'69

PONTIAC

Service Manual

1969

PONTIAC SERVICE MANUAL

SERVICE

This manual applies to all 1969 Pontiac, Grand Prix, Tempest and Firebird models. It contains service information on all components of the car except the body. Body information is contained in a separate Fisher Body Manual. Other information pertaining to the operation of the car is contained in an Owner's Manual which accompanies each vehicle.

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

SERVICE DEPARTMENT
PONTIAC MOTOR DIVISION
GENERAL MOTORS CORPORATION
PONTIAC, MICHIGAN 48053

Reprinted with Permission of
General Motors Corporation

S-6904 May 1971 Litho in U.S.A.

TABLE OF CONTENTS

GENERAL INFORMATION

CONTENTS OF THIS SECTION

GENERAL INFORMATION

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

VEHICLE IDENTIFICATION PLATE

Serial number, assembly plant code and model year identification can be determined from the Manufacturer's Motor Vehicle Identification Number Plate. This plate is fastened to the upper left instrument panel area, visible through the windshield. The plate has embossed numerals as shown in Fig. 0-1.

BODY IDENTIFICATION PLATE

Information as to body style, trim number, body number and paint code may be found stamped on the Body Identification Plate (Fig. 0-2). This plate is attached to the left side of the cowl assembly just below the rear edge of the hood.

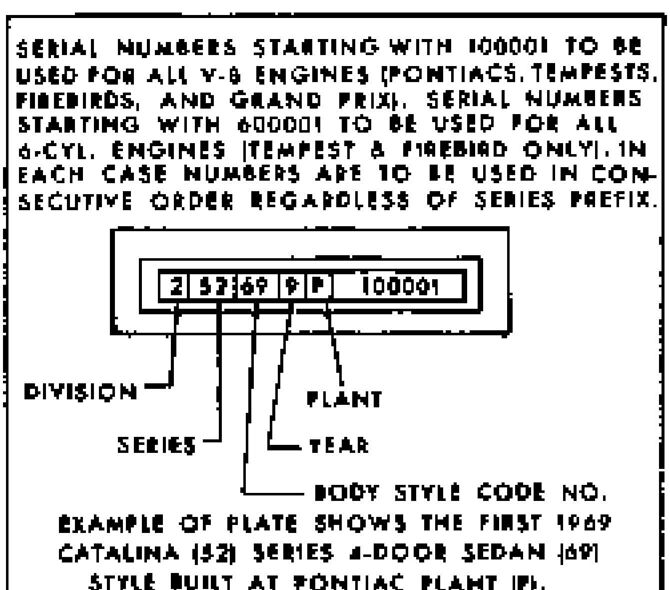


Fig. 0-1 Vehicle Identification Plate

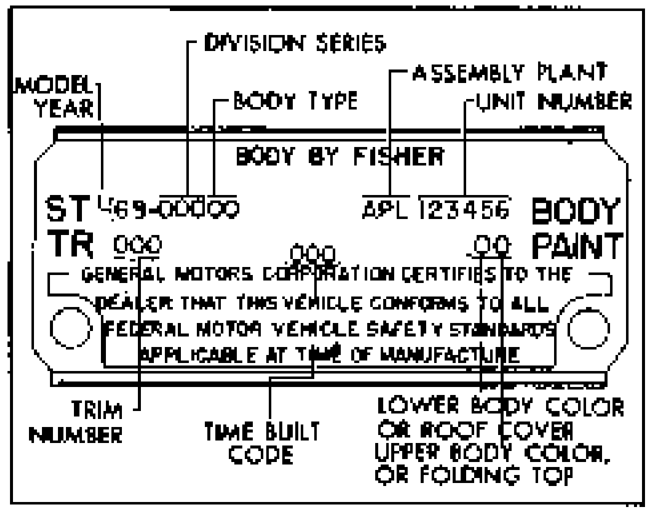


Fig. 0-2 Body Identification Plate

CAR MODEL IDENTIFICATION

Certain publications carry "series" numbers to identify models and others carry sales department names. Figure 0-4 shows both methods of identification.

Plant	Code	Pontiac	Tempest	Grand Prix	Firebird
Atlanta	(A)		X		
Baltimore	(B)		X		
Southgate	(C)	X			
Linden	(E)	X			
Framingham	(G)		X		
Van Nuys	(L)				X
Pontiac	(P)	X		X	
Arlington	(R)	X	X		
Lordstown	(U)				X
Kansas City, Kans.	(X)	X			
Fremont	(Z)		X		

Fig. 0-3 Assembly Plants

SERIES	MODEL	STYLE NUMBER
CATALINA 25200	Hardtop Coupe	25237
	4-Door Hardtop	25239
	4-Door Sedan	25269
	Convertible	25267
	2-Seat Station Wagon	25236
	3-Seat Station Wagon	25246
EXECUTIVE 25600	Hardtop Coupe	25637
	4-Door Hardtop	25639
	4-Door Sedan	25669
	2-Seat Safari	25636
	3-Seat Safari	25646
BONNEVILLE 26200	Hardtop Coupe	26237
	4-Door Hardtop	26239
	4-Door Sedan	26269
	Convertible	26267
	3-Seat Station Wagon	26246
GRAND PRIX 27600	Hardtop Coupe	27657
TEMPEST 23300	Sports Coupe	23327
	4-Dood Sedan	23369
CUSTOM S 23500	Sports Coupe	23527
	4-Door Sedan	23569
	Hardtop Coupe	23537
	4-Door Hardtop	23539
	Convertible	23567
	Station Wagon	23535
LE MANS 23700	Sports Coupe	23727
	Hardtop Coupe	23737
	4-Door Hardtop	23739
	Convertible	23767
LE MANS SAFARI 23935	2-Seat Station Wagon	23935
G.T.O. 24200	Hardtop Coupe	24237
	Convertible	24267
FIREBIRD 22300	Hardtop Coupe	22337
	Convertible	22367

Fig. 0-4 Car Model Identification

ENGINE IDENTIFICATION

8-CYL.

The 8-cyl. engine code is located beneath the production engine number on a machined pad on the right hand bank of the engine block (Fig. 0-5) and should be used whenever referring to a specific engine. For a complete listing of the various codes and engine options, refer to section 6 of this manual. See Sec. 6 for the V.I. number derivative, which identifies the engine with the car.

6-CYL.

The 6 cylinder engine code is stamped on the cylinder head to block contact surface behind oil filler pipe (Fig. 0-6). See Sec. 6 for the V.I. number derivative, which identifies the engine with the car.

TRANSMISSION SERIAL NUMBER

TURBO HYDRA-MATIC (M-40)

The Turbo Hydra-Matic (M-40) transmission identification plate is located on the right side of the

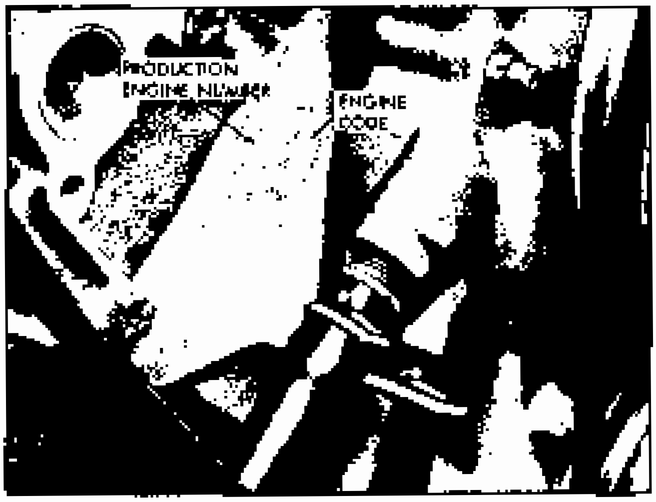


Fig. 0-5 8-Cylinder Engine Serial Number Location

transmission case (Fig. 0-7). The serial number begins with the letter P meaning Pontiac, followed by the letter code A, B, C, etc., designating engine usage. The numerical code 69, following the two-letter code represents the model year. For more details and location of V.I. number derivative see section 7E of this manual.

TURBO HYDRA-MATIC (M-38)

The Turbo Hydra-Matic (M-38) transmission identification number is located on the accumulator, at the right side of the transmission case. The serial number begins with the letter J, followed by the letter code A, B, C, etc., designating engine usage. The numerical code 69, following the two-letter code, represents the model year. For more details and location of V.I. number derivative see section 7G of this manual.

TWO-SPEED AUTOMATIC

The transmission identification number located on the

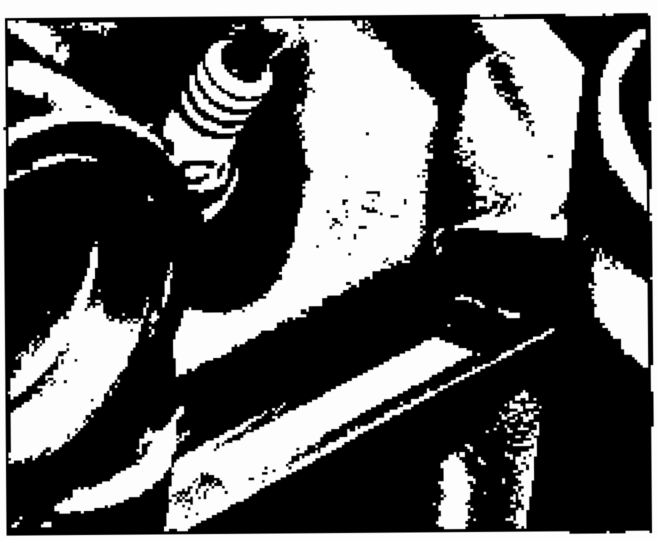


Fig. 0-6 6-Cylinder Engine Serial Number Location

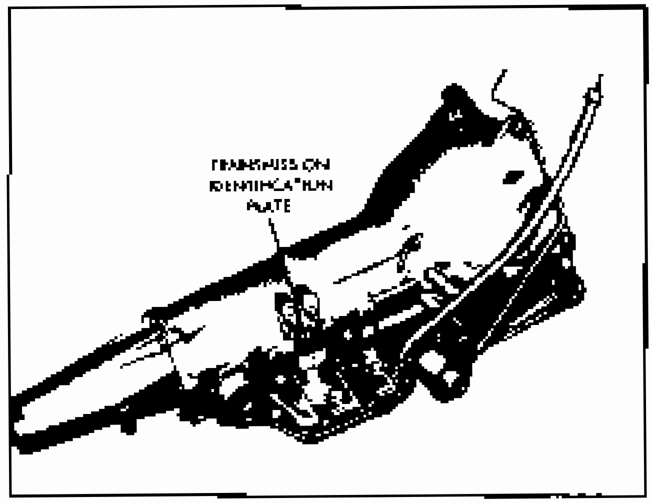


Fig. 0-7 Turbo Hydra-Matic (M-40) Serial Number Location

lower servo cover (Fig. 0-9), right side of the transmission, contains model and assembly date code. For more complete information and location of V.I. number derivative see section 7F.

LIFTING AND TOWING

Pontiac, Tempest, Grand Prix and Firebird may be lifted on the frame rails as shown in Sec. 2. They can also be lifted at front cross member or at either front or rear lower control arms. When lifting on lower control arms, avoid contacting lower shock absorber brackets.

Under no circumstances should lift adapters be used on the bumpers, propeller shaft, transmission, rear axle or engine.

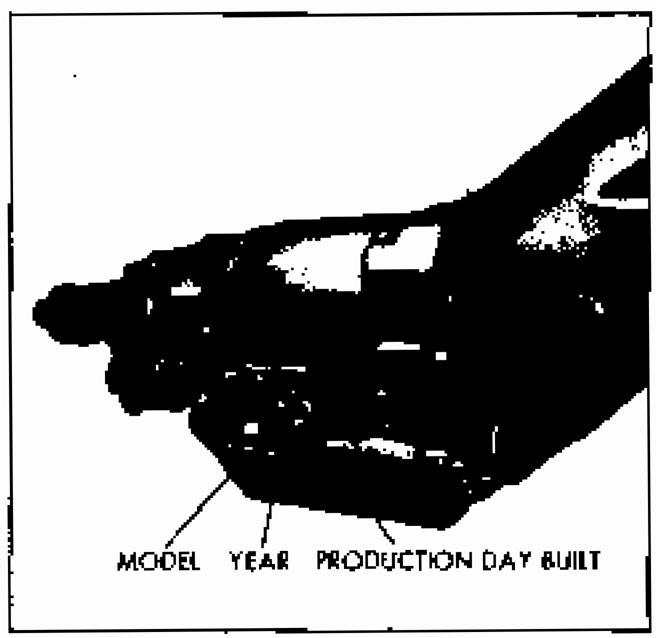


Fig. 0-8 Turbo Hydra Matic (M-38) Serial Number Location

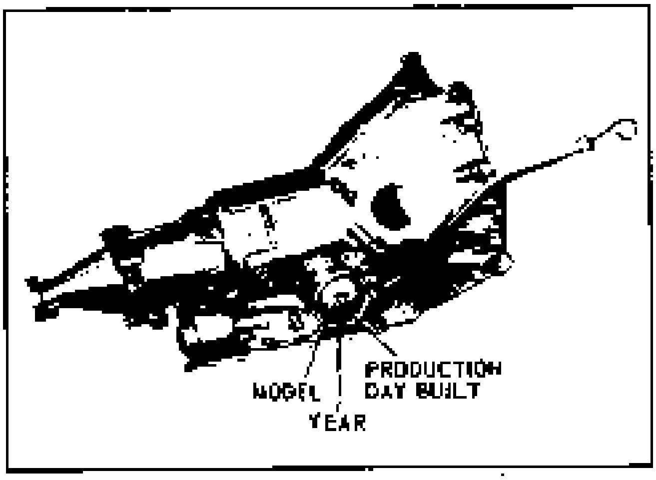


Fig. 0-9 Two-Speed Automatic Transmission Serial Number

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

TOWING PRECAUTIONS

Always place a rubber mat or other suitable material between the bumper and the tow chains or cables. For front end lifting, place chains or cables around the ends of the frame side rails at both sides. All models can be towed without disconnecting the propeller shaft except in cases where the key is not available to unlock the steering column and transmission, or where the transmission or propeller shaft has possibly been subject to failure or damage. In such cases, the propeller shaft must be disconnected from the differential and wired to tailpipe or car must be towed with rear wheels off the ground. If the propeller shaft is disconnected and the "U" joint bearing retaining strap is broken, wrap tape around the bearing caps to prevent loss. When towing with the rear wheels off the ground, the steering wheel must be centered and held in position by a steering wheel holding clamp or by tying it to the window division channel. Tire to ground clearance should not exceed 6 inches while towing the car and speeds should not exceed 35 mph for distances up to 50 miles.

CAUTION: Power steering-equipped cars towed with all four wheels on the ground require extreme caution, since there is no power assist with the engine off.

IGNITION LOCK ASSEMBLY - REMOVE

1. Remove lock assembly from steering column. See Section 9.

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

3. Using suitable pick, depress brass pin in slot on side of cylinder as shown in Fig. 0-10.

NOTE: Some lock cylinders will not have the slot machined in the side of the cylinder. In this case it will be necessary to fashion a pick and insert this behind the cylinder wall to depress the brass pin.

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

5. Pull key out of lock assembly approximately two (2) teeth and, using suitable pick, slide or shake plastic retainer in end of lock toward pin side of cylinder as shown in Fig. 0-11.

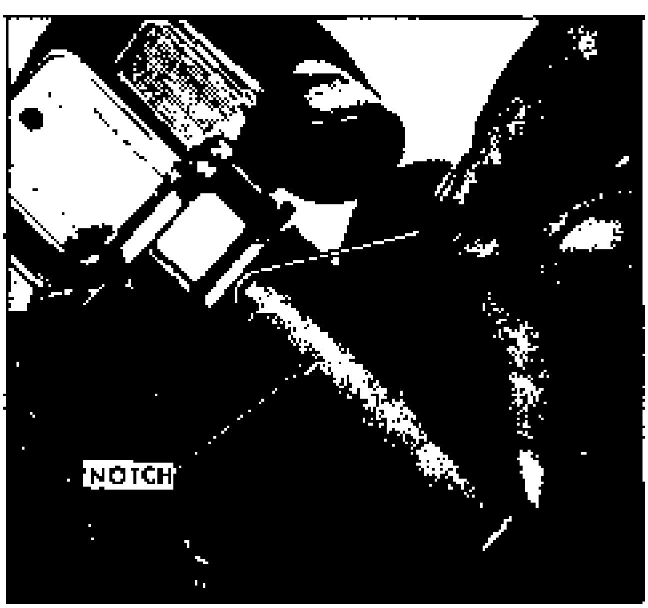


Fig. 0-10 Depressing Lock Cylinder Retainer Pin

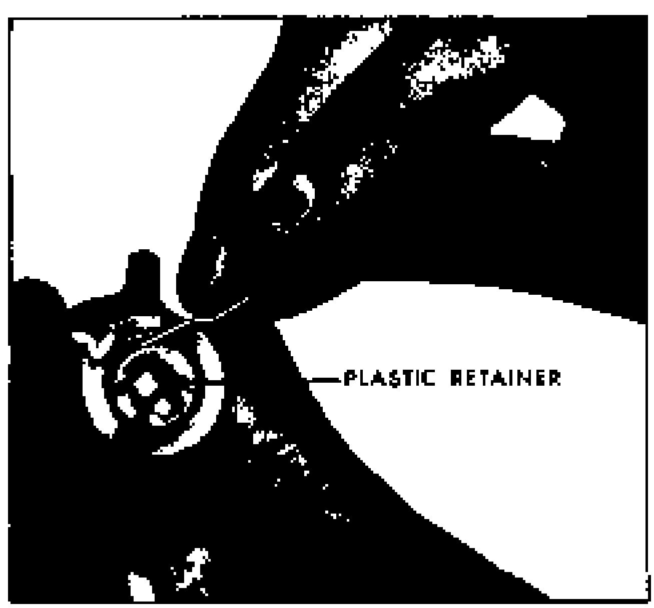


Fig. 0-11 Removing Lock from Cylinder

6. Pull key and lock assembly out of cylinder.

CODING SIDE BAR LOCK

Two separate keys are used; type "E" (square) for ignition switch, door locks and tailgate and type "H" (oval) for the trunk and glove compartment. The keys will not be interchangeable with each other or with those used prior to 1969 because of new keyway design.

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

1. Place the key on the silhouette in Fig. 0-14, aligning the key with the outline as accurately as possible.

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

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

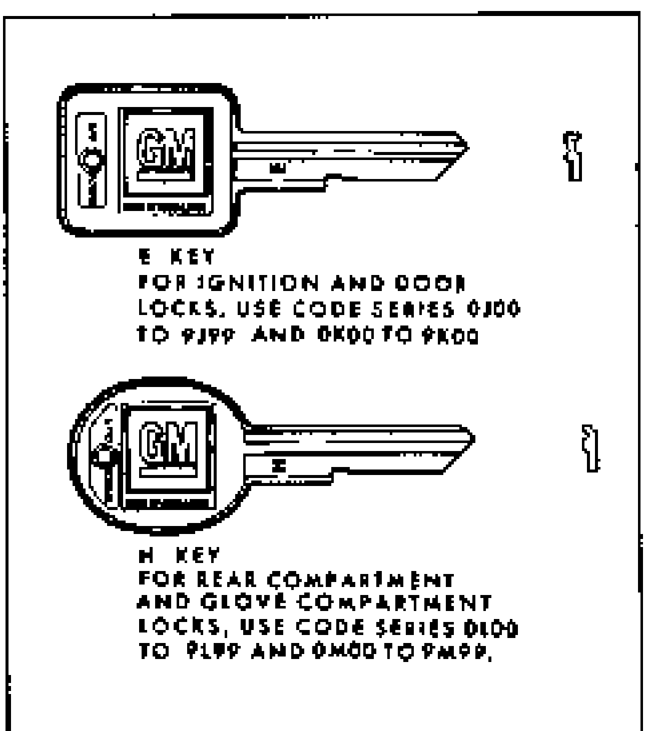


Fig. 0-12 Key Blanks

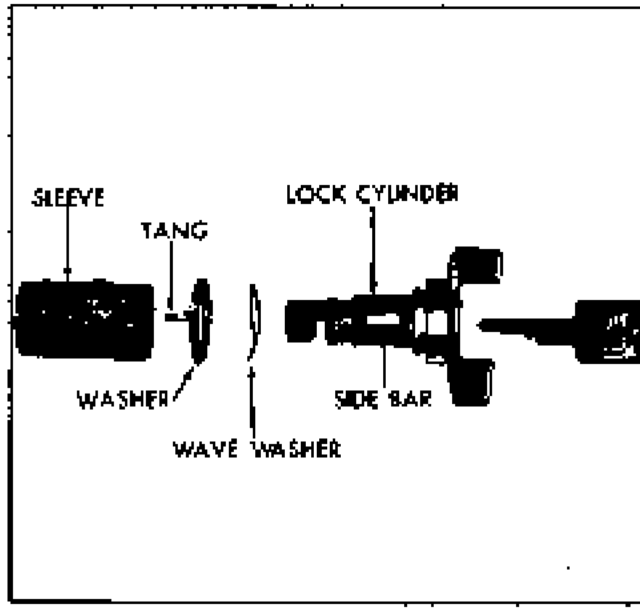


Fig. 0-13 Exploded View of Ignition Lock Assembly

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

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

2. Insert spring in each round cavity of each tumbler lock between slots.

NOTE: Do not pull springs apart; unscrew them.

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

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

5. Install spring retainer using vise.

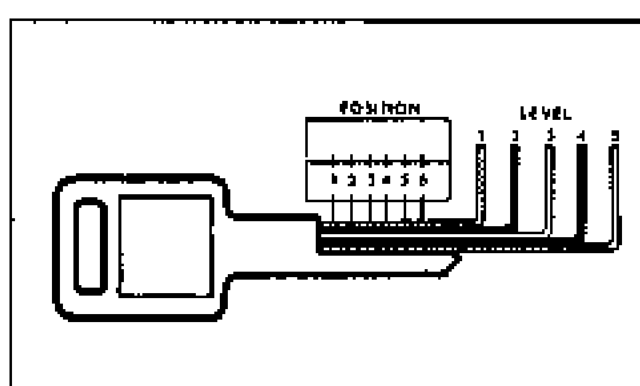
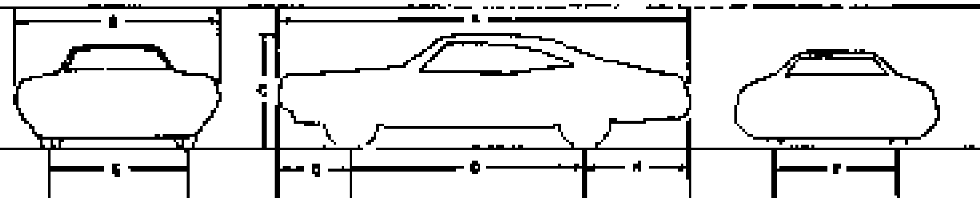


Fig. 0-14 Key Coding Diagram



PONTIAC — GRAND PRIX
(ALL DIMENSIONS IN INCHES)

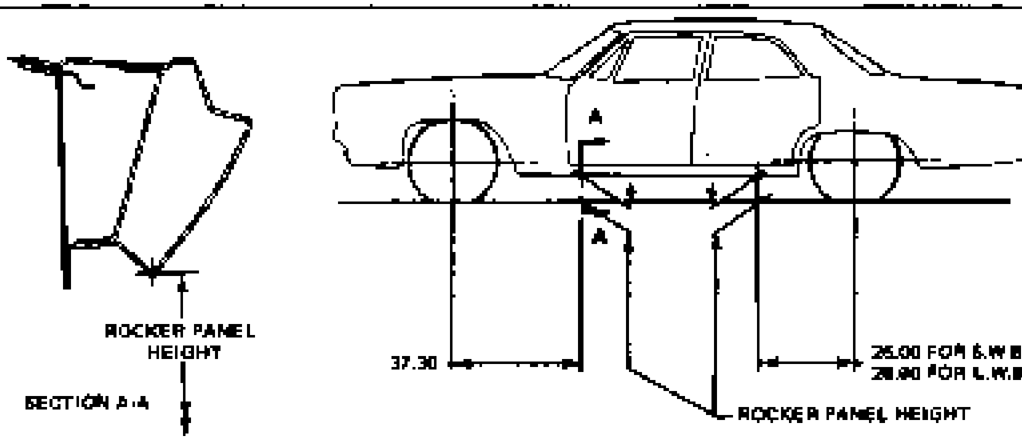
SERIES	Key	[illegible]						[illegible]					[illegible]					276
STYLE		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Overall Length	A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Width	B	[illegible]																[illegible]
Height (Unloaded)	C	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wheelbase	D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tread Front	E	[illegible]																[illegible]
Tread Rear	F	[illegible]																[illegible]
Overhang Front	G	[illegible]																[illegible]
Overhang Rear	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TEMPEST — FIREBIRD
(ALL DIMENSIONS IN INCHES)

STYLE	Key	[illegible]	[illegible]		[illegible]						[illegible]				[illegible]	[illegible]	
SERIES		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Overall Length	A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Width	B	[illegible]	[illegible]				[illegible]								[illegible]	[illegible]	
Height (Unloaded)	C	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wheelbase	D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tread Front	E	[illegible]	[illegible]														
Tread Rear	F	[illegible]	[illegible]														
Overhang Front	G	[illegible]	[illegible]													[illegible]	
Overhang Rear	H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

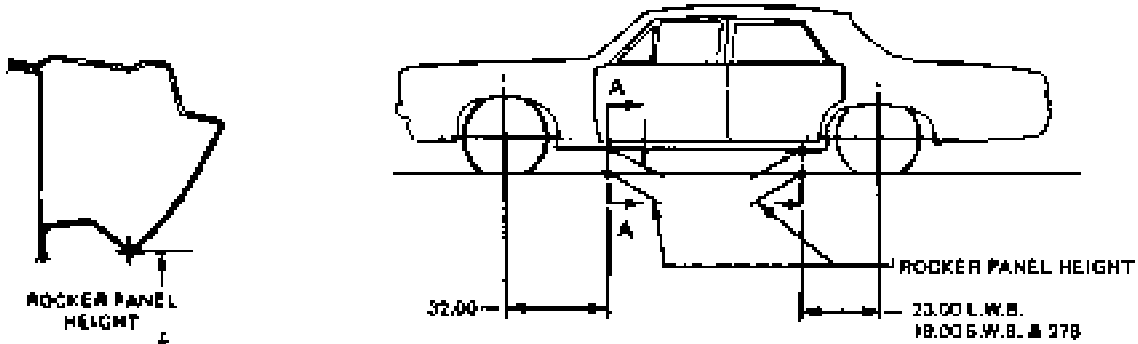
Fig 0-15 Basic Dimensions



CURB ROCKER PANEL HEIGHT (NOMINAL)		MODEL
FRONT	REAR	
9.50	9.20	EXCEPT STATION WAGON & H.D. SPRINGS
9.80	9.80	WITH STATION WAGON
9.80	10.25	ALL H. D. SPRINGS

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

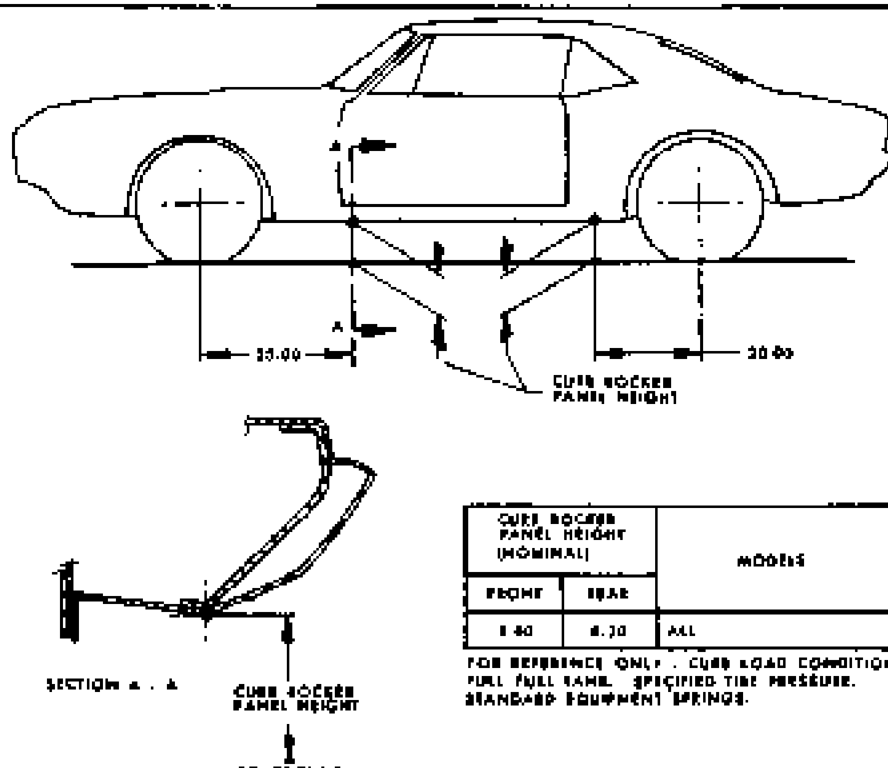
Fig. 0-16 Rocker Panel Heights - Pontiac



CURB ROCKER PANEL HEIGHT (NOMINAL)		MODEL
FRONT	REAR	
9.60	9.10	3327, 3527, 3727, 3537, 3737, 3567, 3767, 3539, 3739 (EXC. H.D. SPRINGS)
9.70	9.30	3369, 3569
8.80	9.10	4237, 4267
10.35	10.10	3838, 3835 EXC. H.D. SPRINGS
10.60	10.50	ALL H.D. SPRINGS EXC. 278
9.25	9.00	278 EXC. Y97, G67, H.D. SPRINGS
8.00	8.75	278 WITH Y97 & G67
10.00	10.00	278 WITH H.D. SPRINGS

FOR REF. ONLY — CURB LOAD CONDITION (FULL FUEL TANK, SPECIFIED TIRE PRESSURE)

Fig. 0-17 Rocker Panel Heights - Tempest and Grand Prix



CURB ROCKER PANEL HEIGHT (NOMINAL)		MODELS
FRONT	REAR	
8.40	8.30	ALL

FOR REFERENCE ONLY . CURB LOAD CONDITION FULL FUEL TANK. SPECIFIED TIRE PRESSURE. STANDARD EQUIPMENT SPRINGS.

Fig. 0-18 Rocker Panel Heights - Firebird

IGNITION LOCK ASSEMBLY - INSTALL

1. With key inserted in lock part way, assemble wave washer and special lock washer over lock as shown in Fig 0-13.

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

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

3. When lock is fully seated in cylinder, push key in all the way and turn clockwise.

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

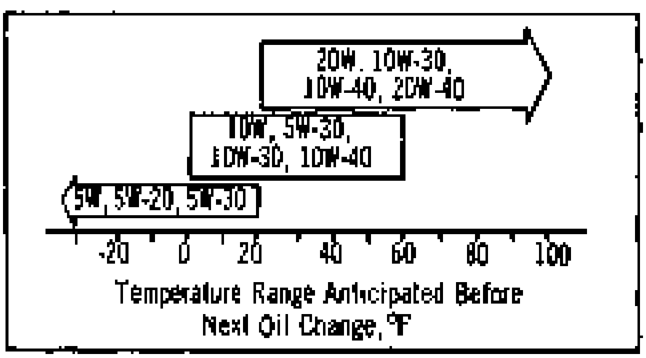
LUBRICATION

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

ENGINE OIL

Change As Outlined Below

RECOMMENDED SAE VISCOSITY NUMBERS—



NOTE: SAE 5W and 5W-20 oils are not recommended for sustained high speed driving. SAE 30W oils may be used at temperatures above 60°F.

NOTE: All engines are equipped with specially engineered piston rings. These rings allow oil to flow freely on the cylinder walls during the break-in period. Therefore, oil consumption may be higher during the break-in period than it will be afterward.

Oil which according to the label on the can is intended for service MS and conforms to GM Standard 6041M should be used.

OIL FILTER

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

MANIFOLD HEAT CONTROL VALVE

Observe for freedom of movement. Lubricate with heat valve lubricant

STATION WAGON TAILGATE HINGE AND LINKAGE

Engine oil every six months, more often if required.

CHASSIS LUBRICATION

Lubricate all normally greased suspension parts including ball joints.

POWER STEERING SYSTEM AND PUMP RESERVOIR

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

STANDARD DIFFERENTIAL

Check for leaks, maintain lubricant level with SAE-80 oil where available or SAE-90 Multi-Purpose gear lubricant meeting requirements of MIL-L-2105B Change lubricant only when necessary to disassemble.

SAFE-T-TRACK DIFFERENTIAL

Check for leaks. Refill with part 1050081 lubricant only. Change lubricant only when necessary to disassemble.

MANUAL TRANSMISSION

Check for leaks. Maintain lubricant level with SAE-80 where available or SAE-90 Multi-Purpose gear lubricant meeting requirements of MIL-L-2105B. Change lubricant only when necessary to disassemble.

CLUTCH LINKAGE - MANUAL TRANSMISSION

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

COLUMN SHIFT LINKAGE, MANUAL TRANSMISSION

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

FLOOR SHIFT LINKAGE, MANUAL TRANSMISSION

Engine oil at all joints under body (lubricate shifter mechanism liberally).

BRAKE SYSTEM AND MASTER CYLINDER

Check system for adequate brake pedal reserve and for

DRILL SIZES

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

DECIMAL EQUIVALENTS

1/64	.015625	17/64	.265625	33/64	.515625	49/64	.765625
1/32	.03125	9/32	.28125	17/32	.53125	25/32	.78125
3/64	.046875	19/64	.296875	35/64	.546875	51/64	.796875
1/16	.0625	5/16	.3125	9/16	.5625	13/16	.8125
5/64	.078125	21/64	.328125	37/64	.578125	53/64	.828125
3/32	.09375	11/32	.34375	19/32	.59375	27/32	.84375
7/64	.109375	23/64	.359375	39/64	.609375	55/64	.859375
1/8	.125	3/8	.375	5/8	.625	7/8	.875
9/64	.140625	25/64	.390625	41/64	.640625	57/64	.890625
5/32	.15625	13/32	.40625	21/32	.65625	29/32	.00625
11/64	.171875	27/64	.421875	43/64	.671875	59/64	.921875
3/16	.1875	7/16	.4375	11/16	.6875	15/16	.9375
13/64	.203125	29/64	.453125	45/64	.703125	61/64	.953125
7/32	.21875	15/32	.46875	23/32	.71875	31/32	.96875
15/64	.234375	31/64	.484375	47/64	.734375	63/64	.984375
1/4	.25	1/2	.5	3/4	.75	1	1.

WEIGHTS AND MEASURES

LINEAR MEASURE

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

AREA MEASURE

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

LIQUID MEASURE

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

DRY MEASURE

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

CUBIC MEASURE

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

COMMON WEIGHT

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

COMMON U.S.A. EQUIVALENTS LENGTH

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

LIQUID CAPACITY

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

DRY CAPACITY

1 quart	1.1012 liters
1 liter	0.9081 quarts
1 peck	8.071 liters
1 liter	.32562 pecks

WEIGHTS AND MEASURES

evidence of leaking. Use only SAE-70R3 fluid such as Delco Supreme II, or equivalent.

HOOD LATCH

Engine oil on pivots and spring anchor points, and light grease on release pawl, every six months or as required.

HOOD HINGES

Engine oil on hinge pins and spring anchor points, every six months or as required.

ACCELERATOR LINKAGE

Engine oil at all pivot points. Do not lubricate the linkage which is a part of the carburetor assembly. Tempest and Firebird cable must not be lubricated.

AUTOMATIC TRANSMISSION SHIFT LINKAGE

Lubricate with chassis grease at cross shaft pivot points. Console control cable must not be lubricated.

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

FRONT WHEEL BEARINGS

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

POSITIVE CRANKCASE VENTILATION

Check hose between valve cover and air cleaner. For clear passages; replace if clogged. Clean and re-oil ventilation filter in air cleaner. Replace valve.

NOTE: This filter should be cleaned and re-oiled after each occasion of driving under severe dust conditions.

U.S. AND IMPERIAL CAPACITIES

	PONTIAC		GRAND PRIX		TEMPEST		FIREBIRD	
	U.S. Gal.	Imp. Gal.	U.S. Gal.	Imp. Gal.	U.S. Gal.	Imp. Gal.	U.S. Gal.	Imp. Gal.
Fuel—All Exc. Sta. Wgn.	26.5	22.0	21.5	18.0	21.5	18.0	18.5	15.5
—Station Wagon	24.0	20.0	—	—	20.0	16.5	—	—
Cooling—	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.
6 Cyl. (w/o A/C)	—	—	—	—	12.0	10.0	12.0	10.0
6 Cyl. (with A/C)	—	—	—	—	12.25	10.25	12.25	10.25
8 Cyl.—								
—V400 (w/o A/C)	18.0	15.0	18.75	15.5	18.25	15.25	18.5	15.5
—V400 (with A/C)	18.0	15.0	21.0	17.5	19.75	16.5	18.75	15.5
—V428	17.25	14.25	17.5	14.5	—	—	—	—
—V350 (w/o A/C)	—	—	—	—	20.0	16.75	19.5	16.25
—V350 (with A/C)	—	—	—	—	21.25	17.75	20.25	16.75
Engine Crankcase—	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.	U.S. Qt.	Imp. Qt.
6 Cyl. (with Oil Filter Chg.)	—	—	—	—	5.0	4.25	5.0	4.25
6 Cyl. (w/o Oil Filter Chg.)	—	—	—	—	4.5	3.75	4.5	3.75
8 Cyl. (with Oil Filter Chg.)	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0
8 Cyl. (w/o Oil Filter Chg.)	5.0	4.25	5.0	4.25	5.0	4.25	5.0	4.25
Transmission—	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.
3-Speed Manual (Standard)	—	—	—	—	3.5	3.0	3.5	3.0
3-Speed Manual (Heavy Duty)	2.8	2.5	2.8	2.5	2.8	2.5	2.8	2.5
4-Speed Manual (6 Cylinder)	—	—	—	—	3.5	3.0	3.5	3.0
4-Speed Manual (8 Cylinder)	—	—	2.5	2.0	2.5	2.0	2.5	2.0
2-Speed Automatic—								
Refill After Draining (Approx.)	—	—	—	—	5.0	4.25	5.0	4.25
Refill After Disassembly (Approx.)	—	—	—	—	15.0	12.5	15.0	12.5
Turbo Hydra-Matic (M40) [Code PA, PB, Etc.]								
Refill After Draining (Approx.)	7.5	6.25	7.5	6.25	7.5	6.25	7.5	6.25
Refill After Disassembly (Approx.)	19.0	15.75	19.0	15.75	19.0	15.75	19.0	15.75
Turbo Hydra-Matic (M38) [Code JA, JB, Etc.]								
Refill After Draining (Approx.)	—	—	—	—	6.0	5.0	6.0	5.0
Refill After Disassembly (Approx.)	—	—	—	—	20.0	16.75	20.0	16.75
Differential—	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.	U.S. Pt.	Imp. Pt.
Standard or Safe-T-Track	4.5	3.75	3.0	2.5	3.0	2.5	3.0	2.5
Brake Master Cylinder—	Fill to ¼" from top using fluid meeting SAE 70R3 specifications.							

CARBURETOR FUEL FILTER - INTEGRAL

Remove and clean bronze filter and filter cavity; replace paper element.

AIR CLEANER ELEMENT (PAPER) - STANDARD ON ALL ENGINES

Replace

NOTE: Clean and re-oil after each occasion of driving under severe dust conditions. Allow excess oil to drain out of filter prior to installation.

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

AUTOMATIC TRANSMISSION

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

COOLING SYSTEM

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

ITEMS REQUIRING LUBRICATION OR SERVICE AT SPECIAL INTERVALS

TIRES

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

PARKING BRAKE CABLES

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

BRAKE ASSEMBLIES

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

CAUTION: Grease must be kept off brake linings; remove by sanding.

MANUAL STEERING GEAR

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

BODY DOOR LOCKS AND STRIKERS

Stick-type lubricant - use sparingly as required.

DOOR HINGE HOLD-PINS

Light grease on friction surface. Use sparingly as required.

BODY DOOR HINGE PINS

Engine oil as required.

STATION WAGON FOLDING SEAT

Engine oil on pivots as required. Use sparingly.

FUEL DOOR HINGE

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

REAR COMPARTMENT LID HINGES

Engine oil as required.

CONVERTIBLE FRONT DOOR-TO-LOCK WEDGE PLATES

Stick-type lubricant, use sparingly as required.

WINDSHIELD WASHER SOLVENT

Use Pontiac solvent, part 1050418, or equivalent and follow instructions on label to ensure proper operation of washer, and to prevent paint damage from excessively strong solutions.

AIR CONDITIONING CONDENSER CORE

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

CAUTION: Do not use steam.

BATTERY

Add distilled water every 30 days. May require more frequent additions during high ambient temperatures and/or extended trip operation. Clean terminals yearly and apply petroleum.

ITEMS NOT NORMALLY REQUIRING SERVICE

STARTING MOTOR

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

ALTERNATOR

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

CONVERTIBLE HYDROELECTRIC PUMP MOTOR

The hydroelectric pump motor does not require periodic service.

CLUTCH RELEASE BEARING

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

SPEEDOMETER CABLE

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

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

HEATING AND VENTILATION SERVICE

CONTENTS OF THIS SECTION

GENERAL INFORMATION

All 1969 heater systems receive air through the grille (or opening) at the rear of the hood. This air passes through the plenum chamber into the heater motor inlet duct and then through the heater core and case where further air distribution is controlled by three doors.

Service and adjustment procedures for Pontiac, Tempest, Grand Prix and Firebird Heating and Ventilation Systems are covered in the following sections.

TEMPERATURE CABLE ADJUST

PONTIAC AND GRAND PRIX

1. Insure that cable is secured at control and at heater, and routed smoothly and free of sharp kinks or bends.

2. Place temperature lever to full cold position (full left on Pontiac and full down on Grand Prix) and hold in this position.

3. Adjust turnbuckle until cam roller bottoms at end of heater cam slot (Fig. 1-1 Pontiac or Fig 1-2 Grand Prix).

4. Move temperature lever to full heat position and back again to full cold position. Lever should return to end of slot and cam roller should be against end of cam slot.

5. If cam roller is not at end of cam slot or if lever did not go full travel, repeat repeat steps 3 and 4 until cable is properly adjusted.

TEMPEST AND FIREBIRD

1. Make sure cable is secure at both ends.

2. Hold lever on top of heater case, Fig. 1-3 Tempest or Fig. 1-4 Firebird, in full cold position (Full left or clockwise when viewed from above).

3. Adjust cable turnbuckle so that temperature control lever will spring back 1/16" to 1/8" when pushed to the OFF position.

AIR CONTROL CABLE ADJUST

PONTIAC, TEMPEST AND FIREBIRD

1. Place air control lever in OFF position.

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

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

4. Move lever to DE-ICE position, then back to OFF.

5. Lever must have slight spring back from end of slot, not to exceed 1/8".

HEATER CONTROL PANEL

Pontiac, Tempest and Firebird heater controls are of the horizontal slide lever design. The levers transmit motion via three bowden cables to the air, defrost and temperature doors.

Grand Prix models utilize vertical control levers. The temperature lever actuates a cable and the select lever a vacuum switch.

All heater control panels use a three speed blower switch.

HEATER CONTROL CABLE ADJUSTMENT PROCEDURE

NOTE: ALL ADJUSTMENTS TO BE MADE AFTER CABLES HAVE BEEN CONNECTED SECURELY AT BOTH ENDS

TEMPERATURE CONTROL

1. PLACE TEMPERATURE LEVER & AT FULL COLD (FULL LEFT)
2. ADJUST TURNBUCKLE UNTIL CAM ROLLER BOTTOMS AT END OF SLOT IN CAM.
3. MOVE TEMPERATURE LEVER FULL RIGHT AND BACK TO FULL LEFT. CAM SHOULD RETURN TO REST AT END OF SLOT
4. IF CAM IS NOT AT END OF SLOT OR IF LEVER DID NOT GO FULL TRAVEL REPEAT STEPS 2 & 3 UNTIL CABLE IS PROPERLY ADJUSTED

AIR CONTROL

1. PLACE AIR CONTROL LEVER IN OFF POSITION
2. HOLD AIR DOOR CRANK ON HEATER CASE IN CLOSED POSITION (CRANK ROTATED FULL CLOCKWISE WHEN VIEWED FROM ABOVE)
3. WHILE HOLDING AIR CONTROL DOOR IN CLOSED POSITION ADJUST TURNBUCKLE TO MOVE LEVER AGAINST END OF SLOT IN CONTROL PANEL. THEN TURN TURNBUCKLE IN OPPOSITE DIRECTION TO MOVE CONTROL LEVER 1/16" TO 1/8" AWAY FROM END OF SLOT
4. MOVE LEVER TO DE-ICE POSITION, THEN BACK TO OFF
5. LEVER MUST HAVE SLIGHT SPRING BACK FROM END OF SLOT NOT TO EXCEED 1/8"

DE-ICE

THIS IS A NON ADJUSTABLE ITEM.

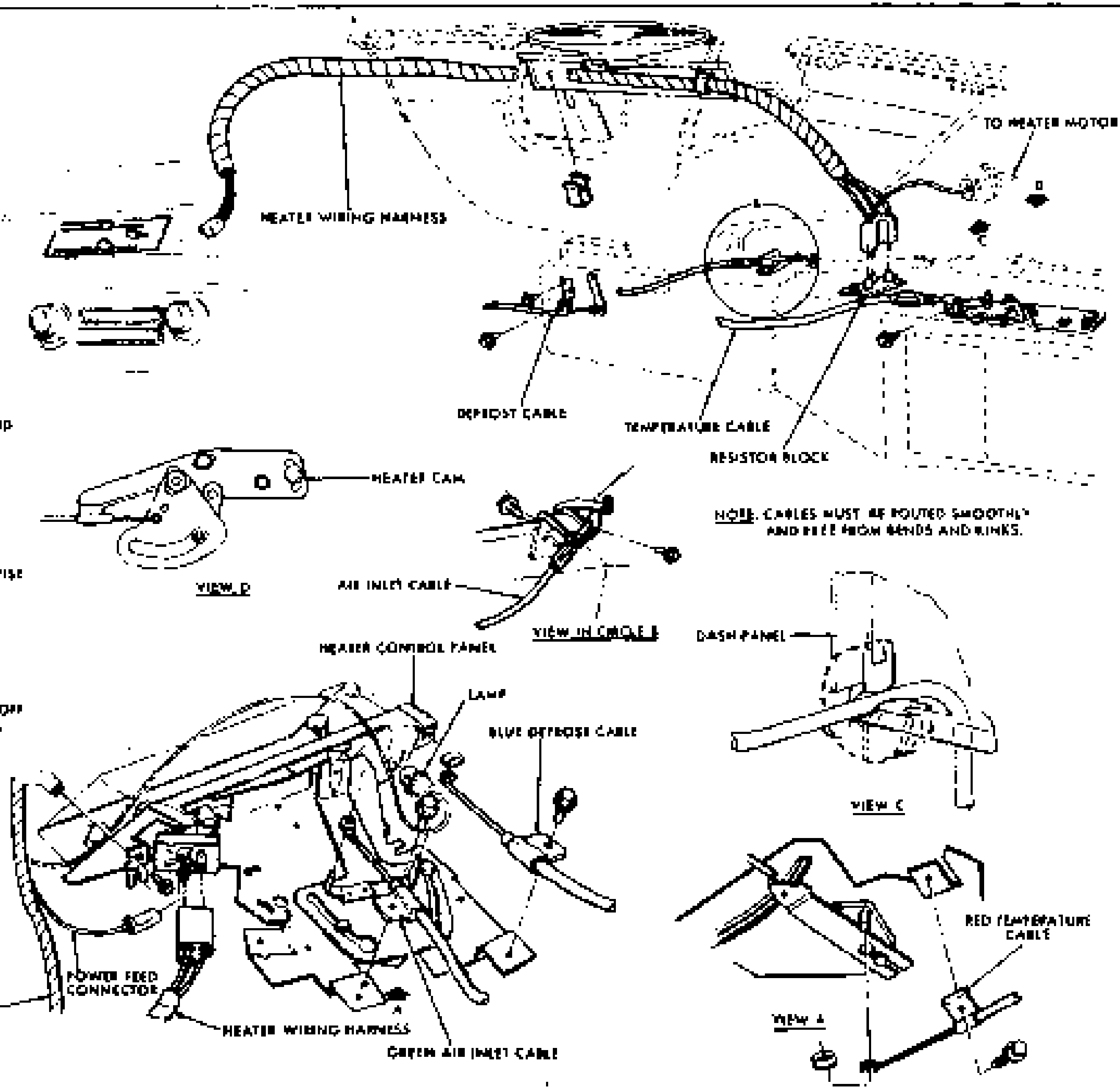


Fig. 1-1 Pontiac Heater Cable and Wire Routing

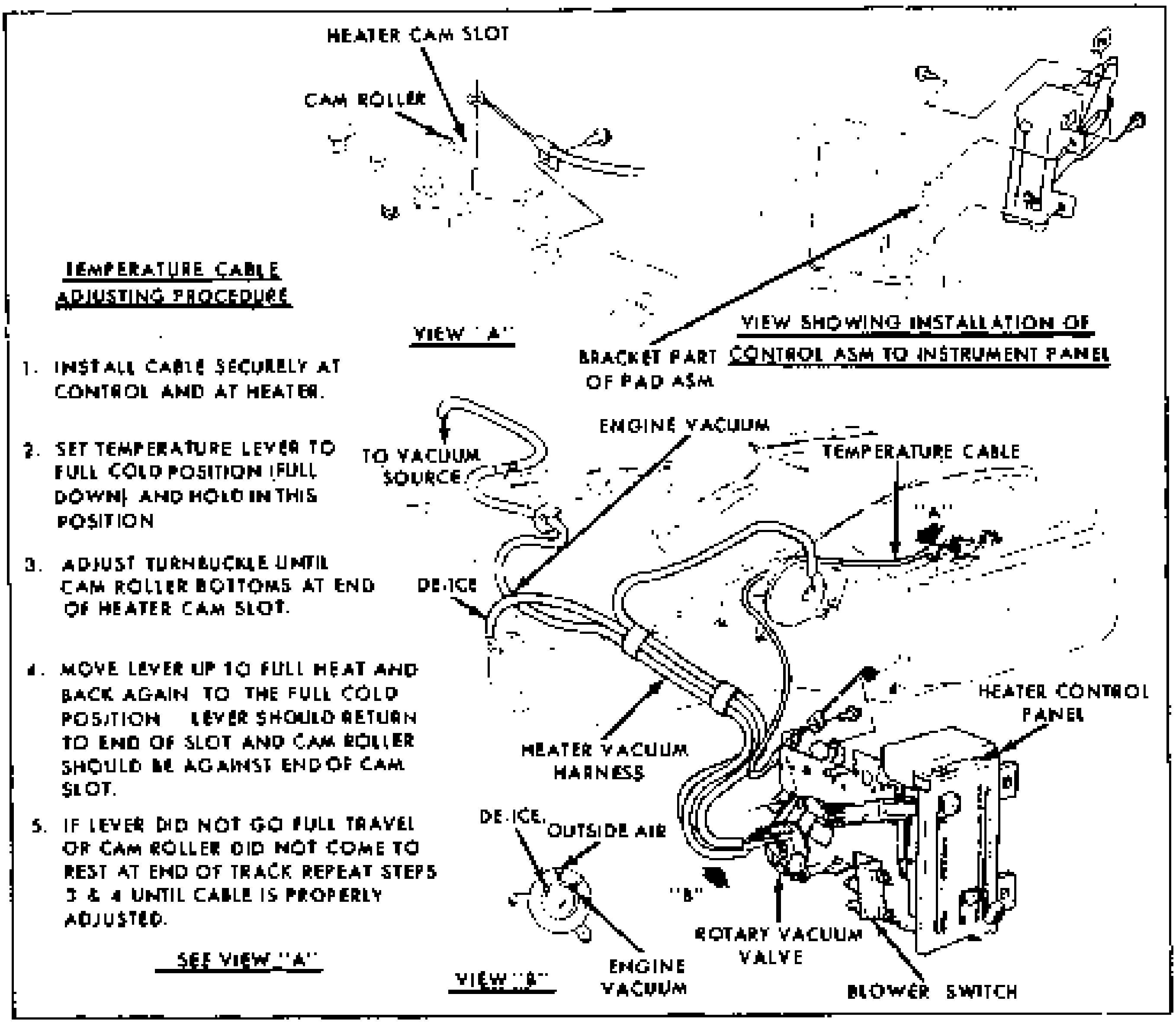


Fig. 1-2 Grand Prix-Heater Cable and Vacuum Hose Routing

ALL - REMOVE AND REPLACE

1. Remove radio.

2. Remove screws retaining control to instrument panel.

3. Disconnect lamp and wire connectors (and vacuum hoses on Grand Prix).

4. Pull panel away from instrument panel and down and disconnect cable(s) at control.

5. Remove control.

6. To install reverse removal procedures. Check cable operation and adjust if necessary.

BLOWER SPEED SWITCH

PONTIAC AND GRAND PRIX-REMOVE AND REPLACE

1. Remove radio.

2. Disconnect wire connector to switch.

3. Remove plastic knob from switch lever.

4. Remove switch retaining screws and switch.

5. To install reverse removal procedure.

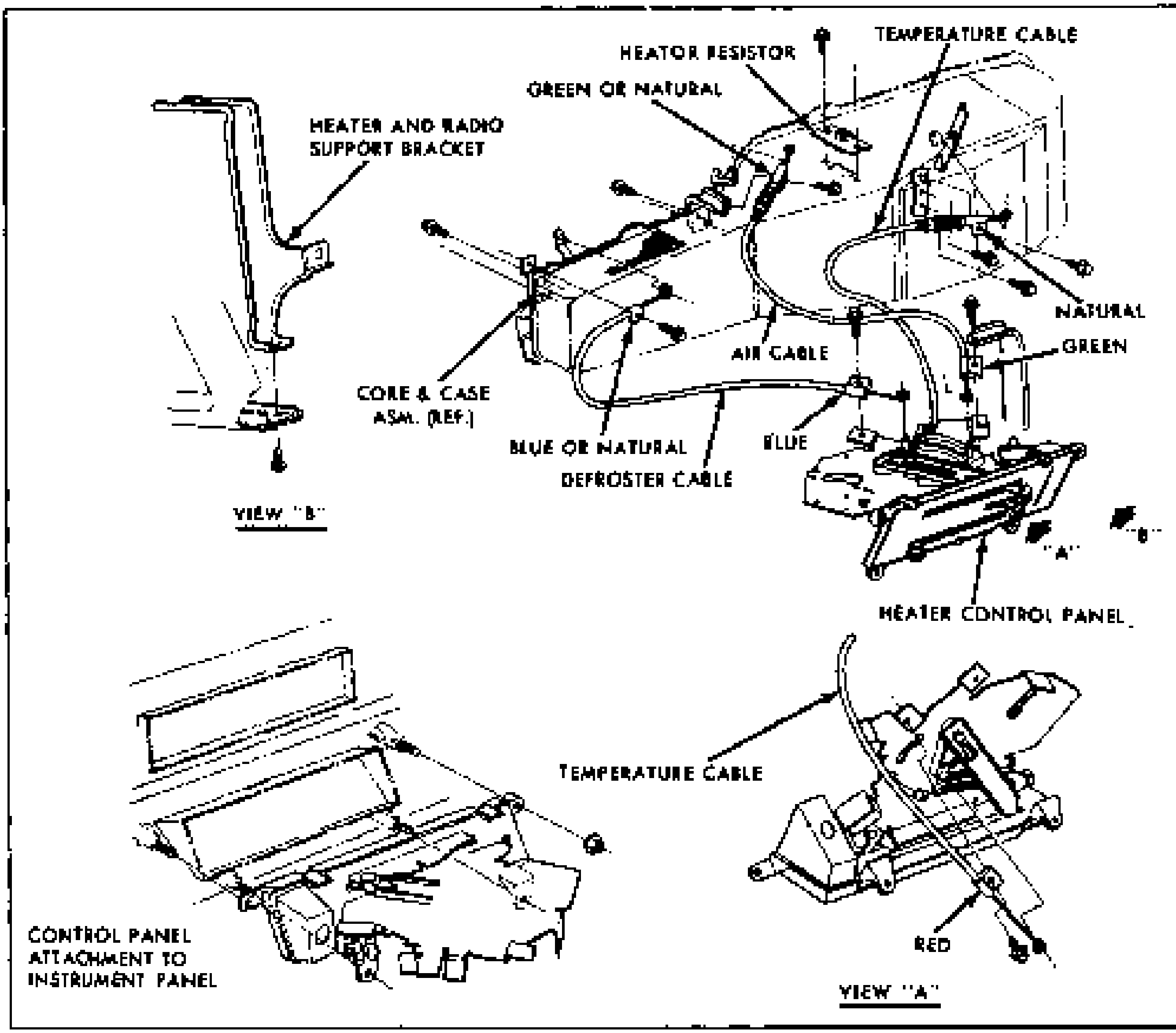


Fig. 1-3 Tempest-Heater Cable Routing

TEMPEST AND FIREBIRD

1. Remove glove compartment.
2. Disconnect wire connector from switch.
3. Remove plastic knob from lever.
4. Remove switch attaching screws and switch.
5. To install reverse removal procedure.

Blower speed is controlled by the blower motor resistor. Resistance values for this unit are shown on the heater wiring schematic.

BLOWER MOTOR RESISTOR

ALL-REMOVE AND REPLACE

1. Remove glove compartment on all except Grand Prix.
2. Remove resistor wire connector (on top of heater case).
3. Remove resistor (2 screws).
4. Replace by reversing removal procedure.
5. Check for operation.

HEATER WIRING HARNESS

ALL-REMOVE AND REPLACE

1. Remove wire connector at blower motor, dash grommet, and feed through dash opening. For installation drawing, see Fig. 1-1 for Pontiac and Fig. 1-5 for typical Tempest, Firebird and Grand Prix. Make sure grommet is in place and resealed.

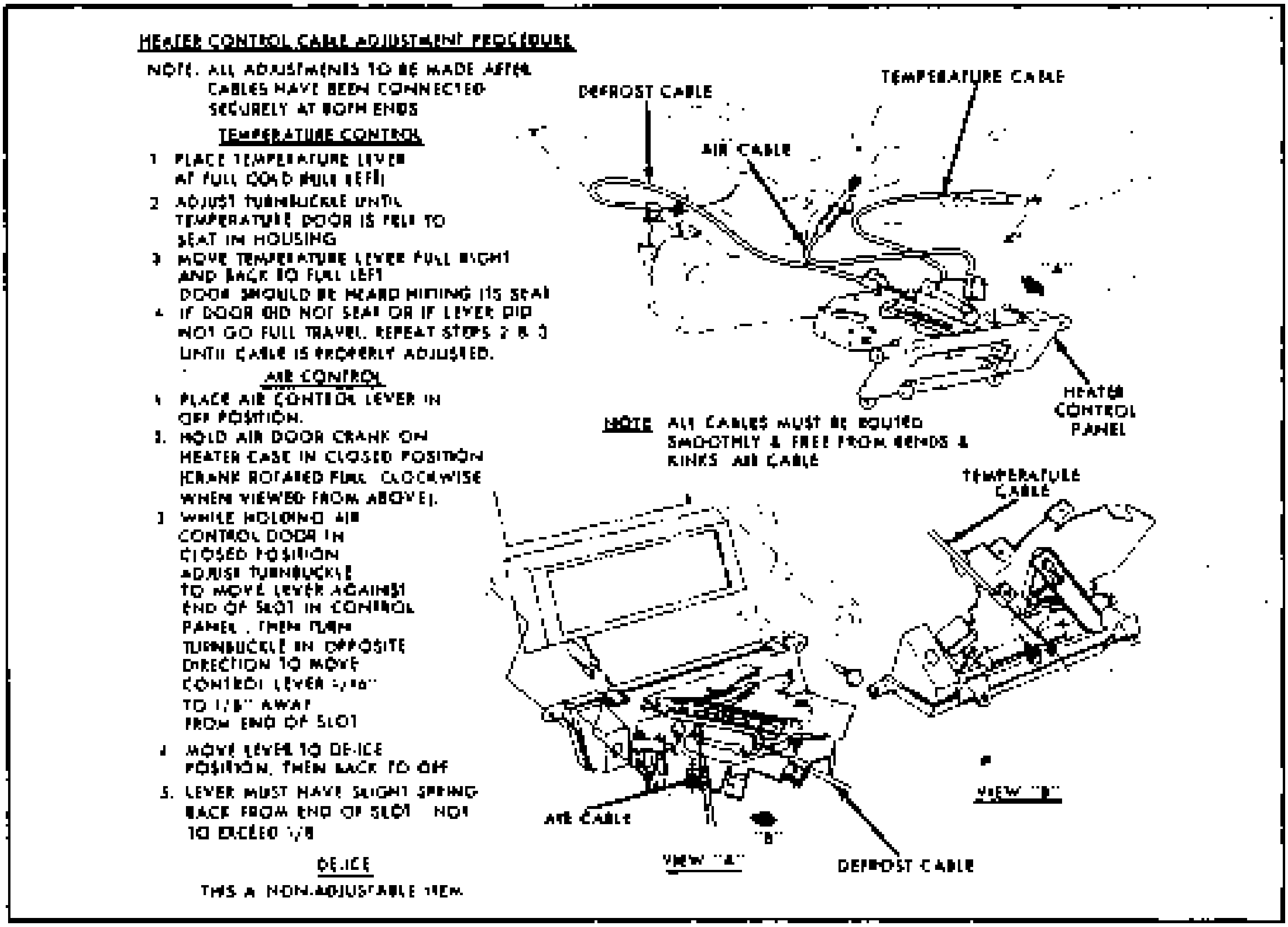


Fig. 1-4 Firebird Heater Cable Routing

2. Disconnect blower switch connector.

3. Disconnect connector at accessory feed.

4. Disconnect resistor connector.

5. Pull harness from wire clips and remove harness.

6. To replace, reverse removal procedure.

7. Check for operation.

TEMPERATURE CONTROL CABLE

ALL-REMOVE AND REPLACE

1. Remove retaining screw and disconnect temperature control cable at top of heater case.

2. Remove nut retaining cable wire to control pin.

3. Remove screw retaining cable to control then remove cable.

4. To reinstall reverse removal procedure. Route smoothly, check operation and adjust if necessary.

AIR CONTROL OR DEFROSTER CABLE

PONTIAC-REMOVE AND REPLACE

1. Remove control from instrument panel.

2. Remove nut and screw retaining cable to control

3. Remove retaining screw at other end of cable and remove cable.

4. To install cable reverse removal procedure, check operation and in the case of the air cable adjust if necessary.

TEMPEST AND FIREBIRD-REMOVE AND REPLACE

1. Remove glove compartment.

2. Remove nut and screw retaining cable to control.

3. Remove screw retaining cable at heater case.

4. To install cable reverse removal procedure check operation and in the case of the air cable adjust if necessary.

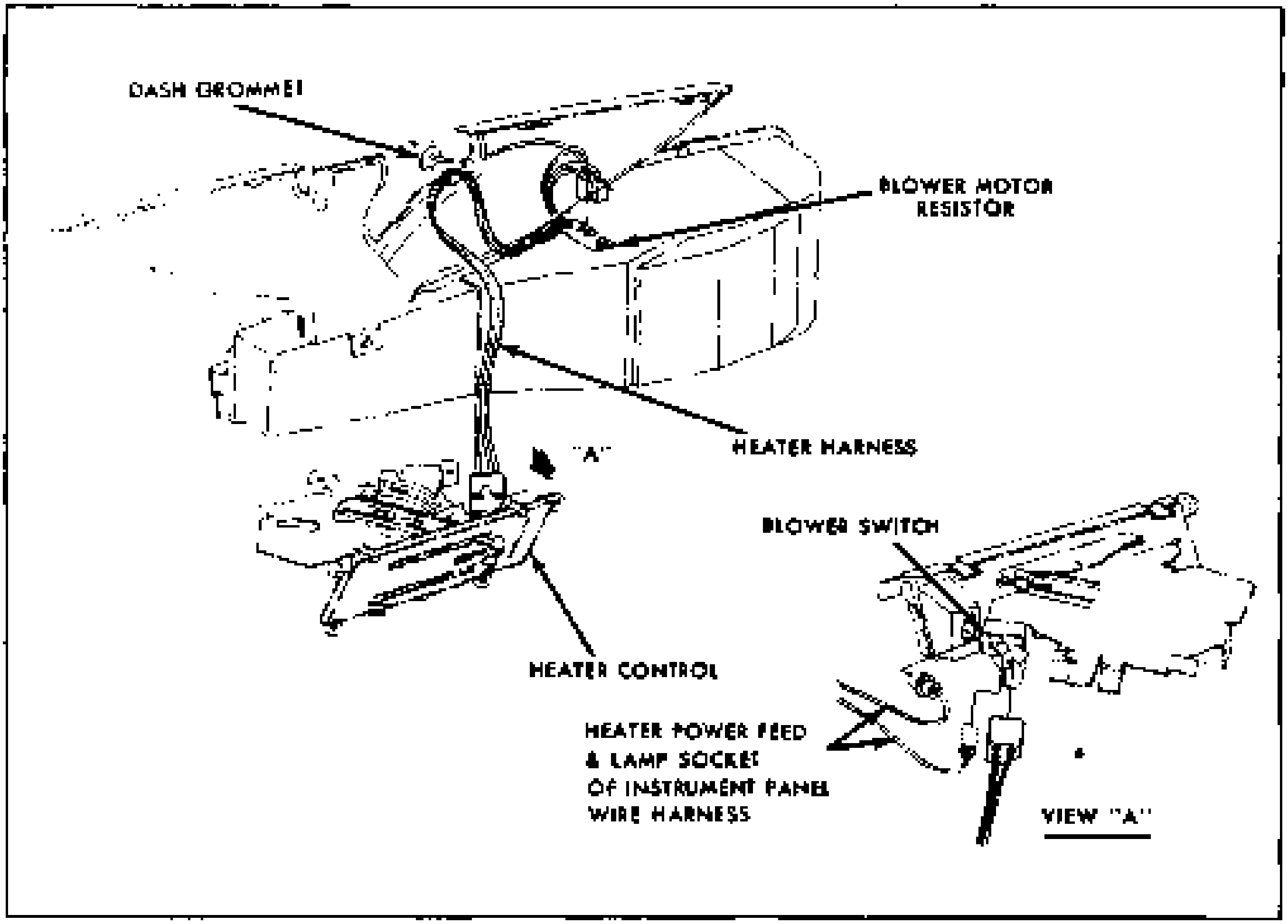


Fig. 1-5 Tempest, Firebird and Grand Prix-Typical Heater Harness

DEFROSTER DIAPHRAGM AND HOSE

GRAND PRIX-REMOVE AND REPLACE

1. Remove vacuum supply hose from diaphragm (Fig. 1-2).
2. Remove heater outlet (Fig. 1-6).
3. Remove diaphragm retaining nuts from below.
4. Remove nut retaining actuating lever to pin.
5. To replace, reverse removal procedure.

