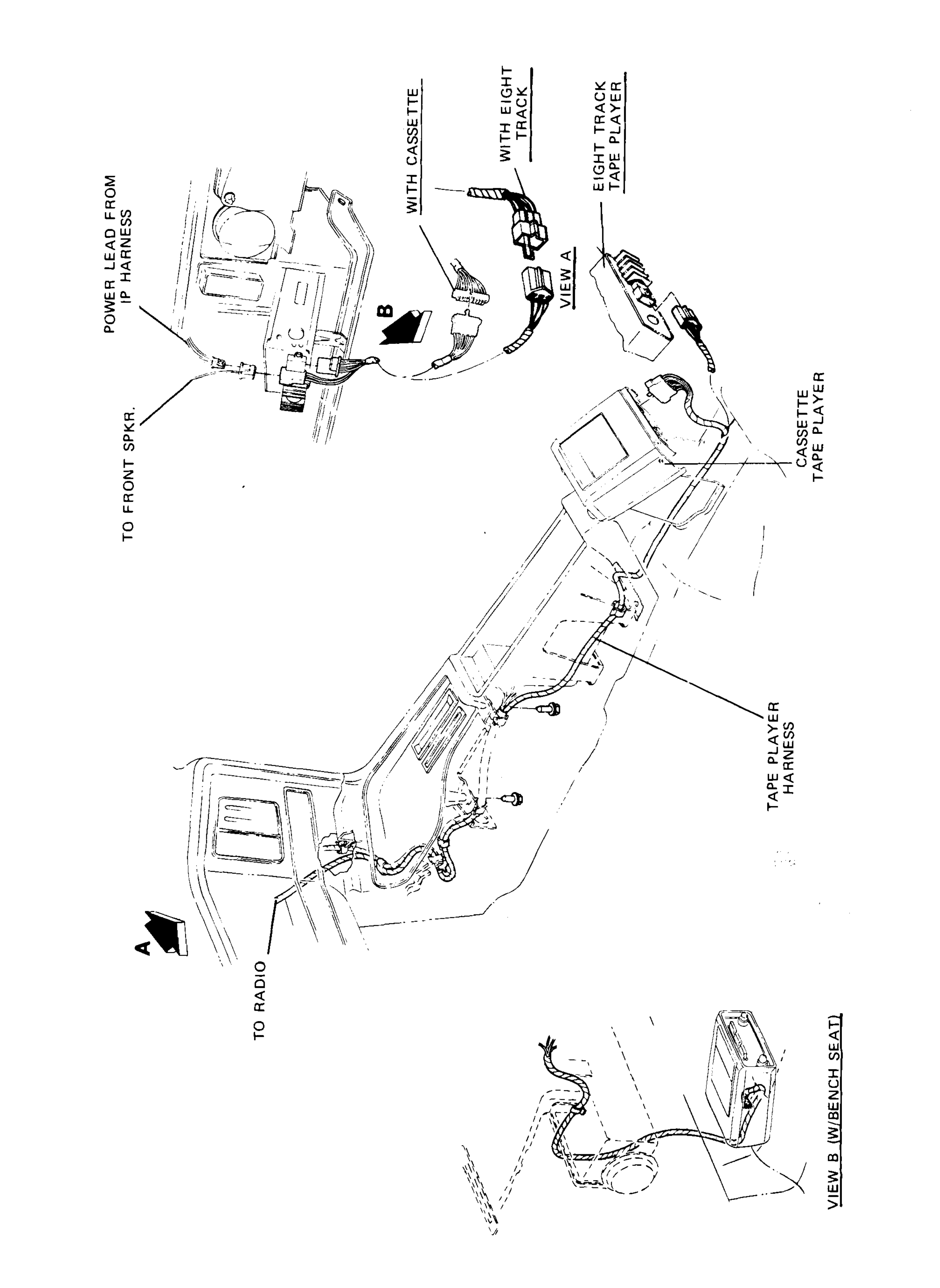


Fig. 15-79 G Series Eight Track and Cassette Stereo Tape Player Wiring

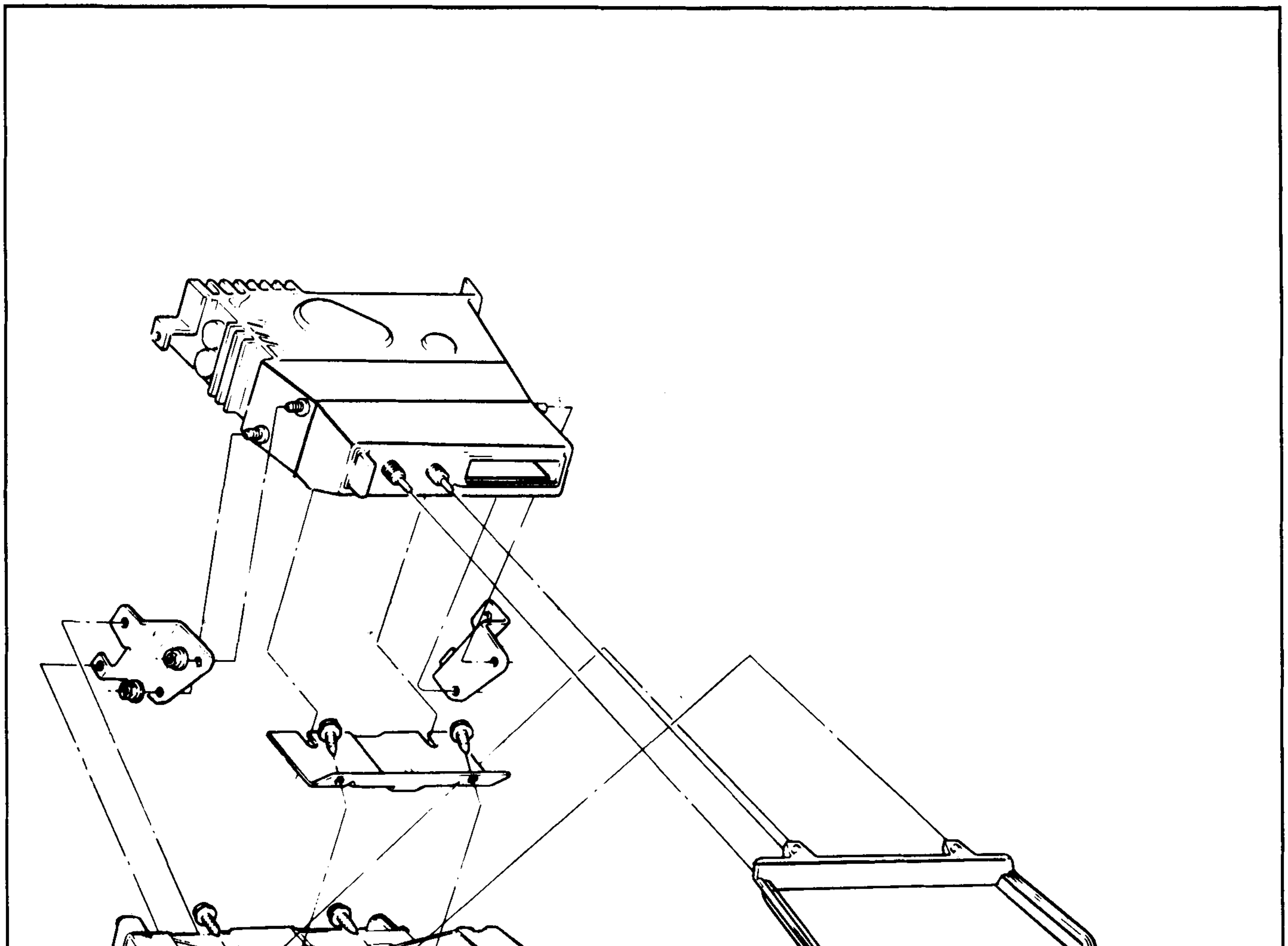


Fig. 15-80 F Series Eight Track Tape Player Installation

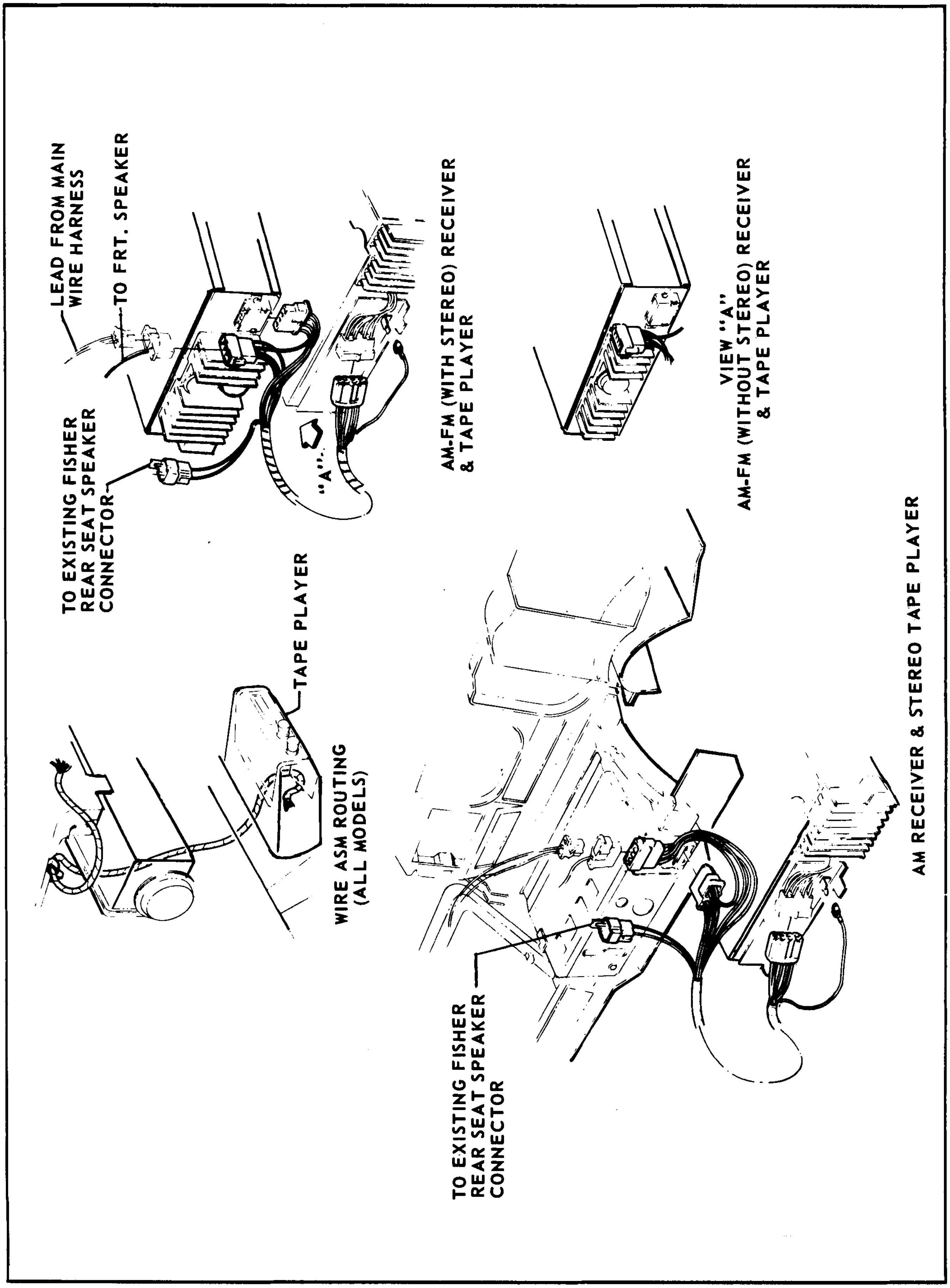


