1971 BUICK CHASSIS SERVICE MANUAL

This manual contains chassis service information for all 1971 Buick models. Refer to the Introduction for a description of the arrangement of this manual. This will enable you to locate desired information easily.

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.

BUICK
Authorized Service

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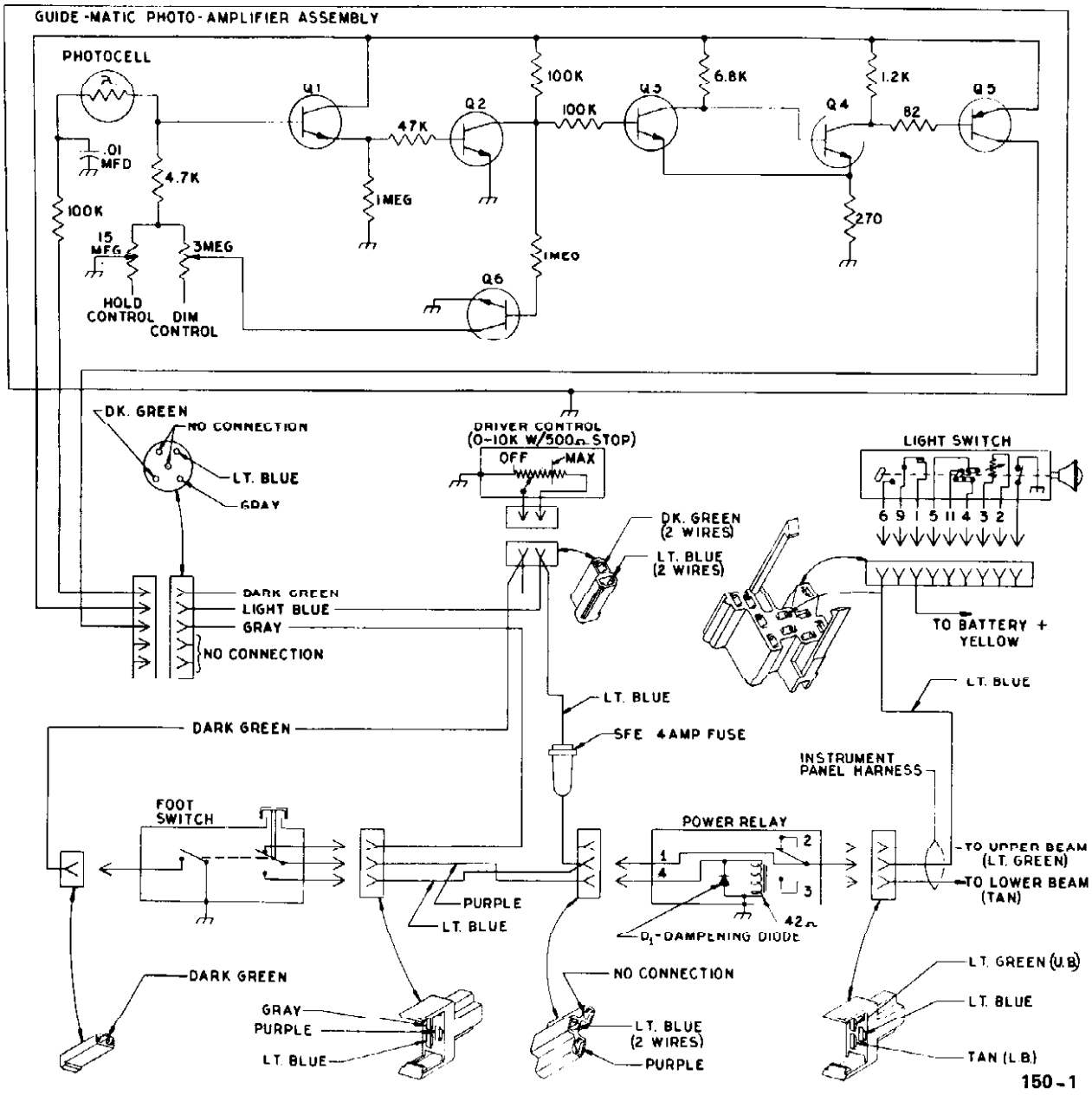


Figure 150-1 Guide Matic Schematic

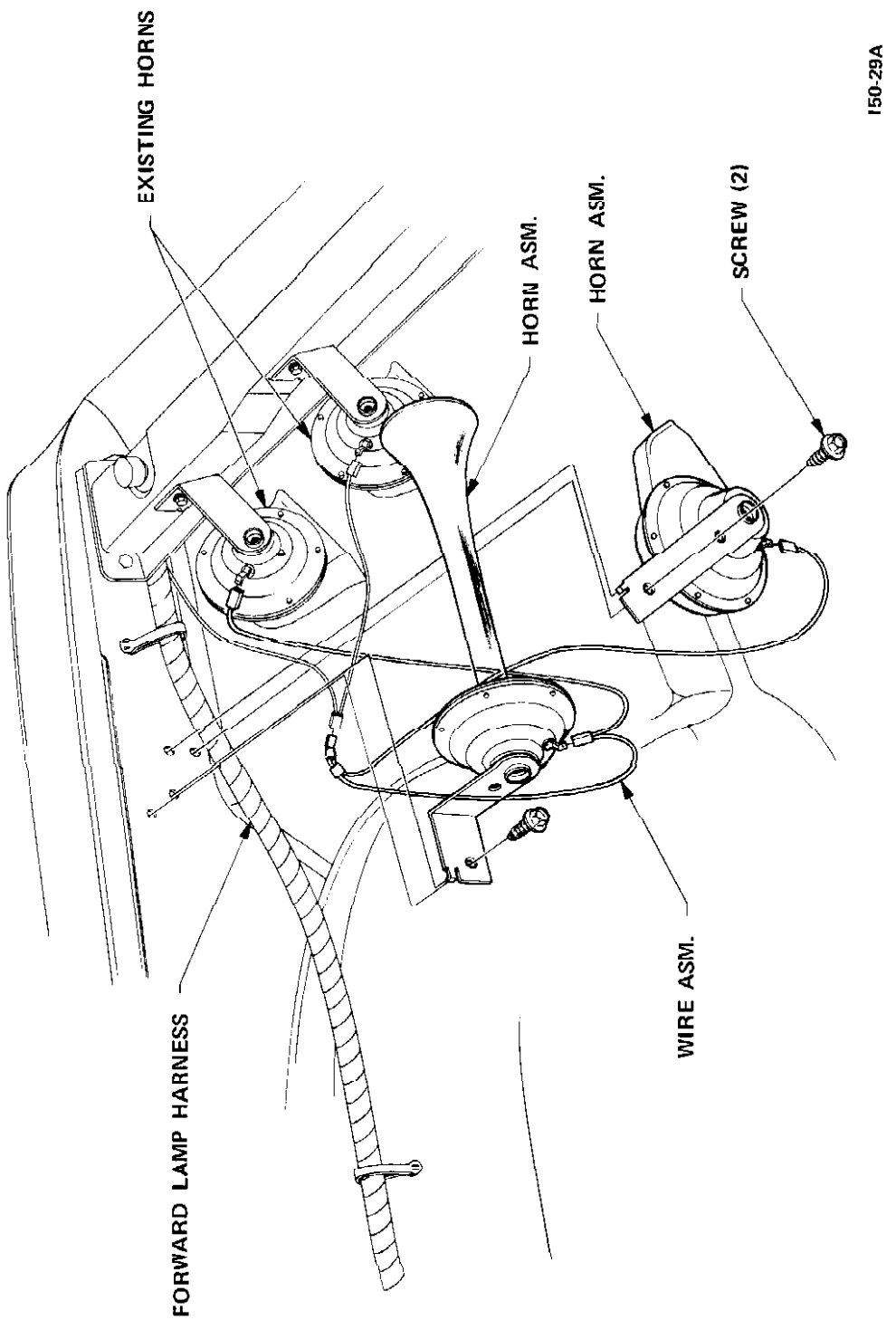


Figure 150-2 Four Note Horn - 45-46-48-49000 Series

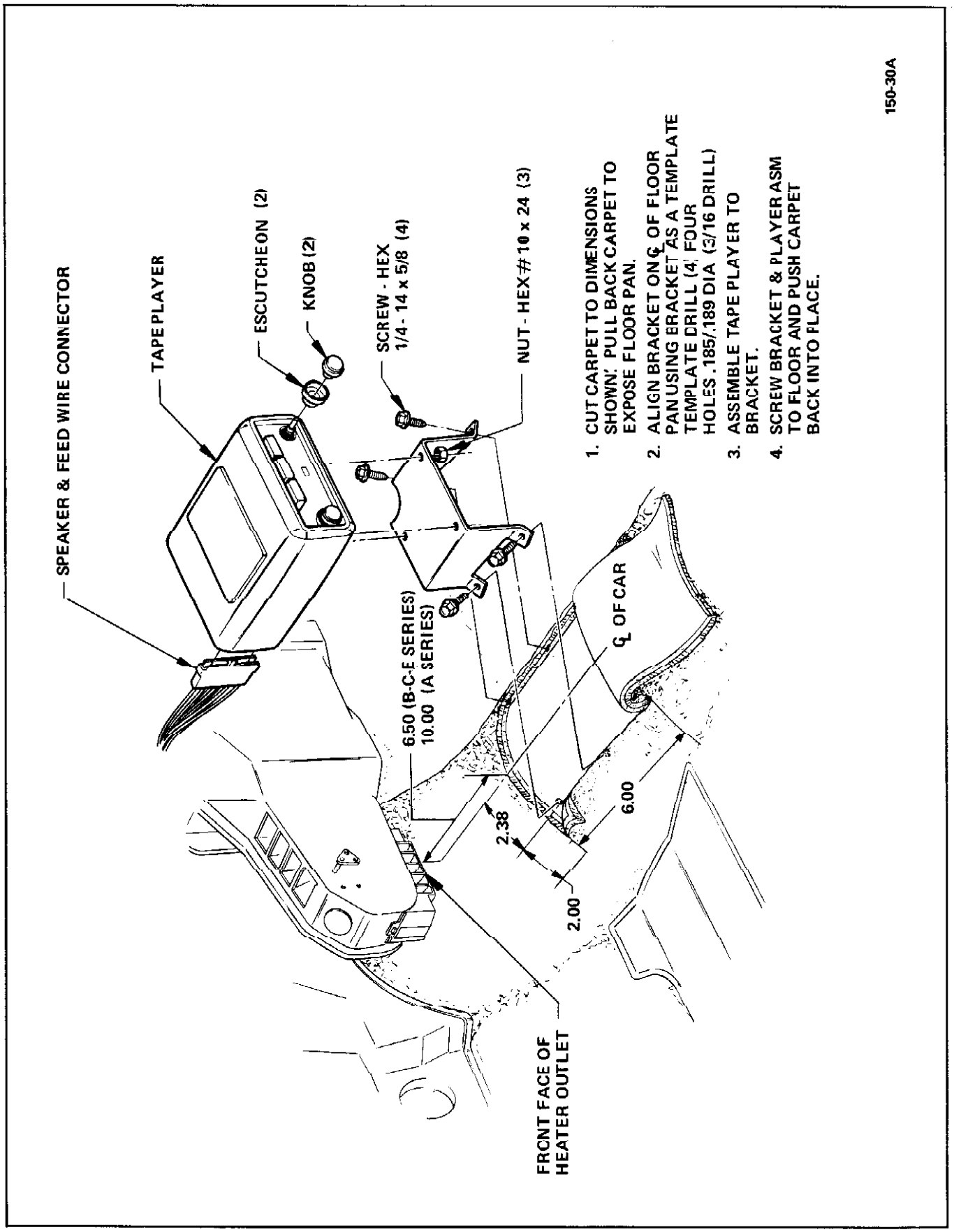
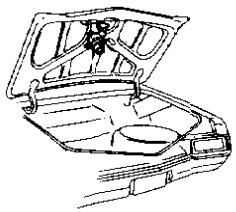


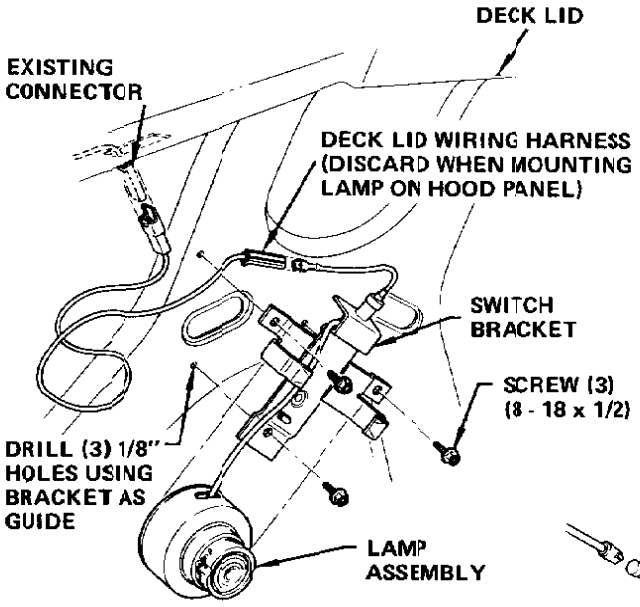
Figure 150-3 Cassette Tape Player Installation - All Series



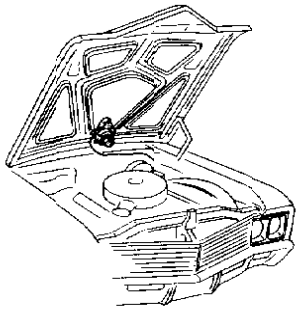
ALL SERIES THRU 1969
"A" BODY - 1970 - 1971

INSTALLATION INSTRUCTIONS (DECK LID)

INSTALL LAMP ASSEMBLY ON DECK LID IN AREA SHOWN ON ALL MODELS. DRILL 3 HOLES USING BRACKET AS GUIDE. SWITCH END OF BRACKET MUST BE POINTING TOWARD REAR OF CAR. USE WIRING HARNESS PROVIDED IN PACKAGE (HARNESS WITHOUT FUSE HOLDER). PLUG INTO EXISTING CONNECTOR AND INSERT EXCESS INTO HOLE IN REAR OF DECK LID.



TYPICAL INSTALLATION OF DECK LID LAMP
ALL SERIES - 1967 THRU 1970 EXCEPT "A" BODY - 1970 - 1971

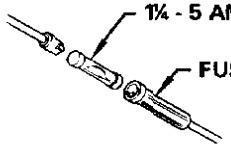


SKYLARK ONLY

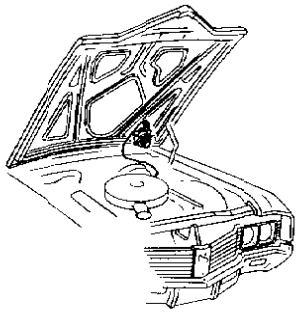
NOTES:

FOR PROPER OPERATION, LAMP SHOULD TURN OFF WHEN DECK LID OR HOOD PANEL IS NOT LESS THAN 12 INCHES FROM THE CLOSED POSITION WHEN CAR IS ON LEVEL GROUND.

IF NECESSARY BEND SWITCH BRACKET (USING CAUTION) DOWNWARD TO RAISE LAMP TURN-OFF POINT AND UPWARD TO LOWER TURN-OFF POINT.



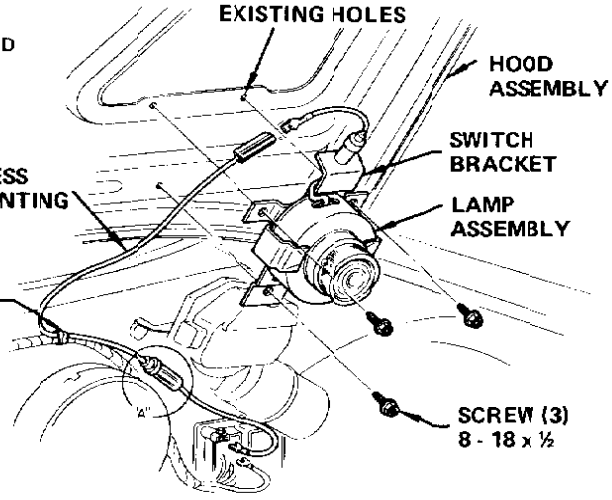
VIEW A



ALL LE SABRE, CENTURION, ELECTRA, RIVIERA

INSTALLATION INSTRUCTIONS (HOOD PANEL)

INSTALL LAMP ASSEMBLY ON HOOD PANELS IN AREA SHOWN, EXCEPT SPECIALS WHICH WILL BE LOCATED ON THE CENTER LINE OF THE HOOD. USE EXISTING HOLES. SWITCH END OF BRACKET MUST BE POINTING TOWARD FRONT OF CAR. USE WIRING HARNESS PROVIDED IN PACKAGE (HARNESS WITH FUSE HOLDER). ROUTE THROUGH WIRING CLIP AND PLUG INTO CONNECTION ON FUSE BLOCK BY LOOSENING SCREW, INSERTING TERMINAL AND RETIGHTENING SCREW. INSERT INTO FUSE HOLDER.



TYPICAL INSTALLATION OF HOOD PANEL LAMP
ALL LE SABRE, CENTURION, ELECTRA, RIVIERA SKYLARK TYPICAL FOR ALL MODELS PRIOR TO 1968 (FOR 1968 - 1971

150-57

Figure 150-4 Utility Light Installation - All Series

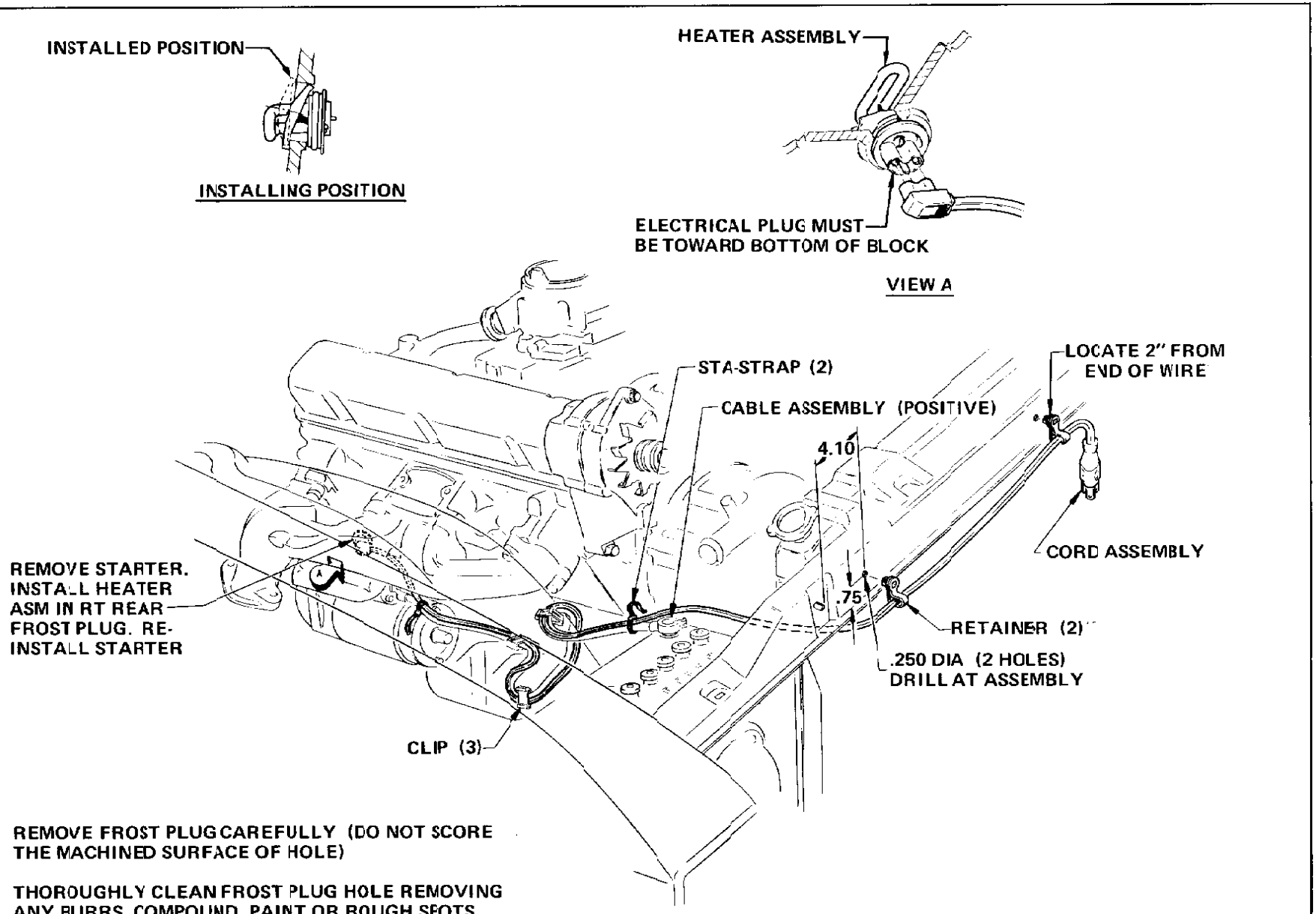


Figure 150-5 Engine Block Heater - 43-44000 Series - 350 Engine

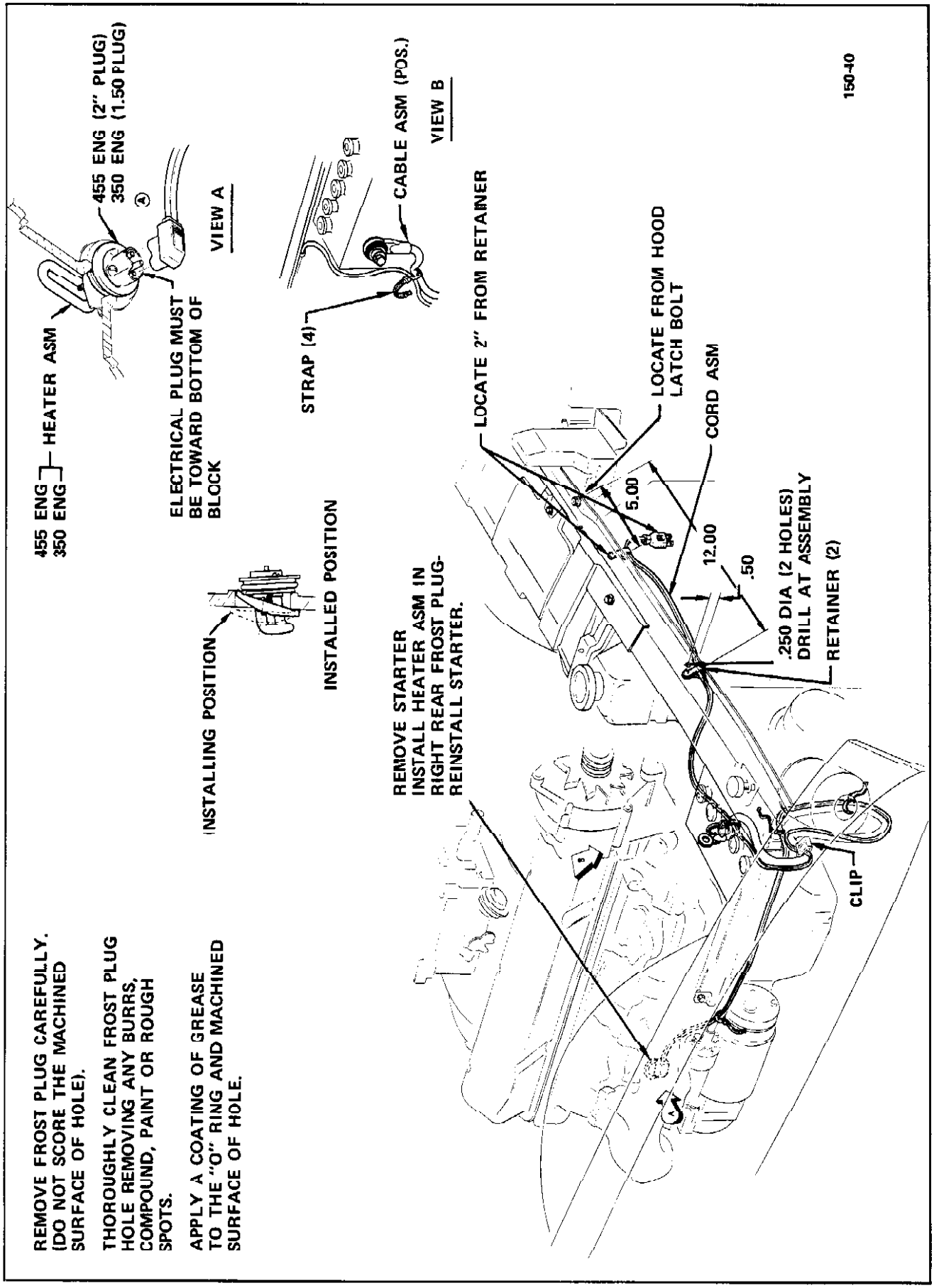


Figure 150-6 Engine Block Heater - 45000 Series - 350 and 455 Engines

ASSEMBLY INSTRUCTIONS

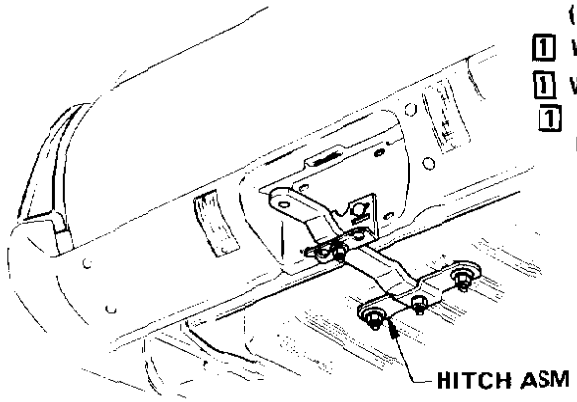
DO NOT TORQUE UNTIL ASSEMBLY IS COMPLETE

STEP 1: SLIDE BUMPER PLATE (B) ONTO DRAW BAR (A) & SECURE WITH FASTENERS MARKED [1]

STEP 2: HOLD HITCH IN POSITION ON CENTERLINE OF CAR WITH DRAW BAR (A) RESTING ON LUGGAGE COMPARTMENT FLOOR & BUMPER PLATE (B) FLUSH AGAINST BUMPER. LOCATE & DRILL TWO .531 INCH HOLES IN BUMPER USING BUMPER PLATE (B) AS A GUIDE. SECURE TO BUMPER WITH FASTENERS MARKED [2]

STEP 3: TURN BACK LUGGAGE COMPARTMENT FLOOR COVERING. ALIGN DRAW BAR AT CENTERLINE OF FLOOR PAN & DRILL .531 INCH HOLE USING DRAW BAR AS A GUIDE. PLACE FLOOR STRAP UPPER (C) & FLOOR STRAP LOWER (D) IN POSITION AS SHOWN. SECURE WITH FASTENERS MARKED [3]

STEP 4: DRILL TWO .531 INCH HOLES USING FLOOR STRAPS AS A GUIDE & SECURE WITH FASTENERS MARKED [4]. REPLACE FLOOR COVERING.



ASSEMBLED VIEW

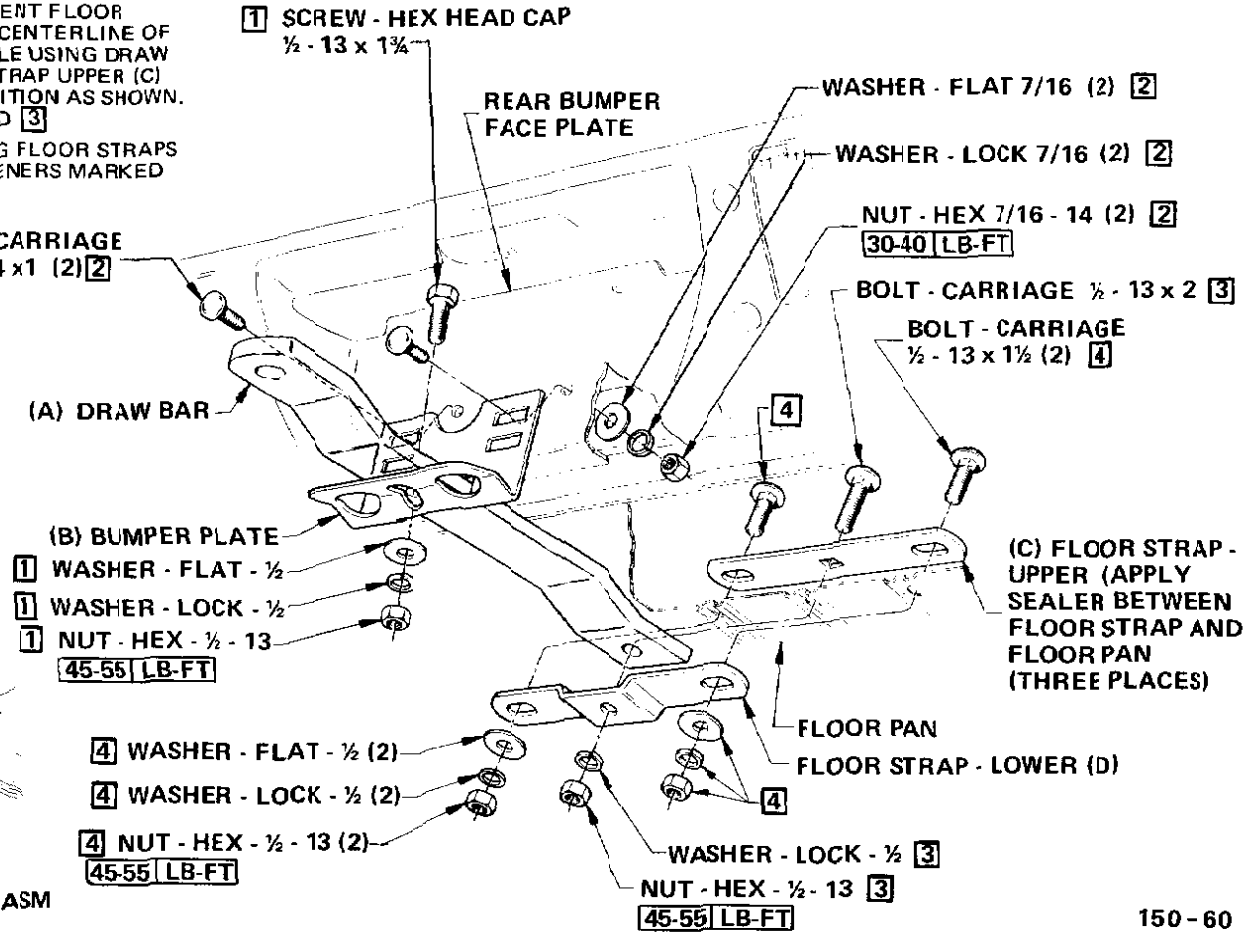


Figure 150-7 Trailer Hitch Assembly - Sportwagon

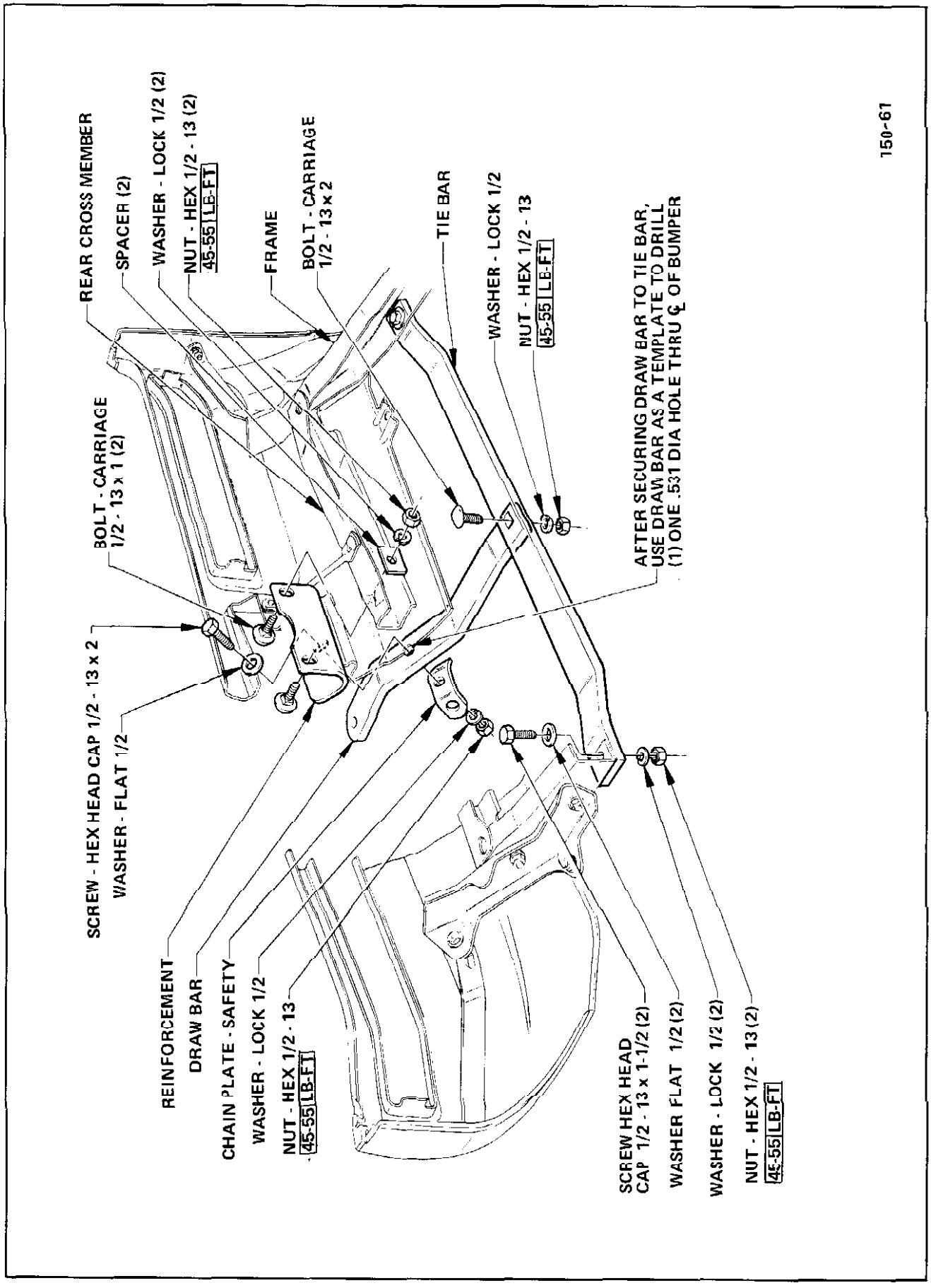


Figure 150-8 Trailer Hitch Assembly - Skylark Less Sportwagon

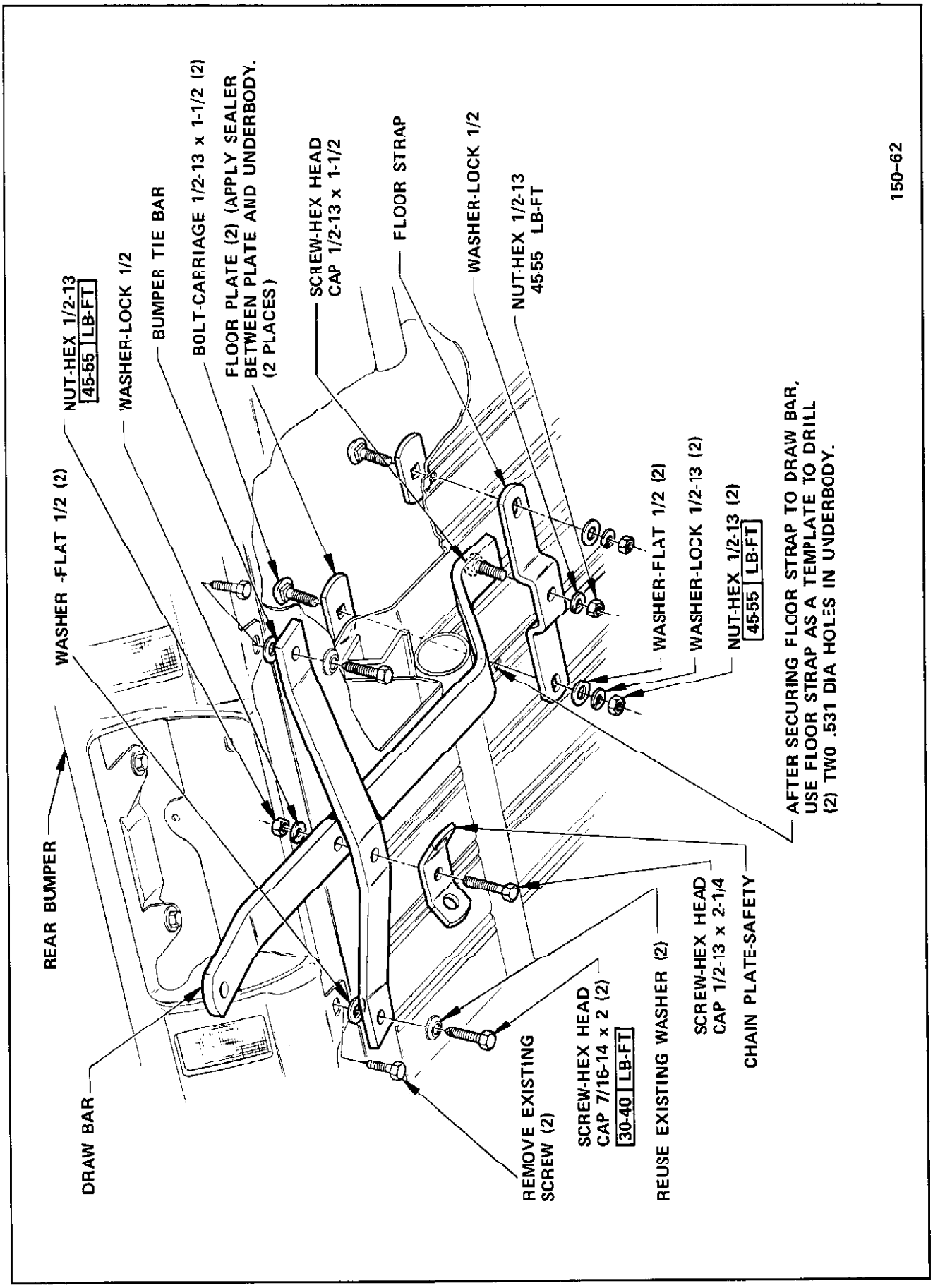


Figure 150-9 Trailer Hitch Assembly - Estate Wagon

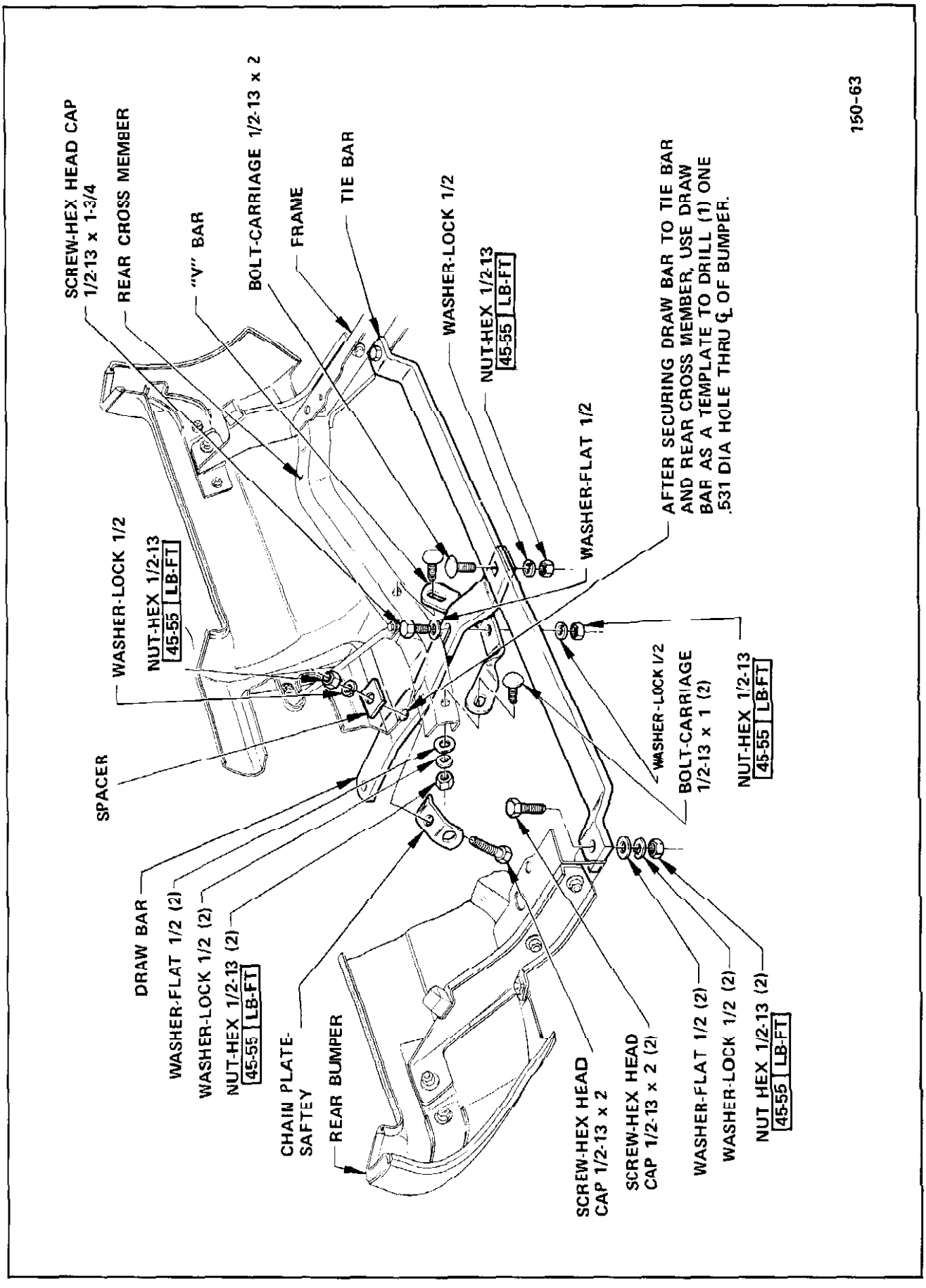


Figure 150-10 Trailer Hitch Assembly - LeSabre and Centurion

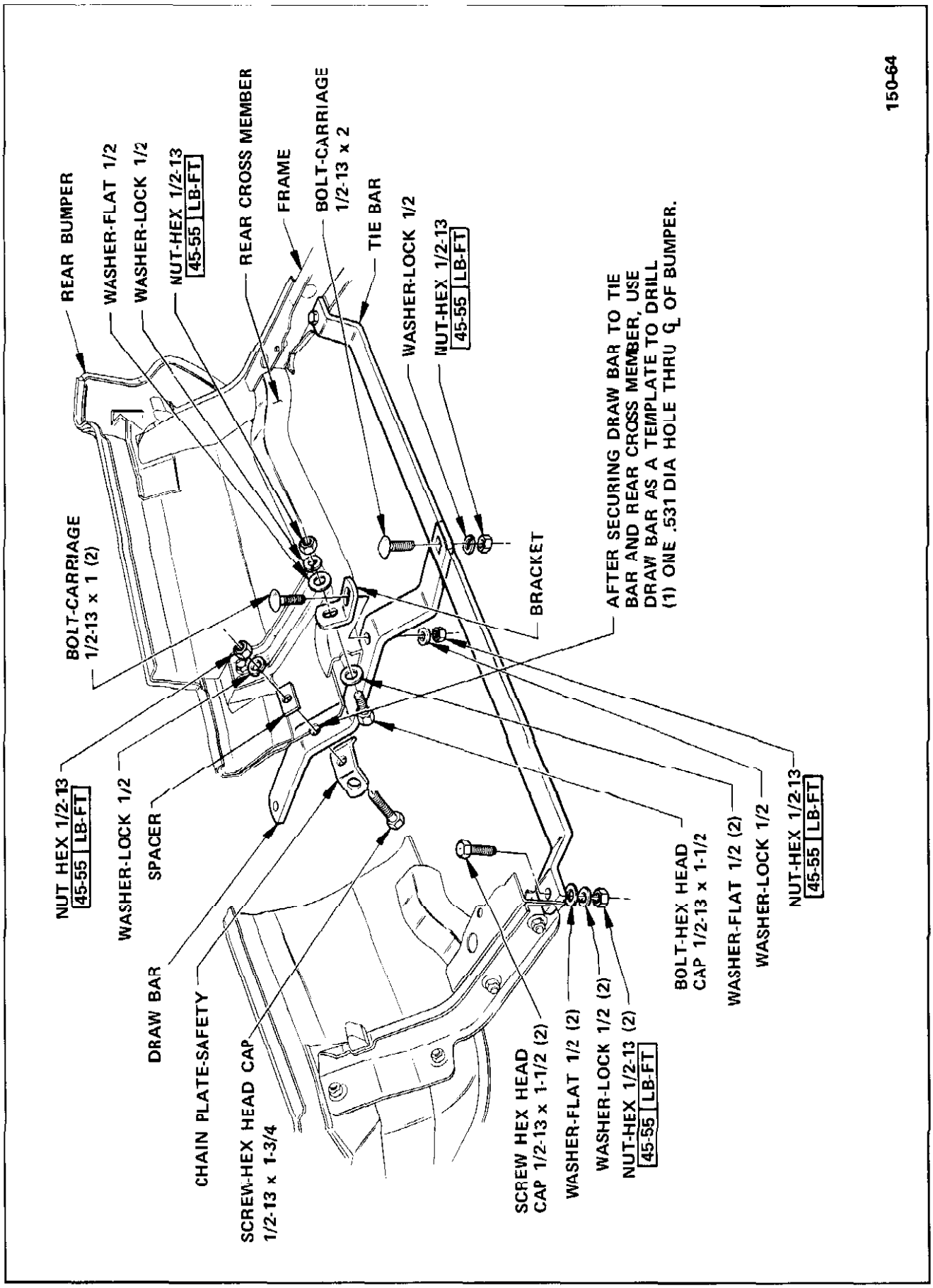


Figure 150-11 Trailer Hitch Assembly - Electra

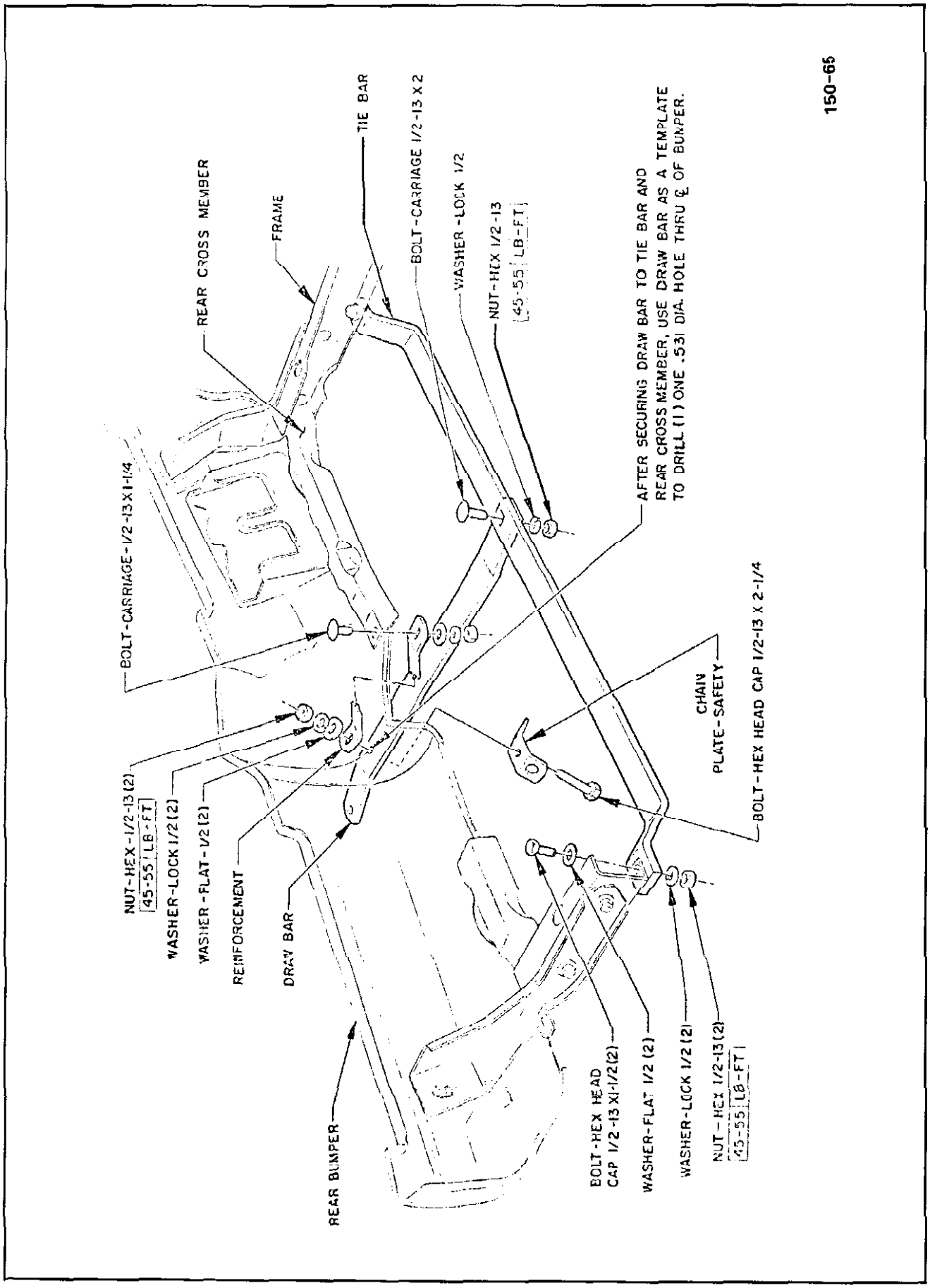


Figure 150-12 Trailer Hitch Assembly - Riviera

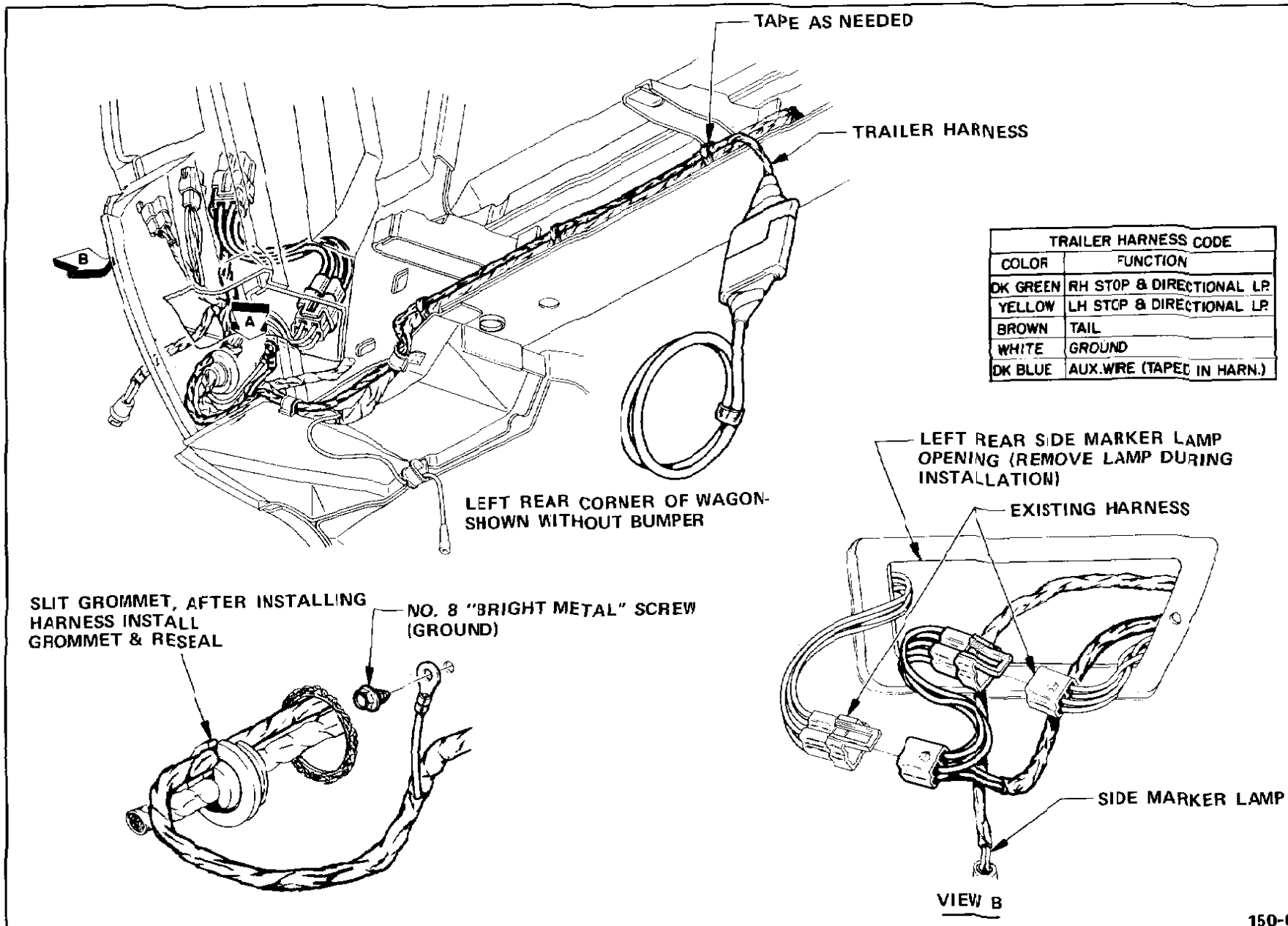
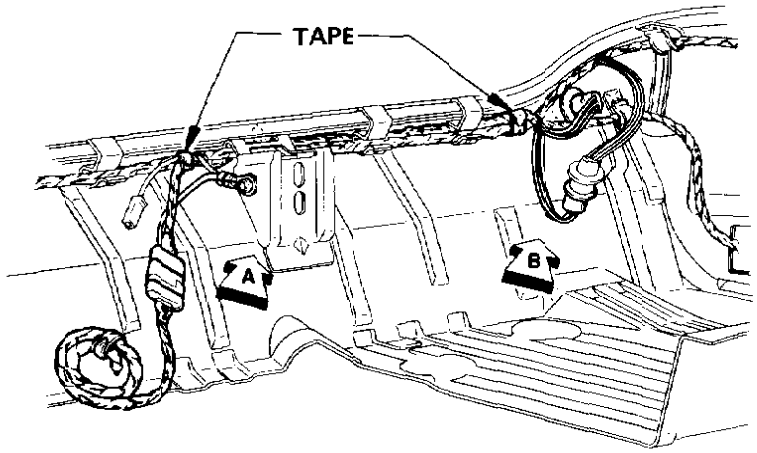
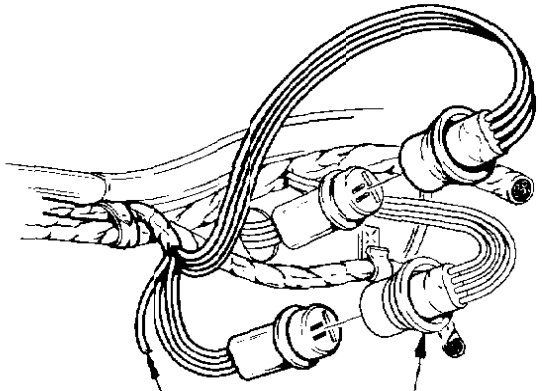


Figure 150-13 Trailer Harness Assembly - Sportwagon



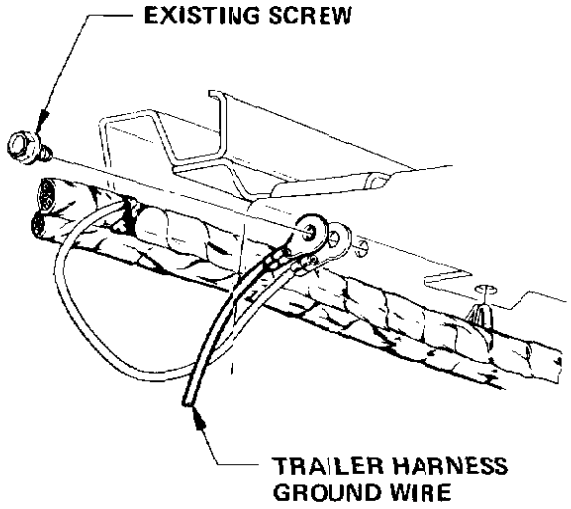
LEFT SIDE OF TRUNK

TRAILER HARNESS CODE	
COLOR	FUNCTION
DK GREEN	RH STOP & DIRECTIONAL LAMP
YELLOW	LH STOP & DIRECTIONAL LAMP
BROWN	TAIL
WHITE	GROUND
DK BLUE	AUX. WIRE (TAPED IN HARNESS)



AUXILIARY WIRE

VIEW B



VIEW A

CAREFULLY REMOVE EXISTING HARNESS CONNECTOR FROM BODY. DISCONNECT BUMPER HARNESS FROM BODY HARNESS. CONNECT TRAILER HARNESS AS SHOWN & REINSTALL CONNECTOR INTO BODY.

150-67

Figure 150-14 Trailer Harness Assembly - Skylark Less Sportwagon

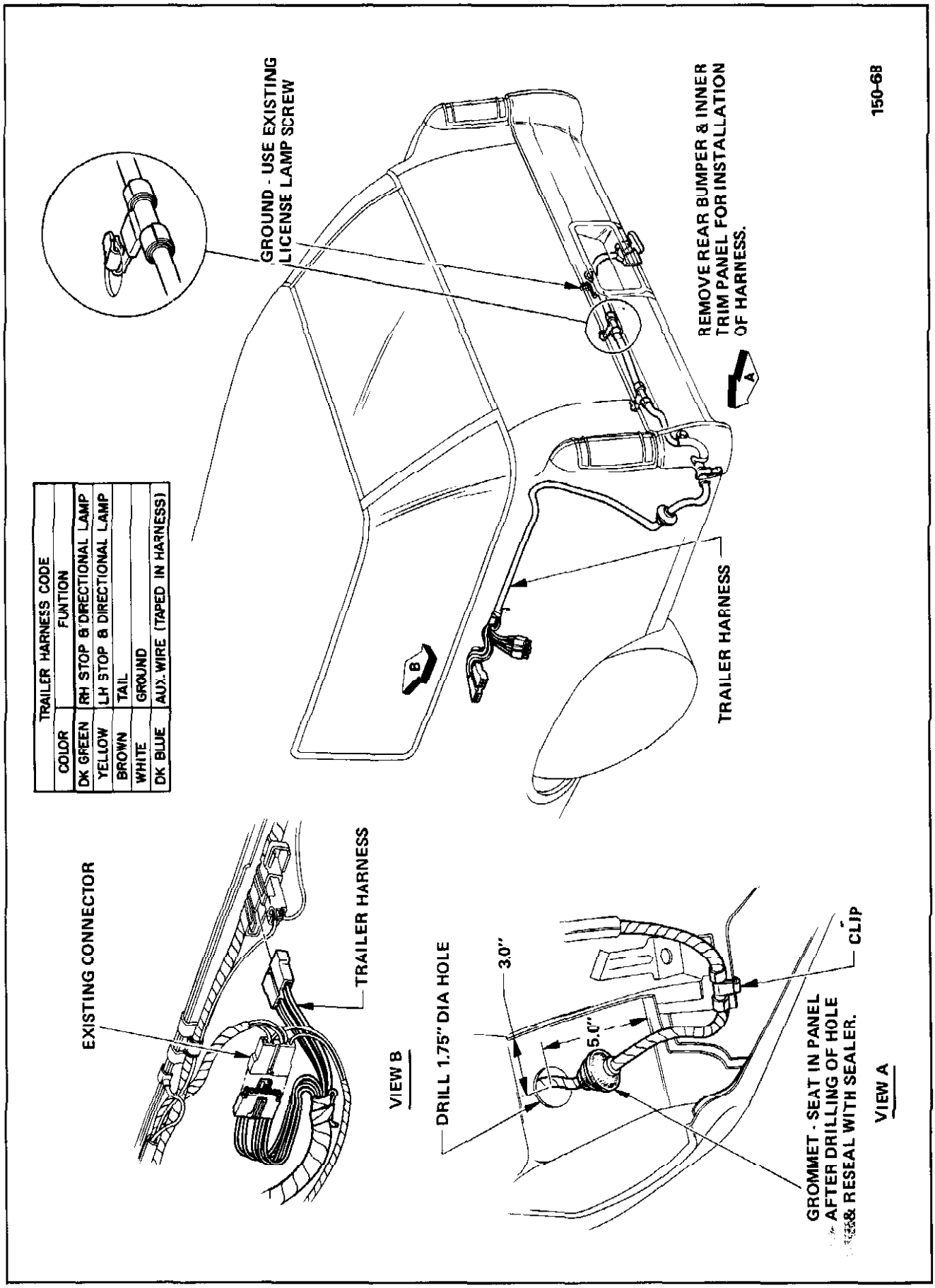
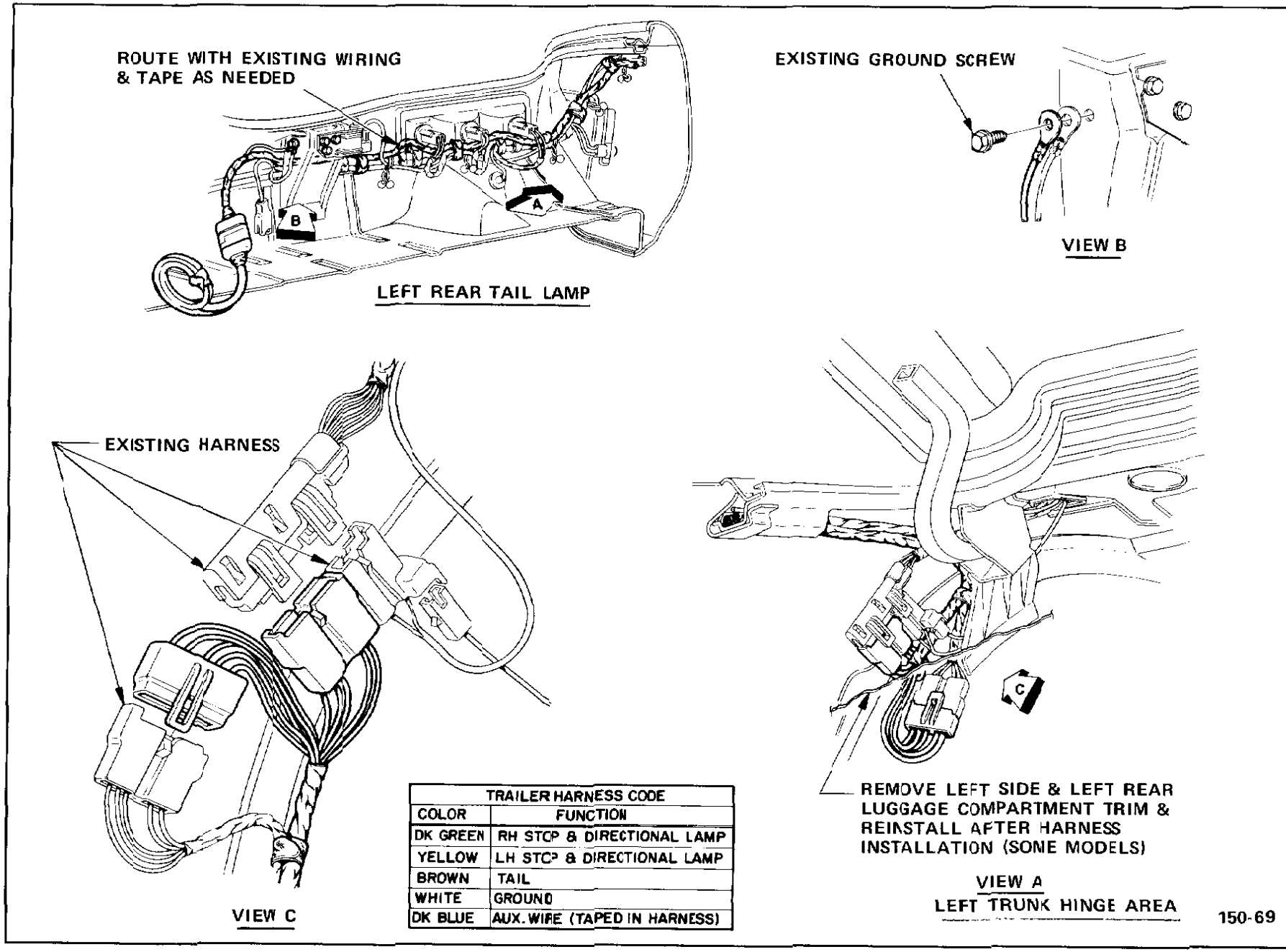


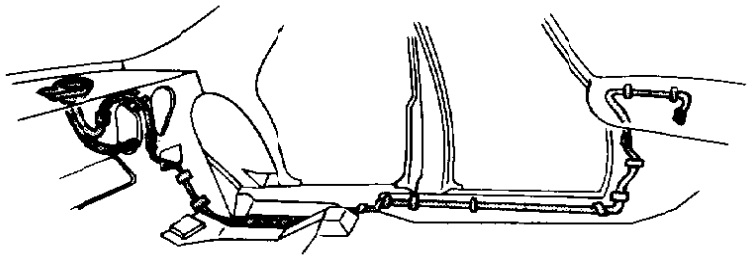
Figure 150-15 Trailer Harness Assembly - Estate Wagon



TRAILER HARNESS CODE	
COLOR	FUNCTION
DK GREEN	RH STOP & DIRECTIONAL LAMP
YELLOW	LH STOP & DIRECTIONAL LAMP
BROWN	TAIL
WHITE	GROUND
DK BLUE	AUX. WIRE (TAPED IN HARNESS)

Figure 150-16 Trailer Harness Assembly - LeSabre, Centruion, Electra, and Riviera

INSTRUCTION SHEET - BACK WINDOW DEFOGGER



STEP 1. REMOVE NECESSARY TRIM AND ROUTE DEFOGGER WIRE ON DRIVER'S SIDE AS SHOWN AND TAPE AS REQUIRED.

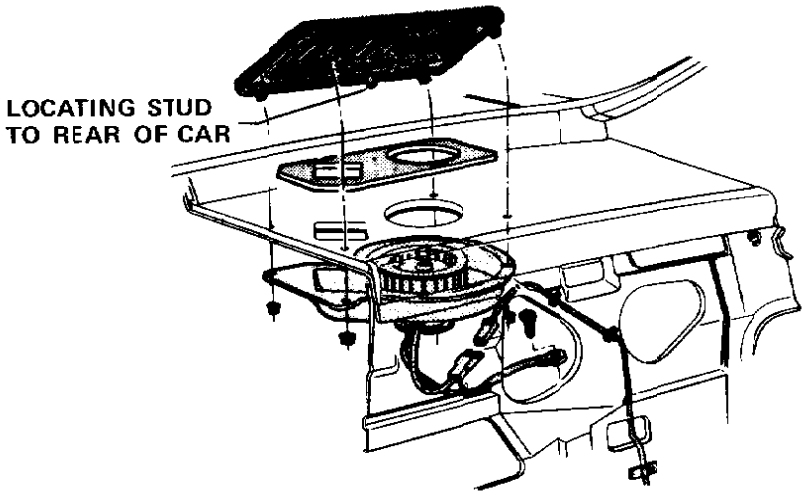
STEP 2. USE EXISTING 1/4" HOLES IN PANEL AS GUIDE AND DRILL FOUR (4) HOLES IN TRIM.

STEP 3. USE EXISTING CUT-OUTS IN PANEL AS GUIDE AND CUT TRIM AS REQUIRED FOR DEFOGGER OPENINGS.

STEP 4. INSTALL GRILLE WITH LOCATING STUD REARWARD TO MAKE IMPRESSION IN TRIM. REMOVE GRILLE AND DRILL HOLE FOR LOCATING STUD.

STEP 5. INSTALL GRILLE, COVER, AND BLOWER WITH FOUR (4) NUTS AS SHOWN.

STEP 6. CONNECT TO HARNESS AS SHOWN. ATTACH GROUND WIRE CLIP FOR BLOWER TO EDGE OF HOLE IN SEAT BACK PANEL.



150-70

Figure 150-17 Rear Window Defogger - Skylark Less Sportwagon

INSTRUCTION SHEET - BACK WINDOW DEFOGGER

STEP 1. REMOVE NECESSARY TRIM AND ROUTE DEFOGGER WIRE ON DRIVER'S SIDE AS SHOWN AND TAPE AS REQUIRED.

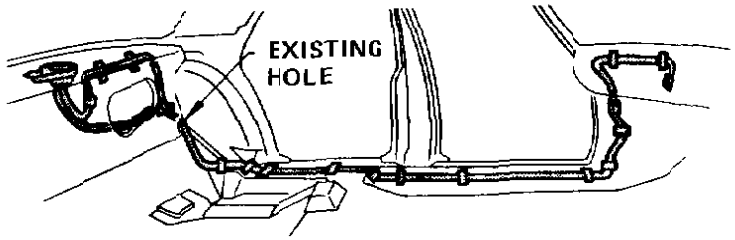
STEP 2. USE EXISTING 1/4" HOLES IN PANEL AS GUIDE AND DRILL FOUR (4) HOLES IN TRIM.

STEP 3. USE EXISTING CUT-OUTS IN PANEL AS GUIDES AND CUT TRIM AS REQUIRED FOR DEFOGGER OPENINGS.

STEP 4. INSTALL GRILLE TO MAKE IMPRESSION IN TRIM. REMOVE GRILLE AND DRILL HOLE FOR LOCATING STUD.

STEP 5. INSTALL GRILLE, COVER, AND BLOWER WITH FOUR (4) NUTS AS SHOWN.

STEP 6. CONNECT TO HARNESS AS SHOWN. ATTACH GROUND WIRE CLIP FOR BLOWER TO EDGE OF HOLE IN SEAT BACK PANEL.



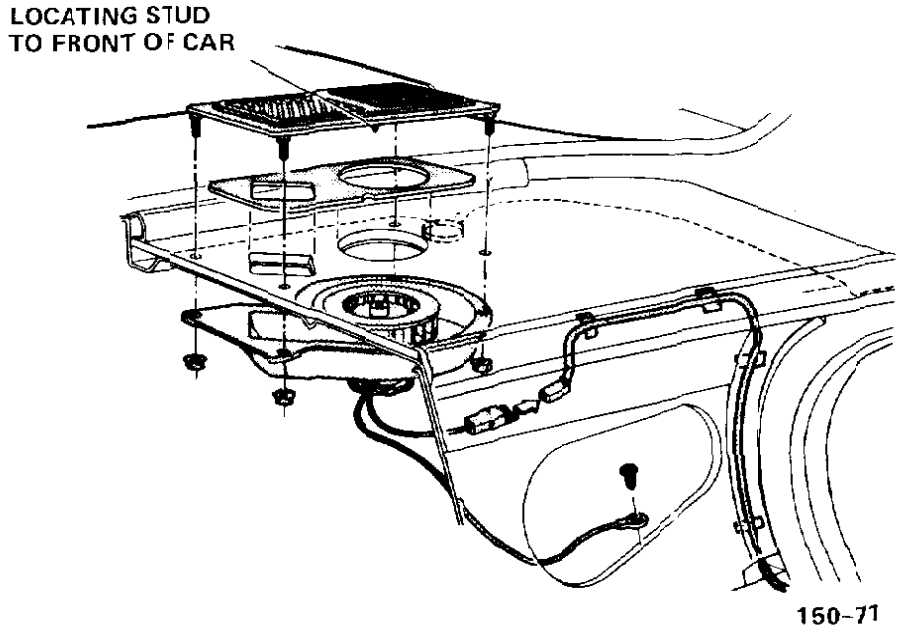
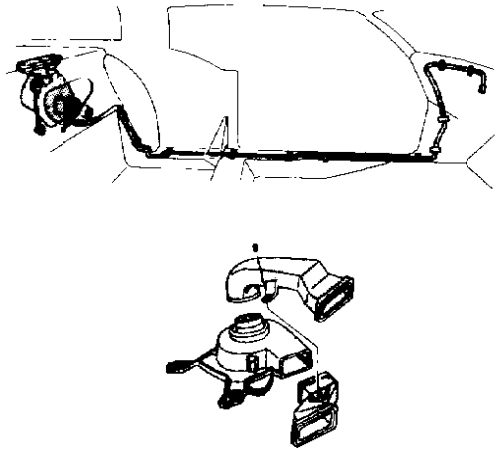
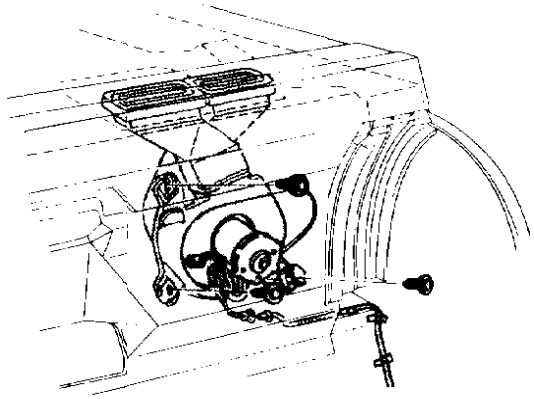


Figure 150-18 Rear Window Defogger - LeSabre, Centurion, and Electra, Less Estate Wagon

RIVIERA ONLY

INSTRUCTION SHEET - BACK WINDOW DEFOGGER





STEP 1. REMOVE NECESSARY TRIM, ROUTE DEFOGGER WIRE ON DRIVER'S SIDE AS SHOWN AND TAPE AS REQUIRED.

STEP 2. ASSEMBLE DUCT AND NOZZLE TO BLOWER WITH ONE (1) SCREW AS SHOWN.

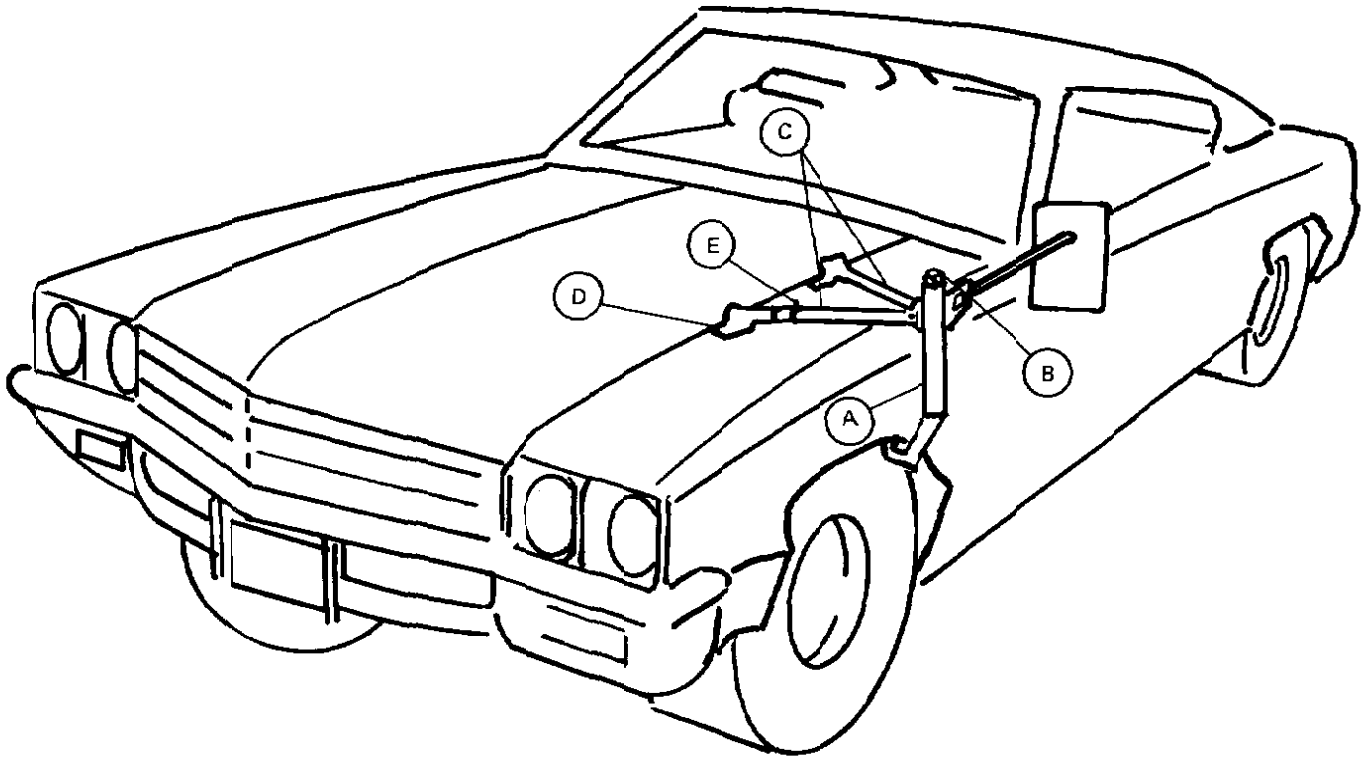
STEP 3. INSERT BLOWER ASSEMBLY THROUGH HOLE IN SHELF AND ALIGN WITH THREE (3) EXISTING SLOTS.

STEP 4. SECURE BLOWER ASSEMBLY WITH THREE (3) SCREWS AS SHOWN.

STEP 5. CONNECT TO HARNESS AS SHOWN. ATTACH GROUND WIRE CLIP FOR BLOWER TO EDGE OF HOLE IN SEAT BACK PANEL.

150-72

Figure 150-19 Rear Window Defogger - Riviera



Unfold arms of tripod and assemble mirror for either left or right hand installation.

1 – Free hook tube assembly (A) by turning hex bolt (B) counterclockwise.

2 – Attach hook tube at center of fender well, making sure it is parallel to fender or angled towards fender. **(NEVER ALLOW THIS TUBE TO ANGLE AWAY FROM FENDER.** Adjust length of telescoping locking tubes (C), keeping them as short and equal in length as possible. Tubes must be either horizontal or angled up from fender. **(NEVER ANGLED DOWN TO THE FENDER).** It is important that anchor brackets (D) lie flat on top of fender before closing hood.

3 – Tighten square head set screws (E) in telescoping locking tube collars.

Before driving, adjust mirror height and angle for best visibility. Check all bolts and nuts to make certain that mirror has been securely mounted.

To remove mirror for storage, just loosen center hex bolt until anchor brackets can be lifted out of hood opening. Fold all arms toward center tube and store.

150-73

Figure 150-20 Typical Fender Mount Mirror Installation

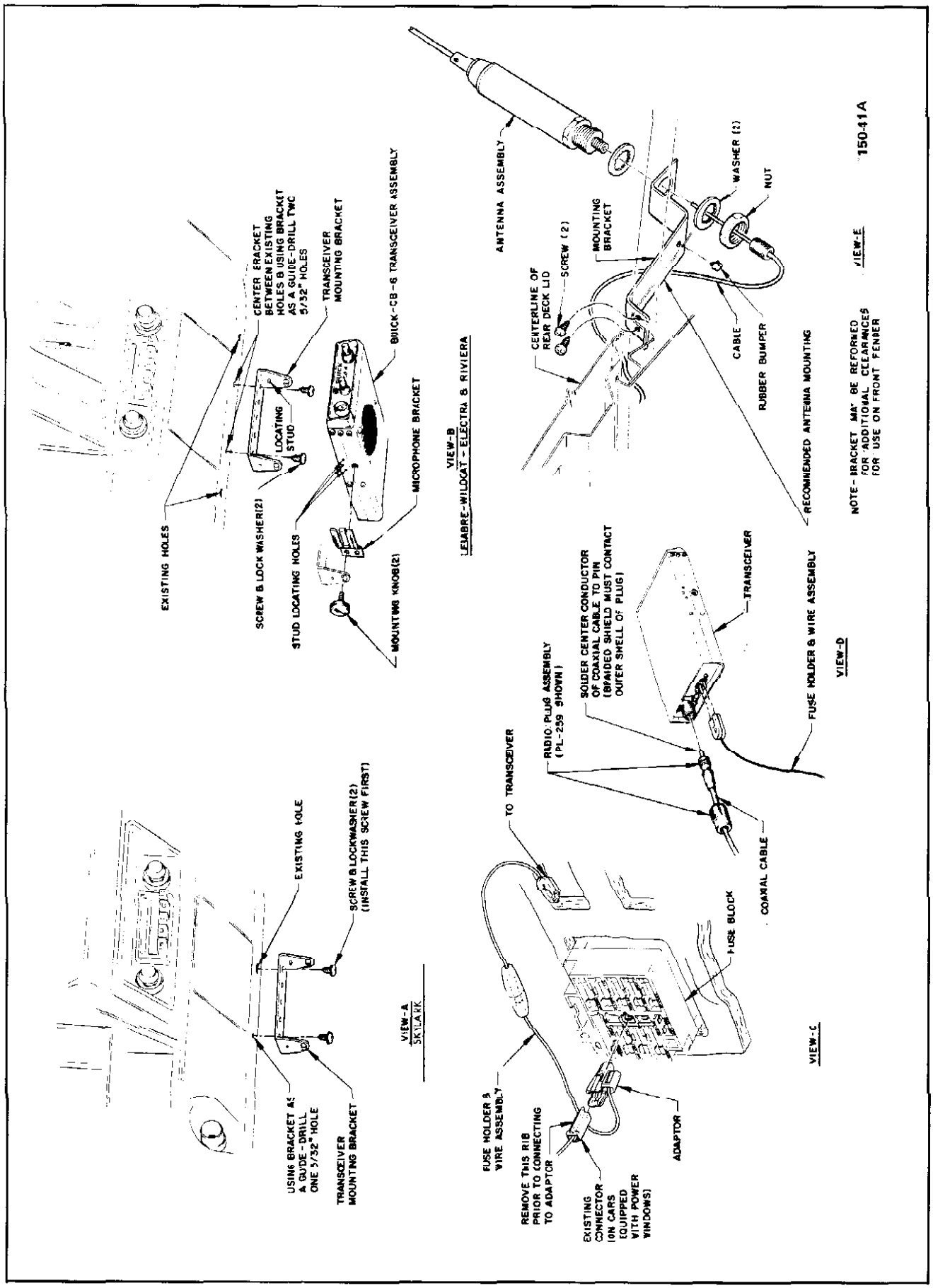


Figure 150-21 Typical CB Radio Installation

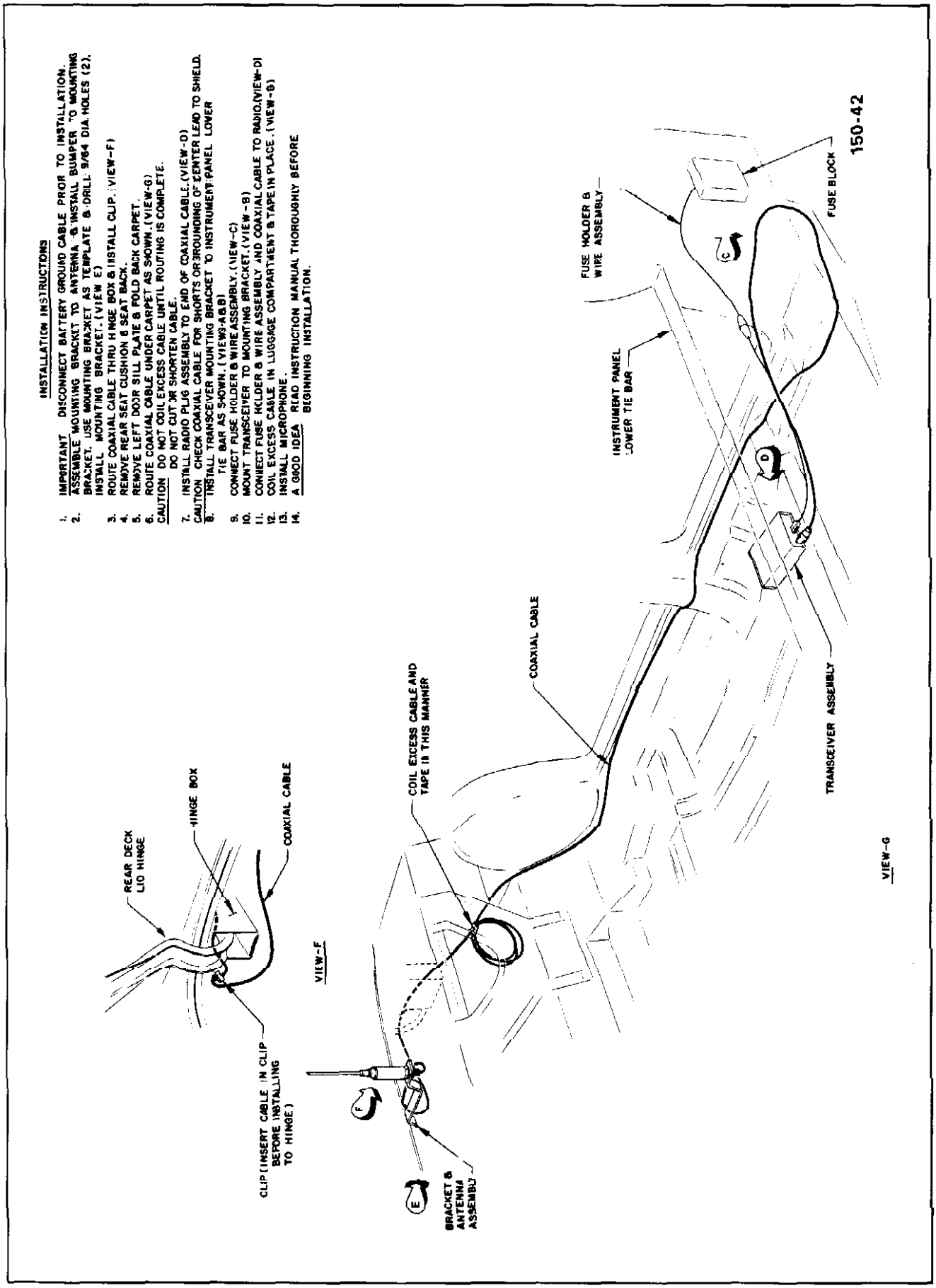
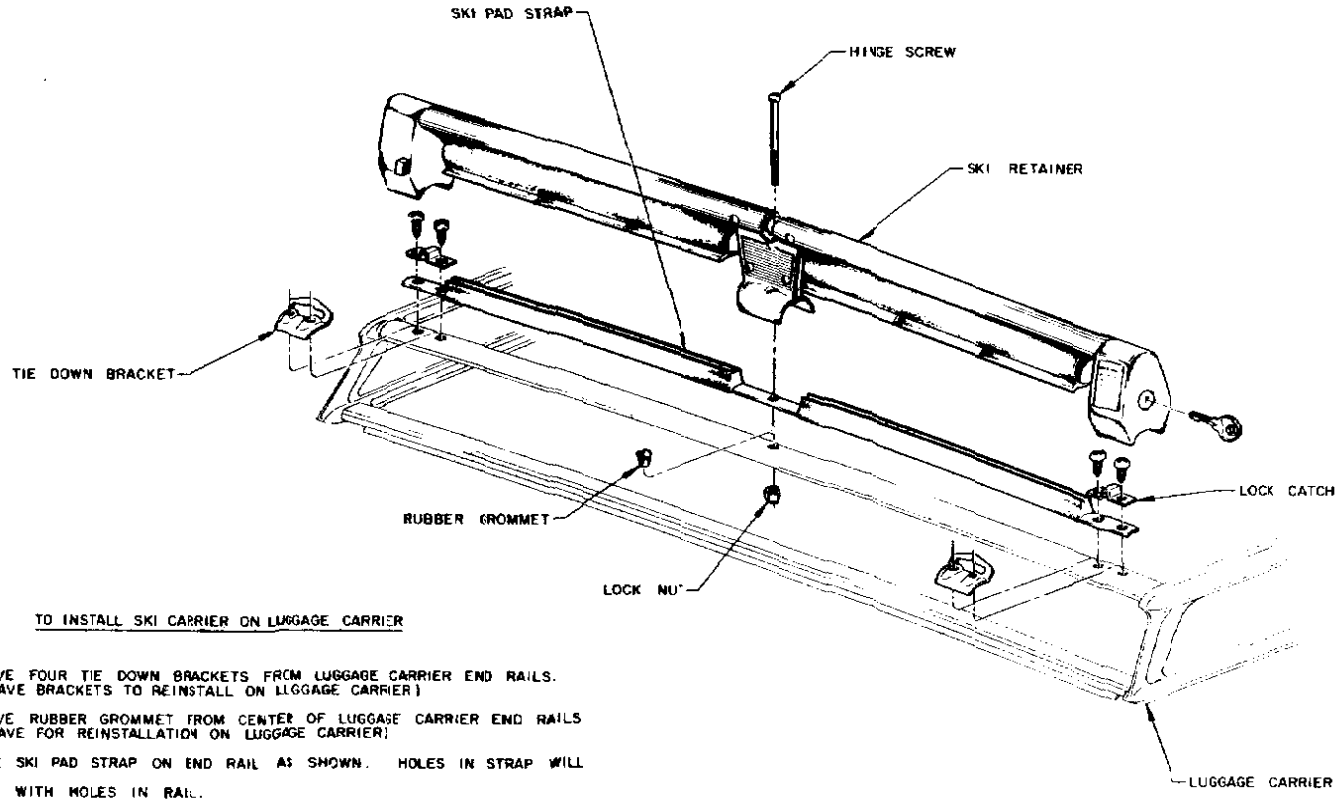


Figure 150-22 Typical CB Cable Routing



TO INSTALL SKI CARRIER ON LUGGAGE CARRIER

1. REMOVE FOUR TIE DOWN BRACKETS FROM LUGGAGE CARRIER END RAILS. (SAVE BRACKETS TO REINSTALL ON LUGGAGE CARRIER)
2. REMOVE RUBBER GROMMET FROM CENTER OF LUGGAGE CARRIER END RAILS (SAVE FOR REINSTALLATION ON LUGGAGE CARRIER)
3. PLACE SKI PAD STRAP ON END RAIL AS SHOWN. HOLES IN STRAP WILL ALIGN WITH HOLES IN RAIL.
4. REPLACE TIE DOWN BRACKETS WITH LOCK CATCHES AS SHOWN, REUSING SCREWS FROM TIE DOWN BRACKETS.
5. PLACE SKI RETAINER ON SKI PAD STRAP AND TIGHTEN HINGE SCREW AT CENTER WITH LOCK NUT, BOTH PROVIDED IN PACKAGE.
6. OUTER END OF SKI RETAINER SHOULD STRIKE LOCK CATCH TO PERMIT LOCKING WITH KEYS PROVIDED IN PACKAGE.

(A) TRUNK MOUNTED SKIS MORE THAN 6" LONGER THAN VEHICLE IS WIDE SHOULD NOT BE CARRIED ON THIS RACK. LOAD SKIS SO THEY DO NOT PROJECT BEYOND LEFT FENDER LINE OR MORE THAN 6" BEYOND RIGHT FENDER LINE.

150-54

Figure 150-23 Ski Carrier to Luggage Carrier Insallation

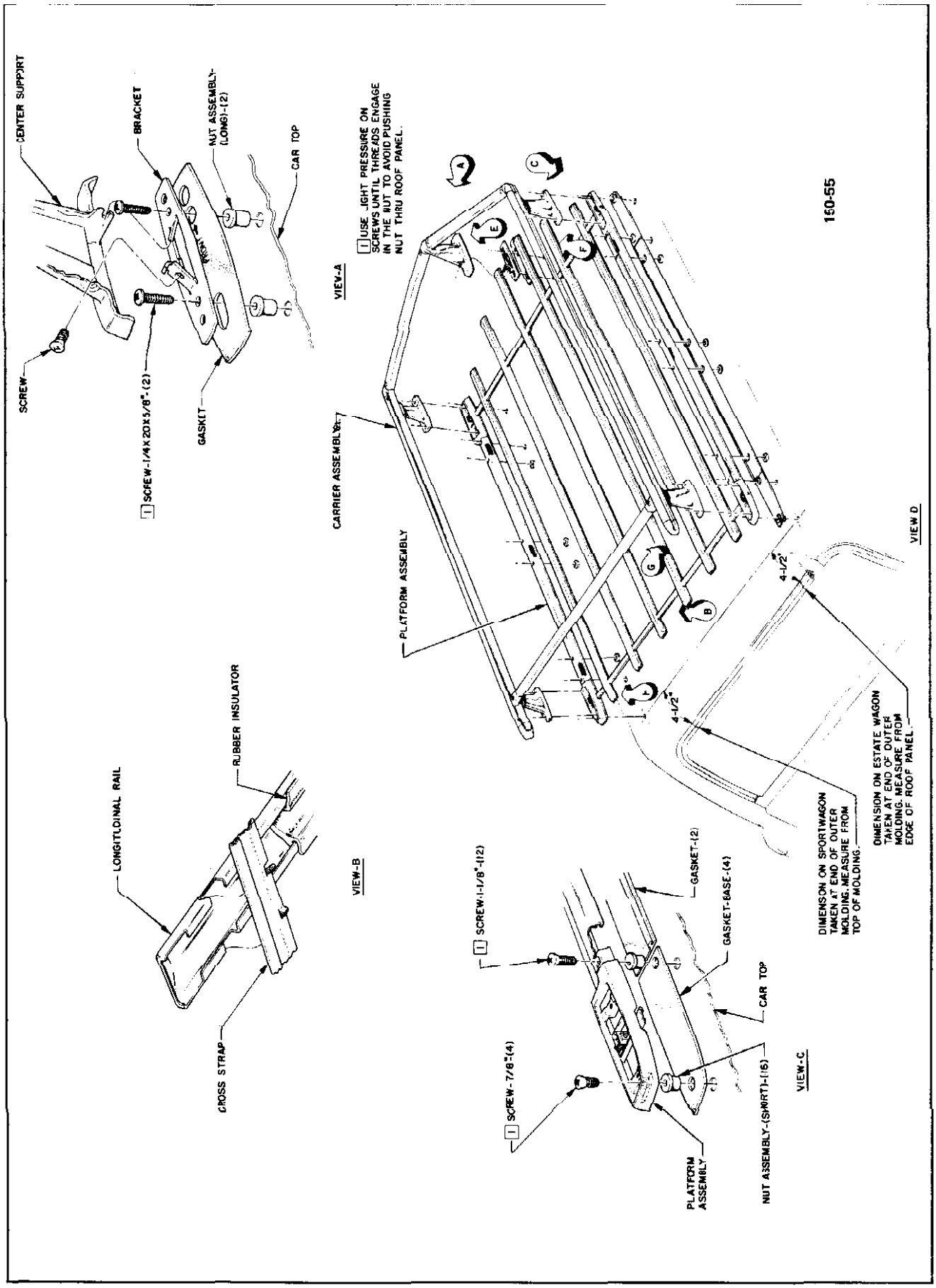


Figure 150-24 Roof Luggage Carrier Installation - Sportwagon and Estate Wagon

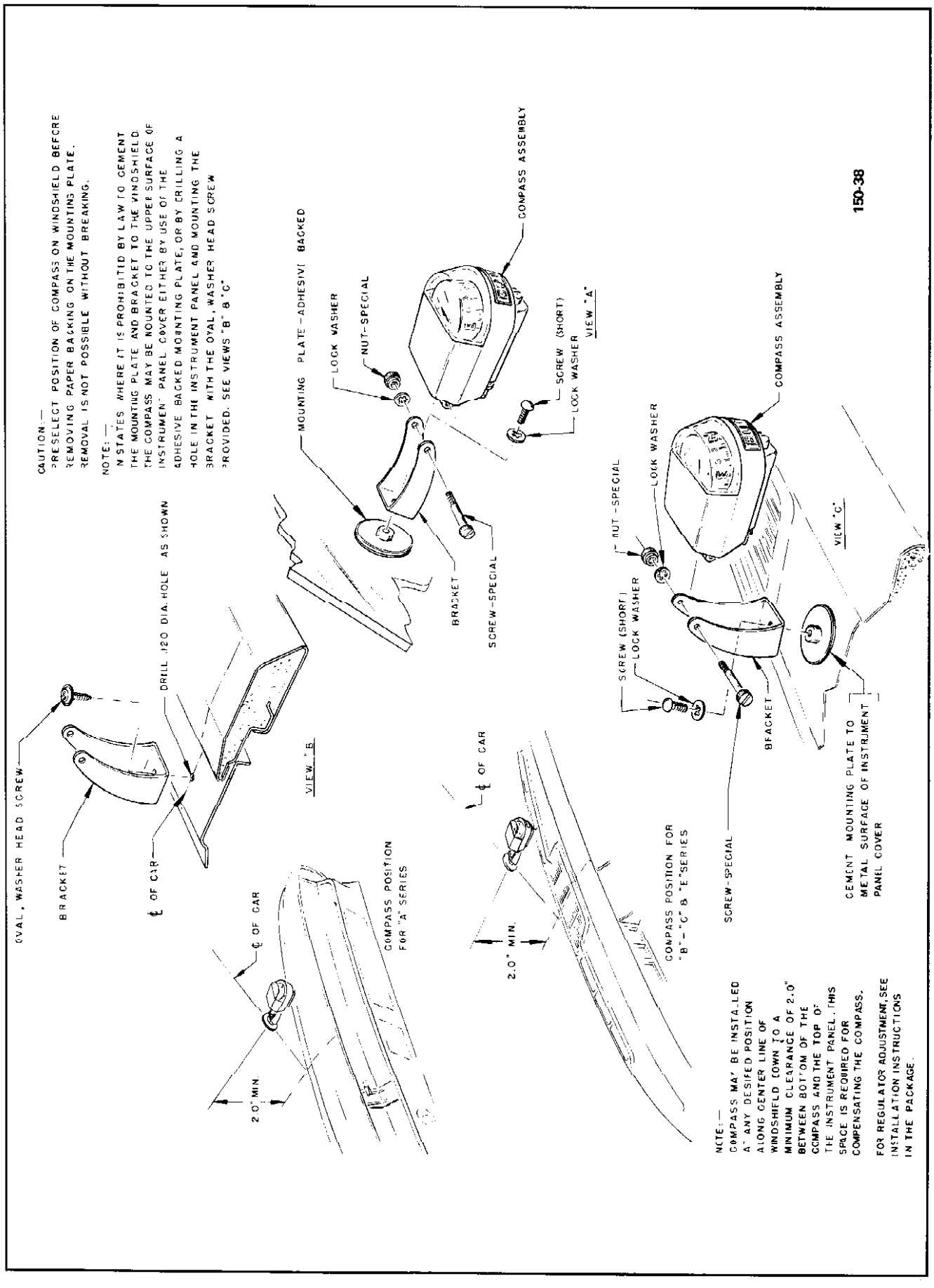


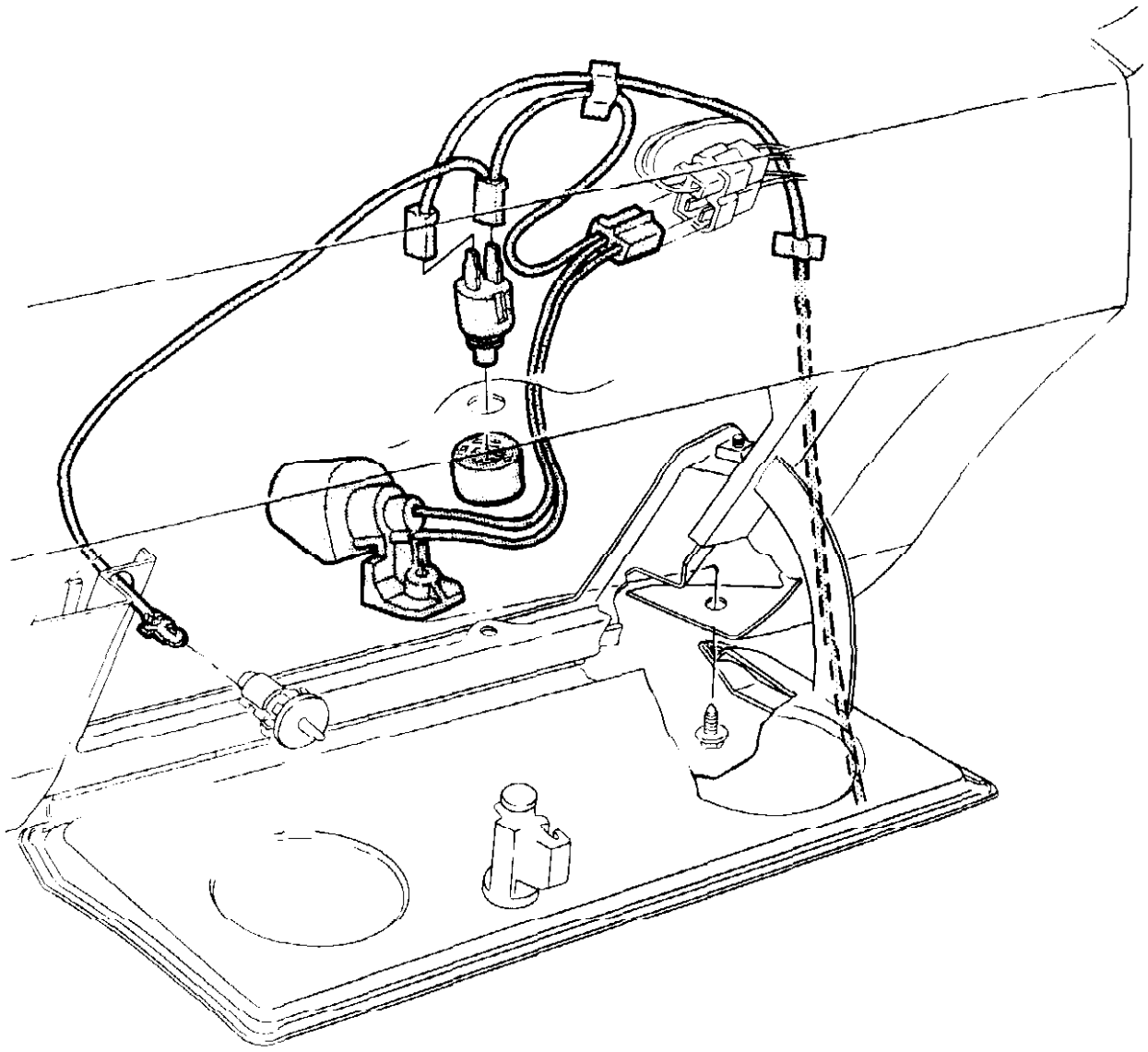
Figure 150-25 Typical Compass Installation

Step 1. Remove and discard existing courtesy lamp and glove box. light harness. Retain bulbs, glove box light switch assembly and courtesy lamp screw.

Step 2. Install lid lock release switch with guard as shown.

Step 3. Install previously used courtesy lamp bulb to lamp portion of new harness and attach lamp to instrument panel with previously used screw.

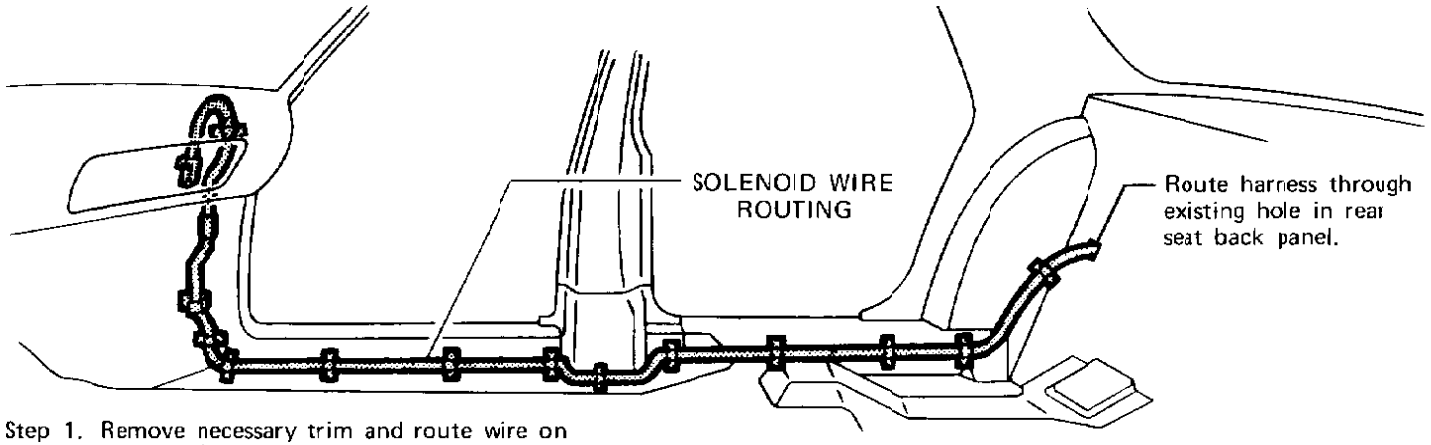
Step 4. Attach previously used glove box light switch assembly to new harnesses and reinsert switch in opening in glove box.



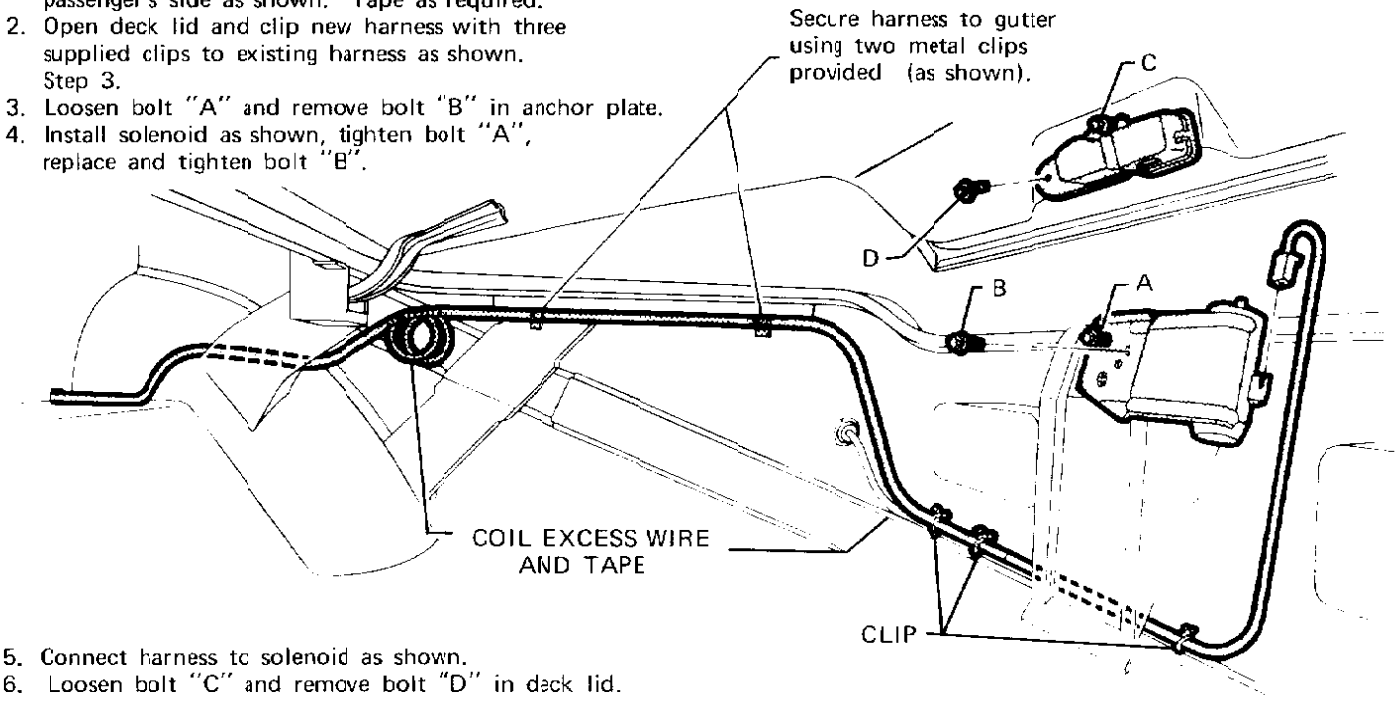
Step 5. Connect harness as shown.

150-74

Figure 150-26 Typical Electric Trunk Release Switch Installation



Step 1. Remove necessary trim and route wire on passenger's side as shown. Tape as required.
Step 2. Open deck lid and clip new harness with three supplied clips to existing harness as shown. Step 3.
Step 3. Loosen bolt "A" and remove bolt "B" in anchor plate.
Step 4. Install solenoid as shown, tighten bolt "A", replace and tighten bolt "B".



Step 5. Connect harness to solenoid as shown.
Step 6. Loosen bolt "C" and remove bolt "D" in deck lid.
Step 7. Install actuator assembly to deck lid, tighten bolt "C", replace and tighten bolt "D".

150-75

Figure 150-27 Typical Electric Trunk Release Wire Routing and Latch Installation

DECIMAL EQUIVALENTS

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

150-58

Decimal Equivalents

TAPS · DIES · GAGES · SCREW PLATES · SCREW EXTRACTORS

DECIMAL EQUIVALENTS AND TAP DRILL SIZES

DRILL SIZE	DECIMAL	TAP SIZE
1/64	.0156	
1/32	.0312	
60	.0400	
59	.0410	
58	.0420	
57	.0430	
56	.0465	
3/64	.0469	0-80
55	.0520	
54	.0550	1-56
53	.0595	1-64, 72
1/16	.0625	
52	.0635	
51	.0670	
50	.0700	2-56, 64
49	.0730	
48	.0760	
5/64	.0781	
47	.0785	3-48
46	.0810	
45	.0820	3-56,4-32
44	.0860	4-36
43	.0890	4-40
42	.0935	4-48
3/32	.0937	
41	.0960	
40	.0980	
39	.0995	
38	.1015	5-40
37	.1040	5-44
36	.1065	6-32
7/64	.1093	
35	.1100	
34	.1110	6-36
33	.1130	6-40
32	.1160	
31	.1200	
1/8	.1250	
30	.1285	
29	.1360	8-32, 36
28	.1405	8-40
9/64	.1406	
27	.1440	
26	.1470	
25	.1495	10-24
24	.1520	
23	.1540	
5/32	.1562	
22	.1570	10-30
21	.1590	10-32
20	.1610	
19	.1660	
18	.1695	
11/64	.1719	
17	.1730	
16	.1770	12-24
15	.1800	
14	.1820	12-28
13	.1850	12-32
3/16	.1875	
12	.1890	
11	.1910	
10	.1935	
9	.1960	
8	.1990	
7	.2010	1/4-20
13/64	.2031	
6	.2040	
5	.2055	
4	.2090	
3	.2130	1/4-28
7/32	.2187	
2	.2210	
1	.2280	
A	.2340	
15/64	.2344	
B	.2380	
C	.2420	
D	.2460	
E, 1/4	.2500	
F	.2570	5/16-18
G	.2610	
17/64	.2656	
H	.2660	
I	.2720	5/16-24
J	.2770	
K	.2810	
9/32	.2812	
L	.2900	
M	.2950	
19/64	.2968	
N	.3020	
5/16	.3125	3/8-16
O	.3160	
P	.3230	
21/64	.3281	
Q	.3320	3/8-24
R	.3390	
11/32	.3437	
S	.3480	
T	.3580	
23/64	.3594	
U	.3680	7/16-14
3/8	.3750	
V	.3770	
W	.3860	
25/64	.3906	7/16-20
X	.3970	
Y	.4040	
13/32	.4062	
Z	.4130	
27/64	.4219	1/2-13
7/16	.4375	
29/64	.4531	1/2-20
15/32	.4687	
31/64	.4844	9/16-12
1/2	.5000	
33/64	.5156	9/16-18
17/32	.5312	5/8-11
35/64	.5469	
9/16	.5625	
37/64	.5781	5/8-18
19/32	.5937	11/16-11
39/64	.6094	
5/8	.6250	11/16-16
41/64	.6406	
21/32	.6562	3/4-10
43/64	.6719	
11/16	.6875	3/4-16
45/64	.7031	
23/32	.7187	
47/64	.7344	
3/4	.7500	
49/64	.7656	7/8-9
25/32	.7812	
51/64	.7969	
13/16	.8125	7/8-14
53/64	.8281	
27/32	.8437	
55/64	.8594	
7/8	.8750	1-8
57/64	.8906	
29/32	.9062	
59/64	.9219	
15/16	.9375	1-12,14
61/64	.9531	
31/32	.9687	
63/64	.9844	
1	1.000	

PIPE THREAD SIZES

THREAD	DRILL	THREAD	DRILL
1/8-27	R	1 1/2-11 1/2	1 47/64
1/4-18	7/16	2-11 1/2	2 7/32
3/8-18	37/64	2 1/2-8	2 5/8
1/2-14	23/32	3 8	3 1/4
3/4-14	59/64	3 1/2-8	3 3/4
1-11 1/2	1 5/32	4-8	4 1/4
1 1/4-11 1/2	1 1/2		

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Decimal Equivalents and Drill Tap Sizes

SECTION C

BUMPERS
49000 SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Not Applicable)	-
II	DESCRIPTION AND OPERATION: (Not Applicable)	-
III	ADJUSTMENTS AND MINOR SERVICE: Adjustment of Front and Rear Bumper	140-3
IV	REMOVAL AND INSTALLATION: Refer to Illustrations.	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION III ADJUSTMENTS AND MINOR SERVICE

140-3 ADJUSTMENT OF FRONT AND REAR BUMPER

The front bumper brackets and supports are slotted to allow alignment to adjacent parts. The rear bumper brackets and braces are also slotted to permit alignment.

INDEX OF ILLUSTRATIONS

Figure Number	Description
140-12	49000 Front Bumper, Lamp Assembly and License Filler
140-13	49000 Front Bumper Anchor Bracket
140-14	49000 Front Bumper Outer Support
140-15	49000 Rear Bumper

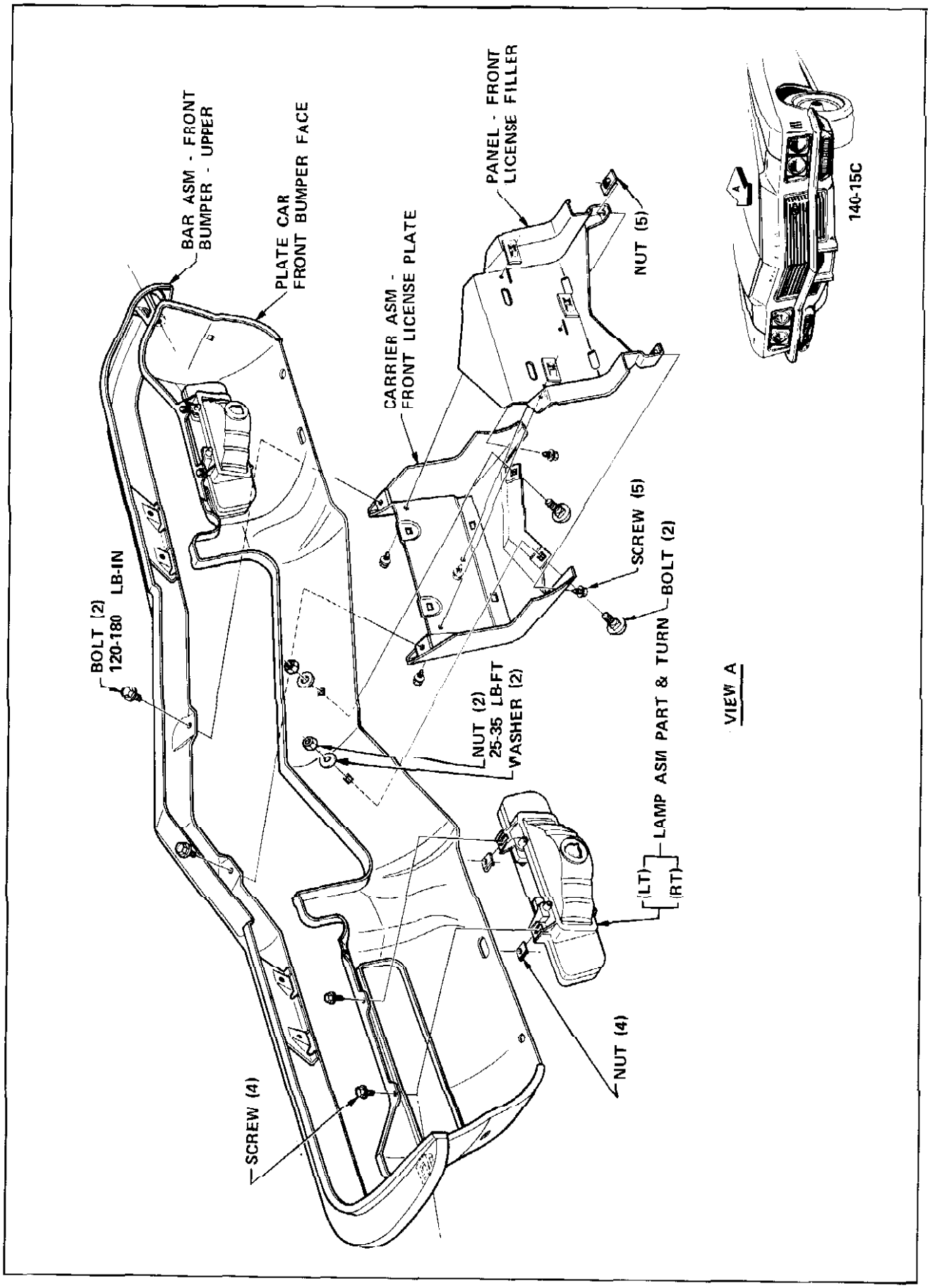


Figure 140-12 - 49000 Front Bumper, Lamp Assembly and License Filler

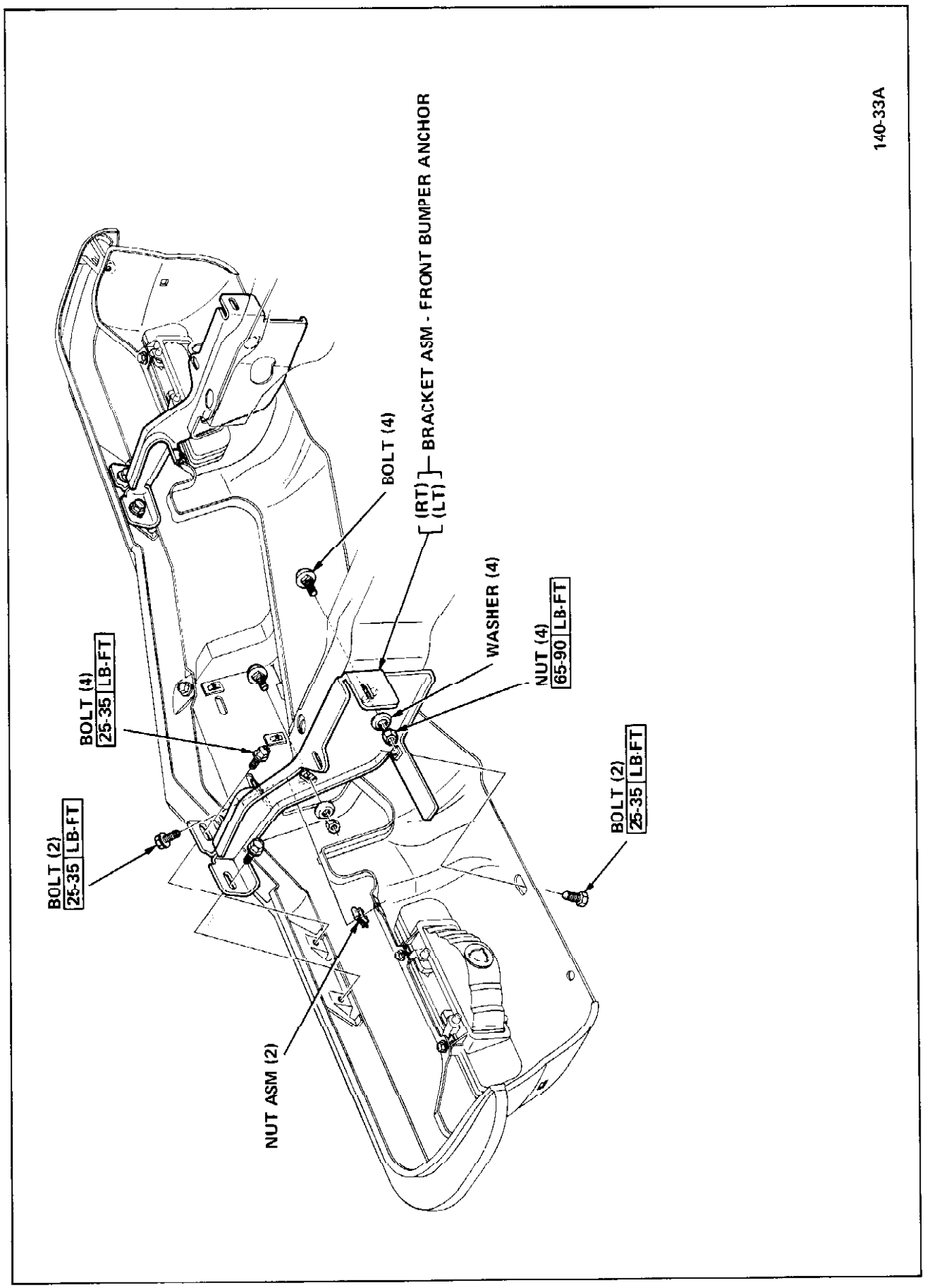


Figure 140-13 - 49000 Front Bumper Anchor Bracket

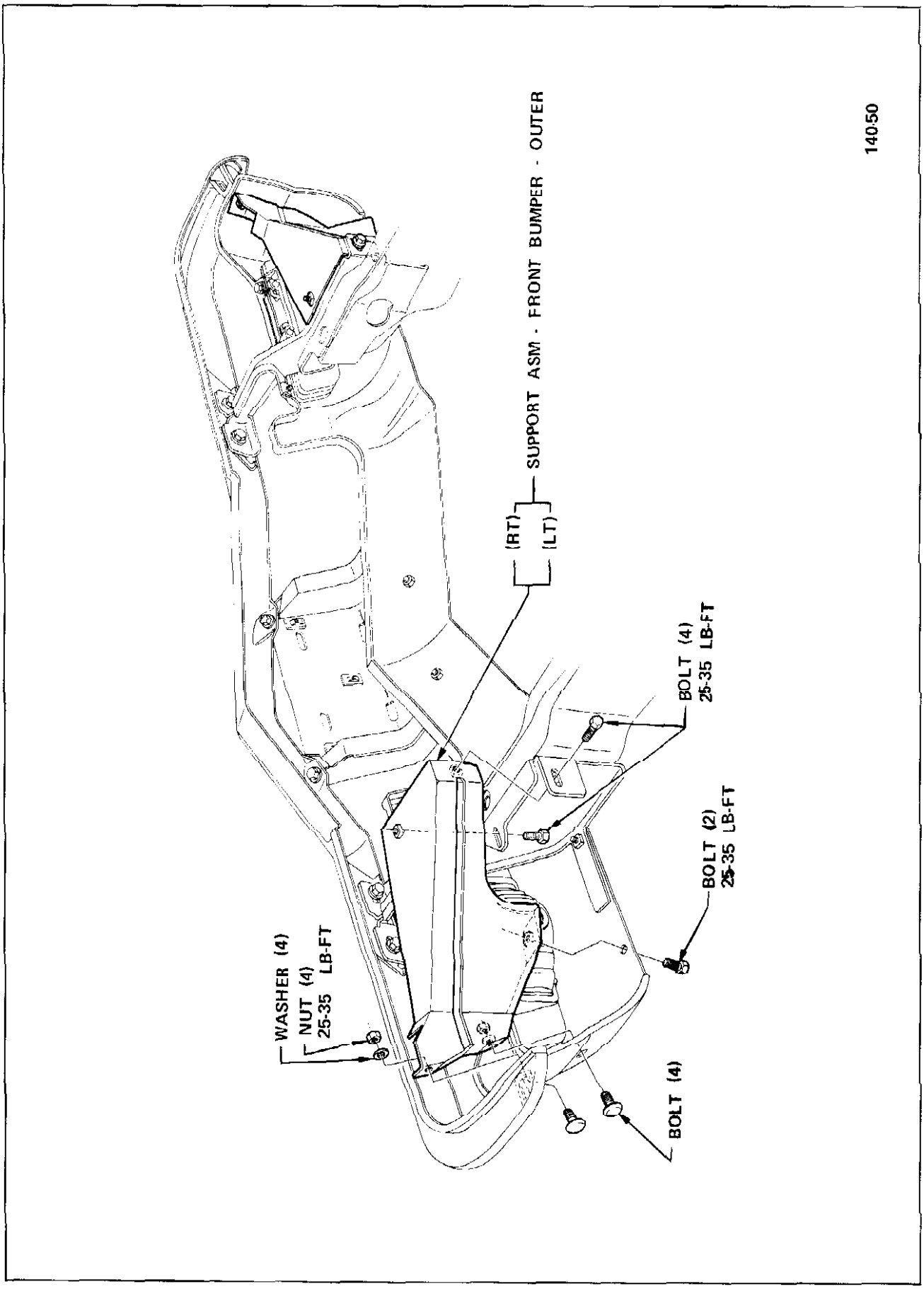


Figure 140-14 - 49000 Front Bumper Outer Support

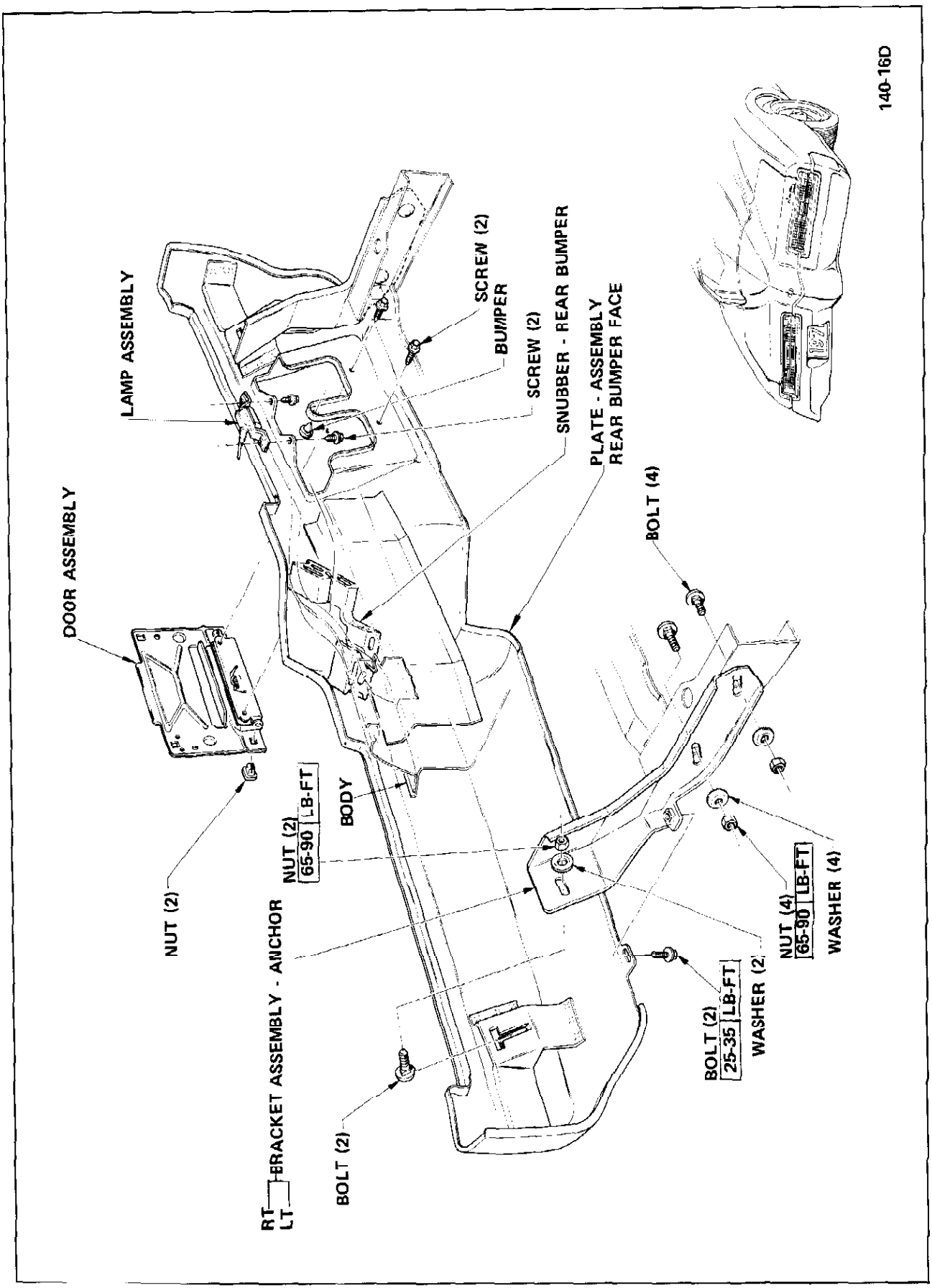


Figure 140-15 - 49000 Rear Bumper

SECTION C

RADIATOR and GRILLE
49000 SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Not Applicable)	-
II	DESCRIPTION AND OPERATION: (Not Applicable)	-
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION:	
	Radiator Mounting	130-3
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION IV REMOVAL AND INSTALLATION

130-3 RADIATOR MOUNTING

The radiator mounting is a four-point system using rubber inserts on "U" shaped brackets (for the lower mounting). The upper brackets are part of the upper radiator mounting panel. The lower brackets mount on the lower portion of the radiator mounting panel.

INDEX OF ILLUSTRATIONS

Figure Number	Description
130-9	49000 Radiator, Fan Shroud
130-10	49000 Overflow Reservoir, and Tubes
130-11	49000 Radiator Support and Upper Mounting Panel
130-12	49000 Headlamp Door, Capsule, Aiming Screw, and Brace Assembly
130-13	49000 Hood Latch, Grille, and Supports

[1] HEAVY DUTY COOLING

PERM. ANTI-FREEZE MAY BE USED TO ASSIST INSTALLATION OF HOSES.

SEALING SURFACES INSIDE RADIATOR FILLER NECK MUST BE CLEAN & FREE OF FOREIGN MATERIAL WHEN CAP IS INSTALLED.

COOLING SYSTEM TO BE PRESSURE CHECKED FOR LEAKS WITH 14 TO 17 LBS. AIR PRESSURE AT THE RADIATOR FILLER NECK.

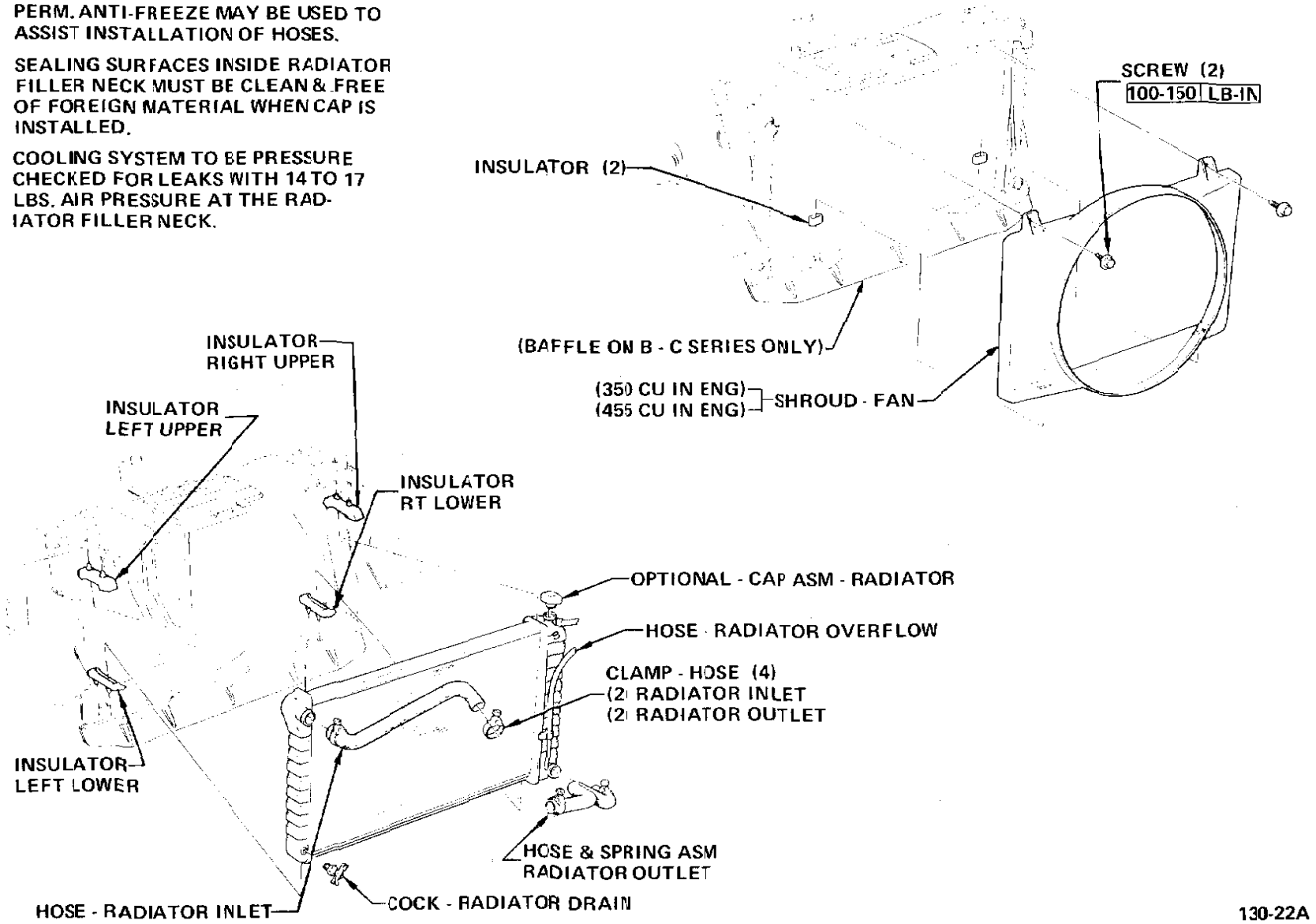


Figure 130-9 - 49000 Radiator, Fan Shroud

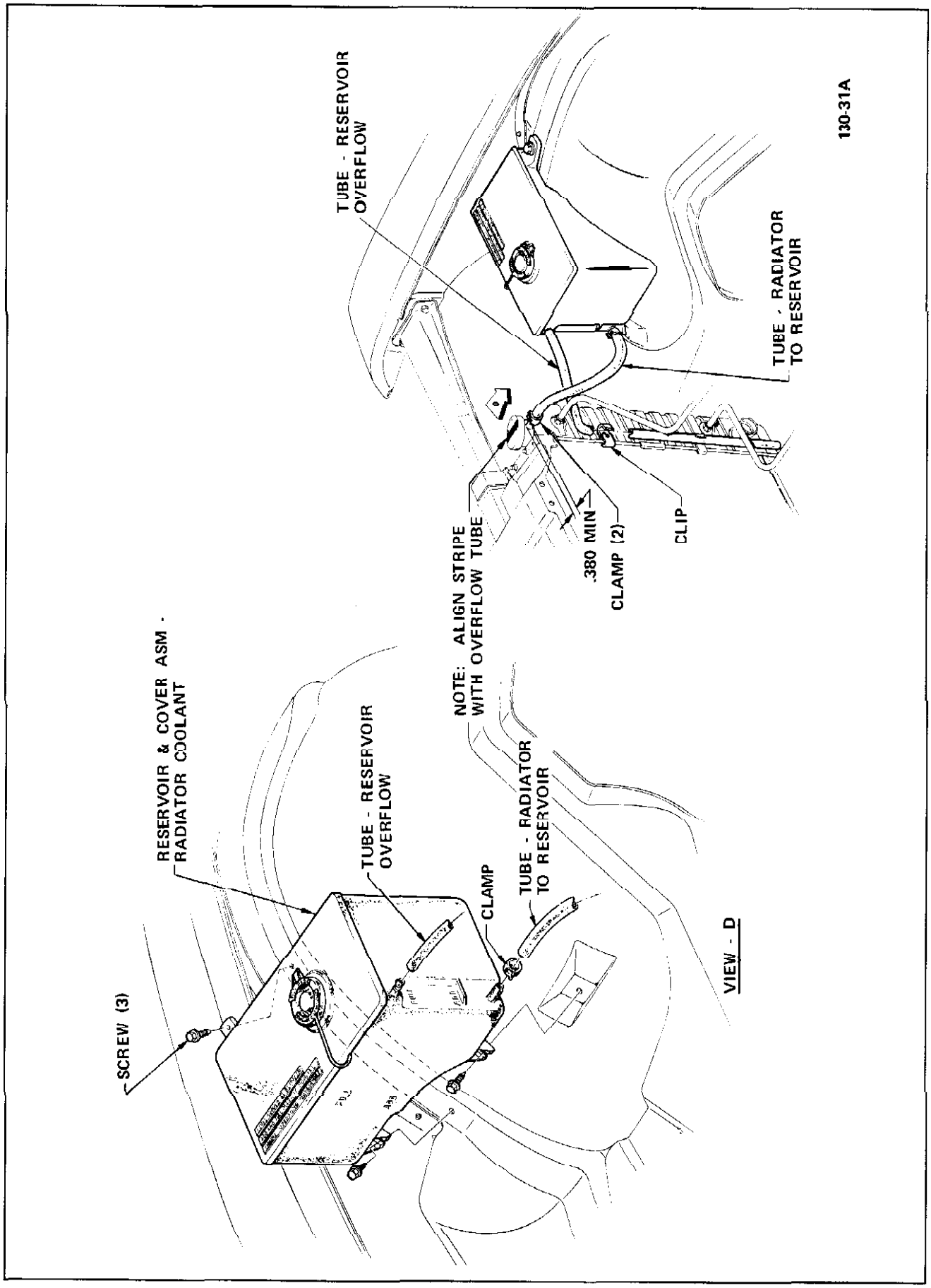


Figure 130-10 - 49000 Overflow Reservoir and Tubes

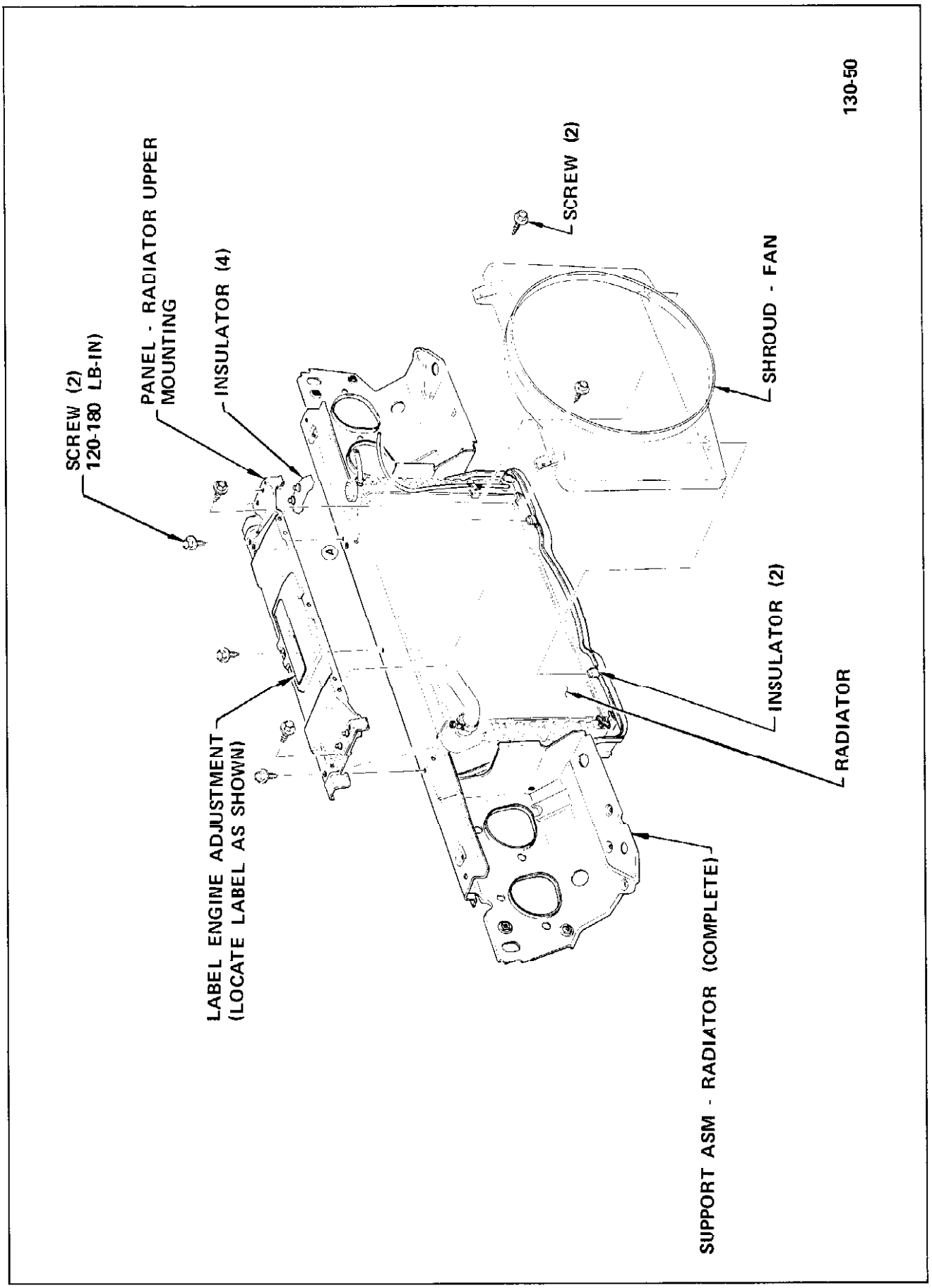


Figure 130-11 - 45000 Radiator Support and Upper Mounting Panel

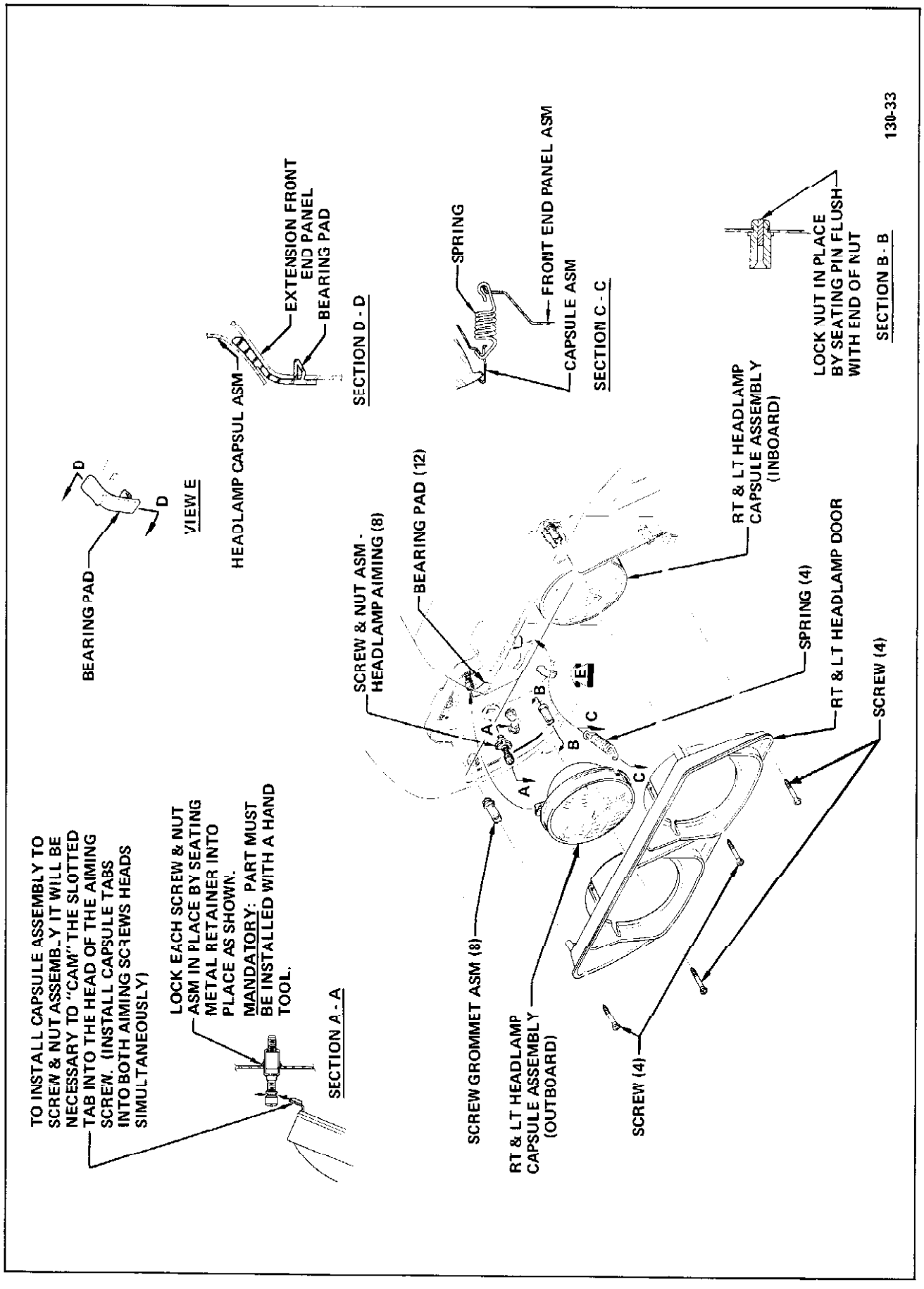


Figure 130-12 - 49000 Headlamp Door, Capsule, Aiming Screw, and Brace Assembly

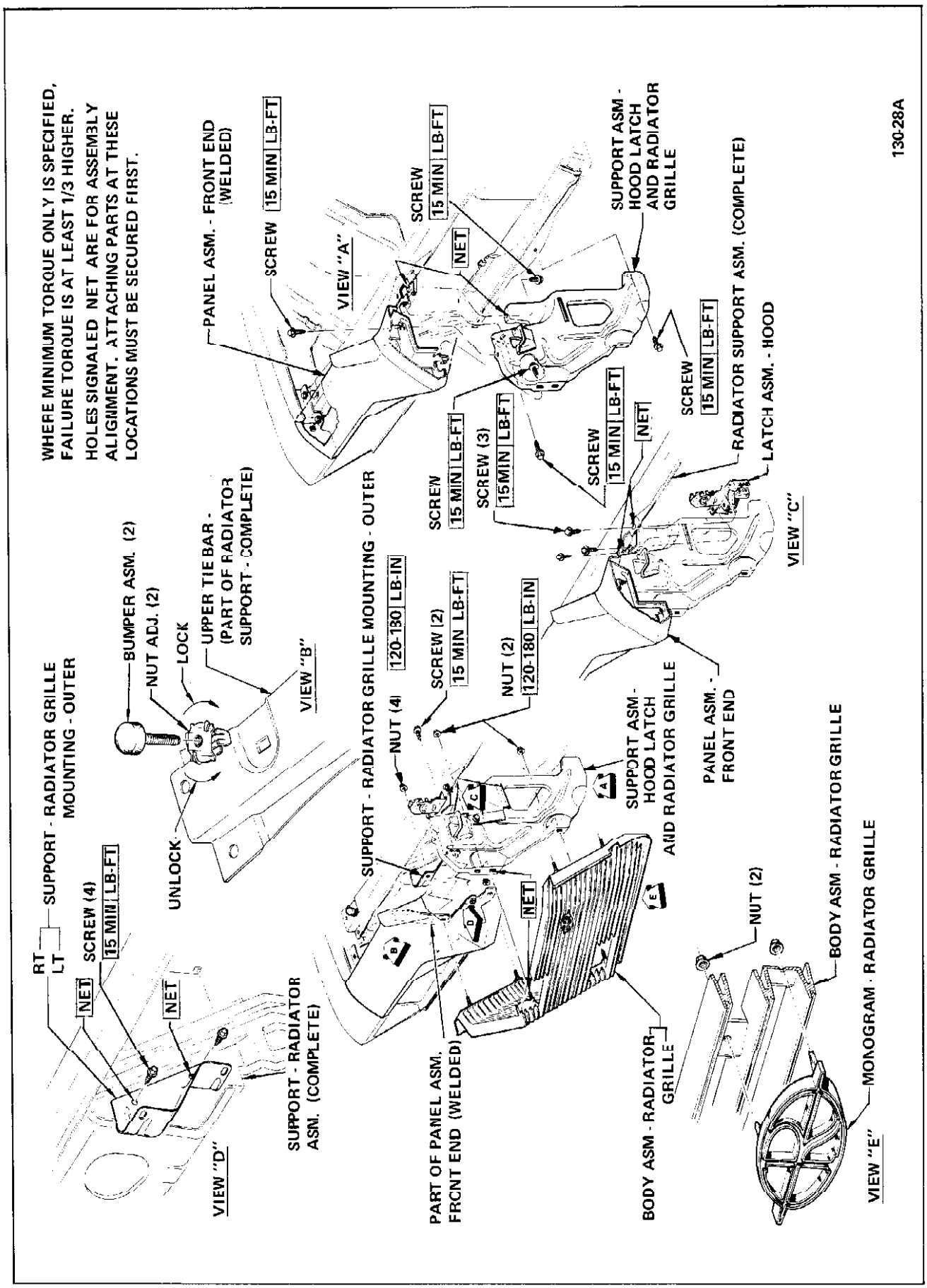


Figure 130-13 - 49000 Hood Latch, Grille, and Supports

SECTION B

STEREO TAPE PLAYER
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Tape Player Trouble Diagnosis	129-15
II	DESCRIPTION AND OPERATION:	
	Stereo Tape Player	129-16
III	ADJUSTMENTS AND MINOR SERVICE:	
	Periodic Maintenance	129 17
IV	REMOVAL AND INSTALLATION:	
	43-44000 Series	129-18
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS:	
	Stereo Tape	129-19

DIVISION I

TROUBLE DIAGNOSIS

129-15 TAPE PLAYER TROUBLE DIAGNOSIS

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 affect a correction, further testing sould 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.

NOTE: *Because tape player service problems are generally corrected by United Motors Service repair shops, there is a tendency for many dealer servicemen to remove a set when a problem is reported. The irritation to an owner of having to drive with the tape player removed can frequently be avoided if the tape player trouble diagnosis guide is used to eliminate problems which can be easily fixed or which are not even caused by a faulty player.*

DIAGNOSIS GUIDE

PLAYER NOISY

(Set all controls to mid-position. Insert test tape.)

A. NOISE ON ONE CHANNEL *(Check interconnecting cable and connections.)*

Cable and/or connectors loose or defective Replace or correct as required.

Cable and connectors okay Check speakers by substitution.

Speaker defective Replace speaker.

Speaker okay Remove player for repair.

B. NO NOISE *(Jar player with heel of hand.)*

Noisy Check speaker connections.

Loose or defective connections Replace or correct as required.

Connections okay Remove player for repair.

No noise Player okay.

C. NOISE ON BOTH CHANNELS *(Check speaker and power line connections.)*

Connections loose or defective Correct as required.

Connections okay Check for loose mounting (player or speakers).

Loose mounting (player or speakers) Correct as required.

Mounting okay Remove player for repair.

PLAYER SPEED INCORRECT
(Set all controls to mid-position. Insert test tape.)

Speed too slow, too fast, or constantly changing Remove player for repair.

Speed normal Player okay.

PLAYER DEAD
(Set all controls to mid-position. Insert test tape and listen for speaker "thump".)

A. NO THUMP HEARD IN ONE CHANNEL ONLY *(Check interconnecting cable and connectors.)*

Cable and/or connections loose or defective Replace or correct as required.

Cable and connectors okay Check speaker by substitution.

Speaker defective Replace speaker.

Speaker okay Remove player for repair.

B. NO THUMP HEARD *(Check fuse.)*

Fuse blown Replace fuse and check for short or open in wiring.

Fuse not blown Check speaker and power line connections.

Connections loose or defective Correct as required.

Connections okay Remove player for repair.

C. THUMP HEARD

Remove player for repair.

DIVISION II

DESCRIPTION AND OPERATION

129-16 TAPE PLAYER STEREO

To operate the tape player, completely insert a cartridge into the unit. This turns on the tape player, 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.

Tape cartridges should be handled carefully and should be kept clean. A cartridge should not be left inserted fully in the player. This may cause permanent damage to the cartridge.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

129-17 TAPE PLAYER - PERIODIC MAINTENANCE

With use, lubricant and oxide from the player may build up on the capstan, head and tape guide. This may cause the tape to slip or run slowly. A head cleaning tape cartridge which contains a mildly abrasive tape is designed to remove these deposits. The cleaning tape cartridge is inserted in the tape player and allowed to run for approximately 30 seconds. This procedure is recommended after every 50 hours of operation or sooner if necessary.

NOTE: *No lubricants should be used since they will cause the player to operate improperly especially at extreme temperatures.*

DIVISION IV

REMOVAL AND INSTALLATION

129-18 REMOVAL AND INSTALLATION 43-44000 SERIES

1. The tape player is installed at the factory with special anti-theft screws. To remove, tap gently in a counterclockwise direction with a punch and hammer until screws are loose. See Figure 129-15.

2. Use a large screwdriver to remove loosened special anti-theft screws. See Figure 129-16.

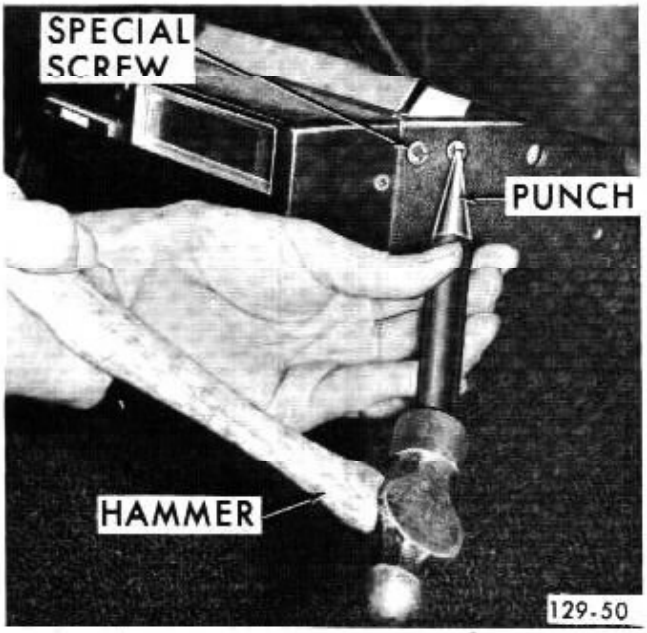


Figure 129-15 Anti-Theft Screw Loosening

Figure 129-16 Anti-Theft Screw Removal

3. Reinstall special anti-theft screws using the same procedure as a standard screw.

DIVISION VI

SPECIFICATIONS

129-19 STEREO TAPE

The 1971 Delco Radio tape player 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 cartridge lock arm reaches a detent point on the cartridge. Always withdraw the cartridge just beyond the detent point, this will enable normal operation from the radio.

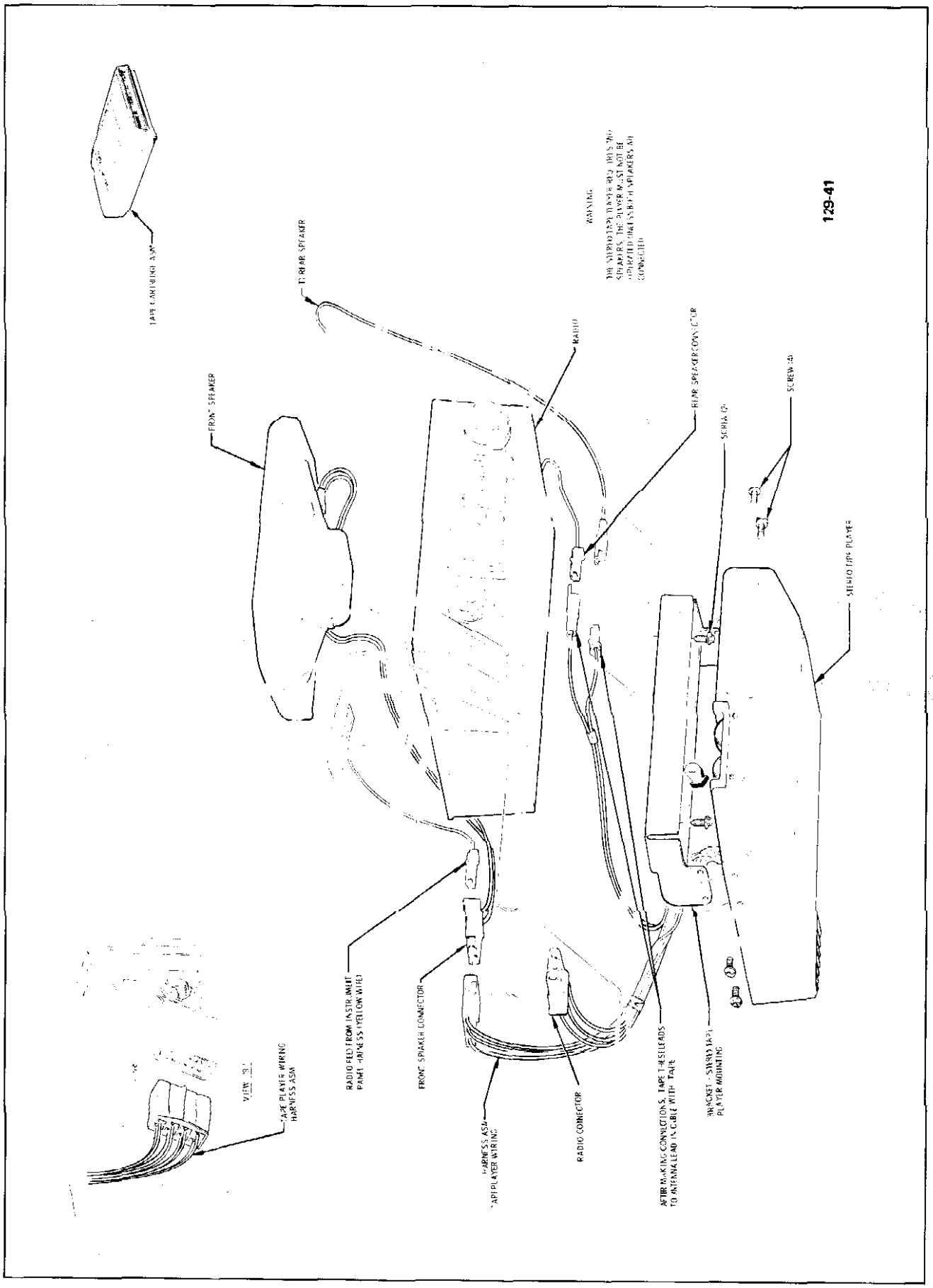


Figure 129-17 43-44000 Stereo Tape Player

SECTION G

WIRING CIRCUIT DIAGRAMS ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Not Applicable)	
II	DESCRIPTION AND OPERATION:	
	Description of Circuit Diagrams and Fuse Block	120-34
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION II

DESCRIPTION AND OPERATION

120-33 DESCRIPTION OF CIRCUIT DIAGRAMS AND FUSE BLOCK

This section contains pictorial and schematic wiring circuit diagrams for complete car. For more detailed *body* wiring diagrams showing the routing of the wires and the location of the switches, connectors and retaining clips - see the Fisher Body Service Manual.

A central fuse block is mounted on the cowl under the left side of the instrument panel. This fuse block serves as a convenient junction point for a number of circuits, provides a mounting for the hazard warning flasher, and contains most of the fuses.

To simplify replacement of the wiring, the circuits to the rear of the cowl are grouped in one harness and the circuits forward of the cowl are grouped in another. in a multiple connector which is held in the cowl. The engine compartment wiring harnesses plug into this connector at the cowl. This type of connector aids in tracing down electrical troubles.

a. Illustration Index

Figure 120-79 Ground and Relay Location Chart

Figures 120-80 through 120-92 Chassis Electrical Wiring - 43-44000 Series

Figures 120-93 through 120-105 Chassis Electrical Wiring - 45-46-48-49000 Series

Figures 120-106 and 120-107 Heater Wiring Diagrams

Figures 120-108 through 120-114 Air Conditioning Wiring Diagrams

Figures 120-115 through 120-135 Miscellaneous Wiring Diagrams

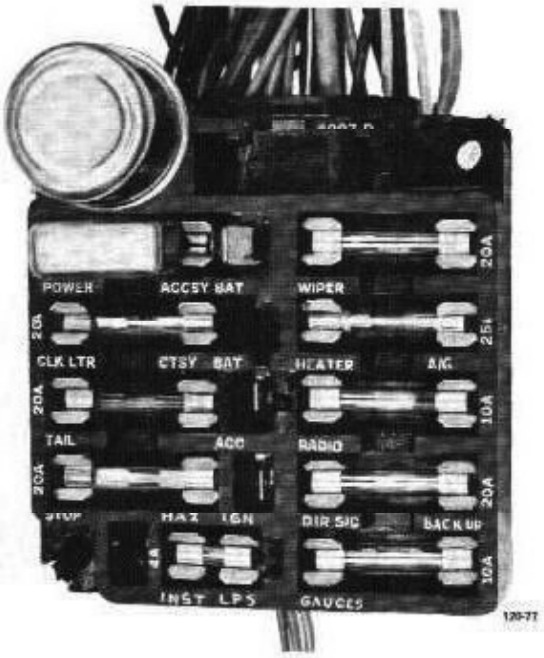


Figure 120-77 Fuse Block - 43-44000 Series

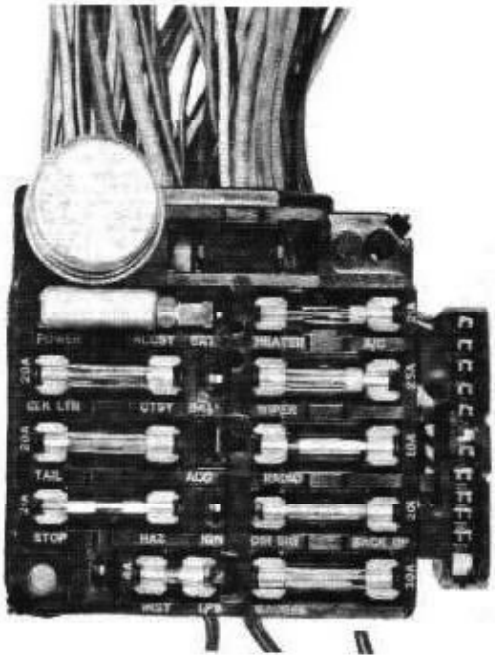


Figure 120-78 Fuse Block - 45-46-48-49000 Series

Electrical Circuit	Series	Ground Location	Relay Location
Buzzer & Horn Relay	All	Jamb Switch & Horn Bracket	Radio Bracket
Cruise	All	Transducer Case	None
Rear Window Defogger	All	Blower to Rear Shelf	None
Heated Rear Glass	All	Right Trunk Bracket	I.P. Lower Tie Bar
Wiper	43-44000	Brake Bracket & Motor Case	None
Wiper	45-46-48-49000	Radio Bracket & Motor Case	None
Wiper, Demand	45-46-48-49000	Radio Bracket & Motor Case	None
Ignition & Starter	All	Coil & Starter Case	None
Charging Circuit	All Except 49000	Generator Field	In Voltage Regulator
Charging Circuit	49000	Integral Voltage Regulator	None
Fuel Gage	43-44000	Brake Bracket & Underbody	None
Fuel Gage	45-46-48-49000	Radio Bracket & Underbody	None
Heater	43-44000	Blower to Dash	None
Heater	45-46-48-49000	Blower to Dash	Right Front of Dash
Air Conditioner	43-44000	Blower to Dash	Right Front of Dash
Air Conditioner	45-46-48-49000	Blower to Dash	2-Right Front of Dash
Air Conditioner Automatic	45-46-48-49000	Blower to Dash	3-Right Front of Dash
I.P. Illumination	43-44000	Brake Pedal Bracket	None
I.P. Illumination	45-46-48-49000	Radio Bracket	None
Indicator Lights	43-44000	Sender Switch & Generator Field	None
Indicator Lights	45-46-48-49000	Sender Switch & Generator Field	None
I.P. Gages	43-44000	Sender Switch & Tank Unit	None
T.C.S. Solenoid & C.E.C. Valve (L-6)	43-44000	Transmission Switch	2-Front of Dash
Back-Up & T.C.S. Solenoid	All Except L-6	Back-Up Lamps & Trans. Switch	None
Dome & Clock	43-44000	Door Jamb Switch & I.P. Ground	None
Dome & Trunk Release	45-46-48-49000	Door Jamb Switch & Solenoid	None
Radio Trans. D.S. & Map Light	45-46-48-49000	Radio Bracket & Transmission Case	None
Turn Signals	All	Bulkhead & Trunk Striker	None
Cornering Lamps	45-46-48-49000	Bulkhead	None
Max. Trac.	45-46-48-49000	Controller	None
Door & Seat Back Lock	45-46-48-49000	Solenoids	Above Right Kick Pad
6-Way Power Seat	45-46-48-49000	Motor & Clutch Solenoid	Under Left Front Seat
Power Windows	45-46-48-49000	Motors	Above Left Kick Pad

120-79

Figure 120-79 Ground and Relay Location Chart

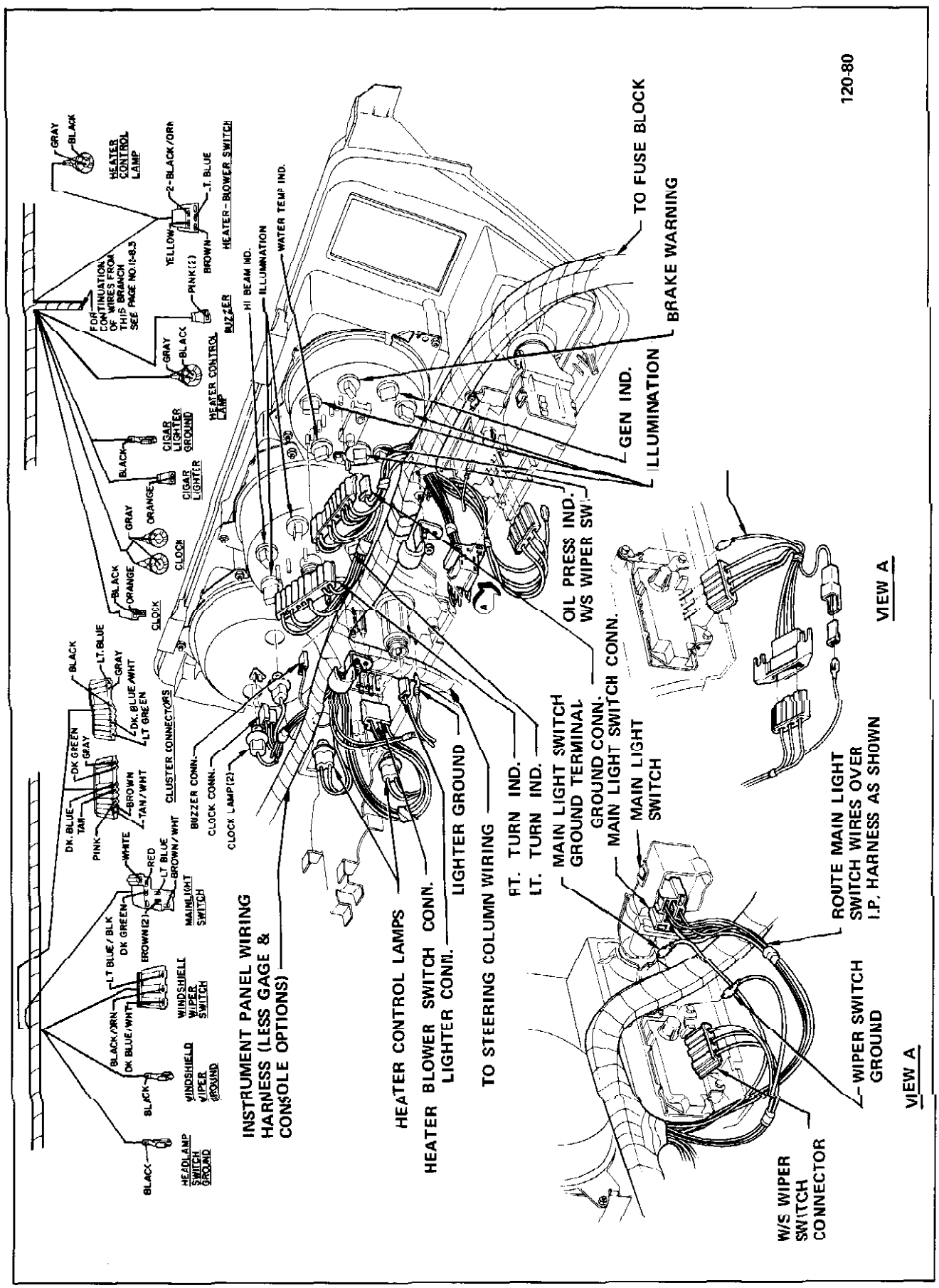


Figure 120-80 Instrument Cluster Wiring - 43-44000 Series

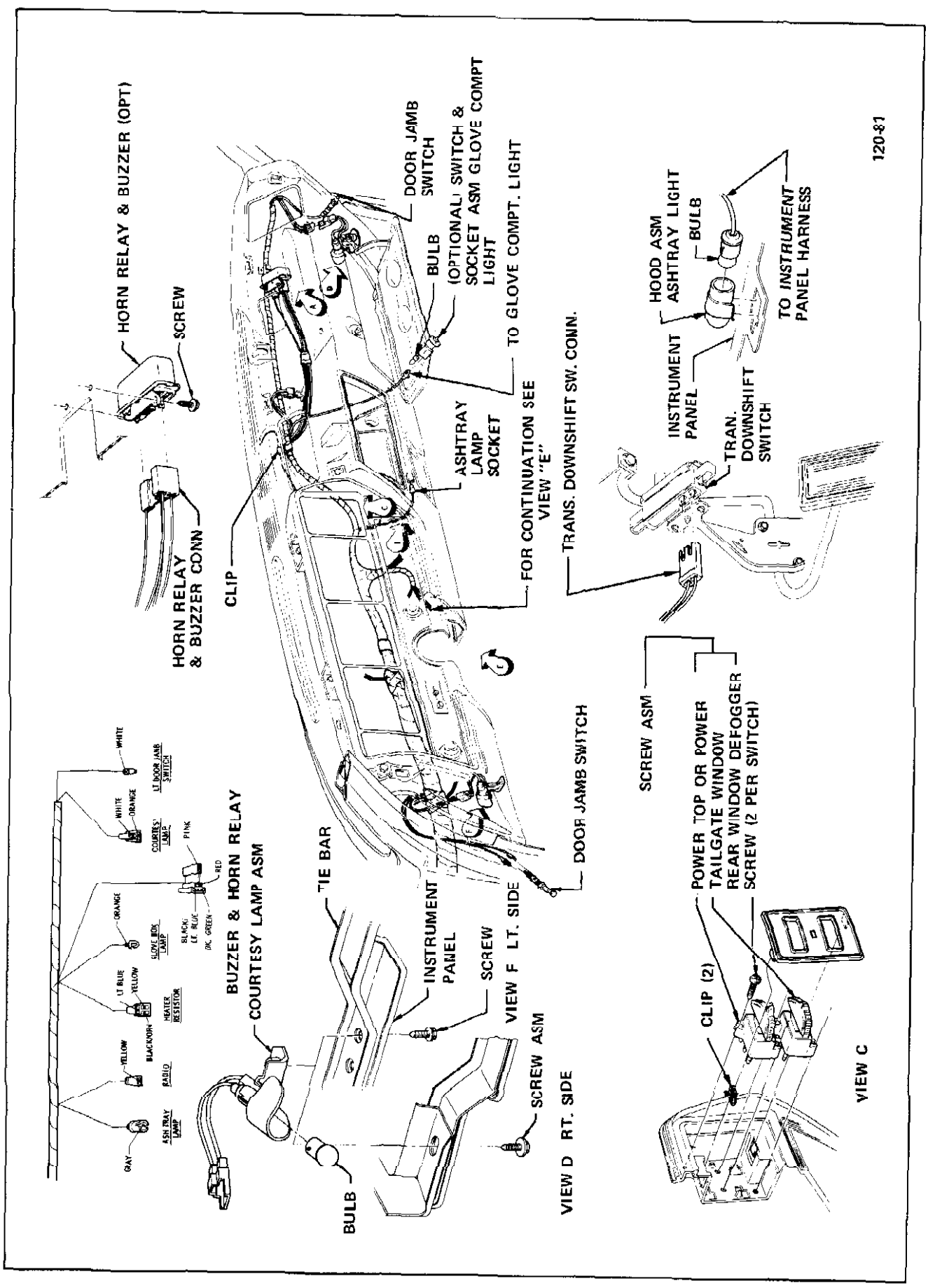


Figure 120-81 Instrument Panel Wiring - 43-44000 Series

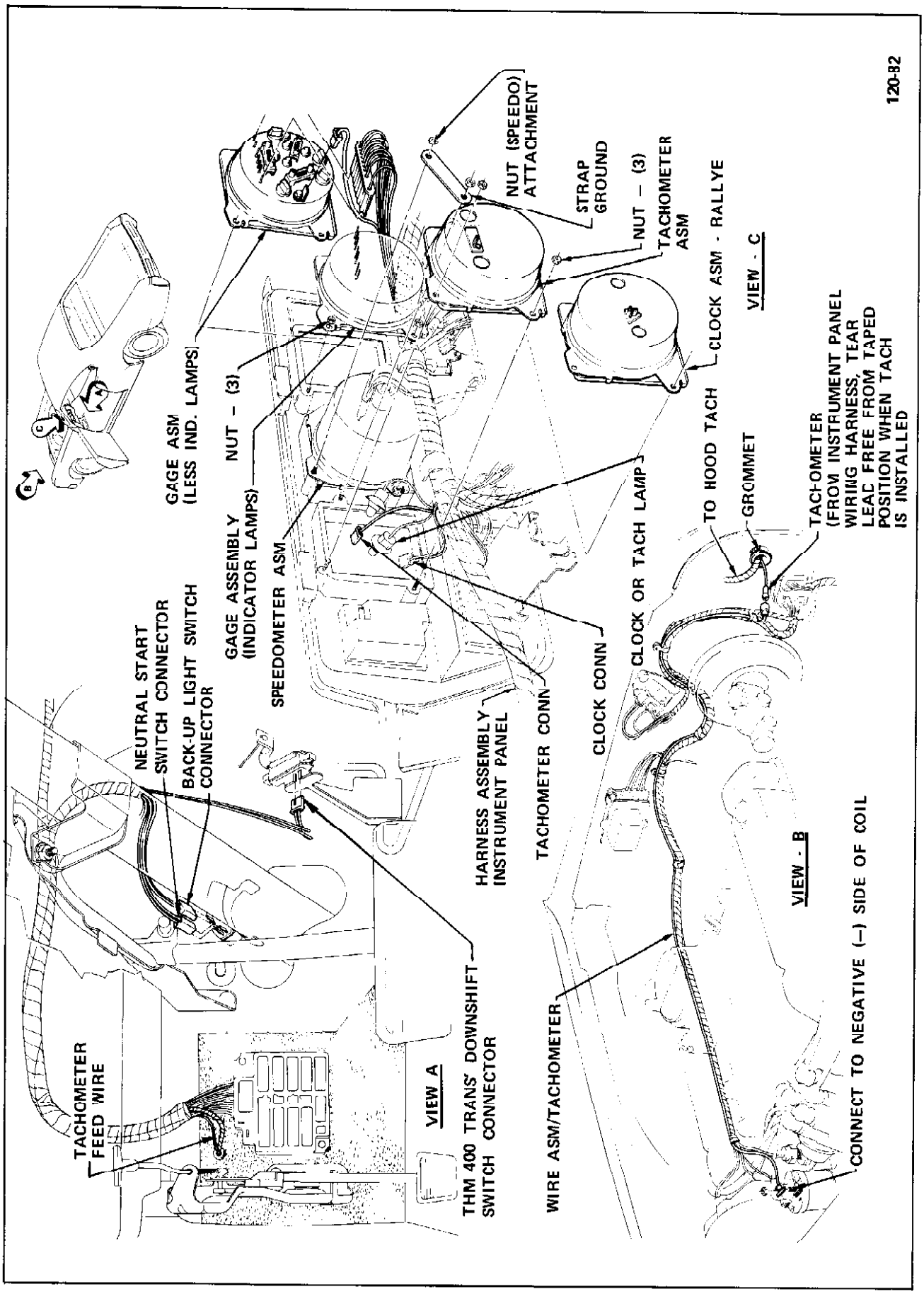


Figure 120-82 Gauges, Tachometer, and Rallye Clock Wiring - 43-44000 Series

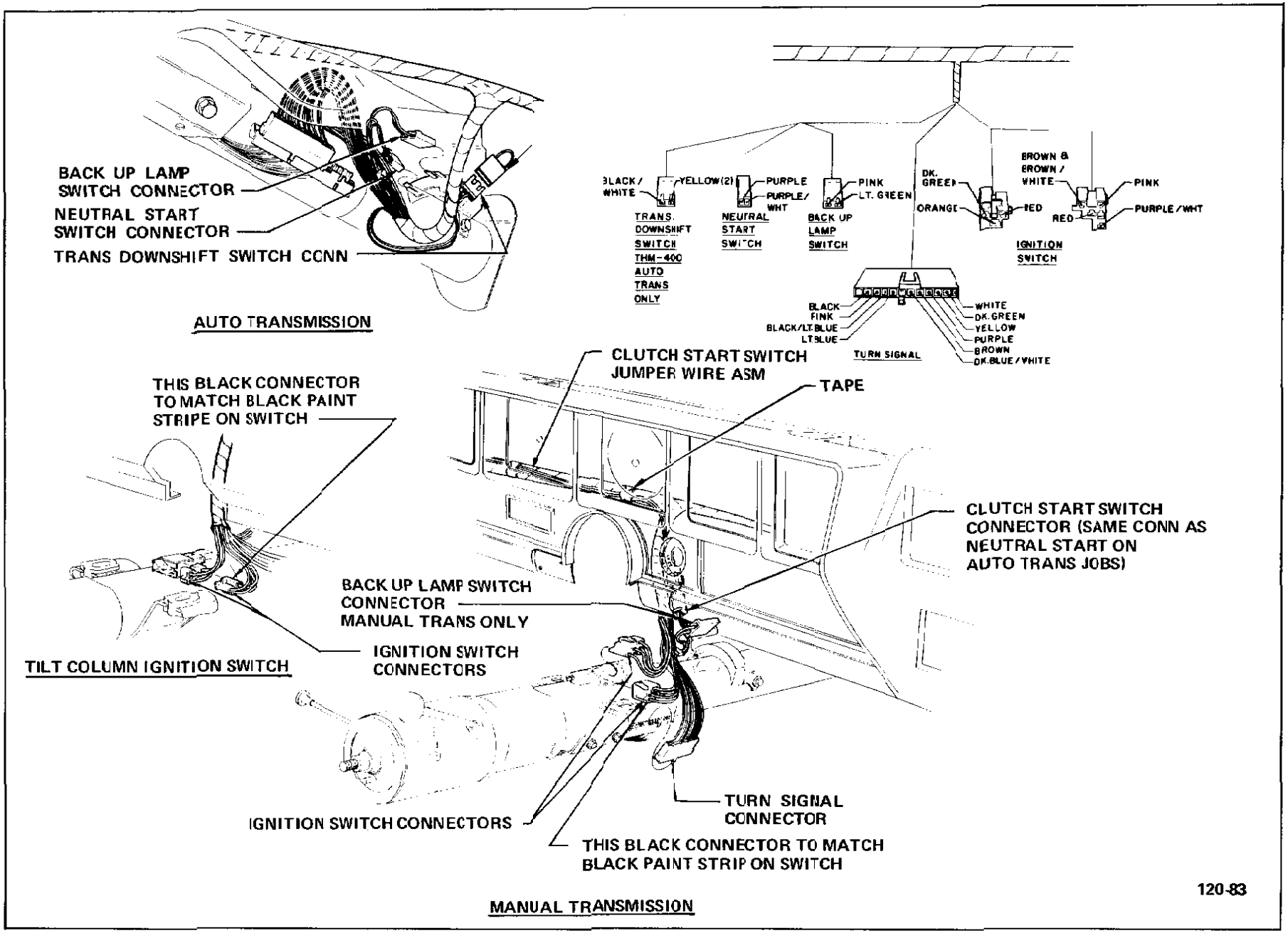


Figure 120-83 Steering Column Wiring - 43-44000 Series

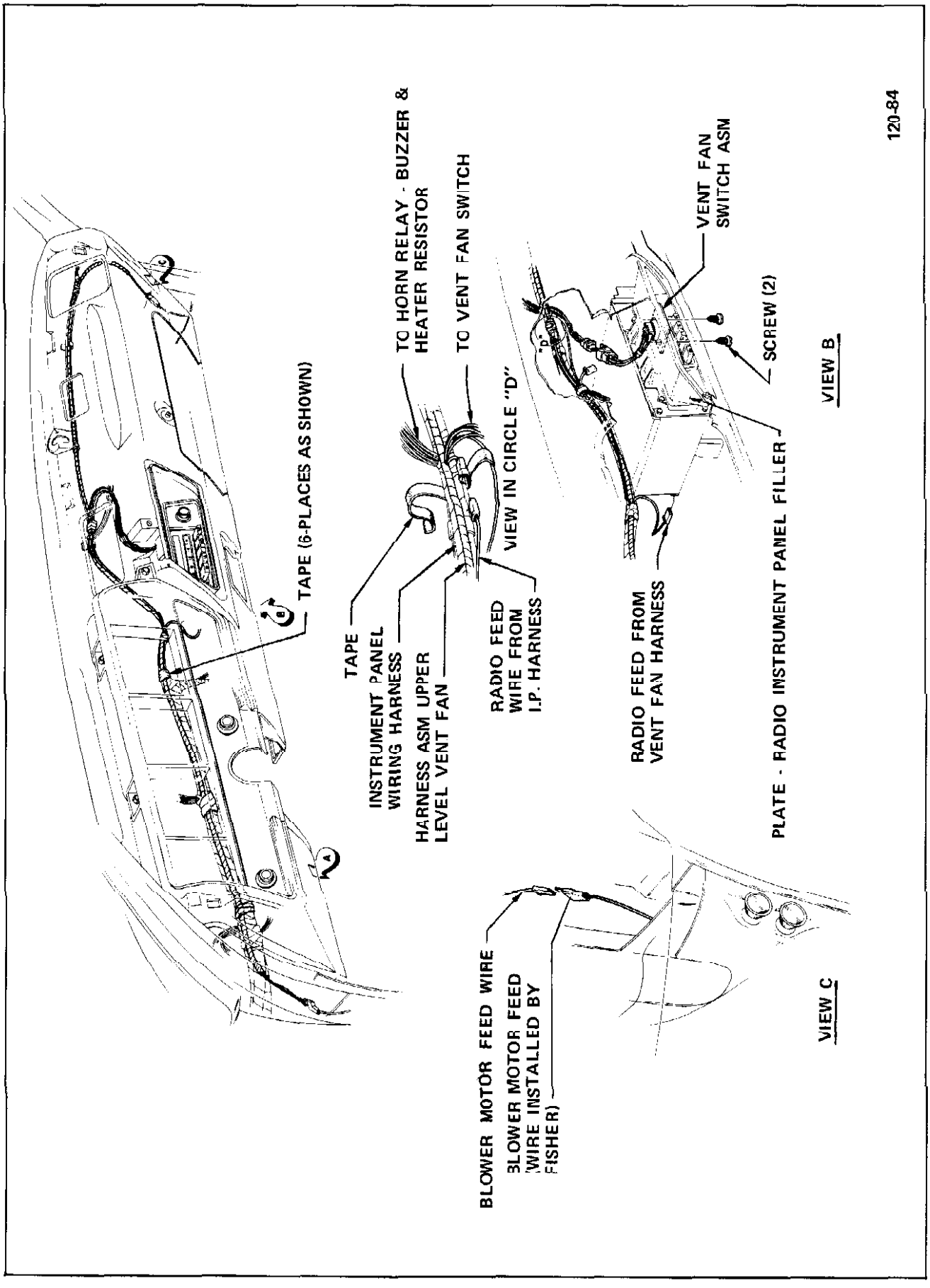


Figure 120-84 Upper Level Vent Fan - 43-44000 Series

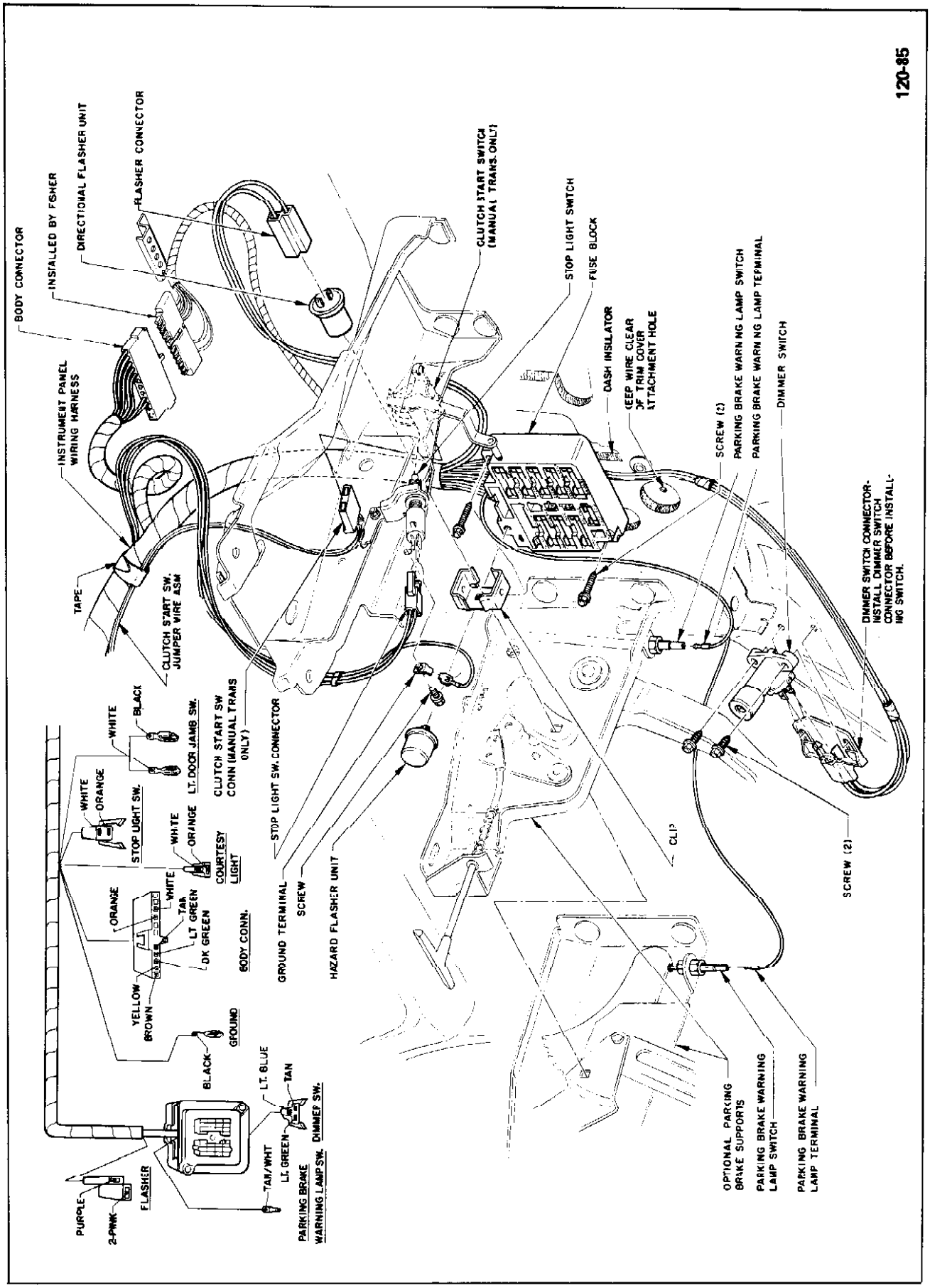


Figure 120-85 Fuse Block Wiring - 43-44000 Series

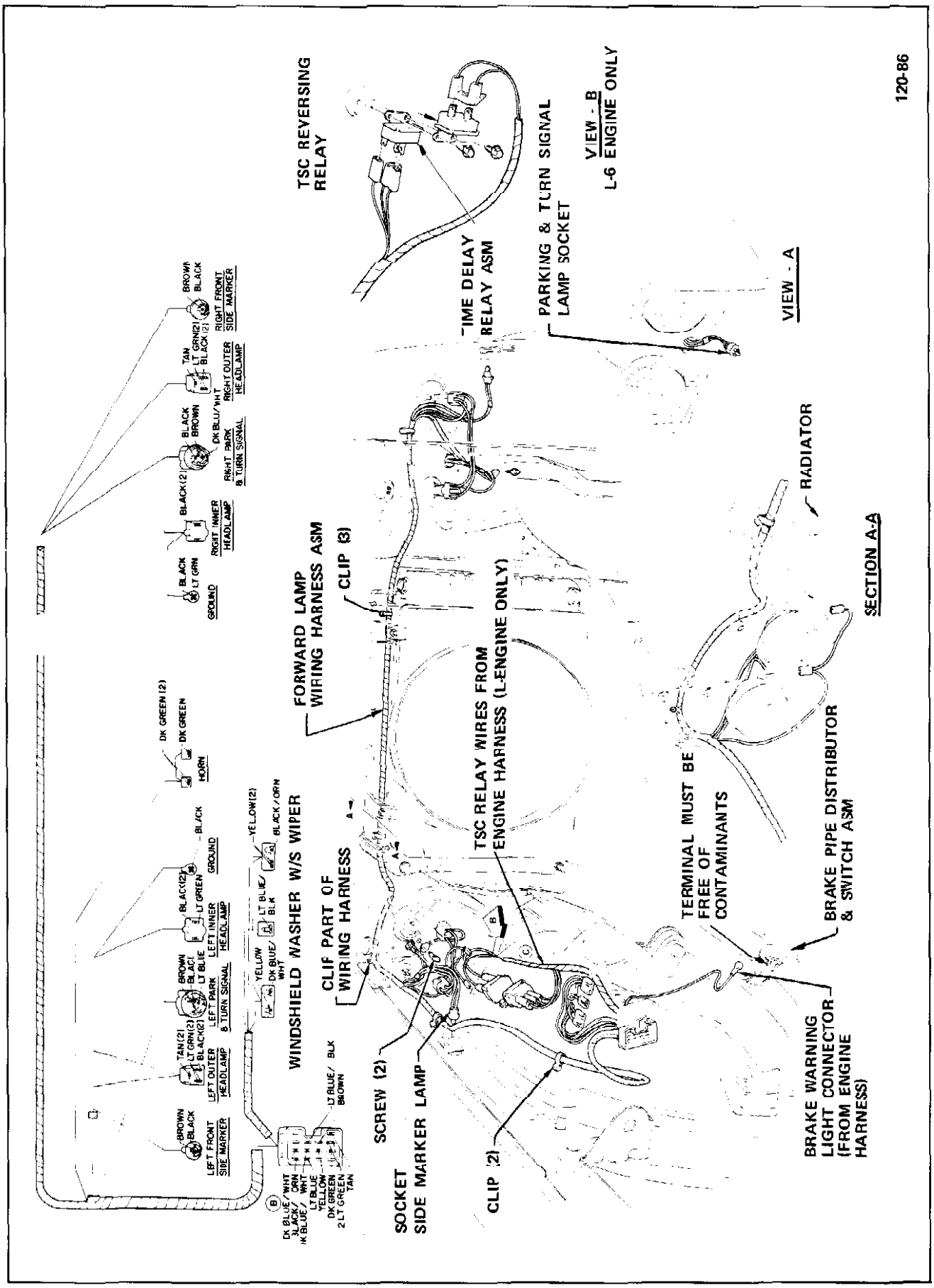


Figure 120-86 Forward Lamp Wiring - 43-44000 Series

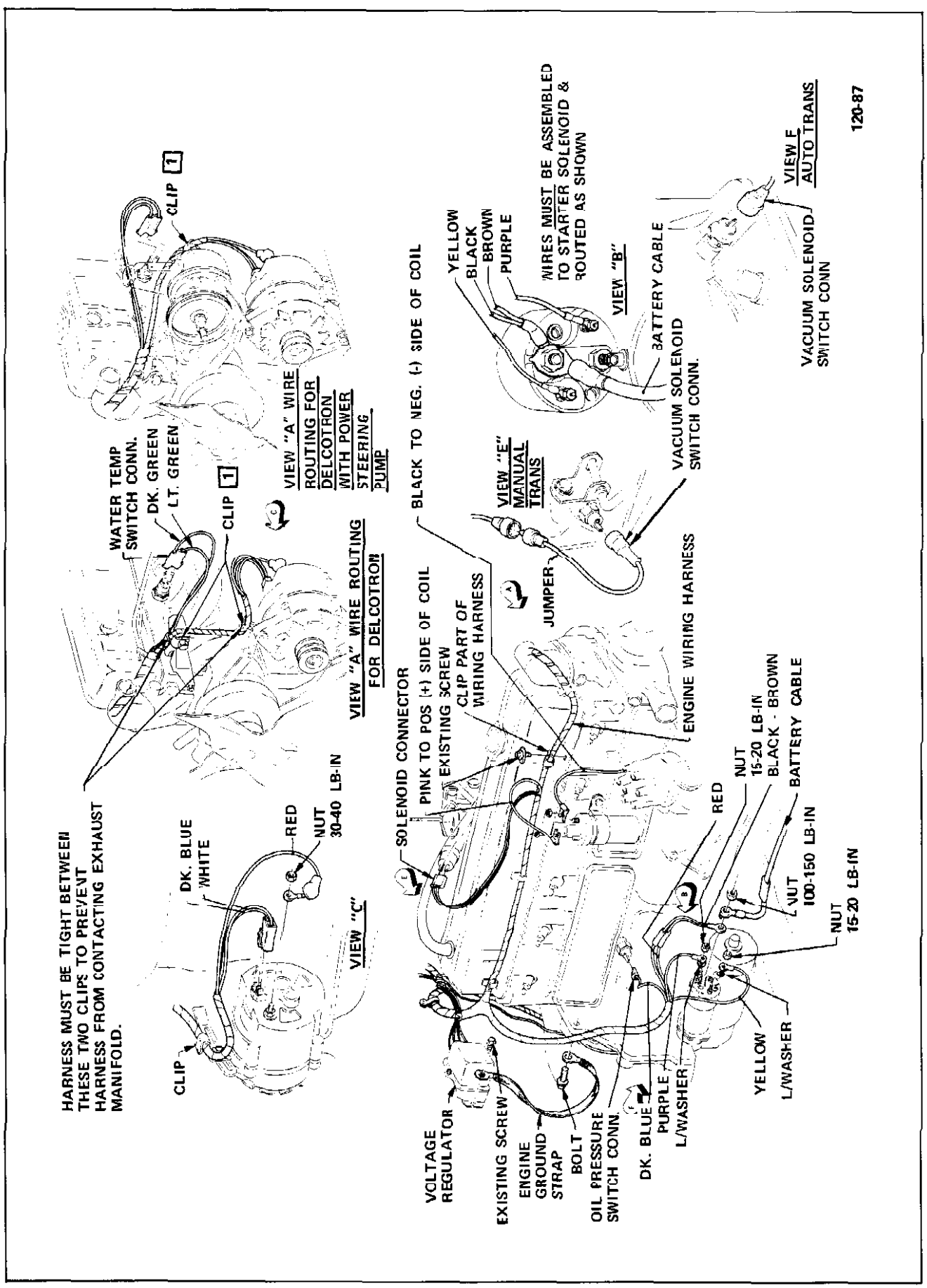


Figure 120-87 L-6 Engine Wiring - 43-44000 Series

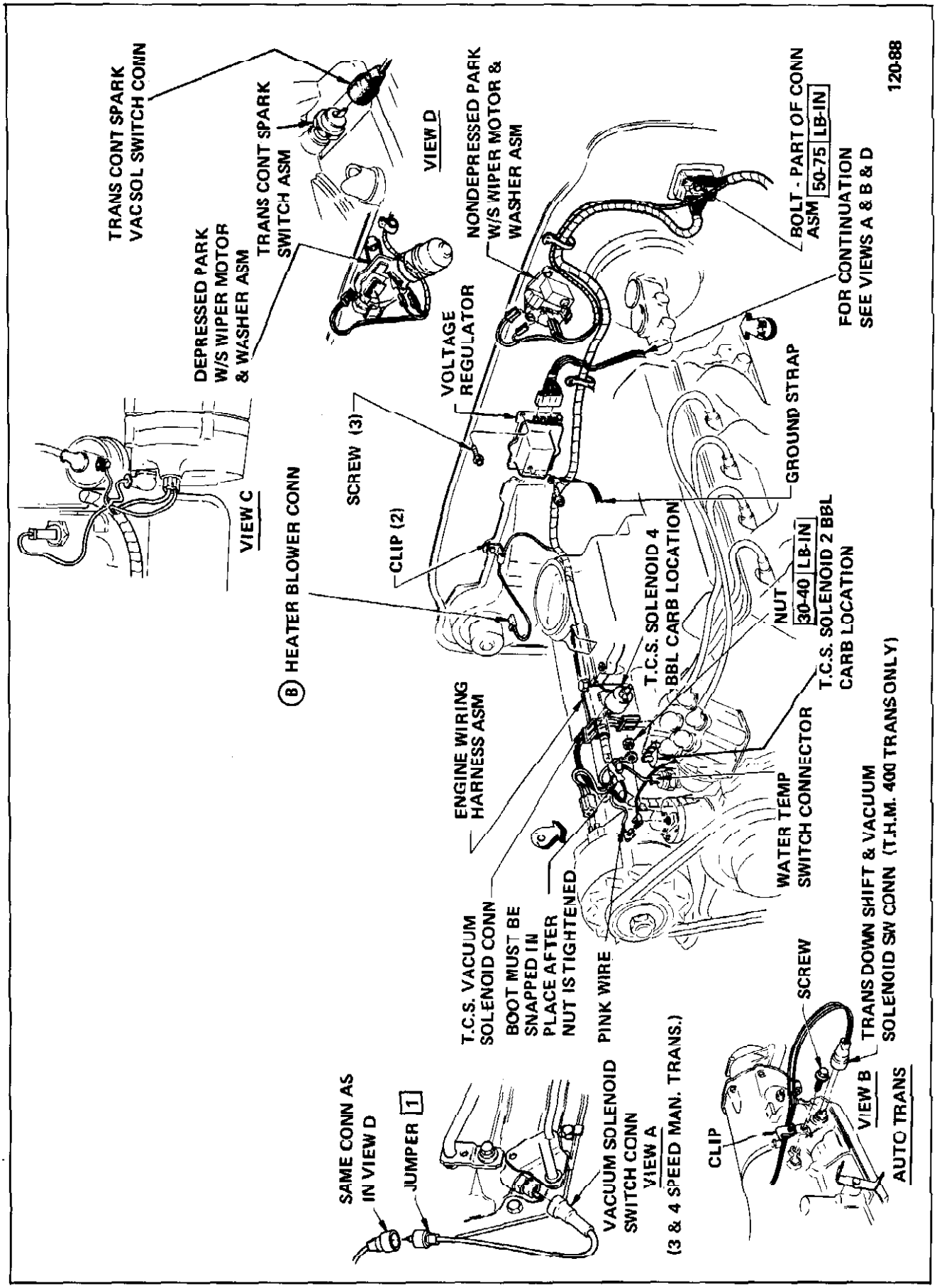


Figure 120-88 V-8 Engine Wiring - 43-44000 Series

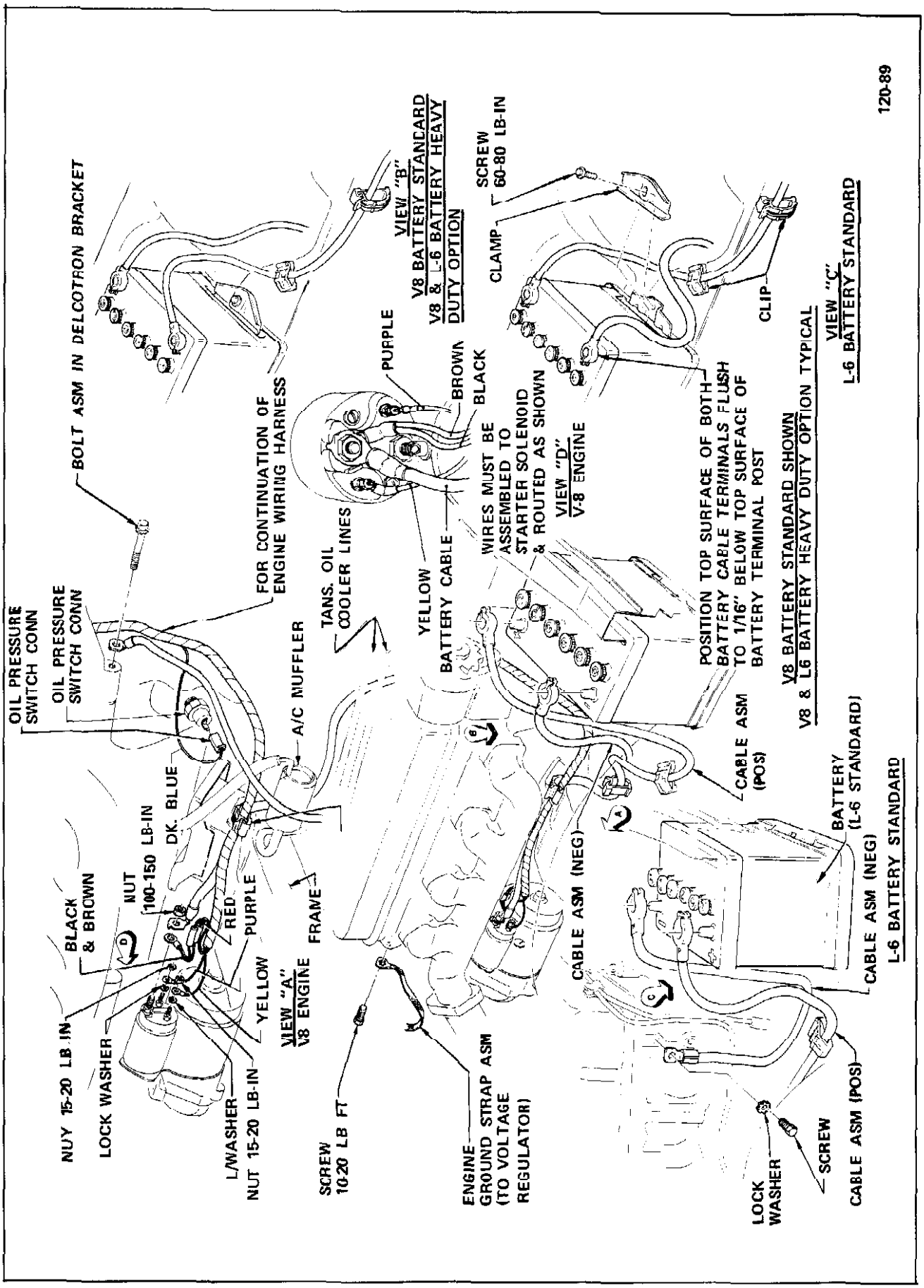


Figure 120-89 Battery Cable Wiring - 230 and 350 Engines - 43-44000 Series

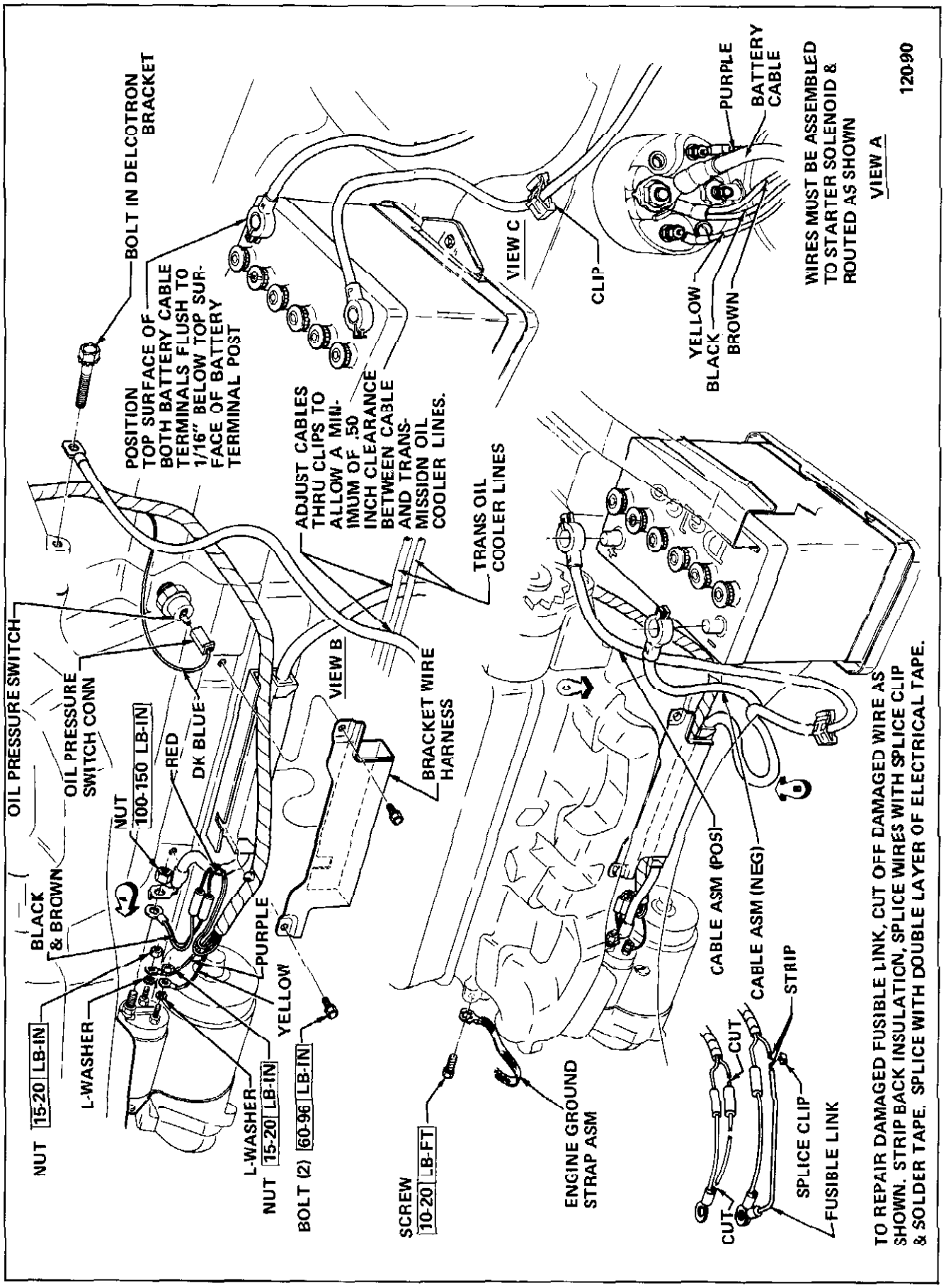


Figure 120-90 Battery Cable Wiring - 455 Engine - 43000 Series

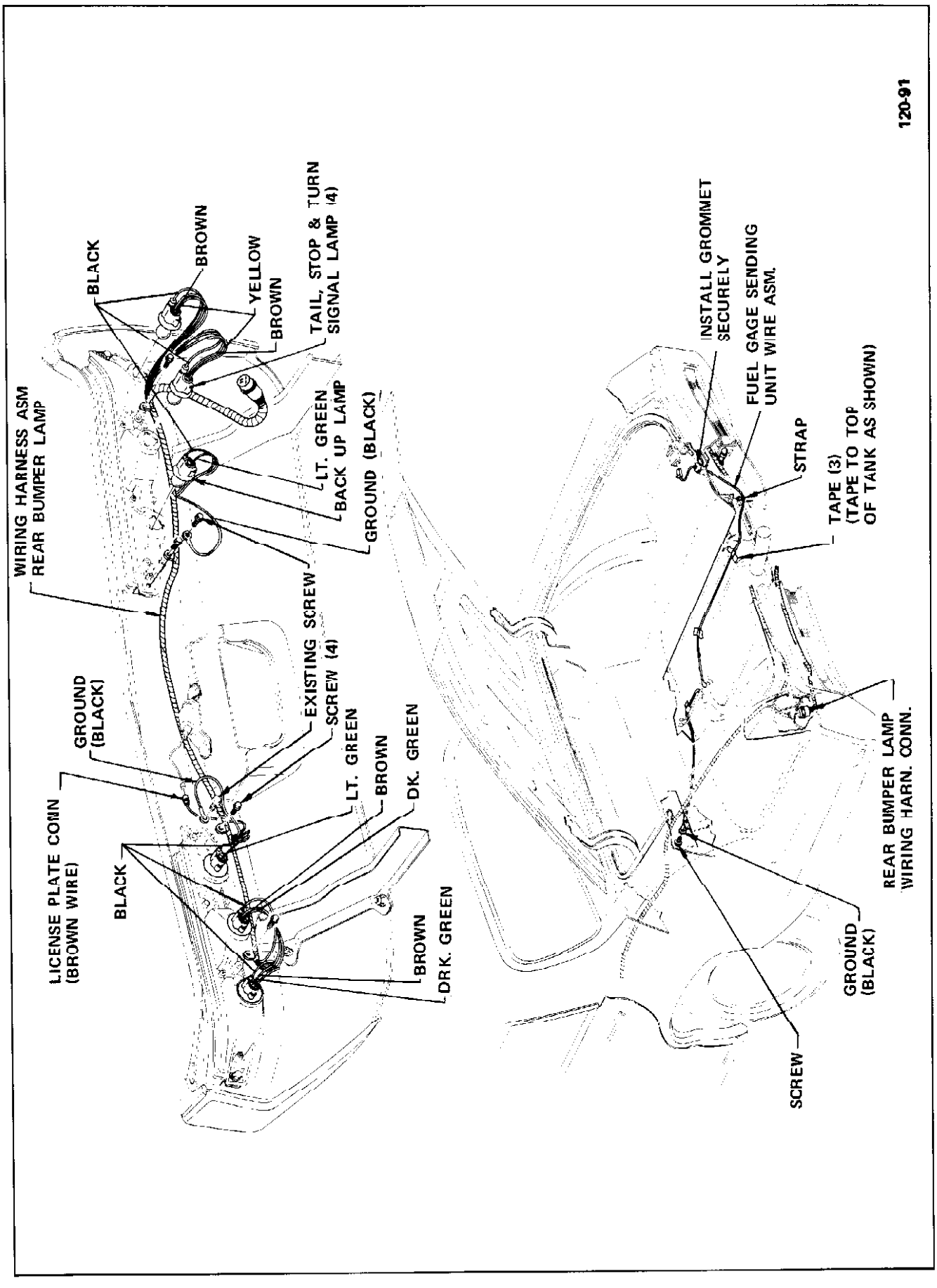


Figure 120-91 Rear Lamp and Fuel Tank Wiring - (Less Wagons) 43-44000 Series

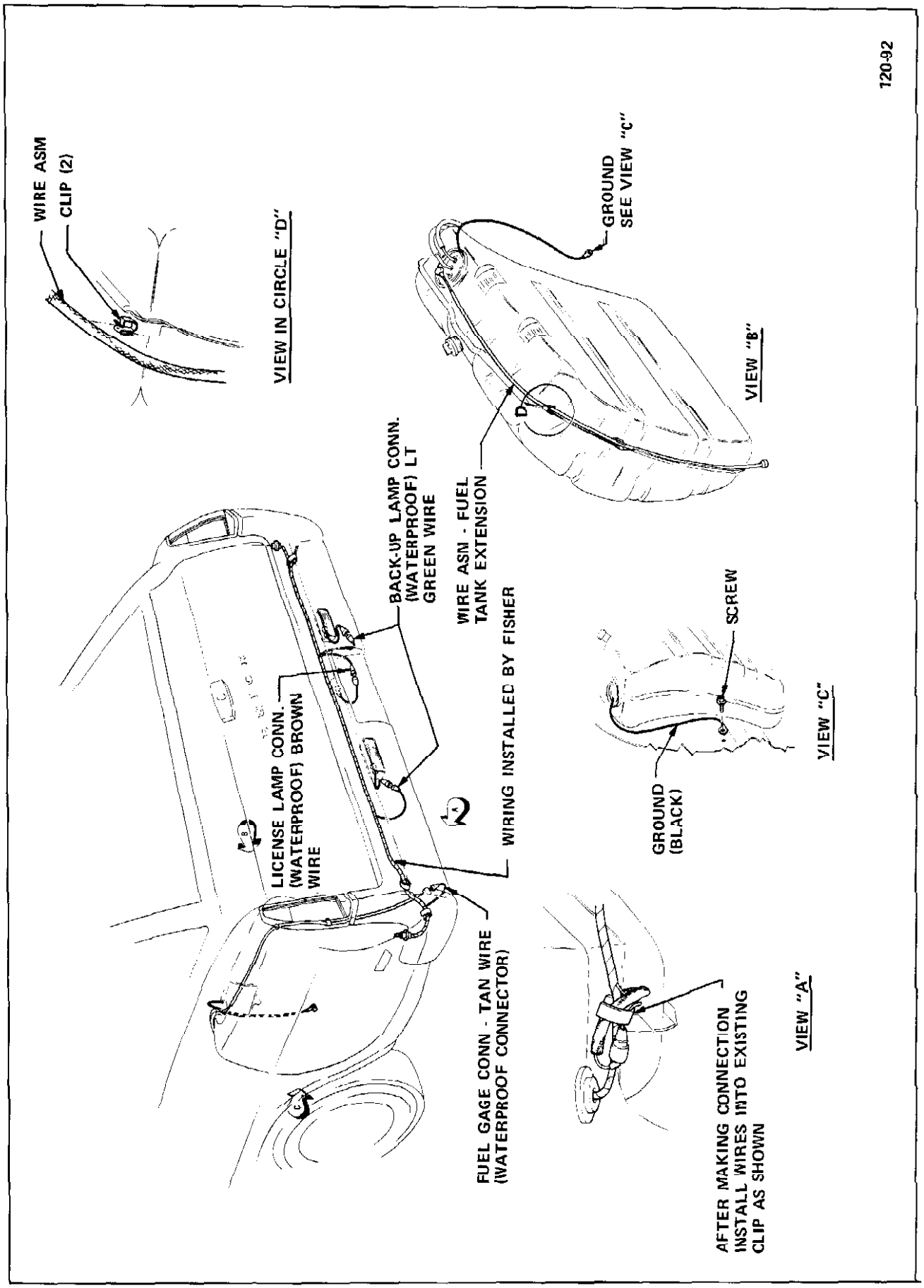


Figure 120-92 Rear Lamp and Fuel Tank Wiring - Sportwagons 43-44000 Series

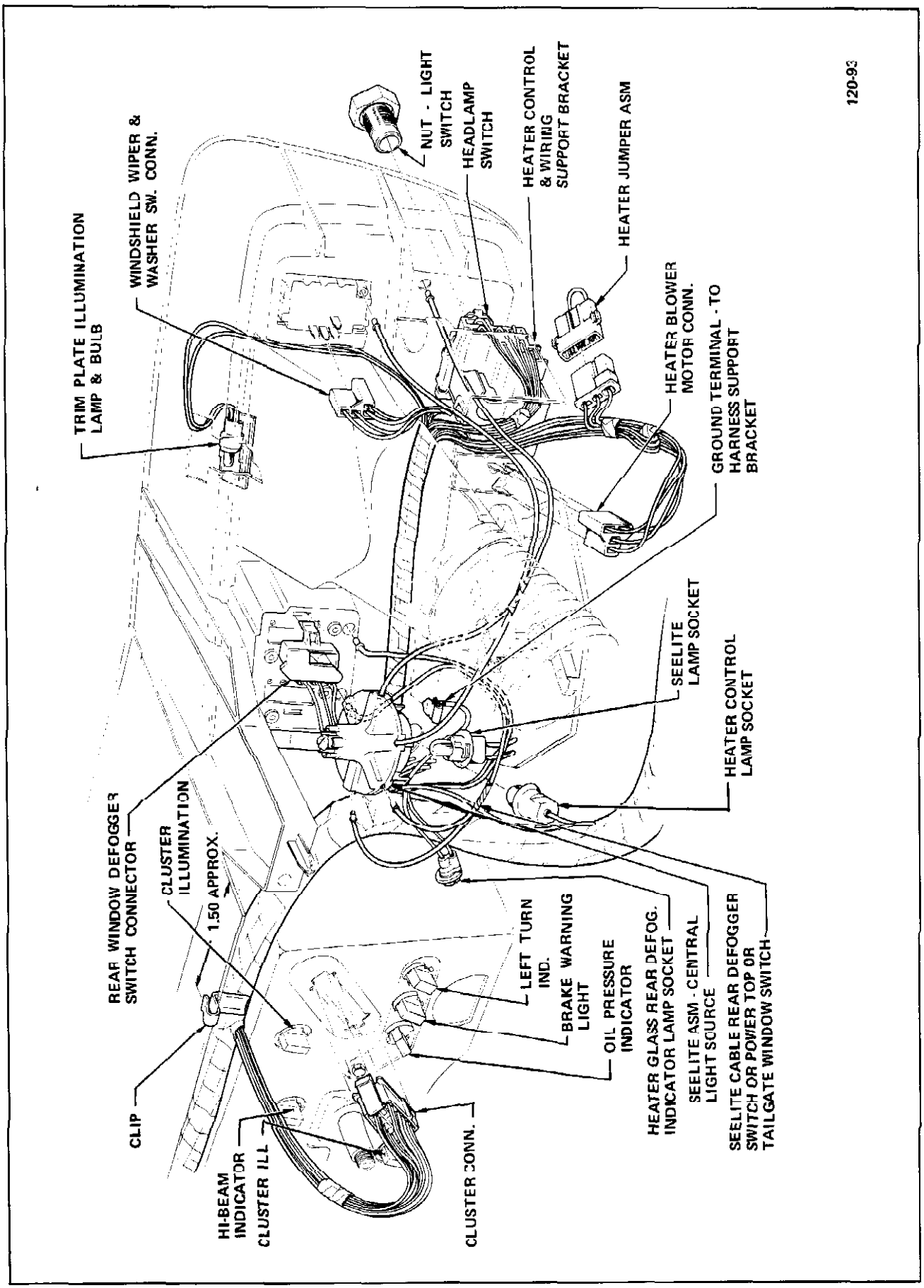


Figure 120-93 Left Side Instrument Panel Wiring - 45-46-48-49000 Series

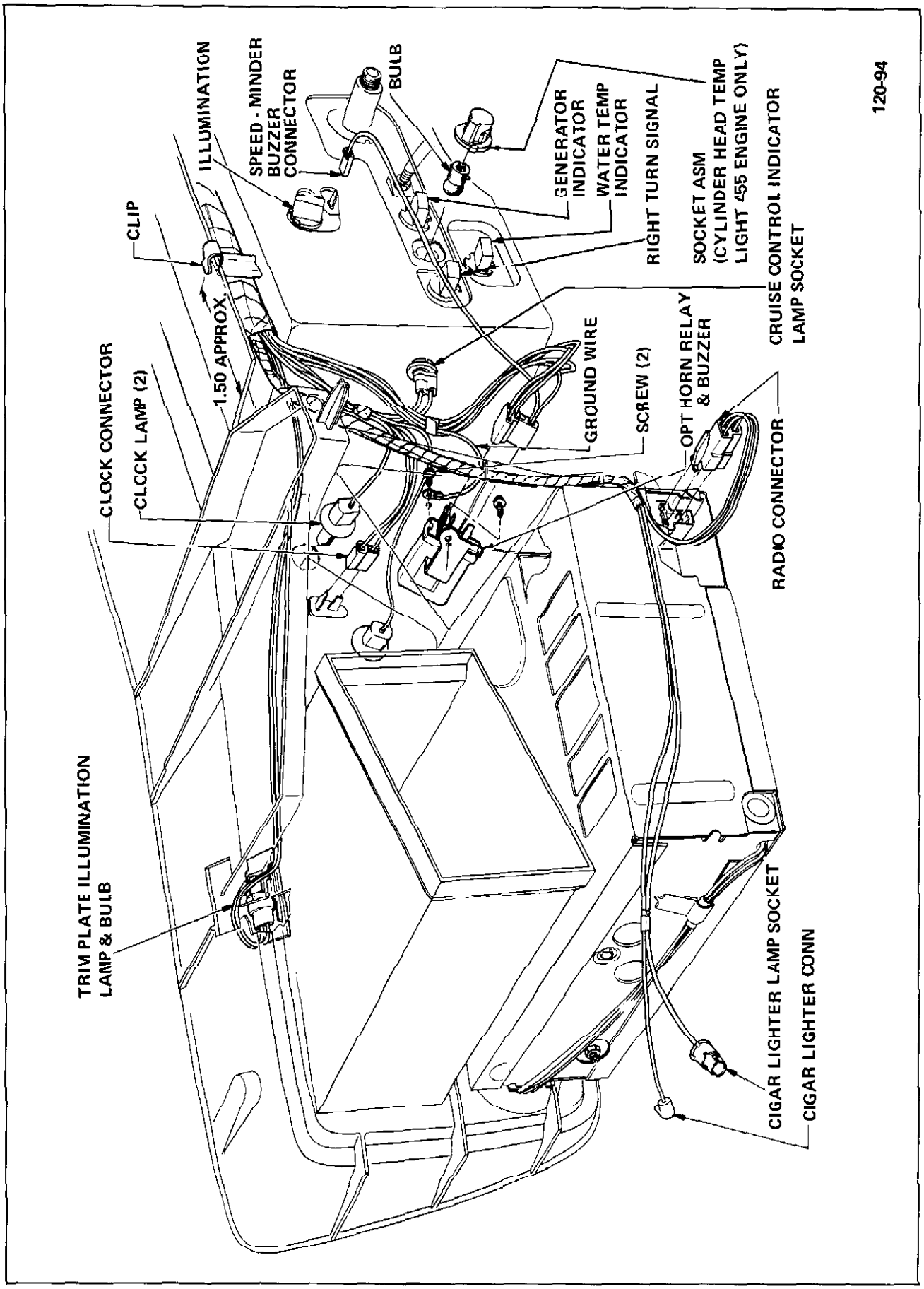


Figure 120-94 Right Side Instrument Cluster Wiring - 45-46-48-49000 Series

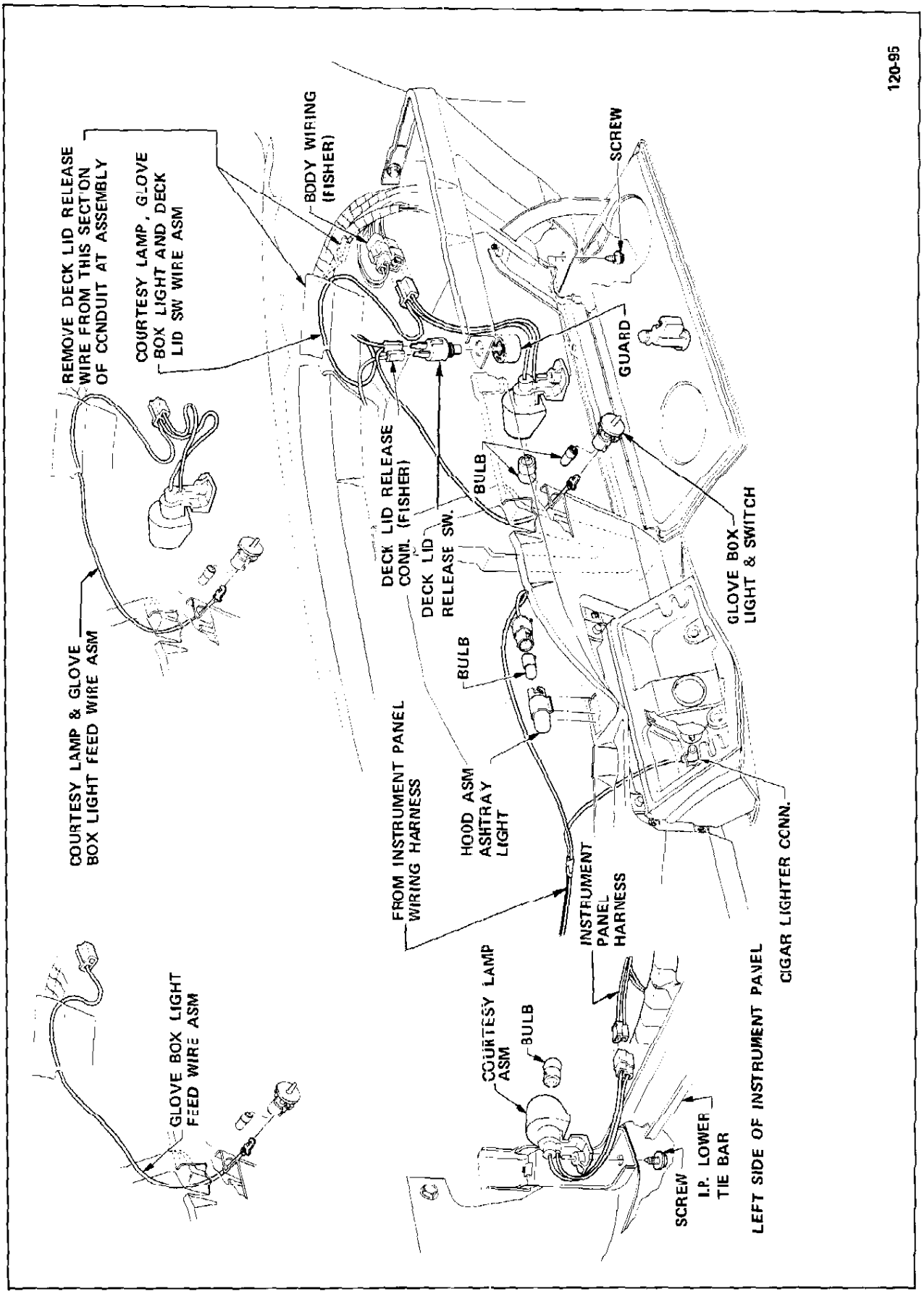


Figure 120-95 Right Side Instrument Panel Wiring - 45-46-48-49000 Series

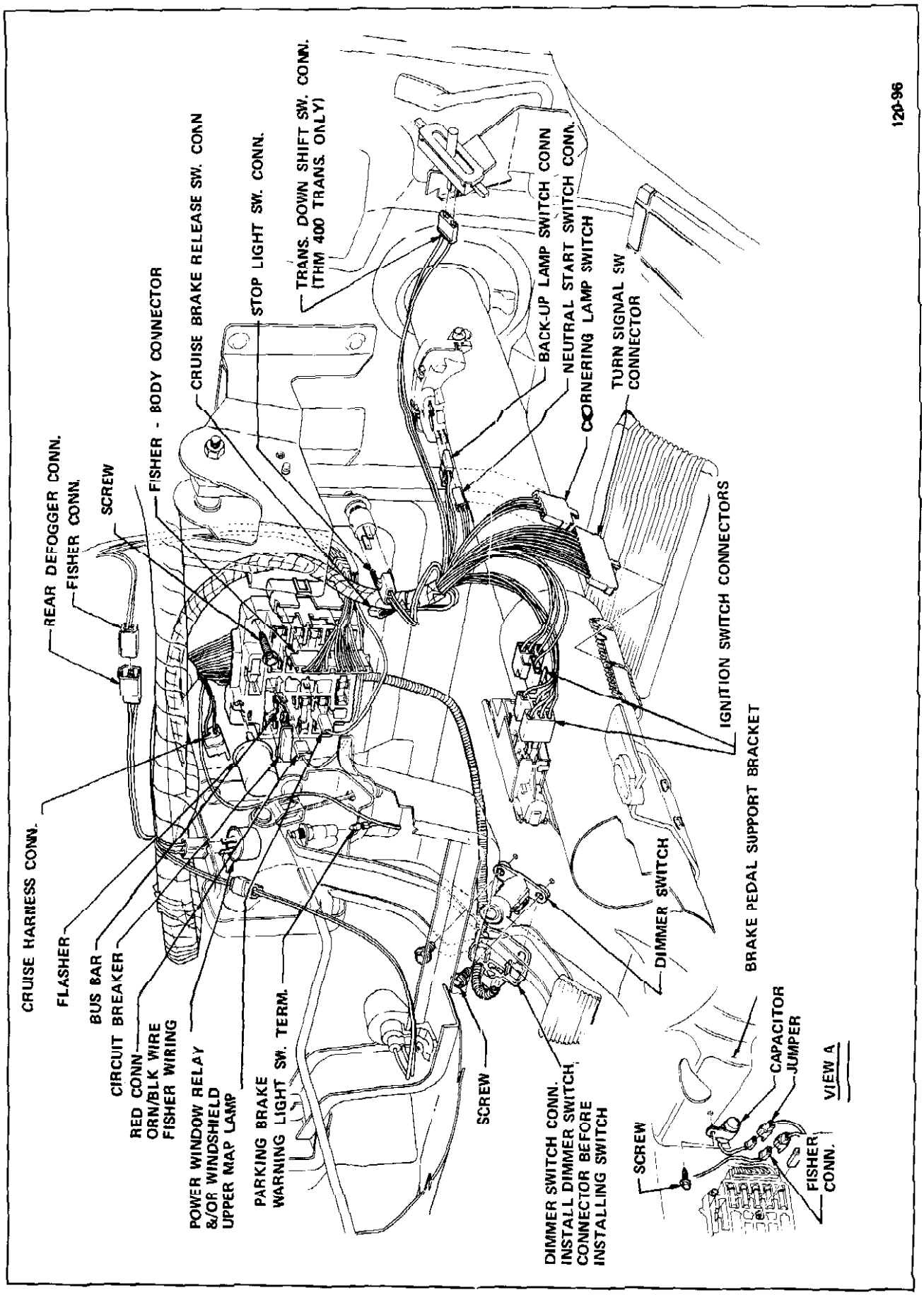


Figure 120-96 Fuse Block and Steering Column - 45-46-48-49000 Series

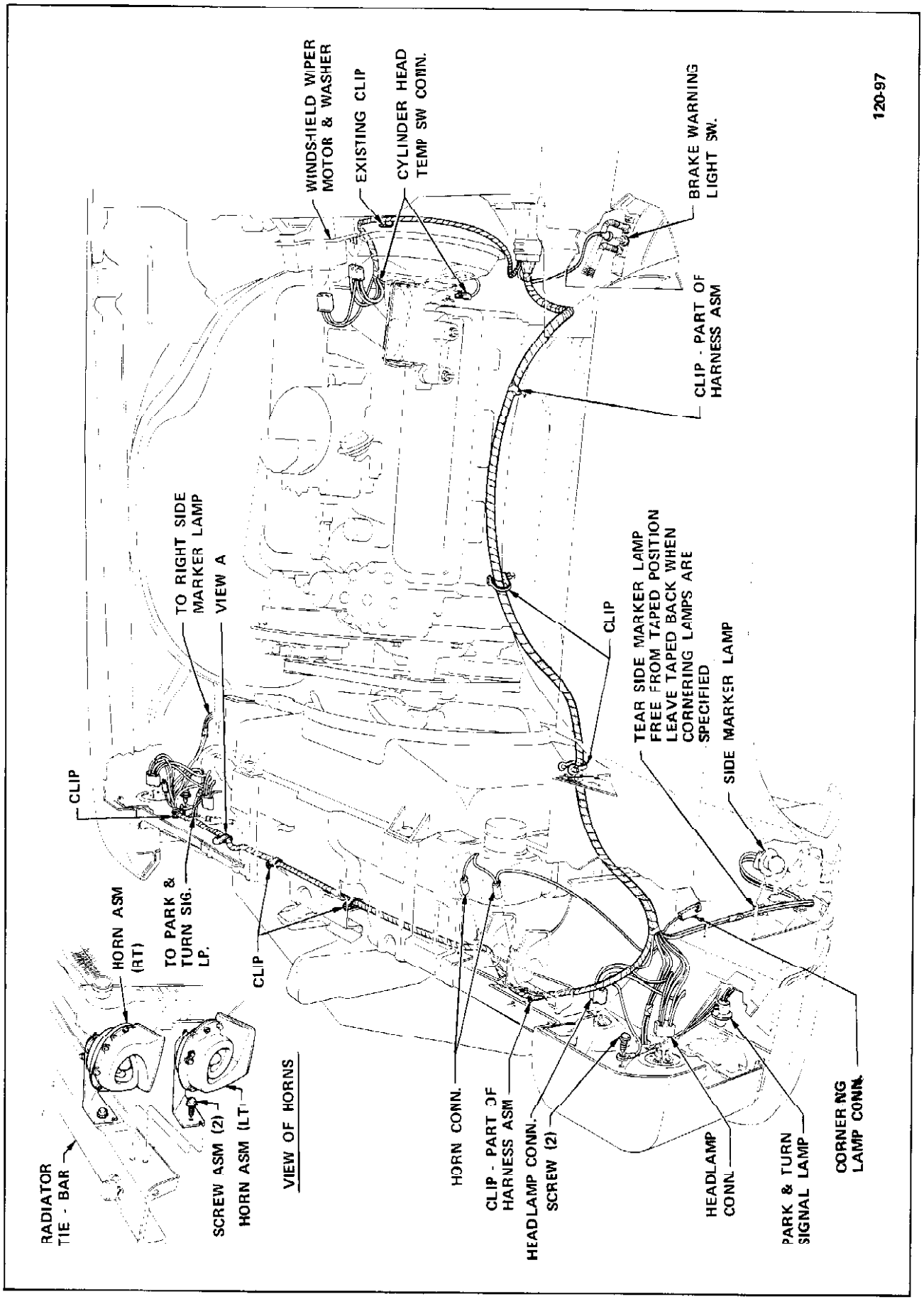


Figure 120-97 Forward Lamp and Horn Wiring - 45-46-48000 SERIES

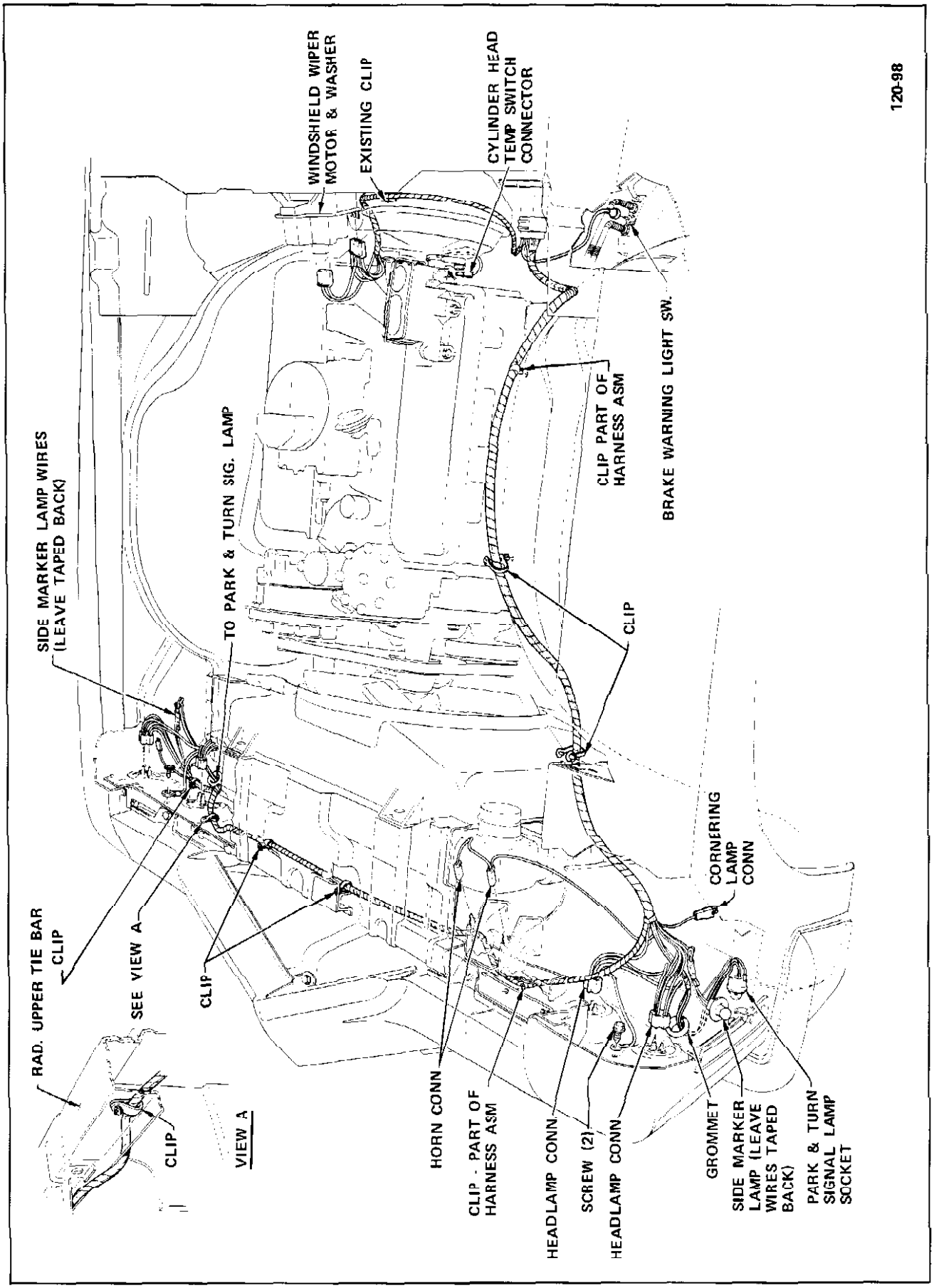


Figure 120-98 Forward Lamp and Horn Wiring - 49000 Series

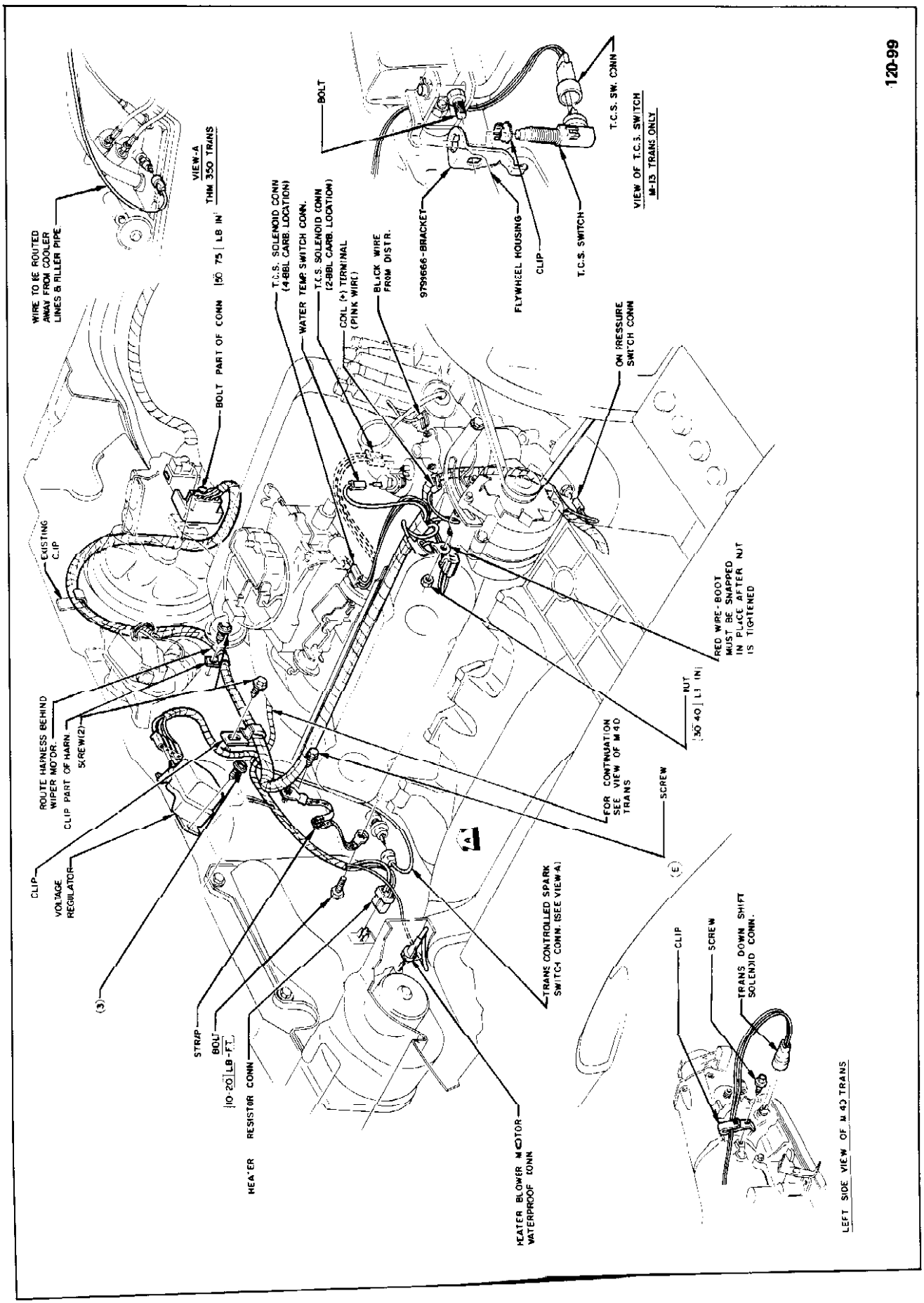


Figure 120-99 Engine Harness - Wiring - 45-46-4800) Series

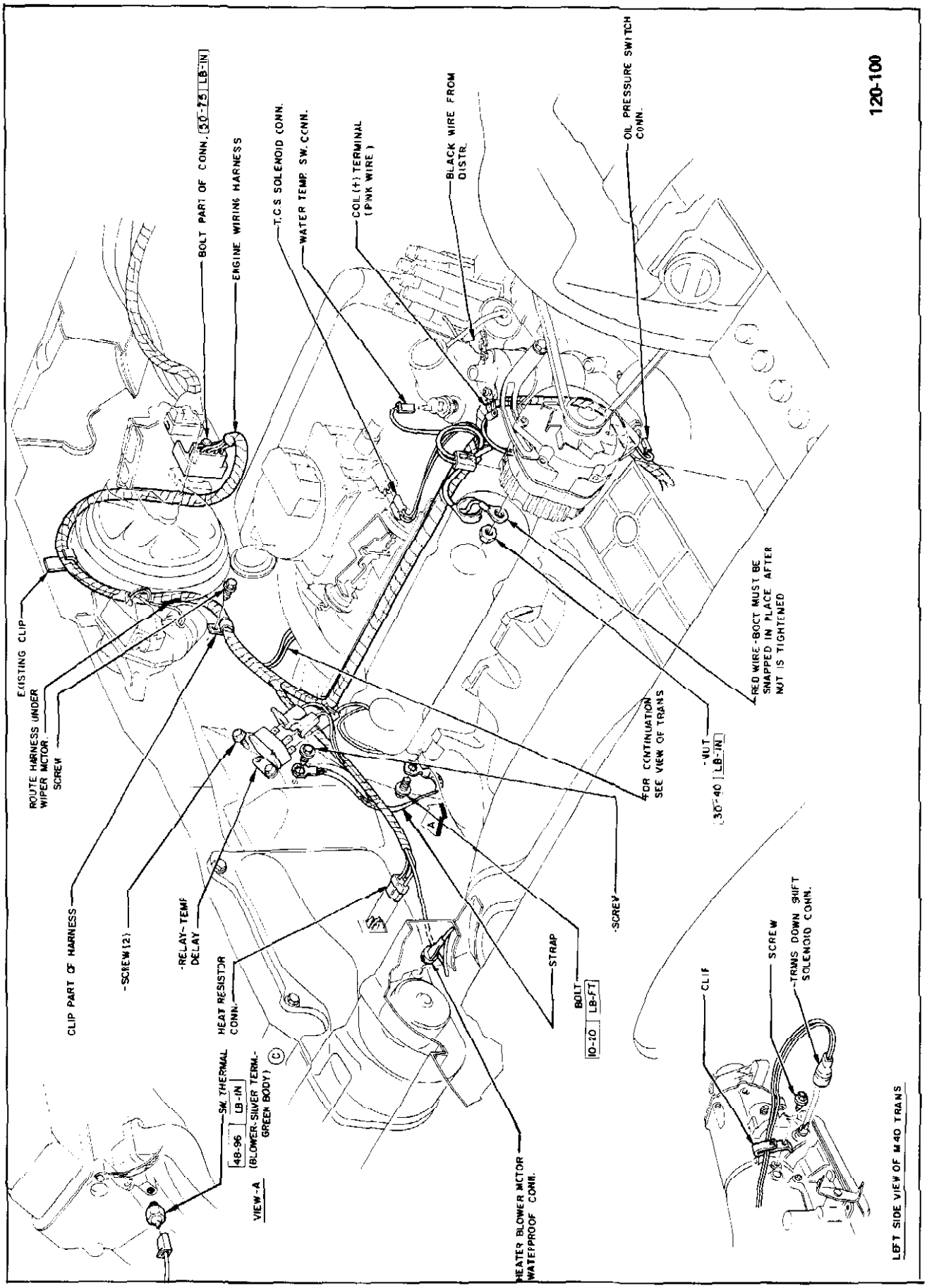


Figure 120-100 Engine Harness - Wiring - 49000 Series

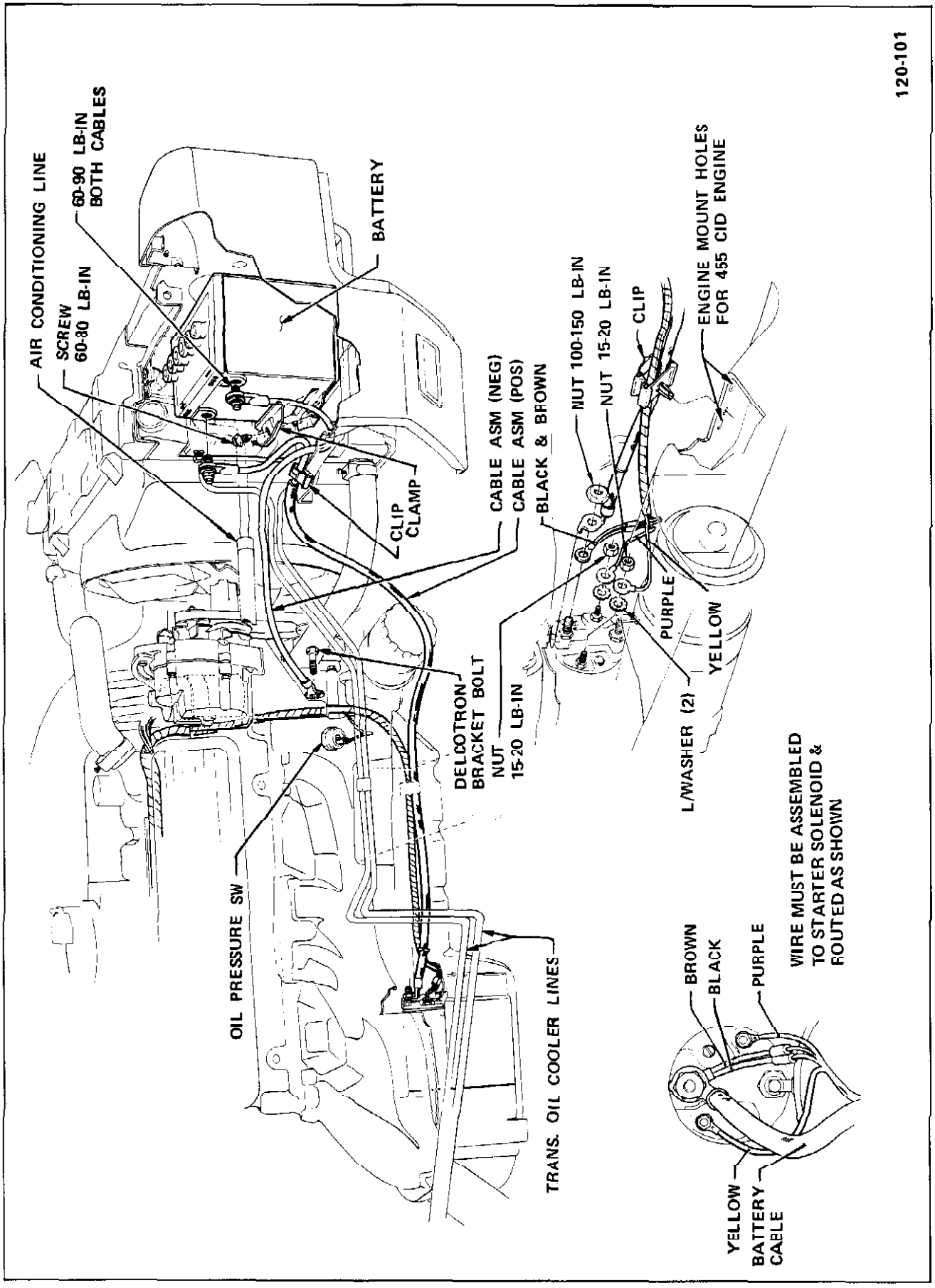


Figure 120-101 Battery Cables and Starter - 350 Engine - 45000 Series

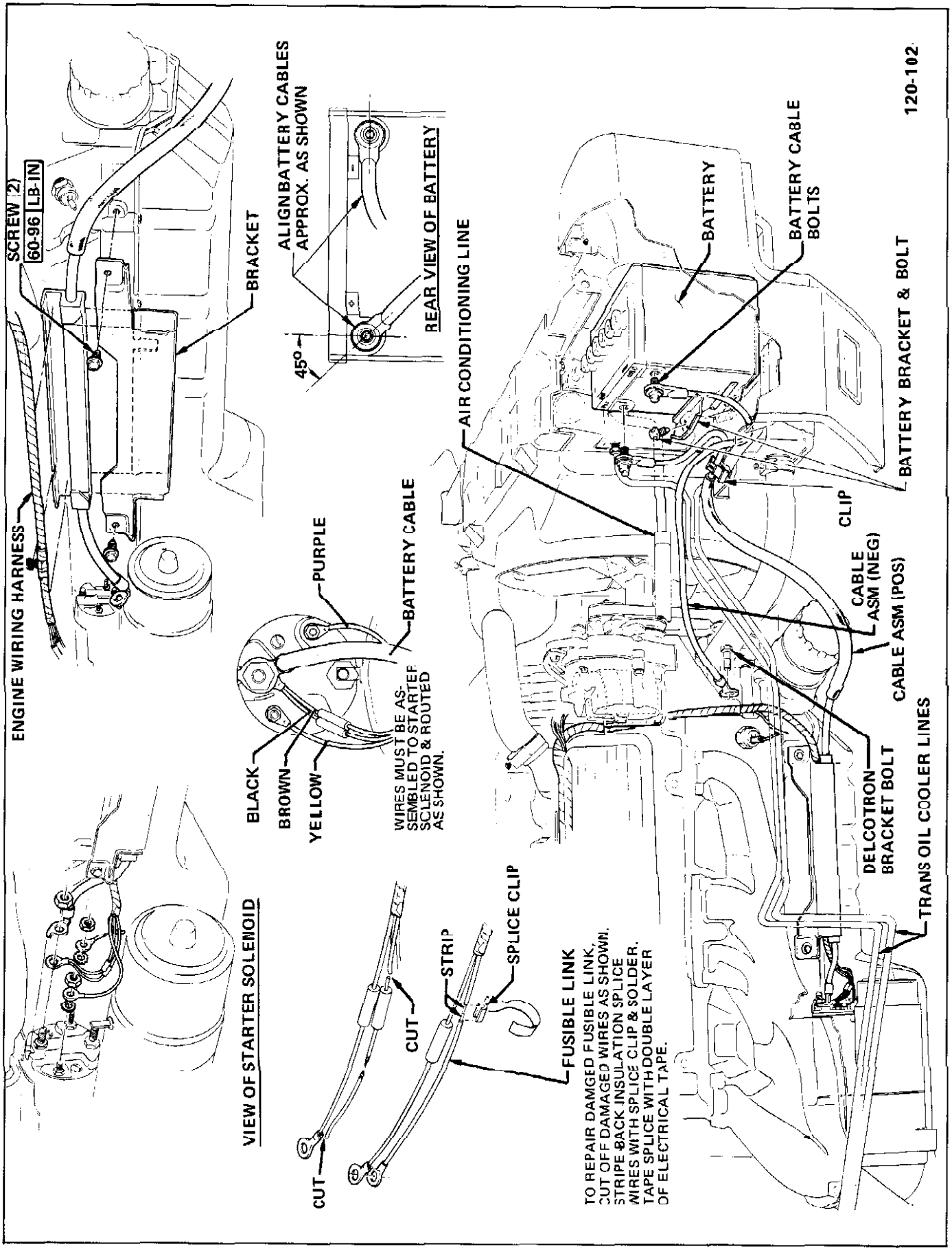


Figure 120-102 Battery Cables and Starter - 455 Engine - 45-46-48-49000 Series

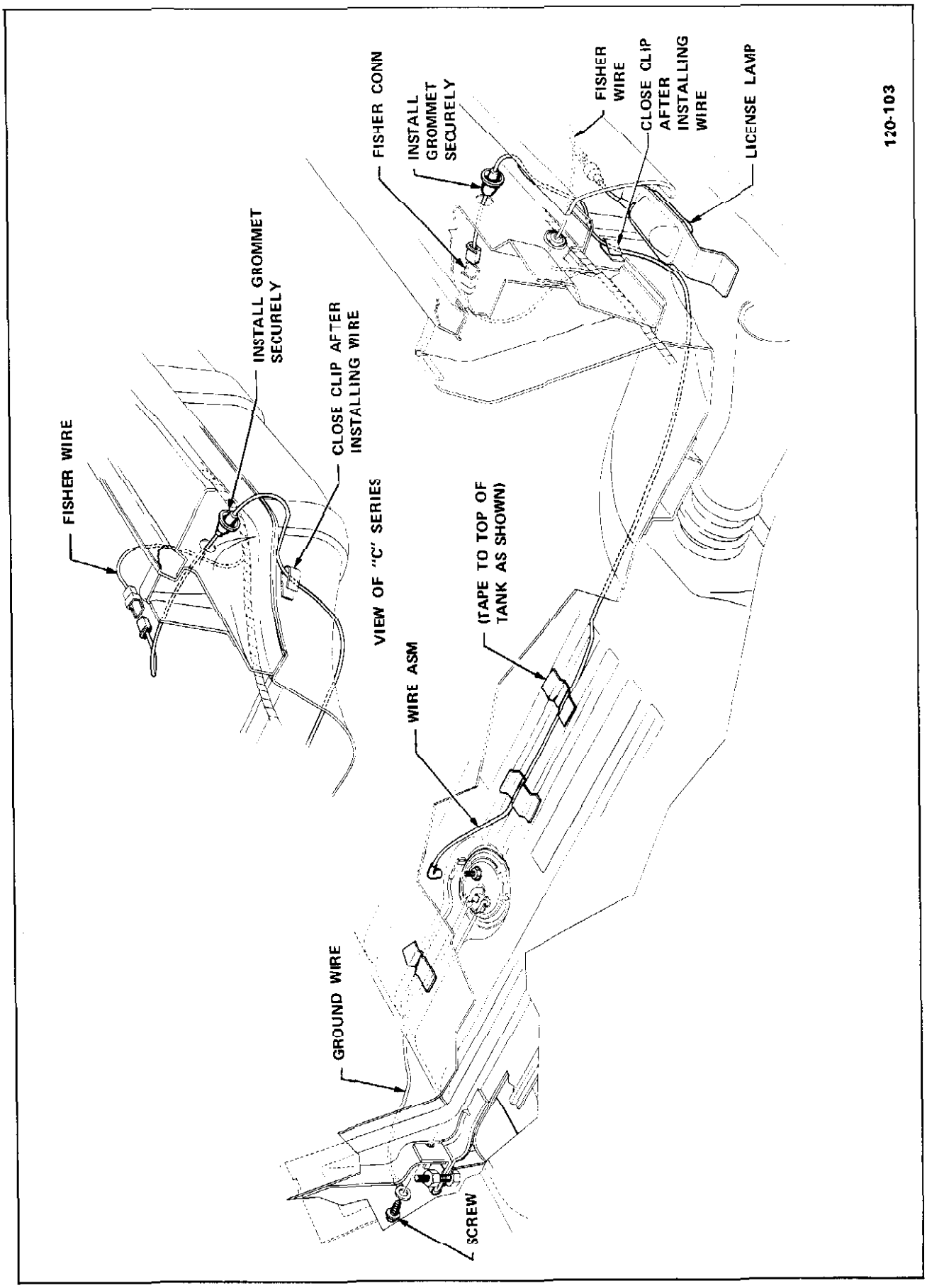


Figure 120-103 Rear Lamp and Fuel Tank - 45-46-48000 Series

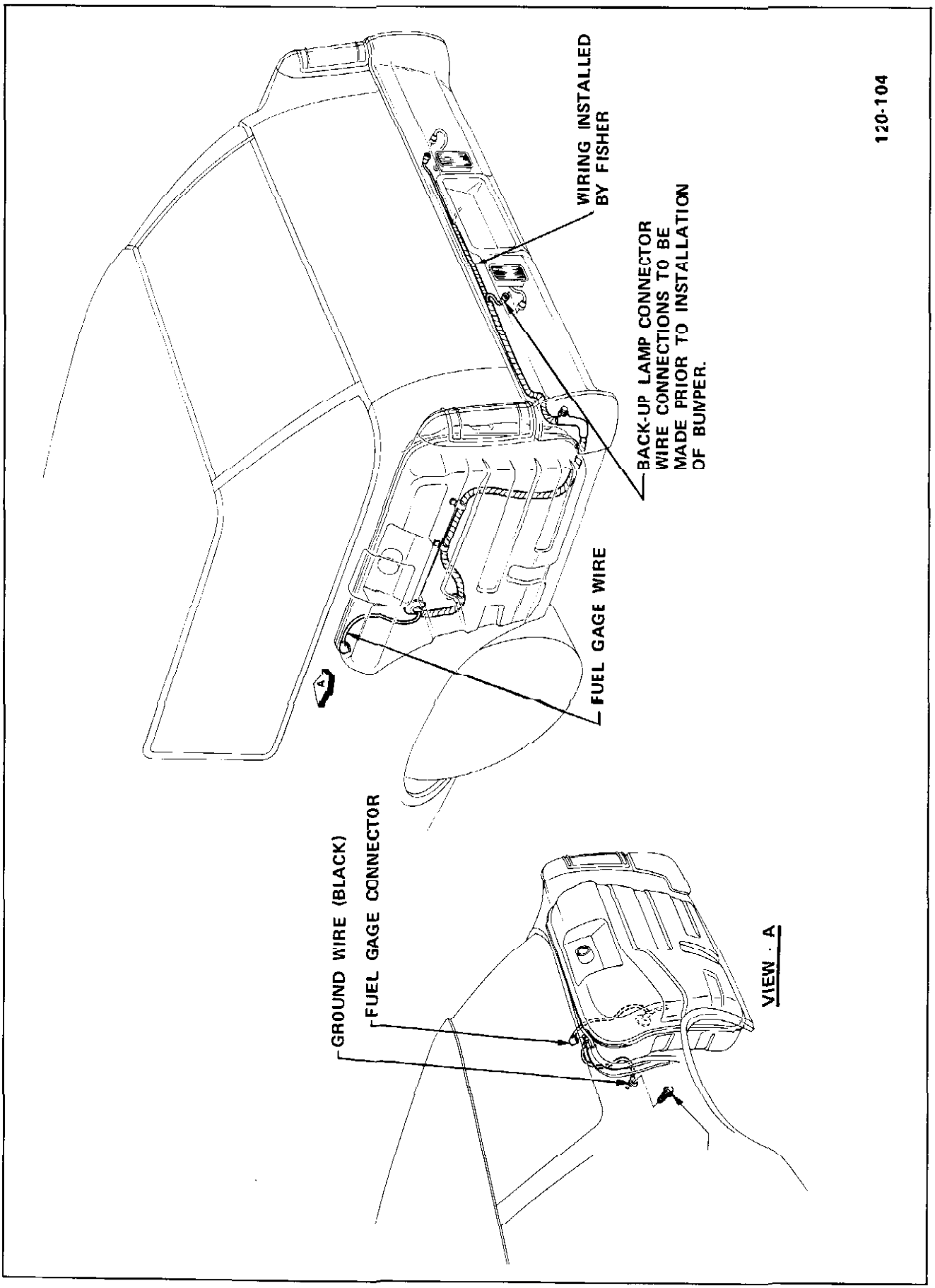


Figure 120-104 Rear Lamp and Fuel Tank - Estate Wagon 45000 Series

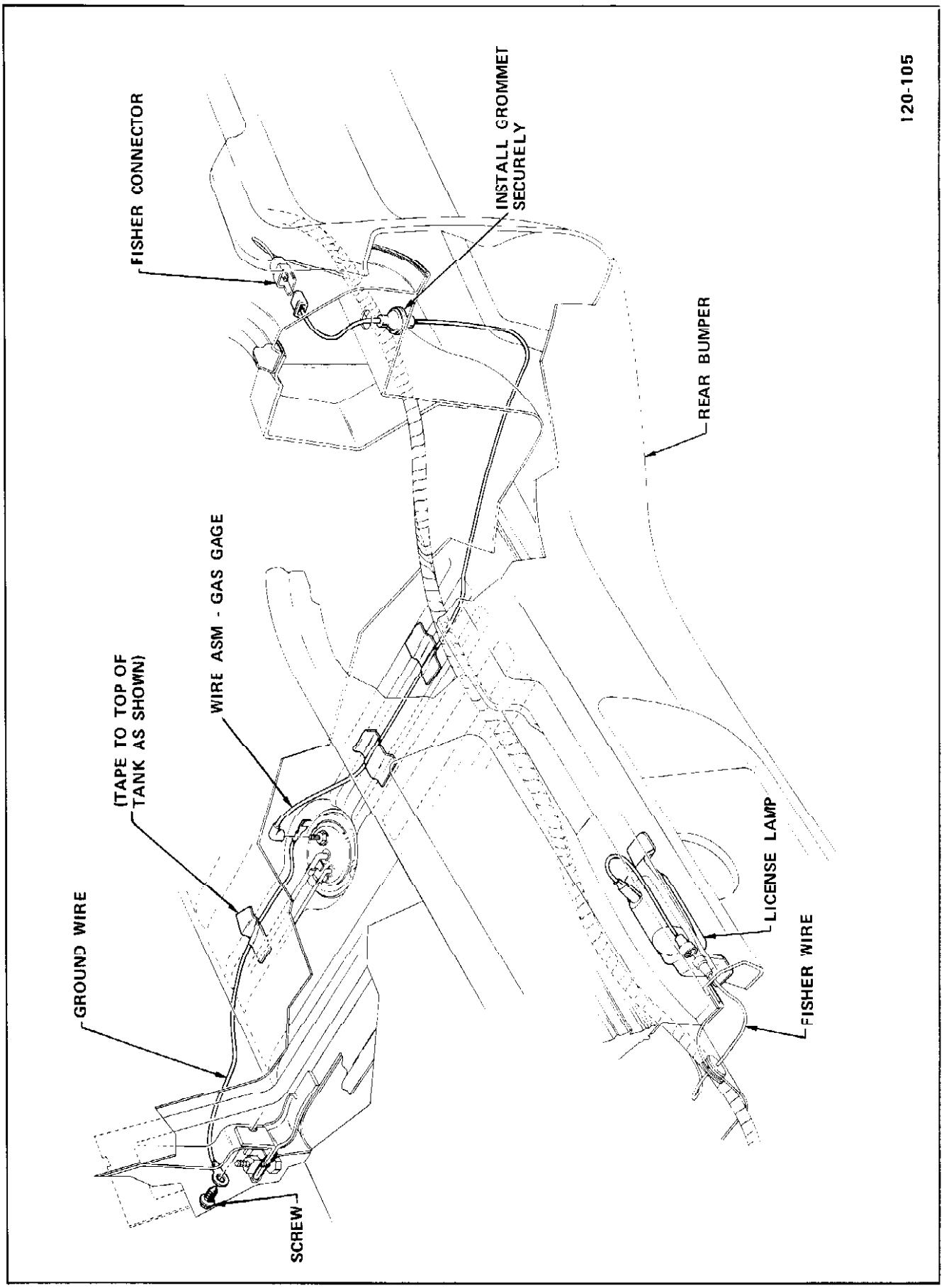


Figure 120-105 Rear Lamp and Fuel Tank - 49000 Series

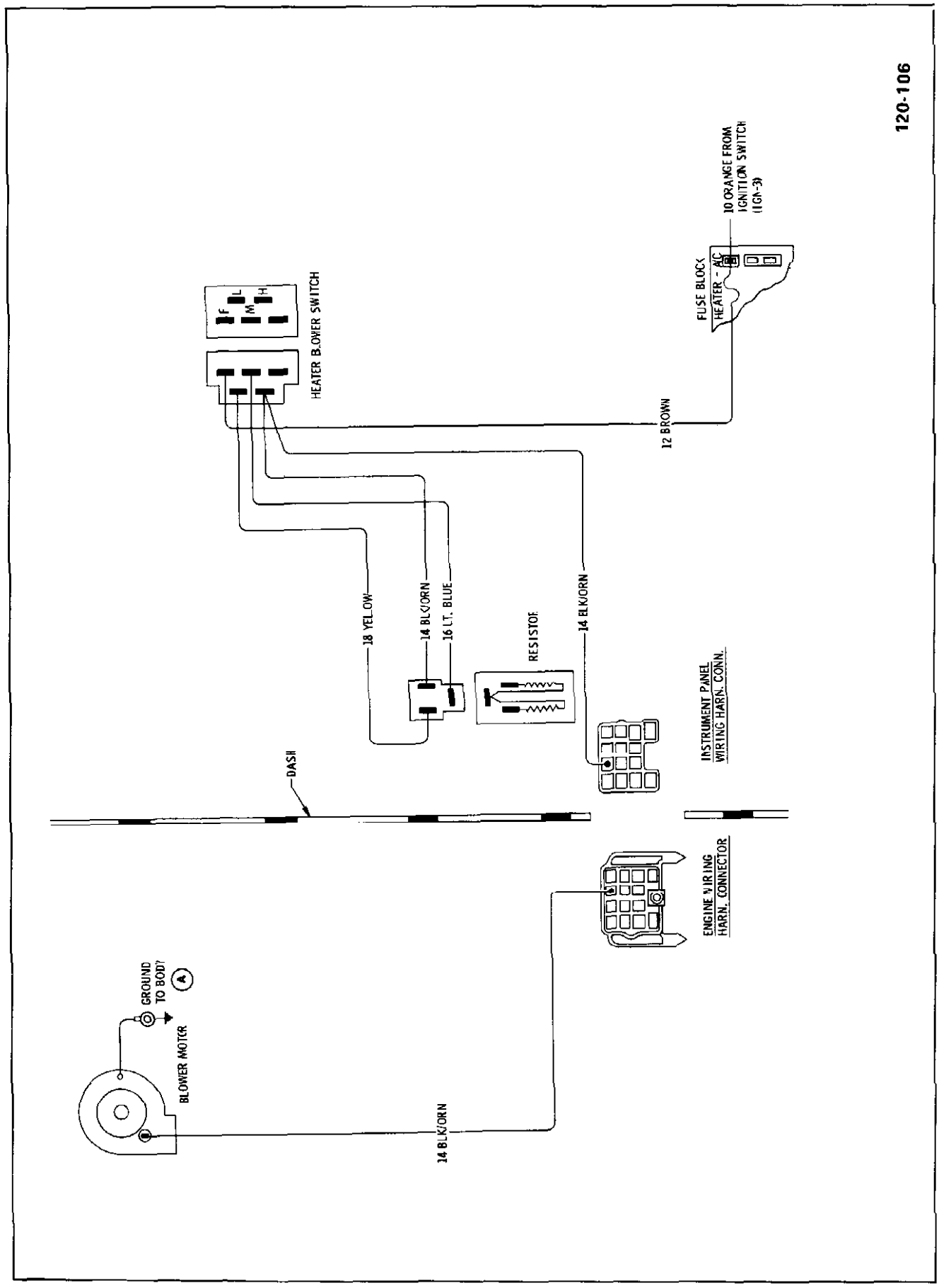


Figure 120-106 Heater Wiring Diagram - 43-44000 Series

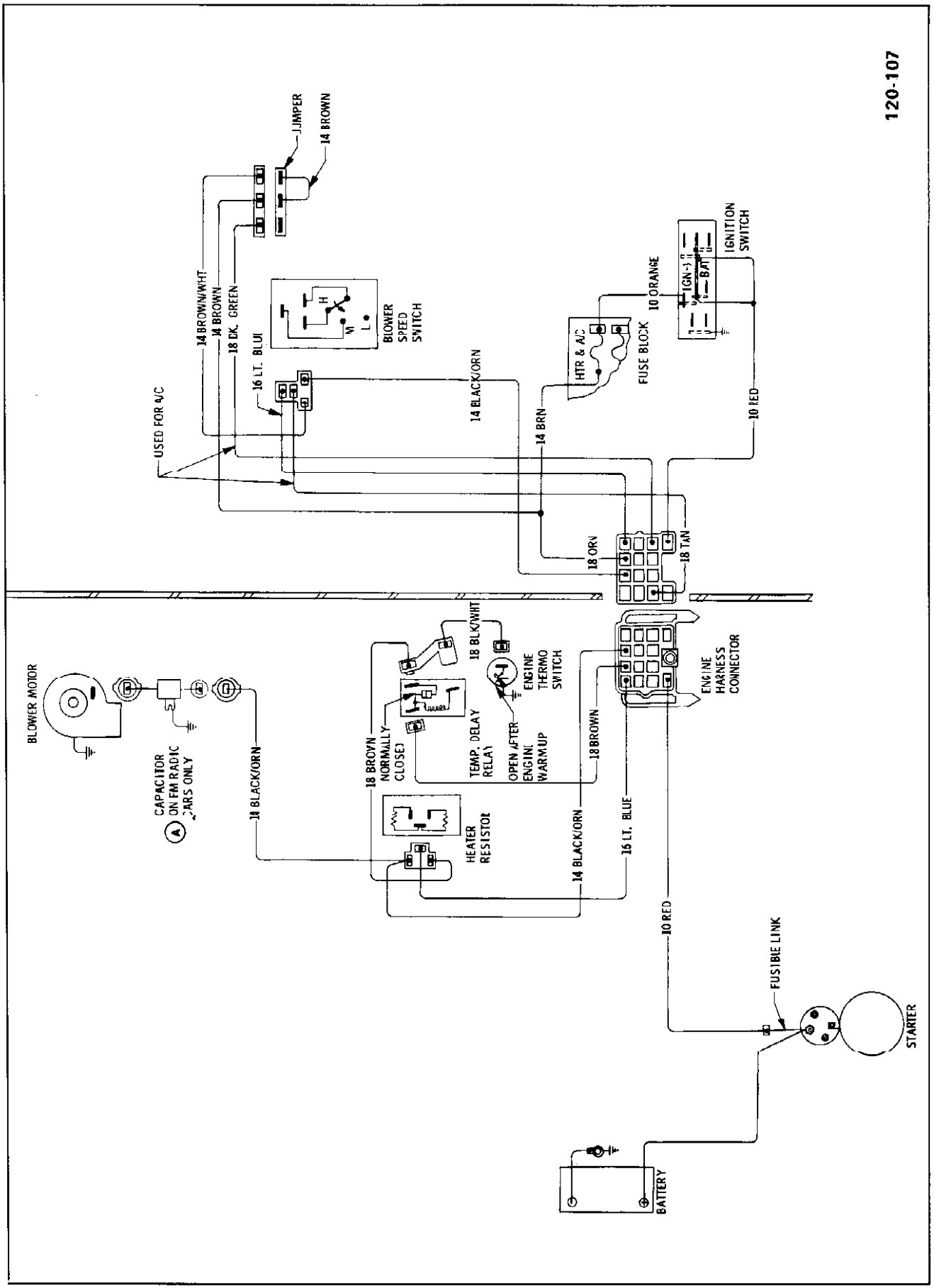


Figure 120-107 Heater Wirirg Diagram - 45-46-48-49000 Series

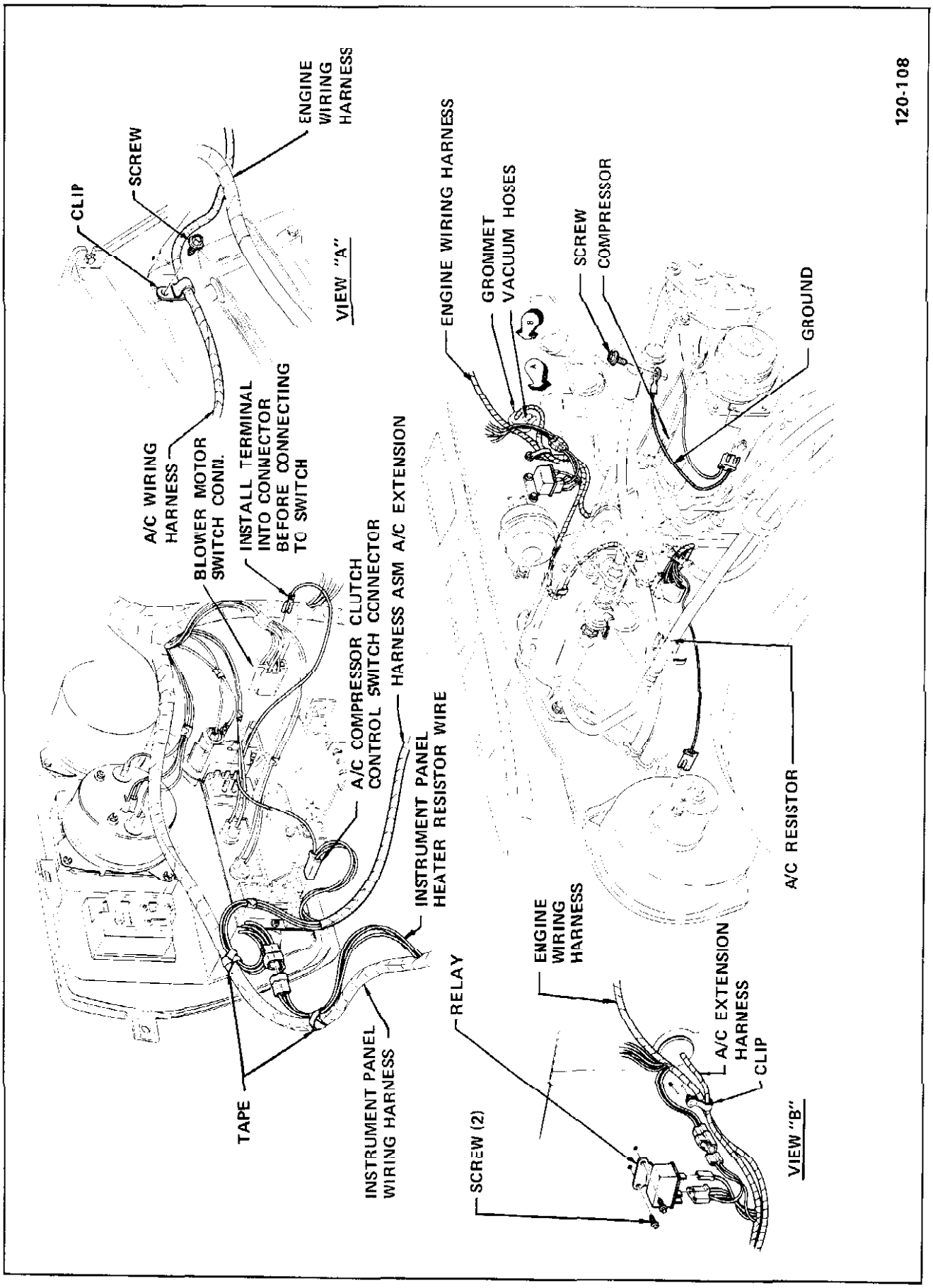


Figure 120-108 Air Conditioning Wiring Diagram - 43-44000 Series

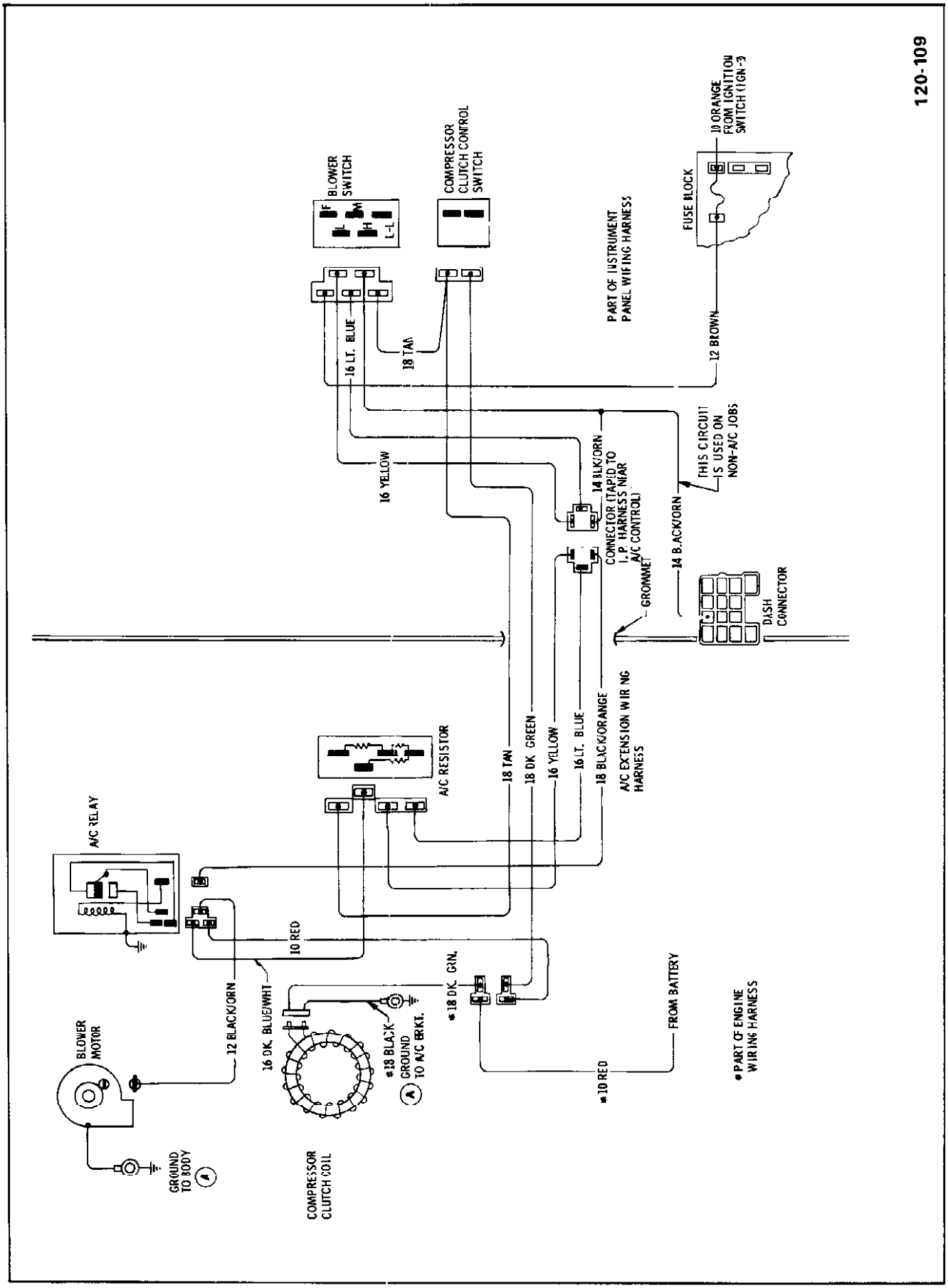


Figure 120-105 Air Conditioning Wiring Diagram - 43-44000 Series

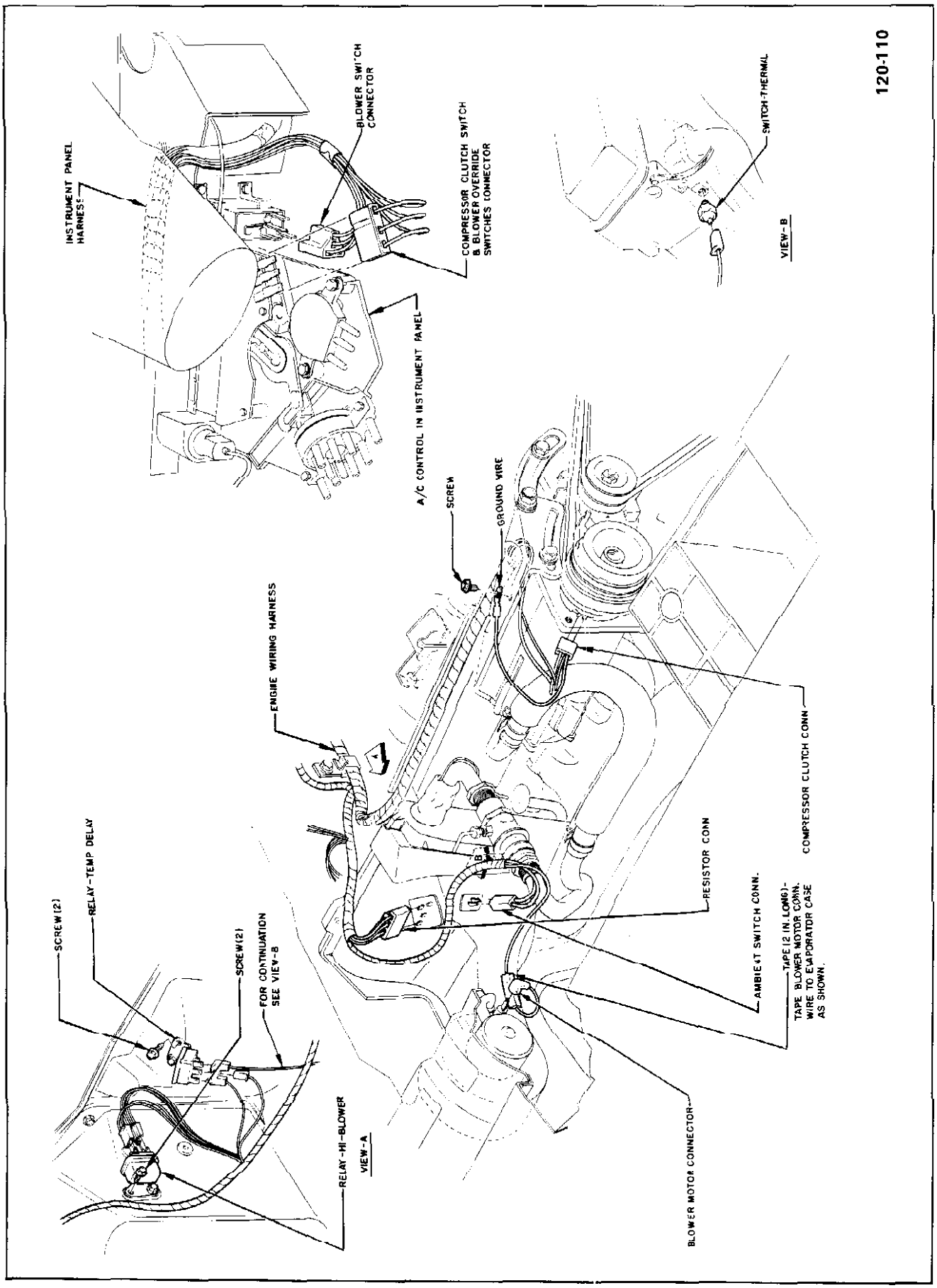


Figure 120-110 Air Conditioning Wiring (Manual) - 45-46-48-49000 Series

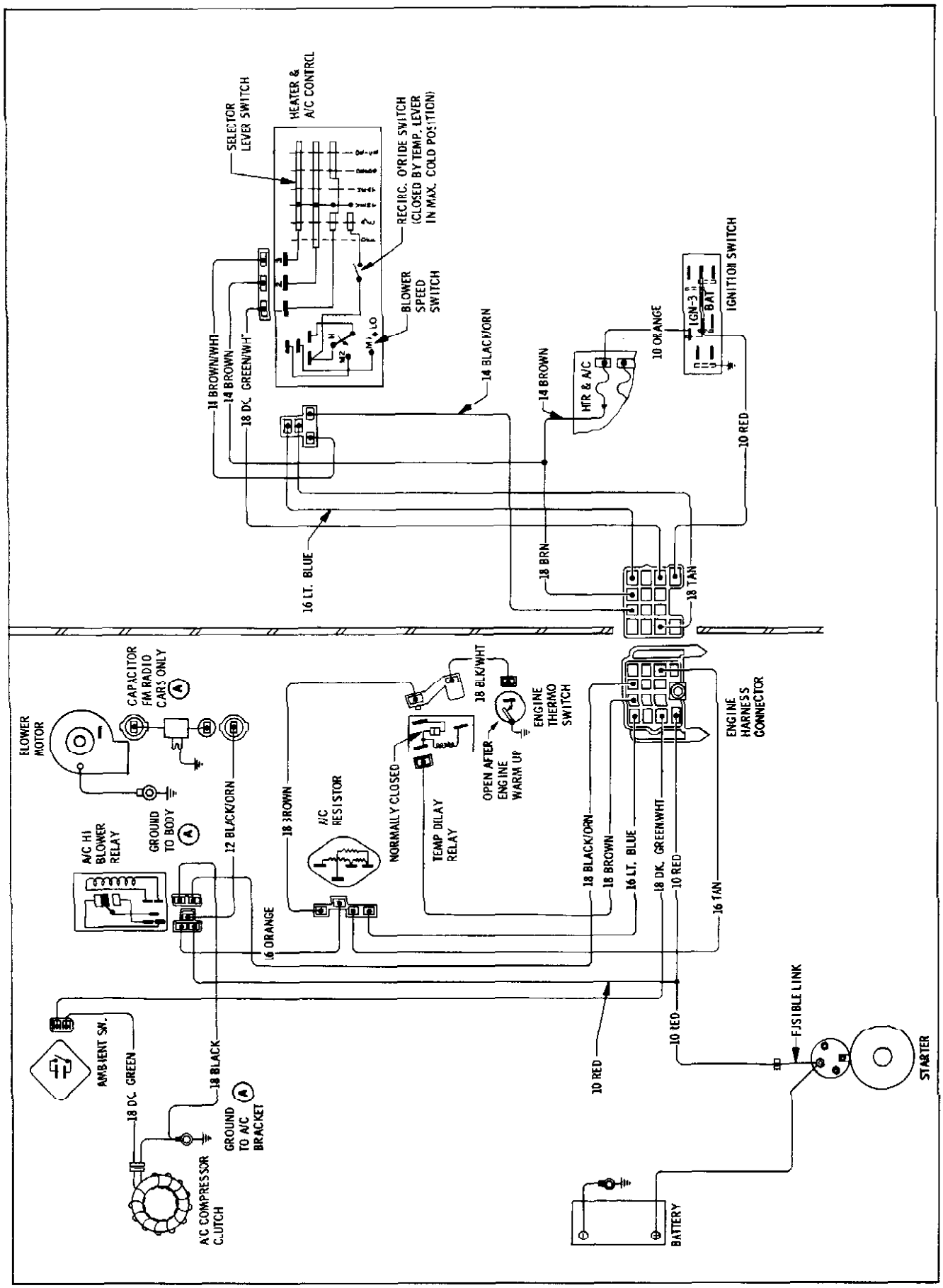


Figure 120-111 Air Conditioning Wiring Diagram (Manual) - 45-46-48-49000 Series

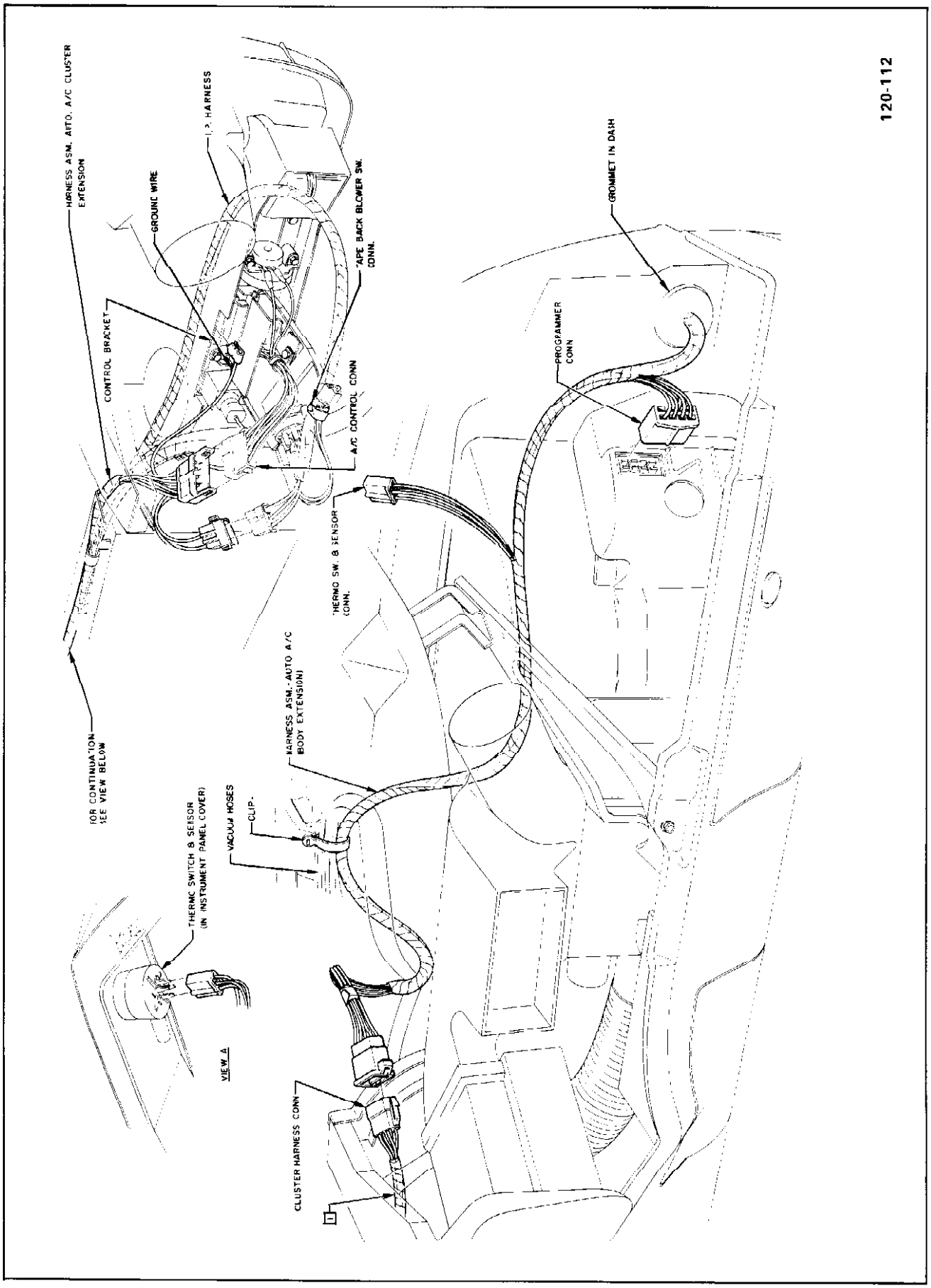


Figure 120-112 Air Conditioning Instrument Panel Wiring (Automatic) - 45-46-48-49000 Series

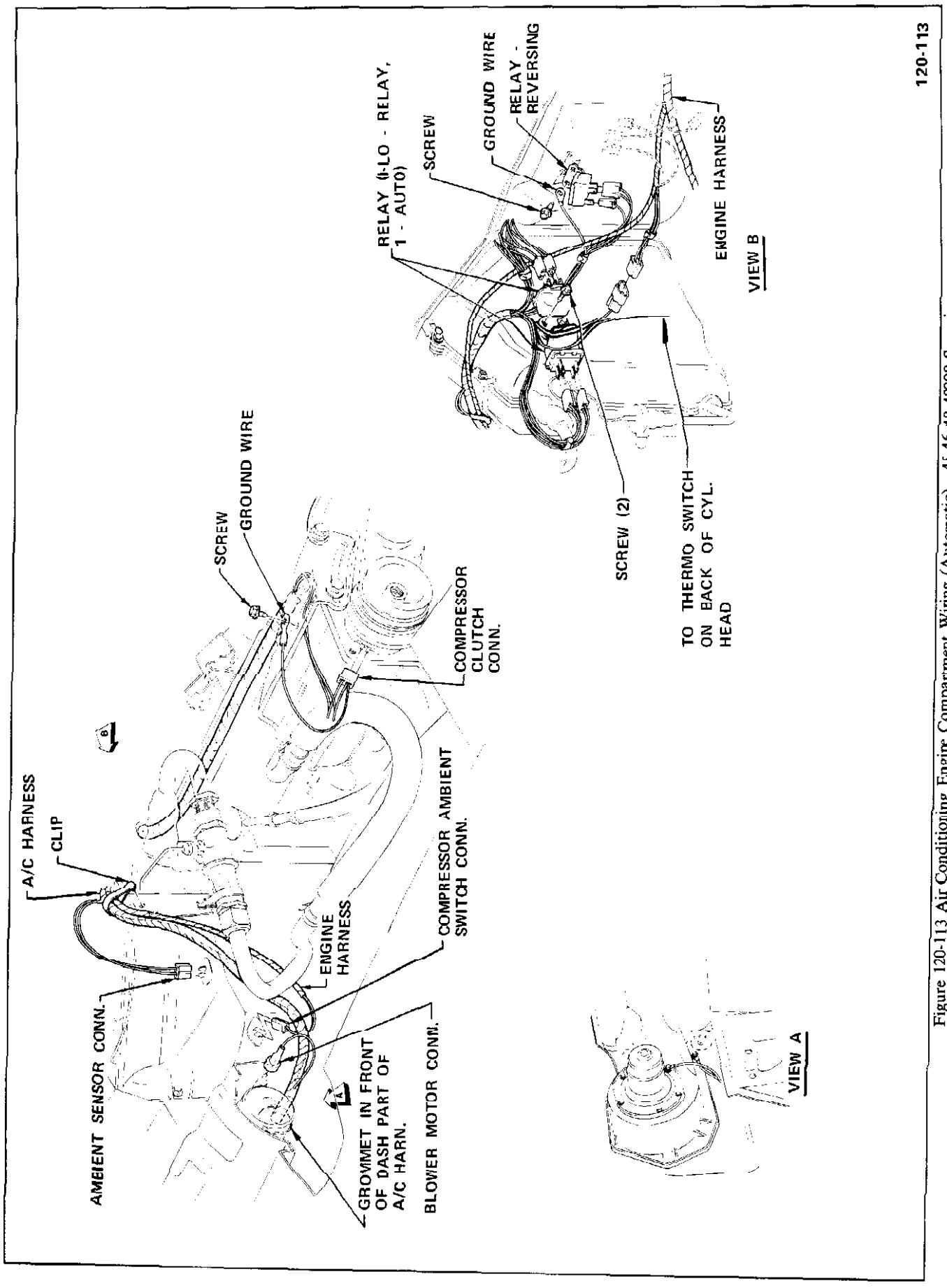


Figure 120-113 Air Conditioning Engine Compartment Wiring (Automatic) - 45-46-48-49000 Series

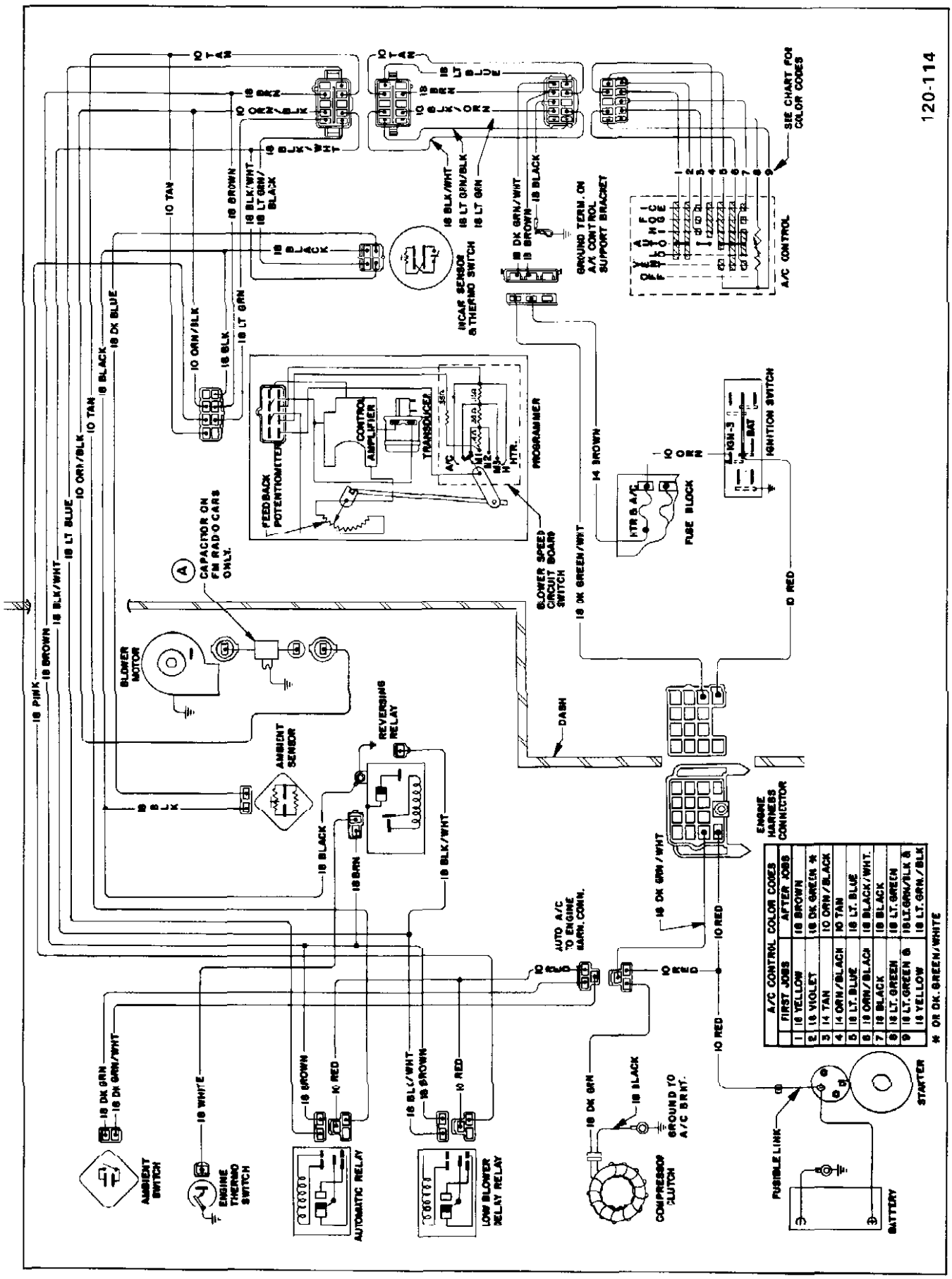


Figure 120-114 Air Conditioning Wiring Diagram (Autoratic) - 45-46-48-49000 Series

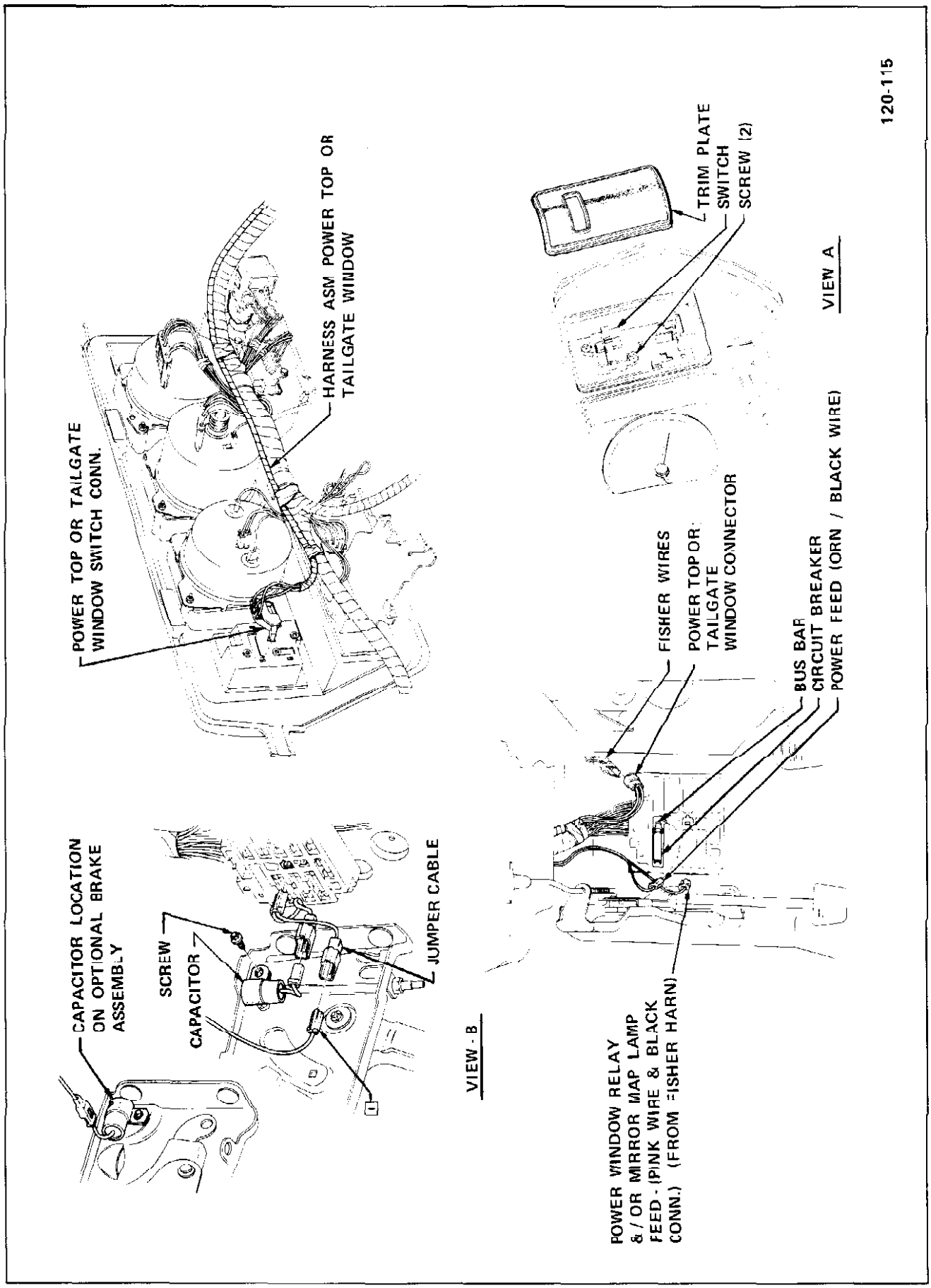


Figure 120-115 Power Top and Tailgate Window - 43-44000 Series

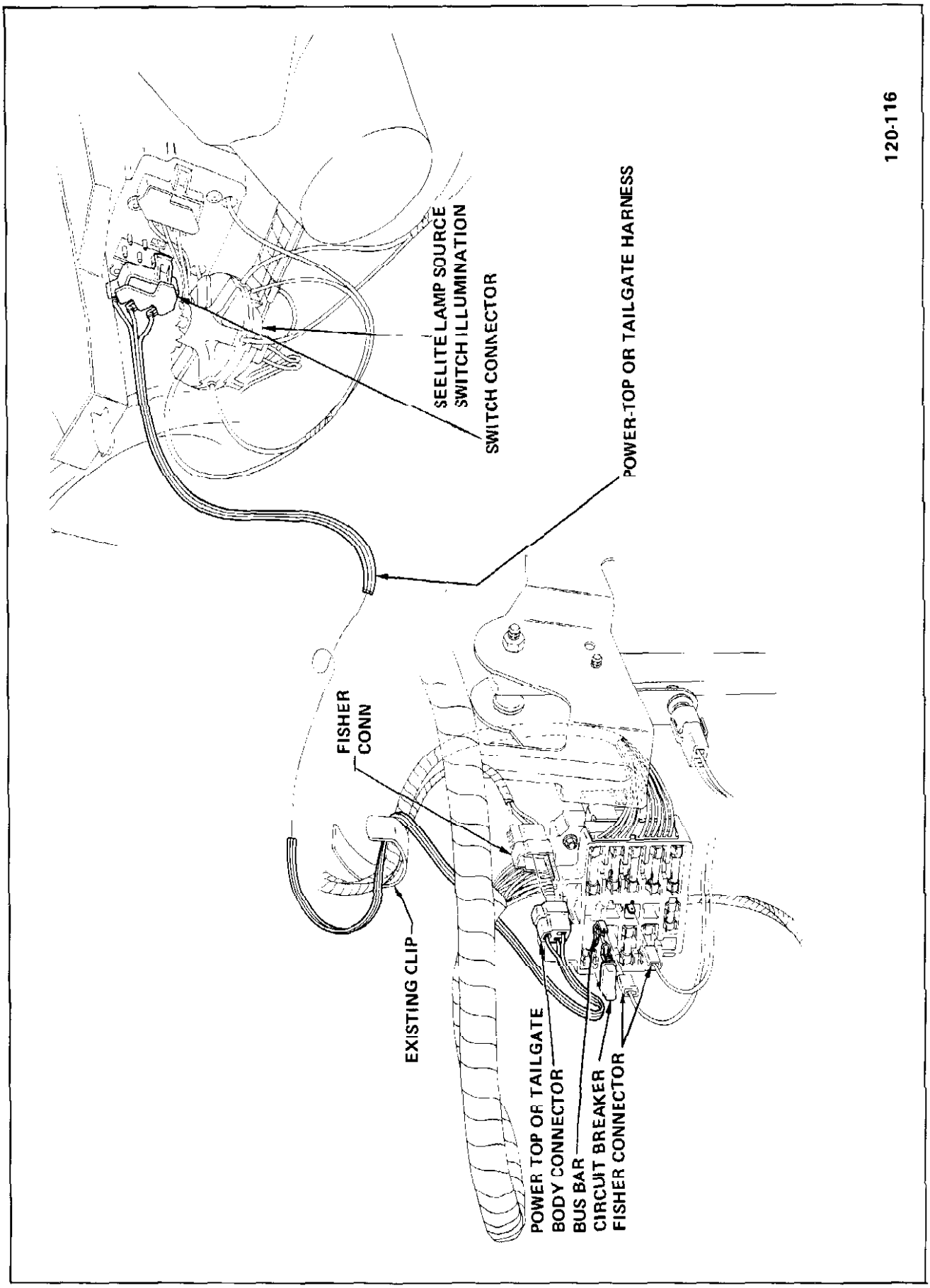


Figure 120-116 Power Top and Tailgate Window - 45000 Series

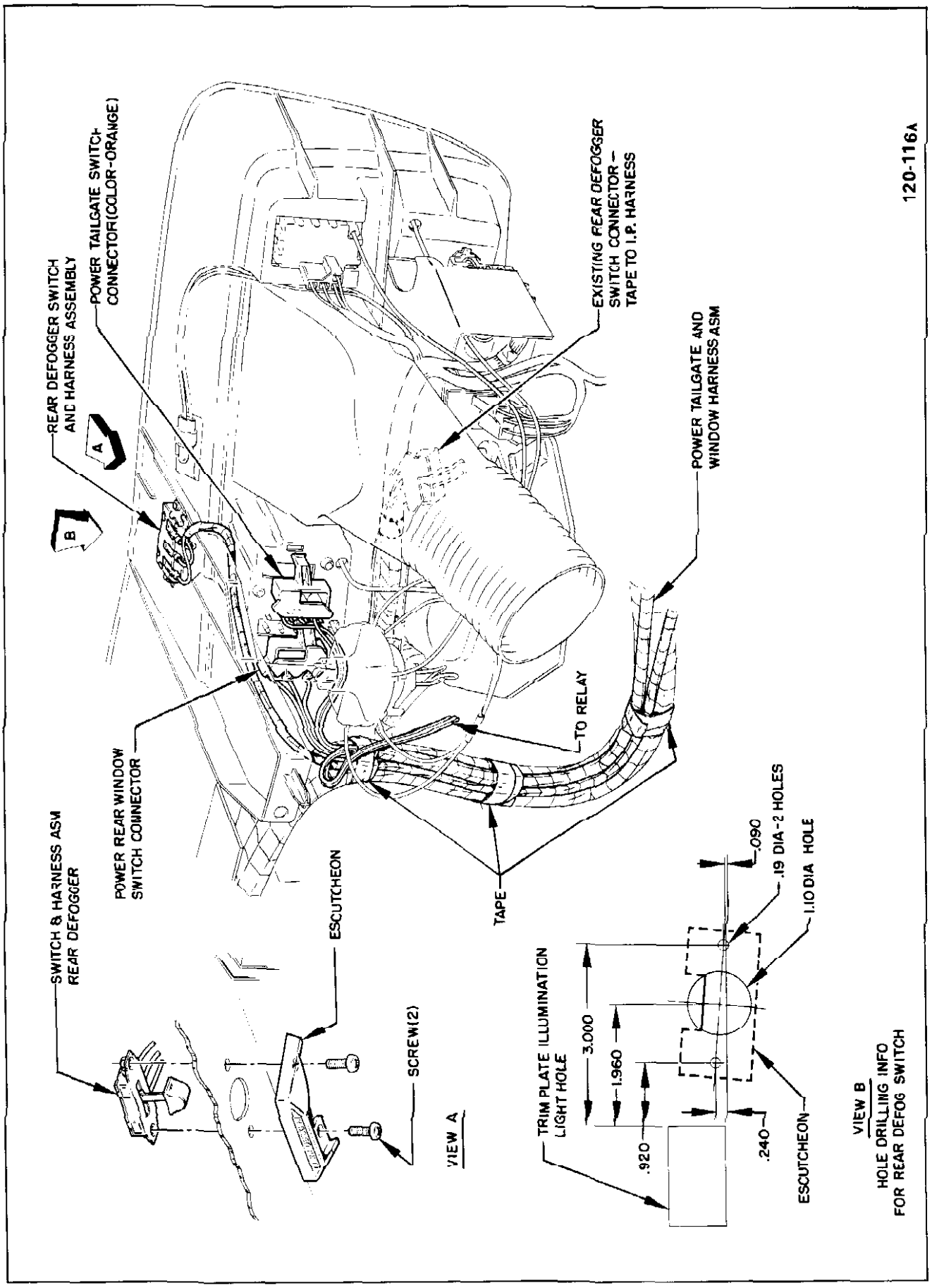


Figure 120-116A Power Tailgate and Window W/Rear Defogger - 45000 Series

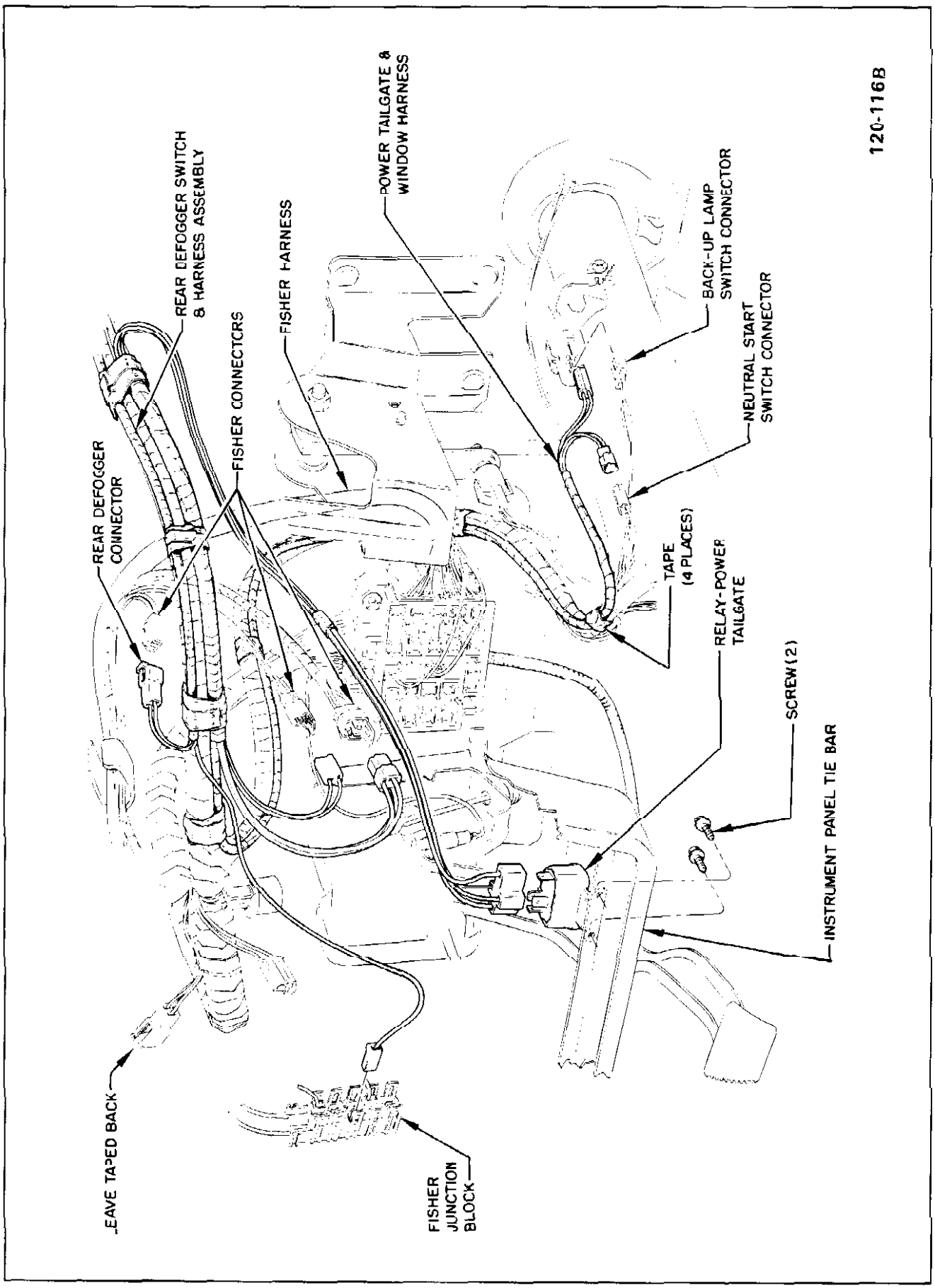


Figure 120-116B Power Tailgate and Window W/Rear Defogger - 45000 Series

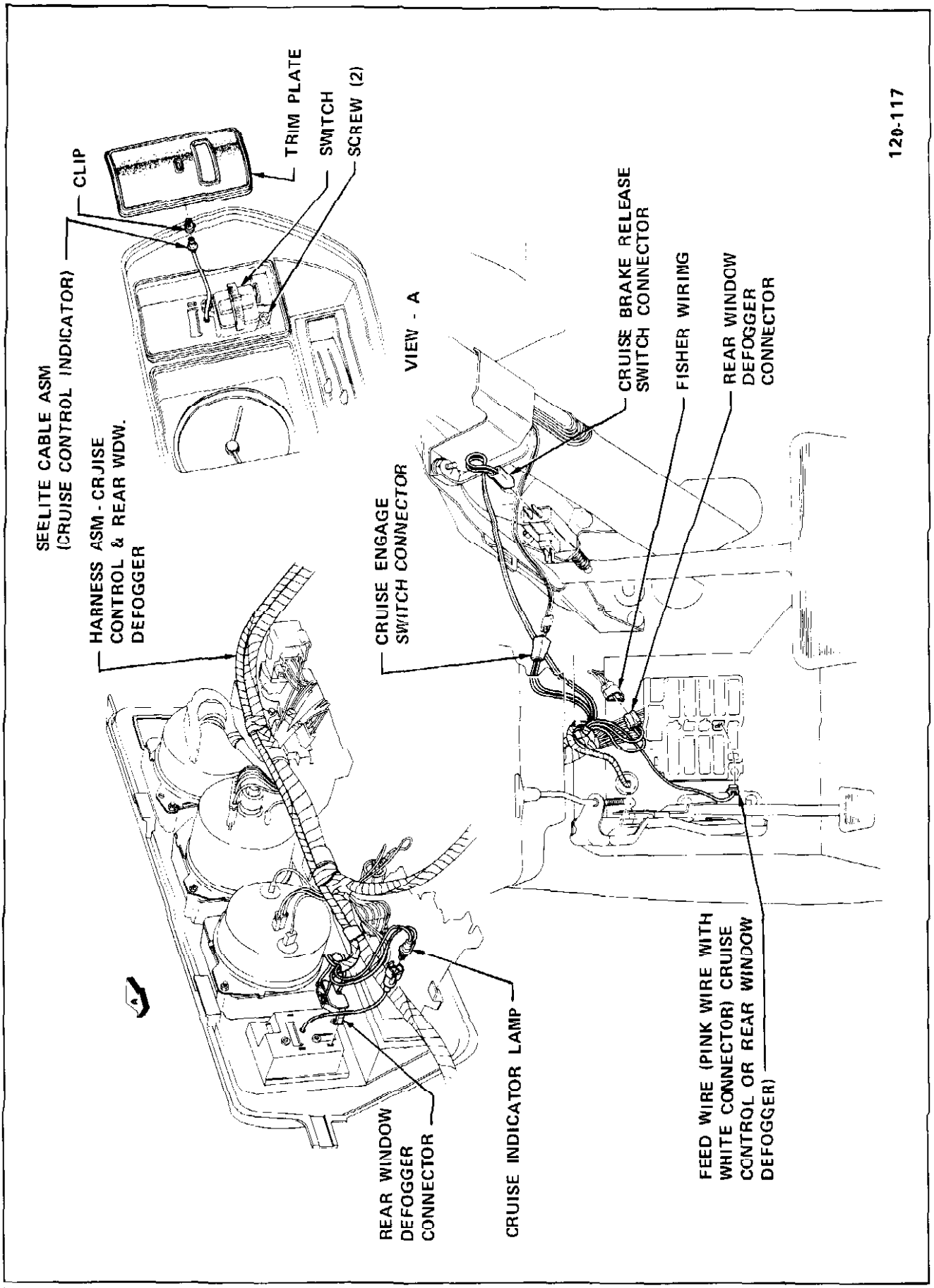


Figure 120-117 Wiring - Cruise Control and Rear Window Defroster - 43-44000 Series

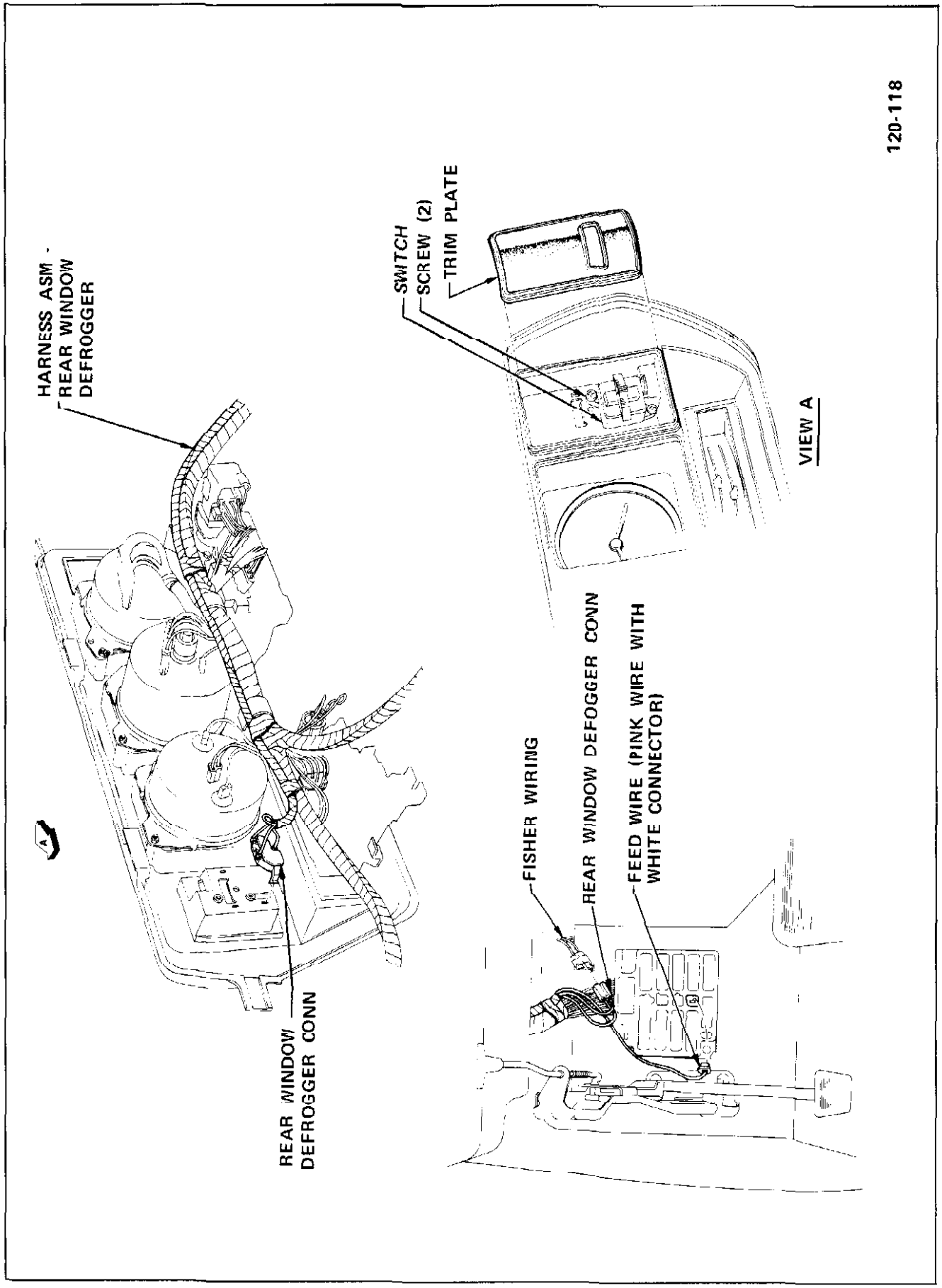


Figure 120-118 Rear Window Defogger Wiring - 43-44000 Series

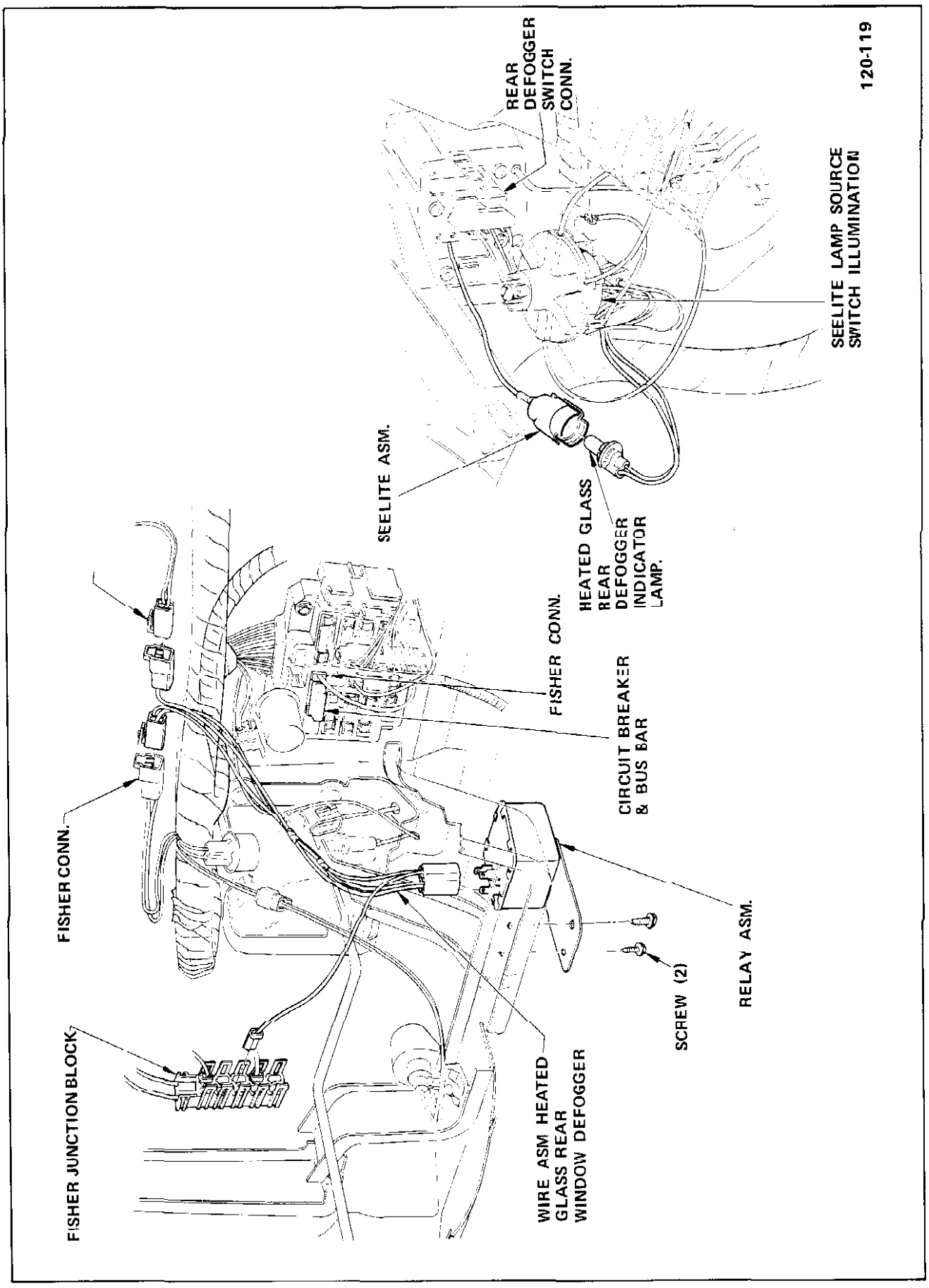


Figure 120-119 Heater Glass Rear Defogger Wiring - 43-44000 Series

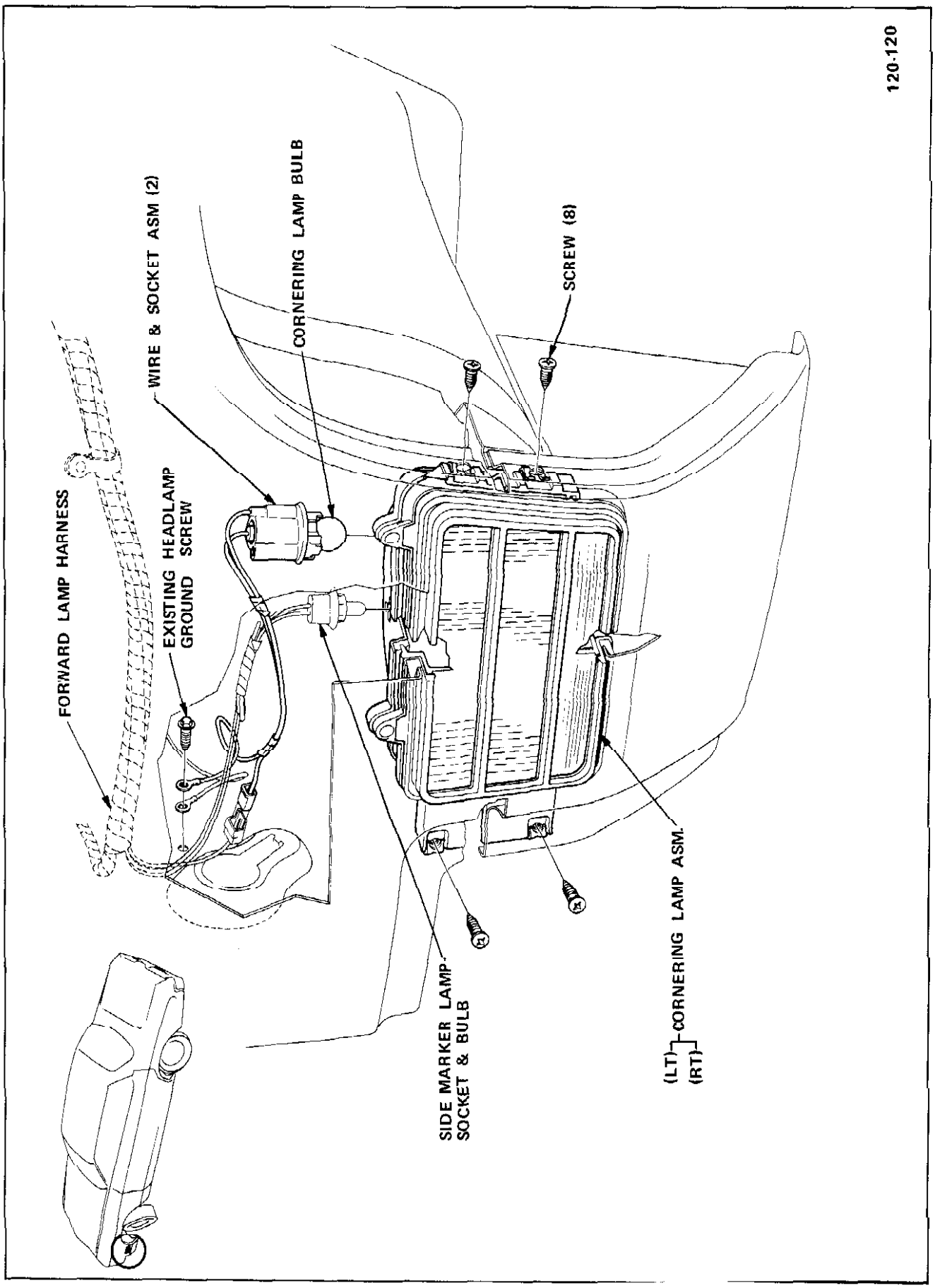


Figure 120-120 Cornering Lamp Wiring - 41-46-4800(Series

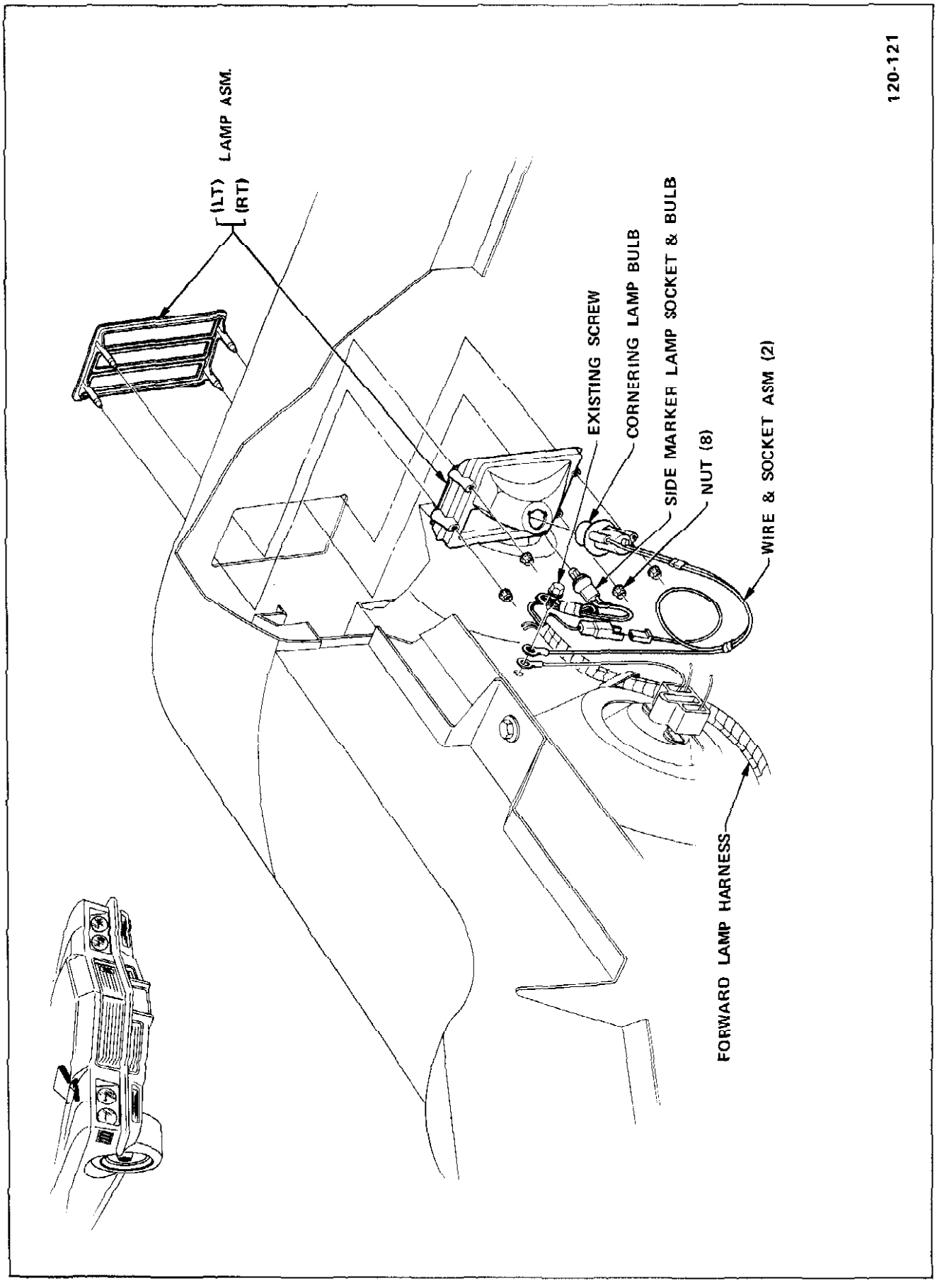


Figure 120-121 Cornering Lamp Wiring - 49000 Series

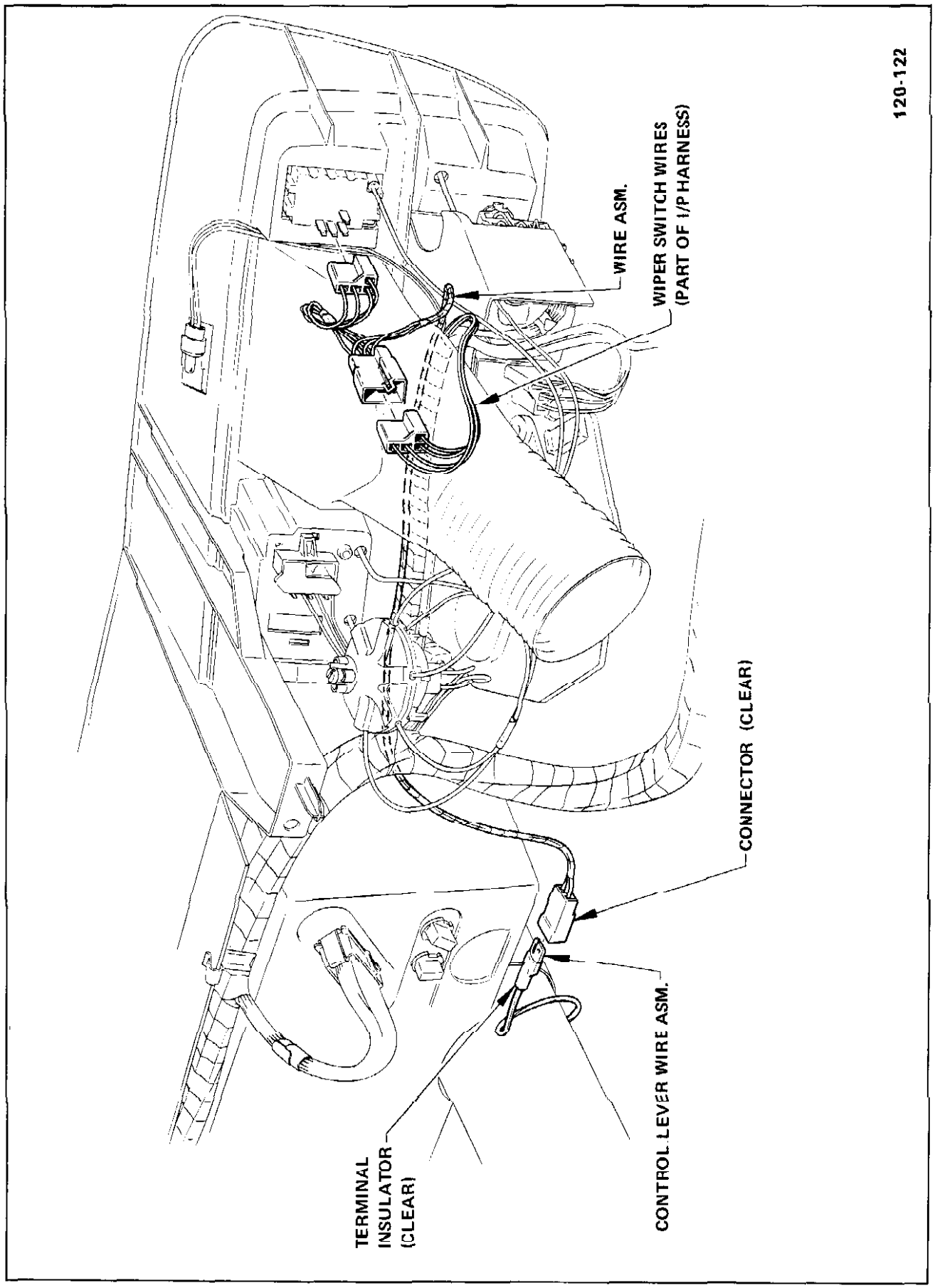


Figure 120-122 Demand Wiper Control Wiring - 45-46-48-49000 Series

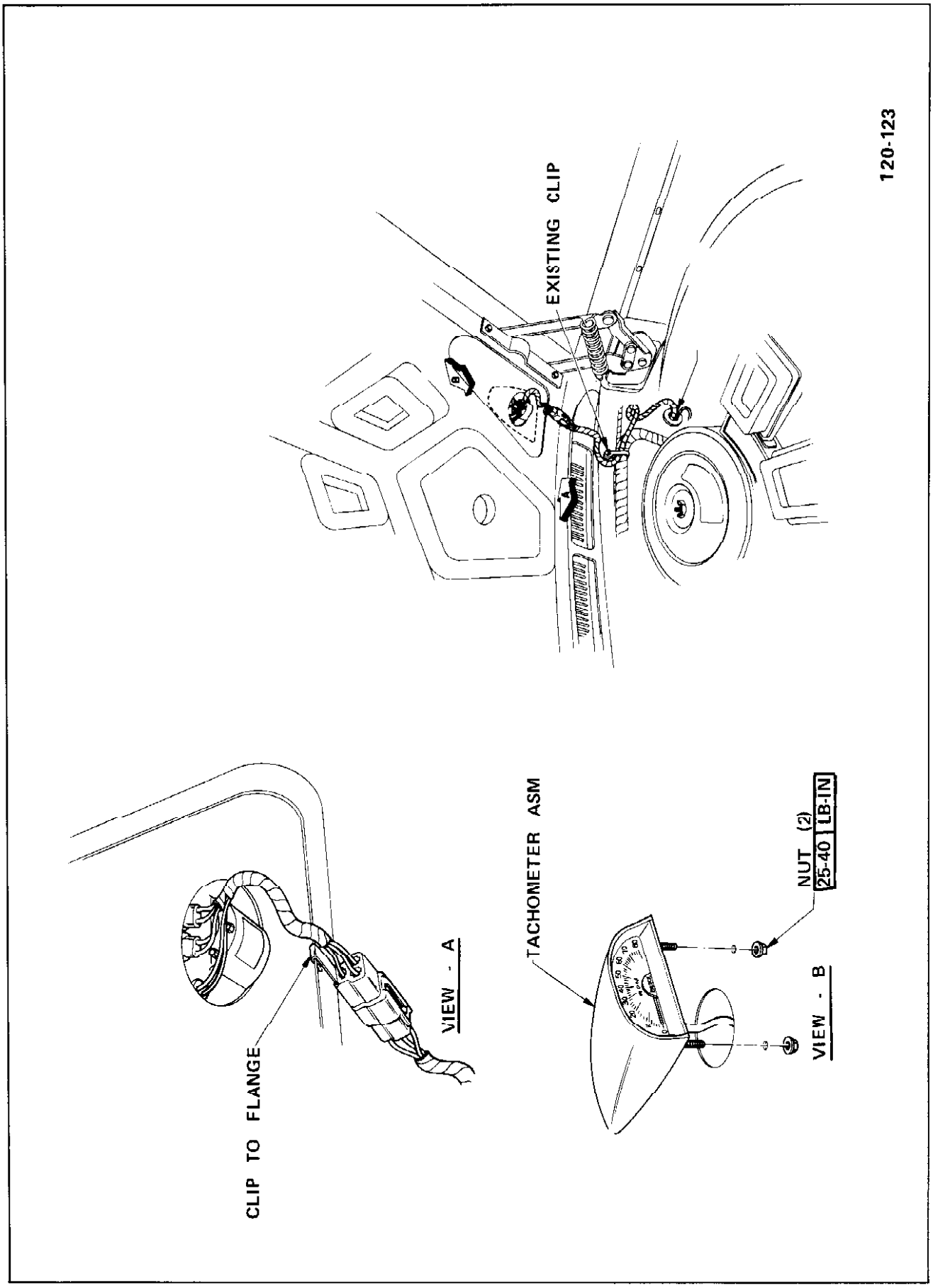
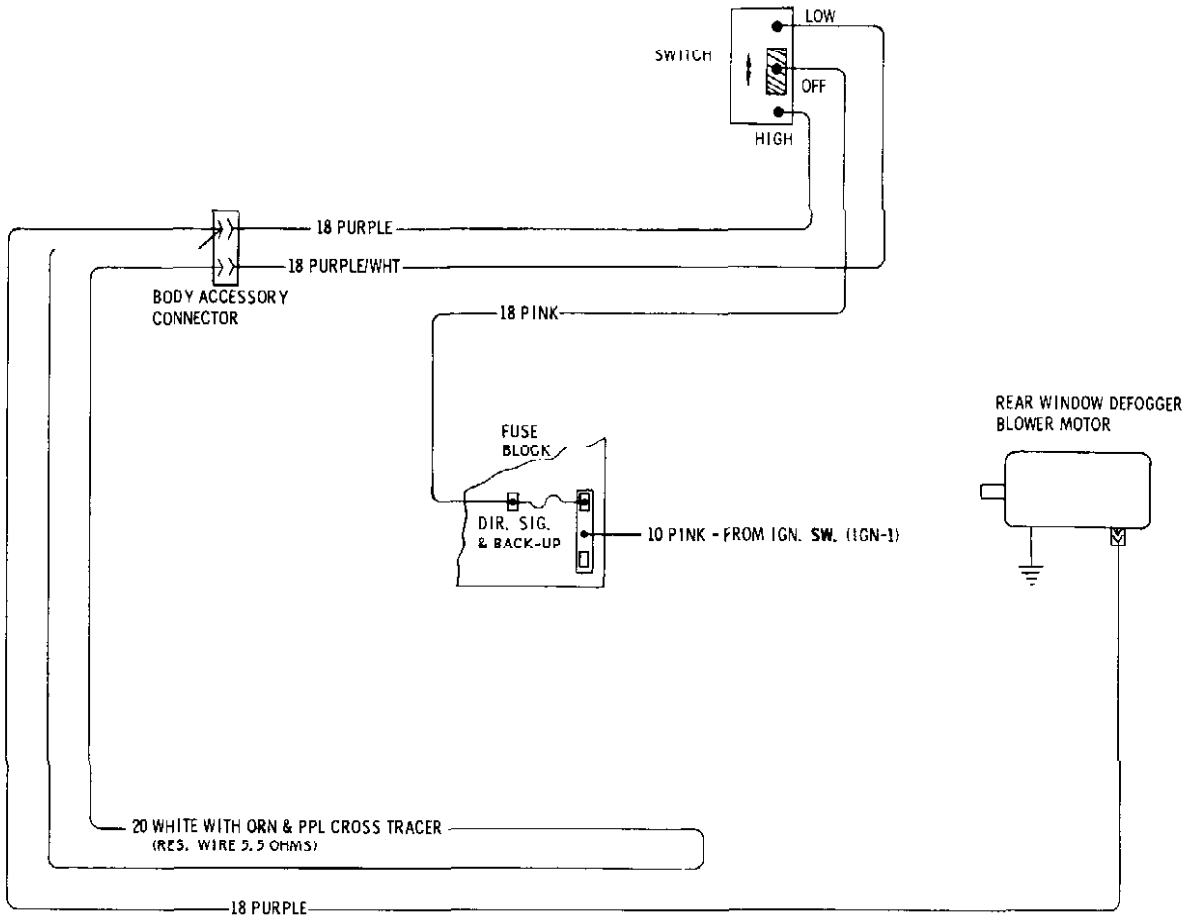


Figure 120-123 Hood Mounted Tachometer - 43000 Series



120-124

Figure 120-124 Rear Window Defogger (Blower) - All Series

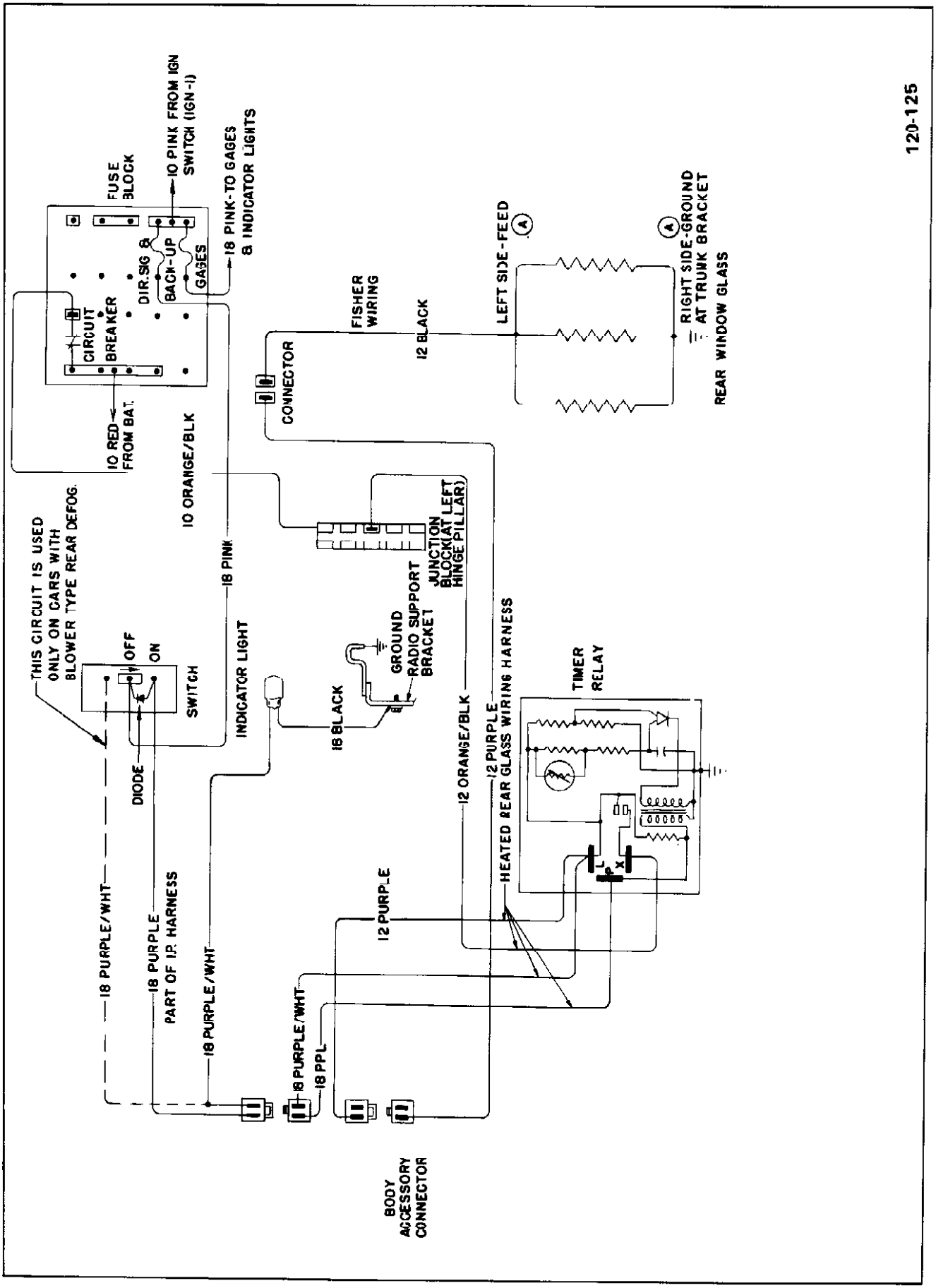


Figure 120-125 Heated Glass Defogger - 45-46-48000 Series

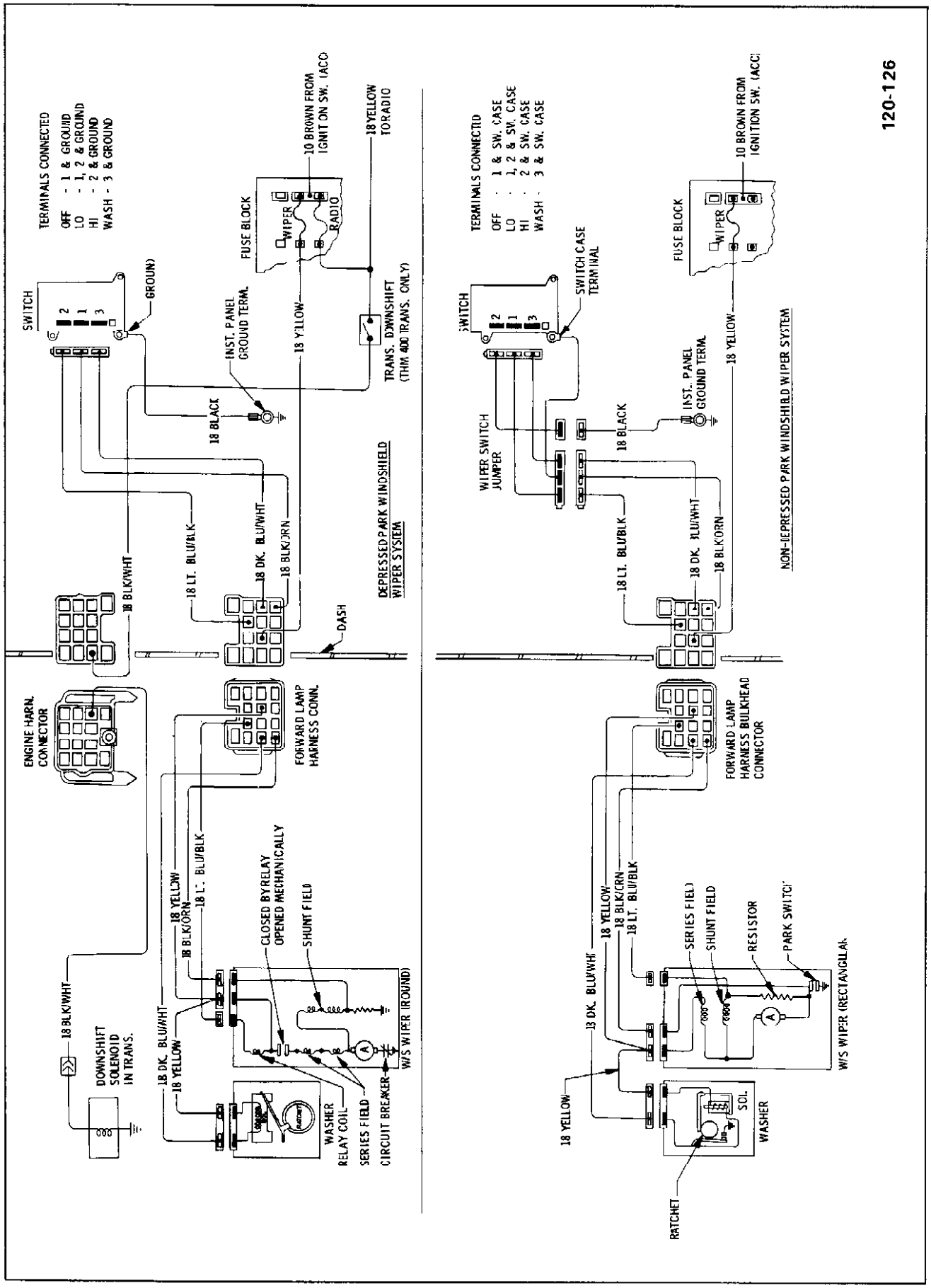


Figure 123-126 Wiper and Transmission Downshift Wiring Diagram - 43-44000 Series

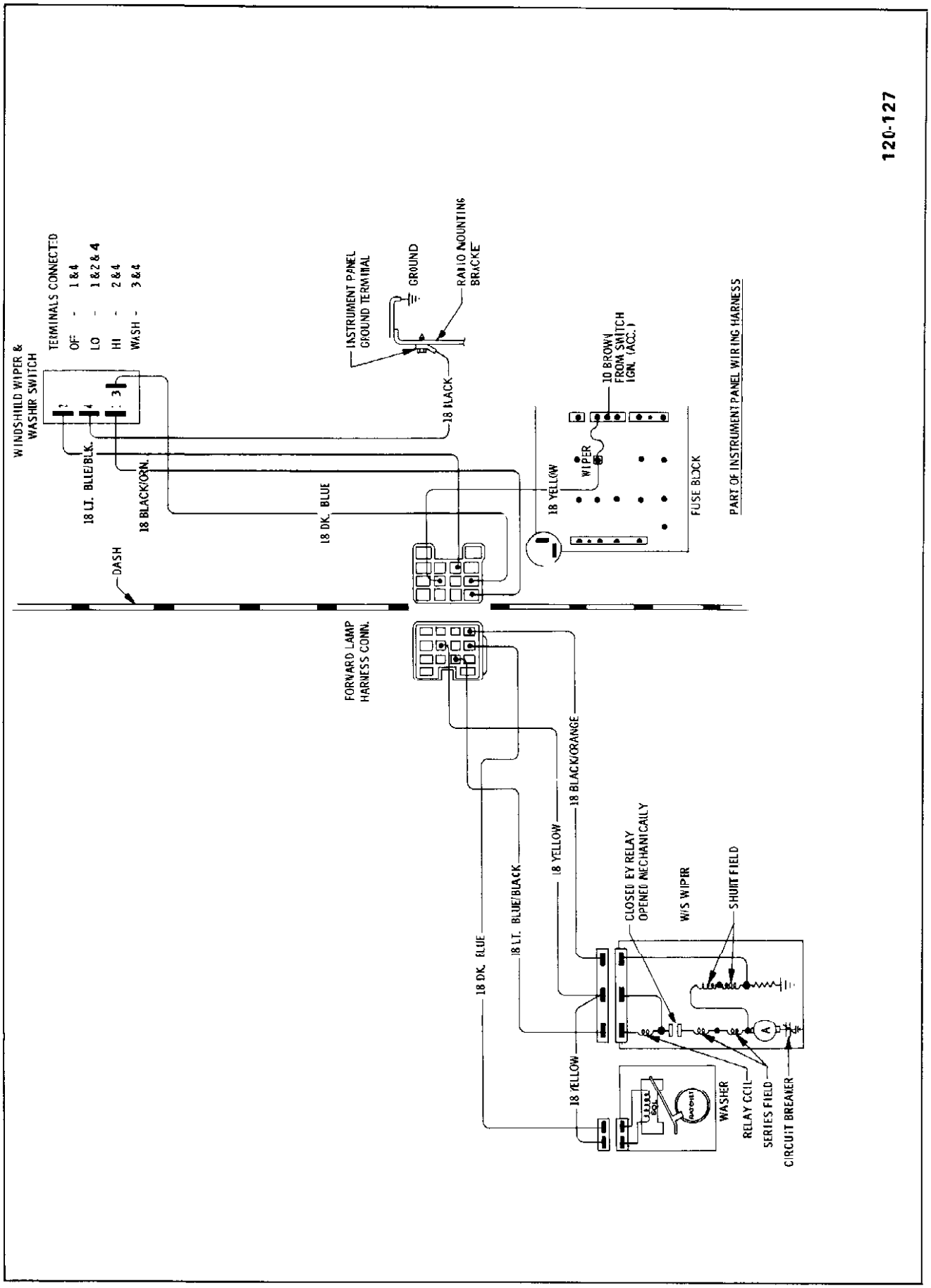


Figure 120-127 Wiper Wiring Diagram - 45-46-48-49000 Series

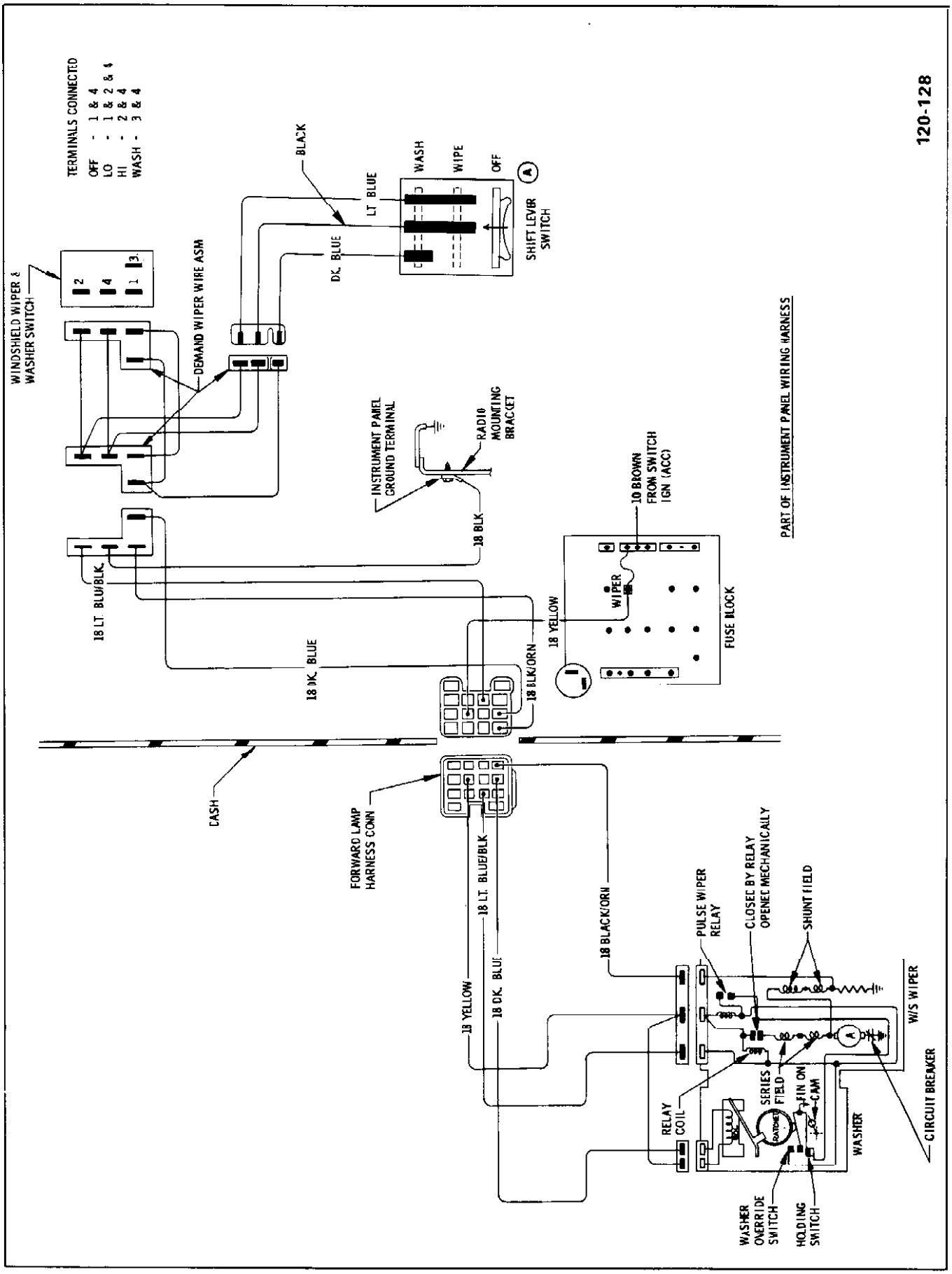


Figure 120-128 Demand Wiper Wiring Diagram - 45-46-48-49000 Series

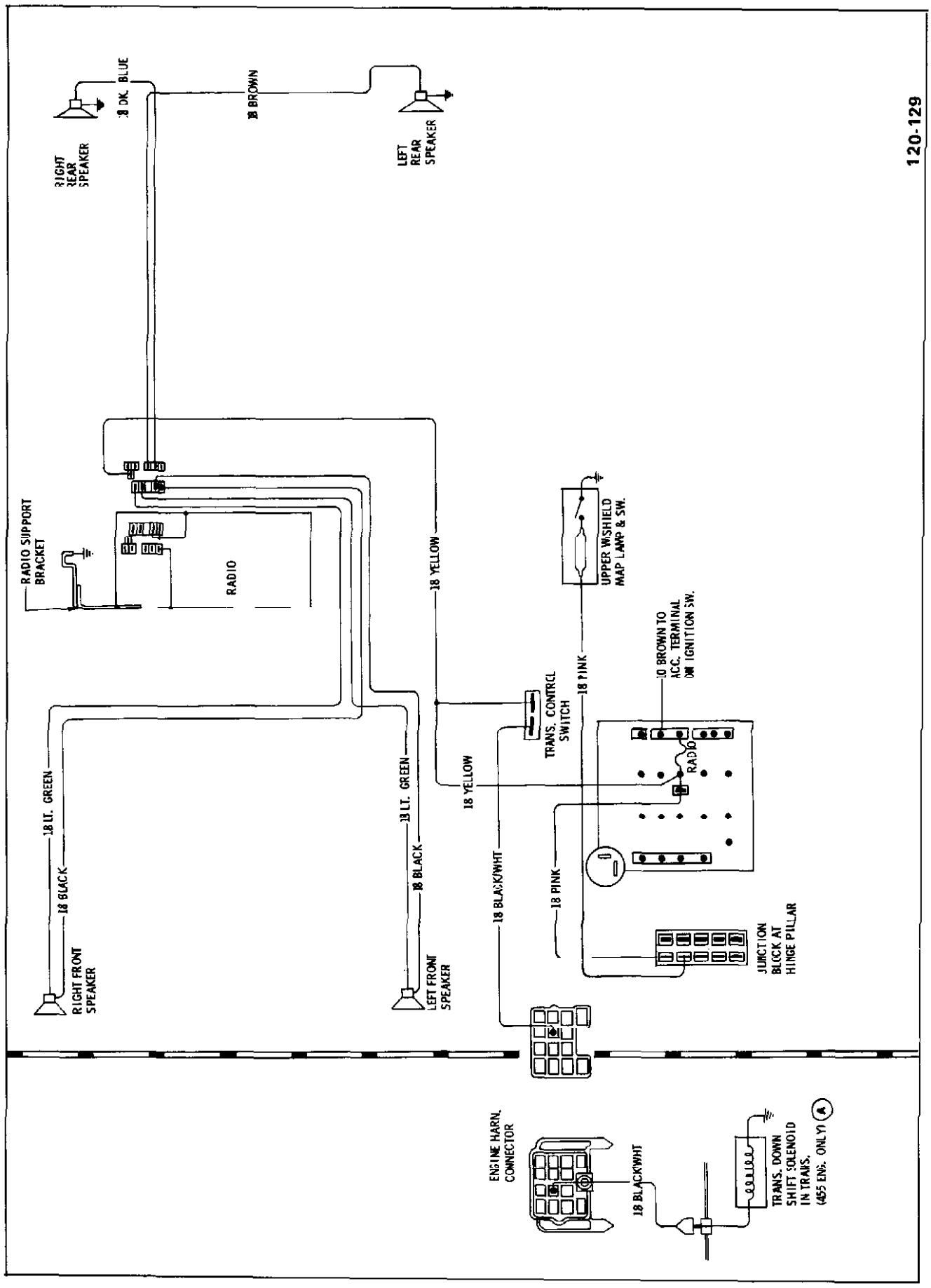


Figure 120-129 Stereo Radio, Transmission Downshift, and Map Light - 45-46-48-49000 Series

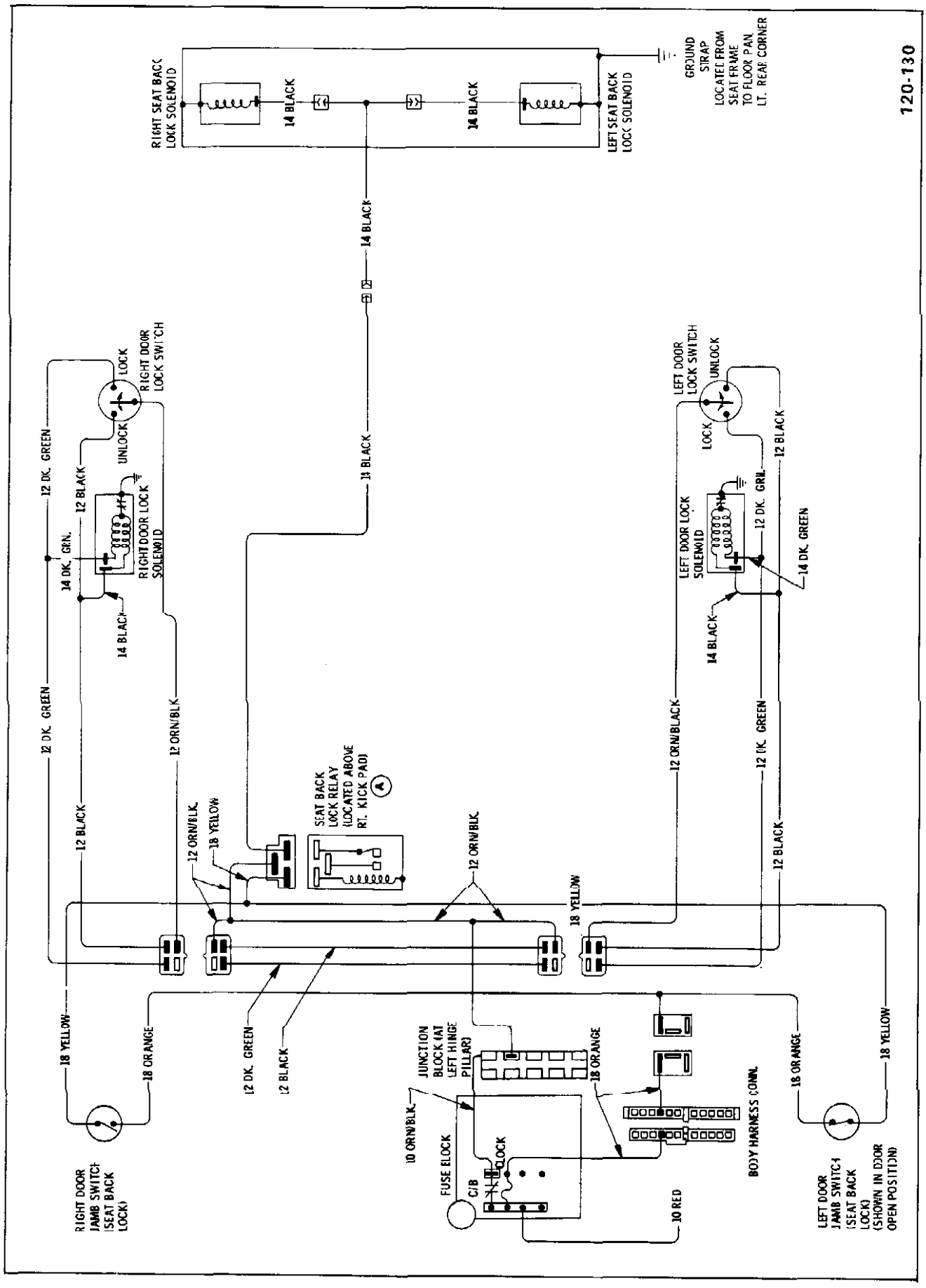


Figure 120-130 Door and Seat Back Lock (Fisher Wiring) - 45-46-48-49000 Series

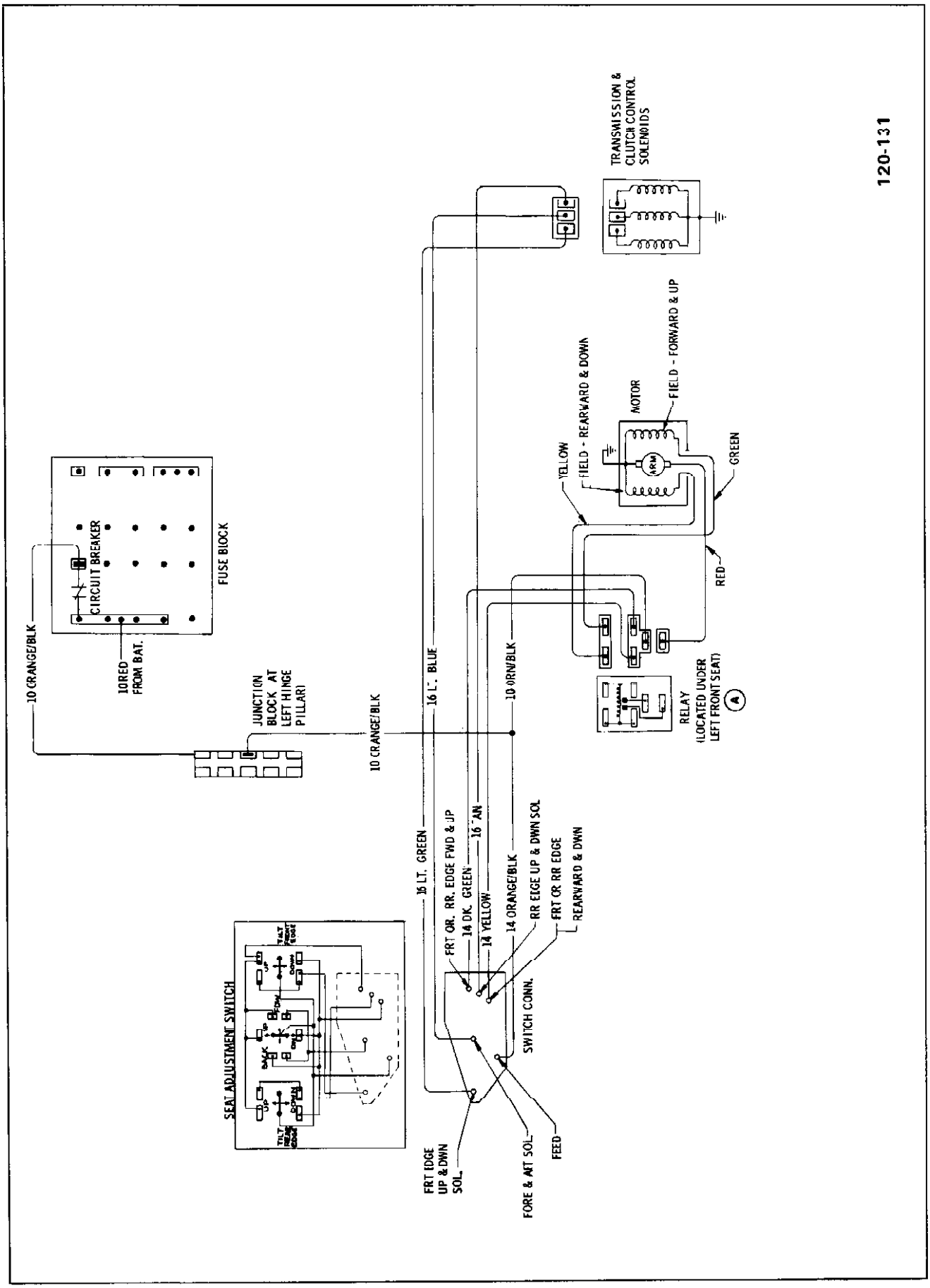


Figure 120-13. Six-Way Power Seat - 45-46-48-49000 Series

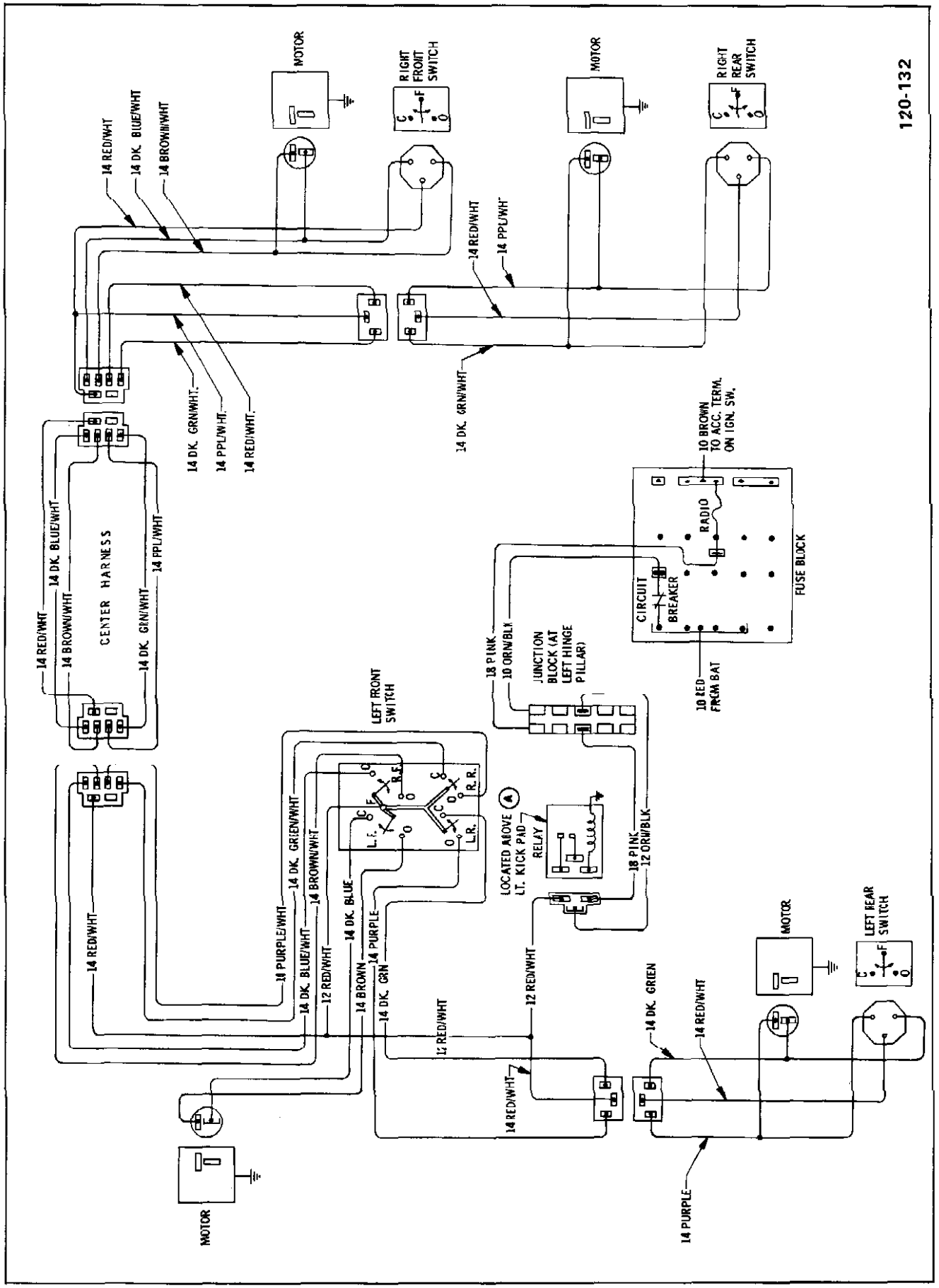


Figure 120-132 Power Window Wiring Diagram - 45-46-48-49000 Series

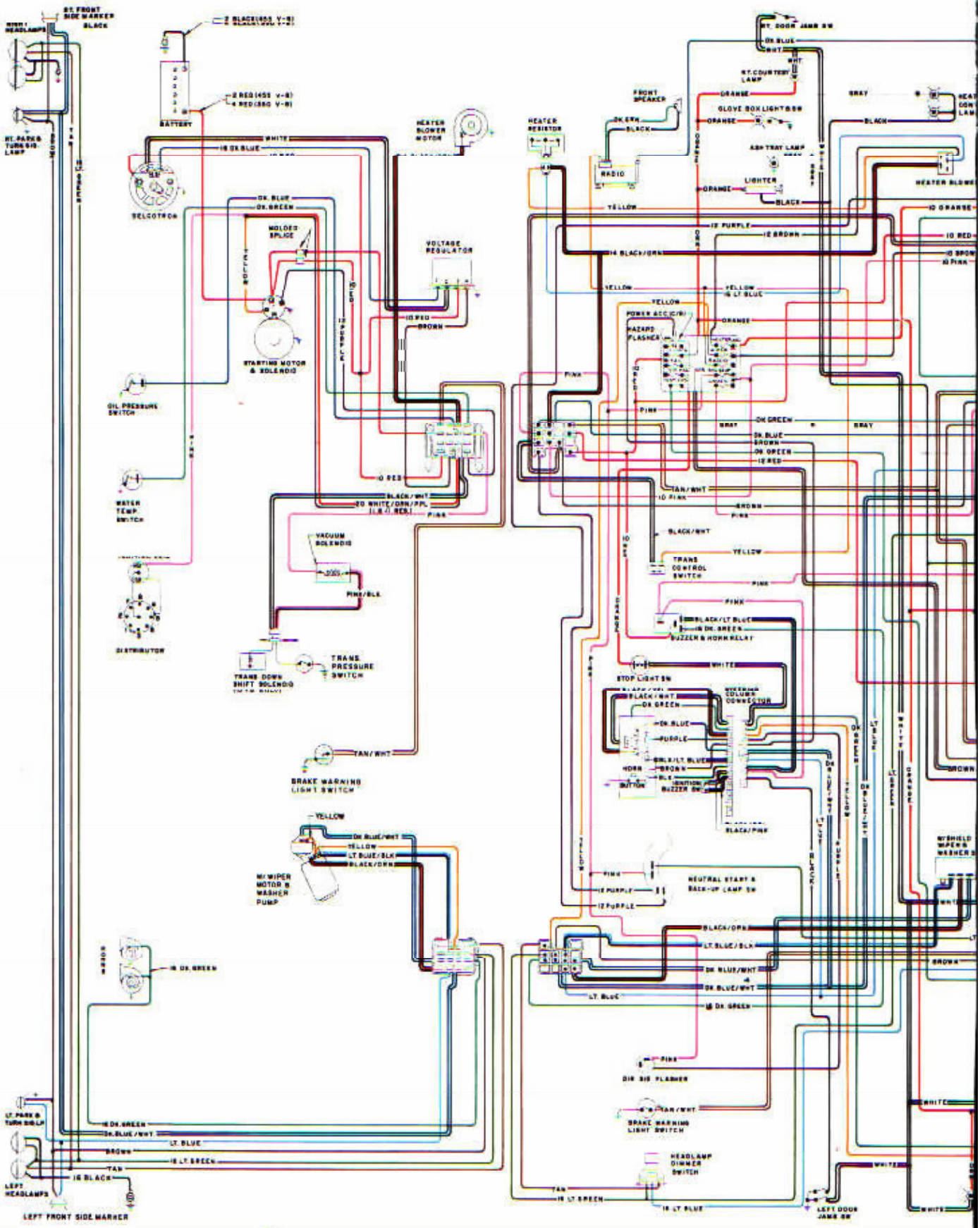


Figure 120-133 Wiring Circuit Diagram - 43-44000 Series

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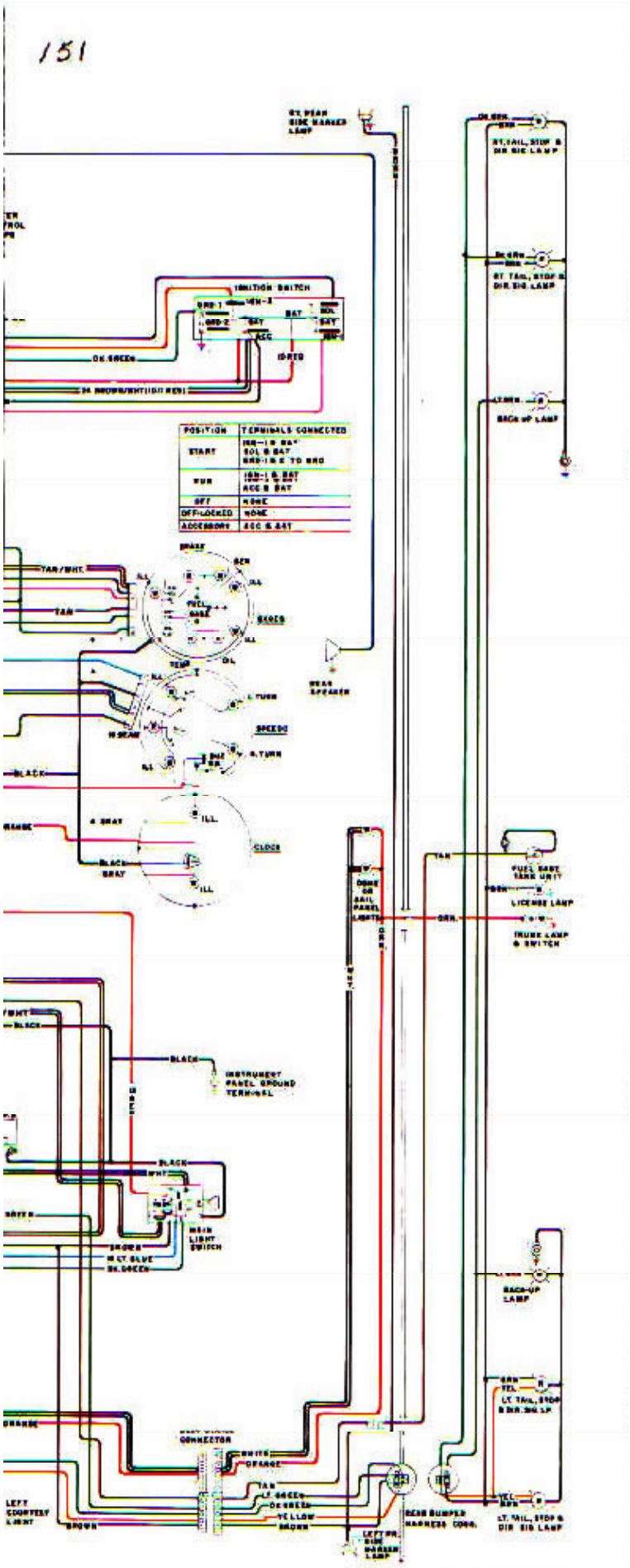


Neg. #120-134

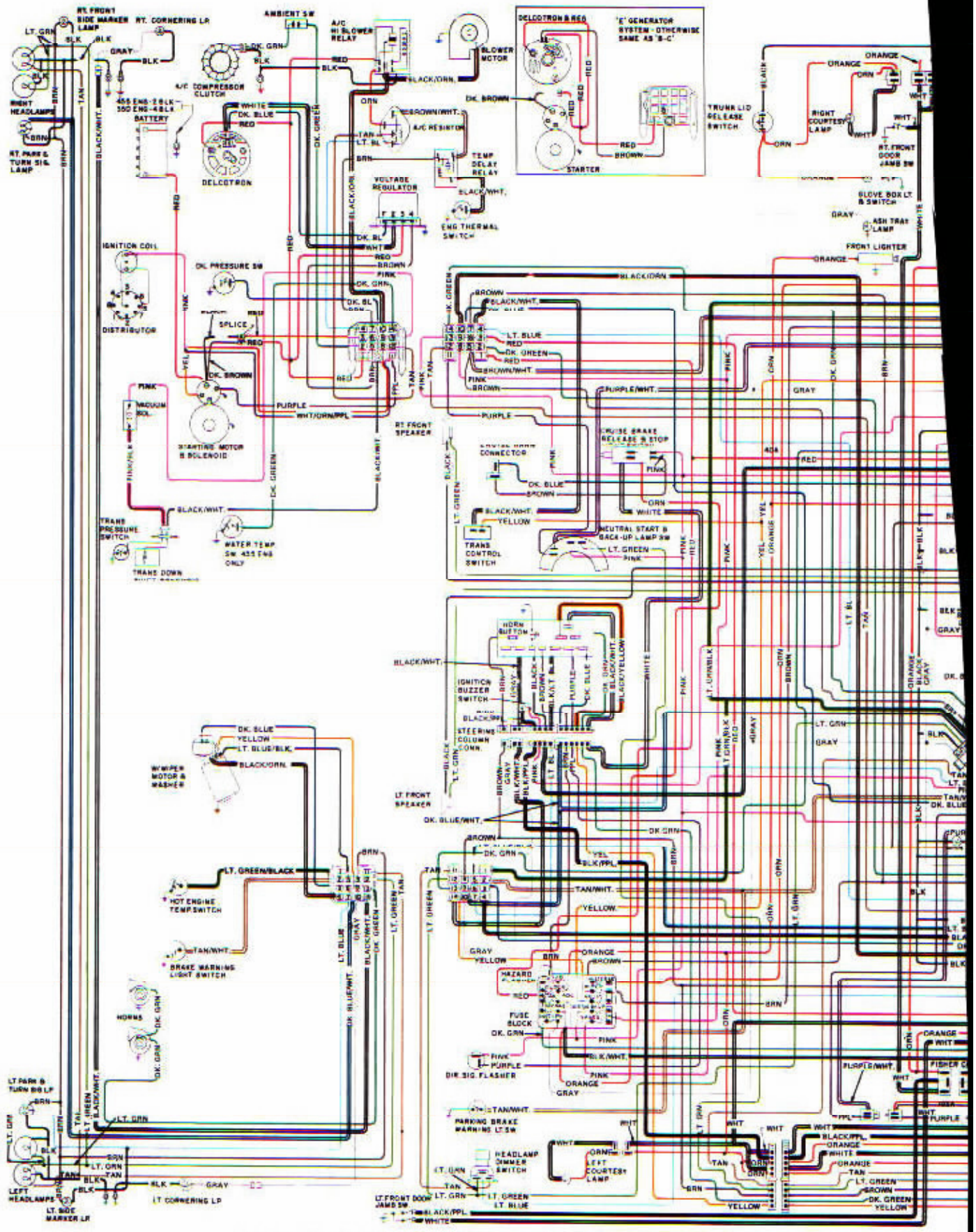
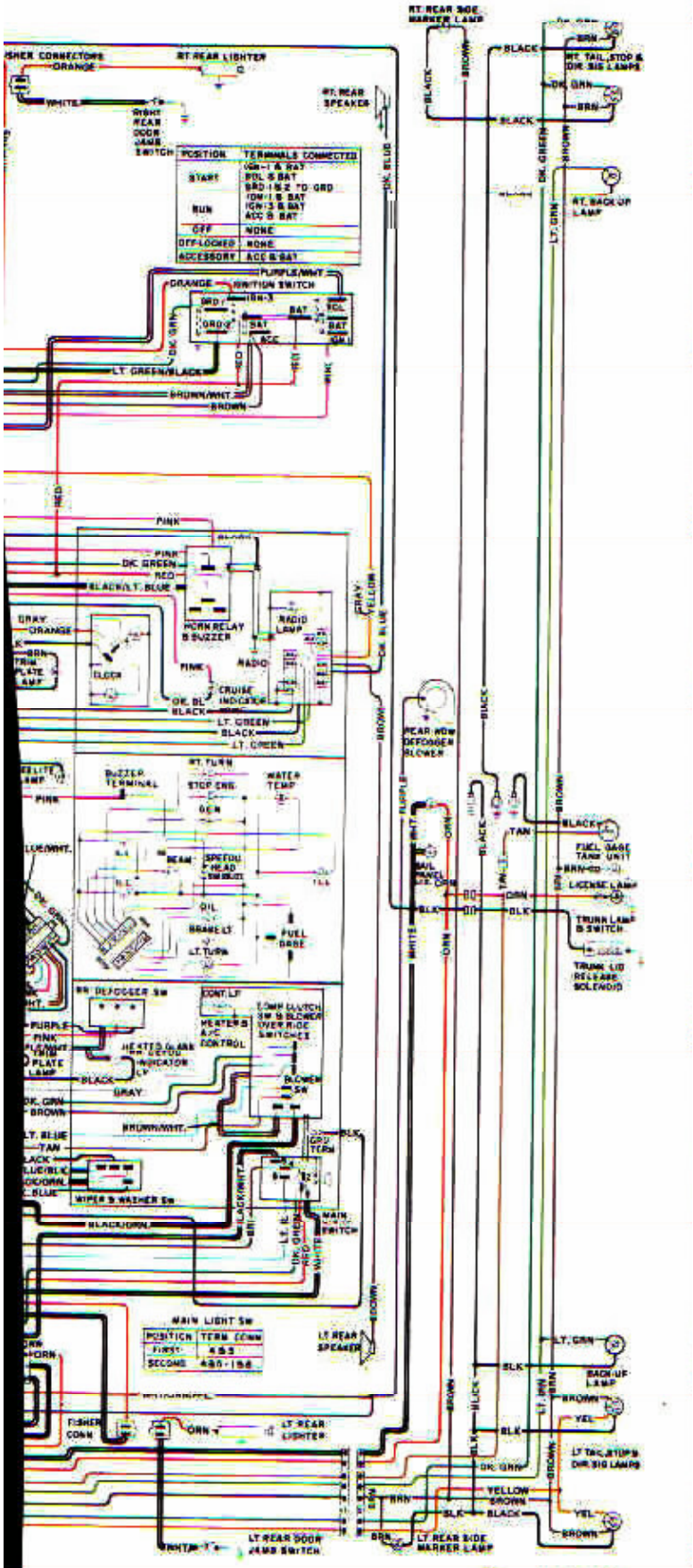


Figure 120-134 Wiring Circuit Diagram - 45-46-48-49000 Series

120-152



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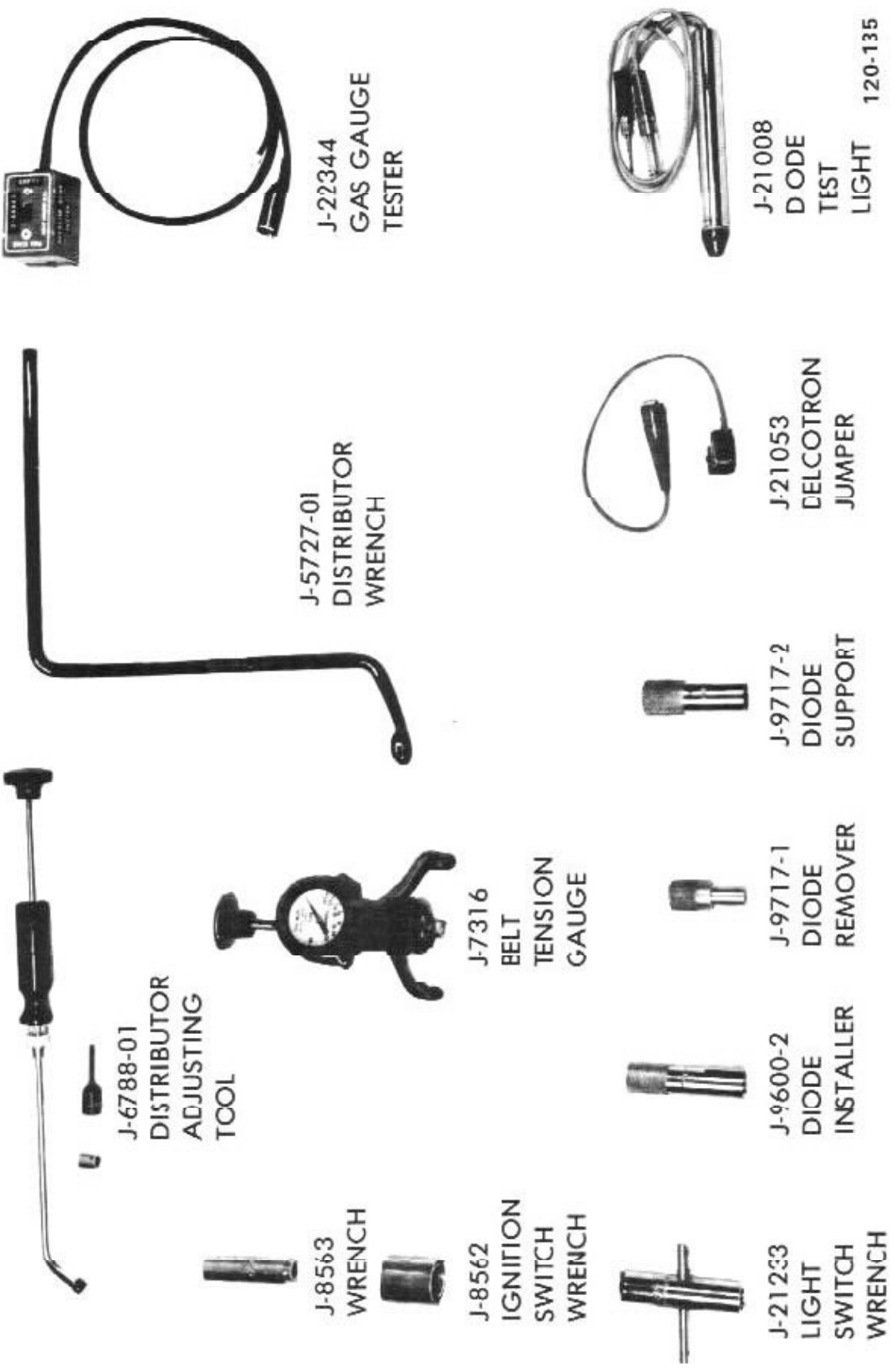

Figure 120-135 Electrical System Special Tools - All Series

SECTION F

INSTRUMENT PANEL MISCELLANEOUS ITEMS

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Fuel Gauge	120-28
	Fuel Gauge Trouble Chart	120-29
	Speedometer and Ignition Key Warning Buzzer Diagnosis	120-30
II	DESCRIPTION AND OPERATION:	
	Electric Clock	120-31
	Fuel Gauge System	120-32
	Speedometer	120-33
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION I

TROUBLE DIAGNOSIS

120-28 FUEL GAUGE - TROUBLE DIAGNOSIS

If the gasoline gage does not operate properly, the dash unit, tank unit wiring and the tank unit should be separately tested to determine which is at fault. The units and wiring may be tested by using Gas Gage Tester J-22344. To use the tester, disconnect the tan wire from the gas gauge tank unit terminal and plug the tester into the end of the tan wire. Connect the other tester lead to a good ground. With the tester switched into the empty position, the gas gauge dash unit pointer should touch the empty line or rest slightly below; with the tester switched to the full position, the gas gauge dash unit pointer should touch the full line or rest slightly above it.