AIR DIAPHRAGM AND HOSE

GRAND PRIX-REMOVE AND REPLACE

1. Remove vacuum supply hose.
2. Remove diaphragm retaining screws and spring.
3. Remove diaphragm.
4. To replace, reverse removal procedure.

VACUUM SUPPLY HOSE

GRAND PRIX-REMOVE AND REPLACE

1. Disconnect supply hose from the tee connector in engine compartment.
2. Pull through grommet in dash to inside of car.
3. Disconnect hose from control panel and untape from harness.
4. To replace, reverse removal procedure being certain to re-tape to harness.

BLOWER MOTOR; IMPELLER AND/OR INLET DUCT

TEMPEST, FIREBIRD AND PONTIAC-REMOVE AND REPLACE

1. Remove battery and tray and unclip hoses on Firebird models.

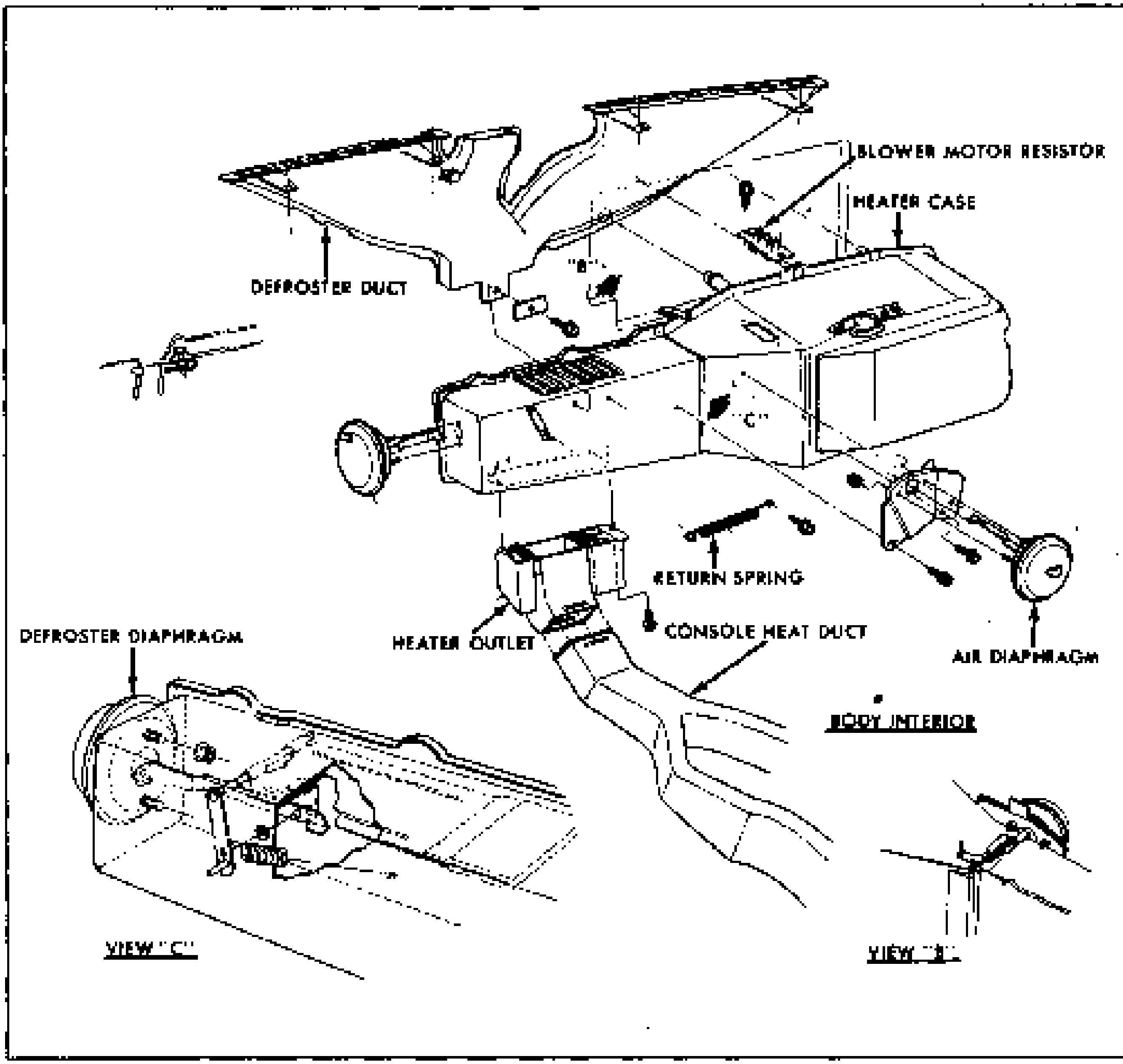


Fig. 1-6 Grand Prix-Vacuum Diaphragm and Duct Installation

2. Remove fender skirt.

3. Disconnect blower feed wire.

4. Remove blower motor or duct retaining screws as desired.

5. Remove motor or duct as desired.

6. To install, reverse removal procedure using care to reseal duct if removed.

GRAND PRIX-REMOVE AND REPLACE

1. Disconnect blower motor feed wire.

2. Remove blower motor or duct retaining screws as required (see Fig. 1-7).

3. Remove motor or duct.

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

HEATER CORE AND/OR CASE

ALL-REMOVE AND REPLACE

1. Drain radiator.

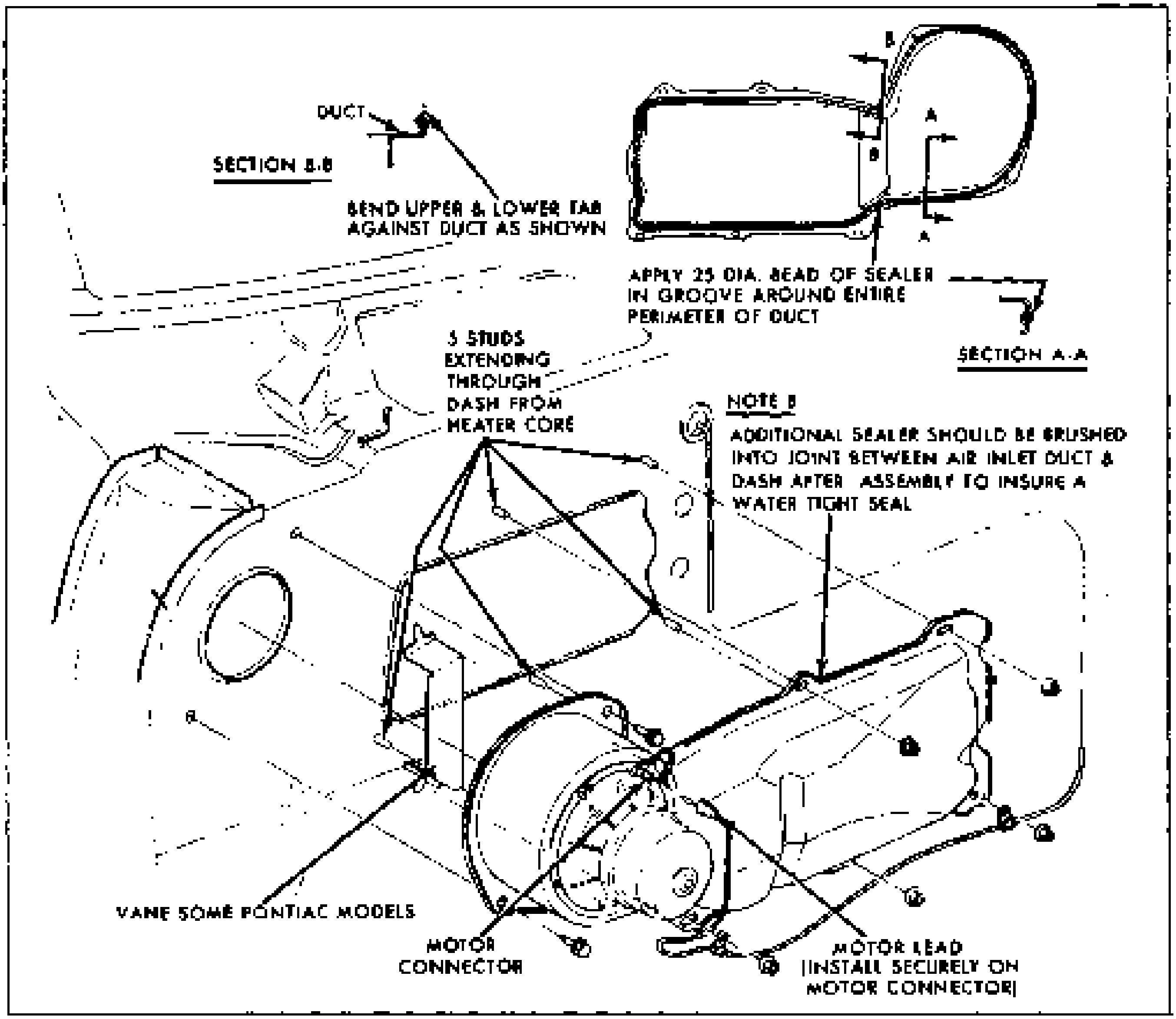


Fig. 1-7 Blower Motor and Air Inlet Duct Installation -Typical

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

NOTE: The hose from the water pump must go to the top heater core pipe; the other hose runs from the rear of the R.H. cylinder head with V-8 engines or the center of the block with L-6 engines to the lower core pipe.

3. Remove (5) nuts from core case studs on the engine side of the dash (Fig. 1-7).

4. Inside the vehicle pull the entire heater assembly from the firewall

5. Remove the bowden cables and all electrical connectors from the heater assembly and remove assembly. On Grand Prix models disconnect vacuum hoses.

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

7. Install the replacement core.

NOTE: Be sure the core to case sealer is intact before installing core. Use new sealer if necessary.

8. Install core retaining strips and core tube seal.

9. Within the vehicle insert the five studs on heater through the holes in cowl and blower and air inlet assembly. Install the case to firewall mounting nuts (on engine side).

NOTE: It may be necessary to first insert coolant tubes through the dash followed by the five studs.

10. Replace the bowden cables and electrical connectors.

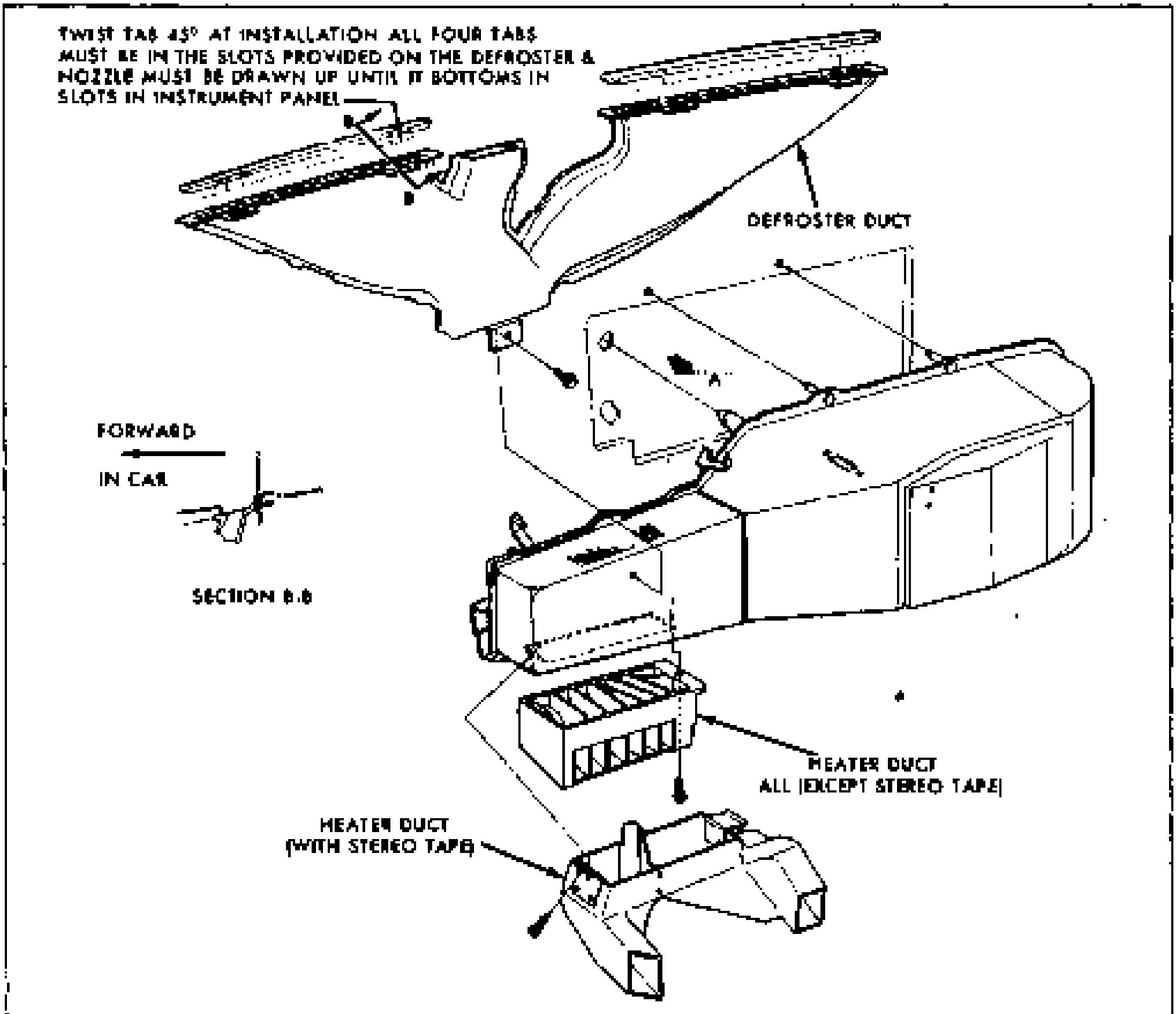


Fig. 1-8 Typical-Duct Installation

11. Replace heater hoses, being careful to install them in their proper location.

12. Refill radiator

HEATER HOSE INLET AND OUTLET

ALL-REMOVE AND REPLACE

1. Partially drain radiator.

2. Remove hose clamps and slide hose from fittings

3. Replace hose and secure clamps.

4. Replace coolant filling to proper level.

DEFROSTER DUCT

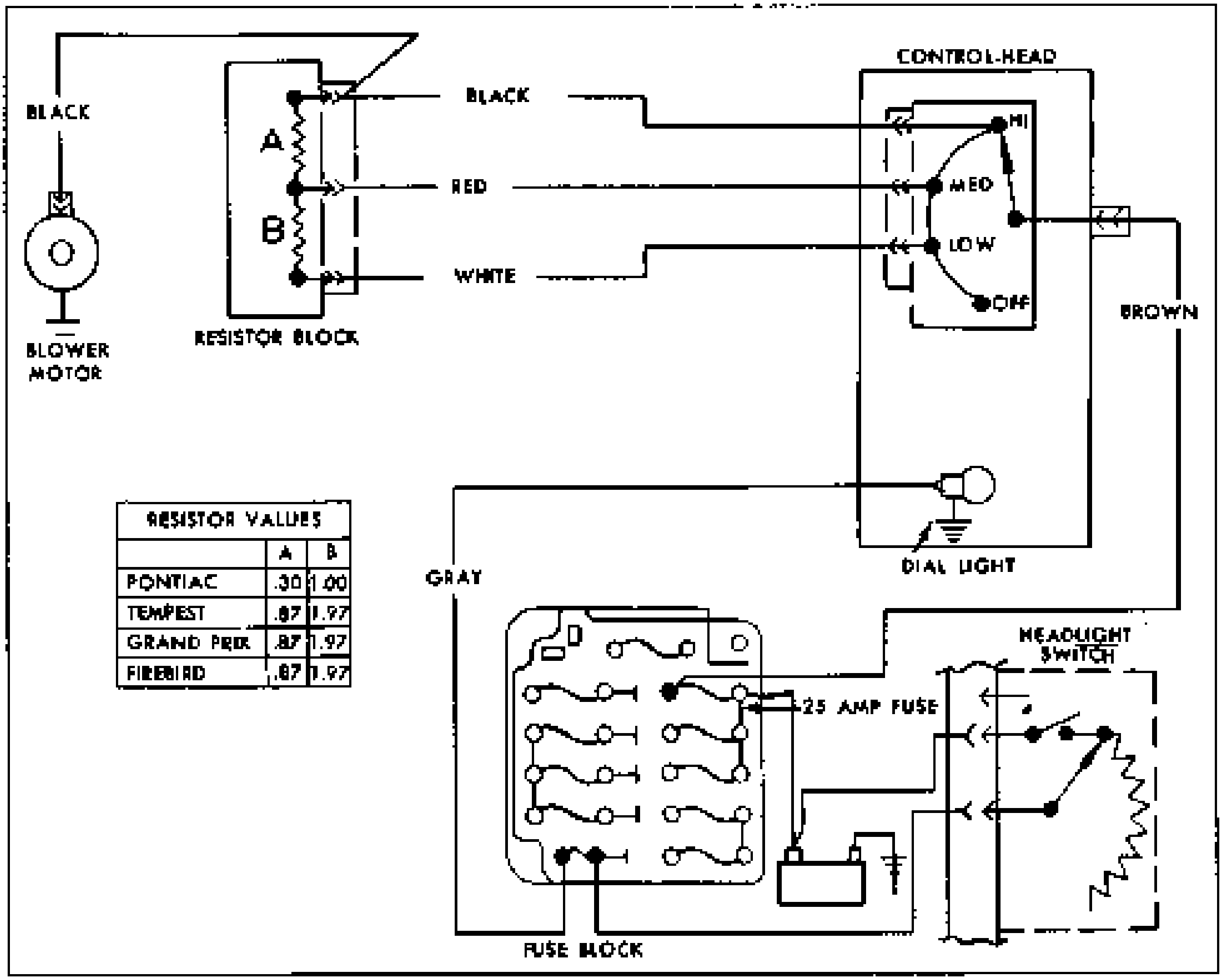
ALL-REMOVE AND REPLACE

Fig. 1-8 is typical of defroster and heater duct installation and should be referred to when replacing these components.

HEATER WIRING SCHEMATIC

ALL

The heater wiring schematic is shown on Fig. 1-9. Note that resistance values for all four models are shown on this figure.



RESISTOR VALUES	A	B
PONTIAC	.30	1.00
TEMPEST	.87	1.97
GRAND PRIX	.87	1.97
FIREBIRD	.87	1.97

Fig. 1-9 Heater Wiring Schematic-All

KICK PAD VENTILATORS

ALL-RIGHT HAND

1. Remove kick pad retaining screws.

2. Remove sill plate.

3. Remove (upper vent actuating lever) in kick pad on models so equipped.

4. Pull assembly from body area.

5. To replace reverse removal procedure using care to reseal duct.

ALL-LEFT HAND

1. Loosen park brake bracket and move to right.

2. Remove sill plate and dimmer switch

3. Remove kick pad retaining screws and pull assembly from body area.

4. To replace reverse removal procedure using care to reseal duct.

UPPER LEVEL VENTILATION

The upper level ventilation system provides cool fresh air to the upper regions of the vehicle and is standard on all models. When the valve is opened by the actuating lever, air enters the vehicle from the plenum chamber. One way valves in the door pillar post allow air in the passenger compartment to pass under the rear seat into the trunk, forward over the wheelhouse and then out through the exit valve.

Installation drawings (Fig. 1-10, 11 and 12) show Pontiac, Tempest, Grand Prix and Firebird systems respectively. These figures should be referred to when servicing ventilation systems.

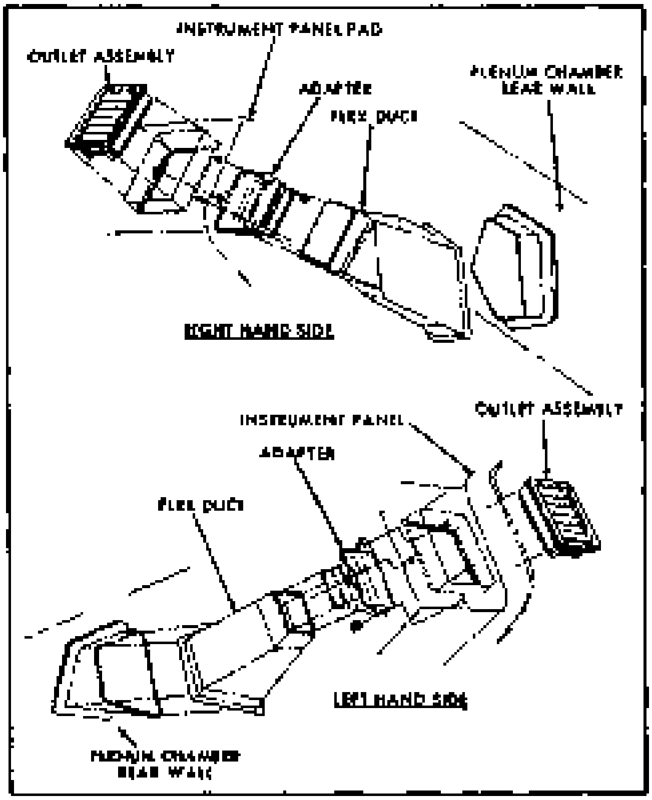


Fig. 1-10 Pontiac-Upper Ventilation System

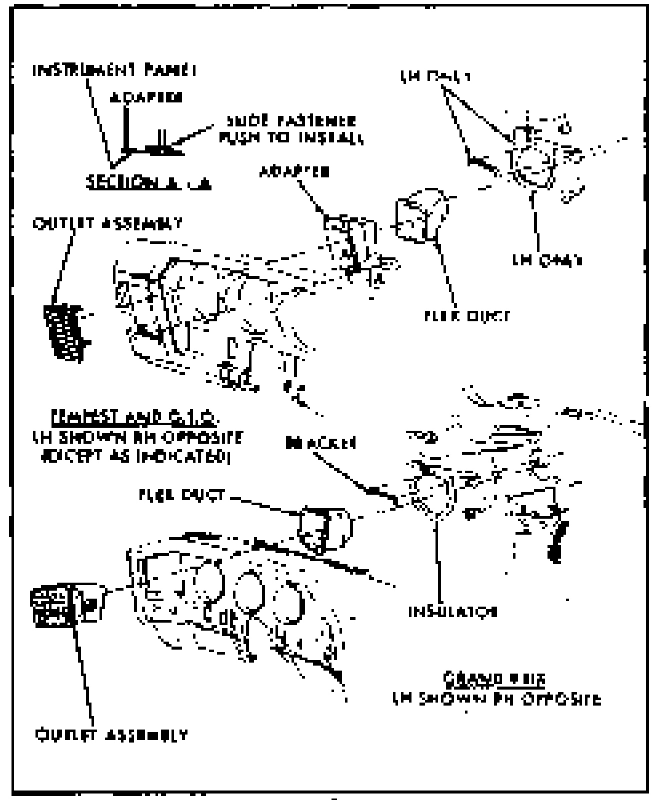


Fig. 1-11 Tempest and Grand Prix-Upper Ventilation System

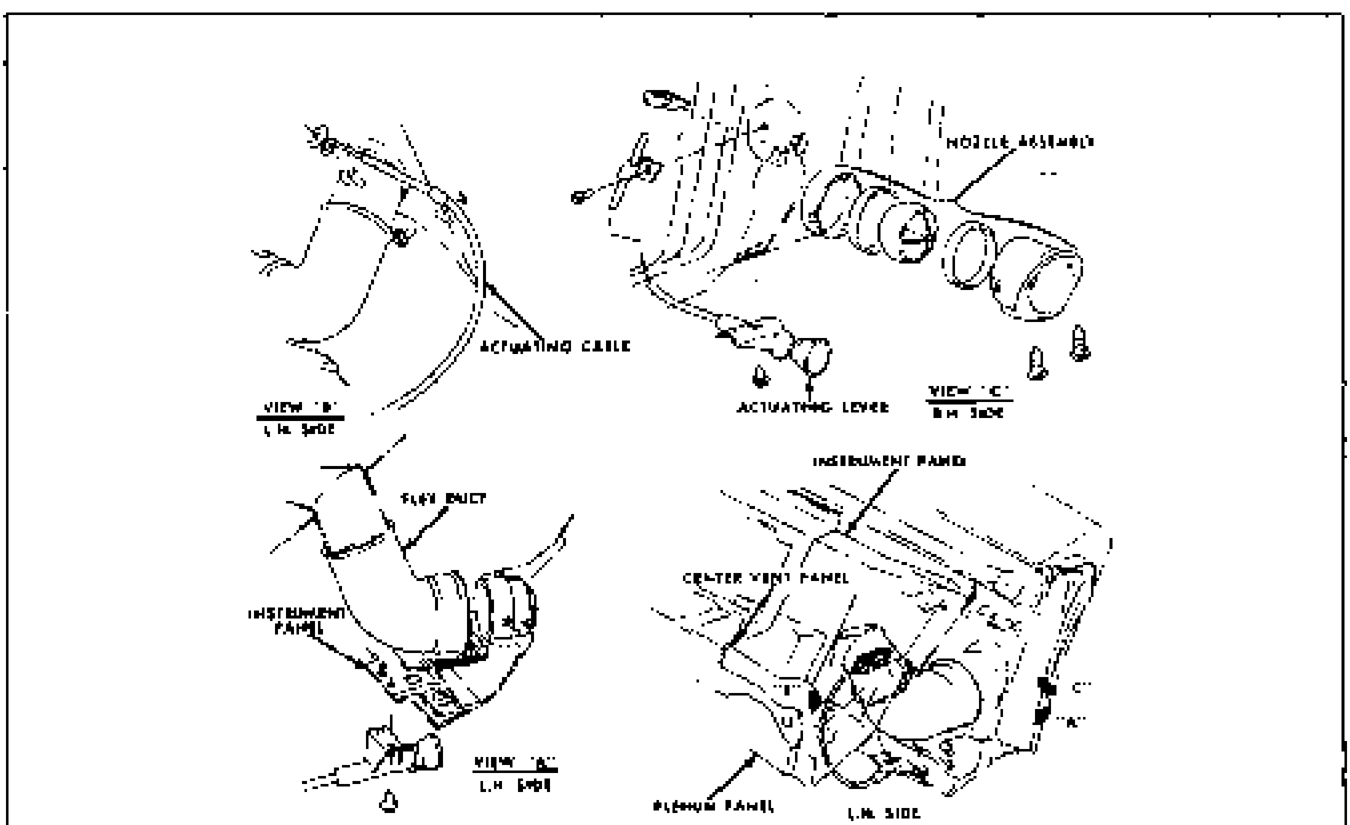


Fig. 1-12 Firebird Upper Ventilation System

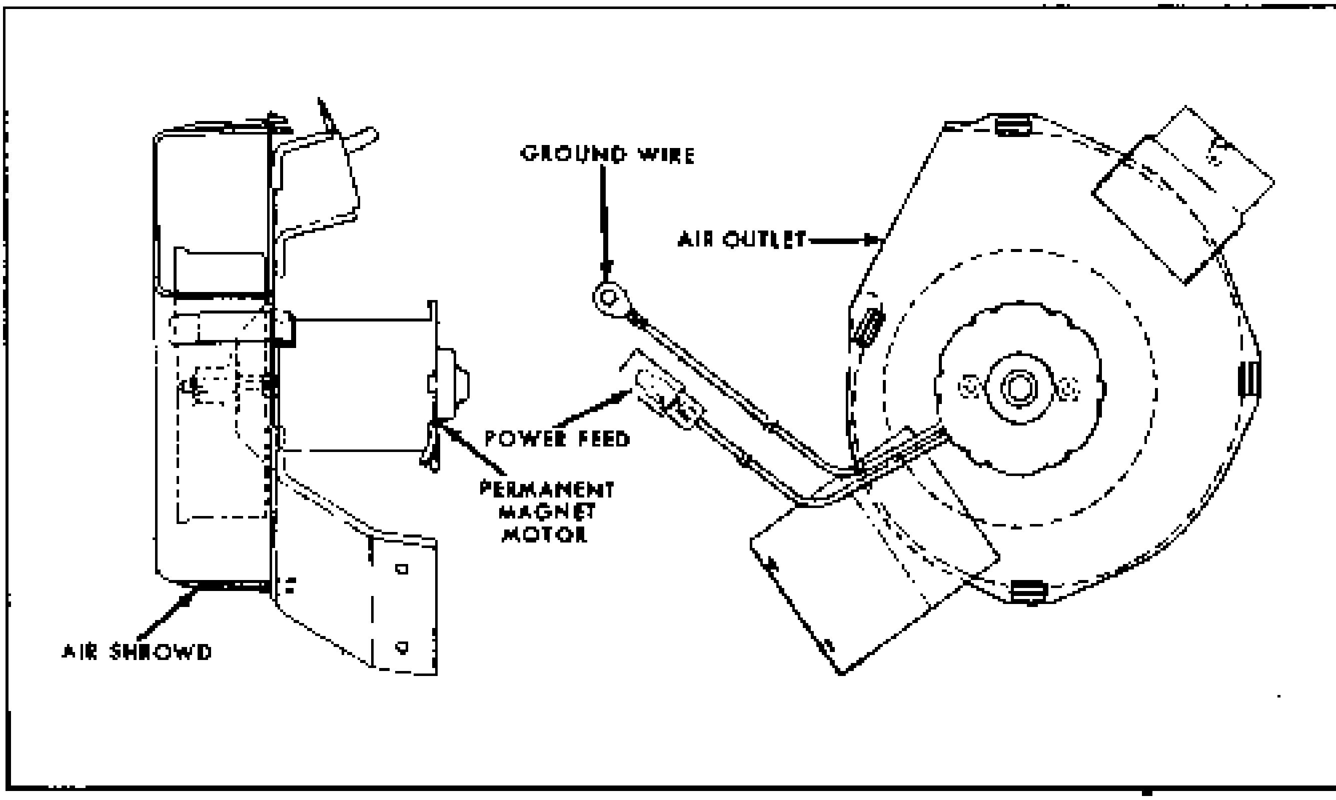


Fig. 1-13 Typical-Power Flow Vent Motor and Duct

POWER FLOW VENTILATION SYSTEM

Power flow ventilation is an extra cost option available on all models. Two small permanent magnet motor and impeller assemblies (Fig. 1-13) force air, at one of two speeds through each upper air vent duct. A three: (Off, Low, High) position switch on the instrument panel controls operation of the motors (Fig. 1-14).

The two motor speeds are achieved by use of a 3.35 ohm resistance wire to each motor. Approximately 106 inches of resistance wire provides low speed while high speed uses no resistance. The motor harness is routed on the upper inner side of the dash to each motor.

VENT MOTOR

ALL-REMOVE AND REPLACE

1. Remove sill plates (or loosen).

2. Remove kick pad ventilator assembly.

3. Remove screws and nuts retaining motor assembly bracket to plenum and disconnect wires.

4. Pull assembly through kick pad opening.

5. To replace reverse removal procedure, and use care to properly reseal kick pad.

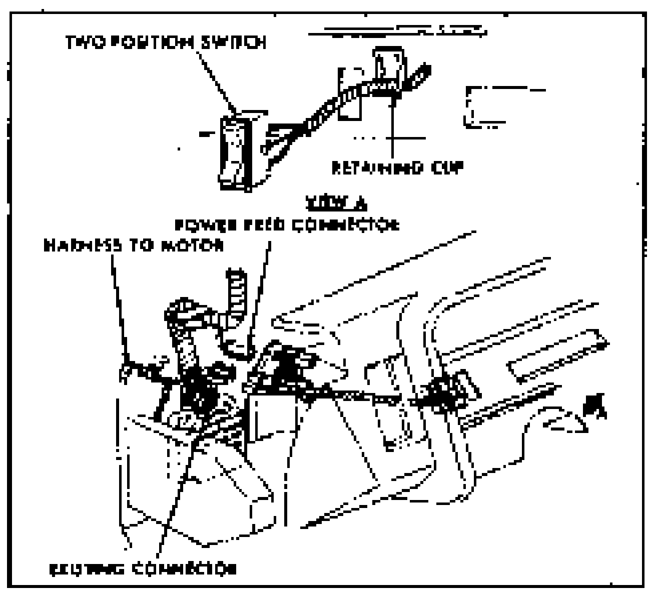


Fig. 1-14 Power Flow Ventilation Wire Harness Typical

CUSTOM AIR CONDITIONER

CONTENTS OF THIS SECTION

COMPONENT REPLACEMENT AND ADJUSTMENT

PRECAUTIONARY SERVICE MEASURES

Before any service is attempted which requires opening of refrigeration pipes or units, the person doing the work should be thoroughly familiar with the material in the Diagnosis Manual - Basic Air Conditioning Information. Also, he should follow very carefully the instructions given on the following pages for the unit being serviced.

The major reasons behind these measures are for safety and to prevent dirt and moisture from getting into system. Dirt contaminant is apt to cause leaky valves or wear in the compressor, and moisture will freeze into ice at expansion valve and freeze valve stem.

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

REFRIGERATION SUB-ASSEMBLIES

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

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

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

4. Compressors are shipped with 10-11 oz. of Frigidaire 525, or equivalent, viscosity oil and charged with a mixture of Refrigerant-12 and dry nitrogen to provide an internal pressure at slightly above atmospheric pressure.

ASSEMBLY

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

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

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

4. Use a small amount of clean refrigeration oil (525 or 1000 viscosity) on all tube and hose joints, and dip the O-ring gasket in this oil before assembling joint, as this oil will help in making a leak-proof-joint.

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

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

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

CAUTION--LIQUID INDICATOR

PONTIAC, GRAND PRIX AND TEMPEST

Under normal conditions, receiver-dehydrator will show clear with about 3-1/2 pounds of refrigerant in the system. However, the air conditioner will not produce its best performance until 4-1/8 pounds of refrigerant are in the system. Do not overcharge with refrigerant, as this will result in extremely high head pressures and the compressor safety valve will blow.

FIREBIRD

Under normal conditions, liquid indicator will show clear with about 2-3/4 pounds of refrigerant in the system. However, the air conditioner will not produce its best performance until 3-3/4 pounds of refrigerant are in the system. Do not overcharge with refrigerant, as this will result in extremely high head pressures and the compressor safety valve will blow.

Metal Tube Outside Diameter	Thread and Fitting Size	Steel Tubing Torque Lb. Ft.	Aluminum or Copper Tubing Torque Lb. Ft.	Nominal Torque Wrench Span
1/4	7/16	10-15	5-7	5/8
3/8	5/8	30-35	11-13	3/4
1/2	3/4	30-35	11-13	7/8
5/8	7/8	30-35	18-21	1 1/16
3/4	1 1/16	30-35	22-28	1 1/4

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

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

DEPRESSURIZING THE SYSTEM-ALL

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

2. With both valves on manifold gauge set J 5725-01 closed (clockwise), attach manifold to P.O.A. valve and compressor, using J 5420 Schrader valve adapter at suction gauge fitting and J 6163 Schrader valve adapter at discharge gauge fitting.

3. Crack open high pressure valve on manifold gauge set to allow slow escape of refrigerant from system through the manifold gauge set and out center fitting and hose. (Place end of hose in clean container.). If oil drips from hose into the container, refrigerant is escaping too rapidly.

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

EVACUATING THE SYSTEM

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

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

PREPARATIONS FOR EVACUATING COMPLETE SYSTEM

1. Check the low pressure gauge for proper calibration, with the gauge disconnected from the refrigeration system. Be sure that the pointer on the guage indicates to the center of O. Tap gauge a few times lightly to be sure pointer is not sticking. If necessary, calibrate as follows:

a. Remove cover from gauge.

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

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

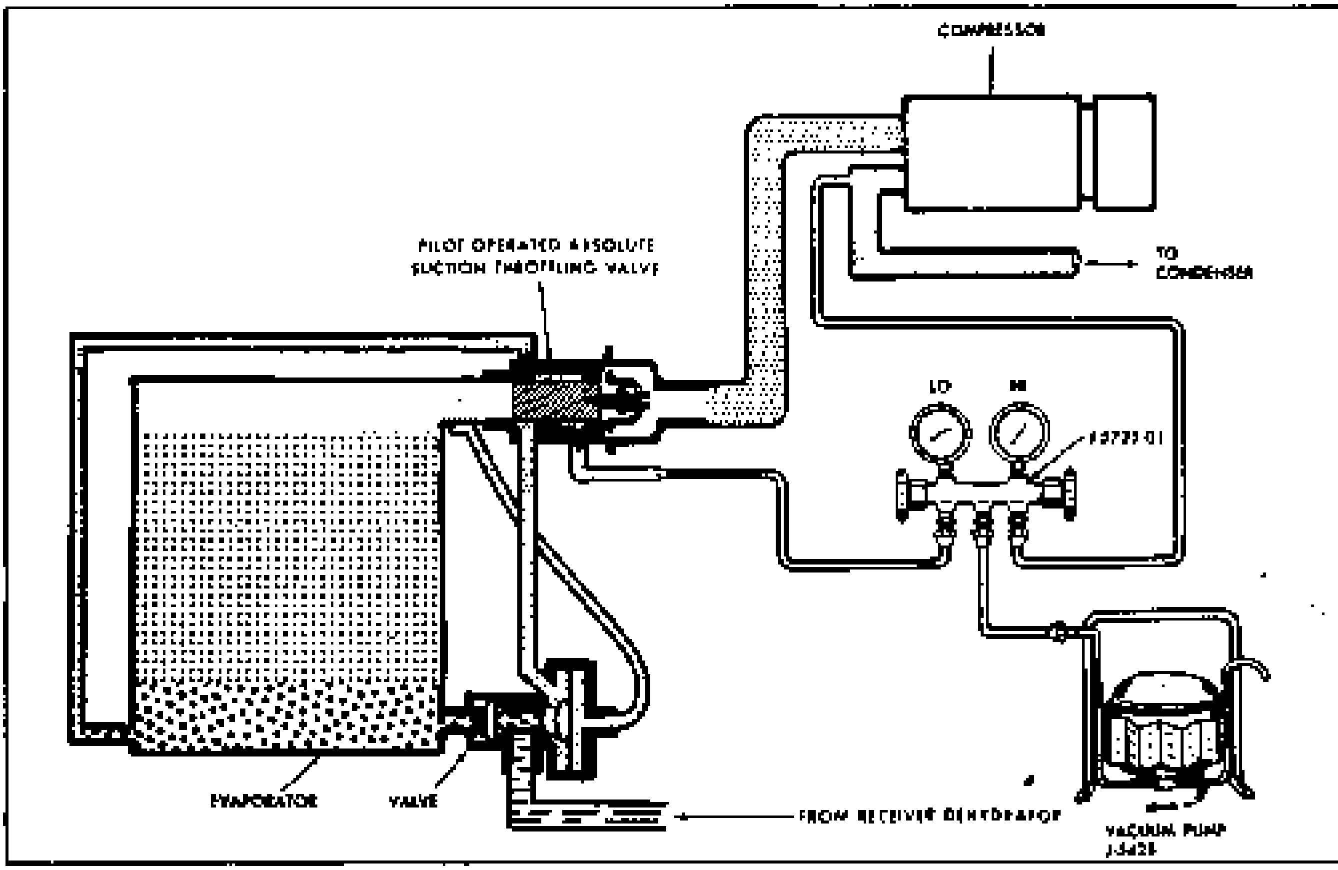


Fig. 1A-2 Schematic - Evacuating Refrigerant System

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

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

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

d. Attach Schrader valve adapter J 6163 to end of hose from high pressure guage and connect this adapter fitted hose to discharge gauge fitting.

3. Attach a flexible gauge hose to center fitting of the gauge set and attach the other end of this hose to the vacuum pump J 5428 or J 5428-01 (Fig. 1A-2).

4. The system can now be evacuated.

EVACUATING COMPLETE SYSTEM

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

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

3. Check oil level in vacuum pump and add Frigidaire 150 viscosity oil or equivalent, if necessary, to bring to proper level. Make sure dust cap on discharge side of vacuum pump has been removed.

4. Start the vacuum pump and slowly open low and high pressure sides of manifold gauge set to avoid forcing oil out of refrigeration system and the pump. Pressure is now being reduced on both sides of refrigeration system.

NOTE: If oil is blown from vacuum pump, it should be refilled to the proper level with Frigidaire 150 viscosity oil or equivalent.

5. Observe low pressure gauge and operate vacuum pump until gauge shows 26-28" vacuum. Continue to run pump for ten additional minutes.

NOTE: In all evacuating procedures specification of 26-28 inches of vacuum is used. This evacuation can only be attained at or near sea level. For each 1000 feet above sea level where this operation is being performed, specification should be lowered by one inch of mercury vacuum. For example; at 5000 feet elevation only 21 to 23 inches of vacuum can normally be obtained. If vacuum cannot be pulled to the minimum specification for the respective altitude, it indicates a leak in the system, gauge connections or a defective vacuum pump. In this case, it will be necessary to check for leaks as outlined below, after a small amount of Refrigerant-12 has been added to the low side of the system.

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

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

NOTE: It may be necessary to use reducer J 5462-4 with washer J 5462-9 to attach flexible hose to refrigerant drum.

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

d. Open suction valve on gauge set. This will allow refrigerant to pass from the drum into the system. When pressure stops rising, close suction valve on gauge set and valve at refrigerant drum (as refrigerant drum is at room temperature, only a small refrigerant charge will enter the system).

e. Using leak detector J 6084, check all fittings in the system, compressor shaft seal and on gauge set for evidence of leakage. When general area of leak has been found with the test torch, a liquid leak detector may be helpful in locating the exact point of leakage. After leak has been corrected, evacuate the system again.

6. Turn the hand shut-off valves at the low and high pressure gauge of the gauge set to the full clockwise position with the vacuum pump operating, then stop pump. Carefully check low pressure gauge to see that vacuum remains constant. If vacuum reduces, it indicates a leak in the system or gauge connections. See NOTE in step 5 above for method of locating leak.

CHARGING THE SYSTEM

The system should be charged only after being evacuated as outlined in EVACUATING THE SYSTEM

REFRIGERANT DRUM METHOD

1. Connect center flexible line of gauge set to refrigerant drum.

NOTE: It may be necessary to use reducer J 5462-4 with washer J 5462-3 and fitting J 5462-9 to attach flexible line to refrigerant drum.

2. Place refrigerant drum in a pail of water which has been heated to a maximum of 125°F.

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

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

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

4. If line at center gauge fitting has not been purged of air, loosen line at center fitting on gauge set and crack valve on refrigerant drum to blow air from line. Retighten line at center fitting and record exact weight of refrigerant tank in water on the scales.

5. Open valve on refrigerant drum and both valves on gauge set to allow refrigerant to flow into system. Continue charging until the scales show that 4 1/8 pounds of refrigerant have been transferred from refrigerant drum to system for Pontiac or Tempest. THE FREON CHARGE FOR THE FIREBIRD CUSTOM AIR CONDITIONING SYSTEM IS 3 3/4 LBS.

NOTE: If full charge cannot be obtained, close both valves on gauge set, start engine, and turn temperature control knob to full cold position with NORMAL or A/C button depressed. Open low pressure valve on gauge set slowly and leave open until full charge is added.

CAUTION: Observe high pressure gauge while charging with compressor running. Shut off engine if pressure exceeds 375 psi. A large fan placed in front of the car will help reduce excessively high head pressure.

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

NOTE: If the engine was used to complete the Refrigerant-12 charge into the system, close valve on refrigerant drum to permit compressor to draw any refrigerant left in the line from the drum to the center fitting of the gauge set, then close the low pressure valve on the gauge set.

7. Operate engine at 2000 rpm with temperature control knob at full cold position and blower control for high speed with NORMAL or A/C button depressed. After ten minutes of operation, observe appearance of refrigerant in receiver-dehydrator. If

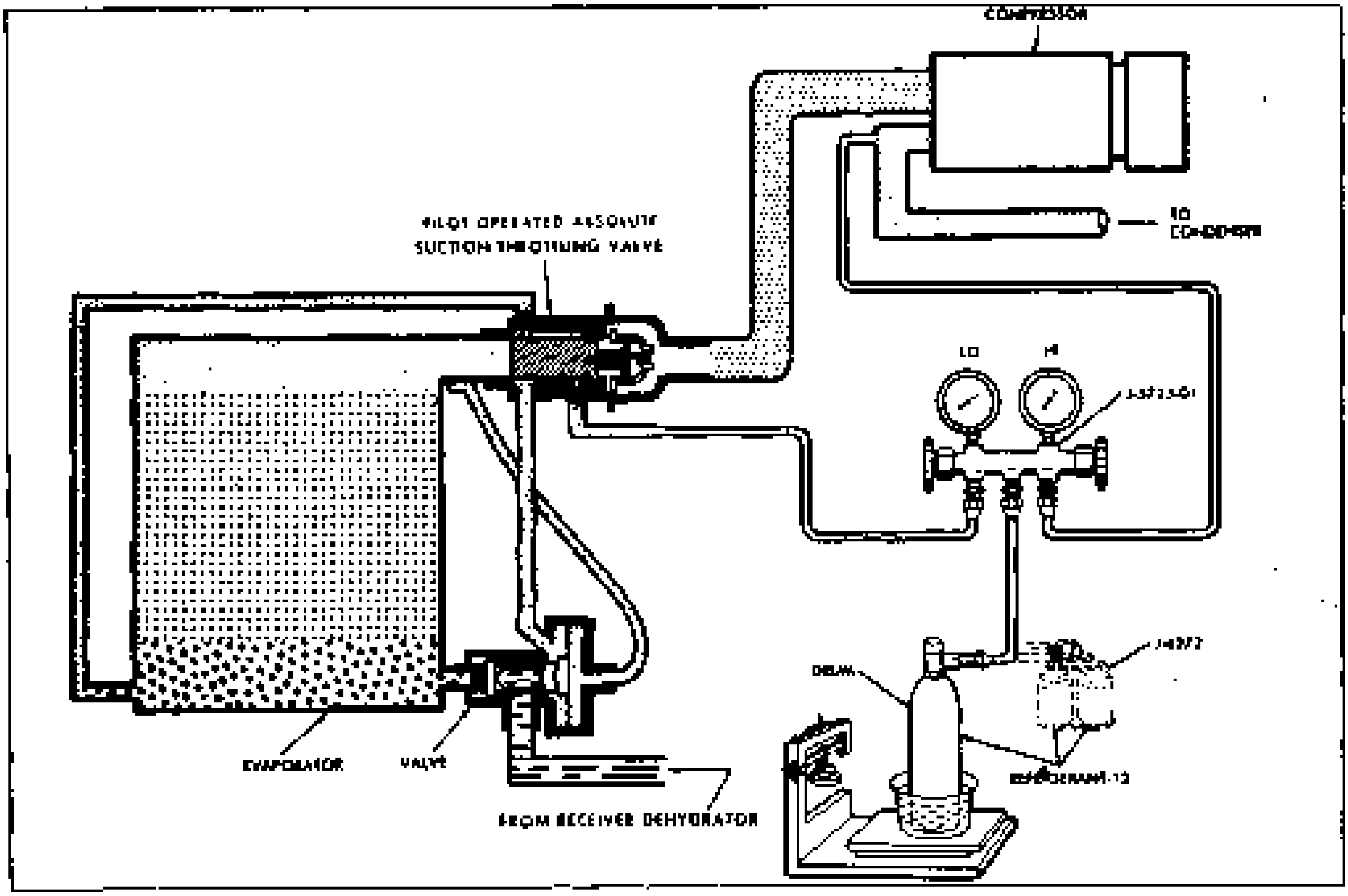


fig. 1A-3 Schematic - Charging Refrigeration System

bubbles are observed, open low pressure gauge valve and valve on refrigerant drum to allow more refrigerant to enter system. Close valve when receiver-dehydrator clears up.

NOTE: If air inlet temperature is below 70°F. when this check is made, bubbles may appear even though the proper amount of refrigerant is in the system. Air inlet temperature must be 70°F. or above to make an accurate check.

8. When refrigerant has been installed, continue to operate system and test for proper operation as outlined under OPERATION TEST

9. When satisfied that air conditioning system is operating properly, stop engine, remove gauge set and replace protective caps on P.O.A. valve and compressor fittings.

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

10. Using leak detector J 6085, check complete system for leaks, as explained under LEAK DETECTORS.

REFRIGERANT-12 DISPOSABLE CAN METHOD

After having depressurized, repaired (if necessary), and evacuated the refrigerant system, the system may be charged as follows when using Refrigerant-12 disposable cans:

1. Obtain four (for Firebird) or five (for Pontiac or Tempest) "one" pound cans of Refrigerant-12.

2. Mount three cans in J 6272 No. 3 Multi-opener or attach J 6271 Fitz-All valve (single can opener valve) on one can.

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

a. If the J 6272 No. 3 Multi-opener is used, raise locking lever, position three cans of refrigerant and force locking lever down to secure cans and at same time puncture top of can to make it ready for charging.

b. If the J 6271 Fitz-All valve is used, back off the valve from the can top retainer, slip the valve onto the can and turn the valve into retainer until tight. DO NOT open outlet valve during this operation as turning the valve into the retainer punctures top of can to make it ready for charging.

3. Connect center flexible line of gauge set to fitting on a can opener valve.

NOTE: If line at center gauge fitting has not been purged of air, loosen line at center fitting on gauge set and "crack" valve at can opener (for a second or two) to force air from the line. Retighten line at center fitting.

4. Open valve on No. 3 Multi-opener (or on single can) and also low pressure and high pressure valves on manifold gauge set. Leave can valve open until all refrigerant has entered the refrigeration system. Close valve on can.

a. If the system is charged using single cans and the J 6271 valve, disconnect valve from can, leaving valve closed to flexible line to the center fitting of the manifold gauge set. Install valve on a new and full disposable can of Refrigerant-12, and repeat until four and-one-third one pound cans of refrigerant have been used to charge system.

Actual net weight of refrigerant is 15 ozs. per can, therefore it will be necessary to use four and one-third cans for Pontiac or Tempest, four cans for Firebird.

b. If system is charged using the 3 can Multi-opener, J 6272, close the valve of opener after all cans are empty. Release the locking lever and discard the three empty cans. If this tool will be used to complete the charge with additional cans to bring the required refrigerant charge, then leave two of the cans emptied in position, locate the one full can and lock the lever into place. (These empty cans balance the assembly and prevent the loss of refrigerant out the open "series" passage.)

NOTE: Align the pierced hole in the empty can with the punch in the cover of the tool. If the J 6271 Fitz-All valve for single cans is available, complete charging as explained in 4a above.

5. Close valves on manifold gauge set.

6. Operate engine at 2000 rpm with temperature control knob at full cold position and blower control for high speed in A/C mode.

NOTE: If air inlet temperature at the condenser is below 70°F. when this check is made, bubbles may appear even though the proper amount of refrigerant is in the system. Air inlet temperature must be 70°F. or above to make an accurate check.

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

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

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

9. Using leak detector J 6084, check complete system for leaks as explained under LEAK DETECTORS.

SERVICE STATION METHOD

INSTALLING J 8393

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

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

3. Connect high pressure gauge line (with J 6163 attached) to compressor high pressure gauge fitting.

4. Turn high pressure hand shut-off valve one turn clockwise, and high pressure control (2) one turn counterclockwise (open). Crack open low pressure control (1) and allow refrigerant gas to hiss from low pressure gauge line for three seconds, then connect low pressure gauge line to low pressure gauge fitting on P.O.A. valve. (Place J 6163 adapter on hose, then attach adapter to gauge fitting.)

FILLING CHARGING CYLINDER

1. Open control valve on refrigerant container.

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

3. Bleed charging cylinder to valve (behind control panel) only as required to allow refrigerant to enter cylinder. When refrigerant reaches desired charge level (4 1/8 or 3 3/4), close valve at bottom of charging cylinder and be certain cylinder bleed valve is closed securely.

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

CHARGING THE SYSTEM USING J 8393

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

2. Crack open high (No. 2) and low (No. 1) pressure control valves on station, and allow refrigerant gas to purge from system. Purge slowly enough so that oil does not escape from system along with refrigerant.

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

4. Turn on vacuum pump and open vacuum control valve (no. 3).

5. With system purged as above, run pump until 26-28 inches of vacuum is obtained. Continue to run pump for 15 minutes after the system reaches 26-28 inches vacuum.

NOTE: In all evacuating procedures, the specification of 26-28 inches of mercury vacuum is used. These figures are only attainable at or near sea level. For each 1000 feet above sea level where this operation is being performed, the specifications should be lowered by 1 inch. Example: at 5000 ft. elevation, only 21 to 23 inches vacuum can normally be obtained.

6. If 26-28 inches vacuum (corrected to sea level) cannot be obtained, close vacuum control valve (No. 3) and shut off vacuum pump. Open refrigerant control valve (No. 4) and allow some refrigerant to enter system. Locate and repair all leaks.

7. After evacuating for 15 minutes, add 1/2 pound of refrigerant to system as described in step 6 above. Purge this 1/2 pound and re-evacuate for 15 minutes. This second evacuation is to be certain that as much contamination is removed from the system as possible.

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

9. Close low pressure valve on charging station. Fully open station refrigerant control valve (No. 4) and allow all liquid refrigerant to enter system. When full charge of refrigerant has entered system turn off refrigerant control valve (No. 4) and close both hand shut-off valves.

10. If full charge of refrigerant will not enter system, close high pressure control and refrigerant control valves. Start engine and run at slow idle with compressor operating. Crack refrigerant control valve (No. 4) and low pressure control on station. Watch low side gauge and keep gauge below 50 psi by regulating refrigerant control valve. Closing valve will lower pressure. This is to prevent liquid refrigerant from reaching the compressor while the compressor is operating. When required charge has entered system, close refrigerant control valve and close low pressure control.

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

ADDING REFRIGERANT-12

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

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

1. Remove caps from P.O.A. valve and compressor gauge fittings. Attach gauge set to gauge fittings, making sure Schrader adapter J 5420 is between low pressure gauge hose and suction gauge fitting, and J 6163 is between high pressure gauge hose and discharge gauge fitting.

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

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

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

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

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

5. Partially charge system.

REFRIGERANT-12 DRUM METHOD

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

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

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

REFRIGERANT-12 DISPOSABLE CAN METHOD (15 OZ. PER CAN).

a. Make sure the outlet valve on the J 6271 Fitz-All valve is fully clockwise and attach the J 6271 to a "one pound" can of refrigerant as follows- back off the valve from the top of the retainer, slip the valve onto the can and turn the valve into the retainer until tight. DO NOT accidentally open outlet valve during this operation as turning the valve into the retainer punctures the top of the can to make it ready for charging.

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

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

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

e. Add an additional one pound of refrigerant by adding refrigerant from the can just weighed until can is empty. Attach another can and add refrigerant until can and valve assembly weigh the same as recorded.

6. Close valves at refrigerant drum or can.

7. Test for leaks and make operational check of system as outlined unde OPERATIONAL TEST.

CHECKING COMPRESSOR OIL LEVEL AND ADDING OIL

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

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

NOTE: The oil level in the compressor should not be checked as a matter of course, such as is done in the car engine crankcase.

In general, the compressor oil level should be questioned only in cases where there is evidence of a major loss of system oil such as:

a. Broken hose or severe hose fitting leak.

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

c. Collision damage to refrigeration system components.

REPLACING REFRIGERATION SYSTEM COMPONENTS OTHER THAN COMPRESSOR

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

1. Evaporator - 3 fluid ozs.

2. Condenser - 1 fluid oz.

3. Receiver - 1 fluid oz.

4. No oil for P.O.A., expansion valves or hoses.

When refrigerant system components other than the compressor are replaced and there are signs of abundant oil leakage, the compressor must also be removed and oil drained from the compressor. The amount of oil to put back into the compressor is found as follows: DO NOT add any more oil than is necessary, or maximum cooling will be reduced.

1. Remove the compressor and place in a horizontal position with the compressor drain plug downward, drain compressor in an empty graduated bottle, measure the amount of oil and discard this oil.

2. If the quantity of oil measured is more than 4 fluid ozs., replace into the compressor the same amount of clean oil as the oil drained, plus the following amount for the refrigeration system component being changed.

a. Evaporator-3 fluid ozs.

b. Condenser-1 fluid oz.

c. Receiver-dehydrator assembly-1 fluid oz.

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

3. If the oil quantity drained from the compressor is

less than 4 ozs., replace into the compressor 6 fluid ozs. of clean oil, plus the amount shown above for the respective component replacements.

4. Replace compressor and system components.

5. Evacuate, charge and perform operational test.

REMOVING AND INSTALLING COMPRESSOR

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

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

INSTALLING COMPRESSOR

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

1. Compressor replaced with new compressor.

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

b. Drain oil from replacement compressor and save it.

c. (1) If amount of oil drained in 'a' is more than 4 ozs., place into the new compressor the same amount of oil drained from the replaced compressor.

(2) If amount of oil drained in 'a' is 4 ozs. or less, place 6 ozs. of oil in the replacement compressor.

d. Install compressor.

2. Compressor replaced with a field repaired (overhauled) compressor.

a. Proceed as in section 1 above, and then add one extra oz. of oil. (More oil is retained in a drained compressor than one that has been rebuilt.)

REPLACING AN INOPERATIVE COMPRESSOR

In the case when it is not possible to idle the compresser to be replaced to effect oil return to it, the following will apply. (DO NOT add any more oil than is necessary or maximum cooling will be reduced.)

1. Remove compressor from car, drain and measure the oil.

2. If amount drained in "1" above is more than 1-1/2 fluid ozs. SUBTRACT this amount drained from the original oil charge of 11 ozs. to obtain "oil loss". Take new compressor assembly and drain from it the amount of "oil loss" above; (provided the refrigeration system shows no evidence of a major leak, indicating that little or no oil has been lost from the system. Minor leak indicating very slow leakage.)

3. If the amount drained in "1" above is less than 1 1/2 ozs. of oil and/or system appears to have lost an excessive amount of oil then:

a. Disconnect the expansion valve outlet connection (evaporator inlet).

b. Plug suction line connection at P.O.A. valve outlet.

c. Disconnect oil bleed line at P.O.A. valve, using care not to damage line.

d. Connect a cylinder of Refrigerant-12 regulated to not exceed 125 psi to this oil bleed fitting to force any retained oil from the evaporator out the evaporactor inlet fitting. (Reverse flush the evaporator.) Catch any oil reverse flushed in this manner. If oil flushed from the system appears clean, install new compressor with 6-7 ounces of oil.

4. If oil drained in "1" above contains any foreign material such as chips, or there is evidence of moisture in the system, replace the receiver-dehydrator assembly and flush all component parts, or replace if necessary. After flushing refrigeration system in this manner, the full oil charge should be left in the new service compressor (11 ozs.) installed in an overhauled or repaired compressor.

COMPRESSOR REMOVAL

1. Connect the high and low pressure gauge lines from the gauge set to the respective connections on the P.O.A. valve and old compressor on the car. Be sure valves on gauge set are fully clockwise to close gauge set to center fitting, that a J 5420 or J 6163 Schrader adapter is between low pressure hose and suction gauge fitting, and also at the discharge gauge fitting.

2. Remove the flare nut from center connection on gauge manifold or the plug in the gauge line attached to the center connection. Wrap the line at the outlet with a cloth to protect persons and car surfaces from oil or regrigerant.