Fig. 15-81 F Series Eight Track Tape Player Wiring

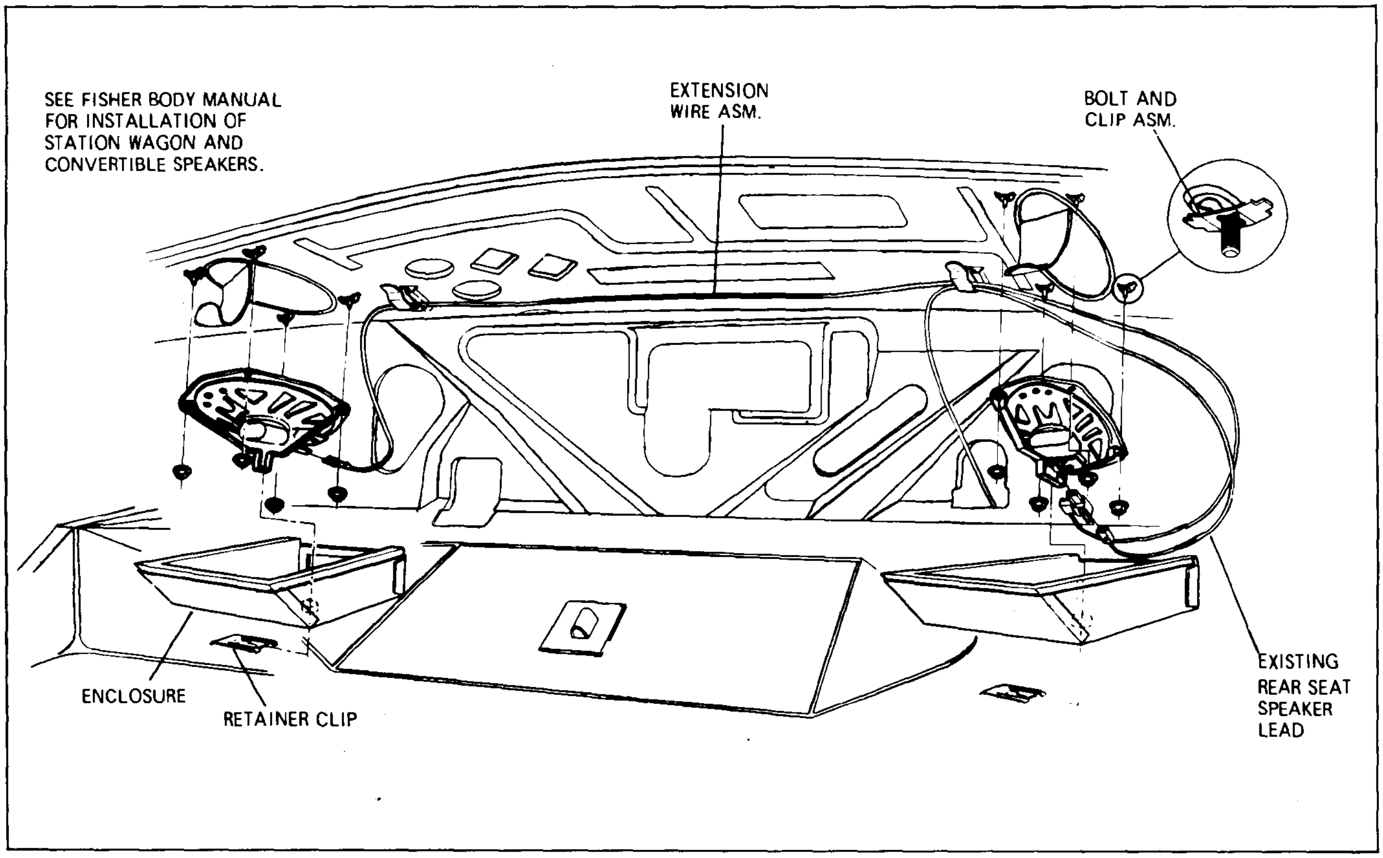


Fig. 15-82 B Series Rear Seat Stereo Speakers

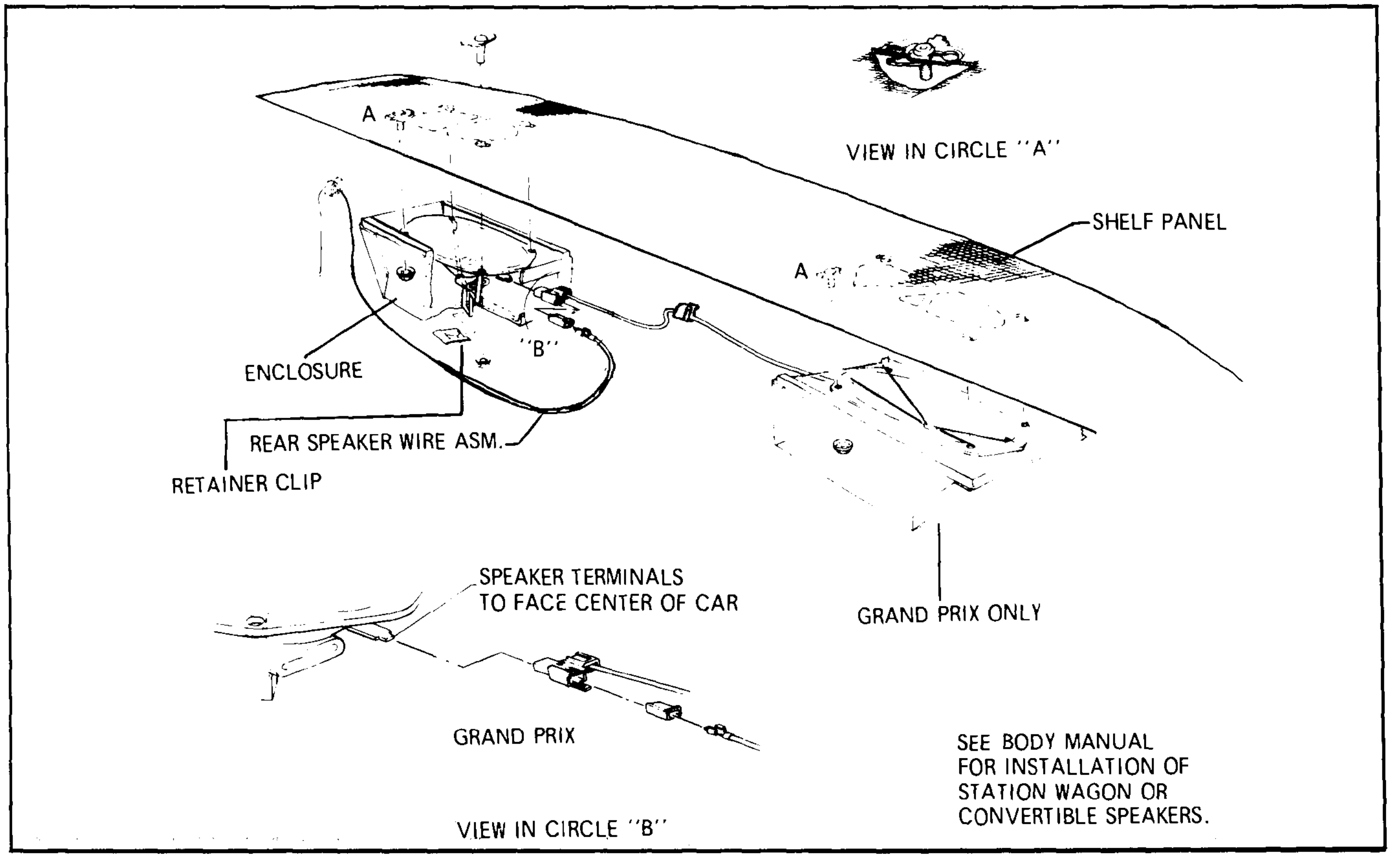


Fig. 15-83 A and G Series Rear Seat Stereo Speakers

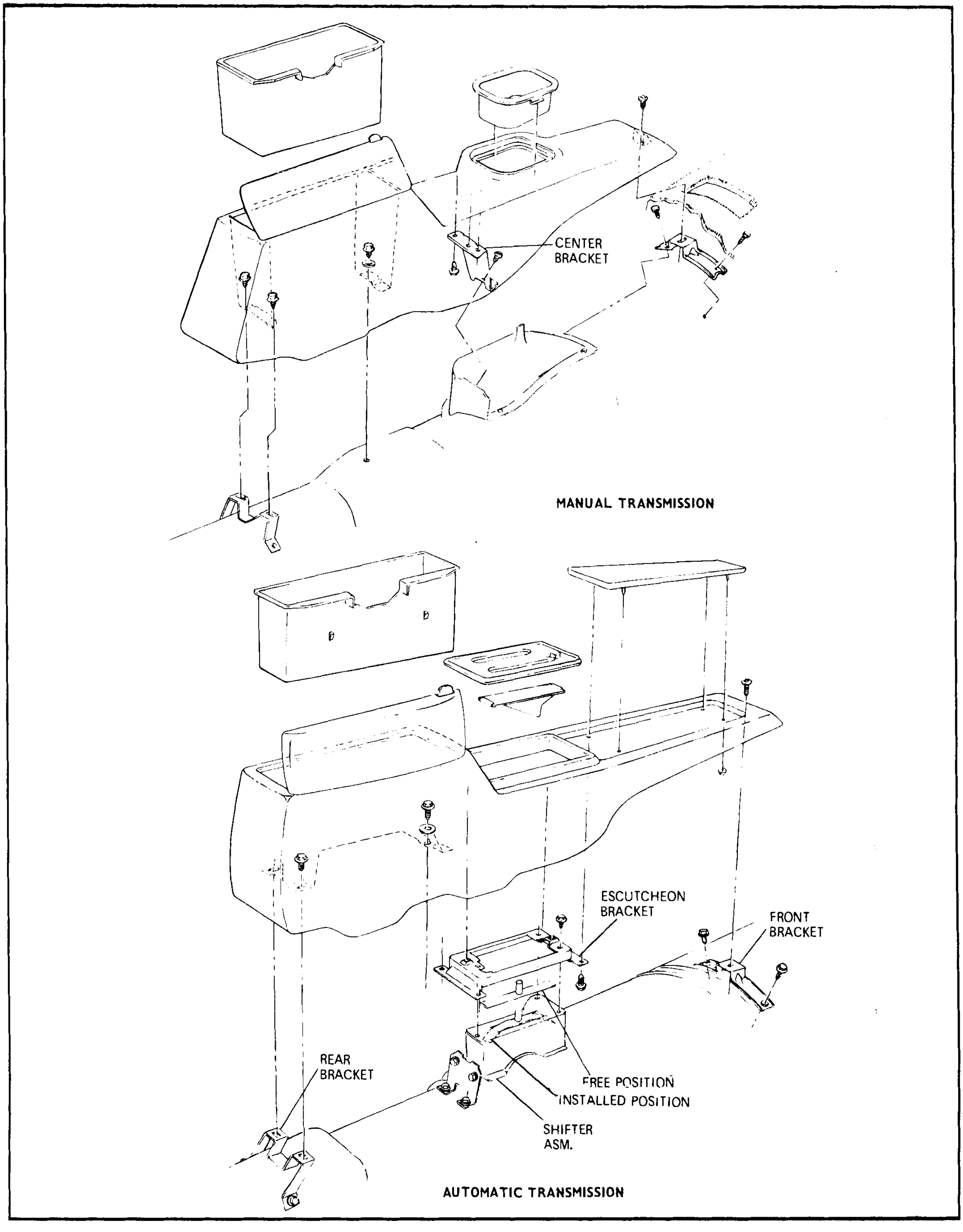