If the gas gauge system fails to pass these two tests, refer to the following chart to diagnose the trouble.

120-30 SPEEDOMETER - TROUBLE DIAGNOSIS

a. Checking Noisy Speedometer

1. Jack up rear wheels in a safe manner and close car windows to exclude outside noises.

2. With transmission in direct drive, run slowly from O to 50 MPH and back to O, noting speed range where noise appears.

3. Apply brakes and shift transmission to park position, then run engine through same speed range as before.

4. If the noise continues even with the transmission output shaft stationary, something other than the speedometer installation is at fault.

5. If noise disappears with transmission stationary, check further for cause of noise by checking for proper installation of speedometer cable as shown in Figures 120-45 through 50.

6. If cable installation is okay, next remove inner cable from casing. 7. If noise stops with inner cable removed, speedometer or cable is at fault. Inspect cable as described in subparagraph c.

b. Inspection of Speedometer Cable and Casing

If the speedometer installation appears to be noisy or the speed indicator wavers, inspect the cable casing for damage, sharp bends, for being out-of position in the supporting clips. See Figures 120- 70 through 73. If casing is in good condition and properly installed, remove inner cable for inspection. If casing is kinked, replace it.

1. Disconnect cable casing at speedometer head, then pull inner cable out of upper end of casing.

2. Inspect cable for worn spots or breaks. Check cable for kinks by holding one end vertically in each hand and turning cable slowly; if cable is kinked, the loop will "flop". Replace a cable which has kinks or bent tips.

3. Before installing a new inner cable, work AC spec. 640 speedometer cable lubricant into the cable throughly, then wipe off all excess lubricant. Since the speedometer casing has a Delrin (plastic) liner, this lubricant is used as a rust preventive only.

4. If noise is still present, install a new speedometer cable assembly.

5. If this does not correct noise, have speedometer head checked by a UMS Service Station.

c. Trouble-Shooting Speedometer and Ignition Key Buzzer

Since both circuits simply provide a separate ground for the same buzzer, trouble-shooting will involve both circuits. See Figure 120-76. Check ignition key buzzer circuit by turning the ignition key to the accessory position and opening the driver's door. Check speedometer buzzer by setting speedometer pointer to a low speed, raising rear wheels of car, and running car in drive until the speedometer speed comes up to the set buzzer speed.

1. Buzzer Will Not Operate On Either Circuit.

(a) Check buzzer operation by sticking a prod in pink wire terminal at buzzer and running a jumper to ground. If buzzer now operates, circuit is okay through buzzer and trouble must be in wire to speedometer and door jamb switch. If buzzer still does not operate, replace buzzer.

2. Speedometer Buzzer Operates - Ignition Key Buzzer Does Not Operate.

(a) Remove driver's door jamb switch. Ground black wire with ignition key in accessory position. If buzzer now operates, replace door jamb switch.

(b) If buzzer still does not operate, remove column lock cylinder buzzer switch and place a jumper between the buzzer terminals. If buzzer now operates, replace column lock cylinder buzzer switch.

3. Ignition Key Buzzer Operates - Speedometer Buzzer Does Not Operate.

(a) Disconnect pink wire from speedometer and run jumper to ground. If buzzer now operates, circuit is okay as far as speedometer and trouble is in speedometer or in cluster ground circuit.

(b) If cluster ground wire is disconnected, there will be a poor ground for the speedometer buzzer, panel illumination lamps and wiper motor. To check for adequate cluster ground, turn on panel lights full bright, then turn on wiper

DASH UNIT NEVER READS EMPTY
OR
DASH UNIT READS FULL AT ALL TIMES WITH IGNITION ON

1. Check for disconnected or loose tank unit feed wire at tank unit.
2. Connect Gas Gauge Tester J-22344 to tank unit feed wire and observe dash unit.

No Improvement

1. Check cluster fuse.
2. Check for proper connections at: Dash unit to printed circuit. I.P. harness to printed circuit. Flat wire to I.P. harness. Trunk harness to flat wire.
3. Remove dash unit and check.

Dash Unit Reads Okay

1. Check ground wire from tank unit to trunk floor pan for continuity.

DASH UNIT READS EMPTY AT ALL TIMES WITH IGNITION ON

1. Disconnect tank unit feed wire. Dash unit should now read full.

Gauge Reads Full

1. Check for grounded tank unit lead.
2. Remove tank unit and check.

Gauge Does Not Read Full

1. Check cluster fuse.
2. Check for proper connections at: Dash unit to printed circuit. I.P. harness to printed circuit.
3. If dash unit is okay, check for opens in printed circuit or shorts due to pinched wires in the body harness.
4. Remove dash unit and check.

ERRATIC FUEL GAUGE READINGS AND OFF CALIBRATION COMPLAINTS

(Gauge fluctuation during acceleration and deceleration is normal.)

Check the following for loose connection:

1. Dash unit mounting screws.
2. I.P. harness to printed circuit.
3. I.P. harness to flat wire.
4. Flat wire to trunk harness.
5. Feed wire to tank unit.
6. Tank unit ground to body.

NOTE: Many fuel gauge tank units and dash units are replaced because of poor diagnosis or lack of knowledge of the variables in the system. For example, some owners complain that when their gauge reads empty the tank cannot be filled to the capacity stated in the owner's manual.

Possible reasons:

1. Empty fuel reserve of 1 to 3 gallons.
2. Gas station attendant did not take time to completely fill the tank.
3. Car was filled on a hill or with a heavy trunk load causing the tank vent pipe to be blocked and therefore preventing the tank from being completely filled.

120-67

Figure 120-67 Fuel Gauge Trouble Diagnosis

DASH UNIT NEVER READS FULL

1. Connect Gas Gauge Tester J-22344 to tank unit feed wire and observe dash unit.

Dash Unit Reads Okay

1. Reconnect tank unit feed wire to tank unit.
2. *Completely* fill fuel tank.
3. Note dash unit pointer with engine running.
4. If pointer still does not go to full, disconnect feed wire to tank unit.
5. With ohmeter check resistance of tank unit. Should read 88 to 92 ohm with a full tank.
6. If low resistance, check tank mounting area for damage.

Gauge Does Not Read Full

1. Check cluster fuse.
2. Check for proper connections at: Dash unit to printed circuit, I.P. harness to printed circuit.
3. If dash unit is okay, check for opens in printed circuit or shorts due to pinched wires in the body harness.
4. Remove dash unit and check.

DASH UNIT DEAD BETWEEN EMPTY AND FULL WITH IGNITION ON (SAME PLACE AT ALL TIMES)

1. Disconnect tank unit feed wire. With voltmeter, check feed wire voltage. Should read 3-4 volts.

No Voltage

1. Indicates open circuit on hot side of dash unit.
   a. Check cluster fuse.
   b. Check for proper connection at: Dash unit to printed circuit, I.P. harness to printed circuit.
2. If circuits are okay, remove dash unit and check

Voltage

1. Connect gas gauge checker to tank unit feed wire and observe dash unit.
2. If still dead, remove dash unit and check

NOTE: The dash unit may be any place with the ignition off.

120-68

Figure 120-68 Fuel Gauge Trouble Diagnosis

motor and note panel light brightness. If panel lights do not dim, cluster has an adequate ground and trouble in (a) above must be due to a defect in speedometer. *A defective speedometer assembly must be sent to the nearest UMS Service Station for repairs.*

4. *Buzzer Operates Continously.*

(a) Eliminate possibility of a continuous ground at door jamb switch by removing switch from door jamb. (b) Eliminate possibility of a continuous ground in speedometer by disconnecting pink wire from speedometer.

(c) If neither (a) or (b) stops buzzer, pink wire must be pinched or accidentally grounded between buzzer and one of these units.

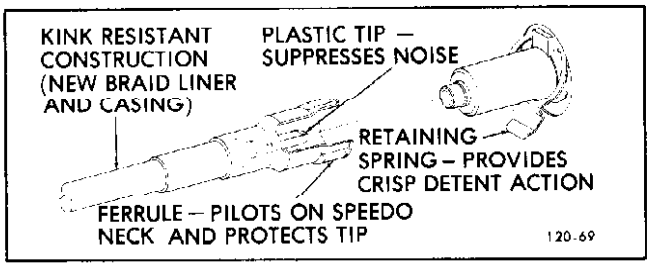

Figure 120-69 Quick Connect Speedo Cable

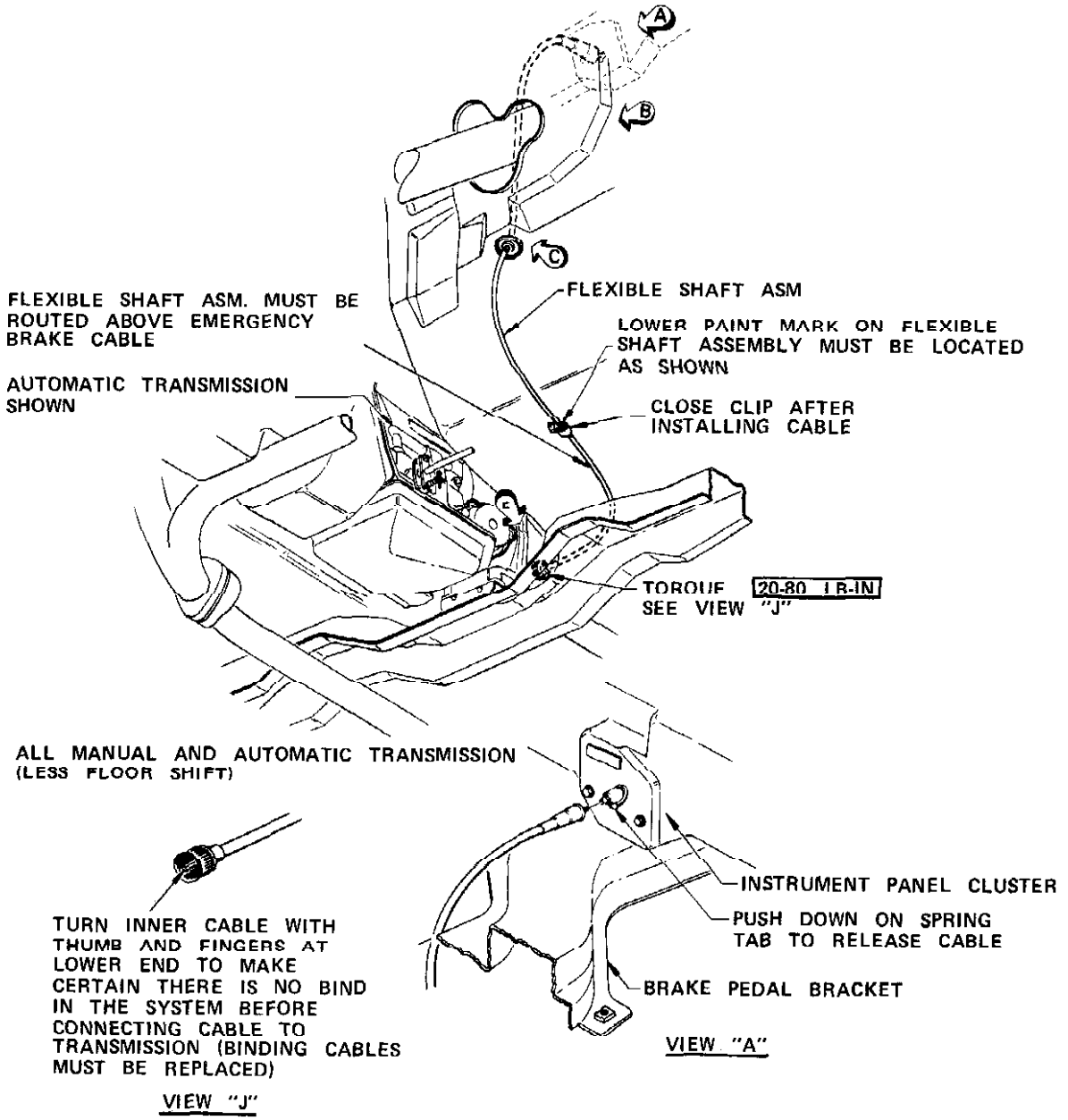

Figure 120-70 Speedo Cable Installation - 43-44000 Series

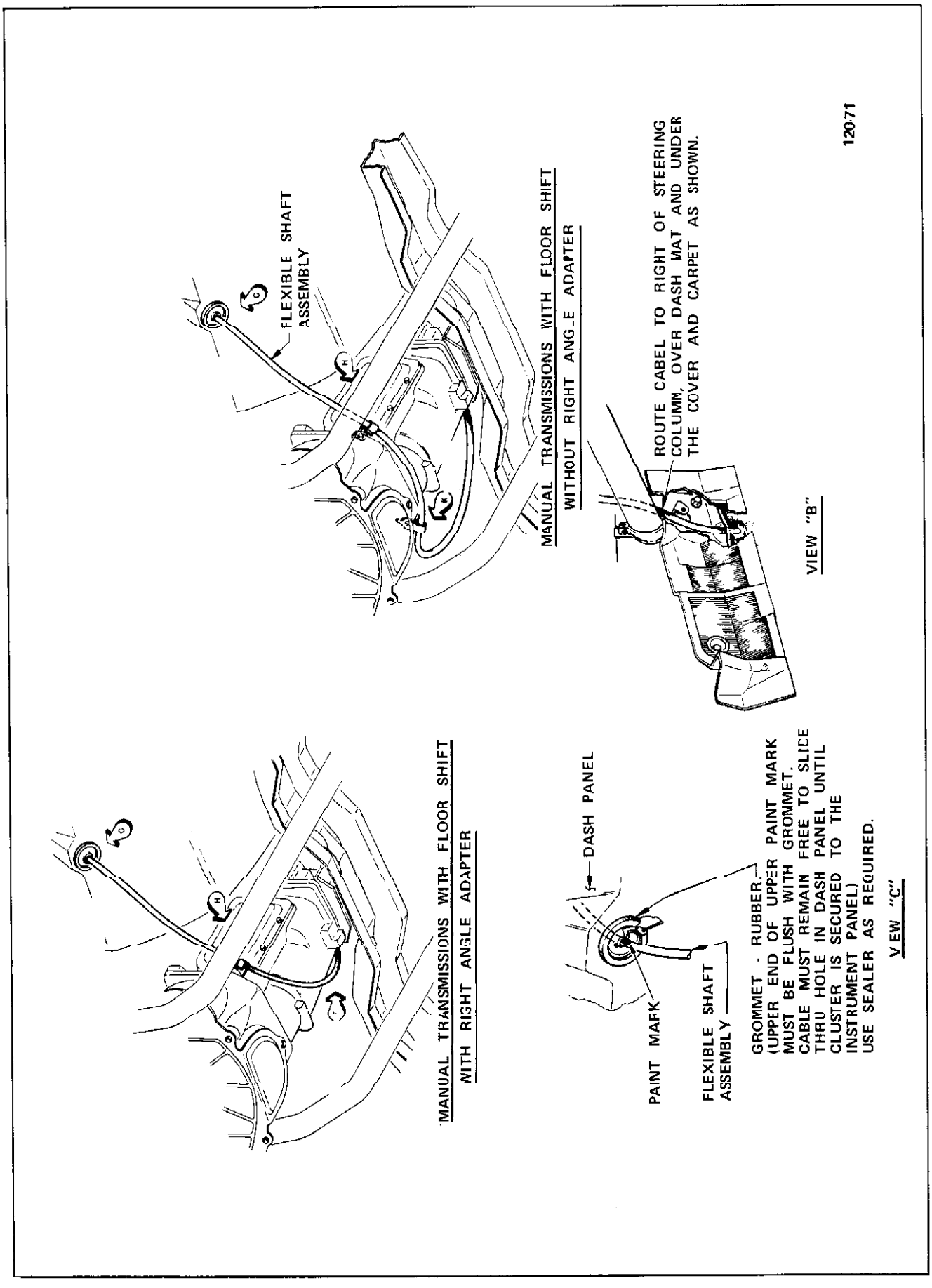

Figure 120-71 Speedo Cable Installation - 43-44000 Series

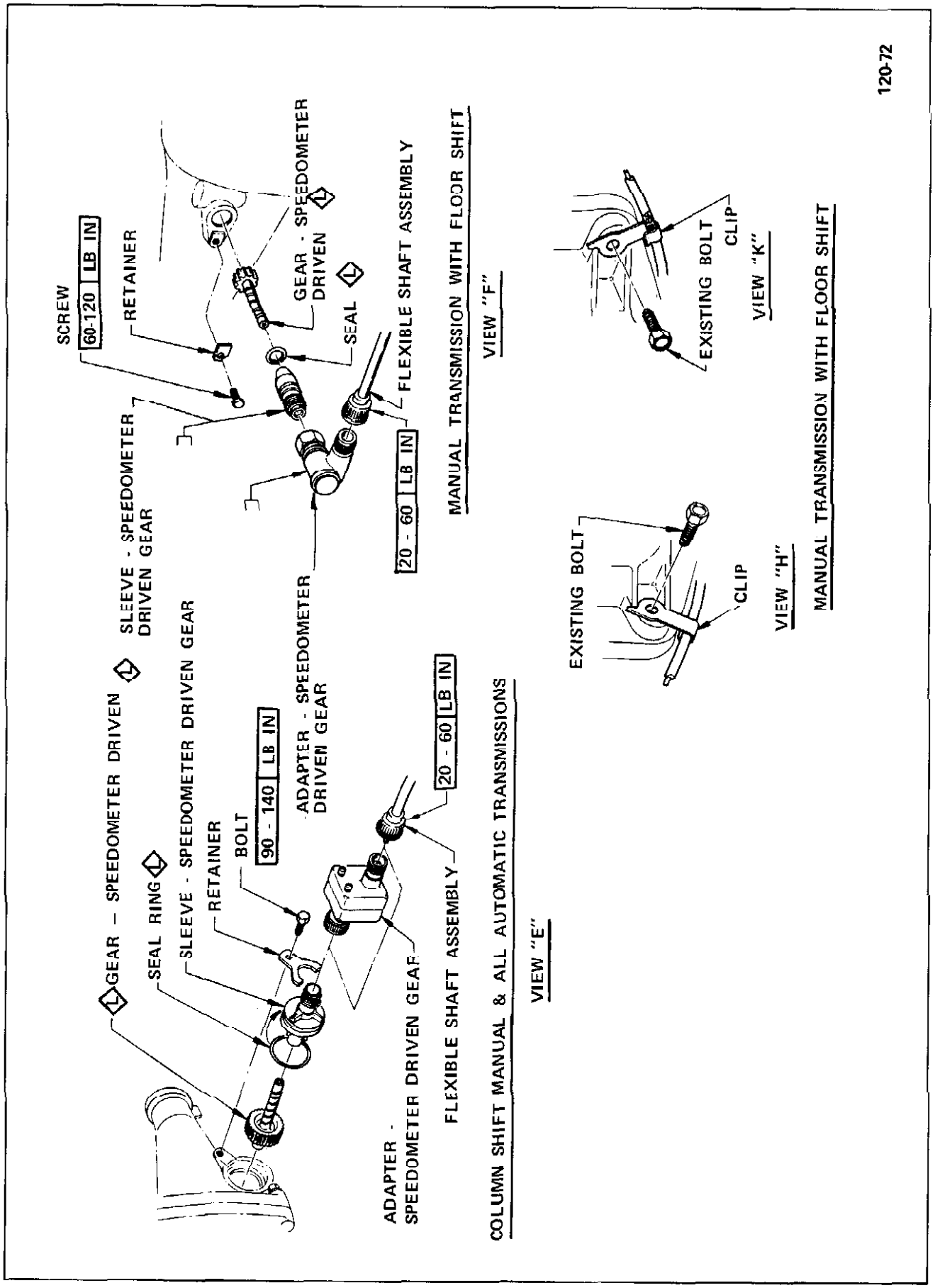

Figure 120-72 Speedo Cable Installation - 43-44000 Series

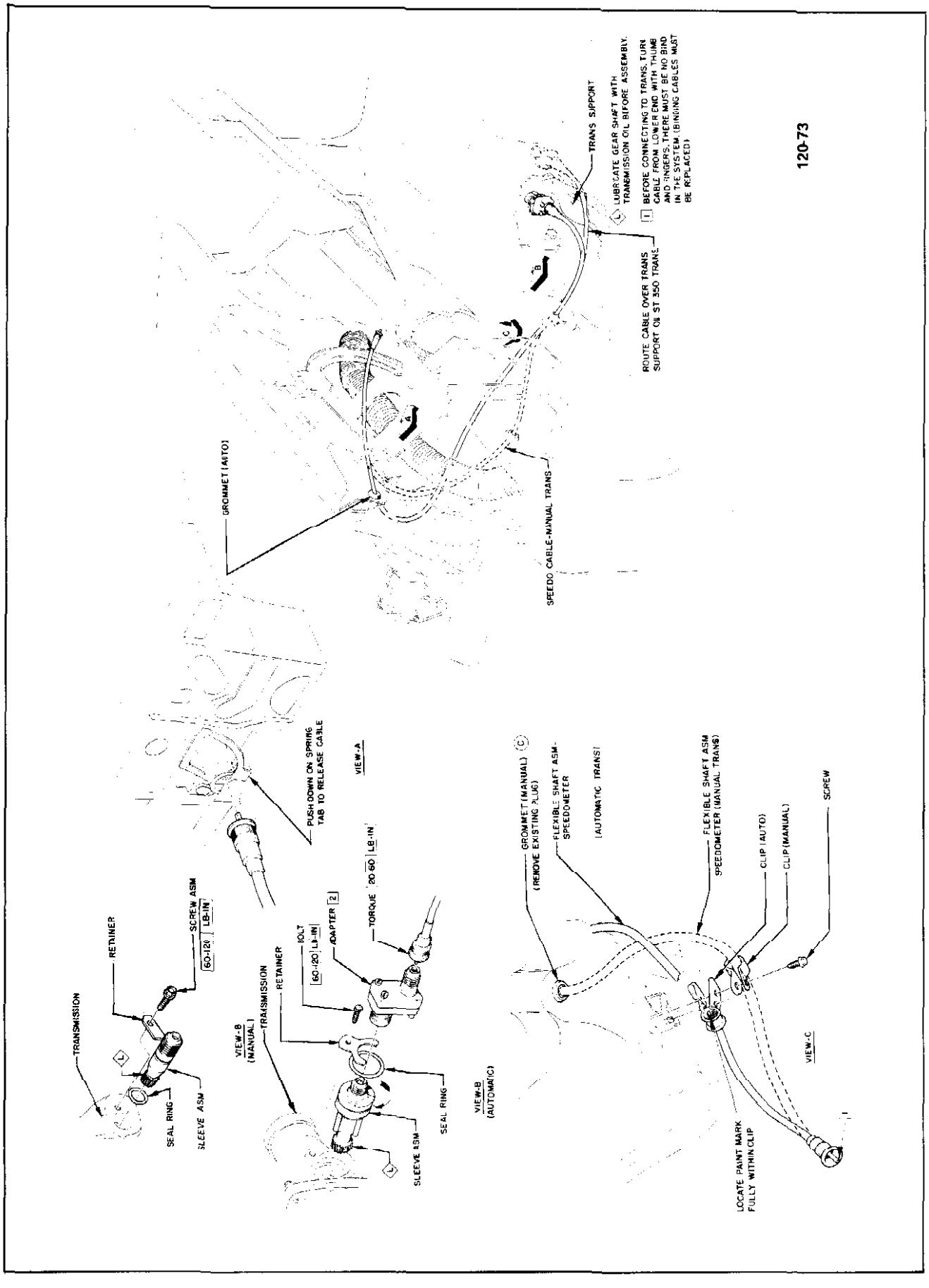

Figure 120-73 Speedo Cable Installation - 45-46-48-49000 Series

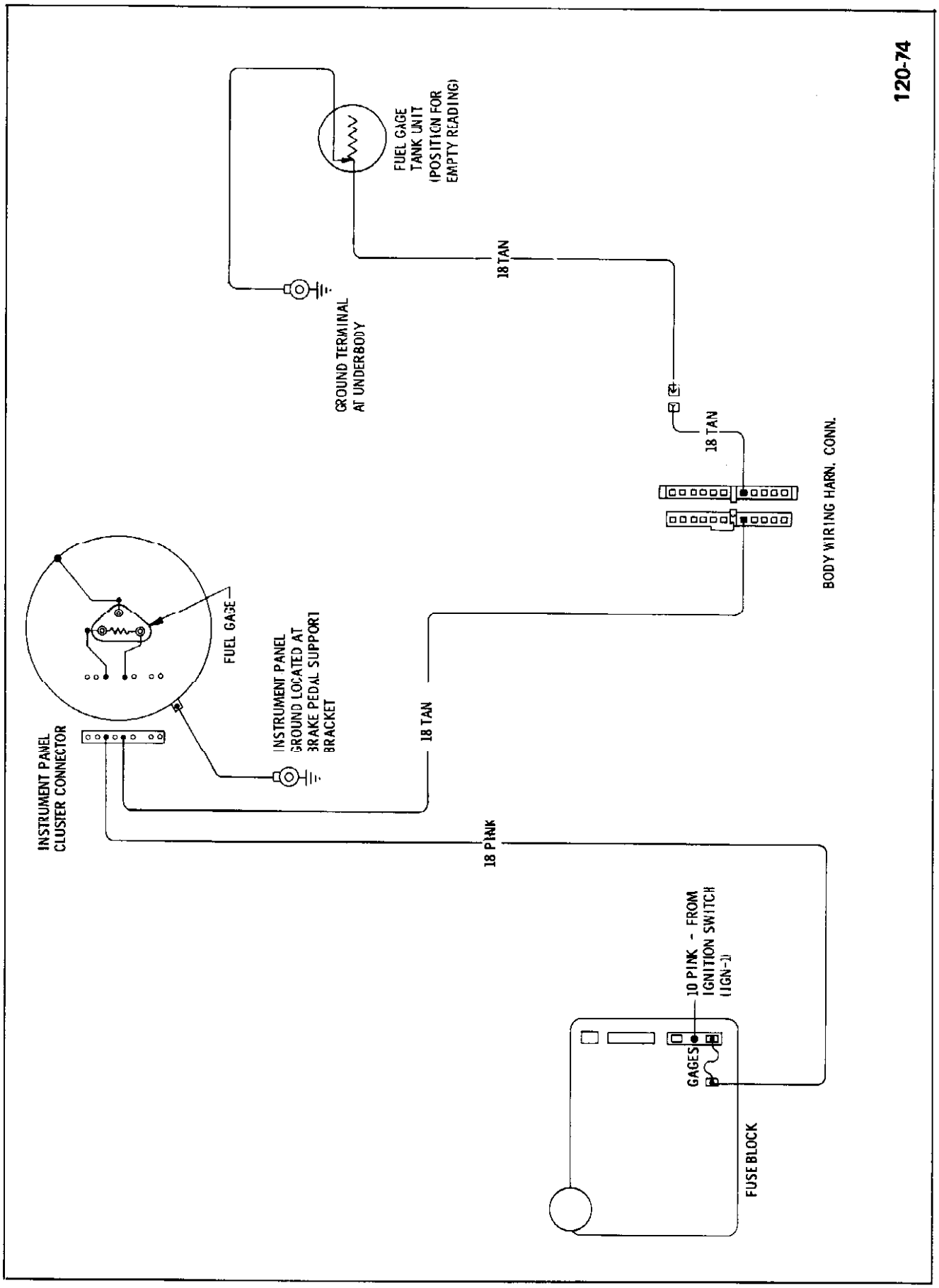

Figure 120-74 Fuel Gauge Wiring Diagram - 43-44000 Series

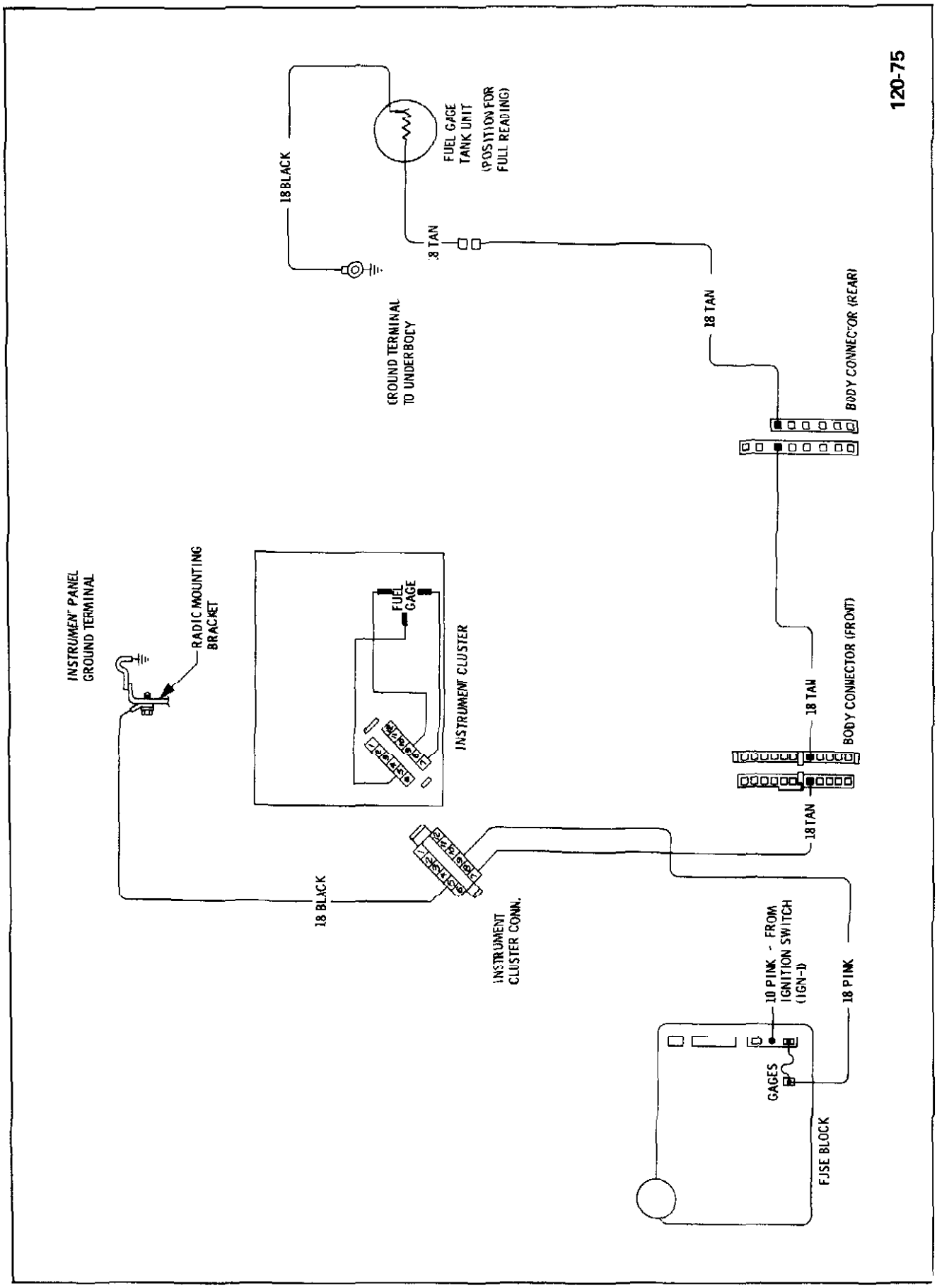

Figure 120-75 Fuel Gauge Wiring Diagram - 45-46-48-49000 Series

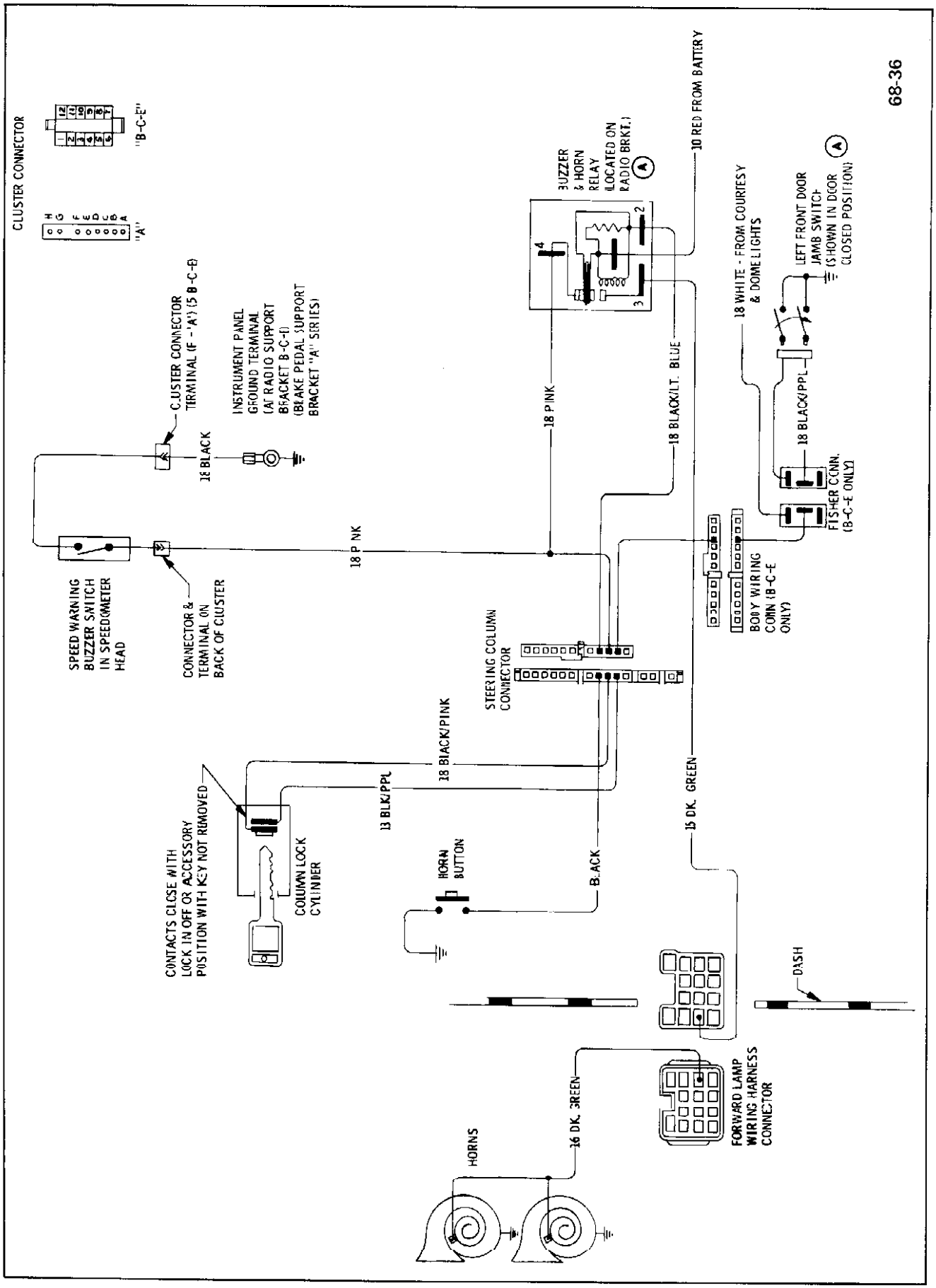

Figure 120-76 Buzzer and Horn Relay Wiring Diagram

DIVISION II

DESCRIPTION AND OPERATION

120-30 ELECTRIC CLOCK

The electric clock is mounted in the right of the instrument cluster housing. The clock wiring circuit is protected by a fuse on the fuse block. Clock lighting is controlled by the rheostat in the lighting switch and is protected by the instrument lamps fuse on the fuse block.

a. Clock Time Reset and Automatic Regulation

The electric clock has a sweep-second hand and an automatic regulator. A reset knob extends through the glass of the clock dial. To reset the time, pull the knob out and turn in either direction as required.

There is no regulator because regulation is accomplished automatically by the action of resetting the time. If a clock is running fast, the action of turning the hands back to correct the time will automatically cause the clock to run slightly slower; if a clock is running slow, the action of turning the hands forward to correct the time will automatically cause the clock to run slightly faster (10 to 45 seconds per day). If clock varies over 10 minutes a day, the clock will never adjust sufficiently and must be disassembled for repair.

A lock-out feature prevents the regulator mechanism from being moved more than once during a rewind period (approximately 2 minutes), regardless of the number of times the clock reset is operated. After clock rewinds, if it is again reset, automatic regulation will take place.

b. Clock Service

The clock manufacturers have established Authorized Service Stations in many cities throughout the United States and Canada. These service stations are prepared to carry out terms of the manufacturer's warranty and also to perform any repairs made necessary through use of clock.

When a clock requires warranty service or repairs other than regulation, it should be removed by the Buick dealer and sent to the nearest authorized service station. *The manufacturer's warranty is void if repairs have been attempted outside of an authorized service station.*

120-31 FUEL GAUGE SYSTEM - DESCRIPTION AND OPERATION

The gasoline gauge system consists of a dash unit (located in the instrument cluster), a tank unit (located in the gasoline tank), a wire between these two units, and a wire to supply battery voltage to the dash unit. See Figure 120-74 or 75. The single tank unit terminal is connected to one dash unit terminal with a tan wire. The other dash unit terminal is connected to the ignition switch, through the "GAGES" fuse, with a pink wire, so that voltage to energize the system is supplied only when the ignition switch is turned on. The dash unit has a balanced- type pointer; when the ignition is turned off, the pointer may come to rest any place on the dial.

The dash unit pointer is moved by changing the balance between the magnetic pull of three coils in the unit. This balance is controlled by action of the tank unit which contains a variable rheostat, the value of which varies with movement of a float. The tank unit is mounted in the tank so that the float rises and falls on the surface of the gasoline. The float is adjusted to provide approximately 1 to 3 gallons reserve when the dash unit pointer is at the "E" position.

When the ignition switch is "On" and the float is in the full position (maximum resistance for the tan wire to ground), the current flow to ground is through the resistor, empty coil, the full coil and the bucking coil. Due to the fact that the bucking coil opposes the empty coil, the full coil has the stronger magnetic pull, and the dash unit pointer is pulled to the "F" position. When the float is in the empty position (practically no resistance for tan wire to ground), the current flow is through the resistor, the empty coil and the tan wire to ground at the tank unit. The dash unit pointer is thus pulled to the "E" position.

120-32 SPEEDOMETER

a. Speedometer Heads

The speedometer head has a magnetic speed indicator and a gear driven odometer. It is driven by a flexible cable connected to a worm gear in the transmission rear bearing retainer.

The speed indicating portion of the speedometer operates on the magnetic principle. There is a permanent magnet in the speedometer head which rotates at the same speed as the cable. This magnet exerts a pull on a speed cup causing it to move through an arc in direct ratio to the revolving magnet speed. A pointer is attached to the speed cup spindle to indicate speed on the speedometer dial. A calibrated hair spring (part of speed cup) opposes the magnetic pull on the speed cup so the pointer indicates speed accurately; this spring also rotates the cup and pointer to zero when the car stops.

b. Speedometer Buzzer

The speedometer buzzer consists of a buzzer which may be adjusted by the driver to sound at any speed between 30 and 120 MPH by turning a knob at the left of the speedometer face. The speed at which the buzzer is set is indicated by a special pointer in the speedometer face.

The speed alert electrical circuit starts at the battery. It feeds through the fusible links to the starter solenoid, to the buzzer contacts. After passing through the buzzer contacts, a very small amount of current goes through a

resistor to ground and the rest of the current passes through a pink wire to the connector located on the speedometer case.

In the speedometer, current is conducted from the separate buzzer connector through a wire to an insulated pin in the lower end of the buzzer pointer. As the speedometer pointer moves up to coincide with the buzzer pointer, a light grounding hair spring on the lower end of the speedometer pointer makes contact with the "hot" insulated pin on the speed alert pointer.

This grounds the circuit, causing the buzzer to buzz. If the car speed is increased beyond the buzzer setting, the insulated pin on the safety-buzzer pointer "picks-up" the hair spring as the speedometer pointer passes under the buzzer pointer and the light grounding hair spring winds-up slightly.

SECTION E

INSTRUMENT PANEL
45-46-48-49000 SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Trouble Diagnosis Chart - Generator, Oil Pressure and Temperature Indicators	120-25
II	DESCRIPTION AND OPERATION:	
	Description of Instrument Panel - 45-46-49000 Series.	120-26
III	*ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)*	-
IV	REMOVAL AND INSTALLATION:	
	Removal and Installation of Instrument Panel Parts 45 46-49000 Series	120-27
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION I TROUBLE DIAGNOSIS

120-25 TROUBLE DIAGNOSIS CHART - GENERATOR OIL PRESSURE AND TEMPERATURE INDICATORS

Complaint	Possible Cause
1. GENERATOR INDICATOR	
Light on, ignition "Off".	Positive diode shorted. Locate and replace.
Light not lit, ignition "On" and engine not running.	Bulb burned out. Replace. Open in light circuit. Locate and correct. Positive diode shorted. Locate and replace.
Light on. engine running above idle speed.	No generator output. Check output, paragraph 68-27 or 68-42, sub paragraph i for 49000 Series. Negative diode shorted. Loose or broken generator belt. Resistance or open in field circuit. Defective field-light relay.
2. OIL PRESSURE INDICATOR	
Light not lit, ignition "On" and engine not running.	Bulb burned out. Replace. Open in light circuit. Locate and correct. Oil pressure switch defective. Replace.
Light on, engine running above idle speed.	Wiring between light and switch grounded. Locate and correct. Oil pressure switch defective. Replace. Oil pressure below 2 lbs. Locate cause and correct.
3. TEMPERATURE INDICATORS	
(a) Hot Indicator	
Light not lit when cranking engine.	Bulb burned out. Replace. Open in light circuit. Locate and correct. Ignition switch defective. Replace.
Light on, engine running.	Wiring between light and switch grounded. Locate and correct. Temperature switch defective. Replace. Cooling system water temperature above 248°F. Find cause and correct. Ignition switch defective. Replace.
(b) Cold Indicator	
Light not lit, ignition "On" and engine cold.	Bulb burned out. Replace. Open in light circuit. Locate and correct. Water temperature switch defective. Replace.
Light on, after normal engine warm-up period.	Wiring between light and switch grounded. Locate and correct. Water temperature switch defective. Replace. Thermostat in cooling system defective. Replace.

120-44

Figure 120-44 Indicator Trouble Diagnosis - 45-46-48000 Series

DIVISION II

DESCRIPTION AND OPERATION

120-26 DESCRIPTION OF INSTRUMENT PANEL - 45-46-48- 49000 Series

CAUTION: *Disconnect battery ground cable before removing any instrument panel unit or wiring.*

a. Description of Instrument Cluster Assembly

The instrument cluster assembly contains the speedometer, fuel gage, indicator lights and clock.

A printed circuit is used to complete the circuits for all the lights and instruments in the cluster assembly. See Figures 120-65 and 120-66. A retangular disconnect plug which is part of the instrument panel wiring harness attaches to the printed circuit connector tabs. The disconnect plug has two retaining fingers of different widths to insure correct assembly of the plug in the printed circuit. If the printed circuit should become defective, it should be replaced as it is not practical to repair it.

An accessory block is an integral part of the instrument panel wiring harness. If the car has a composite wiring harness, this block makes it possible to connect the wiring for the following options quickly and easily: cruise control and rear window defroster.

b. Generator Charge Indicator

The red "GEN" warning light should light when the ignition is turned "ON" and before the engine is started; if not lighted, either the bulb is burned out or the indicator light wiring has an open circuit. After the engine is started, the "GEN" light should be out at all times; if the light comes on, the generator belt may be loose or missing, the generator or regulator may be defective, or the charging circuit may be defective. See paragraph 68-24 or 68-36 for trouble-shooting procedures.

To trace the generator indicator light circuit, see Figure 120-66, With the ignition switch turned on (engine not running), current flow is through the ignition switch, through the generator light in the instrument cluster, to the "4" terminal of the regulator, through the lower contacts of the voltage regulator (held closed by the spring), out the "F" terminal, in the "F" terminal of the generator, through the brush and slip ring, through the field, through another brush and slip ring to ground.

Before the engine is started, the generator light should glow at about 1/2 brightness. This is because the voltage in the circuit before the light is about 12 volts, but the voltage at the "4" terminal after the light is about 5 volts. This makes the effective voltage across the generator light approximately 7 volts for about 1/2 brightness.

After the engine is started, the voltage put-out by the generator immediately closes the field relay. This causes battery voltage from the "3" terminal to be present at the "4" terminal. See Figure 120-66. Since battery voltage is present on both sides of the generator light, the light goes out. If the generator light comes on with the engine running, the charging circuit should be tested at the first opportunity to determine the cause of the trouble. See paragraph 68-6.

c. Oil Pressure Indicator

The engine oil pressure indicator light is controlled by a pressure operated switch located in the main oil gallery at the right front of the engine.

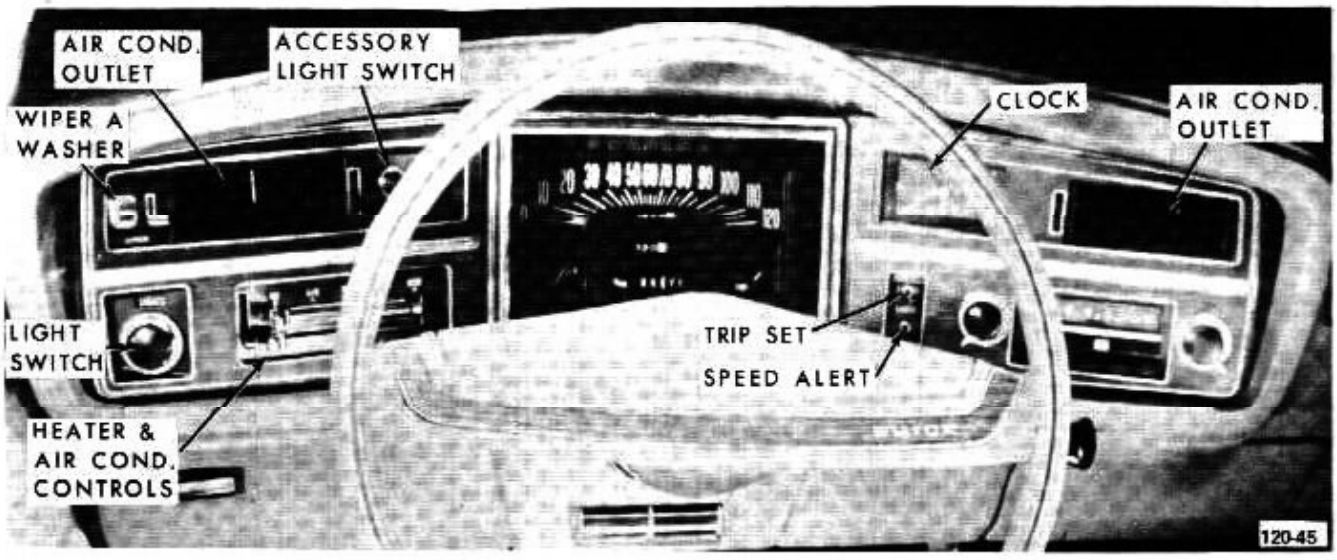

Figure 120-45 Instrument Panel - 45-46-48-49000 Series

This light should come on when the ignition is turned "On" and the engine is not running. If not lit, either the bulb is burned out, the wiring has an open or the oil switch is defective.

If the engine oil pressure drops below a safe level during operation, the circuit is completed through the pressure switch to ground, and the "OIL" indicator light in the cluster will be turned on.

If the "OIL" indicator stays on or comes on when the engine is running at speeds above idle, the following may be the cause, rather than low oil pressure:

1. Wiring circuit between oil pressure switch and light grounded. Remove connector from pressure switch, if light stays on trouble is in wiring.

2. Switch defective. Replace switch.

d. Temperature Indicator

A water temperature switch located in the right front of the intake manifold, controls the operation of a temperature indicator with a red lens. A metal temperature switch located in the rear of the left head controls the operation of a "STOP ENGINE" temperature indicator.

NOTE: *LeSabres do not have a "STOP ENGINE" light.*

If the engine cooling system is not functioning properly and the water temperature should reach approximately 253 degrees F., the "HOT" indicator will be turned on by the water temperature switch. *As a test circuit to check whether the "HOT" indicator bulb is functioning properly, a wire which leads to the "GND" terminal of the ignition switch is connected in to its circuit.* See Figure 120-66. When the ignition is in the "START" position (engine cranking), the "GND" terminal is grounded inside the switch and the "HOT" indicator bulb will be lit. When the engine is started and the ignition switch is in the "ON" position, the test circuit is opened and the bulb is then controlled by the water temperature switch.

If the metal temperature of the left cylinder head should reach approximately 265 degrees F., the "STOP ENGINE" indicator will be turned on by the metal temperature switch. This indicator bulb has a separate test circuit to ground in the ignition switch during cranking. See Figure 120-66.

e. Trouble Diagnosis - Generator, Oil Pressure Temperature Indicators

Use Figure 120-66 to trace wiring circuits for indicator lights. To determine if there is a ground in the indicator light circuit, remove connector from control switch, if light stays on, trouble is in circuit.

DIVISION IV

REMOVAL AND INSTALLATION

120-27 REMOVAL AND INSTALLATION OF INSTRUMENT PANEL PARTS - 45-46-48-49000 SERIES

Before starting any instrument panel repair, always disconnect the battery ground cable.

a. R and R Instrument Cluster Trim Panels

Left Side

1. Remove headlight knob by pulling out to last detent and depress the spring-loaded latch button on switch, while pulling knob and rod assembly out of switch. Remove headlight switch escutcheon.

2. Remove trim panel, as shown in Figure 120-46.

3. Disconnect seelight wires from panel and remove panel.

4. To install, connect seelight wire on panel and snap panel in position.

5. Replace headlight switch knob and escutcheon.

Right Side

1. Remove radio knobs and escutcheons. If equipped with speed alert and trip-set, remove cone shaped knobs.

2. Remove trim panel same as left side. See Figure 120-46.

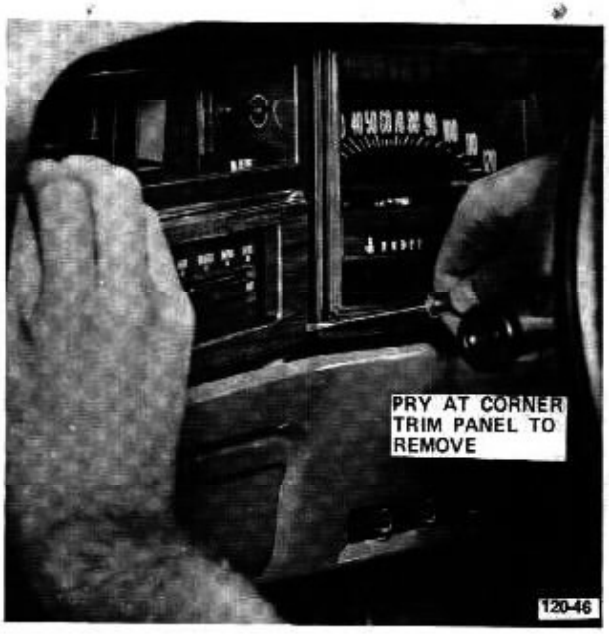

Figure 120-46 Removing Instrument Trim Panels

3. To install, snap panel back in position and replace radio, trip-set, and speed-alert knobs.

b. R and R Speedometer

1. Remove lower instrument filler panel.

2. Place shift lever in "L", and disconnect shift indicator cable on steering column.

3. Remove two screws on speedo face glass. See Figure 120-47.

4. Pull glass out, as shown in Figure 120-48.

5. Remove speedometer by removing three (3) screws marked by arrows in Figure 120-50.

6. Install by replacing speedometer assembly in cluster and replacing three (3) screws.

7. Connect shift indicator cable and adjust, if necessary.

8. Replace lower instrument filler panel.

9. Replace speedo face glass.

c. R and R Printed Circuit

1. Remove lower instrument panel filler.

2. With shift lever in "L", disconnect shift indicator cable on steering column.

3. Remove speedo face glass, as in Figures 120-47 and 120-48.

4. Remove speedometer by removing three screws, as shown in Figure 120-49.

Figure 120-47 Speedo Glass Retaining Screws

Figure 120-48 Removing Speedo Face Glass

5. Disconnect speedo cable on back of cluster.

6. Using needle nose pliers to bend speed-alert and trip-set cable clips, push cables back out of panel.

7. Remove four (4) nuts on printed circuit panel and disconnect wiring harness connector, as shown in Figure 120-50.

8. Remove printed circuit by removing light bulb sockets and fuel gauge clips. See Figure 120-51.

9. Install bulb sockets and fuel gauge clips after replacing printed circuit.

10. To install printed circuit, replace four (4) nuts on panel, connect wiring harness, and connect speedometer, trip-set, and speed-alert cables.

11. Replace speedometer and three (3) screws.

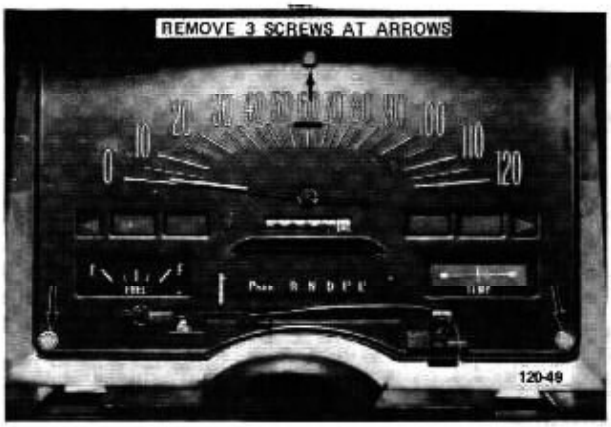

Figure 120-49 Speedometer Retaining Screws

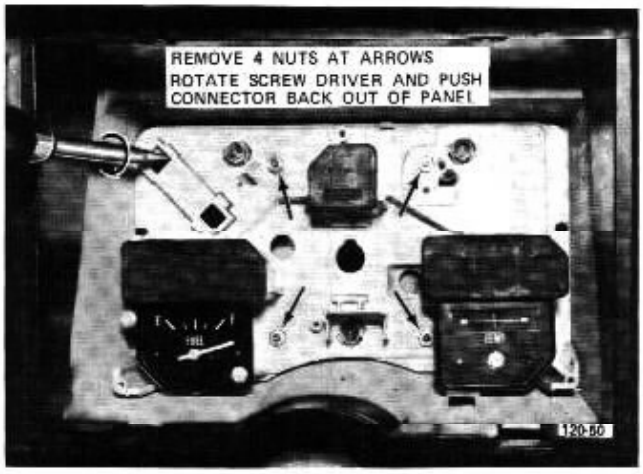

Figure 120-50 Removing Printed Circuit Panel

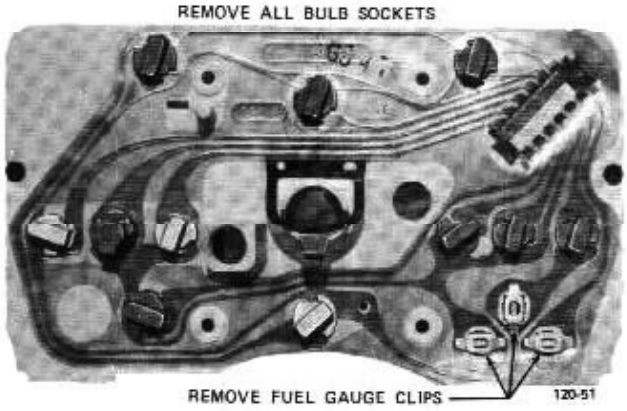

Figure 120-51 Replacing Printed Circuit

12. Hook up shift indicator cable and adjust, if necessary.

13. Replace speedo face glass.

d. R and R Headlight Switch

1. Pull switch out to last notch, then depress the spring-loaded latch button on switch, while pulling knob and rod assembly out of switch. Remove headlight escutcheon.

2. Remove left trim panel. See Figure 120-46.

3. Remove headlight switch retainer nut.

4. Pull Switch down and remove from connector.

5. Plug switch into connector and replace switch retaining nut.

6. Replace left trim panel and headlight switch knob and escutcheon.

e. R and R Fuel Gauge or Temperature Indicator

1. Remove instrument panel lower filler.

2. With shift lever in "L", disconnect shift indicator cable.

3. Remove speedo face glass, as in Figures 120-47 and 120-48.

4. Remove speedometer assembly by removing three (3) screws. See Figure 120-49.

5. Remove fuel gauge by removing two (2) screws, or remove temperature indicator by removing one (1) screw.

6. Install gauge and replace speedometer.

7. Hook up shift indicator cable and adjust, if necessary.

8. Replace lower instrument panel filler.

9. Replace speedo face glass.

f. R and R Windshield Wiper-Washer Instrument Panel Switch

1. Remove headlight switch knob and escutcheon.

2. Remove left trim panel.

3. Remove switch, as shown in Figures 120-52, 120- 53, and 120-54, and remove switch from harness connector.

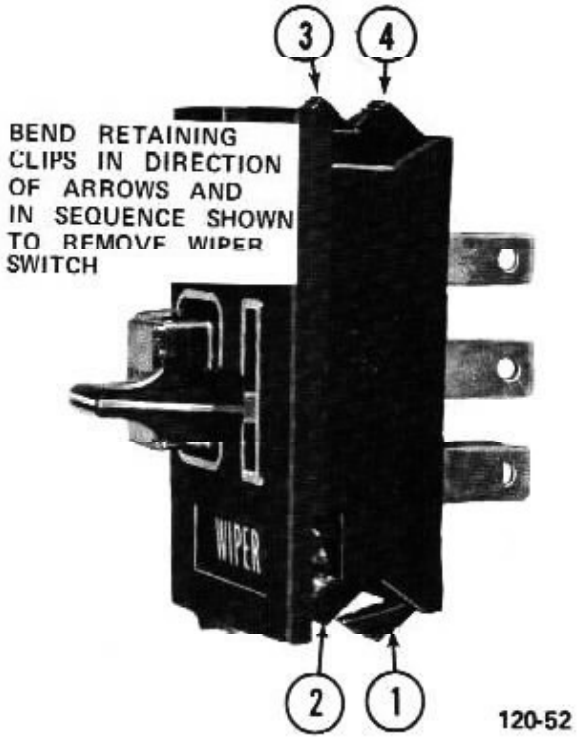

Figure 120-52 Windshield Washer Switch

Figure 120-53 Removing Windshield Wiper Switch

Figure 120-54 Removing Windshield Wiper Switch

4. To install switch, plug switch into connector and replace in panel.

5. Replace left trim panel and headlight switch knob and escutcheon.

g. R and R Accessory Switch

1. Remove headlight switch knob and escutcheon.

2. Remove left trim panel, as shown in Figure 120- 46.

3. Remove accessory switch cover by removing two (2) screws.

4. Remove accessory switch by removing two (2) screws.

5. Replace by installing switch and cover.

6. Replace trim panel and headlight switch knob amd escutcheon.

h. Rear Defogger Switch (Wagons With Power Tail Gate and Window)

1. Remove instrument panel cover, as in subparagraph k.

2. Remove accessory switch escutcheon by removing two (2) screws.

3. Remove switch from connector and remove switch.

4. Install switch and escutcheon on instrument panel.

5. Connect switch wires.

6. Replace instrument panel cover.

i. R and R Clock

1. Remove radio knobs and escutcheons and trip- set and speed-alert knobs, if equipped.

2. Remove right trim panel.

3. Remove clock by removing two (2) screws.

4. Remove bulb socket and wire connector.

5. Install bulb socket and wire and replace clock.

6. Replace right trim panel, radio, trip-set, and speed-alert knobs.

j. R and R Trip-Set and Speed-Alert Cables

1. Remove radio knobs and speed-alert and trip- set knobs.

2. Remove right trim panel.

3. Remove cable retaining nut on right panel. See Figure 120-55.

4. Remove lower instrument panel filler.

5. Place shift lever in "L", and disconnect shift indicator cable.

6. Remove speedometer from cluster. See Figure 120- 49.

7. Remove cable by bending retaining clips with needle nose pliers and removing from back of panel.

8. Replace cable by snapping back into panel.

9. Replace cable retaining nut on right panel. Torque nut to 10-12 in.lbs.

10. Replace trim panel and knobs and escutcheons.

11. Replace speedometer in cluster.

12. Hook up shift indicator cable and adjust, if necessary.

Figure 120-55 Speed-Alert and Trip-Set Cables

13. Repalce speedo face glass.

k. R and R Instrument Panel Cover

1. Remove screws holding cover around instrument cluster.

2. Remove two (2) nuts by reaching through top of glove box opening.

3. Disengage clip on right side of cover. See Figures 120-61 and 120-62 for clip locations.

4. Pull cover back from left and center holding clips.

5. Remove radio speakers.

6. Install by replacing radio speakers.

7. Replace cover by hooking clips in place first.

8. Replace screws around cluster and nuts on right side of cover.

l. R and R Shift Indicator Needle

1. Remove lower instrument panel filler.

2. Disconnect shift indicator cable.

3. Remove speedometer face glass.

4. Remove speedometer by removing three (3) screws.

5. Remove cable guide clip from speedo. See Figure 120-56.

6. Slide shift pointer to opening, disconnect return spring.

7. Replace shift pointer and return spring.

8. Replace cable guide clip on speedo.

9. Replace speedometer in cluster.

10. Hook up shift indicator cable and adjust, if necessary.

11. Replace instrument panel lower filler.

12. Replace speedo face glass.

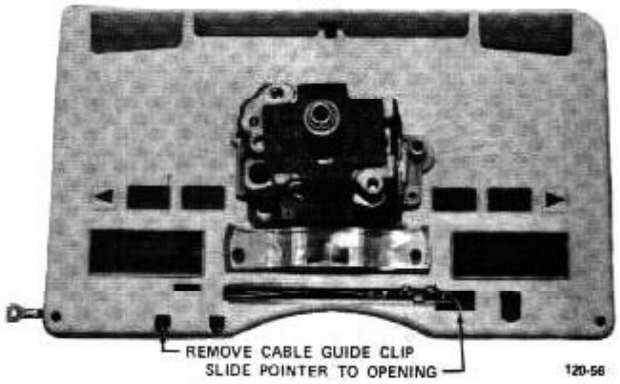

Figure 120-56 Removing Shift Indicator

m. R and R Radio

1. Remove knobs and escutcheons from radio control shafts. If car is equipped with trip-set and speed-alert, unscrew the cone-shaped knobs.

2. Remove right trim panel.

3. Remove the retaining nuts (2) from the threaded portion of the control shaft.

4. Remove ash tray assembly.

5. Separate the two (2) multiple connectors and antenna lead-in before the radio is removed.

6. Unscrew the nuts on the radio support bracket and remove the radio from the opening, lowering it from behind the instrument panel.

7. Install radio by reversing above steps.

8. Trim radio.

n. R and R Front Center Speaker - 45-46-48-49000 Series

1. Disconnect speaker wires from the rear of the radio.

2. Remove two (2) horizontal screws below the instrument panel, four (4) vertical screws on the uppermost horizontal surface of the instrument panel, and three (3) nuts above and inside the glove box.

3. Release three (3) clips located behind the instrument panel, one (1) on the left and two (2) on the right, by grasping the tongue of the clip and pulling forward.

4. Remove the instrument panel cover by pulling outward on the cover.

5. Remove the speaker by removing one (1) screw and slipping the speaker from beneath a side bracket.

6. To install the speaker, reverse the above steps.

o. R and R Front Dual Speaker System - 45-46-48- 49000 Series

1. Disconnect speaker wires from the rear of the radio.

2. Remove two (2) horizontal screws below the instrument panel, four (4) vertical screws on the uppermost horizontal surface of the instrument panel, and three (3) nuts above and inside the glove box. See Figures 1 and 2 for screw and nut location.

3. Release three (3) clips located behind the instrument panel, one (1) on the left and two (2) on the right, by grasping the tongue of the clip and pulling forward.

4. Remove the instrument panel cover by pulling outward on the cover.

5. Remove speakers by removing one (1) screw on each speaker for the 45-46-48000 Series and two (2) nuts on each speaker for the 49000 Series.

6. To install the speakers, reverse the above steps.

p. R and R Horn Relay Buzzer Assembly

1. The horn relay buzzer is found on the steering column side of the left radio bracket and can be removed by removing screw holding relay to bracket from under instrument panel.

2. Install relay by installing screw and connector.

q. R and R Air Conditoner Outlet Vanes

NOTE: *Before removing the A/C vanes, the trim panels, if on the cluster side or the medallion on the right side of the instrument panel, must be removed.*

1. Remove A/C outlet vane, as shown in Figure 120- 57 by inserting screwdriver between A/C duct and A/C vane.

2. Rotate screwdriver and pull A/C vane out.

3. To install, A/C vane will snap back into A/C duct.

Figure 120-57 Removing A/C Outlet Vanes

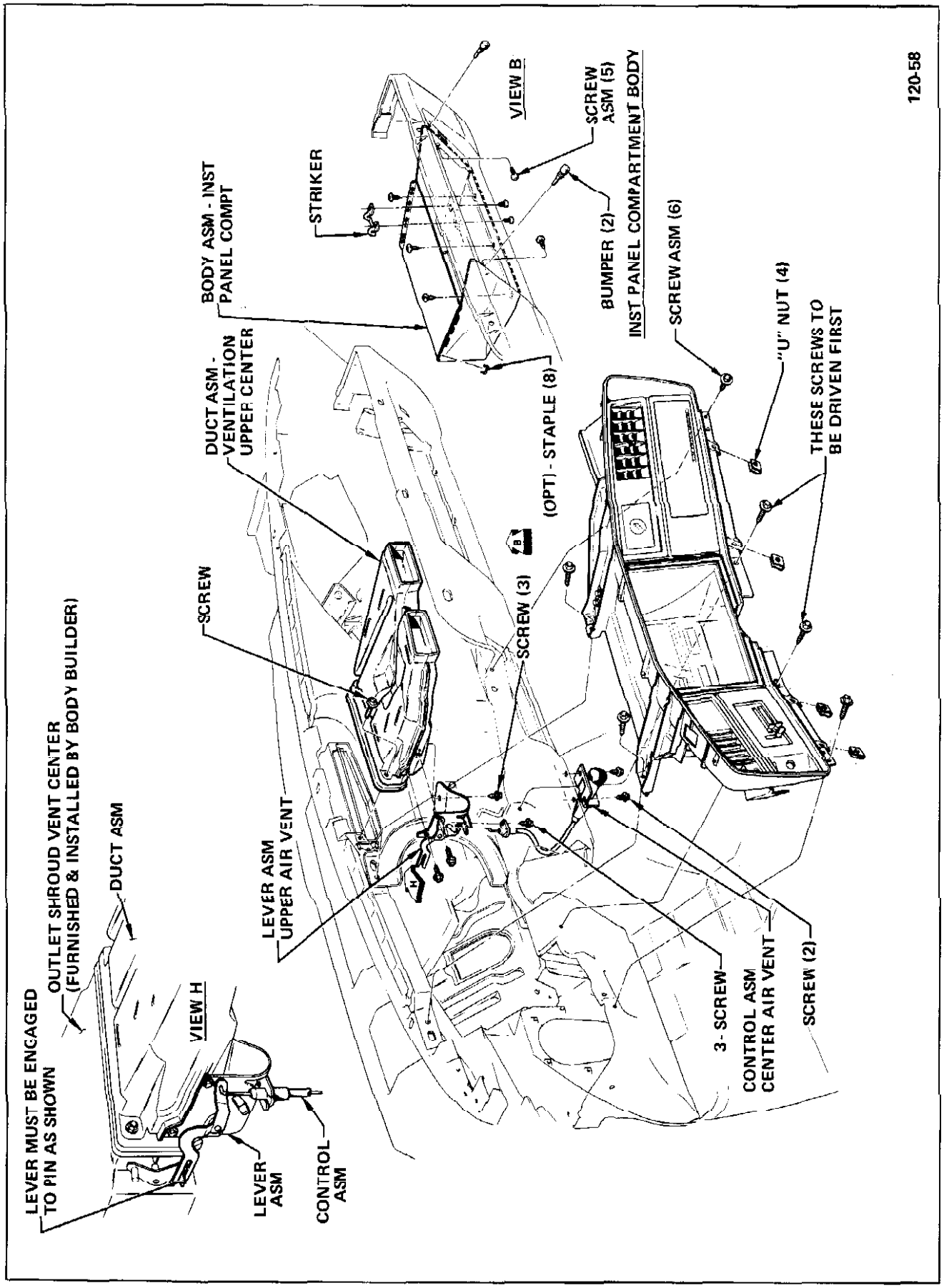

Figure 120-58 Instrument Cluster, Center Duct and Glove Box - 45-46-48-49000 Series

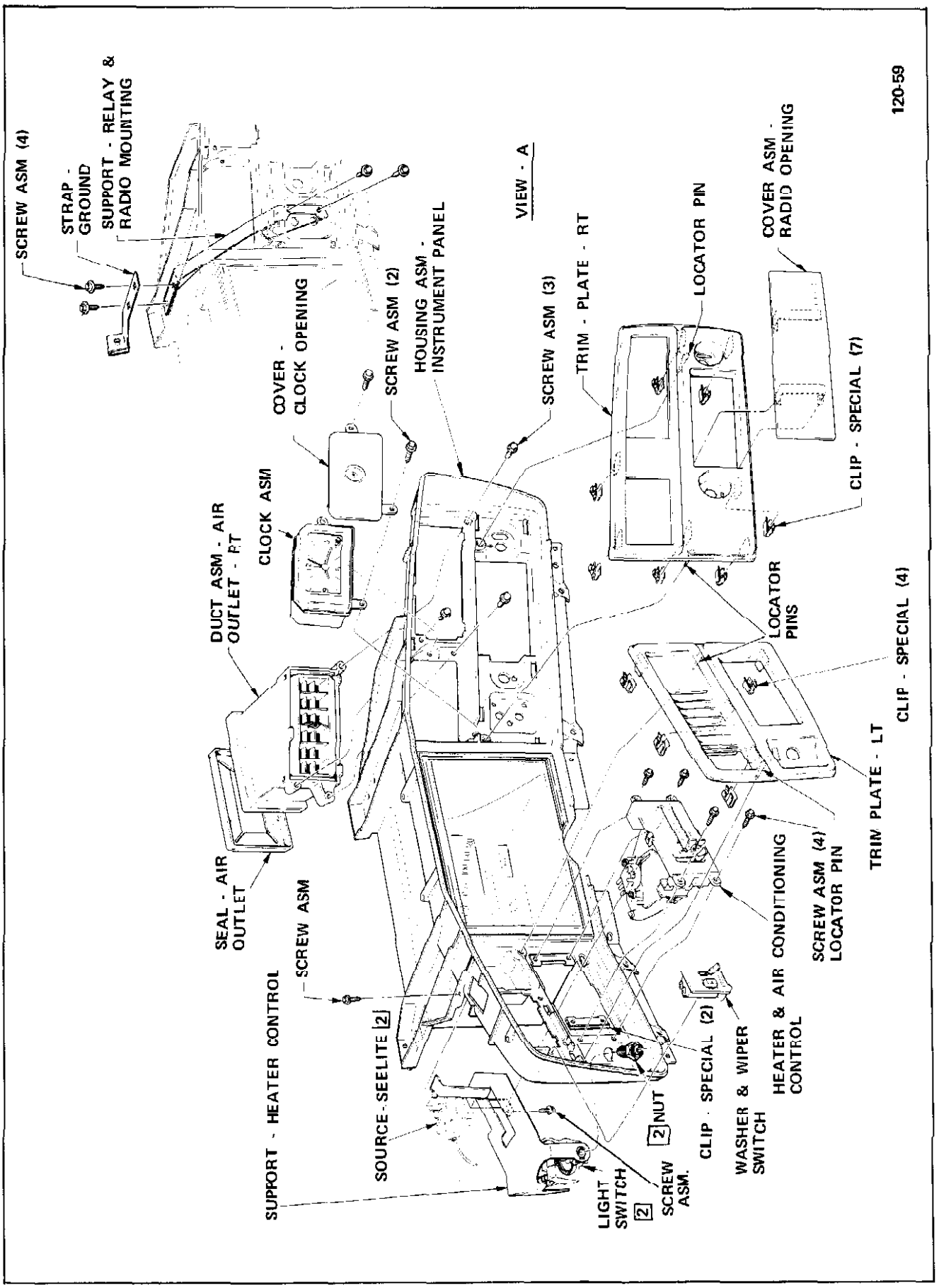

Figure 120-59 Instrument Panel Cluster - 45-46-48-49000 Series

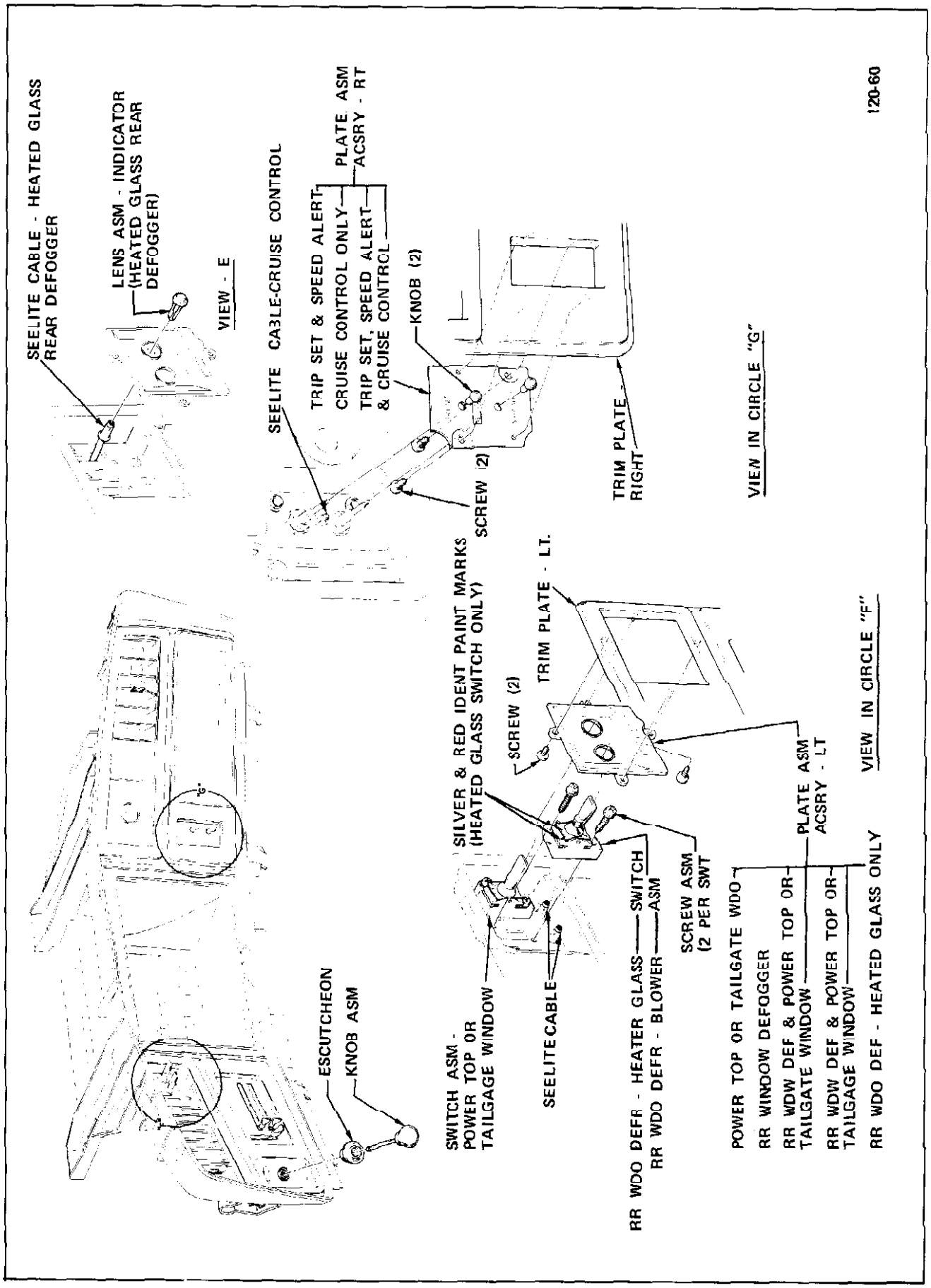

Figure 120-60 Instrument Panel Accessory Plates and Switches - 45-46-48-49000 Series

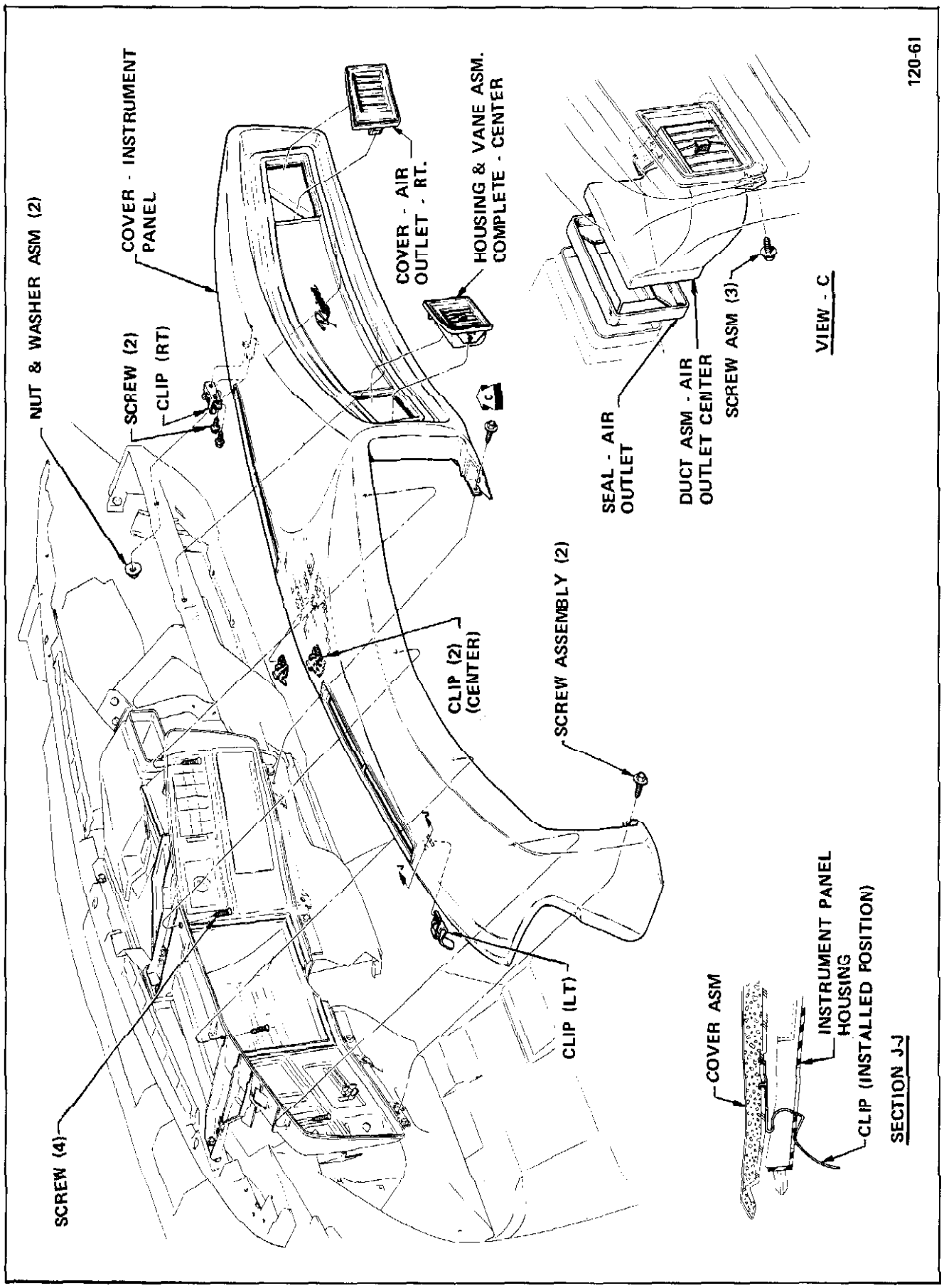

Figure 120-61 Instrument Panel Cover - 45-46-48000 Series

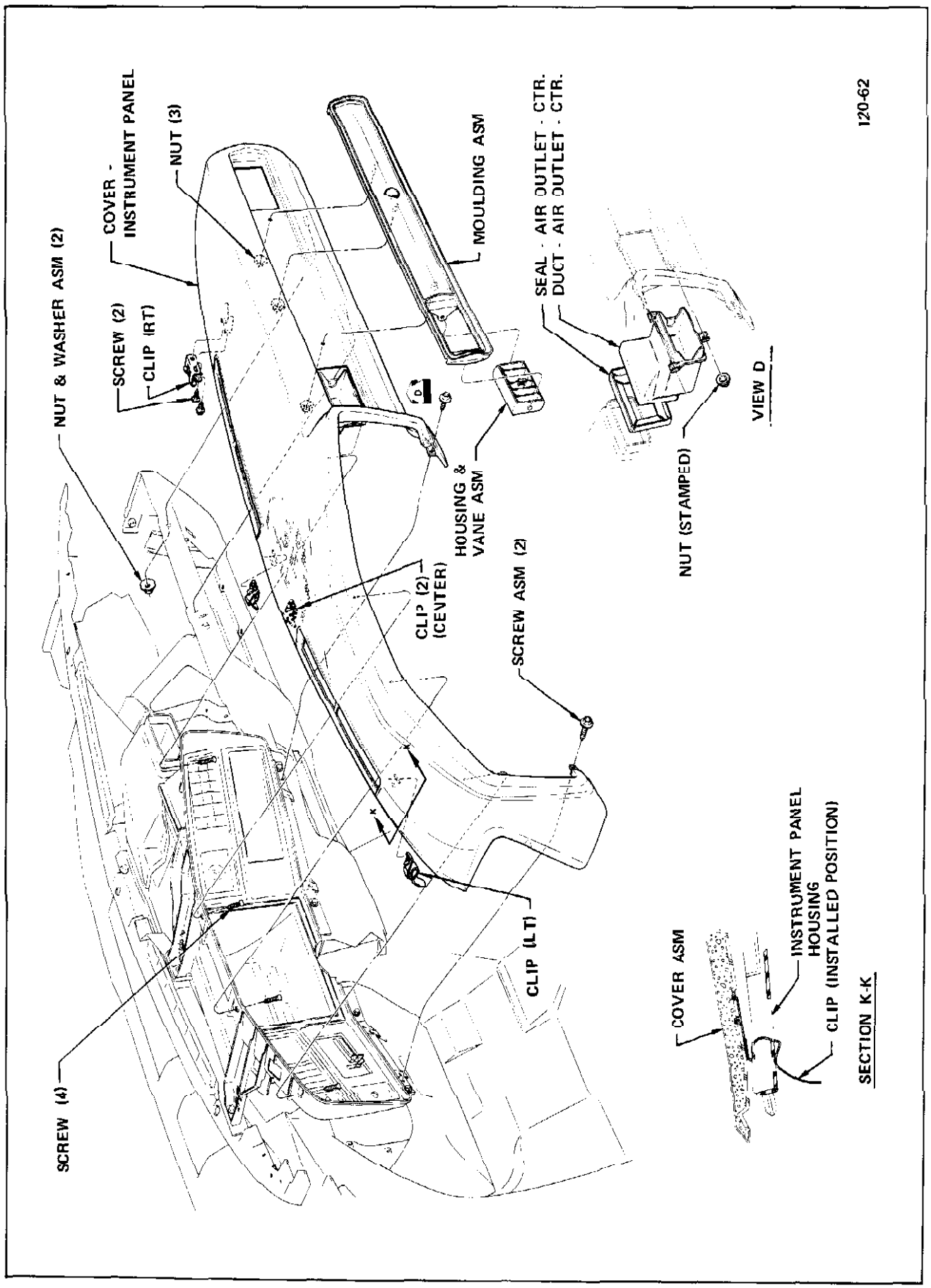

Figure 120-62 Instrument Pane. Cover - 49000 Series

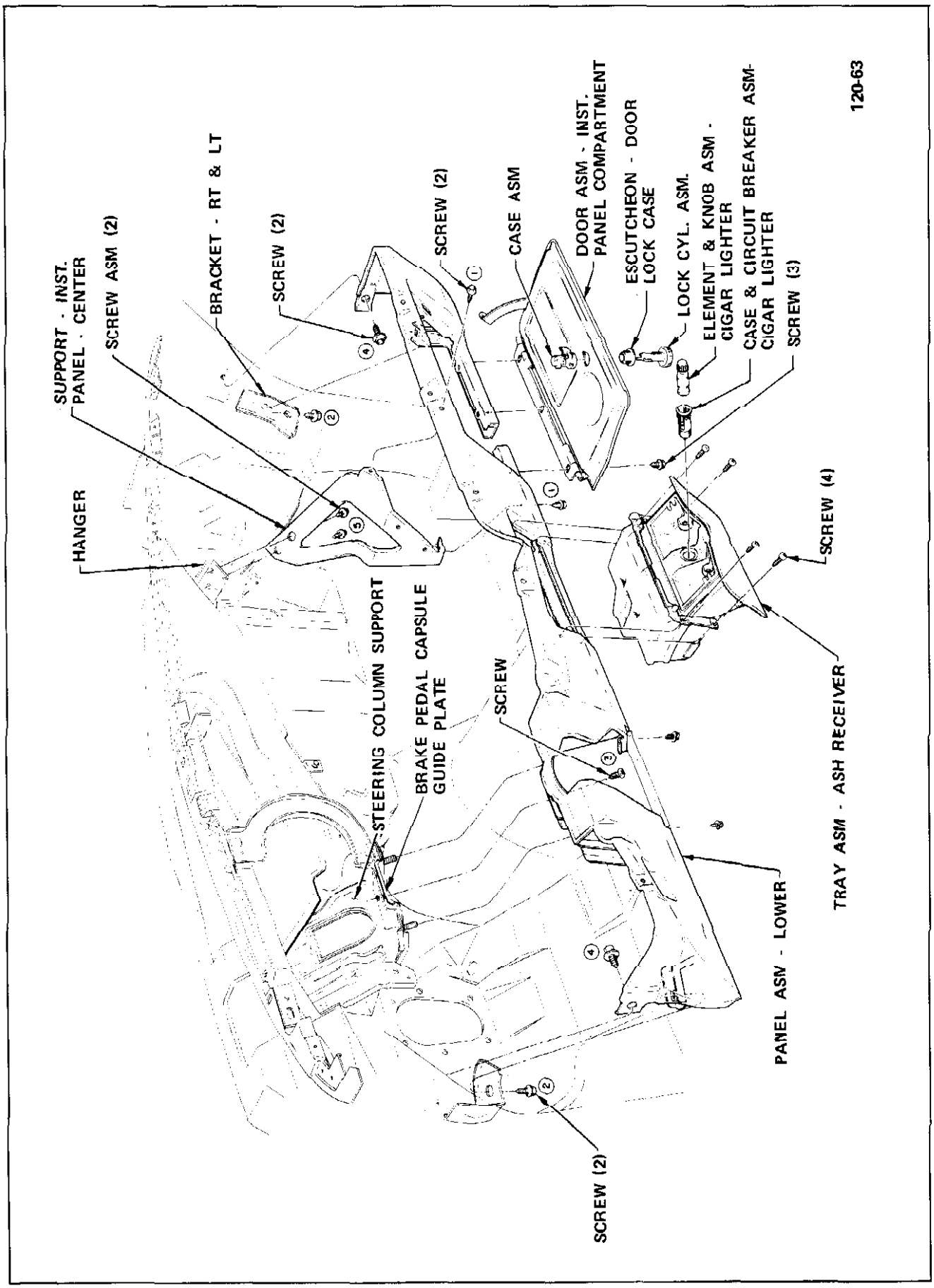

Figure 120-63 Instrument Panel Lower Panel, Ash Tray, and Glove Box - 45-46-48-49000 Series

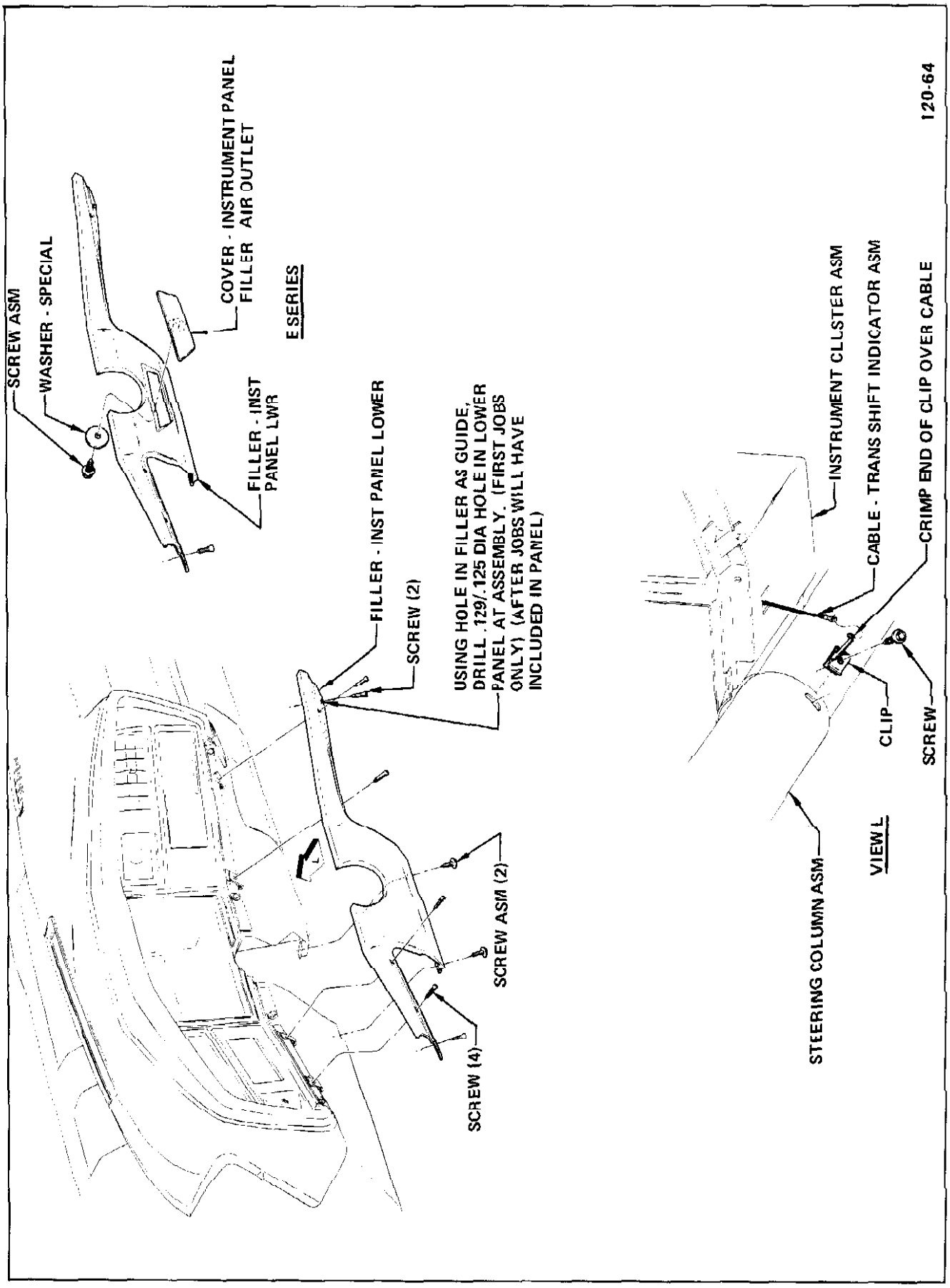

Figure 120-64 Instrument Panel Filler Plate - 45-46-48-49000 Series

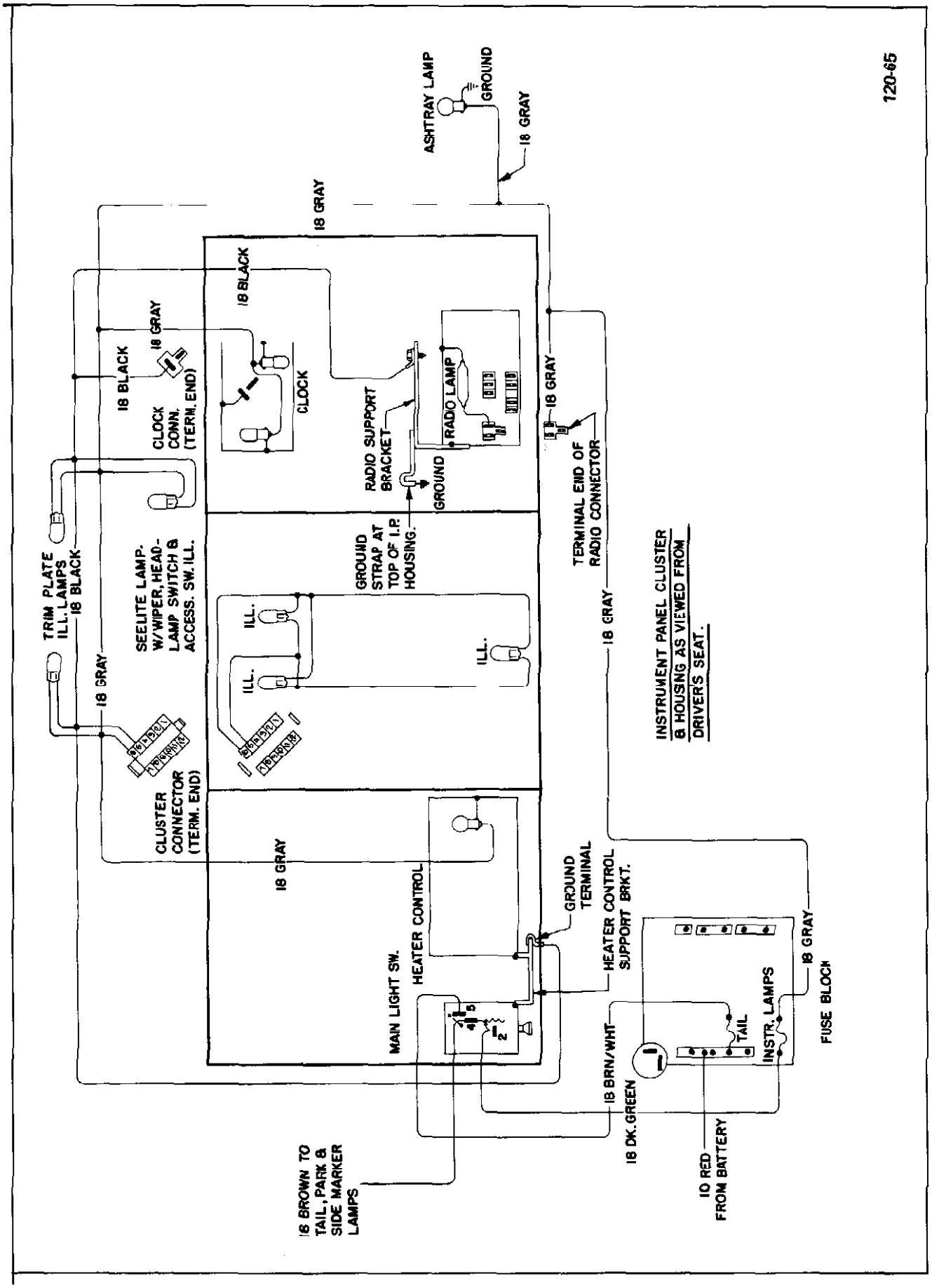

Figure 120-65 Instrument Panel Illumination Lights - 45-46-48-49000 Series

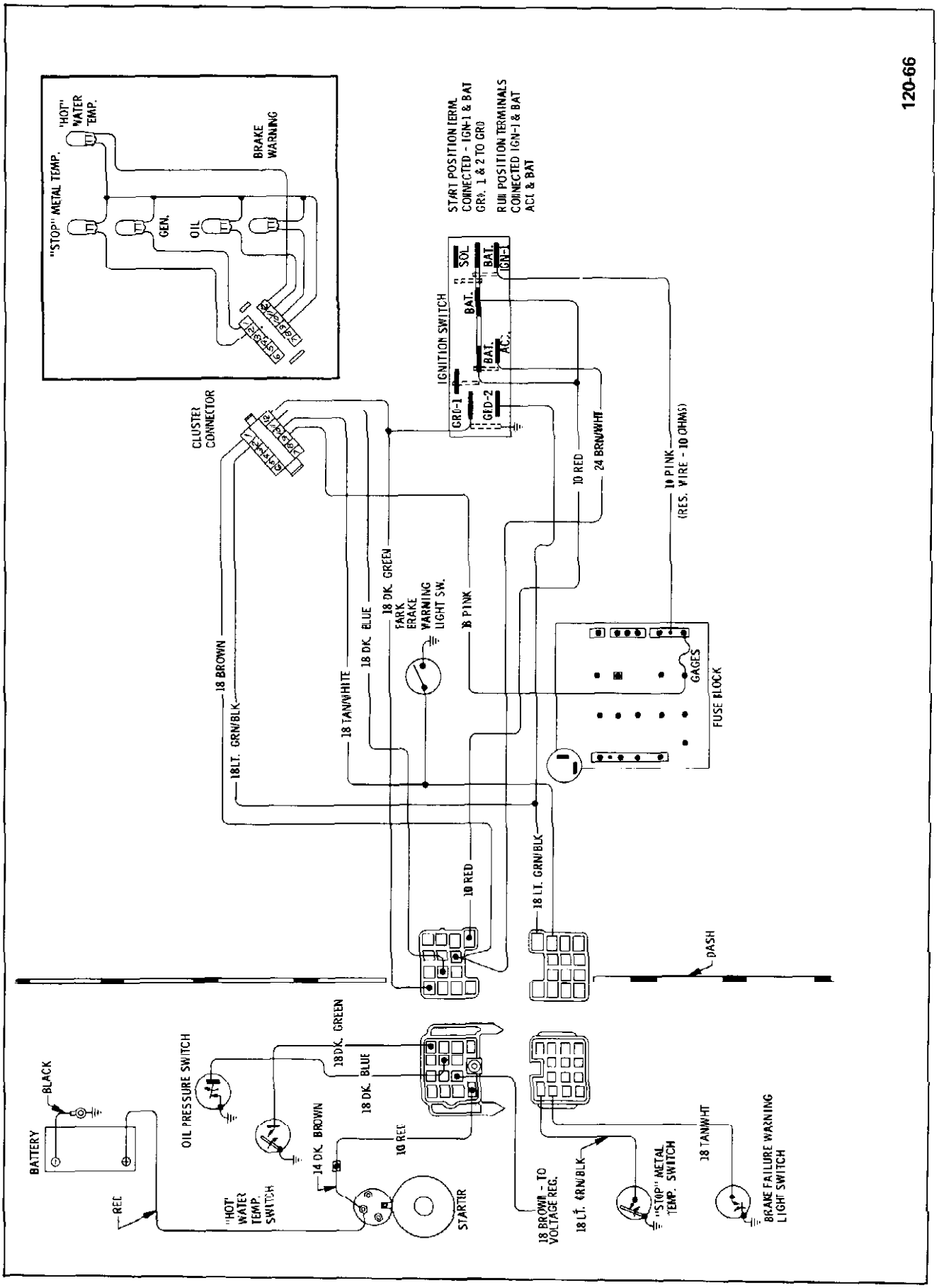

Figure 120-66 Instrument Panel Indicator Light - 45-46-48-49000 Series

SECTION C

SIGNAL SYSTEMS
ALL SERIES

CONTENTS

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I	TROUBLE DIAGNOSIS:	
	Trouble Diagnosis and Adjustment of Horns	120-17
	Trouble Shooting Directional Signal and Hazard Warning Flasher Systems	120-18
II	DESCRIPTION AND OPERATION:	
	Horns and Control Circuit	120-19
	Directional Signal and Hazard Warning Flasher Systems	120-20
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS:	
	Signal System Specifications	120-21

DIVISION I

TROUBLE DIAGNOSIS

120-17 TROUBLE DIAGNOSIS AND ADJUSTMENT OF HORNS

If a horn switch contact is constantly grounded, the horns will not stop blowing or if a contact cannot be grounded, the horns will not blow.

There are two basic troubles, which may be caused by a defective horn relay. If neither horn will blow at all, this trouble may be caused by the relay points not making contact. Or if horns will not stop blowing, this trouble may be caused by relay points sticking.

a. Horns Will Not Blow

When horns fail to blow, first check wiring circuit and relay because even a faulty horn will generally make some sort of noise if current is getting to it. If horns are at fault, or tone is poor, adjust each horn for specified current draw as instructed in subparagraph c.

1. Break circuit at steering column connector and ground black with light blue stripe wire coming from horn relay. If horn now blows, horn relay ground circuit in steering wheel has an open. Reconnect steering column connector and check horn wire and horn contacts. Circuit from steering column connector to contacts in steering wheel must be complete.

2. Check wiring connections and wiring throughout horn circuit. See Figure 120-33 for wiring diagram.

3. If horns still do not blow when wire at steering column is grounded, substitute a gknown good relay. If horns now blow, original relay is defective and must be replaced.

b. Horns Will Not Stop Blowing

1. Break circuit at steering column connector. If horns stop blowing, relay is okay but horn control circuit into steering wheel is grounded. Check horn wire and contacts in steering wheel.

2. Check to see if control circuit is grounded between relay and steering column connector.

3. IIf horns still do not stop blowing, substitute a known good horn relay.

c. Horn Tone is Poor

If either horn blows only part of the time or tone is poor, adjust current draw at horn, subparagraph c. Poor horn tone can also be caused by horn projector contacting the body.

d. Voltage Test at Horn

An improperly operating horn and its wiring circuit can be tested by connecting a voltmeter between the horn terminal and ground and noting the voltage while the horn button is pressed. The voltage at the horn gives an indication of the cause of trouble as follows:

1. No voltage indicates trouble in horn button, relay, wiring, or ground.

2. Less than 9 volts indicates resistance in wiring or excessive current draw due to short circuit in horn.

3. Voltage between 9 and 11 volts indicates that wiring is okay. Look for sticking or improper adjustment of horn.

4. Voltage above 11 indicates improper adjustment or open circuit in horn due to broken coil lead.

e. Adjustment of Horns

1. Remove horn from car.

2. Connect an ammeter in series with horn and a fully charged 12 volt battery to measure current draw while horn is blowing. Current draw for each horn (either high or low note) should be between 4.5 and 5.5 amperes at 12.0 volts.

3. Adjust to specified current draw if necessary, by turning adjusting screw clockwise to decrease or counterclockwise to increase current draw. Turn only 1/4 of a turn at a time. *If adjustment loosens screw excessively, it may be staked* with a prick punch. See Figure 120-15.

Increasing the current draw increases the horn volume. Too much current will cause a high cut-in voltage which will cause a sputtering sound and may cause horn to stick in cold weather.

4. After each horn has been adjusted individually, sound both horns together to check for proper blend of tone. If adjustment does not provide a satisfactory tone, horn contacts are pitted, making horn replacement necessary.

5. With horns reinstalled on car, connect a volt meter between each horn terminal and ground to check voltage while both horns are blowing. This should be between 9 and 11 volts.

120-18 TROUBLE-SHOOTING DIRECTION SIGNAL AND HAZARD WARNING FLASHER SYSTEMS

a. Trouble-Shooting Direction Signal System

When either a front or rear signal bulb is burned- out, the indicator light for that direction will stay on. This immediately notifies the driver when any signal light quits operating.

DIRECTIONAL SIGNAL TROUBLE DIAGNOSIS

CONDITION	POSSIBLE CAUSES	CORRECTION
1. Turn signal operates normally one direction but indicator light stays on other direction.	1. Burned out bulb.	1. Place turn signal in direction where indicator light stays on, check turn signal bulbs and replace bulb not lighted.
	2. Open circuit.	2. Check continuity through all connectors. Check for good ground.
2. Turn signal operates erratically both directions.	1. Defective flasher.	1. Replace flasher.
	2. Intermittent ground.	2. Check front and rear lamp grounds.
3. Turn signal does not operate in either direction.	1. Blown fuse.	1. Replace fuse. If fuse again blows, check for pinched or grounded wire between fuse and flasher. Insulate.
	2. Defective flasher.	2. Replace flasher.
4. Turn signal operates normally one direction, but no indicator light other direction. . . just rapid flasher clicking.	1. Grounded wire between flasher and lamp.	1. Open up Fisher connector to locate trouble to front or rear. Locate pinched wire and insulate. Note: Fuse will not blow because flasher acts like a circuit breaker.
	2. Grounded bulb.	2. Replace bulb.
5. Flashing speed slows down when engine is idling with heavy accessory load.	1. This is normal since flash time will always slow down as voltage to flasher decreases.	1. Replace Flasher only if flash rate drops below 15 flashes during a 15 second period.

Figure 120-28 Directional Signal Diagnosis Chart

Standard flashers are made to operate either two lamps or three lamps. If one of the lamp bulbs in the circuit burns out, the decreased current draw causes the flasher contacts to close and stay closed. In the same way, if a three lamp flasher is installed by mistake in a car having only two lamp bulbs per side, the lights will light but won't flash. Conversely, if a two lamp flasher is used on a car having three lamps, the too high current draw will cause the lights to flash too fast. See Figure 120- 28 for trouble shooting directional signal system.

b. Trouble-Shooting Hazard Warning Flasher System

Since the hazard warning flasher (mounted on the fuse block) is of the heavy duty type, it will flash any number of bulbs (from one to six bulbs) at a constant rate. Therefore, flashing indicator lights do not necessarily mean that *all* signal bulbs are flashing. See Figure 120-29 for trouble shooting chart for hazard warning flasher system.

HAZARD WARNING LAMP DIAGNOSIS

Condition	Possible Causes	Correction
1. INOPERATIVE	1. Blown Fuse	1. Replace fuse. If fuse continues to blow, locate and repair short-circuit. NOTE: Short may be in stop lamp circuit.
2. LAMPS LIGHT BUT DO NOT FLASH (FUSE IS GOOD)	1. Defective Flasher	1. Remove flasher. Connect jumper wire to both flasher socket terminals. Turn on hazard switch and observe all lamps. If all lamps light, replace flasher.
3. LAMPS DO NOT LIGHT. (FUSE AND FLASHER ARE GOOD.	1. Open Circuit Between Flasher and Steering Column Connector. 2. Dirty Contacts in Steering Column Connector. 3. Defective Wiring From Steering Column Connector to Turn Signal Switch or Defective Turn Signal Switch.	1. Use 12 volt test lamp to locate and repair open circuit between flasher and steering column connector. 1. Clean and align connector contacts. 1. Use 12 volt test lamp to check brown wire on both sides of steering column turn signal connector. Repair wiring or replace turn signal hazard warning switch as necessary.

Figure 120-29 Hazard Warning Lamp Diagnosis Chart

DIVISION II

DESCRIPTION AND OPERATION

120-19 HORNS AND CONTROL CIRCUIT

a. Horns and Relay

The Delco-Remy electrically operated vibrator type horns are mounted in the engine compartment. The horns are operated simultaneously by a horn relay which is controlled by the horn switch on the steering wheel. One horn is high pitched and the other is low pitched, so that together they produce a pleasant blended tone.

The horn relay is an electrical switch which closes the circuit between the battery and the horns when the push button is pressed and opens the circuit when the button is released. The relay permits control of the horns with a small amount of current passing through the horn switch contacts.

When the horn switch contacts are closed, a small amount of current flows through the relay winding to ground at the horn switch contact. This magnetizes the relay core which attracts the flat steel relay armature. The armature has a contact point which makes contact with a stationary point to close the horn circuit. When horn switch is released, current stops flowing through relay winding so that the core loses its magnetism; the armature spring then causes contact points to be separated.

b. Horn Relay Ground Circuit

The steering wheel has an actuator bar mounted across the steering wheel. Fastened to the base of the actuator bar, but insulated from it, is a contact plate which is "hot" at all times. When the actuator bar is rocked, the contact plate contacts a ground plate on the steel hub of the steering wheel to ground the horn relay winding, close the relay contacts, and blow the horns. When the actuator bar is released, two springs move the actuator bar and contact plate assembly clear of the ground plate.

Current is supplied to the contact plate by a spring- loaded brush which rides on the contact ring located at the upper end of the steering column. A wire attached to the contact ring runs down the steering column jacket and out under the instrument panel. The wire from the horn relay connects at this point.

120-20 DIRECTION SIGNAL AND HAZARD WARNING FLASHER SYSTEMS

a. Direction Signal Lamps and Indicators

The front direction signal light is produced by the 32 CP filament in the dual purpose bulb mounted in the front parking lamp. The rear direction signal light is produced by the 32 CP filament in the bulb of the rear lamp assembly. This filament also serves as a stoplight.

When the ignition switch is turned on and the direction signal switch is manually operated to indicate a turn, the front and rear signal lights and the front side marker lamps flash on and off on the side of car for which a turn is indicated. The flashing of signal lights is caused by a flasher which is connected into the proper signal circuit by contacts made in the direction switch when switch is set for a turn.

NOTE: *When lights are turned on, the side marker will flash opposite the signal lights.*

When the direction signal lights are flashing, a signal indicator bulb on the instrument panel also flashes. These indicator lights are connected to the front half of the direction signal circuit only.

b. Direction Signal Switch Operation

The direction or turn signal switch is mounted in a housing at the upper end of the steering column mast jacket, just below the steering wheel. The turn signal actuating plate (on the inner end of the control lever) is mounted to a pivot just over and contacting the turn signal switch. This switch is integral with an eight wire harness (about 1-1/2 feet long) and a multiple connector. The switch and a spring-loaded horn brush are both mounted in the switch plate base. See Figure 120-30.

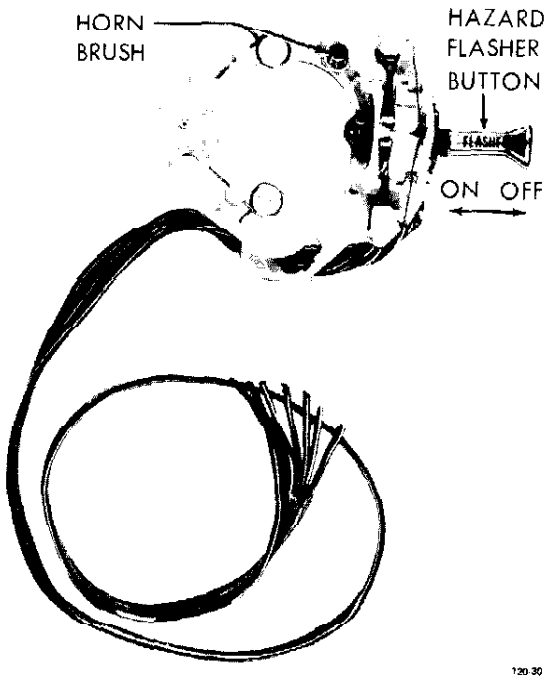

Figure 120-30 - Direction Signal and Hazard Warning Flasher Switch Assembly

A plastic cancelling cam assembly fits over the steering shaft; the lower end of the cam contacts the steering shaft upper bearing and the upper face of the cam engages the steering wheel hub, causing the cam to turn with the wheel. At the outer edge of the cam there is a horn contact ring in a position to depress the horn brush. See Figure 120-31.

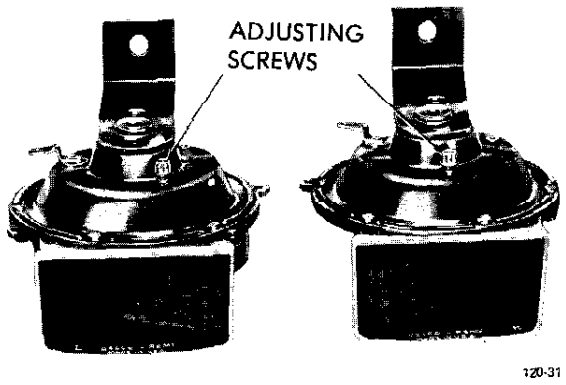

Figure 120-31 - Matched Horn Set

Whenever the control lever is in either turn position, a projection on the cancelling cam contacts a spring on the

actuating plate once per revolution of the steering wheel. Rotation of the cam in one direction simply snaps the spring but does not move the actuating plate; rotation in the other direction causes the actuating plate to be pushed back to neutral position.

c. Direction Signal and Hazard Warning Flasher Circuits

When signaling for a turn, the selected direction signal lights are supplied with current from the ignition switch, through a "DIR. SIG." fuse, through a direction signal flasher mounted on a spring clip on the parking brake bracket, and through standard contacts in the direction signal switch. See Figure 120-32.

When the hazard warning flasher is turned on, however, the normal direction signal supply is disconnected at the direction signal switch and a new supply circuit is connected into the switch directly from the battery. This new hazard flasher circuit comes through a stop and hazard flasher fuse and through a special heavy duty flasher mounted on the fuse block to the direction signal switch, which now has all contacts closed. See Figure 120-33.

d. Hazard Warning Flasher

The hazard warning feature (standard on all cars) is a system which, when turned on, causes all turn signal lamps to flash simultaneously. This system makes use of the regular turn signal wiring and light bulbs, but has a separate supply wire, flasher unit and off-on switch. This makes is possible, when leaving a car with the hazard flasher operating, to lock the ignition switch and car doors. See Figure 120-33.

The hazard warning flasher is turned on by pushing in on the "FLASHER" button located just below the steering wheel on the right side of the steering column. See Figure 120-30. The hazard flasher system should always be turned off, by pulling the button out, before the car is driven.

e. Cornering Lights

Cornering lights (optional equipment) provide extra light in the direction the car is turning. They operate from a special combined turn signal and cornering lamp switch. When either the parking lights or the headlights are on, moving the turn signal lever to indicate a turn causes a cornering light to come on in the direction of the turn. This light does not blink, but remains on steadily until the turn is completed. Each cornering lamp contains a 50 CP bulb. The cornering light circuit is protected along with the tail light circuit by the "TAIL LGT." fuse on the fuse block.

DIVISION VI SPECIFICATIONS

120-21 SIGNAL SYSTEMS SPECIFICATIONS

Stop Light Switch, Type	Mechanical
Stop Light Switch, Location	Pedal Mounting Bracket
Direction Signal Switch, Make	Delco-Remy
Direction Signal Flasher, Make	Signal Stat & Tung-Sol
Location	Parking Brake Bracket
For 2-32 CP Lamp Load	383639
For 3-32 CP Lamp Load	3866804
Flash Rate, Cycles per Min.	60 to 120
Hazard Warning Flasher (Heavy Duty)	3883794
Lamp Bulbs—No. and Candle Power	See Lamp Chart, Sect. 120-B
Direction Signal and Stop Light Fuse	See Lamp & Fuse Chart, Sect. 120 B
Horn—Make and Type	Delco-Remy, Solenoid
Horn Amperage Draw at 12 Volts (Either Horn)	4.5 to 5.5

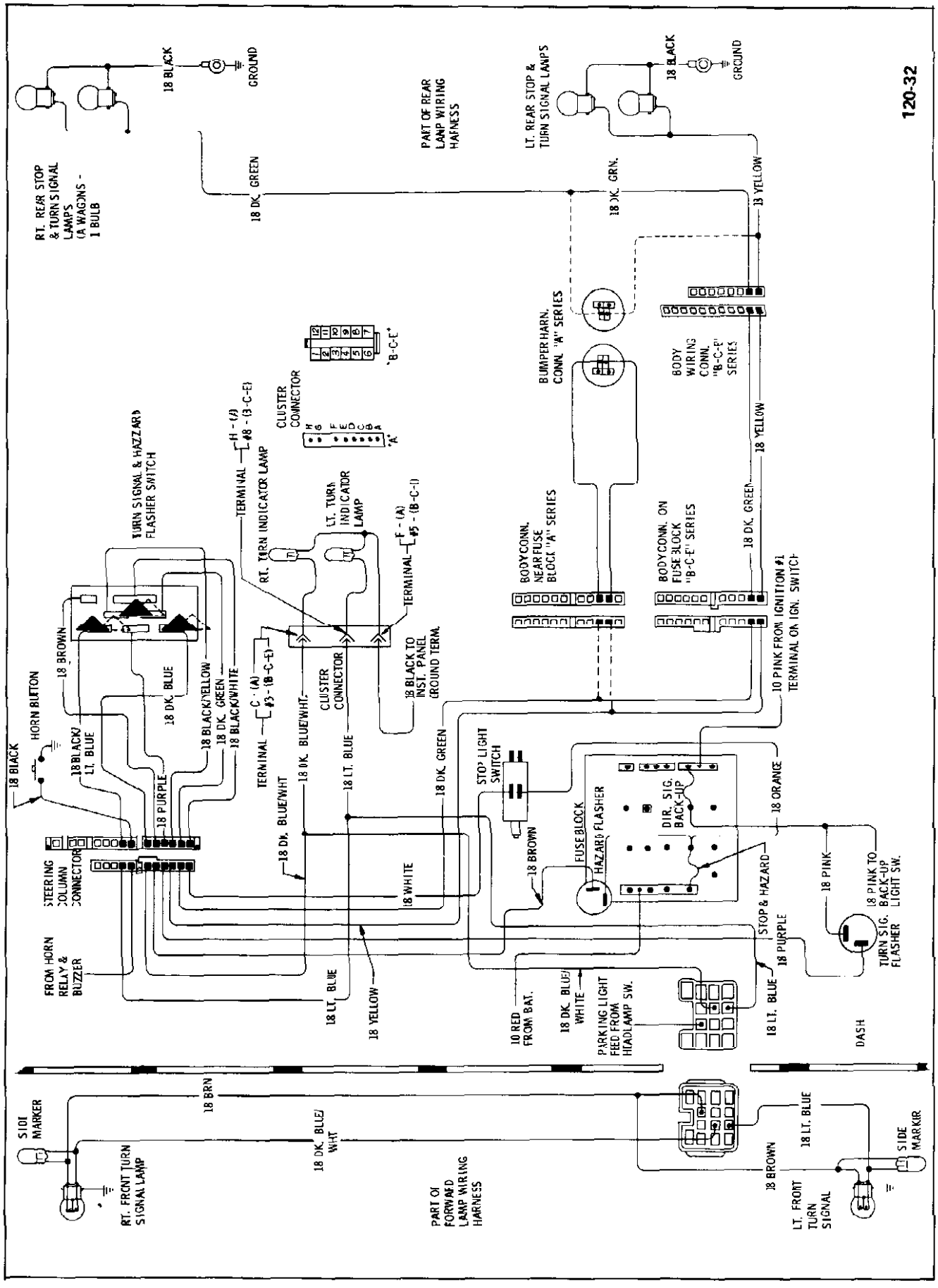

Figure 120-32 Directional Signal Wiring Diagram

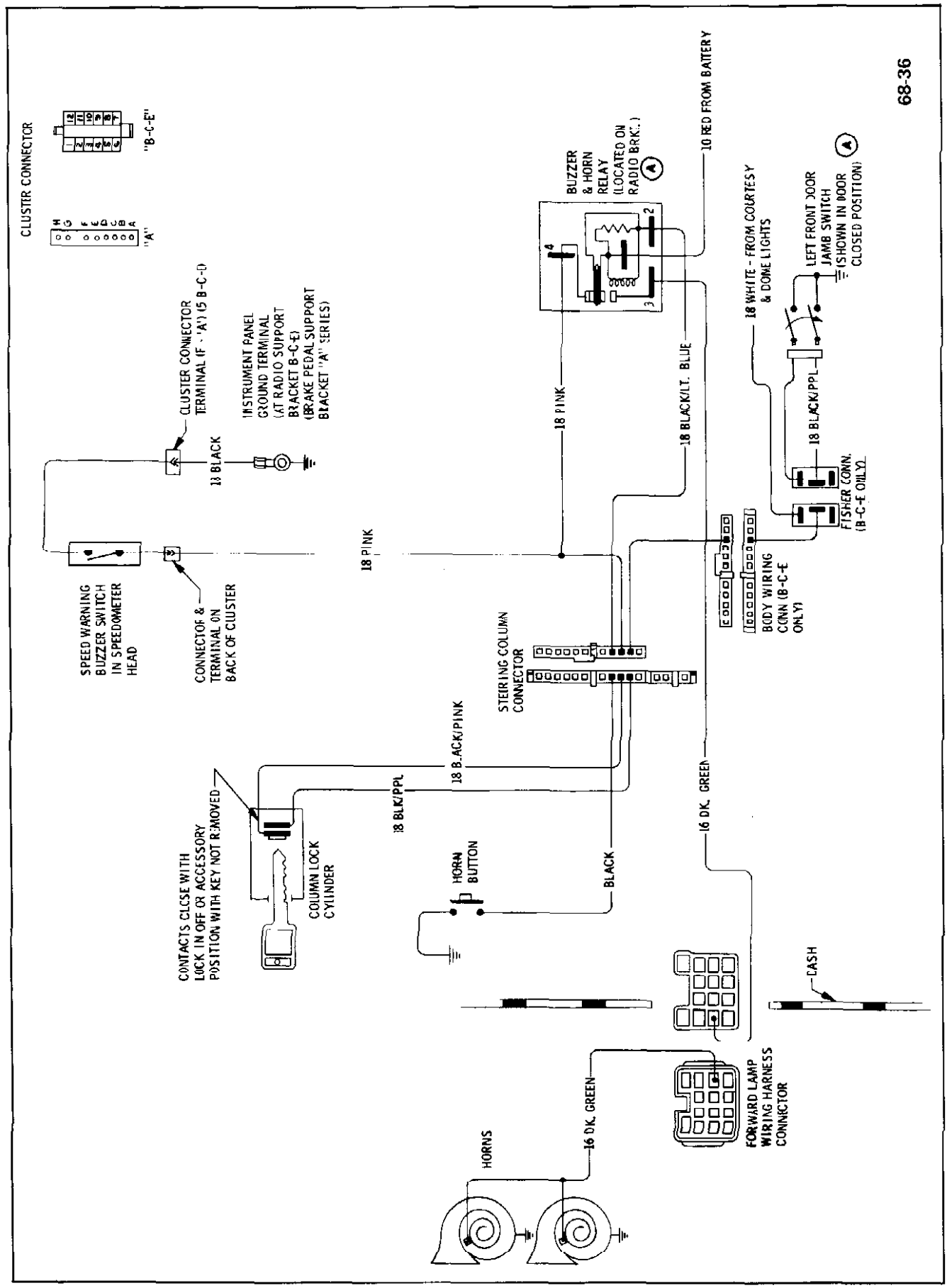

Figure 120-33 Buzzer and Horn Relay Wiring Diagram

SECTION B

LIGHTING SYSTEMS
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	-
	Test of Headlight Switch, Thermo Circuit Breaker, and Exterior Lighting — Trouble Charts.	120-11A
II	DESCRIPTION AND OPERATION:	
	Headlight and Controls.	120-12
	Neutral Start Switch and Exterior Lights	120-13
	Interior Lights and Cigar Lighters	120-14
III	ADJUSTMENTS AND MINOR SERVICE:	
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DIVISION I

TROUBLE DIAGNOSIS

120-11A TEST OF LIGHTING SWITCH, THERMO-CIRCUIT BREAKER, AND EXTERIOR LIGHTING TROUBLE CHARTS

a. Test of Lighting Switch

If the lighting switch is suspected of being faulty, the contacts can be tested by connecting a low reading voltmeter between the wire supplying current to the contact and the wire conducting current away. This must be done with the switch in a position where the contact under test is closed.

1. To check the switch contact for the headlights, pull switch knob out to last notch and also make sure dimmel switch is in upper beam position. Connect voltmeter prods between battery and headlight terminals of switch (between red and light blue wires). If voltage loss through switch contacts if over .2 volt, switch must be replaced.

2. To check the contact for the tail and front parking lights, connect voltmeter between tail lights and tail light fuse terminals (between the brown wire and the brown with white stripe wire). If voltage loss is over .1 volt, switch must be replaced.

b. Test of Light Switch Thermo Circuit Breaker

To test the thermo circuit breaker, remove lighting switch from instrument panel to avoid possible damage to adjacent instruments.

Since the current required to open the circuit breaker contacts depends somewhat on outside temperature, the circuit breaker should be tested at normal temperature (70 degrees to 80 degrees F.).

1. Connect an ammeter and a carbon-pile rheostat in series with the battery terminal of lighting switch and positive terminal of a 12-volt battery, and set rheostat to provide maximum resistance. Rheostat must have capacity for 50 amperes and be adjustable down to .3 ohms.

2. With switch on, connect the headlight terminal of lighting switch and the negative post of battery.

3. Adjust rheostat to give 26 amperes. The circuit breaker should open within 60 seconds.

4. Adjust rheostat to give 15 amperes on ammeter. The circuit breaker should remain closed indefinitely at 15 amperes.

5. If circuit breaker does not operate as specified, the lighting switch assembly must be replaced, since internal repairs cannot be made.

c. Exterior Lighting Trouble Diagnosis Charts

BACKUP LAMP DIAGNOSIS

Condition	Possible Cause	Correction
1. INOPERATIVE	1. Check Turn Signal/Backup Lamp Fuse	1. Replace fuse if burnt out.
	2. Check Bulb(s)	1. Replace bulb(s) if burnt out.
	3. Check Ground Connection at Bulb Socket And/Or Ground Wire Terminal	1. Secure ground connection as necessary.
	4. Check Wire Connections	1. Secure connections as necessary.
	5. Check Neutral-Start Switch Function and Adjustment	1. Adjust neutral-start switch.
2. WILL NOT TURN OFF	1. Check Neutral-Start Switch	1. Readjust neutral-start switch. 2. Replace neutral-start switch if detective.

120-14

Figure 120-14 Back-Up Lamp Diagnosis Chart

STOP OR BRAKE LAMP DIAGNOSIS

Condition	Possible Cause	Correction
1. INOPERATIVE	1. Check Stop and Hazard Lamp Fuse	1. Replace fuse if necessary.
	2. Check Bulb(s)	1. Replace bulb(s) if burnt out.
	3. Check Ground Connection at Bulb Socket And/Or Ground Wire Terminal	1. Secure ground connection.
	4. Check Stop Lamp Switch Function, Adjustment, and Wire Connections	1. Replace stoplamp switch if defective. 2. Adjust stoplamp switch if necessary. 3. Secure wire connections.
	5. Check Turn Signal Switch Operation and Wire Connections	1. Replace turn signal switch if defective. 2. Secure connections if necessary.
2. WILL NOT TURN OFF	1. Check Stop Light Switch Function	1. Readjust stop light switch if necessary.
	2. Check Stop Light Switch Function	1. Replace stop light switch if defective.

120-15

Figure 120-15 Stop Lamp Diagnosis Chart

SEALED BEAM HEADLAMP DIAGNOSIS

Condition	Possible Causes	Correction
BROKEN, CRACKED, OR DISCOLORED INSIDE.	1. Impact (rock) Damage 2. Improperly Installed 3. Damaged Terminals	1. Replace sealed beam. 2. Replace sealed beam. 3. Replace sealed beam.
TOO BRIGHT AND/OR BURNS OUT QUICKLY	1. 6-Volt Unit Installed in 12-Volt System.	1. Replace with correct sealed beam.
DOES NOT LIGHT OR LIGHTS INTERMITTENTLY	1. Check Car Wiring Connections to Terminals 2. Check Voltage at Upper and Lower Beam Terminals. 3. Check Ground Connection of Sealed Unit Connector to Body.	1. Repair terminal connections. 2. Charge or replace energizer as necessary. 3. Secure ground connection.
FILAMENT GLOWS DIM	1. Check for Open Ground Connection. 2. Check for Wrong Sealed Beam.	1. Secure ground connection. 2. Install correct sealed beam if if necessary.
WILL NOT AIM PROPERLY	1. Check for Broken or Chipped Aiming Pad on Lens. 2. Check for Proper Calibration and Floor Compensation of Mechanical Aimers. 3. Check Capsule Retaining Components.	1. Replace sealed beam. 2. Calibrate aimers being used. 3. Replace capsule components as necessary.

120-16

Figure 120-16 Sealed Beam Headlamp Diagnosis Chart

TAIL, PARK, SIDEMARKER, LICENSE, OR CORNERING LAMP DIAGNOSIS

Condition	Possible Causes	Correction
1. INOPERATIVE (ONE SIDE)	1. Check for Burned out Bulb(s)	1. Replace necessary bulb(s).
	2. Check Ground Connection at Bulb Socket or Ground Wire Terminal	1. Repair ground.
	3. Check Wire Harness Connections	1. Correct connections as necessary.
	4. If Cornering Lamp, Check Turn Signal Switch	1. Replace turn signal switch if defective.
2. INOPERATIVE (BOTH SIDES)	1. Check Applicable Fuse	1. Replace fuse if necessary.
	2. Check Wiring Connections Between Lamps and Light Switch	1. Secure connections as necessary.
	3. Check for Multiple Bulb Burnout	1. Replace necessary bulbs.
	4. If Cornering Lamp, Check Turn Signal Switch	1. Replace turn signal switch if defective.

120-17

Figure 120-17 Tail, Park, Side-Marker, License, or Cornering Lamp Diagnosis Chart

DIVISION II

DESCRIPTION AND OPERATION

120-12 HEADLIGHTS AND CONTROLS

a. Description of Lighting Switch

The switch uses a multiple push-on type connector. It is a "push-pull" type which also incorporates a manually-operated rheostat for controlling the intensity of the instrument panel lights, and a detent position which completes the dome light circuit. Three "push-pull" positions of the switch knob provide control of the exterior lights as follows:

1. *Off Position* (Knob all the way in) Cuts off all lights controlled by the switch.

2. *Parking Position* (Knob pulled out to first notch) Turns on the parking lights, tail lights, and license light and side marker lights. The instrument panel lights also will be turned on if the rheostat is set for these lights.

3. *Driving Position* (Knob pulled out to last notch) Turns headlights on, while the other lights remain as in the parking position. The headlights will be on the upper or lower beams, depending on the position of the separate dimmer switch.

In the parking and driving positions, the instrument panel lights are controlled by rotating the light switch knob. With the knob turned counterclockwise, these lights are on maximum brightness. As the knob is turned clockwise, they gradually dim until they are off at the full clockwise position of the knob.

4. *Dome Light Position* (Knob turned fully counterclockwise) Turns the dome and courtesy lights on. These lights can be turned on, regardless of the in or out position of the switch.

b. Description of Thermo Circuit Breaker

A thermo circuit breaker is incorporated in the lighting switch assembly to protect wiring from damage due to short circuits in the headlight circuits only.

The thermo circuit breaker consists of a bi-metal blade and set of contact points connected in series with the lighting circuits. An abnormal flow of current through the circuit breaker, such as would be caused by a short circuit in a lighting circuit, heats the bi-metal blade sufficiently

to separate the points and cause them to vibrate. The vibrating blade alternately opens and closes the circuit, thus reducing the flow of current and protecting the wiring against overheating and burning. The flickering light produced by the vibrating circuit breaker serves as a warning to the operator of vehicle that a short circuit exists.

c. Dual Headlamp Assembly

A dual headlamp system is standard equipment on all series and consists of two dual headlamp assemblies, one mounted on each side of the car.

Each dual headlamp includes two 5 3/4" T-3 sealed beam units mounted in a single housing enclosed by headlamp doors. The inboard unit is used for bright lights only and has a single filament. The outboard unit is used for both high and low beams and has two filaments. For identification, the inboard unit is marked "1"; the outboard unit is marked "2".

When the dimmer switch is in the dim or lower beam position only, the outboard unit of each dual headlamp is on. Both outboard and inboard units of each headlamp are on when the dimmer switch is in the bright or high beam position.

The T-3 sealed beam unit has three projections equally spaced around the perimeter of the lens. These projections are ground off at the factory to provide a mounting surface for aiming devices. These aiming devices are used without having headlights on.

d. Dimmer Switch

The driver may select the upper or lower headlight beam as traffic and road conditions demand by operating the dimmer switch mounted on the toe panel in a convenient position for the left foot.

The dimmer switch opens and closes the circuits to the upper and lower lamp filaments in the sealed beam units, thereby alternately raising and lowering the headlight beams with each successive operation of the switch. Depression of switch button turns the rotary contact one position within the switch. The spring- loaded button automatically returns to the reset position when released.

The wiring connection to the dimmer switch is made by a multiple connector. The dimmer switch is mounted on the inner side of the toe pan, so the switch, connector, and wiring are all inside the car.

e. Headlight Beam Indicator

Whenever the upper headlight beams are lighted, a beam indicator bulb in the instrument cluster also lights, producing a small spot of red light in front of the driver. *For safety reasons, never pass an approaching car with the beam indicator showing red.*

120-13 NEUTRAL START SWITCH AND EXTERIOR LIGHTS

NOTE: *See Figures 120-20 to 120-23 for lamp bulb and fuse specifications.*

a. Back-Up Lamps and Neutral-Start Switch

On manual transmission cars, the back-up light switch is mounted on the upper side of the steering column mast jacket in approximately the same location as the combined neutral-start back-up light switch on automatic transmission cars. The manual back-up light switch has a tang that fits into a slot in the shift tube. When the transmission is shifted into reverse, the shift tube rotates, moving the tang to the left, closing the back-up switch contacts.

To check for proper operation of the back-up light switch, turn on the ignition switch, place the shift lever in reverse, and make sure the back-up lights are lit. Then place the shift lever in neutral and make sure the back-up lights are out. Next, place the shift lever in second gear and make sure the lights are *not* lit. The switch mounting screw holes are slotted slightly, allowing some adjustment, if necessary.

On all column shift automatic transmission cars, the back-up light switch is combined with the neutral start switch. It is mounted on the steering column under the instrument panel. The switch is actuated by the transmission control shaft.

On cars with automatic transmission and console shift, the back-up light switch is combined with the neutral start switch. It is mounted on the steering column under the instrument panel. When the neutral-start portion of the switch is correctly timed, the back- up portion is properly timed automatically. Slotted mounting screw holes permit sidewise movement of the switch for proper timing.

The back-up light circuit is protected by a fuse on the fuse block.

b. Clutch Start Switch

A clutch start switch is installed in all manual transmission cars. This switch is located on the clutch pedal bracket. See Figure 120-18.

When the clutch pedal is released, the clutch start switch is open; when the clutch pedal is depressed, the clutch start switch is closed. Since the switch is connected in series in the solenoid circuit between the ignition switch and the starter solenoid, this means that the engine cannot be started unless the clutch pedal is depressed.

The purpose of the clutch start switch is to prevent the engine from starting under conditions where such starting could cause an accident. For instance, if an engine were started with the transmission in low or reverse gear, and with the clutch pedal released, the car would immediately

move. If any object or person were near, damage would result.

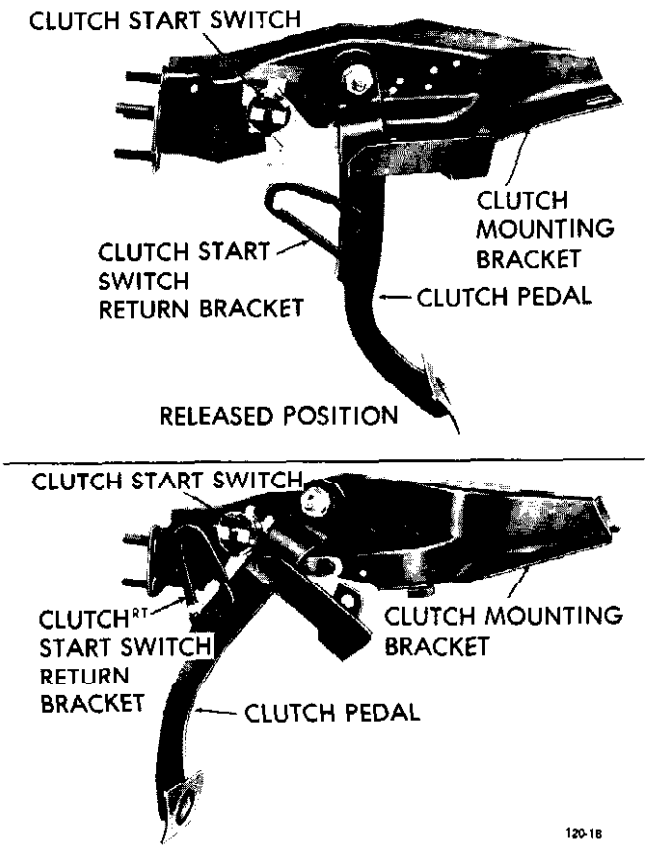


Figure 120-18 Clutch Start Switch

c. Front Parking and Signal Lights

Each front parking and signal lamp contains one 32-3 CP lamp bulb which provides a 3 CP parking light and a separate 32 CP direction signal light. The pins on lamp bulb and slots in socket are offset to prevent improper installation of bulb in socket. The parking light is controlled by the lighting switch and the circuit is protected by the "TAIL" fuse. The turn signal light is separately controlled by the signal switch and the circuit is protected by a fuse on the fuse block under the instrument panel. All front turn signal bulbs have natural amber glass (not painted) and are lighted whenever the light switch is in either the parking light or driving light position.

d. Tail, Stop, and Signal Lights

Each rear lamp assembly contains a 32-3 CP bulb which is used as a combination tail, stop, and direction signal light. The tail lights are controlled by the lighting switch and the circuit is protected by a fuse on the fuse block.

The stop lights are controlled by a mechanical switch mounted on the brake pedal bracket. This spring loaded switch makes contact whenever the brake pedal is applied. When the brake pedal is released, it depresses the switch plunger to open the contacts and turn the brake lights off. The direction signal switch is in the circuit, so the stop lights may be flashing or constant, depending on the position of the switch. The stop light circuit is protected by a fuse mounted on the fuse block.

The combination tail, stop, and directional signal lamp bulb sockets are "twist lock" sockets and can be snapped out from inside the trunk compartment on all 45-46-48-49000 Series.

Since the position of the bulb filaments is important in the rear lamps, these sockets have been provided with a tongue and groove index to insure correct positioning. To change the bulb on the 43-44000 Series and Station Wagons, it is necessary to remove the lamp lens.

e. Rear License Lights (All Series Except 48000)

The rear license lamp is mounted above the license plate to provide adequate lighting of the plate. The lamp contains one 4 CP lamp bulb which operates in conjunction with the tail lights, and its circuit is also protected by the fuse on the fuse block.

The lamp bulb may be replaced by removing the lamp lens.

f. Rear License Light (48000 Series)

The rear license lamp on the 48000 Series is a 2 CP lamp bulb and can be replaced by reaching behind license plate and twisting socket counterclockwise.

g. Side Marker Lights

Four (4) side marker lights are illuminated whenever the light switch is in either the parking light or driving light position. The side marker light circuit is protected by the "TAIL" fuse. The side marker light uses a "twist lock" bulb socket. Rotating the socket assembly counterclockwise will remove it. Replace bulb and reinstall the assembly by rotating it clockwise.

NOTE: *A front side marker lamp that is not lit may be caused by an open filament in turn signal lamp.*

120-14 INTERIOR LIGHTS AND CIGAR LIGHTER

NOTE: *See Figure 120-20 to 120-23 for lamp bulb and fuse specifications.*

a. Instrument Panel Lights

The speedometer, heater-defroster controls, ventilator or air conditioner controls, transmission control dial, clock, and ash tray are illuminated by lamp bulbs mounted to provide indirect lighting.

The instrument panel lights are controlled by the lighting switch, as described in paragraph 120 12, and the circuits are protected by the 4 ampere fuse on the fuse block.

Most instrument cluster bulbs can be removed by reaching under instrument panel and turning socket and bulb assembly counterclockwise. Replace the bulb and reinstall the assembly by rotating it clockwise.

b. Brake Warning Light

The brake warning light functions as a check on three possible brake troubles. If the parking brake is left on while the car is driven, the brake warning light is lit; or, if hydraulic pressure becomes low in either fron or rear half of the dual brake system, the light will light during brake application. The third use will show any electrical malfunction of the wheel lock control system, if the car is so equipped.

1. *The parking brake warning light circuit* will light a red "BRAKE" signal light in the instrument cluster whenever the ignition switch is turned on with the parking brake applied. This circuit is grounded at a plunger-type switch operated by the parking brake lever.

2. *The brake failure warning light circuit* uses the same red "BRAKE" signal light in the instrument cluster to warn that either the front or the rear half of the dual brake system has lost hydraulic pressure and is failing to provide effective braking.

The switch to operate the brake failure warning light is in a simple spring-centered balance valve subjected to front brake line pressure on one side and rear brake line pressure on the other side.

On drum brake cars, a difference of 150 psi between these pressures, as will occur if one system fails, causes the valve to move from center and to contact an electrode which grounds the brake warning light. See Figure 120-19.

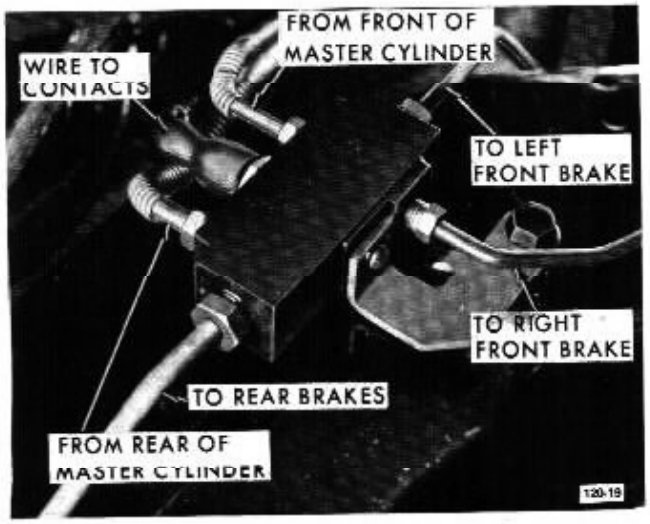


Figure 120-19 Distributor and Brake Failure Warning Switch Assembly - Drum Brakes

On disc brake cars, the switch is part of a hydraulic combination valve assembly. A pressure difference of 100 psi is required to contact and latch the switch in the warning position. See Figure 120-19A.

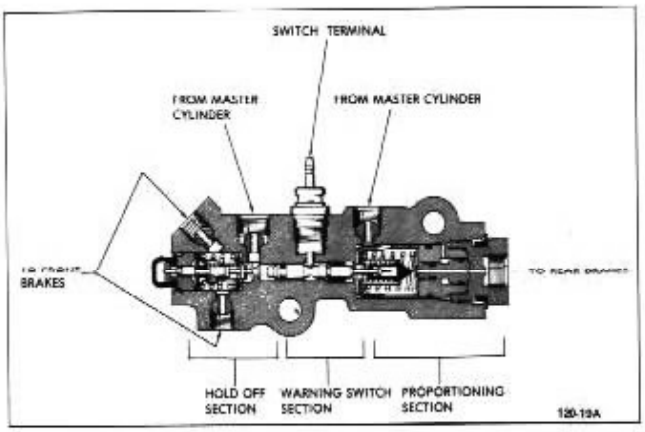


Figure 120-19A Combination Valve Assembly - Disc Brakes

NOTE: *The only way the light can be turned off is to repair the failure and apply a pedal force, as required to develop up to 450 psi line pressure.*

To check the complete system, both hydraulically and electrically, proceed as follows:

a. With ignition switch on, have helper hold foot pressure on brake pedal while watching brake warning light.

b. Hold a rag under front master cylinder fitting to catch brake fluid lost, then crack front brake line fitting. *When brake warning light lights, tighten fitting before helper releases brake pedal to avoid any possibility of drawing air into the brake system.*

c. Repeat step b at *rear* master cylinder fitting to check operation of brake failure warning light from rear half of car brake system.

Since this check causes a loss of brake fluid, always check fluid level of both reservoirs after checking operation of the brake failure warning light. Add fluid as required to bring level within 1/8" of lip of each reservoir.

c. Direction Signal Indicator Lights

The direction signal indicator consists of a 1 or 2 CP bulb mounted at each end of the instrument cluster. See Figures 120-20 to 120-23.

d. Automatic Transmission Control Dial Light

The control dial in the instrument panel is illuminated a a 3 CP lamp bulb mounted in the cluster to provide indirect lighting. The light intensity is controlled by the lighting switch in the same manner as all instrument panel lights.

To replace the lamp bulb, remove the socket and bulb assembly, replace the bulb, and reinstall the assembly.

e. Cigar Lighter

The cigar lighter is heated by pressing the knob in until it latches; the knob will automatically unlatch and pop out when heated to proper temperature.

The lighter is equipped with an ash guard, to prevent ashes and loose tobacco from falling on the user's clothing and to permit the lighter to be passed around without danger of burning the fingers.

f. Courtesy Lights

The two 6 CP courtesy lights are mounted, one on each side, under the instrument panel so that they illuminate the front floor area. They operate, along with the dome light, from the headlight switch, and/or from a door jamb switch.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

120-15 HEADLAMP AIMING

a. General

The headlamps must be properly aimed in order to obtain maximum road illumination and safety that has been built into the headlighting equipment. With the Guide T-3 type sealed beam units, proper aiming is even more important because the increased range and power of this lamp make even slight variations from recommended aiming hazardous to approaching motorists. The headlamps must be checked for proper aim whenever a sealed beam unit is replaced and after any adjustment or repair of the 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. If car will regularly carry an unusual load in rear compartment, or a 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 and vertical aiming of each seal beam unit is provided by two adjusting screws which move the mounting ring in the body against the tension of the coil spring. There is no adjustment for focus, since the sealed beam unit is set for proper focus during manufacturing assembly.

b. Pre-Aiming Instructions - Mechanical Aimer J-6878-01

1. Adjusting Aimer for Floor Level

a. To obtain accurate headlight aim, the vehicle must be placed on a flat surfaced floor area.

b. Place transit 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. See Figure 120-19C.

c. Adjust screw on back of transit until target split image merges into one unbroken line. See Figure 120- 19B.

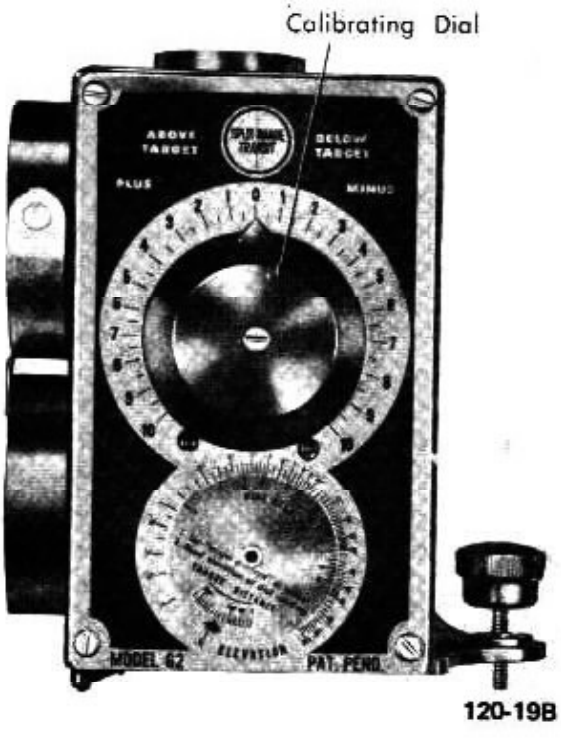


Figure 120-19B Transit

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. See Figure 120-19B. This figure indicates degree of floor slope and must be transferred to each aimer.

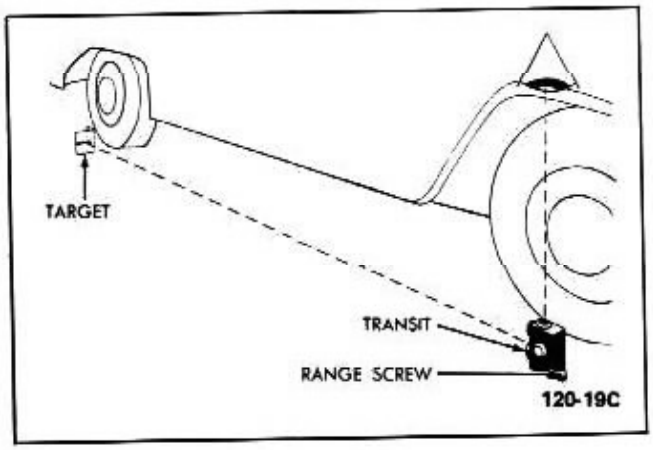


Figure 120-19C Checking Slope of Floor

f. With a screwdriver, turn adjusting slot of floor level compensator in each aimer until adjoining dial reads same as dial on transit. See Figure 120- 19D.

Figure 120-19D Adjusting Aimer to Compensate for Floor Slope

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 headlights 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 headlight lenses thoroughly.

3. Installing Mechanical Aimers J-6878-01

a. While holding aimer in alignment with lens of one outer headlight, 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. See Figure 120-19E.

b. Push handle "Y" forward (to expel air from suction cup) and, while holding aimer firmly against the headlight guide points, slowly pull handle "Y" back until spring catch engages and holds it in position. See Figure 120-19E.

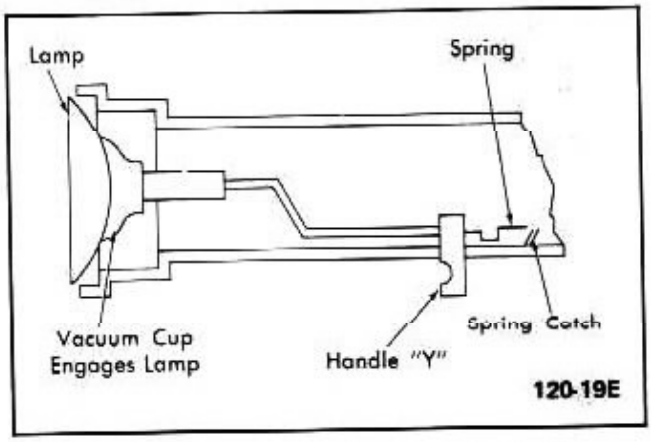


Figure 120-19E Securing Aimers on Sealed Beams

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. See Figure 120-19F. Aimers are now installed for checking the No. 2 units (low beam) of 4-lamp system or 7" units of 2-lamp system

c. Headlight Aim Test

1. Horizontal Aim Test

Turn the "right-left" scale knob on each aimer until the target split image, as seen in the viewing port, merges into one unbroken line. If the right or left reading on the scale exceeds the following values, lights should be aimed. Values given represent inches at 25 feet. See Figure 120-19F.

	Left	Right
No. 2 Unit - (Outboard)	0"	4"
No. 1 Unit - (Inboard)	4"	4"

2. Vertical Aim Test

Turn "down-up" scale knob on each aimer until the spirit level is centered. If down or up reading on scale exceeds the following values, lights should be aimed.

No. 2 Unit - (Outboard)	1/2" down to 3-1/2" down
No. 1 Unit - (Inboard)	1/2" down to 3-1/2" down

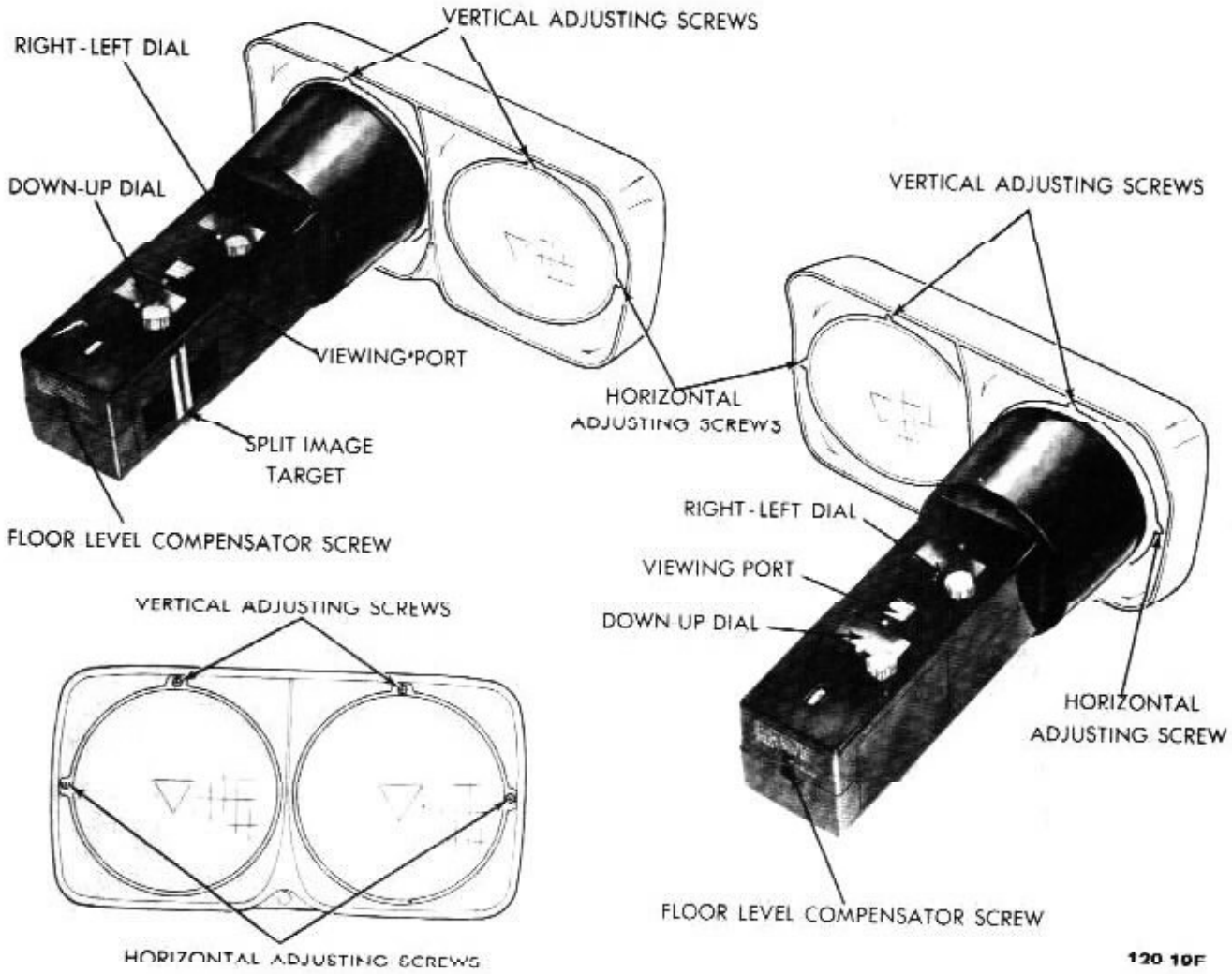


Figure 120-19F Installing Aimers and Aiming Headlamps

d. Headlight Aim

1. Horizontal Aiming

a. Set right-left scale on each aimer to "0". See Figure 120-19F.

b. While sighting through viewing port on top of aimer, adjust headlight 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

a. Set "down-up" scale to read "2 down" on both aimers.

b. Turn headlight 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.

If vehicle uses the 4-lamp system, 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 headlight lens - slide suction cup downward and away from lens.

e. 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.

a. Using a carpenter or stone mason spirit level of known

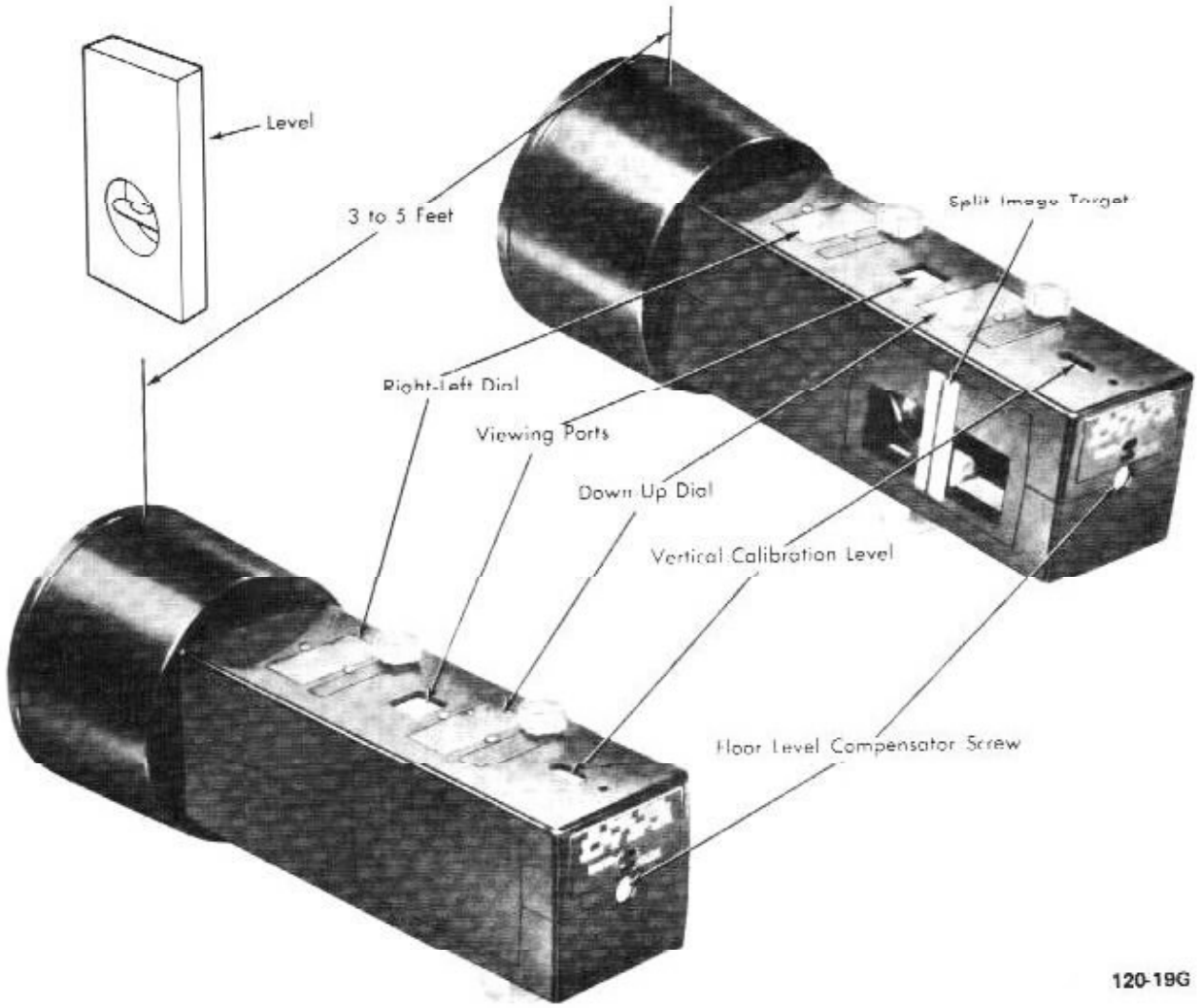


Figure 120-19G Calibrating Aimers

accuracy locate a vertical plate glass window or smooth surface that aimer suction cups will adhere to. See Figure 120-19G.

b. Set aimer "down-up" pointer to read "2 down".

c. Set aimer "right-left" pointer and floor compensator adjustment to read "0".

d. Secure aimers to glass or smooth surface three to five feet apart so split images can be located in viewing ports.

e. If spirit level bubble is centered, vertical calibration is correct. If not, turn level adjusting screw until bubble is centered. See Figure 120-19H.

f. 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. See Figure 120-19I.

NOTE: *A calibration ring H 5 is now available for installing on aimer before mounting on glass window or smooth surface for calibration.*

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 three platforms on the face of the aimer where the sealed beam guide points rest (and any wear occurs) when aiming headlight.

f. 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.

Figure 120-19H Adjusting Vertical Calibration

Figure 120-19I Adjusting Horizontal Calibration

1. 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. See Figures 120-19J and 120-19K.

a. A horizontal line at the level of centers of headlights.

b. A center vertical line which must be lined up with vehicle centerline. A good method is to sight through rear window and align center of rear window molding through mirror bracket or hood centerline.

c. A vertical line on left of screen or wall in line with centerline of left headlight.

3. A vertical line on right of screen or wall in line with centerline of right headlight.

Adjust low beam of headlights to match the patterns in Figure 120-19J and the corresponding numbers listed be-

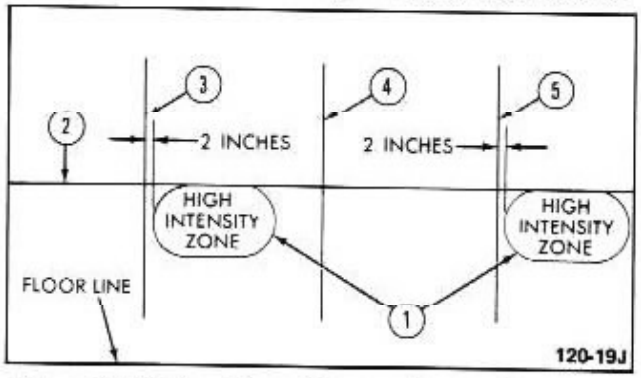


Figure 120-19J Low Beam Adjustment Pattern (Visual Aim at 25 Feet)

(a) Lower beam pattern of both headlights (outboard No. 2 units or 7" units).

(b) Horizontal line at level of headlight centers.

(c) Vertical line in line with center of left headlight.

(d) Vertical line in line with vehicle centerline.

(e) Vertical line in line with center of right headlight.

2. High Beam (4-Beam System)

Adjust high beam of headlights to match patterns in Figure 120-19K and the corresponding numbers listed below:

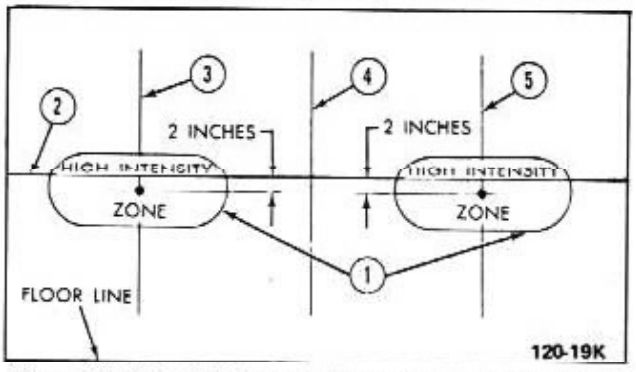


Figure 120-19K High Beam Adjustment Pattern (Visual Aim at 25 Feet)

(a) High beam pattern of both headlights (inboard No. 1 units only).

(b) Horizontal line at level of headlight centers.

(c) Vertical line in line with center of left headlight.

(d) Vertical line in line with vehicle centerline.

(e) Vertical line in line with center of right headlight.

DIVISON IV

REMOVAL AND INSTALLATION

120-15A HEADLAMP, BACK-UP LAMP, CLUTCH START, NEUTRAL START SWITCHES, AND EXTERIOR LIGHTS REMOVAL AND INSTALLATION

a. Replacement of Lighting Switch

1. Disconnect battery to ground cable to avoid a possible short circuit.

2. Pull switch knob out to last notch, then depress the spring-loaded latch button on switch, while pulling knob and rod assembly out of switch.

NOTE: *If latch button is depressed before switch knob is pulled out, knob and rod assembly will not release.*

3. Remove headlight switch escutcheon.

4. Remove left instrument cluster trim panel.

5. Remove headlight switch retaining nut.

6. Unplug multiple connector from lighting switch.

7. Install switch in reverse order of above steps, making sure that switch alignment tang engages slot in cluster and ground plate before tightening escutcheon.

8. Connect battery ground cable.

b. R and R Back-Up Lamp Switch

Manual Transmission

1. On manual transmission, disconnect electrical connection.

2. Remove two screws holding switch to column.

3. Remove switch.

4. To install switch, position shift lever in reverse detent.

5. Holding switch against column grommets, attach switch.

NOTE: *Switch pinned in reverse position during assembly.*

6. Switch adjustment is obtained by moving the switch slightly or by bending the back drive rod.

Automatic Transmission

1. The back-up switch is contained in the neutral- start switch. When the neutral-start switch is correctly timed, the back-up switch is properly timed automatically. See neutral-start adjustment.

c. R and R Clutch Start Switch

1. Remove screws holding switch to clutch mounting bracket.

2. There is no adjustment for the clutch start switch. When the switch is properly installed on the clutch mounting bracket, timing is correct.

d. R and R Nautral-Start Switch

1. Disconnect electrical connector.

2. Remove screws holding switch to steering column.

3. Remove switch.

4. To install switch, position gear shift in neutral position with lever definitely seated in "Neutral Notch" in column.

NOTE: *On console-equipped cars, neutral position is established by the detent in the transmission.*

5. Position switch on column and install screws. Do not tighten.

6. Hold switch tight to column, then tighten right hand screw first.

NOTE: *Switches are assembled pinned in neutral position. Pin is designed to break away with first shift movement.*

7. Check to make sure car starts only in park and neutral positions.

CAUTION: *If a neutral-start switch is removed and the original switch is replaced, the following pre- adjustment procedure must be followed: Insert a .093 (3/32") diameter rod through slotted hole in switch back and into switch actuator while in the neutral position. Fasten switch to column with shift mechanism positioned as described under Step 4.*

HD8 e. Replacement of Sealed Beam Unit

1. Remove headlamp door by removing four retaining screws.

2. Unhook the spring from retaining ring, then remove sealed beam unit and retaining ring, being careful not to disturb the two beam adjusting screws.

3. Install new sealed beam unit by reversing removal procedure. Position lens with the "1" or "2" up. The unit has three lugs which fit into notches in the headlamp mounting ring.

CAUTION: *Make sure that sealed beam unit is marked "1" for an inboard unit or "2" for an outboard unit.*

f. R and R Front Parking and Signal Lights All - All Series

1. Disconnect electrical connections.

2. Remove two screws that hold lamp assembly to bumper. Remove lamp assembly.

3. Install in reverse sequence.

g. R and R Tail Lamp Assembly and Lens
-44-45-46000 Series (Less Wagon)

1. Disconnect twist-lock connectors from tail lamp assembly from beneath vehicle.

2. Remove the two rearmost bumper bracket to frame bolts.

3. Loosen, but do not remove, the two forward bumper bracket to frame bolts.

4. Rotate bumper downward, exposing tail lamp assembly.

5. Disconnect electrical body connector.

6. Remove bolts holding tail lamp assembly to bumper, and remove tail lamp assembly.

7. Remove lens by removing screws holding lens to tail lamp assembly.

8. Install in reverse sequence.

48-49000 Series

1. Disconnect twist lock connectors from tail lamp assembly from inside rear compartment of vehicle.

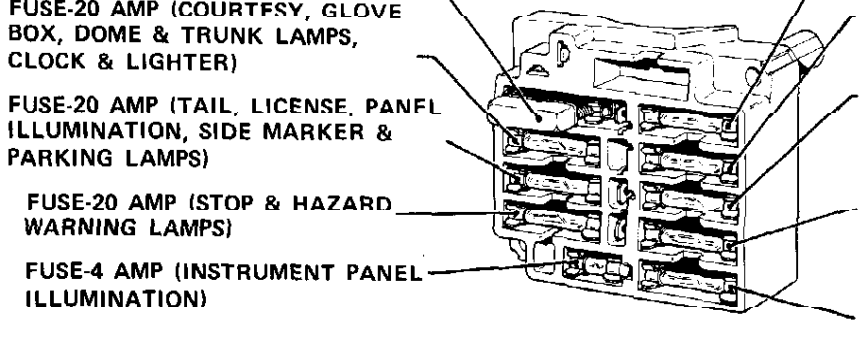
2. Remove the two rearmost bumper bracket to frame bolts.

3. Loosen, but do not remove, the two forward bumper bracket to frame bolts.

4. Rotate bumper downward, exposing tail lamp assembly.

5. Remove lenses by removing screws holding bezel to lamp housing assembly.

6. Install in reverse sequence.



FUSE CHART 43-44000 SERIES

LAMPS

WHERE USED	LAMP NO.	NO. USED	CANDLE POWER	MODEL
FRONT				
HEADLAMP-5-3/4 DIA TYPE 1	4001	2	37.5	ALL
HEADLAMP-5-3/4 DIA TYPE 2	4001-L	2	37.5-55W	ALL
HEADLAMP-5-3/4 DIA TYPE 2 (EXPORT)	4003	2	37.5-55W	ALL
PARK & DIR SIGNAL LAMP	1157NA	2	32 & 3	ALL
SIDE MARKER LAMP	194	2	2	ALL
SPOTLAMP	4404	1	30W	ALL
REAR				
TAIL, STOP & DIR SIGNAL LAMP	1157	4	32 & 3	ALL EXCEPT WAGONS
TAIL, STOP & DIR SIGNAL LAMP	1157	2	32 & 3	WAGONS ONLY
BACK-UP LAMP	1157	2	32 & 3	ALL EXCEPT WAGONS
BACK-UP LAMP	1156	2	32	WAGONS ONLY
LICENSE LAMP	97	1	4	ALL
SIDE MARKER LAMP	194	2	2	ALL
LUGGAGE COMPARTMENT	89	1	6	ALL EXCEPT WAGONS

120-20

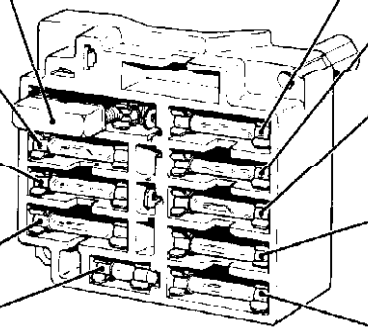
Figure 120-20 Lamp and Fuse Chart - 43-44000 Series

LAMPS

WHERE USED	LAMP NO.	NO. USED	CANDLE POWER	MODEL
INSTRUMENT PANEL				
INDIRECT LAMP (SPEEDO)	194	2	2	ALL
INDIRECT LAMP (GAGES CLUSTER)	168	2	3	ALL
CLOCK OR TACHOMETER	1893	2	2	ALL
INDIRECT LAMP(FUEL GAGE & IND LAMP)	194	2	2	ALL (LOWER BULBS)
INDIRECT LAMP(FUEL GAGE'S IND LAMP)	161	1	1	ALL (UPPER BULB)
TACHOMETER (HOOD MOUNTED)	168	2	3	GSX ONLY
INDICATORS				
HEADLAMP HI BEAM	194	1	2	ALL
DIRECTIONAL SIGNAL	194	2	2	ALL
OIL PRESSURE	168	1	3	ALL
WATER TEMPERATURE	168	1	3	ALL
GENERATOR CHARGE	161	1	1	ALL
BRAKE WARNING	161	1	1	ALL
TAPE PLAYER	2182D	1	.3	ALL
CRUISE CONTROL	181	1	3	ALL
SERVICE ILLUMINATION				
GLOVE COMPARTMENT LAMP	1893	1	2	ALL
RADIO DIAL	1881	1	2	ALL
ASH TRAY ASSEMBLY	1445	1	.5	ALL
HEATER & VENT CONT & CLIMATE CONT (A/C)	1893	2	2	ALL
TROUBLE LAMP	1004	1	15	ALL
MIRROR MAP LAMP	563	1	4	ALL
DOME-ROOF CENTER (OPT WITH 9414045)	211-1	1	15	ALL [1]
DOME-ROOF CENTER (OPT WITH 9423117	211	1	15	ALL [1]
COURTESY-RT & LT SAIL PANELS (OPT WITH 9414049)	212-1	2	6	CUSTOM COUPES ONLY
COURTESY-RT & LT SAIL PANELS (OPT WITH 9423117)	212	2	6	CUSTOM COUPES ONLY
COURTESY-LAMP INST PANEL	89	2	6	ALL
FLASHER DIR SIGNAL (OPT WITH 383637)		1		ALL EXCEPT WAGONS
FLASHER DIR SIGNAL (OPT WITH 383636)		1		ALL EXCEPT WAGONS
FLASHER DIR SIGNAL (OPT WITH 383639)		1		WAGONS ONLY
FLASHER DIR SIGNAL (OPT WITH 383638)		1		WAGONS ONLY
FLASHER HAZARD (OPT WITH 1381303)		1		ALL
FLASHER HAZARD (OPT WITH 3883794)		1		ALL

120-21

Figure 120-21 Lamp and Fuse Chart - 43-44000 Series



FUSE CHART 45-46-48-49000 SERIES

WHERE USED	LAMP NO.	NO. USED	CANDLE POWER	MODEL
INDICATORS				
HEADLAMP HI BEAM	194	1	2	ALL
DIRECTIONAL SIGNAL	194	2	2	ALL
OIL PRESSURE	194	1	2	ALL
WATER TEMPERATURE	194	1	2	ALL
CYLINDER HEAD TEMPERATURE	257	1	2	ALL WITH 455 ENG
GENERATOR CHARGE	194	1	2	ALL
BRAKE WARNING	194	1	2	ALL
CRUISE CONTROL	194	1	2	ALL
RADIO (STEREO INDICATOR)	2128D	1	.3	ALL
REAR WINDOW DEFOGGER (HEATED GLASS)	168	1	3	B&C
SERVICE ILLUMINATION				
GLOVE COMPARTMENT LAMP	1893	1	2	ALL
RADIO DIAL	564	1	2	ALL
ASH TRAY ASSEMBLY	1445	1	.5	ALL
HEATER CONT, CLIMATE CONT, & AUTO CLIM CONT	1893	1	2	ALL
TROUBLE LAMP	1004	1	15	ALL
WINDSHIELD UPPER MAP LAMP	562	1	6	B&C
INTERIOR ILLUMINATION				
DOME - ROOF CENTER (OPT WITH 9422525)	211	1	12	B
DOME - ROOF CENTER (OPT WITH 9414045)	211-1	1	12	B
REAR ARM REST (CONVERTIBLE)	90	2	6	B
COURTESY - SAIL PANEL (OPT WITH 9423117)	212	2	6	C & E
COURTESY - SAIL PANEL (OPT WITH 9414049)	212-1	2	6	C & E
COURTESY - INTERIOR TAILGATE (OPT WITH 9414049)	212-1	1	6	"B" WAGON
COURTESY - INTERIOR TAILGATE (OPT WITH 9423117)	212	1	6	"B" WAGON
COURTESY - INSTRUMENT PANEL	89	2	6	ALL
CENTER CONSOLE - REAR	181	1	3	B&E
FLASHER DIR SIG (OPT WITH 383637)		1		ALL LESS "E"
FLASHER DIR SIG (OPT WITH 383636)		1		ALL LESS "E"
FLASHER HAZARD (OPT WITH 1381303)		1		ALL
FLASHER HAZARD (OPT WITH 3883794)		1		ALL
FLASHER DIR SIG		1		E

120-22

Figure 120-22 Lamp and Fuse Chart - 45-46-48-49000 Series

LAMPS

WHERE USED	LAMP NO.	NO. USED	CANDLE POWER	MODEL
FRONT				
HEADLAMP - 5-3/4 DIA TYPE 1	4001	2	37.5W	ALL
HEADLAMP - 5-3/4 DIA TYPE 2	4002-L	2	37.55W	ALL
HEADLAMP - 5-3/4 DIA TYPE 2 (EXPORT)	4003	2	37.55W	ALL
PARK & DIR SIGNAL LAMP	1157NA	2	32 & 3	ALL
CORNERING LAMP	1295	2	50	ALL
SIDE MARKER LAMP	194	2	2	ALL
SPOTLAMP	4404	1	30 W	B&C
REAR				
REAR TAIL, STOP & DIR SIG LAMP	1157	6	32 & 3	ALL LESS "B" WAG & "E"
REAR TAIL, STOP & DIR SIG LAMP	1157	4	32 & 3	"B" WAGON & "E"
BACK - UP LAMP	1157	2	32 & 3	ALL LESS "B" WAGON
BACK - UP LAMP	1156	2	32	"B" WAGON
LICENSE LAMP	97	1	4	B & E
LICENSE LAMP	194	1	3	C
SIDE MARKER LAMP	194	2	2	ALL LESS "B" WAGON
LUGGAGE COMPARTMENT	89	1	6	ALL LESS "B" WAGON
INSTRUMENT PANEL				
INDIRECT INSTRUMENT LAMP	194	3	2	ALL
CLOCK	1893	2	2	ALL
ACC. SW., WIPER & LIGHTS (SEELITE LAMP SOURCE)	168	1	3	ALL
TRIM PLATE ILL	161	2	1	ALL

120-23

Figure 120-23 Lamp and Fuse Chart - 45-46-48-49000 Series

DIVISION VI SPECIFICATIONS

120-16 LIGHTING SYSTEM SPECIFICATIONS

a. Lamps, Switches, Wiring

Headlamp Make and Type	Guide, Dual T-3 Sealed Beam
Headlamp Lens Diameter	5 3/4"
Tail, Stop, Parking, Signal Lamps, Make	Guide
Lighting Switch, Make	Delco-Remy
Wiring Circuit Type	Single Wire
Wiring Circuit Protection for Head and Front Parking Lights	Thermo Circuit Breaker
Thermo Circuit Breaker Location	In Lighting Switch
Thermo Circuit Breaker Calibration at 75 F.	
Stay Closed Indefinitely at Amps	15
Open Within 60 Seconds at Amps	26

b. Fuses & Circuit Breakers (See Fuse Chart)

c. Lamp Bulbs (See Lamp Chart)

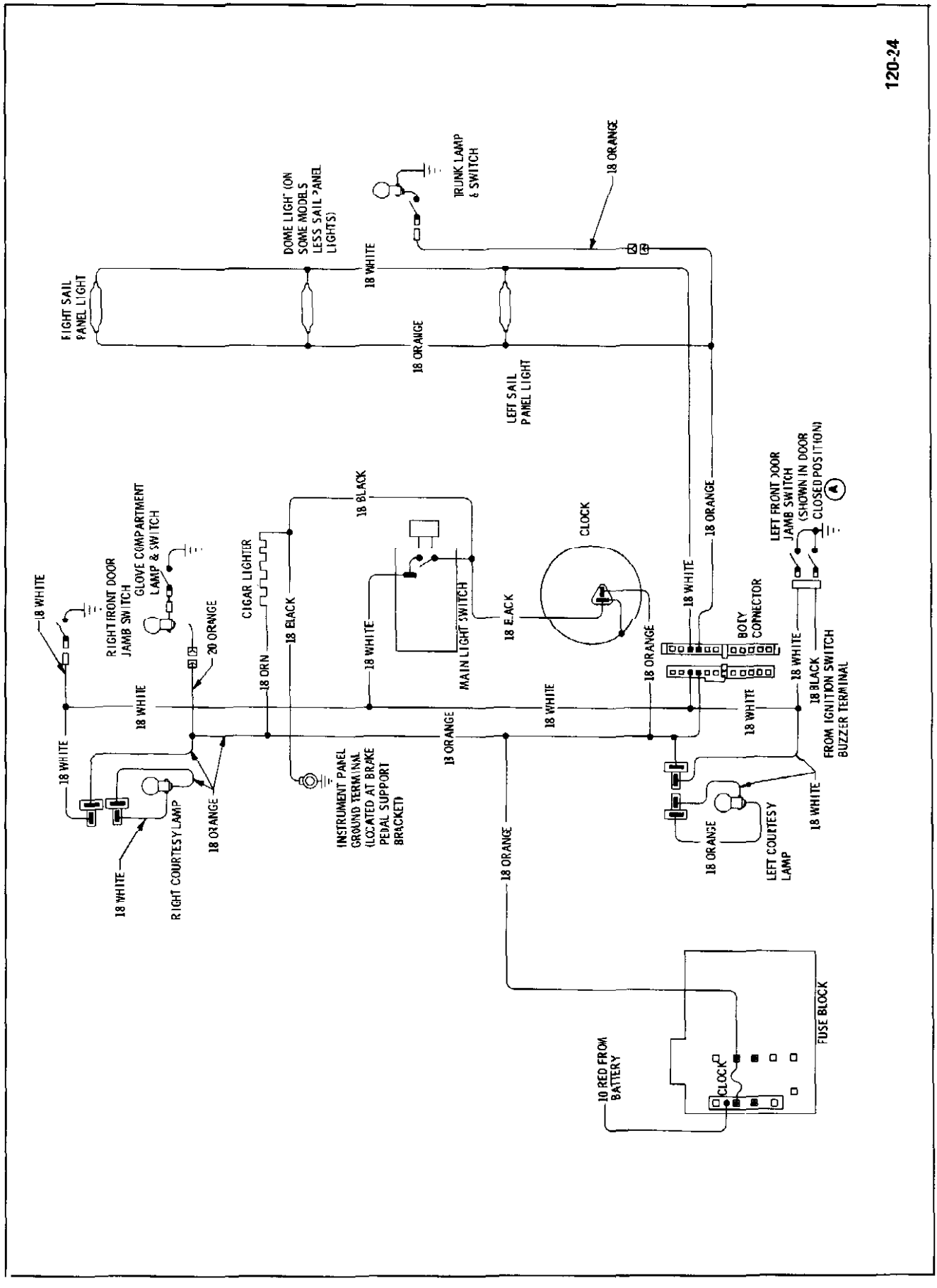


Figure 120-24 Courtesy Lights, Clock, and Dome Light Wiring Diagram - 43-44000 Series

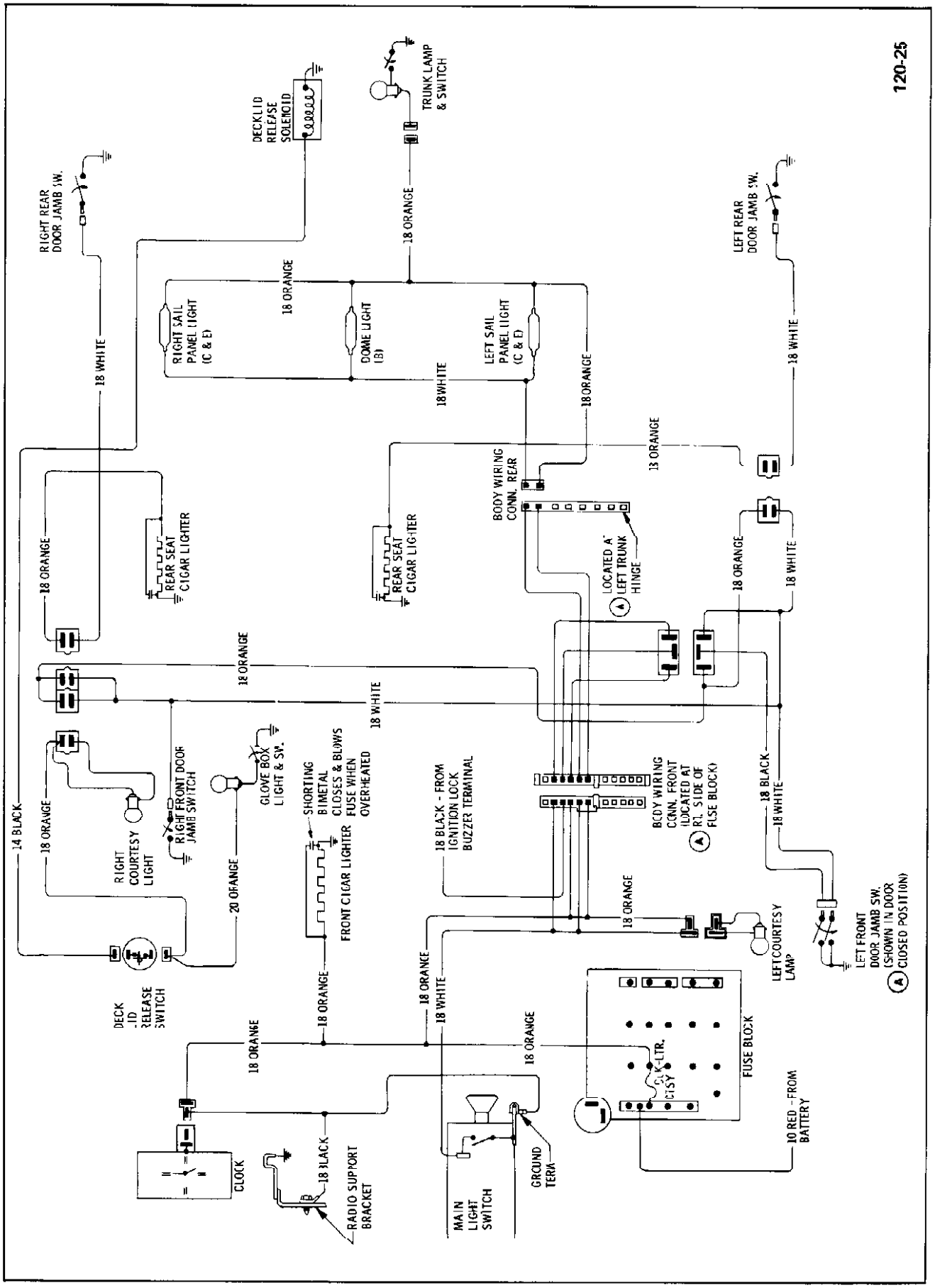


Figure 120-25 Courtesy Lamp and Deck Lid Release Diagram - 45-46-48-49000 Series

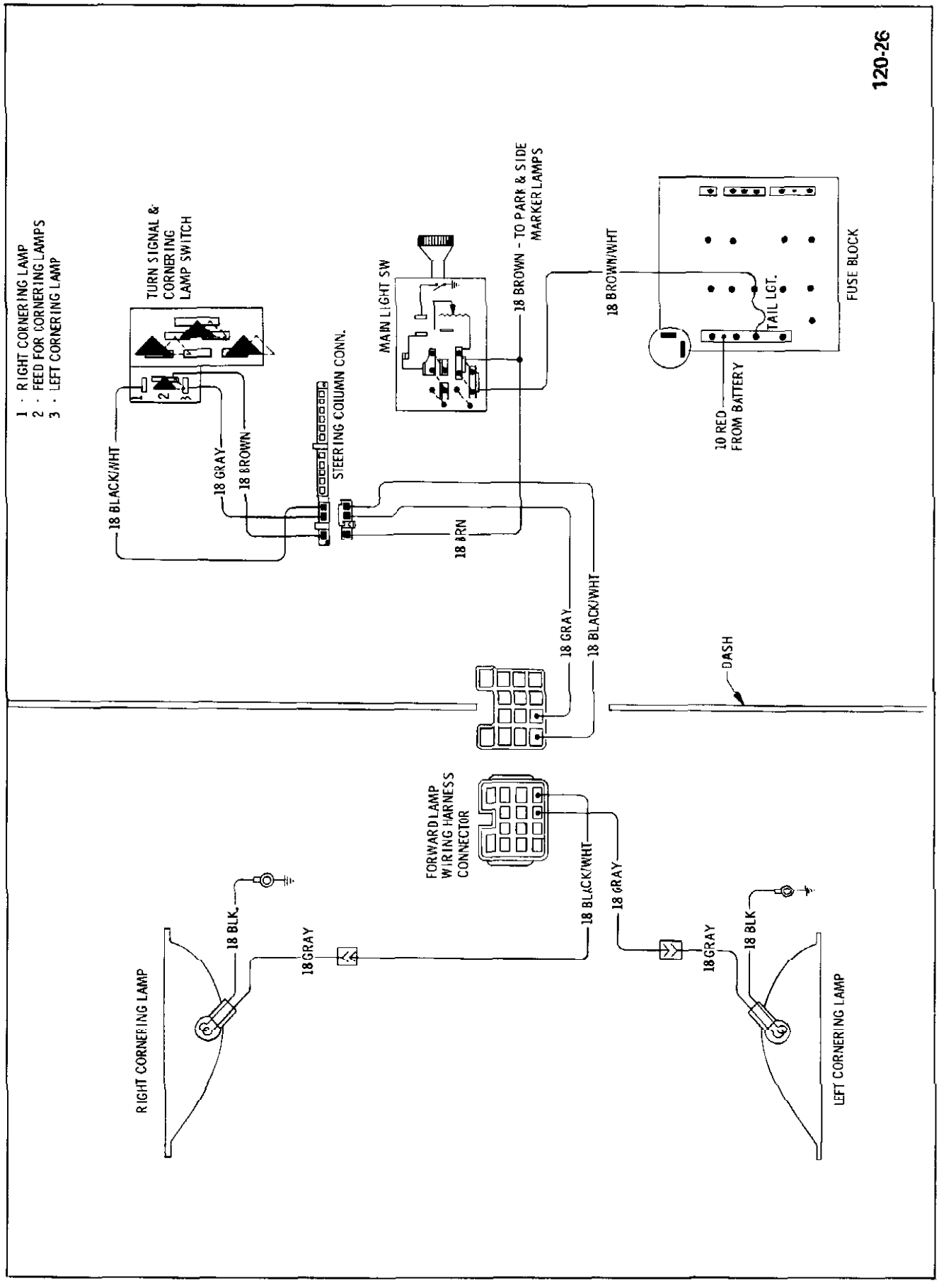
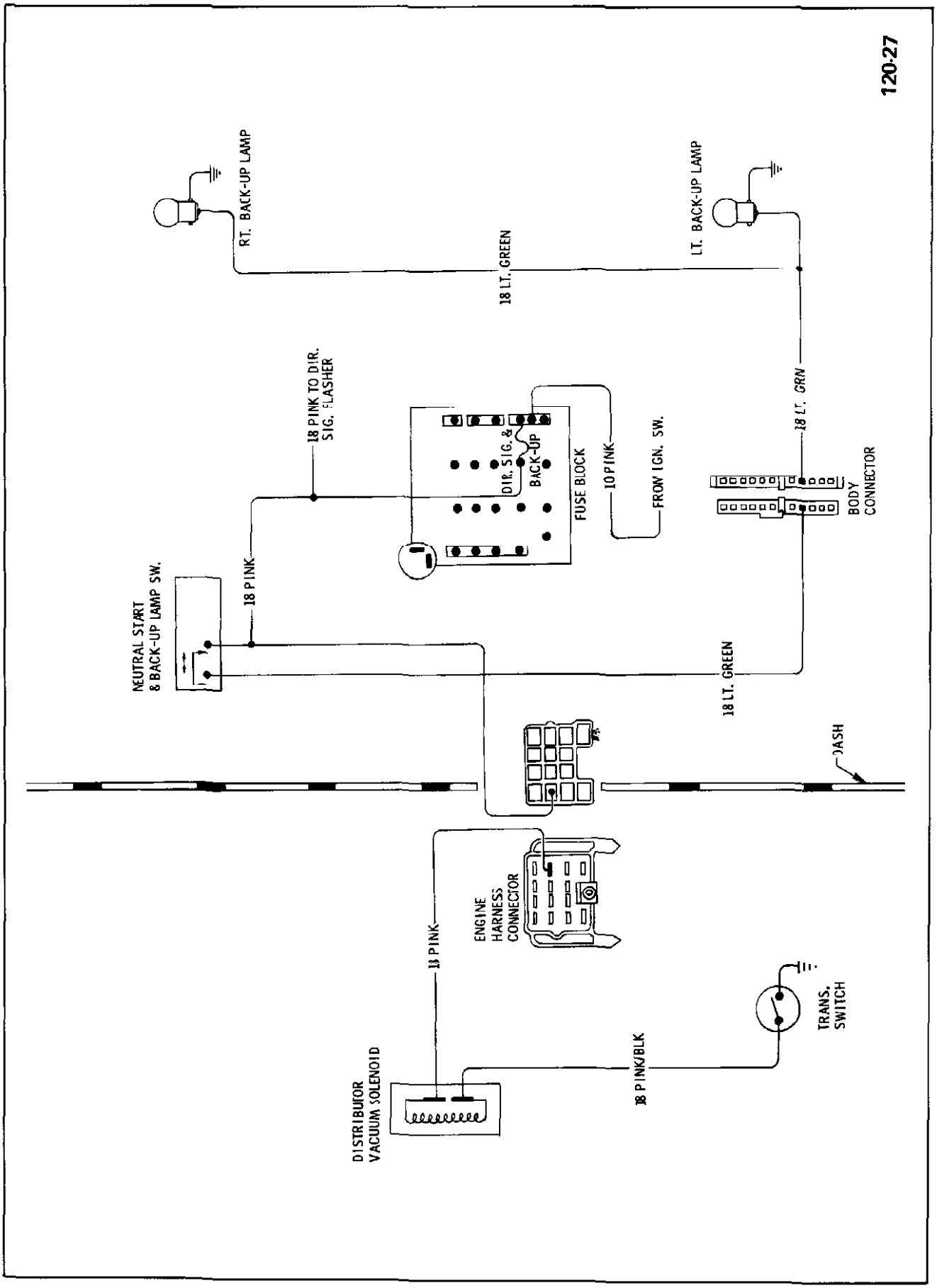


Figure 120-26 Cornering Lights - 45-46-48-49000 Series



Back-Up Lamps and T.C.S. Solenoid (Less L-6) - All Series

GROUP 120

CHASSIS ELECTRICAL AND INSTRUMENT PANEL

Section	Title
A	Battery and Cables . . . . .
B	Lighting Systems . . . . .
C	Signal Systems . . . . .
D	Instrument Panel - 43-44000 Series. . . . .
E	Instrument Panel - 45-46-48-49000 Series. . . . .
F	Instrument Panel - Miscellaneous Items . . . . .
G	Wiring Circuit Diagrams . . . . .

SECTION A

BATTERY AND CABLES
ALL SERIES

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DIVISION I

TROUBLE DIAGNOSIS

120-1 BATTERY AND CABLE TROUBLE DIAGNOSIS

a. Quick Check of Battery and Cables

Whenever electrical trouble develops, it is desirable to make a quick check of the battery and cables to make certain that this source of current is in good condition, securely connected, and is functioning properly. This check will also give a good check on the cranking system.

1. Turn on the lights. They should burn steadily and with normal brilliance.

2. With lights burning, operate the cranking motor. Either have the headlights shining on a wall so their brilliance can be noted or have someone watching the headlights.

3. When cranking motor solenoid switch is closed, one of the following conditions will occur:

a. Lights will stay bright or will dim slightly if temperature is cold, and engine will be cranked at normal speed.

This condition indicates that nothing is wrong with the battery, cables, and cranking system.

b. Lights will go out.

If lights go out as cranking motor solenoid switch is closed, it indicates a poor connection in the circuit between battery and cranking motor. Check battery cables and clean and tighten loose or corroded terminals. See paragraph 120-8.

c. Lights will dim considerably.

If lights dim considerably as cranking motor solenoid switch is closed, it indicates that the battery is run down, or there is a condition in cranking motor or engine which causes an excessive current drain on the battery. A low battery will be indicated by a clattering noise in cranking motor solenoid because the battery cannot sustain the voltage required to hold solenoid plunger "in" after switch contacts close and the "pull in" winding is shorted out.

Test battery with a 421 Battery Test. See paragraph 120-2. If battery is found to be in good condition, check cranking motor.

d. Lights will stay bright but no cranking action will take place.

If lights stay bright but no cranking action occurs when cranking motor solenoid switch is closed, it indicates an open circuit in cranking motor, switch, or control circuit. See paragraph 68-11.

b. Testing Resistance of Cables and Terminal Connections

Battery cables and terminal connections may be tested with equipment comprising a voltmeter (5 volts maximum), ammeter of 300 or more amperes capacity, and carbon pile rheostat having a minimum capacity of 300 amperes connected in series with the ammeter.

1. Adjust rheostat to provide maximum resistance ("Off" position).

2. Connect ammeter positive lead to post on starting motor. Connect ammeter negative lead to one side of rheostat and connect other side of rheostat to ground on engine, preferably at point where battery ground strap is attached. In the instrument shown in Figure 120-1 the ammeter and rheostat are connected in series inside the case.

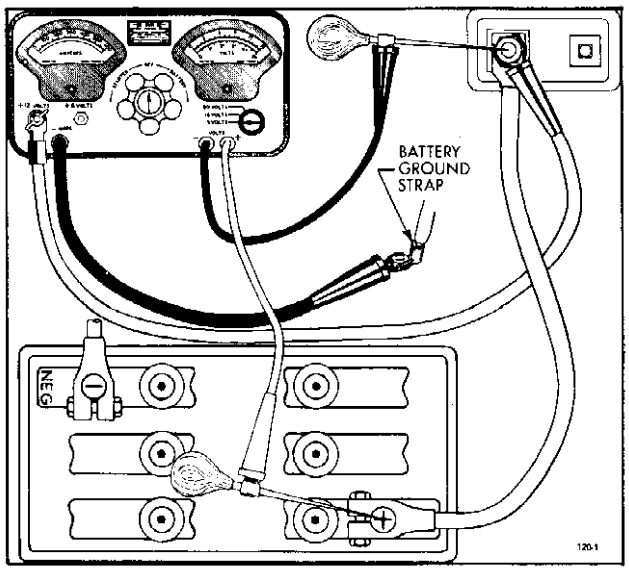

Figure 120-1 Battery, Cable Test Connections

3. Connect voltmeter negative lead to post on starting motor. Use prod with voltmeter lead, if necessary, to insure direct contact with the terminal stud. Do not connect to the ammeter lead clip. Attach a prod to voltmeter positive lead and apply the prod to center of battery positive post. See Figure 120-1. Make sure that clips of voltmeter leads have clean metal contact with prods.

4. Adjust rheostat until ammeter reads 200 amperes, immediately read voltmeter, then turn rheostat to starting ("Off") position to avoid excessive drain on battery. Voltage drop across battery positive cable and terminal connections should not exceed 2/10 volt.

5. Connect voltmeter positive lead to ground on engine. Attach prod to voltmeter negative lead and apply prod to center of battery negative post. Voltage drop across the battery ground cable and terminal connections should not exceed 2/10 volt at 200 amps.

6. A reading in excess of 2/10 volt when testing either battery cable indicates excessive resistance in cable or connections. Clean and tighten cable terminals (subparagraph b below) and recheck for voltage drop. If voltage drop still exceeds 2/10 volt, replace cable with a genuine Buick cable to insure ample capacity.

c. Undercharge Failure of Battery

The most frequent trouble experienced with storage batteries is failure to maintain a state of charge sufficient to crank the engine and also furnish current to the ignition system, lights, and accessories. Failure to maintain a proper state of charge may be due to one or more of the following conditions:

1. *Operating Conditions* When determining cause of premature failure of a battery, consideration must be given to the conditions under which the car is operated.

In very low temperature, the capacity of a storage battery is considerably reduced and the energy required for cranking the engine is considerably increased.

Frequent starting, particularly in cold weather, accompanied by short runs, may take more energy from the battery for cranking than the generator can replace in the limited running time. This condition is aggravated by night driving when lights are turned on, or by operation of an air conditioner in heavy traffic.

When the car is operated under these conditions, adjusting the voltage regulator to the high limit may allow enough increase to keep the battery at a safe state of charge (no adjustment possible on integral voltage regulator). If the high limit setting does not maintain a safe state of charge, an occasional booster charge should be given to the battery or an extra output generator obtained through dealer.

2. *Low Charging Rate* In case of premature battery failure, the charging rate of generator should always be checked and adjusted if below specifications. See paragraph 68-33 or 68-42.

3. *Internal Condition* The internal condition of the battery may be such that it cannot hold a charge satisfactorily. Check electrolyte level and test the battery, using the 421 Battery Test. See paragraph 120-2.

d. Overcharge Failure of Battery

A common cause of battery failure is overcharging, that is, continued input of excessive charging current after the battery has reached a fully-charged condition.

One evidence that a battery is being overcharged is the need for frequent addition of water to the battery in order to maintain the electrolyte level above the tops of the battery separators, since overcharging causes rapid water loss. When this becomes evident, the voltage setting of the voltage regulator should be checked. See paragraph 68-27, sub-paragraph b and 68-38.

Figure 120-2 421 Battery Tester - Charger

120-2 421 BATTERY TEST

New Energizers which have become completely discharged over a relatively long period of time during vehicle storage should not be tested by the 421 Test Procedure. Energizers discharged to this degree cannot accurately be tested by any procedure, as they have no load capability and must be recharged.

Energizers that become discharged in actual service may be accurately tested by the 421 Test Procedure, as periods of inactivity are not involved.

Energizers that are merely discharged are not subject to warranty.

The following test procedure is recommended to determine whether the Energizer or 12-Volt Battery is good and usable, requires recharging, or should be replaced. Any deviation from this complete procedure may produce erroneous results.

a. 421 Test Procedure

1. *Visual Inspection* The first step in testing the Energizer or 12-Volt Battery should be a visual inspection, which very often will save time, labor, and expense in determining the condition.

a. Check for broken or cracked case or cover.

b. Check for loose terminal posts.

c. Check for defective or mutilated sealing compound.

d. Check for other visible signs of physical damage.

Obvious damage, as a result of conditions described above, indicates the need for Energizer or battery replacement.

2. The 421 Test is a programmed test procedure consisting of a series of timed discharge and charge events, requiring

approximately two to three minutes, that will determine the condition of the Energizer or battery with a high degree of accuracy when used in conjunction with this entire test procedure. The 421 Testers are produced by a number of different manufacturers and their directions for tester operation should be carefully followed. General comments on overall 421 Tester operation follow:

a. 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.

b. 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.

c. All meter readings should be made immediately after the meter indicator light comes "on", even if the meter needle is still moving.

d. If additional discharges are required after the initial discharge, set meter indicator following the last discharge cycle.

e. Batteries designated as "bad" by the tester should be replaced.

f. Batteries designated as "good", with no owner's complaint 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 percent state-of-charge.

g. Batteries designated as "good", that are suspected of being questionable because of owner complaints or age of the battery, should be further tested by the Hydrometer Test.

120-3 HYDROMETER TEST OF BATTERY

The 421 Battery Test, as described in the previous paragraph, is the fastest and most accurate means of determining the serviceability of a one-piece cover battery. However, if a 421 Battery Tester is not available, a hydrometer test may be used on a battery that has failed to give proper service.

a. Hydrometer Test

1. Fully charge battery, as described under "Slow Charging".

2. Measure specific gravity of each cell, as described in subparagraph below.

Decide battery serviceability as follows:

a. If all cells read between 1.230 and 1.310, the battery is okay. All it needed was a full charge.

b. After fully charging battery, if any cell reads less than 1.230, the battery is defective and should be replaced.

b. Use of Hydrometer

The hydrometer measures the percentage of sulphuric acid in the battery electrolyte in terms of specific gravity. As a battery drops from a charged to a discharged condition, the acid leaves the solution and enters the plates, causing a decrease in specific gravity of electrolyte. With a hydrometer, an indication of the concentration of the electrolyte is obtained. See Figure 120-3.

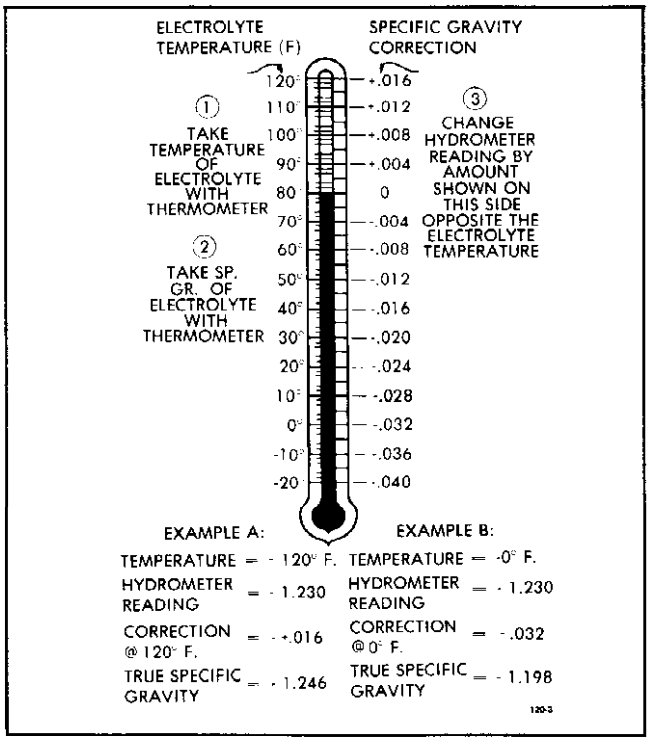

Figure 120-3 Specific Gravity Temperature Correction Scales

The specific gravity of the electrolyte varies, not only with the percentage of acid in the liquid but it also varies with temperature. As temperature increases, the electrolyte expands so that the specific gravity is reduced. As temperature drops, the electrolyte contracts so that the specific gravity increases. Unless these variations in specific gravity are taken into account, the specific gravity obtained by the hydrometer may not give a true indication of the concentration of acid in the electrolyte.

Correction can be made for temperature by adding .004, usually referred to as 4 "points of gravity", to the hydrometer reading for every 10 degrees F. that the electrolyte is above 80 degrees F., or subtracting .004 for every 10 degrees F. that electrolyte is below 80 degrees F. Figure 120-6 shows the exact correction figure to use for any temperature above or below 80 degrees F., the three steps used in obtaining the corrected or true specific gravity and two examples showing how it is figures.

When using a hydrometer, observe the following points:

1. Hydrometer must be clean, inside and out, to insure an accurate reading.

2. Hydrometer readings must never be taken immediately after water has been added. The water must be thoroughly mixed with the electrolyte by charging for at least 30 minutes before hydrometer values are reliable.

3. If hydrometer has built-in thermometer, draw liquid into it several times to insure correct temperature before taking a reading.

4. Hold hydrometer vertically and draw in just enough liquid from battery cell so that float is free floating and with bulb fully released. Hold hydrometer at eye level so that float is vertical and free of outer tube, then take reading at surface of liquid. Disregard the curvation where the liquid rises against float stem due to surface tension.

5. Avoid dropping liquid on car or clothing, as it is extremely corrosive. Any liquid that drops should be washed off immediately with sode solution.

DIVISION II

DESCRIPTION AND OPERATION

120-4 GENERAL BATTERY INFORMATION

Every Buick is equipped with an Energizer, which is a type of battery having a one-piece cover. For 1971, all 45-46-48-49000 Series cars will have as standard equipment a side terminal battery. See Figure 120-4. This battery is constructed similar to the top terminal battery, which is standard on the 43-44000 Series (see Figure 120-5), except for the screw-on type connectors located at the side of the battery. This greatly decreases the cause of terminal corrosion. Also, construction of the terminals is such that the mating cable connector seals the junction and provides a permanently tight and clean connection. The battery is mounted on the front fender skirt under the hood. The battery negative post is grounded to the engine cylinder head by a copper cable. The positive post is connected by an insulated copper cable to a post on the starting motor.

a. Registration of Battery

Delco-Remy battery dealers and distributors are prepared to carry out terms of the manufacturer's warranty on Delco-Remy batteries. In order that Buick owners shall have the protection and benefit of this warranty, it is necessary for the dealer or car owner to register his battery with the local Delco-Remy battery dealer or distributor on all new car deliveries and on all deliveries of new replacement Delco-Remy batteries. The Battery Owner's Certificate is located in the Owner's Protection Plan Folder.

b. Care of Wet Batteries in Storage

Batteries in stored new cars, as well as batteries in stock,

Figure 120-4 Side Terminal Battery - 45-46-48-49000 Series

must be given regular attention to prevent sulphation of plates that may result from inactivity and self-discharge. All automotive wet batteries will slowly discharge on standing idle, whether in stored vehicles or in stock, and will self-discharge much faster when warm than when cold. Batteries in stock should be rotated and the older ones used first.

To minimize the extent of self-discharge, always store batteries fully charged and in a cool place where the temperature does not go below freezing. Every 30 days check the level of electrolyte, add water as required, and charge the batteries at a five (5) ampere rate until fully charged.

Figure 120-5 Battery - 43-44000 Series

Batteries used for display purposes or standing in cars in storage must be treated in the same manner as batteries in stock.

When a new car, or new replacement battery, is delivered, make certain that it is fully charged and the electrolyte is at proper level. This is extremely important because the delivery of a partially discharged battery may not only lead to its return for charging but may also result in shortened life of battery.

c. Importance of Maintaining Electrolyte at Proper Level

Water is the only component of the battery which is lost as the result of charging and discharging, and it must be replaced before the electrolyte level falls to the tops of the separators. If the water is not replaced and the plates become exposed, they may become permanently sulphated which would impair the performance of the plates. Also, the plates cannot take full part in the battery action unless they are completely covered by the electrolyte.

d. Importance of Keeping Battery Properly Charged

The battery has three major functions: (1) It provides a source of energy for cranking the engine; (2) It acts as a stabilizer to the voltage in the electrical system; and (3) It can, for a limited time, furnish energy when the demands of the electrical units in operation exceed the output of the generator.

In order for the battery to continue to function, it is necessary that current withdrawal from the battery be balanced by current input from the generator so that the battery is maintained in a properly-charged condition. If the outgo exceeds the input, the battery will become discharged so that it cannot supply sufficient energy.

The state-of-charge of the battery, as well as the temperature of the electrolyte, has an important bearing on its capacity for supplying energy. Battery efficiency is greatly reduced by decreased electrolyte temperature, as it has a decided numbing effect on its electrochemical action. Under high discharge, such as cranking, battery voltage drops to lower values in cold temperatures than in warm temperatures.

In extremely cold climates, it is important to keep batteries in a nearly full-charged condition to avoid the possibility of freezing which will damage any battery. See Figure 120-6.

The following table shows the temperatures at which freezing will occur in electrolytes of different densities with specific gravity corrected to 80 degrees F.

Specific Gravity	Freezing Point
1.220	–35°F.
1.200	–20°F.
1.160	0°F.

120-6

Figure 120-6 Battery Freezing Points

Care of Dry Batteries in Storage

A "dry charge" battery contains fully-charged positive and negative plates but not electrolyte.

Dry charged batteries should be stored in a dry place away from excessive heat. A dry charged battery should be kept in its original carton until ready to be put into service. This type of battery will retain its "charged" condition indefinitely if protected from moisture. Dry batteries may be stacked in vertical columns, provided they are not stacked more than four high.

f. Preparing Dry Charged Batteries for Service

To prepare "dry charged" batteries for service, use approved battery-grade acid electrolyte (1.265 sp.gr. at 80 degrees F.). Care should be exercised in its use to prevent bodily injury or damage to clothing or other material, resulting from actual contact with the electrolyte. Electrolyte should be added to dry charged batteries in an area where water is readily available for flushing in case the electrolyte comes into contact with the body. Refer to instructions on side of electrolyte container for antidotes to use if electrolyte comes into contact with the body.

It is strongly recommended that a person filling batteries with electrolyte wear glasses (preferably safety glasses) to prevent possible damage to the eyes should any splattering of the electrolyte occur.

1. Remove dry charged battery from its original carton.

2. Remove the vent plugs.

3. Using a glass or acid-proof plastic funnel, fill each battery cell with electrolyte. Do not use a metal funnel for filling the battery. The cell is properly filled when the electrolyte level rises to the split ring at the bottom of the vent well. Do not overfill or underfill. Overfilling will cause acid corrosion in the battery area; underfilling will cause early battery failure.

4. After filling cells, wait five to ten minutes and add additional electrolyte, if necessary, to bring the electrolyte to the proper level.

5. Never finish filling a dry charge battery with water. If electrolyte is spilled, more electrolyte must be obtained.

Tests After Batteries are Prepared for Service

The dry charge battery may be put into service immediately after activation. However, to insure good battery

performance, the following activation tests are recommended:

1. After adding electrolyte, check the open circuit voltage. Less than 10 volts indicate a reverse cell, or an open circuit and the battery should be replaced.

2. Check the specific gravity of all cells. If the specific gravity corrected to 80 degrees F. shows more than a 30-point drop (.030) from the initial filling with electrolyte, or if one or more cells gas violently after addition of electrolyte, the battery should be fully charged before use.

3. For best performance in cold weather (32 degrees F. or less), or if the battery and the electrolyte are not at 60 degrees F. or above at time of activation, warm the battery by boost charging.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

120-5 FUSIBLE LINK REPLACEMENT

All Series Buicks have fusible links located between the starting motor post and the lower ends of the main supply wires. These links are the weakest point in the electrical supply system for the complete car and, as such, will act like a fuse for every wiring harness in the car.

Every electrical accessory is still protected by a fuse or circuit breaker, of course, but fusible links have been added to protect the wiring harnesses before the fuses. In the past, if a wire became grounded in the portion between the battery and the fuse block, a long section of the wire would burn out, making replacement of a complete wiring harness necessary. These wiring harnesses were generally expensive, complicated, and hard to get at; they often required many hours of a skilled electrician's time to replace them. Now, with the fusible links, a short or ground in any unfused wire will only cause a six-inch link at the starting motor to burn out. Because of its location, possibility of a fire, such as was sometimes caused by a burned-out wiring harness, is very remote.

All Series have two (2) fusible links connected to the starting motor post:

1. In the No. 12 red wire circuit which, for safety purposes, supplies only the headlight circuit.

2. In the No. 10 red wire circuit which supplies all electrical units except the headlights.

A fusible link is simply a short section of wire which is several sizes smaller in gauge than the wire in the circuit which it protects. The No. 10 wire supply circuit is protected by a No. 14 brown link; the No. 12 wire headlight circuit is protected by a No. 16 black link. See Figure 120-7. If a short or ground occurs in either of these circuits, the fusible link will melt before the insulation is damaged elsewhere in the circuit.

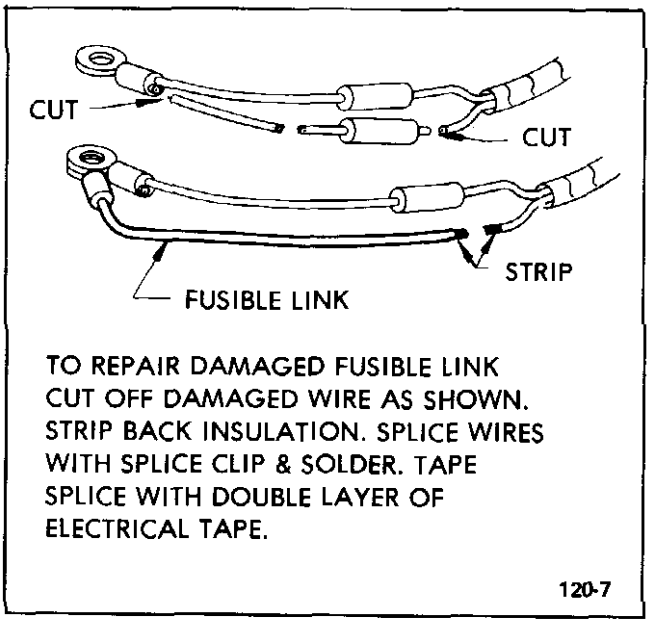

Figure 120-7 Fusible Links

Replace a burned-out fusible link as follows:

NOTE: *Always disconnect battery before attempting any electrical repairs.*

1. Cut off burned-out link close to the starting motor post.

2. Cut off other end of burned-out link along with solder joint.

3. Strip insulation from end of new link and from end of wiring harness so that each will project halfway through soldering sleeve.

4. Crimp new link in soldering sleeve and solder carefully.

5. Cover new connection tightly with electrical tape.

6. Install new link connector eye on starter post.

A burned-out fusible link would be indicated by:

1. All electrical accessories dead except headlights; or, headlights dead but all other electrical units working.

2. Starter dead - won't even click. Even with a nearly dead battery, the starter solenoid will generally engage. Therefore, no click means no solenoid action possibly due to a burned-out fusible link.

3. For a positive test for a burned-out No. 14 fusible link, turn blower switch to high-speed position, turn on ignition switch, but do not run engine. Connect a test light or a voltmeter between positive battery post and No. 10 red

wire terminal at generator regulator. If test light lights brightly, or if voltmeter reads battery voltage, fusible link is burned out.

A voltmeter reading over .2 volt, but less than battery voltage, means that there is excessive resistance in the circuit but fusible link is still in place.

120-6 BATTERY RECHARGING

When the battery is being charged, an explosive gas mixture forms in each cell. Part of this gas escapes through the holes in the vent plugs and may form an explosive atmosphere around the battery itself if ventilation is poor. This explosive gas may remain in or around the battery for several hours after it has been charged. Sparks or flames can ignite this gas, causing an internal explosion which may shatter the battery.

The following precautions should be observed when charging a battery:

1. Do not smoke near the battery being charged or which has been very recently charged.

2. Do not break live circuits near the battery top because a spark usually occurs at the point where a live circuit is broken. Care must always be taken when connecting or disconnecting leads. Poor connections are also a common cause of electrical arcs which cause explosions.

NOTE: *It is recommended that the negative jumper cable be attached at a point remote from the battery (such as the Delcotron adjusting brace). This then should be connected after* the positive jumper cable and *disconnected before* the positive jumper is attached or removed.

3. Exercise care when attaching charger leads to side terminal battery studs to avoid contact with vehicle metal components which would result in damage to the battery.

NOTE: *When out of the vehicle, the battery will require adapters for the terminals to provide a place for attachment of the charging leads. See Figure 120-8.*

When the battery is in the vehicle, the studs provided in the wiring harness are suitable for attachment of the charger's leads.

There are two separate methods of recharging batteries which differ basically in the rate of charge. In the slow-charge method, the battery is supplied a relatively small amount of current for an extended period of time. In the quick-charge method, the battery is supplied with a high current for a short period of time.

a. Slow-Charging

Slow charging is the best and only method of completely charging a battery. The slow-charge method, properly applied, may be safely used under all possible conditions of

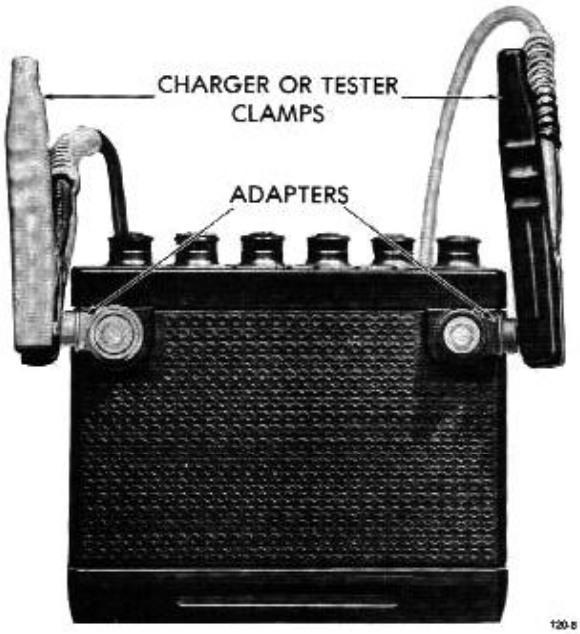

Figure 120-8 Side Terminal Battery Charging Adapters

the battery, provided electrolyte is at proper level in all cells. The battery may be fully charged by this method, unless the battery is not capable of taking a full charge. The normal slow charging rate for the 12-volt battery is 5 amperes.

Full charge of battery is indicated when all cell specific gravities do not increase when checked at three intervals of one hour and all cells are gassing freely.

Due to the low rate during slow charging, plenty of time must be allowed. Charge periods of 24 hours or more are often required. See Figure 120-9 for slow charging guide.

b. Quick-Charging

Since time is often of most importance to the battery owner, quick-charging must sometimes be used to partially charge the battery so that the engine will start and the owner can be on his way.

Charge at 50 amperes for 20 minutes (50 x 20 1,000 ampere minutes). If charger will not give this rate, charge for an equal number of ampere minutes at the best rate available.

CAUTION: *Too high a current during quick-charging will damage battery plates.*

A battery cannot be brought up to a full-charged condition by the quick-charge method. The battery can be substantially recharged or boosted but, in order to bring the battery to a fully-charged condition, the charging cycle must be finished by charging at a low or normal rate. Some quick-chargers have a provision for finishing the charging cycle at a low rate so that the battery can be brought up to a fully-charged condition.

CHARGING GUIDE

Recommended Rate* and Time for Fully Discharged Condition

Watt Rating	5 Amperes	10 Amperes	20 Amperes	30 Amperes	40 Amperes	50 Amperes
Below 2450	10 Hours	5 Hours	2½ Hours	2 Hours		
2450-2950	12 Hours	6 Hours	3 Hours	2 Hours	1½ Hours	
Above 2950	15 Hours	7½ Hours	3¼ Hours	2 Hours	1¾ Hours	1½ Hours

*Initial rate for constant voltage taper rate charger.
To avoid damage, charging rate must be reduced or temporarily halted if:
1. Electrolyte temperature exceeds 125° F.
2. Violent gassing or spewing of electrolyte occurs.

Battery is fully charged when over a two hour period at a low charging rate in amperes all cells are gassing freely and no change in specific gravity occurs. **For the most satisfactory charging, the lower chargin rates in amperes are recommended.**
Full charge specific gravity is 1.260 - 1.280 corrected for temperature with electrolyte level at split ring.

120-9

Figure 120-9 Battery Slow Charging Guide

Used with care, and employing all safeguards provided by the manufacturer, a quick-charger will not damage a battery which is in good condition.

120-7 PERIODIC BATTERY INSPECTION AND SERVICE

The battery requires very little attention, but periodic inspection is essential to secure the maximum efficiency and life. The following services are essential to maintain the battery at maximum efficiency.

CAUTION: *The hydrogen gas which is produced in the battery cells during charging is dangerously explosive. Extreme care must be taken to avoid bringing open flames, lighted matches, etc., near a battery which is, or has been, recently on charge and which is, or has been, gassing. Likewise, care must be taken to avoid causing any sparks near a battery with jumper cables or fast charger cables, since this can also set off an explosion of the gases.*

a. Maintain Electrolyte Level

The Energizer features a Delco Eye, which is a specifically-designed vent plug with a transparent rod extending through the center. See Figure 120-10. When the electrolyte is at the proper level, the lower tip of the rod is immersed, and the exposed top of the rod will appear very dark; when the level falls below the tip of the rod, the top will glow. The Delco Eye reveals at a glance if water is needed, without the necessity of removing the vent plugs. See Figure 120-11.

The Delco Eye is used in only one cell because when the electrolyte level is low in one cell, it is normally low in all cells. Thus, when the Delco Eye indicates water is needed, check the level in all six cells.

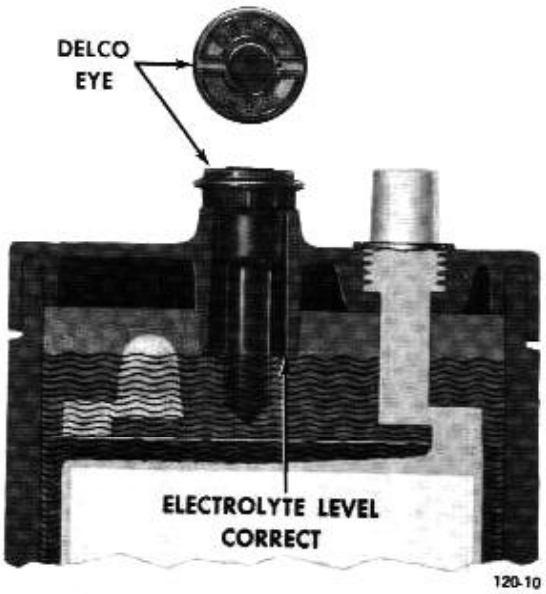

Figure 120-10 Electrolyte Level Correct

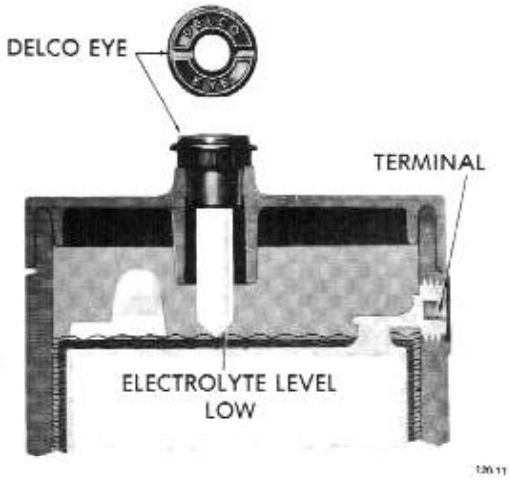

Figure 120-11 Low Electrolyte Level

Add distilled water as required to maintain the electrolyte level at the split ring at bottom of filler well. See Figure 120-12.

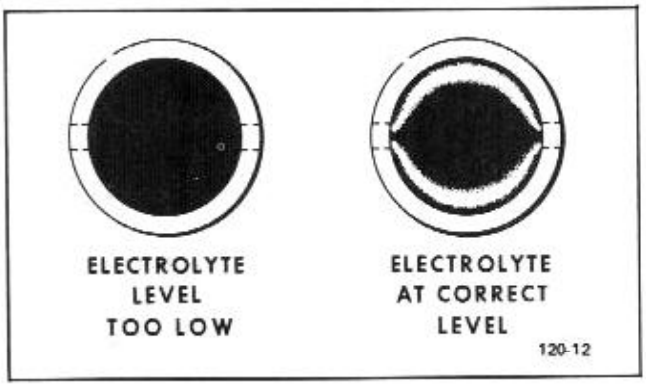

Figure 120-12 View Inside Vent Well Showing Electrolyte

CAUTION: *Do not overfill, as electrolyte may be sprayed out by gassing, or may overflow due to heat expansion during charging.*

If distilled water is not available, it is better to add clean mineral-free tap water than to allow the electrolyte level to remain below the top of the plates.

In freezing weather the water should be added just before using the car or otherwise charging the battery so that the water will be mixed with the acid before it is allowed to stand in freezing temperatures.

If it is found necessary to add water to the battery more frequently than about every 1,000 miles and the quantity of water added per cell is great, check setting of voltage regulator and adjust, if necessary. Abnormal water loss is an indication that the battery is being overcharged.

b. Inspect Battery, Mounting, and Cables

Check outside of battery for damage or signs of serious abuse, such as broken case or broken covers. Check inside of battery by removing the vent caps and inspecting for signs of abuse, such as electrolyte level too low, or bad or unusual odors. If battery shows signs of serious damage or abuse, it should be replaced.

Check the battery hold down bolts to make certain that battery is securely held in place. Excessive tightening may distort or crack the battery case.

If the top of battery is dirty or the hold down strap is corroded, clean thoroughly with a brush dipped in ammonia or soda solution. Care must be used to prevent any solution from getting into battery cells. After the foaming of solution stops, flush off with clean water and dry thoroughly. If hold down strap is corroded, it should be painted with acid-resisting paint after cleaning.

Check battery cables to make certain they are tight at battery posts, engine mounting bracket, and junction block. If a connection is found loose, it should be cleaned before being tightened, as arcing and corrosion may have taken place in the loose connection. Check condition of cables and replace if badly corroded or frayed.

120-8 CLEANING CABLE TERMINALS

a. Side Terminal Battery

Construction of the side terminal battery is such that the mating cable connector seals the junction and provides a permanently tight and clean connection. Cleaning cable or battery terminals should never be necessary.

b. Top Terminal Battery

If loose connections are found by inspection, or high resistance is found by voltage test, disconnect the cable for thorough cleaning of terminals. When removing a corroded cable terminal from battery post, do not pry against battery case of hammer on terminal to break it loose, since either practice will result in broken cell covers. Use a screw-type terminal puller, if terminal cannot be loosened by hand.

Thoroughly clean all corrosion from disconnected battery cable terminals and terminal posts, using suitable wire brushes. If wire brushes are not available, corroded terminals may be cleaned by brushing with a strong soda solution, using care not to get solution into battery cells.

CAUTION: *When cleaning cable terminals, extreme care must be taken to prevent removing excess material from the moulded contact rings inside the terminal. If excessive material is removed, the terminal may not provide a connection that is capable of carrying the current required during engine cranking.*

If cable strands are broken, corroded, or loose in terminals, the cable should be replaced with the correct cable to insure ample capacity.

To prevent corrosion of battery terminals and connections, apply a coating of silicone over the battery post and cable terminals after cables have been installed on terminals.

NOTE: *Do not grease post or terminal before installing terminal to post. It is very desirable to coat the terminal and exposed post with Silicone after installation to discourage corrosion by water and acid.*

DIVISION IV

REMOVAL AND INSTALLATION

120-9 BATTERY REMOVAL AND INSTALLATION

a. Removal

1. Disconnect battery cables. (Remove negative cable first to prevent possible shorting.)

2. Remove battery hold down bracket.

3. Using Tool J-23686, pull battery out, as shown in Figure 120-13.

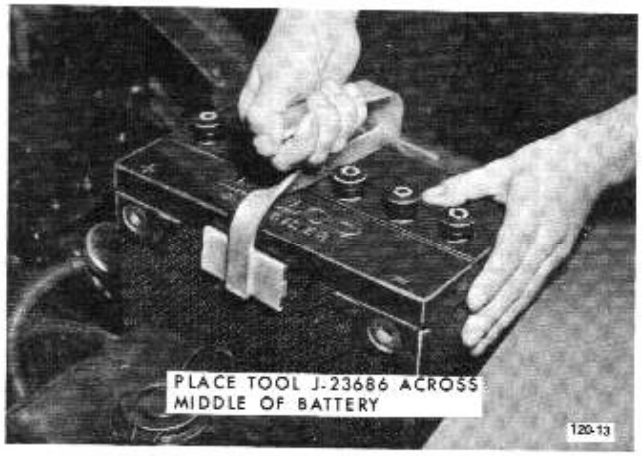

Figure 120-13 Battery Lifting Tool

b. Installation

1. Place battery in carrier and tighten hold down bracket bolt to 60-80 lb.in.

2. Install battery cables. (Install positive cable first to prevent possible shorting.)

3. Torque side terminal cables to 60-90 lb.in. or tighten bolts until the terminals cannot be rotated by hand, then torque bolts 1/2 turn more.

120-9 BATTERY CABLE REMOVAL AND INSTALLATION

a. Positive Cable

1. Disconnect cable at battery. (On side terminal batteries, disconnect negative cable first to prevent possible shorting.)

2. Remove wiring harness bracket screws holding bracket to engine block.

3. Disconnect cable at starter solenoid.

4. Remove cable from chassis slips and remove cable.

5. Install cable on starter solenoid.

6. Install wire harness bracket.

7. Install cable through chassis clips.

8. Connect cables to battery terminals (connect positive cable first on side terminal batteries to prevent possible shorting).

9. Torque side terminal cable to 60-90 lb.in. or tighten bolts until the terminals cannot be rotated by hand, then torque bolts 1/2 turn more.

b. Negative Cable

1. Disconnect battery cable at terminal.

2. Remove cable from chassis clips.

3. Remove delcotron bracket bolt and remove cable.

4. Reverse above steps to install.

NOTE: *Torque bolts on side terminal battery to 60-90 lb.in. or tighten bolts until the terminals cannot be rotated by hand, then 1/2 turn more.*

DIVISION VI SPECIFICATIONS

120-11 BATTERY SPECIFICATIONS	250 Eng. 43000 Series	350 Eng. 43-44000 Series	455 Eng. 43000 Series 350 Eng. H.D. Cooling Opt. 43-44000 Series	350 Eng. 45000 Series	455 Eng. 45-46-48-49000 Series 350 Eng. H.D. Cooling Opt. 45000 Series
Make	Delco	Delco	Delco	Delco	Delco
Model	1980032	1980030	1980036	1980145	1980144
Location Under Hood	Rt. Front	Rt. Front	Rt. Front	Rt. Front	Rt. Front
Terminal Type	Top Post Type	Top Post Type	Top Post Type	Side Screw Type	Side Screw Type
Terminal Grounded	Negative	Negative	Negative	Negative	Negative
Voltage	12	12	12	12	12
Capacity (Amp. Hrs. at 20 Hr. Rate)	44	61	70	61	70
Catalog Number	Y55	R59	R69	R89	Y91
Cranking Power (Watts at 0° F.)	2300	2900	3150	2900	3000
Number of Cells and Plates/Cell	6, 9	6, 11	6, 11	6, 11	6, 11
Specific Gravity, Full Charge at 80° F.	1.260 to 1.280	1.260 to 1.280	1.260 to 1.280	1.260 to 1.280	1.260 to 1.280
Bench Charging Rate, Start	5 Amps.	5 Amps.	5 Amps.	5 Amps.	5 Amps.
Bench Charging Rate, Finish	2 Amps.	2 Amps.	2 Amps.	2 Amps.	2 Amps.
Case	Hard Rubber	Hard Rubber	Hard Rubber	Hard Rubber	Hard Rubber
Dimensions (Overall)					
Length	9 1/2	10 1/4	10 1/4	10 1/4	12 1/32
Width	6 13/16	6 13/16	6 13/16	6 13/16	6 13/16
Height	8 1/4	8 3/4	9 1/2	8 3/4	8 3/4

120 A-4

SECTION C

49000 SERIES
CHASSIS SHEET METAL

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Hood Noises or Panel Flutter	110-18
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	Fender, Bumper and Hood Alignment Inspection	110-20
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IV	REMOVAL AND INSTALLATION:	
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VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION I

TROUBLE DIAGNOSIS

110-18 HOOD NOISES OR PANEL FLUTTER

Squeaks or grunting noises in the hood when driving over rough roads do not necessarily indicate misalignment of hood or fenders. These noises may be caused by metal contact at some point where clearance should exist or by worn or dry hood bumpers.

If the hood squeaks, check for uniform clearance all around the hood and fenders. If an edge of metal is making contact at any point where clearance should exist, a bright metal spot will usually be found. Such spots may be depressed by spring hammering to provide clearance.

A grunting noise in the hood is usually caused by dry rubber bumpers on fender rails and cowl ledge lacing. Lubricate all rubber bumpers on fender rails and cowl with silicone rubber lubricant. To correct a persistent case of squeaking or grunting where hood to panel contacts ledge lacing, even when lubricated, cement a 1/16" thick strip of felt to panel where the lacing makes contact.

To prevent hood panel fluttter, the rear end of the hood panel must have firm contact with the rubber bumpers and lacing attached to cowl ledge. The hood may be raised or lowered by adjusting rear adjustable bumpers. See paragraph 110-21, sub-paragraph c.

DIVISION II

DESCRIPTION AND OPERATION

110-19 DESCRIPTION OF CHASSIS SHEET METAL

a. Chassis Sheet Metal Assembly

The chassis sheet metal assembly is attached to the frame and body at adjustment points. The front of the assembly is supported by two mounts located at the frame side rails. Shims at these locations allow up and down movement of the front of the sheet metal assembly. Fore and aft and side adjustment is allowed by oversize holes at the fender rear attaching points and chassis sheet metal mounts. Special shims at the rear locations allow adjustment of the rear of the assembly. The lower rear edge of the assembly is attached to the body at the rocker panel by bolts on each side. Shims are used at this location to provide up and down adjustment at the rear of the fender.

IMPORTANT: *The bolts that retain the sheet metal braces must be torqued to the required torques. If these bolts are loose, the braces will not provide additional support for the sheet metal assembly.*

b. Hood, Hinges and Latch Mechanism

The hood panel is of one piece construction, strengthened and held to shape by a reinforcement of stamped sheet metal.

The rear of the hood assembly is attached to the body cowl and fender on each side by hinge assemblies which permit the front of the hood to be raised. A heavy coil spring connected between each hinge assembly assists in the open position.

The front of the hood is held down by a rachet-type hood latch which is cable released from inside the passenger compartment. After the latch is released, a secondary latch must be hand released at the front of the hood. This secondary latch is mounted to the hood inner panel and engages the opening in the side of the grille support.

NOTE: THIS HOOD LOCK CATCH ASSEMBLY TO RADIATOR GRILL CENTER SUPPORT 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.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

110-20 FENDER, BUMPER AND HOOD ALIGNMENT INSPECTION

When the front sheet metal is misaligned, it is imperative to make the correct adjustment since an incorrect move on one item can throw the error to another area. Therefore, it is necessary to analyze the sheet metal as a whole before adjustments are made. For best results, the following procedure should be used:

a. Preliminary Tightening

Before deciding upon any adjustment to correct hood or fender misalignment, it is advisable to check tightness of all attaching screws and bolts since a true picture of the correction requirements cannot be obtained when the sheet metal is loose and free to shift.

After all parts are properly tightened, inspect fender and hood alignment (subpar. b) and hood alignment (subpar. c). Make all inspections before performing any adjustments because an adjustment at one point will usually alter alignment at other points. The preliminary inspection should determine the adjustments that will produce the best overall alignment of hood and fenders at all points.

b. Fender and Hood Alignment at Front Doors

1. Fender to leading edge of door should have a 7/32" (approximately) parallel gap and be flush. If realignment is necessary, check what this move will do at the rear end of the hood opening (approximately 1/8" gap between fenders and hood.) The total gap of both sides should be approximately 1/4" regardless of how the hood is spaced. If moving the fender flush with the door will impair this gap too badly, the door must be moved to make it flush with the fender.

Before making any adjustment of sheet metal to provide necessary clearance, first make sure that front doors are properly aligned in the body openings. If fenders and door panel surfaces are not reasonably flush, correction may be made by loosening the two (2) vertical attachments of fender to upper cowl and one (1) attachment of fender to front of dash (rear of hood hinge); this will allow the upper portion of the door to be moved. If the lower portion of the fender must be realigned for flushness, the fender skirt bracket to body bracket located below steering column should be loosened, the vertical attachment of fender to body at the rear of the wheel opening, and the horizontal attachment of the rear lower portion of fender behind the door. Shims must be removed or added to flush the fender to door at this rear lower location.

2. The fender to top edge of door should be flush and parallel.

3. If the hood to fender gap at the rear is correct, the hood split line should be parallel the full length of the hood with the nose of the hood parallel to the front end panel.

4. The hood should be flush with the fenders from front to rear. When the hood and fender split lines are parallel from front to rear and the hood front end is not parallel to the front end panel, it is necessary to shift the front end of the chassis sheet metal (attached at chassis frame on each side of radiator) in the direction of the smaller gap. Some variation of parallel lines and hood to fender nose flushness can be allowed in mild cases, but shifting the sheet metal is the only way a correct alignment can be obtained. Before you have decided this is the move to make, be sure that the rear ends of the fenders are not inboard to the door on one side and outboard on the other; this will have the same effect on out- of-square sheet metal. The hood is the final adjustment item on sheet metal and will not fit in and meet specification in an opening that is not square.

c. Hood Alignment Inspection

When the hood is closed and latched, it should bear firmly against the front rubber bumpers on upper tie bar. Height of hood and width of space between hood and fenders should be reasonably even from front to rear.

110-21 FENDER BUMPER AND HOOD ADJUSTMENT

a. Poor Fender to Door Gap (But Parallel)

To move a fender fore or aft, it is necessary to loosen all attachments to the body (two at the hood hinge area, one at the front of dash slightly below the hood hinge, one at the lower portion of dash attaching to inner fender skirt, and two at the rocker rear lower end of fender).

Many times after loosening these attachments, the fender will spring to its proper position. If the move isn't too great, the fender can be slightly forced to its correct position; but if too much force is necessary to obtain this setting, further procedures should be used. (Remember that putting the fender under severe strain can result in only a temporary alignment or a changing in the door line or hood split line contour, this can also cause the fender at the rocker at the rear of the wheel cut to flare out or in.)

When a major move is necessary, remove the battery and battery base and loosen all sheet metal attachments of the chassis sheet metal to radiator support of both fenders even if only one is to be relocated. Bolts to loosen are fender skirt (wheel house panel) radiator support, fender to radiator support (behind headlamps). Do not loosen the upper tie bar to fender bolts. Loosen the chassis sheet metal to frame bolts located at each side of the radiator on the side to be relocated.

NOTE: *When necessary to make side-to-side adjustments, loosen the radiator braces on models so equipped.*

When all bolts are loose, the sheet metal can shift to any desired position. It is not necessary to remove the hood, but the hood should be in the open position when sheet metal is shifted.

From this point, it is very important to secure the previously-loosened bolts in the following sequence:

Before any tightening is performed at this stage, it should have been determined whether the fender and door will have a parallel gap when set at the correct height at the rear. If correction is needed to make the gap parallel, the sheet metal must be raised or lowered at the chassis sheet metal mounts by adding or removing shims between the radiator support and the mount. Remember that the mount is compressed after tightening and will account for approximately 1/16" smaller gap on the bottom of the door opening than at the top.

1. Tighten the outer vertical fender to body attachment point first. Add or remove shims to position the fender vertically to door. Position the fender and door with a 7/32" (approximately) gap and flush to the door at the upper portion of fender to door.

Lower the hood gently to down position and check for squareness of the fender set. The hood should have parallel split lines with the fender, and the noses of the fenders parallel to the front end panel. If not in line, the sheet metal must be shifted sideways in the direction of the smaller gap until they are parallel. If only one fender has been loosened and much movement is necessary, the other fender must be loosened the same as the fender being reset; that is, all attachments except directly behind the hood hinge. The final position, if correct, will produce parallel hood-to-fender lines and a parallel condition to the front end panel. (See Figure 110-20 for causes of unparallel hood lines.)

Tighten the chassis sheet metal to frame bolts and torque to specifications. The sheet metal will not move once these four attachments (two fender to body at hood hinge and two sheet metal to frame) are tightened.

2. If the fender has poor alignment to upper portion of door, correcting may be made by loosening the two (2) vertical attachments of fender to upper cowl and one (1) attachment of fender to front of dash (rear of hood hinge); this will allow the upper portion of the door to be moved. If the lower portion of the fender must be realigned for flushness, the fender skirt bracket to body bracket located below steering column should be loosened, the vertical attachment of fender to body at the rear of the wheel opening, and the horizontal attachment of the rear lower portion of fender behind the door. Shims must be removed or added to flush the fender to door at this rear lower location.

3. All remaining bolts may now be tightened in any sequence.

If both fenders have been loosened, the other side should be attached using the same procedure.

b. Bumper Adjustment (Face Plate)

The bumper attaching bolt holes in the frame and the back bars are slotted to permit movement of the bumper and permit proper alignment with adjacent parts.

c. Hood Adjustment

1. Hood Set: First, the hood opening must have parallel gaps to front end panel and fenders to make a commercial job. Lower the hood gently to down position and determine the correct move to make fore and aft at the hood hinge to hood attachment. This is done by simply assuming the hinges aren't even there; that is, if the hood hangs forward on one side and back on the other, the hood is moved on the hinge to correct the misalignment at the nose. The parallel lines will fall in by themselves if the sheet metal is square. To align hood in an out-of-square opening, take a little out-of-parallel of the split lines and some misalignment at the front end panel. When the hood is moved fore or aft, on either side, it affects the hood and fender gap on all four corners of the hood. Therefore, don't make one move and spoil three others. The final adjusting is done by the hinge pillar attachment. Try for parallel lines but, as a last resort, you can move one fender outboard and the opposite inboard and pick up enough gap in the hood line to make a good job out of a poor one. Check door swing to hood if this is done.

2. Front Alignment for Flushness to Fender and Front End Panel: Three (3) adjustable bumpers are used for front end flushness. One is on the hood inner panel to the right of the hood latch opening, and one on each side of the upper tie bar. First lower the two (2) outer bumpers to allow the hood to fall below the fenders. Set the bumper in the hood panel to align the hood approximately 1/16 inch above the front end panel when the hood is lowered gently. The outer corners should now be approximately 1/8 inch low to fenders. If not, reform the nose of the hood to do so. Raise outer bumpers to flush hood to fender. This is done to put extreme pressure on outer corners and eliminate hood flutter. The center bumper only controls hood height at the center of the hood where hood is slammed.

3. Rear Vertical Alignment: If all component parts of fender mounting are correct, the hood hinge will pull the hood below the fender when the rear adjustable bumpers are lowered. If the rear of the hood does not fall low to the fenders, file the rear attaching hole of hinge to fender upward to bring the hood lower. Raise the rear adjustable bumper to flush hood to fender. This pressure on the rear hood bumpers is necessary to eliminate hood flutter. In cases of tight hood to fender split lines, the fender bumpers may hold the hood high to fender. Carefully flatten bumper and surface until hood to fender split lines are even.

4. Hood Alignment: *Move hood to right or left at front by hinge adjustment.* Do not depend on the hood latch for hood alignment. The hood latch can, however, be adjusted sideways. If the hood latch is to be adjusted, care should be taken not to injure the mechanism. Always check the secondary latch by use of the release lever to insure absolutely no binding. The latch itself can be checked by closing the hood. Always check hood position in relation to the windshield wipers to be sure there is adequate clearance for wiper operation.

DIVISION IV

REMOVAL AND INSTALLATION

110-22 REMOVAL AND INSTALLATION OF HOOD ASSEMBLY

1. Support hood in extreme "up" position.

2. Place folded rags under rear corners of hood to prevent possible damage to fenders.

3. Scribe a reference line along edge of each hinge flange so hood can be replaced in same position.

4. Remove two hood hinge to hood bolts from each side.

5. Lift hood from car.

6. To install, reverse above procedure.

110-23 REMOVAL AND INSTALLATION OF HOOD HINGE SPRING

1. To remove hood hinge spring, insert Remover and Installer J-9214 through loop in forward end of spring with bend of tool approximately one inch from loop. Using inside corner formed by hinge as a pivot, unseat spring from notch.

2. Then push tool forward, causing hood spring to slide clear of hinge.

3. To replace hood spring, insert Remover and Installer J-9214 through loop in forward end of spring. Using hinge as a pivot, seat spring into notch.

110-24 REMOVAL AND INSTALLATION OF HOOD HINGE

a. Removal

1. Prop the hood in the extreme "up" position and place

folded rags under rear corners of hood to prevent possible damage to fenders.

2. Scribe position of the hood hinge on the hood and remove two hood hinge to hood bolts.

3. Scribe position of the hood hinge on the support. Remove the two bolts attaching the hinge to the support and remove the hinge.

b. Installation

1. Align hood hinge with scribe marks on support and install two bolts attaching the hinge to the support. Do not tighten.

2. Align hood hinge with scribe mark on hood and install two bolts attaching hood hinge to hood. Do not tighten.

3. Close hood and align flush with cowl and fenders.

4 Raise hood and tighten all mounting bolts to 25 lb.ft.

5. Remove all protective coverings.

110-25 REMOVAL AND INSTALLATION OF FENDER AND SKIRT

1. Disconnect battery cables and remove battery if battery is on same side as fender being removed.

2. Unfasten all electrical wires attached to fender skirt.

3. Remove three bolts securing battery base to radiator support and fender skirt. Lift out battery base.

4. Remove one bolt securing bracket to front bumper outer extension.

5. Remove cornering lamp if so equipped.

6. Remove two bolts securing lower portion of radiator support to lower front portion of fender.

7. Remove five bolts securing front of fender to radiator support.

8. Remove three screws securing fender lower front baffle.

9. Remove two hood hinge to fender bolts supporting hood as outlined in paragraph 110-24.

10. Remove two bolts securing skirt to lower portion of cowl.

11. Remove rocker panel moulding.

12. Remove two bolts securing lower rear edge of fender to rocker panel.

13. Remove one bolt securing upper rear portion of fender to bracket at hinge pillar. It is suggested that bracket not be removed from pillar.

14. Remove three bolts securing upper rear portion of fender to upper portion of cowl.

15. Remove two bolts securing fender to upper tie bar.

16. Raise up and lift off fender and skirt.

17. Skirt can now be removed from fender by removing skirt to fender attaching bolts.

18. To install, reverse above procedure attaching at points marked "Net" first.

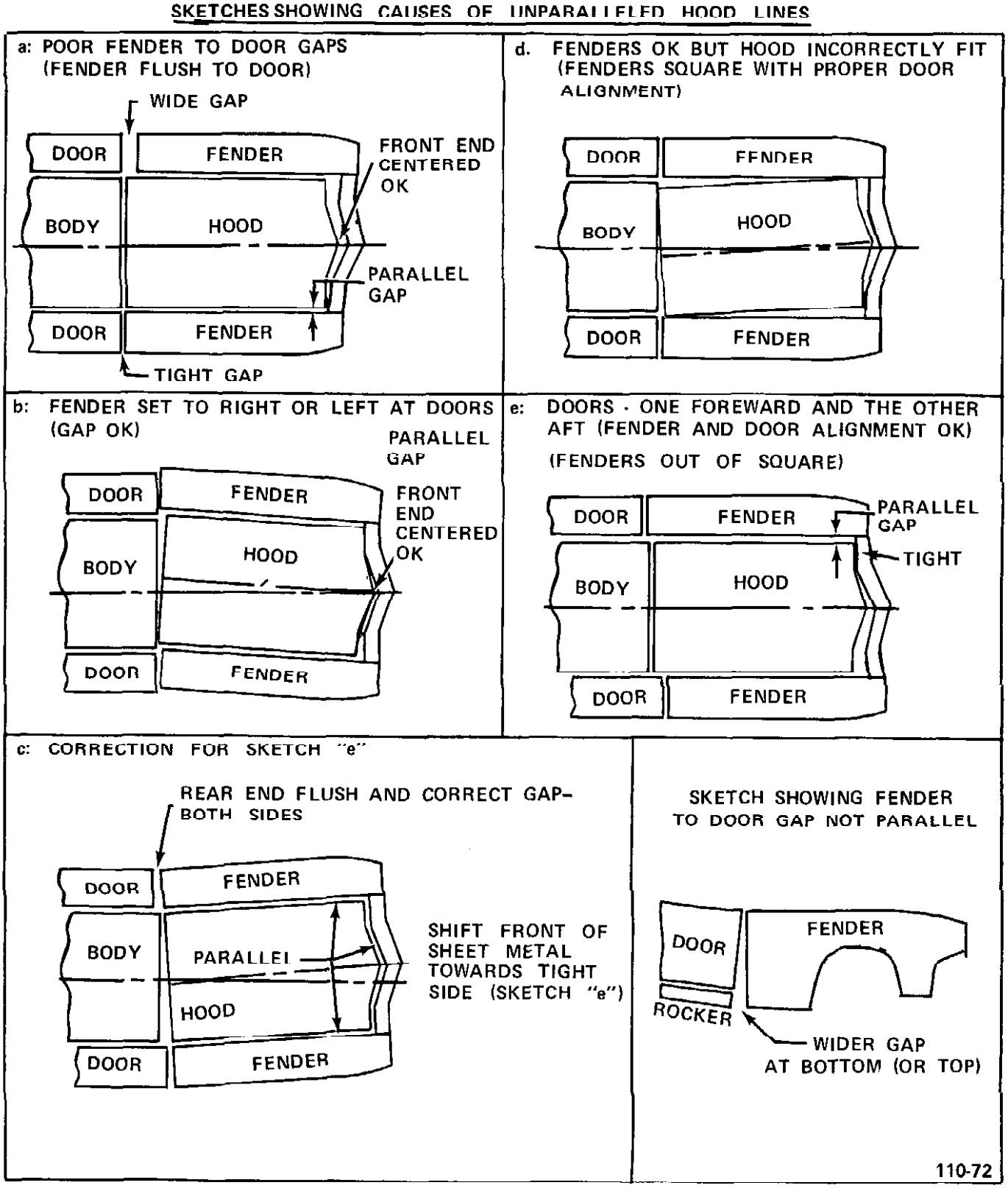

Figure 110-20 Chassis Sheet Metal Alignment

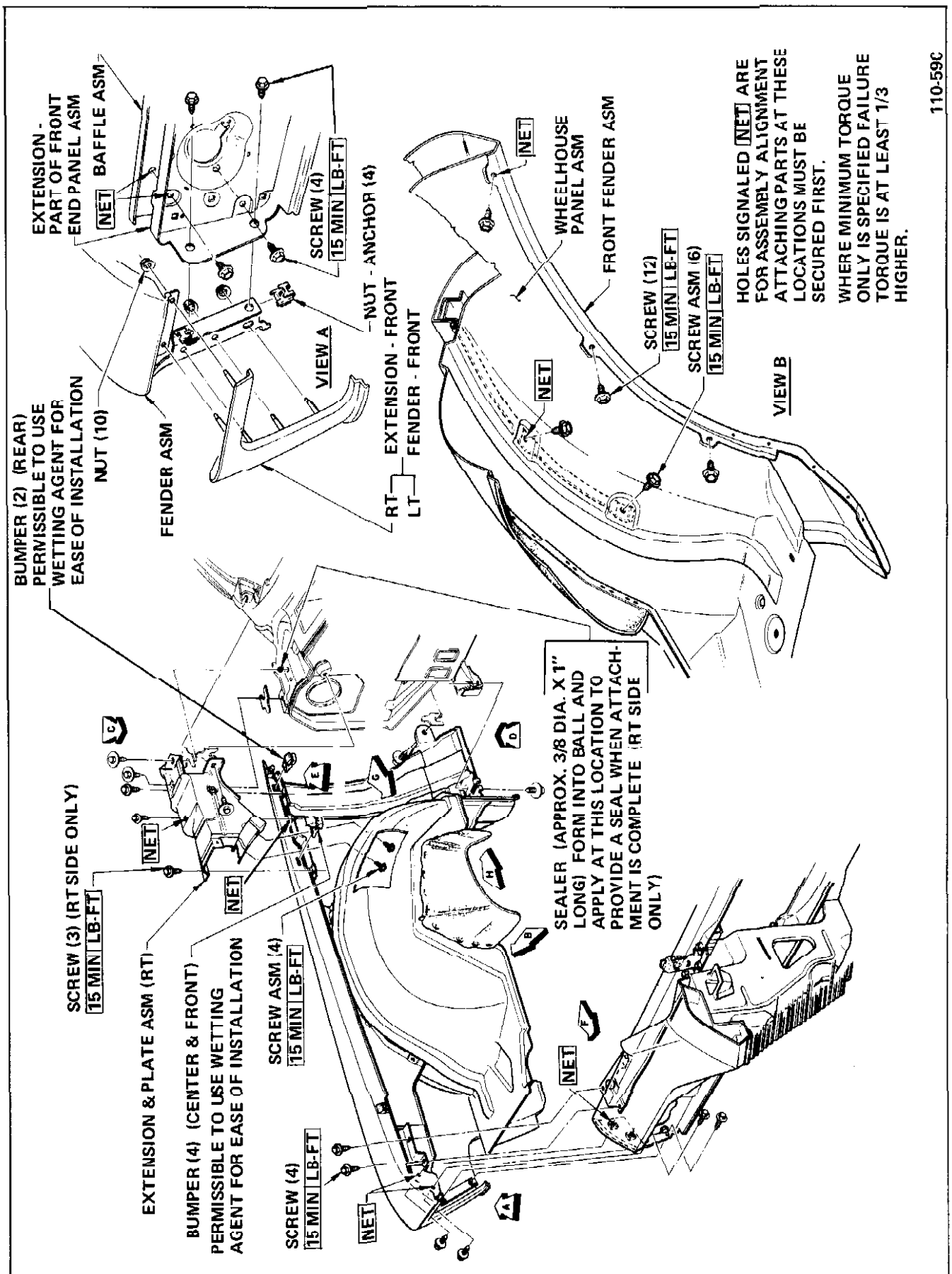

Figure 110-21 49000 Front Fender, Wheelhouse, and Front End Panel

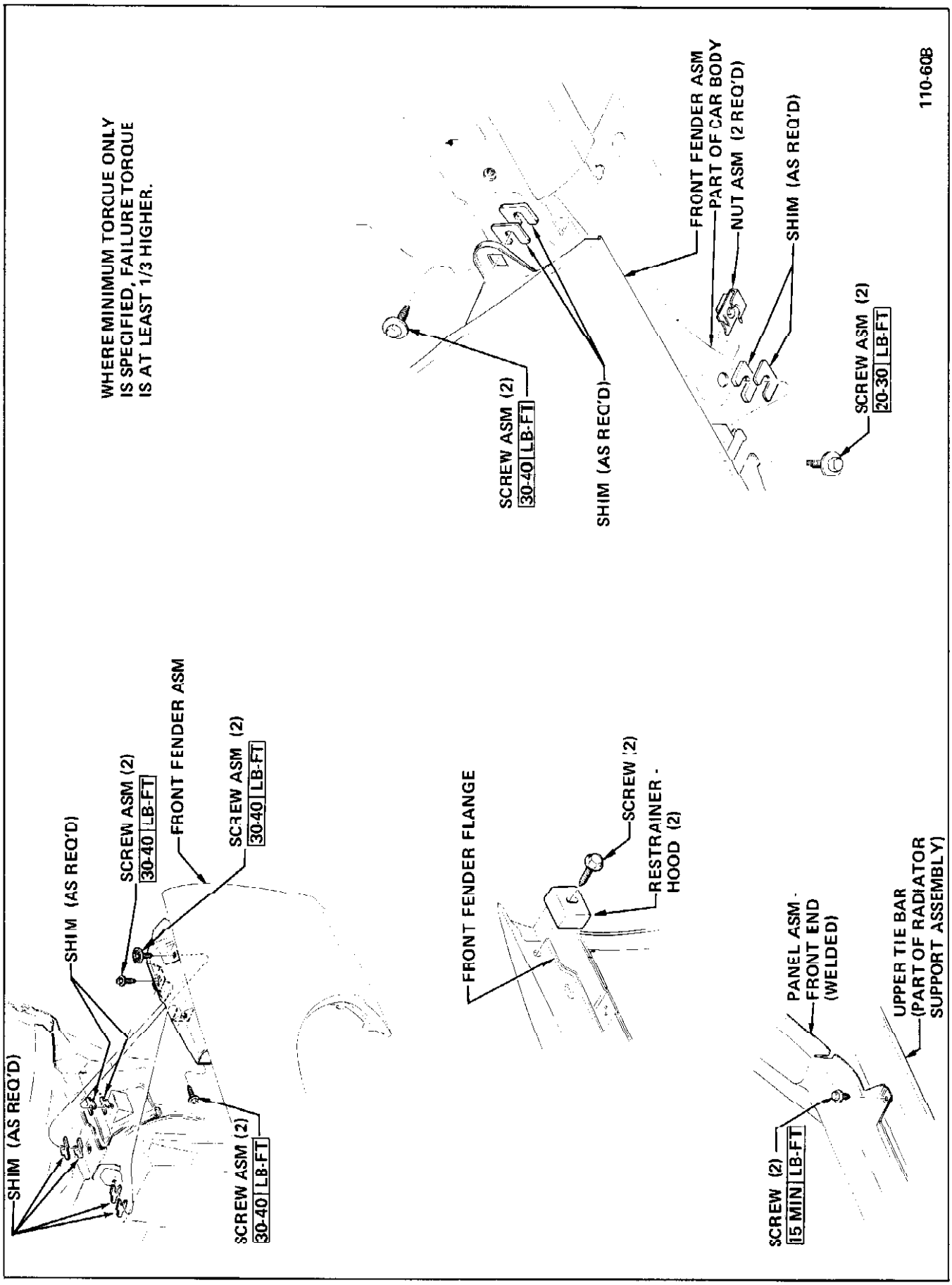

Figure 110-22 49000 Front Fender to Body

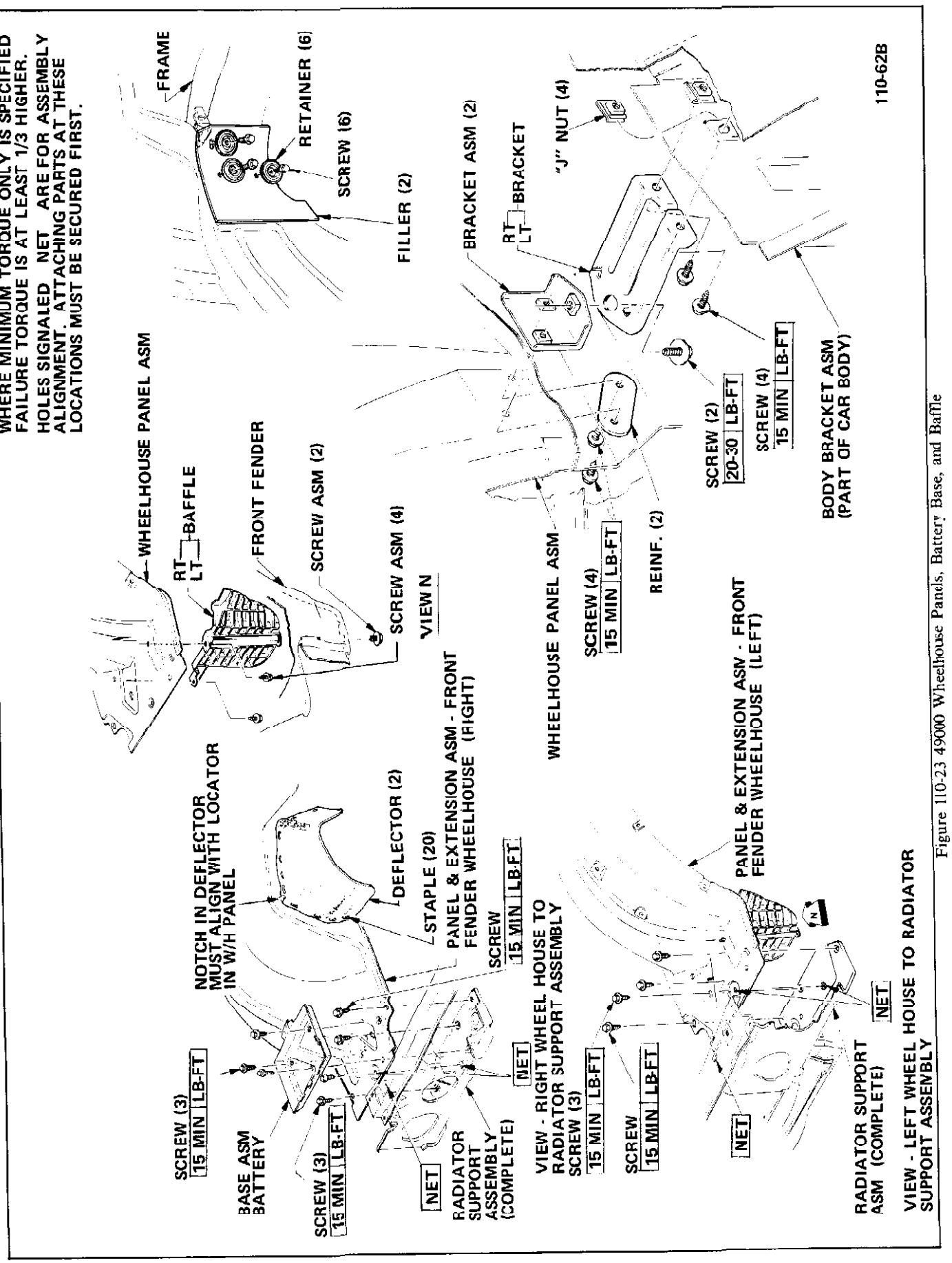

Figure 110-23 49000 Wheelhouse Panels, Battery Base, and Baffle

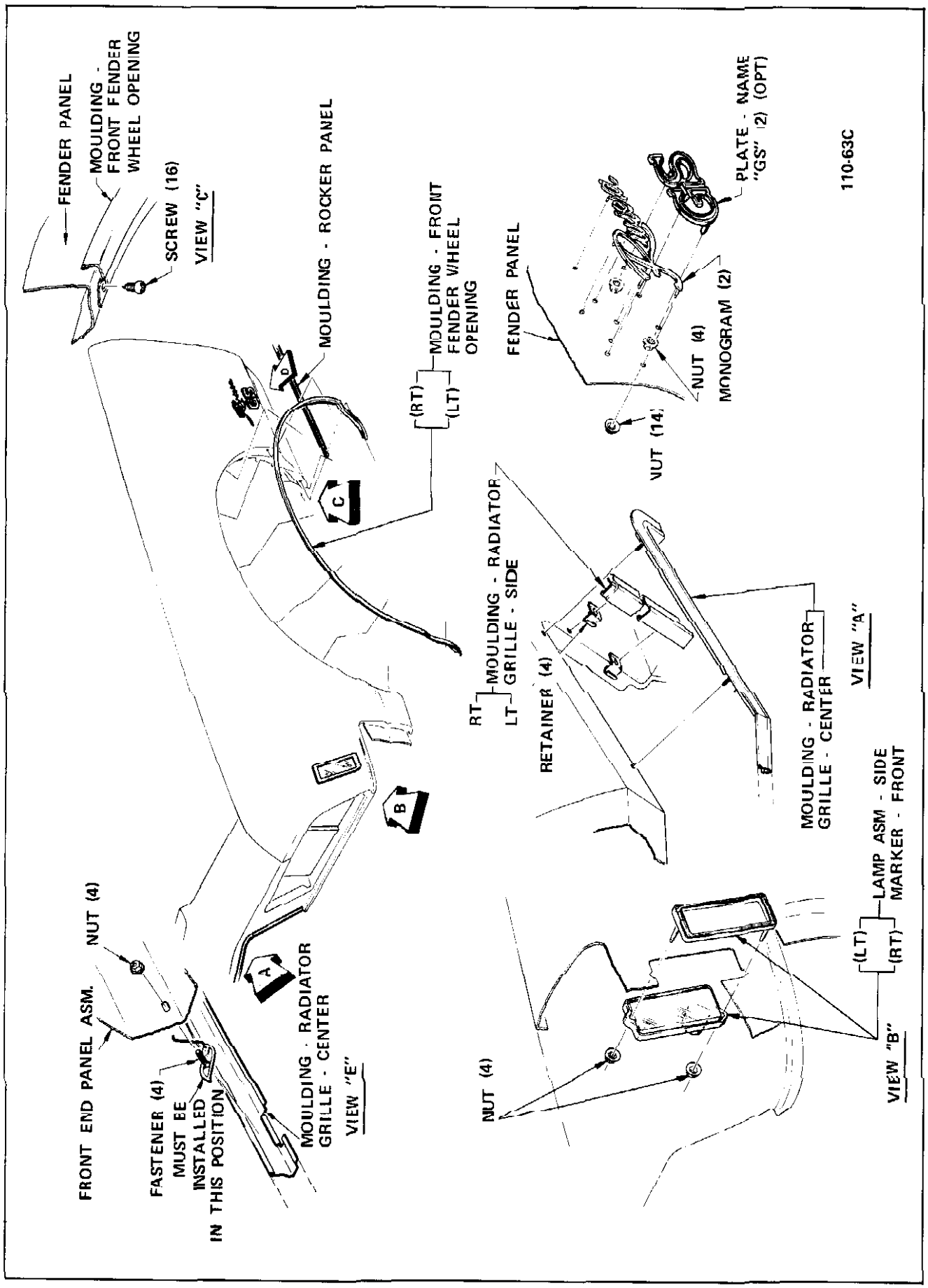

Figure 110-24 49000 Front Fender Ornamentation

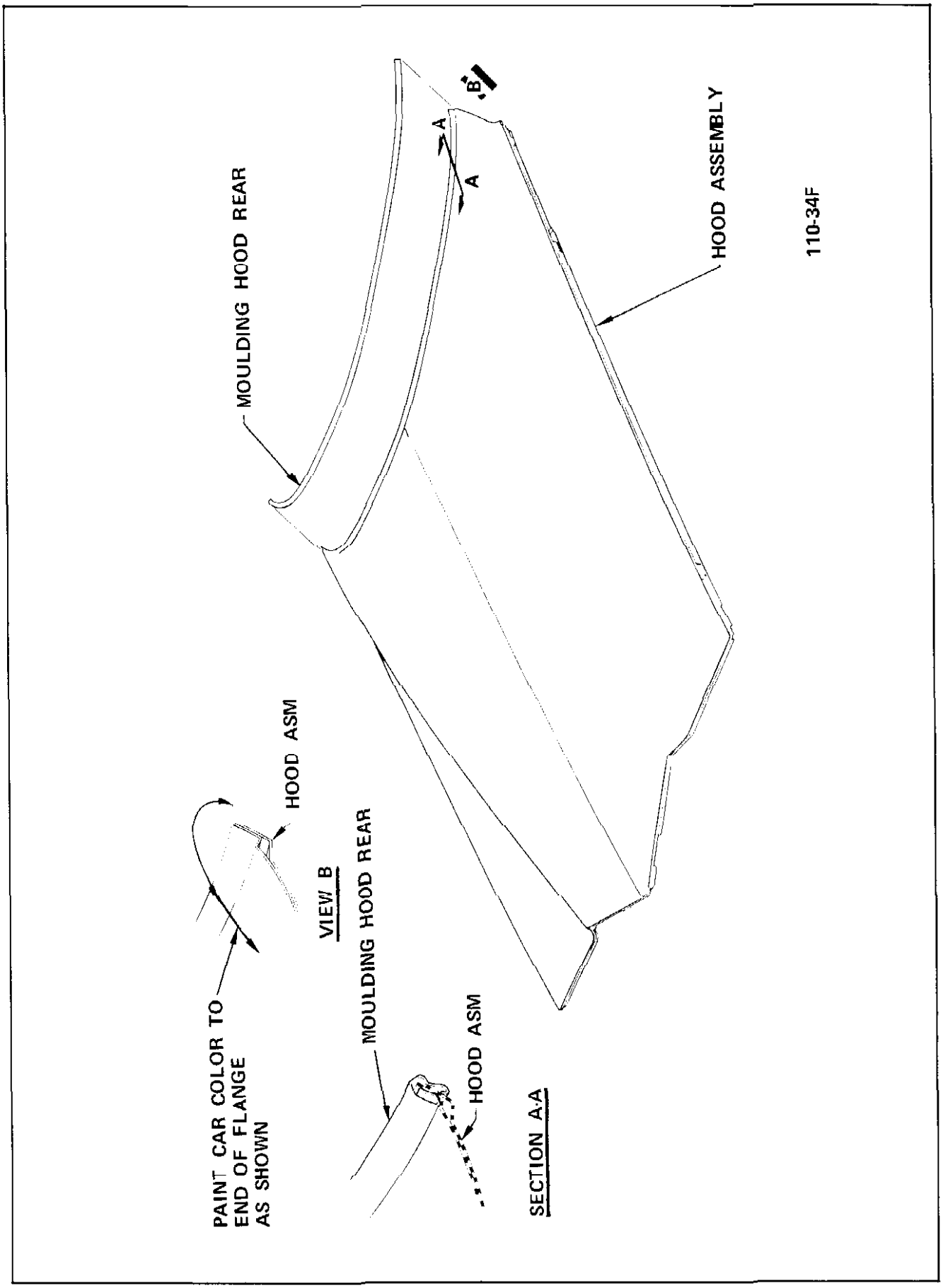

Figure 110-25 49000 Hood Ornamentation

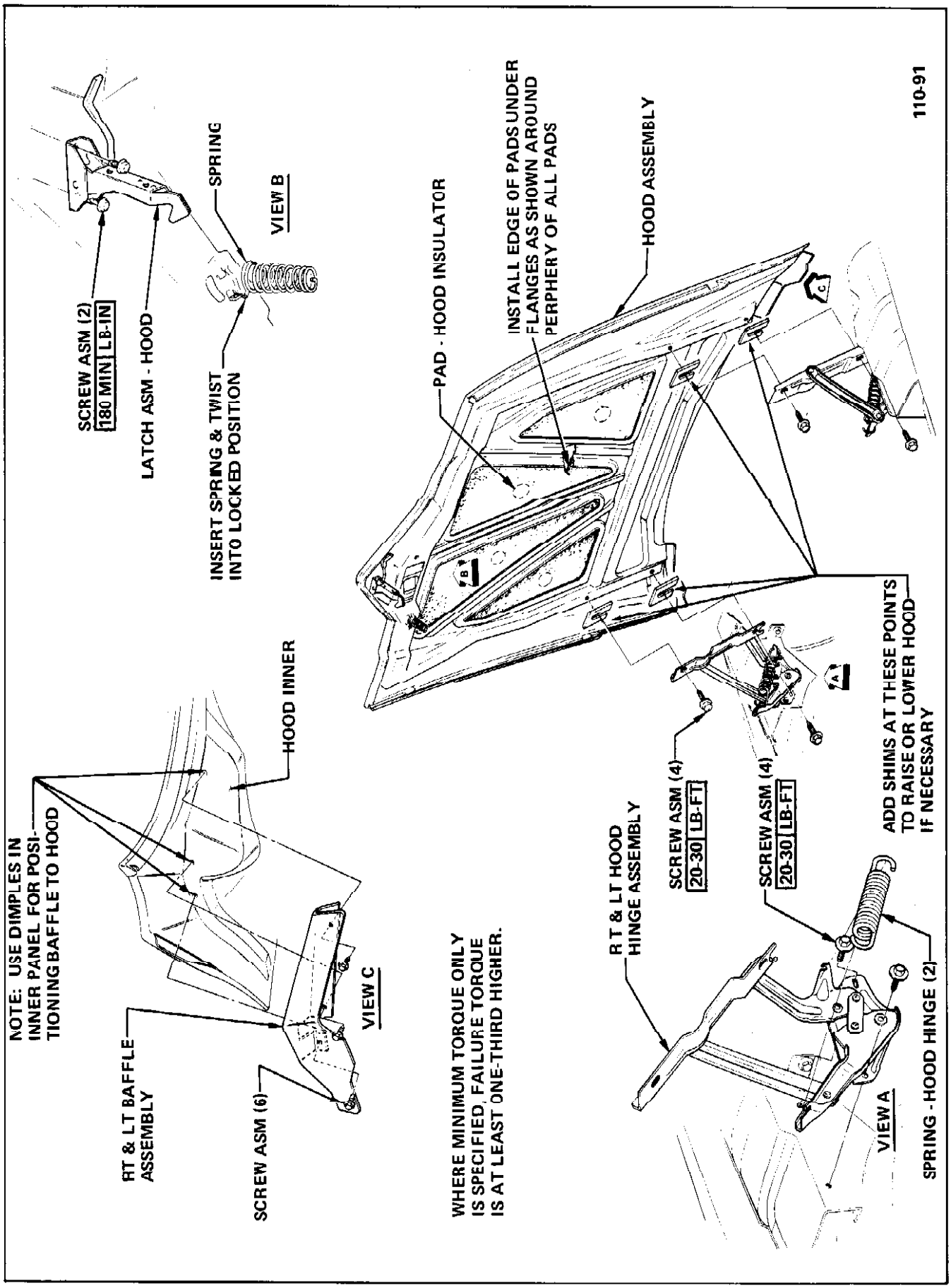

Figure 110-27 49000 Hood Assembly, Insulator, and Hinge

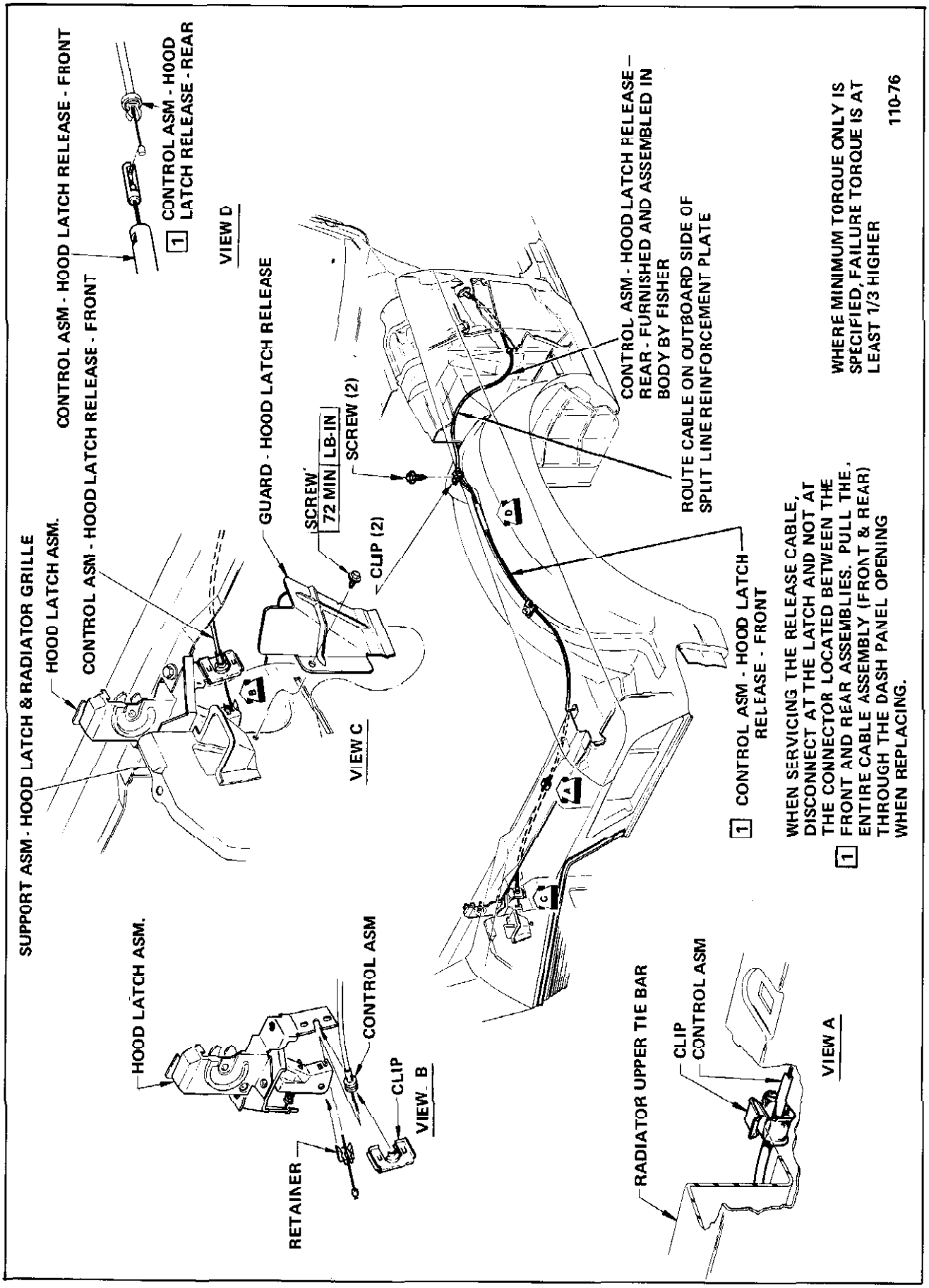

Figure 110-28 49000 Hood Latch Cable Routing and Hood Catch Guard

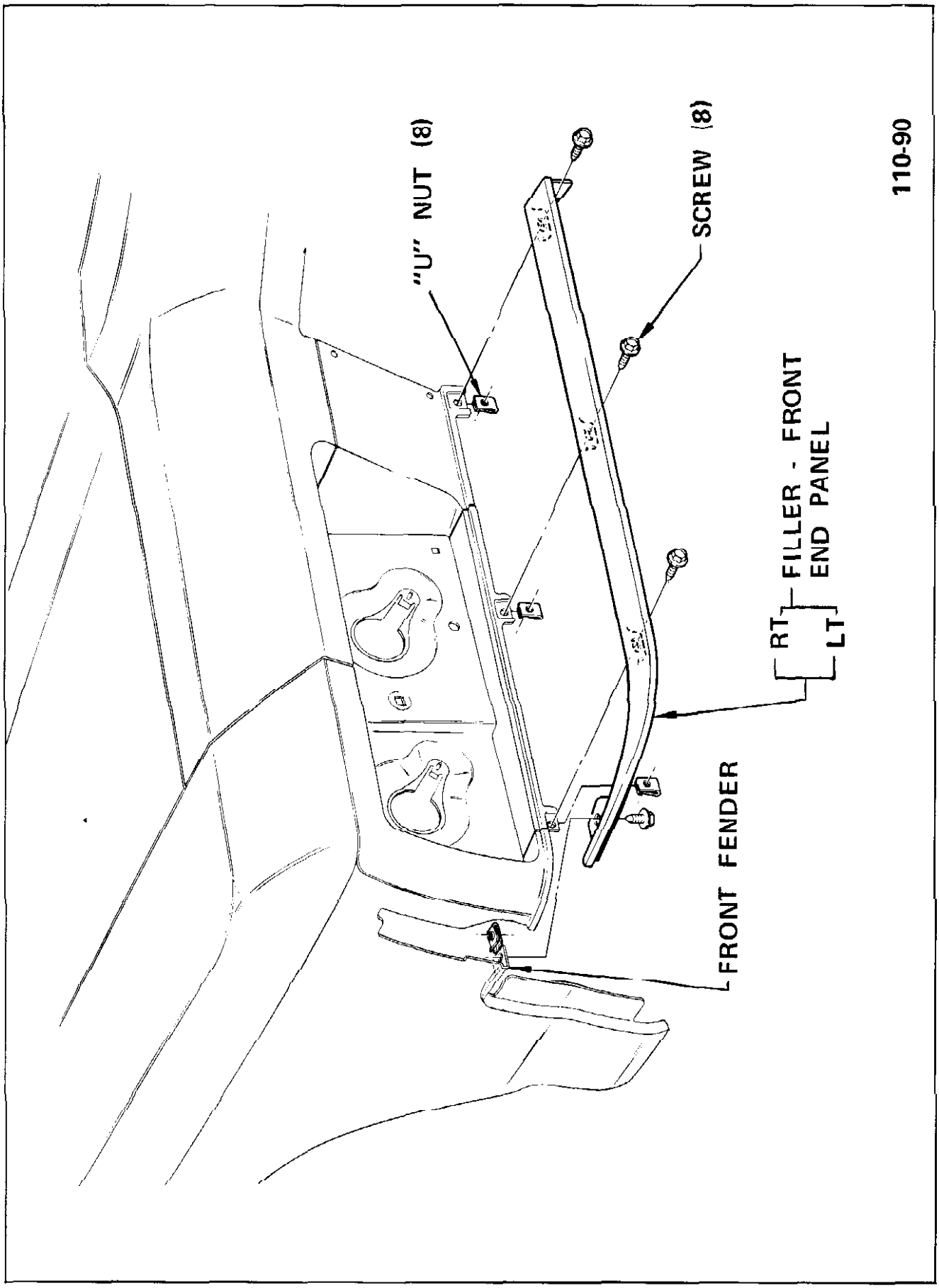

Figure 110-26 49000 Front End Panel Filler

GROUP 100

WHEELS AND TIRES

Section	Title
A	All Series - Wheels and Tires . . . . .

SECTION A

ALL SERIES
WHEELS and TIRES

CONTENTS

Division	Subject	Paragraph
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	Car Roughness and Vibration	100-1
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IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
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	Wheel and Tire Specifications	100-7

DIVISION I

TROUBLE DIAGNOSIS

100-1 CAR ROUGHNESS AND VIBRATION

a. Possible Causes

To assist in the diagnosis and correction of some of the more stubborn cases of tire vibration and roughness conditions that may be encountered, the following information is offered:

VIBRATION, or a quivering motion condition, noticeable by feel through the steering column, steering wheel, floor pan, or by hood and fender shake, usually originates from the front wheels and tires. Front end vibration, when caused by unbalanced front wheels, can be generally felt as steering wheel "nibble".

A vibration felt through the seats as a side-to-side disturbance can usually be attributed to the rear wheels and tires.

Both front and rear vibration can be noticed mainly at highway speeds, usually over 60 mph.

ROUGHNESS, noticeable primarily at speeds between 40 and 65 mph, can be felt (and occasionally heard), and is due to certain irregularities in the tire. Roughness usually sets up a "trembling" feel or a shuddering effect.

b. Road-Test With Owner

When a ride complaint is encountered, first check inflation pressures and perform tire inspection, including removal of any foreign material on tire tread or wheel large enough to upset balance.

NOTE: *Tire inflation pressure recommendations are very important at all times and particularly so on all ride com-*

plaints. Raising or lowering tire pressures to "improve" mileage or traction should not be attempted.

Next, road-test the car with the owner, if possible, and have the owner explain the specific ride disturbance.

After road-testing, raise car on hoist and proceed to isolate the offending tire/wheel assembly.

c. Reproducing the Disturbance

In an attempt to reproduce the disturbance experienced in the ride, a wheel spinner can be used on the front wheels of the car.

The rear wheels may be spun by placing car in "Drive" with engine running.

CAUTION: *When spinning rear wheels, never exceed a speedometer speed of 35 mph with a standard rear axle assembly, or 75 mph on one with a positive traction rear axle. Excessive speeds may cause damage to the rear axle assembly.*

When spinning the rear wheels on a Buick equipped with a positive traction axle, jack up both rear wheels by placing the jack under the differential housing. Spin one wheel with opposite wheel removed. **Use wheel nuts to hold the opposite brake drum to the axle shaft.**

Before removing the wheel, place a chalk mark on a stud and at a lug bolt hole so that the wheel will always be remounted in the same location.

When spinning rear wheels on a Buick equipped with a standard differential, jack up both rear wheels by placing the jack under the differential housing. Spin one wheel and tire with the opposite wheel held from rotating by holding the parking brake cable, as shown in Figure 100-1. Spin the other wheel using same procedure.

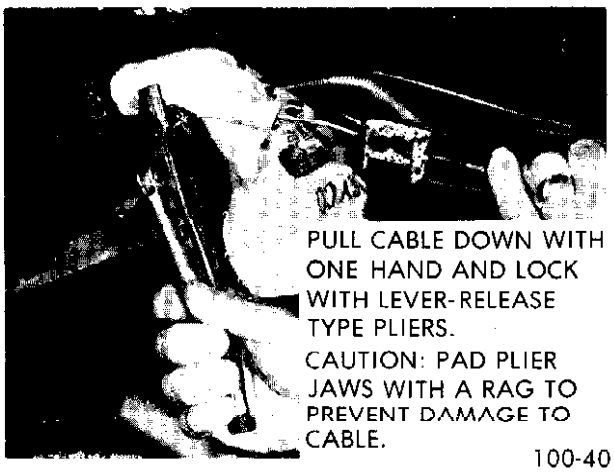


Figure 100-1 Using Parking Brake to Keep Rear Wheel From Rotating

By spinning the wheels, the offending tire will cause vibration that may be felt by touching the bumper or fender. By the process of elimination, proceed on tires that cause vibration as follows:

d. Unbalance

Check for tire/wheel unbalance - An unbalanced wheel assembly that is causing a vibration can, in most cases, be reduced to an acceptable level by static and dynamic wheel and hub balancing. Correct by re-balancing, Figure 100-2.

It is recommended that an on-the-car balancer be used for balancing.

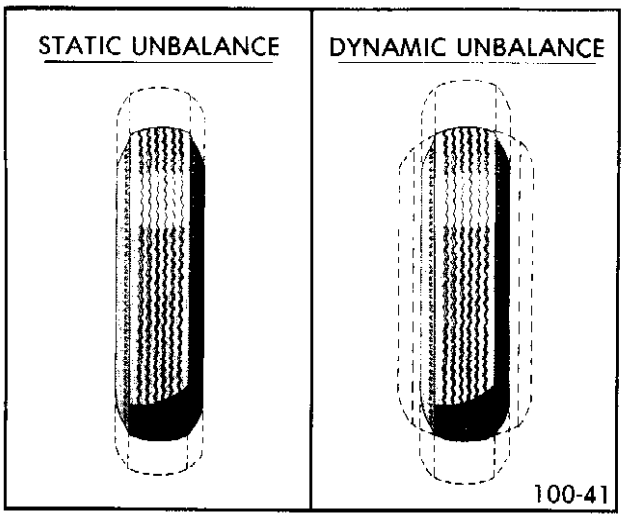


Figure 100-2 Static and Dynamic Unbalance

A tire/wheel assembly that is in balance may still be causing a vibration when the car is driven, but may not set up a vibration when the wheel is off the ground and submitted to the spinner test. In such cases, the next step is to check radial and lateral runout.

e. Runout

A runout gauge should be used to determine the amount of total radial and lateral runout at the tire that causes the vibration. See Figures 100-3 and 100-4.

A guide to runout maximum totals is as follows:

.035" radial - wheel .050" radial - tire/wheel assembly
.045" lateral - wheel .050" lateral - tire/wheel assembly

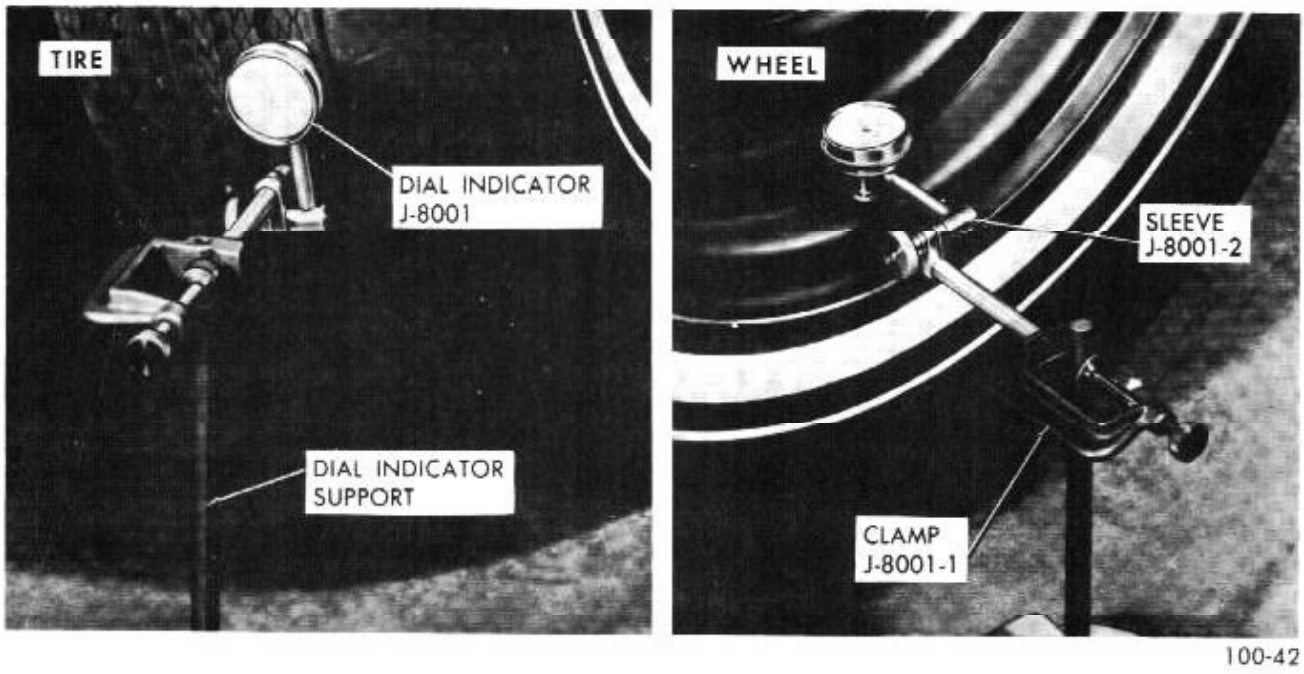


Figure 100-3 Checking Radial Runout

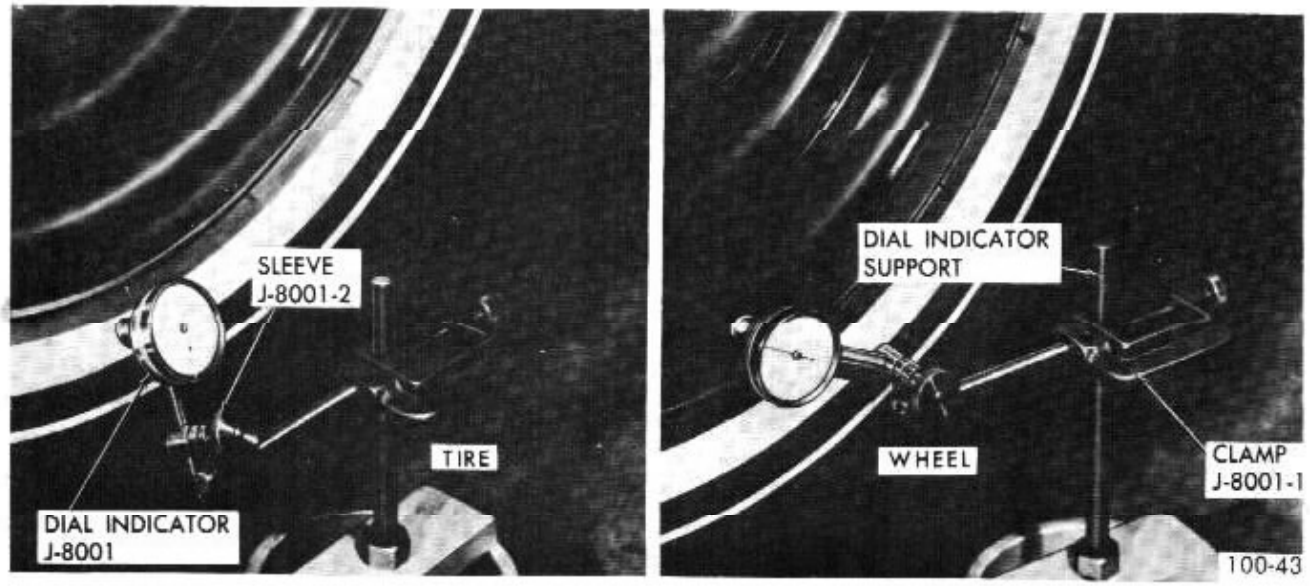


Figure 100-4 Checking Lateral Runout

If the tire and wheel runouts are beyond any of the maximum totals above, the tire should be repositioned 180 degrees opposite its original location on the wheel. Refer to Figure 100-5. This will, in most cases, reduce the runout and vibration to a satisfactory level.

There is no more work involved in repositioning a tire on a wheel than there is in putting on a new tire, and repositioning has a better chance of correcting the difficulty.

It is important that only the tire/wheel assemblies that are

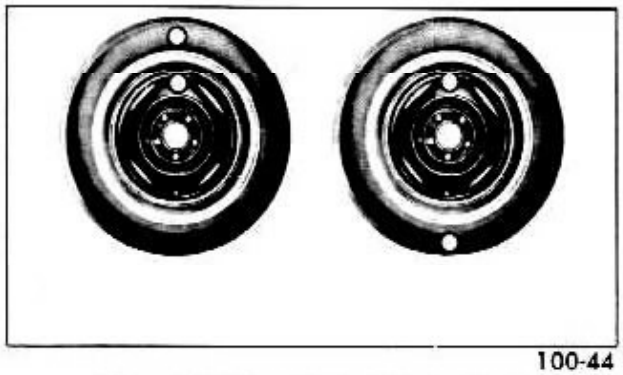


Figure 100-5 Repositioning Tire on Wheel

causing the disturbances be repositioned. Since normally only one, and occasionally two, tire/wheel assemblies per vehicle could be causing the disturbing vibration, it is recommended that repositioning be performed only when required. Repositioning of non-disturbing assemblies could cause these assemblies to create vibration or roughness problems.

After repositioning, balancing the tire/wheel assembly is always necessary. It is very important that the tire/wheel assembly be balanced accurately.

At this point, the car should be road-tested again to assure that the disturbance has been corrected.

f. Tire Grinding

Tire grinding is very effective in eliminating tire complaints due to excessive tire runout. Grinding can be accomplished on or off the car. Grinding is approved by Buick, if done as recommended by the equipment manufacturer.

g. Tire Wear Irregularities

An additional cause of vibrations may sometimes be tire wear irregularities. These can also produce noise disturbances, and can be generally corrected by rotating the tires, Figure 100-6. Before proceeding further, locate and correct the cause of the irregular tire wear. See Figure 100-7.

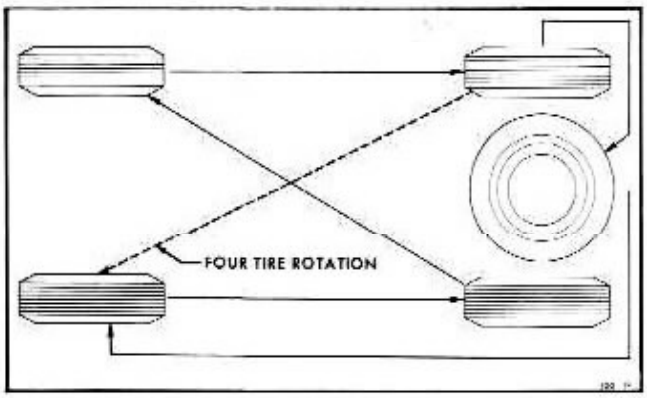


Figure 100-6 Tire Rotation

Use the criss-cross method of rotation of tires only when all four tires are equally worn. In some instances, it may be necessary to put the truest running assemblies (those with the lowest tolerances) on the front of the car.

h. Wheel Nut Torque and Tightening Sequence

During all wheel installations, it is important to use the correct procedure for installing wheel nuts and torquing them uniformly and in proper sequence. This is important in order to avoid possible distortion of the brake drum or disc, and to minimize damage to lug and nut threads and wheel stud holds.

To assure uniform tightening of wheel lug nuts, the following procedure is recommended:

1. Install wheel lug nuts in a criss-cross pattern and tighten just enough to seat wheel against hub. This assures proper piloting of the wheel on its hub.

2. Tighten lug nuts uniformly to proper torque of 70 ft lbs., using criss-cross pattern. See Figure 100-8.

NOTE: *An impact wrench should not be used, as uniform torque control cannot be maintained.*

Summary of Diagnosis and Correction of Tire and Wheel Vibration

1. Inflate all tires to recommended pressure and road-test car with owner to define problem.

2. Spin front tire/wheel assemblies with wheel driving equipment. Rear wheels may be spun with tires off the ground and with one wheel held at a time. The offending tire may cause vibration that may be felt by touching the bumper or fender. By process of elimination, determine offending tire/wheel assembly.

3. Check for tire/wheel unbalance. Balance if necessary.

4. Check each tire/wheel assembly on the car for radial runout on the tire tread. Wheel and tire assemblies exceeding .050" may be considered as offending assemblies. Offending tire/wheel assembly should be deflated and the tire repositioned (indexed) 180 degrees from original location.

5. After repositioning, rebalance tire/wheel assembly (static and dynamic preferred).

6. Test drive and evaluate correction.

The following procedure should be used to determine cause of roughness or vibration with car in operation at various speeds:

1. Jack up all wheels having jack support rear end of car at center of rear axle housing.

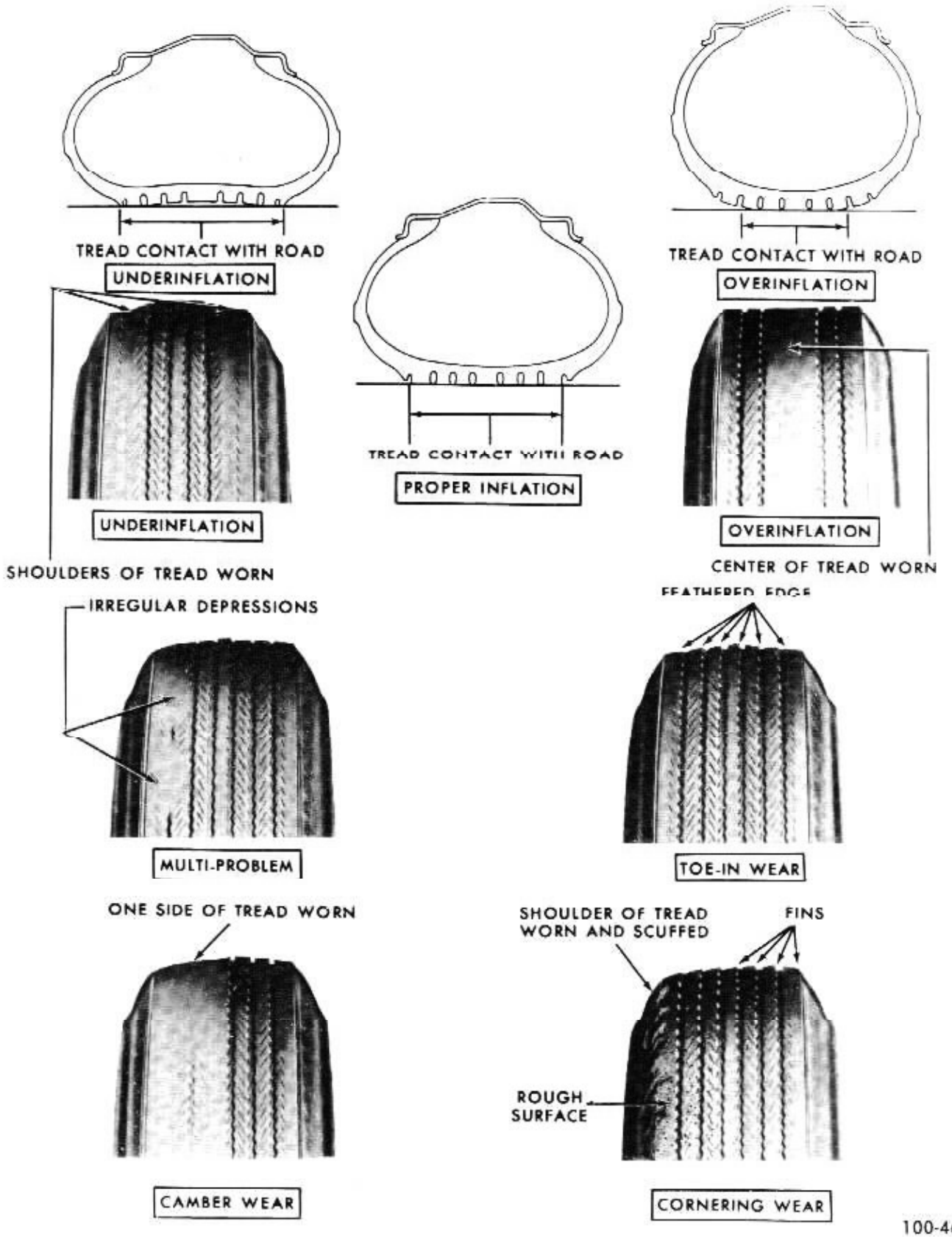


Figure 100-7 Uneven Tire Wear

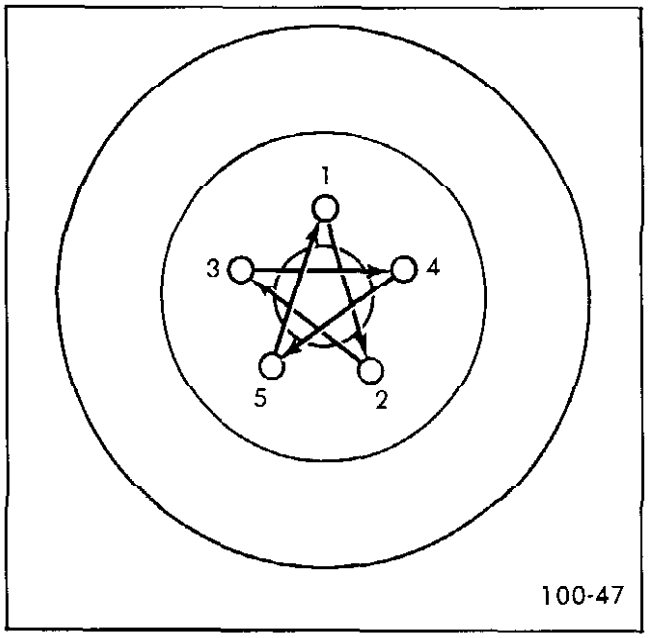


Figure 100-8 Wheel Nut Tightening Sequence

2. With transmission in Drive run engine at various car speeds to note speeds at which vibration or roughness occurs.

3. Remove rear wheels and run engine again at the critical speeds noted in Step 2. If roughness is gone, the condition is caused by unbalanced wheel and tire assemblies.

4. If roughness still exists with rear wheels removed, remove rear brake drums and repeat the running test. Elimination of the roughness indicates out of balance brake drums.

5. If roughness still exists with brake drums removed, run engine with transmission in Neutral. Elimination of the roughness indicates that propeller shaft is out-of balance. Continued roughness indicates an out-of-balance engine.

100-2 IMPROPER STEERING ACTION

Steering action is dependent upon the chassis suspension members as well as the steering gear assembly and tie rods. Improper steering actions which are most likely to be caused by chassis suspension are covered in this paragraph, while conditions most likely to be caused by the steering gear assembly or tie rods are covered in GROUP 90.

a. Car Pulls or Leads to One Side

1. High crowned roads.

2. Low or uneven tire pressure (par. 100-4B).

3. Front tires of unequal diameter due to wear, make or size design.

4. Brakes dragging on one side (GROUP 50).

5. Incorrect caster, camber, or toe of front wheels (GROUP 30).

6. Frame bent or broken.

b. Steering Affected by Application of Brakes

1. Oil or other foreign matter on brake lining (See GROUP 50).

2. Low or uneven tire pressure (par. 100-4B).

3. Front tires of unequal diameter due to wear.

4. Incorrect or uneven caster or bent steering knuckle (GROUP 30).

c. Car Wander or Lack of Steering Stability

1. Heavy cross wind.

2. Type of road surface.

3. Low or uneven tire pressure (par. 100-4B).

4. Wheels toe out in straight ahead position (GROUP 30).

5. Incorrect or uneven caster or camber (GROUP 30).

6. Steering gear or tire rods adjusted too loose or worn, or adjusted too tight (GROUP 90).

7. No lubrication in ball joints or upper ball joint worn (GROUP 30).

d. Road Shocks Transmitted to Steering Wheel

1. High or low tire pressure (par. 100-4).

2. Wrong type or size of tires used (par. 100-4).

3. Uneven tire wear (especially shoulder or corner wear).

4. Steering gear or tie rods loosely adjusted. Broken tie rod spring (GROUP 90).

5. Shock absorbers inoperative (GROUP 30).

6. Steering knuckle upper ball joint worn (GROUP 30).

e. Front Wheel Shimmy (Low Speed)

Low speed shimmy is a rapid series of oscillations of the front wheel and tire assembly as the wheels attempt to point alternately to the right and left. This movement is often transmitted through the steering linkage to the steering gear. Low speed shimmy usually occurs below 30 MPH.

1. Uneven or low tire pressure, or highly-worn tires (par. 100-4B).

2. One or both wheel and tire assemblies out of balance (GROUP 30).

3. Front wheel bearings loose or worn (GROUP 30).

4. Incorrect alignment of front wheels (GROUP 30).

5. Steering knuckle upper ball joint worn (GROUP 30).

6. Steering gear or tie rods incorrectly adjusted or worn (GROUP 90).

100-3 WHEEL TRAMP, FRONT OR REAR

Wheel tramp, sometimes called high speed shimmy, is a rapid up and down movement of a wheel and tire assembly, as though the tire was decidedly eccentric. In severe cases, the tire actually hops clear of the road surface. Wheel tramp may develop in either front or rear wheels and occurs at speeds above 35 MPH.

a. Worn tires.

b. Wheel, tire or brake drum out of balance (GROUP 30).

c. Excessive tire and wheel runout.

d. Shock absorber inoperative (GROUP 30).

e. Items a,b, c, or d in combination with one or more items listed under Front Wheel Shimmy (sub-par. e).

100-4 ABNORMAL TIRE WEAR

a. General Operating Conditions

Assuming that there is no misalignment condition to cause abnormal wear, the life of tires depends largely upon car operation conditions and driving habits.

Tires wear at a much faster rate in some localities than in others because of road and operating conditions. Some types of roads are much more abrasive than others. Tire wear is also dependent upon the number of hills and mountains which the car must go up and down, the severity of grades, the number of starts and stops, driving speeds, the amount of rain and snow, and prevailing temperatures. *Tire wear in-creases rapidly with speed, temperature, and load on tire.* Tires used at low speeds, in cool climates, or with light loads will have longer life than tires used for high speed driving in hot climates with heavy loads.

Driving habits have a very important bearing on tire life. A careful driver may obtain much greater mileage from a set of tires than would be obtained by a severe or careless driver. Rapid acceleration and deceleration, severe application of brakes, taking turns at excessive speed, high speed driving, and striking curbs or other obstructions which lead to misalignment are driving habits which will shorten the life of any tire.

Maintenance of proper inflation pressure and periodic interchanging of tires to equalize wear are within the control of the driver. Underinflation raises the internal temperature of a tire greatly due to the continual friction caused by the flexing of the side walls. Tire squealing on turns is an indication of underinflation or excessive speed on the turns. A combination of underinflation, high road temperatures, and high speed driving will quickly ruin the best tire made.

High speed on straight highways or expressways normally causes more rapid wear on the rear than on the front tires, although cupping of front tires can result if the tires are not periodically switched from wheel to wheel. Driving turns and curves at too high a rate of speed causes the front tires to wear much faster than the rear tires.

An inspection of the tires, together with information as to locality in which the car has been operated will usually indicate whether abnormal wear is due to the operating conditions described above or to mechanical faults which should be corrected.

The various types of abnormal tire wear and their causes are described in the following subparagraphs.

b. Shoulder or Underinflation Tread Wear

When a tire is underinflated, the side walls and shoulders of the tread carry the load while the center of tread folds in or compresses due to the low internal air pressure. This action causes the shoulders to take all of the driving and braking load, resulting in much faster wear of shoulders than of the center of tread. See Figure 100-9, Example A. For maximum results in handling, riding and tire life, tire inflation pressures should never be allowed to go below the specified minimum pressure.

Continuous high speed driving on curves, right and left, may produce tread wear very similar to underinflation wear and might very easily be mistaken for such. Side thrust when rounding turns causes wear on the sides of tire tread. 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 the side thrust and naturally receive th most wear. The only possible correction e is to advise slower speeds on curves. Do not increase tire inflation pressures beyond specified limits as this will cause center or over-inflation wear (subpar. c).

c. Center or Overinflation Tread Wear

Excessive wheel camber, either positive or negative, causes the tire to run at such an angle to the road surface that one side of the tread wears much more than the other. See Figure 100-9, Example D.

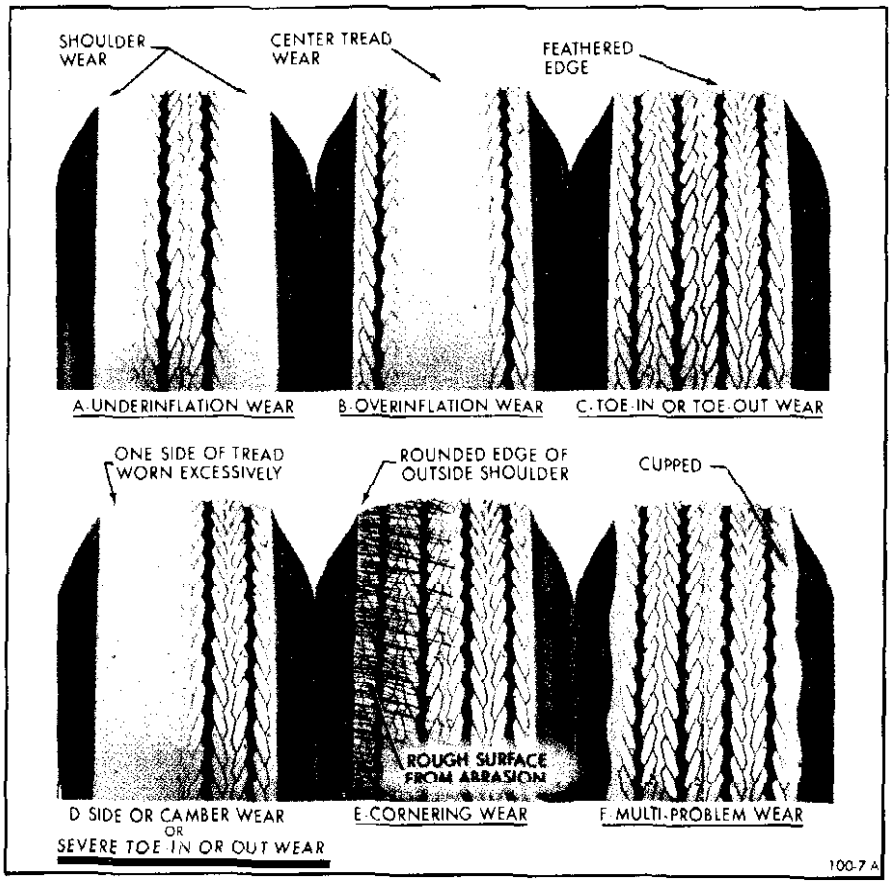


Figure 100-9 Abnormal Tire Wear Patterns

When tire inflation pressures are maintained within the specified limits, the tire will make a full contact across the entire width of tread, thereby distributing the wear evenly over the total surface of the tread area.

d. Cross or Toe Tread Wear

When the front wheels have an excessive amount of either toe-in or toe-out, the tires are actually dragged sideways when they travel straight down the road and cross wear or scraping action takes place rapidly wearing away the tread of tires. This cross wear condition will usually produce a tapered or feathered edge on the ribs of the tire tread. See Figure 100-9, Example C. In most cases, this can be detected by rubbing the hand across the tire tread.

If the tapered or feathered edges are on the inner sides of the ribs on one or both sides, it indicates that one or both tires have excessive toe-in, while the same condition in the outer sides of ribs indicate excessive toe-out. *Usually, excessive toe-in causes excessive tire wear on the outer edge of the right front tire and toe-out causes tire wear on the inner edge of the left front tire.* See GROUP 30 for toe- in correction.

Cornering wear caused by high speed driving on curves (subpar. f. following) sometimes has the appearance of toe wear. Care must be used to distinguish between these two types of wear so that the proper corrective measures will be used.

e. Side or Camber Wear

Excessive wheel camber, either positive or negative, causes the tire to run at such an angle to the road surface that one side of the tread wears much more than the other. See Figure 100-9, Example D.

The amount or angle of the camber wear will be governed by the amount of positive or negative camber. Tire tread wear very similar in appearance to camber wear may be caused by driving on turns at excessive speeds. This "cornering" tread wear (subpar. f) cannot be corrected by change of camber angle.

Adjustments for specified camber are covered in GROUP 30.

f. Cornering Tread Wear

The modern independently sprung automobile allows the driver to negotiate turns at a high rate of speed with a greater feeling of safety. This fact is responsible for a comparatively new type of tread wear that can easily be mistaken for toe or camber wear.

When a car is making a turn, the tires are supposed to be rolling in a circle. When the turn is made at high speed, however, centrifugal force acting on the car causes the tires to be distorted sideways and to slip or skid on the road surface. This produces a diagonal cross type of wear, which in severe cases will result in a fin or sharp edge on each rib of the tire treads.

Cornering wear can be distinguished from toe or camber wear by the rounding of the outside shoulder of the tire and by the roughening of tread surface in this section denoting severe abrasion. See Figure 100-9.

No alignment or tire pressure change can be made that will relieve cornering wear. Only the driver can effect a cure and that is by slowing down on curves.

g. Heel and Toe Tread Wear

Heel and toe wear is a saw-tooth effect with one end of each tread block worn more than the other.

The end which wears is the one that first grips the road when the brakes are applied. High speed driving and excessive use of the brakes will cause this type of irregular tire wear. This type of wear will occur on any type of block tread design. See Figure 100- 9, Example F.

Heel and toe wear is not so prevalent on the rear tires because of the propelling action which creates a counteracting force which wears the opposite end of the tread block. These two stresses on the rear tires wear the tread blocks in opposite directions and result in more even wear while on the front tires, the braking stress is the only one which is effective. This may be counteracted by interchanging tires.

A small amount of irregular wear, slightly saw-toothed in appearance, at the outer segments of tires is a normal condition and is due to the difference in circumference between the center and the outer edges of the tire tread. This saw-toothed appearance, however, will be exaggerated by underinflation, improper toe-in, or both.

h. Cupped or Scalloped Type Tire Wear

Cupping or scalloping is associated with wear on a car driven mostly at highway speeds without recommended tire rotation. Factors which promote cupping include underinflation, incorrect toe-in setting or camber setting, and steady highway speeds on smooth, paved surfaces as opposed to gravel or rough asphalt.

The following recommendations suggest action that may be taken to help prevent cupping.

1. Rotate tires as recommended in Figure 100-10.

2. Frequently inspect front tires for irregular wear due to underinflation, improper toe-in setting, or camber setting.

Regardless of the original cause of cupped tread wear on either front tire, no alignment or balance job, however perfect, can prevent future excessive wear of the spots. Once a front tire acquires flat or cupped spots, additional wear will continue at a rapid rate. At the time of correction, however, the cupped tire should be interchanged with a rear tire on which the tread runs true. The cupped tire will, to a certain degree, true itself on a rear wheel.

Although not normally the cause of cupping, the following factors can contribute to the problem.

Looseness of parts in the suspension system such as worn steering knuckle ball joints, loose wheel bearings, inoperative shock absorbers, and any excessive looseness throughout the steering system all tend to allow the front wheels to kick around, and if any of the wheel alignment factors are incorrect, irregular spotty tire tread wear of one type or another may result.

Wobble or runout of a tire, either front or rear, due to bent wheel or to tire being imporperly mounted will cause uneven wear.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

100 6 TIRE SERVICE AND INSPECTION

A. Tire Inflation and Inspection

Maintenance of correct inflation pressure in all tires is one of the most important elements of tire care. Correct tire pressure is also of great importance to ease of handling and riding comfort.

Overinflation is detrimental to tire life but not to the same degree as underinflation. Inflate all tires according to tire temperature as specified in paragraph 100-4B.

Driving without valve caps contributes to underinflated tires. The valve cap keeps dirt and water out of the valve core and seals the valve against leakage. Whenever tires are inflated, be sure to install valve caps and tighten firmly by hand. Make sure that rubber washer in cap is not damaged or missing.

If tires are checked at frequent intervals and adjusted to correct inflation pressure, it is often possible to detect punctures and make a correction before a tire goes flat, which may severely damage tire if car is in motion. Slight differences in pressure between tires will always be found, but a tire that is found to be 3 or more pounds below the lowest of its running mates can be suspected of having a leaking valve or a puncture.

All tires should be inspected regularly to avoid abnormal deterioration from preventable causes. If tires show abnormal or uneven wear, the cause should be determined and correction should be made.

See that no metal or other foreign material is imbedded in the tread. Any such material should be removed to prevent damage to tread and tire carcass. Cuts in a tire which are deep enough to expose the cords will allow dirt and moisture to work into the carcass and ruin the tire unless promptly repaired.

b. Tubeless Tire Repairs

A leak in a tubless tire may be located by inflating the tire to recommended pressure (par. 100- 4) and then submerging tire and wheel assembly in water, or by applying water to tire with a hose if wheel is mounted on car. Remove water from area where air bubbles show and mark the area with crayon. After removal of the puncturing object from tire, the puncture must be sealed to prevent entrance of dirt and water which would cause damage to the tire carcass.

Tire repair kits are available through tire dealers. These materials should be used as directed in the instructions supplied with the kits. If a puncture is larger than 1/4" or there is other damage to the tire carcass, repairs should be made by authorized tire dealers in accordance with instructions of the tire manufacturer.

c. Wheel Leaks

Examine rim flanges for sharp dents. Any dent visible to the eye should be straightened. The rim flanges should be throughly cleaned with No. 3 coarse steel wool thereby removing all oxidized rubber, soap solution, etc. If the flange is rusted, it can be cleaned with a wire brush or in extreme cases of pitted rims, a file can be used.

In isolated cases loss of air may result from porous welds.

CAUTION: *Under no condition should porous welds be welded or peened.*

d. Demounting and Mounting of Tubeless Tire

When demounting a tubeless tire use care to avoid damaging the rim-seal ridges on tire beads. *DO NOT USE TIRE IRONS TO FORCE BEADS AWAY FROM WHEEL RIM FLANGES.* When tire is removed, inspect it carefully to determine whether loss of air was caused by puncture or by improper fit of beads against rim flanges. If improper fit is indicated, check wheel as follows:

1. Straighten wheel rim flanges if bent or dented.

2. Clean rims thoroughly, using No. 3 coarse steel wool or wire brush to remove all oxidized rubber, soap solution, etc. Remove rust with wire brush.

3. Inspect butt weld and other areas of rim contacted by tire beads to make certain there is no groove or high spot. Remove any groove or high spot by filing smooth.

4. Inspect valve stem and replace it if damaged. Make certain that valve stem is properly installed to provide an air tight joint.

Before mounting a tubeless tire on a wheel, moisten a cloth with mounting compound or soap solution and wipe rim-seal ridges of both beads to remove all foreign substances.

Moisten base of both beads with mounting compound or soap solution to help beads snap into place when tire is inflated. Start tire over rim flange at point opposite valve stem. Align balance mark on tire with valve stem.

Inflate tire until both beads are firmly seated against rim flanges and temporarily inflate to 50 pounds pressure. Leak test wheel and tire assembly and, if satisfactory, reduce to recommended pressure.

e. Interchanging Tires

Tires tend to wear unevenly and become unbalanced as mileage accumulates. Uneven tire wear is frequently the cause of tire noises which are attributed to rear axle gears, bearings, etc., and work is sometimes needlessly done on rear axles in an effort to correct the noise.

Tire life will be increased and uneven wear and noise will be less likely to occur if the tires, including the spare, are balanced and interchanged at regular intervals of approximately 6000 miles. The recommended method of interchanging tires is shown in Figure 100- 10.

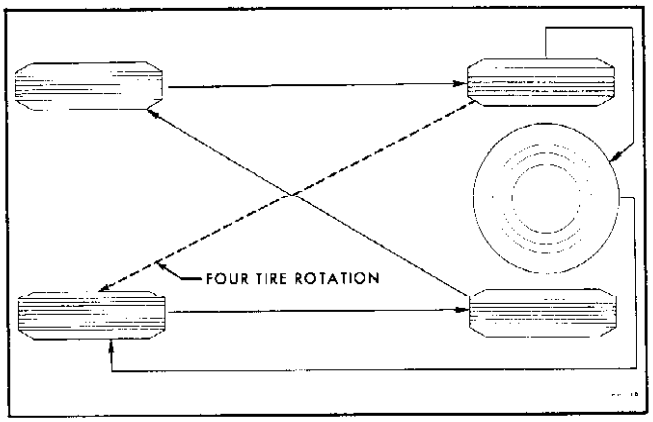


Figure 100-10 Tire Rotation Method

f. Use of Tire Chains

Do not use tire chains on the front wheels under any circumstances because they will interfere with the steering mechanism. Any of the conventional full- type non-skid tire chains can be used on the rear wheels.

Tire chains should be loose enough to "creep" but tight enough to avoid striking fenders or other parts. If chains

remain in one position, the tire side wall will be damaged. Tension springs (either metal coil springs or the rubber band type) must also be used in order to prevent chains contacting frame, etc. The use of tension springs will also reduce ordinary chain noise caused by loose cross links contacting pavement.

NOTE: *On all models equipped with rear fender skirts, the skirts should be left OFF when tire chains are used.*

g. Wheel and Tire Balance

Wheel and tire balance is the equal distribution of the weight of the wheel and tire assembly around the axis of rotation. Wheel unbalance is the principal cause of tramp and general car shake and roughness and contributes somewhat to steering troubles.

The original balance of the tire and wheel assembly may change as the tire wears. Severe acceleration, severe brake applications, fast cornering and side slip wear the tires out in spots and often upset the original balance condition and make it desireable to rebalance the tire and wheel as an assembly. Tire and wheel assemblies should be rebalanced after punctures are repaired.

Because of the speed at which cars are driven, it is occasionally necessary in a severe case to test the wheel and tire assembly for dynamic balance. Dynamic balancing of a wheel and tire assembly must be done on a machine designed to indicate out-of-balance conditions while the wheel is rotating. Since procedures differ with different machines, the instructions of the equipment manufacturer must be carefully followed.

When balancing rear wheels on cars equipped with either standard rear axle or Positive Traction differential, proceed as follows:

1. Jack up both rear wheels by placing the jack under the differential housing.

2. Balance one wheel, leaving the opposite wheel attached to the axle. With positive traction, remove one (1) wheel and brake drum. Place block under brake pedal. Balance the remaining wheel.

CAUTION: *Use engine to drive rear wheels for balancing and never exceed a speedometer speed of 35 M.P.H. on a Buick with a standard rear axle assembly or 75 M.P.H. on one with a Positive Traction rear axle. Excessive speeds do not improve the balancing operation and may cause damage to the rear axle assembly.*

3. Balance the other wheel, observing the speed precautions as noted above. Do not remove the previously balanced wheel as it is now in balance and will not affect the balancing operation.

In some cases, off-the-car wheel and tire balance does not overcome wheel balance complaints because the brake drums themselves are out-of-balance. In this case, either balance the tire and wheel with an on-the-car spin balance or correct the brake drum balance as described in GROUP 50.

DIVISION VI

SPECIFICATIONS

100-6 BOLT TORQUE SPECIFICATIONS

Use a reliable torque wrench when tightening the parts listed below. This will prevent strain or distortion of the parts or damage to the threads. The specifications given are for clean and lubricated threads only. Dry or dirty threads produce increased friction and prevent accurate measurement of tightness. It is important that these specifications be strictly observed. Overtightening may damage threads and prevent the attainment of the proper torque.

Wheel Attaching Nuts	Torque Lb. Ft.
43-44000 Series	
Front	70
Rear	70
Front (Chrome)	70
Rear (Chrome)	70
45-46-48-49000 Series	
Front	75
Rear	75
Front (Chrome)	75
Rear (Chrome)	75

100-7 WHEEL AND TIRE SPECIFICATIONS

A. WHEELS

WHEEL USAGE

SERIES	STANDARD SIZE	OPTIONAL SIZE	RIM TYPE	NO. OF ATTACHING STUDS	STUD CIRCLE DIAMETER	STUD SIZE
43-44000	14 x 6JJ	N/A*	DROP CENTER	5	4.750"	7/16-20
G.S.	14 x 6JJ	15 x 7JJ	DROP CENTER	5	4.750"	7/16-20
45-46-48-49000	15 x 6JJ	N/A*	DROP CENTER	5	5.0"	1/2-20

*NOT AVAILABLE

B. TIRES

TIRE SIZE CHART

SERIES	STANDARD TIRE	*OPTIONAL TIRE* OVERSIZE OR WIDE OVAL
43327-37-69 44437-39-67-69	F78-14 L6 G78-14 V0	H78-14
43436	H78-14	N/A*
G.S.	G78-14	G70-14 G60-15 *H78-14*
45257-39-69 45457-39-67-69 46647-39-67	H78-15	J78-15
46035 46045	L78-15	N/A*
48237-39 48437-39	J78-15	N/A*
49487	H78-15	N/A*
49487-G.S.	H78-15	H70-15

*NOT AVAILABLE

RECOMMENDED TIRE INFLATION PRESSURES

Model	Tire Load Rating	Standard Inflation For All Loads Including Full Rated Load	Optional Inflation Recommended For Reduced Loads
43327-37-69 44437-67-39-69	B	1 to 6 Passengers + 200 Lbs. Luggage (1100 Lbs. Load) Front 26 psi Rear 28 psi	1 to 5 Passengers (750 Lbs. Max.) Front 24 psi Rear 24 psi
GS	B	1 to 6 Passengers + 200 Lbs. Luggage (1100 Lbs. Load) Front 28 psi Rear 28 psi	1 to 5 Passengers (750 Lbs. Max.) Front 26 psi Rear 26 psi
43436	B	1 to 6 Passengers + 300 Lbs. Luggage (1200 Lbs. Load) Front 26 psi Rear 32 psi	1 to 5 Passengers (750 Lbs. Max.) Front 24 psi Rear 28 psi
45257-39-69 45457-39-67-69 46647-39-67 48237-39 48437-39	B	1 to 6 Passengers + 200 Lbs. Luggage (1100 Lbs. Load) Front 24 psi Rear 28 psi	1 to 5 Passengers (750 Lbs. Max.) Front 24 psi Rear 24 psi
46035 46045	B	1 to 6 Passengers + 300 Lbs. Luggage or 8 Passengers (1200 Lbs. Load) Front 22 psi Rear 32 psi	1 to 5 Passengers (750 Lbs. Max.) Front 22 psi Rear 28 psi
49487	B	1 to 6 Passengers + 200 Lbs. Luggage (1100 Lbs. Load) Front 24 psi Rear 28 psi	1 to 5 Passengers (750 Lbs. Max.) Front 24 psi Rear 24 psi

NOTE: 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 pounds per square inch over the recommended pressures up to a maximum of 32 pounds per square inch cool for 4 ply rating tires, or 40 pounds per square inch (cool) for 8 ply rating tires. Sustained speeds above 75 MPH are not recommended when the 4 pounds per square inch adjustment would require pressures greater that the maximums stated above.