3. Slowly depressurize refrigeration system.

4. While system is depressurizing, remove clutch assembly and coil from old compressor as outlined under COMPRESSOR CLUTCH, COIL AND SEAL REPLACEMENT. If parts are not oil soaked and are in good condition, lay them aside on a clean surface as they may be installed on the new compressor.

5. After the system is completely depressurized, very slowly loosen screw which retains compressor fittings assembly to compressor. As screw is being loosened, work fittings assembly back and forth to break seal and carefully bleed off any remaining pressure.

CAUTION: High pressure may still exist at the discharge fitting. If this pressure is released too rapidly, there will be a considerable discharge of refrigerant and oil.

6. When all pressure has been relieved, remove screw and remove fittings assembly and O-ring seals.

7. Immediately cover compressor openings. A simple way is with a plate (similar to the one on new compressor) which can be attached with fittings assembly screw, using the O-rings to provide a seal.

8. Disconnect compressor clutch coil wire and remove compressor mounting plates to bracket bolts, front and rear.

9. If there is any possibility that broken parts from the compressor got into the discharge line or the condenser, all refrigeration system parts should be cleaned and a new receiver-dehydrator assembly should be installed.

10. Drain all oil from compressor just removed in a clean dry container and replace compressor drain plug screw. Measure amount of oil drained. See CHECKING COMPRESSOR OIL LEVEL AND ADDING OIL.

COMPRESSOR REPLACEMENT

NOTE: Before installing a new compressor, rotate compressor shaft four or five times. This permits proper lubrication of compressor seal over all its surface. Before compressor clutch is mounted to the new compressor, wipe the front face of the compressor thoroughly with a clean dry cloth and, if necessary, clean front of compressor with a solvent to remove any excess oil. Cleaning compressor in this manner will prevent any oil from being thrown onto the clutch surfaces which would cause slippage and eventual clutch failure.

1. Stamp refrigerant charge of refrigerant system on new compressor in space on plate provided for this information.

NOTE: Follow procedure for replacing oil in new compressor explained under REMOVING AND INSTALLING COMPRESSOR.

2. Install new compressor on car, leaving compressor fittings opening cover plate on compressor.

3. Remove cover plate over compressor openings very slowly to bleed off pressure

CAUTION: New compressors are charged with a mixture of nitrogen, Refrigerant-12 and 11 fluid ozs. of Frigidaire 525 viscosity oil, or equivalent. If the cover is removed too rapidly, the oil will be blown out violently with the sudden release of pressure.

4. Install coil and clutch parts if not already installed.

5. Evacuate, charge and perform OPERATIONAL TEST.

COMPRESSOR HUB AND DRIVE PLATE ASSEMBLY

REMOVE AND REPLACE

REMOVE

1. Hold the clutch hub with J 9403 wrench and using J 9399 (special thin wall 9/16" socket), remove hub and drive plate assembly lock nut from shaft (Fig. 1A-4).

2. Remove hub and drive plate assembly retainer ring, using J 5403 (No. 21 Truarc pliers). Remove spacer (Fig. 1A-5).

3. Screw threaded hub puller J 9401 into the hub. Holding body of tool with a wrench, tighten the center screw to remove hub and drive plate assembly (Fig. 1A-6). Remove J 9401 puller.

4. Remove hub and drive plate assembly key from shaft.

REPLACE

1. Insert square drive key into shaft so it projects approximately 3/16" out of end of keyway (Fig. 1A-7). Wedge into keyway with blunt tool.

2. Line up key in hub with keyway in shaft.

CAUTION: To avoid internal damage to the compressor, DO NOT drive or pound on hub of drive plate assembly or on end of shaft. If proper tools to remove and replace clutch parts are not used, it is possible to disturb the position of swash plate (keyed to main shaft) and result in compressor damage.

3. Position hub and drive plate assembly into compressor front end casting.

4. Place J 9480-2 "free" spacer on hub and drive plate assembly and screw J 9480 drive plate, installing tool on threaded end of compressor shaft approximately

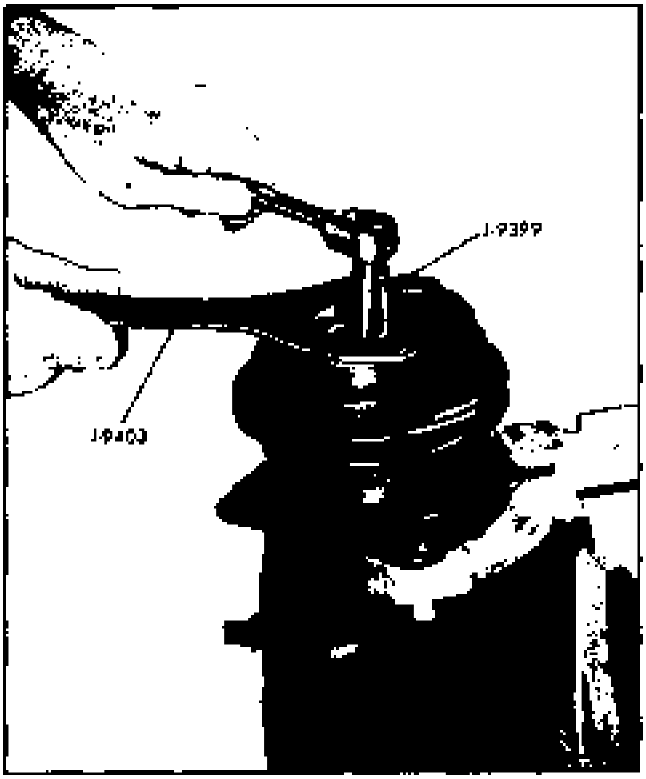


Fig. 1A-4 Removing Hub and Drive Plate Lock Nut

three full turns (to prevent tool from forcing key out of keyway).

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

5. Using wrench on end of tool body and another wrench on hex nut, tighten nut to press hub of drive plate assembly onto shaft approximately 1/4".

6. Remove tool and lock into armature plate hub to make certain key remains in place.

7. Install J 9480 and press until there is approximately .031"-.057" (1/32"-1/16") space between the frictional faces on pulley and drive plate (Fig. 1A-8).

8. Remove J 9480 assembly.

9. Install hub spacer washer.

10. Install hub and drive plate assembly retainer ring with flat side of ring facing spacer, using J 5403 (No. 21 Truarc pliers). J 9399 can be used to "snap" retainer ring in place.

11. Install a new armature plate and hub lock nut, using J 9399 (special thin wall 9/16" socket). Tighten to 15 lb. ft. torque. The air gap between the friction faces of pulley and drive plate should now be between .002" to .057" (1/32" to 1/16") clearance.

12. Operate engine and refrigeration system with

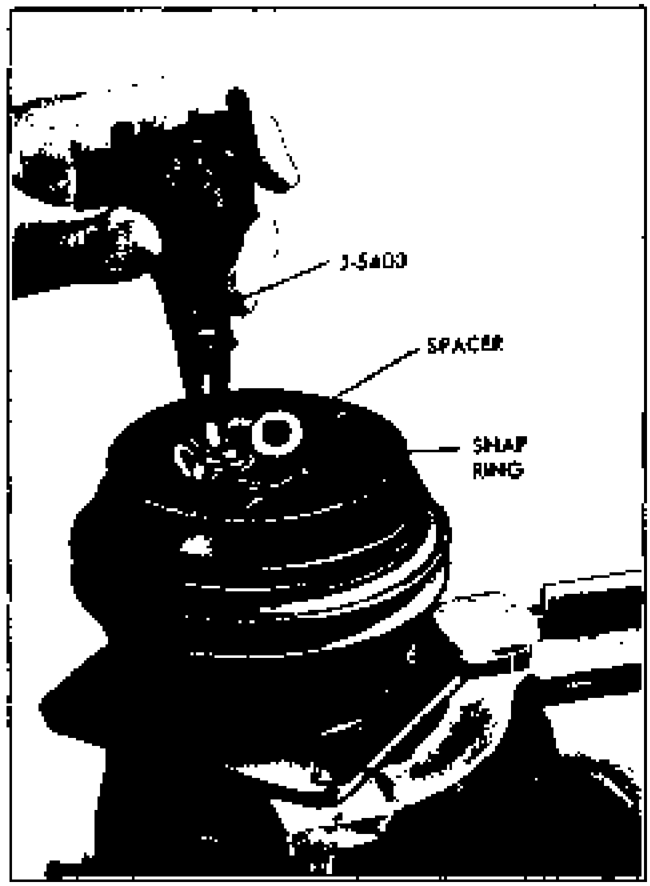


Fig. 1A-5 Removing Hub Retainer Ring and Spacer

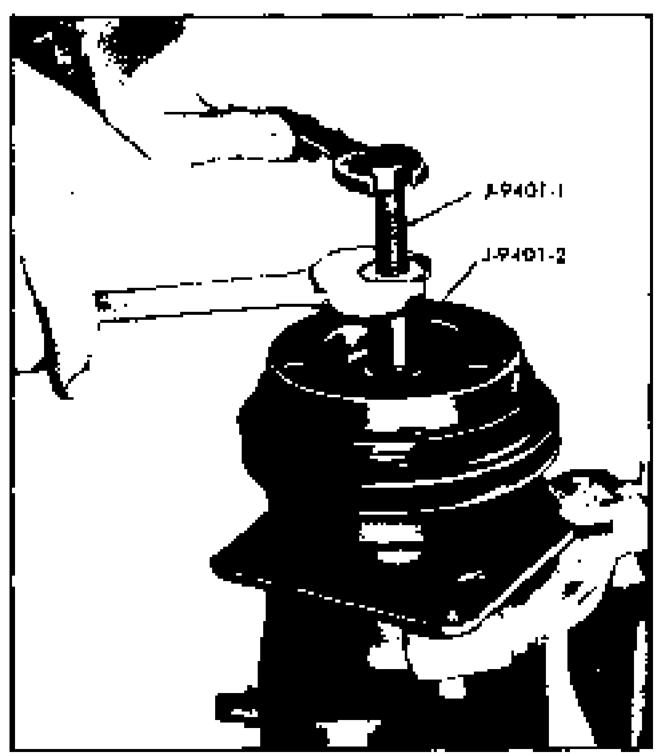


Fig. 1A-6 Removing Hub Retainer and Spacer

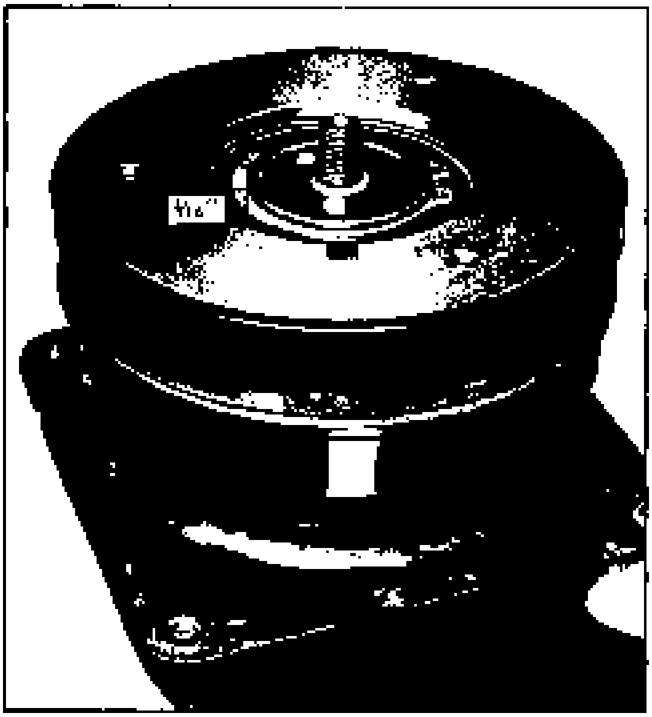


Fig. 1A-7 Proper Position of Hub and Drive Key

suction pressure of at least 30 psig and discharge pressure at least 150 psig. Cycle clutch (by turning air conditioning off and on) at least twenty times at approximately one-second intervals to "seat" or "run-in" mating parts of clutch.

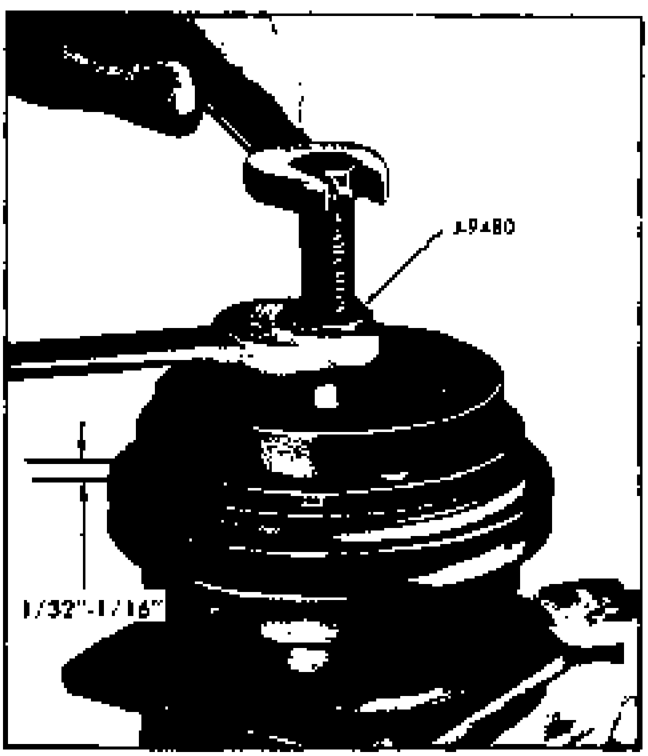


Fig. 1A-8 Installing Hub and Drive Plate Assembly

Fig. 1A-9 Removing Pulley and Bearing Assembly Retainer Ring

COMPRESSOR PULLEY AND/OR BEARING ASSEMBLY

REMOVE AND REPLACE PONTIAC, TEMPEST, FIREBIRD OR GRAND PRIX

REMOVE

1. Remove hub and drive plate assembly

2. Remove pulley assembly retainer ring, using J 6435 (No. 26 Truarc pliers) (Fig. 1A-9).

3. Place J 9395 puller pilot over compressor shaft and remove pulley assembly, using J 8433 pulley puller.

4. Remove puller and J 9395 puller pilot.

5. Remove pulley bearing wire retainer ring with an awl or a small screwdriver (Fig. 1A-10)

6. Remove ball bearing assembly, using J 8849 and J 8092 handle to press out bearing.

REPLACE

If the existing pulley and drive plate and hub assembly are to be reused, clean the drive faces on each part with alcohol or similar solvent. If these parts show evidence of warpage due to overheating, they should be replaced.

1. When replacing a new ball bearing assembly into pulley, use J 9481 pulley bearing installer (Fig. 1A-11).

2. Replace the pulley assembly wire retainer ring in pulley.

3. Press or tap pulley and bearing assembly on the neck of the compressor, using J 9481 (Fig. 1A-12).

4. The pulley should rotate freely.

5. Install pulley snap ring retainer, using J 6435 (No 26 Truarc pliers). Assure installation of snap ring by tapping with J 9481

6. Replace hub and drive plate assembly, making sure to use the proper tools to replace this assembly. DO NOT drive or pound on hub assembly.

COMPRESSOR CLUTCH COIL AND HOUSING ASSEMBLY

ALL - REMOVE AND REPLACE -

REMOVE

1. Remove hub and drive plate assembly

2. Remove pulley and bearing assembly

3. Remove electrical connection plug from terminals on coil.

4. Note position of electrical terminals and scribe location of coil housing terminals on compressor body.

5. Use J 6435 (No. 26 Truarc pliers) and remove coil housing retainer ring (Fig. 1A-13).

6. Remove coil housing assembly.

REPLACE

1. Position clutch coil on compressor front head casting so electrical terminals are in their proper location as previously scribed on compressor body.

NOTE: Make certain coil is properly seated on dowels.

2. Replace the coil retainer ring with flat side of ring facing coil, using J 6435 (No. 26 Truarc pliers).

3. Connect electrical connection.

4. Replace pulley and bearing assembly

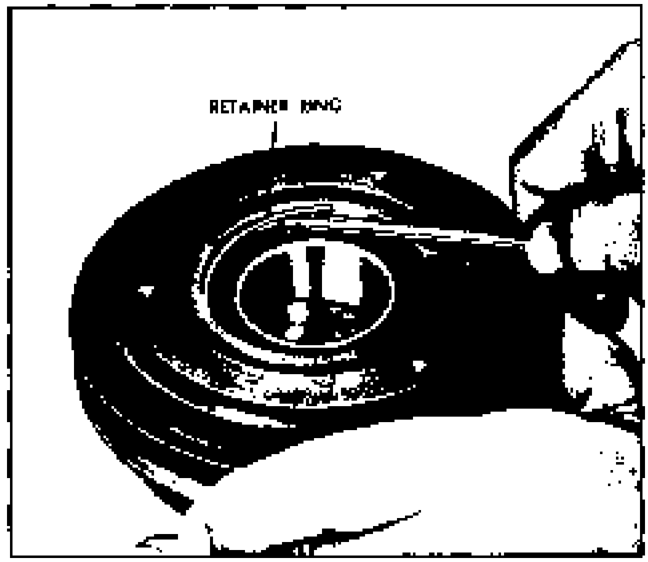


Fig. 1A-10 Removing Pulley Bearing Retainer Ring

5. Replace hub and drive plate assembly, making sure the proper tools are used to replace this assembly. DO NOT drive or pound on hub assembly.

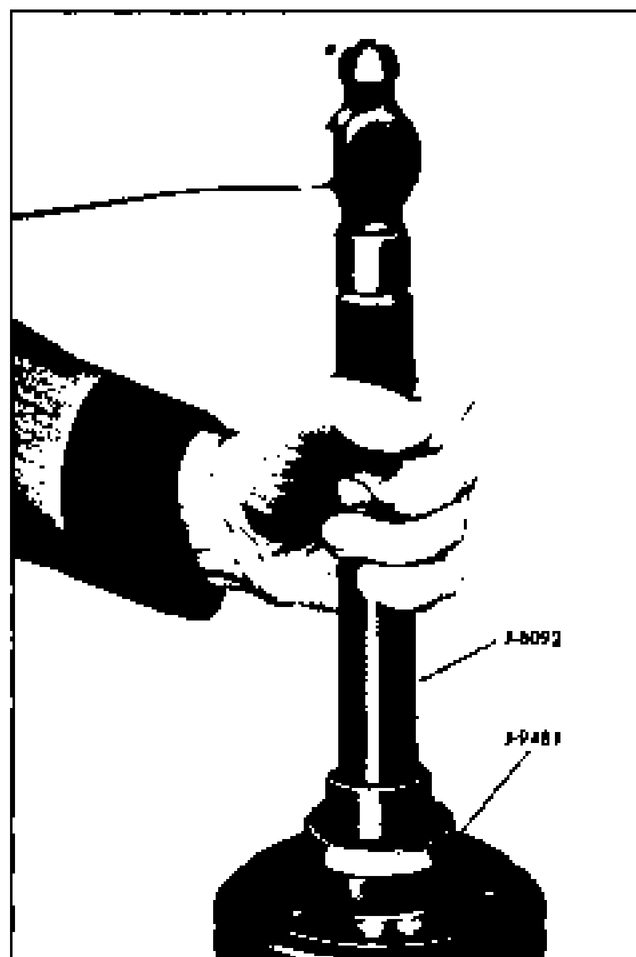


Fig. 1A-11 Installing Pulley Bearing

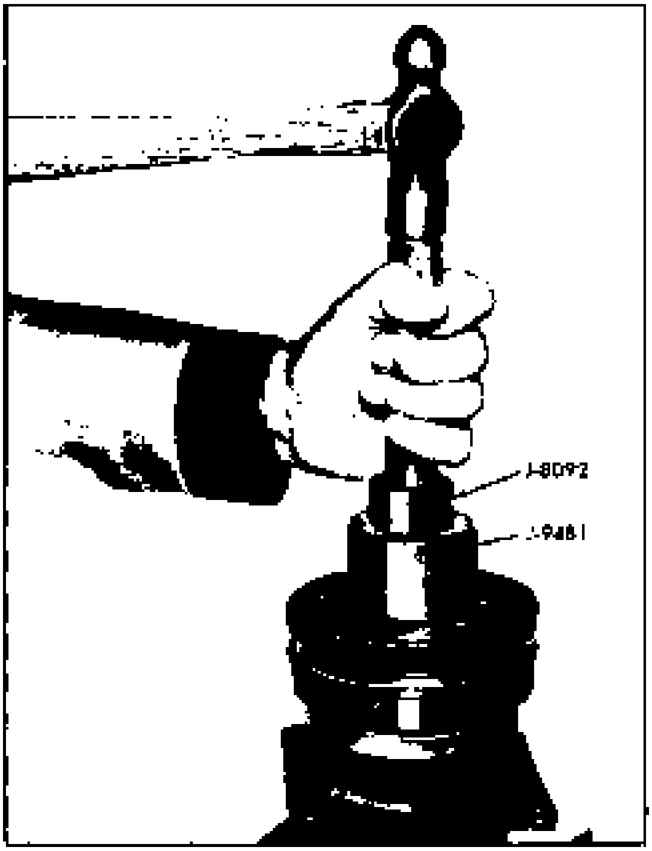


Fig. 1A-12 Installing Pulley Bearing

REMOVE COMPRESSOR ASSEMBLY TO SERVICE ENGINE-PONTIAC AND TEMPEST

1. Disconnect compressor clutch coil ground wire at compressor and wire connector at coil.

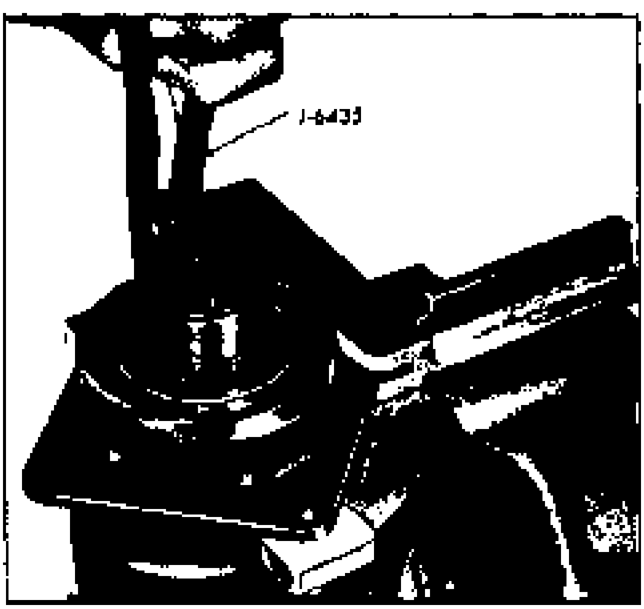


Fig. 1A-13 Removing Coil Housing Retainer Ring

2. Remove compressor drive belt.

3. Remove compressor rear brace to cylinder head brace bolt at compressor mounting bracket.

4. Remove compressor front plate to mounting bracket upper bolts and lower adjusting bolt.

5. Remove compressor rear plate to mounting bracket lower adjusting bolt.

6. Pad fender and fender skirt and place compressor near top of fender skirt, securing compressor to right fender brace (with wire, rope or similar means).

CAUTION: Do not kink any hoses or place excessive tension on the hose.

7. Replace by reversing the above procedure.

8. Tighten compressor belt to give 100-105 lbs. indicated on the Burroughs Belt Tension Gauge, or equivalent.

COMPRESSOR SHAFT SEAL ASSEMBLY

ALL - REMOVE AND REPLACE

NOTE: When refrigeration system components other than the compressor are replaced, the compressor must be removed and oil drained from the compressor if oil was sprayed in large amounts due to leaks or broken shaft seal. See CHECKING COMPRESSOR OIL LEVEL AND ADDING OIL.

NOTE: Compressor shaft seals, other than those replaced during a compressor overhaul, are to be replaced only on the basis of actual refrigerant leakage as determined by test with a propane torch type leak detector in good condition.

REMOVE

1. Depressurize refrigeration system.

2. Remove hub and drive plate assembly, and shaft key.

3. If the compressor has an absorbent sleeve in neck, pry out sleeve retainer and remove sleeve.

4. Remove shaft seal seat retaining ring, using J 5403 (No. 21 Truarc pliers) (Fig. 1A-14).

5. Thoroughly clean the inside of compressor neck area surrounding shaft, exposed portion of seal seat, and shaft itself. This is absolutely necessary to prevent any dirt or foreign material from getting into compressor.

6. Remove shaft seal seat, using J 9393-1 and -2 to grasp flange on seal seat (Fig. 1A-15). Pull straight out at end of tool to remove seal seat.

7. Engage tabs on shaft seal assembly with locking

tangs on J 9392 seal installer and remover. Press down on tool and twist clockwise to engage seal. Remove seal assembly by pulling straight out from shaft (Fig. 1A-16).

8. Remove O-ring from interior of compressor neck using J 9553. (A wire with a hook formed on end may be used. This hook may be made in a manner shown in Fig. 1A-17.)

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

REPLACE

1. Coat the new seal seat O-ring with clean refrigeration oil and install it in its groove in the compressor neck. Tool J 21508 may be used.

2. Place seal protector J 22974 over end of the shaft. Coat the O-ring and seal face of the new seal assembly with clean refrigeration oil and install new seal assembly on the shaft, using J 9392.

3. Coat the seal face of the new seal seat with clean refrigeration oil and install the new seal seat, using J 9393-1 and -2. Be sure the seal seat O-ring is not dislodged and seal seat is making a good seal with O ring.

4. Install new seal seat retainer ring, using J 5403 (No. 21 Truarc pliers), with flat face against seal seat. The sleeve from J 9393 may be used to press on retainer ring so that it snaps into place. Remove seal protector J 22974 from the end of shaft.

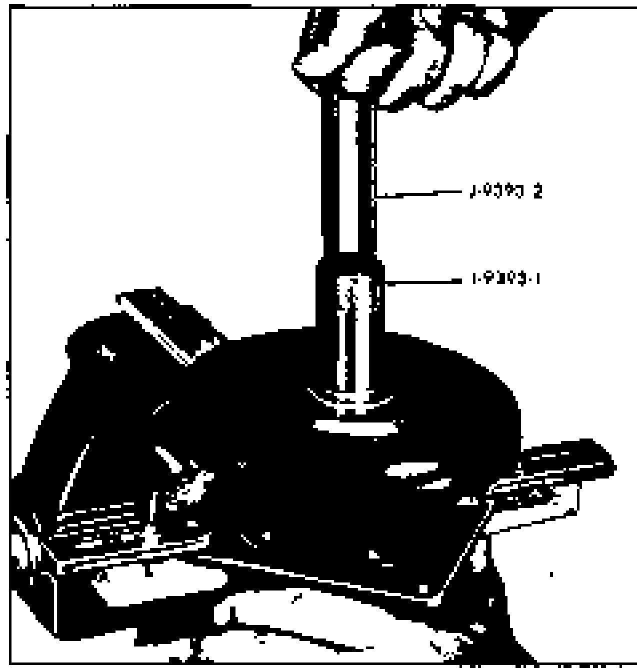


Fig. 1A-15 Removing Shaft Seal Seat

5. Leak test compressor and correct any leaks found.

6. Wipe out any excess oil inside the compressor neck and on the shaft, resulting from installing the new seal parts.

7. Install new absorbent sleeve by rolling the material into a cylinder, overlapping ends, and slipping sleeve into compressor neck with overlap toward the top of compressor. With a small screwdriver or similar

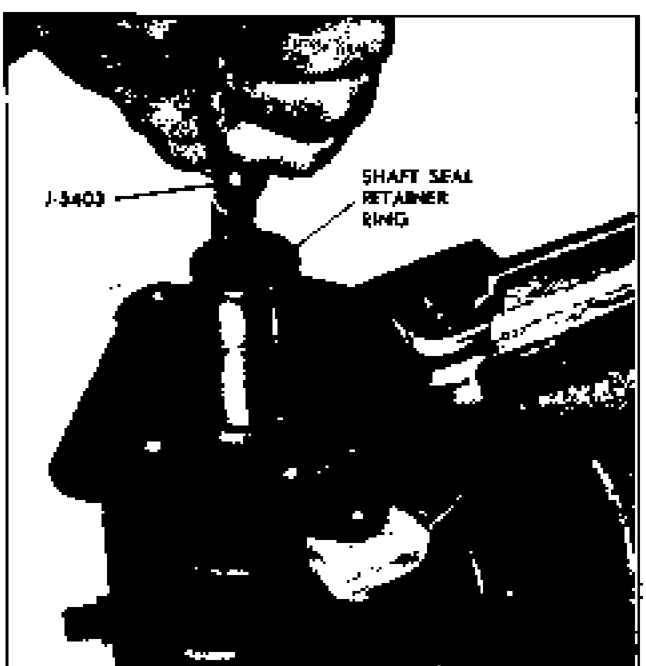


Fig. 1A-14 Removing Shaft Seal Seat Retainer

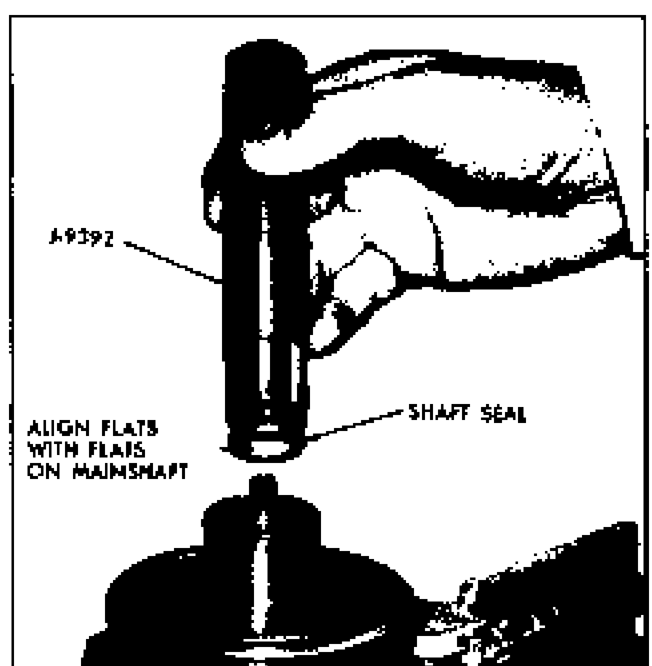


Fig. 1A-16 Removing Shaft Seal Assembly

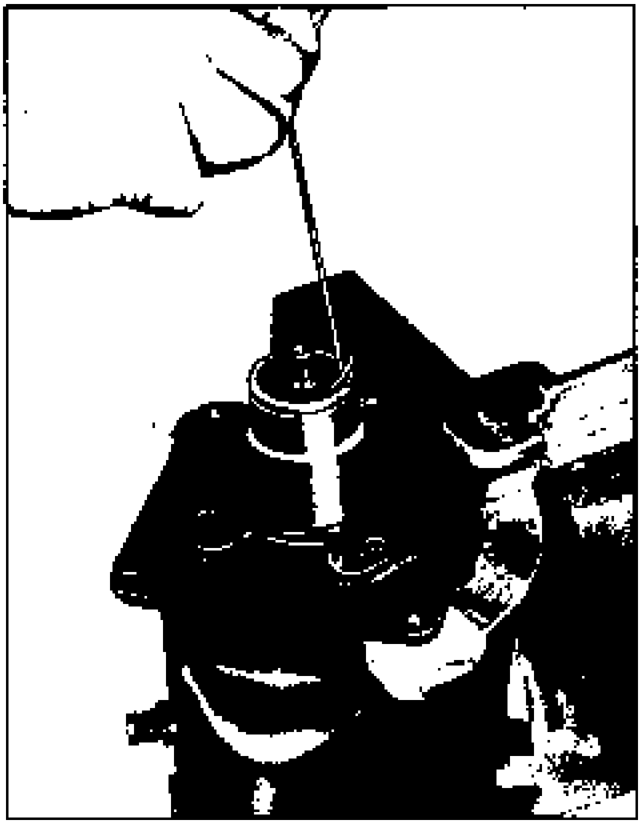


Fig. 1A-17 Removing O-Ring Seal

instrument carefully spread sleeve to remove the overlap so that in the final position the ends of sleeve will butt at top vertical centerline.

8. Position new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Tool J 9395 or the sleeve from J 9393 may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place, until the outer edge of the retainer is recessed approximately 1/32" from the face of the compressor neck.

9. Reinstall the hub and drive plate assembly.

10. Evacuate and charge refrigeration system.

11. Perform operational test.

COMPRESSOR ASSEMBLY-OVERHAUL

These operations are based on the use of recommended service tools and on condition that an adequate stock of service parts to select from is available.

Service parts should include:

1. Standard size piston drive balls.

2. Shoe discs--total of 10 sizes, including ZERO shoe.

3. Thrust races--total of 14 sizes, including the ZERO race.

4. Pistons--both standard head and re-expansion heads.

5. Main shaft-needle bearings.

6. Thrust bearings.

7. Compressor shaft, swash plate and Woodruff key assembly.

8. Service cylinder assembly-front, rear halves, with main bearing in place and halves dowel-pinned together.

9. Major interior mechanism assembly.

10. Suction reed valve-front, rear.

11. Discharge valve assembly-front, rear.

12. Gasket kit--service containing all gaskets, seals, O-rings, etc. This is to be used each time a compressor is rebuilt after a teardown.

13. Shaft seal kit.

14. Nuts-head to shell and shaft.

15. Ring-retainers.

16. Cylinder locator pins.

17. Valve and head locator pins.

18. Service type-discharge crossover tube kit.

A clean work bench, orderliness of the work area and a place for all parts being removed and replaced is of great importance. Any attempt to use makeshift or inadequate equipment may result in damage and/or improper operation of compressor.

PRESERVATION AND PACKING SERVICE PARTS

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

In addition, some parts will be identified on the piece part to denote its size or dimension. This will apply to the piston shoe discs and the shaft thrust races.

To provide suitable and adequate quantities and grouping of parts for servicing the compressor, kits are available which will contain these necessary parts. The gasket kit should be used whenever it is necessary to overhaul or rebuild entire compressor internal mechanism, or when replacing some individual internal part.

OVERHAUL COMPRESSOR

Anytime a major overhaul or rebuilding operation is to be performed on this compressor, obtain and install compressor gasket kit. This kit includes all of the necessary O-rings and gaskets. Obtain also, an ample supply of piston rings.

1. Remove drive plate and hub assembly.

2. Remove pulley and bearing assembly.

3. Remove clutch coil and coil housing assembly.

4. Remove compressor assembly, leaving fittings assembly attached to refrigerant lines. Keep compressor horizontal at all times. Placing the compressor on either end will allow oil from the compressor sump to enter the head.

5. Seal compressor fittings opening and openings in compressor rear head.

6. Thoroughly clean exterior of compressor assembly and blow dry with compressed dry air.

7. Clean compressor assembly on clean, dry work bench.

NOTE: Under NO circumstances should compressor be placed on the pulley end.

COMPRESSOR REAR HEAD ASSEMBLY

REMOVE

1. Remove compressor oil plug, tilt compressor and drain oil into clean dry container. It may be possible to get only 4 to 6 ozs. of oil from the compressor at this time.

2. Attach J 9396 holding fixture to compressor and mount in vise.

3. Remove compressor pressure relief valve.

4. Remove four lock nuts from threaded studs welded to compressor shell and remove rear head.

NOTE: Some oil may drain when the head is removed.

5. Examine surface on the rear head casting web. If any damage is observed, the head should be replaced (Fig. 1A-18).

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

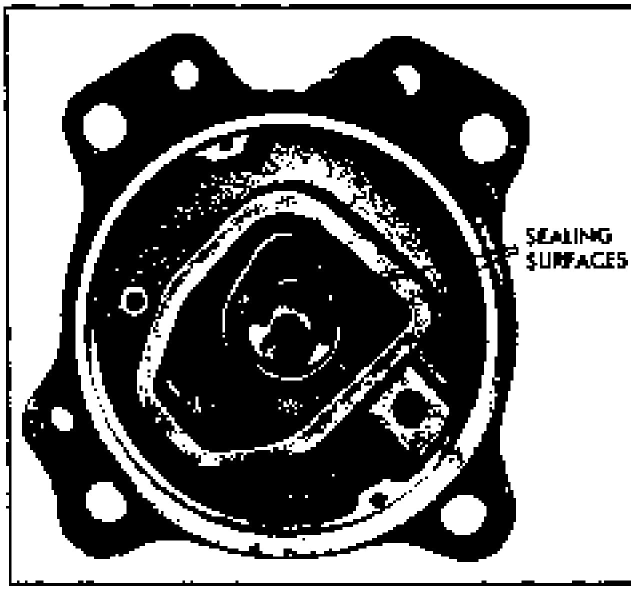


Fig. 1A-18 Sealing Surface on Head Casting Web

7. Remove oil pump gears noting how they are mated (end-to-end) and inspect for damage. Replace both gears if one or both show damage. Keep gears mated as they were when removed.

8. Remove rear head to compressor shell O-ring seal and inspect for damage, cuts nicks or imperfections. A damaged seal may be the cause of a refrigerant leak. In any event, this O-ring seal must be replaced with a new one.

9. Carefully remove rear discharge valve plate assembly by prying up on assembly (Fig. 1A-19. and examine discharge valve reeds and seats. Replace entire assembly if excessively scored or if any one of the three reeds is broken or seats are damaged.

10. Carefully remove rear suction reed and examine for any damage. Replace if necessary (Fig 1A-20).

COMPRESSOR MAJOR INTERIOR MECHANISM

REMOVE, INSPECT AND CHECK

1. Remove shaft seal seat retaining ring, using J 4245 (No 23 Truarc pliers).

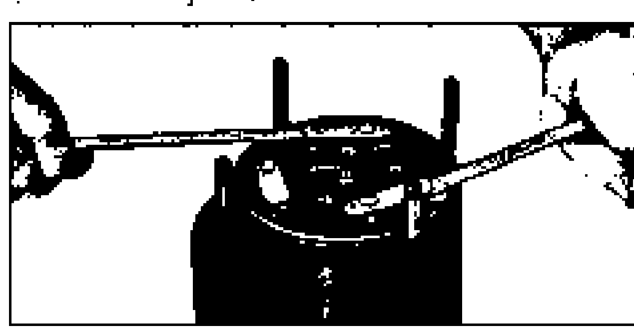


Fig. 1A-19 Removing Discharge Valve Plate

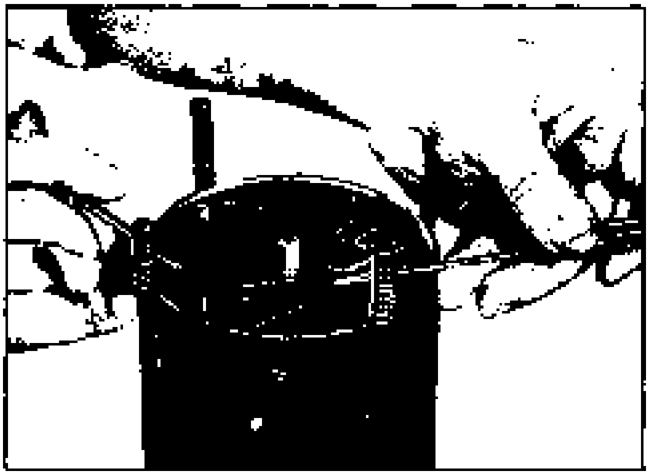


Fig. 1A-20 Removing Suction Reed

2. Remove shaft seal seat, using J 9393-1 and 2 to grasp flange on seal seat. Pull straight out at end of tool to remove seal seat.

3. Engage tabs on compressor shaft seal assembly with locking tangs on J 9392 seal installer and remover. Press down on tool and twist clockwise to engage seal. Remove seal assembly by pulling straight out from shaft.

4. Remove O-ring from interior of front head casting bore. (A wire with a hook formed on the end may be used. This hook may be made in a manner as shown in Fig. 1A-17).

5. Remove oil inlet tube and O-ring, using a wire with a hook formed in one end (Fig. 1A-21).

6. Push on front end of compressor head to remove mechanism from rear of shell. DO NOT hammer on end of compressor shaft or use undue force to remove the compressor internal mechanism. This assembly will slide out easily.

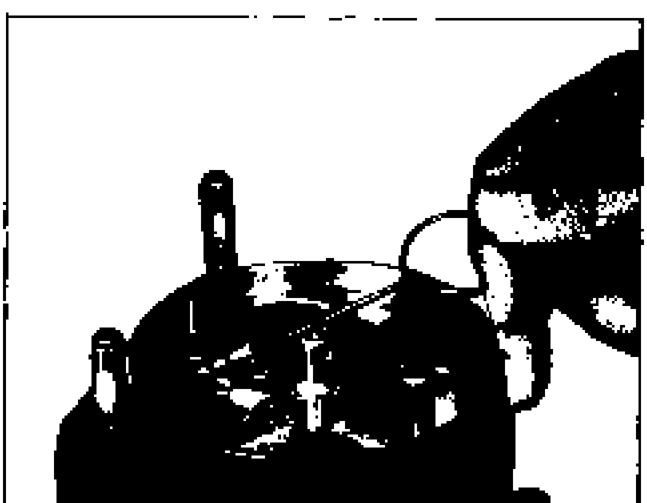


Fig. 1A-21 Removing Oil Inlet Tube

NOTE: Some oil will drain from compressor when mechanism assembly is removed.

7. Remove compressor front head casting assembly from compressor shell. Examine sealing surface for damage and/or deep scratches. Replace if necessary.

8. Remove compressor front head casting to shell O ring seal and inspect for damage, cuts, nicks or imperfections. A damaged seal may be the cause of a refrigerant leak. In any event, this O-ring must be replaced with a new one.

9. Remove the front discharge reed plate and suction reed and examine for damage.

10. Examine mechanism for any obvious damage. Turn compressor shaft and check for smoothness of operation as well as for any scratches in bores, etc.

NOTE: If mechanism has sustained major damage due possibly to loss of refrigerant and/or oil, it may be necessary to use the service interior mechanism or the service cylinder assembly rather than replace individual parts.

11. Remove suction crossover cover by sliding out of slots.

DISASSEMBLE

(Obtain clean J 9402 assembly parts tray to retain compressor parts during disassembly.)

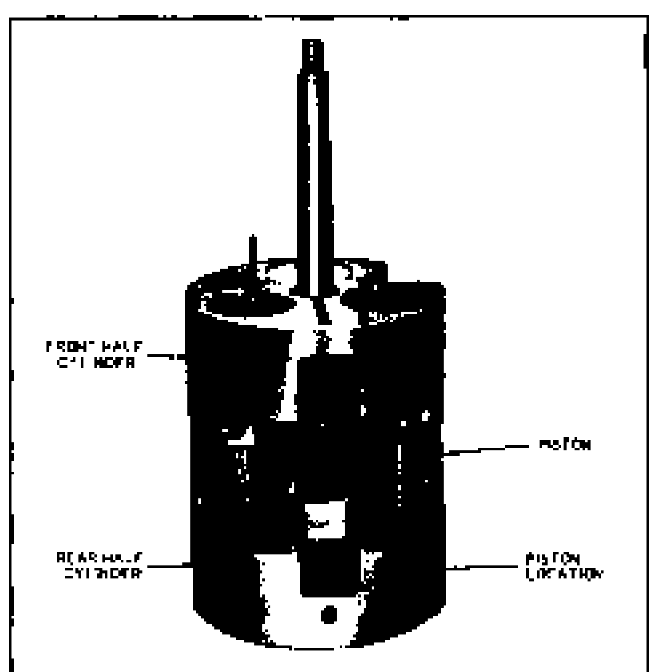


Fig. 1A-22 Pistons and Cylinder

1. Number pistons (1, 2 and 3) and their bores so parts can be replaced in their original locations (Fig. 1A-22).

2. Turn compressor shaft to position swash plate towards front of compressor to area of discharge crossover tube. Using J 9492, drive discharge crossover tube out of rear head assembly toward front of compressor or use a wooden block as shown in Fig. 1A-23. Use care so that discharge crossover tube is not damaged by swash plate.

3. Separate front and rear cylinder assemblies being careful not to damage any parts during separation.

4. Remove rear half cylinder from pistons.

5. Drive discharge crossover pipe from front head, using J 9492.

6. Push on compressor shaft and carefully remove pistons, piston rings, shoes and balls; one assembly at a time. Place parts in the J 9402 tray to keep parts together (Fig. 1A-24). The front end of piston has an identifying notch in the casting web (Fig. 1A-25).

7. Remove all piston shoe discs, examine for indication of failure or probable cause of failure, then discard all shoe discs.

8. Examine piston balls and, if satisfactory for reuse, put aside in assembly tray in compartment associated with proper end of piston.

9. Remove rear combination of thrust races and thrust bearing. Discard all three pieces (Fig. 1A-26).

10. Push on shaft to remove shaft from front half cylinder.

11. Remove front combination of thrust races and thrust bearing. Discard all three pieces.

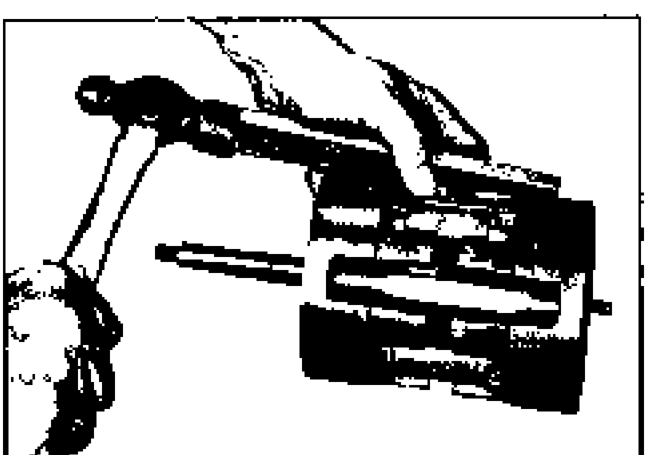


Fig. 1A-23 Separating Cylinder Halves

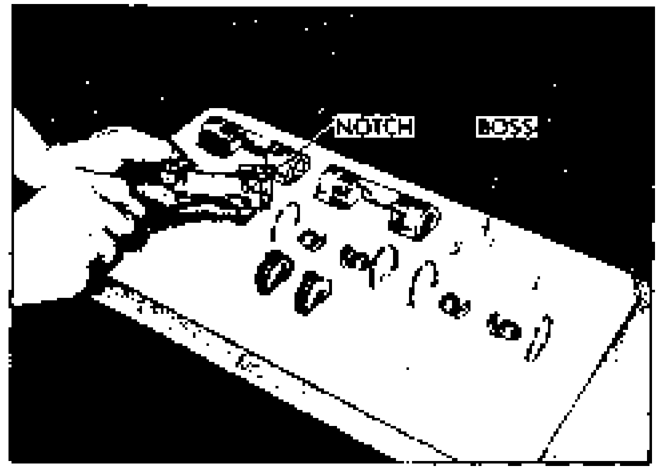


Fig. 1A-24 Compressor Parts in Tray

12. Examine swash plate surfaces for excessive scoring or damage. If satisfactory, reuse. If necessary, replace main shaft and swash plate assembly.

13. Wash all parts to be reused in a tank of clean alcohol or similar solvent. Blow dry all parts using a source of clean, dry air.

14. Examine the front and rear cylinder halves and replace if cylinder bores are deeply scored or damaged.

NOTE: The service cylinder assembly will contain a front and rear half doweled together. This assembly will also include two main bearings; one main bearing pressed into the proper location in the front half and the other in its proper location in the rear half.

15. Check main shaft bearings for roughness and replace as necessary. Use J 9432 to replace bearings.

GAGING FOR NEW PARTS

Obtain the parts discussed in the introduction of this section.

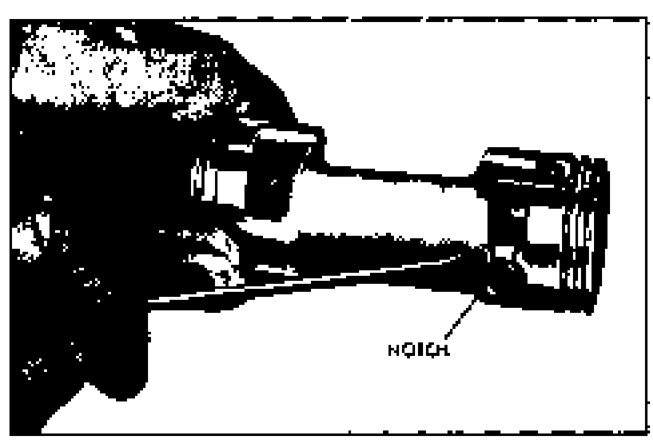


Fig. 1A-25 Identification of Front End of Piston

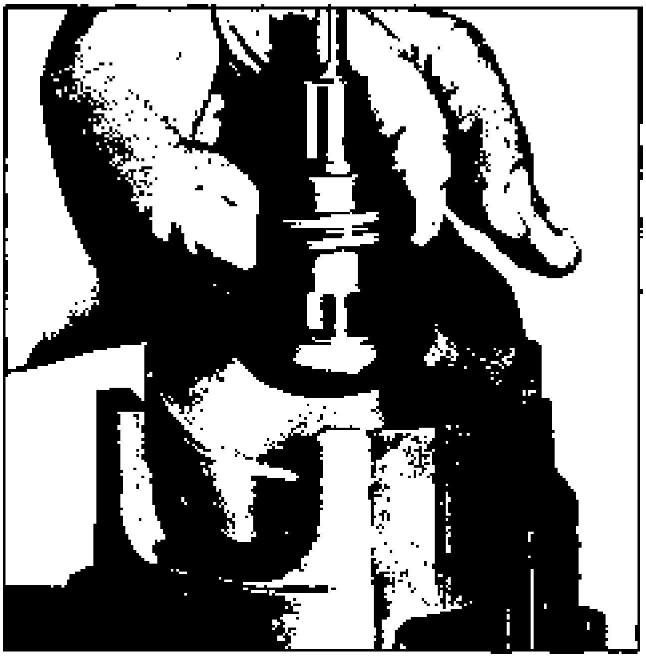


Fig. 1A-26 Removing Rear Thrust Races and Bearings

NOTE: If thrust bearings and races are to be replaced, use parts as outlined below; otherwise use existing bearings and races.

1. Secure four ZERO thrust races, three ZERO shoe discs and two new thrust bearings.

2. Stack a ZERO thrust race, a new needle thrust bearing and a second ZERO thrust race. Assemble this "sandwich" of parts to FRONT end of compressor main shaft.

3. Place FRONT half of cylinder on J 9397 compressing fixture. Insert threaded end of shaft (with front bearing assembly) through front main bearing and allow thrust race assembly to rest on hub of cylinder.

4. Stack a ZERO thrust race, a new thrust bearing and a second ZERO thrust washer. Assemble this "sandwich" of parts to REAR of compressor main shaft so it rests on hub of swash plate (Fig. 1A-28)

5. Apply a light coat of clean refrigerant oil to ball pockets of each of three pistons.

6. Place balls in piston pockets.

7. Apply a light coat of clean refrigerant oil to cavity of three new ZERO shoe discs.

8. Place a ZERO shoe over each ball in FRONT end of piston. Front end of piston has an identifying notch in casting web (Fig. 1A-25).

9. Place a ball only in rear ball pocket of each of three pistons (Fig. 1A-29).

NOTE: Do not assemble any piston rings at this time.

10. Rotate shaft and swash plate until high point of swash plate is over piston cylinder bore, which had been identified as No. 1. Insert front end of No. 1 piston (notched end) in cylinder bore (toward the front of compressor) and at same time, place front ball and shoe and rear ball only over swash plate (Fig. 1A-31).

NOTE: It may be necessary to lift shaft assembly to aid in installing pistons. Hold front thrust bearing pack tightly against swash plate hub while lifting shaft (Fig. 1A-30).

11. Repeat this operation for No. 2 and No. 3 pistons. Balls and shoes must adhere to piston during this assembly.

12. Align rear cylinder casting with bores, suction passage, discharge crossover holes, dowel pins, etc. Tap into place using a hard wood or plastic block and mallet (Fig. 1A-31).

13. Place cylinder assembly in J 9397 compressing fixture with front of compressor shaft pointing down, positioning discharge tube opening between fixture bolts. This will permit access for the feeler gauge. Assemble fixture head ring and nut to the cage, tighten nuts evenly to 25 lb. ft. torque (Fig. 1A-32).

14. Use a leaf-type feeler gauge to check clearance between REAR ball and swash plate for each piston as follows:

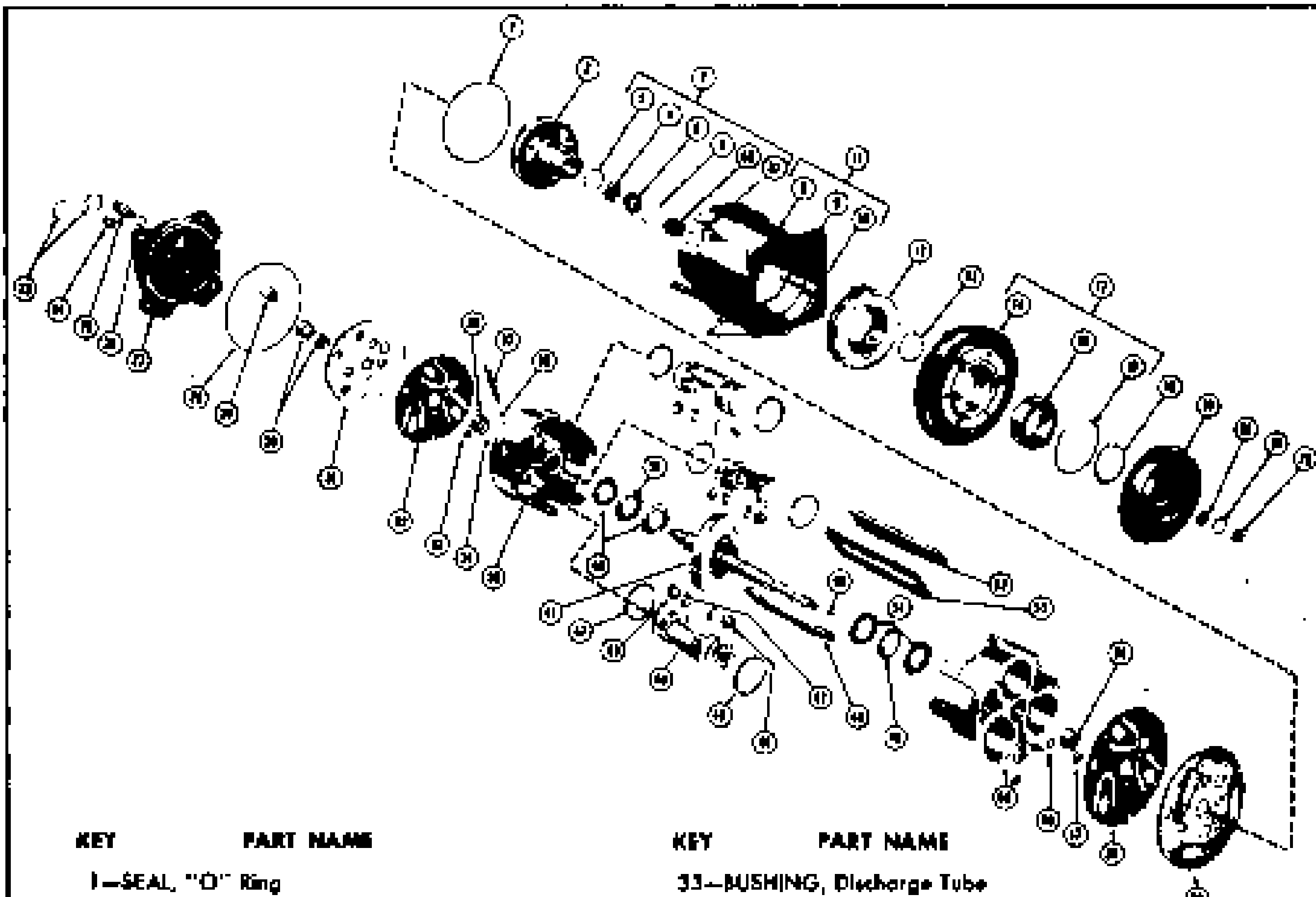
a. Use J 9661 gauge set selecting a suitable feeler gauge leaf until the result is a 4 to 8 oz. pull on the scale between ball and swash plate (Fig. 1A-33). If the pull is just less than 4 ozs., add .0005" to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ozs., then subtract .0005" from the thickness of the feeler stock. Select a shoe accordingly.

b. Rotate the shaft approximately 120° and make a second check with feeler gauge between same ball and plate.

c. Rotate shaft again approximately 120° and repeat check with feeler gauge between these same parts.

d. From this total of three checks between the same ball and swash plate at 120° increments on swash plate for each piston, use the minimum gauge reading to select a numbered shoe to correspond to this reading (Fig. 1A-34).

NOTE: A selection will be made from shoe packages shown in Fig. 1A-34, which will provide a .0005" to .0010" total clearance between shoes and the swash plate at the tightest point throughout its 360° rotation. The reading or resultant reading will correspond to the last three numbers of the part number of the part to be used.



KEY	PART NAME
1	SEAL, "O" Ring
2	HEAD, Compressor—Front
3	SEAL, "O" Ring (Part of #7)
4	SEAL, Shaft Oil (Part of #7)
5	SEAT, Oil Seal (Part of #7)
6	SNAP RING, Oil Seal Seat (Part of #7)
7	SEAL PKG., Shaft Oil (Incl. #3-4-5-6-60-61)
8	HOUSING, Compressor
9	GASKET, Oil Fitting Screw
10	SCREW, Oil Fitting
11	SHELL ASSY., Compressor
12	COIL, Clutch
13	SNAP RING, Coil
14	PULLEY, Compressor
15	BEARING, Pulley
16	RING, Pulley Bearing Ret.
17	PULLEY ASSY., Compressor
18	SNAP RING, Bearing to Head Retainer
19	PLATE ASSY., Clutch
20	SPACER, Clutch Hub
21	SNAP RING, Clutch Hub
22	NUT, Pulley & Clutch to Shaft
23	"O" Ring, Intake & Discharge Port
24	NUT, Compressor Shell
25	VALVE, Pressure Relief
26	GASKET, Pressure Relief
27	HEAD, Cylinder—Rear
28	"O" RING, Cylinder Head
29	SCREEN, Suction
30	PUMP PKG., Comp. Oil
31	PLATE, Discharge Valve—Rear
32	REED, Suction Valve

KEY	PART NAME
33	BUSHING, Discharge Tube
34	"O" RING, Discharge Tube
35	CYLINDER & BEARING ASSY., (Includes Front & Rear Unit & No's. 36-54-55)
36	BEARING, Shaft
37	TUBE, Oil Inlet
38	"O" RING, Oil Inlet Tube
39	BEARING, Needle Thrust
40	RACE, Thrust Bearing
41	SHAFT ASSY., Drive (No. 50 Included)
42	RING, Piston
43	BALL, Piston Drive
44	PISTON
45	RING, Piston
46	BALL, Piston Drive
47	DISC, Shoe
48	TUBE PKG., Crossover Discharge (No. 33 Included)
49	BEARING, Needle Thrust
50	KEY, Clutch Hub
51	RACE, Thrust Bearing
52	COVER, Suction Passage
53	SEAL, Suction Passage Cover (See Note Group 9.170)
54	BEARING, Shaft
55	CYLINDER & BEARING ASSY., (Includes Front & Rear Unit & No's. 35-36-54)
56	"O" RING, Discharge Tube
57	BUSHING, Discharge Tube
58	REED, Suction Valve
59	PLATE, Discharge Valve—Front
60	SLEEVE, Seal—Felt (Part of #7)
61	RETAINER, Seal Sleeve (Part of #7)

Fig. 1A-27 Exploded View - Compressor Assembly

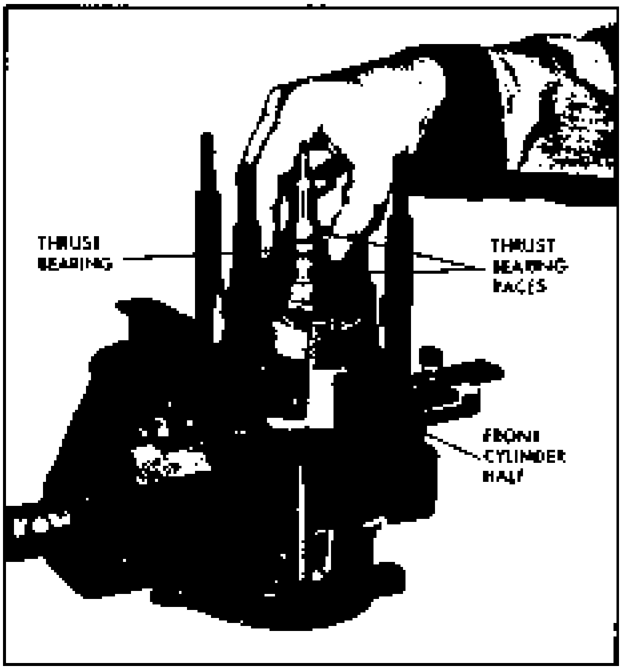


Fig. 1A-28 Mainshaft Thrust Bearing Installed

Once proper selection of shoes has been made, it is imperative that the matched combination of shoe to ball and spherical cavity in the piston be kept intact during disassembly after gauging operation and final reassembly of mechanism. An assembly parts tray (J 9402) with individual compartments for each component of the mechanism will keep parts in their proper relationship.

e. Mark piston number (1, 2 or 3) on shoe package.

f. Place shoes in J 9402 assembly tray in compartment corresponding to piston number and rear ball pocket position.

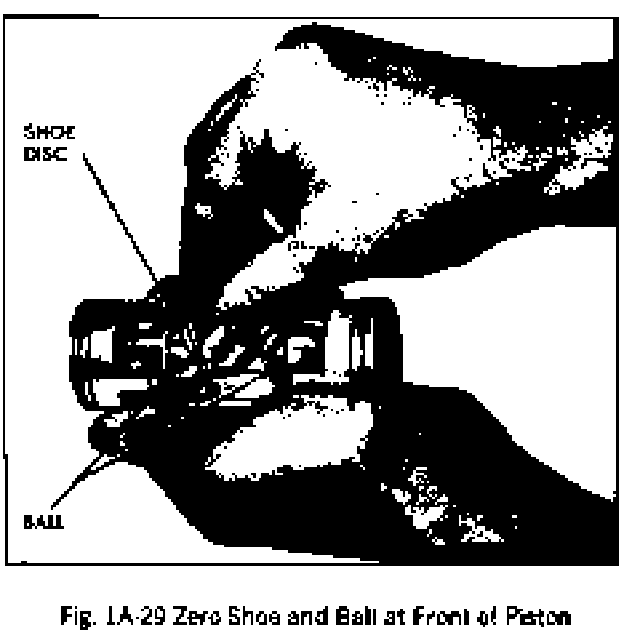


Fig. 1A-29 Zero Shoe and Ball at Front of Piston

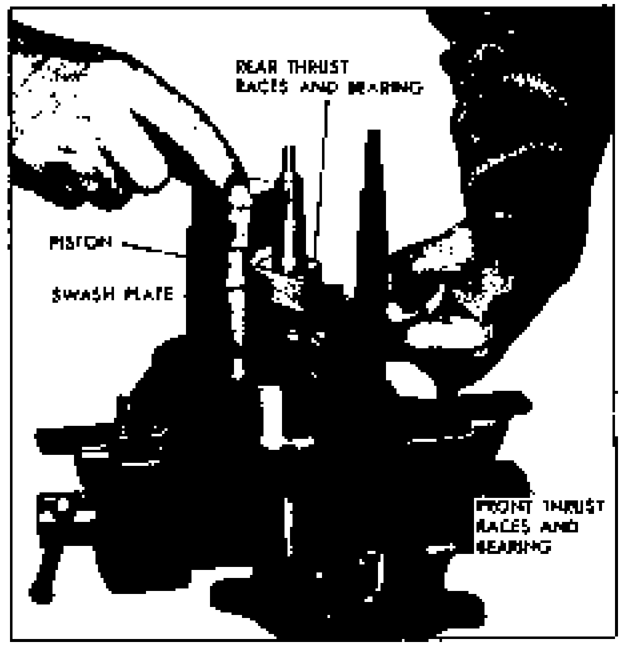


Fig. 1A-30 Installing Piston with Balls

g. Repeat in detail same gauging procedure explained above for each of the other two pistons.