Fig. 15-84 A Series Console Installation

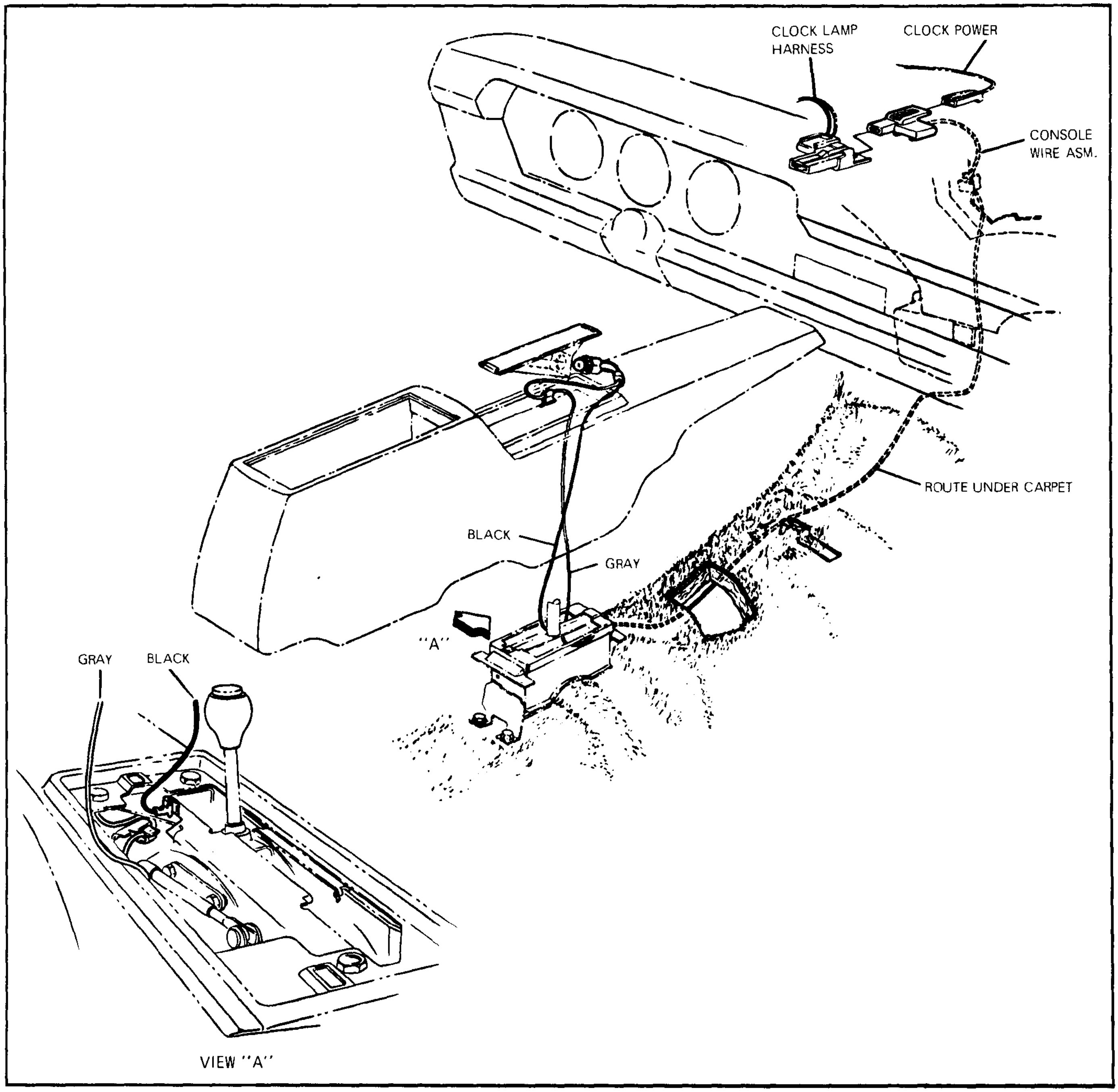


Fig. 15-85 A Series Console Wiring

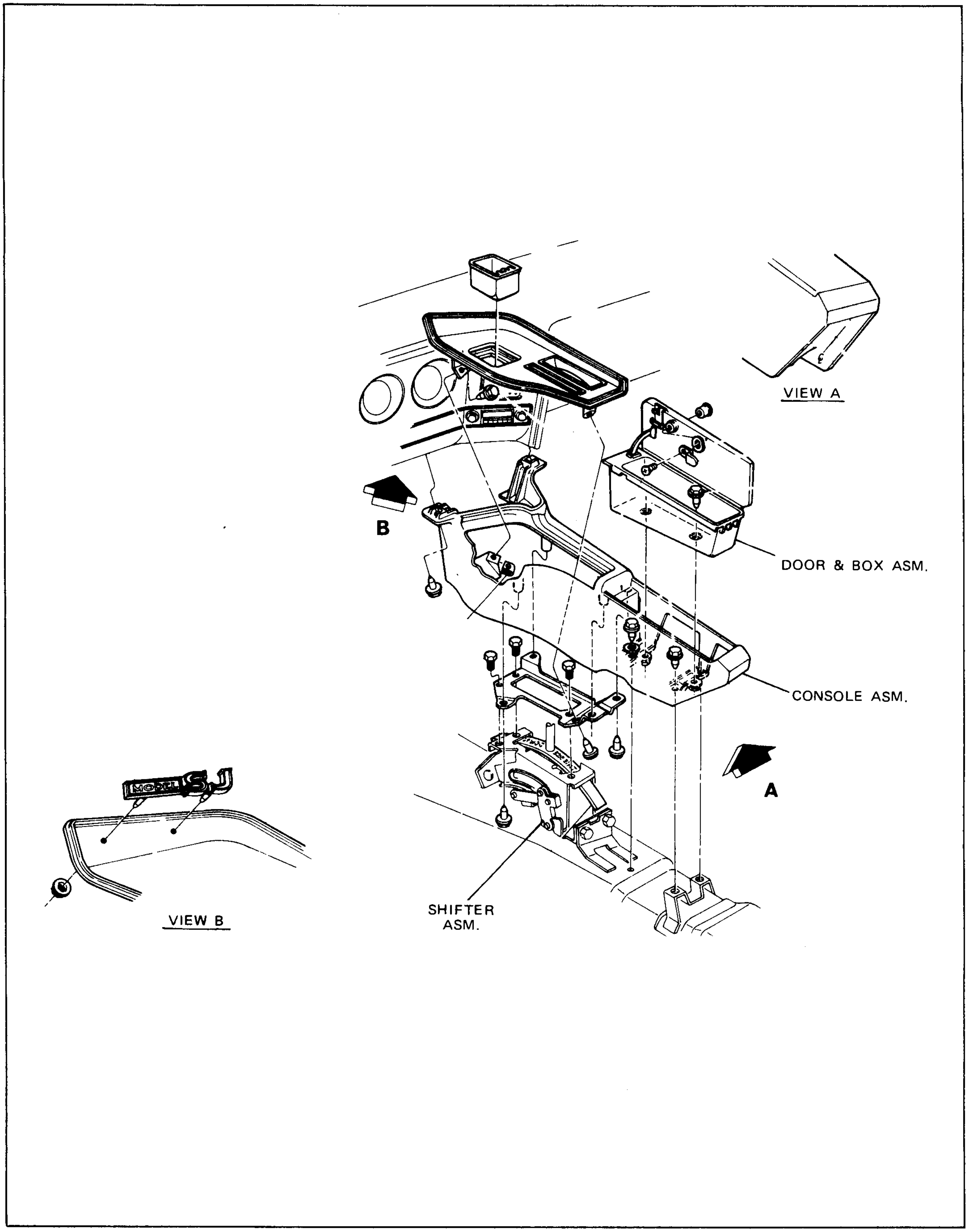


Fig. 15-86 G Series Console Installation

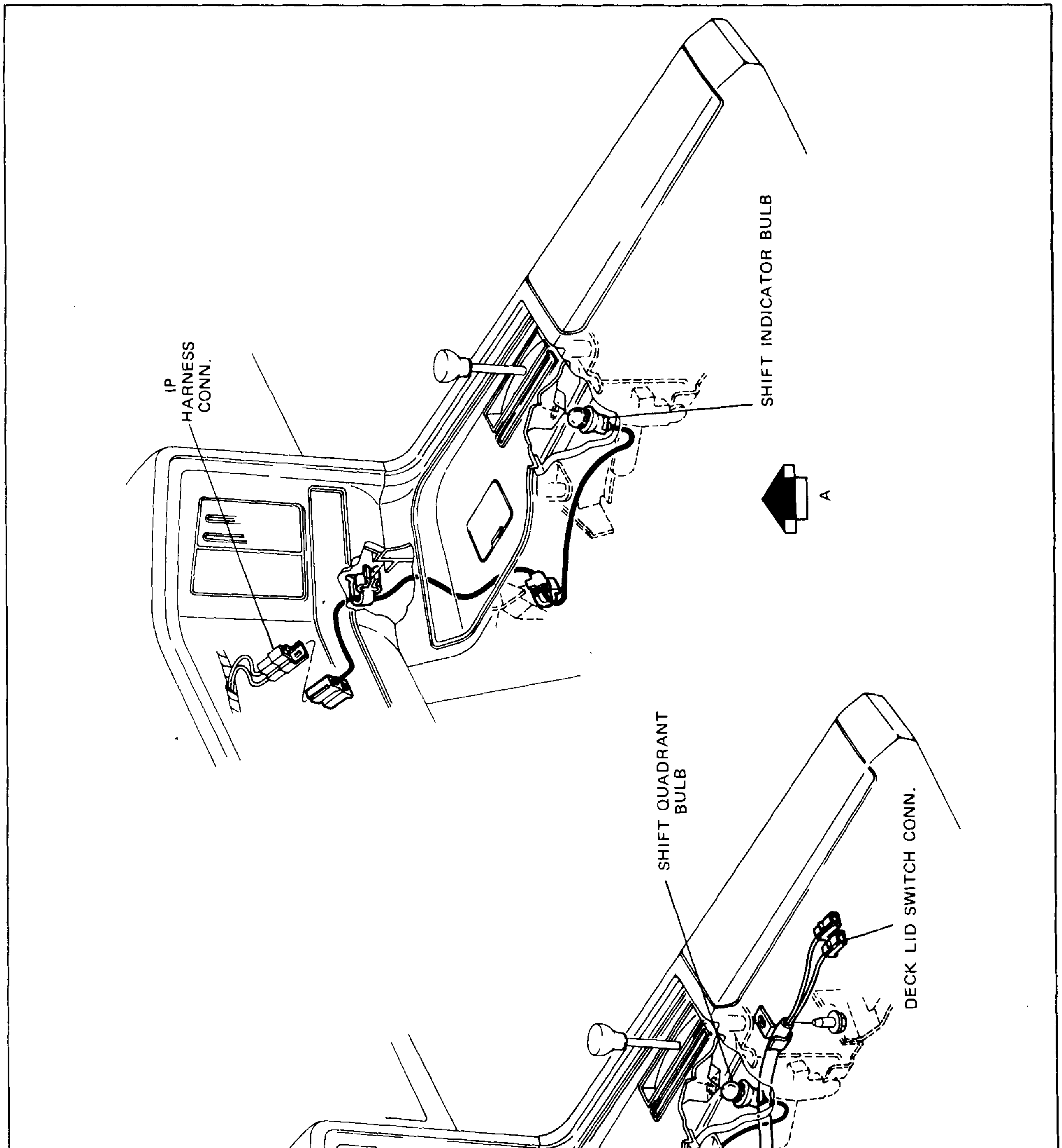