(Alternate for Station Wagons)

For continuous high speed operation (over 75 MPH) increase tire inflation pressures 4 pounds per square inch over the recommended pressures up to a maximum of 32 pounds per square inch cool for 4 ply rating tires, or 40 pounds per square inch cool for 8 ply rating tires. On station wagons, when the 4 psi pressure adjustment for sustained high speed with maximum vehicle load would require inflation pressures above the maximum allowable, speed must be limited to 75 miles per hour.

3. Cool 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 allowable passenger and cargo load must be reduced by an amount equal to the trailer tongue load on the trailer hitch.

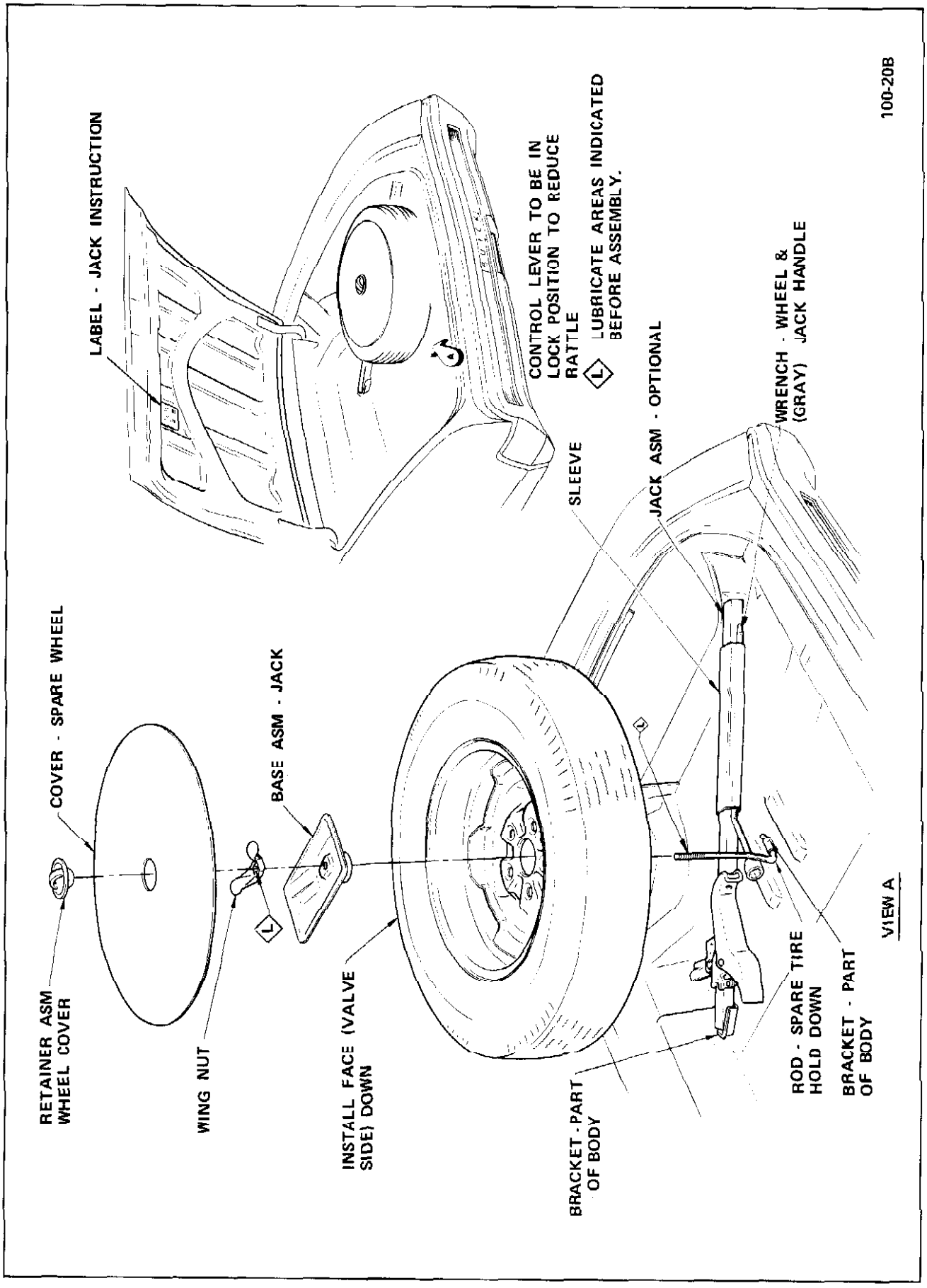


Figure 100-11 Spare Tire and Jack Installation - 43-4400C Series Except Station Wagons

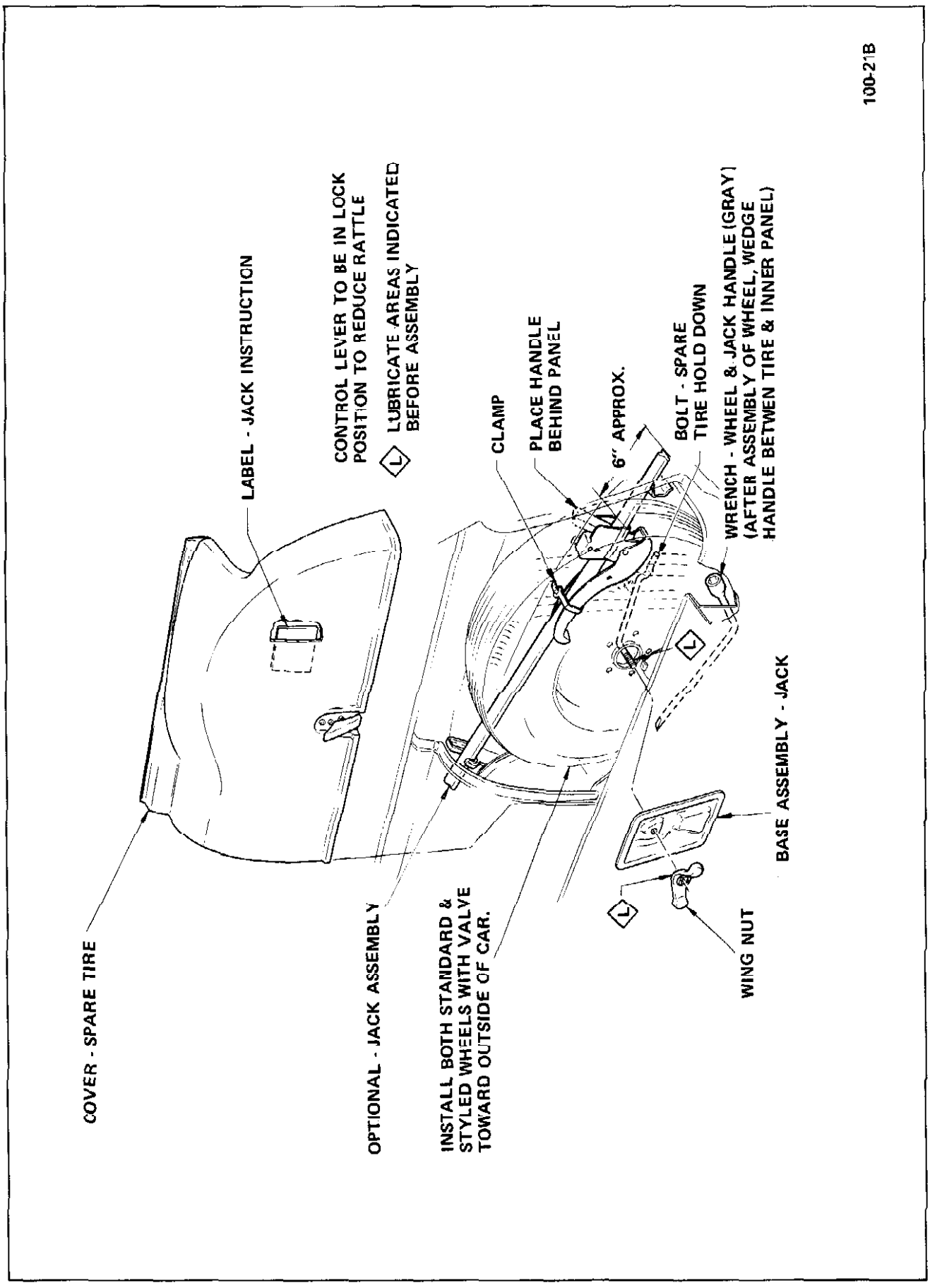


Figure 100-12 Spare Tire and Jack Installation - Sportwagon

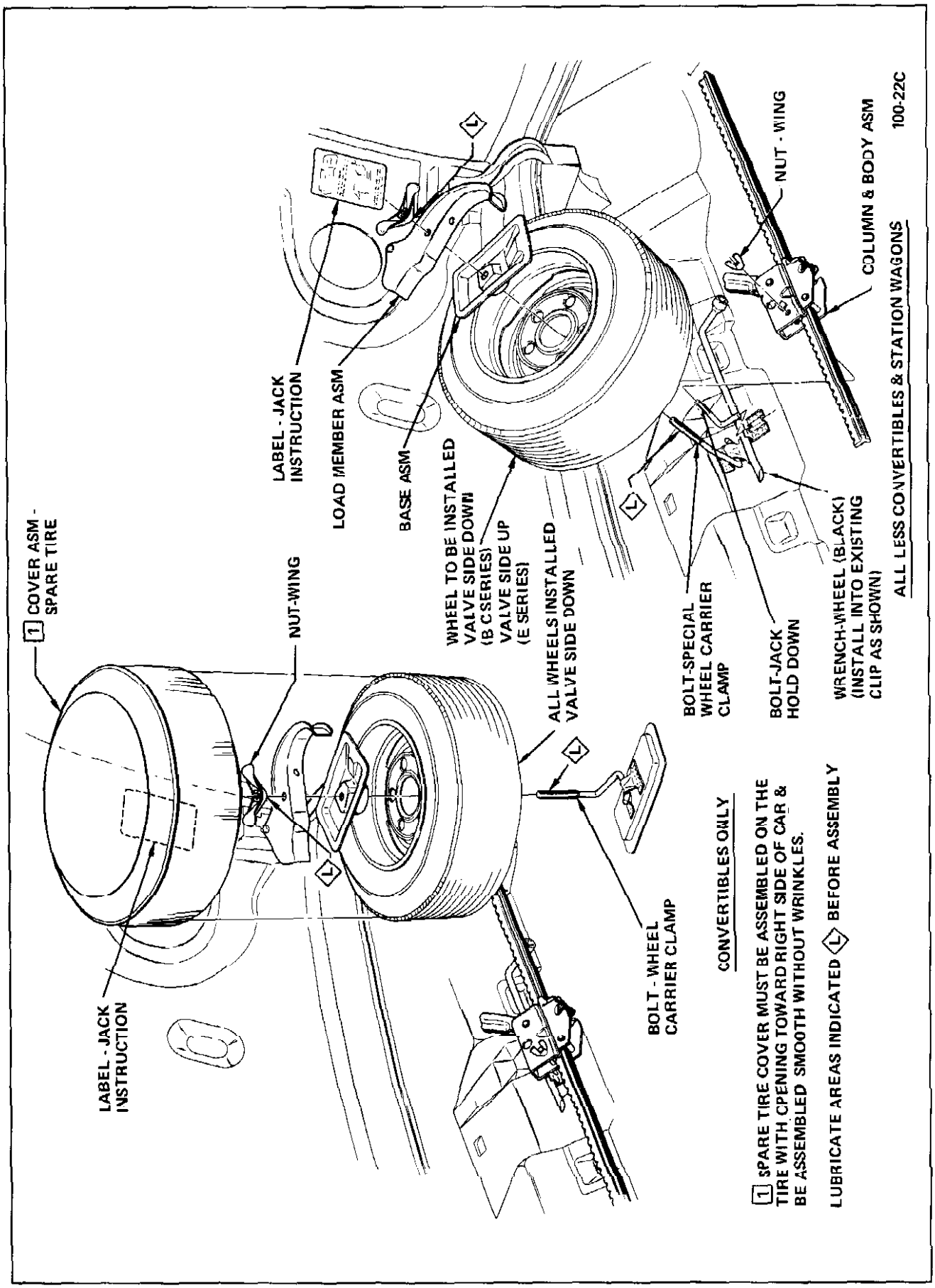


Figure 100-13 Spare Tire and Jack Installations - 45-46-48000 Series

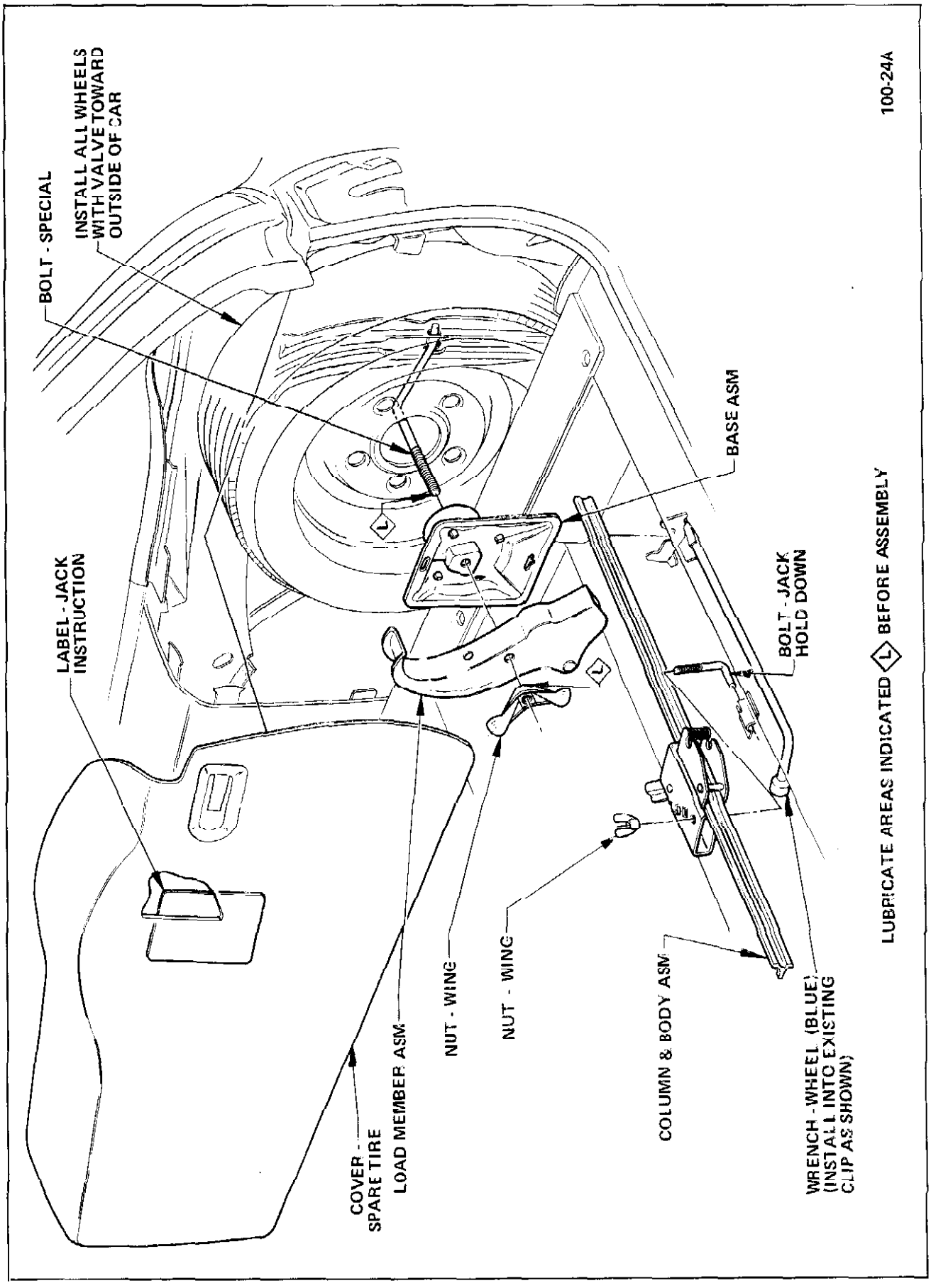


Figure 100-4 Spare Tire and Jack Instalation - Estate Wagon

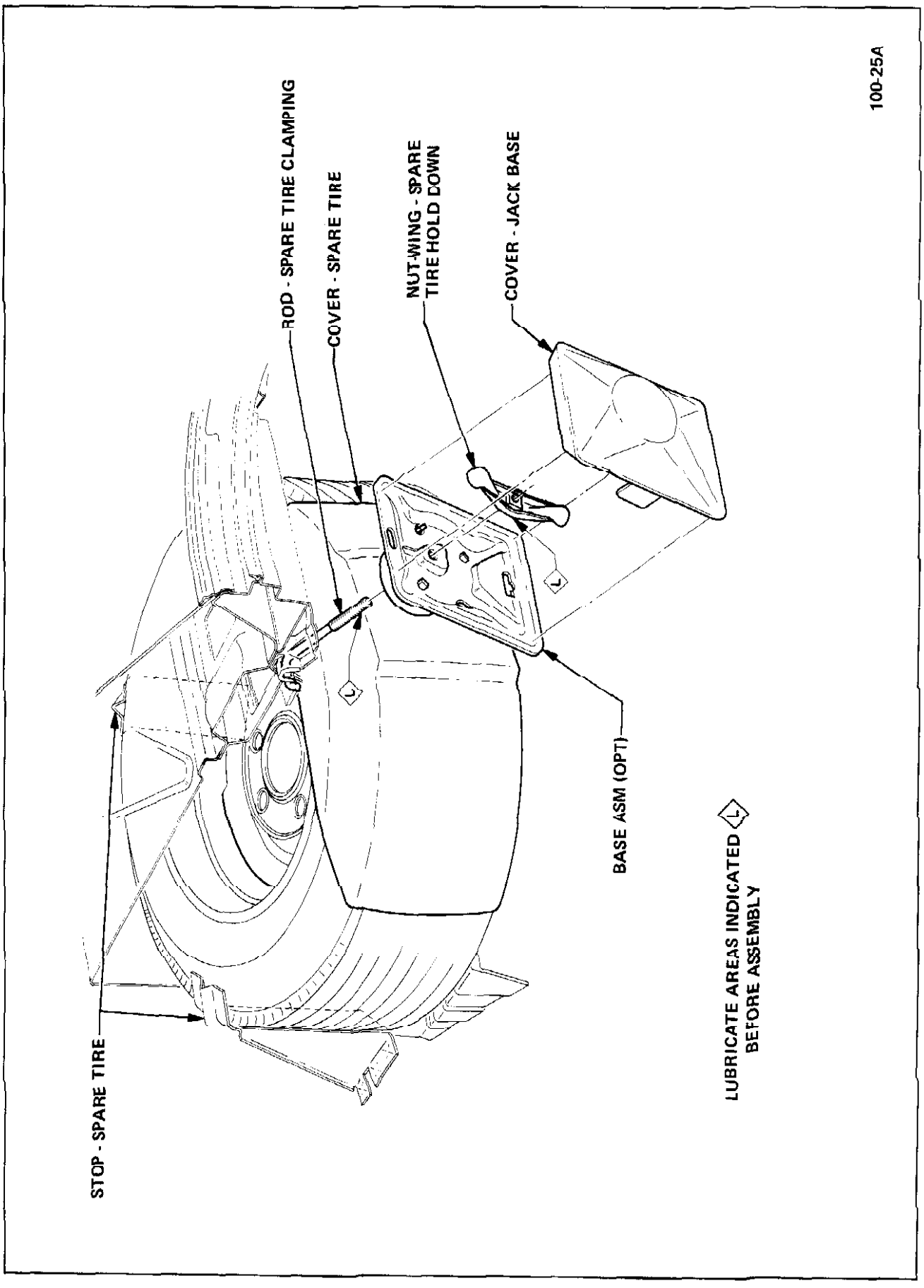


Figure 100-15 Spare Tire and Cover - 49000 Series

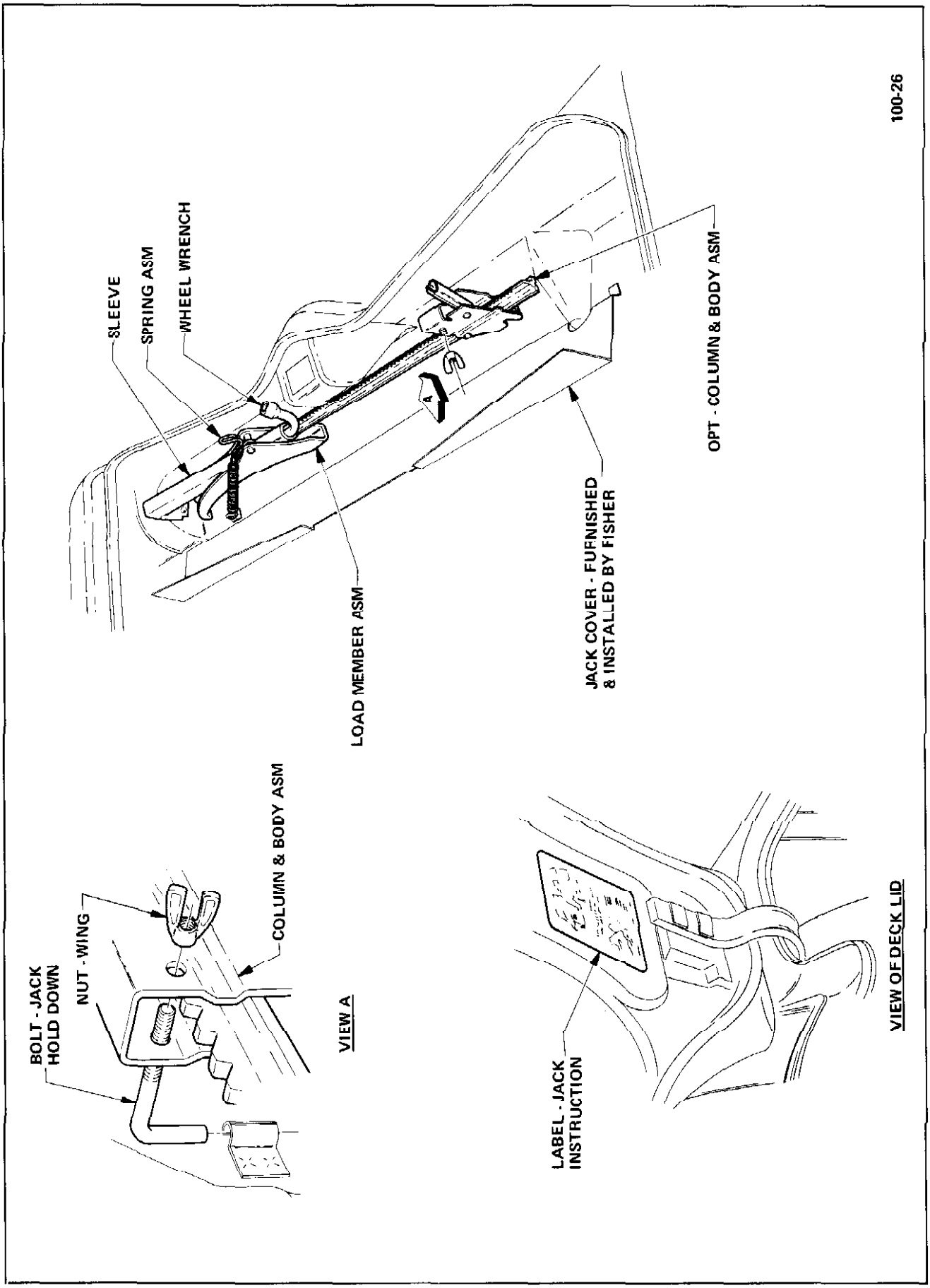


Figure 100-16 49000 - Jack Stowage

SECTION D

STEERING LINKAGES
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	90-27
II	DESCRIPTION AND OPERATION:	
	Description of Steering Linkage	90-28
III	ADJUSTMENTS AND MINOR SERVICE:	
	Adjustment of Steering Linkage Idler Arm	90-29
IV	REMOVAL AND INSTALLATION:	
	Removal and Installation of Tie Rods	90-30
	Removal and Installation of Intermediate Rod	90-31
	Removal and Installation of Idler Arm	90-32
	Removal and Installation of Pitman Arm	90-33
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION I

TROUBLE DIAGNOSIS

90-27 TROUBLE DIAGNOSIS

TROUBLE DIAGNOSIS – STEERING LINKAGE

COMPLAINT AND CAUSE	CORRECTION
A. Excessive Play or Looseness in Steering System	1. Front wheel bearings loosely adjusted. 2. Worn couplings or steering shaft U-joints. 3. Worn upper ball joints. 4. Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball studs. 5. Excessive pitman shaft to ball nut lash. 6. Worm bearings loosely adjusted
B. Hard Steering – Excessive Effort Required at Steering Wheel	1. Low or uneven tire pressure. 2. Insufficient or improper lubricant in steering gear or front suspension. 3. Steering shaft flexible coupling misaligned. 4. Steering gear adjusted too tightly. 5. Front wheel alignment incorrect.
C. Poor Returnability	1. Steering gear adjusted too tightly. 2. Front wheel alignment incorrect. 3. Insufficient or improper lubricant in steering gear or front suspension. 4. Steering column misaligned.

90D-2

DIVISION II

DESCRIPTION AND OPERATION

90-28 DESCRIPTION OF STEERING LINKAGE

All Buicks use a parallelogram type steering linkage to connect both front wheels to the steering gear pitman arm. The right and left tie rods are attached to steering arms and to a forged intermediate rod by ball studs. The left end of the intermediate rod is supported by the pitman arm and the right end by an idler arm which pivots on a support attached to the frame. The pitman and idler arms are always parallel to each other and move through symmetrical arcs. See Figure 90-137.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

90-29 ADJUSTMENT OF STEERING LINKAGE IDLER ARM

The Saginaw linkage requires proper location of the idler arm on its support so that the idler arm ball socket will be level with the pitman arm ball socket. The support

must be threaded into the idler arm bushing until the distance from the center of the bolt hole to the top of the idler arm boss is 3 plus or minus 1/16" on 43-44000 Series cars, or from the inboard side of the center of the bolt hole on frame side to bottom of idler arm boss is 3 1/16 plus or minus 1/16" on 45-46-48-49000 Series cars. When the idler arm is installed on the support, it must be free to rotate a minimum of 90 degrees in both directions from straight ahead.

NOTE: *The allowable lash is the idler arm and support assembly is 1/8" with a plus or minus 25 lbs. applied vertically at the intermediate rod end of the idler arm.*

IMPORTANT: *If the idler arm support is dismounted from the frame for other work, wire the support to the idler arm so that it cannot turn from its existing position and possibly change the toe-in of the front wheels.*

See Group 30 for adjustment of tie rods to obtain proper "toe-in" of front wheels. See Figure 90-137 for correct positioning of tie rod clamps.

DIVISION IV

REMOVAL AND INSTALLATION

When disconnecting any of the steering linkage ball studs, use puller J-5504 where possible. If puller will not work, use remover J-3295 and firmly support the member from which the stud is being removed.

90-30 REMOVAL AND INSTALLATION OF TIE RODS

a. Removal

1. Place vehicle on hoist.

2. Remove cotter pins from ball studs and remove castellated nut.

3. To remove outer ball stud, tap on steering arm at the rod end with a hammer, while using a heavy hammer, or similar tool, as a backing. If necessary, pull downward on tie rod to remove from steering arm.

4. Remove inner ball stud from intermediate rod, using same procedure as described in Steps 2 and 3.

5. To remove tie rod ends from tie rods, loosen clamp bolts and unscrew end assemblies.

b. Installation

NOTE: *Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems and/or could result in major repair expense. It must be replaced with one of the same part number, or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retnetion of this part.*

1. If the tie rod ends were removed, lubricate the tie rod threads with EP chassis lube and thread ends of tie rod into the sleeve, making sure both ends are threaded an equal distance into the sleeve.

2. Make sure that threads on ball stud and in ball stud nuts are perfectly clean and smooth. No nicks on taper. Install seals on ball studs.

NOTE: *If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut.*

3. Install ball studs in steering arms and intermediate rod.

4. Install ball stud nuts and torque to specifications, then advance nuts just enough to insert cotter pins and install cotter pins. Lubricate tie rod ends.

5. Refer to torque specifications at rear of manual for correct torque values.

NOTE: *Before locking clamp bolts on the rods, make sure that the tie rod ends are in alignment with their ball studs (each ball joint is in the center of its travel). If the tie rod is not in alignment with the studs, binding will result.*

6. Remove vehicle from hoist.

7. Adjust toe-in.

90-31 REMOVAL AND INSTALLATION OF INTERMEDIATE ROD

a. Removal

1. Place vehicle on hoist.

2. Remove inner ends of tie rods from intermediate rod, as described under "Tie Rod - Removal".

3. Remove cotter pin and nut from intermediate rod ball stud attachment at pitman arm.

4. Detach intermediate rod from pitman arm. Shift steering linkage, as required, to free pitman arm from intermediate rod.

5. Remove cotter pin and nut from idler arm and remove intermediate rod from idler arm.

b. Installation

NOTE: *Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems and/or could result in major repair expense. It must be replaced with one of the*

same part number, or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

1. Install intermediate rod to idler arm, making certain idler stud seal is in place, then install and tighten nut to specifications. Advance nut just enough to align castellation with cotter pin hole and install pin.

2. Raise end of rod and install on pitman arm. Tighten nut to specifications, then advance nut just enough to insert cotter pin and install cotter pin.

3. Install tie rod ends to intermediate rod, as previously described under "Tie Rods". Lubricate tie rod ends.

4. Install ball stud nuts and tighten to specifications, then advance nut just enough to insert cotter pin and install cotter pin.

5. Refer to torque specifications at rear of manual for correct torque values.

6. Remove vehicle from hoist.

7. Adjust toe-in and align steering wheel.

90-32 REMOVAL AND INSTALLATION OF IDLER ARM

a. Removal

1. Place vehicle on hoist.

2. Remove idler arm to two (2) frame nuts, washers, and bolts.

3. Remove cotter pin and nut from idler arm to intermediate rod ball stud.

4. Remove intermediate rod from idler arm by tapping intermediate rod with a hammer, using a heavy hammer as a backing.

5. Remove idler arm.

b. Installation

1. Position support against frame and secure with two (2) bolts, washers, and nuts. Install and tighten nuts to specifications.

2. Install intermediate rod to idler arm, making certain seal is on stud. Install and tighten nut to specifications.

3. Advance nut just enough to insert cotter pin and install cotter pin.

4. Refer to torque specifications at rear of manual for correct torque values.

5. Remove vehicle from hoist.

90-33 REMOVAL AND INSTALLATION OF PITMAN ARM

a. Removal

1. Place vehicle on hoist.

2. Remove cotter pin from pitman arm ball stud and remove nut.

3. Remove intermediate rod from pitman arm by tapping on side of rod or arm in which the stud mounts with a hammer, while using a heavy hammer, or similar tool, as a backing. Pull down on intermediate rod to remove from stud.

4. Remove pitman arm nut and lock washer from pitman shaft and mark relation of arm position to shaft.

5. Remove pitman arm with Tool J-6632.

CAUTION: *Do not hammer on puller.*

b. Installation

NOTE: *Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems and/or could result in major repair expense. It must be replaced with one of the same part number, or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

1. Install pitman arm on pitman shaft, lining up the marks made upon removal.

2. Install pitman shaft nut and lock washer. Torque to specifications.

3. Position intermediate rod to pitman arm. Install nut. Torque to specifications. Continue to tighten nut enough to align castellation with hole in stud and install cotter pin.

4. Refer to torque specifications at rear of manual for correct torque values.

5. Remove vehicle from hoist.

DIVISION VI SPECIFICATIONS

90-30 STEERING LINKAGE SPECIFICATIONS

Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only. Dry or dirty threads produce increased friction which prevents accurate measurements of tightness.

a. 43-44000 Series

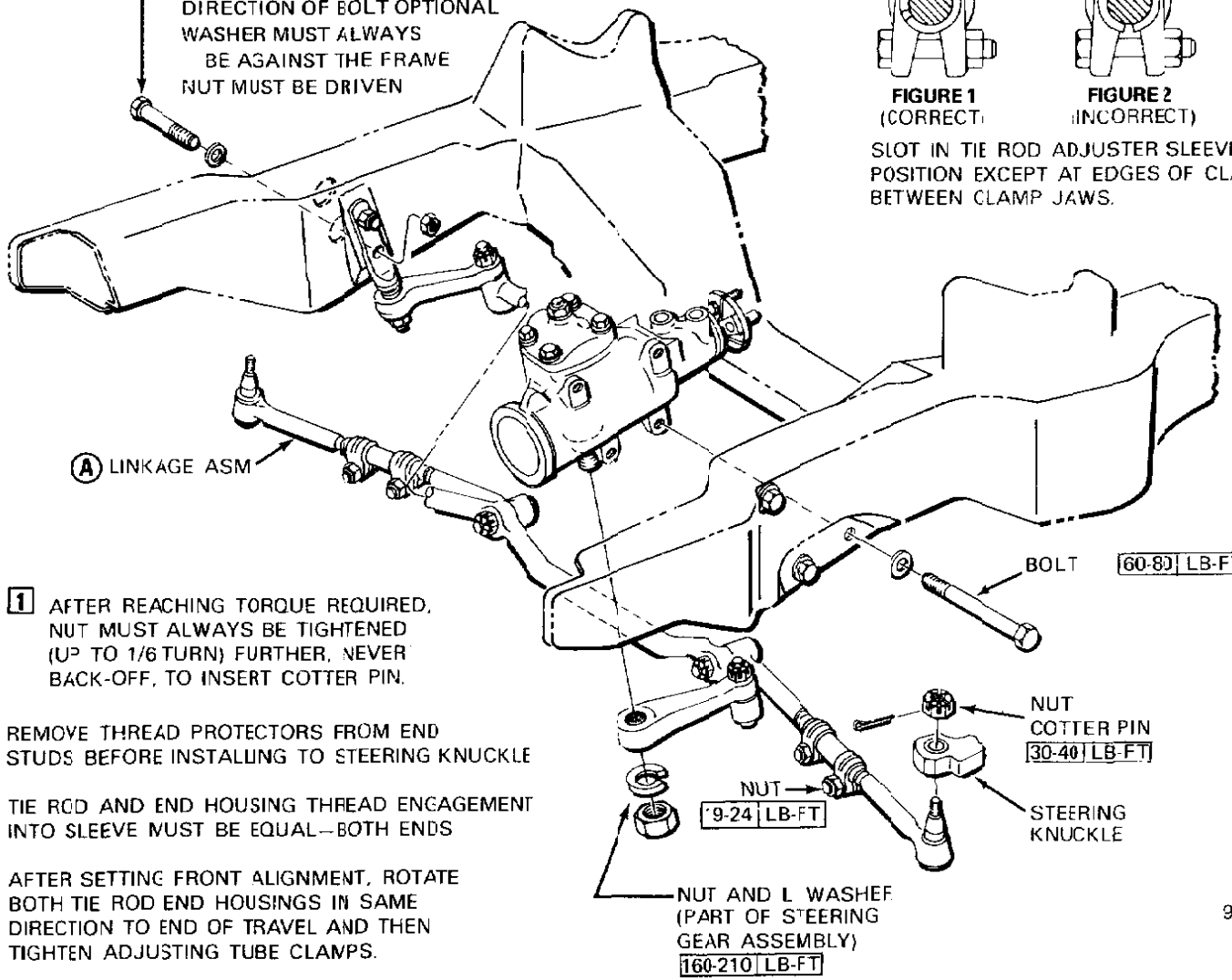
Part	Location	Torque Lb. Ft.
Nut	Steering Arm to Tie Rod End	30-40 Lb. Ft. With 45 Lbs. Max.
Nut	Tie Rod Clamp Nuts	19-24 Lb. Ft.
Nut	Tie Rod to Intermediate Rod	30-50 Lb. Ft. With 55 Lbs. Max.
Nut	Pitman Arm to Intermediate Rod	30-40 Lb. Ft. With 45 Lbs. Max.
Nut	Pitman Arm to Steering Gear	160-210 Lb. Ft.
Nut	Idler Arm to Intermediate Rod	30-50 Lb. Ft. With 55 Lbs. Max.
Nut	Idler Arm to Frame	30-40 Lb. Ft.
Bolt	Idler Arm to Frame	40-50 Lb. Ft.

b. 45-46-48-49000 Series

Part	Location	Torque Lb. Ft.
Nut	Steering Arm to Tie Rod End	40-60 Lb. Ft. With 75 Lbs. Max.
Nut	Tie Rod Clamp Nuts	19-24 Lb. Ft.
Nut	Tie Rod to Intermediate Rod	50-70 Lb. Ft. With 85 Lbs. Max.
Nut	Pitman Arm to Intermediate Rod	40-50 Lb. Ft. With 55 Lbs. Max.
Nut	Pitman Arm to Steering Gear	160-210 Lb. Ft.
Nut	Idler Arm to Intermediate Rod	35-45 Lb. Ft. With 50 Lbs. Max.
Nut	Idler Arm to Frame	40-55 Lb. Ft.
Bolt	Idler Arm to Frame	55-70 Lb. Ft.

NOTE: Where torques shown are, for example 50 to 70 Lb. Ft. lb. torque with 85 Lb. Ft. maximum to insert cotter pin. Do not back off nuts to achieve cotter pin insertion.

TYPICAL LINKAGE 1971



POSITION OF TIE ROD ADJUSTER SLEEVE AND CLAMP

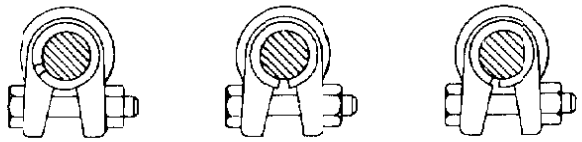


FIGURE 1 (CORRECT)
FIGURE 2 (INCORRECT)
FIGURE 3 (INCORRECT)

SLOT IN TIE ROD ADJUSTER SLEEVE MAY BE IN ANY POSITION EXCEPT AT EDGES OF CLAMP JAWS OR BETWEEN CLAMP JAWS.

[1] AFTER REACHING TORQUE REQUIRED, NUT MUST ALWAYS BE TIGHTENED (UP TO 1/6 TURN) FURTHER, NEVER BACK-OFF, TO INSERT COTTER PIN.

REMOVE THREAD PROTECTORS FROM END STUDS BEFORE INSTALLING TO STEERING KNUCKLE

TIE ROD AND END HOUSING THREAD ENGAGEMENT INTO SLEEVE MUST BE EQUAL—BOTH ENDS

AFTER SETTING FRONT ALIGNMENT, ROTATE BOTH TIE ROD END HOUSINGS IN SAME DIRECTION TO END OF TRAVEL AND THEN TIGHTEN ADJUSTING TUBE CLAMPS.

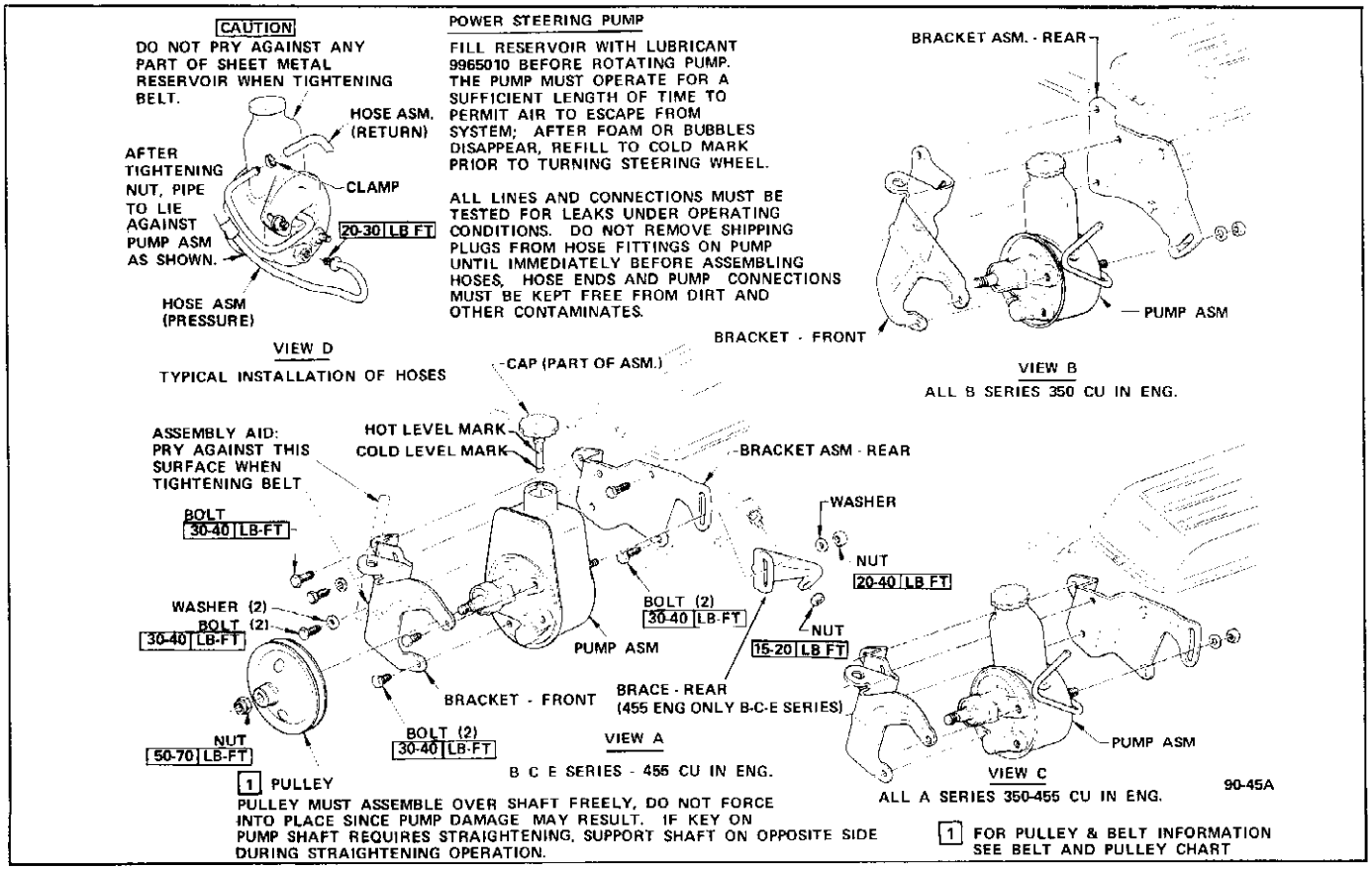


Figure 90-70 Power Steering Pump and Brackets - All Series

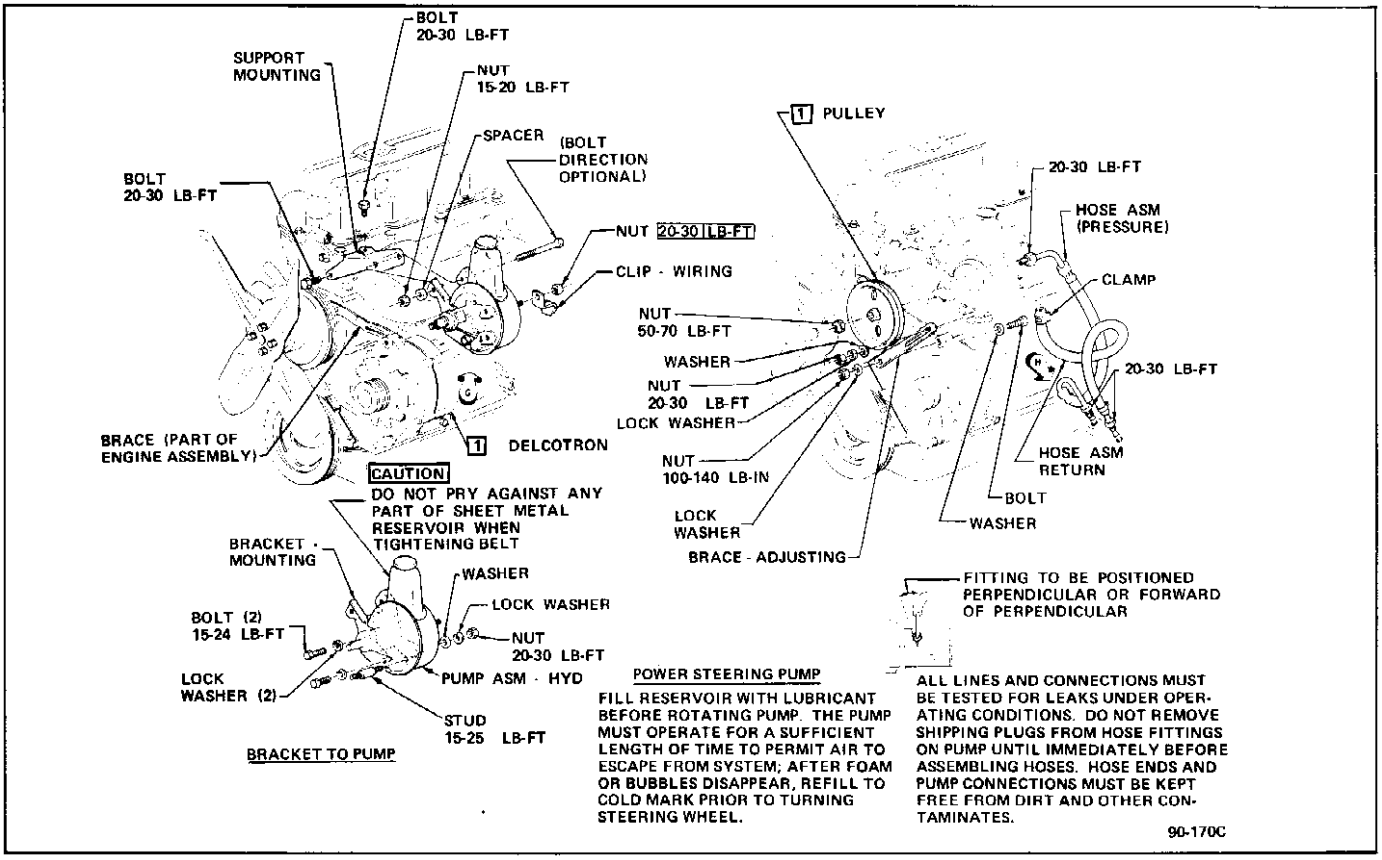


Figure 90-71 Power Steering System - 43-44000 Series L-6

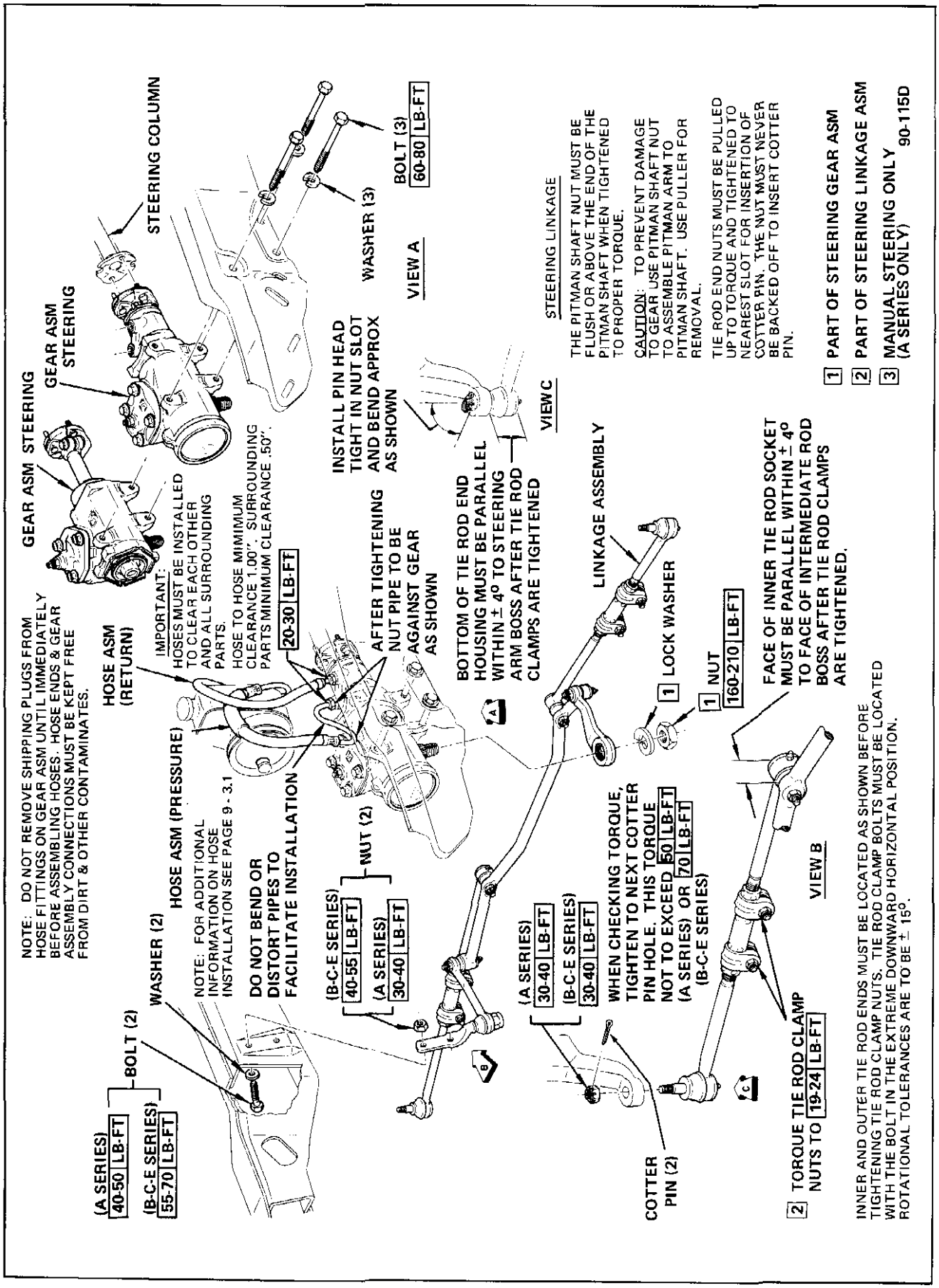


Figure 90-72 Power Steering Gear and Linkage - All Series

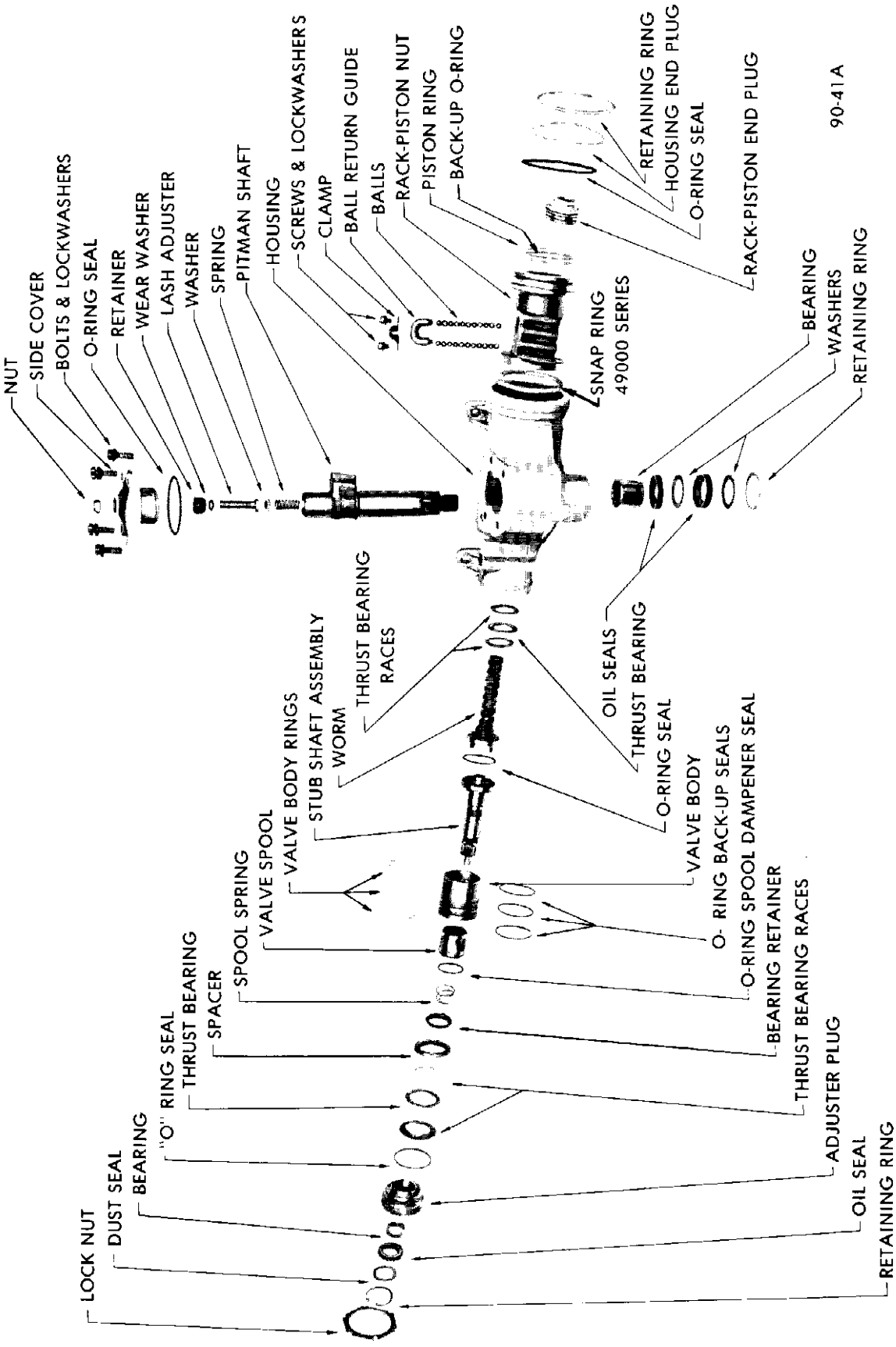


Figure 90-73 Power Steering Gear (Exploded View)

SECTION C

STEERING COLUMN ASSEMBLIES ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Not Applicable)	-
II	DESCRIPTION AND OPERATION:	
	Description	90-21
III	ADJUSTMENTS AND MINOR SERVICE:	
	Checking Steering Column for Damage	90-22
	Removal and Installation of Horn Actuator Bar and Steering Wheel	90-23
IV	REMOVAL AND INSTALLATION:	
	Removal and Installation of Steering Columm Assembly	90-24
V	OVERHAUL AND MAJOR SERVICE:	
	Dissassembly and Reassembly of Standard (Non-Tilt) Steering Column Assembly	90-25
	Disassembly and Reassembly of Tilt Steering Column Assembly	90-26
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION II

DESCRIPTION AND OPERATION

90-21 DESCRIPTION

The Energy Absorbing Function Locking Steering Column assembly is used on all series cars. This column is designed to compress under impact. 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 and thereby reduces 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 Function Locking Column assembly may be easily disassembled and reassembled. The serviceman should be aware that it is important that only the specified screws, bolts and nuts be used as designated during reassembly, and that they are tightened to their specified torque. This precaution will insure the energy absorbing action of the assembly. Particular care should be exercised to avoid using overlength bolts as they may prevent a portion of the assembly from compressing under impact. Equally as important is correct torquing of all

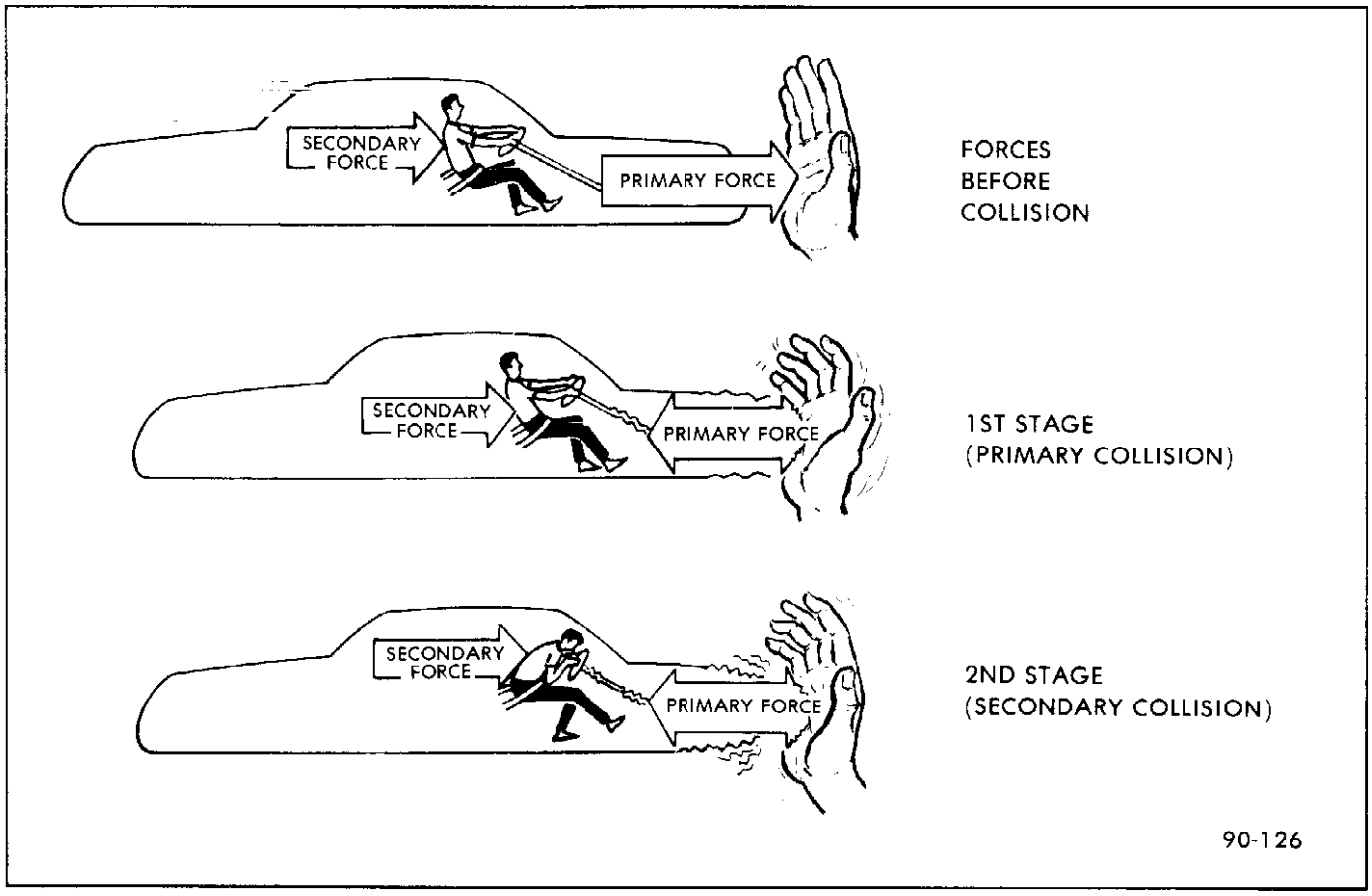


Figure 90-74 Reaction of Forces in a Collision

bolts and nuts. In particular, 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 Function Locking 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, laying things across or on top of the column assembly, leaning on the column assembly, or dropping of the assembly could shear or loosen the plastic fasteners that maintain column rigidity or possibly bend the assembly causing a binding condition. *It is therefore important that the removal and installation and the disassembly and reassembly procedures be strictly followed when servicing this assembly.*

All Series Buicks incorporate a pot joint in the lower portion of the steering shaft. The pot joint acts as a universal joint to compensate for misalignment of the steering column. To insure proper operation of the pot joint, the capsule bracket and toe pan covers have been redesigned to provide exact alignment of the column in the body. It is mandatory that the installation of this column be followed exactly as outlined.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

90-22 CHECKING STEERING COLUMN FOR DAMAGE (ALL SERIES)

NOTE: *Cars involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted may also have a damaged or misaligned steering column.*

1. Check capsules on steering column bracket assembly: They should be within 1/16″ of bottom of the slots.

IMPORTANT: *If capsule has moved more than 1/16″, some column collapse may have occured, and the bracket must be replaced. In this case the steering column must be checked as outlined below.*

2. On cars with automatic transmission and column shift, check operation of the shift lever. If

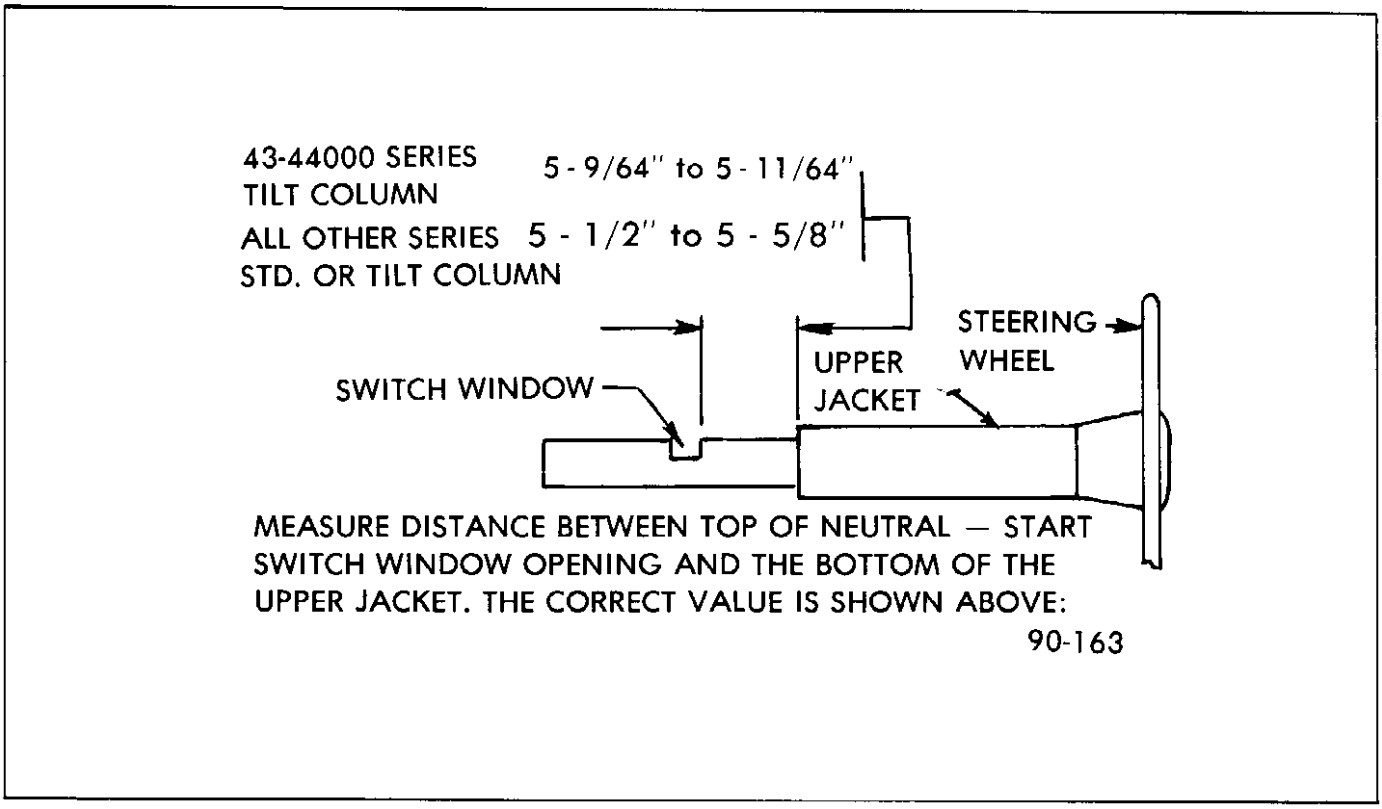


Figure 90-75 Checking for Column Collapse

you are able to move lever to "Park" position without raising lever, it is an indication that the upper shift tube plastic bearing is broken.

3. Check for mast jacket collapse by measuring the distance from the edge of the neutral-start switch window opening and the bottom of the upper jacket.

The correct dimension for the 43-44000 Series cars with Tilt Column is 5-9/64" to 5-11/64". For all other columns (standard or tilt) the dimension is 5 1/2" to 5 5/8". See Figure 90-75.

4. Check for broken plastic bearing adapter at lower end of steering shaft. (All except column shift manual transmission.) If adapter is cracked or broken, it must be replaced and the column aligned.

5. Check steering gear flexible coupling for stretching, compression, tears, excessive angularity or for no pin engagement. This indicates possible misalignment or frame damage. If flexible coupling damage is evident, the coupling is to be replaced and the steering column is to be realigned.

6. Check for lower shaft end-play clearance in pot joint by grasping shaft and pushing into pot joint. Some end-play must be present. If no end-play is present, disconnect lower shaft assembly at flexible coupling and measure the distance, as shown in Figure 90-136.

NOTE: *If the above checks indicate the column has been damaged, the column must be disassembled for further inspection of internal components, such as shift tube, upper steering shaft injection molding, and turn signal switch.*

IMPORTANT: *After all repairs have been made or inspection completed, the column must be reinstalled according to the procedures outlined in Paragraph 90-24.*

90-23 REMOVAL AND INSTALLATION OF HORN ACTUATOR AND STEERING WHEEL

a. Removal of Horn Actuator

1. Unplug flat connector from steering column.

2. On 43-44000 series cars with standard steering wheel, pull off cap, remove three phillips head screws and take off bushing spacer, receiver cup and Belleville spring (see Figure 90-76).

3. On all other Series cars remove screws from underside of steering wheel that secure horn actuator, partially lift off bar, pull lead connector from canceling cam, then fully lift off actuator. See Figure 90-129.

b. Installation of Horn Actuator

Install reverse of removal.

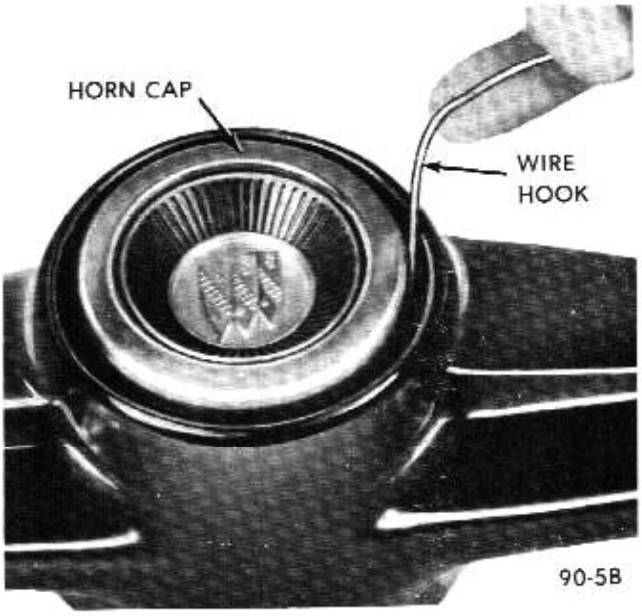


Figure 90-76 Horn Actuator Cap Removal - Standard Steering Wheel

c. Removal of Steering Wheel

1. Remove horn actuator cap or bar (ref. subparagraph a).

2. Loosen steering wheel retaining nut several turns. Do not remove nut.

3. Attach Wheel Puller J-3274 to steering wheel and pull wheel up to nut. See Figure 90-77.

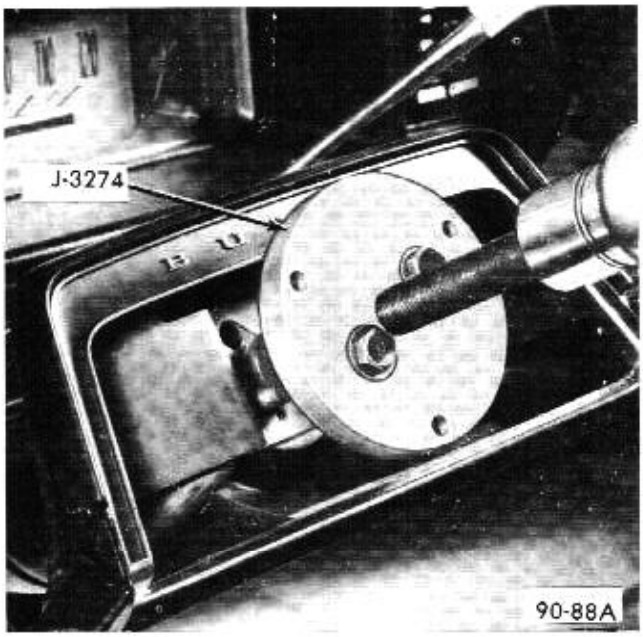


Figure 90-77 Removing Steering Wheel

CAUTION: *Do not tap or strike on end of puller in order to free wheel from shaft that maintain steering shaft rigidity. Striking of underside of steering wheel to jar it loose must also never be done. The only recommendation for freeing frozen steering wheels is to use a penetrating lubricant.*

d. Installation of Steering Wheel

1. Install reverse of removal and align location mark on end of steering shaft with mark on hub of steering wheel.

2. Torque steering wheel nut 35 lb.ft.

NOTE: THIS STEERING WHEEL TO STEERING SHAFT FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

DIVISION IV

REMOVAL AND INSTALLATION

90-24 REMOVAL AND INSTALLATION OF STEERING COLUMN ASSEMBLY

a. Removal

(All Series)

NOTE: *Once the steering column is removed from the car, the column is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic injections which maintain column rigidity. Leaning on the mast jacket could cause jacket to bend or deform. Any of the above damage could impair the column's collapsible design. If it is necessary to remove the steering wheel, use the specified wheel puller. Do not hammer on end of shaft, as hammering could loosen plastic injections which maintain column rigidity.*

1. Remove two nuts securing halves of flexible coupling together.

2. Disconnect shift linkage from shift lever(s).

3. Remove screws securing toe pan cover to floor and loosen cover.

4. Disconnect shift indicator link. See Figure 90- 78.

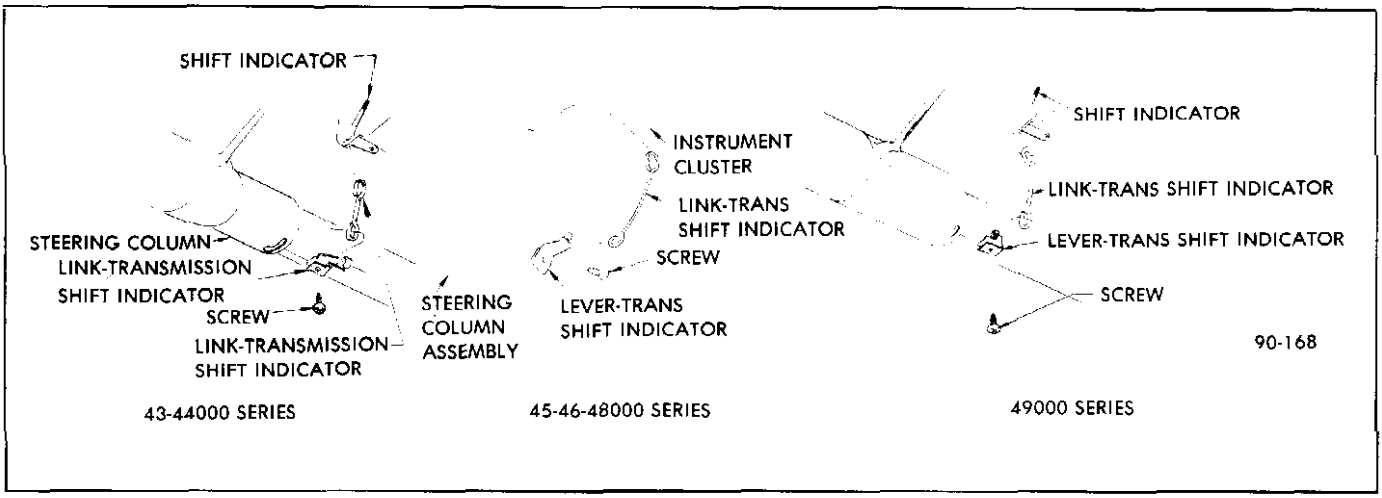


Figure 90-78 - Removing Shift Indicator Link

5. Remove nuts securing bracket to instrument panel and carefully lower column. See Figures 90-130 and 131.

6. Disconnect all electrical connectors from steering column assembly and carefully withdraw column. See Figures 90-79 and 80.

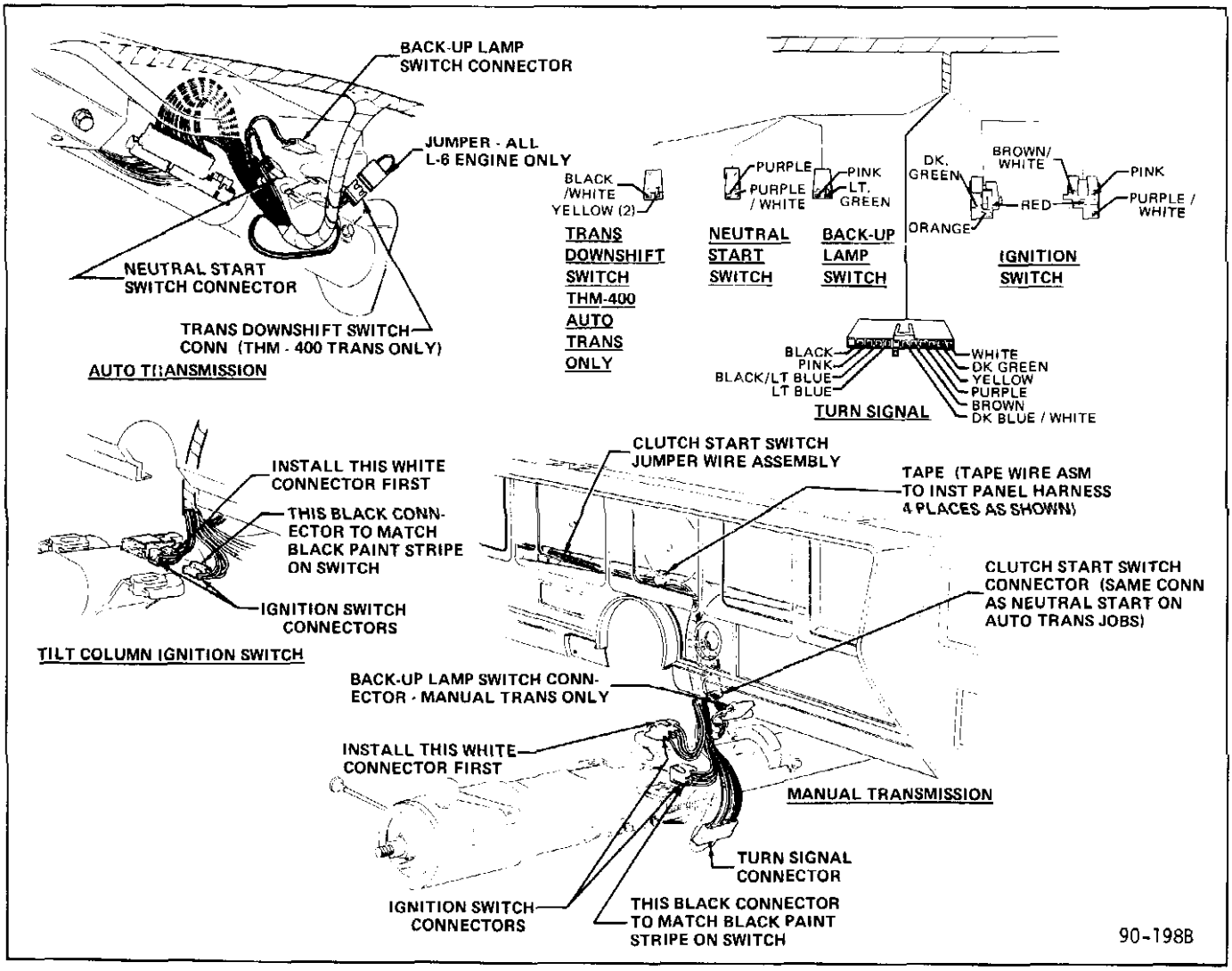


Figure 90-79 43-44000 Steering Column Electrical Connections

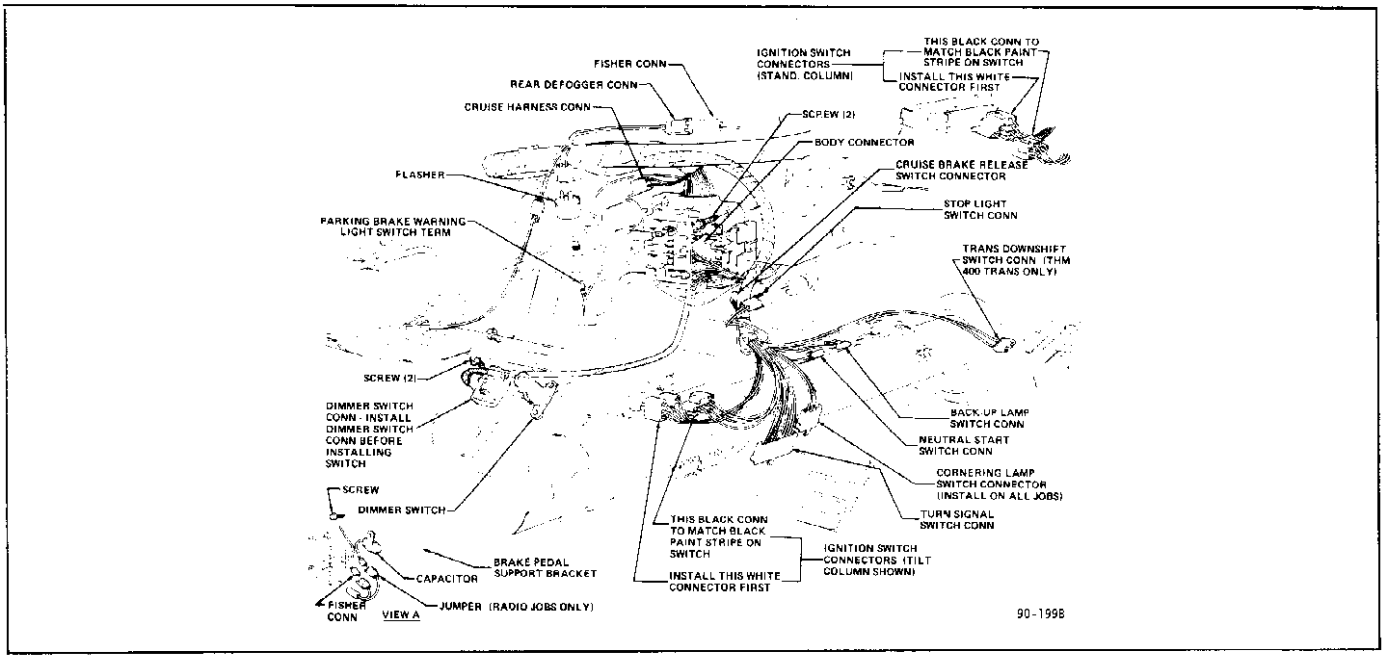


Figure 90-80 45-46-48-49000 Steering Column Electrical Connections

b. Installation

(43-44000 Series)

IMPORTANT: *It is mandatory that the installation procedure be followed in exact sequence.*

NOTE: *Fasteners in following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

1. Position column in the body and position the flange to the rag joint and install lock washers and nuts. With loose rag joint flange, install bolt (K) and torque to 30 lb. ft. See Figure 90-130.

2. Connect all electrical connectors to steering column. See Figure 90-79.

3. Position steering column to instrument panel, connect shift indicator link and loosely attach retaining nuts (F).

4. Position outer cover to dash and start screw (Q).

5. Install screw (L) and tighten to 40 lb.in. Tighten screw (Q) to 40 lb. in. Install and tighten screw (R) to 40 lb. in.

6. Tighten two clamp screws (C) to 40 lb. in.

7. Install and tighten two inner cover screws (J) to 40 lb. in.

8. Tighten two steering column retaining nuts to 20 lb. ft.

9. Install insulator and cover and tighten screws snug.

10. Connect shift linkage to shift lever.

NOTE: *Make certain that column instrument panel mounting is never unsupported when either dash mounting or gear mounting is connected.*

(45-46-48-49000 Series)

IMPORTANT: *It is mandatory that the installation procedure be followed in exact sequence.*

NOTE: *Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

1. Position column in the body and position the flange to the rag joint and install lock washers and nuts and torque to 20 lb. ft. See Figure 90-131.

2. Connect all electrical connectors to steering column. See Figure 90-80.

3. Position steering column to instrument panel loose assemble nuts and connect shift indicator link.

4. Position lower cover to dash by starting screw (7) in round inlet hole. See Figure 90-131.

5. Install screw (8) and torque to 40 lb. ft. Tighten screw (7) and torque to 40 lb. ft.

6. Install screw (3) and (9) and torque to 40 lb. ft.

7. Install clamp screw (4) and torque to 40 lb. ft.

8. Install remaining three cover screws and torque to 40 lb. ft.

9. Torque steering column to instrument panel nuts to 20 lb. ft.

10. Connect shift linkage to shift lever.

DIVISION V

OVERHAUL AND MAJOR SERVICE

90-25 DISASSEMBLY AND ASSEMBLY OF STANDARD (NON-TILT) STEERING COLUMN

NOTE: *All elements of energy absorbing columns are sensitive to damage and must be handled with care.*

a. Disassembly - Upper End Only (Column Out Of Car)

NOTE: *If service is required on the upper end only, steps 1 through 12 can be performed in the car. MAKE SURE COLUMN IS NOT BENT DURING REMOVAL FROM CAR.*

1. Remove steering wheel using specified wheel puller. Do not hammer end of steering shaft.

2. Remove the three cover screws and remove cover. Remove cardboard screw retainers.

3. Depress lock plate using tool J-23653 and the steering wheel nut. Pry the round wire snap ring out of the shaft groove and discard ring. Remove the snap ring and shaft lock plate. See Figure 90-84.

CAUTION *With ring removed, shaft could slide out bottom of column causing damage to shaft.*

4. Slide upper bearing preload spring and horn contact turn signal cancelling cam off upper steering shaft.

5. Slide thrust washer off upper steering shaft.

6. Remove turn signal lever screw and lever.

7. Push hazard warning switch in and unscrew knob.

8. Remove three turn signal switch mounting screws. Pull the connector out of the bracket on the jacket. Wrap a piece of tape around the upper part of the connector and wires to prevent snagging when removing switch. See Figure 90-85.

9. Pull the switch straight up with wire protector. See Figure 90-86.

10. The lock cylinder may be removed in the "LOCK" position with the key removed or in the "RUN" position.

11. Insert a thin tool (small screw driver or knife blade) into the slot next to the switch mounting screw boss (right hand slot) and depress spring latch at bottom of slot,

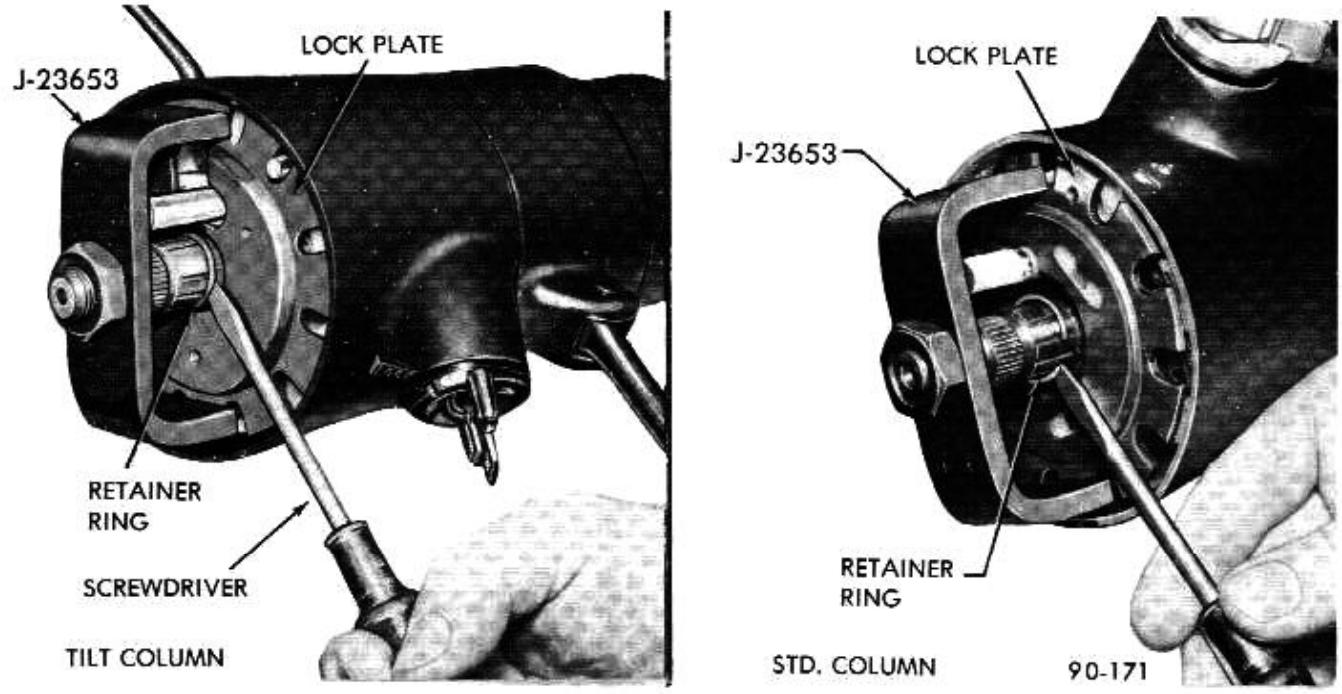


Figure 90-84 Removing Lock Plate Retainer Ring

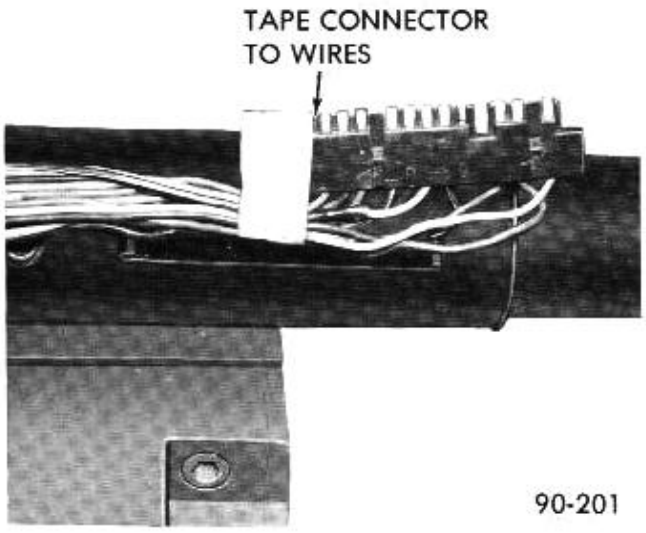


Figure 90-85 Tape Connector to Wires

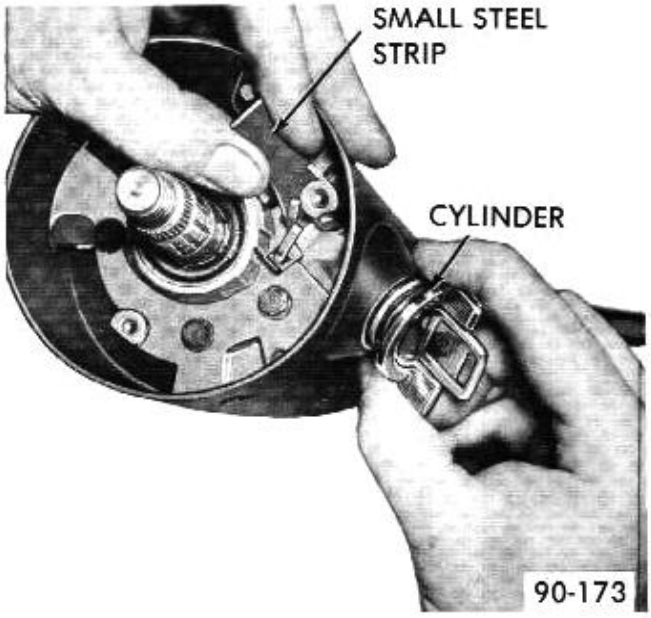


Figure 90-87 Removing Ignition Lock Cylinder

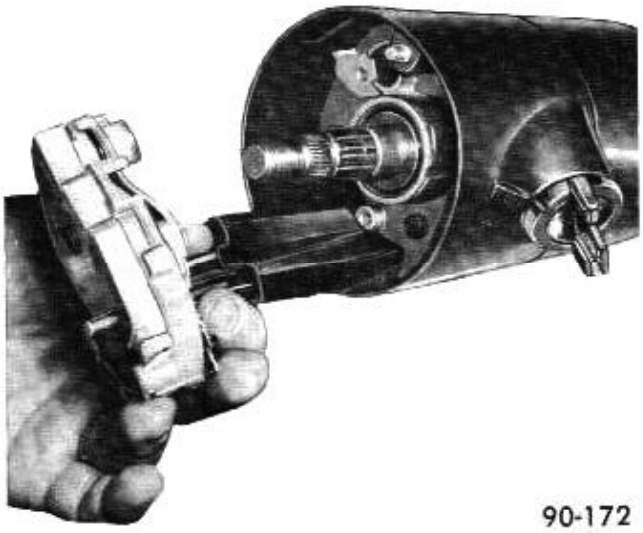


Figure 90-86 Removing Turn Signal Switch and Wires

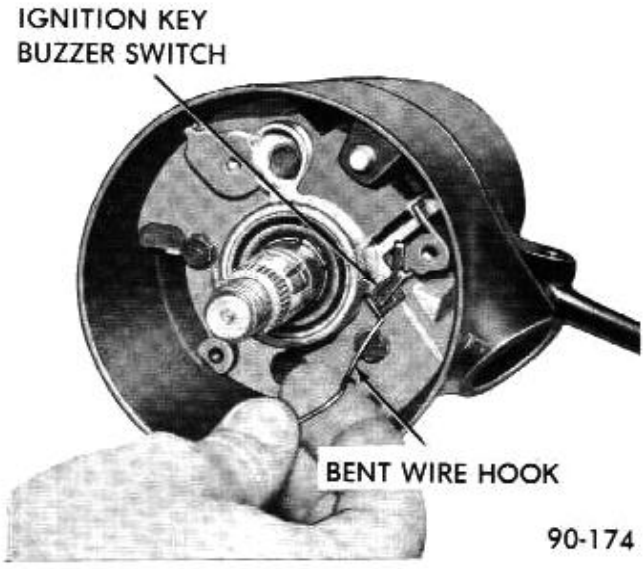


Figure 90-88 Removing Buzzer Switch

which releases lock. Remove lock. See Figure 90-87.

12. The buzzer switch can be pulled straight out of the housing. (This may be done without removing the lock cylinder. However, the lock cylinder must be in the "run" position.) See Figure 90-88.

NOTE: *Do not pull on switch terminals. Use a bent wire or needle nose pliers to pull on switch clip.*

NOTE: *To remove any additional parts from the upper end, the ignition switch should be removed.*

13. The ignition switch should be positioned in "accessory" position before removing. If the lock cylinder has already been removed, the connecting rod to the switch should be pulled up until there is a definite stop, which is the "accessory" position. Now remove the two attaching screws and the switch.

14. Drive out upper shift lever pivot pin and remove upper shift lever.

15. Remove the four screws attaching the upper housing to the jacket. Remove the upper housing assembly.

16. Remove thrust cup. See Figure 90-89.

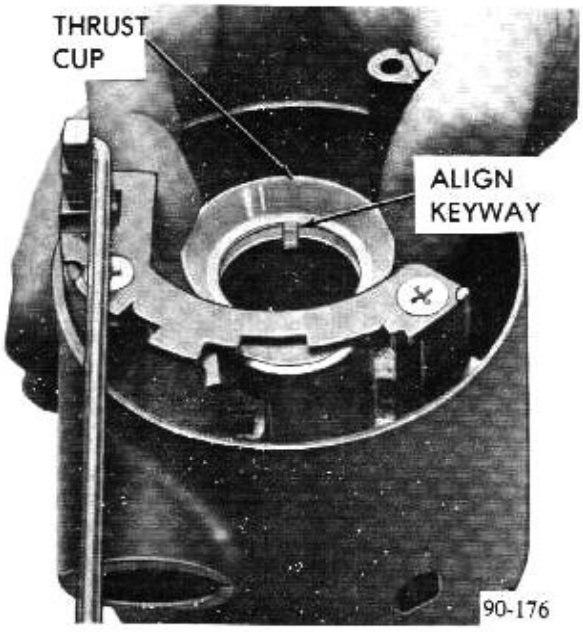


Figure 90-89 Removing or Installing Thrust Cup

17. Remove the rack and lock bolt. See Figure 90-90.

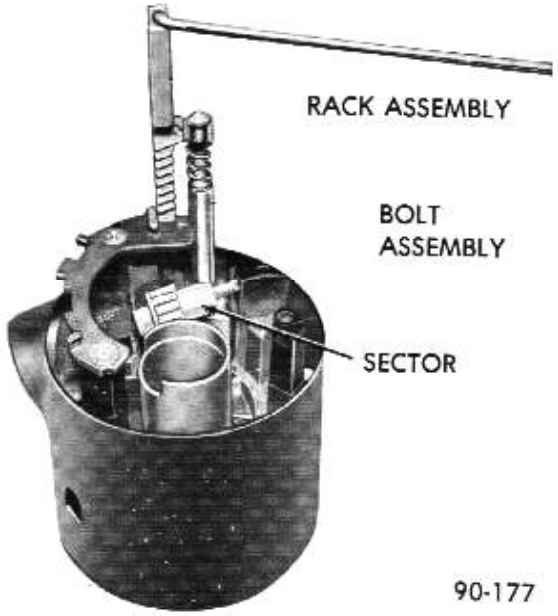


Figure 90-90 Removing or Installing Rack and Lock Bolt

18. Remove the load spring. See Figure 90-91.

19. Remove the shift gate. See Figure 90-92.

20. Remove the sector through the lock cylinder hole by pushing firmly on the block tooth of the sector with a blunt punch. See Figure 90-93.

21. Remove shift bowl and shroud from the jacket.

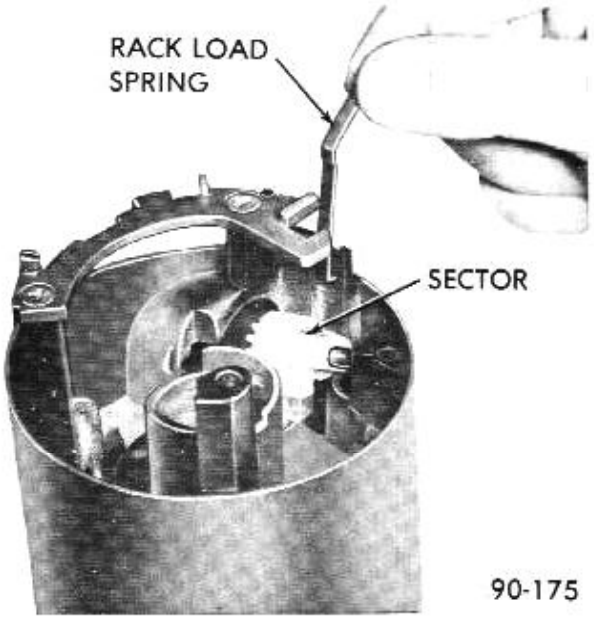


Figure 90-91 Removing or Installing Load Spring

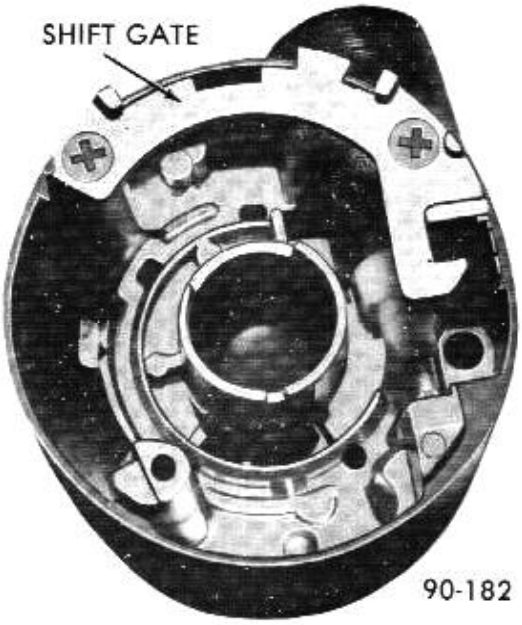


Figure 90-92 Removing Shift Gate

b. Disassembly of Lower End (Column out of Car)

NOTE: *Steering column must be out of car for the following operations.*

Steering wheel, cover, shaft lock, "C" ring, spring, cancelling cam and flat washer must be removed prior to disassembly of the lower end. Follow instructions above.

1. Pull steering shaft assembly from bottom of column.

2. (Automatic Transmission) Remove the two screws holding the neutral-start switch and remove switch. See Figure 90-94.

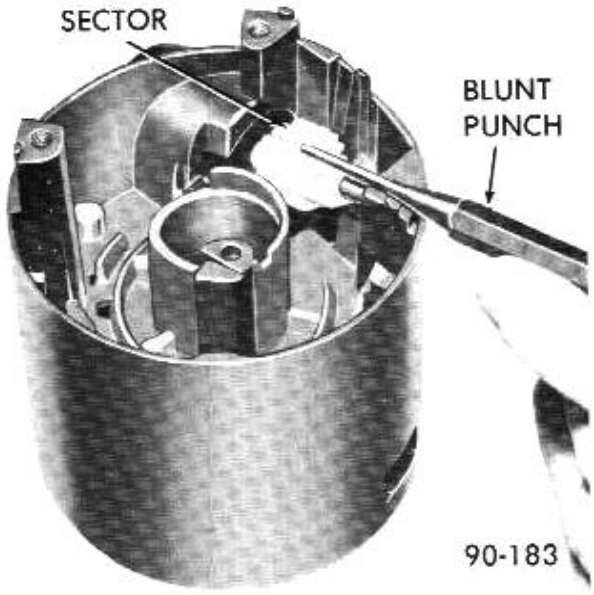


Figure 90-93 Removing Sector

Figure 90-95 Removing Bearing Adapter Clip

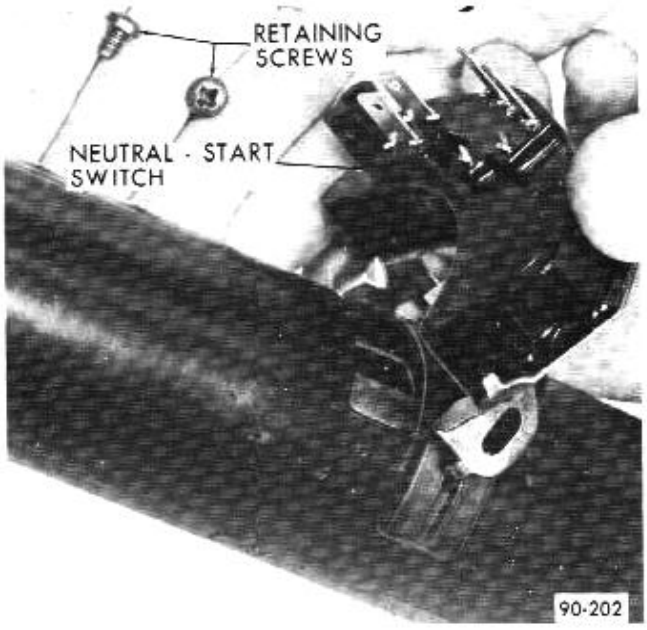


Figure 90-94 Removing or Installing Switch

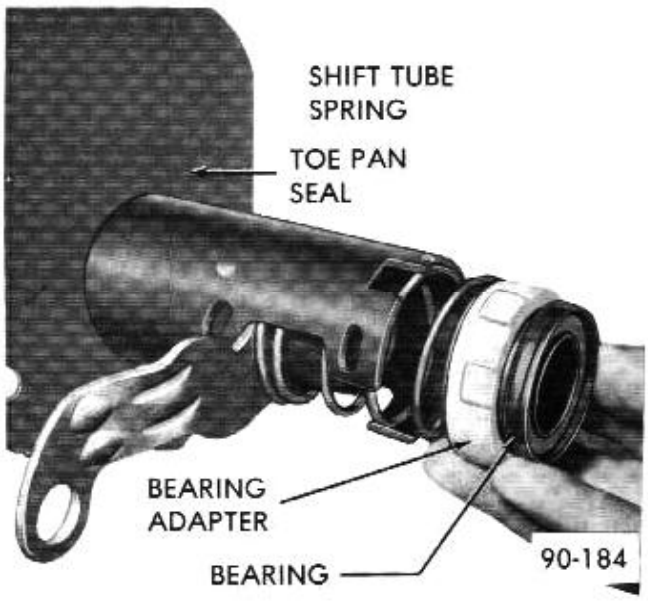


Figure 90-96 Removing Lower Steering Column Bearing

(Manual Transmission) Remove the two screws holding the back-up switch and remove switch. See Figure 90-94.

3. Remove bearing adapter clip. See Figure 90-95.

4. (Automatic Transmission) Remove bearing adapter retainer, bearing and adapter assembly and shift tube spring. (Bearing may be removed from adapter by a light pressout operation on the outer race of the bearing. See Figure 90-96.

(Manual Transmission) Remove bearing and adapter assembly and first/reverse lever. (Bearing may be removed from adapter by a light pressout operation on the outer race.)

5. (Manual Transmission Only) Remove three screws from bearing at lower end. See Figure 90-97.

6. Slide out shift tube assembly.

7. (Automatic Transmission Only) Remove wave washer and lower bowl bearing from top of jacket. See Figure 90-98.

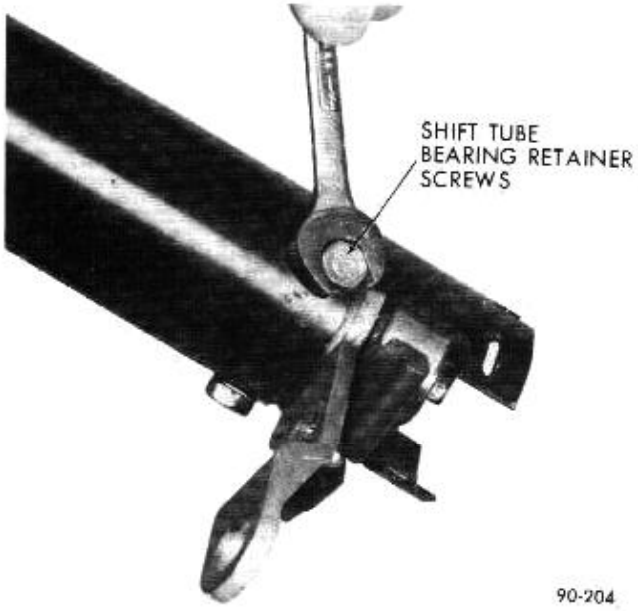


Figure 90-97 Removing Screws from Shift Tube Bearing-Manual Transmission

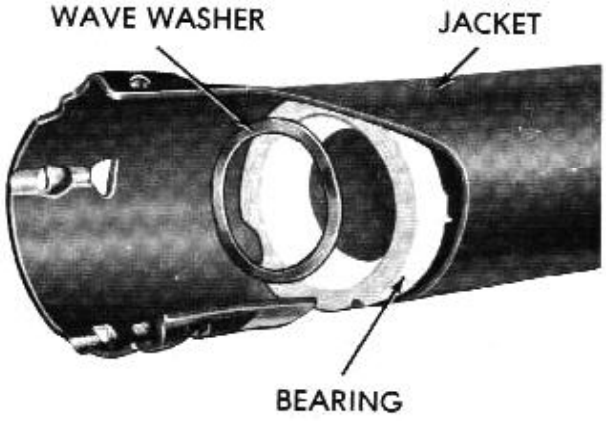


Figure 90-98 Removing Lower Bowl Bearing

c. Reassembly of Upper End

NOTE: *Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Apply a thin coat of E.P. 1 Grease to all friction surfaces.

CAUTION: *Only the specified screws should be used during assembly operations.*

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. See Figure 90-99.

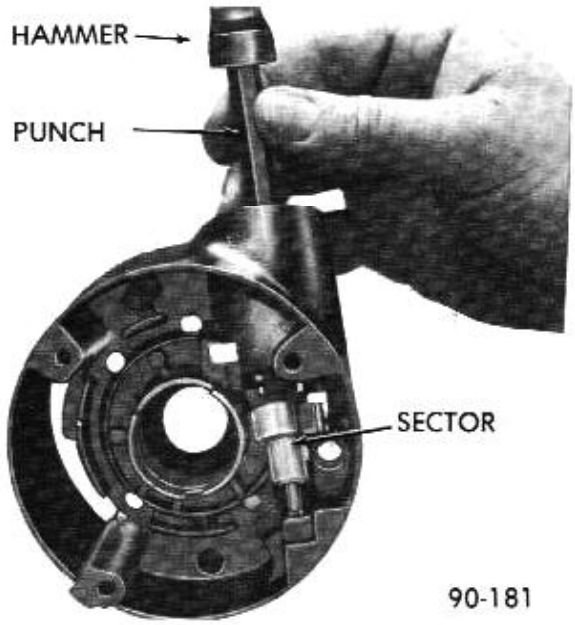


Figure 90-99 - Installing Sector

2. Install the shift gate to the housing.

3. Insert the rack spring in the housing from the bottom side. The long section should be toward the steering wheel and hook on the edge of the housing. See Figure 90-91.

4. Assemble the bolt to the cross-over arm of the rack. See Figure 90-100.

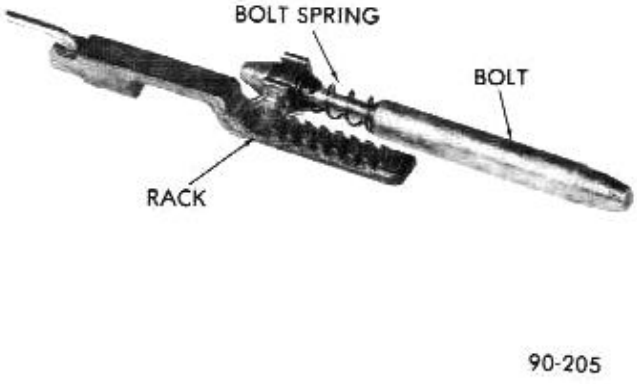


Figure 90-100 - Assembling Bolt to Rack Cross-Over Arm

5. Insert the rack and lock bolt into the housing from the bottom with the teeth up (toward steering wheel) and toward the centerline of the column. See Figure 90-101.

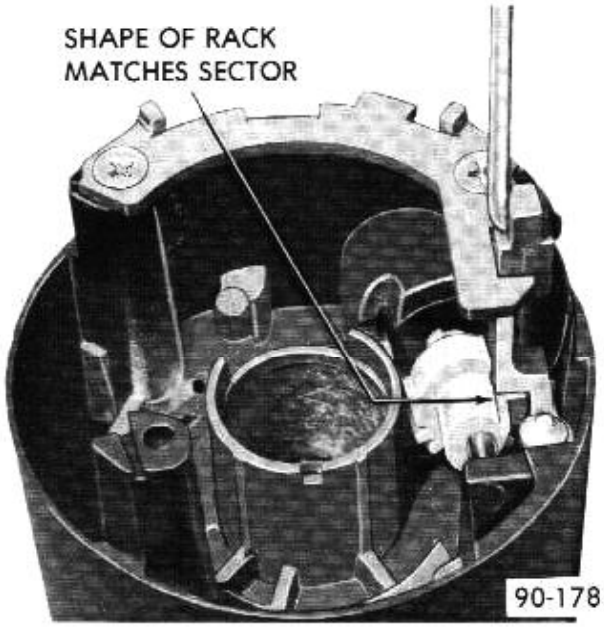


Figure 90-101 - Rack and Lock Bolt Assembled to Sector

6. Install the thrust cup on the bottom hub of the housing. Be sure key of cup aligns with keyway in hub. See Figure 90-89.

7. Install lower bowl bearing in jacket and place wave washer in bowl bearing. See Figure 90-98.

8. Install bowl and rotate it to be sure it is seated in bearing. See Figure 90-102. Shift lever must not be installed before installing bowl.

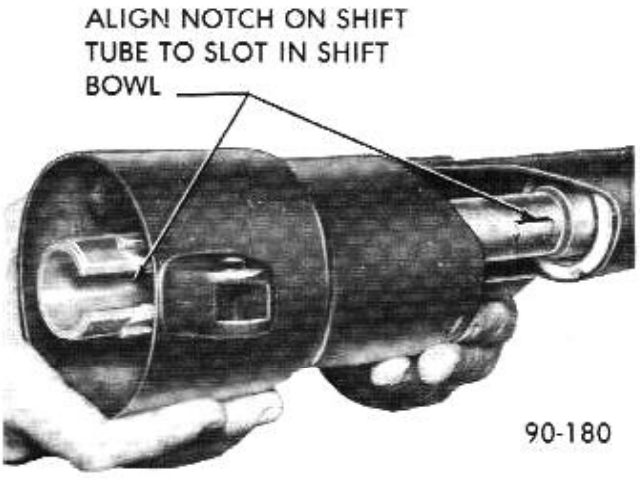


Figure 90-102 - Installing Shift Bowl

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 install the screws. See Figure 90-103.

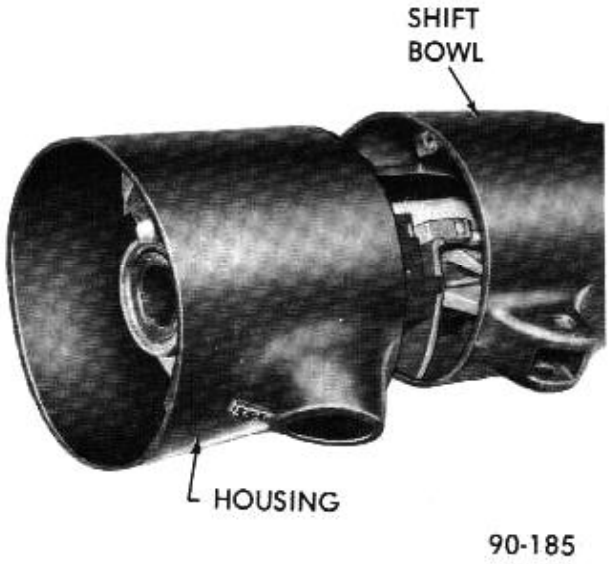


Figure 90-103 - Installing Upper Bearing Housing

10. Assemble buzzer switch to spring clip with formed end of clip around the lower end of switch and spring bowed away from switch. This should lay on the switch opposite the contacts. Push switch and spring into hole with contacts toward the cylinder bore. See Figure 90-104.

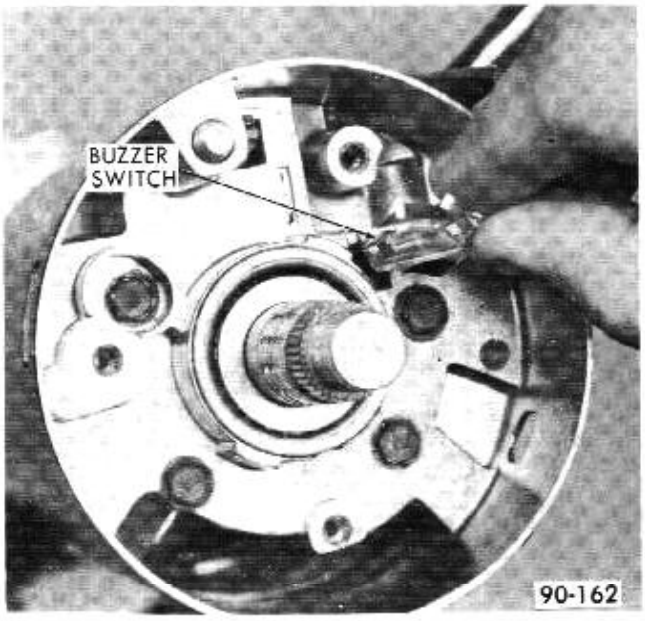


Figure 90-104 - Installing Buzzer Switch Clip and Switch

11. To replace the turn signal switch, be sure the wire harness is in the protector. Feed the connector and protector down through the housing. See Figure 90-82.

12. Drive the three mounting screws. Clip the connector to the bracket on the jacket. See Figure 90-105.

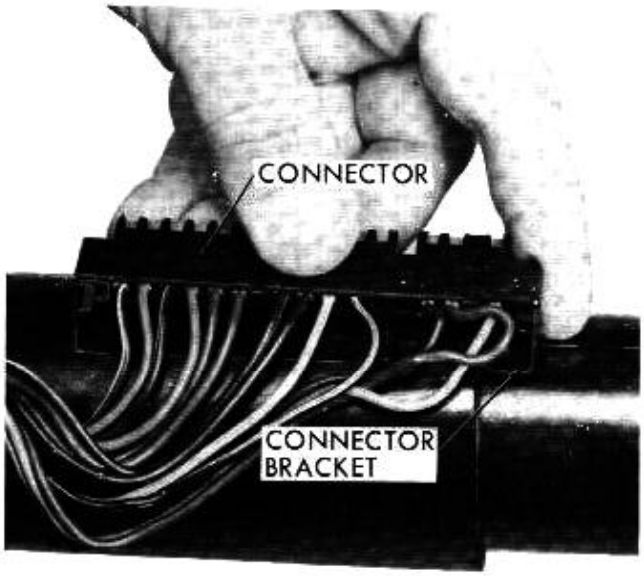


Figure 90-105 - Installing Connector in Column Bracket

13. To install lock, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into housing bore with key on cylinder sleeve aligned to keyway in housing, push in to abutment of cylinder and sector. Rotate knob counterclockwise, maintaing a light push inward on cylinder, until drive section of cylinder mates with sector. Push in until snap ring pops into grooves and lock cylinder is secured in housing. Check freedom of rotation.

14. When installing the ignition switch, be sure the lock cylinder is in "Lock" position. Make certain that the switch is in "Lock". Fit actuator rod into switch and assemble to column with two screws. See Figure 90-106.

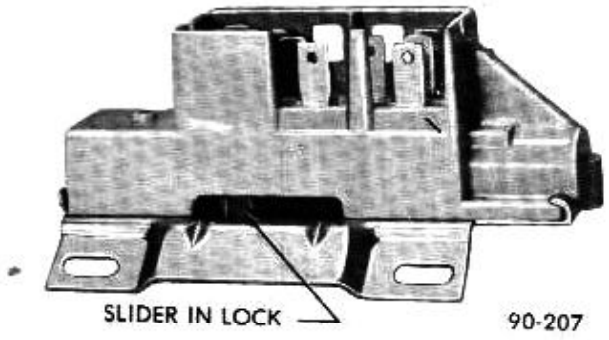


Figure 90-106 - Ignition Switch Slider in "Lock" Position

15. Install the washer, spring and horn contact - cancelling cam on shaft, making certain that the turn signal switch is in "Neutral" and the hazard warning plunger is out. Install the shaft lock plate on the shaft. See Figure 90-107.

NOTE: *The turn signal switch assembly may be damaged if the above procedure is not followed.*

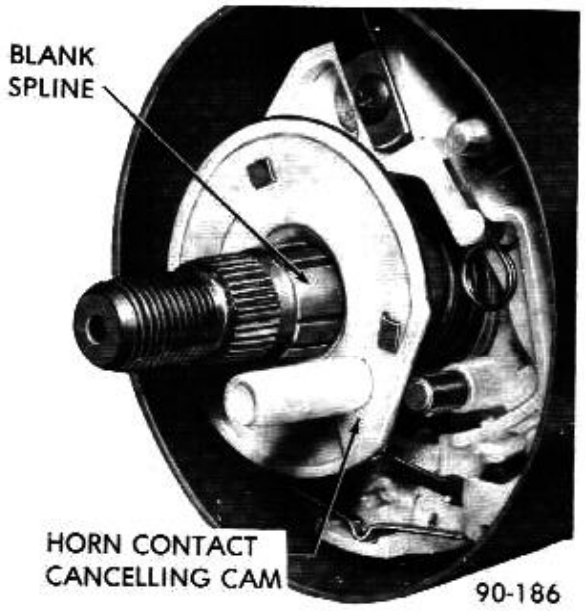


Figure 90-107 - Horn Contact - Cancelling Cam Installed

16. Depress shaft lock plate using Tool J-23131 and install a new snap ring in groove on shaft.

17. Place cover on shaft lock and install screws.

18. Install steering wheel and levers. Be sure to use tongue depressor on bowl spring. Be sure bowl is in "Drive" when inserting shift lever.

19. Adjust neutral-start back-up light switch with shift lever in "Drive" position.

d. Reassembly of Lower End

NOTE: *Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Apply a thin coat of E.P. **1 Grease to all friction surfaces.**

CAUTION: *Only the specified screws should be used during assembly operations.*

1. Press the lower bearing assembly into adapter assembly.

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. See Figure 90-102.

3. (Manual Transmission Only) Loosely attach three screws in jacket and shift tube bearing. See Figure 90-97.

4. (Automatic Transmission) Assemble the spring ahd adapter assembly into the bottom of the jacket. Holding the adapter in place, insert the snap ring in the jacket slots.

(Manual Transmission) Assemble the first/reverse lever and adapter assembly into the bottom of the jacket. Holding the adapter in place, insert the snap ring in the jacket slots. See Figure 90-108.

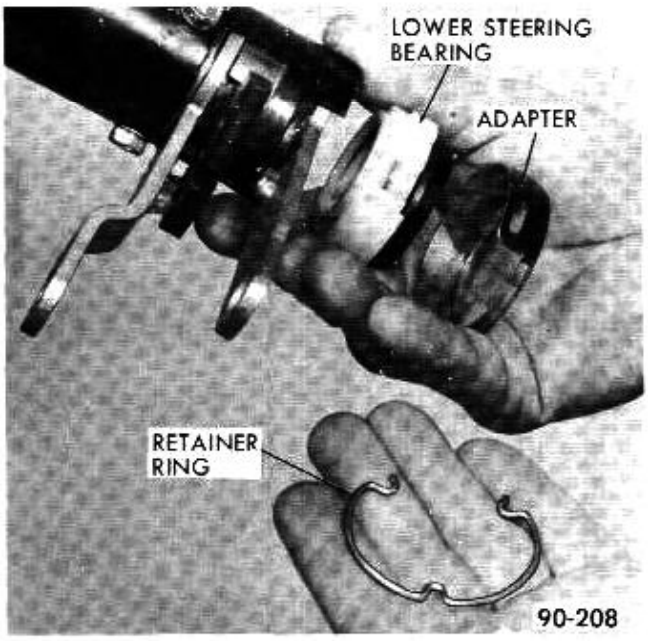


Figure 90-108 - Installing Lower Steering Column Bearing - Manual Transmission

5. (Manual Transmission Only) Place a .005 shim between first/reverse lever and lever spacer and turn upper shift bearing down and tighten the three screws. Remove shim. See Figure 90-109.

Figure 90-109 - Adjusting Shift Tube Bearing

6. (Automatic Transmission) Install the neutral- start switch, making certain the proper screws are used. See Figure 90-94.

(Manual Transmission) Install back-up switch, make certain only the proper screws are used. See Figure 90-94.

7. Slide steering shaft assembly into column.

NOTE: *The upper housing should be in place before the shaft is assembled.*

8. Depress shaft lock plate using Tool J-23653 and install a new snap ring in groove on shaft.

NOTE: *The turn signal switch assembly may be damaged if the above procedure is not followed.*

9. Place cover on shaft lock and install screws.

10. Install steering wheel and levers. Be sure to use tongue depressor on bowl spring. Be sure bowl is in "Drive" when inserting shift lever.

11. Adjust neutral-start back-up light switch with shift lever in "Drive" position.

90-26 DISASSEMBLY AND ASSEMBLY OF TILT STEERING COLUMN

NOTE: *All elements of energy absorbing columns are sensitive to damage and MUST BE HANDLED WITH CARE.*

a. Disassembly (Column Out of Car)

NOTE: *If service is required on the upper end only, steps 1 thru 24 may be performed in the car. It will be necessary however, to lower steering column from instrument panel so that bracket can be removed to allow removal of turn signal switch and wires.*

1. Remove column mounting bracket from column and SET ASIDE TO PROTECT BREAKAWAY CAPSULES.

2. Mount assembly in vise by clamping weld nuts on column in vise.

3. Remove steering wheel using specified wheel puller.

CAUTION: *DO NOT HAMMER ON END OF STEERING SHAFT.*

4. Remove signal switch wire protector. See Figure 90-110.

5. Remove three cover screws and remove cover.

6. Remove tilt release lever, turn signal switch lever, push hazard warning plunger in and remove hazard warning knob. Remove upper shift lever from bowl.

Figure 90-110 - Signal Switch Wire Protector

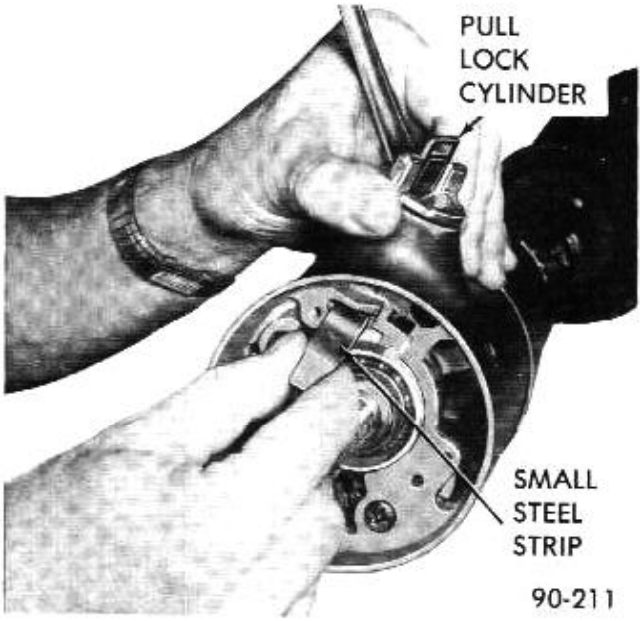


Figure 90-111 - Removing Ignition Lock Cylinder

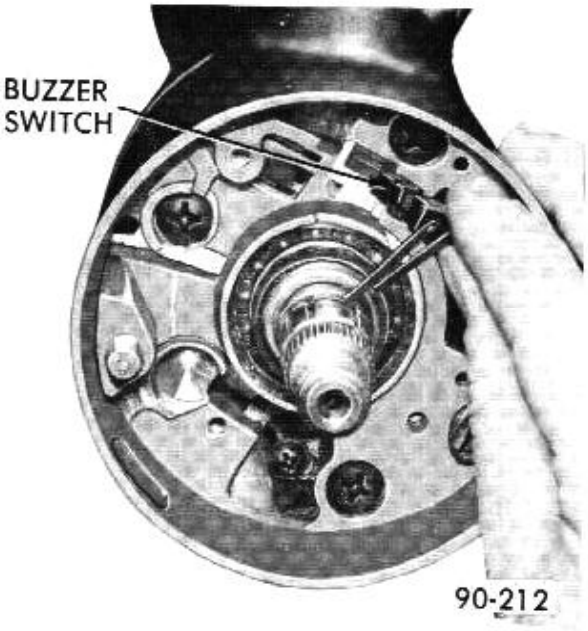


Figure 90-112 - Removing Buzzer Switch

7. Depress lock plate using tool J-23131 and the steering wheel nut. Pry the round wire snap ring out of the shaft groove and discard ring. Remove the shaft lock plate. See Figure 90-84.

8. Remove cancelling cam and cancelling cam spring.

9. Remove three turn signal switch mounting screws. Wrap a piece of tape around the upper part of the connector and wires to prevent snagging when removing switch. See Figure 90-85.

10. Position shift bowl or shroud (if floor shift column) in "Low" position. Pull the switch straight up.

11. The lock cylinder may be removed in ay position from "Accessory" to "Run". However, the accessory position is recommended because of its positive location.

12. Insert a thin tool (small screwdriver or knife blade) into the slot next to the switch mounting screw boss (right-hand slot) and depress spring latch at bottom of slot, which releases lock. Remove lock. See Figure 90-111.

13. The buzzer switch can be pulled straight out of the housing. (This may be done without removing the lock cylinder. However, the lock cylinder must be in the "Run" position.) See Figure 90-112.

NOTE: *Do not pull on switch terminals. Use a bent wire or needle nose pliers to pull on switch clip.*

14. Remove three housing cover screws and remove housing cover.

15. 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 slot, press in approximately 3/16 inch, turn approximately 1/8 turn counterclockwise until cars align with grooves in housing and remove spring and guide. See Figure 90-113.

CAUTION: *Care should be observed when releasing tilt spring due to high compression rate of the spring.*

16. Place tilt column in neutral position, and push upper steering shaft in sufficiently to remove steering shaft inner race seat and inner race.

17. (In car) Remove upper flange pinch bolt.

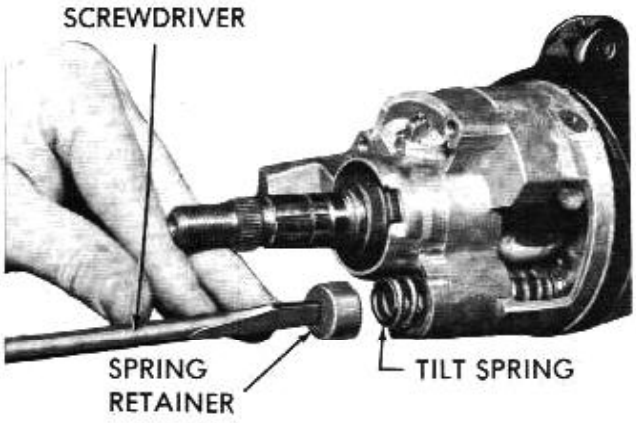


Figure 90-113 - Removing Tilt Spring Retainer

(Out of car) Remove lower steering shaft flange, no- back washer (if one is used), spacer, spring, clip and bearing adapter assembly at lower end of the mast jacket.

18. With ignition switch in "Accessory" position, remove two ignition switch mounting screws and ignition switch. Remove two neutral-start switch screws and neutral-start switch.

19. Remove two pivot pins with Tool No. J-21854-1. See Figure 90-116.

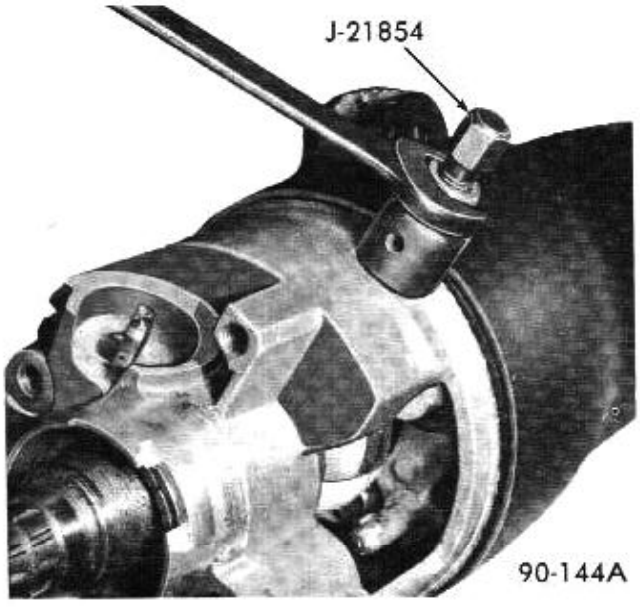


Figure 90-116 - Removing Pivot Pin

20. Install tilt release lever place in full "UP" 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. Remove actuator rod assembly.

21. Remove steering shaft assembly from upper end.

22. Disassemble steering shaft assembly by removing centering spheres and anti-lash spring. See Figure 90-117.

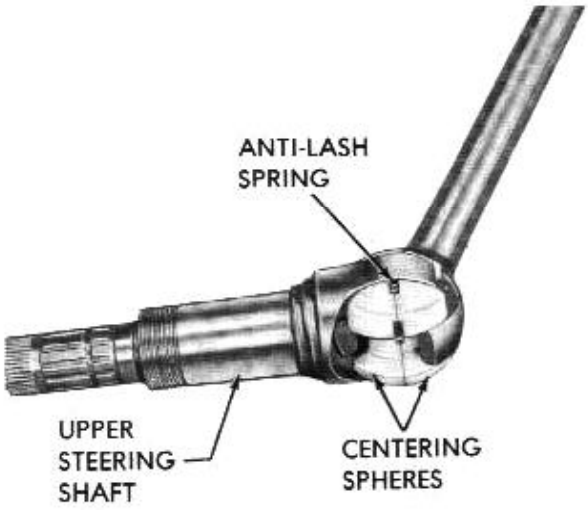


Figure 90-117 - Steering Shaft and Centering Spheres

23. Remove four support screws and remove support assembly.

24. Remove shift tube retaining ring with screwdriver. Remove thrust washer.

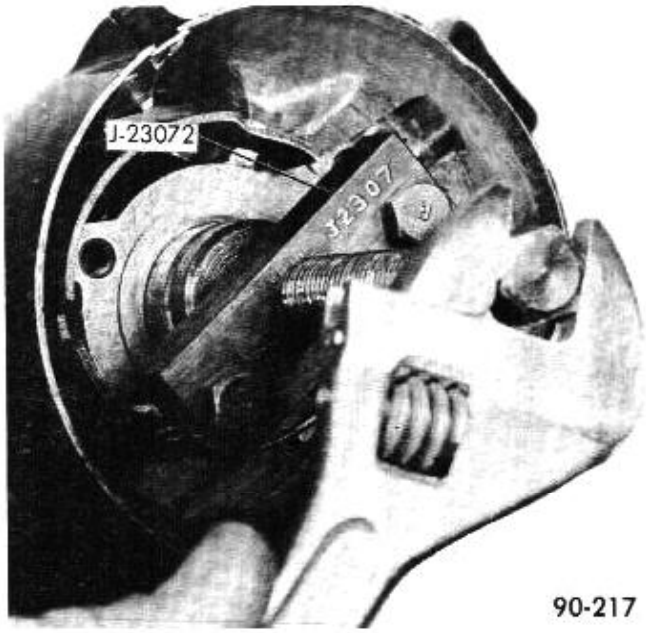


Figure 90-118 - Removing Shift Tube

25. Remove shift tube from bowl using Remover J-23072. Pilot adapter in upper end of shift tube and force tube out of bowl. Care should be taken not to jam lower shift lever into "T" slot on lower end of mast jacket while forcing out shift tube. See Figure 90- 118.

CAUTION: *Do not hammer or pull on lower or upper shift tube because plastic injection may be sheared.*

26. Remove shift tube assembly from mast jacket from lower end.

27. Remove lock plate and wave washer.

Figure 90-119 - Removing Shift Tube

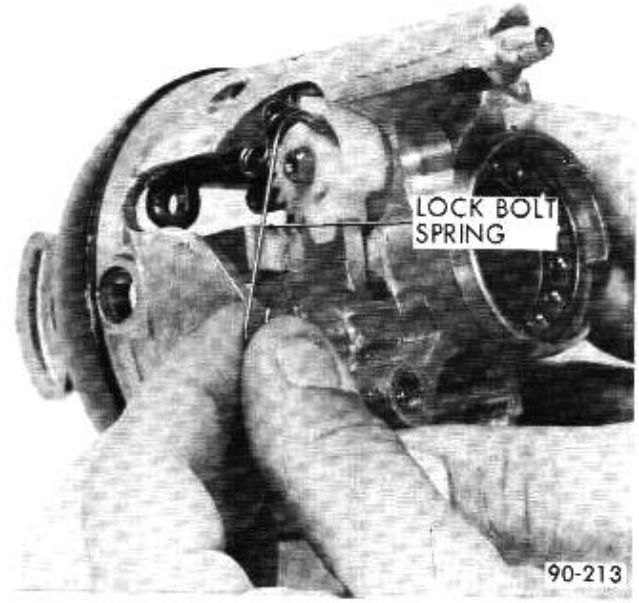


Figure 90-120 - Removing Lock Bolt Spring

28. Remove bowl from mast jacket. Remove shift lever spring from bowl by winding spring up with pliers and pulling out.

(Bearing Housing Disassembly)

1. Remove tilt lever opening shield from housing. See Figure 90-119.

2. Remove lock bolt spring by removing spring retaining screw and moving spring clockwise to remove from bolt. See Figure 90-120.

3. Remove snap ring from sector drive shaft. With small punch, lightly tap drive shaft from sector. Remove drive shaft, washer, sector and bolt. Remove rack and rack spring. See Figure 90-121.

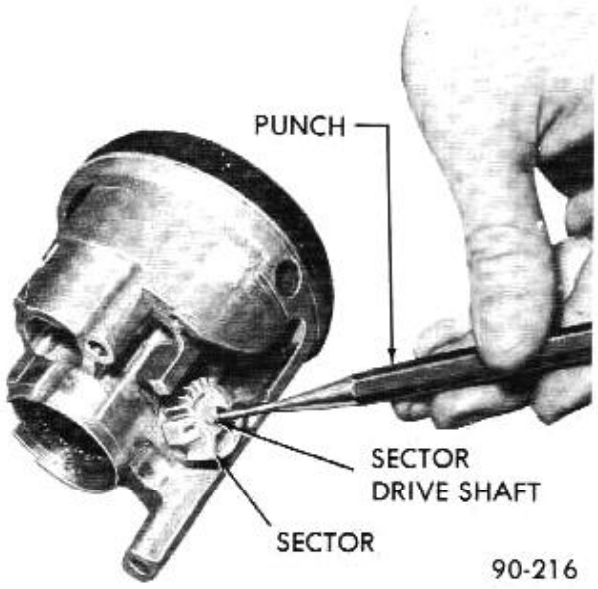


Figure 90-121 - Removing Sector Drive Shaft.

4. Remove tilt release lever pin with J-22635 and hammer. Remove lever and release lever spring. (To relieve load on release lever, hold shoes inward and wedge block between top of shoes (over slots) and bearing housing). See Figure 90-122.

5. Remove lock shoe pin with Tool J-22635 and hammer. Remove lock shoes and lock shoe springs. See Figure 90-123.

NOTE: *With tilt lever opening on left side, shoes facing up, the four slot shoe is on the left.*

6. Remove bearings from bearing housing only if they are to be replaced. Remove separator and balls from bearing. 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.

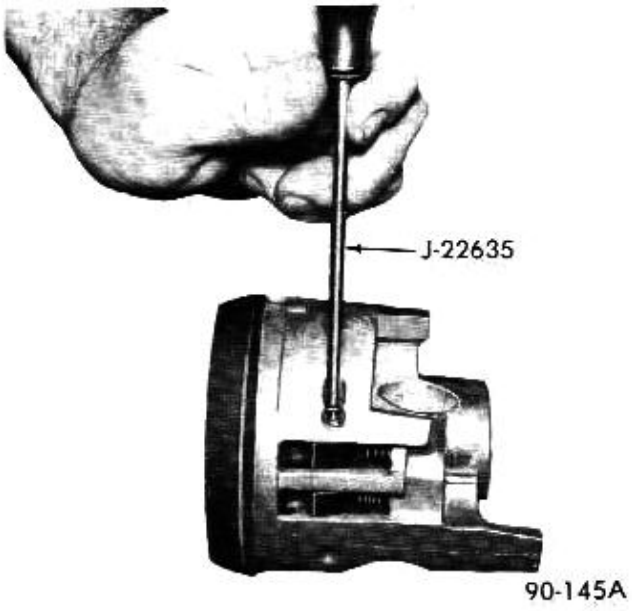


Figure 90-122 - Removing Lock Shoe Pivot Pin

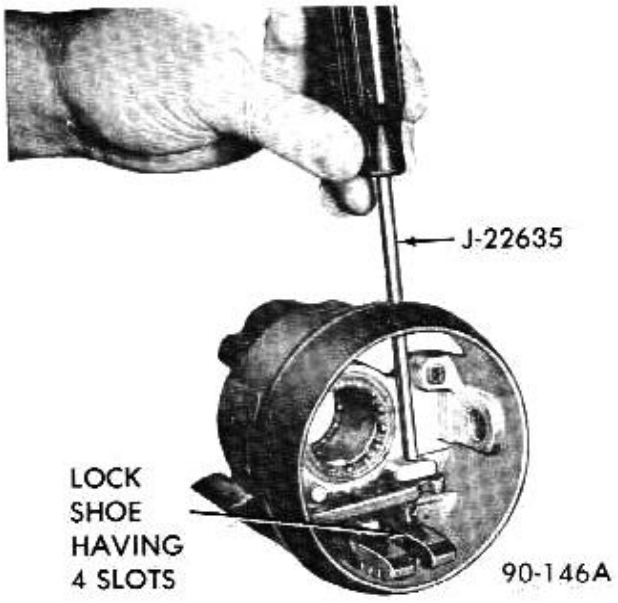


Figure 90-123 - Removing Release Pin

b. Assembly of Steering Column

NOTE: *Fasteners in the following steps are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

Apply thin coat of E.P. No. 1 Grease to all friction surfaces.

1. Install bearings in bearing housing, if removed.

2. Install lock shoe springs, lock shoe and shoe pin in bearing housing. Use .180 inch diameter rod to line up shoes for pin installation.

3. Install spring, release lever and pin in bearing housing. (Relieve load on release lever as in Step 4 of disassembly procedure.)

4. Install washer and 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. See Figure 90-124.

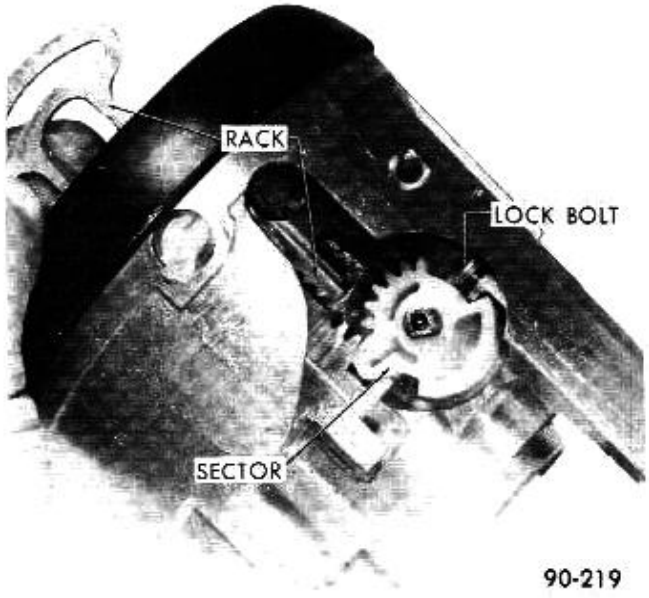


Figure 90-124 - Engaging Block Tooth on Rack to Sector

6. Install rack and spring. Block tooth on rack to engage block tooth on sector. Install external tilt release lever.

7. Install bolt spring and spring retaining screw. Torque to 35 pound inch. See Figure 90-120.

8. Install shift lever spring in bowl by winding up with pliers and pushing in. Slide bowl into mast jacket.

9. Install wave washer and lock plate in place. Work lock plate into notches in jacket.

10. Carefully install shift tube in lower end of mast jacket. Align keyway in tube with key in bowl and using Installer J-23073, pull shift tube into bowl. See Figure 90-125.

CAUTION: *DO NOT PUSH OR TAP ON END OF SHIFT TUBE.*

11. Install thrust washer and retaining ring by pulling bowl up to compress wave washer.

12. Install support by aligning "V" in support with "V"

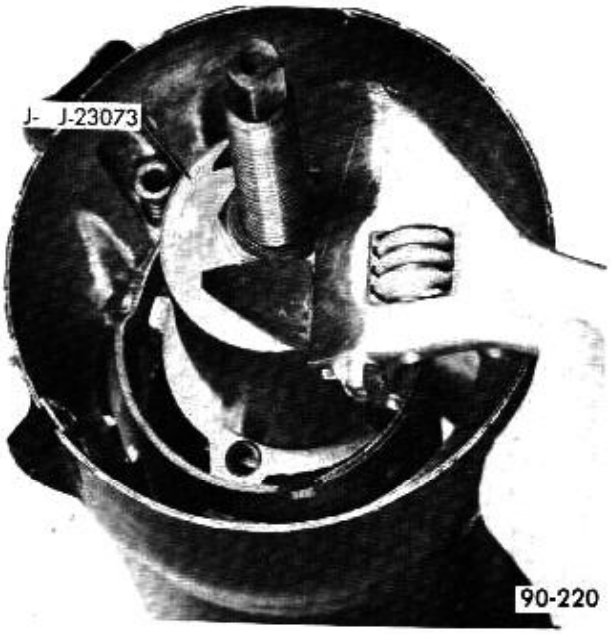


Figure 90-125 - Installing Shift Tube

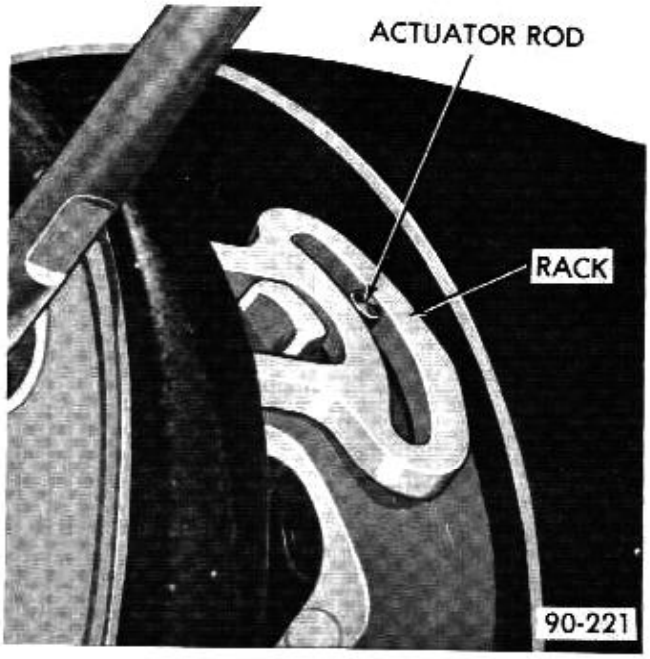


Figure 90-126 - Installing Bearing Housing

notch in jacket. Insert screws through support in lock plate. Torque screws to 60 pound inch.

13. 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.

14. Install centering spheres and anti-lash spring in upper steering shaft. Install lower steering shaft from same side of spheres that spring ends protrude.

15. Install steering shaft assembly in shift tube from upper end. Carefully guide shaft through shift tube and bearing.

16. Install ignition switch actuator rod through bowl from bottom and insert in slot in support. Extend rack downward from bearing housing.

17. Assemble bearing housing over steering shaft and engage rack over end of actuator rod. See Figure 90- 126.

18. Install external tilt release lever and, holding lock shoes in disengaged position, assemble bearing housing over steering shaft until the pivot pin holes line up.

19. Install pivot pins.

20. 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. See Figure 90-113.

21. Install inner race and inner race seat.

22. Install tilt lever opening shield in housing. See Figure 90-119.

23. Remove tilt release lever, install housing cover and torque three screws to 45 pound inch.

24. Assemble buzzer switch to spring clip with formed end of clip under end of switch and spring bowed away from switch on side opposite contact. Push switch and spring into hole in cover to the step with the contacts toward lock cylinder bore.

25. Install cruise switch wires. Install turn signal switch wires and connector through cover, bearing housing and bowl. Push hazard warning knob in, install switch and torque screws to 35 pound inch.

NOTE: *Short screw goes in hole nearest to lock cylinder.*

26. Install spring, spacer, no-back washer (if one is used) and lower steering shaft flange. Torque flange pinch bolt to 30 pound foot.

27. Install hazard warning knob and pull knob out. Install cancelling cam spring, cancelling cam and shaft lock.

28. Depress shaft lock plate using Tool J-23131 and install a new snap ring in groove on shaft.

NOTE: *The turn signal switch assembly may be damaged if the above procedure is not followed.*

29. Install tilt release lever, signal switch lever and hazard warning knob to proper torques. Install upper shift lever and drive in pivot pin.

30. To install lock, hold lock cylinder sleeve and rotate knob clockwise against stop. Insert cylinder into cover bore with key on cylinder sleeve aligned to keyway in

housing, push in to abutment of cylinder and sector. Rotate knob counterclockwise, maintaining a light push inward on cylinder, until drive section of cylinder mates with drive shaft. Push in until snap ring pops into groove and lock cylinder is secured in cover. Check freedom of rotation.

31. Install shaft lock cover and torque three screws to 35 lb.in.

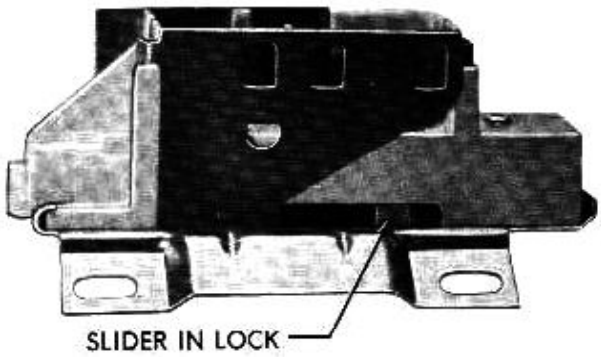
32. When installing the ignition switch, be sure the lock cylinder is in "Lock" position. Put bowl or shroud (if floor shift column) in "park" position. Make certain that the ignition switch is in "Lock". Fit actuator rod into switch and assemble to column with two screws. Torque the two screws to 35 lb.in. See Figure 90-128.

33. Install neutral-start back-up light switch. Do not tighten screws. Neutral-start switch will be adjusted in the car.

34. Install wire protector over wires and on mast jacket. Install mounting bracket. See Figure 90 110.

35. Install steering wheel. Torque steering wheel nut to specified torque. Install horn actuator parts.

36. Adjust neutral-start back-up light switch with shift lever in "Drive" position.



90-222

Figure 90-128 - Ignition Switch Slider in "Lock" Position

DIVISION VI SPECIFICATIONS

90-27 SPECIFICATIONS

Part	Location	Torque Ft. Lbs.
Nut	Steering Wheel Hub	35
Bolt	Mounting Bracket to Steering Column	15
Nuts	Flexible Coupling Halves	20
Bolt	Flexible Coupling Upper Half to Lower Half	20
Nuts	Mounting Bracket to Instrument Panel	20

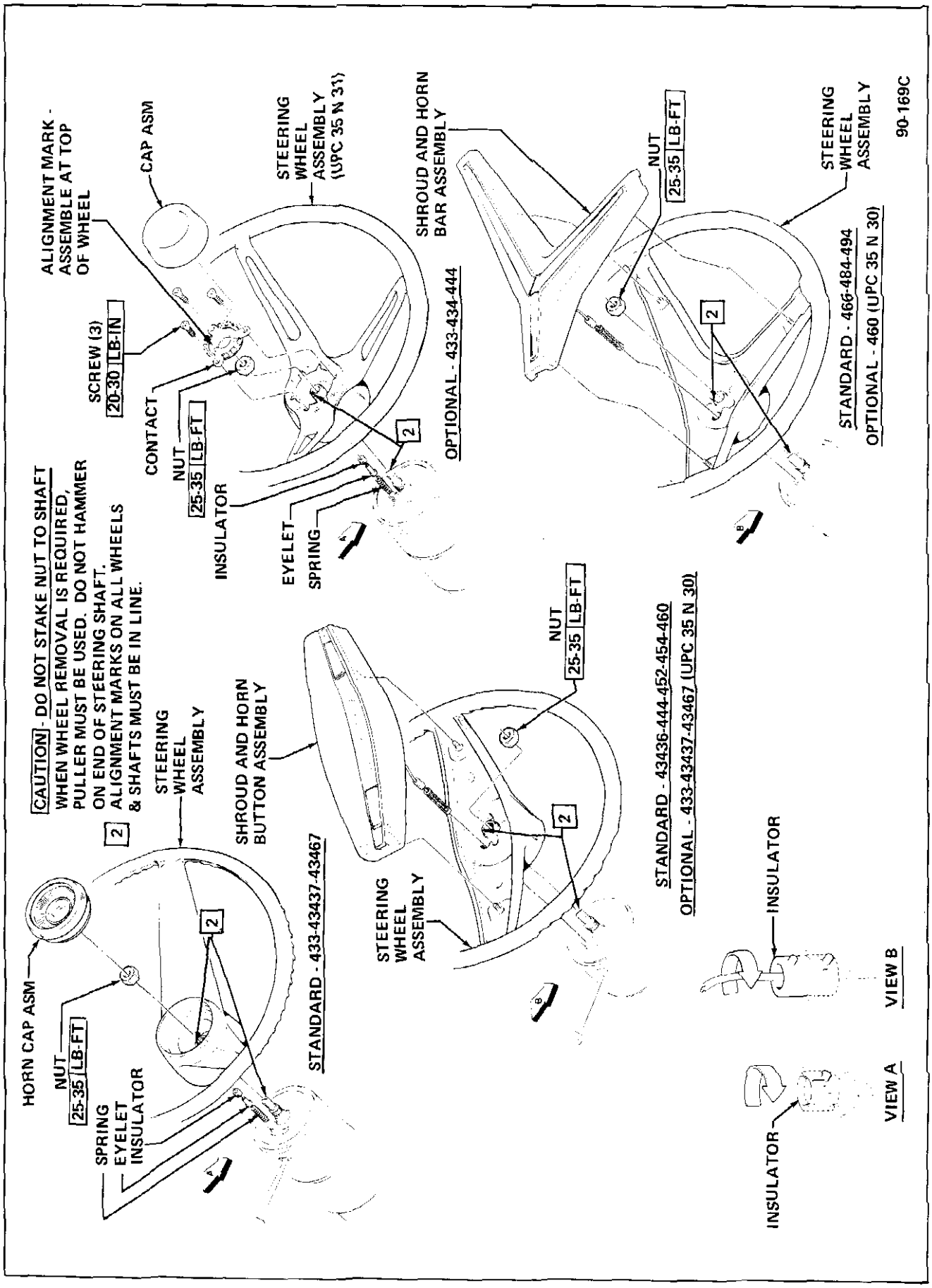


Figure 90-129 Steering Wheel Installation

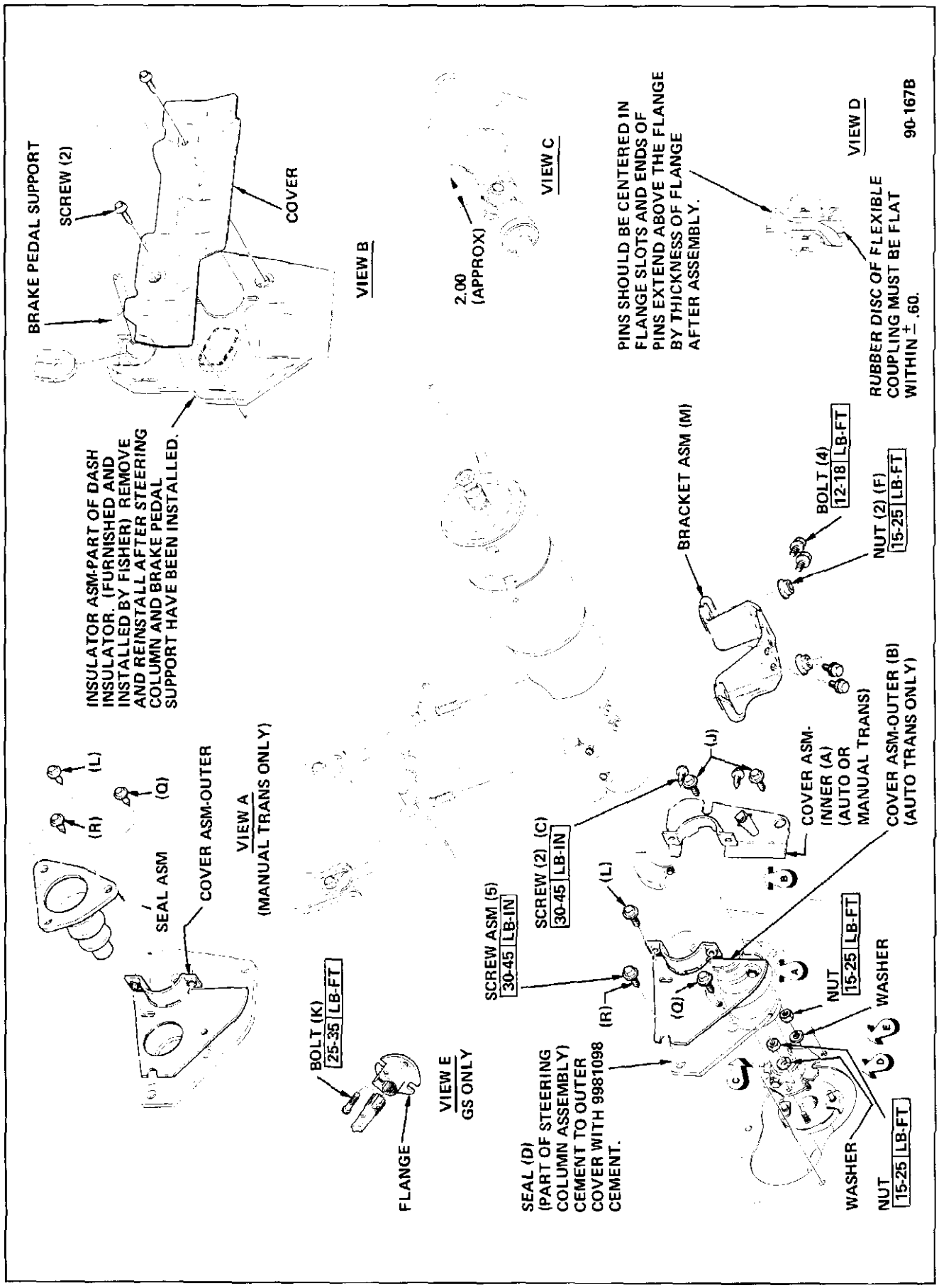


Figure 90-130 43-44000 Steering Column Installation

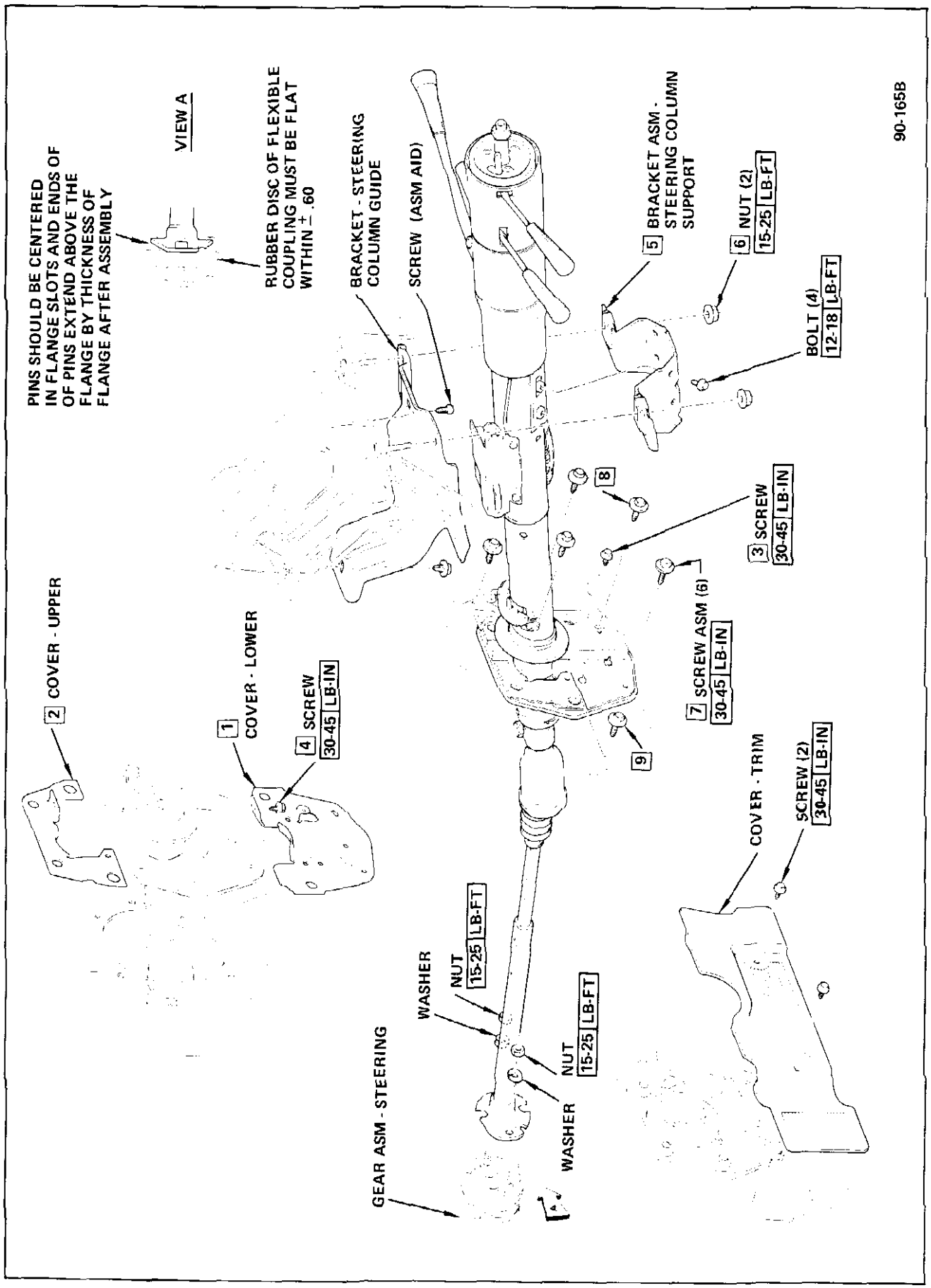
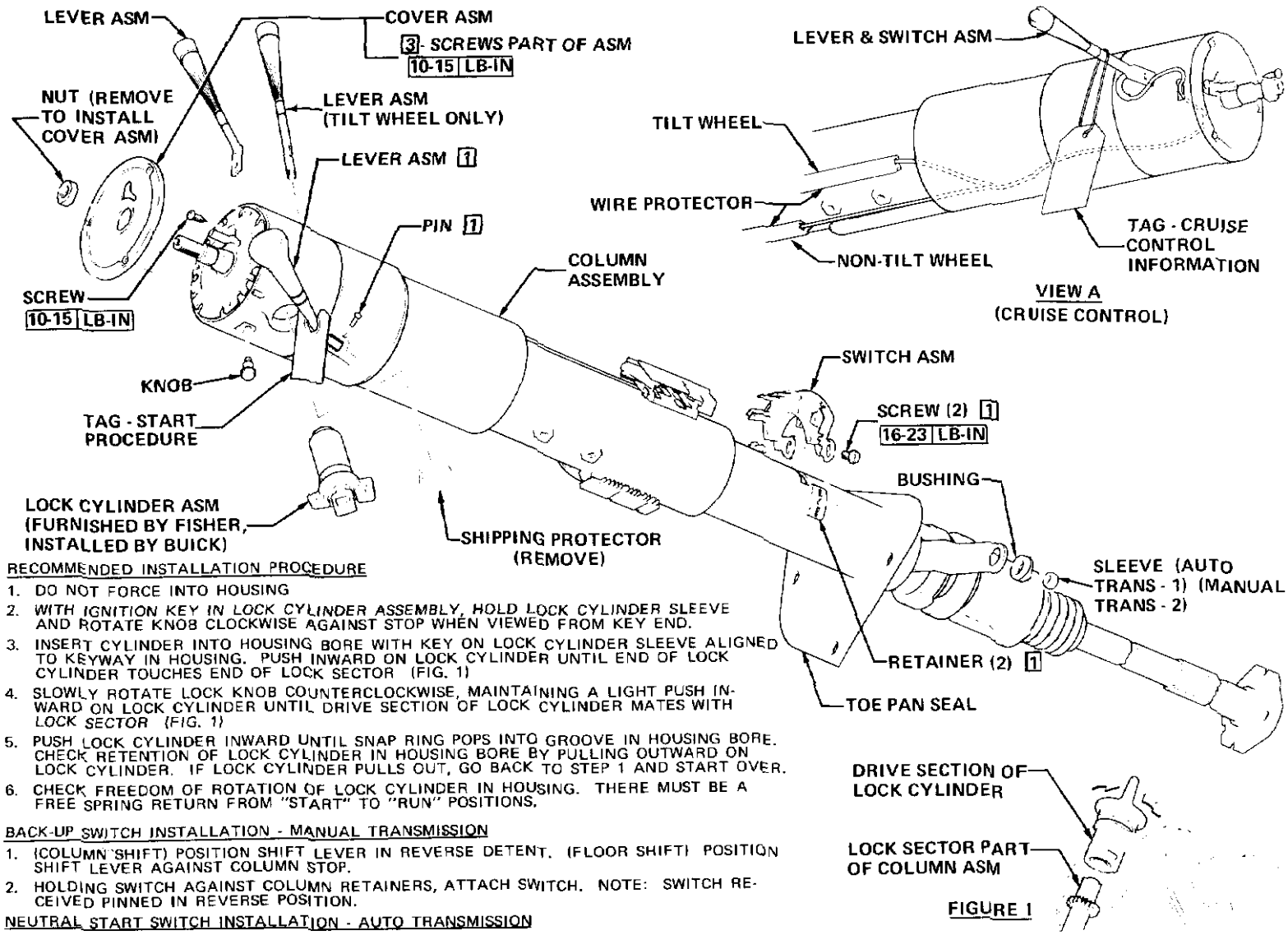


Figure 90-131 45-46-48-49000 Steering Column Installation and Upper Controls



RECOMMENDED INSTALLATION PROCEDURE

1. DO NOT FORCE INTO HOUSING
2. WITH IGNITION KEY IN LOCK CYLINDER ASSEMBLY, HOLD LOCK CYLINDER SLEEVE AND ROTATE KNOB CLOCKWISE AGAINST STOP WHEN VIEWED FROM KEY END.
3. INSERT CYLINDER INTO HOUSING BORE WITH KEY ON LOCK CYLINDER SLEEVE ALIGNED TO KEYWAY IN HOUSING. PUSH INWARD ON LOCK CYLINDER UNTIL END OF LOCK CYLINDER TOUCHES END OF LOCK SECTOR (FIG. 1)
4. SLOWLY ROTATE LOCK KNOB COUNTERCLOCKWISE, MAINTAINING A LIGHT PUSH INWARD ON LOCK CYLINDER UNTIL DRIVE SECTION OF LOCK CYLINDER MATES WITH LOCK SECTOR (FIG. 1)
5. PUSH LOCK CYLINDER INWARD UNTIL SNAP RING POPS INTO GROOVE IN HOUSING BORE. CHECK RETENTION OF LOCK CYLINDER IN HOUSING BORE BY PULLING OUTWARD ON LOCK CYLINDER. IF LOCK CYLINDER PULLS OUT, GO BACK TO STEP 1 AND START OVER.
6. CHECK FREEDOM OF ROTATION OF LOCK CYLINDER IN HOUSING. THERE MUST BE A FREE SPRING RETURN FROM "START" TO "RUN" POSITIONS.

BACK-UP SWITCH INSTALLATION - MANUAL TRANSMISSION

1. (COLUMN SHIFT) POSITION SHIFT LEVER IN REVERSE DETENT. (FLOOR SHIFT) POSITION SHIFT LEVER AGAINST COLUMN STOP.
2. HOLDING SWITCH AGAINST COLUMN RETAINERS, ATTACH SWITCH. NOTE: SWITCH RECEIVED PINNED IN REVERSE POSITION.

NEUTRAL START SWITCH INSTALLATION - AUTO TRANSMISSION

1. POSITION AND RETAIN GEAR SHIFT LEVER IN NEUTRAL NOTCH IN COLUMN DETENT.
2. SEAT SWITCH FULLY ON COLUMN.
3. SECURE SWITCH WITH SCREWS TO SPECIFIED TORQUE. NOTE: SWITCHES ARE RECEIVED PINNED IN "NEUTRAL" POSITION. PIN WILL BREAK WITH FIRST SHIFT MOVEMENT. "NEUTRAL" IS LOCATED AFTER PIN IS BROKEN BY INSERTING A .092 DIA. PIN THROUGH THE SERVICE HOLE (MARKED "N") AND THE SUPPORT.

FIGURE 1

90-250

Figure 90-132 Steering Column and Upper Controls - 43-44000

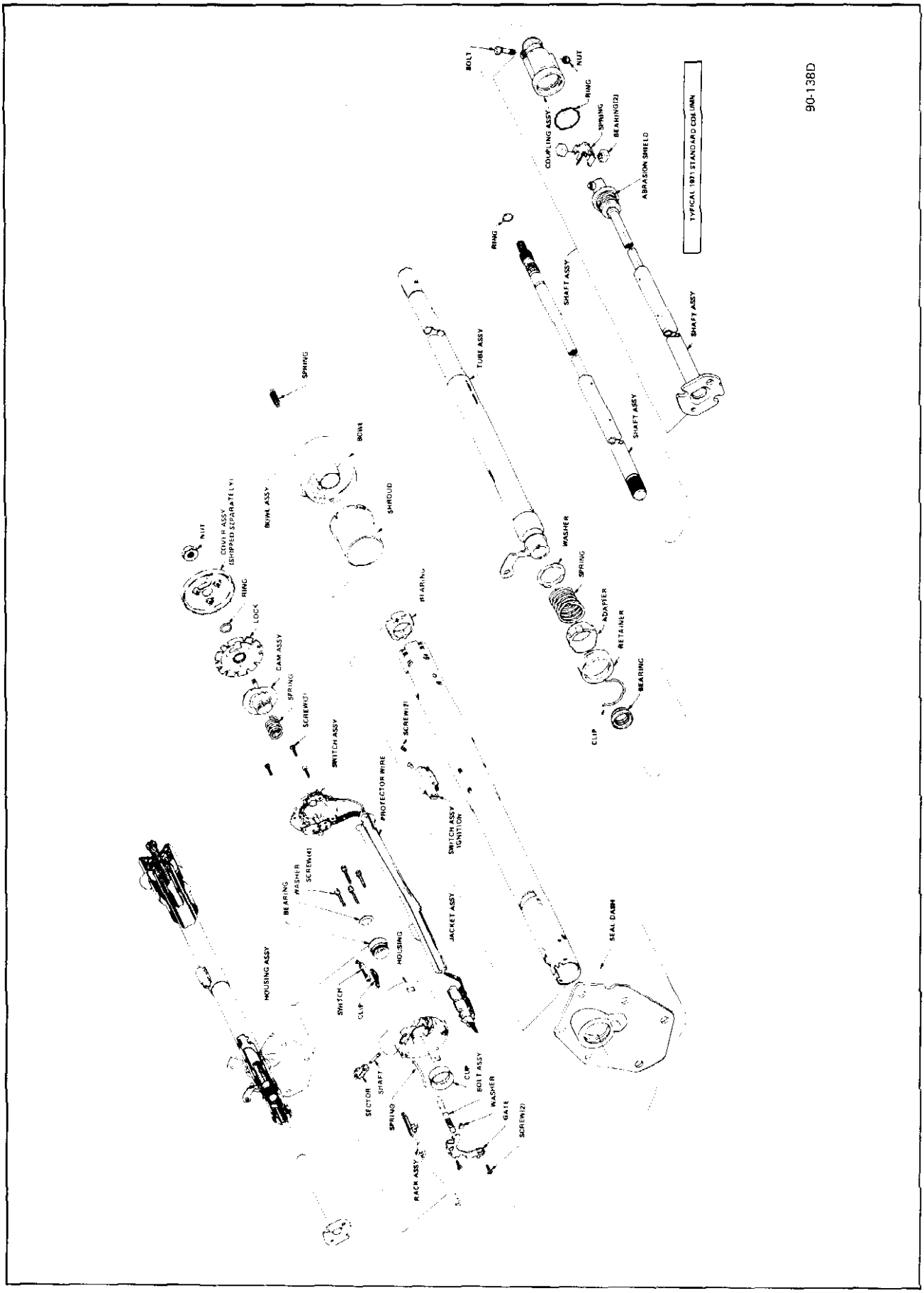


Figure 90-134 All Series Standard Steering Column

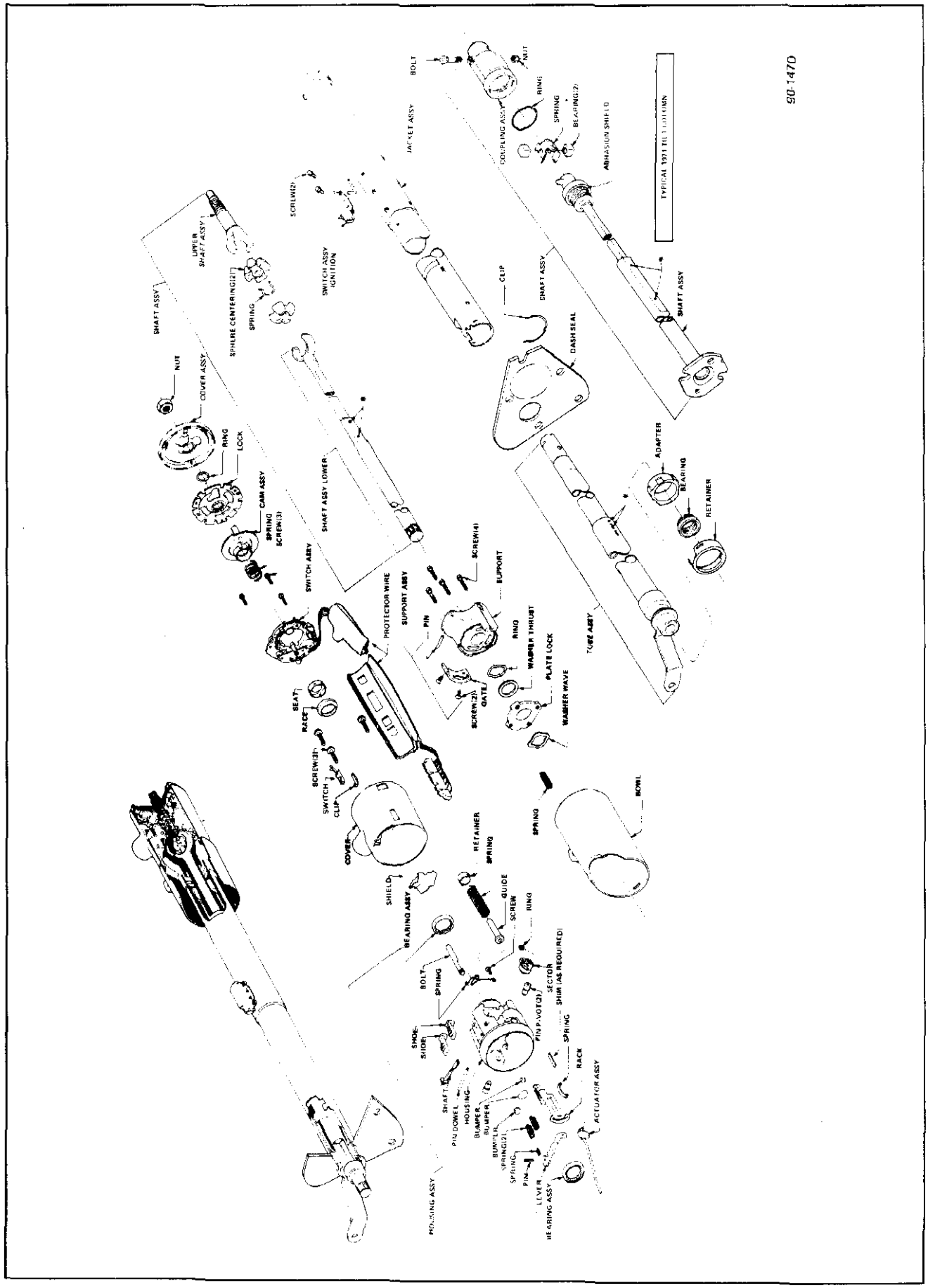


Figure 90-135 Tilt Steering Column - Typical

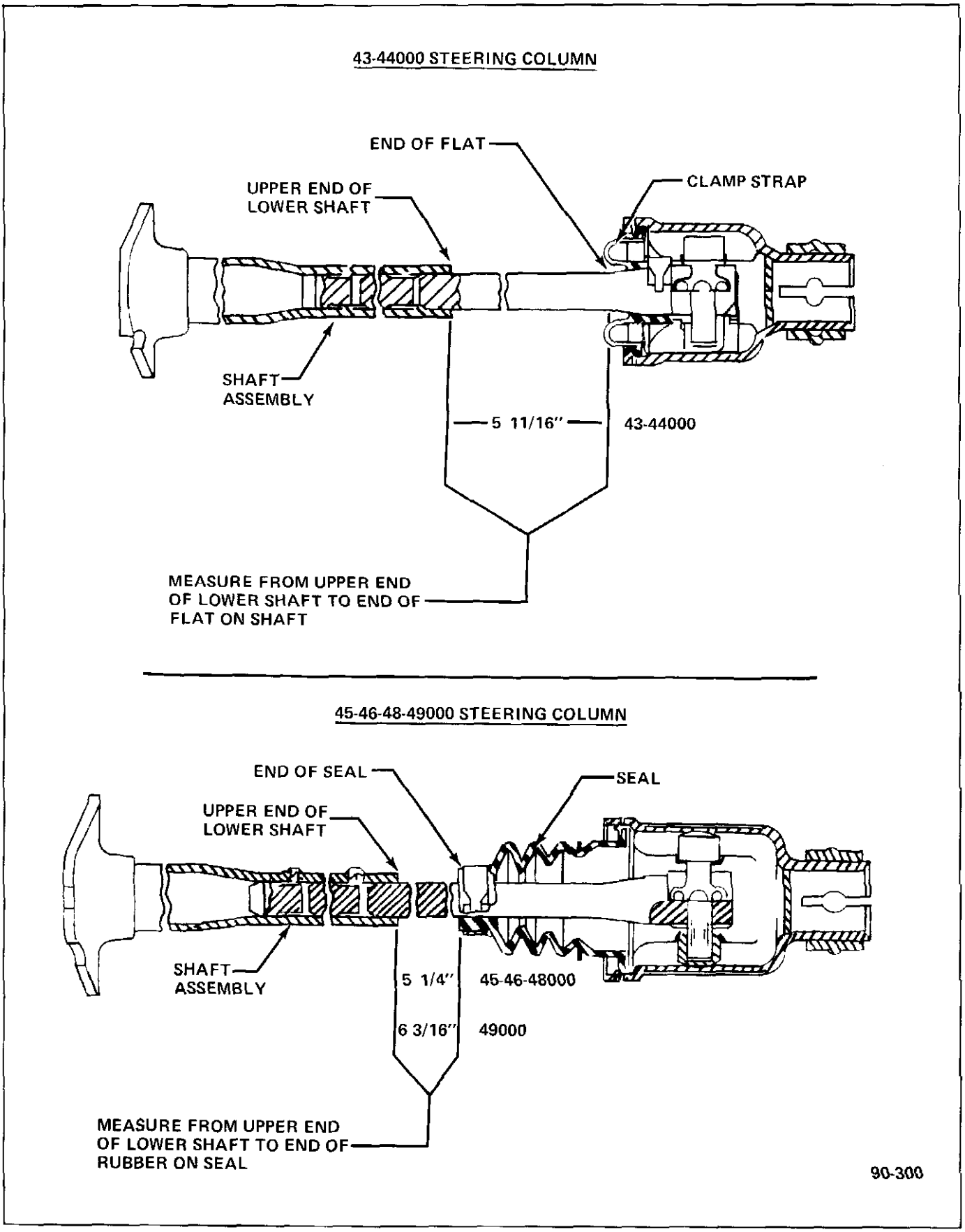


Figure 90-136

SECTION B

POWER STEERING GEAR and PUMP ALL SERIES

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	Description and Operation of Power Steering Oil Pump and Hoses	90-9
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	Removal and Installation of Pitman Shaft Seals, Gear In Car	90-12
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	Removal and Installation of Power Steering Oil Pump	90-14
	Removal and Installation of Oil Pump Shaft Seal With Pump Assembled	90-15
V	OVERHAUL AND MAJOR SERVICE:	
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DIVISION I

TROUBLE DIAGNOSIS

90-7 TROUBLE DIAGNOSIS

NOTE: *This paragraph covers only those causes of trouble which may be due to the hydraulic power mechanism. Causes which are due to the steering linkage and front suspension are the same as described for standard steering gear.*

COMPLAINT AND CAUSE	CORRECTION
a. HARD STEERING WHILE DRIVING	
1. Lower coupling flange rubbing against adjuster plug.	1. Loosen pinch bolt and assemble properly. There should be 1/16" clearance between plug and flange.
2. Steering adjustment tight.	2. Check adjustment by disconnecting pitman arm from gear. (Par. 90-11)
3. Insufficient pressure build-up in gear power cylinder due to leak or faulty valve.	3. Replace defective parts.
4. Incorrect installation or operation of the gear check valve poppet.	4. Check operation of valve, paragraph 90-18, subparagraph c, Step 6. (See Figure 90-23)
b. POOR RETURN OF STEERING GEAR TO CENTER	
1. Lower coupling flange rubbing against adjuster plug.	1. Loosen pinch bolt and assemble properly.
2. Tighten pitman sector to rack-piston nut adjustment.	2. Adjust in car to specification. Par. Par. 90-11
3. Rack-piston nut to worm preload too tight.	3. Remove gear and replace balls as required.
4. Thrust bearing adjustment incorrect.	4. Adjust to specification.
5. Sticky valve spool.	5. Remove and clean valve. Replace rotary valve assembly if necessary.
6. Steering column misalignment	6. Realign
c. PUMP INOPERATIVE OR POOR OR NO ASSIST	
NOTE: Refer to subparagraph i, Step 4, to determine if pump is at fault.	
1. Loose drive belt.	1. Tighten belt.
2. Low oil level.	2. Fill reservoir.
3. Air in the oil.	3. Locate source of air leak and correct.
4. Defective hoses.	4. Replace hose.
5. Flow control valve stuck open.	5. Remove burrs or dirt.
6. Loose screw in end of flow control valve.	6. Tighten.
7. Pressure plate not flat against ring.	7. Properly seat pressure plate against ring.
8. Extreme wear of pump ring.	8. Replace part.
9. Scored pressure plate, thrust and/or rotor.	9. Lap off light scoring. Replace heavily scored parts.
10. Vanes not installed properly.	10. Install properly.
11. Vanes sticking in rotor slots.	11. Free up by removing burrs or dirt.
12. Faulty flow control valve assembly.	12. Replace assembly.
13. "O" ring improperly installed on pressure union.	13. "O" ring must be in groove nearest outlet of union.
14. End plate improperly installed or seal damaged.	14. Install properly. Replace seal.

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TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

COMPLAINT AND CAUSE	CORRECTION
d. MOMENTARY INCREASE IN EFFORT WHEN TURNING WHEEL FAST TO THE RIGHT OR TO THE LEFT.	
1. Air in system.	1. Bleed gear.
2. Low oil level in pump.	2. Check oil level in pump reservoir.
3. High internal leakage.	3. Replace rack-piston ring and back-up "O" ring, rack-piston nut end plug seal, and/or replace valve.
NOTE: With engine idling, very fast movements of steering wheel may give higher effort or feel. This is a normal result and will last momentarily until the system "catches up" with the position of the valve.	
e. EXTERNAL OIL LEAKS	
NOTE: Wipe gear and pump thoroughly and make sure source of leakage is determined.	
1. Gear leaks.	
(a) Loose hose connections.	(a) Tighten.
(b) Damaged hose.	(b) Replace.
(c) Side cover "O" ring seal.	(c) Replace seal.
(d) Pitman shaft seal.	(d) Replace seals.
(e) Housing end plug "O" ring seal.	(e) Replace seal.
(f) Adjuster plug "O" ring seal.	(f) Replace seal.
(g) Torsion bar "O" ring seal (See Figure 90-17).	(g) Replace valve.
(h) Pitman shaft lash adjuster nut.	(h) Replace nut.
(i) Stub shaft seal.	(i) Replace seal.
2. Pump leaks.	
(a) Oil leaking at top of reservoir as it is too full.	(a) Remove oil to proper level.
(b) Oil leaking at top of reservoir caused by air bubbles in oil.	(b) Locate source of air leak and correct.
(c) Reservoir "O" ring seal damaged or improperly installed.	(c) Replace "O" ring.
(d) Pressure union or reservoir to housing bolt and stud not tightened sufficiently.	(d) Torque union and stud and bolt to 35 lb. ft.
(e) Pressure union or reservoir to housing bolt and stud cross threaded or damaged.	(e) Replace damaged parts.
(f) Defective pressure fitting seat on hose end.	(f) Replace hose.
(g) Damaged reservoir to housing or pressure union "O" ring seals.	(g) Replace seals.
(h) Defective shaft seal.	(h) Replace seal.
(i) Damaged shaft at seal area.	(i) Replace shaft.
(j) Leaks in metal parts. (Example: Drawing crack in reservoir.)	(j) Replace defective part.

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COMPLAINT AND CAUSE	CORRECTION
f. NOISE	
1. Gear Noise (rattle or chuck).	
(a) Loose "overcenter" adjustment.	(a) Adjust to specification.
NOTE: A slight rattle may occur on turns because of the increased lash when off the "high point". This is normal and the lash must not be reduced below the specified limits to eliminate this slight rattle.	
(b) Gear loose on frame.	(b) Tighten mounting bolts to 70 lb. ft.
2. Gear Noise ("hissing" sound).	
(a) A hissing noise is natural when steering wheel is at end of travel or when slowly turning at stand still.	(a) Do not replace valve unless "hiss" is extremely objectionable. Investigate clearance around safety drive rivet pins. Be sure there is no metal-to-metal contact around flexible coupling as this will transmit valve hiss to car. Normally this shows up as an intermittant hiss. Realign steering column if necesary.
3. Gear Noise (squawk when turning or when recovering from a turn).	
(a) Cut or worn dampener "O" ring on valve spool.	(a) Replace dampener "O" ring.
4. Pump noise.	
(a) Loose belt.	(a) Tighten belt.
(b) Hoses touching other parts of car.	(b) Adjust hose positions.
(c) Low oil level.	(c) Fill reservoir.
(d) Air in the oil.	(d) Locate source of air leak and correct.
(e) Excessive back pressure caused by hoses or steering gear.	(e) Locate restriction and correct. With pressure gauge installed in pressure hose between pump and gear and engine running at 1500 RPM, oil warm, and no effort on the steering wheel. Pressure should not exceed specification. Check operation of check valve poppet, paragraph 90-18, subparagraph c, Step 6.
(f) Scored pressure plate.	(f) Lap out light scoring. Replace heavily scored part.
(g) Vanes not installed properly.	(g) Install properly.
(h) Vanes sticking in rotor slots.	(h) Free up by removing burrs and dirt.
(i) Extreme wear of pump ring.	(i) Replace part.
(j) Face of thrust plate scored.	(j) Lap out light scoring. Replace heavily scored part.
(k) Scored rotor.	(k) Lap out light scoring. Replace heavily scored part.
(l) Defective flow control valve.	(l) Replace.

TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

COMPLAINT AND CAUSE	CORRECTION
g. EXCESSIVE WHEEL KICKBACK OR LOOSE STEERING	
1. Air in system.	1. Add oil to pump reservoir and bleed.
2. Excessive lash between pitman shaft sector and rack-piston.	2. Adjust to specification.
3. Loose thrust bearing adjustment.	3. Remove gear and adjust to specification.
4. Rack-piston nut to worm preload to low.	4. Remove rack-piston nut and worm, and change balls to obtain specified preload.
5. Incorrect installation or operation of the gear check valve poppet.	5. Check operation of valve, paragraph 90-18, subparagraph c, Step 6.
h. STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING	
Loose pump belt.	Adjust to specification.
I. HARD STEERING WHEN PARKING	
1. Loose pump belt.	1. Adjust to specification.
2. Low oil level in reservoir.	2. Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage.
3. Steering gear adjustments tight.	3. Adjust to specification.
4. Insufficient oil pressure.	4. If all of the above checks do not reveal the cause of hard steering, make the following tests of oil pressure: (a) Disconnect the pressure line at oil pump. Attach pressure gage to pump. Connect the hose to end of gage where the valve is located. (b) With engine at hot idle and gage valve open, note the oil pressure on the gage while turning steering wheel from one extreme position to the other. Especially note the maximum pressure which can be built up with the wheel held in either right or left extreme position. **CAUTION**: Do not hold wheel in extreme position for an extended period of time because it will drastically increase the oil temperature and will cause undue wear on the oil pump. (c) With oil temperature between 150° F and 170° F, as measured with a thermometer in the reservoir, the maximum oil pressure should not be less than 1000 psi for satisfactory power steering operation.

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TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

COMPLAINT AND CAUSE	CORRECTION
i. **HARD STEERING WHEN PARKING** (Cont'd)	(d) If the maximum oil pressure is less than 1000 psi, it indicates trouble in the pump, oil hoses, steering gear, or a combination of these parts. To eliminate the hoses and gear, close the gauge valve and quickly test pressure of the pump only with the engine at warm idle, then open the valve to avoid increasing oil temperature. A minimum pressure of 1000 psi should be present with valve closed. (e) Comparing the maximum pressure obtained in these two tests will indicate source of trouble as follows: Step (b) pressure low and Step (d) pressure normal indicates faulty external oil lines or steering gear. Step (b) and Step (d) pressures equally low indicates faulty oil pump.
5. Low oil pressure in gear caused by restriction in hoses.	
(a) Check for kinks in hoses.	(a) Remove kink.
(b) Foreign object in hose.	(b) Remove hoses and remove restricting object or replace hose.
6. Low oil pressure due to steering gear.	
(a) Leakage at side cover "O" ring, housing end plug "O" ring, pitman shaft seals.	(a) Replace defective seals.
(b) Pressure loss in cylinder due to worn piston ring, damaged back-up "O" ring or scored housing bore.	(b) Remove gear from car for disassembly and inspection of rings and housing bore.
(c) Leakage at valve rings, valve body to worm seal, rack-piston end plug seal.	(c) Remove gear from car for disassembly and replace seals.
(d) Loose fit of spool in valve body or leaky valve body.	(d) Replace rotary valve assembly.
7. Incorrect installation or operation of the gear check popper valve.	7. To determine if the poppet valve is installed and operating correctly, disconnect the pressure hose and install a pressure gage between the hose and the pump. With the engine at warm idle (525 RPM) and no effort on the steering wheel, oil pressure should not exceed 60 psi with warm oil. If gage indicates more than 60 psi the poppet valve should be checked for correct installation. Paragraph 90-18, subparagraph c, Step 6.
j. **NO EFFORT REQUIRED TO TURN**	
Broken torsion bar.	Replace rotary valve assembly.

DIVISION II

DESCRIPTION AND OPERATION

90-8 DESCRIPTION OF POWER STEERING GEAR

All series power steering gears are basically the same except for the following differences:

1. All 45-46-48-49000 Series gears have a snap ring located at the upper end of the housing which serves as a stop for the rack-piston nut assembly.

2. LeSabre with 455 engine, Centurion, Electra, and Riviera steering gears have a larger diameter rack- piston assembly which is required on these heavier cars to give the desired steering effort. This necessitates the use of a different housing.

The power steering gear gives precise, positive steering with very little driver effort. Initial hydraulic assist is obtained with approximately .3 degrees of steering wheel rotation and one pound of effort at the steering wheel rim. Full hydraulic assist is obtained with approximately 4 degrees of wheel rotation and 3-1/4 pounds of effort at the wheel rim.

Manual steering is always available at times when the engine is not running, or in the event of pump failure. Of course, steering effort is increased under such conditions.

The driver's effort on the steering wheel is always proportional to the force necessary to turn the front wheels. When the effort on the wheel drops to less than one pound, power assistance ceases.

The upper inner end of the pitman shaft has a gear sector in mesh with a gear on the rack-piston nut. The one-piece rack-piston nut serves as a nut for the recirculating balls and as a power piston to which the oil under pressure is applied. A Teflon piston ring, backed-up by an "O" ring, are located on the lower O.D. of the rack-piston nut, and serve as a seal between the rack-piston nut and the gear housing. See Figure 90-16.

A worm shaft turns in the rack-piston nut using selectively fitted steel balls as a rolling thread. The ball groove is more shallow in the center of the worm so that when the

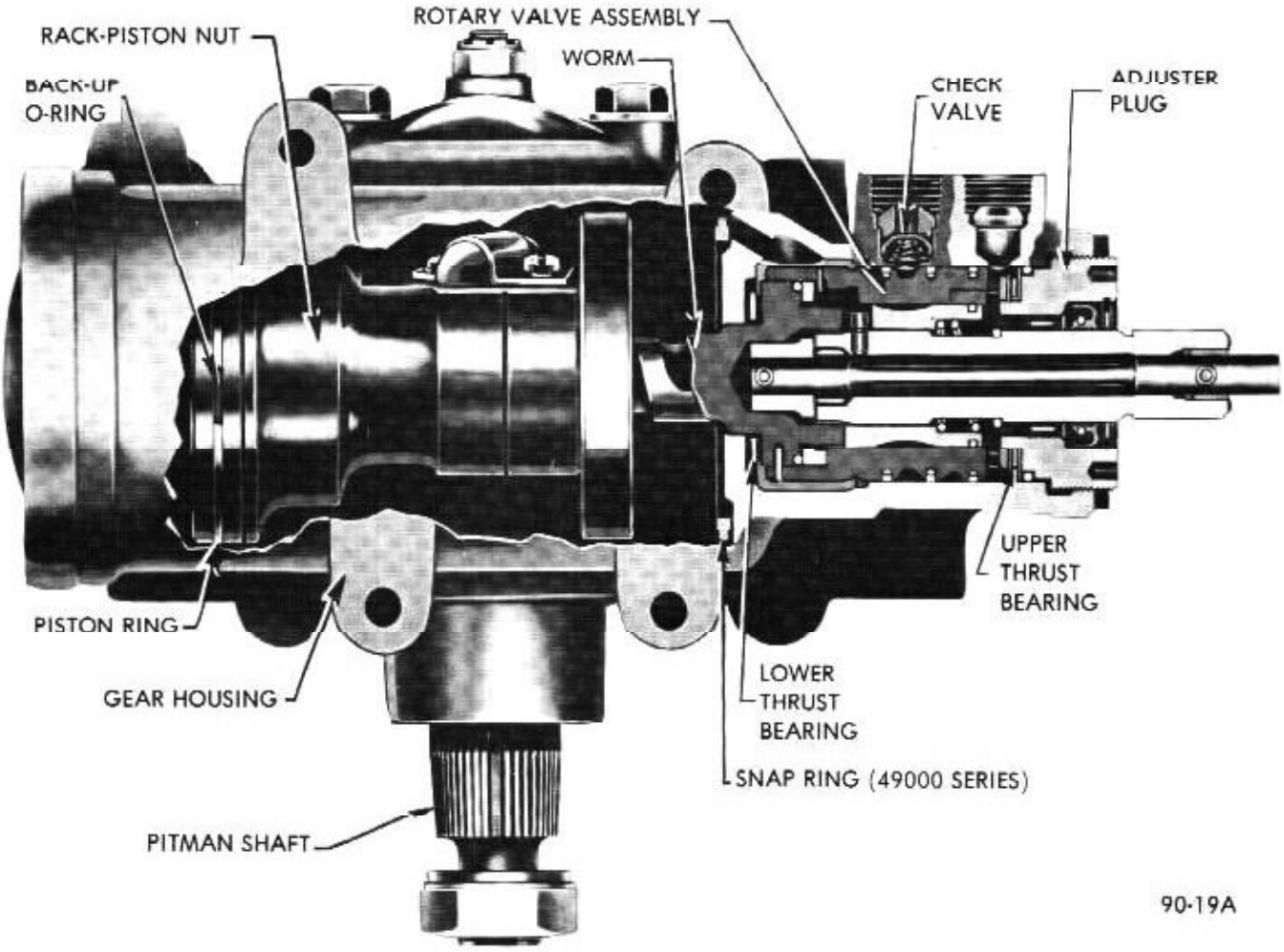

Figure 90-16 Power Steering Gear - Cutaway

proper size balls are used, there is a slight worm to rack-piston nut preload in the straight-ahead position.

Worm shaft end thrust is caused by the tendency of the worm to thread itself into or out of the rack piston nut as the steering wheel is turned right or left. The end thrust is absorbed entirely by the upper and lower thrust bearings. The upper thrust bearing is located between the valve body and adjuster plug, and the lower thrust bearing is located between the housing and upper end of worm. Worm shaft radial loads are transmitted to the gear housing through the rack-piston nut.

The steering shaft is connected to the power steering gear through a flexible coupling which is bolted to the steering shaft flange. This flexible coupling helps absorb minor shocks and vibrations and dampens out hydraulic noises and gear assembly vibrations.

The rotary valve assembly is located in the upper section of the gear housing and consists of a stub shaft, torsion bar, valve body, valve spool, and valve body cap. The rotary valve assembly controls the flow of oil from the pump to the proper side of the rack-piston nut when power assistance is required and cuts off this flow when power assistance is not required. See Figure 90-17.

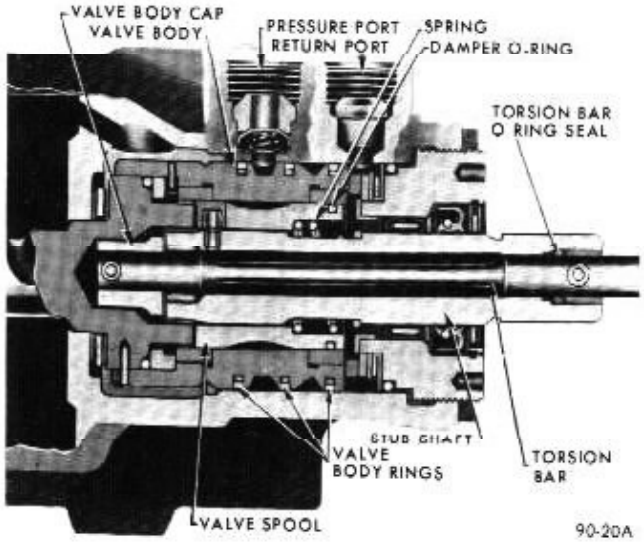

Figure 90-17 Rotary Valve Assembly

Basically the rotary valve assembly is divided into two separate assemblies which are fastened together by the torsion bar. To completely understand how the rotary valve functions, it must be known what parts are firmly connected together. Starting with the stub shaft which is fastened to the steering wheel through the steering shaft, the first assembly consists of the stub shaft, valve spool and upper end of the torsion bar. A pin on the outside diameter of the stub shaft retains the valve spool to the stub shaft. A pin at the upper end of the stub shaft connects the upper end of the torsion bar and stub shaft together. See Figure 90-18.

The balance of the assembly which is connected to the front wheels of the car through linkage, pitman shaft and

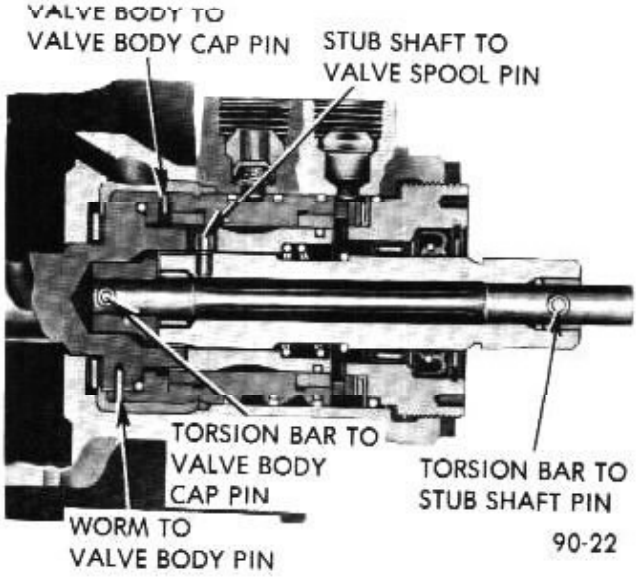

Figure 90-18 Attaching Pins for Rotary Valve Parts

rack-piston nut, consists of the worm, valve body, valve body cap and lower end of the torsion bar.

The stub shaft is attached to the steering shaft through the flange assembly. The lower flange is splined to a stub shaft and is retained by a pinch bolt. The torsion bar is located in the center of the stub shaft. The valve spool is an open center valve positioned on the lower end of the stub shaft. The valve body encloses the valve spool. The valve body cap is located at the lower end of the valve body.

The valve body has two large oil grooves around its outside diameter. Each groove has four holes drilled into the inside diameter of the valve body. The lower groove is lined up with the pressure port in the gear housing. The

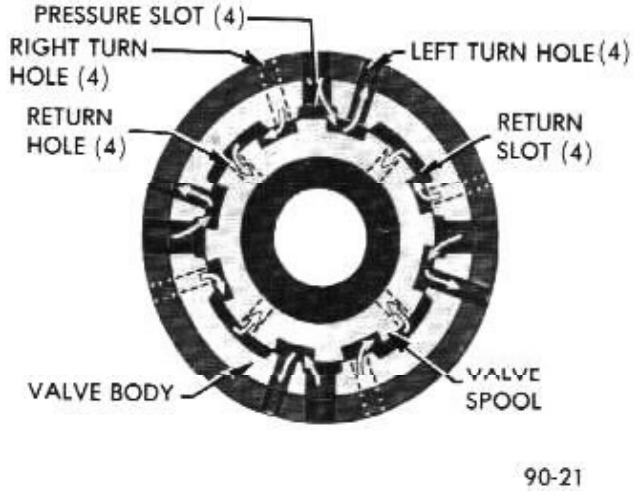

Figure 90-19 Rotary Valve - Left Turn (Upper End View)

upper groove is lined up with a drilled passage in the housing which directs oil to the right turn chamber in the housing, located at the lower end of the rack-piston nut. Three teflon rings on the valve body provide leak-proof seals for the oil grooves on the valve body. The inside diameter of the valve body has eight slots, four are connected to the pressure groove by the four drilled holes. See Figure 90-19. The other four slots, which are wider, are connected to the return port in the housing through the valve spool. Near the center of the valve body are four other drilled holes which are used to direct oil to a passage in the housing that opens to the left turn chamber. This chamber is located at the upper end of the rack-piston nut.

The valve spool which fits inside the valve body may have an outside diameter as close as only .0004 in. smaller than the inside diameter of the valve body. This close fit allows very little, if any, oil flow between the two surfaces. The valve spool has four holes drilled near the upper end of it which are in line with the four return slots in the valve body. These holes allow oil to flow from the return slots in the valve body to the center of the spool and on to return port in the housing. The outside diameter of the spool has eight slots machined on it, four are for opening the right turn holes in the valve body to the pressure slots or to the return slots in the valve body. The other four slots on the spool serve the same function for the left turn holes in the valve body.

The worm is attached to the valve body by a pin located at the upper end of the worm. A pin on the inside diameter of the valve body connects the valve body cap to the valve body. To complete this assembly, a pin attaches the valve body cap to the lower end of the torsion bar. When there is resistance to turning between the roadbed and the wheels of the car, the parts connected to the worm will also resist turning. Thus when the steering wheel is turned by the driver, the torsion bar will deflect and allow the stub shaft and valve spool to rotate with the steering wheel. When this occurs, the relationship between the valve spool and valve body is changed. The oil flow is directed by the slots on the valve spool through the holes in the valve body to the proper side of the rack-piston nut to assist the driver. The torsion bar deflection is limited to

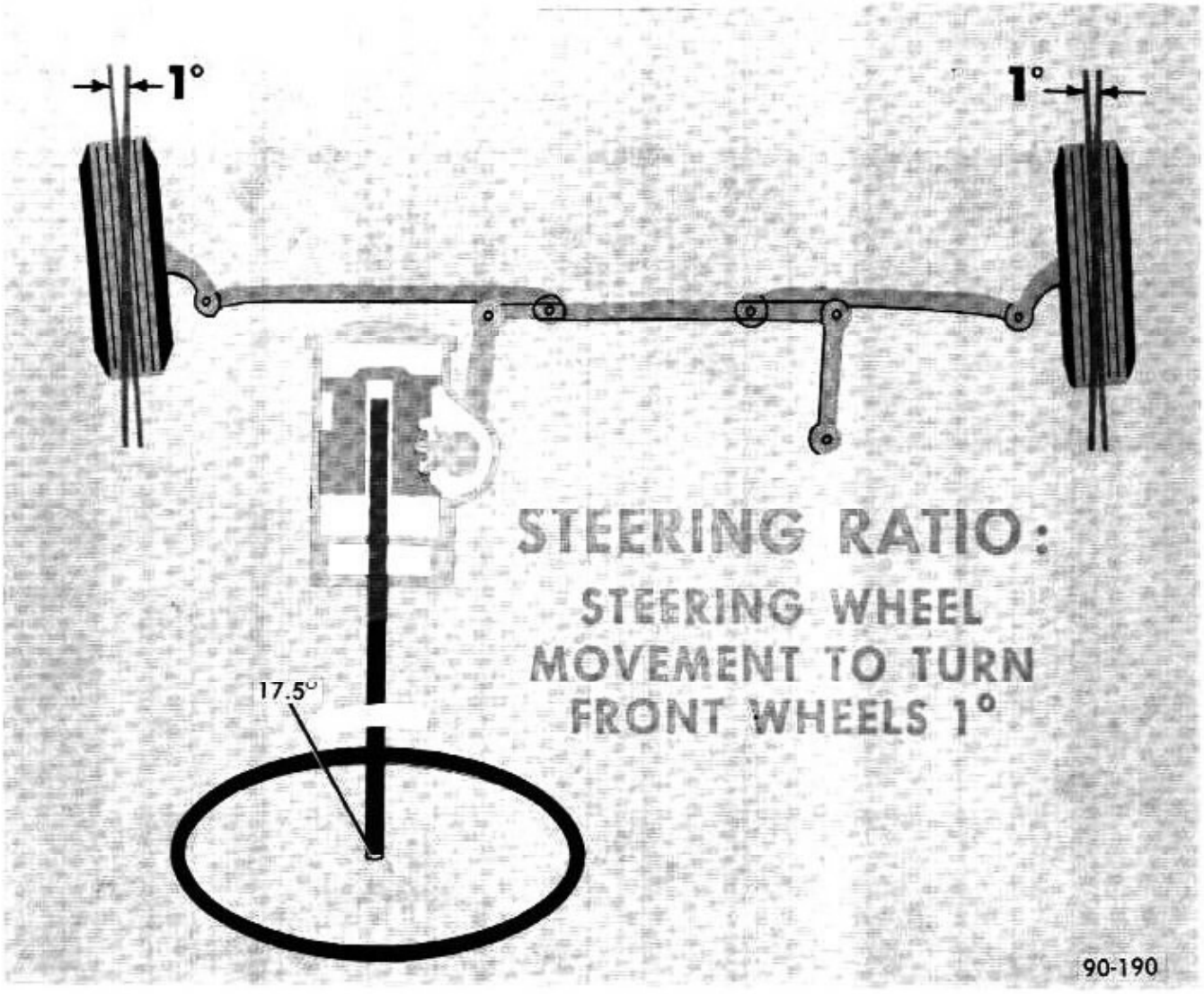

Figure 90-20 - Steering Ratio

a predetermined amount. The upper end of the worm has two tangs which fit through slots in the valve body cap and into two slots in the end of the stub shaft. In case of a power mechanism failure, the stub shaft will contact the tangs of the worm and steering will be manual.

b. Variable Ratio Feature (All Series)

The ratio of a steering system is the relationship of steering wheel movement to that of the front wheels - that is, the amount, in degrees, that the steering wheel must be turned to turn the front wheels one degree. See Figure 90-20.

For example, previous Buicks had a steering ratio of 17.-5:1, and since that was a constant ratio gear, it was necessary to turn the steering wheel approximately 17.5 degrees for each degree of turn desired.

Part of ths ratio is developed in the linkage, but the greatest part of the overall ratio is developed in the steering gear itself.

Comparatively, many American-built cars with manual steering utilize steering ratios of 28:1 to help minimize the steering effort, while lightweight sports cars often provide steering ratios as low as 10:1 for greatest turning agility.

While the terms are not specific, cars with low ratio steering are often referred to as "fast" or "quick" steering because of the car's fast response to steering wheel movements. The term "slow" steering is less frequently heard, but is sometimes applied to cars with higher steering ratios.

Steering ratio varies continuously from a moderate 16.0:1 or 15.0:1 for straight-ahead driving to a low 13.1:1 in full turns.

From the straight-ahead position, the steering ratio stays constant for the first 40 degrees of steering wheel movement, then decreases very gradually at first. This provides precise steering control for highway driving with a ratio always higher than 15:1, as passing or even steering through curves seldom requires more than a quarter turn of the steering wheel.

When cornering, such as at an intersection, the ratio spread will be somewhat broader - anywhere between 16:1 and 13.1:1 -- as the steering necessary generally ranges from a half to a full turn of the steering wheel.

While this provides an excellent average cornering ratio of about 14:1, the most important factor is that the response increases as the need increases!

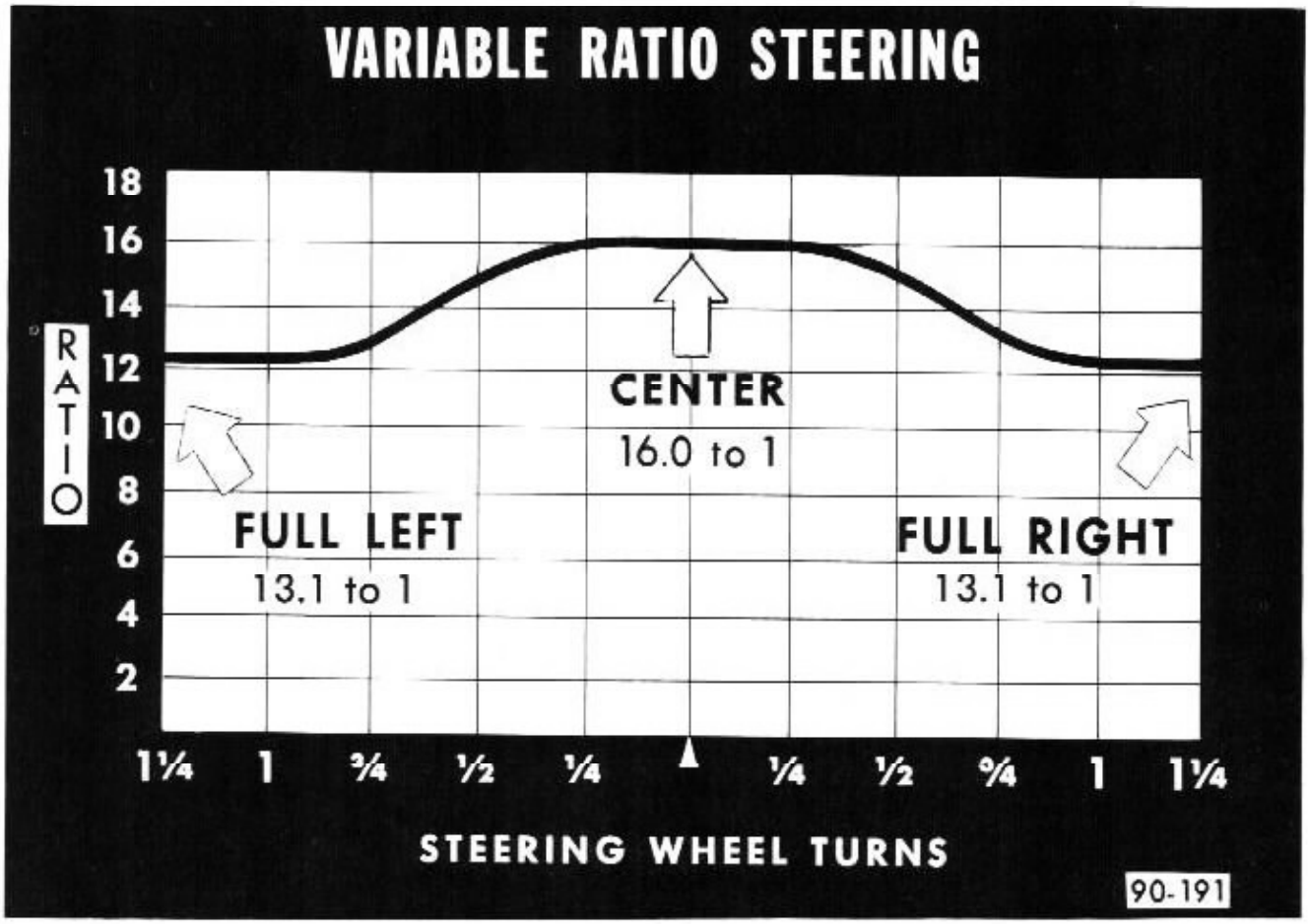

Figure 90-21 - Variable Ratio Steering

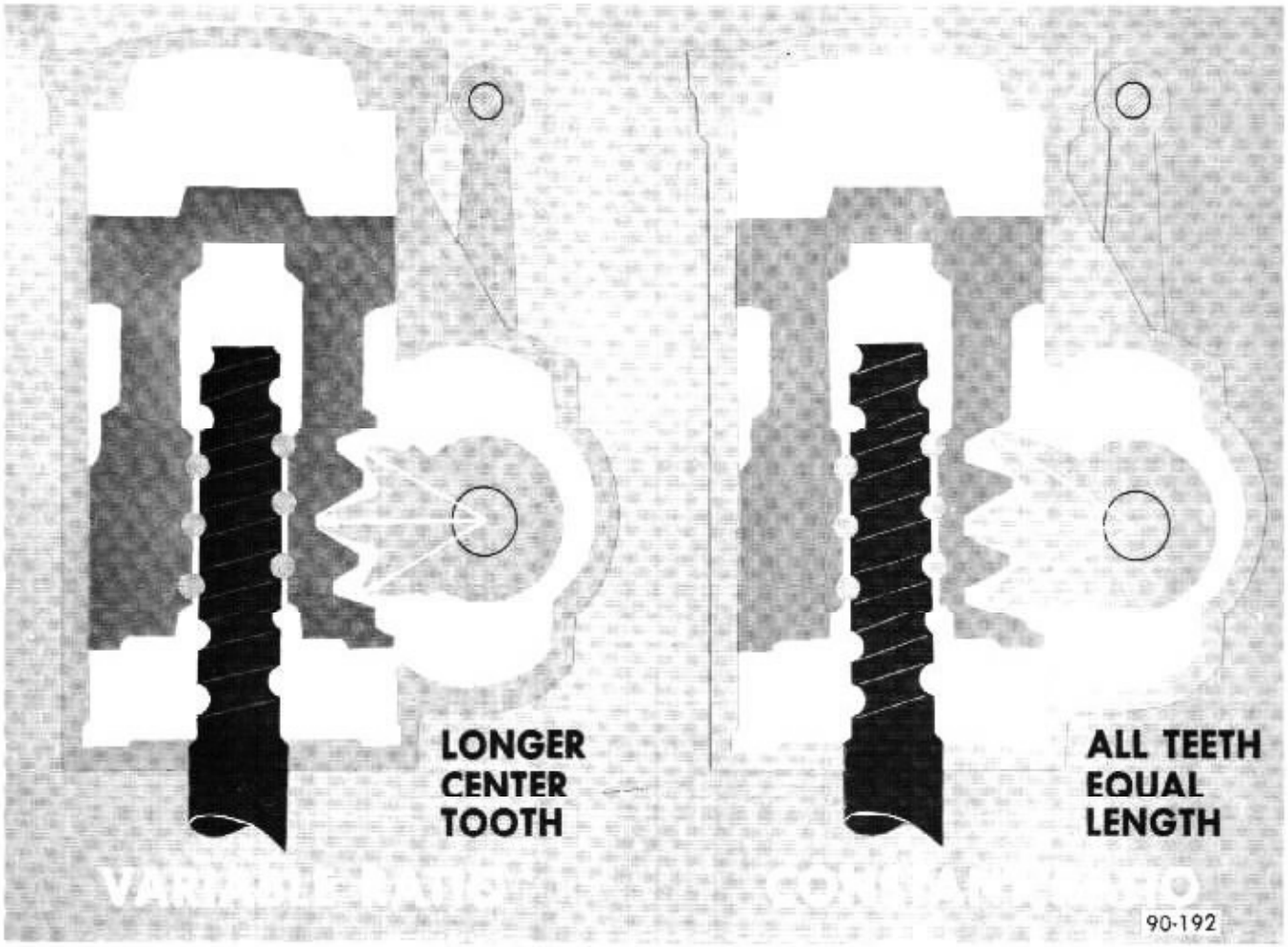

Figure 90-22 - Steering Gear Tooth Design

The low end of the ratio spread is utilized only near the extremes of the steering wheel travel--after approximately one full turn. Since the steering wheel is generally turned to its limit only when parking or backing up, the added maneuverability of these extreme low ratios is purely a "bonus", since directional stability is not a factor at low speeds.

The design of the sector and rack are responsible for the steering flexibility.

Notice that the center tooth of the variable ratio sector is longer than the teeth on either side, while all teeth of the conventional sector are of equal length. See Figure 90-22.

Since the sector, like any gear, is basically a series of levers, it is easily seen that any movement of the rack will always cause the conventional sector to swing the pitman arm in the same ratio--that is, to turn the pitman arm the same number of degrees with each tooth in the sector.

To increase or decrease the ratio, it is only necessary to change the length of the sector teeth, and we see that a low ratio, or smaller radius sector with shorter teeth, produces a greater pitman arm movement than the high ratio sector with its longer teeth and greater leverage.

On this basis, the variable ratio sector is in reality one long high ratio lever at the center flanked by two lower ratio levers for left and right turns.

Since only the tip of the long center tooth is in contact with the rack when the front wheels are straight, initial movement of the rack in either direction causes a relatively small response of the sector and pitman arm because of the high ratio that results from this long lever relationship.

As a result, the steering ratio remains a nearly constant 16.0:1 for the first 40 degrees of steering wheel movement either direction from center.

Turning the steering wheel further, the effective length of the lever is reduced as the point of contact now rolls down the side of the center tooth, to act as a shorter radius.

As a result, the steering ratio is reduced, causing the pitman arm to move noticeably further for a given steering wheel movement. With the wheel turned one-half turn, the steering ratio is reduced to approximately 14.2:1.

With a three-quarter turn of the steering wheel, the leverage has been further reduced to approximately 13.3:1.

Figure 90-23 - Steering Gear Tooth Contact

This smooth reduction in steering ratio is produced by the rolling action between the rack and center tooth that constantly shortens the effective leverage by moving the contact point down the side to the root of the long center tooth. At this time, the tip of the short tooth begins contact with the rack at the same radius and soon takes over the load.

From three-quarters to one full turn of the steering wheel, the ratio continues to diminish as the same rolling action moves the point of contact from the tip to the root of the short tooth.

This action completes the ratio reduction from 13.3 to 13.1:1. For the last quarter turn of the steering wheel, the ratio remains constant at 13.1:1 to provide greatest maneuverability for backing and parking.

90-9 DESCRIPTION OF POWER STEERING OIL PUMP AND HOSES

The oil pump, which is mounted on the engine in position to be driven by a belt from the crankshaft balancer, converts some engine power into oil pressure which is used against the rack-piston nut to rotate the pitman shaft.

Three different pump assemblies are provided for the 1971 Models. These pumps are identical except for the rotor, thrust plate, vanes, pump ring, pressure union and reservoir shape.

The pump used on 45-46-48-49000 Series cars with 455 cu.in. engines has a thicker rotor, pump ring, and vane assembly for increased output.

The pump reservoir encloses the pump housing and provides a reserve supply of oil to assure complete filling of the hydraulic system. See Figure 90-24.

The reservoir cap is vented which permits escape of any air that may be introduced into the system during assembly of the various units and maintains atmospheric pressure in the reservoir.

The pump housing encloses the flow control valve and the rotor assembly. The flow control valve and spring are retained in the pump housing by the pressure union. See Figure 90-25. This allows servicing the flow control valve without removing the pump from the engine. Inside the flow control valve is the pressure relief valve. Also in the end of the flow control valve is a filter screen which filters the oil that enters this valve. The pressure union which is the pump outlet, contains the pump exit hole and an orifice.

The rotor assembly consists of a drive shaft, thrust plate, rotor with ten vanes, pump ring and pressure plate.

Oil enters the rotor section of the housing through a hole which is open to the surrounding reservoir.

The rotor which is loosely splined to the end of the drive shaft, is located adjacent to the face of the thrust plate and is enclosed by the pump ring. The rotor vanes slide radially outward to contact the hardened and ground inside cam surface of the ring. See Figure 90-26.

As the shaft and rotor rotate, centrifugal force and fluid pressure against the inner ends cause the vanes to follow the cam contour of the ring. The cam surface is so shaped that two opposite pumping chambers are formed which cause a complete pumping cycle to occur every 180 degrees of rotation of the rotor. The pump ring has two crossover passages drilled in it, which transfer oil from the thrust plate into a discharge cavity located at the rear of the pressure plate.

When the engine is started, each pumping chamber picks up oil from two openings, one between the pressure plate and ring and the other between the thrust plate and ring. See Figure 90-24. The oil is then propelled by the decreasing pockets in each pumping chamber into the discharge cavity through an opening in the pressure plate and an opening the the thrust plate which is connected to the crossover passage in the ring. The oil flows from the discharge cavity into a passage which is open to the rear of the flow control valve and to the exit hole in one end of

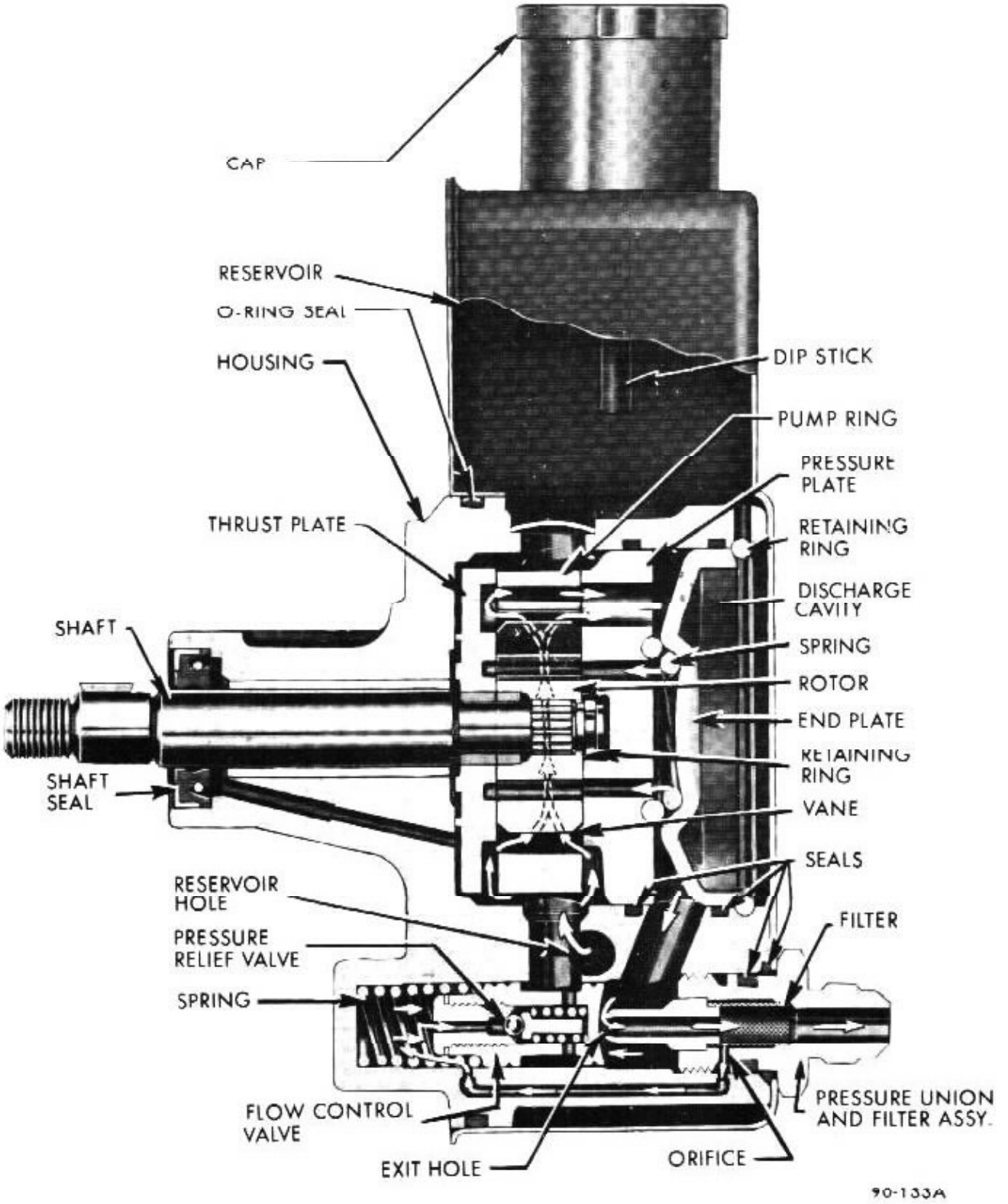

Figure 90-24 Oil Flow in Pump

the pressure union. Oil flows through the outlet end of the pressure union to the steering gear assembly. Some oil flows through the orifice in the pressure union and into a passage in the pump housing which directs oil into the spring chamber located in front of the flow control valve.

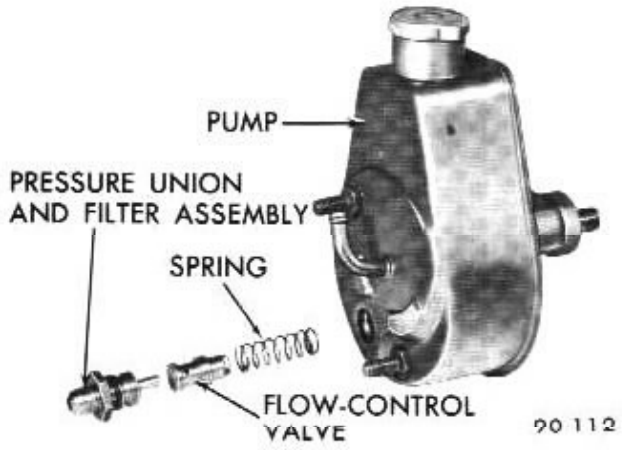

Figure 90-25 Flow Control Valve Installation

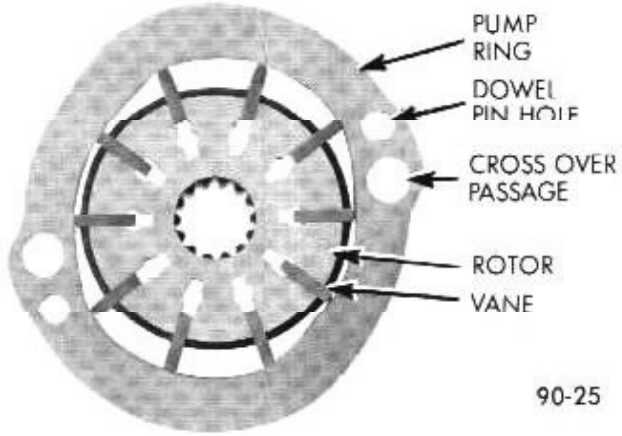

Figure 90-26 Pump Ring and Rotor

Pressure in the discharge cavity is always greater than the pressure of the oil that has passed through the exit hole in the pressure union.

The flow control valve regulates the opening of a by- pass passage through which oil may be returned to the suction and reservoir section of the pump.

When the pump is running without demand for steering pressure, pressure in the discharge cavity is great enough to push the flow control valve open against a spring load of approximately ten pounds. See Figure 90-27. The pressure in the spring chamber tends to close the valve, but since pressure in the discharge cavity is always greater than in the spring chamber, the valve is not closed. The movement of the valve is controlled by the spring tension and the difference in pressure on the front and rear side of the valve.

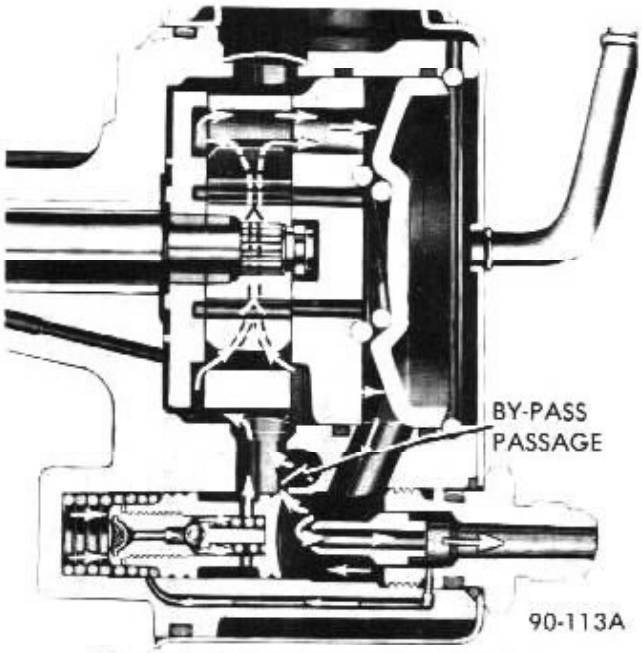

Figure 90-27 Flow Control Valve Operation

When power assistance is required, the steering gear rotary valve restricts free circulation of oil, and the pump pressure builds up rapidly. As the pressure increases in the discharge cavity it also increases in the spring chamber and in turn additional pressure is required to move the flow control valve to open the by-pass passage. The maximum amount of build-up of pressure by the pump depends on the amount of restriction controlled by the rotary valve. When power assistance is no longer required, the restriction is reduced to a predetermined minimum. With a small amount of restriction, the pressure in the spring chamber drops to a minimum. Thus, the pressure in the discharge cavity also is reduced as this pressure is governed by the spring tension and the oil pressure present in the spring chamber of the pump.

If pump output pressure reaches 1100 to 1200 psi, the increased pressure in the spring chamber forces a pressure relief valve open and oil escapes from the spring chamber into the by-pass hole around the pressure relief valve ball. See Figure 90-27.

As oil pressure is relieved in the spring chamber, the high pressure in the pump discharge cavity overcomes the spring load to open the flow control valve. Because outlet pressure has to pass through an orifice to get into the spring chamber, the pressure in the spring chamber drops below outlet pressure for a fraction of a second. This allows the flow control valve to be open enough to lower line pressure to a safe level immediately. Oil is then pumped into the by-pass passage until the line pressure opposing the pump drops below the relief valve setting, permitting this valve to close. The flow control valve then resumes normal operation.

The flow control valve starts to open at 300-400 RPM of pump and is functioning when the pump is running 465 RPM (400 RPM of engine).

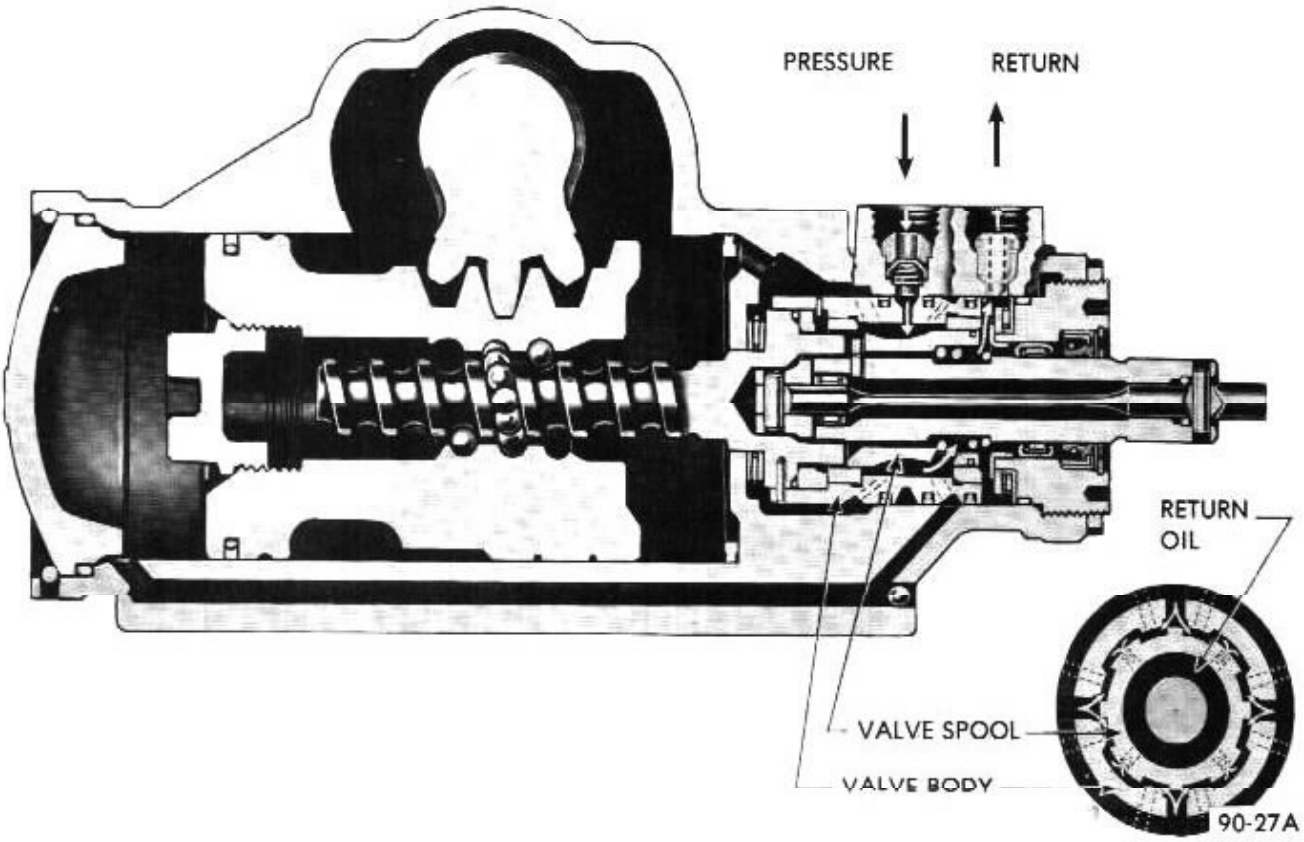

Figure 90-28 Oil Flow in Power Steering Gear (Straight-Ahead Position)

90-10 OPERATION OF POWER STEERING GEAR

a. Neutral or Straight-Ahead

Figure 90-28 shows the rotary valve in the neutral or straight-ahead position. Oil flows from the pump into the pressure port of the gear, through the open center valve spool and back to the pump reservoir through the return port. The slots on the valve spool are so positioned in the valve body that the oil entering through the pressure port is directed to the return slots in the valve body, then through the center of the spool which is open to the return port. There is no flow to either side of the rack-piston nut, but both sides are full of oil at all times. In the straight-ahead position the pressure on both sides is equal. The oil acts as a cushion that absorbs road shocks so they are not transferred to the steering wheel, thus giving safer and more effortless driving. In addition, this oil lubricates all the internal components of the gear.

All passages in the gear are open in the straight- ahead position and the valve remains in this position at all times except when effort applied to the steering wheel is more than one pound. The open center design of the rotary valve reduces pump losses to a minimum by allowing a minimum of restriction to oil flow in the straight-ahead position.

b. Right Turn

Figure 90-29 illustrates the operation of the gear when the steering wheel is turned to the right. Due to the resistance of turning between the front wheels and the roadbed, the torsion bar is deflected, changing the relationship between the slots in the valve spool and the slots in the valve body. The right turn slots on the valve spool are closed off from the return slots in the valve body and are opened more to the pressure slots. The left turn slots of the spool are closed off from the pressure slots and opened more to the return slots. This causes oil to flow into the right turn chamber of the housing and force the rack-piston nut upward. As the rack-piston nut moves upward, it applies turning effort to the pitman shaft.

The oil in the left turn chamber in the housing is simultaneously forced out through the valve and back to the pump reservoir. The higher the resistance to turning between the roadbed and the car wheels, the more the position of the valve spool is changed in relation to the valve body and the higher the oil pressure on the lower end of the rack-piston nut. Since the amount of hydraulic pressure directed to the right turn chamber is dependent upon the resistance to turning, the driver is assured of the proper amount of smooth hydraulic assistance at all times.

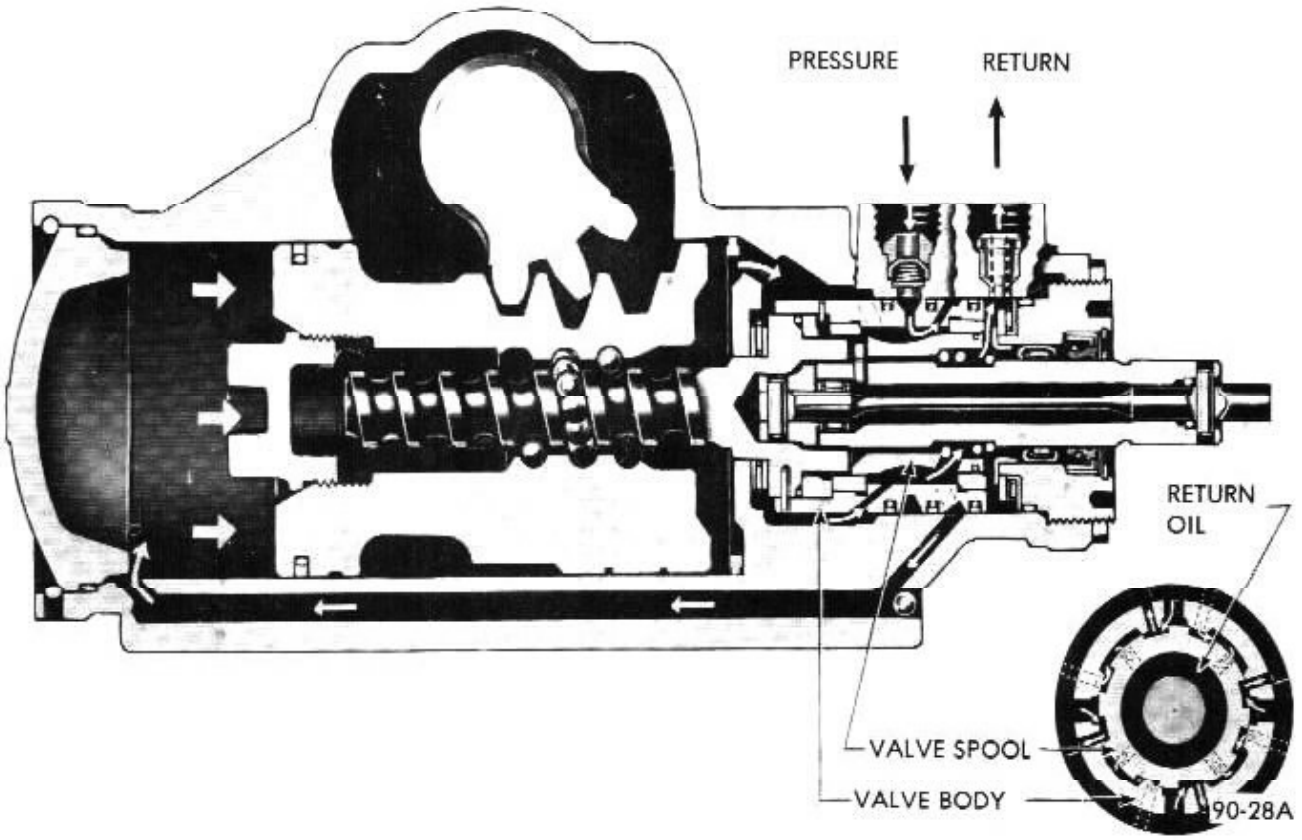

Figure 90-29 Oil Flow in Power Steering Gear (Right Turn)

The instant the driver stops applying steering effort to the steering wheel, the valve spool is moved back into its straight-ahead position in the valve body by the torsion bar.

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.

c. Left Turn

Figure 90-30 illustrates the operation of the gear when the steering wheel is turned to the left. The resistance to turning of the front wheels causes the torsion bar to deflect, changing the relationship between the valve spool slots and the valve body slots. The slots are reversed from the right turn position and change the flow of oil into the left turn chamber in the housing, moving the rack-piston nut downward. Thus, turning effort is applied to the pitman shaft. The oil in the right turn chamber is forced through the valve and back to the reservoir. When the driver stops applying steering effort, the valve spool returns to the straight-ahead position.

d. 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 "kickback". 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.

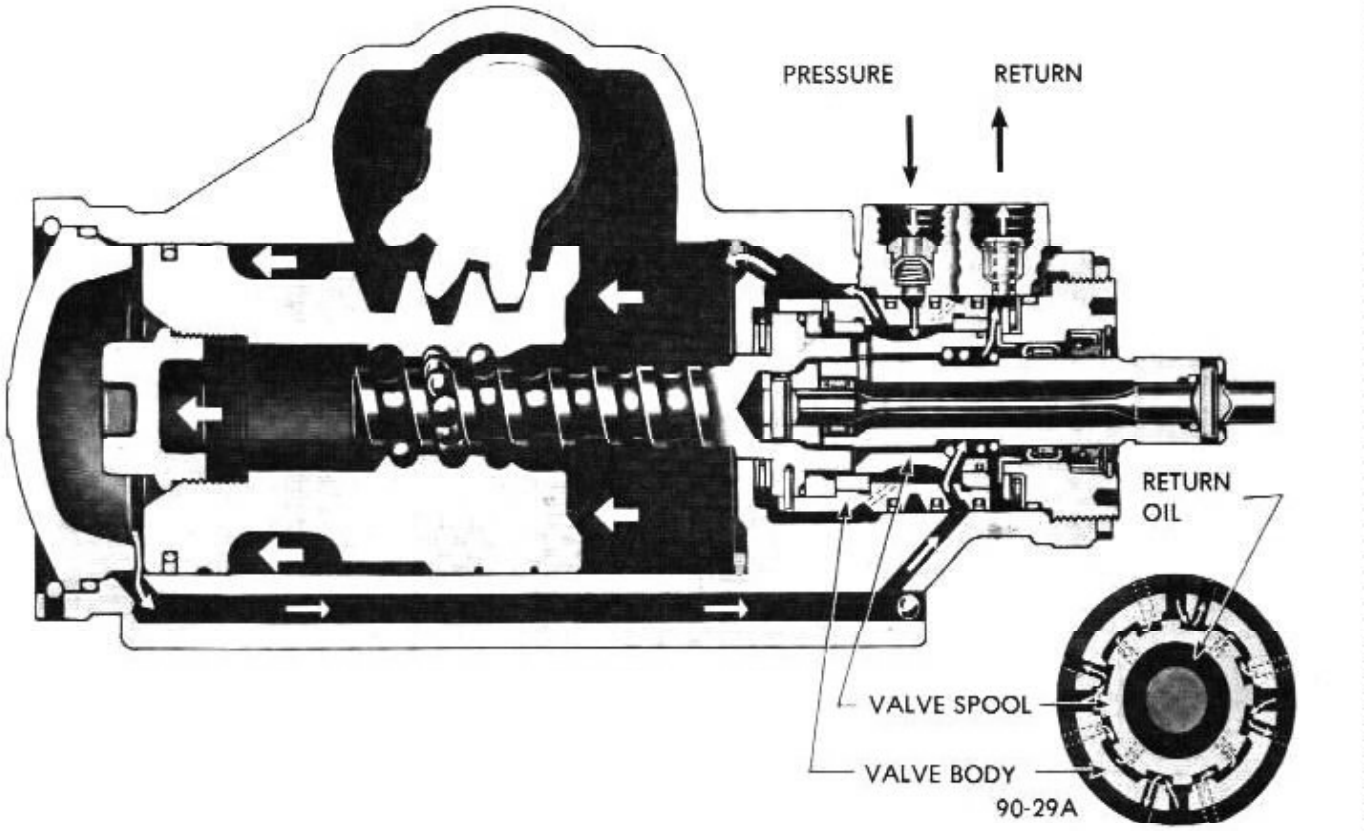

Figure 90-30 Oil Flow in Power Steering Gear (Left Turn)

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

90-11 ADJUSTMENT OF POWER GEAR

Adjustment of the steering gear in the car 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 adjustment, it is necessary that the steering gear assembly be removed from the car and both thrust bearing and over-center preload be checked and corrected as necessary. An in-car check of the steering gear will not pin-point a thrust bearing adjustment error.

a. Initial Checks

1. Remove gear from car.

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 degrees each side of center) - right and left.

b. 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.

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 an inch pound 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 Figure 90-31. Torque to turn stub shaft (drag plus thrust bearing) must not exceed 7 lb. in.

NOTE: *Preload torque tends to drop off when the lock nut is tightened. Therefore, torque reading must be taken with the lock nut tight.*

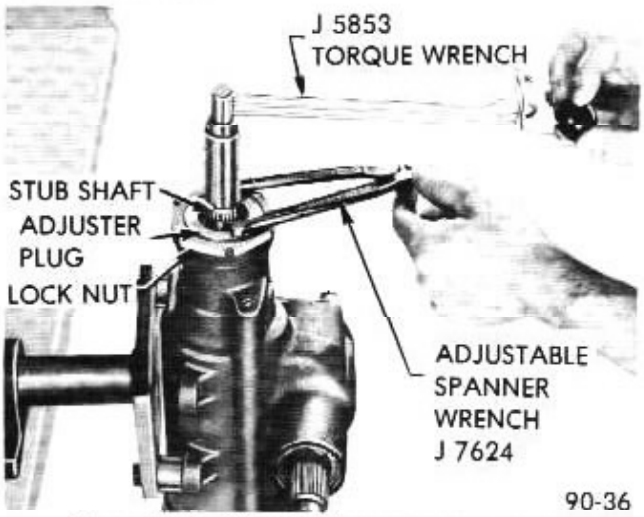

Figure 90-31 Adjusting Thrust Bearing Preload

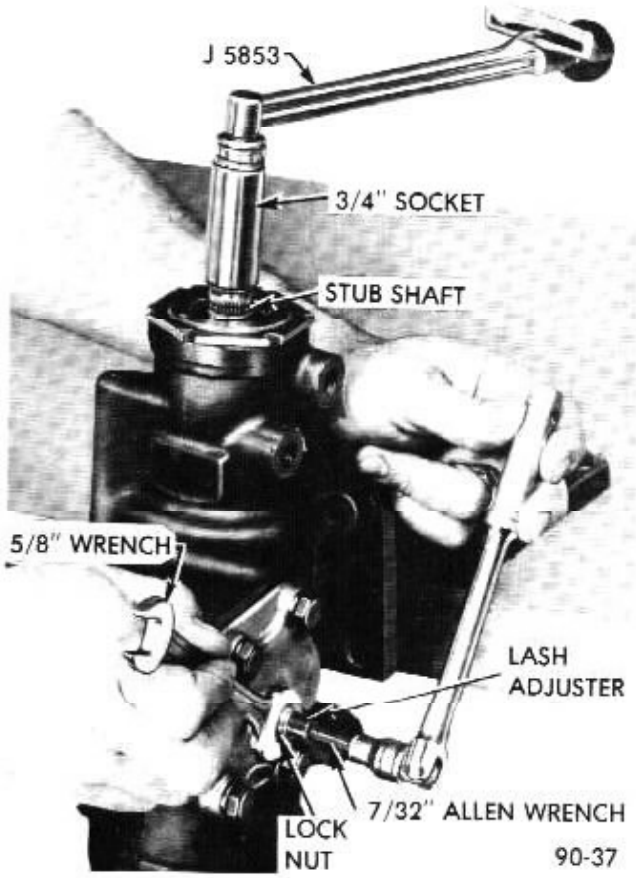

Figure 90-32 Pitman Shaft Over-Center Adjustment

c. Pitman Shaft Over-Center Adjustment

1. With gear on center, loosen pitman shaft adjuster 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 Figure 90-32. Limits for new and old gears are different, as follows:

(a) New gear.

Over center torque to be 8 to 10 lb. in. additional torque, but total over center torque must not exceed 18 lb. in.

(b) Used gear (400 or more miles).

Over center torque to be 4 to 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.

90-12 REMOVAL AND INSTALLATION OF PITMAN SHAFT SEALS, GEAR IN CAR

a. Removal

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 gear assembly from car as follows:

1. Remove pitman arm nut and disconnect pitman arm from pitman shaft using puller J-5504. See Figure 90-33.

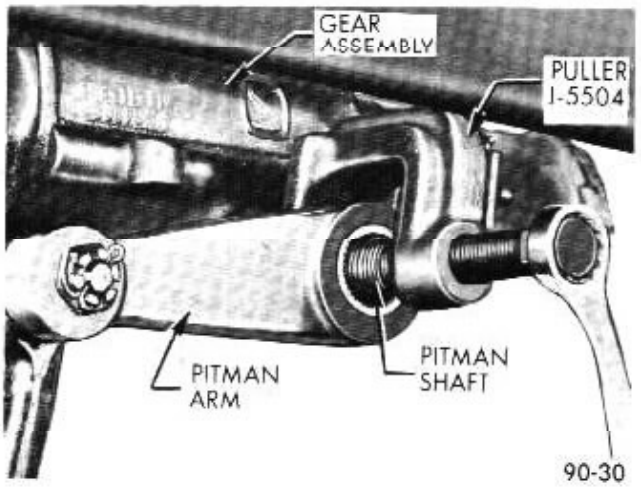

Figure 90-33 Removing Pitman Arm From Pitman Shaft.

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman shaft to insure that seals will not be cut by splines during assembly.

NOTE: *Only one layer of tape should be used; an excessive amount of tape will not allow the seals to pass over it, due the close tolerance between the seals and the pitman shaft.*

3. Remove pitman shaft seal retaining ring with No. 3 truarc pliers J-4245.

4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Turn off engine.

NOTE: *Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out.*

5. Inspect seals for damage to rubber covering on O.D. If O.D. appears scored, inspect housing for burrs. Remove any burrs before installing new seals.

b. Installation

1. Lubricate the seals thoroughly with petroleum jelly and install seals with installer J-6219. Install the inner single lip seal first, then a back-up washer. Drive seal in far enough to provide clearance for the other seal, back-up washer and retaining ring. *Make sure that the inner seal does not bottom on the counterbore.* Install the outer double lip seal and the second back-up washer in only far enough to provide clearance for the retaining ring. Install retaining ring.

2. Fill pump reservoir to proper level. Start engine and allow engine to idle for at least three minutes without turning steering wheel. Turn wheel to left and check for leaks.

3. Remove tape and reconnect pitman arm. Tighten pitman arm retaining nut to 180 lb.ft.

NOTE: THIS PITMAN ARM TO STEERING GEAR 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.

DIVISION IV

REMOVAL AND INSTALLATION

90-13 REMOVAL AND INSTALLATION OF POWER STEERING GEAR

a. Removal

1. Place fender cover over left front fender.

2. Disconnect the pressure and return line hoses at the steering gear and elevate ends of hoses higher than pump to prevent oil from draining out of pump.

3. Remove pinch bolt securing lower steering column flexible coupling flange to steering gear stub shaft.

4. Remove pitman arm nut, then remove the pitman arm using puller J-5504. See Figure 90-33.

5. Loosen the three frame to steering gear bolts at outside of frame and remove steering gear.

b. Installation

NOTE: *Fasteners in step 1 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

1. Install the gear assembly by reversing the procedure for removal. See Figure 90-72 for tightening specifications. Torque pitman nut 180 lb. ft. Torque flexible coupling pinch bolt to 30 lb.ft. Be sure there is 3/64" clearance between adjuster plug and gear coupling flange.

NOTE: *Power steering hoses should be installed to maintain a minimum clearance of 1" between hoses and 1/2" to surrounding parts.*

2. Fill pump reservoir to correct level with Buick Power Steering oil or equivalent.

3. Start engine and maintain oil level in reservoir while allowing engine to idle for at least three minutes before turning steering wheel. Then rotate steering wheel through its entire range slowly a few times with engine running. Re-check oil level and inspect for possible leaks.

NOTE: *If air becomes trapped in the oil, the oil pump may be noisy until all air is out of oil. This may take some time since air trapped in oil does not bleed out rapidly.*

90-14 REMOVAL AND INSTALLATION OF POWER STEERING OIL PUMP

a. Removal

NOTE: *It is not necessary to remove oil pump to service the flow control valve. The flow control valve is retained in pump housing by a pressure union and filter assembly. See Figure 90-37.*

1. Remove pump drive belt tension adjusting bolt. Disconnect belt from pump.

2. Disconnect return and pressure hoses from pump. Cover the hose connector and union on pump and open ends of the hoses to avoid entrance of dirt.

3. On 43-44000 Series cars remove 2 nuts securing rear of pump to bracket, and 2 bolts securing front of pump to bracket and remove pump.

4. On 45-46-48-49000 Series cars remove 1 nut securing rear of pump to rear adapter and 2 bolts securing front of pump to front adapter and remove pump.

b. Installation

1. Install the oil pump by reversing the procedure for removal.

2. When pump is reinstalled on engine adjust drive belt tension to 90 pounds.

CAUTION: *Do not pry against the sheet metal reservoir or use a bar in the neck of the reservoir, or serious leak problems may result. There is a pry tab built into the brackets adjusting belt tension.*

3. Fill pump reservoir to correct level with Buick Power Steering oil or equivalent.

4. Start engine and maintain oil level in reservoir while allowing engine to idle for at least three minutes before turning steering wheel. Then rotate steering wheel through its entire range slowly a few times with engine running. Recheck oil level and inspect for possible leaks.

NOTE: *If air becomes trapped in the oil, the oil pump may be noisy until all air is out of oil. This may take some time since air trapped in oil does not bleed out rapidly.*

90-15 REMOVAL AND INSTALLATION OF OIL PUMP SHAFT SEAL WITH PUMP ASSEMBLED

a. Removal

1. Remove pump pulley nut.

2. Remove pump drive belt from pulley.

3. Remove pulley from pump using a suitable puller. Do not hammer pulley off shaft.

4. Remove pulley drive key from shaft.

NOTE: *On upper series equipped with air conditioner it is necessary to remove pump from its mounting due to interference with fan shroud.*

5. Insert a piece of .005" shim stock (approximately 2-1/2" long) around shaft and push it past seal until it bottoms in pump housing. See Figure 90-34.

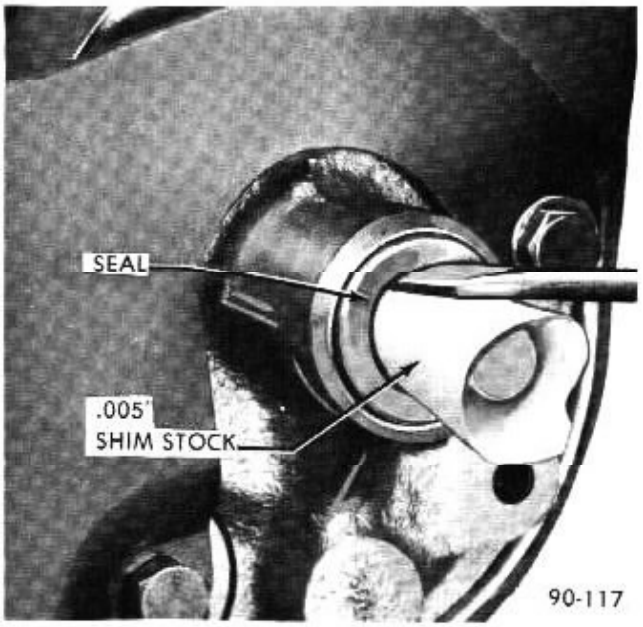

Figure 90-34 Removing Oil Pump Shaft Seal

6. Remove seal by cutting metal body of seal with a sharp tool and prying out. See Figure 90-34. *Extreme care must be used to prevent damage to shaft and pump housing.*

b. Installation

1. Place seal protector J-7586 over shaft. Lubricate new seal with power steering oil and drive in pump housing, spring side first, with installer J-7728. See Figure 90-35. Just bottom seal in housing. *Excessive force must not be used when driving seal in place.*

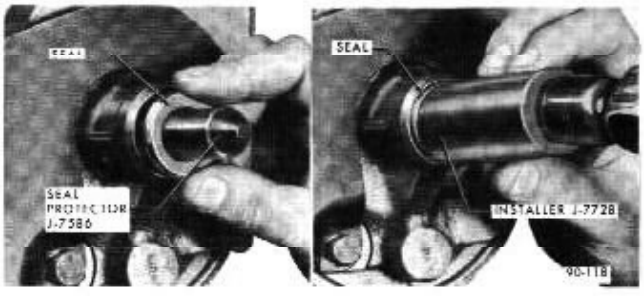

Figure 90-35 Installing Oil Pump Shaft Seal

2. Install pulley drive key in shaft.

3. Install pulley and drive belt. Adjust belt tension to 90 pounds.

4. Fill pump reservoir to proper level with power steering oil and bleed pump.

DIVISION V

OVERHAUL AND MAJOR SERVICE

90-16 DISASSEMBLY, INSPECTION, AND REASSEMBLY OF ADJUSTER PLUG ASSEMBLY AND ROTARY VALVE ASSEMBLY

THE FOLLOWING PROCEDURES ARE WITH THE POWER STEERING GEAR ASSEMBLY REMOVED.

a. Removal of Adjuster Plug Assembly and Rotary Valve Assembly

1. Thoroughly clean exterior of gear assembly with a suitable solvent. Drain the unit by placing the valve ports down and turning the worm through its entire range two or three times.

2. Place gear assembly in vise.

3. Loosen adjuster plug lock nut with punch and remove adjuster plug using adjustable spanner wrench, J-7624.

4. Remove rotary valve assembly from gear by grasping stub shaft and pulling out.

NOTE: *If it is only necessary to service the rotary valve assembly, proceed with subparagraph "d".*

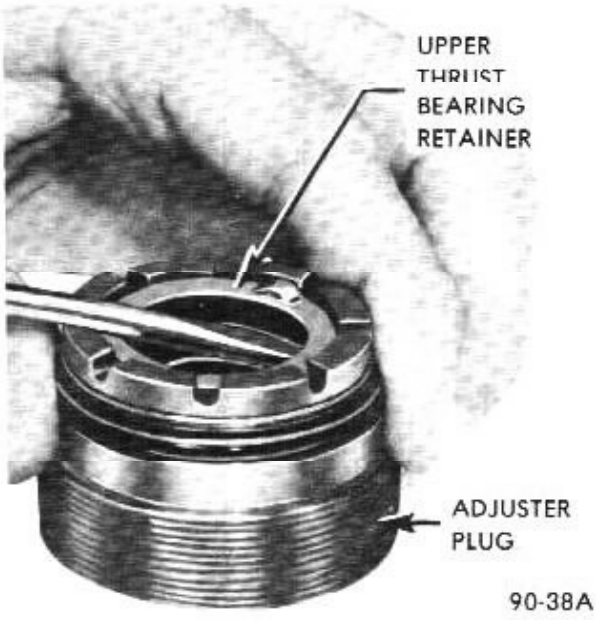

Figure 90-39 Removing Upper Thrust Bearing Retainer

b. Disassembly of Adjuster Plug Assembly

1. Remove the upper thrust bearing retainer with a screwdriver, being careful not to damage the needle bearing bore. See Figure 90-39. Discard retainer. Remove thrust bearing spacer, upper thrust bearing and thrust bearing races.

2. Remove adjuster plug "O" ring and discard.

3. Remove stub shaft seal retaining ring using No. 3 truarc pliers J-4245 and remove and discard dust seal. See Figure 90-40.

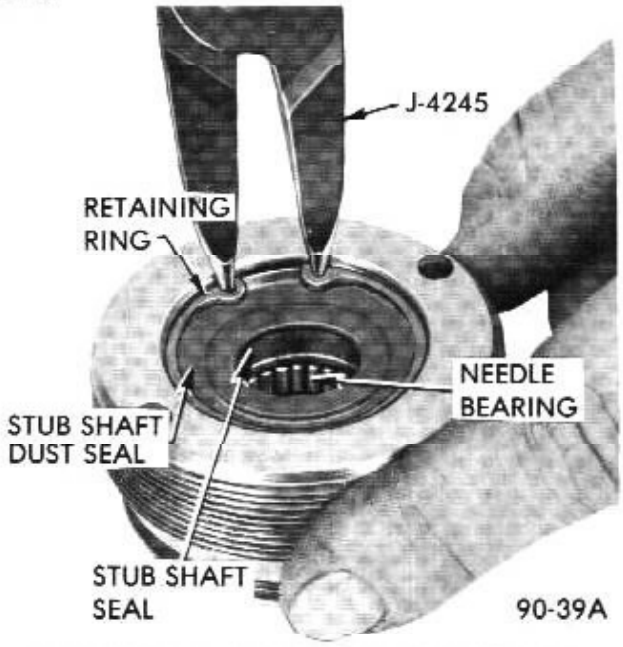

Figure 90-40 Removing Stub Shaft Seal Retaining Ring

4. Remove stub shaft seal by prying out with screwdriver and discard.

5. Inspect needle bearing in adjuster plug and if rollers are broken or pitted, remove needle bearing by pressing from thrust bearing end using tool J-6221 and discard bearing. See Figure 90-41.

6. Inspect thrust bearing spacer for cracks.

7. Inspect thrust bearing rollers and thrust bearing races for wear, pitting, scoring, cracking or brinelling. Replace any damaged parts.

c. Reassembly of Adjuster Plug Assembly

1. If needle bearing was removed because of damage, *install new needle bearing from thrust bearing end of adjuster plug, by pressing against identification end of bearing using tool J-6221.* End of bearing must be flush with bottom surface of stub shaft seal bore.

2. Lubricate new stub shaft seal with power steering oil and install seal with spring in seal toward adjuster plug

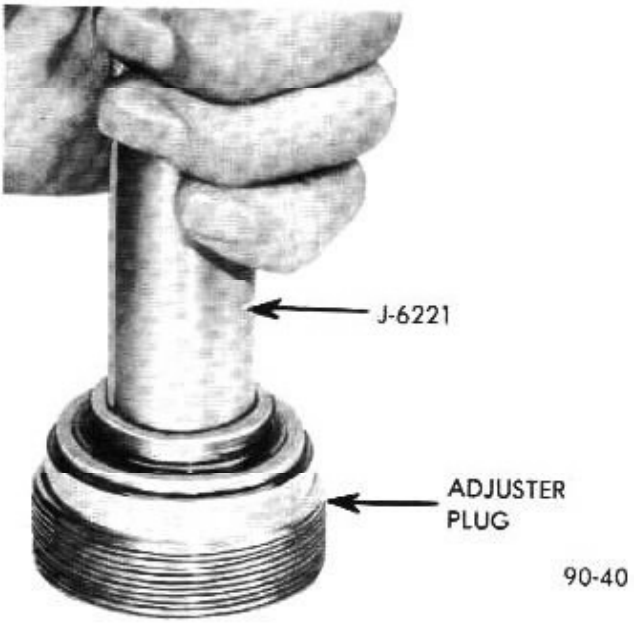

Figure 90-41 Removing Needle Bearing

using tool J-5188. See Figure 90-42. Install seal only far enough in plug to provide clearance for dust seal and retaining ring. Place new dust seal with lip up in plug, then install retaining ring with No. 3 Truarc pliers, J-4245.

3. Lubricate new adjuster plug "O" ring seal with petroleum jelly and install on adjuster plug. Assemble large O.D. thrust bearing race with internal flange up on adjuster plug, then thrust bearing, smaller thrust bearing race and thrust bearing spacer on adjuster plug. Install new thrust bearing retainer into needle bearing bore using punch, being careful not to damage spacer. See Figure 90-43. Radial location of dimples on retainer is not important. Thrust bearing assembly and spacer must be free to

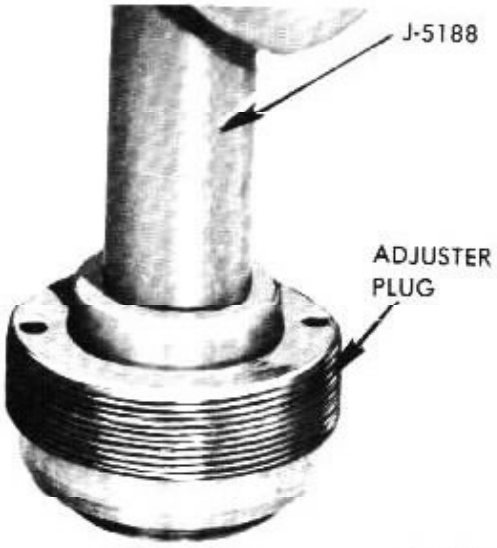

Figure 90-42 Installing Stub Shaft Seal

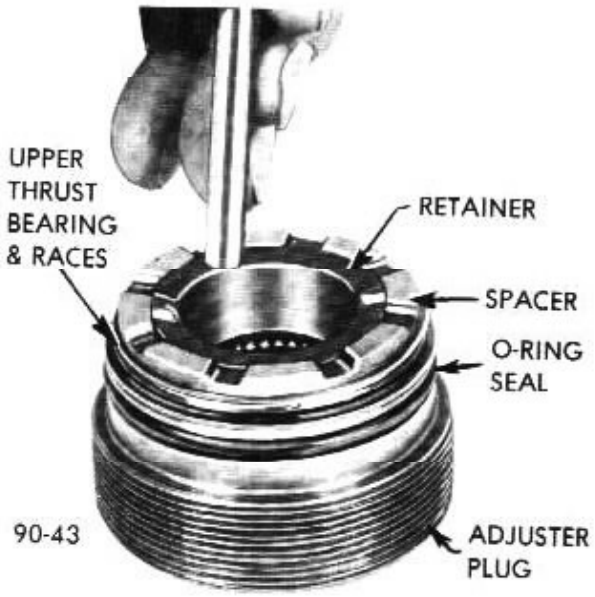

Figure 90-43 Installing Upper Thrust Bearing Retainer

rotate and retainer must be completely bezowsurface of spacer.

d. Disassembly of Rotary Valve Assembly

It is very uncommon to have to make any service repairs to the valve assembly with the possible exception of the valve spool dampener "O" ring seal. DO NOT disassemble the valve unless absolutely necessary since this may result in damage to the assembly. If the valve spool dampener "O" ring seal requires replacement, remove the valve spool only, replace the "O" ring and reinstall the spool immediately. DO NOT disassemble further.

CAUTION: *Cleanliness of parts and work area is of the utmost importance during servicing of the valve assembly.*

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. See Figure 90-44.

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. See Figure 90- 44.

3. Push the spool valve out of the flush end of the valve body until the dampener "O" ring is exposed, then care-

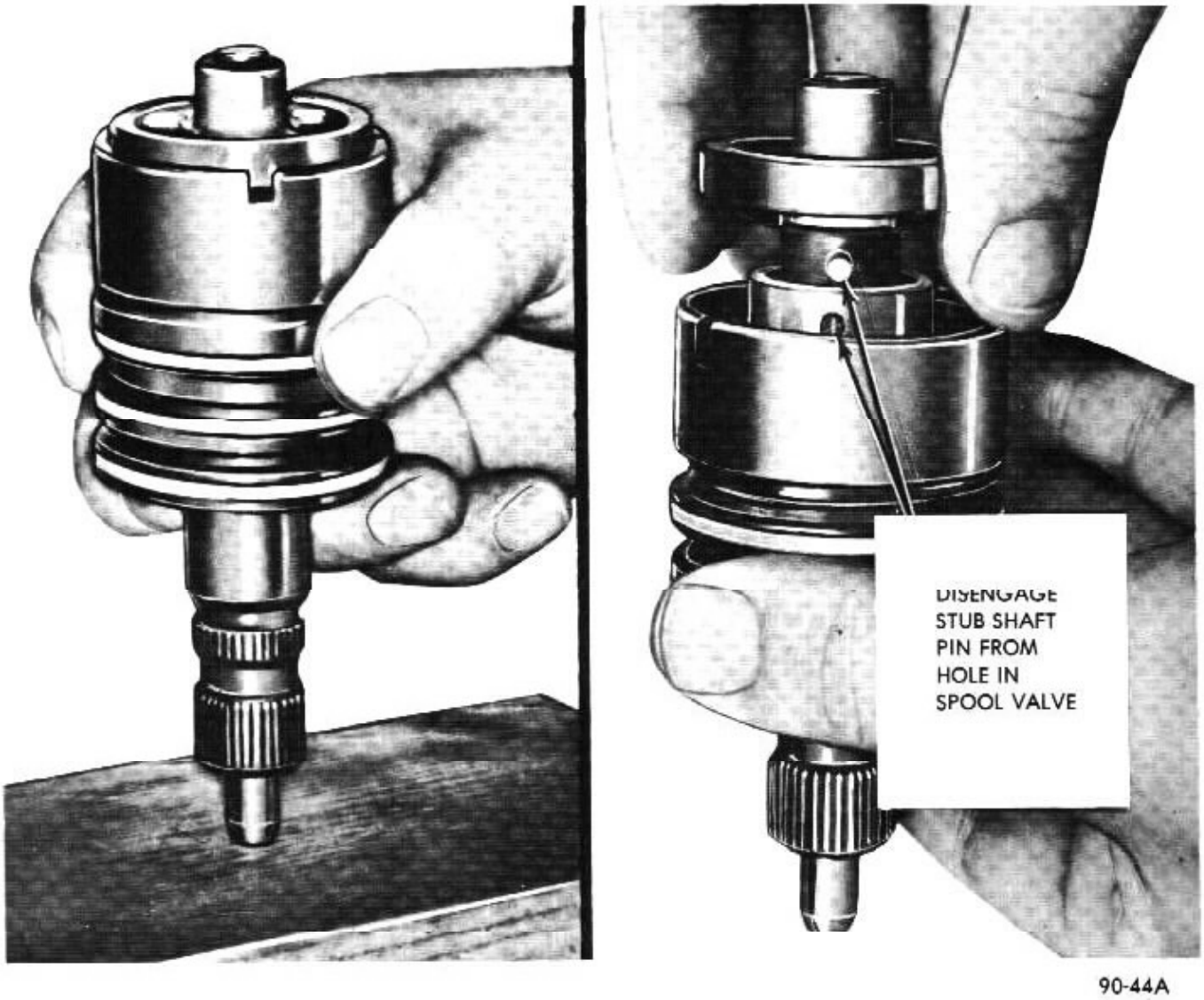

Figure 90-44 Removing Stub Shaft Assembly

fully pull the spool from the valve body, while rotating the valve. See Figure 90-45. If the spool valve becomes cocked, carefully realign the spool valve, then remove.

4. Remove the dampener "O" ring from the spool valve and discard.

5. If the teflon oil rings are to be replaced, cut the three teflon oil rings and "O" rings from the valve body and discard.

e. 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 stub 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 wear spots. If the irregularities cannot be cleaned up by the use of crocus cloth, the complete valve and shaft assembly will have to be replaced.

5. If the small notch in the skirt of the valve body is excessively worn, the complete valve 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.

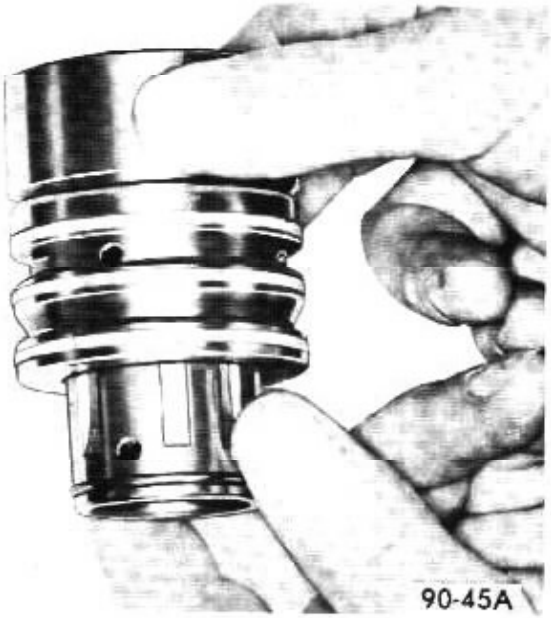

Figure 90-45 Removing Spool Valve

f. Reassembly of Rotary Valve Assembly

1. If valve body "O" rings and teflon rings were removed, install new "O" rings in the oil ring grooves and lubricate with power steering fluid.

2. Lubricate the three new teflon oil rings with power steering fluid and install in grooves over "O" rings.

NOTE: *The teflon rings may appear to be distorted, but the heat of the oil during operation of the gear will straighten them out.*

3. Lubricate the spool valve dampener "O" ring with power steering fluid and install over the spool valve.

4. Lubricate the spool valve and valve body with power steering fluid and slide the spool valve into the valve body. Rotate the spool valve while pushing it into the valve body. 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)

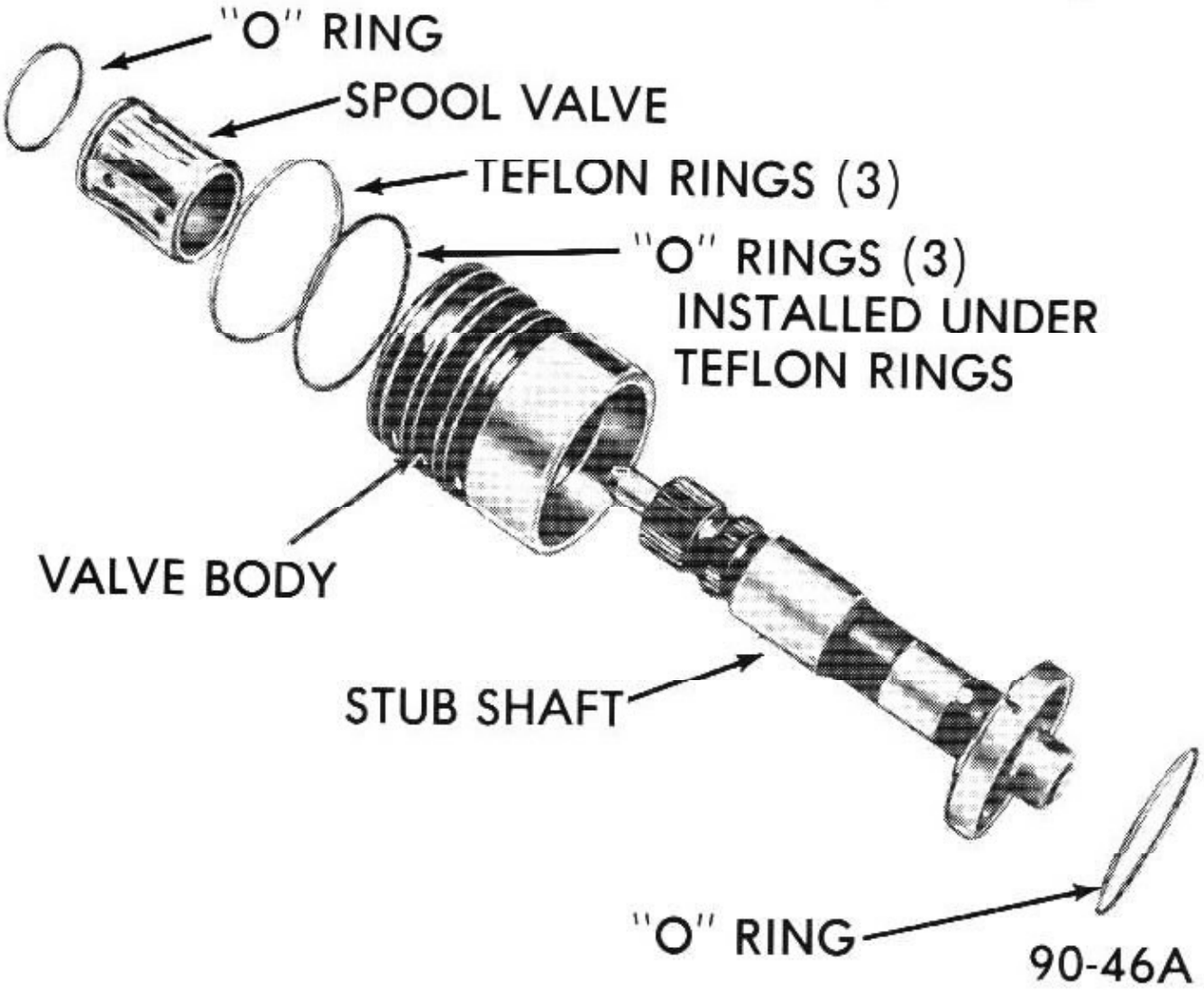

Figure 90-46 Exploded View - Valve Body and Shaft Assembly

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. See Figure 90-47.

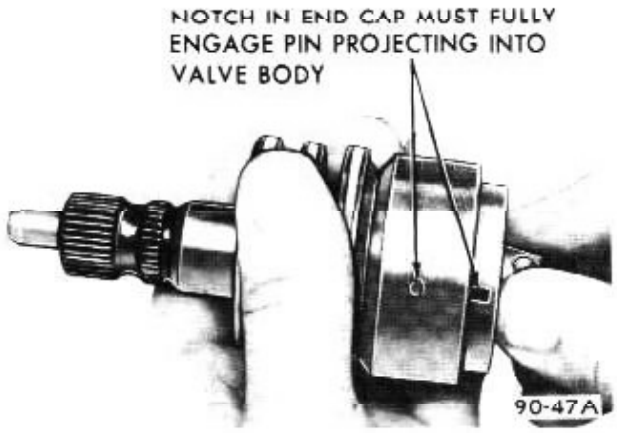

Figure 90-47 Installing Stub Shaft Assembly

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.

g. Installation of Rotary Valve Assembly and Adjuster Plug Assembly

1. Align the narrow pin slot on the valve body with the valve body drive pin on the worm. Insert the valve assembly into the gear housing by pressing against the valve body with the finger tips. Do not press on stub shaft or torsion bar. See Figure 90-50. The return hole in the gear housing should be fully visible when valve is assembled properly. See Figure 90-51.

CAUTION: *Do not push against the stub shaft during assembly as this may cause the stub shaft and cap to pull out of the valve body, allowing the spool dampener "O" ring seal to slip into valve body oil grooves. Be sure valve is properly seated before installing adjuster plug assembly.*

2, Place seal protector J-6222 over end of stub shaft. Install adjuster plug assembly in gear housing snugly with adjustable spanner wrench J-7624 then back plug off approximately 1/8 turn. Install adjuster plug lock nut if removed, but do not tighten.

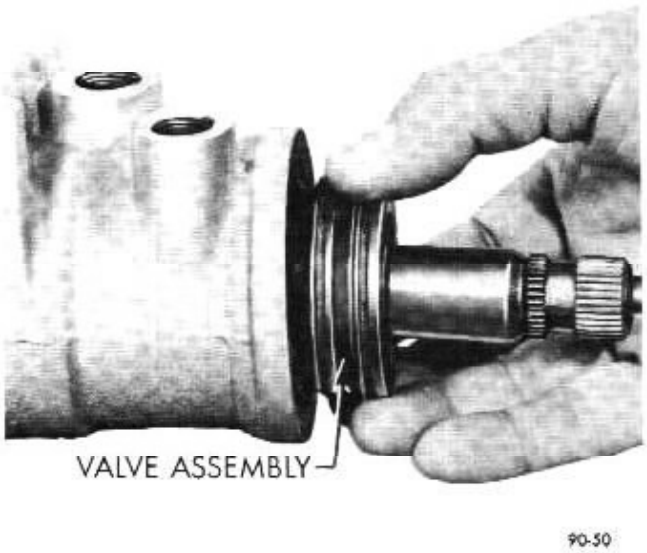

Figure 90-50 Inserting Valve Assembly in Housing

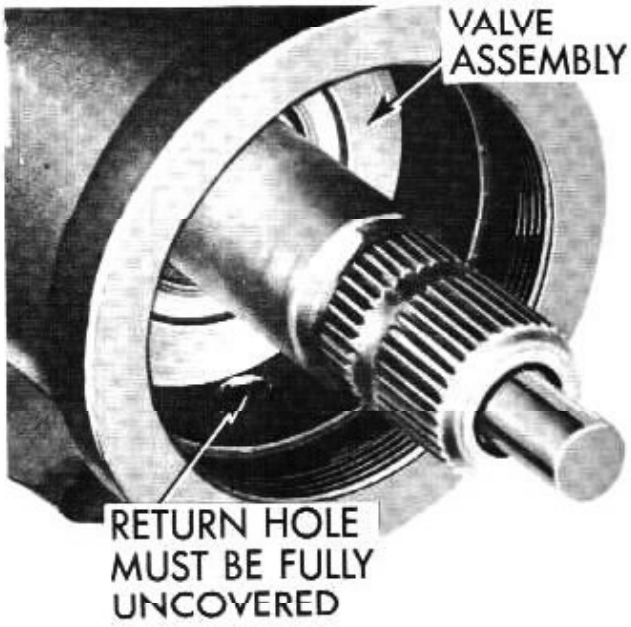

Figure 90-51 Valve Assembly Installed in Housing

3. Refer to paragraph 90-11 for adjustment of gear assembly.

90-17 DISASSEMBLY, INSPECTION AND REASSEMBLY OF PITMAN SHAFT ASSEMBLY

a. Removal of Pitman Shaft Assembly

1. Thoroughly clean exterior of gear assembly with a suitable solvent. Drain the unit by placing the valve ports down and turning the worm through its entire range two or three times.

2. Place gear assembly in vise.

3. Rotate the stub shaft until pitman shaft gear is in center position. Remove the housing side cover retaining bolts.

4. Tap the end of the pitman shaft with a soft mallet and slide shaft out of housing.

5. Remove the side cover "O" ring seal and discard.

b. Disassembly of Pitman Shaft Assembly

1. Remove the pitman shaft seal retaining ring from end of housing using No. 3 truarc pliers J-4245 and remove outer seal back-up washer. Tap a screwdriver between the outer seal and the inner back- up washer and pry out seal. Tap with screwdriver between the inner seal and the shoulder in the gear housing and pry out inner seal. *Be careful not to damage the seal bore in housing.* Discard seals.

2. Check the pitman shaft needle bearing for wear, pitting, or scoring. If damaged, remove needle bearing from gear housing bore by driving from the seal bore side of housing using Tool J-6657. See Figure 90-52. Discard bearing.

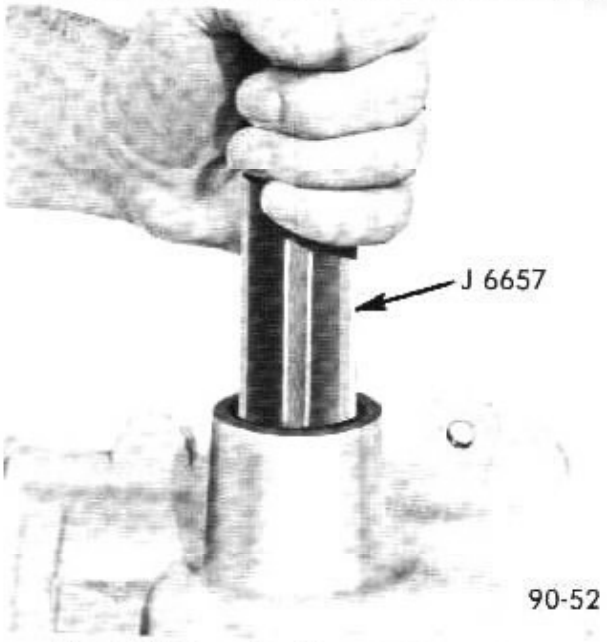

Figure 90-52 Removing Pitman Shaft Needle Bearing

3. Hold the lash adjuster with an Allen wrench and remove the lash adjuster nut. Discard nut. Remove side cover from lash adjuster.

c. Inspection of Pitman Shaft Assembly

1. Inspect pitman shaft bushing surface in side cover for excessive wear or scoring. If worn or scored, replace side cover.

2. Check the pitman shaft sector teeth and the bearing and seal surfaces. If worn, pitted or scored replace pitman shaft.

3. Check the torque on the lash adjuster. See Figure 90-53. If torque exceeds 15 lb. in., pitman shaft assembly should be replaced.

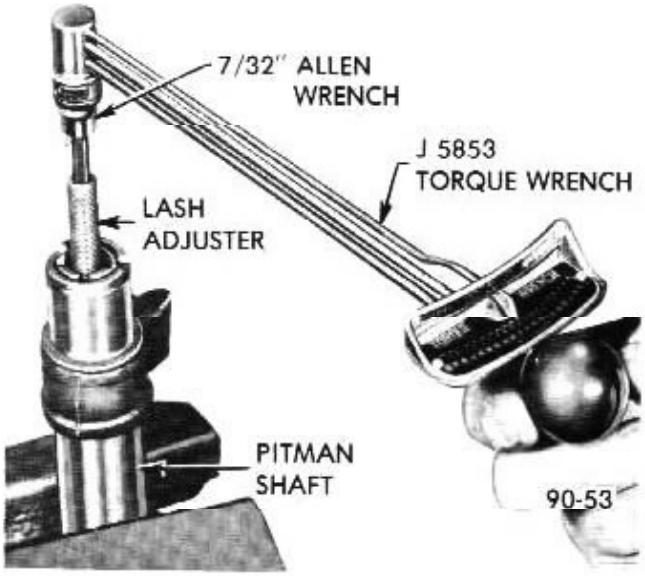

Figure 90-53 Checking Torque on Lash Adjuster

d. Reassembly of Pitman Shaft Assembly

1. If pitman shaft needle bearing was removed because of damage, install new needle bearing into gear housing bore from seal bore end, pressing against stamped identification on bearing with tool J-6657. Press in until bearing clears shoulder in gear housing, 1/32" maximum. Rollers in bearing must be free to rotate.

2. Lubricate new pitman shaft seals with power steering oil. Install the inner, single lip seal in bore first, then a back-up washer. See Figure 90-54. Using tool J-6219, drive the seal and washer in far enough to provide clearance for the outer seal, back- up washer and retaining ring. See Figure 90-55. *The inner seal must not bottom on the counterbore.* Install the outer double lip seal and the second back-up washer in bore only far enough to provide clearance for the retaining ring with tool J-6219. Install retaining ring with No. 3 Truarc pliers tool J-4245, making certain that ring is seated properly.

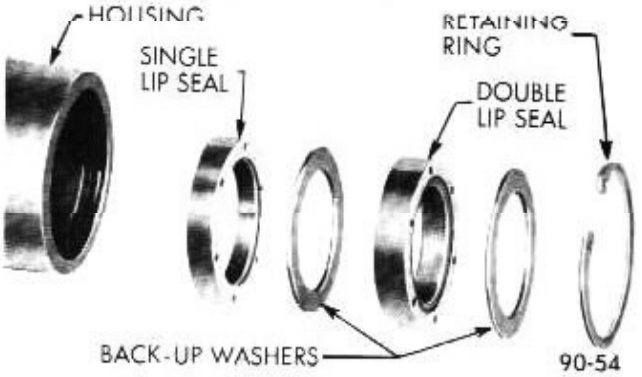

Figure 90-54 Pitman Shaft Seals

3. Assemble the side cover on the pitman shaft. Screw the lash adjuster through the side cover until the side cover bottoms on the shaft and then back off 1/2 turn.

e. Installation of Pitman Shaft Assembly

1. Lubricate a new side cover "O" ring seal with power steering oil and install in groove in face of side cover.

2. Turn the stub shaft until the center groove of the rack-piston is aligned with the center of the pitman shaft hole.

3. Wrap masking tape over the end of pitman shaft. Install the pitman shaft so that the center tooth in the sector meshes with the center groove of the rack- piston nut. Make sure the side cover "O" ring seal is in place before pushing the side cover down on gear housing. Remove masking tape from end of pitman shaft.

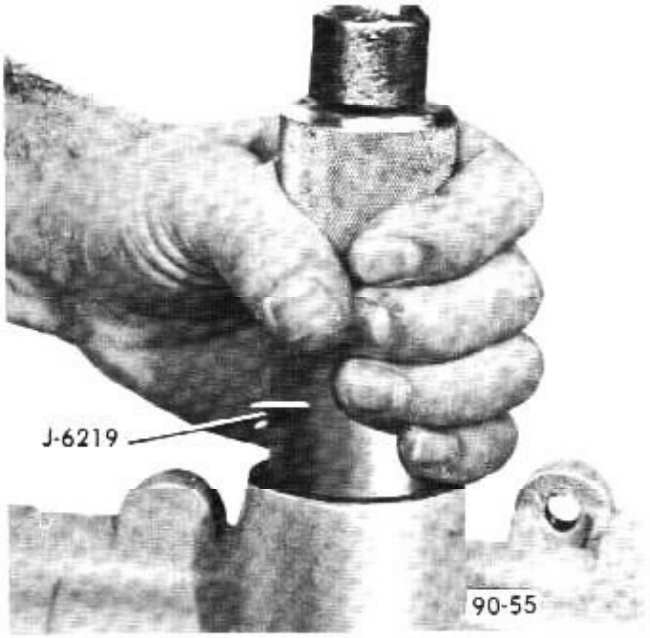

Figure 90-55 Installing Pitman Shaft Seals

4. Install the four side cover bolts with lock washers and tighten to 30 lb. ft.

5. Install new lash adjuster nut on lash adjuster, but do not tighten.

6. Refer to paragraph 90-11 for adjustment of gear assembly.

90-18 DISASSEMBLY, INSPECTION AND REASSEMBLY OF RACK-PISTON NUT AND WORM ASSEMBLY

a. Removal of Rack-Piston Nut and Worm Assembly

1. Thoroughly clean exterior of gear assembly with a suitable solvent. Drain the unit by placing the valve ports down and turning the worm through its entire range two or three times.

2. Remove pitman shaft assembly as outlined in paragraph 90-17 (a).

3. Rotate housing end plug retainer ring so that one end of ring is over hole in gear housing. Spring one end of ring with punch to allow screwdriver to be inserted to lift ring out. See Figure 90-56.

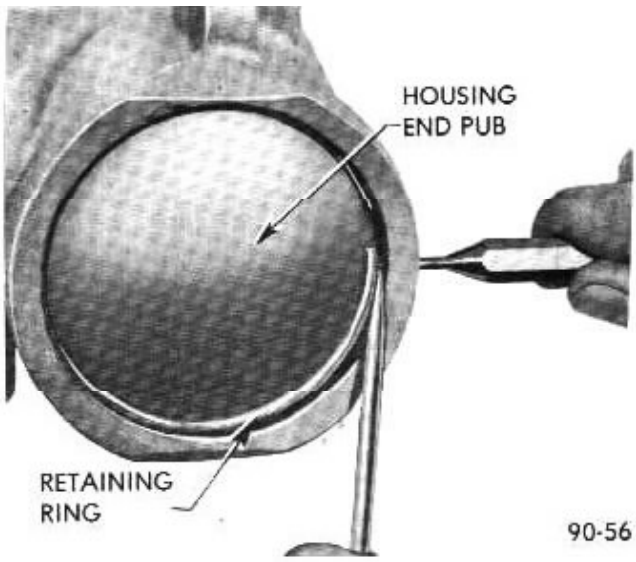

Figure 90-56 Removing Housing End Plug Retaining Ring

4. Rotate stub shaft to full left turn position to force end plug out of housing.

CAUTION: *Do not rotate farther than necessary or the balls from the rack-piston and worm assembly will fall out.*

5. Remove and discard housing end plug "O" ring seal.

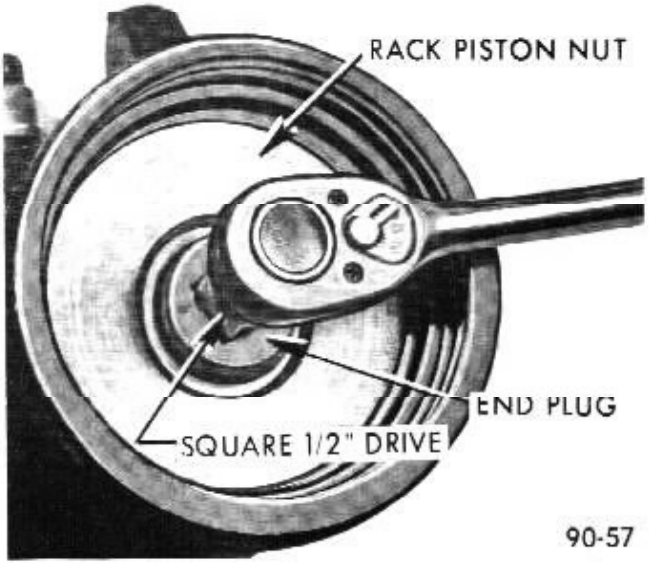

Figure 90-57 Removing Rack-Piston Nut End Plug

6. Remove rack-piston nut end plug with a 1/2" square drive. See Figure 90-57.

7. Insert ball retaining tool J-7539 in end of worm. See Figure 90-58. Turn stub shaft so that rack-piston nut will go onto the tool and remove rack- piston nut from gear housing. Keep ball retaining tool completely through rack-piston nut to prevent balls from falling out.

NOTE: *On 45-46-48-49000 Series gears, do not remove snap ring in upper end of piston bore in housing.*

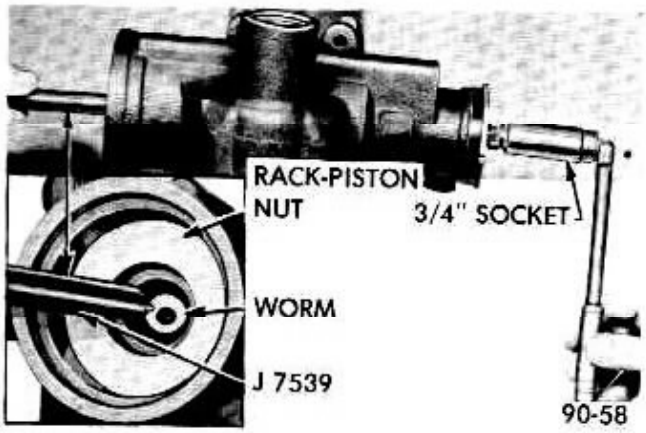

Figure 90-58 Removing Rack-Piston Nut

8. Remove adjuster plug assembly and rotary valve assembly as outlined in paragraph 90-16 (a).

9. Remove worm and lower thrust bearing and races.

10. Remove cap to worm "O" ring seal and discard.

b. Disassembly of Rack-Piston Nut and Worm Assembly

1. Remove and discard piston ring and back-up "O" ring on rack-piston nut.

2. Remove ball return guide clamp to rack-piston nut screws and lock washers and remove clamp.

3. Place the rack-piston nut on a clean cloth and remove ball return guide and ball retaining tool.

Make sure all balls are caught on the cloth. See paragraph 90-20 (c) for number of balls for the various gears.

c. Inspection of Rack-Piston Nut and Worm Assembly

1. Inspect gear housing bore. If badly scored or worn, replace housing.

2. Inspect the worm and rack-piston nut grooves and all the balls for excessive wear or scoring. Inspect rack-piston nut teeth for pitting, wear or scoring. Inspect O.D. of rack-piston nut for wear, scoring or burrs. If either the worm or rack-piston nut need replacing, both must be replaced as a matched assembly.

3. Inspect ball return guides, making sure that the ends where the balls enter and leave the guides are not damaged. Replace if necessary.

4. Inspect lower thrust bearing and races for wear, pitting, scoring or cracking. Replace any damaged parts.

5. Inspect the hose connectors in the gear housing. If badly brinelled or scored, replacement will be necessary. To remove the connectors, tap threads using 5/16-18 tap. Thread a bolt with a nut and flat washer into the tapped hole. Pull the connector by holding the bolt and turning the nut off the bolt. Wash and blow the housing out thoroughly to remove any tapping chips. To install new connector, use replacer J-6217 to drive connector in place.

6. Check the operation of check valve poppet located under connector in pressure port of housing. Poppet should reseat itself against connector after being lightly pushed down. If poppet is not operating properly, remove connector, poppet and spring from pressure port. Then install a new spring with large end down and a new poppet with tangs pointed down. Install a new connector using installer J-6217. Be sure new poppet operates properly.

7. Inspect the ball plug in gear housing. If it is leaking or raised above the housing surface, it may be driven in flush to 1/16 inch below surface. The ball can be tightened by staking the housing. If the leakage cannot be stopped, the housing should be replaced.

d. Reassembly of Rack-Piston Nut and Worm Assembly

1. Thoroughly clean and lubricate the internal parts with power steering oil.

2. Install new piston ring back-up "O" ring in groove on

Figure 90-59 Installing Rack-Piston Ring on Rack-Piston Nut

rack-piston nut. Place a new piston ring over the back-up "O" ring. See Figure 90-59.

3. Install worm into rack-piston nut to bearing shoulder.

4. Align the ball return guide holes in the rack piston nut with the worm groove. Load all balls, except 6 (3 plain and 3 black) in alternate sequence into the guide hole nearest the piston ring while slowly rotating worm counterclockwise. See Figure 90-60.

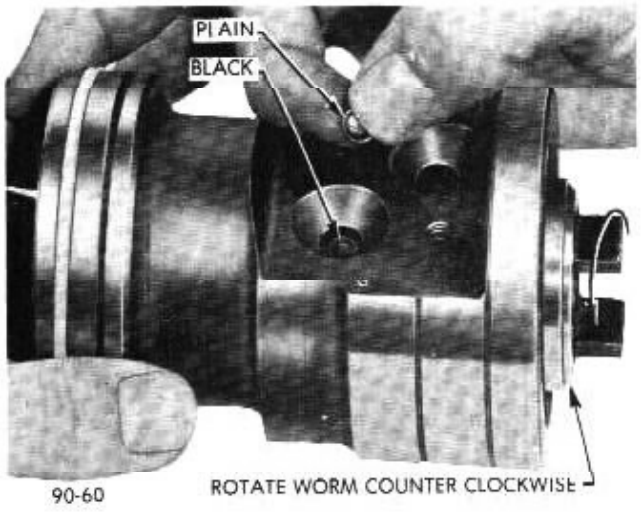

Figure 90-60 Loading Balls in Rack-Piston Nut

5. Fill one-half the ball return guide with the remaining 6 balls, 3 plain and 3 black balls in alternate sequence. Place the other half of guide over the balls and plug each end with heavy grease to prevent the balls from falling out when installing the guide to the rack-piston nut.

6. Insert ball return guide into guide holes in the rack-piston nut so that balls in the guide alternate with the balls in the rack-piston nut. Guide should fit loosely.

7. Place clamp over guide and install 2 screws with special lock washers and tighten.

8. The worm groove is ground with a high point in the center. When the rack-piston nut passes over this high point, a preload of 1 to 5 pound inch should be obtained. To measure the preload of the assembly, lightly clamp rack-piston nut in a soft jaw vise with worm pointing up. Do not distort rack-piston nut by tightening too heavily. Place valve assembly on worm, engaging worm drive pin. Rotate the worm until it extends 1-1/4 inches from the edge of rack-piston nut to the thrust bearing face of worm; this is the center position. Attach torque wrench J-5853 with 3/4 inch, 12 point socket to the stub shaft. See Figure 90-61. Rotate the wrench through a total arc of approximately 60 degrees (1/6 turn) in both directions several times and take a reading. The highest reading obtained with the worm rotating should be from 1 to 3 pound inch. If the reading is too high, disassemble and reassemble, using the next size smaller plain balls and recheck. (A rack-piston nut with a ball size of 7 does not have a number stamped on the flat surface. For ball sizes other than 7, the ball size is stamped on the flat surface of the rack-piston nut.) If the reading is too small, use the next size larger plain balls and recheck. See paragraph 90-20, subparagraph b for ball size. Remove valve assembly from worm.

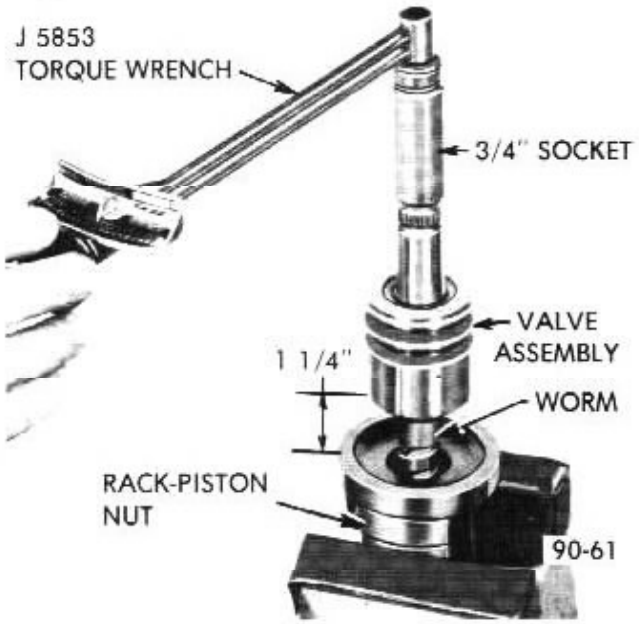

Figure 90-61 Checking Rack-Piston Nut Ball Preload

9. Turn the rack-piston nut and worm assembly to a horizontal position in the vise and insert ball retaining tool J-7539 in end of worm and turn worm out of the rack-piston nut. Do not allow the tool to separate from the worm until worm is fully removed from rack-piston nut.

e. Installation of Rack-Piston Nut and Worm Assembly

1. Assemble lower thrust bearing and races on worm.

Install new cap to worm "O" ring seal. Assemble rotary valve assembly to worm by aligning narrow pin slot in valve body with pin on worm.

2. Insert the valve assembly and worm in gear housing as an integral unit. Do not press on stub shaft or torsion bar. See Figure 90-50. Return hole in housing should be fully visible when valve and worm are properly installed. See Figure 90-51.

3. Place seal protector J-6222 over end of stub shaft. Install adjuster plug assembly in gear housing snugly with adjustable spanner wrench J-7624 then back plug off approximately 1/8 turn. Install adjuster plug lock nut if removed, but do not tighten.

4. Adjust the thrust bearing preload. Using torque wrench J-5853, rotate stub shaft to measure valve assembly drag.

See Figure 90-31. Then tighten adjuster plug to obtain a reading 1 to 3 pound inch in excess of valve drag.

NOTE: *Total of thrust bearing preload and valve drag should not exceed 11 pound inches.*

5. Tighten adjuster plug lock nut. Recheck thrust bearing preload to be sure that tightening lock nut did not change adjustment.

6. Install ring compressor sleeve tool (J-8947 used for 43-44000 Series and 45000 Series with 350 engine; J-7576 used for 45-46-48-49000 Series) in gear housing and hold it tightly against shoulder in the housing. See Figures 90-62 and 90-63. Insert the rack-piston nut into the housing until the ball retaining tool J-7539 engages the worm. Turn the stub shaft drawing the rack-piston nut into the housing. When the piston ring is into the housing bore, the ball retaining tool and ring compressor may be removed.

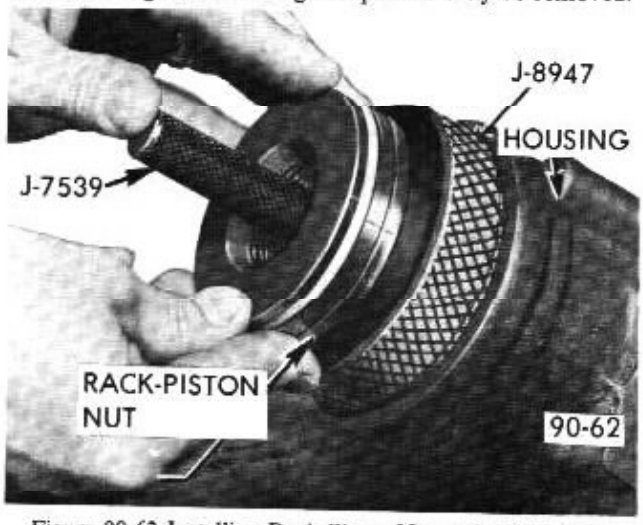

Figure 90-62 Installing Rack-Piston Nut - 43-44000 Series

Figure 90-63 Installing Rack-Piston Nut - 45-46-48-49000 Series

7. Install rack-piston end plug using 1/2" square drive. Torque plug to 50 lb. ft. See Figure 90-64.

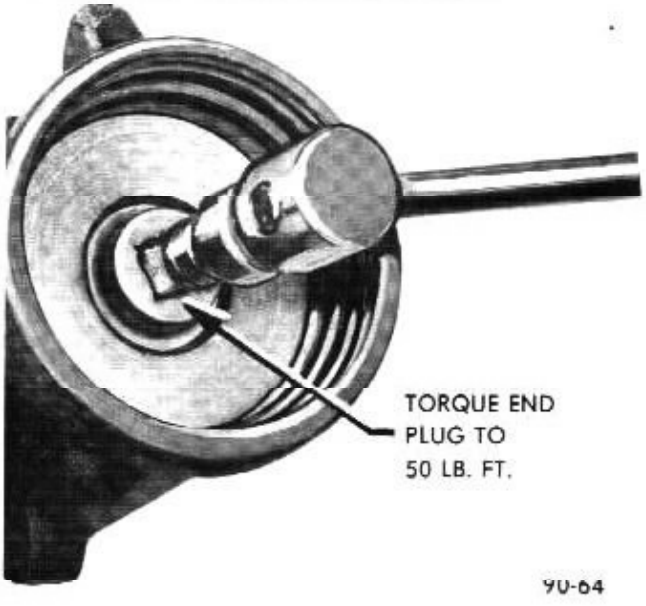

Figure 90-64 Torquing Rack-Piston Nut End Plug

8. Lubricate housing end plug "O" ring seal with power steering oil and install in gear housing.

9. Insert end plug into gear housing and seat against "O" ring seal. Slight tapping with a soft mallet may be necessary to seat plug properly. Install end plug retainer ring.

10. Install pitman shaft assembly as outlined in paragraph 90-17, subparagraph e, Steps 1 through 6.

90-19 DISASSEMBLY, INSPECTION AND REASSEMBLY OF OIL PUMP

NOTE: *Refer to paragraph 90-14 for removal and installation of oil pump.*

a. Disassembly of Oil Pump

1. Using masking tape, cover the hose union and pipe on pump and then thoroughly clean exterior of pump.

2. Remove pump pulley key from pump shaft.

3. Remove reservoir cap and drain out oil in pump reservoir.

4. Install pump in a soft jaw vise with pump shaft pointing down. Do not clamp pump too tightly in vise as this may distort bushing.

5. Remove two reservoir to pump housing studs and "O" rings. Discard the "O" rings.

6. Remove pressure union. Remove "O" ring from union and discard "O" ring.

7. Remove flow control valve and spring.

8. Remove reservoir from housing by rocking housing back and forth while pulling upward. Remove reservoir "O" ring seal on housing and discard. Remove small reservoir to housing "O" ring seal from counterbore in housing and discard.

9. Rotate end plate retaining ring until one end of ring is over hole in housing. Spring inward on one end of ring with 1/8" punch to allow screwdriver to be inserted and lift ring out. See Figure 90-65.

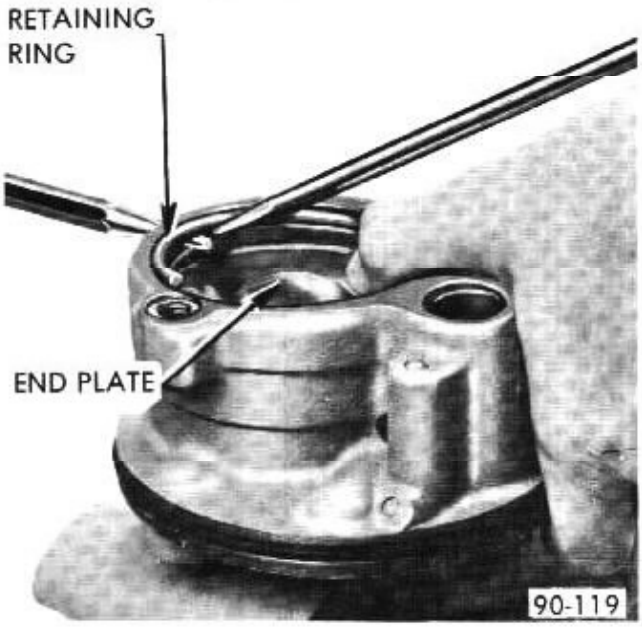

Figure 90-65 Removing End Plate Retaining Ring

10. Remove pump from vise and remove end plate, pressure plate spring, flow control valve and spring by turning pump over. If end plate should stick in housing, lightly tap it to align and free it.

NOTE: *Do not disassemble control valve.*

11. Remove and discard end plate "O" ring seal.

12. Place shaft end on bench and press down on housing until shaft is free. Turn housing over and remove shaft and rotor assembly, being careful not to drop parts. If the two dowel pins did not come out with assembly, remove dowel pins from housing.

13. If it is desired to disassemble the shaft and rotor assembly, use a screwdriver as shown in Figure 90-66.

14. Remove and discard pressure plate "O" ring seal.

15. Remove shaft seal, if defective, by prying out with small screwdriver.

b. Inspection of Oil Pump Parts

Clean all parts thoroughly with solvent and wipe dry with clean, lint-free cloth before inspecting.

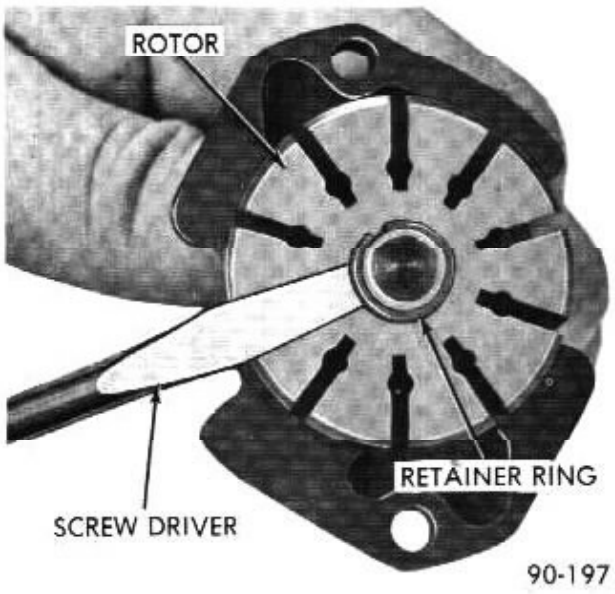

Figure 90-66 Removing Rotor Retaining Ring

1. Inspect shaft for wear.

2. Check fit of the ten vanes in slots of rotor; vanes must slide freely but fit snugly in slots. Tightness may be removed by thorough cleaning or removal of irregularities using a hard Arkansas stone. Replace rotor if excessive looseness exists between rotor and vanes. Replace vanes if they are irregularly worn or scored. Light scoring on the rotor can be repaired by carefully lapping surface of rotor.

3. Inspect all ground surfaces of the rotor ring for roughness or irregular wear. Slight irregularities may be removed with a hard Arkansas stone. Replace ring if inside cam surface is badly scored or worn and inspect outside radius of vanes very closely for damage.

4. Inspect the surfaces of the pressure plate and thrust plate for wear or scoring. Light scoring can be repaired by carefully lapping until surface is smooth and flat, after which all lapping compound must be thoroughly washed away.

5. Inspect the flow control valve bore in the housing for scoring, burrs or other damage. Hair line scratches are normal. Inspect bushing in housing, if worn or scored, replace housing.

6. Inspect the surfaces of the flow control valve for scores and burrs. Hair line scratches are normal. Replace valve if badly scored or if it is the cause of low pump pressure. Check the screw in the end of the valve, if loose, tighten being careful not to damage machined surfaces. Filter in end of screw must be clean.

7. Check orifice in pressure union to be sure it is not plugged.

c. Reassembly of Oil Pump

1. Make sure all parts are absolutely clean. Lubricate seals and moving parts with power steering oil during assembly.

2. If shaft seal was removed, use installer J-7017 to drive new seal into housing with spring side of seal toward housing. See Figure 90-67. Just bottom seal in housing.

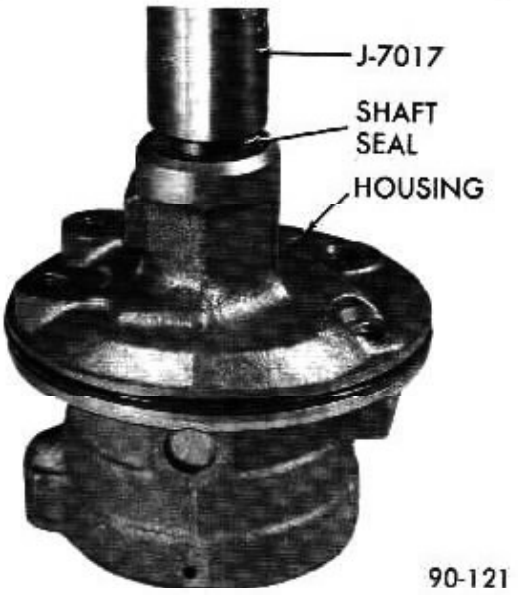

Figure 90-67 Installing Shaft Seal

3. Mount housing in vise with shaft end down. Install new pressure plate "O" ring seal in groove in housing bore. This seal is smaller than the end plate "O" ring seal and it has a daub of paint on it for identification.

4. Insert shaft into housing and press down with thumb on splined end to properly seat shaft. Be careful not to damage shaft seal in housing.

5. Install the two dowel pins in housing and install thrust plate on the pins with ported face of plate to rear of housing.

6. Install pump ring with small holes in ring on dowel pins and with arrow on outer edge to rear of housing.

7. Install rotor on pump shaft with spline side of rotor to rear of housing. Rotor must be free on shaft splines.

8. Install ten vanes in rotor slots with radius edge toward outside and flat edge toward center of rotor.

9. Install shaft retaining ring on pump shaft.

10. Lubricate the outside diameter and chamfer of pressure plate with petroleum jelly and install on dowel pins with ported face toward rotor. Dowel pins fit into slots in plate that are nearest outside diameter of plate. Use a soft plastic or wood rod and lightly tap around *outside diameter* of pressure plate to seat it. See Figure 90-68. Pressure plate will travel about 1/16" to seat. *Never press or hammer on the center of pressure plate as this will cause permanent distortion and result in pump failure.*

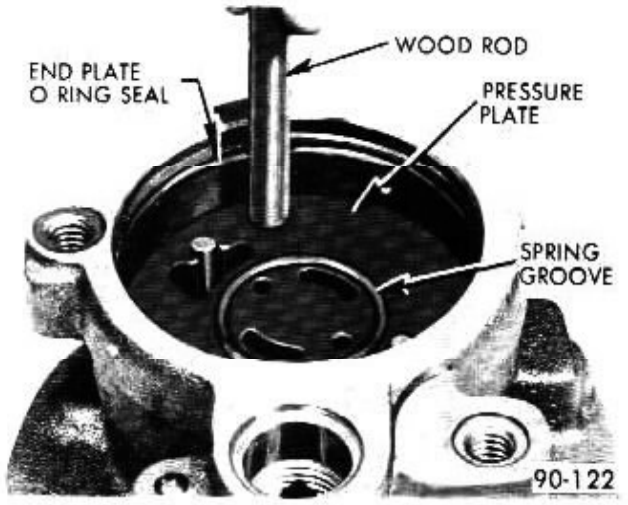

Figure 90-68 - Seating Pressure Plate in Housing

11. Install new end plate "O" ring seal in groove in bore of housing. Be sure not to install it in end plate retaining ring groove which is first groove from rear of housing. See Figure 90-68.

12. Install the pressure plate spring.

13. Lubricate outside diameter and chamfer of end plate with petroleum jelly and insert in housing.

14. Place end plate retaining ring on top of end plate. Use an arbor press to lower end plate into housing until ring groove in housing is evenly exposed. Be sure ring is completely seated in housing groove and end plate is aligned properly.

CAUTION: *Press end plate into housing only far enough to install retaining ring in groove.*

15. Install new reservoir "O" ring seal on housing. Place pressure union seal and two stud seals in proper counterbores on rear of housing.

16. Install reservoir on housing and line up holes for studs. Tap reservoir with a soft mallet to seat it on housing and install reservoir to housing studs with short end of stud in housing. Torque studs to 35 lb. ft.

17. Install flow control valve spring in housing. Then install flow control valve with hex head of valve going in housing first. Check movement of valve.

18. Assemble new "O" ring in groove nearest outlet end of pressure union. Install union in pump and torque 35 lb. ft.

CAUTION: *If "O" ring is installed in groove on pressure union that contains the flow orifice, pump will not build up pressure.*

19. Remove pump from vise and install shaft key on shaft. Support shaft on opposite side while installing key.

20. Check for bind in pump by rotating drive shaft. Shaft must rotate freely by hand.

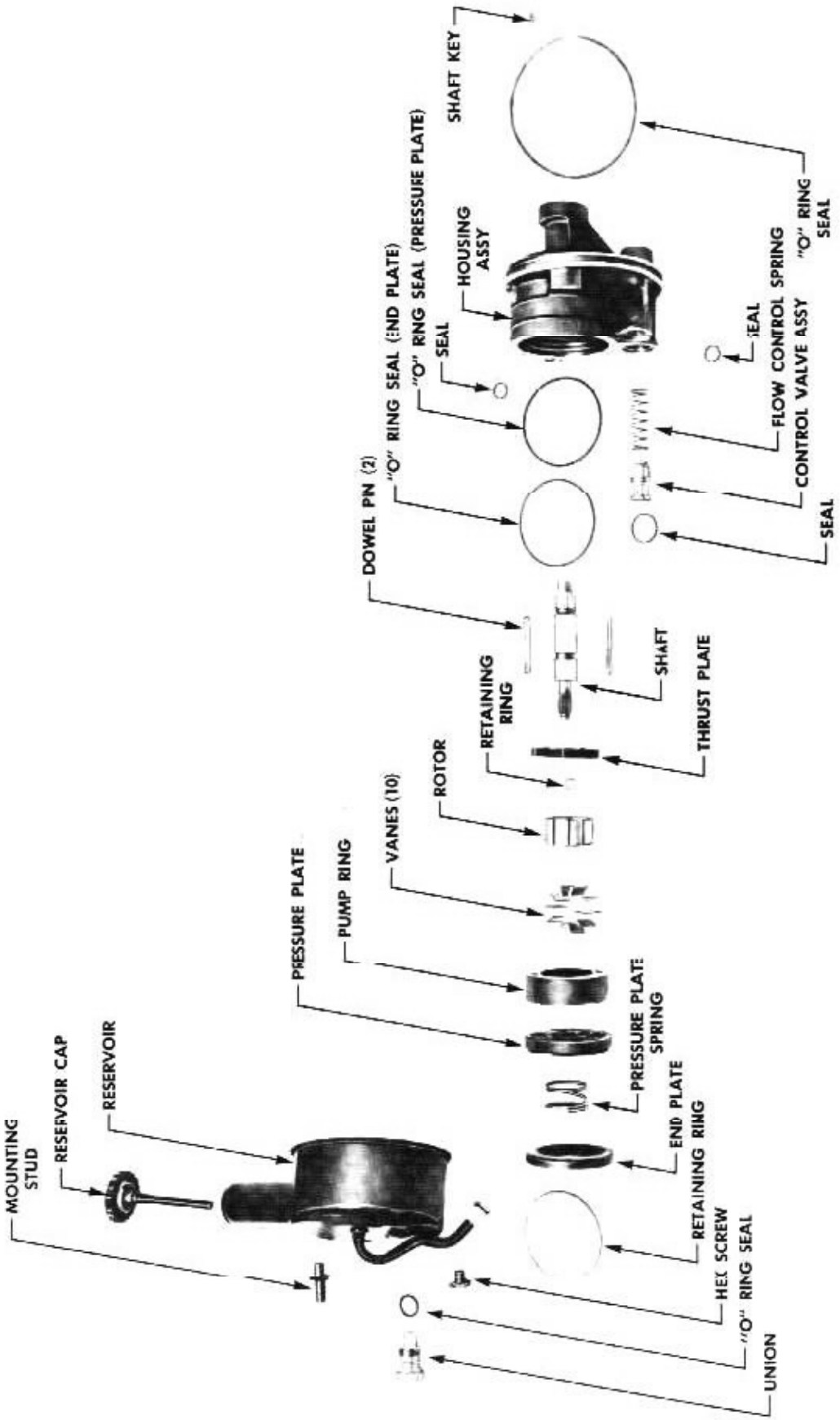

Figure 90-69 Oil Pump-Exploded View

DIVISION VI

SPECIFICATIONS

90-20 POWER STEERING GEAR AND PUMP SPECIFICATIONS

Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only. Dry or dirty threads produce increased friction which prevents accurate measurements of tightness.

a. Gear

Part	Location	Thread Size	Torque Lb. Ft.
Bolt	Gear Housing to Frame	7/16-14	70
Bolt	Lower Coupling Flange to Worm Shaft	3/8-24	30
Nut	Steering Column Coupling to Steering Gear Shaft Flange	5/16-24	20
		3/8-24	20
Bolt	Gear Side Cover to Housing	3/8-16	30
Nut	Pitman Arm to Pitman Shaft	Special	180
Nut	Adjuster Plug Locking	Special	80
Nut	Pitman Shaft Lash Adjuster Locking	Special	23
Plug	Rack—Piston Nut End	Special	75
Screw	Ball Return Guide Retainer	1/4-28	10

b. Pump

Fitting	Pump Discharge Part	5/8-18	35
Nut	Pump Pulley Retaining	9/16-18	60
Nut	Pump to Mounting Bracket	3/8-16	35
Bolt	Pump Mounting Bracket to Engine	3/8-16	35
Fitting	Pressure Hose to Pump	5/8-18	25
Fitting	Pressure Hose to Gear	11/16-18	25
Fitting	Return Hose to Gear	5/8-18	25

90B-2

GENERAL SPECIFICATIONS

a. Gear

Gear Type	Recirculating Ball, Worm and Nut
Make	Saginaw
Gear Ratio Only	
43-44000	16.0 to 1
45000 with 350 Eng. and Estate Wagon	16.0 to 1
46-48-49000 and 45000 with 455 Eng.	15.0 to 1
Ratio Overall (Including Linkage)	
43-44000	18.7 to 1
45000 with 350 Eng. and Estate Wagon	17.9 to 1
46-48-49000 and 45000 with 455 Eng.	16.5 to 1
Turns of Steering Wheel, Stop to Stop	
43-44000	3.30
45000 with 350 Eng.	2.99
46-48-49000 and 45000 with 455 Eng.	2.94
Steering System Oil Type	Buick Power Steering Oil (Or Equivalent)
Number of Worm and Rack-Piston Nut Balls	
All Series	12 Black 12 Plain

b. Pump

Pump Capacity, (minimum) Gal. Min. at 465 R.P.M. (Pump) X 665-735 P.S.I.	
250 and 350 Cu. In. Engine	1.25
455 Cu. In. Engine Less 43-44000	1.75
Pump Capacity (Maximum), Gal. Min. at 1500 RPM (Pump) x 50 P.S.I.	
250 Cu. In. Engine	3.10
350 and 455 Cu. In. Engines	2.80
Relief Valve Opening Pressure (P.S.I.)	
250 Cu. In. Engine	1350-1450
350 and 455 Cu. In. Engines	1250-1350
Pump Test Pressure, Min. P.S.I. at 525 R.P.M. (Engine) and 170 F. Oil Temperature	1000 Minimum

90B-3

SECTION B

EXHAUST SYSTEM
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Non-Applicable)	
II	DESCRIPTION AND OPERATION:	
	Description of Exhaust System.....	80-4
III	ADJUSTMENTS AND MINOR SERVICE: (Non-Applicable)	
IV	REMOVAL AND INSTALLATION:	
	Removal and Installation of Exhaust System.....	80-5
V	OVERHAUL AND MAJOR SERVICE: (Non-Applicable)	
VI	SPECIFICATION: (Non-Applicable)	

DIVISION II

DESCRIPTION AND OPERATION

80-5 DESCRIPTION OF EXHAUST SYSTEM

The single exhaust system is standard equipment on all 43, 44000 series models except G. S. Series. The 350 four barrel hi-performance engines are available with the dual exhaust system. On the G. S. models, dual exhaust systems are standard equipment. Single exhaust is standard on all 45-46- 48000 series cars. Dual exhaust systems are available as an option on LeSabre (with 455 engine), Centurion, and Electras.

The 43-44-45000 Series (less the 455 cu.in. engine) exhaust systems do not have resonators. Sportwagons have a tail pipe which crosses over just behind the rear axle. In all wagons, the tail pipe exits just behind the left rear tire. This side exit reduces the possibility of having exhaust gas enter an open tail gate window.

All 45-46-48-49000 Series exhaust pipes, plus the 43000 G. S. models, are of the double wall laminated type. This double layer pipe is used to muffle pipe "ring" which is set-up by the firing impulses of the individual cylinders; the life of the pipe is also greatly increased.

For long life, all single exhaust system mufflers and tail pipes are aluminized. The 350 cubic inch four barrel hi-performance engines with dual exhaust systems have stainless steel inner shells, baffles, and end caps.

The single exhaust system mufflers and all rear exhaust pipes (both single and dual) on the 455 engines are aluminized for longer life; the dual exhaust system mufflers are constructed of stainless steel inner sheels, baffles, and end caps. All resonators are constructed of stainless steel.

All exhaust pipe connections to exhaust manifold are of the ball joint type to allow angular movement for alignment purposes. On all single exhaust systems, the rear end of the front exhaust pipe (crossover) assembly is also of the ball joint type. All other connections are of the slip joint type. No gaskets are used in the entire system.

The muffler is of the oval-shaped dynamic flow type having very low back pressure. It is double wrapped of heavy gage aluminized and stainless steel with a layer of asbestos placed between wrappings to aid in reduction of noise transfer and to prevent any "oil- canning" effect. The exhaust system is supported by free-hanging rubber mountings which permit free movement of the system but do not permit transfer of noise and vibration into the passenger compartment.

The routing of the rear exhaust pipe, between the muffler and resonator, for 1971 Estate Wagons is different than in 1970. The pipe is routed underneath the axle tube. Extreme care should be taken when lifting the Estate Wagon on an axle lift hoist to make sure the pipe is not pinched or damaged. The resonator and rear exhaust pipe are serviced as a single unit if the resonator is damaged. If, for some reason, the pipe is damaged but not the resonator, the pipe may be cut off and a new slip joint type pipe used as a replacement.

DIVISION IV

REMOVAL AND INSTALLATION

80-6 REMOVAL AND INSTALLATION OF EXHAUST SYSTEM PARTS

NOTE: *Sealer* **1051249 (Group 8.800), or equivalent, to be applied to all slip joints before assembly.**

A. Removal and Installation of Muffler

NOTE: *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. Any defects should be corrected immediately. To help insure continued integrity, exhaust system pipes and resonators rearward of the muffler must be replaced whenever a new muffler is installed.*

The following instructions apply, in general, to all exhaust systems. For specific information, see the illustrations following this paragraph.

1. Remove U-bolts and clamps from muffler inlet and outlet nipples.

2. Split muffler inlet nipple on opposite sides so that it is loose on inner pipe. Be careful not to damage inner pipe.

3. Disconnect front or intermediate exhaust pipe at forward end ball joint by removing bolts or nuts.

4. Pull exhaust pipe forward and twist to disengage from muffler. Lay exhaust pipe on floor.

5. Remove old muffler by pulling forward and twisting.

6. Subassemble exhaust pipe and new muffler on floor, tightening new U-bolt and nuts just snug so that muffler will move but will stay where moved.

7. Raise exhaust pipe-muffler subassembly into position and install new bolts or nuts at forward ball joint just snug.

8. Install new U-bolt and nuts at rear of muffler just snug.

9. Align muffler and exhaust pipe. See illustration that applies--Figures 80-16 through 80-24.

10. Tighten all bolts and nuts.

B. Removal and Installation of Resonator

1. Remove tail pipe clamp bolt and spread clamp so that resonator-tail pipe assembly will slide through clamp.

2. Split resonator inlet nipple on opposite sides so that it is loose on rear exhaust pipe. Be careful not to damage exhaust pipe.

3. Slide old resonator to rear and then forward out of tail pipe clamp.

4. Install new hanger where necessary.

5. Install new resonator-tail pipe assembly.

6. Install new U-bolt and clamp. Install new tail pipe hanger bolt. Tighten all nuts so that resonator can be moved but will stay where moved.

7. Align resonator assembly. See illustration that applies- -Figures 80-16 through 80-24.

8. Tighten all clamps.

C. Removal and Installation of Front or Intermediate Exhaust Pipe

1. Cut off defective exhaust pipe just forward of muffler nipple.

2. Remove U-bolt and clamp from forward muffler nipple. Disconnect exhaust pipe at forward end ball joint by removing bolts or nuts.

3. Split stub end of exhaust pipe in muffler, being careful not to damage muffler nipple. Collapse stub end and remove.

4. Raise new exhaust pipe into position and install new bolts or nuts at forward ball joint just snug.

5. Install new U-bolt and clamp just snug.

6. Align exhaust pipe. See illustration that applies- -Figures 80-16 through 80-24.

7. Tighten all bolts and nuts.

D. Removal and Installation of Tail Pipe

1. Raise car so that rear axle and frame are separated as far as possible.

2. Cut off defective tail pipe just rearward of muffler nipple.

3. Remove tail pipe clamp bolt and spread clamp. Remove oil tail pipe.

4. Split stub end of tail pipe in muffler, being careful not to damage muffler nipple. Collapse stub end and remove.

5. Position new tail pipe over rear axle and into position.

6. Install new U-bolt and clamp. Install new tail pipe hanger clamp bolt. Tighten all nuts just snug.

7. Align tail pipe. See Figures 80-16 through 80- 24.

8. Tighten all nuts.

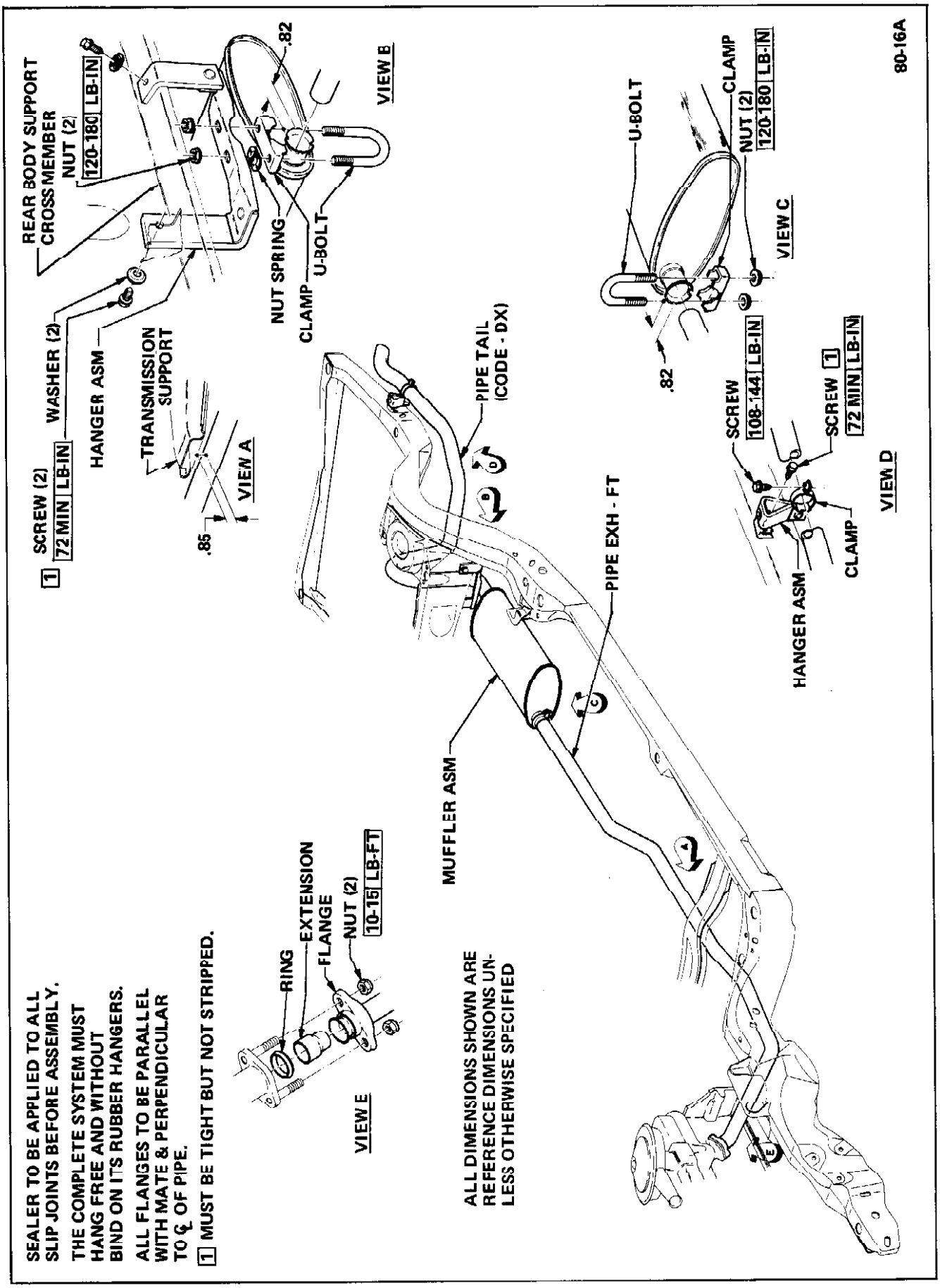

Figure 80-16 Exhaust System L-6 Skyark

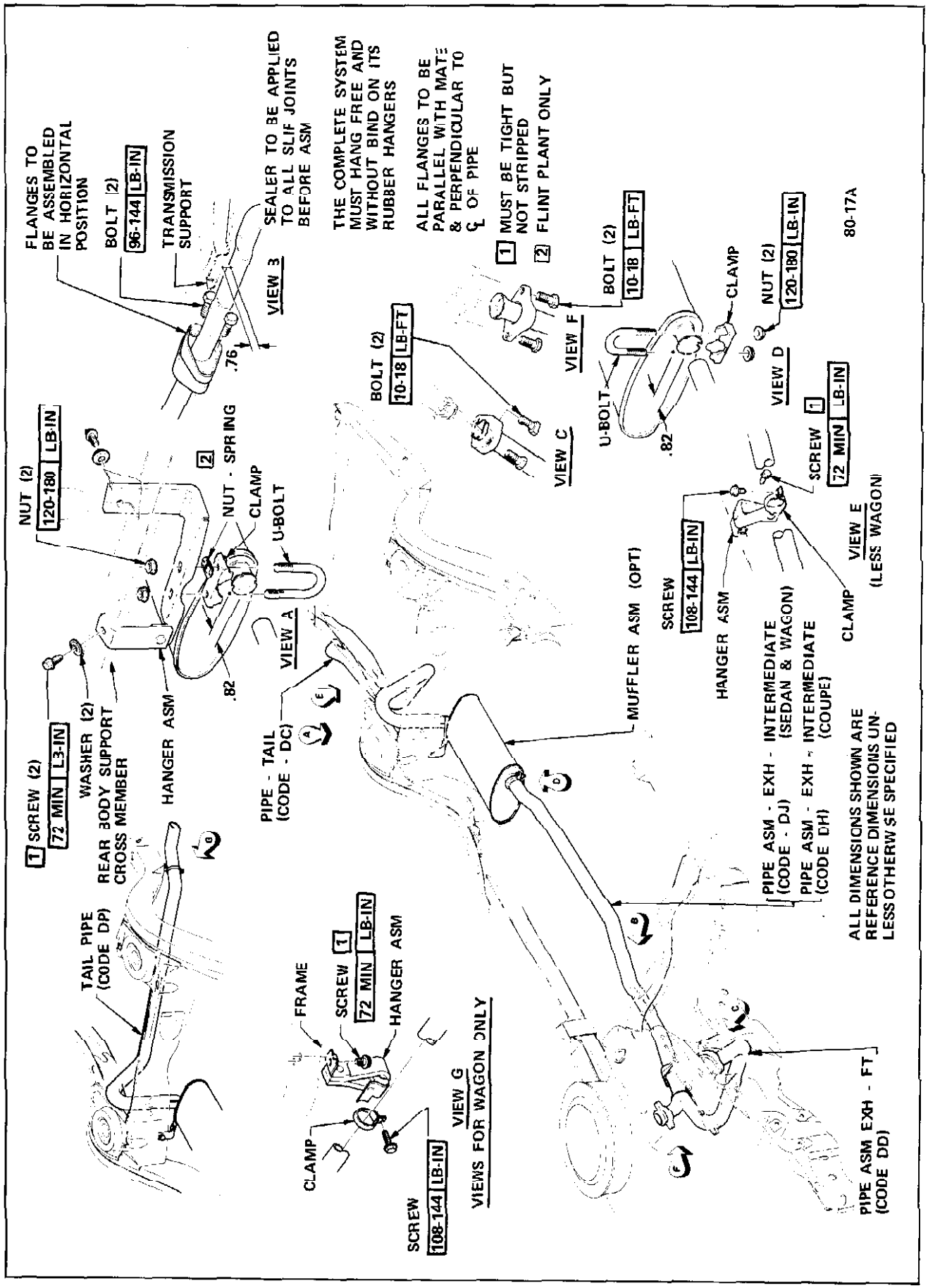

Figure 80-17 Exhaust System V-8 Skylark, Skylark Custom, and Sport Wagon Except G. S.

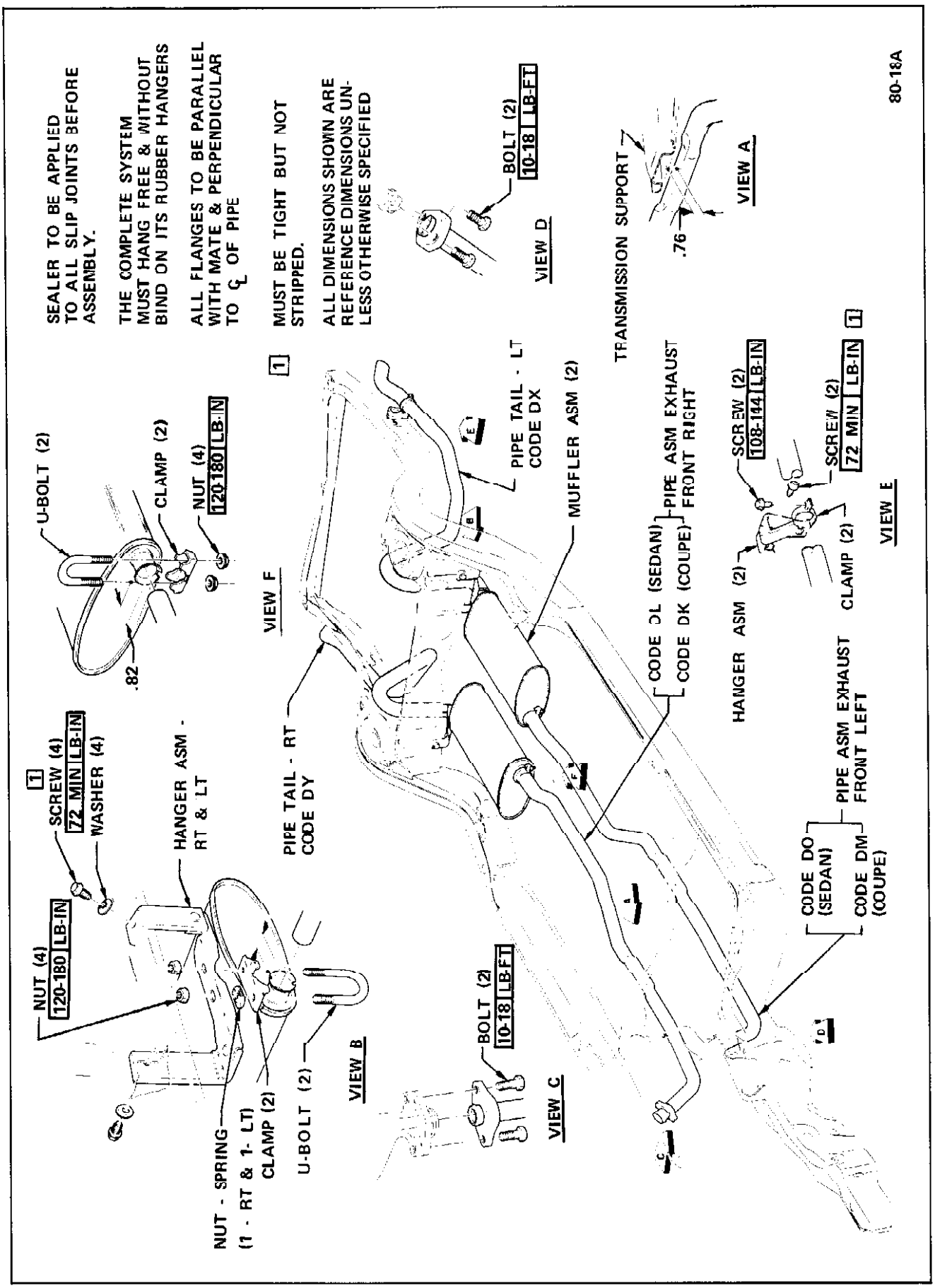

Figure 80-18 Exhaust System 350 4 BBL. - High Performance - Dual Exhaust System

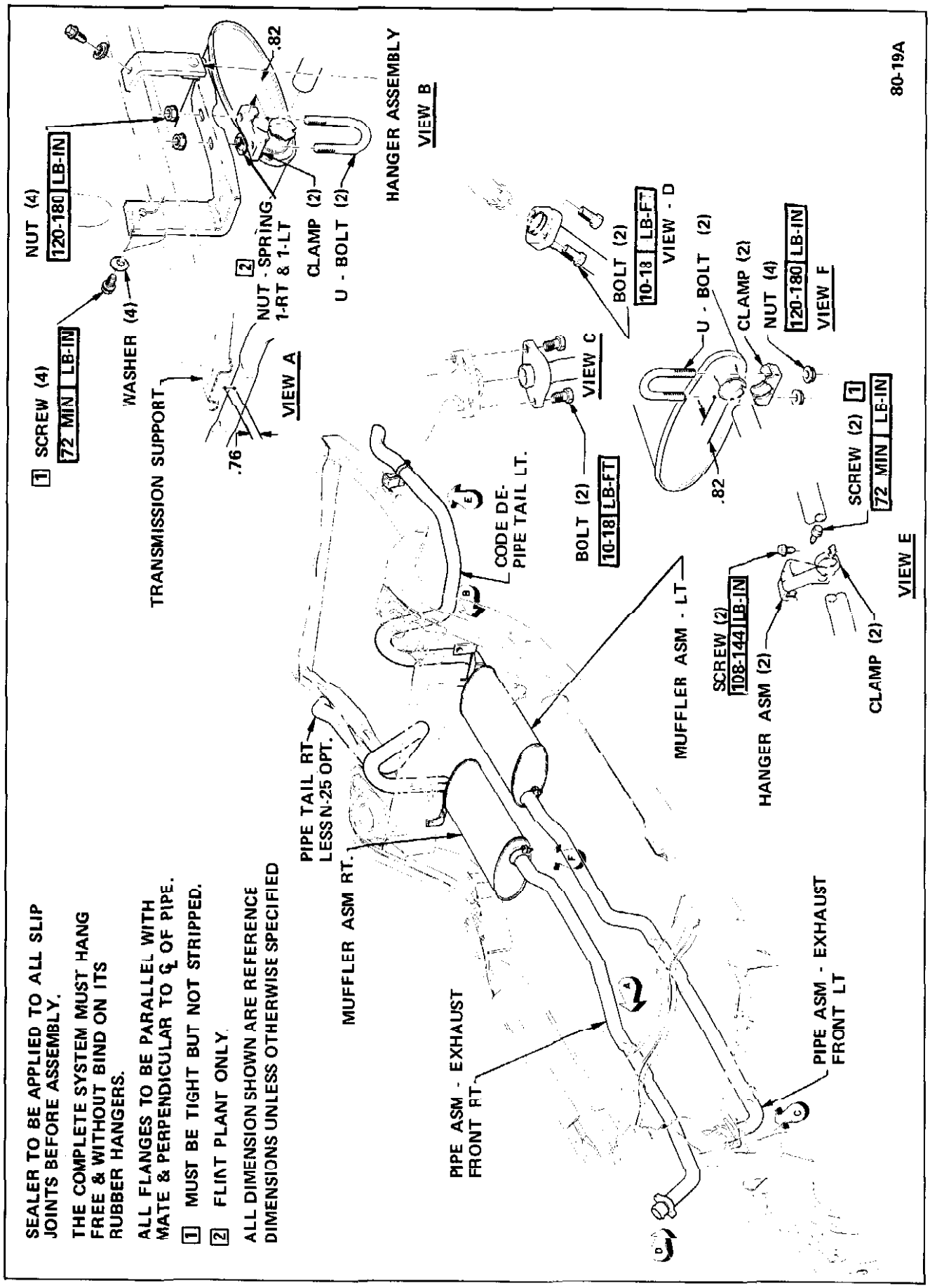

Figure 80-19 G. S. Series - Dual Exhaust - Less N-25 Option

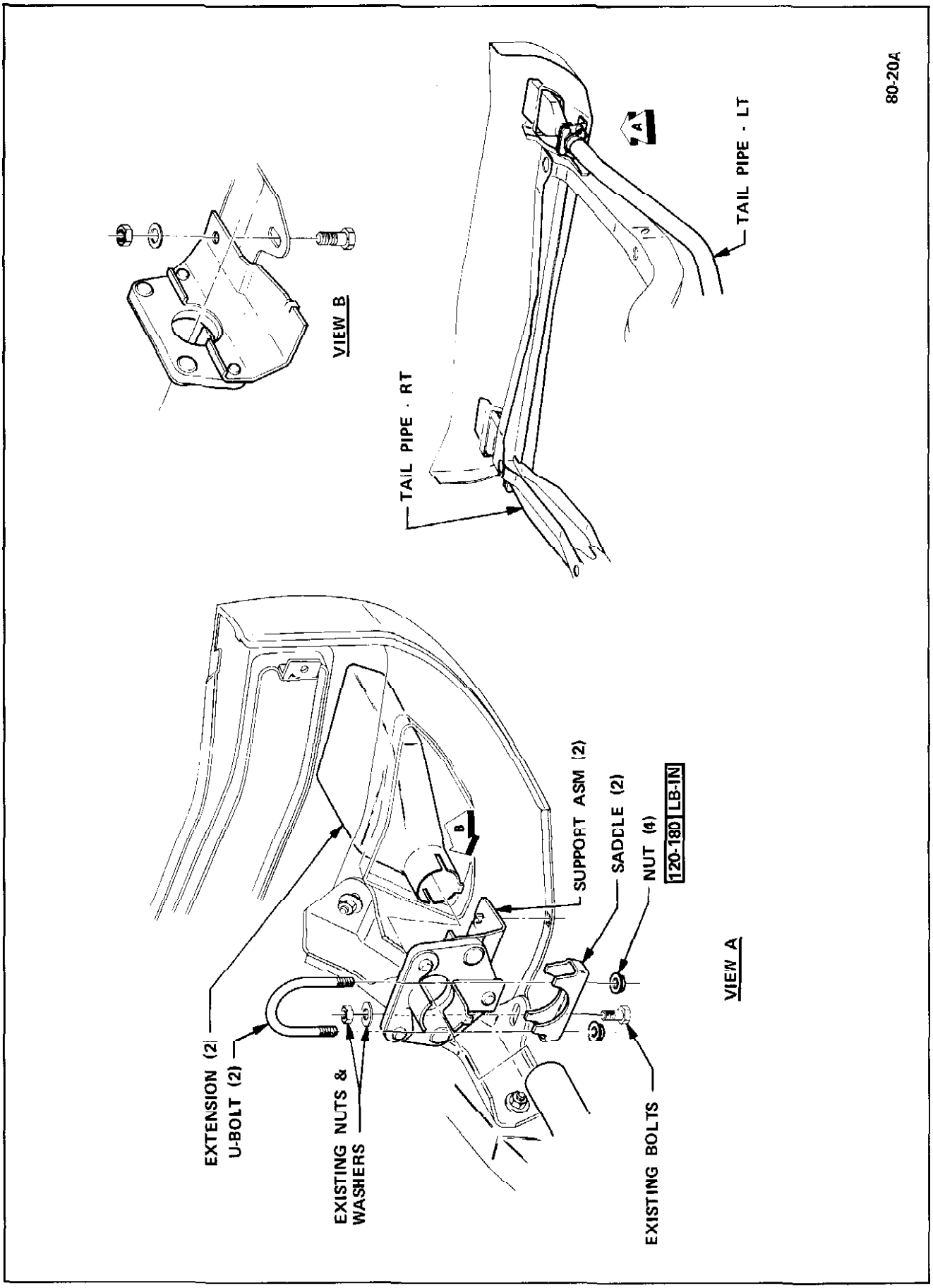

Figure 80-20 G.S. Dual Exhaust System - N-25 Option

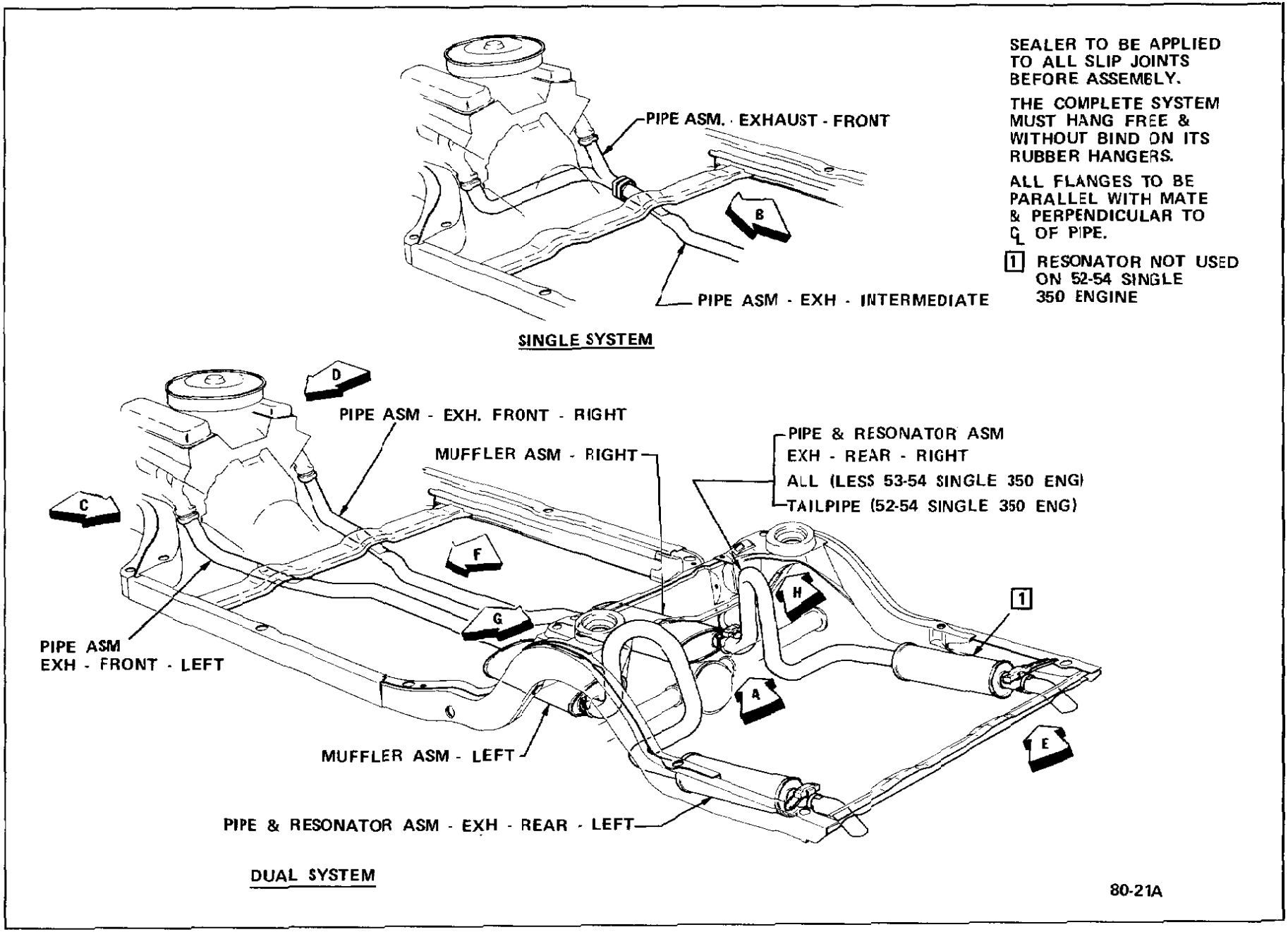

Figure 80-21 Exhaust Systems (Single and Dual) - LeSabre, Centurion, Electra, and Riviera

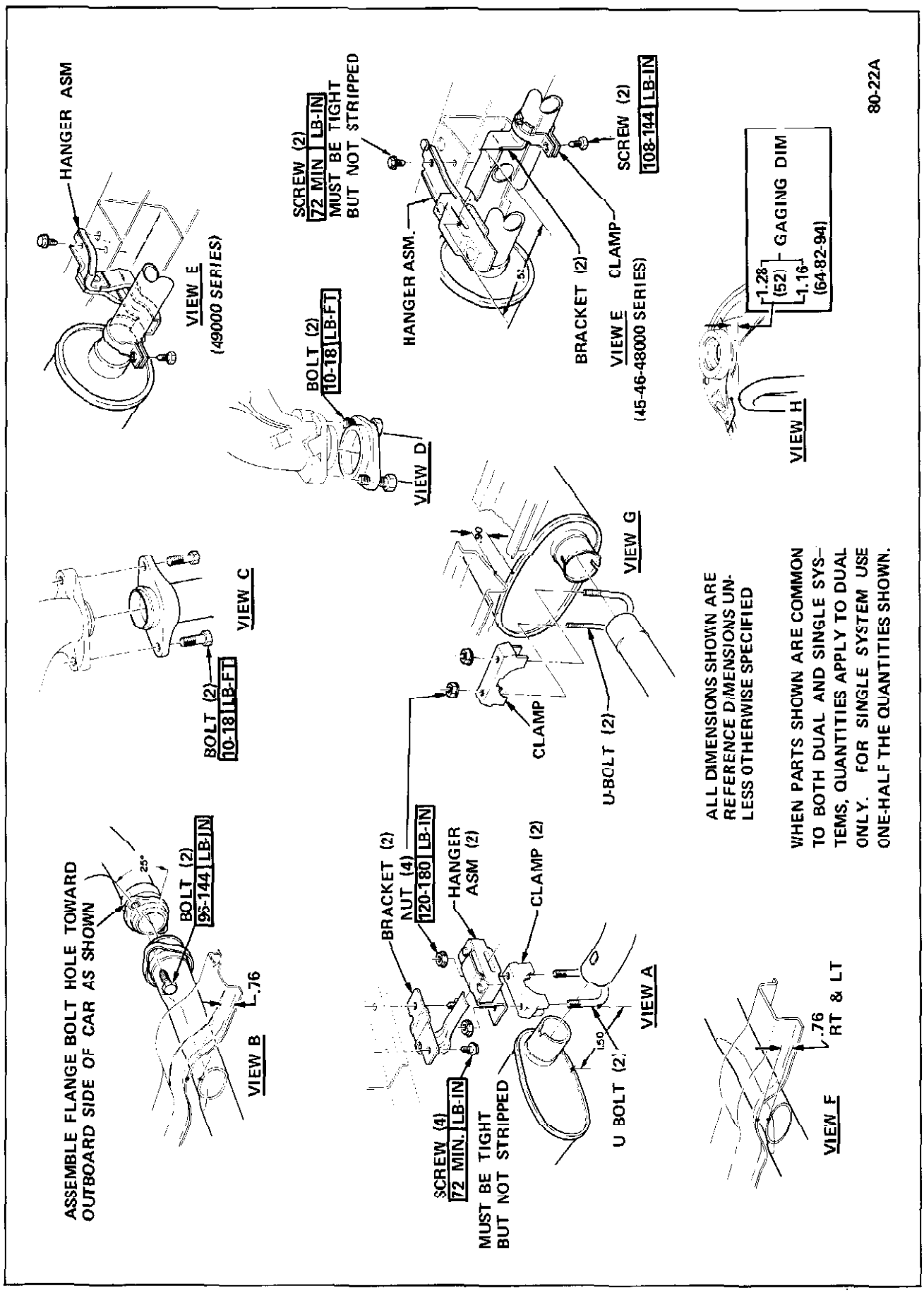

Figure 80-22 Assembly Information for Figure 80-21

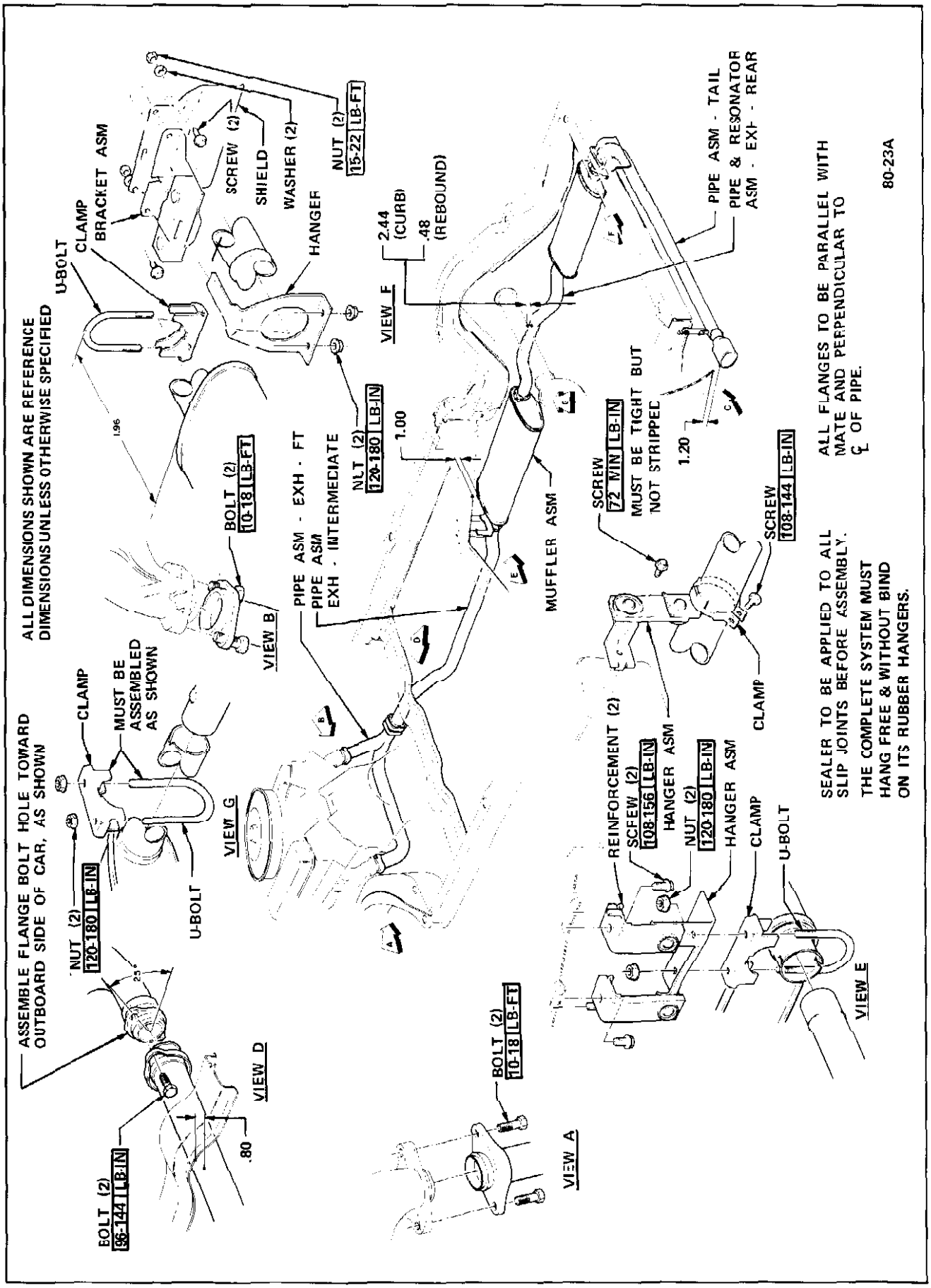

Figure 80-23 Single Exhaust System - Estate Wagon

GROUP 80

FUEL TANK AND EXHAUST

Section	Subject
A	Fuel Tank and Fuel System .
B	Exhaust System . . . . .

SECTION A

FUEL TANK and FUEL SYSTEM
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Non-Applicable)	
II	DESCRIPTION AND OPERATION:	
	Description of Fuel Tank and Fuel System	80-1
	Description of Evaporative Emission Control System	80-2
III	ADJUSTMENTS AND MINOR SERVICE: (Non-Applicable)	
IV	REMOVAL AND INSTALLATION:	
	Removal of Fuel Tank or Fuel Gauge Tank Unit	80-3
V	OVERHAUL AND MAJOR SERVICE: (Non-Applicable)	
VI	SPECIFICATIONS: (Non-Applicable)	

DIVISION II

DESCRIPTION AND OPERATION

80-1 DESCRIPTION OF FUEL TANK AND FUEL SYSTEM

In all models except Rivieras and station wagons, the fuel tank is attached under the trunk floor pan by two straps and is of the center fill design. The filler neck extends from the rear upper center of the tank to a point just forward of the rear bumper. See Figures 80-1, 4, and 5. To fill the tank, pull down the spring-loaded license plate bracket and remove the filler cap.

All station wagons have the fuel tank mounted in the left rear quarter panel area. See Figure 80-3. To fill the tank, lift the spring-loaded filler door and remove the filler cap.

Filler necks are soldered into the tank in all series cars. See Figures 80-1 thru 80-5.

In all models except station wagons, the tank is vented during filling by an internal baffle inside the filler.

In station wagons, the tank is vented only at the filler cap. See Figure 80-3.

In all models the tank outlet consists of a combination fuel pickup, filter and fuel gage tank unit. The tank unit can be removed by removing a cam ring which retains the unit.

The fuel line is coated, welded steel tubing. Connections from the tank unit to the line and from the line to the fuel pump are made with synthetic rubber hose attached with spring clamps.

All engines have a replaceable pleated paper filter located in the carburetor inlet.

All air conditioned cars (except L-6) have a vapor return system. These cars have a special fuel pump which has a metering outlet. Any vapor which forms is bled off and returned to the fuel tank, along with continuously circulating fuel, through a separate line. This system keeps cool fuel recirculating to the pump, thereby greatly reducing any possibility of vapor lock. All 455 cubic inch engine cars have the vapor return system, regardless of whether or not they are equipped with an air conditioner.

80-2 DISCRIPTION OF EVAPORATIVE EMISSION CONTROL SYSTEM

All 1971 Buicks will be equipped with a system designed to prevent escape of fuel vapor to the atmosphere. Vapor generated by evaporation of fuel in the tank, previously exhausted to atmosphere, will be transferred by a emission line to the engine compartment. During periods of operation, vapors are fed directly to the engine for consumption. During periods of inoperation, an activated charcoal canister located in the emission line stores any vapor generated for consumption during the next period of operation.

NOTE: *The emission hose that runs from the stand pipe to the evaporator pipe is a specific hose in that it has an orifice in it. It is important that if this hose has to be replaced, it be replaced by a hose of the same part number to make sure the orifice is in place. See Figure 80-12 for hose and orifice location.*

The amount of vapor drawn into the engine at any time is too small to have any effect on fuel economy or engine operation.

With this closed system it is extremely important that only vapors be transferred to the engine. To avoid the possibility of liquid fuel being drawn into the system, these following features are included as part of the total system:

1. A fuel tank overfill protector is provided on all models to assure adequate room for expansion of liquid fuel volume with temperature changes.

2. A three (3) point fuel tank venting system is provided on all models except station wagons, which have one (1) point, to assure that the tank will be vented under any conceivable car attitude.

3. On all models, except station wagons, a liquid vapor standpipe, located in back of the rear seat back rest, transfers the multiple tank vents to the single vapor transfer line, and assures that no liquid fuel will pass that point.

4. To protect the tank from mechanical damage in the event of excessive internal or external pressures resulting from the operation of this closed system, a pressure-vacuum relief valve, located in the gas cap, will control the tank internal pressure.

Gas Cap

1. The fuel tank filler cap has a new two-step removal and installation procedure, plus a pressure- vacuum safety relief valve.

2. It is equipped with a double set of locking tangs. To remove:

a. Rotate cap one-half turn counterclockwise to clear the first set of tangs from the slots inside the filler neck.

b. This will allow any residual pressure to escape.

c. Pull the cap outward and rotate one-quarter turn counterclockwise to clear second set of tangs, and remove the cap.

d. To install, reverse this procedure.

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 malfunction of the*

system. Correct replacement caps may be obtained from your Buick or General Motors dealer.

CANISTER PURGE VALVE (L-6)

A. Disassembly

1. Disconnect lines at valve.

2. Snap off valve cap (Slowly remove cap as diaphragm is under spring tension). Remove diaphragm, spring retainer and spring.

3. Replace parts as necessary. Check orifice openings.

B. Assembly

1. Install spring, spring retainer, diaphragm and cap.

2. Connect lines to valve.

Liquid Vapor Standpipe Removal

1. Remove rear seat and back cushion assembly.

2. Disconnect hoses at standpipe.

3. Remove four (4) sheet metal bolts securing standpipe.

4. To install standpipe, reverse above steps.

NOTE: *Make sure hoses are properly and fully seated to standpipe and gasket is in place.*

Maintenance requirements demand only that the accumulator purge air filter, an oiled fiber-glass filter assembled in the bottom of the canister, be replaced every 12,000 miles or 12 months. Under extremely dusty conditions, more frequent attention may be required.