15. The next gauging operation is to determine space between REAR thrust bearing and upper or outer-rear thrust race. Check compressor shaft end play as follows (Fig. 1A-35).

a. Mount dial indicator to read clearance at end of compressor shaft.

b. Move compressor shaft along its longitudinal axis and measure end play.

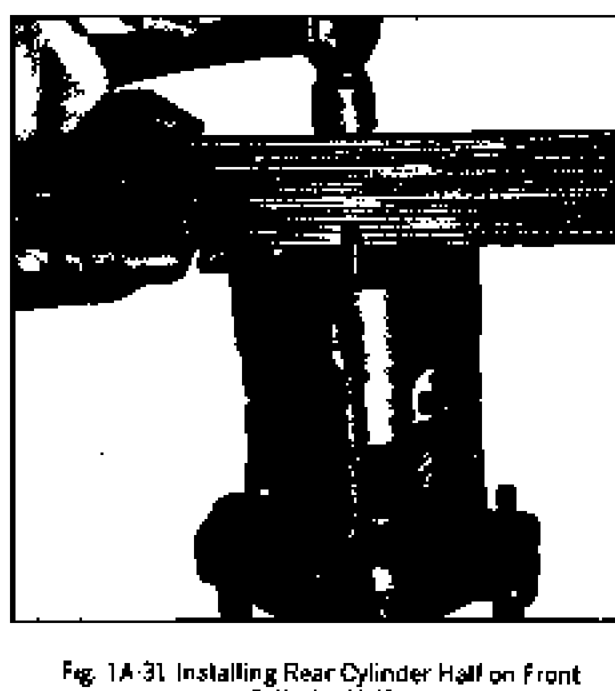


Fig. 1A-31 Installing Rear Cylinder Half on Front Cylinder Half

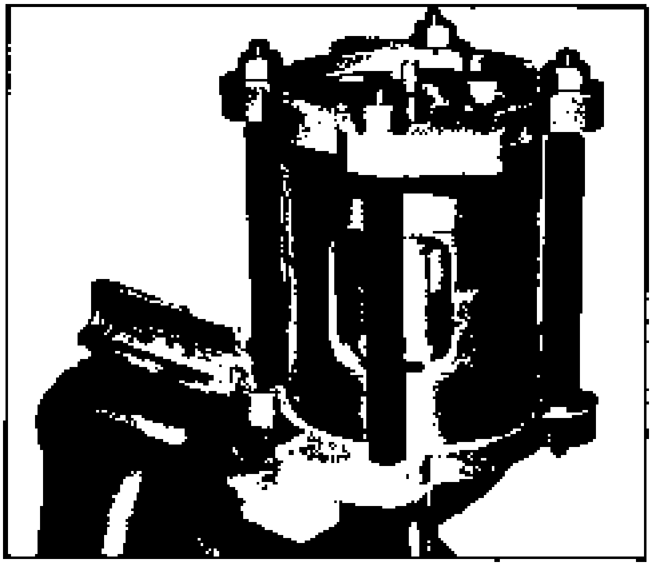


Fig. 1A-32 Internal Mechanism in Fixture

NOTE: Apply full hand force at end of mainshaft a few times before reading clearance. This will help squeeze the oil out from between mating parts.

c. An alternate method of selecting a proper race is to use J 9661 gauge set selecting a suitable feeler gauge leaf until the result is a 4 to 8 oz. pull on the scale between the rear thrust bearing and upper (or outer rear) thrust race (Fig. 1A-36). If the pull is just less than 4 ozs., add .0005" to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ozs., then subtract .0005" from the thickness of the feeler stock. Select a race accordingly.

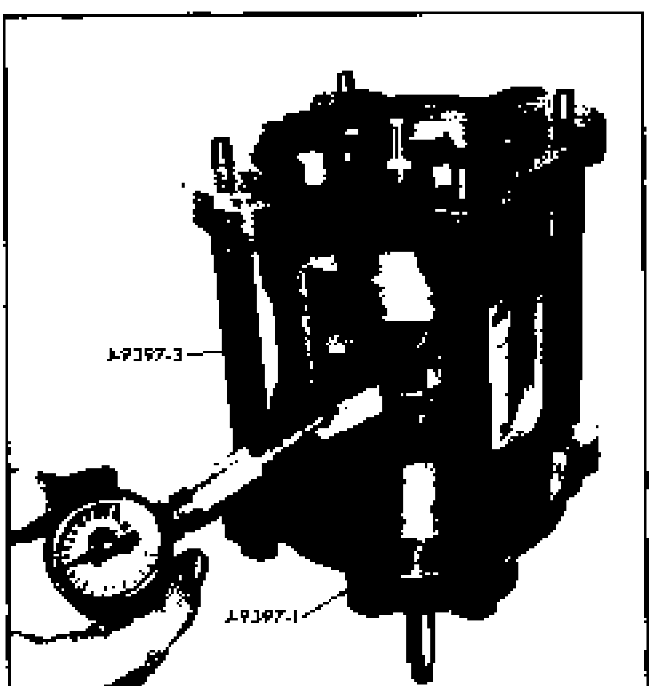


Fig. 1A-33 Measuring for Proper Shoe

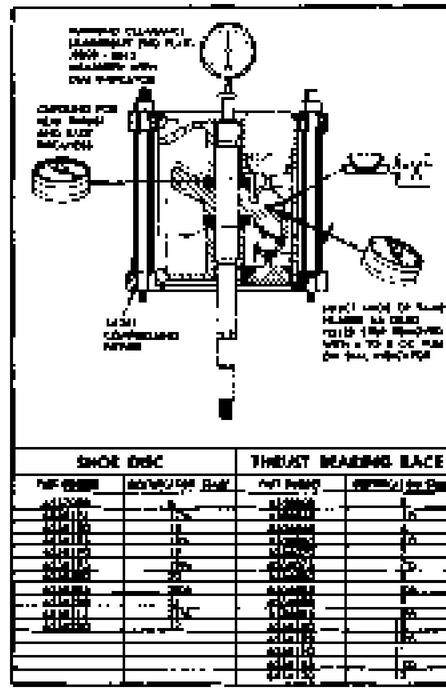


Fig. 1A-34 Measurements and Table of Available Service Shoes and Thrust Races

d. Select from stock a numbered thrust race that corresponds to dial indicator reading (Fig. 1A-37).

NOTE: Thrust races are made of steel and ground to a fixed thickness. A total of fourteen thrust races are available for field service. They will have increments of .0005" thickness to provide the required clearance.

The thrust races will be identified on the part by their thickness, and the number on thrust race will correspond to the last three digits of the piece part number.

If an improper selection of thrust races or shoes is made and the tolerance is GREATER than the maximum clearance, noisy operation of the compressor will result. If the tolerance is LESS than the minimum

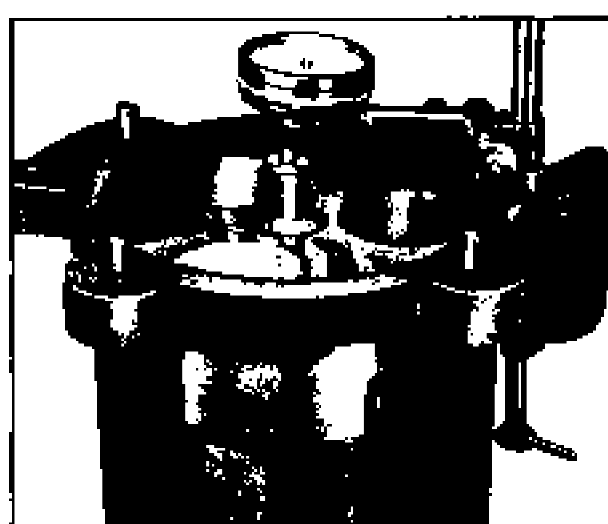


Fig. 1A-35 Checking Compressor Mainshaft End Play

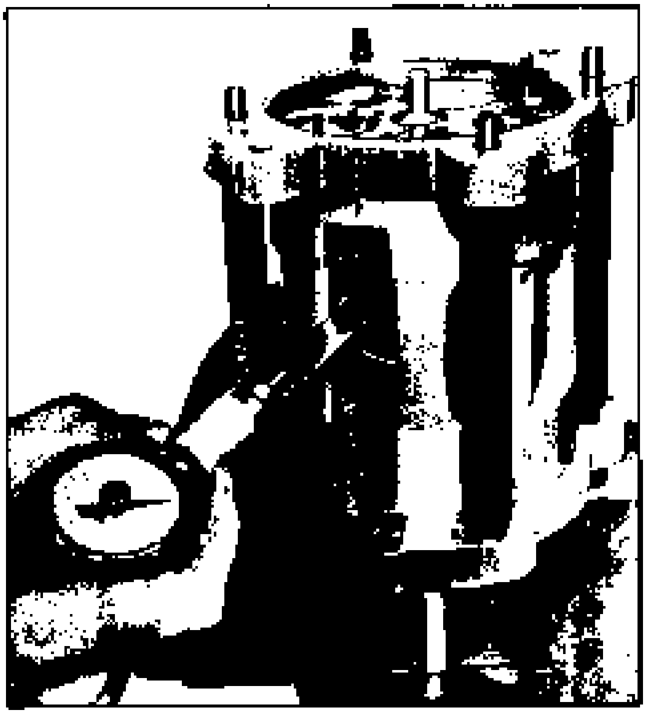


Fig. 1A-36 Measuring for Proper Thrust Race

clearance, it is likely that the mechanism assembly will be too tight. This may result in galling and seizure of parts.

Therefore, it is very important that care be used during gauging operations and the proper selection of parts be made. Once selection has been made, be sure that they are assembled into the correct position in the mechanism.

e. Mark the package "REAR" thrust race or place it in J 9402 assembly parts tray corresponding to this position.

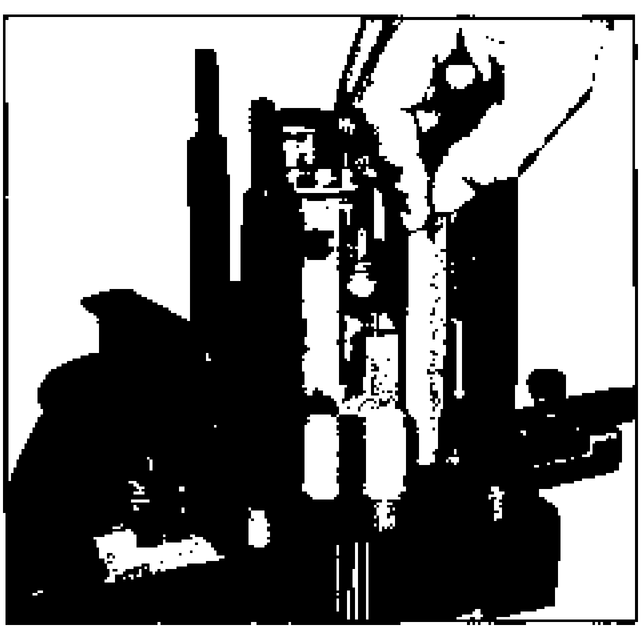


Fig. 1A-37 Installing Service Discharge Crossover Tube

16. Loosen and remove nuts and ring from J 9397 compressing fixture.

17. Separate cylinder halves (it may be necessary to use a fiber block and mallet)

18. Remove rear half cylinder.

19. Carefully remove one piston at a time from swash plate and front half cylinder. Do not lose relationship or position of front ball and shoe and rear ball only. Transfer each piston, balls and shoe assembly to its proper place in the J 9402 assembly tray.

20. Remove REAR outer ZERO thrust race from shaft and replace it with numbered thrust race, determined in step No. 15. Apply a LIGHT smear of petrolatum to thrust races to aid in holding them in place during assembly.

NOTE: This ZERO thrust race may be put aside for reuse in additional gauging and/or rebuild operations.

21. Apply a light smear of petrolatum to numbered shoes and place them over correct ball in rear of piston

ASSEMBLE WITH NEW PARTS

Be sure to install all new seals, gaskets and O-rings. These are all included in the compressor gasket kit.

1. Assemble a piston ring, scraper groove toward the center of piston, to each end of three pistons.

2. Place front half cylinder on J 9397 compressing fixture with compressor main shaft (threaded end) projecting downward through the fixture. Rotate swash plate so high point is above cylinder base No. 1 With open end of ring toward center of compressor, carefully assembly No. 1 piston (complete with ball and a ZERO shoe on front end and ball and numbered shoe on REAR end) over swash plate. Compress and enter piston ring into front half cylinder. Repeat this operation for pistons No. 2 and No. 3.

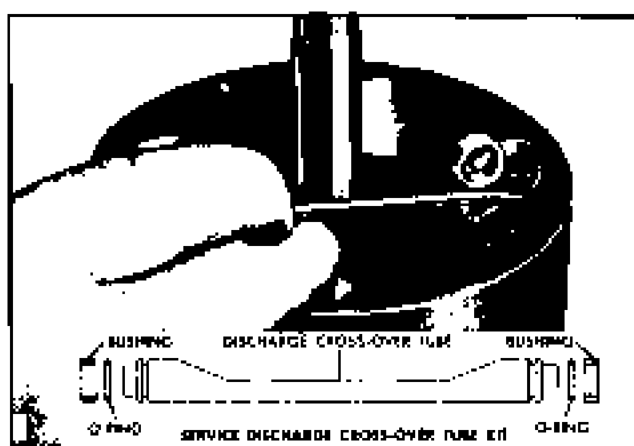


Fig. 1A-38 Installing Service Discharge Crossover Parts

3. Assemble one end of service discharge crossover tube into hole in front cylinder (Fig. 1A-37).

4. Rotate shaft to position pistons in a "stair step" arrangement. Place rear half cylinder over shaft and start pistons into cylinder bores

5. Invert cylinder on fixture and complete assembly as follows:

a. Compress piston ring on each piston so as to permit its entrance into cylinder.

b. When all three pistons and rings are in their respective cylinders, align end of the discharge crossover tube with hole in rear half cylinder, making sure flattened portion of this tube faces inside of compressor (for swash plate clearance).

c. When satisfied that all parts are in proper alignment, tap with a fiber block mallet to "seat" rear cylinder over locating dowel pins.

6. Generously lubricate all moving parts with clean Frigidaire 525 viscosity oil, or equivalent. Check for free rotation of mechanism.

7. Check operation and smoothness of piston travel before proceeding with remainder of assembly. If any improper operation is observed during this check, the mechanism may have to be regauged. Complete assembly when correct operation is obtained.

8. Install crossover cover in cylinder.

9. Place internal mechanism in J 9397 compressing fixture if cylinder head dowel pins are to be replaced.

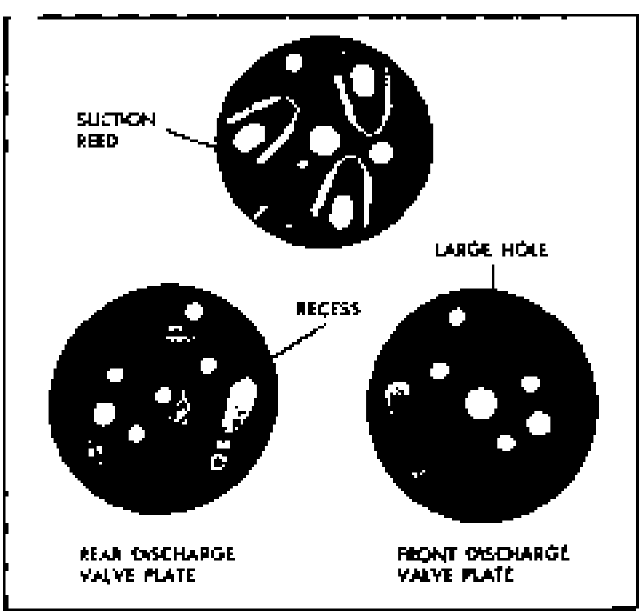


Fig. 1A-39 Identification of Front and Rear Discharge Valve Plate

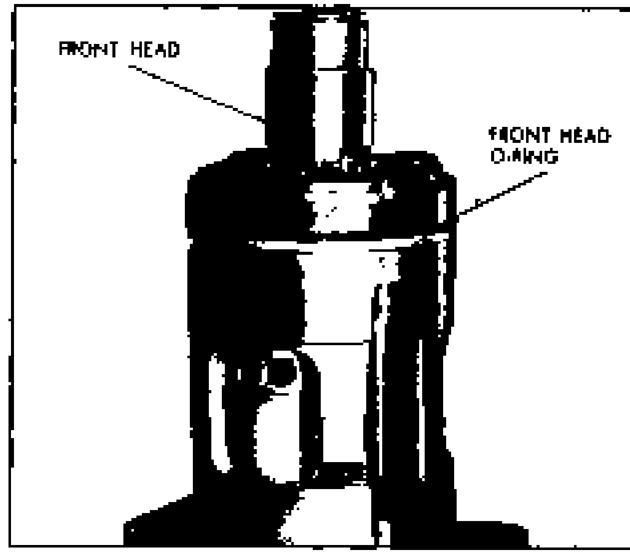


Fig. 1A-40 Installing Front Head Casing

10. Replace two dowel pins in front cylinder if previously removed.

NOTE: A rod drilled 1/4" deep to O.D. of dowel pins will aid in installing pins.

11. Remove internal mechanism from J 9397 fixture.

REPLACE

1. Install service discharge crossover pipe front O-ring and spacer (Fig. 1A-38).

2. Assemble suction reed valve to front end of cylinder. Align dowel pin holes, suction ports and oil return slot.

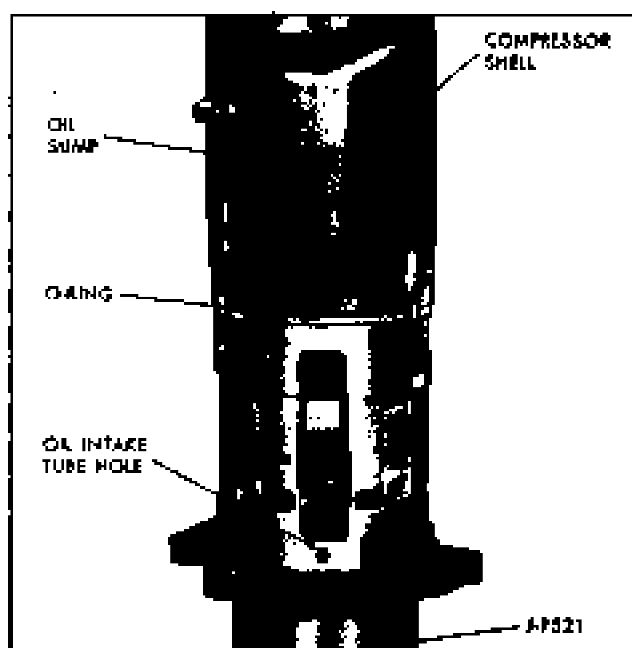


Fig. 1A-41 Installing Service Discharge Crossover Tube

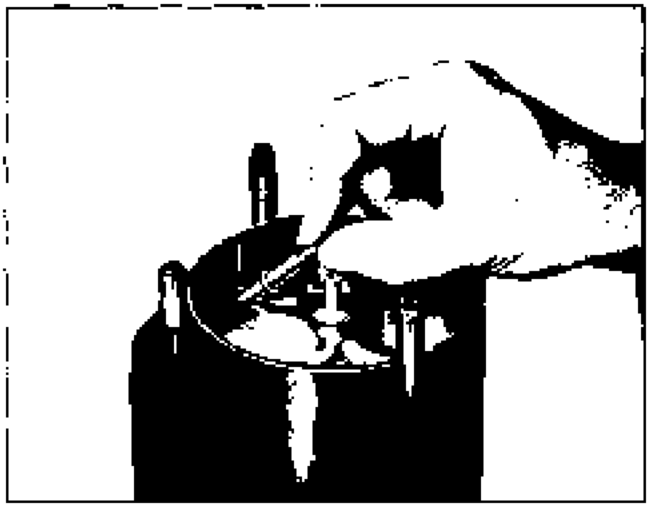


Fig. 1A-42 Installing Oil Intake (Pick-Up) Tube

3. Assemble front discharge valve plate, aligning holes with dowel pins and proper openings in head.

NOTE: The front discharge valve plate has a large diameter hole in the center (Fig. 1A-39).

4. Remove oil charging screw from compressor shell, inspect for damage, dirt or contamination, clean and replace.

5. Coat sealing surfaces on webs of compressor front head casting with clean 525 viscosity Frigidaire oil, or equivalent.

6. Examine location of dowel pins and contour of webs (mark dowel location). Rotate so as to position it properly over discharge reed retainers. Use care to avoid damaging sealing surfaces. When in proper alignment, seat on compressor front head casting with light mallet taps (Fig. 1A-40).

Fig. 1A-43 Positioning Oil Pump Outer Gear

7. If previously removed, place compressor shell with J 9396 holding fixture in vise so shell is up.

NOTE: Examine corners of oil baffle to be sure they do not damage O-rings on reassembly. Tap corners at oil baffle down carefully with small ball peen hammer.

8. Apply an ample amount of clean 525 viscosity Frigidaire oil, or equivalent, around angle groove at the lower edge of casting. Coat large diameter head to shell O-ring and assemble O-ring on shoulder of shell (at front Fig. 1A-41).

9. Coat the inside machined surfaces of shell with clean 525 viscosity Frigidaire oil, or equivalent. Line up oil sump with oil intake tube hole and slide mechanism into shell. Maintain this alignment when lowering mechanism into place (Fig. 1A-41).

10. Place an O-ring on the oil pick-up tube, apply oil to cavity and O-ring. Insert tube and O-ring (Fig. 1A-42), rotating compressor mechanism as necessary and align tube with hole in the shell baffle. Be sure O-ring and intake tube are properly seated.

11. Replace split dowel pins (in rear cylinder) if previously removed.

NOTE: A rod drilled 1/4" deep to O.D. OF DOWEL PINS will aid in installing pins.

12. Install service discharge crossover pipe rear O-ring and spacer.

13. Position rear suction reed valve to align with dowel pins, reed tips, and ports in head.

14. Position rear discharge valve assembly to align with dowel pins and ports and slide it into place over pins.

15. Position rear head casting to align with dowel pins. Rotate mechanism assembly back and forth by hand, if necessary, to permit this alignment and assure proper seating of front head cylinder assembly. Remove rear head from this trial assembly.

16. Assemble inner oil pump gear over "D" shaped flat on shaft. Place outer oil pump gear over inner oil pump gear.

NOTE: Before attempting the final assembly of the rear head casting, position outer gear as follows:

a. Observe position of oil pump in shell.

b. Note position of pump race in head.

c. Align pump with head and install head (Fig. 1A-44).

COMPRESSOR REAR HEAD ASSEMBLY

REPLACE

1. Generously oil valve plate around outer edge where large O-ring will be placed. Oil valve reeds, oil pump gears, and area where teflon gasket will contact valve plate.

2. Coat new head-to-shell O-ring with oil and place it on valve plate in contact with shell.

3. Replace suction screen in rear head.

4. Assemble rear head to compressor shell, using care not to damage sealing surface (Fig. 1A-45).

5. Assemble new nuts to threaded shell studs. Tighten 25-28 lb. ft. torque.

6. Replace pressure relief valve, if removed, using new copper washer.

7. Coat the new seal seat O-ring with clean refrigerant oil and install it in its groove in the compressor neck. Tool J 21508 may be used.

8. Place seal protector J 21303 over the end of the shaft. Coat the O-ring and seal face of new seal assembly with clean refrigerant oil and install new seal assembly on shaft, using tool J 9392.

9. Coat the face of new seal seat with clean refrigerant oil and install new seal seat, using tool J 9393. Be sure seal seat O-ring is not dislodged and seal seat is making a good seal with the O-ring. (Fig. 1A-45).

10. Install new seal seat retainer ring with tool J 5403, with flat face against seal seat. The sleeve from tool J 9393 may be used to press on the retainer ring so that it snaps into place. Remove tool J 21303 from end of shaft.

11. Leak test compressor as described under LEAK TESTING THE COMPRESSOR, using a propane torch type of leak detector, in good condition. Correct any leaks found.

12. Wipe out any excess oil inside compressor neck and on shaft, resulting from installing new seal parts.

13. Install new absorbent sleeve by rolling the material into a cylinder, overlapping the ends, and slipping sleeve into compressor neck with overlap toward the top of the compressor. With a small screwdriver or similar instrument, carefully spread sleeve to remove overlap so that in final position ends of sleeve will butt at top vertical centerline.

14. Position new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Tool J

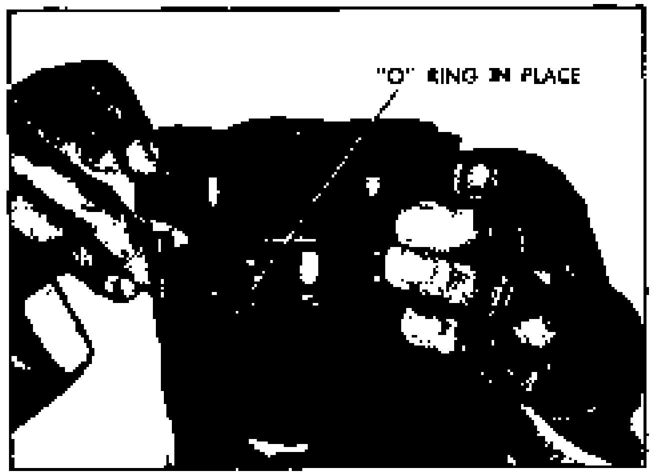


Fig. 1A-44 Installing Rear Head

9395 or the sleeve from tool J 9393 may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place, until the outer edge of the retainer is recessed approximately 1/32" from the face of the compressor neck.

15. Reinstall the clutch driven plate.

P.O.A. VALVE

ALL - REMOVE AND REPLACE

1. Depressurize system.

2. Disconnect oil bleed fitting (Figs. 1A-46 and 47).

3. Disconnect equalizer fitting.

4. Disconnect inlet and outlet fittings.

5. Remove valve from bracket.

NOTE: If valve is not immediately replaced, cap openings to prevent entry of dirt and moisture.

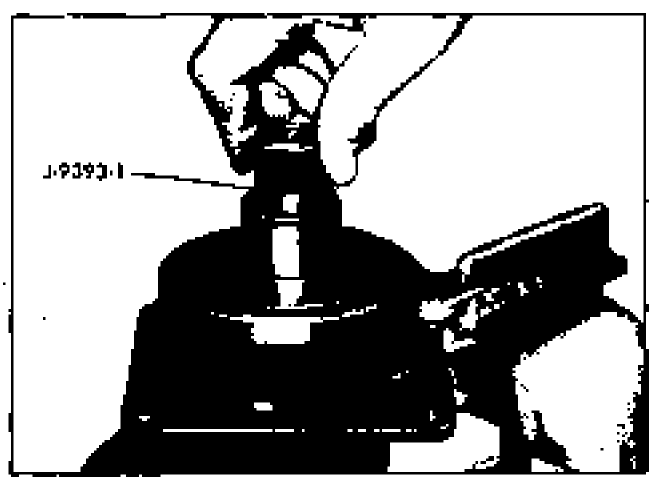


Fig. 1A-45 Seating Seal Seat Retainer

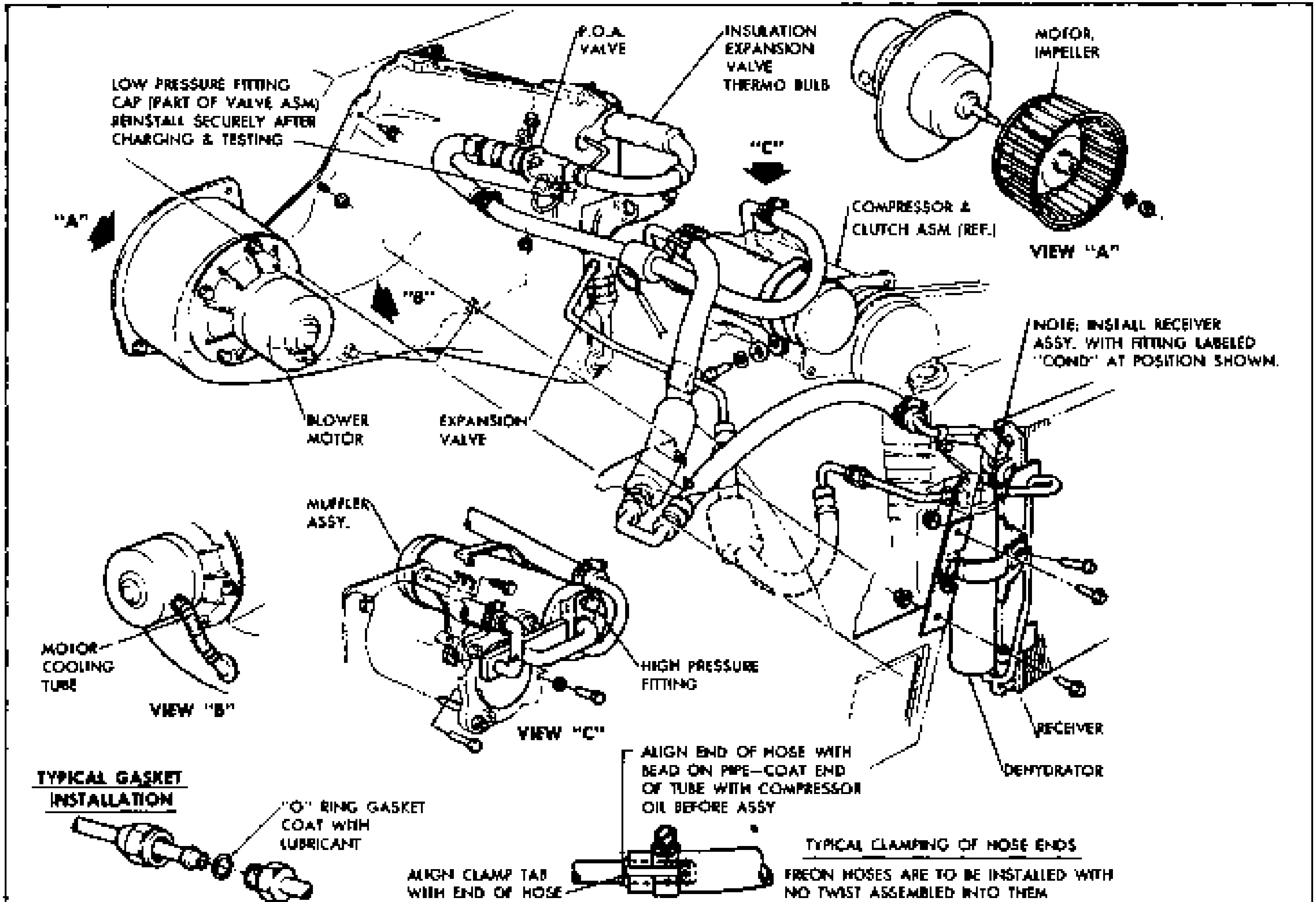


Fig. 1A-46 Refrigeration System Typical - Pontiac, Tempest and Grand Prix

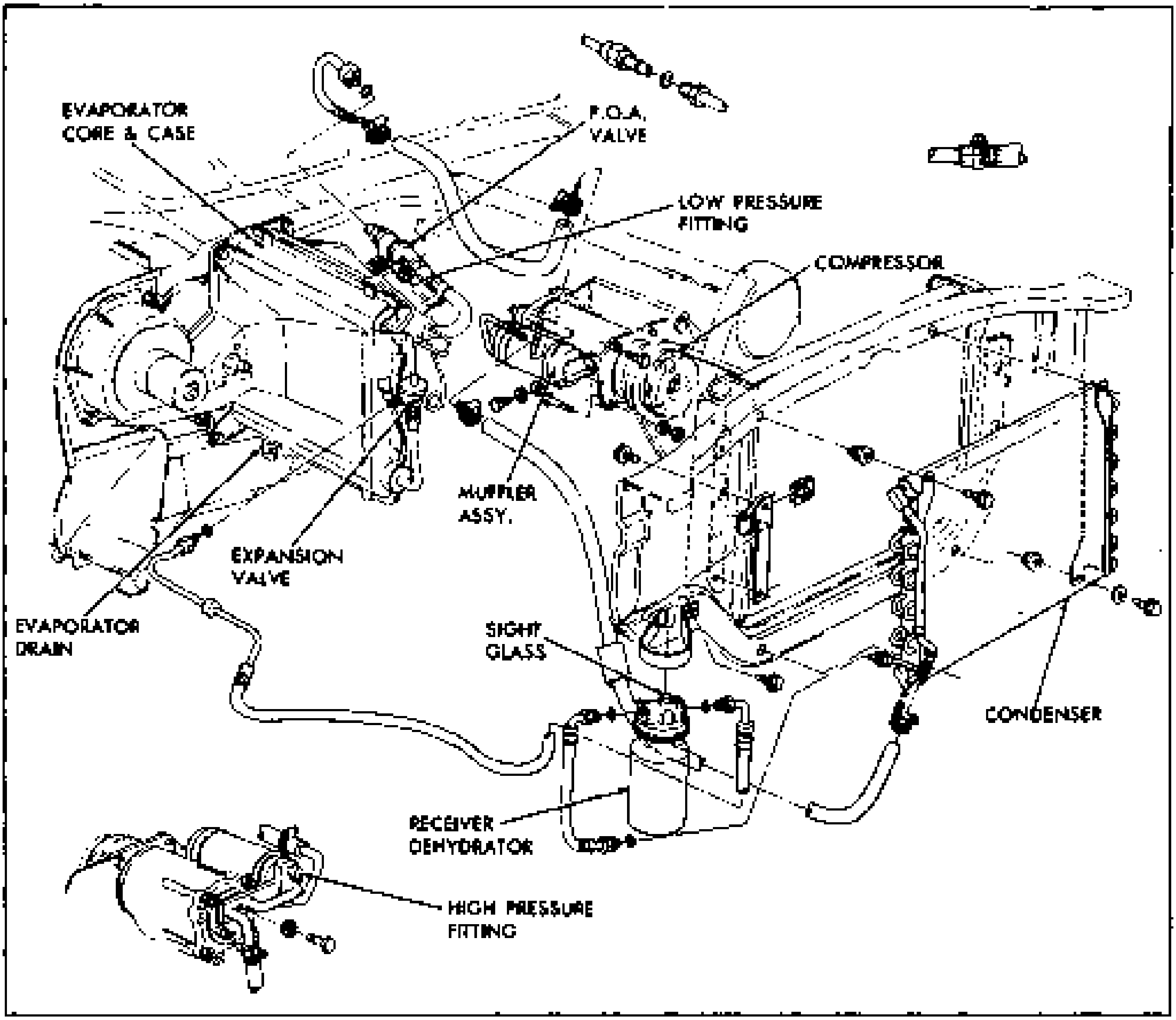


Fig. 1A-47 Refrigeration System Components - Firebird

6. Replace by reversing above procedure using new O ring seals coated with compressor oil.

7. Evacuate and charge system.

Compressor belt tension specifications are as follows:

New Belt (140-145 lbs.)

Old belt (100-105 lbs.)

EXPANSION VALVE AND SEALS

ALL - REMOVE AND REPLACE

1. Depressurize system.

2. Remove thermo bulb from insulation at evaporator outlet (Figs. 1A-46 and 47).

3. Disconnect equalizer line at P.O.A. valve.

4. Remove inlet and outlet fittings of valve.

NOTE: On some Firebirds it may be necessary to loosen and tip the compressor to gain access to these fittings.

5. If valve is not immediately replaced, cap openings to prevent entry of dirt and moisture.

6. Replace by reversing above procedure using new O ring seals coated with compressor oil.

7. Evacuate and charge system.

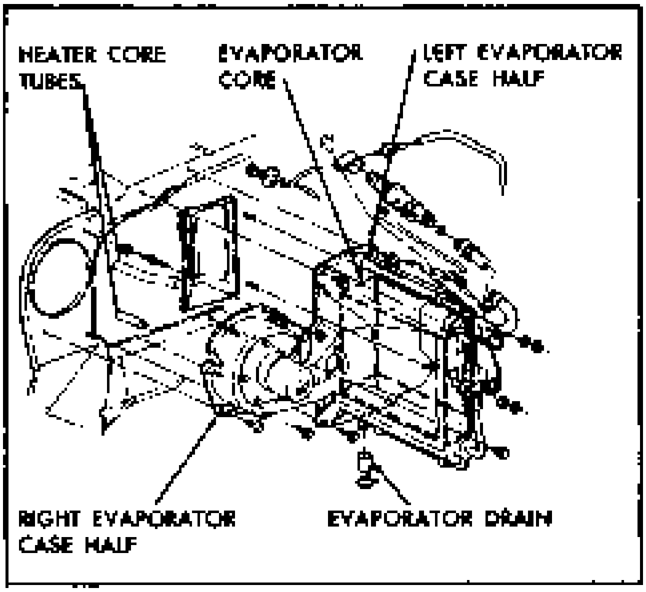


Fig. 1A-48 Typical Evaporator Core and Case Installation

EVAPORATOR CORE

ALL - REMOVE AND REPLACE

1. Depressurize refrigeration system.

2. Disconnect oil bleed and equalizer line at P.O.A. valve.

3. Disconnect P.O.A. inlet and expansion valve outlet fittings and cap all openings.

4 Remove insulation at expansion valve thermo bulb and remove clamps.

5. Disconnect water control valve hoses and remove valve from bracket.

6. Remove screw retaining expansion valve to bracket

7. Remove screws retaining P.O.A. valve to bracket.

NOTE: On Firebird V-8 models remove fender skirt then entire core and case assembly. Then separate case halves to service core.

8. Remove screws retaining left half of case (inboard side) to dash and to right half of case, Fig. 1A-48.

9. Remove spark plug wire bracket.

10. Gently pry case from sealer (if equipped with gasket use care not to destroy).

11. On Tempest V-8, use a long bar and pry up slightly on right side of engine to allow removal of case and on Pontiac models, tilt top of case towards engine. On Firebird and Tempest 6-cylinder models, remove left case half.

12. Remove core.

13. To replace, reverse removal procedure.

14. Use care to reseal case halves and case to dash.

EVAPORATOR CASE LEFT HALF

PONTIAC - REMOVE AND REPLACE

Follow procedure for core removal. Case half can then be removed.

TEMPEST AND GRAND PRIX MODELS - REMOVE AND REPLACE

1. Remove screws attaching left case and separate from dash and right case half. Remove expansion valve bracket retaining screw.

2. Pry gently on case and separate from dash and right case half. On V-8's, use a long bar to lift right side of engine slightly which allows removal of case.

3. Remove case and carefully reseal when replacing.

FIREBIRD 6-CYLINDER MODELS - REMOVE AND REPLACE

1. Remove P.O.A. valve to bracket, disconnect inlet oil bleed and equalizer line, and lay aside.

2. Disconnect resistor and relay wires.

3. Remove case attaching screws, pry loose and remove case. Carefully reseal when assembling.

FIREBIRD 8-CYLINDER MODELS - REMOVE AND REPLACE

1. Depressurize refrigeration system.

2. Remove battery and tray.

3. Remove fender skirt.

4. Disconnect expansion valve inlet and P.O.A. outlet.

5. Remove screws retaining case assembly to dash.

6. Separate case halves and remove core.

7. To replace reverse removal procedure.

NOTE: Position equalizer line close to evaporator case so that engine movement will not cause rocker cover to contact line.

CONDENSER AND SEALS

ALL - REMOVE AND REPLACE

1. Depressurize refrigeration system.

2. Remove front valance panel except on Firebird. On Firebird, remove filler panels from radiator support to bumpers.

3. On GTO models with vacuum headlamps, remove bumper.

4. Remove hood latch and support brace.

5. Remove radiator shroud screws and tip radiator towards fan carefully.

6. Disconnect receiver outlet

7. Disconnect condenser inlet (Figs. 1A-46 and 47).

8. Remove condenser bracket retaining screws.

9. Remove condenser assembly by pulling left side of condenser (driver side) forward and down.

10. Cap all openings.

11. Separate condenser from brackets.

NOTE: Trim excess metal from left hand (driver side) condenser bracket ears with hack saw to ease installation.

12. To replace, reverse removal procedure, add one ounce of refrigerant oil, and purge and recharge system with refrigerant.

RECEIVER DEHYDRATOR

PONTIAC, TEMPEST AND GRAND PRIX - REMOVE AND REPLACE

1. Depressurize system.

2. Remove valance panel.

3. Disconnect inlet and outlet fittings (Figs. 1A-46).

4. Remove bracket retaining screw.

5. Remove front strap.

6. Remove receiver.

7. To replace reverse removal procedure.

8. Evacuate and charge system.

FIREBIRD-REMOVE AND REPLACE

1. Depressurize system.

2. Remove baffle covering receiver dehydrator assembly (Fig. 1A-47)

3. Remove the receiver inlet and outlet connections and attaching screw from bracket.

4. Remove from vehicle and plug openings.

5. To replace reverse removal procedure and add one fluid oz. of refrigerant oil

6. Purge and recharge system with 3-3/4 lbs. refrigerant.

AIR INLET AND VALVE

PONTIAC-REMOVE AND REPLACE

1. Remove lower duct and outlet assembly.

2. Remove right kick pad.

3. Identify and disconnect vacuum hoses.

4. Remove air inlet diaphragm.

5. Remove six air inlet assembly retaining screws (Fig. 1A-49).

6. Remove air inlet assembly by pulling out from bottom and rotating (it may be necessary to pull carpeting out of way).

7. Replace by reversing above procedures, making certain air inlet assembly locating pin is in its proper location.

TEMPEST AND GRAND PRIX - REMOVE AND REPLACE

1. Remove kick panel.

2. Remove vacuum hoses (Fig. 1A-49).

3. Remove cold air distributor duct.

4. Remove inlet assembly retaining screws.

5. Remove blower motor case as outlined under **Blower Motor or Case Removal.**

6. Remove three upper retaining screws.

7. To replace reverse above procedure.

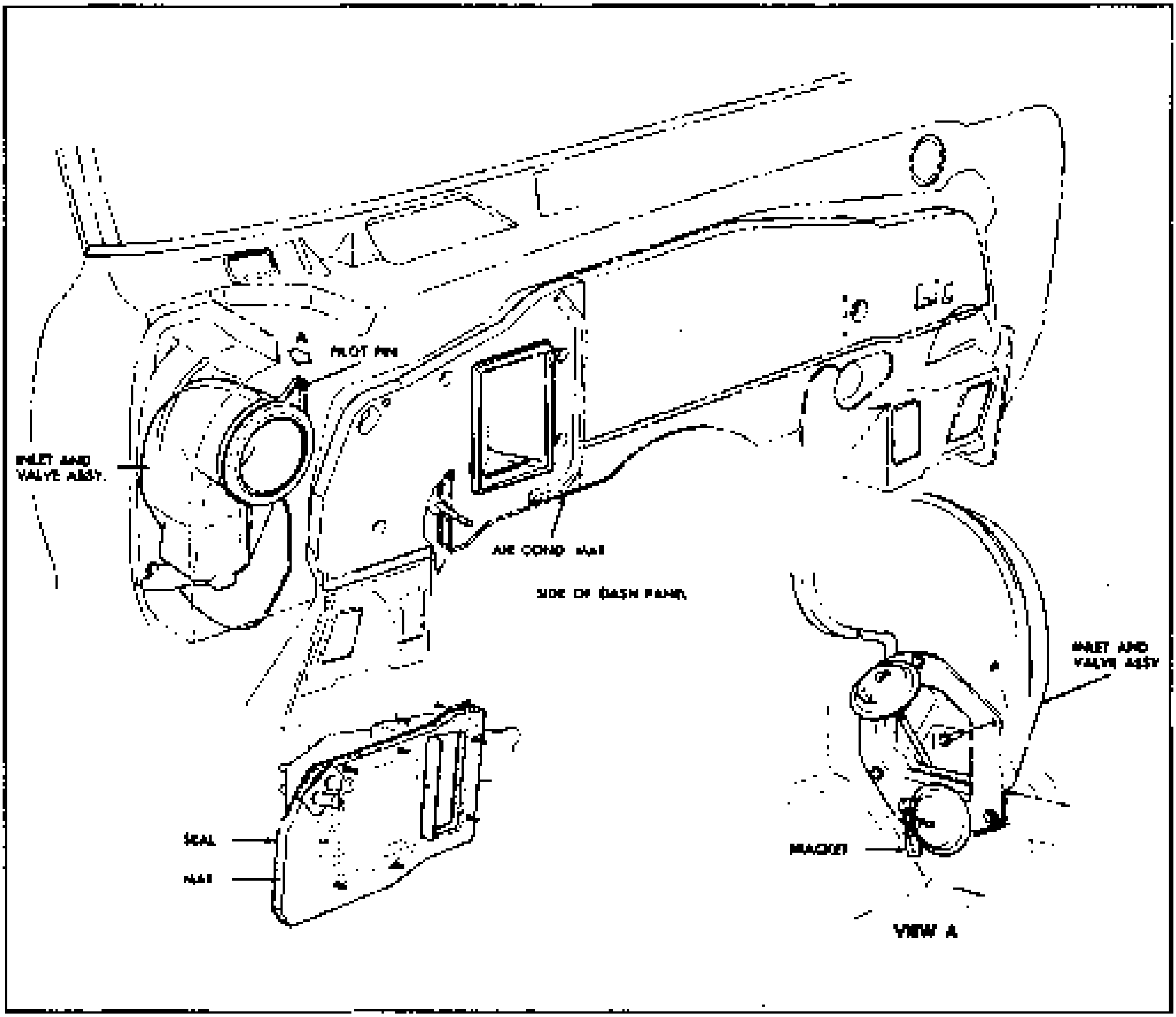


Fig. 1A-49 Air Inlet Assembly Typical Pontiac, Tempest and Grand Prix

FIREBIRD - REMOVE AND REPLACE

Firebird air inlet is composed of two air valves controlled by vacuum diaphragms. One valve is located in the kick pad and the other in the right hand plenum area. Refer to Fig. 1A-50 for service information.

BLOWER MOTOR IMPELLER AND/OR BLOWER MOTOR CASE

ALL-REMOVE AND REPLACE

1. Unclip hoses from fender skirt.

2. Remove rocker molding.

3. Loosen lower rear fender retaining screws to allow bottom of fender to move.

4. Remove fender skirt. (On FIREBIRD first remove battery and tray and then remove fender and skirt as an assembly.)

5. Remove blower motor or inlet duct retaining screws. (If removing inlet duct, remove P.O.A. valve heater hoses and screws retaining duct to right case half.)

6. Remove motor feed wire and cooling tube.

7. Remove motor and impeller.

8. To replace reverse removal procedure.

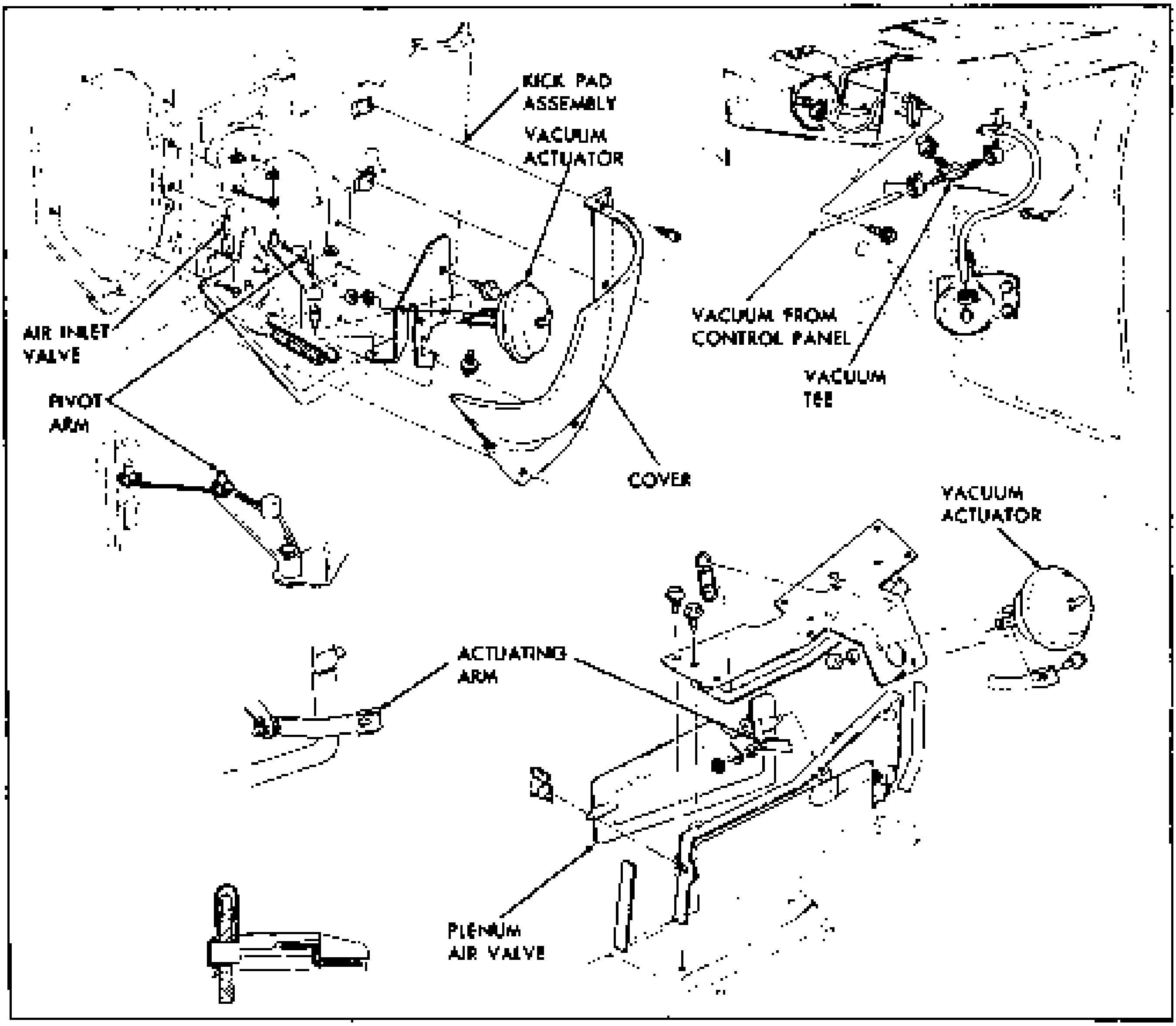


Fig. 1A-50 Firebird - Air Inlet and Plenum Air Valve

HEATER CORE AND CASE ASSEMBLY

ALL - REMOVE AND REPLACE

1. Drain coolant.

2. Remove heater case to cowl attaching nuts (Fig. 1A 51). One some models it may be necessary to drill a On inch hole in fender skirt to gain access to lower nut.

3. Remove two water hoses attached to heater core.

4. Remove lower duct and outlet assembly.

5. Remove glove box.

6. Remove defroster duct attaching screw.

7. Remove screws retaining case to dash.

8. Move core and case assembly rearward to free attaching studs from cowl and remove core and case assembly.

9. Disconnect cables and wire connectors.

10. Adequately mark heater cam and bracket assembly in three places to insure proper reinstallation.

11. Remove heater cam and bracket assembly.

12. Remove front case to rear case attaching screws. 4z1 13. Separate front and rear case.

14. Remove screws retaining core attaching bands and remove core.

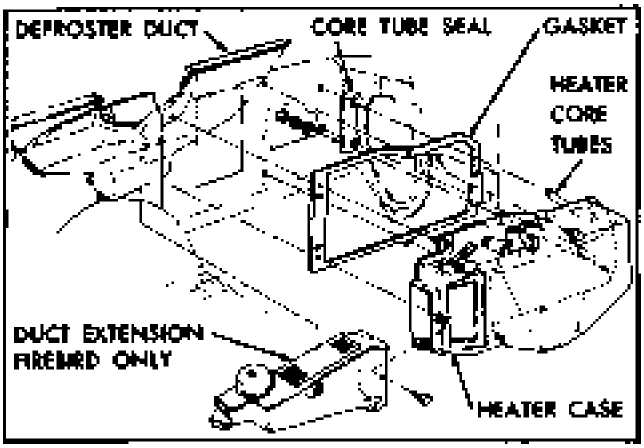


Fig. 1A-51 Typical Heater Core and Case Installation

15. Replace by reversing the above procedure and plug hole in fender skirt using a one inch plastic plug.

ALL-REMOVE AND REPLACE

1. Remove glove compartment on all except Grand Prix.

2. Scribe alignment marks on case for cam placement.

3. Remove control cable.

4. Remove cam hold down screws

5. Remove cam.

6. To replace reverse removal procedure.

7. Adjust cable.

TEMPERATURE CABLE

ALL - REMOVE AND REPLACE

1. Remove cold air duct.

2. Remove glove compartment and disconnect cable at heater case (Fig. 1A-52, 53, 54 and 55).

3. Disconnect cable at control panel.

models it will be necessary to remove radio for this operation.

4. To replace reverse removal procedure.

ALL - TEMPERATURE CABLE ADJUST

Temperature cables on all standard air conditioned models are Bowden type with an adjusting turnbuckle. Rotating the turnbuckle in one direction extends the outer sleeve and rotating in the other direction shortens the sleeve. Adjustment procedures are listed for Pontiac, Tempest, Firebird and Grand Prix models on Figs. 1A-52, 53, 54 and 55 respectively.

CONTROL PANEL

Control panels used on all models are of the slide lever design. The select lever provides the mode of operation. The temperature lever moves the temperature door to control incoming air temperature. The blower lever controls blower speed. The vent lever controls compressor operation and will turn on the compressor whenever the select lever is moved. The lever may then m be moved to vent to turn off the compressor. Serviceable items include the rotary vacuum valve, water control valve, master switch, blower switch, compressor switch and panel face.

ALL - REMOVE AND REPLACE

1. Remove lower duct and outlet assembly.

2. Remove radio.

3. Remove wire and vacuum connections.

NOTE: Identify wire connectors to switches and vacuum connectors for correct reassembly and remove.

4. Remove control panel retaining screws (nuts on Tempest).

5. Lower control panel assembly.

6. Remove temperature control cable and remove control.

To service components of the control panel see Figs. 1A-56, 57, 58 and 59 for Pontiac, Tempest, Firebird and Grand Prix models respectively.

HI BLOWER RELAY; RESISTOR BLOCK; AND AMBIENT SWITCH

ALL - REMOVE AND REPLACE

Fig. 1A-60 shows the location of the relay, resistor block and ambient switch. All three items are retained by two (2) screws.

The ambient switch should open when ambient temperature lowers to approximately 32°F which would shut off the compressor. Resistance values, in ohms, are shown on the A/C wiring schematic at the end of this section for each model.

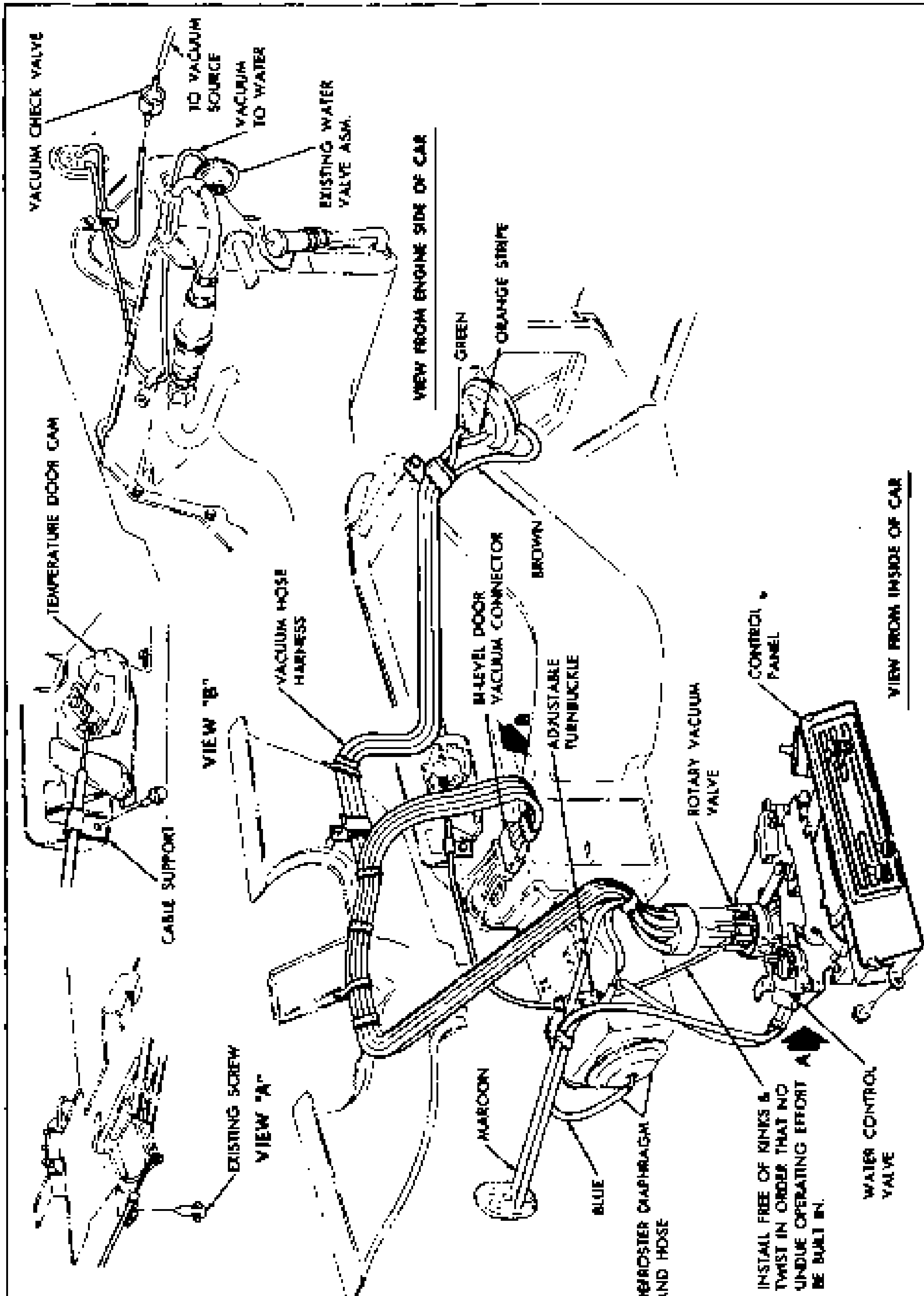


Fig. 1A-57 Pontiac Air Conditioning Control Cable and Vacuum Hoses

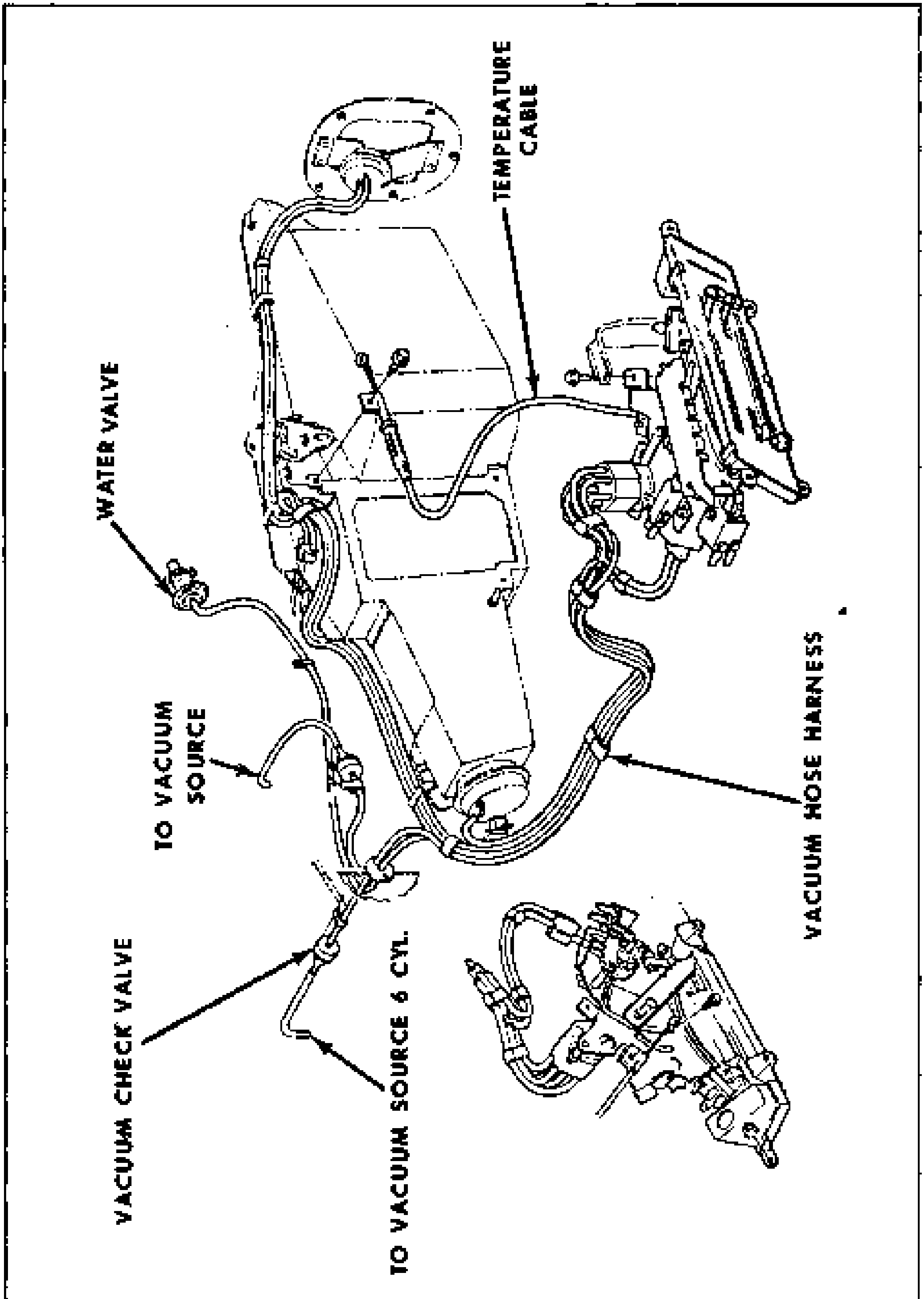


Fig. 1A-53 Tempest - Air Conditioning Control Cable and Vacuum Hoses

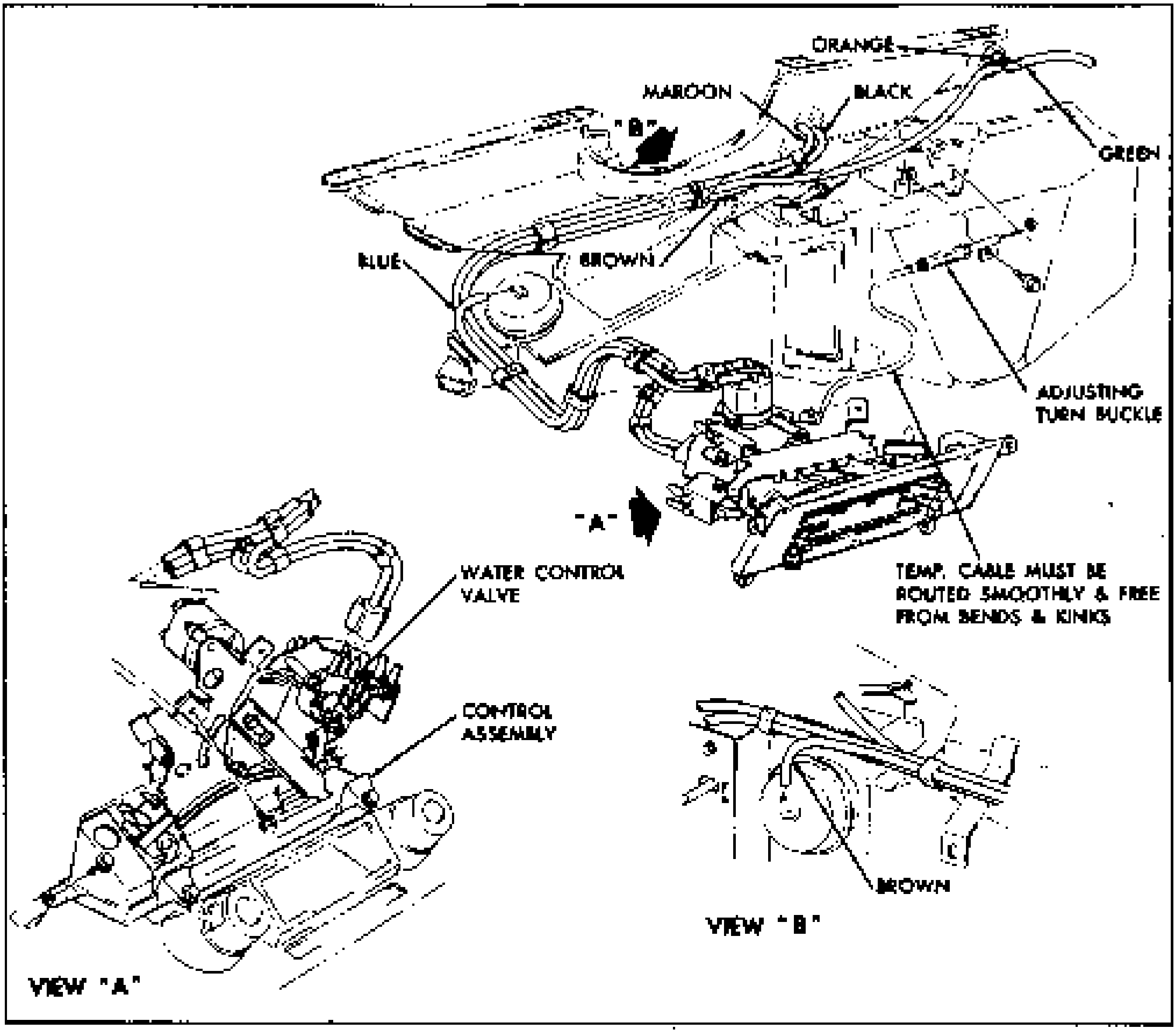


Fig. 1A-54 Firebird - Air Conditioning Control Cable and Vacuum Hoses

A/C ENGINE COMPARTMENT AND JUMPER HARNESSES

Fig. 1A-60 shows the routing of the A/C engine harness. This harness joins the in-car A/C harness through a rubber grommet just to the left of the evaporator assembly. The jumper lead used on V-8 models provides power to the compressor and blower via a 30 amp line fuse from the generator.