Fig. 15-87 G Series Console Wiring

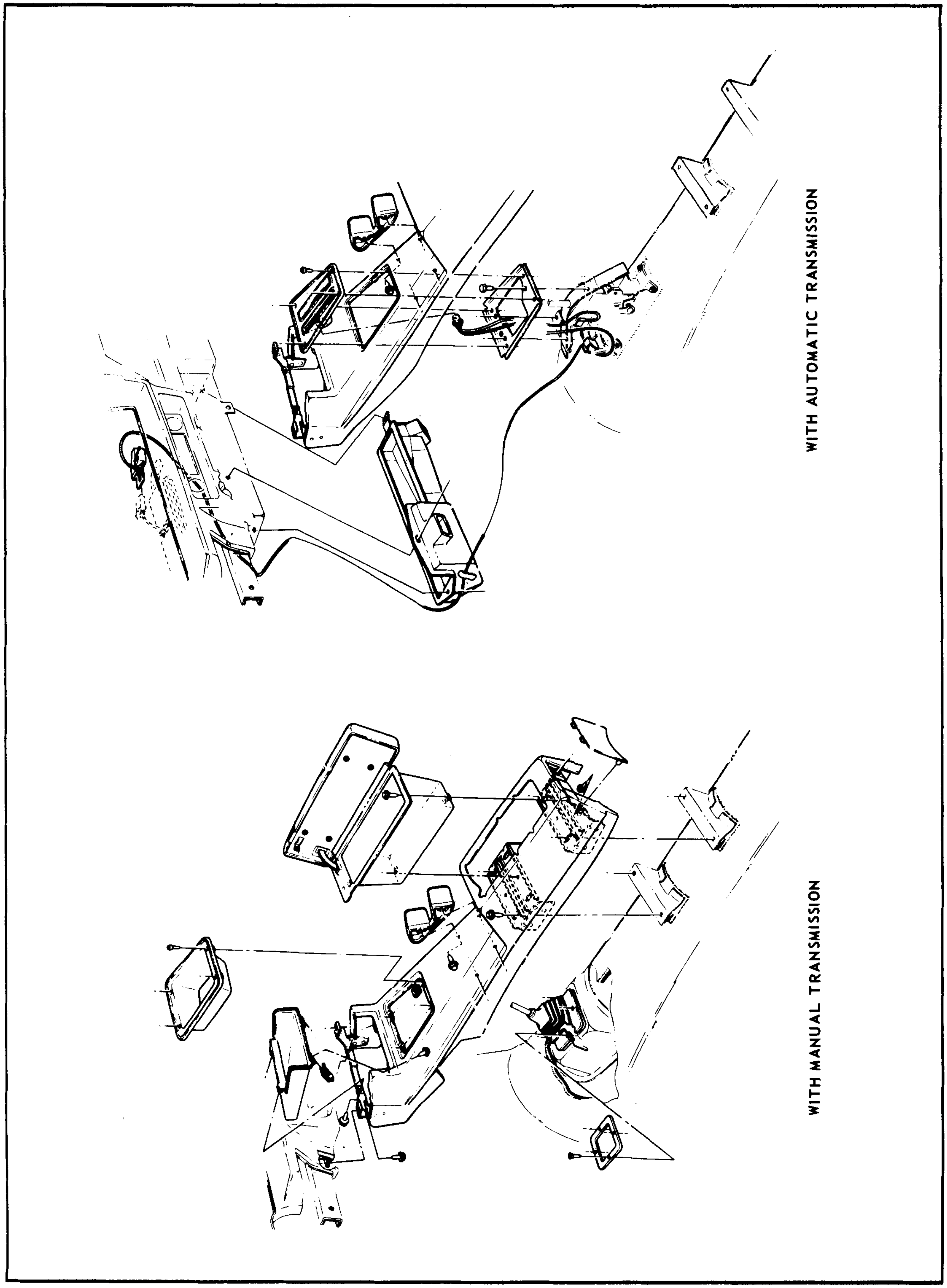


Fig. 15-88 F Series Front Console Installation

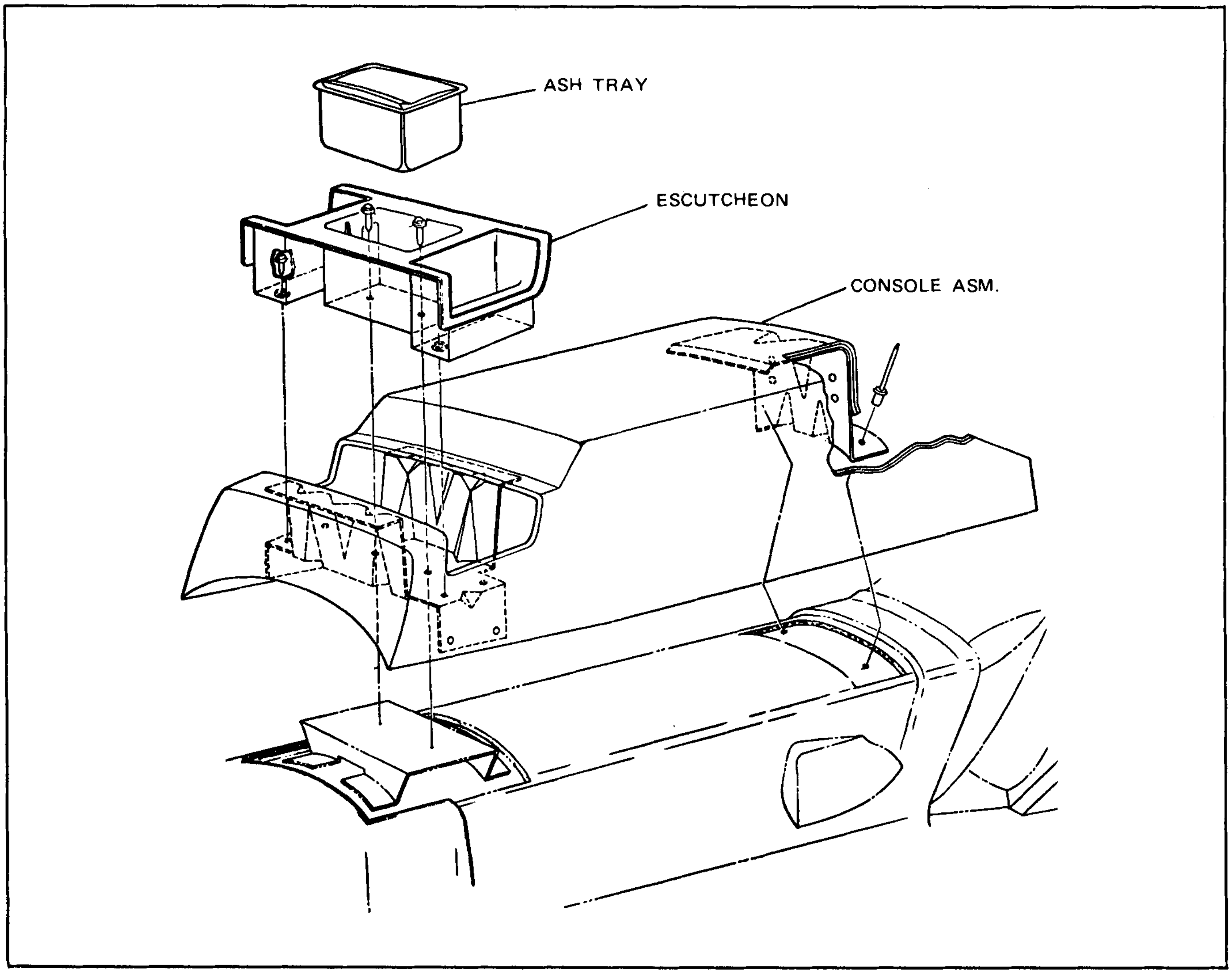


Fig. 15-89 F Series Rear Console Installation

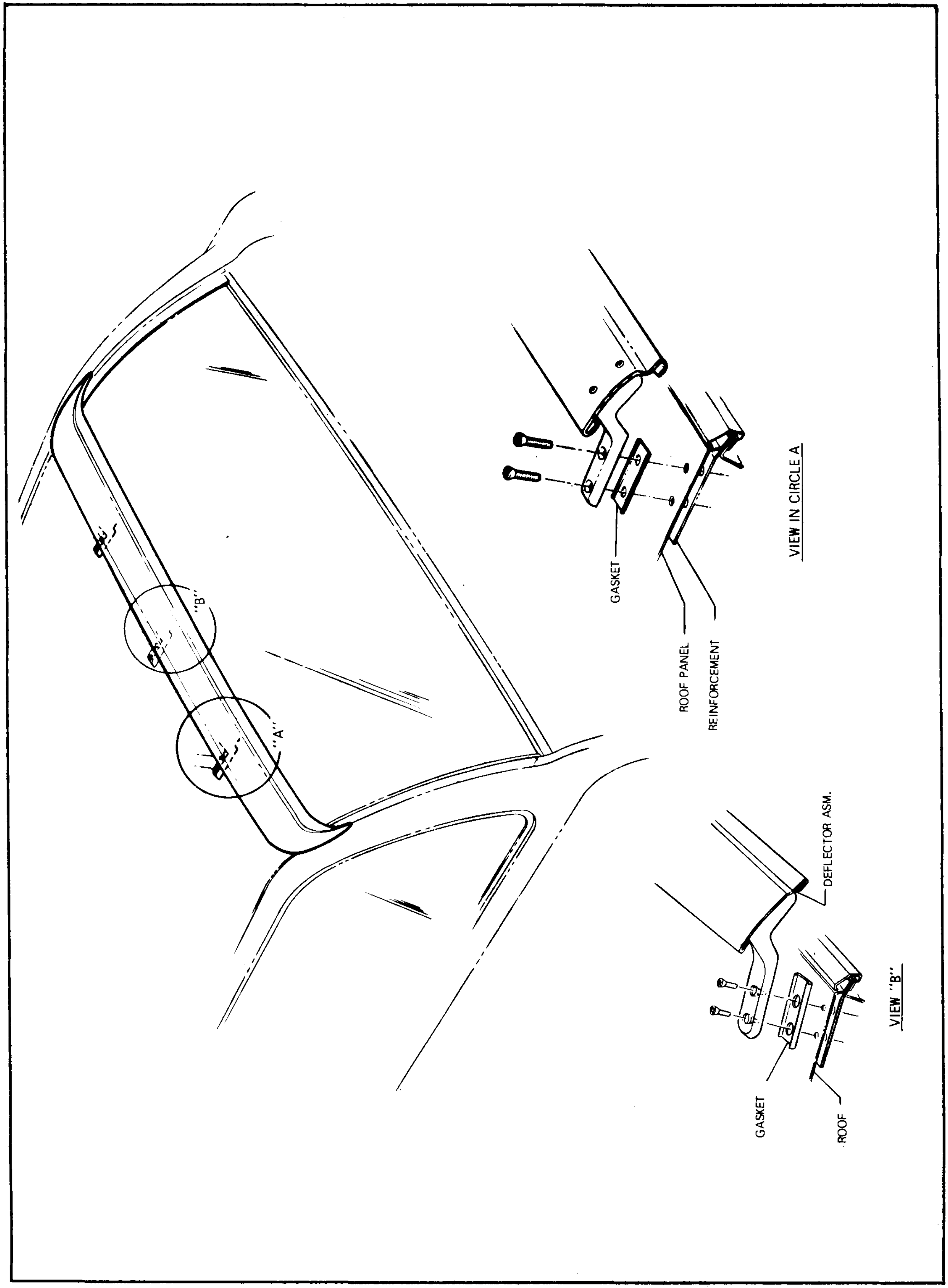