DIVISION IV

REMOVAL AND INSTALLATION

80-3 REMOVAL OF FUEL TANK OR FUEL GAUGE TANK UNIT

All Series (Except Station Wagons) The fuel gauge tank unit is combined with the pickup pipe and the tank filter. All series require lowering the fuel tank to replace the tank unit.

To lower a fuel tank, proceed as follows:

1. Disconnect battery.

2. Syphon all fuel from tank into a clean container.

3. Disconnect fuel hose and vapor return hose from gauge tank unit.

4. Remove ground (black) wire screw.

5. Unplug tan wire from gauge unit.

6. Disconnect vent hoses.

7. Disconnect support straps and lower tank.

8. To install fuel tank, reverse above procedures.

To remove fuel gauge tank unit, proceed as follows:

1. Disconnect battery.

2. Unscrew cam ring using Wrench J-21518 for 43-44000 Series; or use Wrench J-22554 for 45-46-48 or 49000 Series

3. Remove fuel gauge tank unit.

unit, being careful not to bend or damage it.

4. Complete gauge unit installation by reversing above steps. Make sure tan wire and black wire connections are clean and tight.

43-46000 Series Wagons

1. Disconnect battery.

2. Drain gas from tank into suitable container and disconnect fuel gauge tank wire.

3. Raise car on hoist.

4. Remove left rear tire and wheel assembly.

5. Remove left quarter panel to wheelhouse filler panel (mud deflector) and bend lower attaching tab out of way.

6. Disconnect gas tank to wheelhouse ground wire.

7. Disconnect tail pipe hanger.

8. Disconnect fuel lines from gas tank.

9. Remove the end and bottom tank support straps.

10. Work tank forward and remove.

11. For installation reverse previous steps.

80-4 CLEANING FUEL SYSTEMS - ALL SERIES

If trouble is due to contaminated fuel or foreign material that has been put into the tank, it can usually be cleaned. If tank is rusted internally, it should be replaced.

1. Disconnect battery and ignition coil primary wire (plus wire on ignition coil).

2. Drain fuel tank.

3. Remove fuel tank (see "Removal of Tank").

4. Remove fuel inlet filter at carburetor and inspect for contamination. If filter is plugged, replace (leave fuel line disconnected).

5. Locate tank away from heat, flame, or other source of ignition. Remove fuel gauge tank unit and inspect condition of filter. If filter is contaminated, a new filter should be installed upon reassembly.

6. Complete draining of tank by rocking it and allowing fuel to run out of tank unit hole.

7. Purge fuel tank with steam or running hot water for at least five minutes. Pour water out of tank unit hole (rock tank to assure complete removal of water).

IMPORTANT: *This procedure will not remove fuel vapor. Do not attempt any repair on tank or filler neck where heat or flame is required.*

8. Disconnect inlet fuel line at pump and use air pressure to clean fuel line and fuel return line (if equipped). Apply air pressure in the direction fuel normally flows through line.

9. Use low air pressure to clean pipes on tank unit.

10. Install new filter on fuel tank unit, if required. Install fuel tank unit with new gasket into tank and install tank. Connect tank unit wires and all fuel lines, except pump to carburetor line (see "Removal of Tank" for proper procedure).

11. Connect a hose to fuel line at carburetor; insert other end of hose into a one gallon fuel can.

12. Connect battery cable. *Make sure ignition coil primary wire is disconnected.*

13. Put six gallons of clean fuel in tank and operate starter to pump two quarts of fuel into fuel can. This will purge fuel pump.

14. Remove hose and connect fuel line to carburetor.

15. Connect coil primary wire.

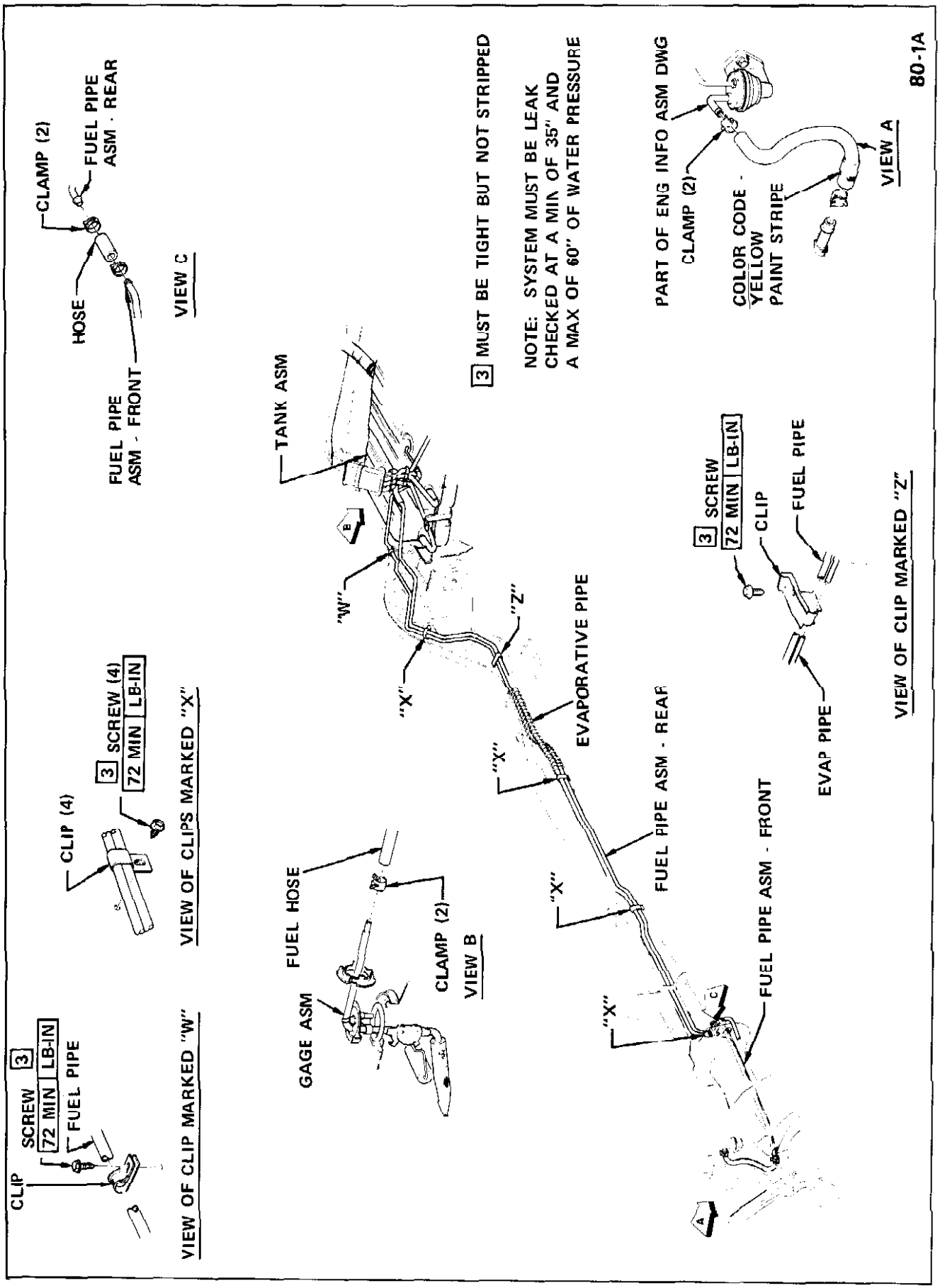

Figure 80-1 Fuel System - (L-6) Skylark

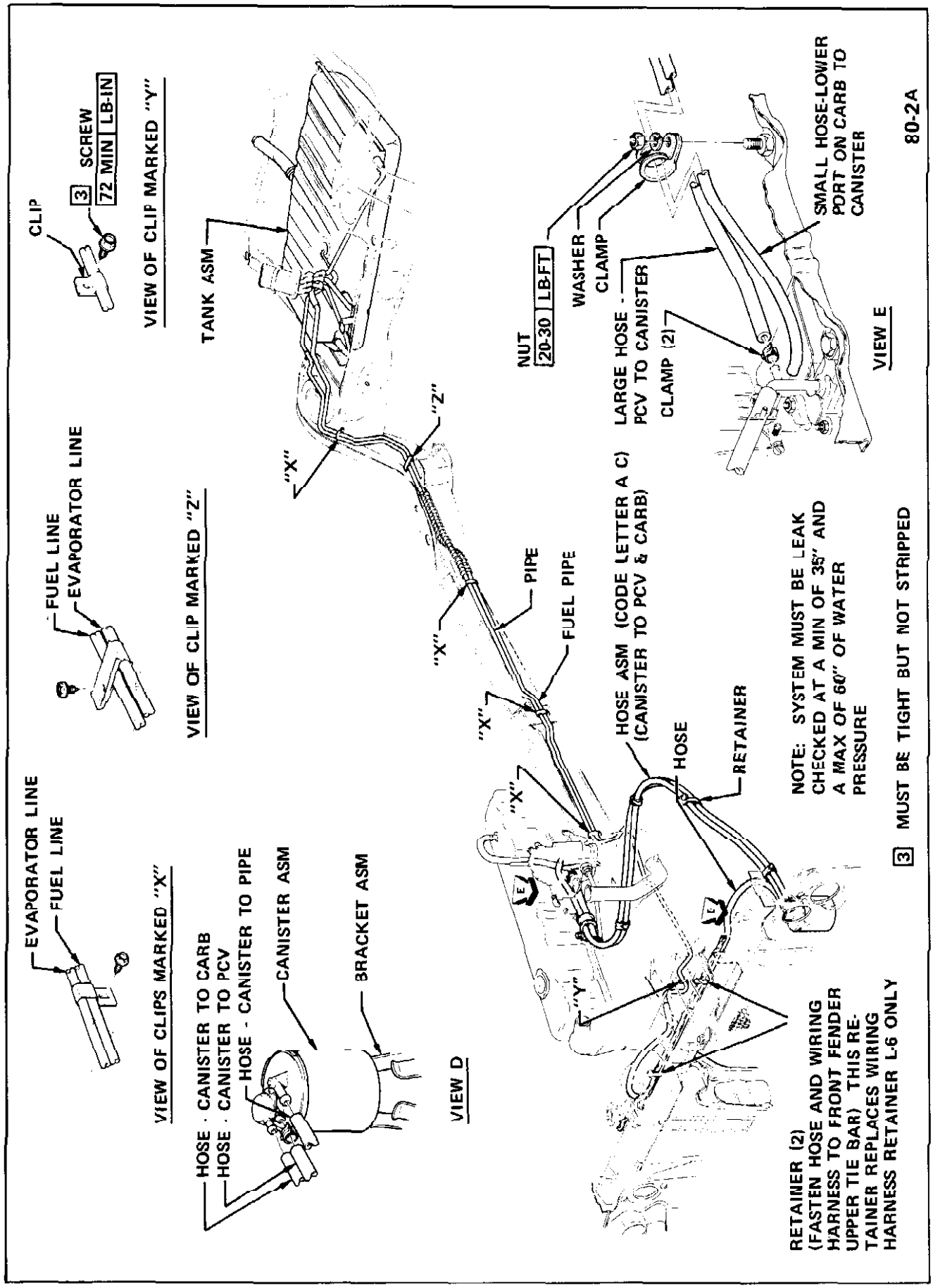

Figure 80-2 Evaporative Emission Control System - (L-6) Skylark

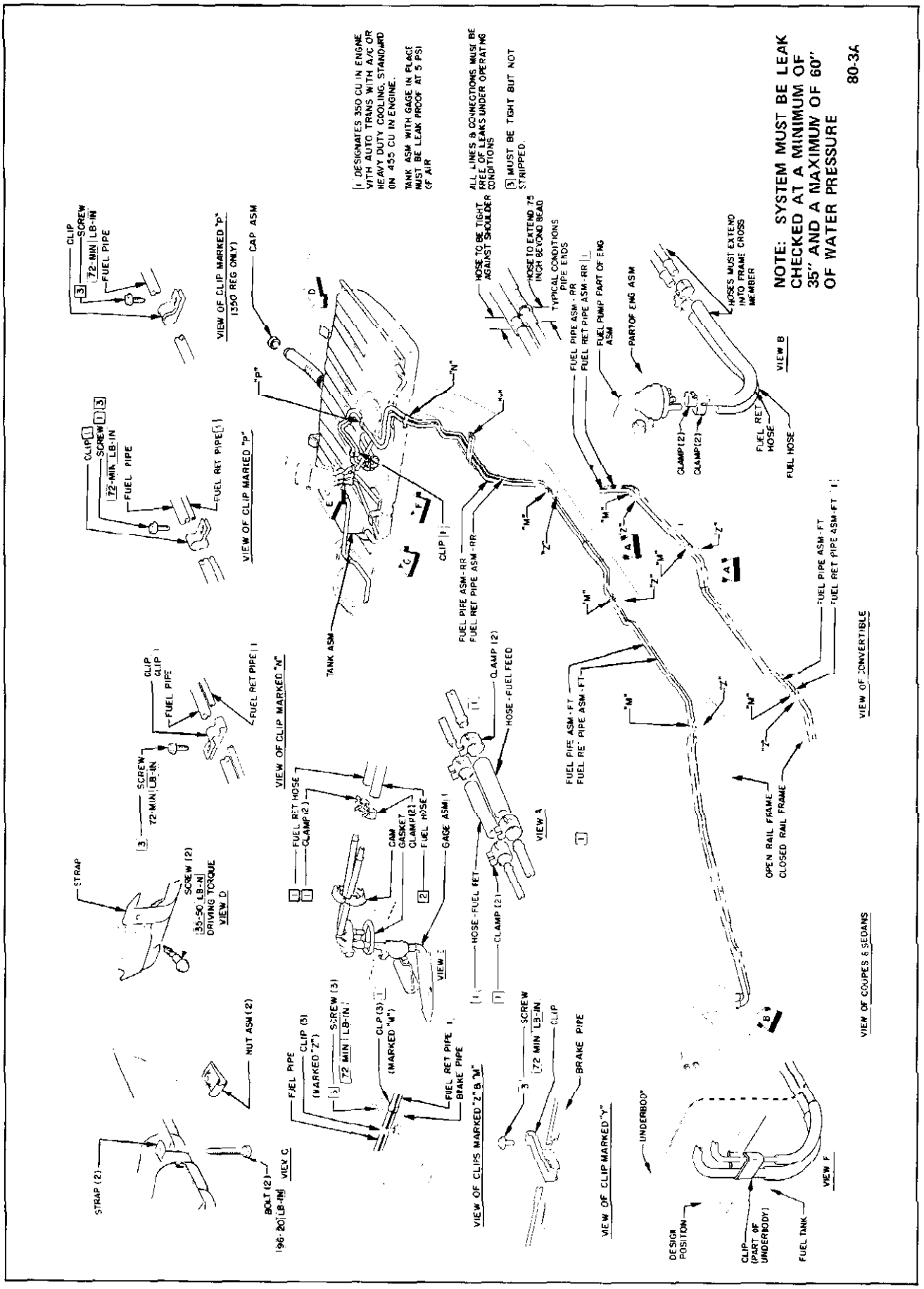

Figure 80-3 Fuel System - (V-8) Skylark, Skylark Custom and G.S.

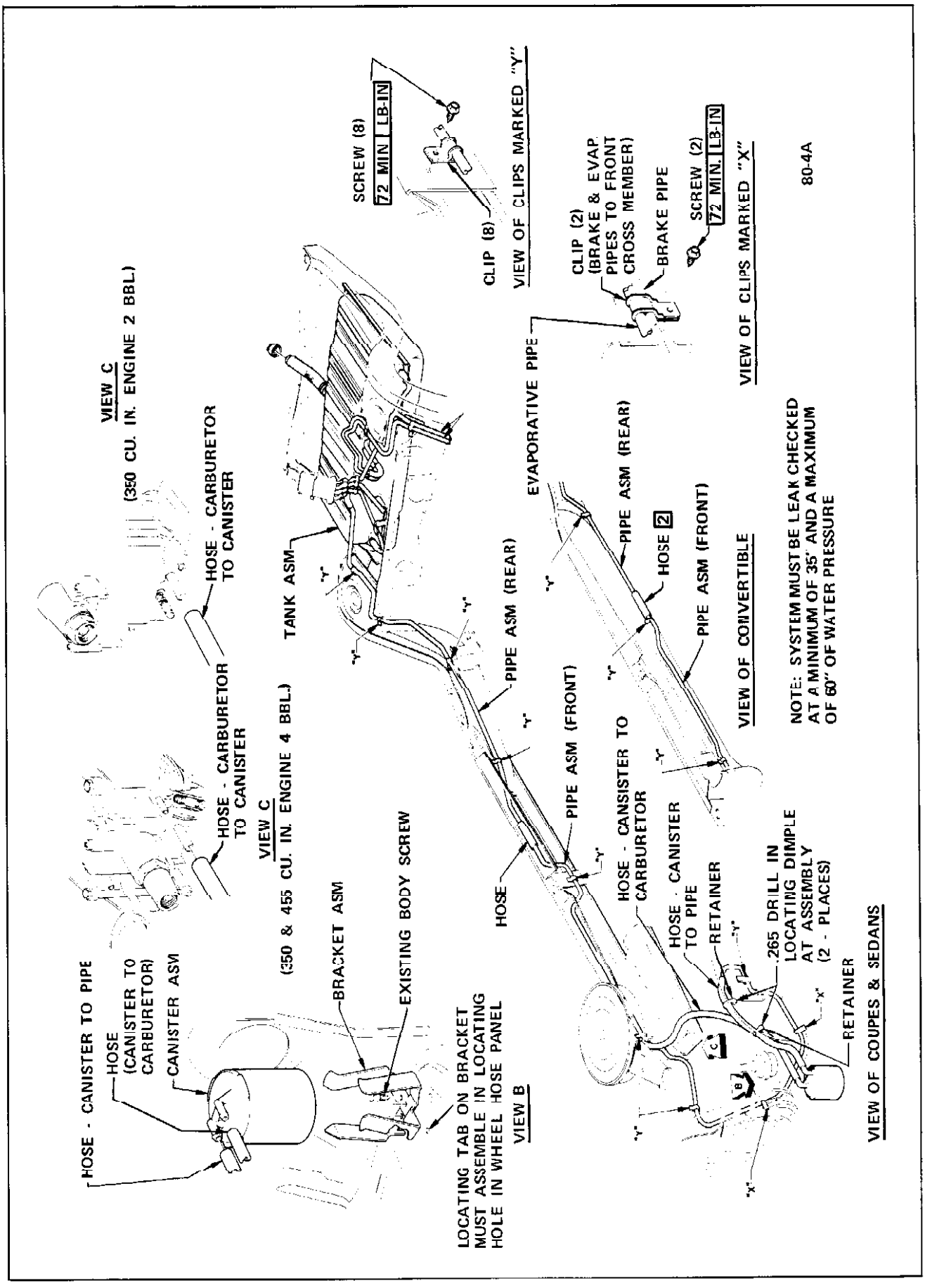

Figure 80-4 Evaporative Emission Control System (V-8) Skylark, Skylark Custom and G.S.

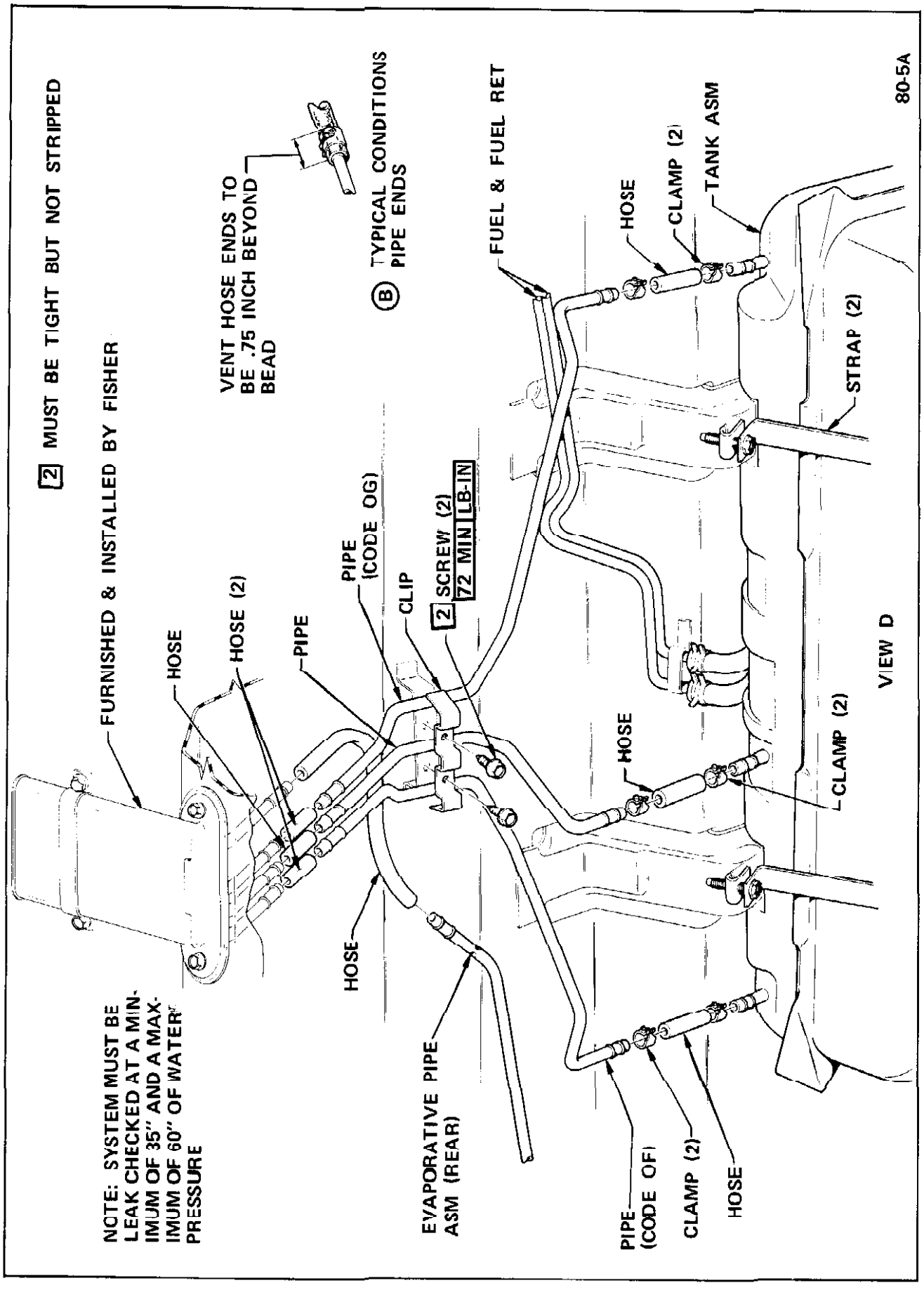

Figure 80-5 Fuel and Evaporative Emission Control Vent Pipes and Hoses - Skylark, Skylark Custom and G.S.

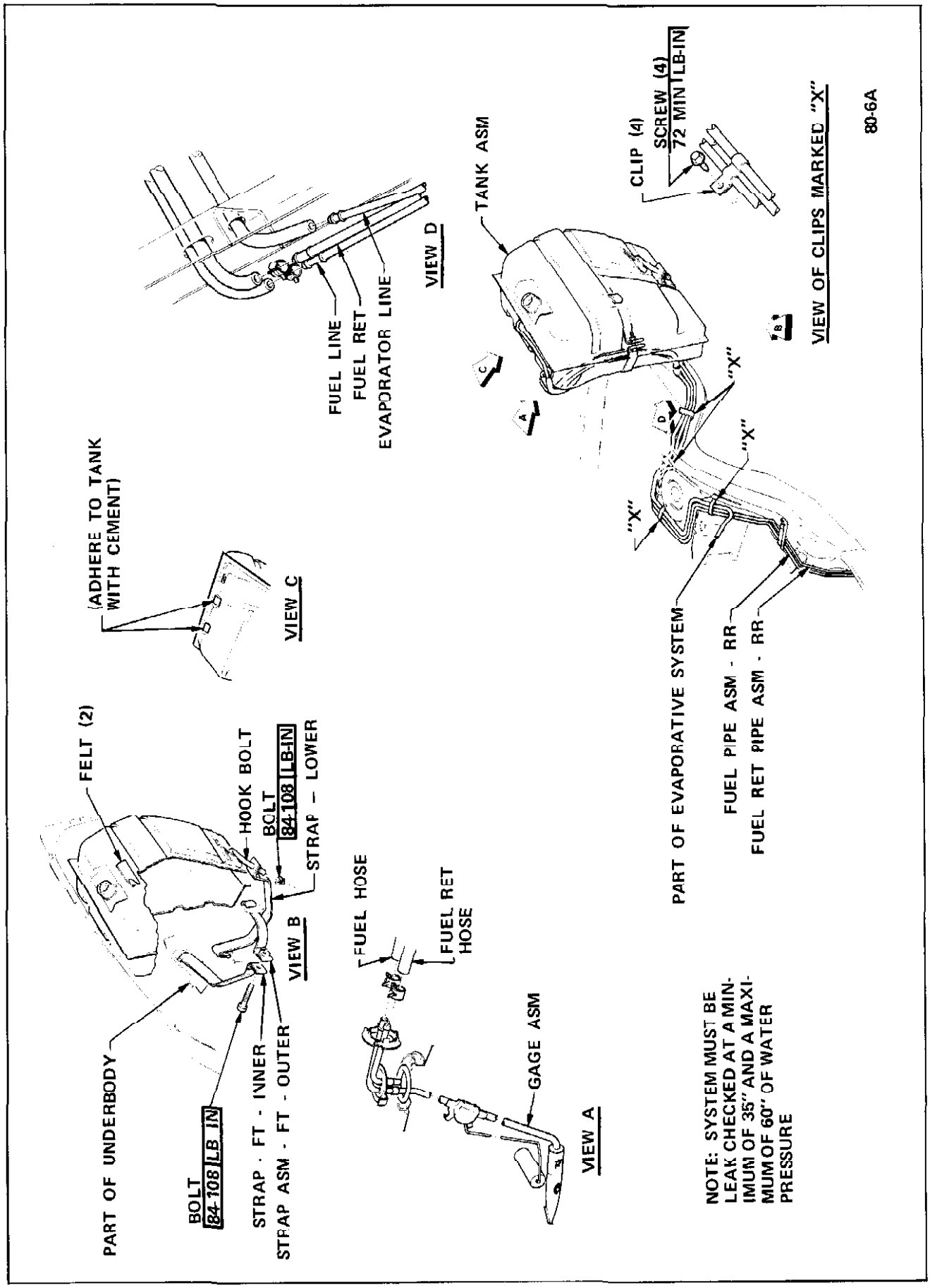

Figure 80-6 Fuel System - Sportwagon

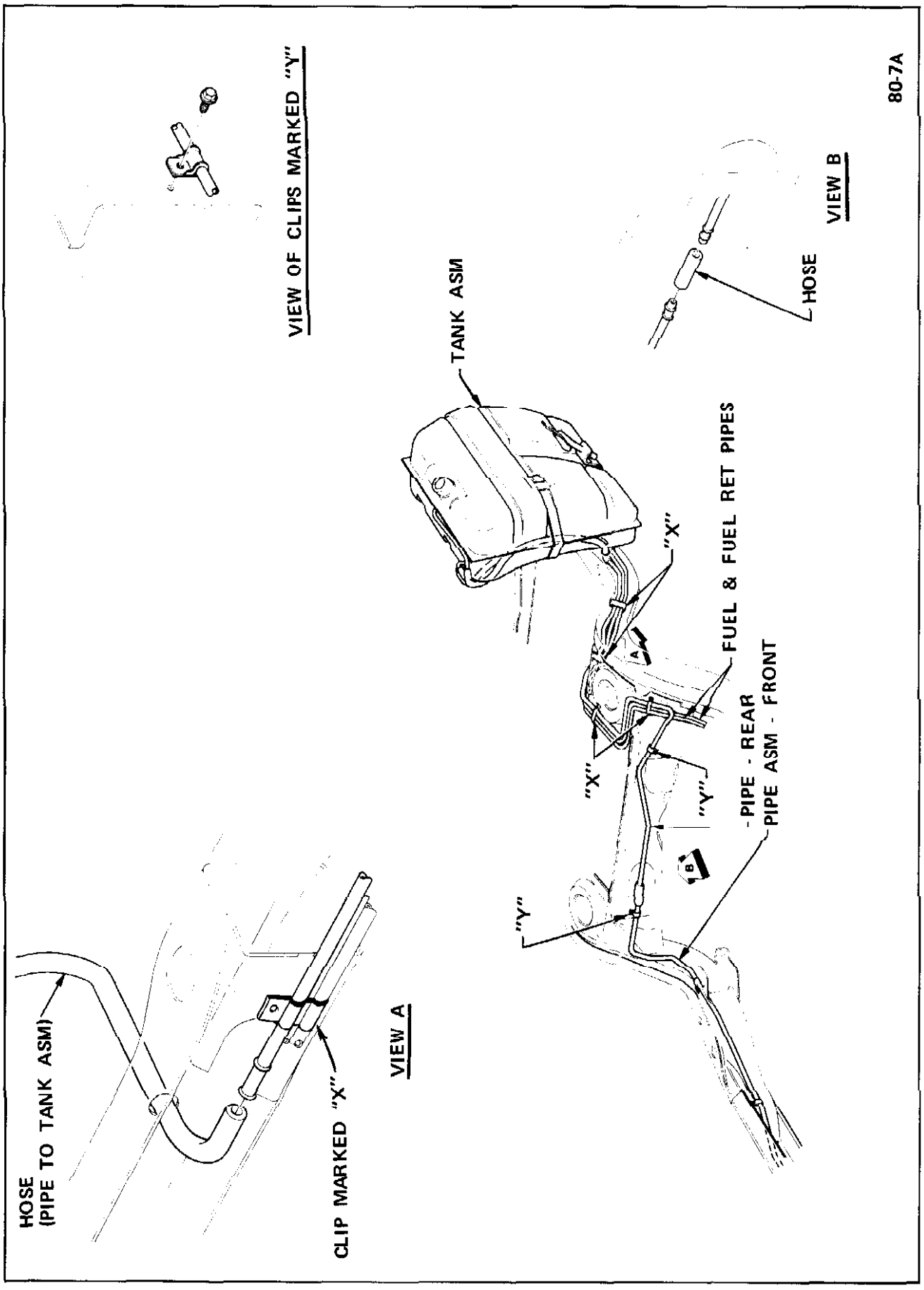

Figure 80-7 Evaporative Emission Control System - Sportwagon

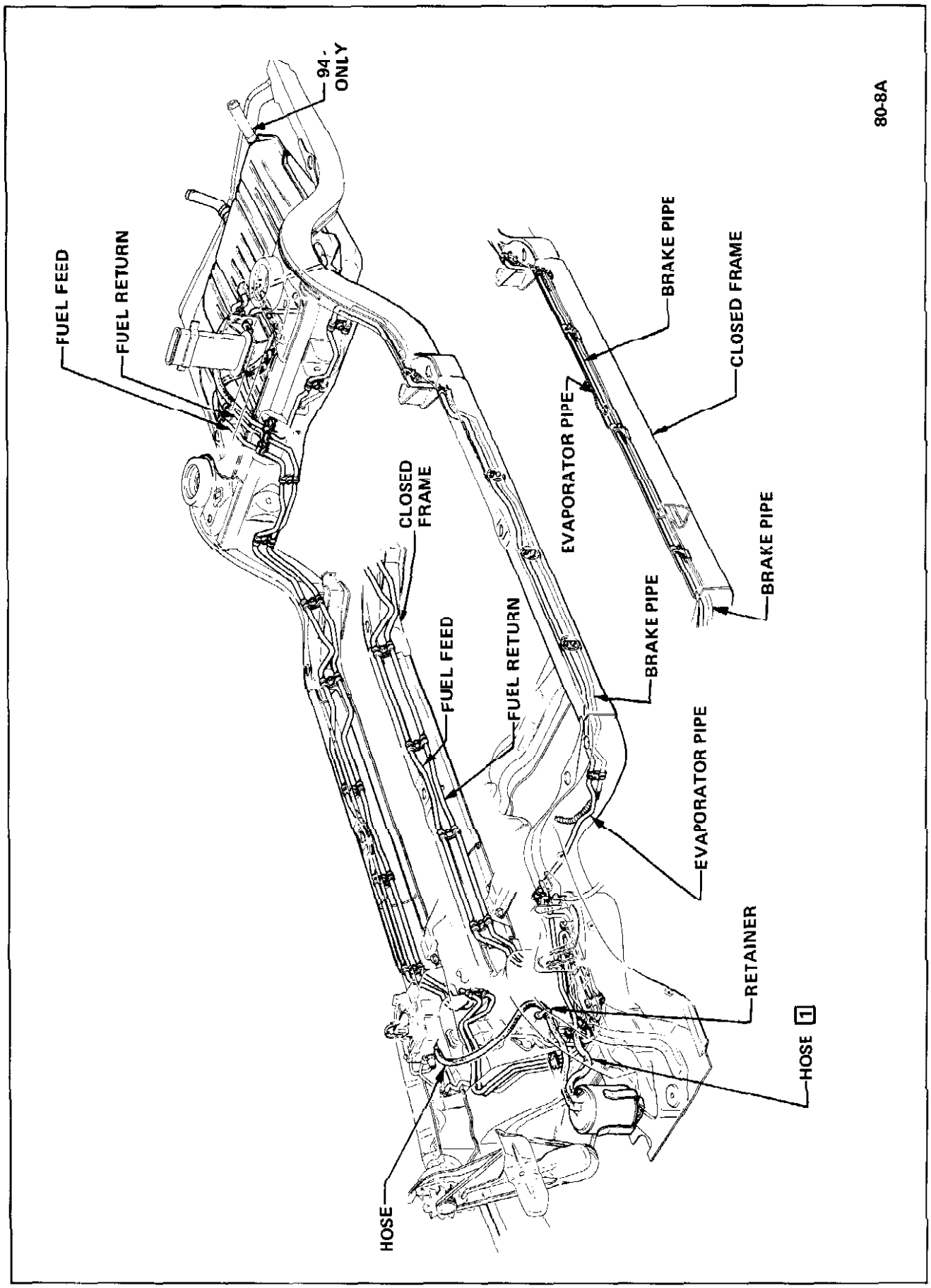

Figure 80-8 Fuel System - 45,46,48 and 4900 Series, Except Estate Wagon

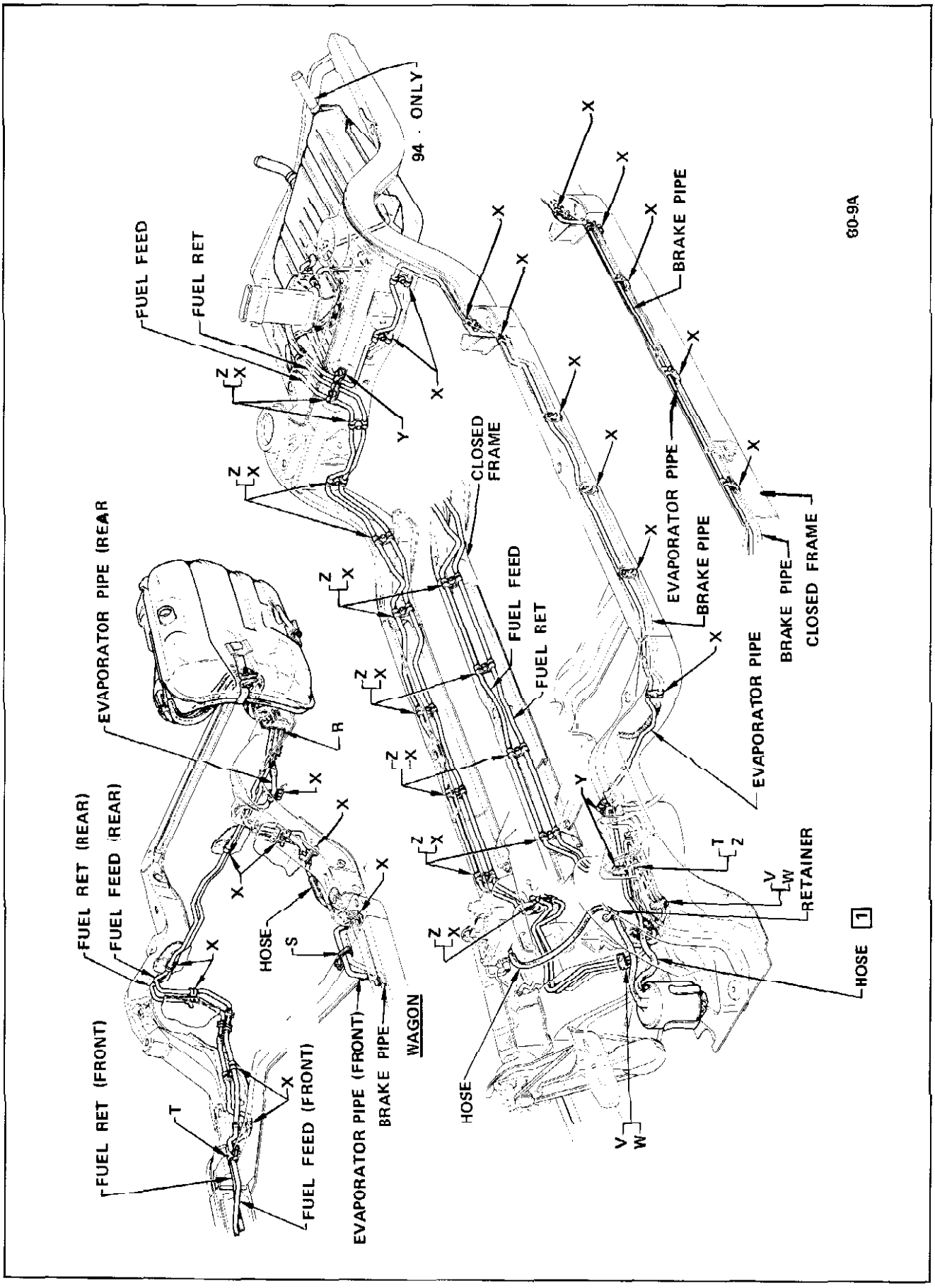

Figure 80-9 Fuel System - Clip Installation

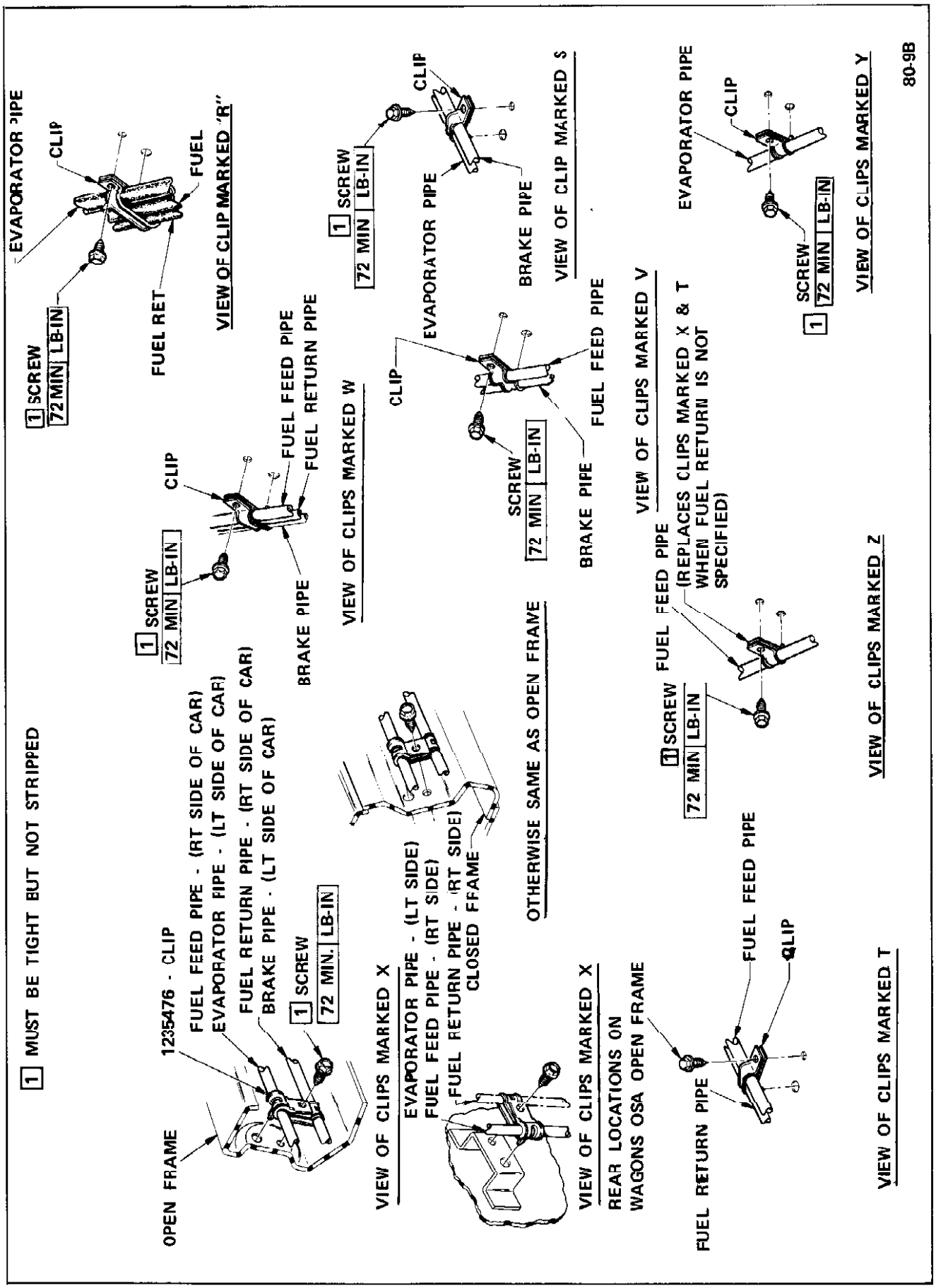

Figure 80-9B Clip Identification

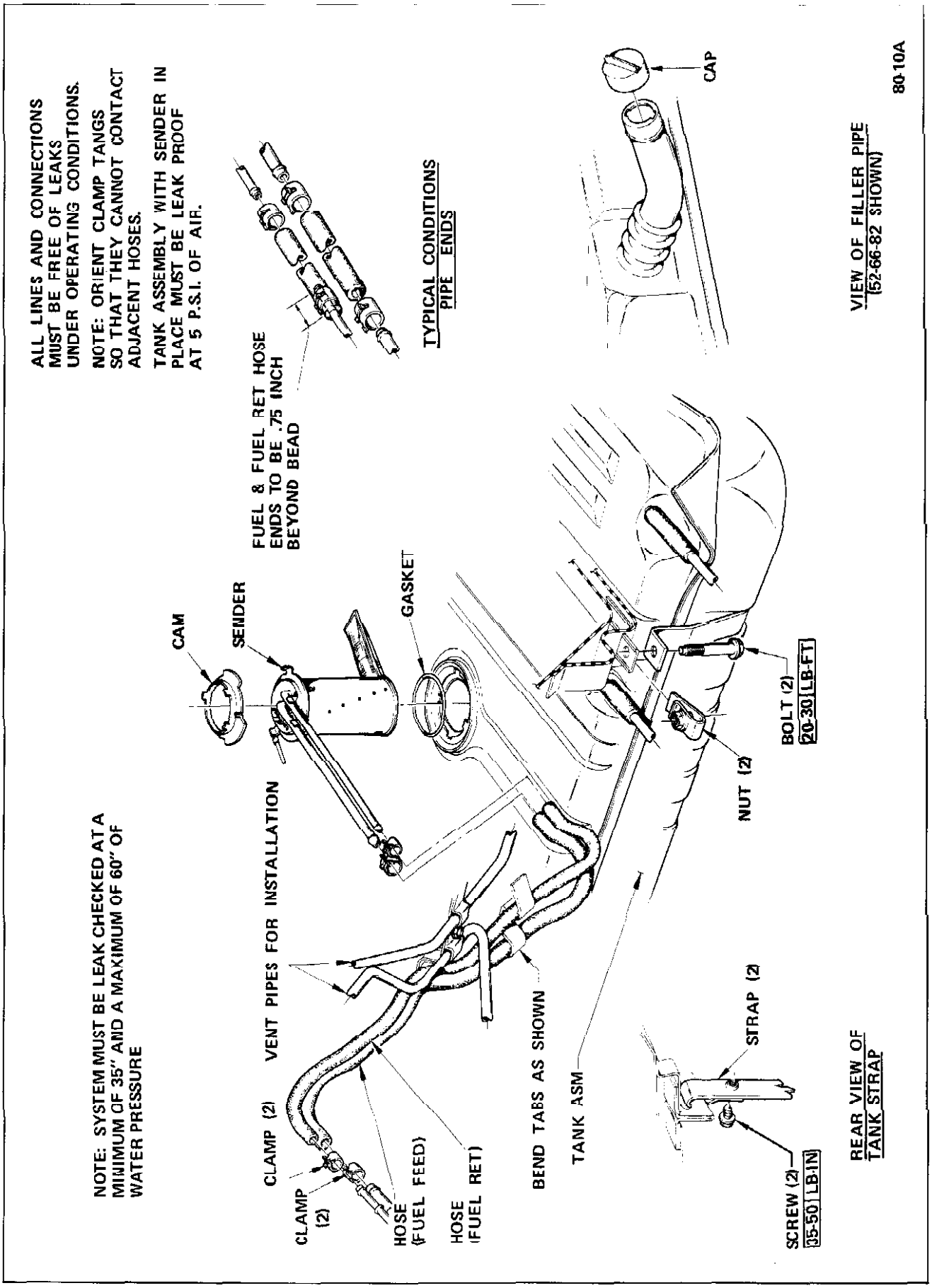

Figure 80-10 Fuel Tank and Gauge Sender Unit - 45,46,48 and 49000 Series, Except Estate Wagon

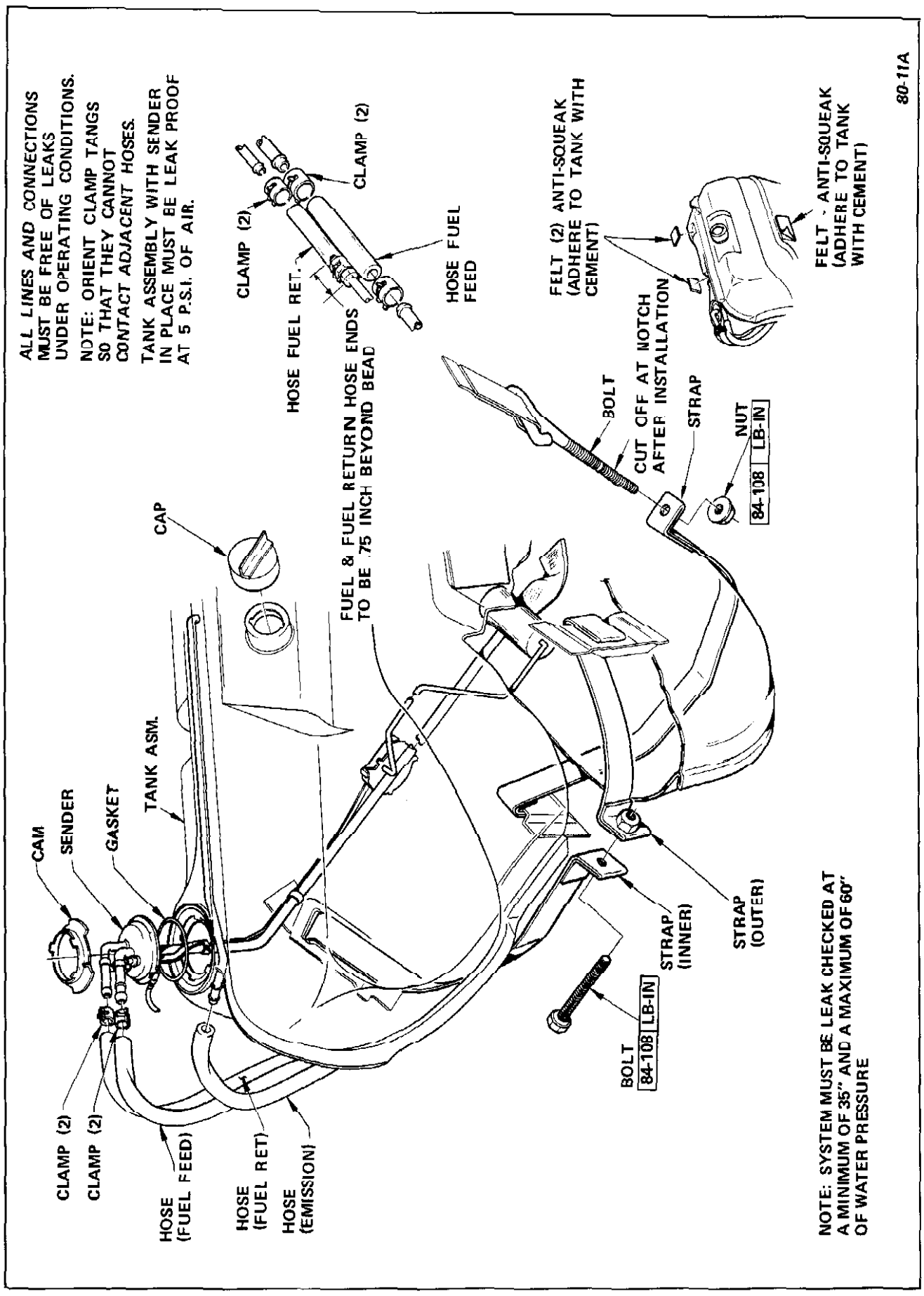

Figure 80-11 Fuel Tank and Gauge Sender Unit - Estate Wagon

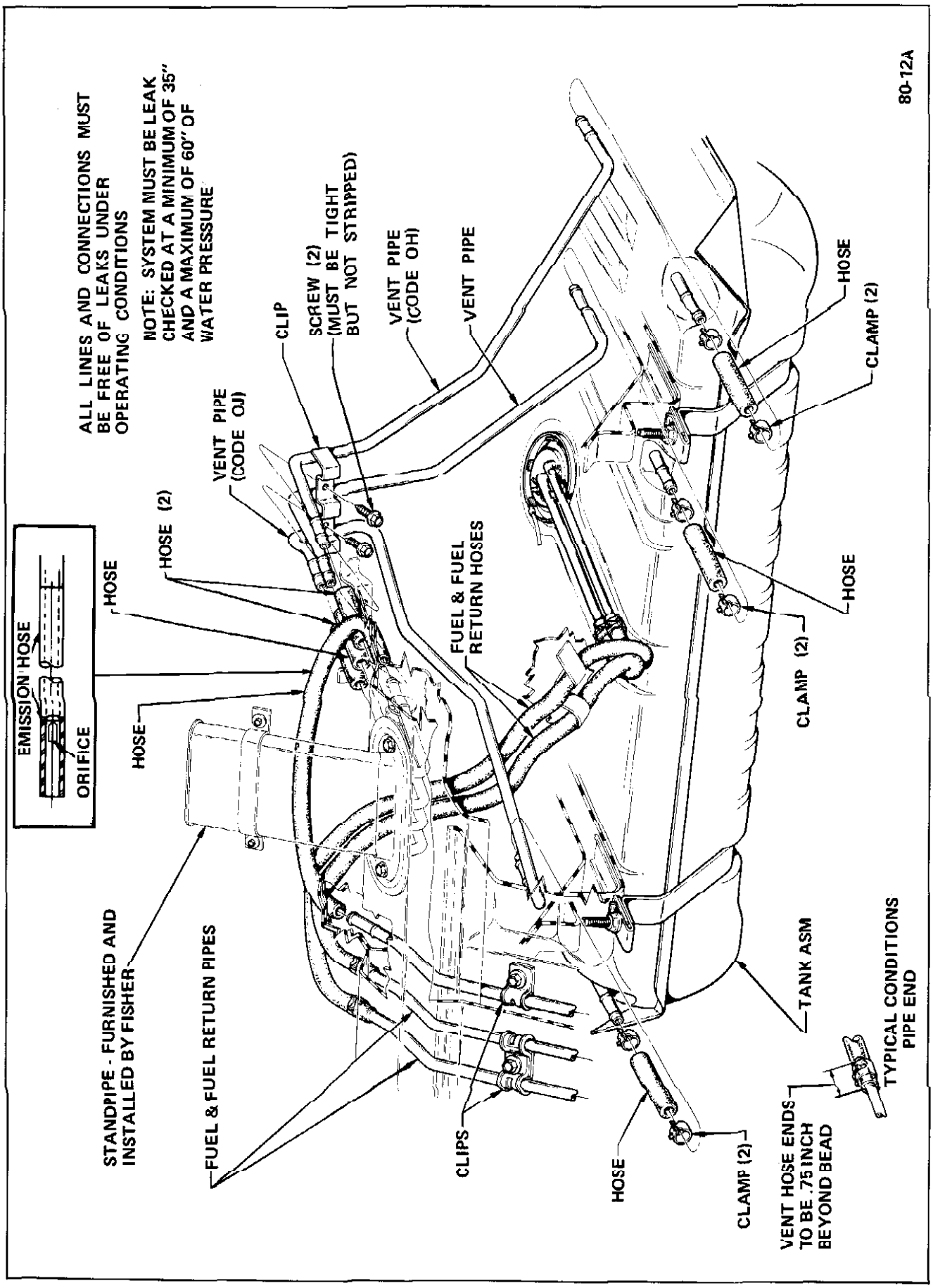

Figure 80-12 Fuel System Vent Pipes and Hoses - 45,46,48 and 49000 Series, Except Estate Wagon

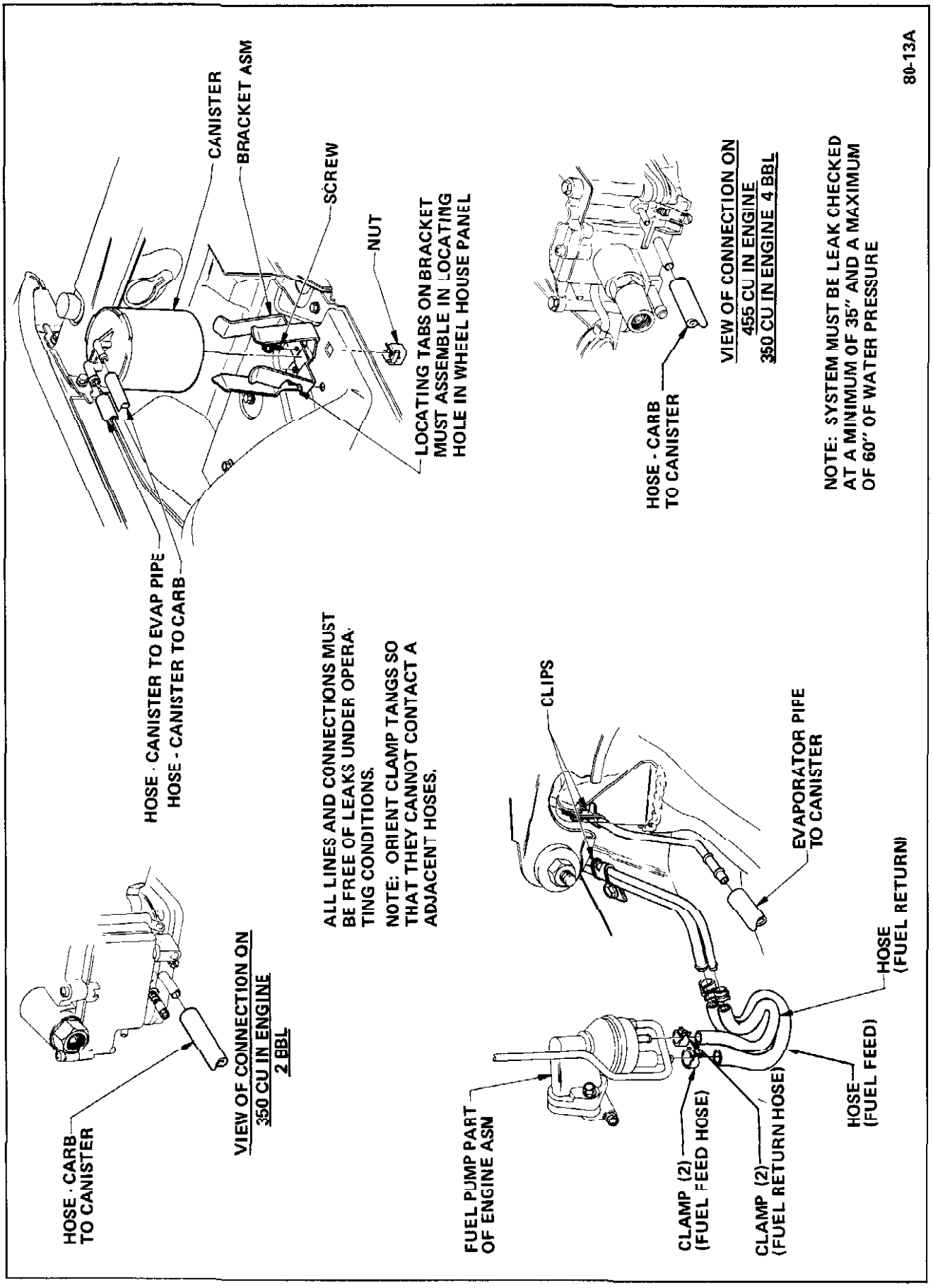

Figure 80-13 Fuel System Hose Connections - Carburetor, Fuel Pump and Cannister

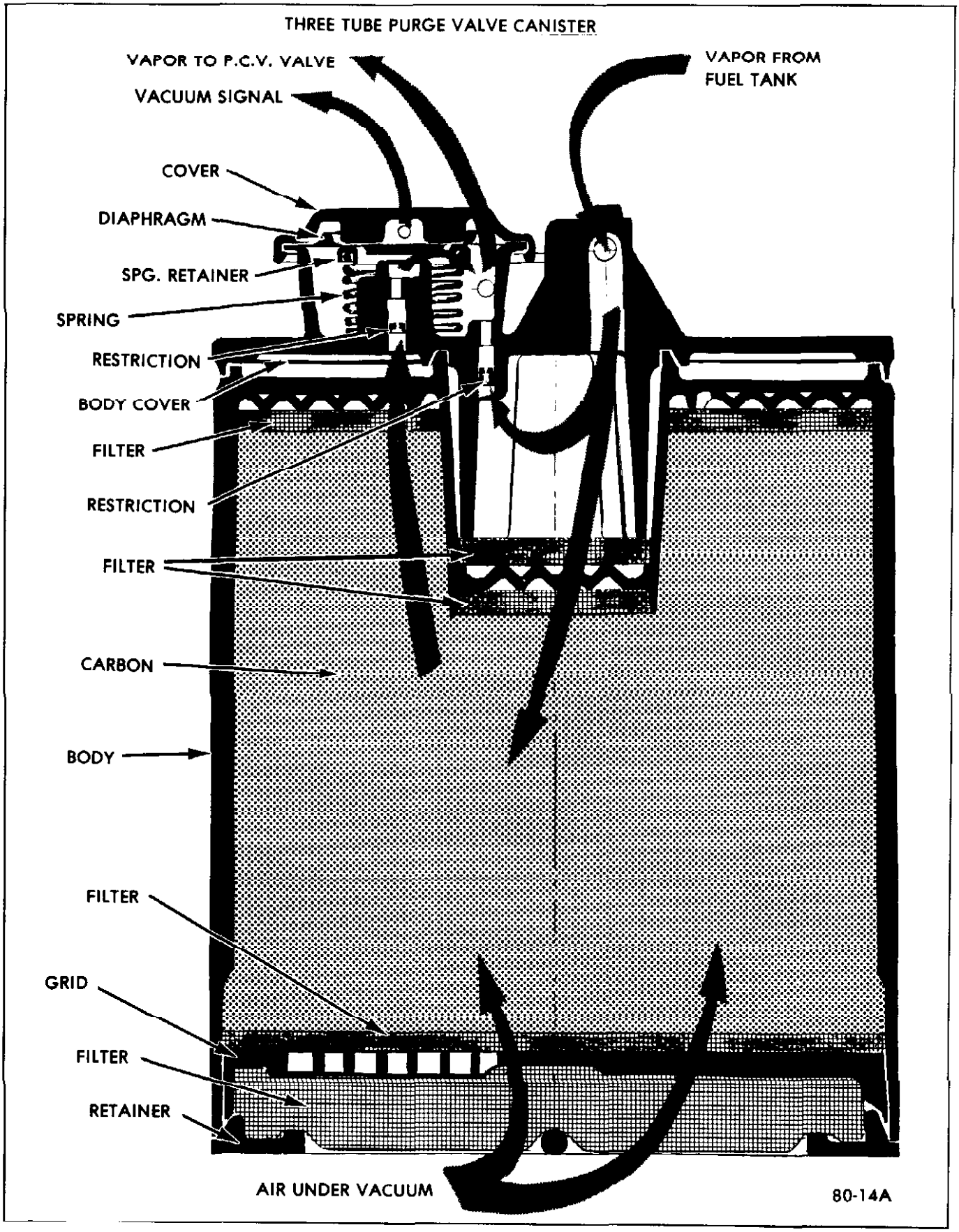

Figure 80-14 Evaporative Emission Control Cannister (L-6)

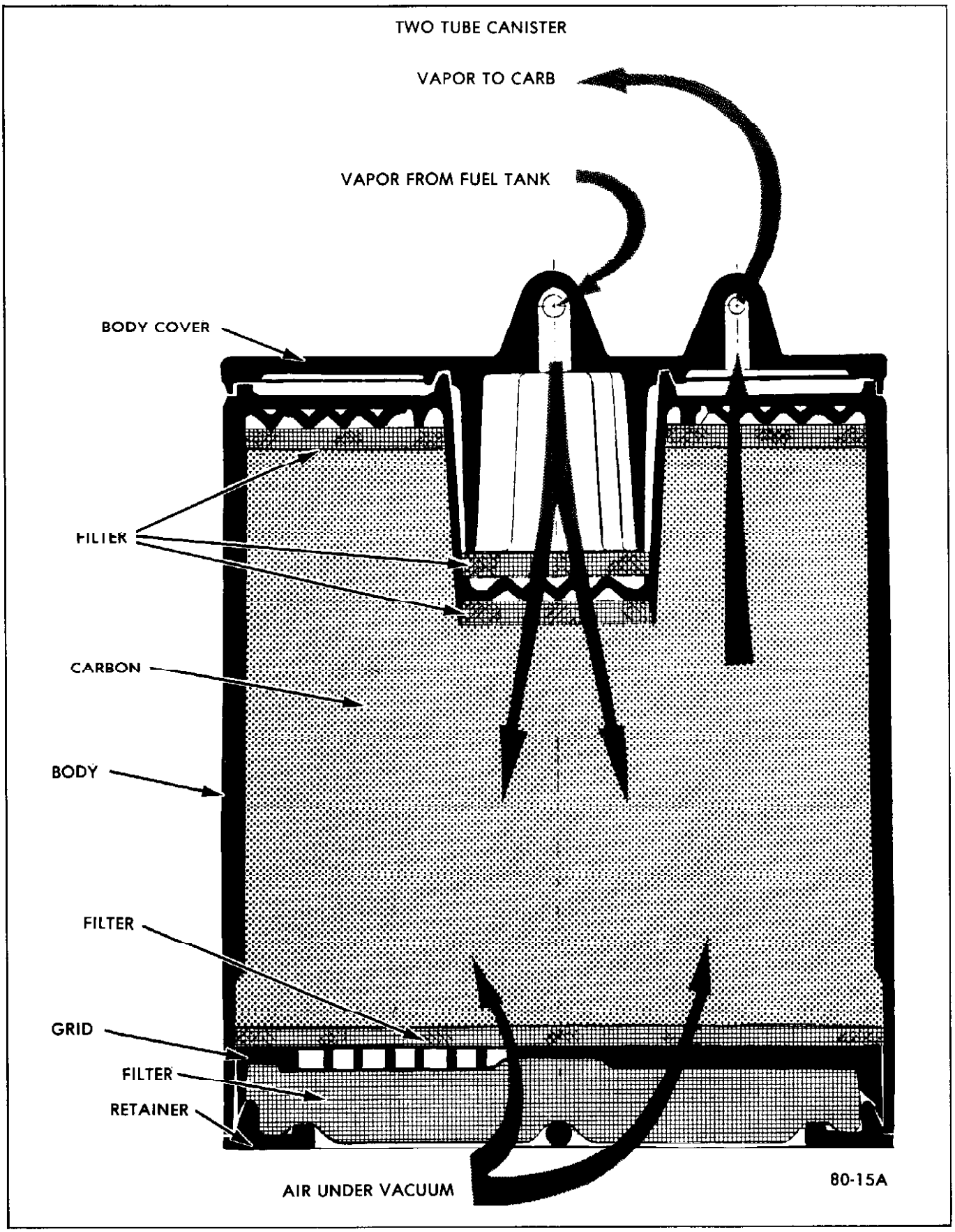

Figure 80-15 Evaporative Emission Control Cannister (V-8)

GROUP 76

TURBO HYDRA-MATIC 400 AUTOMATIC TRANSMISSION

Section	Title
A	Turbo Hydra-matic 400 Automatic Transmission . .

SECTION A

TURBO HYDRA-MATIC "400" AUTOMATIC TRANSMISSION 45-46-48-49000 SERIES

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Turbo Hydra-Matic "400" Automatic Transmission
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DIVISION I

TROUBLE DIAGNOSIS

76-1 SEQUENCE FOR TURBO HYDRO-MATIC 400 TRANSMISSION DIAGNOSIS

1. Check and correct oil level.

2. Check detent switch.

3. Check and correct vacuum line and fittings.

4. Check and correct manual linkage. See Group 73.

5. Install oil pressure gage.

6. Road test car.

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.

76-2 TURBO HYDRA-MATIC 400 TRANSMISSION OIL CHECKING PROCEDURES

Before diagnosis of any transmission complaint is attempted, there must be an understanding of oil checking procedures 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 in the Turbo Hydra-matic 400, the procedure outlined in Paragraph 76-41, subparagraph C, should be observed 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 slipping.

76-3 EXTERNAL OIL LEAKS

A. Determining Source of Oil Leak

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to "wind flow" around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a "Black Light" to locate the point at which the oil is leaking is helpful. Comparing the oil from the leak to that on the engine or transmission dipstick, when viewed by black light, will determine the source of the leak - engine or transmission.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission oil fill pipe 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:

A "BLACK LIGHT" testing unit can be obtained from your local service tool supplier.

1. Degrease underside of transmission.

2. Road test to get unit at operating temperature. (180 degrees F.)

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.

B. Possible Points of Oil Leaks

1. Transmission Oil Pan Leak

a. Attaching bolts not correctly torqued.

b. Improperly installed or damaged pan gasket.

c. Oil pan gasket mounting face not flat.

2. Case Extension

a. Attaching bolts not correctly torqued.

b. Rear seal assembly damaged or improperly installed.

c. Extension to case, gasket damage or improperly installed.

d. Porous casting. See paragraph C.

e. Output shaft "O" ring damaged.

3. Case Leak

a. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine "loading" one side of "O" ring.

b. Modulator assembly "O" ring seal damaged or improperly installed.

c. Electrical connector "O" ring seal damaged or improperly installed.

d. Governor cover bolts not torqued, gasket damaged or leak between case face and gasket.

e. Speedometer gear "O" ring damaged.

f. Manual shaft lip seal damaged or improperly installed.

g. Parking pawl shaft cup plug damaged, improperly installed.

h. Line pressure band release tap plug loose.

i. Vent pipe (refer to item 5).

j. Porous casting. See subparagraph C.

4. Leak at Front of Transmission

a. Front pump seal leaks.

(1) Seal lip cut. Check converter hub for nicks, etc.

(2) Bushing moved forward and damaged.

(3) Garter spring missing from seal.

b. Front pump attaching bolts loose or bolt seals damaged or missing.

c. Front pump housing "O" ring damaged or cut.

d. Converter leak in weld area.

e. Porous casting (pump).

5. Oil Comes Out Vent Pipe

a. Transmission over-filled.

b. Water in oil.

c. Foreign matter between pump and case or between pump cover and body.

d. Case - porous, front pump cover mounting face shy of stock near breather. See subparagraph C.

e. Pump to case gasket mispositioned.

f. Incorrect dipstick.

g. Cut "O" ring or grommet on filter.

h. Pump - shy of stock on mounting faces, porous casting, breather hole plugged in pump cover.

C. Case Porosity Repair

Turbo Hydra-Matic 400 transmission leaks caused by case porosity have successfully been repaired with the transmission in the car by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 180 degrees.

2. Raise car on a hoist or jack stand, engine running and locate source of oil leak. See subparagraph B.

NOTE: *Use of a mirror is helpful in finding leaks.*

3. Shut engine off and thoroughly clean area to be repaired with a cleaning solvent and a brush 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 repair.

NOTE: *Observe cautions of mfg. in handling.*

5. While the transmission case is still HOT, apply the epoxy to the area to be repaired,

NOTE: *Make certain the area to be repaired is fully covered.*

6. Allow cement to cure for *three hours* before starting engine.

7. Road test and check for leaks.

76-4 VACUUM MODULATOR DIAGNOSIS

The vacuum modulator, see Figure 76-1, has three areas to be checked. If any one of the three (3) areas fail to pass the prescribed checks, the modulator must be replaced.

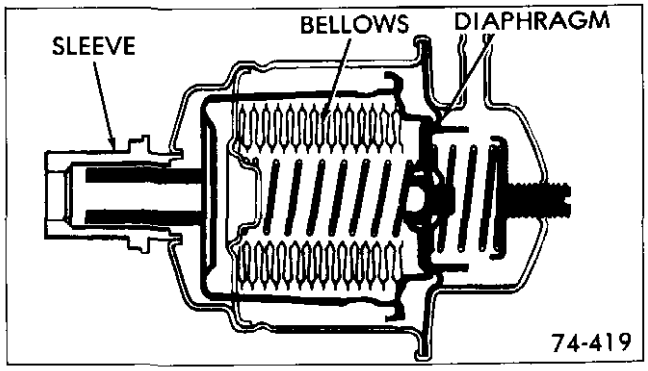


Figure 76-1 - Vacuum Modulator Assembly

1. Bellows Comparison Check

Using a comparison gage, furnished with Dealer Service Information Bulletin 67-I-37, one per dealer, compare the load of a known good modulator *of the same part number* with the modulator in question.

NOTE: *Refer to modulator usage chart in paragraph 76-41, subparagraph A.*

To check bellows load proceed as follows:

a. Insert one end of the comparison gage into the suspected defective modulator sleeve. Insert the opposite end of the gage into a known good modulator *of the same part number* as the suspected defective modulator.

NOTE: *Refer to modulator usage chart in paragraph 76-41, subparagraph a.*

NOTE: *The part number of the modulator assembly is located on the back side of the modulator.*

b. Holding the modulators in a horizontal position, see Figure 76-2, bring them slowly together under pressure.

The modulator bellows in question, if defective, will reach the center line of the comparison gage before the known good modulator lines up with the outer gage line. See Figure 76-3.

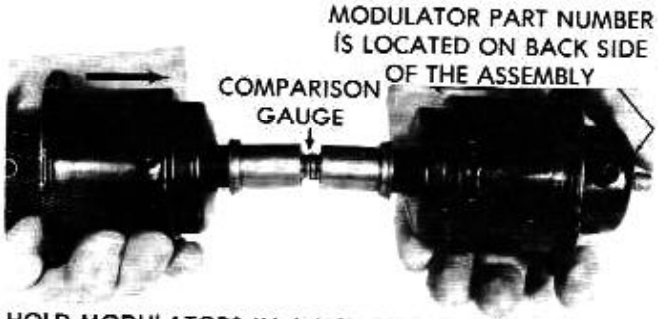


Figure 76-2 - Holding Modulators in Horizontal Position

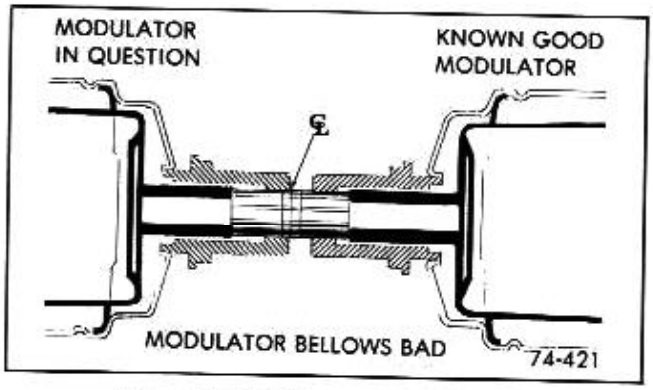


Figure 76-3 - Modulator Bellows (Bad)

If the modulator bellows in question is good, both modulator assemblies will be within the outer gage lines as the assemblies are slowly brought together. See Figure 76-4.

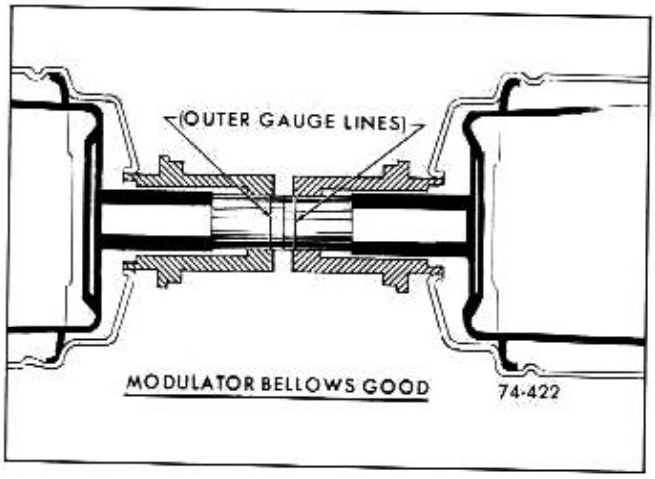


Figure 76-4 - Modulator Bellows (Good)

2. Vacuum Diaphragm Leak Check

Turn modulator so vacuum line stem points downward. If transmission oil comes out, the vacuum diaphragm is defective.

IMPORTANT: *Gasoline and/or water vapor may settle in the vacuum side of the modulator. If this is found WITHOUT the presence of oil, the modulator MUST NOT BE CHANGED.*

Check solution that comes out of the modulator for evidence of lubricity. If the solution does not have the feel of oiliness it can be assumed the solution is a mixture of gas and/or water. The only way transmission oil can be on the vacuum side of the modulator is by a leak in the vacuum diaphragm.

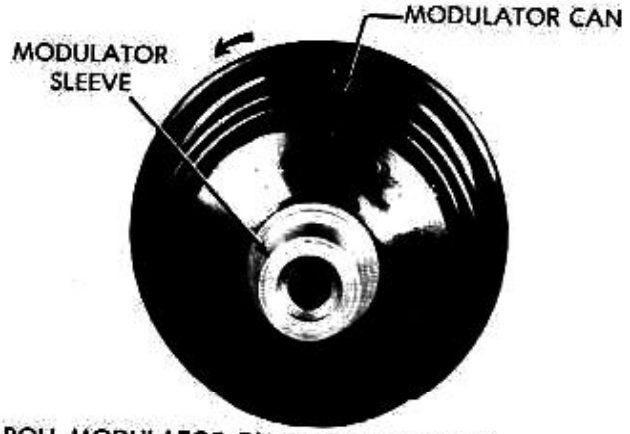
If oil is found, the modulator must be replaced. If oil is not found in the vacuum side of the modulator but the transmission oil level is continually low, *and No external leaks are found,* there is a possibility that a pin hole leak exists in the diaphragm and the modulator should be replaced.

3. Inspection for External Damage

1. Check for dents or cracks in modulator.

2. Check modulator valve sleeve alignment. Roll modulator on a flat surface to determine if the sleeve is concentric to the modulator can. See Figure 76- 5. If the sleeve is bent, runout will be visible, and modulator must be replaced.

If the modulator passes the above checks, the following items should also be checked as a possible cause of the problem.



ROLL MODULATOR ON FLAT SURFACE TO DETERMINE IF THE SLEEVE IS CONCENTRIC TO THE MODULATOR CAN. IF THE SLEEVE IS BENT, RUNOUT WILL BE VISABLE. 74-423

Figure 76-5 - Checking Modulator Sleeve Alignment

1. Check freeness of modulator valve in modulator.

2. Check freeness of modulator valve in transmission case.

3. Check the vacuum line from the manifold to modulator for holes, cracks or dents. Check the rubber hose connections at the modulator and at the intake manifold for leaks.

76-5 TRANSMISSION OIL PRESSURE CHECK TURBO HYDRA-MATIC 400

1. Oil Pressure Check - Road or Normal Operating Conditions

While road testing (with the transmission oil pressure gage attached and the vacuum modulator tube connected) the transmission pressures should check approximately as follows:

L² Range	Min.	Max.
2nd gear — Steady road load	150 (±5) psi	150 (±5) psi

76-A61

Gear	Selector Lever Position	Min.	Max.
1st	Drive	60	150
2nd	(Zero throttle to full throttle)	60	150
3rd	Drive Range, (Zero throttle 30 mph)	60	
Rev.	Reverse (full throttle)	220	260

76-A62

2. Oil Pressure Check - Vacuum Modulator Check

The vacuum modulator assembly can be checked by making an oil pressure check as described in parts "A" and "B" of this section. The pressures given are approximate and can vary with changes in atmosphere pressure, but if this method is used as an indication of a source of malfunction, it can be a valuable service tool.

Using procedure "A" the oil pressures should be approximately as shown. Oil pressures taken in this manner, that vary appreciably from the chart, indicate further inspection of the following:

1. Vacuum lines and fittings.

2. Vacuum modulator.

3. Modulator valve.

4. Governor.

5. Pressure regulator.

6. Oil pump.

If the results of procedure "A" indicate further inspection is required, procedure "B" should be followed. If the pressures are appreciably different from those given in "B", a second check should be made with a new modulator assembly or one from a vehicle that is known to be operating standard. On the second check, if the pressures changed and were as shown on the chart, or closer to them, it would indicate a faulty modulator assembly and it should be suspected as a cause or part of the cause of the malfunction.

A. Car Stationary

Transmission oil pressure gage and engine tachometer should be connected. Pressures indicated are with the

vacuum line connected for normal modulator operation and service brakes holding vehicle with engine at 1000 rpm.

Drive Neutral Park	L^2 or L^1	Reverse
60	150	95

76-A63

NOTE: *Pressures are approximate.*

B. Oil pressures indicated are at zero output speed with the vacuum line disconnected from the modulator assembly and with the engine at 1200 RPM.

Alt. of Check (Ft. Above Sea Level)	Drive Neutral Park	L^2 or L^1	Rev.
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	179

76-A64

NOTE: *Altitude and pressures are approximate.*

76-6 TRANSMISSION CONTROL SPARK SWITCH CHECKING PROCEDURES

The pressure switch in the Turbo Hydra-matic 400 transmission may be easily checked with a continuity tester which uses either the vehicle's battery or a separate source to power the test lamp or meter.

CAUTION: *To prevent damaging the pressure switch, the tester used must have sufficient resistance that it does not supply the switch with more than .8 amp of current at 12 volts. Test lamps which use size 1893 or smaller bulb, will not damage the switch.*

1. Disconnect electrical wire harness from transmission electrical connector. If using a continuity tester which has a self-contained power source, connect one tester lead to pressure switch terminal of transmission connector (See Figure 76-6), and connect other lead to ground. Tester should show current flowing through the switch (switch closed).

If the vehicle's battery is to be used to power a simple light blub type tester, connect one lamp lead to pressure switch terminal of transmission connector and connect other lead to a "hot" terminal of the car wiring harness. Check that vehicle's battery cables are connected.

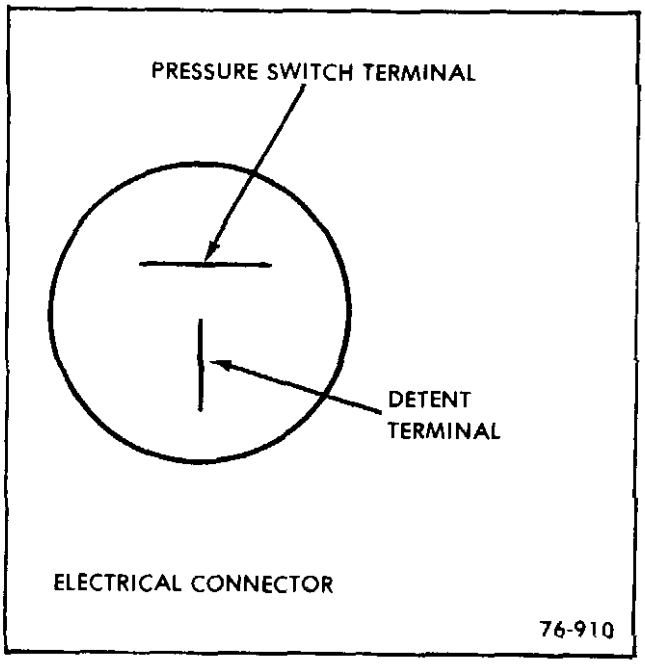


Figure 76-6

2. Set parking brake, apply service brakes, start engine and let it idle. Move transmission selector to "Drive" and tester should show current flowing through switch to ground (switch closed).

3. With brakes still applied, move transmission selector to "Reverse" (which supplies transmission oil pressure to pressure switch) and tester should show no current flowing through switch to ground (switch open).

4. If above test indicates a defective pressure switch circuit, the transmission bottom pan must be removed to service the pressure switch or lead wire assembly.

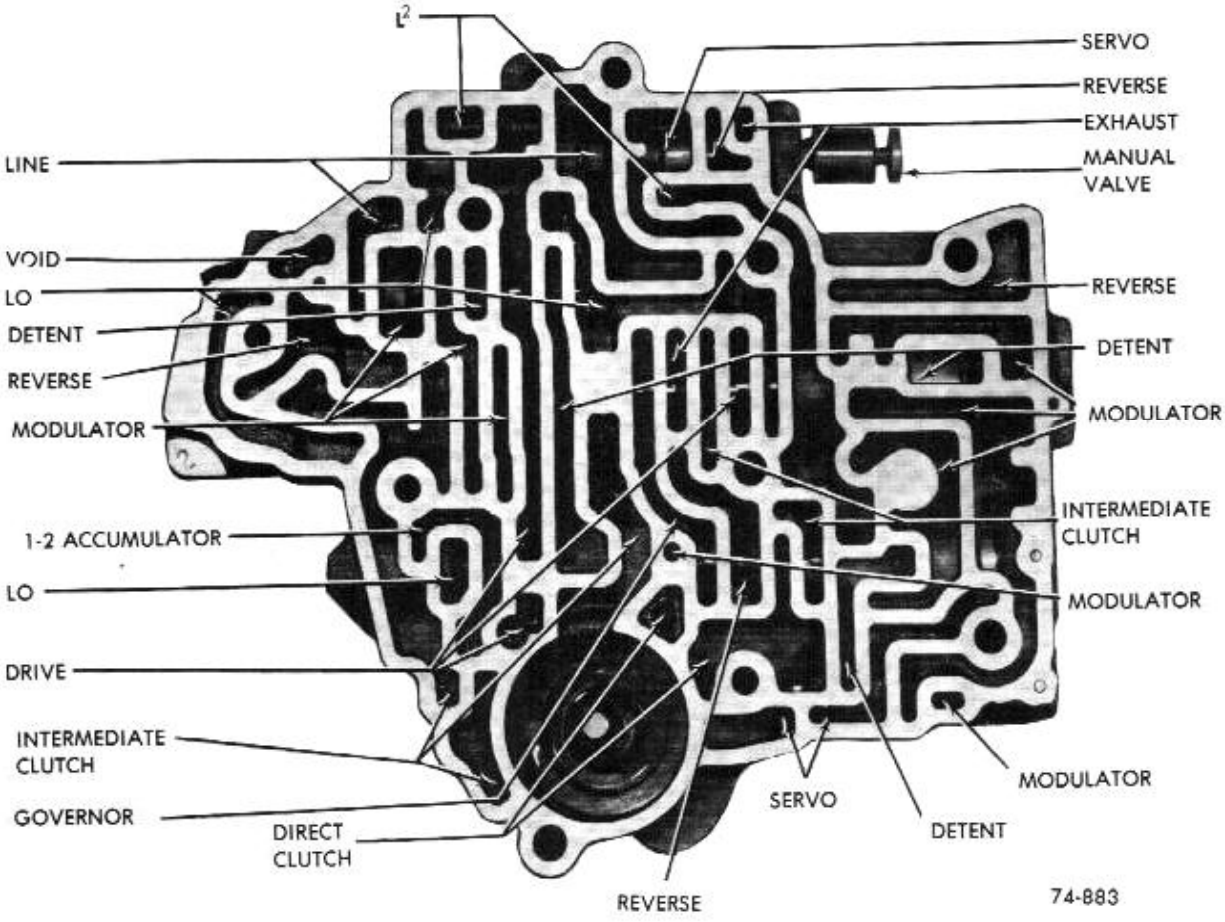


Figure 76-7 - Valve Body

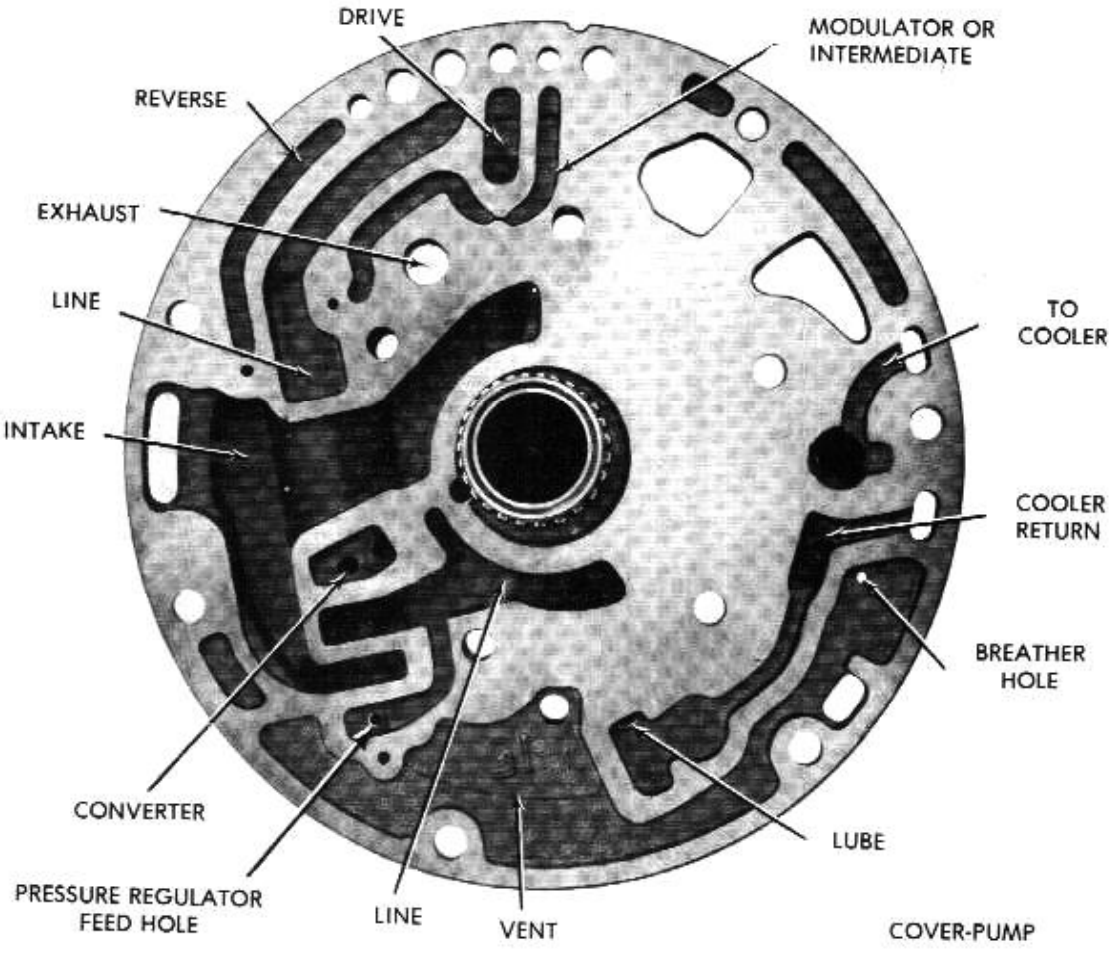


Figure 76-8 - Oil Pump Cover

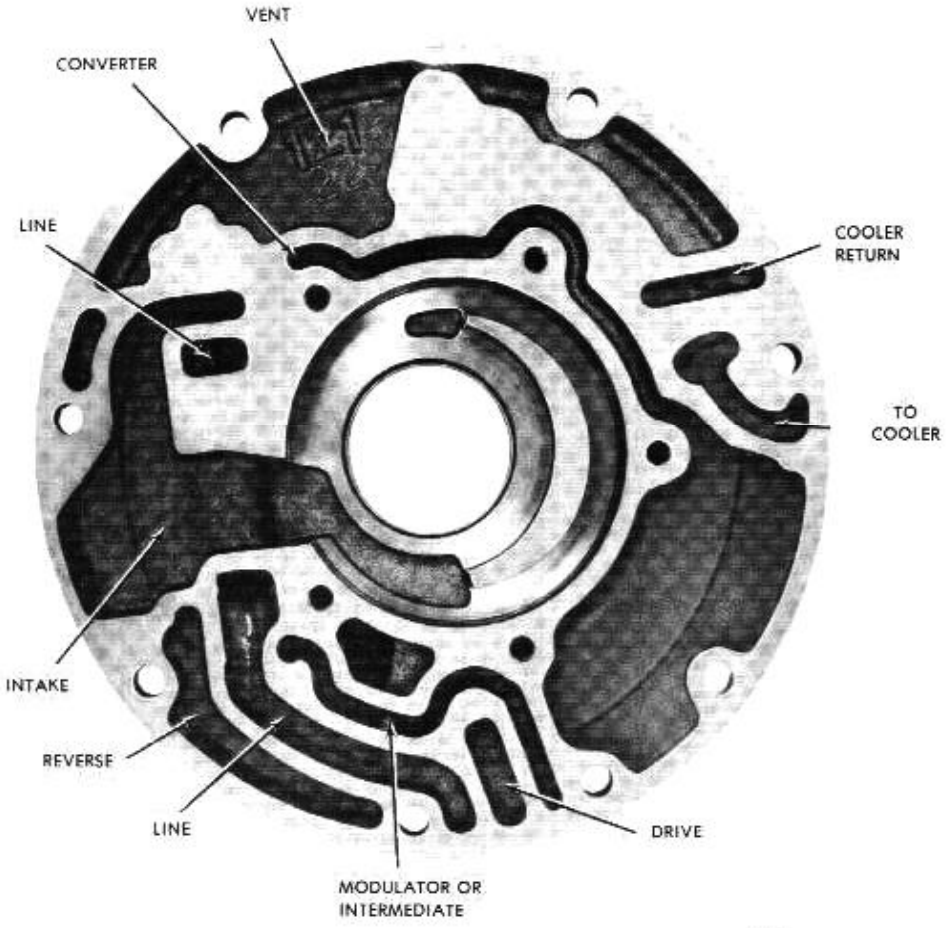


Figure 76-9 - Oil Pump Body

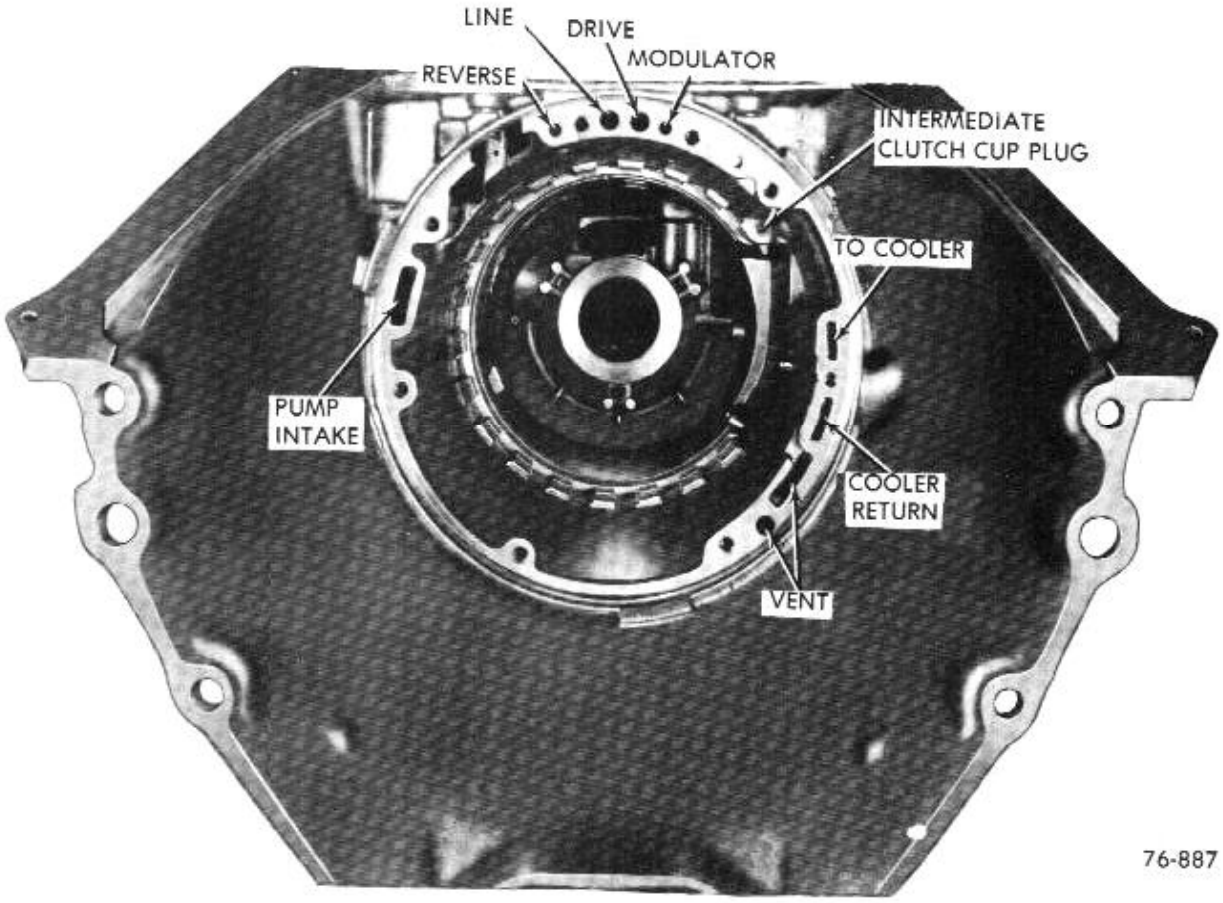


Figure 76-10 - Front of Case

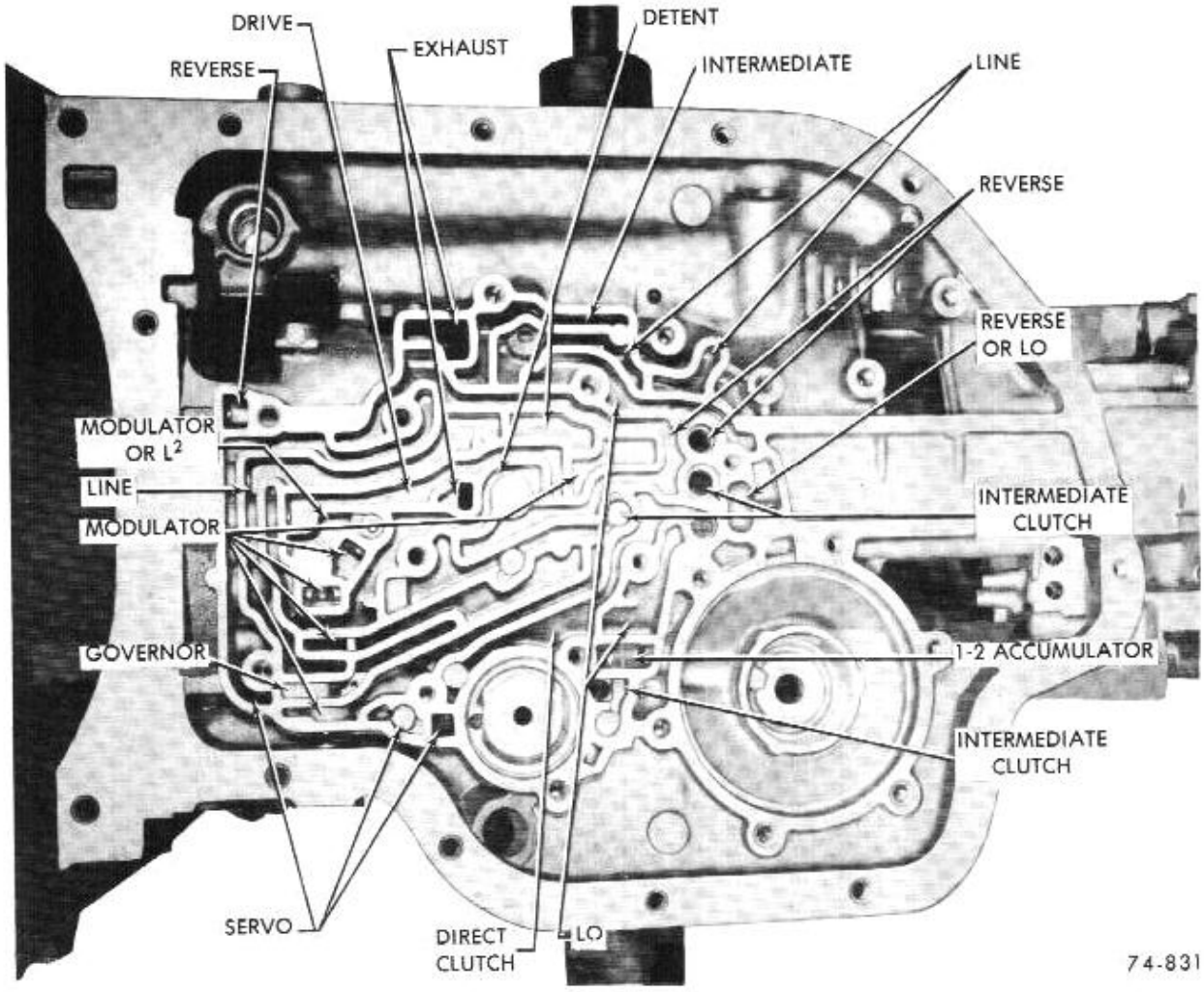


Figure 76-11 - Bottom of Case

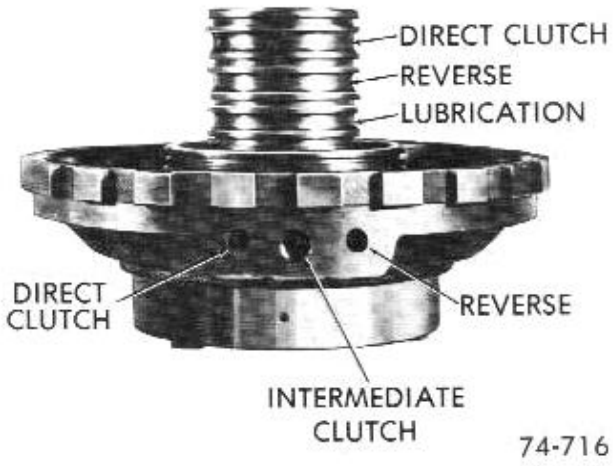


Figure 76-12 - Center Support

76-7 TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART

Problem	Possible Cause	Possible Condition
I. NO DRIVE IN DRIVE RANGE — (INSTALL PRESSURE GAGE).	A. Low Oil Level	1. Correct level — check for external leaks or defective vacuum modulator (leaking diaphragm will evacuate oil from unit).
	B. Manual Linkage Adjustment	1. See Section 73.
	C. Low Oil Pressure — (Refer to par. 76-4).	1. Filter Assembly — "O" ring missing or damaged, neck weld leaking, filter blocked. 2. Pump Assembly — Pressure Regulator, pump drive gear — tangs damaged by converter. 3. Case — porosity in intake bore.
	D. Control Valve Assembly	1. Manual valve disconnected from manual lever.
	E. Forward Clutch	1. Forward clutch does not apply — piston cracked; seals missing, damaged; clutch plates burned, (Look for cause. (See Problem No. XX). 2. 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.
	F. Roller Clutch Assembly	1. Broken spring or damaged cage.
II. OIL PRESSURE HIGH or LOW (SEE OIL PRESSURE CHECK) Paragraph 76-4.	A. High Oil Pressure	1. Vacuum line or fittings leaking. 2. Vacuum modulator. 3. Modulator valve. 4. Pressure regulator. 5. Oil Pump.
	B. Low Oil Pressure	1. Vacuum line or fittings obstructed. 2. Vacuum modulator.

TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART (Cont'd.)

Problem	Possible Cause	Possible Condition
II. OIL PRESSURE HIGH or LOW (SEE OIL PRESSURE CHECK) Paragraph 76-4. (Cont'd.)	B. Low Oil Pressure (Cont'd.)	3. Modulator valve. 4. Pressure regulator. 5. Governor. 6. Oil pump.
III. 1-2 SHIFT – FULL THROTTLE ONLY.	A. Detent Switch. See Figures 120-59 and 120-68 for wiring diagrams.	1. Sticking or defective (See Figure 76-39.)
	B. Detent Solenoid	1. Loose. 2. Gasket leaking. 3. Sticks open.
	C. Control Valve Assembly	1. Valve body spacer plate-to-cover gasket – leaking, damaged, incorrectly installed. 2. Detent valve train stuck. 3. 3-2 valve stuck.
*See paragraph 76-3, sub-paragraph c.	D. Case Assembly	1. Porosity.*
IV. FIRST SPEED ONLY, NO 1-2 SHIFT	A. Governor Assembly	1. Governor valve sticking. 2. 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.
	B. Control Valve Assembly	1. 1-2 shift valve train stuck closed. 2. Governor feed channels blocked, leaking, pipes out of position. 3. Valve body spacer plate-to-cover gasket – leaking, damaged, incorrectly installed.
	C. Case	1. Intermediate clutch plug leaking or blown out. 2. Porosity between channels. 3. Governor feed channel blocked, governor bore scored or worn allowing cross pressure leak.

TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART (Cont'd.)

Problem	Possible Cause	Possible Condition
IV. FIRST SPEED ONLY, NO 1-2 SHIFT (Cont'd.)	D. Intermediate Clutch	1. Clutch piston seals – missing, improperly assembled, cut. 2. Center support – oil rings missing, broken, defective – orifice plug missing.
V. FIRST AND SECOND SPEEDS ONLY, NO 2-3 SHIFT.	A. Detent Solenoid	1. Stuck open (Detent shifts only – the 2-3 shift would occur at very high speeds, being interpeted as no 2-3 shifts). 2. Refer to Figure 76-39.
	B. Detent Switch. See Figures 120-59 and 120-68 for wiring diagrams.	
	C. Control Valve Assembly	1. 2-3 shift train stuck. 2. Valve body spacer plate-to-cover gasket – leaking, damaged, incorrectly installed.
	D. Direct Clutch	1. Center support – oil rings missing, broken, defective. 2. Clutch piston seals – missing, improperly assembled, cut, piston ball check stuck or missing.
VI. DRIVE IN NEUTRAL.	A. Manual Linkage	1. Maladjusted.
	B. Forward Clutch	1. Clutch does not release – (this condition will also cause "No Reverse").
VII. NO DRIVE IN REVERSE, or SLIPS IN REVERSE – (Install Pressure Gage).	A. Low Oil Level	1. Add oil – See Paragraph 76-41 Subparagraph c.
	B. Manual Linkage	1. Misadjusted. Refer to Group 73.
	C. Oil Pressure – (Refer to par. 76-4).	1. Vacuum modulator assembly – defective. 2. Vacuum modulator valve – sticking. 3. Restricted strainer leak at intake pipe grommet, or "O" ring.

TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART (Cont'd.)

Problem	Possible Cause	Possible Condition
VII. NO DRIVE IN REVERSE, or SLIPS IN REVERSE — (Install Pressure Gage) (Cont'd.)	C. Oil Pressure — (Refer to par. 76-4) (Cont'd.)	4. Pump assembly — regulator or boost valve sticking.
	D. Control Valve Assembly	1. Valve body spacer plate-to-cover gasket — leaking, damaged, incorrectly installed (Other malfunctions may also be indicated.) 2. Low Reverse ball check — Missing from case (This will also cause no overrun braking in L^1 Range). 3. 2-3 Valve train stuck open (This will also cause 1-3 upshift in Drive Range). 4. Reverse feed passage — missing check case passages.
	E. Rear Servo and Accumulator	1. Servo piston seal ring, damaged or missing. 2. Short band apply pin (This may also cause no overrun braking or slips in overrun braking — L^1 Range).
	F. Reverse or Low Band	1. Burned, loose lining, apply pin or anchor pins not engaged, band broken.
	G. Direct Clutch	1. Outer seal damaged or missing. 2. Clutch plates burned — may be caused by stuck ball check in piston. (See problem No. XX)
	H. Forward Clutch	1. Clutch does not release (will also cause Drive in Neutral).
VIII. SLIPS IN ALL RANGES, SLIPS ON START — (Install Pressure Gage)	A. Oil Level Low	1. Add oil — See Paragraph 76-41 subparagraph c.
	B. Oil Pressure (Refer to par. 76-4)	1. Vacuum modulator defective. 2. Vacuum modulator valve sticking. 3. Filter assembly — plugged or leaks; grommet "O" ring missing or damaged.

TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART (Cont'd.)

Problem	Possible Cause	Possible Condition
VIII. SLIPS IN ALL RANGES, SLIPS ON START – (Install Pressure Gage) (Cont'd.)	B. Oil Pressure (Refer to par. 76-4) (Cont.d.)	4. Pump assembly – regulator or boost valve sticking, cross leak. 5. Pump to case gasket damaged or incorrectly installed.
	C. Case	1. Cross leaks, porosity.
	D. Forward and Direct Clutches Slipping	1. If burned, look for cause. (See Problem No. XX.) 2. Oil seal rings on pump cover broken or worn.
IX. SLIPS 1-2 SHIFT – (Install Pressure Gage)	A. Oil Level Low	1. Add oil – See Paragraph 76-41 subparagraph c.
	B. Oil Pressure (Refer to par. 76-4)	1. Vacuum modulator assembly defective. 2. Modulator valve sticking. 3. Pump pressure regulator valve.
	C. Front Accumulator	1. Oil ring damaged or missing.
	D. Control Valve Assembly	1. 1-2 accumulator valve train sticking. 2. Porosity in valve body or case. 3. Valve body attaching bolts not properly torqued.
	E. Rear Accumulator	1. Oil ring missing or damaged, case bore damaged.
	F. Pump to Case Gasket	1. Mispositioned.
	G. Case	1. Intermediate clutch plug – leaking excessively. 2. Porosity between channels.
	H. Intermediate Clutch	1. Piston seals missing or damaged; clutch plates burned, look for cause. (See Problem No. XX. 2. Center support leak in feed circuit (oil rings damaged or grooves defective), excessive leak between tower and bushing, orifice bleed plug hole (0.20 dia.) blocked. Center support bolt not seated properly in case. 3. Extra waved steel plate – should have only one waved steel plate. No waved plate in "BB" and "OW" models.

TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART (Cont'd.)

Problem	Possible Cause	Possible Condition
X. ROUGH 1-2 SHIFT — (Install Pressure Gage)	A. Oil Pressure — (Refer to par. 74-4)	1. Vacuum modulator — check for loose fittings, restrictions in line, modulator assembly defective. 2. Modulator valve stuck. 3. Pump — regulator or boost valve stuck. 4. Pump to case gasket — off location or damaged.
	B. Control Valve Assembly	1. 1-2 accumulator valve train. 2. Valve body to case bolts loose. 3. Valve body spacer plate-to-cover gasket off location, wrong gasket or damaged.
	C. Case	1. Intermediate clutch ball missing or not sealing. 2. Porosity between channels.
	D. Rear Servo Accumulator Assembly	1. Oil rings damaged. 2. Piston stuck. 3. Broken or missing spring. 4. Bore damaged.
	E. Intermediate Clutch	1. Extra waved steel plate. No waved plate in "BB" and "OW" models.
XI. SLIPS 2-3 SHIFT — (Install Pressure Gage)	A. Oil Level Low	1. Add oil — See Paragraph 76-41 subparagraph c.
	B. Oil Pressure Low — (Refer to par. 76-4)	1. Modulator assembly. 2. Modulator valve. 3. Pump pressure regulator valve or boost valve; pump to case gasket off location.
	C. Control Valve Assembly	1. Accumulator piston pin — leak at swedge end.
	D. Case	1. Porosity.
	E. Direct Clutch	1. Piston seals leaking, or ball check leak. 2. Center support — oil seal rings damaged; excessive leak between tower and bushing. 3. Extra waved steel plate — should have only one waved plate. No waved plate in "OW" model.

TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART (Cont'd)

Problem	Possible Cause	Possible Condition
XII. ROUGH 2-3 SHIFT – (Install Pressure Gage)	A. Oil Pressure – High (Refer to par. 76-4)	1. Modulator assembly defective. 2. Modulator valve sticking. 3. Pump – pressure regulator or boost valve inoperative
	B. Front Servo Accumulator or Assembly	1. Front accumulator spring missing, broken. 2. Accumulator piston stuck.
	C. Direct Clutch	1. Extra waved steel plate. No waved plate in "BB" and "OW" models.
XIII. NO ENGINE BRAKING – L^2 – 2nd GEAR	A. Front Servo and Accumulator	1. Servo or accumulator oil rings or bores leaking. 2. Servo piston stuck.
	B. Front Band	1. Front band broken, burned (Check for cause); not engaged on anchor pin and/or servo pin.
XIV. NO ENGINE BRAKING – L^2 – 1st GEAR	A. Control Valve Assembly	1. Lo-Reverse check ball missing from case.
	B. Rear Servo	1. Oil seal ring, bore or piston damaged; leaking apply pressure. 2. Rear band apply pin short, improperly assembled.
	C. Rear Band NOTE: Item A, B, C, will also cause slips in Reverse or no Reverse.	1. Rear band – broken, burned (check for cause), not engaged on anchor pins or servo pin.
XV. NO PART THROTTLE DOWNSHIFT – (INSTALL PRESSURE GAGE)	A. Oil Pressure – (Refers to Par. 76-4 For Oil Pressure Specifications.	1. Vacuum modulator assembly, modulator valve, pressure regulator valve train. (Other malfunctions may also be noticed).
	B. Control Valve Assembly	1. 3-2 valve stuck, spring missing or broken.
XVI. NO DETENT DOWNSHIFTS	A. Control Valve Assembly	1. 3-2 valve stuck, spring missing or broken.
	B. Detent Switch	1. Adjustment, connections fuse.
	C. Solenoid	1. Inoperative, connections.
	D. Control Valve Assembly	1. Detent valve train, sticking.

TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART (Cont'd.)

Problem	Possible Cause	Possible Condition
XVII. LOW or HIGH SHIFT POINTS – Install Pressure Gage)	A. Oil Pressure – (Refer to par. 76-4)	1. Engine vacuum – check at transmission end of the modulator pipe. 2. Vacuum modulator assembly vacuum line connections at engine and transmission, modulator valve, pressure regulator valve train.
	B. Governor	1. Valve sticking. 2. Feed holes restricted or leaking, pipes damaged or mispositioned. 3. Feed line plugged.
	C. Detent Solenoid	1. Stuck open, loose, etc. (Will cause late shifts).
	D. Control Valve Assembly	1. Detent valve train. 2. 3-2 valve train. 3. 1-2 shift valve train. a. 1-2 regulator valve stuck – (This would cause a constant 1-2 shift point regardless of throttle opening). 4. Valve body spacer plate-to-cover gasket – mispositioned, spacer plate orifice holes missing or blocked.
	E. Case	1. Porosity; intermediate plug leaking, missing.
XVIII. WON'T HOLD IN PARK	A. Manual Linkage	1. Maladjusted.
	B. Internal Linkage	1. Parking brake lever and actuator assembly – defective (Check for chamfer on actuator rod sleeve). 2. Parking pawl broken or inoperative.
XIX. TRANSMISSION NOISY	A. Pump Noise	1. Oil low or high. 2. Cavitation due to plugged Filter, "O" ring damaged, porosity in intake circuit, water in oil. 3. Pump gears – driving gear assembled backwards, gears damaged or defective, crescent interference.

TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART (Cont'd)

Problem	Possible Cause	Possible Condition
XIX. TRANSMISSION NOISY (Cont'd.)	B. Gear Noise – First, Second, and/or Reverse	1. Transmission grounded to body. 2. Planetary gear set. 3. Thoroughly clean thrust bearings and thrust races, and closely inspect for pitting or roughness.
	C. Clutch Noise – During Application	1. Forward clutch – (Neutral to Drive, Park to Drive); Check clutch plates. 2. Intermediate clutch – (1-2 shift in L^2 and Drive Range); Check clutch plates. 3. Direct clutch – (2-3 shift in Drive Range and in Neutral to Reverse, Park to Reverse); Check clutch plates.
	D. Converter Noise	1. This Condition will occur in R-D-L^2-L^1 Due to damaged Needle Bearings in Converter. Noise Level is generally lower in Park and Neutral.
Problem	**Plates Burnt**	**Possible Condition**
XX. BURNED CLUTCH PLATES	A. Forward Clutch	1. Check ball in clutch housing damaged, stuck or missing. 2. Clutch piston cracked, seals damaged or missing. 3. Low Line Pressure (Refer to paragraph 76-5) 4. Manual valve mispositioned (Refer to paragraph 76-9). 5. Restricted oil feed to forward clutch (Examples: clutch housing to inner and outer areas not drilled, restricted or porosity in pump). 6. Pump cover oil seal rings missing, broken or undersize; ring groove oversize. 7. Case valve body face not flat or porosity between channels. 8. Manual valve bent and center land not ground properly.

TURBO HYDRA-MATIC 400 TROUBLE DIAGNOSIS CHART (Cont'd)

Problem	Plates Burnt	Possible Condition
XX. BURNED CLUTCH PLATES (Cont'd.)	B. Intermediate Clutch	1. Constant bleed orifice in center support missing. 2. Rear accumulator piston oil ring, damaged or missing. 3. 1-2 accumulator valve stuck in control valve assembly. 4. Intermediate clutch piston seal damaged or missing. 5. Center support bolt loose. 6. Low Line pressure (Refer to paragraph 76-5). 7. Intermediate clutch plug in case missing. 8. Case valve body face not flat or porosity between channels. 9. Manual valve bent and center land not ground properly.
	C. Direct Clutch	1. Restricted orifice in vacuum line to modulator (Poor vacuum response.) 2. Check ball indirect clutch piston damaged, stuck or missing. 3. Defective modulator bellows. (Refer to paragraph 76-4). 4. Center support bolt loose. (Bolt may be tight in support but not holding support tight to case.) 5. Center support oil rings or grooves damaged or missing. 6. Clutch piston seals damaged or missing. 7. Front and rear servo pistons and seals damaged. 8. Manual valve bent and center land not cleaned up. 9. Case valve body face not flat or porosity between channels. 10. Intermediate sprag clutch installed backwards. 11. 3-2 Valve, 3-2 spring or 3-2 spacer pin installed in wrong location in 3-2 valve bore.

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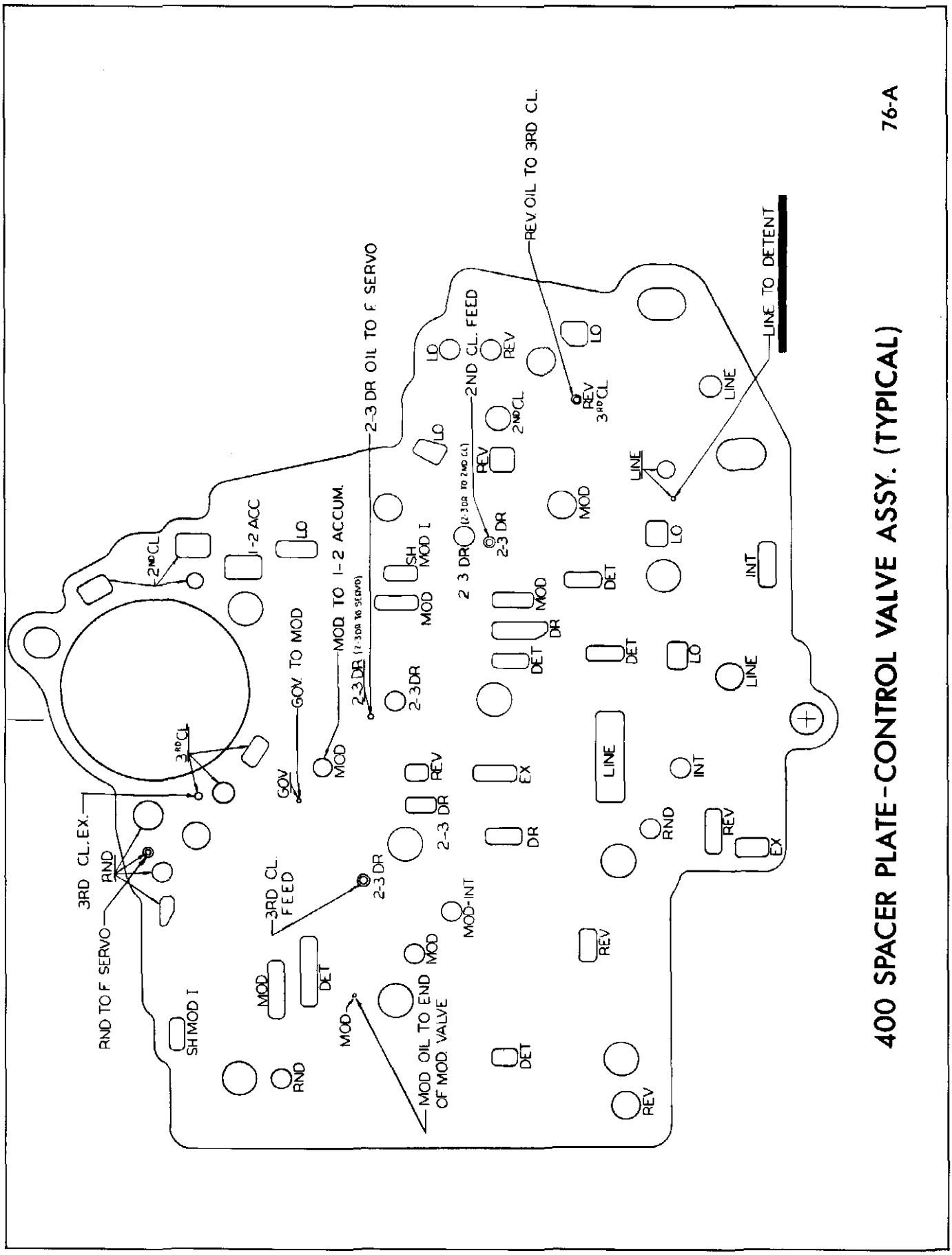
NOTE: Burned clutch plates can be caused by incorrect usage of clutch plates. Also anti-freeze in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.

NOTE: If direct clutch plates and front band are burned, check manual linkage. (Refer to Group 73).



400 SPACER PLATE-CONTROL VALVE ASSY. (TYPICAL) 76-A

DIVISION II

DESCRIPTION AND OPERATION

76-8 DESCRIPTION

The Turbo Hydra-matic 400 Automatic Transmission, see Figure 76-38, is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and a compound planetary gear set. Three multiple- disc clutches, one (1) one way roller clutch, one (1) one way sprag clutch and two bands provide the friction elements required to obtain the desired function of the compound planetary gear set.

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.

The torque converter housing 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 through 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, the 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 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 a 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.

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 solenoid is activated by a signal from the detent switch that is connected to the throttle linkage. When the throttle is fully open, the switch on the linkage is closed, energizing the detent solenoid and causing the transmission to downshift at speeds below approximately 70 MPH.

The selector quadrant has six selector positions: P, R, N, D, L2, L1.

P. - Park position positively locks the output shaft to the transmission case by means of a locking pawl to prevent the vehicle from rolling either direction. This position should be selected whenever the driver leaves the vehicle. The engine may be started in Park position.

R. - Reverse range enables the vehicle to be operated in a reverse direction.

N. - Nuetral 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 downshift is available for safe passing by depressing the accelerator to the floor.

L2 - L2 range adds new performance for congested traffic or hilly terrain. L2 range has the same starting ratio as drive range, but prevents the transmission from shifting above second gear to retain second gear acceleration when extra performance is desired. L2 range can also be used for engine braking. L2 range can be selected at any vehicle speed, and the transmission will shift to second gear and remain in second gear until the vehicle speed or the throttle are changed to obtain first gear operation in the same manner as in drive range.

L1 - L1 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 30-40 MPH, depending on axle ratio. The transmission will then downshift into first gear. Under no circumstances will it again upshift while the selector lever is in L1 range.

L1 range 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.

76-9 HYDRAULIC OPERATION, FUNCTIONS OF VALVES AND HYDRAULIC CONTROL UNITS

A. Pressure Control

The transmission is automatically controlled by a hydrau-

lic 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. See Figure 76-13.

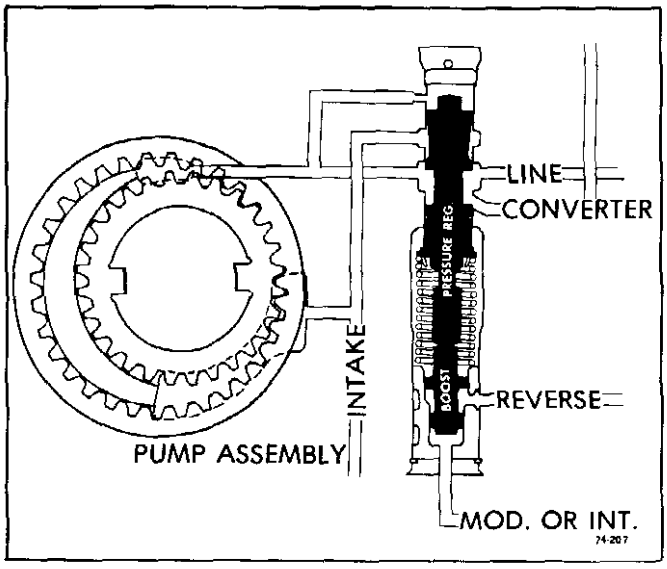


Figure 76-13 - Pump and Pressure Regulator Valve

To control line pressure properly, 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 increase in vehicle speed because converter torque ratio also decreases.

B. 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. 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 internal spring act in the opposite direction to decrease modulator, or low engine vacuum high modulator pressure; high engine vacuum, and low modulator pressure. See Figure 76-14.

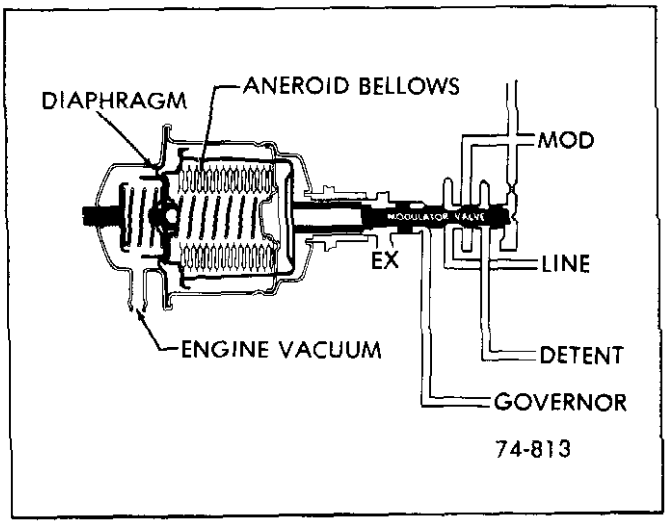


Figure 76-14 - Vacuum Modulator Assembly

To reduce the effect of altitude 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.

C. 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 two flyweights and a regulator valve. Centrifugal force of the flyweights is imposed on the regulator valve causing it to regulate a pressure signal that increases with speed. See Figure 76-15.

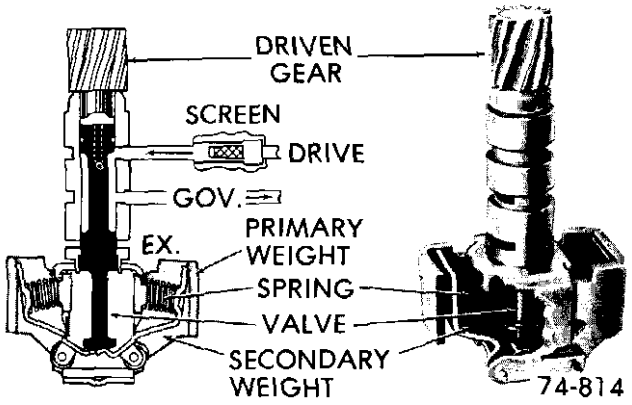


Figure 76-15 - Governor Assembly

To increase the accurcy of the governor signal at low speeds, the flyweights are so designed that their effective mass is greater at speeds below approximately 720 output RPM than it is above this speed.

This is done by dividing each flyweight into two parts and arranging them so that the primary weights act through preloaded springs on the secondary weights, which in turn acts on the valve. At approximately 720 RPM the cen-

trifugal 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.

Governor pressure acts on the modulator valve to cause modulator pressure to decrease as vehicle speed increases.

1. *Pressure Regulator*

a. Regulates line pressure according to a fixed spring force and forces controlled by modulator and reverse pressure. See Figure 76-13.

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, L2, L1, as selected by the vehicle operator through the manual control lever. See Figure 76-16.

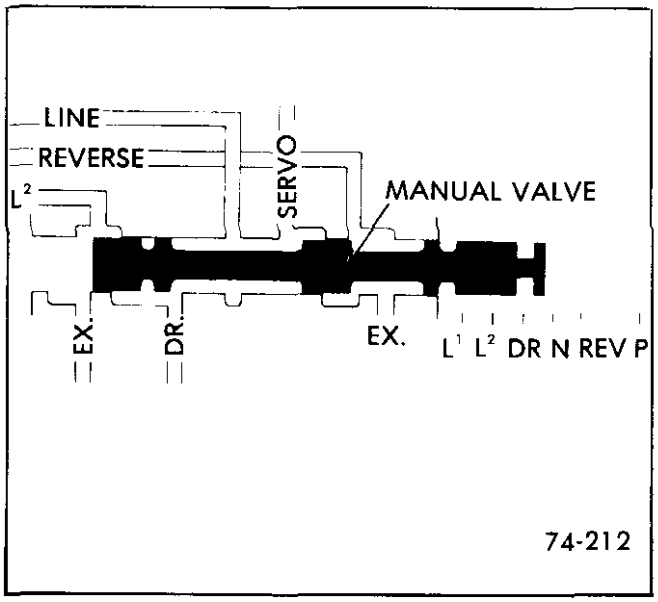


Figure 76-16 Manual Valve

3. *Governor Assembly*

Generates a speed sensitive oil pressure that increases with output shaft or vehicle speed. Governor pressure is used to vary the shift points and modulator pressure regulation. See Figure 76-15.

4. *Modulator Valve*

Regulates line pressure to modulator pressure that varies with torque to the transmission. See Figure 76-14. It senses forces 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, low oil pressure, detent pressure, modulator pressure, and spring force. See Figure 76-17.

6. *1-2 Regulator Valve*

Regulates modulator pressure to a pressure proportional to modulator pressure, tending to keep the 1-2 shift valve in the downshift position. See Figure 76-17.

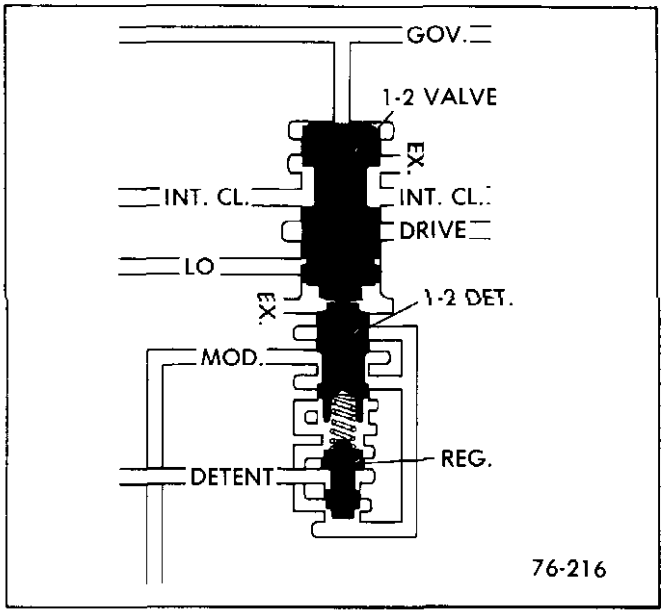


Figure 76-17 - 1-2 Shift Valve and 1-2 Detent Valve and Regulator Valve (Typical)

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. See Figure 76-17.

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, L2, governor and detent pressure as well as a spring force. See Figure 76-18.

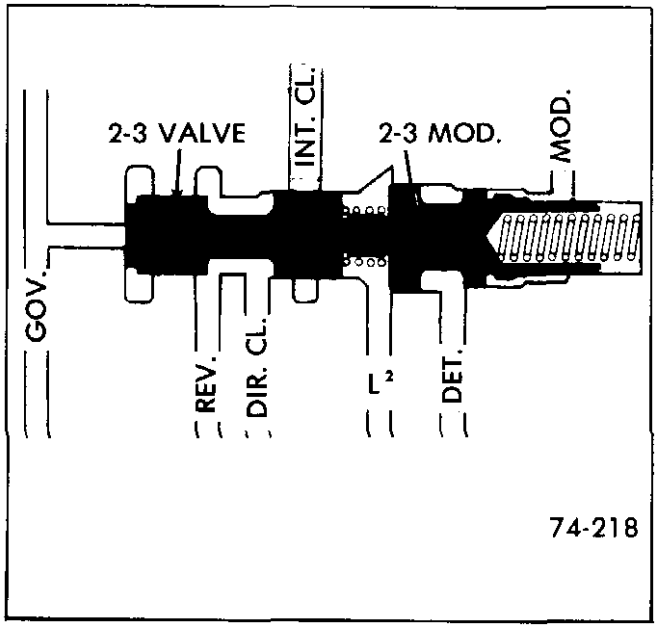


Figure 76-18 - 2-3 Valve and 2-3 Modulator Valve Train (Typical)

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. See Figure 76- 18.

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 gear without downshifting. In third speed, modulator pressure or detent pressure above 87 psi will provide part throttle downshift forces. (Resulting in a 3- 2 downshift at less than wide open throttle) See Figure 76-19.

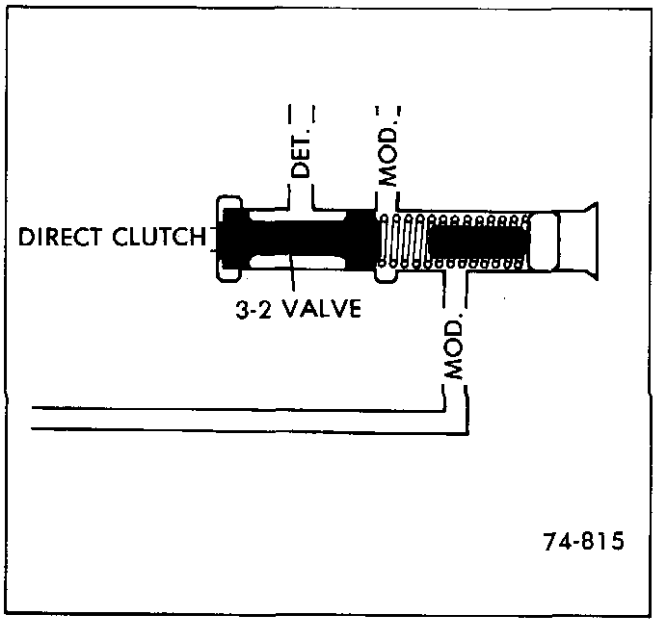


Figure 76-19 - 3-2 Valve

11. *Detent Valve*

Shifts when line oil is exhausted at the end of the valve when the detent solenoid is energized, thus allowing the detent regulator valve to regulate. This directs detent pressure to the 1-2 accumulator valve, 1-2 regulator and 2-3 modulator valves, 3-2 valve, and the vacuum modulator valve. See Figure 76-20.

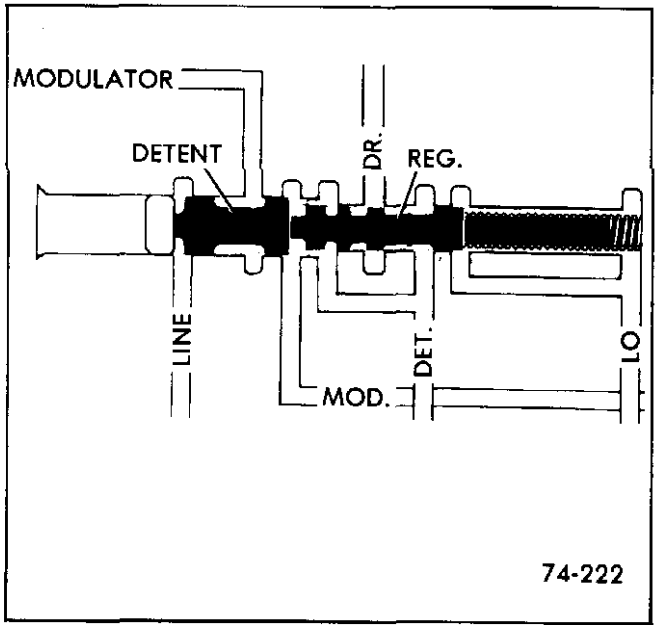


Figure 76-20 - Detent Valve and Detent Regulator Valve

12. *Detent Regulator Valve*

When the detent valve shifts, the detent regulator is free to allow drive oil to enter the detent passage and thus becomes regulated to a value of 70 psi. Detent pressure will also flow into the modulator passage which flows to the 2-3 modulator valve, 3-2 valve and the 1-2 detent valve. Lo oil moves the detent regulator open to drive oil allowing drive oil to enter the modulator and detent passages. See Figure 76-20.

13. *Front Servo*

The front servo, see Figure 76-21, applies the front overrun band to provide engine braking in 2nd gear in L2 Range. It is also used as an accumulator for the application of the direct clutch and in conjunction with a series of check balls and controlling orifices is a part of the timing for the release of the direct clutch.

To prevent the application of the front overrun 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 also acts to charge the servo in preparation for the application of the direct clutch.

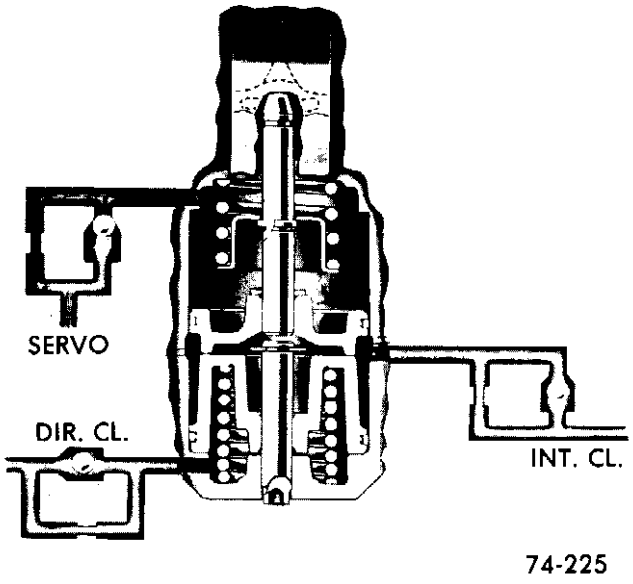


Figure 76-21 - Front Servo

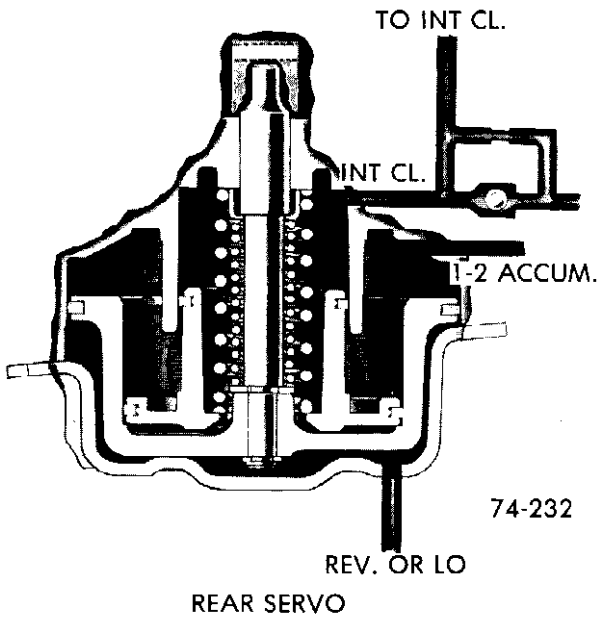


Figure 76-22 - Rear Servo

Direct clutch oil is directed to the front servo accumulator piston where spring force plus direct clutch pressure stroke the piston up against the force of servo release oil. This lowers the clutch apply pressure during the shift 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 ratio, which results in a smooth shift and better acceleration.

14. *Rear Servo*

The rear servo, see Figure 76-22, applies the rear band for overrun engine braking in L1 range 1st gear. It applies the band in Reverse to hold the reaction carrier to provide the reverse gear ratio.

15. *1-2 Accumulator*

1-2 accumulator oil charges the rear servo accumulator in 1st gear in preparation for the apply of the intermediate clutch on the 1-2 shift.

The valve train consists of a 1-2 primary valve and spring, a 1-2 accumulator valve and spring and plug. See Figure 76-23.

1-2 accumulator oil pressure is a two-stage pressure which increases as modulator pressure increases to obtain greater flexibility in obtaining the desired curve during the 1-2 shift for various engine requirements.

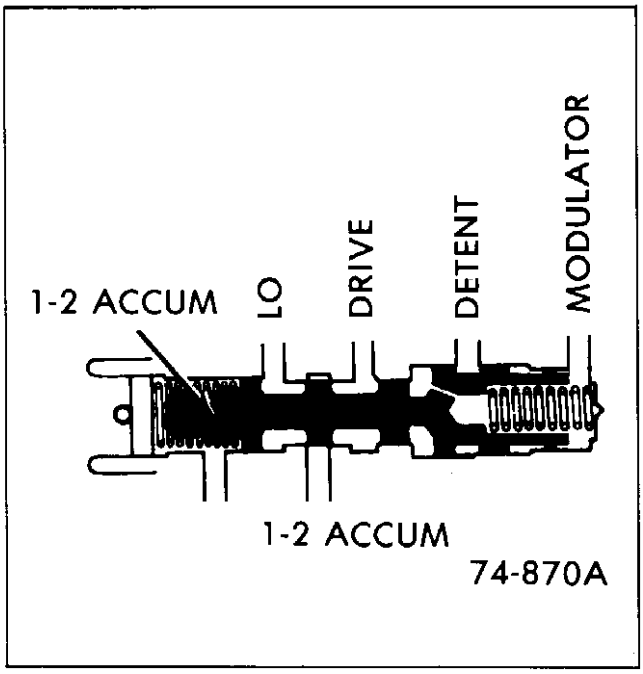
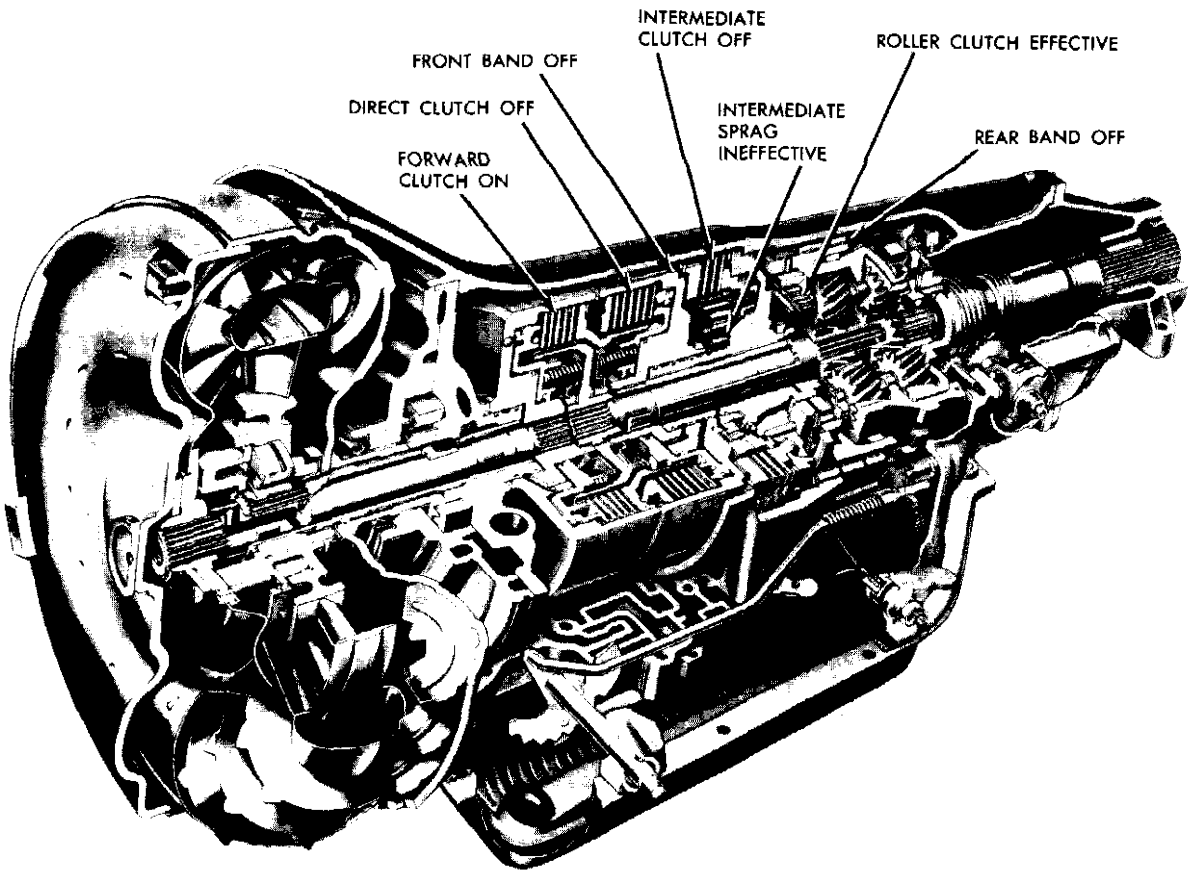


Figure 76-23 - 1-2 Accumulator Valve Train (Typical)

76-10 MECHANICAL OPERATION

a. Operation of Components in Drive Range — First Gear



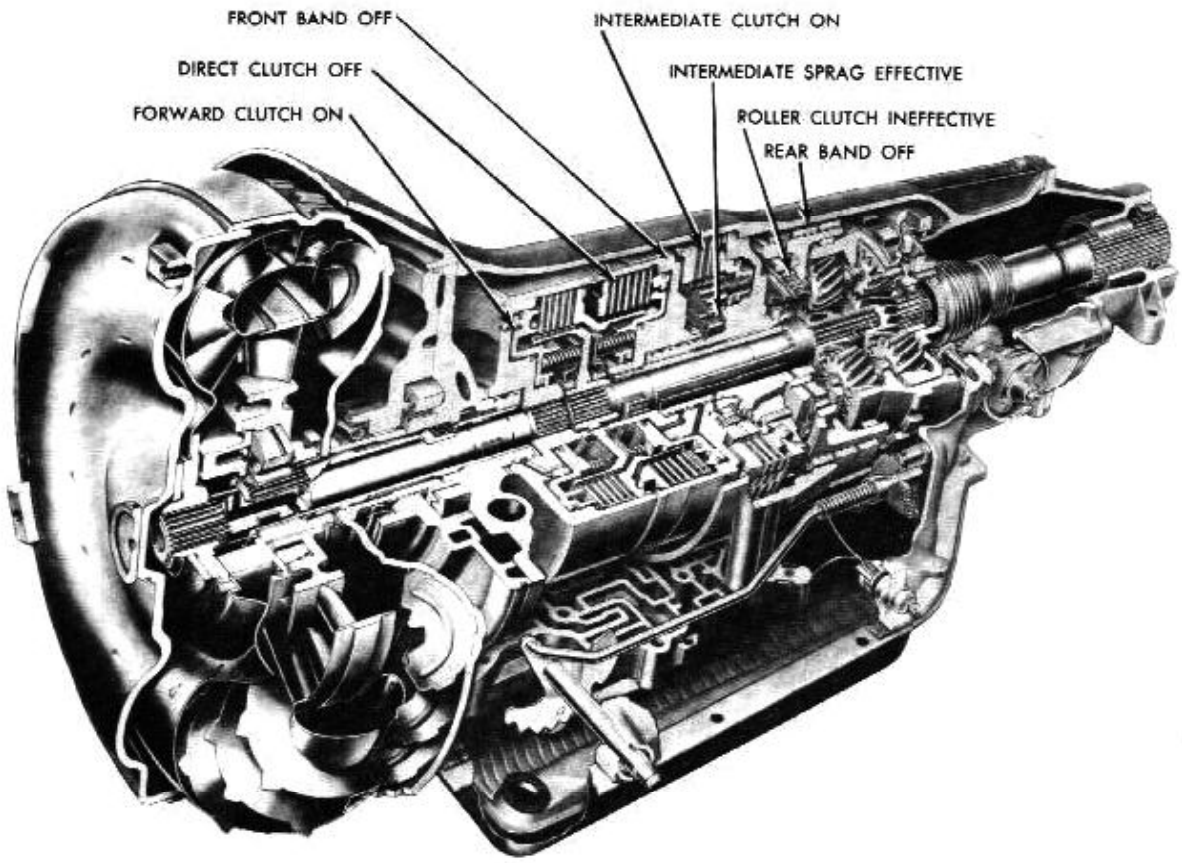
With the selector lever in Drive Range, the forward clutch is applied. This delivers turbine torque to the mainshaft and turns the rear internal gear in a clockwise direction. (Converter torque ratio = approximately 2.:1. at stall).

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 one-way roller clutch assembly to the transmission case. (Approximate stall ratio = 5.:1.)

76-864A

Figure 76-24 - Drive Range - First Gear

b. Operation of Components in Drive Range – Second Gear



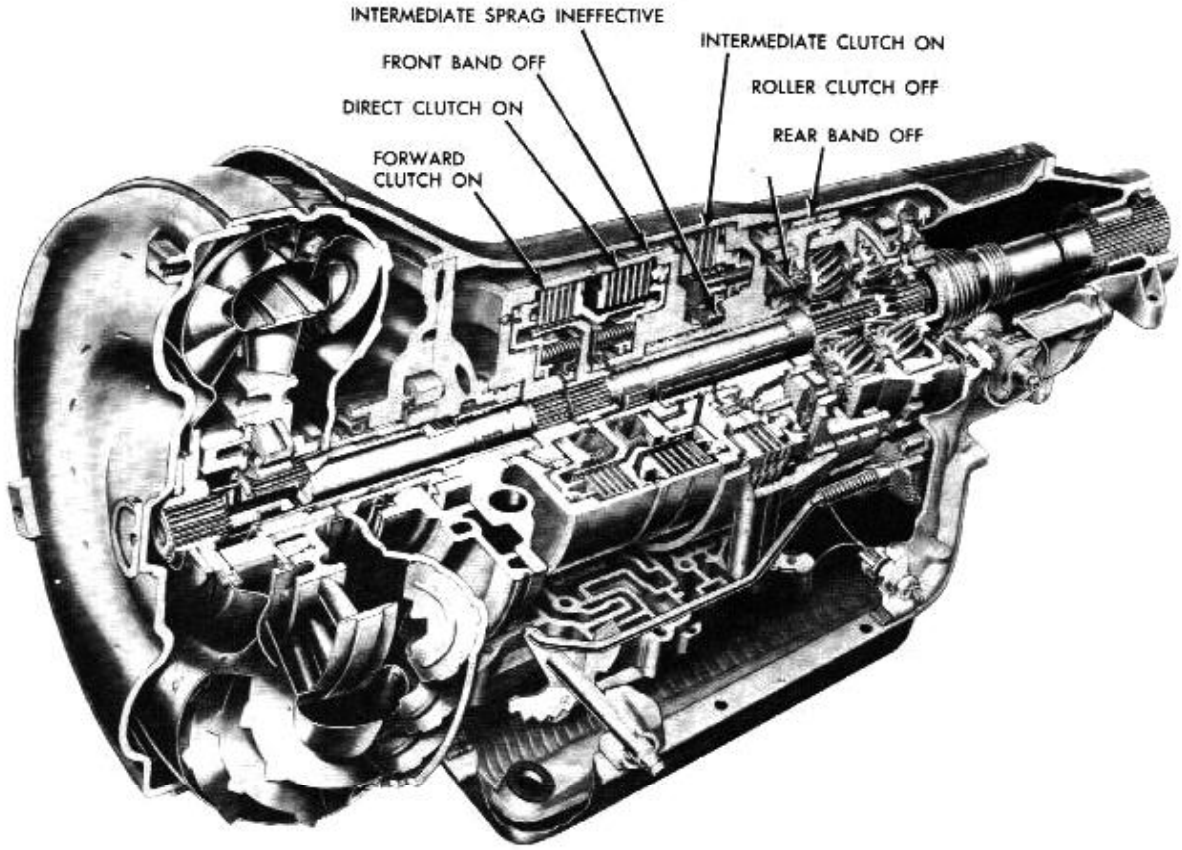
In second gear, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against counterclockwise rotation. Turbine torque through the forward clutch is now applied through the mainshaft to the rear internal gear in a clockwise direction.

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.

76-865A

Figure 76-25 - Drive Range - Second Gear

c. Operation of Components in Drive Range — Third Gear

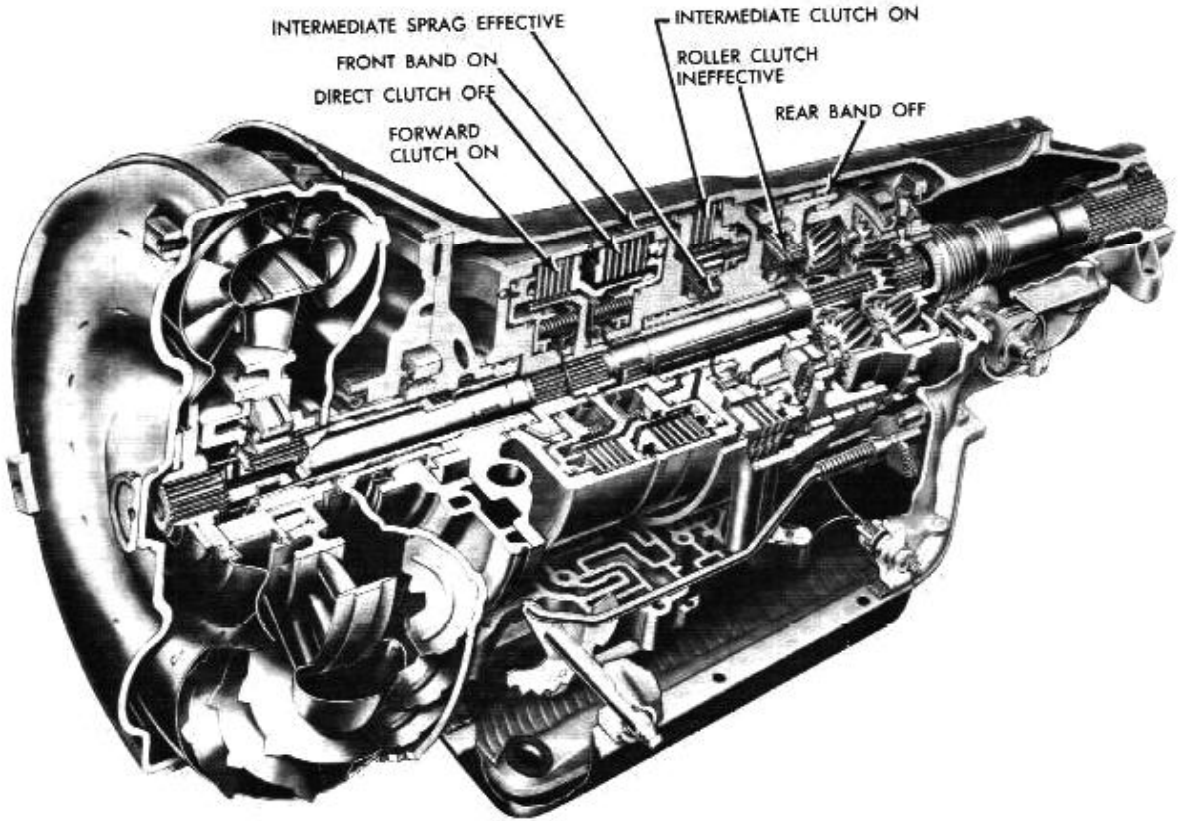


In direct drive, engine torque is transmitted to the converter through the forward clutch to the mainshaft and rear internal gear. Because the direct clutch is applied, equal power is also transmitted to the sun gear shaft and the sun gear. Since both the sun gear and internal gears are now turning at the same speed, the planetary gear set is essentially locked and turns as one unit in direct drive or a ratio of 1:1.

76-866A

Figure 76-26 - Drive Range - Third Gear

d. Operation of Components in Low – L^2 Range – Second Gear



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.

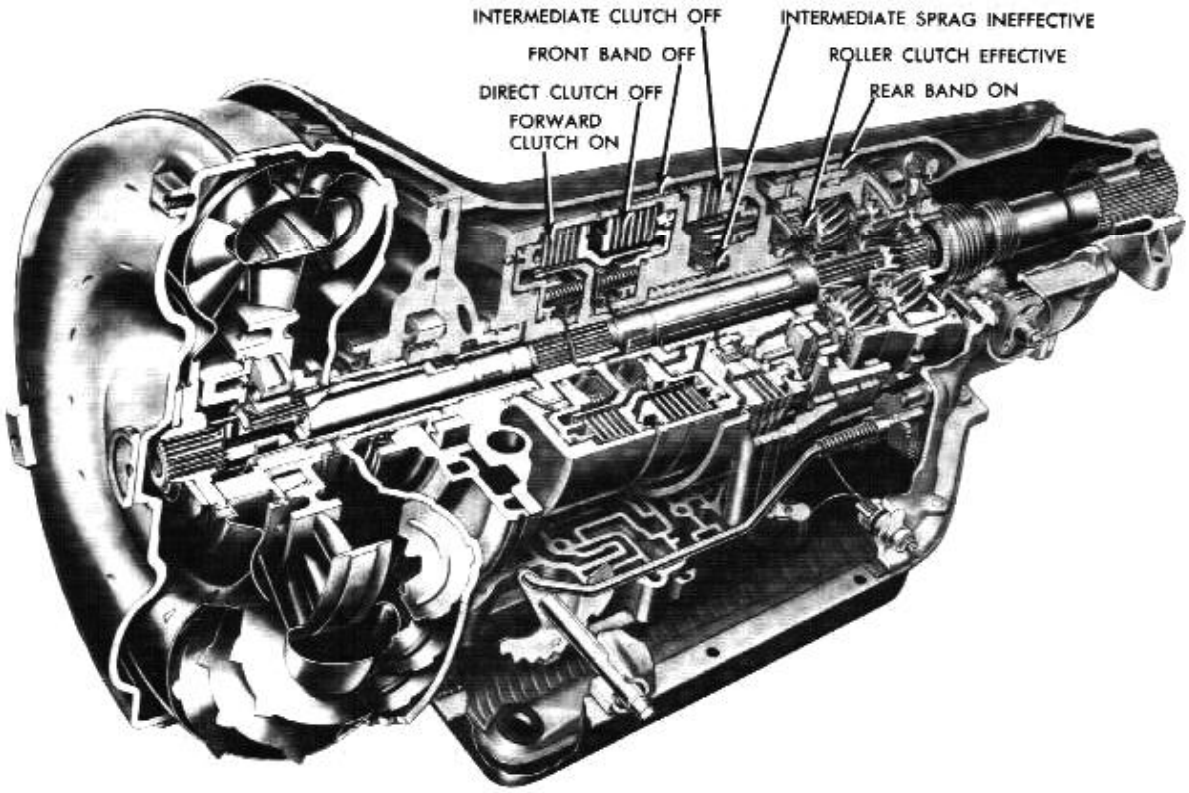
Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of approximately 1.5:1.

In L^2 Range second gear, overrun braking is provided by the front band as it holds the sun gear fixed. Without the band applied, the sun gear would overrun the intermediate sprag.

76-867A

Figure 76-27 - L2 Range - Second Gear

e. Operation of Components in Low — L¹ Range — First Gear



With the selector lever in L¹ 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 ratio = approximately 2.:1. at stall.)

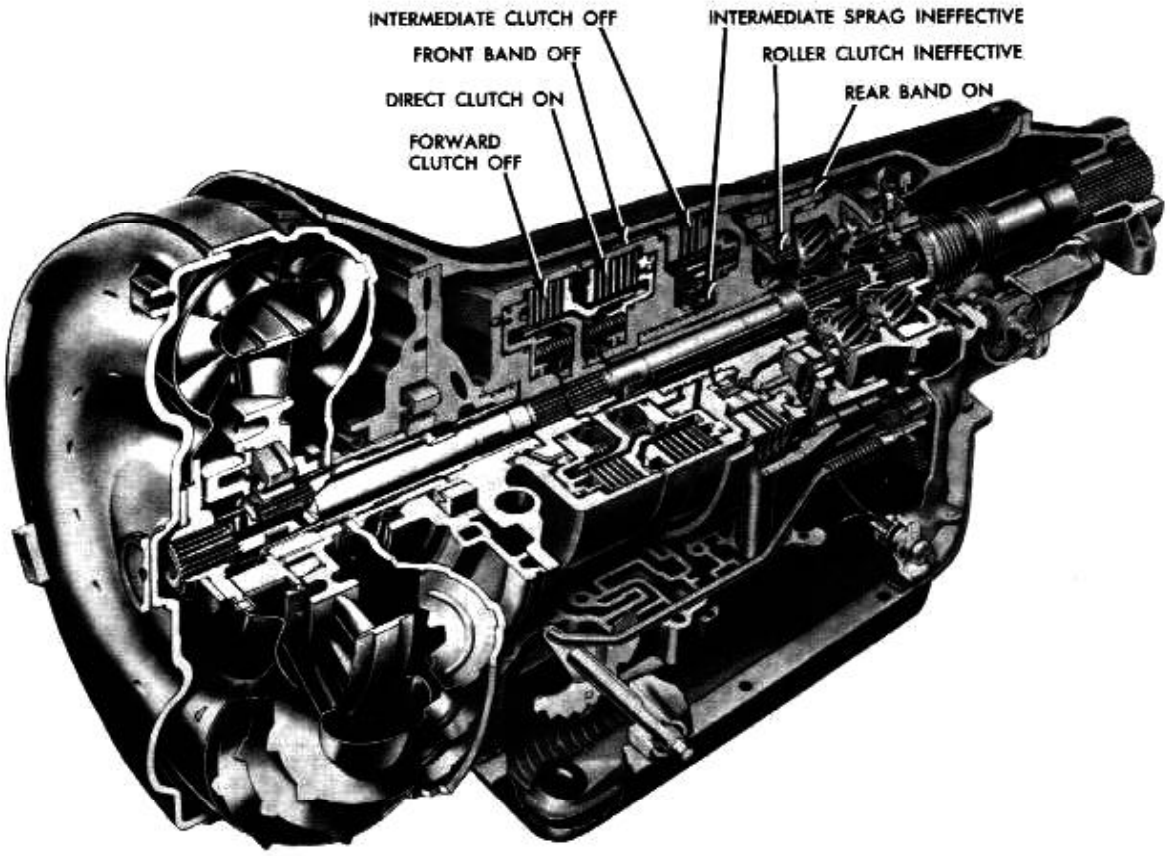
Clockwise motion of the rear internal gear causes the rear pinions to turn clockwise to drive the sun gear counterclockwise. In turn, the sun gear drives the front pinions clockwise, thus turning the front internal gear, output carrier, and output shaft clockwise in a reduction ratio of approximately 2.5:1. The reaction of the front pinions against the front internal gear is taken by the reaction carrier and the one way clutch. (Total stall ratio = approximately 5.:1.)

Downhill or overrun braking is provided in L¹ Range by applying the rear band as this prevents the reaction carrier from overrunning the one way clutch.

76-915

Figure 76-28 - L1 Range - First Gear

f. Operation of Components in Reverse



In Reverse, the direct clutch is applied to direct turbine torque to the sun gear shaft and sun gear. The rear band is also applied, holding the reaction carrier.

Clockwise torque to the sun gear causes the front pinions and front internal gear to turn counter-clockwise in reduction. The front internal gear is connected directly to the output shaft, thus providing the reverse output gear ratio of approximately 2.:1. The approximate reverse torque multiplication at stall (converter and gear ratios) is approximately 4.:1.

76-868A

Figure 76-29 - Reverse

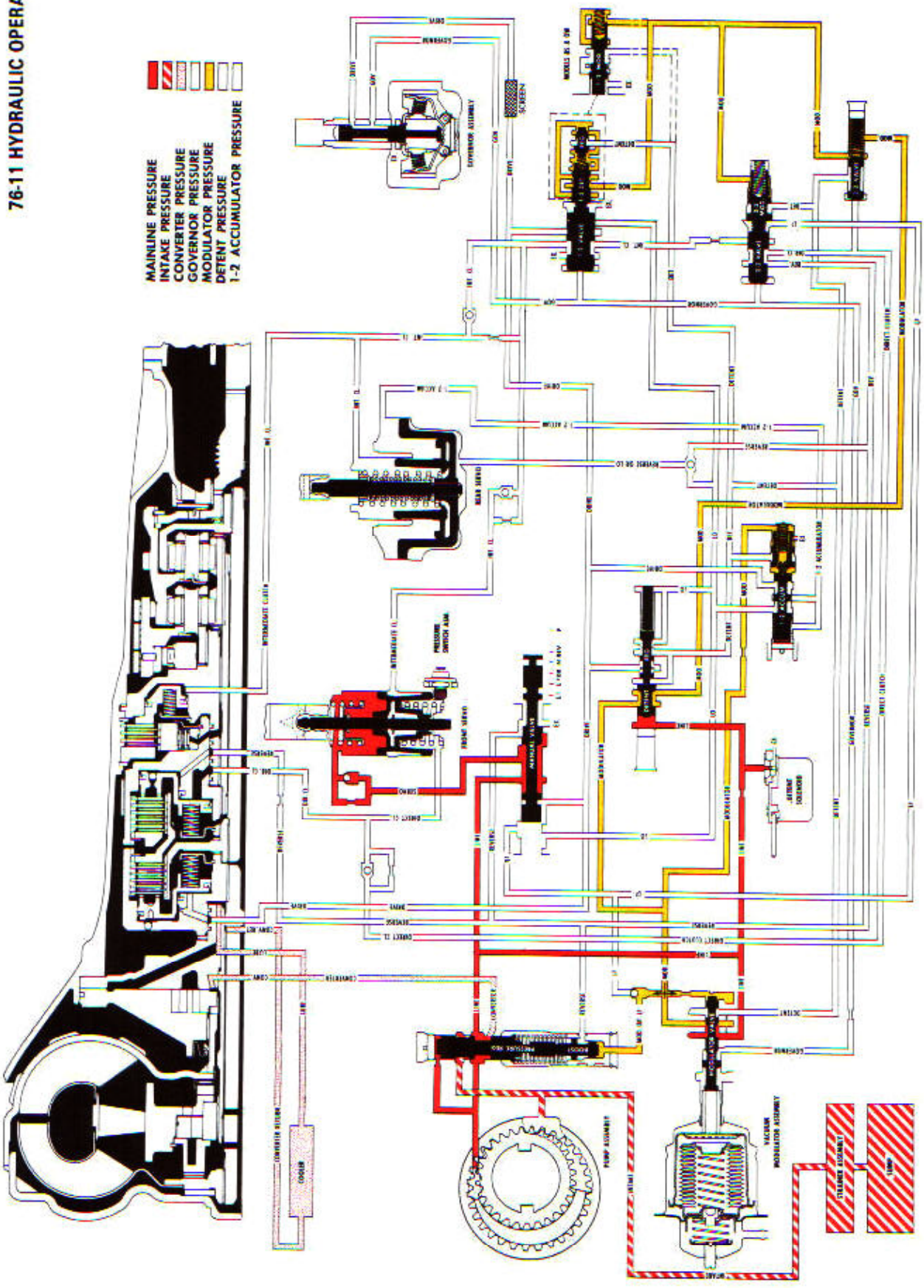


Figure 76-30 - Park or Neutral

a. Operation of Controls
Park or Neutral (throttle closed)

Forward Clutch	— Off	Front Band	— Off	Intermediate Sprag	— Ineffective
Direct Clutch	— Off	Rear Band	— Off	Detent Solenoid	— De-energized
Intermediate Clutch	— Off	Roller Clutch	— Ineffective		

Whenever the engine is running at idle with the selector lever in "P" or "N", oil from the pump is directed to the: (See Figure 76-30).

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)

Cooling and Lubrication

Oil flows from the pump to the pressure regulator valve which regulates the 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, termed converter return oil, 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 regulated to a pressure called modulator oil, which acts on the pressure boost valve, 1-2 accumulator and 1-2 accumulator primary valve and passes through the detent valve and 3-2 valve to the 1-2 detent valve and 2-3 modulator valve.

SUMMARY

The converter is filled and all clutches and bands are released. The transmission is in Neutral.

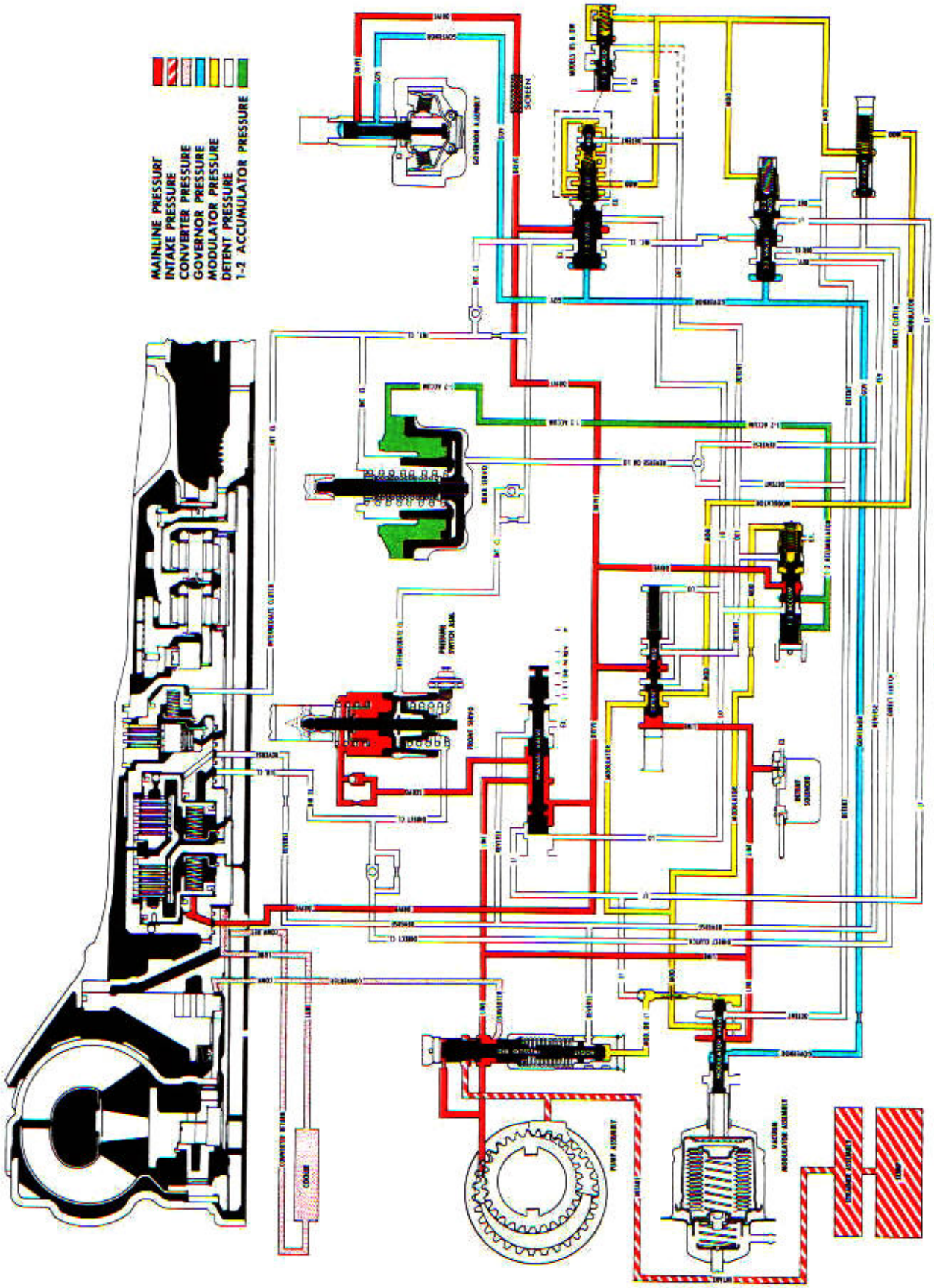


Figure 76-31 - Drive Range - First Gear

b. Operation of Controls
Drive Range — First Gear

Forward Clutch — On
Direct Clutch — Off
Intermediate Clutch — Off
Front Band — Off
Rear Band — Off
Roller Clutch — Effective
Intermediate Sprag — Ineffective
Detent Solenoid — De-energized

When the selector lever is moved into Drive position, the manual valve is repositioned to allow line pressure to enter the drive circuit. Drive oil then flows to the: (See Figure 76-31).

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 first, or 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, called governor oil, 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.

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. The forward clutch is applied. The transmission is in first gear.

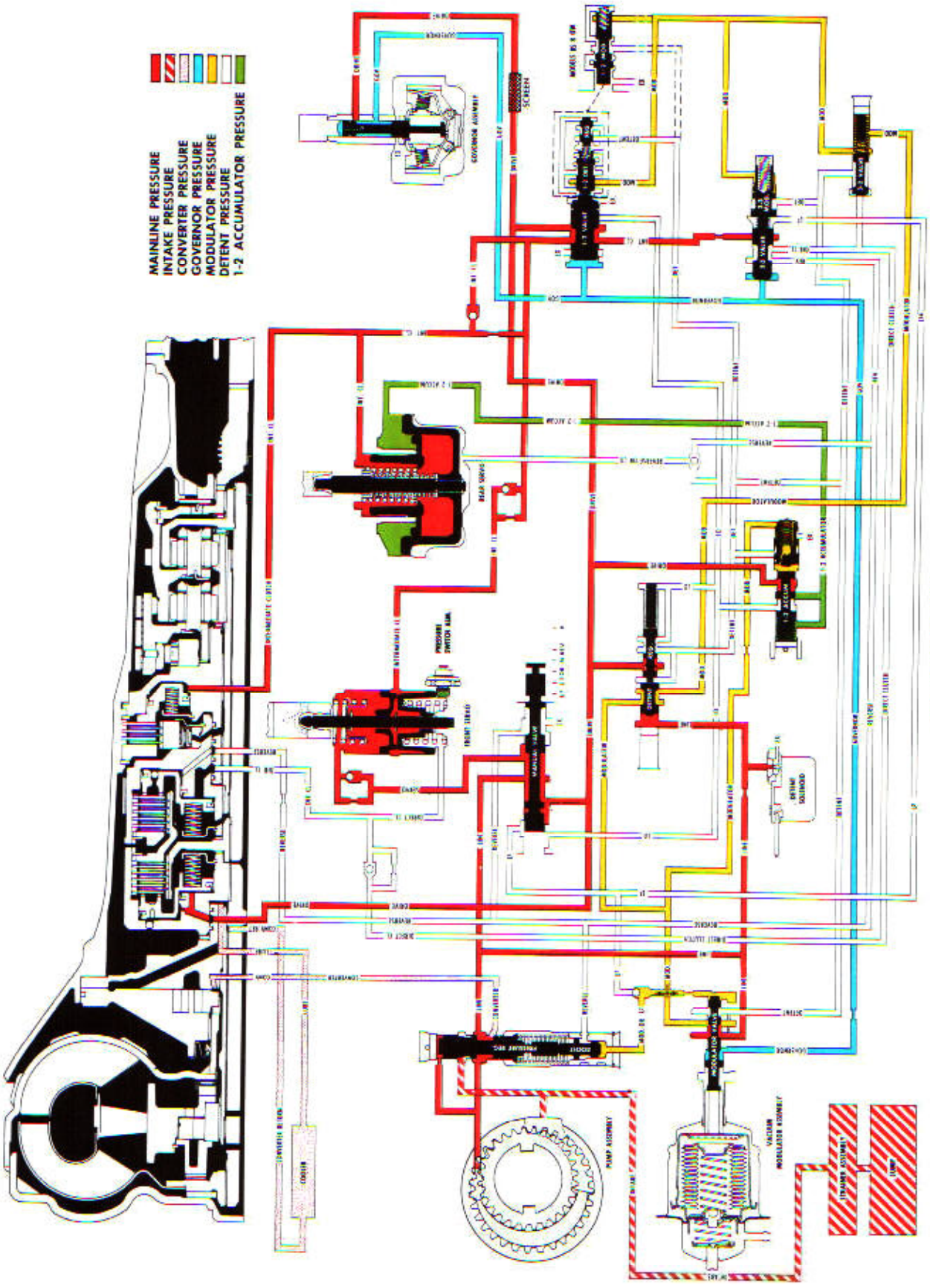


Figure 76-32 - Drive Range - Second Gear

c. Operation of Controls
Drive Range — Second Gear

Forward Clutch	— On	Front Band	— Off	Intermediate Sprag	— Effective
Direct Clutch	— Off	Rear Band	— Off	Detent Solenoid	— De-energized
Intermediate Clutch	— On	Roller Clutch	— Ineffective		

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. Oil in this passage is called intermediate clutch oil. (See Figure 76-32).

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 and accumulator spring to maintain lower 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 second gear.

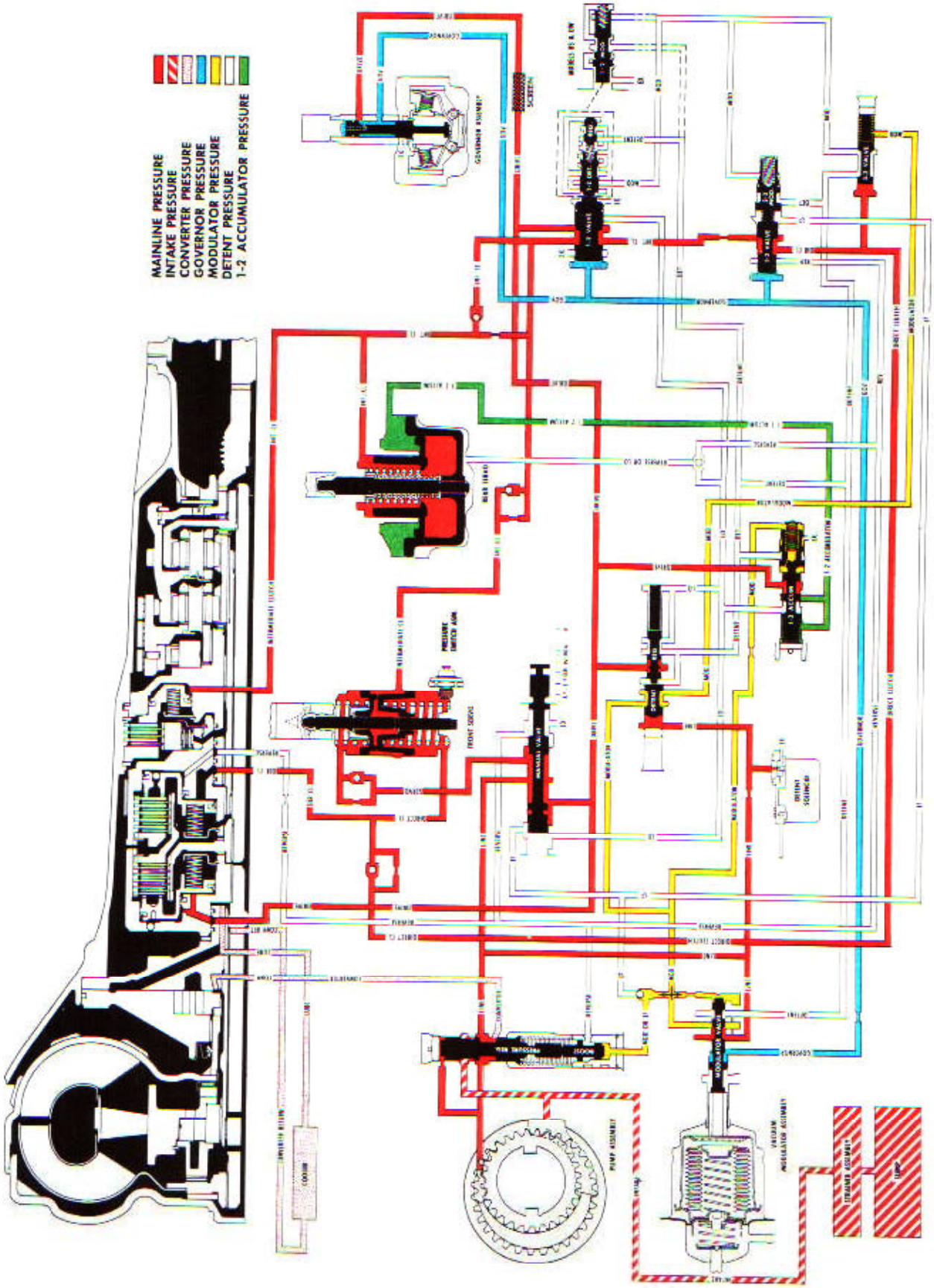


Figure 76-33 - Drive Range - Third Gear

d. Operation of Controls
Drive Range — Third Gear

Forward Clutch	— On	Front Band	— Off	Intermediate Sprag	— Ineffective
Direct Clutch	— On	Rear Band	— Off	Detent Solenoid	— De-energized
Intermediate Clutch	— On	Roller Clutch	— Ineffective		

As vehicle speed and governor pressure increase, the force of governor oil acting on the 2-3 shift valve overcomes the force of the 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. This oil is termed direct clutch oil. (See Figure 76-33).

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. The 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 against modulator pressure. This cuts off modulator oil to the 1-2 detent and 2-3 modulator valves 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 third gear (direct drive).

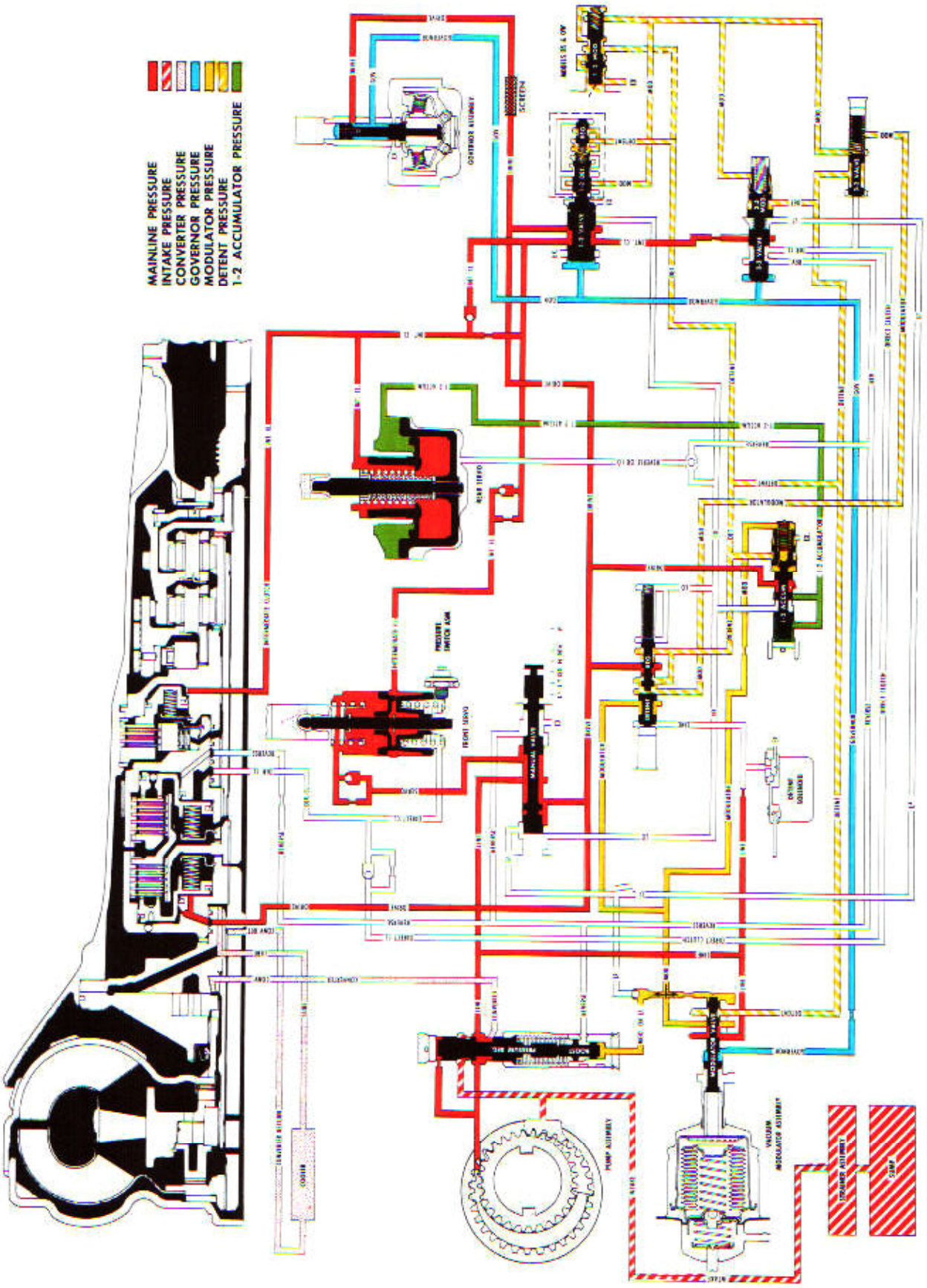


Figure 76-34 - Detent Downshift - Valves in Second Gear Position

e. Operation of Controls
Detent Down Shift — Valves in Second Gear Position

Forward Clutch	— On	Front Band	— Off	Intermediate Sprag	— Effective
Direct Clutch	— Off	Rear Band	— Off	Detent Solenoid	— Energized
Intermediate Clutch	— On	Roller Clutch	— Ineffective		

While operating at speeds below approximately 70 MPH a forced 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 smaller orifice. (See Figure 76-34).

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 shift valve below approximately 70 MPH, shifting the transmission to second gear.

A detent 2-1 downshift can also be accomplished below approximately 20 MPH because detent oil is directed to the 1-2 regulator valve, regulating or exhaust port. 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 intermediate 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 speeds or at high altitudes.

PART THROTTLE 3-2 DOWNSHIFTS

Forward Clutch — Applied

Roller Clutch — Ineffective

Direct Clutch — Released in 2nd

Direct Clutch — Applied in 3rd

Front Band — Released

Rear Band — Released

Intermediate Clutch — Applied

Intermediate Sprag — Effective in 2nd

Intermediate Sprag — Ineffective in 3rd

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 87 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 speed.

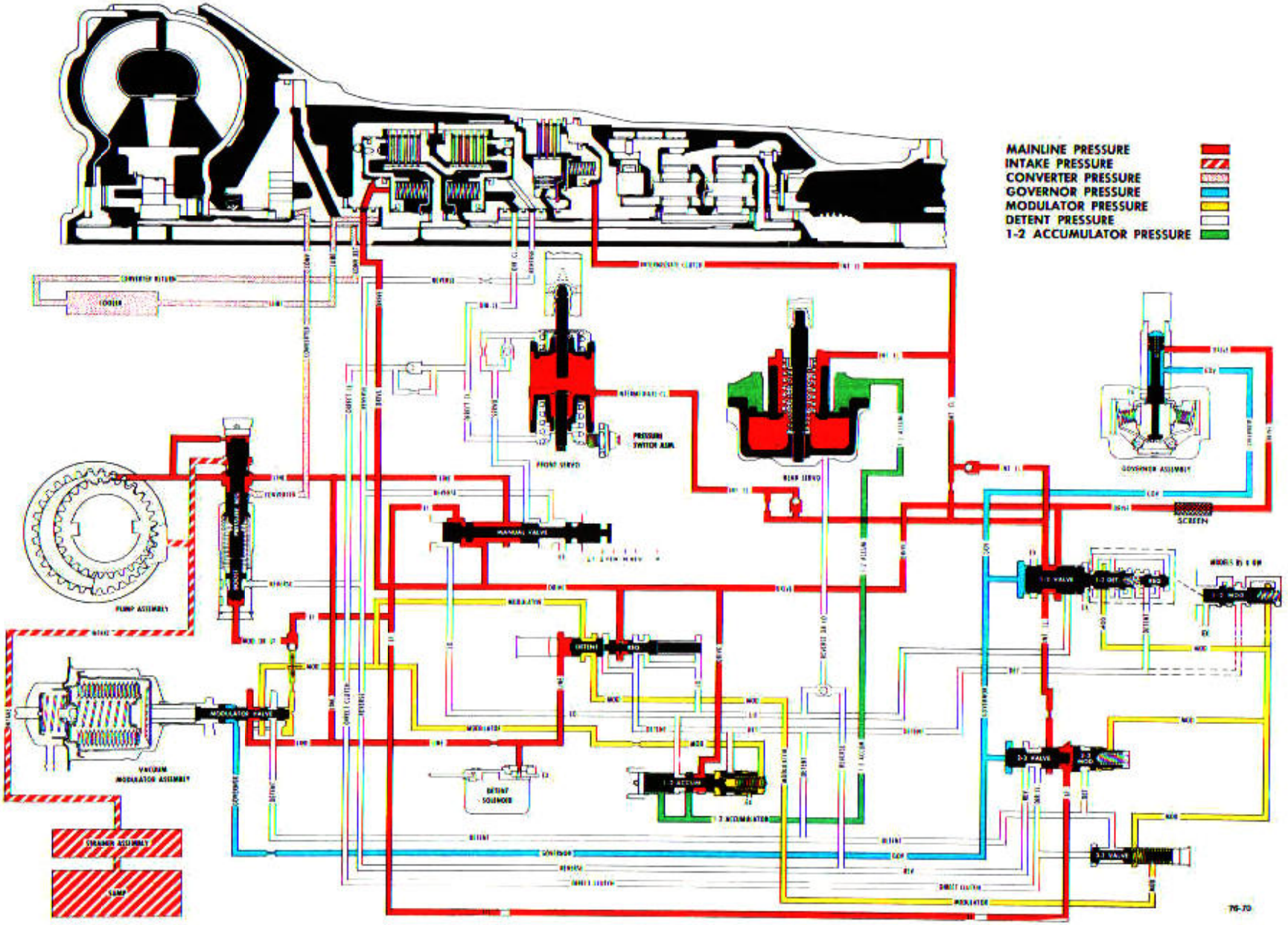


Figure 76-35 - L2 Range -Valves in Second Gear Position

f. Operation of Controls
L² Range — Valves in Second Gear Position

Forward Clutch	— On	Front Band	— On	Intermediate Sprag	— Effective
Direct Clutch	— Off	Rear Band	— Off	Detent Solenoid	— De-energized
Intermediate Clutch	— On	Roller Clutch	— Ineffective		

A 3-2 downshift can be accomplished by moving the selector lever from Drive to L² Range. When the selector lever is in the L² Range, L² oil from the manual valve is directed to the: (See Figure 76-35).

1. Pressure Boost Valve
2. 2-3 Shift Valve

L² oil at the boost valve will increase line pressure to 150 psi. This increased L² 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 in L² Range. 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 — L² Range, 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 second gear — L² Range.

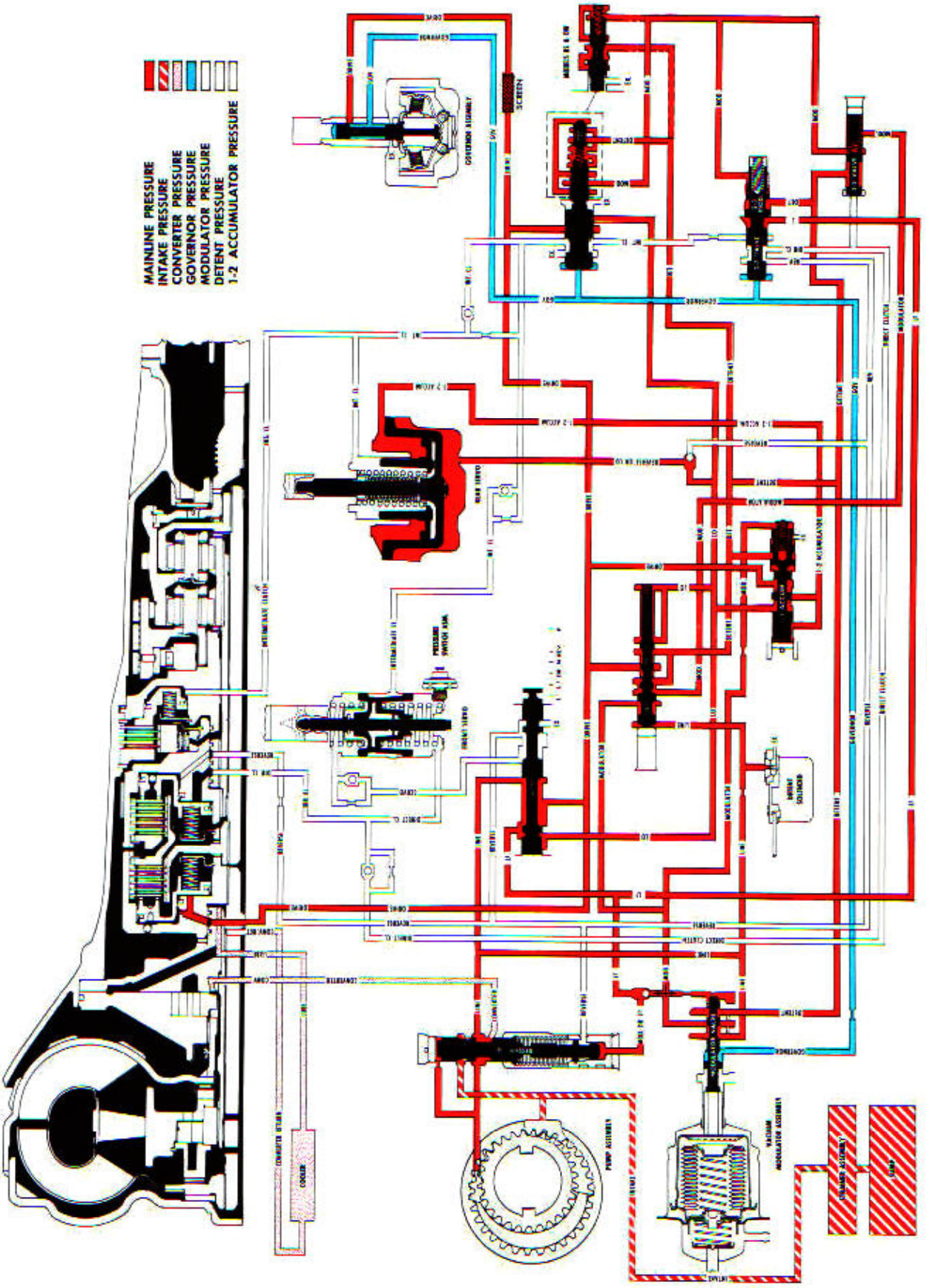


Figure 76-36 - L1 Range - First Speed - Valves in First Gear Position

g. Operation of Controls
L¹ Range — First Gear —
Valves in First Gear Position

Forward Clutch	*— On*	*Front Band*	*— Off*	*Intermediate Sprag*	*— Ineffective*
Direct Clutch	— Off	Rear Band	— On	Detent Solenoid	— De-energized
Intermediate Clutch	— Off	Roller Clutch	— Effective		

Maximum downhill braking can be attained at speeds below 40 mph with the selector lever in L¹ Range as this directs Lo oil from the manual valve to the: (See Figure 76-36).

1. Rear Servo
2. 1-2 Accumulator Valve
3. Detent Regulator
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. Modulator 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 30-40 MPH and the transmission will shift to first gear.

With the transmission in first speed — L¹ Range, the transmission cannot upshift to second gear regardless of vehicle or engine speed. The forward clutch and rear band are applied. The transmission is in first gear — L¹ Range.

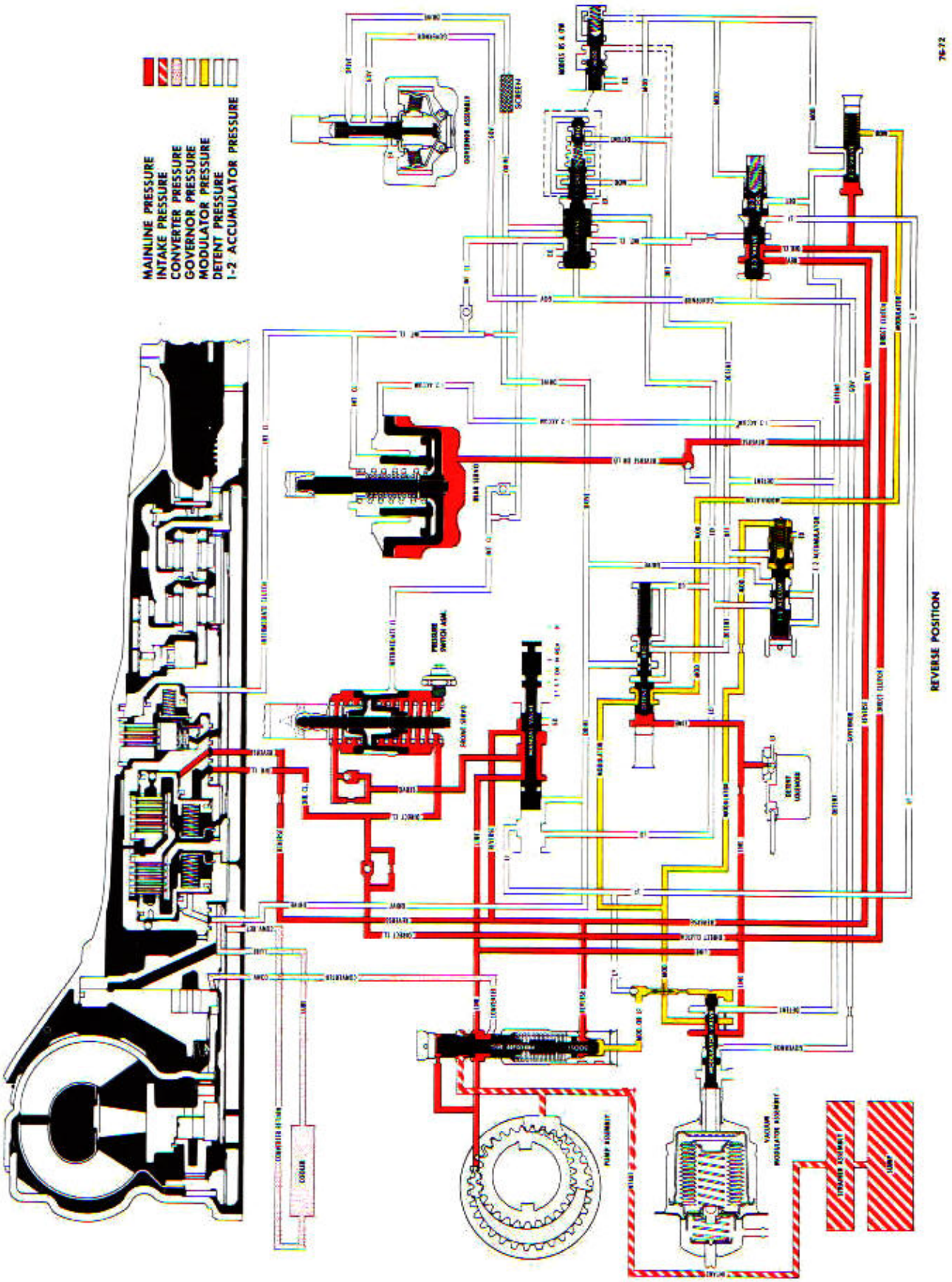


Figure 76-37 - Reverse

h. Operation of Controls
Reverse

Forward Clutch	— Off	Front Band	— Off	Intermediate Sprag	— Ineffective
Direct Clutch	— On	Rear Band	— On	Detent Solenoid	— De-energized
Intermediate Clutch	— Off	Roller Clutch	— Ineffective		

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: (See Figure 76-37).

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 direct clutch.

Reverse oil seats a check ball and 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 rear band are applied. The transmission is in Reverse.

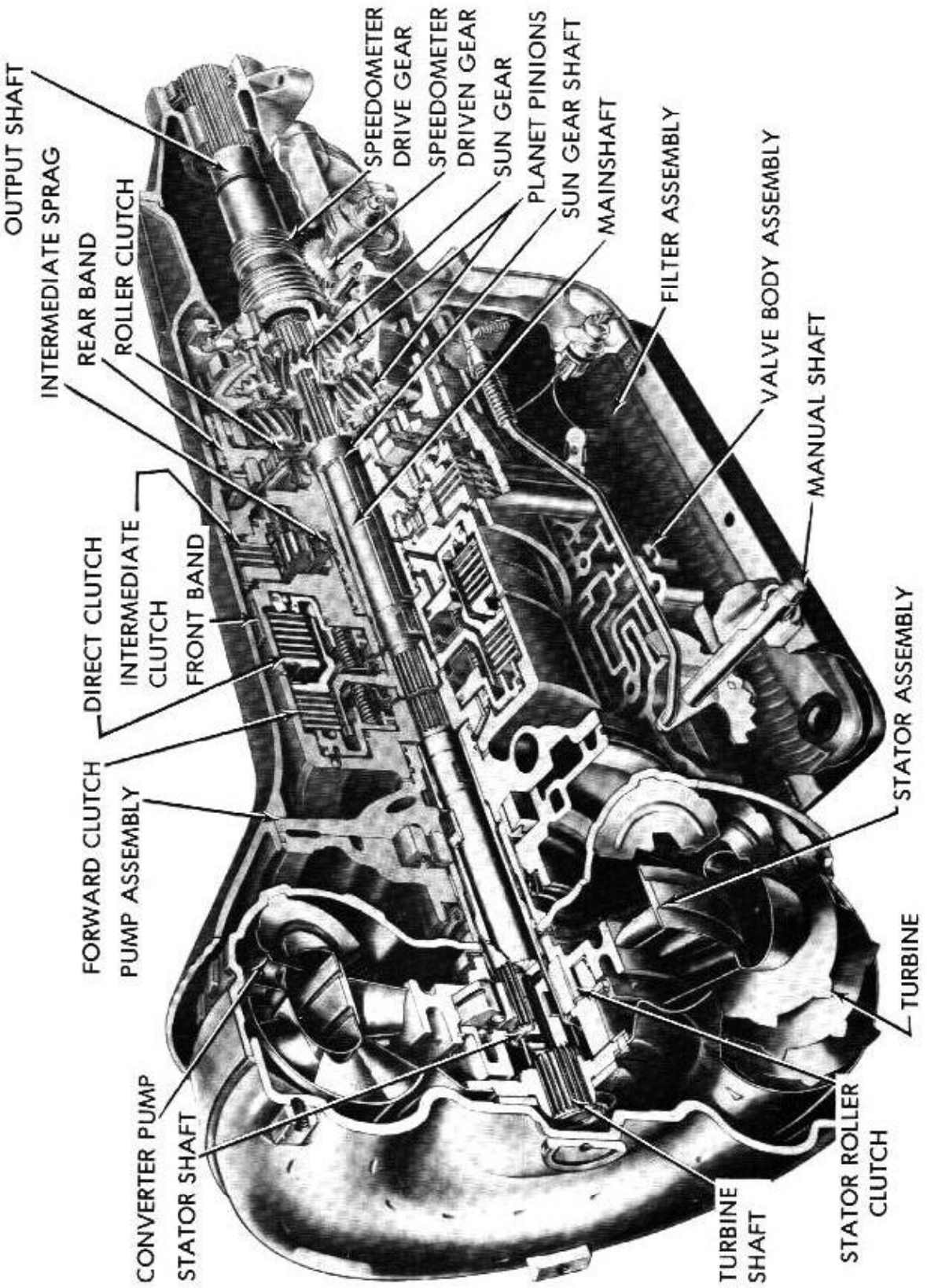


Figure 76-38 - Cross Section of Transmission

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

76-12 DETENT SWITCH ADJUSTMENT

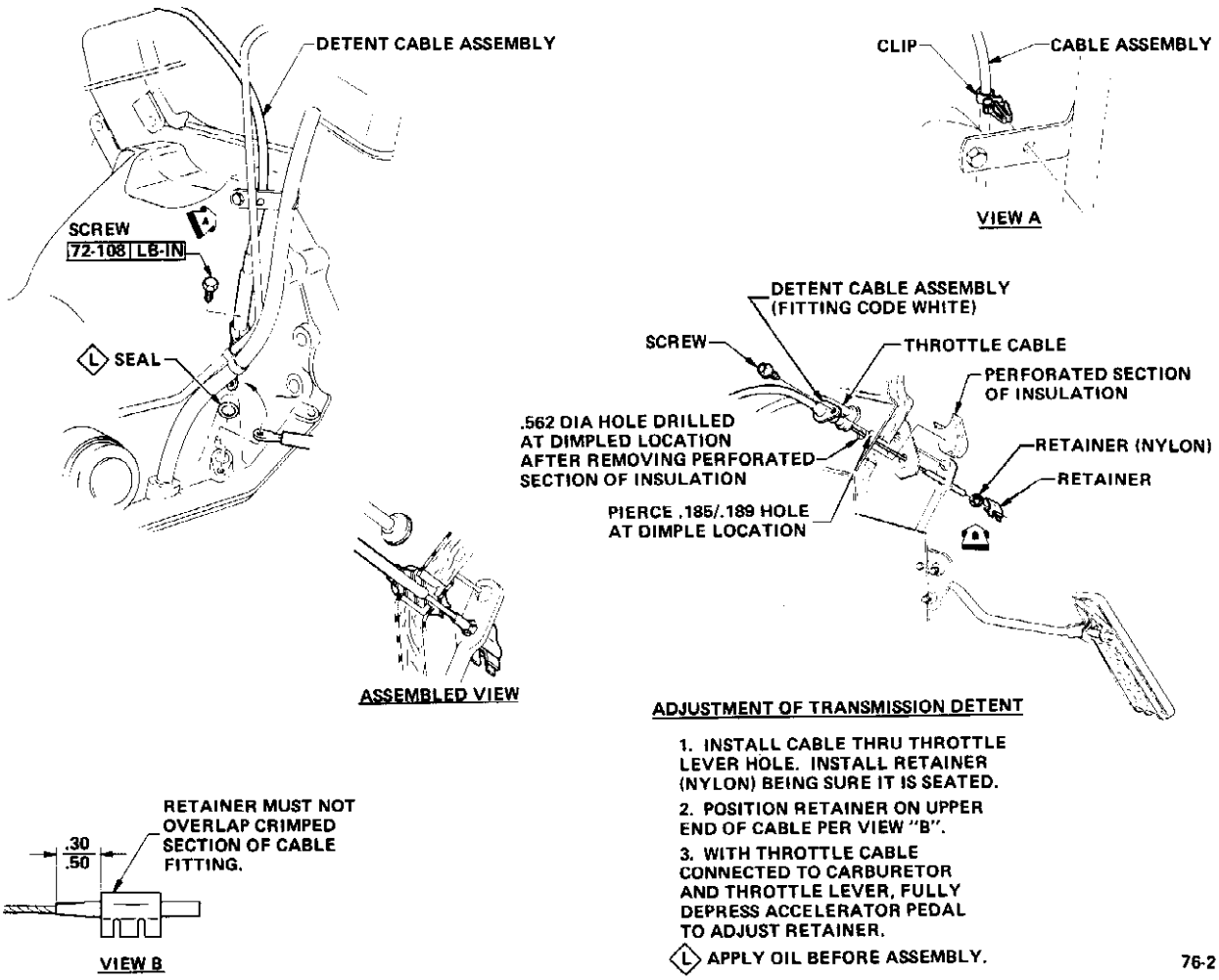


Figure 76-39 - Detent Switch Adjustment

76-13 REMOVAL OF CONVERTER AND VACUUM MODULATOR

1. With transmission in portable jack, remove J-21366. Remove converter assembly, by pulling straight out.

NOTE: *The converter contains a large amount of oil.*

2. Install Holding Fixture J-8763-01 on the transmission so that the modulator assembly will be located on the side of the holding fixture that is nearest the bench.

3. Install fixture and transmission into Holding Tool Base, J-3289-20, with bottom pan facing up. See Figure 76-40.

4. Remove modulator assembly attaching bolt and retainer. See Figure 76-41.

5. Remove modulator assembly and "O" ring seal from case. See Figure 76-42.

6. Remove modulator valve from transmission case.

76-14 REMOVAL OF GOVERNOR, SPEEDOMETER DRIVEN GEAR, OIL PAN, AND FILTER

NOTE: *The following operations can be performed with transmission in vehicle.*

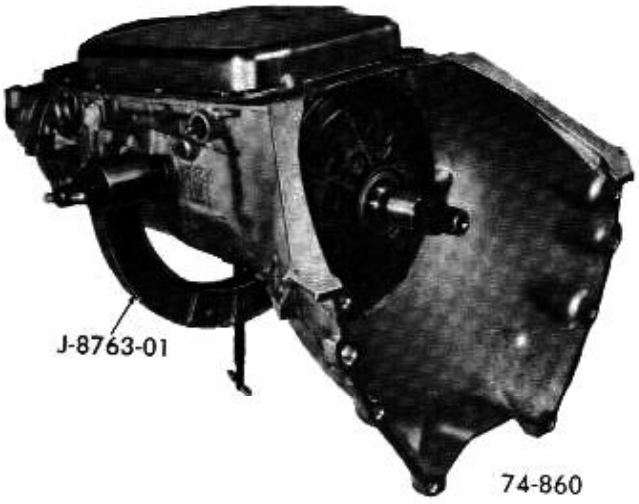


Figure 76-40

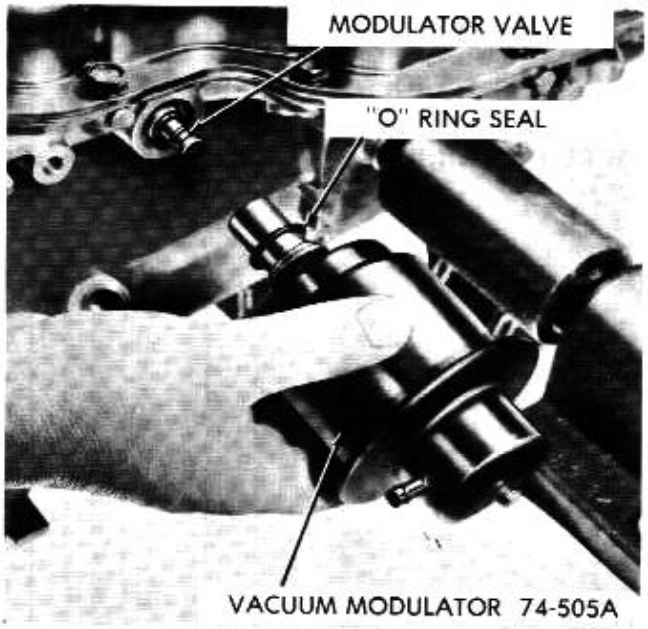


Figure 76-42

Figure 76-41

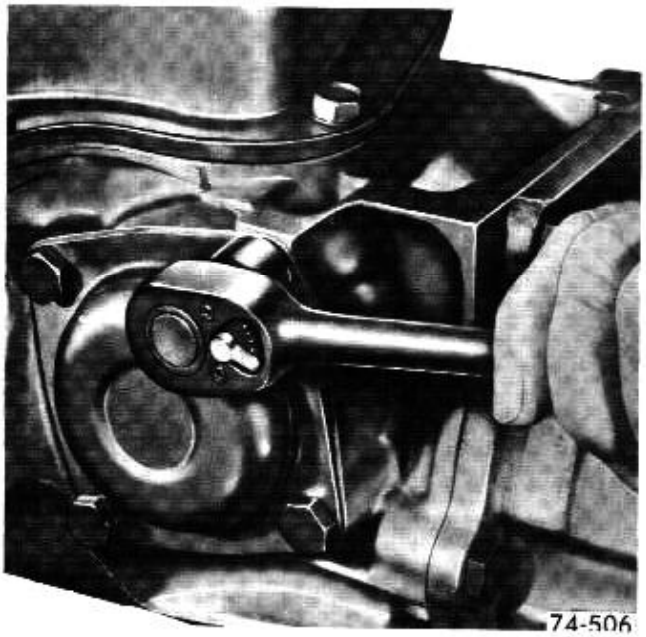


Figure 76-43

1. Remove attaching bolts, governor cover and gasket. See Figure 76-43.

2. Withdraw governor assembly from case. See Figure 76-44.

3. Remove speedometer driven gear attaching bolt and retainer. See Figure 76-45.

4. Withdraw speedometer driven gear assembly from case. See Figure 76-46.

5. Remove oil pan attaching bolts.

6. Remove oil pan and gasket. Discard gasket.

7. Remove the filter assembly retainer bolt. See Figure 76-47.

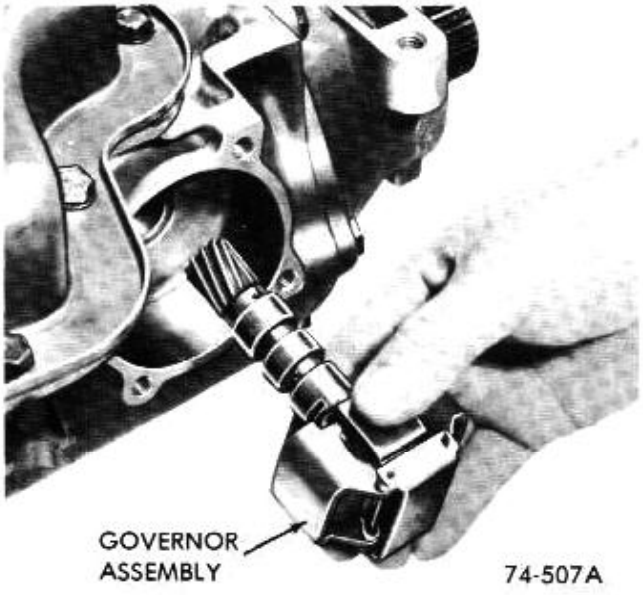


Figure 76-44

Figure 76-46

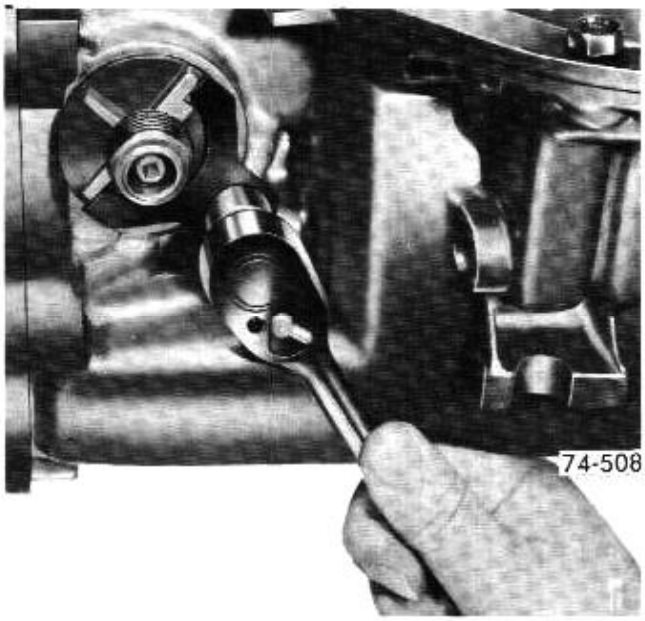


Figure 76-45

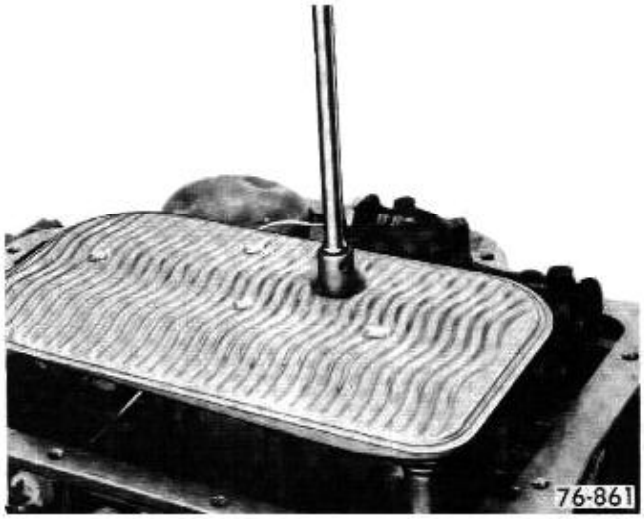


Figure 76-47

8. Remove filter and intake pipe assembly. Discard filter. See Figure 76-48.

9. Remove intake pipe to case "O" ring seal and discard. See Figure 76-48.

76-15 INSTALLATION OF OIL FILTER

1. Install new case to intake pipe "O" ring on intake pipe and new filter assembly. See Figure 76- 48.

2. Install filter and intake pipe assembly attaching filter to valve body assembly with retainer bolt. Torque to 10 lb. ft. See Figure 76-47.

3. Install a new pan gasket on oil pan. Install attaching bolts and torque 10-13 lb. ft.

76-16 INSTALLATION OF MODULATOR VALVE AND VACUUM MODULATOR

1. Install modulator valve into the case, stem end out. See Figure 76-42.

2. Install the "O" ring seal on the vacuum modulator.

3. Install the vacuum modulator into the case.

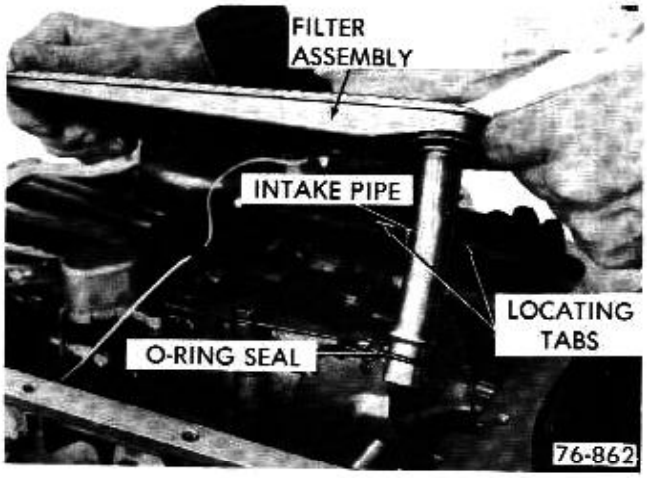


Figure 76-48

4. Install the modulator retainer and attaching bolt. Torque bolt to 15-20 lb.ft. See Figure 76-41.

76-17 INSTALLATION OF GOVERNOR ASSEMBLY

1. Install governor assembly into case. See Figure 76-44.

2. Attach the governor cover and new gasket with four (4) attaching bolts. Torque bolts to 15-20 lb.ft. See Figure 76-54.

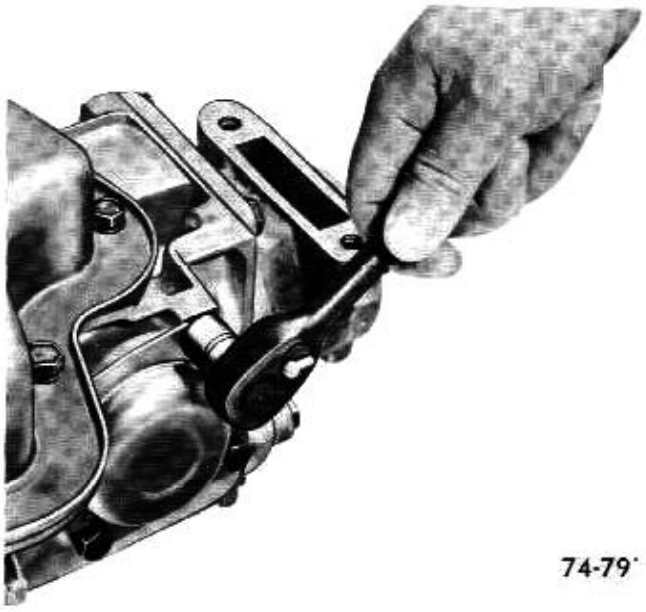


Figure 76-54

DIVISION IV

REMOVAL AND INSTALLATION

76-18 TRANSMISSION ASSEMBLY - REMOVAL AND INSTALLATION

A. Removal

1. Raise vehicle and provide support for front and rear of car.

2. Disconnect front exhaust crossover pipe if necessary.

3. Disconnect propeller shaft.

4. Place suitable jack under transmission and fasten transmission securely to jack.

5. Remove vacuum line from vacuum modulator. See Figure 76-55.

6. Loosen cooler line nuts and separate cooler lines from transmission. See Figure 76-56.

7. Remove transmission mounting pad to cross member bolts.

8. Remove transmission cross member support to frame rail bolts. Remove cross member.

9. Disconnect electrical wire harness from transmission electrical connector.

10. Disconnect speedometer cable.

11. Disconnect shift linkage from transmission.

12. Disconnect transmission filler pipe at engine. Remove filler pipe from transmission.

13. Support engine at oil pan.

14. Remove transmission flywheel cover pan to case tapping screws. REMOVE FLYWHEEL COVER PAN.

15. Mark flywheel and converter pump for reassembly in same position, and remove three converter pump to flywheel bolts.

16. Remove transmission case to engine block bolts.

17. Move transmission rearward to provide clearance between converter pump and crankshaft. Install Converter Holding Tool J-21366 to retain converter. Lower transmission and move to bench.

B. Installation

1. Assemble transmission to suitable transmission jack

and raise transmission into position. Rotate converter to permit coupling of flywheel and converter with original relationship. Remove J-21366.

2. Install transmission case to engine block bolts. Torque to 30-40 lb. ft. Dot not overtighten.

CAUTION: *Converter assembly must rotate freely by hand after converter pilot has been pushed forward into the engine crankshaft pilot hole.*

3. Install flywheel to converter pump bolts. Torque to 25-35 lb. ft.

4. Install transmission cross member support. Install mounting pad to cross member.

5. Remove transmission jack and engine support.

6. Install transmission flywheel cover pan with tapping screws.

7. Install transmission oil filler pipe using a new "O" ring.

8. Reconnect speedometer cable.

9. Connect electrical wire harness to transmission electrical connector.

10. Install propeller shaft.

11. Reinstall front exhaust crossover pipe, if removed.

12. Install oil cooler lines to transmission. See Figure 76-56.

13. Install vacuum line to vacuum modulator.

14. Fill transmission with fluid as described in Paragraph 76-41, subparagraph C.

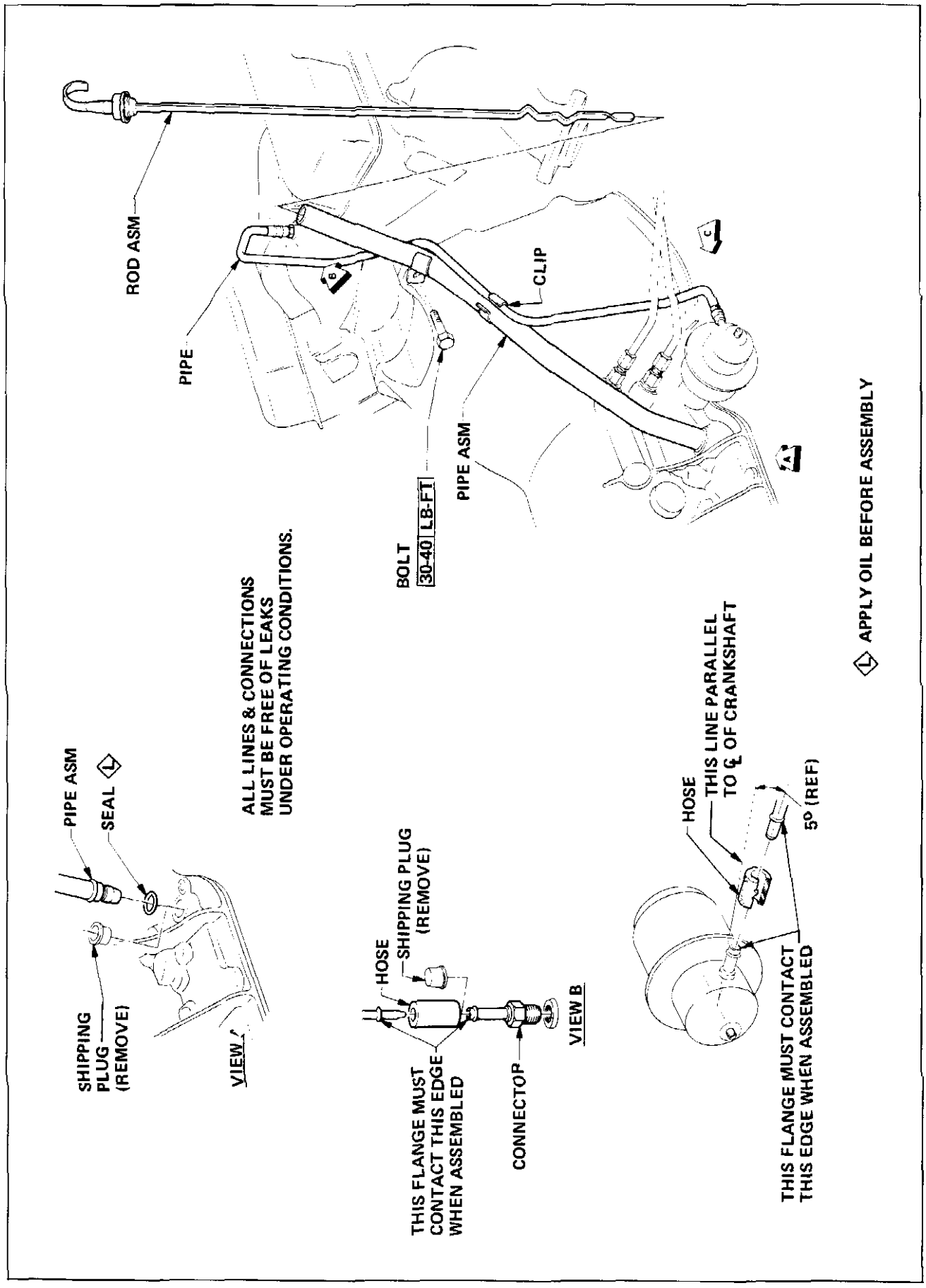


Figure 76-55 - Vacuum Modulator Line and Dipstick

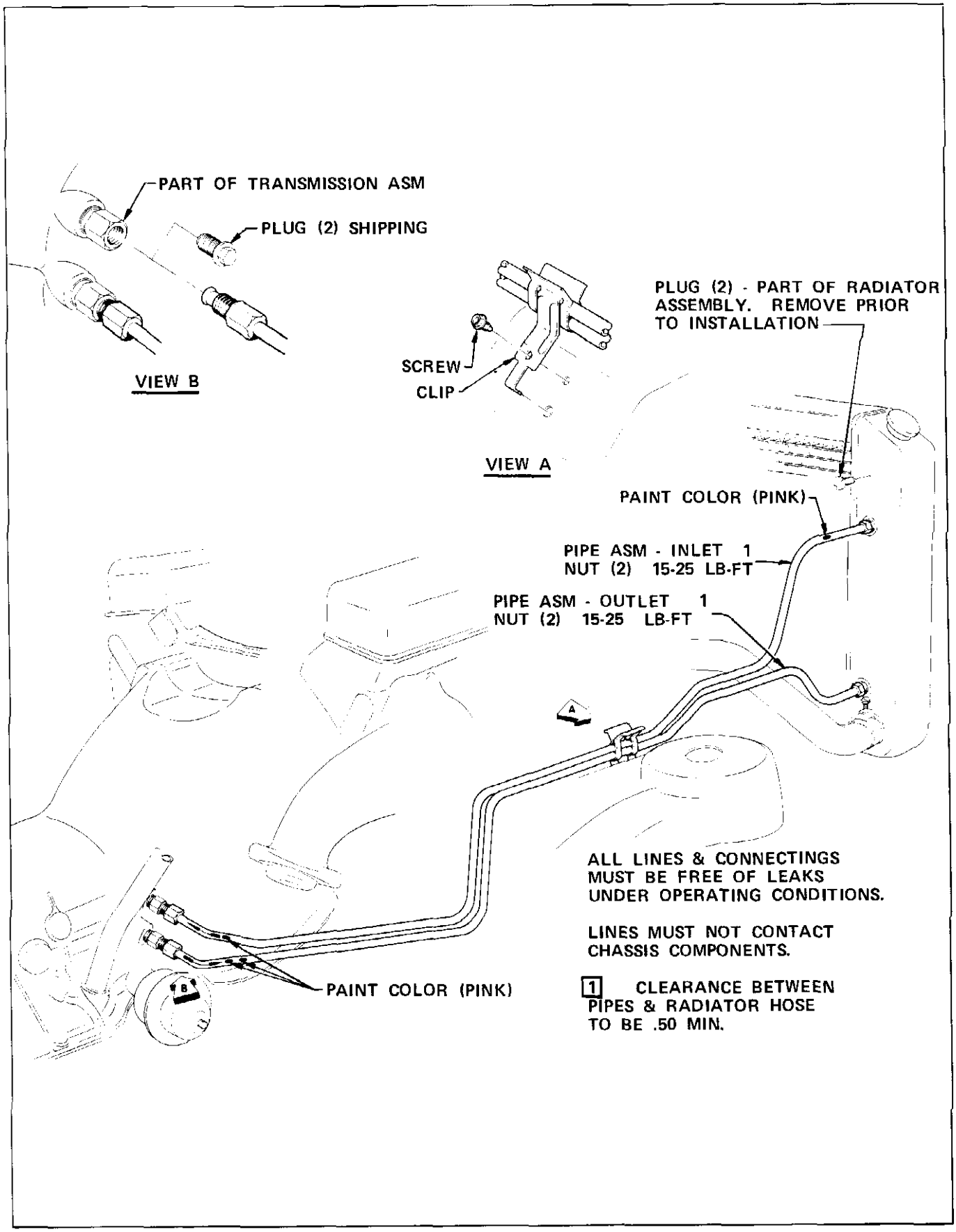


Figure 76-56 - Oil Cooler Lines

DIVISION V

OVERHAUL AND MAJOR SERVICE

76-19 REMOVAL OF PRESSURE SWITCH ASSEMBLY, VALVE BODY ASSEMBLY, GOVERNOR PIPES, AND DETENT SPRING ASSEMBLY

NOTE: *The following operations can be performed with transmission in vehicle.*

1. Disconnect the lead wire assembly from the pressure switch assembly. See Figure 76-57.

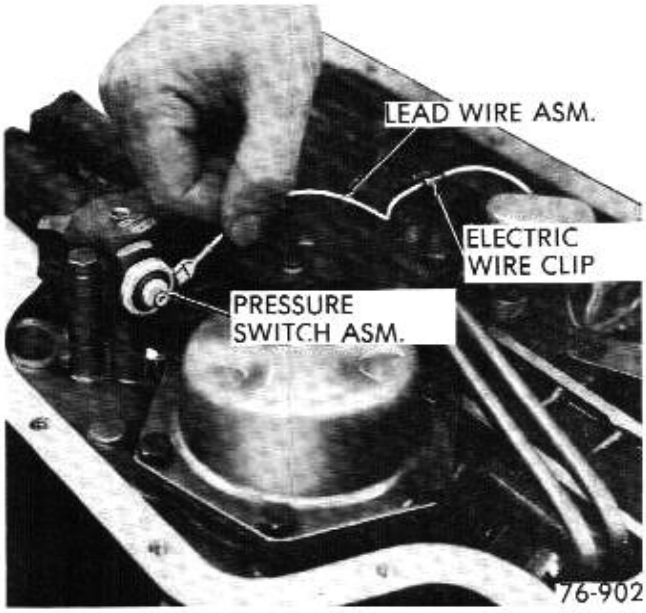


Figure 76-57

2. If necessary, remove the pressure switch assembly. See Figure 76-58.

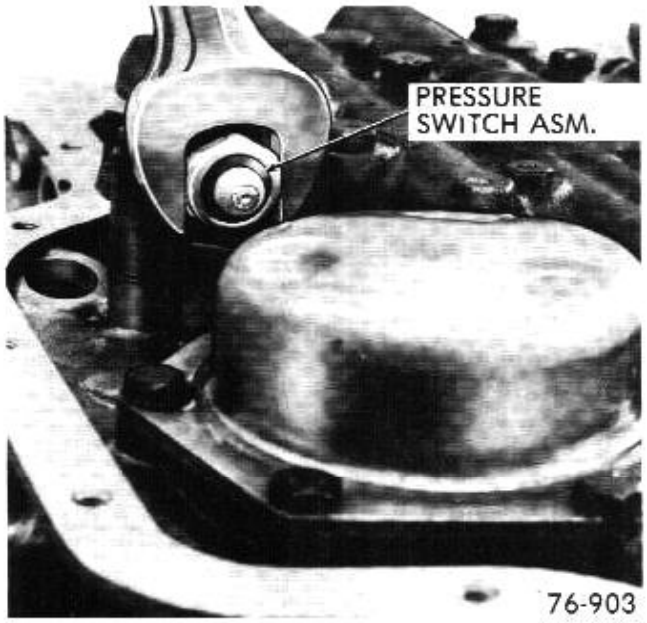


Figure 76-58

3. Remove valve body attaching bolts and detent roller and spring assembly. See Figure 76-59.

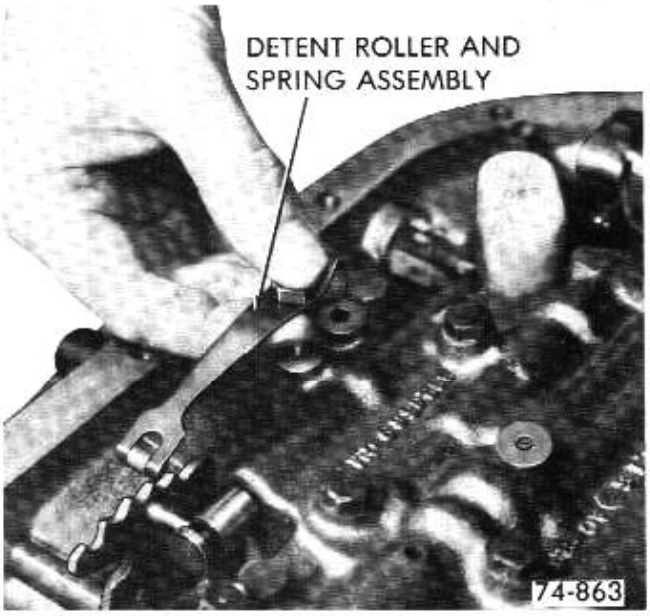


Figure 76-59

NOTE: *Do not remove solenoid attaching bolts.*

NOTE: *If transmission is in vehicle, front servo group may drop out as control valve assembly is removed.*

4. Remove valve body assembly and governor pipes. See Figure 76-60.

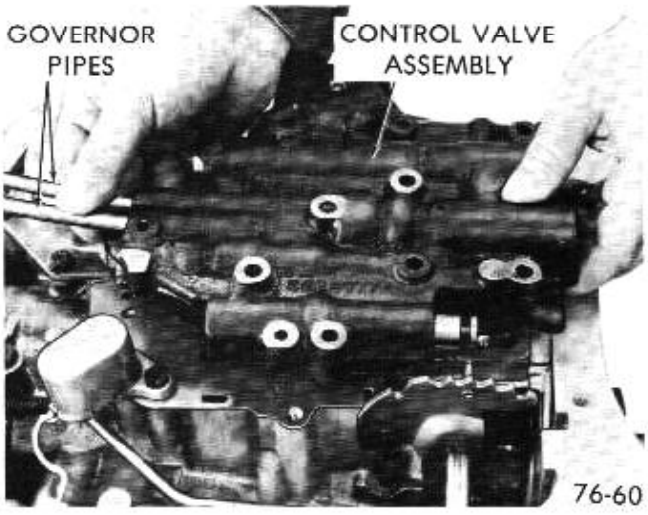


Figure 76-60

NOTE: *Do not allow manual valve to fall out of valve body assembly.*

5. Remove governor screen assembly from governor feed pipe in case or from end of governor feed pipe. See Figure 76-61. Clean screen in clean solvent and air dry.

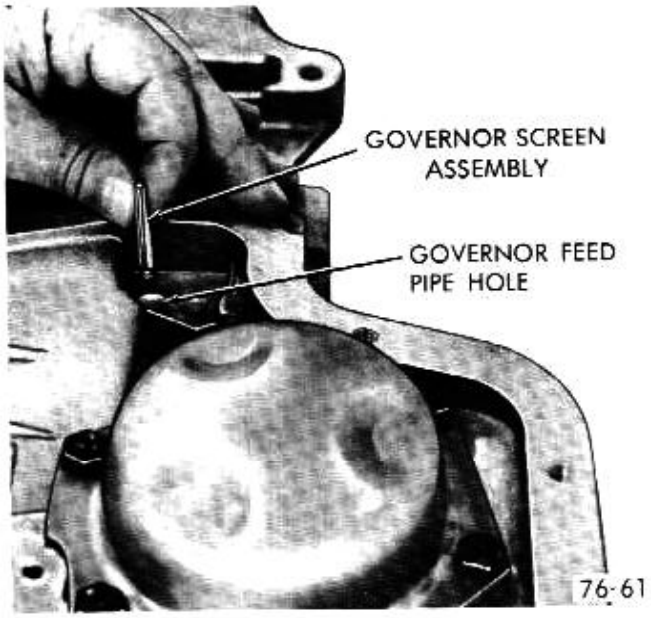


Figure 76-61

6. Remove governor pipes from valve body assembly. See Figure 76-62.

Figure 76-62

7. Disconnect detent solenoid wire from case connector. See Figure 76-63.

76-20 REMOVAL OF SERVO, CASE CONNECTOR, VALVE BODY SPACER, GASKET FRONT SERVO, MANUAL DETENT, AND PARK LINKAGE

NOTE: *The following operations can be performed with the transmission in the vehicle.*

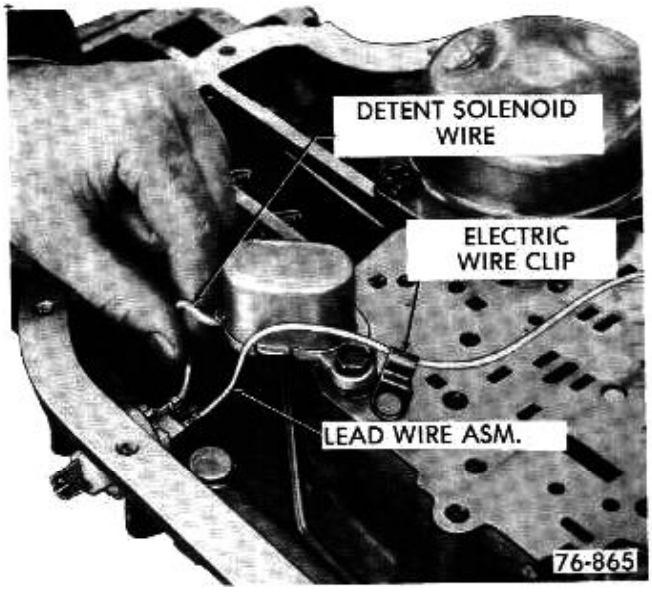


Figure 76-63

1. Remove rear servo cover attaching bolts, servo cover, and gasket. (Discard gasket). See Figure 76- 64.

Figure 76-64

2. Remove rear servo assembly from case. See Figure 76-65.

3. Remove servo accumulator spring. See Figure 76-66.

4. Check band apply Pin.

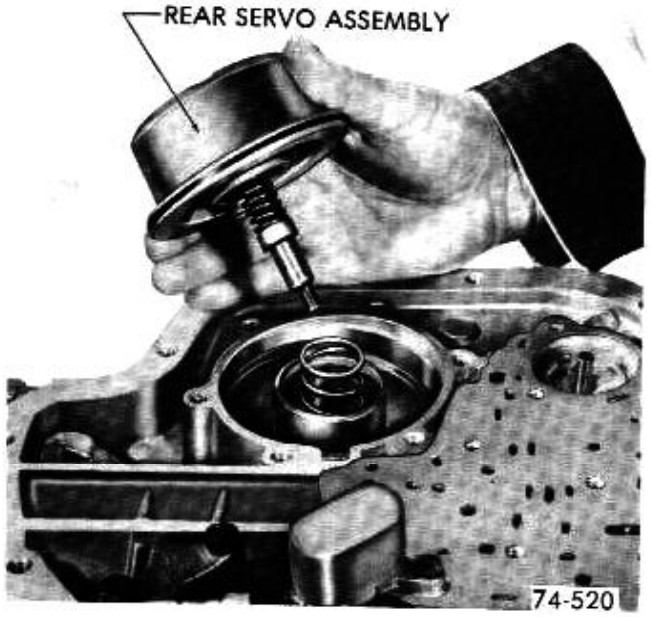


Figure 76-65

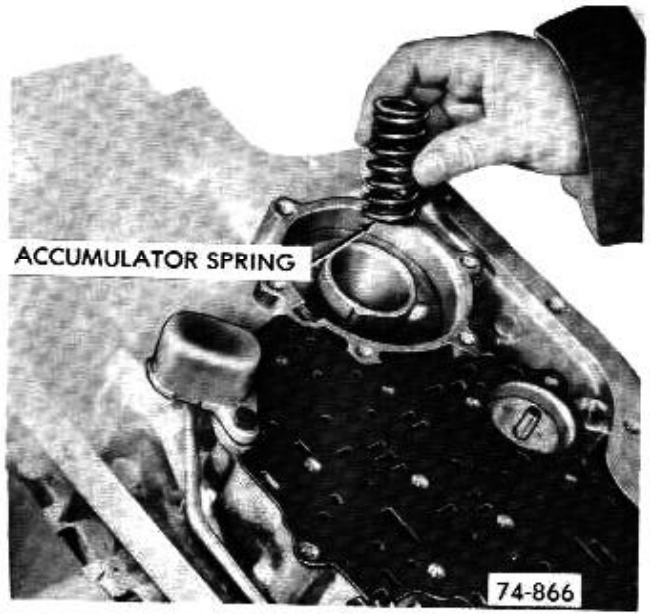


Figure 76-66

a. Attach band apply pin Selection Gage J-21370-6 with J-21370-5, to transmission case with attaching bolts. Torque 6-10 lb.ft.

b. Apply 25 lb.ft. torque and *select proper pin to be used during assembly of transmission.* See Figure 76-67.

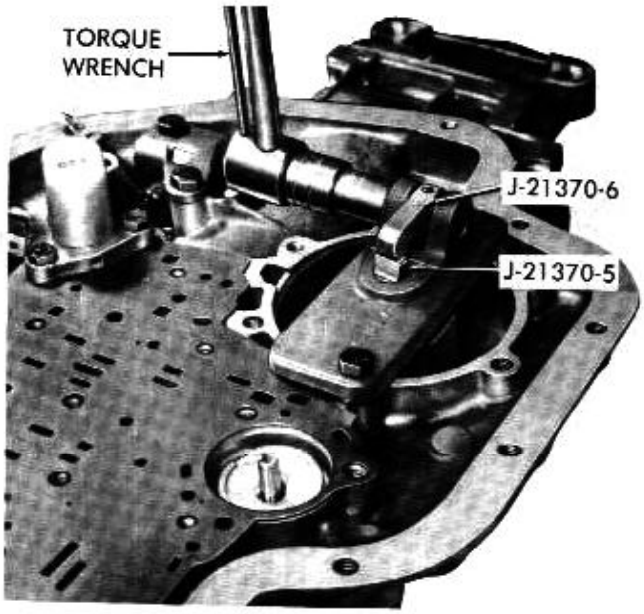


Figure 76-67

There are three selective pins identified as follows:

Pin Identification	Pin Size
3 Rings	Long
2 Rings	Medium
1 Ring	Short

76-47

If both steps of J-21370-5 are below the gage surface, the long pin should be used. If the gage surface is between the steps, the medium length pin should be used. The short pin should be used if both steps of the gage pin are above the gage surface.

The identification ring is located on the band lug end of the pin. Selecting the proper pin is the equivalent of adjusting the band.

NOTE: *If a new pin is required, make note of pin size required, and remove gage from transmission case.*

5. Compress fingers on electrical connector sleeve and withdraw. See Figure 76-68.

CAUTION: *If the transmission is in the vehicle, be careful when the detent solenoid is removed, as it prevents the spacer plate and gasket and check balls from dropping down.*

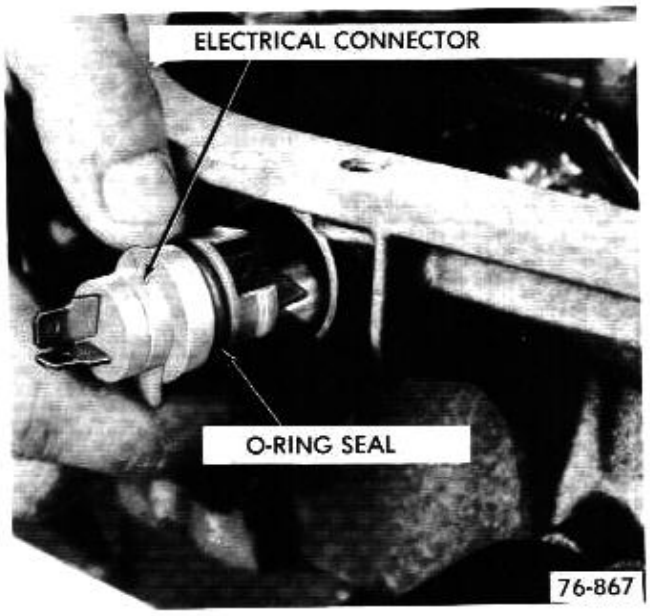


Figure 76-68

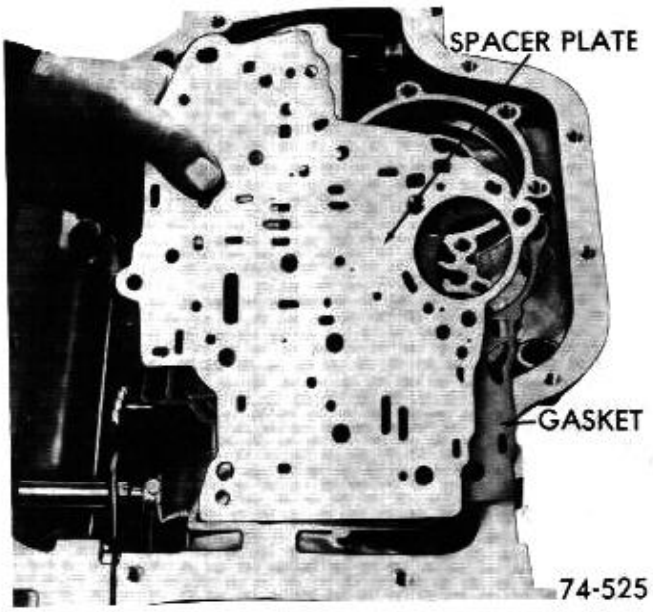


Figure 76-70

8. Remove six (6) check balls from cored passages in transmission case. See Figure 76-71.

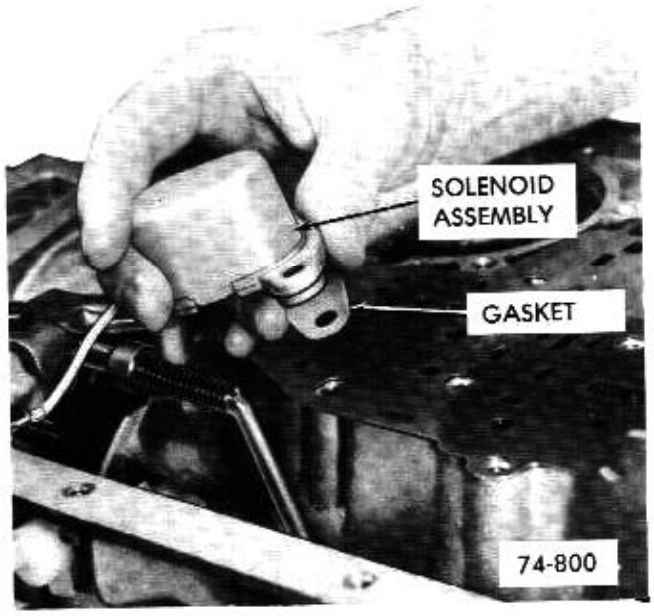


Figure 76-69

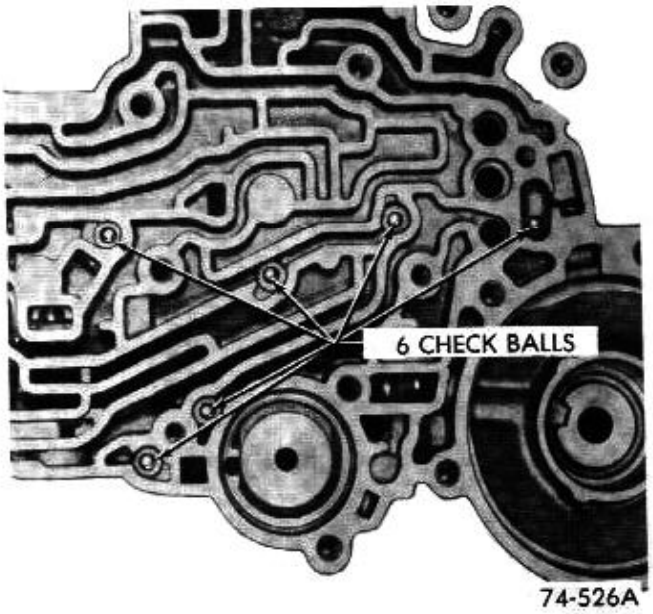


Figure 76-71

6. Remove detent solenoid attaching bolts, solenoid assembly, and gasket. See Figure 76-69.

7. Remove valve body assembly spacer plate and gasket. See Figure 76-70.

9. Remove front servo piston, retainer ring, servo pin, spring retainer, and spring from transmission. See Figure 76-72.

10. If it becomes necessary to remove the internal manual linkage proceed as follows:

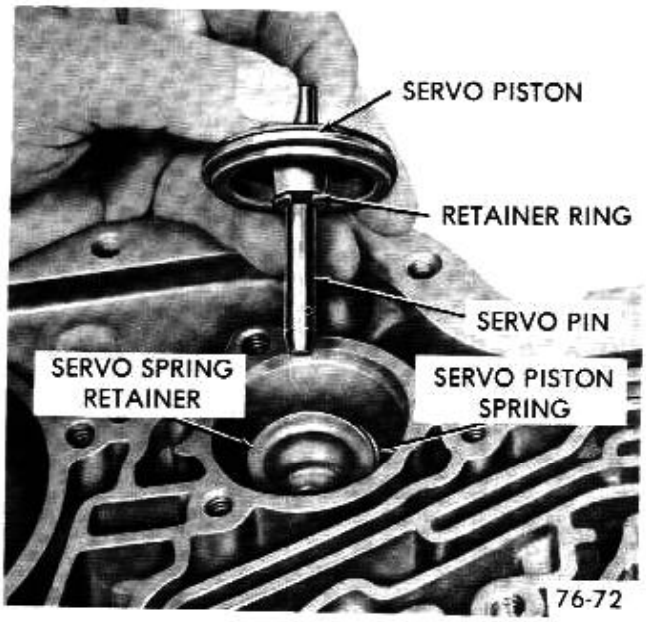


Figure 76-72

a. Unthread jam nut holding detent lever to manual shaft. See Figure 76-73.

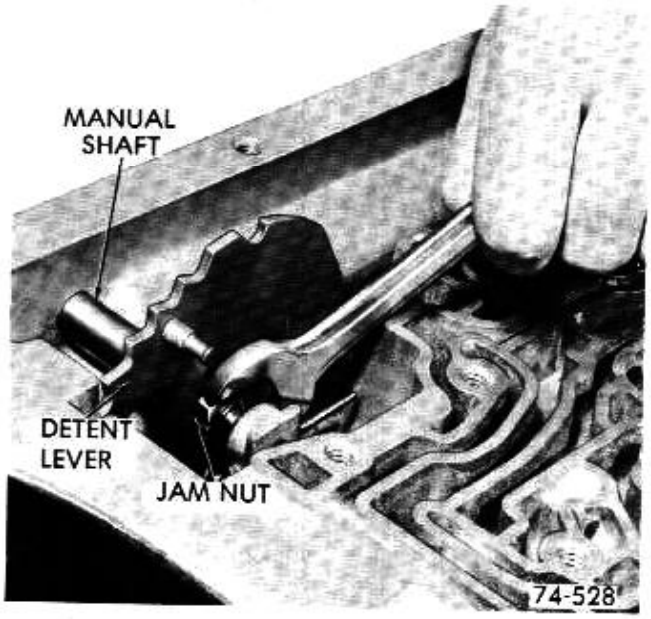


Figure 76-73

CAUTION: *Do not lose jam nut as it becomes free from shaft.*

b. Remove manual shaft retaining pin from case. See Figure 76-74.

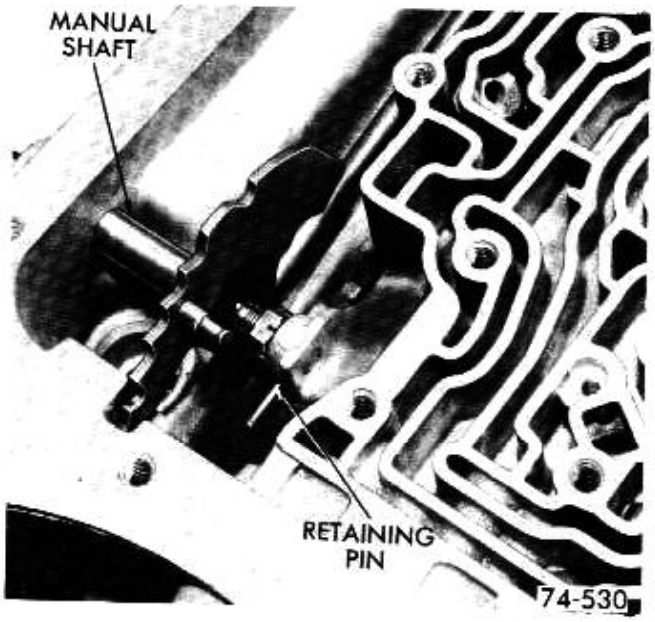


Figure 76-74

NOTE: *It may be necessary to bend pin to remove.*

c. Remove detent lever from the manual shaft.

d. Remove manual shaft and jam nut from case. See Figure 76-75.

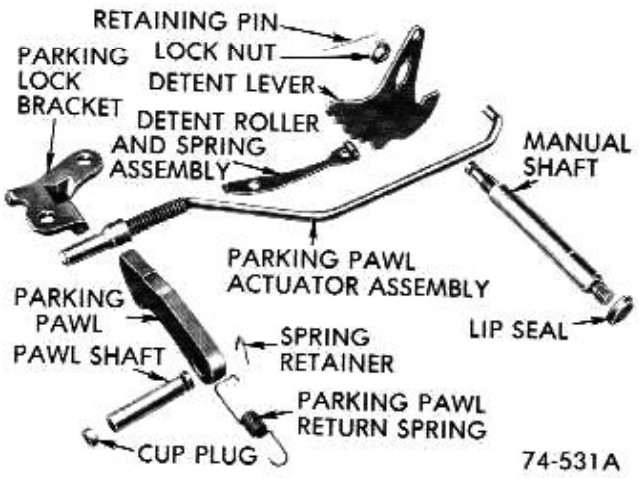


Figure 76-75

NOTE: *If necessary remove manual shaft to case lip seal.*

e. Remove parking pawl actuator rod and detent lever assembly.

f. Remove attaching bolts and parking lock bracket. See Figure 76-76.

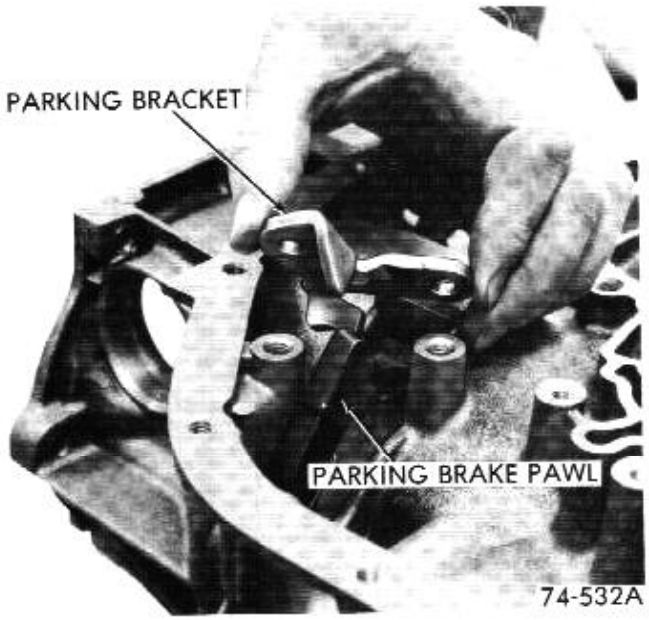


Figure 76-76

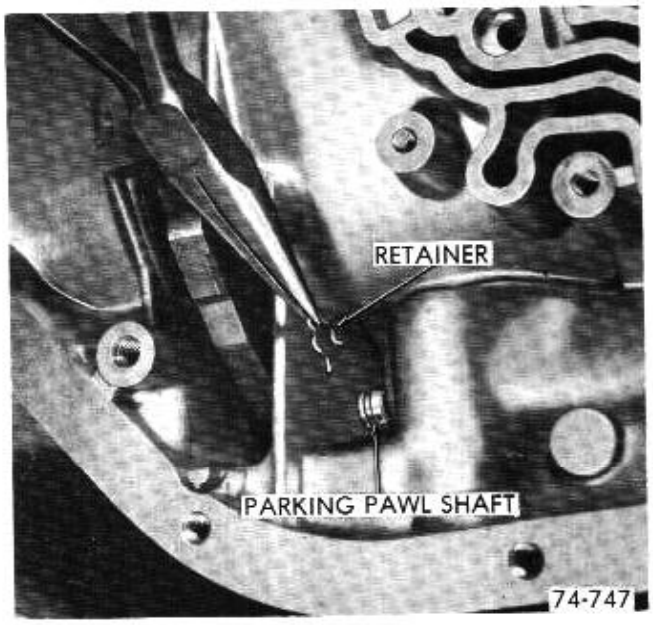


Figure 76-78

g. Remove parking pawl return spring. See Figure 76-77.

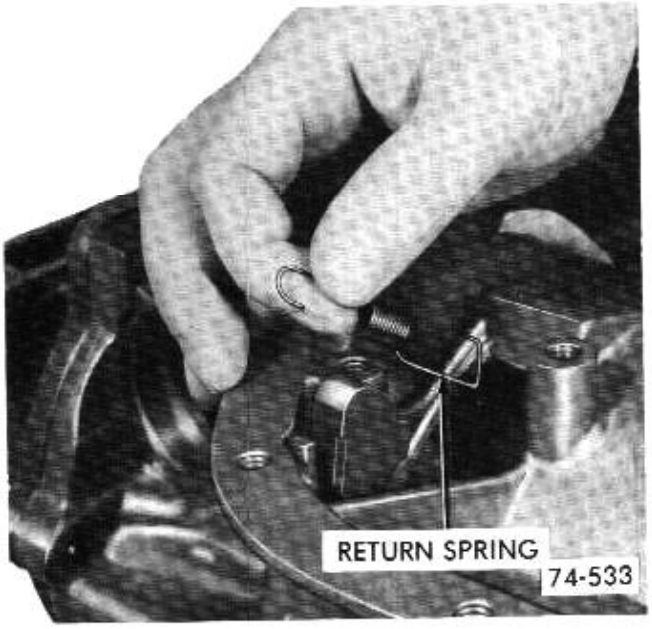


Figure 76-77

NOTE: *The following steps are to be completed only if one or more of the parts involved require replacement.*

h. Remove parking pawl shaft retainer. See Figure 76-78.

i. Remove parking pawl shaft cup plug by inserting a screwdriver between the parking pawl shaft and the case rib, and prying outward. See Figure 76-79.

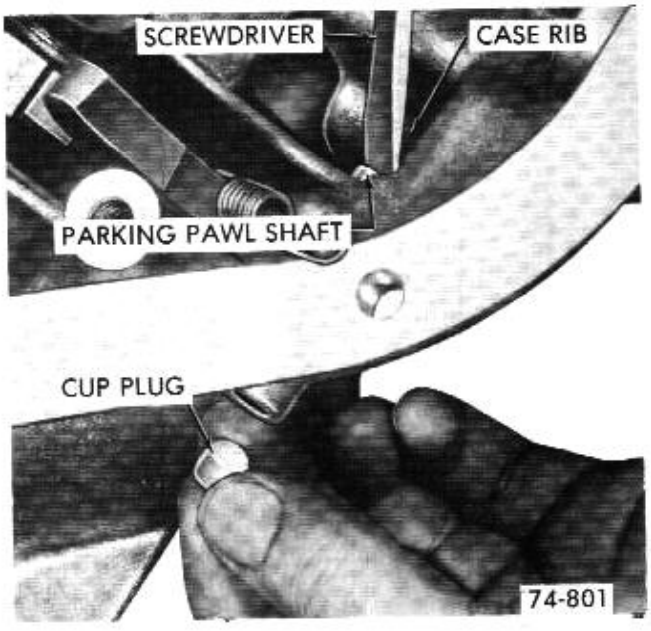


Figure 76-79

j. Remove parking pawl shaft, and parking pawl. See Figure 76-80.

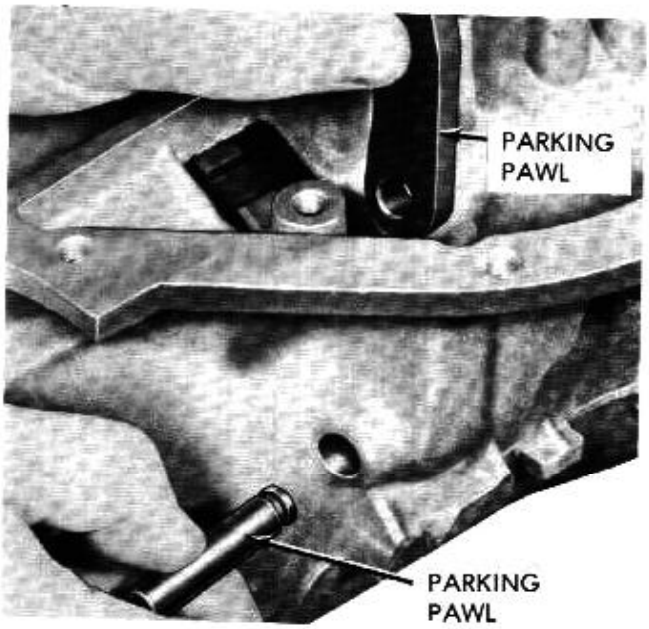


Figure 76-80

76-21 REMOVAL OF REAR OIL SEAL AND EXTENSION HOUSING

NOTE: *The following operation can be performed with the transmission in the vehicle.*

1. If necessary to replace, pry the rear oil seal from the

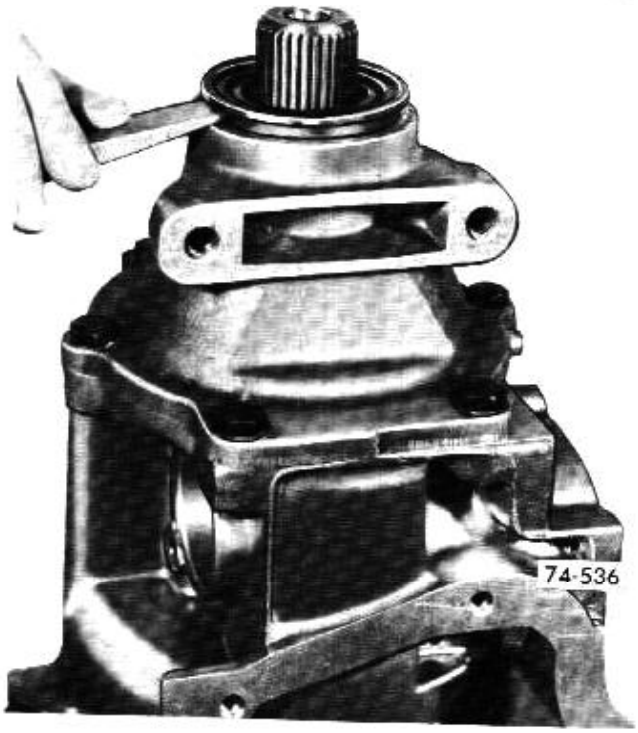


Figure 76-81

2. Remove extension housing to case attaching bolts. See Figure 76-82.

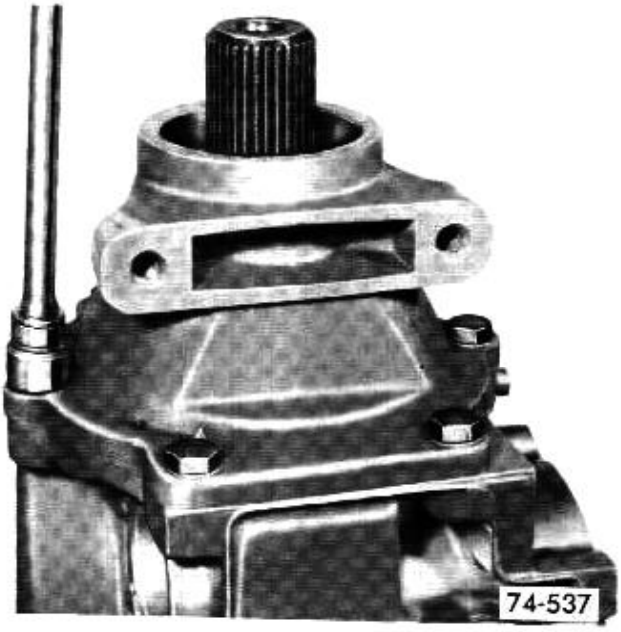


Figure 76-82

3. Remove extension housing and extension housing to case gasket. See Figure 76-83.

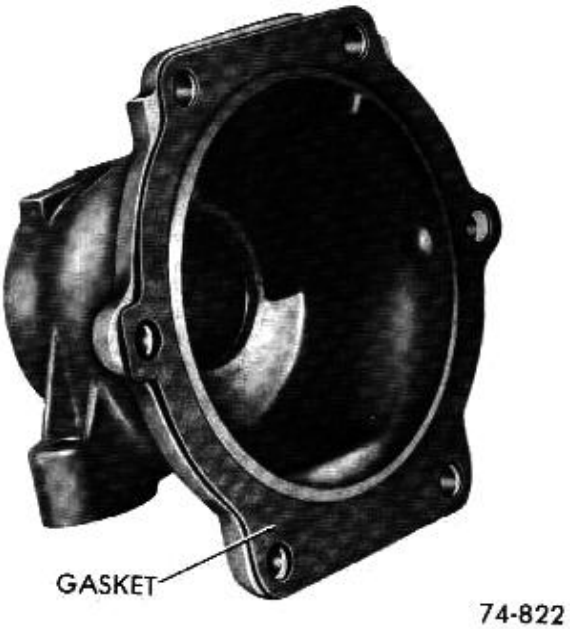


Figure 76-83

76-21A FRONT UNIT END PLAY CHECKING PROCEDURE

1. Check front unit end play as follows:

a. Remove one front pump attaching bolt.

b. Install a 5/16-18 threaded slide hammer bolt or J-7004, into bolt hole in pump. See Figure 76-84.

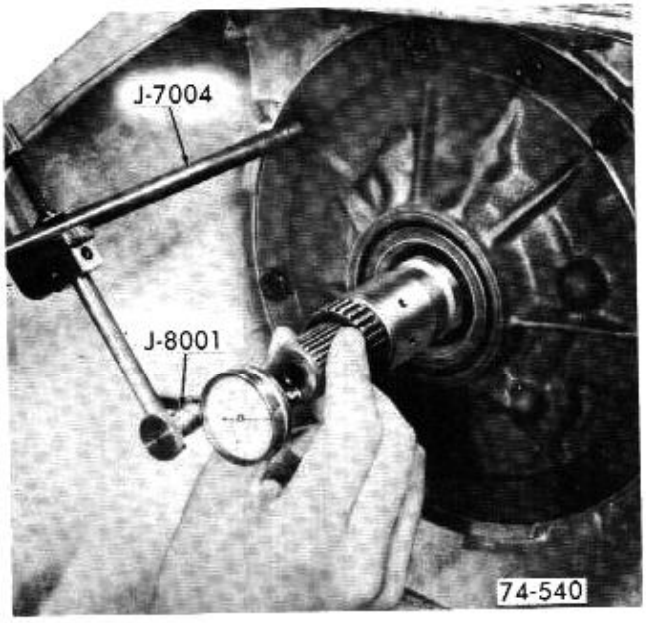


Figure 76-84

c. Mount dial indicator on the rod and index indicator to register with end of turbine shaft. See Figure 76-84.

d. Push turbine shaft rearward.

e. Push output shaft forward.

f. Set dial indicator to Zero.

g. Pull turbine shaft forward.

Read the resulting travel or end play which should be .003" - .024".

The selective washer controlling this end play is the washer located between the pump cover and the forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select the 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 so that it will be necessary to measure the washer for its actual thickness.*

76-22 REMOVAL OF OIL PUMP, FORWARD CLUTCH, INTERMEDIATE CLUTCH AND GEAR UNIT ASSEMBLY

1. If seal replacement is necessary, pry seal from pump. See Figure 76-85.

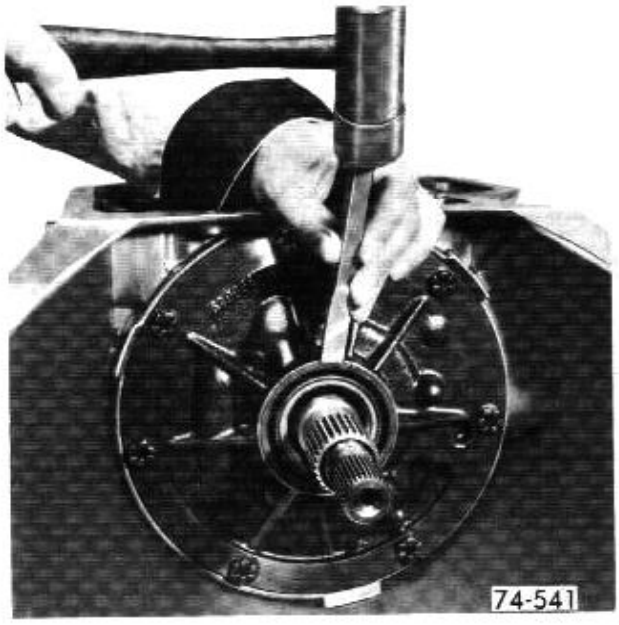


Figure 76-85

2. Remove pump attaching bolts.

3. Install threaded slide Hammers, J-7004, into bolt holes in the pump body, tighten jam nuts and remove pump assembly from case. See Figure 76-86.

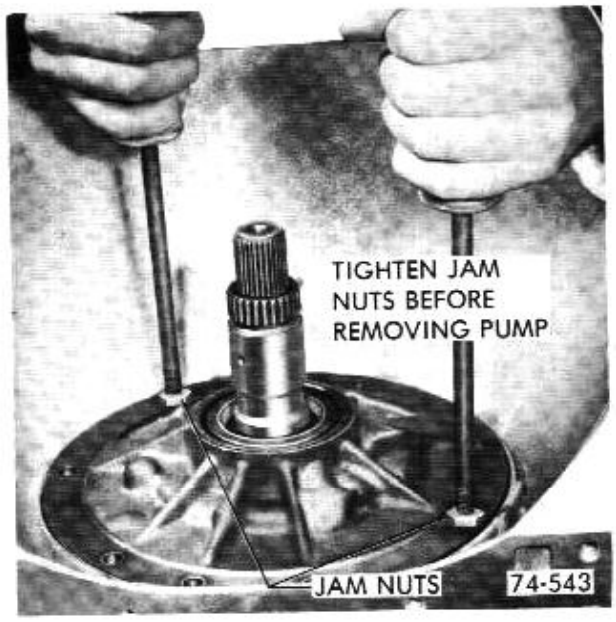


Figure 76-86

4. Remove and discard pump to case oil seal ring and gasket.

5. Remove forward clutch and turbine shaft assembly from transmission. See Figure 76-87.

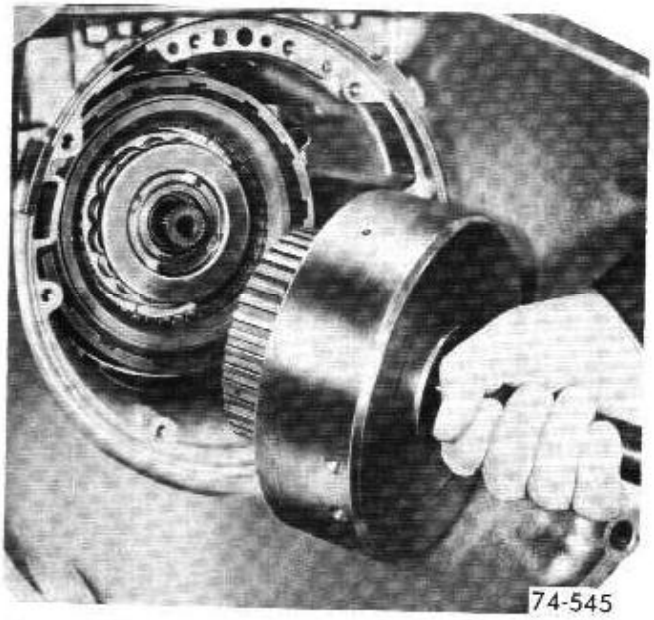


Figure 76-87

6. Remove forward clutch hub to direct clutch housing thrust washer, if it did not come out with forward clutch housing assembly.

7. Remove direct clutch assembly. See Figure 76-88.

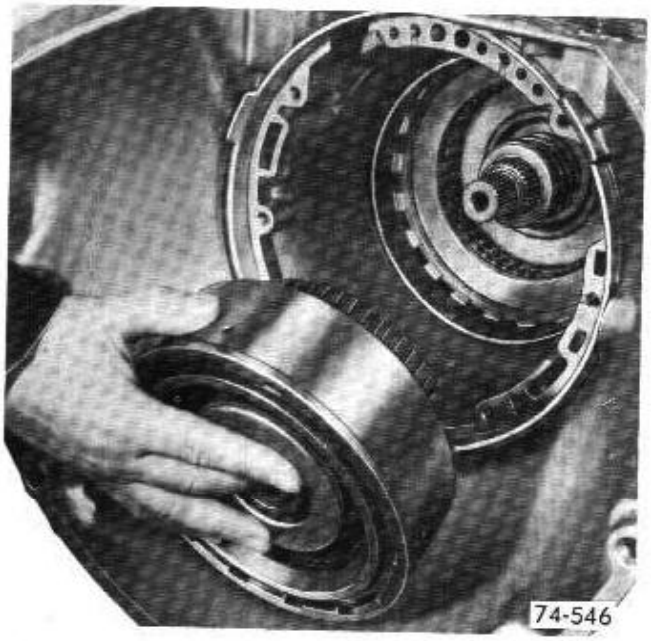


Figure 76-88

8. Remove front band assembly.

9. Remove sun gear shaft. See Figure 76-89.

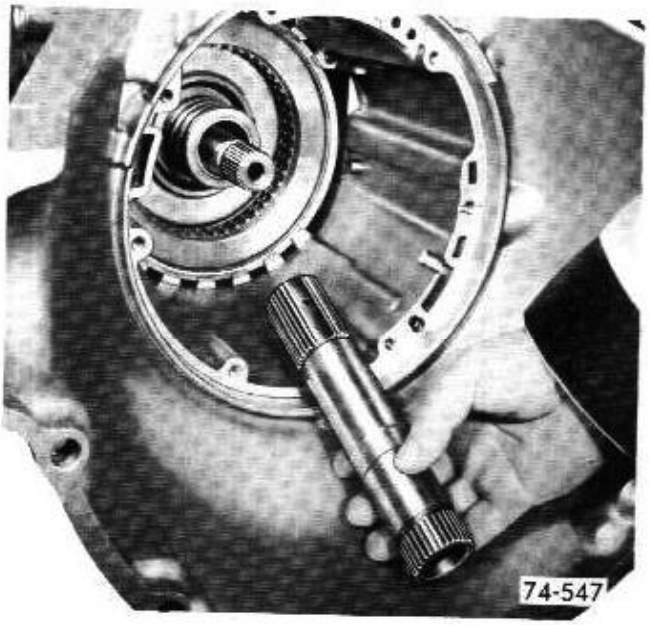


Figure 76-89

10. Check rear end play as follows:

a. Install J-7004 into an extension housing attaching bolt hole.

b. Mount dial indicator, on Slide Hammer Bolt J-7004 and index with end of the output shaft. See Figure 76-90.

Figure 76-90

c. Move output shaft in and out to determine end play. End play should be from .007" - .019". The selective washer controlling this end play is the steel washer having 3 lugs that is located between the thrust washer and the rear face of the transmission case.

If different washer thickness is required to bring the end play within specification, it can be selected from the following chart.

Thickness	Notches and/or Numeral	
.074-.078	None	1
.082-.086	1 Tab Side	2
.090-.094	2 Tabs Side	3
.098-.102	1 Tab O.D.	4
.106-.110	2 Tabs O.D.	5
.114-.118	3 Tabs O.D.	6

76-49

11. Remove center support to case bolt using a 3/8" 12 point thin wall deep socket. See Figure 76-91.

Figure 76-91

12. Remove intermediate clutch backing plate to case snap ring. See Figure 76-92.

13. Remove intermediate clutch backing plate, 3 composition and 3 steel clutch plates. See Figure 76-93.

14. Inspect condition of composition and steel plates. *Do not diagnose a composition drive plate by color.*

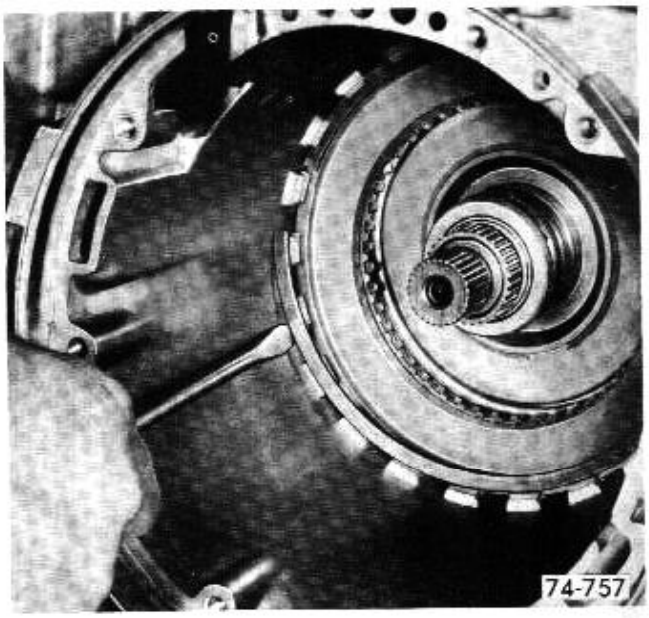


Figure 76-92

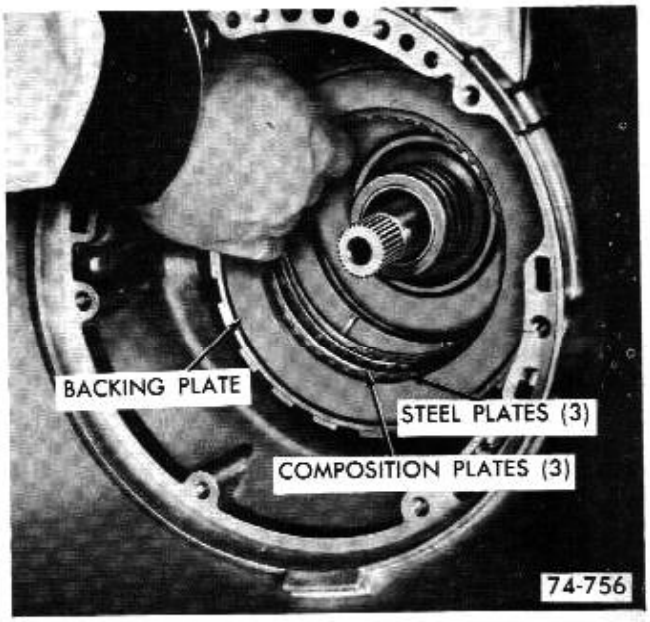


Figure 76-93

A. Dry composition plates with compressed air and inspect the composition surface for:

1. Pitting and flaking

2. Wear

3. Glazing

4. Cracking

5. Charring

6. Chips or metal particles imbedded in lining

If a composition drive plate exhibits any of the above conditions, replacement is required.

B. Wipe steel plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plates must be replaced.

15. Remove center support to case retaining snap ring. See Figure 76-94.

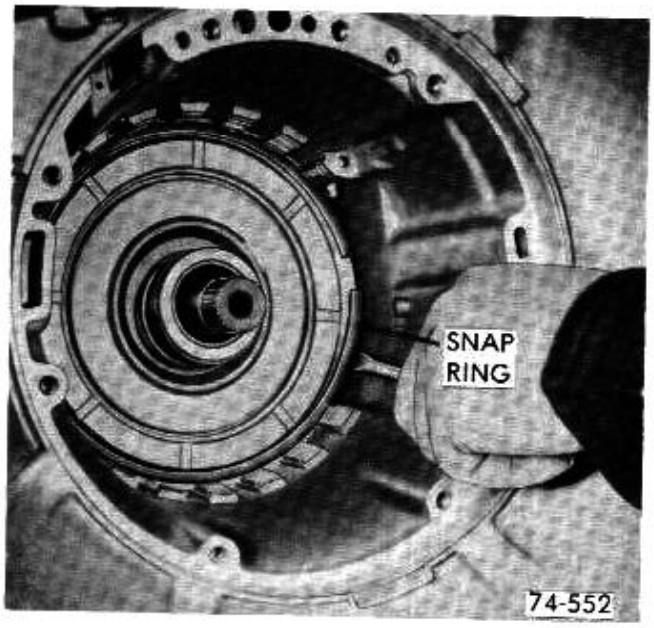


Figure 76-94

16. Remove entire gear unit assembly by lifting with J-21795 and J-7004 Slide Hammer. See Figure 76- 95.

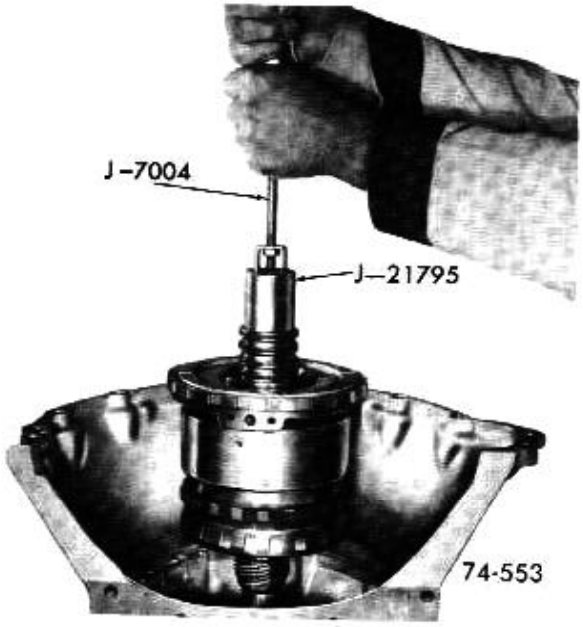


Figure 76-95

17. Remove output shaft to case thrust washer from rear of the output shaft or inside case. See Figure 76-96.

Figure 76-96

18. Remove output shaft to yoke "O" ring if required.

19. Place gear unit assembly with output shaft facing down in hole in work bench. See Figure 76-97.

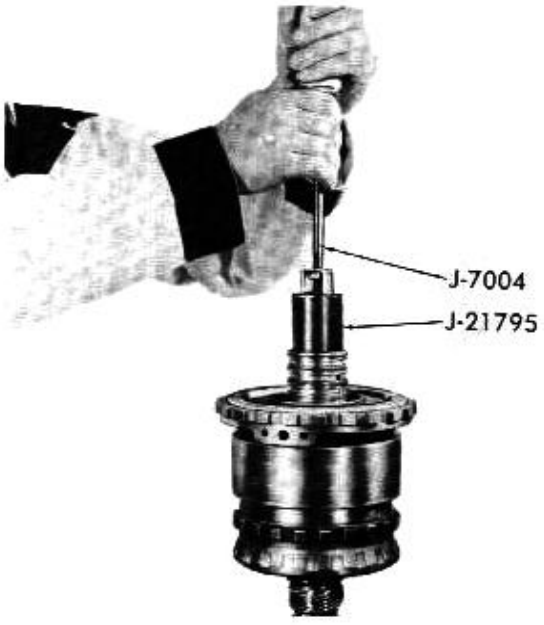


Figure 76-97

20. Remove rear unit selective washer from the transmission case. See Figure 76-98.

Figure 76-98

21. Remove support to case spacer. See Figure 76-99.

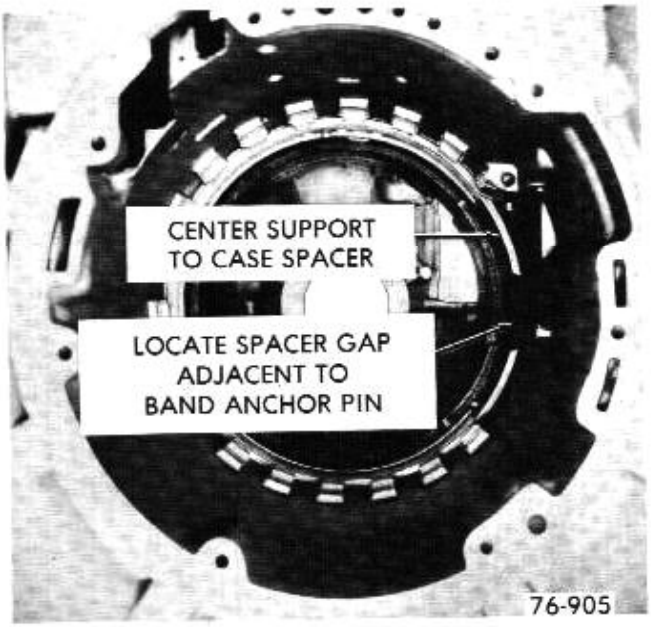


Figure 76-99

22. Remove rear band assembly. See Figure 76- 100.

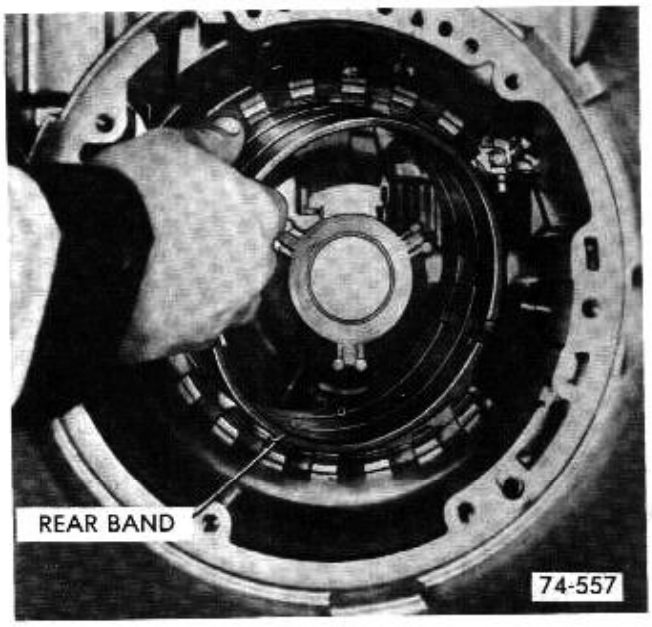


Figure 76-100

76-23 GEAR UNIT ASSEMBLY (See Figure 76-288)

A. Disassembly

1. Remove center support assembly. See Figure 76-101.

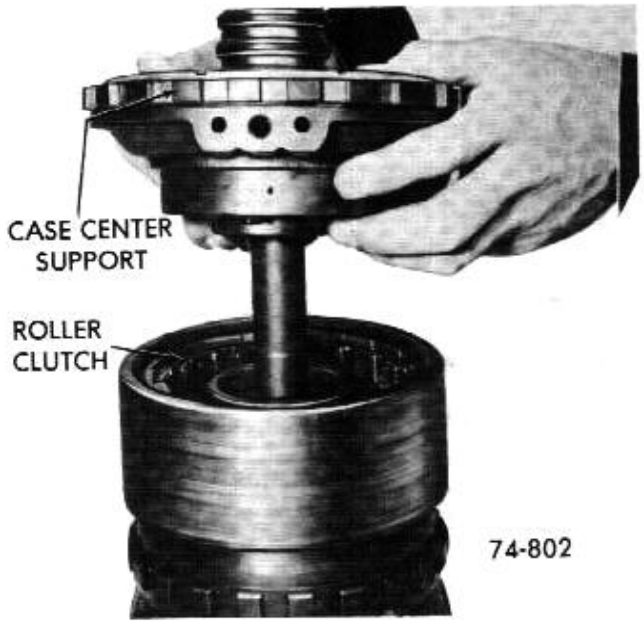


Figure 76-101

2. Remove center support to reaction carrier thrust washer. See Figure 76-102.

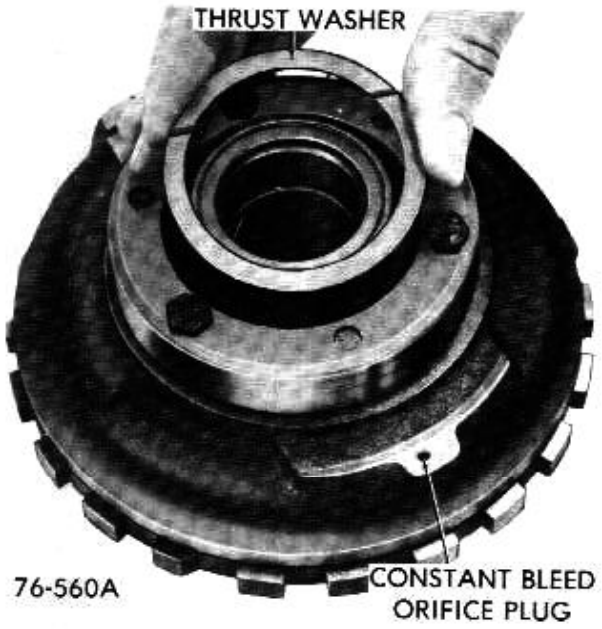


Figure 76-102

3. Remove center support to sun gear races and thrust bearing. See Figure 76-103.

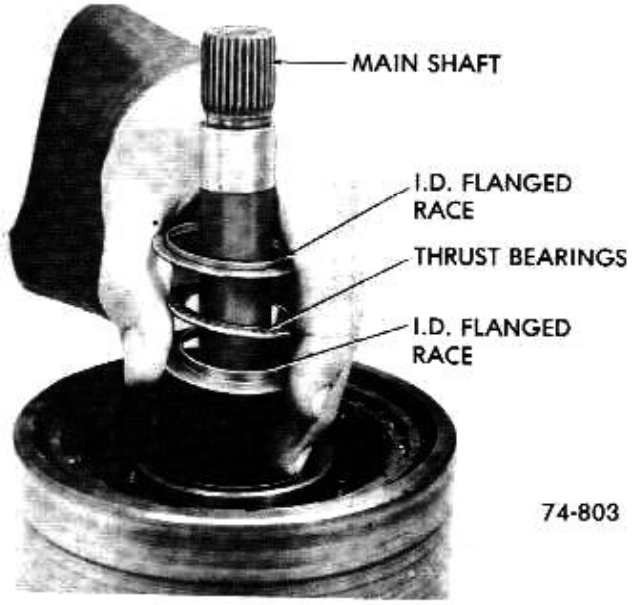


Figure 76-103

NOTE: *One of races may have been removed with the center support.*

4. Remove reaction carrier and roller clutch assembly. See Figure 76-104.

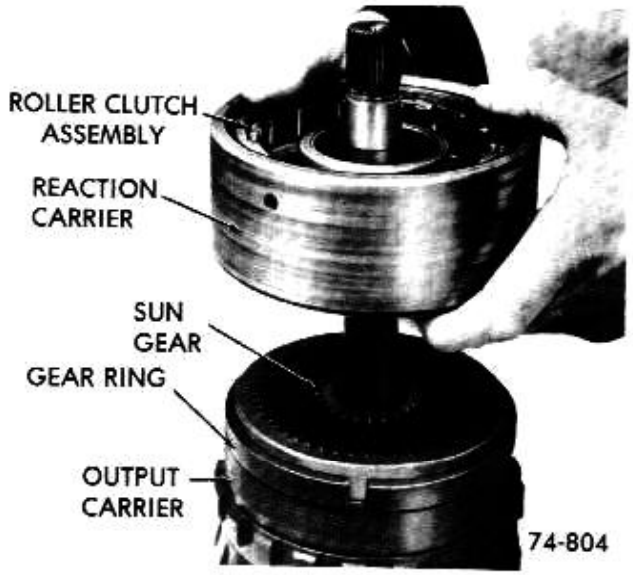


Figure 76-104

5. Remove front internal gear ring from output carrier assembly. See Figure 76-105.

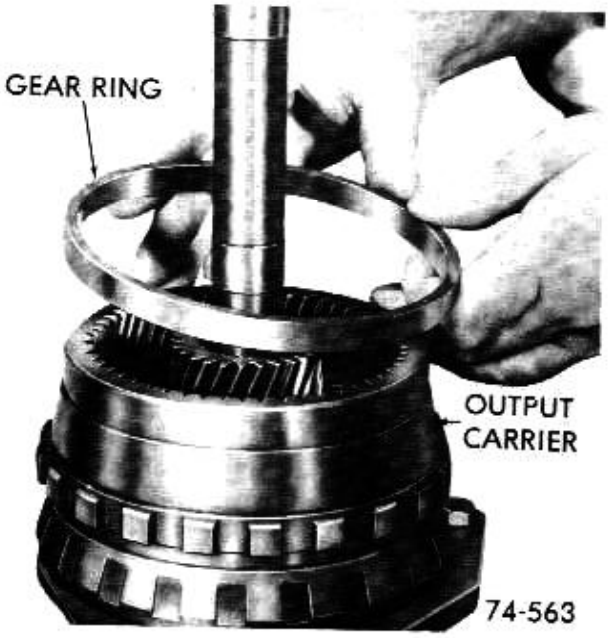


Figure 76-105

6. Remove sun gear. See Figure 76-106.

7. Remove reaction carrier to output carrier thrust washer. See Figure 76-107.

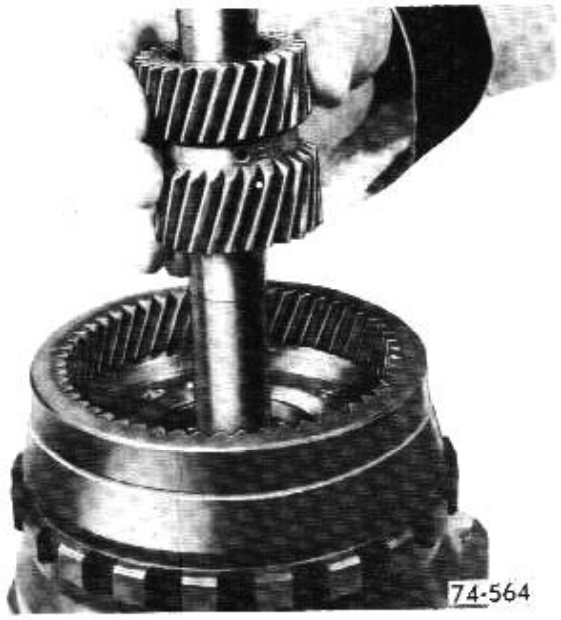


Figure 76-106

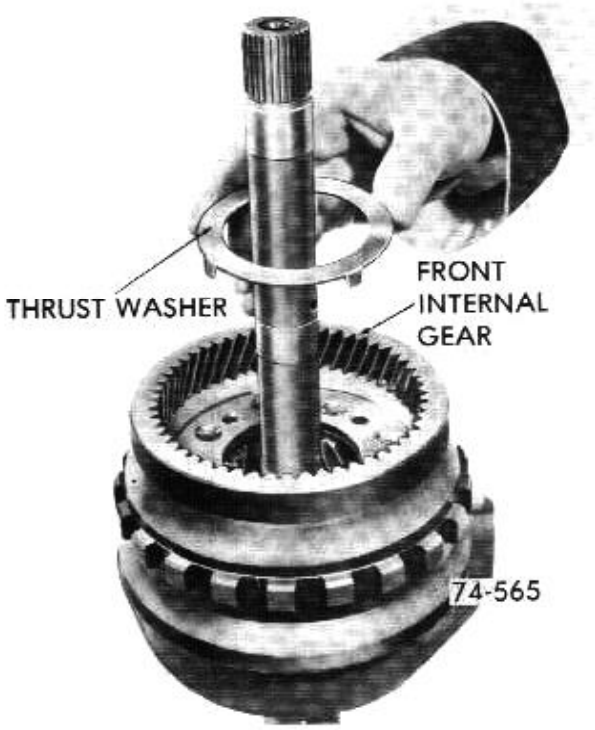


Figure 76-107

8. Turn assembly over and place mainshaft through hole in work bench.

9. Remove output shaft to rear carrier snap ring. See Figure 76-108.

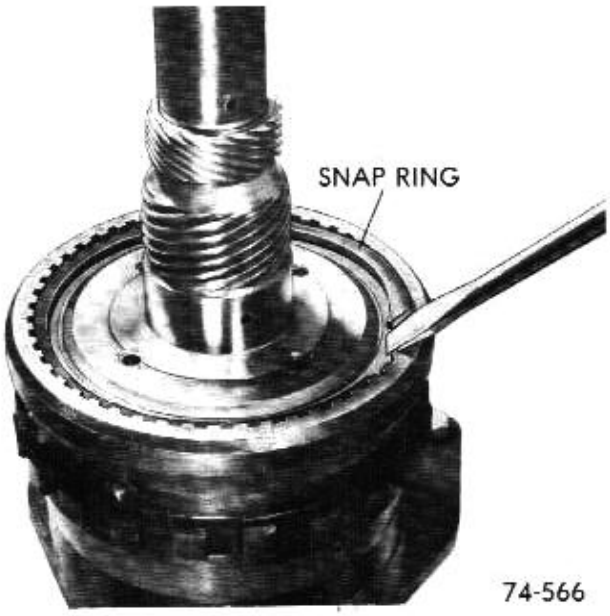


Figure 76-108

10. Remove output shaft.

NOTE: *If replacement of the speedometer drive gear is necessary remove in the following manner.*

a. *Steel Speedometer Gear:* Install steel Speedometer Gear Removing Tool J-21427 and J-9578, on output shaft and remove speedometer drive gear. See Figure 76-109.

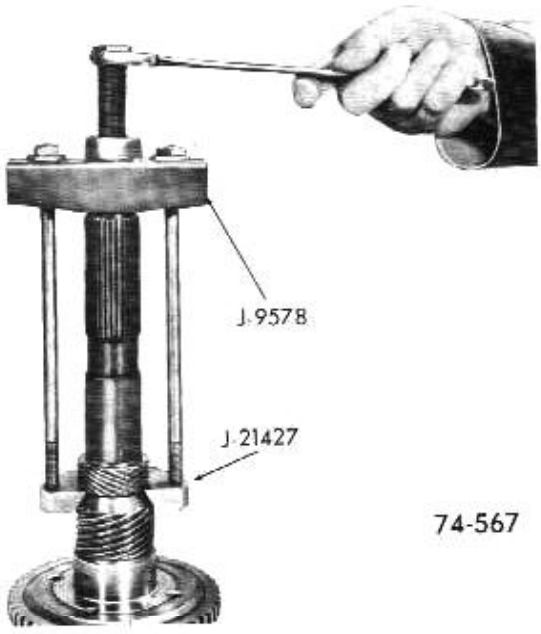


Figure 76-109

b. Install new steel speedometer drive gear. Press to 5-21/32″ for "BS", "BB", and "OW" models,

and 11-15/32″ for "BC" and "BT" models. See Figure 76-110.

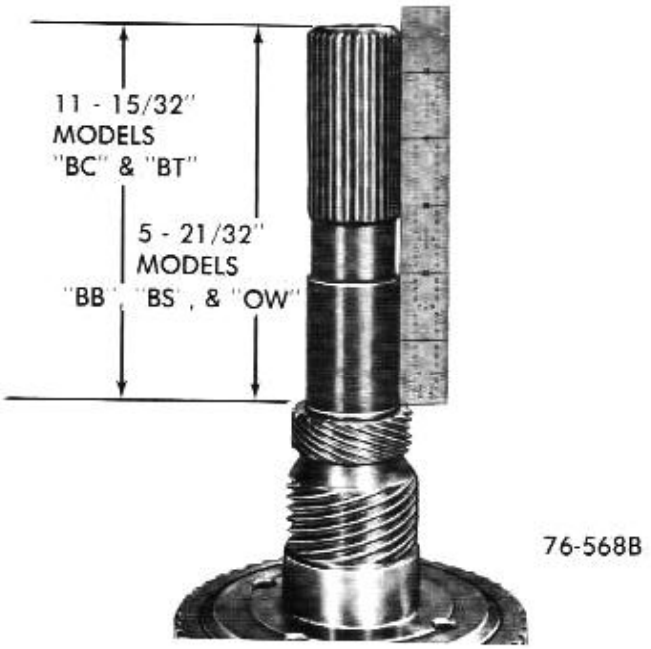


Figure 76-110

c. *Nylon Speedometer Drive Gear:* Depress retaining clip and slide nylon gear off output shaft. See figure 76-111.

d. To install, place retaining clip (square end toward flange of shaft) into hole in output shaft. See Figure 76-111.

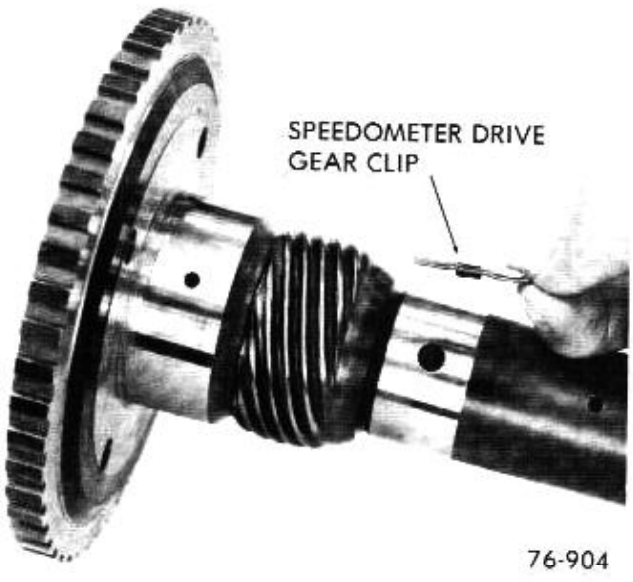


Figure 76-111

e. Align slot in speedometer drive gear with retaining clip and install gear. See Figure 76-112.

NOTE: *The nylon speedometer drive gear is installed at the factory only. All service replacement gears are steel. When a service gear is required, discard the retaining clip and proceed as described in step b above.*

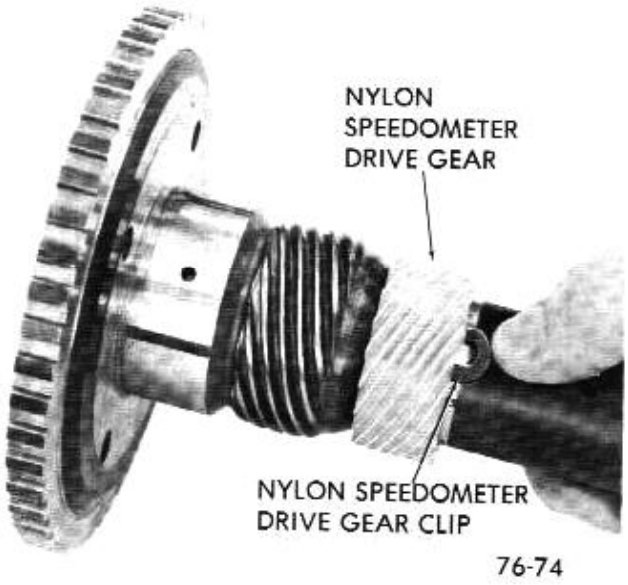


Figure 76-112

11. Remove output shaft to rear internal gear thrust bearing and two (2) races. See Figure 76-113.

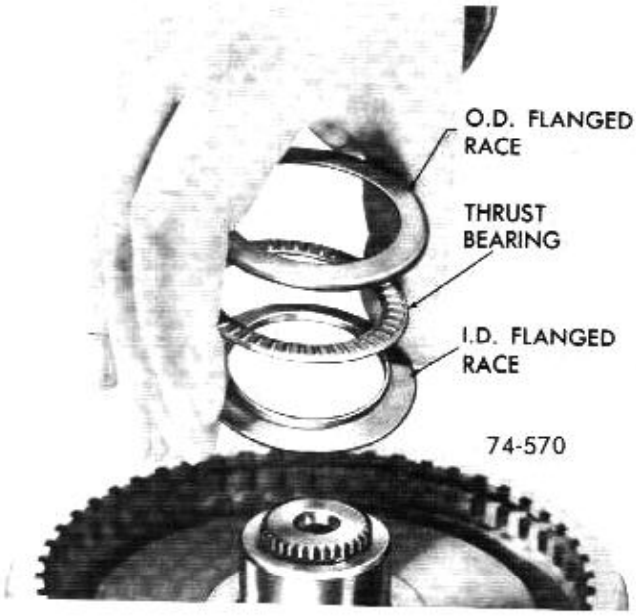


Figure 76-113

12. Remove rear internal gear and mainshaft. See Figure 76-114.

Figure 76-114

NOTE: *Do not drop bearings.*

13. Remove rear internal gear to sun gear thrust bearing and two (2) races. See Figure 76-115.

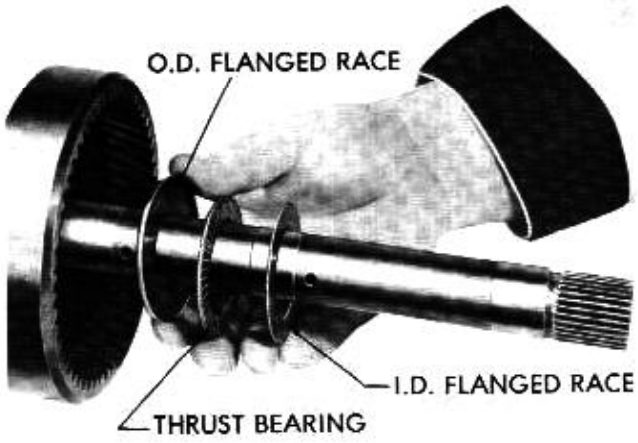


Figure 76-115

14. To remove mainshaft, remove the rear internal gear to mainshaft snap ring. See Figure 76-116.

B. Pinion Replacement Procedure

1. Support carrier assembly on its front face.

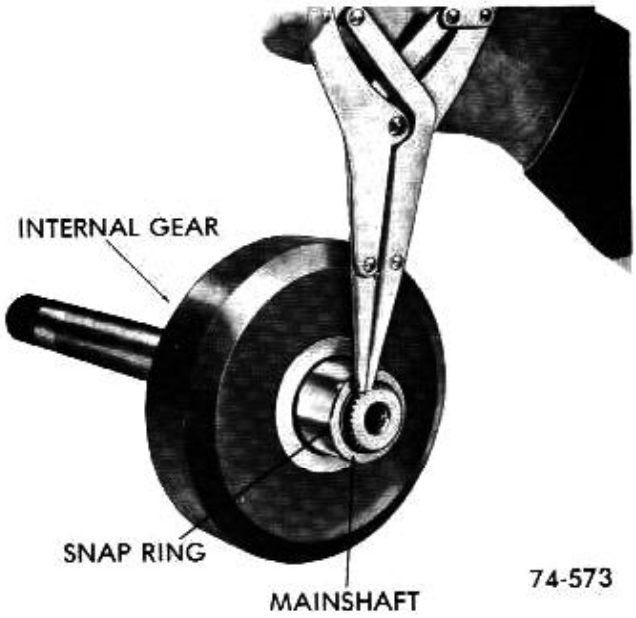


Figure 76-116

2. Using a 1/2 inch diameter drill, remove the stake marks from the 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 the pinions out of the carrier. See Figure 76-117.

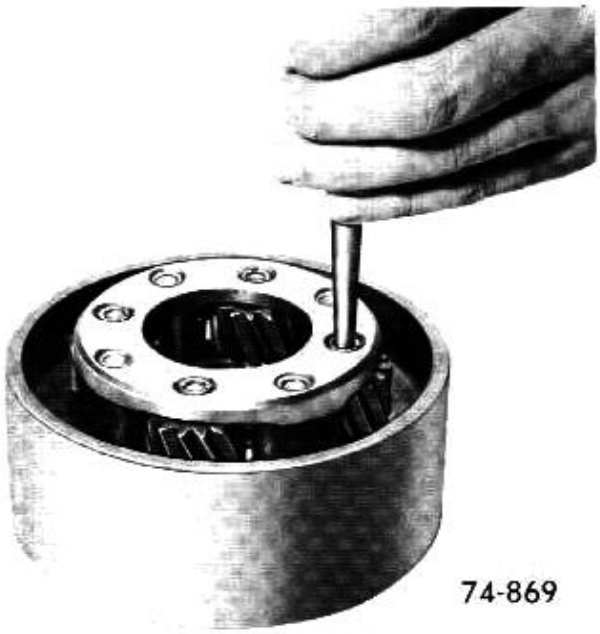


Figure 76-117

4. Remove pinions, thrust washers and needle roller bearings.

5. Inspect pinion pocket thrust faces for burrs and remove if present.

6. Install eighteen (18) needle bearings into each pinion, using petroleum jelly to hold the bearings in place. Use a pinion pin as a guide. See Figure 76-118.

Figure 76-118

7. Place a bronze and steel thrust washer on each side of pinion so steel washer is against pinion, hold them in place with petroleum jelly.

8. Place pinion assembly in position in the carrier and install a pilot shaft through the rear face of the assembly to hold the parts in place.

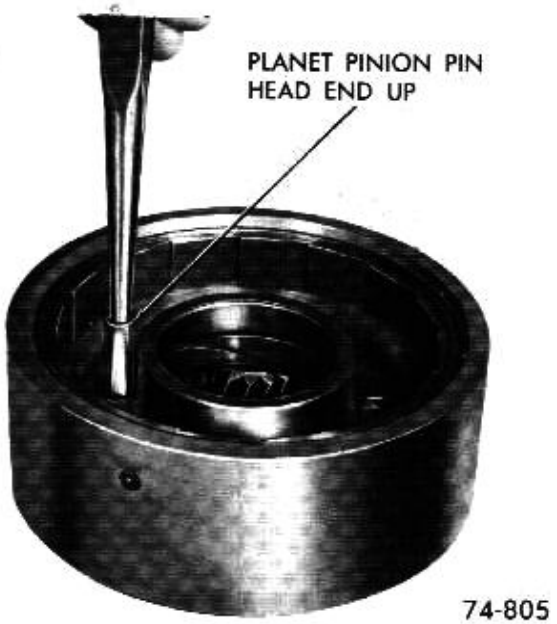


Figure 76-119

9. Drive a new pinion pin into place while rotating pinion from the front, being sure that the headed end is flush or below the face of the carrier. See Figure 76-119.

10. Place a large punch in a bench vise to be used as an anvil while staking the opposite end of the pinion pin in three places. See Figure 76-120.

Figure 76-120

NOTE: *Both ends of the pinion pins must lie below the face of the carrier or interference may occur.*

C. Inspection

Output Shaft

1. Inspect bushing for wear or galling. If replacement is necessary proceed as follows:

a. Thread Tool J-21465-16 into bushing using Slide Hammer J-2619, remove. See Figure 76-121.

b. Using Tool J-21465-1 install bushing. See Figure 76-122.

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 the lubrication passage.

6. Inspect drive lugs for damage.

Inspection of Rear Internal Gear

1. Inspect gear teeth for damage or wear.

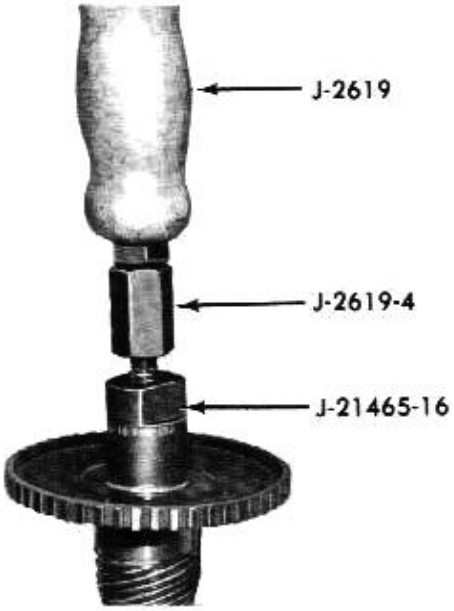


Figure 76-121

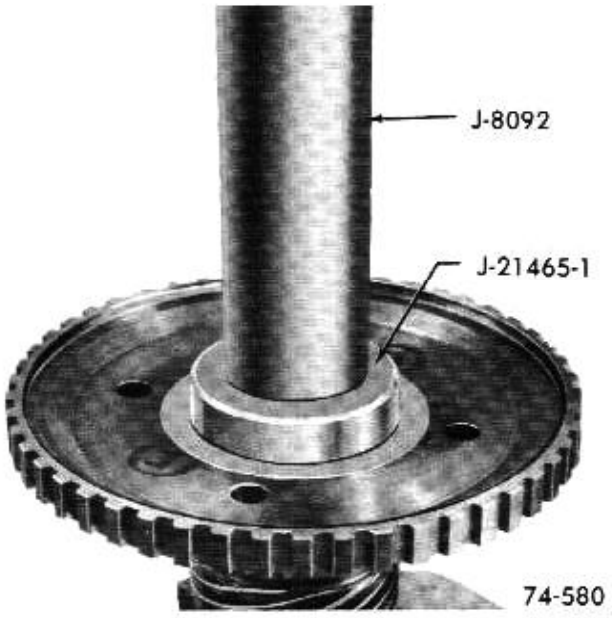


Figure 76-122

2. Inspect splines for damage.

3. Inspect gear for cracks.

D. Mainshaft–Inspection

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. Be sure oil lubrication holes are open.

Inspection of Sun Gear

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Inspect the gear for cracks.

Inspection of Sun Gear Shaft

1. Inspect shaft for cracks or splits.

2. Inspect splines for damage.

3. Inspect bushings for scoring or galling. If replacement is necessary proceed as follows:

a. Thread J-21465-15 into Sun Gear Shaft. Thread Slide Hammer J-2619 into remover. Clamp slide hammer handle into vise. Grasp sun gear shaft and remove bushing.

b. Using Installer J-21465-5 and Drive Handle 8092, install new bushing.

NOTE: *This procedure applies to bushings in both ends of shaft.*

4. Inspect ground bushing journals for damage.

5. Be sure the oil lubrication hole is open.

Inspection of reaction Carrier, Roller Clutch and Output Carrier Assembly

1. Inspect band surface on reaction carrier for signs of burning or scoring.

2. Inspect roller clutch outer race for scoring or wear. See Figure 76-123.

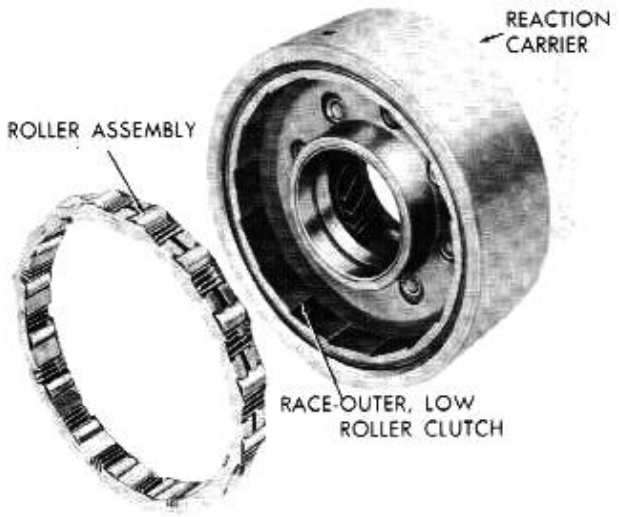


Figure 76-123

3. Inspect thrust washer surfaces for signs of scoring or wear.

4. Inspect bushing for damage. If bushing is damaged the reaction carrier must be replaced.

5. Inspect pinions for damage, rough bearings or excessive tilt.

6. Check pinion end play. Pinion end play should be .009" - .024". See Figure 76-124.

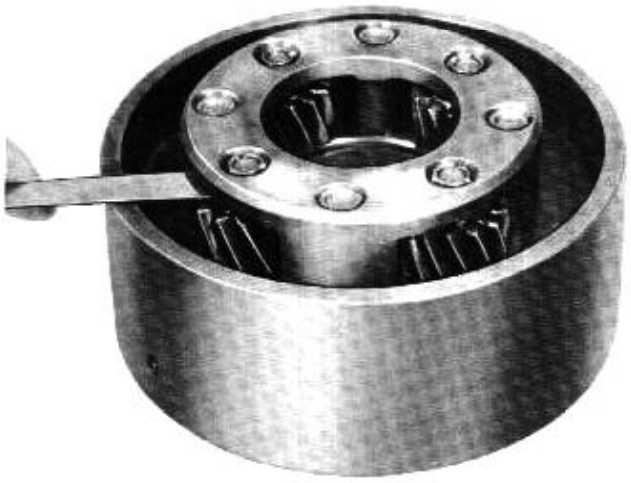


Figure 76-124

7. Inspect roller clutch for damaged members.

8. Inspect roller cage and retaining springs for damage.

9. Inspect front internal gear for damaged teeth.

10. Inspect pinions for damage, rough bearings or excessive tilt.

11. Check pinion end play. Pinion end play should be .009" - .024". See Figure 76-125.

12. Inspect parking pawl lugs for cracks or damage.

13. Inspect output locating splines for damage.

14. Inspect front internal gear ring for flaking or cracks.

E. Installation

Install rear internal gear on end of mainshaft having snap ring groove.

Install internal gear retaining snap ring. See Figure 76-126.

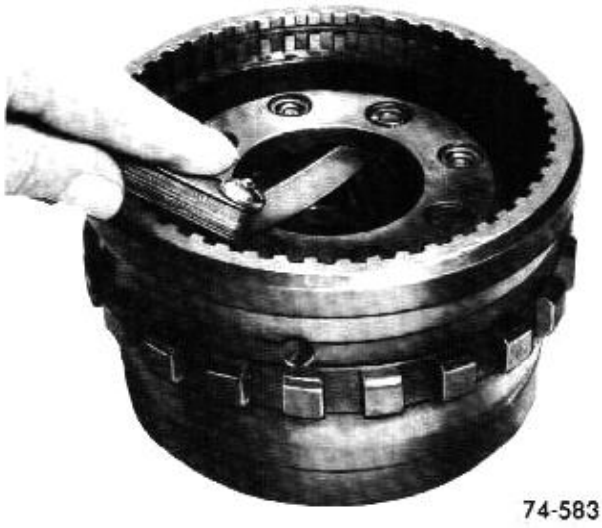


Figure 76-125

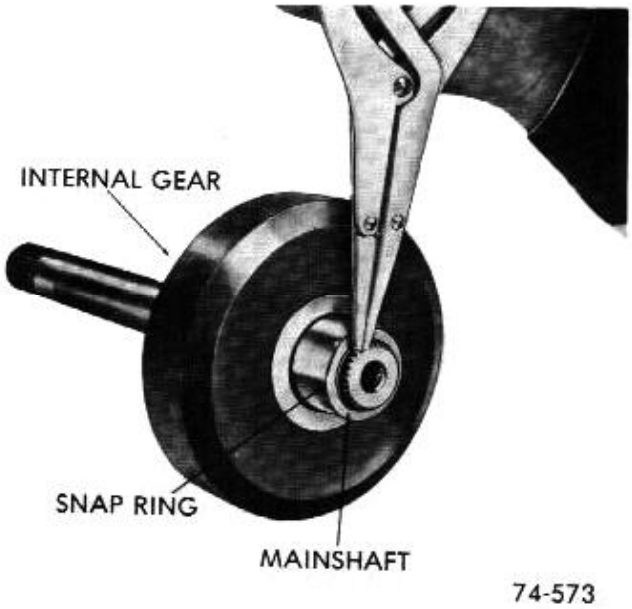


Figure 76-126

3. Install sun gear to internal gear thrust races and bearings against the inner face of the rear internal gear as follows: and retain with petroleum jelly. See Figure 76-127.

a. Place large race against the internal gear with flange facing forward or up.

b. Place thrust bearing against race.

c. Place small race against bearing with inner flange facing into the bearing or down.

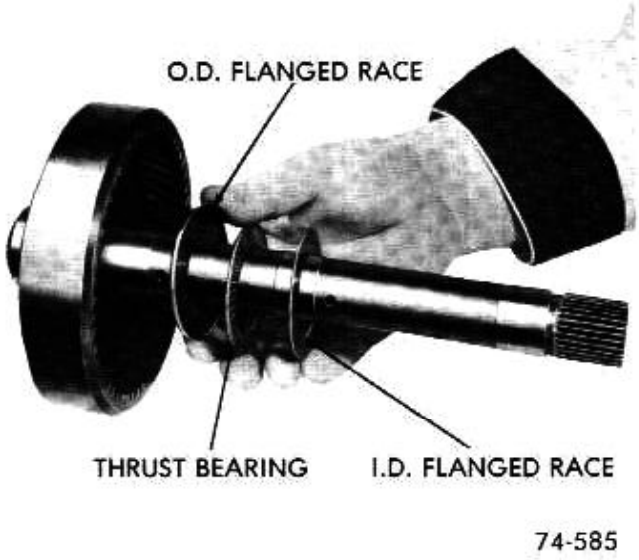


Figure 76-127

4. Install output carrier over the mainshaft so that the 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 bearing as follows; and retain with petroleum jelly. See Figure 76-128.

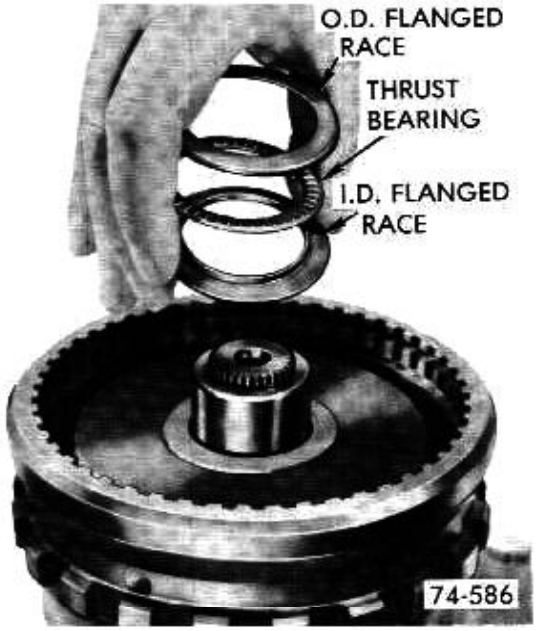


Figure 76-128

a. Place small diameter race against internal gear with center flange facing up.

b. Place bearing on race.

c. Place second race on bearing with outer flange cupped over bearing.

7. Install output shaft into output carrier assembly. See Figure 76-129.

Figure 76-129

8. Install output shaft to output carrier snap ring. See Figure 76-130.

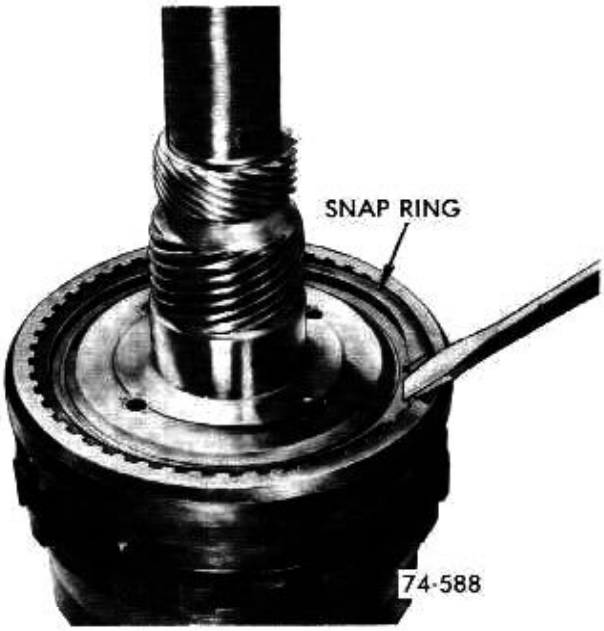


Figure 76-130

9. Lubricate with petroleum jelly and install output shaft to case thrust washer and turn unit over. See Figure 76-131.

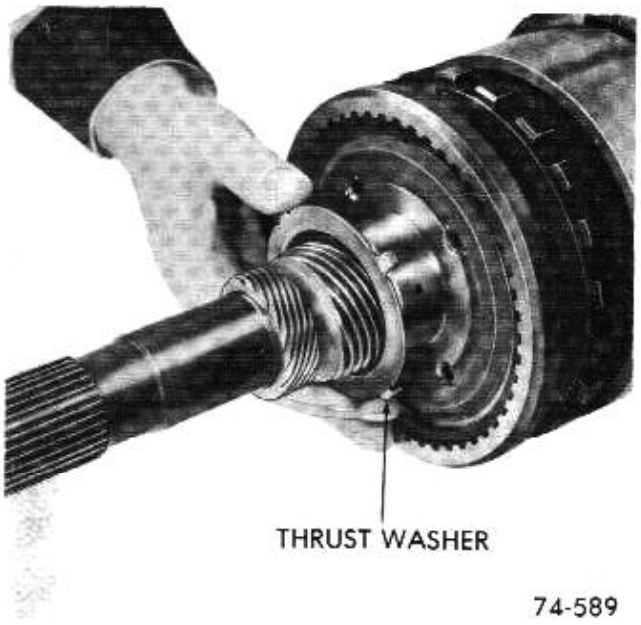


Figure 76-131

10. Install output shaft "O" ring seal.

11. Lubricate with petroleum jelly and install reaction carrier to output carrier thrust washer with tabs facing down in pockets. See Figure 76-132.

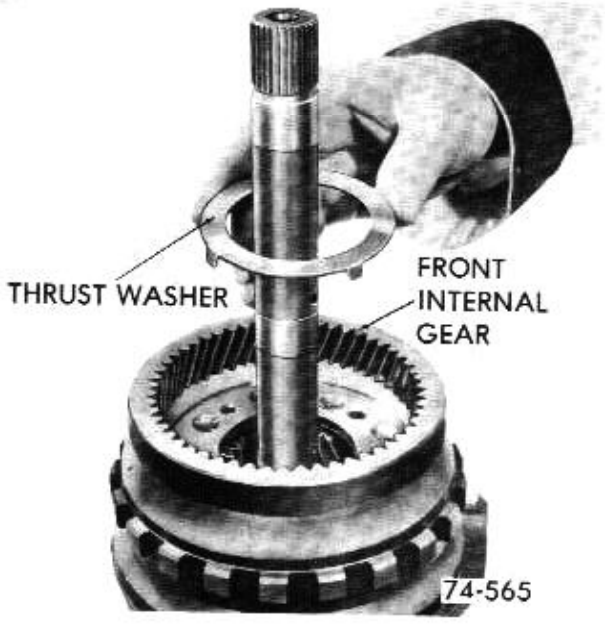


Figure 76-132

12. Install sun gear splines with inner chamfer down. See Figure 76-133.

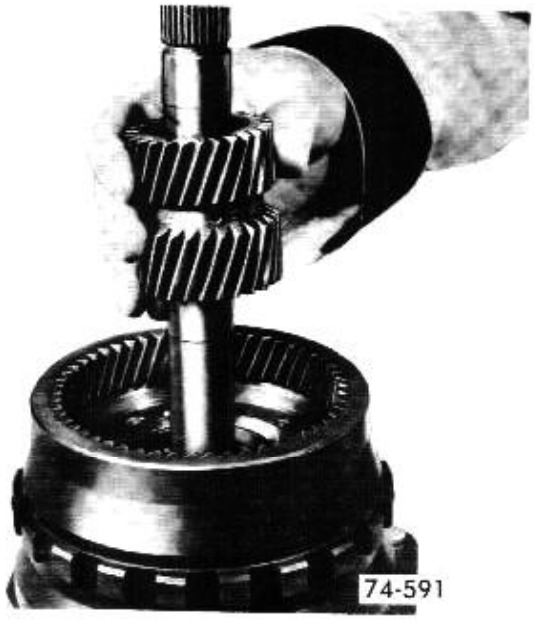


Figure 76-133

13. Install gear ring over output carrier. See Figure 76-134.

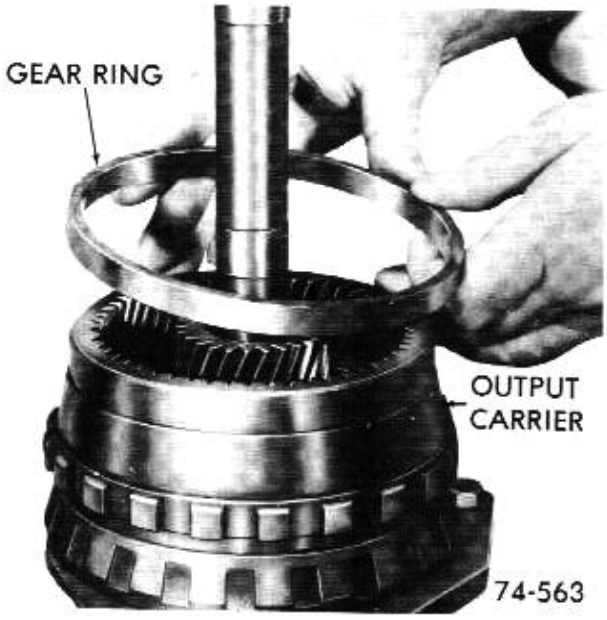


Figure 76-134

14. Install sun gear shaft with longest splined- end first.

15. Install reaction carrier. See Figure 76-135.

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 with the SERVICE ring.*

Figure 76-135

16. Lubricate with petroleum jelly and install center support to sun gear thrust races and bearing as follows: See Figure 76-136.

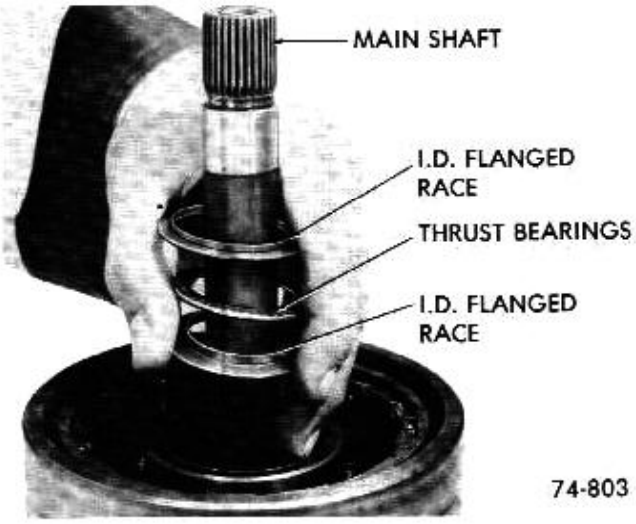


Figure 76-136

a. Install large race, center flange up over the sun gear shaft.

b. Install thrust bearing against race.

c. Install second race, center flange up.

17. Lubricate with petroleum jelly and install center support to reaction carrier thrust washer into recess in center support. See Figure 76-137.

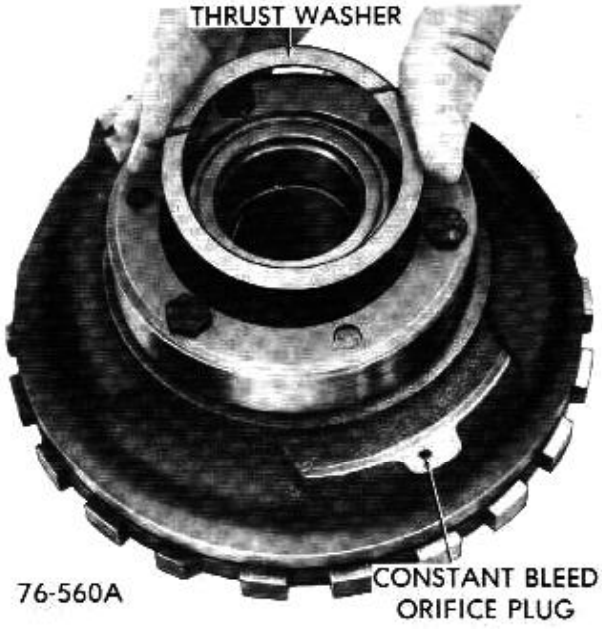


Figure 76-137

18. Install rollers in roller clutch cage, by compressing energizing spring with forefinger and inserting roller from outer side. See Figure 76-138.

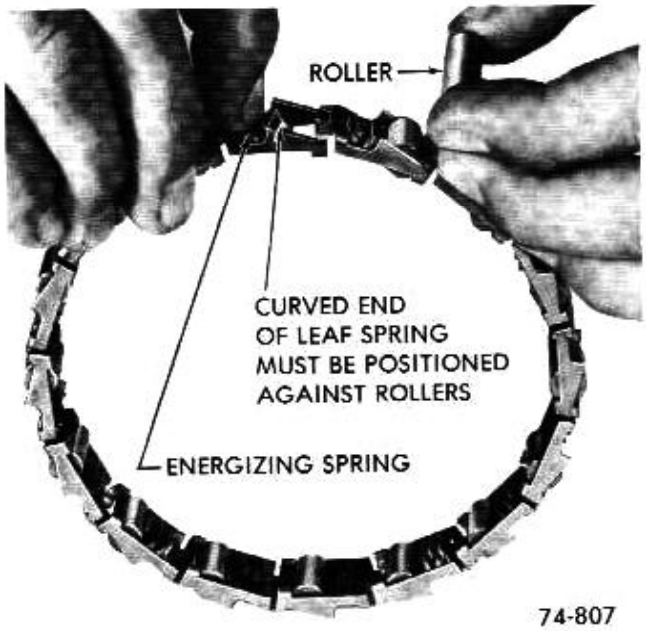


Figure 76-138

NOTE: *Make certain that energizing springs are not distorted, and that curved end of leaf of springs are positioned against rollers.*

19. Install roller clutch assembly into reaction carrier. See Figure 76-139.

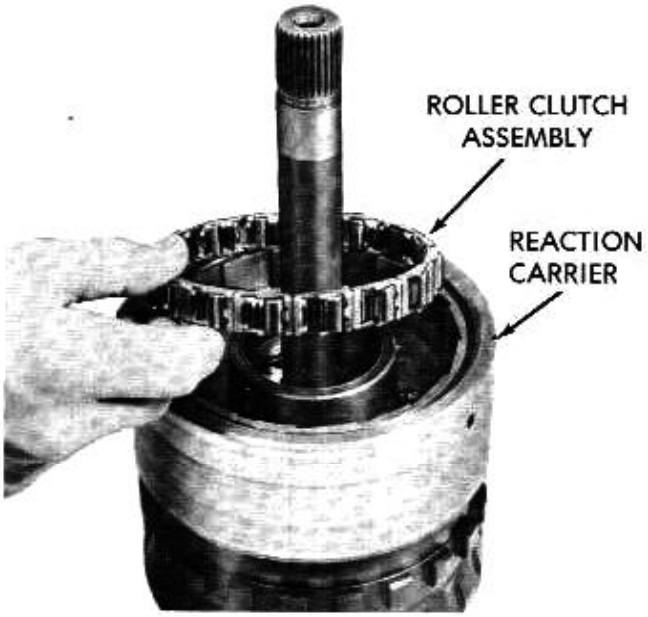


Figure 76-139

20. Install center support into roller clutch in reaction carrier. See Figure 76-140.

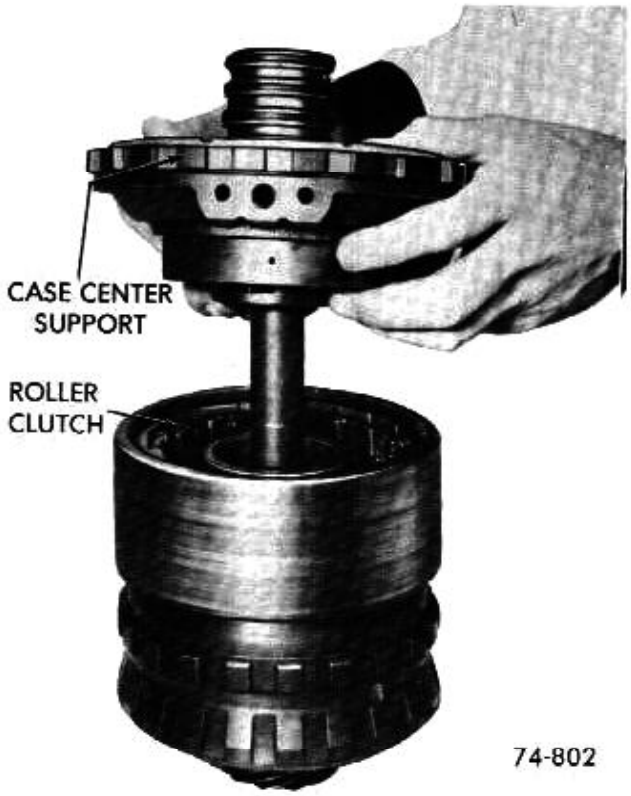


Figure 76-140

NOTE: *With reaction carrier held, center support should turn counterclockwise only. See Figure 76-141.*

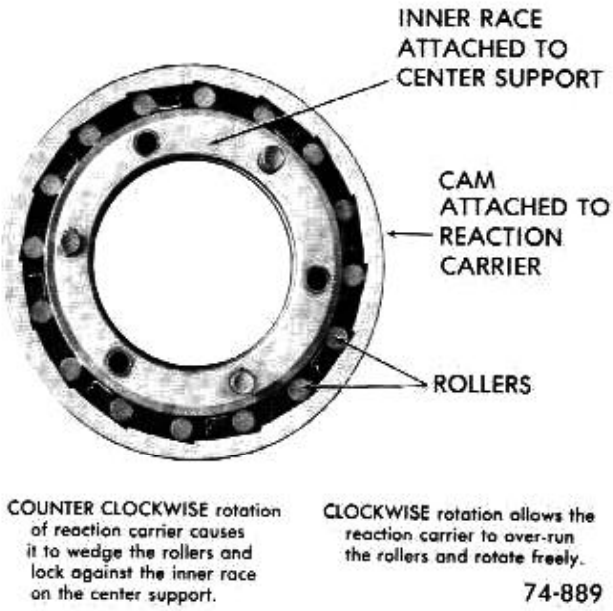


Figure 76-141

76-24 GOVERNOR ASSEMBLY

All components of the governor assembly, with the exception of the 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 the governor assembly in order to replace the driven gear. Disassembly may also be necessary due to foreign material causing improper operation. In such cases, proceed as follows:

A. Disassembly (See Figure 76-142)

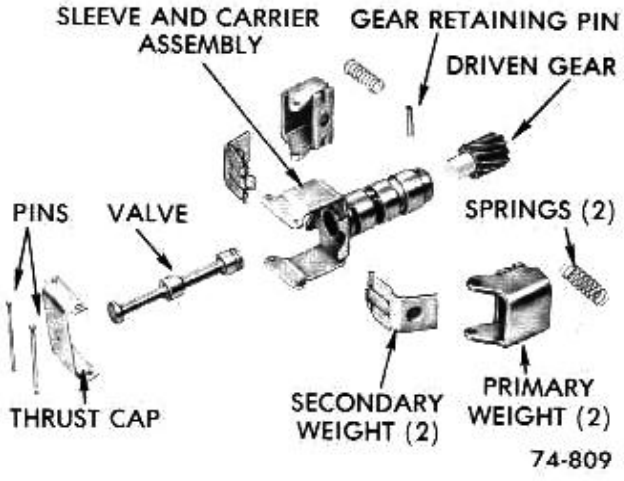


Figure 76-142

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.

2. Remove governor valve from governor sleeve. Be careful not to damage valve.

3. Perform the following inspections and replace governor driven gear, if necessary.

B. Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.

2. Inspect governor sleeve for nicks, burrs, scoring or galling.

3. Check governor sleeve for free operatin in bore of transmission case.

4. Inspect governor valve for nicks, burrs, scoring or galling.

5. Check governor valve for free operation in bore of governor sleeve.

6. Inspect governor driven gear for nicks, burrs, or damage.

7. Check governor driven gear for looseness on governor sleeve.

8. Inspect governor weight springs for distortion or damage.

9. Check governor weights for free operation in their retainers.

10. Check valve opening at entry (.020 inch minimum) with a feeler gage, holding governor as shown in Figure 76-143, with governor weights extended completely outward. For exhaust (.020" minimum) governor weights must be completely inward.

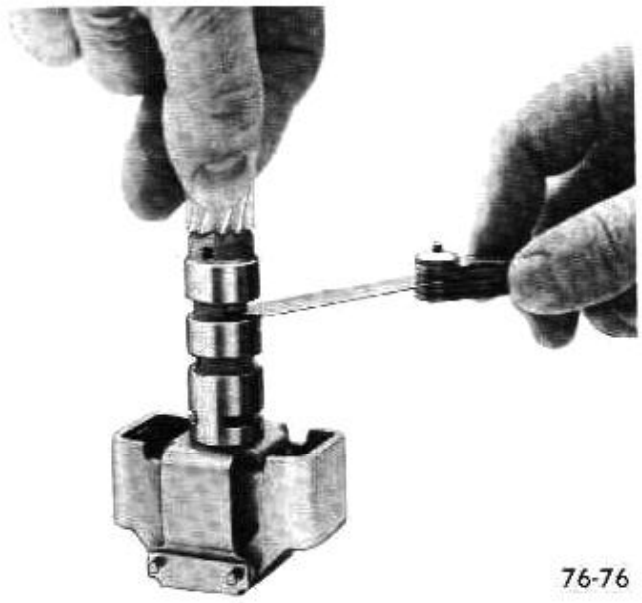


Figure 76-143

C. Governor Driven Gear Replacement

To facilitate governor repair in the field, 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 or 1/8" drill rod. See Figure 76-144.

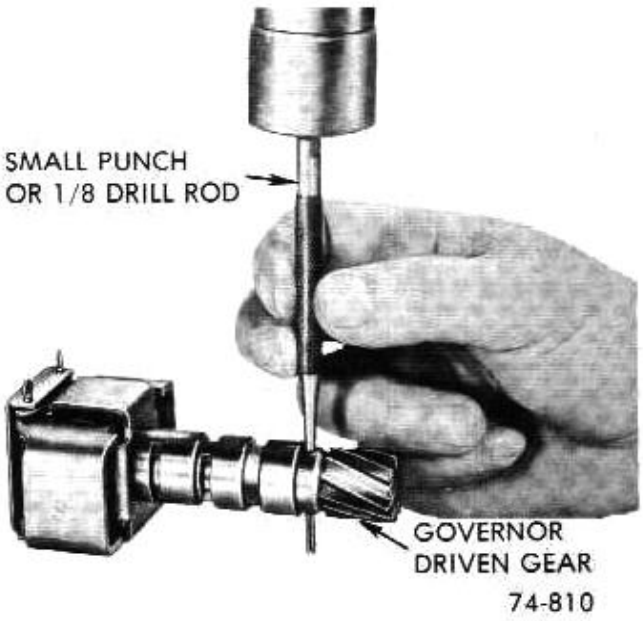


Figure 76-144

2. Support governor on 7/64 inch plates installed in exhaust slots of governor sleeve, place in 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 7/64 inch plates, installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.

5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch, and then while supporting governor in press, drill new hole through sleeve and gear using a standard (1/8 inch) drill.

6. Install retaining pin.

7. Wash governor assembly thoroughly to remove any chips that may have collected.

D. Assembly (See Figure 76-142)

1. Install governor valve in bore of governor sleeve.

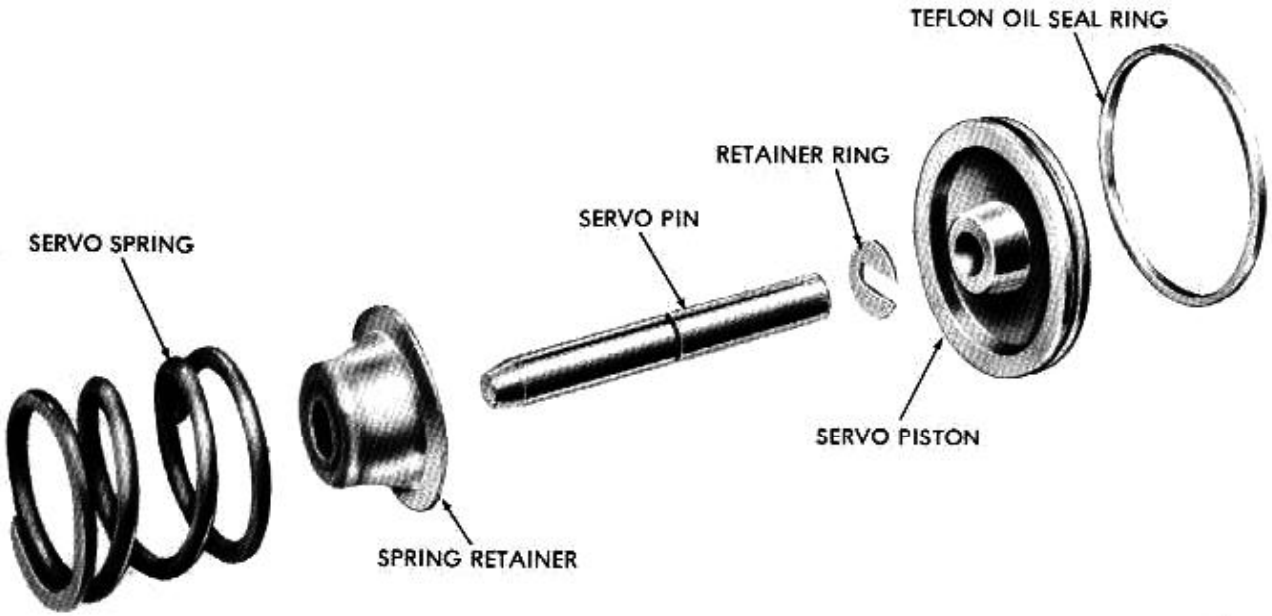


Figure 76-145

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 pin to prevent them from falling out.

4. Check governor weight assemblies for free operation on pins and governor valve for free operation in governor sleeve.

76-25 FRONT SERVO INSPECTION

NOTE: *See Figure 76-145. Do not remove the teflon oil seal ring from the front servo piston, unless the oil seal ring requires replacement. For Service, the oil seal ring will be aluminum.*

CAUTION: *The spring retainer, servo pin, retainer ring, and servo piston are new for 1971. These individual parts are not interchangeable with the pre-1971 parts.*

1. Inspect servo pin for scores and cracks. See Figure 76-145.

2. Inspect piston and oil seal ring for damage.

3. Check fit of servo pin in piston.

76-26 REAR SERVO ASSEMBLY

A. Disassembly

1. Remove rear accumulator piston from rear servo piston.

2. Remove "E" ring retaining rear servo piston to band apply pin. See Figure 76-146.

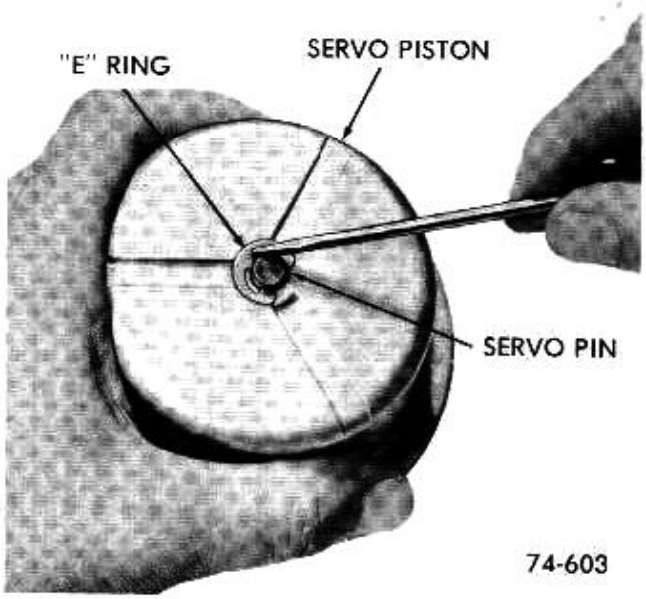


Figure 76-146

3. Remove rear servo piston and seal from band apply pin. See Figure 76-147.

B. Inspection

1. Inspect freedom of accumulator ring in piston.

2. Inspect fit of band apply pin in servo piston.

Figure 76-147

3. Inspect band apply pin for scores and cracks.

C. Reassembly

1. Install spring retainer, spring and washer on band apply pin. See Figure 76-148.

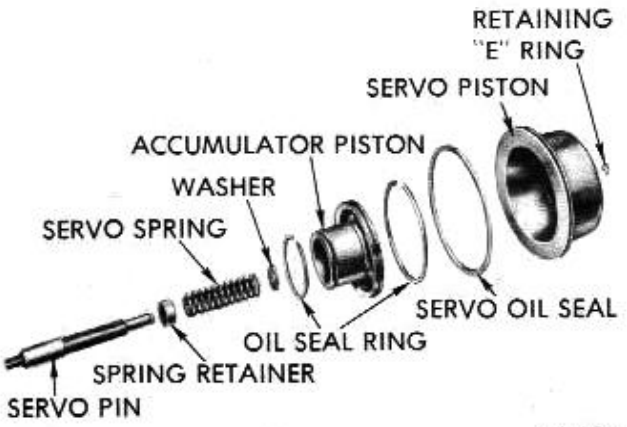


Figure 76-148

NOTE: *If new pin is required, install here.*

2. Install band apply pin retainer, spring and washer into bore of servo piston and secure with "E" ring. See Figure 76-149.

3. Install oil seal ring on servo piston, if removed.

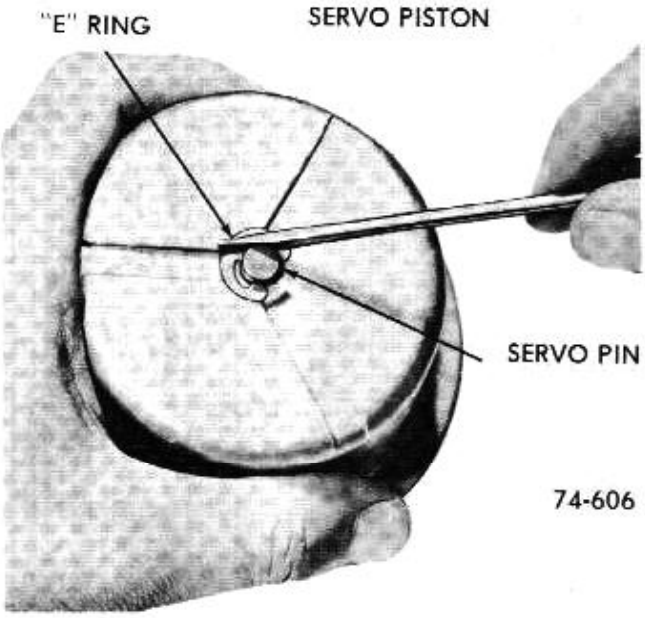


Figure 76-149

4. Install outer and inner oil rings on accumulator piston, if removed, and assemble into bore of servo piston.

76-27 VALVE BODY ASSEMBLY

A. Disassembly

1. Position valve body assembly with cored face up and servo pocket nearest operator.

2. Remove manual valve from upper bore.

3. Install special Tool J-21885 on accumulator piston and remove retaining "E" ring. See Figure 76-150.

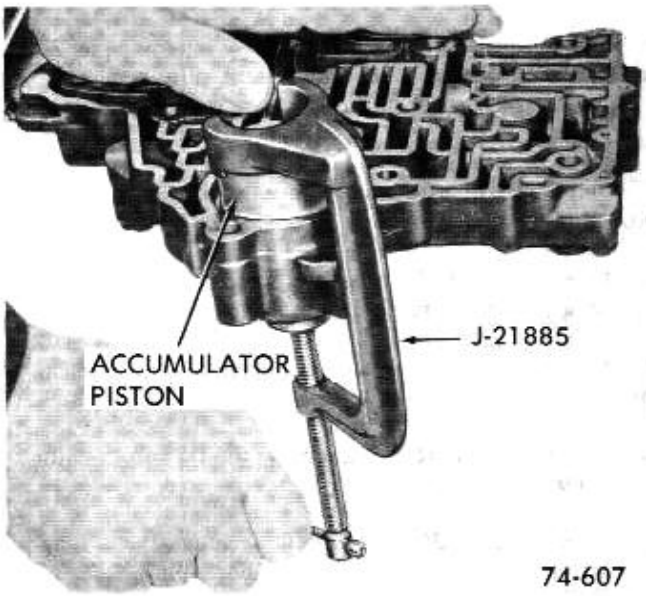


Figure 76-150

4. Remove front accumulator piston and spring. See Figure 76-151.

Figure 76-151

5. On the right side, top bore, remove 1-2 valve train as follows:

a. Model "BC", remove the retaining pin, 1-2 modulator bushing, 1-2 regulator valve, 1-2 regulator spring, 1-2 detent valve, and 1-2 shift valve. See Figure 76-287.

b. Models "BS", "BB", "BT", and "OW" remove the retaining pin, 1-2 modulator bushing, 1-2 modulator valve spring, 1-2 modulator valve, and 1-2 shift valve.

6. From the next bore down, remove the retaining pin; 2-3 modulator bushing, and 2-3 modulator valve spring, 2-3 modulator valve, 3-2 intermediate spring and the 2-3 valve. See Figure 76-287.

7. From the next bore down, remove the retaining roll pin, bore plug, spacer, spring and 3-2 valve. See Figure 76-287.

8. At the other end of the assembly, top bore, remove the retaining pin and bore plug. See Figure 76-287.

9. Remove the detent valve, detent regulator valve, spring and spacer. See Figure 76-287.

10. From the next bore down, remove the 1-2 accumulator valve train as follows:

a. Models "BS", "BC", and "BT", remove the 1-2 accumulator grooved retaining pin, bore plug, 1-2 accumulator secondary spring, 1-2 accumulator valve, 1-2 accumulator bushing, 1-2 primary accumulator valve, and 1-2 accumulator primary spring. See Figure 76-287.

b. Models "BB" and "OW", remove 1-2 accumulator grooved retaining pin, bore plug, 1-2 accumulator secondary spring, and 1-2 accumulator valve. See Figure 76-287.

B. Inspection

NOTE: *See Figure 76-151. Do not remove the teflon oil seal ring from the front accumulator piston, unless the oil seal ring requires replacement. For service, the oil seal ring will be cast iron.*

CAUTION: *The front accumulator piston is new for 1971, and it is not interchangeable with the pre-1971 piston.*

1. Inspect all valves for scoring, cracks and free movement in their respective bores.

2. Inspect the body for cracks, scored bores, interconnected oil passages and flatness of mounting face.

3. Check all springs for distortion or collapsed coils.

4. Inspect piston and oil seal ring for damage.

C. Reassembly

1. Install front accumulator spring and piston into valve body.

2. Install special Tool J-21885 and compress spring and piston. Secure with retaining "E" ring. See Figure 76-153.

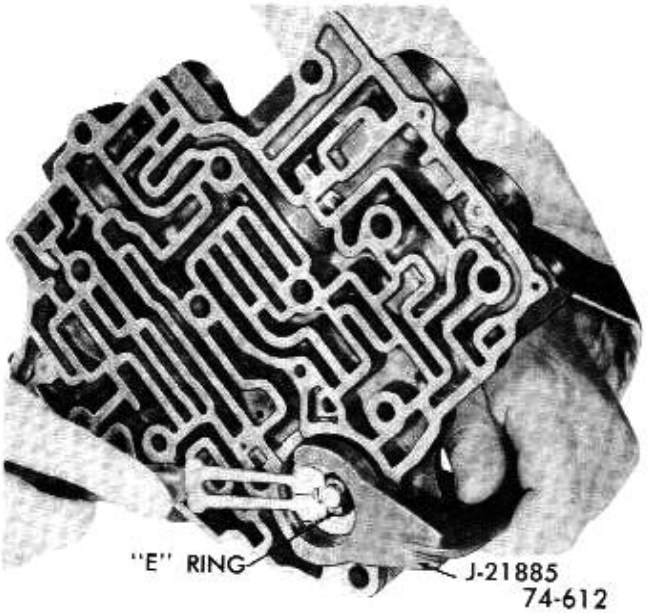


Figure 76-153

NOTE: *Align piston and ring when entering bore.*

3. Install the 1-2 accumulator valve train into lower left bore as follows:

a. Models "BS", "BC", and "BT", install the 1-2 accumulator primary spring and primary valve into the valve bore using a retaining pin to temporarily hold the spring and valve in their operating position. Install the 1-2 accumulator valve, stem end out, and the 1-2 accumulator secondary spring into the 1-2 accumulator bushing. Install the bushing into the bore and, using the bore plug, compress the spring until the grooved retaining pin can be inserted from the cast surface side of the valve body with the grooved end entering the pin hole last. Tap the retaining pin with a hammer until the pin is flush with the cast surface side of the valve body. Remove the temporary retaining pin.

b. Models "BB" and "OW", install the 1-2 accumulator valve, stem end out, and the 1-2 accumulator secondary spring. Install the bore plug and install the grooved retaining pin from cast surface side of the valve body with grooved end entering the pin hole last. Tap the retaining pin with a hammer until the pin is flush with the cast surface side of the valve body.

4. In the next bore up, install the detent spring and spacer. Compress spring and secure with small screwdriver. See Figure 76-154.

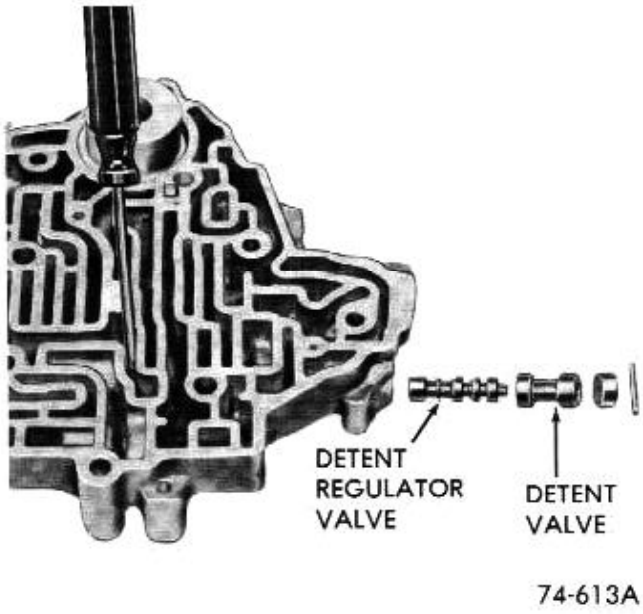


Figure 76-154

5. Install the detent regulator valve. Wide land first. See Figure 76-154.

6. Install the detent valve, narrow land first. See Figure 76-154.

7. Remove the screwdriver as the bore plug (hole out) and retaining pin are installed. See Figure 76- 154.

8. In the lower right hand bore, install the 3-2 valve. See Figure 76-287.

9. Install the spacer, spring bore plug (hole out) and retaining pin. See Figure 76-287.

10. In the next bore up, install the 2-3 valve, stem end out, and 3-2 intermediate spring. See Figure 76- 287.

11. Install the 2-3 modulator valve into bushing. See Figure 76-287.

12. Install the 2-3 modulator valve and bushing, into valve body bore. See Figure 76-287.

13. Install the 2-3 valve spring, compress spring and install retaining pin.

14. In the next bore up, install 1-2 shift valve train as follows:

a. Model "BC", install the 1-2 shift valve, stem end out. Install 1-2 regulator valve, larger stem first, spring and 1-2 detent valve, hole end first, into 1- 2 modulator bushing, aligning spring in bore of 1-2 detent valve and install in upper right bore of valve body. Compress bushing, against spring and secure with retaining pin from cored side of valve body.

b. Models "BS", "BB", "BT", and "OW", install the 1- 2 shift valve, stem end out. Install the 1-2 modulator spring and 1-2 modulator valve into the 1-2 modulator bushing. Install parts into upper right bore of valve body. Compress bushing against spring and secure with retaining pin from cored side of valve body.

15. Install the manual valve with detent pin groove to the right. See Figure 76-287.

76-28 OIL PUMP ASSEMBLY

A. Disassembly

1. Place pump assembly through hole in bench.

2. Compress the regulator boost valve bushing against the pressure regulator spring and remove the snap ring using J-5403 pliers. See Figure 76-155.