When servicing use care to route the harness as shown in Fig. 1A-60.

DIVERTER DOOR DIAPHRAGMS

ALL - REMOVE AND REPLACE

1. Remove heater case assembly.
2. Remove vacuum hoses noting arrangement.
3. Remove retaining screws.
4. Remove actuator link attaching screw.
5. Remove diaphragms.

DEFROSTER DIAPHRAGM

PONTIAC, TEMPEST AND GRAND PRIX - REMOVE AND REPLACE

1. Remove heater outlet duct.
2. Remove two retaining screws and actuator link retaining screw.

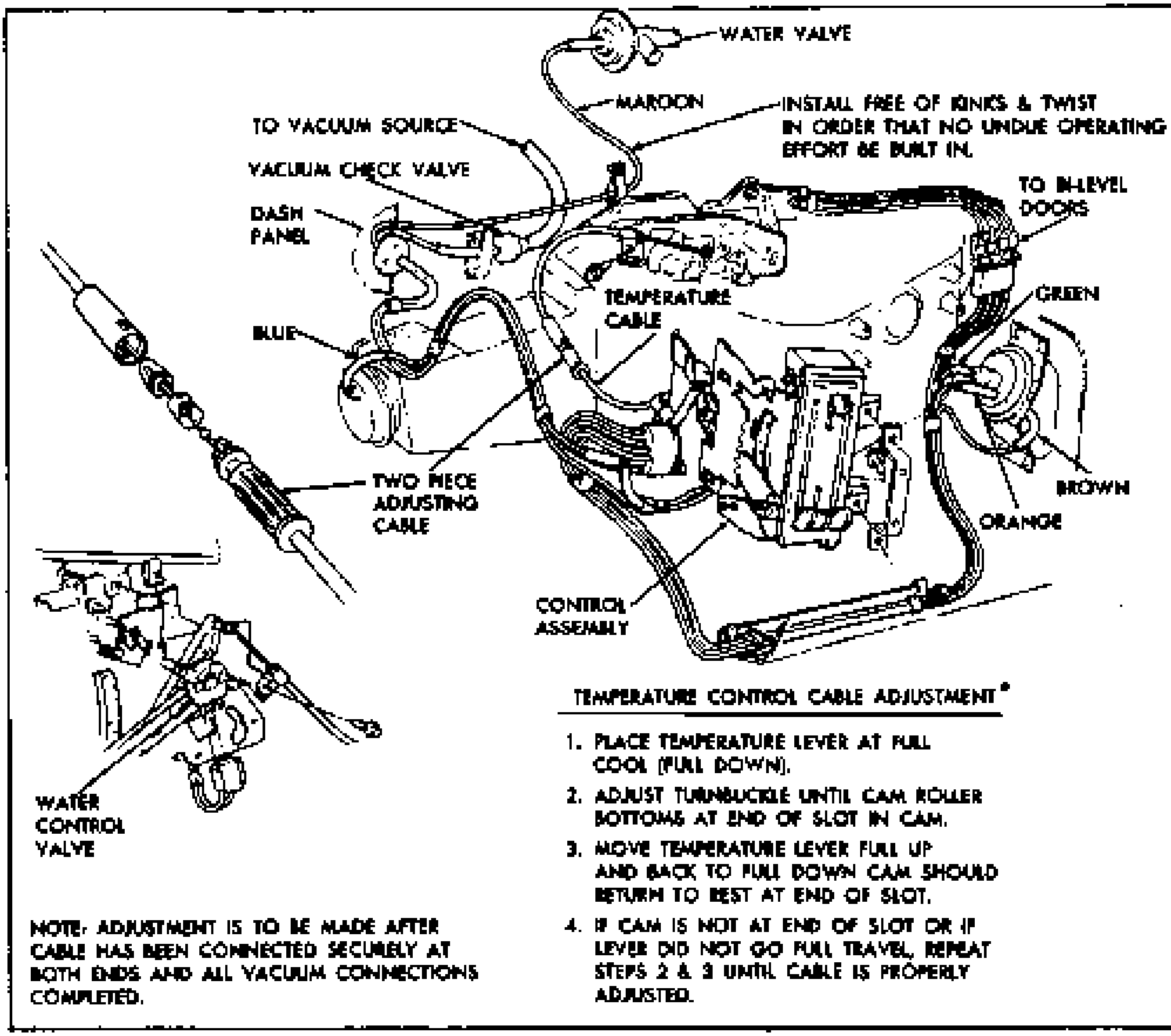


Fig. 1A-55 Grand Prix - Air Conditioning Control Cable and Vacuum Hoses

3. Remove vacuum hose, then diaphragm.

4. To replace, reverse removal procedure.

AIR INLET DIAPHRAGMS

ALL - REMOVE AND REPLACE

1. Remove kick panel.

2. Remove vacuum hoses.

3. Remove two attaching screws.

4. Remove link actuator attaching screws.

5. Remove diaphragm.

6. To replace, reverse removal procedure.

PLENUM AIR VALVE DIAPHRAGM

FIREBIRD - REMOVE AND REPLACE

1. Remove windshield wiper arms.

2. Remove air vent grille.

3. Remove attaching screws and link actuator screw.

4. Remove diaphragm.

5. To replace, reverse above procedure.

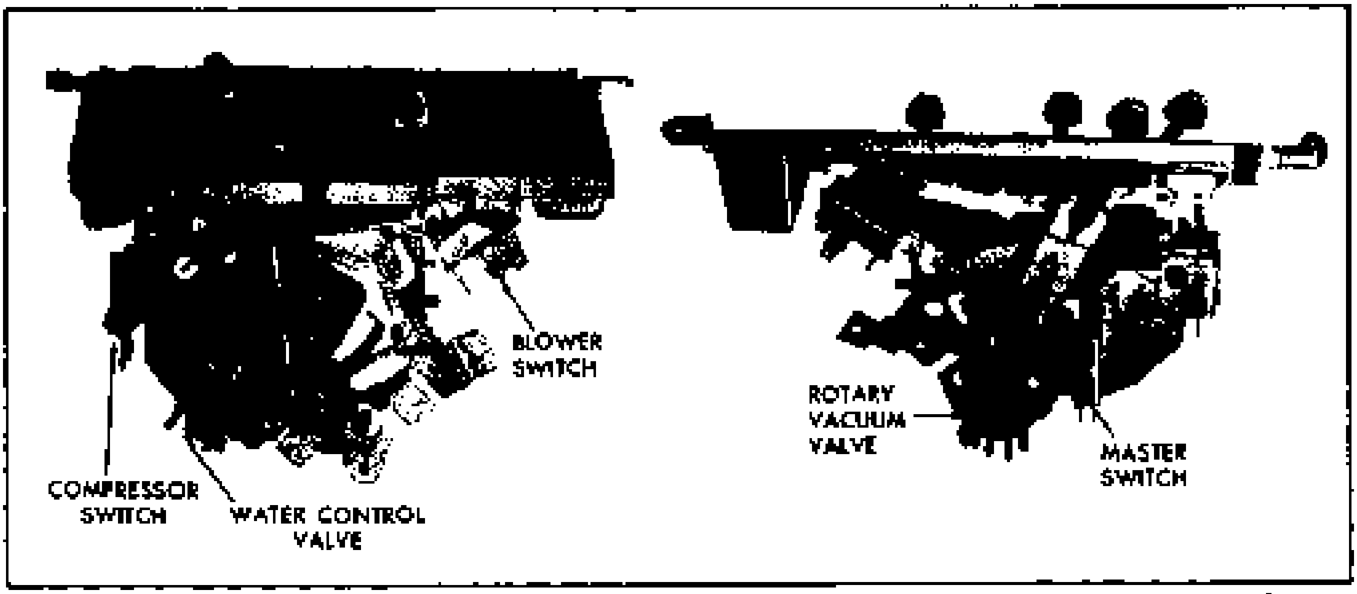


Fig. 1A-56 Pontiac Control Panel Details

COLD AIR DISTRIBUTION; CENTER AIR OUTLET; AND SIDE OUTLET DUCTS

ALL - REMOVE AND REPLACE

When servicing cold air, center air outlet or side outlet ducts refer to Figs. 1A. 61, 62, 63 and 64. All duct systems are of the same basic design. Air from the heater case is directed to the cold air distributor duct then to the center and side outlets. All of the five (5) outlets have adjustable nozzles.

Right and left hand nozzles on Pontiac models may be removed by inserting a thin blade screwdriver approximately 3/4 inch between instrument pad and upper edge of nozzle to disengage two retaining tabs. There is a tab on each corner.

On Tempest models, insert screwdriver in same position as Pontiac, however, the blade need only be inserted a short distance since tabs are directly behind front of nozzle.

Nozzles on Grand Prix models are retained by two metal clips, one on each side.

The nozzle may be removed by inserting a screwdriver into the nozzle and disengaging.

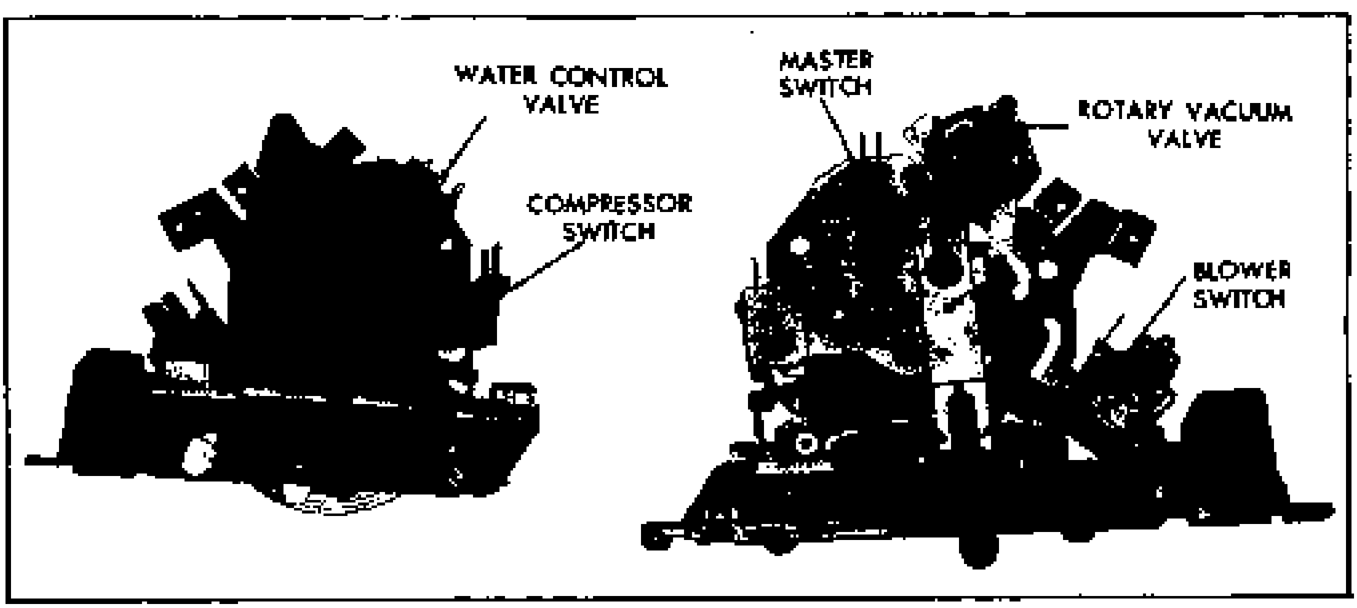


Fig. 1A-57 Tempest Control Panel Details

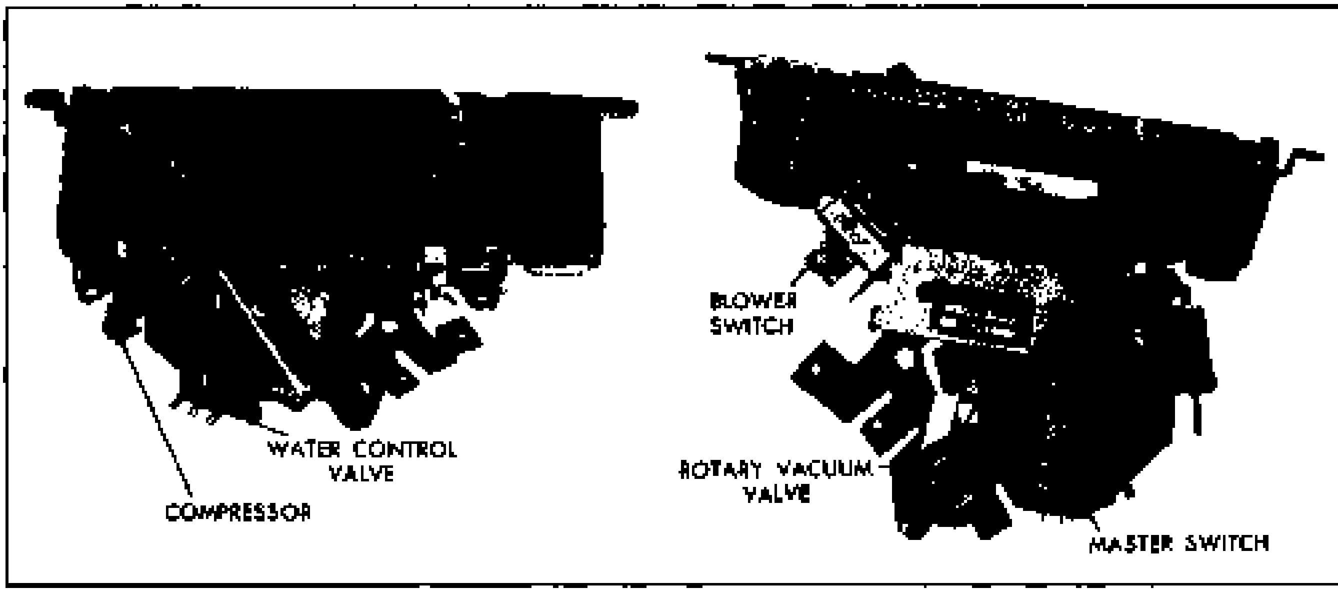


Fig. 1A-58 Firebird - Control Panel Details

VACUUM HOSE HARNESS

ALL - REMOVE AND REPLACE

Vacuum hoses supply vacuum to the various air control doors. These hoses are contained in a harness, which is routed as shown in Figs. 1A-52, 53, 54 and 55. Vacuum schematics for these systems are shown in Figs. 1A-69, 70, 71.

IN CAR A/C WIRING HARNESS

ALL - REMOVE AND REPLACE

The In-Car A/C wiring harness connects the control panel switches to the A/C engine harness. The system receives control power from the power feed connector (brown lead to instrument panel harness). To service the harness refer to Fig. 1A-65 which shows typical harness connections and routing.

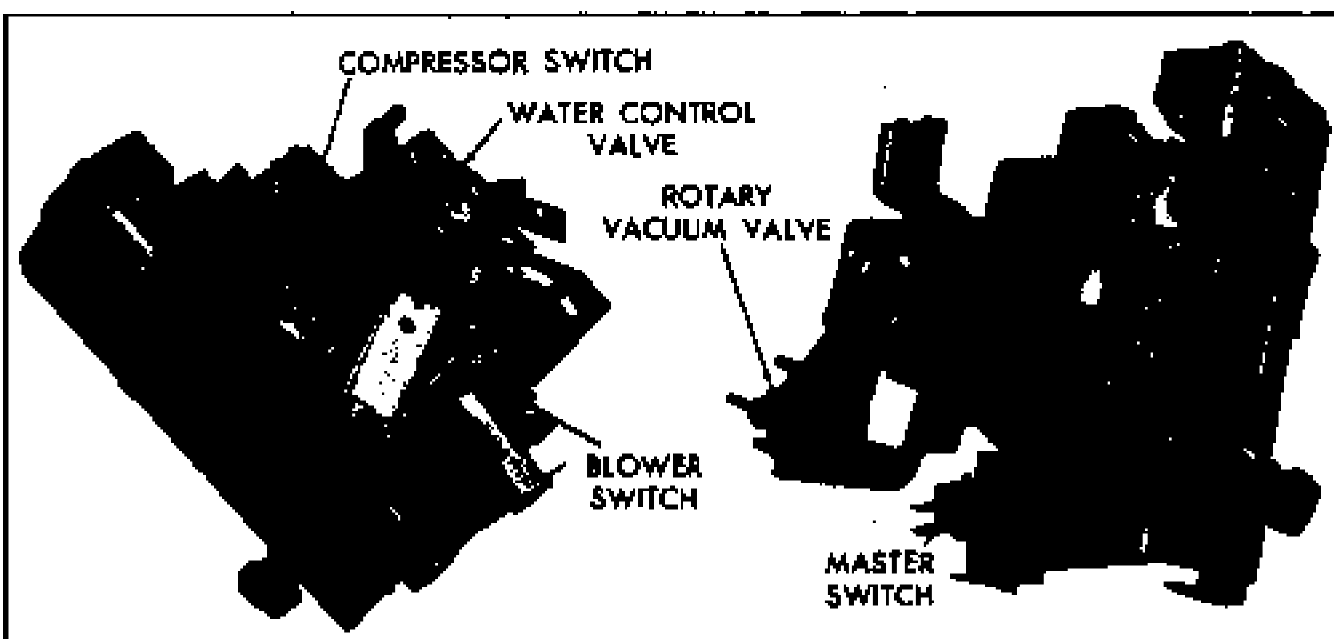


Fig. 1A-59 Grand Prix - Control Panel Details

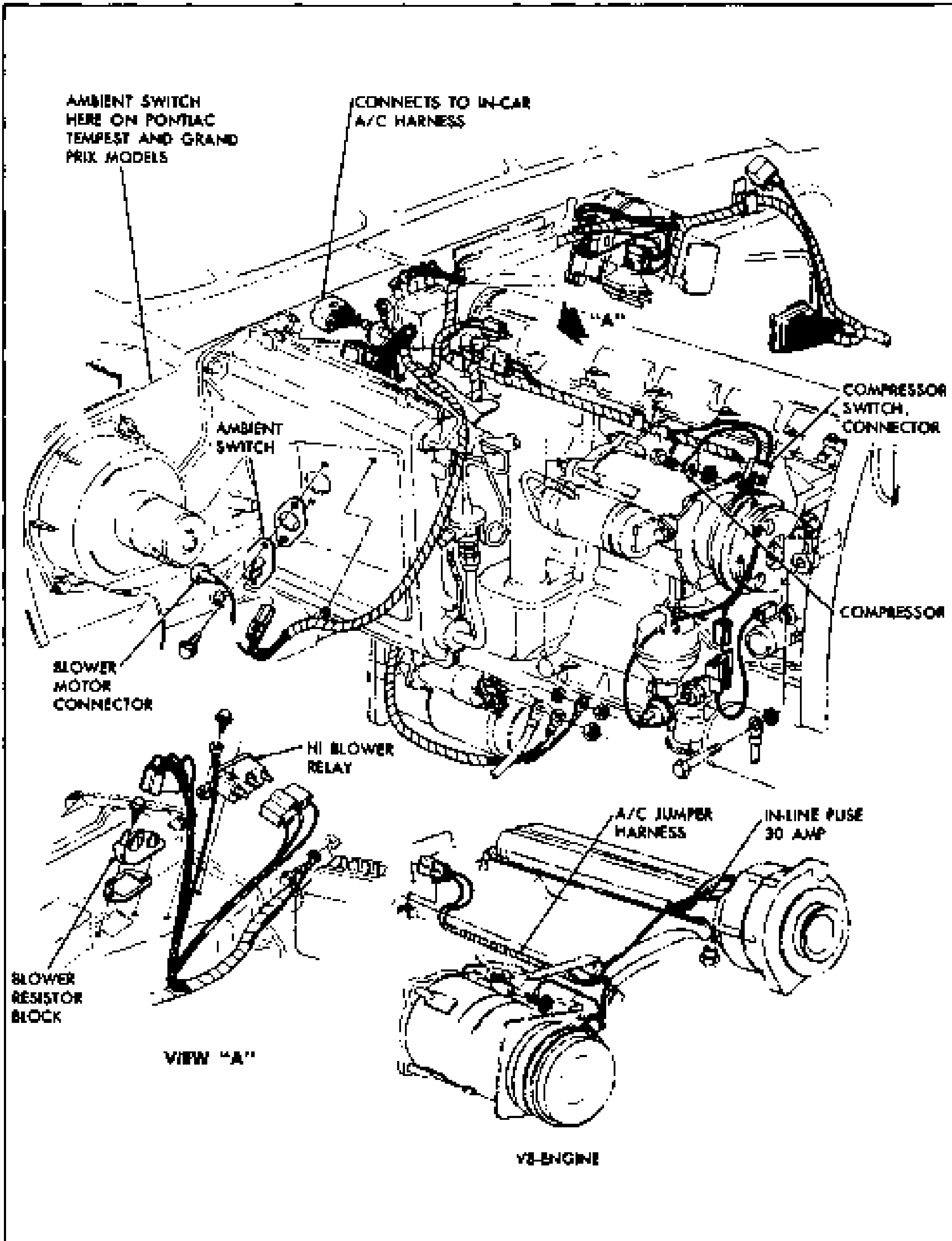


Fig. 1A-60 Typical A/C Engine Harness Installation

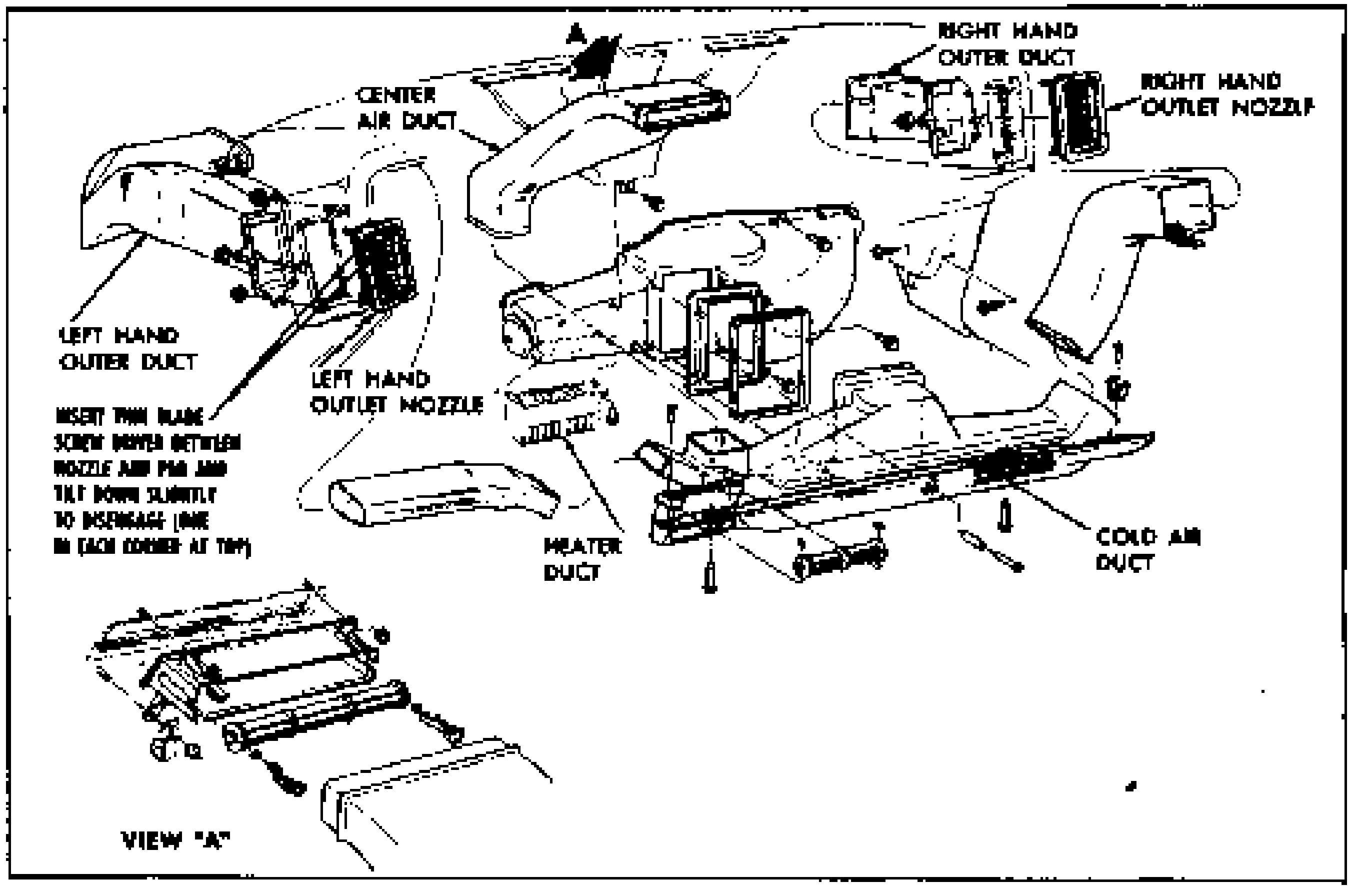


Fig. 1A-61 Pontiac - Air Distribution System

COMPRESSOR MOUNTING AND BELT ADJUSTMENT

ALL - REMOVE AND REPLACE OR ADJUST BELT

Follow detailed instructions on illustration for compressor belt adjustment, Fig. 1A-66 for V8 engines and Fig. 1A-67 for six cylinder engines.

AIR CONDITIONING WIRING SCHEMATIC

The wiring schematic of Fig. 1A-68 is common to all 1969 standard air conditioned cars. Note that each model has a specific resistor block and that the resistance values are shown in the lower left hand corner. Values for A can be obtained by connecting a previously calibrated ohm meter across terminal 1 and 2 on the resistor. B and C can be measured similarly.

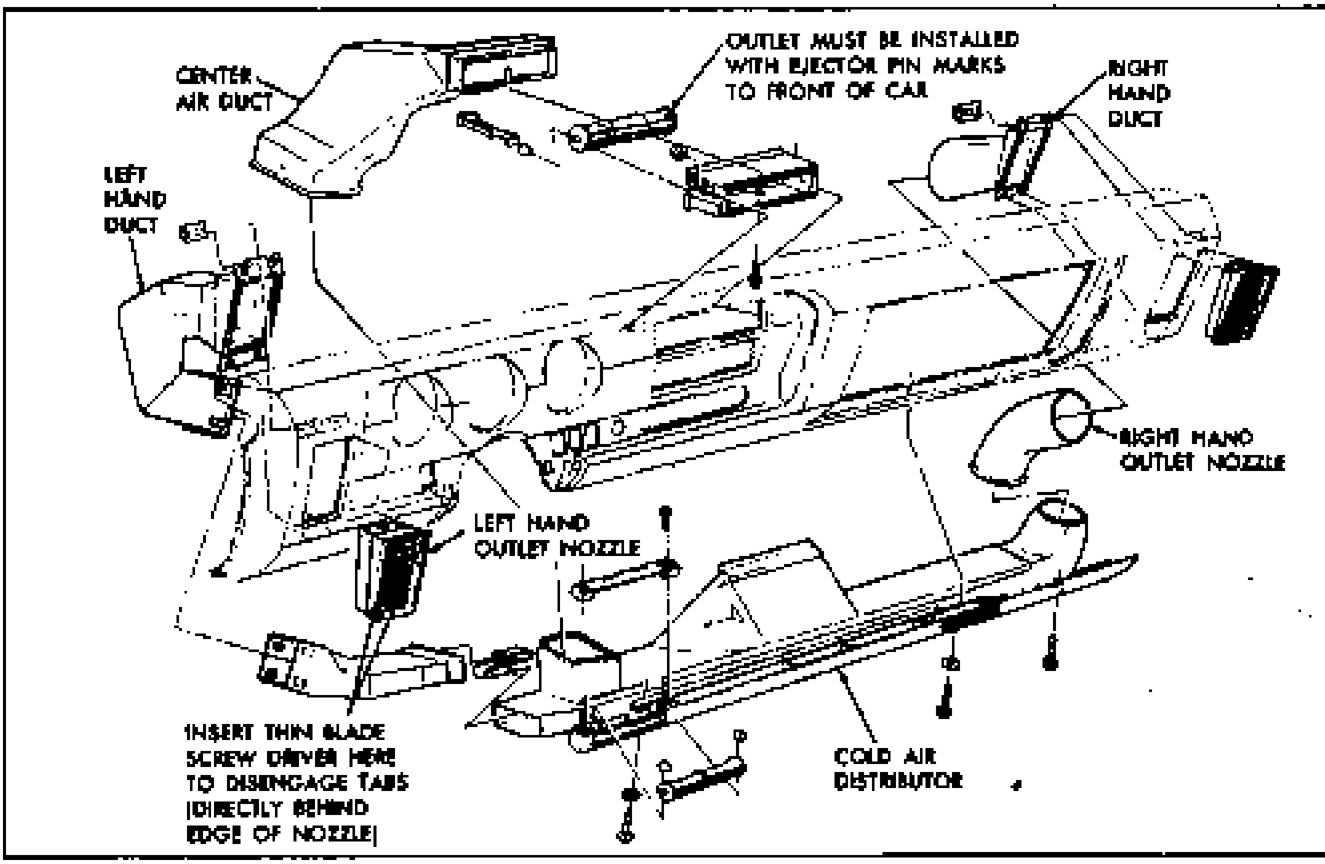


Fig. 1A-62 Tempest - Air Distribution System

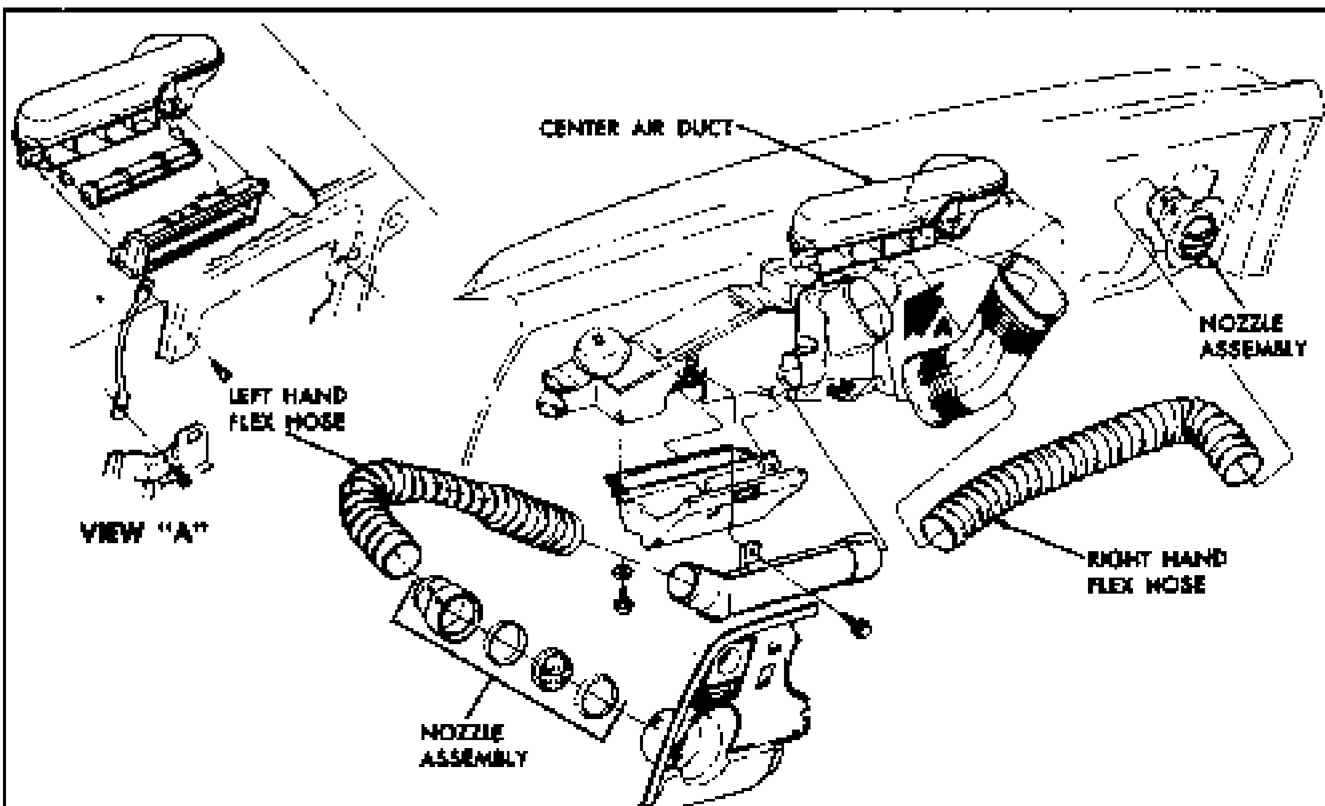


Fig. 1A-63 Firebird - Air Distribution System

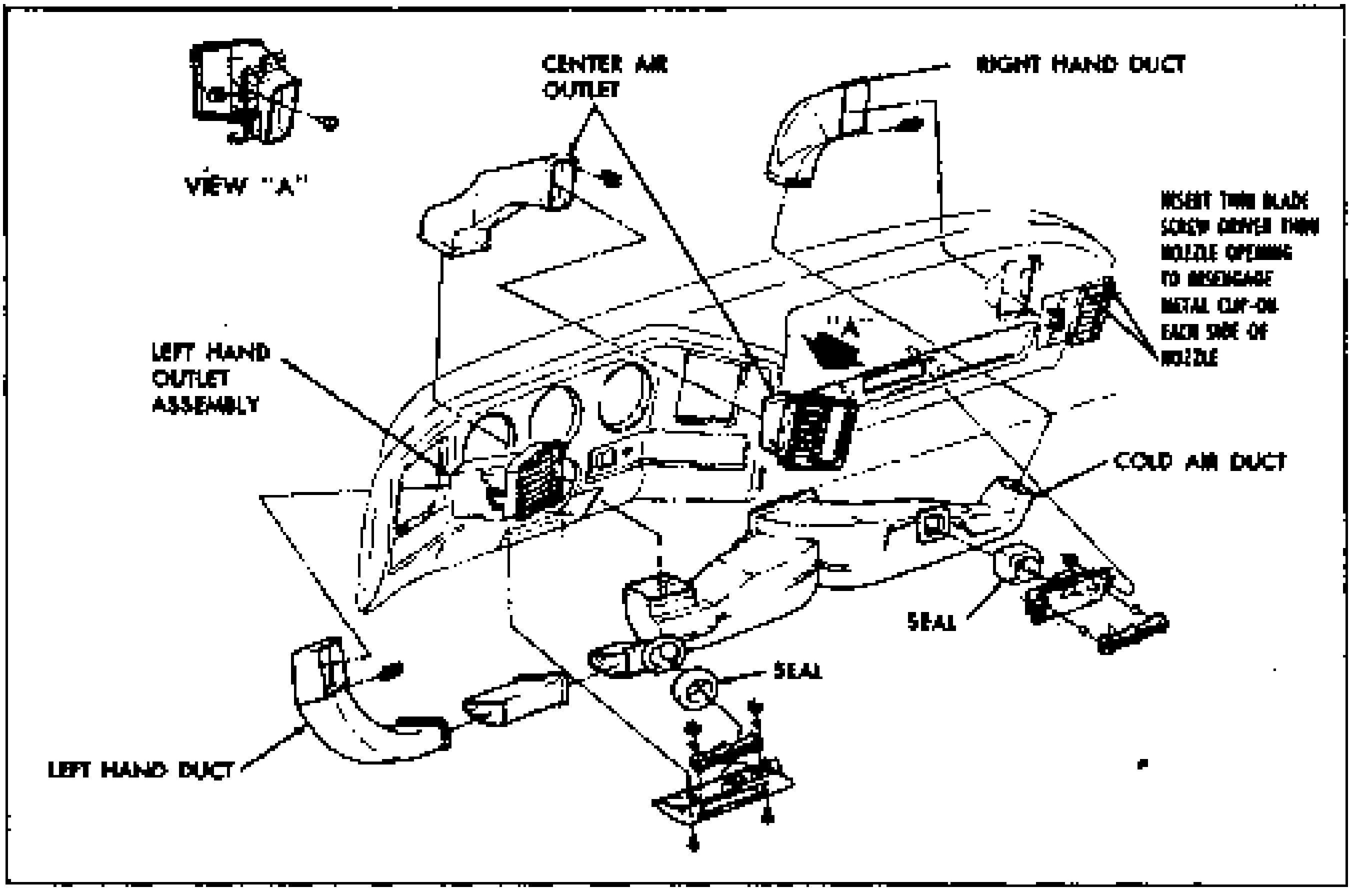


Fig. 1A-64 Grand Prix - Air Distribution System

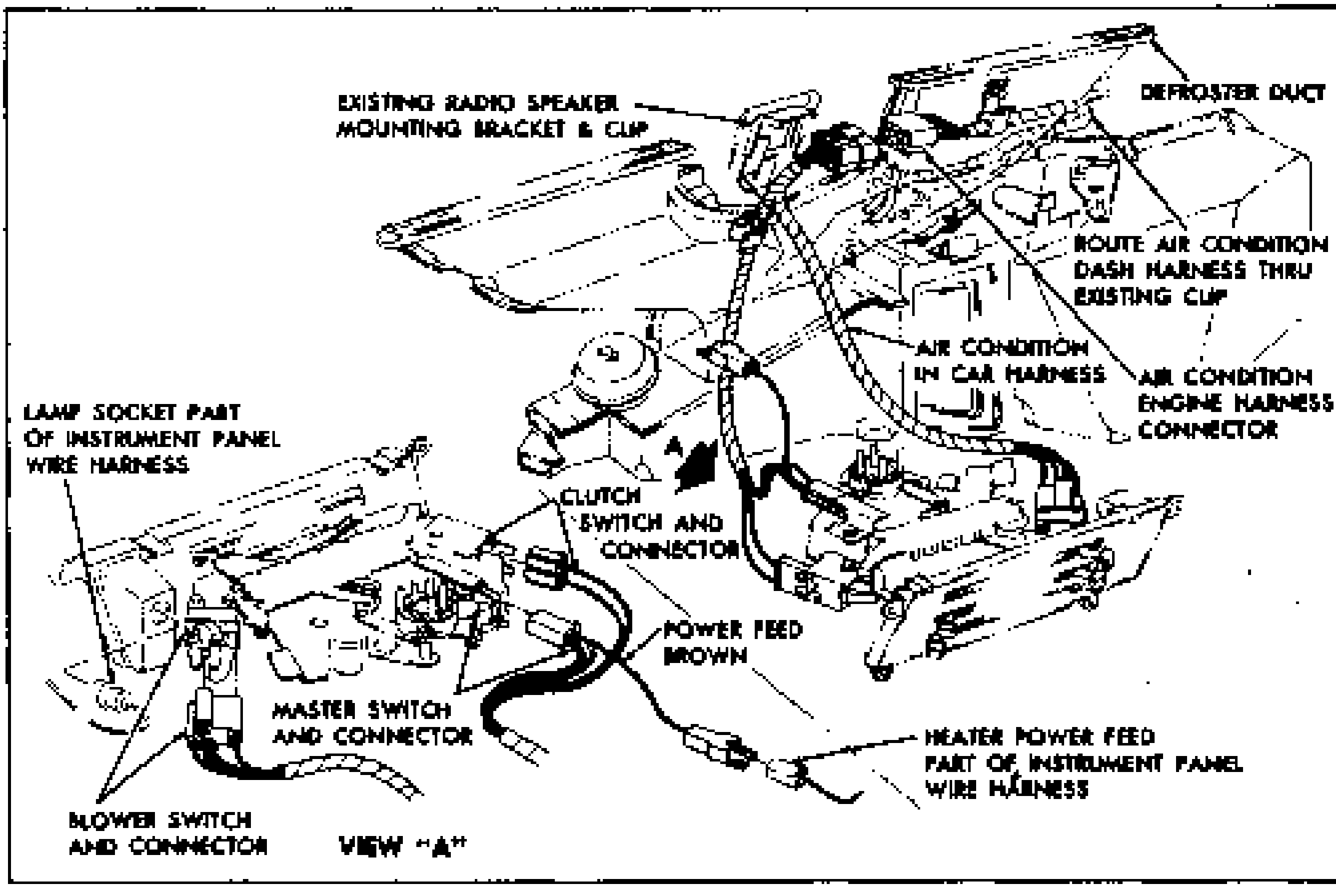


Fig. 1A-65 Typical - A/C In Car Harness Routing And Connections

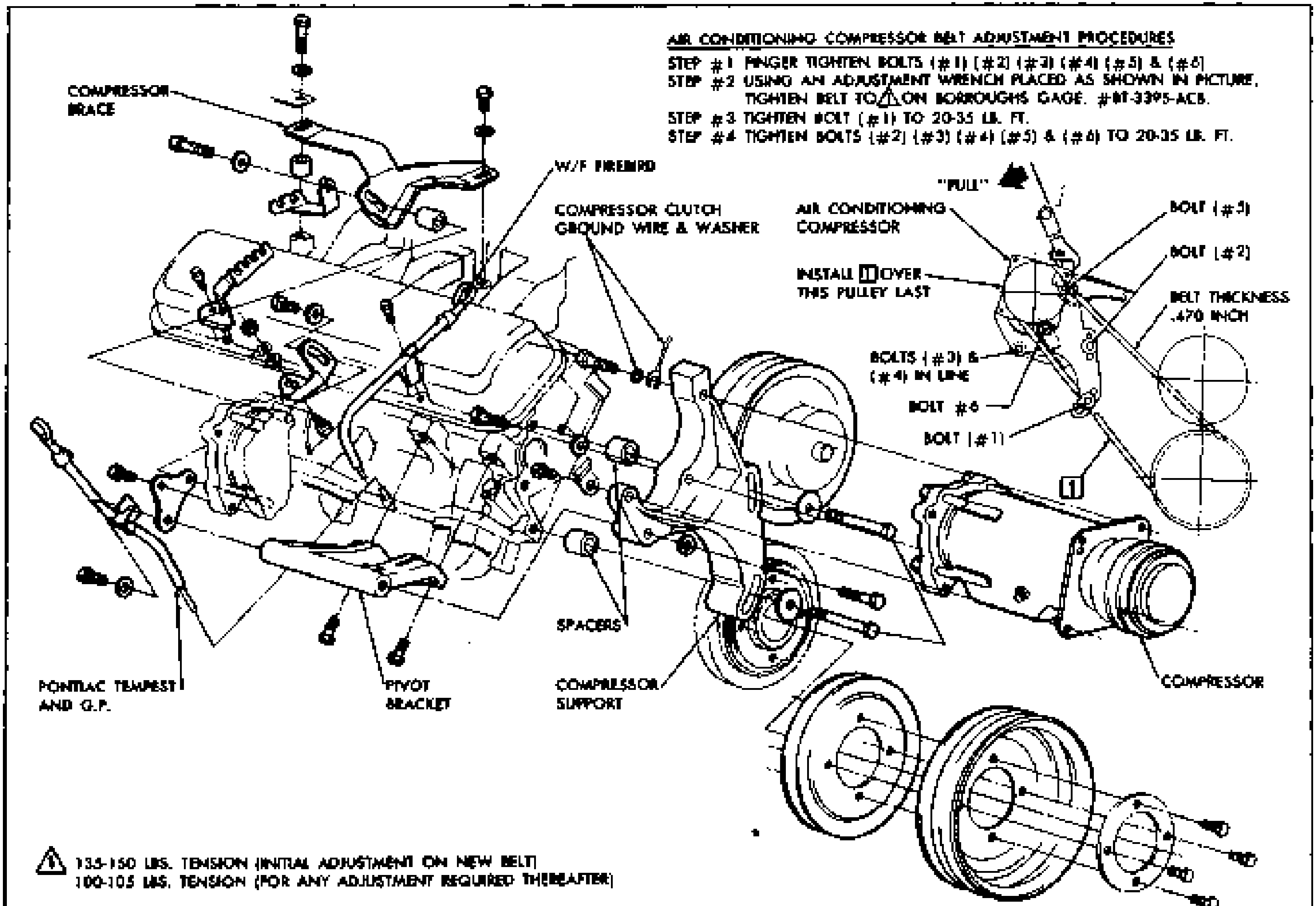


Fig. 1A-66 Typical Compressor Installation V-8 Models

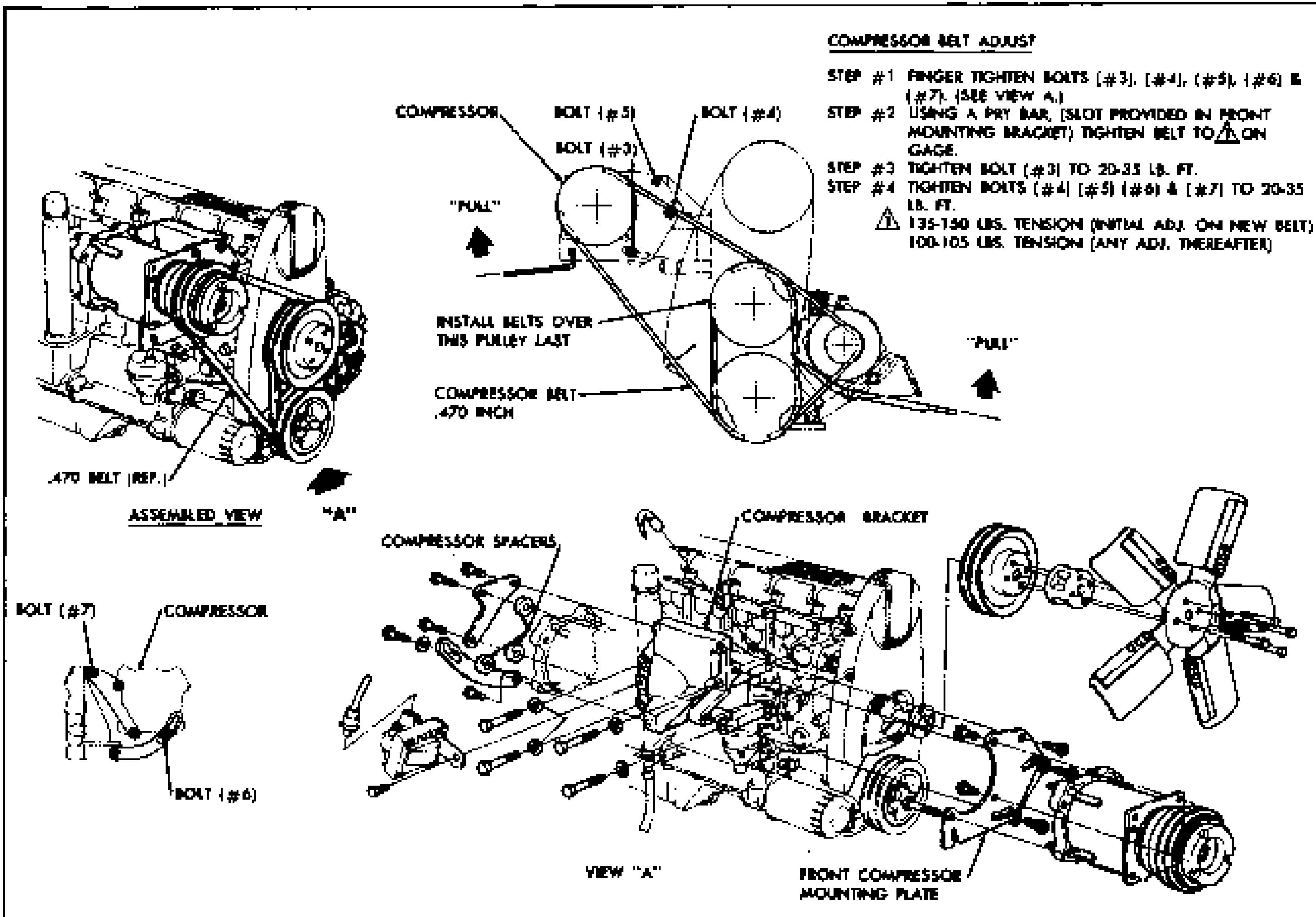
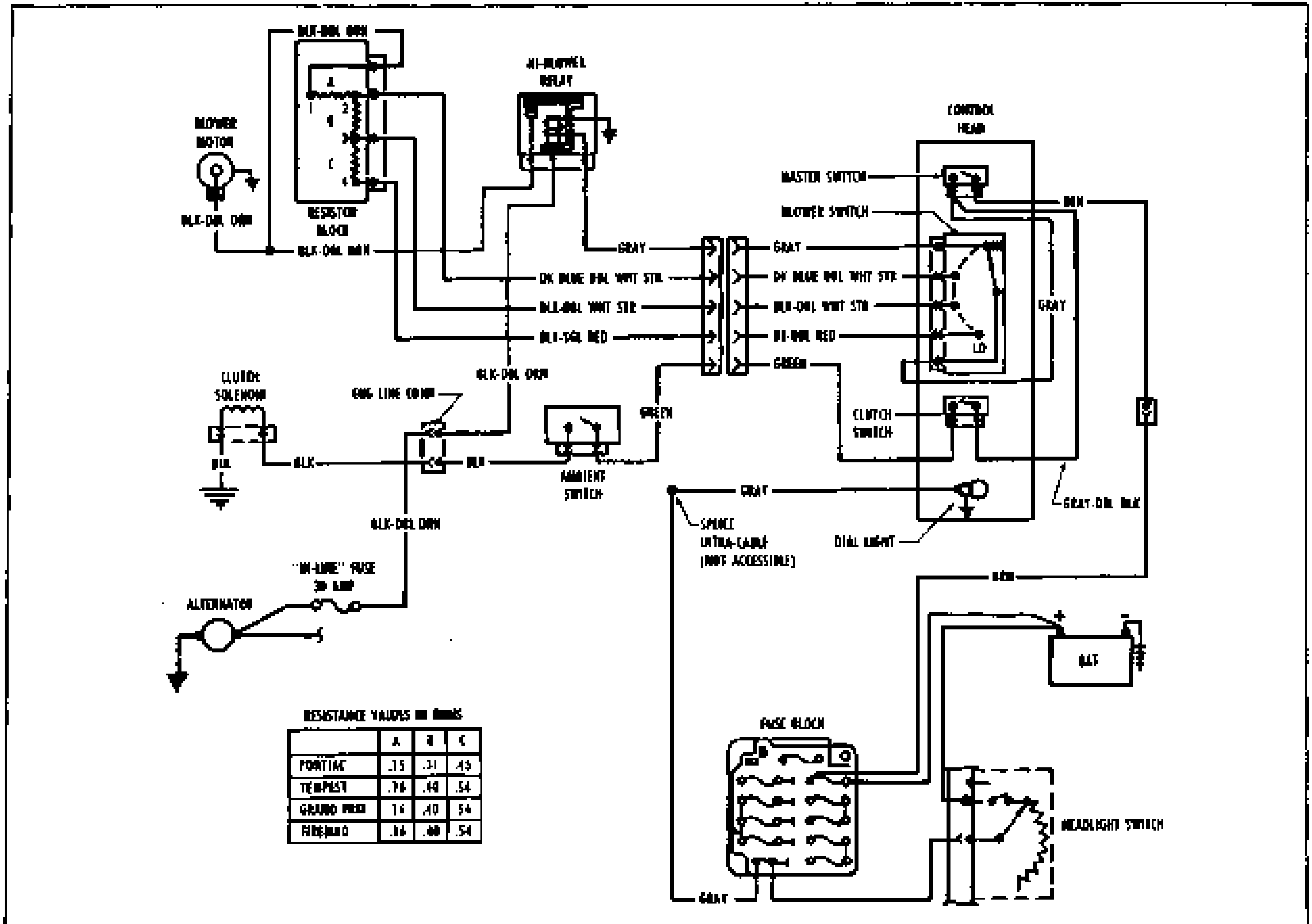


Fig. 1A-67 Typical Compressor Installation 6-Cyl. Models



RESISTANCE VALUES IN OHMS

	A	B	C
PONTIAC	.15	.31	.43
TEMPEST	.16	.40	.54
GRAND PRIX	16	.40	54
FIREBIRD	.16	.40	.54

Fig. 1A-68 Air Conditioning Wiring Shcematic - All

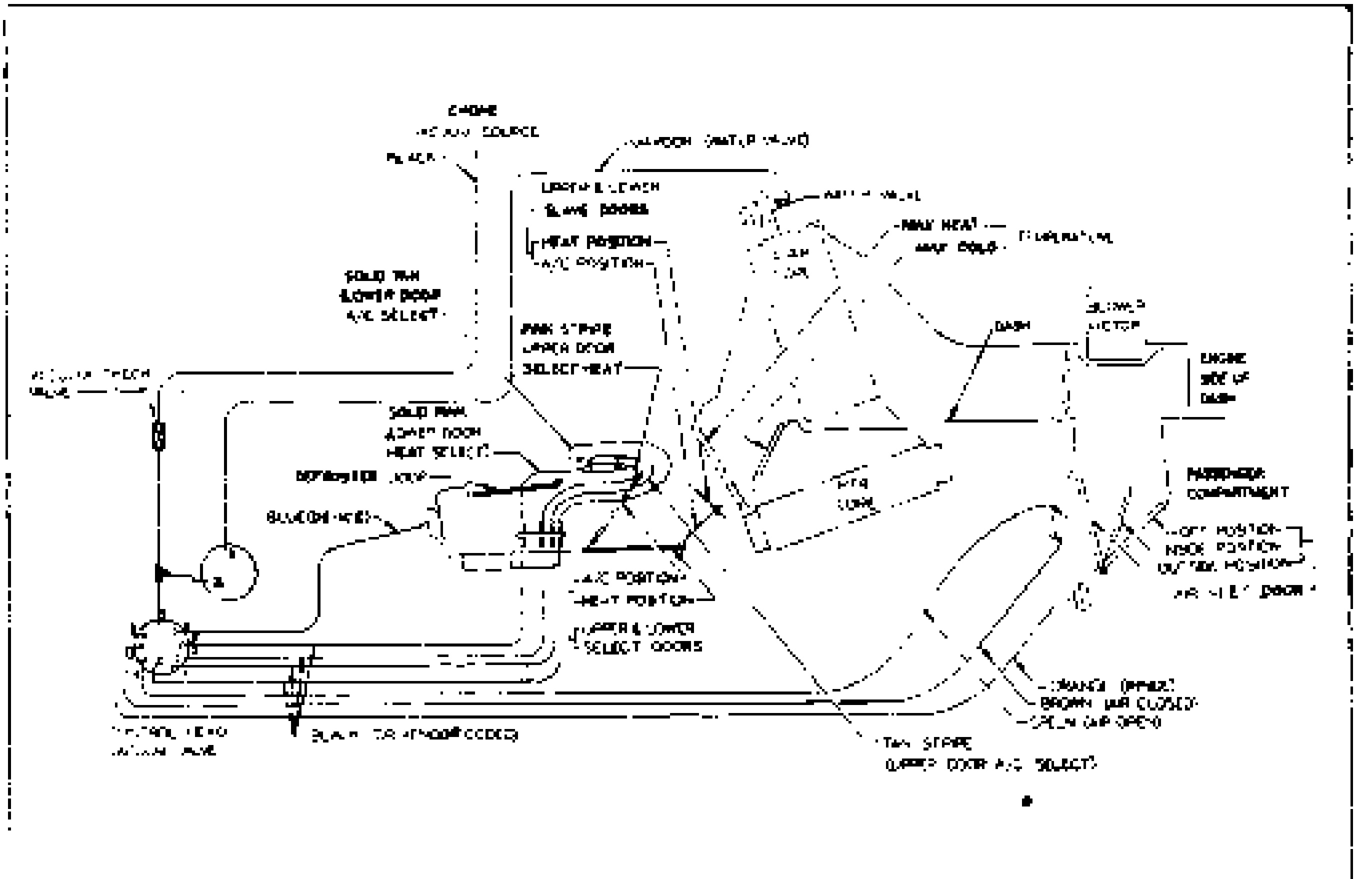


Fig. 1A-69 Typical Pontiac and Grand Prix Vacuum Schematic

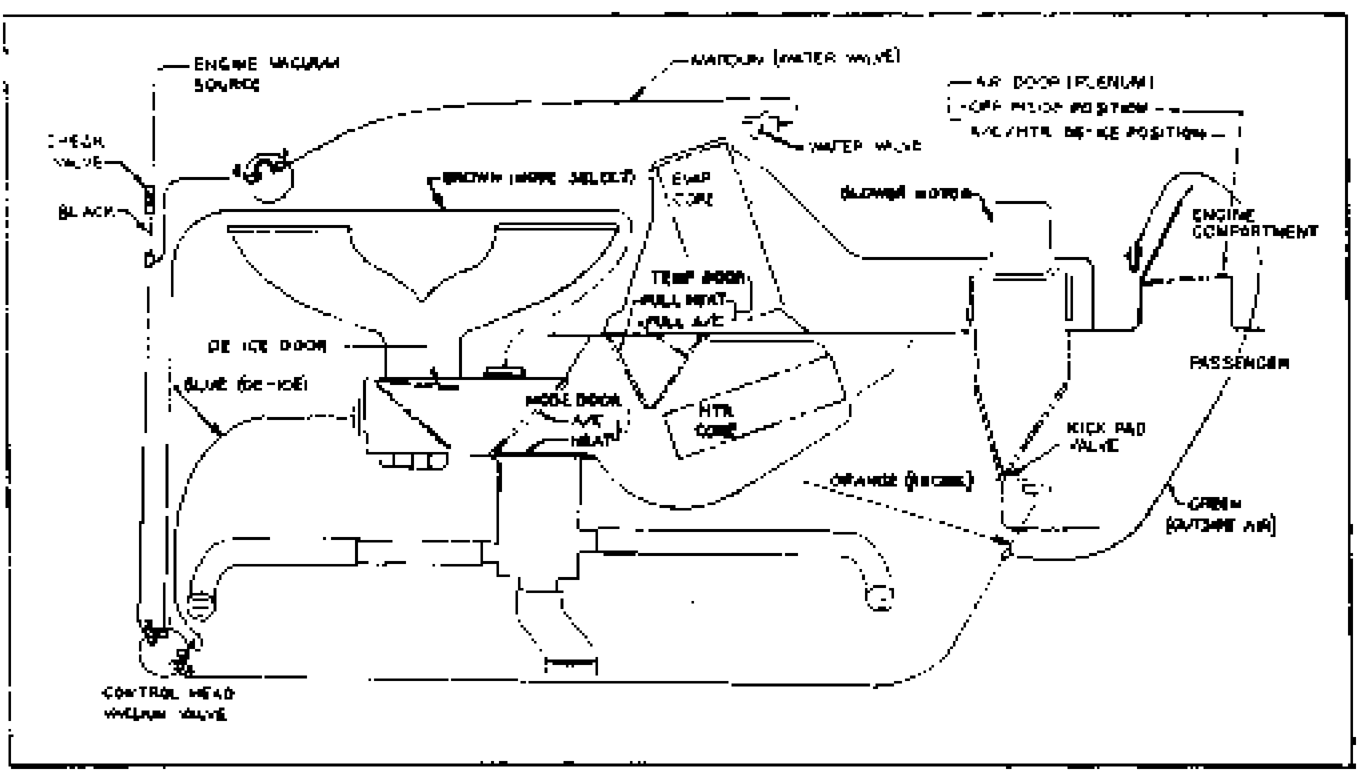


Fig. 1A-70 Tempest Vacuum Schematic

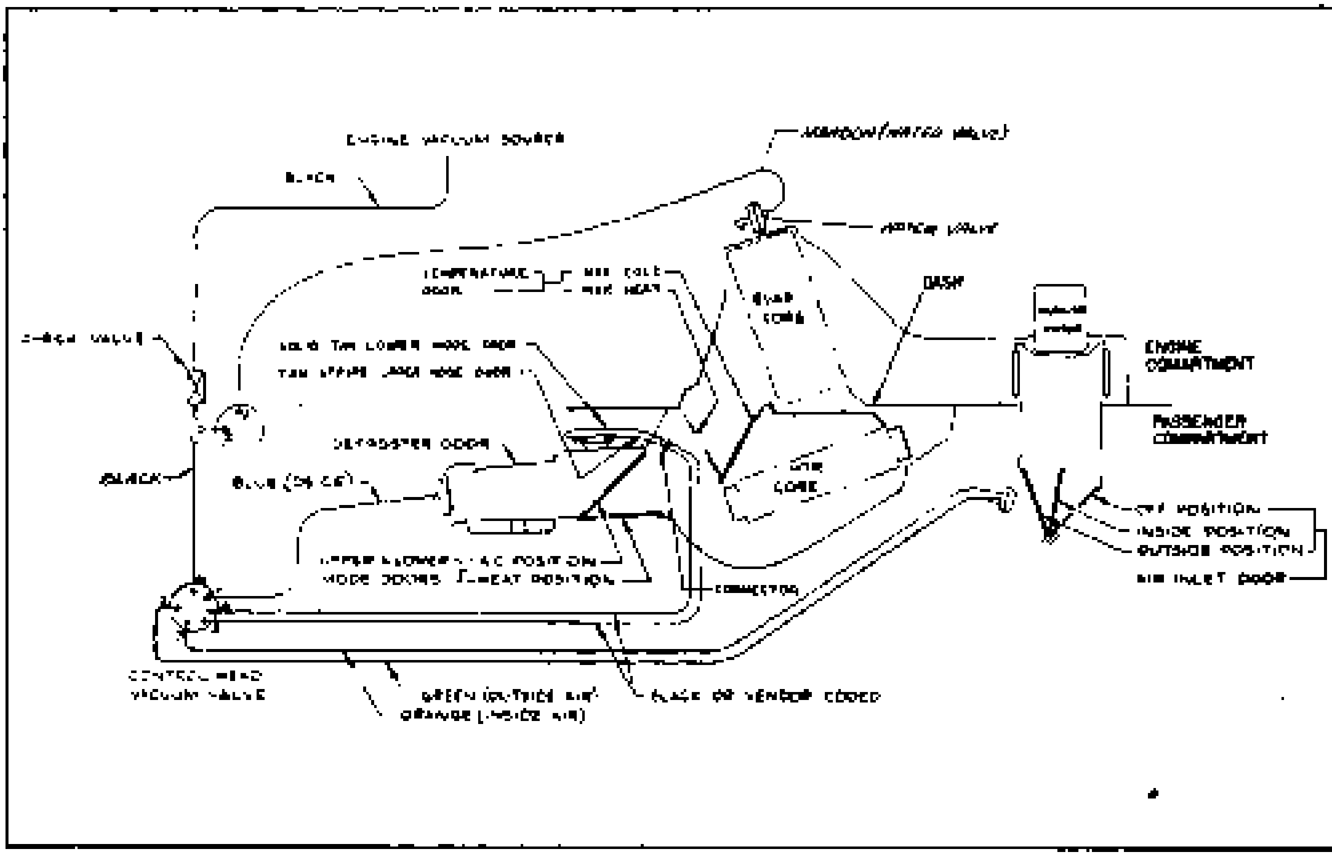


Fig. 1A-71 Firebird Vacuum Schematic

AUTOMATIC TEMPERATURE CONTROL

CONTENTS OF THIS SECTION

The Automatic Temperature Control system, A.T.C., is an option offered with air conditioning on all Pontiac and Grand Prix models. The A.T.C. system controls in-car temperature automatically by utilizing two thermistors (temperature sensing devices) and a variable resistor in the control panel (controled by operator).