Fig. 15-90 A Series Station Wagon Air Deflector

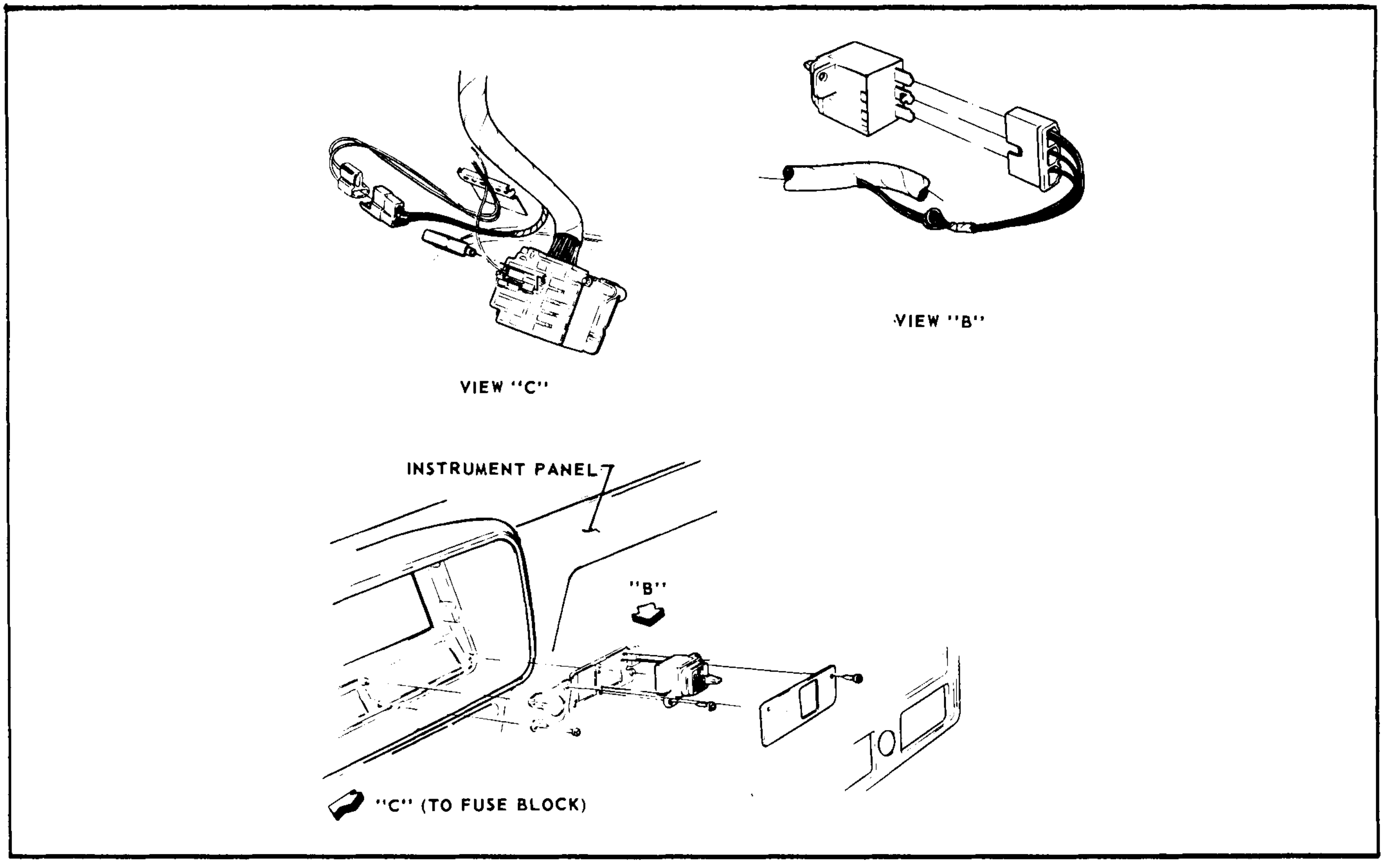


Fig. 15-91 F Series Electric Door Lock Switch Installation

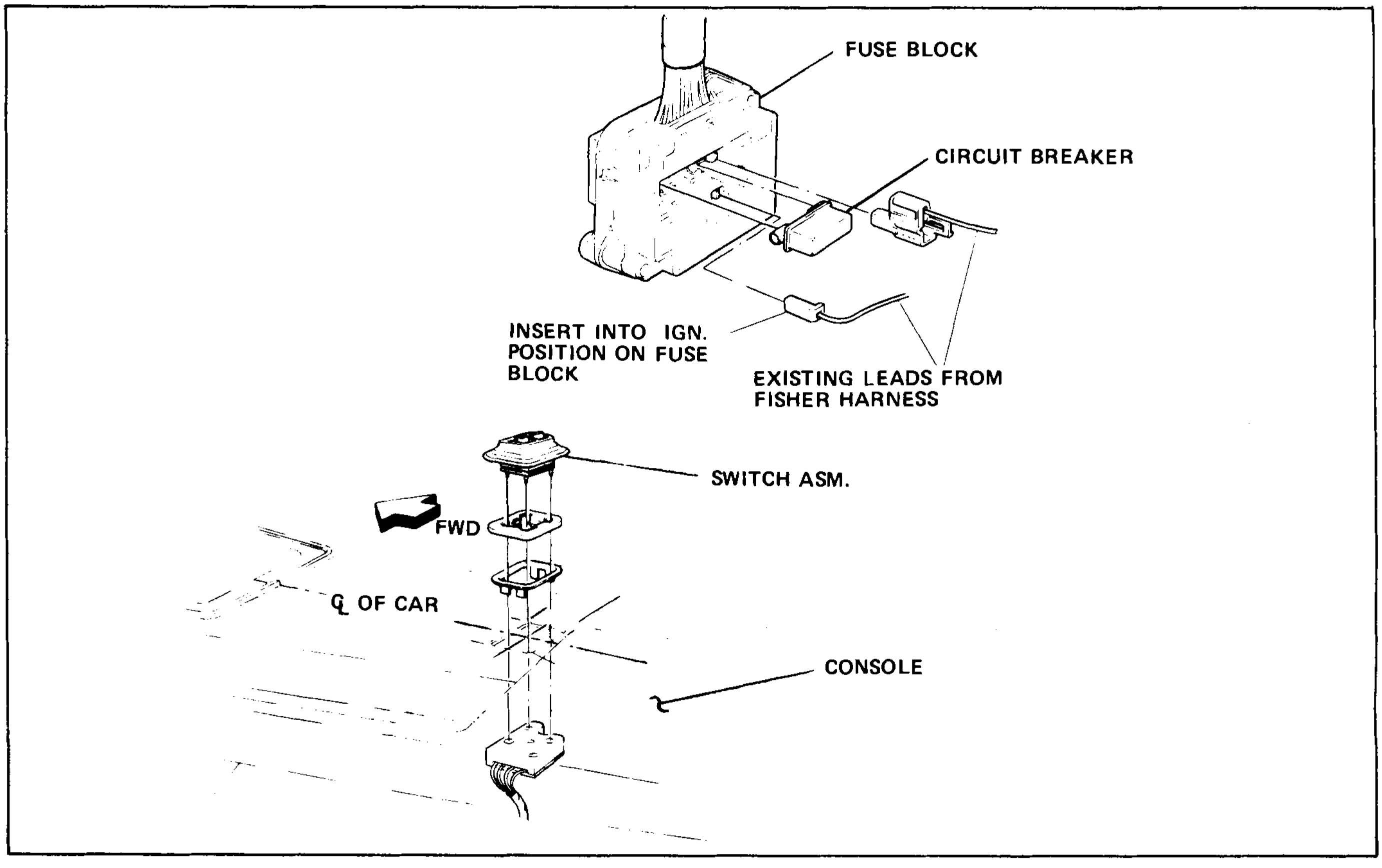


Fig. 15-92 F Series Power Window Switch Installation

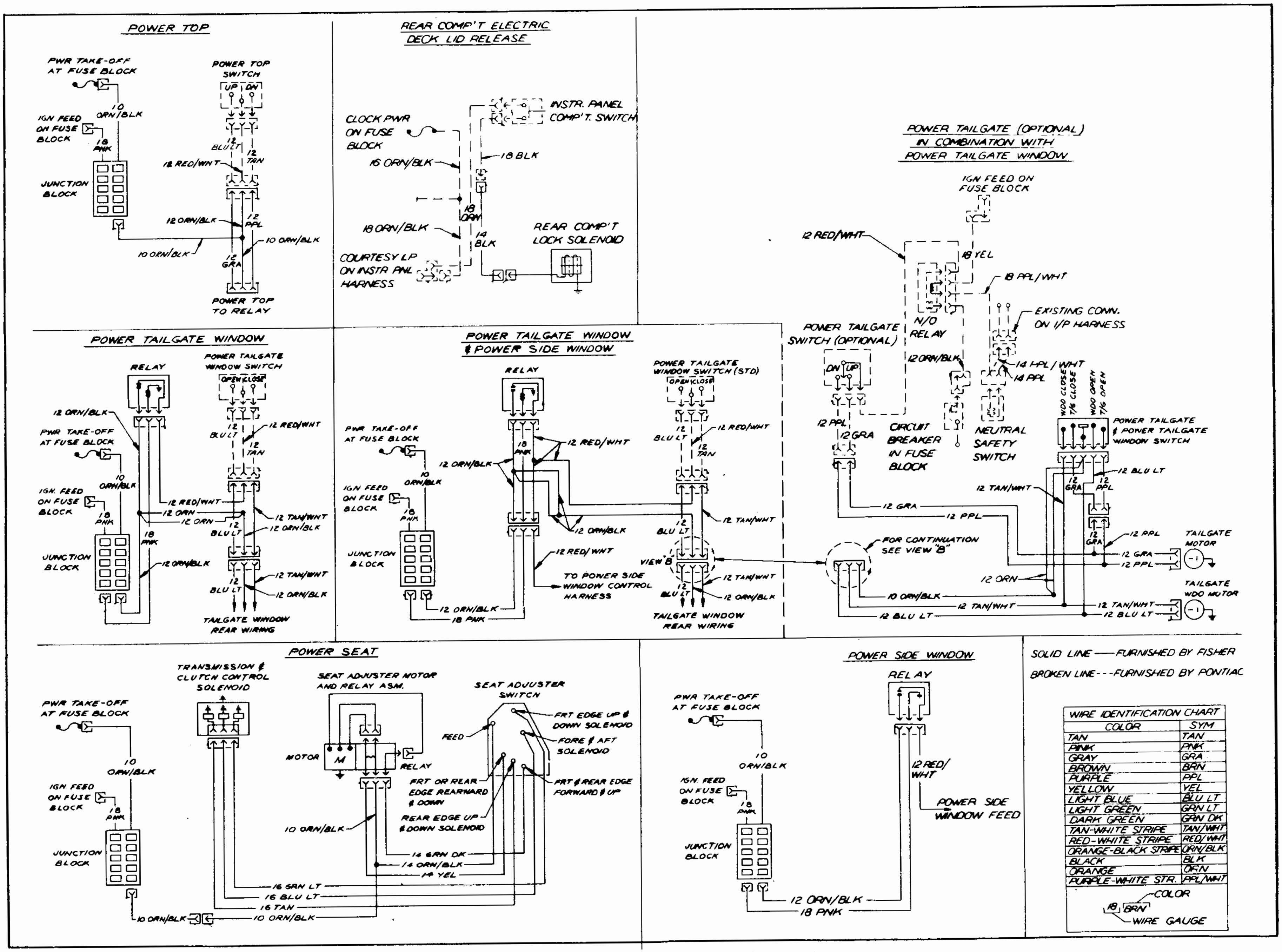