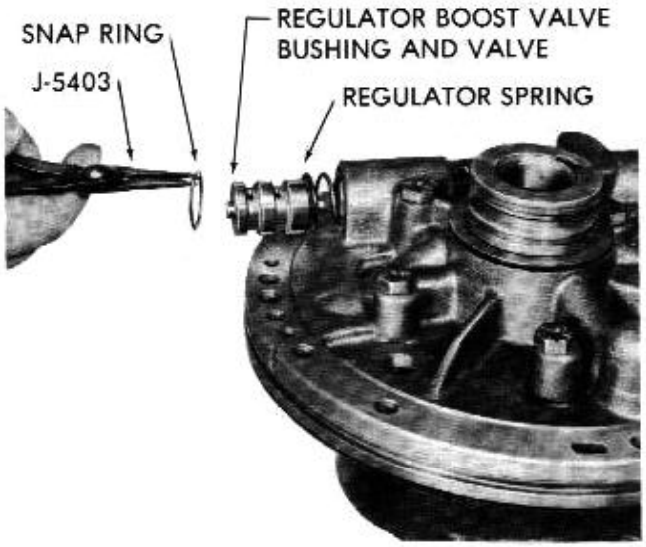


Figure 76-155

3. Remove the regulator boost valve bushing and valve.

4. Remove the pressure regulator spring.

5. Remove the regulator valve, spring retainer and spacer(s), if present. See Figure 76-156.

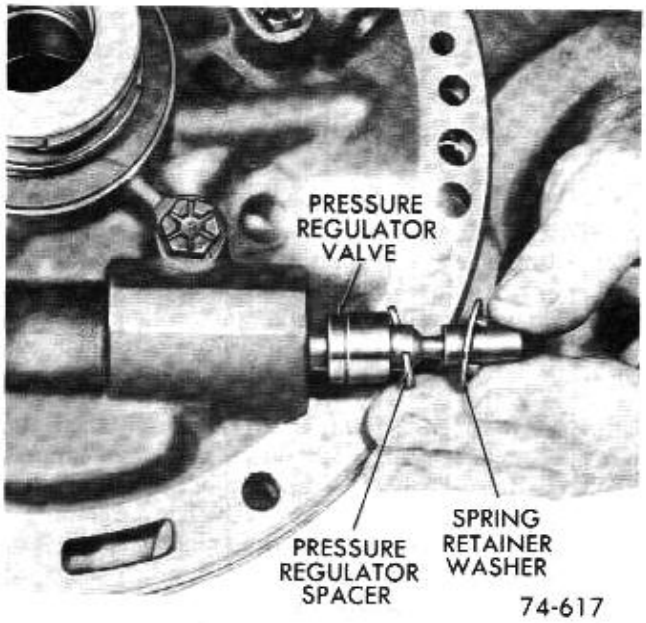


Figure 76-156

6. Remove the pump cover to body attaching bolts. See Figure 76-157.

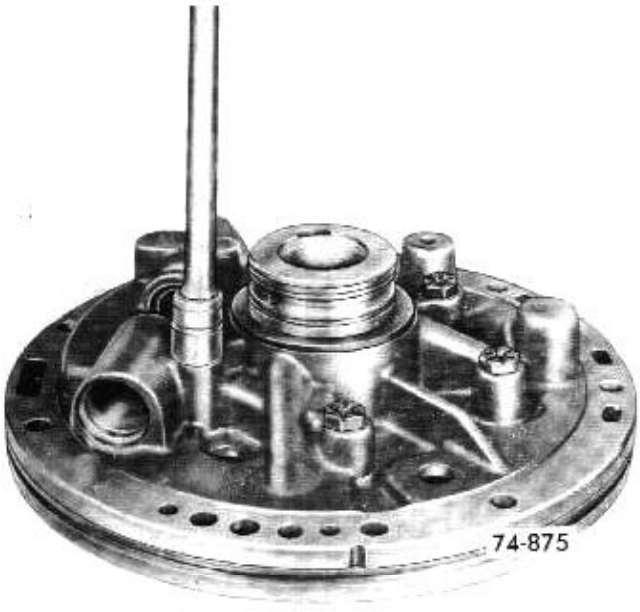


Figure 76-157

7. Remove pump cover from body. See Figure 76- 158.

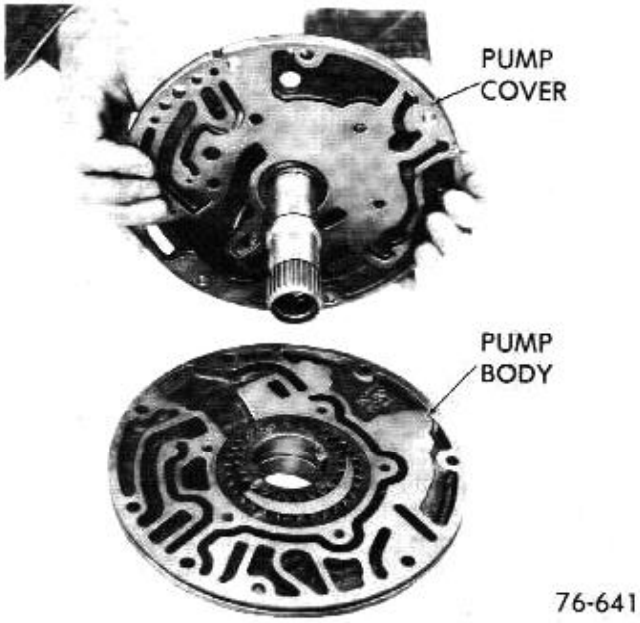


Figure 76-158

8. Remove the retaining pin and bore plug from the pressure regulator bore. See Figure 76-159.

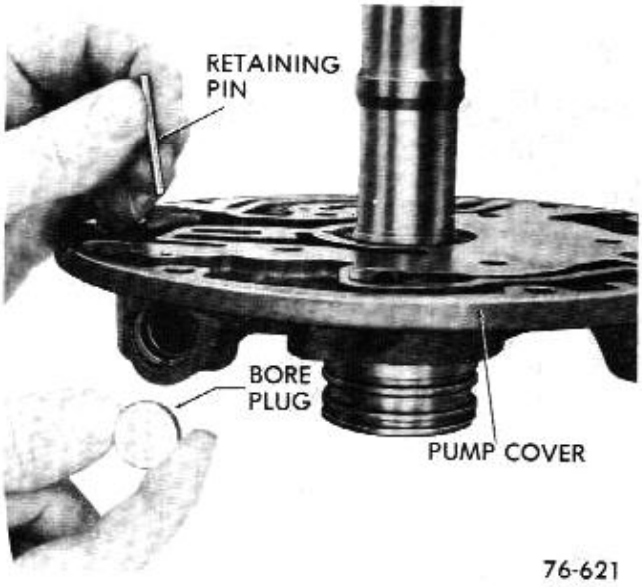


Figure 76-159

9. Remove two hook type oil rings from the pump cover. See Figure 76-160.

10. Remove the pump to forward clutch housing selective washer.

11. Mark drive and driven gears for reassembly in same position and remove drive gear. See Figure 76- 161.

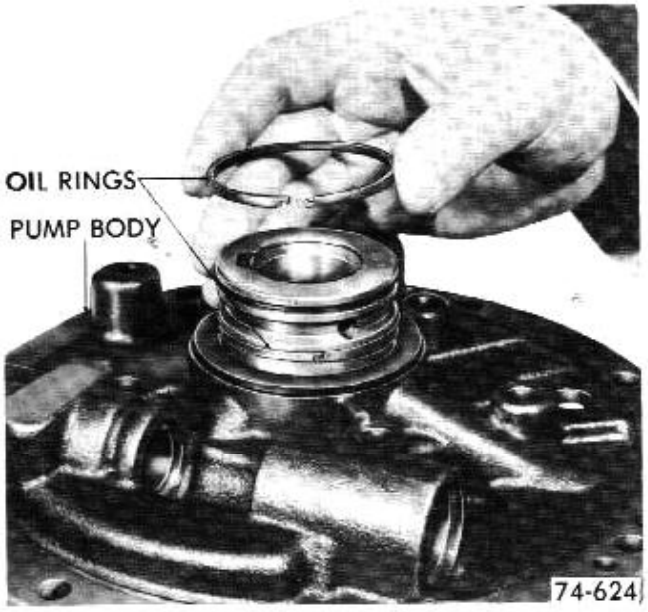


Figure 76-160

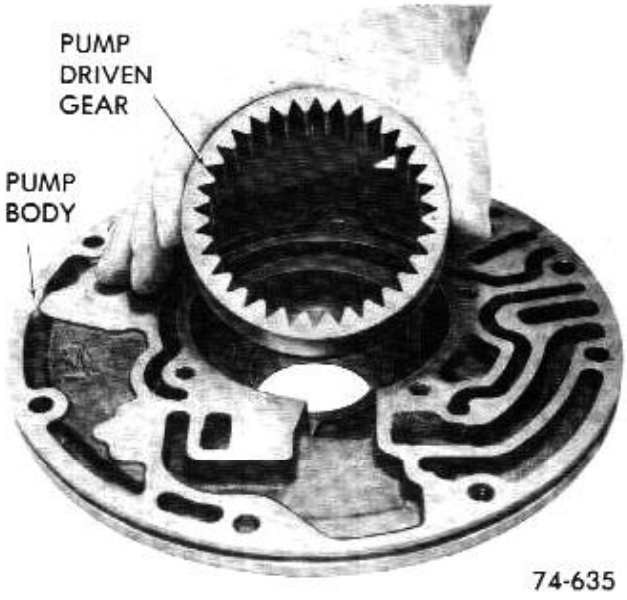


Figure 76-162

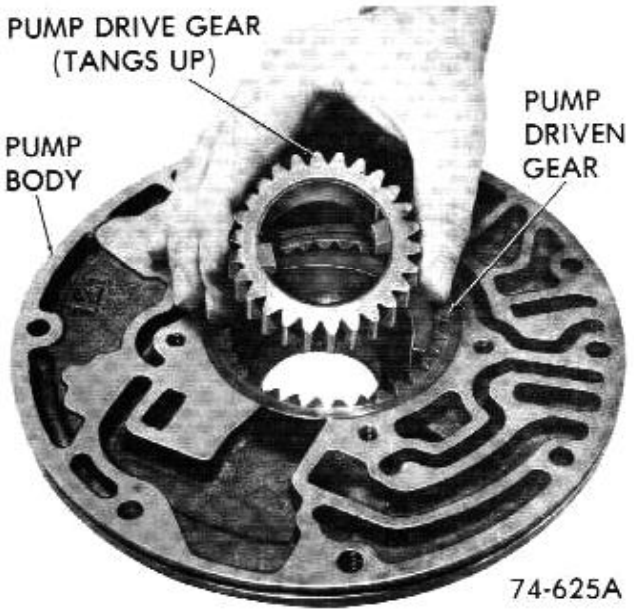


Figure 76-161

12. Remove driven gear from pump body. See Figure 76-162.

B. Inspection

NOTE: *The 1971 solid type pressure regulator valve does not contain oil holes and an orifice cup plug like the previous pressure regulator valve. The solid style valve must only be used in the pump cover with the squared off pressure regulator boss (pressure boost bushing end). See Figure 76-160A. The previous pressure regulator valve with the oil holes and orifice cup plug will be used to service either type pump cover.*

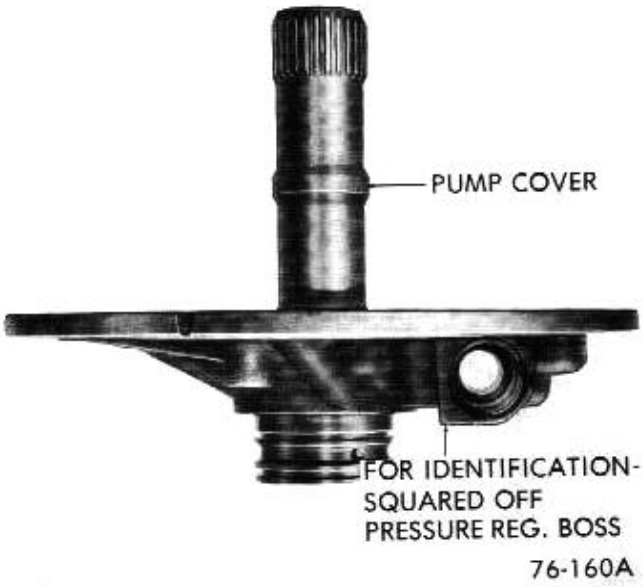


Figure 76-160A

1. Inspect the gear pocket and crescent for scoring, galling or other damage.

2. Place pump gears in pump and check the following clearance.

a. Pump body face to gear face clearance. Clearance should be .0008" - .0035". See Figure 76-163.

Figure 76-163

3. Check face of pump body for scores or nicks.

4. Check oil passages. See Figure 76-9.

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 damaged replace as follows:

a. Support oil pump on wood blocks. Using Tool J-21465-17 and Drive Handle J-8092 press bushing out of oil pump body. See Figure 76-164.

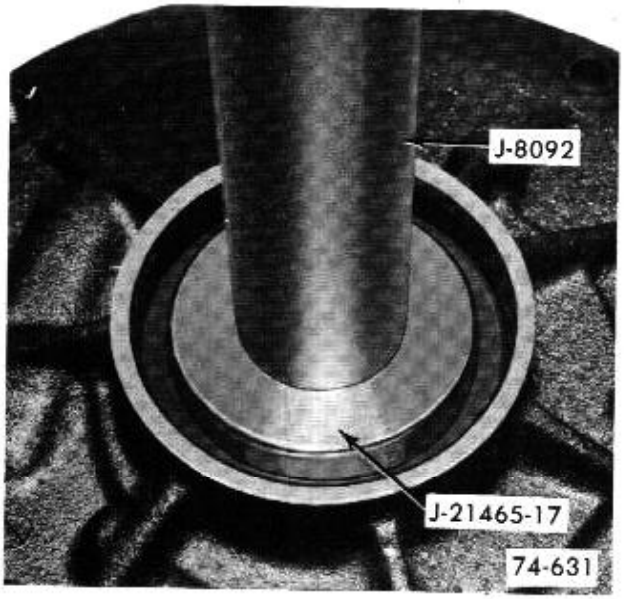


Figure 76-164

b. Using Tool J-21465-17 drive bushing into pump body from gear pocket face until it is flush to .010 below machined surface.

8. Inspect the pump attaching bolt seals for damage, replace if necessary.

9. Inspect pump cover face for overall flatness.

10. Check for scores or chips in pressure regulator bore.

11. Check that all passages are open and not interconnected. See Figure 76-8.

12. Check for scoring or damage at pump gear face.

13. Inspect stator shaft for damaged splines or scored bushings.

If replacement of bushing 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 bushing. See Figure 76-165.

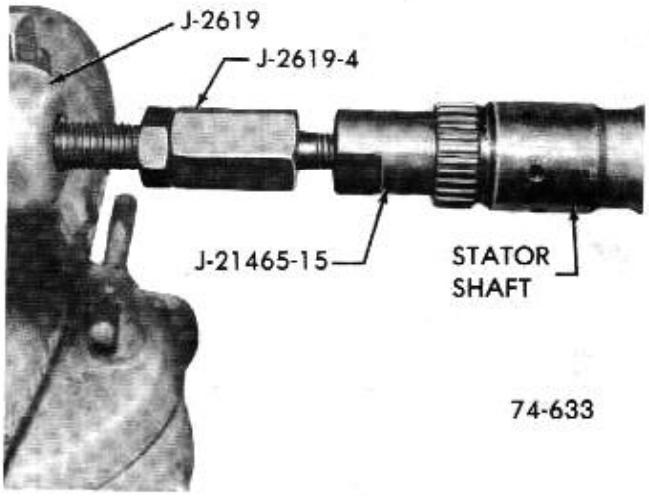


Figure 76-165

b. Using Installer J-21465-3 install bushing in front of shaft. See Figure 76-166.

c. See Figure 76-166 for installation of bushing in rear of shaft.

14. Inspect oil ring grooves and rings for damage or wear.

15. Inspect selective washer thrust face for wear or damage.

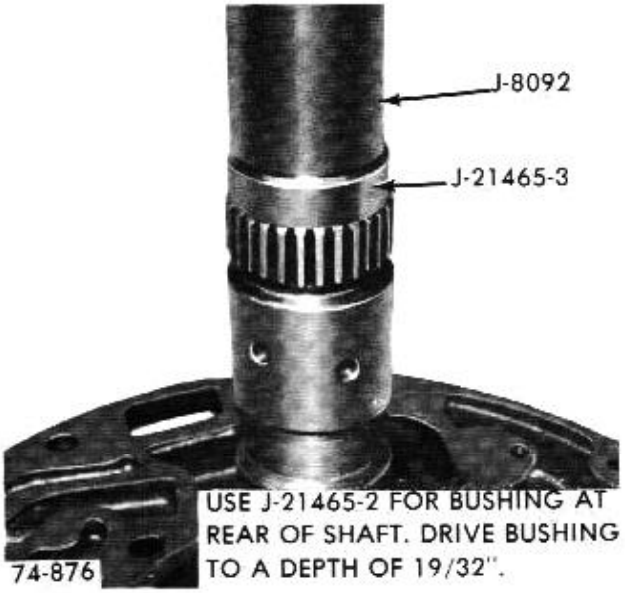


Figure 76-166

16. Inspect pressure regulator and boost valve for free operation.

C. Reassembly

1. Install drive and driven pump gears into the pump body with alignment marks up. See Figures 76- 167 and 76-168.

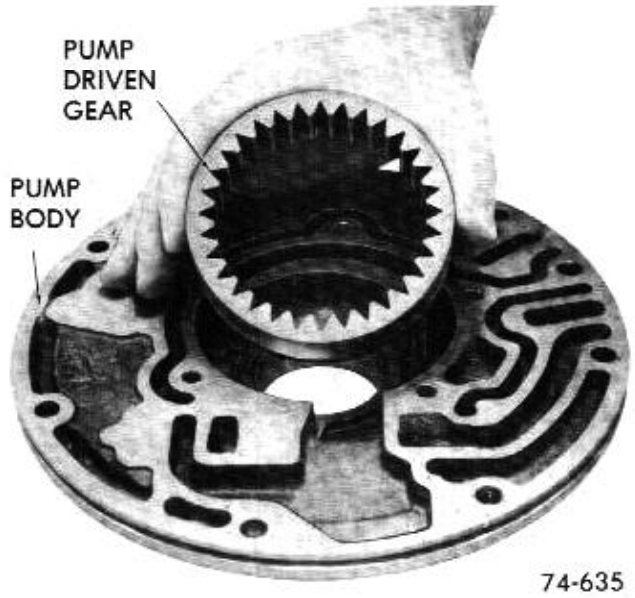


Figure 76-167

CAUTION: *Install the drive gear with drive tangs up.*

2. Install pressure regulator spring retainer, spacer(s) if used, and spring into the pressure regulator bore. See Figure 76-169.

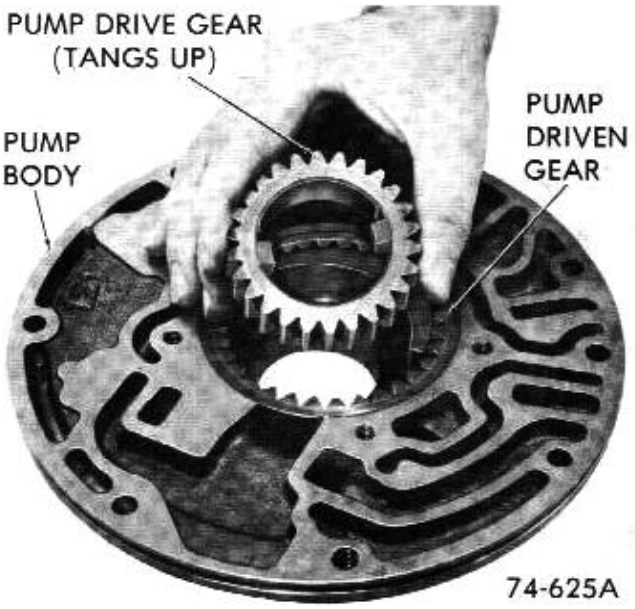


Figure 76-168

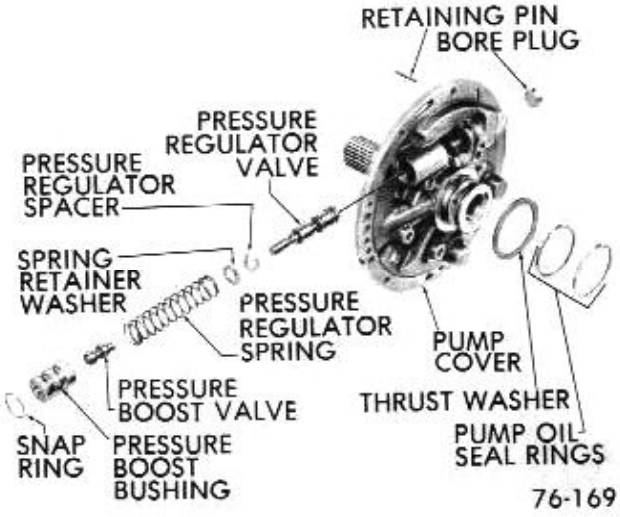


Figure 76-169

3. Install the pressure regulator valve from opposite end of bore, stem end first.

4. Install the boost valve into the bushing, stem end out, and install both parts into the pump cover by compressing the bushing against the spring.

5. Install the retaining snap ring.

6. Install the pressure regulator valve bore plug and retaining pin into opposite end of bore. See Figure 76-170.

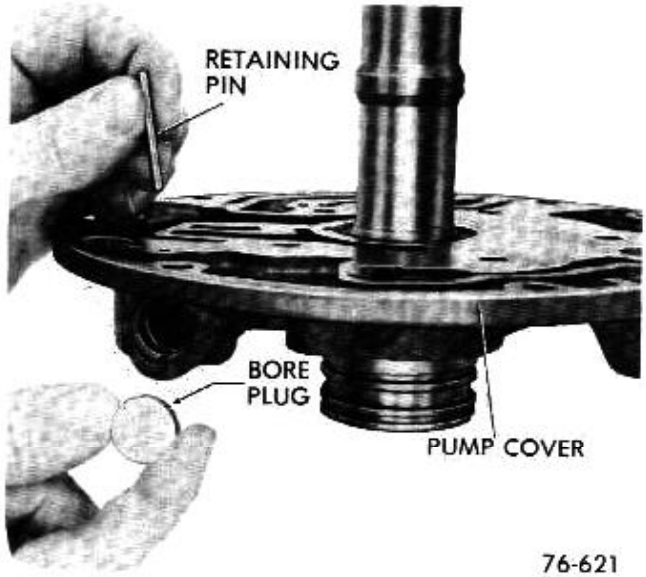


Figure 76-170

7. Install the previously selected front unit selective thrust washer over the pump cover delivery sleeve.

8. Install two (2) hook type oil seal rings. See Figure 76-171.

Figure 76-171

9. Assembly pump cover to pump body.

10. Install bolts as shown in Figure 76-173.

NOTE: *Leave bolts one turn loose at this time.*

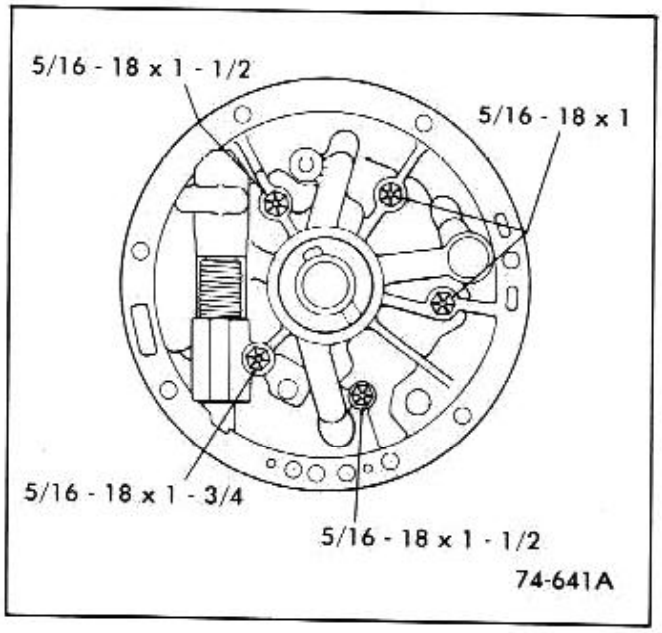


Figure 76-173

11. Place Pump Aligning Strap, J-21368, over pump body and cover, and tighten tool. See Figure 76-174.

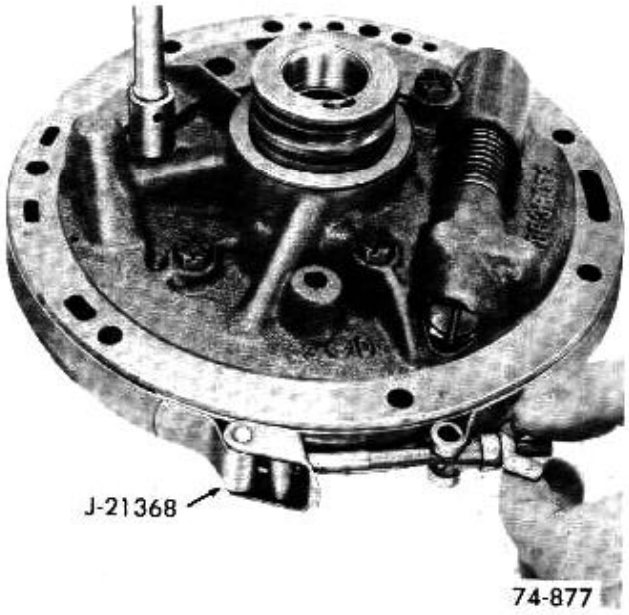


Figure 76-174

12. Tighten pump cover bolts. Torque to 15- 20 lb.ft.

13. Install pump to case "O" ring seal.

76-29 FORWARD CLUTCH ASSEMBLY

A. Disassembly

1. Place forward clutch and turbine shaft in hole in bench

and remove the forward clutch housing to direct clutch hub snap ring. See Figure 76-175.

Figure 76-175

2. Remove the direct clutch hub. See Figure 76- 176.

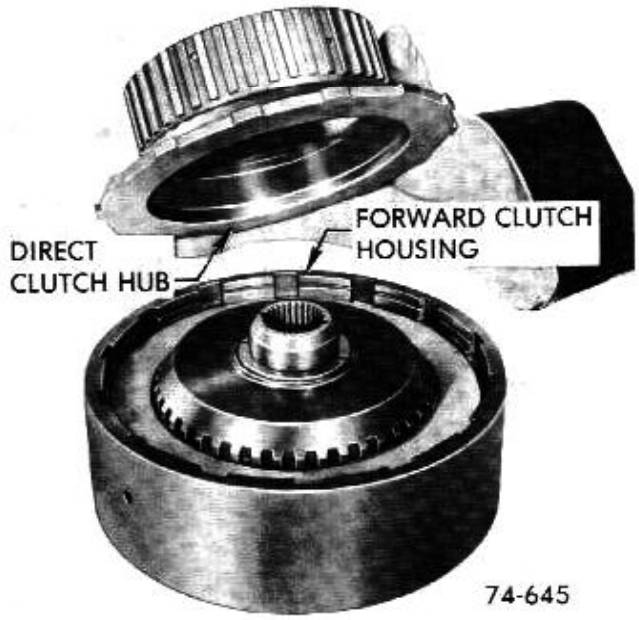


Figure 76-176

3. Remove the forward clutch hub and thrust washers. See Figure 76-177.

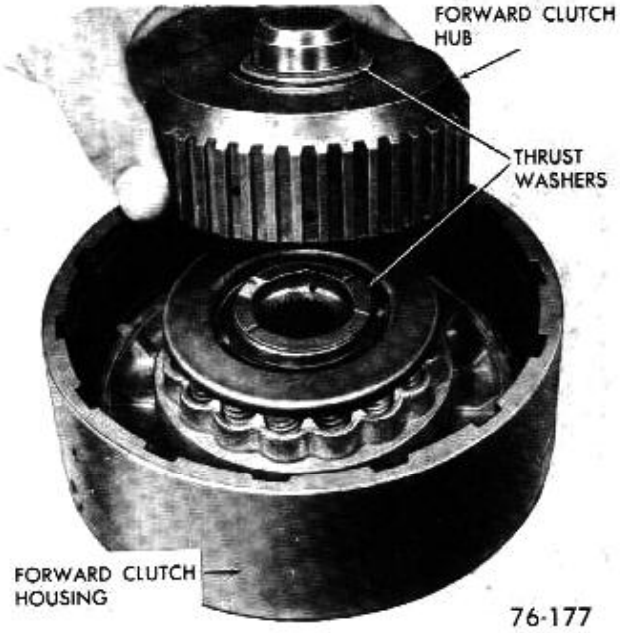


Figure 76-177

4. Remove five (5) radial groove composition and five (5) steel clutch plates. See Figure 76-178.

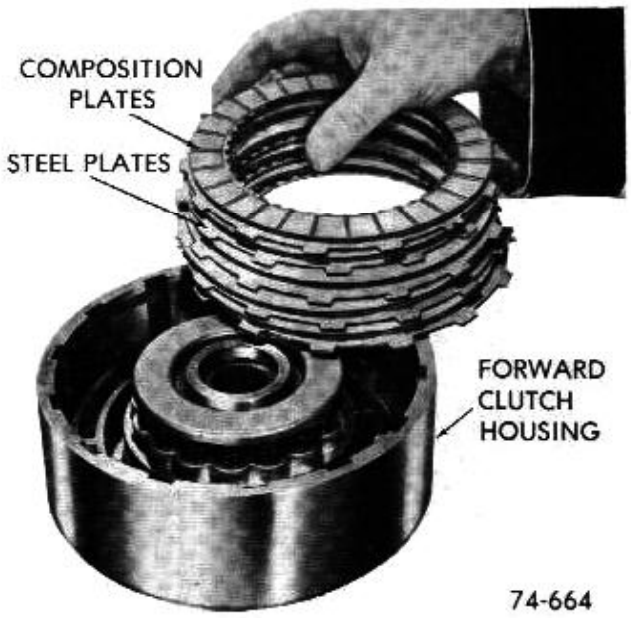


Figure 76-178

5. If necessary remove turbine shaft. See Figure 76-179.

6. Using J-2590 clutch spring compressor, compress the spring retainer and remove the snap ring. See Figure 76-180.

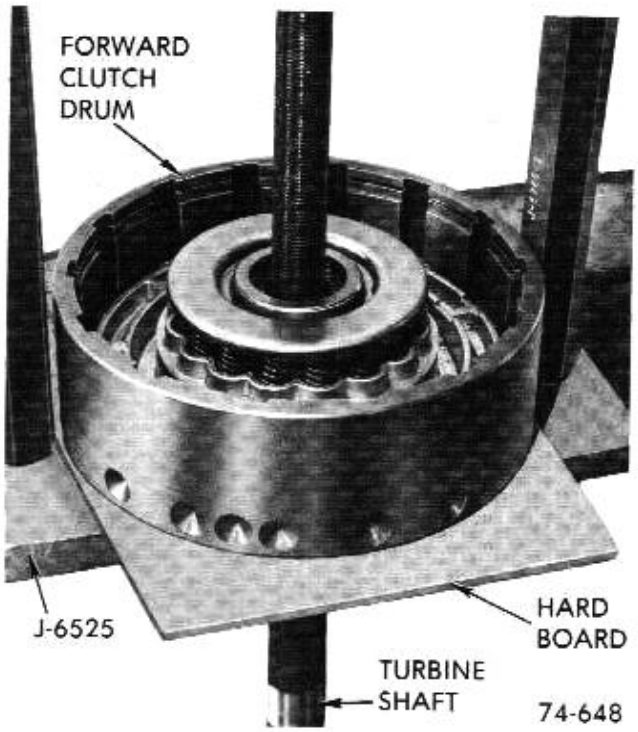


Figure 76-179

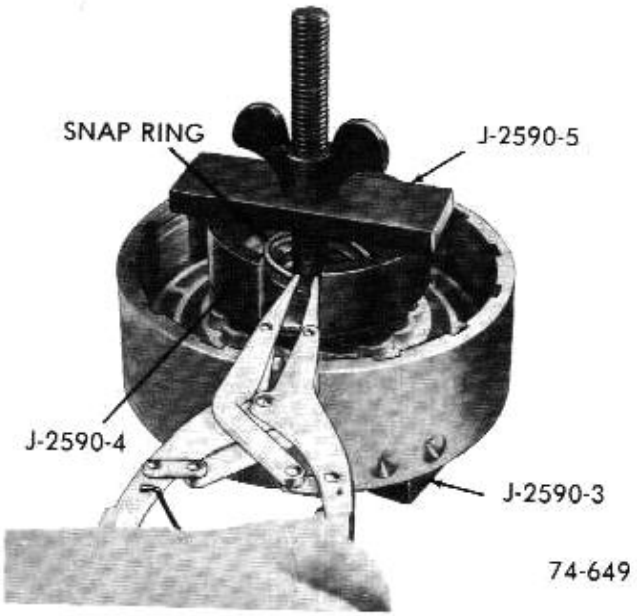


Figure 76-180

NOTE: *If turbine shaft is not removed, compress spring retainer as shown in Figure 76-181.*

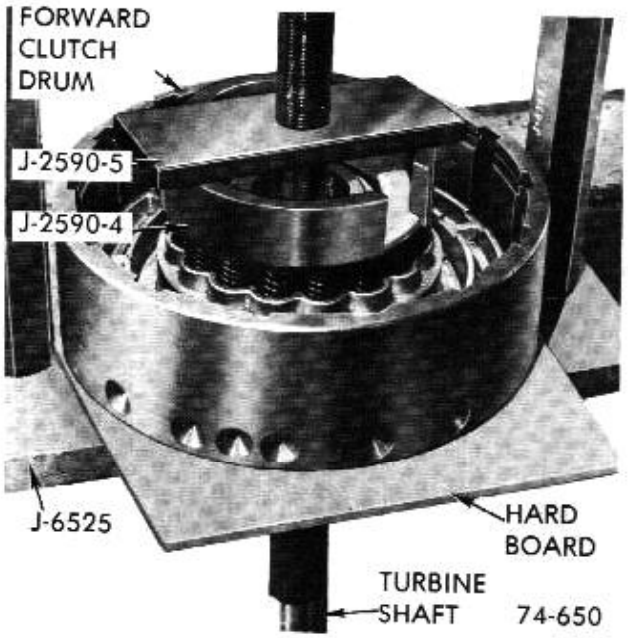


Figure 76-181

7. Remove tools, snap ring, spring retainer and sixteen clutch release springs. See Figure 76-182.

NOTE: *Keep these springs separate from the direct clutch release springs.*

Figure 76-182

8. Remove clutch piston.

9. Remove inner and outer clutch piston seals. See Figure 76-183.

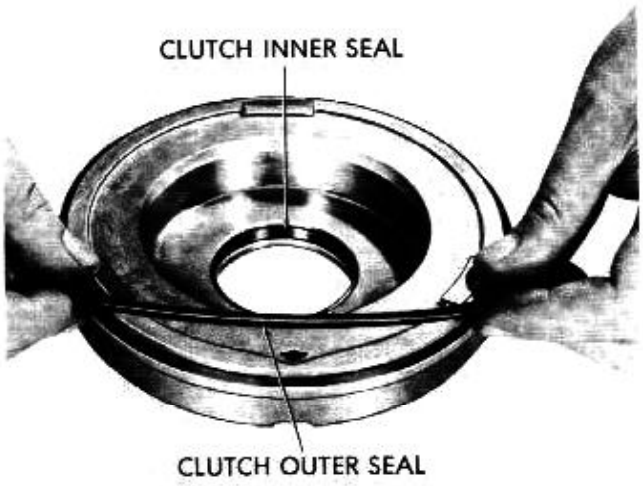


Figure 76-183

10. Remove center piston seal from the forward clutch housing. See Figure 76-184.

Figure 76-184

B. Inspection

1. Inspect condition of composition-faced and steel plates. *Do not diagnose a composition plate by color.*

A. Dry composition-faced with compressed air and inspect the composition surfaces for:

1. Pitting and flaking

2. Wear

3. Glazing

4. Cracking

5. Charring

6. Chips or metal particles imbedded in lining

If a composition-faced plate exhibits any of the above conditions, replacement is required.

B. Wipe steel plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plates must be replaced. See Figure 76-185.

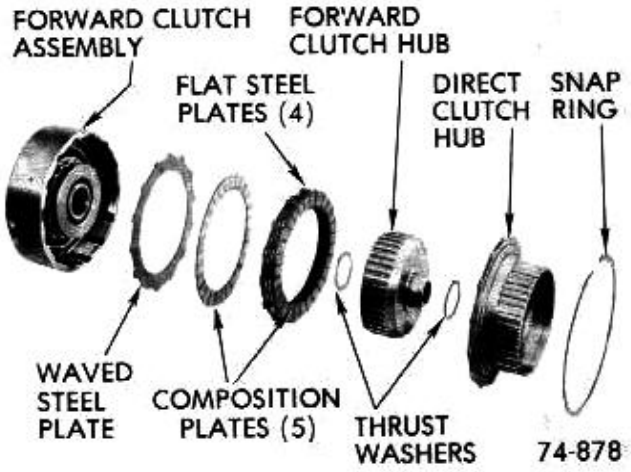


Figure 76-185

2. Inspect the 16 return springs. Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would justify replacement of the springs.

3. Inspect clutch hubs for worn splines, proper lubrication holes and worn thrust faces.

4. Inspect the piston for cracks.

5. Inspect clutch housing for wear, scoring, open oil passages and free operation of the ball check.

6. Inspect turbine shaft.

a. Inspect for open lubrication passages at each end.

b. Inspect splines for damage.

c. Inspect ground bushing journals for damage.

d. Inspect shaft for cracks or distortion.

NOTE: *Turbine shaft and clutch housing are serviced separately.*

C. Reassembly

1. Place new inner, and outer oil seals on clutch piston, lips face away from spring pockets. See Figure 76-183.

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 Figure 76-186. The forward clutch piston can be identified by the blind hole in the clutch apply face of the piston.*

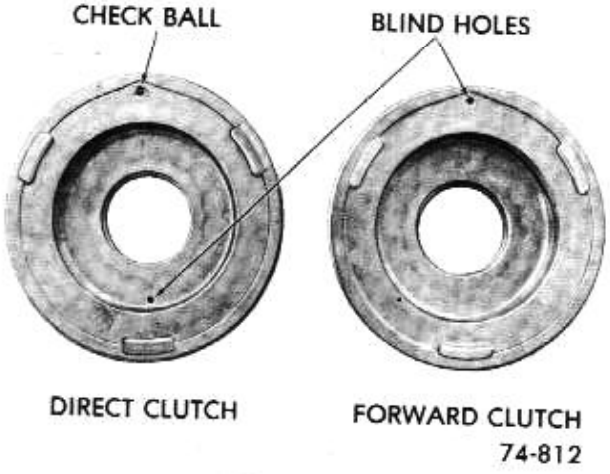


Figure 76-186

2. Place a new center seal on the clutch housing, lip faces up. See Figure 76-184.

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. See Figure 76-187.

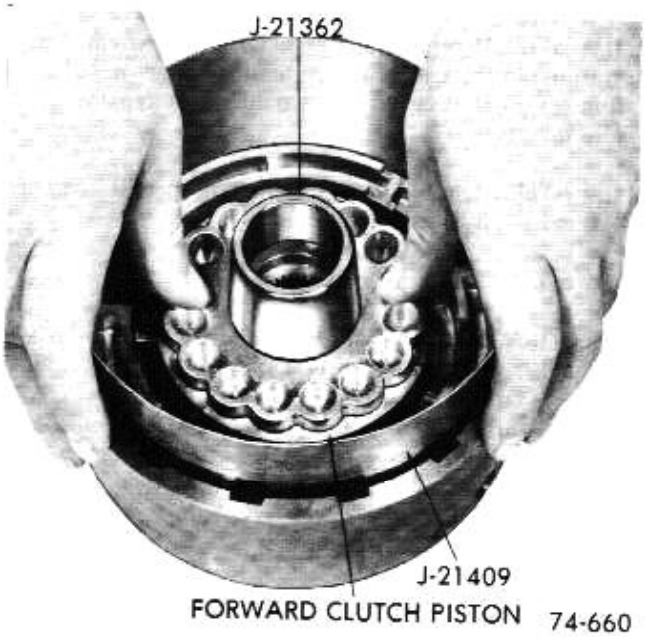


Figure 76-187

4. Install clutch release springs into pockets in piston. See Figure 76-188.

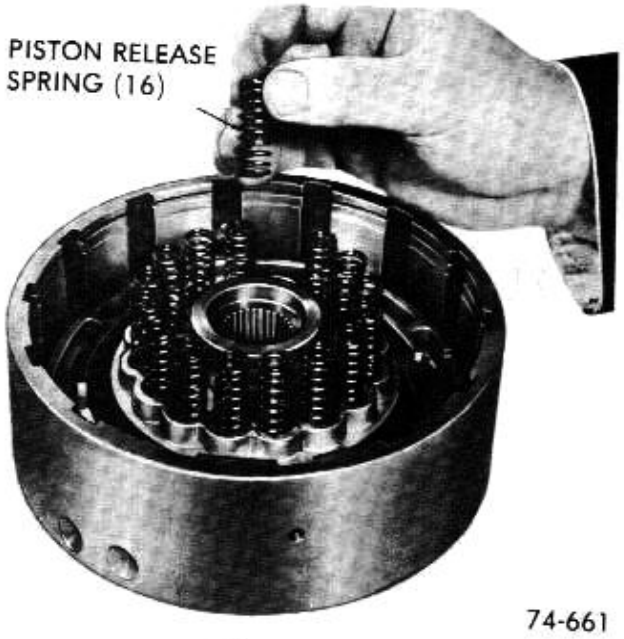


Figure 76-188

5. Place spring retainer and snap ring on springs.

6. Compress springs using Clutch Compressor Tool J-2590, and install snap ring. See Figure 76-189.

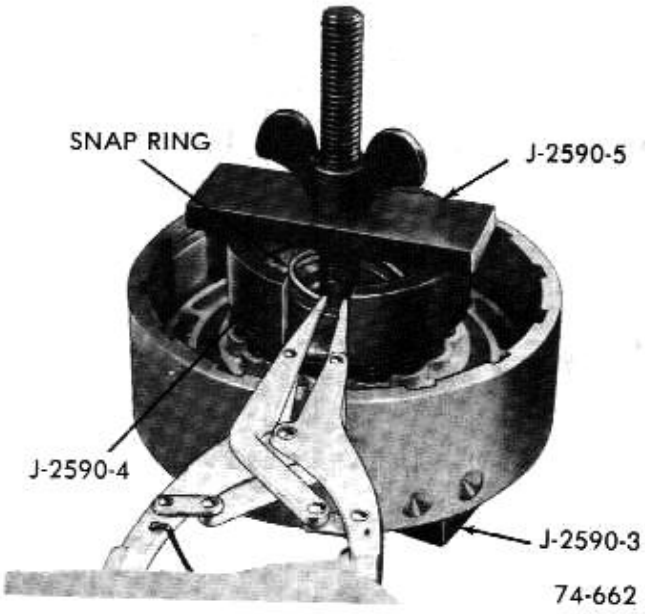


Figure 76-189

NOTE: *If turbine shaft was not removed, install retainer as shown in Figure 76-179.*

7. If removed, install turbine shaft into forward clutch drum. See Figure 76-190.

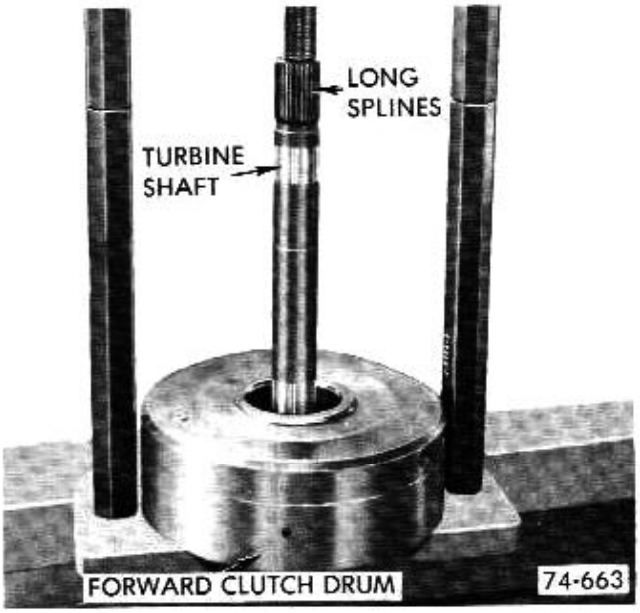


Figure 76-190

8. Install the forward clutch hub thrust washers on forward clutch hub. Retain with petroleum jelly. See Figure 76-191.

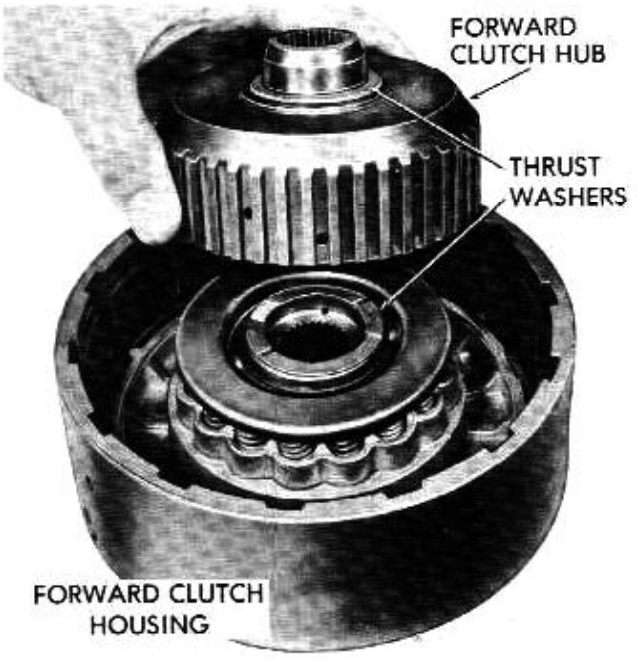


Figure 76-191

9. Place forward clutch hub into forward clutch housing. See Figure 76-191.

10. Oil and install five (5) radial groove composition, four (4) flat steel clutch plates and one (1) waved steel plate (plate with "U" notches), starting with waved steel and alternating composition and steel plates. See Figure 76-192.

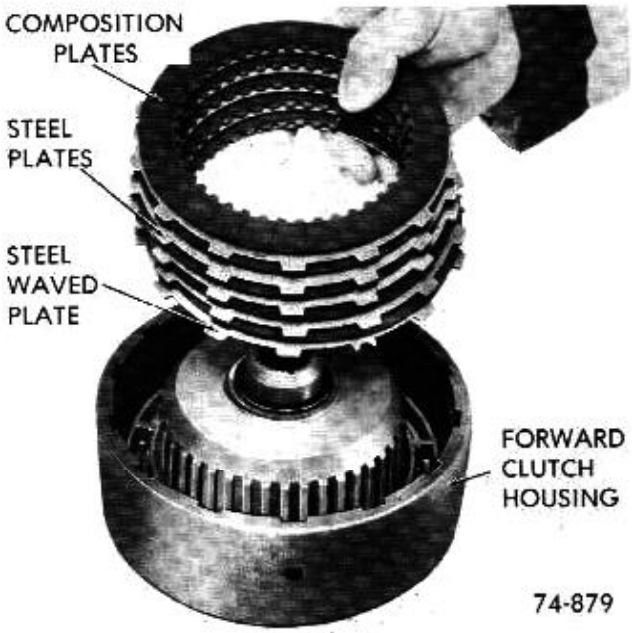


Figure 76-192

CAUTION: *Do not confuse the flat steel clutch plate (plate with "V" notch) with the waved steel clutch plate (plate with "U" notch.)*

NOTE: *Radially groved composition clutch plates are installed at the factory only. All service composition plates have the smooth surface configuration.*

11. Install the direct clutch hub and retaining snap ring. See Figure 76-193.

Figure 76-193

12. Place forward clutch housing on pump delivery sleeve and air check clutch operation. See Figure 76-194.

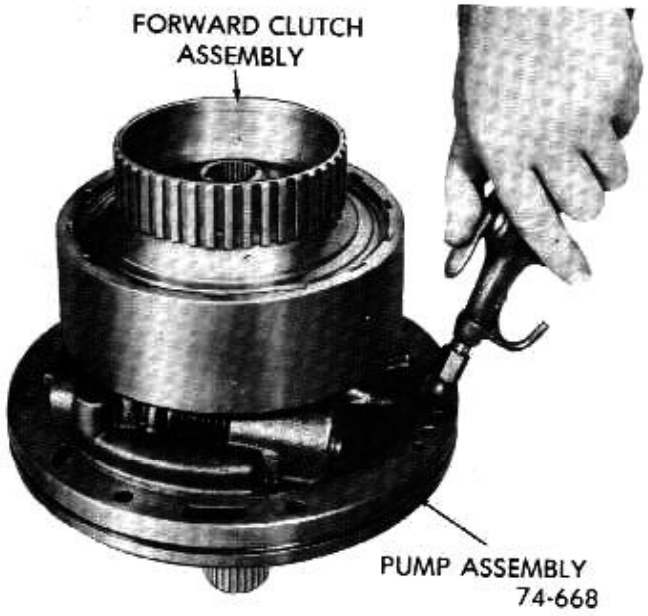


Figure 76-194

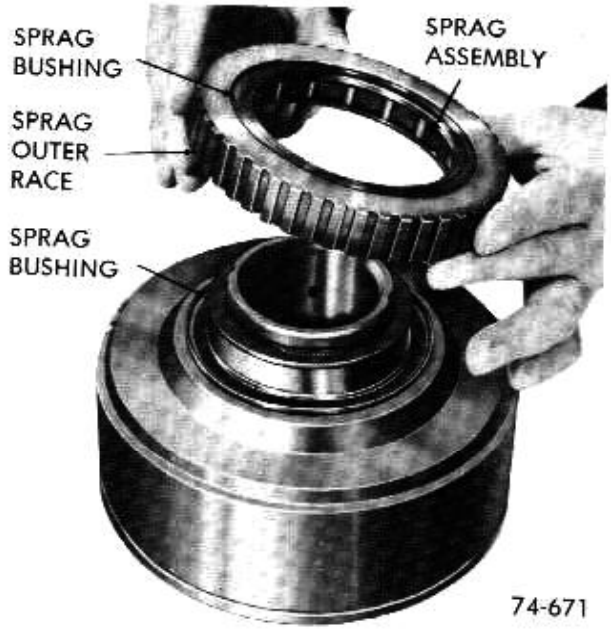


Figure 76-196

76-30 DIRECT CLUTCH AND INTERMEDIATE SPRAG

A. Disassembly

1. Remove sprag retainer snap ring and retainer. See Figure 76-195.

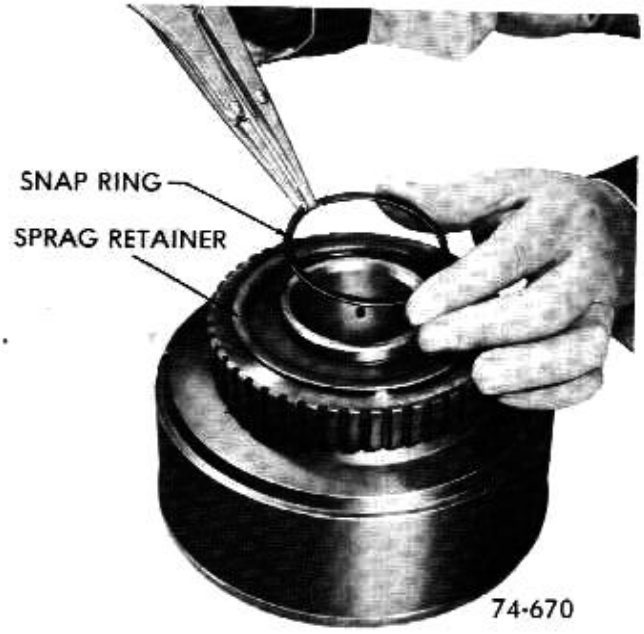


Figure 76-195

2. Remove sprag outer race, bushings and sprag assembly. See Figure 76-196.

3. Turn unit over and remove backing plate to clutch housing snap ring. See Figure 76-197.

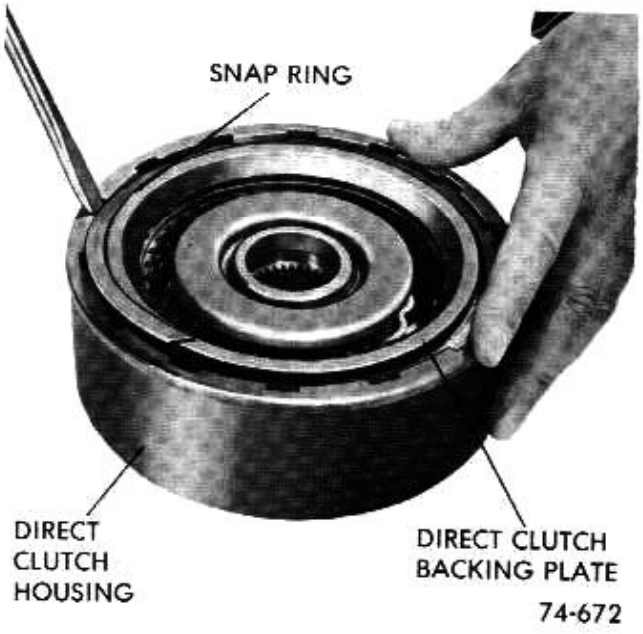


Figure 76-197

4.a. Models "BA", "BB", and "OW", remove direct clutch backing plate, six (6) composition-faced and six (6) steel clutch plates.

b. Models "BC" and "BT", remove direct clutch backing plate, five (5) composition-faced, and five (5) steel clutch plates.

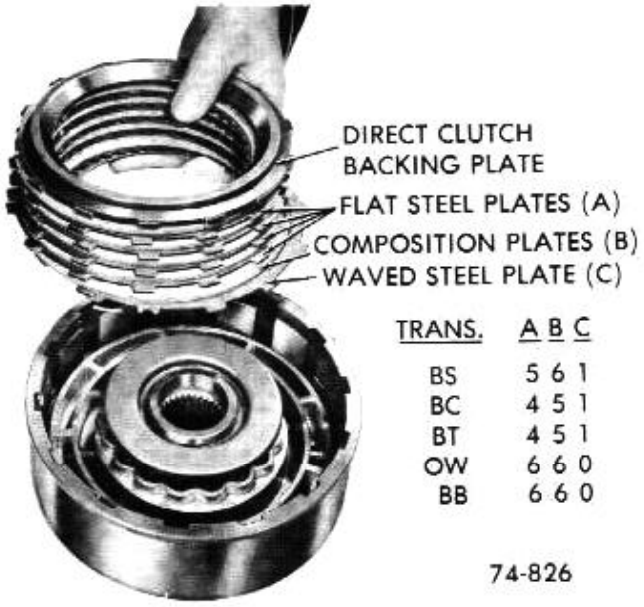


Figure 76-198

5. Using Tool J-2590, compress spring retainer and remove snap ring. See Figure 76-199.

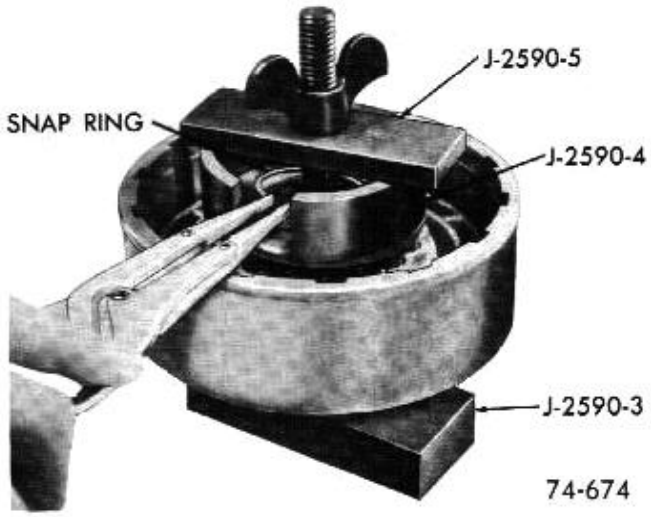


Figure 76-199

6. Remove retainer and fourteen (14) piston release springs. See Figure 76-200.

NOTE: *Keep these springs separate from foreward clutch release springs.*

7. Remove direct clutch piston. See Figure 76-201.

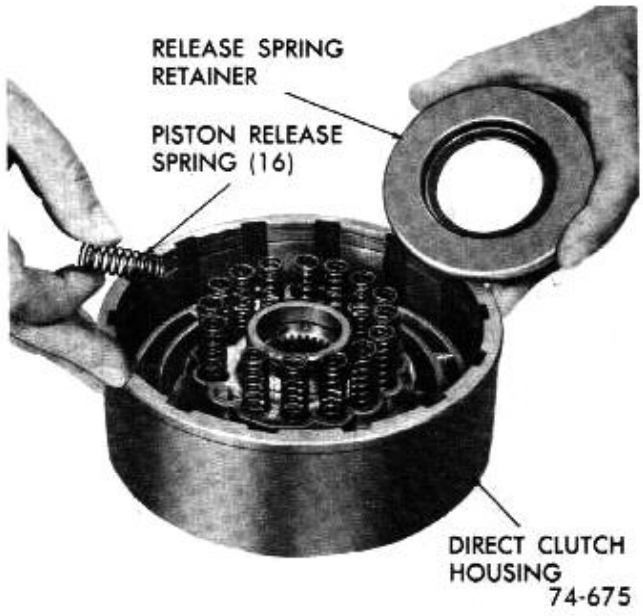


Figure 76-200

Figure 76-201

8. Remove outer seal from piston. See Figure 76-202.

9. Remove inner seal from piston. See Figure 76-203.

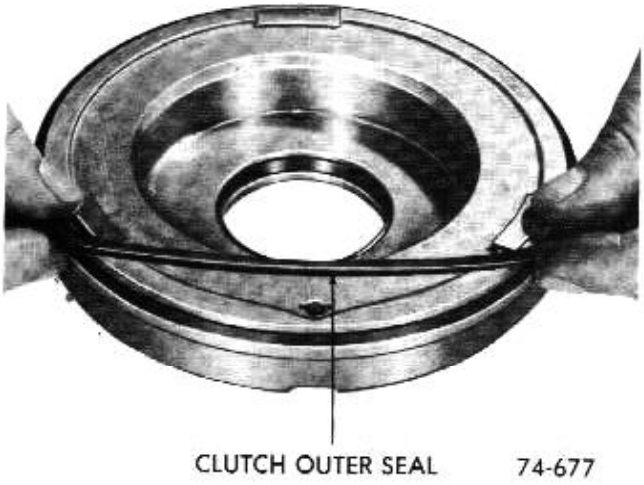


Figure 76-202

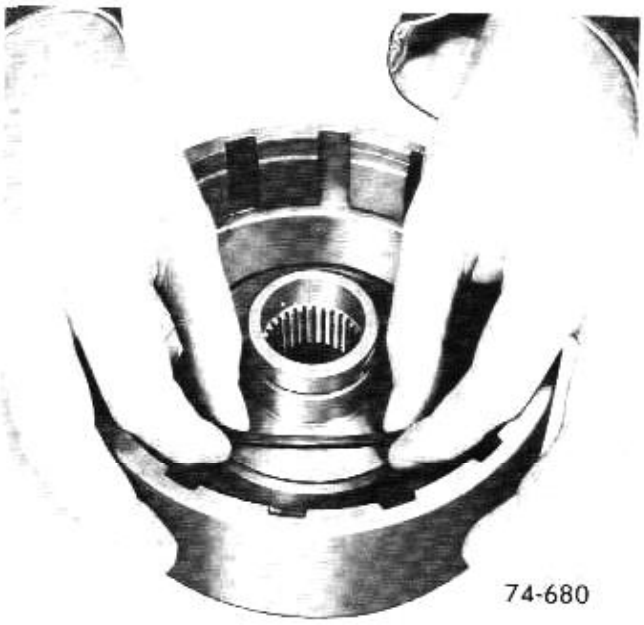


Figure 76-204

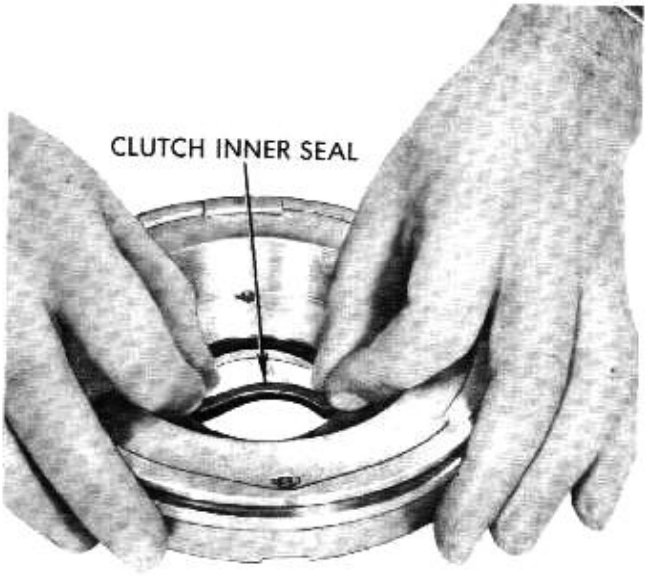


Figure 76-203

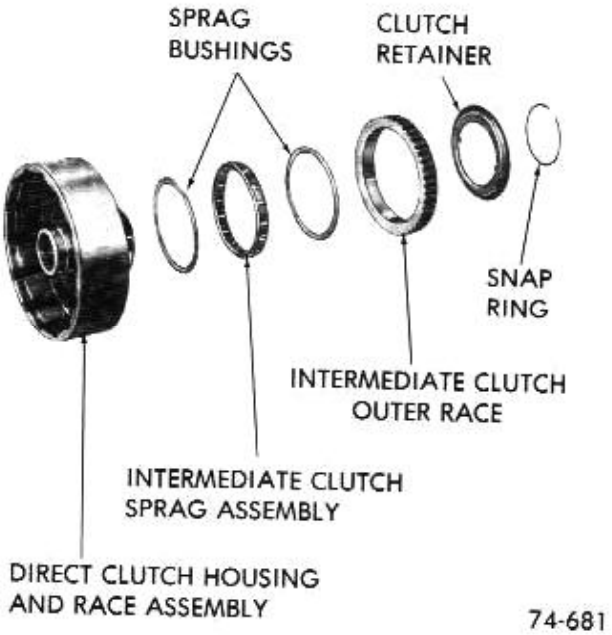


Figure 76-205

10. Remove center piston seal from direct clutch housing. See Figure 76-204.

B. Inspection

1. Inspect sprag assembly for popped or loose sprags. See Figure 76-205.

2. Inspect sprag bushings for wear or distortion.

3. Inspect the inner and outer races for scratches or wear.

4. Inspect clutch housing for cracks, wear, proper opening of oil passages or wear on clutch plate drive lugs.

5. Inspect condition of composition and steel plates. *Do not diagnose a composition-faced plate by color.*

A. Dry composition plates with compressed air and inspect the composition surface for:

1. Pitting and flaking

2. Wear

3. Glazing

4. Cracking

5. Charring

6. Chips or metal particles imbedded in lining

If a composition-faced plate exhibits any of the above conditions, replacement is required.

B. Wipe steel plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plates must be replaced.

6. Inspect the fourteen (14) return springs. Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would justify replacement of the springs.

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 release springs.*

NOTE: *See Figure 76-198 for "A", "B", and "C" callouts on Figure 76-206.*

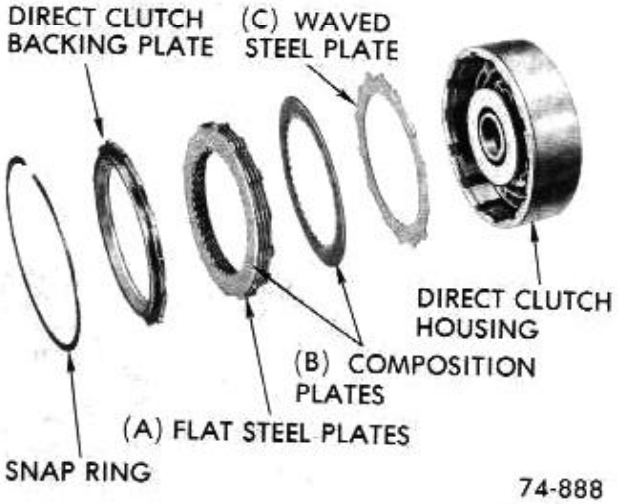


Figure 76-206

7. Inspect the backing plate for scratches or other damage.

8. Inspect the clutch piston for cracks and free operation of the ball check.

C. Reassembly

1. Install a new inner clutch piston seal on piston with lip facing away from spring pockets. Make certain correct piston is used. See Figure 76- 203.

2. Install a new outer clutch piston seal with lip away from spring pockets. See Figure 76-202

NOTE: *Make certain the piston has a ball check (Models "BB" and "OW" direct clutch piston has two (2) check balls). The piston with a blind hole is for the forward clutch assembly. See Figure 76-207.*

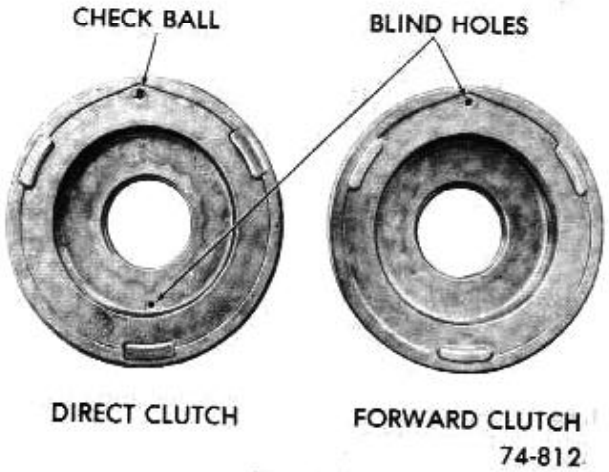


Figure 76-207

3. Install a new center seal on clutch housing with lip of seal facing up. See Figure 76-204.

CAUTION: *The direct clutch housing for the "BS", "BB", and "OW" models use the six (6) plate direct clutch assembly. This housing can be identified by the elimination of the I.D. chamfer on the clutch plate end of the housing and/or a groove in the face at the base of the tower. See Figure 76-208. Should replacement of the direct clutch housing become necessary, extreme care must be taken in obtaining the correct part for the model involved.*

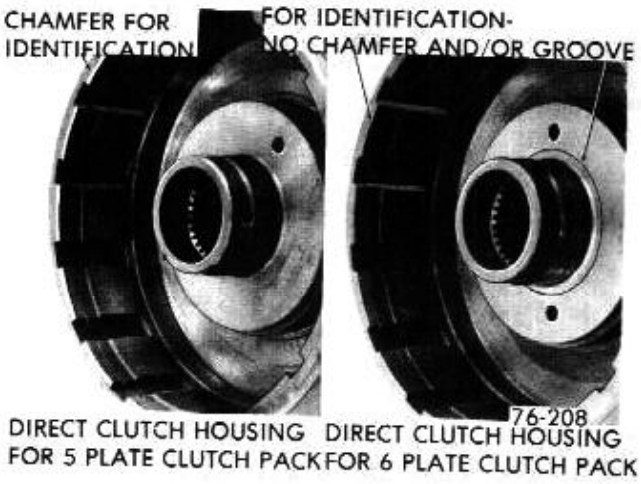


Figure 76-208 Direct Clutch Housing Identification

4. Place Seal Protectors, Tools J-21362 - Inner, J- 21409 - Outer, over hub and clutch housing and install clutch piston. See Figure 76-209.

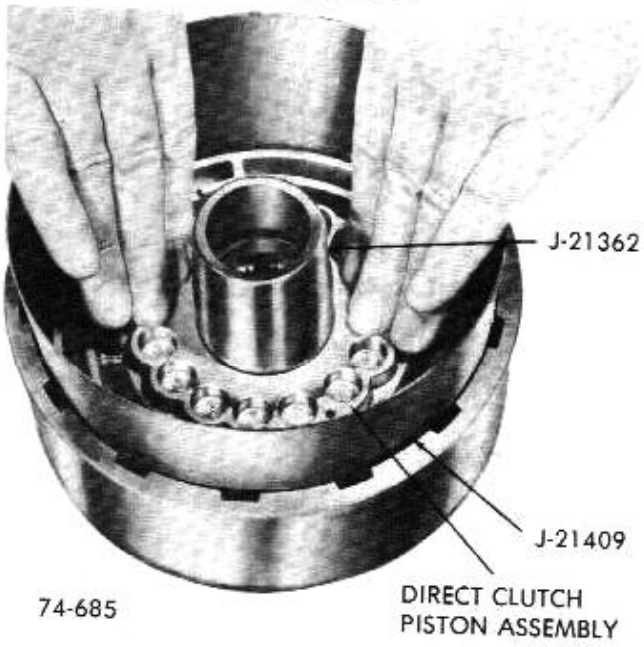


Figure 76-209

5. Install fourteen (14) clutch release springs into spring pockets in clutch piston, leaving two (2) pockets directly opposite one another with no springs.

6. Place spring retainer and snap ring on springs.

7. Using Tool J-2590, install snap ring. See Figure 76-199.

8.a. Model "BS", lubricate with transmission fluid and install six (6) composition-faced, five (5) flat steel, and one (1) waved steel plate (plate with "U" notch), starting with the waved steel and alternating composition and steel plates. See Figure 76-198.

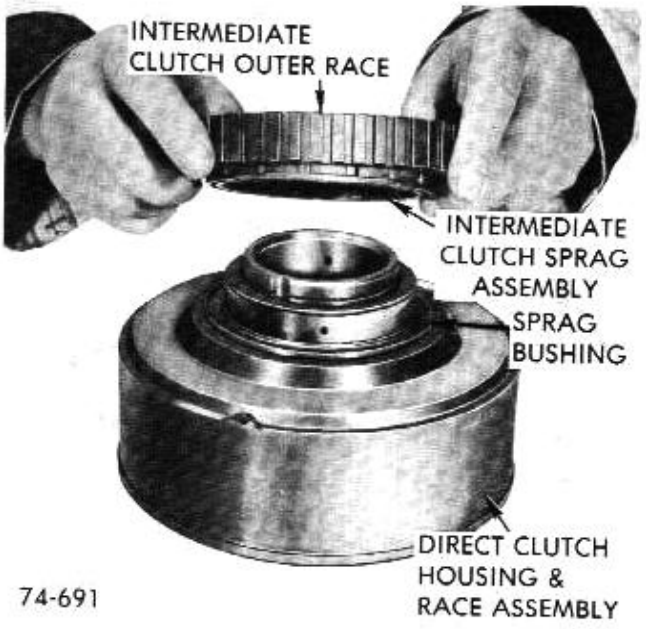


Figure 76-212

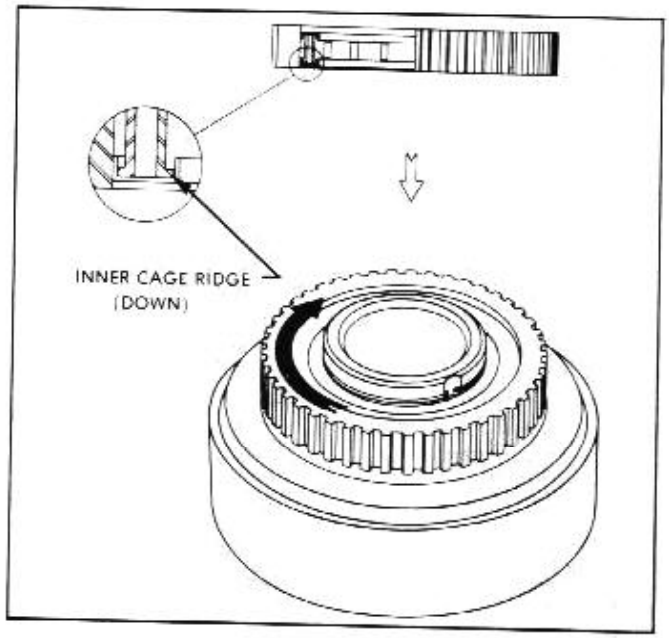


Figure 76-213

b. Models "BC" and "BT", lubricate with transmission fluid and install five (5) composition-faced, four (4) flat steel, and one (1) waved steel plate (plate with "U" notch), starting with the waved steel and alternating composition and steel plates. See Figure 76-198.

c. Models "BB" and "OW", lubricate with transmission fluid and install six (6) composition-faced and six (6) flat steel plates, starting with the flat steel and alternating composition and steel plates. See Figure 76-198.

NOTE: *Do not use radial groove compositon plates here.*

Figure 76-214

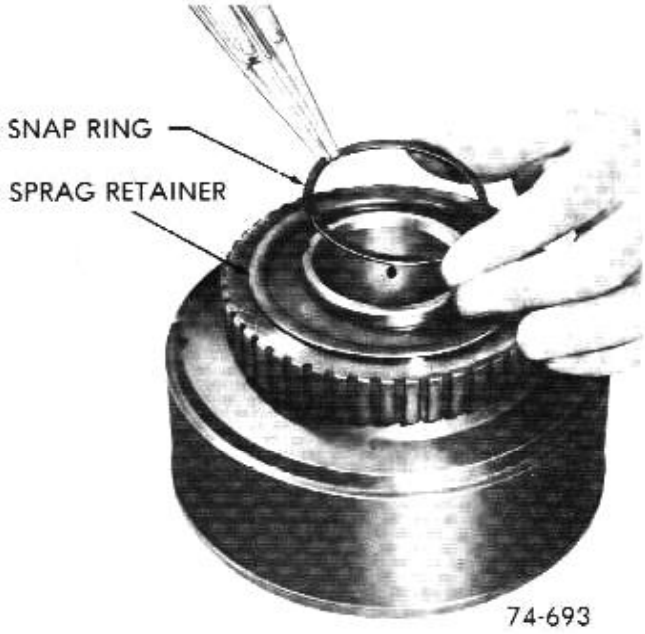


Figure 76-215

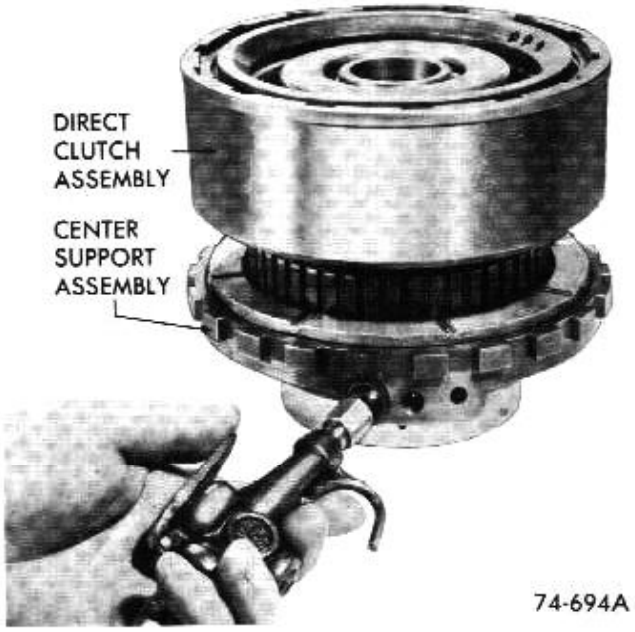


Figure 76-216

9. Install the clutch backing plate.

10. Install the backing plate retaining snap ring. See Figure 76-197.

11. Turn unit over and install one sprag bushing, cup side up, over inner race.

12. Install sprag assembly into outer race.

13. With ridge on inner cage facing down start sprag and outer race over inner race with clockwise turning motion. See Figure 76-212.

NOTE: *Outer race should not turn counterclockwise after installation. See Figure 76- 213.*

14. Install sprag bushing over sprag, cup side down.

15. Install sprag retainer over sprag, cup side down. See Figure 76-214.

16. Install sprag retainer snap ring. See Figure 76-215.

17. Place direct clutch assembly over center support and air check operation of direct clutch. See Figure 76-216.

NOTE: *If air is applied through the reverse passage, (right oil feed hole) it will escape from the direct clutch passage (left oil feed hole). This is considered normal. Apply air through left oil feed hole to actuate piston and move direct clutch.*

76-31 CENTER SUPPORT AND INTERMEDIATE CLUTCH (See Figure 76-217)

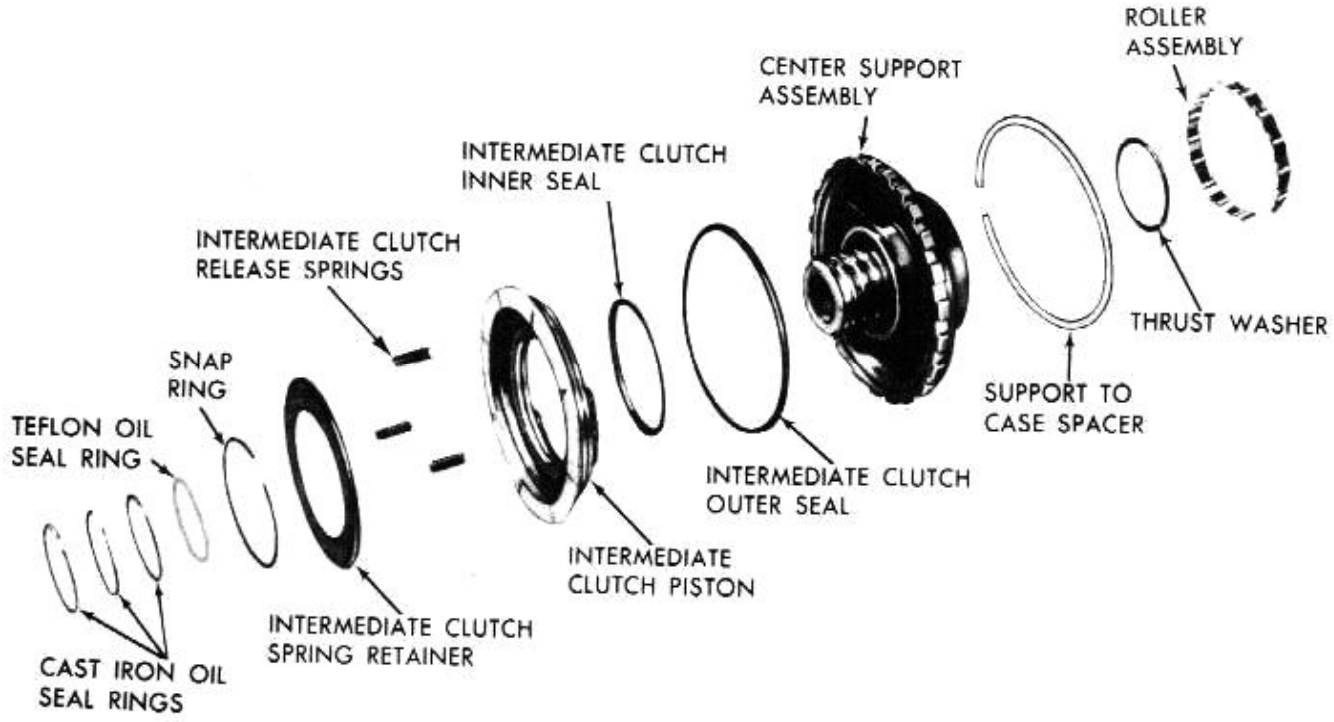


Figure 76-217

A. Disassembly

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 hood type cast iron. See Figure 76-218.

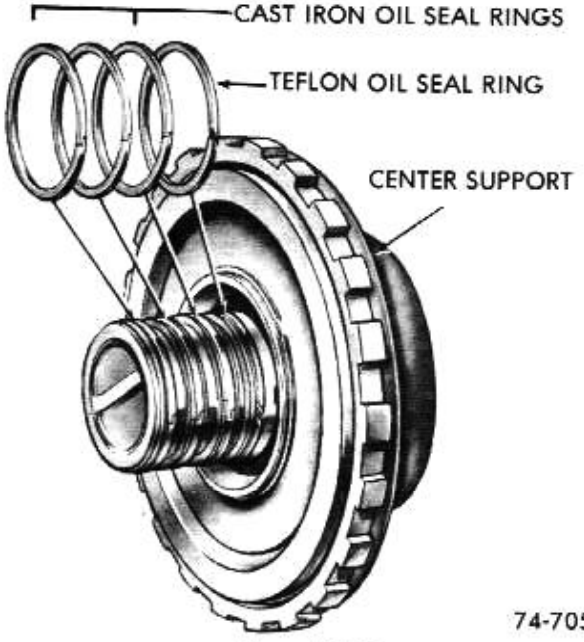


Figure 76-218

2. Using Clutch Compressor J-2590, compress spring retainer and remove snap ring. See Figure 76- 219.

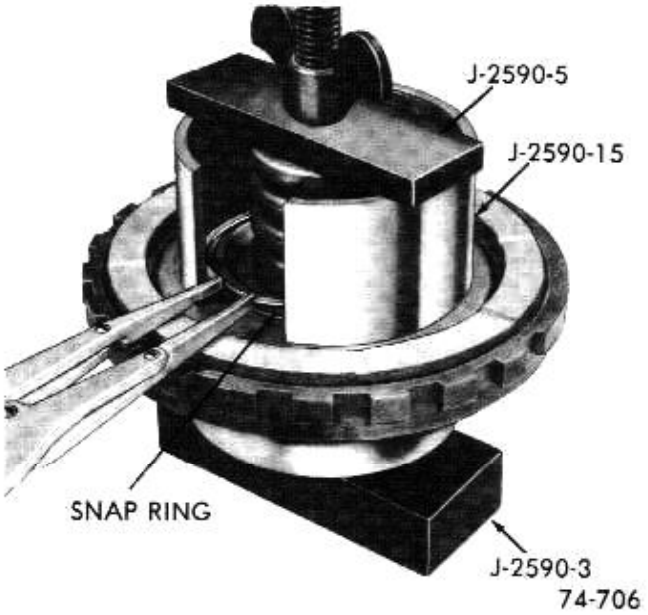


Figure 76-219

3. Remove spring retainer. See Figure 76-220. Remove three (3) clutch release springs. See Figure 76-221.

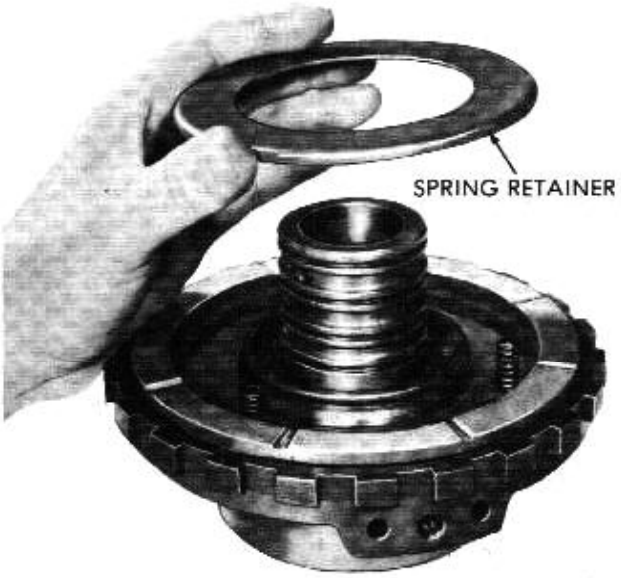


Figure 76-220

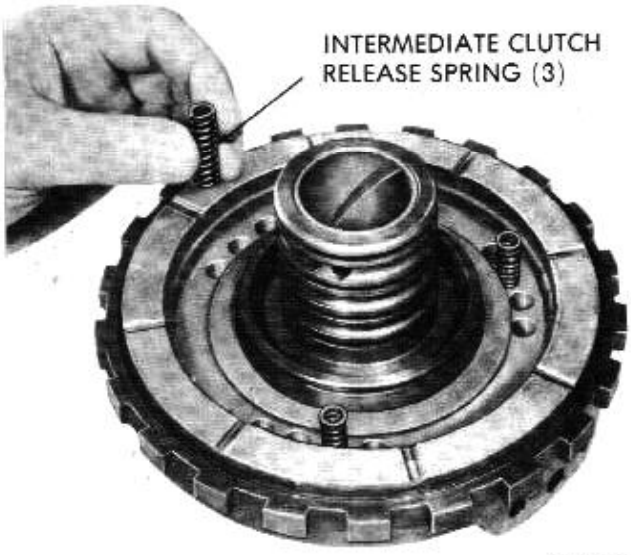


Figure 76-221

4. Remove the intermediate clutch piston. See Figure 76-222.

NOTE: *Do not remove the three (3) bolts retaining the roller clutch inner race to the center support.*

5. Remove the inner piston seal. See Figure 76-223.

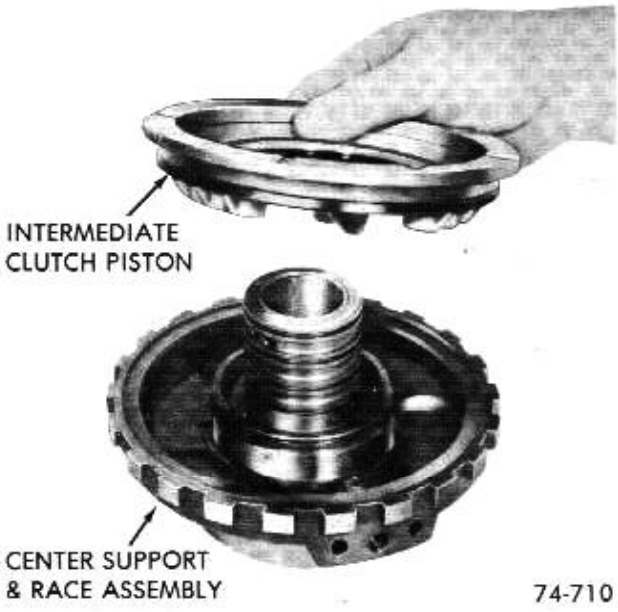


Figure 76-222

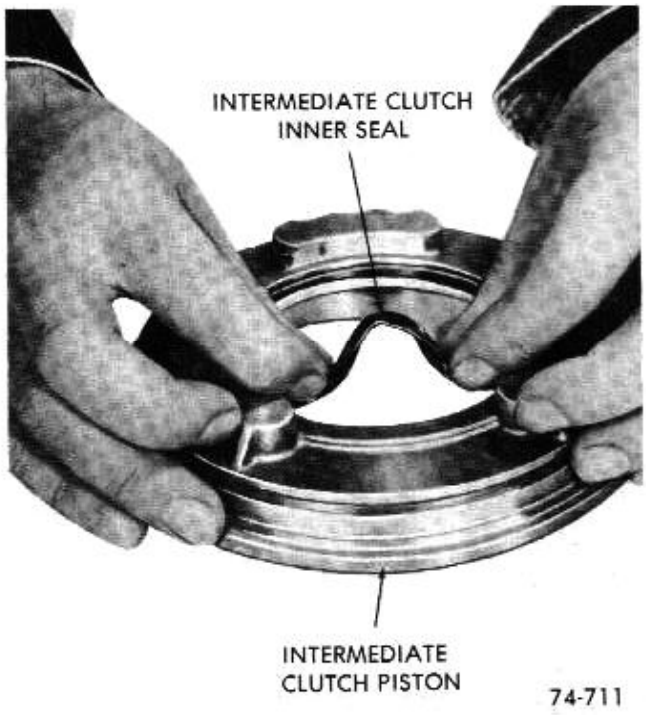


Figure 76-223

6. Remove the outer piston seal. See Figure 76- 224.

B. Inspection

1. Inspect the roller clutch inner race for scratches or indentations. Be sure the lubrication hole is open.

2. Inspect the bushing for scoring, wear or galling. If replacement is necessary proceed as follows:

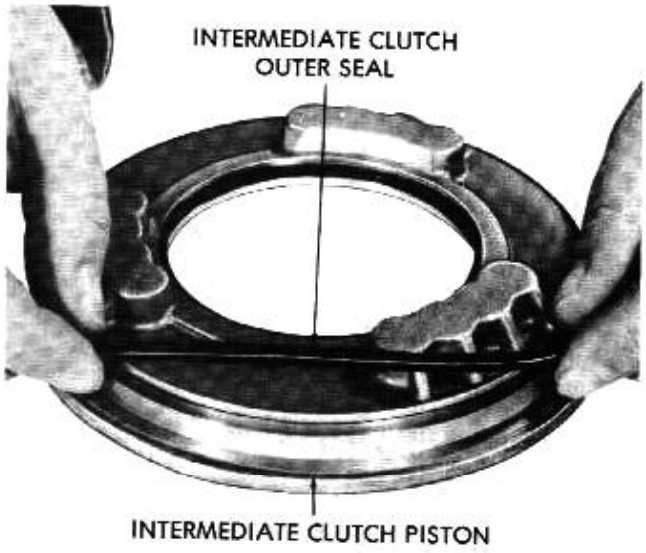


Figure 76-224

a. Using Tool J-21465-6, remove bushing. See Figure 76-225.

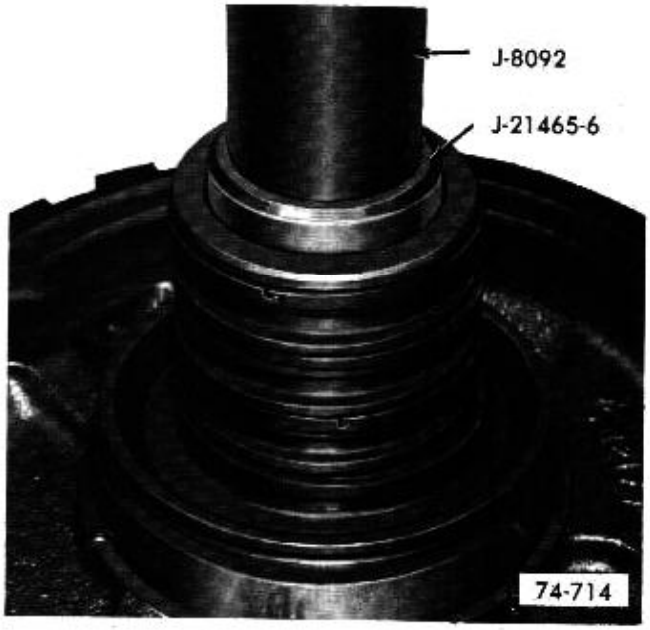


Figure 76-225

b. From front side of center support, align elongated slot in bushing with drilled hole in the oil delivery sleeve closest to the piston. Using Tool J-21465-6 and Drive Handle J-8092, drive bushing squarely into the bore until the bushing is flush to .010" below top of oil delivery sleeve.

2. Check the oil ring grooves and rings for damage.

NOTE: *All Service center support oil seal rings are hook type cast iron.*

3. Air check the oil passages to be sure they are open and not interconnected. See Figure 76-226. Be sure constant bleed plug orifice is open. See Figure 76-137.

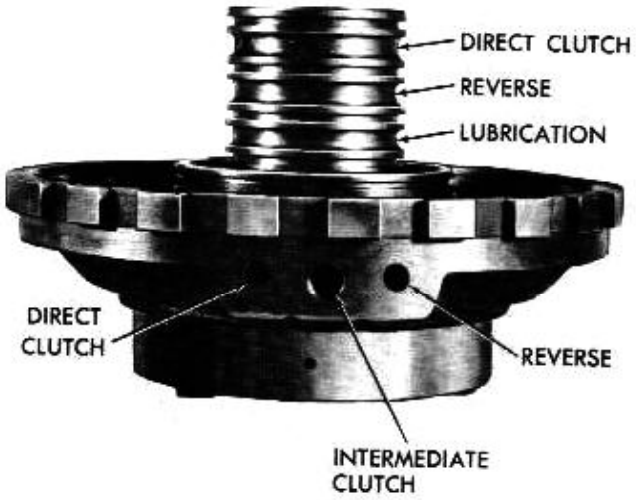


Figure 76-226

4. Inspect piston sealing surfaces for scratches.

5. Inspect the piston seal grooves for nicks or other damage.

6. Inspect the piston for cracks or porosity.

7. Inspect the release springs. Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would justify replacement of the springs.

C. Reassembly

1. Install new inner seal on the piston with lip of the seal facing away from the spring pocket. See Figure 76-223.

2. Install new outer seal with the lip away from the spring pockets. See Figure 76-224.

3. Install inner seal protector, Tool J-21363, on the center support hub, install piston. See Figure 76-227.

4. Install three (3) release springs into the piston, space equally during assembly. See Figure 76-221.

5. Place the spring retainer and snap ring over the springs.

6. Using the Clutch Spring Compressor, J-2590, compress the springs and install the snap ring. See Figure 76-219.

7. Install three (3) hook type cast iron oil seal rings on the center support if the teflon ring was not removed. If the

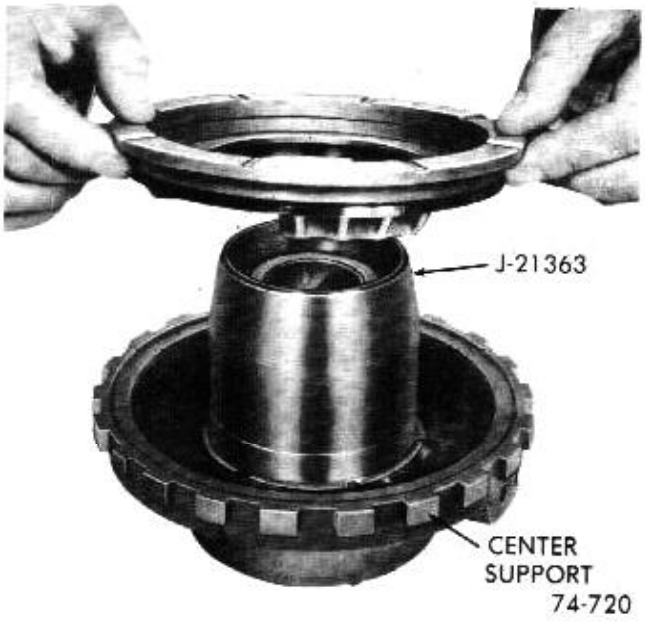


Figure 76-227

teflon ring was removed, install four (4) hook type cast iron oil seal rings. See Figure 76-218.

8. Air check operation of intermediate clutch piston. See Figure 76-231.

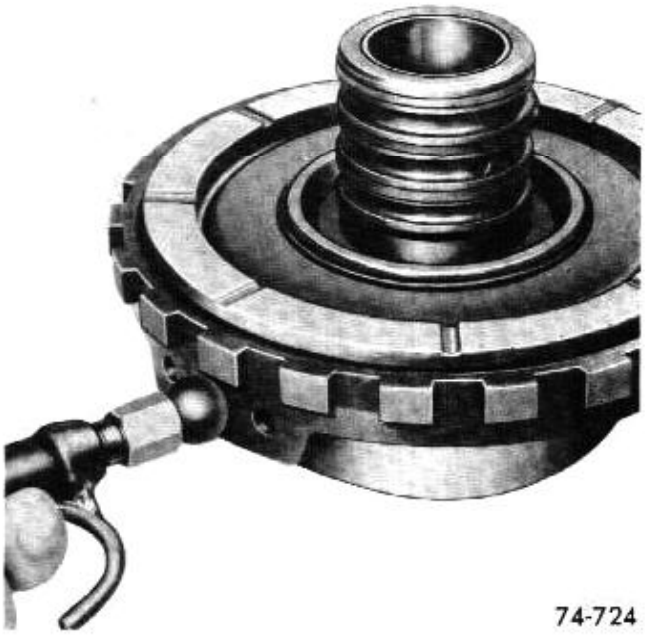


Figure 76-231

9. Install center support into roller clutch in reaction carrier. See Figure 76-140.

76-32 INSPECTION OF TRANSMISSION PARTS

A. Case Bushing

1. Inspect case bushing for wear or galling. If replacement is necessary proceed as follows:

a. Thread Extension Handle J-21465-13 into Bushing Remover J-21465-8. Using Drive Handle J-8092 remove bushing. See Figure 76-232.

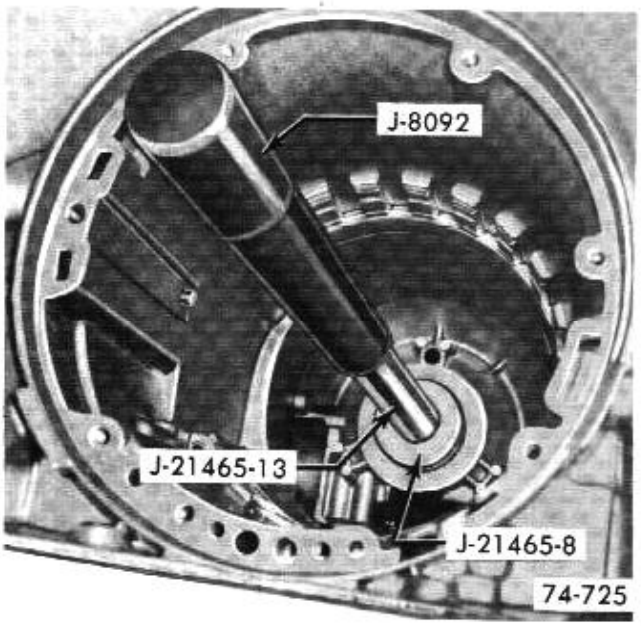


Figure 76-232

b. Using Adapter J-21465-9 on J-21465-8 driver handle and extension J-21465-13, with lube passage facing front of transmission case, install new bushing into case, until .040" - .055" above selective thrust washer face. See Figure 76-233

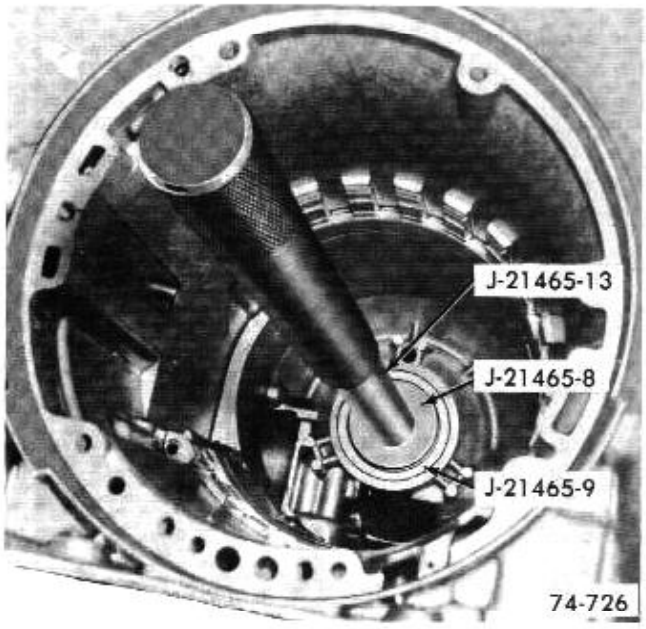


Figure 76-233

c. Using J-21465-10 stake bushing in oil groove.

B. Inspection of Front and Rear Bands and Center Support-to-Case Spacer

1. Inspect the lining for cracks, flaking, burning or looseness. See Figure 76-234.

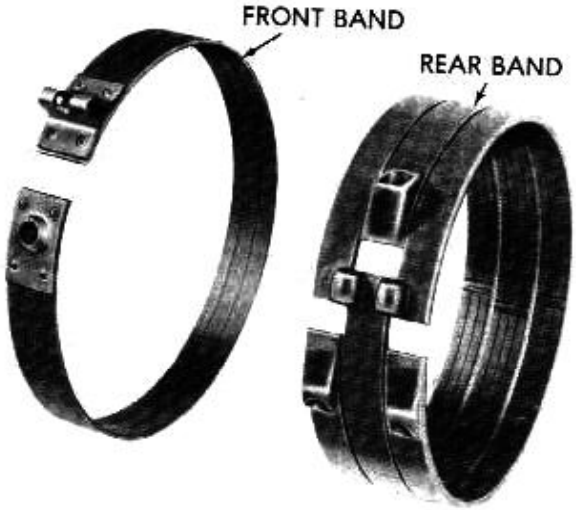


Figure 76-234

2. Inspect the bands for cracks or distortion.

3. Inspect the end for damage at the anchor lugs or apply lugs.

4. Inspect support to case spacer for burrs or raised edges. If present, remove with a stone or fine sand paper.

C. Inspection of Case Extension

1. Inspect the bushing for excessive wear or damage. If replacement is necessary, remove rear seal, position housing on bench with seal end up, and proceed as follows:

All Models Except "BT"

a. Using Drive Handle J-8092 and Tool J-21465-17, remove bushing. See Figure 76-235.

b. Using Drive Handle J-8092 and Tool J-21465-17, install bushing. See Figure 76-235.

c. Using J-21465-10, stake bushing in oil grooves. See Figure 76-236.

2. Inspect the housing for cracks or porosity.

3. Be sure rear seal drain back port is not obstructed.

D. Inspection of Manual and Parking Linkage

1. Inspect the parking pawl actuator rod for cracks or broken spring retainer lugs. See Figure 76-75.

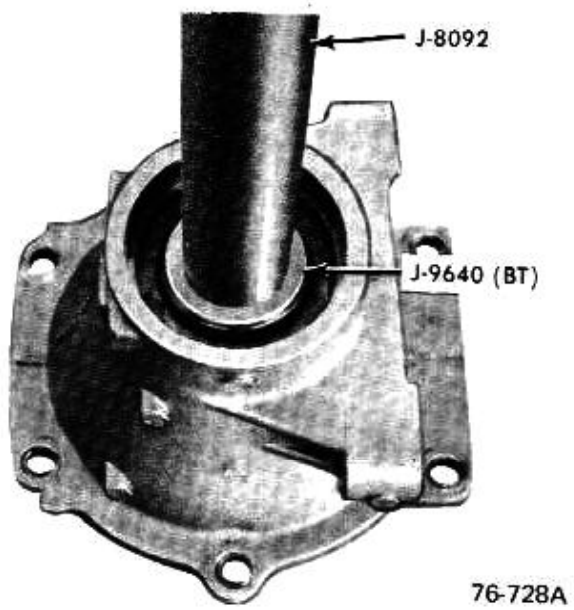


Figure 76-235

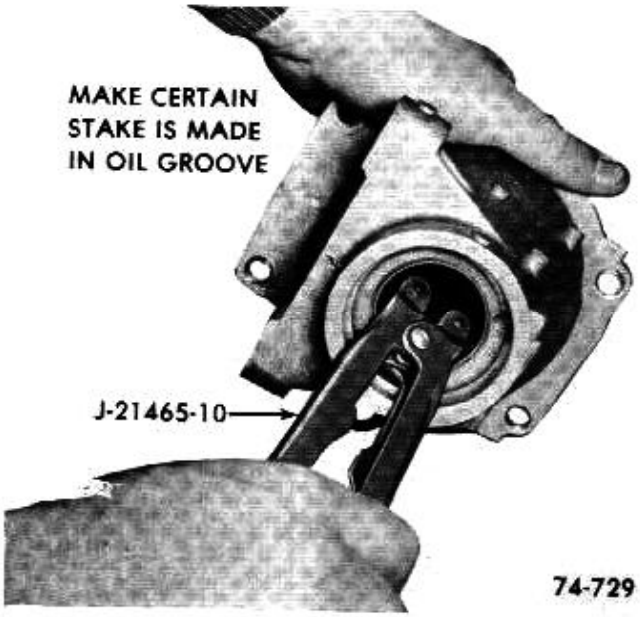


Figure 76-236

2. Inspect the actuator spring for damage.

3. Inspect actuator for a free fit on the actuator rod.

4. Inspect the parking pawl for cracks or wear, if removed.

5. Inspect the manual shaft for damaged threads, rough oil seal surface or loose lever.

6. Inspect the inside detent lever for cracks or a loose pin.

7. Inspect the parking pawl shaft for damaged retainer groove if removed.

8. Inspect the parking pawl return spring for deformed coils or ends.

9. Inspect the parking lock bracket for cracks or wear.

10. Inspect detent roller and spring assembly.

E. Inspection of Case Assembly

CAUTION: *If the case assembly requires replacement, make sure the center support-to-case spacer is removed from the old case and reinstalled in the new case. See Figure 76-246.*

1. Inspect case assembly for cracks, porosity or interconnected passages. See Figure 76-11.

NOTE: *If case porosity exists, repair following procedures outlined in Paragraph 76-3, subparagraph C.*

2. Check for good retention of ban anchor pins.

3. Inspect all threaded holes for thread damage.

4. Inspect the intermediate clutch driven plate lugs for damage or brinelling.

5. Inspect the snap ring grooves for damage.

6. Inspect the bore of the governor assembly for scratches or scoring.

7. Inspect the modulator valve bore for scoring or damage.

8. Inspect the cup plug inside the case for good staking and sealing.

F. Inspection of Torque Converter

1. Check converter for leaks as follows: (See Figure 76-237.)

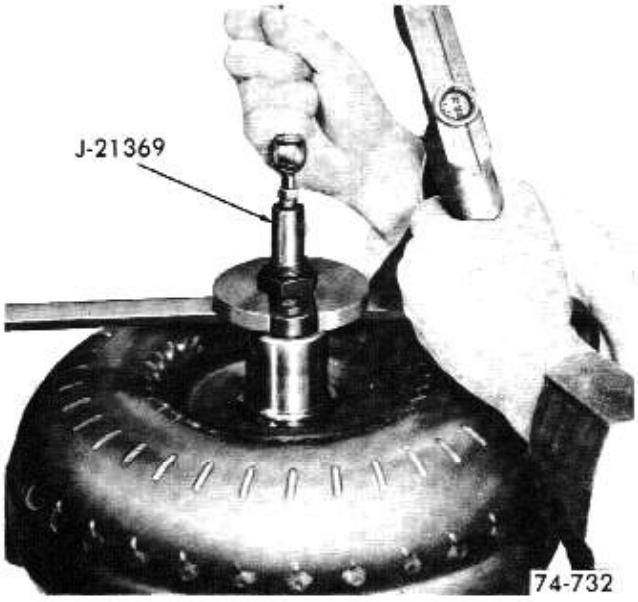


Figure 76-237

a. Install Tool J-21369, and tighten.

b. Fill converter with air; 80 psi.

c. Submerge in water and check for leaks.

2. Check converter hub surfaces for signs of scoring or wear.

3. Check converter end clearance as follows:

a. Install Tool J-21371-2 and tighten brass nut. See Figure 76-238.

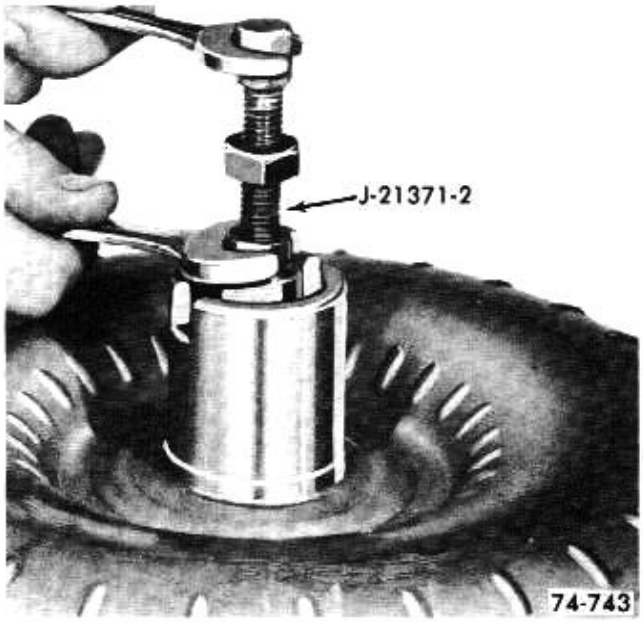


Figure 76-238

b. Install Tool J-21371-3 and tighten hex nut. See Figure 76-239.

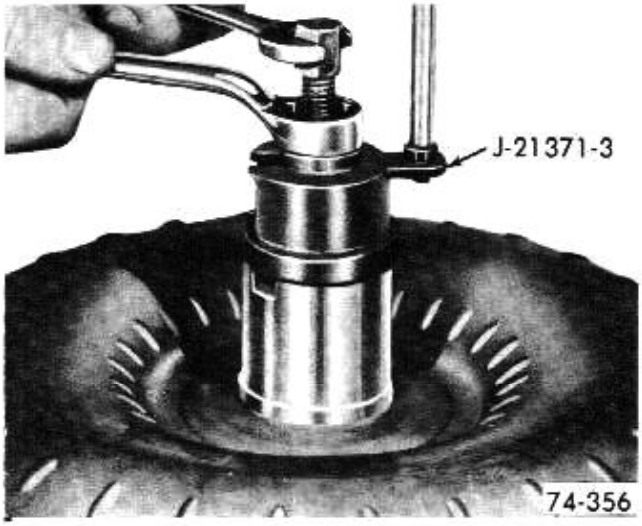


Figure 76-239

c. Install dial indicator set at 0 as shown in Figure 76-240.

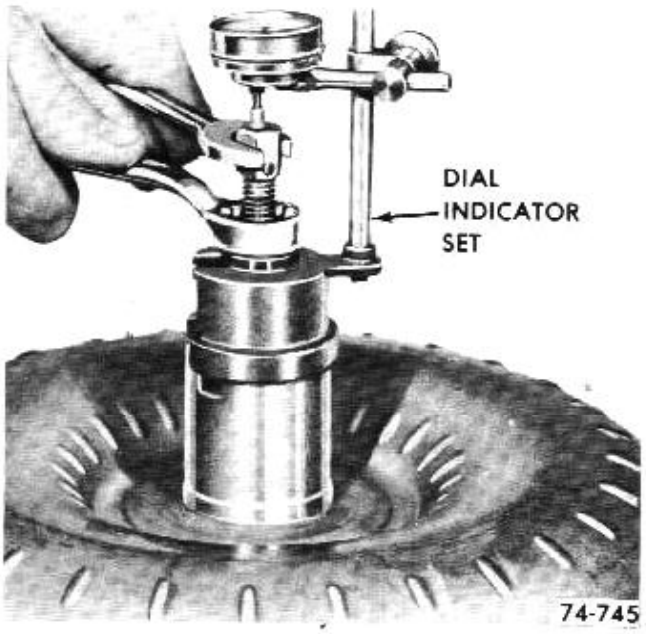


Figure 76-240

d. Loosen hex nut. When nut is fully loosened the reading obtained on the dial indicator will be converter end clearance. If clearance is .050" or over and the oil has the appearance of having been mixed with aluminum paint, replace the converter. See Figure 76-240.

76-33 ASSEMBLY OF MAJOR UNIT

NOTE: *The first three steps can be omitted if the parts involved were not removed on disassembly.*

1. Install the parking pawl, tooth toward the inside case and parking pawl shaft. See Figure 76-241.

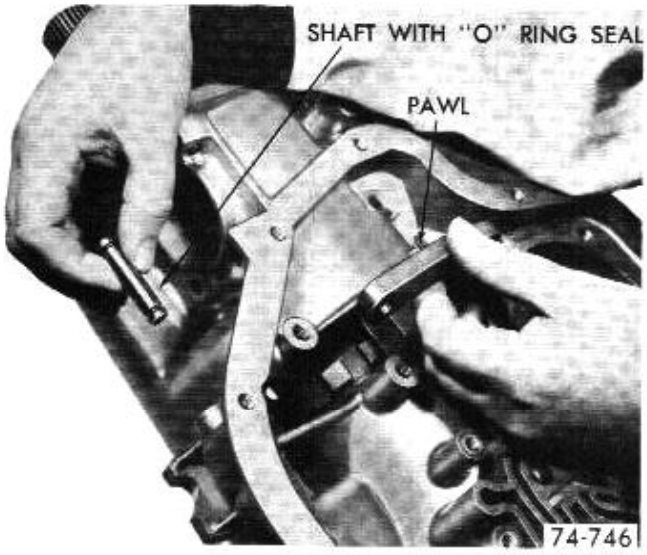


Figure 76-241

2. Install the parking pawl shaft retainer clip. See Figure 76-242.

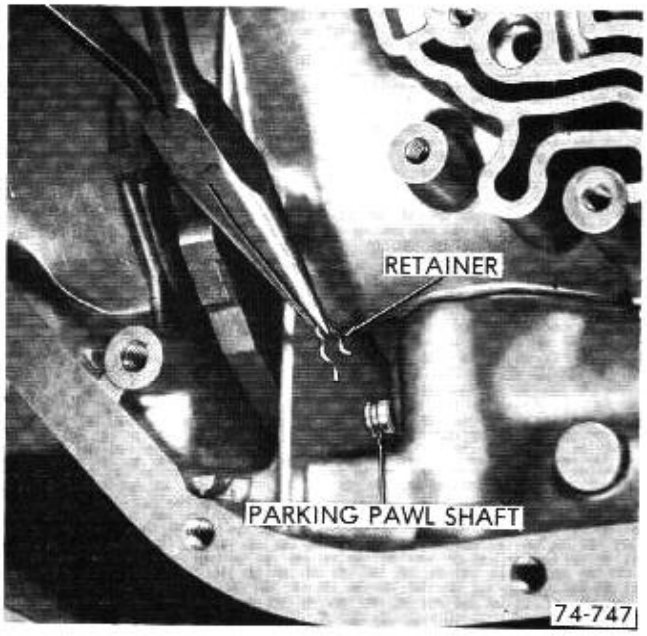


Figure 76-242

3. Install cup plug and drive into case, using a 3/8" dia. rod, until parking pawl shaft bottoms on case rib. See Figure 76-243.

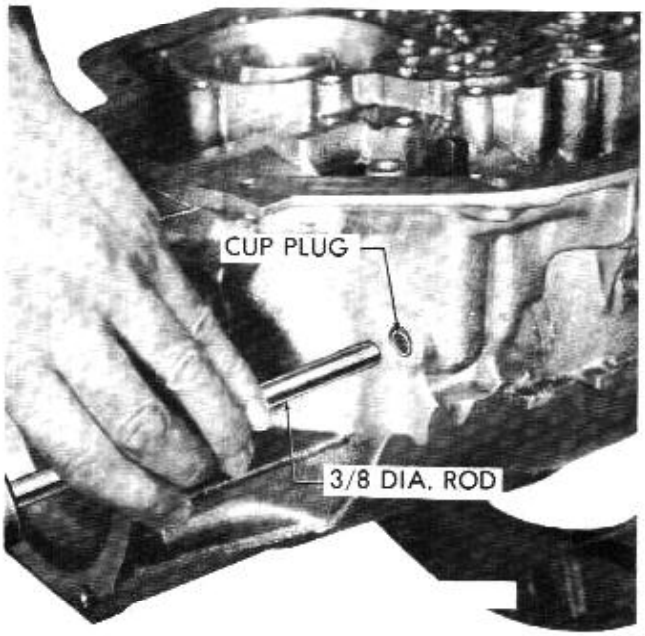


Figure 76-243

4. Install the parking pawl return spring, square end hooked on pawl. See Figure 76-244.

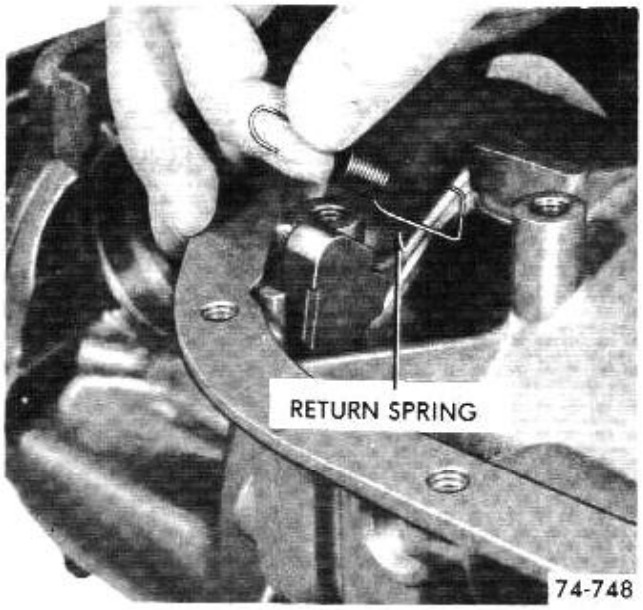


Figure 76-244

5. Install the parking lock bracket, guides over parking pawl, using two attaching bolts torque to 15- 20 lb.ft. See Figure 76-245.

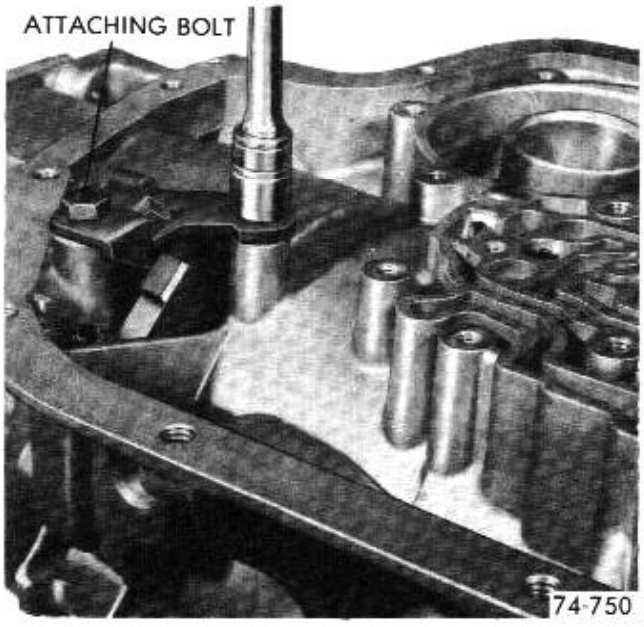


Figure 76-245

6. Install the support to case spacer against the shoulder at the bottom of case splines and the gap located adjacent to the band anchor pin. See Figure 76-246.

CAUTION: *Do not confuse this spacer (.040" thick and both sides flat) with either the center support to case snap ring (one side beveled) or the intermediate clutch backing plate to case snap ring (.093" thick and both sides flat).*

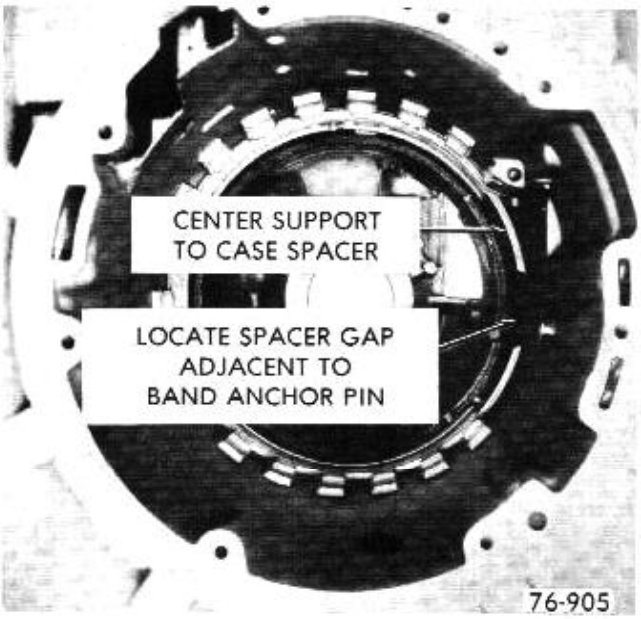


Figure 76-246

7. Install the rear band assembly so that the two lugs index with the two anchor pins. See Figure 76-247. Check band to be sure band ends are seated on lugs.

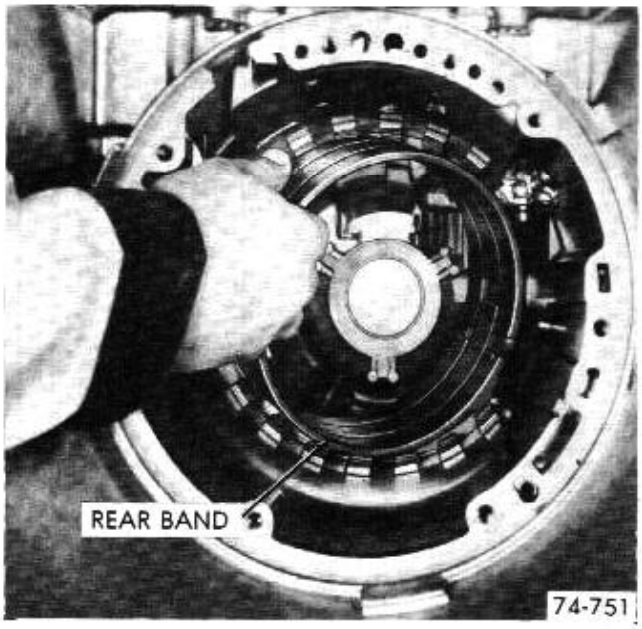


Figure 76-247

8. Lubricate and install gear selective washer into slots provided inside rear of transmission case. See Figure 76-248.

9. Install complete gear unit assembly into case making certain center support bolt hole is properly aligned with hole in case. See figure 76-249.

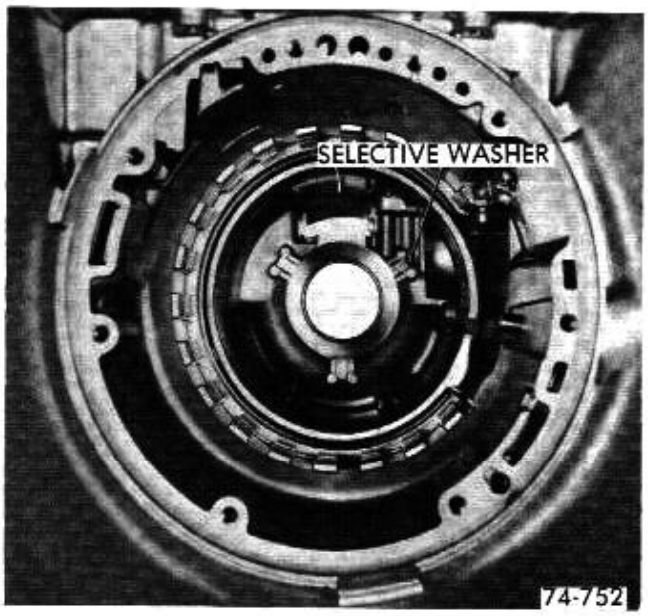


Figure 76-248

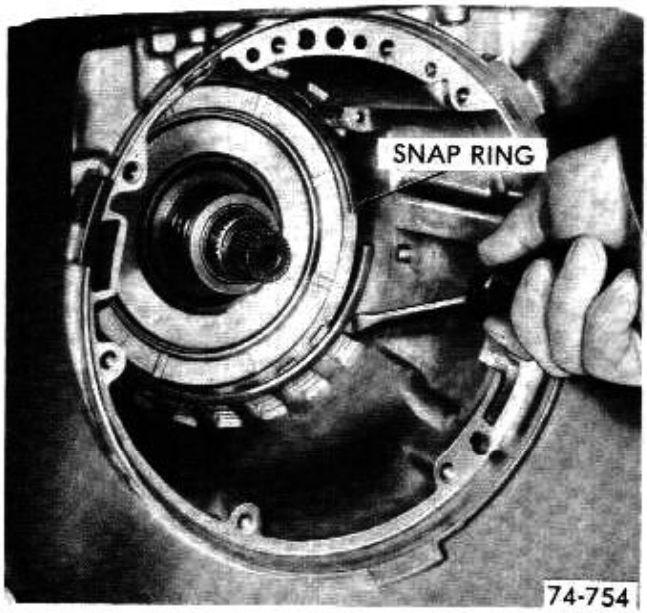


Figure 76-250

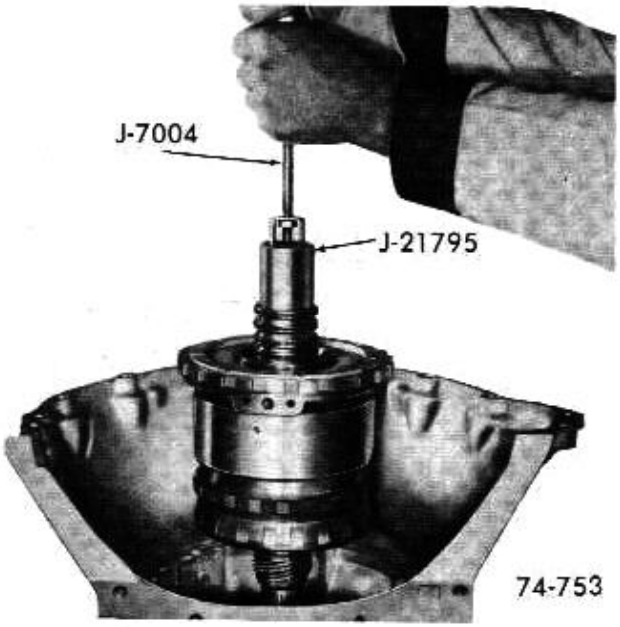


Figure 76-249

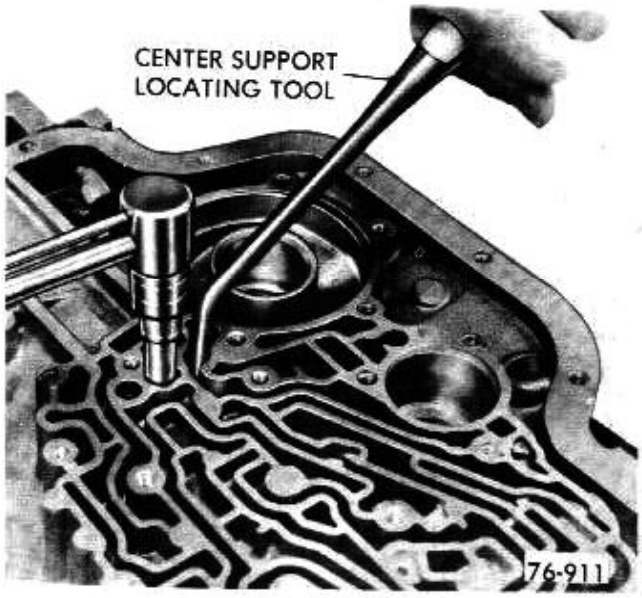


Figure 76-251

NOTE: *Make certain tangs on output shaft to case thrust washer are positioned in pockets. See Figure 76-131.*

10. Install center support to case retaining snap ring with bevel side up, flat side against center support, and locating gap adjacent to band anchor pin. Make certain ring is properly seated in case. See Figure 76-250.

11. Install case to center support bolt by placing the center support locating tool J-23093 into the case direct clutch passage, with the handle of the tool pointing to the right as viewed from the front of the transmission and parallel to the bell housing mounting face. See Figure 76-251.

Apply pressure downward on Tool J-23093 handle which will tend to rotate the center support counter- clockwise as viewed from the front of the transmission. While holding the center support firmly counter clockwise against the case splines, torque the case to center support bolt to 20-25 lb. ft., using a 3/8" 12-point thin wall deep socket.

CAUTION: *When using locating tool, care must be taken not to raise burrs on the case valve body mounting face.*

12. Lubricate with transmission fluid and install three (3) steel and three (3) composition intermediate clutch plates.

Start with waved steel and alternate composition and steel clutch plates. See Figure 76- 252.

NOTE: *No waved plate used in Models "BB" and "OW". Three (3) flat steel plates are used.*

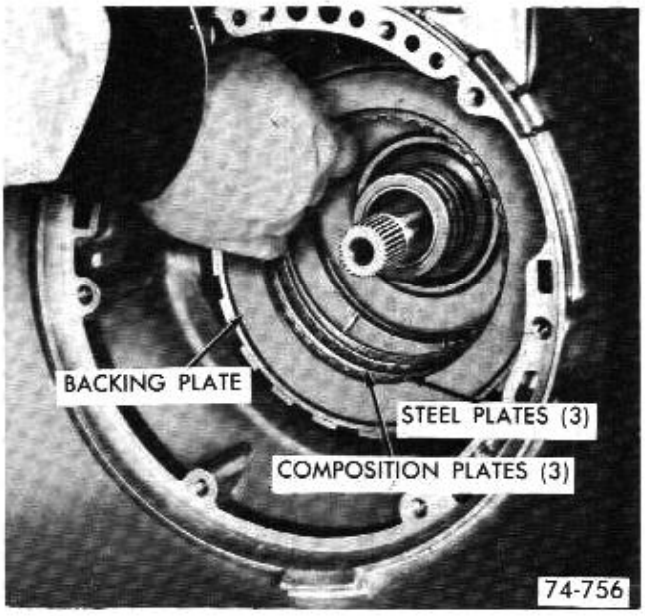


Figure 76-252

13. Install the intermediate clutch backing plate ridge up.

14. Install the intermediate clutch backing plate to case snap ring. Gap in snap ring should be opposite band anchor pin. See Figure 76-253.

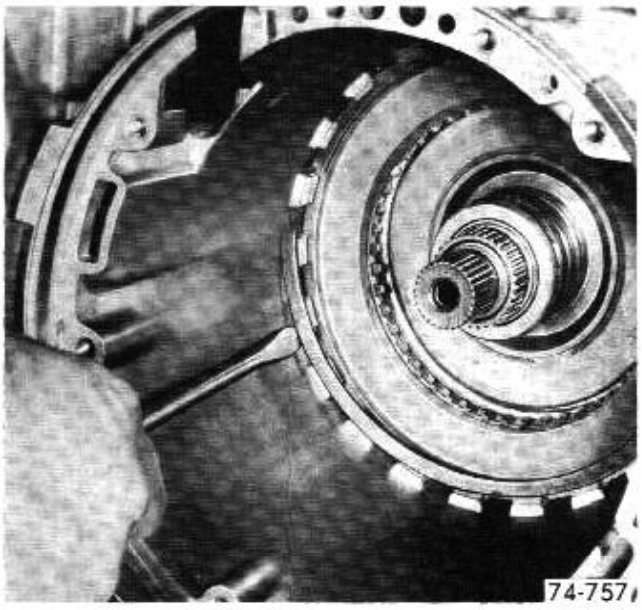


Figure 76-253

NOTE: *Both sides of this snap ring are flat and it is .093" thick.*

15. Check rear end play as follows: See Figure 76 254.

a. Install J-7004 into an extension housing attaching bolt hole. See Figure 76-254.

b. Mount the Dial Indicator, J-8001, on the rod and index with the end of the output shaft.

c. Apply air pressure to apply the intermediate clutch (center oil passage) while moving the output shaft in and out to read the end play. End play should be from .007" - .019". The selective washer controlling this end play is the steel washer having 3 lugs that is located between the thrust washer and the rear face of the transmission case.

Figure 76-254

If a different washer thickness is required to bring the end play within specification, it can be selected from the following chart.

Thickness	Notches and/or Numeral	
.074-.078	None	1
.082-.086	1 Tab Side	2
.090-.094	2 Tabs Side	3
.098-.102	1 Tab O.D.	4
.106-.110	2 Tabs O.D.	5
.114-.118	3 Tabs O.D.	6

76-49

16. Install front band with band anchor hole placed over the band anchor pin and apply lug facing servo hole. See Figure 76-255.

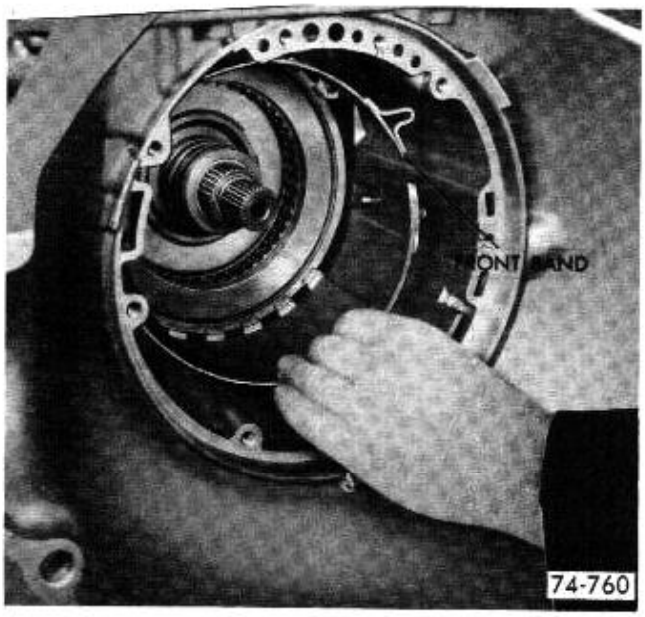


Figure 76-255

17. Install the direct clutch and intermediate sprag assembly. It will be necessary to twist the housing to allow the sprag outer race to index with the composition clutch plates. The housing hub will bottom on the sun gear shaft. See Figure 76-256.

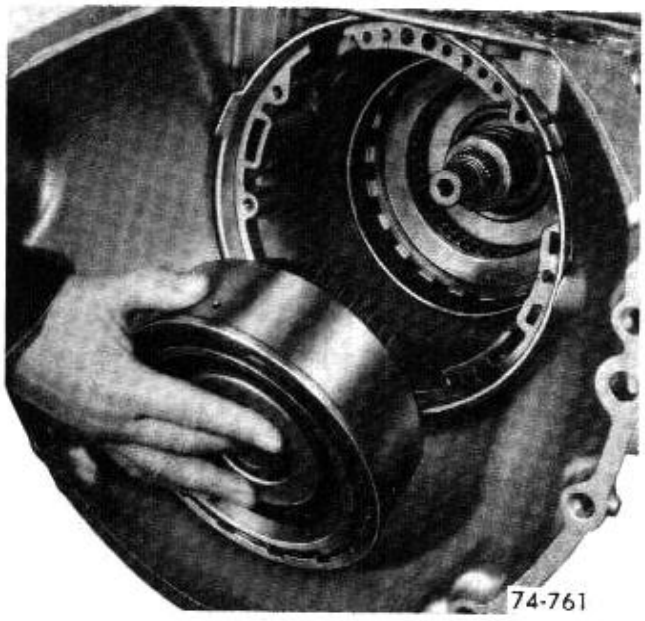


Figure 76-256

NOTE: *Removal of direct clutch, composition and steel plates may be helpful.*

18. Install the forward clutch hub to direct clutch housing thrust washer on the forward clutch hub. Retain with petroleum jelly.

19. Install the forward clutch and turbine shaft assembly, see Figure 76-257, indexing the direct clutch hub so end of the mainshaft will bottom on end of the forward clutch hub. When forward clutch is seated it will be approximately 1-1/4" from pump face in case.

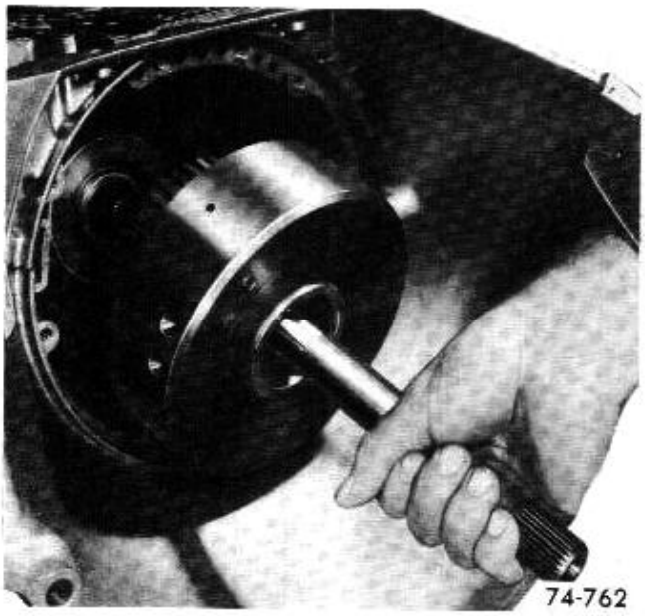


Figure 76-257

20. Install guide pins into transmission case. See Figure 76-258.

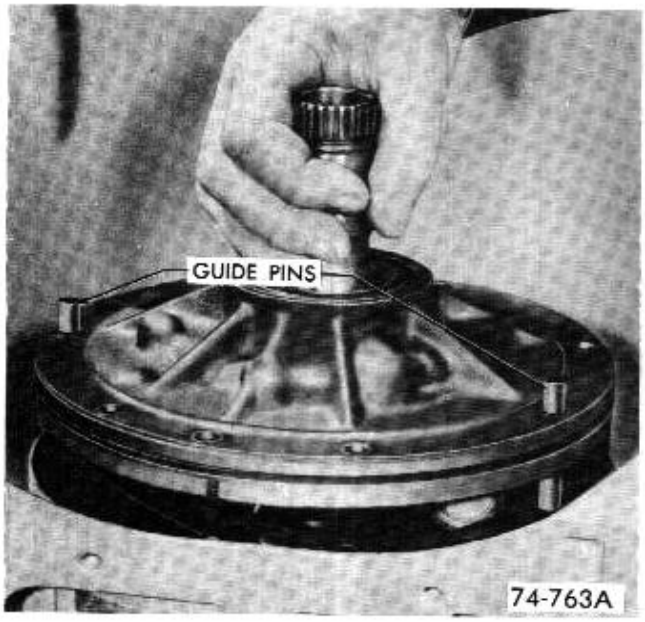


Figure 76-258

21. Install the front pump assembly, gasket and pump and all but one attaching bolt and seal. *Always use new seal on bolt.* Torque 15-20 lb. ft.

NOTE: *If the turbine shaft can not be rotated as the pump is being pulled into place, the forward or direct clutch*

housings have not been properly installed to index with all the clutch plates. This condition must be corrected before the pump is pulled fully into place.

22. If necessary, install a new front seal, coat the outside diameter with a good sealer and using Tool J-21359, drive the seal in place. See Figure 76-259.

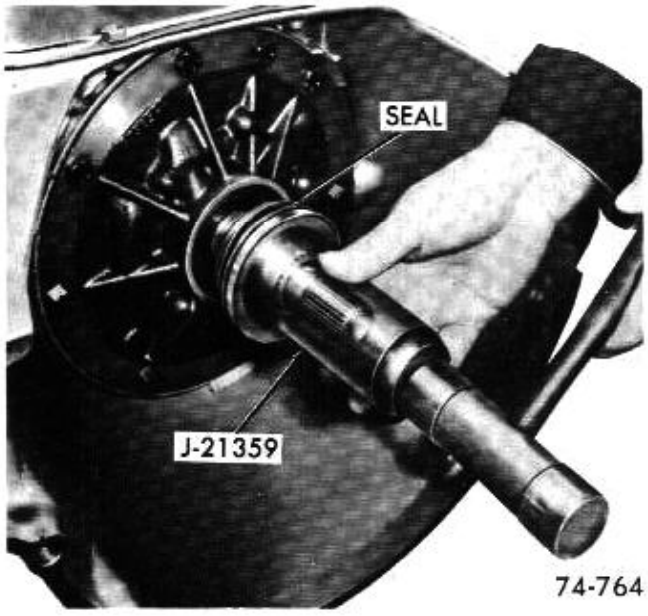


Figure 76-259

23. Check front unit end play as follows: See Figure 76-260.

a. Remove one front pump attaching bolt, and bolt seal.

b. Install J-7004, Slide Hammer into bolt hole.

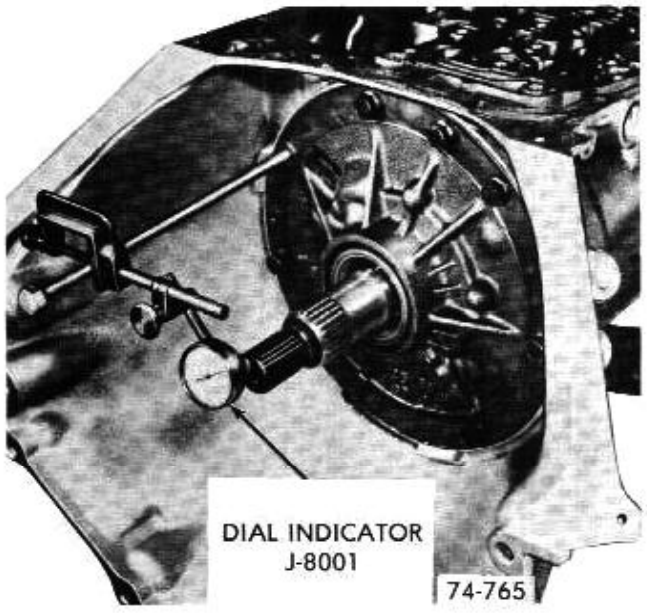


Figure 76-260

c. Mount the dial indicator on the rod and index indicator to register with end of turbine shaft.

d. Push turbine shaft rearward.

e. Push output shaft forward.

f. Set dial indicator to zero.

g. Pull turbine shaft forward.

Read the resulting travel or end play which should be .003" - .024".

The selective washer controlling this end play is the washer located between the pump cover and the forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select the 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

76-48

NOTE: *An oil soaked washer may tend to discolor so that it will be necessary to measure the washer for its actual thickness.*

24. Install the remaining front pump attaching bolt and new seal. Torque bolts to 15-20 lb. ft.

76-34 REAR EXTENSION HOUSING

1. Install the extension housing to case gasket on the extension housing.

2. Attach the extension housing to the case using attaching bolts. Torque bolts to 20-25 lb. ft.

3. If necessary, install a new rear seal, coat the outside diameter with a good sealer and using Tool J-21464 on "BT" and Tool J-21359 on other models, drive the seal in place. See Figure 76-261.

Figure 76-261

76-35 INSTALLATION MANUAL LINKAGE

1. If necessary, install a new manual shaft to case lip seal using a 3/4" diameter rod to seat seal in case.

2. If removed, insert the actuator rod into manual detent lever from side opposite pin.

3. Install the actuator rod plunger under the parking bracket and over the parking pawl.

4. Install the manual shaft through the case and detent lever. See Figure 76-262.

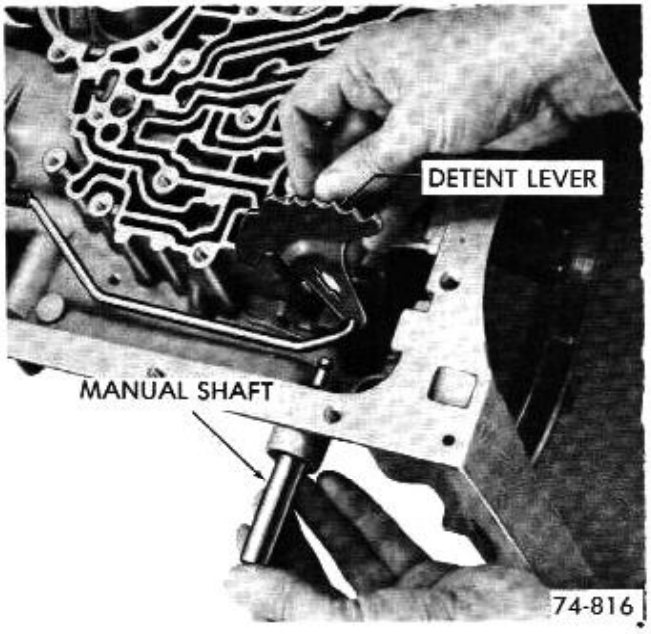


Figure 76-262

5. Install retaining hex-lock nut on manual shaft. See Figure 76-263.

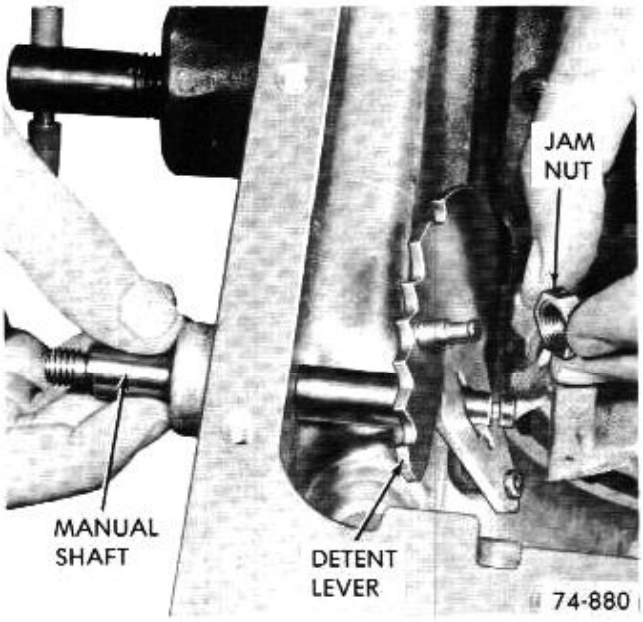


Figure 76-263

6. Install manual shaft retaining pin indexing with groove in manual shaft. See Figure 76-264.

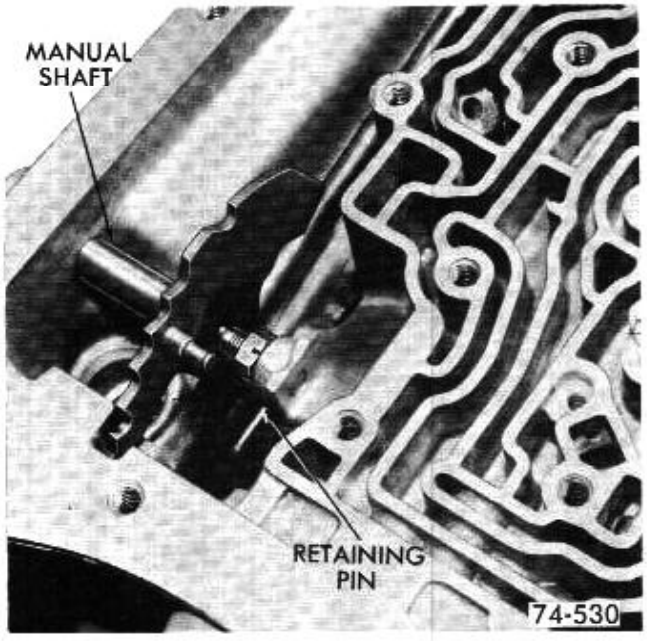


Figure 76-264

NOTE: *It may be necessary to bend pin to install. Straighten pin as it is installed.*

7. Tighten lock nut on manual shaft.

76-36 INSTALLATION OF CHECK BALLS, CONTROL VALVE SPACER PLATE AND GASKET, DETENT SOLENOID, FRONT SERVO ASSEMBLY, AND ELECTRICAL CONNECTOR

1. Install two control valve assembly attaching bolts with heads cut off as guide pins, as shown in Figure 76-265.

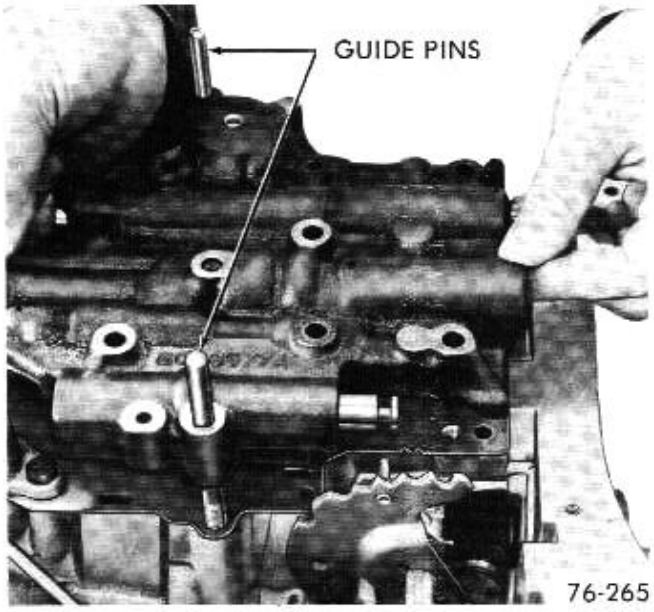


Figure 76-265

2. Install six check balls into ball seat pockets in transmission case. See Figure 76-266.

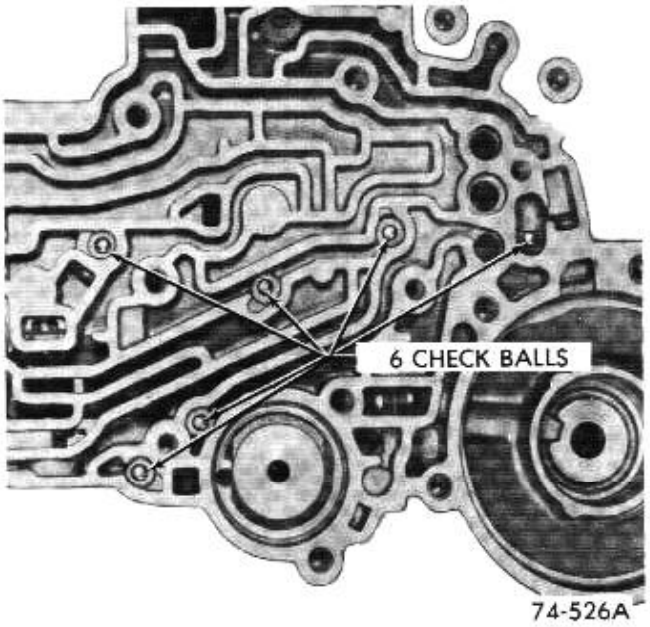


Figure 76-266

NOTE: *If transmission is in car, install check balls into ball seat pockets on spacer plate. See Figure 76-266A.*

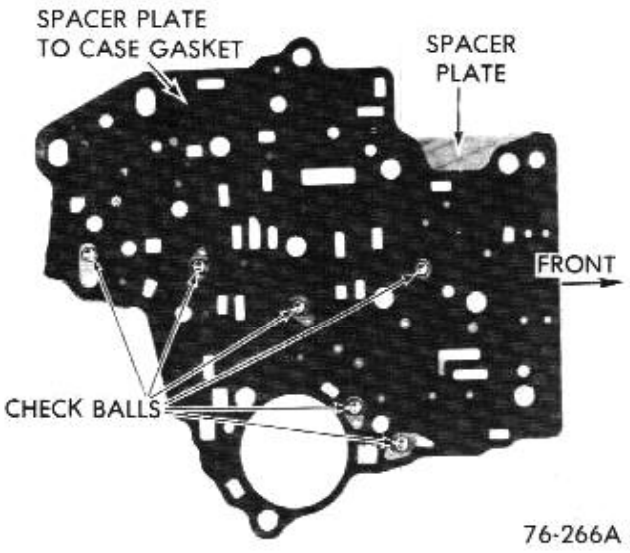


Figure 76-266A

3. Install control valve spacer plate-to-case gasket (gasket with extension for detent solenoid).

4. Install control valve spacer plate.

5. Install detent solenoid gasket. See Figure 76- 267.

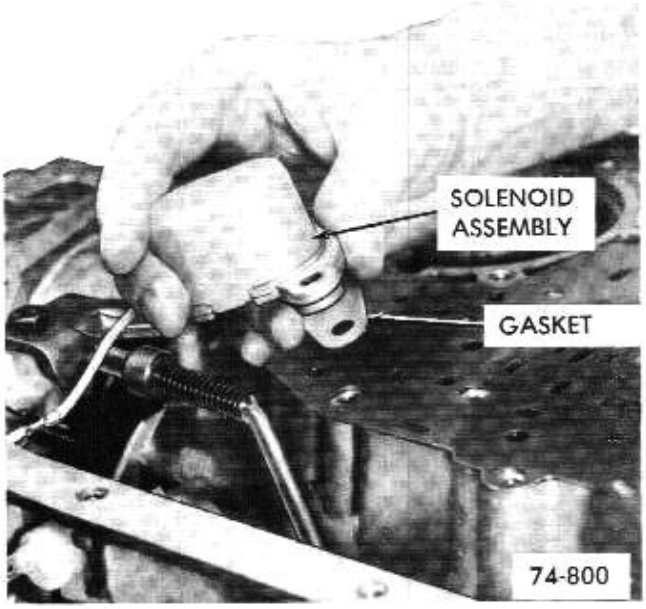


Figure 76-267

6. Install detent solenoid assembly with connector facing outer edge of case. Do not tighten bolts at this time.

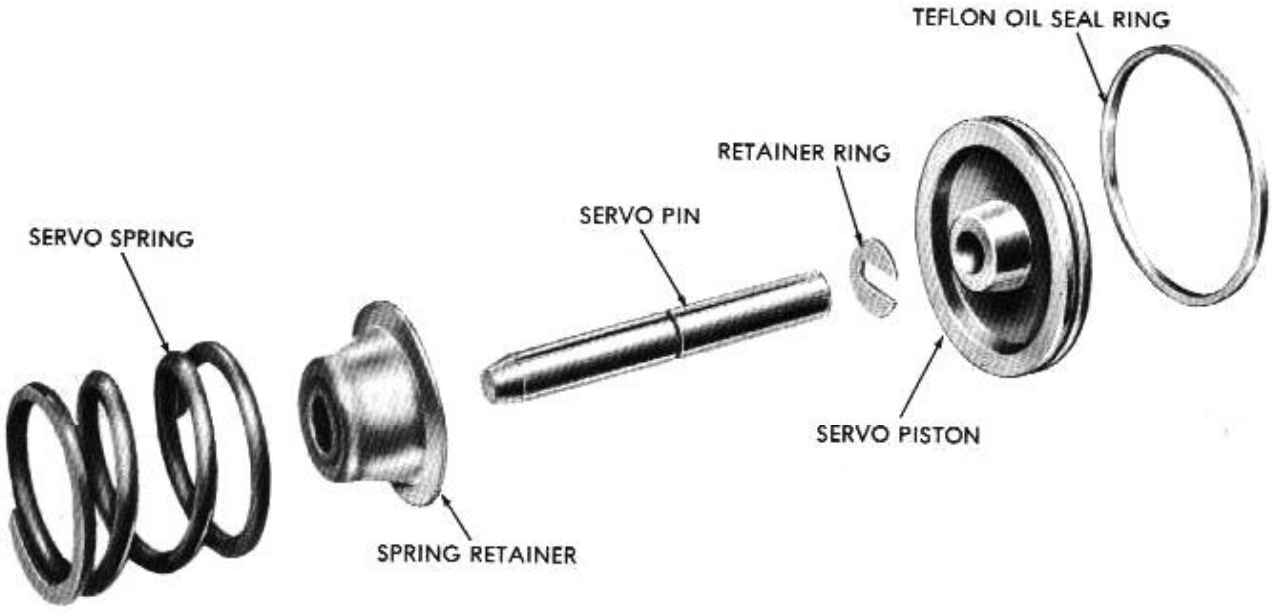


Figure 76-268

7. Install front servo spring and spring retainer into transmission case. See Figure 76-268.

8. Install retainer ring in front servo pin groove and install pin into case so that tapered end contacts band. Make certain retainer ring is installed in servo pin groove.

9. Install seal ring on servo piston, if removed, and install on servo pin with flat side of piston positioned toward bottom pan. See Figure 76-268.

NOTE: *The teflon ring allows the front servo piston to slide very freely in the case. The free fit of the ring in the bore is a normal characteristic and does not indicate leakage during operation. The teflon ring should only be replaced if it shows damage or if evidence of leakage during operation exists.*

NOTE: *If transmission is in car, assemble front servo group, as shown in Figure 76-268, and install this group of parts into front servo bore in case and hold. Slip a*

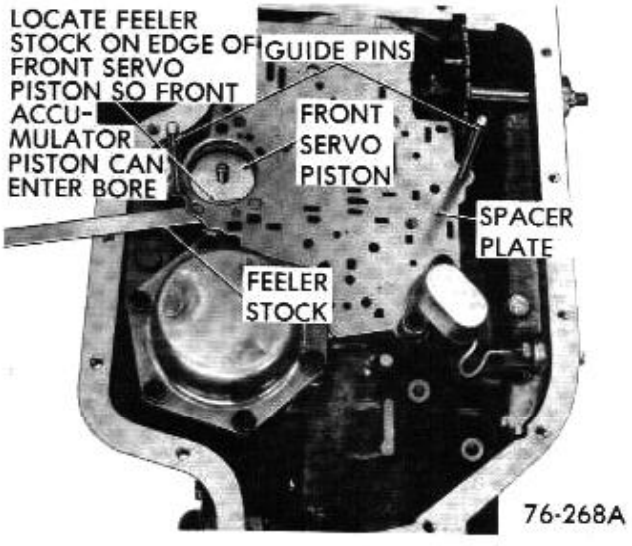


Figure 76-268A

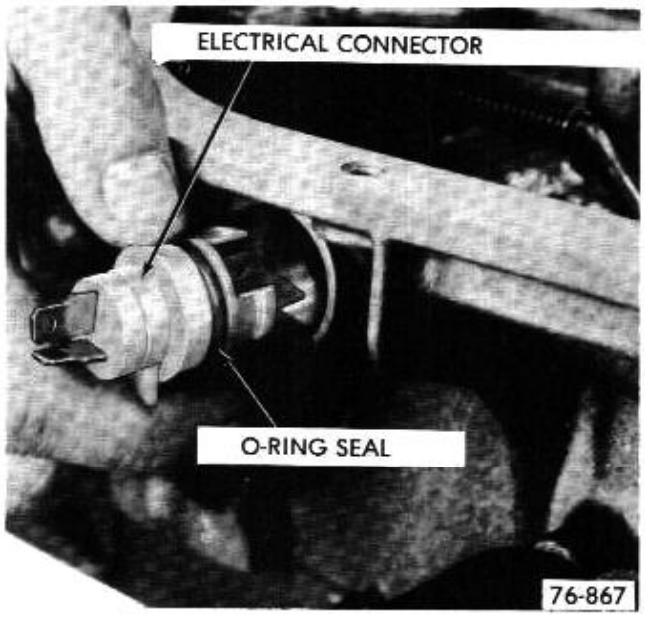


Figure 76-269

length of straight, clean feeler gauge or shim stock (about .020") between spacer plate and front servo piston to temporarily retain front servo group. See Figure 76-268A.

10. Install "O" ring seal on the solenoid connector.

11. Install connector with lock tabs facing into case, positioning locator tab in notch on side of case. See Figure 76-269.

12. Install detent wire and lead wire to case connector. See Figure 76-270.

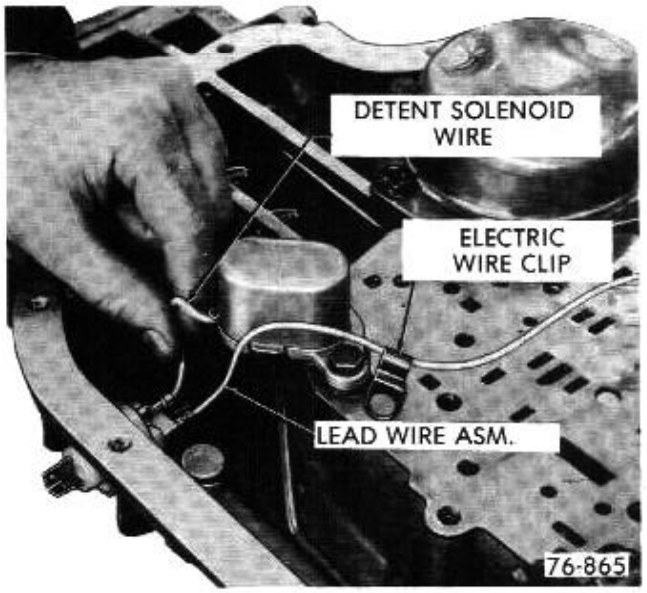


Figure 76-270

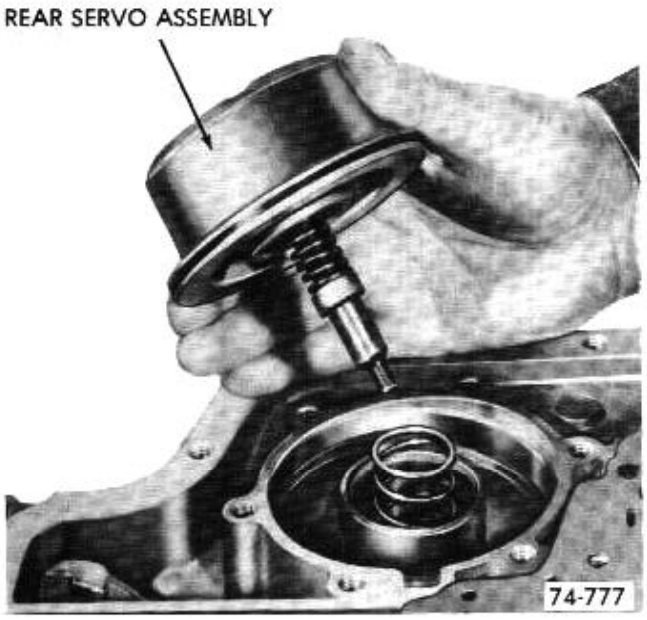


Figure 76-271

NOTE: *Check by pulling on detent connector wire. If detent connector wire can be removed, turn wire connector over and reinstall into connector. See Figure 76-270.*

76-37 INSTALLATION OF REAR SERVO ASSEMBLY

1. Install rear servo accumulator spring into case.

2. Install rear servo assembly into case. See Figure 76-271.

3. Install rear servo gasket and cover. See Figure 76-272.

Figure 76-272

4. Install attaching bolts. Torque bolts to 15- 20 lb. ft. See Figure 76-273.

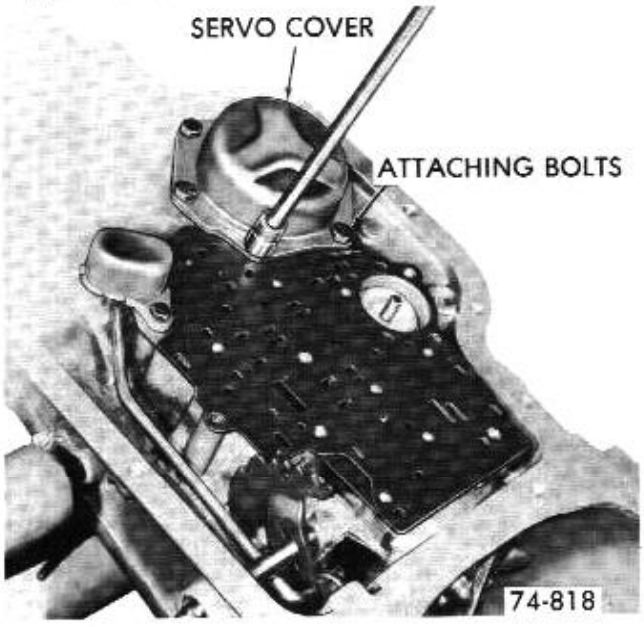


Figure 76-273

76-38 INSTALLATION OF CONTROL VALVE ASSEMBLY, GOVERNOR PIPES, AND GOVERNOR SCREEN ASSEMBLY

1. Install governor pipes on control valve assembly. Governor pipes are interchangeable. See Figure 76-274.

Figure 76-274

2. Install governor screen assembly, *open end first,* into governor feed pipe hole in case (hole nearest the center of transmission). See Figure 76- 275.

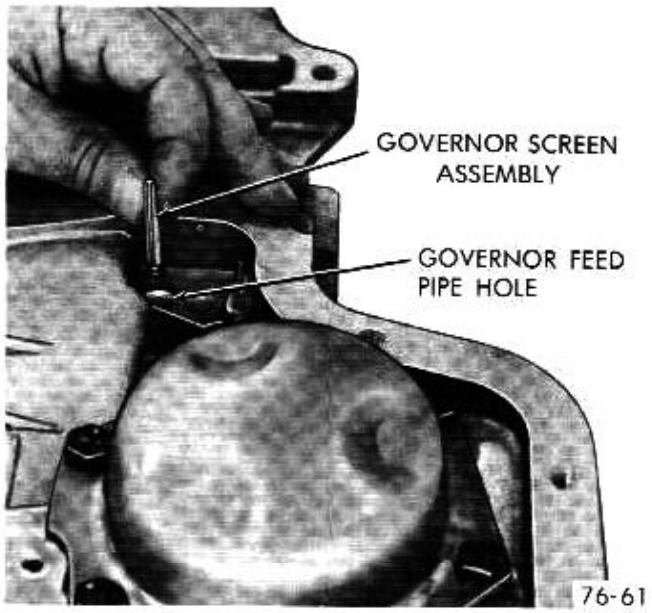


Figure 76-275

NOTE: *If transmission is in vehicle, before installing the control valve assembly and governor pipes, as outlined in Step 3 below, insert governor screen, closed end first, into governor feed pipe. (This pipe locates in the governor feed pipe hole in the case nearest the center of the transmission). See Figure 76-265.*

3. Install control valve assembly and governor pipes on transmission, while carefully aligning the governor feed pipe over the governor screen. See Figure 76- 265. Make certain gasket and spacer do not become mispositioned.

NOTE: *Check manual valve to make sure it is indexed properly with pin on detent lever and governor pipes to make certain they are properly seated in case holes.*

4. Start control valve assembly attaching bolts and make certain lead wire assembly clip is installed.

NOTE: *If transmission is in vehicle, remove feeler stock before tightening any control valve bolts.*

5. Remove guide pins and install detent roller and spring assembly and remaining bolts. See Figure 76- 276.

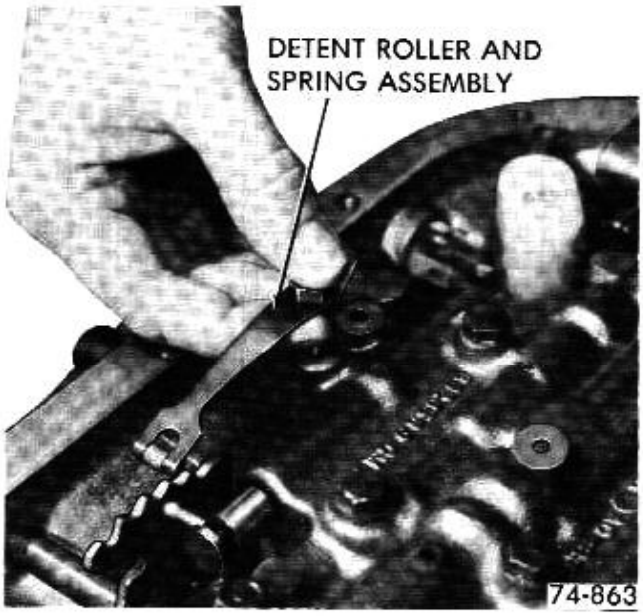


Figure 76-276

6. Tighten solenoid and valve body attaching bolts. Torque bolts to 6-10 lb. ft.

7. If removed, install the pressure switch assembly.

8. Connect lead wire assembly to pressure switch assembly.

76-39 INSTALLATION OF SPEEDOMETER DRIVEN GEAR ASSEMBLY AND CONVERTER ASSEMBLY

1. Install the speedometer driven gear assembly. See Figure 76-277.

Figure 76-277

2. Install the speedometer driven gear retainer and attaching bolt. See Figure 76-278.

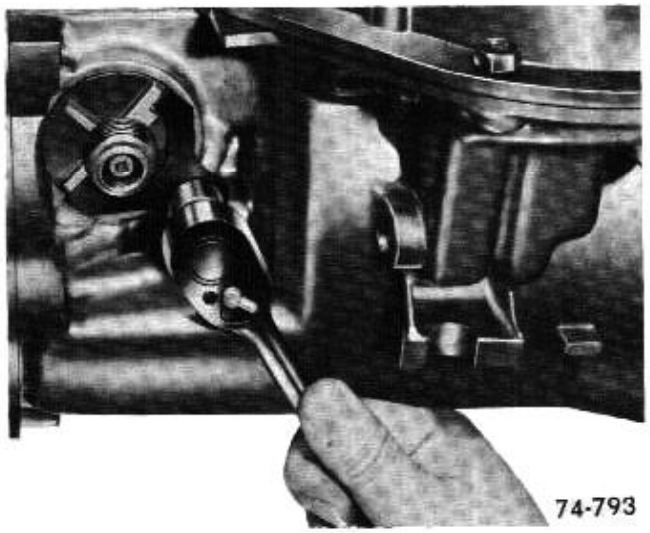


Figure 76-278

3. Install converter assembly into oil pump. Extreme care must be taken not to damage seal.

NOTE: *Make certain converter hub drive tangs are fully engaged with pump drive gear tang.*

4. Install Converter Holding Tool J-21366 to retain converter until ready to install in car.

76-40 INSTALLATION OF GOVERNOR BUSHING

1. Remove transmission from car.

2. Remove the output shaft, valve body, support plate, and governor from the case.

3. Assemble transmission case in fixture J-8763 and mount in a vise. See Figure 76-279.

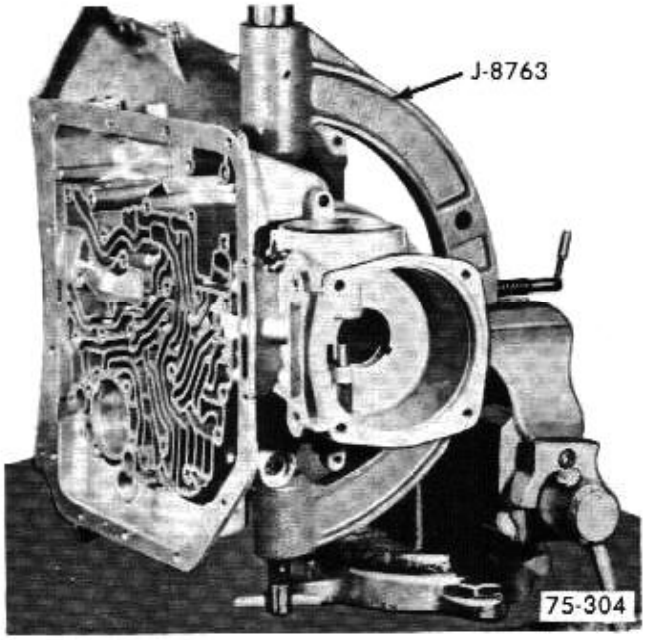


Figure 76-279

4. Clean off excess stock from the governor o- ring seal to case mating surface. See Figure 76-280.

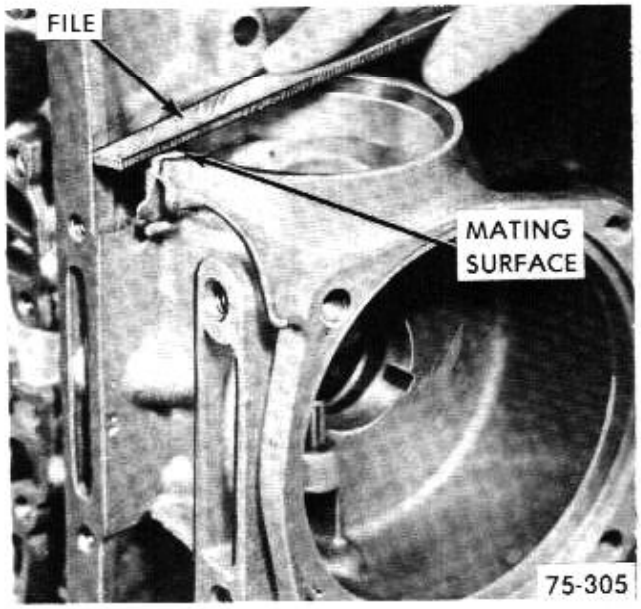


Figure 76-280

5. *Loosely* bolt the drill bushing fixture J-22976-1 to the case.

6. Place the alignment arbor J-22976-3 into the drill bush-

ing fixture and down into the governor bore until it bottoms on the dowel pin. See Figure 76-281.

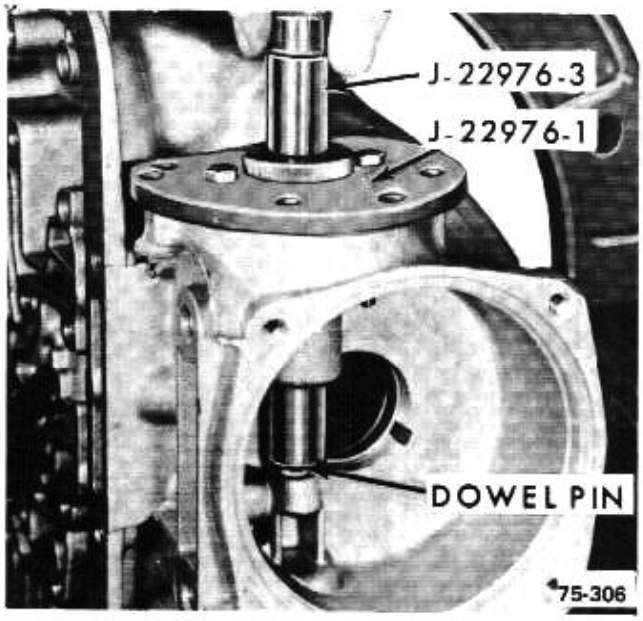


Figure 76-281

7. Torque the bolts on the drill bushing fixture 8-12 lb. ft. *Do not over torque and strip the threads.*

NOTE: *The alignment arbor should be able to rotate freely after the bolts are properly torqued. If the alignment arbor cannot be rotated by hand, recheck the work performed in step 4.*

8. Remove the alignment arbor.

9. Using reamer J-22976-9 and drive rachet, *hand* ream the governor bore using the following procedure:

CAUTION: *Hand Ream Only*

a. Oil the reamer, drill bushing, and governor bore.

b. Use 5-10 lbs. of feeding force on the reamer. See Figure 76-282.

c. *After each 10 revolutions* remove the reamer and dip it into a cup full of transmission oil. This will clean the chips from the reamer and lubricate it. See Figure 76-283.

d. When the reamer reaches the end of the bore, continue reaming the bore until the reamer bottoms out on the dowel pin in the case. *At this point, rotate the reamer 10 complete revolutions.*

e. Remove the reamer using a clockwise rotation and 5-10 lbs. force upward.

IMPORTANT: *Pulling the reamer out without rotating it may score the bore causing a leak between the case and the bushing.*

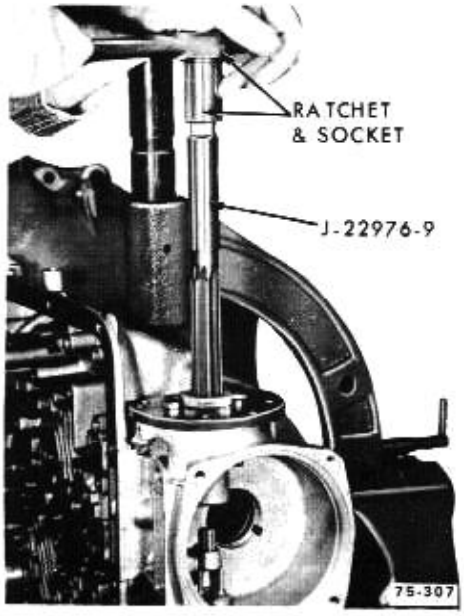


Figure 76-282

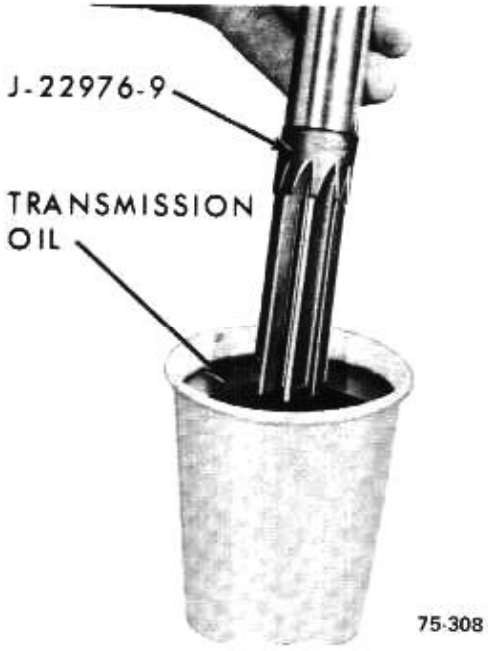


Figure 76-283

10. Remove the drill bushing fixture from the case.

11. Thoroughly clean the chips from the case, visually check the governor feed holes to insure that they are free from chips.

12. Install the bushing using the following procedure:

a. Note the two (2) notches at one end of the bushing.

b. Position the notches so that one notch is toward the front of the case and the other is toward the bottom of the case. See Figure 76-284.

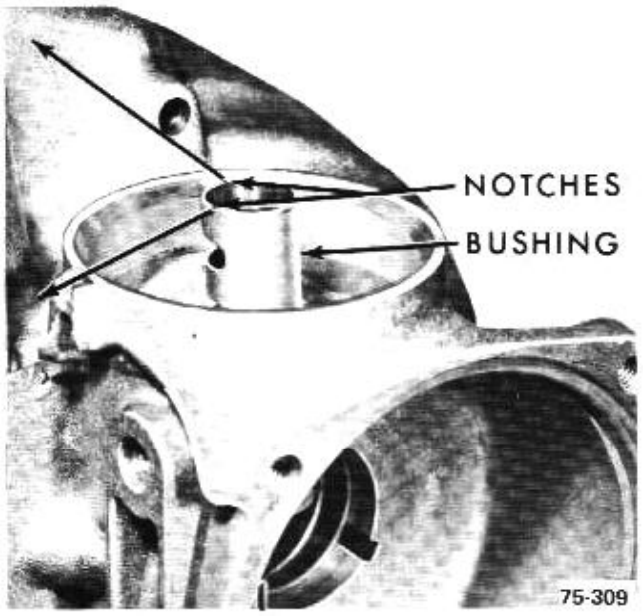


Figure 76-284

c. Use J-22976-3 alignment arbor and bushing installer to drive the bushing into the case. See Figure 76-285.

CAUTION: *A brass hammer should be used to strike the hardened steel bushing installer tool.*

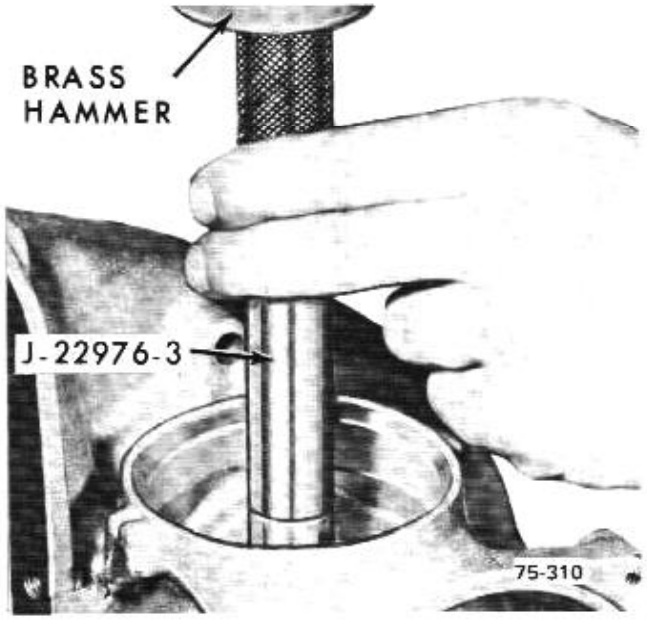


Figure 76-285

d. Drive the bushing until it is flush with the top of the bore. See Figure 76-286.

13. Oil a new governor and insert it into the installed bushing. The governor should spin freely. If slight honing on the bushing is necessary, use crocus or fine emery cloth and move in the annular direction only.

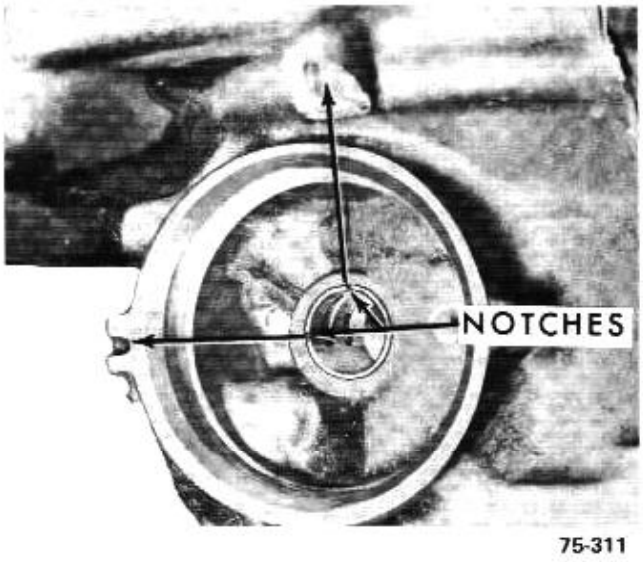


Figure 76-286

B. Transmission Identification Number

A production identification number is stamped on a metal tag, located in the lower right side of the transmission case.

The production code number is located along the top of the tag. Since the production code number furnishes the key to construction and interchangeability of parts in each transmission, the number should be used when selecting replacement parts as listed in the master parts list. The number should always be furnished on product reports, *AFA forms, and all correspondence with the factory* concerning a particular transmission.

On all 1971 Turbo Hydra-Matic 400 transmissions, the car serial number is stamped on a pad located just above the bottom pan face on the left hand side of the transmission.

C. Turbo Hydra-Matic 400 Fluid Recommendations

Use DEXRON Automatic Transmission Fluid *only* in all 1971 model Turbo Hydra-Matic 400 automatic transmissions (GM Part No. 1050568-69-70 or other fluid having DEXRON identifications).

DEXRON is an especially formulated automatic transmission fluid designed to improve transmission operation.

NOTE: *Use DEXRON or type "A" automatic transmission fluid identified by the mark "AQ-ATF" followed by a number and the suffix letter "A" (AQ-ATF-XXXX-A) in all automatic transmissions prior to the 1968 models.*

The oil pan should be drained and the filter replaced every 24,000 miles and fresh fluid added to obtain the proper level on the dipstick. See sub-paragraph 2 for proper refill

procedures. For cars subjected to heavy city traffic during hot weather, or in commercial use, when the engine is regularly idled for prolonged periods, the oil pan should be drained and the filter replaced every 12,000 miles.

1. *Checking and Adding Fluid*

Fluid level should be checked at every engine oil change. The "FULL" and "ADD" marks on the transmission dipstick indicate one pint difference.

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 degrees F. This temperature is only obtained after at least 15 miles of expressway 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 fluid to the "FULL" mark on the dipstick.

If vehicle can not be driven 15 expressway miles or equivalent, and it becomes necessary to check fluid level, the transmission fluid must be at room temperature (70 degrees F).

With fluid at room temperature (70 degrees 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.

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, especially when cold, complete loss of drive may result which can cause transmission failure.*

NOTE: *If transmission fluid level is correctly established at 70 degrees F it will appear at the "FULL" mark on the dipstick when the transmissions reaches normal operating temperature (180 degrees F). The fluid level is set 1/4" below the "ADD" mark on the dipstick to allow for expansion of the fluid which occurs as transmission temperatures rise to normal operating temperature of 180 degrees F.*

2. *Draining Oil Pan and Replacing Filter*

(a) Raise car on hoist or place on jack stands, and provide container to collect draining fluid.

(b) Remove oil pan and gasket. Discard gasket.

(c) Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.

(d) Remove oil filter retainer bolt, oil filter, intake pipe assembly and intake pipe to case "O" ring. Discard the filter and intake pipe to case "O" ring.

(e) Install new "O" ring seal on intake pipe and place pipe assembly into grommet on new filter assembly. With new "O" ring on intake pipe, install pipe and filter assembly into case, attaching filter to valve body assembly with retainer bolt. Torque to 10 lb.ft.

(f) Install new gasket on oil pan and install pan. Tighten attaching bolts to 12 lb.ft.

(g) Lower car and add 5 pints of transmission fluid through filler tube.

(h) With manual control lever in Park position, start engine. DO NO RACE ENGINE. Move manual control lever through each range.

(i) Immediately check fluid level with selector lever in Park, engine running, and vehicle on LEVEL surface.

(j) Add additional fluid to bring level to 1/4" below the "ADD" mark on the dipstick.

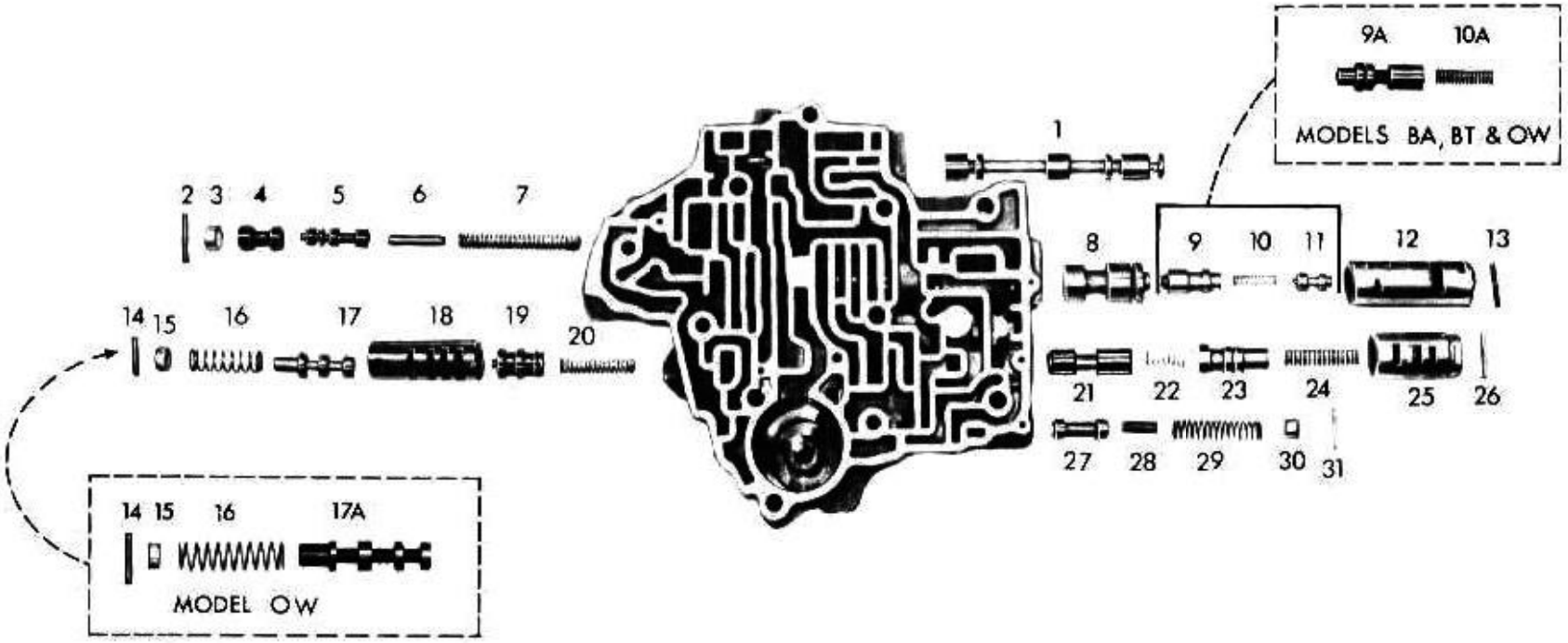
NOTE: *The fluid level is set 1/4" below the "ADD" mark on the dipstick to allow for expansion of the fluid which occurs as transmission temperatures rise to normal operating temperature.*

CAUTION: *Do not overfill.*

3. Adding Fluid to Fill Dry Transmission and Converter Assembly

The fluid capacity of the Turbo Hydra-matic 400 transmission and converter assembly is approximately 23 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:

NOTE: *The converter should be replaced only if the converter itself fails. On any major failure, such as a clutch or gearset, the filter must be replaced.*



1. MANUAL VALVE
2. RETAINING PIN
3. BORE PLUG
4. DETENT VALVE
5. DETENT REGULATOR VALVE
6. SPACER PIN
7. DETENT REGULATOR SPRING
8. 1-2 SHIFT VALVE
9. 1-2 DETENT VALVE
9A. 1-2 MODULATOR VALVE
10. 1-2 REGULATOR SPRING
10A. 1-2 MODULATOR VALVE SPRING
11. 1-2 REGULATOR VALVE
12. 1-2 MODULATOR BUSHING
13. RETAINING PIN
14. GROOVED RETAINING PIN
15. BORE PLUG
16. 1-2 ACCUMULATOR SECONDARY SPRING (NOT USED IN "BB" MODEL)
17. 1-2 ACCUMULATOR VALVE
18. 1-2 ACCUMULATOR BUSHING
19. 1-2 PRIMARY ACCUMULATOR VALVE
20. 1-2 ACCUMULATOR PRIMARY SPRING
21. 2-3 SHIFT VALVE
22. 3-2 INTERMEDIATE SPRING
23. 2-3 MODULATOR VALVE
24. 2-3 VALVE SPRING
25. 2-3 MODULATOR BUSHING
26. RETAINING PIN
27. 3-2 VALVE
28. SPACER PIN
29. 3-2 VALVE SPRING
30. BORE PLUG
31. RETAINING PIN

76-287

Figure 76-287

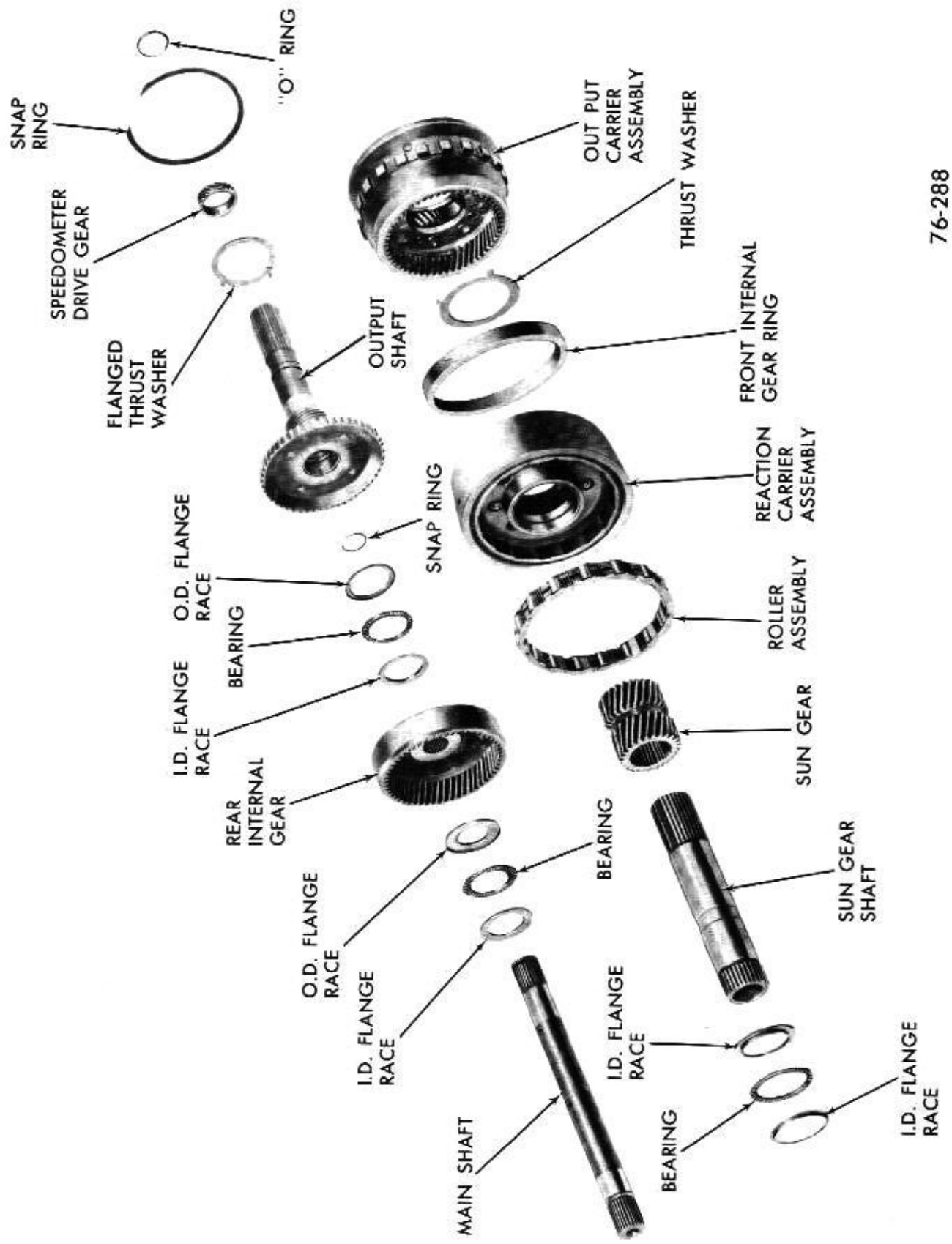


Figure 76-288 Exploded View of Gear Unit Assemt

DIVISION VI SPECIFICATIONS

76-41 GENERAL SPECIFICATIONS

A MODEL DESIGNATIONS

TRANS. CODE	ENG.	MODEL USE	CONVERTER IDENTIFICATION NUMBER	SPEEDOMETER DRIVE GEAR	FORWARD CLUTCH				DIRECT CLUTCH			INTERMEDIATE CLUTCH		
					FLAT STEEL PLATES		NO. OF WAVED STEEL PLATES	NO. OF COMPOSITION PLATES	NO. OF FLAT STEEL PLATES	NO. OF WAVED STEEL PLATES	NO. OF COMPOSITION PLATES	NO. OF FLAT STEEL PLATES	NO. OF WAVED STEEL PLATES	NO. OF COMPOSITION PLATES
					NO.	THICKNESS								
BA	455	GS 455	5	16 Tooth	4	.0775"	1	5	5	1	6	2	1	3
BC	455	Le Sabre, Centurion, Electra & Estate Wagon	5	18 Tooth	4	.0775"	1	5	4	1	5	2	1	3
BT	455	Riviera	5	18 Tooth	4	.0775"	1	5	4	1	5	2	1	3
BB & OW	455	GS 455 Stage 1	5	16 Tooth	4	.0775"	1	5	6	0	6	3	0	3

Forward & Direct Clutch
Waved steel plate thickness – All models – .0615"
Direct clutch flat steel plate thickness – All models – .0915"

76-42 BOLT TORQUE SPECIFICATIONS

Location	Thread Size	Torque Lbs. Ft.
Solenoid Assembly to Case	1/4-20	8
Valve Body to Case	1/4-20	8
Pump Body to Cover	5/16-18	18
Pump Assembly to Case	5/16-18	18
Rear Servo Cover to Case	5/16-18	18
Governor Cover to Case	5/16-18	18
Parking Brake Bracket to Case	5/16-18	18
Vacuum Modulator Retainer to Case	5/16-18	18
Valve Body to Case	5/16-18	8
Oil Pan to Case	5/16-18	12
Case Extension to Case	3/8-16	23
Oil Filter to Valve Body	1/4-20	10
Pressure Switch Assembly	1/8-27	6-10
Case to Center Support	3/8-16	20-25
Manual Shaft to Inside Detent Lever	3/8-24	15-20
Line Pressure Take-Off	1/8-27	10-15
Cooler Connector	1/4-18	23-30

(a) Add 10 pints of transmission fluid through filler tube.

NOTE: *If installation of a new converter is not required add only 6 pints of transmission fluid.*

(b) With manual control lever in Park position start engine and place fast idle screw on middle of fast idle cam. DO NOT RACE ENGINE. Move manual control lever through each range.

(c) Immediately check fluid level with selector lever in Park, engine running, and vehicle on LEVEL surface.

(d) Add additional fluid to bring level to 1/4" below the "ADD" mark on the dipstick.

NOTE: *Fluid level is set at 1/4" below the "ADD" mark on the dipstick to allow for expansion as fluid heats up.*

CAUTION: *Do not overfill.*

D. Turbo Hydra-matic 400 Towing Instructions

If a Buick equipped with Turbo Hydra-matic 400 transmission must be towed, the following precautions must be observed: The car may be towed safely on its rear wheels with the shift lever in neutral position at speeds of 35 miles per hour or less under most conditions.

However, the drive shaft must be disconnected or the car towed on its front wheels if:

Tow speeds in excess of 35 mph are necessary,

Car must be towed for extended distances (over 50 miles) or,

Transmission is not operating properly.

If car is towed on its front wheels, the steering wheel should be secured to keep the front wheels in a straight-ahead position.

E. Rocking Car

If it becomes necessary to rock the car to free it from sand, mud or snow, move the selector lever from "D" to "R" in a repeat pattern while simultaneously applying moderate pressure to the accelerator. Do not race engine. Avoid spinning wheels when trying to free the car.

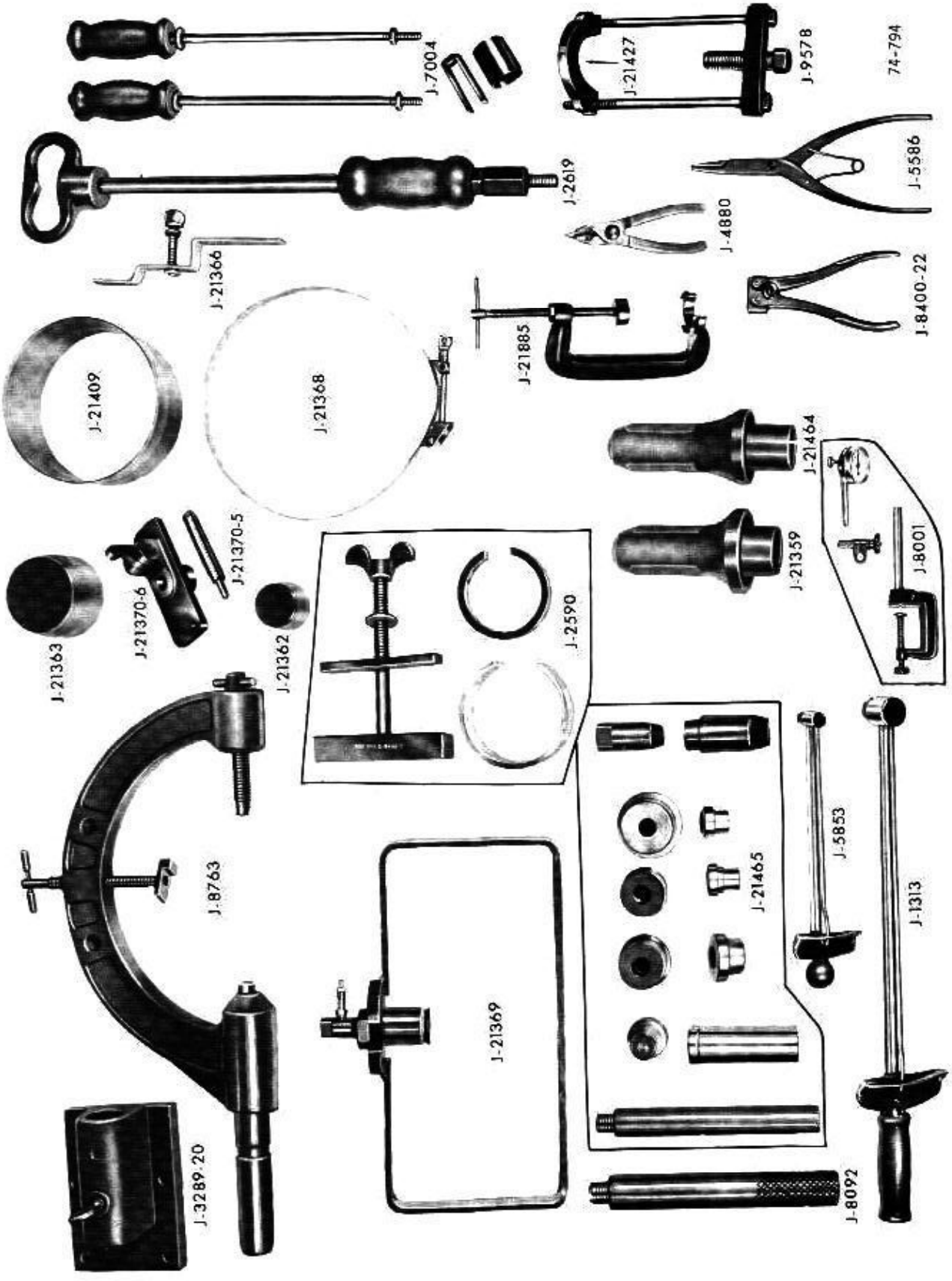


Figure 76-300 - Tool Picture

J-3289-20	-	HOLDING FIXTURE BASE
J-8763	-	HOLDING FIXTURE
J-21363	-	SEAL INSTALLER
J-21362	-	SEAL INSTALLER
J-21409	-	SEAL INSTALLER
J-21368	-	PUMP BODY TO COVER ALIGNMENT BAND
J-21366	-	CONVERTER HOLDING STRAP
J-2619	-	SLIDE HAMMER
J-7004	-	SLIDE HAMMERS
J-4880	-	SNAP RING PLIERS
J-5586	-	SNAP RING PLIERS
J-9578	-	SPEEDO GEAR REMOVER
J-21795	-	GEAR ASSEMBLY REMOVER AND INSTALLER
J-21370	-	APPLY PIN SELECTION GAUGE
J-8001	-	DIAL INDICATOR SET
J-21464	-	REAR SEAL INSTALLER
J-21359	-	OIL PUMP SEAL INSTALLER
J-21369	-	CONVERTER PRESSURE CHECK FIXTURE
J-21465	-	BUSHING SET
J-8092	-	DRIVE HANDLE
J-1313	-	FT. LB. TORQUE WRENCH
J-21885	-	1 - 2 ACCUMULATOR "C" CLAMP

74-795

Figure 76-301 - Tool Picture Identification

GROUP 73

SHIFT LINKAGE

Section	Title
A	Shift Linkage Adjustments - All Series . . . . .

SECTION A

SHIFT LINKAGE
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Not Applicable)	-
II	DESCRIPTION AND OPERATION: (Not Applicable)	-
III	ADJUSTMENTS AND MINOR SERVICE:	
	"350" and "400" Turbo Hydra-Matic Transmission Linkage Adjustment (Console Shift) - 43-44 and 49000 Series	73-1
	"350" and "400" Turbo Hydra-Matic Transmission Linkage Adjustment (Column Shift) - All Series	73-2
	3-Speed Manual Transmission Linkage Adjustment - 43-44000 Series	73-3
	4-Speed Manual Transmission Linkage Adjustment (Floor Shift) - All G.S. Series	73-4
	3-Speed Manual Transmission Linkage Adjustment 45-46000 Series	73-5
IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

73-1 350 AND 400 TURBO HYDRA-MATIC TRANSMISSION LINKAGE ADJUSTMENT (Console Shift)
. 43.44. 49000 SERIES

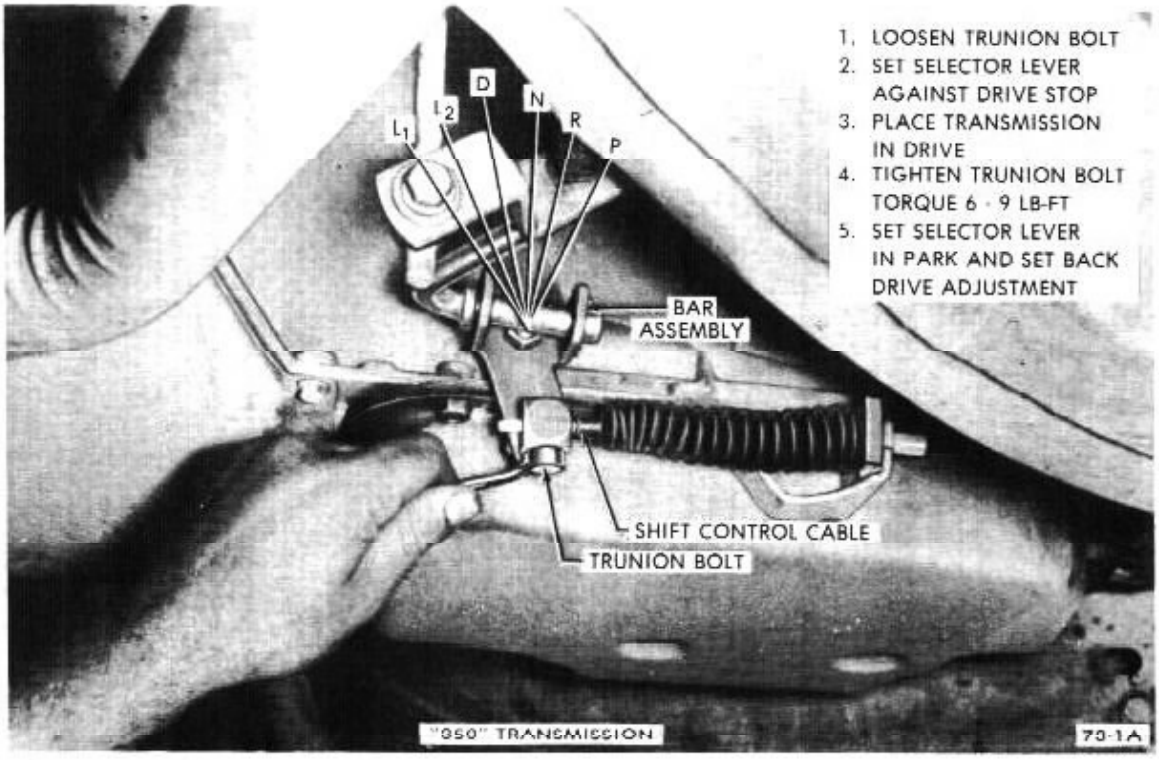


Figure 73-1

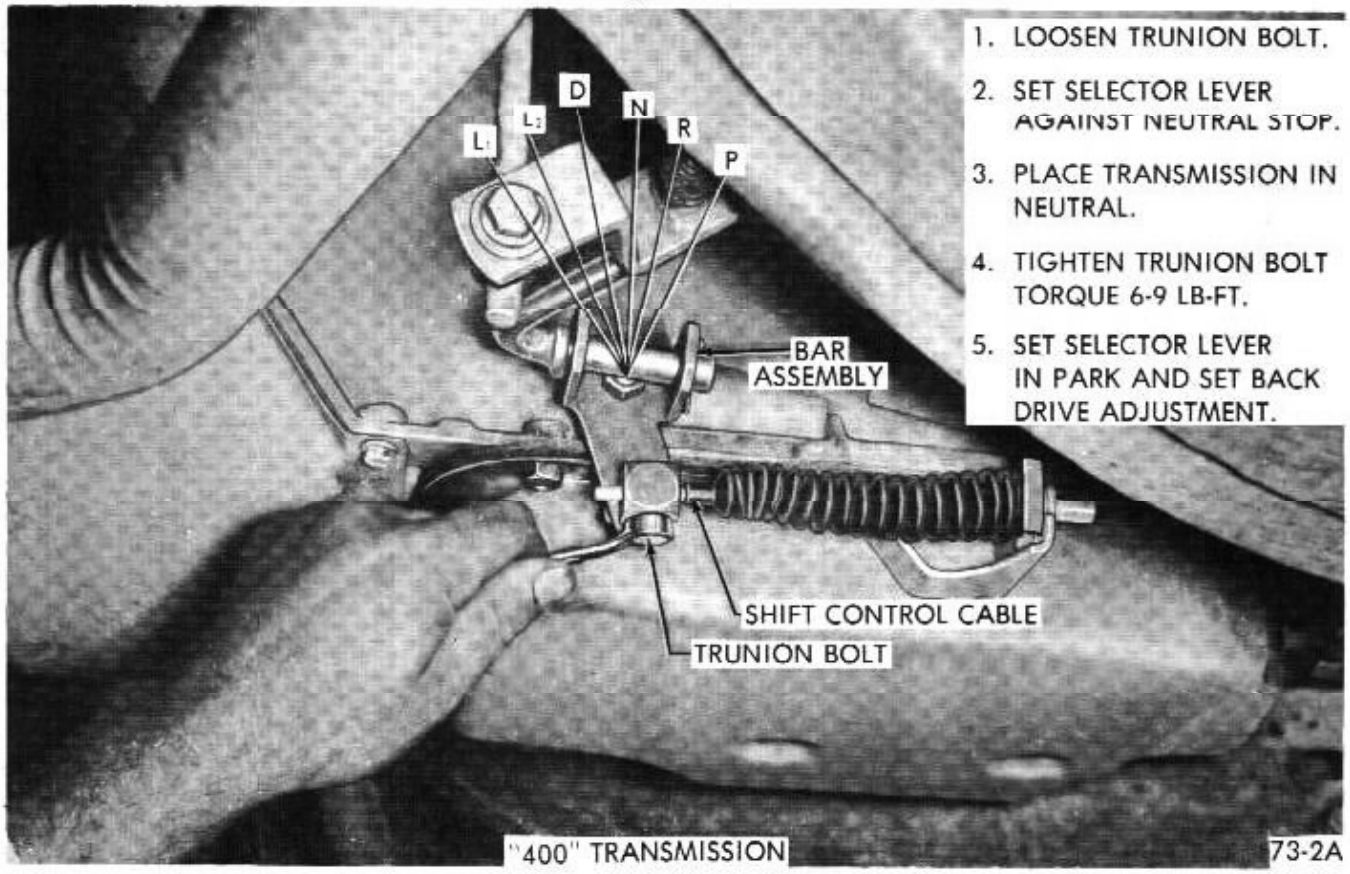


Figure 73-2

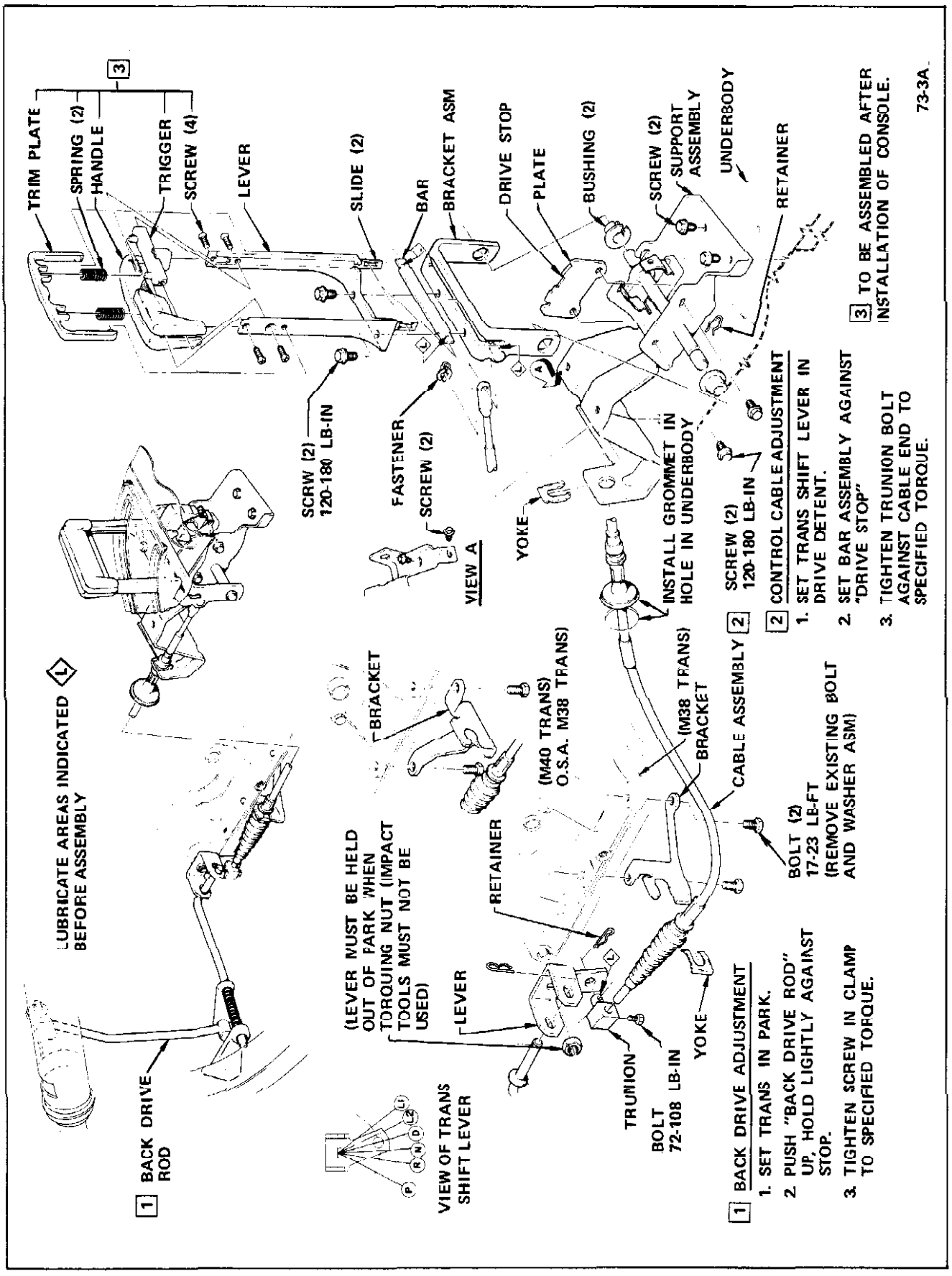

TRIM PLATE
SPRING (2)
HANDLE
3
TRIGGER
SCREW (4)
LEVER
SLIDE (2)
BAR
BRACKET ASM
DRIVE STOP
PLATE
BUSHING (2)
SCREW (2)
SUPPORT ASSEMBLY
UNDERBODY
RETAINER
SCRW (2) 120-180 LB-IN
FASTENER
SCREW (2)
VIEW A
YOKE
INSTALL GROMMET IN HOLE IN UNDERBODY
SCREW (2) 120-180 LB-IN
2 CONTROL CABLE ADJUSTMENT
1. SET TRANS SHIFT LEVER IN DRIVE DETENT.
2. SET BAR ASSEMBLY AGAINST "DRIVE STOP"
3. TIGHTEN TRUNION BOLT AGAINST CABLE END TO SPECIFIED TORQUE.
3 TO BE ASSEMBLED AFTER INSTALLATION OF CONSOLE.
73-3A
LUBRICATE AREAS INDICATED L BEFORE ASSEMBLY
1 BACK DRIVE ROD
(LEVER MUST BE HELD OUT OF PARK WHEN TORQUING NUT (IMPACT TOOLS MUST NOT BE USED)
BRACKET
(M40 TRANS) O.S.A. M38 TRANS)
RETAINER
LEVER
VIEW OF TRANS SHIFT LEVER
(M38 TRANS) BRACKET
CABLE ASSEMBLY 2
BOLT (2) 17-23 LB-FT (REMOVE EXISTING BOLT AND WASHER ASM)
TRUNION
BOLT 72-108 LB-IN
YOKE
1 BACK DRIVE ADJUSTMENT
1. SET TRANS IN PARK.
2. PUSH "BACK DRIVE ROD" UP, HOLD LIGHTLY AGAINST STOP.
3. TIGHTEN SCREW IN CLAMP TO SPECIFIED TORQUE.

Figure 73-3

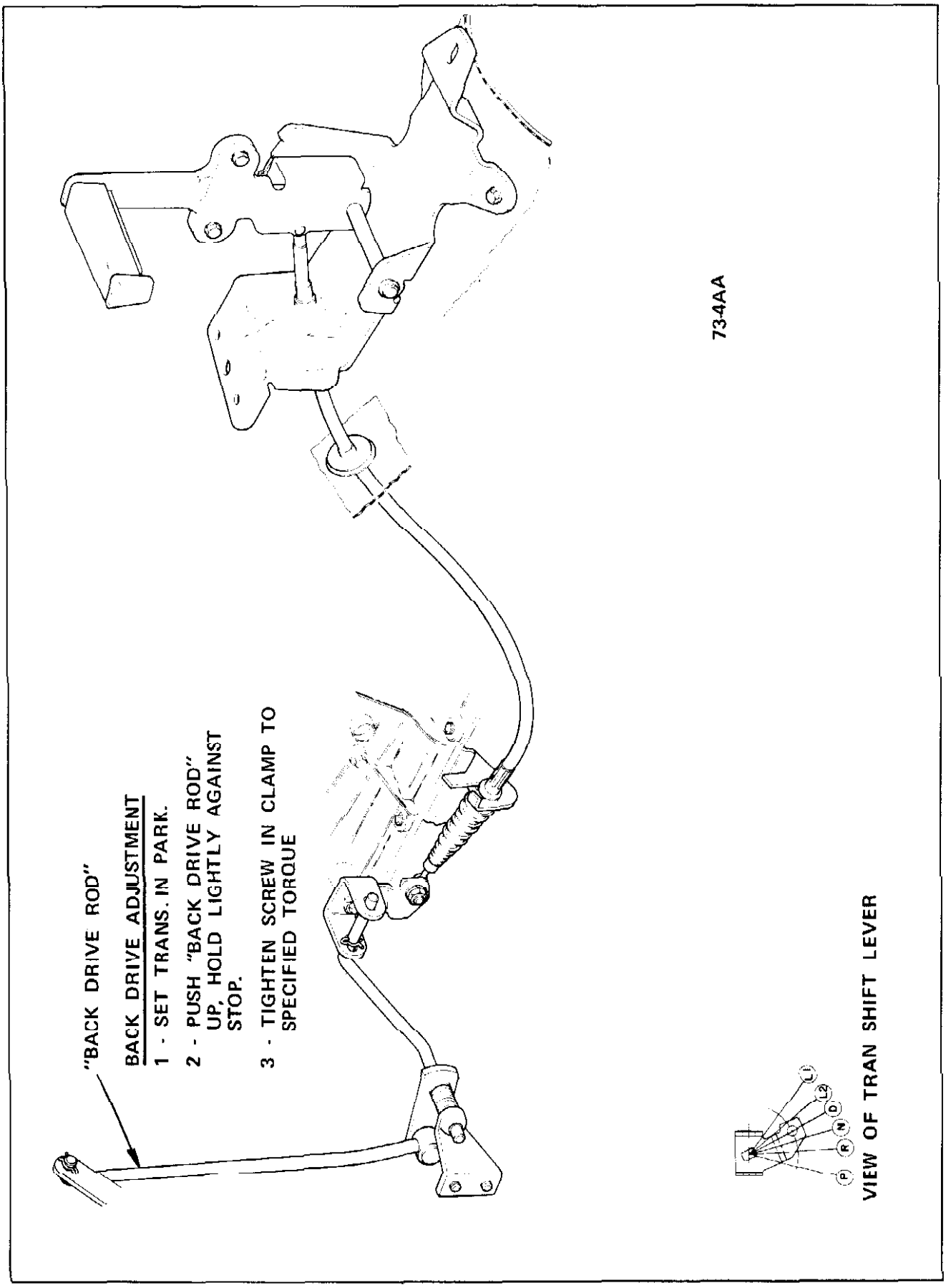
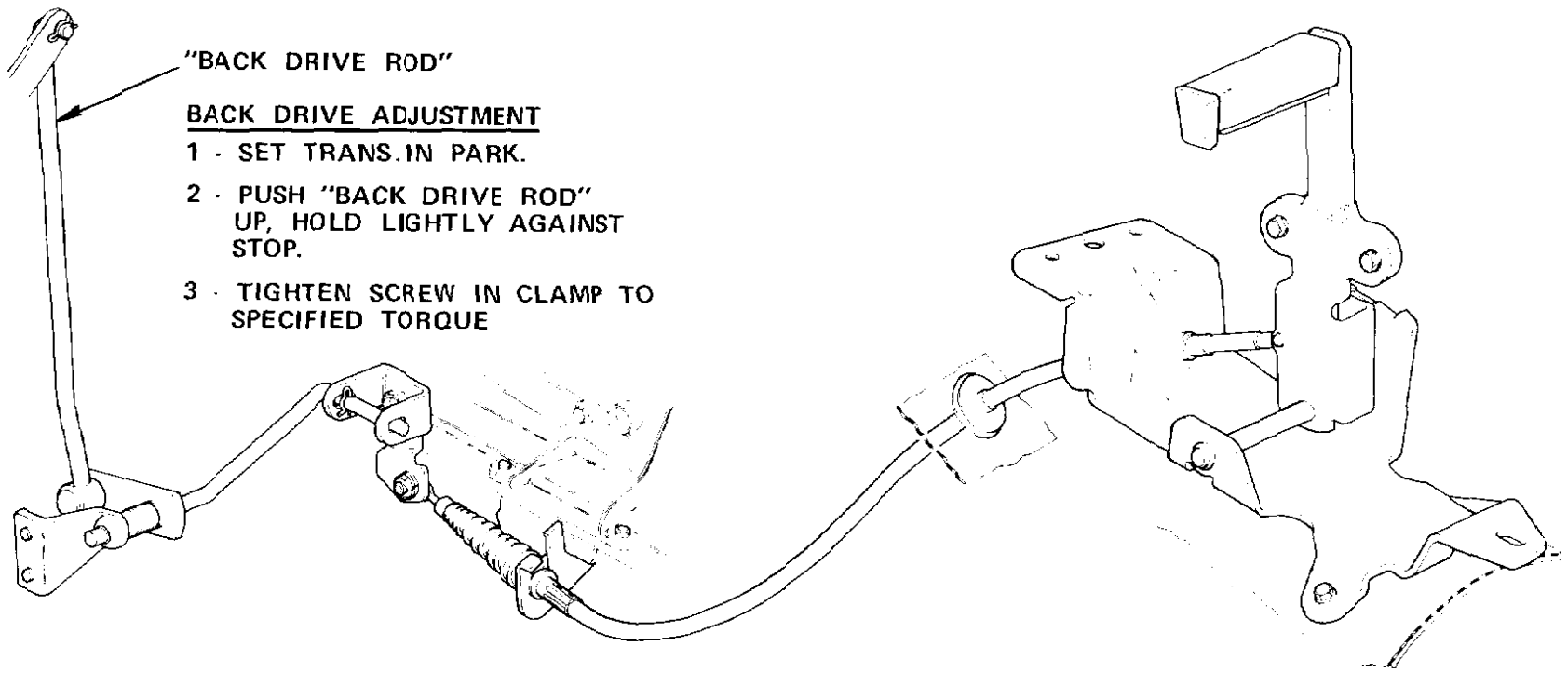
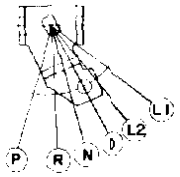

"BACK DRIVE ROD"
BACK DRIVE ADJUSTMENT
1 - SET TRANS. IN PARK.
2 - PUSH "BACK DRIVE ROD" UP, HOLD LIGHTLY AGAINST STOP.
3 - TIGHTEN SCREW IN CLAMP TO SPECIFIED TORQUE
73-4AA
VIEW OF TRAN SHIFT LEVER
L1
L2
D
N
R
P

Figure 73-4





VIEW OF TRAN SHIFT LEVER

Figure 73-4A

73-2 350 and 400 TURBO HYDRA-MATIC TRANSMISSION LINKAGE ADJUSTMENT (Column Shift) - ALL SERIES

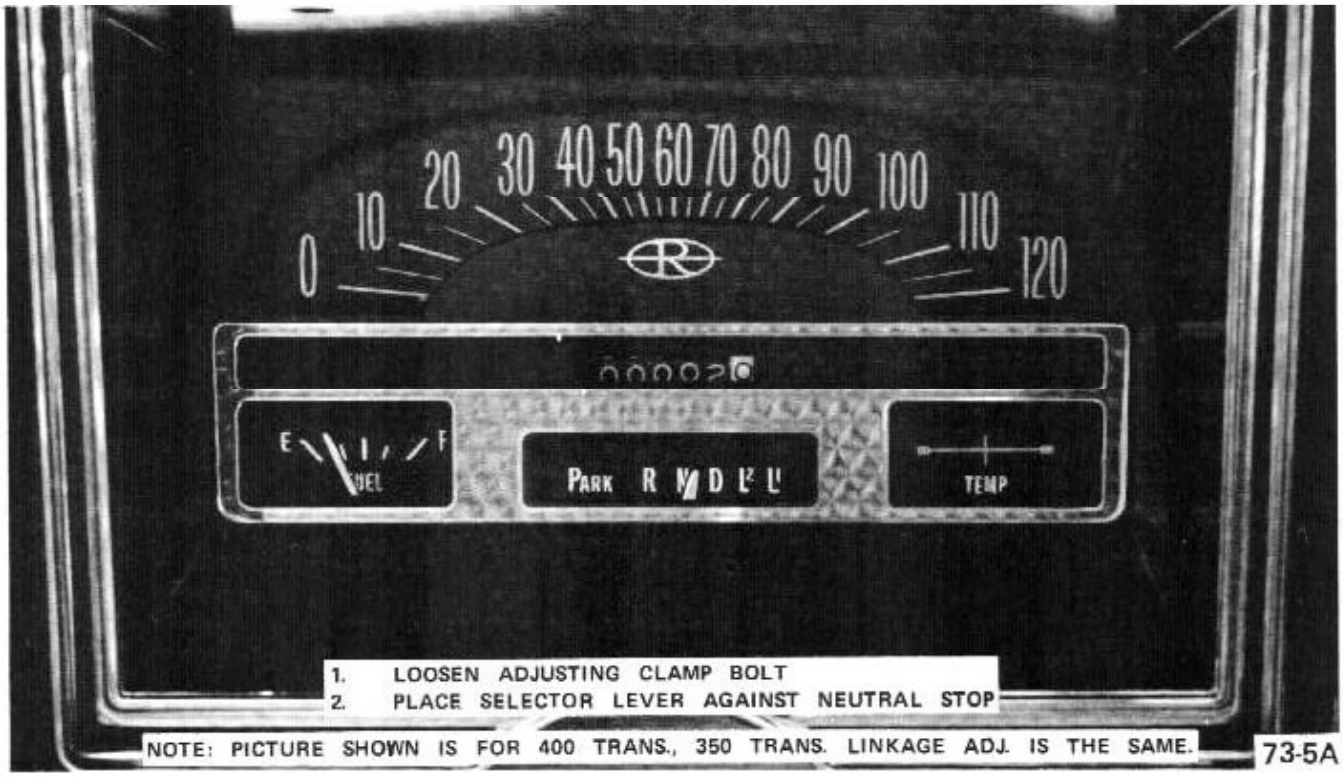


Figure 73-5

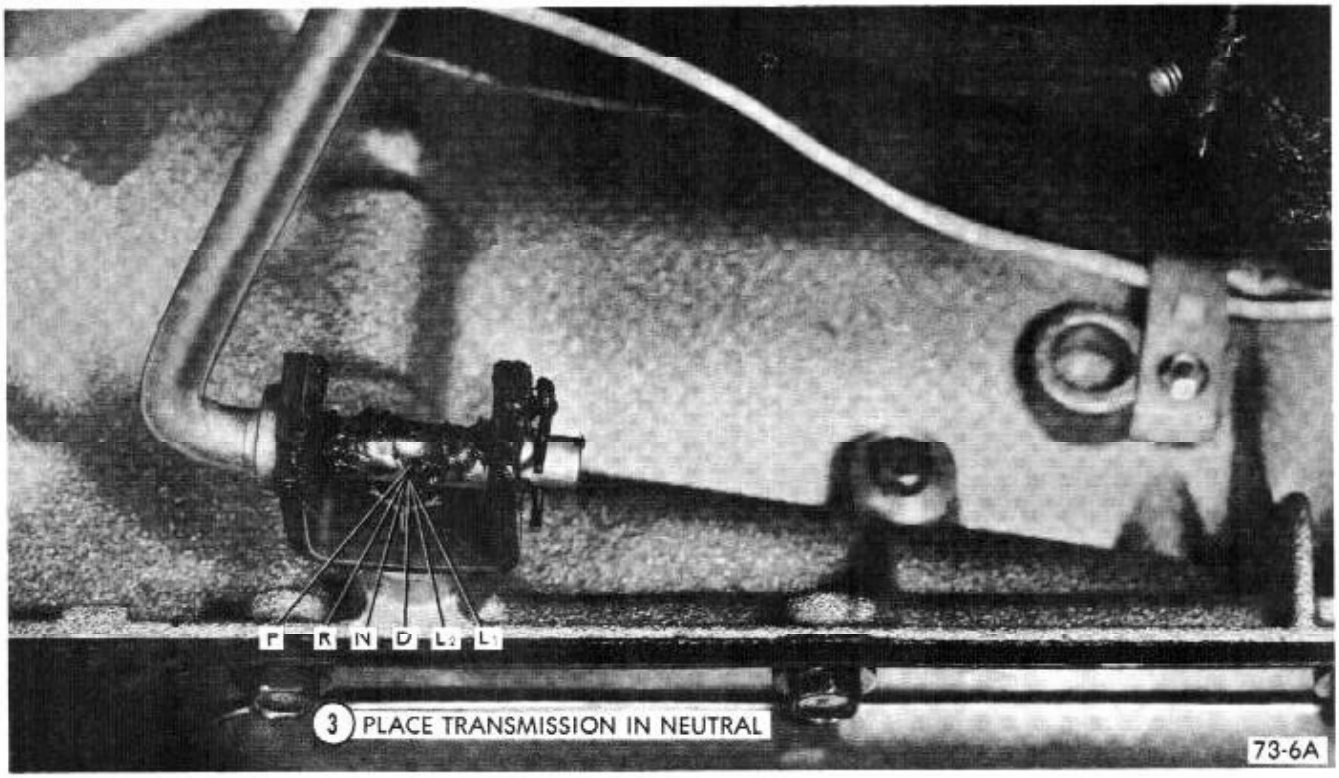


Figure 73-6

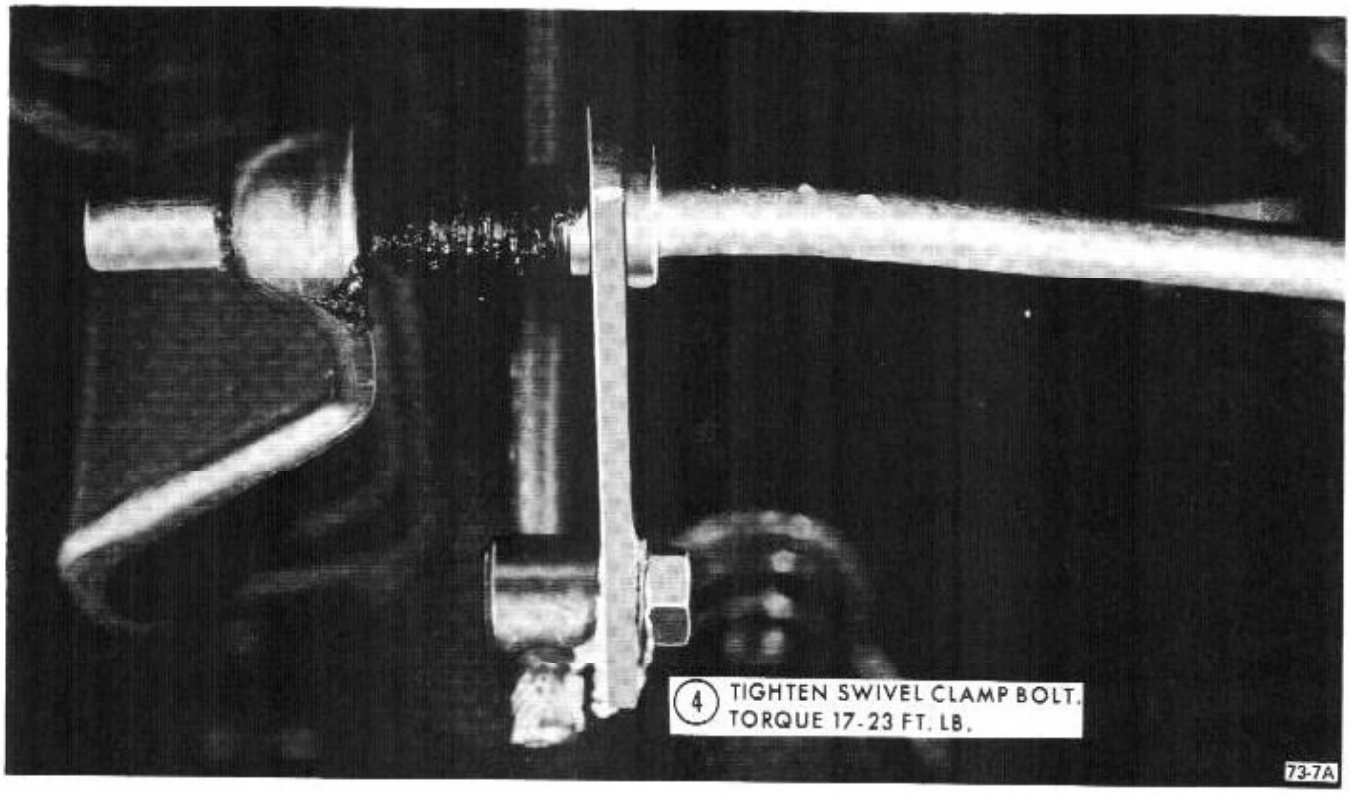


Figure 73-7

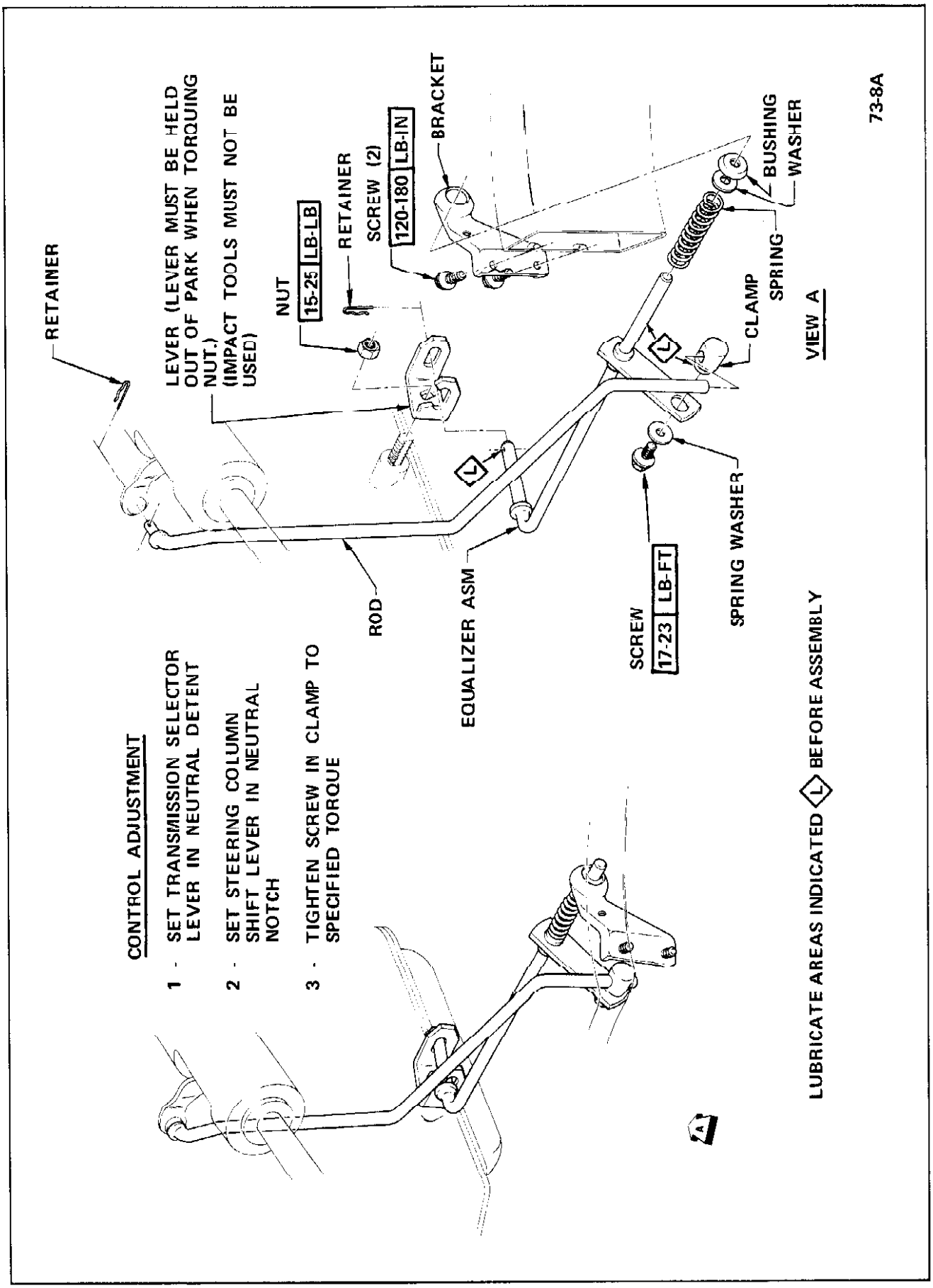

RETAINER
LEVER (LEVER MUST BE HELD OUT OF PARK WHEN TORQUING NUT.) (IMPACT TOOLS MUST NOT BE USED)
NUT
15-25 LB-LB
RETAINER
SCREW (2)
120-180 LB-IN
BRACKET
BUSHING
WASHER
SPRING
CLAMP
VIEW A
73-8A
ROD
EQUALIZER ASM
SCREW
17-23 LB-FT
SPRING WASHER
CONTROL ADJUSTMENT
1 - SET TRANSMISSION SELECTOR LEVER IN NEUTRAL DETENT
2 - SET STEERING COLUMN SHIFT LEVER IN NEUTRAL NOTCH
3 - TIGHTEN SCREW IN CLAMP TO SPECIFIED TORQUE
LUBRICATE AREAS INDICATED ◇L BEFORE ASSEMBLY

Figure 73-8

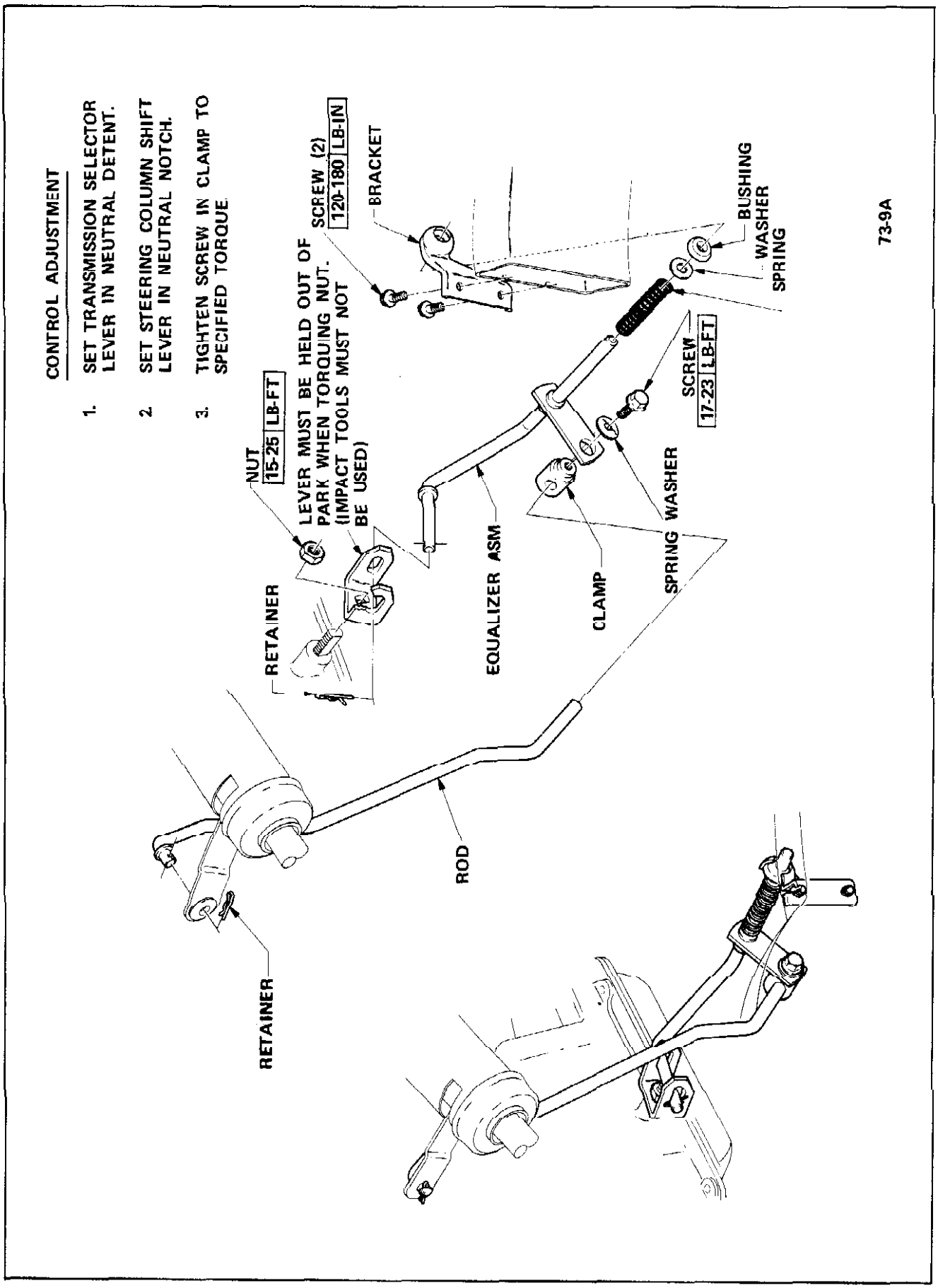

CONTROL ADJUSTMENT
1. SET TRANSMISSION SELECTOR LEVER IN NEUTRAL DETENT.
2. SET STEERING COLUMN SHIFT LEVER IN NEUTRAL NOTCH.
3. TIGHTEN SCREW IN CLAMP TO SPECIFIED TORQUE.
NUT 15-25 LB-FT
LEVER MUST BE HELD OUT OF PARK WHEN TORQUING NUT. (IMPACT TOOLS MUST NOT BE USED)
SCREW (2) 120-180 LB-IN
BRACKET
BUSHING
WASHER
SPRING
RETAINER
EQUALIZER ASM
CLAMP
SPRING WASHER
SCREW 17-23 LB-FT
ROD
RETAINER
73-9A

Figure 73-9

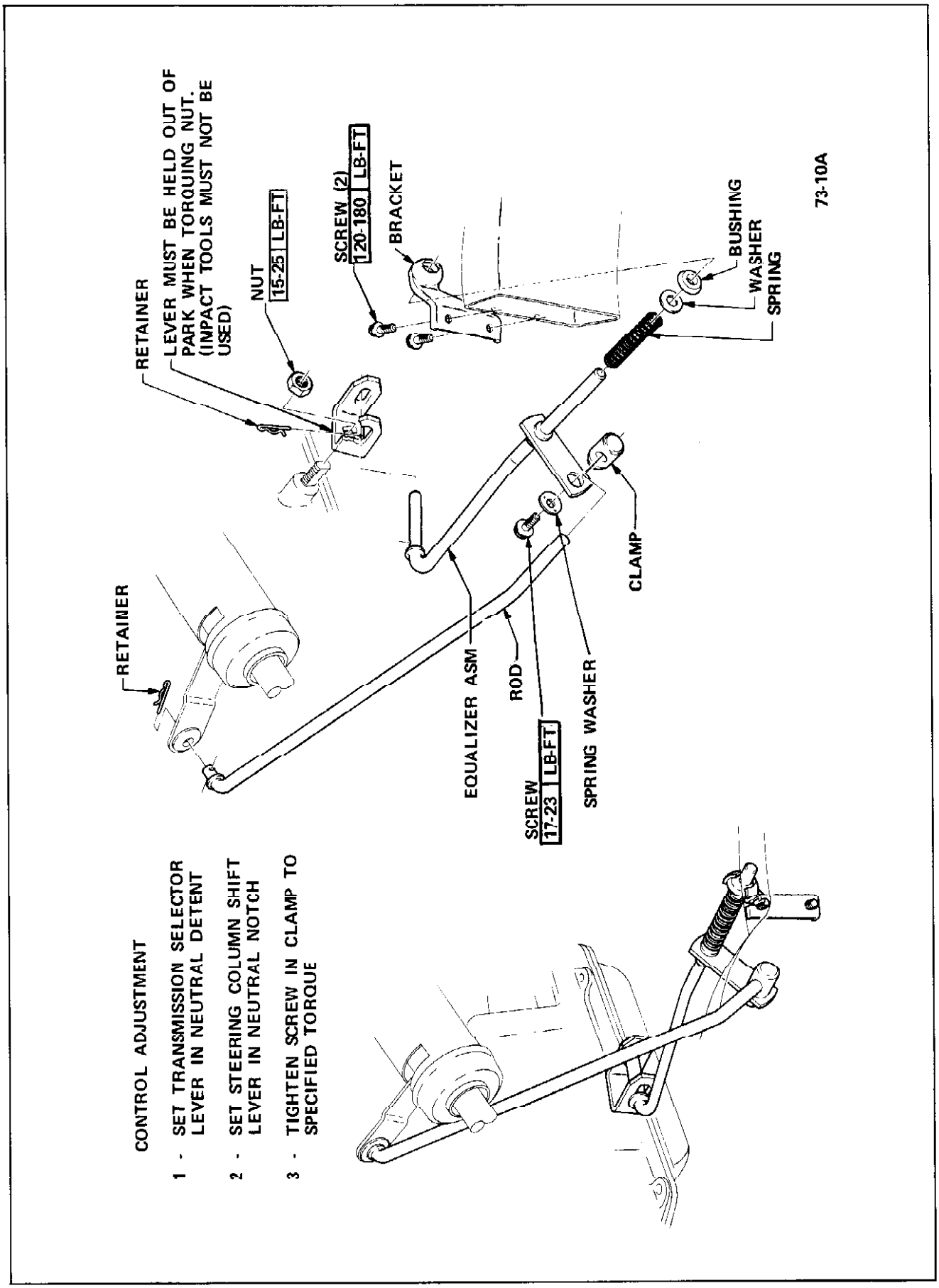

CONTROL ADJUSTMENT
1 - SET TRANSMISSION SELECTOR LEVER IN NEUTRAL DETENT
2 - SET STEERING COLUMN SHIFT LEVER IN NEUTRAL NOTCH
3 - TIGHTEN SCREW IN CLAMP TO SPECIFIED TORQUE
RETAINER
LEVER MUST BE HELD OUT OF PARK WHEN TORQUING NUT. (IMPACT TOOLS MUST NOT BE USED)
NUT 15-25 LB-FT
SCREW (2) 120-180 LB-FT
BRACKET
BUSHING
WASHER
SPRING
CLAMP
RETAINER
EQUALIZER ASM
ROD
SCREW 17-23 LB-FT
SPRING WASHER
73-10A

Figure 73-10

73-3 3-SPEED MANUAL TRANSMISSION LINKAGE ADJUSTMENT - 43-44000 SERIES

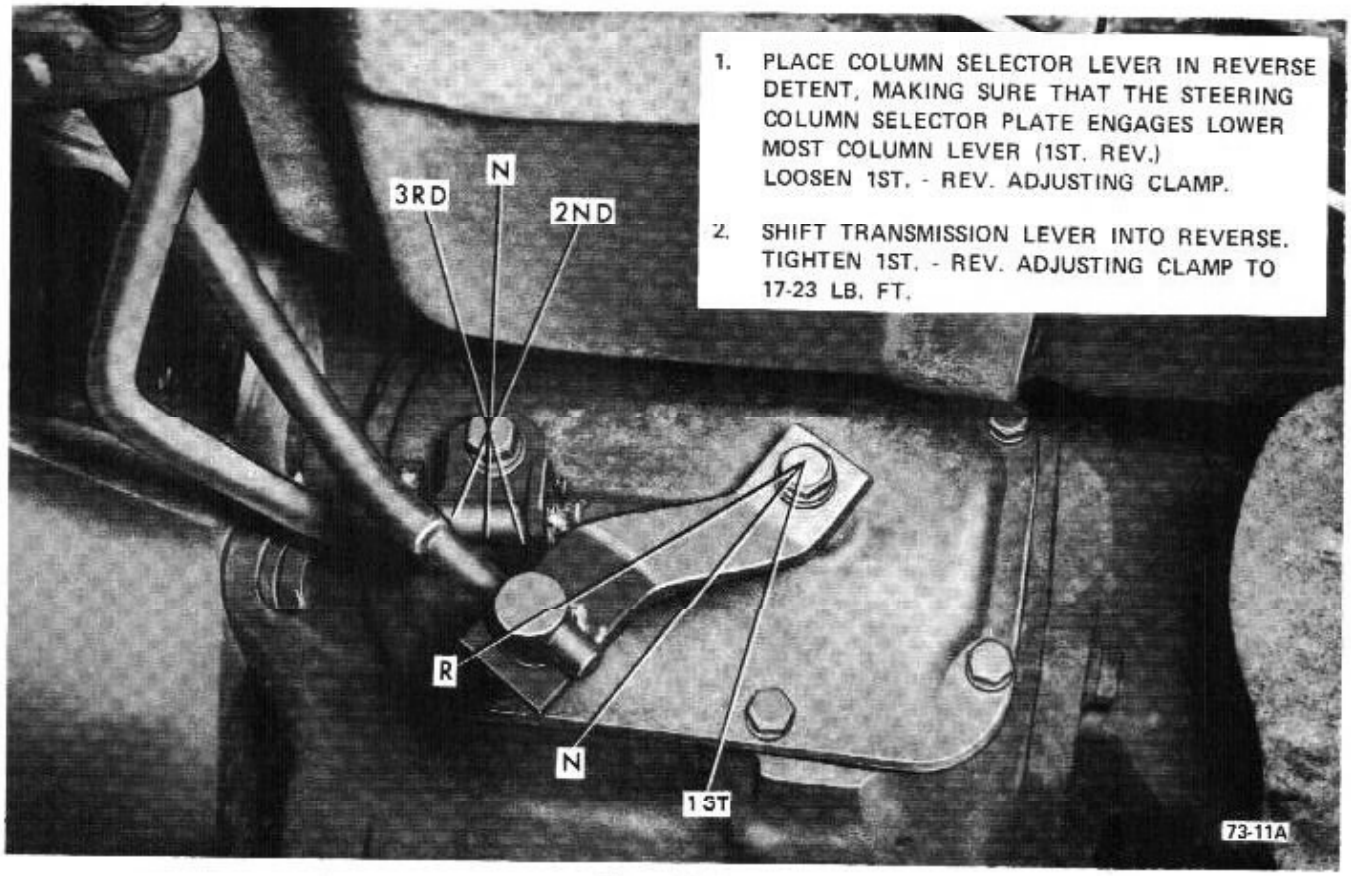


Figure 73-11

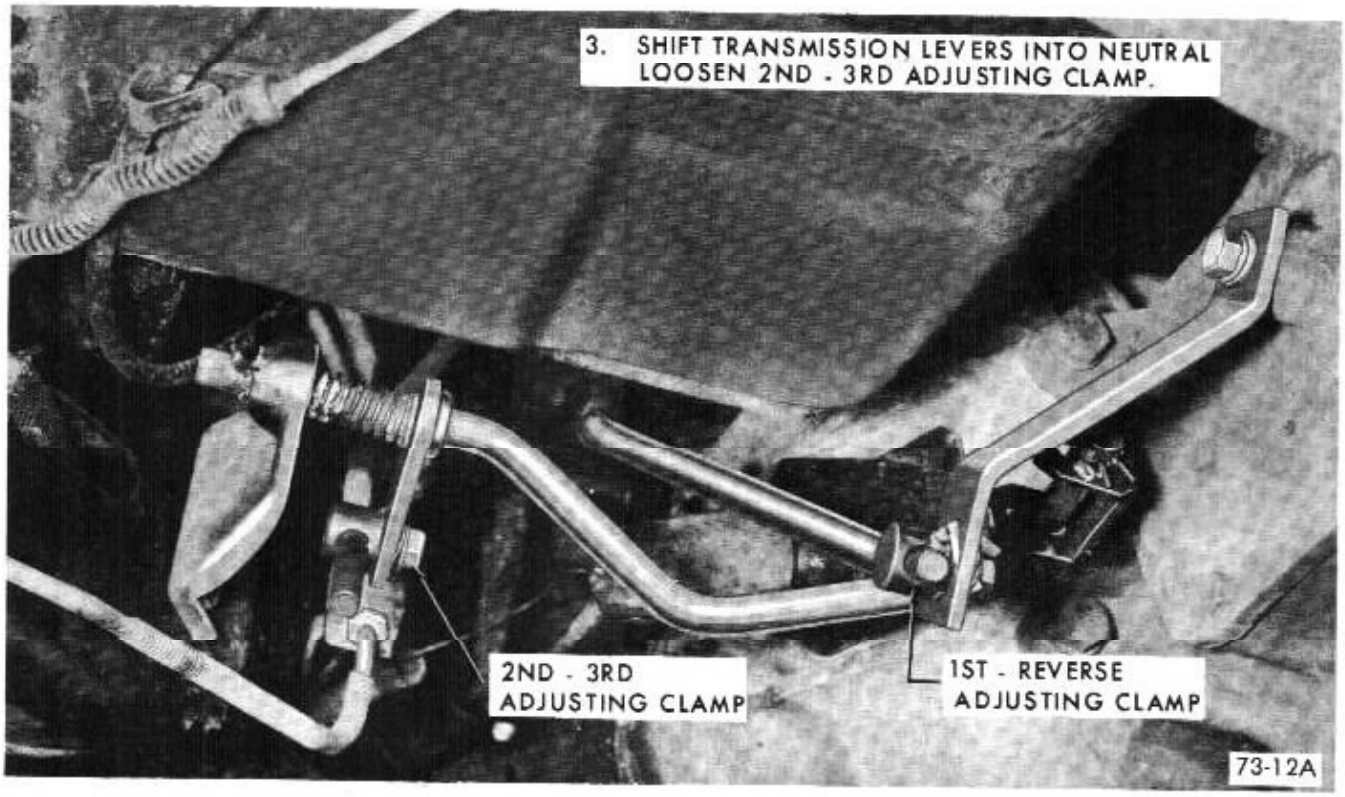
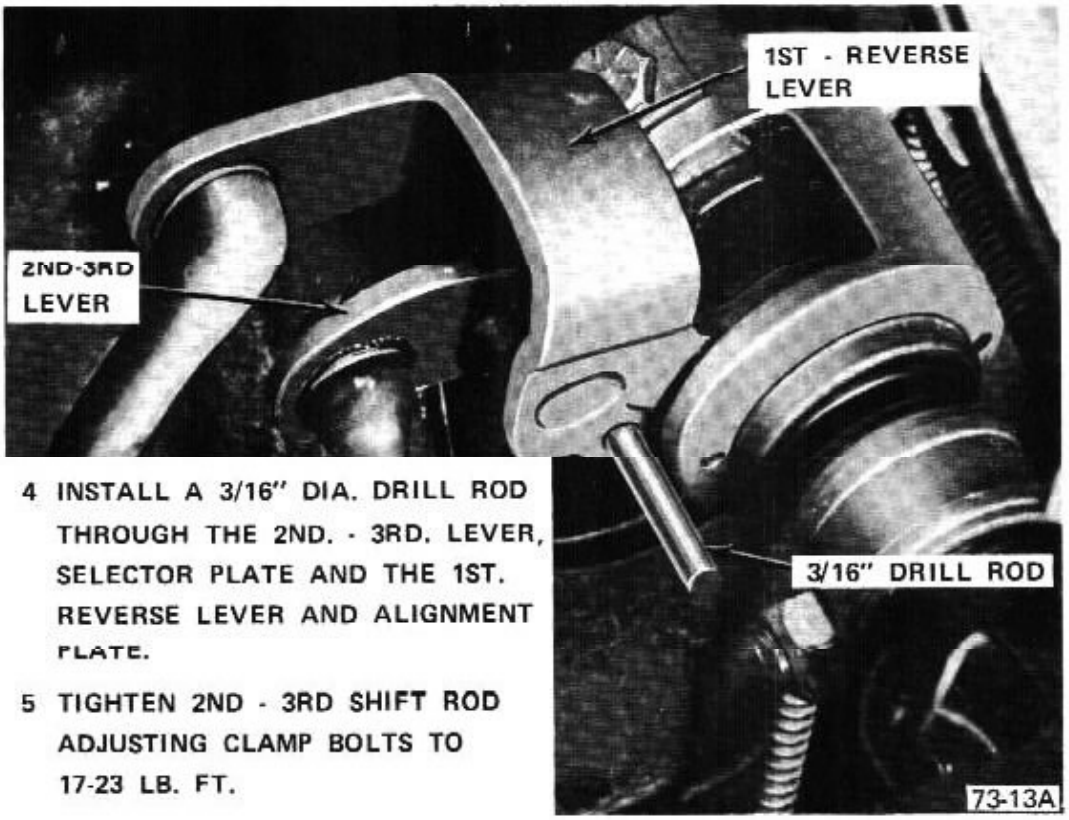


Figure 73-12



4 INSTALL A 3/16" DIA. DRILL ROD THROUGH THE 2ND. - 3RD. LEVER, SELECTOR PLATE AND THE 1ST. REVERSE LEVER AND ALIGNMENT PLATE.

5 TIGHTEN 2ND - 3RD SHIFT ROD ADJUSTING CLAMP BOLTS TO 17-23 LB. FT.

Figure 73-13

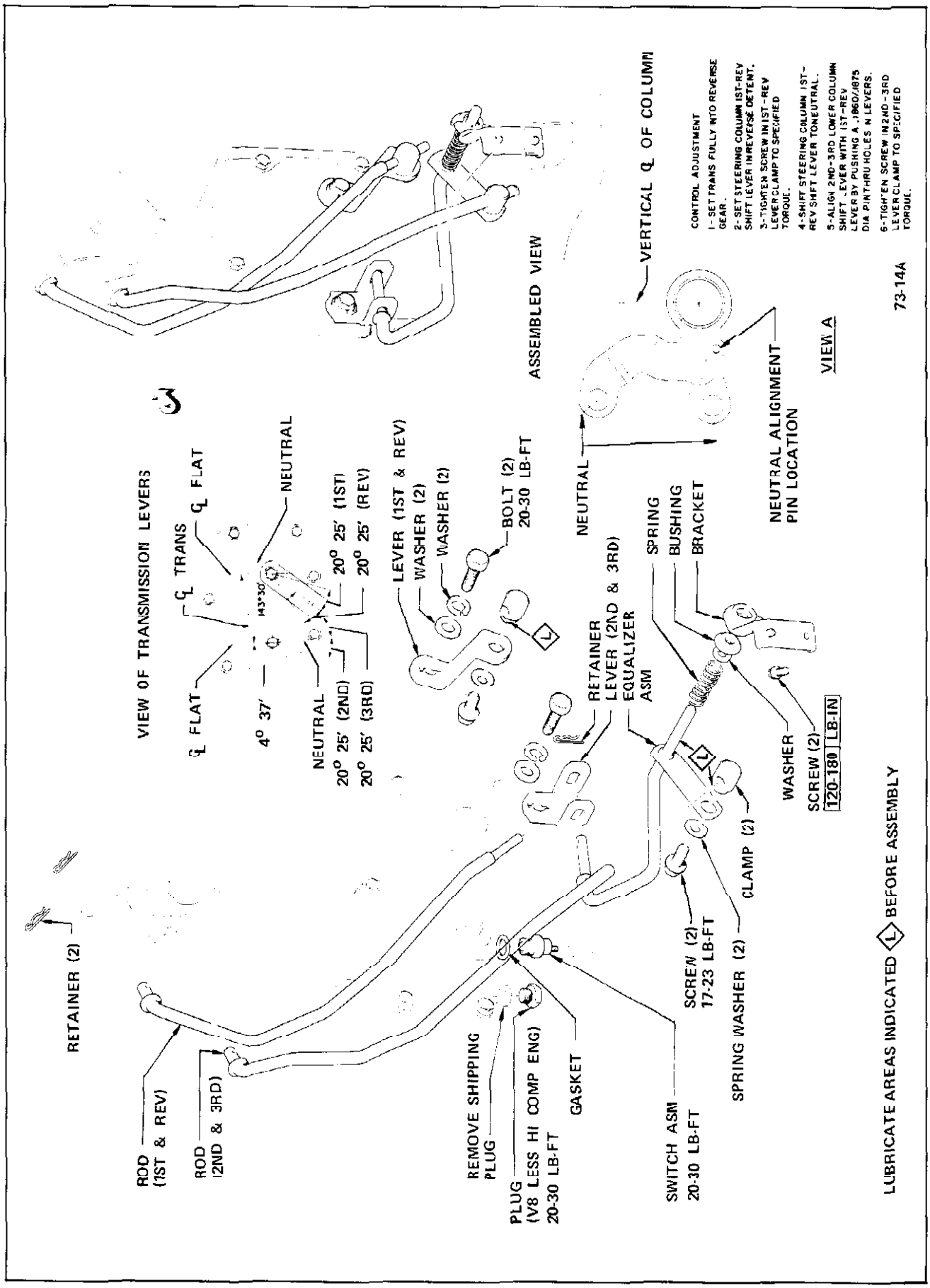

VIEW OF TRANSMISSION LEVERS
ASSEMBLED VIEW
VERTICAL ℄ OF COLUMN
℄ TRANS
℄ FLAT
NEUTRAL
4° 37'
20° 25' (2ND)
20° 25' (3RD)
20° 25' (1ST)
20° 25' (REV)
LEVER (1ST & REV)
WASHER (2)
BOLT (2)
20-30 LB-FT
NEUTRAL
RETAINER
LEVER (2ND & 3RD)
EQUALIZER ASM
SPRING
BUSHING
BRACKET
NEUTRAL ALIGNMENT
PIN LOCATION
VIEW A
CONTROL ADJUSTMENT
1-SET TRANS FULLY INTO REVERSE GEAR.
2-SET STEERING COLUMN 1ST-REV SHIFT LEVER IN REVERSE DETENT.
3-TIGHTEN SCREW IN 1ST-REV LEVER CLAMP TO SPECIFIED TORQUE.
4-SHIFT STEERING COLUMN 1ST-REV SHIFT LEVER TO NEUTRAL.
5-ALIGN 2ND-3RD LOWER COLUMN SHIFT LEVER WITH 1ST-REV LEVER BY PUSHING A .1960/.1875 DIA PIN THRU HOLES IN LEVERS.
6-TIGHTEN SCREW IN 2ND-3RD LEVER CLAMP TO SPECIFIED TORQUE.
73-14A
RETAINER (2)
ROD (1ST & REV)
ROD (2ND & 3RD)
REMOVE SHIPPING PLUG
PLUG (V8 LESS HI COMP ENG) 20-30 LB-FT
GASKET
SWITCH ASM 20-30 LB-FT
SCREW (2) 17-23 LB-FT
SPRING WASHER (2)
CLAMP (2)
WASHER
SCREW (2) 120-180 LB-IN
LUBRICATE AREAS INDICATED ◇L BEFORE ASSEMBLY

Figure 73-14

73-4 4-SPEED MANUAL TRANSMISSION LINKAGE ADJUSTMENT (Floor Shift) - ALL G.S. SERIES

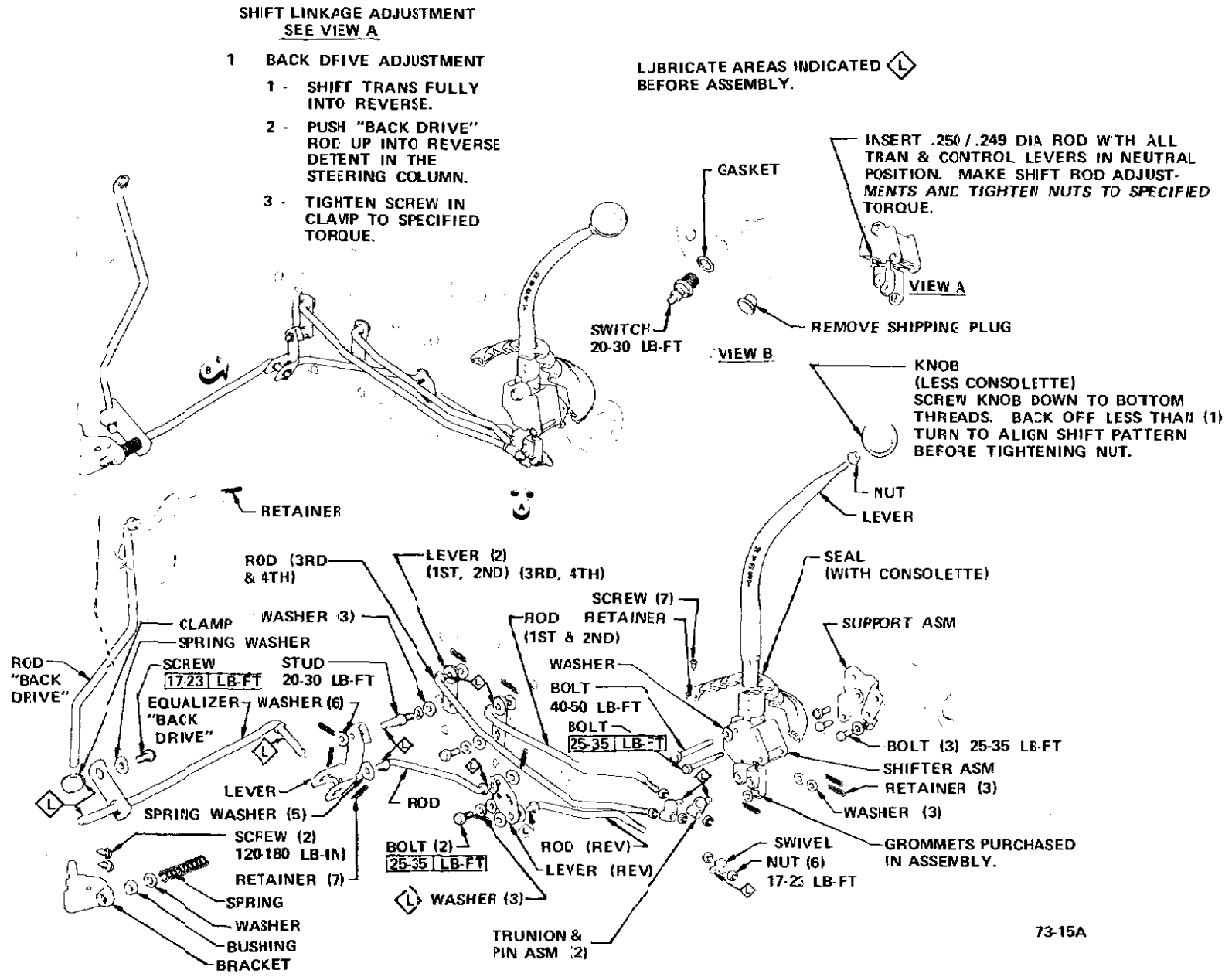


Figure 73-15

73-5 3-SPEED MANUAL TRANSMISSION LINKAGE ADJUSTMENT (Column Shift) 45-46-000 SERIES

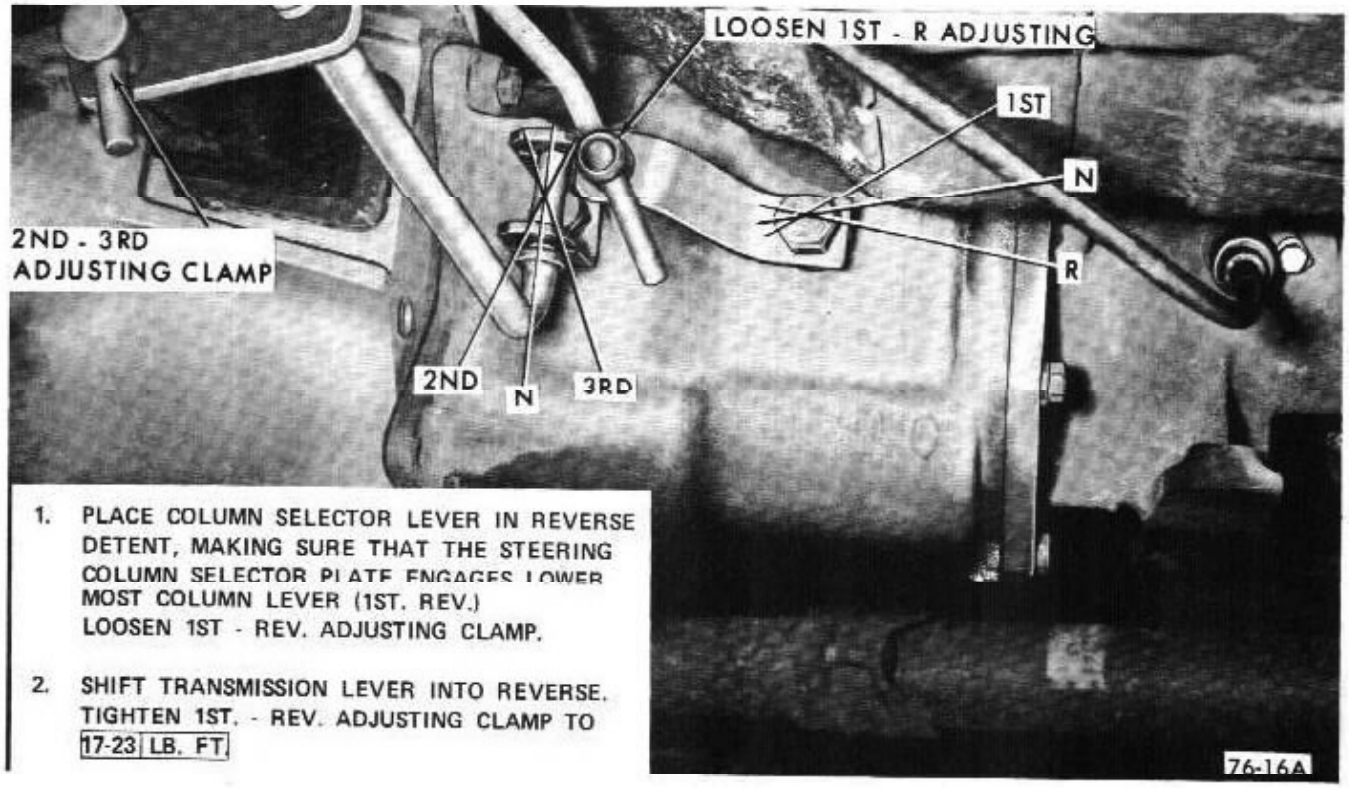


Figure 73-16

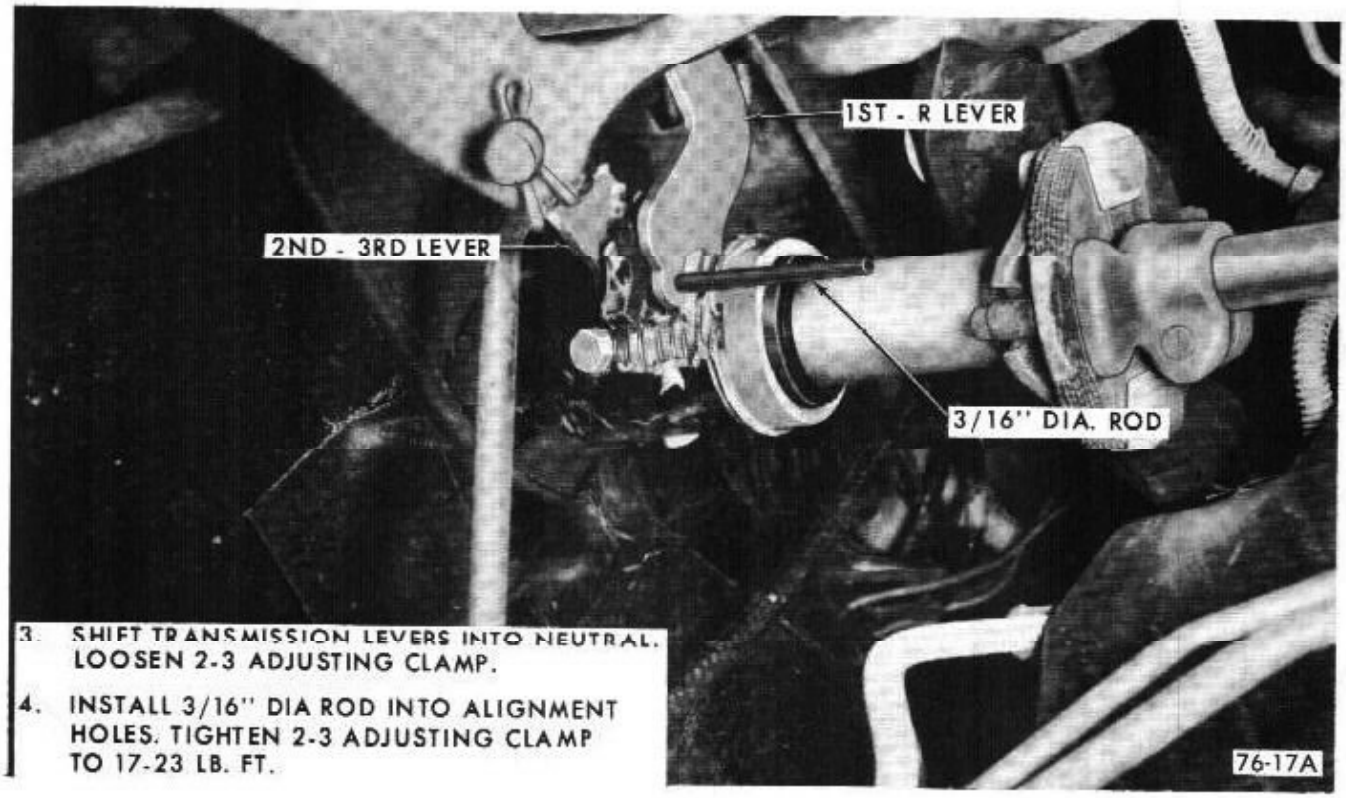


Figure 73-17

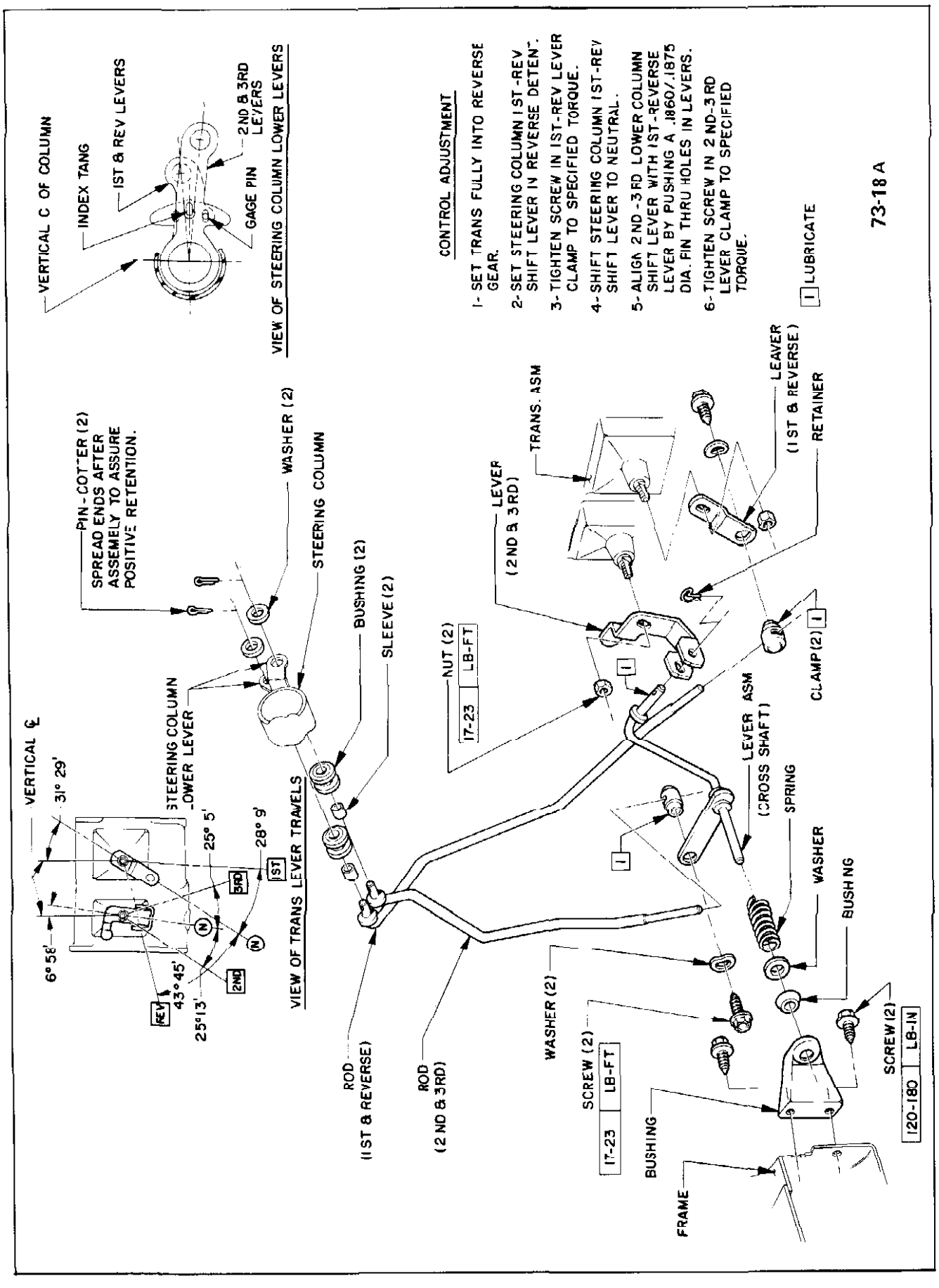

VERTICAL C OF COLUMN
INDEX TANG
1ST & REV LEVERS
GAGE PIN
2ND & 3RD LEVERS
VIEW OF STEERING COLUMN LOWER LEVERS
CONTROL ADJUSTMENT
1- SET TRANS FULLY INTO REVERSE GEAR.
2- SET STEERING COLUMN 1ST-REV SHIFT LEVER IN REVERSE DETEN".
3- TIGHTEN SCREW IN 1ST-REV LEVER CLAMP TO SPECIFIED TORQUE.
4- SHIFT STEERING COLUMN 1ST-REV SHIFT LEVER TO NEUTRAL.
5- ALIGN 2ND-3RD LOWER COLUMN SHIFT LEVER WITH 1ST-REVERSE LEVER BY PUSHING A .1860/.1875 DIA. PIN THRU HOLES IN LEVERS.
6- TIGHTEN SCREW IN 2ND-3RD LEVER CLAMP TO SPECIFIED TORQUE.
1 LUBRICATE
73-18 A
PIN-COTTER (2)
SPREAD ENDS AFTER ASSEMELY TO ASSURE POSITIVE RETENTION.
WASHER (2)
STEERING COLUMN
BUSHING (2)
SLEEVE (2)
STEERING COLUMN LOWER LEVER
VERTICAL ℄
31° 29'
6° 58'
43° 45'
25° 13'
25° 5'
28° 9'
REV
2ND
3RD
1ST
N
VIEW OF TRANS LEVER TRAVELS
NUT (2)
17-23 LB-FT
LEVER (2ND & 3RD)
TRANS. ASM
LEAVER (1ST & REVERSE)
RETAINER
CLAMP (2) 1
LEVER ASM (CROSS SHAFT)
SPRING
WASHER
BUSHING
SCREW (2)
120-180 LB-IN
ROD (1ST & REVERSE)
ROD (2ND & 3RD)
WASHER (2)
SCREW (2)
17-23 LB-FT
BUSHING
FRAME

Figure 73-18

GROUP 69

ENGINE

TUNE-UP

Section	Title
A	Engine Tune-Up - All Series .

SECTION A

ENGINE TUNE-UP
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Not Applicable)	-
II	DESCRIPTION AND OPERATION:	
	Tune-Up Purpose	69-1
III	ADJUSTMENTS AND MINOR SERVICE:	
	Tune-Up Procedures	69-2
IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS:	
	Tune-Up Specifications and Adjustments	69-3
	Tune-Up Chart	69-4
	Distributor Advance Chart	69-5

DIVISION II

DESCRIPTION AND OPERATION

69-1 TUNE-UP PURPOSE

The purpose of an engine tune-up is to restore power and performance that has been lost through wear, corrosion or deterioration of one or more parts or units. In the normal operation of an engine, these changes take place gradually at a number of points so that it is seldom advisable to attempt an improvement in performance by correction of one or two items only. Time will be saved and more lasting results will be obtained by following a definite and thorough procedure of analysis and correction of all c items affecting power and performance.

Because of federal laws limiting exhaust emissions, it is even more important that the engine tune-up be done accurately, using the specifications listed on the tune-up sticker found in each engine compartment.

Economical, trouble-free operation can better be assured if a complete tune-up is performed each 12,000 miles.

The parts or units which affect power and performance may be divided into three groups:

(1) Units affecting compression

(2) Units affecting ignition

(3) Units affecting carburetion

The tune-up procedure should cover these groups in the order given. Correction of items in the carburetion group should not be attempted until all items affecting compression and ignition have been satisfactorily corrected.

Most of the service procedures for performing a complete engine tune-up are covered in Groups 64 and 68; therefore, this paragraph provides an outline only with reference to these sections where detailed s information is given.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

69-2 TUNE-UP PROCEDURES

NOTE: *To make sure hydrocarbon and carbon monoxide emissions will be within limits, it is very important that the adjustments be followed exactly as listed on the sticker found in each engine compartment.*

The suggested procedure for engine tune-up is as follows:

1. Run engine until warm.

2. Remove all spark plugs.

3. Position throttle and choke valve in full open position.

4. Connect jumper wire between distributor terminal of coil and ground on engine to avoid high tension sparking while cranking engine.

5. Firmly insert compression gage in spark plug port.

6. Check compression of each cylinder. *Repeat* compression check and record highest reading obtained on each cylinder during the two pressure checks.

The recorded compression pressures are to be considered normal if the lowest reading cylinder is more than 75 percent of the highest reading cylinder. See Figure 69-1.

Cylinder No.	Pressure (PSI)
1	129
2	135
3	140
4	121
5	120
6	100
7	130
8	126

69-1

Figure 69-1 - Compression Test Example

EXAMPLE: *75 percent of 140 (highest) is 105. Thus, cylinder number 6 is less than 75 percent of number 3. This condition accompanied by low speed missing, indicates an improperly seated valve or worn or broken piston ring.*

7. If one or more cylinders read low, inject about a tablespoon of engine oil on top of pistons in low reading cylinders through spark plug port. Repeat compression check on these cylinders.

a. If compression improves considerably, rings are worn.

b. If compression does not improve, valves are sticking or seating poorly.

c. If two adjacent cylinders indicate low compression and injecting oil does not increase compression, the cause may be a head gasket leak between the cylinders. Engine coolant in cylinders could result from this defect.

8. Clean, inspect and test spark plugs; if necessary, replace spark plugs. Gap to .030" (.035" - L-6), and install spark plugs (par. 68-19).

9. Inspect and test battery and cables (par. 120-7 and 120-1).

10. If battery is in good condition but cranking speed is low, test cranking motor circuit (par. 68-2).

11. Adjust generator and power steering belts (also air conditioner belt if so equipped). If difficulty is experienced in keeping battery charged, check generator and regulator (Group 68, Section C or D).

12. Inspect and test entire ignition system and make indicated corrections (par. 68-19).

13. Inspect and test fuel pump (par. 64-9).

14. Inspect gasoline filter (par. 64-7).

15. Check operation of choke valve and fast idle cam.

16. Check operation of choke unloader.

17. Check throttle linkage and dash pot adjustment (par. 64-6).

18. Adjust carburetor idle speed and mixture (par. 64-5).

19. Inspect all water hose connections and tighten clamps, if necessary.

20. Check transmission controlled vacuum advance system (Paragraph 67-2).

21. Road test car for power and overall performance.

b. Compression Pressure Limit Chart

This chart may be used when checking cylinder compression pressures. It has been calculated so that lowest reading number is 75 percent of the highest reading number. See Figure 69-2.

EXAMPLE: *After checking the compression pressures in all cylinders, it was found that the highest pressure obtained was 182 psi. The lowest pressure reading was 145 psi. By locating 182 in the maximum column, it is seen that the minimum allowable pressure is 136 psi. Since the*

Maximum Pressure Pounds/ Sq. Inch	Minimum Pressure Pounds/ Sq. Inch	Maximum Pressure Pounds/ Sq. Inch	Minimum Pressure Pounds/ Sq. Inch
134	101	186	140
136	102	188	141
138	104	190	142
140	105	192	144
142	107	194	145
144	108	196	147
146	110	198	148
148	111	200	150
150	113	202	151
152	114	204	153
154	115	206	154
156	117	208	156
158	118	210	157
160	120	212	158
162	121	214	160
164	123	216	162
166	124	218	163
168	126	220	165
170	127	222	166
172	129	224	168
174	131	226	169
176	132	228	171
178	133	230	172
180	135	232	174
182	136	234	175
184	138	236	177
		238	178

69-2

Figure 69-2 - Compression Pressure Limit Chart

lowest reading obtained was 145 psi, the car is within limits and the compression is considered satisfactory.

c. Cylinder Head Torque and Valve Adjustment (L-6)

Retorquing the cylinder head bolts is not necessary unless a gasket has been replaced, or a leak is suspected. Valve lash must always be adjusted after the head has been torqued.

Before adjusting the valve lash, it is extremely important that the engine be thoroughly warmed up to normalize the expansion of all parts. This is very important because during the warm-up period, the valve clearances will change considerably.

1. After the engine has been normalized, remove rocker arm cover and gasket.

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 the palm of hand or a rubber mallet.*

2. With the engine running at idle, back off valve rocker arm nut until the valve rocker arm starts to clatter.

3. Turn rocker arm nut down slowly until the clatter just stops. This is the zero lash position.

4. Turn nut down 1/4 additional turn and pause 10 seconds until engine runs smoothly. Repeat additional 1/4 turns, pausing 10 seconds each time, until nut has been turned down 1 full turn from the zero lash position.

NOTE: *This 1 turn preload adjustment must be done slowly to allow the lifter to adjust itself to prevent the possibility of interference, between the inlet valve head and top of piston, which might result in internal damage and/or bent push rods. Noisy lifters should be replaced.*

5. Repeat Steps 2, 3 and 4 to adjust the rest of the valves.

6. Clean gasket surface on cylinder head and rocker arm cover with degreaser then install rocker arm cover, using new gasket and torque bolts to specifications.

DIVISION VI SPECIFICATIONS

69-3 SPECIFICATIONS AND ADJUSTMENTS

Gasoline Tank Capacity (Approximately)
- Series 43-44000 ..... 20 Gal.
- Series 45-46-48000 ..... 25 Gal.
- Series 49000 ..... 25 Gal.

Gasoline Gauge, Make & Type ..... A.C., Electric
Fuel Pump, Make ..... A.C.
Fuel Pump, Type & Location
- All ..... Mechanical, Left Front Engine

Fuel Pump Pressure — At Carb, Level
- 250-350 Engines ..... 3 Lbs. Min.
- 455 Engines ..... 4-1/2 Lbs. Min.

Fuel Pump Volume ..... 1 Pt. in 30 Seconds or Less
Carburetor, Make & Type ..... Rochester, Remote Choke Coil
Air Cleaner Element, Make & Material ..... A.C., Oiled Paper Element

Air Cleaner Element, Type — Standard Duty
- 250 Engine A169CW
- 350-455 Engines A329C
- All G.S. Engines A212CW

Air Cleaner Element, Type — Heavy Duty
- 250 Engine A227C
- 350-455 Engines A368C
- All G.S. Engines A279C

Fuel Filter, In Carb. Inlet, Make, Material & Type
- 1 & 2-Barrel Carb ..... A.C., 1 In. Paper, GF-427
- 4-Barrel Carb ..... A.C., 2 In. Paper, GF-4411

Fuel Filter, In Gas Tank ..... Woven Plastic

Positive Crankcase Ventilator Valve, Type
- L-6 Engine CV-723C
- V-8 Engine CV-679C

Intake Manifold Heat, Type ..... Exhaust Crossover
- Thermostat Wind-Up at 70 F., Valve Closed ..... 1/2 Turn

Fast Idle Speed (On Low Step of Cam)
- Manual Transmission (In Neutral 350 Engine ..... 820 RPM
- 455 Engine ..... 720 RPM
- Automatic Transmission (In Drive) 350 & 455 Engine ..... 650 RPM

C. E. C. Valve Adjustment (250 L-6)
- Manual Transmission ..... 850 RPM
- Automatic Transmission ..... 650 RPM

Throttle Control Solenoid Adjustment
- All 350 and 455 cu. in. Engines w/Man. Trans. ..... 1100 RPM

69-4 ENGINE TUNE-UP CHART

Fast Idle Speed (On Low Step of Cam)	*250 Eng.	350 Eng.	455 Eng.
Manual	850	820	720
Automatic	650	650	650

*C.E.C. Valve Adjustment for 250 L-6

Engine	Spark Plug	Plug Gap	Dwell Angle	Breaker Gap	Initial Timing	Curb Idle Speed
250 Eng. (Man. Trans.)	R46TS	.035'	32° ±2°	.019"	4° B.T.D.C.	550 in N
250 Eng. (Auto. Trans.)	R46TS	.035'	32° ±2°	.019"	4° B.T.D.C.	500 in D
350 Erg. (Man. Trans.) 43-44-45000 Series	R45TS	.030'	30° ±2°	.016"	6° B.T.D.C.	800 in N
350 Eng. (Auto. Trans.) 43-44000 W/2BBL. Carb.	R45TS	.030'	30° ±2°	.016"	10° B.T.D.C.	600 in D
350 Eng. (Auto. Trans.) 43-44000 W/4BBL. Carb. and 45000 W/2 & 4BBL.	R45TS	.030"	30° ±2°	.016"	4° B.T.D.C.	600 in D
455 Eng. (Man. Trans.)	R44TS	.030"	30° ±2°	.016"	6° B.T.D.C.	700 in N
455 Eng. (Auto. Trans.)	R44TS	.030"	30° ±2°	.016"	4° B.T.D.C.	600 in D
455 Stage I (Man. Trans.)	R44TS	.030"	30° ±2°	.016"	10° B.T.D.C.	700 in N
455 Stage I (Auto. Trans.)	R44TS	.030"	30° ±2°	.016"	10° B.T.D.C.	600 in D

69-5 DISTRIBUTOR ADVANCE CHART

	Total Dist. Adv.	Cent. Adv. Only
250 Eng.	41° – 55°	18° – 22°
350 Eng. (Man. Trans.) 43-44-45000 Series	30° – 38°	16° – 20°
350 Eng. (Auto. Trans.) 43-44000 W/2BBL. Carb.	24° – 33°	10° – 14°
350 Eng. (Auto. Trans.) 43-44000 W/4BBL & 45000 W/2 & 4BBL. Carb.	28° – 37°	14° – 18°
455 Eng. (Man. Trans.)	35° – 43°	20° – 24°
455 Eng. (Auto. Trans.)	32° – 40°	16° – 20°
455 Stage I Eng.	35° – 43°	20° – 24°

SECTION D

Generating System 49000 Series

CONTENTS

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	Trouble Shooting Charging System	68-35
	Faulty Indicator Lamp Operation	68-36
	Undercharged Energizer	68-37
	Overcharged Energizer	68-38
II	DESCRIPTION AND OPERATION:	
	Description of Delcotron Generator	68-39
	Operation of Delcotron Generator	68-40
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION:	
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V	OVERHAUL AND MAJOR SERVICE:	
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DIVISION I

TROUBLE DIAGNOSIS

68-35 TROUBLESHOOTING PROCEDURES

NOTE: *(Close adherence to the following procedures in the order presented will lead to the location and correction of charging system defects in the shortest possible time. Only a portion of these procedures need be performed. It will never be necessary to perform all the procedures in order to locate the trouble.)*

A basic wiring diagram showing lead connections is shown in Figure 68-54. To avoid damage to the electrical equipment, always observe the following precautions:

1. Do not polarize the generator.

2. Do not short across or ground any of the terminals in the charging circuit, except as specifically instructed herein.

3. Never operate the generator with the output terminal open circuited.

4. Make sure the generator and Energizer have the same ground polarity.

5. When connecting a charger or a booster Energizer to the vehicle Energizer, connect negative to negative and positive to positive.

Trouble in the charging system will show up as one or more or the following conditions:

1. Faulty indicator lamp operation.

2. An undercharged Energizer, as evidenced by slow cranking and low specific gravity readings.

3. An overcharged Energizer, as evidenced by excessive water usage.

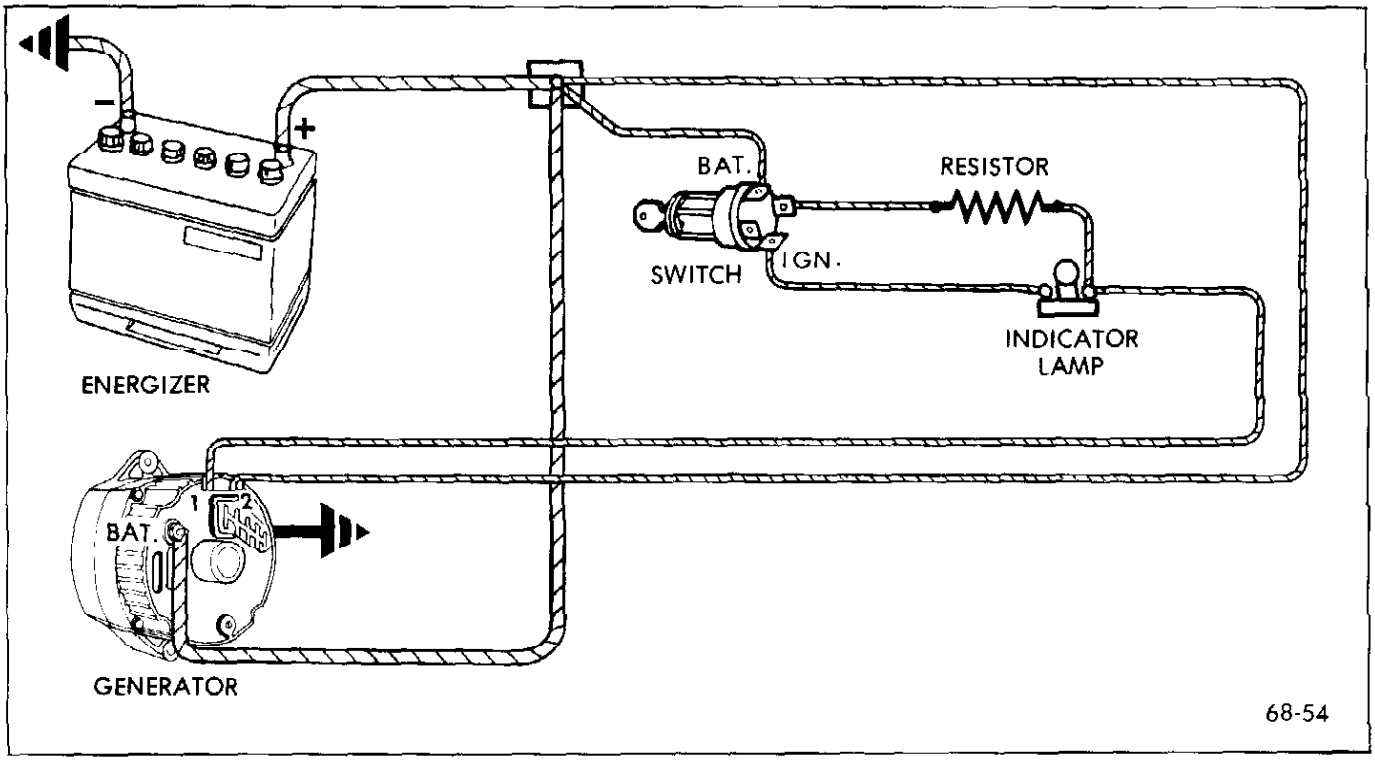
68-36 FAULTY INDICATOR LAMP OPERATION

Check the indicator lamp for normal operation, as shown below:

Switch	Lamp	Engine
OFF	OFF	STOPPED
ON	ON	STOPPED
ON	OFF	RUNNING

If the indicator lamp operates normally, proceed to "Undercharged Energizer" or "Overcharged Energizer" section. Otherwise, proceed to either one of the following three abnormal conditions.

1. *Switch Off, Lamp On* - In this case, disconect the two leads from the generator No. 1 and No. 2 terminals. If the lamp stays on, there is a short between these two leads. If the lamp goes out, replace the rectifier bridge, as covered



- Figure 68-54 - Delcotron Generator Wiring

in the "Generator Repair" section. This condition will cause an undercharged Energizer.

2. *Switch On, Lamp Off, Engine Stopped* - This condition can be caused by the defects listed in Part I above, by reversal of the No. 1 and No. 2 leads at these two terminals, or by an open in the circuit. This condition can cause an undercharged Energizer. To determine where an open exists, proceed as follows:

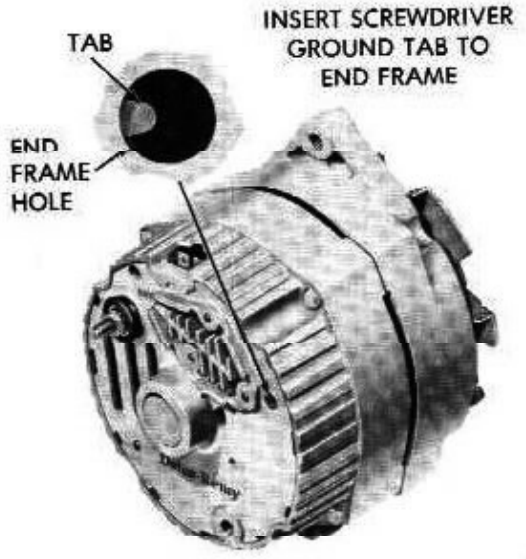
a. Connect voltmeter from No. 2 generator terminal to ground. If reading is obtained, go to Step b. If reading is zero, repair open circuit between No. 2 terminal and Energizer. If lamp now comes on, no further checks need be made.

b. With ignition switch on and with No. 1 and No. 2 terminal leads connected or disconnected, at generator, momentarily ground No. 1 terminal lead.

CAUTION: *Do not ground No. 2 lead.*

c. If lamp does not light, check for a blown fuse, a burned out bulb, defective bulb socket, or an open in No. 1 lead circuit between generator and ignition switch.

d. If lamp lights, remove ground at No. 1 terminal and with No. 1 and No. 2 terminal leads connected at generator, insert screwdriver into test hole (Figure 68-55) to ground field winding.



- Figure 68-55 - Grounding Generator Field Winding

e. If lamp does not light, check connection between wiring harness and No. 1 terminal of generator, and check brushes, slip rings, and field winding for opens, as covered in "Generator Repair" section.

f. lamp lights and voltmeter reading is obtained in Step "a" preceding, replace regulator, as covered in "Generator Repair" section, and check field winding.

3. *Switch On, Lamp On, Engine Running* - The possible causes of this condition are covered in the "Undercharged Energizer" section.

If a defect has been found and corrected at this point, no further checks need be made.

68-37 UNDERCHARGED ENERGIZER

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions, even though the indicator lamp may be operating normally. The following procedure also applies to circuits with an ammeter.

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.

2. Check the drive belt for proper tension.

3. If a battery or Energizer defect is suspected, check "Battery" section in this Manual.

4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and firewall, and the cable clamps and battery posts.

5. With ignition switch on and all wiring harness leads connected, connect a voltmeter from:

a. Generator "BAT" terminal to ground

b. Generator No. 1 terminal to ground

c. Generator No. 2 terminal to ground

A zero reading indicates an open between voltmeter connection and Energizer.

NOTE: *Generators have a built-in feature which avoids overcharge and accessory damage by preventing the generator from turning on if there is an* **open** *in the wiring harness connected to the No. 2 generator terminal. Opens in the wiring harness connected between the No. 2 generator terminal and Energizer may be between the terminals, at the crimp between the harness wire and terminal, or in the wire.*

6. If previous Steps 1 through 5 check satisfactorily, check Delcotron generator as follows:

a. Check generator belt condition and tension. Adjust to 80 lbs., using Gage J-23600.

b. Install a battery post adapter at the positive post, as shown in illustration 68-38.

NOTE: *Illustration shows "top" terminals. Adapters are available for side terminals also.*

c. Connect ammeter leads, as shown in illustration: Red lead toward generator; black lead to battery positive post; and ground lead to battery negative post.

d. Connect voltmeter across the battery: Red lead at generator side of battery post adapter; and black lead to battery negative post.

e. Make sure all electrical accessories are turned off. Start engine with battery post adapter switch closed. Open switch as soon as engine is started.

f. Place carburetor on highest step of fast idle cam.

g. Turn tester control knob to "LOAD" position and adjust knob to obtain highest possible ammeter reading. Highest ammeter reading must be at least two-thirds amperes of output rating stamped on generator (i.e., 37A, 42A, 55A).

h. If output is low, by-pass voltage regulator to cause full generator output as follows: Ground the field winding by inserting a screwdriver into the test hole (Figure 68-55).

CAUTION: *Tab is within 3/4" of casting surface. Do not force screwdriver deeper than 1" into end frame.*

i. Retest as described in Steps f and g. If output is still low, generator is faulty and must be removed for repairs.

j. If output (using screwdriver) is now okay, defect is in regulator. Replace regulator, as covered in "Generator Overhaul".

k. Remove battery post adapter and turn accessories off.

68-38 OVERCHARGED ENERGIZER

1. To determine Energizer or battery condition, check "Battery" section in this Manual.

2. Connect a voltmeter from generator No. 2 terminal to ground. If reading is zero, No. 2 lead circuit is open.

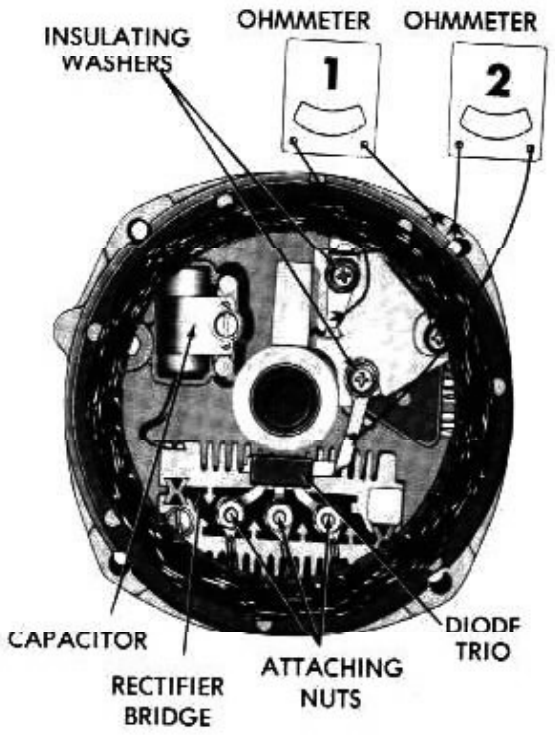
3. If Energizer and No. 2 lead circuit check good but an obvious overcharge condition exists, as evidenced by excessive Energizer water usage, proceed as follows:

a. Separate end frames, as covered in "Disassembly" section under heading of "Generator Overhaul". Check field winding for shorts. If shorted, replace rotor and regulator.

b. Connect ohmmeter using lowest range scale from brush lead clip to end frame, as shown in Step 1, Figure 68-56; then reverse lead connections.

c. If both readings are zero, either the brush lead clip is grounded or regulator is defective.

d. A grounded brush lead clip can result from omission of insulating washer (Figure 68-56), omission of insulating sleeve over screw, or damaged insulating sleeve. Remove



- Figure 68-56 - Inside View End Frame Assembly

screw to inspect sleeve. If satisfactory, replace regulator, as covered under heading of "Generator Overhaul" section.

DIVISION II

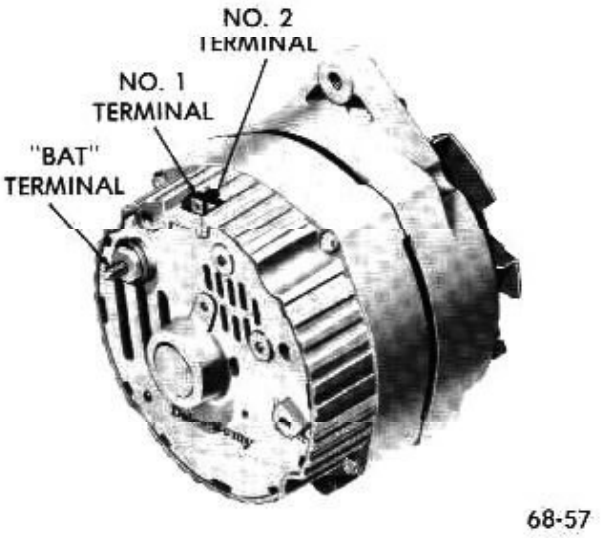
DESCRIPTION AND OPERATION

68-39 DESCRIPTION OF DELCOTRON GENERATOR

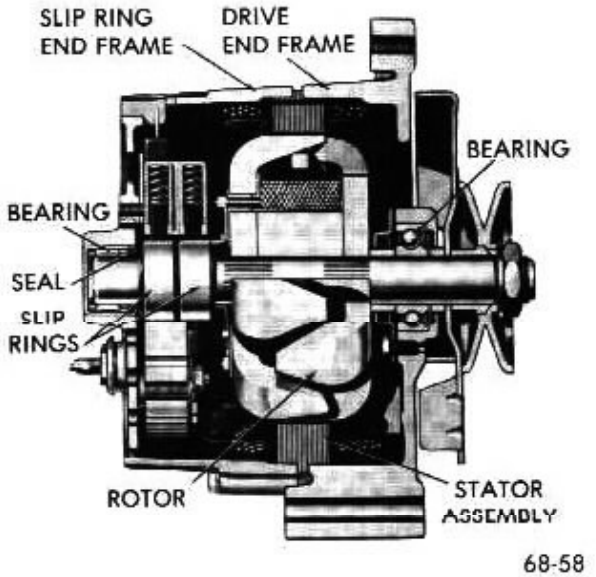
The Delcotron generator illustrated in Figures 68-57 and 68-58 features a solid state regulator that is mounted inside the generator slip ring end frame. All regulator components are enclosed into a solid mold, and this unit, along with the brush holder assembly, is attached to the slip ring end frame. The regulator voltage setting never needs adjusting, and no provision for adjustment is provided.

The generator rotor bearings contain a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor and, under normal conditions, will provide long periods of attention-free service.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes and electrically changes the stator A.C. voltages to



- Figure 68-57 - Delcotron Generator With Solid State Regulator



- Figure 68-58 - Sectional View

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.

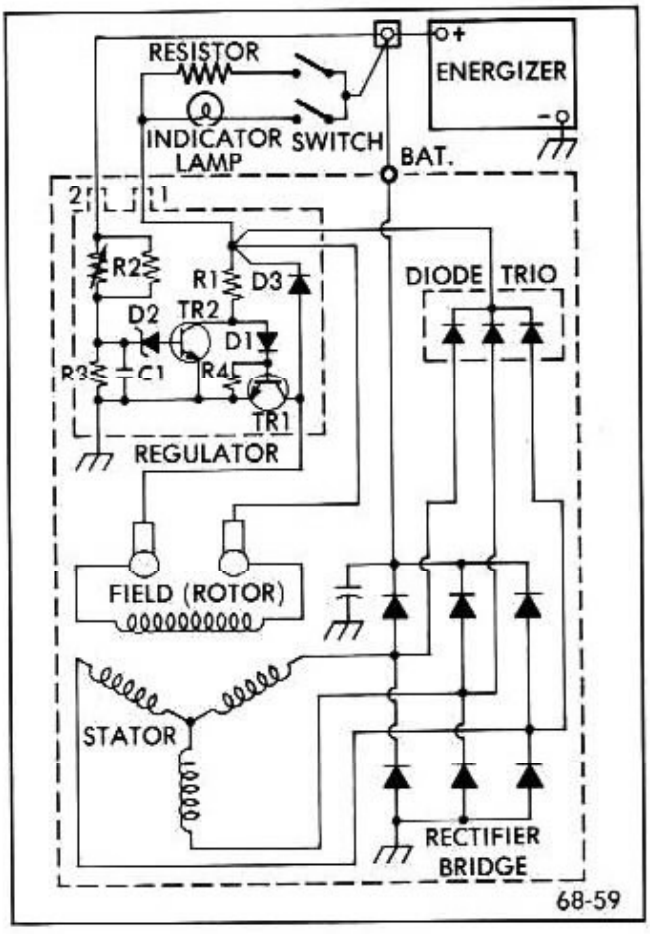
No periodic adjustments or maintenance of any kind are required on the entire generator assembly.

68-40 OPERATION OF DELCOTRON GENERATOR

A typical wiring diagram is illustrated in Figure 68-59. The basic operating principles are explained as follows:

When the switch is closed, current from the Energizer flows through the indicator lamp and resistor to the generator No. 1 terminal, through resistor R1, diode D1, and the base-emitter of transistor TR1 to ground, and the back to the Energizer. This turns on transistor TR1 and current flows through the generator field coil and TR1 back to the Energizer. The resistor in parallel with the indicator lamp reduces total circuit resistance to provide higher field current for initial voltage build-up when the engine starts.

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.



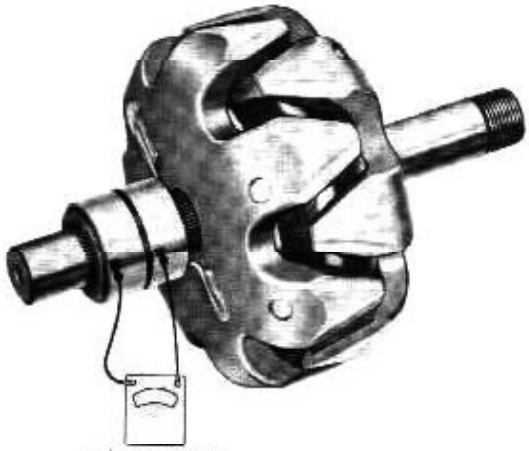
- Figure 68-59 - Delcotron Generator Wiring Circuit Diagram

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 be-

CAUTION: *Avoid excessive tightening, as this may cause distortion of the rotor. Remove the shaft nut, washer pulley, fan, and the collar, and then separate the drive end frame from the rotor shaft.*

B. Rotor Field Winding Checks

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open (Figure 68-60).



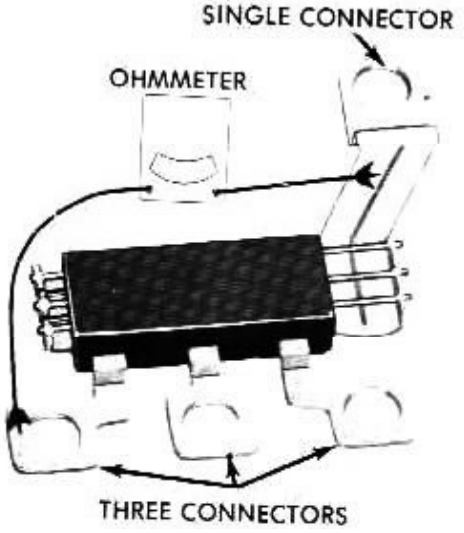
68-60

- Figure 68-60 - Checking Rotor Field Windings

The winding is checked for short-circuits or excessive resistance by connecting a battery and ammeter in series with the edges of the two slip rings. An ammeter reading above the specified value indicates shorted windings; a reading below the specified value indicates excessive resistance. An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings (Figure 68-60). If the resistance reading is below the specified value, the winding is shorted; if above the specified value, the winding has excessive resistance. The specified resistance value can be determined by dividing the voltage by the current given in Specifications. Remember that the winding resistance and ammeter readings will vary slightly with winding temperature changes. If the rotor is not defective but the generator fails to supply rated output, the defect is in the diode trio, rectifier bridge, or stator.

C. Diode Trio Check

The diode trio is identified in Figure 68-61. First, connect an ohmmeter using lowest range scale from brush lead clip to end frame, as shown in Step 2, Figure 68-56, then reverse lead connections. If both readings are the same, check for grounded brush lead clip caused by omission of insulating washer (Figure 68-56), omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. *If screw assembly is correct and both ohmmeter readings are the same, replace regulator.*



68-61

- Figure 68-61 - Diode Trio Check

To check the diode trio, remove it from the end frame assembly by detaching the three nuts, the attaching screw, and removing the stator assembly. Note that the insulating washer on the screw is assembled over the top of the diode trio connector. Connect an ohmmeter having a one and one-half volt cell, and using the lowest range scale, to the single connector and to one of the three connectors (Figure 68-61). Observe the reading. Then reverse the ohmmeter leads to the same two connectors. If both readings are the same, replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors.

NOTE: *Figures 68-56 and 68-61 illustrate two diode trios differing in appearance. Either one of these diode trios may be used in these generators and the two are completely interchangeable.*

D. Rectifier Bridge Check

Note that the rectifier bridge has a grounded heat sink and an insulated heat sink connected to the output terminal. Also, note the insulating washer located between the insulated heat sink and end frame (Figure 68-62).

To check the rectifier bridge, connect the ohmmeter to the grounded heat sink and one of the three terminals (Figure 68-62). Then reverse the lead connections to the grounded heat sink and same terminal. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two terminals, and between the insulated heat sink and each of the three terminals. This makes a total of six checks, with two readings taken for each check.

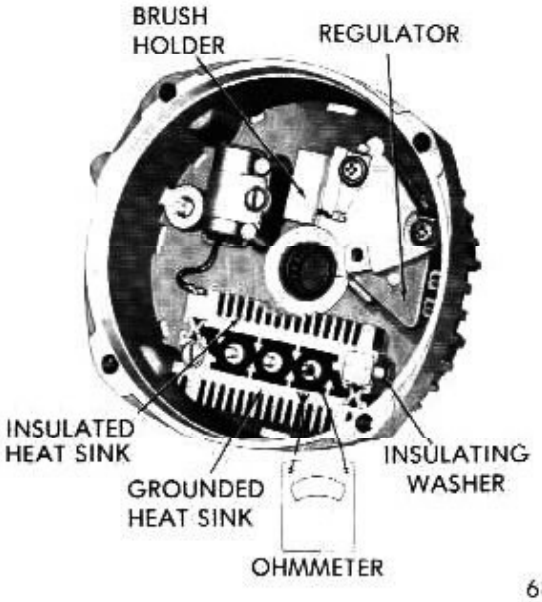


Figure 68-62 - Rectifier Bridge Check

IMPORTANT: *If rectifier bridge is constructed, as shown in Figure 68-63, check with the rectifier bridge mounted in the end frame in the same manner as Figure 68-62, except* connect ohmmeter pressing down very firmly onto flat metal connector and not onto threaded stud (Figure 68-63).

- Figure 68-63 Rectifier Bridge Check

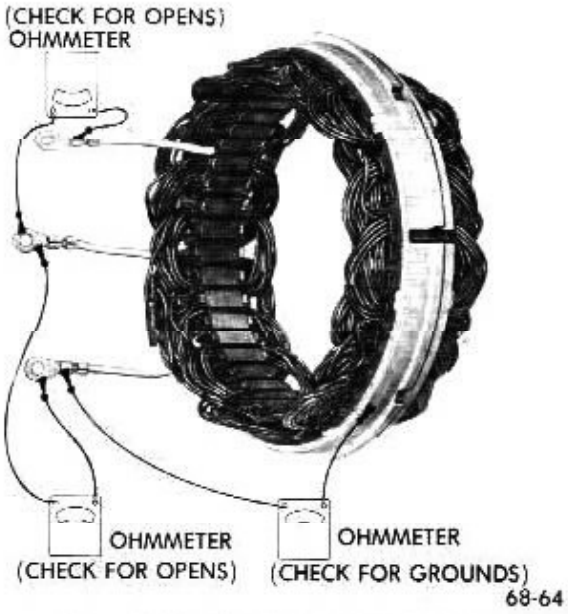
The ohmmeter check of the rectifier bridge and of the diode trio, as previously covered, is a valid and accurate check. *Do not* replace either unit unless at least one pair of readings is the same.

CAUTION: *Do not use high voltage to check these units such as a 110-volt test lamp.*

To replace the rectifier bridge, remove the attaching screw and the "BAT" terminal screw and disconnect the capacitor lead. Note the insulator between the insulated heat sink and end frame (Figure 68-62). Rectifier bridges may vary in appearance but are completely interchangeable in these generators.

E. Stator Checks

The stator windings may be checked with a 110- volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light, or if the meter reading is high when successively connected between each pair of stator leads, the windings are open (Figure 68-64).



- Figure 68-64 - Checking Stator Windings

A short circuit in the stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated. Also, a shorted stator can cause the indicator lamp to be on with the engine at low speed.

F. Brush Holder and Regulator Replacement

After removing the three attaching nuts, the stator , and diode trio screw (Figure 68-62), the brush holder and regulator may be replaced by removing the two remaining screws. Note the two insulators located over the top of the brush clips in Figure 68- 56 and that these two screws have special insulating sleeves over the screw body above the threads. The third mounting screw may or may not have an insulating sleeve. If not, this screw must not be interchanged with either one of the other two screws, as a ground may result causing no output or uncontrolled generator output. Regulators may vary in appearance but are completely interchangeable in these generators.

G. Slip Ring Servicing

If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor and hold the polishing cloth against the slip rings until they are clean.

CAUTION: *The rotor must be rotated in order that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.*

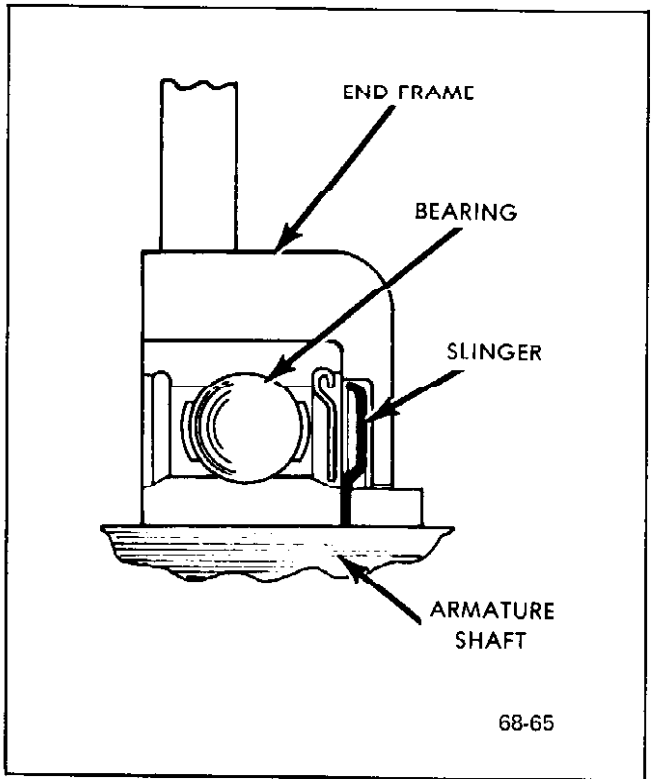
Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

H. Bearing Replacement and Lubrication

The bearing in the drive end frame can be removed by detaching the retainer plate screws and then pressing the bearing from the end frame. If the bearing is in satisfactory condition, it may be reused and it should be filled one-quarter full with Delco- Remy lubricant, or equivalent, before reassembly.

CAUTION: *Do not overfill, as this may cause the bearing to overheat.*

To install a new bearing, press in with a tube or collar that just fits over the outer race with the bearing and slinger



- Figure 68-65 - Drive End Bearing Assembly

assembled into the end frame, as shown in Figure 68-65. It is recommended that a new retainer plate be installed if the felt seal in the retainer plate is hardened or excessively worn. Fill the cavity between the retainer plate and bearing with 1948791 lubricant, or equivalent.

The bearing in the slip ring end frame should be replaced if its grease supply is exhausted. No attempt should be made to re-lubricate and reuse the bearing. To remove the bearing from the slip ring end frame, press out with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing towards the inside.

To install a new bearing, place a flat plate over the bearing and press in from the outside towards the inside of the frame until the bearing is flush with the outside of the end frame. Support the inside of the frame with a hollow cylinder to prevent breakage of the end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on the bearing.

It is recommended that a new seal be installed whenever the bearing is replaced. Press the seal in with the lip of the seal toward the rotor when assembled, that is, away from the bearing. Lightly coat the seal lip with oil to facilitate assembly of the shaft into the bearing.

H. Reassembly

Reassembly is the reverse of disassembly.

Remember when assembling the pulley to secure the rotor in a vise only tight enough to permit tightening the shaft nut to 40-60 lb. ft. If excessive pressure is applied against the rotor, the assembly may become distorted. To install the slip ring end frame assembly to the rotor and drive end frame assembly, remove the tape over the bearing and shaft and make sure the shaft is perfectly clean after removing the tape. Insert a pin through the holes to hold up the brushes. Carefully install the shaft into the slip ring end frame assembly to avoid damage to the seal. After tightening the thru-bolts, remove the brush retaining pin to allow the brushes to fall down onto the slip rings.

I. Generator Bench Check

To check the generator in a test stand, proceed as follows:

1. Make connections, as shown in Figure 68-66, except leave the carbon pile disconnected.

IMPORTANT: *Ground polarity of Energizer and generator must be the same. Use a fully-charged Energizer or battery and a 10 ohm resistor rated at six watts or more between the generator No. 1 terminal and the Energizer.*

2. Slowly increase the generator speed and observe the voltage.

3. If the voltage is uncontrolled with speed and increases above 15.5 volts on a 12-volt system, or 31 volts on a 24-volt system, check for a grounded brush lead clip, as

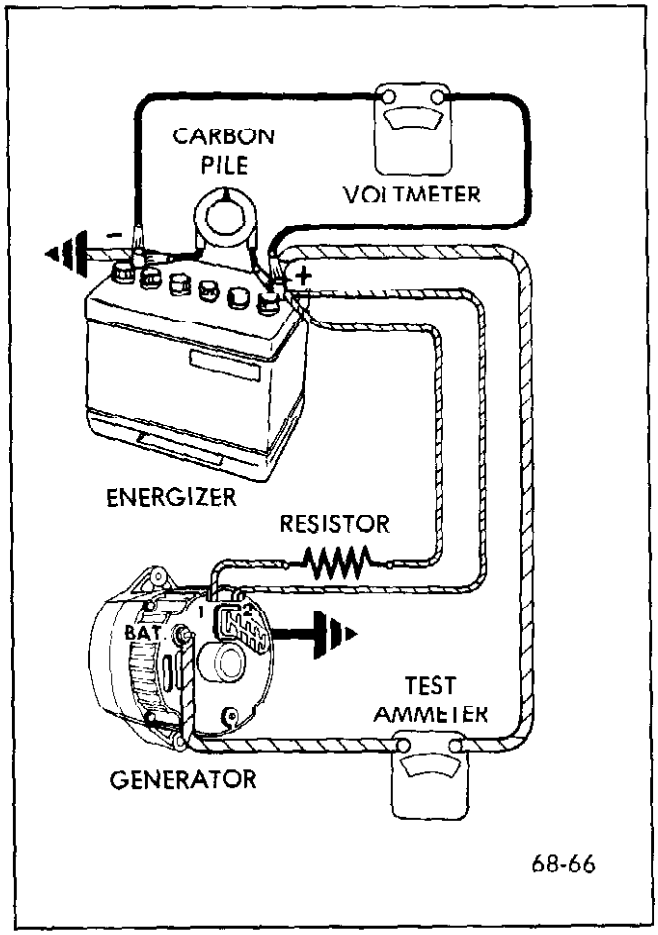


Figure 68-66 - Connections For Bench Check of Generator

covered under heading of "Overcharged Energizer," Step 3. If not grounded, replace the regulator and check field winding.

NOTE: *The Energizer or battery must be fully charged when making this check.*

4. If voltage is below 15.5 volts on a 12-volt system, or 31 volts on a 24-volt system, connect the carbon pile as shown.

5. Operate the generator at moderate speed as required, and adjust the carbon pile as required to obtain maximum current output.

6. If output is within 10 percent of rated output, as stamped on generator frame, generator is good.

7. If output is not within 10 percent of rated output, keep Energizer or battery loaded with carbon pile and ground generator field (Figure 68-55).

8. Operate generator at moderate speed and adjust carbon pile as required to obtain maximum output.

9. If output is within 10 percent of rated output, replace regulator, as covered in "Regulator Replacement" section, and check field winding.

10. If output is not within 10 percent of rated output, check the field winding, diode trio, rectifier bridge, and stator, as previously covered.

Division VI Specifications

68-43 GENERATING SYSTEM SPECIFICATIONS

a. Generator

Make and Type ..... Delco-Remy, Delcotron
Location Side of Engine ..... Upper Right
Drive and Rotation (Viewing Drive End) ..... Fan Belt, Clockwise

	Standard 42 Amp.	Air Condition 55 Amp.
Generator Number	1100926	1100924
Field Current Draw (Amps) at 80°F. and 12 Volts	4-4.5 Amp.	4-4.5 Amp.
Bench Test at 14 Volts and 80°F. (Amps at Gen RPM)	42 at 6500	55 at 6500
Min. Current Output at 500 Eng. RPM	9 Amps	9 Amps
Min. Current Output at 1,500 Eng. RPM	32 Amps	44 Amps
Belt Tension	80 Lbs.	80 Lbs.

b. Generator Regulator

Make and Type ..... Delco-Remy, Integral W/Delcotron
Regulator Number 1116384
Voltage Regulator Setting at 2000 Eng. RPM ..... 14 + .5 Volts
(After 15 Minutes Warm-Up at 1,500 Eng. RPM)

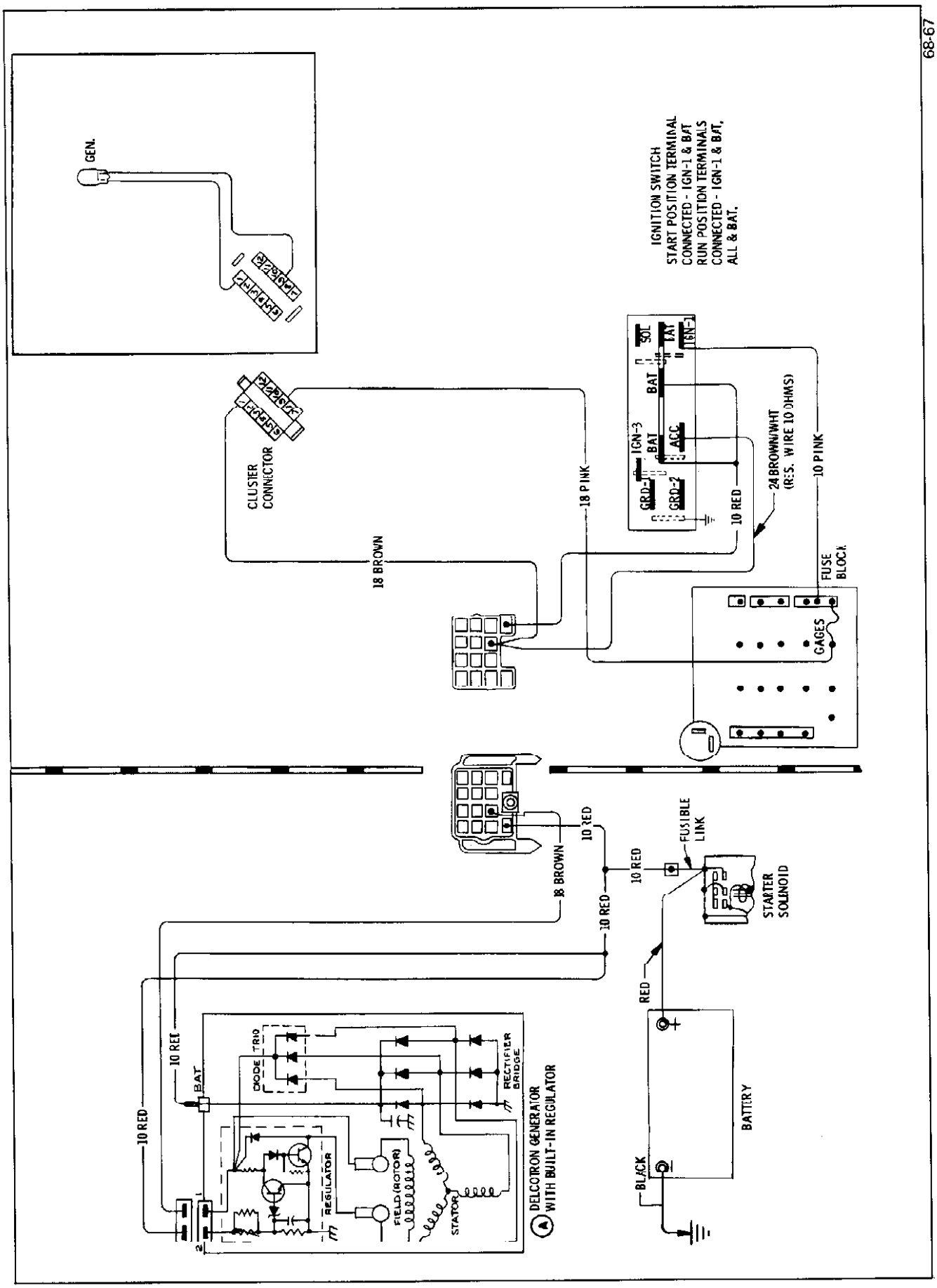


Figure 68-67 - Charging Circuit Wiring, 49000 Series

SECTION B

Ignition System
All Series

CONTENTS

Division	Subject	Paragraph
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	Spark Plug and Wire Service	68-20
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DIVISION I

TROUBLE DIAGNOSIS

68-13 IGNITION SYSTEM-TROUBLE DIAGNOSIS

If engine trouble has arisen which seems to be due to improper operation of the ignition system, it may be desirable to make a quick preliminary check of the ignition system before making a complete analysis, in order to determine whether the ignition system is actually at fault. The quick check s described in this paragraph may be used but it must be understood that they are no substitute for the complete ignition system inspection. The checks to be made depend on whether the engine will or will not run.

a. Engine Will Not Run

1. Make quick check of battery and cables if cranking motor does not turn engine at normal cranking speed.

2. Pull coil high tension cable from distributor cap and hold the lead terminal about 3/16" from a clean ground point on engine. If a good spark occurs while engine is being cranked, the primary circuit and the secondary circuit to this point may be considered to be okay. Proceed with Steps 3 through 6.

3. Remove distributor cap and check interior for moisture, corroded terminal segments, and check terminal sockets for corrosion. Check rotor for corrosion. Clean off corrosion and wipe distributor cap dry. Check for a crack or carbon path in cap or rotor.

4. Inspect ignition cables for possible short circuits and corroded terminals. Remove and inspect spark plugs (paragraph 68-20).

5. If cause of trouble has not been found, check approximate ignition timing (paragraph 68-19).

6. If engine still fails to run, the trouble is probably due to causes other than ignition, such as lack of fuel, carburetion, or compression loss.

7. If spark did not occur at coil high tension lead (Step 2 above) then connect 12-volt test lamp between distributor terminal of coil and ground and crank engine. If test light flickers on and off as engine is cranked the primary circuit is probably okay. Check ignition coil (paragraph 68-14) and condenser (paragraph 68-15).

8. If test light remains on as engine is cranked, contact points are not closing properly; check point opening and ground connection in distributor (paragraph 68-18).

9. If test light remains off as engine is cranked, the primary circuit is open or the points are not opening properly. Check for loose connections, broken leads, defective switch contact point opening, and , primary circuit winding in coil. Visual inspection of points and the use of a test lamp or voltmeter will locate the source of this trouble.

b. Engine Runs, But Not Satisfactorily

1. When missing, loss of power, or hard starting is present a complete checkup of the ignition system is in order, since these conditions may result from anything from a low battery to defective spark plugs, or from other engine conditions not related to ignition. In this case, the complete inspection of ignition system should be used.

2. Detonation may be caused by improper timing (par. 68-18), improper operation of centrifugal or vacuum advance mechanism (paragraph 68-17), worn distributor bearings or a bent shaft, dirty or wrong heat range spark plugs (paragraph 68-20). It may also be caused by overheating, excessive carbon in cylinders, or by *low octane fuel.*

3. Overheating may be caused by one or more of the conditions which contribute to detonation, as well as by faults in engine cooling system.

68-14 IGNITION COIL TESTS

a. Weak Coils

Most ignition coils that are replaced by service stations are classified by them as weak. Many coils rejected as weak actually test up to specifications and give normal performance.

A coil that actually is weak will first affect engine performance when the ignition reserve is at a minimum. This may be in starting, low speed acceleration or top speed. Eventually the engine will fail to start.

High resistance connections in either the primary or secondary circuit wiring will react the same as a weak coil. Wide spark plug gaps, which require higher voltage than the coil can produce, put the coil under suspicion. High compression and lean carburetion increase the voltage requirements and lead to many needless coil changes. Leakage of high tension current through moisture on an unprotected coil terminal may produce carbon tracks which weaken the coil output voltage. For this reason the nipple on coil high tension terminal must be properly installed and in good condition.

When an ignition coil is suspected of being defective it should be tested as described below before being replaced.

b. Testing Coil for Open and Grounded Circuits

Before using a coil test instrument, the coil should be tested for open and grounded circuits, using a 110-volt test lamp and test points.

1. Apply test points to both primary terminals of coil. If test lamp does not light, the primary circuit is open.

2. Apply one test point to the high tension terminal, and the other test point to one of the primary terminals. If secondary circuit is not open, the lamp will not light but tiny sparks will appear at test points when they are rubbed over terminals. If secondary circuit is open, no sparks will occur.

3. Apply one test point to a clean spot on the metal coil case and touch the other point to the primary and high tension terminals. If the lamp lights, or tiny sparks appear at the points of contact, the coil windings are grounded.

4. A coil with open or grounded windings must be replaced since internal repairs cannot be made. It is unnecessary to test such a coil with instruments. If windings are not open or grounded, a test for short circuits and other internal defects should be made with a reliable coil test instrument.

c. COIL TEST INSTRUMENTS

Two general types of instruments are used in testing ignition coils. One type makes use of an open or protected spark gap, while the other reports the condition of the coil on a meter.

The spark gap type of tester should always be used comparatively, that is, the questionable coil should be compared with a coil of same model that is known to be good. Both coils must be at the same temperature and identical test leads must be used.

Certain variables caused by altitude, atmosphere or spark gap electrode conditions are usually present in the spark gap type of test.

The meter type testers are usually designed to permit testing the coil without making any connection to the secondary terminal. This eliminates the variables usually present in the spark type of test and avoids the necessity for comparison with a good coil.

Some different makes and models of coil testers differ in their methods of use, as well as in the markings on meters, *the instructions of the manufacturer must be carefully followed when using any coil tester. The instrument must be frequently checked to make certain that it is accurately calibrated.*

Regardless of instrument or method used, the coil must be tested at normal operating temperature because internal defects often fail to show up on a cold test.

68-15 DISTRIBUTOR CONDENSER TESTS

When a condenser is suspected of being faulty it should be tested with a reliable condenser tester to determine whether it is actually the cause of ignition trouble. The condenser should be tested for (a) high series resistance (b) insufficient or ex cessive capacity (c) low insulation resistance.

A special condenser tester is required to make these tests. When using a condenser tester the instructions of the manufacturer must be carefully followed.

IMPORTANT: *The condenser must be at normal operating temperature when it is being tested.*

a. High Series Resistance

High series resistance in the condenser causes the condenser to be slow in taking the charge and, consequently, a higher than normal voltage is developed across the contact points when they first start to open. The higher voltage causes more disturbance at the contact points, which in turn causes more rapid wear and more tendency toward oxidized surfaces. The condition can become severe enough to cause complete failure of the ignition system. It would first show up during starting and low speed operation.

High series resistance may be caused by internal resistance in condenser or by resistance in the connections. Any defect caused by internal resistance should show up at low mileage since this does not change very much with time or use. *The damaging changes are in the connections, in which looseness, corrosion, or broken strands may develop.*

New condensers may have a series resistance as low as .05 ohm. Some condenser testers are set to reject condensers which have a resistance of .3 ohm; however, test show that the resistance can go to .5 ohm before ignition performance is affected.

b. Insufficient or Excessive Capacity

The condenser specified for use in the Buick ignition system has a capacity of .18 to .23 microfarads.

If a condenser is used which does not have the specified capacity of .18 to .23 microfarads, excessive pitting of one contact point and a corresponding buildup of metal on the other contact point will result. A condenser having insufficient capacity will cause build-up of metal on the breaker arm (positive) point. A condenser having excessive capacity will cause build-up of metal on the contact support (negative) point.

In exceptional cases, pitting and metal buildup on contact points may be experienced even when condenser capacity is within the specified limits. In such cases the life of contact points will be improved by installing a condenser of high-limit capacity if metal build-up is on breaker arm point, or a condenser of low-limit capacity if metal buildup is on contact support point. There is usually sufficient variation in the capacities of stock condensers to permit selection of a high or low limit condenser by testing the available stock.

c. Low Insulation Resistance

A weak or leaking condenser is usually one that has absorbed water so that the insulation resistance of the wind-

ing is lowered to the extent that the condenser will not hold a charge satisfactorily. A condenser with low insulation resistance will drain sufficient energy from the ignition system to lower the secondary voltage seriously. The condenser specified for use in the Buick ignition system is sealed to prevent absorption of water, and no other type should be used.

A leaky condenser usually does not affect engine performance except when hot. It is unlikely that a condenser with low insulation resistance would cause missing at low or medium speeds under conditions where the condenser does not get hot. A condenser that has low enough resistance to affect engine performance when cold would probably be indicated as broken down on most condenser testers.

Condenser testers equipped to check condensers for low insulation resistance usually give a reading in megohms, a megohm being one million ohms. The scale is marked to indicate whether the condenser is good or bad.

When testing a condenser for low insulation resistance the lead should always be disconnected from the distributor. Since the distributor terminals and the connected circuit have much lower insulation resistance than the condenser, failure to disconnect the condenser lead will give a reading much too low.

68-16 IGNITION SYSTEM RESISTANCE TEST

Check for proper functioning of the resistance in the primary ignition circuit by turning on the ignition. With the engine not running, a voltmeter connected from the battery side of the coil to ground should read approximately 5 to 5.5 volts. If the reading is a full 12 volts, the ignition points may be open; "bump" the starter a few times until the engine comes to rest with the ignition points closed and again check for a 5.5 volt reading. A reading of 12 volts or over for all engine positions would indicate that the shorting switch is making contact all the time; this condition must be corrected immediately or ignition point life will be very short.

Check for proper closing of the shorting switch and also for proper functioning of the complete starting circuit by grounding the secondary coil wire so the engine won't start. With the engine cranking, a voltmeter connected from the battery side of the coil to ground should read at least 9 volts. A reading of under 5 volts would indicate that the shorting switch is not closing; this condition would result in hard cold starting.

Briefly, the advantages of our resistance with shorting switch system are: it sends full battery voltage to the coil for good cold weather starting, and it cuts down the voltage to the coil with the engine running for long ignition point life.

NOTE: *Discourage any attempts to measure voltage at the coil with the engine running; because of variations in current flow at high speeds and in regulated voltage, this check would be meaningless. Voltage readings on a perfectly-functioning ignition system may go over 11 volts.*

DIVISION II

DESCRIPTION AND OPERATION

68-17 IGNITION SYSTEM DESCRIPTION AND OPERATION

a. Ignition System General Description

The ignition system (Figure 68-15) consists of the ignition coil, condenser, ignition distributor, ignition switch, low and high tension wiring, spark plugs, and a source of electrical energy (battery or generator).

The ignition system has the function of producing high voltage surges and directing them to the spark plugs in the engine cylinders. The sparks must be timed to appear at the plugs at the correct instant near the end of the compression stroke with relation to piston position. The spark ignites the fuel-air mixture under compression so that the power stroke follows in the engine.

There are two separate circuits through the ignition system. One of these is the primary circuit which includes the ignition switch, primary winding of the ignition coil, distributor contact points, and condenser. The other is the secondary, or high tension circuit, which includes the secondary winding of the ignition coil, the high tension lead, distributor cap, rotor, and spark plug.

b. Basic Operation of Ignition System

The basic operation is described as follows:

With the switch closed, current flows through the primary circuit, that is, from the battery through the primary winding of the ignition coil and closed distributor contacts to ground, and then back to the battery. A cam mounted on the rotating distributor shaft causes the distributor contacts to open and close. When the contacts open, the current decreases very rapidly in the ignition coil primary winding, and a high voltage is induced in the coil secondary winding.

This high voltage is impressed through the distributor cap and rotor across one of the spark plugs. As the voltage establishes an arc across the spark plug electrodes, the air-fuel mixture in the cylinder is ignited to provide the power stroke. The secondary electrons flow from the coil secondary winding, across the distributor rotor gap and spark plug gap, and then back to the secondary winding through ground, the battery, and switch. The distributor contacts then reclose, and the cycle repeats. The next-firing spark plug then will be the one connected to the distributor cap insert that is aligned with the rotor when

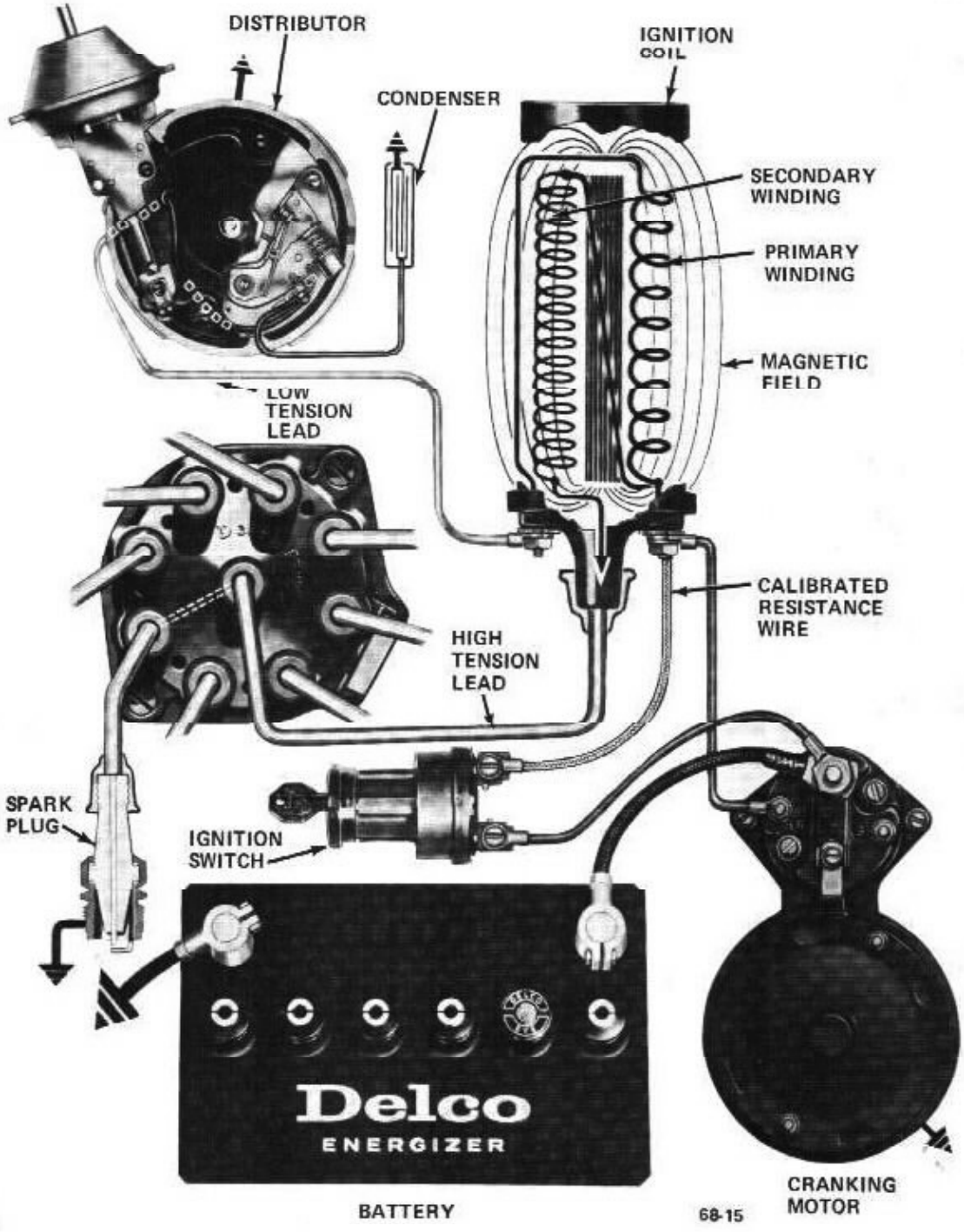


Figure 68-15 Ignition System

the contacts separate. With the engine running, current flows through the coil primary calibrated resistance wire; the other lead connected between the coil and solenoid terminal is a by-pass feature that will be covered in the section entitled "Ignition Coils".

When the contacts separate, a high voltage is induced in the coil primary winding. This voltage may be as high as 250 volts, which causes an arc to form across the distributor contacts. To bring the primary current to a quick controlled stop, and in order to greatly reduce the size of the arc and threreby insure prolonged contact point life, a capacitor (condenser) is connected across the distributor contacts.

c. Description of Distributors

The distributor has three jobs. First, it opens and closes the low tension circuit between the source of electrical energy and the ignition coil so that the primary winding

is supplied with intermittent surges of current. Each surge of current builds up a magnetic field in the coil. The distributor then opens its circuit so that the magnetic field will collapse and cause the coil to produce a high voltage surge. The second job that the distributor has is to time these surges with regard to the engine requirements. This is accomplished by the centrifugal and vacuum advance mechanisms. Third, the distributor directs the high voltage surge through the distributor rotor, cap, and high tension wiring to spark plug which is ready to fire.

The typical ignition distributor (Figure 68-16) consists of a housing, shaft, centrifugal advance assembly, vacuum advance assembly, breaker plate assembly, capacitor or condenser, and rotor.

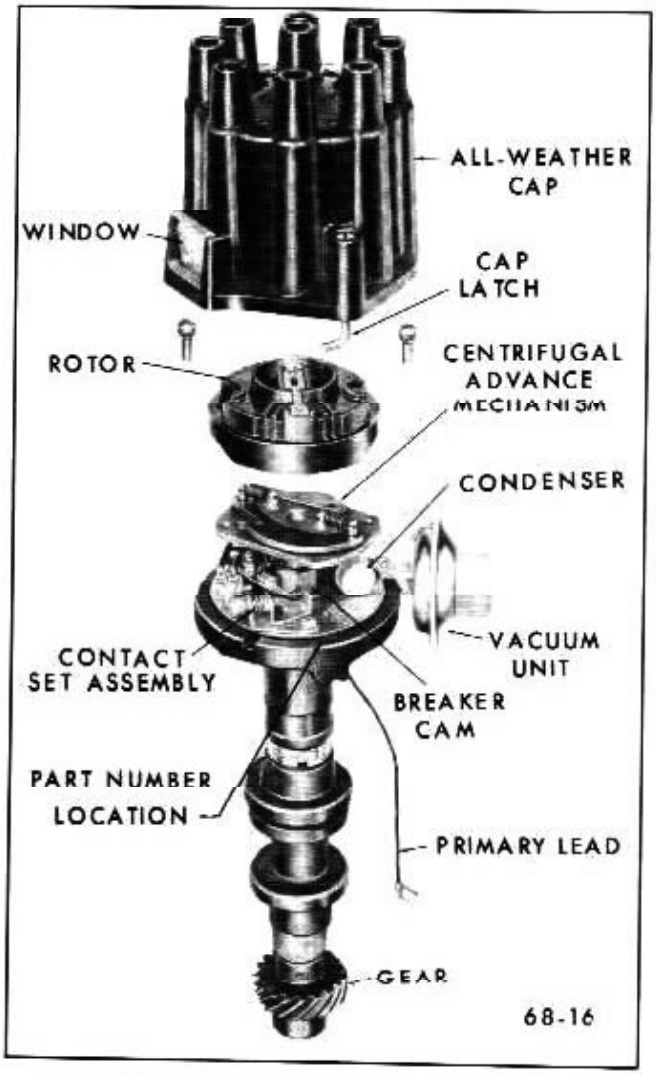


Figure 68-16 Distributor Assembly

d. Operation of Distributor Assembly - Basic Features

The cap, rotor, and high voltage leads in a distributor form a distribution system that conveys the high voltage surges to the spark plugs in correct sequence.

The breaker plate contains the breaker lever, contact support, and capacitor. When the breaker cam rotates, each cam lobe passes by and contacts the breaker lever rubbing block, separating the contact points and producing a high voltage surge in the ignition system. With every breaker cam revolution, one spark will be produced for each engine cylinder. Since each cylinder fires every other revolution in a four-cycle engine, the distributor rotates at one-half engine speed.

The shaft and weight base assembly is fitted in suitable bearings made of such materials as cast iron, bronze, or iron. Centrifugal advance weights are pivoted on studs in the weight base and are free to move against calibrated weight springs which connect them to the breaker cam assembly. The breaker cam assembly fits on the top of the shaft (slip fit) and rotates with the shaft, being driven by the weight springs actuated by the advance weights.

Outward movement of the weights advances the cam assembly in relation to the shaft as engine speed is increased, providing an earlier spark. Each engine model requires an individual spark advance cam design to insure delivery of the spark at the right instant for maximum power at all speeds. Because of this, very little standardization of complete distributors can be made.

It is possible to improve fuel economy on engines operating under part-throttle conditions by supplying additional spark advance. Vacuum advance mechanisms are provided on some distributors for this purpose. The mechanism used rotates either the complete distributor or the breaker plate in order to time the spark earlier when the engine is operating at part throttle.

e. Centrifugal Advance

The centrifugal advance mechanism times the high voltage surge produced by the ignition coil so that it is delivered to the engine at the correct instant, as determined by engine speed.

When the engine is idling, the spark is timed to occur in the cylinder just before the piston reaches top dead center. At higher engine speeds, however, there is a shorter interval of time available for the fuel- air mixture to ignite, burn, and give up its power to the piston. Consequently, in order to obtain the maximum amount of power from the mixture, it is necessary at higher engine speeds for the ignition system to delivery the high voltage surge to the cylinder earlier in the cycle.

To illustrate this principle, assume that the burning time of a given gas mixture in an automotive engine is .003 of a second. To obtain full power from combustion, maximum pressure must be reached while the piston is between 10 degrees and 20 degrees past top dead center. At 1,000 engine RPM the crankshaft travels through 18 degrees in .003 of a second, at 2,000 RPM the crankshaft travels through 36 degrees. See Figure 68-17. Since maximum pressure point is fixed, it is easy to see why the spark must be delivered into the cylinder earlier in the cycle in order to deliver full power, as engine speed increases.

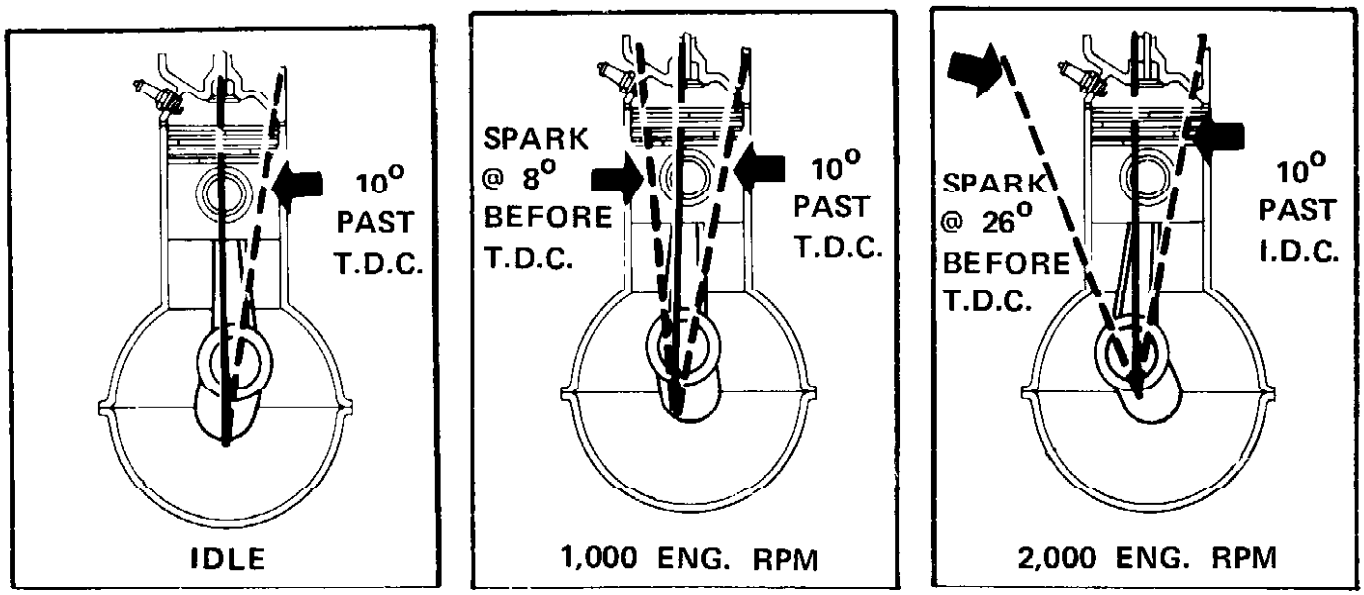


Figure 68-17 Spark Timing

As previously mentioned, the timing of the spark-to-engine speed is accomplished by the centrifugal advance mechanism, which is assembled on the distributor shaft. The mechanism consists primarily of two weights and a cam assembly. The weights throw out against spring tension, as engine speed increases. This motion of the weights turns the cam assembly so that the breaker cam is rotated in the direction of shaft rotation to advanced position, with respect to the distributor drive shaft. The higher the engine speed, the more the weights throw out and the further the breaker cam is advanced. See Figure 68-18.

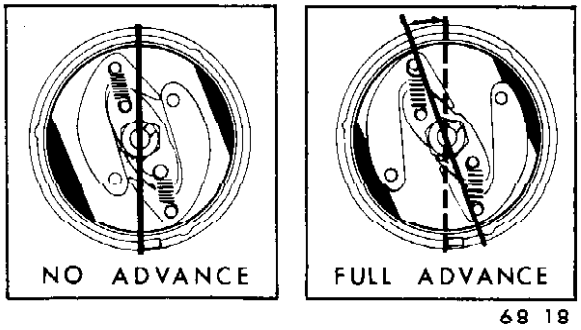


Figure 68-18 Centrifugal Advance

The centrifugal advance required varies considerably between various engine models. In order to determine the advance for a given engine, the engine is operated on a dynamometer at various speeds with a wide-open throttle. Spark advance is varied at each speed until the range of advance that gives maximum power is found. The cam assembly weights and springs are then selected to give this advance. Timing, consequently, varies from no advance at idle to full advance at high engine speed where the weights reach the outer limits of their travel.

f. Vacuum Advance

Under part-throttle operation a high vacuum develops in the intake manifold and a smaller amount of air and gasoline enters the cylinder. Under these conditions, additional spark advance (over and above advance provided by

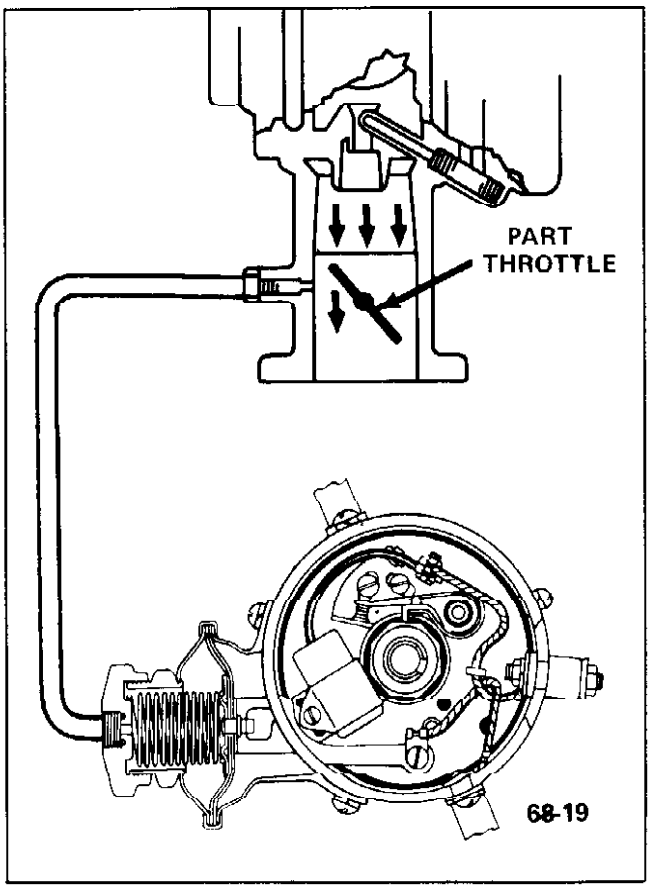


Figure 68-19 Vacuum Advance Mechanism

the centrifugal advance mechanism) will increase fuel economy. In order to realize maximum power, ignition must take place still earlier in the cycle.

To provide a spark advance based on intake manifold vacuum conditions, many distributors are equipped with a vacuum advance mechanism. The mechanism has a spring-loaded diaphragm connected by linkage to the distributor. The spring-loaded side of the diaphragm is air-tight and is connected in many cases by a vacuum passage to an opening in the carburetor. See Figure 68-19. This opening is on the atmospheric side of the throttle when the throttle is in the idling position. In this position, there is

When the throttle is partly opened, it swings past the opening of the vacuum passage. Intake manifold vacuum then can draw air from the air-tight chamber in the vacuum advance mechanism and this causes the diaphragm to be moved against the spring. This motion is transmitted by linkage to the distributor breaker assembly, causing it to rotate. The amount of distributor breaker assembly rotation is governed by the amount of vacuum in the intake manifold up to the limit imposed by the design of the vacuum advance mechanism.

When the distributor breaker plate assembly is rotated, the contact points are carried around the breaker cam to an advanced position so that the breaker cam contacts the rubbing block and closes and opens the points earlier in the cycle. This provides a spark advance based on the amount of vacuum in the intake manifold. Thus, for vary-

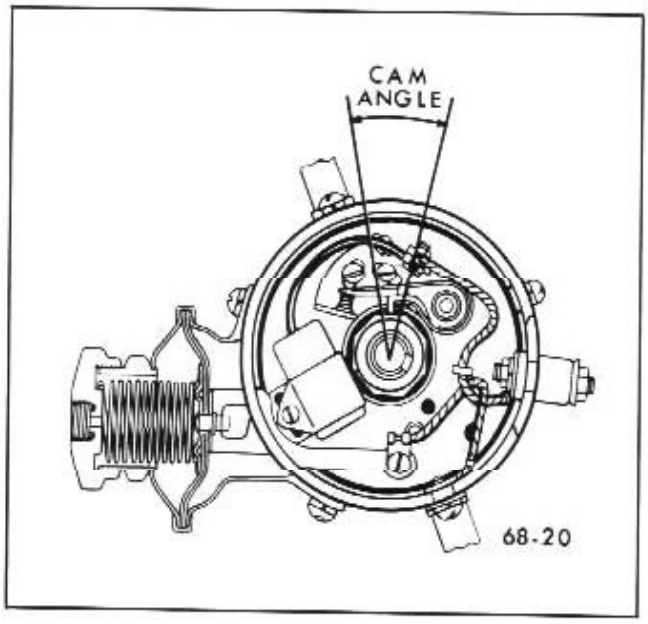


Figure 68-20 Cam Angle

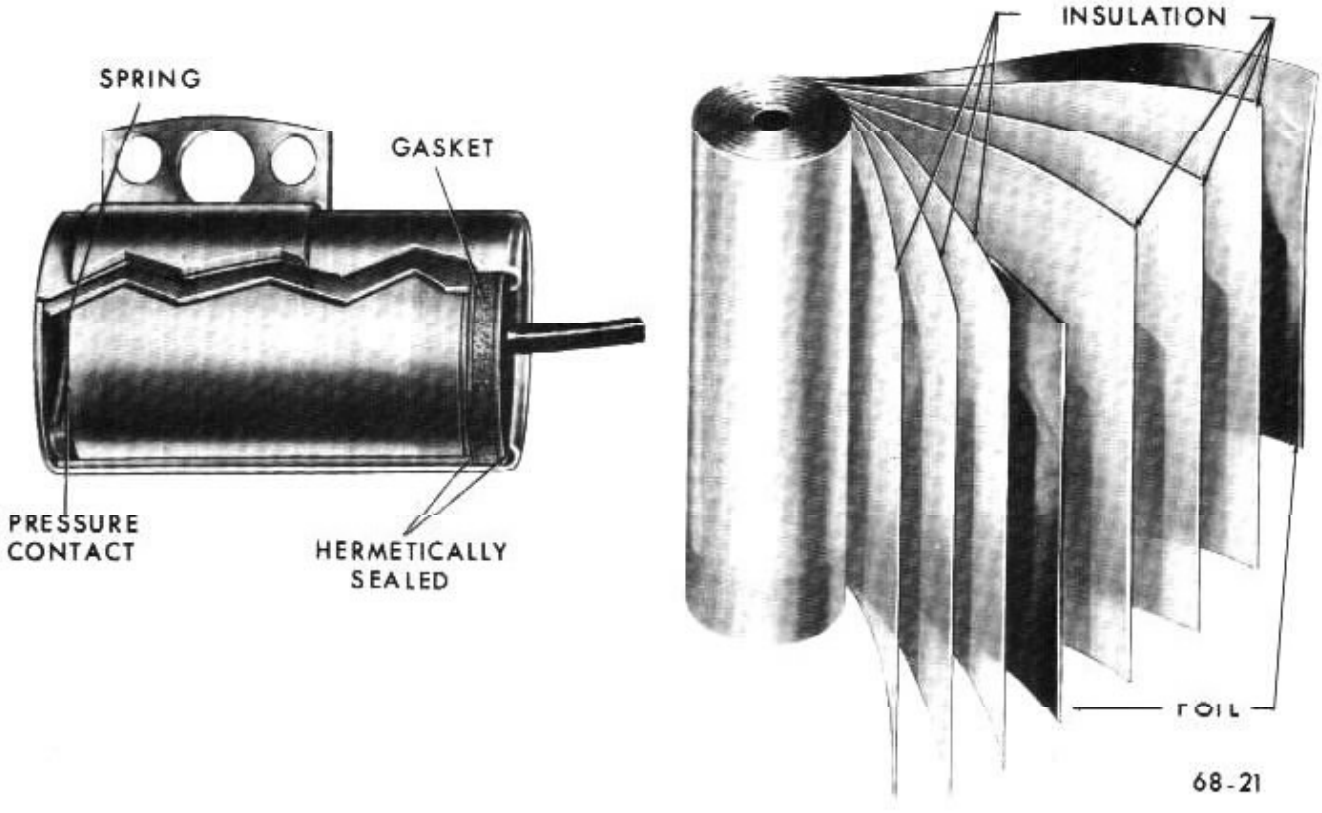


Figure 68-21 Ignition Condenser

ing compressions in the cylinder, the spark advance will vary, permitting greater economy of engine operation. It should be recognized that the additional advance provided by vacuum control is effective in providing additional economy only on *part-throttle* operation.

At any particular engine speed there will be a certain definite advance, resulting from operation of the centrifugal advance mechanism, plus a possible additional advance, resulting from operation of the vacuum advance mechanism. For example, an initial timing advance of 5 degrees, plus a centrifugal advance of 10 degrees, makes a total of 15 degrees advance at 40 miles an hour. If the throttle is only partly opened, an additional vacuum advance of up to 15 degrees more may be obtained, making a total of 30 degrees. When the throttle is wide open, there is no appreciable vacuum in the intake manifold, so this additional advance will not be obtained. All advance then is based on engine speed alone and is supplied by the centrifugal advance mechanism.

The vacuum advance mechanism is an economy device which will increase fuel economy when properly used. The driver who drives with wide-open throttle, whether in low or high gear, will not obtain this additional advance with its resulting increased fuel economy.

g. Cam Angle

The cam angle, often referred to as contact angle or dwell angle, is the number of degrees of cam rotation during which the distributor contact points remain closed. See Figure 68-20. It is during this period of cam rotation that the current in the primary winding increases. Although the cam angle may not change, the length of time the contacts remain closed becomes less and less, as the engine speed increases. At higher engine speeds, the ignition coil primary current does not reach its maximum value in the short length of time the contacts are closed. In order to store the maximum amount of energy obtainable in the coil and, consequently, obtain sufficient energy to fire the plug, it is necessary to design a breaker lever assembly that will operate properly at high speeds. Most Delco-Remy distributors are equipped with a special high rate-of-break cam and a special high-speed breaker lever which is capable of following the cam shape at high speeds without bouncing. The high rate-of-break cam separates the contact points faster for each degree of rotation and permits closing earlier, thus, increasing cam angle. With the special cam and breaker lever combination, it is possible to obtain the maximum cam angle and, consequently, optimum ignition performance at high speeds.

The point opening is the maximum distance that occurs between the separated contacts as the cam rotates. If the cam angle is properly set, the point opening most likely will also be according to specifications. In some cases, it may be necessary to measure point opening, in addition to cam angle, to insure that the contacts are properly set. A feeler gauge on new contacts, or a dial indicator on used contacts, may be used to measure point opening.

h. Ignition Condenser (Capacitor)

The capacitor consists of a roll of two layers of thin metal foil separated by a thin sheet or sheets of insulating material. See Figure 68-21. This assembly is sealed in a metal can with a flat spring washer providing a tight seal.