The refrigeration portion of the A.T.C. system is the same as the Custom Air Conditioning system and can be serviced by referring to the appropriate section.

IN-CAR SENSOR

ALL - REMOVE AND REPLACE

1. Remove glove box on Pontiac and cold air duct on Grand Prix models.

2. Remove wire connector (Fig. 1B-1)

3. Remove aspirator hose

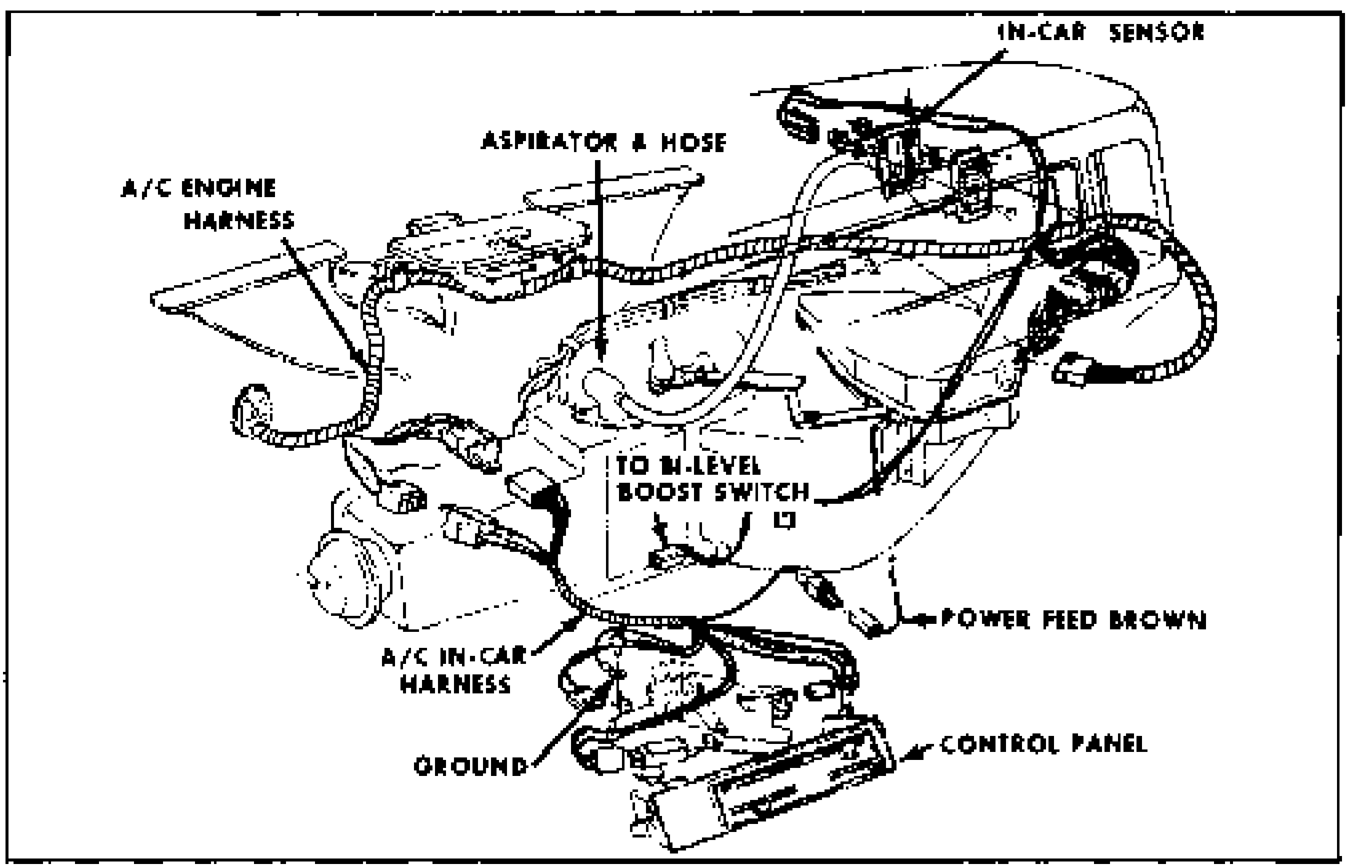


Fig. 1B-1 Automatic Temperature Control-In Car Wire Harness

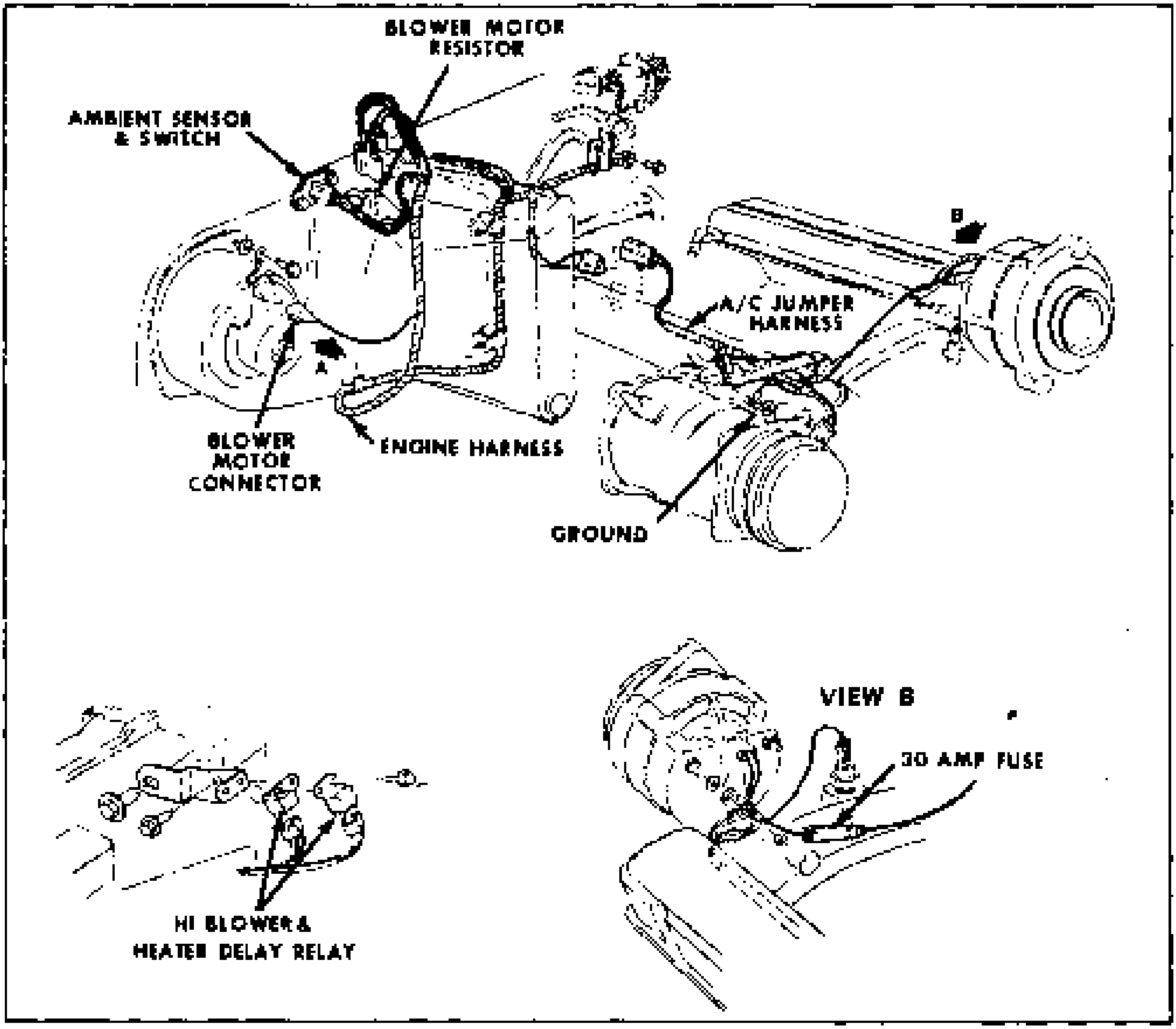


Fig. 1B-2 Pontiac Automatic Temperature Control A/C Engine Harness

4. Remove retaining screws.

5. Remove sensor.

6. To replace reverse removal procedure

When checking with an ohmmeter, the resistance value of the in-car sensor should be approximately 1000 ohms at 75°.

AMBIENT SENSOR AND SWITCH

PONTIAC REMOVE AND REPLACE

1. Remove ambient sensor wire connector and remove sensor attaching screws, Fig. 1B-2.

2. To replace reverse removal procedure. When checking with an ohmmeter, the resistance value of the ambient sensor should be approximately 500 ohms at 75°F. The switch should be open at or below 32°F.

GRAND PRIX - REMOVE AND REPLACE

1. Remove two wire connectors, Fig. 1B-3

2. Remove retaining screws.

3. Remove sensor and switch assembly.

VACUUM HOSE HARNESS

ALL - REMOVE AND REPLACE

1. Remove cold air distributor duct

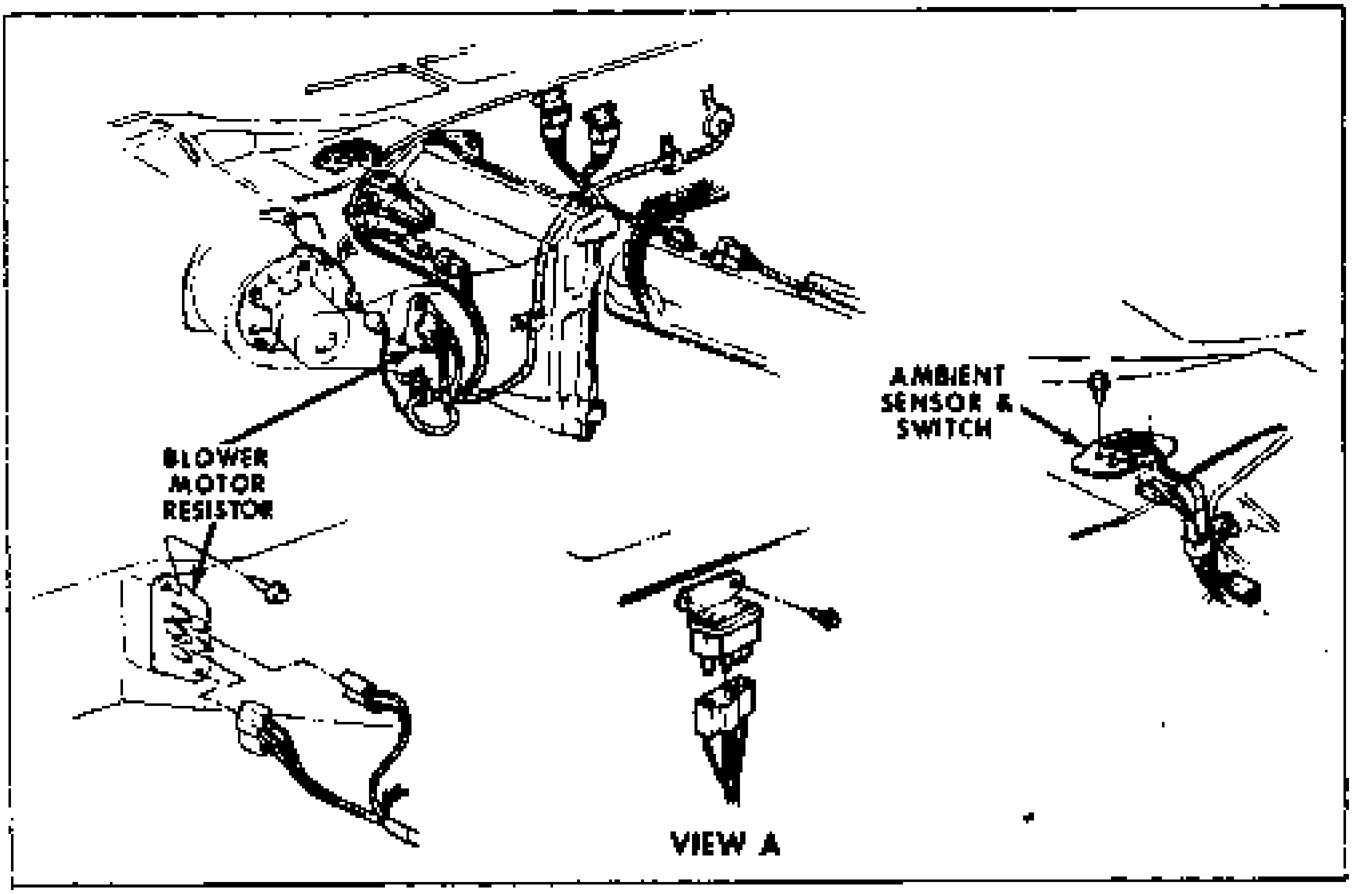


Fig. 1B-3 Grand Prix Automatic Temperature Control A/C Engine Harness

2. Remove glove box on Pontiac.

3. Refer to Fig. 1B-4 and 1B-5 respectively for hose routing and connections.

CONTROL PANEL

ALL - REMOVE AND REPLACE

Pontiac and Grand Prix control panels for Automatic Temperature Control systems can be removed by using procedures for standard systems. These procedures are in section 1A.

CONTROL PANEL COMPONENTS

Several items on the Automatic Temperature Control panel are serviced. They include the rotary vacuum valve, contact switches, blower switch and variable resistor. Figs. 1B-6 and 1B-7 show the Pontiac and Grand Prix panels respectively and should be referred to when servicing individual components.

TEMPERATURE CONTROL SWITCH - VARIABLE RESISTOR

Two methods of adjusting the temperature control variable resistor are available. Use the first method to adjust the unit in the car and the second to adjust the variable resistor after installing a new one.

ALL - ADJUST IN CAR

1. TO LOWER THE IN CAR TEMPERATURE to suit owner preference, insert tool J 23187 in slot adjacent to lever as shown in Fig. 1B-8.

2. Engage teeth on variable resistor and pull towards you to lower outlet temperature.

3. TO RAISE THE IN CAR TEMPERATURE push the variable resistor away from you with tool J 23187.

After installing a new variable resistor, use the method in Fig. 1B-8 to adjust.

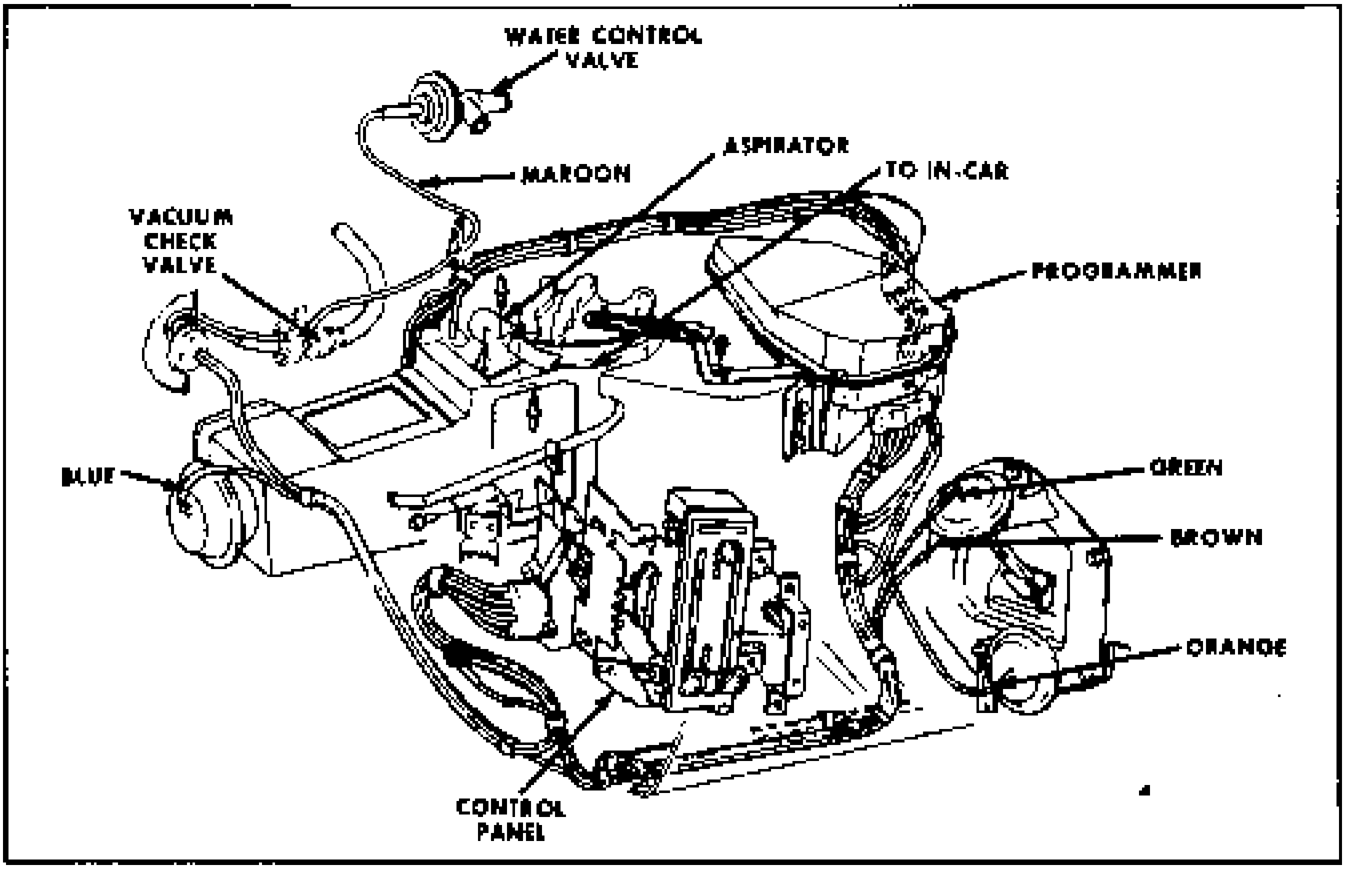


Fig. 1B-4 Grand Prix Vacuum Hose Installation

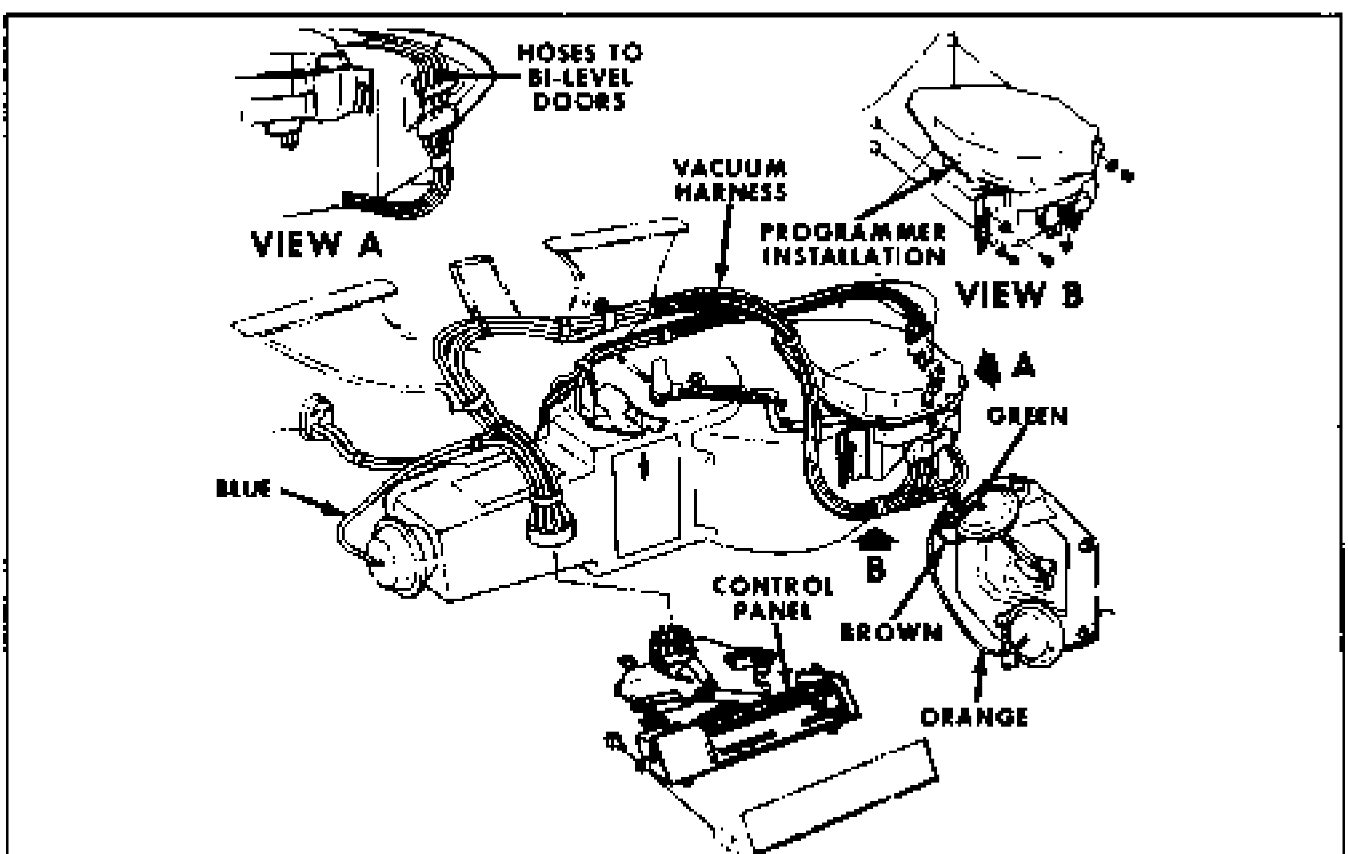
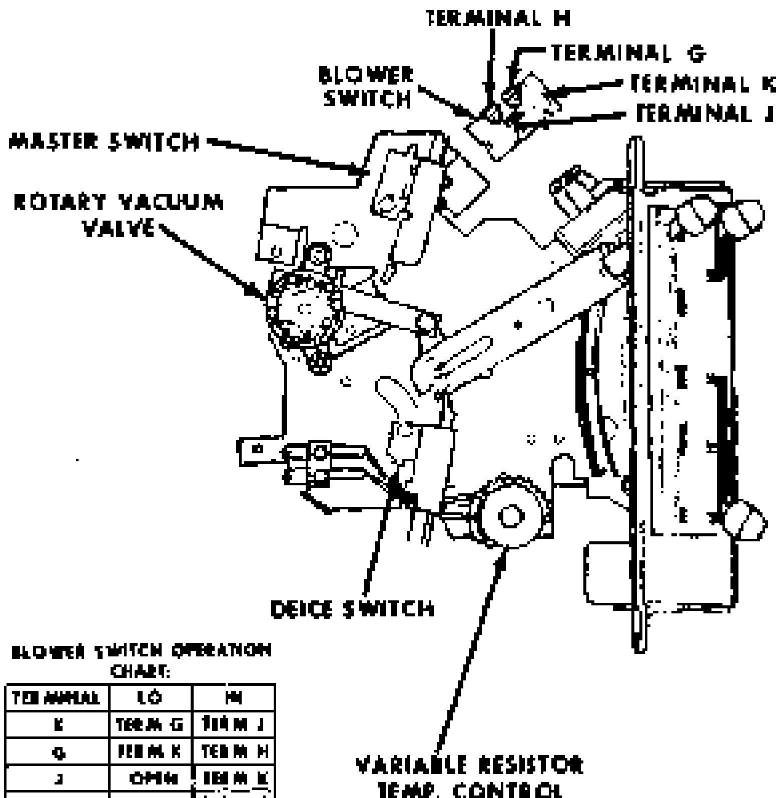


Fig. 1B-5 Pontiac Vacuum Hose Installation



BLOWER SWITCH OPERATION CHART:

TERMINAL	LO	HI
K	TERM G	TERM J
G	TERM K	TERM H
J	OPEN	TERM K
H	OPEN	TERM G

SWITCH CHART

SWITCH	POSITION				
	OFF	NORMAL	INSIDE	DEFOG	DEICE
MASTER	OPEN	CLOSED	CLOSED	CLOSED	CLOSED
DEICE	OPEN	OPEN	OPEN	OPEN	CLOSED

VACUUM VALVE CHART

PORT NO.	CONNECTION	OFF	NORMAL	INSIDE	DEFOG & DEICE
1	OUTSIDE AIR CLOSED	VAC	CONN 2	CONN 3	CONN 2
2	PROGRAMMER #9	SEAL	CONN 1	SEAL	CONN 1
3	PROGRAMMER #6	SEAL	SEAL	CONN 1	SEAL
4	PROGRAMMER #10	CONN 5	CONN 5	SEAL	CONN 5
5	OUTSIDE AIR OPEN	CONN 4	CONN 4	CONN 6	CONN 4
6	PROGRAMMER #7	SEAL	SEAL	CONN 5	SEAL
7	PROGRAMMER #1	VENT	VAC	VAC	VAC
8	INPUT	VAC	VAC	VAC	VAC
9	PROGRAMMER #4	VENT	VENT	VENT	VAC
10	PROGRAMMER #3	VAC	VAC	VAC	VENT

VENT - MEANS LINE VENTED TO ATMOSPHERIC PRESSURE
VAC - MEANS VACUUM APPLIED TO LINE
CONN. - MEANS PORT CONNECTED TO ANOTHER PORT
SEAL - MEANS LINE SEALED AT END

Fig. 1B-6 Pontiac Control Panel

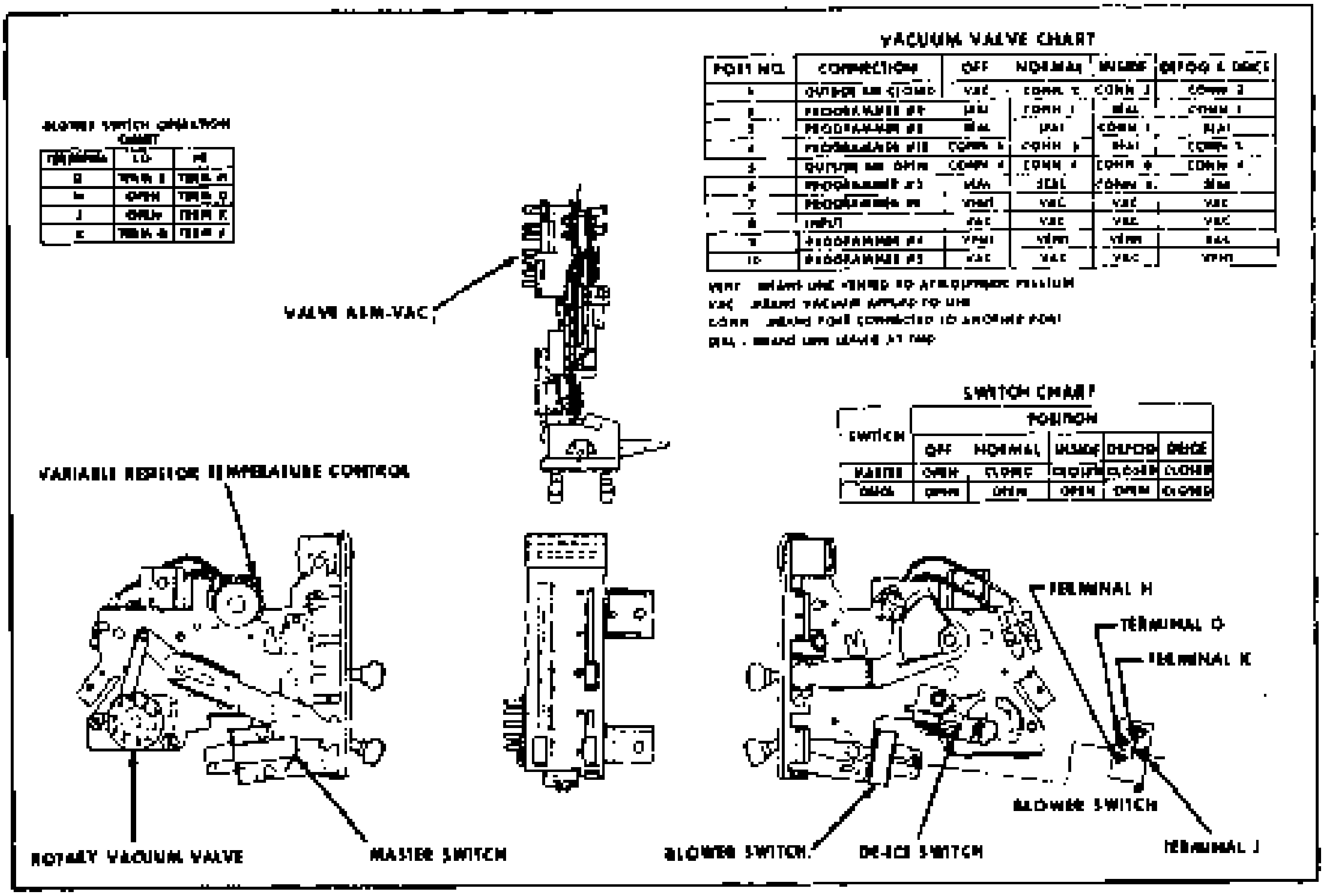


Fig. 1B-7 Grand Prix Control Panel

TEMPERATURE DOOR LINK TO PROGRAMMER

ALL - ADJUST

1. Remove cold air duct.

2. Remove glove compartment.

3. Loosen screw retaining link to programmer arm and separate the units, Fig. 1B-9.

4. Disconnect programmer connector shown in Fig. 1B 10.

5. With ignition on and control lever off, ground terminals 2, 3 and 4 (Fig. 1B-10 identifies terminals).

6. Apply +12 volts DC (available at BAT terminal of fuse block) to terminal number 1 (one) only. This will cycle programmer to full cold position. Allow minimum time of 30 seconds for this operation.

7. Remove +12 volts DC from terminal number one (1) and apply to terminal No. 8 only. This will cycle programmer to the AC park position.

8. Push lower diverter door inward if necessary and install tool J 22667 in hole in heater core and case assembly (Fig. 1B-11).

9. Position temperature door against tool, attach link to programmer arm and tighten adjusting screw.

10. Apply +12 volts DC to terminal number 1 only. Programmer will cycle to full cold allowing removal of tool.

11. Connect programmer connector.

12. Replace glove compartment and cold air duct.

IN-CAR A/C WIRE HARNESS

The in-car sensor, programer bi-level boost switch, control panel and A/C engine harness are connected via the in-car A/C wire harness.

ALL - REMOVE AND REPLACE

1. Remove cold air duct.

2. Refer to Fig. 1B-1 for in car harness routing.

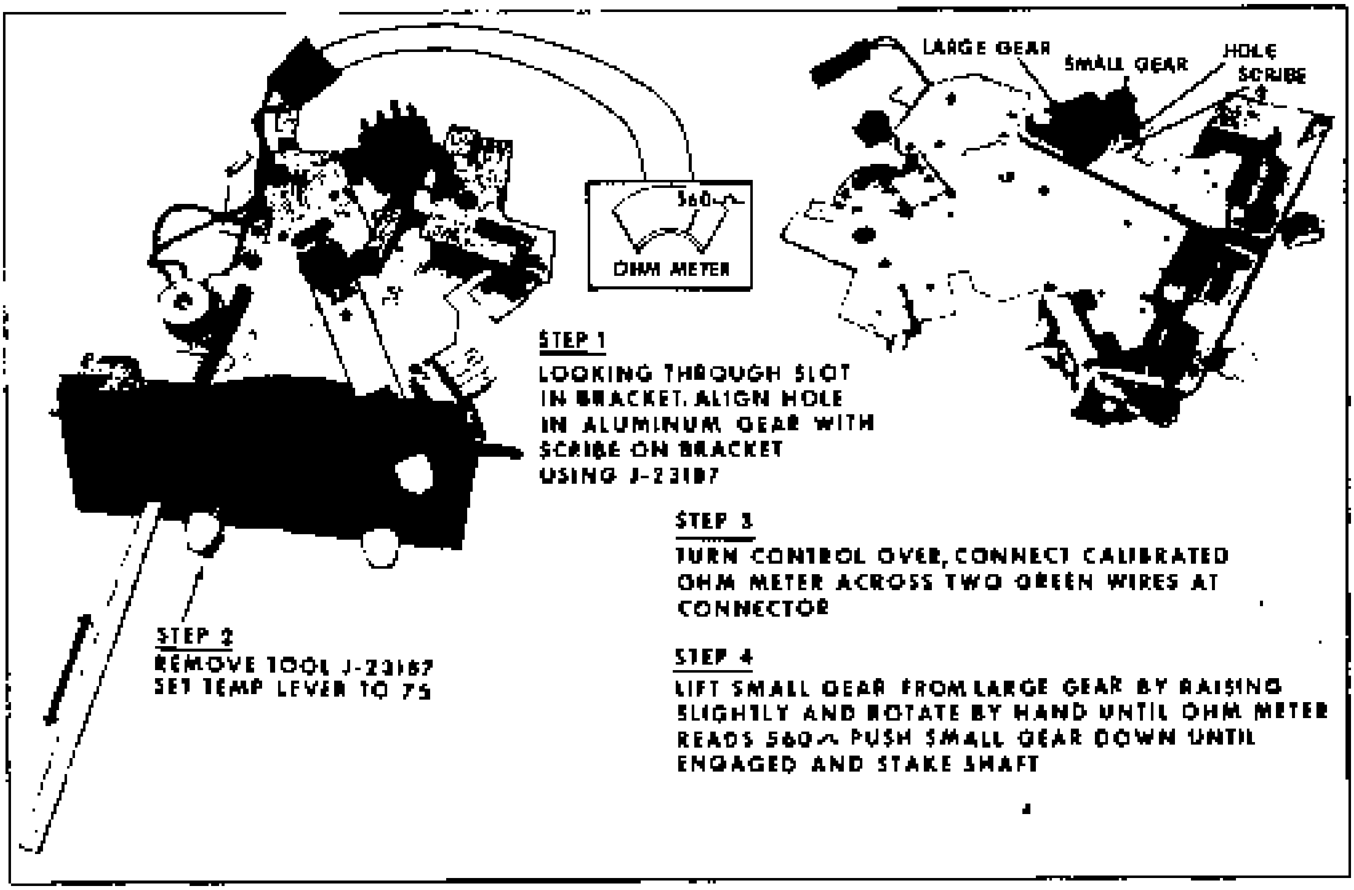


Fig. 1B-8 Using Tool J 23187 To Adjust Variable Resistor

PROGRAMMER

Pontiac and Grand Prix programmers are of the same construction and the following procedure apply to both models. Programmer links are different in length. Grand Prix links are colored black.

ALL-REMOVE AND REPLACE

1. Remove positive battery terminal.

2. Remove cold air duct and glove compartment on Pontiac models.

3. Remove programmer link screw (scribe marks for reinstallation) (Fig. 1B-10). If new programmer is installed or new parts placed in programmer, adjust door link.

4. Remove vacuum harness connector from programmer.

5. Disconnect two electrical connectors.

6. Remove programmer retaining screws.

7. Pull programmer carefully rearward so as not to break heat sensor.

8. To replace, reverse removal procedure.

ALL-DISASSEMBLE

1. Remove cover from programmer by removing five

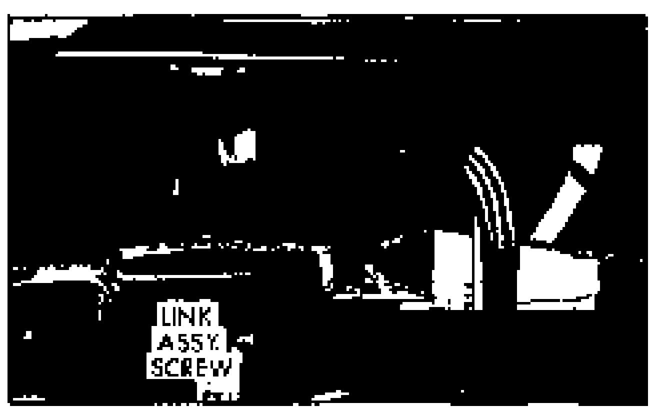
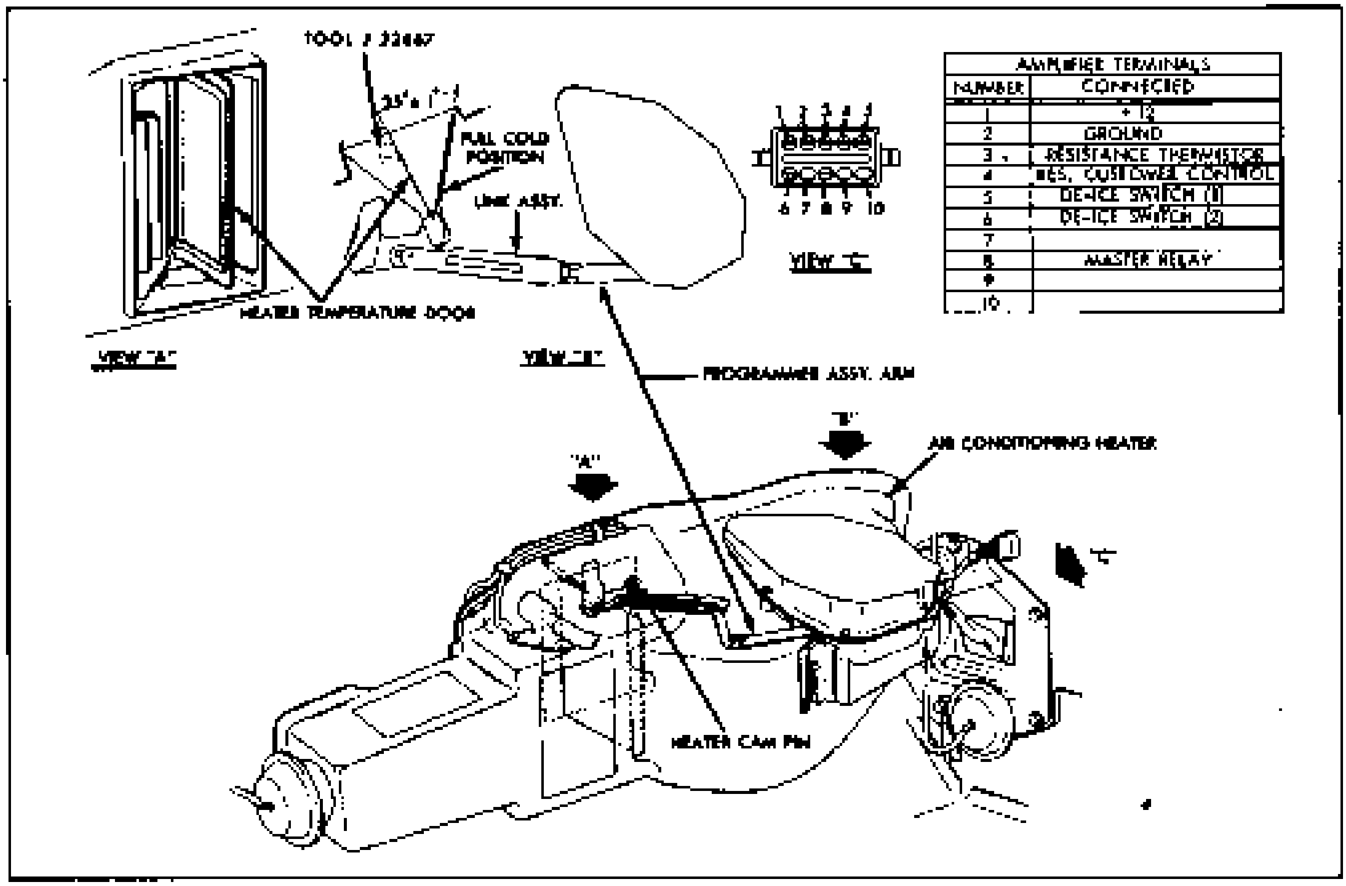


Fig. 1B-9 Programmer Link Assembly



AMPLIFIER TERMINALS	
NUMBER	CONNECTED
1	+ 12
2	GROUND
3	RESISTANCE THERMISTOR
4	RES. CUSTOMER CONTROL
5	DE-ICE SWITCH (1)
6	DE-ICE SWITCH (2)
7	
8	MASTER RELAY
9	
10	

Fig. 1B-10 Temperature Door Adjustment

screws and carefully lift away cover from programmer without bending fingers on finger block assembly.

AMPLIFIER-REMOVE AND REPLACE

2. Remove finger block screws and move out of way.

3. Unsolder nine leads (two orange, one light green, one dark green, two brown, two gray and one red lead) where leads attach to amplifier, Fig. 1B-12.

A heat sensor was not used on 1967 models, therefore, it will have two less leads. Remove two circuit board mounting screws. Lift board carefully straight up and off finger block mounting post.

4. Install new board by reversing removal procedure and secure with two mounting screws making certain that ground lug is under the mounting screw nearest wheel. Note that circuit board comes with a new finger block and lead cable attached.

5. Solder previously disconnected leads. Use resin core solder for all soldering operations.

6. Install finger block and rubber cable clamp. Make certain that cable clamp is properly seated in its bracket.

7. Replace cover with five screws.

PROGRAMMER WHEEL

ALL - REMOVE

1. Scribe a thin line (using a screwdriver, knife or other sharp instrument) on the potentiometer clip in line with edge of wheel rib so that clip can be replaced in same position on wheel, Fig. 1B-13. There is a white paint mark in this area.

2. Remove finger block assembly and move out of way.

3. Remove retaining screw in hub of wheel and remove potentiometer clip. Programmer wheel may now be slipped off.

4. To replace reverse removal procedure.

GEAR INSPECTION

1. Remove programmer wheel as described above.

2. Carefully remove wire clamps by placing a small

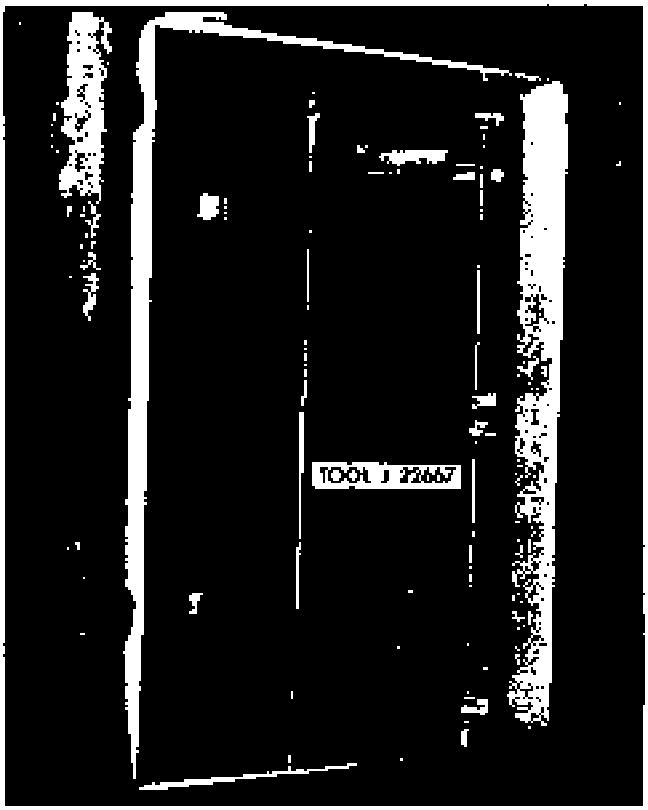


Fig. 1B-11 Tool J 22667 Installed

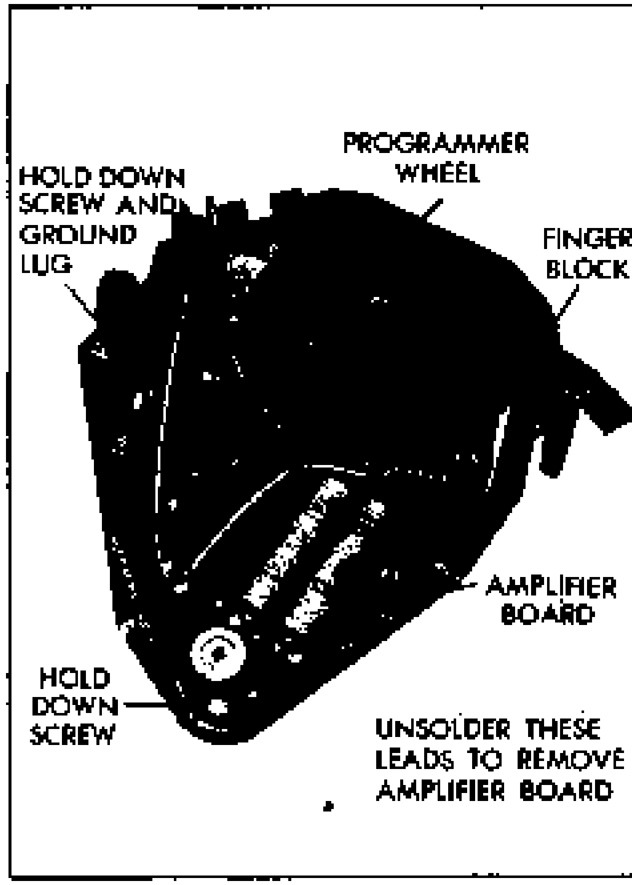


Fig. 1B-12 Programmer Amplifier

screwdriver under the higher of the two locking tabs and gently work clips off mounting stubs.

3. Remove two mounting screws on circuit board and lift board off finger block mounting post out of way. Do not put undue strain on attached wiring.

4. Remove potentiometer bracket being careful of attached leads. The gears and motor are located directly below the bracket.

5. Inspect gears, Fig. 1B-14, for broken teeth or other abnormal conditions. Replace gears if broken or inoperative.

MOTOR

REMOVE AND REPLACE

1. Follow procedure for programmer wheel removal and gear inspection.

2. Remove motor by moving it back and up from its normal position.

3. Unsolder orange lead to old motor from circuit board and solder orange lead from new motor to same point. Transfer green motor wire in same manner. Be sure to use resin core solder.

4. Install new motor making certain that worm gear is properly seated in its bearing block and properly meshed with helical spur gear.

5. Reassemble unit by reversing disassembly procedure. When reinstalling programmer wheel, follow special instructions provided below.

PROGRAMMER WHEEL

REPLACE

1. Position vacuum valve approximately in center of its travel.

2. Install program wheel so that peg on vacuum valve is visible through alignment hole in programmer wheel vacuum valve slightly to accomplish this.

3. Install potentiometer clip and rotate so that scribe marks (made previously) on program wheel and clip line up. Tighten retaining screw on program wheel hub.

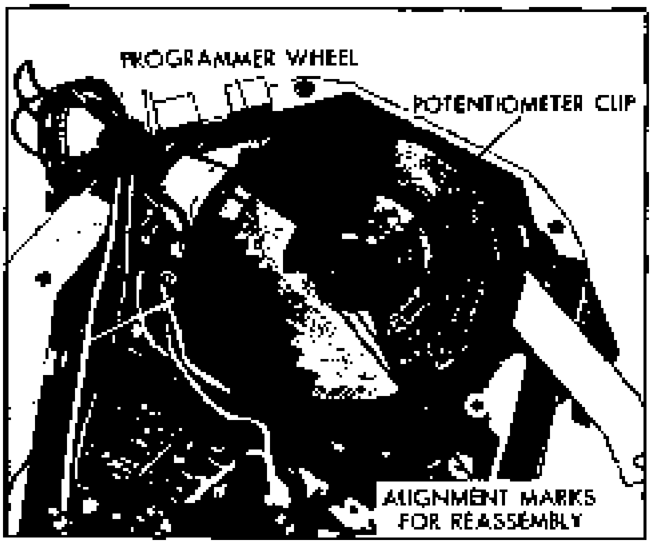


Fig. 1B-13 Marking Programmer Wheel

4. Slip the round circuit board off of wheel and check to be certain that four ball bearings are still in their proper positions in bearing retainer cups. Replace board and reinstall finger block with two screws.

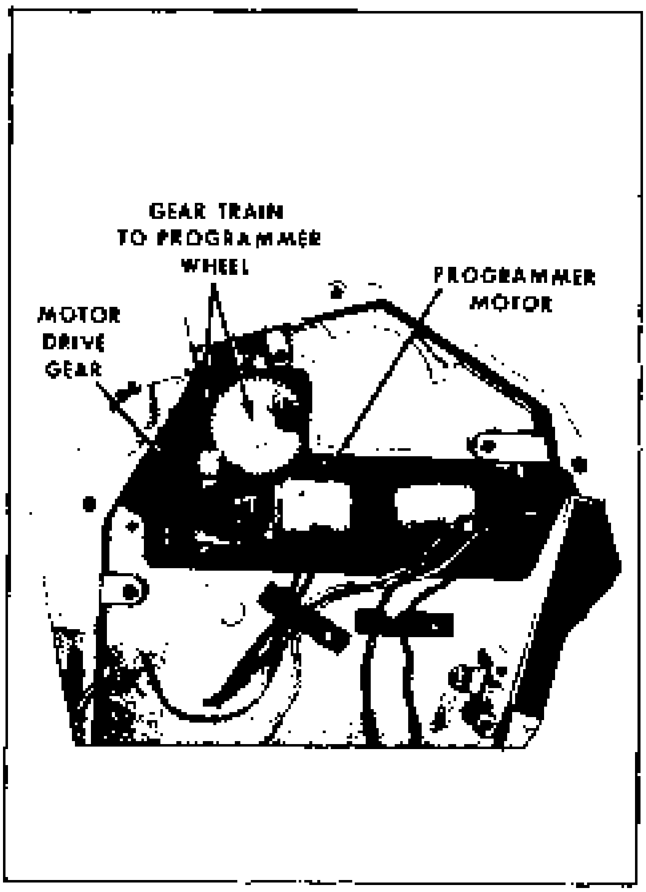


Fig. 1B-14 Programmer Gears and Motor

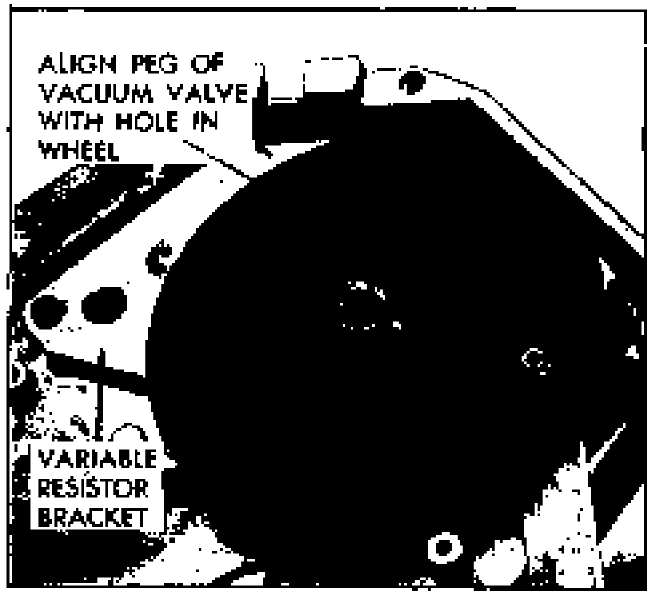


Fig. 1B-15 Aligning Vacuum Valve With Track In Programmer Wheel

POWER RESISTOR - REMOVE AND REPLACE

1. Remove cover plate on lower side of programmer.

2. Unsolder green and orange lead.

3. Install new resistor board and solder leads.

4. Replace cover plate.

BI-LEVEL BOOST SWITCH

PONTIAC - REMOVE AND REPLACE

1. Remove cover plate on bottom of heater core and case.

2. Remove wire connector.

3. Remove retaining screws, then switch

4. Replace by reversing removal procedures.

GRAND PRIX - REMOVE AND REPLACE

1. Remove cold air duct.

2. Check both switches for operation.

3. Remove gasket seal.

4. Remove defective switch or switches.

5. To replace reverse removal procedure.

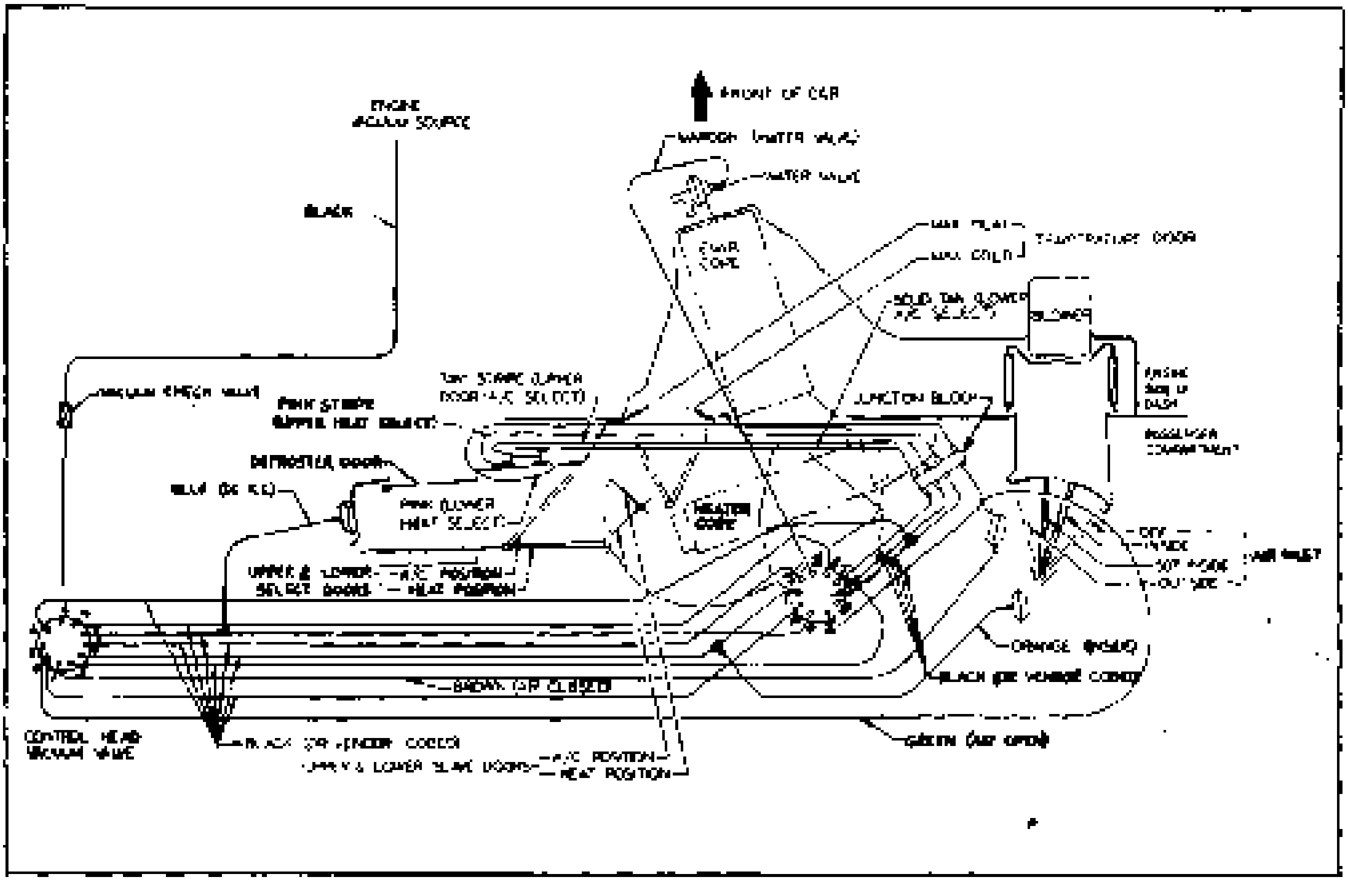


Fig. 1B-16 Vacuum Schematic

VACUUM SCHEMATIC

Fig. 1B-16 shows the vacuum hose attachment and function. Some of the hoses are color coded (those which are not in connectors). Hoses at connectors can be identified by using numbers on rotary vacuum valves and connector position.

Wiring Schematic

The in car and engine A/C harnesses are represented schematically in Fig. 1B-17. Wire color, function and connector identification can be obtained from figure.

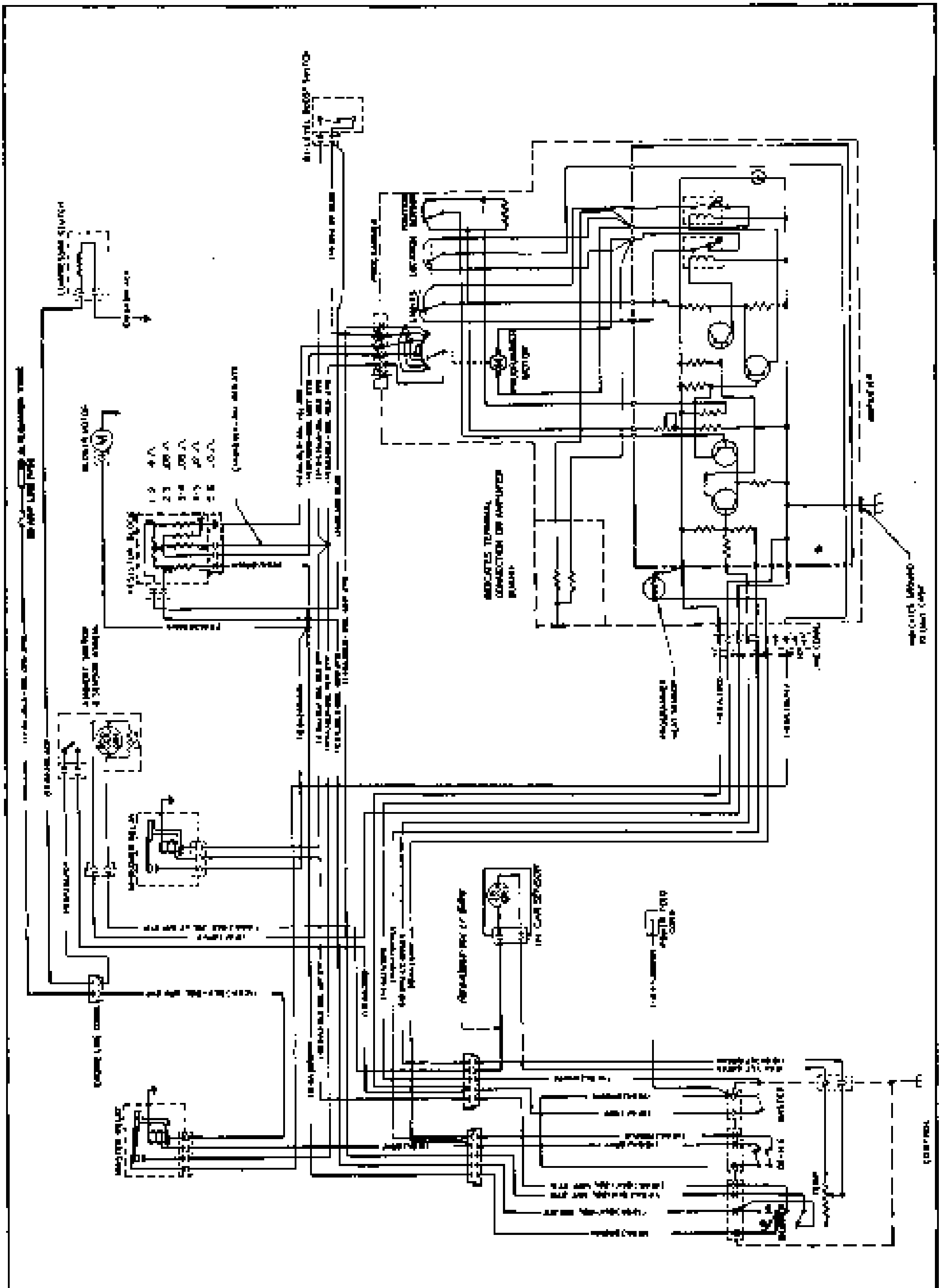


Fig. 1B-17 Wiring Schematic

FRAME AND BODY MOUNTINGS

PONTIAC AND TEMPEST

FRAME

The frame is of swept hip perimeter design (Fig. 2-1) for easier servicing. It also permits use of a simplified, two-joint propeller shaft and exhaust system.