Fig. 15-93 B Series Power Accessories Schematics

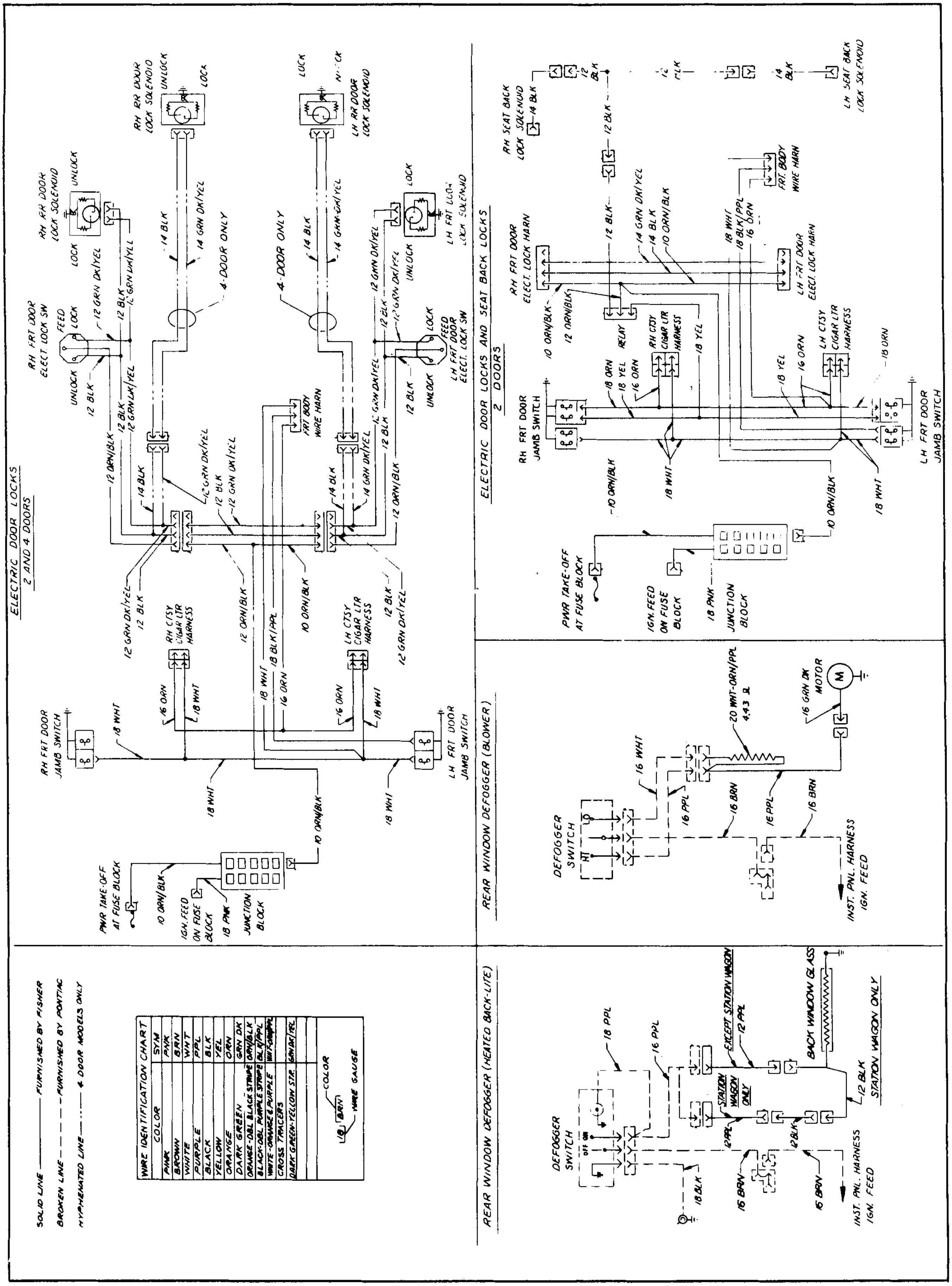


Fig. 15-94 B Series Power Accessories Schematics

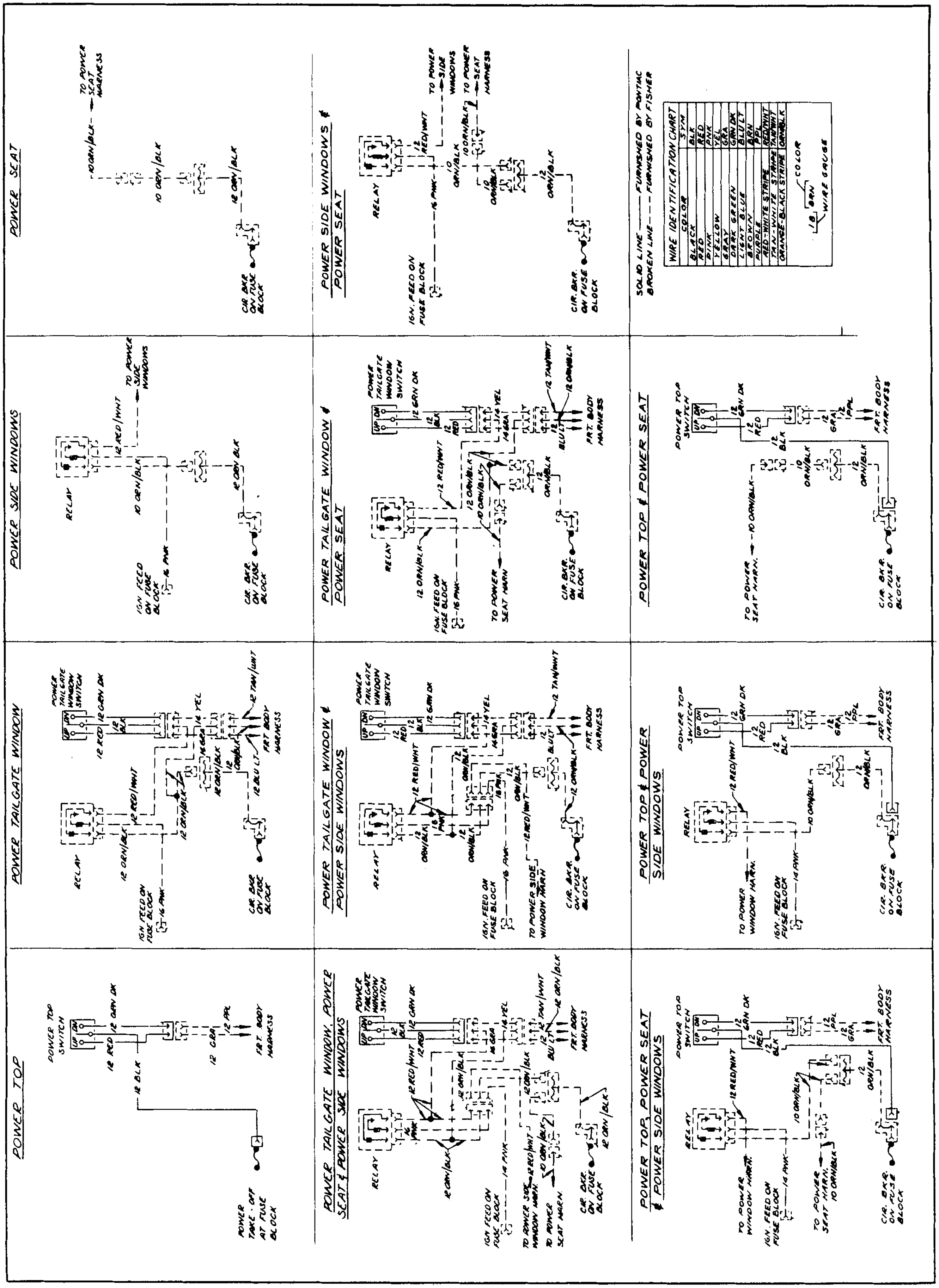


Fig. 15-95 A and G Series Power Accessories Schematics