The high voltage induced in the coil primary causes the capacitor plates to charge when the contacts first separate; the capacitor acts initially like a short circuit and current flows into the capacitor to minimize arcing at the contacts.

i. Ignition Coils

An ignition coil is a pulse transformer that steps up the low voltage from the battery or generator to a voltage high enough to ionize the spark plug gap and ignite the air-fuel mixture in the cylinder. A typical coil is made up of a primary winding, consisting of a few hundred turns of relatively large wire, and a secondary winding, consisting of many thousand turns of very small wire. See Figure 68-22. These windings are assembled over a soft iron core and are enclosed by a soft iron shell. This assembly is

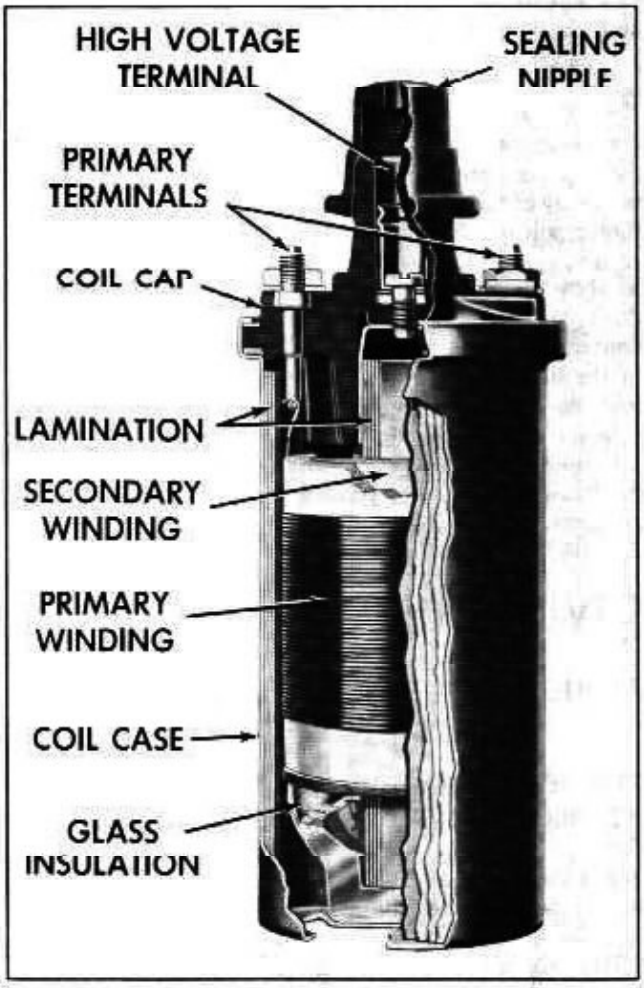


Figure 68-22 Ignition Coil

inserted into a one-piece, steel or diecast aluminum coil case, which is filled with oil and hermetically sealed by a coil cap made of molded insulating material. The cap contains the primary and secondary high voltage terminals.

All Delco-Remy ignition coils are hermetically sealed to prevent the entrance of moisture which would cause coil failure. During manufacture, the coil case also is filled with oil at a high temperature. As the oil temperature decreases to more nearly match the temperature of the surrounding air, the oil contracts to occupy less volume, thus allowing room for expansion when the coil heats up during normal operation. The oil acts as an insulator to prevent high voltage arc-over within the coil.

In the design of an ignition system, sufficient primary circuit resistance must be present to protect the distributor contacts from excessive arcing and burning. In some ignition systems, part of this resistance may take the form of a separate resistor or a calibrated resistance wire connected between the ignition switch and the coil primary terminal. Since the value of this resistor, along with the resistances of the other components in the entire primary circuit, affects the coil performance at higher engine speeds, a 12-volt coil used on a 6-volt system without the external resistor, will not provide equal performance results. In other words, a 12-volt coil without the resistor is not necessarily a 6-volt coil.

During cranking, the external resistance on most applications is by-passed to provide full battery voltage to the coil for improved performance and easier starting. The by-pass wire may be connected to an "R" terminal on the cranking motor solenoid which contacts the contact disk during cranking, or to a separate terminal on the ignition switch, as shown in the previous section. The higher currents during cranking are not sufficient to cause distributor contact deterioration because of the short periods of time in the life of contacts spent during cranking. Also, the lowered battery voltage during cranking causes a lower primary current, so the resistor by- pass feature is an offsetting factor. By-passing the resistor with the engine operating will cause very rapid failture of the distributor contacts.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

68-18 REPLACEMENT AND ADJUSTMENT OF DISTRIBUTOR CONTACT POINT SET - V-8 ENGINES

When inspection of the contact points shows replacement to be advisable, the following procedure should be used.

NOTE: *The service replacement contact point set has the breaker spring tension and point alignment adjusted at the factory.*

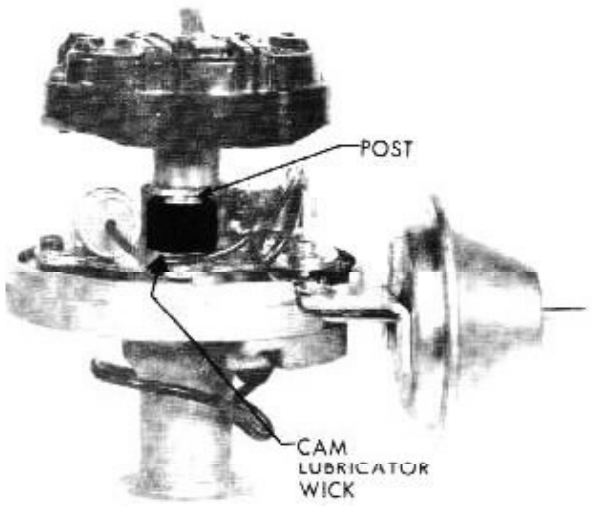


Figure 68-23 - Cam Lubricator Wick

a. Removal of Contact Point Set

In 1970, Buick distributors have installed an ignition point shield. The purpose of this device is to shield the windshield antenna from picking up ignition point interference. See Figure 68-19.

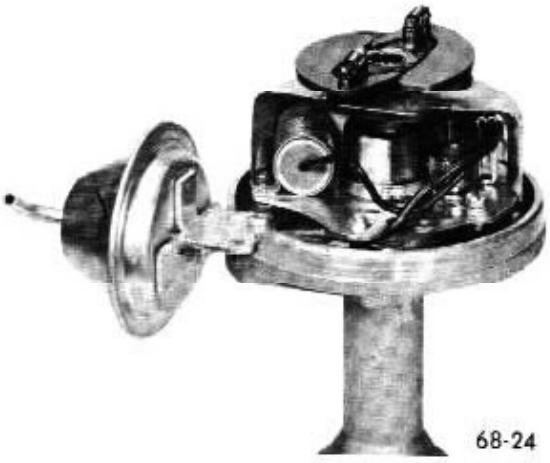


Figure 68-24 Distributor Ignition Point Shield

When replacing ignition points, the snap lock type connector points must be used, as the screw fastened type will interfere with the ignition shield.

Should the points come in contact with the shield a short circuit will result.

1. Remove distributor cap by inserting a screwdriver in upper slotted end of cap retainers, press down and turn 90 counterclockwise. Push distributor cap aside and remove rotor.

2. Loosen two screws and lock washers which hold the contact point set in place. Then remove point set.

3. Disconnect the condenser and primary leads from their terminal by loosening the retaining screw. If there is no retaining screw, simply slip leads out.

b. Installation of Contact Point Set

1. Remove old cam lubricator wick and discard. Install a new lubricator, working it down over post by using a small nail in a circular direction around the post.

2. Remove two screws holding ignition point shield. See Figure 68-25.

Figure 68-25 Removing Screws

3. Remove shield from distributor assembly. See Figure 68-26.

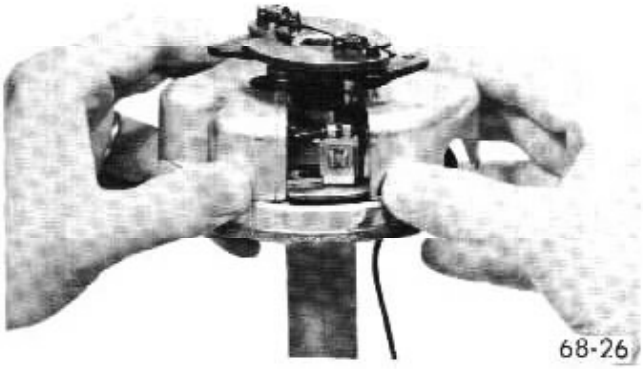


Figure 68-26 Removing Shield

4. Install condenser and primary leads.

5. Slide contact point set over boss on breaker plate and under the two screw heads. Tighten two screws and lock washers.

NOTE: *Leads must be properly positioned so they will not come in contact with bottom of weight base or rotor.*

6. Install ignition point shield, making sure of correct positioning to insure against leakage and a short circuit. See Figure 68-27.

Figure 68-27 Installing Ignition Point Shield

7. If engine does not start readily, position contact arm rubbing block on peak of cam lobe, insert a 1/8" Allen wrench in adjusting screw and turn screw in (clockwise) until contact points just close. Then back screw out (coun-

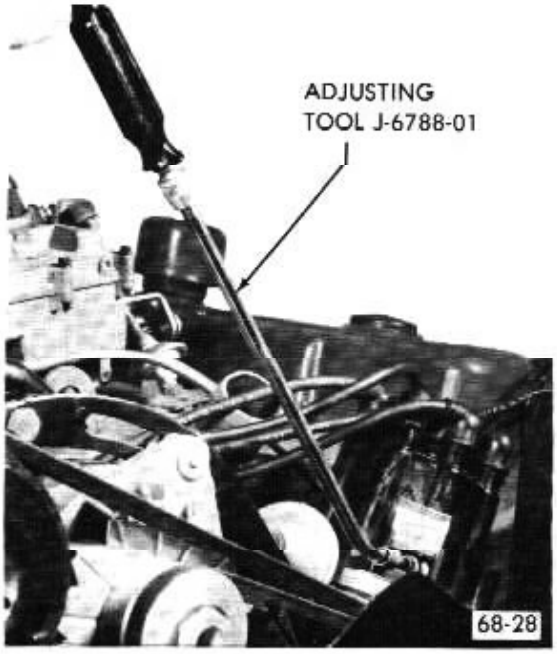


Figure 68-28 - Adjusting Contact Point Dwell Angle - V-8 Engines

terclockwise) 1/2 turn (180 degrees) to obtain a point gap of approximately .016" for a preliminary setting.

c. Adjustment of Contact Points - Engine Running - V-8 Engines

NOTE: *When adjusting contact point dwell angle, always follow the instructions which come with the dwell meter.*

1. Connect dwell tester leads: red to distributor side of coil, black to ground.

2. Turn selector switch to position for 8-lobe cam (6-lobe cam for L-6). Turn ignition switch on.

3. Start engine. Lift adjustment window and insert 1/8" Allen wrench in adjusting screw. See Figure 68- 28. Set dwell angle at 30 degrees.

4. After adjusting dwell angle, always check ignition timing.

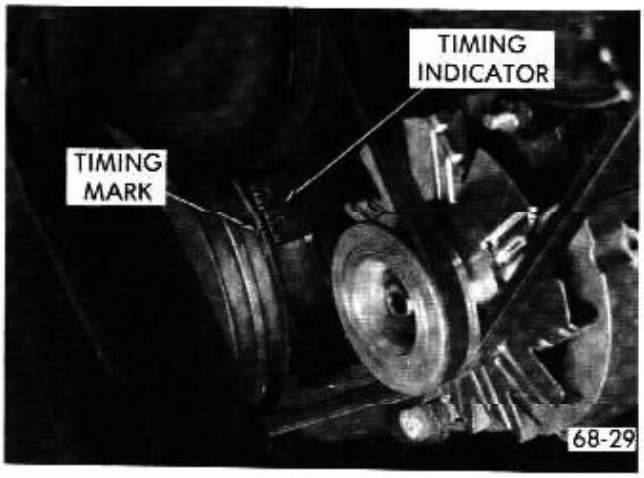


Figure 68-29 - Ignition Timing Mark and Indicator - L-6 Engine

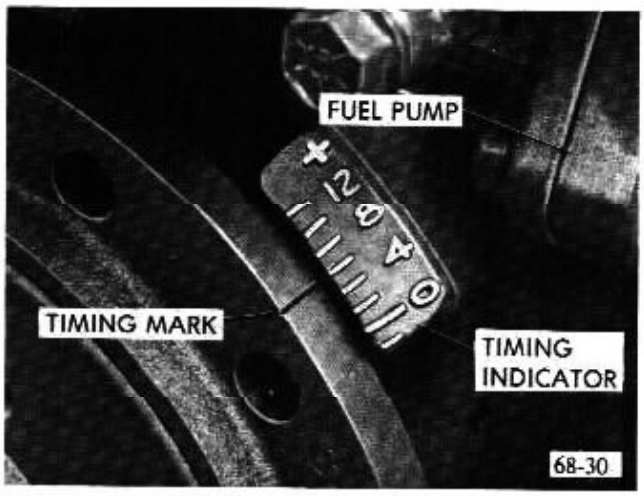


Figure 68-30 - Ignition Timing Mark and Indicator - V-8 Engines

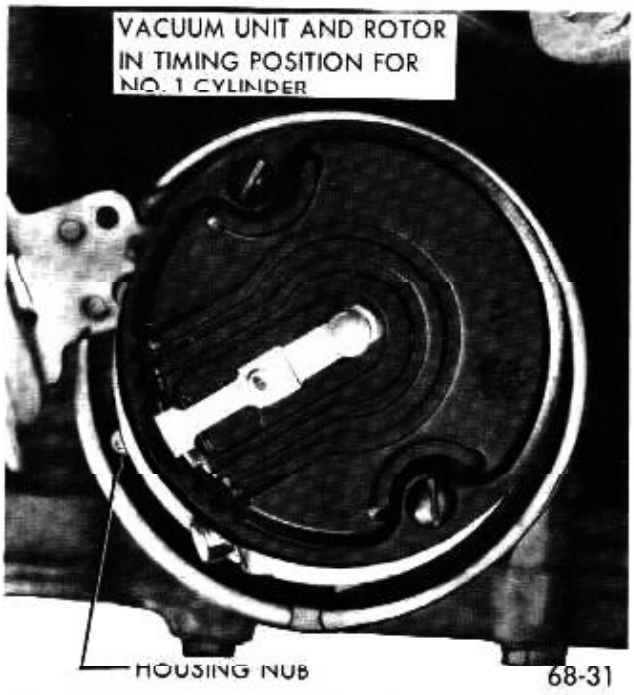


Figure 68-31 - Installing Distributor in Engine - V-8 Engines

68-19 IGNITION TIMING

a. L-6 Engines

The timing mark is a cut in the edge of the harmonic balancer. The timing indicator, a part of the timing chain cover, has a series of grooves which indicate two degree intervals. The "O" on the timing indicator is at T.D.C. and the "A" is at the ten degrees advance mark. See Figure 68-29.

The L-6 engine with both manual and automatic transmissions is timed at 4 degrees B.T.D.C.

b. V-8 Engines

The timing mark is a groove filled with yellow paint, which is in the edge of the harmonic balancer. The timing indicator, a part of the timing chain cover, has ridges outlined with yellow paint. See Figure 68-30.

c. Preliminary Timing (Engine Won't Run)

To time the ignition on any engine which will run, use subparagraph b only. However, if the timing of an engine is completely off, the following procedure must first be used to get the engine to run.

1. With No. 1 spark plug removed and with hole plugged, rotate crankshaft in a forward direction using a suitable wrench on the harmonic balancer to crankshaft bolt. When plug blows from No. 1 cylinder, continue rotation until timing mark on balancer is aligned with proper mark on timing indicator. See Figure 68-29 or 30. No. 1 cylinder is now in position to fire.

2. Install distributor in engine with rotor in position to fire No. 1 cylinder and with vacuum control in position to connect vacuum hose. See Figure 68- 30. Install distributor clamp and bolt with lock washer, leaving bolt just loose enough to allow movement of distributor with hand pressure.

NOTE: *If distributor does not seat in engine block, press down lightly on distributor housing while cranking engine with starter. After distributor tang snaps into slot in oil pump shaft, start timing again from Step 1, leaving distributor installed.*

3. Connect primary wire to coil.

4. Rotate distributor counterclockwise slightly until contact points just start to open.

CAUTION: *This must be done very carefully or engine will not start.*

5. Install distributor cap. Make sure that spark plug wires are correctly installed in distributor cap, through clips on rocker arm covers, and on spark plugs. See Figure 68-32 and 33.

d. Finish Timing (Engine Running)

Contact point dwell angle should always be checked before adjusting ignition timing.

1. Connect a 12-volt power timing light to No. 1 spark plug, following the instructions of the instrument manufacturer.

CAUTION: *Be careful not to puncture wire or boot as this would start a high voltage leak*

2. Connect a tach-dwell meter from distributor terminal of coil to ground.

3. Adjust contact point dwell angle. While engine is warming up, make certain that spark plug wires are pushed all the way down into the distributor cap terminal and onto the spark plugs. Nipples must be pushed firmly over the terminals and boots over the spark plugs. If any shock is received, secondary insulation is defective and must be replaced.

4. Leave engine running until upper radiator inlet is hot and choke valve is wide open. On automatic transmission cars, place a block in front of a front wheel and apply parking brake firmly, then shift transmission into drive.

5. Adjust idle speed. See paragraph 64-5.

6. Disconnect vacuum hose from vacuum advance unit and plug with a pencil.

7. Direct beam of timing light on the timing indicator and edge of harmonic balancer. Turn distributor slowly until yellow mark on balancer is at specified degree mark on timing indicator on any V-8 engine car. L-6 engine cars are timed at 4 degrees B.T.D.C.

8. Recheck timing mark. Reset if necessary.

9. Recheck idle speed and mixture adjustments.

10. Reconnect vacuum hose.

68-20 SPARK PLUG AND WIRE SERVICE

a. Remove and Inspect Spark Plugs and Wires

1. To disconnect wires, pull only on boot because pulling on wire might cause separation of the core of the wire. Remove spark plugs and gaskets using a 13/16" deep socket on R46T plugs, or a 5/8 deep socket on R44TS or R45TS plugs. Use care in this operation to avoid cracking spark plug insulators.

2. Carefully inspect the insulators and electrodes of all spark plugs. Replace any spark plug which has a cracked or broken insulator. If the insulator is worn away around the center electrode, or the electrodes are burned or worn, the spark plug is worn out and should be discarded. Spark plugs which are in good condition except for carbon or oxide deposits should be thoroughly cleaned and adjusted.

3. The spark plug wires are of a special resistance type. The core is carbon-impregnated linen. This wire is designed to eliminate radio and television interference radiation, but is also superior in resistance to cross-fire. The resistance type wire, however, is more easily damaged than copper core wire. For this reason care must be taken that the spark plug wires are removed by pulling on the spark plug boots rather than on the wire insulation. Also, when it is necessary to replace a spark plug boot, the old boot should be carefully cut from the wire and a small amount of silicone lubricant used to aid in installing the new boot. If the wire is stretched, the core may be broken with no evidence of damage on the outer insulation. The terminal may also pull off the wire. If the core is broken, it will cause missing. In the case of wire damage, it is necessary to replace the complete wire assembly as a satisfactory repair cannot be made.

4. Wipe ignition wires with cloth moistened with kerosene, and wipe dry. Bend wires to check for brittle, cracked, or loose insulation. Defective insulation will permit missing or cross-firing of engine, therefore defective wires should be replaced.

5. If the wires are in good condition, clean any terminals that are corroded and replace any terminals that are broken or distorted. Replace any broken or deteriorated cable nipples or spark plug boots.

Spark plug wires have a built-in resistance of approximately 2000 ohms per foot. However, even the longer wires should never have a total resistance over 20,000 ohms; a wire having more than 20,000 ohms resistance should be replaced.

b. Spark Plug Cleaning

Spark plugs which have carbon or oxide deposits should be cleaned in a blast type spark plug cleaner. Scraping with a pointed tool will not properly remove the deposits and may damage the insulator. If spark plugs have a wet or oily deposit dip them in a degreasing solvent and then dry thoroughly with dry compressed air. Oily plugs will cause the cleaning compound to pack in the shell.

Carefully follow the instructions of the manufacturer of the cleaner being used, cleaning each plug until the interior of shell and the entire insulator is clean; however, *avoid excessive blasting.*

Examine interior of plug in good light. Remove any cleaning compound with compressed air. If traces of carbon oxide remain in plug, finish the cleaning with a light blasting operation. Clean firing surfaces of center and side electrodes with several strokes of a fine file.

When spark plugs have been thoroughly cleaned, carefully inspect for cracks or other defects which may not have been visible before cleaning.

c. Adjusting Spark Plug Gap

Use round wire feeler gages to check the gap between spark plug electrodes of used plugs. Flat feeler gages will not give a correct measurement if the electrodes are worn. Adjust gap by bending the *side* electrodes only; bending the center electrode will crack the insulator. Adjust gaps to .030" (L-6 - .035"). Setting spark plug gap to any other specification to improve idle or effect other changes in engine performance is not recommended.

68-32

Figure 68-32 - Installing Spark Plug Wires in Cap - L-6 Engine

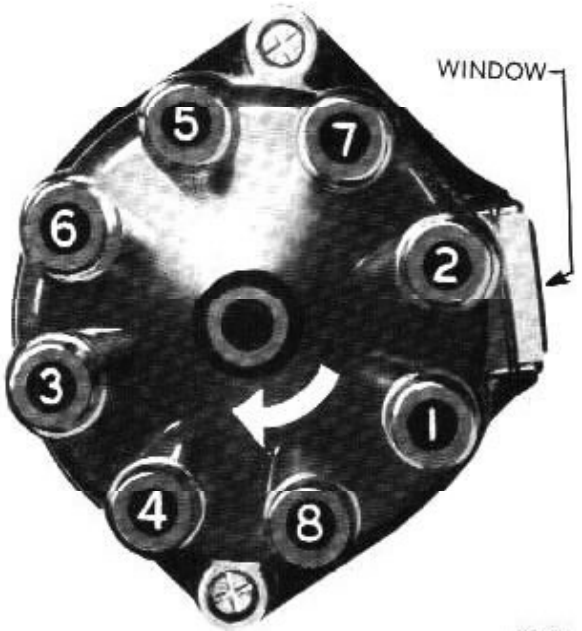
d. Installation of Spark Plugs

When installing R44TS, R43TS, or R40TS spark plugs, tighten to 15 lb.ft., using a 5/8" deep socket, an extension and and a torque wrench.

CAUTION: *If tapered seat spark plugs are overtightened, they will be very difficult to remove at the next tune-up.*

e. Installation of Spark Plug Wires

No. 1 spark plug wire is installed in the first distributor cap tower after the adjusting window, moving in the direction of rotation (V-8), or in the foremost tower (L-6). The other wires are then installed in a clockwise direction according to the firing order. See Figure 68-32 or 33.



68-33

Figure 68-33 - Installing Spark Plug Wires in Cap - V-8 Engines

68-21 DISTRIBUTOR SERVICE OPERATIONS

a. Removal and Disassembly of Distributor for Inspection - V-8 Engines

1. Disconnect the distributor primary wire from coil and disconnect hose from vacuum unit. Remove distributor cap by inserting a screwdriver in upper slotted end of cap latches; then press down and turn 90° counterclockwise.

2. Make a mark on distributor base in line with center of rotor. Then carefully note the direction the vacuum unit points in relation to the engine so that the distributor can be replaced in the exact same position after it is serviced. See Figure 68-31.

CAUTION: *If engine is turned over while distributor is out, complete ignition timing procedure must be followed (paragraph 68-19).*

3. Remove distributor clamp and lift distributor out of crankcase.

4. Remove rotor from end of distributor shaft by removing two attaching screws and lock washers. Remove ignition point shield.

5. Remove contact point set and condenser as described in paragraph 68-18.

6. Remove cam lubricator wick.

7. Remove two screws holding vacuum advance unit to housing. Remove advance unit.

8. Remove "O" ring seal from shaft housing.

b. Inspection of Distributor Parts

1. Wash the distributor assembly in clean solvent, holding housing horizontal to avoid getting cleaning solvent into the lubricant reservoir. Dry parts thoroughly.

2. *Cap.* Wipe out distributor cap with a clean cloth and inspect it for chips, cracks and carbonized paths which would allow high tension leakage to ground. Such defects require replacement of cap. Clean loose corrosion from surfaces of terminal segments inside the cap. *Do not use emery cloth or sand paper.* If segments are deeply grooved, the cap should be replaced. Pull cables from terminal sockets and inspect sockets for corrosion. Clean sockets, using a stiff wire brush to loosen corrosion.

3. *Rotor.* If rotor is cracked, spring contact is badly worn, or rotor tip is badly burned, rotor must be replaced.

4. *Condenser.* Inspect condenser and primary leads for loose or frayed terminal connections. Check condenser in a reliable condenser tester as described in paragraph 68-15.

5. *Vacuum Advance Unit.* Inspect rod end for excessive wear. Push rod into unit as far as possible, hold finger tightly over nipple and then release rod. After about 15 seconds, release finger from hole and notice if air is drawn in. If not, diaphragm is leaking and unit must be replaced.

6. *Contact Points.* Carefully examine the mating surfaces of the contact points, noting whether they are flat and making good contact, or whether they are blackened, pitted, burned, or worn excessively. Contact points which have been in service for some time will appear dull and gray. This condition is normal and such points should not be replaced.

Contact points which are blackened or only slightly burned or pitted may be cleaned with a thin contact stone or a clean fine-cut contact file. Remove high spots only; it is not necessary to remove all buildup or pit.

CAUTION: *Do not use emery cloth or sandpaper to clean contact points because particles of these materials usually embed in contact surfaces and cause points to burn.*

Excessively burned, pitted or worn contact points cannot be cleaned up and aligned satisfactorily; therefore, they must be replaced to insure satisfactory ignition.

If contact points are excessively burned, pitted, or blackened it is advisable to check for cause and make the necessary correction so that new points will give satisfactory service. Burned or pitted points may be caused by:

(a) Ignition coil resistance wire not properly connected into circuit. With ignition on and engine not running, voltage at the coil positive terminal should be 5 to 5.5 volts.

(b) Defective condenser. Test the condenser (paragraph 68-15).

(c) Insufficient contact point opening. Adjust contact point dwell as described in paragraph 68-18 (c).

(d) Vapors getting into the distributor and depositing on contact surfaces of points. This causes arcing and rapid burning of contact points. Oil vapor entering distributor usually produces a smudgy line under the points.

(e) High voltage, or any other condition in electrical system causing excessive current flow through contact points. This results in a blue scale forming on point surfaces. Check condenser for high series resistance (paragraph 68-15). Check voltage regulator (paragraph 68-26).

(f) Radio capacitor connected to distributor terminal. This will cause excessive pitting of contact points. Capacitor should be connected to the positive (battery) terminal of coil.

7. If any remaining parts are defective, the distributor must be completely disassembled to replace them. Before disassembling distributor further, inspect parts as follows:

(a) *Centrifugal Advance.* Inspect for excessive wear between centrifugal weights and advance cam, or pivot pins. Turn weight base plate in a clockwise direction until weights are fully extended, then release and allow springs to return weights to retard position. Repeat several times. Springs should return weights to stop without sticking and there should be no excess free movement in the retard position.

(b) *Cam and Weight Base Plate.* Inspect cam lobes for scoring or excessive wear. Check weight base plate for bind or excessive looseness on distributor shaft.

(c) *Breaker Plate.* Attempt to rotate plate to check for excess free motion between plate and vacuum advance

unit linkage. Check plate for excess looseness on O.D. of upper distributor shaft bushing. Check breaker plate ground lead for poor spot-weld at plate end or for loose or frayed terminal connections.

(d) *Distributor Shaft.* Check for excessive wear between shaft and bushings in housing.

(e) *DRIVEN Gear* Inspect gear for scoring of teeth or excessive wear.

8. To replace any part found to be defective in Step 7, the distributor must be completely disassembled as follows:

(a) Drive out driven gear pin using a hammer and a 1/8" straight punch. See Figure 68-20.

CAUTION: *Be careful not to bend distributor shaft or damage gear when driving pin out.*

(b) Slide gear off shaft and then pull the shaft, breaker cam, and centrifugal advance mechanism from the housing.

(c) Remove two advance weight springs and weights. Slide the integral weight base plate and breaker cam off the lower end of shaft.

(d) Remove retainer from upper bushing and lift breaker plate and felt washer from upper bushing.

(e) Remove distributor primary lead and grommet from housing.

NOTE: *No attempt should be made to replace the shaft bushings in the housing as the housing and bushings are only serviced as an assembly.*

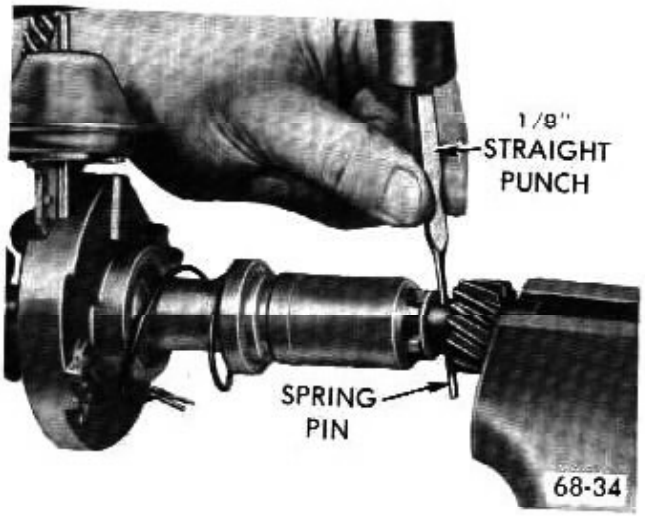


Figure 68-34 Removing Distributor Gear Pin

c. Assembly and Installation of Distributor

NOTE: *The first five steps apply only if the distributor has been completely disassembled.*

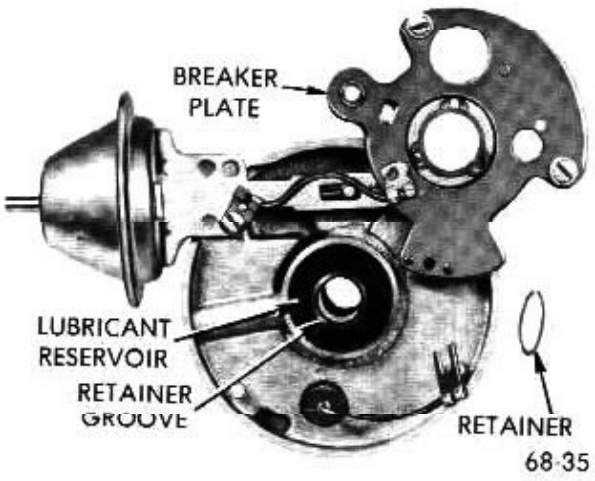


Figure 68-35 Installing Breaker Plate and Retainer

1. Install distributor primary lead and rubber grommet. Install vacuum advance unit with ground lead terminal from breaker plate under outer mounting screw and lock washer.

2. Install felt washer over upper bushing and apply a few drops of light oil. Then place breaker plate over upper bushing and vacuum advance link. Install retainer on upper bushing. See Figure 68-35.

3. Slide distributor cam and weight base plate on distributor shaft.

4. Install distributor shaft and breaker cam assembly in housing. Install advance weights and springs.

5. Slide driven gear on shaft. Drive roll pin through gear and shaft. Be careful not to damage gear.

6. Place condenser and bracket over bosses on breaker plate and secure with screw.

7. Place contact point set over boss on breaker plate and secure with two screws and lock washers. Apply one drop of light oil to breaker arm pivot. Then install condenser and primary leads.

8. Work a small amount of high temperature cam and ball bearing lubricant (available through U.M.S.) into a clean cloth, then hold cloth against distributor cam while turning distributor shaft.

CAUTION: *Excessive grease may throw off into contact points when hot. Petroleum jelly is not suitable for temperature reached by the cam.*

9. Install a new cam lubricator.

10. Make the preliminary contact point adjustment (paragraph 68-18, b).

11. Install ignition point shield. Install rotor and secure with two screws, lock washers, and plain washers.

NOTE: *The square and round lugs on the bottom of the rotor must be positioned in the corresponding holes in the weight base plate*

12. If a reliable distributor tester is available, check the distributor to make certain that the centrifugal and vacuum advance mechanisms are operating according to the specifications given in paragraph 68-23.

13. Install new "O" ring seal on distributor housing. Insert distributor in engine block so that rotor is pointing to mark made on distributor base, with vacuum advance unit pointing in exact original direction. Connect vacuum pipe to advance unit.

14. Install distributor clamp and bolt with lock washer, leaving bolt just loose enough to permit movement of the distributor with heavy hand pressure.

15. Connect primary wire to distributor side of coil. Install distributor cap.

16. If spark wires were removed make certain that , they are replaced as shown in Figure 68-32 or 33. Wires must be pushed all the way down into the distributor cap terminals and onto the spark plugs. Nipples must be pushed firmly over the terminals and boots over the spark plugs.

17. Start engine and adjust contact point dwell angle (paragraph 68-18, c) Then adjust ignition timing (paragraph 68-19, b).

NOTE: *If engine was accidentally turned over while distributor was out, complete ignition timing procedure must be followed (paragraph 68-19, a and b).*

68-22 IGNITION SWITCH AND LOCK REPAIRS

a. Ignition Switch Key

If ignition key sticks or feels rough as it is inserted into the lock, examine it for burrs and smooth with a fine cut file. Blow finely powered graphite into lock cylinder, then work key in and out of cylinder a number of times to work graphite into tumblers. *Do not use oil in lock cylinder as this will cause tumblers to stick.*

The ignition switch key has a rectangular shaped head and also operates the door locks. The oval head key operates the glove box lock and trunk lock. The key code number for each key is stamped in the small knock-out insert.

b. Ignition Lock Cylinder Replacement

The ignition lock cylinder cannot be removed until the steering column is partially disassembled to gain access to an internal lock cylinder retainer. The steering wheel, lock plate and turn signal switch assembly must be removed. See Group 90, Section C for detailed instructions.

c. Lock Cylinder and Key Information

All 1971 Buicks have new lock cylinders and keys. The new lock cylinder outside dimensions are not changed and there are still six tumblers per lock cylinder. The code consists of a number, a letter and two numbers. The rectangular head key fits the ignition and door locks and the oval head key fits the glove box and trunk locks; however, these new keys have different grooves to that neither can be inserted in any lock cylinder previous to 1971 and so that neither can be inserted in the other type of 1971 lock cylinder.

d. Ignition Key Buzzer

The ignition key operated buzzer is designed to warn the driver that he has left his key in the ignition switch, and his car is therefore subject to theft. The buzzer operates whenever the driver's door is opened with the ignition key left in the switch in either the Off, the Lock, or the Accessory position. It may also operate in the Run or Crank positions with the door open.

The ignition key buzzer circuit is supplied, along with the speed warning buzzer and horns, by a No. 10 red wire from the battery. A combination buzzer and horn relay is used. See Figure 68-37. The circuit passes through the buzzer, then through the ignition switch and to ground through one contact of a double contact left front door jamb switch.

The optional speed warning buzzer use part of s the same circuit, then provides a second path to ground through adjustable contacts in the speedometer head.

DIVISION VI

SPECIFICATIONS

68-23 IGNITION SYSTEM SPECIFICATIONS

a. Ignition Coil and Resistor

Make	Delco-Remy
Coil Number	(L-6) 1115208 (V-8) 1115247
Current Draw, Amperes at 12.6 Volts	
Engine Stopped	(L-6) 4.0 — (V-8) 3.8
Engine Idling	(L-6) 1.8 — (V-8) 2.3
Coil Resistance (Ohms) at 80° F.	
Primary	1.28 to 1.42
Secondary	7200 to 9500
Resistance Wire	Part of Wiring Harness
Resistance, Ohms at 80°F.	1.80 ± .05
Voltage at Coil (Ignition On and Points Closed)	5 to 5.5

b. Spark Plugs

	250 Eng.	350 Eng.	455 Eng.
Make and Model (for Normal Operation)	ACR46T	ACR45TS	ACR44TS
Thread and Shell Hex. Sizes	14MM, 5/8"	14MM, 5/8"	14MM, 5/8"
Terminal Nut Length	3/8"	3/8"	3/8"
Gap at Points	.035"	.030"	.030"
Tightening Torque (lb. ft.)	15	15	15

c. Distributor

Make	Delco-Remy
Drive	From Camshaft
Rotation, Top View	Clockwise
Firing Order (L-6 Engine)	1-5-3-6-2-4
Firing Order (All V-8 Engines)	1-8-4-3-6-5-7-2
Contact Point Opening and Dwell Angle	
L-6	.019", 32° ± 2°
V-8	.016", 30° ± 2°
Dwell Variation	3° Max.
Breaker Arm Spring Tension, Ounces	19 to 23
Condenser Make and Capacity, Microfarads	Delco-Remy, .18 to .23

68B-2

	250 Eng. Man. & Auto. Trans. 43000 Series	350 Eng. Man. Trans. 43-44-45000 Series	350 Eng. Auto. Trans. 43-44000 W/2 BBL	350 Eng. Auto. Trans. 43-44000 W/4 BBL 45000 W/2 & 4 BBL
Distributor Number (less Cap)	1110489	1112006	1112037	1112080
Vacuum Control Number	1973345	1116210	1116210	1116210
Timing, Crankshaft Degrees (with Vacuum Disconnected and Engine Idling)	4°	6°	10°	4°
Centrifugal Advance, Crankshaft Degrees RPM				
Start Advance, at RPM	1000	700 1100	1400-1600	1400-1600
Medium Advance, Degrees at RPM	8-12 at 2300	7-11 at 2000	5-7 at 1850	12-16 at 2100
Max. Advance, Degrees at RPM	18-22 at 4100	16-20 at 4600	10-14 at 4600	14-18 at 2900
Vacuum Advance, Crankshaft Degrees and Inches of Vac.				
Start Advance, at In. of Vacuum	0 at 8"	6-8	6-8	6-8
Maximum Advance, Degrees at In. of Vacuum	23 at 16"	14-18 at 16	14-18 at 16	14-18 at 16

	455 Eng. Man. Trans.	455 Eng. Auto. Trans.	455 Eng. Stage I
Distributor Number (less Cap)	1112016	1112077	1112016
Vacuum Control Number	1116210	1973440	1116210
Timing, Crankshaft Degrees (with Vacuum Disconnected and Engine Idling)	6°	4°	10°
Centrifugal Advance, Crankshaft Degrees and RPM			
Start Advance, at RPM	700-1000	1400-1600	700-1000
Medium Advance, Degrees at RPM	9-13 at 1800	14-18 at 2000	9-13 at 1800
Max. Advance, Degrees at RPM	20-24 at 4600	16-20 at 3000	20-24 at 4600
Vacuum Advance, Crankshaft Degrees and Inches of Vac.			
Start Advance, at In. of Vacuum	6-8	6-8	6-8
Maximum Advance, Degrees at In. of Vacuum	14-18 at 16	16-20 at 16	14-18 at 16

68B-3

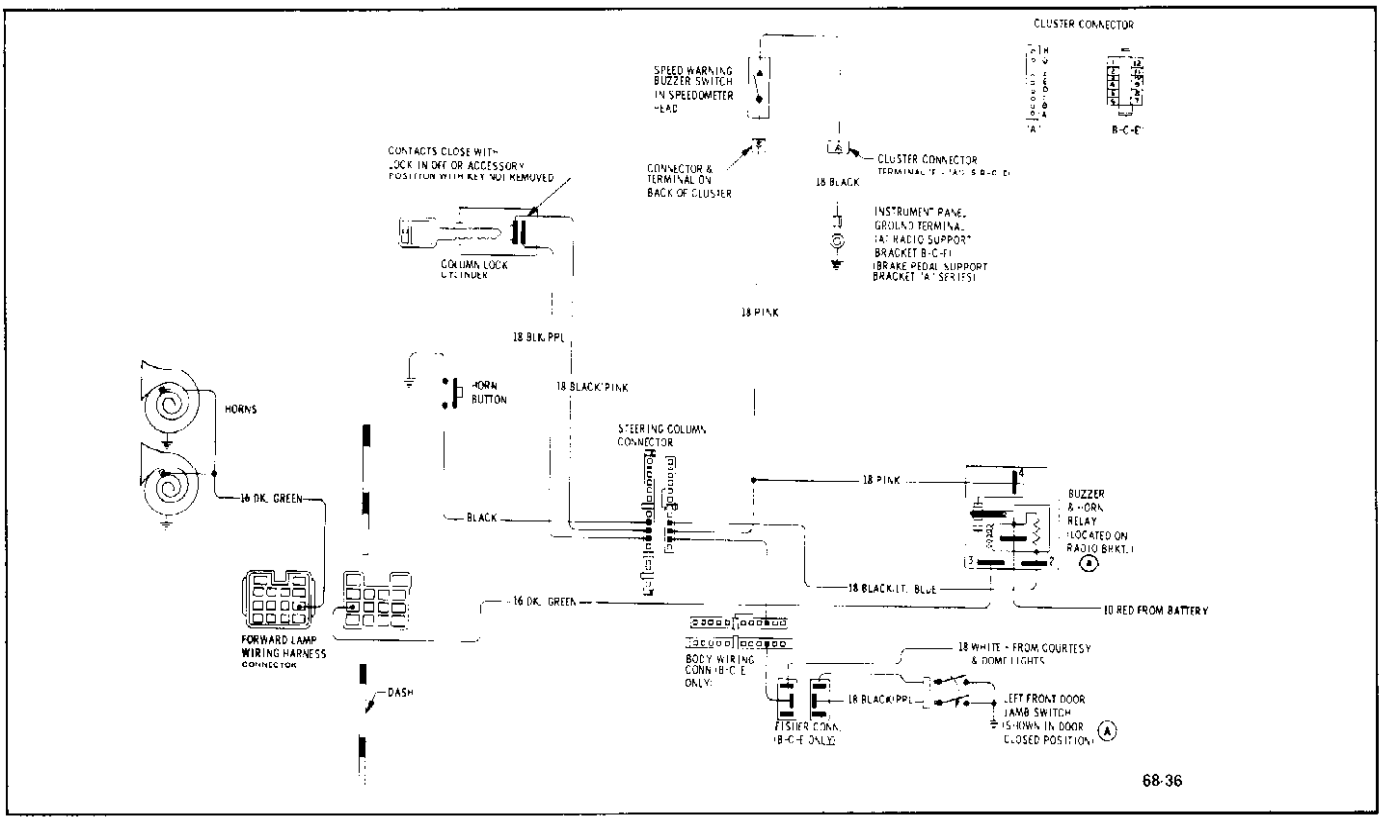


Figure 68-36 - Buzzer and Horn Relay Wiring

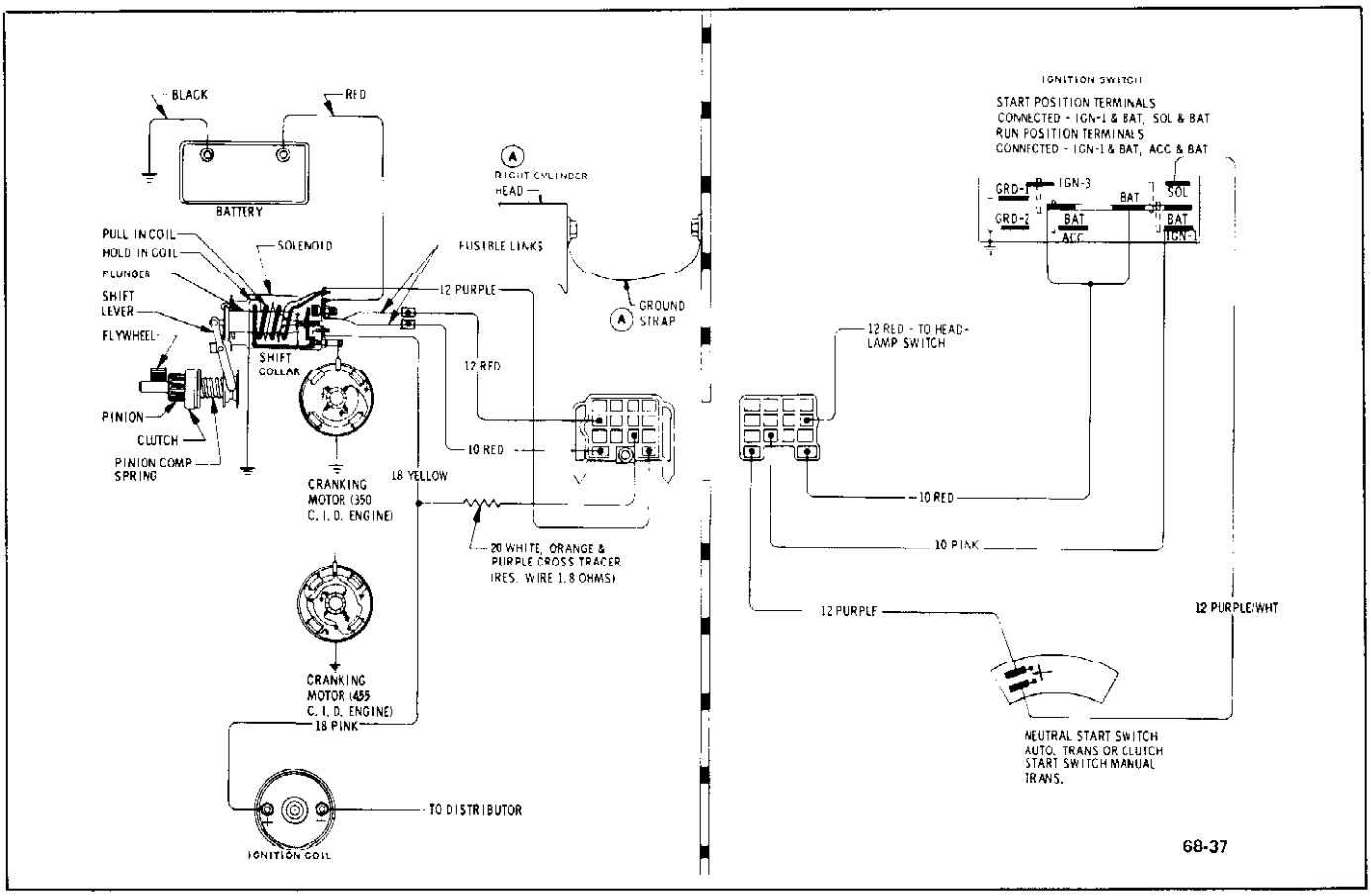


Figure 68-37 - Ignition and Starter Wiring

GROUP 68

ENGINE ELECTRICAL

Section	Title
A	Starting System (All Series)
B	Ignition System (All Series)
C	Generating System (All Except 49000 Series)
D	Generating System (49000 Series)

SECTION A

Starting System
All Series

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Trouble Shooting Starting System	68-1
	Periodic Inspection of Starter	68-2
	Voltage Test of Starting System and Solenoid Switch	68-3
	Amperage Test of Solenoid	68-4
	Pinion Clearance Check	68-5
	Bench Test of Starting Motor	68-6
II	DESCRIPTION AND OPERATION:	
	Description of Starting System	68-7
	Operation of Starting System	68-8
	Starting Motor and Solenoid Switch	68-9
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION:	
	Starter Removal and Installation	68-10
V	OVERHAUL AND MAJOR SERVICE:	
	Starting Motor Repairs - On Bench	68-11
VI	SPECIFICATIONS:	
	Starting System Specifications	68-12

DIVISION I

TROUBLE DIAGNOSIS

68-1 TROUBLE-SHOOTING STARTING SYSTEM

a. Refer to Rear of Section for Starting Motor Trouble Chart

b. No Cranking Action

1. Make sure that control lever is in neutral (N) or park (P) position or that clutch pedal is depressed on manual transmission.

2. Make quick check of battery and cables. If battery is low, the solenoid usually will produce a clattering noise, because a nearly discharged battery will not sustain the voltage required to hold solenoid plunger in after solenoid switch has been closed.

3. If cranking motor spins and drive pinion engages ring gear but does not drive it, overrunning clutch is slipping. Remove motor to replace drive assembly.

4. If cranking motor does not operate, note whether solenoid plunger is pulled into solenoid when solenoid circuit is closed. Ordinarily the plunger makes a loud click when it is pulled in. If plunger is pulled in, solenoid circuit is okay and trouble is in solenoid switch, cranking motor, or cranking motor circuit. The cranking motor must be removed for repairs to switch or motor (par. 68-11).

5. If plunger does not pull into solenoid when ignition switch is turned to "START", the solenoid circuit is open, or solenoid is at fault.

6. To find reason why plunger does not pull into solenoid, connect jumper between solenoid battery terminal and terminal on solenoid switch to which purple wire is connected. If cranking motor operates, solenoid is okay; trouble is in ignition switch, neutral start switch, or in wires and connections between these units.

7. If cranking motor still does not operate, remove motor for inspection and test of solenoid switch (paragraph 68-4).

c. Cranking Speed Abnormally Low

Abnormally low cranking speed may be caused by low battery or defective cables, defective solenoid switch, defective cranking motor, or an internal condition of engine.

1. Make quick check of battery. If low battery is indicated, test battery. If defective cables are indicated, test cables.

2. If battery and cables are okay, test cranking motor and solenoid switch (paragraph 68-3).

3. If cranking motor and solenoid switch test okay, the trouble is due to an internal condition of engine. This may be due to use of engine oil which is too heavy for prevailing temperatures.

68-2 PERIODIC INSPECTION OF STARTING MOTOR

No periodic lubrication of the cranking motor or solenoid is required. The cranking motor and brushes cannot be inspected without disassembling the unit, so no service is required on the cranking motor and solenoid between inspection periods.

Cranking motor action is indicative, to some extent, of the cranking motor condition. A cranking motor that responds readily and cranks the engine at normal speed when the control circuit is closed is usually in good condition.

Check motor and solenoid switch attaching bolts to make sure these units are solidly mounted. Inspect and manually check all wiring connections at solenoid switch, ignition switch, and neutral start switch. Make sure that all these connections in the cranking motor and control circuits are clean and tight. It is advisable to test the cranking circuit to make certain that excessive resistance does not exist. See paragraph 68-3.

68-3 VOLTAGE TEST OF STARTING SYSTEM AND SOLENOID SWITCH

The voltage across the cranking motor and switch while cranking the engine gives a good indication of any excessive resistance.

NOTE: *Engine must be at normal operating temperature when test is made.*

1. Inspect battery and cables to make certain that battery has ample capacity for cranking and ignition.

2. Connect jumper wire to distributor terminal of coil and to ground on engine, so that engine can be cranked without firing.

3. Connect voltmeter positive lead to the motor terminal on solenoid switch; connect voltmeter negative lead to ground. See Figure 68-1.

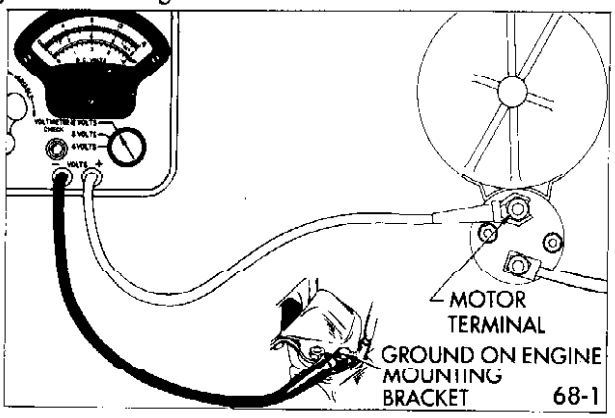


Figure 68-1--Cranking Voltage Test Connections

4. Turn ignition switch on, crank engine and take voltmeter reading as quickly as possible. If cranking motor turns engine at normal cranking speed with voltmeter reading 9 or more volts, the motor and switch are satisfactory. If cranking speed is below normal and voltmeter reading is 9 volts or greater, the cranking motor is defective.

CAUTION: *Do not operate cranking motor more than 30 seconds at a time without pausing to allow motor to cool for at least two minutes; otherwise, overheating and damage to motor may result.*

5. If cranking motor turns engine at low rate of speed with voltmeter reading less than 9 volts, test solenoid switch contacts as follows:

6. With voltmeter switch turned to any scale above 12 volts, connect voltmeter negative lead to the motor terminal of solenoid switch, and connect positive lead to battery terminal of switch. See Figure 68- 2.

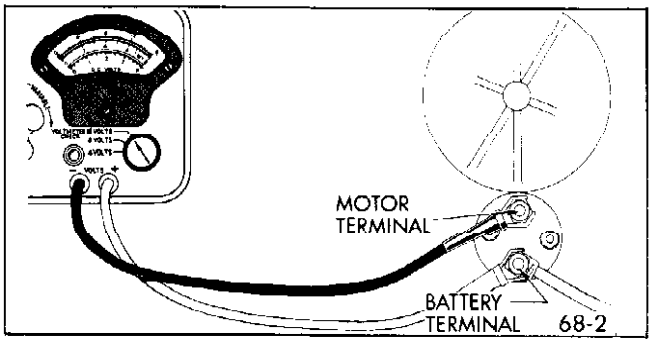


Figure 68-2--Solenoid Switch Contact Test Connections

7. Turn ignition switch on and crank engine. Immediately turn voltmeter switch to low scale and take reading as quickly as possible, then turn switch back to higher scale and stop engine.

The voltmeter will read not more than 2/10 volt if switch contacts are satisfactory. If voltmeter reads more than 2/10 volt, switch should be repaired or replaced.

68-4 AMPERAGE TEST OF SOLENOID

a. Testing Solenoid Switch Windings

(1) Current draw of both windings in parallel.

(2) Current draw of hold-in winding alone.

1. Remove screw from solenoid motor terminal and bend field leads slightly until clear of terminal. Then ground solenoid motor terminal with a heavy jumper wire. See Figure 68-3.

2. Connect a 12-volt battery, a variable resistance, and an ammeter of 100 amperes capacity in series with solenoid

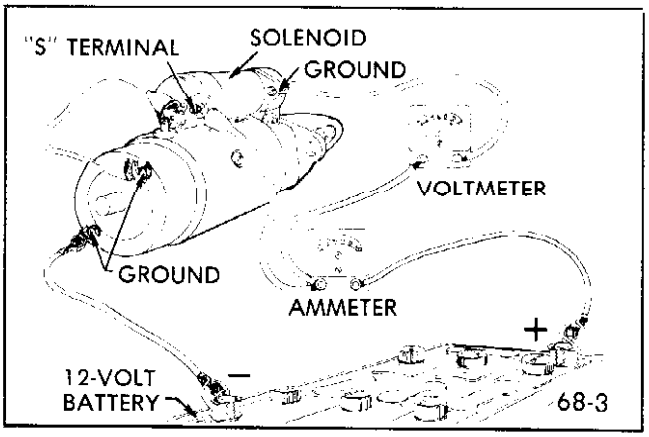


Figure 68-3--Amperage Test of Solenoid

"S" terminal. Connect a heavy jumper wire from solenoid base to ground post of battery.

3. Connect a voltmeter between base of solenoid and small solenoid "S" terminal.

4. Slowly adjust resistance until voltmeter reads 10 volts and note ammeter reading. This shows current draw of both windings in parallel. See paragraph 68- 12 for specifications on the starter being tested.

5. Remove jumper wire from solenoid motor terminal and readjust resistance until voltmeter reads 10 volts, then note ammeter reading. This shows current draw of hold-in winding alone. See paragraph 68-12 for specifications.

6. If solenoid windings do not test within specifications given, solenoid switch assembly should be replaced.

68-5 CHECKING PINION CLEARANCE

Whenever the cranking motor is disassembled and reassembled, the pinion clearance should be checked. This is to make sure that proper clearance exists between the pinion and pinion stop retainer when pinion is in cranking position. Lack of clearance would prevent solenoid starter switch from closing properly; too much clearance would cause improper pinion engagement in ring gear.

1. Connect a source of approximately 6 volts (3 battery cells or a 6 volt battery) between the solenoid "S" terminal and ground.

CAUTION: *Do not use more than 6 volts or the motor will operate. As a further precaution to prevent motoring, connect a heavy jumper wire from the solenoid motor terminal to ground.*

2. After energizing the solenoid, push the pinion away from the stop retainer as far as possible and use feeler gauge to check clearance between pinion and retainer. See Figure 68-4.

3. If clearance is not between .010" and .140", it indicates excessive wear of solenoid linkage, shift lever mechanism, or improper assembly of these parts.

NOTE: *Pinion clearance cannot be adjusted. If clearance is not correct, motor must be disassembled and checked for the above mentioned defects. Any defective parts must be replaced.*

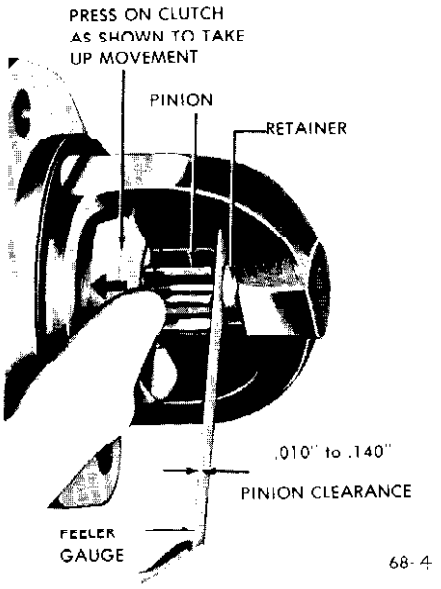


Figure 68-4--Checking Pinion Clearance

68-6 BENCH TEST OF STARTING MOTOR

To obtain full performace data on a cranking motor, or to determine the cause of abnormal operation, the motor should be removed from the engine and be submitted to a no-load test with equipment designed for such tests. A high current carrying variable resistance should be connected into the circuit so that the specified voltage at the cranking motor may be obtained, since a small variation in the voltage will produce a marked difference in the current draw. Test specifications are given in paragraph 68-12.

(a) *No-load Test.* Connect the cranking motor in series with a 12-volt battery and an ammeter capable of indicating several hundred amperes. If an RPM indicator is available, set it up to read armature RPM. Check current draw and armature RPM at the specified voltage.

1. *Low no-load speed and high current draw may result from:*

(a) Tight, dirty, or worn bearings, bent armature shaft or loose field pole screws which would allow the armature to drag.

(b) Shorted armature. Check armature further on growler.

(c) A grounded armature or field.

Check for grounds by raising the grounded brushes and insulating them from the commutator with cardboard. If the cranking motor has shunt field coils which are grounded to the field frame (see Figure 68-9 or 10), disconnect these fields from ground. Then check with a test lamp between the insulated terminal and the frame. If lamp lights, raise other brushes from commutator and check fields separately to determine whether it is the fields or armature that is grounded.

2. *Failure to operate with high current draw may result from:*

(a) A direct ground in the terminal or fields.

(b) Frozen shaft bearings which prevent the armature from turning.

3. *Failure to operate with no current draw may result from:*

(a) Open field circuit. Inspect internal connections and trace circuits with test lamp.

(b) Open armature coils. Inspect the commutator for badly burned bars.

(c) Broken or weakened brush springs, worn brushes, high mica on the commutator, or other causes which would prevent good contact between the brushes and commutator. Any of these conditions will cause burned commutator bars.

4. *Low no-load speed with low current draw indicates:*

(a) An open field winding. Raise and insulate ungrounded brushes from commutator and check fields with test lamp.

(b) High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under item 3 (c).

5. *High no-load speed with high current draw indicates* shorted fields. There is no easy way to detect shorted fields, since the field resistance is already low. If shorted fields are suspected, replace the fields and check for improvement in performance.

DIVISION II

DESCRIPTION AND OPERATION

68-7 DESCRIPTION OF STARTING SYSTEM

In the Buick cranking system, the engine is cranked by turning the ignition switch to the extreme clockwise position. The Start position is spring loaded in such a way that the switch returns to the On position when released.

The cranking system, shown schematically in Figure 68-16, is composed of the following units:

1. *Battery* and battery cables (par. 120-4).

2. *Cranking motor,* including the drive assembly which engages the flywheel ring gear during cranking operation (paragraph 68-9).

2. *Cranking motor solenoid switch,* mounted on the cranking motor, for shifting the drive assembly and closing the motor circuit (paragraph 68-9).

4. *Ignition switch,* which when in the Start position connects a lead from the battery to the solenoid switch, passing through the neutral start switch on the way. During cranking, the ignition switch also connects the battery directly to the ignition coil, thereby by-passing the resistance wire which normally supplies the ignition coil at a lower voltage.

5. *Neutral start switch* (automatic transmission cars only). This switch is connected between the ignition switch and the solenoid switch to prevent cranking of the engine except when the transmission control lever is in either neutral or park position.

6. *Clutch start switch* (manual transmission cars only). This switch is connected in series between the ignition switch and the starter solenoid switch to prevent cranking of the engine except when the clutch pedal is depressed.

68-8 OPERATION OF STARTING SYSTEM

When the ignition switch is turned fully clockwise to the Start position, a connection is made from the battery terminal to the ignition switch to the solenoid terminal of the switch. From here a large wire carries the current to a terminal on the solenoid switch of the cranking motor. A neutral start switch is located in series in this wire. The transmission control lever must be in neutral or park position so that the neutral start switch is also closed.

Closing of the ignition Start switch and the neutral start switch permits battery current to flow through the "pull-in" and "hold-in" coils of the solenoid magnetizing the solenoid. The plunger is pulled into the solenoid so that it operates the shift lever to move the drive pinion into engagement with the flywheel ring gear. The solenoid switch contacts then close *after* the drive pinion is partially engaged with the ring gear. This prevents any possible gear clash. See Figure 68-5 or 6.

The closing of the solenoid switch contacts causes the motor to crank the engine and also cuts out the "pull-in" coil of the solenoid, the magnetic pull of the "hold-in" being sufficient to hold the pinion in mesh after the shifting has been performed. This reduces the current consumed by the solenoid while the cranking motor is operating. See Figure 68-5 or 6.

As soon as the engine starts running, the overrunning clutch starts free-wheeling. This allows the starter pinion to be driven by the flywheel ring gear without causing the armature speed to increase greatly. (Because of the large ratio between the pinion and the ring gear, a seized overrunning clutch will cause the armature to be driven at an excessive speed which may cause the armature windings to be thrown). As soon as the driver realizes that the engine has started, he releases the ignition key and a spring in the ignition switch returns it to the On position. This breaks the solenoid circuit so that the solenoid is

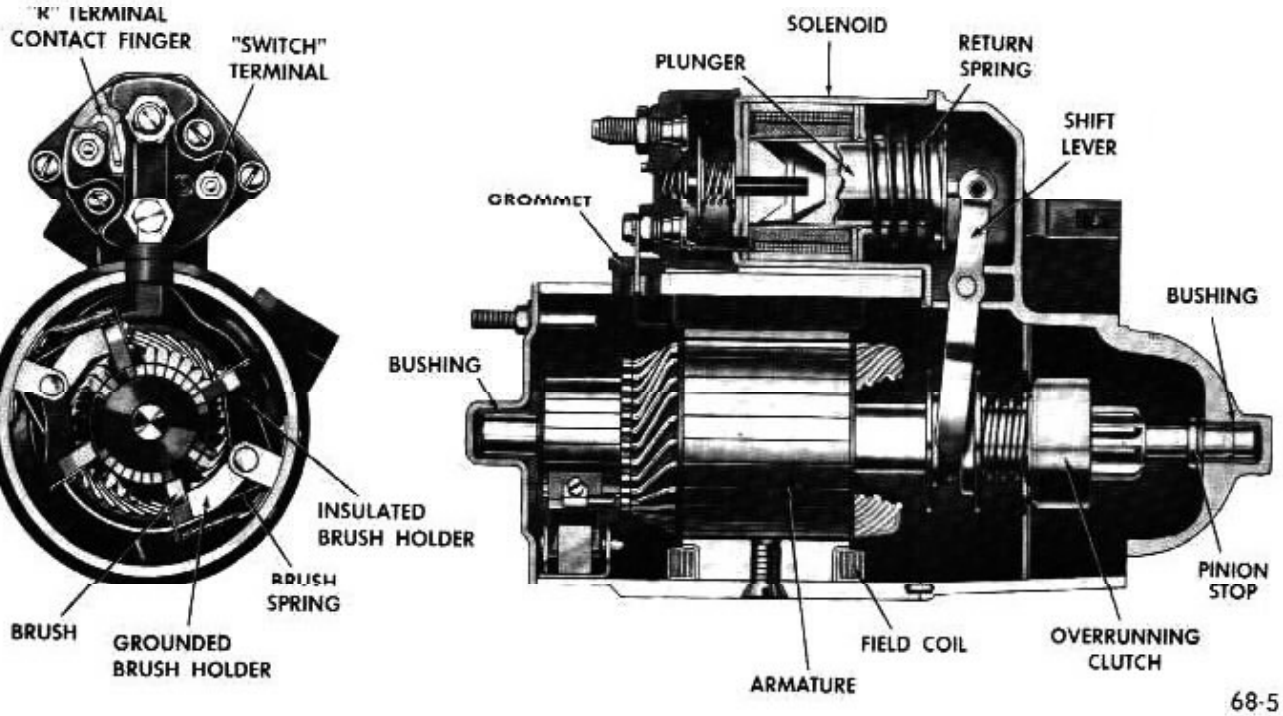


Figure 68-5 - Starting Motor - 250 and 350 Engines

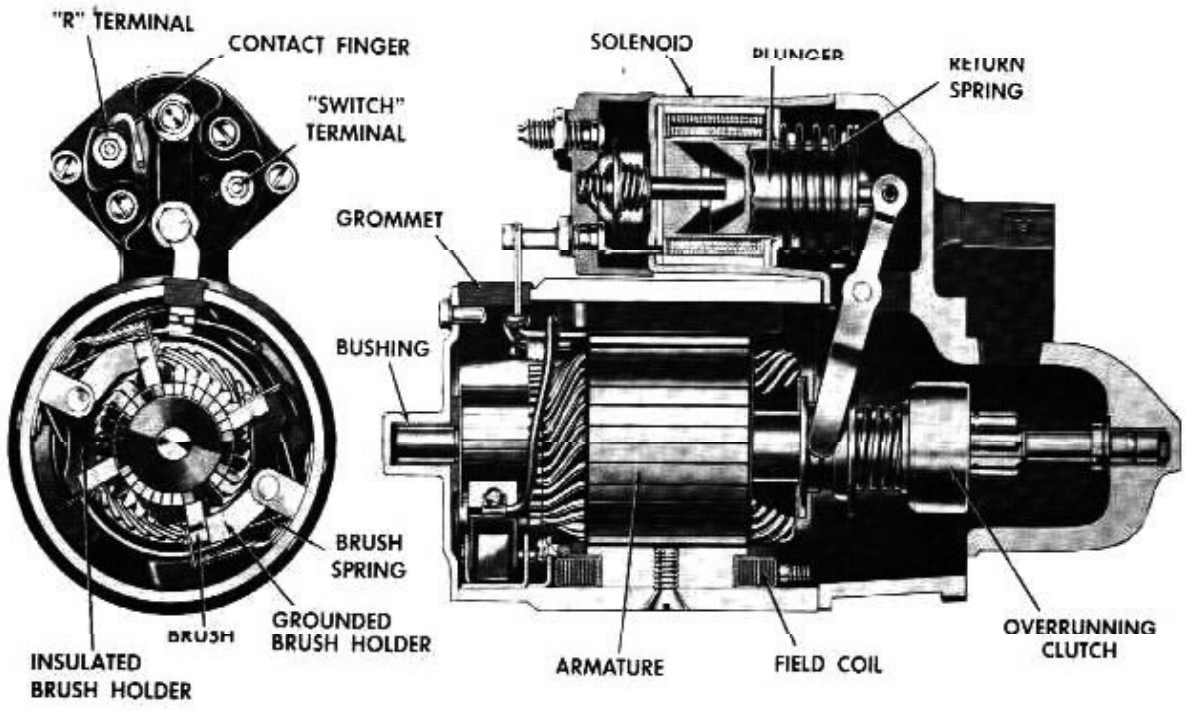


Figure 68-6 - Starting Motor - 455 Engines

demagnetized. A return spring then actuates the shift lever to retract the solenoid plunger, which permits another spring to open the solenoid switch contacts. The shift lever then disengages the drive pinion from the flywheel ring gear. After the transmission is shifted out of park or neutral, the neutral start switch will prevent accidental engagement of the drive pinion with the flywheel.

68-9 STARTING MOTOR AND SOLENOID SWITCH

The cranking motor assembly consists of a motor, drive assembly, shift lever, and solenoid switch. See Figure 68-5 or 6.

a. Cranking Motor, Drive and Shift Lever

The cranking motor is an enclosed shift lever type, having an extruded frame, four poles and a compound field. The drive end housing is extended to enclose the entire shift lever mechanism and plunger to protect them from road dirt, icing conditions, and splash. The solenoid is flange mounted onto the drive end housing and is sealed to the drive housing by a sealing compound. The shift lever return spring is a compression type and is located inside the solenoid case.

The armature shaft is supported at both ends in graphite bronze bushings pressed into the commutator end frame and the drive housing. Neither of these bearings require lubrication except during assembly. See Figure 68-5 or 6.

The four brushes are supported by brush holders mounted on the field frame. Two opposing brushes are connected to the field coils. The field coils are held in place by the pole shoes which are attached to the field by large screws. The field coils are connected to an insulated connecting link in the field frame, through which current is supplied to the motor.

The drive assembly is mounted on the motor armature shaft and keyed to it by helical splines so that it can be moved endwise on the shaft by the solenoid operated shift lever. It transmits cranking torque to the flywheel ring gear, but its overrunning clutch allows the drive pinion to rotate freely with reference to the armature shaft when the engine begins to operate, thus preventing the armature from being driven at excessive speed by the engine.

The drive assembly pinion is moved into engagement with flywheel ring gear by action of the solenoid upon the shift lever, which engages the shift collar of drive assembly. The shift collar moves the drive assembly by pushing on the clutch spring, which serves as a cushion in case the pinion and gear teeth butt instead of meshing. The helical splines assist in obtaining proper pinion engagement. The drive pinion is pulled out of engagement, after engine starts, by action of the shift lever return spring. The shift lever is connected to the solenoid switch plunger by a roll pin. See Figure 68-5 or 6.

The cranking motor in the L-6 engine has four field coils connected in series between the terminal and the insulated brushes. See Figure 68-7.

The cranking motor in the 350 engine has three field coils connected in series between the terminal and the insulated brushes, and one shunt field coil connected to ground. See Figure 68-8.

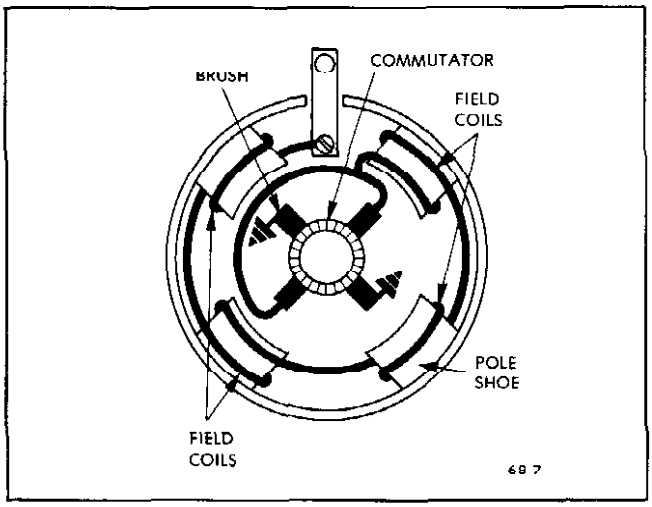


Figure 68-7 - Starting Motor Internal Circuits - 250 Engine

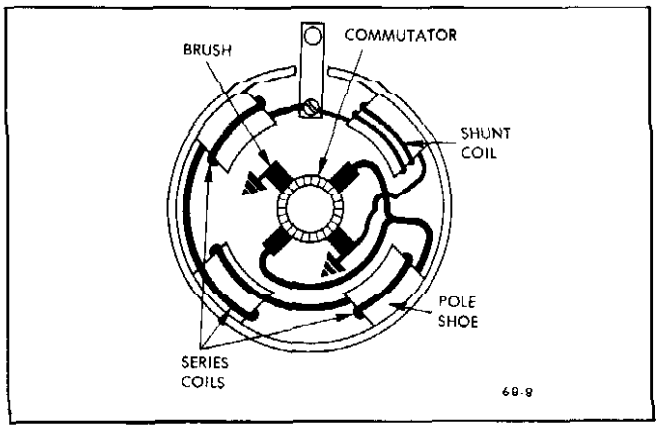


Figure 68-8 - Starting Motor Internal Circuits - 350 Engine

The large V-8 cranking motor has two parallel field coils connected to the insulated brushes, and two shunt field coils connected to ground. The purpose of this design is to increase starting torque. Heavier field and armature windings help accomplish this. The additional shunt field is required to control free speed of the motor. See Figure 68-9.

b. Solenoid Switch

The solenoid switch not only closes the circuit between the battery and the cranking motor to produce cranking action, but it also operates the shift lever to move the drive pinion into engagement with the flywheel ring gear.

The solenoid section of the switch has a plunger and two windings, the "pull-in" winding and the "hold-in" winding. Together, they provide sufficient magnetic attraction to pull the solenoid plunger into the solenoid. The plunger actuates the shift lever and drive assembly and it also closes the solenoid switch contacts by pressing against a push rod upon which a contact disc is mounted between two coil springs. One spring serves as a cushion to insure firm contact of the disc with two stationary contacts. The other spring pushes the disc away from the stationary contacts to break the circuit when the solenoid is demagnetized after the engine starts. One stationary contact is connected to the battery positive cable c and the other is connected to the motor windings through a connector or bus bar. See Figure 68-5 or 6.

Operation of solenoid switch, as well as the entire cranking system, is described in paragraph 68-9.

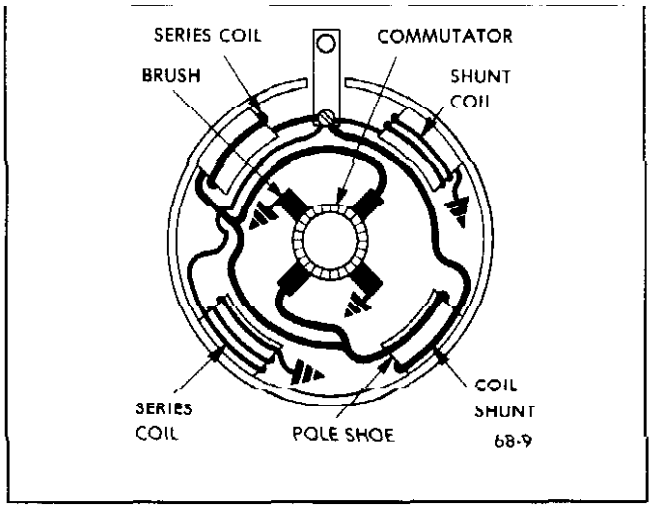


Figure 68-9 - Starting Motor Internal Circuits - 455 Engines

DIVISION IV

REMOVAL AND INSTALLATION

68-10 STARTER R and R

a. Removal (V-8 Engines)

1. Disconnect battery

2. Raise on hoist.

3. Remove four (4) screws securing flywheel inspection cover, using a 3/8" socket.

4. Disconnect the three (3) electrical wires from the starter solenoid, using a 3/8" socket for the two (2) small terminals and a 9/16" socket for the large nut on the battery terminal.

5. Remove one (1) bolt from starter bracket to engine block, using a 1/2" socket; after this bolt is removed, use a 9/16" socket to remove the two (2) rear starter bolts.

NOTE: *On 43-44000 Series cars, the starter bracket to block bolt is hidden and must be broken loose with a short 1/2" open-end wrench. It is necessary to restart this bolt with your fingers and then retighten with the same wrench used in removal.*

b. Removal (L-6 Engines)

1. Disconnect battery ground cable at battery terminal post.

2. Disconnect battery positive cable and wiring harness leads from starting motor solenoid.

3. Remove starting motor.

c. Installation (V-8 Engines)

1. Fasten the purple wire onto the starter solenoid first.

2. Install two (2) rear starter bolts.

3. Install starter bracket to engine block bolt.

4. Secure battery cable and the small yellow wire to the solenoid.

5. Reinstall the flywheel inspection cover.

6. Lower car and connect battery cable.

d. Installation (L-6 Engines)

1. Install starting motor.

2. Connect battery positive cable and wiring harness leads to starting motor solenoid.

3. Connect battery ground cable at battery terminal post.

DIVISION V

OVERHAUL AND MAJOR SERVICE

68-11 STARTING MOTOR REPAIRS-ON BENCH

a. Disassembly, Cleaning and Inspection

When it is necessary to disassemble cranking motor for any reason, make a complete clean-up and inspection to make sure all parts are in satisfactory condition.

1. Remove field lead connecting screw from motor terminal of solenoid.

2. Remove two thru bolts and remove commutator end frame and field frame assembly.

3. Pull out brush holder pivot pin and remove the two brush holders and the spring as a group. Remove screws attaching brushes and leads to holders.

4. Remove two screws holding solenoid to drive housing and remove solenoid. Remove small nut and insulating washer from the solenoid "S" terminal. Remove large nut and insulating washer from the solenoid motor terminal. See Figure 68-5 or 6. Then, remove two screws that attach switch cover to solenoid and remove cover for inspection of switch parts.

5. Remove shift lever fulcrum bolt and remove shift lever, plunger and return spring.

6. Remove armature and drive assembly from drive housing. Remove thrust collar from pinion end of armature shaft.

7. To remove drive assembly from armature, place a metal cylinder of proper size (1/2" pipe coupling will do) over end of shaft to bear against the pinion stop retainer. Tap retainer toward armature to uncover snap ring. See Figure 68-10. Remove snap ring from groove in shaft, then slide retainer and pinion drive assembly from shaft.

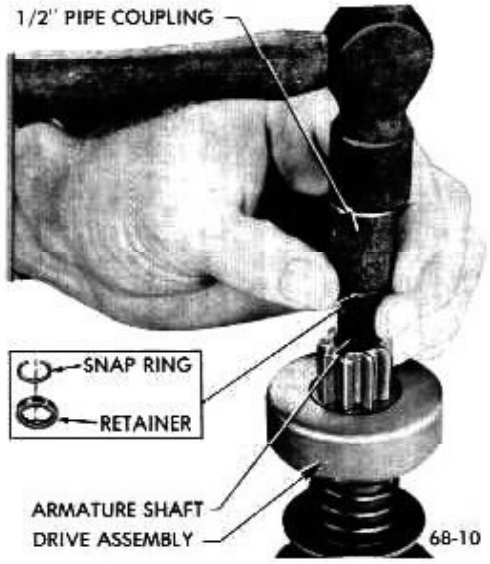


Figure 68-10 Removing Pinion Stop Retainer and Snap Ring

8. Clean all parts by wiping with clean cloths. The armature, field coils, and drive assembly must not be cleaned by any degreasing or high temperature method. This might damage insulation so that a short or ground would subsequently develop, and will remove lubricant originally packed in the overrunning clutch so that clutch would soon be ruined.

9. Carefully inspect all parts for wear or damage and make necessary repairs to replace unserviceable parts. Any soldering must be done with rosin flux; *never use acid flux on electrical connections.*

10. Test armature and make necessary repairs or turn commutator if required.

b. Assembly of Cranking Motor

1. Lubricate shift lever linkage and install in drive housing.

CAUTION: *Never lubricate solenoid plunger or plunger cylinder.*

2. Assemble solenoid by reversing the disassembly procedure. Install return spring. Apply sealing compound on both sides of solenoid flange where it extends between drive housing and field frame. Then install solenoid.

3. Lubricate armature shaft. Install drive assembly with pinion outward.

4. Slide pinion stop retainer down over shaft with recessed side outward.

5. Place a new snap ring on drive end of shaft and hold it in place with a hard wood block. Strike block with hammer to force snap ring over end of shaft, then slide the ring down into groove in shaft. See Figure 68-11, View A.

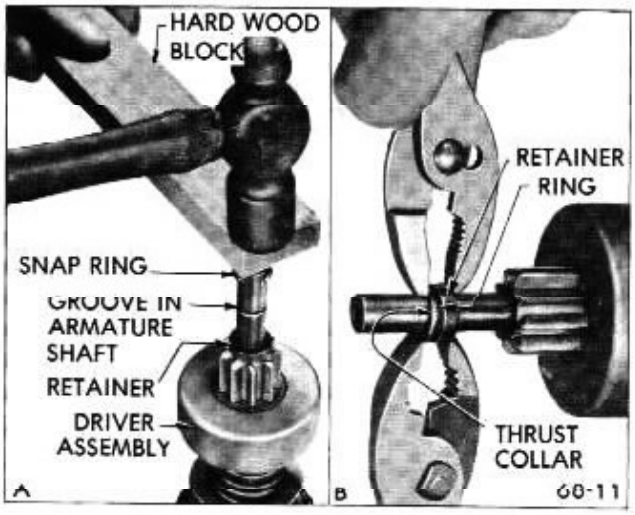


Figure 68-11 - Pinion Stop Retainer and Snap Ring Installation

6. Place thrust collar on shaft with shoulder next to snap ring, and move the retainer into contact with ring. Using pliers on opposite sides of shaft squeeze retainer and thrust collar together until snap ring is forced into the retainer. See Figure 68-11, View B.

7. Lubricate drive housing bushing and install armature and drive assembly in housing.

8. Continue with assembly of cranking motor by reversing dissassembly procedure. If field coils were removed from field frame us care in tightening e pole shoe screws to avoid distortion of parts and make sure that screws are securely tightened.

9. Position field frame assembly over armature assembly so that dowel pin engages hole in drive housing. Use care to prevent damage to brushes and brush holders. Make sure that brushes are properly seated in commutator.

10. Lubricate bushing in commutator end frame and install end frame.

11. Install thru bolts and tighten securely. Connect field leads to motor terminal of solenoid with connecting screw.

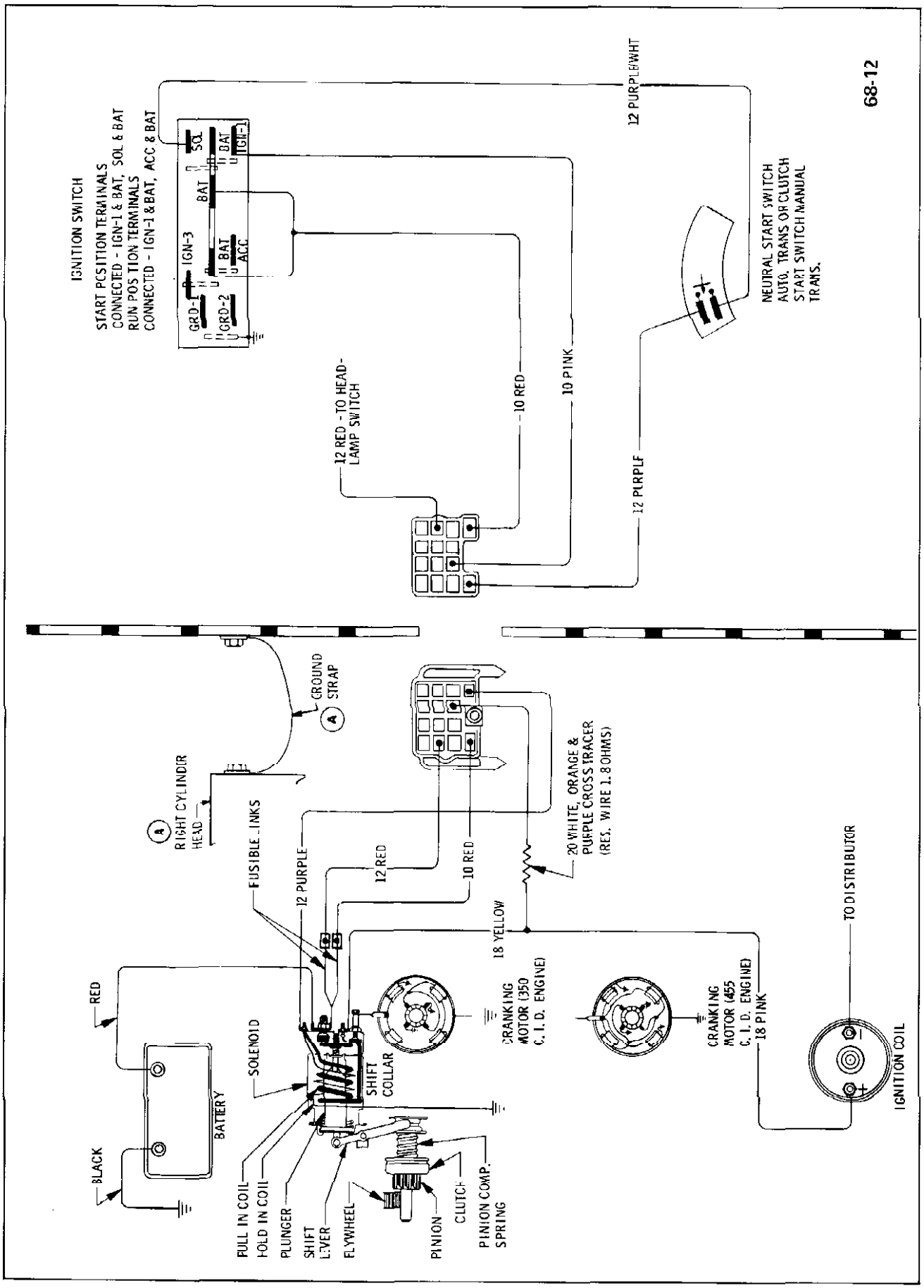
12. Test solenoid switch and check pinion clearance as described in paragraph 68-4 and 5. If a reliable starter tester is available, test motor as described in paragraph 68-11.

Division VI Specifications

68-12 STARTING SYSTEM SPECIFICATIONS

a. Starting Motor	250 Eng.	350 Eng.	455 Eng.
Make	Delco-Remy	Delco-Remy	Delco-Remy
Number	1108365	1108391	1108392
Location Side of Engine	Right	Right	Right
Type of Shift	Mechanical	Mechanical	Mechanical
Shift Actuation	Solenoid	Solenoid	Solenoid
Shift Operation	Ignition Switch	Ignition Switch	Ignition Switch
Type of Drive	Overrunning Clutch	Overrunning Clutch	Overrunning Clutch
Rotation, Viewing Drive End	Clockwise	Clockwise	Clockwise
Gear Ratio, Motor to Engine	17.8 to 1	17.8 to 1	18.4 to 1
No. Teeth on Ring Gear and Drive Pinion	160,9	160.9	166,9
Cranking Speed, Engine RPM (Normal Temp.)	160 Approx.	160 Approx.	160 Approx.
No Load Test			
Amperes	50 to 80	80	45 to 80
Volts	9	9	9
RPM	5,5000 to 10,500	3,500 to 6,000	4,000 to 6,500
Brush Spring Tension—Ounces	35 min.	35 min.	35 min.
Armature End Play	.005" to .050"	.005" to .050"	.005" to .050"
Pinion Clearance in Cranking Position	.010" to .140"	.010" to .140"	.010" to .140"

b. Solenoid Switch	250 Eng.	350 Eng.	455 Eng.
Make	Delco-Remy	Delco-Remy	Delco-Remy
Solenoid Switch Number	1114356	114356	1114356
Current Draw of Solenoid Windings at 80°F Hold-in Winding, Amps. at 10 Volts	14.5 to 16.5	14.5 to 16.5	14.5 to 16.5
Both Windings in Parallel, Amps, at 10 Volts	41 to 47	41 to 47	41 to 47
Pull-in Windings, Amps. at 5 Volts	13 - 15.5	13 - 15.5	13 - 15.5



- Figure 68-12 - Ignition and Starter Wiring

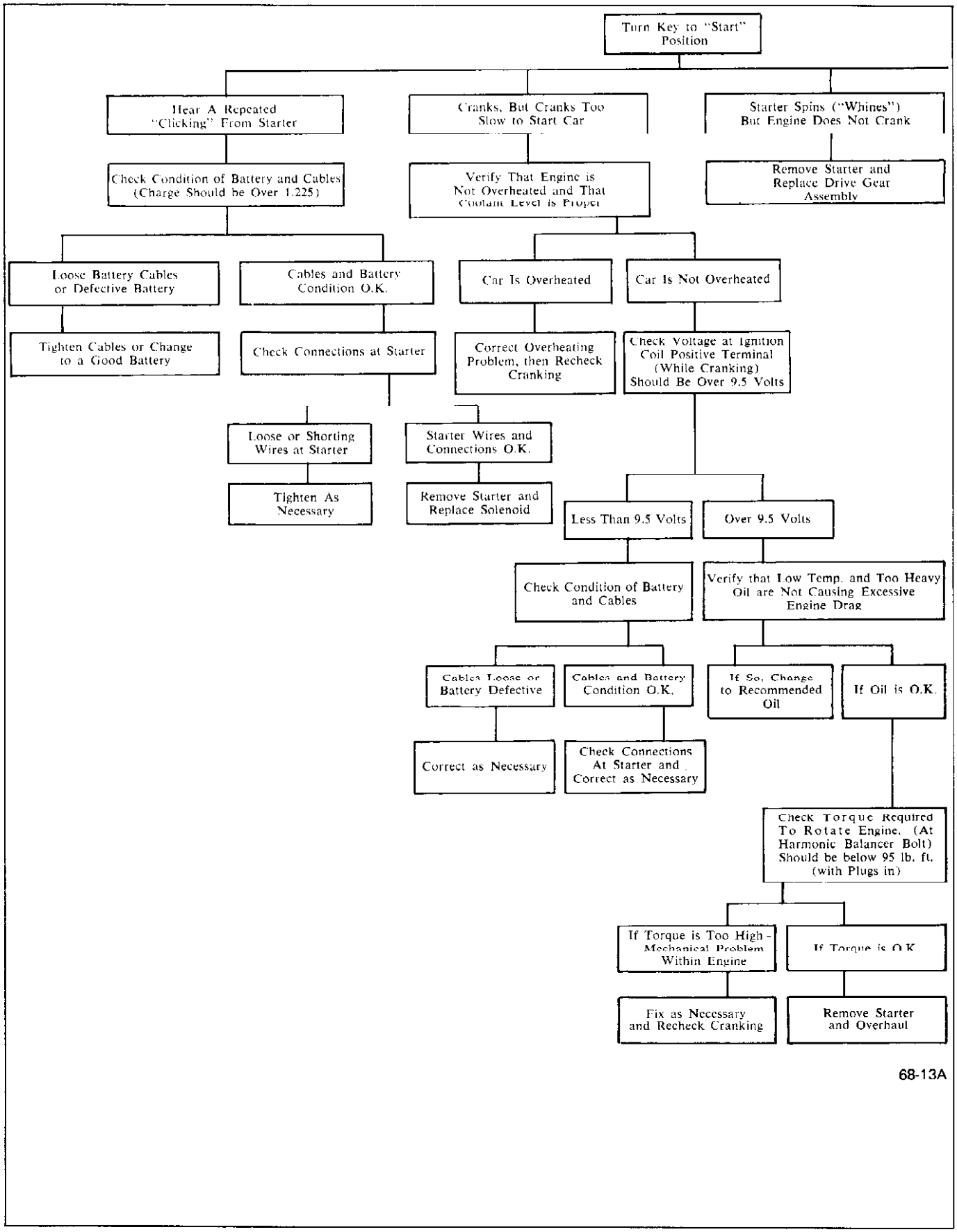


Figure 68-13A Starting Motor Trouble Chart

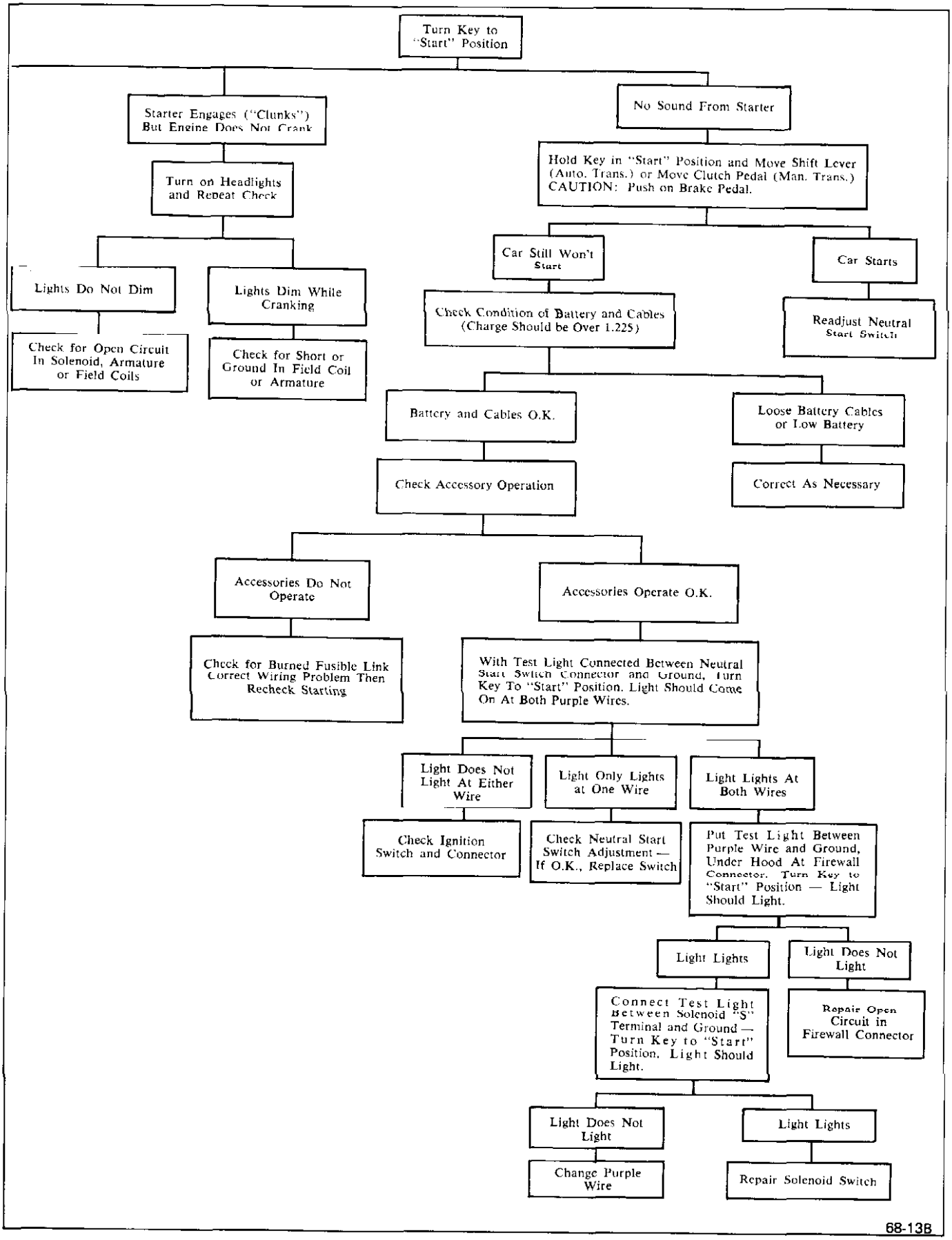


Figure 68-13B Starting Motor Trouble Chart

GROUP 67

CONTROLLED COMBUSTION SYSTEM

Section	Title
A	Controlled Combustion System . . .

SECTION A

CONTROLLED COMBUSTION SYSTEM ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Testing Thermo Air Cleaner Operation	67-1
	Testing Transmission-Controlled Vacuum Advance	67-2
II	DESCRIPTION AND OPERATION:	
	Description and Operation of Controlled Combustion System and Transmission-Controlled Vacuum Advance	67-3
III	ADJUSTMENTS AND MINOR SERVICE:	
	Removal and Replacements of CCS Units	67-4
IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS:	
	Controlled Combustion System Specifications	67-5

DIVISION I

TROUBLE DIAGNOSIS

67-1 TESTING THERMO AIR CLEANER OPERATION

Since failure of the thermo air cleaner will generally result in the snorkel cold air door staying open, failure will probably go unnoticed in warm or hot weather. In cold weather, however, owners will complain of leaness, hesitation, sag, surge or stalling. When any type of lean operation complaint is received, always test the thermo air cleaner for proper functioning before doing any work on the carburetor.

NOTE: *Always perform checks in the same order as listed below.*

a. Vacuum Motor Check

1. Check all hoses for proper hook-up. Check for kinked, plugged or damaged hoses.

2. With the engine "OFF", observe damper door position through snorkel opening. If position of snorkel makes observation difficult use the aid of a mirror. At this point damper door should be in such a position that the heat stove passage is covered (snorkel passage open). If not, check for binds in linkage.

3. Apply at least 9 in. Hg. of vacuum to diaphragm assembly through hose disconnected at sensor unit. This can be done by mouth. Damper door should completely close snorkel passage when vacuum is applied. If not check to see if linkage is hooked up correctly and for a vacuum leak.

4. With vacuum applied, bend or clamp hose to trap vacuum in diaphragm assembly. Damper door should remain in position (closed snorkel passage). If it does not, there is a vacuum leak in diaphragm assembly. Replace diaphragm assembly.

b. Sensor Check

Quick Check of System:

1. Start test with engine cold, air cleaner at a temperature below 85 degrees. If the engine has been in recent use, allow it to cool.

2. Observe the cold air door before starting the engine: it should be wide open.

3. Start the engine and allow it to idle. Immediately after starting the engine, the cold air door should close.

4. As the engine warms up, the cold air door should start to open and the air cleaner should become warm to the hand.

5. The system is operating normally as described above. If the air cleaner fails to operate as above or if correct operation of the air cleaner is still in doubt, proceed to the thermometer check.

Thermometer Check of Sensor:

1. Start test with air cleaner temperature below 85 degrees. If engine has been run recently, allow it to cool down. While engine is cooling, remove air cleaner cover and install a temperature gage such as J-22973 as close as possible to sensor. Reinstall air cleaner cover. Do not install wing nut. Let car stand idle for 1/2 hour or more before proceeding to step 2.

2. Start and idle engine. Cold air door should close immediately if engine is cool enough. When cold air door starts to open (in a few minutes), remove air cleaner cover and read temperature gage. It must read 115 degrees plus or minus 20 degrees. (L-6 engine - 105 degrees plus or minus 20 degrees.)

3. If cold air door does not start to open at temperature indicated, temperature sensor is defective and must be replaced.

67-2 TESTING TRANSMISSION CONTROLLED VACUUM ADVANCE

A failure in the transmission controlled vacuum advance system could result in either of two troubles:

1. Continuous vacuum advance in first and second gears which would prevent the car from passing the Federal emissions standards.

2. No vacuum advance in third gear which would result in lower gas mileage.

Check for proper operation of the transmission controlled vacuum advance system as a part of each engine tune-up, as follows:

1. With a timing light and tachometer hooked up and with transmission in D, increase engine speed to approximately 1000 RPM by positioning the fast idle cam. Check timing mark--there should be no vacuum advance.

CAUTION: *Make sure parking brake is applied firmly and that a wheel is blocked in front and back.*

2. Shift transmission into R. Check timing mark @ 1000 RPM - there should now be full vacuum advance.

A check of the vacuum retard switch can be accomplished as follows:

CAUTION: *To prevent damaging the pressure switch, the tester used must have sufficient resistance that it does not supply the switch with more than .8 amp of current at 12 volts. Test lamps which use size 1893 or smaller bulb, will not damage the switch.*

1. With engine running, place a continuity light on the transmission connector and to ground. The light should be on when the transmission is in "D" or drive gear.

2. Shift the transmission from drive into "R" reverse, the light in this position, should go out. If above check shows lack of continuity, a check at the output terminal of the transmission will be necessary.

3. With engine running, place a continuity light on the output terminal of the transmission, the light should be on when the transmission is in "D" or drive gear.

This is a positive check for the retard switch in the transmission only. This check shows the switch is operating as designed and further checking of the switch will not be necessary.

DIVISION II

DESCRIPTION AND OPERATION

67-3 DESCRIPTION AND OPERATION OF CONTROLLED COMBUSTION SYSTEM

All 1971 cars must be capable of passing certain tests which measure the quantity of unburned impurities in the exhaust gases. Federal law places a limit on the hydrocarbon and carbon monoxide emissions from the exhaust system. The purpose of this law is to keep the atmosphere cleaner, particularly in populous areas where these impurities add to the smog problem.

Basically, excessive exhaust emissions are caused by incomplete combustion of the air-fuel mixture in the cylinders.

In order to pass the stricter 1971 Federal emissions requirements, all engines will have a transmission controlled vacuum advance control system; and the controlled combustion system.

The Controlled Combustion System and Transmission Controlled Vacuum Advance are used with engines designed for no spark advance at lower engine speeds plus leaner carburetor and choke calibrations. With retarded idle timing, the throttle must be opened slightly more to maintain the same idle speed. This gives better mixture distribution and less exhaust dilution, resulting in much more complete combustion.

All 1971 Buicks, therefore, have "ported" spark advance, with the vacuum take-off just above the throttle valve, so that there is no vacuum advance at closed throttle. The transmission controlled vacuum advance system consists of a solenoid valve (inserted in the ported vacuum hose to the distributor), an oil pressure operated switch (installed in the transmission) and an electrical harness connecting these two units.

The solenoid valve is normally open but closes off vacuum when electricity flows through the solenoid. A vent bleeds off any vacuum in the hose to the distributor advance unit when the valve closes.

The oil pressure switch is located internally in the direct clutch circuit and is pressurized when the car has shifted into third or drive gear.

The oil pressure switch is normally closed but opens to stop electrical flow to ground when there is oil pressure to the switch. The switch is controlled by direct clutch apply pressure.

An electrical harness connects the ignition switch to one terminal of the solenoid valve, through the solenoid, out the other solenoid terminal and to ground thru the oil pressure switch (when closed).

Operation of the transmission controlled vacuum advance system is as follows:

1. When operating in P, N, L2, or L1 positions; or Neutral, 1st gear or 2nd gear, in the case of synchromesh transmission, there is no oil pressure in the direct clutch circuit to the transmission switch, so there can be no vacuum advance.

2. When operating in D, there is no oil pressure to the transmission switch until the transmission upshifts to third gear, at which time vacuum advance starts to operate normally.

3. When operating in R, there is always oil pressure in the direct clutch circuit to the transmission switch, so there is normal vacuum advance.

Because of the greater heat rejection to the coolant during idle with little vacuum spark advance, some engines are liable to overheat if allowed to idle for an extended period. For this reason, some engines have a thermo vacuum switch located in the coolant passage at the left front corner of the intake manifold. This vacuum switch has three nipples:

1. The nipple marked "MT" has a hose either directly to the intake manifold or to a tee which connects to the manifold.

2. The nipple marked "C" is connected to the carburetor for a "ported" vacuum source.

3. The nipple marked "D" is connected to the distributor vacuum advance unit.

When engine coolant is at normal temperatures, the thermo vacuum switch (not included on manual transmission equipped cars) is positioned internally to supply "ported" vacuum to the distributor. However, if coolant temperature should ever rise above 220 degrees, the thermo vacuum switch will supply full intake manifold vacuum to the distributor, even at closed throttle. This

will improve idle quality and will cause an idling engine to speed-up, resulting in improved fan and water pump action, besides reducing heat rejection to the coolant because of the 14 to 20 degrees spark advance.

The C.C.S. package includes leaner carburetor calibration at idle and part throttle plus leaner choke calibration Since past model carburetion was as lean as possible consistent with good driveability with inlet air temperatures as low as -20 degrees, this still leaner C.C.S. carburetion is only possible because of the heated air system that is also a part of the C.C.S. package. With the heated air system operating, inlet air temperature is around 115 degrees after the first few minutes of operation; this makes use of leaner (hot weather) calibration possible, and the car still responds and drives well in cold weather.

The heated air part of the C.C.S. consists of a heat stove, a corrugated paper heated-air pipe, a plastic adapter elbow and an air cleaner containing temperature control doors operated by vacuum through a temperature sensor.

The heat stove is a sheet metal cover, shaped to and bolted on with the left exhaust manifold. Air drawn in along the lower edge of the stove passes across the manifold surface, picking-up heat. The heated air is drawn out from the upper center of the manifold, through the heated air pipe and plastic adapter elbow into the snorkel of the air cleaner.

The temperature control air cleaner is designed to mix this heated air with cold air from under the hood so that carburetor inlet air temperature averages about 115°. This mixing is done by two air doors, a cold air door and a hot air door, which move together so that when the cold air door is closed, the hot air door is open and vice versa. Most of the time, both doors will be partially open as required to control the temperature. When the underhood temperature reaches about 135°, the cold air door will open wide and the hot air door will close tight. See Figure 67-1. Obviously, if underhood temperatures rise above 135 degrees, the air cleaner will no longer be able to control temperature and the inlet air temperature will rise with underhood temperature.

The temperature doors are moved by a diaphragm type vacuum motor. When there is no vacuum present in the motor, the diaphragm spring forces the cold air door open and the hot air door closed. Whenever the engine is running, the amount of vacuum present in the vacuum motor depends on the temperature sensor in the air cleaner which is located in the vacuum line between the intake manifold and the vacuum motor. In the sensor, a bi-metal temperature sensing spring starts to open a valve to bleed more air into the vacuum line whenever the temperature in the air cleaner rises above about 115°. Whenever the temperature falls below about 115 degrees, the sensing spring starts to close the air bleed into the vacuum line, allowing more manifold vacuum to reach the vacuum motor. Whenever there is 9 inches or more of vacuum in the vacuum motor, the diaphragm spring is compressed, the cold air door is closed and the hot air door is opened.

When the engine is not running, the diaphragm spring will always hold the cold air door open and the hot air door closed. However, when the engine *is* running, the position of the doors depends on the air temperature in the air cleaner.

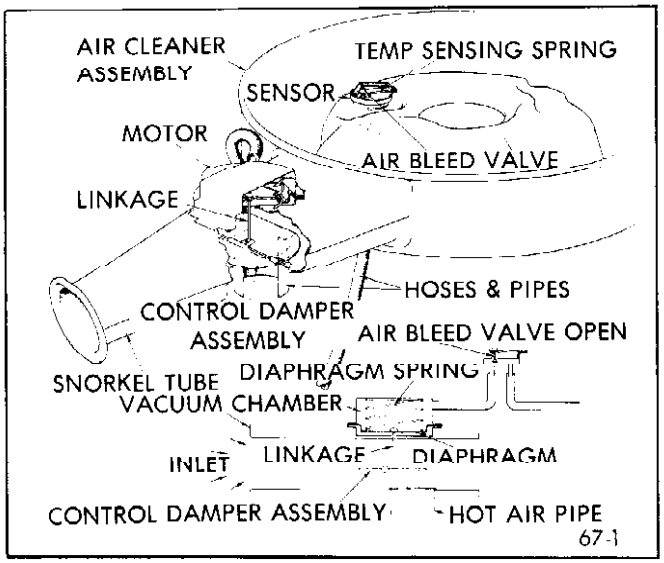


Figure 67-1 - Cold Air Door Open

When starting a cold engine (air cleaner temperature under 85 degrees), the cold air door will close and the hot air door will open immediately. See Figure 67-2. This is because the air bleed valve in the sensor is closed so that full manifold vacuum, is applied in the vacuum motor. The cold air door will remain tightly closed only a few minutes, however. As soon as the air cleaner starts receiving hot air from the heat stove, the sensor will cause the cold air door to open partially, mixing cold air with the hot air as necessary to regulate air cleaner temperature within 20 degrees of the ideal 115 degrees air inlet temperature. See Figure 67-3.

If underhood air temperature rises to 135 degrees, the air bleed valve in the sensor will be wide open so that vacuum to the vacuum motor approaches zero. The diaphragm spring in the vacuum motor will hold the cold air door wide open and close the hot air door tightly. If underhood temperature rises above 135 degrees, carburetor inlet air termperature will also rise above 135 degrees.

While air cleaner temperature is being regulated, accelerating the engine hard will cause the vacuum level in the intake manifold and in the vacuum motor to drop. Whenever vacuum drops below 5 inches, the diaphragm spring will open the cold air door wide in order to get the maximum air flow required for maximum acceleration.

With an L-6 engine, a different air cleaner controls the

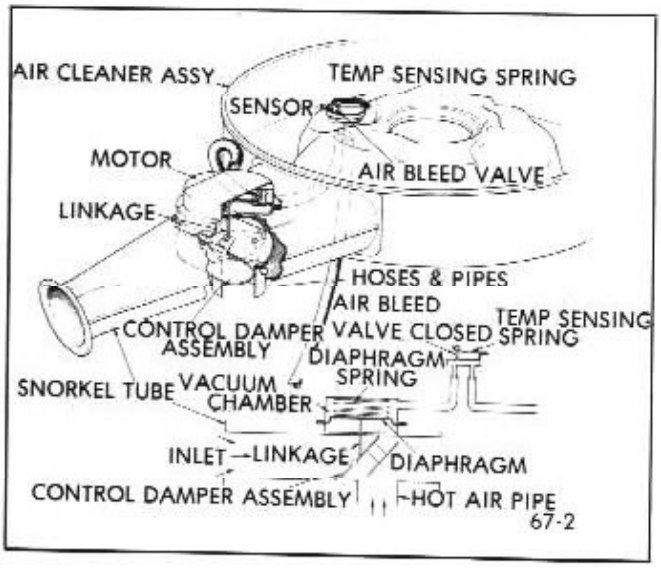


Figure 67-2 - Hot Air Door Open

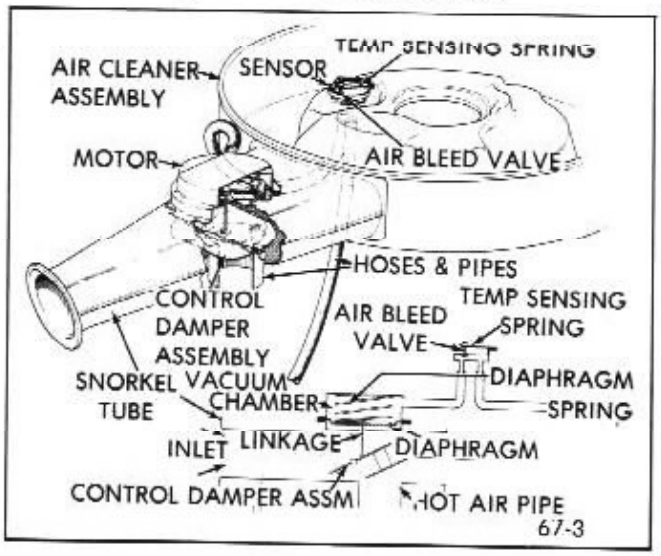


Figure 67-3 - Cold and Hot Air Doors Both Partially Open

inlet air temperature 10 degrees lower than the V-8 engines. On L-6 engines, ideal inlet air temperature is 105 degrees plus or minus 20 degrees.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

67-4 REMOVAL AND REPLACEMENT OF C.C.S. UNITS

NOTE: *The damper door is not serviceable. The air cleaner assembly must be replaced if the damper door is defective.*

a. R and R Vacuum Motor

1. Drill center of two spot welds using a 1/16 inch drill. Do not center punch.

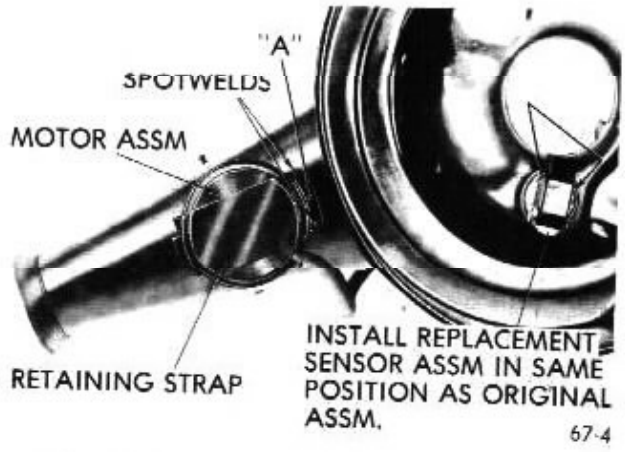


Figure 67-4 - Replacing Vacuum Motor Assembly

2. Enlarge two holes using a 5/32 inch drill.

CAUTION: *Use extreme care not to damage the air cleaner snorkel.*

3. Remove vacuum motor retainer strap. See Figure 67-4.

4. Lift vacuum motor, cocking it to one side to unhook motor linkage at the control door.

5. Drill a 7/64" hole in snorkel tube at point "A" as shown in Figure 67-4.

6. Use the motor strap retainer and the sheet metal screw provided in the motor service package to secure the retainer and motor to the snorkel tube.

7. Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.

b. R and R Air Cleaner Sensor

1. Remove two sensor retaining clips by prying. See Figure 67-5.

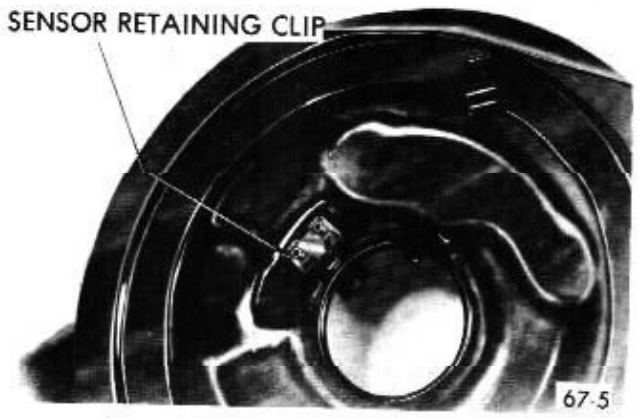


Figure 67-5 - Replacing Sensor Assembly

2. Pull vacuum hoses from sensor.

3. Note carefully the installed position of the sensor so that

you can install new sensor in same position. Then remove sensor.

4. Install sensor and gasket assembly in air cleaner in same position as noted in Step 3. This is to eliminate the possibility of interference with the air filter element.

5. Install sensor retaining clip. Meanwhile supporting sensor at "B" around the outside rim to prevent damage to the temperature sensing spring. See Figure 67-4.

6. Reinstall vacuum hoses.

DIVISION VI SPECIFICATIONS

67-5 CONTROLLED COMBUSTION SYSTEM SPECIFICATIONS

Carburetor Inlet Air Regulated Temperature . . . . . 115° ‡ 20°
Idle Mixture Setting (Lean from Best Idle) . . . . . 50 RPM
Thermo Vacuum Switch Operating Temperature . . . . . 220°
Engine Thermostat Operating Temperature
L-6 Engine . . . . . 195°
V-8 Engine . . . . . 190°

Idle Speed and Ignition Timing	Fast Idle Speed (On Low Step of Cam)	Idle Speed (With AC Off)	Ign. Timing
250 Eng. - (Man. Trans.)	N.A.*	550 in N	4° B.T.D.C.
250 Eng. - (Auto. Trans.)	N.A.*	500 in D	4° B.T.D.C.
350 Eng. - (Man. Trans.) 43-44-45000 Series	820 +	800 in N	6° B.T.D.C.
350 Eng. - (Auto. Trans.) 43-44000 With 2 BBL Carb.	N.A. +	600 in D	10° B.T.D.C.
350 Eng. - (Auto. Trans.) 43-44000 W/4 BBL & 45000 W/2 & 4 BBL	650 +	600 in D	4° B.T.D.C.
455 Eng. - (Man. Trans.)	720	700 in N	6° B.T.D.C.
455 Eng. - (Auto. Trans.)	650	600 in D	4° B.T.D.C.
455 Stage I - (Man. Trans.)	720	700 in N	10° B.T.D.C.
455 Stage I - (Auto. Trans.)	650	600 in D	10° B.T.D.C.

+ No Fast Idle Adjustment on 350 cu. in. 2 BBL

*C. E. C. Valve Adjustment (250 L-6)
Manual Transmission . . . . . 850 RPM
Automatic Transmission . . . . . 650 RPM
Throttle Control Solenoid Adjustment
All 350 and 455 cu. in. Engines w/Man. Trans. . . . . 1100 RPM

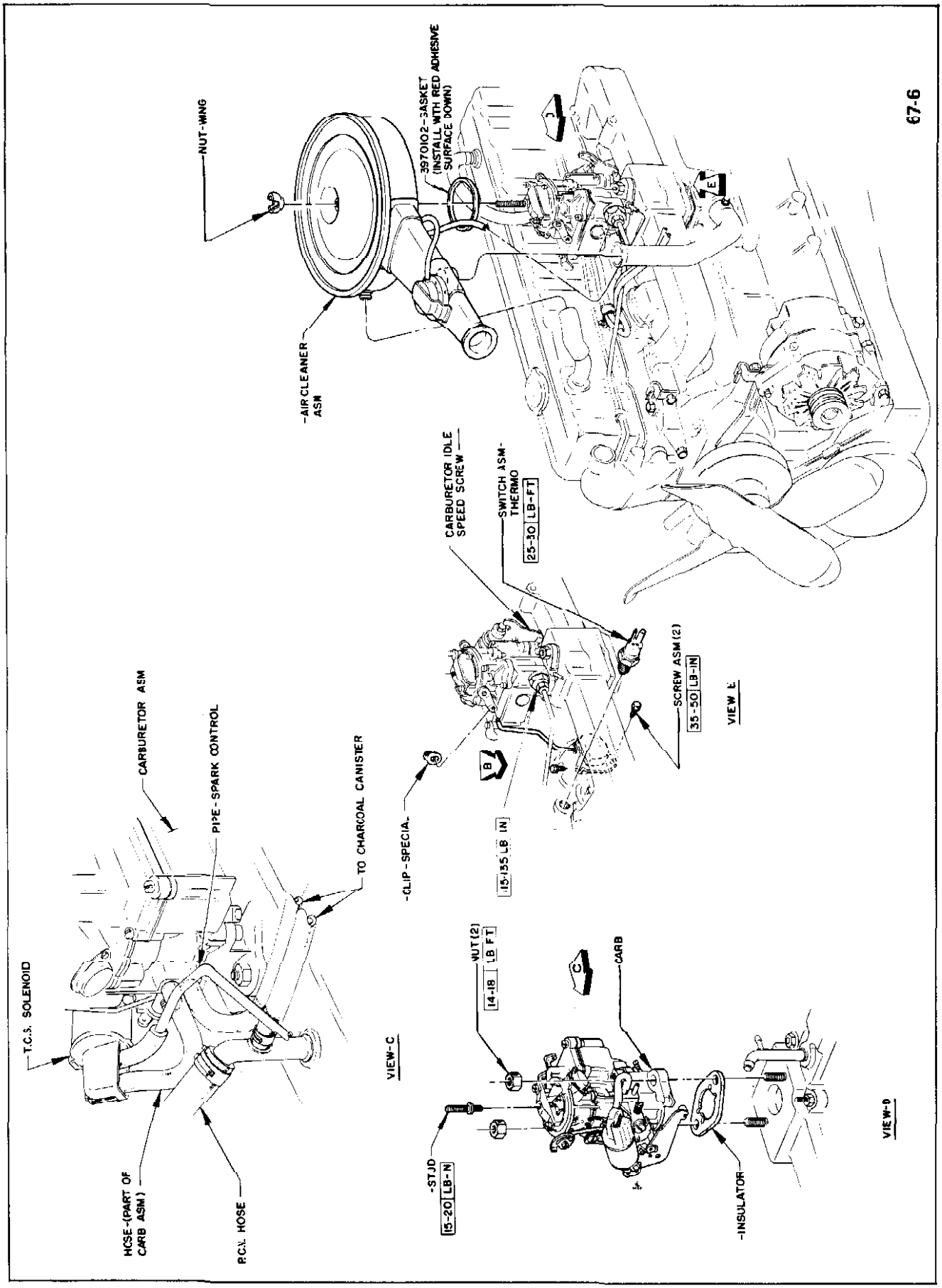


Figure 67-6 Heated Air System Installed - 250 Engine (L-6)

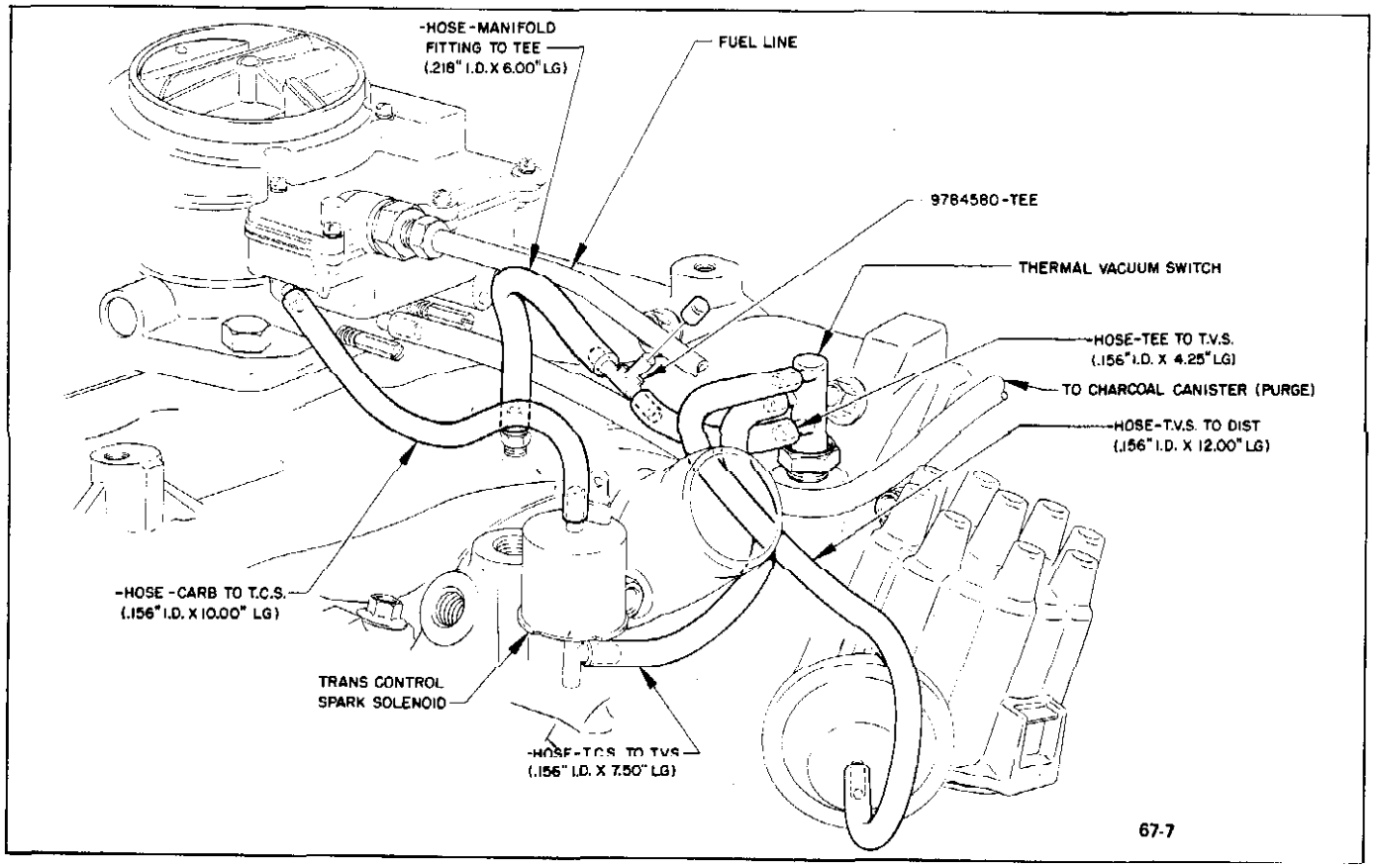


Figure 67-7 Vacuum Tube Routing - 350-2 Barrel 43-44000 With Heavy Duty Cooling

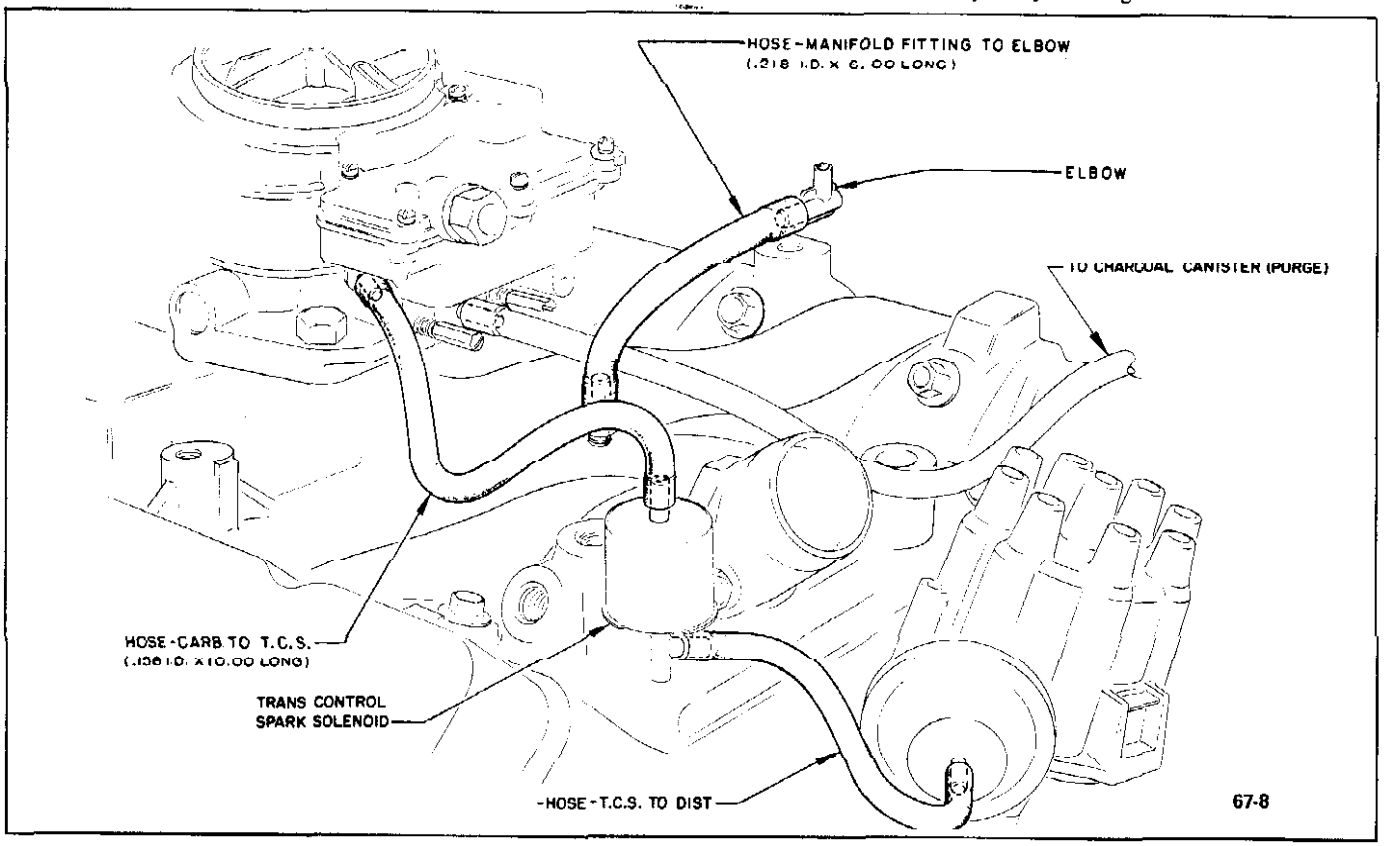


Figure 67-8 Vacuum Tube Routing - 350-2 Barrel 43-44000 Less Heavy Duty Cooling - 45000 Series Less A/C and/or Heavy Duty Cooling

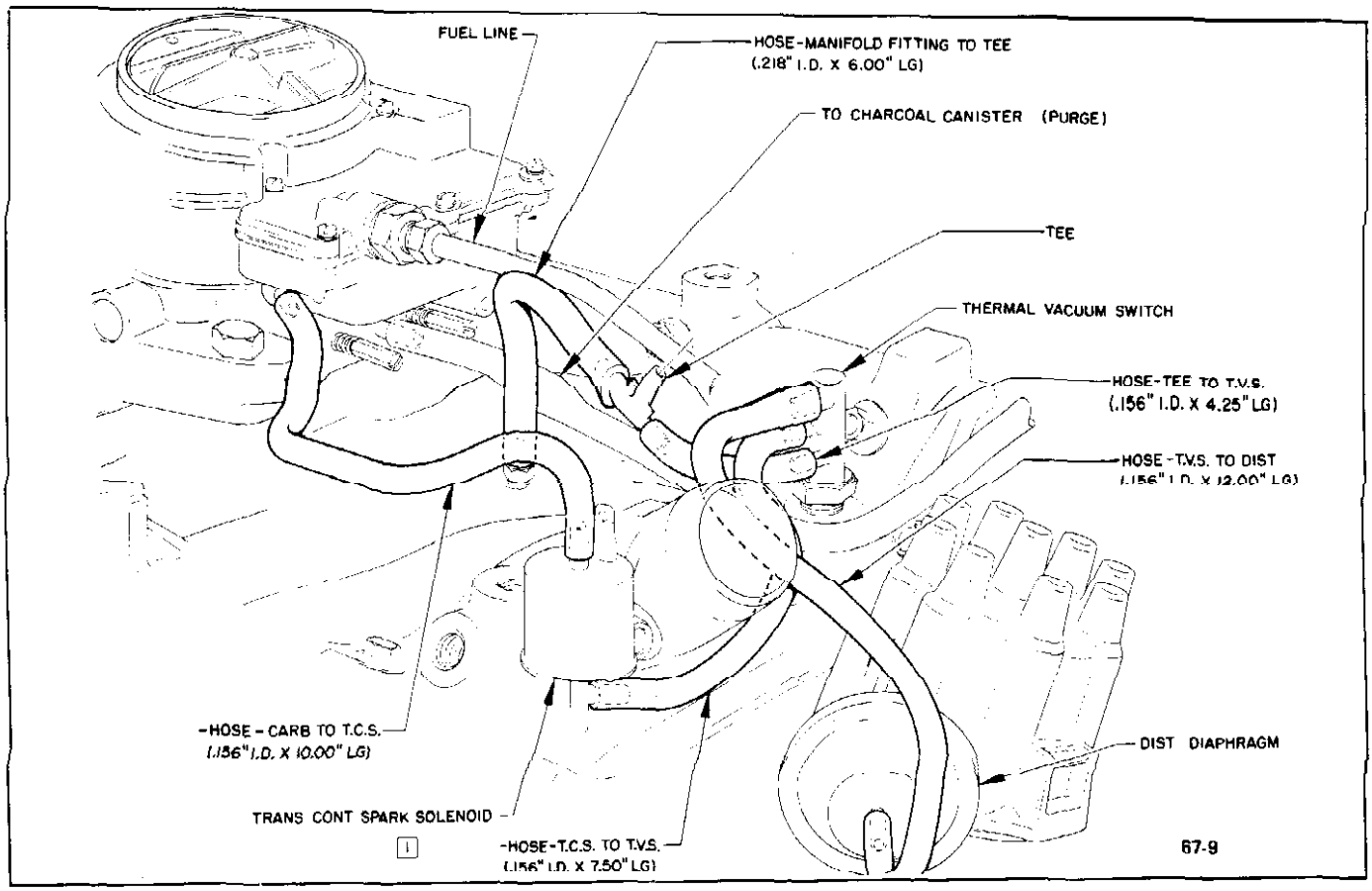


Figure 67-9 Vacuum Tube Routing - 350-2 Barrel 45000 With A/C and/or Heavy Duty Cooling

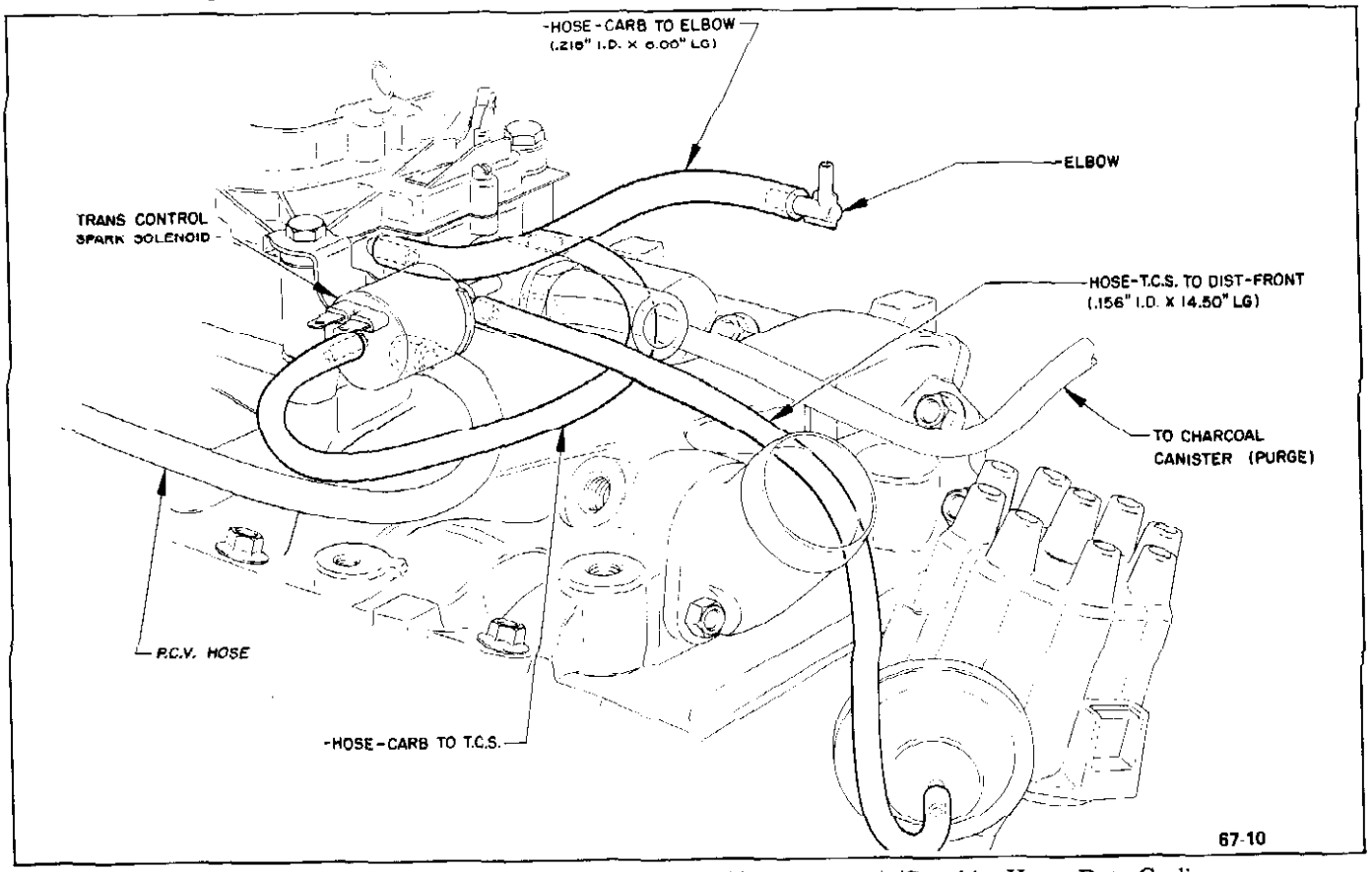


Figure 67-10 Vacuum Tube Routing - 350-4 Barrel 43-44-45000 Less A/C and/or Heavy Duty Cooling

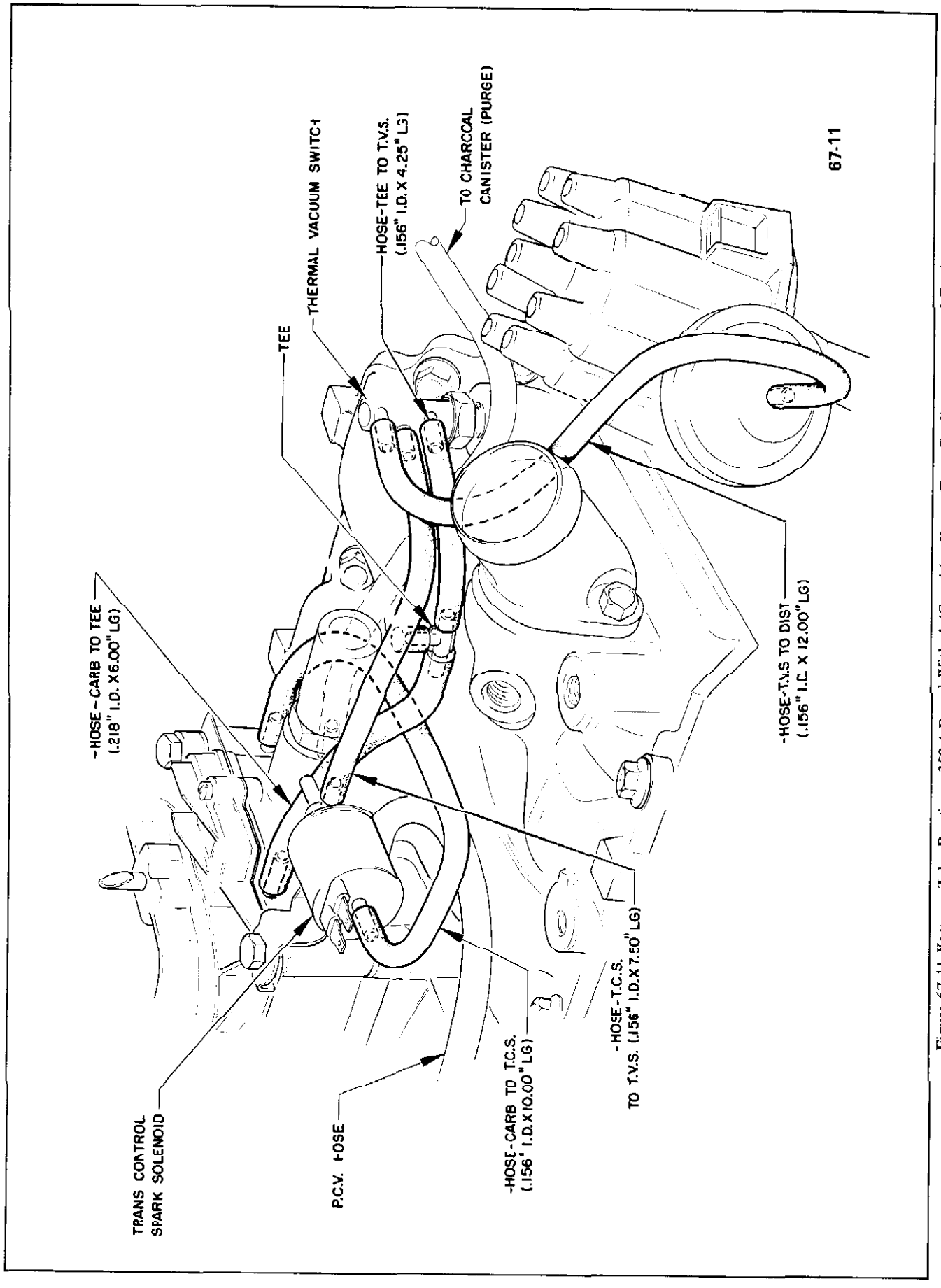


Figure 67-11 Vacuum Tube Routing - 350-4 Barrel With A/C and/or Heavy Duty Cooling and All 455 Engines

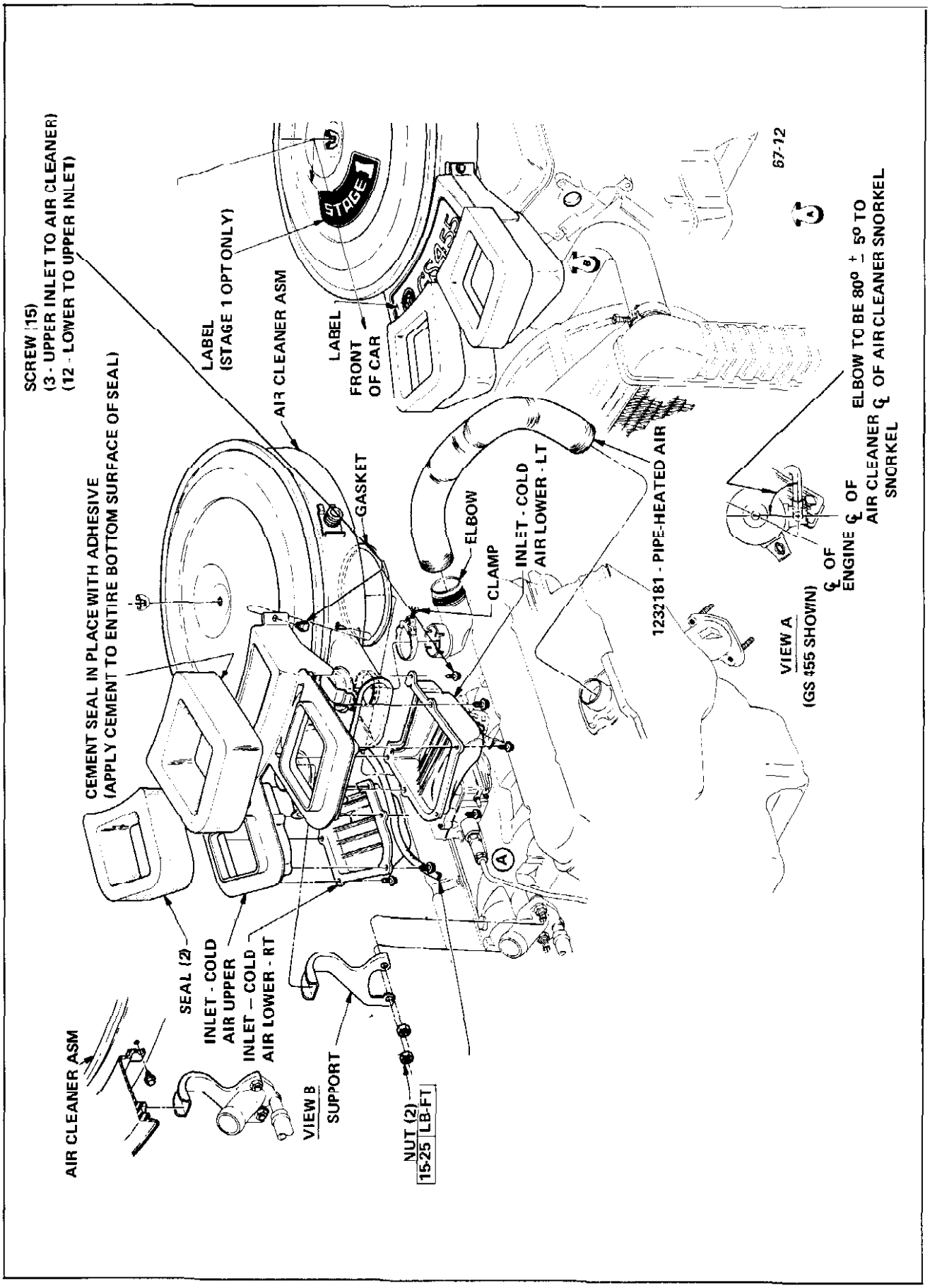


Figure 67-12 - Dual Snorkel Air Cleaner - G.S. 455

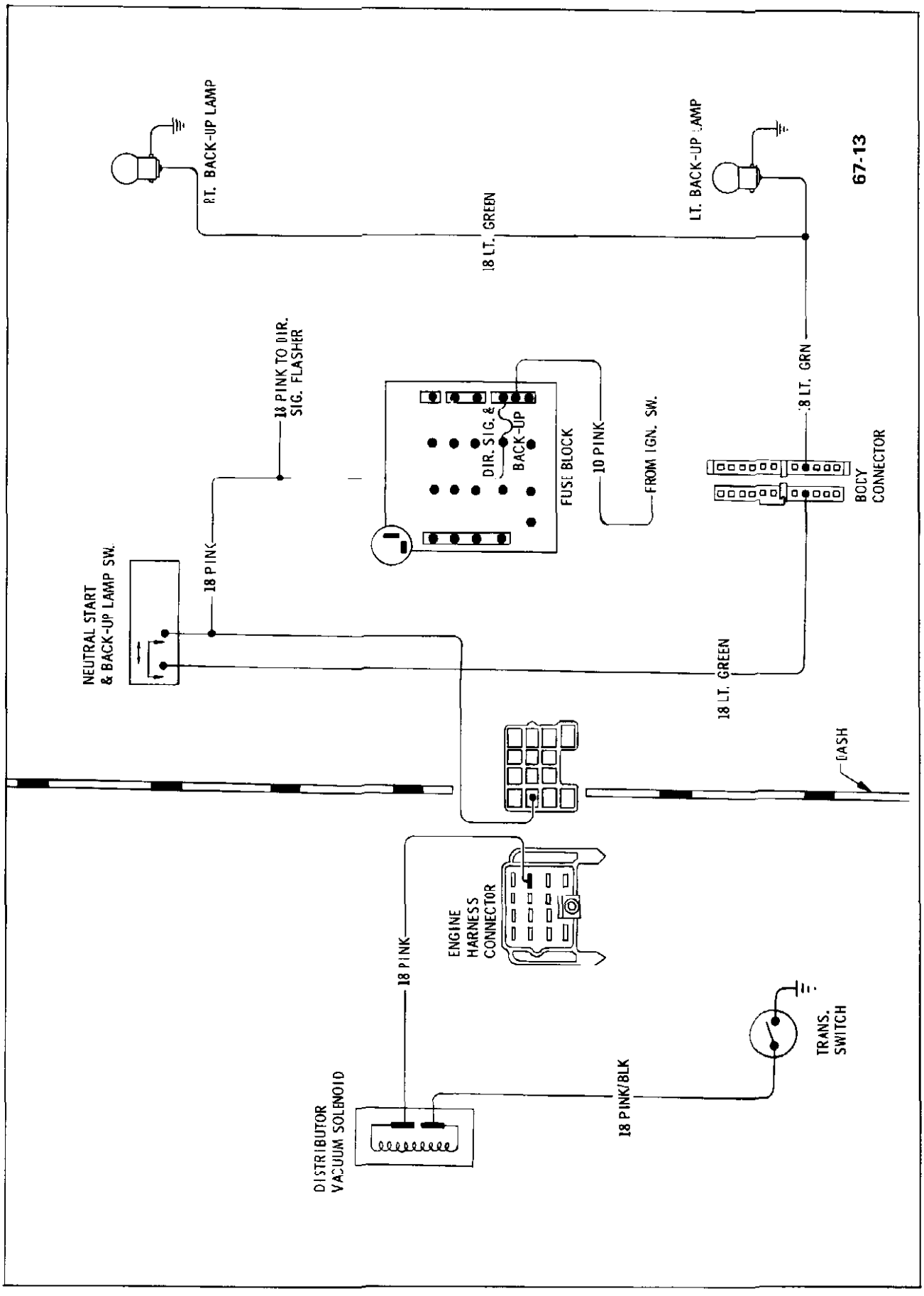


Figure 67-13 Back-Up Lamps and Transmission Controlled Spark Solenoid Wiring (Less L-6 Engine)

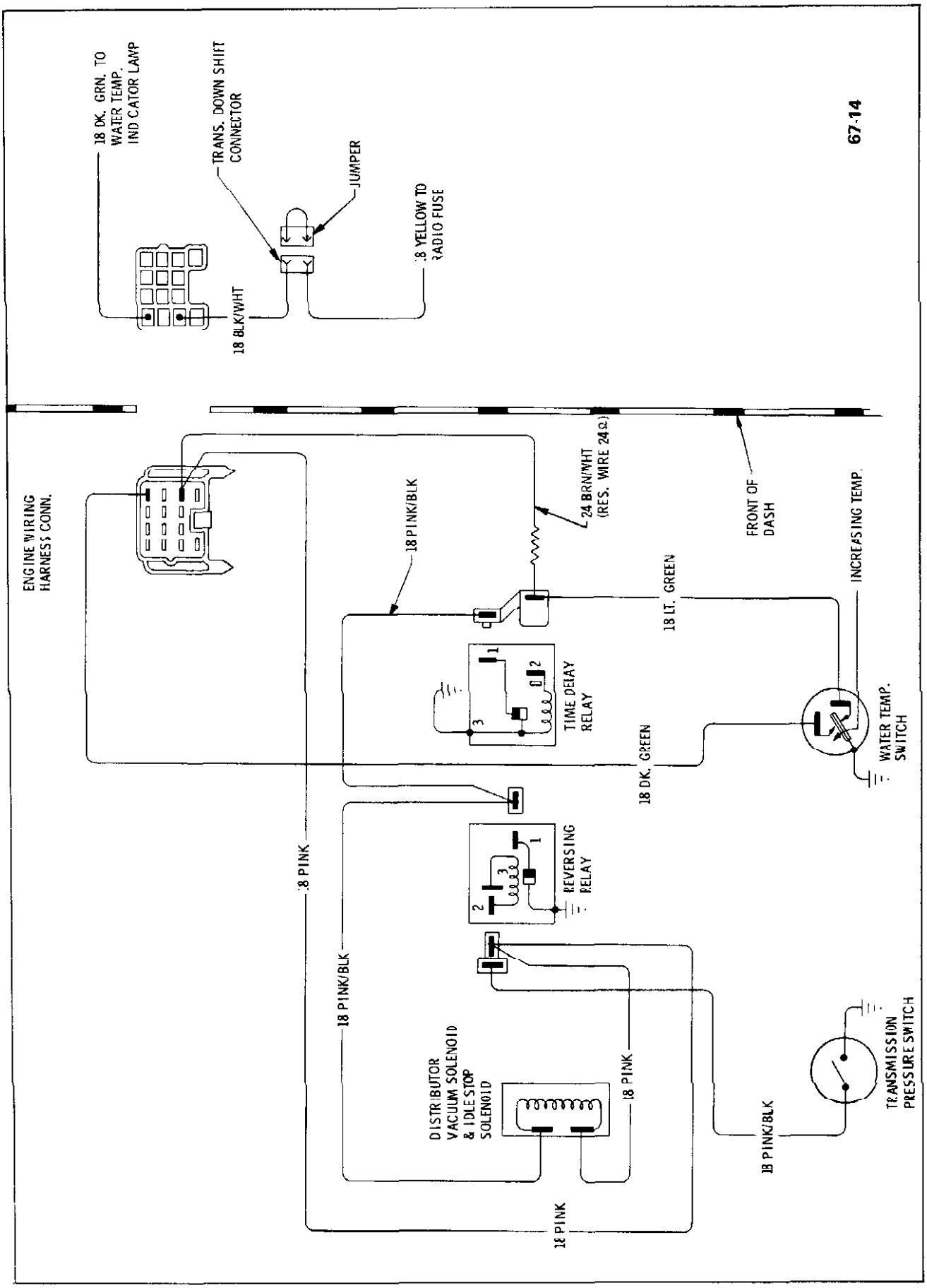


Figure 67-14 Transmission Controlled Spark and Idle Stop Solenoid (L-6 Engine)

GROUP 66

MAX-TRAC

SECTION	TITLE
A	Max-Trac

SECTION A

MAX-TRAC SYSTEM
45-46-48-49000 SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Max-Trac Trouble Diagnosis Chart	66-1
II	DESCRIPTION AND OPERATION:	
	General Description	66-2
	Operation of Max-Trac System.	66-3
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION:	
	Removal and Installation of Max-Trac Components	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION I
TROUBLE DIAGNOSIS
66-1 MAX-TRAC DIAGNOSIS

The following chart, showing "Conditions", "Possible Causes", and "Corrections" is offered as a diagnositic tool to aid in effecting rapid repairs in the event of a malfunctioning Max-Trac System. It is recommended that for each symptom, the possible causes be evaluated in the order shown on the attached chart.

CONDITION	POSSIBLE CAUSE	CORRECTION
A. System inoperative at all speeds. . .	1. On-Off switch set at "Off".	Set switch to "On".
	2. Brake lights dead.	Repair brake lights.
	3. No signal from transmission speed sensor (faulty harness or an open circuit in the sender).	Unplug 6 terminal connectors at Controller. Resistance between red and white wires at harness connector should be 1600 to 2400 ohms. If circuit is open, unplug connector at sensor and check resistance across sensor terminals. If open, replace sensor. If 1600 to 2400 ohms, replace the harness.
	4. No signal from front wheel speed sensor (a faulty harness or open circuit in sensor).	Unplug 6 terminal connectors at Controller. Resistance between light green and white wires in harness connector should be 1250 to 1750 ohms. If circuit is open, unplug connector at sensor and check resistance at sensor terminals. If open, replace sensor. If 1250 to 1750 ohms, replace the harness.
	5. Low signal from front wheel speed sensor (excessive gap between sensor and speed).	Check and adjust gap between sensor and speed disc at the sensor mounting. Felt spacer should touch the speed disc. If felt spacer is missing, set gap between end of sensor and speed disc at .05 inches.
	6. Controller faulty.	Replace the controller.
B. Engine will start but will not run until "on-off" switch is set at "Off".	1. No battery (+) electrical supply to controller.	Unplug 3 terminal connectors at controller. With ignition switch "ON", battery voltage should be available between the pink wire at the harness connection and ground. If not, repair or replace instrument panel harness.

CONDITION	POSSIBLE CAUSE	CORRECTION
	2. No ground connection to the controller.	Unplug 6 terminal connectors at controller. The black wire at the controller connector should be grounded. If not, connect controller ground wire to ground.
	3. No connection between controller output and ignition ballast resistor.	Unplug 3-terminal connector at controller. Resistance between pink/black wire at harness connector and positive terminal of coil should be 1.8 ohms. If open, repair or replace harness.
	4. Faulty controller.	Replace the controller.
C. System functions or engine stops during braking.	1. No B + from brake circuit.	Unplug 3-terminal connector at controller with brakes applied. Battery voltage should be available between white wire and ground. If not, repair or replace I.P. harness.
	2. Brake lights dead.	Repair car harness.
	3. No connection from controller to brake switch.	Unplug 3-terminal connector at controller. With the brakes applied, battery voltage should be available between white wire and ground. If not, repair or replace the harness.
	4. Faulty controller.	Replace the controller.
D. System functions properly at high speeds, but is inoperative at some speeds greater than 2 mph.	1. Low signal from the undriven wheel speed sensor (excessive gap between sensor and speed).	Check and adjust gap between sensor and speed disc at the sensor mounting. Felt spacer should touch the speed disc. If felt spacer is missing, set gap between end of sensor and speed disc at .05 inches.
	2. Faulty controller.	Replace the controller.
E. System functions below 2 mph.	1. Faulty controller.	Replace the controller.
F. System inoperative below 2 mph.	1. This is a normal characteristic of the MAX TRAC SYSTEM.	
G. System operates when not necessary.	1. Wrong speedo gear.	Replace with correct gear.

DIVISION II

DESCRIPTION AND OPERATION

66-2 DESCRIPTION

The purpose of the Max-Trac System is to aid the operator in maintaining vehicle directional stability and maneuverability during acceleration and/or cornering. The system accomplishes this purpose by automatically limiting engine power to a value required for maximum acceleration without excessive rear wheel slippage.

Basic system components include the transmission speed sensor, front wheel speed sensor and speed disc, electronic controller, "on-off" switch, and electrical harness. In addition, the system uses the existing ignition switch, brake switch, brake light, and ignition components.

1. Transmission Speed Sensor

This sensor is a mechanically driven electro magnetic device which produces an AC voltage with frequency proportional to the input shaft speed. The sensor is mounted in the transmission at the speedometer cable connection. Its function is to convert the rear wheel speed into an electrical signal at a frequency of 25 Hz/mph. This rear wheel speed signal is transmitted via the electrical harness to the electronic controller.

2. Front Wheel Speed Sensor and Speed Disc

This sensor is an electro-magnetic device which, in conjunction with the rotating speed disc, produces an AC voltage with frequency proportional to the speed of the disc. The speed disc is mounted on the hub of the left front wheel. The sensor is mounted at a predetermined distance from the disc and the gap is adjustable at the sensor mounting. The function of the sensor is to convert the front wheel speed into an electrical signal at a frequency of 6.25 Hz/mph.

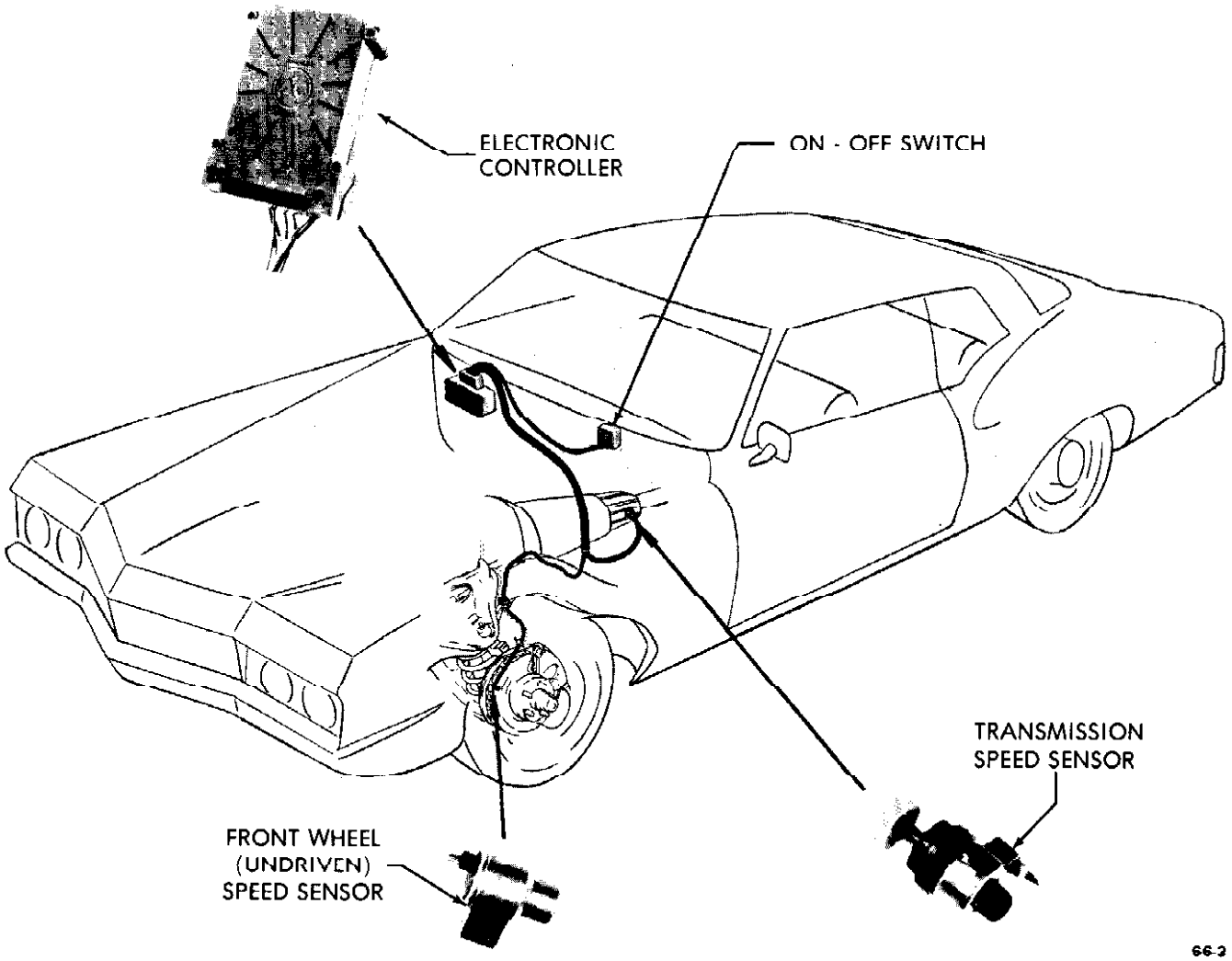


Figure 66-3 Max-Trac System

This front wheel speed signal is transmitted via the electrical harness to the electronic controller.

3. Electronic Controller

The controller is a solid state electronic computer and is mounted in the passenger compartment. It receives the driven and undriven wheel speed signals from the sensors. Its function is to compare the two-speed signals and, when the difference exceeds a predetermined amount, to generate a 30 Hz output signal with a duty cycle proportional to the speed difference. This output signal is transmitted via the electrical harness to the ignition system.

4. On-Off Switch

The "on-off" switch is located on the vehicle's instrument panel. It allows the operator to make the Max-Trac operation optional. It is recommended that the switch normally be in the "on" position. However, it is desirable to have the system inoperative under certain driving conditions, i.e., rocking the car in snow. Also, should a malfunction in the system occur, the vehicle may be driven with the switch "off" until repairs are made. In the "off" position, this switch shorts the controller output signal and prevents it from being transmitted to the ignition system.

5. Electrical Harness

The harness provides the electrical connection between the sensors, controller, power source, ignition switch, brake switch, and ignition coil.

NOTE: *Refer to Figure 66-6 for replacing an upper control arm on cars with the Max-Trac option. Two new holes in the control arm for the wiring harness clips must be drilled as shown.*

66-3 OPERATION

The components of the Max-Trac System are interconnected, as shown in Figure 66-7. The system is not operable whenever the ignition switch is "off" and/or the "on-off" switch is "off" and/or the brakes are applied. When the ignition switch is "on", the vehicle can be driven in the normal manner without Max-Trac operation, regardless of the amount of slippage.

The system is operable whenever the ignition switch is "on" and the "on-off" switch is "on" and the brakes are not applied. The vehicle can then be driven in the normal manner and no ignition interrupts will occur if the slippage does not exceed a predetermined value. However, under particular driving conditions, i.e., excessive acceleration or hard cornering, which reduces the normal load on the rear wheel, the amount of slippage can exceed the predetermined amount. The controller, continuously comparing the speed signals from the sensors, determines that the excessive slippage has occurred and generates an output signal which interrupts the ignition in the prescribed manner, resulting in a power reduction and a corresponding reduction in slippage.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

When the system fails to function properly and the trouble is isolated to a particular portion of the system, the bad part should be replaced by a new and functioning part.

DIVISION IV

REMOVAL AND INSTALLATION

66-4 REMOVAL AND INSTALLATION OF MAX-TRAC COMPONENTS

Electronic Controller

A. Removal

1. Remove glove box.

2. Remove controller and mounting bracket attaching screws from cowl.

3. Disconnect wiring harness connectors from controller pigtails and remove controller.

4. Remove controller to mounting bracket attaching screws.

B. Installation

1. Assemble controller and mounting bracket, making sure the controller ground wire is positioned between the controller and bracket and secured with the right attaching screw.

2. Attach the controller wire connectors to the harness connectors.

3. Attach controller and mounting bracket assembly to cowl.

4. Install glove box.

On-Off Switch

A. Removal

1. Remove instrument panel cover.

2. Disconnect "on-off" switch wiring connector.

3. Remove "on-off" switch escutcheon and "on-off" switch by removing two attaching screws.

B. Installation

1. Install "on-off" switch and escutcheon in instrument panel with two attaching screws.

2. Connect switch wiring connector to harness connector.

3. Install instrument panel cover.

Transmission Speed Sensor

A. Removal

1. Disconnect wire connector from speed sensor terminal.

2. Disconnect speedo cable from speed sensor.

3. Remove speed sensor retainer bolt, retainer, and shim sleeve.

4. Pull speed sensor and driven gear out of transmission and have a container ready to receive transmission oil that will drain out.

B. Installation

1. Assemble speedo driven gear onto speed sensor and install with new "O" ring seal into transmission.

2. Install speed sensor retainer, shim sleeve, and bolt.

3. Connect speedo cable to speed sensor.

4. Attach harness connector to speed sensor terminal.

5. Using transmission filling procedures, check transmission fluid level and add as necessary.

Front Wheel Sensor

A. Removal

1. Remove cable attaching screw from rotor shield.

2. Disconnect wire connector from front wheel sensor.

3. Remove wheel sensor retaining bolt and sensor.

B. Installation

1. Install wheel speed sensor with felt tip of sensor against the speed disc attached to the rotor. If the original wheel speed sensor is reinstalled, an air gap of .050" must exist between the tip of the sensor and the speed disc.

2. Connect wire connector to wheel speed sensor terminal, making sure the retaining clamp is in place.

3. Attach cable retaining clamp to rotor shield.

DIVISION V

OVERHAUL AND MAJOR SERVICE

If any of the major components of this system are found to be defective through diagnosis and checking, they are to be replaced, as they are not repairable.

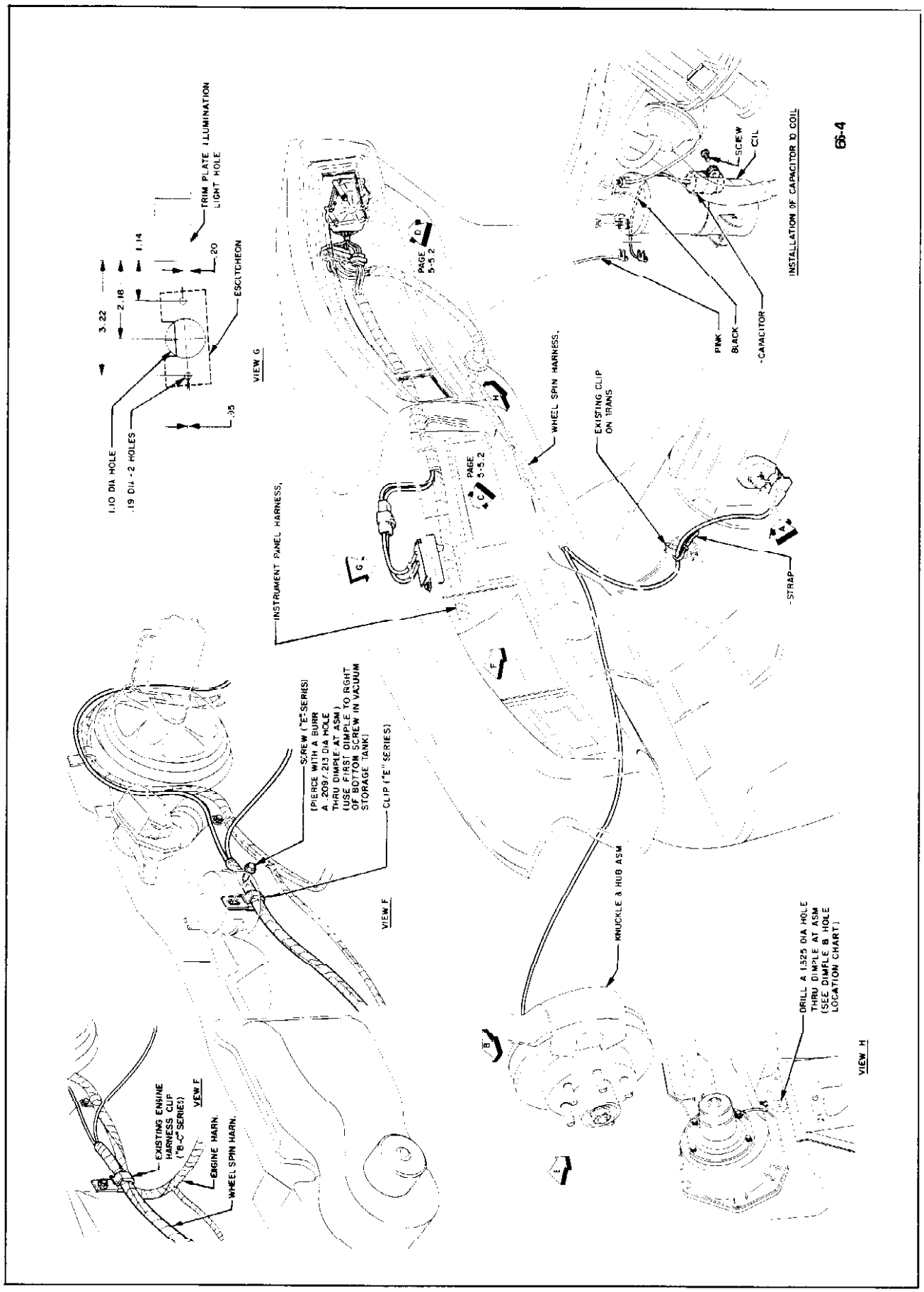


Figure 66-4 Max-Trac Wiring Harness Routing

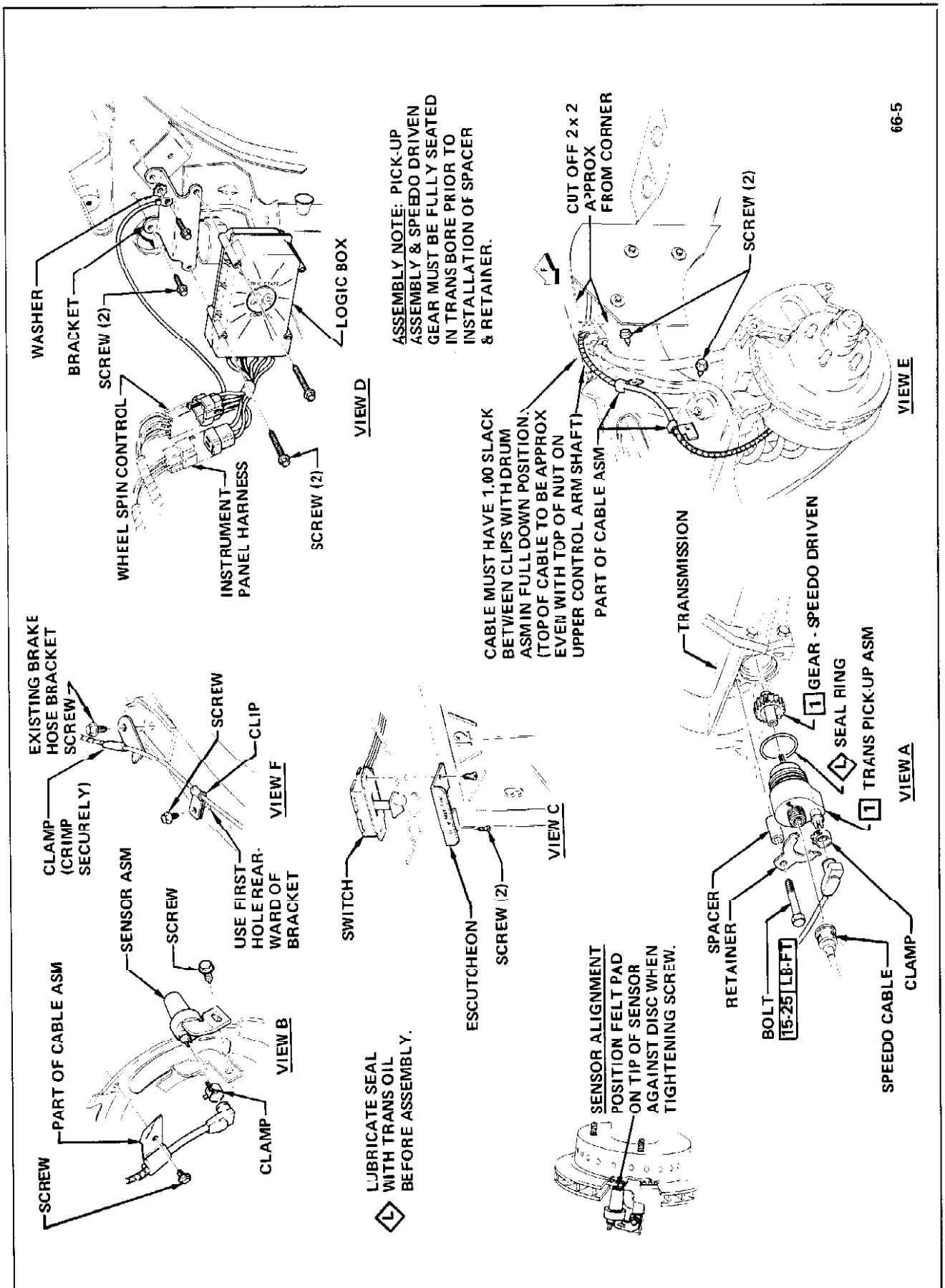


Figure 66-5 Max-Trac Component Installation

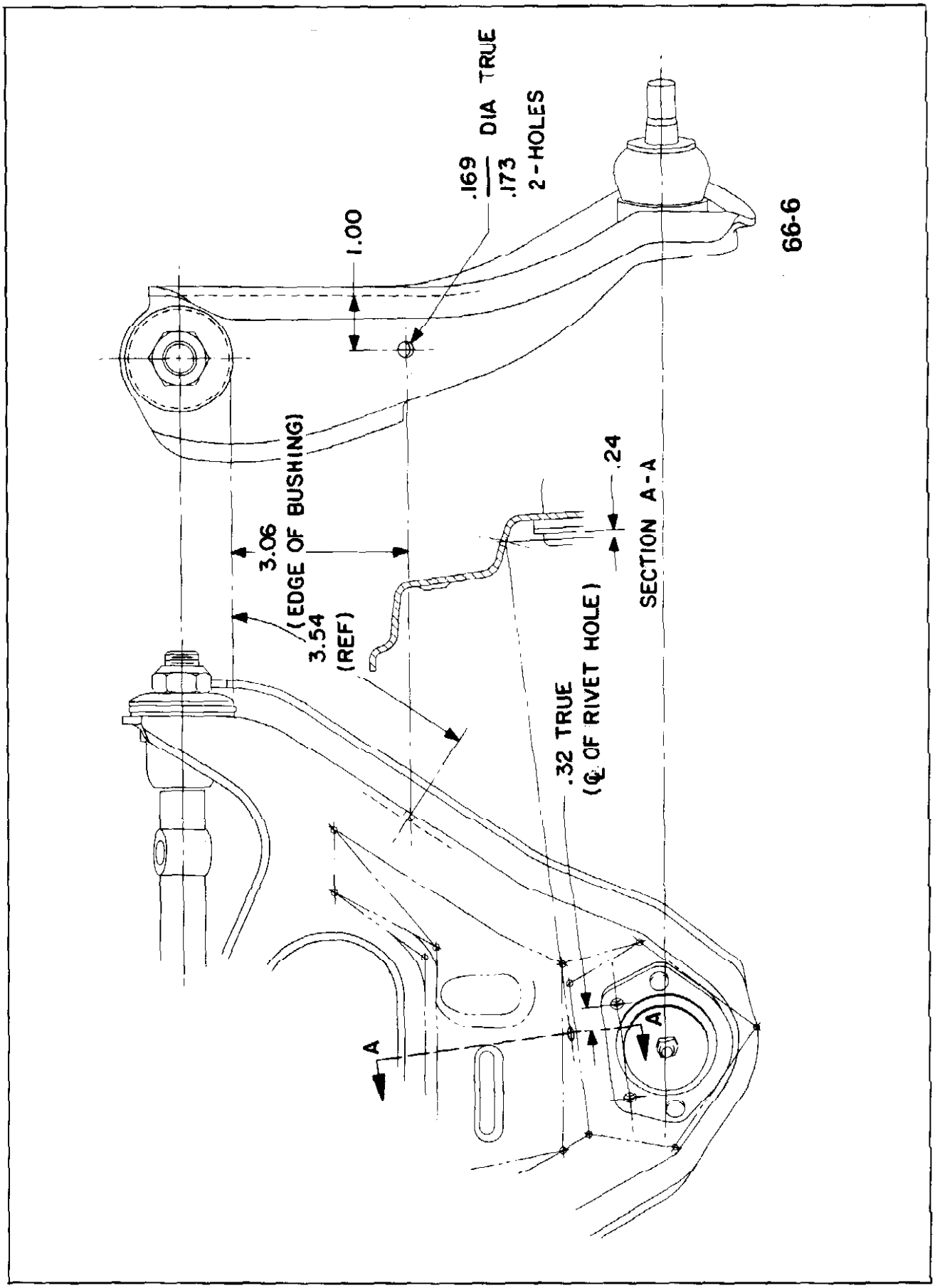


Figure 66-6 Upper Control Arm Drilling Information

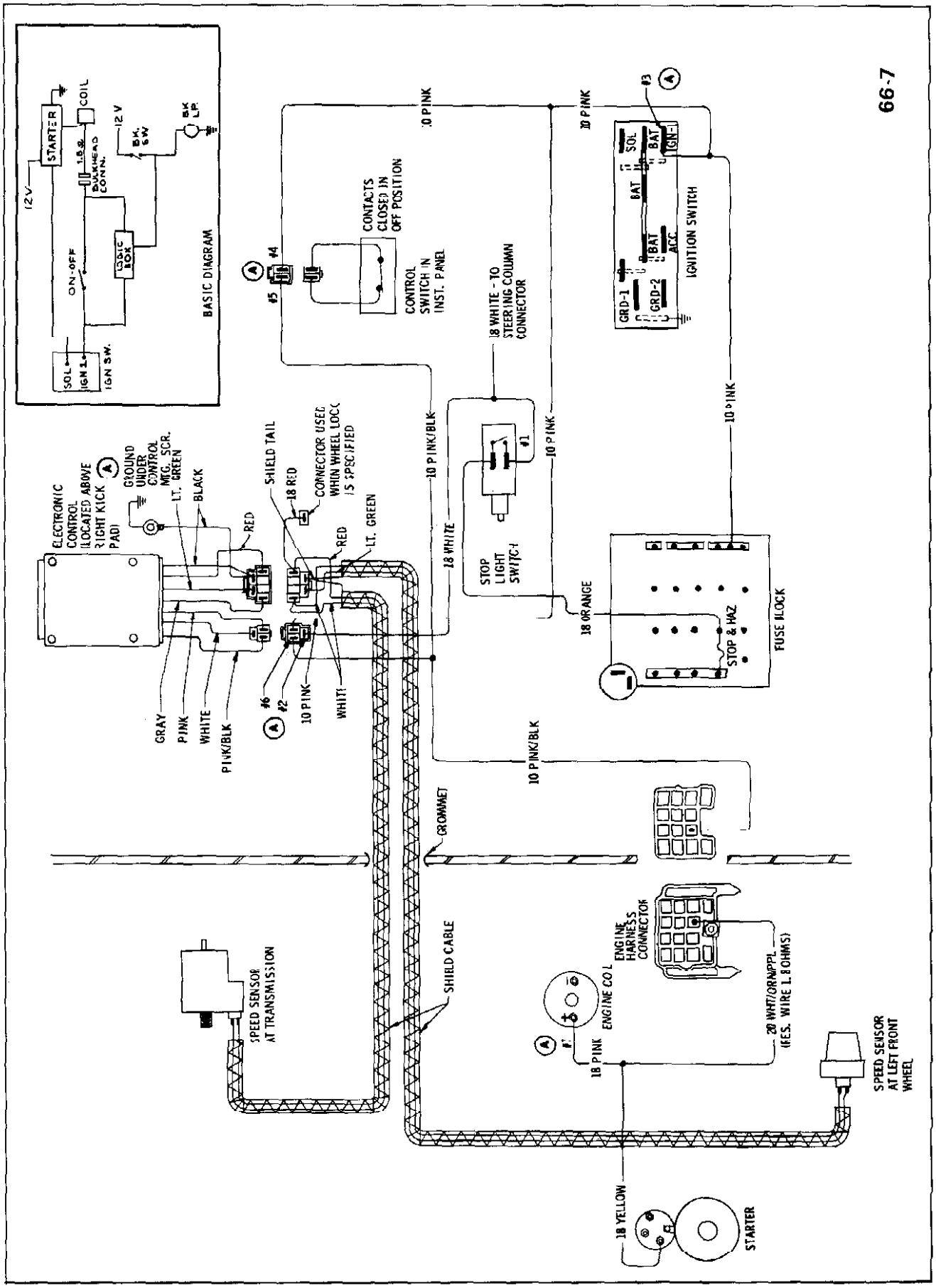


Figure 66-7 Max-Trac Wiring Diagram

GROUP 65

CRUISE MASTER

Section	Title
A	Cruise Master . . . . .

SECTION A

CRUISE MASTER
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Cruise Master Trouble Diagnosis	65-1
II	DESCRIPTION AND OPERATION:	
	Description and Operation of Cruise Master	65-2
III	ADJUSTMENTS AND MINOR SERVICE:	
	Cruise Master Adjustments and Service Procedures	65-3
IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION I

TROUBLE DIAGNOSIS

65-1 CRUISE MASTER TROUBLE DIAGNOSIS

a. Cruise Master Quick Check

Refer to Trouble Diagnosis Chart in rear of section.

b. Electrical Check Out

1. Check all fuses and connections.

2. Check adjustment of cruise brake release switch and brake release valve. See paragraph 65-3,b.

3. Check cruise control engagement switch as follows:

(a) Disconnect switch connector from wiring harness at lower part of steering column (refer to Figure 65- 10 for location of terminal numbers and for circuit function) as required perform the following test.

Test No. 1 - Connect ohmmeter between Terminal No. 1 (brown wire) and Terminal No. 2 (blue wire). Continuity shall be maintained until switch is depressed all the way in.

Test No. 2 - Connect ohmmeter between Terminal No. 1 (brown wire) and Terminal No. 3 (black). No continuity shall be shown; however, when the button is depressed to the detent, continuity shall be indicated. When the button is pressed all the way down, no continuity shall be shown.

Test No. 3 - Connect ohmmeter between Terminal No. 2 (blue wire) and Terminal No. 3 (black). Button released, no continuity; however, when the button is depressed partially and fully, continuity shall be shown.

4. With the cruise control engagement switch connector disconnected as in Step 3, above, disconnect battery and check wiring harness and circuitry as follows:

(a) Connect an ohmmeter at appropriate terminals and junction points as indicated in the schematic diagram of Figure 65-10 to measure the following resistances:

(1) Harness brown-white resistance wire, R1, which is approximately 40 ohms.

(2) Transducer solenoid coil resistance, which is 5.2 plus or minus 0.2 ohms.

Note that these resistance values are given for parts at normal room temperatures of 68-72 degrees F. Use care to disconnect transducer as needed to eliminate possible parallel paths to ground when making resistance checks. Except for the brown-white resistance wire, all harness wires shall indicate zero resistance (continuity) when checked per the schematic of Figure 65-10. If values of resistance other than those indicated above occur, take corrective action and repair or replace as required.

(b) Check cruise lamp bulb if indicated. Replace if required.

(c) Replace cruise control switch connector and reconnect battery.

DIVISION II

DESCRIPTION AND OPERATION

65-2 DESCRIPTION AND OPERATION OF CRUISE MASTER

a. Introduction

Cruise Master is a driver-operated cruise control system which maintains desired vehicle speed by regulating throttle position. It may be either factory or dealer installed.

b. Driver Operation

1. *Engagement* - The driver accelerates to the speed at which he desires to cruise and depresses and releases the cruise control engagement switch button located at the end of the directional signal lever. The cruise system immediately takes over speed control and, within engine limitation, maintains this speed regardless of changes in terrain.

The engagement switch button performs these functions:

(a) When depressed to the detent, it engages the system.

(b) When depressed fully and held there, it disengages the system.

(c) When released completely, it holds the system in engagement. (The lowest speed at which the system should be used is 40 MPH).

When the system is engaged the cruise lamp will light, indicating that the system is engaged.

2. *Disengagement* - The system automatically disengages whenever the brake is depressed or the ignition switch turned off.

The cruise lamp will go out, indicating that the system is no longer in use.

3. *Speed Adjustment* -

(a) Upward - Depress the accelerator pedal to the new desired speed. Then fully depress and slowly release the

cruise control engagement switch button. The system re-engages at the higher speed when the button is released through the detent.

(b) Downward - Disengage the system by depressing the engagement switch button fully and holding it there until the car has decelerated to the new desired speed; then release the button slowly.

4. *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 the previous cruise speed.

c. Cruise Master Units

(Figures 65-8 and 9 show the units in the installed position on the three series of vehicles.)

1. *The engagement switch,* which is located at the end of the directional signal lever, is used to control the system and for upward and downward speed adjustments.

2. *The speed transducer,* which is mounted in the speedometer cable line, is a combination speed sensing device and control unit. When engaged, it senses vehicle speed and positions the power unit to maintain the selected speed. It also provides a ground path for the cruise lamp.

3. *The power unit,* which is mounted at the rear of the engine, is connected by a ball chain to the throttle linkage. It opens or closes the throttle as dictated by the speed transducer.

4. *The cruise brake release switch,* which is mounted on the brake pedal bracket, disengages the system electrically when the brake pedal is depressed.

5. *The cruise brake release valve,* which is mounted on the brake pedal bracket, disengages the system pneumatically when the brake pedal is depressed.

6. *The cable and casing assemblies* drive the transducer and speedometer.

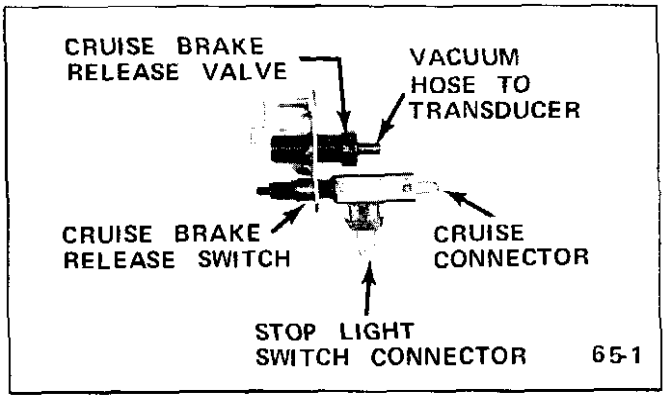


Figure 65-1 Cruise Brake Release Switch and Valve

d. Operation of Cruise Master

The transducer consists of two sub-assemblies: The magnet housing assembly and the solenoid and clutch housing assembly. The magnet housing assembly contains the drive adapter assembly, magnet and shaft assembly, and the speed disc field plate and spindle assembly. See Figures 65-2 and 65-3.

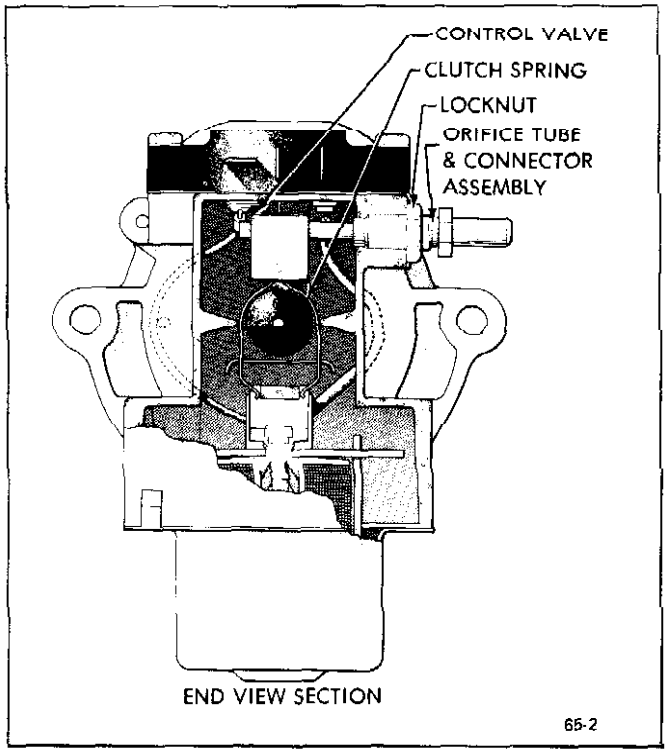


Figure 65-2 - Cruise Master Speed Transducer-End Section View

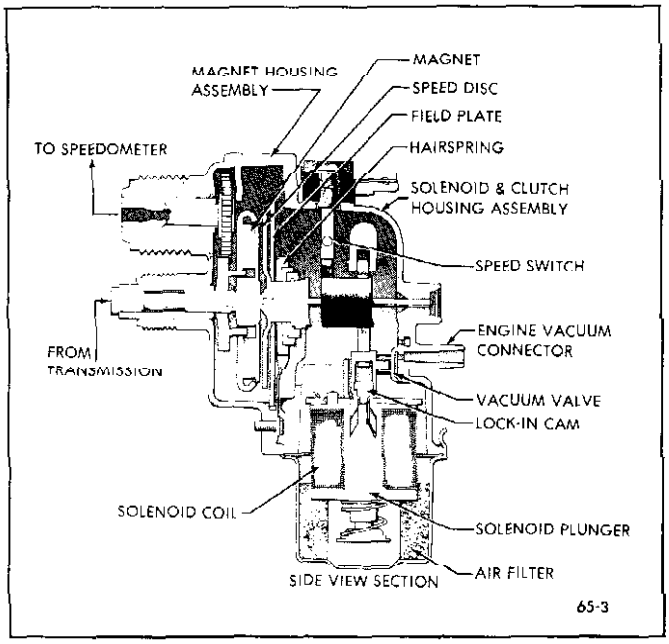


Figure 65-3 Cruise Master Speed Transducer - Side View Section

The solenoid and clutch housing contains the orifice tube and connector assembly, the control valve, the engagement clutch spring, the low speed switch, the engagement solenoid assembly, and the air filter assembly.

The power unit consists of a diaphragm and return spring. The vacuum level of the sealed chamber is controlled by the transducer. The ball chain connects directly to the throttle linkage to control carburetor throttle position. See Figure 65-4.

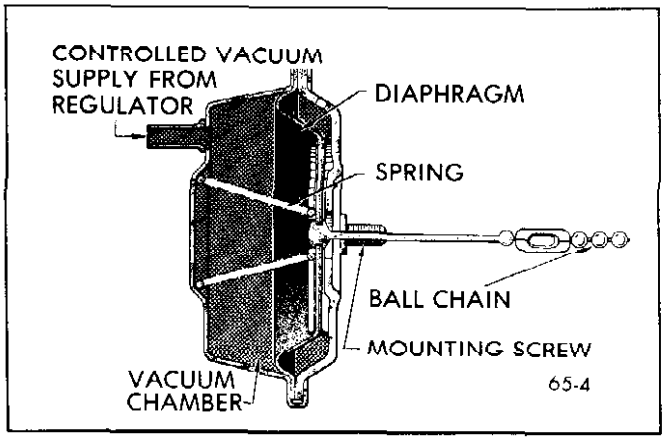


Figure 65-4 - Power Unit

The engage switch mounted in the turn signal lever is a single pole, three-position type. See Figure 65-10. This switch normally has car voltage applied to switch terminal No. 1, except when the ignition is off, or the cruise release switch is open, and in the rest position Terminals No. 1 and No. 2 are closed. This supplies car voltage through a 40 ohm resistor to the hold terminal on the transducer. This resistor limits the current flow to the transducer so that there is insufficient energy to engage the solenoid; yet, there is enough to hold the solenoid in the engaged position once it has been engaged. With the engage switch in the detent or middle position, Terminals No. 1, No. 2, and No. 3 are closed. This supplies car voltage to the transducer, through the engage terminal on the transducer, which will engage the transducer solenoid mechanism if the low speed switch is closed. The low speed switch is open below approximately 35 mph and closed above 35 mph. Once the cruise system is engaged, the turn signal engage switch can be released because there is sufficient current flow through the 40 ohm resistor to keep the system engaged. The third switch position is when it is completely depressed (past the detent position). At this time, voltage is removed from Terminals No. 2 and No. 3. This disengages the cruise system and is normally used as a trim-down operation to reduce cruise speed. When the switch is slowly released from this trim-down position, the switch goes through the engage position before returning to the normal rest position, there re-engages the system at that time.

Theoretically, the rubber clutch behaves as does a speedometer pointer - that is, it moves either clockwise or counterclockwise in proportion to the speed of the rotating magnet. Since the control valve is mechanically connected to the clutch spring, the valve moves either to the right or to the left, proportional to the speed of the rotating magnet. This motion of the control valve changes the size of the openings in the orifice tube. Also, energizing the transducer positions the vacuum valve within the transducer to connect engine vacuum directly to the power unit. See Figure 65-10.

The transducer is a device which has two primary functions. First, it is a vacuum switch which, when engaged by the driver, supplies vacuum to a "Tee" fitting. Second, it meters a small variable quantity of air to the "Tee" fitting where it blends with vacuum, thus providing the power unit with controlled vacuum which will maintain the selected speed. If the transducer begins to supply less bleed air (vehicle speed decreasing) the vacuum in the chamber increases and the diaphragm moves toward the vacuum port. If the transducer begins to supply more bleed air (vehicle speed increasing) the vacuum in the chamber drops and the diaphragm moves away from the vacuum port. In operation, at cruise speed, a proper balance of air and vacuum is blended at the "Tee" fitting and is imposed upon the power unit to maintain as "On Speed" cruise condition. See Figure 65-2 and 65-3.

If the car goes upgrade, there is a tendency for speed reduction. When speed reduction occurs (refer to Figure 65-5) the valve, wire and spring assembly moves in the direction which makes the window openings smaller, reducing the amount of atmospheric air to the power unit thereby increasing the vacuum level in the power unit. This draws in the diaphragm, thus increasing the carburetor throttle opening via the connecting ball chain and maintaining cruise speed.

Conversely, if the car goes down grade, there is a tendency to exceed the set speed. In this case, the valve moves in the direction which increases the size of the window openings. This admits a larger volume of air to the power unit, reducing its vacuum level and in turn allowing the diaphragm to move out and reduce the carburetor throttle

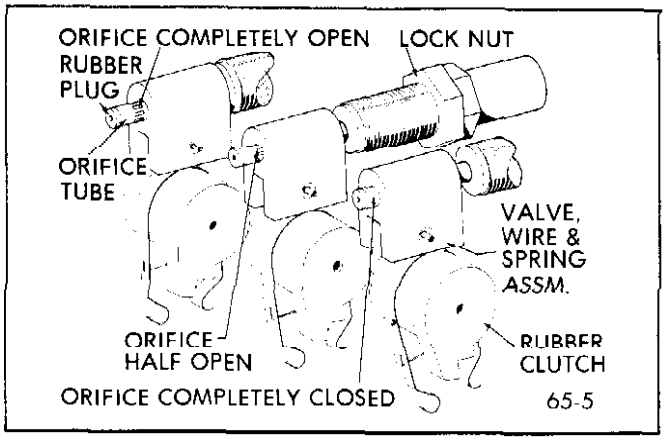


Figure 65-5 - Transducer Air Bleed Orifice Openings

opening, thereby maintaining cruise speed under normal terrain conditions.

Both overspeed and underspeed tendencies are immediately corrected since 3 MPH speed change will result in a change in the size of window openings capable of moving the power unit through its complete range. This means that the throttle will be moved through its complete cruise range with a speed change of 3 MPH. This results in accurate control of cruise speed.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

65-3 CRUISE MASTER ADJUSTMENTS AND SERVICE PROCEDURES

a. Power Unit Bead Chain Adjustment

1. Adjust engine hot idle speed and mixture, then shut off engine.

2. Check bead chain slack by unsnapping swivel from ball stud and holding chain taut at ball stud; center of swivel should extend 1/8 inch beyond center of ball stud. See Figure 65-8 or 9.

3. Adjust bead chain slack, if necessary, by sliding sleeve back on chain and removing loose rivet. Move swivel on ball chain until slack is correct, reinstall rivet and again slide sleeve over rivet.

b. Brake Release Switch and Valve Adjustment

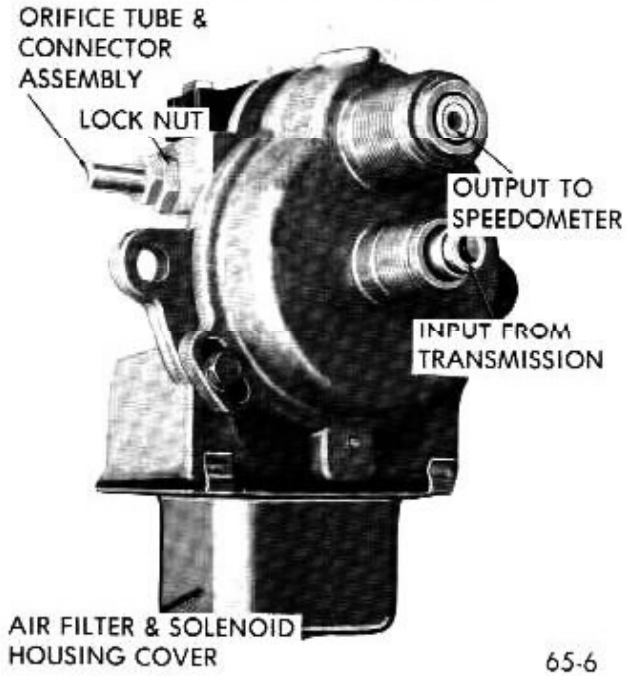


Figure 65-6 - Speed Transducer

With brake pedal fully depressed, push switch and valve forward until they stop against bracket or arm, pull pedal rearward with 15-20 lbs. force to properly adjust switch and valve.

c. Cruise Speed Adjustment

If the car cruises at a speed above or below the engagement speed, this error can be corrected with a simple adjustment of the orifice tube in the transducer. See Figure 65-6.

1. To check cruise speed error, engage Cruise Master at exactly 60 MPH.

2. If car cruises below engagement speed, screw orifice tube outward.

3. If car cruises above engagement speed, screw orifice tube inward.

NOTE: *Each 1/4 turn of the orifice tube will change cruise speed approximately one MPH. Snug-up lock nut after each adjustment before testing.*

d. Tranducer Air Filter Replacement

1. Replace air filter when it becomes contaminated. When making the replacement:

(a) Place polyurethane filter in bottom of solenoid and filter cover. Note rectangular shape of filter and cover. See Figure 65-7.

(b) Position the solenoid and filter cover and its rubber gasket to the solenoid housing casting and *secure with the cover retaining clips.* Use care to insure that a tight gasket seal is obtained.

e. Removal of Cruise Master Actuating Engagement Switch

NOTE: *Shift Lever must be in low*

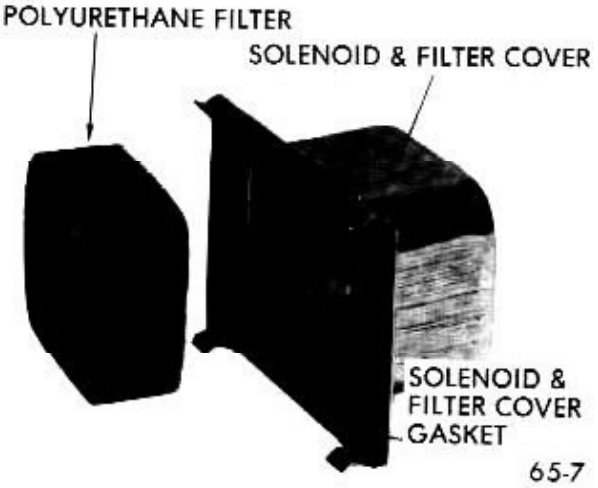


Figure 65-7 - Replacing Cruise Master Air Filter

1. Remove horn actuator and steering wheel.

2. Remove cover plate (three screws).

3. Remove turn signal lever screw and conduit from wire assembly.

4. Attach fine pliable wire through hole in connector. Tape end of wire and connector.

5. Pull switch and wire assembly through column. (Threading pliable wire).

6. Attach and tape wire to new connector.

7. Pull connector and wire through column.

8. Replace conduit on wire assembly.

9. Install turn signal lever screw.

10. Install cover plate.

11. Install steering wheel and horn actuator.

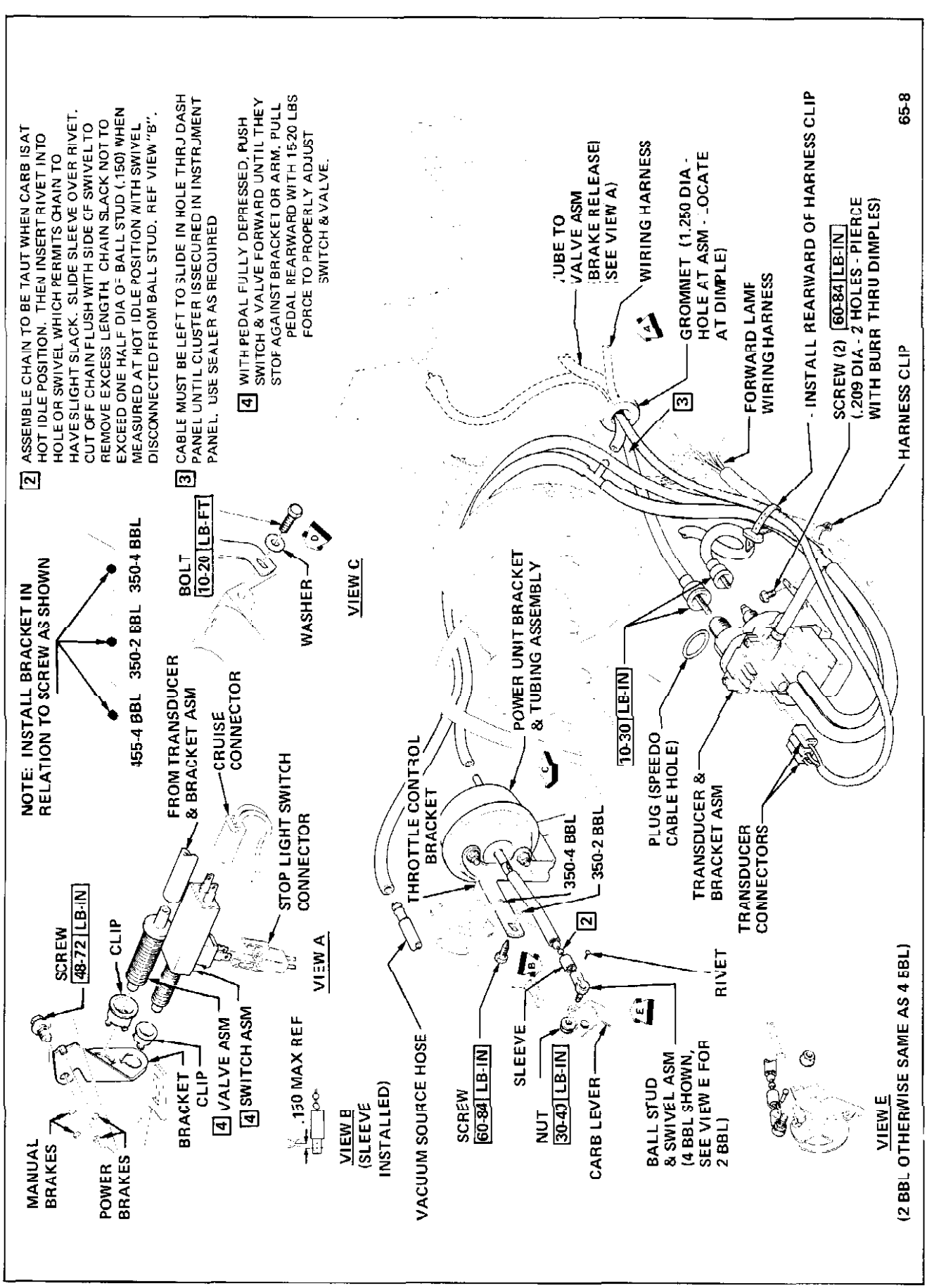


Figure 65-8 -Cruise Master Installation 43-44000 Series

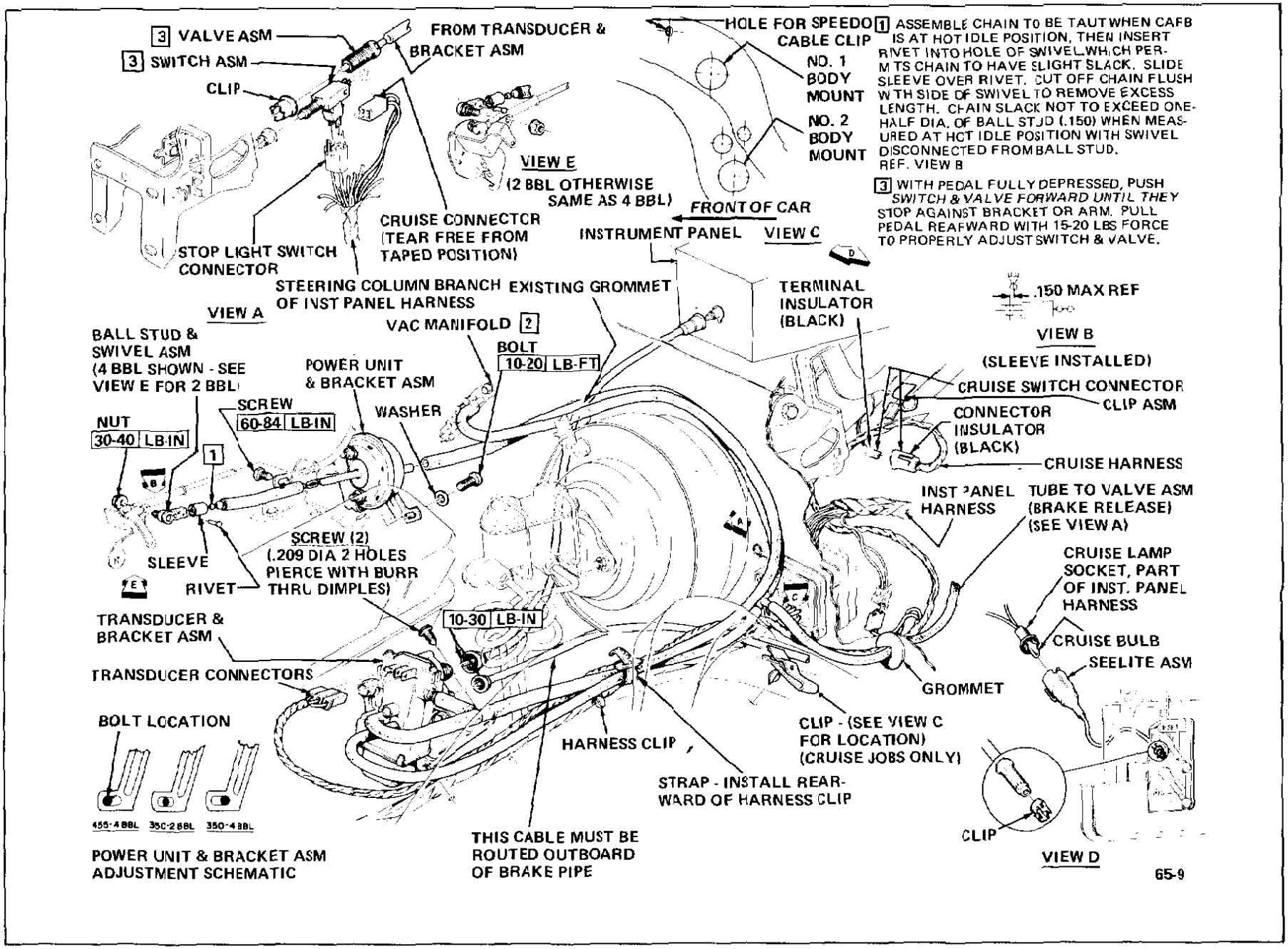


Figure 65-9 - Cruise Master Installation 45-46-48-49000 Series

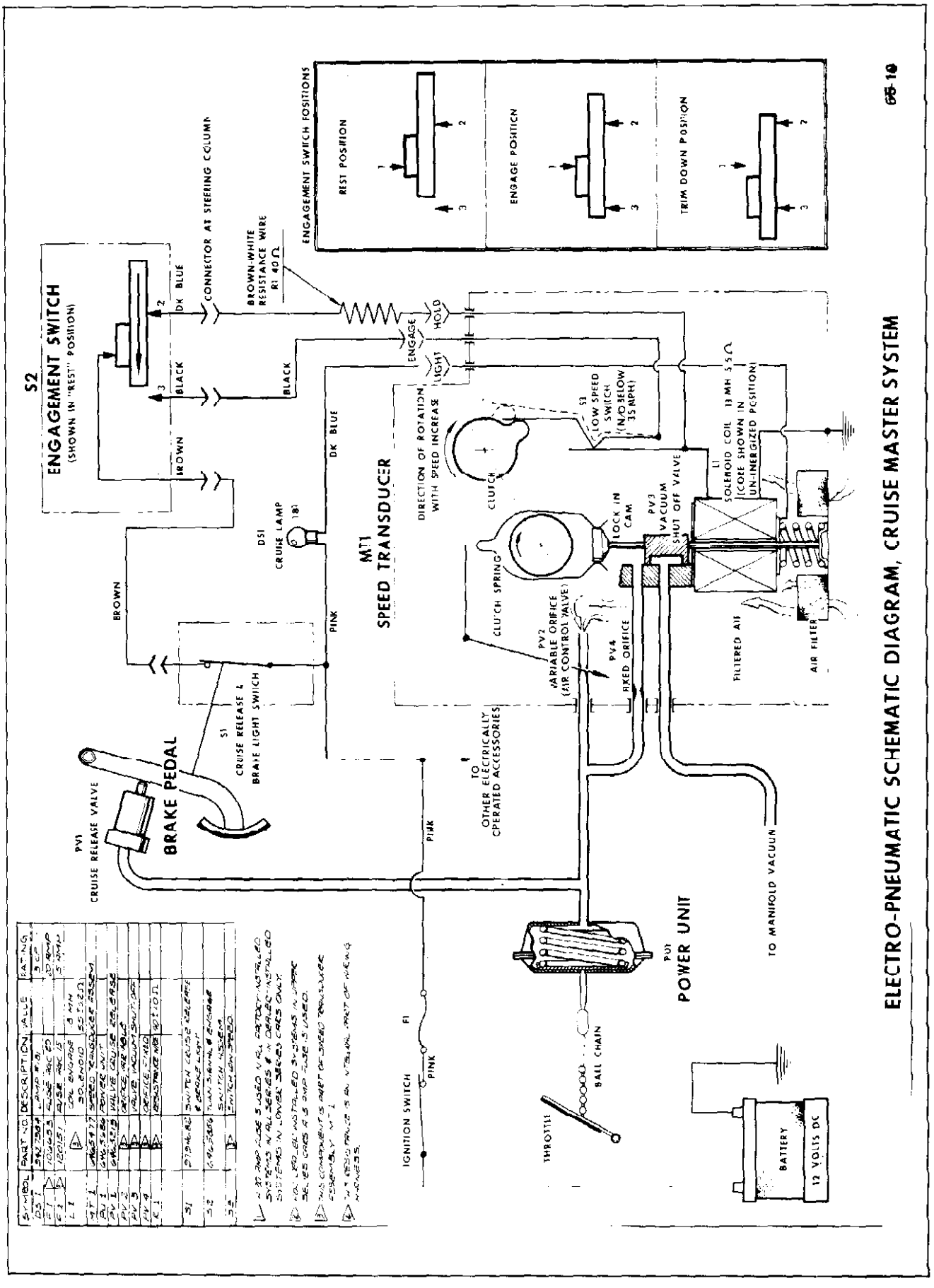


Figure 65-10 - Cruise Master Electric - Vacuum Schematic

Quick Checks

Check 1 - For inoperative systems.
Check 2 - For systems with erratic cruise performance.
Make all tests with transmission selector in "Park" and parking brake on except where indicated otherwise.
Reconnect any disconnected hoses and/or electrical connectors in proper manner at completion of test.
For detailed information, refer to the Service Manual.

FIGURE 1

CHECK 1

Preliminary inspection - Make physical inspection of all components. Check for electrical (see Figure 1) or mechanical disconnections, pinched, misrouted or disconnected vacuum hoses. If no defects are found, proceed as follows:

1. Unplug two terminal connector at Transducer.
2. Reconnect connector as per Figure 2.
3. Turn "on" ignition key, (do not start engine) and depress engage switch to detent and hold at detent.

Cruise Lamp Light
"Thunk" is heard

Cruise Lamp Does Not Light
No "Thunk" is heard

Cruise Lamp Does Not Light
"Thunk" is heard

1. Ground harness light connector with ignition on.
   a. If light comes on, replace transducer.
   b. If no light, check wiring harness, light bulb, and fibre optic.

a. Check fuse and brake switch (6b-3).
b. Check transducer circuit between "hold" blade terminal and ground. It should read 4-6 Ohms.
c. Check engagement switch (Par. 65-1).
d. Check black wire in harness assembly for battery voltage (12 volts) with engagement switch "on".

If all above conditions are o.k. and no "thunk" is heard in transducer, replace unit.

Normal Result
Transducer engages with audible "thunk"

Start Engine, car in "park". Engage switch on "on".

Engine Accelerates

Engine Does Not Accelerate

a. Check to see that approx. two threads of the orifice tube are showing.
b. Pinch orifice tube hose at transducer. If required, disconnect it at transducer and plug it with pencil.

Cruise Lamp Lights
Continue if all original symptons are not corrected.

Check brown/white stripe wire by either of the following methods:

1. For Ohmmeter check, refer to Par. 65-1.
2. With ignition "on", voltmeter must read battery voltage at the disconnected brown/white wire terminal at Transducer connector.

If 1 or 2 are OK, replace transducer.

Engine running, Engage switch "on".

Normal Result
Engine accelerates.

Engine Does Not Accelerate

a. Vacuum leak or restriction is indicated. Disconnect orifice tube hose at transducer and plug with a pencil. Start engine and hold engage switch on "on".
b. Disconnect large tube connected to the "tee" fitting at transducer and check for vacuum at transducer fitting.

- Figure 65-11 - Cruise Master Trouble Chart

No Vacuum
Remove engine manifold vacuum supply tube at transducer. Check for vacuum at tube

- **Vacuum** — Replace transducer
- **No Vacuum** — Check tube and vacuum fitting at engine.

Vacuum
a. Reinstall large tube at transducer.
b. Remove tube at power unit. Check for vacuum at end of tube.

- **vacuum** — Replace power unit.
- **No Vacuum**
  a. Check tubes and fittings back to transducer.
  b. Check brake release tube and valve.

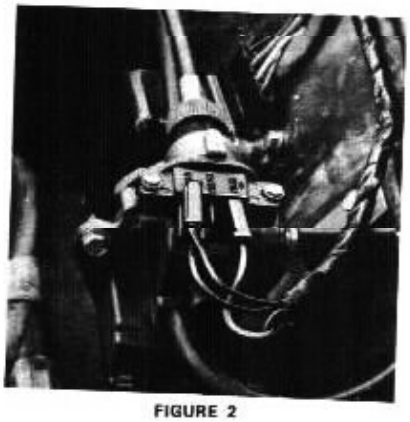


FIGURE 2

CHECK 2

1. Check bead chain -- at hot idle bead chain must be snug, but no so tight as to effect idle speed.
2. Check for pinched, plugged, damaged tubes or fittings and their routing.
3. Check cable routing -- they must not be kinked or have too sharp a turning radius. Check drive cables for kinks or bent tips. Ferrules must be snug.
4. Check for a binding throttle linkage condition.
5. Check adjustment of brake release switch (Par. 65-3).
6. If Steps 1 thru 5 do not solve the problem, replace Transducer.

Special note pertaining to engagement cruising speed zeroing.

(Preliminary check - approximately two threads should be shown on orifice tube adjacent to lock nut.) If the car cruises below engagement speed, screw the orifice tube outward. If the car cruises above the engagement speed, screw the orifice tube inward. Each 1/4 turn will change the car speed approximately one MPH. Engagement accuracy testing to be done at 60 MPH. Snug up lock nut after each adjustment.

65-20A1

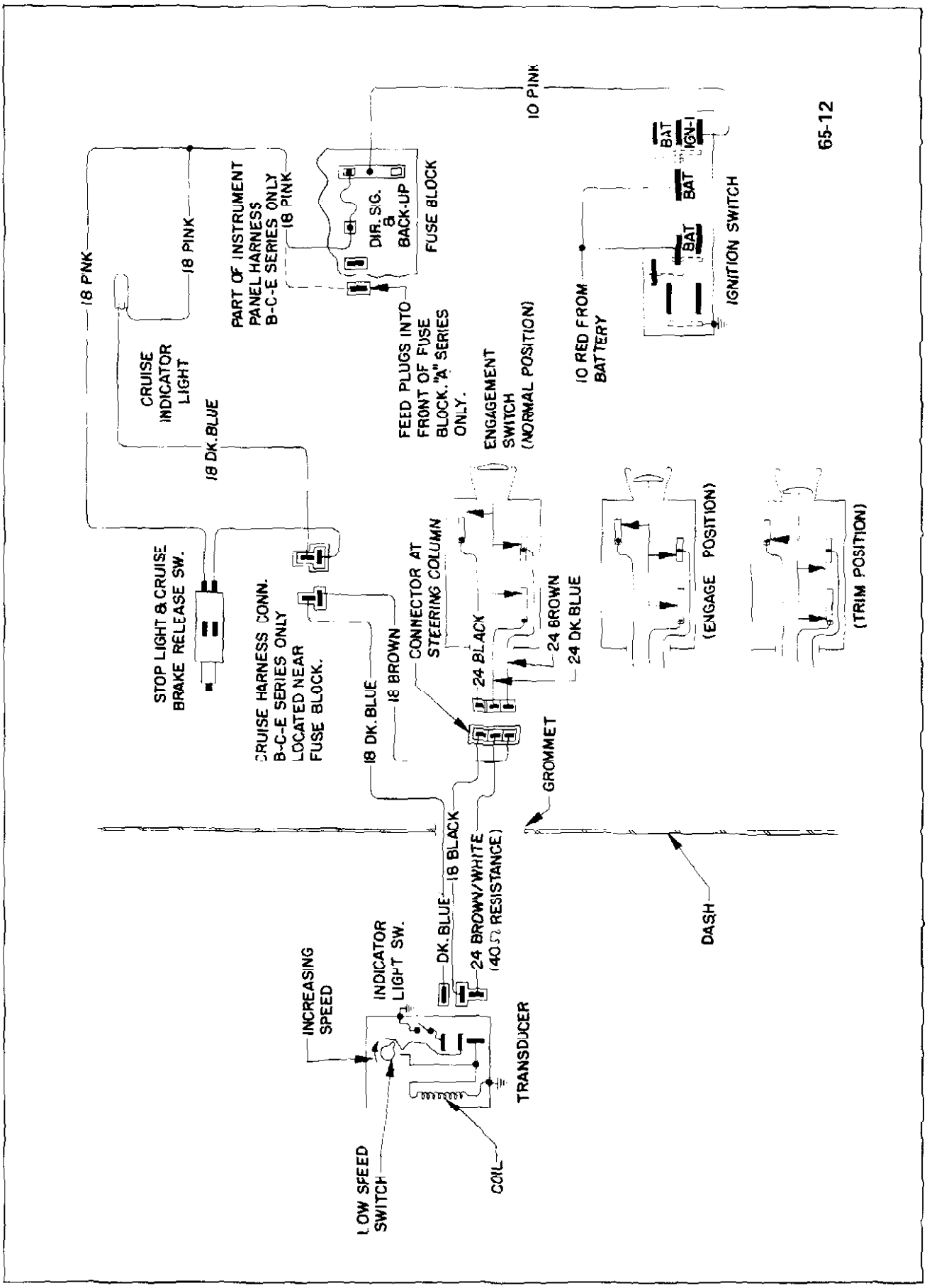


Figure 65-12 - Cruise Master Wiring Diagram

SECTION D

ROCHESTER 4MV CARBURETOR

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Model 4MV Diagnosis Chart	64-21
II	DESCRIPTION AND OPERATION:	
	Description and Operation of Rochester 4MV Carburetor	64-22
III	ADJUSTMENTS AND MINOR SERVICE:	
	External Adjustments of Rochester 4MV Carburetor	64-23
IV	REMOVAL AND INSTALLATION:	
	Rochester 4MV Carburetor Removal and Installation	64-24
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	Rochester 4MV Calibrations	64 27
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DIVISION I

TROUBLE DIAGNOSIS

64-21 MODEL 4MV DIAGNOSIS CHART

CONDITION										CHECK POINTS
HARD STARTING—COLD	HARD STARTING—HOT	POOR OPERATION—DURING WARM UP	STUMBLE ON ACCELERATION	STALLING	ROUGH IDLE	ECONOMY	FLOODING	SURGE	LACK OF HIGH SPEED PERFORMANCE	**IMPORTANT** Before attempting carburetor diagnosis as outlined below, all other engine systems must be operating properly. Diagnosis of these systems (electrical, exhaust, mechanical, and in the case of fuel economy, odometer accuracy) is found in this Service Manual. The numbers 1, 2 and 3, under the CONDITION are the order of probability. The * indicates additional possibilities.
1	1					1				Driver Habits (Instruct Owner on Proper Procedures)
*		3				*				Check Choke Rod Adjustment
*		*				*				Check Vacuum Break Adjustments
*		*				*				Check Choke Coil Rod Adjustment
*										Check Choke Unloader Adjustment
2		1				2				Check Choke Valve & Linkage, Binding, Stuck or Gummed Up
			3						3	Air Valve Binding, Stuck, Wrong Spring Tension Adjustment
			*						*	Secondary Metering Rods Bent, Wrong Part
			*							Secondary Baffle Plates Missing
			*						*	Secondary Main Discharge Nozzles Plugged or Dirty
			*			3		3	*	Power Piston Stuck or Binding
			*			*		*		No Vacuum to Power Piston
			*			*		*	*	Primary Metering Rods Altered, Bent or Wrong Part
*		*	1							Check Accelerator Pump System & Adjustment
				3						Throttle Return Check Misadjusted
									2	Fuel Pump Pressure or Vacuum Not to Specification
			*	1	1	*				Check Slow Idle Adjustment
		2		*		*				Check Fast Idle Adjustment
						*		1	*	Primary Metering Jets Loose or Wrong Part
	*		*		*	*	2	4	*	Float Sticking or Level Misadjusted
*	*				*	*	3	*		Float Bowl Porous, Cracked, Etc.
*					*				*	Throttle Body to Float Bowl Screws Loose
	2	*		*		*	1	2		Needle Leaking
				*	2					Idle Passages Plugged or Dirty
				*	*	*				Crankcase Vent Valve Plugged
								*	*	Fuel Filter in Gas Tank Plugged
							*	*	1	Fuel Filter in Carburetor Plugged or Dirty, By Passing Fuel
						5				Air Cleaner Element Plugged
								*	4	Hole in Fuel Pump Suction Line or Kinked Hose
*	*	*	*	2	*					Secondary Throttle Valves Sticking Open
									*	Check for Full Throttle Position at Carburetor
*		*	2							Accelerator Pump Inoperative
									*	Fuel Tank Vent Plugged

64-29

Figure 64-29 - Model 4MV Trouble Diagnosis Chart

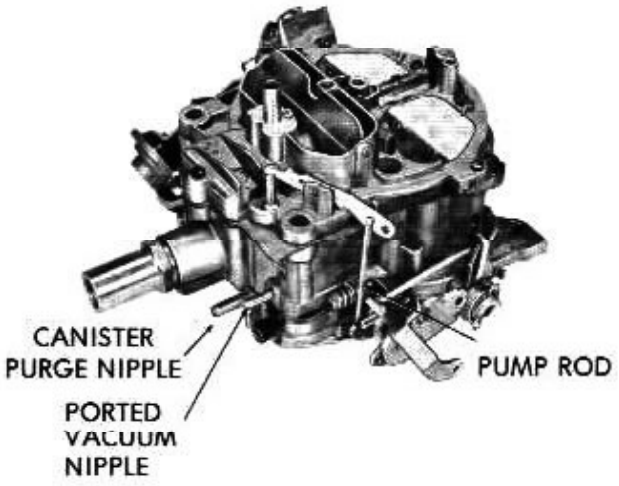


Figure 64-30 Rochester Quadrajet Carburetor

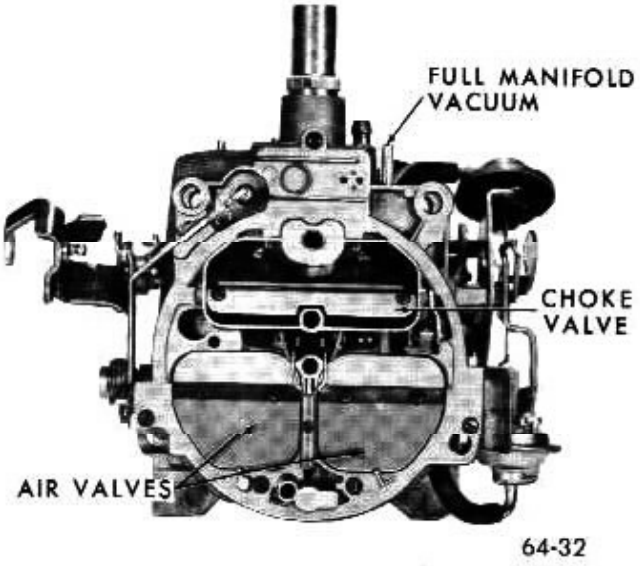


Figure 64-32 Quadrajet Carburetor - Top View

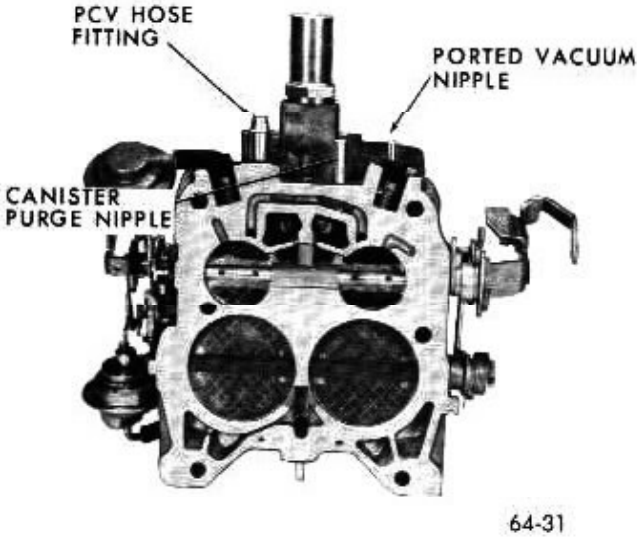


Figure 64-31 Quadrajet Carburetor - Bottom View

DIVISION II

DESCRIPTION AND OPERATION

64-22 DESCRIPTION AND OPERATION OF ROCHESTER QUADRAJET CARBURETOR

a. General Description

The Quadrajet carburetor has two stages in operation. The primary side has small bores with triple venturi equipped with plain tube nozzles. The triple venturi, plus the smaller primary bores, give excellent 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 vacuum piston.

The secondary side has two very large bores which have ample air capacity to meet engine horsepower requirements. See Figure 64-31.

Using the air valve principle, fuel is metered in direct proportion to the air passing through the secondary bores. See Figure 64-32.

The small 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. The float valve has a synthetic tip which gives added insurance against flooding problems caused by dirt.

A 2 inch pleated paper fuel filter is mounted in the fuel inlet casting and is easily removed for inspection and/or replacement.

The 1971 model carburetors have a dual vacuum break system for improved cold driveaway during choke operation. The secondary throttle valve lockout mechanism will be used on all models for 1971. Operation will be explained under "Choke System".

All external carburetor vents have been removed to prevent raw fuel vapors from being vented externally into the atmosphere. The carburetor is vented internally as in previous years to insure adequate fuel balance between the float chamber and air passing through the carburetor venturi.

Plastic limiter caps will be installed over the idle mixture needles so that idle mixture adjustment on the engine will be restricted to a partial turn of the mixture screw. The idle mixture will be set at the factory and the plastic limiter caps installed. During cleaning or overhaul, it may be necessary to remove the mixture screws or replace due to damage or dirt in the idle mixture passages. New limiter caps will be provided in the carburetor overhaul kits.

The 1971 model cars will have completely closed fuel tank venting. The vent from the fuel tank will lead into a vapor collection canister. The carburetor will be equipped with a purge tube which will be connected to the vapor canister to remove any fuel vapors stored there.

A tube located between the two idle mixture needles leads into a cavity which has a constant bleed purge located below the throttle valves and a variable bleed purge located above the throttle valves.

Operation of the purge system will be described under "Idle System".

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.

b. Operation of Float System

The float system consists of a fuel chamber in the float bowl, single pontoon float, float hinge pin, and retainer combination, float needle valve and seat, and a float valve pull clip. A plastic filler block is located in the top of the float chamber over the float valve to prevent fuel slosh into this area.

The float system operates in the following manner: Fuel from the engine fuel pump enters the carburetor fuel inlet passage. It passes through the filter element, fuel inlet valve and on into the float chamber. As the incoming fuel fills the float bowl to the prescribed level, the float pontoon rises and forces the fuel inlet valve closed, shutting off fuel flow. As fuel is used from the float bowl the float drops, which opens the float needle valve, allowing more fuel to again fill the bowl. This cycle continues, maintaining a constant fuel level in the float bowl.

A float needle pull clip, fastened to the float needle valve, hooks over the edge of the float arm at the center as shown

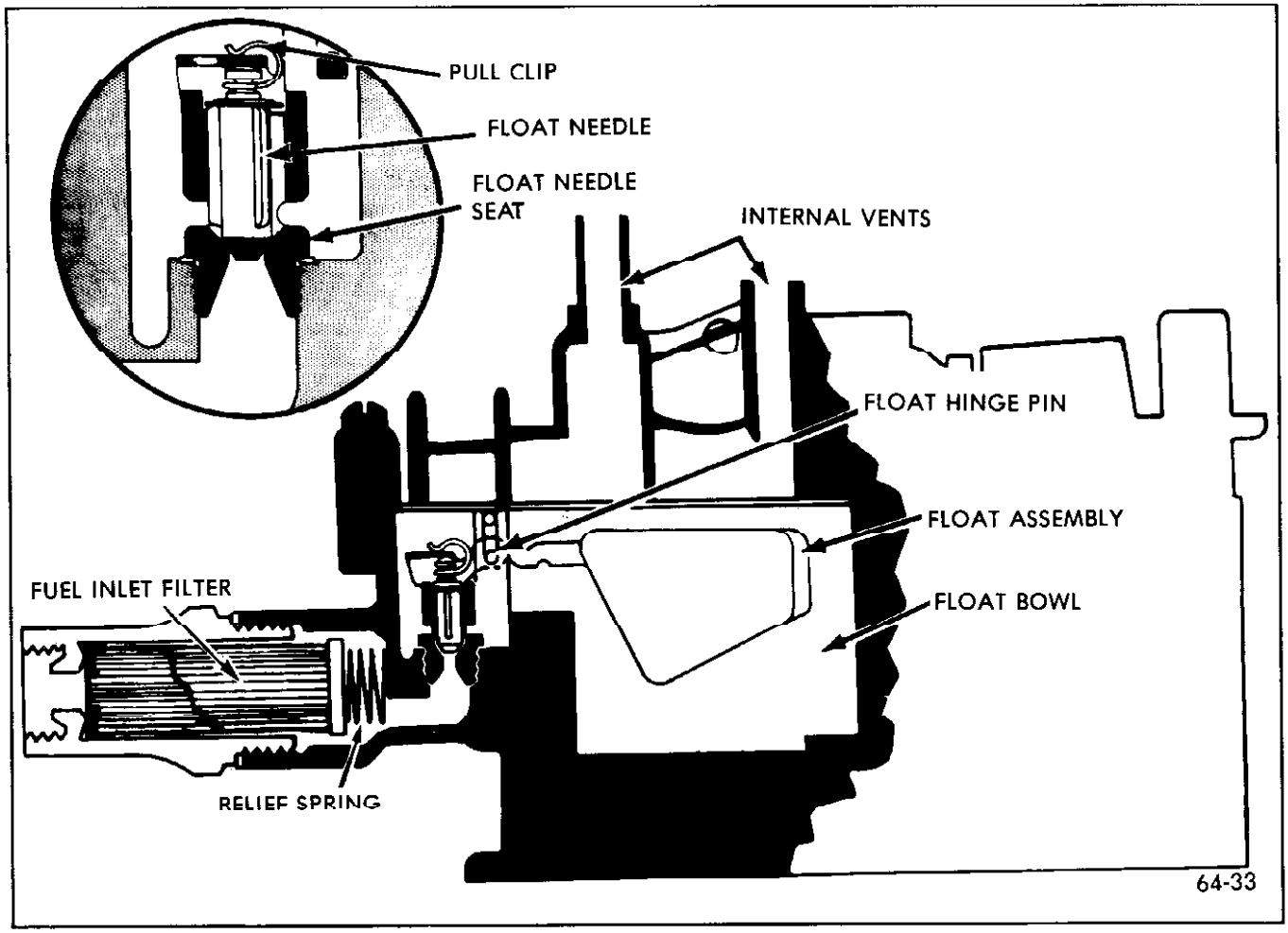


Figure 64-33 Float System

in Figure 64-33. Its purpose is to assist in lifting the float valve off its seat whenever fuel level in the float bowl is low.

The carburetor float chamber is internally vented through two vent tubes located in the air horn. The internal vent tubes lead from beneath the air cleaner to the float bowl chamber. Their purpose is to balance air pressure acting on the fuel in the bowl with air flow through the carburetor bores. In this way, balanced air/fuel ratios can be maintained throughout all carburetor ranges of operation. The internal vent tubes also allow the escape of fuel vapors which may form in the float chamber during hot engine operation. This prevents fuel vaporization from causing excessive pressure build up in the float bowl, which can result in excessive fuel spillage into the carburetor bores.

c. Operation of Idle System

The Quadrajet carburetor has an idle system on the primary side of the carburetor only. Each primary bore has a separate and independent idle system consisting of an idle tube, idle passages, idle air bleeds, an idle channel restriction, an idle mixture adjustment needle, and an idle discharge hole. See Figure 64-34.

The idle system operates as follows:

Fuel is forced from the float bowl down through the primary metering jets into the main fuel well. It passes from the main fuel well into the idle passage 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 mixes finally with air passing around the slightly open throttle valves. The idle needle hole size is fixed to limit richness in the idle range.

The carburetor models used on the larger engines for 1971 have a fixed idle air by-pass system. This consists of air channels which lead from the top of each carburetor bore in the air horn to a point below each primary throttle valve. At normal idle, extra air passes through these channels supplementing the air passing by the slightly opened throttle valves. The purpose of the idle air by-pass system is to allow reduction in the amount of air going past the throttle valves so that they can be nearly closed at idle. This reduces the amount of air flowing through the carubretor venturi to prevent the main fuel nozzles from feeding during idle operation. The venturi system is very sensitive to air flow and on these applications where larger amounts of idle air are needed to maintain idle speed, the fixed idle air by- pass system is used.

As mentioned under "General Description", a vapor canister purge system is used to remove fuel vapors from the collection canister. A tube located between the two idle mixture needles leads into a common chamber in the throttle body. From this common chamber, a single bleed leads to the throttle bore area below the throttle valves. This is called the constant bleed purge. The constant bleed purge operates during idle operation of the engine. This provides a constant purge of the canister at all times when the engine is running.

d. 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. 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. See Figure 64-34.

Along with the constant bleed purge for the vapor collection canister, a variable bleed purge is used. The variable bleed port is located in each bore adjacent to the off-idle discharge ports. The variable purge operates during the off-idle range and also during part throttle and wide open throttle operation. This provides a larger purge capacity for the vapor collection canister and prevents over rich mixtures being added to the carburetor metering at any time.

NOTE: *As described under "General Description", idle mixture needle limiters are used which restrict the amount of idle mixture adjustment. The limiter caps should be left in place and not removed unless it is necessary for overhaul or cleaning purposes.*

e. Operation of Main Metering System

The main metering system supplies fuel through the primary bores from off-idle to wide open throttle operation.

loads, the high engine manifold vacuum holds the main metering rods down in the main metering jets against spring tension. Fuel flow is then metered between the largest section of the metering rods and the main metering jets. See Figure 64-35.

Fuel flows from the float bowl through the main metering jets into the main fuel well and is mixed with air from the

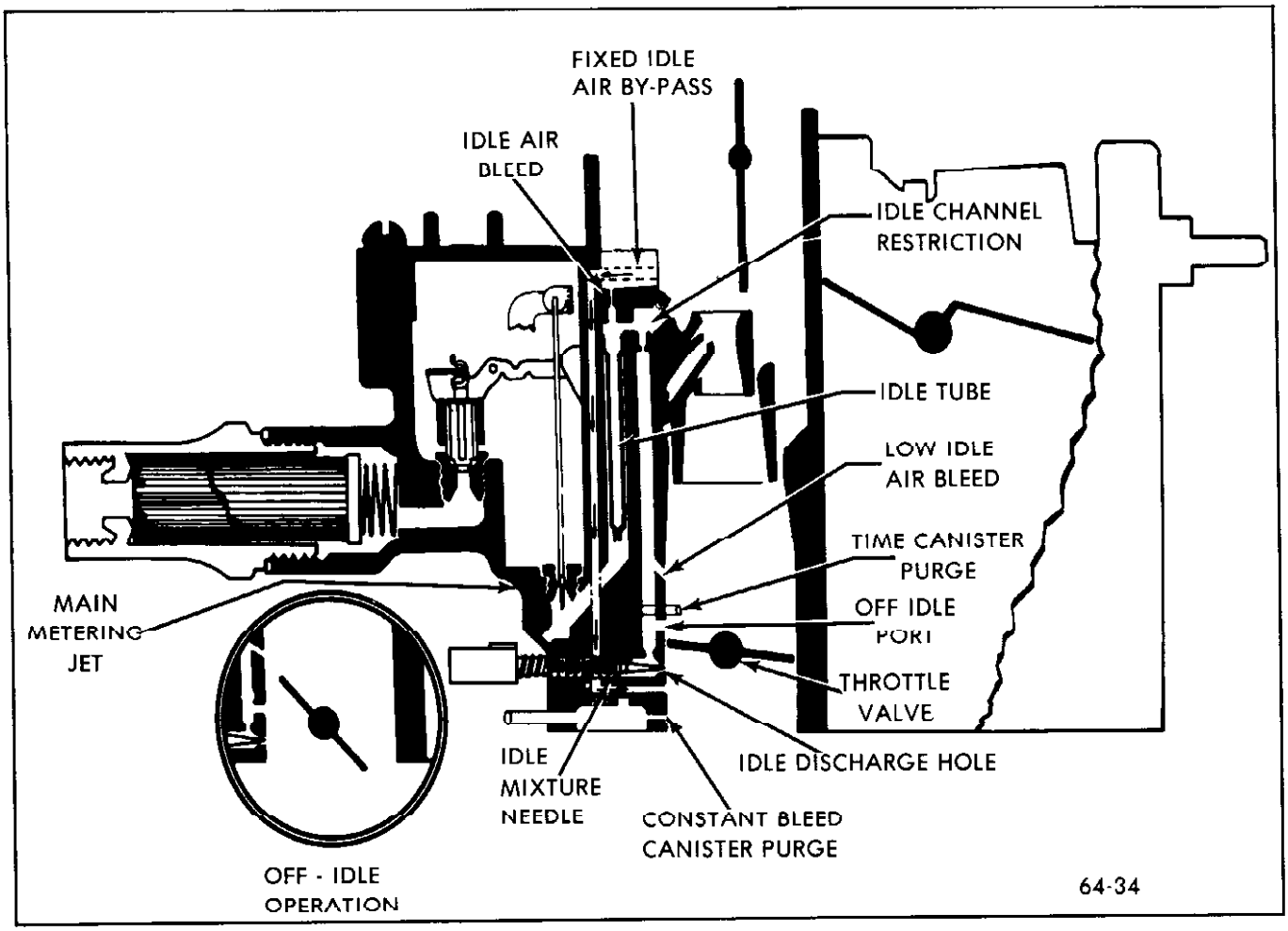


Figure 64-34 Idle System

vent at the top of the main well and side bleeds (one of which leads from inside the bore area above the venturi and another from the cavity around the main fuel nozzle in the main well) The fuel then passes through the main discharge nozzle into the boost venturi and on into the engine.

A part throttle adjustment is made at the factory, then sealed; no attempt should be made to adjust it in the field. The adjustable part throttle feature includes a new power piston and primary metering rods. The new piston has a pin pressed into it, which protrudes through the float bowl and gasket and contacts the adjustable link in the throttle body. See Figure 64-35. The new primary metering rods have a different taper than the rods used before. These rods can be identified by the suffix "B" stamped after the diameter on the rod. The purpose of the adjustable part throttle feature is to give a finer metering control in the part throttle range for elimination of exhaust emissions. If the throttle body needs replacement in the field, there are specifications and adjustment procedures included in the throttle body kit.

f. Operation of Power System

The power system provides extra mixture enrichment for 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. See Figure 64-36.

In 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 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 fuel enrichment is required, the spring tension overcomes the vacuum pull on the power piston and the tapered primary metering rod moves upward in the main metering jet orifice. The smaller diameter of the metering rod 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.

As the engine speed increases, the primary side of the

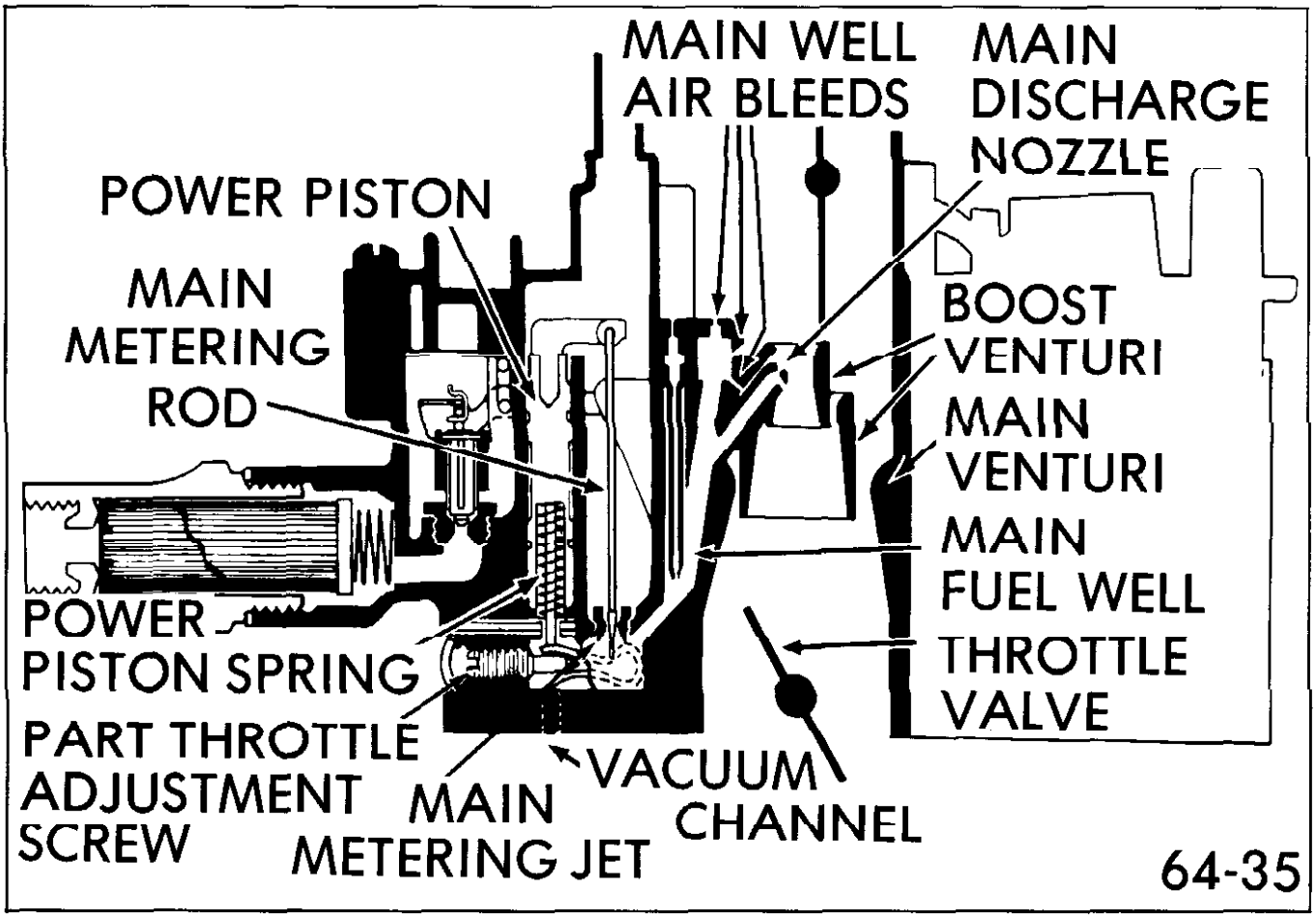


Figure 64-35 Main Metering System

carburetor can no longer meet the engine air and fuel requirements. To meet these demands, the secondary side of the carburetor is used. 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 secondary throttle valves begin to open, the accelerating well ports are exposed to manifold vacuum. The ports immediately start to feed fuel from the accelerating wells and continue to feed fuel until the fuel in the well is gone. This prevents a momentary leanness as the air valve opens and before 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. See Figure 64-31. 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.

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 disc is directly proportional to air flow through the secondary carburetor bores.

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 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 insure adequate fuel supply in the secondary fuel wells. These are necessary because when the air valve is in

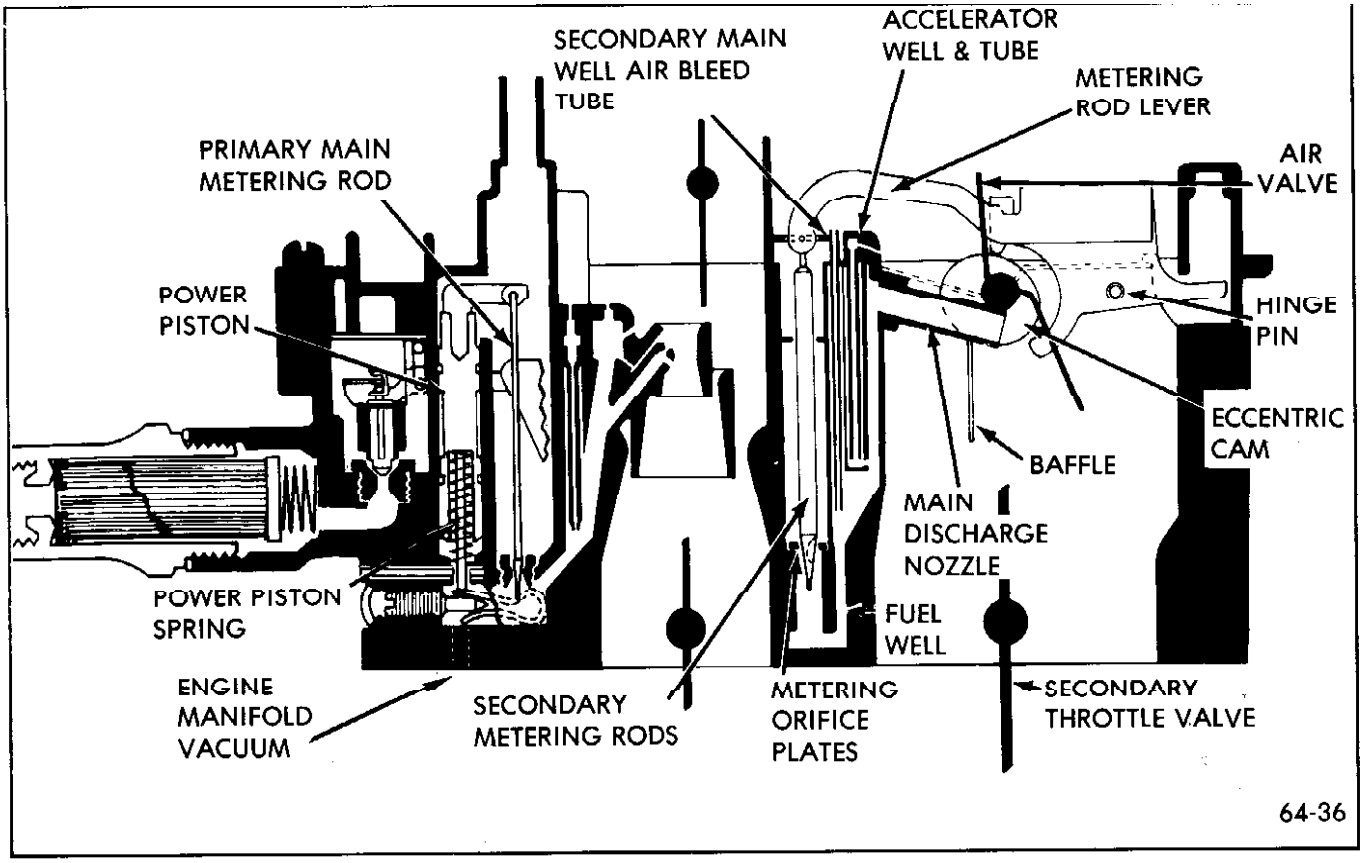


Figure 64-36 Power System

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 insures immediate fuel delivery from the secondary fuel wells at all times.

3. Two baffle plates are used, one in each secondary bore. They extend up and around the secondary fuel discharge nozzles. Their purpose is to provide good fuel distribution at lower air flows by preventing too much fuel from going to the front of the engine.

g. Operation of Air Valve Dash Pot

The air valve dashpot operates off of the main choke vacuum break diaphragm unit. The secondary air valve is connected to the choke vacuum break unit by a rod, to control the opening rate of the air valve. This delays the air valve opening rate to prevent secondary discharge nozzle "lag."

Whenever manifold vacuum is above approximately 5" to 6" Hg, the vacuum break diaphragm is seated (plunger is fully inward) against spring tension. At this point, the vacuum break rod is in the forward end of the slot in the air valve lever and the air valves are closed.

During acceleration or heavy engine loads, when the secondary throttle valves are open, the manifold vacuum drops. The spring located in the vacuum break diaphragm overcomes the vacuum pull and forces the plunger and link outward which, in turn, allows the air valves to open. The opening rate of the air valves is controlled by the calibrated restriction in the vacuum inlet nipple in the diaphragm cover. This gives the dashpot action required to delay air valve opening enough for efficient fuel flow from the secondary discharge nozzles.

h. Operation of Accelerating Pump System

During quick acceleration, when the throttle is opened rapidly, the air flow changes almost instantaneously. The fuel, which is heavier, tends to lag behind causing a momentary leanness. The accelerator pump is used to provide the extra fuel necessary for smooth operation during this time.

When the pump plunger moves upward in the pump well, 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 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

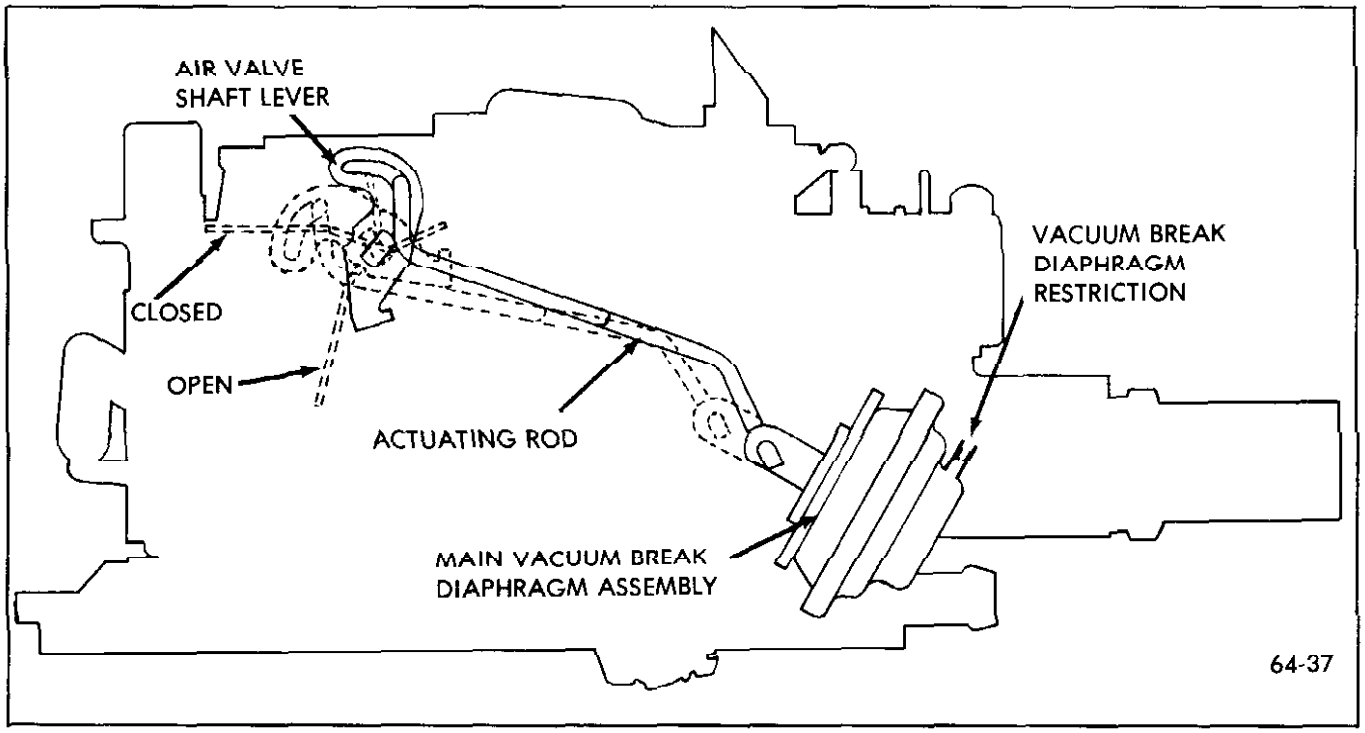


Figure 64-37 Air Valve Dash Pot Operation

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. See Figure 64-38.

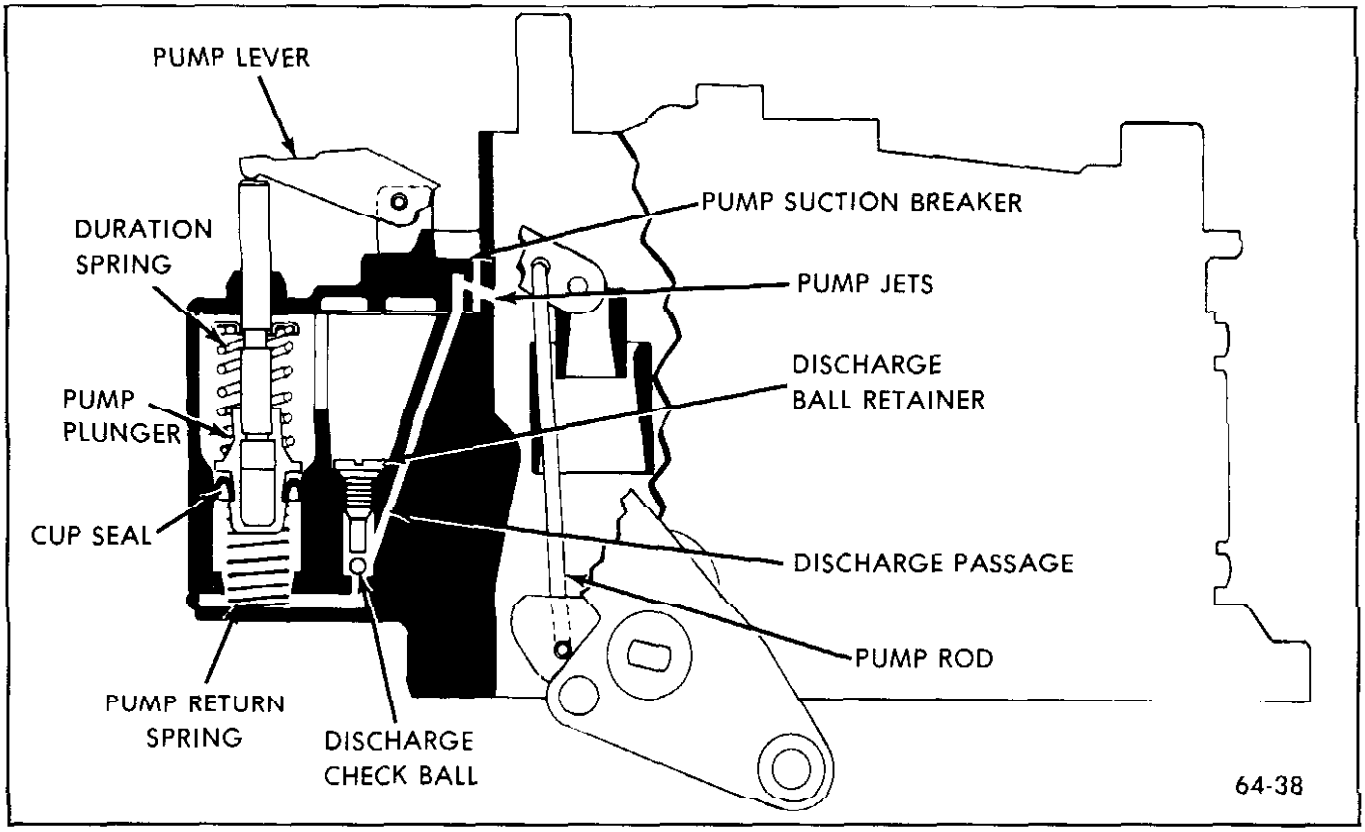


Figure 64-38 - Accelerator Pump System

It should be noted 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 insures a full pump stream when needed and prevents any fuel "pull over" from the pump discharge passage.

i. Operation of Choke System

The choke valve is located in the primary side of the carburetor. It provides the correct air/fuel mixture enrichment to the engine for quick cold starting and during warm-up period.

A secondary throttle valve lockout mechanism is used to prevent the secondary throttle valves from opening during the engine warm-up. A lockout lever located on the float bowl is weighted so that a tang on the lower end of the lever catches a lock pin on the secondary throttle valve shaft and holds the secondary throttle valves closed. As the engine warms up, the choke valve opens and the fast idle cam drops. When the engine is thoroughly warm, the choke valve is wide open and the fast idle cam drops down so the cam follower is completely off the steps of the cam. As the cam drops the last few degrees, it strikes the secondary lockout lever and pushes it away from the secondary valve lockout pin. This allows the secondary valves to open and operate, as described under the power system.

The engine automatic choke operates as follows:

During engine cranking, the choke valve is held closed by the tension of the thermostatic coil. This restricts air flow through the carburetor to provide a richer starting mixture. When the engine starts and is running, manifold vacuum is applied to the two vacuum diaphragm units mounted on the side of the float bowl. The front or primary vacuum break diaphragm will open the choke valve to a point where the engine will run without loading or

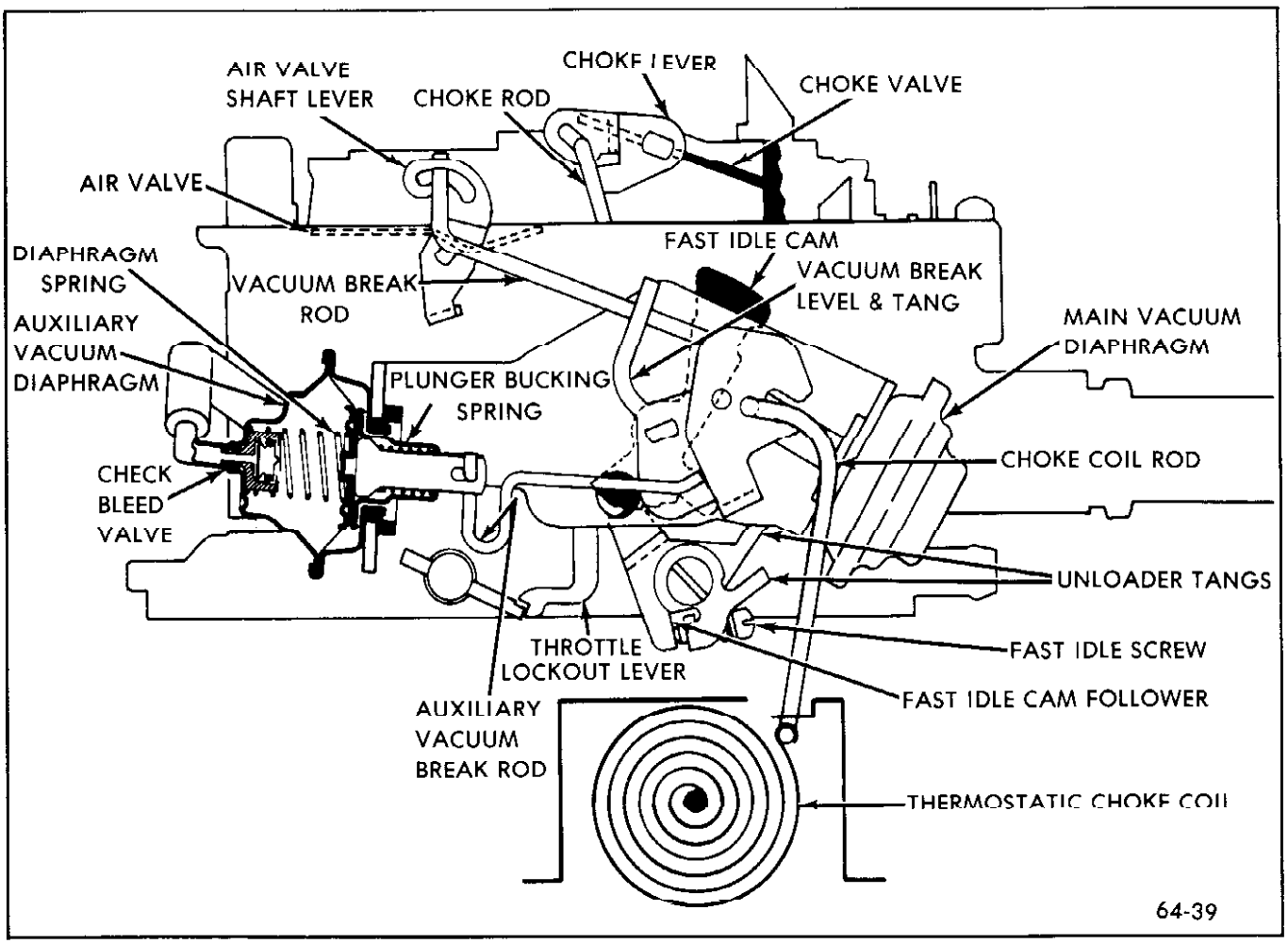


Figure 64-39 - Choke System

stalling. As the engine manifold is wetted and friction decreases after the start, the secondary, or rear, vacuum break unit, which has a delayed action, gradually opens the choke valve a little further to prevent loading and provide reduced exhaust emissions.

The primary vacuum break unit is standard and operates the same as on previous applications. The secondary (or rear) vacuum break unit is delayed in operation by an internal bleed. This prevents further opening of the choke valve a few seconds until the engine will run at a slightly leaner mixture.

Included in the secondary vacuum break unit is a spring-loaded plunger. The purpose of the spring is to offset choke thermostatic coil tension to provide leaner mixtures during warm-up for reduced exhaust emissions. In very cold temperatures the extra tension created by the thermostatic coil will overcome the tension of the plunger spring and provide less choke valve opening with a resultant slightly richer mixture. In warmer temperatures the thermostatic coil will have less tension and, consequently, will not compress the spring as much, thereby giving a greater choke valve opening for slightly leaner mixtures.

After the vacuum break diaphragm units open the choke valve and the accelerator pedal is depressed, the fast idle cam follower lever on the end of the primary throttle shaft will drop from the highest step on the fast idle cam to a lower step. This gives the engine the correct fast idle speed and fuel mixture 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 offset choke valve. The choke valve opening continues until the thermostatic coil is completely relaxed, at which point the choke valve is wide open.

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. To unload the engine, the accelerator pedal must 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 to lean out the fuel mixture so that the engine will start.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

64-23 EXTERNAL ADJUSTMENT OF ROCHESTER QUADRAJET CARBURETOR

a. Accelerator Pump Adjustment

Completely close primary throttle valves by backing out slow idle screw and making sure fast idle cam follower is off steps of fast idle cam (choke valve wide open). It will also be necessary to bend the secondary throttle closing tang away from primary throttle lever, to obtain closed throttle valves. See inset Figure 64-40.

With pump rod in specified hole in pump lever, gauge from top of choke valve wall next to vent stack, to top of pump stem.

To adjust, bend pump lever, as shown, with adjustable wrench, and also supporting pump lever between lever and top of air horn with tip of screwdriver.

After adjustment is made, readjust secondary throttle closing tang and slow idle screw.

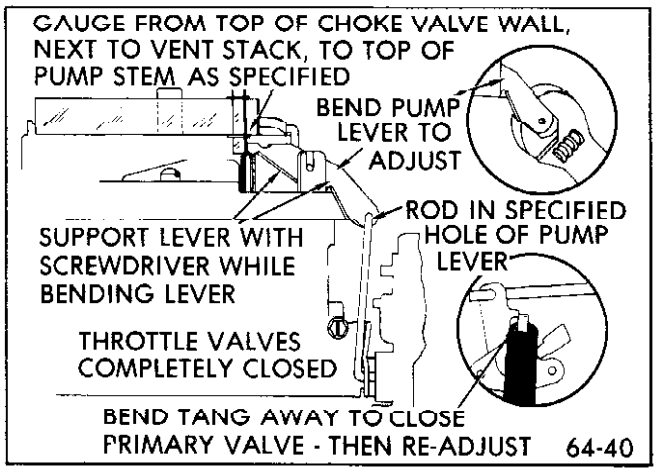


Figure 64-40 - Accelerator Pump Adjustment

b. Fast Idle Adjustment

With engine warm, transmission in drive and cam follwer on low step of fast idle cam, adjust fast idle screw so that engine runs 650 RPM (auto. transmission), 720 RPM for 455 engine, or 820 RPM for 350 engine (manual transmission). See Figure 64-41.

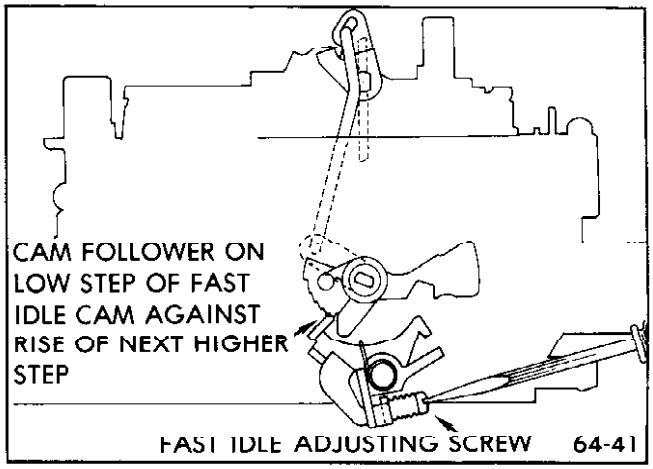


Figure 64-41 Fast Idle Adjustment

c. Choke Rod Adjustment

Place the fast idle cam follower on the second step of the

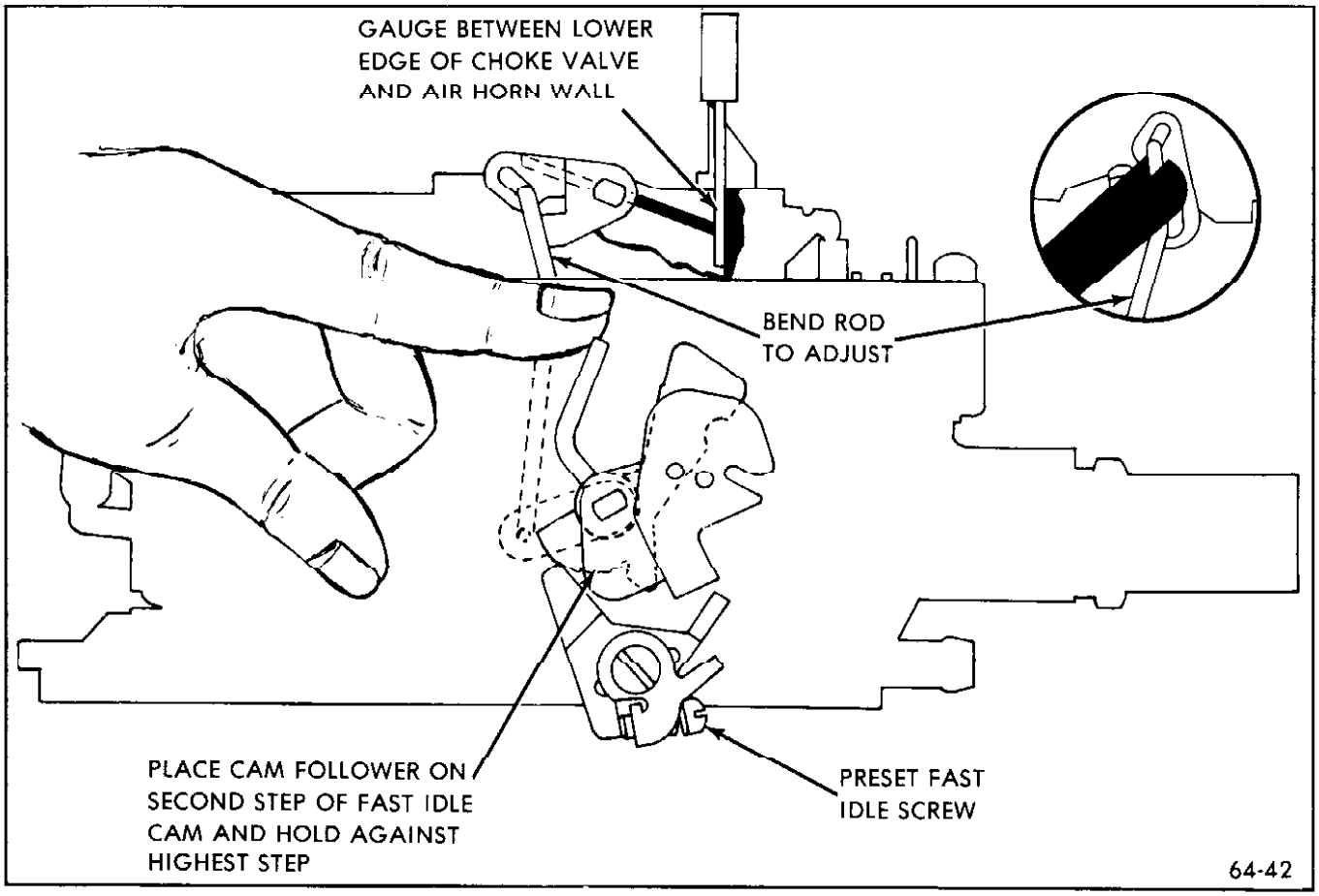


Figure 64-42 - Choke Rod Adjustment

fast idle cam and hold it against the high step by pushing lightly upward on the vacuum break lever. With the choke rod in the bottom of the slot in the choke lever, measure the dimensions between the lower edge of the choke valve at choke lever end, and air horn wall. The dimension should be as specified.

If adjustment is necessary, bend the choke rod at the point shown. See Figure 64-42.

d. Primary Vacuum Break Adjustment

Seat vacuum break diaphragm using Special Tool J-23417, Vacuum Break Actuator.

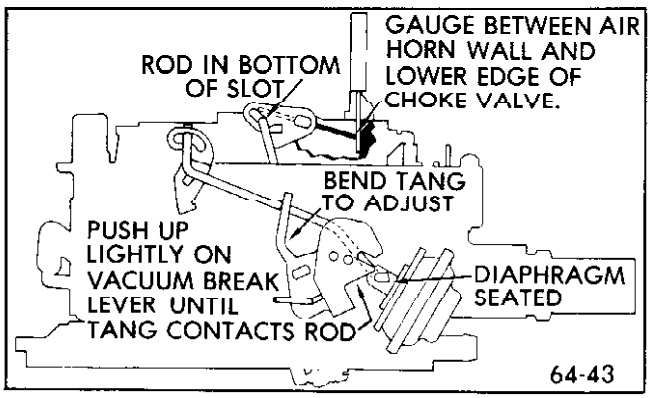


Figure 64-43 - Primary Vacuum Break Adjustment

With vacuum break diaphragm seated and with vacuum break lever tang held lightly against the vacuum break rod, measure the dimension between the lower edge of choke valve and air horn, as shown.

Bend vacuum break tang on lever to adjust. See Figure 64-43.

e. Secondary Vacuum Break Adjustment

Fully seat the auxiliary vacuum break diaphragm plunger using an outside vacuum source. With the secondary

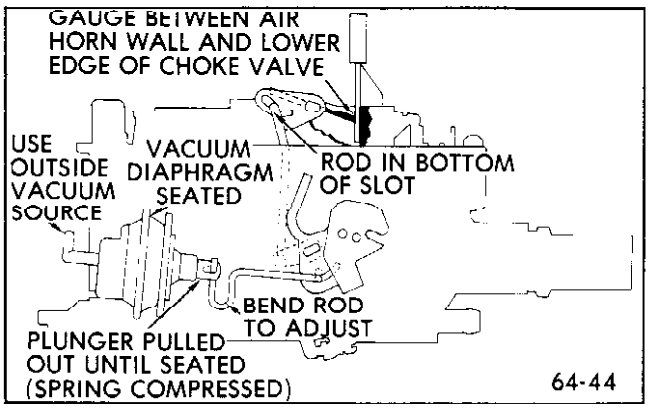


Figure 64-44 - Secondary Vacuum Break Adjustment

vacuum break diaphragm in the fully seated position, rotate the choke valve towards the closed choke position, pushing on the vacuum break lever until the spring loaded diaphragm plunger is fully extended. With the choke valve held in this position, measure the distance between the lower edge of choke valve and inside air horn wall. Dimensions should be as specified; if not, bend the vacuum break link at the point shown to adjust. See Figure 64-44.

CAUTION: *Care should be used when compressing the diaphragm plunger spring so that the force used in closing the choke valve does not pull the vacuum diaphragm off its seat.*

f. Air Valve Dash Pot Adjustment

With the vacuum break diaphragm seated, there must be .030 inch clearance between the dash pot rod and end of slot in air valve lever.

Bend rod, at air valve end, to adjust. See Figure 64-45.

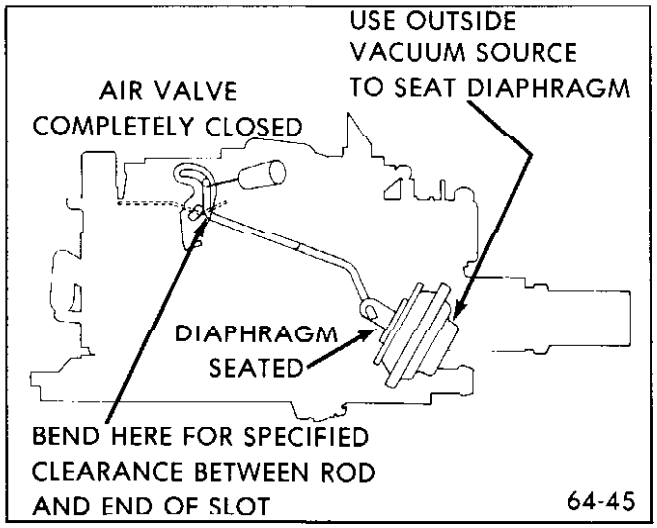


Figure 64-45 Air Valve Dash Pot Adjustment

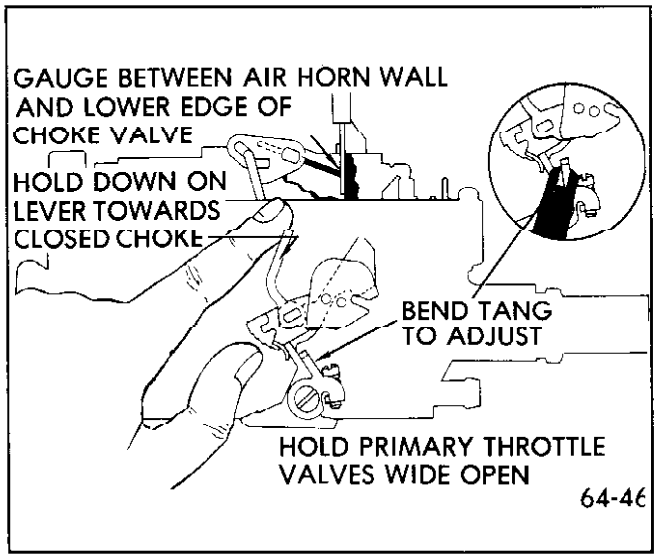


Figure 64-46 Choke Unloader Adjustment

g. Choke Unloader Adjustment

Push up lightly on vacuum break lever, then open the primary throttle to the wide open position. With the valves in this position, the dimension between the lower edge of choke valve and air horn wall should be .335 inch.

Bend the tang on the fast idle lever to adjust. See Figure 64-45.

h. Choke Coil Rod Adjustment

Hold choke valve fully closed by rotating vacuum break lever counterclockwise, as shown. Pull upward on choke termostatic coil rod to end of travel. Rod should fit freely in gaging notch at edge of lever. Bend rod at loop as required to make it fit gaging notch.

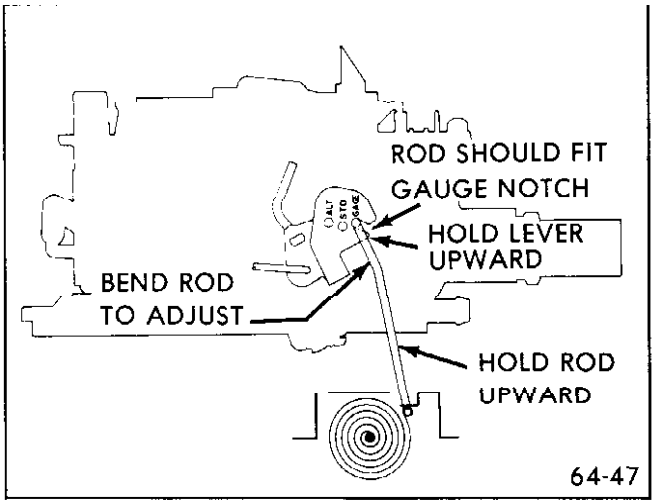


Figure 64-47 Choke Coil Rod Adjustment

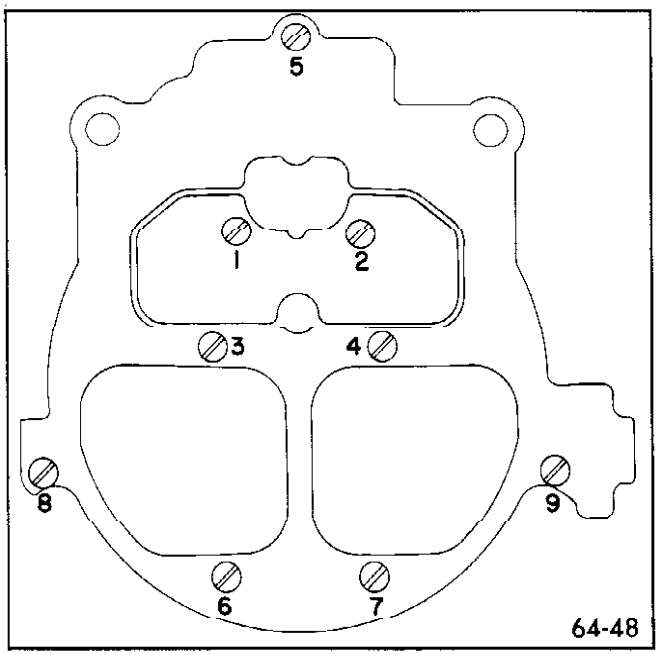


Figure 64-48 - Air Horn Screw Tightening Sequence

Connect the thermostatic coil rod to the specified hole in lever. See Figure 64-47.

i. Air Horn Screw Tightening Sequence

To prevent binding of the choke valve or air valve due to distortion of the air horn, the air horn screws must be tightened in the proper sequence. Figure 64-48 show the proper tightening sequence.

j. Secondary Closing Adjustment

To insure proper closing of the secondary throttle valves, check the closing adjustment as follows:

1. Set slow idle (curb idle) to recommended engine RPM, making sure cam follower is not resting on the steps of the fast idle cam (choke valve wide open).

2. There should be .020" clearance between secondary throttle actuating rod and front of slot in secondary throttle lever with closing tang on throttle lever resting against actuating lever.

3. Bend tang on primary throttle actuating lever to adjust. See Figure 64-49.

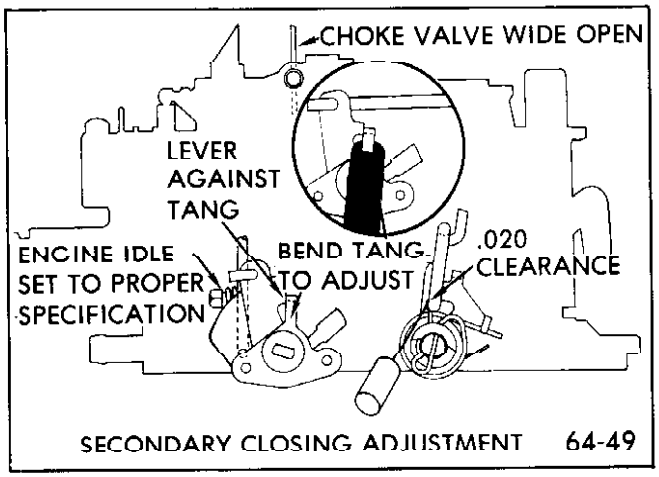


Figure 64-49 - Secondary Closing Adjustment

k. Secondary Opening Adjustment

For correct opening of the secondary throttle valves, the following adjustment should be checked:

1. Open primary throttle valves until actuating link contacts upper tang on secondary lever. When valve s are in this position:

(a) *With 2 point pick-up linkage,* bottom of link should be in center of secondary lever slot. See lower part of Figure 64-50.

(b) *With 3 point pick-up linkage,* clearance between link and middle tang should be .070 inch. See upper part of Figure 64-50.

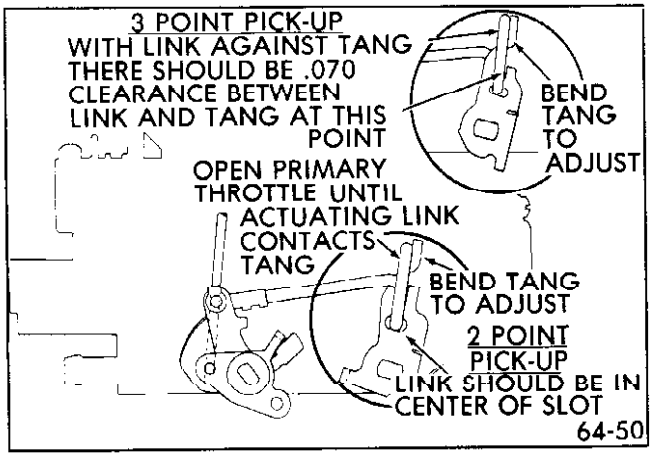


Figure 64-50 - Secondary Opening Adjustment

2. Bend upper tang on secondary lever as required to adjust.

l. Secondary Metering Rod Adjustment

1. Check secondary metering rod adjustment by measuring from top of each metering rod to top of air horn casting next to air cleaner stud hole. Measurement should be 53/64 in. See Figure 64-51.

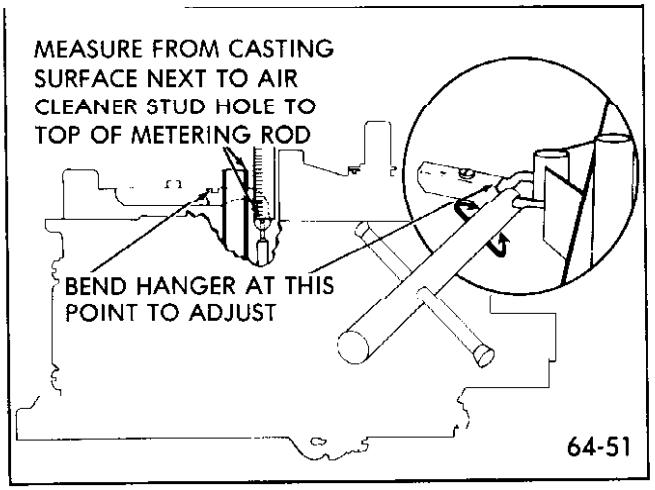


Figure 64-51 - Secondary Metering Rod Adjustment

2. Adjust, if necessary, by bending metering rod hanger at point shown in Figure 64-51. Make sure *both* rods are correctly adjusted.

m. Air Valve Spring Wind-Up Adjustment

To adjust air valve spring wind-up, loosen lock screw (Allen screw) and turn adjusting screw counterclockwise to remove all spring tension. With air valve held closed, turn adjusting screw clockwise until torsion spring just contacts pin in shaft; then turn adjusting screw clockwise exactly 1/2 turn. While holding adjusting screw in this position, tighten lock screw. See Figure 64-52.

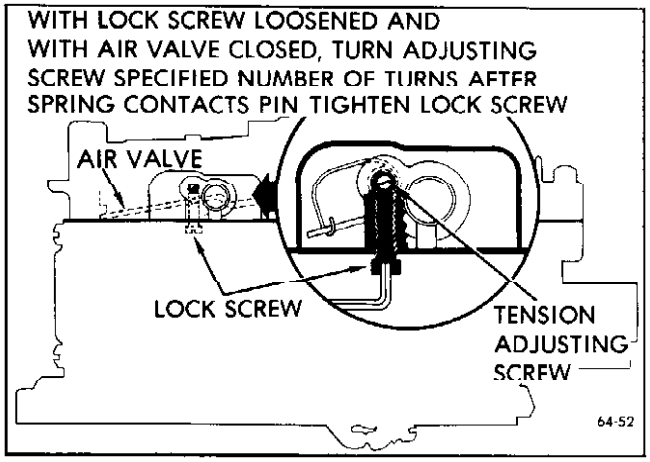


Figure 64-52 - Air Valve Spring Wind-Up Adjustment

n. Secondary Throttle Valve Lockout Adjustment

NOTE: *The secondary throttle valve lockout is used on all units except the small engine, automatic transmission model. This uses an air valve lockout in its place.*

To adjust the secondary throttle valve lockout, proceed as follows:

1. *Opening Clearance* - Hold choke valve wide open by rotating vacuum break lever toward open choke (clockwise). With secondary throttle valves held partially open, measure the clearance between the end of the lockout pin and toe of lockout lever, as shown. Bend lockout lever at point shown to adjust.

2. *Secondary Lockout Pin Side Clearance* - With choke valve and secondary throttle valve fully closed, bend lockout pin at point shown to maintain specified side clearance between side of lockout pin and lockout lever. See Figure 64-53.

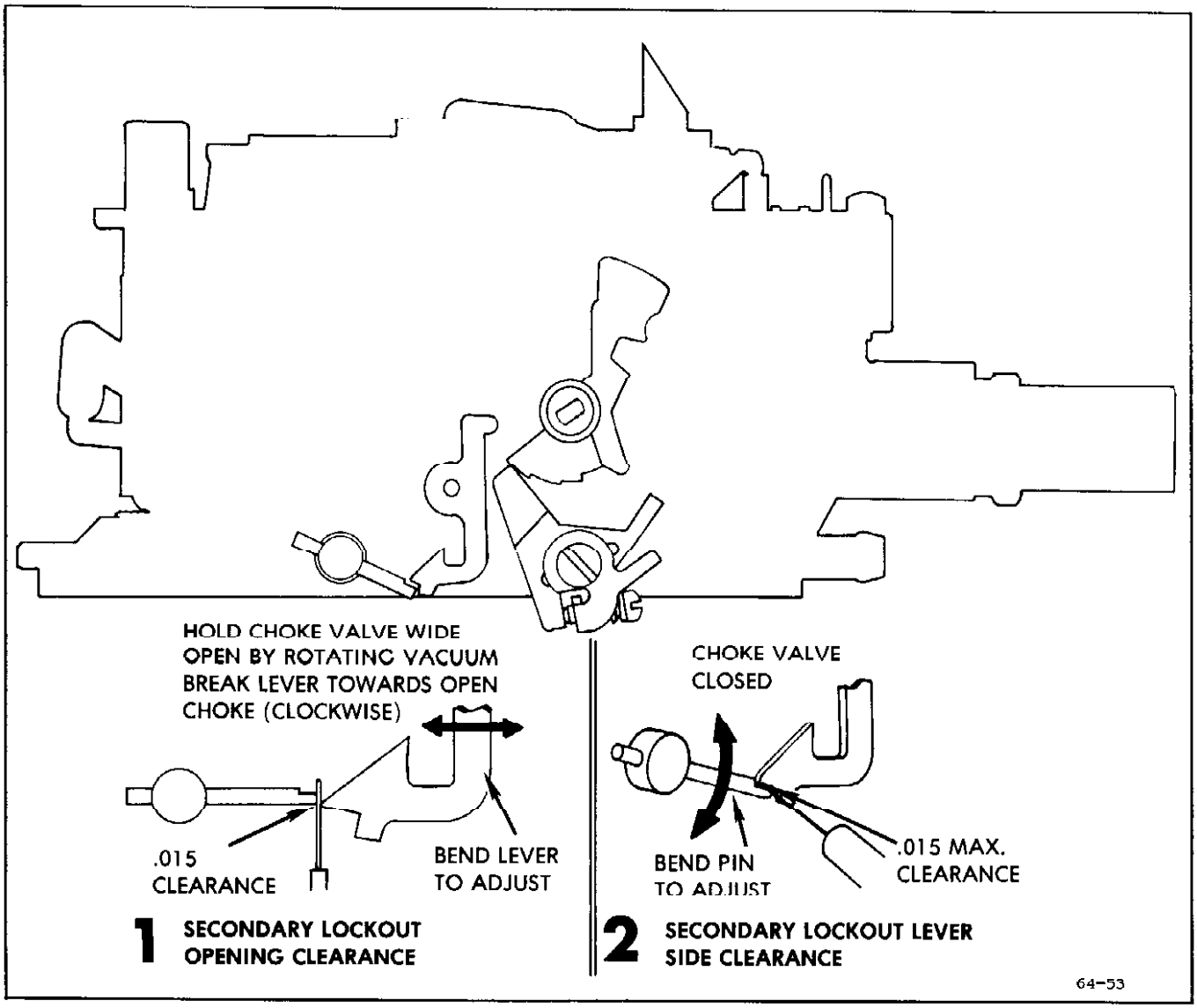


Figure 64-53 - Secondary Lockout Adjustment

DIVISION IV

REMOVAL AND INSTALLATION

64-24 ROCHESTER 4MV CARBURETOR REMOVAL AND INSTALLATION

a. Removal

1. Remove air cleaner.
2. Disconnect gas line fitting at carburetor.
3. Remove choke coil rod clip and disconnect rod.
4. Disconnect throttle cable.
5. Disconnect vacuum lines to carburetor.
6. Remove T.C.S. switch bracket bolt.
7. Disconnect cruise control head chain, if equipped.
8. Disconnect throttle spring.
9. Remove four (4) carburetor-to-manifold bolts.

b. Installation

1. Install carburetor hose gasket and install carburetor.
2. Connect throttle spring.
3. Connect cruise control head chain.
4. Replace T.C.S. switch and switch.
5. Connect vacuum lines to carburetor.
6. Connect throttle cable.
7. Connect choke coil rod to carburetor.
8. Connect gas line to carburetor.
9. Replace air cleaner and connect vacuum hoses.

DIVISION V

OVERHAUL AND MAJOR SERVICE

64-25 DISASSEMBLY, CLEANING AND INSPECTION OF ROCHESTER QUADRAJET CARBURETOR

NOTE: *Place carburetor on proper holding fixture.*

a. Air Horn Removal

1. Remove clip from upper end of choke rod, disconnect choke rod from upper choke shaft lever, and remove the choke rod from lower lever in bowl cavity.

2. To disconnect pump rod, drive small roll pin (pump lever pivot pin) inward, using a small drift, until pump lever can be removed from air horn. Then remove pump lever from pump rod.

3. Remove secondary metering rods from secondary wells by removing small screw in the secondary metering rod holder. Lift rods and holder as an assembly from carburetor.

NOTE: *The vacuum break diaphragm rod is clipless, so it will be necessary to remove during air horn removal.*

4. Remove nine air horn to bowl attaching screws, two of which are located next to the primary venturi; (two long screws, five short screws, and two countersunk screws).

5. Remove air horn by lifting straight up. After air horn is clear of float bowl, rotate air horn to remove vacuum break diaphragm rod from dashpot lever on the end of the air valve shaft. Air horn gasket should remain on bowl for removal later.

CAUTION: *Care must be taken not to bend the small tubes protruding from the air horn. These are permanently pressed into the casting. Do not remove.*

b. Air Horn Disassembly

NOTE: *Further disassembly of the air horn is not required for cleaning purposes. If part replacement is required, proceed as follows:*

1. Remove choke valve attaching screws, then remove choke valve and shaft. Caution: Air valves and air valve shaft are calibrated and should not be removed.

c. Float Bowl Disassembly

1. Remove pump plunger from pump well.

2. Remove air horn gasket from dowels on secondary side of bowl, then remove gasket from around power piston and primary metering rods.

3. Remove pump return spring from pump well.

4. Remove plastic filler over float valve.

5. Remove power piston and primary metering rods, by pushing downward on the power piston against spring tension and allowing to snap upward. Do this several times until the plastic retainer pops out of the recess in float bowl casting. Then remove power piston and rod assembly from float bowl. Remove power piston spring from power piston cavity.

6. Remove metering rods from power piston by disconnecting tension springs from top of each rod; then rotate rod to remove from hanger.

7. Remove float and needle assembly by lifting up on retaining pin.

8. Remove float needle and pull clip assembly from float arm.

9. Remove needle seat and gasket.

10. Remove primary metering jets. No attempt should be made to remove secondary metering plates.

11. Remove pump discharge check ball retainer and check ball.

12. Remove baffle from secondary side of float bowl.

13. Remove vacuum break hoses from primary vacuum break assembly and secondary vacuum break assembly.

14. Remove retaining screw from choke bracket assembly and remove complete assembly from float bowl. Vacuum break rod can now be removed from the primary break diaphragm plunger by rotating rod out of plunger stem.

NOTE: *If further disassembly of the choke is necessary, spread the retaining ears on bracket for removing either the primary vacuum break diaphragm assembly or the secondary vacuum break assembly. The secondary vacuum break assembly has a rod connecting the plunger to the intermediate choke shaft lever. This can also be removed by rotating the vacuum break diaphragm assembly and sliding rod out of plunger stem and the other end out of vacuum break lever.*

CAUTION: *Do not place vacuum break assemblies in carburetor cleaner.*

15. Remove the fast idle cam from bushing on choke bracket assembly.

16. Remove lower choke rod actuating lever from inside of float bowl well.

17. Remove fuel inlet filter nut gasket, filter, and spring.

18. Remove throttle body by removing throttle body to bowl attaching screws.

19. Remove throttle body to bowl insulator gasket.

d. Throttle Body Disassembly

1. Remove pump rod from throttle lever by rotating rod out of primary throttle lever.

2. If necessary to clean the idle mixture channels and idle needle holes, remove the plastic limiter caps by breaking them. Then remove the idle mixture screws and springs.

NOTE: *New plastic limiter caps are provided in the carburetor overhaul kit, should it be necessary to remove the idle mixture needles. No further disassembly of the throttle body is required.*

CAUTION: *Extreme care must be taken to avoid damaging the throttle valves.*

e. 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.

CAUTION: *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 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.

64-26 ASSEMBLY AND INTERNAL ADJUSTMENT OF ROCHESTER QUADRAJET CARBURETOR

a. Throttle Body Assembly

1. If removed for cleaning, install the idle mixture needles and springs until seated. Back out needles two turns as a preliminary idle adjustment.

NOTE: *The new plastic idle limiter caps should not be installed until the carburetor is adjusted according to procedures listed under Engine Idle Adjustment.*

After adjustment on the engine, then install new idle limiter caps over the idle mixture screws.

2. Install the pump rod in the hole in the throttle lever by rotating end of rod into hole in lever.

b. Float Bowl Assembly

1. Install new throttle body to bowl insulator gasket being certain the gasket is properly installed over two locating dowels on bowl.

2. Install throttle body making certain throttle body is properly located over dowels on float bowl then install throttle body to bowl screws and tighten evenly and securely.

3. Place carburetor on proper holding fixture.

4. Install fuel inlet filter spring, filter, new gasket and inlet nut. Tighten nut securely.

NOTE: *If the vacuum break diaphragm assemblies were removed from choke bracket, slide assemblies between retaining ears and bend ears slightly together to hold securely. The secondary vacuum diaphragm rod must be installed in the vacuum break lever and plunger stem previous to installing the unit on the choke bracket.*

5. Install fast idle cam on the vacuum break assembly. Be sure fast idle cam actuating tang on the intermediate choke shaft lever (vacuum break lever) is located in cut out area of fast idle cam.

6. Connect choke rod to choke rod actuating lever (plain end) then holding choke rod, with grooved end pointing inward, position choke rod actuating lever in well of float bowl and install choke assembly, engaging intermediate choke shaft with hole in actuating lever. Install retaining screw and tighten securely. Remove choke rod from lever for installation later.

NOTE: *Lower choke lever holding tool J-6911 can be used for holding lever in place while installing choke bracket assembly.*

7. Install both vacuum break diaphragm hoses. The shorter vacuum hose goes to the primary or front vacuum break diaphragm unti.

8. Install air deflector in secondary side of bowl with notches towards top.

9. Install pump discharge check ball and retainer in passage next to pump well. Tighten securely.

10. Install primary main metering jets. Tighten securely.

11. Install float needle seat and gasket. Tighten securely.

12. Install pull clip on needle. Install needle and pull clip on float.

NOTE: *The float needle pull clip hooks over the edge of the float arm and not through the locating holes in the center.*

13. Install float, needle and retaining pin assembly in float bowl.

14. *Float level adjustment.*

a. With adjustable T-scale measure from top of float bowl gasket surface (gasket removed) to top of float at toe (locate gaging point 1/16" back from radius at toe). See Figure 64-54.

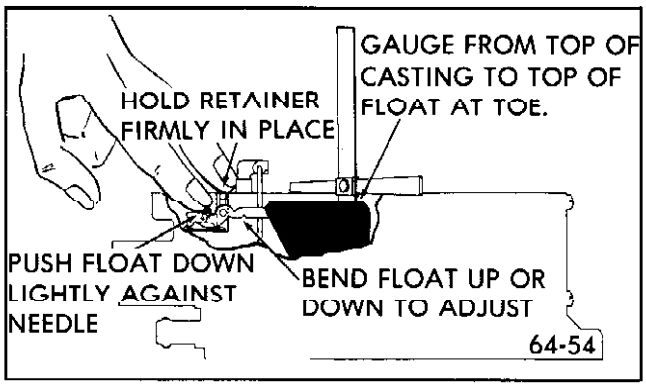


Figure 64-54 - Float Level Adjustment

NOTE: *Make sure retaining pin is held firmly in place and tang of float is seated on float needle. See specifications in paragraph 64-27.*

b. Bend float up or down for proper adjustment.

15. Install power piston spring into power piston well. If the primary main metering rods were removed from hanger, reinstall making sure that the tension spring is connected to top of each metering rod. Install power piston assembly in well with metering rods properly positioned in the main metering jets. Press downward on plastic power piston retainer so that it is seated in the recess provided in the float bowl.

NOTE: *It may be necessary to tap the plastic retainer lightly in place with a hammer and drift. Make sure the plastic retainer is flush with the top of the float bowl casting.*

16. Install plastic filler over float needle, pressing downward until seated properly.

17. Install pump return spring in pump well.

18. Install air horn gasket around primary metering rods and piston. Position gasket over two dowels on secondary side of bowl.

19. Install pump plunger in pump well.

c. Air Horn Assembly

1. Install the following if removed: choke shaft, choke valve, and two attaching screws. Make sure to stake the two attaching screws after tightening securely.

2. Normally, the air valve and shaft do not have to be removed from the air horn for cleaning purposes. A repair kit is available which includes a new plastic cam, an air valve torsion spring, retaining pin. Complete instructions are included in the kit for installation.

d. Air Horn to Bowl Installation

1. Place air horn assembly on bowl carefully, positioning vent tubes and accelerating well tubes over air horn gasket. Install vacuum break rod into main vacuum break diaphragm plunger and into slotted air valve lever on air horn before the air horn is lowered onto float bowl. Carefully lower air horn assembly over pump plunger stem and locating dowels until properly seated.

2. Install two long air horn screws, five short screws, and two countersunk screws in primary venturi area. All screws must be tightened evenly and securely. See Figure 64-48 for proper tightening sequence.

3. Install two secondary metering rods into the secondary metering rod hanger (upper ends of rod point towards each other). Install secondary metering rod holder onto air valve cam follower. Install retaining screw and tighten securely. Work air valves up and down several times to make sure they are free in all positions.

4. Connect pump lever to upper end of pump rod. Place pump lever on air horn casting. Align hole in pump lever with hole in air horn casting and push pump roll pin back through casting until end of pin is flush with casting.

5. Connect choke rod in lower choke lever and retain in upper lever with clip.

SECTION D

Rochester 4MV Carburetor

Division VI Specifications

64-27 Rochester 4MV Carburetor Calibrations

NOTE: All carburetors have a color code paint mark and a part number stamped on the float bowl for identification.

	350 Eng. Man. Trans.	350 Eng. Auto. Trans. 43-44-45000 Series	455 Eng. Man. Trans.	455 Eng. Auto. Trans.	455 Eng. Stage I
Paint Color	Red	Lt. Blue	Dark Blue	Black	Lt. Green
Model Designation	4MV	4MV	4MV	4MV	4MV
Number of Barrels	4	4	4	4	4
Carburetor Number	7041245	7041544	7041243	7041540	7041242
Code Letters	RD	MH	ME	MF	MD
Throttle Bore (Primary)	1-3/8"	1-3/8"	1-3/8"	1-3/8"	1-3/8"
Throttle Bore (Secondary)	2-1/4"	2-1/4"	2-1/4"	2-1/4"	2-1/4"
Small Venturi	9/32"	9/32"	9/32"	9/32"	9/32"
Middle Venturi	5/8"	5/8"	5/8"	5/8"	5/8"
Large Venturi	1-3/32"	1-3/32"	1-7/32"	1-7/32"	1-7/32"
Main Metering Jet	.069"	.068"	.073	.073"	.075"
Metering Rod (Primary) Production	.044"	.044"	.045	.044"	.045"
Altitude	Same	Same	Same	Same	Same

NOTE: Specia Kits Are Not Required for Altitude

Metering Rod (Secondary)	BS	BS	AY	AS	AU
Idle Needle Hole	#49	#49	#44	#44	#44
Spark Hole	.045" x .151"	.045" x .151"	.045 x .151"	.045" x .151"	.045" x .151"
Pump Discharge Hole	2 - #70	2 - #70	2 - #66	2 - #66	2 - #66
Fast Idle Cam Number	7043723	7040809	7040810	7043753	7043753
Choke Assembly Number	7041192	7041192	7041191	7041190	7041190

SECTION D (Continued)

64-28 Rochester 4MV Carburetor Adjustments

	350 Eng. Man. Trans.	350 Eng. Auto. Trans. 4344-45000 Series	455 Eng. Man. Trans.	455 Eng. Auto. Trans.	455 Eng. Stage I
Choke Coil Rod Adjustment	Gauge Slot	Gauge Slot	Gauge Slot	Gauge Slot	Gauge Slot
Choke Hole Setting	Std. Hole	Std. Hole	Std. Hole	Std. Hole	Std. Hole
Float Level	15/32"	15/32"	13/32"	3/8"	3/8"
Pump Rod Location	Inner Hole	Inner Hole	Inner Hole	Inner Hole	Inner Hole
Pump Adjustment	9/32"	9/32"	1/4"	1/4"	1/4"
Choke Rod Adjustment	.130"	.130"	.130"	.130"	.130"
Vacuum Break Adjustment (Primary)	.170"	.170"	.215"	.180"	.200"
Vacuum Break Adjustment (Secondary)	.150"	.150"	.195"	.160"	.160"
Air Valve Dash Pot Adjustment	.030"	.030"	.030"	.030"	.030"
Choke Unloader Adjustment	.335"	.335"	.335"	.335"	.335"
Throttle Valve Lockout Adjustment	.015"	.015"	.015"	.015"	.015"
Secondary Opening Adjustment	.070"	.070"	.070"	.070"	.070"
Secondary Closing	.020"	.020"	.020"	.020"	.020"
Secondary Metering Rod	53/64"	53/64"	53/64"	53/64"	53/64"
Air Valve Spring Wind-Up	1/2 Turn	1/2 Turn	1/2 Turn	1/2 Turn	1/2 Turn
Fast Idle Speed (In Drive, Low Step)	820	650	720	650	650
Slow Idle Speed (In Drive)	800	600	700	600	600

SECTION B

FUEL PUMP
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Fuel Pump Inspection and Test	64-9
	Fuel Pump Trouble Diagnosis	64-10
II	DESCRIPTION AND OPERATION:	
	Description and Operation of Fuel Pump	64-11
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	
IV	REMOVAL AND INSTALLATION:	
	Mechanical Fuel Pump Removal and Installation	64-12
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS: (Not Applicable)	-

DIVISION I

TROUBLE DIAGNOSIS

64-9 FUEL PUMP INSPECTION AND TEST

If the fuel system is suspected of delivering an improper amount of fuel to the carburetor, it should be inspected and tested in the car, as follows:

a. Inspection of Fuel System

1. Make certain that there is gasoline in the tank.

2. With engine running, inspect for leaks at all gasoline feed hose connections from fuel tank to carburetor. Tighten any loose connections. Inspect all hoses for flattening or kinks which would restrict the flow of fuel. *Air leaks or restrictions on suction side of mechanical fuel pump will seriously affect pump output.*

3. Inspect for leaks at fuel pump diaphragm flange (mechanical pump only).

4. Disconnect feed pipe near carburetor. Ground distributor terminal of coil with jumper wire so that engine can be cranked without firing. Place suitable container at end of pipe and crank engine a few revolutions. If no gasoline, or only a little flows from pipe, the feed line is clogged or fuel pump is inoperative. Before condemning the fuel pump, disconnect feed line at both ends and blow through it with air hose to make sure that it is clear.

5. If gasoline flows in good volume from pipe at carburetor it may be assumed that the fuel pump and feed line are okay; however, it is advisable to make the following pressure and volume tests to make ceratain that fuel pump is operating within specifications.

b. Fuel Pump Pressure Test

1. Disconnect gasoline line near carburetor and connect a suitable pressure gage (such as Pressure- Leakdown Tester J-22109).

2. Start engine and check pressure with engine running at slow idle speed. Fuel pump pressure on 250 and 350 engines should be 3 lbs. minimum; on 455 engines it should be 4 1/2 lbs. minimum. On cars equipped with a vapor return system, squeeze off the return hose so that an accurate reading can be obtained.

3. If fuel pump pressure is below minimum, pump must be replaced.

c. Fuel Pump Flow Test

1. Disconnect fuel line from carburetor. Run fuel line into a suitable measuring container.

2. While observing the sweep second hand of a clock or watch, run the engine at idle until there is one pint of fuel in the container. One pint should be pumped in 30 seconds or less.

3. If flow is below minimum, check for a restriction in the line.

64-10 FUEL PUMP TROUBLE DIAGNOSIS

Complete diagnosis of all possible causes of the trouble prior to replacement of the fuel pump will save time, expense and possibly prevent a repeat complaint.

a. Low Pressure Complaint

The only way to check fuel pump pressure is by connecting an accurate pressure gauge to the fuel line at carburetor level. Never replace a fuel pump without first making this simple check. See Paragraph 64-9, b.

b. Not Enough Fuel Flow Complaint

When an engine has a "starving-out" condition, many mechanics jump to the conclusion that the fuel pump is not pumping enough fuel. Many times the "starving" condition is actually due to a weakness in the ignition system, since these two troubles are very hard to separate. Even when an engine is starving for fuel, the cause is more likely to be a plugged fuel filter or a restricted fuel line than a defective fuel pump. See Paragraph 64-9, c.

DIVISION II

DESCRIPTION AND OPERATION

64-11 DESCRIPTION AND OPERATION OF FUEL PUMPS

a. Description of Mechanical Pump

An AC fuel pump is used on all engines. The pump assembly is mounted on the timing chain cover in an inverted position, and the pump rocker arm is actuated by an eccentric mounted on front end of the camshaft.

The fuel pump is a diaphragm type pump and is actuated by the rocker arm through a link and a pull rod. See Figure 64-11.

b. Operation of Mechanical Fuel Pump

The fuel pump draws gasoline from the tank and supplies it to the carburetor in sufficient quantity to meet engine requirements under all operating conditions. The principal parts of the fuel pump are shown in Figure 64-11.

The rocker arm spring holds the rocker arm in constant contact with the eccentric on the engine camshaft so that the rocker arm swings up and down as the camshaft rotates. As the arm swings downward, it bears against a

shoulder on the link which is pivoted on the rocker arm pin. The link swings upwards, thereby pulling the fuel diaphragm upward by means of the connecting pull rod.

Upward movement of the fuel diaphragm compresses the diaphragm spring and also creates a vacuum in the fuel chamber under the diaphragm. The vacuum causes the outlet valve to close and causes fuel from the gasoline tank to enter the fuel chamber through the inlet valve.

As the rotating eccentric permits the rocker arm to swing upward, the arm releases the fuel link; it cannot move the link downward. The compressed diaphragm spring then exerts pressure on the diaphragm and the fuel in the chamber below diaphragm. This pressure closes the inlet valve and forces fuel out through the outlet valve to the carburetor.

Since the fuel 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. The condition arises when the carburetor float needle valve is not seated and the fuel passage from the pump into the carburetor float chamber is open. When the needle valve is closed and held in place by the pressure of the fuel on the float, the pump builds up pressure in fuel chamber until it overcomes the pressure of the diaphragm spring. This pressure results in almost complete stoppage of diaphragm movement until more fuel is needed.

The air space in the bottom of the fuel pump provides a pocket in which fuel under pressure can compress a certain volume of air. When the pressure is relieved (pump on suction stroke) the pocket of compressed air pushes the fuel on to its destination. The air pocket minimizes flow variation experienced with two-cycle pump stroke and increases the pump output.

d. Fuel Pump Repairs

Because fuel pump covers for both mechanical pumps are crimped onto the pump body at the factory, it is not possible to disassemble the pump for any repairs.

If a fuel pump fails to pass the following tests and the failure is found to be the fault of the pump, the fuel pump must be replaced with a new one.

DIVISION IV

REMOVAL AND INSTALLATION

64-12 MECHANICAL FUEL PUMP

a. Mechanical Fuel Pump Removal

1. Disconnect fuel inlet hose from pump. Disconnect vapor return hose, if so equipped.

2. Disconnect fuel outlet pipe.

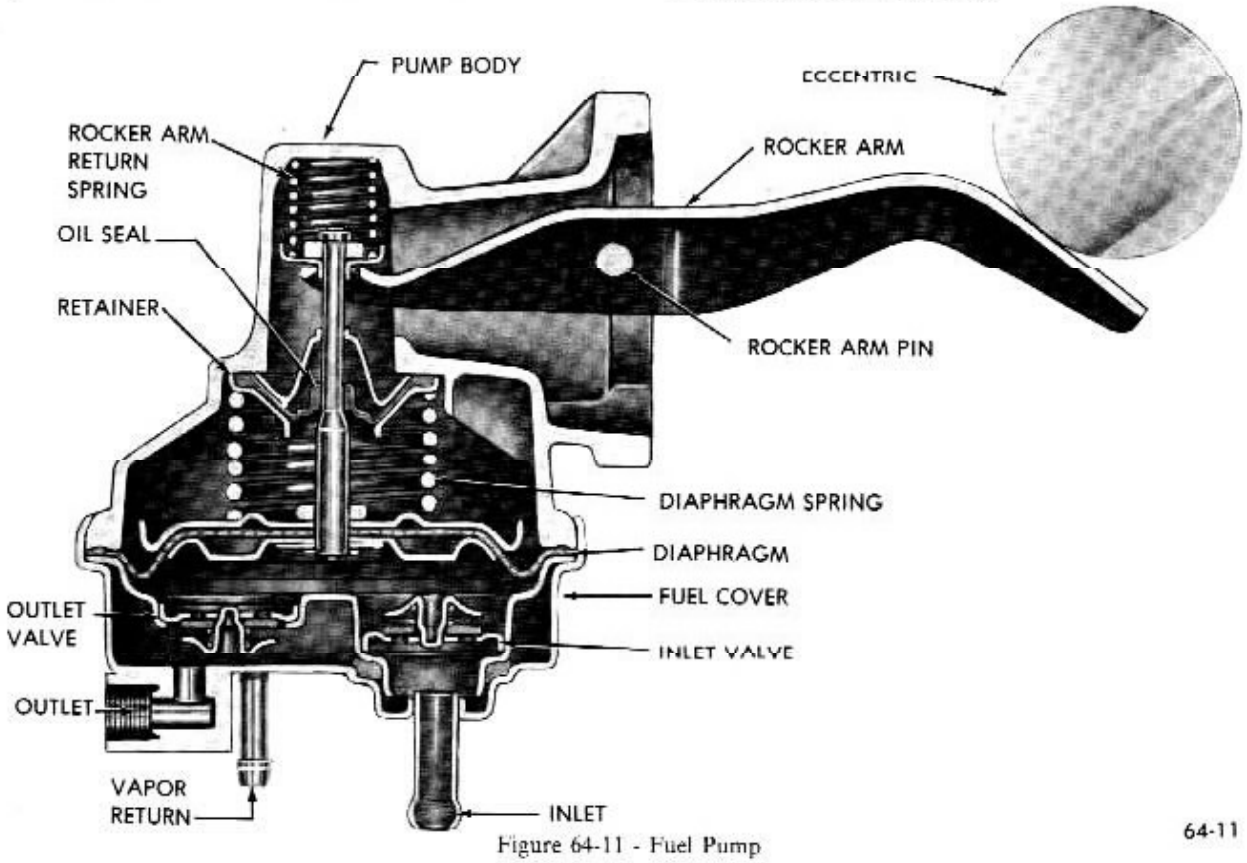


Figure 64-11 - Fuel Pump

3. Remove two 1/2 inch hex head bolts, using a 3/8 inch drive deep socket and a ratchet handle.

4. Remove old fuel pump.

b. Mechanical Fuel Pump Installation

1. Install new fuel pump with new gasket.

2. Install two 1/2 inch hex head bolts, driving them in alternately and evenly.

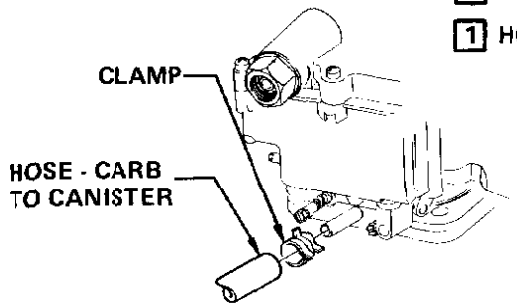
3. Install fuel outlet pipe. If it is difficult to start fitting, time can be saved by disconnecting upper end of pipe from carburetor. Tighten fitting securely, meanwhile holding fuel pump nut with a wrench. Install and tighten fitting at carburetor, if removed.

4. Install fuel inlet hose. Install vapor return hose, if so equipped.

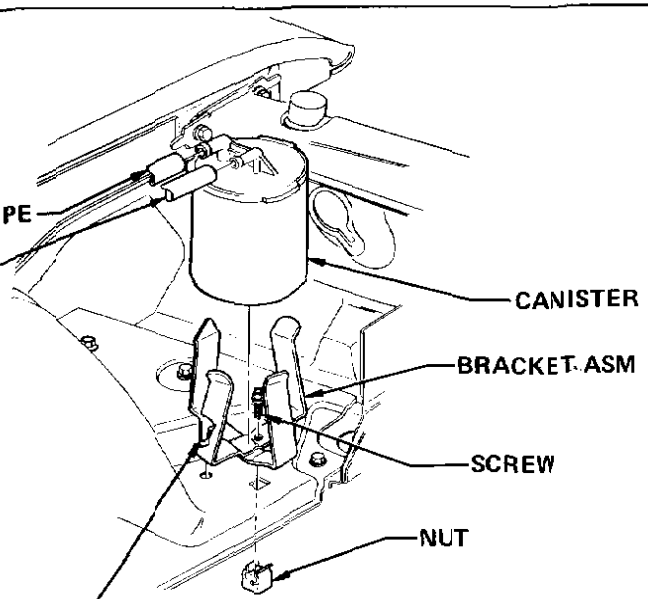
5. Start engine and check for leaks.

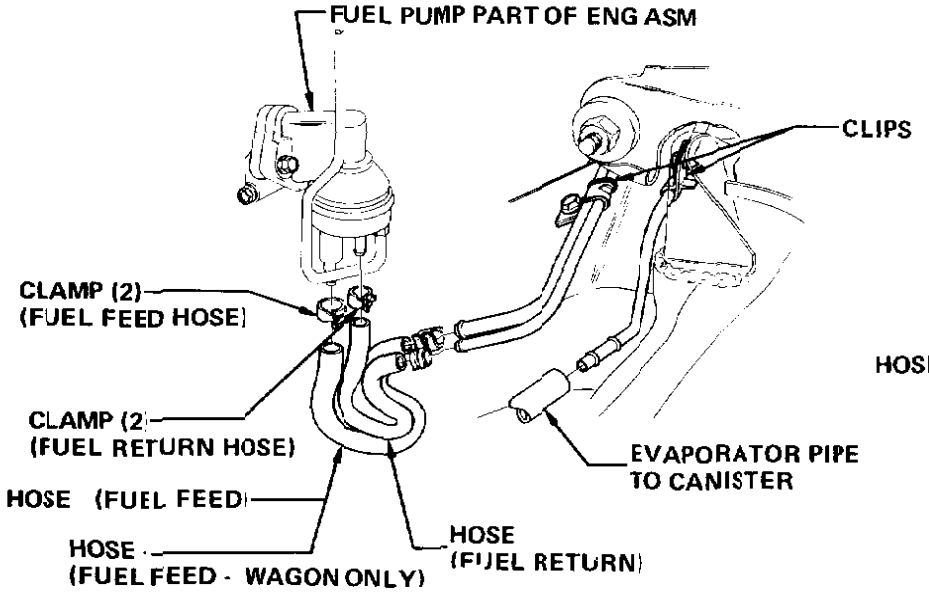
ALL LINES AND CONNECTIONS MUST BE FREE OF LEAKS UNDER OPERATING CONDITION.

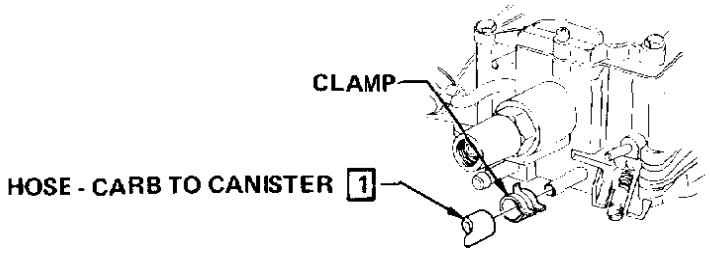
NOTE: ORIENT CLAMP TANGS SO THAT THEY CANNOT CONTACT ADJACENT HOSES.



VIEW OF CONNECTION ON 350 CU IN ENGINE 2 BBL







VIEW OF CONNECTION ON 455 CU IN ENGINE 350 CU IN ENGINE 4 BBL

64-12

Figure 64-12 - Carburetor, Fuel Pump, and Canister Hose Connections

GROUP 64

ENGINE

FUEL

Section	Subject
A	Engine Fuel System-General.
B	Fuel Pump . . . . .
C	Rochester 2GV Carburetor .
D	Rochester 4MV Carburetor .
E	Rochester MV Carburetor .

SECTION A

FUEL SYSTEM GENERAL
ALL SERIES

CONTENTS

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I	TROUBLE DIAGNOSIS:	
	Hard Starting	64-1
	Improper Engine Performance	64-2
	Excessive Fuel Consumption	64-3
II	DESCRIPTION AND OPERATION:	
	Description of Engine Fuel System	64-4
III	ADJUSTMENTS AND MINOR SERVICE:	
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	Throttle Linkage and Dash Pot Adjustments	64-6
	Air Cleaner, Fuel Filter and Vent Valve Service	64-7
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V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS:	
	Specifications and Adjustments	64-8

DIVISION I

TROUBLE DIAGNOSIS

64-1 HARD STARTING

a. Improper Starting Technique

Hard starting may be due to improper starting technique. If possible, observe the owner's method of starting; if not correct, suggest that he use the following procedure.

1. *Automatic Transmission.* Place control lever in "P" or "N" position. Starter cannot be operated in any other position.

Place control lever in neutral and depress clutch pedal to floor. Starter cannot be operated unless clutch pedal is depressed.

2. *Engine Cold.* Depress accelerator pedal to floor once, release and remove foot completely from accelerator pedal. This presets the automatic choke and throttle.

Engine Warm. Hold accelerator pedal about 1/3 down.

3. Turn ignition switch to "START" and release when engine starts. As soon as the engine is running smoothly, depress the accelerator pedal to slow the engine down to warm up speed.

If the engine is warm, but fails to restart promptly, there may be an excess of fuel or "flooding" (this is more likely to occur at low temperatures).

Flooding. Hold the accelerator pedal to the floor (fully depressed) while cranking the engine; this opens the choke to "unload" any excess fuel. When the engine fires, do not immediately release the accelerator pedal, but hold it down until the engine speed increases.

If the engine has not been started for several days, most of the fuel will have evaporated from the carburetor. Pumping the accelerator pedal, while cranking, will pump fuel directly into the engine which will hasten the start.

b. Improper Ignition

Before attempting any correction in fuel system make certain that the battery and ignition system are in proper condition. See paragraph 120-2 and 68-22.

c. Improper Adjustment of Fast Idle Cam or Choke Unloader

An incorrectly-adjusted fast idle cam may not provide sufficient throttle opening and stalling will result.

If the choke unloader goes into action too soon it may cause hard starting when engine is cold. If choke unloader goes into action too late or not at all, it may cause hard starting when engine is flooded.

d. No Fuel at Carburetor

Fuel may not be delivered to carburetor due to empty gasoline tank or stoppages in filters, strainers or feed hoses, or inoperative fuel pump. Test fuel supply as described in paragraph 64-9.

e. Improper Carburetor Adjustment

A high fuel level in float bowl will cause flooding and consequent hard starting. Adjust carburetor (par. 64-5).

f. Low Grade Gasoline

Low grade gasoline is usually insufficiently volatile to provide easy starting in cold weather even though it may perform reasonably well after the engine is started and warmed up. A change to high grade gasoline is the only remedy.

g. Volatile Gasoline

In some parts of the country, gasolines are marketed which are very volatile and generally advertised as "easy starting gasolines." Some of these fuels are so volatile they boil (commonly referred to as "percolation") in a carburetor bowl which is only normally warm, especially when the engine is shut off following a run. This overloads the manifold, resulting in an over rich mixture which may cause "delayed" starting.

64-2 IMPROPER ENGINE PERFORMANCE

a. Engine Idles Too Fast

A cold engine should operate on fast idle for two to five minutes depending on air temperature. At 32 degrees F. the fast idle cam should move to slow idle position in approximately 1/2 to 1 1/4 mile of driving. At high temperatures it should move to slow idle position in a correspondingly shorter distance.

If the engine operates too long on the fast idle cam, check the choke coil ro setting and the fast idle d cam adjustment.

If the engine idles faster than the specified idle speed when off the fast idle cam, check throttle linkage for binding or weak return spring and adjust throttle stop screw (par. 64-6). This trouble can also be caused by a sticking choke.

b. Improper Idle and Low Speed Performance

Rough idling and tendency to stall may be caused by idling speed set below the specified idle speed.

Rough idling, poor performance, and back firing at low speeds frequently originates in improper ignition. Check ignition system.

High fuel pump pressure will cause rough idling and poor low speed performance (par. 64-10).

An intake manifold air leak will cause rough idling and poor low speed performance. A manifold air leak produces a low, erratic reading on a vacuum gage connected to the intake manifold.

Check for leaks at all pipe connections and check manifold joints with gasoline.

When rough idling and poor low speed performance cannot be corrected by checks of carburetion and ignition mentioned above, check cylinder compression.

Improper performance which is most noticeable at low speeds may be caused by sticking valves.

Sticking valves may be caused by the use of low grade fuel or fuel that has been in storage too long. *When a car is stored for any length of time, fuel should be drained from the tank, feed hoses, fuel pump, and carburetor in order to avoid gum formation.*

c. Improper High Speed Operation

Roughness or poor performance above 22 MPH indicates faulty ignition (par. 68-13) or improper settings in the high speed circuit of carburetor. Surging at high speed may be caused by low fuel pump pressure (par. 64-10).

Surging at 75 to 80 MPH constant speed indicates that the power jet is stopped up or the vacuum piston is sticking.

If there is lack of power at top speed, check throttle linkage to insure full throttle valve opening (par. 64-6).

d. Excessive Detonation or Spark Knock

Light detonation may occur when operating a synchromesh car in high gear with full throttle between 14 and 22 MPH, or when operating an automatic transmission car in Drive with full throttle at low speed even when ignition timing is correct and proper fuel is used. This light detonation is normal and no attempt should be made to eliminate it by retarding the ignition timing, which would reduce economy and over-all performance.

Heavy detonation may be cause by improper ignition d timing (par. 68-19), improper grade of fuel, or by an accumulation of carbon in combustion chambers.

Heavy detonation is injurious to any automotive engine. A car driven continuously under conditions and fuels which produce heavy detonation will overheat and lose power, with the possibility of damage to pistons and bearings.

64-3 EXCESSIVE FUEL CONSUMPTION

Complaints of excessive fuel consumption require a careful investigation of owner driving habits and operating conditions as well as the mechanical conditions of the engine and fuel system; otherwise, much useless work may be done in an attempt to increase fuel economy.

Driving habits which seriously affect fuel economy are: high speed driving, frequent and rapid acceleration, driving too long in a low speed range when getting under way, excessive idling while standing.

Operating conditions which adversely affect fuel economy are: excessive acceleration, frequent starts and stops, congested traffic, poor roads, hills an d mountains, high winds, low tire pressures.

High speed is the greatest contributor to low gas mileage. Air resistance increases as the square of the speed. For instance, a car going sixty miles an hour must overcome air resistance four times as great as when going thirty miles an hour. At eighty miles an hour the resistance is over seven times as great as when going thirty miles an hour.

Over seventy-five per cent of the power required to drive a car eighty miles an hour is used in overcoming air resistance, while at thirty miles an hour only thirty per cent of the power required is used to overcome air resistan e.

Gas mileage records made by car owners never give a true picture of the efficiency of the engine fuel system since they include the effects of driving habits and operating conditions. Because of the wide variation in these conditions, it is impossible to give average mileage figures for cars in general use: therefore, any investigation of a mileage complaint must be based on an accurate measurement of gasoline consumption per mile under proper test conditions.

a. Gasoline Mileage Test

A gas mileage test should be made with an accurate measuring device on a reasonably level road, at fixed speeds, without acceleration or deceleration. Test runs should be made in both directions over the same stretch of road to average the effect of grades and wind resistance. Test runs made at 30-50 and 70 MPH will indicate the approximate efficiency of the low speed, high speed, and power systems of the carburetor and show whether fuel consumption is actually abnormal. If a mileage test indicates that the fuel consumption is above normal, check the following items.

1. *Fuel Leaks.* Check all gasoline hose connections, fuel pump, gasoline filter, and carburetor bowl gasket.

2. *Tires.* Check for low tire pressures.

3. *Brakes.* Check for dragging brakes.

4. *Ignition Timing--Spark Plugs.* Late ignition timing causes loss of power and increases fuel consumption. Dirty or worn out spark plugs are wasteful of fuel.

5. *Low Grade Gasoline.* Use of gasoline of such low grade that ignition timing must be retarded to avoid excessive detonation will give very poor fuel economy.

6. *Air Cleaner.* Check for dirty or clogged cleaner element (par. 64-7).

7. *Automatic Choke.* Check for sticking choke valve and improper setting of choke coil rod.

8. *Valves.* Check for sticking valves.

9. *Fuel Pump.* Check for excessive fuel pump pressure (par. 64-9).

10. *Carburetor Adjustment.* Check idle speed adjustment (par. 64-5).

For all other adjustments to high speed and power systems, the carburetors must be removed and disassembled.

b. Changing Carburetor Calibrations

Under no circumstances should the jet sizes, metering rods, and other calibrations of a carburetor be changed from factory specifications. The calibrations given in the calibrations paragraph must be adhered to unless these are later changed by a bulletin issued from the Buick Service Department.

DIVISION II

DESCRIPTION AND OPERATION

64-4 DESCRIPTION OF ENGINE FUEL SYSTEM

a. Fuel Filter

All engines have a pleated paper fuel filter located in the carburetor inlet.

All cars have a woven plastic fuel filter in the fuel tank on the lower end of the pick-up pipe.

b. Fuel Pump

The fuel pump is mounted at the lower left side of the timing chain cover on V-8 engines, and the lower right side on L-6 engines. It is actuated by an eccentric mounted on the front end of the camshaft. The pump is inverted, thereby placing it in a lower, cooler location. It has a built-in air pocket to dampen out pulsations in fuel pressure. The construction and operation of the fuel pump are described in Section 64-B.

All V-8 air conditioner equipped cars have a special fuel pump which has a metering outlet for a vapor return system. Any vapor which forms is returned to the fuel tank along with hot fuel through a separate line alongside the supply line. This greatly reduces any possibility of vapor lock by keeping cool fuel from the tank constantly circulating through the fuel pump. All 455 engines have the vapor return system regardless of whether or not the car is equipped with an air conditioner.

c. Air Cleaner and Intake Silencer

All engines are equipped with oiled paper element air cleaners as standard equipment; the optional heavy duty air cleaner is identical except that it contains a two layer element of oiled polyurethane and oiled paper. The air cleaner removes abrasive dust and dirt from the air before it enters the engine through the carburetor. The intake silencer reduces to a very low level the roaring noise made by the air as it is drawn through the intake system. The cleaner and silencer also functions as a flame arrester in event of "backfire" through the intake system.

There are five standard air cleaner and silencer assemblies: one for L-6 engines, one for 350 two- barrel carburetor engines, one for standard four barrel carburetor engines, one for G.S. 350-455 engines and one for G.S. Riviera engines.

Before installing an air cleaner, always make sure the air cleaner gasket is in good condition and is properly located on the carburetor flange. It is important to securely tighten the wing nut *by hand* to make sure the air cleaner remains stationary and to make sure the gasket seals properly.

For normal operating conditions, the element should be replaced every 24,000 miles (more often under dusty operating conditions).

d. Throttle Linkage and Dash Pot

All 1971 Buicks have a flexible cable-type throttle linkage that is not adjustable.

On all automatic transmission cars, a dash pot is mounted in position to be contacted by an arm of the carburetor throttle lever as the throttle is closed. The dash pot cushions the closing of the throttle to prevent engine stalling when the accelerator pedal is suddenly released.

On all automatic transmission cars, a transmission downshift mechanism is mounted inside the car just above the accelerator pedal. When the accelerator pedal is moved to wide open throttle position (fully depressed), the mechanism operates, causing the transmission to "downshift". See Figure 64-7 thru 10.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

64-5 CARBURETOR IDLE SPEED AND MIXTURE ADJUSTMENTS

Idle Mixture: Correct mixtures for emission compliance and idle quality are pre-set by the manufacturer. All 1971 Buick carburetors are equipped with mixture limiters to maintain this adjustment (plastic caps installed over mixture screw heads). These mixtures should not be altered under normal circumstances. In the few exceptional cases, overhaul or rework (new throttle bodies, bowls, jets, etc.), where idle mixture requires readjusting, the following procedures must be carefully adhered to. Whenever idle mixtures are altered, a *Red* Service Cap must be installed to denote a change has been made and the proper procedures have been followed for emission compliance.

Carburetor adjustments should not be attempted until it is known that engine ignition and compression are in good order. Any attempt to adjust or alter the carburetor to compensate for faulty conditions elsewhere will result in high exhaust emissions and poor overall performance.

CAUTION: *Idle speed and mixture adjustments cannot be made satisfactorily with an abnormally hot engine. On any engine having a thermo vacuum switch, it is particularly important that idle adjustments be made at normal temperature so that these valves will be in normal position.*

The air cleaner must be left in place during engine warm-up and while making idle speed and mixture adjustments. The positive crankcase ventilator system should also be in good operating condition when making carburetor adjustments. Either of these items noticeably affects the air-fuel ratio at idle.

NOTE: *Any car which is equipped with an Automatic Level Control has a vacuum regulator valve which shuts off all vacuum to the air compressor during engine idle, thereby preventing compressor from operating and upsetting engine idle. Feel compressor with hand; if it is operating, this malfunction must be fixed before adjusting engine idle. See Group 40, Section B.*

a. Idle Speed and Mixture Adjustment (V-8 Engines)

1. Connect an accurate tachometer to engine.

2. Start engine and run it at fast idle until upper radiator inlet is hot and choke valve is wide open.

3. Disconnect and plug distributor vacuum line, start engine, and set ignition timing.

4. Adjust throttle stop screw to set idle speed according to specifications.

NOTE: *Carburetor speed screws are pre-adjusted to obtain specified engine RPM after the engine is broken in (approximately 500 miles). New engines are expected to idle as much as 100 RPM slower. If the idle speed is adjusted to specifications at new car delivery, care should be taken to reset it after a few hundred miles to prevent dieseling and improve idle quality.*

5. Adjust idle mixture needles, one at a time, to obtain highest tachometer reading. After highest reading is reached using mixture needles, readjust throttle stop screw and mixture screws, as required, to obtain 50 RPM faster than specified idle. Next, turn each mixture needle in (lean as required to reduce engine speed 25 RPM). This reduces idle speed to the recommended RPM.

6. Adjust fast idle speed on all four-barrel carburetors. Fast idle must be adjusted after slow (curb) idle speed and mixture have been adjusted. Automatic transmission cars are adjusted on the low step of the fast idle cam in "Drive" to 620 RPM. Manual transmission cars are adjusted on the low cam step to 720 RPM.

7. On V-8 engines with manual transmissions, check throttle control solenoid adjustment (see sub-paragraph c).

8. Connect distributor vacuum hose.

9. Install "red" service idle needle limiter caps on mixture screws.

b. Idle Speed and Mixture Adjustments (L-6 Engine)

1. Connect an accurate tachometer to engine.

2. Start engine and run it at fast idle until upper radiator inlet is hot and choke valve is wide open.

3. Disconnect and plug distributor vacuum line, start engine, set ignition timing, and stop engine.

4. Turn mixture screw *in* until it contacts seat lightly, then back *out* four (4) full turns.

5. Adjust idle mixture screw and idle speed screw to give best idle at 530 RPM (Automatic) and 625 RPM (Manual).

6. Finally, turn in idle mixture screw to achieve idle speed of 500 RPM (Automatic) and 550 RPM (Manual) without touching idle speed screw.

7. Check C.E.C. valve adjustment (see sub-paragraph d).

8. Connect distributor vacuum hoses.

9. Install "red" service idle needle limiter caps on mixture screw.

c. Throttle Control Solenoid Adjustment (V-8 Manual Transmission)

1971 350 and 455 engines with manual transmissions have a throttle control solenoid. See Figure 64-1. This solenoid is controlled by a transmission-mounted switch and provides a higher idle when in 3rd or 4th gear to reduce exhaust gas dilution and misfiring on closed throttle deceleration.

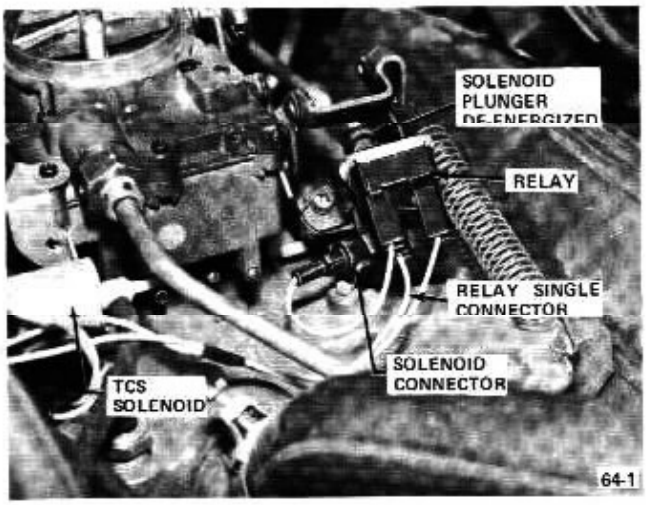

Figure 64-1 Throttle Control Solenoid (V-8 Man. Trans.)

The normal idle speed adjustment is made by adjusting the throttle stop screw on the carburetor with the transmission in "Neutral". The throttle control solenoid adjustment does not affect normal idle speed.

Although the throttle control solenoid is energized in 3rd or 4th gear, it can be energized in "Neutral" for adjustment, using the following procedure:

1. Position shift lever in "Neutral".

2. Start engine.

3. Disconnect solenoid connector wire.

4. Disconnect relay single connector and plug into solenoid connector, as shown in Figure 64-2.

5. Place throttle in hot idle position.

6. Adjust solenoid plunger bolt to obtain a speed of 1100 RPM.

NOTE: *Solenoid is assembled in production with plunger screwed in against stop of solenoid. If RPM is over 1100, the solenoid bracket may have to be adjusted back to obtain proper RPM.*

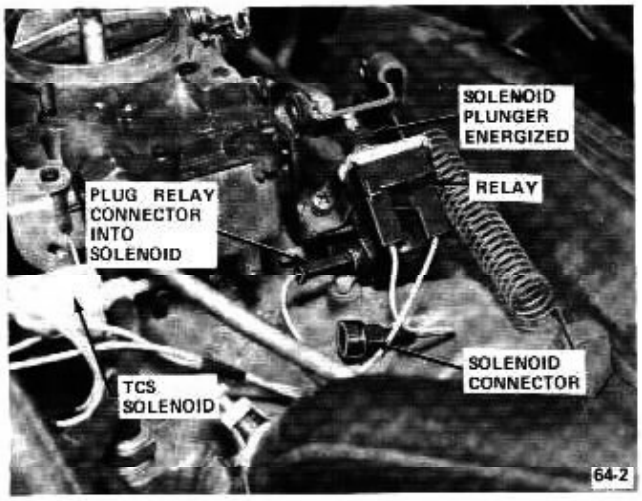

Figure 64-2 Throttle Control Solenoid Adjustment (V-8 Man. Trans.)

d. L-6 Engine, Combination Emission Control Valve Adjustment

The idle stop solenoid has been replaced by a combination emission control valve (C.E.C. valve). The 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 hydrocarbons, 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. Normal idle speed setting will be made with the idle stop screw.

This adjustment is to be made only after (1) replacement of the solenoid; (2) major overhaul of the carburetor is performed; or (3) the throttle body is removed and replaced.

The following procedure is used to adjust the C.E.C. valve controlled engine speed on a running engine (in "Neutral" for manual or in "Drive" for automatic transmissions), with distributor vacuum hose removed and plugged, and fuel tank hose from vapor canister disconnected.

1. Follow instructions on vehicle tune-up sticker before proceeding.

2. Manually extend the C.E.C. valve plunger to contact throttle lever. See Figure 64-3.

3. Adjust plunger length to obtain specified engine speeds.

4. Reconnect distributor vacuum hose and fuel tank vapor hose.

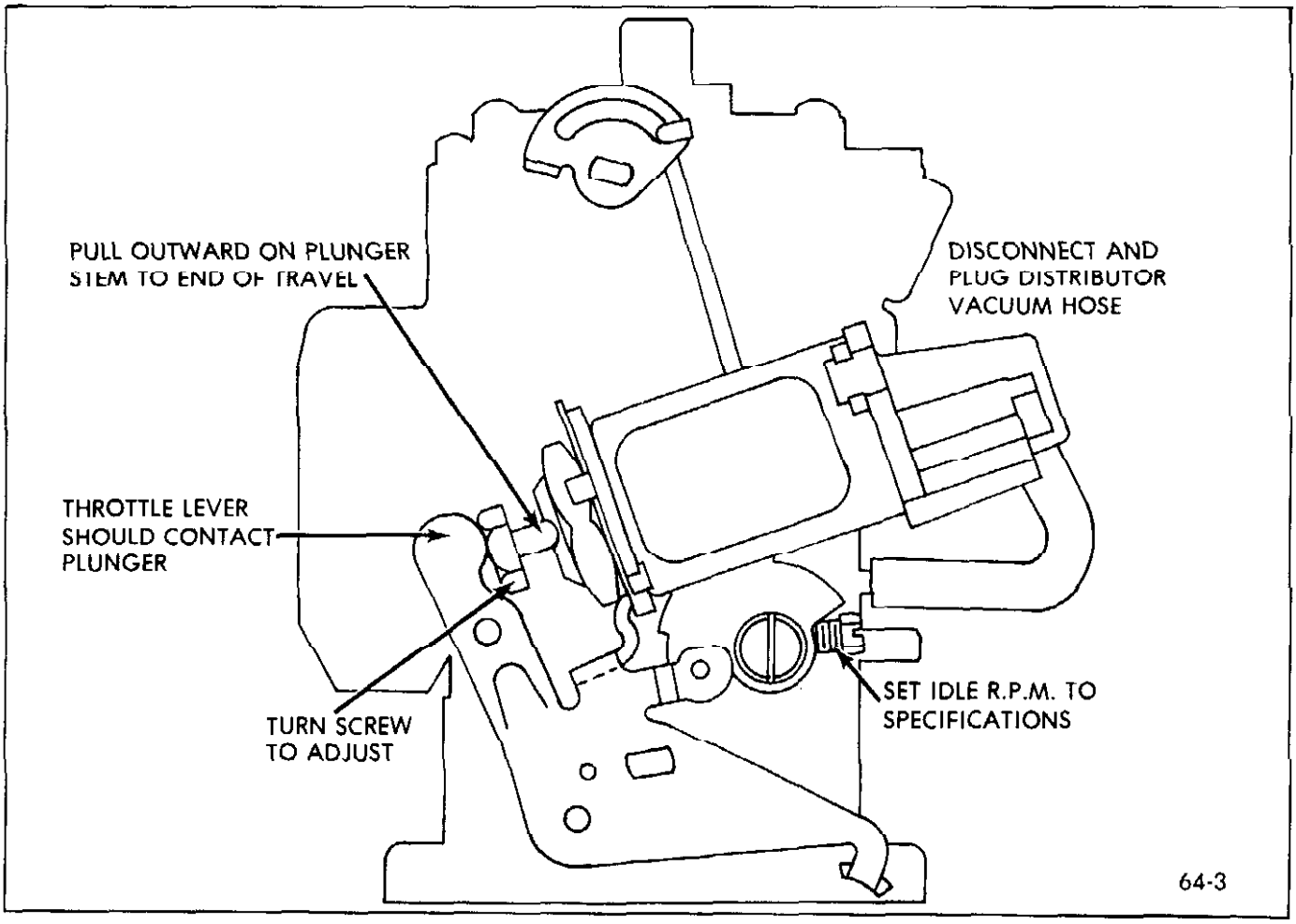

Figure 64-3 Combination Emission Control Valve Adjustment (L-6 Engine)

64-6 THROTTLE LINKAGE AND DASH POT ADJUSTMENTS

a. Throttle Linkage Check

All 1971 Buicks have a flexible cable-type throttle linkage that is not adjustable. The following check is for proper operation of the throttle cable.

1. Remove air cleaner.

2. Check throttle linkage for proper lubrication.

3. Make sure that linkage is free in all positions and that nothing touches or interferes with the linkage (inside and outside of car). Throttle cable must be routed correctly and free of any kinks or damage.

4. Hold choke open and make sure that return spring fully closes throttle, even though throttle is released very slowly.

b. Dash Pot Adjustments

Remove air cleaner. Check throttle linkage for proper lubrication. Make sure that linkage is free in all positions and that nothing touches or interferes with the linkage (inside and outside of car). Throttle cable must be routed correctly and free of any kinks or damage. Hold choke open and make sure that return spring fully closes throttle, even though throttle is released very slowly.

Before adjusting the dash pot, the engine idle speed should be correctly adjusted. With the engine idling at normal operating temperature, adjust the dash pot as follows:

1. While observing dash pot, open carburetor and allow throttle to snap closed. Time dash pot delaying action from the point where the throttle lever hits the dash pot to the point where the lever stops moving. The dash pot should delay or cushion closing action for one to two seconds. Measure two seconds by saying, "one thousand and one, one thousand and two."

2. As a final check, hold car with brakes and put transmission in drive, then jab accelerator pedal. If engine stalls, adjust dash pot for slightly more interference and recheck as necessary.

3. Tighten lock nut securely.

64-7 AIR CLEANER, FUEL FILTER AND VENTILATOR VALVE SERVICE

a. Air Cleaner Service

An air cleaner with a dirty element will not properly remove dirt from the air and the dirt entering the engine will cause abnormal formation of carbon, sticking valves, and wear of piston rings and cylinder bores.

Regular replacement of the element at 24,000 mile intervals (or more frequently in dusty territory) is necessary to prevent excessive engine wear.

b. Fuel Filter - All Engines

All engine fuel filters are located in the carburetor fuel inlet. See Figure 64-4. These fuel filter elements are of pleated paper. Elements are placed in the inlet hole with the cupped end outward. A spring holds the element outward, sealing it by compressing a gasket surface against the inlet fitting. If the element should ever become plugged, pump pressure is sufficient to depress the spring slightly so that some fuel by-passes the element. Thus, a plugged element, instead of causing a car stoppage on the road, allows the engine to continue running on unfiltered fuel. However, the spring pressure is designed to allow only enough fuel to by-pass to let the car run 50 to 60 MPH at a constant speed, or to cut-out at a much lower speed with heavy acceleration. If surging is encountered in the 50 to 60 MPH range, try several hard accelerations; if the engine also runs out of fuel during acceleration, the problem is insufficient fuel, and the most likely reason is a plugged filter. If the owner has "put-up" with this trouble for some time, there is probably dirt in the carburetor due to usage of unfiltered fuel and also due to "dumping" of dirt from the plugged filter element.

The carburetor inlet fuel filter should be replaced every 12,000 miles.

After assembling any filter element in the carburetor, always start the engine and check for leaks in the fuel line and fittings before installing the air cleaner.

c. Other Filters or Strainers

A woven plastic filter is located on the lower end of the fuel pickup pipe in the gas tank. This filter prevents dirt from entering the fuel line and also stops water unless the filter becomes completely submerged in water. This filter is self cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the gas tank contains an abnormal amount of sediment or water; the tank should therefore be removed and thoroughly cleaned.

d. Closed Positive Crankcase Ventilator System Service

All cars have a closed positive crankcase ventilating system to help reduce air pollution and to provide more complete scavenging of crankcase impurities. Ventilation air is drawn through a filter assembly located in the air cleaner, through a hose, into the left rocker arm cover, down into the crankcase, across and up into the rear of the intake manifold, up through the ventilator valve, through a hose, and into the intake manifold. Intake manifold vacuum draws any fumes from the crankcase to be burned in the engine. See Figure 64-6.

When air flow through the carburetor is high, added air from the positiv crankcase ventilating system e has no noticeable effect on engine operation; however, at idle speed, air flow through the carburetor is so low that any large amount added by the ventilating system would upset the air fuel mixture, causing rough - idle. For this reason, a flow control valve is used which restricts the ventilating system flow whenever intake manifold vacuum is high. See Figure 64-5.

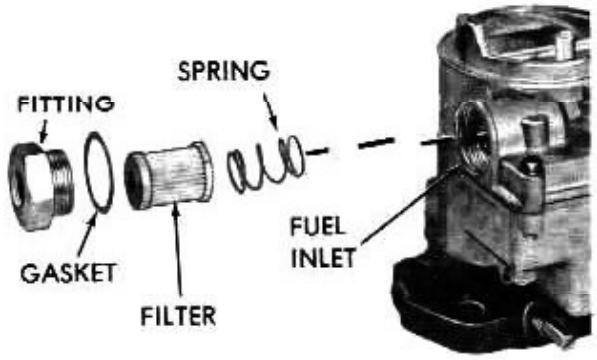

Figure 64-4 - Fuel Filter Parts

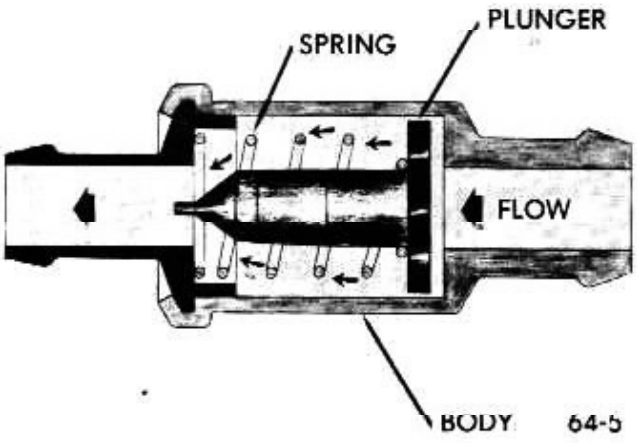

Figure 64-5 - Positive Crankcase Ventilator Valve

After a period of operation, the ventilator valve tends to become clogged, which reduces and finally stops all crankcase ventilation. An engine which is operated without any crankcase ventilation ca be n damaged seriously. Therefore, it is important to replace the ventilator valve periodically.

CAUTION: *If an engine is idling too slow or rough, this may be caused by a clogged ventilator valve or plugged*

hose; therefore, never adjust the carburetor idle without first checking the crankcase ventilator check valve and hose.

1. After installing a new ventilator valve, always readjust engine idle.

All cars have a closed P.C.V. system. With this system, any blow-by in excess of the system capacity (from a badly worn engine, sustained heavy load, etc.) is exhausted into the air cleaner and is drawn into the engine.

e. P.C.V. Filter

Inspect positive crankcase ventilator filter every 4 months or 6000 miles and replace if necessary. Remove filter from inside air cleaner by removing breather hose clamp, breather hose and filter retainer clip. See Figure 64-6 - Positive Crankcase Ventilator System.

Division VI Specifications

64-8 SPECIFICATIONS

Gasoline Tank Capacity (Approximately)
- Series 43-44000 ..... 20 Gal.
- Series 45-46-48000 ..... 25 Gal.
- Series 49000 ..... 25 Gal.

Gasoline Gauge, Make & Type ..... A.C. Electric
Fuel Pump, Make ..... A.C.
Fuel Pump, Type & Location
- L-6 Engine ..... Mechanical, Right Front Engine
- V-8 Engine ..... Mechanical, Left Front Engine

Fuel Pump Pressure — At Carb, Level
- 250-350Engines ..... 3 Lbs. Min.
- 455 Engine ..... 4-1/2 Lbs. Min.