Frames are supplied by various manufacturers. All convertibles are equipped with A.O. Smith frames while all other models utilize frames built by both A.O. Smith and Parrish Pressed Steel.

Frames can be identified by the number of holes located at left front outer side bar in steering gear mounting area (Fig. 2-2).

The perimeter frame has two advantages: first, the body comes down over the frame and forms an integrated structure with body sheet metal contributing greatly to the strength of the car; secondly, although the body and frame strengthen each other, there is no metal-to-metal contact, because they are connected by means of rugged butyl rubber body mounts which isolate the driver and passenger from engine, transmission drive-line, and road disturbances.

The dimensions given in (Fig. 2-3) may be used in checking frames. Dimensions for X, Y, and Z are not given, but are used merely to illustrate points for taking diagonal measurements for checking squareness of frame. Holes or rivet heads are located on the frame at approximate terminal point of arrowheads, and can be used for this purpose.

Of the seven basic frames used by Pontiac, five are for the 121" wheelbase vehicles, and two for the 124" wheelbase vehicles.

The Pontiac convertible and station wagon frames are essentially the same as other corresponding wheelbase frames but have the center side rail fully boxed for additional stiffness.

Five different frames of two wheelbases are used on Tempest models; all 4-door styles and station wagons are 116" and all 2-door styles 112". The basic frame for the sedans and station wagons has a fully boxed front section and open 'C' section center side rails extending to the rear hip area. The convertible frame is of heavier metal thickness and has a boxed section front and center side rail. The frame for 4-door hardtop models is similar to the standard frame, but with added metal thickness.

The Grand Prix frame from the front hip rearward is essentially the same as the Tempest convertible. Forward of the front hip, the Grand Prix frame has its own individual design.

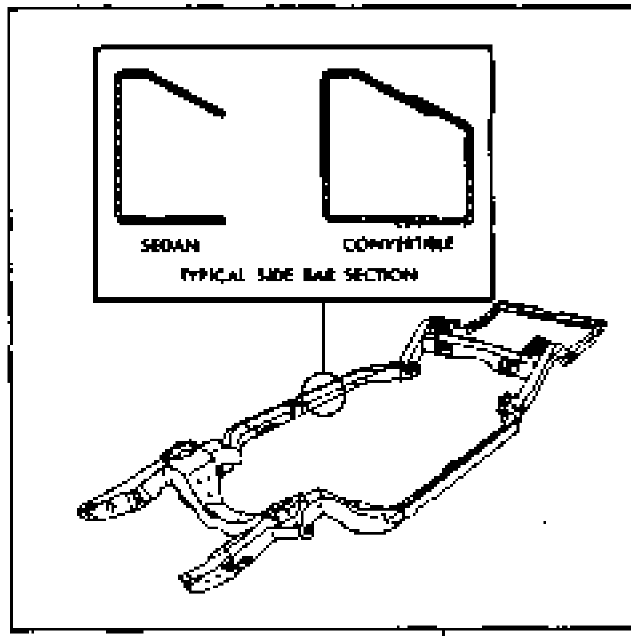


Fig. 2-1 Typical Perimeter Design Frame (Tempest Shown)

LIFTING PONTIAC CARS WITH HOISTS

Lifting can be accomplished without adapters when using drive-on or twin-post type hoists, with hoists or lifts making contact with front suspension lower control arms or rear axle. Since the frame is perimeter type, some hoists designed to contact side rails require adapters to raise the car without damage to parts of exhaust system, body, floor, etc. Suppliers of original lifting equipment should have information on adapters to use with Pontiac cars. Fig. 2-4 shows proper lift point connections.

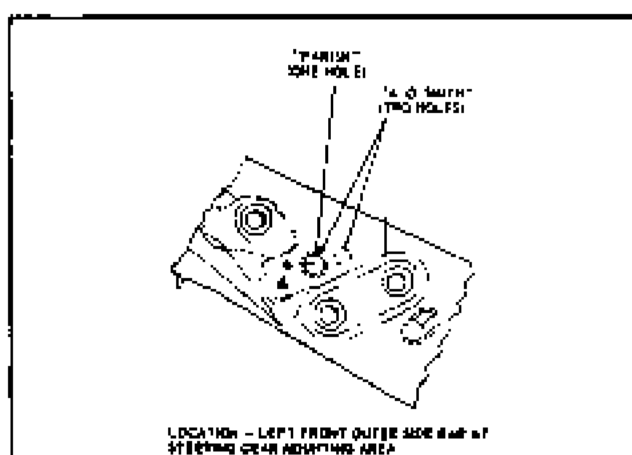
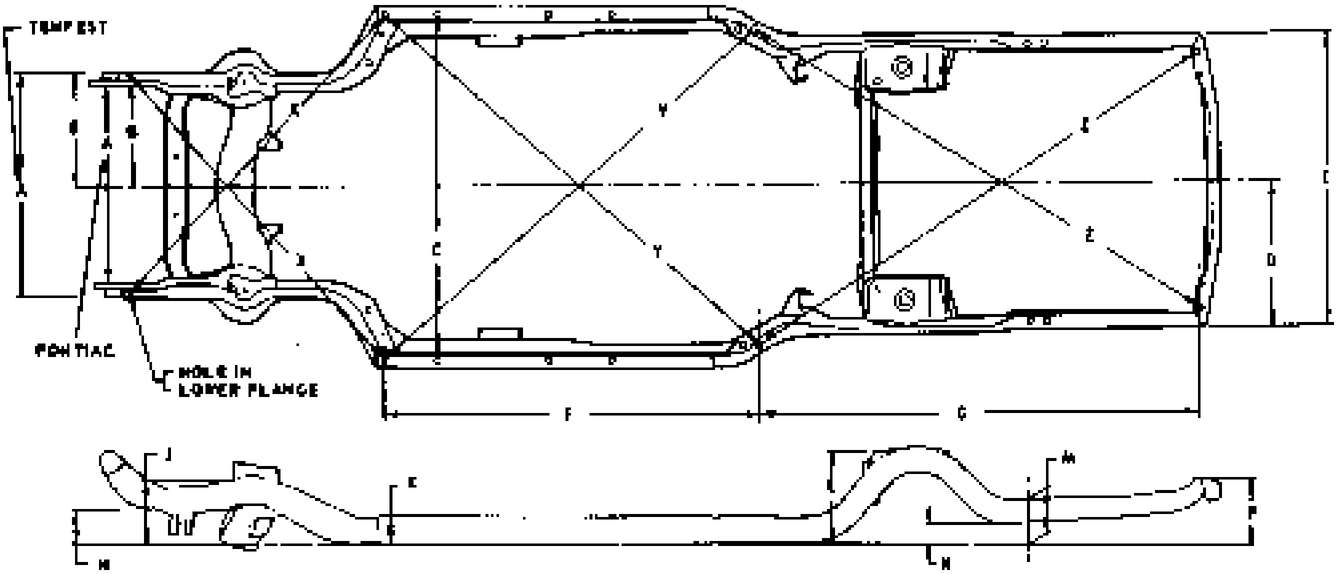


Fig. 2-2 Frame Identification



PONTIAC

BODY STYLES	A	B	C	D	E	F	G	H	J	K	L	M	N	P
5211, 5269	38.40	19.20	60.20	25.32	50.64	68.10	78.64	6.64	11.51	4.75	16.03	7.79	3.52	11.08
5287, 5239	38.40	19.20	60.20	25.34	50.68	68.10	78.64	6.64	11.51	4.75	16.03	7.79	3.52	11.08
5267	38.40	19.20	60.20	25.34	50.68	68.10	78.64	6.64	11.51	4.78	16.06	7.84	3.53	11.08
5236, 5246 5636, 5646 6246	38.40	19.20	60.20	25.34	50.68	68.10	78.64	6.64	11.51	4.75	16.03	7.79	3.52	11.08
5639, 5669 5687, 6239 6287	38.40	19.20	60.20	25.34	50.68	68.10	85.64	6.64	11.51	4.78	16.06	7.83	3.53	11.11
6267	38.40	19.20	60.20	25.34	50.68	68.10	85.64	6.64	11.51	4.78	16.06	7.83	3.53	11.11
6657	38.40	19.20	60.20	25.34	50.68	68.10	78.64	6.64	11.51	4.75	16.03	7.79	3.52	11.08

TEMPEST

BODY STYLES	A	B	C	D	E	F	G	H	J	K	L	M	N	P
3369, 3569, 3539, 3739	41.30	20.65	52.36	21.59	43.18	66.19	68.18	7.03	11.05	4.30	12.24	7.91	4.59	10.63
3327, 3337 3527, 3727 3737, 4237	41.30	20.65	52.36	21.59	43.18	62.19	68.18	7.03	11.05	4.30	12.24	7.91	4.59	10.63
3535, 3536 3936	41.30	20.65	52.36	21.59	43.18	66.19	74.38	7.03	11.05	4.30	12.24	7.91	4.59	9.43
3567, 3767 4267	41.34	20.67	52.36	21.59	43.18	62.19	68.18	7.03	11.05	4.30	12.24	7.91	4.59	10.63

Fig. 2-3 Frame Alignment Chart

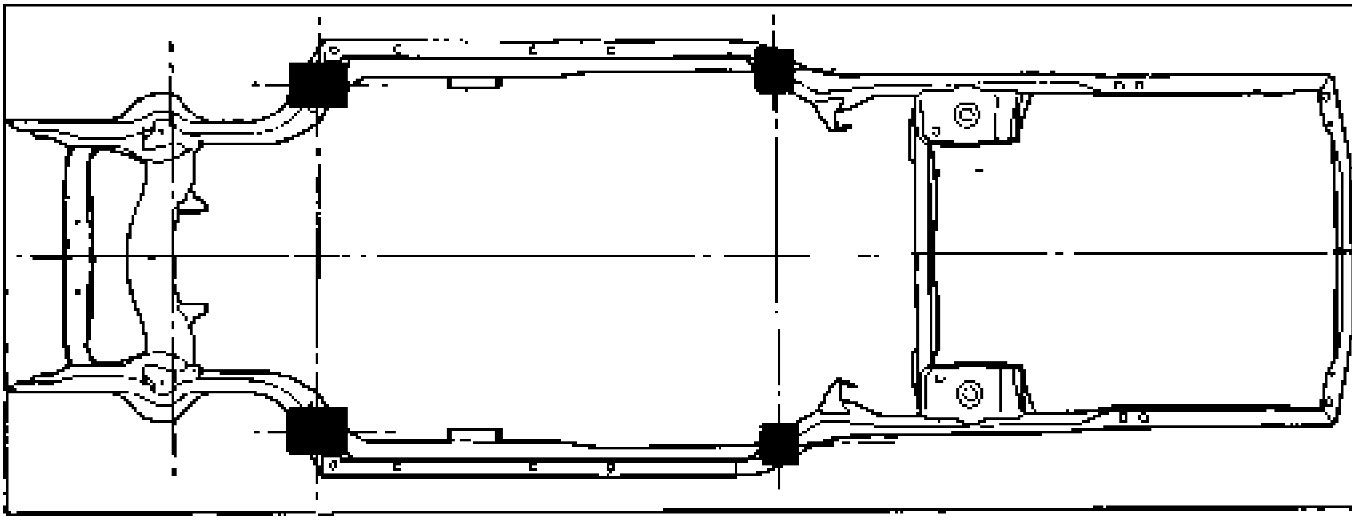


Fig. 2-4 Lift Point Locations

BODY TO FRAME MOUNTINGS

With the use of a perimeter frame, noise isolation from the body is accomplished with soft butyl-rubber mounts, see Figues 2-5 and 2-6.

FIREBIRD

UNDERBODY ALIGNMENT

Firebird bodies are of unitized construction. A partial frame supports the front end sheet metal, front suspension, engine and other mechanical components. Unitized construction demands that underbody components be properly aligned to ensure correct suspension location. In the event of collision damage it is important that the underbody be thoroughly checked and, if necessary, realigned in order to accurately establish suspension locations.

To assist in checking alignment of the underbody components, repairing minor underbody damage or locating replacement parts, the following underbody dimensions and alignment checking information is presented.

For additional information see Section 3 of the Fisher Body Service Manual.

REFERENCE POINT DIMENSIONS

Dimensions to gage holes are measured to dead center of the holes and flush to adjacent surface metal unless otherwise specified. The master gage holes adjacent to the No. 1 body mount (Fig. 2-7) and in the side rails near the rear spring front attachment are key locations and should be used whenever possible as a basis for checking other reference points.

LIFTING - FIREBIRD

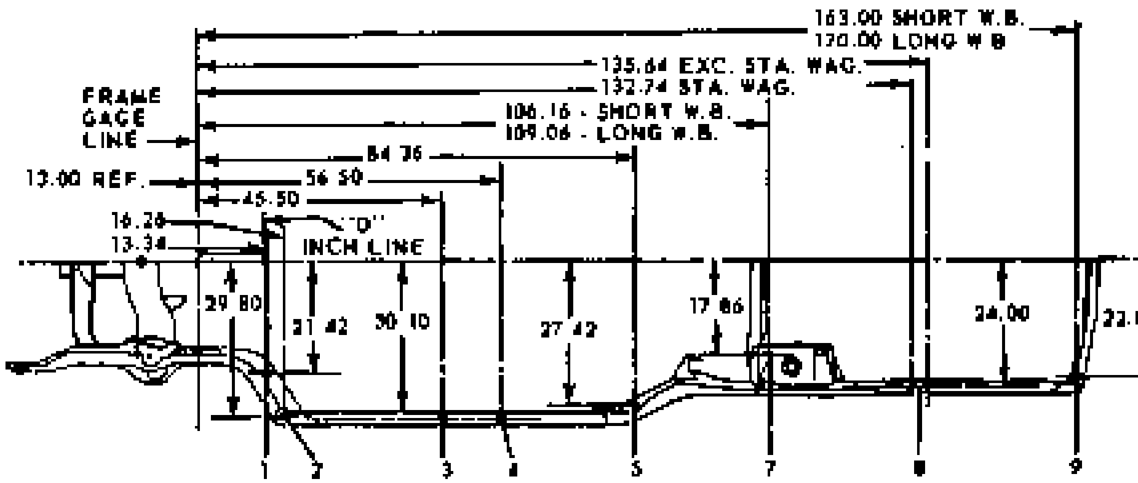
Lifting can be accomplished without adapters when using a drive-on hoist or with a twin-post type hoist by making contact with front suspension lower control arms and rear wheels. Since there is a bolted on stub frame in front and welded side rails at the rear, the car may also be lifted at the points illustrated in Fig. 2-7. Proper adapters must be used to prevent damage to the various parts of the underbody. Caution should be exercised so as not to nick the rear springs.

FIREBIRD BODY VIBRATION DAMPERS

All Firebird convertibles contain four body vibration dampers, one of which is mounted at each corner of the vehicle as shown in Fig. 2-9. Rear dampers are mounted to the vertical quarter panel brace and floor pan; front dampers are mounted to the radiator support.

FIREBIRD CONVERTIBLE FLOOR PAN REINFORCEMENT

Firebird convertibles have a bolt on floor pan reinforcement as shown in Fig. 2-10. It is of stamped steel and straddles the drive shaft tunnel.



MODELS	#1 BOLT INNER	#2 BOLT OUTER	#3 BOLT	#4 BOLT	#5 BOLT R.H.	#5 BOLT L.H.	#7 BOLT	#8 BOLT	#9 BOLT
5269, D/F35	B	B	B	B	F	E	G	B	B
5236, 5246, 5636, 5646, 6246	A	A	A	A	F	E	F	A	A
5639, 5469, 5237, 5637, 6237, 6239, 5239, 6269 D/F35	C	C	B	F			G	B	B
6267, 5267	D	D	D	D	F	E	F	D	D
5269 W/F35	B	B	A	A	F	E	G	B	B
6240, 6290	D	D	D	D					
5639, 5669, 5237, 6237, 6239, 5239, 5637 6269, W/F35	C	C	A	F	F	E	G	B	B

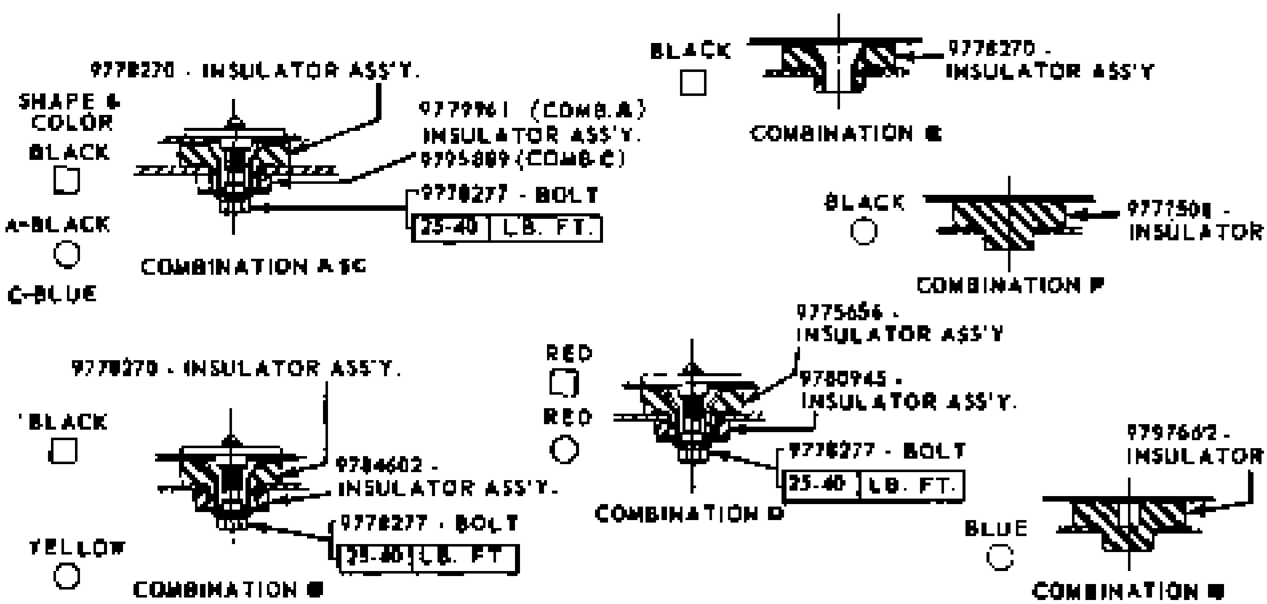
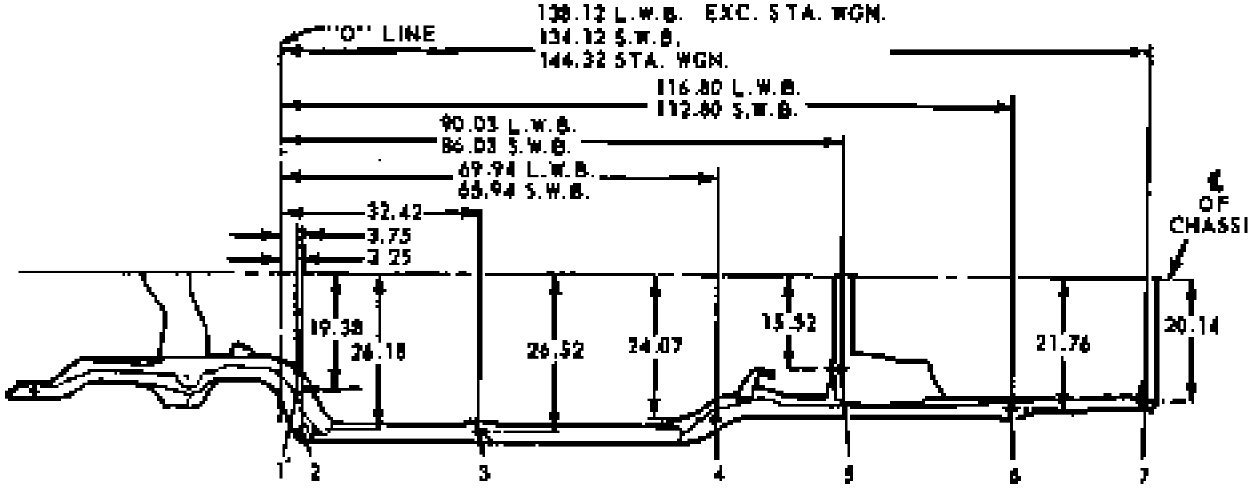


Fig. 2-5 Pontiac Body Bolts and Frame Gage Line Dimensions



MODELS	#1 BOLT	#2 BOLT	#3 BOLT	#4 BOLT	#5 BOLT	#6 BOLT	#7 BOLT
3567, 3767, 4267	F	F	C	A	E	A	D
3327, 3527, 3537, 3727, 3737, 4237	B	F	C	E	E	A	D
3369, 3569	B	F	C	A	B	A	D
3535, 3536, 3936	F	F	C	A	E	A	G
3539, 3739	B	F	C	B	B	A	D
276	B	J	C	H	H	A	D

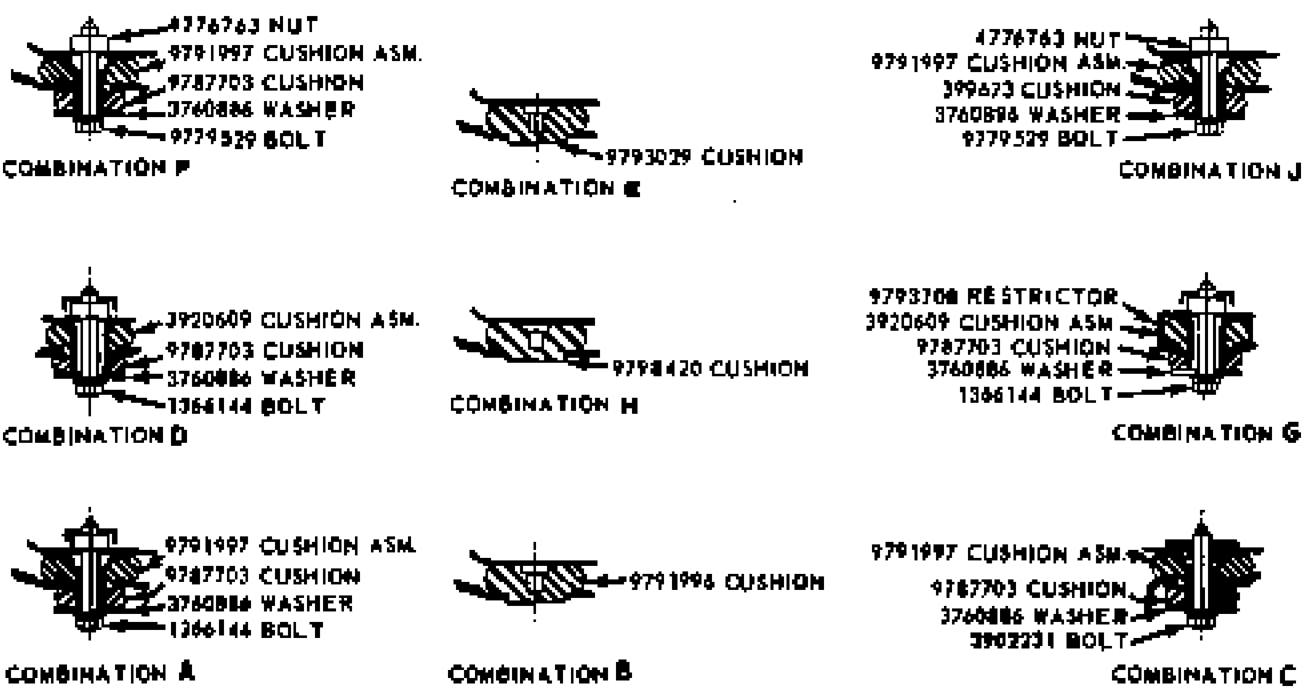


Fig. 2-6 Tempest and Grand Prix Body Bolts and Frame Gage Line Dimensions

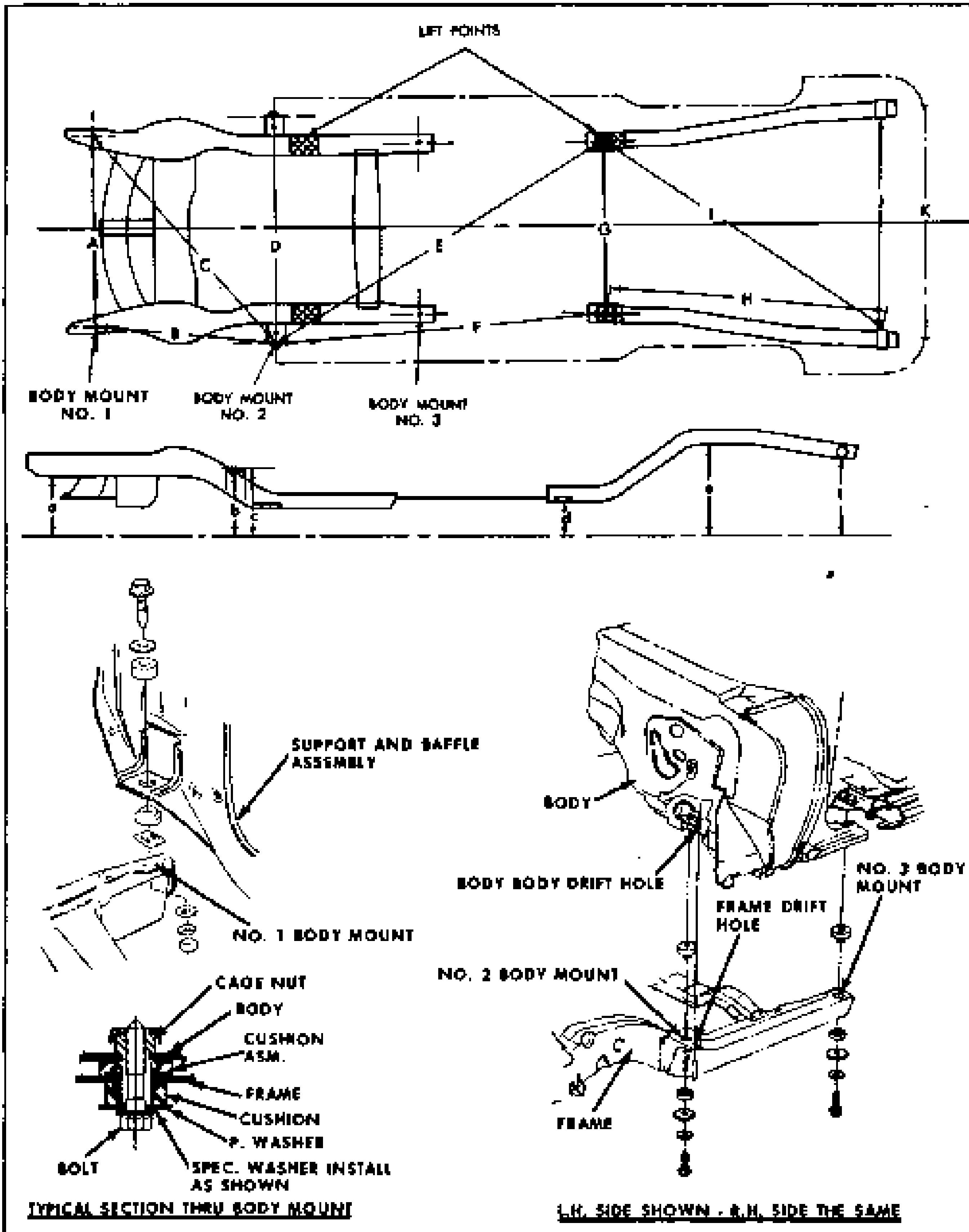


Fig. 2-7 Firebird Checking Dimensions, Lift Points and Body Bolt Locations

SPECIFICATIONS

HORIZONTAL DIMENSIONS (Fig. 2-7)

FIG. REF.	DIMENSION	LOCATION
A	38 5/16"	Rear edge at centerline of 1" gage hole.
B	34 15/16"	Rear edge at centerline of gage hole and center of master gage hole adjacent to No. 2 body mount on same side of frame.
C	54 1/8"	Rear edge at centerline 1" master gage hole adjacent to No. 1 body mount in opposite side of frame.
D	44 9/16"	Center of master gage hole adjacent to No. 1 body mount.
E	75 1/4"	Center of master gage hole adjacent to No. 1 body mount and center of master gage hole in side rail on opposite side of body.
F	65 3/4"	Center of master gage hole adjacent to No. 1 body mount and center of master gage hole in side rail on same side of body.
G	33 1/2"	Center of master gage hole in side rail.
H	55 5/16"	Center of master gage hole in side rail and a point at inboard edge of same side rail at centerline of shackle bolt hole (Fig. 2-8).
I	66 11/16"	Center of master gage hole in side rail and a point at inboard edge of opposite side rail at centerline of shackle bolt hole (Fig. 2-8).
J	42 3/4"	Inboard edge of side rail at centerline of shackle bolt hole (Fig. 2-8).
K	44 3/4"	Center of rear bumper lower attaching bolts.

VERTICAL DIMENSIONS (Fig. 2-7)

FIG. REF.	DIMENSION	LOCATION
a	11 15/16"	1" gage hole at front of frame.
b	13"	Master gage hole adjacent to No. 1 body mount in frame.
c	13 15/16"	Master gage hole adjacent to No. 1 body mount on body.
d	6 15/16"	Master gage hole in side rail.
e	11 3/4"	Lower surface of side rail at kick up either side of rear axle housing.
f	15 15/16"	Lower surface of side rail at centerline of shackle bolt hole.

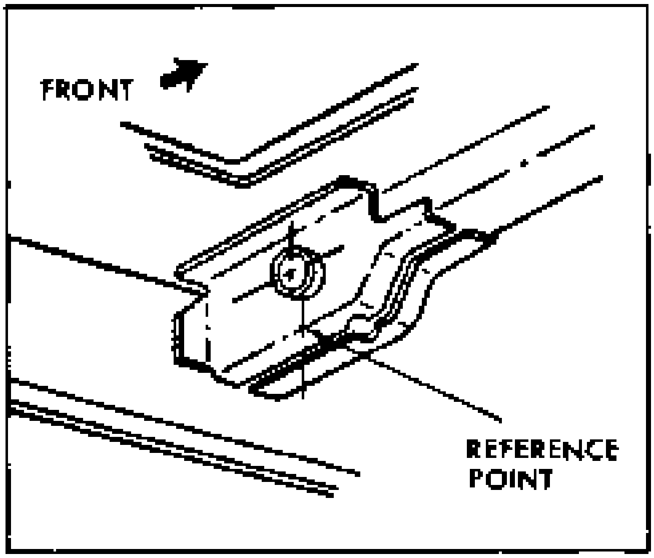


Fig. 2-8 Side Rail at Spring Rear Shackle Hole

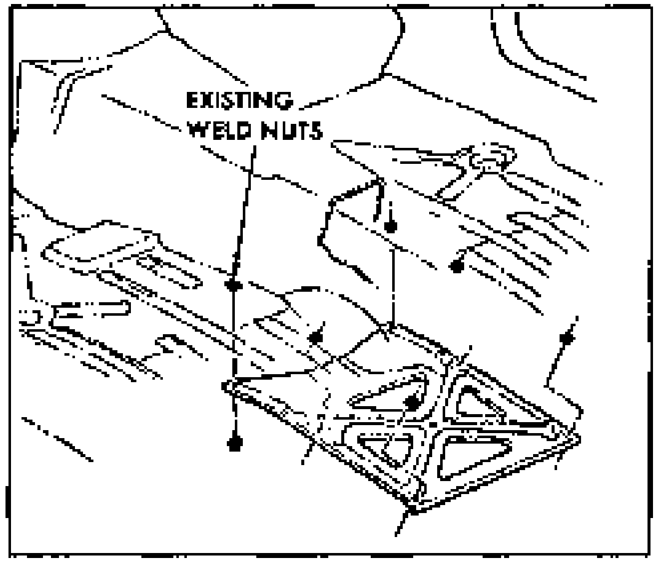


Fig. 2-10 Firebird Convertible Floor Pan Reinforcement

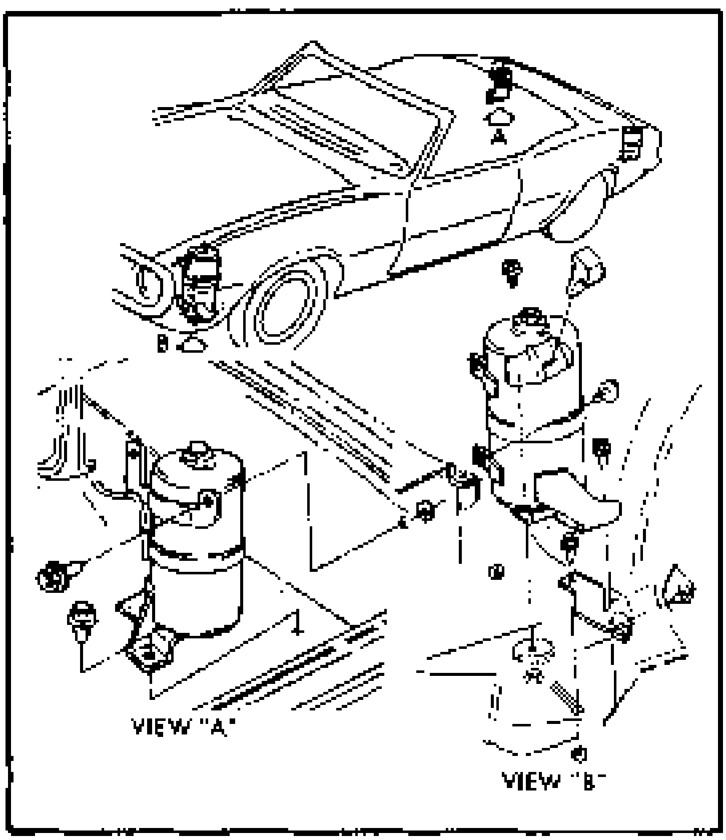


Fig. 2-9 Firebird Body Damper Locations

FRONT SUSPENSION

CONTENTS OF THIS SECTION

GENERAL INFORMATION

Periodic service of the suspension system consists of regular lubrication as outlined in the GENERAL LUBRICATION section.

Lubrication fittings are provided at the front suspension ball joints. Shock absorbers do not require lubrication and, in case of leaks or malfunction, they should be replaced.

Periodically it may be necessary to make certain adjustments and checks of the suspension system to maintain desirable handling and steering characteristics and minimize tire wear. These checks are: front wheel bearings, wheel and tire balance, lateral run-out, upper and lower control arm spherical ball joints, chassis springs, shock absorbers, and wheel alignment. They are made with the parts on the car.

ADJUSTMENT PROCEDURES

FRONT WHEEL BEARINGS

NOTE: Tapered roller bearings have a slightly loose feel when properly adjusted. This differs from ball bearings which may be pre-loaded without adverse effect. Tapered roller bearings can be damaged by the steady thrust on roller ends which comes from pre-loading (Fig. 3-1 or 3-2).

CHECK ADJUSTMENT

1. Raise car and support at front lower control arm.

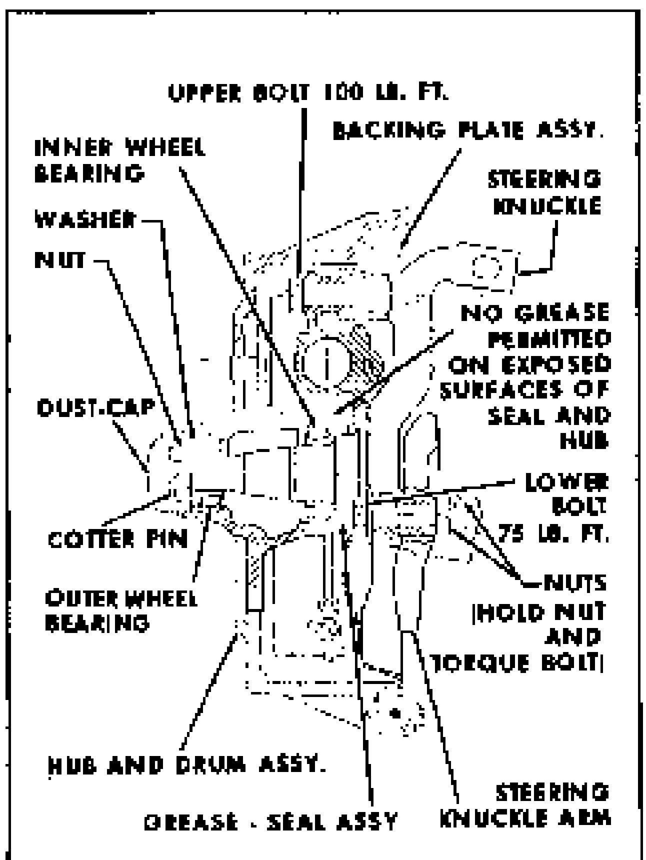


Fig. 3-1 Cross Section of Steering Knuckle, Hub And Drum Assembly

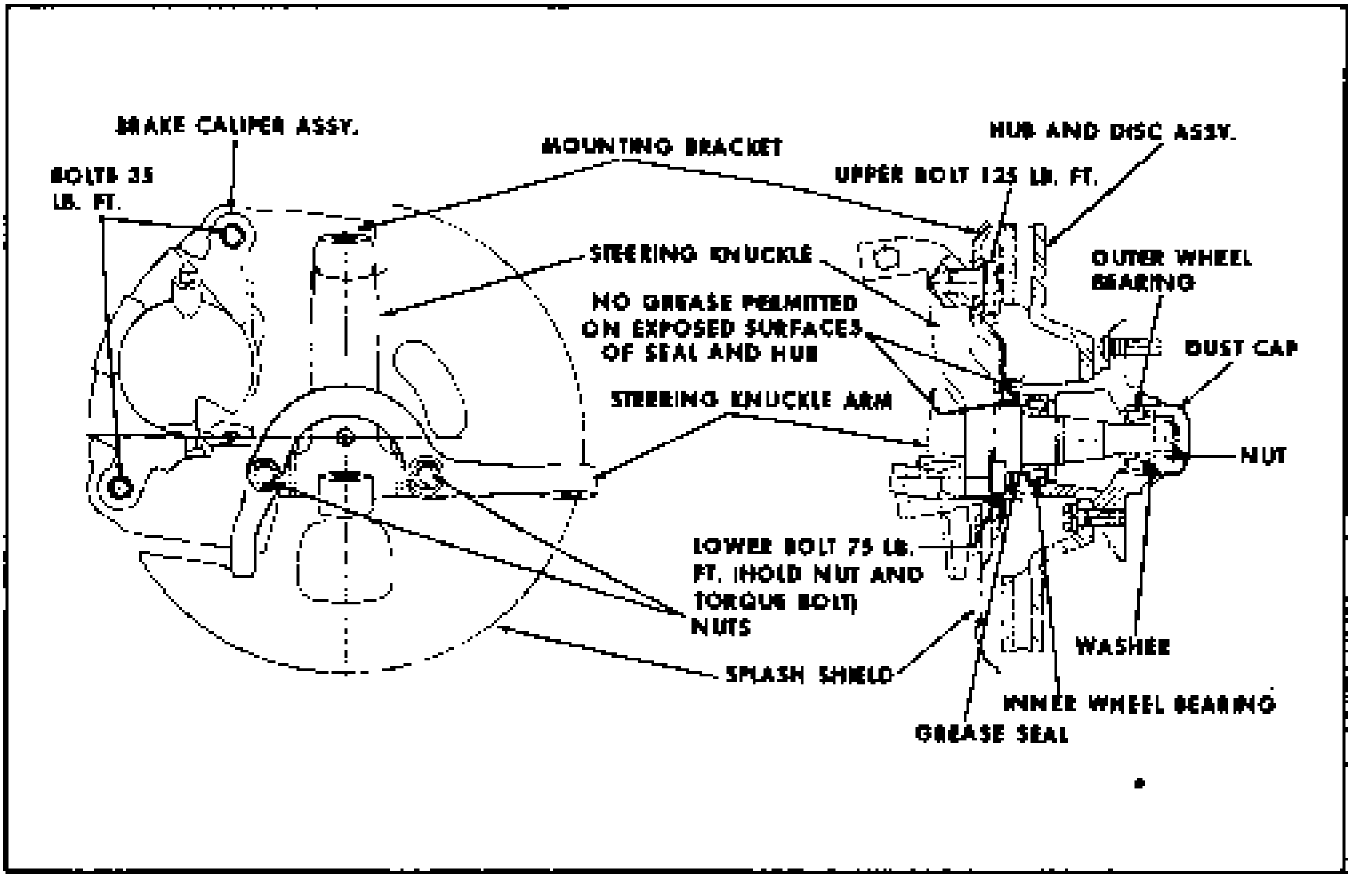


Fig. 3-2 Cross Section of Steering Knuckle, Hub And Disc Assembly

2. Spin wheel to check for unusual noise.

3. If bearings are noisy or excessively loose, they should be cleaned and inspected prior to adjustment.

NOTE: To check for loose bearings, grip the tire at the top and bottom and move the wheel assembly in and out on the spindle. Movement greater than .005" indicates a loose bearing. If necessary to inspect bearings, see MINOR SERVICES - WHEEL BEARING REMOVE AND INSTALL.

ADJUSTMENT

1. Raise car and support at front lower control arm.

NOTE: This will maintain load on the ball joints.

2. Remove hub cap or wheel disc from wheel.

3. Remove dust cap from hub.

4. Remove cotter pin from spindle and adjuster nut.

5. Adjust bearing as shown in Fig. 3-3.

6. Insert cotter pin and bend ends against nut, cut off extra length to ensure ends will not interfere with dust cap.

7. Install dust cap on hub.

8. Install hub cap or wheel disc.

9. Lower car to ground.

SUSPENSION ALIGNMENT

Front suspension components are adjusted to a specific alignment while the vehicle is motionless so that suspension components can properly function together when vehicle is moving to minimize tire wear and maintain desirable steering and handling characteristics.

INSPECTION BEFORE CHECKING FRONT WHEEL ALIGNMENT

Before any checking or corrective work is started on wheel alignment elements, including toe-in, caster, camber, steering axis inclination, and toe-out on turns, the following items which will affect steering should be considered:

1. Check tire inflation and bring to recommended pressure.

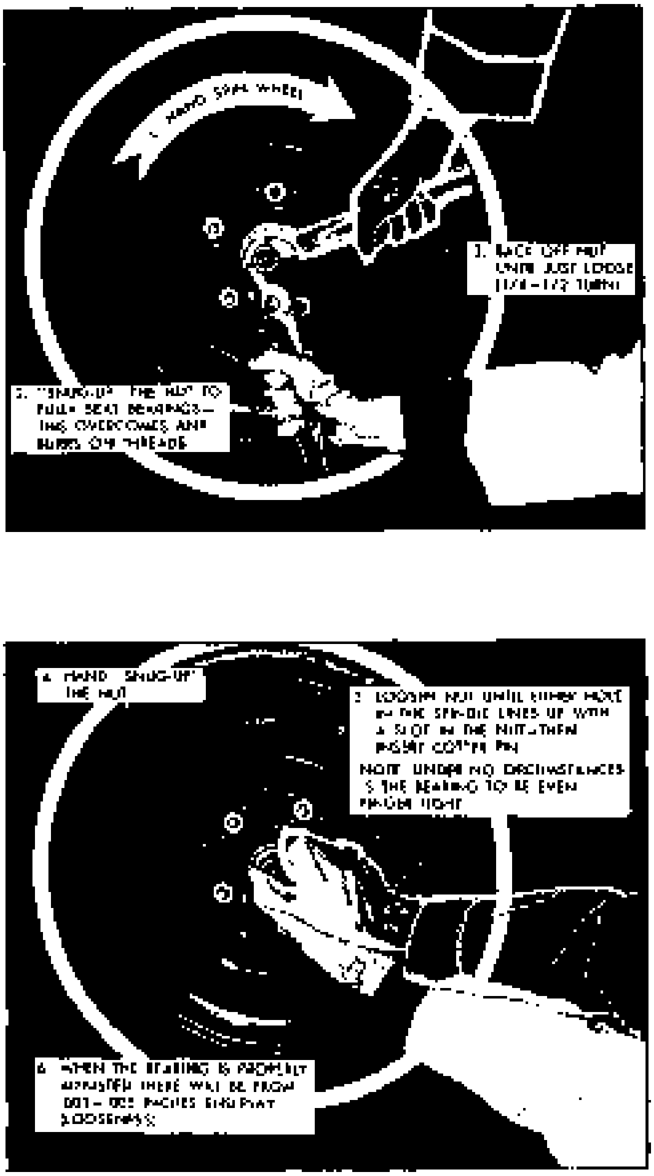


Fig. 3-3 Wheel Bearing Adjustment

2. Check front wheel bearing adjustment and correct if necessary.

3. Check wheel and tire run-out.

4. Check wheel and tire for excessive unbalance which would affect steering.

5. Check spherical ball joints.

6. Check steering linkage for looseness. Replace or tighten parts.

7. Check shock absorbers for leaks or lack of control.

8. Check for extraordinary load in car. Remove load or compensate for setting height. (Samples, tools, etc., carried regularly should not be considered extraordinary load.)

9. Check for proper lubrication of front end suspension components.

CHECKING AND ADJUSTING SEQUENCE-FRONT WHEEL ALIGNMENT

All measurements and adjustments should be made in the following order

a. Curb height (see Curb Height chart in section 0).

b. Caster and camber.

c. Toe-in

d. Steering axis inclination.

e. Toe-out on turns

ADJUST CASTER AND CAMBER

Caster and camber are adjusted to specifications by placing shims between the upper control arm shaft and the frame (Fig. 3-5). Both adjustments can be made at the same control arm shaft to frame bolts. Tool J 22618 can be used to loosen upper control arm shaft to frame bolts on the Pontiac (Fig. 3-6).

1. To increase negative caster add shims to front bolt or remove shims from rear bolt.

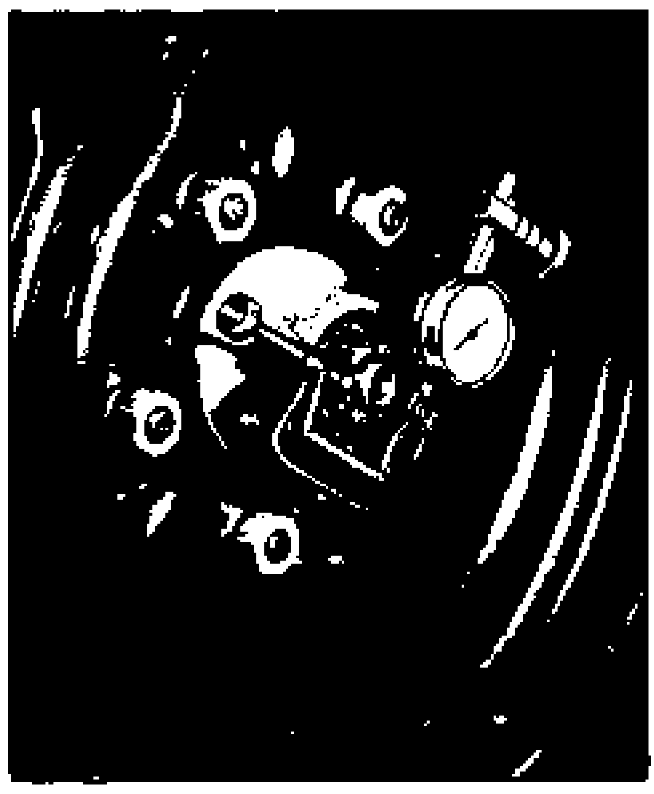


Fig. 3-4 Checking Wheel Bearing Adjustment

2. To decrease negative caster (positive caster) remove shims from front bolt or add shims to rear bolt.

3. To increase positive camber remove shims from both front and rear bolts.

4. To decrease positive camber (negative camber) add shims to both front and rear bolts.

NOTE. By adding or subtracting an equal amount of shims from front and rear bolts, camber will be changed without affecting caster.

CHECK AND SET TOE-IN

Check and set toe-in (see SPECIFICATIONS) with a trammel or with other reputable front end aligning equipment, measuring from sidewall of tire or wheel felloes, using methods given below.

MEASURING BY TRAMMEL

1. After moving car forward on level floor, chalk mark tread on both front tires at point 9" above floor.

2. With trammel set at center-to-center distance of front tires, make a chalk mark on each front tire exactly trammel width apart.

3. Push car forward (never backward) until chalk mark with trammel marks is 9" above floor at rear of wheels.

4. Measure difference from trammel marks made when chalk mark was in front of wheel: if trammel marks are now greater than when marked at front, wheels toe-in by this amount (see SPECIFICATIONS).

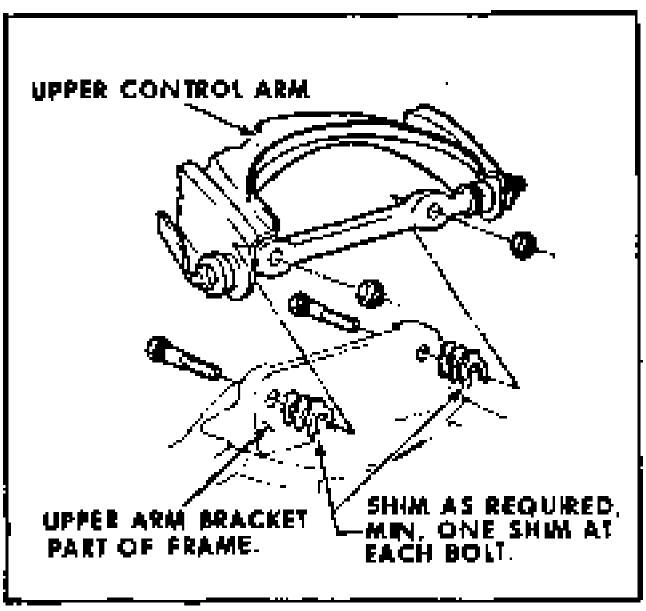


Fig. 3-5 Caster-Camber Shims (Tempest Shown)

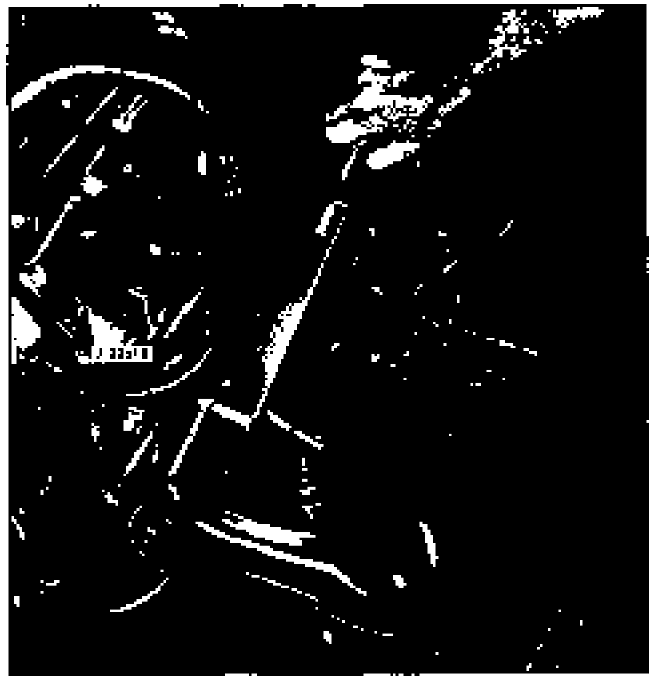


Fig. 3-6 Removing Pontiac Upper Control Arm Nuts With J 22618

EQUIPMENT MEASURING FROM SIDEWALL OR WHEEL FELLOES

When using this type of equipment, wheel run-out will have a very direct bearing on the readings. Since the allowable run-out is 1/8", the readings could possibly be off as far as 1/8" on each wheel if the effect of run out is not cancelled. By taking the average of three readings with the wheel rotated 120° for each reading, the error due to wheel run-out can be cancelled. This should be done as follows:

1. After moving the car forward on level floor, take first reading.

2. Mark sidewall of both tires with the number "1" at rear of tire where instrument bears.

3. At 120° intervals (i.e. 1/3 and 2/3 distance around the tire) mark the numbers "2" and "3" on both tires.

4. Raise wheels off floor and hand spin until the number "2" is in the position which number "1" occupied when the first reading was taken.

5. Push car back one foot and bring forward to position and take second reading. This reading will then be taken with the instrument bearing 120° around the wheel from where the first reading was taken.

6. Use the same procedure for taking the third reading.

7. Average the three readings to find the actual toe-in

SET TOE-IN

1. Remove wheel cover or bezel and set gear on high point of worm by turning steering wheel until mark on shaft is exactly at top. This mark locates the high point, or middle of gear travel.

2. a. On Pontiac and Firebird loosen all tie rod clamp bolts. To increase toe-in turn right tie rod adjuster sleeve in direction of rotation of wheels, when car moves *forward*, turn left tie rod adjuster sleeve in opposite direction. Turn both sleeves an equal amount until toe-in is set at proper specification.

b. On Tempest and Grand Prix loosen all tie rod clamp bolts. To increase toe-in - turn left tie rod adjuster sleeve in direction of rotation of wheels, when car moves forward; turn right tie rod adjuster sleeve in opposite direction. Turn both sleeves an equal amount until toe-in is set at proper specification.

3. Make sure front wheels are straight ahead by measuring from a reference point at same place on each side of frame center to front of wheel rims. If measurements are not equal, turn both tie rod adjuster sleeves in same direction (so as not to change toe-in) until measurements become equal. Re-check toe-in since toe-in measurement is accurate only with wheels in straight-ahead position.

4. Tighten all tie rod clamp bolts to 17 lb. ft. torque. Open end of clamps on Pontiac should be 0°-15° rearward of vertical down position and on Tempest and Grand Prix open end of clamps should be 0°-15 forward from vertical down position. On Firebird the open end of clamps should be on the high side of adjuster sleeve and 30° either side of vertical up position.

CHECK STEERING AXIS INCLINATION

Generally there is no need to check steering axis inclination unless a problem exists after setting caster and camber to specification. Failure to obtain correct measurement indicates a bent or damaged steering or suspension part.

CHECK TOE-OUT ON TURNS

Check toe-out after any necessary corrections to camber, caster, and toe-in have been made.

1. Check with any reputable front end aligning equipment, using full floating turn tables. With front wheels resting on turn tables, turn wheels to left until left wheel has been turned 20° from straight ahead. The right wheel should have turned 18° to 19°.

2. Turn wheels to right until right wheel has been turned 20° from straight ahead. Left wheel should have turned 18° to 19°.

3. Incorrect toe-out on turns may be caused by incorrect front end adjustments, but generally indicates bent steering arms which must be replaced.

Replacement of one or both steering arms should be followed by a complete front end check.

MINOR SERVICES

WHEEL BEARING

REMOVE

1. Raise car and support at front lower control arm.

NOTE: This will maintain load on the ball joints.

2. Remove hub cap or wheel disc from wheel.

3. a. Standard Brakes: Remove dust cap from hub.

b. Disc Brakes: Remove wheel and tire assembly before removing dust cap from hub.

4. a. Standard Brakes: Remove cotter pin, wheel adjustment nut and washer from spindle, then remove wheel with hub and drum assembly from spindle with a gentle rocking motion.

CAUTION: When hub and wheel assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.

NOTE: In some cases it may be necessary to back off brake adjustment to remove hub and wheel assembly.

b. Disc Brakes: Remove brake caliper assembly before removing cotter pin, wheel adjustment nut and washer from spindle. Then, remove disc assembly from spindle.

CAUTION: Brake hose is still connected to caliper; therefore, caliper must be moved out of way and supported so brake hose will not be damaged.

5. Remove inner bearing from hub by tapping out inner grease seal with a brass drift. DISCARD SEAL.

6. Wipe old grease out of hub and from spindle of steering knuckle.

7. Wash bearings in solvent and air-dry. Do not spin dry with compressed air. Inspect bearings and races for cracking, pitting, etching, etc.

NOTE: If necessary to replace either a bearing (inner race and rolls assembly) or its outer race, both bearing and outer race should be replaced together.

When inspecting or replacing bearing (inner race and rolls assembly), make sure the race is free to creep on spindle. The inner race is designed to creep on the spindle in order to afford a constantly changing load contact between the race and the roller bearings. Polishing the spindle or *applying bearing lubricant will permit creeping and prevent rust forming between race and spindle.*

8. If necessary to replace an outer race, drive out old race from the hub with a brass drift inserted behind race in notches in hub. Install new race by driving it into hub with a brass drift.

NOTE: Use care when installing new race to start it squarely into hub, to avoid distortion and possible cracking.

9. Use a bearing lubricator if available and thoroughly lubricate bearing assemblies with new high melting point wheel-bearing lubricant. Remove any excess lubricant.

NOTE: Be sure bearing parts have been thoroughly cleaned and air-dried because bearing lubricant will not adhere to wet or oily surfaces.

INSTALL

1. Apply a light coat of lubricant to spindle and inside surface of hub.

2. Place inner bearing in race of hub and install a new grease seal.

NOTE: Clean loose material from brake drum on standard brakes with compressed air. Be sure inner hub and bearings are covered. Inspect lining contact area for grease. Clean with a non-flammable non-toxic solvent (such as denatured alcohol). Make sure wiping cloth and fluid do not become loaded with grease from repeated use.

Inspect brake linings for grease contamination. Clean by wiping with a non-flammable, non-toxic solvent (such as denatured alcohol).

3. a. Standard Brakes: Carefully install hub and drum assembly with wheel on spindle.

b. Disc Brakes: Carefully install hub and disc assembly on spindle.

4. Install outer wheel bearing.

6. Install washer and adjusting nut.

7. Adjust wheel bearings as outlined under ADJUSTMENT PROCEDURES.

8. a. Standard Brakes: Check brake adjustment if needed.

b. Disc Brakes: Position caliper, install and tighten two caliper mounting bolts to 35 lb. ft. torque.

9. Install dust cap on hub.

10. a. Standard Brakes: Install hub cap or wheel disc.

b. Disc Brakes: Install wheel and tighten nuts to 70 lb. ft. torque on all models except Pontiac and to 75 lb. ft. torque on Pontiac. Install hub cap or wheel disc.

11. Lower car to ground.

SHOCK ABSORBER

REMOVE

1. Raise car sufficiently to allow removal of shock.

2. Remove nut, retainer and grommet which attach upper end of shock absorber to frame bracket (Fig. 3-7).

NOTE: Shock absorber piston rod must not turn while loosening nut. If necessary, use pliers or wrench to hold top of rod while removing nut.

3. Remove two shock absorber lower attaching screws and remove shock absorber through lower control arm.

INSTALL

1. Install shock absorber by reversing the above steps (Fig. 3-7).

NOTE: Make sure all grommets and retainers are correctly installed. Upper stud nut must be tightened

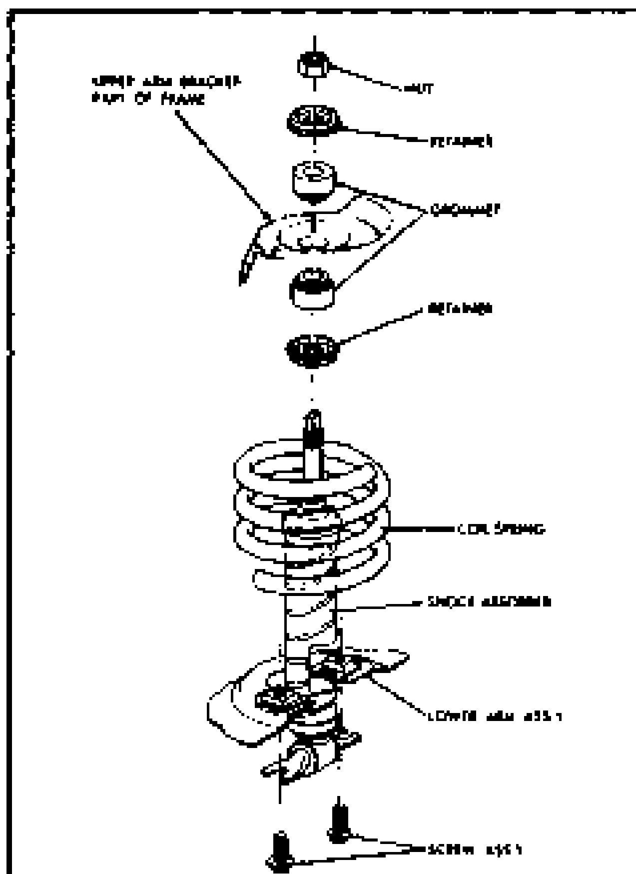


Fig. 3-7 Typical Shock Absorber Installation

until it bottoms at end of steel threads.

2. Tighten upper stud nut to 8 lb. ft. torque and torque two lower attaching screws to 20 lb. ft.

STABILIZER SHAFT

REMOVE

1. Raise car and support front end with stands at frame side rails.

NOTE: This allows lower control arms to swing down and provide more clearance for stabilizer shaft removal on Pontiac and Firebird.

2. Disconnect both links from stabilizer shaft by removing each link nut and rotating shaft up from lower control arm (Fig. 3-8).

3. Remove screws holding two stabilizer shaft brackets to frame and remove two brackets and bushings from shaft. Remove two clamps and sleeves (Fig. 3-9) from shaft on Firebird (early models only).

4. Remove shaft.

INSTALL

1. Install by reversing the above steps.

2. Tighten bracket attaching screws to 30 lb. ft. torque on Pontiac and 12 lb. ft. torque on all other models with car at curb height. Tighten clamp nuts to 9 lb. ft on Firebird.

3. Install link assembly as shown in Fig. 3-8. Tighten nut 15 lb. ft. torque on all models except Firebird. Torque nut to 8 lb. ft. on Firebird models.

MAJOR SERVICES

SPRING

REMOVE

1. Remove nut, retainer and grommet which attach upper end of shock absorber to frame bracket.

NOTE: Shock absorber piston rod must not turn while loosening nut. If necessary, use pliers or wrench to hold top of rod while removing nut.

2. Raise car and support front end with stands at frame side rails.

3. Remove two shock absorber lower attaching screws and remove shock through lower control arm.

4. Remove stabilizer link nut, link, spacer, grommets and retainers.

5. Using a hydraulic transmission jack, bolt adjustable spring removal tool J 23028 onto the jack and position under the two inner control arm bushings (Fig. 3-10).

NOTE: When positioning spring tool under lower control arm bushings, on some models it is necessary to tilt the tool at a slight angle to provide clearance to let control arm swing down.

6. Remove the two lower control arm to front crossmember pivot bolts.

7. Carefully allow lower control arm to swing down by lowering jack.

CAUTION: Allow spring to completely expand before attempting to remove it.