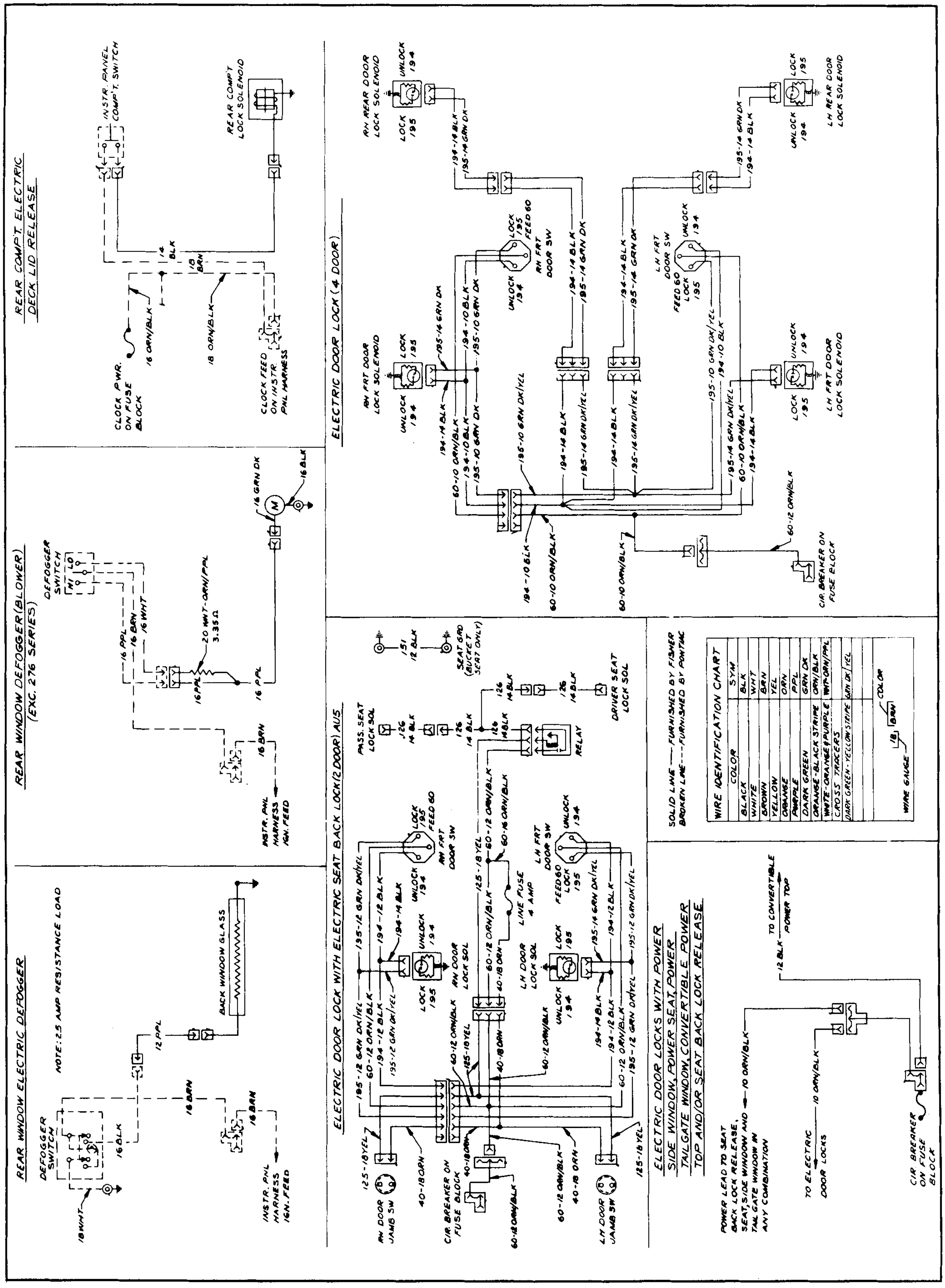


Fig. 15-96 A and G Series Power Accessories Schematics

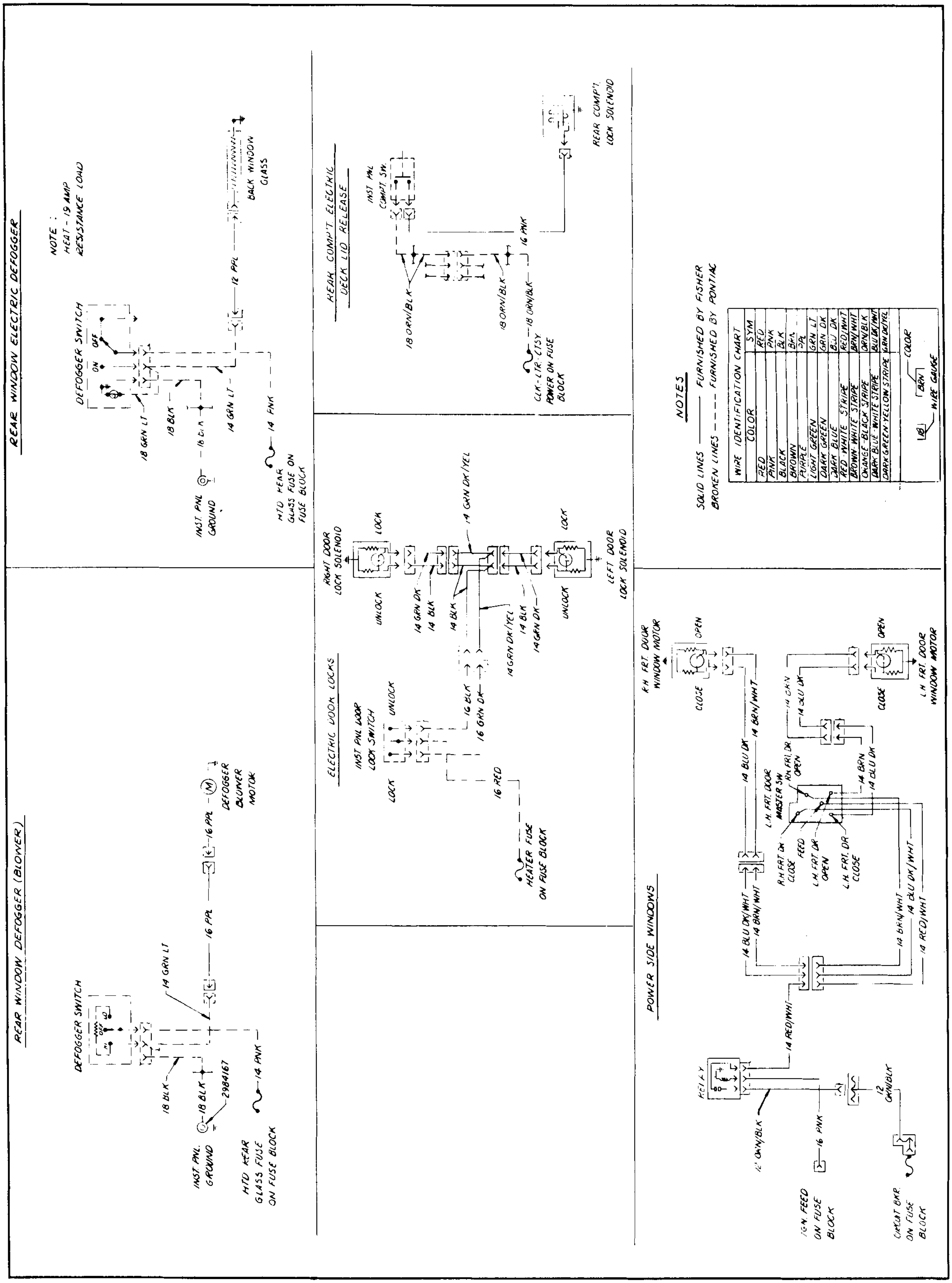


Fig. 15-97 F Series Power Accessories Schematics

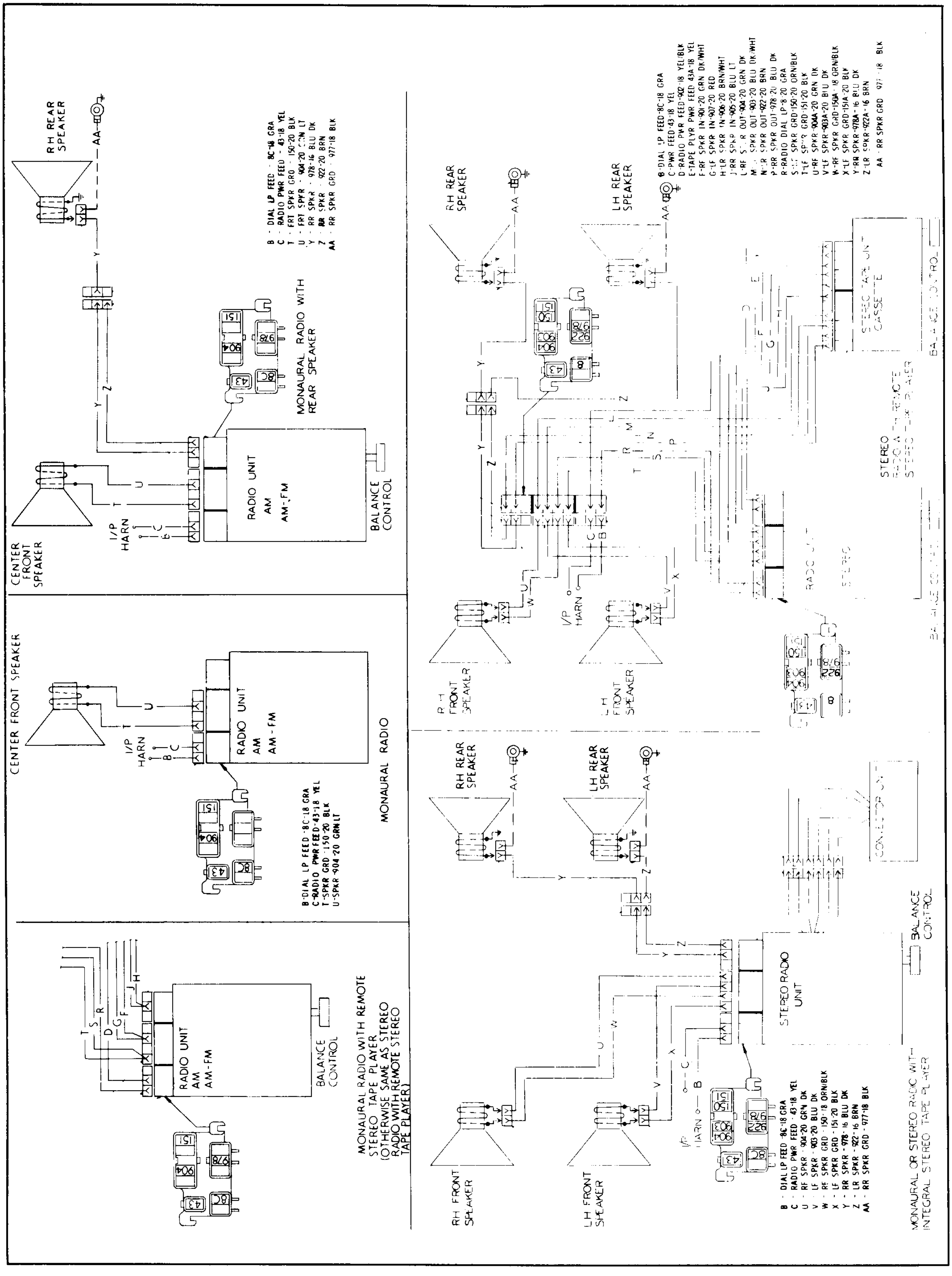


Fig. 15-98 B Series Electronic Accessories Schematics