Fuel Pump Volume ..... 1 Pt. in 30 Seconds or Less
Fuel Filter in Carb. Inlet, Make & Type
- 1 & 2-Barrel Carb. ..... A.C., 1 In. Paper, GF-427
- 4 Barrel Carb. ..... A.C., 2 In. Paper, GF-441

Fuel Filter, in Gas Tank ..... Woven Plastic
Carburetor, Make & Type ..... Rochester, Remote Choke Coil
Air Cleaner, Make & Material ..... A.C., Oiled Paper Element
Air Cleaner Element, Type—Standard
- L-6 Engines A169CW
- G.S. Engines A212CW
- All Other Engines A329C

Air Cleaner Element, Type—Heavy Duty
- L-6 Engines A227C
- G.S. Engines A279C
- All Other Engines A368C

Positive Crankcase Ventilator Valve, Type
- L-6 Engine CV-723C
- V-8 Engine CV-679C

Intake Manifold Heat, Type ..... Exhaust Crossover
Idle Speed (Automatics in Drive)
- 250 Eng. — Manual Transmission ..... 550 RPM
- 250 Eng. — Automatic Transmission ..... 500 RPM
- 350 Eng. — Manual Transmission ..... 800 RPM
- 350 Eng. — Automatic Transmission ..... 600 RPM
- 455 Eng. — Manual Transmission ..... 700 RPM
- 455 Eng. — Automatic Transmission ..... 600 RPM

Fast Idle Speed (On Low Step of Cam)	350 Eng.	455 Eng.
Automatic Transmission	650	650
Manual Transmission	820	720

C. E. V. Valve Adjustment for 250 L-6 ..... 850 Auto. 650 Man.

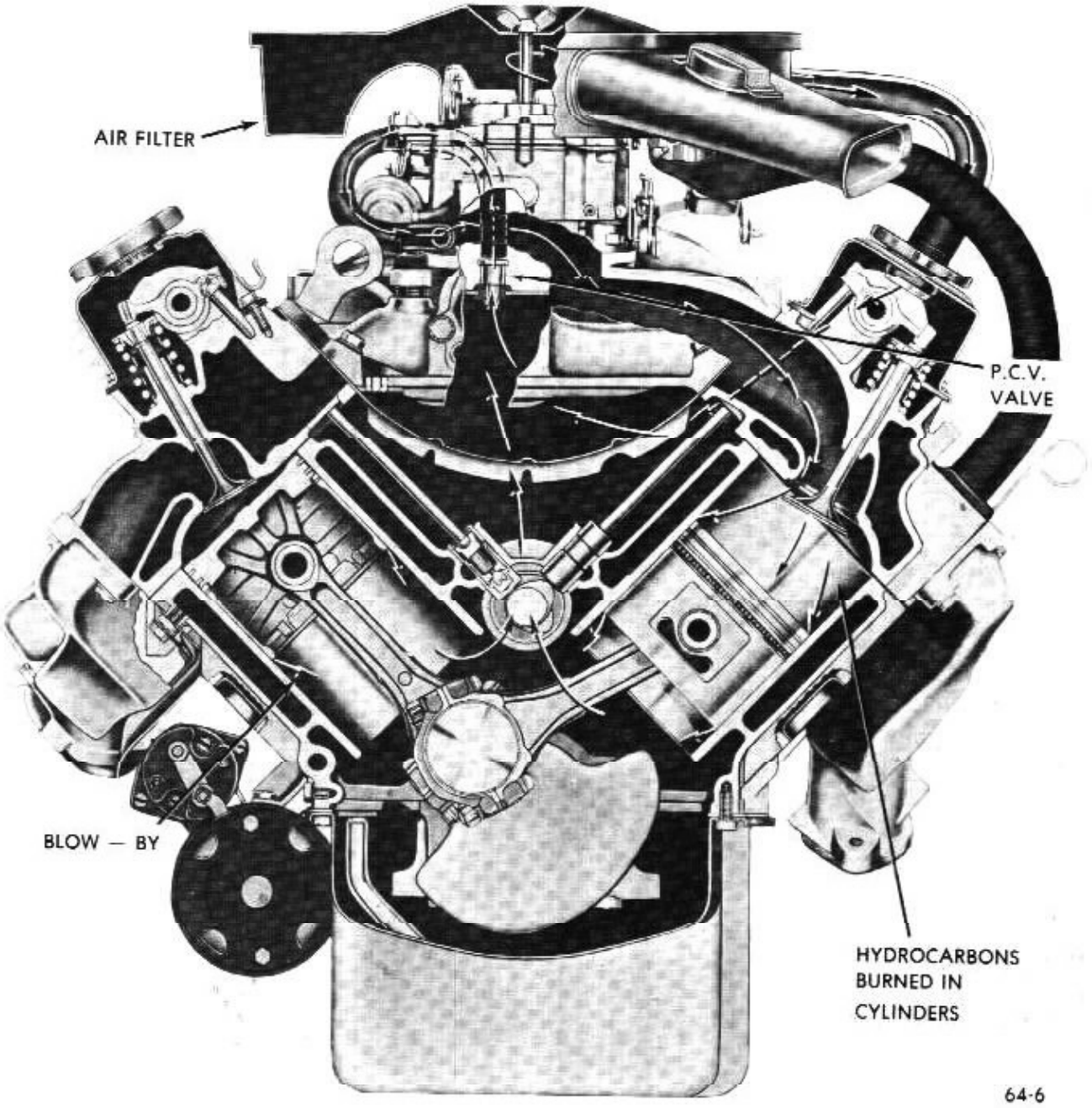

Figure 64-6 Positive Crankcase Vent System

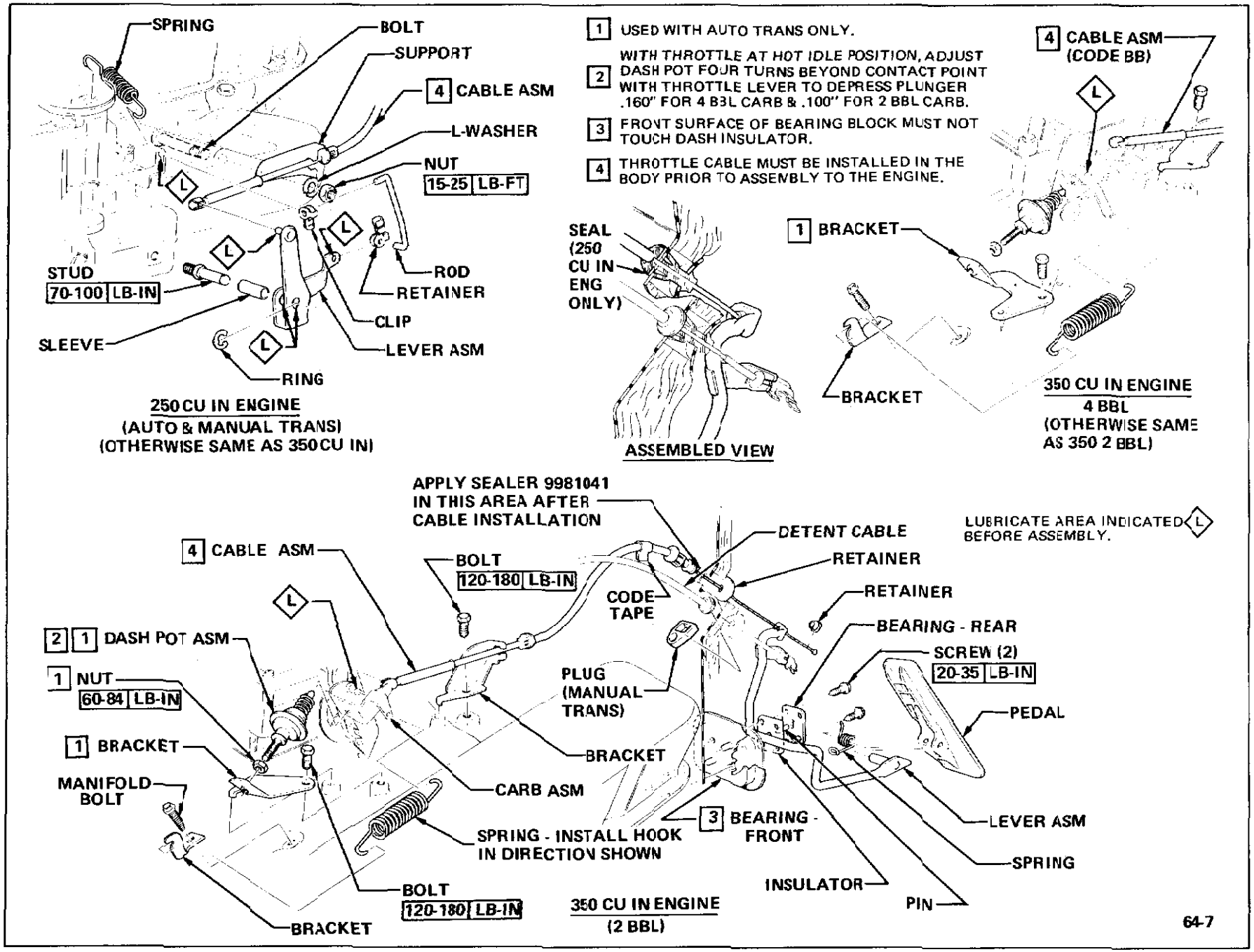

Figure 64-7 Throttle Controls (250 and 350 Cu.In. Engine) 43-44000

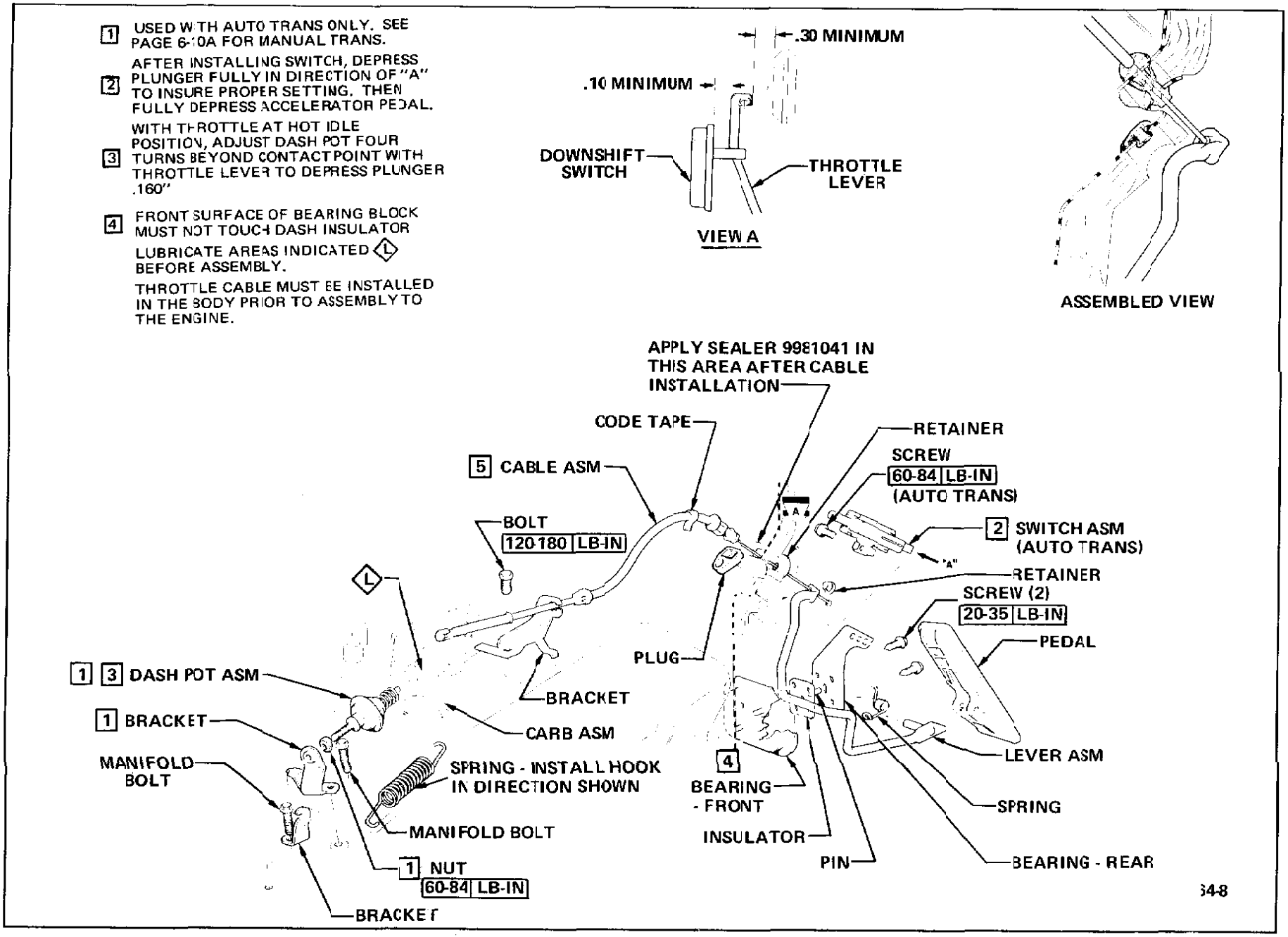

Figure 64-8 Throttle Controls (455 Cu.In. Engine) 43-44000

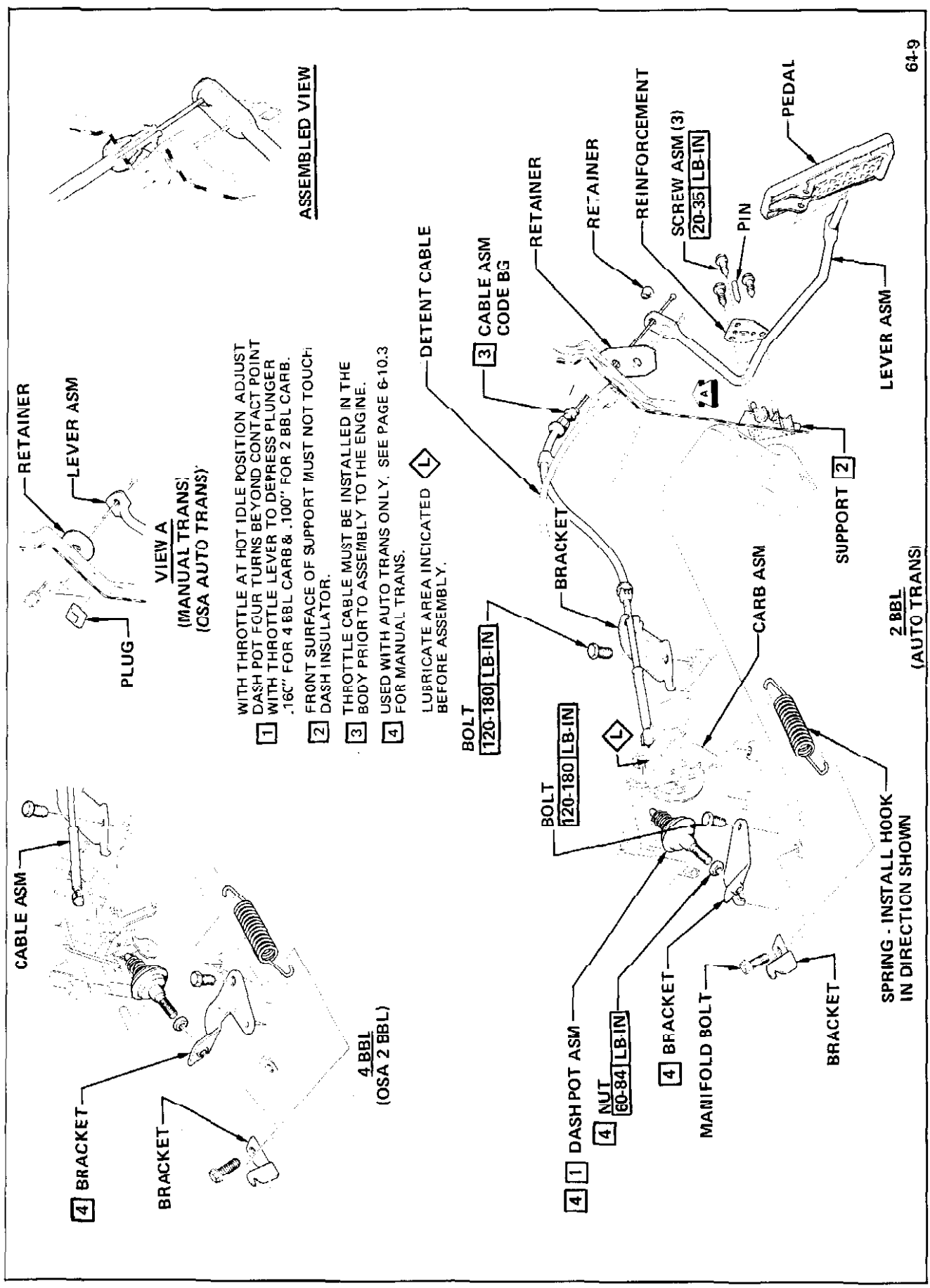

Figure 64-9 Throttle Controls (350 Cu.In. Engine) 4500C

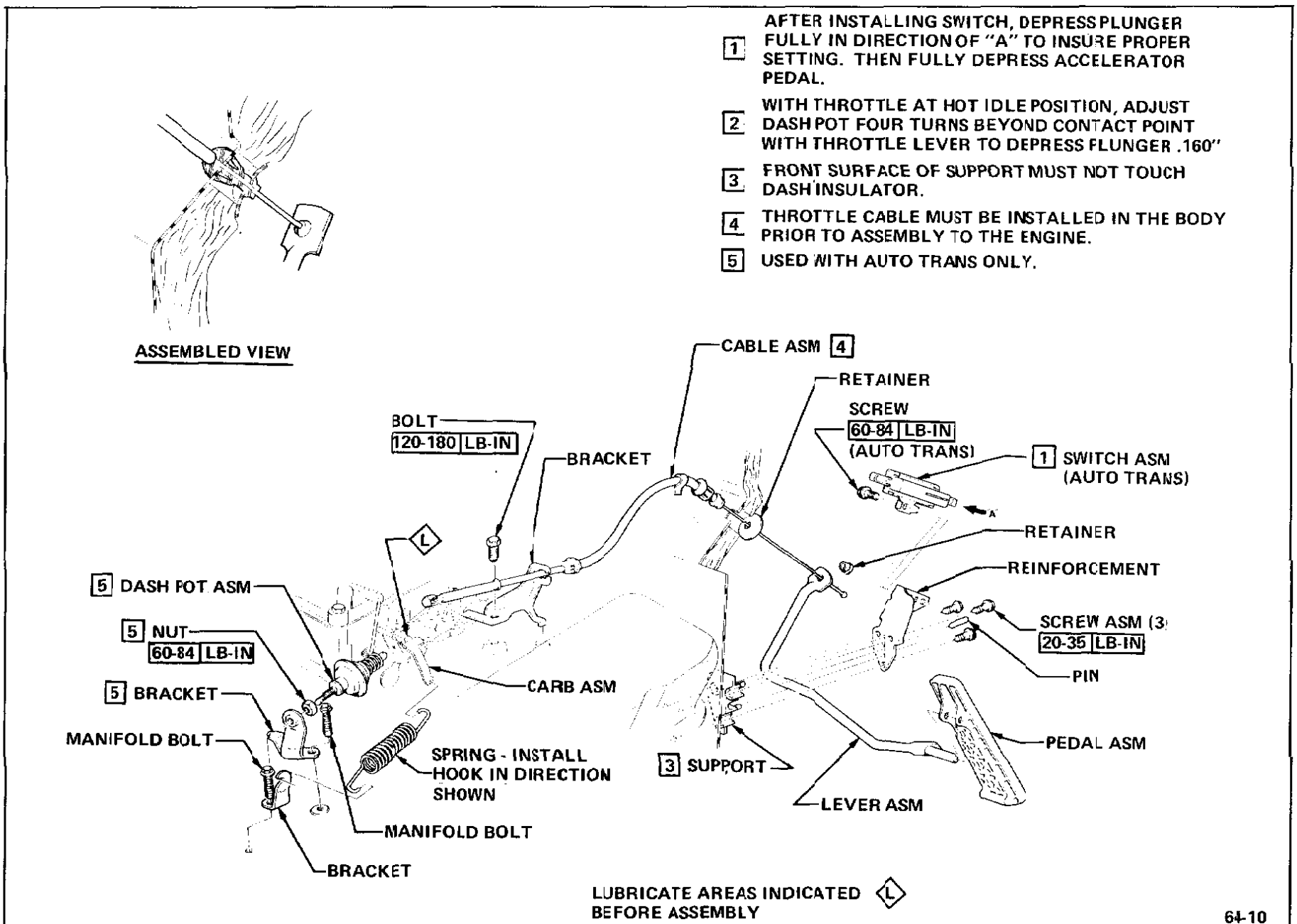

Figure 64-10 Throttle Controls (455 Cu.In. Engine) 45-46-48-49000

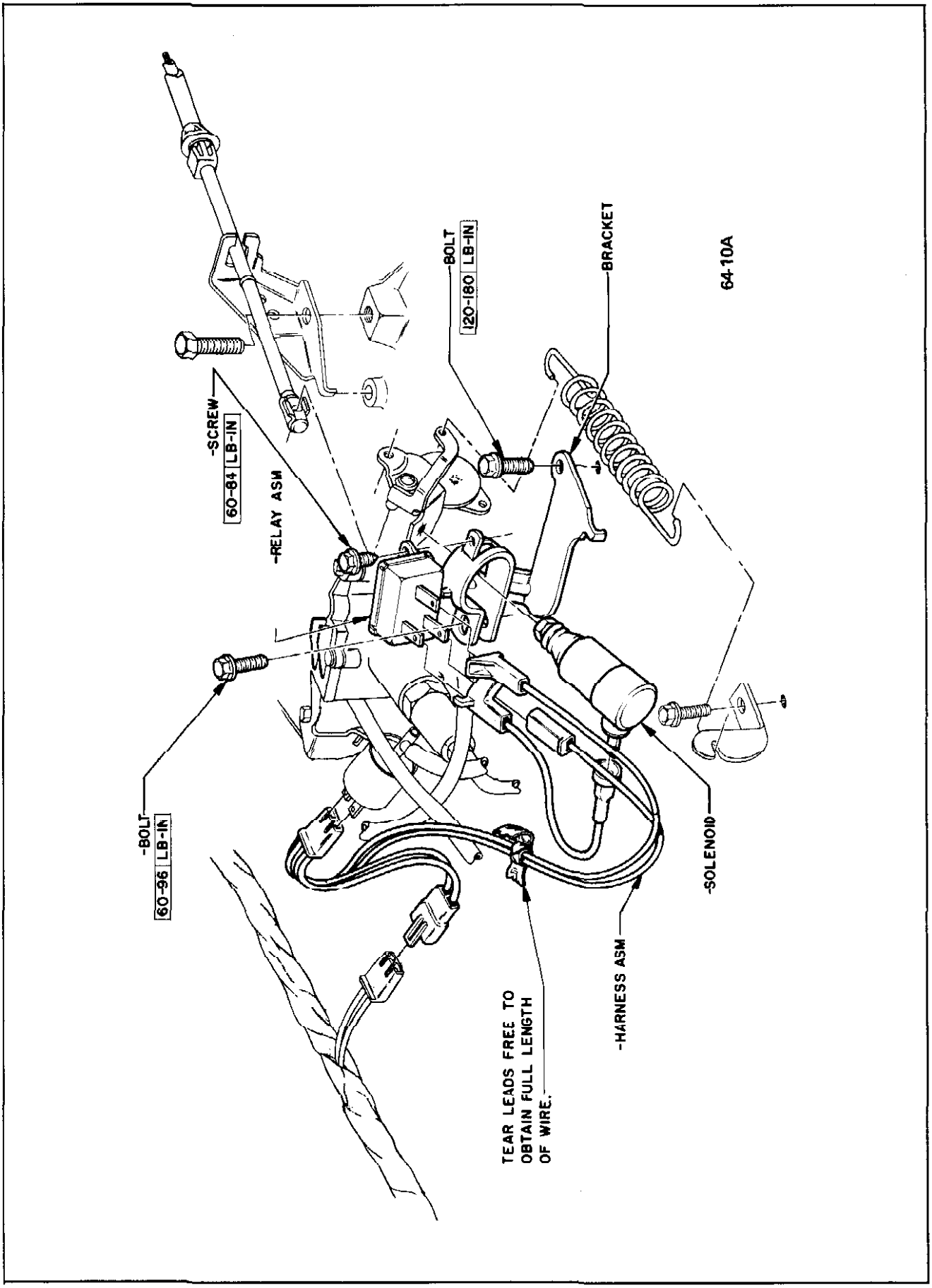

Figure 64-10A Throttle Controls - Solenoid (350 Engine 4BBL) Manual Transmission

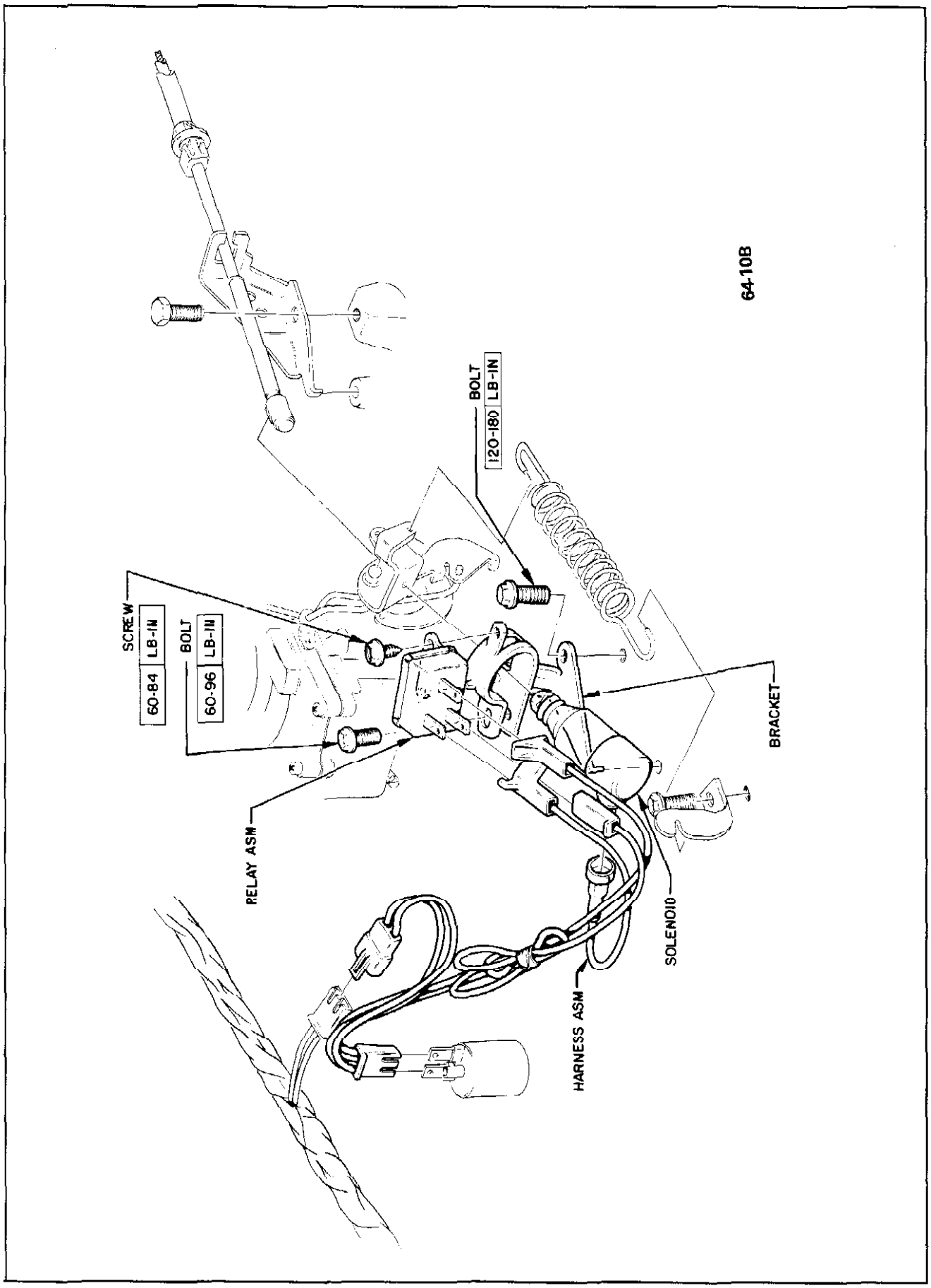

Figure 64-10B Throttle Controls - Solenoid (350 Engine 2BBL) Manual Transmission

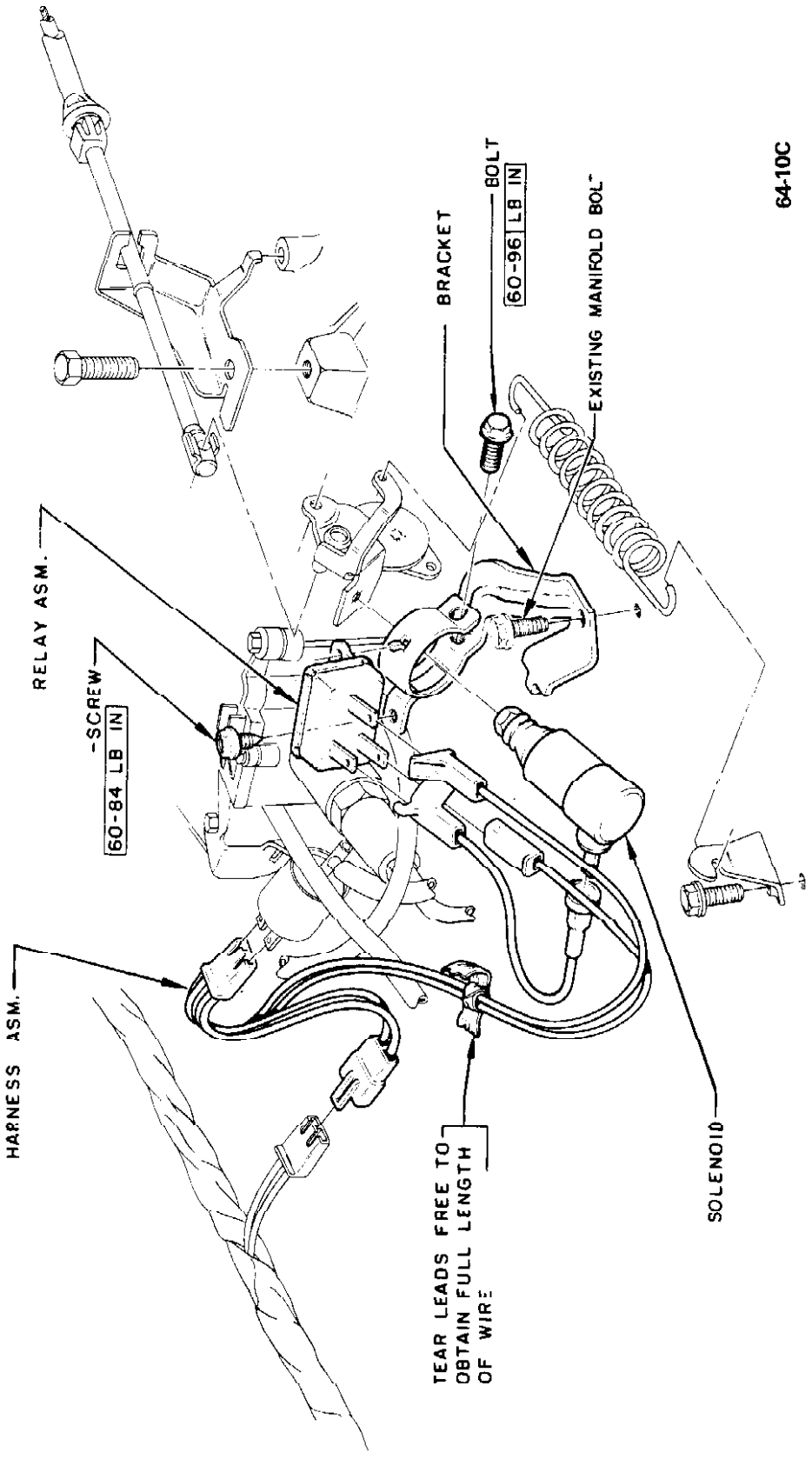

Figure 64-10C Throttle Controls - Solenoid (455 Engine) Manual Transmission

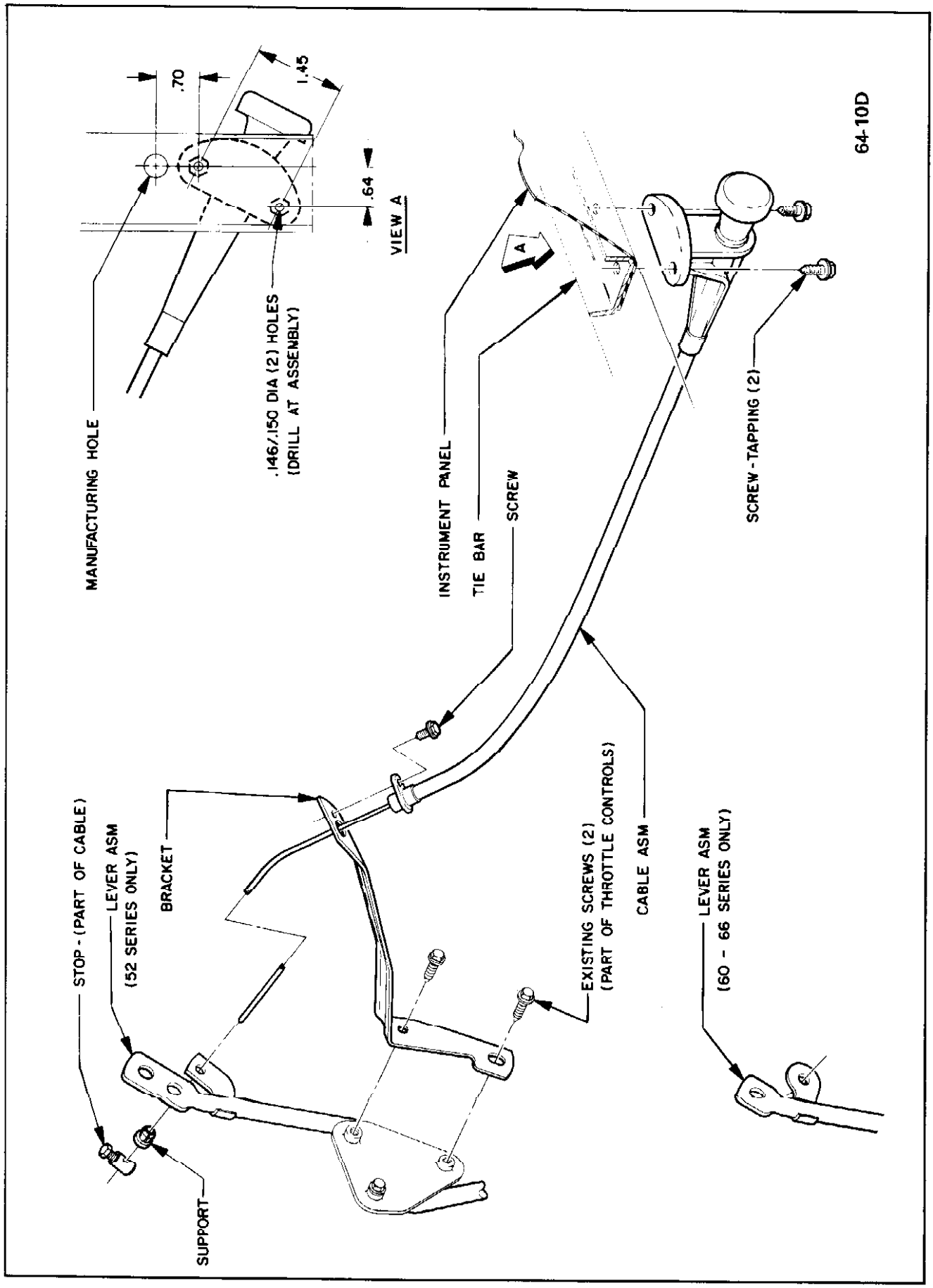

Figure 64-10D Manual Throttle Control - 45-46000 Series - Manual Transmission

SECTION B

"350" AND "455" CUBIC INCH V-8 ENGINES

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DIVISION I

TROUBLE DIAGNOSIS 60-22 EXCESSIVE OIL CONSUMPTION

Possible Cause	Correction
External Oil Leaks at: Rocker Arm Covers Timing Chain Cover Oil Pan and Gasket Between Oil Pan and Flywheel Housing Intake Manifold Gasket	Tighten attaching bolts. If leaks persist, remove cover (or pan), check sealing surfaces for burrs or scoring, replace gasket, and seal attaching bolts with Permatex #2 or equivalent. Make sure oil level is not overfull.
Improper Reading of Dip Stick	Car may not be level when taking reading. Insufficient oil "drain-back" time allowed after stopping engine (three minutes must be allowed). Dip stick may not be completely pushed down against stop. Dip stick may be bent.
Oil Viscosity too Light	Use recommended S.A.E. viscosity for prevailing temperatures.
Continuous High Speed	At speeds above 60 MPH, increased oil consumption can be expected with any engine. Inform customer of this fact.
High Speed Driving following Normal Slow Speed City Driving	When principal use of automobile is city driving, crankcase dilution from condensation occurs. High speed and temperatures will remove water, resulting in what appears to be rapid lowering of oil level. Inform customer of this fact.
Valve Guides and/or Valve Stem Seals Worn — Excessive Clearance	Ream out guides and install service valves with oversize stems and new valve stem seals. Refer to Paragraph 60-13.
Piston Rings not "broken in"	Allow engine to accumulate at least 4,000 miles before attempting any engine disassembly to correct for oil consumption.

60-23 NOISY VALVES AND LIFTERS

a. Noisy Valve Train

The noise level of the valve mechanism cannot be properly judged where the engine is below operating temperature when the hood is raised, or when the valve rocker arm covers are removed.

Before attempting to judge valve noise level, the engine must be thoroughly warmed up (at least 20 minutes of operation at 1200 to 1500 RPM) to stabilize oil and coolant temperatures and bring all engine parts to a normal state of expansion. When the engine is warmed up, listen for engine noise while sitting in the drivers seat with the hood closed. Run the engine at idle and at various higher speeds. It is advisable to observe the noise level in several engines that have been properly broken in, in order to develop good judgment for checking the noise level in any given engine.

If the preceding check indicates the valve mechanism is abnormally noisy, remove the rocker arm covers so that the various conditions that cause noise may be checked. A piece of heater hose of convenient length may be used to pick out the particular valves or valve train components that are causing abnormal noise. With the engine running at a speed where the noise is pronounced, hold one end of hose to an ear and hold other end about 1/2" from point of contact between rocker arm and valve stem. Mark or record the noisy valves for investigation of following causes.

(1) *Excessive Oil In Crankcase.* Crankcase oil level high enough to allow the crankshaft to churn the oil will cause air bubbles in the lubricating system. Air bubbles entering the hydraulic lifters will cause erratic operation resulting in excessive lash in the valve train. Locate and correct cause of high oil level, then run engine long enough to expel air from system.

(2) *Sticking, Warped or Eccentric Valves, Worn Guides.* Sticking valves will cause irregular engine operation or missing on a low speed pull and will usually cause intermittent noise.

Pour penetrating oil over the valve spring cap and allow it to drain down the valve stem. Apply pressure to the one side of the valve spring and then the other, and then rotate the valve spring about 1/2 turn. If these operations affect the valve noise, it may be assumed that valves should be reconditioned.

(3) *Worn or scored parts in the valve train.* Inspect rocker arms, push rod ends for scoring. Check for bent push rods. Check valve lifters and camshaft surfaces for scoring. Replace faulty parts.

(4) *Valves and seats cut down excessively.* Noisy and improper valve action will result if a valve and its seat have been refinished enough to raise the end of the valve stem approximately .050" above normal position. In this case it will be necessary to grind off the end of the valve stem or replace parts. The normal height of the valve stem above the valve spring seat is 1.933 inches, for 350 cu.in. engines and 2.082 inches for 455 cu.in. engines.

(5) *Faulty Hydraulic Valve Lifters.* If the preceding suggestions do not reveal the cause of noisy valve action, check operation of valve lifters as described in paragraph 60-33, subparagraph c.

b. Noisy Valve Lifters

When checking hydraulic valve lifters, remember that grit, sludge, varnish or other foreign matter will seriously affect operation of these lifters. If any foreign substance is found in the lifters or engine where it may be circulated by the lubrication system, a thorough cleaning job must be done to avoid a repetition of lifter trouble.

To help prevent lifter trouble, the engine oil and oil filter must be changed as recommended in Group 00. The engine oil must be heavy-duty type (MS marked on container) and must also conform to General Motors Specification 6041-M to avoid detrimental formation of sludge and varnish. A car owner should be specifically advised of these requirements when the car is delivered. Faulty valve lifter operation usually appears under one of the following conditions:

(1) *Rapping noise only when engine is started.* When engine is stopped, any lifter on a camshaft lobe is under pressure of the valve spring; therefore, leak down or escape of oil from the lower chamber can occur. When the engine is started a few seconds may be required to fill the lifter, particularly in cold weather. If noise occurs only occasionally, it may be considered normal requiring no correction. If noise occurs daily, however, check for (a) oil too heavy for prevailing temperatures (b) excessive varnish in lifter.

(2) *Intermittent Rapping Noise.* An intermittent rapping noise that appears and disappears every few seconds indicates leakage at check ball seat due to foreign particles, varnish, or defective surface of check ball or seat. Recondition, clean, and/or replace lifters as necessary.

(3) *Noise at idle and low speed.* If one or more valve lifters are noisy on idle at up to approximately 25 MPH but quiet at higher speeds, it indicates excessive leakdown rate or faulty check ball seat on plunger. With engine idling, lifters with excessive leakdown rate may be spotted by pressing down on each rocker arm above the push rod with equal pressure. Recondition or replace noisy lifters.

(4) *Generally noisy at all speeds.* Check for high oil level in crankcase. See subparagraph a (1) above. With engine idling, strike each rocker arm above push rod several sharp blows with a mallet; if noise disappears, it indicates that foreign material was keeping check ball from seating. Stop engine and place lifters on camshaft base circle. If there is lash clearance in any valve train, it indicates a stuck lifter plunger, worn lifter body lower end, or worn camshaft lobe.

(5) *Loud noise at normal operating temperature only.* If a lifter develops a loud noise when engine is at normal operating temperature, but is quiet when engine is below normal temperature, it indicates an excessively fast leak-down rate or scored lifter plunger. Recondition or replace lifter.

60-24 COOLING SYSTEM TROUBLE

a. Cooling System Trouble Diagnosis

If the radiator is filled too full when cold, expansion when hot will overfill the radiator and coolant will be lost through the overflow pipe. Adding unnecessary water will weaken the anti-freeze solution and raise the temperature at which freezing may occur.

If the cooling system requires frequent addition of water in order to maintain the proper level in the radiator, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold. Small leaks which may show dampness or dripping can easily escape detection when the engine is hot, due to the rapid evaporation of coolant. Tell-tale stains of grayish white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no damage.

Air or gas entrained in the cooling system may raise the level in radiator and cause loss of coolant through the overflow pipe. Air may be drawn into the cooling system through leakage at the water pump seal. Gas may be forced into the cooling system through leakage at the cylinder head gasket even though the leakage is not sufficient to allow water to enter the combustion chamber. The following quick check for air leaks on suction side of pump or gas leakage from engine may be made with a piece of rubber tubing and a glass bottle containing water.

1. With cooling system cold, add water to bring coolant to proper level.

2. Block open the radiator cap pressure valve, or use a plain cap, and be sure radiator cap is on tight. Attach a suitable length of rubber hose to overflow pipe.

3. Run engine in neutral at a safe high speed until the engine reaches a constant operating temperature.

4. Without changing engine speed, put the free end of rubber hose into a bottle of water, avoiding kinks or low bends that might block the flow of air.

5. Watch for air bubbles in water bottle. A continuous flow of bubbles indicates that air is being sucked into the cooling system, or exhaust gas is leaking into the cooling system past the cylinder head gasket.

b. Cooling System Overheating

It must be remembered that the Buick pressure system operates at higher temperatures than systems operating at atmospheric pressure. Depending on the pressure in cooling system, the temperature of permanent type anti-freeze may go considerably above 212 degrees F. without danger of boiling.

In cases of actual overheating the following conditions should be checked:

1. Excessive water loss.

2. Slipping or broken fan belt.

3. Radiator thermostat stuck, radiator air passages clogged, restriction in radiator core, hoses, or water jacket passages.

4. Improper ignition timing.

5. Shortage of engine oil or improper lubrication due to internal conditions.

6. Dragging brakes.

DIVISION II

DESCRIPTION AND OPERATION

60-25 ENGINE CONSTRUCTION

a. Engine Mounting

For details of engine and transmission mounts refer to Figures 60-124, 60-125, and 60-126.

b. Engine Construction

The 350, 455 cu. in. engines, with the exception of cylinder bore size and stroke are very similar. Because of the similarity between the two engines, the service procedures, unless otherwise specified will be combined.

The left bank of cylinders (as viewed from rear) is set slightly forward of the right bank so that connecting rods of opposite sides can be connected to the same crankpin. *Starting at the front of the engine, cylinders in the left* bank are numbered 1-3-5-7 and cylinders in the *right* bank are numbered 2-4-6-8.

The *crankshaft,* cast nodular iron, is supported in the crankcase by five bearings which are identical except number three, which takes end thrust and the rear main which has a different width and material. See Figure 60-60.

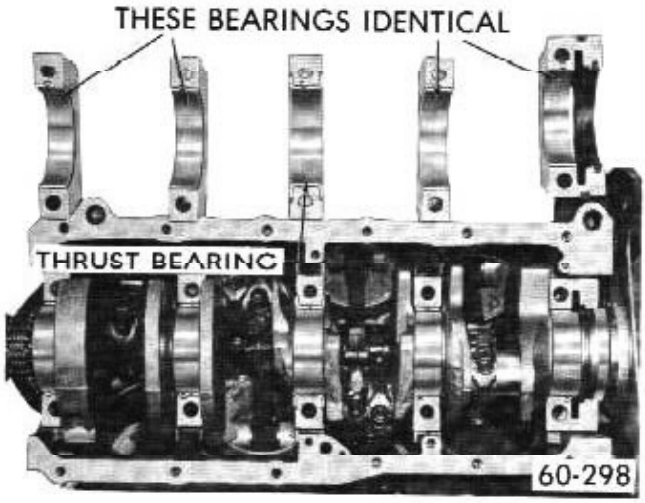


Figure 60-60 - Engine Crankshaft and Bearings

The *crankshaft* is counterbalanced by weights cast integral with the crankshaft. Additional counterbalancing is obtained by an offset flywheel flange.

The tin plated *aluminum alloy pistons* have full skirts and are cam ground. Two transverse slots in the oil ring grooves extend through the piston wall and permits drain back of oil collected by the oil ring.

The *camshaft* is supported in the crankcase by five steel-backed babbitt-lined bearings. It is driven from the crankshaft by sprockets and chain.

The *cylinder heads* are cast iron and incorporate integral valve stem guides and rocker arm shaft pedestals. The 455 STAGE I and the Riviera G.S. incorporate exhaust valve seat inserts which are pressed in at assembly. Right and left cylinder heads are identical and interchangeable, although in service, it is good practice to reinstall the cylinder heads on the side from which they are removed.

The intake manifold on the V-8 engine utilizes a low restriction, dual intake manifold. It is bolted to the inner edges of both cylinder heads so that it connects with all inlet ports. Since the intake manifold is cast iron, as is the carburetor throttle body, the manifold incorporates a special exhaust heat passage to warm the throttle body. Fuel-air mixture distribution to each intake port is shown in Figure 60-61.

Each *valve* has a spring of ample capacity to insure positive seating throughout the operating speed range. Intake valve heads are 1-7/8" (350 cu.in.) and 2" (455 cu.in.) in diameter and exhaust valves are 1-1/2" (350 cu.in.) and 1-5/8" (455 cu.in.) in diameter. In the 455 STAGE I and the Riviera G.S. versions, the intake valves are 2-1/8" in diameter; the exhaust valves are 1-3/4" diameter.

The valve rocker arms for each bank of cylinders are mounted on a tubular steel shaft supported on the cylinder

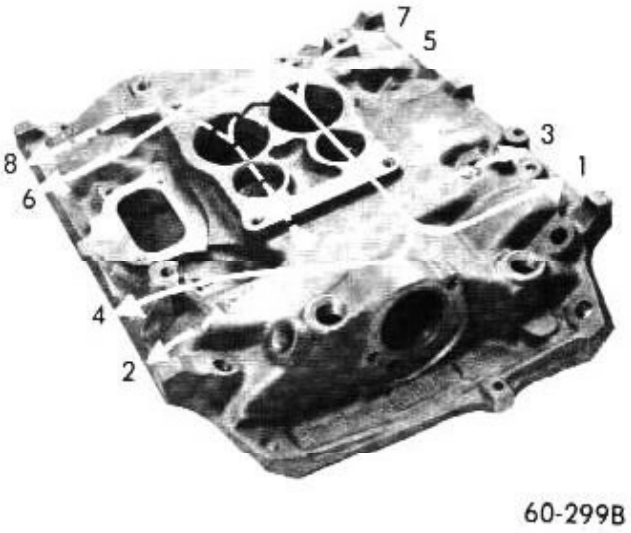


Figure 60-61 - Intake Manifold Distribution (350 Shown)

head by four pedestals. The rocker arms are die cast aluminum with inserts at the push rod sockets and the valve stem contact face. The rocker arm sockets are offset to accommodate the different planes of movement of the valve and the pushrods which pass through the cylinder head to one side of the valves. See figure 60-62.

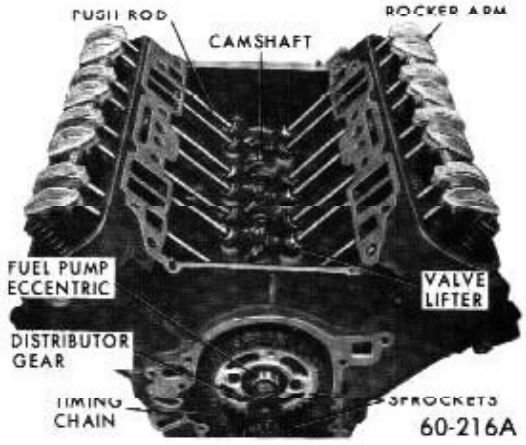


Figure 60-62 - Engine Valve Mechanism (455 Shown)

Hydraulic valve lifters and tubular push rods are used to operate overhead rocker arms and valves of both banks of cylinders from a single camshaft. This system requires no lash adjustment at time of assembly or in service. Construction and operation of hydraulic valve lifters are described below.

In addition to its normal function of a cam follower, each hydraulic valve lifter also serves as an automatic adjuster which maintains zero lash in the valve train under all operating conditions. By eliminating all lash in the valve train and also providing a cushion of oil to absorb operating shocks, the hydraulic valve lifter promotes quiet valve operation. It also eliminates the need for periodic valve adjustment to compensate for wear of parts

As shown in Figure 60-63 all parts of a hydraulic lifter are housed in the lifter body, which is the cam follower. The body and the plunger are ground to very close limits, then a plunger is selectively fitted to each body to assure free movement with very little clearance. The push rod seat is free to move with the plunger in the body and, as its name implies, it provides a spherical seat to support the lower end of the push rod.

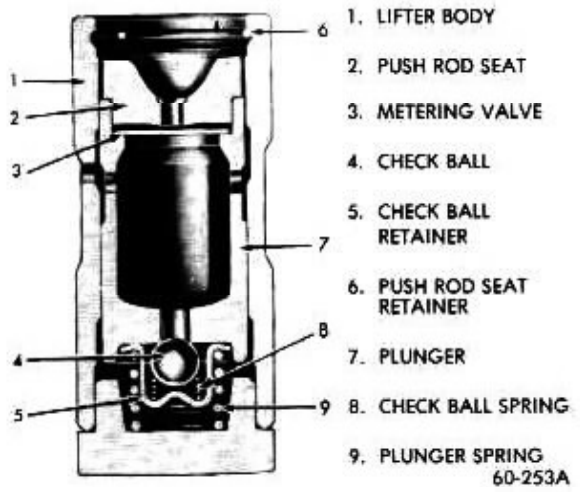


Figure 60-63 - Hydraulic Valve Lifter

The plunger and seat are pressed toward the upper end of the lifter body by a coil spring which also holds a check ball retainer against the lower end of the plunger. When lifter is out of engine, a spring wire retainer holds all parts in the body. The ball retainer holds a spring loaded check ball in position over the lower end of a feed hole in the plunger.

When the valve lifter is installed in the engine, the push rod holds the seat and plunger downward and clear of the plunger retainer at all times. The plunger spring then presses the lifter body down against the camshaft and presses the plunger and seat up against the push rod with an eight pound load: this is enough to take up all lash clearances between parts in the valve train without affecting positive seating of the valve.

Oil is fed to all lifters through galleries in the crankcase. Oil enters each lifter through grooves and oil holes in the lifter body and plunger, flows down into the chamber below the plunger through the feed hole and around the check ball. The first few cycles of operation after the engine is started forces out all air and completely fills the plunger and lower chamber of each lifter with oil.

At the start of a cycle of valve operation, the lifter body rests on the camshaft base circle. The plunger spring absorbs all lash clearances of the valve train.

As the rotating camshaft starts raising the valve lifter body, oil in the lower chamber and the check ball spring firmly seat the check ball against the plunger to prevent appreciable loss of oil from the lower chamber. The lifting force against the body is then transmitted through the entrapped oil to the check ball and plunger so that the plunger and push rod seat move upward with the body to operate the linkage which opens the engine valve.

As the camshaft rotates further to close the engine valve, the valve spring forces the valve train and lifter to follow the cam down. When the engine valve seats, the valve train parts and lifter plunger stop but the plunger spring forces the body to follow the cam downward .002" to .003" until it again rests on the camshaft base circle. Oil pressure against the check ball from the lower chamber ceases when the plunger stops and allows passage of oil past the check ball into the lower chamber to replace the slight amount of oil lost by "leak-down".

During the valve opening and closing operation a very slight amount of oil escapes through the clearance between plunger and body and returns to the crankcase. This slight loss of oil (called "leak-down") is beneficial in providing a gradual change of oil in the lifter, since fresh oil enters the lower chamber when pressure is relieved on the check ball at the end of each cycle of operation.

When engine temperature increases and the valve train components expand, the plunger must move to a slightly lower position in the lifter body to assure full closing of the engine valve. When engine temperature decreases and the valve train components contract, the plunger must move to a slightly high position in body to prevent lash clearance in the valve train. In either case, the capacity of the lower chamber changes and the volume of oil present is automatically controlled by passage of oil through the plunger feed hole.

60-26 LUBRICATION SYSTEM AND OIL PUMP

The engine lubrication system is of the force- feed type in which oil is supplied under full pressure to crankshaft, connecting rods, and camshaft bearings, and is supplied under controlled volume to the valve lifters, rocker arms, and push rods. All other moving parts are lubricated by gravity flow or splash. See Figure 60-64.

The supply of oil is carried in the lower crankcase (oil pan) which is filled through a filler opening in the right rocker arm cover. A removable oil gage rod on the left side of the crankcase is provided to check oil level.

The *oil pump* is located in the timing chain cover where it is connected by a drilled passage in the cylinder crankcase to an oil screen housing and pipe assembly. The screen is submerged in the oil supply and has ample area for all operating conditions. If the screen should become clogged for any reason, oil may be drawn into the system through the relief valve in the screen.

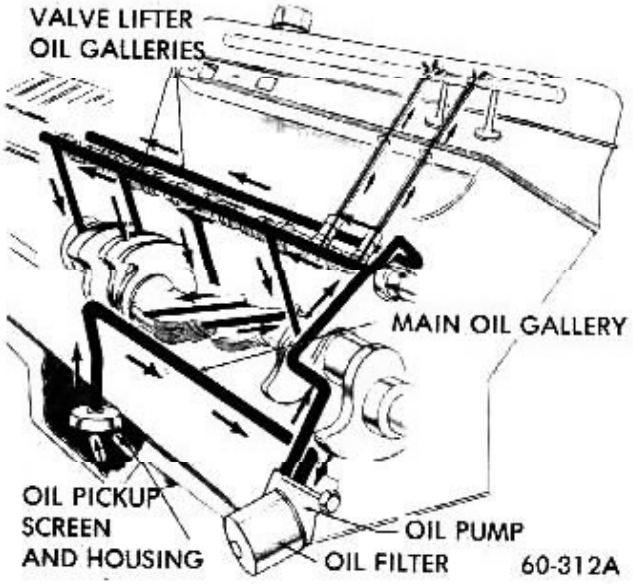


Figure 60-64 - Schematic Diagram of Engine Oil Flow

Oil is drawn into the pump through the *screen and pipe assembly* and a drilled passage in the crankcase which connects to drilled passages in the timing chain cover. *All* oil is discharged from the pump to the oil pump cover assembly. The cover assembly consists of an oil pressure relief valve, an oil filter by-pass valve and a nipple for installation of an oil filter. The spring loaded oil pressure relief valve limits the oil pressure to approximate 40 pounds per square inch. The oil filter by-pass valve opens when the filter has become clogged to the extent that approximately 15 pounds pressure difference exists between the filter inlet and discharge to by- pass the oil filter and channel unfiltered oil directly to the main oil galleries of the engine.

An *AC full flow oil filter* is externally mounted to the oil filter cover nipple on the lower right front side of the engine. Normally, all engine oil passes through the filter element, however, if the element becomes restricted, a spring loaded by- pass valve opens as mentioned above.

The *main oil galleries* run the full length of the crankcase and cut into the valve lifter guide holes to supply oil at full pressure to the lifters, and camshaft bearings.

Holes drilled in the crankshaft carry oil from the crankshaft bearings to the connecting rod bearings. Pistons and cylinder walls are lubricated by oil forced through a small notch in the bearing parting surface on the connecting rod, which registers with the hole in the crankpin once every revolution. Piston pins are lubricated by splash.

A drilled hole in the *camshaft* connects the front camshaft bearing journal to the keyslot in the front of the

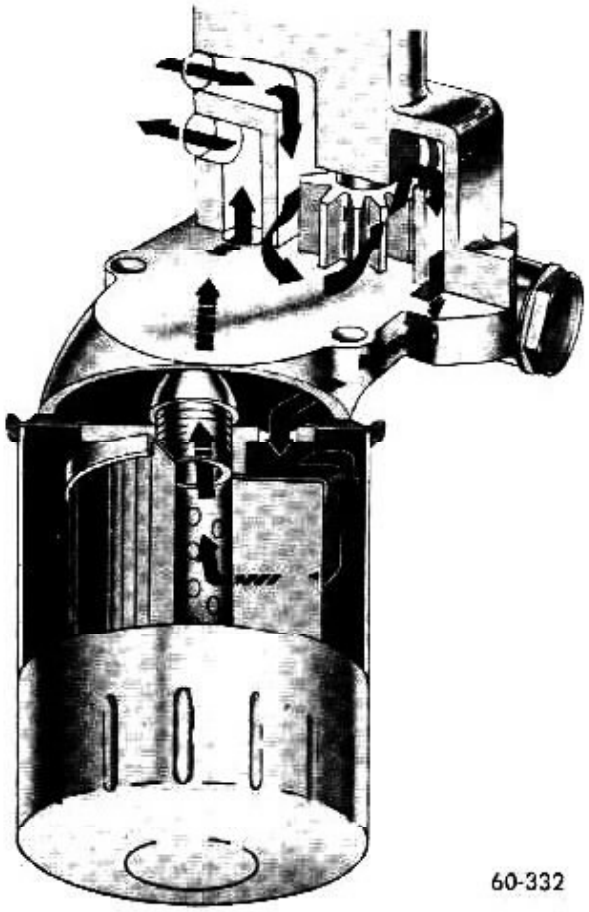


Figure 60-65 - Oil Pump and Filter Assembly

camshaft. Oil flows from the journal into the keyslot over the woodruff key in the space between the key and the camshaft sprocket and fuel pump eccentric.

455 cu. in.

A drilled hole in the *camshaft connects the front camshaft bearing journal to the front of the camshaft. Oil flows from the journal through a passage to an outlet between the crankshaft sprocket and distributor gear.*

The oil stream strikes the distributor gear and provided ample lubrication of the timing chain and sprockets by splash.

Each rocker arm and valve is supplied with oil through the tubular push rod. This oil comes from the inside of the lifter, passing around the metering valve and through a hole in the lifter push rod seat. Oil from the push rod passes through a hole in the rocker arm push rod seat, and emerges on top of the push rod seat boss. Part of this oil is metered to the valve stem by means of overflowing onto an external rib on the rocker arm. Gravity carries this oil along the rib to the valve tip. The remaining oil flows

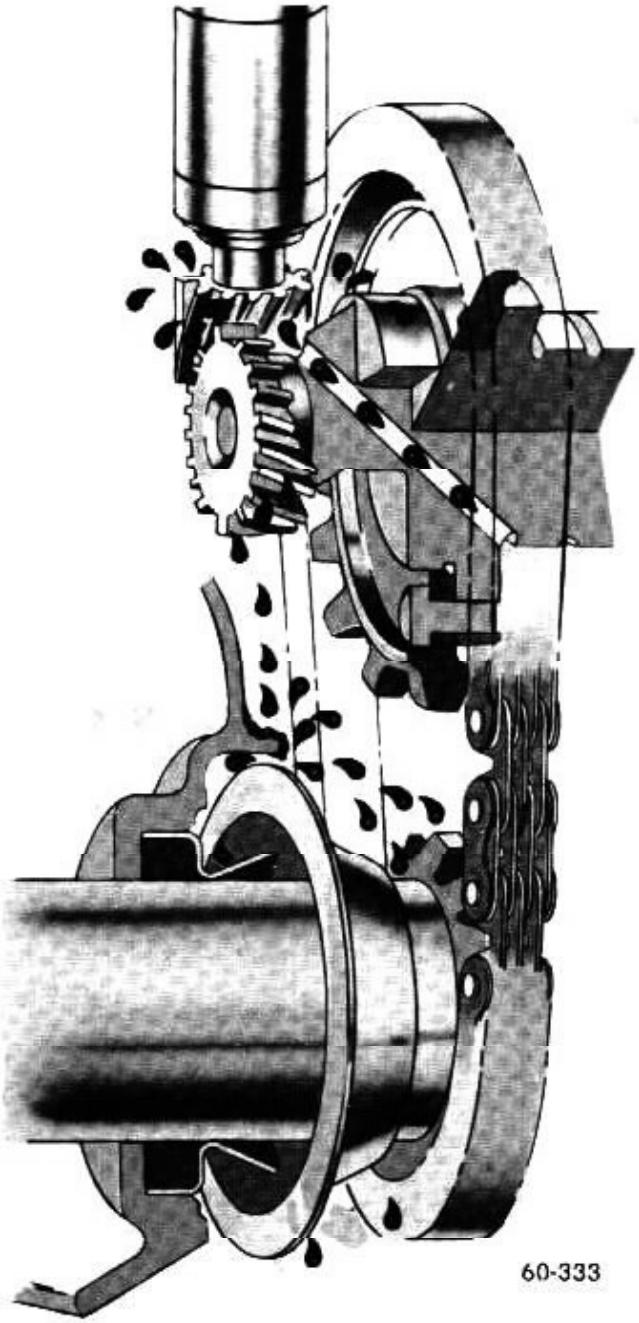


Figure 60-66 - Front End Lubrication

down into grooves provided for lubrication of the rocker arm bearing surface. See Figure 60-67.

60-27 WATER PUMP AND COOLING SYSTEM

The engine cooling system is the semi-closed pressure type, with thermostatic coolant temperature control and water pump circulation. In such a system, coolant is checked and added to a separate reservoir bottle and not at the radiator. It should be noted, however, that if a quantity of coolant is needed because of a leak, repair, or for complete replacement, the coolant should be added directly to the radiator to insure that the system is filled.

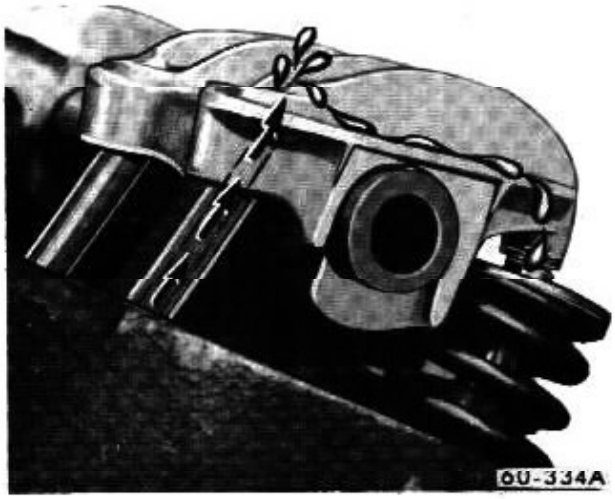


Figure 60-67 - Overhead Lubrication

A translucent plastic reservoir, similar to the familiar windshield washer bottle, is connected to the radiator by a hose. As the car is driven, the coolant is heated and expands. The portion of the fluid displaced by this expansion flows from the radiator into the reservoir. When the car is stopped and the coolant cools and contracts, the displaced coolant is drawn back into the radiator by vacuum. Thus, the radiator is kept filled with coolant to the desired level at all times, resulting in increased cooling efficiency.

A single contact temperature sensitive switch is located in the intake manifold. Engine water temperature above 246 degrees causes the set of contacts to close and light a red signal on the instrument panel.

There is also a temperature sensitive switch located in the rear of the left cylinder head (on upper series vehicles). If engine temperature should go above 265 degrees plus or minus 10 degrees, a set of contacts are closed and lights a red "stop engine" signal on the instrument panel.

A Harrison tube and center type of radiator core of brass and copper is used on all models. The outlet radiator tank houses the tranamission oil cooler.

All V-8 engines without air conditioning are equipped with a 18", 4 blade fan except Riviera. The Riviera has an 18", 7 blade fan. Air conditioned and heavy duty cars are equipped with an 18", 7 blade fan (350 cu.in.) and 20", 5 blade fan (455 cu.in.) driven by a torque and temperature sensitive clutch. See Figure 60-68.

NOTE: *A bent or damaged fan or fan clutch must always be replaced and repair not attempted. This is essential to maintain balance and durability.*

The torque sensitive fan clutch is equipped with a temperature sensitive coil which controls the flow of silicone through the clutch.

During periods of operation when radiator discharge air

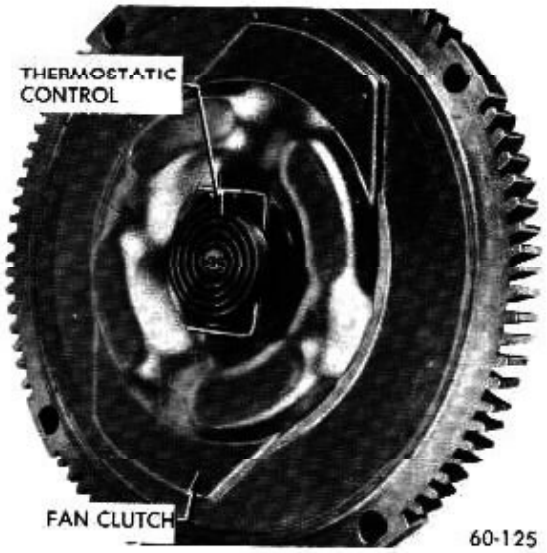


Figure 60-68 - Fan Clutch

temperature is low, the fan clutch limits the fan speed to a maximum speed of 1200 RPM.

Operating conditions that produce high radiator discharge air temperatures cause the temperature sensitive coil to turn a shaft which opens a port inside the clutch. This open port allows a greater flow of silicone providing a maximum fan speed of approximately 2600 RPM.

The clutch coil is calibrated so that at road load with an ambient temperature of approximately 80 degrees F. the clutch is just at the point of shift between high and low fan speed.

The cooling system is sealed by a pressure type radiator filler cap which causes the system to operate at higher than atmospheric pressure. The higher pressure raises the boiling point of coolant and increases the cooling efficiency of the radiator. The 15 pound pressure cap used on all series permits a possible increase of approximately 38 degrees F. in boiling point of coolant.

The pressure type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. See Figure 60-69. 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 coolant hoses to collapse.

The coolant is circulated by a centrifugal pump mounted on the timing chain cover which forms the outlet side of the pump. The fan and pulley(s) are bolted to the forward end of the pump shaft. In this manner both the fan and pump are belt driven by a crankshaft driven pulley integral with harmonic balancer.

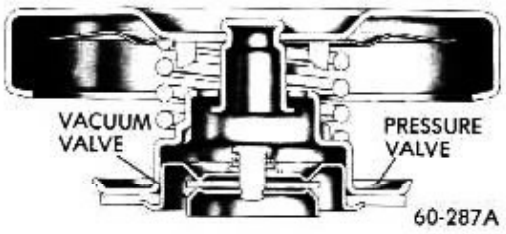


Figure 60-69 - Pressure Type Radiator Cap

The pump shaft is supported on a double row ball bearing shrunk fit in the aluminum water pump cover. The bearings are permanently lubricated during manufacture and sealed to prevent loss of lubricant and entry of dirt.

The pump is sealed against coolant leakage by a packless non-adjustable seal assembly mounted in the pump cover in position to bear against a ceramic face assembly. See Figure 60-70.

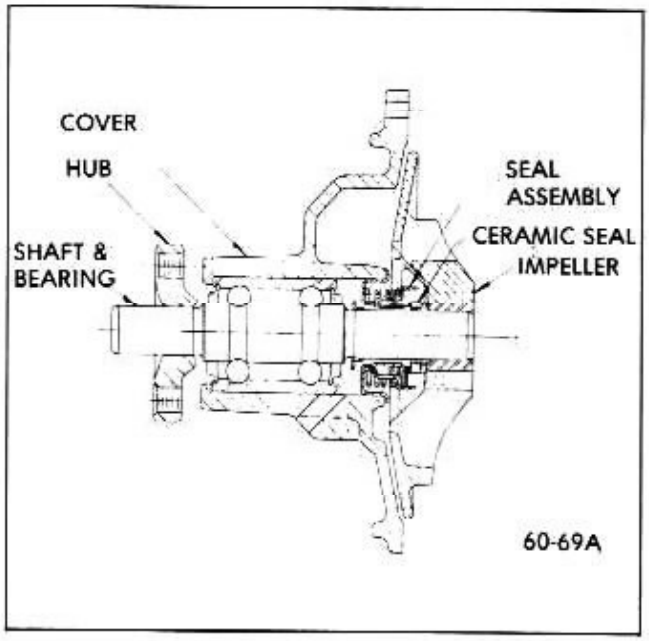


Figure 60-70 - Water Pump Assembly (455 cu. in. shown)

The inlet pipe case on the timing chain cover feeds into the passage formed by the cover and the front face of the impeller, which is mounted on the bearing shaft with the vanes facing rearward. Coolant flows through the inlet passage to the low pressure area at the center, where it then flows rearward through holes in the impeller. Vanes on the rotating impeller cause the coolant to flow radially outward into two discharge passages cast in the timing chain cover, and these passages deliver an equal quantity of coolant to each cylinder bank water jacket.

Cylinder water jackets extend down below the lower limits of piston ring travel and the coolant completely surrounds

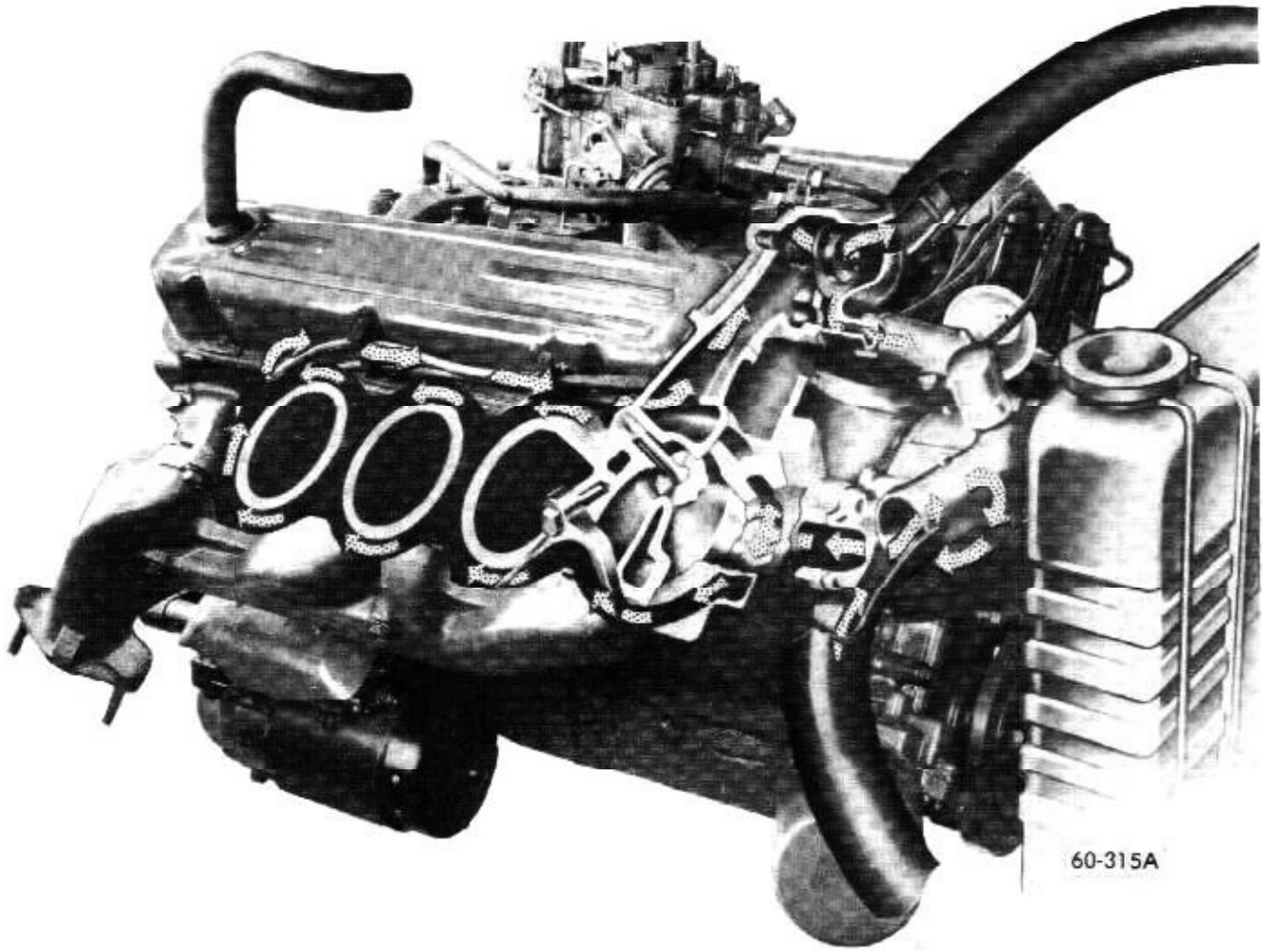


Figure 60-71 - Coolant Flow

each cylinder barrel to provide uniform cooling. See Figure 60-71.

The coolant leaves the cylinder heads through the intake manifold that provides a common connection between both heads and the radiator. The intake manifold also houses the "pellet" type radiator thermostat and outlet provides the by-pass passage through which coolant returns to the water pump for recirculation whenever the thermostat valve closes to block circulation through the radiator. This thermostatically operated by-pass type of water temperature control permits the engine to reach its normal operating temperature quickly. The thermostat valve opens at 190 degrees F.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

60-28 COOLING SYSTEM SERVICE

a. Checking and Filling Cooling System

Engine coolant level is checked by raising the car's hood and glancing at the translucent reservoir. The radiator cap is *not removed.* The design of the radiator cap has been changed to discourage inadvertent removal. The finger grips have been removed so the cap is round in shape. It must be pushed downward before it can be turned. A decal has been added to the cap cautioning against its being opened and indicating the proper closed position.

The proper coolant level at *normal operating temperature* is between the "Full" and the "Add" marks on the coolant reservoir. Since the level may be below the "Add" mark when the system cools and the coolant is below its normal operating temperature, *always* check the coolant level after the car has been driven.

NOTE: *Coolant freeze protection should be checked at the radiator and not at the reservoir.*

CAUTION: *Never remove the radiator cap quickly when the radiator is HOT. Sudden release of cooling system pressure may cause the coolant to boil and escape with some force.*

If the cap must be removed when the engine is at normal or above temperature, a cloth should be placed over the cap. The cap should then be rotated *counterclockwise* without pressing downward until the relief position is reached. The pressure must be allowed to escape completely. This may take more than 10 minutes for a large, hot engine. The cap should then be depressed and rotated again *counterclockwise* to the removal position.

b. Draining and Flushing the Cooling System

When the cooling system has been drained, reinstall an ethylene glycol type anti-corrosion cooling system protection solution developed for year around use (General Motors Specification GM 1899-M). *Water alone, methanol, or alcohol type anti-freeze is definitely not recommended.* To drain the cooling system, remove radiator cap, open the drain at the bottom of the radiator and remove the drain plugs on both sides of cylinder block. If car is air conditioned equipped, set heater temperature control valve at "HOT" position.

After the cooling system is drained, plugs reinstalled, and drain cock closed, fill the system with clean water. Run the engine long enough to open the thermostat for complete circulation through the system then completely drain the cooling system before sediment has a chance to settle.

c. Conditioning the Cooling System

It is very important to make certain that the cooling system is properly prepared before an anti- freeze solution is installed; otherwise, loss of solution through leakage may occur or seepage may result in damage to the engine. The cooling system should be drained and flushed as described above (subpar. b). All joints should be pressure checked for leakage and corrected.

Inspect the water pump, radiator core, heater core, drain cocks, water jacket plugs, and edge of cylinder head gaskets for evidence of leaks. Tighten all hose clamps in the cooling and heating systems and replace any deteriorated hoses.

d. Using and Testing Anti-Freeze Solutions

Inhibited year around (ethylene gylcol type) engine coolant solution which is formulated to withstand two full calendar years of normal operation without draining or adding inhibitors should be used at all times (not less than 0 degrees F., to freeze protection should be provided to protect against corrosion). When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -20 degrees F. may be encountered, a sufficient amount of any of the several brands of year around coolant (Ethylene Glycol base) compatible to GM Specification 1899-M available on the market should be used.

NOTE: *Alcohol base coolants are not recommended for this vehicle at any time.*

If for any reason water is used as a coolant in a emergency, it is extremely important that Buick Heavy Duty Cooling System Protector and Water Pump Lubricant or equivalent be added to the cooling system as soon as possible. If any other cooling system protector is used, be certain it is labeled to indicate that it meets General Motors Sepcification GM 1894-M. It should be recognized that this is only a temporary measure. The manufacturer intends that ethylene glycol type coolant solution be used year around in the cooling system of your Buick.

The cooling system should be completely drained and the recommended coolant installed every two years. At this time, also add GM cooling system inhibitor and sealer or equivalent. It is advisable to check the anti-freeze solution at intervals during the winter to make certain that the solution has not been weakened by evaporization or leakage. Use only hydrometers which are calibrated to read both the specific gravity and the temperature. Obtain a table or similar means of converting the freezing point at various temperatures of the solution. Disregarding the temperature of the solution when making the test may cause an error as large as 30 degrees F. Care must be exercised to use the correct float or table for the particular type of anti-freeze being tested.

60-29 FAN BELT ADJUSTMENT AND REPLACEMENT

A tight fan belt will cause rapid wear of the Delcotron generator and water pump bearings. A loose belt will slip and wear excessively causing noise, engine overheating and unsteady generator output. A fan belt which is cracked or frayed, or is worn so that it bottoms in the pulleys should be replaced.

The fan belt may be replaced by loosening the generator brace at both ends, slightly loosening the generator mounting bolts, and moving generator inward to provide maximum slack in the belt.

The Delcotron generator must be moved outboard to adjust the fan belt. After the Delcotron generator brace and mounting bolts are securely tightened, the fan belt tension should be checked. See Figure 60- 72.

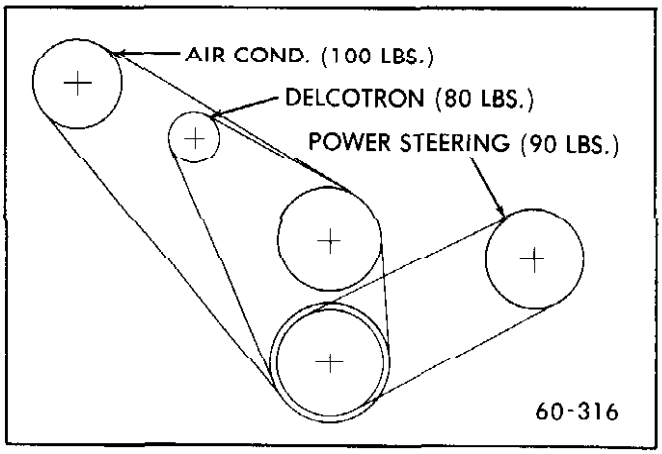


Figure 60-72 Engine Belt Tension Chart

If the power steering oil pump belt is removed it should be adjusted to tension specified, in Figure 60-72.

If the Air Conditioner compressor belt is distrubed it should be adjusted as specified, in Figure 60-72.

60-30 RADIATOR THERMOSTAT INSPECTION AND TEST

A sticking radiator thermostat will prevent the cooling system from functioning properly. If the thermostat sticks in the open position, the engine will warm up very slowly. If the thermostat sticks in the closed position, overheating will result.

The thermostat may be removed for inspection by partially draining the cooling system and removing the thermostat housing.

If the thermostat valve does not fully close when cold, check for the presence of foreign material that could hold it open. If no foreign material is present and valve still does not close, replace the thermostat.

Test the thermmostat for correct opening temperature by immersing the unit and a thermomoeter in a container of water. While heating the water do not rest either the thermometer or thermostat on bottom of container as this will cause them to register a higher temperature than the water. Agitate the water to insure uniform temperature of water, thermostat and thermometer.

The standard temperature (190 degrees) thermostat valve should start to open at approximately 190 degrees F., and should be fully open at approximately 212 degrees F. If thermostat does not operate at specified temperatures, it must be replaced as it cannot be adjusted.

60-31 WATER PUMP REPAIRS

The water pump cover is die cast aluminum into which the water pump bearing outer race is shrunk fit. For this reason the cover, shaft bearing, and hub are not replaceable.

a. Removal of Water Pump

1. Drain coolant into a clean container.

2. Loosen belt or belts, then remove fan blade, and pulley or pulleys from hub on water pump shaft. Remove belts.

3. Disconnect hose from water pump inlet and heater hose from nipple. Remove bolts, pump assembly, and gasket from timing chain cover.

4. Check pump shaft bearings for end play or roughness in operation. If bearings are not in serviceable condition, the assembly must be replaced.

b. Installation of Water Pump

1. Make sure the gasket surfaces on pump and timing chain cover are clean. Install pump assembly with new gasket. Bolts must be tightened uniformly.

2. Connect radiator hose to pump inlet and heater hose to nipple. Fill cooling system and check for leaks at pump and hose joints.

3. Install fan pulley or pulleys and fan blade, tighten attaching bolts securely. Install belts and adjust for proper tension. See Figure 60-72.

DIVISION IV

REMOVAL AND INSTALLATION

60-32 350 AND 455 CU.IN. ENGINE REMOVAL AND INSTALLATION

a. Removal

1. Remove hood; for easier installation, scribe marks should be made at hood hinge and the hinge bracket.

2. Disconnect battery.

3. Drain coolant into a suitable container.

4. Remove air cleaner.

5. On cars equipped with air conditioning, disconnect compressor ground wire from the mounting bracket. Remove the electrical connector from the compressor clutch, remove the compressor to mounting bracket attaching bolts, and position the compressor out of the way.

6. Remove fan blade, pulley, and belts.

7. Disconnect radiator and heater hoses from engine and fasten them out of the way.

8. Remove fan shroud assembly.

9. Remove power steering pump to mounting bracket bolts and position pump assembly out of the way.

10. Remove fuel pump hoses and plug hoses.

11. Disconnect battery ground cable from engine.

12. Disconnect the vapor emission line from the carburetor to the emission canister and disconnect the line at the carburetor. Disconnect the vacuum supply hose from carburetor to the vacuum manifold. On cars so equipped, the vacuum modulator, load leveler, and power brake vacuum hoses should all be disconnected at the engine.

13. Disconnect throttle control cable at carburetor.

14. Disconnect oil and coolant sending unit switch connections at the engine.

15. Disconnect engine to body ground strap at engine.

16. Raise car, disconnect starter cables, and disconnect the cable shield from the engine.

17. Disconnect crossover pipe from exhaust manifolds and support the exhaust system.

18. Remove flywheel and converter cover.

19. Remove flywheel to converter attaching bolts. Scribe chalk mark on the flywheel and converter for reassembly alignment (this is not necessary on manual transmissions).

20. Remove transmission to engine attaching bolts.

21. Remove the nuts from the motor mount and through-bolts.

22. Lower the car and support the transmission.

23. Attach a lifting device to the engine and raise the engine enough so mounting through-bolts can be removed.

NOTE: *Make certain wiring harness, vacuum hoses, and other parts are free and clear before lifting engine out of car.*

24. Raise engine far enough to clear engine mounts, raise transmission support accordingly and alternately until engine can be disengaged from the transmission and removed.

b. Installation

1. Slowly lower engine into car until engine and transmission are engaged and scribe marks are aligned.

NOTE: *On manual transmissions, make sure guide pins are used on the transmission so engine engages without damaging the clutch.*

2. It may be necessary to alternately raise and lower transmission to fit motor mount through-bolts into position. Install through-bolt nuts and torque to 63 lb.ft.

3. Raise car and install transmission to engine attaching bolts. Torque flywheel housing to engine bolts to 35 lb.ft. Install flywheel cover and torque bolts to 4 lb.ft.

4. Connect crossover pipe to exhaust manifold and torque bolts to 10-18 lb.ft.

5. Connect the starter cables to the starter and cable shield to the engine block.

6. Lower the car and reconnect the body ground strap to the engine, the coolant and oil switch sending unit connectors, the throttle control cable, all vacuum and water hoses, and the emission control line from the canister to the carburetor.

7. Connect the battery ground cable to the engine.

8. Connect the fuel lines to the fuel pump.

9. Reposition the power steering pump into the pump brackets and secure.

10. Install fan shroud.

11. Install pulley, fan, and belts. Belt tension is as follows:

a. Delcotron - 110-125 lb.ft.

b. Power Steering - 135-150 lb.ft.

c. Air Conditioning - 135-150 lb.ft.

12. Reinstall air conditioning compressor to bracket.

13. Reinstall air cleaner.

14. Reinstall coolant and check to make certain proper level is attained.

NOTE: *After complete engine assembly, start engine and recheck for proper fill.*

15. Reinstall hood, noting proper alignment of scribe marks.

16. Connect battery.

DIVISION V

OVERHAUL AND MAJOR SERVICE

60-33 INTAKE MANIFOLD, CYLINDER HEAD, VALVE TRAIN AND LIFTERS AND ENGINE OIL PAN.

a. Intake Manifold Removal

1. Disconnect battery.

2. Drain coolant from radiator and cylinder block.

3. Remove air cleaner.

a. Disconnect breather tube at air cleaner.

b. Disconnect heated air pipe at top end of pipe.

c. Disconnect air cleaner sensor hose at tee (auto trans only)

d. Disconnect hose at elbow from carburetor to air cleaner (Manual Trans Only.)

4. Remove air conditioning mounting bracket bolt (if equipped). Loosen bracket to compressor bolt and slide bracket outboard.

5. Disconnect water temperature and metal temperature indicator wire from switch.

6. Disconnect throttle linkage at carburetor.

7. Disconnect fuel line at carburetor inlet.

8. Remove manifold attaching bolts and manifold.

b. Intake Manifold Installation

1. Place new intake manifold gasket and rubber manifold seals in position at front and rear rails of cylinder block. Be sure pointed end of seal fits snugly against block and head.

NOTE: *Before installing intake manifold seals apply Silastic Rubber or equivalent to ends of seals. See Figure 60-73.*

Figure 60-73 - Intake Manifold Seal Installation

2. Install one piece manifold gasket and carefully set intake manifold on the engine block dowel pin.

3. Install manifold to cylinder head bolts.

NOTE: *New intake manifold gasket and seals must be obtained whenever a manifold is removed.*

When installing a manifold, start with the No. 1 and No. 2 bolts. See Figure 60-74. Gradually tighten both bolts until snug. Then continue with the rest of the bolts in the sequence shown in Figure 60-74. Torque bolts to 55 lb. ft.

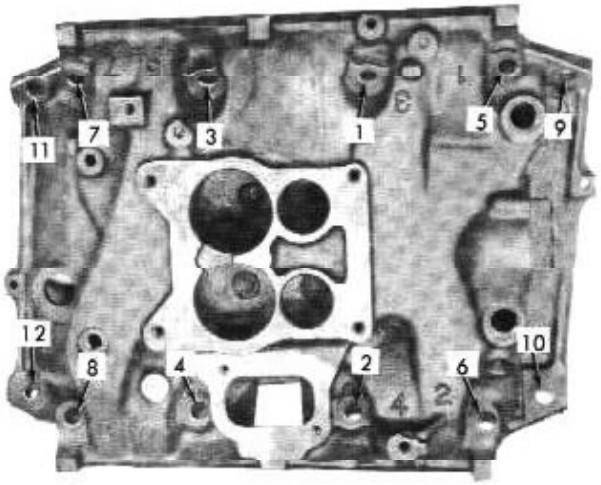


Figure 60-74 - Intake Manifold Bolt Tightening Sequence

4. Connect parts removed in Steps 3 thru 9 in subpar. a.

5. Connect battery.

6. Close drain plug and fill radiator to proper level.

C. Cylinder Head Removal

1. Remove intake manifold as outlined in subpar. a.

2. When removing RIGHT cylinder head:

(a) Loosen and remove belt (s).

(b) Remove wires from Delcotron.

(c) If equipped with air conditioning compressor, remove compressor from mounting bracket and position it out of the way with hoses connected, then remove Delcotron with mounting bracket.

3. When removing LEFT cylinder head;

(a) Remove oil gage rod, or

(b) Remove power steering gear pump with mounting bracket if present, and move it out of the way with hoses attached.

4. Disconnect wires from spark plugs, and remove the spark plug wire clips from the rocker arm cover studs.

5. Remove exhaust pipe to manifold bolts.

6. Disconnect exhaust manifold from head being removed.

7. With air hose and cloths, clean dirt off cylinder head and adjacent area to avoid getting dirt into engine. *It is extremely important to avoid getting dirt into the hydraulic valve lifters.*

8. Remove rocker arm cover and rocker arm and shaft assembly from cylinder head. Lift out push rods.

NOTE: *If lifters are to be serviced, remove them at this time. Otherwise, protect lifters and camshaft from dirt by covering area with a clean cloth. Whenever lifters or push rods are removed, place in a wooden block with numbered holes or similar device to keep them identified as to position in engine.*

9. Slightly loosen all cylinder head bolts, then remove bolts and lift off the cylinder head. Remove gasket.

10. With cylinder head on bench, remove all spark plugs for cleaning and to avoid damage during work on the head.

d. Cylinder Head Installation

1. Thoroughly clean off engine block gasket surface and be certain no foreign material has fallen in the cylinder bores, bolt holes, or in the valve lifter area. It is good practice to clean out bolt holes with an air hose.

2. Install new head gasket on cylinder block. Dowels in the block will hold the gasket in place. Always handle gaskets carefully to avoid kinking or damage to the surface of the gasket.

3. Clean gasket surface of cylinder head and carefully set in place on the engine block dowel pins.

4. Clean and lubricate the head bolts with "Perfect Seal" or equivalent sealing compound.

NOTE: *Damage to the cylinder block threads can result if bolts are not lubricated with "Perfect Seal" or equivalent prior to installation or if bolts are tightened excessively. Use an accurate torque wrench when installing head bolts. Uneven tightening of the cylinder head bolts can distort the cylinder bores, causing compression loss and excessive oil comsumption.*

5. Install head bolts. Tighten the bolts a little at a time about three times around in the sequence shown in Figure 60-75. Give bolts a final torque in the same sequence. Torque to 75 lb.ft. (350 Cu In.) and 100 lb. ft. (455 Cu. In.).

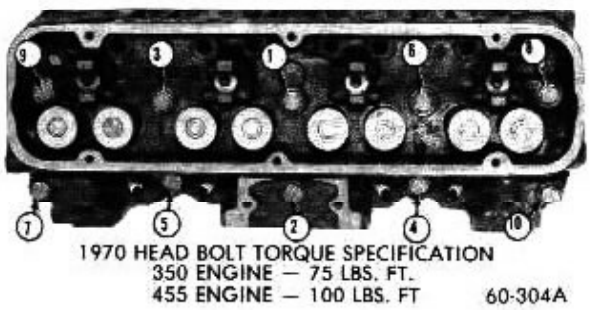


Figure 60-75 - Cylinder Head Bolt Tighten Sequence (350 Shown)

6. Assemble exhaust manifolds to heads. See Figure 60-76. Torque bolts to 18 lb. ft.

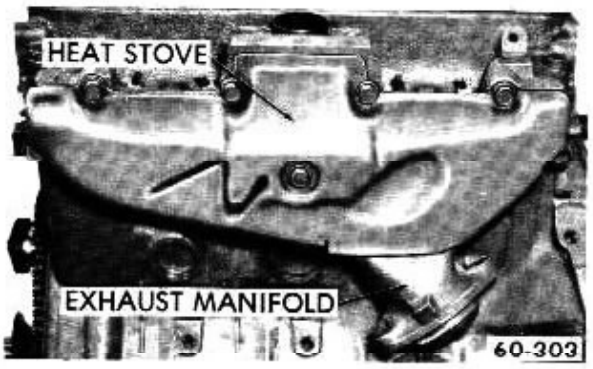


Figure 60-76 - Exhaust Manifold Installation (350 Left Side Shown)

7. Wipe rocker arm shaft and bosses on cylinder head with a clean cloth.

8. Install push rods.

9. Tilt the rocker arm toward the push rod and locate the top of each push rod in its rocker arm seat.

10. Draw down the rocker arm and shaft assembly by tightening the shaft bolts a little at a time. Use a reliable torque wrench to torque the shaft bolts to 25 lb. ft. Do not overtighten.

11. Install rocker arm cover and new gasket. Torque bolts to 4 lb. ft.

12. Place spark plug wires in position on rocker arm cover studs and connect spark plug wires.

13. Install intake manifold as outlined in subpar. b.

14. Replace components removed in Steps 2 or 3 (subparagraph c) and tighten belt(s). See Figure 60- 72 for correct belt tension.

15. After installation is completed and engine has been warmed up to operating temperature, recheck cylinder head bolt torque. Reinstall rocker arm cover and gasket and torque bolts to 4 lb. ft.

e. Reconditioning Valves and Guides

1. Remove cylinder head per subparagraph c above. Place on clean surface.

2. Using suitable spring compressor, such as J-8062, compress valve spring and remove valve spring cap key. Release tool and remove spring and cap. See Figure 60-72.

3. Remove valve seals from intake and exhaust valve guides. Seals must be discarded. Remove valves. Place valves in numerical order so that they can be reinstalled in original location.

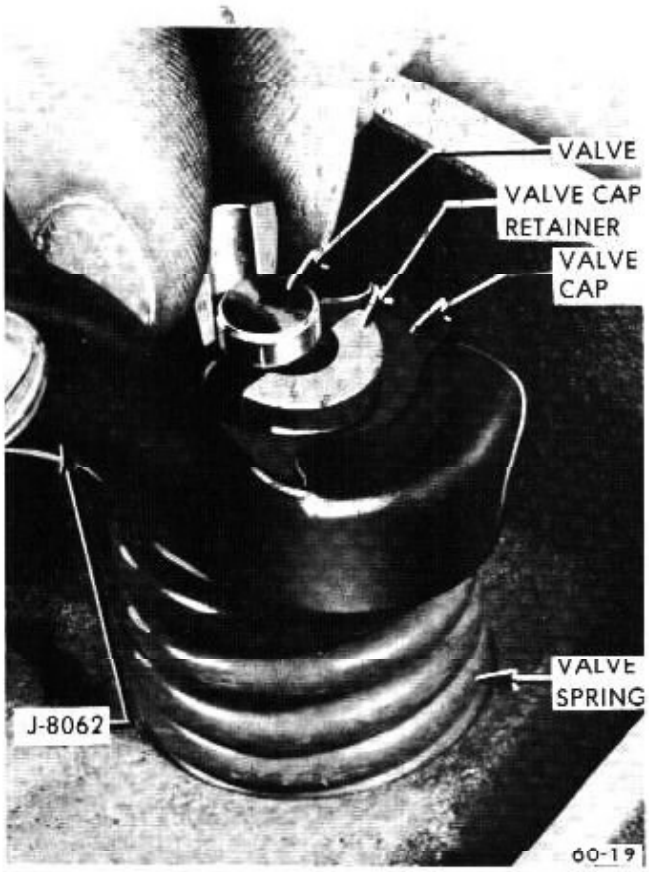


Figure 60-77 - Removing Valve Cap Retainers.

NOTE: *The 455 cu.in. engines Do Not have exhaust valve guide seals.*

4. Remove all carbon from combustion chambers, piston heads, and valves. When using scrapers or wire brushes for removing carbon, avoid scratching valve seats and valve faces. A soft wire brush (such as J-8358) is suitable for this purpose.

5. Clean carbon and gum deposits from valve guide bores. Use Reamer J-8003.

6. Inspect valve faces and seats for pits, burned spots or other evidences of poor seating. If a valve head must be ground until the outer edge is sharp in order to true up the face, discard the valve because the sharp edge will run too hot. 45 degrees is the correct angle for valve faces.

7. If valve stem has too much clearance in its guide, the guide should be reamed to .006" oversize using J-22612 and then to .010" oversize using Reamer J 9345-1. See Figure 60 78.

NOTE: *.006" oversize valves are occasionally used in production. If clearance in the guide exceeds .006" the guide should be reamed to .010" oversize using J-9345-1. Oversize valves are identified by the oversize marking stamped on the valve head. See Figure 60-79.*

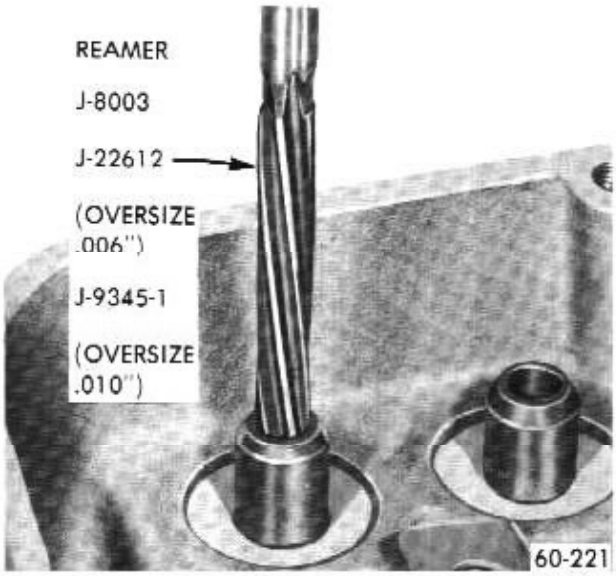


Figure 60-78 - Reaming Valve Guide

The Parts Department stocks .010" oversize valves for replacement purposes. See Figure 60-79.

Figure 60-79 - Oversize Valve Identification

8. True up valve seats to 45 degrees. Cutting a valve seat results in lowering the valve spring pressure and increases the width of the seat. The nominal width of the valve seat is 1/16". If a valve seat is over 5/64" wide after truing up it should be narrowed to specified width by the use of 20 degrees and 70 degrees stones.

Improper hydraulic valve lifter operation may result if valve and seat have been refinished enough to allow the end of valve stem to raise approximately .050" above normal position. In this case it will be necessary to grind off end of valve stem or replace parts. *The normal height of*

the valve stem above the valve spring seat surface of the head is 1.933 (350 Cu. In.) and 2.082" (455 Cu. In.).

9. Lightly lap the valves into seats with the fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that a minimum of lapping is required. Excessive lapping will groove the valve face preventing a good seat when hot.

IMPORTANT: *New valves should not be lapped under any condition as the .0002" - .0015" aluminum alloy surface on the intakes or the .0004 to .0015 nickel- plated surface on the exhausts will be removed.*

10. Test valves for concentricity with seats and for tight seating. The usual test is to coat the valve face lightly with Prussian blue and turn the valve against seat. If the valve seat is concentric with the valve guide a mark will be made all around the seat, while if the seat is not concentric with the guide, a mark will be made on only one side of the seat. Next, coat the valve seat lightly with Prussian blue. Rotate the valve against the seat to determine if the valve face is concentric with the valve stem, and if the valve is seating all the way around. Both of these tests are necessary to prove that a proper seat is being obtained.

11. Remove any burrs from valve stem with fine stone or crocus cloth.

12. Lubricate valve stems and guides with "Service MS" engine oil and reinstall valves.

13. Install valve seal.

NOTE: *Do Not install exhaust valve guide seals on 455 cu.in. engines.*

a. Start valve seal carefully over valve stem. Push seal down until it touches top of guide.

b. Use installation tool J-22509 to push seal over valve guide until upper inside surface of seal touches top of guide.

NOTE: *COMPRESS SPRINGS ONLY ENOUGH TO INSTALL KEEPERS. EXCESS COMPRESSION CAN CAUSE SPRING RETAINER TO DAMAGE VALVE SEAL.*

14. Install intake valve spring on the 350 Cu. In. with closely wound coil toward the cylinder head. See Figure 60-80.

NOTE: *The top inside diameter of 350 cu.in. intake valve springs is .860" - .846" and the bottom inside diameter is .945" - 931". The large diameter must be toward the cylinder head. The exhaust valve spring on the 350 cu.in. and all valve springs for 455 cu.in. engines may be installled with either end up. See Figure 60-80.*

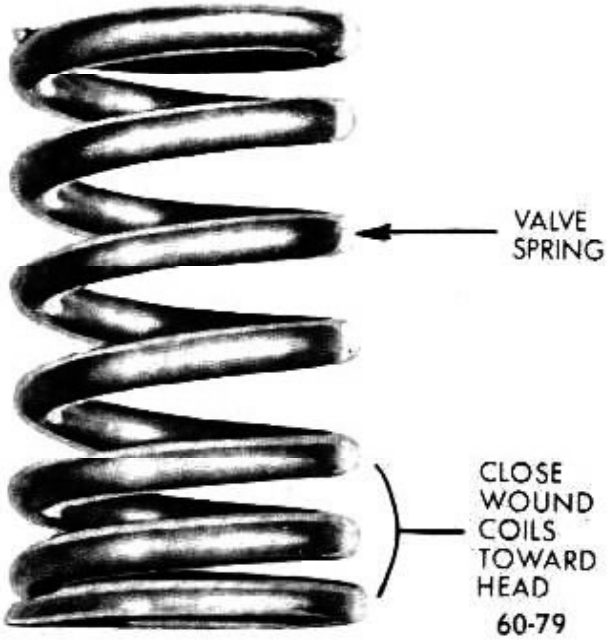


Figure 60-80 - Intake Valve Spring (350 cu.in.)

Figure 60-81 - Valve Spring (All 455 Cu.In. 350 Cu.In. Exhaust Valve Similar)

15. Reinstall valve spring, cap and cap retainer, using same equipment used for removal.

16. Install cylinder head as described in subparagraph d above.

f. Rocker Arm Assembly Removal

1. Remove rocker arm cover and remove four rocker arm and shaft assembly to cylinder head bolts. Remove shaft assembly.

2. Place assembly on clean surface.

3. Remove nylon arm retainers by breaking them below their head with a chisel. See Figure 60-82.

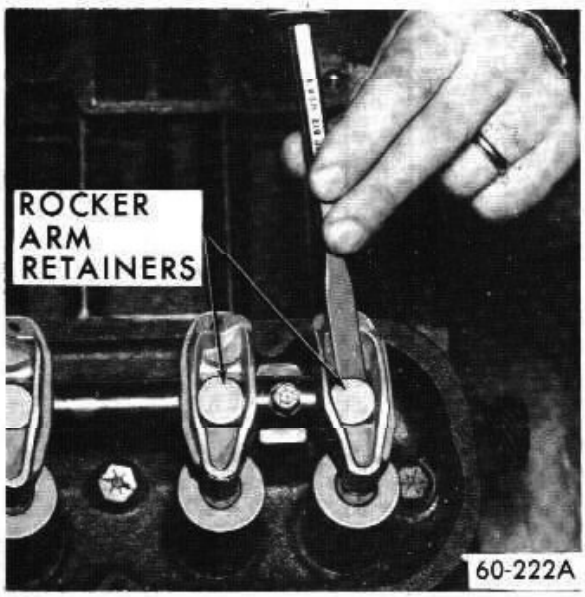


Figure 60-82 - Removing Nylon Retainer

4. Remove rocker arms and clean in suitable solution. Inspect for wear. Remove retainer pieces from inside shaft.

g. Rocker Arm Assembly Installation

1. Install rocker arms on shaft lubricating all parts as they are assembled with engine oil. Each pair of rocker arms must be installed so that the external rib on each arm points away from the rocker arm shaft bolt. See Figure 60-83

Figure 60-83 - Rocker Arms Positioned on Shaft

2. Center each arm on the 1/4" hole in the shaft. Install new nylon rocker arm retainers in the 1/4" holes using a drift of at least 1/2" dia.

3. Install rocker arm assembly as outlined in subparagraph d.

h. Valve Lifter Service

1. Refer to procedure outlined under "Cylinder Head Removal" (par. 60-33, subpar. c) for lifter removal.

2. Place lifter in a wooden block with numbered holes or similar device to keep them identified as to position in engine.

3. If less than a complete set of lifters are being removed, disassemble one or two and check for dirt or varnish. If this condition exists, it is advisable to remove all lifters for cleaning and inspection. Otherwise, service only those lifters that are not operating properly.

4. Examine the cam contact surface at lower end of lifter body. If this surface is extremely worn, galled, or otherwise damaged, discard the lifter assembly. In this case, examine the mating camshaft lobe for excessive wear or damage.

5. Disassemble each valve lifter by using a push rod to hold down the push rod seat while removing the plunger retainer from the lifter body using Retainer Remover J-5238. See Figure 60-84. Remove push rod seat, oil metering valve, and plunger from lifter body.

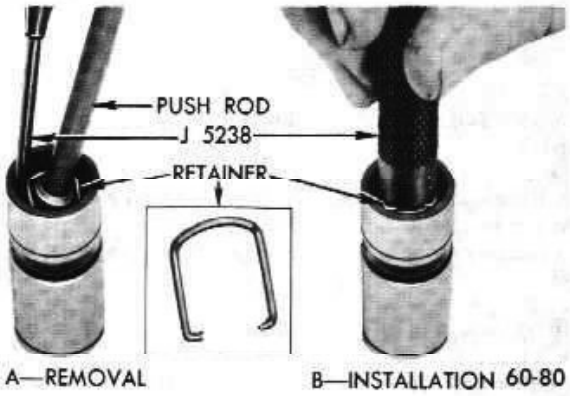


Figure 60-84 - Removing and Installing Plunger Retainer

6. If a plunger sticks in lifter body, place lifter in large end of Plunger Remover J-4160-A with plunger inward. While holding lifter with thumb, rap the open end of remover against a block of wood with just enough force to jar the plunger from body. See Figure 60-85.

7. Drain oil out of body into waste can and remove the ball retainer, ball, ball spring, and plunger spring. A strainer placed over waste can will prevent dropping these parts into can.

8. Place all parts of each lifter in a separate compartment of a tray.

The body and plunger are selectively fitted to each other and must not be interchanged with parts of other lifters. Keeping all parts of the lifter together until cleaned and

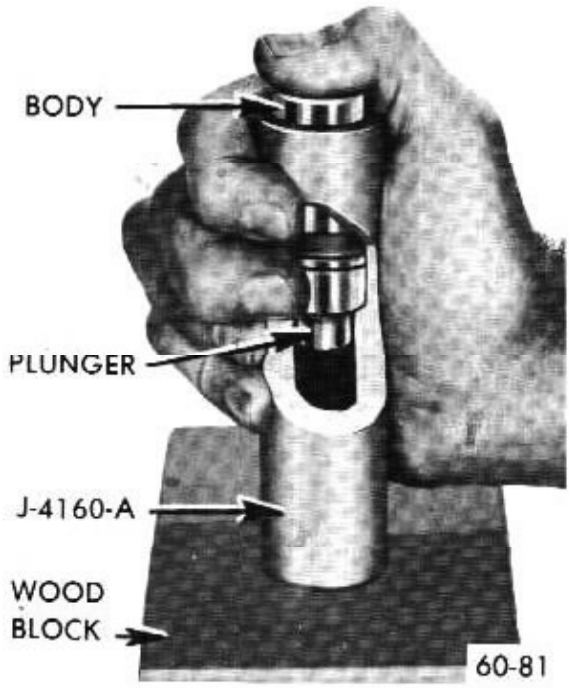


Figure 60-85 Removing Stuck Plunger

inspected will aid in diagnosing cause of improper operation.

9. Rinse the tray full of lifter parts in a pan of kerosene to remove as much oil as possible. This will reduce contamination of the cleaning solvent and extend its effective life.

10. Submerge the tray and parts in the cleaning solvent and leave to soak for approximately one hour. The time required will depend on the varnish on lifter parts and the effectiveness of the solvent.

11. After the varnish has dissolved or has softened sufficiently to permit removal by wiping, raise the tray and allow tray and parts to drain so that solvent will be saved.

12. Rinse the tray of parts in the pan of kerosene to cut the solvent and avoid injury to hands.

13. Working on one lifter at a time and using CLEAN lint-free cloths, thoroughly wipe off all parts. Clean the plunger and the external and internal surfaces of the body with a hard wiping action to remove any varnish deposits. Rinse the parts in the kerosene using Cleaning Brush J-5099 in the bore of lifter body.

NOTE: *To insure absolute cleanliness of a reconditioned lifter assembly, it is advisable to inspect and assemble each lifter before cleaning the next lifter.*

14. The following list outlines the inspection of lifter parts. An inspection should be made at this point to determine whether or not a lifter is in need of replacement.

NOTE: *The hydraulic valve lifter is serviced as a complete assembly only. If one or more of the valve lifter components are faulty, the complete lifter must be replaced.*

(a) *Lifter Body.* Inspect inner and outer surfaces of body for blow holes and scoring. Replace lifter assembly if body is roughly scored or grooved, or has a blow hole extending through the wall in position to permit oil leakage from lower chamber. The prominent wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored; it is caused by side thrust of cam against body while the lifter is moving vertically in its guide.

Inspect the cam contact surface on lower end of lifter body. Replace the lifter assembly if this surface is excessively worn, galled, or otherwise damaged. A lifter body that has been rotating will have a round wear pattern and a non-rotating lifter body will have spalling on the lifter base.

NOTE: *All 1971 V-8 engines have valve lifters with a slight spherical shaped base that will allow lifter rotation, which is induced by the tapered lobes on the camshaft producing camshaft thrust rearward, causing lifter rotation.*

(b) *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 scoring 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 plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore it may be disregarded.

(c) *Push Rod and Seat.* Replace lifter if the area where the push rod contacts the push rod seat is rough, or otherwise damaged. Replace any push rod having a rough or damaged ball end.

(d) *Check Ball.* Using a magnifying glass, carefully examine the check ball for nicks, imbedded material or other defects which would prevent proper seating. Such defects would indicate the cause of intermittently noisy lifter operation.

(e) *Check Ball Spring.* Examine check ball spring for wear or damage. Replace lifter if any spring is distorted or shows evidence of wear.

(f) *Ball Retainer.* Replace lifter if a retainer is cracked or which has a heavily worn area. A small bright spot where the ball contacts the retainer is the normal condition.

(g) *Plunger Spring.* Replace lifter if the plunger spring is distorted or damaged. Exhaustive tests have shown that plunger springs seldom break down in service.

15. Rinse lifter plunger in the kerosene in middle compartment of cleaning tank and then give it a thorough final rinsing in the kerosene in right compartment.

16. Hold plunger in vertical position with feed hole up, then rinse and install the check ball, check ball spring, ball retainer, spring, and body over the plunger. See parts in Figure 60-86.

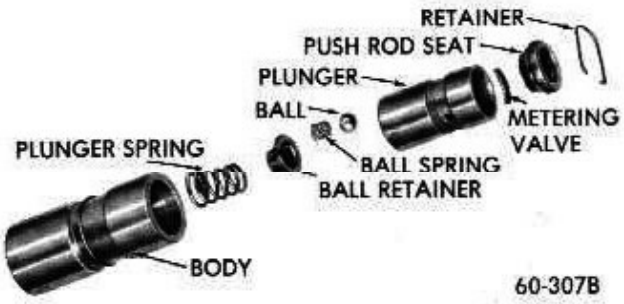


Figure 60-86 - Hydraulic Valve Lifter Parts

17. Rinse push rod seat, metering valve, and plunger retainer. Place these parts in end of body and push with handle of Remover J-5238 until retainer engages groove in body. See Figure 60-84, View B.

18. Wrap the lifter in clean paper or otherwise protect it from dirt while reconditioning the other valve lifters, preparatory to testing all lifters for leakdown rate.

19. Check lifter leakdown rate according to subparagraph i below.

20. Make certain that valve lifter guide holes and adjacent area of cylinder block are clean. Liberally lubricate the camshaft and lifter bores with "Service MS" oil and install lifters. Each lifter must slide freely in its guide hole.

21. Following the procedure outlined in paragraph 60- 33, subparagraph d, reassembly engine.

i. Checking Valve Lifter Leakdown Rate

After a hydraulic lifter has been cleaned, inspected, and assembled it must be tested before it is installed in an engine. Lifter Test Fixture J 5790 has been designed to test the leakdown rate of a lifter to determine whether it is within limits which assure satisfactory lifter operation.

The following procedure must be carefully followed to obtain an accurate test.

1. Thoroughly clean the cup of test fixture, install cup on fixture, and fill it to within 1/2" of the top with "Hydraulic Lifter Test Fluid," which is available through Kent-Moore Organization, Inc., under K-M- number J-5268.

2. Remove rubber washer (used for larger lifters) and install Gage Sleeve J-5790-27 in the cup; also install Gage Rod Nose J-5790-13 in the arm.

3. Swing the weight arm up out of the way, raise the ram and place the valve lifter (top side up) in Sleeve J-5790-27. The lifter must be completely covered by the fluid during test.

4. Lower the ram to rest in the lifter push rod seat, then lower the weight arm to rest on the roller of ram as shown in Figure 60-87.

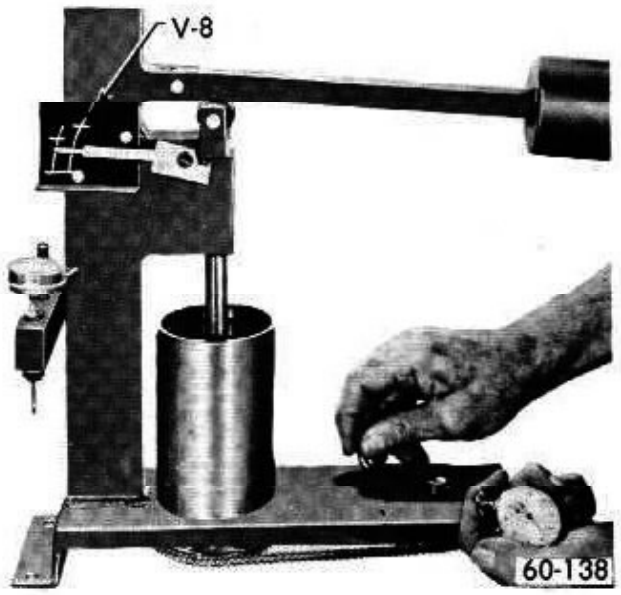


Figure 60-87 - Checking Lifter Leakdown Rate

5. Operate the lifter plunger through its full travel to force all air out of the lifter by using a vigorous pumping action on the weight arm. Continue the pumping action until considerable resistance is built up in the lifter and a definite grab point is felt at the top of the stroke, when the indicator pointer is at the bottom of the scale.

Finally, pump vigorously for approximately 10 additional strokes to make sure all air is removed from the lifter.

6. Raise weight arm to allow the lifter plunger to come up to its retainer, then lower the arm to rest on the ram roller. As the pointer starts moving upward start rotating the

fluid cup by turning the handle one revolution every two seconds.

7. Use a stop watch to check the time required for pointer to move from the lower to the upper mark on scale where marked "BUICK V-8." The cup must be rotated during this test.

8. The leakdown rate (time between marks) must be between 12 and 60 seconds to assure satisfactory lifter performance. A doubtful lifter should be tested three or four times. Replace any lifter which does not test within the specified limits.

NOTE: *The newer Model J-5790 leakdown tester will have a different scale than the one shown in Figure 60-84. In this case, time the pointer travel from "Start" to the .125 mark on the scale. The leakdown rate must still be between 12 and 60 seconds.*

9. After all lifters have been tested, place the cover over the test fixture to keep dirt out of the cup and fluid. The fluid should be discarded and the cup should be thoroughly cleaned after a few sets of lifters have been tested.

j. Exhaust Manifold Removal (Left Side)

A. *43,44000 Series*

1. Raise front of car and support on stands.

2. Disconnect exhaust pipe from exhaust manifold on both sides of engine and lower. If dual exhaust, disconnect left exhaust pipe and lower.

3. If manual transmission remove equalizer shaft.

4. Remove exhaust manifold to cylinder head bolts.

5. Remove exhaust manifold from beneath the car.

b. *45,000 Series*

1. Remove left exhaust pipe from exhaust manifold.

2. Remove exhaust manifold to cylinder head bolts.

3. Remove exhaust manifold from the top of the car.

c. *46-48-49000 Series*

1. Raise front of car and support on stands.

2. Disconnect exhaust pipe from exhaust manifold on both sides of engine and lower. If dual exhaust, disconnect left exhaust pipe and lower.

3. If manual transmission, remove equalizer shift.

4. Remove pitman arm from pitman shaft using Tool J-5504. Swing steering linkage forward.

NOTE: *Mark location of pitman arm to pitman shaft for reinstallation*

5. Remove exhaust manifold to cylinder head bolts.

6. Remove exhaust manifold from beneath the car.

k. Exhaust Manifold Installation

1. Install manifold by reversing above procedures.

2. Torque exhaust manifold bolts to 18 lb. ft.

3. Torque pitman shaft nut to 140 lb. ft.

NOTE: This Pitman Arm to Steering Shaft FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

l. Oil Pan Removal

1. Disconnect battery.

2. Remove fan shroud to radiator tie bar screws

3. Remove air cleaner and disconnect throttle linakge.

4. Raise car and support on stands.

5. Drain oil.

6. If equipped with manual transmission:

(a) Loosen clutch equalizer bracket to frame attaching bolts.

(b) Disconnect exhaust crossover pipe at engine.

7. If equipped with automatic transmission:

(a) Remove lower flywheel housing.

(b) Remove shift linkage attaching bolt and swing out of way.

(c) Disconnect exhaust crossover pipe at engine.

8. Disconnect idler arm at frame and push steering linkage forward to cross member.

9. Remove front engine mounting bolts.

10. Raise engine by placing jack under crankshaft pulley mounting.

NOTE: *At this point, on A/C equipped cars, it will be necessary to place a support under the right side of the transmission prior to raising engine. This is necessary to prevent the engine transmission assembly from cocking to the right when being raised.*

11. Remove oil pan bolts and remove pan.

NOTE: *It may be necessary to position crankshaft so* **1 and 2 crankpin and counterweight will not interfere with front of oil pan.**

12. Remove rear seal (455 cu.in. engines only).

m. Oil Pan Installation

1. Clean oil pan. Make sure the gasket surfaces on pan and block are clean.

2. Install rear seal (455 cubic inch engines only).

3. Apply non-hardening Permatex to a few spots on a new pan gasket (cork) and install on block. *Make sure seal and gasket are properly fitted.* See Figure 60-88. (455 cu.in. only).

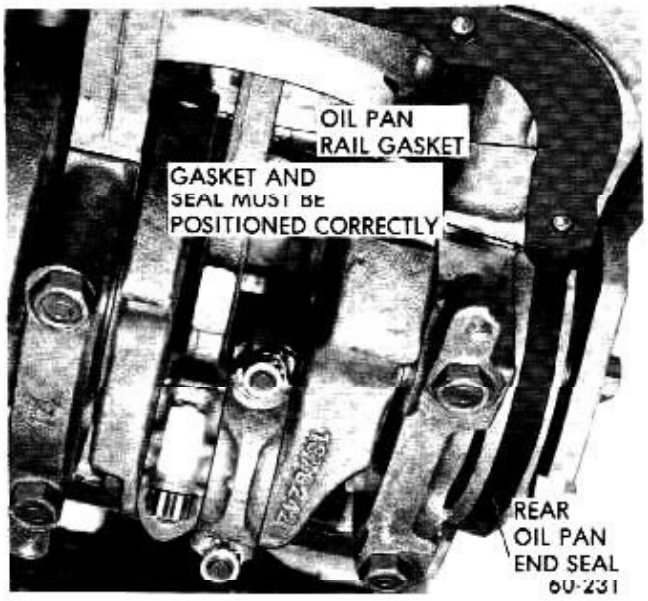


Figure 60-88 - Oil Pan Gasket and Seal Installation

4. Install oil pan. Torque bolts to 14 lb. ft. Do not overtighten.

5. Reverse procedures in subparagraph c.

n. Removal and Inspection of Oil Pump Pipe and Screen Assembly

1. Remove oil pan (subpar. c).

2. Remove oil pump pipe and screen assembly to cylinder block bolts.

3. Clean the screen and housing thoroughly in solvent and blow dry air with air stream.

o. Installation of Oil Pump Pipe and Screen Assembly

Install by reversing removal procedure, paying particular attention to the following points.

1. Make sure oil pump pipe flange gasket surface of block is smooth and free of dirt.

2. Use new gasket and tighten bolts to 8 lb. ft. torque. See Figure 60-89.

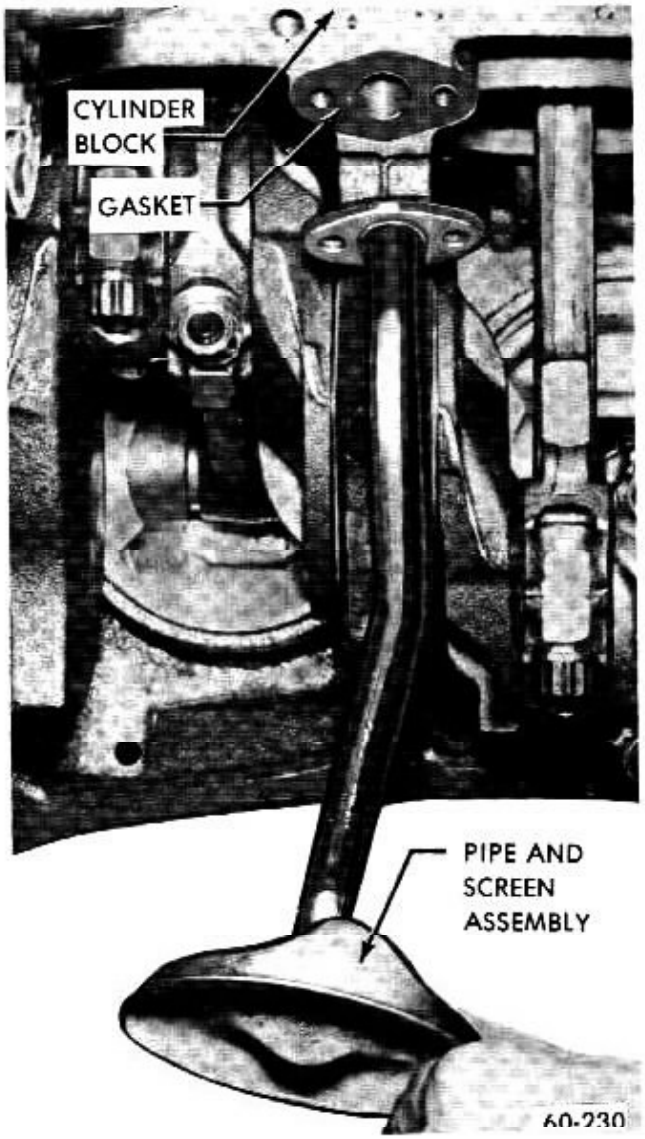


Figure 60-89 - Oil Pickup Pipe and Screen

3. Install oil pan (subpar. m).

60-34 CONNECTING ROD BEARINGS

A connecting rod bearing consists of two halves or shells

which are interchangeable in rod and cap. When the shells are placed in position, the ends extend slightly beyond the parting surfaces so that when the rod bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. *The ends of the bearing shells must never be filed flush with parting surface of rod or cap.*

If a rod bearing becomes noisy or is worn so that clearance on the crankpin is excessive, a new bearing of proper size must be selected and installed since no provision is made for adjustment. *Under no circumstances should the connecting rod or cap be filled to adjust the bearing clearance.*

a. Inspection of Connecting Rod Bearings and Crankpin Journals

After removal of engine oil pan, paragraph 60- 33, subparagraph l., disconnect two connecting rods at a time from crankshaft and inspect the bearings and crankpin journals. While turning crankpin it is necessary to temporarily reconnect the rods to crankshaft to avoid possibility of damaging the journals through contact with loose rods.

NOTE: *Do Not interchange rod caps with rods.*

If connecting rod bearings are chipped or scored they should be replaced. If bearings are in good physical condition check for proper clearance on crankpin as described in subparagraph b, below.

If crankpin journals are scored or ridged the crankshaft must be replaced, or reground for undersize bearings, to insure satisfactory life of connecting rod bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil. Burrs may be honed off with a fine oil stone.

Use an outside micrometer to check crankpins for out-of-round. If crankpins are more than .0015" out-of-round, satisfactory life of new bearings cannot be expected.

b. Checking Clearance and Selecting Replacement Bearings

Service bearings are furnished in standard size and several undersizes (including undersizes for reground crankpins).

The clearance of connecting rod (and crankshaft) bearings may be checked by use of Plastigage Type PG- 1 (green) or equivalent which has a range of .001" to .003".

1. Remove connecting rod cap with bearing shell. Wipe oil from bearing and crankpin journal, also blow oil out of hole in crankshaft.

NOTE: *Plastigage is soluble in oil.*

2. Place a piece of Plastigage lengthwise along the bottom center of the lower bearing shell (Figure 60- 80, View A), then install cap with shell and tighten bolt nuts to 35 lb. ft. torque. (350 Cu. In.) and 45 lb. ft. (455 Cu. In.)

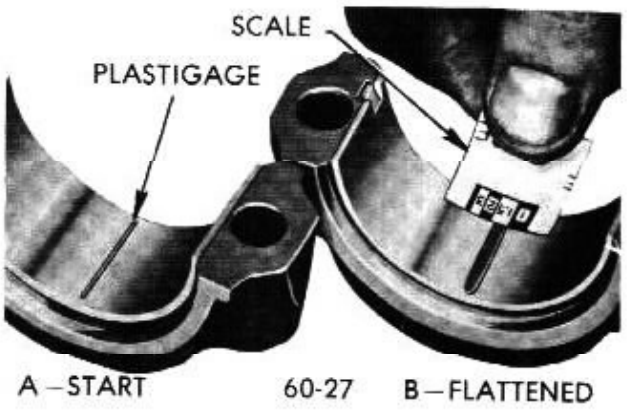


Figure 60-90 - Checking Bearing Clearance with Plastigage

NOTE: *The rib on edge of cap and the conical boss (455 cu.in. engine) or rib (350 cu.in. engine) on web of rod must be toward rear of engine on all rods in left bank and toward front of engine in right bank.*

3. DO NOT TURN CRANKSHAFT with Plastigage in bearing.

4. Remove bearing cap with bearing shell, the flattened Plastigage will be found adhering to either the bearing shell or the crankpin. *Do not remove it.*

5. Using the scale printed on the Plastigage envelope, measure the flattened Plastigage at its widest point. The number within the graduation which most closely corresponds to the width of Platigage indicates the bearing clearance in thousandths of an inch. See Figure 60-80, View B.

6. The desired clearance with a new bearing is .0002" to .0023". If bearing has been in service it is advisable to install a new bearing if the clearance exceeds .003"; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

7. If a new bearing is being selected, try a standard size, then each undersize bearing in turn until one is found that is within the specified limits when checked for clearance with Plastigage.

NOTE: *Each undersize bearing shell has a number stamped on outer surface on or near the tang to indicate amount of undersize. See Figure 60-91.*

8. After the proper size bearing has been selected, clean off the Plastigage, oil the bearing thoroughly, reinstall cap with bearing shell and tighten bolt nuts to 35 lb. ft. torque (350-Cu In.) and 45 lb. ft. (455 cu. in.). See Note in Step 2.

Figure 60-91 - Location of Undersize Mark on Bearing Shell

9. With selected bearing installed and bolts tightened, it should be possible to move connecting rod freely back and forth on crankpin as allowed by end clearance. If rod cannot be moved, either the bearing is too much undersize or a misaligned rod is indicated.

60-35 CRANKSHAFT BEARINGS AND SEALS

a. Replacement of Crankshaft Bearings

A crankshaft bearing consists of two halves or shells which are not alike and not interchangeable in cap and crankcase. The upper (crankcase) half of the bearing is grooved to supply oil to the connecting rod bearings while the lower (bearing cap) half of the shell is not grooved. The two bearing halves must not be interchanged. All crankshaft bearings except the thrust bearing and rear main upper are identical. The thrust bearing (No. 3) is flanged to take end thrust and the rear main upper bearing groove does not extend the full length of the bearing. When the shells are placed in crankcase and bearing cap, the ends extend slightly beyond the parting surfaces so that when cap bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. *The ends of shells must never be filed flush with parting surface of crankcase or bearing cap.*

Crankshaft bearings are the precision type which do not require reaming to size. Shims are not provided for adjustment since worn bearings are readily replaced with new bearings of proper size. Bearings for service replacement are furnished in standard size and undersizes. *Under no circumstances should crankshaft bearing caps be filed to adjust for wear in old bearings.*

After removal of oil pan, pipe and screen assembly, oil pan baffle, per paragraph 60-33, subparagraph l, perform the following removal, inspection and installation operations on each crankshaft bearing in turn so that the crankshaft will be well supported by the other bearings

NOTE: *If crankshaft has been removed to check straightness the following procedure is suggested.*

Rest crankshaft on "V-blocks" at no. 1 and no. 5 main bearing journals. Check indicator runout at No. 2, 3, and 4 main bearing journals. Total indicator readings at each journal should not exceed .003"

While checking runout at each journal note relation of "high" spot (for maximum eccentricity) on each journal to the others.

"High" spot on all journals should come at the same angular location. If "high" spots do not come at nearly the same angular location, crankshaft has a "crook" or "dogleg" in it and is unsatisfactory for service.

1. Since any service condition which affects the crankshaft bearings may also affect the connecting rod bearings, it is advisable to inspect connecting rod bearings first. If crankpins are worn to the extent that crankshaft should be replaced or reground, replacement of crankshaft bearings only will not be satisfactory.

NOTE: *If replacement of cylinder block or crankshaft is required, always check main bearing clearance with Plastigage to obtain specified limits.*

2. Remove one bearing cap, then clean and inspect lower bearing shell and the crankshaft journal. If journal surface is scored or ridged, the crankshaft must be replaced or reground to insure satisfactory operation with new bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil, and burrs may be honed off with a fine stone.

3. If condition of lower bearing shell and crankshaft journal is satisfactory, check the bearing clearance with Plastigage as described for connecting rod bearing in paragraph 60-34, subparagraph b.

4. When checking a crankshaft bearing with Plastigage, turn crankshaft so that oil hole is up to avoid dripping of oil on Plastigage. Place paper shims in lower halves of adjacent bearings and tighten cap bolts to take the weight of crankshaft off the lower shell of bearing being checked.

NOTE: *Arrow on cap must point to front of engine.*

5. If bearing clearance exceeds .003", it is advisable to install a new bearing; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

6. Loosen all crankshaft bearing cap bolts 1/2 turn, and remove cap of bearing to be replaced.

7. Remove upper bearing shell by inserting Bearing Shell Remover and Installer J-8080 in oil hole in crankshaft,

then slowly turning crankshaft so that the tool rotates the shell out of place by pushing against the end without the tang. See Figure 60-92.

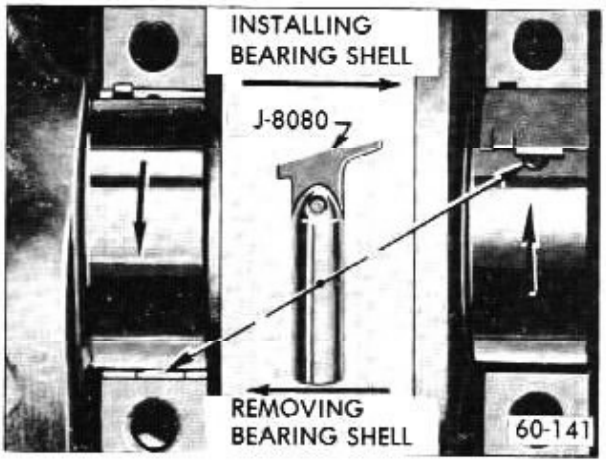


Figure 60-92 - Removal and Installation of Crankshaft Bearing Upper Shell

CAUTION: *When turning crankshaft with rear bearing cap removed, hold oil seal to prevent it from rotating out of position in crankcase.*

8. The crankshaft journal cannot be measured with an outside micrometer when shaft is in place; however, when upper bearing shell is removed the journal may be checked for out-of-round by using a special crankshaft caliper and inside micrometer. The caliper should not be applied to journal in line with oil hole.

If crankshaft journal is more than .0015" out-of round, the crankshaft should be replaced since the full mileage cannot be expected from bearings used with an excessively out-of-round crankshaft.

9. Before installation of bearing shells make sure that crankshaft journal and the bearing seats in crankcase and cap are thoroughly cleaned.

10. Coat inside surface of upper bearing shell with engine oil and place shell against crankshaft journal so that tang on shell will engage notch in crankcase when shell is rotated into place.

IMPORTANT: *Upper bearing shells have an oil groove in their center, while lower shells are not grooved. They must not be interchanged.*

11. Rotate bearing shell into place as far as possible by hand, then insert Installer J-8080 in crankshaft oil hole and rotate crankshaft to push shell into place.

CAUTION: *Bearing shells should move into place with very little pressure. If heavy pressure is required, shell was not started squarely and will be distorted if forced into place.*

12. Place lower bearing shell in bearing cap, then check clearance with Plastigage as previously described.

13. The desired clearance with a new bearing is .0004" to .0015" (350 Cu. In.) and .0007" to .0018" (455 cu. in). If this clearance cannot be obtained with a standard size bearing, insert an undersize bearing and check again with Plastigage.

NOTE: *Each undersize shell has a number stamped on outer surface on or near the tang to indicate amount of undersize.*

14. When the proper size bearing has been selected, clean out all Plastigage, oil the lower shell and reinstall bearing cap. Clean the bolt holes and lube bolts, then torque cap bolts to specification given in paragraph 60-40.

The crankshaft should turn freely at flywheel rim; however, a very slight drag is permissible if an undersize bearing is used.

15. If the *thrust* Bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel serveral times (last movement fore) with the thrust bearing cap bolts finger tight.

16. After bearing is installed and tested, loosen all bearing cap bolts 1/2 turn and continue with other bearings. When bearings have been installed and tested, tighten all bearing cap bolts to specification given in paragraph 60-40.

17. Refer to subparagraph b for replacement of rear bearing oil seals.

18. Install oil pan baffle, pipe and screen assembly, and oil pan following procedure outlined in paragraph 60-33, subparagraph 1.

b. Installation of Rear Bearing Oil Seals

Braided fabric seals are pressed into grooves formed in crankcase and rear bearing cap to rear of the oil collecting groove, to seal against leakage of oil around the crankshaft. See Figure 60-93 or 60- 94.

The braided fabric seal can be installed in crankcase only when crankshaft is removed; however, the seal can be replaced in cap whenever cap is removed. Remove old seal and place new seal in groove with both ends projecting above parting surface of cap. Force seal into groove by rubbing down with hammer handle or smooth stick until seal projects above the groove not more than 1/16". Cut ends off flush with surface of cap, using sharp knife or razor blade. See Figure 60-93 or 60-94.

CAUTION: *The engine must be operated at slow speed when first started after new braided seal is installed.*

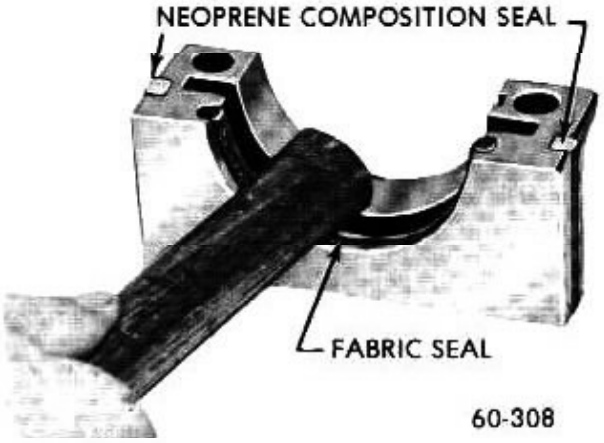


Figure 60-93 - Installing Rear Bearing Oil Seals (350 Cu. In.)

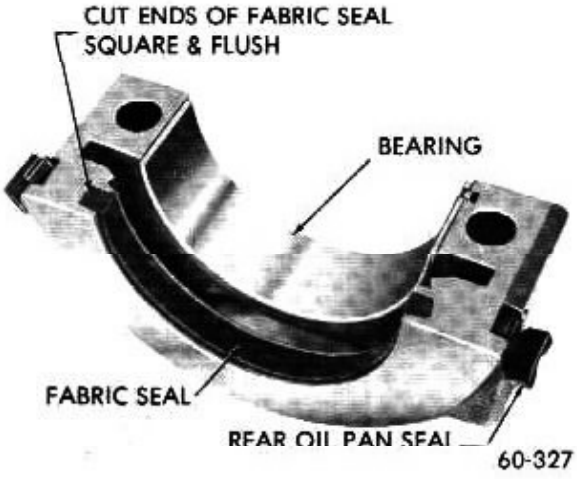


Figure 60-94 - Rear Bearing Oil Seal (455 Cu. In.)

Neoprene composition seals (350 cu.in. only) are placed in grooves in the sides of bearing cap to seal against leakage in the joints between cap and crankcase. The neoprene composition swells in the presence of oil and heat. The seals are undersize when newly installed and may even leak for a short time until the seals have had time to swell and seal the opening. See Figure 60-93.

The neoprene seals are slightly longer than the grooves in the bearing cap. The seals must not be cut to length. Before installation of seals, soak for 1 to 2 minutes in light oil or kerosene. After installation of bearing cap in crankcase, install seal in bearing cap.

After seal is installed, force seals up into the cap with a blunt instrument to be sure of a seal at the upper parting line between the cap and case.

60-36 PISTONS, RINGS, AND CONNECTING RODS

a. Replacement, Disassembly, and Inspection of Piston and Rod Assemblies

1. Remove cylinder heads. (par. 60-33, subparagraph c) and oil pan (par. 60-33, subparagraph l)

2. Examine the cylinder bores above the ring travel. If bores are worn so that a shoulder or ridge exists at the top of the cylinder, remove the ridges with a ridge reamer to avoid damaging rings or cracking ring lands in pistons during removal. See Figure 60- 95.

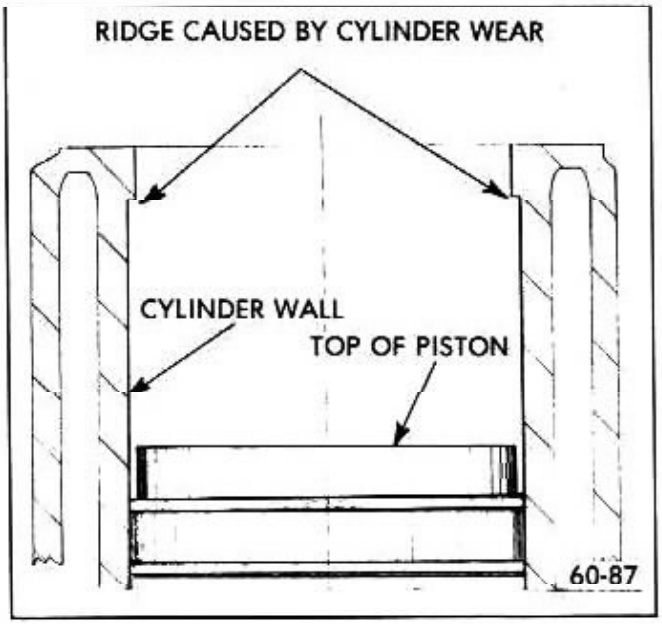


Figure 60-95 - Ridge Formed by Rings at Top of Travel

3. Use a silver pencil or quick drying paint to mark the cylinder number on all pistons, connecting rods and caps. Starting at the front end of the crankcase the cylinders in the right bank are numbered 2-4-6-8. Those in the left bank are numbered 1-3-5- 7.

4. With No. 1 crankpin straight down, remove the cap with bearing shell from No. 1 connecting rod, install the *short* Connecting Rod Bolt Guide J-5239-1 on the connecting rod bolt, above crankpin. Install the *long* Connecting Rod Bolt Guide J-5239-2 on remaining stud. Turn guides down fully to hold the upper bearing shell in place while removing piston and rod assembly. See Figure 60-96.

5. Use the long guide to push the piston and rod assembly out of the cylinder, then remove guides and reinstall cap with bearing shell on rod.

6. Remove all other piston and rod assemblies in the same manner.

7. Remove compression rings and remove oil ring by removing the two rails, and spacer-expander which are separate pieces in each piston third groove.

8. To remove piston pin:

455 Engine

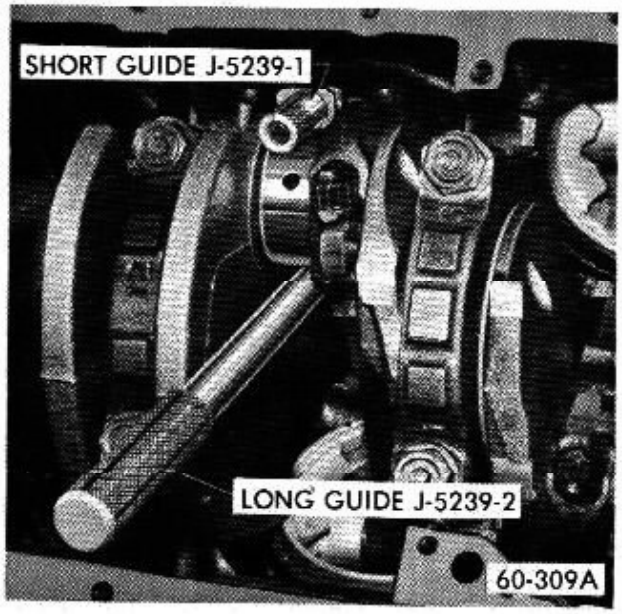


Figure 60-96 - Connecting Rod Bolt Guides Installed

(a) Place piston and rod assembly in press, using Piston Support J-6047-17 (with full radial face up) under the piston.

(b) Place Drive Pin J-6047-4 in upper end of piston pin.

(c) Press pin from rod and piston.

350 Engine

(a) Place piston and rod assembly in press, using Piston Support J-6047-5 (with full radial face up) under the piston.

(b) Place Drive Pin J-6047-4 in upper end of piston.

(c) Press pin from rod and piston.

9 (a) Inspect cylinder walls for scoring, roughness, or ridges which indicate excessive wear. Check cylinder bores for taper and out-out-round with an accurate cylinder gage at top, middle and bottom of bore, both parallel and at right angles to the centerline of the engine. The diameter of the cylinder bores at any point may be measured with an inside micrometer or setting the cylinder gage dial at "O" and measuring across the gage contact points with outside micrometer while the gage is at same "O" setting.

(b) If a cylinder bore is moderately rough or slightly scored but is not out-of-round of tapered, it is usually possible to remedy the situation by honing the bore to fit a standard service piston since standard service pistons are high limit production pistons. If cylinder bore is very rough or deeply scored, however, it may be necessary to rebore the cylinder to fit an oversize piston in order to insure satisfactory results.

(c) If cylinder bore is tapered .005" or more or is out-of-round .003" or more, it is advisable to rebore for the smallest possible oversize piston and rings.

10. Clean carbon from piston surfaces and under side of piston heads. Clean carbon from ring grooves with suitable tool and remove any gum or varnish from piston skirts with suitable solvent.

11. Carefully examine pistons for rough or scored bearing surfaces, cracks in skirt or head cracked or broken ring lands, chipping or uneven wear which would cause rings to seat improperly or have excessive clearance in ring grooves. Damaged or faulty pistons should be replaced.

The pistons are cam ground, which means that the diameter at a right angle to the piston pin is greater than the diameter parallel to the piston pin. When a piston is checked for size, it must be measured with micrometers applied to the skirt at points 90 degrees to the piston pin. See Figure 60-97. The piston should be measured (for fitting purposes) 1/4" below the bottom of the oil ring groove.

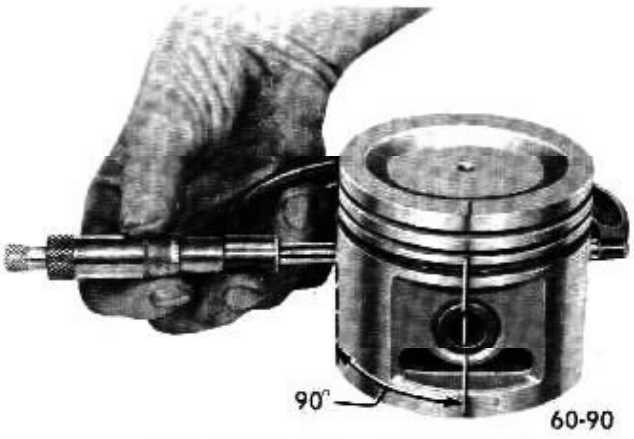


Figure 60-97 - Measuring Piston

12. Inspect bearing surfaces of piston pins and check for wear by measuring worn or unworn surfaces with micrometers. Rough or worn pins should be replaced. Test fit of piston pins in piston bosses. Occasionally pins will be found tight due to gum or varnish deposits. This may be corrected by removing the deposit with a suitable solvent. If piston bosses are worn out-of-round or oversize, the piston and pin assembly must be replaced. Oversize pins are not practical due to the pin being a press fit in the connecting rod. Piston pins must fit the piston with an easy finger push at 70 degrees F (.0004" to .0007" clearance).

13. Examine all piston rings for scores, chips or cracks. Check compression rings for tension by comparing with new rings. Check gap of compression rings by placing rings in bore at bottom of ring travel. Measure gap with feeler gage. Gap should be between .010" and .020". If gaps are excessive (over .020") it indicates the rings have worn considerably and should be replaced.

b. Reboring Cylinder and Fitting New Pistons

If one or more cylinder bores are rough, scored, or worn beyond limits prescribed under subparagraph a, it will be necessary to smooth or true up such bores to fit new pistons.

If relatively few bores require correction it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance, since all oversize service pistons are held to the same weights as standard size pistons. If conditions justify replacement of all pistons, however, all new pistons should be the same nominal size.

Standard size service pistons are high limit or maximum diameter; therefore, they can usually be used with a slight amount of honing to correct slight scoring or excessive clearances in engines having relatively low mileage. All service pistons are diamond bored and selectively fitted with piston pins; pistons are not furnished without pins.

No attempt should be made to cut down oversize pistons to fit cylinder bores as this will destroy the surface treatment and affect the weight. The smallest possible oversize service pistons should be used and the cylinder bores should be honed to size for proper clearances.

Before the honing or reboring operation is started, measure all new pistons with micrometer contacting at points exactly 90 degrees to piston pin (Figure 60-97 then select the smallest piston for the first fitting. The slight variation usually found between pistons in a set may provide for correction in case the first piston is fitted too free.

If wear at top of cylinder does not exceed .005" on the diameter or exceed .003" out-of-round, honing is recommended for truing the bore. If wear or out-of- round exceeds these limits, the bore should be trued up with a boring bar of the fly cutter type, then finish honed.

When reboring cylinders, all crankshaft bearing caps must be in place and tightened to proper torque to avoid distortion of bores in final assembly. Always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. When taking the final cut with boring bar leave .001" on the diameter for finish honing to give the required clearance specified below.

When honing cylinders use clean sharp stones of proper grade for the amount of metal to be removed, in accordance with instructions of the hone manufacturer. Dull or dirty stones cut unevenly and generate excessive heat. When using coarse or medium grade stones use care to leave sufficient metal so that all stone marks may be removed with the fine stones used for finishing to provide proper clearance.

When finish honing, pass the hone through the entire length of cylinder at the rate of approximately 60 cycles per minute. This should produce the desired 45 degree cross hatch pattern on cylinder walls which will insure maximum ring life and minimum oil consumption.

It is of the greatest importance that refinished cylinder bores are trued up to have not over .0005" out-of-round or taper. Each bore must be final honed to remove all stone or cutter marks and provide a smooth surface. During final honing, each piston must be fitted individually to the bore in which it will be installed and should be marked to insure correct installation.

After final honing and before the piston is checked for fit, each cylinder bore must be *thoroughly* washed to remove all traces of abrasive and then dried thoroughly. The dry bore should then be brushed clean with a power-driven fibre brush. If all traces of abrasive are not removed, rapid wear of new pistons and rings will result. A satisfactory method of fitting pistons is as follows:

1. Expand a telescope gage to fit the cylinder bore at right angles to the piston pin and between 1-1/2" and 2" from the top. See Figure 60-98.

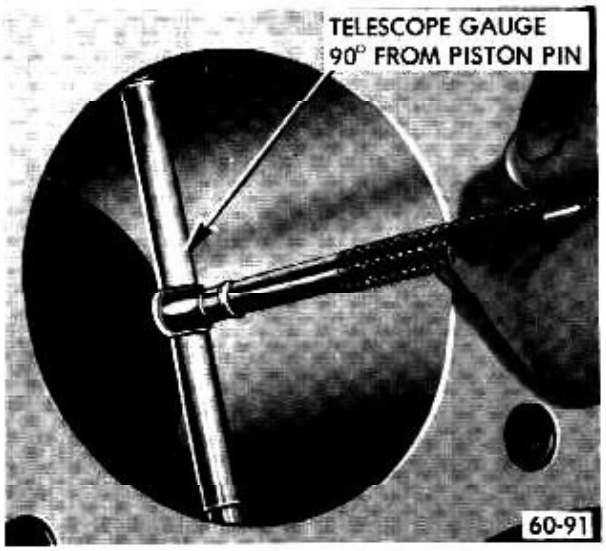


Figure 60-98 - Checking Cylinder Bore

2. Measure the telescope gage. See Figure 60-99.

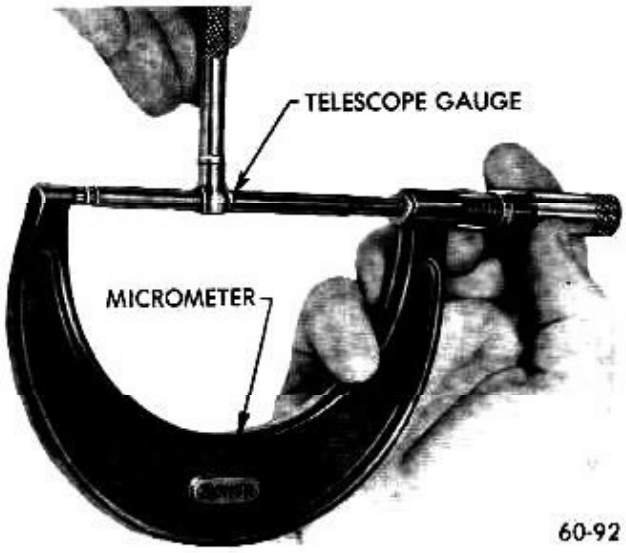


Figure 60-99 Measuring Telescope Gauge

3. Measure the piston to be installed. See Figure 60-97. The piston must be measured at right angles to the piston pin 1/4" below the oil ring groove. The piston must be between .0008" and .0014" (350 Cu. In.) and .0007" to .0013" (455 Cu. In.) smaller than the cylinder bore.

NOTE: *Both block and piston must be at very nearly the same temperature when measurements are made or errors due to expansion will occur. A difference of 10 degrees F. between parts is sufficient to produce a variation of .0005".*

c. Fitting New Piston Rings

When new piston rings are installed without reboring cylinders, the glazed cylinder walls should be slightly dulled, but without increasing the bore diameter, by means of the finest grade of stones in a cylinder hone.

New piston rings must be checked for clearance in piston grooves and for gap in cylinder bores. The cylinder bores and piston grooves must be clean, dry and free of carbon and burrs.

With rings installed, check clearance in grooves by inserting feeler gages between each ring and its *lower* land because any wear that occurs forms a step at inner portion of the lower land.

If the piston grooves have worn to the extent that relatively high steps exist on the lower lands, the piston should be replaced because the steps will interfere with the operation of new rings and the ring clearances will be excessive. Piston rings are not furnished in oversize widths to compensate for ring groove wear.

When fitting new rings to new pistons the side clearance of the compression rings should be .003" to .005" and side clearance of the oil ring should be .0035" to .0095".

To check the end gap of compression rings, place the ring in the cylinder in which it will be used, square it in the bore by tapping with the lower end of a piston, then measure gap with feeler gages. Piston rings should not have less than .010" (350 Cu. In.) and .013" (455 Cu. In.)(compression rings) and .015" (oil ring) gap when placed in cylinder bores. If gap is less than specified, file the ends of rings carefully with a smooth file to obtain proper gap.

d. Assembly and Installation of Piston and Connecting Rod Assemblies

NOTE: *Connecting rods may be sprung out of alignment in shipping or handling. Always check a new rod before installing piston and pin.*

Check bend and twist on an accurate rod aligning fixture using Guide Pin J-6047-16 for 455 engines, and J-6047-20 for 350 engines, in place of wrist pin. Press V-block firmly and evenly against guide pin to prevent cocking pin in eye of rod which may be up to .00125" tight on pin.

1. To assemble piston and pin to connecting rod, first place Piston Pin Spacer, J-6047-21, and Piston Support, J-6047-17, or J-6047-5 whichever applies, in base plate of press.

2. If the piston and rod assembly is to be installed in the *left* bank, the assembly must be made as shown in Figures 60-100 and 60-101.

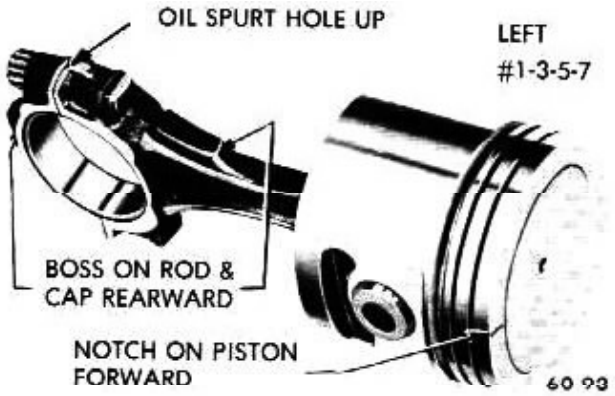


Figure 60-100 - Left Bank Piston and Rod Assembly (455 cu.in. engines)

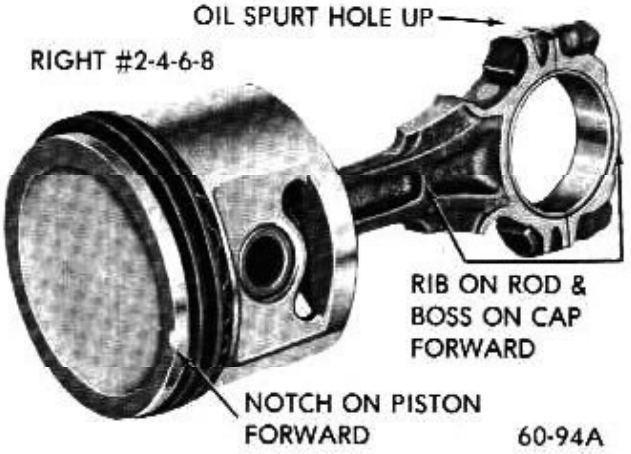


Figure 60-101 - Left Bank Piston and Rod Assembly (350 cu.in. Engine)

3. If the piston and rod assembly is to be installed in the *right* bank, the assembly must be made as shown in Figures 60-102 and 60-103.

4. Lubricate piston pin to avoid damage when pressing into connecting rod.

5. Assemble piston and rod on spring loaded guide pin.

6. Install drive pin in upper end of piston pin. Press on drive pin till piston pin bottoms.

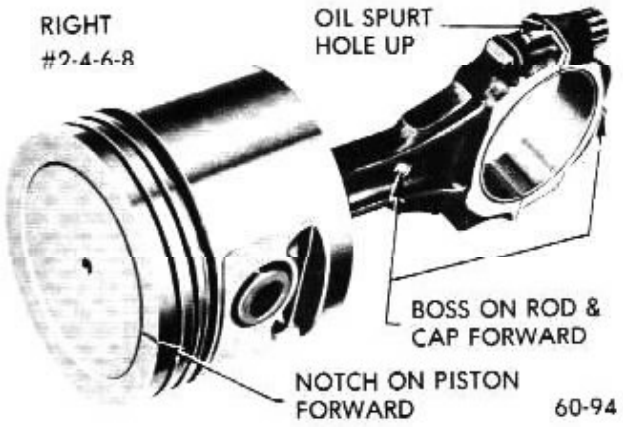


Figure 60-102 - Right Bank Piston and Rod Assembly (455 cu.in. Engines)

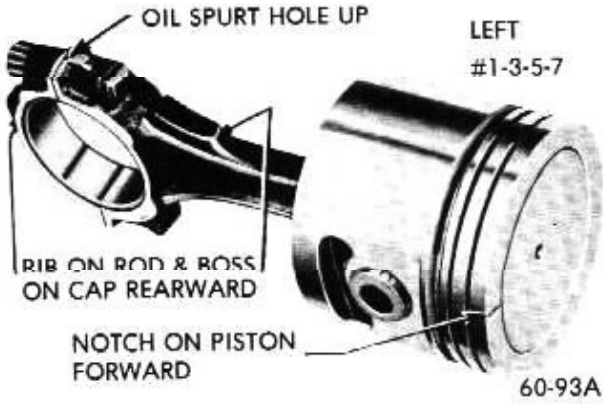


Figure 60-103 - Right Bank Piston and Rod Assembly (350 cu.in. engine)

7. Remove piston and rod assembly from press. Rotate piston on pin to be sure pin was not damaged during the pressing operation.

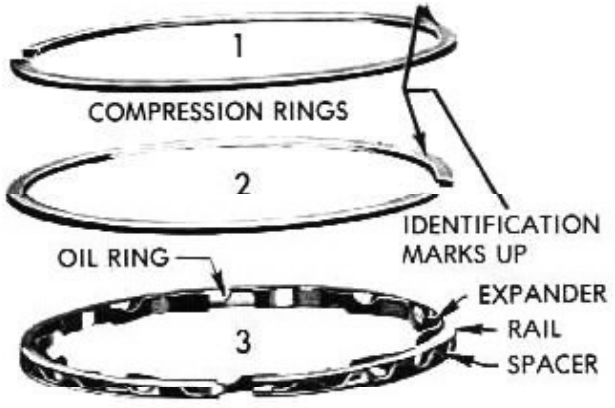


Figure 60-104 - Piston Rings (350 Cu In.)

8. Install piston rings as shown in Figures 60-104 and 60-238. Position expander ends over piston pin. Install oil ring rail spacer, and oil ring rails. Position gaps in rails "up" on same side of piston as oil spurt hole in connecting rod. Install compression rings in upper two grooves.

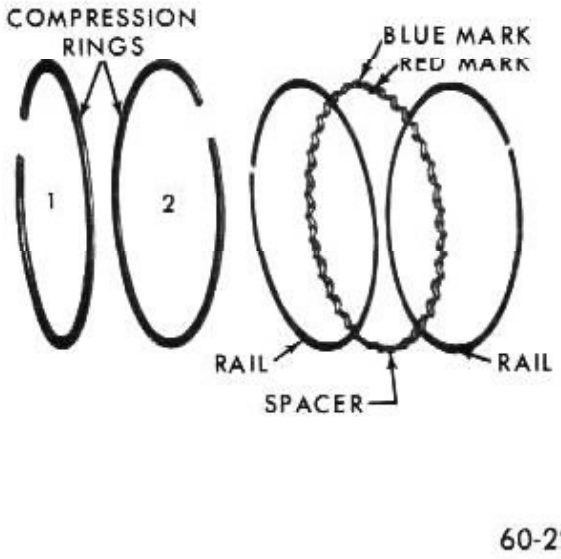


Figure 60-105 - Piston Rings (455 Cu. In.)

a. Top compressing ring - When installed, the manufacturer's indentification mark ("O", "DOT" or "TOP") facing up.

b. Second compression ring - When installed, the manufacturer's identification mark ("O", "DOT" or "TOP") facing up.

c. Oil ring - Can be installed with either rail facing up.

d. Ring gaps - All three ring gaps must be 90 apart. See Figure 60-106.

NOTE: *To make certain expander ring does not overlap a red or blue mark will be visable on ring. See Figure 60-105.*

NOTE: *The rails and and spacer of the oil ring are lightly held together with an oil soluble cement. If parts have separated they may be installed as individual pieces.*

9. Make sure cylinder bores, pistons, connecting rod bearings and crankshaft journals are absolutely clean, then coat all bearing surfaces with engine oil.

10. Before installation of a piston and rod assembly in its bore, position the crankpin straight down.

11. Remove cap, and with bearing upper shell seated in connecting rod, install the *long* Guide J-5239- 2 on bolt which is on same side of rod as the oil spurt notch in the bearing parting surface. Install short Guide J-5239-1 on the other connecting rod bolt.

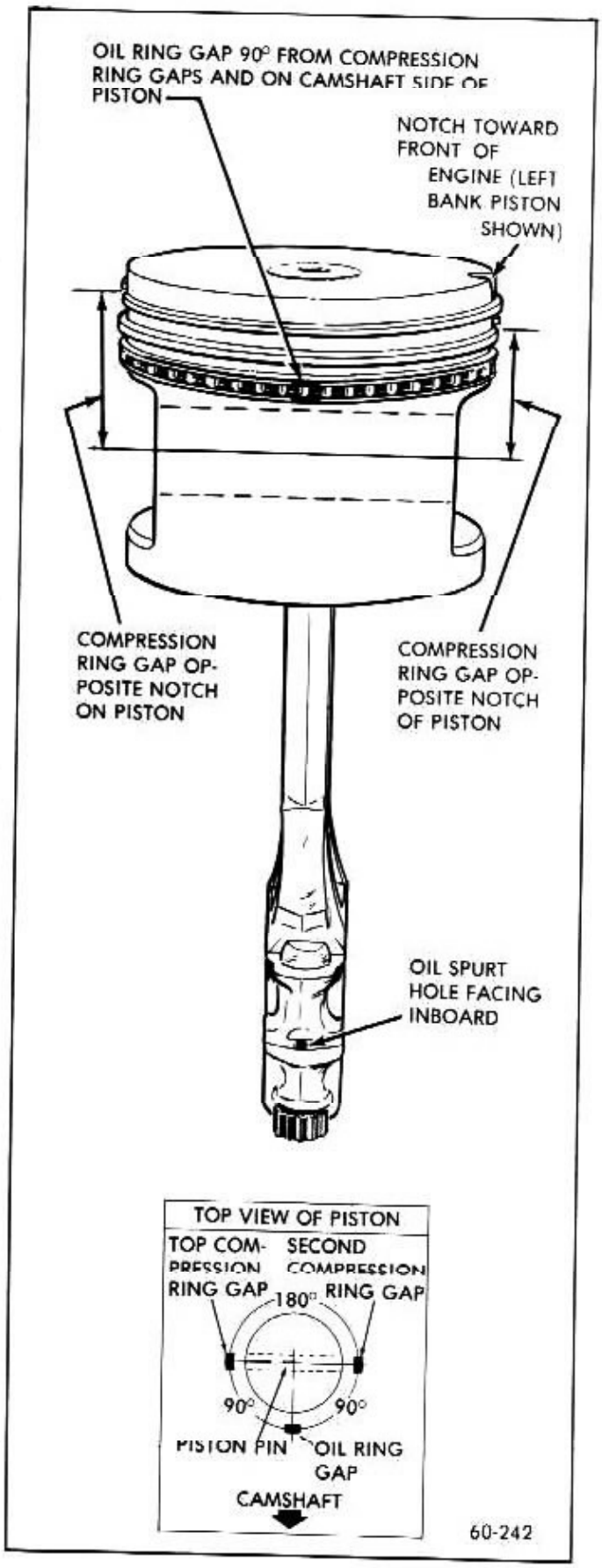


Figure 60-106 - Piston Ring Gap Positioning

These guides hold the upper bearing shell in place and protect the crankpin journal from damage during installation of connecting rod and piston assembly.

12. Make sure the gap in the oil ring rails is "up" toward center of engine and the gaps of the compression rings are positioned as shown in Figure 60-107.

13. Lubricate the piston and rings and install in bore by compressing the rings either with a "wrap around" compressor or a split ring type such as shown in Figure 60-107.

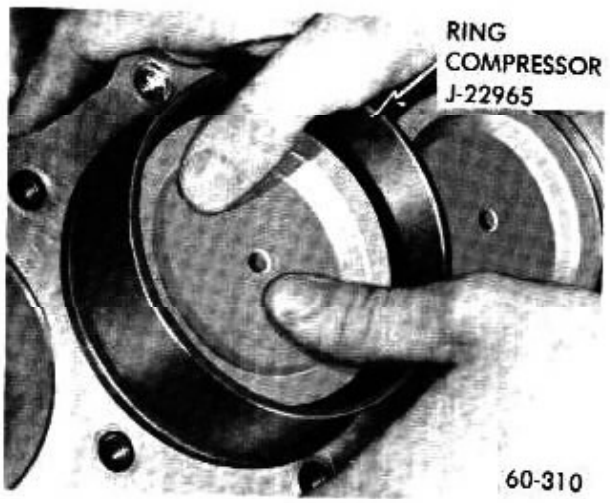


Figure 60-107 - Installing Piston with Ring Compressor Installed (350 Shown)

14. Select new connecting rod bearing, if necessary, as described in paragraph 60-34. Otherwise install cap with bearing lower shell on rod and tighten bolt nuts to 35 lb. ft. (350 Cu. In.) and 45 lb. ft. (455 Cu. In.) torque.

15. Install all other piston and rod assemblies in same manner. When piston and rod assemblies are properly installed, the oil spurt holes in the connecting rods will be "up" toward the camshaft, the rib on the edge of the rod cap will be on the same side as the conical boss on the connecting rod web, and these marks, (rib and boss) will be toward the other connecting rod on the same crankpin. See Figure 60-100 and 60-102.

16. Check end clearance between connecting rods on each crankpin using feeler gages. Clearance should be between .005" and .012".

17. Install cylinder head (par. 60-33). Install oil screen and engine oil pan (60-33, subparagraph 1).

IMPORTANT: *After installation of new pistons and rings, care should be used in starting the engine and running it for the first hour. Avoid high speeds until the parts have had a reasonable amount of "break in" time. This practice will avoid unnecessary "scuffing" of new parts.*

60-36 CAMSHAFT AND TIMING CHAIN

a. Timing Chain Cover Removal

1. Drain radiator and block.

2. Disconnect upper and lower radiator hose and heater return hose at water pump, disconnect lower bolts and brackets and remove radiator.

3. Remove fan, fan pulleys and belt(s).

4. Remove fan driving pulley (crankshaft) and pulley reinforcement.

5. Disconnect fuel lines and remove fuel pump.

6. Remove Delcotron generator and brackets.

7. Remove distributor cap and pull spark plug wire retainers off brackets on rocker arm cover. Swing distributor cap with wires attached out of the way. Disconnect distributor primary lead.

8. Remove distributor. If timing chain and sprockets are not going to be disturbed, note position of distributor rotor for reinstallation in same position.

9. Loosen and slide front clamp on thermostat by-pass hose rearward.

10. Remove harmonic balancer bolt and washer and remove harmonic balancer.

11. Remove bolts attaching timing chain cover to cylinder block. See Figures 60-108 and 60-109. Remove two oil pan to timing chain cover bolts 350 Cu In. and 4 bolts on the 455 Cu. In. Remove timing chain cover assembly and gasket. Thoroughly clean the cover, taking care to avoid damage to the gasket surface.

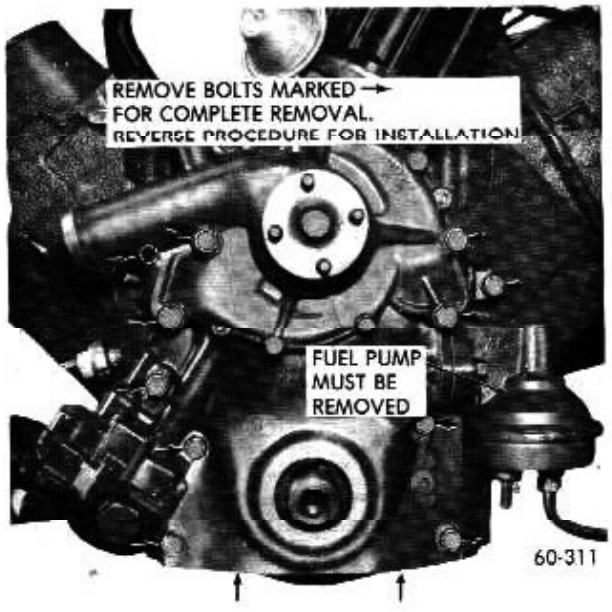


Figure 60-108 - Timing Chain Cover Removal and Installation (350 cu.in.)

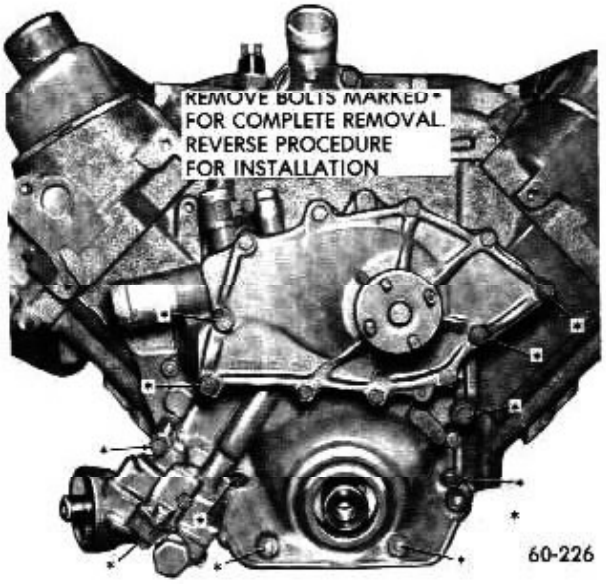


Figure 60-109 - Timing Chain Cover Removal and Installation (455 cu.in.)

b. Timing Chain Cover Replacement

Reinstall timing chain cover by reversing removal procedure, paying particular attention to the following points.

1. Remove oil pump cover and pack the space around the oil pump gears completely full of petroleum jelly. There must be no air space left inside the pump. Reinstall cover using new gasket. This step is very important as the oil pump may "lose its prime" whenever the pump, pump cover or timing chain cover is disturbed. If the pump is not packed, it may not begin to pump oil as soon as the engine is started.

2. The gasket surface of the block and timing chain cover must be smooth and clean. Use a new gasket and be certain it is positioned correctly.

3. Position timing chain cover against block and be certain dowel pins engage dowel pin holes before starting bolts.

4. Lubricate the bolt threads before installation and install as shown in Figures 60-108 and 60-109.

5. Install harmonic balancer, bolt and washer. By using a screwdriver or other suitable tool, lock flywheel and torque bolt to (140-160 lb. ft. on 350 cu.in.) and (200-220 lb. ft. on 455 cu.in.) See Figure 60-110.

c. Crankshaft Oil Seal Replacement

1. Use a punch to drive out old seal and shedder. Drive from the front toward the rear of the timing chain cover.

2. Coil new packing around opening so ends of packing are at top. Drive in shedder using suitable punch. Stake the shedder in place in at least three places.

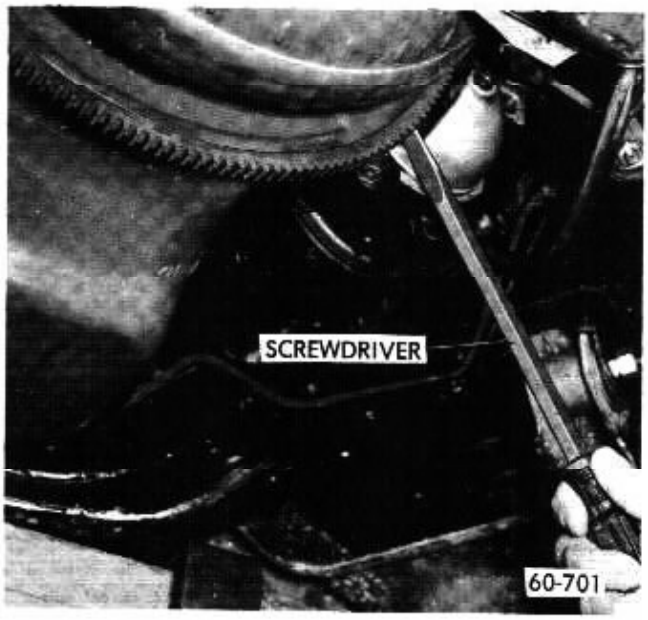


Figure 60-110 - Locking Flywheel to Torque Harmonic Balancer Bolt.(350 cu.in. Shown)

3. Size the packing by rotating a hammer handle or similar tool around the packing until the balancer hub can be inserted through the opening.

d. Timing Chain and Sprocket Removal

350 Cu. In.

1. With timing chain cover removed (subpar. a above) temporarily install crankshaft pulley bolt and washer in end of crankshaft. Turn crankshaft so sprockets are positioned as shown in Figure 60-111. Remove harmonic balancer bolt and washer using a sharp blow on the wrench handle, so that the bolt can be started out without changing position of sprockets.

2. Remove front crankshaft oil slinger.

3. Remove bolt and special washer retaining camshaft distributor drive gear and fuel pump eccentric to camshaft forward end. Slide gear and eccentric off camshaft. See Figure 60-112.

4. Use two large screwdrivers to alternately pry the camshaft sprocket then the crankshaft sprocket forward until the camshaft sprocket is free, then remove the camshaft sprocket and chain and finish working crankshaft sprocket off crankshaft.

5. Thoroughly clean the timing chain, sprockets, distributor drive gear, fuel pump eccentric and crankshaft oil slinger.

455 Cu. In.

1. With timing chain cover removed (subpar. a above) Temporarily install crankshaft pulley bolt and washer in

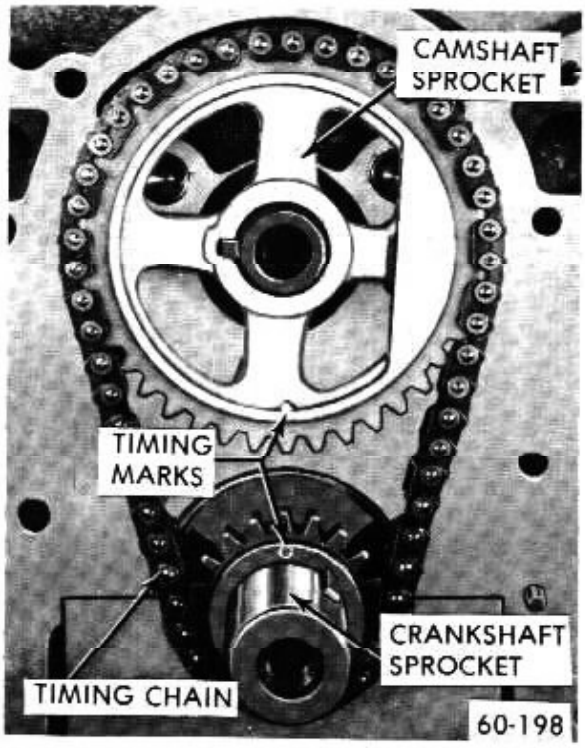


Figure 60-111 - Installation of Timing Chain and Sprocket - 350 Cu. In.

end of crankshaft. Turn crankshaft so sprockets are positioned as shown in Figure 60-113. Remove crankshaft pulley bolt and washer using a sharp blow on the wrench handle, so that the bolt can be started out without changing position of sprockets.

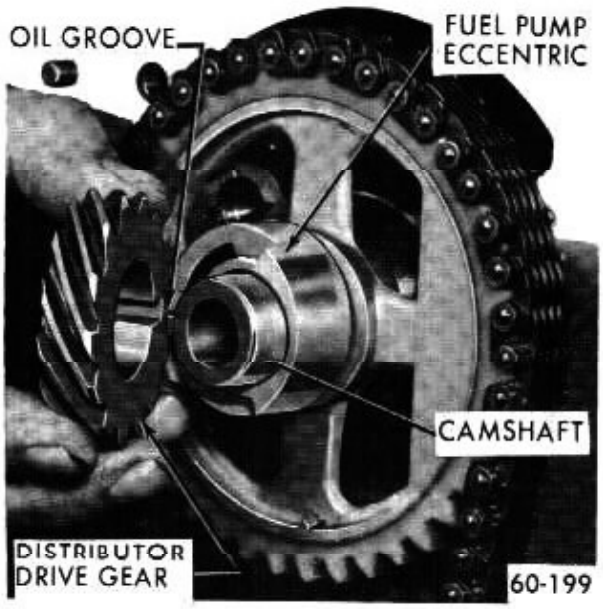


Figure 60-112 - Fuel Pump and Distributor Drive Gear Installation - 350 Cu. In.

2. Remove oil pan per paragraph 60.33, subparagraph 1.

3. Remove front crankshaft oil slinger.

4. Remove camshaft sprocket bolts.

5. Use two large screwdrivers to alternately pry the camshaft sprocket then the crankshaft sprocket forward until the camshaft sprocket is free, then remove the camshaft sprocket and chain and finish working crankshaft sprocket off crankshaft.

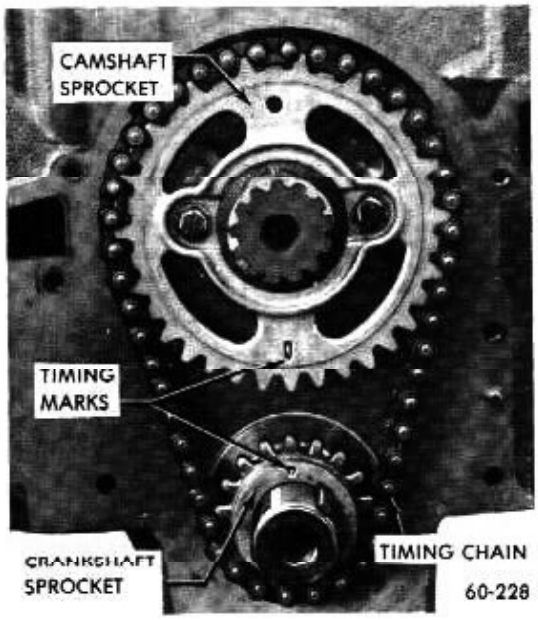


Figure 60-113 - Installation of Timing Chain and Sprocket (455 cu.in.)

6. Thoroughly clean the timing chain, sprockets, distributor drive gear, fuel pump eccentric and crankshaft oil slinger.

e. Timing Chain and Sprocket Installation

350 Cu. In.

1. Turn crankshaft so that Number 1 piston is at top dead center.

2. Turn camshaft so with sprocket temporarily installed, timing mark is straight down. See Figure 60-243. Remove sprocket.

3. Assemble timing chain on sprockets and slide the sprocket and chain assembly on the shafts with the timing marks in their closest together position and in line with the sprocket hubs. See Figure 60-111.

4. Assemble slinger on crankshaft with I.D. against sprocket (concave side toward front of engine). See Figure 60-114.

5. Slide fuel pump eccentric on camshaft and Woodruff key with oil groove forward. See Figure 60-112.

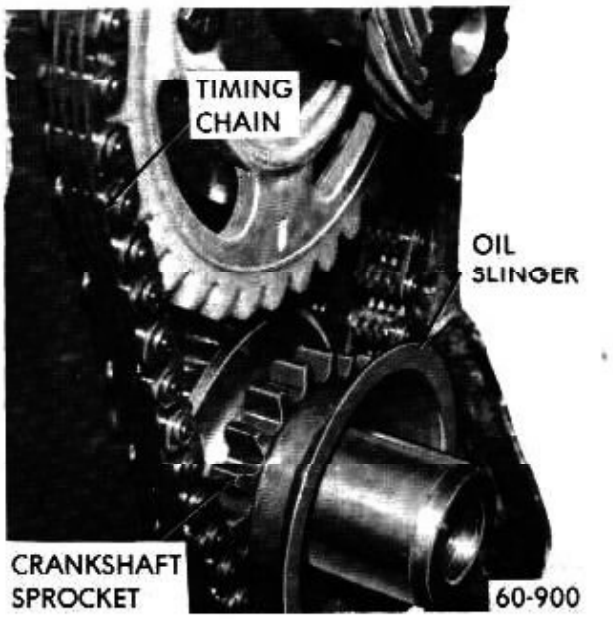


Figure 60-114 - Oil Slinger Installation

6. Install distributor drive gear. See Figure 60-112.

7. Install drive gear and eccentric bolt and retaining washer. Torque to 50 lb. ft.

8. Reinstall timing chain cover (subpar. b above).

455 Cu. In.

1. Turn crankshaft so that Number 1 piston is at top dead center.

2. Turn camshaft so with sprocket temporarily installed, timing mark is straight down. See Figure 60-113. Remove sprocket.

3. Assemble timing chain on sprockets and slide the sprocket and chain assembly on the shafts with the timing marks in their closest together position and in line with the sprocket hubs. See Figure 60-113.

4. Assemble slinger on crankshaft with I.D. against sprocket (concave side toward front of engine). See Figure 60-114.

5. Reinstall oil pan.

6. Install camshaft sprocket bolts. Torque to 22 lb. ft.

7. Reinstall timing chain cover (subpar. b above).

f. Camshaft Service

1. Remove intake manifold as outlined in paragraph 60-33.

2. Remove rocker arm covers.

3. Remove rocker arm and shaft assemblies, push rods and valve lifters.

4. Remove timing chain cover, timing chain and sprocket, subparagraph d above.

5. Slide camshaft forward out of bearing bores carefully to avoid marring the bearing surfaces.

6. When replacing camshaft, take particular care to avoid marring the bearing surfaces.

7. Replace valve mechanism as outlined in paragraph 60-33d.

8. Replace intake manifold as outlined in paragraph 60-33d.

Camshaft Bearing Service

Slightly scored camshaft bearings will be satisfactory if the surfaces of camshaft journals are polished and bearings are cleaned up to remove burrs, and the fit of shaft in bearings is free and within the clearance limits of .0015" to .004"

Should the bearing be gauled beyond repair, the bearing will have to be replaced.

To install precision replacement cam bearing, special Tool J-27408 is required. To remove and install replacement bearing proceed as follows:

BEARING REMOVAL

CAUTION: *Extreme care must be exercised during bearing removal and installation, not to damage bearings that are not being replaced.*

1. Remove camshaft and crankshaft.

2. Assemble puller screw to required length.

3. Select proper size expanding collect and back-up nut.

4. Install expanding collet on expanding mandrel. Install back-up nut.

5. Insert this assembly into camshaft bearing to be removed. Tighten back-up nut to expand collet to fit I.D. of bearing.

6. Thread end of puller screw assembly into end of expanding mandrel and collet assembly.

7. Install pulling plate, thrust bearing, and pulling nut on threaded end of puller screw.

8. Bearing can then be removed by turning pulling nut. See Figure 60-115.

CAUTION: *Make certain to grip the 5/8" hex end of the puller screw with a wrench to keep it from rotating when the pulling nut is turned. Failure to do this will result in the "locking up" of all threads in the pulling assembly and possible over expansion of the collet.*

9. Repeat the above procedure to remove the remaining bearings, except the front bearing, which may be pulled from the rear of the engine.

NOTE: *When removing rear cam bearing, it is mandatory to remove welch plug at the back of cam bore. However, if only the front bearing is being replaced, it is not necessary to remove the engine or welch plug. The front bearing can be removed by using a spacer between the pulling plate and the cylinder block.*

BEARING INSTALLATION

1. Assemble puller screw to required length.

2. Select proper size expanding collet and back-up nut.

3. Install expanding collet on expanding mandrel.

4. Install back-up nut.

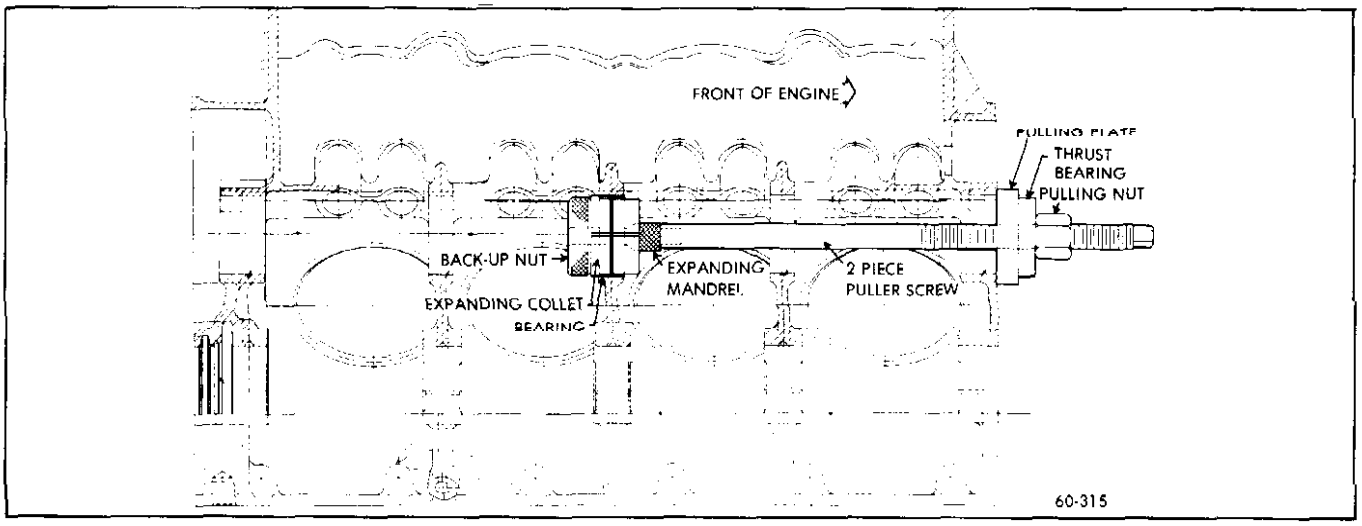


Figure 60-115 - Removing and Installing Camshaft Bearings

5. Place new camshaft bearing on collet and GENTLY hand tighten back-up nut to expand collet to fit bearing.

CAUTION: *Do not over tighten back-up nut. A loose sliding fit between collet and bearing surface is adequate. This will provide just enough clearance to allow for the "collapse" which will occur when the new bearing is pulled into the engine block.*

6. Slide mandrel assembly and bearing into bearing bore as far as it will go without force.

7. Thread end of puller screw onto the end of the mandrel.

NOTE: *Make certain to align oil holes in bearing and block properly. One of the collet separation lines may be used as a reference point.*

8. Install pulling plate, thrust bearing and pulling nut on threaded end of puller screw.

9. Install bearing in the same manner as described in Steps 8 and 9 under "Bearing Removal."

NOTE: *When installing rear cam bearing, install new welch plug at back of cam bore. Coat O.D. of plug with non-hardding Permatex before installation.*

60-38 REMOVAL AND INSPECTION OF OIL PUMP COVER AND GEARS

a. Removal

1. Remove oil filter.

2. Remove screws attaching oil pump cover assembly to timing chain cover. Remove cover assembly and slide out oil pump gears.

3. Wash off gears and inspect for wear, scoring, etc. Replace any gears not found serviceable.

4. Remove the oil pressure relief valve cap, spring and valve. See Figure 60-116. Oil filter by-pass valve and spring are staked in place and should not be removed.

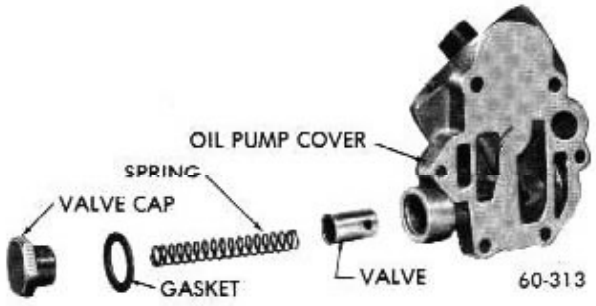


Figure 60-116 - Oil Pump Cover and Pressure-Relief Valve

5. Wash the parts thoroughly and inspect the relief valve for wear or scoring. Check the relief valve spring to see that it is not worn on its side or collapsed. Replace any relief valve spring that is questionable. Thoroughly clean the screen staked in the cover.

6. Check the relief valve in its bore in the cover. The valve should have no more clearance than an easy slip fit. If any perceptible side shake can be felt the valve and/or cover should be replaced.

7. Check filter by-pass valve for cracks, nicks, or warping. The valve should be flat and free of nicks or scratches.

b. Installation

1. Lubricate and install pressure relief valve and spring in bore of oil pump cover. See Figure 60- 116. Install cap and gasket. Torque cap to 35 lb. ft. with a reliable torque wrench. Do not over tighten.

2. Install oil pump gears and shaft in oil pump body section of timing chain cover to check gear end clearance.

3. Place a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. See Figure 60-117. Clearance should be between .0023" and .0058". If clearance is less than .0018" check timing chain cover gear pocket for evidence of wear.

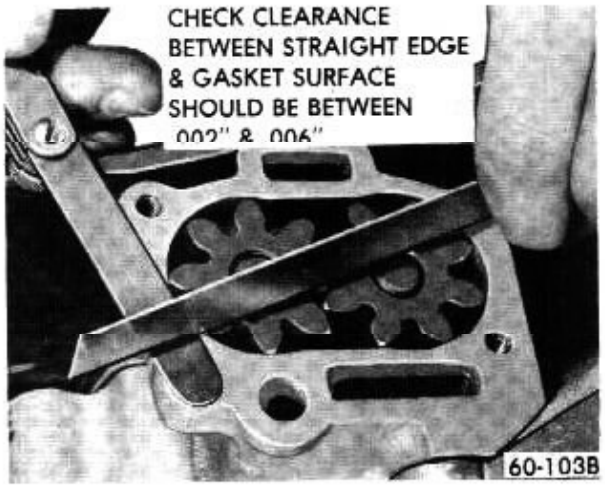


Figure 60-117 - Checking Oil Pump End Clearance

4. If gear end clearance is satisfactory, remove gears and pack gear pocket full of petroleum jelly. Do not use chassis lube.

5. Reinstall gears so petroleum jelly is forced into every cavity of the gear pocket and between the teeth of the gears. Place *new* gasket in position.

NOTE: *This step is very important. Unless the pump is packed with petroleum jelly it may not prime itself when the engine is started.*

6. Install cover assembly screws. Tighten alternately and evenly. The torque specification is 10 lb. ft.

7. Install filter on nipple.

60-39 ENGINE MOUNTING, FLYWHEEL, AND ENGINE BALANCING

a. Removal of Front Mounts

1. Raise car and provide frame support at front of car.

2. Support weight of engine at forward edge of oil pan.

3. Remove mount to engine block bolts. Raise engine slightly and remove mount to mount bracket bolt and nut. Remove mount.

b. Installation of Front Mount

1. Install mount to engine block bolts and torque to 70 lb. ft.

2. Lower engine so mounts rest on frame cross member in normal manner. Install mount to bracket bolt and torque to 55 lb. ft.

3. Remove frame support and lower car.

c. Removal of Rear (transmission) Mount

For details of engine and transmission mounts and transmission support installation refer to Figures 60-124, 60-125, and 60-126.

d. Removal and Replacement of Automatic Transmission Flywheel

1. Remove transmission (GROUP 74).

2. Remove six bolts attaching flywheel to crankshaft flange.

3. Inspect flywheel, if cracked at flywheel bolt holes, replace flywheel.

4. Inspect crankshaft flange and flywheel for burrs. Remove any burrs with a mill file.

5. Install flywheel. Bolt holes are unevenly spaced so all flywheel bolts can be in correct position. Install bolts and torque evenly to 60 lb. ft.

6. Mount dial indicator on engine block and check flywheel run-out at three attaching bosses. Run-out should not exceed .015".

NOTE: *The crankshaft end play must be held in one direction during this check.*

7. If run-out exceeds .015", attempt to correct by tapping high side with mallet. If this does not correct, remove flywheel and check for burrs between flywheel and crankshaft mounting flange.

e. Replacement of Flywheel or Ring Gear on Manual Transmission Engine

1. Remove transmission and clutch assembly, being certain to mark clutch cover and flywheel so clutch may be reinstalled in original position.

2. Remove flywheel. Flywheel is located in a predetermined location on crankshaft by attaching bolts, which are unevenly spaced.

3. If ring gear is to be replaced, drill a hole between two teeth and split gear with a cold chisel.

4. Heat and shrink a new gear in place as follows:

a. Polish several spots on ring with emery cloth.

b. Use a hot plate or slowly moving torch to heat the ring until the polished spots turn blue (approximately 600 degrees F.)

CAUTION: *Heating the ring in excess of 800 degrees F. will destroy the heat treatment.*

c. Quickly place ring in position against shoulder of flywheel with chamfered inner edge of ring gear toward flywheel shoulder. Allow ring to cool slowly until it contracts and is firmly held in place.

5. Make certain the flywheel and crankshaft flange are free from burrs that would cause run-out. Install flywheel.

f. Manual Transmission Flywheel Balance

All manual transmission flywheels are balanced at the factory by drilling holes at various points on the flywheel surface. *No attempt should be made to balance a flywheel after the initial factory balance.*

g. Automatic Transmission Flywheel Balance

Clips are available from the Parts Department that will serve as balance weights for automatic transmission flywheels. These clips are secured by their clamping pressure and a series of indentations stamped into the flywheels. See Figure 60-118 for clip installation locations.

If a flywheel is found to be out of balance, it can be corrected in the following manner.

1. Remove lower flywheel housing. Mark the flywheel at four locations, 90 degrees apart.

2. Install one clip at one of the marked locations. Run engine with transmission in neutral and note vibration.

(a) If vibration increases, remove clip and relocate 180 degrees from original location.

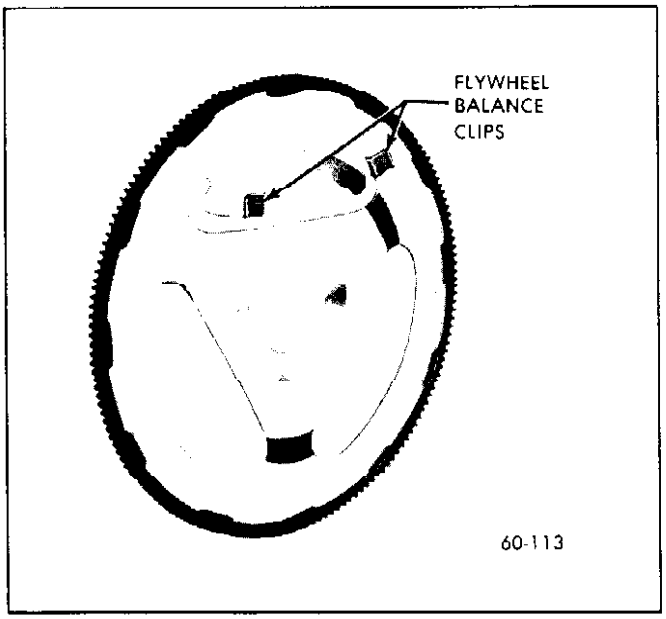


Figure 60-118 - Automatic Transmission Flywheel Balance Clip Location (350 cu.in. Shown)

(b) If vibration decreases, install another clip next to the original.

(c) If no change is noted, move clip 90 degrees and re-check.

3. Continue this procedure until a reduction in vibration is noted. Fine adjustments can be made by moving the clips, by small increments, to different locations.

CAUTION: *Be certain that the tangs on the clip are setting in the stamped grooves on the flywheel. Otherwise, the clip(s) may shift when the flywheel is turned at high speeds.*

h. Harmonic Balancer

If the harmonic balancer is suspected of being a cause of vibration, it can be checked and/or balanced by following the outline below:

a. Using a tachometer, determine the engine speed at which the greatest amount of vibration occurs.

b. Place an amount of body putty or similar material on the inside surface of the fan driving pulley. Run engine at critical speed and note vibration.

c. Repeat Step 2 above using varying amounts of putty at different locations until the vibration is diminished to a minimum.

d. When point of minimum vibration is found, mark the nearest hole drilled in the balancer at that point.

e. Cut a piece of 7/16" drill rod approximately 1/2" long. Use a chisel, upset a small amount of material on the side of the piece of drill rod. See Figure 60-119.

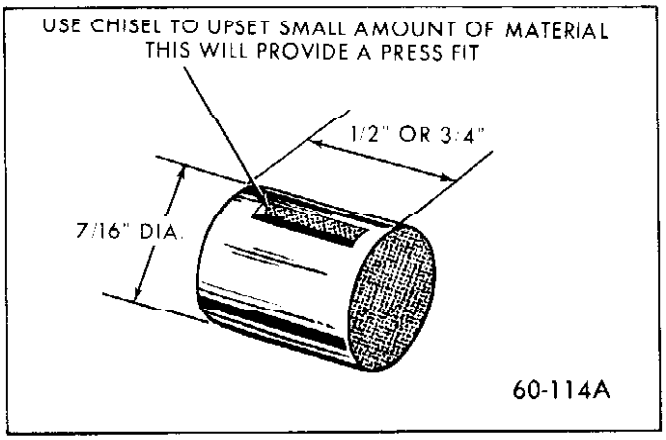


Figure 60-119 - Harmonic Balancer - Balance Weight Details

f. Install drill rod into hole marked in Step 4.

g. Additional weight should be added (if necessary) in adjoining holes.

DIVISION VI SPECIFICATIONS

60-40 BOLT TORQUE SPECIFICATIONS

Use a reliable torque wrench to obtain the figures listed below. This will prevent straining or distorting the parts as well as preventing thread damage. These specifications are for clean and lightly lubricated threads only. Dry or dirty threads produce friction which prevents accurate measurements of the actual torque. It is important that these specifications be strictly observed. Overtightening can damage threads. This will prevent attainment of the proper torque and will require replacement of the damaged part.

Area	Torque Lb. Ft.
Spark Plugs	15
Crankshaft Bearing Caps to Cylinder Block	350 (95) 455 (110)
Connecting Rods	350 (35) 455 (45)
Cylinder Head to Cylinder Block	350 (75) 455 (100)
Harmonic Balancer to Crankshaft	350 (120 Minimum) 455 (200 Minimum)
Fan Driving Pulley to Harmonic Balancer	23
Flywheel to Crankshaft (Auto. & Manual)	350 (60) 455 (58)
Oil Pan to Cylinder Block	14
Oil Pan Drain Plug	30
Oil Pump Cover to Timing Chain Cover	10
Oil Pump Pressure Regulator Retainer	35
Oil Screen Housing to Cylinder Block	8
Oil Pan Baffle to Cylinder Block	350 (11) 455 (13)
Oil Gallery Plugs	25
Oil Pressure Switch to Cylinder Block	23
Filter Assembly to Pump Cover	13
Timing Chain Cover to Block	29
Water Pump Cover to Timing Chain Cover	7
Fan Driven Pulley	20
Thermostat Housing to Intake Manifold	20
Automatic Choke Cover to Intake Manifold	8
Intake Manifold to Cylinder Head	350 (55) 455 (65)
Exhaust Manifold to Cylinder Head	18
Carburetor to Intake Manifold	13
Fuel Pump to Cylinder Block	20
Motor Mount to Cylinder Block	63
Fuel Pump Eccentric and Timing Chain Sprocket to Camshaft	350 (48) 455 (22)
Rocker Arm Cover to Cylinder Head	4
Rocker Arm Shaft to Cylinder Head	25
Delcotron Bracket to Cylinder Head	35
Delcotron Adjusting Bracket to Cylinder Head	22
Delcotron Mounting Bracket Thru Delcotron to Cylinder Head at Pivot Location	35

Starting Motor to Block 35
Starting Motor Brace to Block 11
Starting Motor Brace to Starting Motor 11
Distributor Hold-down Clamp 13
Automatic Lower Flywheel Housing Plate 4
Flywheel Housing to Cylinder Block 35

60-41 GENERAL SPECIFICATIONS

A. GENERAL

	350-2 (43-44000)	350-2 (45000)	350-4 (43-44000)	350-4 (45000)
Code Number Prefix	TO	TC	TB	TD
Engine Type	90° V-8			
Bore and Stroke	3.800 x 3.850			
Piston Displacement	350 Cu. In.			
Carburetor Type	2BBL-Roch	2BBL-Roch	4BBL-Roch	4BBL-Roch
Compression Ratio	8.5:1			
Gasoline Requirements	Regular			
Octane Requirement - Motor	82			
Octane Requirement - Research	91			
Taxable Horsepower	46.2			
Cylinder Numbers - Front to Rear Left Bank	1-3-5-7			
Cylinder Numbers - Front to Rear Right Bank	2-4-6-8			
Firing Order	1-8-4-3-6-5-7-2			

	455-4	455-4 (Stage I)	455-4 (GS Riviera)
Code Number Prefix	TR	TS	TA
Engine Type	90° V-8		
Bore and Stroke	4.3125 x 3.900		
Piston Displacement	455 Cu. In.		
Carburetor Type	4BBL-Roch	4BBL-Roch	4BBL-Roch
Compression Ratio	8.5:1		
Gasoline Requirements	Regular		
Octane Requirement - Motor	82		
Octane Requirement - Research	91		
Taxable Horsepower	59.5		
Cylinder Numbers - Front to Rear Left Bank	1-3-5-7		
Cylinder Numbers - Front to Rear Right Bank	2-4-6-8		
Firing Order	1-8-4-3-6-5-7-2		

60-41 GENERAL SPECIFICATIONS

b. Piston and Pin Specifications

Piston
- Material ..... Cast Aluminum Alloy
- Type ..... Divorced Skirt
- Finish ..... Cam Ground

Piston Pins
- Material ..... Extruded SAE-1018
- Type ..... Pressed In Rod

c. Connecting Rods

Material ..... (350) Pearlite Malleable Iron Forged — SAE-1053 Steel
Rod Bearing ..... Removable Steel Backed M/400 Aluminum

d. Ring Specifications

#1 Compression ..... Cast Iron Molybdenum Coated
#2 Compression ..... Cast Iron-Lubrited
Oil Control ..... (350) Uncoated Steel (455) SAE-1070 Steel-Chrome Plated
Oil Ring Expander ..... (350) Hump Type (455) Abutment Type
Ring Locations ..... Above Pin

e. Crankshaft Specifications

Material ..... Nodular Iron
Bearings ..... 5 Replaceable Steel Backed
Bearing Material ..... #1, #2, #3, and #4 — M/400 #5 — M/100A Durex
Bearing Taking End Thrust ..... #3

f. Camshaft Specifications

Material ..... Cast Alloy Iron
Bearings ..... Steel Backed Babbitt
Number of Bearings 5
Drive ..... Chain
Number of Links ..... (350) 54 (455) 48
Crankshaft Sprocket ..... Sintered Iron
Camshaft Sprocket ..... Nylon Coated Aluminum

g. Valve Specifications

350 Cu. In.
- Intake Valve Material ..... SAE 1041 Steel — Aluminized Face and Chrome Flashed Stem
- Exhaust Valve Material ..... 21-2 Nickel Plated Face and Chrome Flashed Stem
- Valve Lifter Mechanism ..... Hydraulic
- Valve Spring ..... Intake-Single Helical Exhaust-Single Spring with Damper

455 Cu. In.

Intake Valve Material ..... Aluminized Face and Chrome Flash Stem SAE 1041 Steel
Exhaust Valve Material ..... Nickel Plated Face and Chrome Flash Stem GN-N82152 (21-4N)
Valve Lifter Mechanism ..... Hydraulic
Valve Spring ..... Single Spring with Damper

h. Lubrication System Specifications

Type of Lubrication
Main Bearings ..... Pressure
Connecting Rods ..... Pressure
Piston Pins ..... Splash
Camshaft Bearing ..... Pressure
Timing Chain ..... (350) Splash and Nozzle (455) Drip From Front Cam Bearing
Cylinder Walls ..... Splash and Nozzle
Oil Pump Type ..... Gear Driven
Normal Oil Pressure ..... (350) 37 lbs. at 2400 RPM (455) 40 lbs. at 2400 RPM
Oil Pressure Sending Unit ..... Electrical
Oil Intake ..... Stationary
Oil Filter System ..... Full Flow
Filter Type ..... Throw-Away Element and Can
Crankcase Capacity — With Filter ..... 5 Quarts
Less Filter ..... 4 Quarts

i. Cooling System Specifications

System Type ..... Pressure
Radiator Cap Relief Pressure ..... 15 psi
Thermostat ..... Choke Type Opening at 190°
Water Pump
Type ..... Centrifugal
GPM at RPM ..... (350) 10 at 1000 (455) 15 at 1000
Drive ..... V-Belt
Bearings ..... Double Row
By-Pass Recirculation Type ..... External

Cooling System Capacities	**(350 Cu. In. "A")**	**(350 Cu. In. LeSabre)**	**(455 Cu. In.)**
With Heater	16.5 qts.	16.2 qts.	19.7 qts.
With Air Conditioning	15.5 qts.	16.6 qts.	20.0 qts.

Fan Diameter and Number of Blades

350 Less AC ..... 18" x 4
350 With AC ..... 18" x 7
G.S. 455 Less AC ..... 18" x 4
G.S. 455 With AC ..... 18" x 7

Wildcat and Electra 225
Less AC ..... 18" x 4
With AC ..... 20" x 5
Riviera Less AC ..... 18" x 7
With AC ..... 20" x 5

Fan Drive
Less AC ..... Water Pump Shaft
With AC ..... Torque and Temperature Sensitive Clutch

60-42 ENGINE DIMENSIONS AND FITS

a. General

	350 Cu. In.	455 Cu. In.
Piston Clearance Limits*		
Top Land	.013 - .018	.018 - .022
Skirt Top	.0008 - .0020	.0010 - .0016
Skirt Bottom	.0013 - .0029	.0030 - .0042
Ring Groove Depth		
#1—Compression Ring	.1930 - .1855	.213 - .206
#2—Compression Ring	.1955 - .1880	.213 - .206
#3—Oil Ring	.1955 - .1880	.190 - .206
Ring Width		
#1—Compression Ring	.077 - .078	.077 - .078
#2—Compression Ring	.077 - .078	.077 - .078
#3—Oil Ring	.0235 - .0245	.023 - .025
Ring Gap		
#1—Compression Ring	.013 - .023	.013 -.023
#2—Compression Ring	.013 - .023	.013 - .023
#3—Oil Ring	.015 - .035	.015 - .055
Piston Pin Length	3.060	3.520
Diameter of Pin	.931 - .9394	.9991 - .9994
Clearance		
In Piston (Selected)	.0004 - .0007	.0004 - .0007
In Rod (Selected Press)	.00075 - .00125	.00075 - .000125
Direction & Amount Offset in Piston	.040 Major Thrust Side	.060 Major Thrust Side

*All Measurements in Inches Unless Otherwise Specified.

b. Connecting Rod Specifications

	350 Cu. In.	455 Cu. In.
Bearing Length	.737	.820
Bearing Clearance (Limits)	.0002 - .0023	.0002 - .0023
End Play — Total for Both Rods	.006 - .014	.005 - .012

c. Crankshaft Specifications

	350 Cu. In.	455 Cu. In.
End Play at Thrust Bearing	.003—.009	.003—.009
Main Bearing Journal Diameter	2.9995	3.2500
Crankpin Journal Diameter	2.0000	2.249—2.250
Main Bearing Overall Length		
#1	.864	.865
#2	.864	.865
#3	1.057	1.057
#4	.864	.865
#5	.864	1.143
Main Bearing to Journal Clearance	.0004—.0015	.0007—.0018

d. Camshaft Specifications

Bearing Journal Diameter
- #1 ..... 1.785—1.786
- #2 ..... 1.785—1.786
- #3 ..... 1.785—1.786
- #4 ..... 1.785—1.786
- #5 ..... 1.785—1.786

Journal Clearance In Bearings ..... .005—.0025 (#1)
.005 .0035 (#2, #3, #4, & #5)

e. Valve System Specifications

350 Cu. In.
Rocker Arm Radio ..... 1.55 to 1
Valve Lifter Diameter ..... .8420—.8427
Valve Lifter Clearance in Crankcase ..... .0008—.0025
Valve Lifter Leakdown Rate ..... 12 to 60 Sec. in Text Fixture
Intake Valve
- Overall Length ..... 5.024—4.994
- Head Diameter ..... 1.880—1.870
- Seat Angle ..... 45°
- Stem Diameter ..... .3725 ± .0005
- Clearance in Guide ..... .0015— .0035 & .0003 Max. Taper

Valve Spring
- Valve Closed—Pounds at Length ..... 75 5 at 1.727
- Valve Open—Pounds at Length ..... 180 ± 7 at 1.340

Exhaust Valve
- Overall Length ..... 5.044—5.014
- Head Diameter ..... 1.505—1.495
- Seat Angle ..... 45°
- Stem Diameter ..... .3723 Min. and .3730 Max.
- Clearance in Guide ..... .0015—.0032 & .0002 Max. Taper

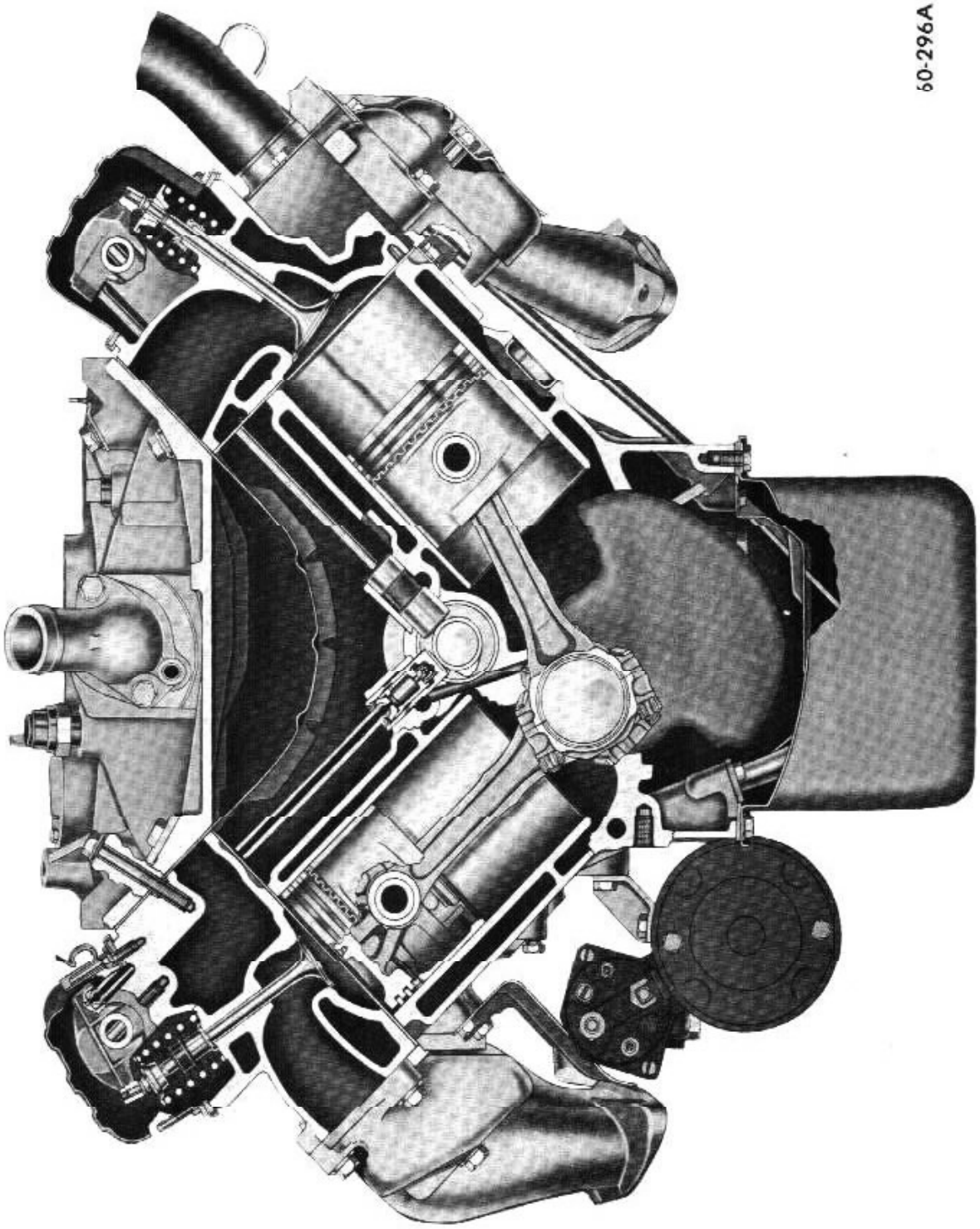
Valve Spring
- Valve Closed—Pounds at Length (Not including Damper) ..... .70 ± 5 at 1.727
- Valve Open—Pounds at Length (Not including Damper) ..... 175 ± 7 at 1.340

455 Cu. In.
Rocker Arm Ratio ..... 1.60 to 1
Valve Lifter Diameter ..... .8427—.8420
Valve Lifter Clearance in Crankcase ..... .0008—.0025
Valve Lifter Leakdown Rate ..... 12 to 60 Sec. in Test Fixture
Intake Valve
- Head Diameter ..... 2.005—1.995
- Seat Angle ..... 45°
- Stem Diameter ..... .3725 ± .0005—Max. Allowable Taper to be .0003 with Smallest Dia. at Valve Head End
- Clearance in Guide ..... .0015—.0035 & .0003 Max. Taper

Valve Spring
- Valve Closed—Pounds at Length (Not including Damper) . . . . . 72 ± 5 at 1.890
- Valve Open—Pounds at Length (Not including Damper) . . . . . 177 ± 7 at 1.450

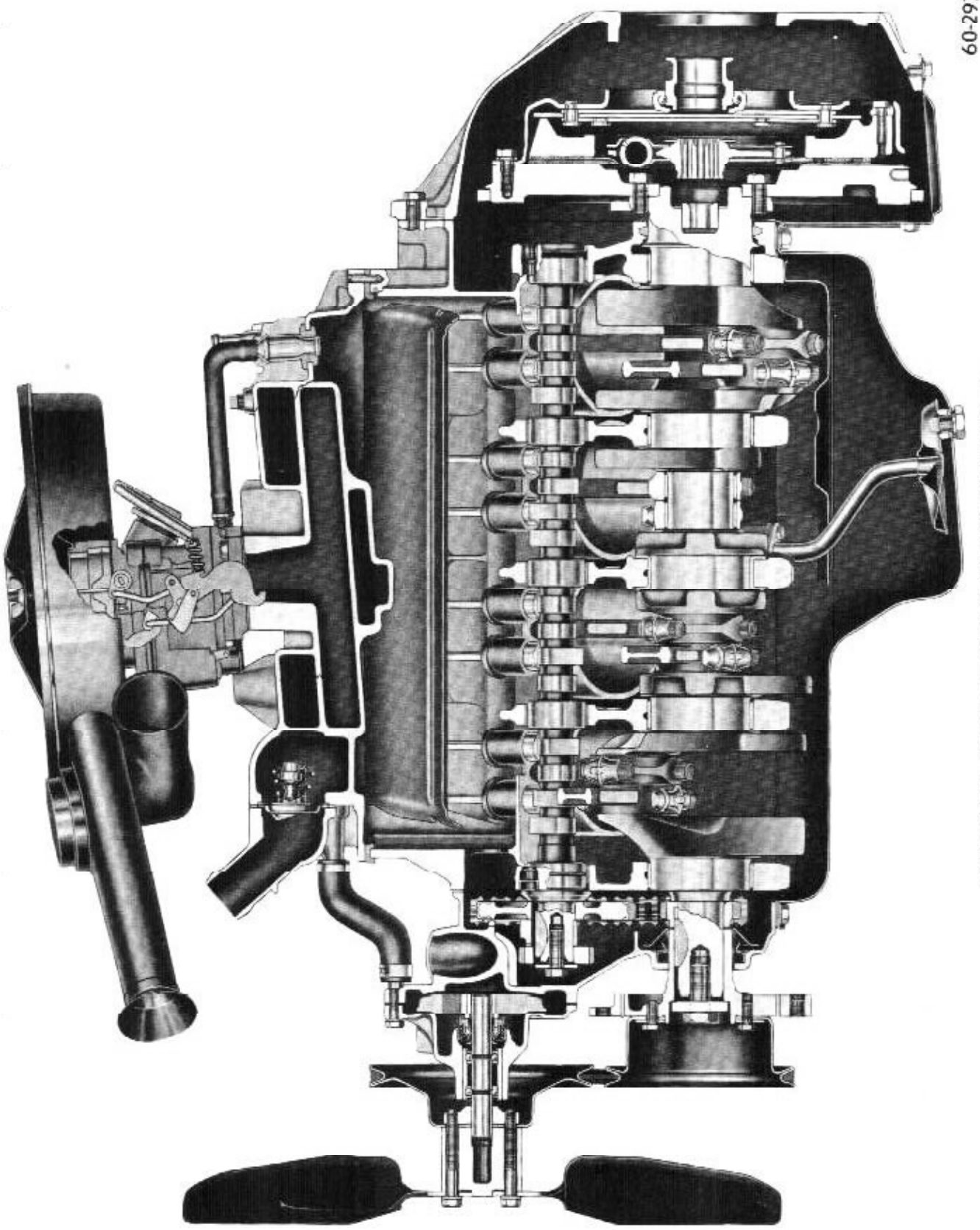
Exhaust Valve
- Head Diameter 1.625
- Seat Angle. . . . . 45°
- Stem Diameter . . . . . .3723 Min. and .3730 Max.
- Clearance in Guide . . . . . .0015—.0032 & .0002 Max. Taper

Valve Spring
- Valve Closed—Pounds at Length (Not including Damper) . . . . . 72 ± 5 at 1.890
- Valve Open—Pounds at Length (Not including Damper) . . . . . 177 ± 7 at 1.450



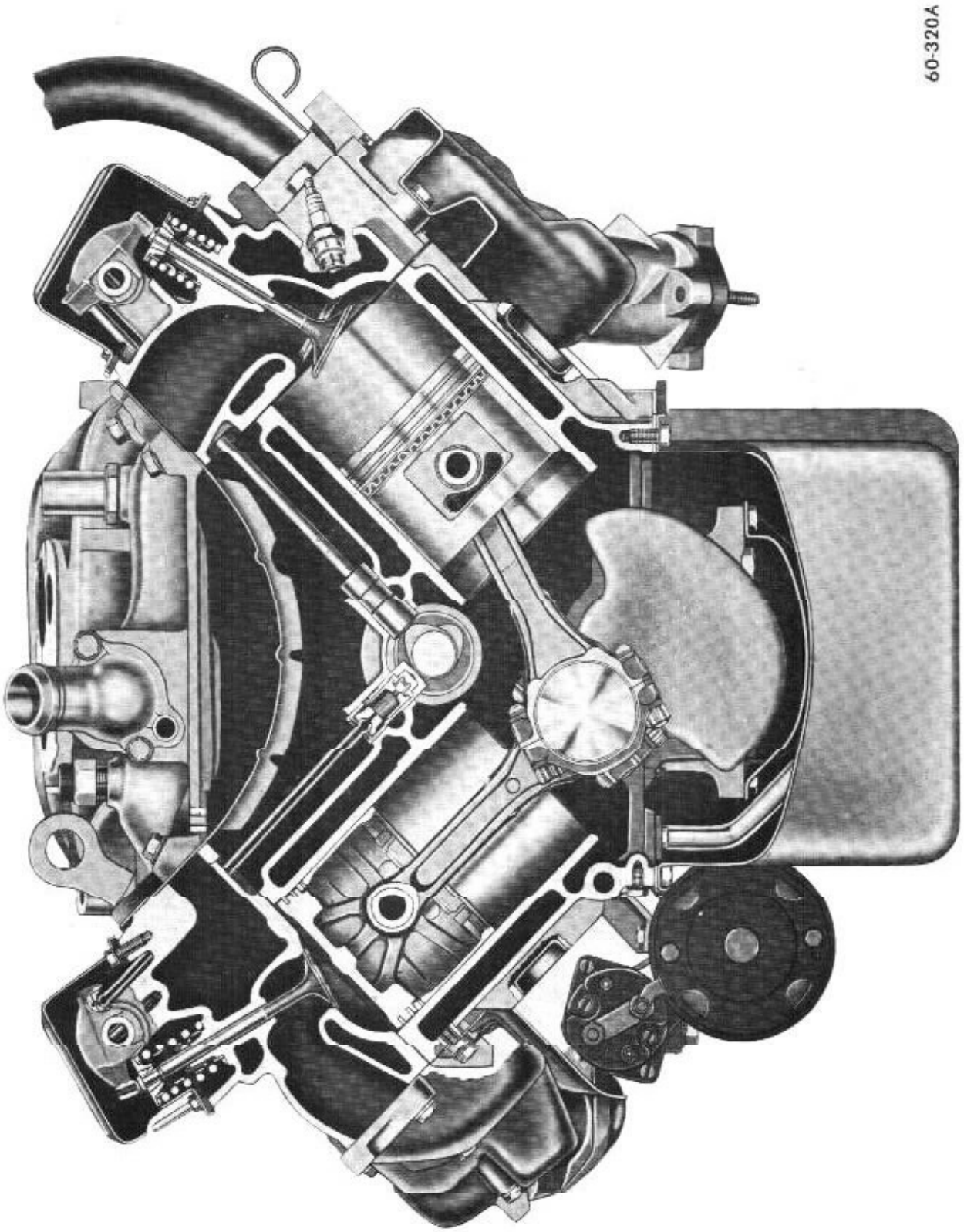
60-296A

Figure 60-120 - 350 Cu. In. V-8 Engine Cross Section (Front View)



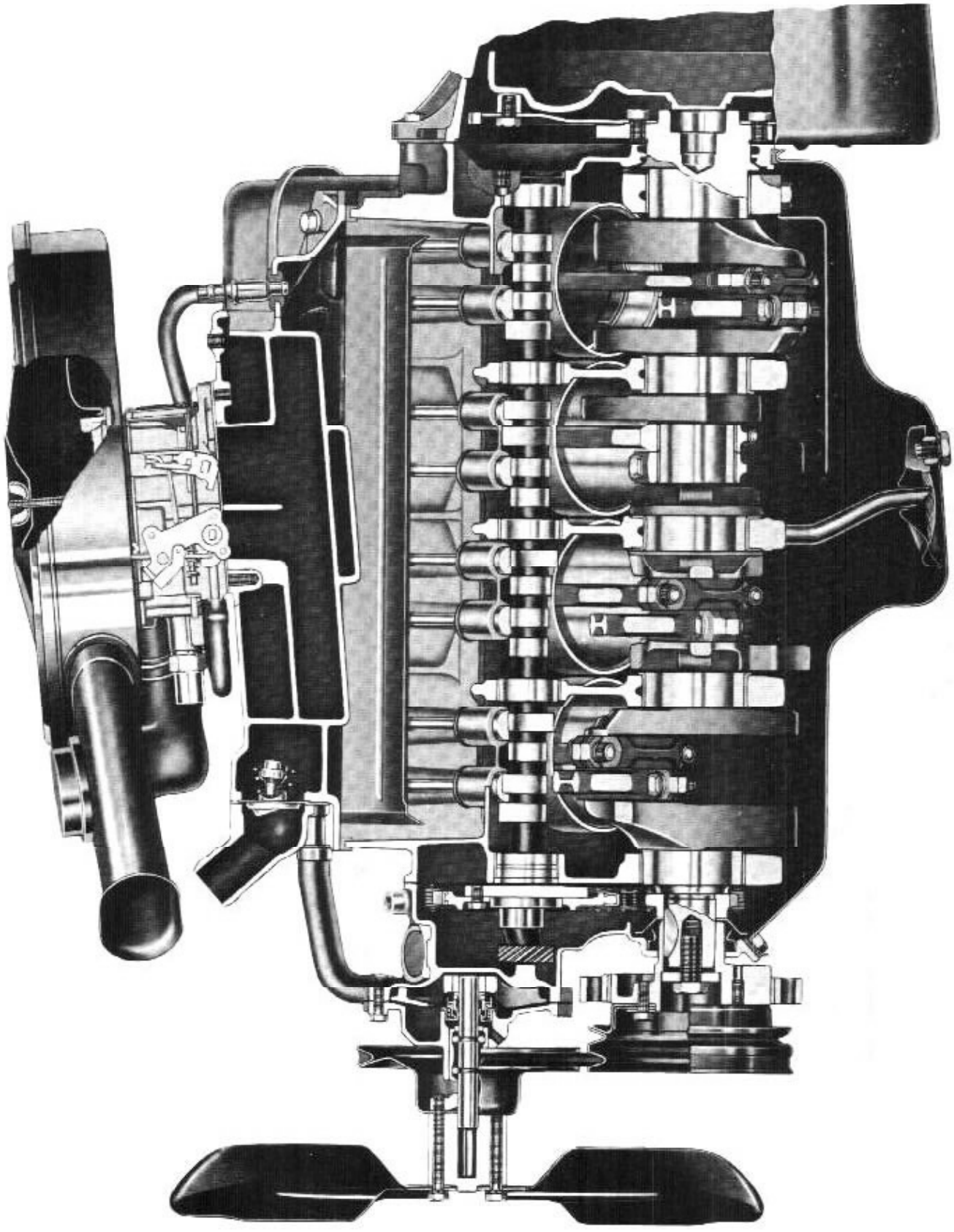
60-297

Figure 60-121 - 350 Cu. In. V-8 Engine Cross Section (Side View)



60-320A

Figure 60-22 - 455 Cu. In. (End Section View)



60-322

Figure 60-123 - 455 Cu. In. (Side Section View)

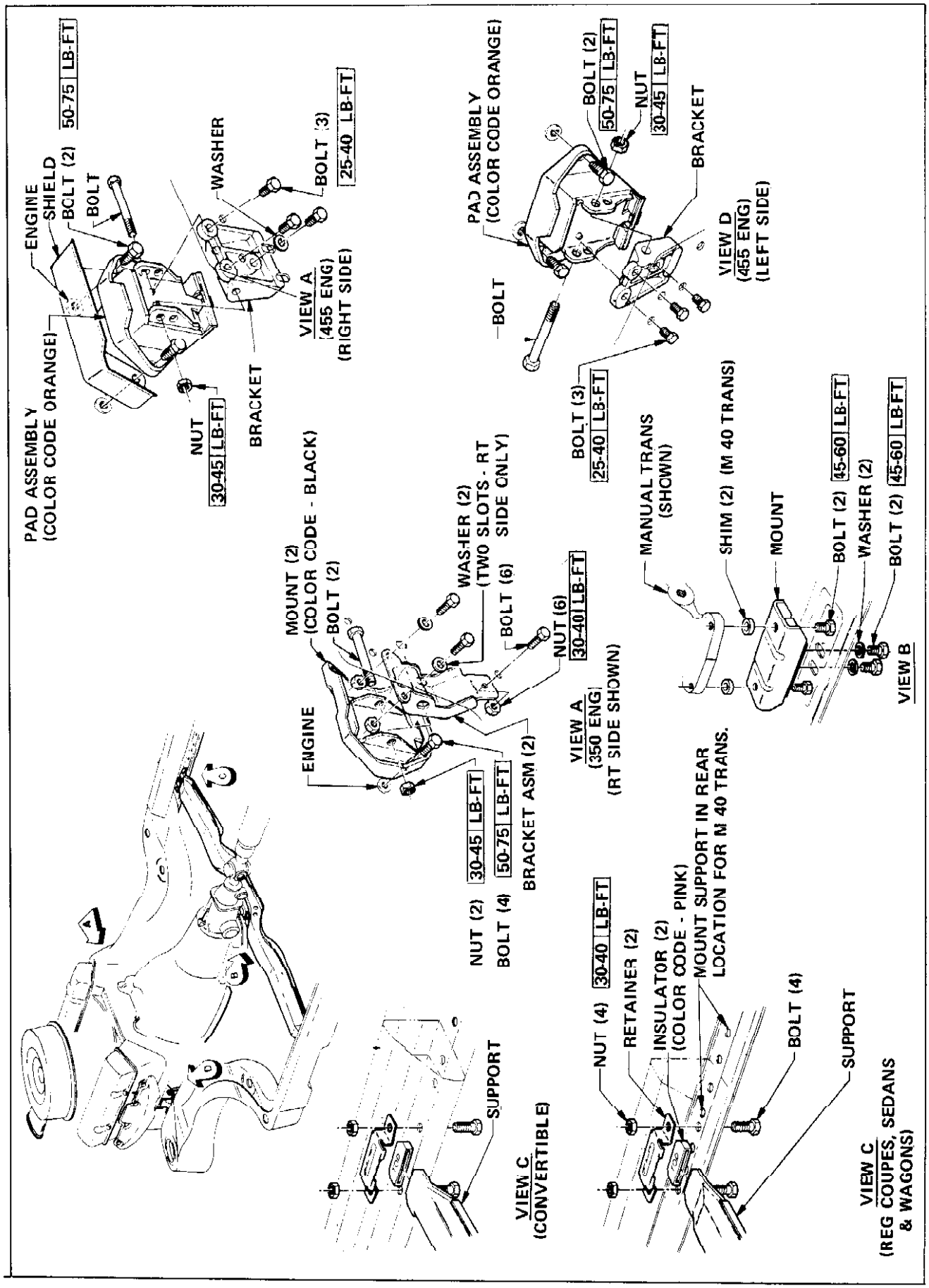


Figure 60-124 - Engine and Transmission Mounting 43 and 44000 Series

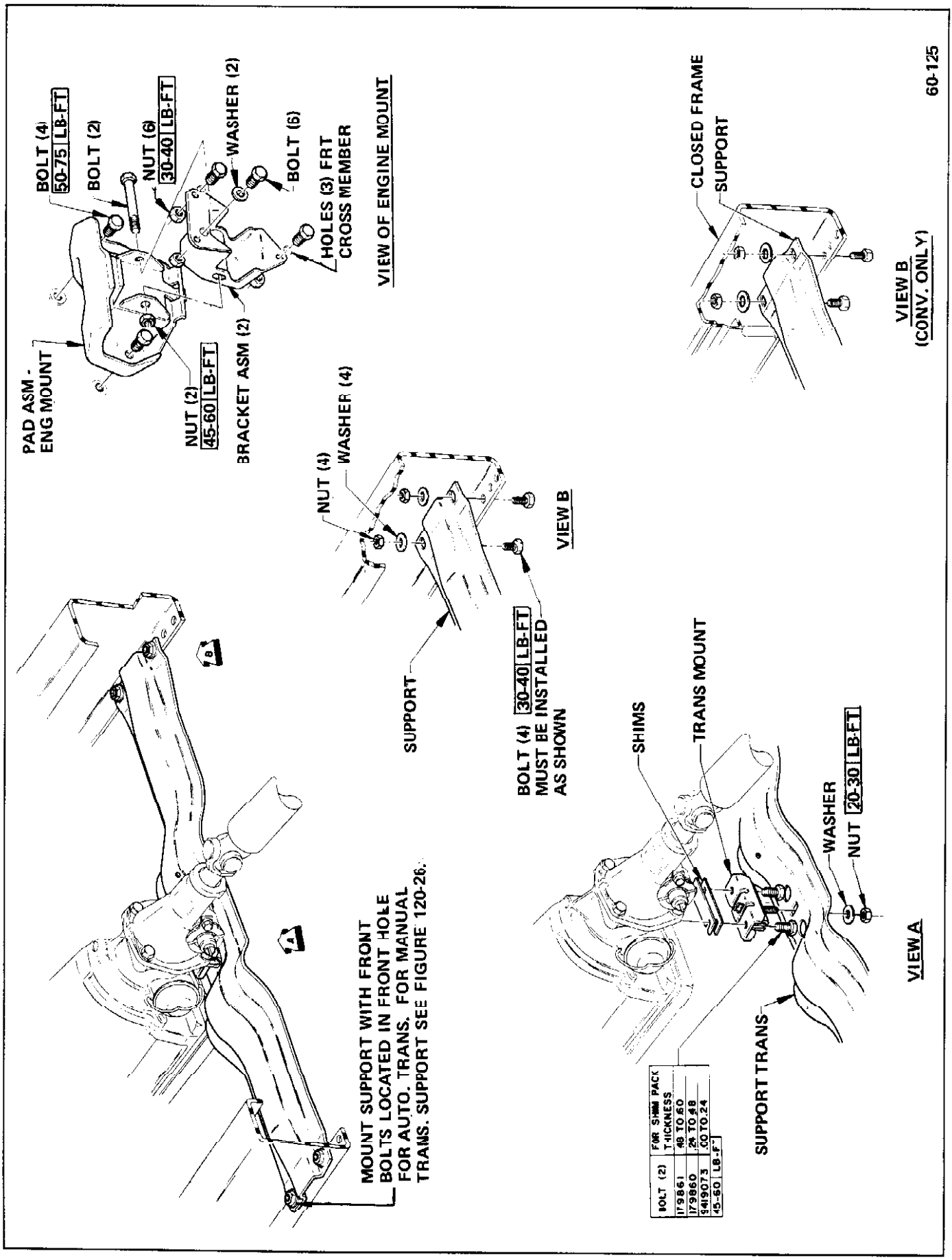
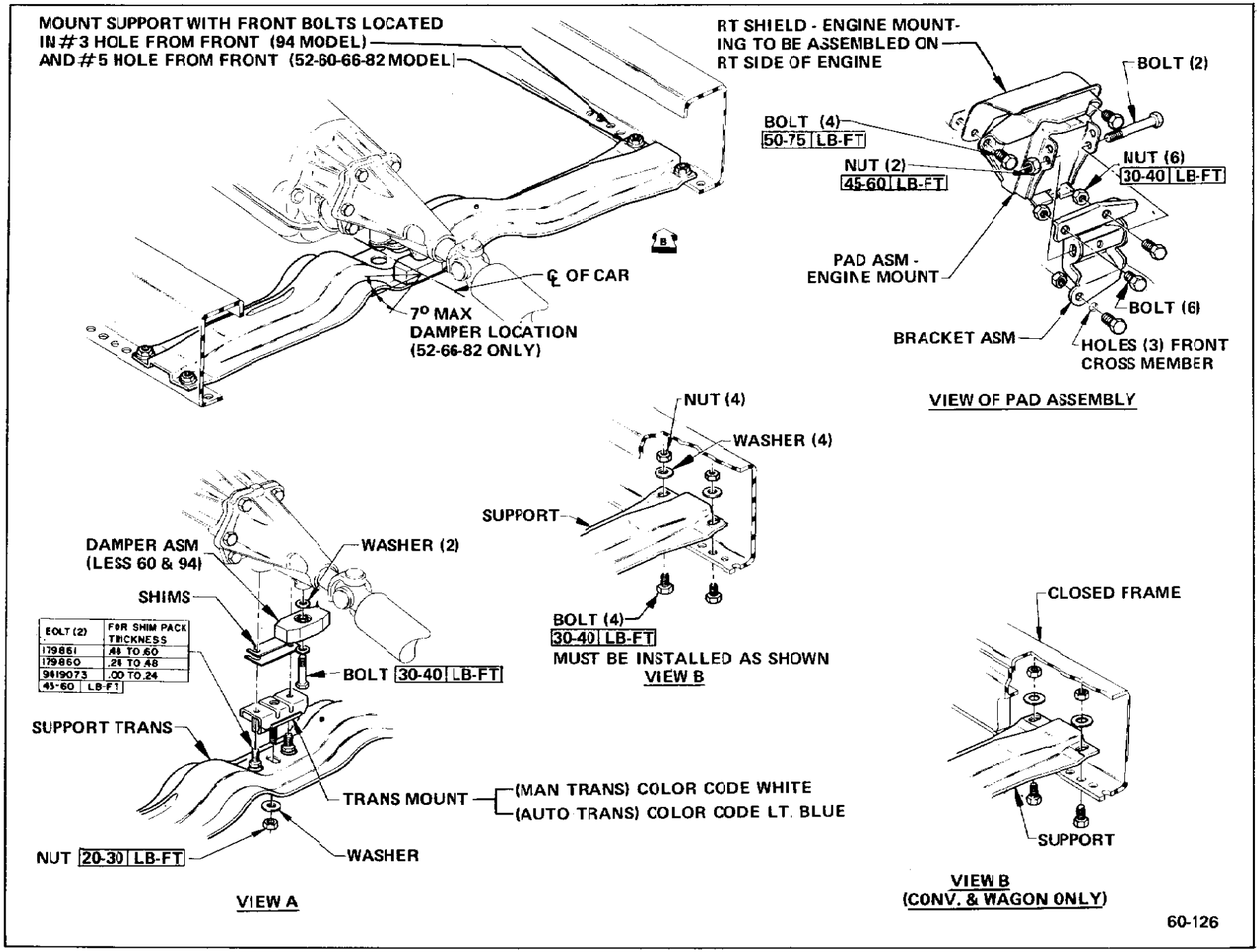
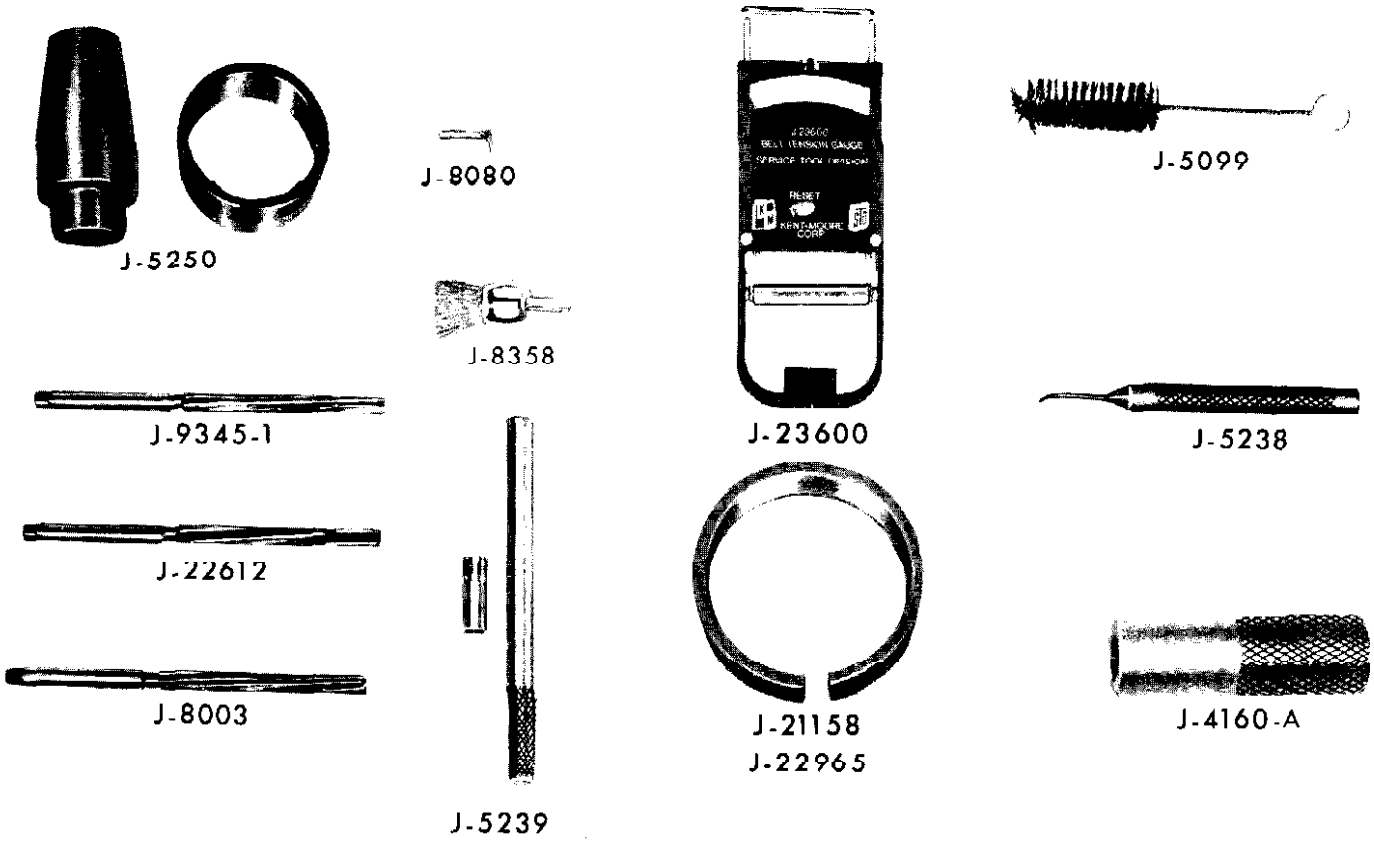


Figure 60-125 - Engine and Transmission Mounting - 45-46-48000 Series



BOLT (2)	FOR SHIM PACK THICKNESS
179861	.48 TO .60
179860	.24 TO .48
9419073	.00 TO .24
45-60 LB-FT	

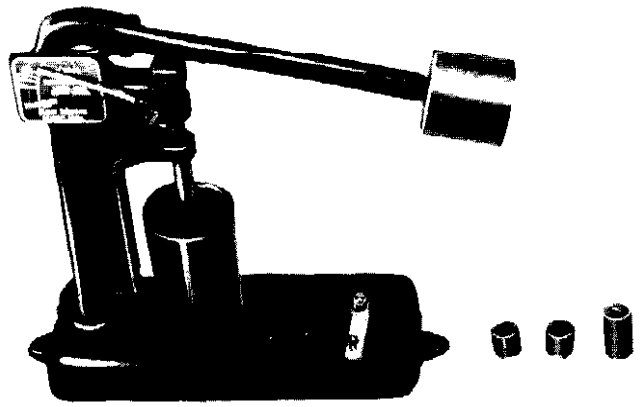
Figure 60-126 - Engine and Transmission Mounting - Riviera



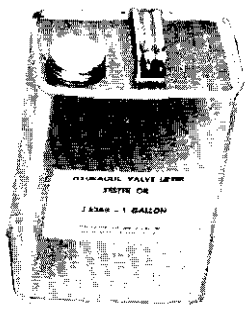
J 4160-A	HYDRAULIC VALVE LIFTER PLUNGER REMOVER
J 5099	HYDRAULIC VALVE LIFTER BODY CLEANING BRUSH
J 5238	HYDRAULIC VALVE LIFTER PLUNGER RETAINER REMOVER & INSTALLER
J 5601	PISTON RING COMPRESSOR 3-3/4"
J 5250	TIMING CHAIN COVER OIL SEAL INSTALLER
J 22612	VALVE GUIDE REAMER .006 OVERSIZE
J-23600	BELT TENSION GAUGE
J 8080	MAIN BEARING SHELL REMOVER
J 8358	CARBON REMOVING BRUSH
J-8003	VALVE GUIDE REAMER 11/32"
J 5239	CONNECTING ROD BOLT GUIDE SET
J 21158	PISTON RING COMPRESSOR (455 CU. IN.)
	PISTON RING COMPRESSOR (350 CU. IN.)

60-127

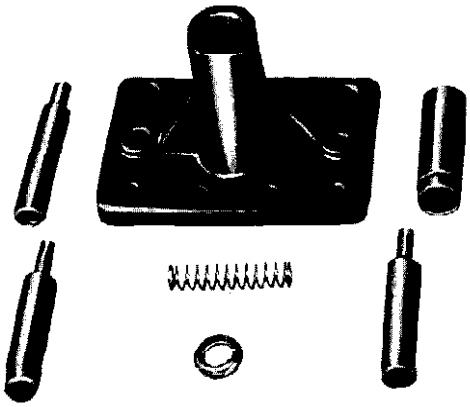
Figure 60-127 - Special Tools - 350 and 455 Cu. In.



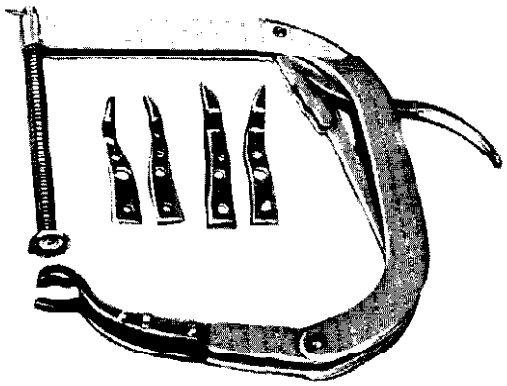
J-5790



J-5268



J 22965



J-8062

J-5268 HYDRAULIC VALVE LIFTER TESTER OIL - ONE GALLON
J-5790 HYDRAULIC VALVE LIFTER LEAKDOWN TESTER
J-6047 PISTON PIN ASSEMBLY TOOL SET

J-8062 VALVE SPRING COMPRESSOR 60-128

Figure 60-128 - Special Tools 350 and 455 Cu. In.

SECTION D

DIFFERENTIAL
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Pre-Repair Investigation and Trouble Diagnosis	40-44
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	Description and Operation of Standard and Positive Traction Differential	40-45
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION:	
	Removal and Installation of Differential Assembly	40-46
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V	OVERHAUL AND MAJOR SERVICE:	
	Removal and Disassembly of Differential Case Assembly	40-48
	Assembly and Installation of Differential Case Assembly	40-49
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	Differential Specifications	40-50

DIVISION I

TROUBLE DIAGNOSIS

40-44 PRE-REPAIR INVESTIGATION AND TROUBLE DIAGNOSIS

A close examination of the differential prior to disassembly will often reveal valuable information as to the extent and type of repairs or adjustments necessary. The information thus gained, coupled with the report of malfunctioning, will provide a basis for determining the degree of disassembly required. Since frequent cause of axle noise are improper backlash, pinion bearing preload, or side bearing preload, or a combination, a few simple adjustments may be all that are necessary to correct a problem. Therefore, before removing the differential from the housing, the following checks should be made with the results recorded and analyzed: 1) Backlash; 2) Total Assembly Preload; and 3) Tooth Contact Pattern Test.

Use care at all times to keep dirt and other foreign matter, such as grinder dust, soot, or sand, away from differential to prevent possibility of subsequent failure.

The pinion and ring gear must be completely assembled, installed, and all preload and backlash adjustments completed prior to the start of this method of pinion depth setting. The following procedure can be used in place of the gage method of pinion depth setting.

a. Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or

TROUBLE DIAGNOSIS

Problem	Cause
1. Noise is the same in drive or coast	1. a) Road noise b) Tire noise c) Front wheel bearing noise d) Front or rear U-joint angle too great
2. Noise changes on a different type of road	2. a) Road noise b) Tire noise
3. Noise lowers tone as car speed is lowered	3. Tire noise
4. Similar noise is produced with car standing and driving	4. a) Engine noise b) Transmission noise c) Driveline angle
5. Vibration	5. a) Rough rear wheel bearing b) Unbalanced or damaged propeller shaft c) Tire unbalance d) Worn universal joint in propeller shaft e) Front or rear U-joint angle too great f) Mis-indexed propeller shaft at companion flange g) companion flange runout too great (See paragraph 41-10)
6. A knock or click approximately every two revolutions of rear wheel	6. A brinelled rear wheel bearing
7. Noise most pronounced on turns	7. Differential side gear and pinion
8. A continuous low pitch whirring or scraping noise starting at relatively low speed	8. Pinion bearing
9. Drive noise, coast noise or float noise	9. Ring and pinion gear
10. Clunk on acceleration or deceleration	10. a) Worn differential cross shaft in case b) Engine dash pot out of adjustment
11. Grunt on stops	11. No grease in propeller shaft slip yoke
12. Groan in Forward or Reverse	12. Wrong lube in differential
13. Chatter on turns	13. a) Wrong lube in differential b) Clutch plates worn
14. Clunk or knock on rough road operation	14. Excessive end play of axle shafts to differential cross shaft.

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. 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.

b. Tooth Contact Pattern Test

1. Wipe oil out of carrier and carefully clean each tooth of ring gear.

2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth, using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.

3. Tighten bearing cap bolts to 55 lb. ft.

4. Expand brake shoes until a torque of 40-50 lb. ft. is required to turn the pinion.

A test made without loading the gears will not give a satisfactory pattern. Turn companion flange with wrench 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.

5. Observe pattern on ring gear teeth and compare with Figures 40-100 and 40-101.

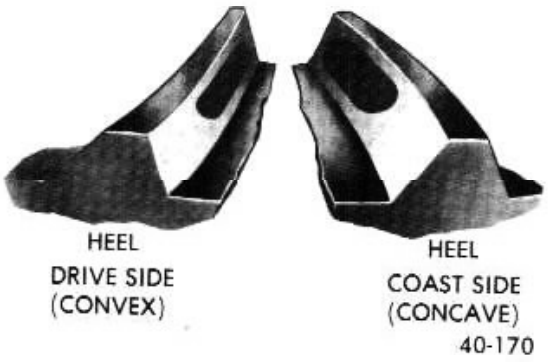


Figure 40-100 Gear Teeth Nomenclature

c. Effects of Increasing Load on Tooth Contact Pattern

When "load" on ring and pinion gear is increased, such as when car is accelerated forward from standstill or from

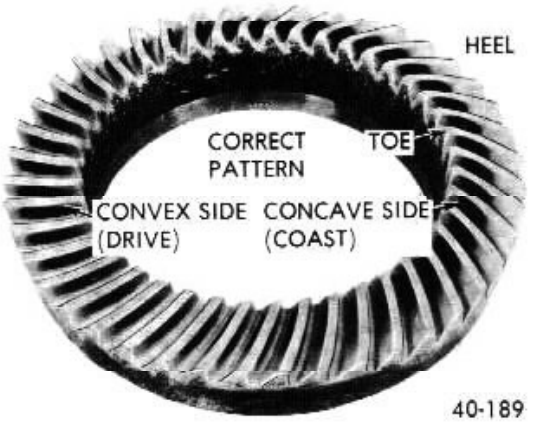


Figure 40-101 Desired Tooth Contact Under Light Load

normal drive, the tooth contact will tend to spread out and, under very heavy load, will extend from near toe to near heel on the drive side. The entire contact also tends to shift toward heel under increasingly heavier loads and will become somewhat broader with respect to tops and bottoms of teeth. The patterns obtained by this tooth contact pattern test approximate a light load and, for this reason, they will extend only about halfway.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

d. Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern, backlash, and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on (hand-loaded) tooth contact pattern 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 moves the entire case and ring gear assembly closer to, or farther from, the drive pinion. (The adjusting shims are also used to set side bearing preload.) The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

e. Effects of Pinion Position on Tooth Pattern

When the drive pinion is too far away from centerline of the ring gear, the pattern will be a high heel contact on the drive side and high toe contact on coast side, provided backlash is within specifications of .007", .008", .009". See

Figure 40-102. Moving the pinion closer to centerline of the ring gear by increasing shim thickness will cause the high heel contact on drive side to lower and move toward the toe; the high toe contact on coast side will lower and move toward the heel. See Figure 40- 103.

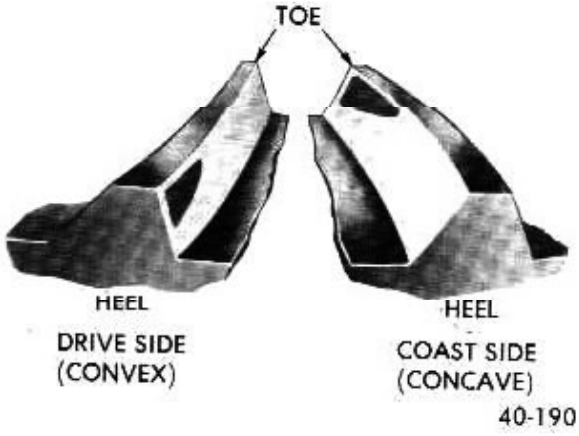


Figure 40-102 Tooth Pattern - Pinion Too Far Away From Ring Gear (Insufficient Shim Thickness)

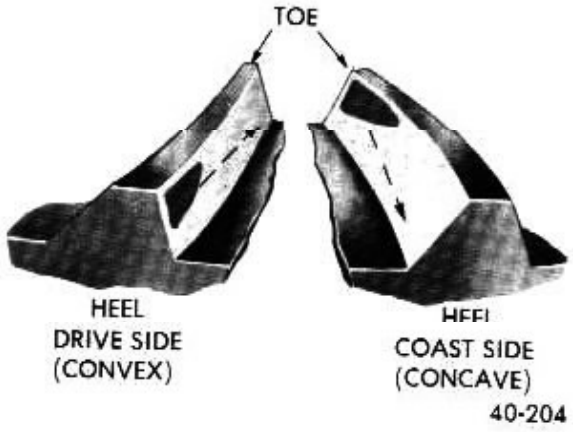


Figure 40-103 Effect on Pattern As Shim Thickness is Increased

When the pinion is too close to the centerline of the ring gear, the pattern will be a low toe contact on drive side, and a low heel contact on coast, provided backlash is within specifications. See Figure 40-104. Moving the pinion farther away from the ring gear by decreasing shim thickness will cause low toe contact on drive side to raise and move toward the heel; the low heel contact on coast side will raise and move toward the toe. See Figure 40-105.

NOTE: *Whenever the rear axle is overhauled to the point of requiring a new ring gear and pinion set, the rear axle should be filled ONLY with the lubricant included with the gear set. Whenever the rear axle is overhauled to the point of requiring only pinion and/or side bearings, it is recommended that lubricant 5.535 - 1051022, or equivalent, be used to refill for positive traction units and for regular units.*

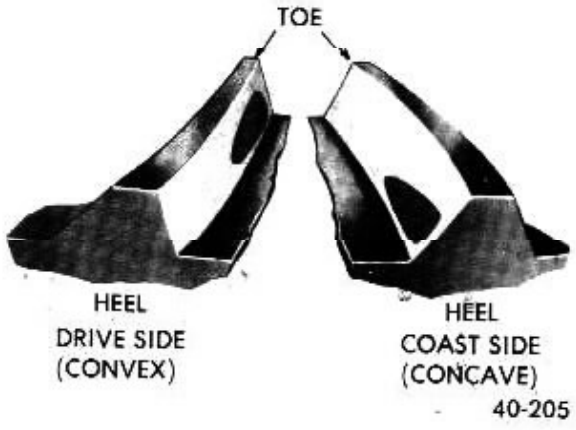


Figure 40-104 Tooth Pattern - Pinion Too Close to Ring Gear (Excessive Shim Thickness)

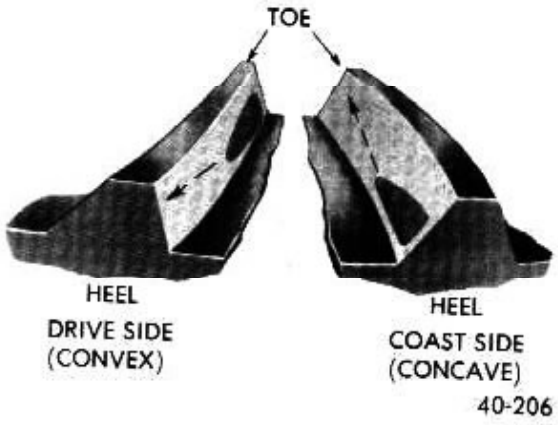


Figure 40-105 Effect on Tooth Pattern As Shim Thickness is Decreased

f. Elimination of External Noises

When a rear axle is suspected of being noisy, it is advisable to make a thorough test to determine whether the noise originates in the tires, road surface, front wheel bearings, engine, transmission, or rear axle assembly. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly.

Road Noise Some road surfaces, such as brick or rough-surfaced concrete, cause noise which may be mistaken for tire or rear axle noise. Driving on a different type of road, such as smooth asphalt or dirt, will quickly show whether the road surface is the cause of noise. Road noise usually is the same on drive or coast.

Tire Noise Tire noise may easily be mistaken for rear axle noise, even though the noisy tires may be located on the front wheels. Tires worn unevenly, or having surfaces on non-skid divisions worn in saw- tooth fashion, are usually noisy and may produce vibrations which seem to originate elsewhere in the vehicle. This is particularly true with low tire pressure.

Test for Tire Noise Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 50 pounds pressure, *for test purposes only,* will materially alter noise caused by tires but will not affect noise caused by rear axle. Rear axle noise usually ceases when coasting at speeds under 30 miles per hour; however, tire noise continues but with lower tone as car speed is reduced. Rear axle noise usually changes when comparing "pull" and "coast", but tire noise remains about the same.

Front Wheel Bearing Noise Loose or rough front wheel bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing "pull" and "coast". Light application of brake, while holding car speed steady, will often cause wheel bearing noise to diminish, as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, and also by shaking wheels to determine if bearings are excessively loose.

Engine and Transmission Noises Sometimes a noise which seems to originate in the rear axle is actually caused by the engine or transmission. To determine which unit is actually causing the noise, observe approximate car speeds and conditions under which the noise is most pronounced; then stop car in a quiet place to avoid interfering noises. With transmission in neutral, run engine slowly up and down through engine speeds corresponding to car speed at which the noise was most pronounced. If a similar noise is produced with car standing, it is caused by the engine or transmission and not the rear axle.

g. Rear Axle Noises

If a careful test of car shows that noise is not caused by external items, as described in subparagraph f, it is then reasonable to assume that noise is caused by rear axle assembly. The rear axle should be tested on a smooth level road to avoid road noise. It is not advisable to test rear axle for noise by running with rear wheels jacked up.

Noises in rear axle assembly may be caused by a faulty propeller shaft, faulty rear wheel bearings, faulty differential or pinion shaft bearings, misalignment between two U-joints, or worn differential side gears and pinions; noises may also be caused by mismatched, improperly adjusted, or scored ring and pinion gear set.

Rear Wheel Bearing Noise A rough rear wheel bearing produces a vibration or growl which continues with car coasting and transmission in neutral. A brinelled rear wheel bearing causes a knock or click approximately every two revolutions of rear wheel, since the bearing rollers do not travel at the same speed as the rear axle and wheel. With rear wheels jacked up, spin rear wheels *by hand* while listening at hubs for evidence of rough or brinelled wheel bearing.

Differential Side Gear and Pinion Noise Differential side gears and pinions seldom cause noise, since their movement is relatively slight on straight-ahead driving. Noise produced by these gears will be most pronounced on turns.

Pinion Bearing Noise Rough or brinelled pinion bearings produce a continuous low pitch whirring or scraping noise starting at relatively low speed.

Ring and Pinion Gear Noise Noise produced by the ring and pinion gear set generally shows up as drive noise, coast noise, or float noise. Drive noise is noise produced during vehicle acceleration; coast noise is noise produced while allowing car to coast with throttle closed; and float noise is noise occuring while just maintaining constant car speed at light throttle on a level road. Drive, coast, and float noises will vary in tone with speed and will be very rough and irregular if the differential or pinion shaft bearings are rough, worn, or loose.

h. Body Boom Noise or Vibration

Objectional "body boom" noise or vibration at 55-65 mph can be caused by an unbalanced propeller shaft. Excessive looseness at the spline can contribute to this unbalance.

Other items that may also contribute to the noise problem are as follows:

1. Undercoating or mud on the shaft, causing unbalance.

2. Shaft or companion flange balance weights missing.

3. Shaft damage, such as bending, dents, or nicks.

4. Tire-type roughness. Switch tires from a known good car to determine tire fault.

i. Check for Propeller Shaft Vibration

See paragraph 40-25.

j. Oil Leaks

It is difficult to determine the source of some oil leaks. When there is evidence of an oil leak, determine source as follows:

1. Oil coming from the axle housing at the brake backing plate is caused by a leaking axle shaft seal.

2. Oil coming from between the rear pinion flange slinger and the carrier is caused by a leaking pinion seal.

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 OD of the seal. Therefore, it is a good idea to make sure the leak is stopped by using a non-hardening sealing compound around the OD of the new pinion seal.

3. Oil leaking at the junction of the axle tubes to the carrier, or at the puddle weld holes, are difficult to repair. Under no circumstances should any welding be done in attempts to stop leaks in these areas. If the leak is severe, the complete rear axle housing shouldd be replaced.

k. Testing Positive Traction Differential

If there is a doubt that a Buick is equipped with a Positive Traction Differential, or to determine if this option is performing satisfactorily, a simple test can be performed.

1. Place transmission in neutral.

2. Raise one wheel off floor and place a block of wood in front and rear of opposite wheel.

3. Remove wheel cover and install torque wrench with extension on lug nut.

4. Disregard breakaway torque and observe only torque required to continuously turn wheel smoothly. If differential assembly is equipped with Positive Traction Differential, the rotating torque will be at least 35 lb. ft.

l. Positive Traction Flushing Procedure

The following procedure is established for flushing the Positive Traction Differential in the event the wrong lubricant is accidentally added.

1. Drain original lubricant from differential housing.

2. Fill axle with a light, non-detergent engine oil.

3. Raise both rear wheels off floor.

4. With car properly supported, run car in "Drive" range for three to four minutes. Do not exceed 30 mph on speedometer or accelerate or decelerate rapidly.

5. Remove oil from axle.

6. Repeat Steps 2, 3, 4, and 5. It is important that the axle be flushed two times to ensure complete removal of the original lubricant.

7. Fill differential housing with positive traction lubricant, GM Part No. 1051022, or equivalent.

DIVISION II

DESCRIPTION AND OPERATION

40-45 DESCRIPTION AND OPERATION OF STANDARD AND POSITIVE TRACTION DIFFERENTIAL

a. Standard Differential Description

The differential is a device that divides the torque equally to both 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 equal force to the wheels. The amount of force available depends upon the traction under the tires.

The differential assembly is of the semi-floating type in which the car weight is carried on the axle housing. The differential assembly is designed for use with an open drive line and coil or leaf springs. The differential has a hypoid type ring gear and pinion with the centerline of the pinion gear below the centerline of the ring gear.

All parts necessary to transmit power from the propeller shaft to the rear wheels are enclosed in a salisbury type axle housing (a carrier casting with tubes pressed and welded into the carrier to form a complete carrier and tube assembly). A removable steel cover bolted to the rear of the carrier permits service of the differential without removing the entire assembly from the car.

A universal joint connects the rear end of the propeller shaft to a companion flange, having a splined end which fits over and drives the hypoid pinion gear. Two preloaded tapered roller bearings support the hypoid pinion gear in the carrier. The inner race of the rear bearing is a tight press fit on the pinion stem. The inner race of the front bearing combines a light press fit to a close sliding fit on the 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 enable accurate bearing preload adjustment and maintain a preload on both front and rear pinion bearings. Adjustment of the fore and aft position of the pinion is obtained by placing shims between the head of the drive pinion and the rear pinion bearing. Torque from the pinion gear is transmitted to a ring gear attached to a differential case.

The differential case is of one-piece construction and is supported in the carrier by two tapered roller side bearings. These are preloaded by inserting shims between the bearings and the carrier. The differential case assembly is positioned for proper ring gear to pinion backlash by varying the shim thickness from side to side. The ring gear is bolted to the case. Two side gears have splined bores for driving the axle shafts. They are positioned to turn in counterbored cavities in the case. The two differential pinions have smooth bores and are held in position by a solid pinion cross shaft, mounted and locked in the differential case. All four gears are in mesh with each other and, because the pinion gears turn freely on their shaft, they act as idler gears when the rear wheels are turning at different speeds. The pinions and side gears are backed by steel thrust washers.

b. Positive Traction Differential Description

The positive traction differential differs from the standard differential in that a different type of case assembly is used.

The positive traction case assembly provides increased resistance to differential action and multiplies the tractive force available at the wheel with the least traction. This multiplied force is then available to the wheel with the better traction.

Three types of positive traction differential case assemblies are used: 1) Cone clutch type; 2) Plate clutch type (waffle pattern plates and rounded ear lugs); and 3) Plate clutch type (swirl pattern plates and square ear lugs). The cone clutch type is only serviced as a complete case assembly. The plate clutch type case assemblies are serviced individually; the internal parts are not interchangeable between types of differentials.

Rear axle assemblies having positive traction differentials may be identified by a rectangular stainless steel tag on the five o'clock inspection cover bolt, or by a red plastic triangular tag on the filler plug. In addition, identification may be made by reading the code letters from the forward side of the right axle tube, three inches outboard of the carrier.

Axle Shaft and Wheel Bearings - Two types of axle shafts and wheel bearings are used. Both types of bearings are roller bearings. One type rolls directly on the axle shaft. With this type, the shaft is retained in the housing by 'C'-Locks in the differential side gears. This type may be identified by reading the code letters from the forward side of the right rear axle tube three inches outboard of the carrier. The third letter "C" or "K" identifies this type. For example, the code letters "NAC" would indicate a 3.08 ratio, standard differential, and direct-on type roller bearing, 'C'-Lock retained axle shaft. The second type wheel bearing has its own inner race and is retained on the axle shaft by a retainer ring. This type may be identified by reading the code letters on the right rear axle tube. The third letter "B" or "O" identifies this type. For example, the code letters "NAO" would indicate a 3.08 ratio, standard differential, unit roller wheel bearing retained in the axle housing by an outer retainer plate bolted to the housing end flange and retained on the shaft by a pressed on ring. See Figures 40- 143 and 40-144.

Axle Shaft Wheel Bearing Seals - Two types of wheel bearing seals are used, depending upon the type of wheel bearing. One type is used with the "Direct On" wheel

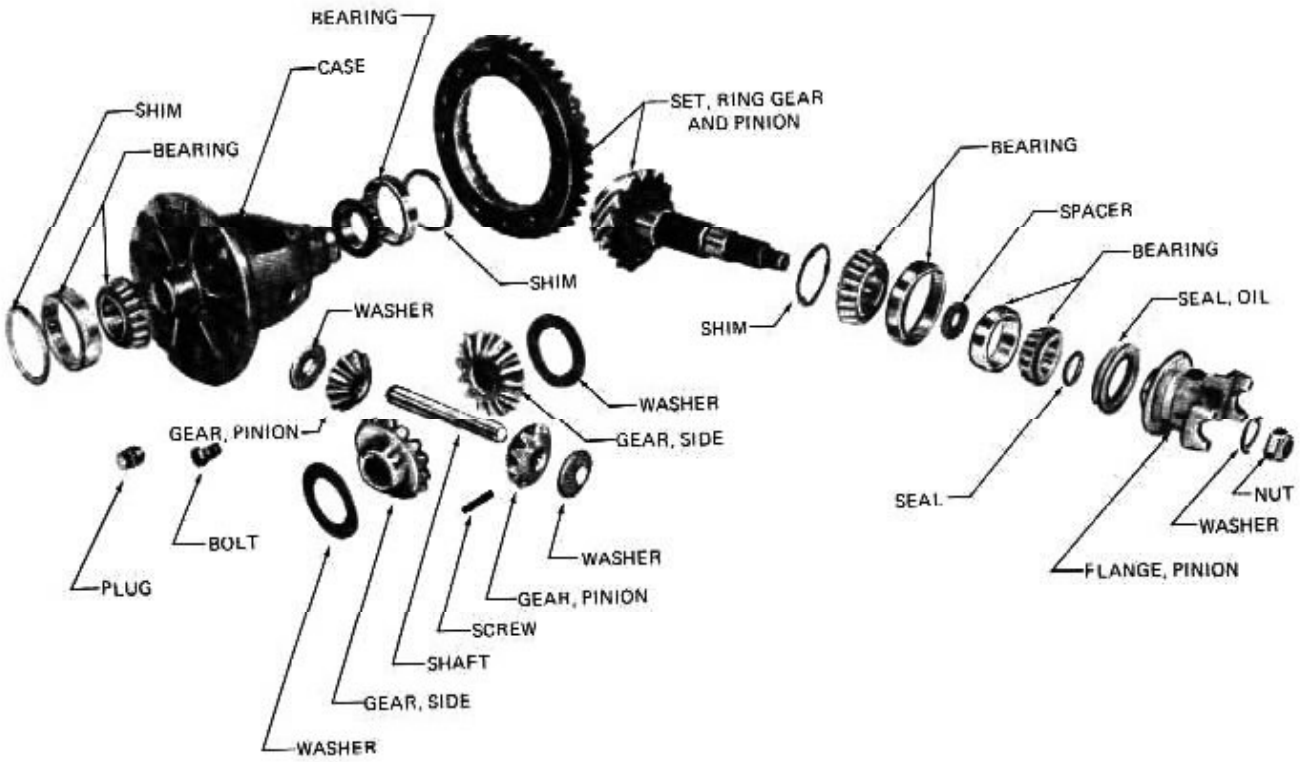


Figure 40-106 Exploded View - Typical Standard Differential

bearing. This seal is pressed into the axle housing end outboard of the wheel bearing. The second type is used with the "Unit Bearing" and is assembled onto the axle shaft before the bearing is pressed on.

c. Operation - Standard Differential

Power from the engine is transferred to the transmission via a clutch or a fluid coupling. The transmission then provides the transfer of power to its output shaft, which is splined to the propeller shaft by means of a universal joint connection. Since the rear of the propeller shaft is connected to the differential drive pinion through the companion flange, the transmission output shaft, propeller shaft, and differential drive pinion all turn at the same speed.

Power from the drive pinion gear is transmitted to the ring gear which is bolted to the differential case. When driving in a straight line and there is equal resistance on each rear wheel, the force through the drive pinion and ring gear turns the axle shafts at the same rate of speed and there is no movement between differential pinions and side gears.

When the vehicle turns a corner, the outer rear wheel must turn faster than the inner wheel. The inner wheel, turning slower with respect to the outer wheel, slows its differential side gear (as the axle shaft is splined to the side gear) and the differential pinion gears will roll around the slowed differential side gear, driving the other differential side gear and wheel faster. See Figure 40-106.

d. Operation - Positive Traction Differential

Operation of the positive traction differential is the same as the standard differential, except that there is additional friction provided by the clutches (cone or plate type). Under ordinary driving and cornering conditions, the clutches slip, allowing the outside wheel to turn faster than the inner. Under poor traction conditions, such as ice, snow, or loose gravel under one driving wheel, the increased friction provided by the clutches increases the driving torque available to the wheel with the better traction. The clutches (cone or plate type) are spring loaded to provide the increased driving torque under extremely low tractive conditions. See Figure 40-107.

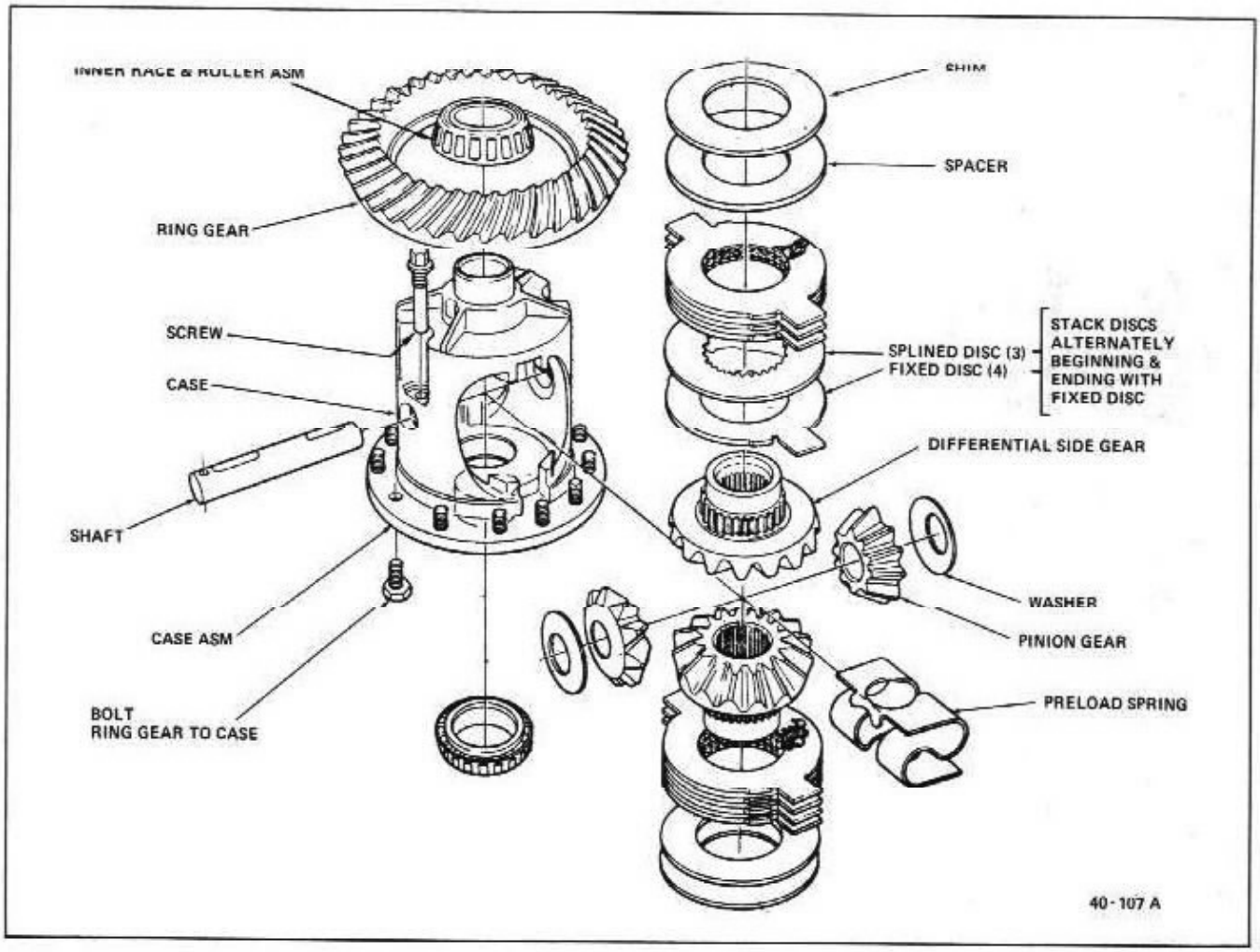


Figure 40-107 Exploded View - Typical Positive Traction Differential

DIVISION IV

REMOVAL AND INSTALLATION

40-46 REMOVAL AND INSTALLATION OF DIFFERENTIAL ASSEMBLY

It is not necessary to remove the rear axle assembly for any normal repairs. However, if the housing is damaged, the rear axle assembly may be removed and installed using the following procedure.

a. Removal of Rear Axle Assembly

1. Raise rear of car high enough to permit working underneath. Place a floor jack under center of axle housing so it just starts to raise rear axle assembly. Place jack stands solidly under frame members on both sides.

2. Mark rear universal joint and pinion flange for proper reassembly then disconnect rear universal joint from pinion flange by removing four bolts and two straps on the single joint connection, or by removing four bolts on the CV joint connection.

3. Disconnect parking brake cables by removing adjusting nuts at equalizer. Slide center cable rearward and disconnect two rear cables at connectors to free from body.

4. Disconnect rear brake hose at floor pan. Cover brake hose and pipe openings to prevent entrance of dirt.

5. On all cars, except the Estate Wagons, disconnect shock absorbers at lower end and push shock absorbers up out of the way. Lower jack under housing until rear springs can be removed.

6. On Estate Wagons only, proceed as follows:

a. Raise car on hoist.

b. Disconnect shock at lower by removing nut.

c. Support car by placing jack stands at frame in front of leaf springs and at rear of leaf springs at bumper.

d. Disconnect right side of exhaust system by removing exhaust hanger screw to rear frame cross member.

e. Remove lower spring plate attaching nuts.

f. Remove front and rear attaching bolts and remove spring.

7. Roll assembly out from under car.

b. Installation of Rear Axle Assembly

NOTE: *Fasteners in subparagraph b are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

1. Connect lower control arms to housing.

NOTE: *Control arm bushing bolts and shock absorbers to be tightened with suspension in normal load position.*

2. Connect upper control arms to housing.

3. On all cars, except the Estate Wagon, place rear springs in position and jack axle housing upward until shock absorbers will reach. Connect shock absorbers.

4. On Estate Wagons, proceed as follows:

a. Connect leaf spring at front attachment.

b. Attach lower spring plate. Be sure spring cushions are in plate. Torque nuts to 40 lb. ft.

NOTE: *It may be necessary to lower axle to attach spring plate.*

c. Attach leaf spring at rear shackle. Torque nut to 115 lb. ft.

d. Torque nut at front attachment to 75 lb. ft.

e. Reconnect shock.

f. Reconnect exhaust system.

5. Connect upper and lower control arm bolts. Tighten to specified torque.

6. Connect and adjust parking brake cable.

7. Connect rear universal joint to pinion flange aligning marks previously made. Tighten bolts evenly to 15 lb. ft. on single joint and tighten to 85 lb. ft. on CV joint.

8. Connect rear brake hose at floor pan. Bleed both rear brakes and refill master cylinder.

9. Fill rear axle with specified gear lubricant.

40-47 REMOVAL AND INSTALLATION OF AXLE SHAFT, WHEEL BEARING OR OIL SEAL

Most rear axle service repairs can be made with the rear axle assembly in the car by raising the rear end of the car with the rear axle hanging on the shock absorbers.

Rear axle lubricant may be drained by backing-out all cover bolts and breaking cover loose at the bottom.

a. Remove Axle Shaft Assemblies

Design allows for maximum axle shaft end play of .018". 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 .018" is excessive. Compensating for all of the end play by inserting a shim inboard of the bearing in the housing is not recommended since it ignores the end play of the bearing itself, and may result in improper seating of the backing plate against the axle tube flange. If the end play is excessive, the axle shaft and bearing assembly should be removed and the cause of the excessive end play determined and corrected.

1. Remove wheels. Both right and left wheels have right hand threads.

2. Remove brake drums.

3. For the C-K type axles, proceed as follows:

a. Remove differential carrier cover and allow lubricant to drain.

b. Remove pinion shaft lock bolt and pinion shaft. See Figure 40-110.

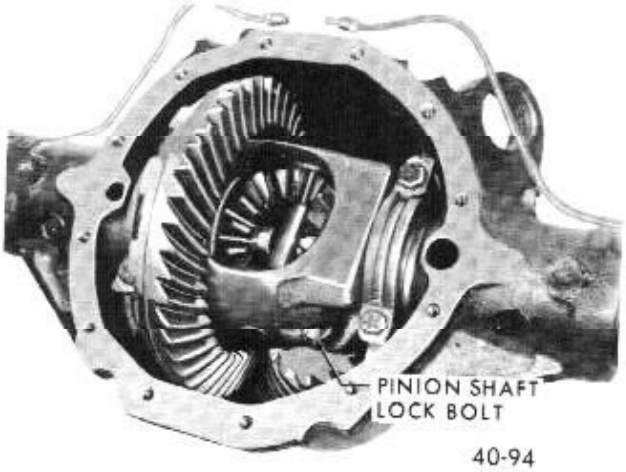


Figure 40-110 Pinion Shaft Lock Bolt

c. Push axle shafts inward to permit removal of "C" locks, then remove axle shafts. See Figure 40-111.

4. For the B-O type axles, proceed as follows:

a. Remove nuts holding retainer plates to brake backing plates. Pull retainers clear of bolts and reinstall two opposite nuts finger tight to hold brake backing plate in position.

b. Pull out axle shaft assemblies, using Puller J 21579 with a slide hammer. See Figure 40-112.

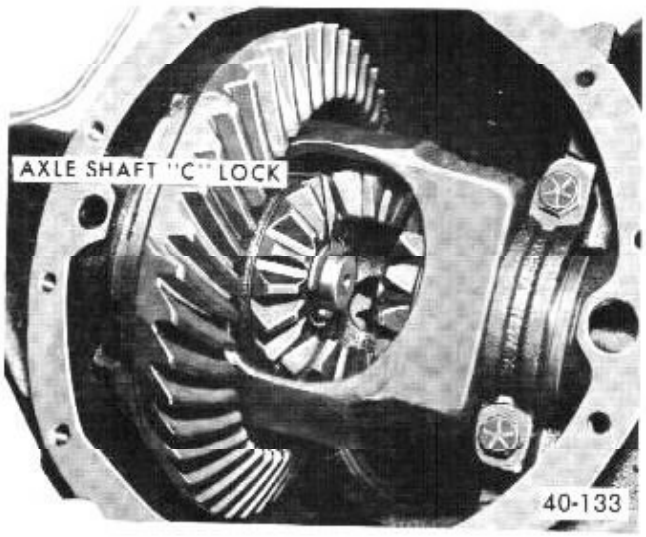


Figure 40-111 Axle Shaft "C" Locks

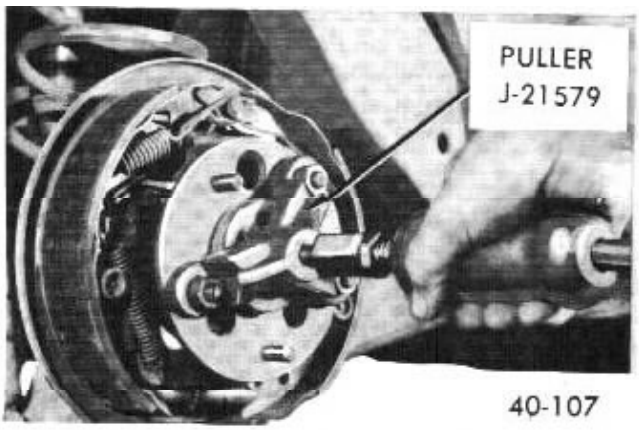


Figure 40-112 Removing Rear Axle Shaft

b. Remove and Install Axle Shaft Bearing and/or Seal (B-O Type Axles)

The rear wheel bearing and bearing retainer ring both have a heavy press fit on the axle shaft. Because of this fit they should be removed or installed separately. Both the retainer ring and the bearing must be removed to replace the seal.

1. Position and tighten axle shaft in vise so that the retainer ring rests on vise jaws. Use a heavy chisel and hammer to crack ring. See Figure 40-113.

NOTE: *Do not use torch.*

2. Press axle shaft bearing off using Plate J- 23133. See Figure 40-114.

3. Remove axle shaft seal if necessary and install new seal. Insure against damaging the seal lip.

NOTE: *Retainer plate which retains axle shaft in housing must be installed on axle shaft before seal and bearing are installed.*

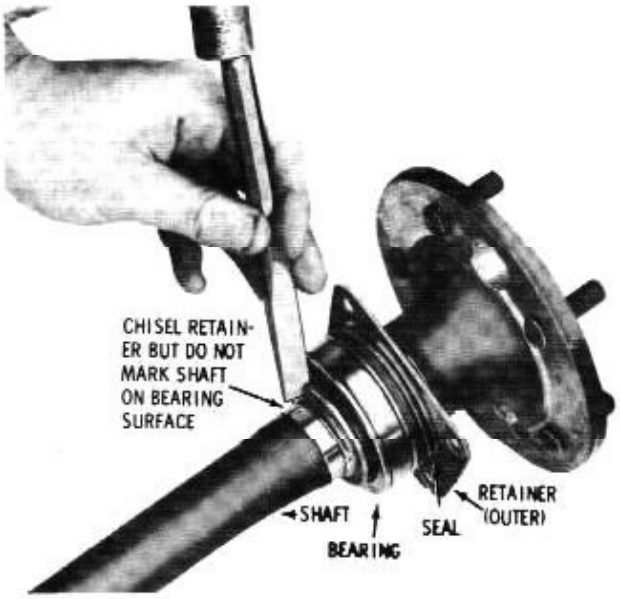


Figure 40-113 - Removing Axle Shaft Bearing Retainer

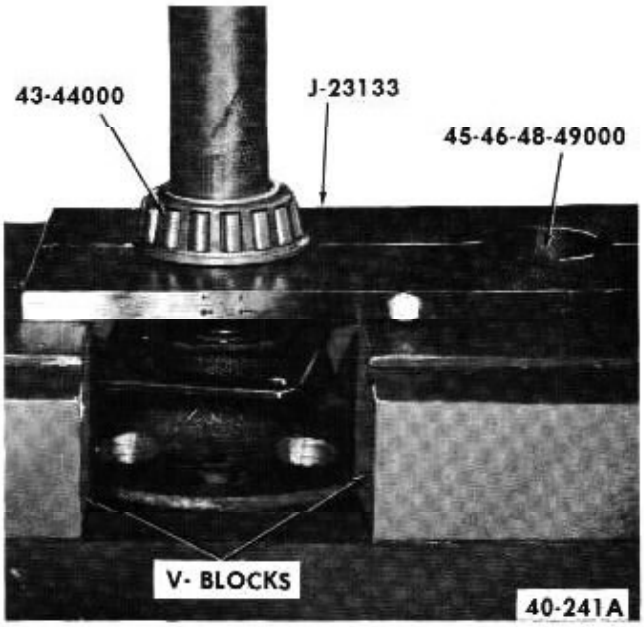


Figure 40-114 Removing Axle Shaft Bearing

4. Press new bearing against shoulder on axle shaft, using Installer J-21022 for 43-44000 and Installer J-8609 for 45-46-48-49000.

5. Press new service retainer ring against bearing, using Installer J-21022 for 43-44000 and Installer J-8609 for 45-46-48-49000. See Figure 40-115.

c. Remove and Install Axle Shaft Bearing and/or Seal C-K Type Axles

1. Position axle shaft bearing and seal, remove J-23689, and remove the bearing and seal. See Figures 40-116 and 40-117.

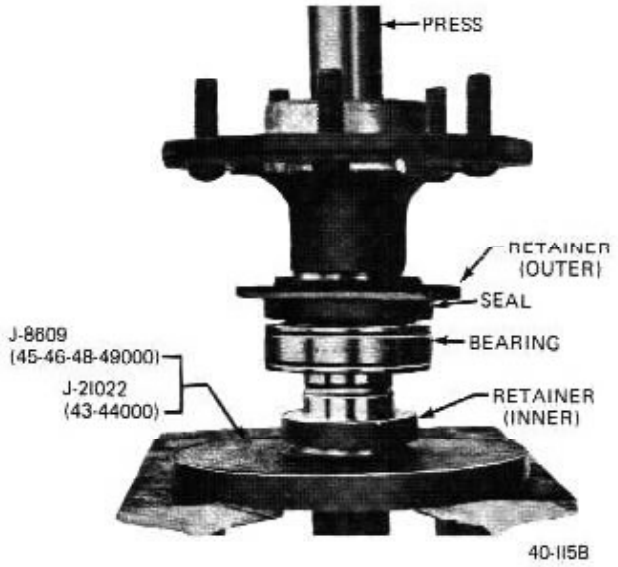


Figure 40-115 Pressing New Retainer Ring Against Bearing

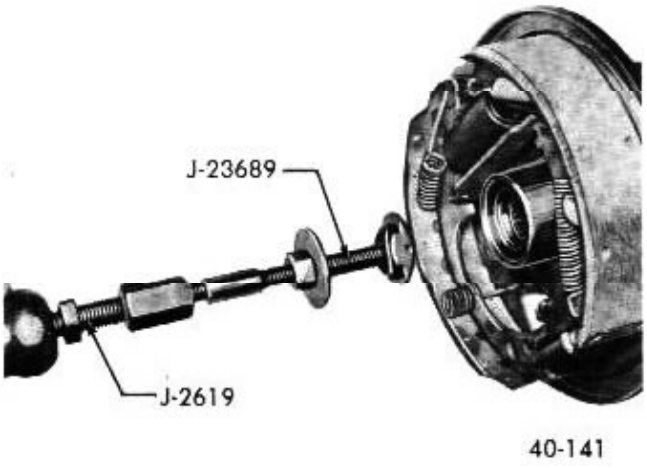


Figure 40-116 Axle Shaft Bearing and Seal Remover

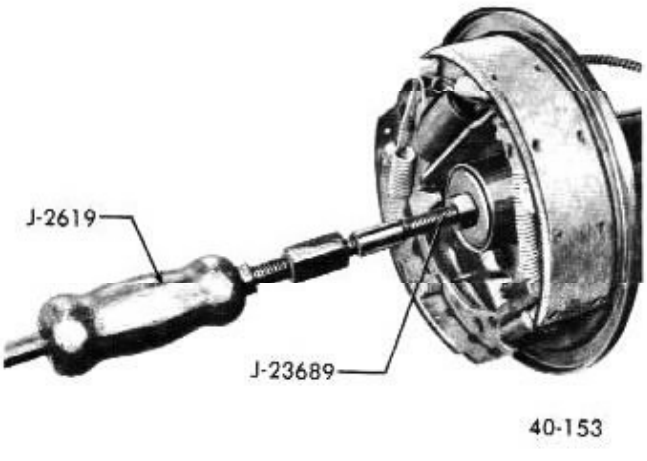


Figure 40-117 Axle Shaft Bearing and Seal Remover Installed

2. Using the axle shaft bearing and seal Installer J-23690, install the bearing and then the seal. See Figure 40-118.

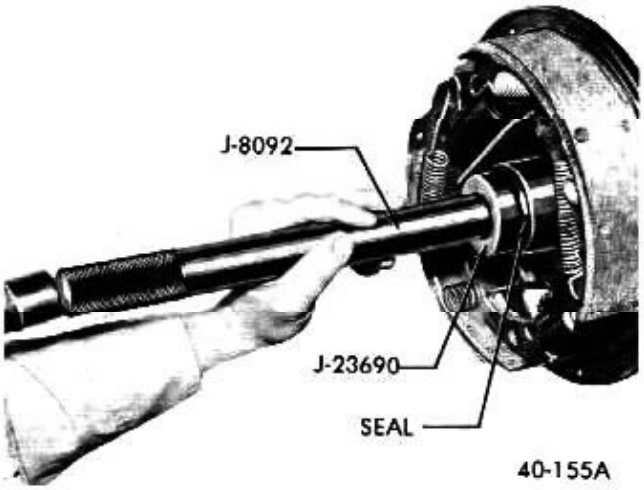


Figure 40-118 Axle Shaft Bearing and Seal Installer

d. Remove and Install Rear Wheel Bolt

1. To remove and install a rear wheel bolt, axle shaft assembly must be out of car. Remove rear wheel bolt by pressing from axle flange.

2. Install new rear wheel bolt by pressing through axle flange. Check new bolt for looseness; if bolt is loose, axle shaft must be replaced.

e. Install Axle Shaft Assembly

Rear axle shafts are interchangeable between sides.

1. Apply a light coat of wheel bearing grease in wheel bearing and seal recess of housing.

2. On the B-O type axles, apply gear lubricant to the splines at the inner end of the axle shaft. Apply a coat of wheel bearing grease on the seal surface of the shaft. Install axle shaft.

NOTE: *If the axle to be installed is a positive traction axle, only positive traction lubricant should be used.*

3. For C-K type axles, proceed as follows:

a. Insert axle shaft through the seal and bearing and, as far as possible, through the side gear.

b. Install "C" lock onto axle shaft. Move axle shaft and "C" lock outward to bottom the "C" lock in the recess of the side gear.

c. Install pinion shaft and secure with lock bolt (15 lb. ft.).

d. Install new gasket and cover, torque bolts to 30 lb. ft.

e. Install specified quantity and type of lubricant.

NOTE: *Fasteners in Steps 4 and 5 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number, or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lower quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

4. Install retainer nuts and tighten to specified torque.

5. Install drum and wheel. Tighten lug nuts to specified torque.

DIVISION V

OVERHAUL AND MAJOR SERVICE

40-48 REMOVAL AND DISASSEMBLY OF DIFFERENTIAL CASE ASSEMBLY

a. Removal of Differential Case Assembly - Differential In Car

1. Raise rear of car and support securely under rear of frame.

2. Loosen parking brake cables so that brake is not applied when axle assembly is lowered.

3. Mark rear universal joint and pinion flange for proper alignment at reassembly. Disconnect rear universal joint.

4. Lower differential assembly just far enough to clear lower portion of fuel tank.

NOTE: *The following steps also apply when making repairs with differential assembly removed from car.*

5. Remove bolts securing cover to housing to drain lubricant.

6. While lubricant is draining, remove rear wheels and drums.

7. Remove rear axle shafts as described in paragraph 40-47.

NOTE: *Before proceeding with following steps, it is advisable to check the existing ring gear to pinion backlash as described in paragraph 40-49, subparagraph g. This will indicate gear or bearing wear or an error in backlash or preload setting which will help in determining cause of axle noise. Backlash should be recorded so that if same*

gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

8. Mark side bearing caps for proper installation at reassembly. Remove bolts holding differential side bearing caps to housing.

9. Differential case assembly can now be removed by prying against ring gear bolt, using a suitable pry bar. See Figure 40-119. Remove case assembly and place right and left bearing outer races and shims in sets with marked bearing caps so that they can be reinstalled in their original positions.

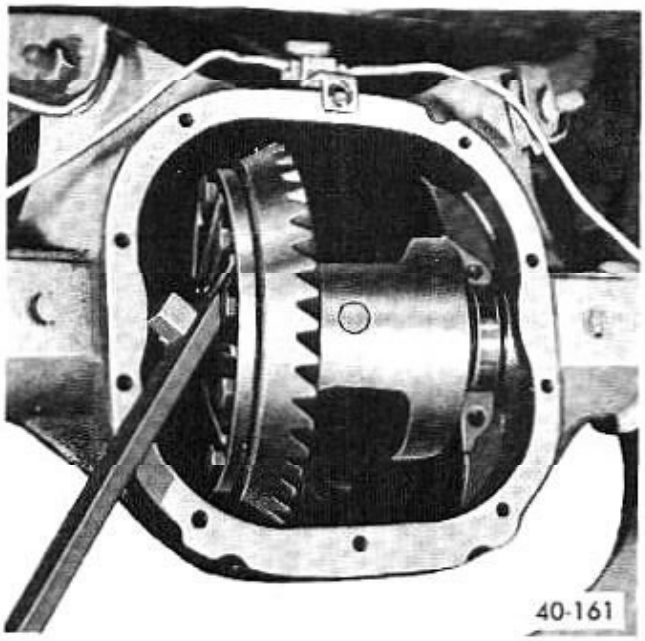


Figure 40-119 Removing Differential Case Assembly

CAUTION: *Do not allow case assembly to drop as this may cause injury or damage parts.*

b. Disassemble Standard Differential Case Assembly

1. If differential side bearings are to be replaced, insert Remover Adapter J-2241-10 in center hole and pull bearing using Puller J-22588. See Figure 40-120.

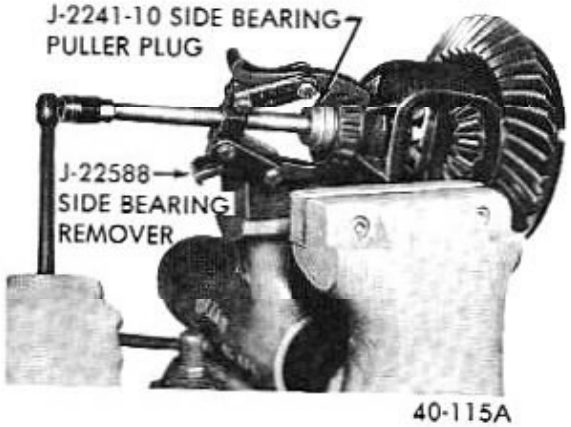


Figure 40-120 - Removing Differential Side Bearings

2. Remove screw that retains differential pinion shaft. See Figure 40-121. Remove differential pinions, side gears and thrust washers from case.

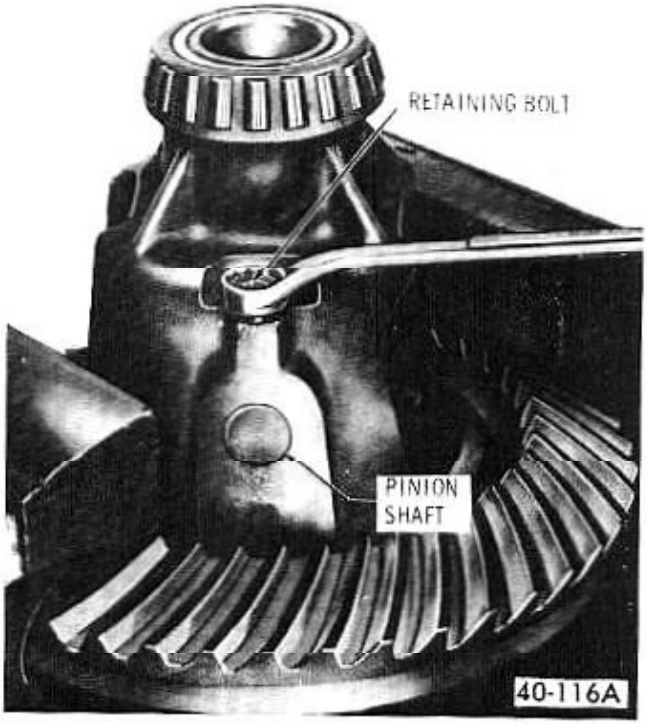


Figure 40-121 - Removing Pinion Shaft Lock Screw

3. If ring gear is to be replaced and it is tight on case after removing bolts, tap it off using a soft hammer; do not pry between ring gear and case.

c. Disassemble Plate Type Positive Traction Differential Case Assembly

1. Remove screw that retains differential pinion shaft and remove differential cross shaft. Remove preload spring thrust blocks and springs from the case. See Figure 40-122.

2. Rotate side gears until the pinions are in the open area of the case, remove the pinions and thrust washers.

3. Remove a side gear, clutch pack, and shims from the case, noting location to aid in reassembly. Remove the side gear, clutch pack, and shims from the opposite side.

4. Remove clutch plates from side gears, keeping plates in their original location in the pack.

d. Removal of Pinion and Bearings

1. Check pinion bearing preload as described in paragraph 40-49, subparagraph c.

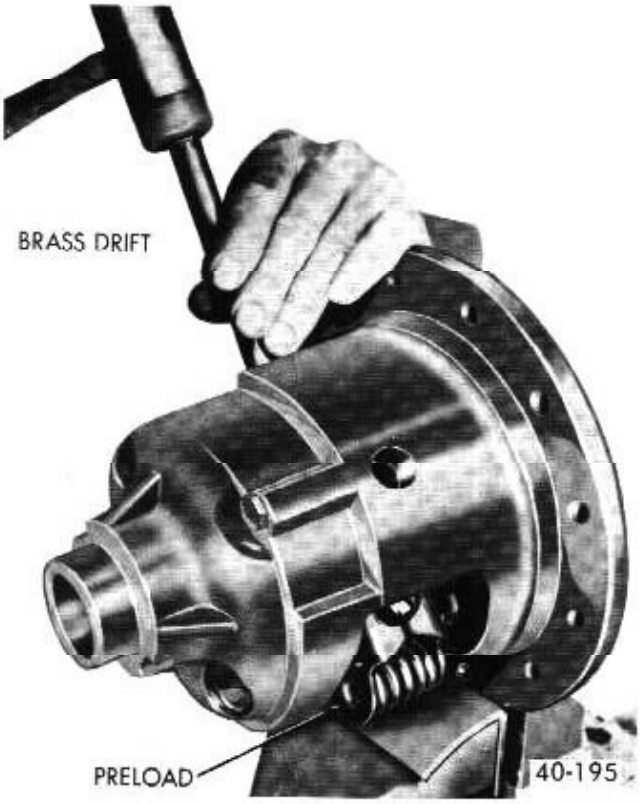


Figure 40-122 Removing Preload Thrust Blocks and Springs

If there is no preload reading, check for looseness of pinion assembly by shaking. Looseness indicates need for bearing replacement. If assembly is run long with very loose bearings, ring and pinion will also require replacement.

2. Install Holder J-8614 on flange by using two 5/16-18x2" bolts with flat washers. Remove pinion nut and washer. See Figure 40-123.

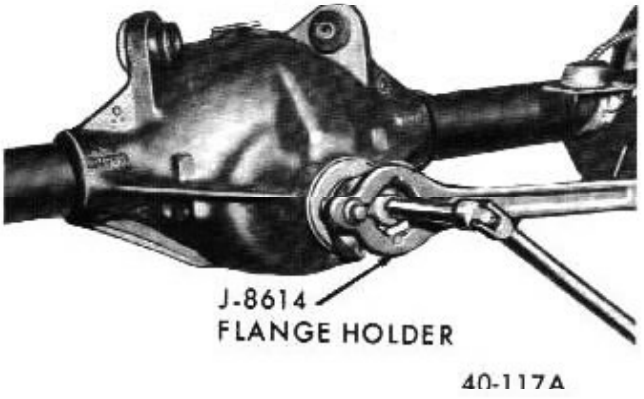


Figure 40-123 - Removing Pinion Nut

3. Pull pinion flange from pinion using Puller J-8614. To install puller, back out puller screw, insert puller through holder, and rotate 1/8 turn. See Figure 40-124.

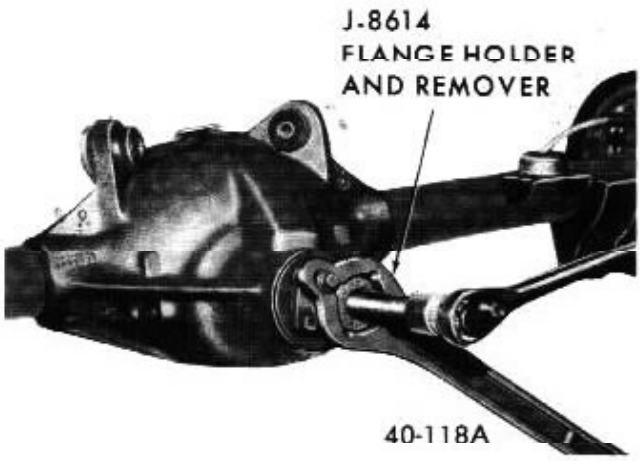


Figure 40-124 - Removing Pinion Flange

4. Remove pinion assembly. If necessary, tap pinion out with soft hammer, while being careful to guide pinon with hand to avoid damage to bearing outer races.

5. If rear pinion bearing is to be replaced, remove rear pinion bearing from pinon shaft using Remover J-8612 on 8 1/2 inch ring gear axles or Remover J 9746 on 9 3/8 inch ring gear axles with Holder J-6407. See Figure 40-125.

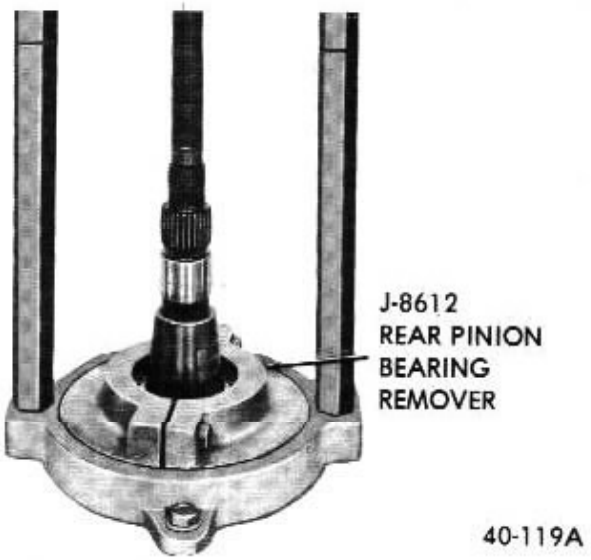


Figure 40-125 - Removing Rear Pinion Bearing

6. Pry pinion oil seal from carrier and remove front pinion bearing. If this bearing is to be replaced, drive outer race from carrier using a brass drift.

7. If rear pinion bearing is to be replaced, drive outer race from carrier using a brass drift in slots provided for this purpose.

40-49 ASSEMBLY AND INSTALLATION OF DIFFERENTIAL CASE ASSEMBLY

Before installation of any parts, examine the wearing surfaces of all parts for scoring or unusual wear. Make certain

that the interior of the carrier housing is absolutely clean and dry. Also make certain that the parts to be assembled are absolutely clean and that there are no burred edges. Lubricate all parts with the specified rear axle lubricant just before assembly.

NOTE: *If the Buick is equipped with a Positive Traction Differential, only Positive Traction Lube should be used.*

NOTE: *If the ring gear and pinion are changed, only factory hypoid lubricant should be used for filling because of its special anti-scoring properties. For this reason the proper lubricant is included in the carton with the replacement gears as received.*

a. Install Pinion Bearing Outer Races In Carrier

1. If rear pinion bearing is to be replaced, use Installer J-8608 on 8 1/2 inch ring gear axles or Installer J-9745 on 9 3/8 inch ring gear axles with Driver Handle J-8092. See Figure 40-126.

2. If front pinion bearing is to be replaced, install new outer race using Installer J-8611-01 with Driver Handle J-8092. See Figure 40-127.

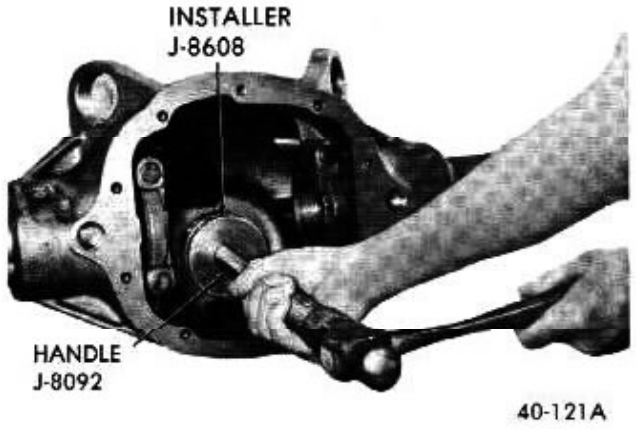


Figure 40-126 - Installing Rear Pinion Bearing Outer Race

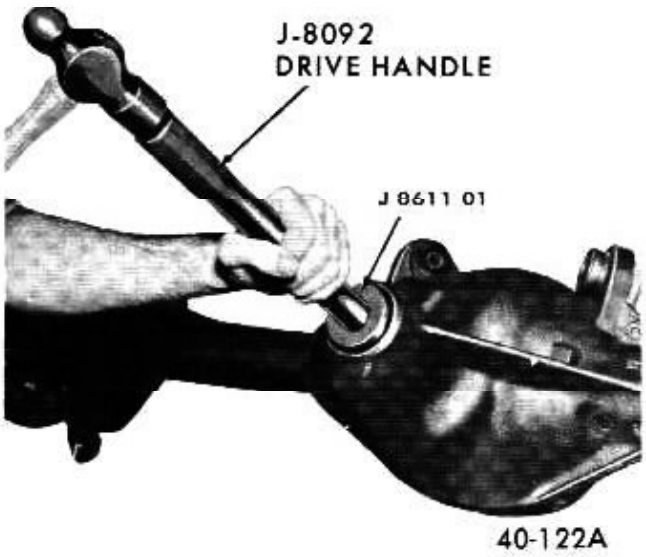


Figure 40-127 - Installing Front Pinion Bearing Outer Race

b. Set Pinion Depth

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in machining the parts. However, most production pinions and all pinions used for service replacement are zero or nominal pinions.

If during repair, a pinion is found having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure of gaging the carrier and shimming the pinion has been developed. After gaging a carrier, the assembler is able to install a shim between the front face of the pinion and its bearing so that pinion depth can be adjusted to an exact required specification for best tooth contact in each axle assembly.

Pinion depth for all axles is set with Pinion Setting Gage J-5647. See Figure 40-129 for gage usage on the 8 1/2 inch ring gear axles and Figure 40-129A for gage usage on the 9 3/8 inch ring gear axles. Although production pinions are marked, neither production nor service pinions have a gaging tooth. The pinion setting gage provides in effect a nominal or zero pinion as a reference.

Set up pinion setting gage as follows:

1. Be certain that all parts of pinion setting gage are clean.

2. Lubricate front and rear pinion bearings which will be used in final reassembly and position them in their respective races in the carrier. Thread Stud J-8619-13 into Gage Plate J-5647-45 on the 8 1/2 inch ring gear axles and Gage Plate J-5647-47 on the 9 3/8 inch ring gear axles. With bearings held in place in races, install gage plate and stud assembly on rear pinion bearing inner race. Install Pilot J-5647-37 on front pinion bearing with small diameter on raised portion of bearing race. See Figure 40 130.

3. Install nut on Stud J-8619-13. Hold stud stationary with wrench positioned on flats on end of stud; tighten nut until a reading of 20 pound inches is obtained when rotating gage plate assembly with a pound inch torque wrench.

4. Install Discs J-5647-46 (L) and J-8619-10 (R) 8 1/2 inch ring gear axles or Discs J-5647-40 (R) and J-5647-41 (L) 9 3/8 inch ring gear axles on the indicator gage. Install the small ball-tipped contact button on the stem of the dial indicator and mount the dial indicator on the indicator gage. See Figure 40-129.

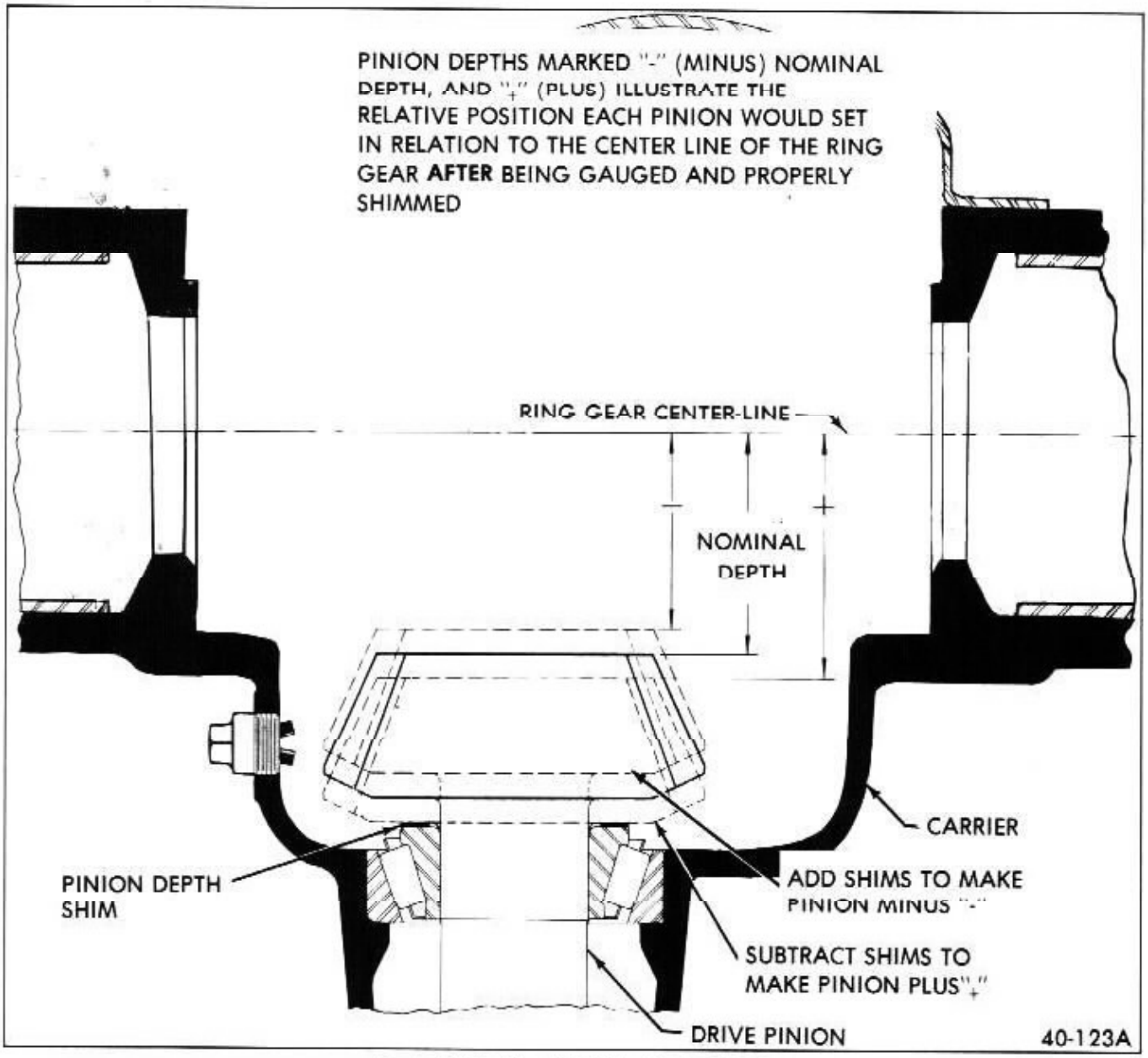


Figure 40-128 - Nominal Pinion Setting Depth

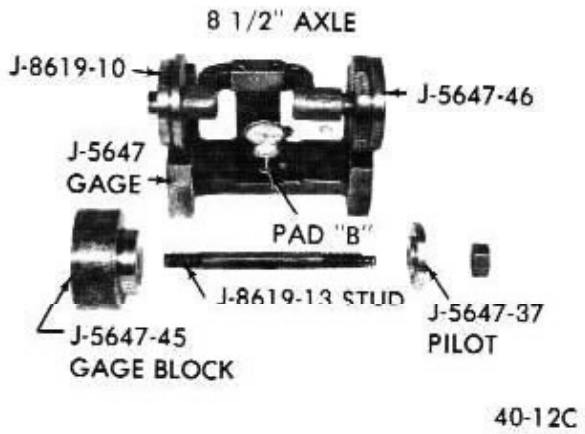


Figure 40-129 - Pinion Setting Gage

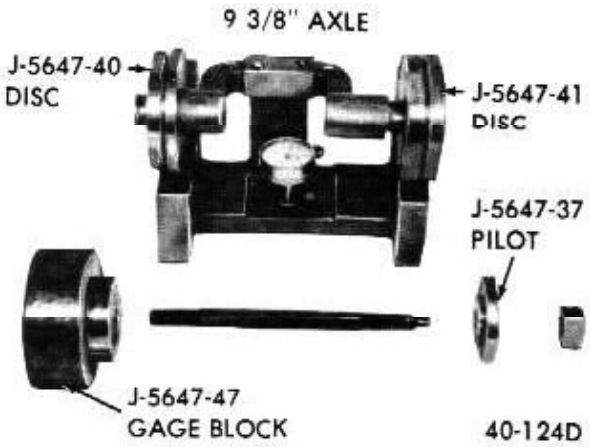


Figure 40-129A - Pinion Setting Gage

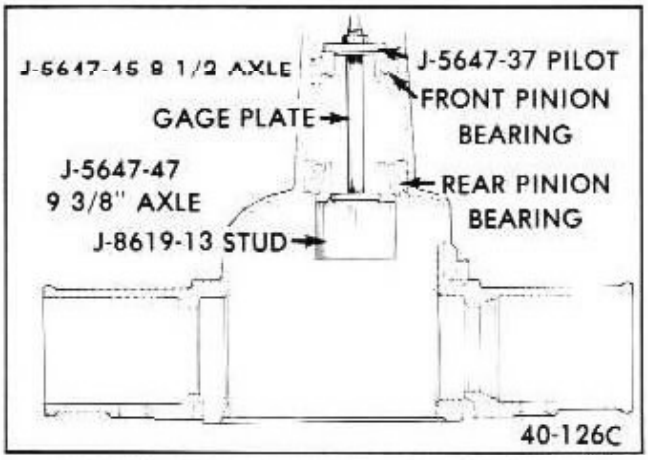


Figure 40-130 - Pinion Gage Plate Installed in Carrier

5. Place the indicator gage on the master gage, as shown in Figure 40-131 so that its spring loaded center is engaged in the centering hole for Pad "B" on the Master Gage.

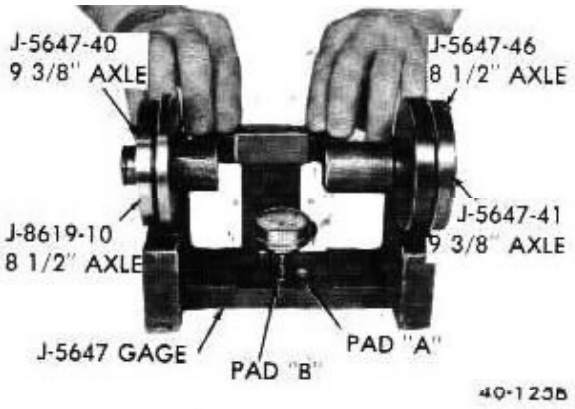


Figure 40-131 - Zeroing Pinion Setting Gage

6. Center the dial indicator contact button on the contact pad and lock the dial indicator by tightening the thumb screw.

7. Hold gage yoke down firmly, with large diameter portion of each disc contacting both the horizontal and vertical pads on master gage; set dial indicator at zero.

8. Be certain differential bearing support bores are free of dirt and burrs. Install indicator gage in carrier so that small diameter portion of discs rest in differential bearing pedestal support bores. Spring-loaded center of gage must be located in centering hole of gage plate, and ball-tipped contact button of dial indicator must be positioned to bear against outer edge of gage plate top surface. See Figure 40-132.

9. Press gage yoke down firmly toward gaging plate. Record the dial indicator reading. Remove indicator gage and recheck "zero setting" on master gage to make sure this setting was not disturbed by handling.

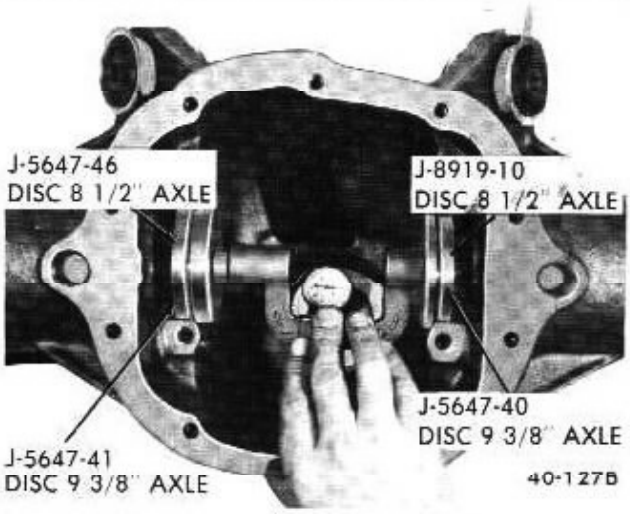


Figure 40-132 - Checking Pinion Depth

10. If zero setting is still correct, remove gaging set-up and both bearings from the carrier. Then subtract reading recorded in previous step from .100. For example, a typical reading of .070" should be subtracted from .100 this answer .030 indicates the thickness of the shims to be selected as further qualified in Step 12 following.

NOTE: *An average dial indicator reading will range from .060" to .070" with a corresponding shim thickness range of .040" to .030".*

11. Examine the ring gear for nicks, burrs or scoring. Any of these conditions will require replacement of the gear set.

12. Select the correct pinion shim to be used during pinion reassembly on the following basis:

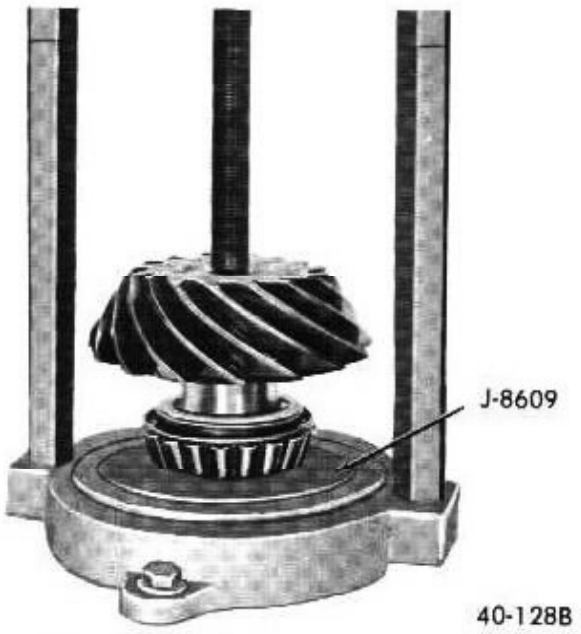


Figure 40-133 - Installing Rear Pinion Bearing

(a) If the production (marked) pinion is being reused and the pinion is marked (plus), subtract the amount specified on the pinion from the shim thickness as determined in step 10.

(b) If the production (marked) pinion is being reused and the pinion is marked (minus), add the amount specified on the pinion to the shim thickness as determined in Step 10.

(c) If a service pinion is being used (no marking), shim pinion using shim thickness directly as determined in Step 10.

NOTE: *Frequently production pinions are nominal or zero pinions (no marking). When reusing a nominal production pinion, shim as with service pinion using shim thickness directly as determined in Step 10.*

13. Position correct shim on pinion shaft and install rear pinion bearing. Use Installer J-8609 on 8 1/2 inch ring gear axles or Installer J-6377-01 on 9 3/8 inch ring gear axles. See Figure 40-133.

c. Install Pinion Assembly and Adjust Pinion Preload

1. Position pinion assembly in carrier and install collapsible spacer.

2. Place front pinion bearing in position on pinion. Hold pinion fully forward and drive bearing over pinion until seated. Use Installer J-22388.

3. Install pinion oil seal in carrier. Coat O.D. of seal with sealing compound. Install seal by using Installer J-22388. See Figure 40-134.

NOTE: *A correctly installed pinion seal should be .150" from flush with nose of carrier casting.*

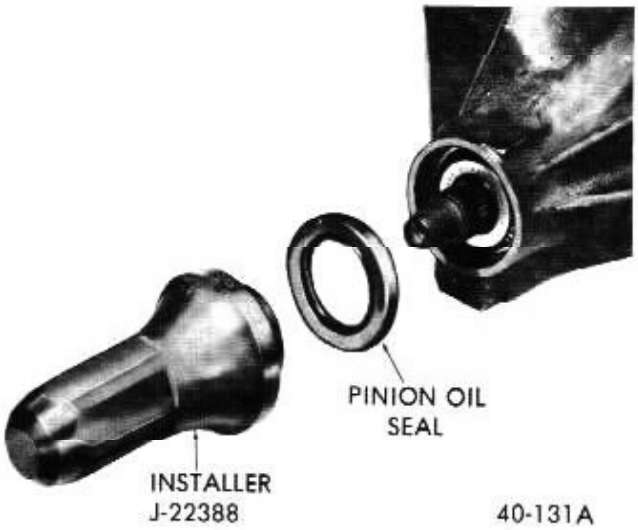


Figure 40-134 - Installing Pinion Oil Seal

4. Coat lips of pinion oil seal and seal surface of pinion flange with gear lube. Install pinion flange on pinion by tapping with a soft hammer until a few pinion threads project through flange.

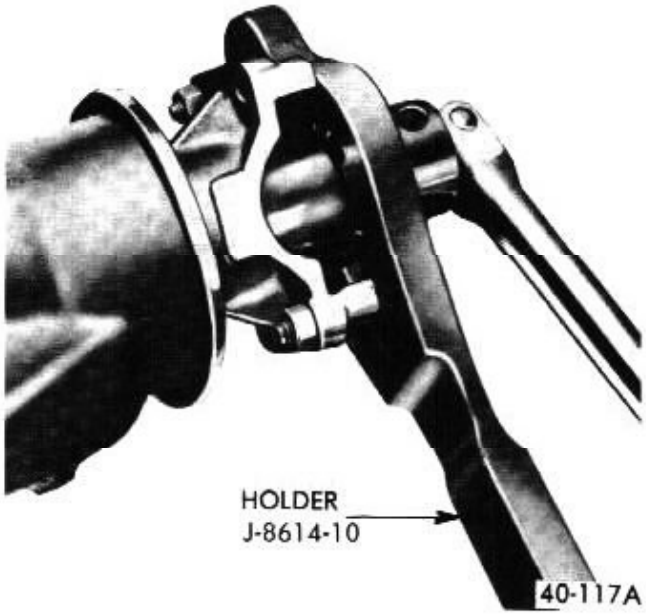


Figure 40-135 - Installing Pinion Nut

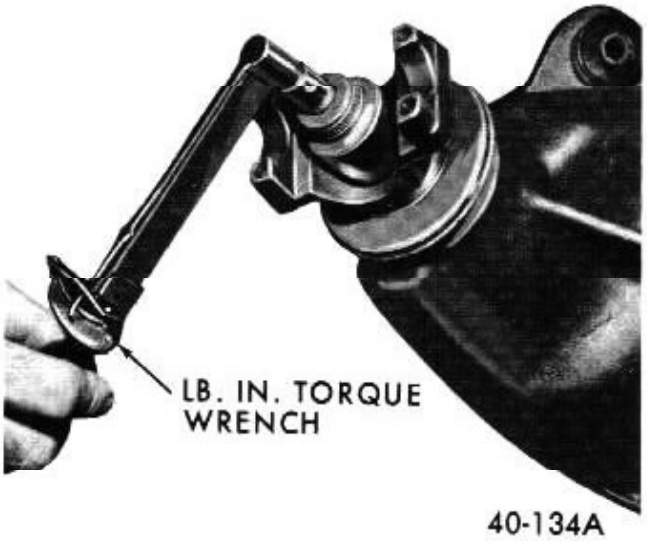


Figure 40-136 - Checking Pinion Preload

5. Install pinion washer and nut. Hold pinion flange with Holder J-8614. While intermittently rotating pinion to seat bearings, tighten pinion nut until end play begins to be taken up. See Figure 40-135.

NOTE: *When no further end play is detectable, and when Holder J-8614 will no longer pivot freely as pinion is rotated preload specifications are being neared. Further tightening should be done only after preload has been checked.*

6. Check preload by using a pound inch torque wrench as shown in Figure 40-136.

NOTE: *After preload has been checked, final tightening should be done very cautiously. For example, if when checking, preload was found to be 5 pound inches, additional tightening of the pinion nut as little as 1/8 turn can add 5 additional pound inches drag. Therefore, the pinion nut should be further tightened only a little at a time and preload should be checked after each slight amount of tightening. Exceeding preload specifications will compress the collapsible spacer too far and requires its replacement.*

7. While observing the preceding caution, carefully set preload drag at 20-25 lb. in. on new bearings or 10-15 lb. in. on reused bearings.

8. Rotate pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced by rotating pinion, re-set preload to specification.

d. Assemble Standard Differential Case Assembly

Before assembling the differential, examine the wearing surfaces of all parts for scoring or unusual wear. Also make certain that all parts are absolutely clean. Lubricate parts with rear axle lubricant just before assembly.

1. Place side gear thrust washers over side gear hubs and install side gears in case. If same parts are reused, replace in original sides.

2. Install the two pinion gears and washers, through the two big windows in the case, into mesh with the side gears making sure the pinion gear bores are 180 degrees apart.

3. Rotate the side and pinion gears as one assembly until the pinion gear bores are in alignment with the pinion shaft bores in the case.

4. Install pinion shaft and lock screw. Torque to 15 lb. ft.

5. After making certain that mating surfaces of case and ring gear are clean and free of burrs, thread two 7/16x20x2 (LH) studs into opposite sides of ring gear, then install ring gear on case. See Figure 40-137. Install ring gear attaching bolts just snug. Torque bolts alternately in progressive stages to 85 lb. ft.

6. If differential side bearings were removed, install new bearings using Installer J-22761 on 8 1/2 inch ring gear axles or Installer J-8606 on 9 3/8 inch ring gear axles with Driver Handle J-8092. See Figure 40-138.

e. Assemble Plate Type Positive Traction Differential Case Assembly

1. Inspect cross shaft, pinions, and side gears. Replace any parts which are excessively scored, pitted, or worn. Inspect clutch discs and plates for worn, cracked, or distorted condition. If any of these defects exist, new clutch packs must be installed.

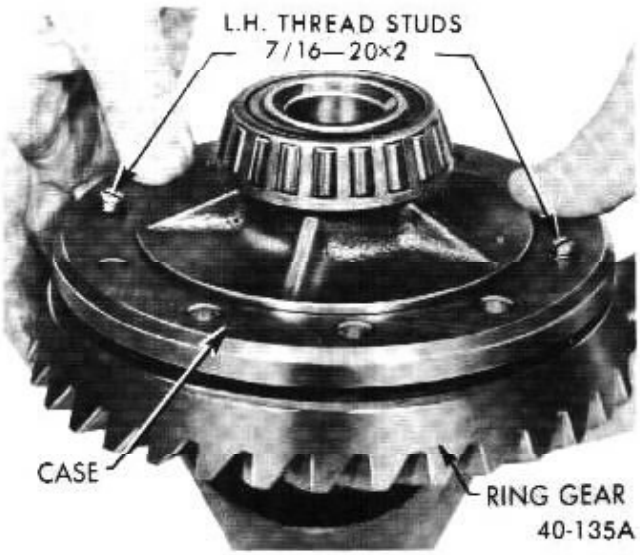


Figure 40-137 - Installing Ring Gear On Differential Case

Figure 40-138 - Installing Differential Side Bearings

2. Apply positive traction lubricant to the clutch plates.

NOTE: *Any other lubricant used may cause chatter.*

3. Assemble the clutch packs as follows. Alternately posi-

tion clutch plates on each side gear starting and ending with a clutch plate having external lugs. Assemble original spacer plate and shim to complete the stack.

4. On plate clutch type having rounded ear lugs, install ear guides over the lugs. The square ear lug type require no guides.

5. Install side gears and clutch pack assemblies into case on the same side from which they were removed. Install pinions, pinion thrust washers, and cross shaft.

6. Check the pinion to side gear backlash as follows: a. Compress one clutch pack by inserting screwdriver or wedge between the cross shaft and side gear. See Figure 40-139.

b. Mount dial indicator with contact button against tooth of pinion gear. Rotate pinion. Backlash should be .001″ to .006″.

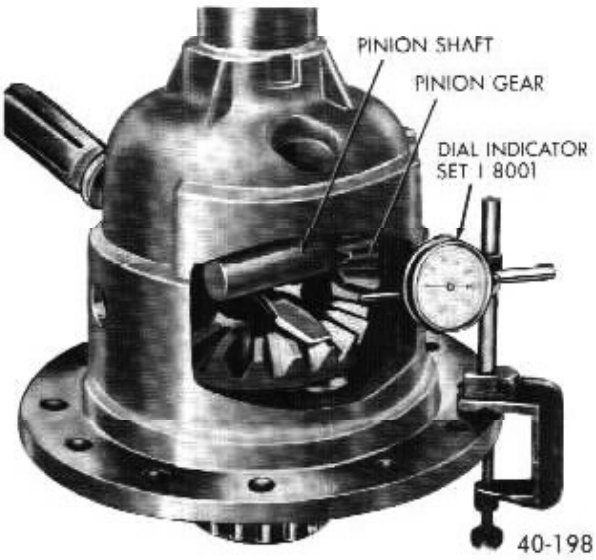


Figure 40-139 Checking Side Gear to Pinion Gear Backlash

c. If backlash is more than .006″, add shims between clutch pack and case. If backlash is less than .001″, remove shims. A .002″ shim will change backlash approximately .001″.

d. Repeat procedure with opposite side gear.

7. Remove cross shaft. Drive preload spring into position between the side gears. See Figure 40-140.

8. Assemble the cross shaft and lockscrew, torque to 15 lb. ft.

f. Install Differential Case and Adjust Side Bearing Preload

Differential side bearing preload is adjusted by changing the thickness of both the right and left shims by an equal

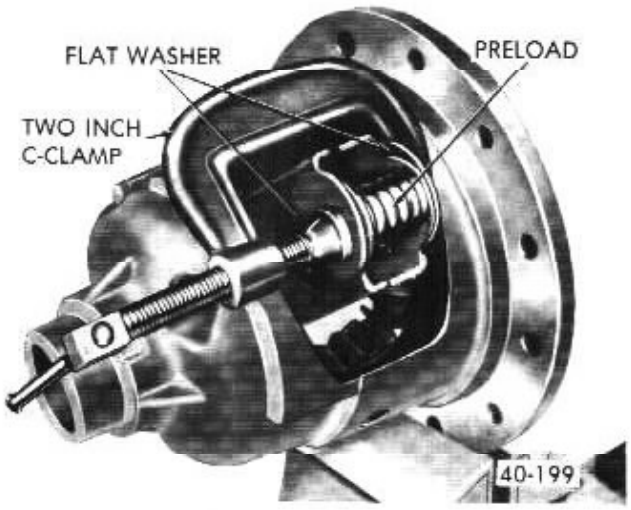


Figure 40-140 Compressing Preload Springs

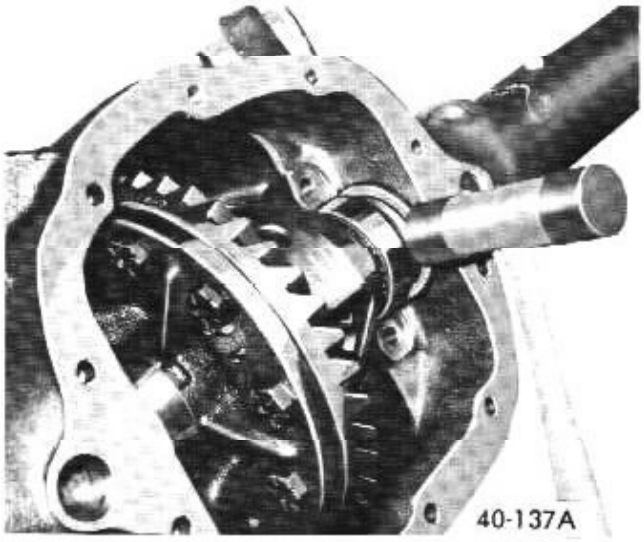


Figure 40-141 - Installing Differential Adjusting Shims

amount. 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, nominal thickness, cast shim. Stamped steel service shims must be used when differential repairs are made that require changing side bearing preload. Service, steel, adjusting shims are available in thicknesses ranging from .040" to .100" 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 and if same bearings are being reused, they must have original outer races in place.

2. Place differential case and bearing assembly in position in carrier. Use service type adjusting shim totaling same thickness as original production type adjusting shims if either new or reused bearings are to be used. Slip left shims

in position at left bearing with steel shim next to bearing, then place nominal thickness shim for right side in position and drive steel shim carefully into position between bearing and cast shim using a soft hammer. See Figure 40-141.

Install side bearing caps, as previously marked and tighten bolts to 55 lb. ft. before checking side bearing preload or backlash.

3. Rotate differential case assembly several complete turns to seat bearings. Check bearing preload using an inch pound torque wrench connected at pinion nut.

Bearing preload should read 35-40 lb. in. of rotating torque with new bearings or 20-25 lb. in. of rotating torque with reused bearings. See Figure 40-114. If preload is not according to these specifications, increase shim thickness on each side .002" for each additional 10 lb. in. preload desired, or decrease shim thickness .002" on each side for each 10 lb. in. preload to be subtracted.

g. Adjust Differential Backlash

1. Rotate differential case several times to seat bearings, then mount dial indicator as shown in Figure 40-142. 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.

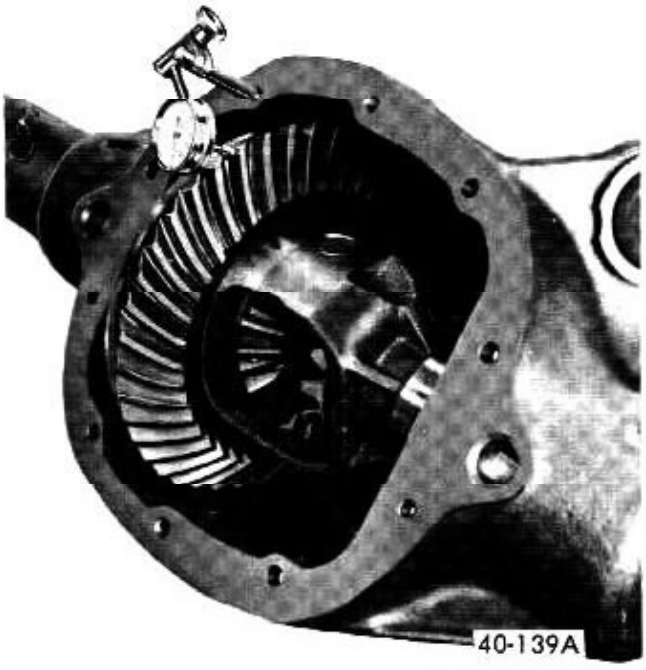


Figure 40-142 - Checking Ring Gear to Pinion Backlash

2. With pinion locked to carrier, check gear lash at 3 or 4 points around ring gear. Lash must not vary over .001" around ring gear. If variation is over .001" check for burrs, uneven bolting conditions or distorted case flange and make corrections as necessary.

3. Gear lash at the point of minimum lash should be .006" to .008" for all new gears. If adjustment is necessary, adjust to .007".

If original gear set having a wear pattern is being reinstalled, original gear lash should be maintained with in plus or minus .001".

4. If gear backlash is not within specifications, correct by increasing thickness of one differential shim and decreasing thickness of other shim the same amount. In this way, correct differential bearing preload will be maintained.

Shift .002" in shim thickness for each .001" change in backlash desired. If backlash is .002" too much, decrease thickness of right shim .004" and increase thickness of left shim .004". If backlash is .002" too little, increase thickness of right shim .004" and decrease thickness of left shim .004".

5. Install new cover gasket and cover torquing bolts to 30 lb. ft.

After waiting 20 minutes retorque bolts to 30 lb. ft.

h. Install Axle Shaft Assemblies

1. Apply a coat of wheel bearing grease in bearing recesses of housing. Insert axle shaft assemblies carefully until shaft splines engage in differential to avoid damage to seals.

2. Drive axle shaft assemblies into position.

NOTE: *Fasteners in steps 3 and 5 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. These must be replaced with one of the same part number of with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these part.*

3. Place retainer over studs and install nuts. Tighten to specified torque.

4. Install brake drums over wheel bolts.

5. Install wheels and tighten wheel nuts to specified torque.

6. Install lubricant. See Specifications Chart for correct quantity and type.

i. Install Pinion Oil Seal with Differential Installed in Car

In case of pinion oil seal failure, remove old oil seal and install new one (with differential remaining in car) as follows:

1. Mark propeller shaft and companion flange to permit

proper alignment at reinstallation. Disconnect propeller shaft from companion flange and support shaft out of way. If U joint bearings are not held by a retainer strap, use a piece of wire or tape to retain bearings in their journals.

2. Remove wheels and brake drums. Install an inch pound torque wrench on pinion nut, and record torque required to rotate pinion freely.

3. Mark position of companion flange, pinion shaft, and pinion nut so that they can be reinstalled in the same position.

4. Remove companion flange nut and washer using Holder J-6814-01 to hold flange.

5. Pry oil seal out of carrier.

6. Examine oil seal surface of companion flange for grooves, nicks or damaged surface. If damaged, replace flange.

7. Examine carrier bore and remove any burrs that might cause leaks around O.D. of seal.

8. Apply thin coating of No. 2 Permatex or equivalent on O.D. of new pinion oil seal and install seal using Installer J-22388.

NOTE: *A correctly installed pinion seal should be .150" from flush with nose of carrier casting.*

9. Apply seal lubricant to O.D. of companion flange.

10. Install companion flange, with Holder J-8614-01 attached, onto pinion noting that the splines are mated as when removed.

11. Remove holding Tool J-8614.

12. Check pinion preload using a pound inch torque wrench; the torque reading should be equal to or five pound inches above that recorded in Step 2 above.

13. Connect propeller shaft to companion flange using alignment marks. Torque the four (4) bolts to 15 lb. ft. on the single joint connection, and 75 lb. ft. on the CV joint connection.

DIVISION VI

SPECIFICATIONS

40-50 DIFFERENTIAL SPECIFICATIONS

DIFFERENTIAL SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed, to insure proper tightening without staining or distorting parts. These specifications are for clean and lightly-lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Torque
Bolt	Rear Universal Joint to Pinion Flange 43-44000 and Estate Wagon — 5/16 — 24	15 lb. ft.
Bolt	Rear Universal Joint to Pinion Flange — 45-46-48-49000 — 7/16 — 14	85 lb. ft.
Bolt	Rear Axle Housing Cover to Carrier — 5/16 — 18	30 lb. ft.
Nut	Brake Assembly to Rear Axle Housing — 43-44000 — 3/8 — 24	35 lb. ft.
Nut	Brake Assembly to Rear Axle Housing — 45-46-48-49000 — 7/16 — 14	55 lb. ft.
Bolt	Ring Gear to Differential Case — 7/16 — 20	85 lb. ft.
Bolt	Bearing Cap to Carrier — 7/16 — 14	60 lb. ft.
Nut	Rear Wheel to Axle Shaft — 43-44000 — 7/16 — 20	70 lb. ft.
Nut	Rear Wheel to Axle Shaft — 45-46-48-49000 — 1/2 — 20	75 lb. ft.
*Nut	Upper and Lower Control Arm — 43-44000 — 1/2 — 13	80 lb. ft.
*Bolt	Upper and Lower Control Arm — 43-44000 — 1/2 — 13	110 lb. ft.
*Nut	Upper Control Arm at Frame — 45-46-48-49000 — 9/16 — 12	115 lb. ft.
*Bolt	Upper Control Arm at Frame — 45-46-48-49000 — 9/16 — 12	140 lb. ft.
*Nut	Upper Control Arm at Axle — 45-46-48-49000 — 1/2 — 13	80 lb. ft.
*Bolt	Upper Control Arm at Axle — 45-46-48-49000 — 1/2 — 13	115 lb. ft.
*Nut	Lower Control Arm — 45-46-48-49000 — 9/16 — 12	115 lb. ft.
*Bolt	Lower Control Arm — 45-46-48-49000 — 9/16 — 12	115 lb. ft.
Nut	Lower End of Shock Absorber to Lower Control Arm Axle Bracket — 1/2 — 20	65 lb. ft.
Nut	Pinion Nose Bumper — 45-46-48-49000 (Less Estate Wagon) — —	90 lb. in.
Nut	Leaf Spring Rear Shackle — Estate Wagon — 9/16 — 12	115 lb. ft.
Nuts	Bottom Leaf Spring Plate — Estate Wagon — 7/16 — 20	40 lb. ft.
Screw	Pinion Nose Bumper Bracket to Carrier — Estate Wagon — 5/16 — 12	72 lb. in.
Nut	Pinion Nose Bumper to Bracket — —	20 lb. ft.
Screws	Rear Exhaust Hanger to Frame — Estate Wagon — —	72 lb. in.

*Torquing of nut or bolt to be optional.

b. General Specifications

Rear Axle Type	Semi-Floating Hypoid
Drive and Torque — (Except Estate Wagon)	Through 4 Arms
Drive and Torque — Estate Wagon	Leaf Spring
Rear Axle Oil Capacity — 46-48-49000	5.4 Pints
Rear Axle Oil Capacity — 43-44-45000	4.25 Pints
Ring and Pinion Gear Set Type	Hypoid
Differential Lubricant (Standard Axle)	SAE 90 GL-5
Differential Lubricant (Positive Traction Axle)	Special Lubricant//1051022 or Equivalent

c. Limits for Fitting and Adjusting

Pinion Bearings 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 Preload (Measured at Pinion Flange Nut)	
New Bearings	35-40 lb. in. rotating torque with new seal, with ring gear
Reused Bearings	20-25 lb. in. rotating torque with new seal, with ring gear
Ring Gear Position	.006" — .008" Backlash

40D-4

d. Differential Gear Ratios

Rear axle ratio, differential type, manufacturer, and build date information is stamped on the right rear axle tube on the forward side. Refer to Figures 40-143 and 40-144. Any reports made on rear axle assemblies must include the full code letters and build date numbers.

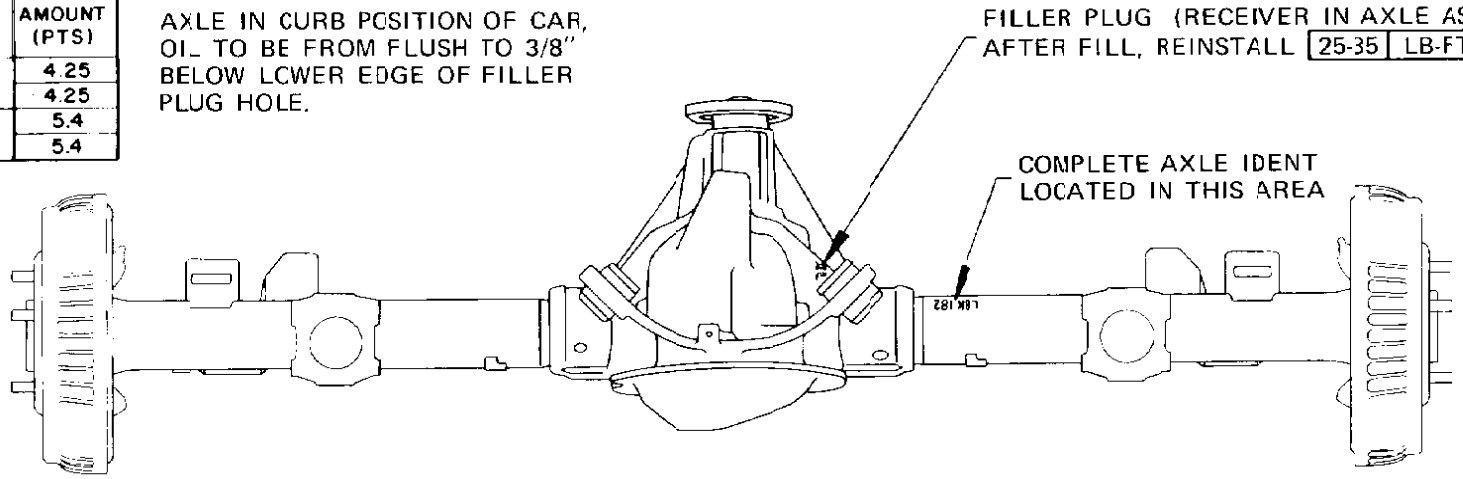
e. Speedometer Gears

Speedometer gears must correspond with axle ratios and tire sizes in order to have correct speedometer and odometer readings.

AXLE CIL FILL

SERIES	AMOUNT (PTS)
43-44-45	4.25
	4.25
45-48-49	5.4
	5.4

AXLE IN CURB POSITION OF CAR, OIL TO BE FROM FLUSH TO 3/8" BELOW LOWER EDGE OF FILLER PLUG HOLE.



MODELS	ENG INE	TRANSMISS ON	AXLE ASSEMBLY RATIO USAGE								
			STANDARD			ECONOMY			PEFFORMANCE		
			RATIO	REGULAR CODE	LIMITED SLIP CODE	RATIO	(G95) REGULAR CODE	(G96) LIMITED SLIP CODE	RATIO	(G92) REG CODE	(G91) LTD. SLIP CODE
43327 43337 43369	250 L-6	3-SPEED MANUAL	3.08	LAB	LSB						
		THM-350	3.08	LAB	LSB				3.42	LHB	LWB
43327 43337 43369 44437 44439 44469 44467	350	3-SPEED MANUAL	3.08	LAB	LSB						
		2 BBL THM 350	2.56	LKB	LTB				3.08	LAB	LSB
		4 BBL THM 350	2.73	LLB	LOB	2.56	LKB	LTB			
43437-67	350	3 & 4 SPEED MANUAL –THM 350	3.08	LAB	LSB				3.42	LHB	LWB
43436	350	3-SPEED MANUAL –THM 350	3.08	LAB	LSB	2.73	LLB	LOB	3.42	LHB	LWB
43437-67	455	4-SPEED MANUAL	3.42	LHB	LWB				3.42	LHB	LWB
		THM-400	3.08	LAB	LSB						
	455 GSX	4-SP MAN & THM 400	3.42		LWB						
	455	4 SPEED MANUAL –THM-400	3.42		LWB						

40-250

Figure 40-43 43-44000 Differential Identification

MODELS	ENGINE	TRANSMISSION	AXLE ASSEMBLY RATIO USAGE								
			STANDARD			ECONOMY			PERFORMANCE		
			RATIO	REGULAR CODE	LIMITED SLIP CODE	RATIO	(G95) REGULAR CODE	G96) LIMITED SLIP CODE	RATIO	(G92) REGULAR CODE	(G91) LIMITED SLIP CODE
LE SABRE	350	1 THM-350	3.08	NAB	NPB	2.73	NKB	NTB	3.42	NHB	NSB
				NAO			NKO			NHO	NSO
				NAC	NPC		NKC	NTC			
				NAK	NPK		NKK	NTK			
		3-SPEED MAN	3.42	NHB	NSB					NHB	NSB
LE SABRE	455	THM-400	2.93	QIO	QJO				3.42	QTO	QAO
ESTATE WAGON	455	THM-400	2.93	QEO	QLO				3.42	QHO	QMO
		3-SPEED MAN	3.42	QHO	QMO						
CENTURION	455	THM-400	2.93	QIO	QJO				3.42	QTO	QAO
		3-SPEED MAN	3.42	QTO	QAO						
ELECTRA	455	THM-400	2.73	QPO	QSO				2.93	QIO	QJO
RIVIERA	455	THM-400	2.93	QIO	QJO				3.42	QTO	QAO
RIVIERA GS			3.42		QAO						

LAST LETTER OF CODE DESIGNATES MANUFACTURER

B – BUICK
O – OLDSMOBILE
C – CHEVROLET
K – GM CANADA

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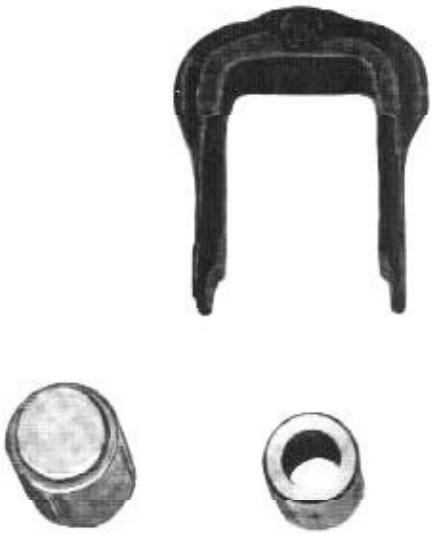
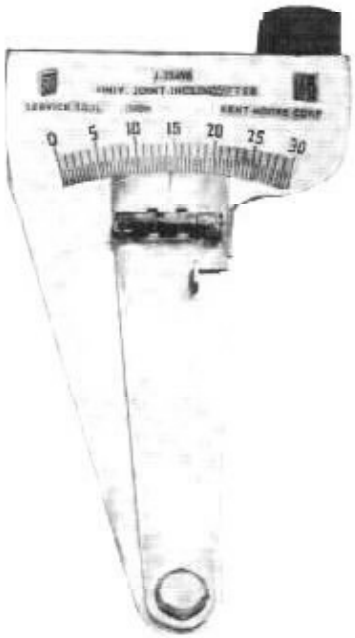
Figure 40-144 45-46-48-49000 Differential Identification

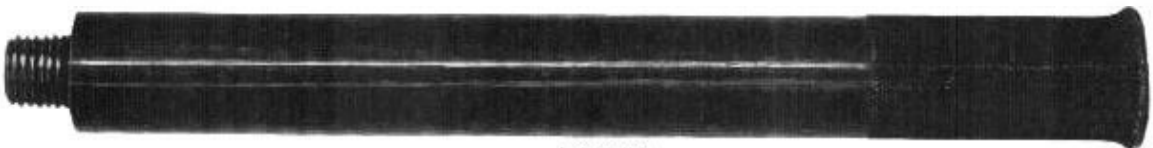


J-9522



J-23498

J-9113



J-8092

J-9522 - PROPELLER SHAFT SERVICE TOOL SET
J-8092 - DRIVE HANDLE
J-9113 - 1/2" TORQUE WRENCH ADAPTER
J-23498 - INCLINOMETER

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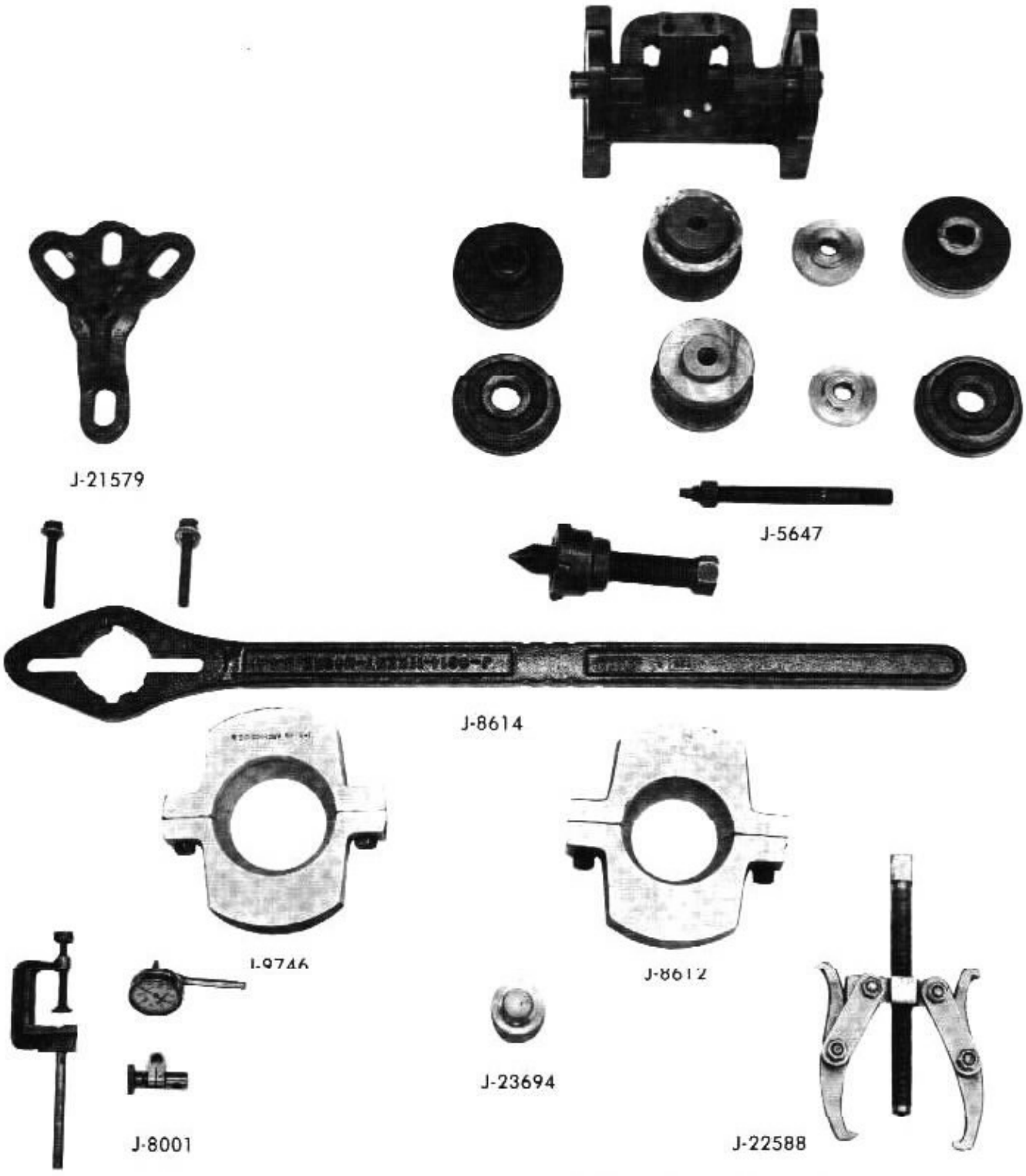
Figure 40-145 Special Tools - Propeller Shaft

J-2241 - DIFFERENTIAL SIDE BEARING PLUG
J-2619 - SLIDE HAMMER ASSEMBLY
J-6197 - FRONT PINION BEARING CUP INSTALLER
J-6377 - PINION BEARING INSTALLER PRESS PLATE
J-7817 - FRONT PINION BEARING OUTER RACE INSTALLER
J-8853 - AXLE BEARING AND BEARING RETAINER REPLACER
J-9739 - AXLE SHAFT BEARING AND LOCK RING INSTALLER
J-9740 - AXLE SHAFT OIL SEAL INSTALLER
J-9745 - REAR PINION BEARING CUP INSTALLER
J-21005 - PINION OIL SEAL INSTALLER
J-21022 - AXLE SHAFT BEARING INSTALLER
J-21128 - PINION OIL SEAL INSTALLER
J-21129 - AXLE SHAFT OIL SEAL INSTALLER
J-22761 - DIFFERENTIAL SIDE BEARING INSTALLER
J-22771 - DIFFERENTIAL SIDE BEARING INSTALLER
J-22813 - AXLE SHAFT BEARING AND SEAL REMOVER
J-23133 - AXLE SHAFT BEARING REMOVER
J-23690 - AXLE SHAFT BEARING INSTALLER

40-253

Figure 40-146 Special Tools - Differential



J-5647 - PINION SETTING GAUGE
J-8001 - DIAL INDICATOR
J-8612 - REAR PINION BEARING REMOVER
J-8614 - COMPANION FLANGE HOLDER AND REMOVER
J-9746 - REAR PINION BEARING REMOVER
J-21579 - AXLE SHAFT REMOVER
J-22588 - DIFFERENTIAL SIDE BEARING PULLER
J-23694 - BALL STUD SEAL INSTALLER
J-21322 - (NOT PICTURED) RING GEAR AND CASE REMOVER

40-254

Figure 40-147 Special Tools - Differential

SECTION C

PROPELLER SHAFT
ALL SERIES

CONTENTS

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DIVISION I

TROUBLE DIAGNOSIS

40-25 PROPELLER SHAFT TROUBLE DIAGNOSIS

a. Body Boom Noise or Vibration

Objectional "body boom" noise or vibration at 55-65 MPH can be caused by an unbalanced propeller shaft. Excessive looseness at the spline can contribute to this unbalance.

Other items that may also contribute to the noise problem are as follows:

1. Undercoating or mud on the shaft causing unbalance.

2. Shaft balance weights missing.

3. Shaft damage such as bending, dents or nicks.

4. Tire-type roughness. Switch tires from a known good car to determine tire fault.

b. Check for Propeller Shaft Vibration

Objectionable 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 transmission gear ratio in which the vibration occurs.

EXAMPLE: *With the THM 400 in low range, divide by 1.50. If vibration is most pronounced in direct drive at 65 MPH, the same engine speed would be produced in low range (THM 400) at 65/1.50 ..... 43 MPH*

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. See paragraph 40-29 for propeller shaft balance.

DIVISION I
TROUBLE DIAGNOSIS AND TESTING

COMPLAINT	POSSIBLE CAUSE	CORRECTION
Leak at front slip yoke. **NOTE: An occasional drop of lubricant leaking from splined yoke is normal and requires no attention.**	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. c. Bring transmission oil up to proper level after correction.
Knock in drive line clunking noise when car is operated under floating condition at 10 mph in high gear or neutral.	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.	a. Loose upper or lower control arm bushing bolts.	a. Tighten bolts to specified torque.
Usually occurs on initial load application after transmission has been put into gear, either forward or reverse.	b. Loose companion flange.	b. Remove companion flange, turn 180° from its original position.

COMPLAINT	POSSIBLE CAUSE	CORRECTION
Roughness, Vibration, or Body Boom at any speed.	a. Bent or dented drive shaft.	a. Replace.
	b. Undercoating on drive shaft.	b. Clean drive shaft.
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.	c. Tire unbalance. (30-80 mph, not throttle conscious)	c. Balance or replace as required.
	d. Excessive U-bolt torque.	d. Check and correct to specified torque.
	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.
Vibration occurs at the same engine speed (rpm), regardless of transmission gear range selected, drive shaft assembly is **not** at fault, since the shaft speed varies.	g. Burrs or gouges on companion flange. Check snap ring surfaces on end yoke.	g. Rework or replace companion flange.
If vibration decreased, or is eliminated, in a different gear range but at the same engine speed (rpm), check the possible causes:	h. Drive shaft or companion flange unbalance.	h. Check for missing balance weights on drive shaft. Remove and reassemble drive shaft to companion flange, 180° from original position. Rebalance shaft in car using (2) hose clamp method.
	i. Incorrect rear joint angle. The angle is usually too large when it is a factor.	i. Check and correct trim height at curb weight. Measure joint angle with inclinometer method.
	j. Replace necessary parts.	j. Excessive looseness at slip yoke spline.
	k. Check propeller shaft runout at front and rear. Should be less than specified. If above, rotate shaft 180° and recheck. If still above specified, replace shaft.	k. Drive shaft runout (50-80 mph throttle conscious)
Roughness usually at low speeds, light load, 15-35 MPH.	Improper joint angles. Usually rear joint angle is too large.	Check rear trim height at curb weight Check rear joint angle using inclinometer method.
	U bolt clamp nuts excessively tight.	Check and correct torque to that specified. If torque on trunnions was excessive or if brinnelled pattern is evident, replace joint.
Scraping noise.	Slinger, companion flange, or end yoke rubbing on rear axle carrier.	Straighten slinger to remove interfernece.
Roughness on heavy acceleration (short duration).	Double cardan joint ball seats worn. Ball seat spring may be broken.	Replace with ball seat repair kit. If centering ball is badly worn, the yoke or shaft must be replaced.
Roughness usually at low speeds, light load, 15-35 MPH.	Improperly adjusted front joint angle.	Check and adjust front joint angle by shimming transmission support.
Roughness—above 35 MPH felt and/or heard.	Tires unbalanced or worn.	Balance or replace as required.
Whine or whistle.	Center support bearing (if one is present).	Place car on hoist with rear wheels free to rotate and diagnose for source of noise. Replace center support bearing if found to be noisy.
Squeak.	Lack of lubricant or worn double cardan joint ball or ball seat.	To lubricate the centering ball and seat it is necessary to tear down the joint at one end of the coupling yoke. If this much work is required it is best to replace the ball seat with a complete repair kit. If failure is far advanced it may be necessary to replace the entire drive shaft.
Shudder on acceleration, low speed.	Loose or missing bolts at center bearing support to frame cross member. Incorrectly set front joint angle.	Replace or tighten bolts to specified torque. Shim under transmission support mount to decrease front joint angle.
	Incorrect plan view joint angle.	Use alignment gage cable and weighted strings from engine pulleys and drive shaft to align shaft in plan view.

DIVISION II

DESCRIPTION AND OPERATION

40-26 DESCRIPTION OF PROPELLER SHAFT

Power is transmitted from the transmission output shaft to the differential by either one of two type propeller shaft assemblies: One type used on the 43- 44000 and Estate Wagons is a one-piece shaft with two cardan universal joints. The other type used on 45- 46-48 and 49000 (less Estate Wagons) also has a one- piece propeller shaft but has a cardan universal joint in the front and a double cardan universal joint at the rear. See Figure 40-49.

The propeller shaft used on 43-44000 and Estate Wagons is made up of concentric steel tubes with rubber elements between. See Figure 40-49.

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 slip yoke permits fore and aft movement of the drive shaft, as the differential assembly moves up and down. The spline is lubricated internally by transmission lubricant or grease. An oil seal at the transmission prevents leakage and protects the slip yoke from dust, dirt, and other harmful material. On cars with automatic transmissions, the slip yoke spline is lubricated with grease and provided with a small vent hole to prevent "blowing" the o-ring seal during installation. These slip yokes should be inspected to be sure the vent hole is clear. See Figure 40-50.

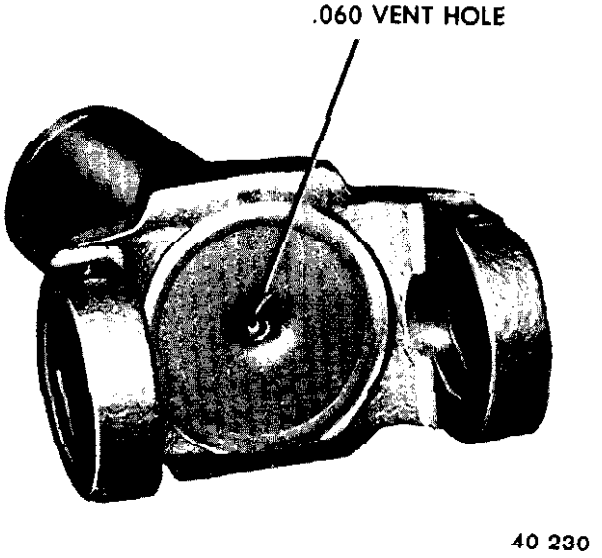


Figure 40-50 - Slip Yoke With Vent Hole

A second universal joint attached by two straps is used where the drive shaft mates with the companion flange at the rear.

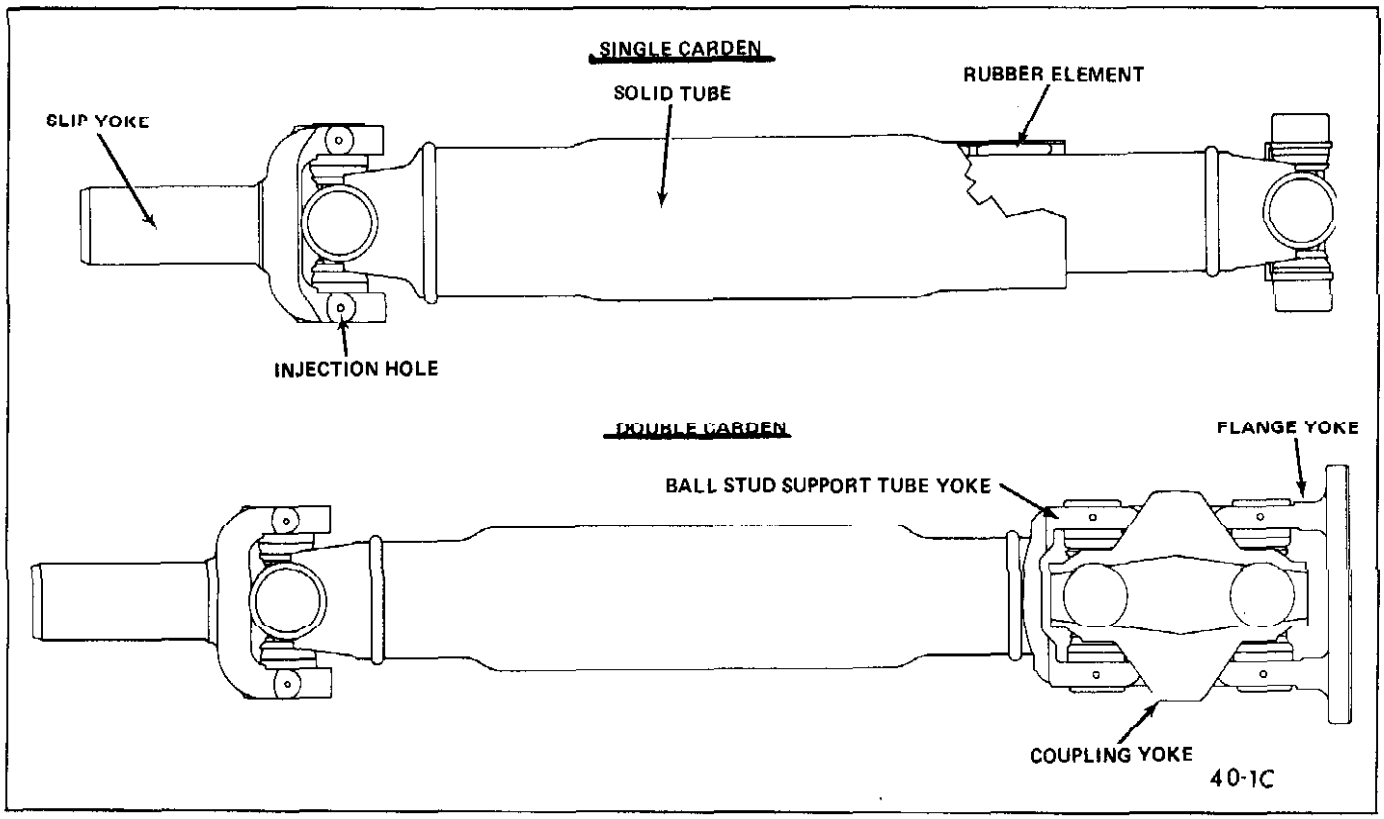


Figure 40-49 - Propeller Shaft Assemblies

The propeller shaft used on 45-46-48 and 49000 is similar to the type used on 43-44000 and Estate Wagons, except for the double cardan universal joint at the rear.

This joint consists of two cardan joints, closely coupled with a link yoke.

A centering ball socket between the joints maintains the relative position of the two units. This centering device causes each of the two units to operate through one-half of the complete angle between the drive shaft and differential carrier.

This drive shaft is attached to the differential carrier by means of a double flange connection. A flange on the rear universal joint is attached to a flange on the differential carrier pinion by four screws and bolts.

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 which consists of a spider with bearing assemblies and snap rings must be installed on the car if a universal joint becomes worn or noisy. If it becomes necessary to repair a universal joint, the entire propeller shaft must be removed from the car. Care should be taken to avoid jamming, bending, or over-angulating of any parts of the assembly.

If a car is to be undercoated, the propeller shaft must be kept completely free of undercoating material. Undercoating material or any other foreign material will upset the propeller shaft balance and produce serious vibration.

Production universal joint bearing caps are now retained by a nylon injection ring instead of the conventional snap ring. Service universal joints however, will still use snap rings.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

40-27 CHECKING REAR UNIVERSAL JOINT ANGLE

When torque is transmitted through any ordinary universal joint, the driven yoke fluctuates slightly in speed. In other words, although the driving yoke rotates at a constant speed, the driven yoke speeds up and slows down twice per revolution. This fluctuation of the driven yoke is in direct proportion to the angle through which the universal joint is operating; the greater the angle, the greater the fluctuation.

Whenever two universal joints are used, this fluctuation effect can be eliminated by staggering the joints so that the two driving yokes are 90 degrees apart provided the two joints are transmitting torque through the same angle.

Therefore, when two universal joints are used, the angles through which they operate must be very nearly the same. This allows the alternate acceleration and deceleration of one joint to be offset by the alternate deceleration and acceleration of the second joint. When the two joints do not run at approximately the same angle, operation is rough and an objectionable vibration is produced.

The actual optimum angles desired must also consider the effects of various passenger loadings and rear axle windup during acceleration so that it is unlikely that the front and rear joints will be found to be the same in actual practice.

In addition, universal joints are designed to operate safely and efficiently within certain angles. If the designed angle is exceeded, the joint may be broken or otherwise damaged.

The front universal joint angle is actually the angle between the engine-transmission centerline and the propeller shaft. This angle is determined by the design of the frame assembly and may be altered by adding or removing shims between the transmission rear bearing retainer and the transmission mount.

Because sensitivity to pinion angle adjustment has been reduced, non-adjustable rear upper control arms are installed at the best pinion angle during factory installation.

All complaints of propeller vibration should be accompanied by rear trim height measurements at curb weight. An incorrect trim height may cause some vibration. If vibration is severe enough, removal or installation of spring shims may be required. If any irregular roughness or vibration is detectable in the drive line, the rear universal joint angle should be checked. Also, if a car is involved in a severe rear end collision, or if the rear axle housing is replaced, the rear universal joint angle should be checked and arms replaced if necessary.

INCLINOMETER METHOD

This method can be used with the car over a pit or on a drive-on hoist as long as the car is at curb weight with a full tank of gasoline.

NOTE: *Jounce car up and down to assure curb height.*

Readings should be taken at the following locations in the following manner.

a. Angle at Rear Universal Joint - Single Cardan Type

1. Place inclinometer on rear propeller shaft bearing cap. See Figure 40-51. Center bubble in sight glass and record measurement.

CAUTION: *Bearing cap must be straight up and down and free of dirt or other foreign material to obtain an accurate measurement.*

2. Rotate propeller shaft 90 degrees and place inclinome-

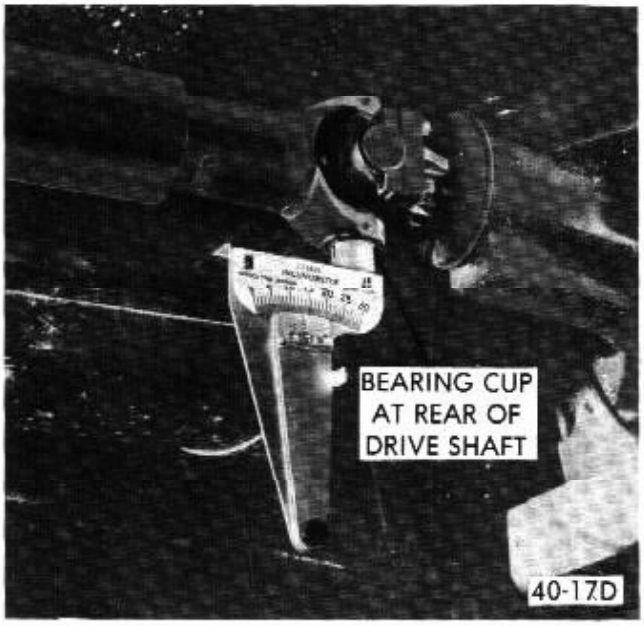


Figure 40-51 Measuring Angle at Rear of Propeller Shaft

Figure 40-52 Measuring Angle at Rear of Propeller Shaft

ter on rear drive yoke bearing cap. See Figure 40-52. Center bubble in sight glass and record measurement.

Universal joint needle rollers are held in place by a round bearing cup. There is a groove in the O.D. of this round bearing cup which mates with another groove in the I.D. of the yoke bearing bore. Once the grooves are aligned by seating the bearing cups against the ends of the cross, a plastic ring is injected between them, through a hole in the yoke. This retains the bearing cup in the yoke.

3. Add both figures to obtain existing rear joint angle.

b. Angle at Front Universal Joint - Single Cardan Type

1. Place inclinometer on front propeller shaft bearing cap. See Figure 40-54. Center bubble in sight and record measurement.

2. Rotate propeller shaft 90 degrees and place inclinometer on front slip spline yoke bearing car. See Figure 40-55. Center bubble on sight glass and record measurement.

3. Subtract smaller figure from larger figure to obtain existing front universal joint angle.

c. Angle at Rear Universal Joint - Double Cardan Joint

1. Place inclinometer on rear drive shaft bearing cup. See Figure 40-55A. Center bubble in sight glass and record angle.

UNIVERSAL JOINT ANGLES

	FRONT	REAR
43-44000 Coupes	$2\frac{3}{4}°$	$1\frac{3}{4}°$
43-44000 Sedans	$2\frac{3}{4}°$	$1\frac{3}{4}°$
Sportwagon	$1\frac{1}{2}°$	$2\frac{3}{4}°$
G.S.	$3\frac{1}{2}°$	$1\frac{1}{2}°$
LeSabre and Centurion	0°	$10\frac{1}{4}°$
Electra	0°	10°
Riviera	$\frac{1}{4}°$	10°
Estate Wagon	$\frac{1}{4}°$	$2\frac{3}{4}°$

*THE ABOVE ANGLES MAY BE ±1/2°

40-232 B

Figure 40-53 Universal Joint Angles

Figure 40-54 Measuring Angle at Front or Propeller Shaft

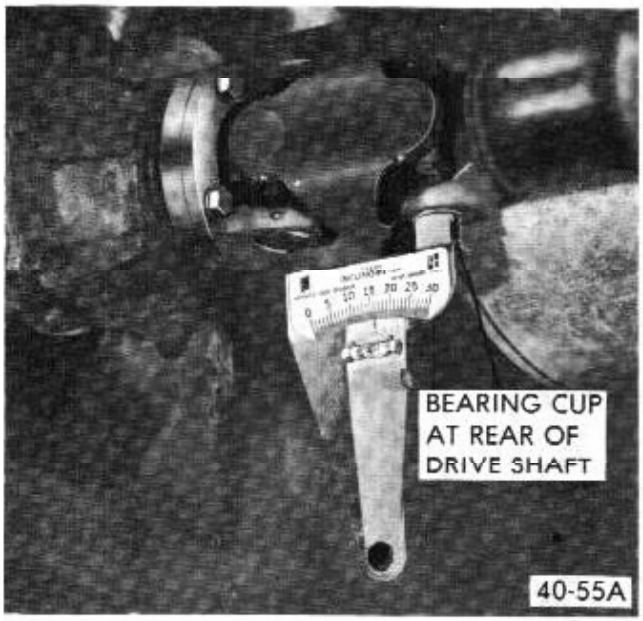


Figure 40-55A - Measuring Angle at Rear of Propeller Shaft

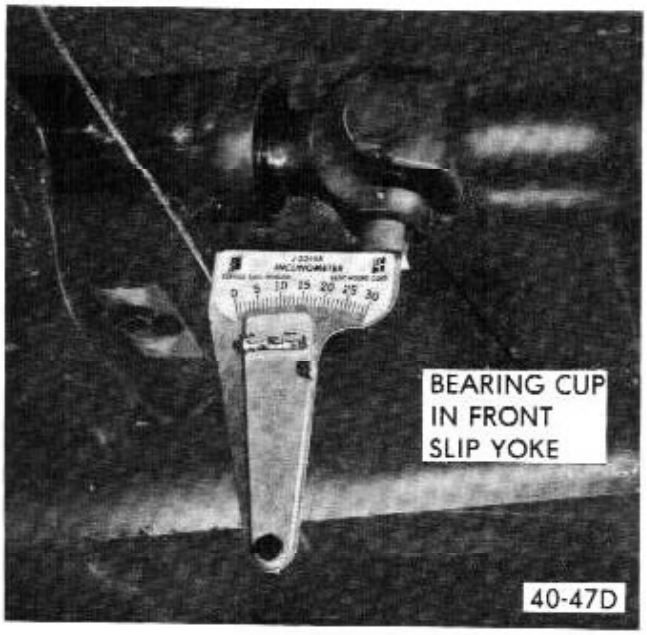


Figure 40-55 Measuring Angle at Front of Propeller Shaft

Figure 40-55B - Measuring Angle at Rear of Propeller Shaft

2. Place inclinometer on rear flange yoke bearing cup. See Figure 40-55B. Center bubble in sight glass and record angle.

3. Add both figures to obtain rear joint angle.

NOTE: *When measuring the angle of any double cardan joint, the inclinometer measurements are made on the faces of the bearing cups joining the two shafts or shaft and flange yoke to the two crosses. Do not measure on the bearing cups on the coupling yoke. Rotate the drive shaft so that the bearing cups to be measured are in the straight up and down position. Measurements must be made on the clean metal face of the bearing cup ends.*

40-28 CHECKING PROPELLER SHAFT RUN-OUT

If there is noise or vibration at high speed which might be caused by a bent shaft or if shaft has been damaged through rough handling or a collision, it may be checked for straightness as follows:

1. Raise car on a twin post hoist so that rear of car is supported on rear axle housing with wheels free to rotate.

2. Mount a dial indicator on a movable support that is high enough to permit contact of indicator contact button

with propeller shaft. Readings are to be taken at points indicated in Figure 40-75.

3. With transmission in neutral, check for run- out by having a second person turn rear wheel so that propeller shaft will rotate. At points "A" and "B" run-out should not exceed .010". At point "C" run- out should not exceed .015". Care must be taken not to include indicator variation caused by ridges, flat spots or other variations of the tube.

4. If run-out exceeds specifications because the propeller shaft is bent, it is probably more economical to replace propeller shaft than to attempt straightening it. However, if run-out is within specifications and noise or vibration problem exists, see paragraph 40-29 for propeller shaft corrective balancing procedure.

40-29 PROPELLER SHAFT BALANCING PROCEDURE

1. Place the car on a twin post hoist so that the rear of the car is supported on the rear axle housing and the rear wheels are free to rotate. Remove both rear tire and wheel assemblies and reinstall wheel lug nuts with flat side next to drum.

2. Mark and number propeller shaft at four (4) points 90 degrees apart at rear of shaft just forward of balance weight.

3. Install two (2) Wittek type hose clamps on the rear propeller shaft and slide them rearward until the clamps stop at the nearest balance weight welded to the tube. Align both clamps to any one of the four marks made on shaft in Step 2. Tighten the clamps. See Figure 40-56.

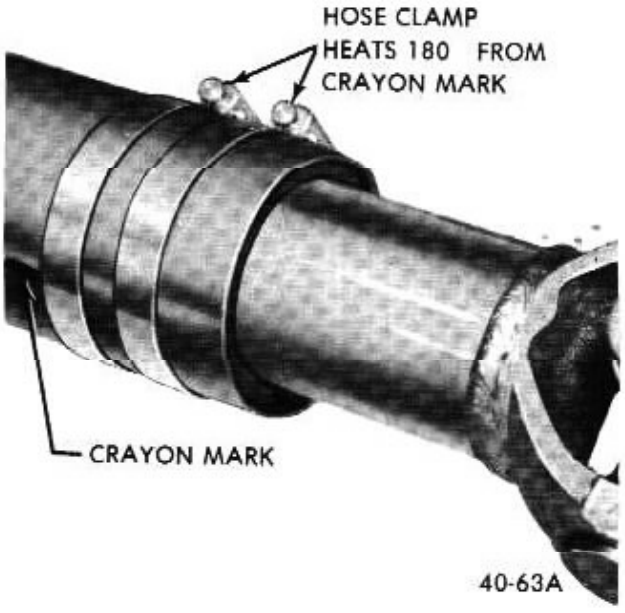


Figure 40-56 - Balance Hose Clamps in Place

CAUTION: *Be sure sufficient clearance is maintained so that clamp heads do not contact floor pan of car when axle is in contact with rebound bumper in frame. In order to gain sufficient clearance, it may be necessary to position the clamps over the balance weights.*

4. Run the car through the speed range to 65-70 MPH. Note amount of unbalance.

5. Loosen clamps and rotate clamp heads 90 degrees to the next mark on shaft. Tighten clamps and repeat Step 4.

6. Repeat Step 5 until car has been run with clamp heads located at all four marks on shaft.

7. Position clamps at point of minimum unbalance. Rotate the clamp heads away from each other 45 degrees. (One each way from the point of minimum unbalance) Run the car and note if unbalance has improved. See Figure 40-57.

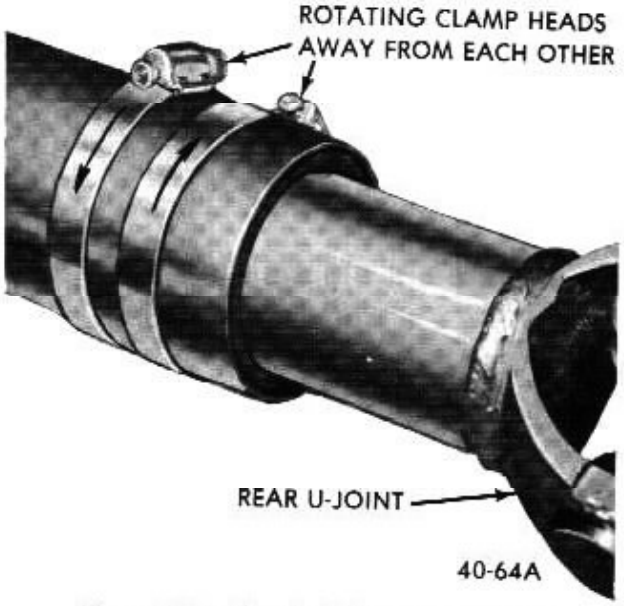


Figure 40-57 - Rotating Balance Hose Clamps

In some cases it may be necessary to use one clamp or possibly three clamps in order to obtain a good balance.

8. Continue to rotate the clamps apart in smaller angular increments until the car feel for unbalance is best.

CAUTION: *Do not run car on hoist for extended periods due to danger of overheating the transmission or engine.*

9. Reinstall tire and wheel assemblies and roadtest the car for final check of balance.

NOTE: *Vibration felt in the car on the hoist may not show up in a roadtest which is, after all, the final determining factor.*

If a wheel balancer of the type that is equipped with a strobe light is available, the use of such a unit will facilitate the balancing of the propeller shaft. The balance pick-up

unit should be placed directly under the nose of the rear axle carrier and as far forward as possible.

DIVISION IV

REMOVAL AND INSTALLATION

40-30 REMOVAL OF PROPELLER SHAFT

NOTE: *Do not pound on original propeller shaft yoke ears as injection joints may fracture.*

There are two methods of attachment of the rear of the drive shaft to the differential companion flange or end yoke. One method is a pair of straps, while the other method is a set of bolted flanges. See Figure 40-58.

1. Raise vehicle on hoist. Mark relationship of shaft to companion flange and disconnect the rear universal joint by removing straps or flange bolts. If bearing cups are loose, tape together to prevent dropping and loss of bearing rollers.

2. Withdraw propeller shaft slip yoke from transmission by moving shaft rearward, passing it under the axle housing.

CAUTION: *Do not allow drive shaft to drop or allow universal joints to bend to extreme angle, as this might fracture injected joint internally. Support propeller shaft during removal.*

40-31 INSTALLATION OF PROPELLER SHAFT ASSEMBLY

The propeller shaft must be supported carefully during handling to avoid jamming or bending any of the parts.

1. Inspect outer diameter of splined yoke to ensure that it is not burred, as this will damage transmission seal.

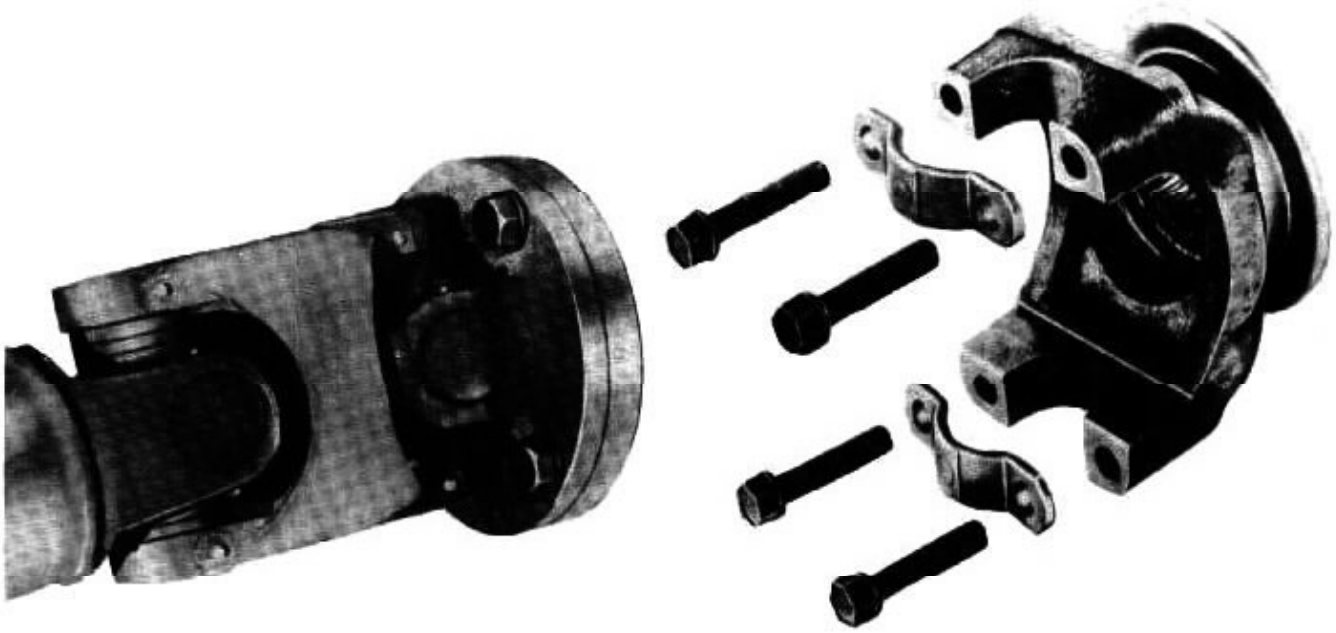
2. Apply engine oil to all splined propeller shaft yokes which do not have vent holes, then slide yoke and drive shaft assembly onto transmission output shaft. Apply grease (EP 1 grade) to internal splined area of slip spline on slip yokes which have vent holes and slide the splined yoke onto the transmission output shaft. See Figure 40-50. Make sure the vent hole in the yoke is not plugged.

CAUTION: *Do not drive propeller shaft in place with hammer. Check for burrs on transmission output shaft spline or possibly the wrong U-joint yoke. Make sure that the splines agree in number and fit.*

NOTE: *When making rear shaft connection, be sure to align mark on companion flange or end yoke with mark on drive shaft rear yoke.*

3. Position rear universal joint to rear axle companion flange, making sure bearings are properly seated in companion flange yoke.

4. Install rear joint fasteners and tighten evenly to torque specified.



40-58

Figure 40-58 Rear Propeller Shaft Attachments

NOTE: *These propeller shaft to companion flange or end yoke fasteners are important attaching parts in that they may affect the performance of vital components and systems, which may result in major repair expense. They must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

DIVISION V

OVERHAUL AND MAJOR SERVICE

40-32 DISASSEMBLY OF PROPELLER SHAFT

a. Disassembly of Single Cardan Universal Joint

When disassembling a propeller shaft, one or both of the two types of universal joints, as shown in Figure 40-59, may be found.

Figure 40-59 - Production Universal Joints

1. Position propeller shaft and spider press J- 9522-3 in power ram equipped with base plate J-8853 and ram screw adapter J-9522-2. See Figure 40-60.

2. Actuate the pump to force the spider and bearing to shear the nylon retaining ring and remove the bearing.

3. Release pump valve, rotate propeller shaft 1/2 revolution and install spider guide J-9522-7 into yoke bore of removed bearing and onto the journal end of the spider.

4. Position propeller shaft as before and use spider press and power ram hydraulic pump to shear the nylon injection ring and remove the opposite bearing. See Figure 40-61.

NOTE: *The above procedures should also be used to disassemble the front universal joint.*

NOTE: *Once a production universal joint is disassembled, it cannot be reassembled as there are no snap ring grooves provided in the bearing cap.*

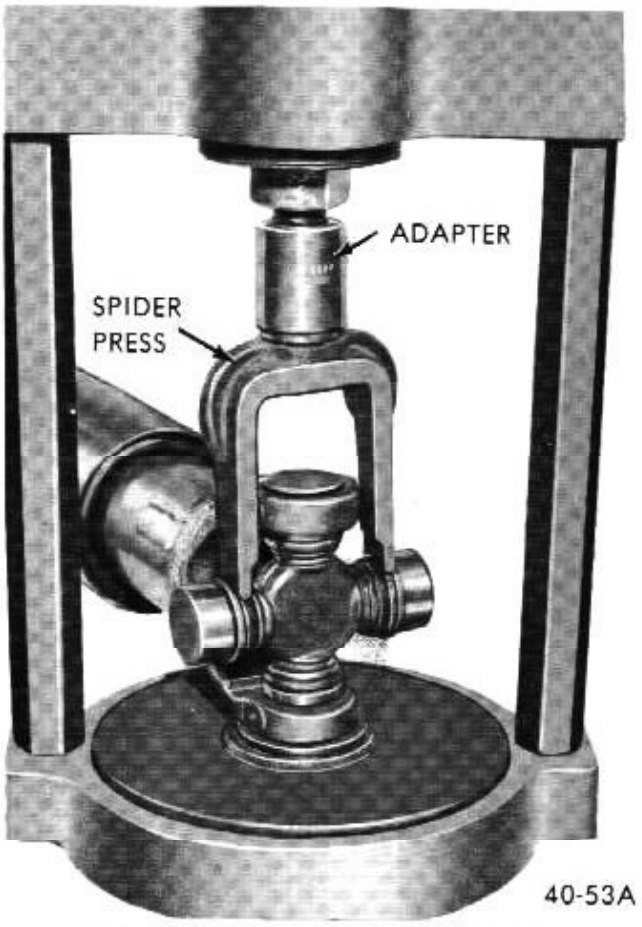


Figure 40-60 - Pressing Out U-Joint Bearing

b. Disassembly of Double Cardan Universal Joint

NOTE: *Never clamp propeller shaft tubing in a vise, as the tube may be dented. Always clamp on one of the yokes. Be careful not to damage the front propeller shaft slip yoke sealing surface. Any nicks can damage the bushing or cut the seal.*

1. Support the propeller shaft in a horizontal position in line with the base plate of a hydraulic press. The bearing cups should be removed in the order indicated in Figure 40-62. This method requires the least work to get to the heart of the centering ball system where the most critical inspection should be made so that the correct service method can be determined.

2. Mark all yokes before disassembly so that they can be reassembled in their original relationship to retain drive shaft balance. See Figure 40-63 for marking method.

3. Support the propeller shaft horizontally in line with the base plate of a press. Place the rear ear of the coupling yoke over a 1 1/8" socket. Place the spider press (J-9522-3) on the bearing cups in the flange yoke. See Figure 40-64.

NOTE: *See Figure 40-65 for rework of older spider presses (J-9522-3) to clear the coupling yoke. Press the bearing cup out of the coupling yoke ear. If the bearing cup is not*

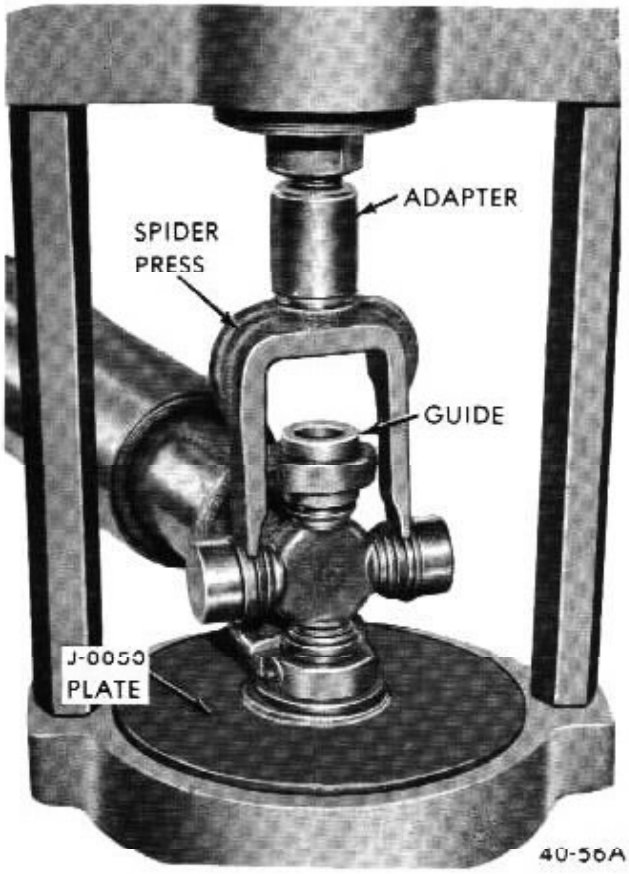


Figure 40-61 - Pressing Out U-Joint Bearing With Guide Installed

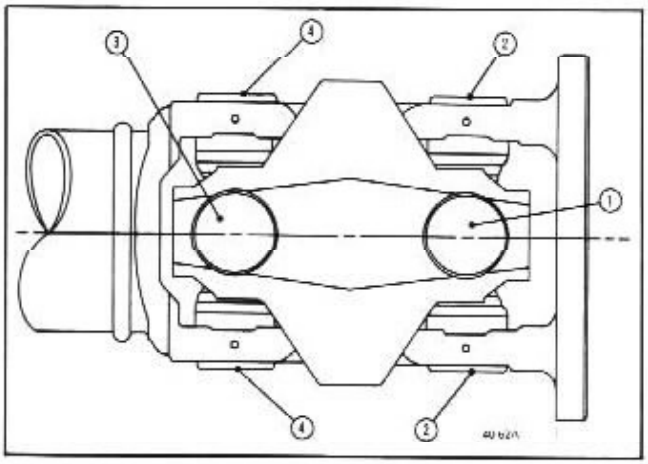


Figure 40-62 Bearing Cap Removal Sequence

completely removed, insert spacer (J-9522-5), shown in Figure 40-66, and complete the removal of the bearing cup.

4. Rotate the propeller shaft 180 degrees. Shear the opposite plastic retainer and press the bearing cup out of the coupling yoke as before, using Spacer J-9522-5.

5. Disengage the trunnions of the spider still attached to the flange yoke from the coupling yoke, and pull the flange

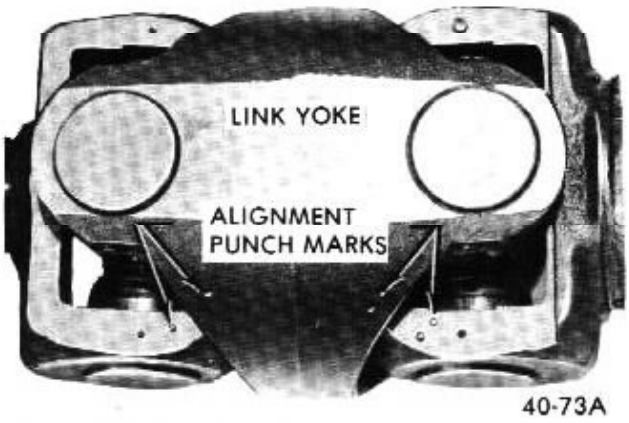


Figure 40-63 Link Yoke Showing Alignment Punch Marks

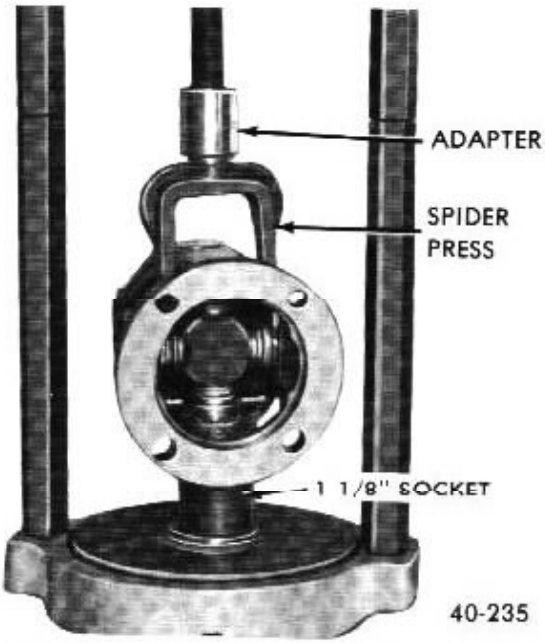


Figure 40-64 Disassembling Rear CV Rear U-Joint

yoke and spider from the centering ball on the ball support tube yoke. The ball socket is part of the flange yoke.

NOTE: *The ball is integral with the shaft. If the ball is damaged, a complete replacement propeller shaft is required. If the ball is smooth, the ball seat should be disassembled and inspected.*

6. Pry the seal from the ball cavity, remove washers, spring, and three shoes, as shown in Figure 40-67.

7. The coupling yoke can now be removed from the shaft, as described above, for removal of the flange yoke.

40-33 ASSEMBLY OF PROPELLER SHAFT

c. Assemble of Single Cardan Universal Joint

When reassembling a propeller shaft, install complete uni-

Figure 40-65 Spider Press Leg Rework

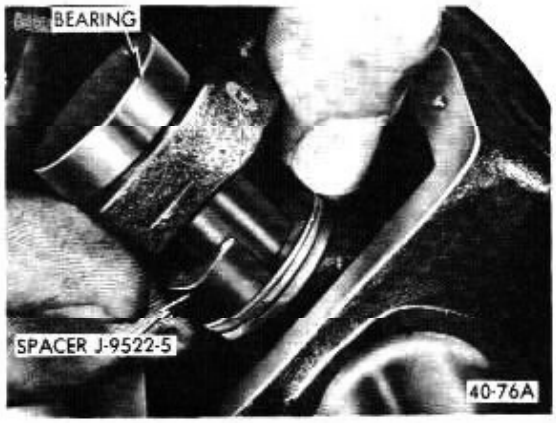


Figure 40-66 Installing Spacer

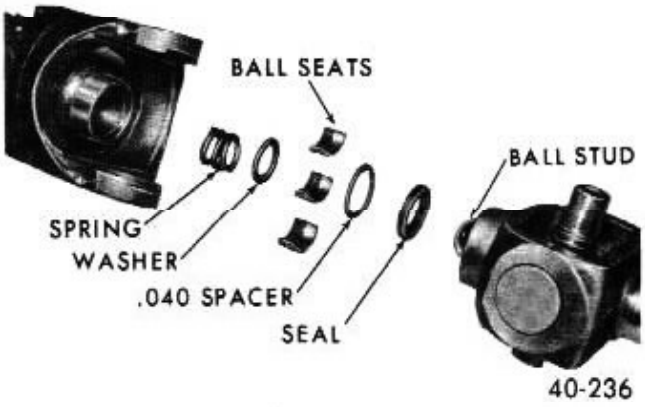


Figure 40-67 Ball Stud Seat - Exploded View

versal joint repair kits. Repair kits are listed in the Buick Master Parts Catalog under Group 5.442 and include a spider, four bearing assemblies, four delrin spacers, four seals and four shields. The four bearings come equipped with snap rings. See Figure 40-68.

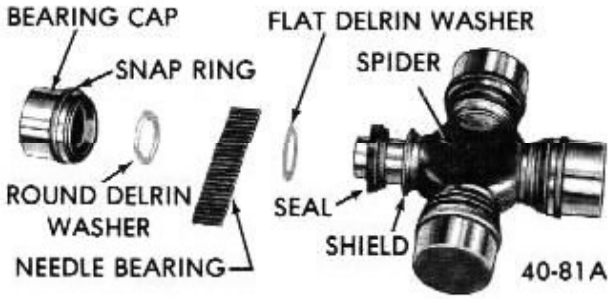


Figure 40-68 - Service Universal Joint

1. Make certain the shields and seals are in firm position and not damaged on the spider and install the spider in the yoke. The spider may face in either direction.

2. Install spider guide J-9522-7 into one yoke bore and position spider journal into the guide. Push guide in far enough for opposite journal to extend slightly above yoke bore.

NOTE: *Spider journals and bearings must be free of dirt or foreign material.*

3. Place the propeller shaft and yoke assembly in position with the Power Ram and Pump. Inspect bearing cup to see that all needle bearings are in place and lubricated. Make certain the Delrin Washer is in place against the needle bearings. Position bearing straight over yoke bore and onto spider journal.

NOTE: *Failure to pilot the spider journal into the bearing could cause the bearing needles to become dislodged during installation of the bearing cup.*

With the pump, force the bearing into the yoke. As the bearing nears the end of its required travel, it will cause the spider to push the guide outward without damage to the seal or shield. The bearing cup is properly positioned in the yoke when the snap ring groove is exposed enough to install the snap ring. When the bearing is correctly positioned in the yoke, turn the assembly over, remove the guide J-9522-7 and again place bearing over the bore in the yoke.

Carefully slide the spider partially out of the previously seated bearing and start it carefully into the bearing being installed. This prevents the bearing needles from burring the edge of the spider journal if forced over journal other than straight. Even slight burring of the journal can cause premature failure.

While pressing bearings into position, move the spider back and forth to make certain that the spider journals engage the bearings squarely to avoid damage and binding. If binding exists, remove the bearings and spider and examine for dislodged rollers or damaged journals.

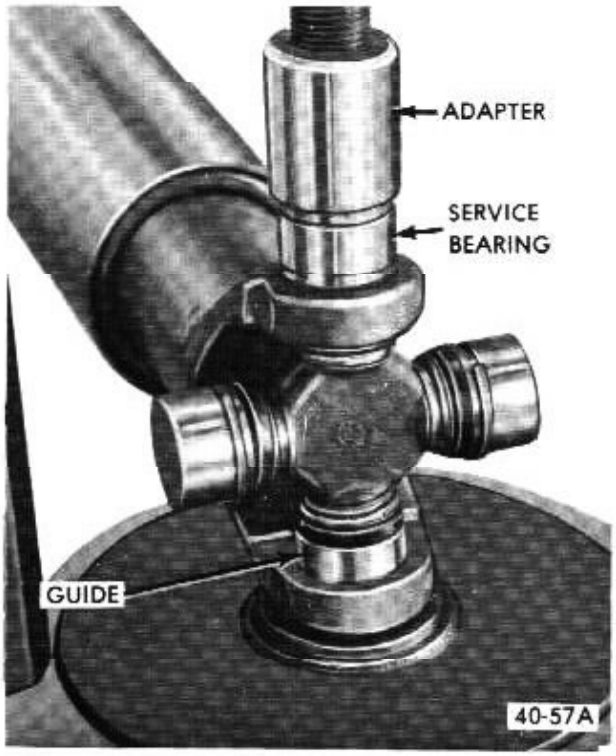


Figure 40-69 - Installing U-Joint Bearing With Guide in Place.

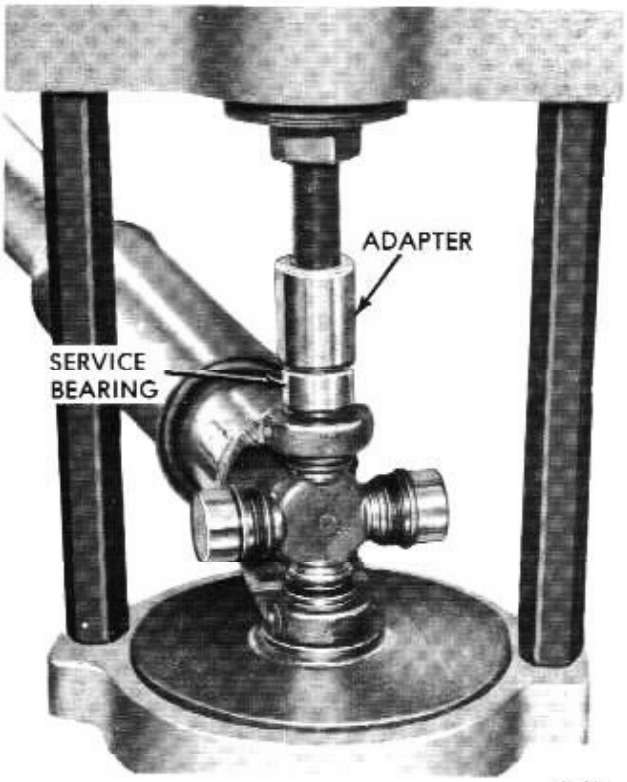


Figure 40-70 - Installing U-Joint Bearing

NOTE: *If excessive resistance is encountered, the bearings should be removed as this is an indication that one or more of the needles are out of place.*

3. While observing the previous precautions, install the balance of the bearings necessary to complete the assembly and install snap rings.

4. Strike the yoke firmly with a hammer to fully seat the snap rings against the yoke. Turn the spider to make certain that it is free. See Figure 40-71.

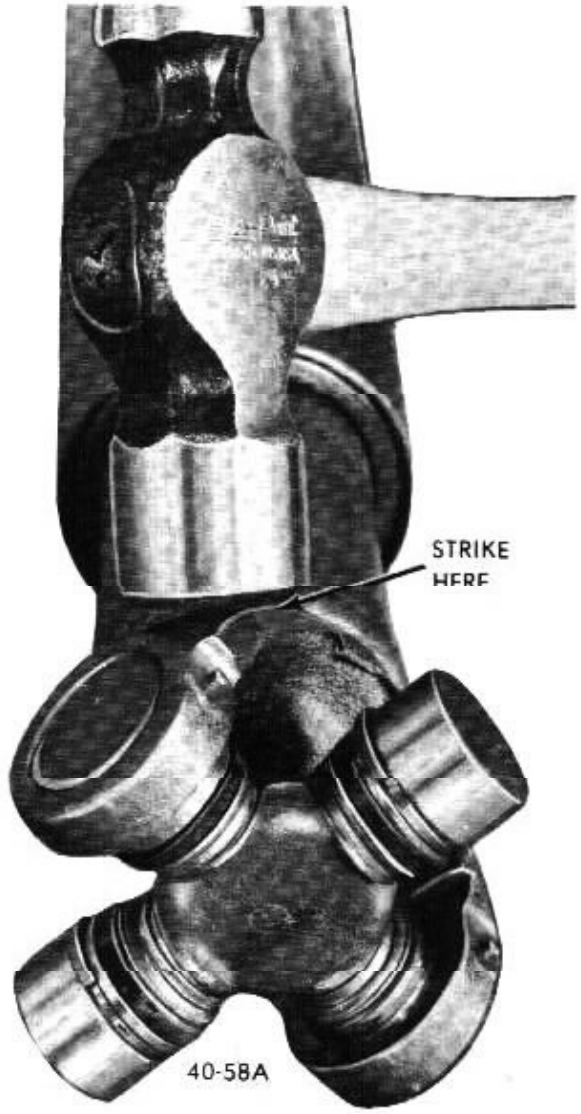


Figure 40-71 Seating U-joint Snap Rings

d. Assemble of Double Cardan Universal Joint

When reassembling a propeller shaft, always install complete universal joint service kits. These kits include one pregreased cross assembly, four bearing cup assemblies with seals, roller bearings, washers, and grease, and four retaining rings. See Figure 40-68. Make sure that the seals are in place on the service bearing cups to hold the roller bearings in place for handling.

1. Install one bearing cup part way into one ear of the ball

support tube yoke, and turn this bearing cup to the bottom.

2. Insert cross into tube yoke so that the trunnion seats freely into the bearing cup.

3. Install opposite bearing cup part way, making sure that both trunnions are started straight and true into both bearing cups.

4. Press against opposite bearing cups, working the cross all of the time to insure free movement of the trunnions in the bearings. If there seems to be a hangup, stop pressing and recheck roller bearings, because one or more of them has probably been tipped under the end of the trunnion.

5. As soon as one snap ring groove clears the inside of the yoke, stop pressing and snap the retaining ring into place. See Figure 40-72.

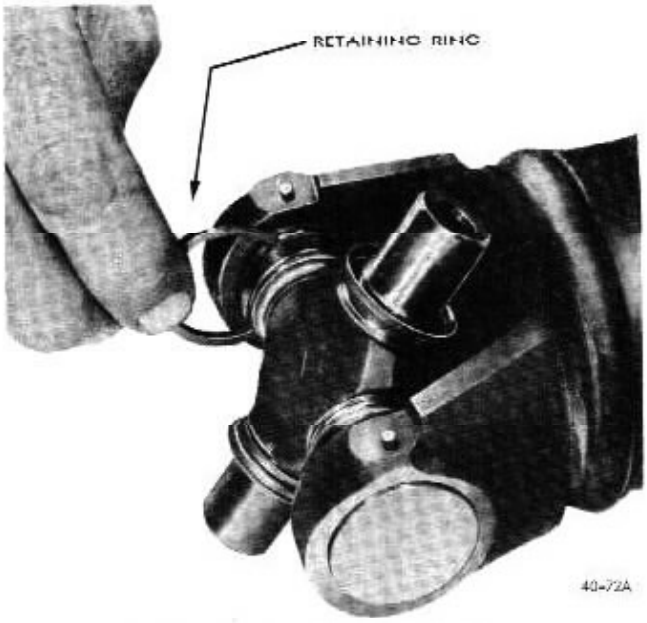


Figure 40-72 Installing Retaining Ring

6. Continue to press until the opposite retaining ring can be snapped into place. If difficulty is encountered, strike the yoke sharply with a hammer to aid in seating the rings. See Figure 40-73.

7. Install one bearing cup part way into the one ear of the coupling yoke.

8. Making sure that the alignment marks on the coupling yoke and ball support tube yoke are correctly positioned, engage the coupling yoke over the cross already installed and press the bearing cups, installing the retaining rings as before.

9. Using the grease provided in the ball seat kit, lubricate all of the parts and insert them into the clean ball seat cavity in the following order: Springs, washer (smallest OD), three ball seats, washer (largest OD), and seal.

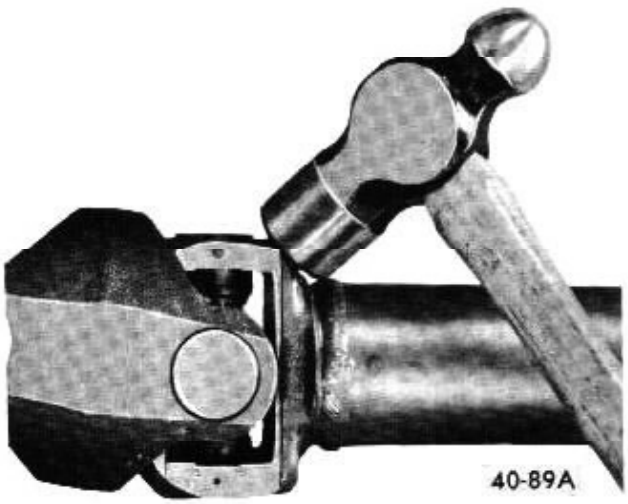


Figure 40-73 Seating Snap Ring

10. Lubricate the seal and press into cavity with Tool J-23694. The sealing lip should tip inward. See Figure 40-74.

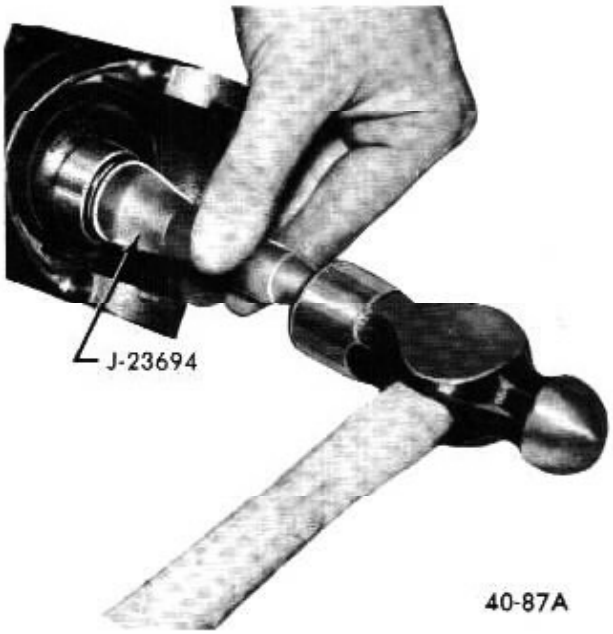


Figure 40-74 Installing Ball Stud Seal

11. Install bearing cups and cross into the flange yoke, as detailed for the ball support tube yoke.

12. Making sure that the alignment marks on the coupling yoke and flange yoke are correctly positioned, insert one bearing cup part way into the coupling yoke.

13. Engage the ball stud into its seat and the coupling yoke over the exposed cross trunnion. Push the ball stud into its seat.

14. Press the bearing cups into the coupling yoke and seat the retaining rings.

NOTE: *The flange yoke should snap over center to right or left and up or down by the pressure of the ball seat spring freely, if correctly installed.*

DIVISION VI SPECIFICATIONS

40-34 PROPELLER SHAFT SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed, to insure proper tightening without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque Lbs. Ft.
Bolt	Rear Universal Join to Pinion Flange (Strap) 43-44000 and Estate Wagon	5/16 - 18	15
Bolt	Rear Propeller Shaft Flanged Yokes to Pinion Flange 45-46-48-49000 (Less Estate Wagon)	7/16 - 14	70

GENERAL SPECIFICATIONS

Propeller Shaft. . . . . All Series. . . . . 1 Piece-Open Drive Line
Universal Joints. . . . . 43-44000 and Estate Wagons 2-Single
Universal Joints. . . . . 45-46-48-49000 (Less Estate Wagon) . . . . . Front Single
40C-2 Rear Double Cardan

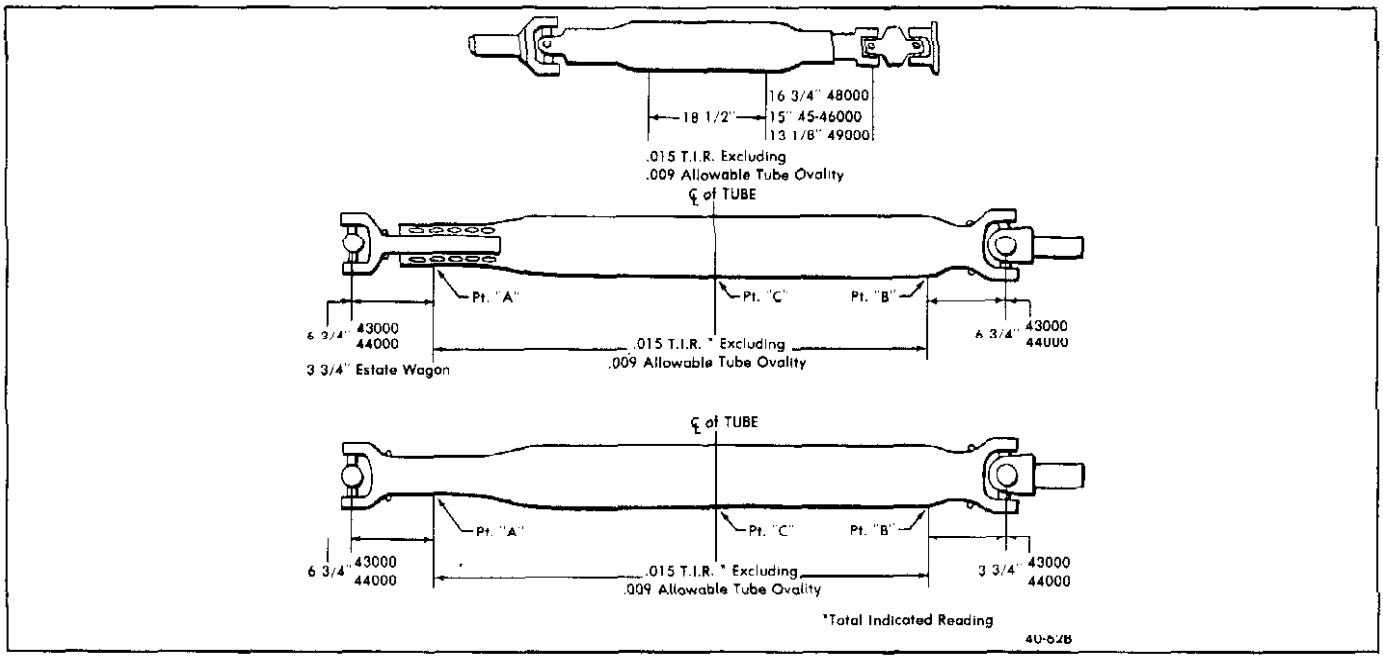


Figure 40-75 Checking Propeller Shaft Run-Out

SECTION B

AUTOMATIC LEVEL CONTROL

CONTENTS

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	Quick Check of Automatic Level Control System	40-11
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	Pressure Regulator Test	40-13
	Height Control Valve Test	40-14
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II	DESCRIPTION AND OPERATION:	
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IV	REMOVAL AND INSTALLATION:	
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DIVISION I

TROUBLE DIAGNOSIS

40-11 QUICK CHECK OF AUTOMATIC LEVEL CONTROL SYSTEM

a. Trim Height

1. Record rear trim height of car at curb weight (basic car with fuel tank full). Measure from ground to lower edge of rear wheel cutout.

2. Place 200 pounds of weight in trunk area of passenger cars or on the tail gate of station wagons. Car should begin to level in 4-22 seconds at 70 degrees F. Final position should be no more than one inch lower than original dimension. If the dimension is more than one inch lower than original, jounce rear of car to neutralize rear suspension and recheck. If dimension is still more than one inch lower than original, adjust height control valve.

3. Remove weight. Car should begin to settle slowly in 4-22 seconds at 70 degrees F. Final position should vary no more than 1/2 inch from original dimension. If the dimension varies more than 1/2 inch from original, jounce rear of car to neutralize rear suspension and recheck. If variation still exists, adjust height control valve.

NOTE: *To properly service the automatic level control, it will be necessary to obtain Test Gage J- 22124 or equivalent.*

b. Vacuum Regulator Valve

1. Slow Engine Idle

The compressor should not operate during slow engine idle conditions. (V-8 engines with automatic transmission in drive and accessories turned off 600 RPM - V-8 engines with manual transmission in neutral and accessories turned off 700 RPM). If the compressor operates during slow engine idle, the problem could be improperly connected vacuum links, improperly adjusted deceleration valve, misadjusted carburetor (intake manifold leak), or a relay valve leaking.

It can be determined whether or not the relay valve is leaking by first checking line routing, and then disconnecting and plugging hose from vacuum source (yellow hose). If compressor stops pumping, adjust deceleration valve.

The deceleration valve adjusting screw can be turned counterclockwise to lessen the spring tension on the valve which then requires less vacuum to open the valve. By turning the adjusting screw clockwise, more spring tension is applied on the valve, thus requiring greater vacuum for it to open.

To properly adjust the valve, turn the adjusting screw clockwise (if compressor is operating at slow idle) until the compressor stops. From this point, turn the adjusting screw 1/2 turn clockwise for final setting.

If compressor still functions at idle, disconnect carburetor advance hose (white hose). If compressor stops pumping, carburetor is misadjusted or there is a vacuum leak.

If compressor continues to pump, the relay valve is leaking and needs to be replaced.

2. Fast Idle

With the engine operating at fast idle (above 1000 RPM), the compressor should be in operation, unless balanced pressures exist in the system (150- 275 psi). If a balanced pressure condition does exist, deflate the system until the compressor begins to operate. If the compressor fails to operate after being deflated, either the restriction (orifice) is plugged, a vacuum leak exists in the P.C.V. or compressor hose, or the relay valve is faulty.

(a) If there are no apparent vacuum leaks and the compressor still fails to operate, bypass the relay valve by removing the compressor and P.C.V. hose from the relay valve and connect them together. If the compressor starts to operate, the problem is in the relay valve, requiring the replacement of the vacuum regulator valve assembly.

(b) If the restriction is plugged, remove the spark advance port hose and use a piece of tag wire, or something similar, to dislodge the foreign material, accelerate the engine and let it decelerate, as this will cause the deceleration valve to open and allow manifold vacuum to remove the foreign material from the spark advance port.

3. Deceleration Condition

When the engine is operating in a deceleration condition, the compressor should be working if the system pressure is low. Deflate if necessary. Disconnect spark advance port hose and plug it. Cap or cover the spark advance port. With a vacuum gage installed in the manifold vacuum line, accelerate engine and let it decelerate. The deceleration valve should open at 18.3" of vacuum and thus actuate the relay valve which in turn permits the compressor to operate on P.C.V. vacuum. The deceleration valve can be adjusted if necesssary by removing the protective cap and turning the adjusting screw clockwise to increase the amount of vacuum required to open the valve or counterclockwise to decrease the amount of vacuum required to open this valve. If the deceleration valve is faulty the vacuum regulator assembly must be replaced as a unit.

40-12 COMPRESSOR OUTPUT TEST - ON CAR

1. With all engine operated accessories turned off and ignition turned off, deflate system through service valve. Remove high pressure line at regulator and connect test gage.

2. Inflate reservoir to 70 psi through service valve.

3. Observe test gage for evidence of compressor air leak.

4. If leaking, proceed to leak test of the compressor, reservoir and regulator as outlined in paragraph 45- 14. If not leaking, continue with this test.

5. With engine running at 1000 RPM, observe reservoir pressure build-up for five minutes. Reservoir pressure should build up from 70 psi to a minimum of 90 psi.

6. If compressor fails to operate, by-pass the relay valve by connecting the P.C.V. hose to the compressor hose and repeat Step 5.

NOTE: *Make certain restriction orifice is not plugged.*

7. If compressor fails to cycle, make sure the vacuum line and filter are open and unobstructed before removing compressor for repair.

8. If build-up is too slow, proceed to repair compressor as outlined in Division III.

9. Satisfactory build-up indicates system problem to be in the control section. See paragraph 45-13. However, again observe the test gage for evidence of an air leak and proceed accordingly.

40-13 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. Install test gage on regulator valve high pressure fitting. See Figure 40-9.

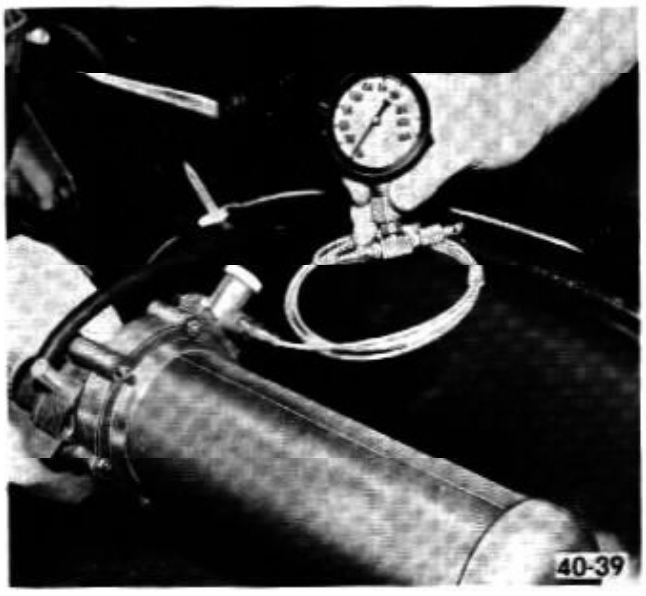

Figure 40-9 - Test Gage Installed on Regulator Valve

2. Inflate system through service valve to maximum available pressure. See Figure 40-22.

NOTE: *If available pressure is less than 140 psi, start engine to build-up reservoir to this pressure.*

3. Regulated pressure should build-up to and hold steady at 100-130 psi on test gage.

4. Check regulated pressure by momentarily (not more than one second) depressing valve core on test gage and observe gage reading.

5. If regulated pressure now reads less than 100 psi, replace regulator assembly.

6. If regulated pressure exceeds 130 psi, replace regulator assembly.

40-14 HEIGHT CONTROL VALVE TEST

a. Exhaust (Superlifts Inflated)

1. Disconnect overtravel lever from link.

2. Hold lever down in exhaust position until Superlifts slowly deflate. They should start to deflate within 22 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.

b. Intake (Reservoir Pressure 125 psi Minimum)

1. Disconnect overtravel lever from link.

2. Hold lever up in intake position until Superlifts inflate. They should start to inflate within 22 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, paragraph 45-14, subparagraph c. Also check and, if necessary, replace intake and Superlift screens and "O" rings. If Superlifts still do not inflate, perform leak test on valve, paragraph 40-15, subparagraph b. Repair as indicated and proceed to time delay check.

c. Time Delay Check

1. Disconnect overtravel lever from link.

2. Disconnect lines at Superlift and intake ports.

3. Connect test gage to intake valve port and open air pressure (95 psi). Move overtravel lever approximately one inch down from neutral position as measured from end of lever.

4. Quickly move overtravel lever upward two inches; at the same time, begin timing number of seconds before air starts to escape from Superlift port. This delay should be from 4-22 seconds at 70 degrees F. Repeat check. This will check the air intake time delay. Proceed with check to determine air exhaust time delay.

5. Remove test gage and plug intake port with Fill Valve J-21999.

6. Connect test gage to Superlift port and open air pressure (95 psi). Move overtravel lever approximately one inch up from neutral position as measured from end of lever.

7. Quickly move overtravel lever downward two inches; at the same time, begin timing number of seconds until air begins to escape from exhaust port. This delay should be 4-22 seconds at 70 degrees F. 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.

40-15 LEAK TEST

a. Lines and Fittings

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.

b. Superlifts

1. Disconnect lines and remove Superlift from car.

2. Inflate individually to 50-60 psi utilizing Fill Valves J-21999, submerge in water and observe for leaks.

3. Install Superlifts and connect lines.

c. Compressor, Reservoir and Regulator

1. Remove assembly intact.

2. Connect test gage to regulator. Inflate reservoir through service valve to 80-110 psi.

3. Route an 8" piece of rubber hose between vacuum and vent ports. See Figure 40-10.

4. While holding assembly in a vertical position with reservoir end down, immerse in water until diaphragm is just

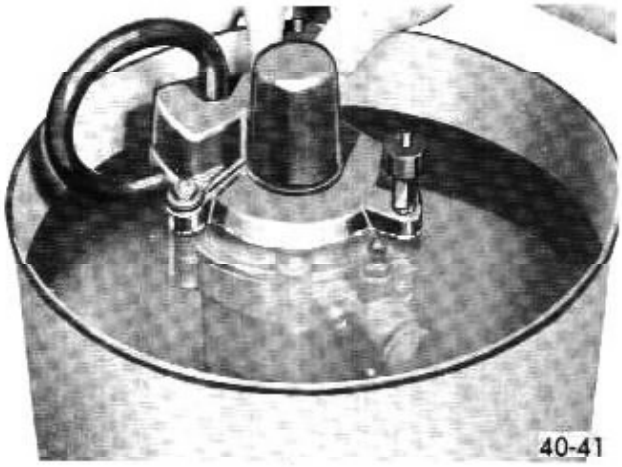

Figure 40-10 - Checking Compressor, Reservoir Tank and Regulator for Leaks

submerged. Do not submerge completely, as water can enter around the cover gasket. Observe for air leaks at:

Reservoir weld seam.

Reservoir to compressor "O" ring. A stream of bubbles may appear in this area and then cease. The bubbles are caused by atmospheric air being purged from air pockets in the second stage housing. If the bubbles stop, there is no leak.

Regulator to compressor "O" ring.

Regulator boot-defective internal "O" ring.

Diaphragm between first and second stage housings - tightening through-bolts may correct the leak.

Service valve.

Test gage connections.

5. Remove hose from vacuum port and submerge disconnected end in water. Cover vacuum port with finger. Do not permit water to enter through vacuum port. If bubbles are evident, the probable cause is defective second stage housing check valve.

6. Correct any leaks by either tightening screws or replacing parts.

7. If the cover gasket area is inadvertently submerged, remove cover and tilt unit so that water may drain through openings by distributor valve mechanism. Move distributor valve from side to side until all water is purged. Blow dry with compressed air, both the distributor valve mechanism and interior of the cover. Replace cover.

If the compressor passes this test, yet fails the output test, the compressor, reservoir and regulator need to be overhauled.

d. Control Valve

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, J-21999.

6. Connect test gage to Superlift port and open air pressure.

7. With overtravel lever in "neutral" position, no air should escape. If bubbles escape from exhaust port, replace control valve.

8. If air escapes around edge of cover plate, the gasket must be replaced.

9. Remove control valve from water. Actuate overtravel lever to expel any water from unit.

10. Shut off air pressure and remove line from Superlift port.

40-16 TROUBLE DIAGNOSIS CHART

Condition	Cause	Correction
Car loaded, will not raise.	External damage or breakage.	Visually inspect — Lines Link Control valve Superlifts
	Line leak.	Leak Test — Lines and fittings.
	Control valve setting incorrect.	Perform trim adjustment on car.
	Defective component.	Perform system test and proceed as indicated.
Car loaded. Raises to level and then leaks down.	Line leak.	Leak test lines and fittings from control valve to Superlifts and crossover line.
	Control valve exhaust leak.	Control valve test — on car.
	Superlift leak.	Leak test Superlifts.
	Control valve leak.	Leak Test — Control Valve Off Car.
Car loaded, raises partially.	Load excessive (over 500 lbs. at axle) on cars with special springs.	Distribute load, shift forward if practical.
	Control valve setting incorrect.	Perform trim adjustment on car.
	Low supply pressure.	Perform compressor output test on car.
Car unloaded, rides too high, will not come down.	Control valve setting incorrect.	Perform trim adjustment on car.
	External damage or breakage.	Visually inspect — Lines Link Control Valve Superlifts
	Defective control valve.	Control valve test.
	Supply line and Superlift line reversed.	Install lines in correct locations.
Car rises when loaded but leaks down while driving.	Time delay mechanism not functioning properly.	Check time delay mechanism.
Compressor will not operate during fast idle or cruising speeds. (Low system pressure.)	Plugged restriction orifice.	Clean restriction orifice.
	Defective relay valve.	Replace vacuum regulator valve assembly.
	Vacuum leak.	Inspect for and correct.
	Faulty compressor.	Correct as necessary.

40-44A

Condition	Cause	Correction
Compressor operates at slow idle speed. (Low system pressure.)	Defective relay valve. Intake manifold leak. Improper deceleration valve spring adjustment. Excessive spark port vacuum.	Replace vacuum regulator valve assembly. Readjust deceleration valve spring screw. Check out engine vacuum.
Compressor will not operate during deceleration period. (Low system pressure.)	Defective deceleration valve. Improper valve spring adjustment. Vacuum leak. Faulty Compressor.	Replace vacuum regulator valve assembly. Readjust decelerator valve spring screw. Inspect for and correct. Correct as necessary.

40-44B

DIVISION II

DESCRIPTION AND OPERATION

40-17 DESCRIPTION AND OPERATION OF AUTOMATIC LEVEL CONTROL SYSTEM

The Automatic Level Control System is available on Sportwagons, LeSabre, Wildcat, Electra and Riviera as a factory or dealer installed option. Its function is to maintain automatically the rear standing height of the car, even with load changes of up to 500 pounds placed directly over the rear axle. The system consists of a vacuum regulator valve, a vacuum operated air compressor, reservoir tank and pressure regulator assembly, height control valve, link, two Superlift rear shock absorbers and flexible air lines. See Figures 40-45, 46 and 47.

a. The vacuum regulator valve assembly consists of a relay valve which is pre-set to open at 6" of vacuum and a deceleration valve that is set to open at 18.3" of vacuum. The deceleration valve controls the relay during periods of deceleration. The relay valve is connected to the compressor and to the positive crankcase ventilator line by rubber hose. The spark advance port of the regulator valve assembly is connected into the vacuum hose of the distributor vacuum advance and the intake manifold port is tapped into the rear of the intake manifold by rubber hose.

When the engine is operating at slow idle speed, the compressor will not operate due to insufficient vacuum availa-

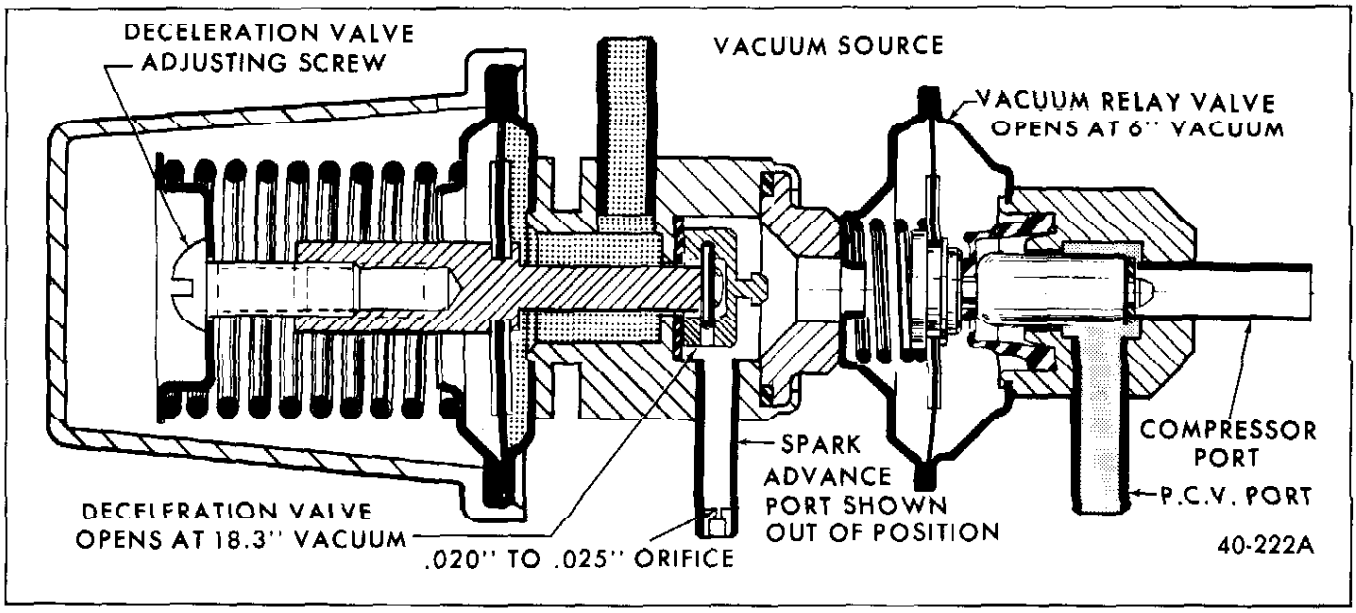

Figure 40-11 - Slow Idle Condition - Both the Deceleration Valve and the Vacuum Relay Valve are CLOSED

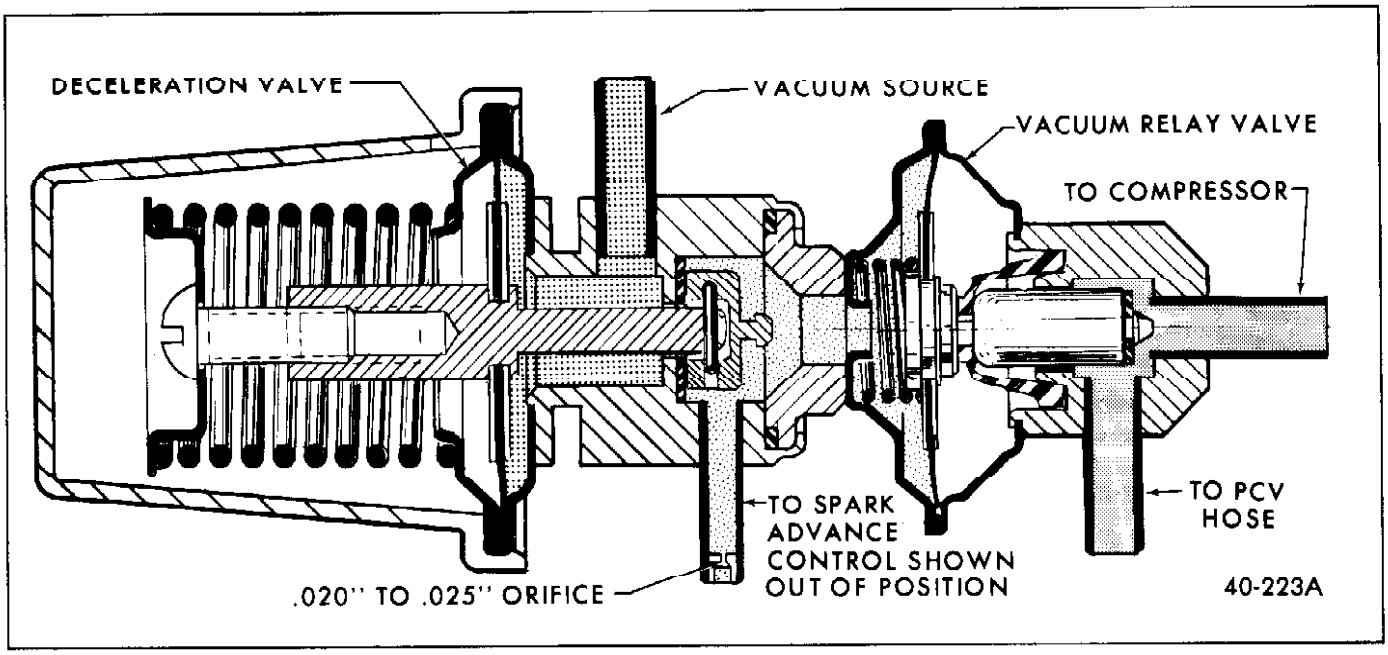

Figure 40-12 - Fast Idle Condition - Vacuum Relay Valve is OPEN

ble to open the vacuum relay valve. See Figure 40-11. As engine RPM is increase to fast idle or to cruising speed, the increased engine vacuum is metered through a .020" to .025" restriction (orifice) located in the spark advance port of the vacuum regulator valve. See Figure 40-12.

This increased vacuum overcomes the relay valve spring tension causing the relay valve to open and allows the compressor to operate on vacuum from the positive crankcase ventilation system.

To help maintain compressor output, it is necessary to provide vacuum to the compressor during deceleration conditions. This is accomplished through the connection of the deceleration valve vacuum port to the vacuum source. See Figure 40-13.

During deceleration, vacuum at the rear of the intake manifold exceeds 17" and vacuum at the spark advance port is negligible. The manifold vacuum overcomes the deceleration valve spring tension and causes the deceleration valve to open permitting vacuum to overcome the relay valve spring tension and open the relay valve to admit P.C.V. vacuum which in turn operates the compressor. Since there is literally no vacuum to the spark advance port, the .020" to .025" restirction (orifice) in the spark

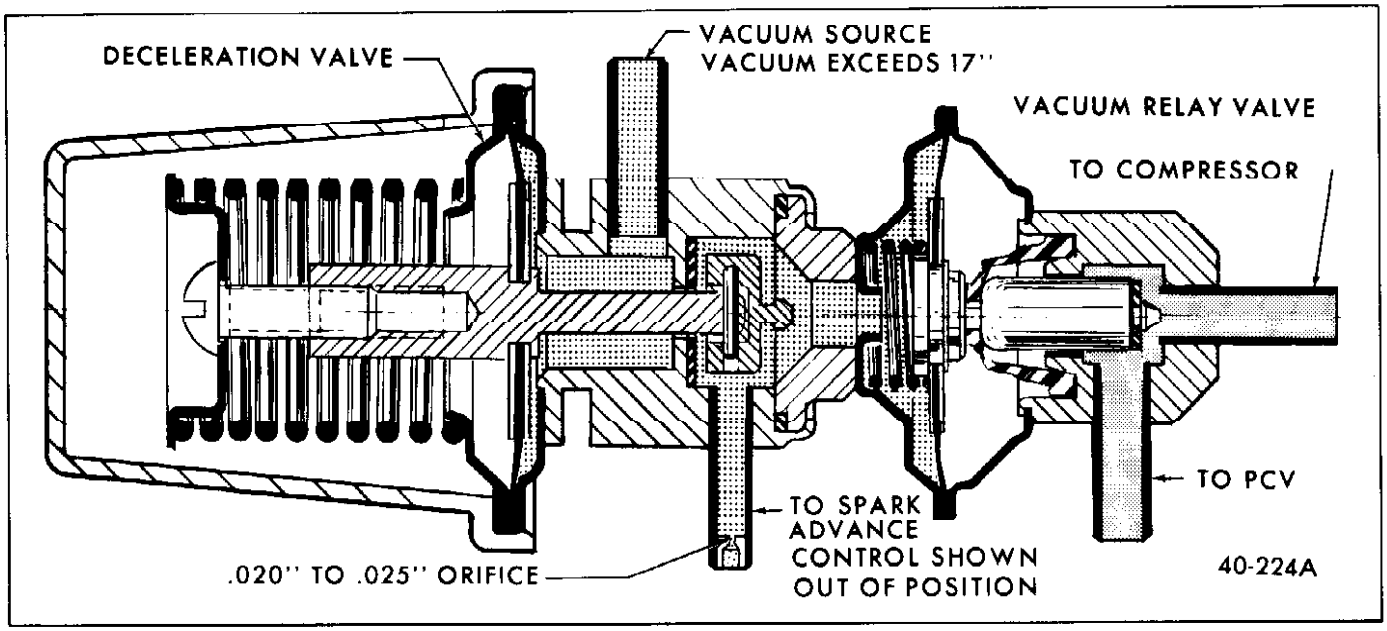

Figure 40-13 - Deceleration Condition - Both the Deceleration Valve and the Vacuum Relay Valve are OPEN

port prevents vacuum feed back from advancing the spark in the ignition distributor.

b. The compressor is a two-stage, vacuum actuated type, requiring no lubrication. See Figure 40-14. 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 one way check valve located in the end of the first stage housing under the first stage housing cover. See Figure 40-15. 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. See Figure 40-16. The second stage compression stroke closes the check valve in the piston and opens the check valve in the end of the second stage housing. See Figure 40-17.

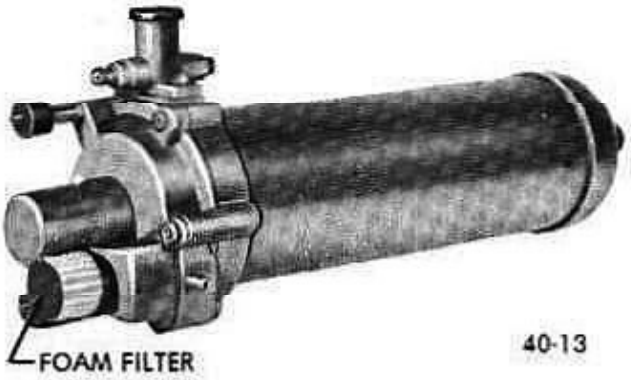

Figure 40-14 - Compressor, Reservoir Tank and Regulator Valve Assembly

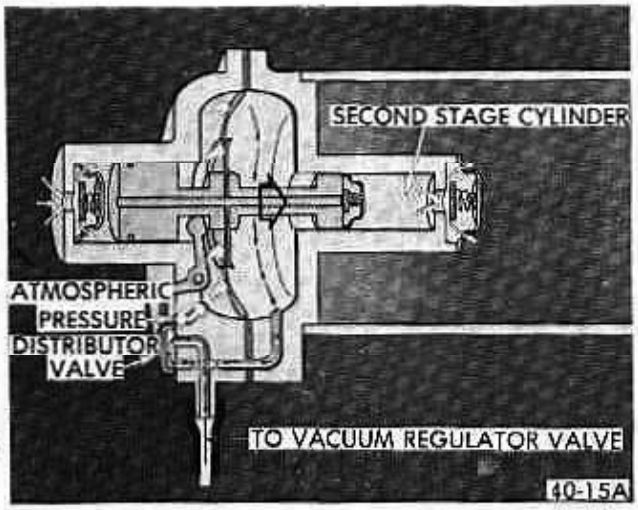

Figure 40-15 - First Stage Intake Stroke

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 under atmospheric pressure, alternately to opposite sides of the compressor diaphragm. See Figures 40- 16 and 17.

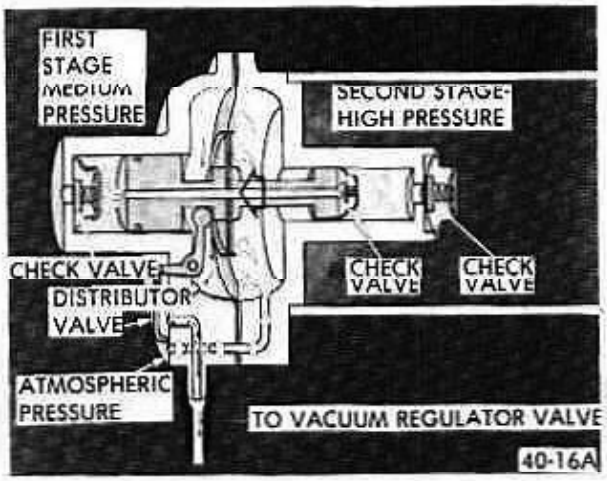

Figure 40-16 - First Stage Compression Stroke

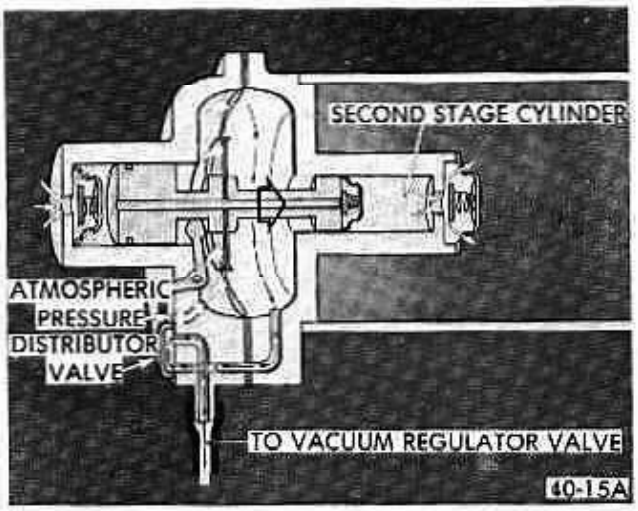

Figure 40-17 - Second Stage Compression Stroke

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.

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.

c. 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. See Figure 40-22.

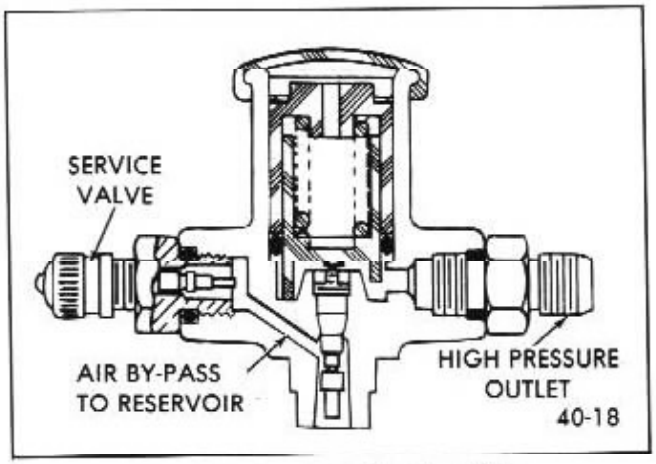

Figure 40-22 - Pressure Regulator Valve

d. The height control valve, which is mounted on the frame, senses rear car height through a link attached to the rear upper control arm on all cars except Estate Wagons. Link is attached to axle assembly on Estate Wagons. When load is added to the car, the overtravel lever is forced up causing an internal lever to open the intake valve. See Figure 40-23. When this valve is open, high pressure air is admitted to the Superlift shocks. As the car raises to level (depending upon position of load), the intake valve shuts off.

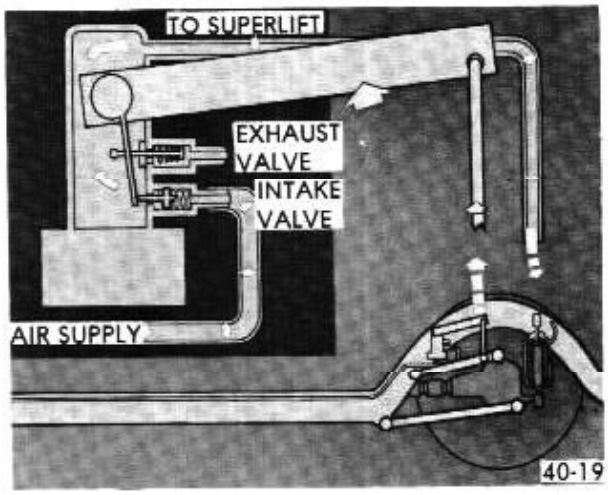

Figure 40-23 - Load Added to Car

When load is removed from the car, the overtravel lever is forced down causing the internal arm to open the exhaust valve. As the car lowers to the level position (depending upon position of load), the exhaust valve shuts off. See Figure 40-24.

A four to twenty-two second (at 70 degrees F.) 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. See Figure 40-25.

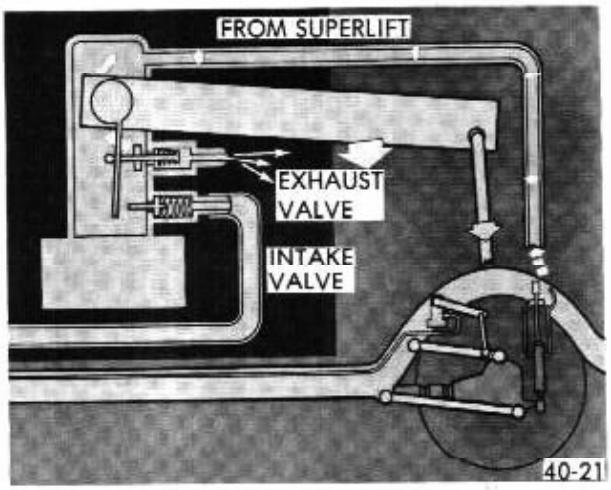

Figure 40-24 - Load Removed From Car

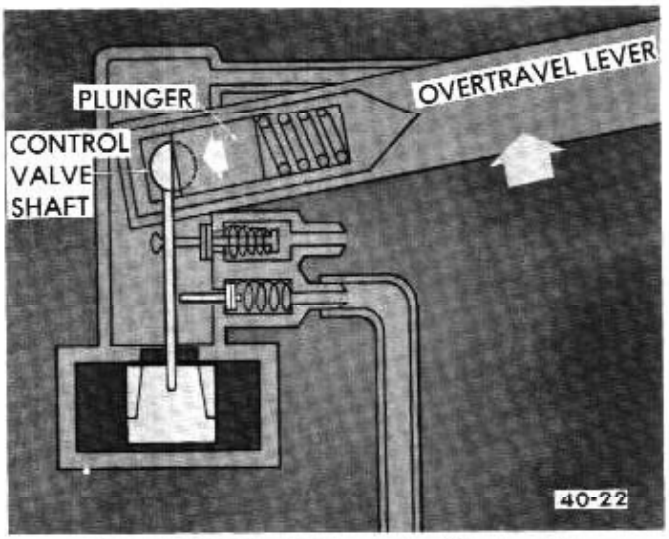

Figure 40-25 - Rapid Movement of Overtravel Lever

During changes due to loading, the time delay mechanism will allow the control valve shaft to open either the intake or exhaust valve as required, since this is not a rapid movement. See Figure 40-26.

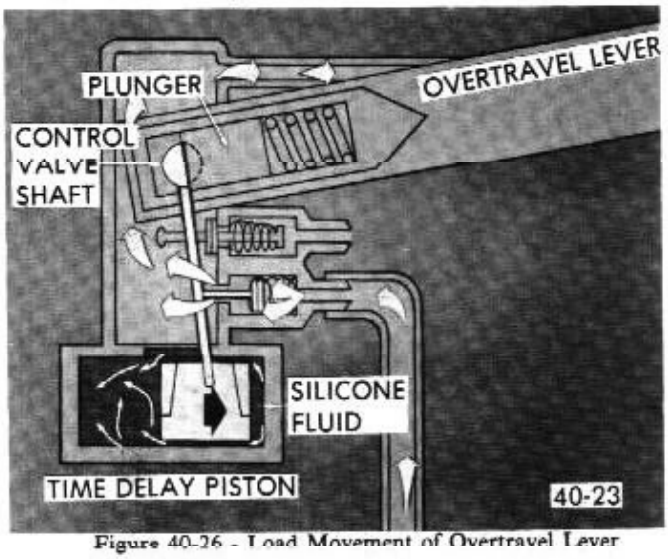

Figure 40-26 - Load Movement of Overtravel Lever

e. The Superlift shock absorber is essentially a conventional hydraulic unit with a pliable nylon reinforced neoprene boot acting as an air chamber. See Figure 40-27.

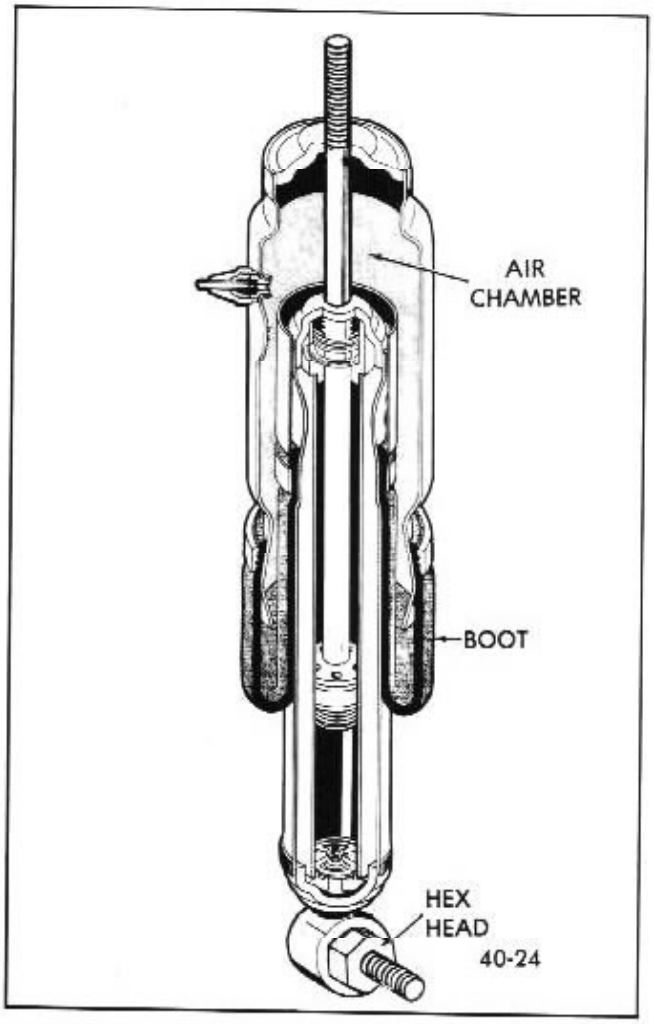

Figure 40-27 - Superlift Shock Absorber - Sectional View

An eight to fifteen 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 thru rear coil springs is impaired in the event of accidental air pressure loss.

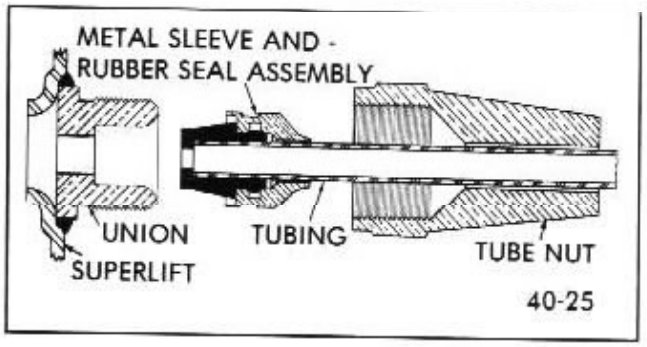

Figure 40-28 - Fitting Nut and Seal

f. 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. See Figure 40-28. These parts are intended specifically for the 1/8" diameter line and must be used to effect a reliable seal.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

40-18 TRIM ADJUSTMENT - ON CAR

Trim adjustment should be performed with a full fuel tank (or the equivalent in load at the rate of six pounds per gallon of gasoline added over center of fuel tank.)

a. Preparation

1. Raise car using drive-on hoist.

2. Remove Superlift air supply line at height control valve. See Figure 40-29.

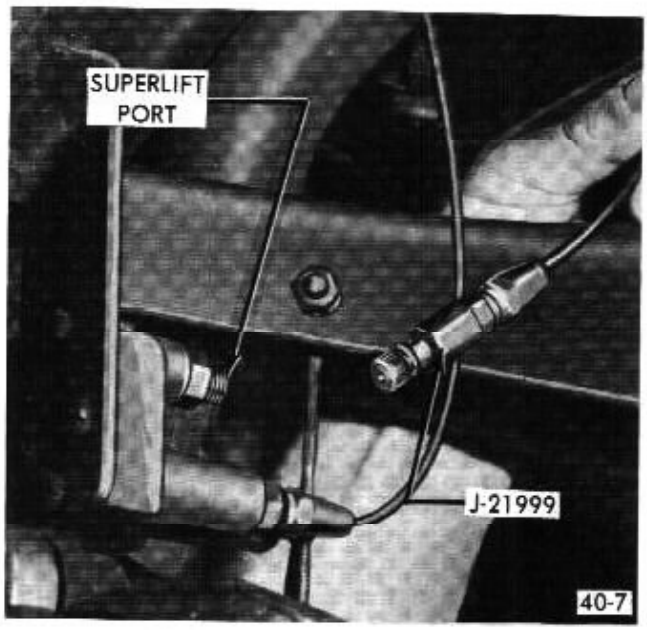

Figure 40-29 - Remove Superlift Air Supply Line

3. Connect male end of Fill Valve Assembly, J- 21999, to Superlift air supply line.

4. Inflate Superlifts to 8-15 psi, use tire gage on fill valve to determine pressure. Jounce car to neutralize suspension.

5. Connect test gage J-22124 to Superlift outlet on height control valve and attach an 80-110 psi air pressure source to test gage. See Figure 40-30.

b. Adjustment

1. Loosen height control valve lever adjusting nut. See Figure 40-31.

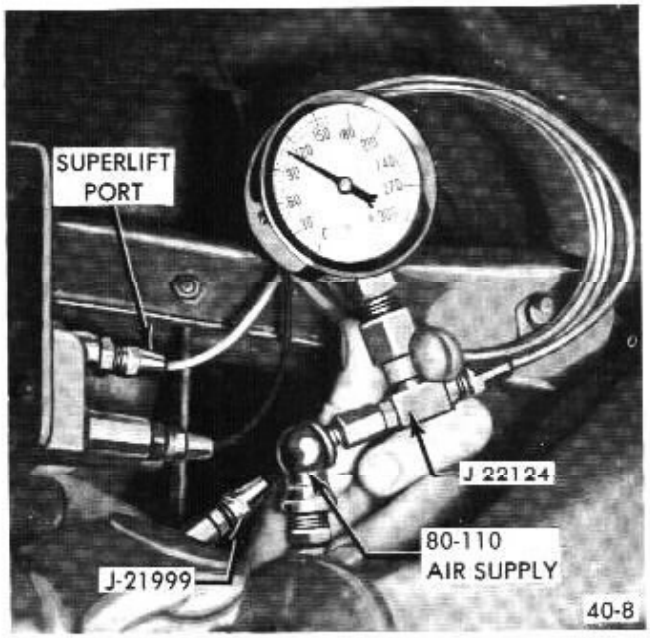

Figure 40-30 - Connect Test Gage to Superlift Outlet

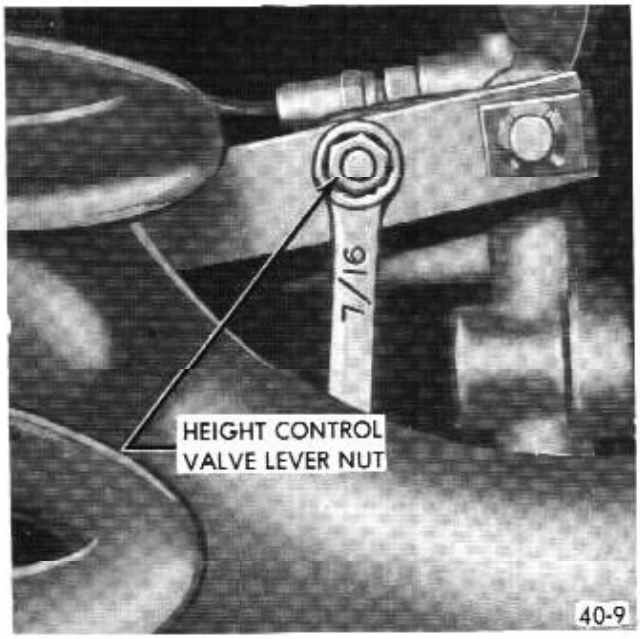

Figure 40-31 - Loosen Height Control Valve Lever Nut

2. Hold overtravel body down in exhaust position until air escapes from exhaust port. See Figure 40-32.

3. Slowly move overtravel body toward neutral position and point of minimum air bleed thru exhaust port. Tighten nut to 75 lb.in. With nut tight, a slight continuous air bleed should be noticable thru exhaust port.

c. Restore System

1. Remove test gage and air pressure source from Superlift outlet on height control valve.

2. Remove Fill Valve Assembly from Superlift air supply line and reconnect line to height control valve. Torque to 70 lb.in.

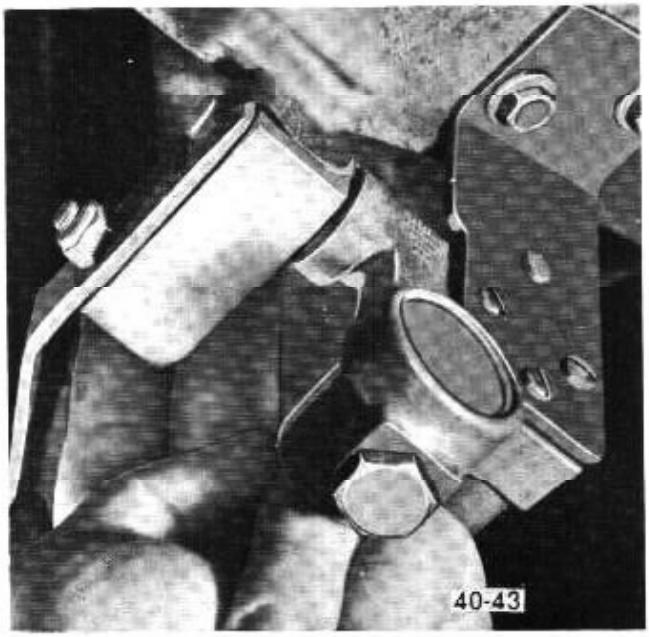

Figure 40-32 - Hold Overtravel Body in Exhaust Position

3. Lower car and inflate system through service valve on compression. See Figure 40-33. Load rear suspension and allow car to come to level position. Unload rear suspension, this will put the minimum 8 to 15 psi air pressure in the Superlifts.

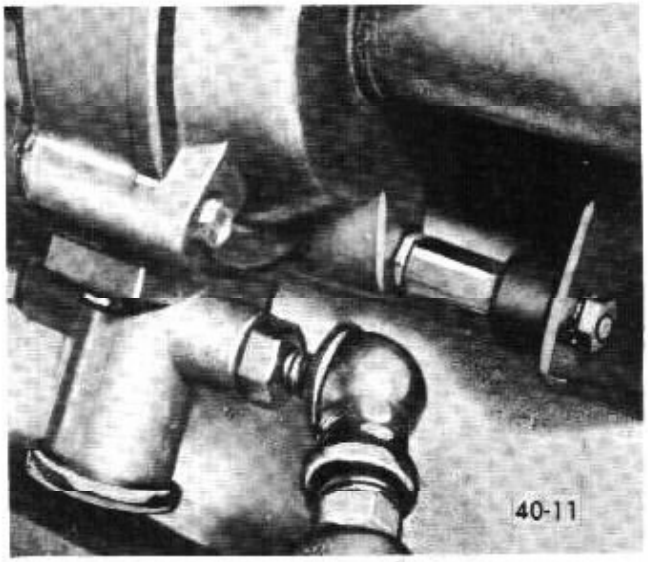

Figure 40-33 - Filling System Through Service Valve

DIVISION IV

REMOVAL AND INSTALLATION

40-19 REMOVAL AND INSTALLATION OF TUBING

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.

Tubing may be removed by simply unscrewing a fitting nut. Be sure system is deflated thru service valve before separating air lines. When installing tubing at any Automatic Level Control fitting, be careful not to kink line.

1. Preassemble metal sleeve and rubber seal. See Figure 40-28.

2. Place nut on tubing.

3. Insert tube into metal sleeve and rubber seal until tube bottoms.

4. Holding tubing in bottomed position, tighten tube nut securely (70 lb.in.)

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 assembly as described above. Be careful not to remove too much tubing, 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 cross member.*

40-20 REMOVAL OF COMPRESSOR, RESERVOIR AND REGULATOR VALVE ASSEMBLY

1. Deflate system through service valve.

2. Disconnect high pressure line at pressure regulator valve. Also disconnect vacuum line at compressor.

3. Remove nuts securing the assembly to the brackets and remove assembly.

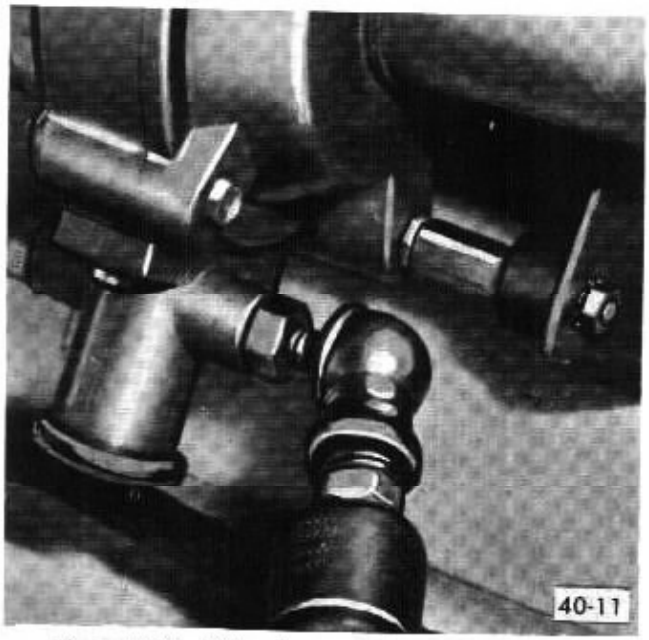

Figure 40-34 - Filling System Through Service Valve

1. Install assembly in brackets and tighten nuts to 30 lb inch.

2. Connect high pressure line to regulator valve and tighten fitting nut to 70 lb. inch. Install vacuum line to compressor.

3. Inflate system through service valve to maximum available pressure. See Figure 40-34.

NOTE: *If available pressure is less than 140 psi, start engine to build up reservoir to this pressure.*

DIVISION V

OVERHAUL AND MAJOR SERVICE

40-21 DISASSEMBLY OF COMPRESSOR ASSEMBLY

a. Disassembly of Compressor into Major Components

The compressor 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. This unit must not be lubricated as it is designed to operate dry.

1. Remove compressor as outlined in paragraph 40-20.

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.

NOTE: *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. Remove valve assembly from second stage housing and discard "O" ring seal.

10. Disconnect distributor arm tension spring from swivel arm.

11. Remove actuating arm retaining screw and arm.

12. Piston and diaphragm assembly can now be removed from first stage housing by carefully sliding the assembly straight out of housing.

b. Disassembly of Piston Diaphragm Assembly

1. Remove diaphragm retainer with diagonal pliers and discard retainer. See Figure 40-35.

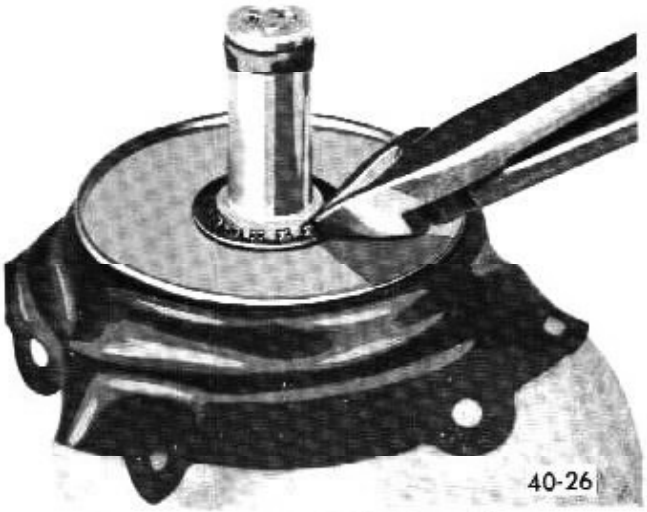

Figure 40-35 - Removing Diaphragm Retainer

2. Remove diaphragm plate, diaphragm, second diaphragm plate and corprene washer. The diaphragm and corprene washer can be discarded.

3. Remove and discard piston seals and "O" rings from piston.

NOTE: *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.

c. Disassembly of First Stage Housing and Valve Mechanism

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 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. See Figure 40- 36.

2. Remove two arm assembly stop bushings and two distributor valve stop bushings.

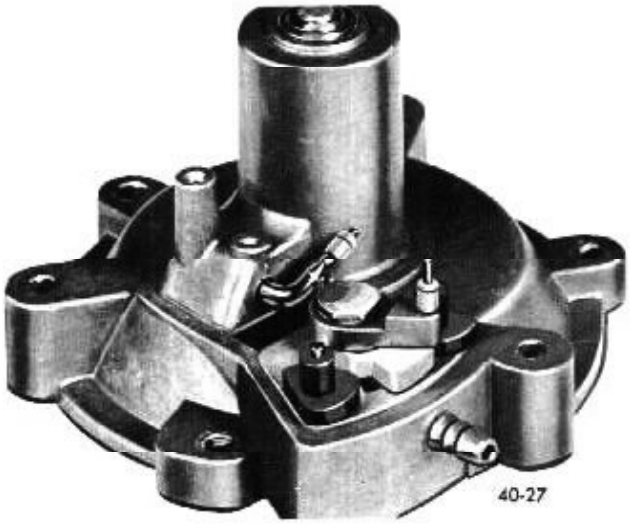

Figure 40-36 - Removal of Distributor Valve

3. Remove distributor valve being careful not to distort valve tension spring.

4. Carefully remove valve tension spring from boss. Do not distort spring.

NOTE: *Tension spring has one short foot and one long foot. The short foot fits under the distributor valve and the long foot fits into a hole drilled at an angle in the boss. See Figure 40-37.*

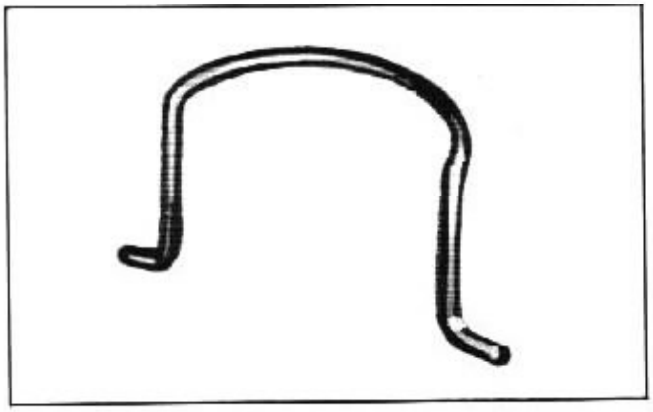

Figure 40-37 - Valve Tension Spring

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. See Figure 40- 38.

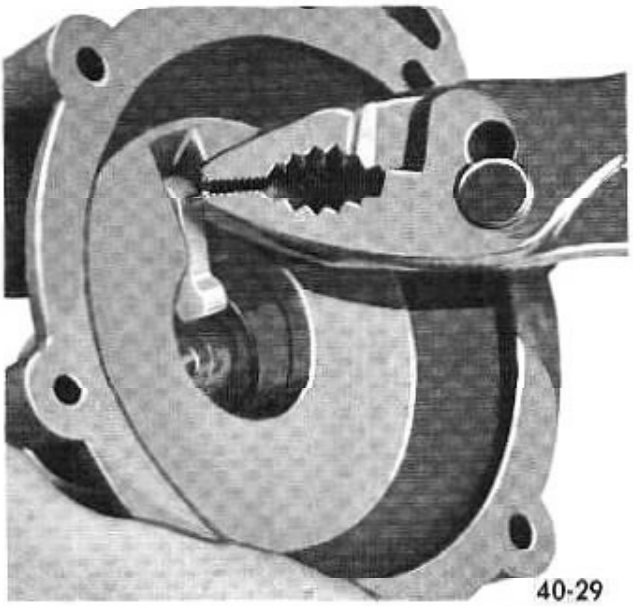

Figure 40-38 - Removing Rocker Arm Pin

d. Disassembly of Second Stage Housing

Remove check valve in second stage housing by inserting a suitable punch or piece of 3/32" welding rod through air passage and tapping.

40-22 CLEANING AND INSPECTION OF PARTS

All metal parts should be cleaned in clean solvent and blown zrywith compressed air.

a. 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 defect, replace if necessary.

b. 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.

c. 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.

40-23 ASSEMBLY OF COMPRESSOR ASSEMBLY

a. Assembly of Second Stage Housing

1. Install new check valve and spring.

2. Insert new expansion plug retainer and tap in until it bottoms. See Figure 40-39.

Figure 40-39 - Installing Check Valve

b. Assembly of First Stage Housing and Valve Mechanism

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.

NOTE: *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. See Figure 40-40.

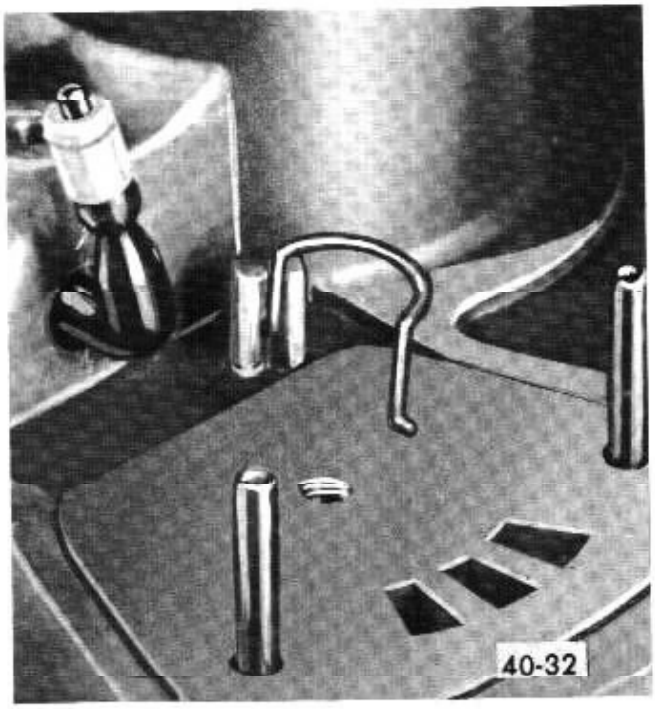

Figure 40-40 - Installing Valve Tension Spring in Boss

4. Position distributor valve so that short foot of tension spring fits under valve and vertical leg is in slot. See Figure 40-41.

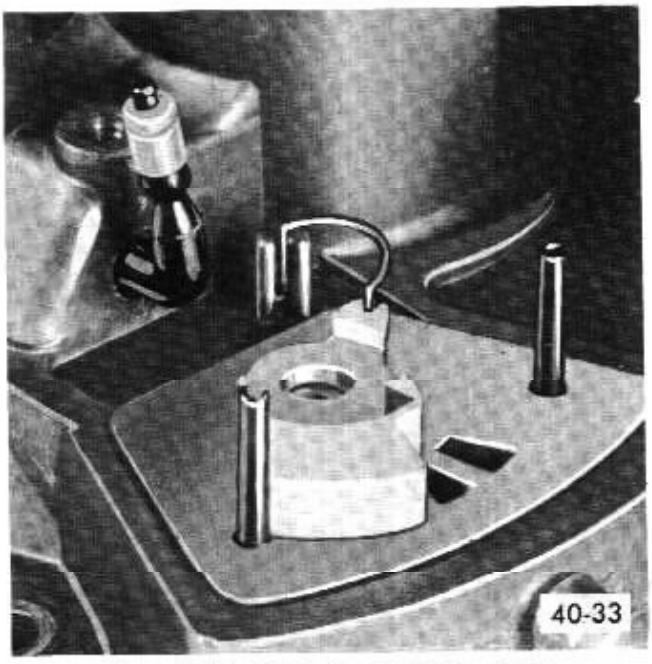

Figure 40-41 - Positioning Distributor Valve

5. Install distributor valve bushing, washer, distributor arm assembly, washer and secure with screw. Tighten to 12 lb.in. See Figure 40-42.

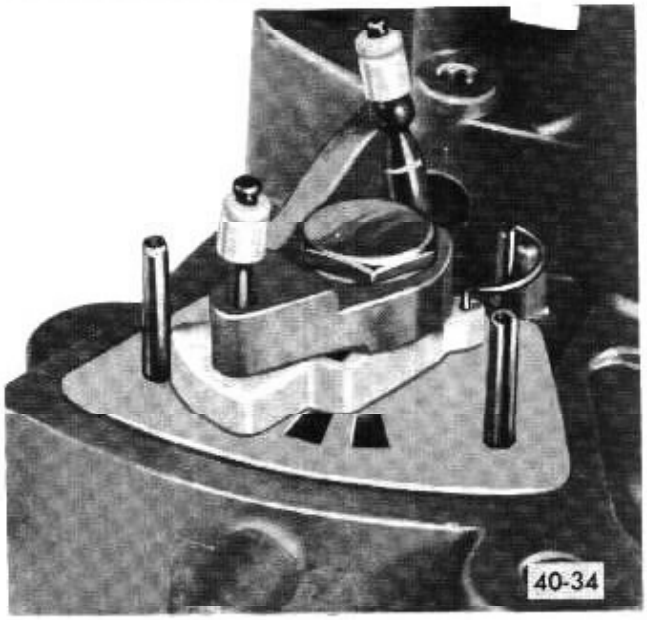

Figure 40-42 - Installing Distributor Arm Assembly

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.*

c. Assembly of Piston - Diaphragm Assembly

1. Install new corprene washer, old plate (unless damaged), new diaphragm (with outer lip toward second stage end of piston) and second plate. See Figure 40-43.

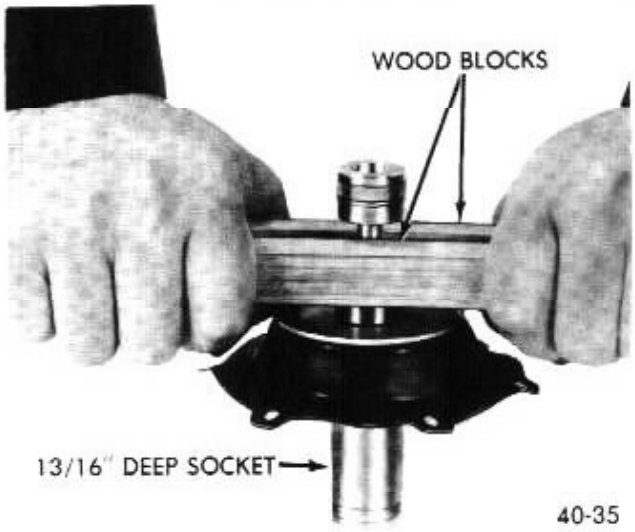

Figure 40-43 - Installing Diaphragm Retainer

2. Using a 13/16 inch 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".

NOTE: *Be sure retainer is securely seated in order to effect an air tight seal against the corprene seal.*

3. Install new "O" rings by rolling into groove. Relieve any resulting twist.

4. Install new seals using a piece of .020" shim stock. See Figure 40-44.

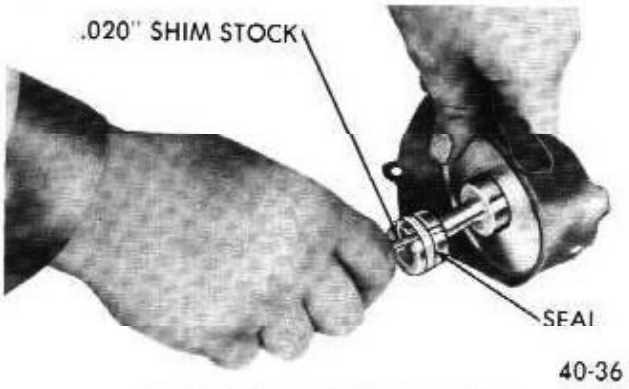

Figure 40-44 - Installing Piston Seal

NOTE: *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.*

d. Assembly of Major Components

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.

3. Connect arm tension spring to swivel arm.

4. Rotate piston in first stage housing to align elongated hole in diaphragm with vent port in housing.

5. Install second stage housing by sliding straight onto second stage piston.

6. Install three compressor retaining (short) bolts from the first stage housing side, through the second stage housing hex shaped, recessed holes. The first and second stage housings will align one way only. Position three small nuts in hex recesses and tighten bolts to 28 lb. inch.

7. Install new "O" ring on second stage housing. Install reservoir on second stage housing with three large nuts. Tighten to 28 lb. inch. Install the two reservoir retaining (long) bolts, from reservoir side, that do not go through cover. Tighten to 28 lb. inch.

8. Install new gasket and cover and secure with retaining screw. Tighten screw to 35 lb. inch. Install third reservoir retaining (long) bolt. Tighten to 28 lb. inch.

9. Install new "O" ring on pressure regulator and secure with two retaining screws with high pressure fitting toward reservoir. Tighten to 35 lb. inch.

10. Install two adapters and flexible mounts on the two reservoir (long) bolts that do not go through cover. Tighten to 28 lb. inch.

11. Compressor should be output tested before installation on car. See Division IV, Compressor Output Test on Car.

12. If compressor passes output test, install Compressor, Reservoir and Regulator Valve Assembly on car.

40-24 AUTOMATIC LEVEL CONTROL SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque Lbs. In.
Screw	Compressor Bracket to Skirt	1/4-14	96
Nut	Compressor to Bracket	#10-32	30
Bolt	Pressure Regulator Valve to Compressor	#10-32	30
Nut	Reservoir or Compressor Retaining Bolt	#10-32	30
Adapter	Rubber Mount to Compressor Retaining Bolt	#10-32	30
Nut	Height Control Valve Bracket to Frame	1/4-14	90
Screw	Height Control Valve Bracket to Valve	#8-32	18
Nut	Overtravel Body to Lever Adjusting	1/4-28 Locking	75
Screw	Vacuum Regulator Valve	1/4-14	96

b. General Specifications

Compressor, Pressure Regulator Valve and Tank Assembly ..... Two-Stage, Vacuum Actuated
Shocks ..... Delco Superlift Direct Double Acting
Spring ..... All Except Estate Wagon - Coil
Spring ..... Estate Wagon - Multi Leaf

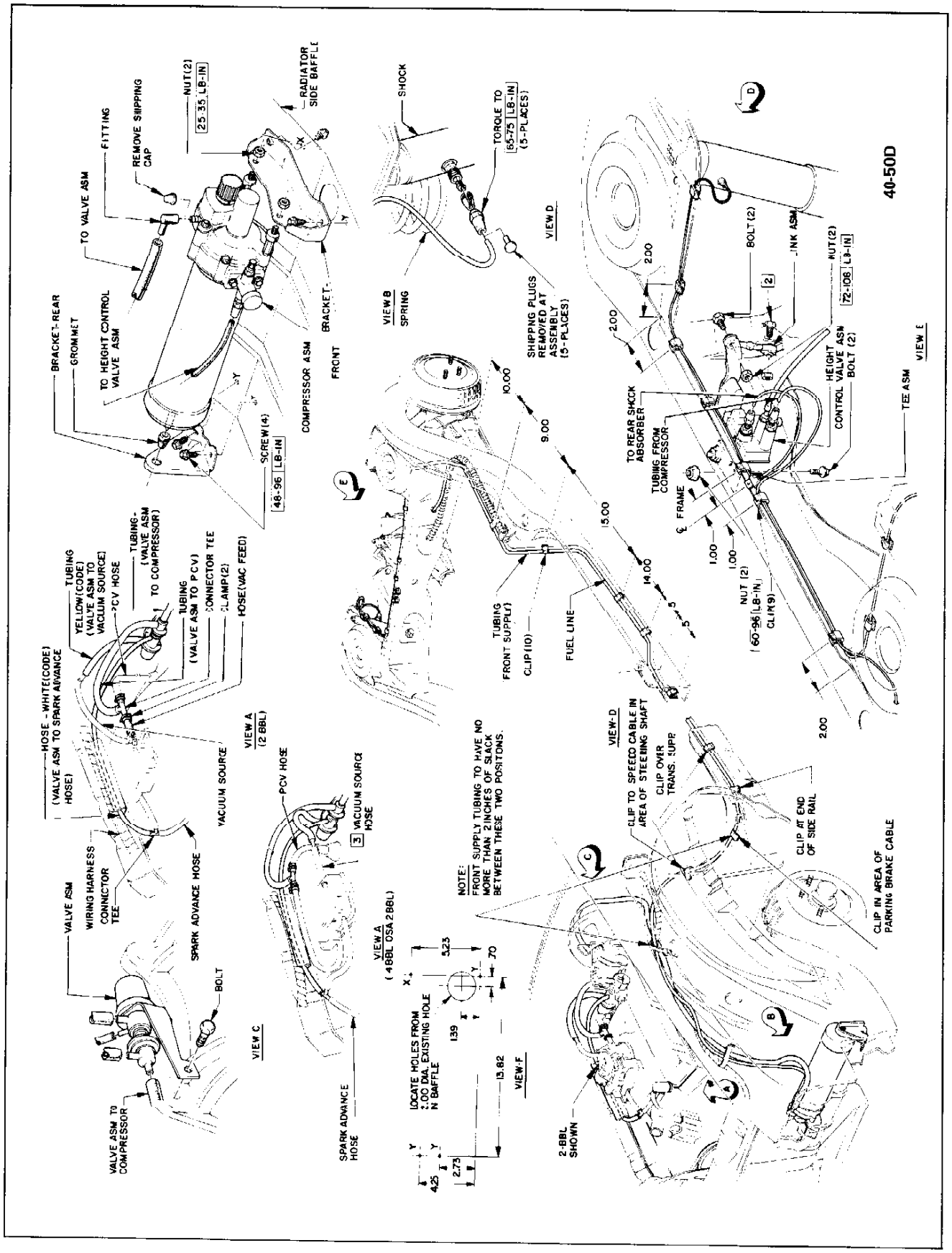

Figure 40-45 - Sportwagon - Automatic Level Control Details

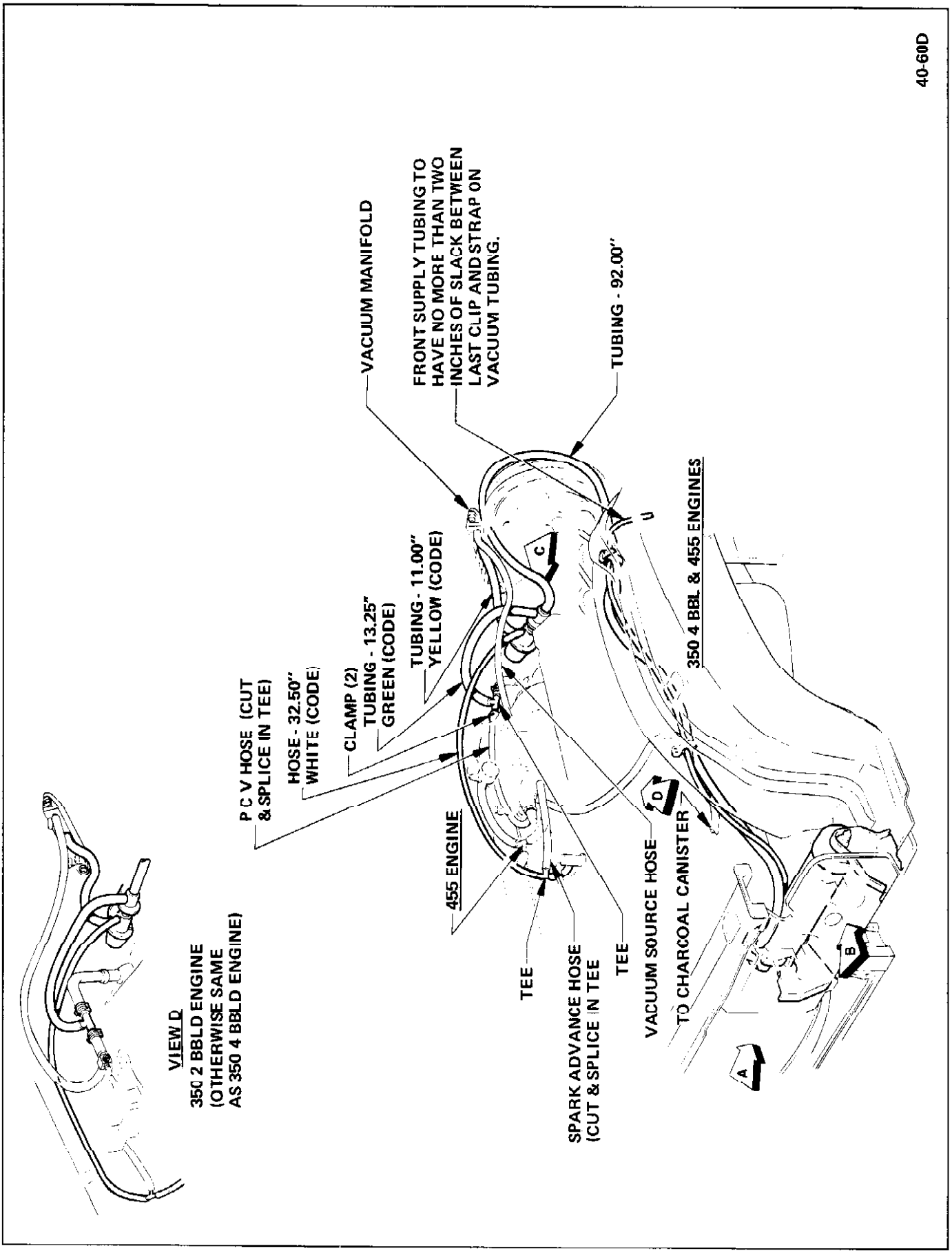

Figure 40-46 - 45-46-48-49000 (Less Estate Wagon) - Automatic Level Control Details

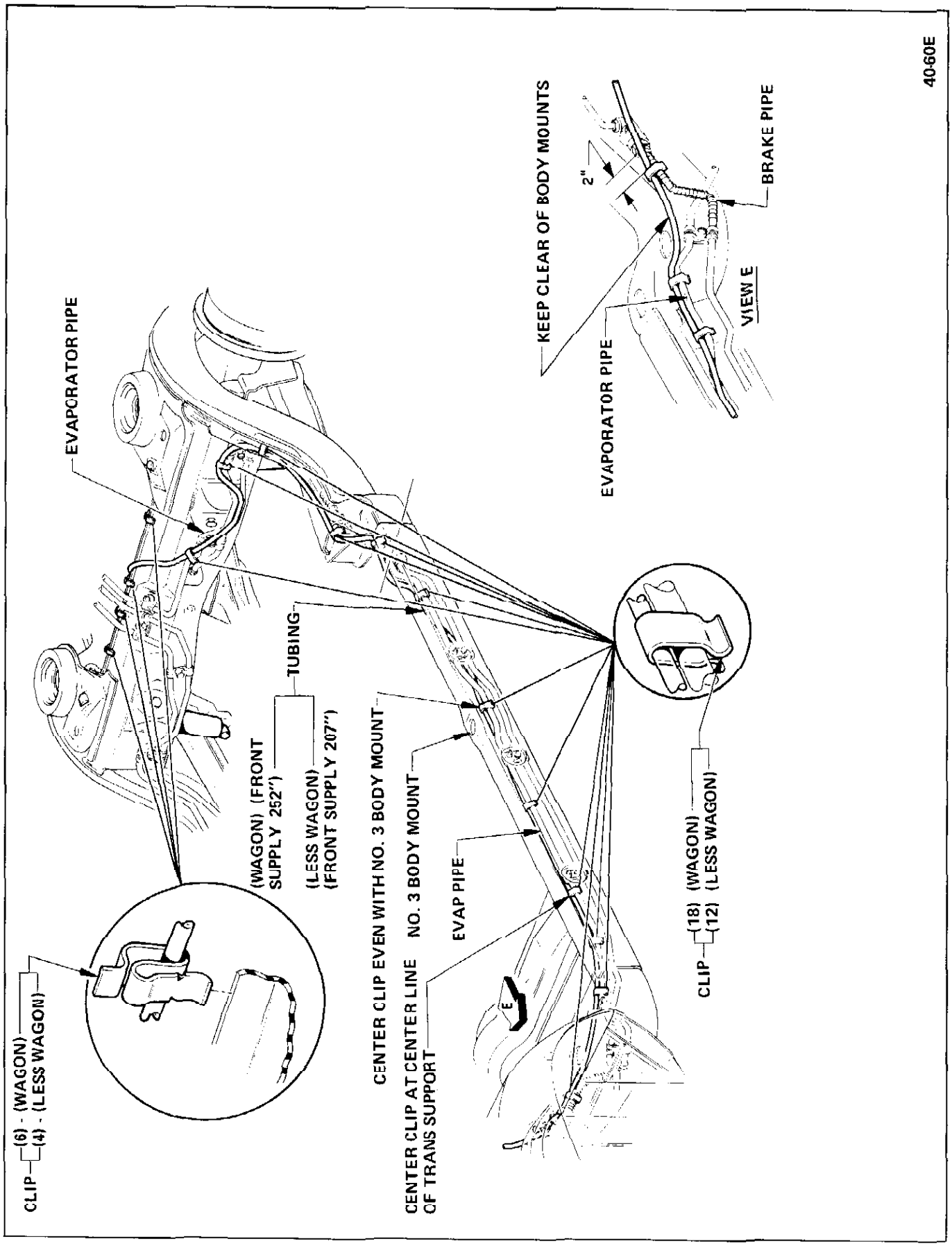

Figure 40-46A - 45-46-48-49000 (Less Estate Wagon) - Automatic Level Control Details

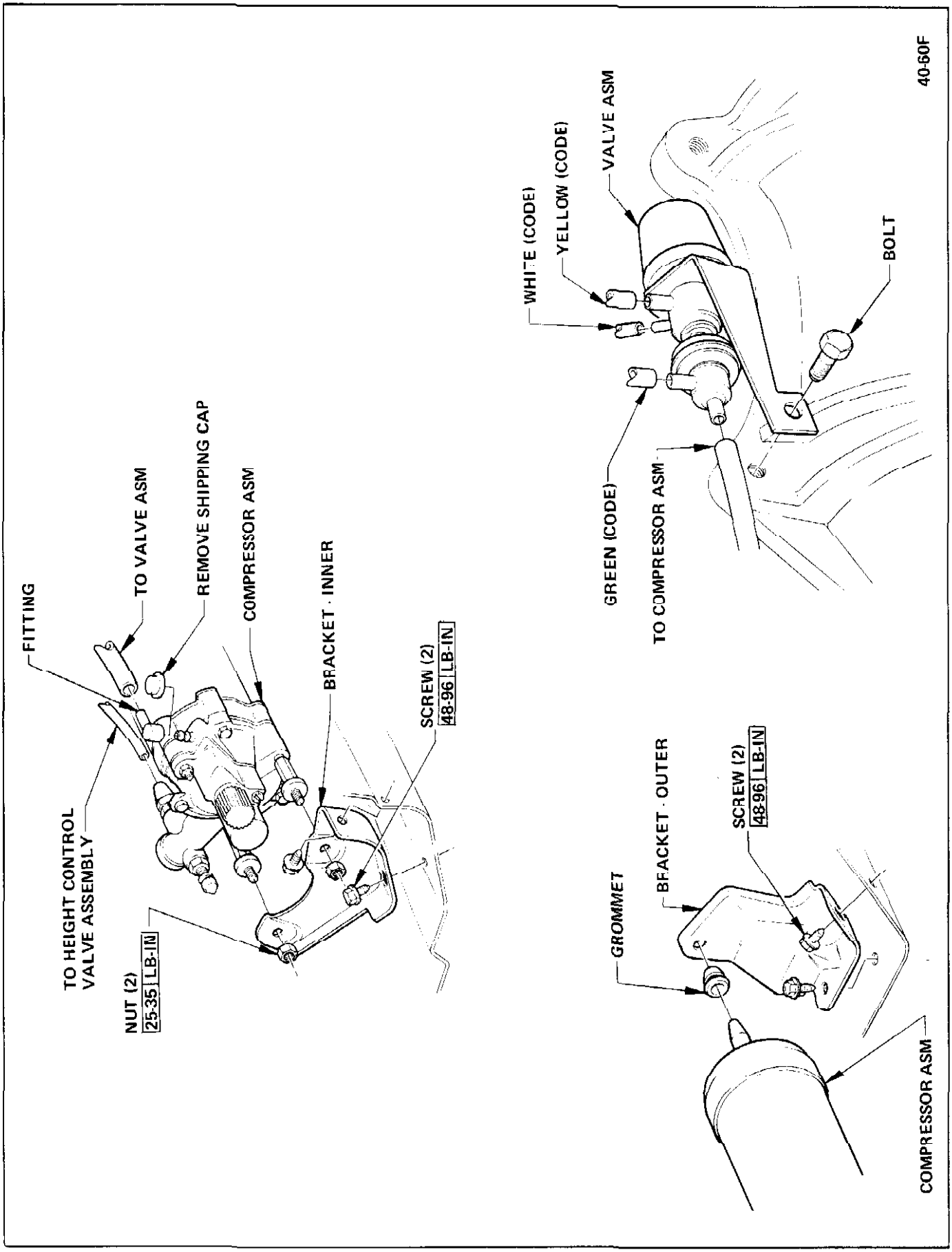

Figure 40-46B - 45-46-48-49000 (Less Estate Wagon) - Automatic Level Control Details

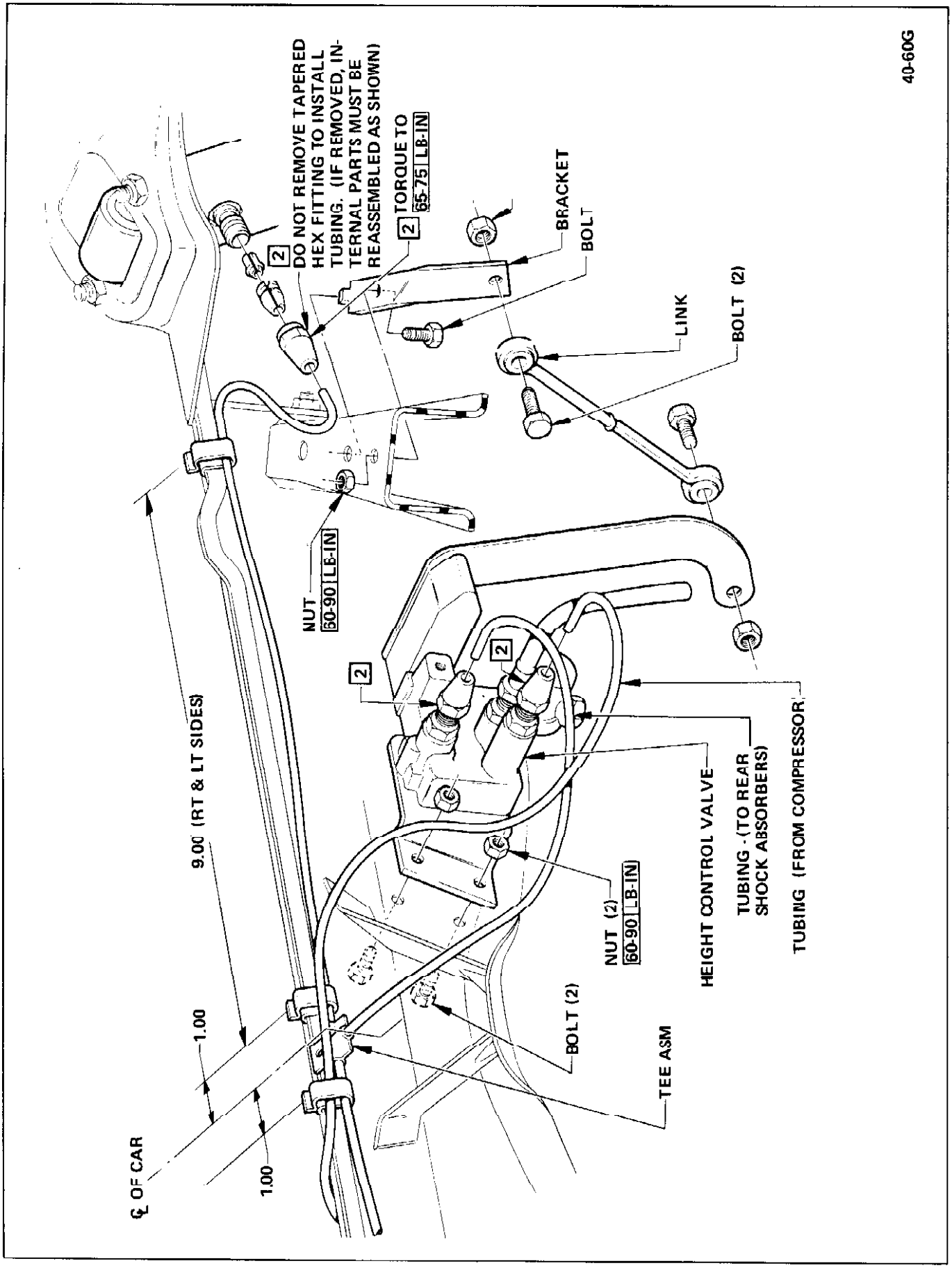

Figure 40-46C - 45-46-48-49000 (Less Estate Wagon) - Automatic Level Control Details

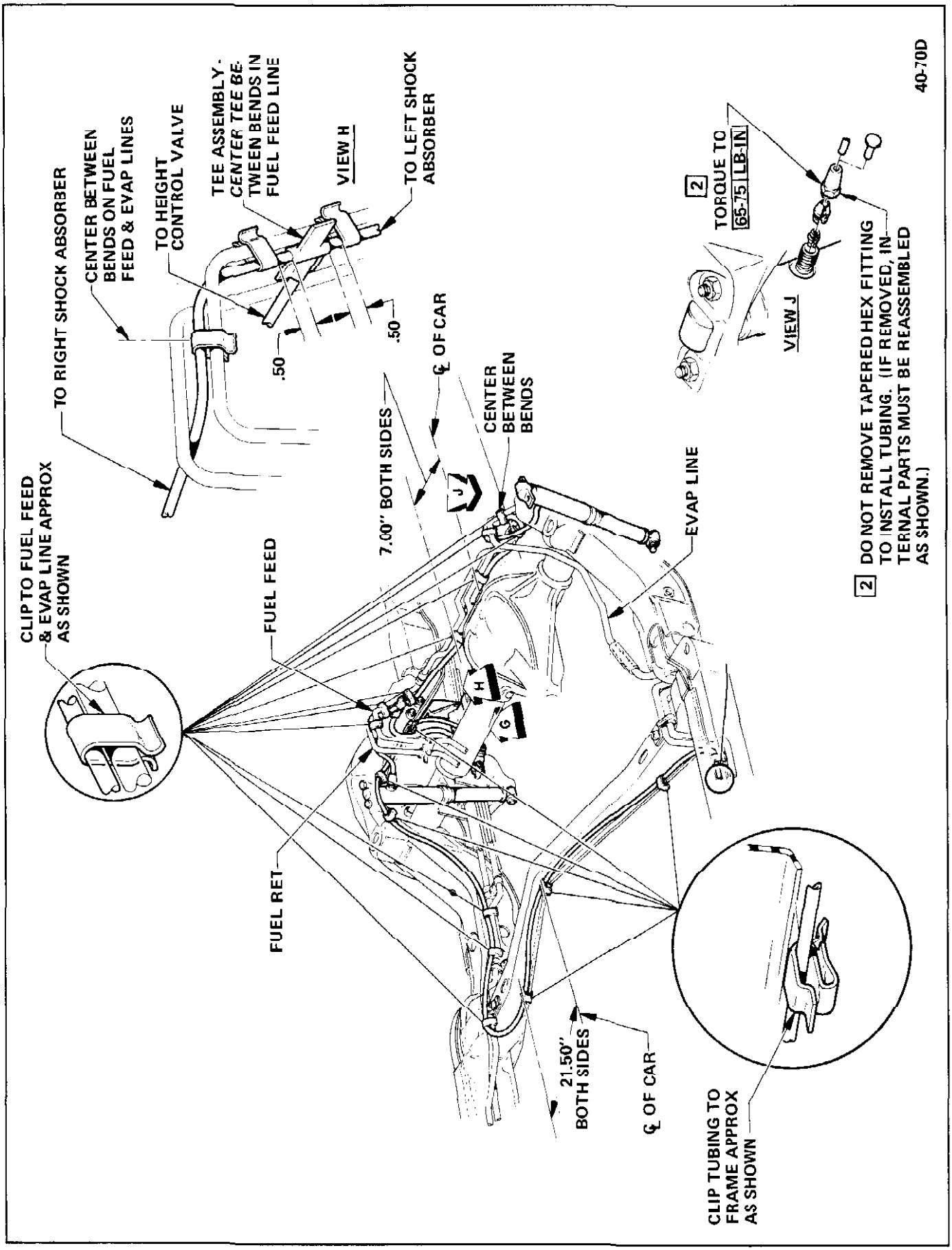

Figure 40-47 - Estate Wagon - Automatic Level Controls

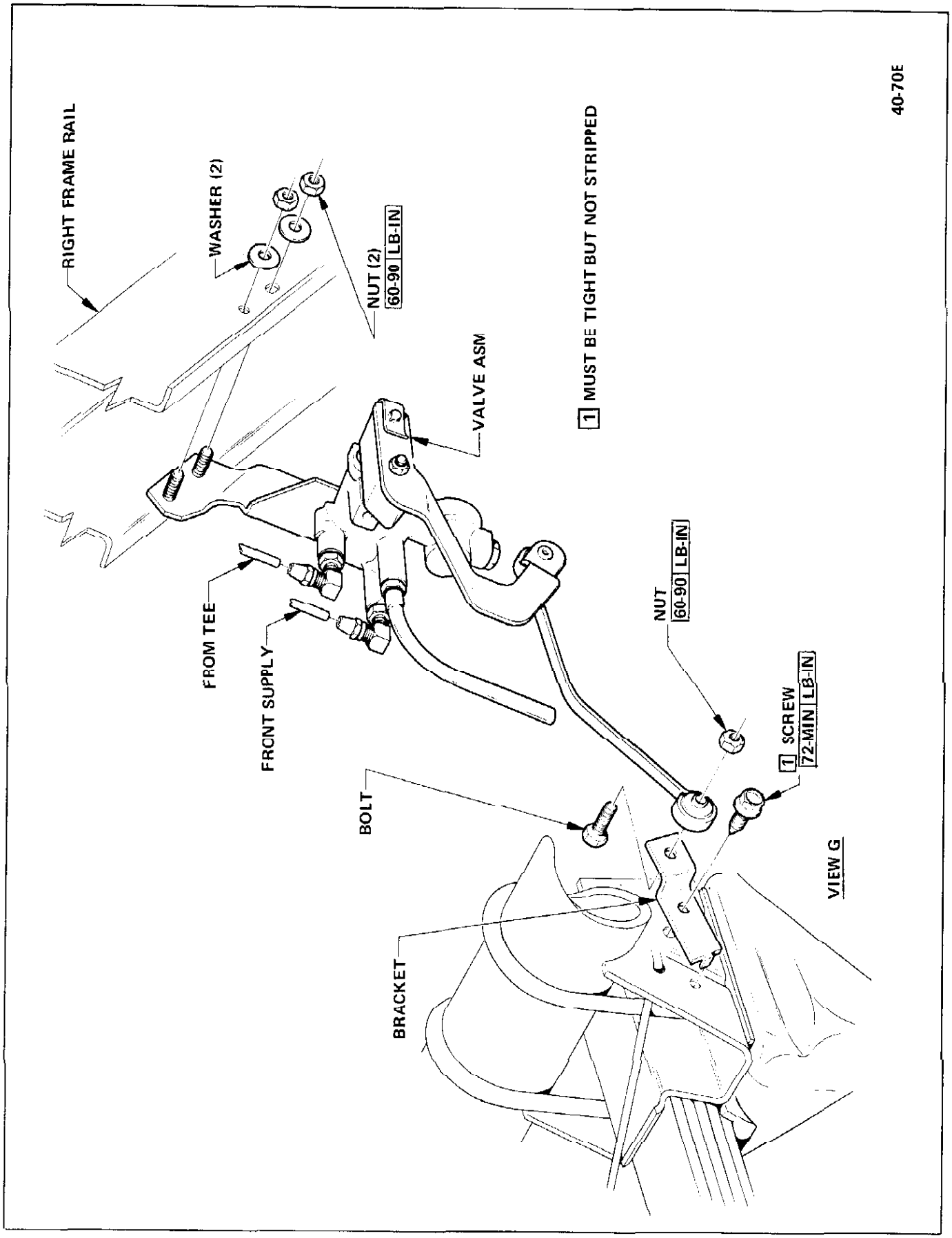

Figure 40-47A - Estate Wagon - Automatic Level Controls

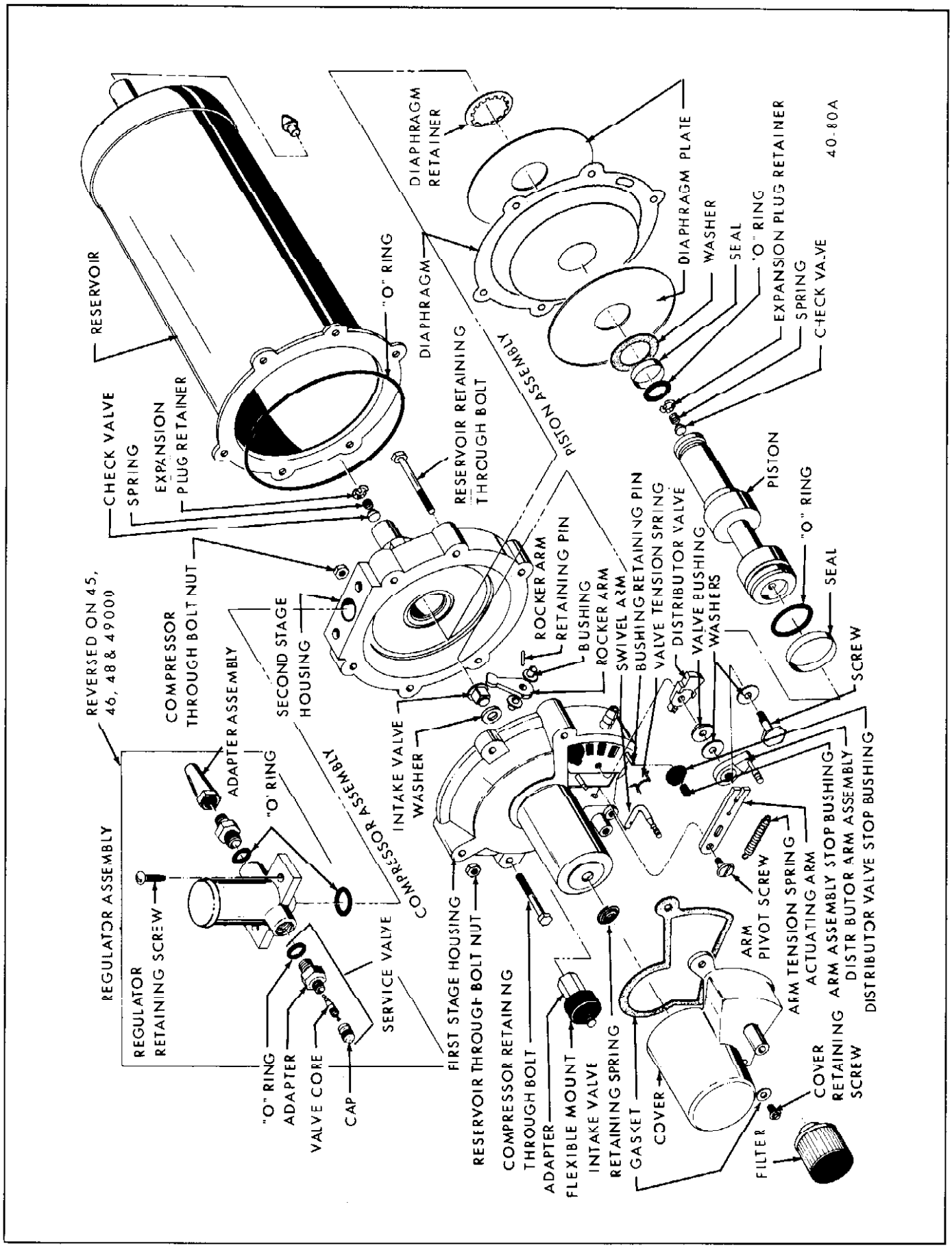

Figure 40-48 - Compressor Reservoir Tank and Regulator Valve Assembly - Exploded View

GROUP 40

REAR SUSPENSION, PROPELLER SHAFT AND DIFFERENTIAL

Section	Title
A	Rear Suspension . . . . .
B	Automatic Level Control . . . . .
C	Propeller Shaft, All Series. . . . .
D	Differential, All Series . . . . .

SECTION A

REAR SUSPENSION
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Checking Rear Shock Absorbers	40-1
	Checking Rear Chassis Springs	40-2
II	DESCRIPTION AND OPERATION:	
	Description of Rear Suspension	40-3
	Description of Rear Shock Absorbers	40-4
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION:	
	Removal and Installation of Rear Shock Absorbers	40-5
	Removal and Installation of Chassis Springs All Series Except Estate Wagon	40-6
	Removal and Installation of Chassis Springs - Estate Wagon	40-7
	Removal and Installation of Rear Lower Control Arm	40-8
	Removal and Installation of Rear Upper Control Arm	40-9
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	Rear Suspension Specifications	40-10

DIVISION I

TROUBLE DIAGNOSIS

40-1 CHECKING REAR SHOCK ABSORBERS

Many shock absorbers have been replaced and returned to the factory with the report that they were weak. When tested with special factory equipment, very few of these replaced units have been found weak or otherwise below standard in operation. This indicates that these shock absorbers were needlessly replaced in an attempt to improve riding conditions that were actually standard or that erroneous methods were used in judging the operating condition of the shock absorbers.

NOTE: *Slight dampness around piston rod seal is normal and represents fluid used to lubricate the piston rod and seal.*

Before attempting to test shock absorbers, make sure that all attaching bolts and nuts are tight. Tires should be uniformly inflated to specified pressure (Group 100). The chassis should be well lubricated to make sure that suspension parts are free moving.

Test each front and rear shock absorber in turn by quickly pushing down and then lifting up on the end of the car bumper adjacent to the unit being checked. Use the same force as near as possible on each test and note the amount of resistance provided by the shock absorber on compression and rebound. A little practice on another car of the same model which has satisfactory ride control will aid in judging the amount of resistance that should exist.

Both rear shock absorbers should provide the same feeling of resistance. Any noticeable variation between right and left shock absorbers indicates that one unit is not operating normally.

If there is any doubt about the action of a shock absorber after testing as described above, remove the unit from car. See paragraph 40-5. Mount it vertically in a vise with jaws gripping the lower mounting eye firmly, then move the piston rod up and down by hand several times. There should be no free movement in this test after cycling several times. Lack of resistance to movement indicates air in the shock absorber, or that the valve is held open by dirt. A faulty shock abosrber must be replaced as it cannot be disassembled for repairs. However, shocks should not be replaced in pairs (or car sets) to correct one faulty shock.

NOTE: *Do not operate shock absorber in a horizontal position or upside down. This will cause air to be trapped and shock will "lag" (appear defective).*

In the test given above, the amount of force that can be applied is not sufficient to open a valve against its spring pressure; therefore, this test only checks the flow of fluid through the valve bleeder hole or due to a valve being held open or due to internal wear of piston and cylinder.

Since it is unlikely that the valve springs will weaken in service, it may be assumed that the shock absorber action is normal if it operates satisfactorily in the test given above.

40-2 CHECKING REAR CHASSIS TRIM

Optional equipment, undercoating, accumulated dirt, etc., change the car weight and must be considered when checking trim height. When checking trim height, be sure that car is at curb weight. Curb weight includes gas, oil, water and spare tire but no passengers or luggage. See Figure 40-4.

Before measuring spring dimensions, bounce both ends of car up and down several times to make sure there is no bind in suspension members and to let springs take a natural position.

DIVISION II

DESCRIPTION AND OPERATION

40-3 DESCRIPTION OF REAR SUSPENSION

a. Rear Suepension All Seriee Exoept Estate Wagon

The rear wheels are not independently sprung, being incorporated in the rear axle assembly. Alignment is maintained by the rigid rear axle housing. See Figures 40-5 and 7.

The rear axle assembly is attached to the frame through a link type suspension system. Two rubber bushed lower control arms mounted between the axle assembly and the frame maintain fore and aft relationship of the axle assembly to the chassis. Two rubber bushed upper control arms, angularly mounted with respect to the centerline of the car, control driving and braking torque and sideways movement of the axle assembly.

The upper control arms are shorter than the lower arms, causing the differential housing to "rock" or tilt forward on compression. This rocking or tilting lowers the rear propeller shaft to make possible the use of a lower tunnel in the rear floor pan area than would be possible with a conventional rear suspension. See Figure 40-1.

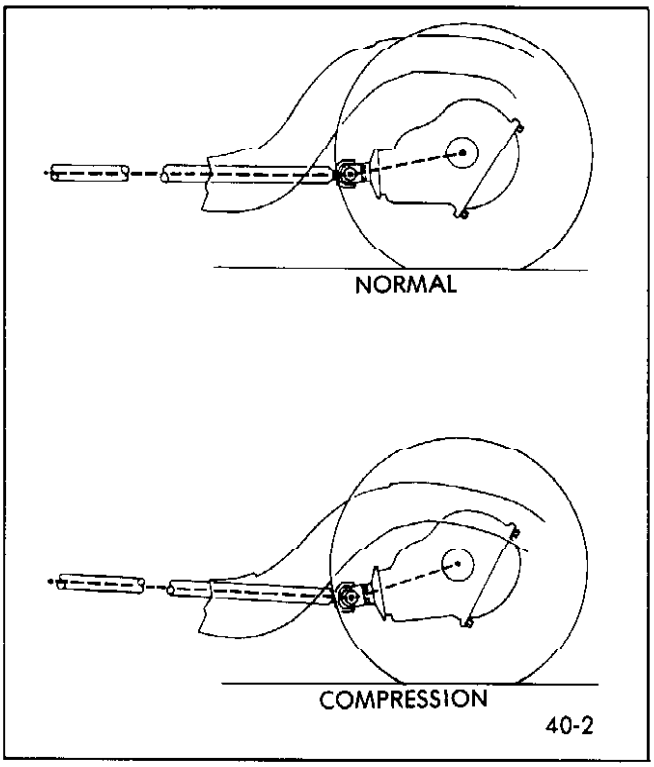


Figure 40-1 - Differential Tilting Action

The rear upper control arms control drive forces, side sway and pinion nose angle. Pinion angle adjustment can greatly affect car smoothness and must be maintained as specified.

The rear chassis springs are located between brackets on the axle tube and spring seats in the frame. The springs are held in the seat pilots by the weight of the car and by the shock absorbers which limit axle movement during rebound.

Ride control is provided by two identical direct double

acting shock absorbers angle-mounted between brackets attached to the axle housing and the rear spring seats.

b. Rear Suspension Estate Wagon

The rear wheels are not independently sprung, being incorporated into the rear axle assembly. The rear wheels are held in proper alignment with each other by the rigid construction of the axle housing. With the use of an open type drive line, driving and braking forces are taken by multi leaf springs. See Figure 40-8.

Ride control is provided by two identical direct double acting shock absorbers angle-mounted between spring attaching plates at the axle housing and to the frame.

40-4 DESCRIPTION OF REAR SHOCK ABSORBERS

a. Shock Absorber Type and Location

Rear shock absorbers are Delco direct double action, (telescoping) hydraulic type. All shocks are filled with a calibrated amount of fluid and sealed during production; therefore, no refilling or other service is necessary or possible.

Each rear shock absorber is mounted at an angle with the upper end "in" toward the center of the car. The upper end is attached to a frame bracket. The lower end is attached to a bracket welded to the rear axle tube.

The rear shock absorbers except for Superlifts are interchangeable with respect to left and right.

Front and rear are not interchangeable with each other.

b. Shock Absorber Construction and Operation

The shock absorber consists of two concentric tubes, a piston and rod, and valves for controlling hydraulic resistance. The rear shock absorber has an additional tube which acts as a stone shield. See Figure 40-2.

The pressure (inner) tube provides a cylinder in which the piston and rod operate. The upper end is sealed by a piston rod seal and the lower end is closed by the compression valve assembly. This tube is completely filled with fluid at all times. The reservoir outer tube provides space for reserve fluid and for overlfow from the pressure tube during operation.

This piston, piston rod and stone shield are attached to the car frame, while the pressure and reservoir tubes are attached as a unit to the chassis suspension through the lower mounting. As the wheel moves up and down with respect to the frame, the chassis spring is compressed or elongated and the shock absorber is compressed or extended. This action forces the fluid to move between the pressure and reservoir tubes through small restricting orifices in the valves. The relative slowness of fluid movement imposes restraint on the telescoping or extension of the shock absorber, thus providing the required control of axle and body movements.

1. Compression Stroke Operation

When the chassis spring is being compressed, the shock absorber is compressed causing the piston to move down in the pressure tube, forcing fluid through holes in the

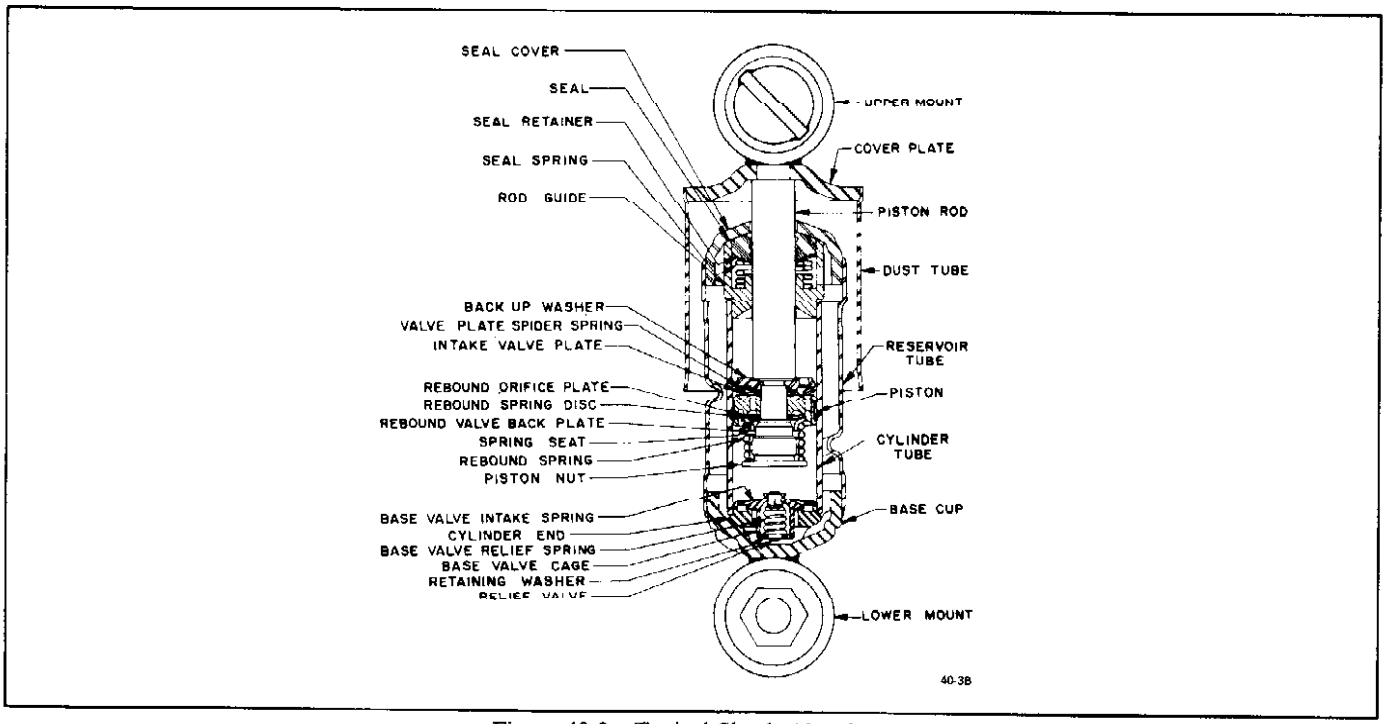


Figure 40-2 - Typical Shock Absorber

piston. The pressure lifts the intake valve plate, allowing fluid in lower chamber to pass into the upper chamber. As the piston rod moves downward into the pressure tube, it occupies space previously filled with fluid and this displaced fluid is forced out of the lower chamber into the reservoir through the restricting orifice in the compression valve. On fast or extreme movements when the fluid flow exceeds the capacity of the orifice, the spring loaded relief valve in the compression valve assembly is forced open to permit more rapid escape of fluid. The amount of compression control is governed by the area of the orifice, the area of the piston holes, and the force of the compression relief valve spring.

2. Rebound Stroke Operation

When the chassis spring expands or rebounds, the shock absorber is extended and its resistance is instantly effective. As the piston is pulled upward, the intake valve plate seats and fluid in the upper chamber is forced through slots in the plate and holes in the piston to build up pressure against the rebound orifice plate. As the pressure increases, the rebound spring is compressed and the orifice plate leaves its seat to permit fluid to pass into the lower chamber. As the piston rod moves upward out of the pressure tube, the space previously occupied by the rod is filled with fluid drawn into the lower chamber from the reservoir. A separate intake valve in the compression valve assembly opens to permit return of this fluid.

DIVISION IV

REMOVAL AND INSTALLATION

40-5 REMOVAL AND INSTALLATION OF REAR SHOCK ABSORBER

NOTE: *This Section covers the standard shock absorber only. See Section B for Automatic Level Control.*

Both rear shock absorbers are filled and sealed in production and cannot be refilled in service.

a. Removal

1. Raise rear of car and support rear axle assembly.

2. Disconnect shock at lower end. Disconnect shock at upper end and remove shock. See Figures 40-4, 6, and 8.

NOTE: *A hex is located on the stud between the axle bracket and shock absorber lower bushing so that a wrench can be used to remove the lower attaching nut without turning the stud. Failure to hold the stud in this manner will result in damage to the mechanical bond between the shock absorber bushing and the lower mounting stud.*

b. Installation

NOTE: *Do not operate shock absorber in a horizontal position. This will cause air to be trapped and shock will "lag" (appear defective).*

1. Make certain that new shock absorber is correct for car model as indicated by part number stamped on the outer tube. See Master Chassis Parts Catalog Group 7.345 for standard and optional parts.

NOTE: *Before installing new shock absorbers, place each one vertically in a vise and stroke through full travel until hydraulic resistance is smooth. This pumps trapped air out of the inner cylinder. Keep the shock in a vertical position until installed in the car.*

2. Loosely attach shock at upper and lower mounting points. While observing the following "NOTE", tighten mounting parts to specified torque.

NOTE: *Car weight must be on rear wheels when tightening shock absorber lower ends in order to clamp rubber bushings in a neutral or unloaded position.*

Shock absorber calibrations as furnished in production have been carefully engineered to provide the best ride control over a wide range of driving conditions. Substitution of other calibrations can alter handling and ride characteristics and are not normally recommended by Buick Motor Division.

40-6 REMOVAL AND INSTALLATION OF REAR CHASSIS SPRINGS - ALL SERIES EXCEPT ESTATE WAGON

a. Removal

1. Raise rear end of car and support frame on jack stands.

2. Mark universal joint and pinion flange for correct reinstallation. This maintains the balance between these two parts as installed during original assembly.

3. Disconnect and slide propeller shaft forward far enough to clear rear companion flange. Wire or otherwise suitably support propeller shaft up out of the way. This will prevent damage to universal joint caused by allowing it to bend to the end of its travel.

4. Position jack under rear axle housing and raise jack slightly to relieve tension on shock absorber.

5. Disconnect shock absorbers at axle bracket by removing nut.

6. Carefully lower jack to fully extend spring after disconnecting shocks and remove spring.

NOTE: *It may be necessary to disconnect rear brake line in order to obtain sufficient axle drop to remove spring.*

NOTE: *Do not completely lower jack as this will cause strain on brake hose.*

b. Installation

NOTE: *Position spring, as shown in Figure 40-7.*

1. Install insulator on top of spring. Rotate spring so that top end is located as shown in Figure 40-7.

2. Raise rear axle and connect shock absorber. Tighten mounting stud nut to 45 lb.ft.

NOTE: *Car weight must be on rear wheels before tightening shock absorber lower ends.*

3. Carefully attach the propeller shaft to the rear companion flange. Tighten U-bolt nuts on 43-44-45- 46-48000 to 12 lb. ft. On 49000, tighten flange bolts to 85 lb.ft.

NOTE: THIS PROPELLER SHAFT TO PINION FLANGE 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.

NOTE: *If rear brake line was disconnected, connect line and bleed rear brake system.*

4. Remove jack stands and lower car.

40-7 REMOVAL AND INSTALLATION OF CHASSIS SPRINGS - ESTATE WAGON

a. Removal

1. Raise car on hoist.

2. Disconnect shock at lower attachment by removing nut.

3. Support car by placing jack stands at frame in front of leaf springs and at rear of leaf springs at bumper. It is also necessary to support axle.

4. Disconnect right side of exhaust system by removing exhaust hanger screw to rear frame cross member.

5. Remove lower spring plate attaching nuts.

6. Remove front and rear attaching bolts and remove spring.

b. Installation

NOTE: *See Figure 40-8 for leaf spring attachment.*

1. Connect leaf spring at front attachment.

2. Lubricate rubber spring cushions and attach lower spring plate. Be sure spring cushions are in plate. Torque nuts to 40 lb.ft.

NOTE: *It may be necessary to lower axle to attach spring plate.*

3. Attach leaf spring at rear shackle. Torque nut to 115 lb. ft.

4. Torque nut at front attachment to 75 lb. ft.

5. Reconnect shock.

6. Reconnect exhaust system.

7. Remove jack stands and lower hoist.

40-8 REMOVAL AND INSTALLATION OF REAR LOWER CONTROL ARM

NOTE: *If both right and left lower control arms are to be replaced, one side should be completed before opposite side is started in order to keep axle from rotating out of position.*

a. Removal

1. With axle housing and frame supported, remove lower control arm rear bracket bolt. If some difficulty is encountered in removing bolt, reposition jack farther forward under nose of carrier and slowly raise to relieve pressure and bind at control arm bushing. It may be necessary to use suitable brass drift to tap out bolt.

2. Remove lower control arm front bracket nut and bolt. After nut is removed, it may be necessary to tap out bolt with brass drift. Remove lower control arm.

b. Installation

NOTE: *Fasteners in steps 1 and 2 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

1. Position control arm in front bracket and install bolt and nut. Do not tighten.

2. Raise or lower nose of axle slowly with jack until bush-

ing in arm and holes in axle bracket align. Install nut and bolt.

3. Torque attaching nuts and bolts to specification.

NOTE: *Attaching parts should be tightened with suspension in curb load position.*

40-9 REMOVAL AND INSTALLATION OF REAR UPPER CONTROL ARM

NOTE: *If both right and left upper control arms are to be replaced, one side should be completed before opposite side is started in order to keep axle from rotating out of position.*

a. Removal

1. Raise rear of car and support frame and rear axle assembly.

2. Disconnect control arm at axle housing by removing attaching nut and bolt.

3. Disconnect arm at frame by removing nut and bolt.

4. Remove upper arm assembly.

b. Installation

NOTE: *Fasteners in steps 1 and 2 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

1. Position new arm in the frame bracket with nut and bolt Do not tighten.

2. Align holes in bushing and holes in axle housing. Install nut and bolt. Torque attaching nuts and bolts to specification.

NOTE: *Attaching parts should be tightened with suspension in curb load position.*

NOTE: *It may be necessary to jack the carrier nose up or down slightly to align the mounting holes for bolt removal or installation.*

40-10 REAR SUSPENSION SPECIFICATIONS

a. Tightening Specifications

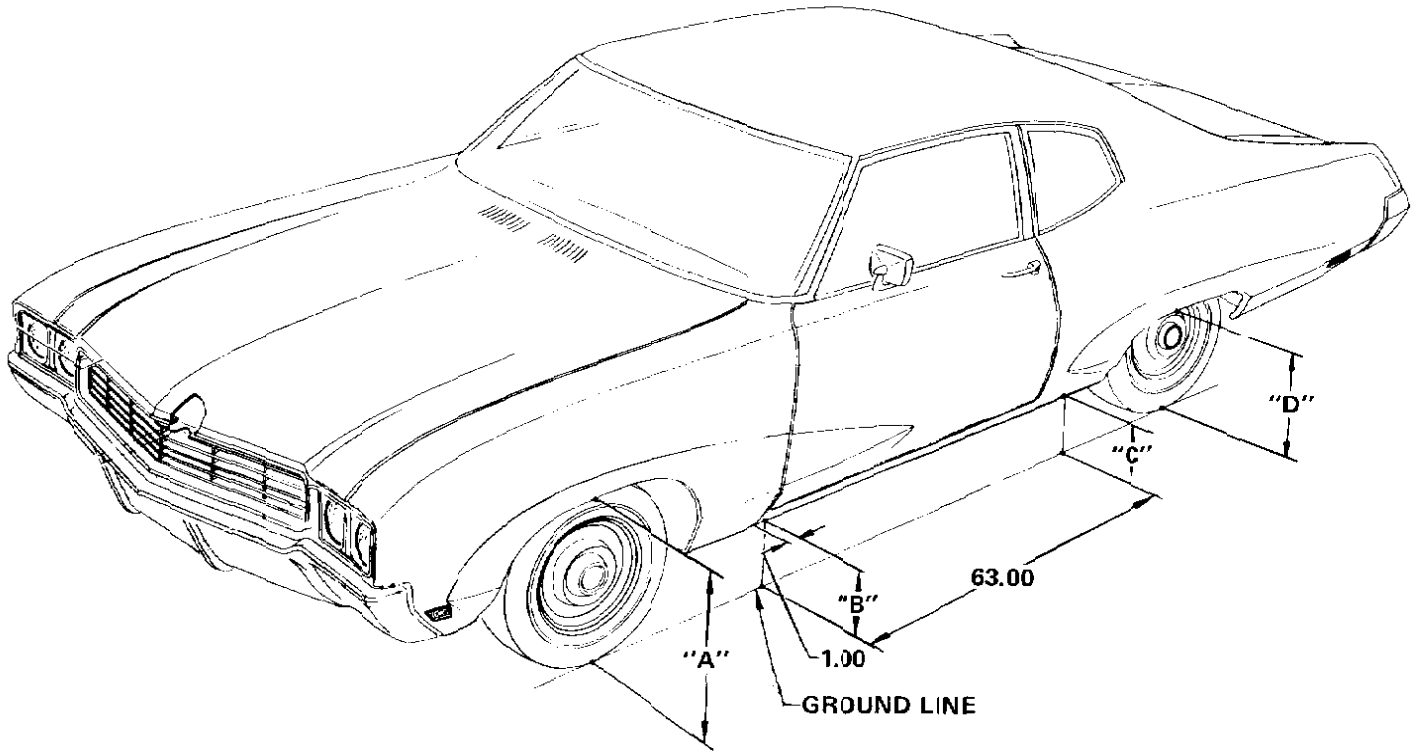
Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque
Nut and Bolt	Rear Shock Upper Mounting	5/16-18	18 lb. ft.
Nut	Rear Shock Lower Mounting	1/2-20	65 lb. ft.
*Nut	Upper and Lower Control Arm	1/2-13	80 lb. ft.
*Bolt	Upper and Lower Control Arm	1/2-13	110 lb. ft.
Nut	Rear Propeller Shaft "U" Joint to Pinion Flange (43-44000 & Estate Wagon)	5/16-18	15 lb. ft.
Bolt	Rear Propeller Shaft Flanged Yoke to Pinion Flange (45-46-48-49000)	7/16-14	70 lb. ft.

*Torquing of Nut or Bolt to be optional

b. General Specifications

Shock Absorbers ..... Delco Direct Double Acting
Springs ..... (All Except Estate Wagon) Coil
Springs ..... Estate Wagon - Multi-Leaf



Dim	Skylark	·G.S.	Sportwagon	Estate Wagon	LeSabre	Centurion	Electra	Riviera
CURB HEIGHT AT CURB WEIGHT								
A	26 15/16	26 1/2	28 1/8	29 11/16	28 1/2	28 1/2	28 5/8	29
B	10 1/4	9 3/4	11 1/2	10 1/2	9 1/4	9 1/4	9 3/8	9
C	10 1/8	9 7/16	11 1/2	10 1/2	9 3/16	9 3/16	9 5/16	8 5/8
D	25 1/8	24 15/16	26 11/16	25 11/16	25 5/16	25 5/16	24 7/16	28 13/16
Dimensions given do not include moldings except for "B" and "C" dimensions on Riviera.								

ALLOWABLE VARIATIONS

Locations "B" and "C" ± 3/4
Side to Side ± 3/8

40-42C

Figure 40-3 - Trim Dimensions

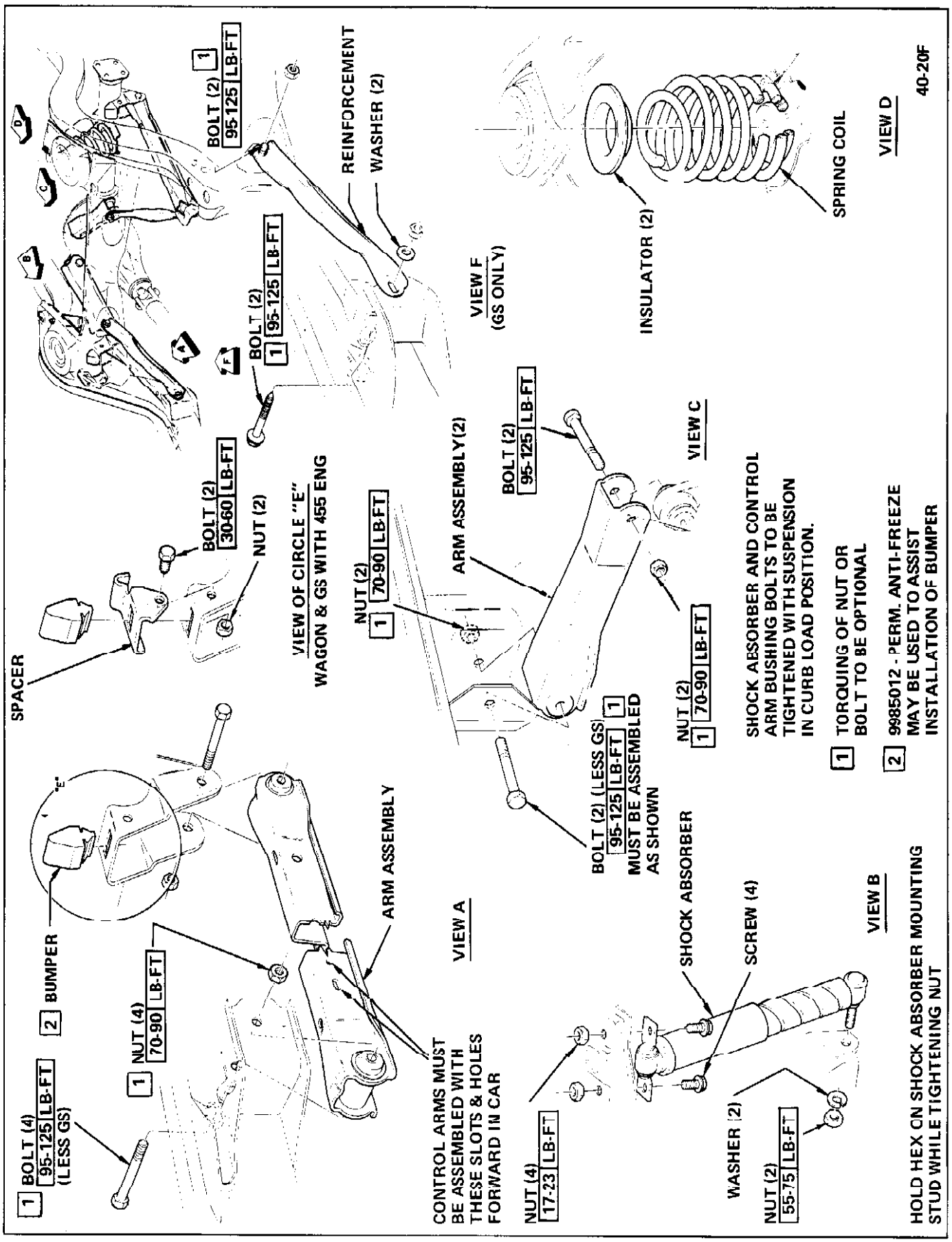


Figure 40-4 - 43-44000 Rear Suspension

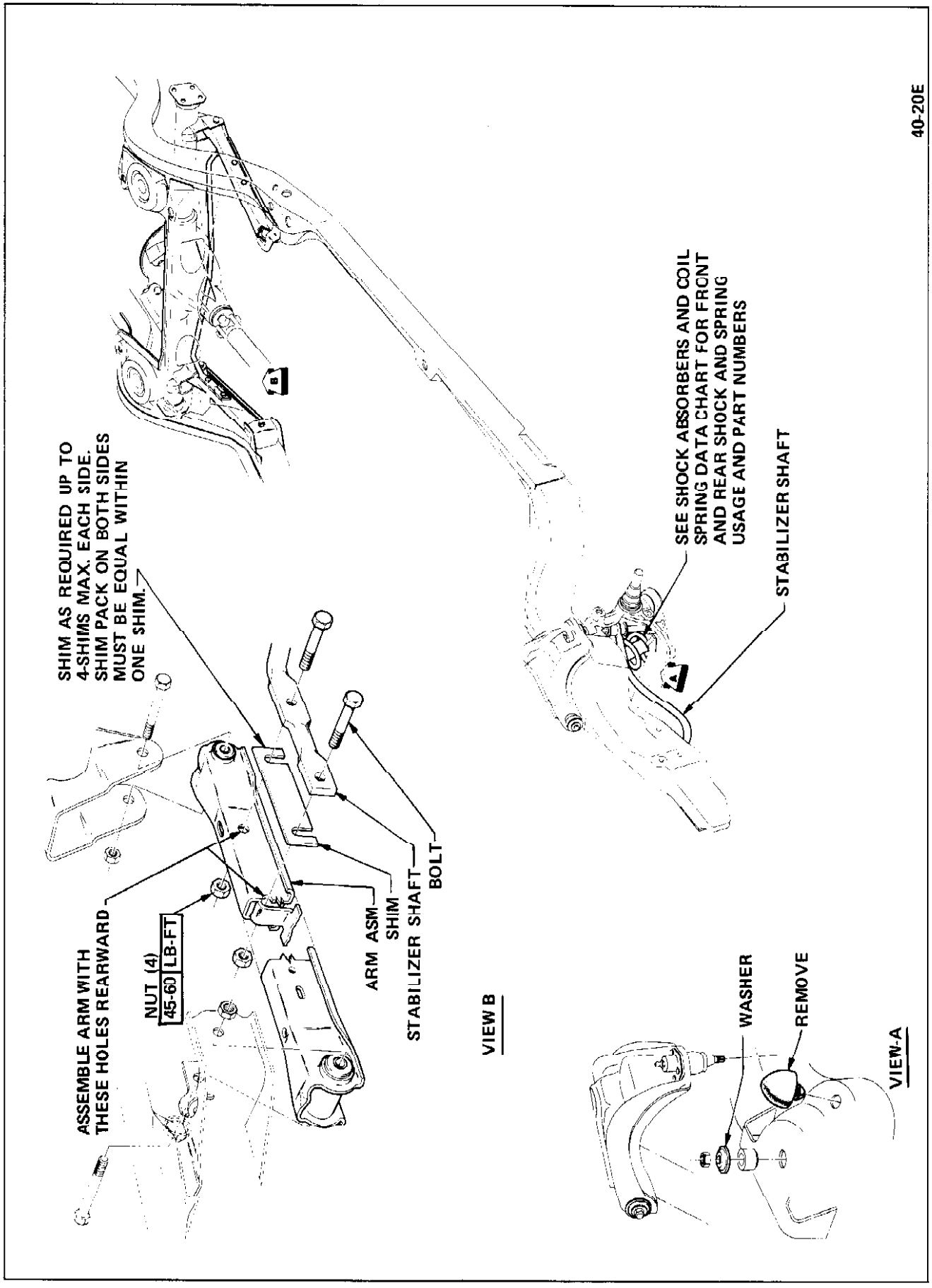


Figure 40-5 - Rear Suspension - Rallye Pac

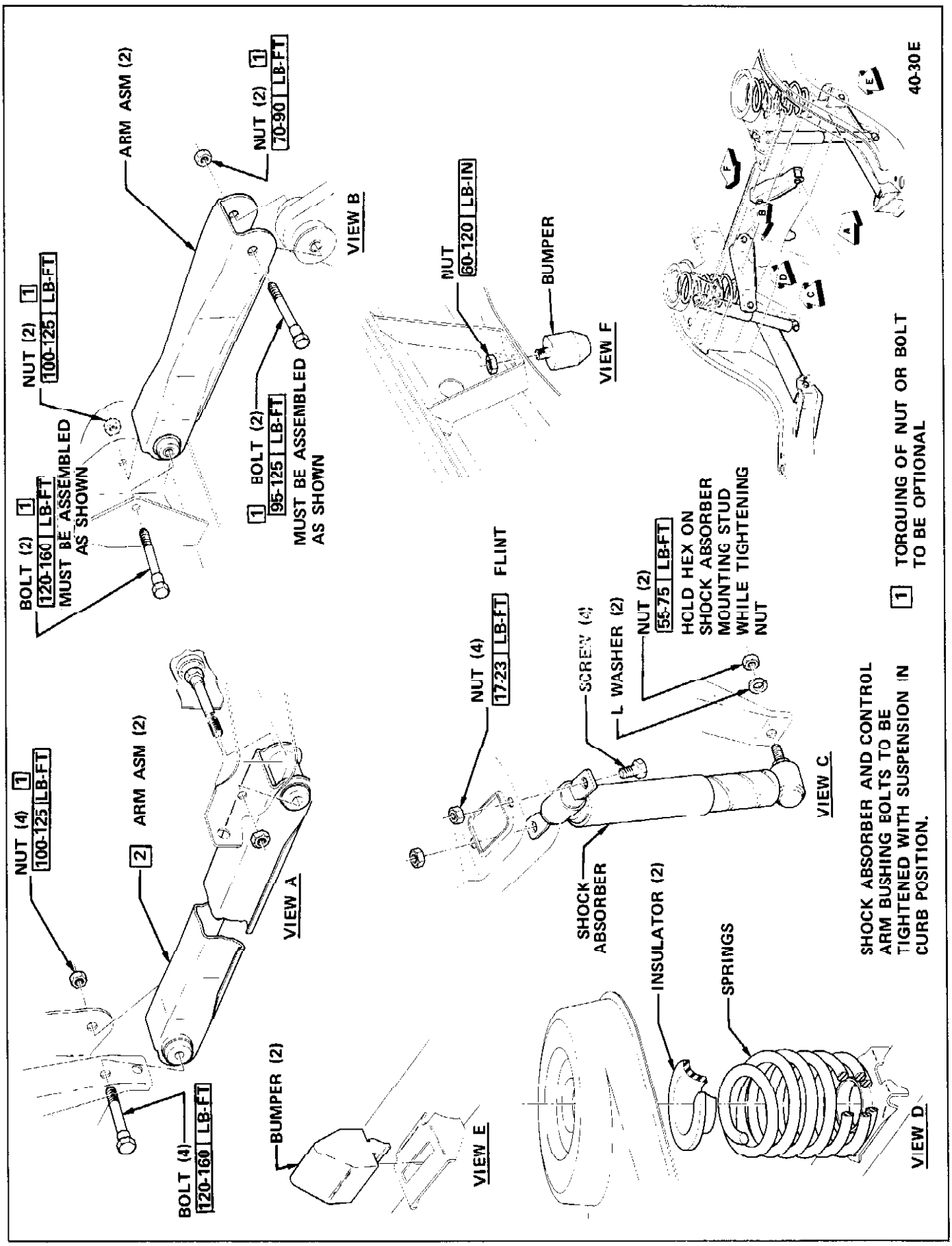


Figure 40-6 - 45-46-48-49000 (Less Estate Wagon) Rear Suspension

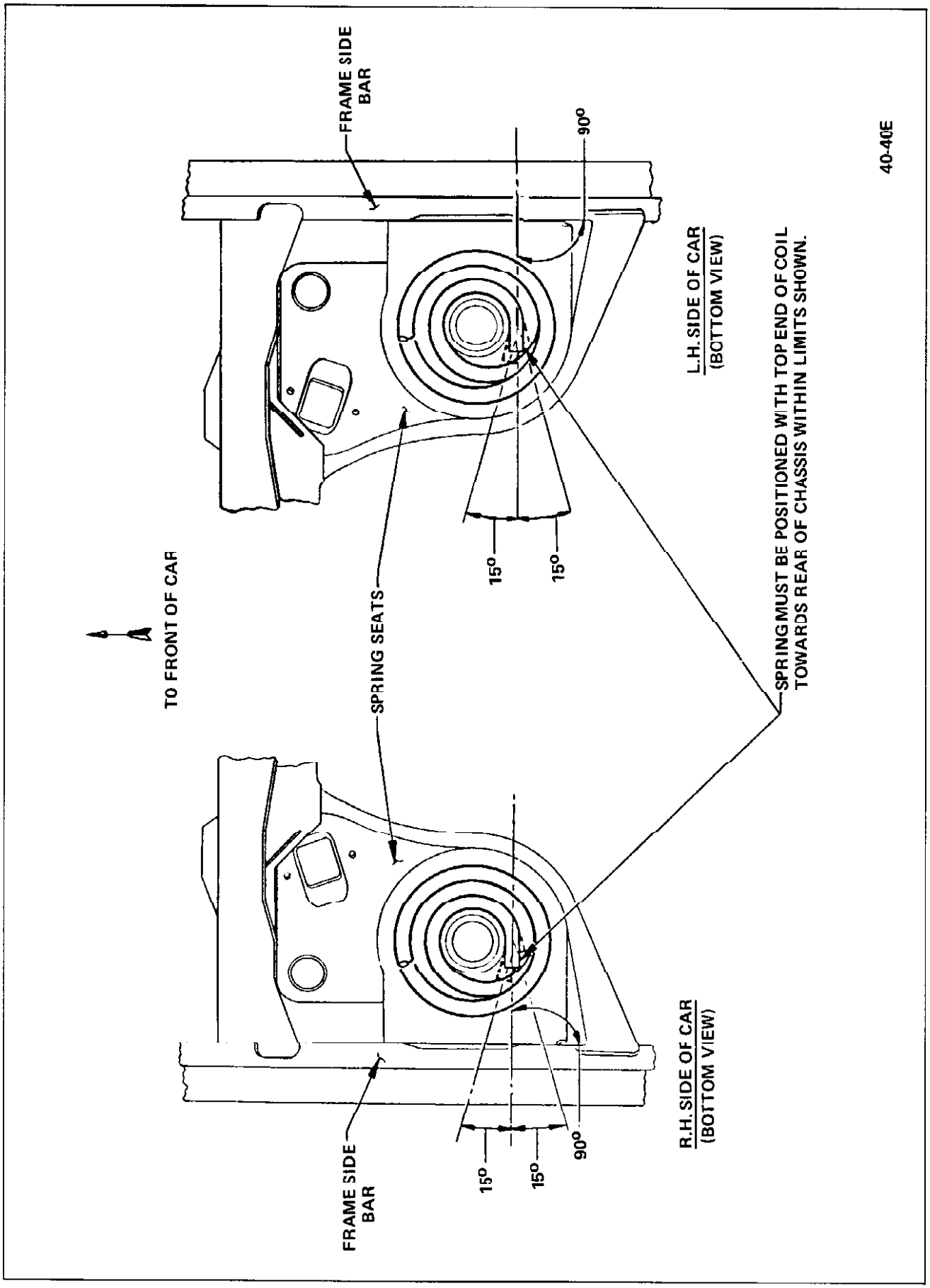


Figure 40-7 Rear Chassis Spring Orientation

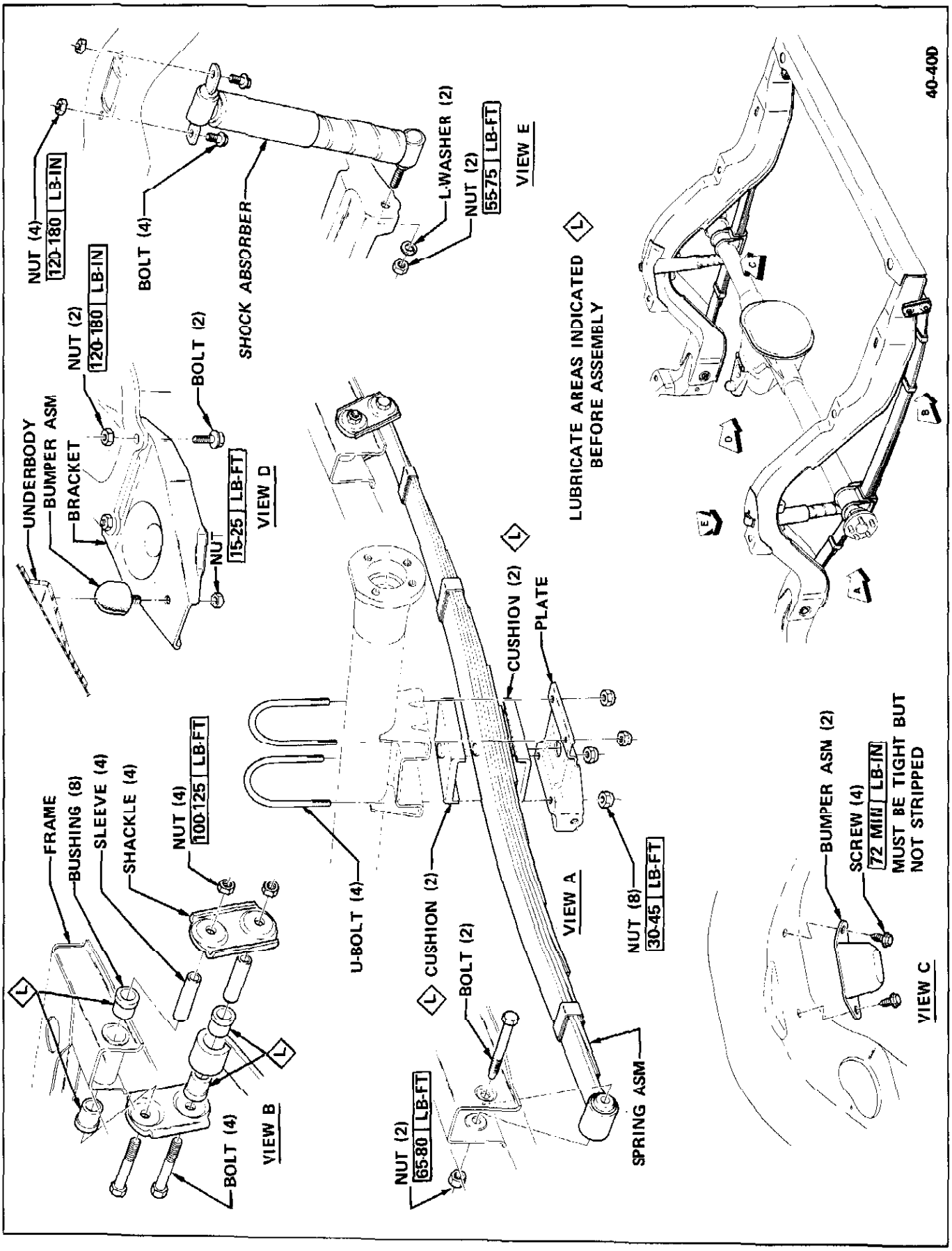


Figure 40-8 - Estate Wagon Rear Suspension

SECTION B

FRONT SUSPENSION
45-46-48-49000 SERIES

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DIVISION I

TROUBLE DIAGNOSIS

30-14 FAULTY SPRINGS, SHOCK ABSORBERS, AND BALL JOINTS

a. Trim Height Checking Considerations

Optional equipment, undercoating, accumulated dirt, etc., change the car weight and must be considered when checking spring trim dimensions. Because of the many possible variations in loading due to optional equipment, it is not possible to give dimensions for all conditions; therefore, the spring trim dimensions following are for the standard car only, without optional equipment or undercoating and with car at curb weight. Curb weight includes a full tank of gas, oil, water, and spare tire but no passengers.

Before measuring spring trim dimensions, bounce both ends of the car up and down several times to make sure there is no bind in suspension members, and to let springs take a natural position.

b. Measuring Trim Height

1. On a new car, the *front* spring trim dimension "K" should be as shown in Figure 30-43.

NOTE: *On a car having service miles the trim height may be less due to normal settling of bushings, dirt accumulation, etc.*

2. On a new car, the *rear* spring trim dimension "L" should be as shown in Figure 30-43.

NOTE: *On a car having service miles the trim height may be less due to normal settling of bushings, dirt accumulation, etc.*

3. When checking *side to side* differences in trim height at the *front* take measurements at the front rocker panel as shown in Figure 40-4.

NOTE: *A maximum of two (2) front shims may be installed on top of the front spring with a change in trim height double the thickness of the shims. This will provide for a maximum correction at the fender of .50 inch. A maximum of two (2) rear shims may be installed between the rear spring and the spring seat on the axle with a change in trim height the same as the thickness of the shims. This will provide for a maximum correction at the fender of .24 inch. Cars with 1 inch tilt right to left cannot be corrected by shims. If side to side variation is in excess of one inch, check suspension components for damage, excessive wear, or incorrect spring installation. See subparagraph c following for front shim installation.*

4. When checking side to side differences in trim height at the *rear* take measurements at the rear rocker panel as shown in Figure 40-4. If shimming is required, see subparagraph c following.

NOTE: *Shimming of only one rear spring is not effective in correcting tilt. Side to side variation should be corrected by changing or shimming front springs.*

c. Installation of Front Spring Shim

To correct variations in trim height, front spring shims may be ordered from the Parts Department under Group 7.425.

1. Remove front spring from car as described in paragraph 30-21.

2. Place shim at top of spring as shown in Figure 30-26. Taping shim to spring will aid installation.

3. Install shimmed spring in car per paragraph 30-21.

d. Weak and Non-Operative Shock Absorbers

Many shock absorbers have been replaced and returned to the factory with the report that they were weak or leaking

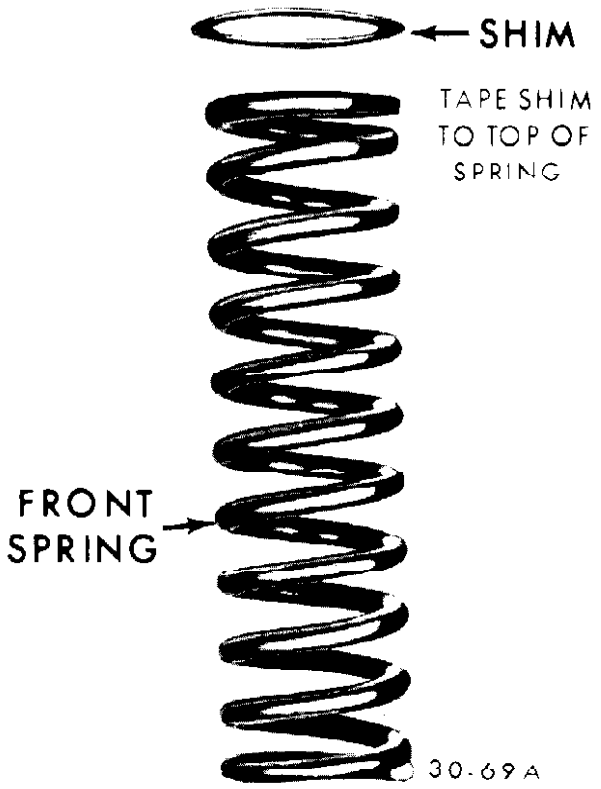


Figure 30-26 - Installing Shim on Spring

oil. When tested with special factory equipment very few of these replaced units have been found weak, leaking oil, or otherwise below standard in operation. This indicates that these shock absorbers were needlessly replaced in an attempt to improve riding conditions which were actually standard, or that erroneous methods were used in judging the operating condition of the units.

Leaking shocks should not be diagnosed by observing a light oil film on or around the shock.

The shock absorber seal is designed to allow for lubrication of the piston rod, which under normal conditions, causes a light oil film to accumulate on the shock. This does not affect shock operation nor is replacement necessary as *all Delco shocks contain an added fluid reserve for this purpose*

A leaking shock absorber is easily spotted as there will be evidence of fluid droplets on or around the shock. Before replacing any shock absorber, verify that the oil present on the shocks is not from some other chassis component.

Before attempting to test shock absorbers make sure that all attaching bolts and nuts are tight. Tires should be uniformly inflated to specified pressure (Group 100). The chassis should be well lubricated to make sure that suspension parts are free moving.

Test each front and rear shock absorber in turn by quickly pushing down and then lifting up on the end of the car bumper closest to the unit being checked. Use the same

amount of force on each test, and note the amount of resistance provided by the shock absorber on compression and rebound. A little practice on another car of the same model which has satisfactory ride control will aid in judging the amount of resistance that should exist. Both front shock absorbers should provide the same feeling of resistance as should both rear shock absorbers. Any noticeable variation between right and left shock absorbers indicates that one unit is not operating normally. Little or no resistance on compression or rebound indicates air in the shock absorbers, internal leakage due to wear, or that the valve is held open by dirt. Excessive resistance indicates that the bleeder holes in the valve are plugged with dirt.

If there is any doubt about the action of a shock absorber after testing as described above, remove the unit from car. Mount it vertically in a vise with the jaws gripping the lower mounting firmly, then move the piston rod up and down by hand. There should be no free movement in this test. Lack of resistance or jerky resistance to movement indicates air in the shock absorber, internal leakage due to wear, or that the valve is held open by dirt. A faulty shock absorber must be replaced as it cannot be disassembled for repairs. In the test given above, the amount of force that can be applied is not sufficient to open a valve against its spring pressure; therefore, this test only checks the flow of fluid through the valve bleeder hole as well as any leakage due to a valve being held open, or due to internal wear of piston and cylinder. Since it is unlikely that the valve springs will weaken in service, it may be assumed that the shock absorber action is normal, if it operates satisfactorily in the test given above.

e. Loose Ball Joints

The upper ball stud is rubber spring equipped and thus preloaded in its socket at all times. This minimizes looseness at this point and compensates for normal wear. If the upper stud has any perceptible lateral shake, or if it can be twisted in its socket with the fingers, the upper ball joint should be replaced.

The lower ball joint is also rubber spring loaded and is held seated by the weight of the car. With the chassis spring load removed from the ball joint, this ball joint should not show any looseness. If looseness is noted, ball joint should be replaced.

The upper and lower ball joints are checked for wear by checking the torque required to rotate the ball joint in the assembly. After dislodging the ball joint from the steering knuckle, proceed as follows:

1. Install the stud nut to the ball stud.

2. Check the torque required to rotate the ball stud in the seat.

NOTE: *Specified rotating torque for a new joint is 2 to 10 lb.ft.*

3. If torque readings are excessively high or low and the joint is properly lubricated, replace the ball joint.

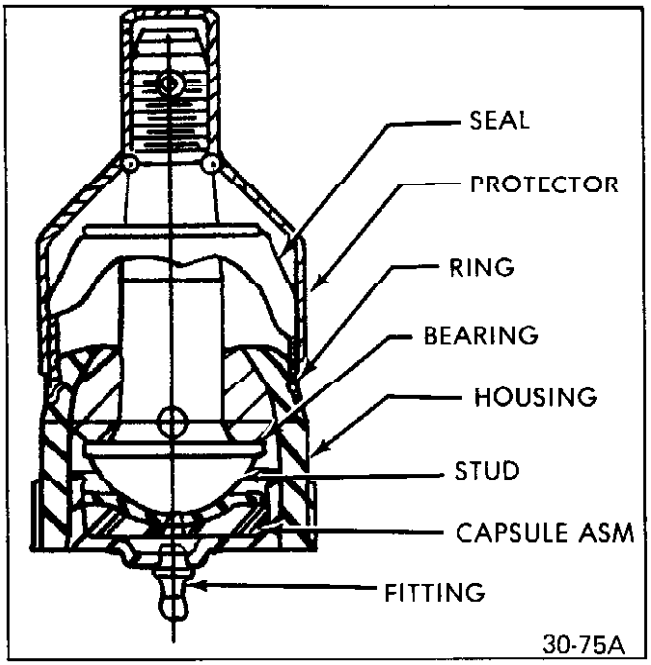


Figure 30-27 - Lower Ball Joint Construction

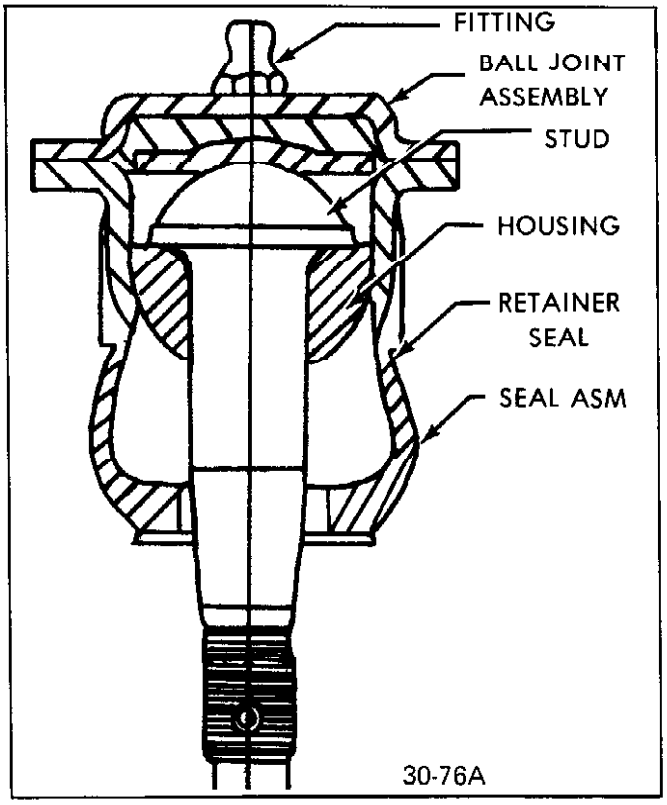


Figure 30-28 - Upper Ball Joint Construction

f. Loose Upper Control Arm Bushing Retaining Bolts

If loose upper control arm bushing retaining nuts are encountered, it is necessary to torque nuts to 55 lb.ft. On some cars equipped with air conditioning, power brakes, etc. it might be necessary to remove the upper control arm per paragraph 30-19 to torque the bolts. Bolts should be tightened with the car at curb height.

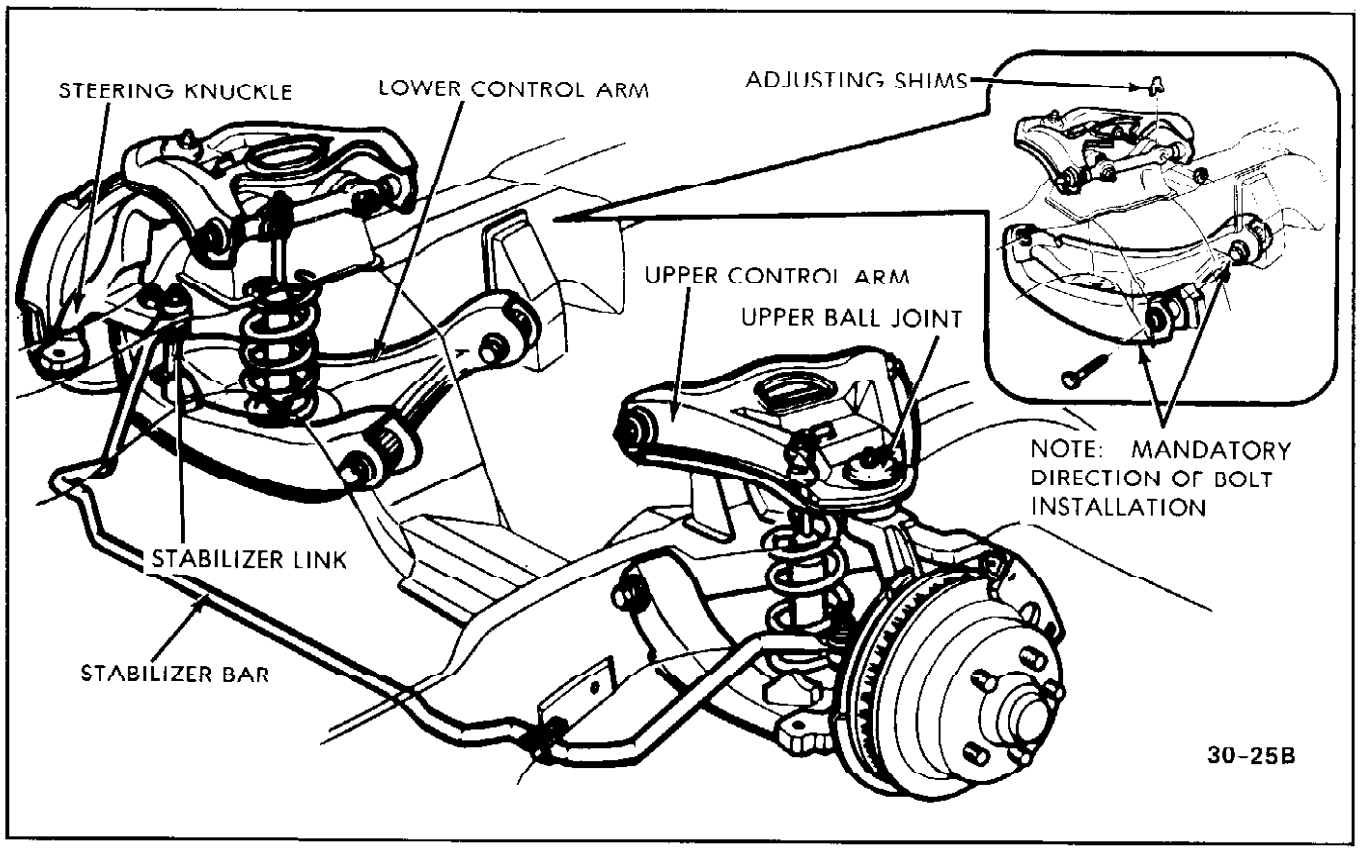


Figure 30-31 - Front Suspension

DIVISION II

DESCRIPTION AND OPERATION

30-15 SUSPENSION DESCRIPTION

The front suspension is designed to allow each wheel to compensate for changes in the road surface level without appreciably affecting the opposite wheel. Each wheel is independently connected to the frame by a steering knuckle, ball joint assemblies, and upper and lower control arms. The control arms are specifically designed and positioned to allow the steering knuckles to move in a prescribed three dimensional arc. The front wheels are held in proper relationship to each other by two tie rods which are connected to steering arms on the knuckles and to an intermediate rod.

Coil chassis springs are mounted between the spring housings on the frame and the lower control arms. Ride control is provided by double, direct acting shock absorbers mounted inside the coil springs and attached to the lower control arm by bolts. The upper portion of each shock absorber extends through the frame bracket and is secured with two grommets, two grommet retainers, and a nut.

Side roll of the front suspension is controlled by a spring steel stabilizer shaft. It is mounted in rubber bushings which are held to the frame side rails by brackets. The ends of the stabilizer are connected to the lower control arms by means of links which are isolated by rubber grommets which provide flexibility and ride features.

A ball joint is rivited to the outer end of the upper arm. The upper control arm is attached to a cross shaft through rubber bushings. The cross shaft, in turn, is bolted to frame brackets. It is pre-loaded by a rubber spring to insure proper seating of the ball in the socket.

The inner ends of the lower control arms are bolted to the frame through rubber bushings. The outer end of each arm is connected to the steering knuckle with a ball joint assembly pressed in the lower control arm and bolted to the steering knuckle. Fore-aft alignment is maintained by the wide span lower control arm.

Rubber seals are part of the ball joint assemblies to keep dirt and moisture from entering the joint and damaging bearing surfaces.

Shock absorbers are Delco direct double-acting type. Details on the operation of this type of shock absorber can be found under paragraph 30-3, Section A.

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

30-16 FRONT WHEEL ALIGNMENT

Wheel alignment is the process of adjusting the position of the front wheels in order to attain proper vehicle han-

dling characteristics and the least steering effort with a minimal amount of tire wear.

Wheel and tire balance has an important effect on steering and tire wear. If wheels and tires are out of balance, "shimmy" or "tramp" may develop causing tires to wear unevenly and give the erroneous impression that the wheels are not in proper alignment. For this reason, the wheel and tire assemblies should be known to be in proper balance before assuming that the front suspension is out of alignment.

Close limits on front wheel caster, camber, and theoretical king pin inclination are necessary for proper car handling, but require only reasonable accuracy to provide normal tire life. With the type of front suspension used, the toe-in adjustment is usually more important than caster and camber as far as tire wear is concerned.

In the majority of cases, services consisting of inflating tires to specified pressure and interchanging tires at recommended intervals, balancing all wheels and tires, adjusting steering gear and setting toe- in correctly will provide more improvement in car handling and tire wear than will front end alignment adjustments.

The correct use of accurate front end alignment equipment is essential to determine whether front suspension parts have been damaged, and to obtain correct alignment settings after new parts have been installed.

a. Inspection Before Checking Front Wheel Alignment

Before making any adjustment affecting caster, camber, toe-in, theoretical king pin inclination, or steering geometry, the following checks and inspections should be made to insure correctness of alignment equipment readings and alignment adjustments.

1. Front tires should have approximately the same wear and all tires must be inflated to specified pressures (Refer to Group 100).

2. Check front wheel bearings for looseness and adjust if necessary (par. 30-17).

3. Check for run-out of wheels and tires.

4. Check wheels and tires for balance and correct if out-of-balance (Refer to Group 100).

5. Check for looseness at ball joints, tie rod ends, and steering relay rods; if found excessive, it must be corrected before alignment readings will have any value.

NOTE: *Fasteners in steps 1, 2, and 3 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

6. Check trim height; if out of limits, correct with shims or replace spring.

CAUTION: *Consideration must be given the optional equipment on the car, undercoating, dirt, etc. Vehicle should be at curb or free height when an alignment operation is performed. (All excess equipment, such as tool boxes, fishing or golfing equipment, should be removed from the vehicle.) The vehicle should have a full tank of fuel.*

Good judgment should be exercised before replacing a spring when car trim height is only slightly out of limits. Spring replacement under conditions of excessive weight as mentioned above will accomplish little and must be accompanied by shimming to obtain satisfactory results.

Front and rear shims are available through the Parts Department. Refer to paragraph 30-21 for front springs and Group 40 for rear springs.

7. It is advisable to check the condition and accuracy of any equipment being used to check front end alignment and to make certain that instructions of the manufacturer are thoroughly understood and followed.

b. Checking Caster and Camber Settings

Caster is the forward or rearward tilt of the steering knuckle pivot centerline from true vertical as viewed from the side of the vehicle. If the top of the steering knuckle pivot centerline is tilted forward of true vertical, it is called "negative caster." If the top of the steering knuckle pivot centerline is tilted rearward of true vertical, it is called "positive caster."

Camber is the inward or outward tilt of the top of a wheel from true vertical as viewed from the front of the vehicle. If the top of a wheel is tilted outward from true vertical, it has "positive camber." If the top of a wheel is tilted inward from true vertical, it has "negative camber."

Since caster and camber settings are both adjusted by shimming in the same locations, both of these settings must be checked before changing shims.

CAUTION: *Regardless of equipment used to check caster and camber, the car must be on level surface both transversely and fore and aft.*

When alignment equipment is used which bears against the tire or wheel rim to obtain readings, it is very essential that the tires or wheels be checked for lateral run-out.

Caster and camber readings must be taken at points on the wheels which have no run-out or which lie in the same plane. Caster and camber should be within the service limits shown in Figure 30-43. Note that the caster angles at both front wheels need not be exactly the same but must

be within 1 degree of each other. Likewise, the camber angles on both sides must be within 1 degree of each other. If caster and camber are not within the specified limits, adjust in the following manner.

c. Caster and Camber Adjustment

For caster and camber adjustment purposes, use the following guide:

1. To increase camber only - (More positive) Remove and equal amount of shims from front and rear bolts.

2. To decrease camber only - (Less positive) add an equal amount of shims to front and rear bolts.

3. To increase caster only - (More positive) Remove an amount of shims from front bolt and add an equal amount of shims at rear bolt.

4. To decrease caster only - (Less positive) Add an amount of shims at the front bolt and remove an equal amount of shims from the rear bolt.

5. To increase caster and camber at the same time - remove an amount of shims *at front bolt only.*

6. To decrease caster and camber at the same time - add an amount of shims *at front bolt only.*

The following guide lines will help you select and correctly shim with minimum effort. Shim thickness limit for any one stack is .600 of an inch.

Shims are available in .030", .060", and .120" thickness.

By adding a pack of shims .090" thick at both sides, camber will be decreased by approximately 1/2 degree.

By adding a .030" shim on one bolt and removing a .030" shim from the other, caster will change approximately 3/8 degree.

To help you determine the shim thickness change required to return caster and camber to design dimension, two dimension change charts have been developed to enable you to do quicker and more accurate work. See Figure 30-41. This chart indicates in thousandths of an inch, the change required at (F) front and (R) rear shim position in order to return the initial reading to factory specifications. For example: Assume the initial readings for one B Series wheel were, camber minus 3/4 degrees and caster minus 1-1/2 degrees. Figure 30-42 indicates that an addition of plus 0.02 shim thickness to the (F) front shim position and addition of plus 0.40 shim thickness to the (R) shim position would be required to adjust this wheel to factory specifications.

Torque control arm shaft nuts to 75 lb. ft.

It is imperative that this torque specification be closely adhered to.

d. Checking Theoretical Kingpin (Steering Axis) Inclination

CAUTION: *When checking theoretical king pin inclination, car must be on a level surface both transversely and fore and aft, must have trim heights within limits, and must be at curb load.*

Set camber and caster to the desired specifications as shown in Figure 30-43. Measure king pin or steering axis inclination relative to a vertical plane. Add to the measured king pin axis angle the value of the positive camber angle (subtract if the camber is negative) and compare the resulting angle to the value given in Figure 30-43.

There is no adjustment for theoretical king pin inclination as this factor depends on the accuracy of the front suspension parts. Distorted steering knuckles should be replaced with new parts.

CAUTION: *Any heating, welding, or bending of front suspension parts to correct errors or repair damage must be avoided as this may produce soft spots in the metal in which fatigue and breakage may develop in service.*

e. Checking and Adjusting Toe-In

Toe-in is the distance in fractions of an inch that the front of the wheels are turned inward from a straight-ahead position.

CAUTION: *Car must be at curb weight and front and rear suspension trim should be within specified limits. Bounce front end and allow it to settle to operating height. Steering gear and front wheel bearings must be properly adjusted with no looseness at tie rod ends. The car should be moved forward one complete revolution of the wheels before the toe-in check and adjustment are started and the car should never be moved backward while making the check and adjustment. This presets the front suspension and removes lash from the joints.*

1. Turn steering wheel to straight-ahead position, with front wheels in same position.

NOTE: *Check steering gear straight-ahead position. See Figure 30-9.*

2. Using a suitable toe-in gauge, measure the distance between outside walls of tires at the front at a height approximately horizontal to floor and through the centerline of the wheel assembly. See Figure 30- 30.

NOTE: *An accurate check also can be made by raising and rotating front wheels to scribe a fine line near the center of each tire, then, with tires on the floor and front end at running height, measure between scribed lines with a suitable trammel.*

4. Roll the car forward until measuring points on tires are approximately 180 degrees from point used in Step 3 above.

The measurement at the front should be 1/16" to 5/16" less than the measurement at the rear (5/64" to 21/64" for Riviera).

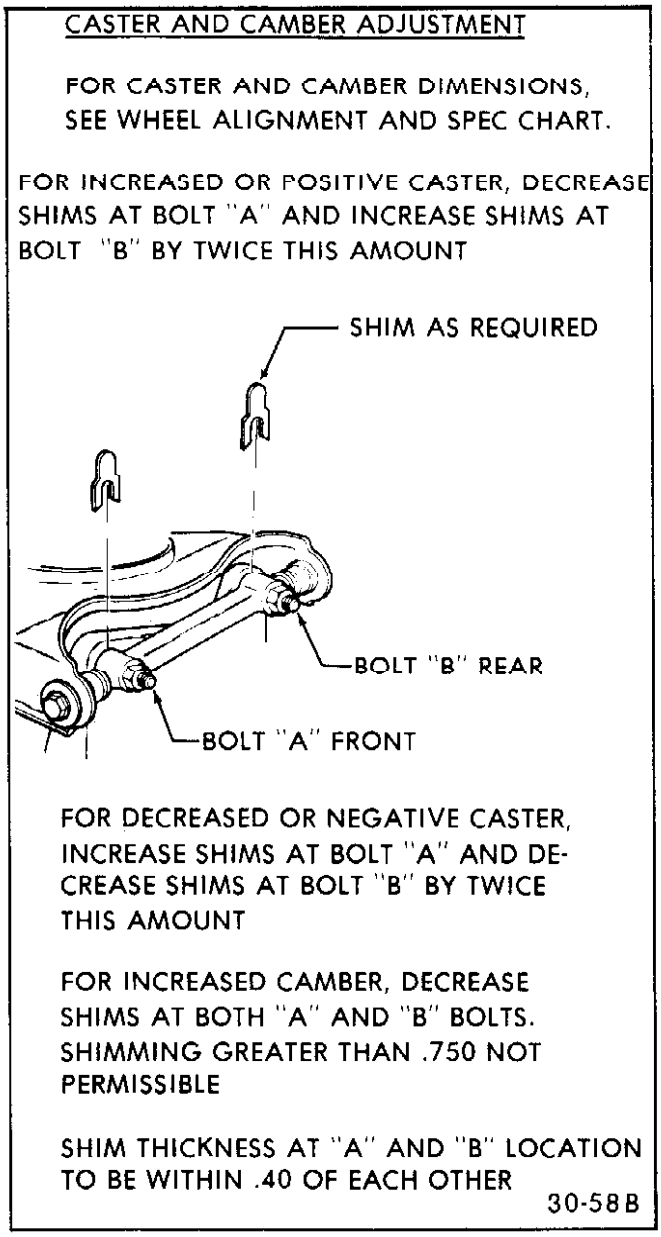


Figure 30-32 - Upper Control Arm Shimming Locations

5. If toe-in is not within specified limits, loosen clamp bolts and turn adjusting sleeves at tie rod ends as required. Decrease toe-in by turning left sleeve in same direction as wheel rotates moving forward and turn right sleeve in opposite direction. Increase toe-in by turning both sleeves in opposite direction.

CAUTION: *Left and right adjusting sleeves must be turned exactly the same amount but in opposite directions when changing toe-in, in order to maintain front wheels in straight-ahead position when steering wheel is in straight-ahead position.*

Approximately the same amount of thread engagement in the adjuster sleeve should be noted for the inner and outer tie rod ends. The distance between the inner and outer tie rod ends in the adjuster sleeve should be approximately equal for both right and left wheels. The tie rods should never be lengthened to the point where the inner and outer threaded tie rod ends are outboard of the inner edge of the adjuster sleeve "U" clamps. If proper toe-in cannot be obtained within this amount of adjustment, inspect the suspension and steering linkage for bent parts.

6. After correct toe-in is secured, tighten clamp bolts securely.

CAUTION: *The steering knuckle and steering arm "rock" or tilt as front wheel rises and falls. Therefore, it is of vital importance to center the travel of the inner tie rod joint by centering the tie rod stud in the socket (socket front face should be approximately vertical) and then position the bottom face of tie rod end parallel with machined surface at outer end of steering arm when tie rod length is adjusted. Severe damage and possible failure can result unless this precaution is observed. Tie rod sleeve clamps must be positioned straight down plus or minus 15 degrees to provide clearance between the frame and the steering linkage for all combinations of wheel motions.*

f. Checking Steering Geometry (Turning Angles)

CAUTION: *Be sure that caster, camber, and toe-in have all been properly corrected before checking steering geometry. Steering geometry must be checked with the weight of the car on the wheels.*

1. With the front wheels resting on full floating turntables, turn wheels to the right until the outside (left) wheel is set at 20 degrees. The inside (right) wheel should then be at the angle specified in Figure 30-43.

2. Repeat this test by turning front wheels to the left until the outside (right) wheel is at 20 degrees; the inside (left) wheel should then be at the angle specified in Figure 30-43.

3. Errors in steering geometry generally indicate bent steering arms, but may also be caused by other incorrect front end factors. If the error is caused by a bent steering arm, the complete knuckle must be replaced. Replacement of such parts must be followed by a complete front end alignment check as described above. Never heat or bend a steering arm or knuckle to correct steering geometry, since doing so may cause the part to break in service.

30-17 REPLACEMENT AND ADJUSTMENT OF FRONT WHEEL BEARINGS

a. Replacement of Bearings

1. Raise front of car and remove wheel with hub and drum assembly.

2. Remove outer race and outer bearing assembly from hub. Remove oil seal from hub so that inner race and bearing assembly can be removed from hub.

3. Clean and inspect all bearing parts. When inspecting or replacing race and bearing assemblies, make certain the assemblies are free to creep on spindle of steering knuckle. Wiping the spindle clean and applying bearing lubricant will permit creeping and prevent rust forming between races and spindle.

4. If bearings require replacement, drive the old outer races from the hub. Install new outer races with a soft (brass) drift, being certain to start each squarely into hub to avoid distortion and possible cracking.

5. Thoroughly pack both roller bearing assemblies with new wheel bearing lubricant. Remove surplus lubricant. Apply light coating of lubricant to spindle and inside surface of wheel hub.

6. Place inner race and bearing assembly in cup and install new oil seal.

7. Install wheel on spindle; then install outer race and bearing assembly, washer, and spindle nut.

8. Adjust bearings, as described in subparagraph b following.

b. Adjustment of Front Wheel Bearings - All Series

1. Hand spin wheel in forward direction.

2. "Snug-up" spindle nut to fully seat bearings, while wheel is spinning. This will overcome any burrs on threads.

3. Back off spindle nut until just loose (1/4 to 1/2 turn).

4. Hand "snug-up" spindle nut.

NOTE: *Do not install cotter pin if hole in spindle lines up with a slot in spindle nut.*

5. Loosen spindle nut a minimum of 1/12 turn or a maximum of 1/6 turn. Then insert new cotter pin.

IMPORTANT: *Under no circumstances is the spindle nut to be even finger tight.*

6. When the bearing is properly adjusted, there will be from .002 to .006 inches end play (looseness).

7. Remove support at front lower control arm and lower car.

DIVISION IV

REMOVAL AND INSTALLATION

30-18 REMOVAL AND INSTALLATION OF BALL JOINTS AND STEERING KNUCKLE

a. Removal of Upper Control Arm Ball Joint Assembly

1. Support car on car stand at the frame so front suspension is in full rebound position.

2. Remove front wheel.

3. Remove upper ball stud cotter key.

4. Loosen but do not remove ball stud nut. Nut should be loosened not more than 1/8".

WARNING: *If ball stud nut is removed, injury could result, since heavily compressed chassis spring will be completely released.*

5. Install Tool J-23742-1 between ball stud and turn threaded end of tool until the ball stud is free of steering knuckle. Remove tool.

6. Place jack under lower control arm at spring seat. Raise jack until compression is relieved on upper control arm rubber rebound bumper.

7. Remove the stud nut and lift upper control arm from knuckle.

8. Place a wood block between the upper control arm and the frame to act as a support during the following operations.

9. Center punch the four rivets, as close to the center as possible.

10. Drill a 1/8" hole through the center of the rivets about 1/2 to 3/4 the length of the rivet.

11. Using a 7/32" drill, enlarge the hole, drilling again about 1/2 the length of the rivet.

12. With a chisel, remove the rivet heads.

13. Using a 3/4" punch and hammer, remove the rivets. Remove ball joint.

CAUTION: *Care must be used not to hit and damage the ball joint seat and rivet holes in the control arm.*

b. Installation of Upper Control Arm Ball Joint

NOTE: *An inspection of the tapered holes in the knuckle should be made. If any out-of-roundness, deformation, or damage is noted, the knuckle should be replaced. Refer to paragraph e.*

1. Install the new ball joint in the upper control arm and attach with the bolt and nut assemblies provided. Insert the bolts from the bottom with the nut on top. Torque to 8 lb ft.

2. Turn tapered stud so cotter pin hole is fore and aft. Remove the wood block from between the arm and the frame, move the knuckle up by jacking under outer edge of spring seat. Knuckle and brake drum assembly should be in a straight-ahead position.

3. Wipe tapered hole in knuckle and tapered stud free of

dirt and grease, and assemble stud to knuckle with castellated nut. Torque to 50 lb.ft.

WARNING: *Never back off nut to align cotter pin holes. Always tighten nut to next slot that lines up with hole in ball joint stud.*

Install new cotter pin.

NOTE: *This front upper control arm ball joint to steering knuckle 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.*

4. Install wheel and tire.

c. Lower Ball Joint Removal

1. Raise front of car and place jack stands under frame side rails. Remove tire and wheel assembly.

2. For safety, place a floor jack under the lower control arm as far outboard on the arm as possible to gain maximum leverage advantage. Do not place the jack against the arm but about 1/2" below. Now remove cotter pin and loosen (do not remove) nut on lower ball joint tapered stud. Nut should be loosened not more than 1/8".

WARNING: *If jack is not used and nut is removed, injury could result since heavily compressed chassis spring will be completely released.*

3. Install Tool J-23742-1 between ball studs.

4. Turn the threaded end of J-23742-1 until the ball stud is free of steering knuckle. Remove tool.

5. Place the jack under the lower control arm at the spring seat. Raise the jack until compression is relieved on the upper control arm rubber rebound bumper. Remove the lower ball joint stud nut. Move the steering knuckle out of the way.

6. Install lower ball joint remover and installer as shown in Figure 30-33.

7. Tighten Detail J-9519-8 with a socket and handle until ball joint is forced out of the lower control arm.

CAUTION: *Ball joint may pop out suddenly.*

d. Lower Ball Joint Installation

NOTE: *An inspection of the tapered holes in the knuckle should be made every time a ball joint is replaced. If any out-of-roundness, deformation or damage is noted, the knuckle should be replaced. Refer to paragraph e.*

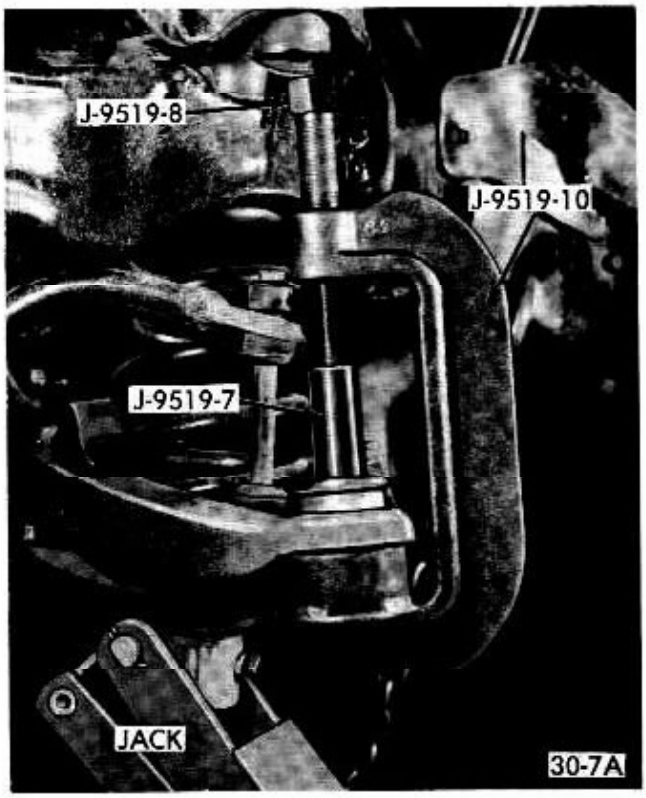


Figure 30-33 - Lower Ball Joint Remover in Place

1. Position ball joint in lower control arm and install Tool J-9519 as shown in Figure 30-34.

NOTE: *Position bleed vent in rubber boot of the new ball joint facing inward.*

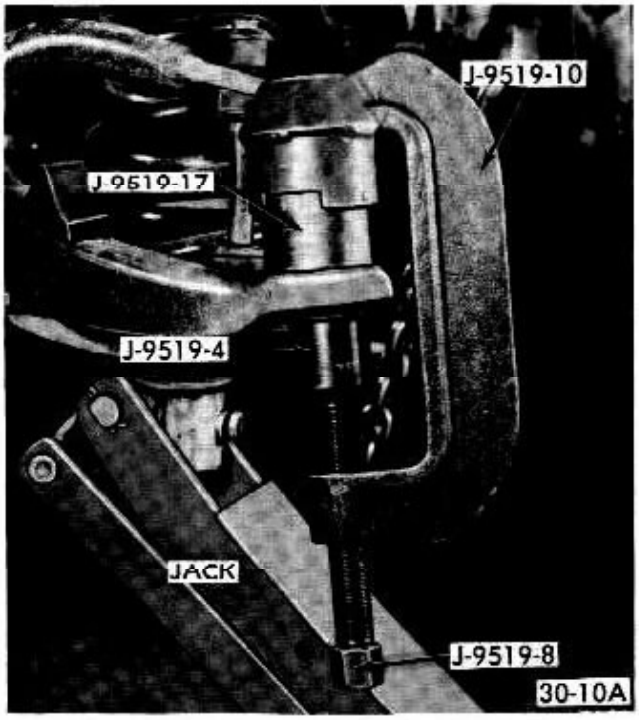


Figure 30-34 - Lower Ball Joint Installer in Place

2. With a suitable socket and handle force the ball joint into the lower control arm until it is fully seated.

3. Turn the stud so the cotter pin hole is fore and aft. Knuckle should be in a straight-ahead wheel position. Stud and knuckle hole must be free of dirt and grease before assembly.

4. Position the tapered stud in the knuckle and install castellated nut. Tighten the nut to 85 lb.ft. *Warning: Never loosen nut to align cotter pin holes. Always tighten nut to next slot that lines up with hole.* Install new cotter pin.

NOTE: THIS FRONT LOWER CONTROL ARM BALL JOINT TO STEERING KNUCKLE 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.

5. Install tire and wheel assembly. Adjust wheel bearing (paragraph 30-17). Remove car stand and lower car.

e. Removal and Installation of Steering Knuckle

It is recommended that the vehicle be raised and supported on a twin-post hoist so that the front coil spring remains compressed, yet the wheel and steering knuckle assembly remain accessible. If a frame hoist is used, support the lower control arm with an adjustable jack stand to retain spring in the curb height position.

1. Raise vehicle on a hoist and support the lower control arm.

2. Remove the wheel and tire assembly.

3. Remove the brake caliper and brake disc.

4. Remove the splash shield.

NOTE: *Hang the brake caliper assembly from some part of the suspension assembly. Do not allow the unit to hang by the hydraulic line.*

5. Remove upper and lower ball stud cotter pins.

6. Remove ball studs from steering knuckle, using Tool J-23742-1. See paragraph 30-18, sub-paragraphs a and c.

7. To install, place steering knuckle into position and insert upper and lower ball studs into knuckle bosses.

8. Install ball stud nuts and torque to specifications. If necessary, tighten one more notch to align cotter pin.

NOTE: THE UPPER AND LOWER CONTROL ARM BALL JOINT TO STEERING KNUCKLE FASTENERS ARE IMPORTANT ATTACHING PARTS IN THAT THEY COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. THEY MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THESE PARTS.

9. Install the splash shield and install hub and disc.

10. Install outer bearing and spindle washer and nut and adjust bearing.

11. Install brake caliper and tire and wheel.

12. Lower vehicle to floor.

30-19 REMOVAL AND INSTALLATION OF UPPER CONTROL ARM ASSEMBLY

a. Removal

1. Raise car with jack under frame. Remove wheel and tire.

2. Remove cotter pin from castellated nut on upper ball joint tapered stud.

3. Loosen, but do not remove nut. Force of chassis spring will be tending to disengage ball joint tapered stud from steering knuckle using Tool J-23742-1. See Figure 30-35.

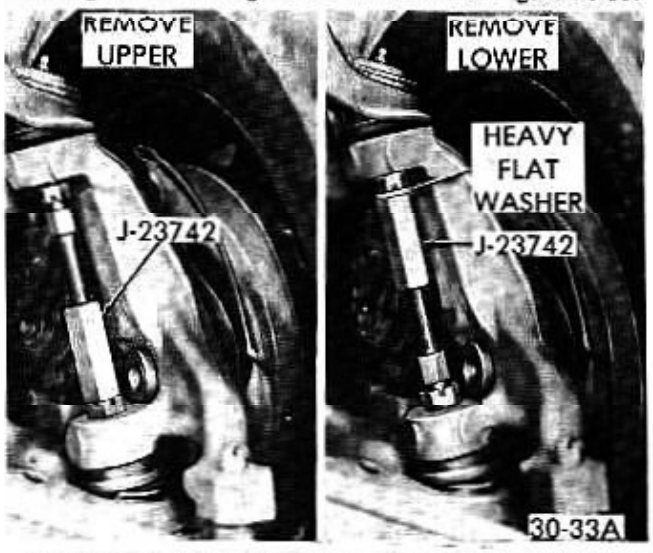


Figure 30-35 - Separating Steering Knuckle from Ball Joint

WARNING: *If ball stud nut is removed, injury could result since heavily compressed chassis spring will be completely released.*

4. With another jack, support car weight under outer edge of lower control arm. Raise jack until compression is relieved on upper control arm bumper and remove castellated nut from ball joint tapered stud.

5. Wire brake and knuckle assembly in place to prevent damage to the brake hose, and rotate upper control arm upward and away from knuckle.

6. Remove the upper control arm shaft to frame bracket nuts, carefully noting the number, location, and thickness of adjusting shims between the shaft and frame bracket. Remove the control arm assembly. Remove rebound rubber bumper from arm.

7. Inspect stud hole in knuckle. If elongated or damaged, replace knuckle.

b. Installation

NOTE: *Fasteners in steps 1, 2 and 3 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

1. Assemble upper control arm and shaft assembly to bracket, making certain the number, thickness and location of adjusting shims between shaft and bracket are correct. Assemble rubber rebound bumper to arm. Torque shaft to bracket nuts to 75 lb.ft. Those bolts may be torqued from within the engine compartment through the use of a standard 11/16"-1/2" drive socket and J-1313 Torque Wrench or its equivalent.

2. Make sure stud and tapered hole in knuckle are free of dirt and grease. Spindle should be in a straight-ahead wheel position when the stud is inserted. Assemble tapered stud to knuckle with cotter pin holes fore and aft. Install castellated nut. Torque to 35 lb.ft. *Never loosen nut to align cotter pin holes. Always tighten nut to next slot that lines up with hole.* Install new cotter pin.

3. With car at curb load, loosen upper control arm bushing to shaft bolts and bounce front end of car. Retorque bolts to 35 ft.lbs.

4. Install wheel. Check and adjust front end alignment. Adjust wheel bearings. When working in the area of the front upper control arm, make certain that the rubber water deflectors on fender skirt are securely attached in their original positions when the work is completed. If reasonable care is exercised in removing the fasteners for these rubber deflectors, they may be satisfactorily reused.

30-20 REMOVAL AND INSTALLATION OF LOWER CONTROL ARM ASSEMBLY

a. Removal

1. Remove coil spring and stabilizer link according to outline in paragraph 30-21.

2. Remove ball stud from steering knuckle. See paragraph 30-18.

3. Remove two nuts and bolts securing control to frame.

4. Remove the control arm from vehicle.

5. If lower control arm is to be replaced, remove the rubber bumper and attaching nut.

b. Installation

1. Install new arm assembly with the arm to frame bolt head to the front of car. Install rubber side bumper to arm. Torque to 17 lb.ft. Make sure bolts point to rear of car.

2. Reinstall coil spring and stabilizer link as outlined in paragraph 30-21.

3. With the car at curb load, tighten control arm attaching bolt nut to 100 lb.ft.

NOTE: THIS FRONT LOWER CONTROL ARM TO FRAME 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.

4. Check and adjust front end alignment.

30-21 REMOVAL AND INSTALLATION OF FRONT SPRING

a. Removal

1. Raise front of car and support solidly with a car stand under the frame side rail on the side where the spring removal is to be performed.

2. Remove wheel and hub assembly.

3. Remove shock absorber according to outline in paragraph 30-22.

4. Remove the front stabilizer rod link from the lower control arm.

5. Remove tie rod.

6. Remove control arm bumper.

7. As a safety precaution place a floor jack under the lower control arm as far outboard as possible to gain maximum leverage advantage.

Do not place the jack against the arm, but about 1/2 inch below. Now remove the cotter pin and *LOOSEN, DO NOT REMOVE* the nut on the lower ball joint tapered stud. The nut should be loosened not more than 1/8".

8. Install Tool J-23742-1 between ball studs and turn threaded end of Tool J-23742-1 until ball stud is free of steering knuckle.

9. Raise the jack against the control arm to relieve pressure on the nut, remove the nut and separate the steering knuckle from the tapered stud.

10. Carefully lower the jack supporting the lower control arm to release the spring. With the jack all the way down to the floor it still may be necessary to pry the spring off its seat on the lower control arm with long pry bar. *Warning: Caution should be exercised in handling this preloaded spring while it is still installed in the car.* Care should be taken so the spring, when removed, does not damage the ball joint stud or seal.

11. Inspect stud and hole in knuckle. If stud is damaged or hole in knuckle is elongated, replace the necessary parts.

b. Installation

1. Position spring in upper seat with lower spring resting on lower control arm.

2. Raise lower control arm with jack and connect lower ball joint to steering knuckle. Do not tighten.

3. Lower jack so that control arm hangs free and install shock (lower mountings). Tighten screws to 20 lb.ft.

NOTE: *Fasteners in Steps 4, 5, 6, 7, 8, and 9 are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number, or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

4. Raise lower control arm with jack and torque lower ball joint nut to 95 lb.ft.

5. Install stabilizer link to control arm and torque nut to 12 lb.ft. See Figure 30-38.

6. Install tie rod end to knuckle and torque to 35 lb.ft.

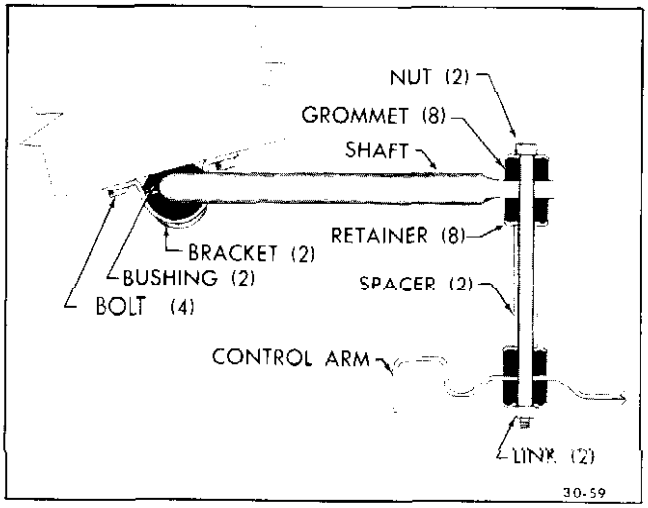


Figure 30-38 - Stabilizer Link Installation

7. Install lower control arm rubber bumper and torque nut to 17 lb.ft.

8. Install shock absorber upper nut and torque to 8 lb.ft.

9. Install wheel. Torque to 75 lb.ft.

10. Lower jack and remove. Recheck and adjust toe- in.

30-22 REMOVAL AND INSTALLATION OF SHOCK ABSORBERS

a. Removal

1. Remove upper shock absorber attaching nut, grommet retainer and grommet.

2. Remove the lower retaining screws. Lower shock through hole in lower control arm.

c. Installation

1. Select the correct shock absorber for the particular car model. Refer to Master Chassis Parts Catalog for correct absorber. Substitution of an incorrectly calibrated shock absorber will adversely affect car handling performance.

2. Assemble lower grommet retainer and grommet on shock stem. Extend shock and install through lower control arm. With shock upright in vise, push and pull shock rod thrugh its full travel several times to pump out any air which might be trapped in the inner cylinder. Keep shocks upright until installed. It is a good idea to replace the shock absorber rubber grommets whenever a shock is removed or replaced.

3. Install shock, lower attaching screws. Torque to 20 lb.ft.

4. Assemble top grommet, grommet retainer, and nut on stem. Torque to 8 lb.ft.

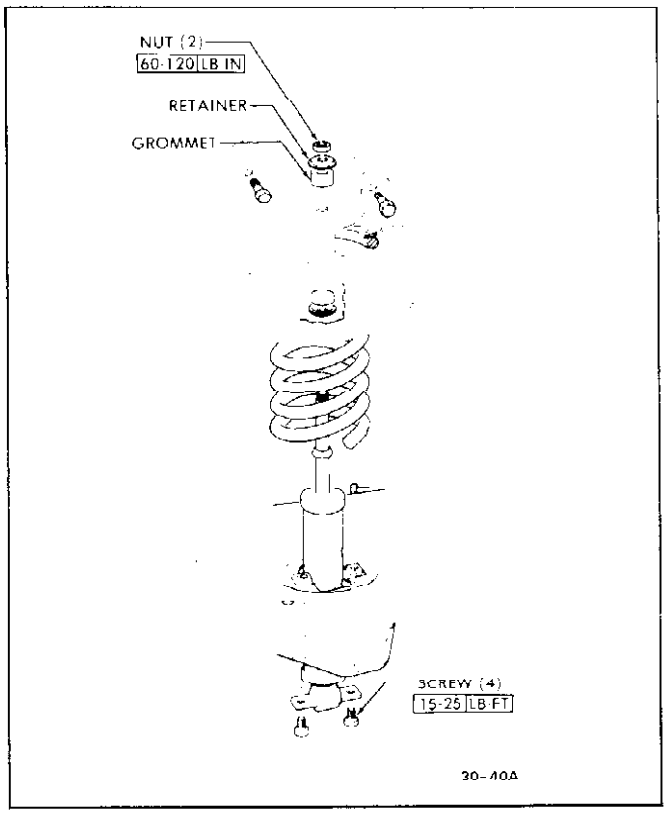


Figure 30-39 - Shock Absorber Mounting Details

30-23 REMOVAL AND INSTALLATION OF STABILIZER BAR

NOTE: *Fasteners in subparagraph A, B, and C are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part or lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.*

a. Stabilizer Shaft, Removal and Replacement

Disconnect stabilizer links (subpar. c following) and disconnect the two frame-to-shaft insulator mounts and brackets.

To install, position insulator mounts and brackets over shaft and connect bracket to frame.

Torque bracket bolts to 24 lb.ft. Connect stabilizer links subparagraph c below. Do *not* lubricate insulator mounts.

b. Stabilizer Bracket and Insulator, Removal and Replacement

Stabilizer brackets should be replaced if damaged, and rubber insulator mounts replaced if deteriorated.

Replace by supporting stabilizer shaft in position and replacing brackets and mounts one at a time. Torque bracket bolts to 24 lb.ft.

c. Stabilizer Link Removal and Replacement

1. Remove nut from lower end of link. Remove link, spacer, retainers and grommets. See Figure 30- 41.

2. Inspect link and grommets.

3. Install grommets dry and use care to center the grommets in the seats on stabilizer shaft and hole in control arm. Also, center the retainers on grommets before tightening link nut.

4. Tighten link nut to 13 lb.ft.

DIVISION VI

SPECIFICATIONS

30-24 BOLT TORQUE SPECIFICATIONS

DIVISION VI SPECIFICATIONS

30-24 BOLT TORQUE SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed to insure tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Parts	Location	Torque Lb. Ft.
Screws	Front Shock to Lower Control Arm	20
Nut	Front Shock to Frame	8
(Screw)	Stabilizer Bushing to Frame	24
Nut & Bolt	Upper Control Arm Shaft to Frame	Nut 75
Nut	Upper Ball Joint to Knuckle	50
Bolt & Nut	Front Lower Control Arm to Frame	Nut 100
Nut	Lower Ball Joint to Knuckle	95
Nut & Bolt	Stabilizer Link to Lower Control Arm	Nut 12
Nut, Bolt & Washer	Idler Arm to Frame	Bolt 65, Nut 35
Nut	Tie Rod End to Steering Knuckle	35
Nut	Lower Rubber Bumper to Lower Control Arm	17

30-25 DIMENSIONAL SPECIFICATIONS

Stabilizer Bar Diameter ..... 45, 48000 13/16"
..... 46, 49000 27/32"

Steering Knuckle Spindle Bearing Diameter
- Large End 1.3743-1.3748
- Small End ..... .8430- .8435

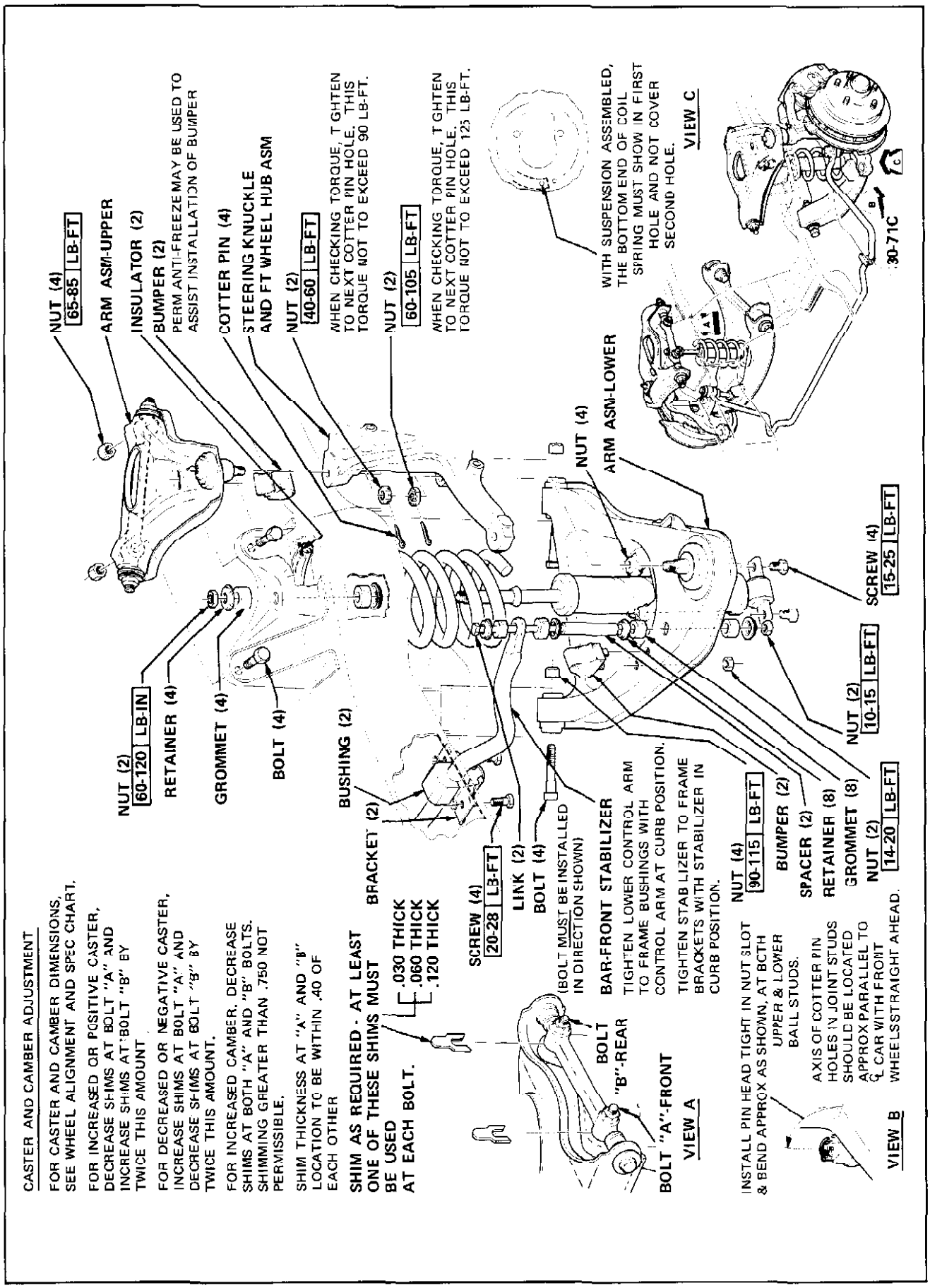


Figure 30-40 Front Suspension Details

Front Suspension Alignment Chart
1971 45-46-48-49000 Series
Curb Load

Measured Caster (Degrees)

Measured Camber (Degrees)

		−1½°	−1¼°	−1°	−¾°	−½°	−¼°	0°	+¼°	+½°	+¾°	+1°	+1¼°	+1½°
−1½°	F		+0.39	+0.37	+0.35	+0.32	+0.30	+0.28	+0.26	+0.24	+0.22			
	R		+0.09	+0.13	+0.17	+0.21	+0.25	+0.29	+0.33	+0.37	+0.41			
−1¼°	F	+0.37	+0.34	+0.32	+0.30	+0.28	+0.26	+0.23	+0.21	+0.19	+0.17	+0.15		
	R	0	+0.04	+0.08	+0.12	+0.16	+0.20	+0.24	+0.28	+0.32	+0.36	+0.41		
−1°	F	+0.32	+0.30	+0.27	+0.25	+0.23	+0.21	+0.19	+0.17	+0.15	+0.13	+0.11	+0.09	
	R	−0.04	−0.01	+0.03	+0.07	+0.11	+0.15	+0.19	+0.23	+0.27	+0.32	+0.36	+0.40	
−¾°	F	+0.27	+0.25	+0.23	+0.21	+0.18	+0.16	+0.14	+0.12	+0.10	+0.08	+0.06	+0.04	+0.02
	R	−0.09	−0.05	−0.01	+0.02	+0.06	+0.10	+0.14	+0.18	+0.23	+0.27	+0.31	+0.35	+0.40
−½°	F	+0.23	+0.20	+0.18	+0.16	+0.14	+0.12	+0.09	+0.07	+0.05	+0.03	+0.01	−0.03	−0.05
	R	−0.14	−0.10	−0.06	−0.02	+0.02	+0.06	+0.10	+0.14	+0.18	+0.22	+0.31	+0.35	+0.39
−¼°	F	+0.18	+0.16	+0.13	+0.11	+0.09	+0.07	+0.05	+0.03	+0.01	−0.01	−0.03	−0.05	−0.07
	R	−0.19	−0.15	−0.11	−0.07	+0.03	+0.01	+0.05	+0.09	+0.13	+0.17	+0.21	+0.26	+0.30
0°	F	+0.13	+0.11	+0.09	+0.07	+0.04	+0.02	0	−0.02	−0.04	−0.06	−0.08	−0.10	−0.12
	R	−0.23	−0.20	−0.16	−0.12	−0.08	−0.04	0	+0.04	+0.08	+0.12	+0.17	+0.21	+0.25
+¼°	F	+0.09	+0.06	+0.04	+0.02	0	−0.02	−0.05	−0.07	−0.09	−0.11	−0.13	−0.15	−0.17
	R	−0.28	−0.24	−0.21	−0.17	−0.13	−0.09	−0.05	−0.01	+0.03	+0.08	+0.12	+0.16	+0.20
+½°	F	+0.04	+0.02	−0.01	−0.03	−0.05	−0.07	−0.09	−0.11	−0.13	−0.15	−0.17	−0.19	−0.21
	R	−0.33	−0.29	−0.25	−0.21	−0.18	−0.14	−0.10	−0.05	−0.01	+0.03	+0.07	+0.11	+0.16
+¾°	F	−0.01	−0.03	−0.05	−0.07	−0.10	−0.12	−0.14	−0.16	−0.18	−0.20	−0.22	−0.24	−0.26
	R	−0.38	−0.34	−0.30	−0.26	−0.22	−0.18	−0.14	−0.10	−0.06	−0.02	+0.02	+0.07	+0.11
+1°	F		−0.08	−0.10	−0.12	−0.14	−0.16	−0.18	−0.21	−0.23	−0.25	−0.27	−0.29	−0.31
	R		−0.39	−0.35	−0.31	−0.27	−0.23	−0.19	−0.15	−0.11	−0.07	−0.03	+0.02	+0.06
+1¼°	F			−0.14	−0.17	−0.19	−0.21	−0.23	−0.25	−0.27	−0.29	−0.31	−0.33	−0.35
	R			−0.40	−0.36	−0.32	−0.28	−0.24	−0.20	−0.16	−0.12	−0.07	−0.03	−0.01
+1½°	F				−0.21	−0.23	−0.26	−0.28	−0.30	−0.32	−0.34	−0.36	−0.38	−0.40
	R				−0.41	−0.37	−0.33	−0.29	−0.25	−0.20	−0.16	−0.12	−0.08	−0.04

F - Shim pack thickness change required at front Bolt (inches)

R - Shim pack thickness change required at rear bolt (inches)

+ Means shim addition

- Means shim removal

30-81A

Figure 30-41 Alignment Instructions 45-46-48-49000 Series

FRONT END ALIGNMENT

Satisfactory vehicle operation may occur 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 Chart "A" of this manual should be used by owners, dealers, and repairmen as guidelines in vehicle diagnosis, either for repairs under the new vehicle warranty or for maintenance service at customers' requests. These specifications provide an acceptable all-around operating range in that they prevent abnormal tire wear caused by wheel alignment.

WHEEL ALIGNMENT SPECIFICATIONS

	CHART A Specifications for Diagnosis for Warranty Repairs Or Customer Paid Service		CHART B Specifications for Resetting Alignment	
	43-44000 Series	45-46-48-49000 Series	43-44000 Series	45-46-48-49000 Series
Caster	-1 1/2° to +1/2°	+2° to 0°	-1/2° (±1/2°)	+1° (±1/2°)
Camber	+1 1/4° to -1/4°	+1° to -1/2°	+1/2° (±1/2°)	+1/4° (±1/2°)
Toe-In	1/16" toe-in to 5/16" toe-in		3/16" toe-in (±1/16")	
Cross Caster	No More Than 1° Side to Side Variation		No More Than 1/2° Side to Side Variation	
Cross Camber	No More Than 1° Side to Side Variation		No More Than 1/2° Side to Side Variation	

Governmental Periodic Motor Vehicle Inspection programs usually include wheel alignment among items that are inspected. To provide useful information for such inspections, the tolerances shown in Chart "C" are applicable and well within the range of safe vehicle operation.

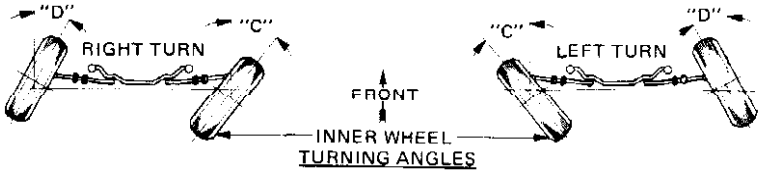
MOTOR VEHICLE INSPECTION STATION TOLERANCES

	CHART C	
	43-44000 Series	45-46-48-49000 Series
Caster	+1 1/2° to -2 1/2°	+3° to -1°
Camber	+2° to -1°	+1 3/4° to -1 1/4°
Toe-In	3/16" toe-out to 9/16" toe-in	

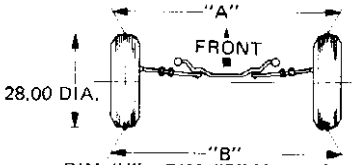
In the event the actual settings are beyond the specifications set forth in Chart "A" or "C" (whichever is applicable), or whenever for other reasons the alignment is being reset, Buick recommends that the specifications given in Chart "B" of the aforesaid applicable chart be used.

30-63B

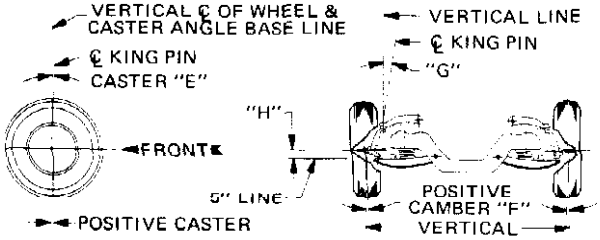
Figure 30-42 Wheel Alignment and Chassis Trim Chart 45-46-48-49000 Series



TURNING ANGLES

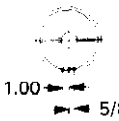


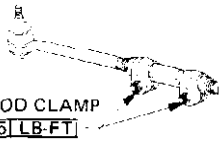
DIM. "J" = DIM. "B" MINUS DIM. "A"
TOE-IN



CASTER & CAMBER

NOTE: STEERING WHEEL MUST BE HELD IN STRAIGHT AHEAD POSITION DURING TOE-IN SETTING. AFTER TOE-IN SET, THE STEERING WHEEL MUST BE IN STRAIGHT AHEAD POSITION WITHIN 1.00 LEFT AND 5/8 RIGHT.





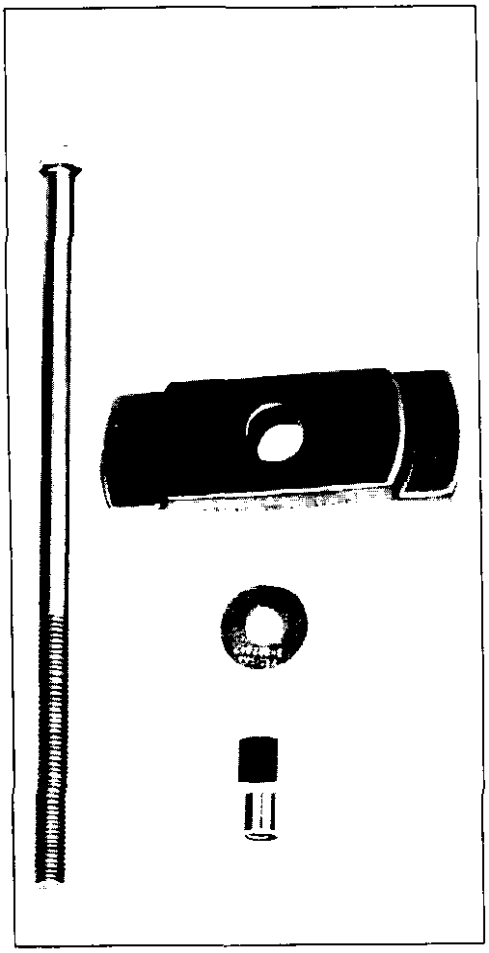
TORQUE TIE ROD CLAMP NUTS TO 15-25 LB-FT

INNER & OUTER TIE ROD ENDS MUST BE LOCATED AS SHOWN BEFORE TIGHTENING TIE ROD CLAMP NUTS. TIE ROD CLAMP BOLTS MUST BE LOCATED WITH THE BOLT IN THE EXTREME DOWNWARD HORIZONTAL POSITION. ROTATIONAL TOLERANCES ARE TO BE ± 15°.

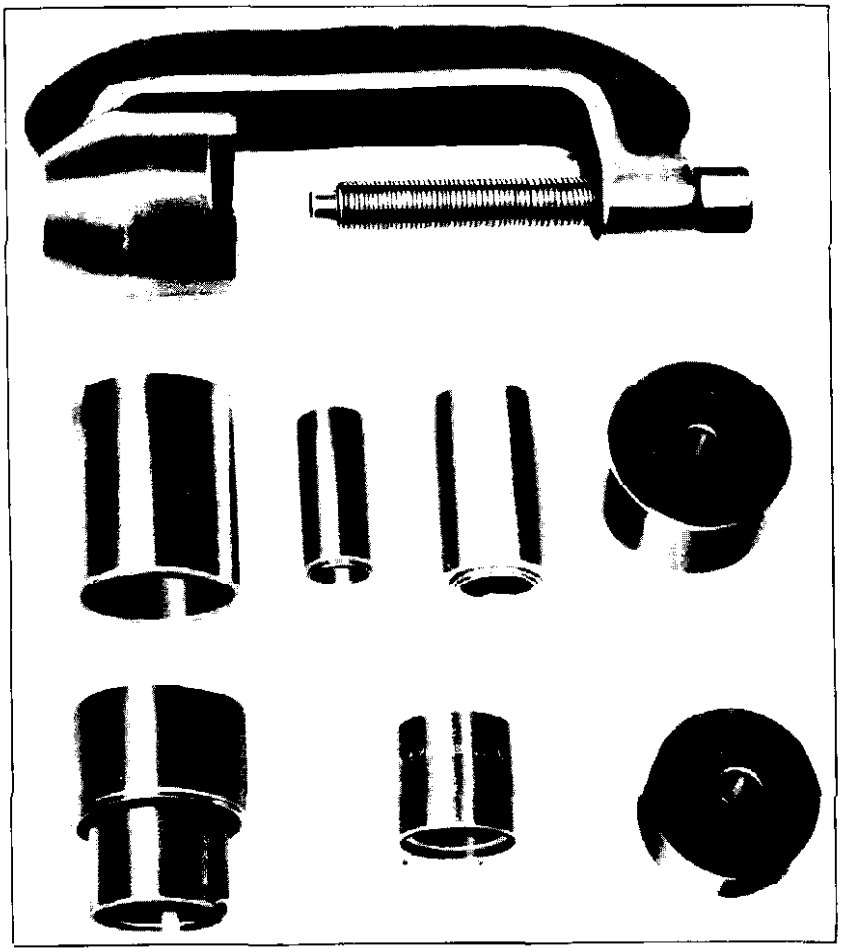
MODEL	FULL TURN INNER WHEEL "C" CURB	FULL TURN OUTER WHEEL "D" CURB	OUTER WHEEL ANGLE WITH INNER WHEEL AT 20°	STEERING AXIS ANGLE "G" AT 0° CAMBER
45237 45239 45269 45467 45439 45467 45469	35 1/4°	32 1/4°	18 1/2°	10 1/2°
46035 46045	34 3/4°	31 1/2°	18 1/2°	10 1/2°
46647 46639 46667	35 1/4°	32 1/4°	18 1/2°	10 1/2°
48237 48239 48437 48439	35 1/4°	32 1/4°	18 1/2°	10 1/2°
49487	35 1/4°	32 1/4°	18 1/2°	10 1/2°

30-72D

Figure 30-43 Wheel Alignment and Chassis Trim Chart 45-46-48-49000 Series



J 9552



J-9519-01

J 9519-01	LOWER CONTROL BALL JOINT REMOVER AND REPLACER SET
J 9552	FRONT COIL SPRING COMPRESSOR

30-49

Figure 30-44 Special Tools

SECTION B

FRAME and BODY MOUNTINGS 45-46-48-49000 SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS:	
	Trouble Diagnosis	20-5
II	DESCRIPTION AND OPERATION:	
	Description of Body Mounts	20-6
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	-
IV	REMOVAL AND INSTALLATION:	
	Removal and Installation of Body Mounts	20-7
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS:	
	Body Mount Specifications	20-8

DIVISION I

TROUBLE DIAGNOSIS

20-5 TROUBLE DIAGNOSIS

Improper body mount installations may result in the following problems:

1. Structure shake
2. Road noise
3. Squeaks

The above problems can sometimes be caused by the wrong part being installed or the mount not being properly torqued.

DIVISION II

DESCRIPTION AND OPERATION

20-6 DESCRIPTION OF BODY MOUNTS

The body of the car is mounted to the chassis by means of thick rubber mounts. These mounts are specifically designed for each location to give the maximum amount of structure rigidity while at the same time providing optimum road noise isolation. Two basically different mounts are used for this purpose. At those locations where a bolt is used, the mounting consists of a load carrying mount which rests on top of the frame side rails or mounting brackets, a metal tube spacer which limits the amount of compression of the mount and an insulator which fits on the bottom side of the frame side rail surface. All bolt-in body mounts have a specified bolting torque.

The second type of body mount used is of a plug-in design and has no mounting bolt. This mount plugs into a mounting hole on top of the frame side rail or rear spring seat and acts as a steady rest for the body.

DIVISION IV

REMOVAL AND INSTALLATION

20-7 REMOVAL AND INSTALLATION OF BODY MOUNTS

The removal of any one body mount necessitates the loosening of adjacent body mountings to permit the frame to be separated from the body

NOTE: *Front bumper, rear bumper, and radiator cross rods must be loosened before replacing body mounts.*

During installation of a body mount, caution should be used to insure that the body mount is properly seated in the frame mounting hole, otherwise a direct metal to metal short circuit will result between the frame and body. The tube spacer should be in all bolt-in body mounts and the insulator and metal washer positioned to prevent the washer from contacting the frame side rail. Do not use lubricants of any kind on the rubber parts of the mounts. Proper clamping by the mount depends on clean and dry surfaces. Do not over-torque the body mount or a collapsed tube spacer or stripped bolt will result. Lubricating the bolt threads will result in a higher clamping force for the same torque setting. If the body mount bolt does not screw in smoothly, it may be necessary to run a tap through the cage nut in the body to remove foreign material. If caution is not observed, broken body mount bolts may result. Caution should also be used to insure that tap doesn't punch through underbody.

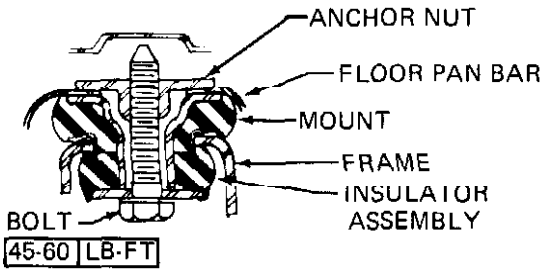
DIVISION VI

SPECIFICATIONS AND ADJUSTMENTS

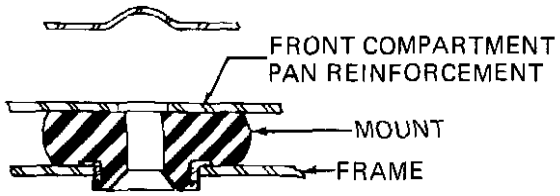
20-8 BODY MOUNT SPECIFICATION AND ADJUSTMENT

The 1971 body mount design is different from past model designs. Parts should not be intermixed.

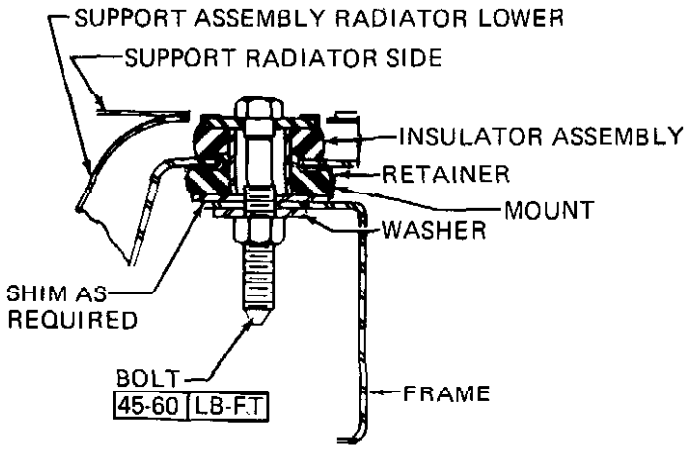
See diagrams for correct installation and torque specifications.



BODY BOLTS 1-2-3-4-6-7



BODY MOUNTS NO. 5



SHEET METAL MOUNT

20-16B

Figure 20-5 - Body Mounts - 45-46-48-49000

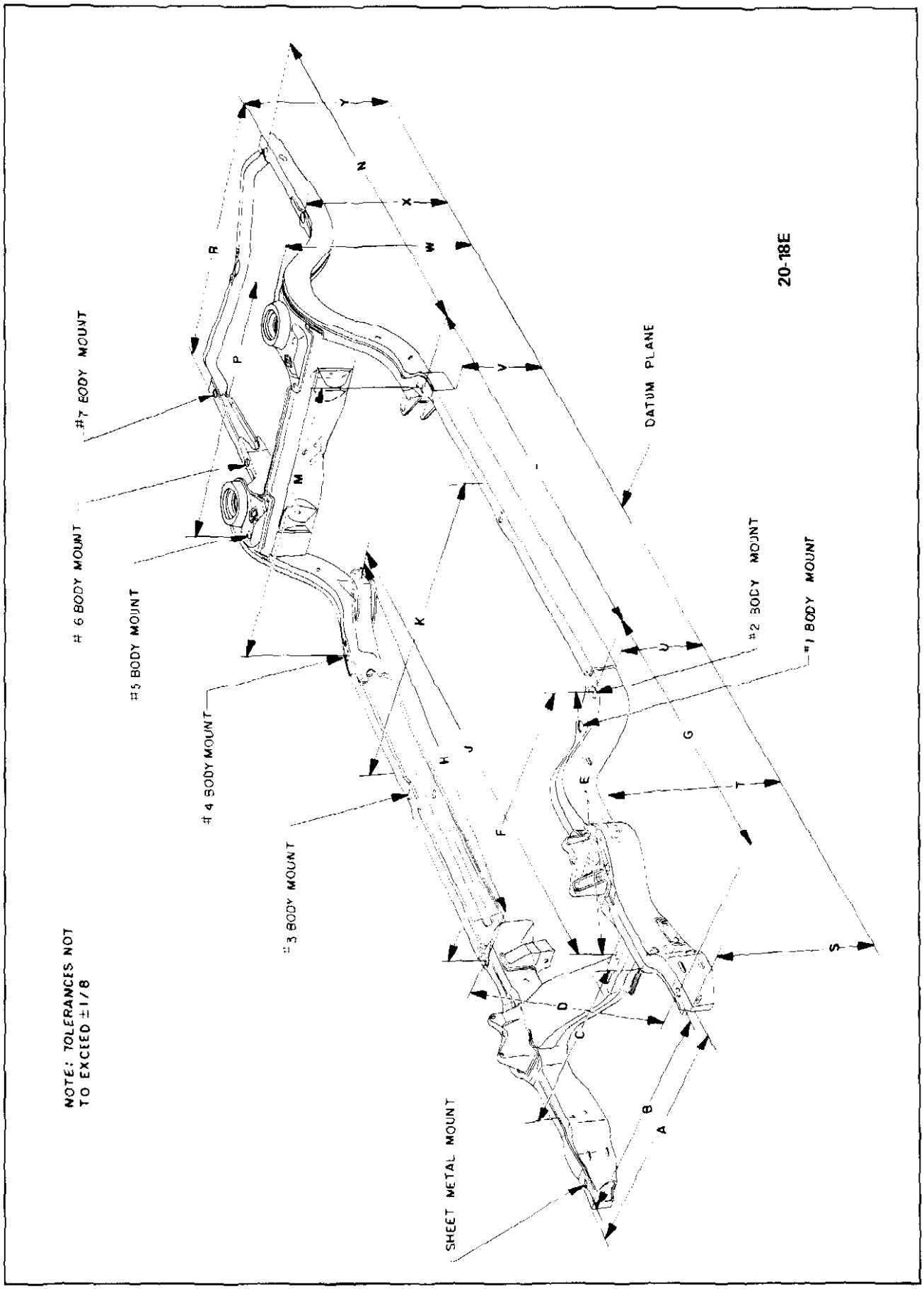


Figure 20-6 - Frame Details - 45-46-48-49000

LeSabre Centurion	Electra	Riviera	Estate Wagon	
A — 42 27/64	42 27/64	42 7/16	42 27/64	Outside edge to outside edge of frame front side rail.
B — 39 1/2	39 1/2	39 1/2	39 1/2	Center to center of sheet metal mount holes.
C — 31 55/64	31 55/64	31 59/64	31 55/64	Center top front steering gear bolt hole to center top hole idler arm mounting.
D — 58 25/64	58 25/64	68 3/16	58 25/64	Center of sheet metal mount hole across to center number 2 body mount hole.
E — 36 39/64	36 39/64	38 19/64	36 39/64	Center gage hole front cross member to center number 2 body mount hole.
F — 55 1/8	55 1/8	55 1/8	55 1/8	Center to center of number 2 body mount holes.
G — 46 5/8	46 5/8	49 1/8	46 5/8	Center sheet metal mount hole to center number 2 body mount hole.
H — 77 25/64	80 5/16	73 27/64	—	Center number 2 body mount hole to center rear lower control arm frame bracket hole.
J — 100 59/64	104 27/64	100 1/16	—	Center gage hole front cross member to center rear lower control arm frame bracket hole.
K — 59 45/64	59 45/64	59 11/16	59 45/64	Outside edge to outside edge of frame center side rail.
L — 68 37/64	72 5/64	64 37/64	70 5/32	Center number 2 body mount hole to center number 4 body mount hole.
M — 54 5/16	54 5/16	54 5/16	55 1/4	Center to center of number 4 body mount holes.
N — 72 9/32	72 9/32	67 23/32	67 11/32	Center of number 4 body mount hole to center number 7 body mount hole.
P — 51 13/64	51 13/64	51 1/4	49 9/32	Outside edge to outside edge of frame at rear spring seat.
R — 54 59/64	54 59/64	54 31/32	47 5/8	Outside edge to outside edge of frame at rear corner.
S — 15 3/64	15 3/64	15 1/64	15 3/64	Top of front of frame to datum plane.
T — 19 7/16	19 7/16	19 13/32	19 7/16	Center front upper control arm frame bracket front hole to datum plane.
U&V — 5	5	5	5	Locations for mounting number 2 and 3 datum gages.
W — 23 49/64	23 49/64	23 41/64	—	Bottom surface rear spring seat to datum plane.
X — 12 61/64	12 61/64	12 61/64	14 31/32	Top of frame at number 6 body mount to datum plane.
Y — 13 17/64	13 17/64	13 17/64	12 2/32	Top of rear of frame to datum plane.

20-18B

Figure 20-7 - Frame Dimensions - 45-46-48-49000

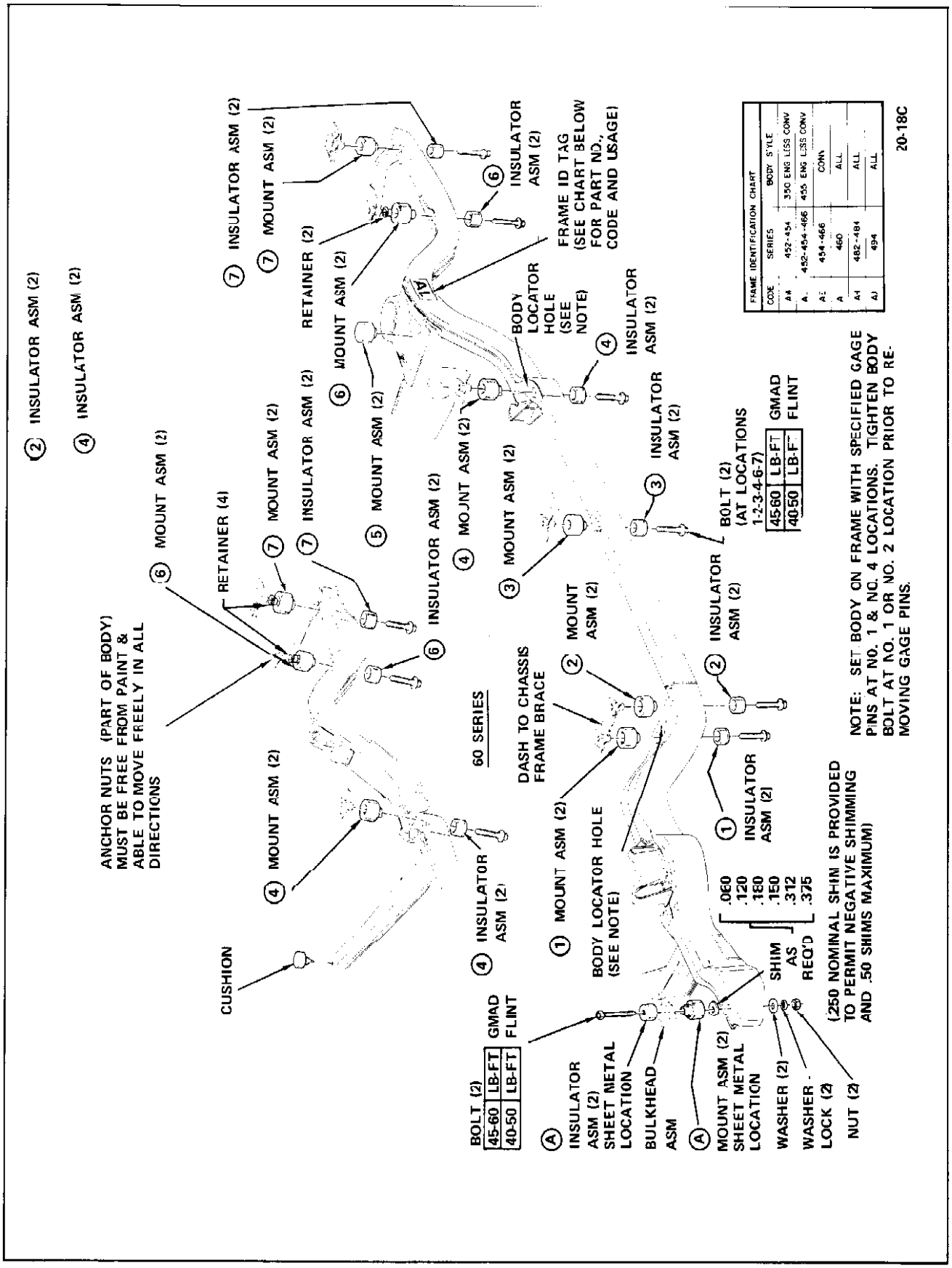


Figure 20-8 - Body Mount and Frame Usage - 45-46-48-49000

GROUP 10

WINDSHIELD WIPER AND WASHER SYSTEM

Section	Title
A	Windshield Wiper and Washer System Removal and Installation . . . . .

SECTION A

WINDSHIELD WIPERS
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: See 1971 Fisher Body Service Manual	
II	DESCRIPTION AND OPERATION: See 1971 Fisher Body Service Manual	
III	ADJUSTMENTS AND MINOR SERVICE: See 1971 Fisher Body Service Manual	
IV	REMOVAL AND INSTALLATION:	
	43-44000 Series Wiper Motor (Non-Depressed Park)	10-1
	43-44000 Series Wiper Motor (Depressed Park)	10-2
	45-46-48-49000 Series Wiper Motor	10-3
	Washer Pump Removal (All Depressed Park Systems)	10-4
	43-44000 Wiper Transmission	10-5
	45-46-48-49000 Wiper Transmission	10-6
V	OVERHAUL AND MAJOR SERVICE: See 1971 Fisher Body Service Manual	
VI	SPECIFICATIONS: See 1971 Fisher Body Service Manual	

DIVISION IV

REMOVAL AND INSTALLATION

10-1 43-44000 SERIES WIPER MOTOR (NON-DEPRESSED)

1. Disconnect battery.

2. Remove cowl screen.

3. Loosen the two (2) nuts on the adjustable motor drivelink at the crank arm and slip drivelink off. See Figure 10-1.

4. Remove electrical connectors from washer motor and pump.

5. Disconnect washer pump hoses.

6. Remove three (3) bolts securing motor to cowl and carefully lift motor away from cowl.

7. To reinstall motor, reverse the above removal procedure.

10-2 43-44000 SERIES WIPER MOTOR (DEPRESSED PARK)

1. Disconnect battery.

2. Remove hoses from washer nozzles.

3. Remove rubber weatherstrip and cowl screen.

4. Use a 3/8" socket and loosen the two (2) nuts on the adjustable motor drivelink at the crank arm and slip off.

5. Disconnect washer hoses and electrical connectors from pump and motor.

6. Remove three (3) wiper motor to cowl retaining screws, using a 5/16" socket.

7. To reinstall wiper motor, reverse the removal procedure.

10-3 45-46-48-49000 WIPER MOTOR

1. Disconnect battery.

2. Remove cowl screen.

3. Using a 3/8" socket, loosen two (2) nuts on the wiper transmission drivelink to wiper motor cranking arm and slip drivelink off of cranking arm.

4. Disconnect washer pump hoses and two (2) electrical connectors, one from washer pump and one from wiper motor.

5. Using a 5/16" socket, remove three (3) screws holding motor to cowl.

6. To reinstall, reverse removal procedure.

10-4 WASHER PUMP REMOVAL (ALL DEPRESSED PARK SYSTEMS)

NOTE: *This operation can be done with washer motor on or off the car.*

1. Remove washer pump hoses.

2. Disconnect electrical connector at pump.

3. Snap off plastic shield.

4. Remove three (3) screws securing pump to motor and lift pump off of motor.

5. To install washer pump, reverse removal procedure. Rotate washer pump drive cam so that hole in cam and hole in washer pump mounting plate are aligned. Insert a length of 1/8" rod through pump mounting plate and cam to maintain alignment while installing pump on wiper motor.

10-5 43-44000 SERIES WIPER TRANSMISSION

1. Disconnect washer hose from washer nozzles.

2. Remove rubber weatherstrip from front of cowl screen and five (5) snap clips from the rear of the screen; then remove the cowl screen.

3. Use a 3/8" socket and loosen the two (2) nuts on the drivelink socket bearing at the crank arm and slip drivelink link off of the crank arm. See Figure 10-1.

4. Remove both wiper arm and blade assemblies.

5. Remove two (2) screws from the right and left transmission pilot shaft with a 5/16" socket. The third screw on the left side takes a 7/16" socket and should be removed last.

6. With the transmission assembly laying loose, rotate it towards front of car and remove through the access hole in right side of cowl.

7. To reinstall transmission, reverse the removal procedure.

10-6 45-46-48-49000 SERIES WIPER TRANSMISSION

1. Remove cowl screen.

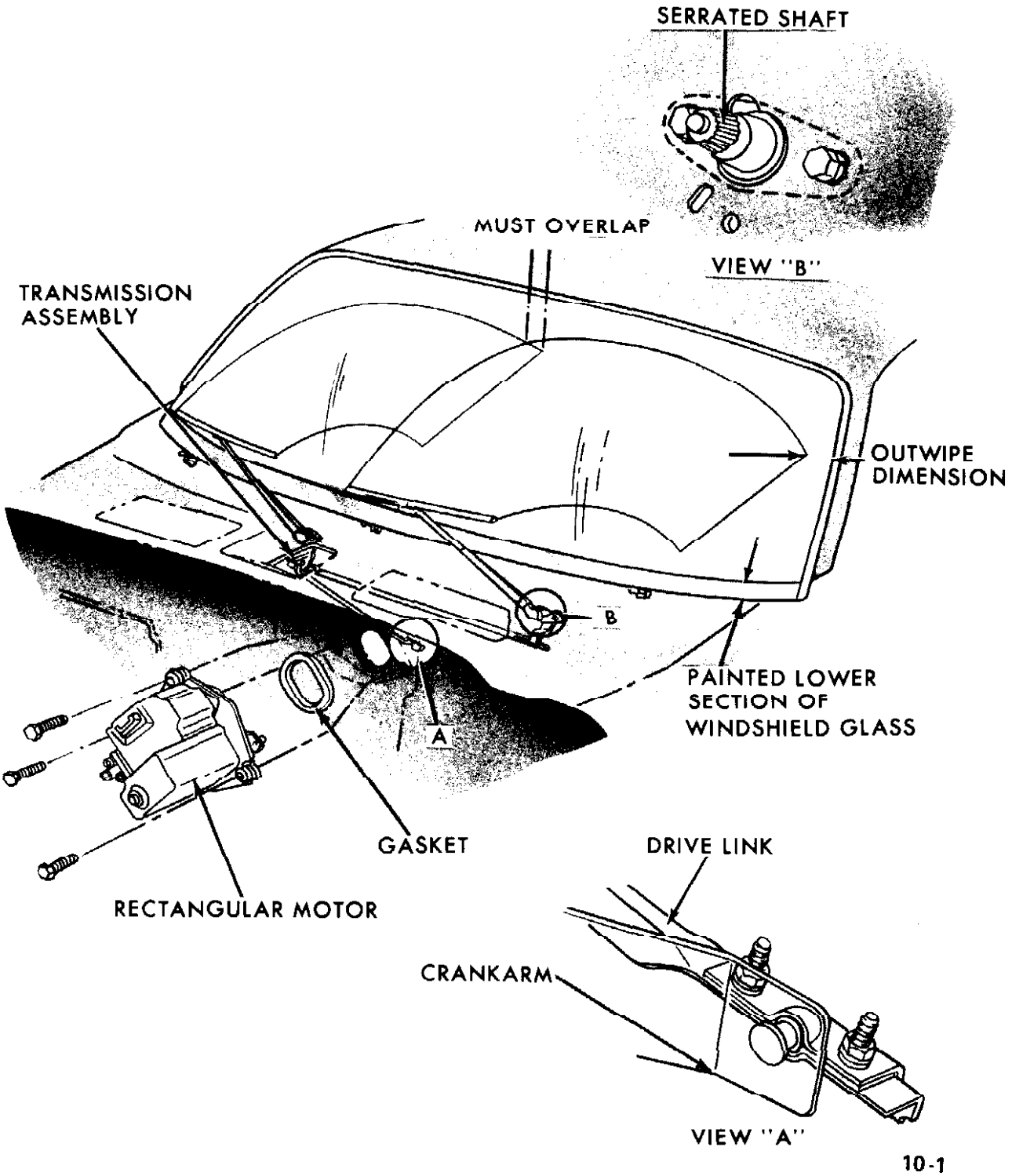
2. Remove both wiper blade assemblies.

3. Loosen the two (2) drivelink to crank arm adjusting nuts and slip drivelink off crank arm.

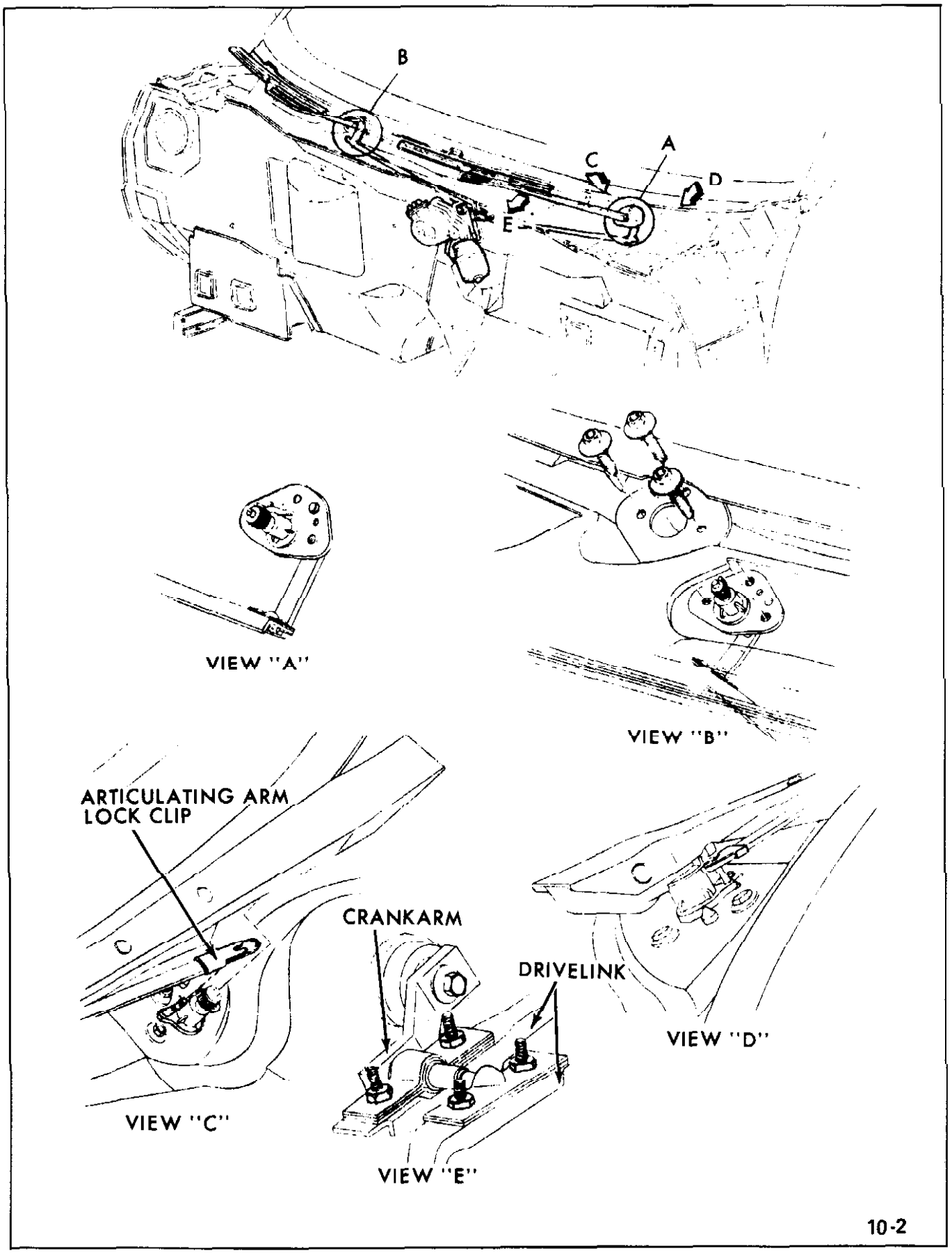
4. Remove the two (2) wiper blades and wiper arm assemblies.

5. Remove six (6) bolt securing wiper transmissions to cowl, three on each side at the serrated head of output shaft.

6. To reinstall transmission assembly, reverse removal procedure.


SERRATED SHAFT
MUST OVERLAP
VIEW "B"
TRANSMISSION ASSEMBLY
OUTWIPE DIMENSION
B
PAINTED LOWER SECTION OF WINDSHIELD GLASS
A
GASKET
RECTANGULAR MOTOR
DRIVE LINK
CRANKARM
VIEW "A"

10-1


B
A
C
D
E
VIEW "A"
VIEW "B"
ARTICULATING ARM LOCK CLIP
CRANKARM
DRIVELINK
VIEW "C"
VIEW "D"
VIEW "E"

SECTION B

MAINTENANCE and LUBRICATION
ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Not Applicable)	-
II	DESCRIPTION AND OPERATION: (Not Applicable)	-
III	ADJUSTMENTS AND MINOR SERVICE:	
	Engine Oil Recommendations	00-9
	Periodically While Vechicle is Being Refueled	00-10
	Maintenance Recommendations - Every 4 Months	00-11
	Maintenance Recommendations - Every 4 Months or 6,000 Miles	00-12
	Maintenance Recommendations - Every 12,000 Miles	00-13
	Maintenance Recommendations - Every 18,000 Miles	00-14
	Maintenance Recommendations - Every 24,000 Miles	00-15
	Maintenance Recommendations - Seasonal (Cooling System)	00-16
	Vechicle Operation Under Dusty Conditions	00-17
IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
V	OVERHAUL AND MAJOR SERVICE: (Not Applicable)	-
VI	SPECIFICATIONS:	
	Lubrication and Capacity Charts	00-18

DIVISION III

ADJUSTMENTS AND MINOR SERVICE

00-9 ENGINE OIL RECOMMENDATIONS

a. Engine Oil

Engine crankcase oils have a definite effect on ease of starting, oil economy, combustion chamber deposits and engine wear. It is recommended that an oil which, according to the label on the can, is: (1) intended for service MS and (2) passes car makers' tests or meets General Motors Standard GM 6041-M be used. Oils conforming to these types contain detergent additives.

b. Grade or Viscosity

The grade or viscosity (SAE number) of engine oil should be selected for the lowest anticipated temperature at which cold engine starting will be required as recommended in the temperature-viscosity chart in subparagraph d.

Oil level should be checked more frequently during the break-in period since somewhat higher oil consumption is normal until piston rings become seated.

The oil level should be maintained between the "operating range" marks on the gage rod; the space between marks represents one quart. Do not fill above the upper mark.

c. Oil Color

The color of "Service MS" type oil does not indicate its condition since it normally becomes dark (black or gray) after only a few hundred miles of driving. This is because the detergent content envelopes and holds in suspension extremely fine but harmless soot (soft carbon) and lead particles. The oil filter element does not remove this harmless material but it does remove harmful particles such as road dust, metal chips and hard carbon.

d. Engine Oil Change and Viscosity Recommendations

ANTICIPATED LOWEST TEMPERATURES	USE SAE VISCOSITY NO.	CHANGE YOUR OIL AT LEAST
ABOVE FREEZING (32° F.)	SAE 10W-30 SAE 20W SAE 10W-40 SAE 20W-40	EVERY 4 MONTHS*
BELOW FREEZING (32° F. TO 0° F.)	SAE 10W SAE 10W-30 SAE 10W-40 SAE 5W-30	EVERY 4 MONTHS*
BELOW 0° F.	SAE 5W-20 SAE 5W SAE 5W-30	EVERY 4 MONTHS*

*NEVER EXCEED 6,000 MILES BETWEEN OIL CHANGES. DURING EXTREME DRIVING CONDITIONS WHICH PRODUCE OIL CONTAMINATION BY DUST, WATER, OR OTHER FOREIGN MATERIAL, THE OIL SHOULD BE CHANGED MORE FREQUENTLY THAN EVERY 4 MONTHS. YOUR AUTHORIZED BUICK DEALER IS WELL QUALIFIED TO ADVISE YOU.

NOTE: WHEN CHANGING THE OIL, CONSIDER THE LOWEST ANTICIPATED TEMPERATURE FOR THE NEXT 4 MONTHS.

SAE 5W AND 5W-20 OILS ARE NOT RECOMMENDED FOR SUSTAINED HIGH SPEED DRIVING.

SAE 30 OILS MAY BE USED AT TEMPERATURES ABOVE 60° F.

00-85

e. Crankcase Flushing

Flushing the crankcase with oils or solutions other than a good grade of 10-W engine oil is not recommended. When flushing to remove contamination appears advisable, use 3 quarts 10-W oil (4 quarts if filter is drained) and idle the engine at 1000 RPM (equivalent to 20 MPH) until the oil is hot, then drain crankcase and oil filter immediately after stopping engine. Fill crankcase with correct quantity and seasonal grade of oil. Install new oil filter element.

f. Engine Oil Supplement

Engine Oil Supplement or equivalent is a compound of the materials used by oil refiners to manufacture high detergent motor oils. It is intended for use in engines operating under aggravated conditions where engine deposits, rust and corrosion cannot be adequately retarded by motor oils readily available to the average motorist. It is especially recommended for engines operated under restricted conditions such as frequent stops, short trips and slow speeds where such symptoms are sticking valves, valve lifters and rings are noticed.

Although Engine Oil Supplement may be used continually, it is normally unnecessary to use it with every crankcase refill. When used, the instructions on the container should be carefully observed.

00-10 PERIODICALLY WHILE VEHICLE IS BEING REFUELED

1. Battery - Check Level

If necessary, add colorless, odorless drinking water to bring level to split ring at bottom of filler wells.

CAUTION: *DO NOT OVERFILL.*

2. Tires

For maximum tire life with corresponding good ride characteristics, maintain the tire pressure recommended in Group 100.

3. Engine Oil

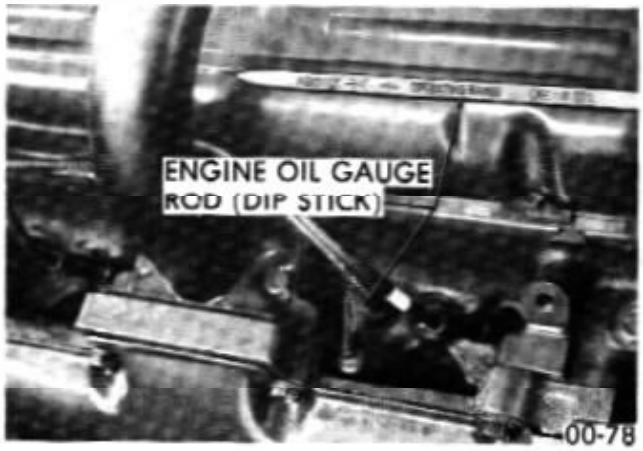


Figure 00-15 - Engine Oil Gauge Rod

This check should be performed last to allow the oil to drain back into the pan. Always add oil if the level is below the lower mark on the dip stick. See Figure 00-15.

4. Windshield Washer Solvent

If necessary, add solvent using GM Optikleen or equivalent. Follow instructions on label for correct concentration of solvent and water.

00-11 MAINTENANCE RECOMMENDATIONS - EVERY 4 MONTHS

1. Engine Oil Change

Drain and refill engine crankcase every 4 months. If more

than 6,000 miles are driven in a 4 month period, change oil every 6,000 miles. See subparagraph d. for oil recommendations.

Certain driving conditions including prolonged operation in sub-zero temperatures, trailer hauling and extensive idling necessitates more frequent oil changes. Under these conditions oil change intervals should not exceed 2 months or 3,000 miles, whichever occurs first.

2. Engine Oil Filter Change

Replace engine oil filter at the first engine oil change and every second oil change thereafter.

To change, screw filter off the filter base and discard. Wipe the gasket area of the base clean and install a new gasket in the groove of a new AC type PF-24 filter (V-8), PF-25 (L-6) or equivalent. Lubricate the gasket and screw the filter on the nipple until the gasket just touches the base; tighten filter 2/3 of a turn more. Start engine. *Do not accelerate engine beyond the normal idle speed until oil pressure light goes out.* Check the filter area for leaks after the engine has run for five (5) minutes.

3. Emission Control

Check engine idle speed, ignition timing, idle fuel mixture and Positive Crankcase Ventilation System at first oil change (four months or 6,000 miles, whichever occurs first). Subsequent checks should be made every 12 months or 12,000 miles, whichever occurs first.

4. Positive Traction Differential (45-46-48-49000 Series only)

Change lube at first oil change only. Refill with SAE 90 lube, conforming to GM Specification 1051022.

00-12 MAINTENANCE RECOMMENDATIONS - EVERY FOUR MONTHS OR 6,000 MILES

1. Front Suspension and Steering Linkage

The front suspension and steering linkage should be lubricated with a water resistant extreme pressure EP No. 2 Multi-Purpose grease equivalent to GM Specification 6031-M every four months or 6,000 miles whichever occurs first.

NOTE: *If lubricants not meeting GM Specification 9985038 are used, the lubrication interval should be shortened and should not exceed 2,000 miles.*

Wipe dirt from the lubrication fittings and apply lubricant under pressure at the following points:

Upper Ball Joints (2 fittings)

Lower Ball Joints (2 fittings)

Steering Linkage (7 fittings)

2. Manifold Heat Valve (L-6)

Spray "Buick CRC 5-56" or equivalent on end of shaft, and free up if required. See Figure 00-16.

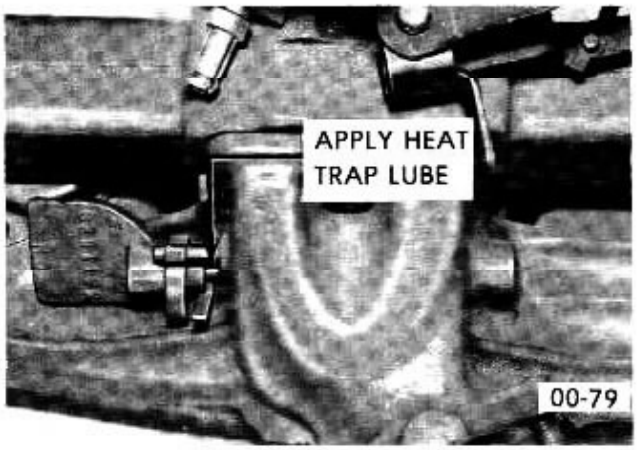


Figure 00-16 - Lubricating Points on Manifold Heat Control Valve - L-6 Engine

3. Clutch Lash

Should be adjusted every 6,000 miles. See Group 71 for procedures.

4. Tires

For best tire mileage, rotate tires every four months or 6,000 miles as shown in Figure 00-17. After tire rotation, adjust tire pressure to the recommended pressure listed in Group 100.

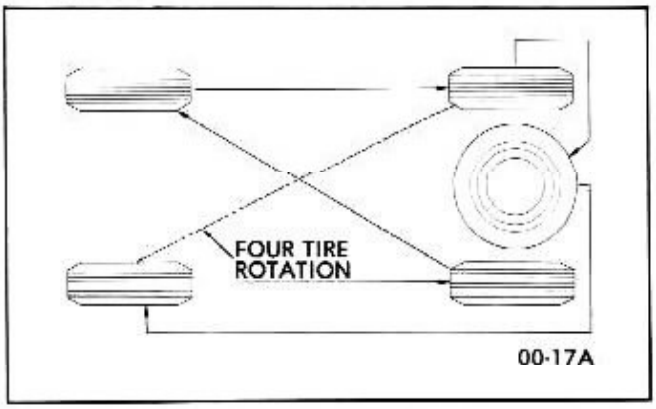


Figure 00-17 - Tire Rotation Method

A decrease in traction and anti-skid properties, as well as road hazard resistance, occurs as tires become worn out. The original equipment tires incorporate built-in tread wear indicators to assist in judging when tires should be replaced. These indicators are molded into the bottom of the tread grooves and will appear as 1/2 inch wide bands when tire tread depth becomes a 1/16 of an inch. When the indicators appears in two or more adjacent grooves, tire replacement is recommended. See Figure 00-18.

Figure 00-18 Tread Wear Indicators

5. Check Fluid Level

Brake Master Cylinder All models are equipped with dual master cylinders. Maintain fluid level 1/4 inch plus or minus 1/8 inch below top of each filler opening. When adding brake fluid, use Delco Supreme No. 11 hydraulic brake fluid or equivalent. Never use reclaimed fluid, mineral oil, or fluid inferior to SAE Standard J1703.

Manual Transmission Check oil level, after allowing time for oil to settle. Clean the surrounding area before removing filler plug. Level should be maintained at filler plug opening by adding SAE/80 or 90 multi-purpose gear lubricant.

NOTE: *Draining and flushing transmission is not recommended.*

Automatic Transmission **IMPORTANT:** *Refer to Group 75 or 76 for correct refill procedures.*

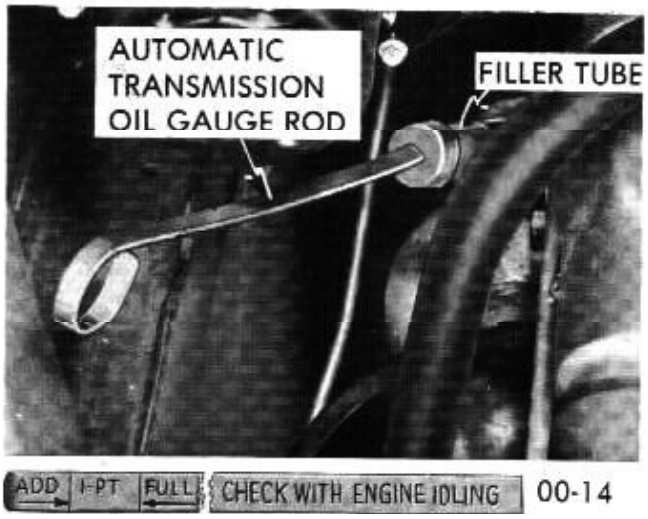


Figure 00-19 - Automatic Transmission Oil Gauge Rod

Power Steering Reservoir Thoroughly clean any excessive amounts of dirt from reservoir cap before removing. Maintain level in accordance with fill marking on cap dip stick. Use *only* Power Steering Fluid meeting GM Specification 9985010.

Standard Differential Rear Axle Check lubricant level after allowing time for lube to settle. Clean surrounding area before removing filler plug. Level should be maintained not lower than 1/4" below filler plug opening by adding SAE 80 or 80-90 Multi-Purpose Gear Lubricant meeting GL-5 specification.

NOTE: *Draining and flushing are not recommended. When complete refilling is necessary, SAE 80 or 80- 90 Multi-Purpose Gear Lubricant may be used, provided the axle has been in service for 1,000 miles or more. Axles with less than 1,000 miles must not be completely refilled with any lubricant other than Factory Hypoid Lubricant or equivalent.*

Positive Traction Differential Rear Axle U.S. Built Axles Identified by a stainless steel plate attached by a rear cover bolt stating "Use positraction differential lube only" and by an X enclosed in a circle stamped on the bottom of the left axle tube. See Figure 00- 20

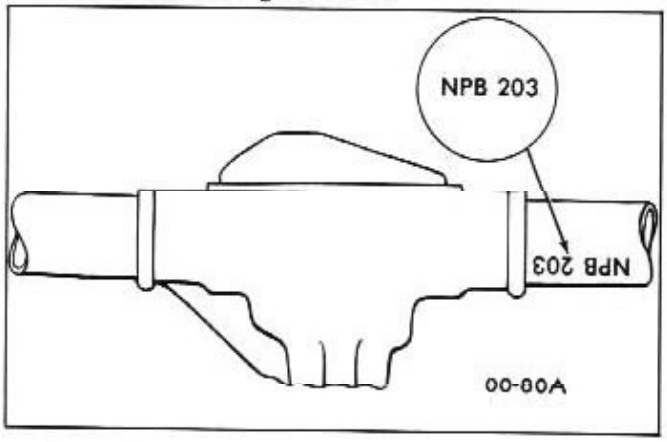


Figure 00-20 - Positive Traction Identification -U.S. Built Axles

Canadian Built Axles

Identified by a red plastic tag attached to the filler plug stating "USE POSITRACTION DIFF. LUBRICANT ONLY" and by an E stamped below the production month and date on the front face of right axle tube. See Figure 00-21.

Check lubricant level after allowing time for lubricant to settle.

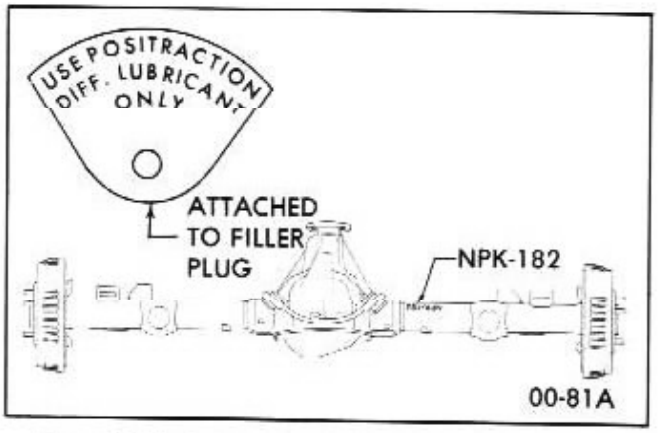


Figure 00-21 - Positive Traction Identification - Canadian Built Axles

Level should be maintained not lower than 1/4" below filler plug opening by adding SAE 90 gear lube meeting GM Specification 1051022 **NOTE:** *If Positive Traction Differential lube becomes contaminated, the axle assembly may be flushed with engine oil. Refer to Group 40 for complete flushing and refill procedures.*

6. Minor Lubrication

Occasionally lubricate the pivot points at the following locations with the recommended material.

Hood Hinge - Lubriplate or equivalent.

Door Hinges - Lubriplate or equivalent.

Door Lock Cylinders - powdered graphite. DO NOT USE OIL.

Gas Tank Door Hinge - Engine Oil.

Door Lock Fork Bolt - Stick type lubricant.

Rear Compartment lid lock - Lubriplate or equivalent.

Door Jam Switch - Lubriplate or equivalent.

Front Seat Adjuster Tracks - Lubriplate or equivalent.

Convertible Top Mechanism - Lubriplate or equivalent.

Station Wagon Folding Seat Linkage - Dripless Oil.

Tail Gate Lock Striker - Stick type lubricant.

Tail Gate Hinges - Dripless Oil.

Folding Top Lift Cylinder Piston - With folding top in raised position, wipe exposed portion of each top lift cylinder piston rod with a cloth dampened with brake fluid to remove any oxidation or accumulated grime. With another clean cloth apply a light film of brake fluid to act as a lubricant.

NOTE: *Do not allow brake fluid to come in contact with any painted or trimmed parts of the body.*

NOTE: *Do not lubricate carburetor or throttle linkage.*

7. Body Rubber Parts

Door, hood, and rear compartment rubber weatherstrips may be kept pliable and quiet by the application of a light coat of GM Part No. 1050110 Lubricant or suitable silicone lubricant equivalent.

00-13 MAINTENANCE RECOMMENDATIONS - EVERY 12,000 MILES

1. Ignition Points, Timing, Spark Plugs, Point Dwell and Idle Speed Mixture

It is recommended that the spark plugs be cleaned and gapped or, if necessary replaced at 12,000 miles. Also the ignition points should be replaced and the engine timing, point dwell and idle speed mixture should be set to specifications as stated in Group 69.

NOTE: *More frequent service may be required depending on driving conditions.*

2. Fuel Filters

Replacement of fuel filter is recommended at 12,000 miles or 12 months whichever occurs first. Remove from carburetor inlet and replace with filter type GF-427 or equivalent for L-6 and 350 2 bbl. or GF-441 or equivalent for all V-8's with 4 bbls. More frequent servicing may be necessary if contaminants have entered the fuel system.

3. Distributor Cam Lubricator

It is recommended that the distributor cam lubricator be replaced every 12,000 miles. Remove from post on distributor plate and replace with a new wick. See Figure 00-22.

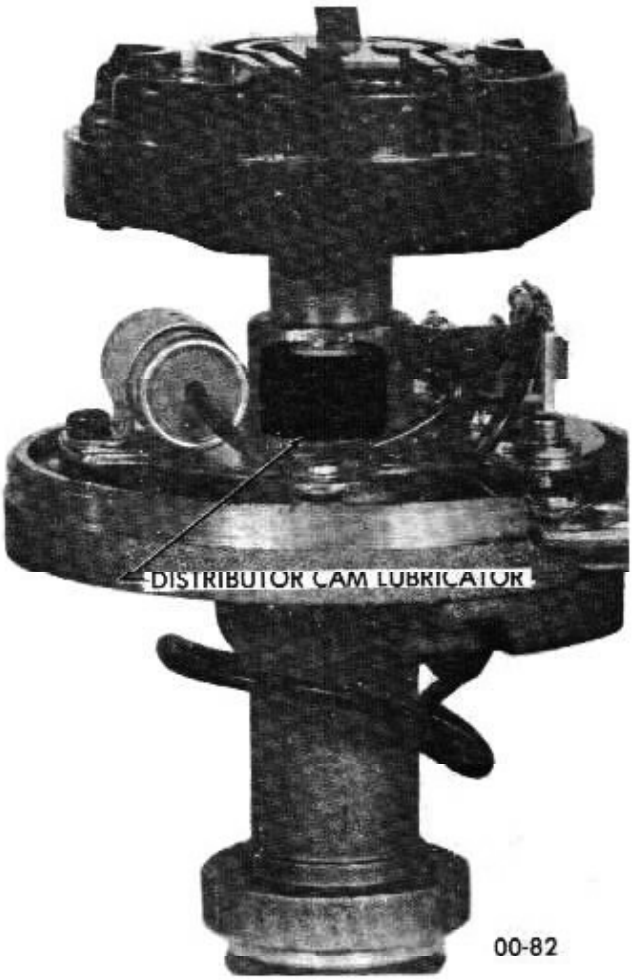


Figure 00-22 - Distributor Cam Lubricator

4. Belts

Inspect engine driven belts for condition and proper tension.

5. Wheel Alignment and Balance

Refer to Group 30.

6. Turbo Hydra-matic 350 and 400

If transmission is subjected to heavy duty usage, such as heavy city traffic during hot weather, or in commercial use, when engine is regularly idled for prolonged periods, the transmission recommendations listed under "24,000 Mile" should be performed at 12,000 miles.

7. Air Conditioner-Equipped Model

It is recommended that the system should be functionally checked by the dealer each spring.

Keep insects and dirt from accumulating on the air conditioner condenser.

8. Brakes

Examine brake linings for wear and the self adjusting mechanism for proper functioning. Although linings may not be excessively worn, this check will indicate when another inspection should be made.

If equipped with Disc brakes observe friction pad thickness through the inspection opening in the caliper. Refer to Group 50 for service procedure and specifications.

If required use Buick approved replacement linings and friction pads or equivalent. Lubricate self adjusting mechanism adjusting screw with Delco Moraine Special Brake Lubricant or equivalent.

00-14 MAINTENANCE RECOMMENDATIONS - EVERY 18,000 MILES

1. Front Wheel Bearings (Drum Type Brakes)

Inspect and lubricate with a high melting point wheel bearing grease conforming to GM specifications 6031M when brakes are serviced. Always follow with correct bearing adjustment as outlined in Group 30.

2. Front Wheel Bearings (Disc Type Brakes)

Inspect and lubricate with a premium high melting point wheel bearing grease meeting GM Specification 9048-P when brakes are serviced. Always follow with correct bearing adjustment, as outlined in Group 30.

00-15 MAINTENANCE RECOMMENDATIONS - EVERY 24,000 MILES

1. Automatic Transmission Turbo Hydra-matic 350 and 400

At this interval the automatic transmission should be drained, the oil pan and oil strainer cleaned (Turbo Hydra-matic 350), and oil filter replaced (Turbo Hydra-matic 400) and new oil added as stated in Groups 75 or 76.

When adding transmission fluid use only DEXRON Automatic Transmission Fluid or Automatic Transmission Fluid identified with the mark DEXRON on the container.

2. Engine Air Cleaner Element

Replacement of element is required every 24,000 miles. If car is operated in dusty territory, check condition of air cleaner element more frequently and replace if necessary. Service with the following AC type air cleaner element or equivalent for maximum engine protection.

Air Cleaner Element Chart

ELEMENT		
USAGE	REGULAR	HEAVY DUTY
L-6 All	A169W*	A227C*
350 2 & 4-BBL	A329C*	A368C*
455 All	A212CW*	A279C*
*OR EQUIVALENT		00-86B

3. Crankcase Ventilation Filter

Inspect at every oil change - replace if necessary with AC type FB-59 or equivalent. Replace at least every 24,000 miles - more often under dusty conditions. See Figure 00-23.

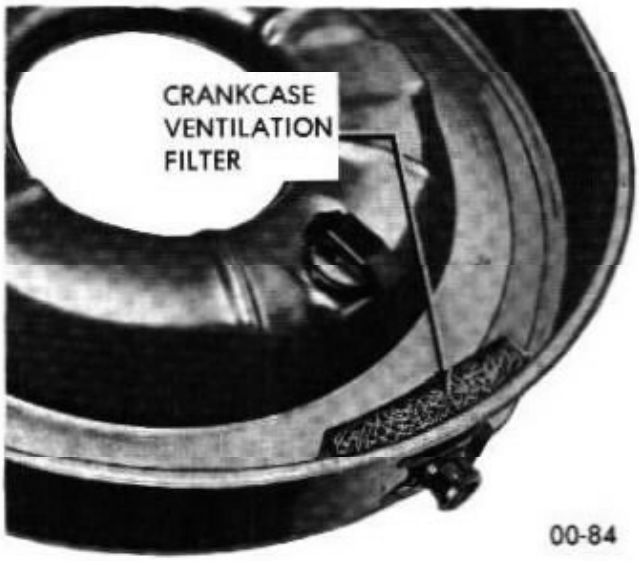


Figure 00-23 - Crankcase Ventilation Filter Location

4. Cooling System Inhibitor

It is required that GM cooling system inhibitor and sealer or equivalent be added every 24,000 miles.

5. Positive Crankcase Ventilator Valve

Replace PCV valve at 24,000 or 24 months, whichever occurs first. Remove positive crankcase ventilation valve and replace with a new AC-type CV- 679C, or equivalent, for V-8 engines; or AC-type CV- 723C, or equivalent, for L-6 engines.

Inspect PCV system hoses and fittings, clean and replace as necessary. Make certain all connections are tight.

00-16 MAINTENANCE RECOMMENDATIONS - SEASONAL (COOLING SYSTEM)

1. Anti-Freeze

An ethylene glycol type anti-corrosive and anti- freeze cooling system protection solution developed for year around use (General Motors Specifications, GM 1899-M) has been installed in the cooling system of the vehicle at the factory for protection to -20 degrees F. (-32 degrees F. in Canada) to provide adequate cooling performance and corrosion protection.

Although this type coolant should be maintained to at least -20 degrees F. (-32 degrees F. in Canada) throughout the year, once every two years the cooling system should be drained, flushed and ethylene glycol type anti-freeze also conforming to General Motors Specification GM 1899-M installed. At this time, also add GM cooling system inhibitor and sealer or equivalent. *Water alone, Methanol, or alcohol type anti-freeze is definitely not recommended.*

If water alone must be used as coolant in an emergency, it is extremely important that Buick Heavy Duty Cooling System Protector and Water Pump Lubricant or equivalent be added to the cooling system as soon as possible. If any other cooling system protector is used, be sure it is labeled to indicate that it meets General Motors Specification GM 1899-M.

00-17 VEHICLE OPERATION UNDER DUSTY CONDITIONS

When cars are operated in adverse dusty climates or conditions, the following precautions should be taken to prevent dirt and other foreign materials from entering the engine.

1. Change Engine Oil.

Change more often than is recommended in subparagraph C. The severity of the conditions should determine the frequency of oil changes.

2. Oil Filter.

Change each time that the oil is changed under these conditions.

3. Air Cleaner Element.

Inspect element. If dirty, replace as recommended under Paragraph 00-15.

4. Manual Steering Gear.

If gear is disassembled for inspection or repairs, refill with 14 ounces of calcium grease conforming to (General Motors Specifications, GM 4673M). *Do not use chassis lube because of adverse cold weather characteristics.*

DIVISION VI

SPECIFICATIONS

00-18 LUBRICATION AND CAPACITY CHARTS

a. Refer to Lubrication Charts

b. Refer to U.S., Imperial and Metric Measure Chart.

1971 LUBRICATION CHART - ALL MODELS

STEERING LINKAGE - LUBE (7)
-CL- 6,000 Mi. or 4 Mos.
Whichever Occurs First

DISTRIBUTOR CAM LUBRICATOR
Replace 12,000

ENGINE BELTS - Check Condition and Proper Tension 12,000

EVAPORATION CONTROL CANISTER FILTER
Replace filter on underside of canister every 12 months or 12,000 miles, whichever occurs first.

FUEL FILTER - Replace With Recommended Element 12,000 or 12 Mos.
Whichever Occurs First

WINDSHIELD WASHER FLUID
Check Level Periodically

LOWER BALL JOINTS (2) - CL - 6,000 Miles or 4 Mos. Whichever Occurs First

ENGINE OIL - Drain and Refill - EO - 4 Mos.
Never exceed 6,000 miles between changes

STD. STEERING GEAR - Lubed for Life SG - Used for refill after repair only

CHECK HEAT CONTROL VALVE - HTL - 6,000
L-6 Engine only

POWER STEERING RESERVOIR - Check Fluid Level -PSF-
Whichever Occurs First 4 mos. or 6,000

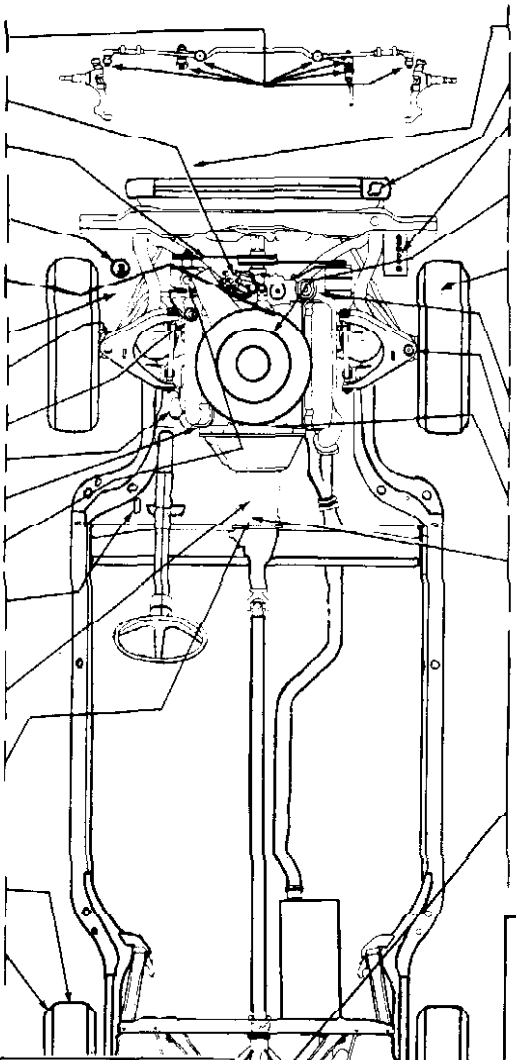
BRAKE MASTER CYLINDER -
Maintain Level 1/4" ± 1/8" Below Top of Each Reservoir - HBF -
Whichever Occurs First 4 mos. or 6,000

MANUAL TRANSMISSION - Maintain at Filler Opening - Flushing & Seasonal Changes NOT Recommended. M.P.G. - SAE - 80 or 90

CHECK CLUTCH LASH – (43-44-45-46000 ONLY)
Adjust if necessary 6,000

TIRES – Rotate
Maintain Pressure Periodically
Refer to Group 100 For Correct Pressure 6,000

BRAKE MECHANISM - Apply at Starwheel Point of Contact and Lightly to 6 Surfaces on Which Shoe Rim Rests -BL- 12,000



AIR CONDITIONER - Functional Check Once a Year

RADIATOR - Check Coolant level at each oil change. Replace every 24 months.

ENERGIZER (Battery) - Check Level Periodically

CRANKCASE VENTILATION ELEMENT AND AIR CLEANER ELEMENT - Inspect at each oil change - replace if necessary. Replace at least every 24,000 miles - more often under dusty conditions.

FRONT WHEEL BEARINGS - (Drum Type Brakes) Inspect and lubricate with a high melting point wheel bearing grease when brakes are serviced.

FRONT WHEEL BEARINGS - (Disc Type Brakes) Inspect and lubricate with a premium high melting point wheel bearing grease meeting GM SPEC 9048-P when brakes are serviced.

OIL FILTER ELEMENT - Replace With First Oil Change and Then at Alternate Oil Changes.

UPPER BALL JOINTS (2)
-CL- 6,000 Mi. or 4 Mos.
Whichever Occurs First

PCV VALVE - Replace 24,000 miles or 24 months.

TURBO HYDRAMATIC 350
Clean Strainer at - 24,000 Normal
12,000 Heavy Duty

TURBO HYDRAMATIC 400
Replace Filter at - 24,000 Normal
12,000 Heavy Duty

STANDARD DIFFERENTIAL - REAR AXLE - Maintain at Filler Opening to 1/4" Below - Flushing & Seasonal Changes NOT Recommended MPG - SAE - 80 or 90.

For Complete Refill Use Only Factory Hypoid Gear Lubricant - Unless Axle in Service 1,000 Miles or more. Then Use MPG - SAE - 90.

POSITIVE TRACTION DIFFERENTIAL - Change lube at 1st oil change only (45-46-48-49000 Series only) Maintain at Filler Opening to ¼" Below - Flushing or Seasonal Change is NOT Recommended. Use TL-SAE 90

CAPACITIES (U.S. MEASURE)

	L - 6	350 (Except LeSabre)	350 (LeSabre)	455 (GS 455)	455
COOLING SYSTEM					
With Heater	16.04	16.45	16.20	19.70	19.70
With Air Conditioner	16.04	16.52	16.55	19.67	20.0
CRANKCASE (All Series)					
Refill – Qts.	4				
With Oil Filter Change	5				

GAS TANK (Gals.)	43-44000	Sportwagon	Estatewagon	45-46-48000	49000
Approx.	20	23	23	25	24

REAR AXLE (Pts.)	U.S. Built	Canada Built	350 45000	455 45000	46-48-49000
TRANSMISSION	4¼	4¼	4¼	5½	5½

Turbo Hydra-matic 350
Turbo Hydra-matic 400
See Refill Procedure, GROUP 75 or 76
3-Speed Manual 3 1/2 Pts.
4-Speed Manual 3 Pts.
NOTE: Refer to Measures Chart for Imperial & Metric Measures
MANUAL STEERING GEAR 14 oz.
POWER STEERING RESERVOIR (All Series) 1¾ Qts.

LUBRICANTS

CL	Chassis Lubricant - Water Resistant Extreme Pressure EP No. 2 Multi-purpose Grease Which Meets G.M. Spec. 6031M
AT	DEXRON Automatic Transmission Fluid G.M. Part No. 1050568-69-70 or Equivalent
EO	Engine Oil (Current Viscosity) G.M. 6041 - M*
HTL	Buick CRC 5 - 60*
HBF	Hydraulic Brake Fluid - Delco Super No. 11*
BL	Brake Lube, Self-adjusting Per Spec. M.P. 6805
MPG	Multi-Purpose Gear Lubricant GL-5
TL	Lube Conforming to G.M. Specification 1051022
SG	Calcium Soap #2 Meeting G.M. Spec. 4673M. Do Not Use GL
PSF	Buick Power Steering Gear Fluid or Equivalent Meeting G.M. Spec. 9986010

*Equivalent Acceptable if it Meets Specifications

00-75B

Figure 00-24 - Lubrication Chart - All Models

U.S., IMPERIAL AND METRIC MEASURE CHART

	U.S. Measure	Imperial Measure	Metric Measure
Cooling System			
(L-6) 250 Cu. In.			
w/Heater	16.04 Qts.	13.37 Qts.	15.18 Liters
w/Air Conditioner	16.04 Qts.	13.37 Qts.	15.18 Liters
350 Cu. In. (All Except LeSabre)			
w/Heater	16.45 Qts.	13.71 Qts.	15.57 Liters
w/Air Conditioner	16.52 Qts.	13.77 Qts.	15.63 Liters
350 Cu. In. (LeSabre)			
w/Heater	16.20 Qts.	13.50 Qts.	15.33 Liters
w/Air Conditioner	16.55 Qts.	13.79 Qts.	15.66 Liters
455 Cu. In. (GS)			
w/Heater	19.17 Qts.	15.97 Qts.	18.14 Liters
w/Air Conditioner	19.67 Qts.	16.39 Qts.	18.61 Liters
455 Cu. In.			
w/Heater	19.70 Qts.	16.42 Qts.	18.64 Liters
w/Air Conditioner	20.0 Qts.	16.67 Qts.	18.93 Liters
Crankcase (All Series)			
Refill	4 Qts.	3.30 Qts.	3.78 Liters
With Oil Filter Change	5 Qts.	4.20 Qts.	4.73 Liters
Gasoline Tank			
43-4400 Series	Approx. 20 Gal.	16.67 Gal.	75.60 Liters
Sportwagon	Approx. 23 Gal.	19.17 Gal.	86.94 Liters
Estatewagon	Approx. 23 Gal.	19.17 Gal.	86.94 Liters
45-46-4800 Series	Approx. 25 Gal.	20.83 Gal.	94.50 Liters
4900 Series	Approx. 24 Gal.	19.99 Gal.	90.72 Liters
Rear Axle			
43-44000 Series (U.S. Built)	4¼ Pts.	3¾ Pts.	2.25 Liters
43-44000 Series (Canada Built)	4¼ Pts.	3¾ Pts.	2.25 Liters
45000 – 350	4¼ Pts.	3¾ Pts.	2.25 Liters
455	5½ Pts.	5 Pts.	2.91 Liters
46-48-49000 Series	5½ Pts.	5 Pts.	2.91 Liters
Transmission			
T.H.M. 350	See Group 75		
T.H.M. 400	See Group 76		
3 Speed Manual	3½ Pts.	3 Pts.	1.66 Liters
4-Speed Manual	3 Pts.	2½ Pts.	1.43 Liters
Manual Steering Gear			
(All Series)	11 Oz.	11 Oz.	311.85 Grams
Power Steering (All Series)			
Hydraulic System	2¼ Pts.	2 Pts.	1.10 Liters

1971 BUICK CHASSIS SERVICE MANUAL

This manual contains chassis service information for all 1971 Buick models. Refer to the Introduction for a description of the arrangement of this manual. This will enable you to locate desired information easily.

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.

BUICK
Authorized Service

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BUICK MOTOR DIVISION
GENERAL MOTORS CORPORATION
FLINT, MICHIGAN 48550

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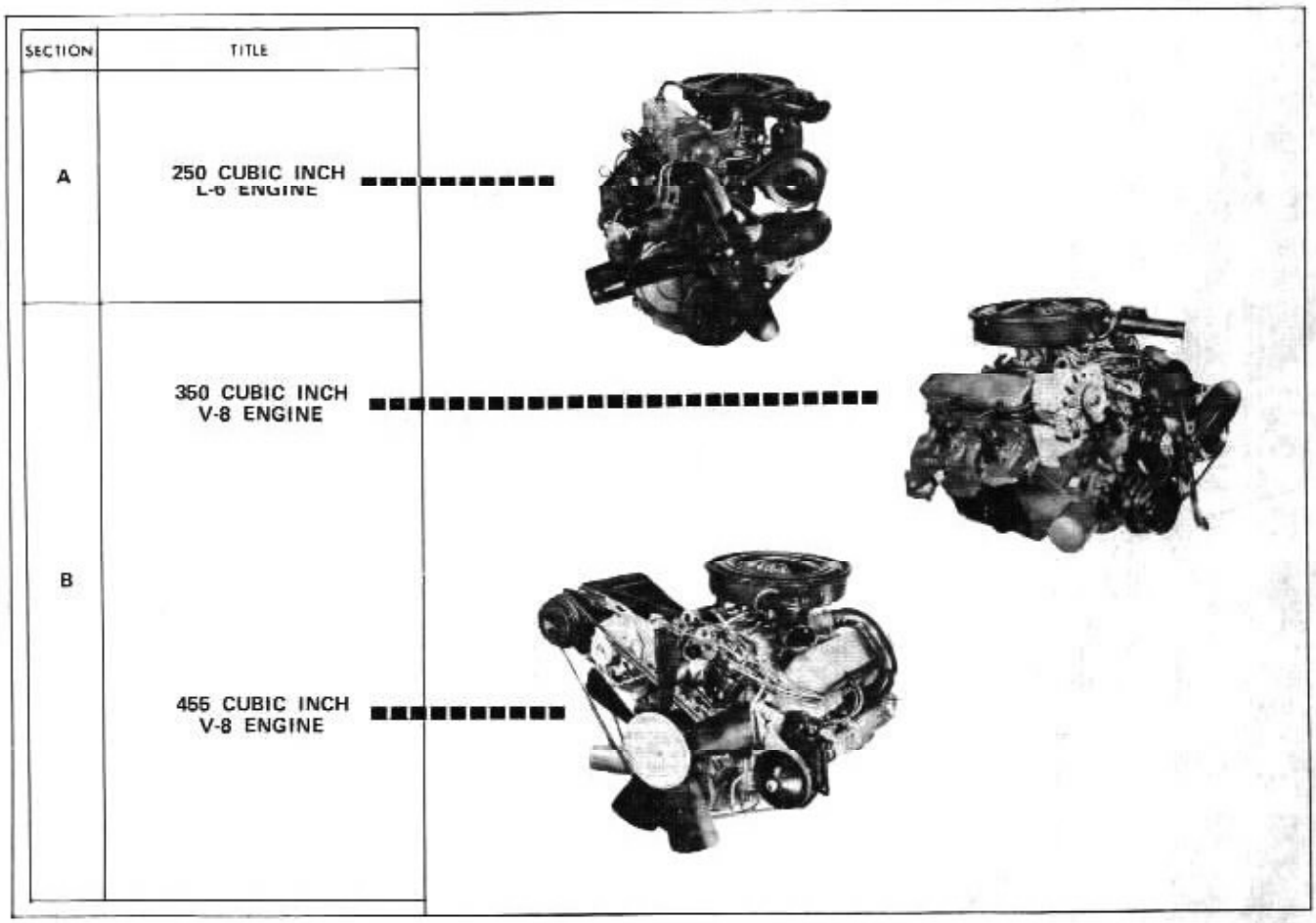
INTRODUCTION

The 1971 Buick Chassis Service Manual is organized to correspond with current servicing techniques. The various chassis components and systems have been classified into the sixteen major areas listed on the previous page. Each area corresponds to a GROUP with the exception of the 1st, 6th and 7th which are comprised of more than one GROUP.

Every GROUP contains one or more SECTIONS. Each SECTION deals with a specific version of a component or system. For instance, since there are major differences between the 250 cubic inch L6 and the 455 cubic inch V-8, each engine will be treated in separate SECTIONS of GROUP 60.



00A-3

The service information included in a SECTION is divided into six basic DIVISIONS. The titles of each DIVISION are:

Division	Area
I	Trouble Diagnosis
II	Description and Operation
III	Adjustments and Minor Service
IV	Removal and Installation
V	Overhaul and Major Service
VI	Specifications

A DIVISION contains one or more PARAGRAPHS which can be identified by the series of numbers preceeding them. The PARAGRAPH number consists of the GROUP number, a hyphen, and a sequence number; paragraph arrangement is numerical.

SUB-PARAGRAPHS are used when necessary for clarity or to provide distinction between component procedures. SUB-PARAGRAPHS are designated by a letter and are in alphabetical order.

SPECIAL TOOLS

References are made throughout the manual to special tool numbers, designated by the prefix letter "J". These tools are manufactured by the Kent-Moore Organization, Inc. If equivalent special tools are not available locally, they may be obtained through:

Kent-Moore Corporation, Inc.
28635 Mound Road
Warren, Michigan 48092

LOCATING DESIRED INFORMATION

To locate any desired information, locate the proper GROUP listed on the front page of the manual. Bend the manual until the black tab on the first page of the GROUP can be seen in line with the GROUP title on the front page. The first page of the GROUP lists the SECTIONS contained herein. Turn to the proper SECTION, locate the desired DIVISION, and note the page number of the PARAGRAPH containing the information you are seeking.

GROUP 00

GENERAL INFORMATION, MAINTENANCE, AND LUBRICATION

Section	Title
A	All Series - General Information . . . .
B	All Series - Maintenance . .

SECTION A

GENERAL INFORMATION ALL SERIES

CONTENTS

Division	Subject	Paragraph
I	TROUBLE DIAGNOSIS: (Not Applicable)	-
II	DESCRIPTION AND OPERATION: (Not Applicable)	-
III	ADJUSTMENTS AND MINOR SERVICE:	
	Keys and Locks	00-1
IV	REMOVAL AND INSTALLATION: (Not Applicable)	-
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DIVISION III

ADJUSTMENTS AND MINOR SERVICE

00-1 KEYS AND LOCKS

All 1971 model Buick cars are equipped with a new five bitting level lock cylinder and key. Five bitting levels are used to form one of 2,000 possible combinations.

Two non-interchangeable keyways are used. One keyway, known as the "A" type, is used in ignition and door lock cylinders. The second keyway, known as the "B" type is used in the glove compartment, console compartment and rear compartment lock cylinders.

To fit these lock cylinders, two keys are required. The ignition and door lock key for these five level lock cylinders may be identified by a small capital "A" stamped on one side of the key. The "A" type key has a rectangular type head. A second key is used for the glove, console, and rear compartment locks. This key has an oval head and may be identified by a small capital "B" stamped on one side. These marks serve to distinguish the keys for five level locks from those used in previous years.

Because of the way in which the key blade is grooved, each key will fit *only* the type of lock it is to be used in.

For Service replacement keys, see subparagraph a.

Key code numbers are stamped on the "knock-out" plug in the key head. After the code has been recorded by the owner to facilitate replacements or duplications of a key, the plugs should be knocked out of the key heads. If key code numbers are not available from records or from the "knock-out" plug, the code can be determined by laying the key on the diagram in Figure 00-1, or from the ignition lock cylinder housing and glove compartment lock assemblies themselves. The station wagon ignition lock cylinder will be marked with the key code number for the tailgate lock cylinder, the door lock cylinders and ignition lock cylinder.

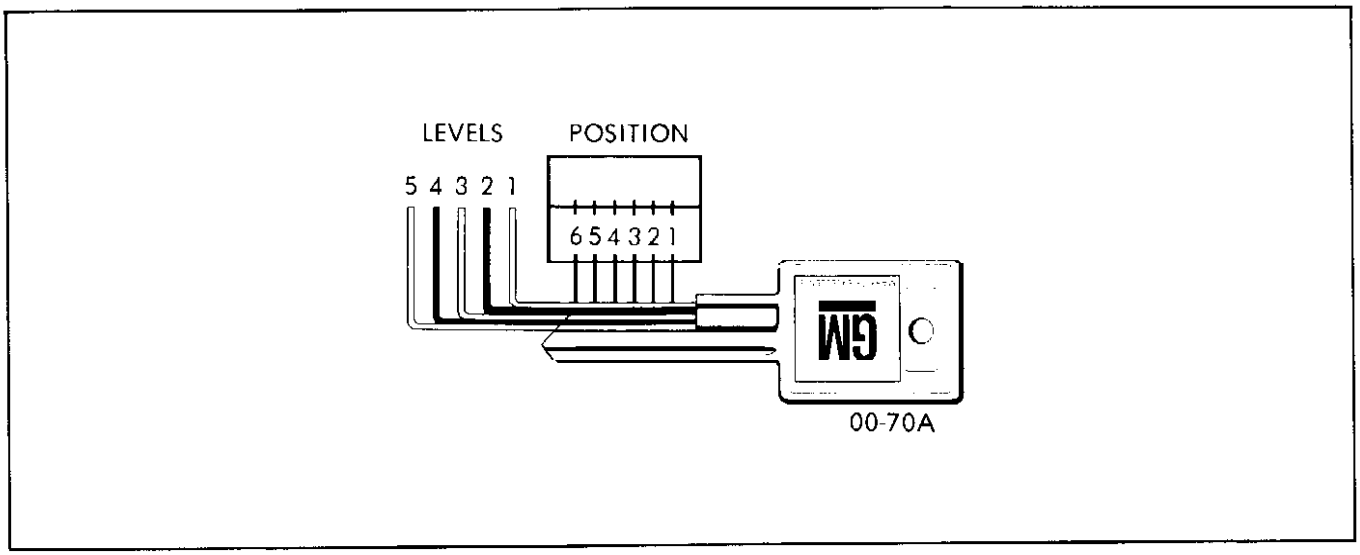


Figure 00-1 - Key Code Diagram

For "A" type lock cylinders assemblies, the key code number is stamped on the ignition lock cylinder housing; for "B" type lock cylinder assemblies, the number is stamped on the glove compartment (marked on the tumbler carrying plug) lock cylinder. From these numbers the lock combination can be determined by use of a code list for cutting new keys for coding a replacement service lock cylinder assembly. Door lock, rear compartment, and tailgate lock cylinders coded by the car division do not have key code numbers stamped on them; therefore, codes may be determined either from a ignition or glove compartment lock cylinder of the same car which will have the same lock tumblers, or from the key code diagram. See Figure 00-1.

a. Cutting Keys

After the special code has been determined, either from the code list or the Key Code Diagram, cut a blank key to the proper level for each of the six tumbler positions, and check the key in the lock cylinder. The new key should agree with the combination opposite the code number in the code list.

b. Removal and Installation of the Ignition Lock

Remove and install the ignition lock assembly from the steering column following the procedures outlined in Group 90.

c. Selecting Lock Cylinder Tumblers

NOTE: *The 1971 factory-installed ignition lock is not serviceable. Should failure require service, a new ignition lock package is available from the Parts Department less tumblers. Tumblers are also available and must be installed into the ignition lock cylinder according to the following special code.*

When it is necessary to code a new lock cylinder to agree with a key code number, install the proper tumblers into their respective slots, as indicated by Key Code Diagram or Briggs and Stratton Code List.

Tumblers for all locks except the glove and console compartments are shaped exactly alike, with the exception of the position of a notch on one side. Tumblers for glove and console lock cylinders are different and will not interchange with any other lock tumblers. As the key is inserted in the lock cylinder, the tumblers are raised to the correct height so that the notches on each tumbler are on the same level. When the notches on all six tumblers line up, the locking bar is pushed into the notches by two small springs, allowing the cylinder to turn in its bore. Five types of tumblers are used to make all the various lock tumbler combinations and each is coded according to a number, 1 through 5, stamped on its side.

Only one type of tumbler is used to make the various lock tumbler combinations for glove and console compartment locks. Tumblers for these two lock cylinders are of a different design than the tumblers used in all other lock cylinders.

As the key is inserted in the lock cylinder, each tumbler is depressed so that no part of any tumbler is exposed above the level of the lock cylinder allowing the cylinder to turn in its bores. Refer to subparagraph f, to assemble glove and console compartment lock cylinders.

To determine which tumblers should be installed in what position for a given key, when a code list is not available, proceed as follows:

1. Lay the key on the Key Code Diagram, Figure 00- 1, with the key outlined by the diagram as accurately as possible.

2. Starting at the base of the key blade, determine the lowest level that is 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 provided above the position numbers.

4. Cuts that fall in the first white section, mark Level No. 1 on top of appropriate position number.

5. Cuts that fall in the first black section, mark No. 2 on top of appropriate position number.

6. Cuts that fall in the second white section, mark No. 3 on top of appropriate position number.

7. Cuts that fall in the second black section, mark No. 4 on top of appropriate position number.

8. Cuts that fall in the third white section, mark No. 5 on top of appropriate position number.

d. Installing Lock Cylinder Tumblers (Except Glove and Console Compartments)

After the tumbler arrangement has been determined as shown in subparagraph c, ignition and door lock cylinders should be assembled as follows:

1. Hold cylinder with head of cylinder away and starting at the head of the cylinder, insert the tumblers in their proper slots in the order called for by the code, ribbed side toward you and long point down. See Figure 00-2.

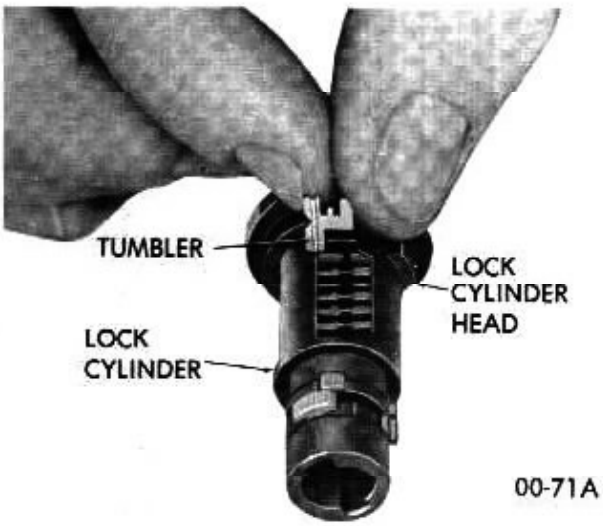


Figure 00-2 - Installing Tumblers

2. Insert one tumbler spring in the space provided above each tumbler.

CAUTION: *If the springs become tangled, do not pull them apart - unscrew them.*

3. Reverse the lock cylinder so that the head of the cylinder is now toward you. Insert the spring retainer so that the two end prongs slide into the slots at either end of the cylinder. Press the retainer down. See Figure 00-3.

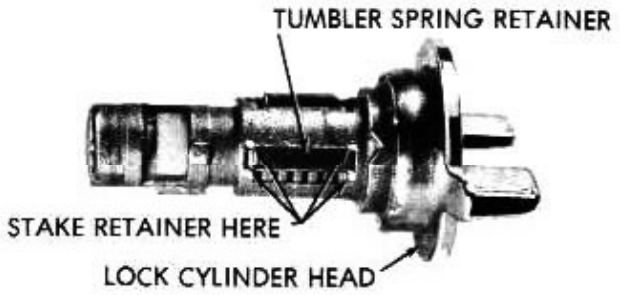


Figure 00-3 - Installing Spring Retainer

4. To check, insert proper key and if tumblers are installed properly the side bar will be allowed to drop down. If bar does not drop down, remove the key, spring retainer, springs and tumblers and reassemble correctly.

NOTE: *If the tumblers have not been assembled correctly, they can be removed from the cylinder by holding it with the tumbler slots down, pulling the locking bar out with the fingers and jarring the cylinder to shake the tumblers out. This procedure is necessary because once the tumblers have been pressed down into the cylinder they are held in their slots by the side bar.*

5. If after checking, it is found that the lock is assembled properly, remove key and secure cylinder in a vise with spring retainer exposed. Use leather or wood at each vise jaw to prevent damage to the cylinder.

6. Stake the retainer securely in place by staking the cylinder metal over both edges at each retainer end using a suitable staking tool at right angles to the top of the retainer.

e. Assembling Service Ignition Locks

1. Place the key part way into the lock cylinder assembly. Place the wave washer and anti-theft ring onto the lower end of the lock cylinder.

NOTE: *If the key is installed all the way into the lock cylinder, the plastic keeper in the lock cylinder protrudes and prevents installation of the sleeve assembly.*

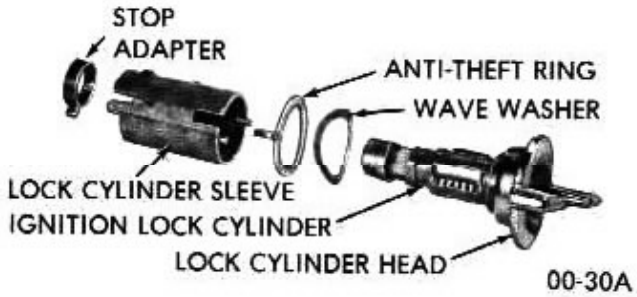


Figure 00-4 Ignition Lock Assembly - Exploded View

2. Make sure that the plastic keeper in the sleeve assembly protrudes from the sleeve.

3. Align the lock bolt on the lock cylinder and the tab on the anti-theft washer with the slot in the sleeve assembly. Push the sleeve all the way onto the lock cylinder assembly, push the ignition key the rest of the way in and rotate the lock cylinder clockwise. See Figure 00-5.

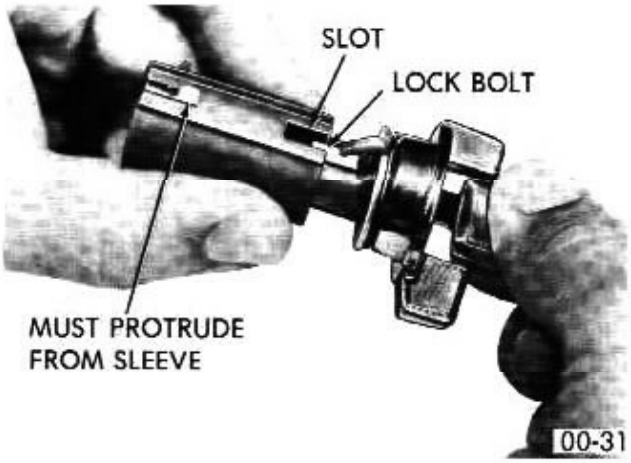


Figure 00-5 Ignition Lock - Assembly

4. Place assembled ignition lock assembly into vise with wood blocks to protect finish. Place stop adapter on lock cylinder with stop positioned down. See Figure 00-6.

Figure 00-6 Installing Stop Adapter on Lock Cylinder

5. Using a hammer and a small pin punch, stake lock cylinder at four (4) places to retain stop adapter. Do not use force when striking cylinder, as metal is soft and only a light tap with a hammer is necessary. See Figure 00-7.

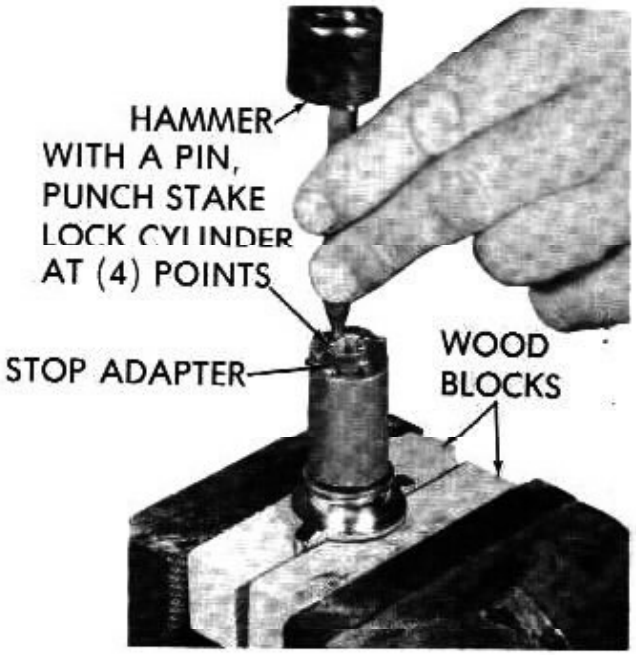


Figure 00-7 Staking Lock Cylinder to Retain Lock Adapter

f. Assembling Glove and Console Compartment Lock Cylinders

NOTE: *These two lock assemblies are equipped with four or five tumblers rather than six required in other locks. Tumblers for positions 3-4-5-6 or 2-3-4-5-6 only. Do not install tumblers which correspond to positions 1 and 2 on the key. The non- brass "tumbler" that is closest to the head of the lock cylinder is a locking device and must not be removed unless damaged. See Figure 00-8.*

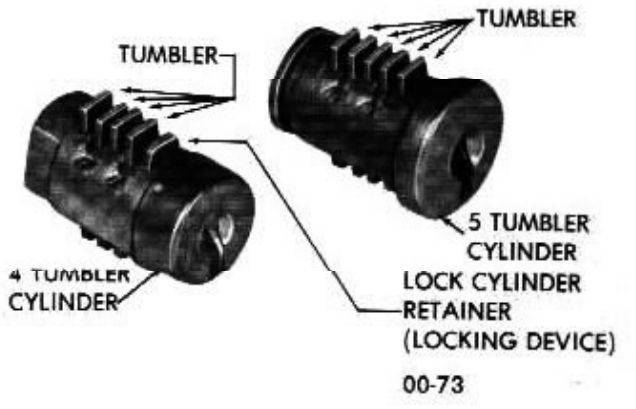


Figure 00-8 - Glove Compartment Lock Cylinder

1. Insert properly coded key in position.

2. Place cylinder in a vise using leather or wood at each vise jaw to prevent damage to the cylinder.

3. File tumblers down so that no part of any tumbler extends above the lock cylinder. A standard 5/8" double cut bastard file is recommended for this operation. To finish the job, use a flat 5-1/2" No. 2 cut needle equaling file.

NOTE: *Do not file any part of black "tumbler" in position No. 2. This is a locking bar and should not be altered.*

4. Reverse lock cylinder position in vice and repeat Step 5 for bottom of tumblers. See Figure 00-7.

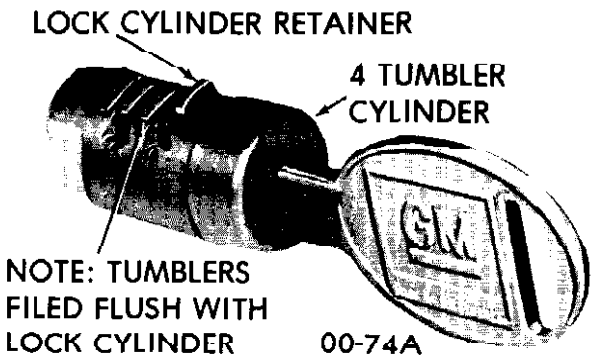


Figure 00-9 - Coded Glove Compartment Lock Cylinder

DIVISION VI

SPECIFICATIONS

00-2 1971 MODEL CHART

Series	Body Style	Designation
Skylark	2-Door Coupe Thin Pillar	43327
	2-Door Coupe Hardtop	43337
	4-Door Sedan Thin Pillar	43369
Skylark Custom	2-Door Coupe Hardtop	44437
	2-Door Convertible	44467
	4-Door Hardtop	44439
	4-Door Sedan Thin Pillar	44469
GS	2-Door Coupe Hardtop	43437
	2-Door Convertible	43467
Sportwagon	4-Door 2-Seat Wagon	43436
LeSabre	2-Door Coupe Hardtop	45257
	4-Door Hardtop	45239
	4-Door Sedan Thin Pillar	45269
LeSabre Custom	2-Door Coupe Hardtop	45457
	2-Door Convertible	45467
	4-Door Hardtop	45439
	4-Door Sedan Thin Pillar	45469
Estate Wagon	4-Door 2-Seat Wagon	46035
	4-Door 3-Seat Wagon	46045
Centurion	2-Door Coupe Hardtop	46647
	2-Door Convertible	46667
	4-Door Hardtop	46639
Electra 225	2-Door Coupe Hardtop	48237
	4-Door Hardtop	48239
Electra 225 Custom	2-Door Coupe Hardtop	48437
	4-Door Hardtop	48439
Riviera	2-Door Coupe Hardtop	49487

00-3 STANDARD REAR AXLE RATIOS

Models	Engine	Transmission	Standard
43327-37-69	250 L-6	3-Speed Manual/THM-350	3.08
43327-37-69		3-Speed Manual	3.08
44437-39-69-67	350 V-8	THM-350 2 BBL	2.56
		THM-350 4 BBL	2.73
43437-67	350 V-8	3 & 4-Speed Manual/THM-350	3.08
43436	350 V-8	3-Speed Manual/THM-350	3.08
43437-67	455 V-8	4-Speed Manual	3.42
	455 V-8	THM-400	3.08
	455 GSX	4-Speed Manual/THM-400	*3.42
	455 STG I	4- Speed Manual/THM-400	*3.42
45257-39-69		3-Speed Manual	3.42
45457-67-39-69	350 V-8	THM-350	3.08
45257-39-69		3-Speed Manual	3.42
45457-67-39-69	455 V-8	THM-400	2.93
46035-45	455 V-8	3-Speed Manual	3.42
		THM-400	2.93
46647-67-39	455 V-8	THM-400	2.93
48237-39			
48437 39	455 V-8	THM-400	2.73
49487			
49487 GS	455 V-8	THM-400	2.93
			*3.42 PT

*Positive Traction

00-4 PAINT COLOR CODE CHART

SALES CODE	SERV. CODE	COLOR NAME
A	19	REGAL BLACK
B	26	STRATOMIST BLUE
C	11	ARCTIC WHITE
D	24	CASCADE BLUE
E	29	NOCTURNE BLUE
F	70	PEARL BEIGE
G	55	CORNET GOLD
H	43	LIME MIST
I	39	TWILIGHT TURQUOISE
J	68	DEEP CHESTNUT
K	42	WILLOMIST GREEN
L	16	TEALMIST GRAY
M	49	VERDEMIST GREEN
N	78	ROSEWOOD
P	13	PLATINUM MIST
Q	53	CORTEZ GOLD
R	75	FIRE RED
S	65	COPPER MIST
T	62	BITTERSWEET MIST
U	67	BURNISHED CINNAMON
V	73	SUNSET MIST
W	61	SANDPIPER BEIGE
X	74	VINTAGE RED
Y	50	BAMBOO CREAM
Z	41	SILVER FERN

00A-10

00-5 CONVERTIBLE TOP COLOR CODE CHART

SALES CODE	SERV. CODE	COLOR NAME
1	A	WHITE
2	B	BLACK
5	E	SANDALWOOD
9	G	DARK GREEN

00A-12

00-6 VINYL TOP COLOR CODE CHART

SALES CODE	SERV. CODE	COLOR NAME
1	A	WHITE
2	B	BLACK
5	E	SANDALWOOD
8	F	DARK BROWN
9	G	DARK GREEN

00A-13

00-7 VEHICLE AND MAJOR COMPONENT IDENTIFICATION NUMBERS

a. Vehicle Identification Numbers

1971 Buick models have a serial number identification plate attached to the top of the instrument panel on the drivers side to be viewed through the windshield from outside the car. An example of this plate is shown in Figure 00-11.

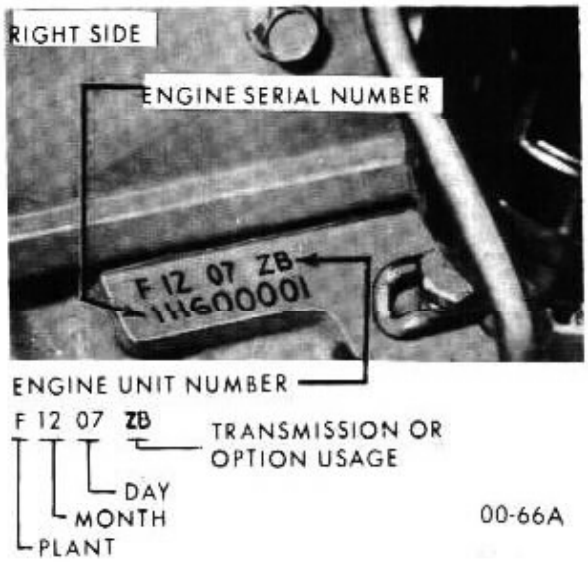


Figure 00-10 - Engine Serial Number and Production Code Location (L-6)

b. Fisher Body Number Plate

Body identification is provided by the Fisher Body Number Plate.

Information such as style and body numbers, trim numbers, and paint color code is contained on this plate. Refer to the 1971 Fisher Body Service Manual for detailed information about this plate.

c. Engine Numbers

1971 Buick engines are stamped with two different identification codes. *One is an engine production code number.* This identifies the engine and its approximate production date. Refer to Group 60 for Engine Usage.

The other code is the *engine serial number* and is the same number found on the vehicle identification plate mentioned previously in Paragraph a. This is the legal engine number and is used on registrations, titles, and other legal documents, while the production code number is used to identify the engine on product reports and other factory correspondence.

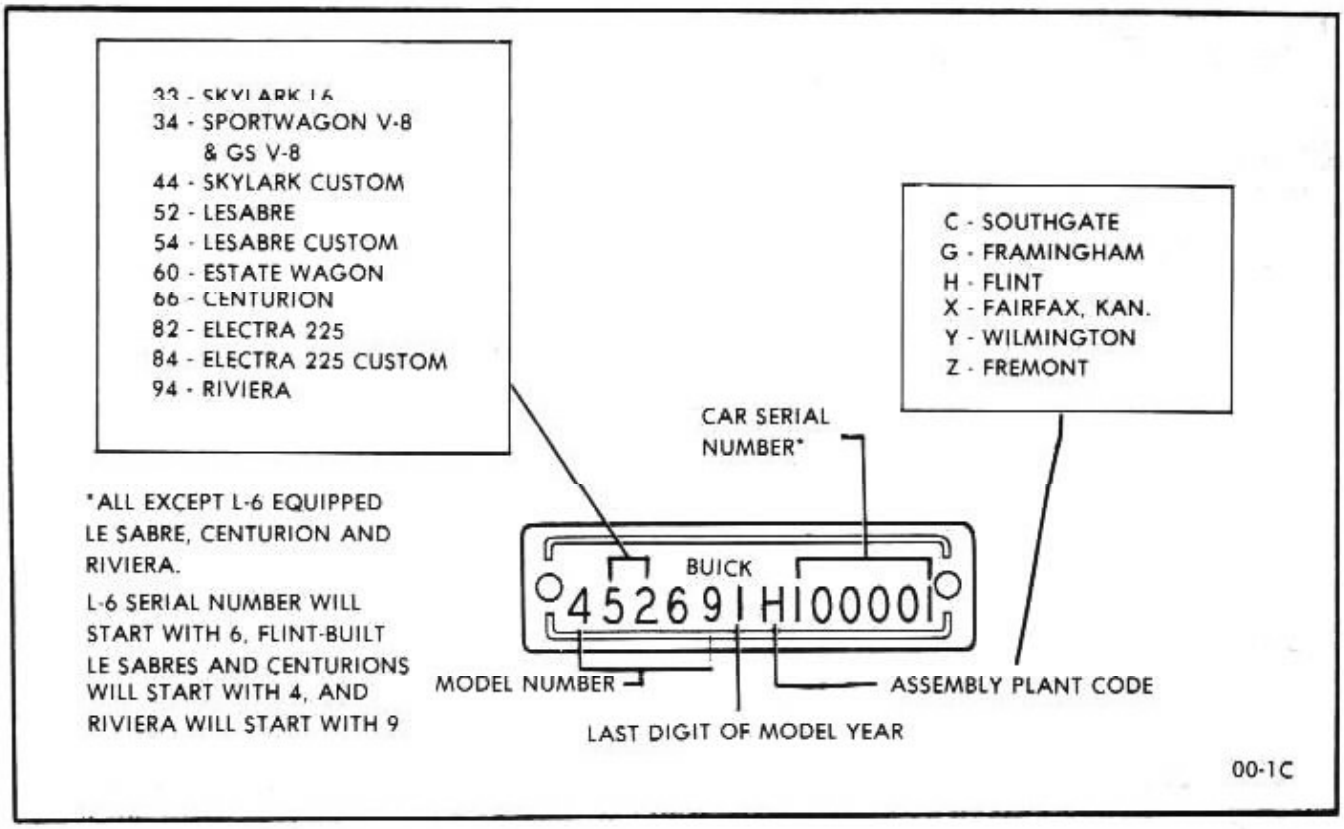


Figure 00-11 - Vehicle Identification Plate

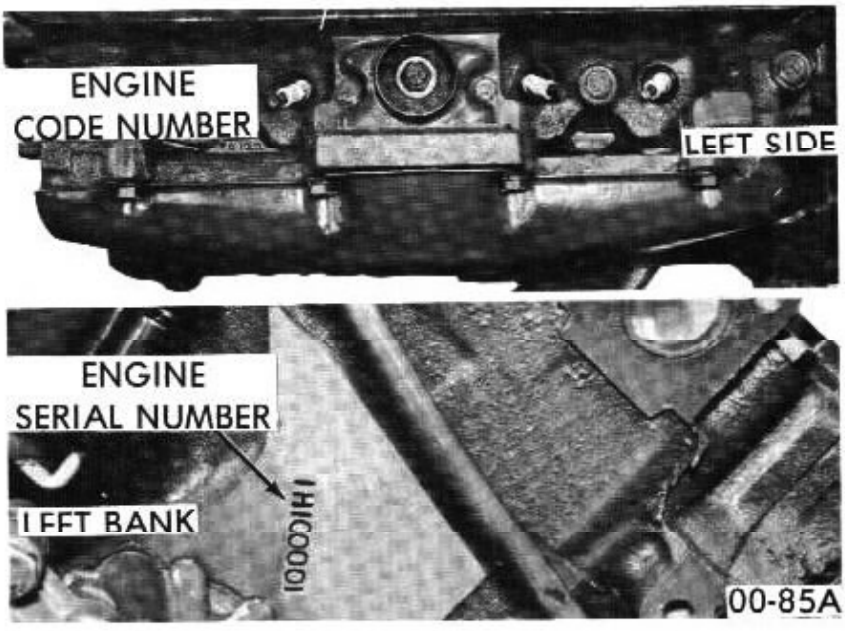


Figure 00-12 -Engine Serial Number and Production Code Location (350 Cu.In.)

d. Automatic Transmission Identification Numbers

Refer to Groups 75 and 76.

e. Manual Transmission Identification Numbers

Refer to Group 72.

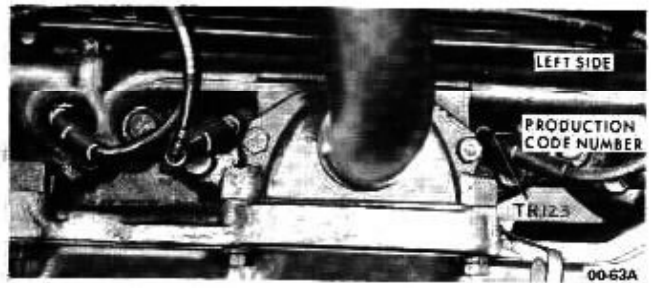
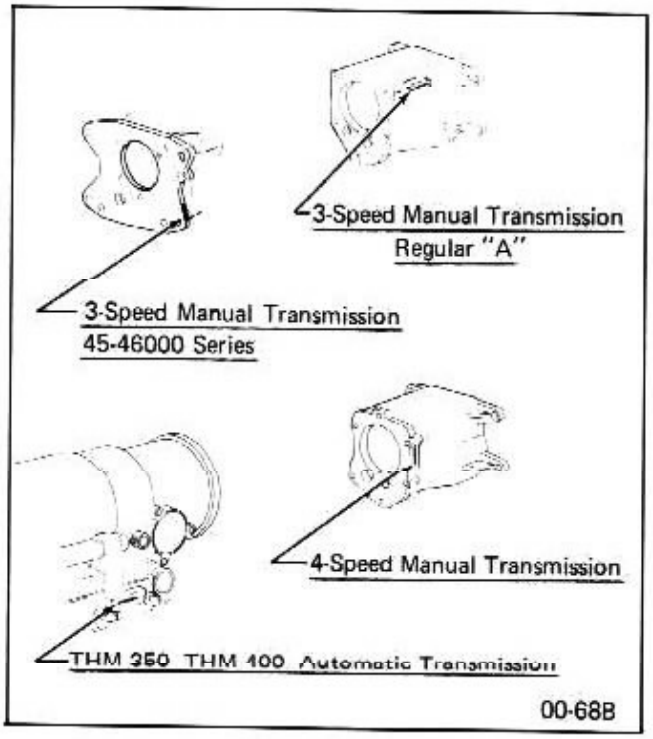


Figure 00-13 - Engine Serial Number and Production Code Location (455 Cu.In.)

Figure 00-14 - Transmission Identification Number Location



00-8 GENERAL SPECIFICATIONS

1971 Models	Wheel Base	Overall Length	Overall Width	Front Tread	Rear Tread	Curb* Weight Pounds	Liquid Weight	
							Fuel	Coolant
43327	112.0	202.8	77.3	59.0	59.0	3363	122.0	35.0
43337	112.0	202.8	77.3	59.0	59.0	3369	122.0	35.0
43369	116.0	206.8	77.3	59.0	59.0	3415	122.0	35.0
44437	112.0	202.8	77.3	59.0	59.0	3580	122.0	36.0
44467	112.0	202.8	77.3	59.0	59.0	3637	122.0	36.0
44439	116.0	206.8	77.3	59.0	59.0	3712	122.0	36.0
44469	116.0	206.8	77.3	59.0	59.0	3619	122.0	36.0
43437	112.0	202.8	77.3	59.0	59.0	3580	122.0	36.0
43467	112.0	202.8	77.3	59.0	59.0	3634	122.0	36.0
43436	116.0	212.7	77.3	59.0	59.0	4084	140	36.0
45257	124.0	220.1	79.7	63.8	63.7	4211	153	36.0
45239	124.0	220.1	79.7	63.8	63.7	4254	153	36.0
45269	124.0	220.1	79.7	63.8	63.7	4248	153	36.0
45457	124.0	220.1	79.7	63.8	63.7	4225	153	36.0
45467	124.0	220.1	79.7	63.8	63.7	4289	153	36.0
45439	124.0	220.1	79.7	63.8	63.7	4266	153	36.0
45469	124.0	220.1	79.7	63.8	63.7	4260	153	36.0
46035	127.0	227.1	79.7	64.0	64.0	4995	153	41.0
46045	127.0	227.1	79.7	64.0	64.0	5079	153	41.0
46647	124.0	220.1	79.7	63.8	63.7	4390	153	41.0
46667	124.0	220.1	79.7	63.8	63.7	4445	153	41.0
46639	124.0	220.1	79.7	63.8	63.7	4472	153	41.0
48237	127.0	226.4	79.7	63.8	63.7	4490	153	41.0
48239	127.0	226.4	79.7	63.8	63.7	4543	153	41.0
48437	127.0	226.4	79.7	63.8	63.7	4570	153	41.0
48439	127.0	226.4	79.7	63.8	63.7	4570	153	41.0
49487	122.0	217.4	79.9	63.8	63.7	4435	128	41.0

*Estimated Curb Weights Only