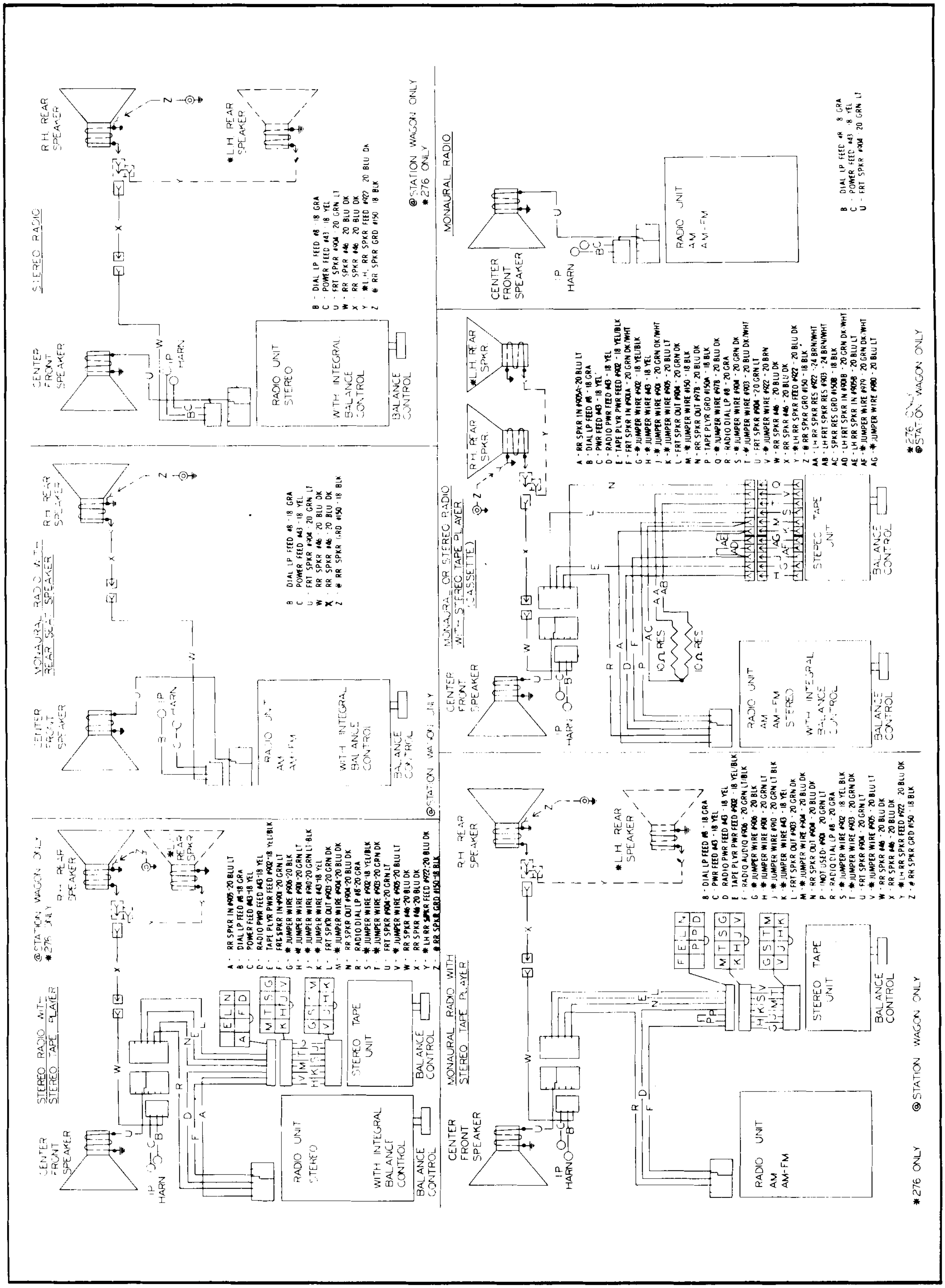


Fig. 15-99 A and G Series Electronic Accessories Schematics

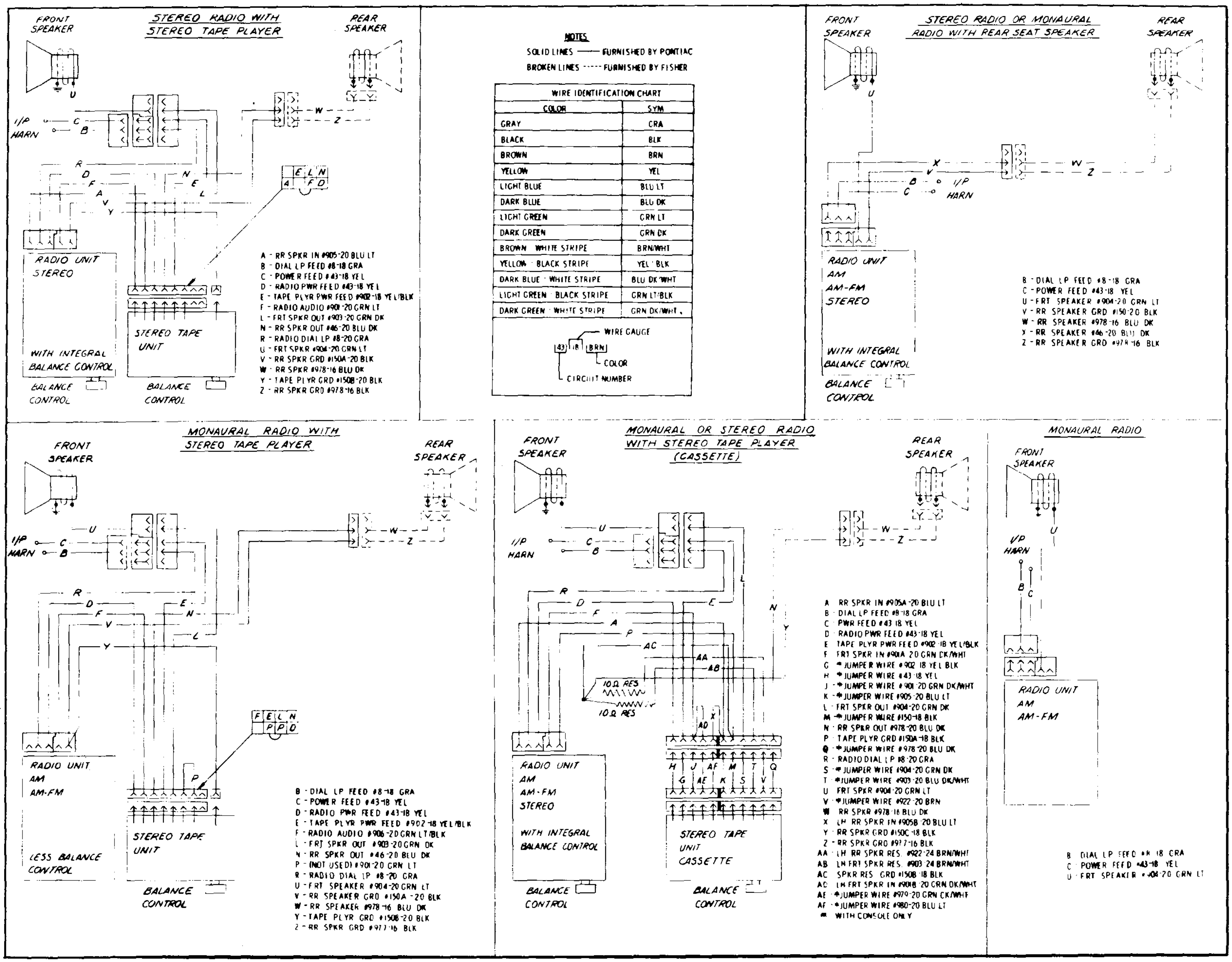


Fig. 15-100 F Series Electronics Accessories Schematics

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