8. Remove spring.

INSTALL

1. Install by reversing the above steps. Take care to ensure that spring is properly installed as shown in Fig. 3-11 on Pontiac, Tempest and Grand Prix models.

2. Tighten lower control arm pivot bolts to 110 lb. ft. torque or nuts to 80 lb. ft. torque with lower control arm in normal curb height position.

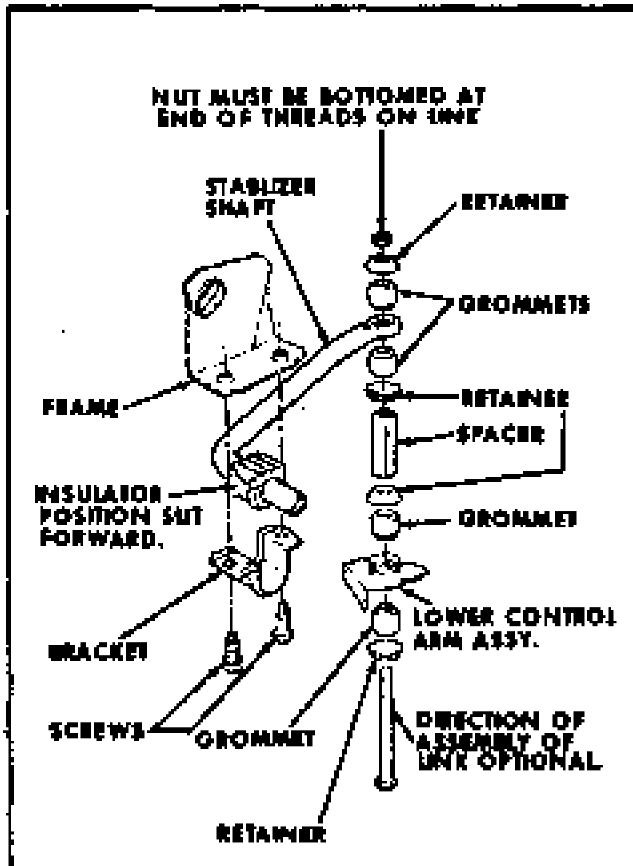


Fig. 3-8 Stabilizer Link Installation - Except Firebird

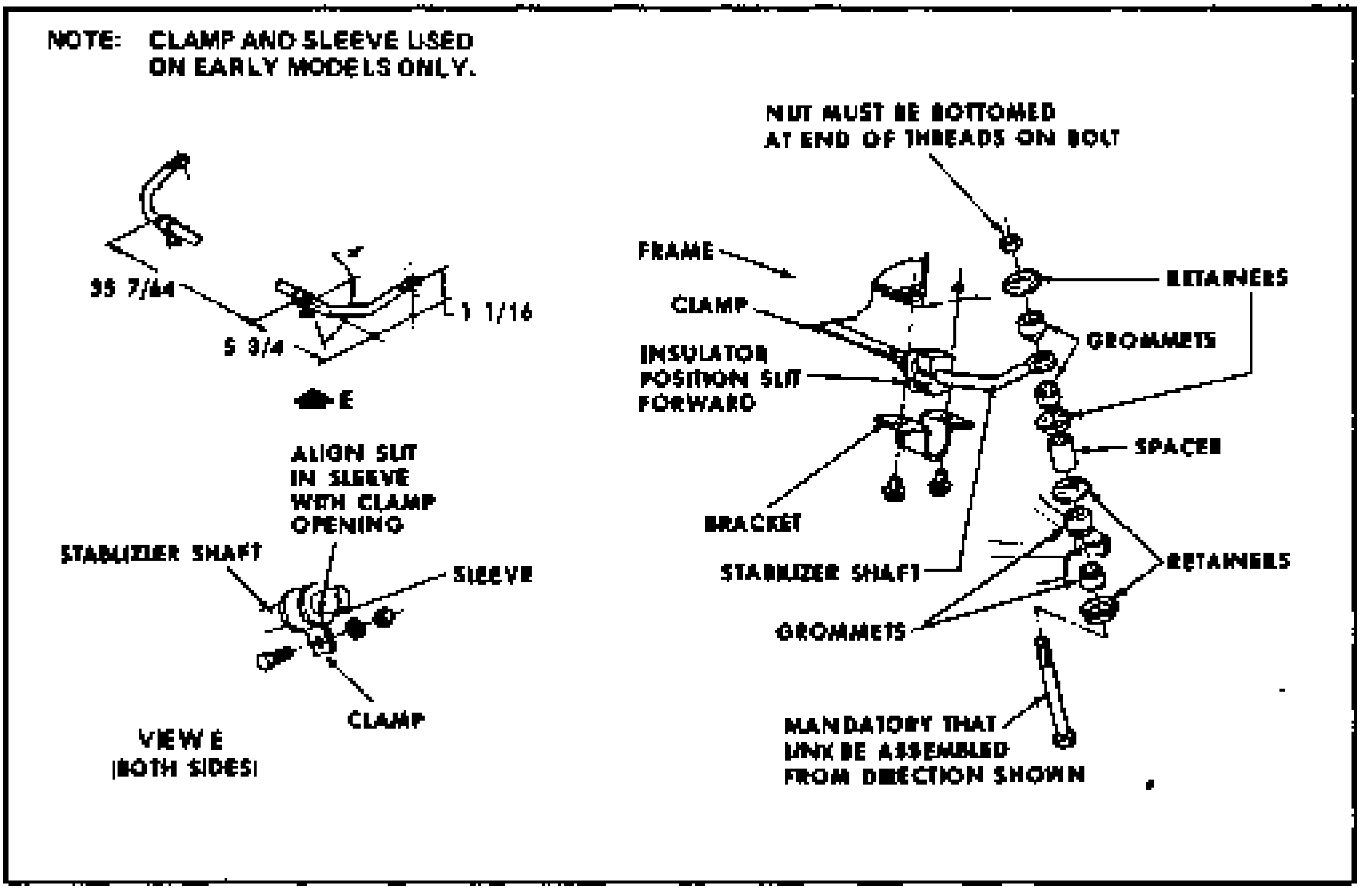


Fig. 3-9 Stabilizer Shaft Installation - Firebird

NOTE: On Pontiac, lower control arm rear pivot bolt must be assembled with head of bolt towards rear of car.

3. Tighten shock absorber upper stud nut to 8 lb. ft. torque and torque two lower attaching screws to 20 lb. ft.

4. Tighten stabilizer link nut to 15 lb. ft. torque on all models except Firebird. Torque nut to 8 lb. ft. on Firebird.

STEERING KNUCKLE

REMOVE

1. Raise car and support at front lower control arm.

NOTE: This keeps spring compressed.

2. Remove hub cap or wheel disc from wheel.

3. a. Standard Brakes: Remove dust cap from hub.

b. Disc Brakes: Remove wheel and tire assembly before removing dust cap from hub.

4. a. Standard Brakes: Remove cotter pin, wheel adjustment nut and washer from spindle, then remove wheel with hub and drum assembly from spindle with a gentle rocking motion.

CAUTION: When hub and wheel assembly is partially loose on spindle, remove outer wheel bearing. DO NOT DROP BEARING.

NOTE: In some cases it may be necessary to back off brake adjustment to remove hub and wheel assembly.

b. Disc Brakes: Remove brake caliper assembly before removing cotter pin, wheel adjustment nut and washer from spindle. Then remove hub and disc assembly from spindle.

5. a. Standard Brakes: Remove backing plate and brake assembly from steering knuckle and move steering arm out of way.

b. Disc Brakes: Remove splash shield and mounting bracket from steering knuckle and move steering arm out of way.

CAUTION: Brake hose is still connected to backing plate and brake assembly or brake caliper assembly; therefore, either one must be moved out of way and supported so brake hose is not damaged.

6. Remove upper and lower ball joint studs from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

NOTE: Instead of using a pry bar, tool J 6627 can be used on Pontiac and tool J 8806-1 can be used on all models except Pontiac (Fig. 3-12 or 3-13).

INSTALL

1. Install steering knuckle by reversing above stpes.

2. Tighten lower ball joint stud nut on Pontiac and upper ball joint stud nut on all models to 50 lb. ft. torque. Tighten Tempest, Grand Prix and Firebird lower ball stud nut to 85 lb. ft. torque. Insert cotter pins.

CAUTION: Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut.

NOTE: Turn nut in tightening direction only to align slot with hole to insert cotter pin. Do not back off nut.

3. a. Standard Brakes: Tighten backing plate and brake assembly upper bolt to 100 lb. ft. torque and two lower bolts to 75 lb. ft. torque while holding nuts.

b. Disc Brakes: Tighten splash shield and mounting bracket upper bolt to 125 lb. ft. torque and two lower bolts to 75 lb. ft. torque while holding nuts. Tighten two caliper assembly mounting bolts to 35 lb. ft. torque.

4. Adjust wheel bearings as outlined in this section under ADJUSTMENT PROCEDURES.

5. Disc Brakes: Tighten wheel nuts to 70 lb. ft.

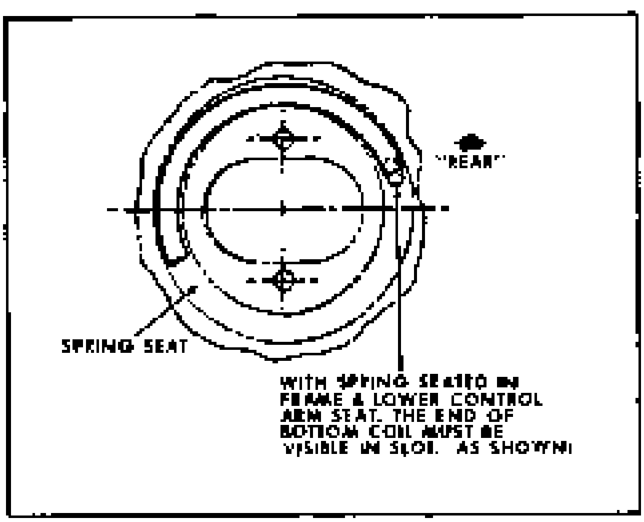


Fig. 3-11 Coil Spring Position In Lower Control Arm Spring Seat - Except Firebird

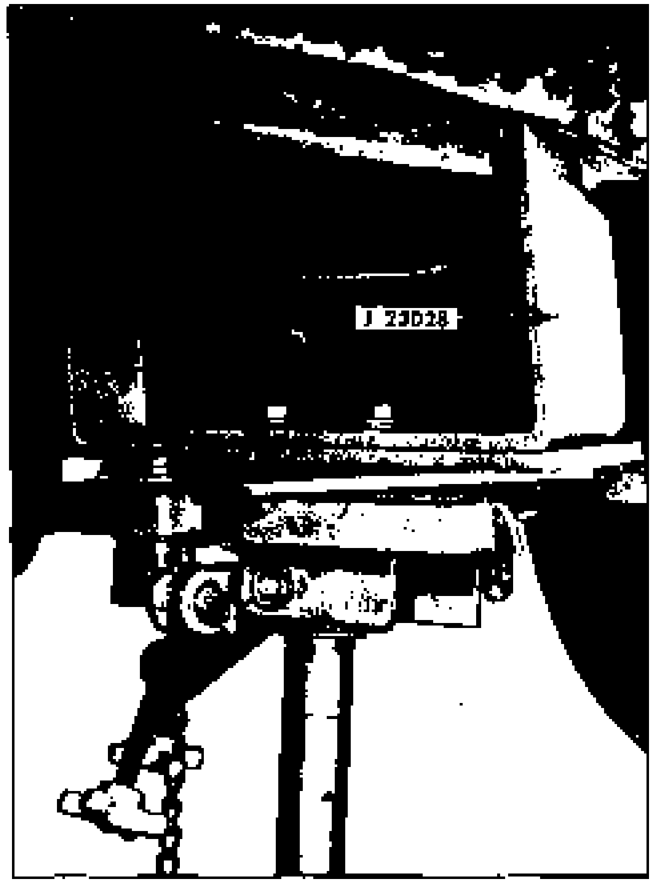


Fig. 3-10 Removing Coil Spring With J 23028

torque on all models except Pontiac and to 75 lb. ft. torque on Pontiac.

UPPER CONTROL ARM

REMOVE

1. Raise car and support at front lower control arm.

NOTE: This keeps spring compressed.

2. Remove wheel and tire assembly.

3. Remove upper ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

NOTE: Instead of using a pry bar, tool J 6627 can be used on Pontiac and tool J 8806-1 can be used on all models except Pontiac (Fig. 3-12 or 3-13).

3. Remove two self-locking nuts, washers and bolts holding upper control arm shaft to frame; remove shims, control arm and shaft assembly. Use tool J 22618 on Pontiac (Fig. 3-6).

NOTE: Firebird models equipped with air conditioning and V-8 engine, follow steps below before loosening upper control arm attaching bolt nuts.

a. Remove the three front and two rear compressor mounting bolts and disconnect clutch wires.

b. Remove A/C belt and tip compressor up and move to rear of engine compartment.

INSTALL

1. Position control arm and shaft assembly on frame crossmember and install two bolts, shims, washers and self-locking nuts. Tighten nuts to 75 lb. ft. torque on Pontiac and to 50 lb. ft. on all other models while holding bolts.

2. Insert upper ball joint stud into steering knuckle and tighten nut to 50 lb. ft. torque. Insert cotter pin.

CAUTION: Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut.

NOTE: Turn nut in tightening direction only to align slot with hole to insert cotter pin. Do not back off nut.

3. Tighten the control arm shaft nuts (or bolts on Firebird) if control arm bushings have been replaced. Torque nuts on all models except Firebird to 50 lb. ft., and on Firebird torque bolts to 35 lb. ft. with control arm in normal curb height position.

Fig. 3-12 Removing Ball Joint Stud With J 6627
Pontiac

4. Install wheel and tighten nuts to 70 lb. ft. torque on all models except Pontiac and to 75 lb. ft. torque on Pontiac.

5. Lower car and check front end alignment.

NOTE: On Firebird models equipped with V-8 engine and air conditioning, reposition A/C compressor and install mounting bolts. Reconnect all clutch wires to compressor clutch.

UPPER CONTROL ARM SHAFT AND/OR BUSHINGS (CONTROL ARM REMOVED FROM CAR) - FIREBIRD

REMOVE

1. Remove bolt, lock washer and retainer from both ends of control arm shaft.

2. Install a 3/8"-24 bolt in one end of control arm shaft.

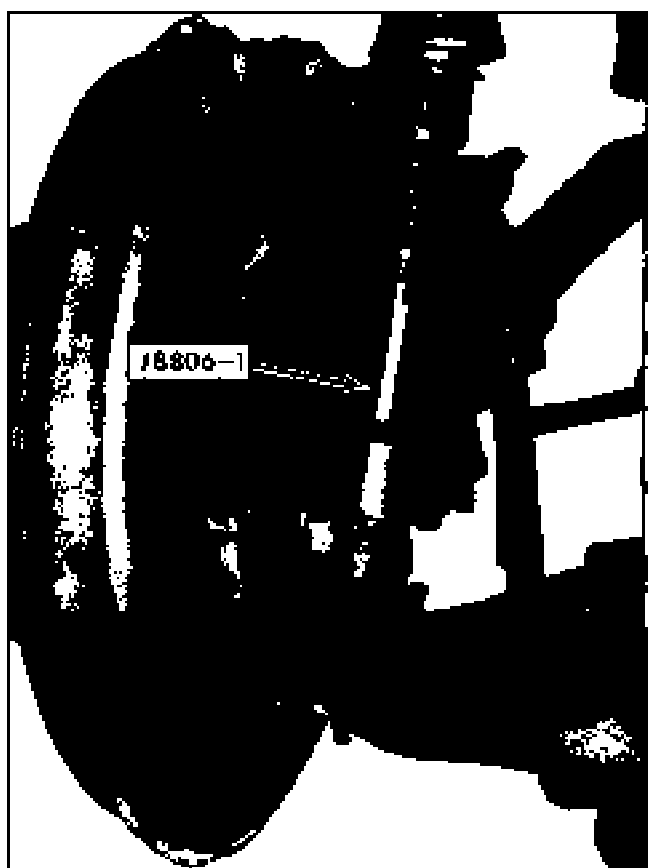


Fig. 3-13 Removing Ball Joint Stud With J 8806-1
Except Pontiac

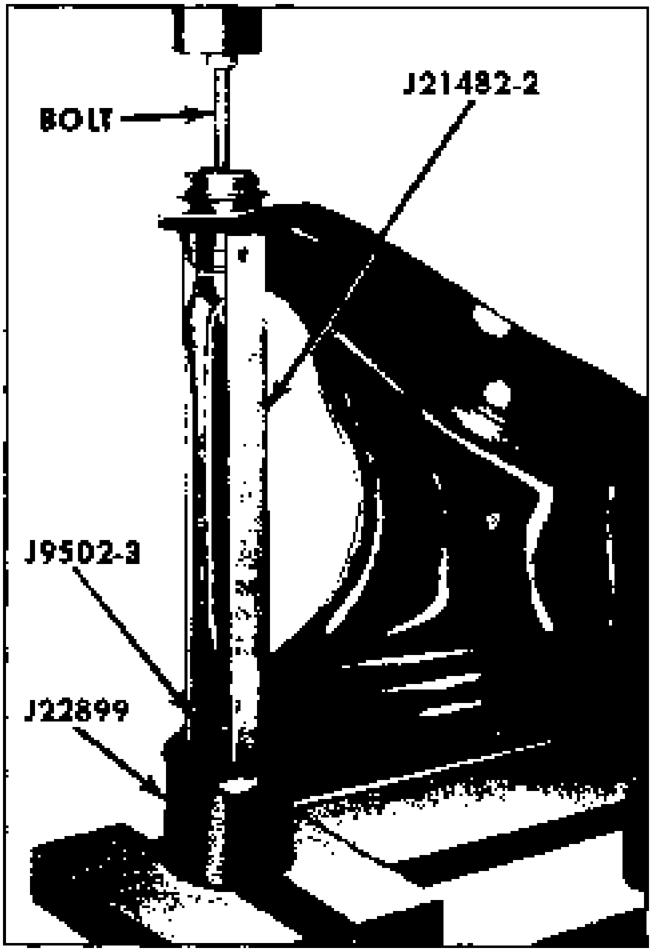


Fig. 3-14 Removing Upper Control Arm Bushing Firebird

3. Place control arm in an arbor press and position tools J 22899 and J 21482-2 as shown in Fig. 3-14.

NOTE: Be certain flange of bushing does not contact tool J 22899.

4. Press out one bushing, invert control arm and repeat process on other bushing. Discard bushings.

5. Remove bolt from control arm shaft.

NOTE: If bushing rubber is deteriorated to the extend that the bushing sleeve cannot be pushed out, release the press, install J 9502-3 as shown in Fig. 3-14 and press out the sleeve.

INSTALL

1. Install control arm shaft and/or bushings in control arm as follows:

a. Press in one bushing* by placing control arm in arbor press with tools J 21482-2, J 21474-2 and J 22899 positioned as shown in Fig. 3-15.

b. Install control arm shaft in arm, invert in press, and press in second bushing as above.

NOTE: Control arm shaft should be able to be turned by hand.

2. Install retainer, lock washer and bolt in both ends of shaft.

NOTE: Do not tighten bolts until control arm is installed on car and is in normal curb height position.

UPPER CONTROL ARM SHAFT AND/OR BUSHINGS (CONTROL ARM REMOVED FROM CAR) - EXCEPT FIREBIRD

REMOVE

1. Remove nut and retainer from both ends of control arm shaft.

2. Place control arm in an arbor press and position tools J 9502-3 and J 22899 as shown in Fig. 3-16.

NOTE: Be certain flange of bushing does not contact tool J 22899.

3. Press out one bushing, invert control arm and repeat process on other bushing. Discard bushings.

INSTALL

1. Install control arm shaft and/or bushings in control arm as follows:

a. Place tool J 7167 in position as shown in Fig. 3-17 and expand until tool is snug between inner faces of arm.

b. Position shaft in control arm.

c. Insert bushings on ends of shaft.

d. Press bushings in control arm with arbor press, using two large sockets or J 22899 for installers (Fig. 3-17).

NOTE: Control arm shaft should be able to be turned by hand.

2. Install retainer and nut on both ends of shaft.

NOTE: Do not tighten nuts until control arm is installed on car and is in normal curb height position.

LOWER CONTROL ARM

REMOVE

1. Remove spring (see SPRING - REMOVE).

2. Remove lower ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

NOTE: Instead of using a pry bar, tool J 6627 can be used on Pontiac and tool J 8806-1 can be used on all models except Pontiac (Fig. 3-12 or 3-13).

INSTALL

1. Insert lower ball joint stud into steering knuckle and tighten nut to 85 lb. ft. torque on all models except Pontiac. Tighten nut on Pontiac to 50 lb. ft. torque. Insert cotter pin

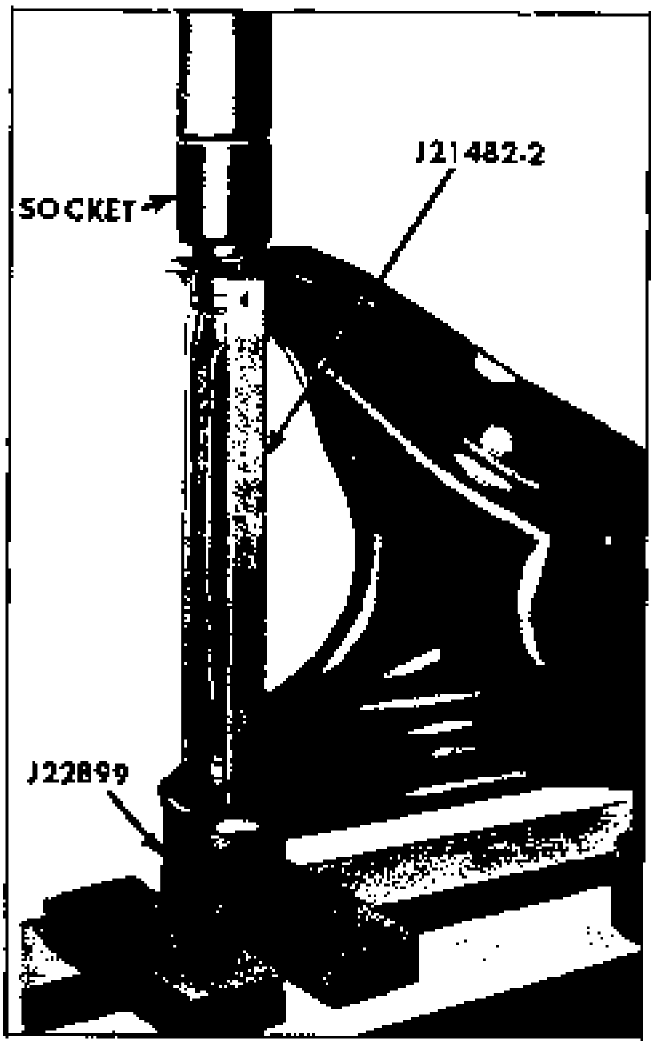


Fig. 3-15 Installing Upper Control Arm Bushing Firebird

CAUTION: Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut.

NOTE: Turn nut in tightening direction only to align slot with hole to insert cotter pin. Do not back off nut.

2. Install spring (see SPRING - INSTALL).

LOWER CONTROL ARM BUSHING

NOTE: If the control arm is not removed from car. The bushings can be replaced without removing control arm from car by disconnecting control arm from frame at the two pivot bolts. When performing the repair in this manner, care must be taken to raise car off ground and support weight of car at frame side rail. Then place a jack under the lower control arm, remove pivot bolts and carefully lower control arm until there is clearance to install bushing removal tools. After bushings are replaced, reposition control arm to frame and install pivot bolts, tighten bolts to proper torque with control arm at curb height position. Use tool J 23028 to lower and raise control arm. (see SPRING - REMOVE, step 5).

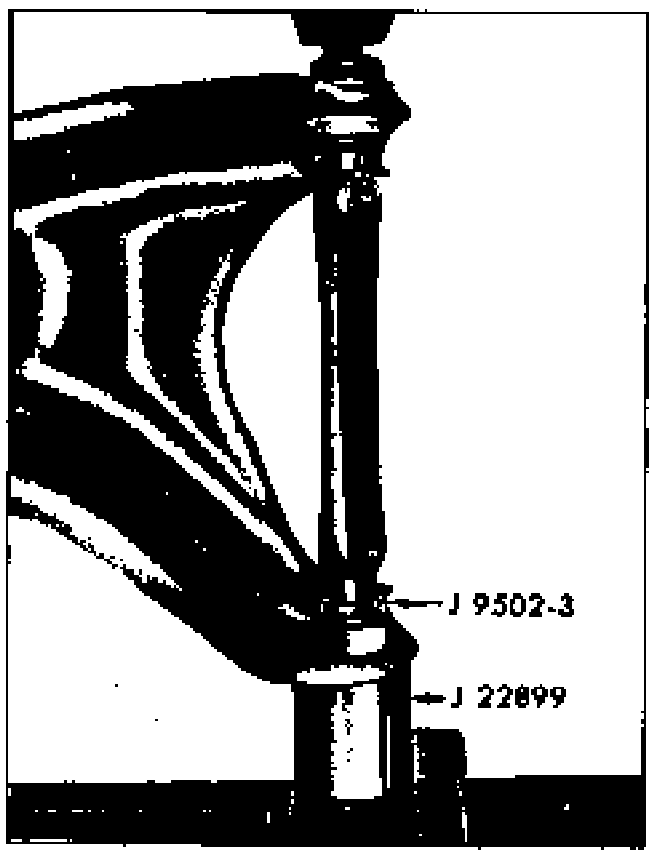


Fig. 3-16 Removing Upper Control Arm Bushing Except Firebird

REAR BUSHING - TEMPEST AND GRAND PRIX

FRONT BUSHING - PONTIAC

REMOVE

1. Remove lower control arm (see LOWER CONTROL ARM -REMOVE).

2. Remove bushing from control arm by arranging tools as shown in Fig. 3-18.

INSTALL

1. Install bushing in lower control arm by arranging tools as shown in Fig. 3-19 and press bushing into arm.

2. Install lower control arm (see LOWER CONTROL ARM -INSTALL).

FRONT BUSHING - EXCEPT PONTIAC

REAR BUSHING - PONTIAC

REMOVE

1. Remove lower control arm (see LOWER CONTROL ARM -REMOVE).

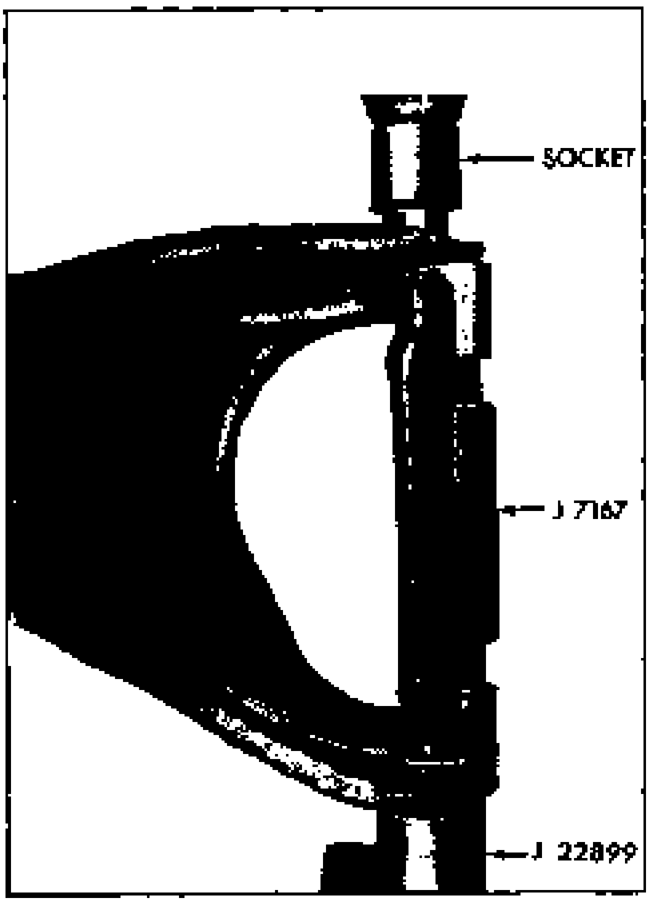


Fig. 3-17 Installing Upper Control Arm Bushing Except Firebird

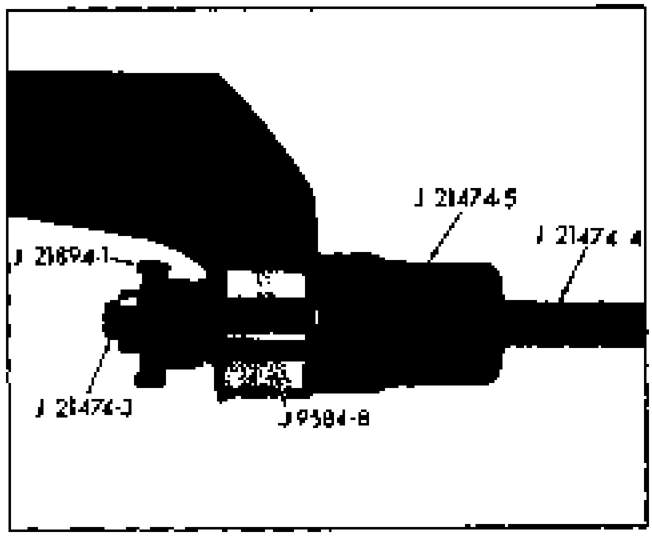


Fig. 3-18 Removing Pontiac Lower Control Arm Front Bushing or Tempest and Grand Prix Rear Bushing

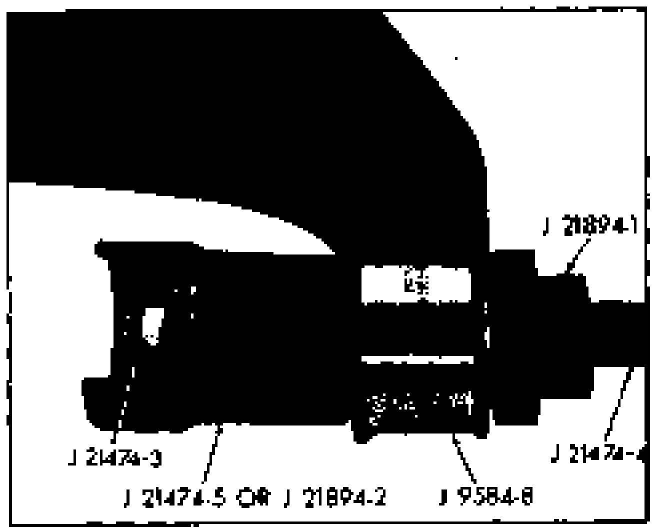


Fig. 3-19 Installing Pontiac Lower Control Arm Front Bushing or Tempest and Grand Prix Rear Bushing

2. Remove bushing from control arm by arranging tools as shown in Fig. 3-20.

INSTALL

1. Install bushing in control arm by arranging tools as shown in Fig. 3-21.

2. Install lower control arm (see LOWER CONTROL ARM -INSTALL).

REAR BUSHING - FIREBIRD

1. Remove lower control arm (see LOWER CONTROL ARM -REMOVE).

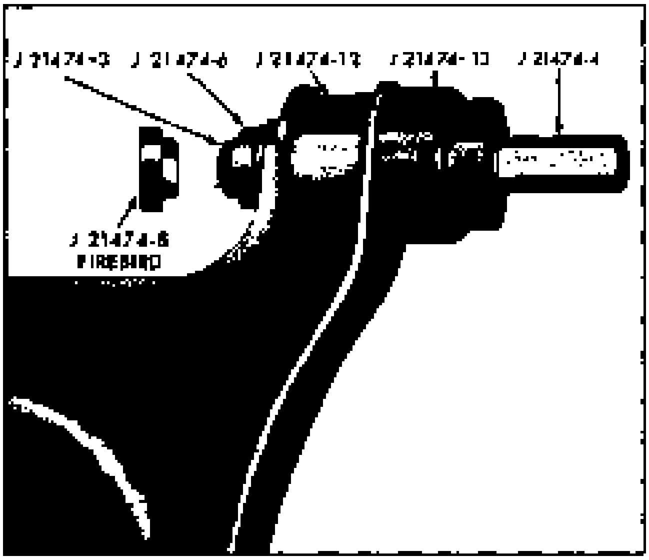


Fig. 3-20 Removing Lower Control Arm Front Bushing (Except Pontiac) and Rear Bushing - Pontiac

2. Remove bushing from control arm by arranging tools as shown in Fig. 3-22.

INSTALL

1. Install bushing in control arm by arranging tools as shown in Fig. 3-22.

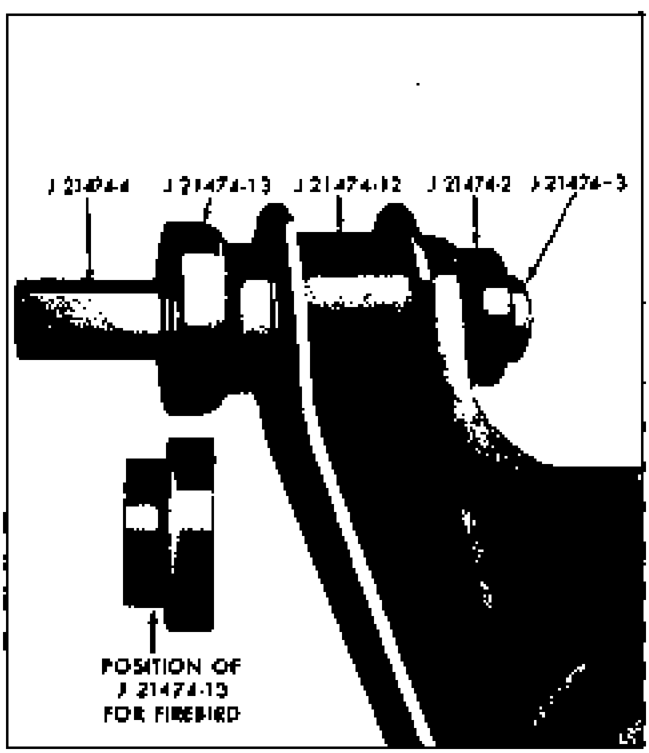


Fig. 3-21 Installing Lower Control Arm Front Bushing (Except Pontiac) and Rear Bushing - Pontiac

2. Install lower control arm (see LOWER CONTROL ARM -INSTALL).

UPPER BALL JOINT -

REMOVE

1. Raise car and support lower control arm.

NOTE: This keeps spring compressed.

2. Remove wheel and tire assembly.

3. Remove ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on steering knuckle in area of ball stud.

NOTE: Instead of using a pry bar, tool J 6627 can be used on Pontiac and tool J 6806-1 can be used on all models except Pontiac (Fig. 3-12 or 3-13).

4. Remove ball joint assembly from upper control arm by chiseling or drilling rivet heads which retain ball joint assembly to control arm, and drive out rivets.

INSTALL

1. Install new ball joint assembly using the special bolts, washers and nuts supplied with ball joint package.

CAUTION: Use only the special alloy bolts supplied with ball joint package.

2. Tighten ball joint assembly attaching nuts to 9 lb. ft. torque on all models except Firebird and to 25 lb. ft. torque on Firebird.

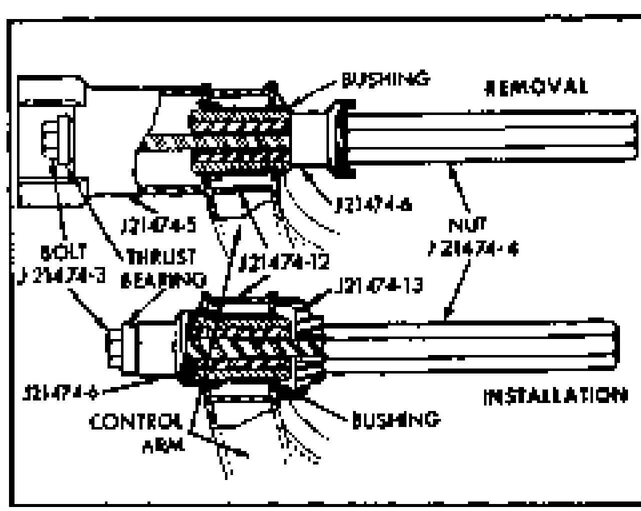


Fig. 3-22 Lower Control Arm Rear Bushing - Firebird

3. Insert ball stud in steering knuckle and tighten nut to 50 lb. ft. torque. Insert cotter pin.

CAUTION: Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut.

NOTE: Turn nut in tightening direction only to align slot with hole to insert cotter pin. Do not back off nut.

4. Install wheel and tighten nuts to 70 lb. ft. torque on all models except Pontiac; install and tighten nuts to 75 lb. ft. torque on Pontiac.

5. Lower car.

LOWER BALL JOINT - PONTIAC

REMOVE

1. Remove hub and backing plate assembly or hub and brake caliper assembly (see STEERING KNUCKLE - REMOVE, steps 1 through 5).

2. Remove lower ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

NOTE: Instead of using a pry bar, tool J 6627 can be used on Pontiac and tool J 8806-1 can be used on all models except Pontiac (Fig. 3-12 or 3-13).

3. Remove ball joint assembly from lower control arm by chiseling or drilling rivet heads which retain ball joint assembly to control arm, and drive out rivets.

INSTALL

1. Install new ball joint, using the special bolts, washers and nuts supplied with ball joint package.

CAUTION: Use only the special alloy bolts supplied withh ball joint package.

2. Tighten ball joint assembly attaching nuts to 9 lb. ft. torque.

3. Insert lower ball joint stud into steering knuckle hole and tighten nut to 50 lb. ft. torque. Insert cotter pin.

CAUTION: Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut.

NOTE: Turn nut to tightening direction only to align slot with hole to insert cotter pin. Do not back off nut.

4. Install hub and backing plate assembly or brake caliper assembly (see STEERING KNUCKLE INSTALL, steps 3 through 5).

5. Lower car.

LOWER BALL JOINT - EXCEPT PONTIAC

REMOVE

1. Raise car and support front lower control arms under spring seats.

NOTE: This keeps spring compressed and allows clearance to position tool J 9519-10.

2. Remove hub and backing plate assembly or brake caliper assembly (see STEERING KNUCKLE - REMOVE, steps 2 through 5).

3. Remove lower ball joint stud from steering knuckle by prying on control arm using a suitable pry bar and tapping sharply on knuckle in area of ball stud.

NOTE: Instead of using a pry bar, tool J 6627 can be used on Pontiac and tool J 8806-1 can be used on all models except Pontiac (Fig. 3-12 or 3-13).

4. Pry off ball joint seal and retainer with a screwdriver.

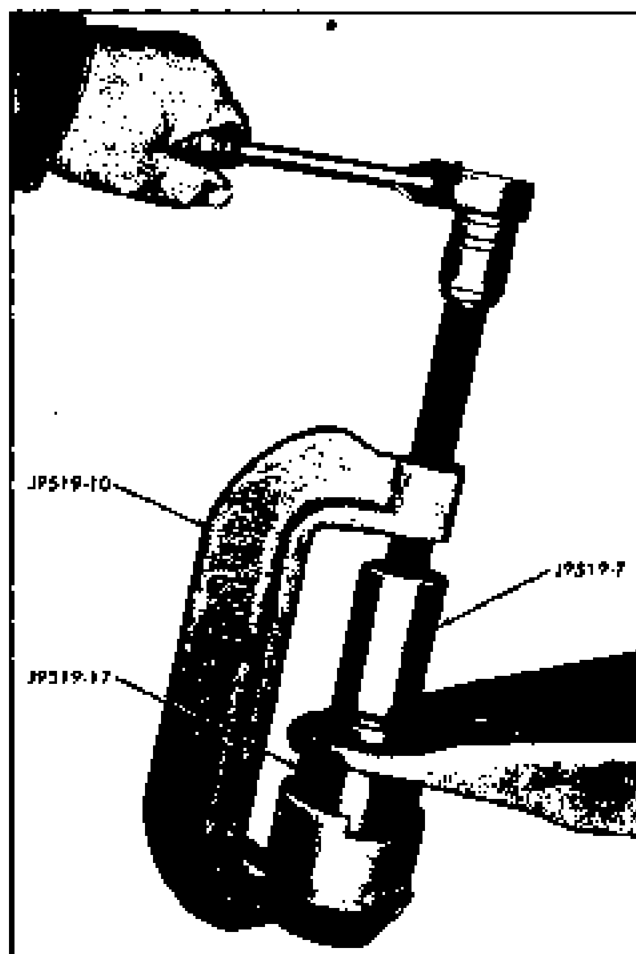


Fig. 3-23 Lower Ball Joint Removal Except Pontiac

5. Position tools J 9519-10, J 9519-17 and J 9519-7, as shown in Fig. 3-23, and turn down on the hex head screw until the ball joint assembly is pushed out of the control arm.

INSTALL

1. Start the replacement ball joint assembly into the control arm and position tools J 9519-10, J 9519-16 and J 9519-17 as shown in Fig. 3-24.

2. Turn down on the hex head screw until the ball joint assembly is seated properly in the control arm.

3. Insert ball joint stud into steering knuckle hole and tighten nut to 85 lb. ft. torque. Insert cotter pin.

CAUTION: Care should be taken to insure that steering knuckle hole, ball stud and nut are free of dirt and grease before tightening nut.

NOTE: Turn nut in tightening direction only to align slot with hole to insert cotter pin. Do not back off nut.

4. Install hub and backing plate assembly or brake caliper assembly (see STEERING KNUCKLE INSTALL, steps 3 through 5).

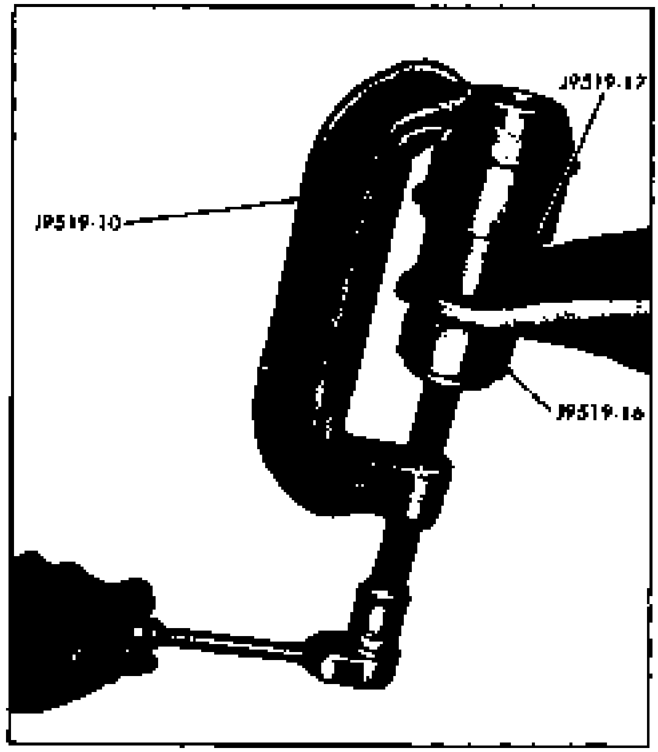


Fig. 3-24 Lower Ball Joint Installation Except Pontiac

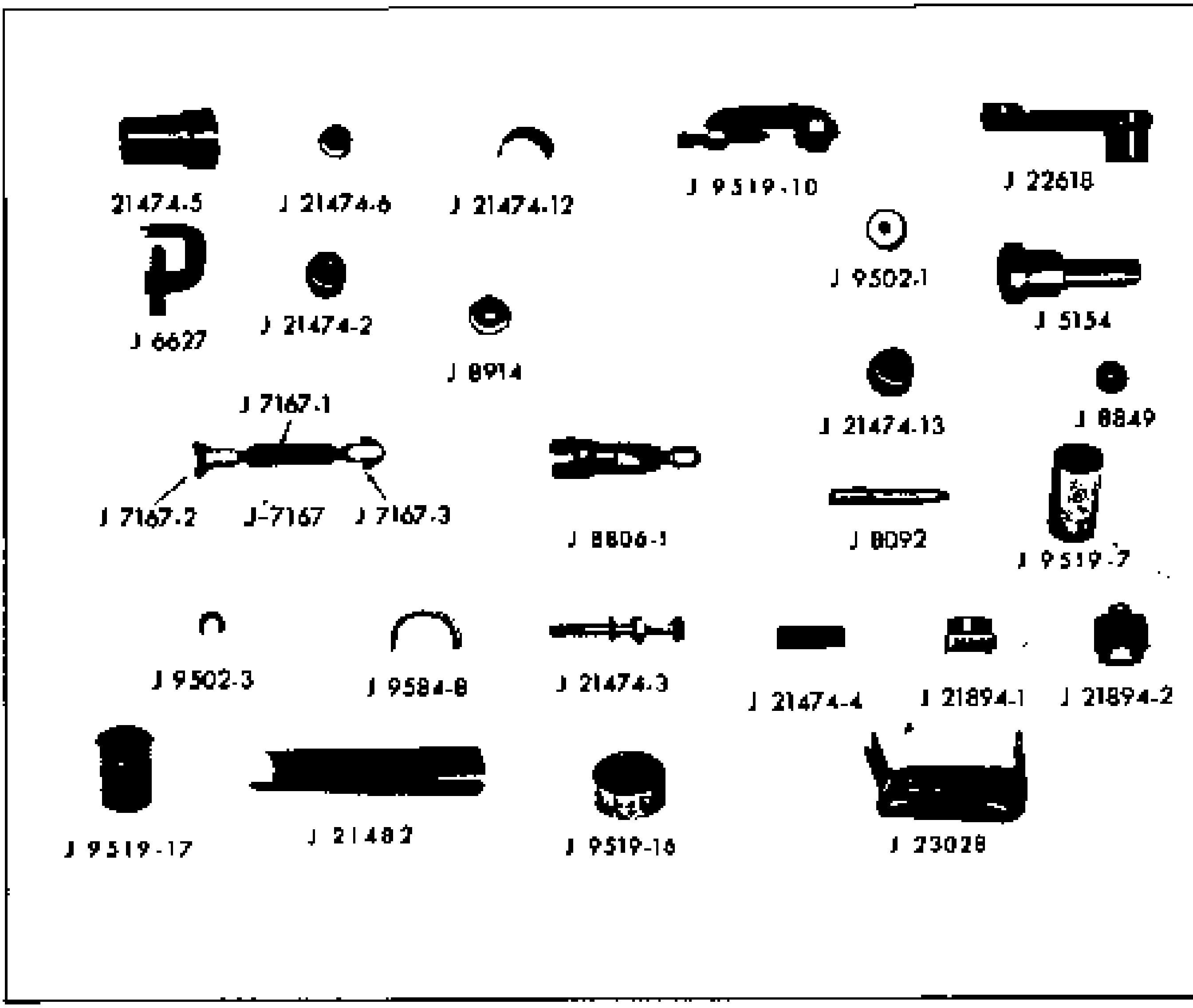


Fig. 3-25 Special Tools

Tool No.	Name
J 5154	Grease Seal Installer
J 6627	Ball Joint Remover
J 7167	Upper Control Arm Spreader
J 8092	Driver Handle
J 8806-1	Ball Joint Remover
J 8849	Front Wheel Outer Bearing Cup Installer (Use with J 8092)
J 8914	Front Wheel Inner Bearing Cup Installer (Use with J 8092)
J 9502-1	Front Upper Control Arm Bushing Remover & Installer
J 9502-3	"C" Washer Upper Control Arm Bushing
J 9519-7 J 9519-10	Ball Joint Remover & Installer

Tool No.	Name
J 9519-16 J 9519-17	Ball Joint Remover & Installer
J 9584-8	Control Arm Bushing Remover & Installer
J 21474-2 J 21474-3 J 21474-4 J 21474-5 J 21474-6 J 21474-12 J 21474-13	Control Arm Bushing Service Set
J 21482	Front Upper Control Arm Spacer
J 21894-1 J 21894-2	Lower Control Arm Oblong Bushing Installer
J 22618	Upper Control Arm Torque Wrench Adapter
J 23028	Front Coil Spring Remover & Installer

TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise specified

APPLICATION	TORQUE
Nut, Upper Control Arm Bushing	
Pontiac, Tempest & Grand Prix	50
Bolt, Upper Control Arm Bushing—Firebird	35
Nut, Upper Ball Joint to Steering Knuckle	50
Nut, Lower Ball Joint to Steering Knuckle	
Pontiac	50
Tempest, Grand Prix and Firebird	85
Nut, Tie Rod Adjustor Sleeve Clamp	
Pontiac, Tempest & Grand Prix	20
Firebird	11
Nut, Wheel Stud	
Pontiac	75
Tempest, Grand Prix and Firebird	70
Nut, Steering Arm to Tie Rod End	35
Bolt (Lower), Backing Plate to Steering Arm (Standard Brake)	75
Bolt (Upper), Backing Plate to Steering Knuckle (Standard Brake)	100
Bolt (Lower), Splash Shield & Mounting Bracket to Steering Arm (Disc Brake)	75
Bolt (Upper), Splash Shield & Mounting Bracket to Steering Knuckle (Disc Brake)	125

APPLICATION	TORQUE
Bolt, Brake Caliper Assembly Mounting	35
Nut, Upper Control Arm to Frame	
Pontiac	75
Pontiac (using J 22618 and 12" Torque Wrench)	65
Tempest, Grand Prix and Firebird	50
Nut, Lower Control Arm to Frame (Pivot)	80
Bolt, Lower Control Arm to Frame (Pivot)	110
Nut, Shock Absorber Upper Stud	8
Screw, Shock Absorber to Lower Control Arm	20
Nut, Stabilizer Link to Shaft	
Pontiac, Tempest and Grand Prix	15
Firebird	8
Screw, Stabilizer Shaft Bracket to Frame	
Pontiac	30
Tempest, Grand Prix and Firebird	12
Nut, Upper Ball Joint Assembly to Control Arm (Service)	
Pontiac, Tempest and Grand Prix	9
Firebird	25
Nut, Lower Ball Joint Assembly to Control Arm (Service) Pontiac	9

FRONT WHEEL ALIGNMENT SPECIFICATIONS

Caster	
Pontiac	$-1\frac{1}{2}°$
Tempest and Grand Prix (except Tempest Station Wagon)	$-1\frac{1}{2}°$
Tempest Station Wagon	$-2°$
Firebird	$+\frac{1}{2}°$
Camber—All Models	$+\frac{1}{4}°$
Toe-In—(Except Firebird)	0" to ⅛"
Toe-In (Firebird)	⅛" to ¼"
Steering Axis Inclination	
Pontiac	$8\frac{1}{4}°$ (with 1° camber)
Tempest and Grand Prix	9° (with 0° camber)
Firebird	$8\frac{3}{4}°$ (with $+\frac{1}{2}°$ camber)
Toe-Out on Turns	2°
(Difference in Left to Right Direction of Toe-Out at 20° Turn of Inside Wheel)	

NOTE: Give left wheel up to ¼° more camber than right wheel to correct for road crown.

REAR SUSPENSION

CONTENTS OF THIS SECTION

GENERAL INFORMATION

Shock absorbers do not require lubrication and in case of leaks or malfunction, they should be replaced.

On the Automatic Level Control System an air filter located on the compressor should be inspected periodically to see if it has become plugged. The compressor does not require lubrication as the unit is designed to operate dry.

ADJUSTMENT PROCEDURES

Automatic Level Control on car trim adjustment should be performed with a full fuel tank (or an equivalent load at the rate of six pounds per gallon of gasoline). The proper adjustment procedure is listed below:

1. Fill compressor through service valve with air at available line pressure.

2. Raise the car on twin post or drive-on hoist.

3. Disconnect the link from the height control valve lever.

4. Move the height control valve lever downward until air stops escaping from the exhaust port on the height control valve. The Superlifts will now automatically hold 8-15 psi.

6. Let the lever go to its neutral position and loosen the lever adjustment nut.

7. Connect the link to the height control valve lever and tighten the lever adjustment nut.

NOTE: Do not move control valve lever and over travel body while tightening nut.

MAJOR SERVICE

SHOCK ABSORBER-EXCEPT FIREBIRD

NOTE: To test Superlift shock absorber for air leaks remove shock absorber as outlined below and inflate to

80-110 psi utilizing fill valve from J 22695 package, submerge in water and observe for leaks. See Precautions under PONTIAC AND GRAND PRIX AUTOMATIC LEVEL CONTROL SYSTEM for further Superlift information.

REMOVE

CAUTION: If car is elevated, support rear axle assembly so it will not swing down and damage brake line when shocks are removed.

1. a. Remove nuts and washer head screws from upper end of shock absorber.

b. Disconnect air line from Superlift.

CAUTION: To prevent damage to neoprene boot on Superlift unit, do not rotate free end with opposite end still attached.

2. Remove nut and lock washer from shock absorber lower end stud and remove shock absorber

NOTE: Clean and inspect rubber inserts. If rubber inserts have shifted from their original position in either eye, replace shock absorber.

INSTALL

1. Install shock absorber by reversing the above steps.

2. Tighten upper screws to 20 lb. ft. torque. Tighten lower nut to 65 lb. ft. torque

NOTE: Shock absorber stud must not rotate while tightening nut.

3. Lower car and test shock absorber action.

SHOCK ABSORBER-FIREBIRD

REMOVE

1. Raise rear of car and support rear axle assembly

2. Remove nut and lock washer from shock absorber lower end stud (Fig. 4-1).

3. Remove shock absorber upper mounting bracket to rear compartment floor pan retaining screws and withdraw shock absorber with mounting bracket.

4. Remove nut, upper bracket, grommets and retainers from the shock absorber rod.

NOTE: Inspect rubber grommets for damage and deterioration. Replace as required.

INSTALL

1. Assemble lower retainer, grommet, bracket, upper grommet, retainer and nut to the shock absorber rod. Torque nut to 8 lb. ft.

NOTE: Place a ring of sealer around shock absorber rod hole on surface of bracket that fits against floor pan.

2. Position shock absorber bracket to floor pan with two washers (seals) between bracket and floor pan. Install and torque bracket retaining screws to 10 lb. ft.

3. Insert shock absorber lower end stud into spring and shock absorber anchor plate. Torque nut to 60 lb. ft.

NOTE: Shock absorber stud must not rotate while tightening nut.

4. Lower car and test shock absorber action.

SPRING AND SHOCK ABSORBER ANCHOR PLATE OR SPRING CUSHION PADS - FIREBIRD

REMOVE

1. Raise car at axle housing

2. Remove nut and lock washer from shock absorber lower end stud.

NOTE: Compress shock to move out of way.

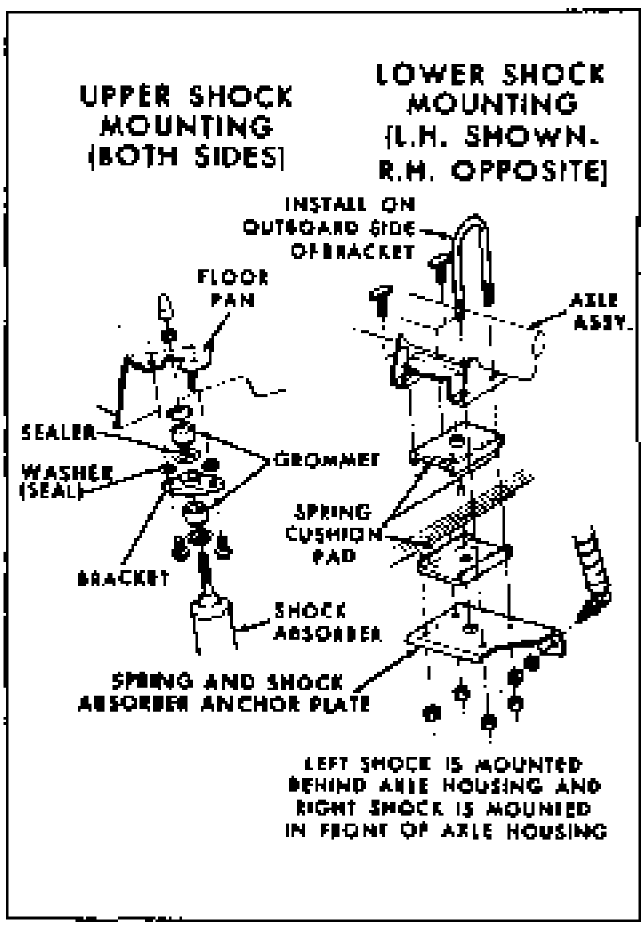


Fig. 4-1 Rear Shock Absorber Installation - Firebird

3. Place jack stand under frame side rail and lower axle to relieve load on axle.

4. Remove four nuts attaching lower spring and shock absorber anchor plate and withdraw anchor plate with spring cushion pad

NOTE: Right and left anchor plates will not interchange.

5. Raise axle up to provide clearance to remove upper spring cushion pad.

INSTALL

1. Install by reversing the above steps.

NOTE: Place upper and lower spring cushion pads on spring so that cushions are indexed on spring center locating bolt and nut. Upper cushion and lower cushion will be aligned if installation is correct.

2. Tighten anchor plate attaching nuts to 40 lb. ft. torque.

3. Tighten shock absorber lower end nut to 60 lb. ft. torque.

NOTE: Shock absorber stud must not rotate while tightening nut.

REAR SPRING - EXCEPT FIREBIRD

REMOVE

1. Raise rear of car.

2. Remove screw attaching brake hose bracket to axle housing.

NOTE: Do not disconnect brake line from connector.

3. a. Place jack stand under frame side rail to support car if car raised with jack placed under axle housing.

b. Place jack stand under axle housing tube to support car is car raised with jack placed under frame side rail.

5. Remove nut and lock washer from shock absorber lower end stud and disconnect shock absorber from axle housing bracket

6.a. If axle housing is supported by jack, carefully lower axle housing by lowering jack.

b. Place jack stand under axle housing tube to support car, if car raised with jack place under frame side rail.

CAUTION: Care must be taken to prevent contact between the rear lower control arm upper flange and the rear lower control arm axle housing bracket when lowering the axle housing.

7. Remove spring.

8. Remove rubber insulator from upper spring seat, inspect and replace if in poor condition.

INSTALL

1. Install spring, making sure that the end of the bottom coil is towards the rear of car.

2. Either raise axle housing or lower car until shock absorber can be connected to axle housing bracket.

3. Install lock washer and nut on shock absorber stud. Tighten nut to 65 lb. ft. torque.

NOTE: Shock absorber stud must not rotate while tightening nut.

4. Position brake hose bracket to axle housing and tighten attaching screw to 8 lb. ft. torque.

LEAF SPRING AND SPRING EYE BUSHING - FIREBIRD

REMOVE

1. Raise rear of car at axle housing.

NOTE: Support weight of car at both frame side rails near front eye of springs with jack stands.

2. Remove nut and lock washer from shock absorber lower end stud.

NOTE: Compress shock to move out of way.

3. Loosen the spring front eye bolt.

4. Remove the screws securing the spring front bracket to the floor pan.

5. Lower axle assembly sufficiently to permit access to front spring bracket and remove bracket from spring.

6. The spring eye bushing can be replaced without completely removing the spring from the vehicle. If bushing requires replacement, proceed as follows:

a. Insert wood wedge or plank between spring and frame to pry spring eye down for clearance to use bushing removal tool.

b. Position remover adapter J 21978-1 over puller screw J 21058-15 so that adapter is against head of puller screw (Fig. 4-2).

c. Position puller screw through eye of bushing so that remover adapter J 21978-1 is against unflanged side of bushing.

d. Position large end of barrel J 22553-1 over puller screw and seat barrel against spring eye.

e. Position thrust bearing on puller screw. Then install and tighten nut J 21058-8 against thrust bearing.

f. Check to make sure that all puller parts are properly aligned. Then proceed to tighten nut until bushing is pulled free of spring eye. Disassemble puller tool.

g. Position installer adapter J 22553-2 over flange end of bushing. Then position puller screw J 21058-15 through installer adapter and bushing (Fig. 4-3).

h. Position puller screw through spring eye until bushing contacts spring. Install small end of barrel J 22553-1 over puller screw and seat barrel against spring.

i. Install thrust bearing and nut J 21058-8. Check puller tools and bushing for proper alignment; then tighten nut to pull bushing into spring. Install bushing until bushing is centered in spring eye.

NOTE: Do not apply additional torque to nut J 21058-8 after bushing flange contacts spring. Torque applied after flange is seated will tend to distort flange and reposition bushing in spring.

j. Disassemble bushing installation tools and remove from spring.

7. Remove spring and shock absorber anchor plate nuts; withdraw anchor plate with lower and upper spring cushion pads.

NOTE: Right and left lower anchor plates will not interchange.

8. Loosen upper rear spring shackle bolt.

9. Support spring; then remove lower bolt from spring rear shackle. Separate shackle and withdraw spring from vehicle.

10. Remove spring shackle upper bolt and withdraw shackle bushings from frame side rail.

INSTALL

NOTE: Do not tighten spring front mounting bracket screws and eye bolt nuts until car is at curb height.

1. Position spring front mounting bracket to spring front eye and loosely install spring eye bolt and nut.

2. Position spring shackle upper bushing in frame side rail, position shackles to bushing and loosely install bolt and nut.

3. Install bushing halves in spring rear eye, place spring to shackles and loosely install shackle lower bolt and nut.

NOTE: When installing spring, make sure parking brake cable is positioned on top side of spring.

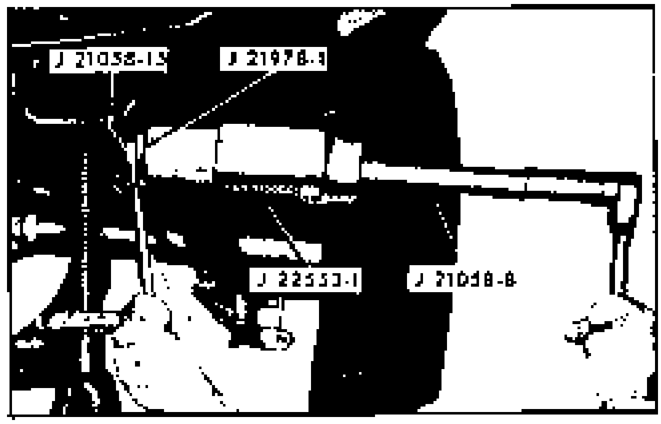


Fig. 4-2 Removing Spring Front Bushing - Firebird

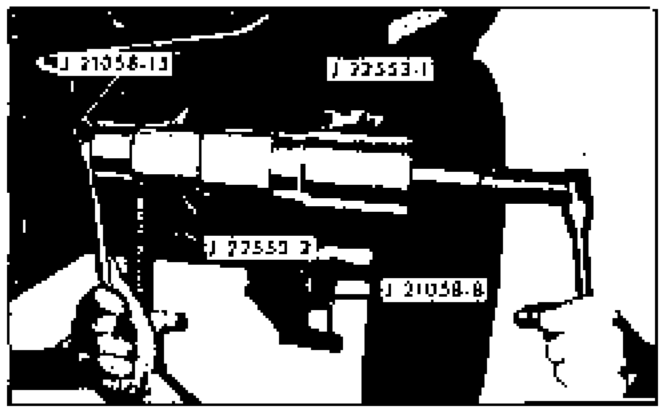


Fig. 4-3 Installing Spring Front Bushing - Firebird

4. Raise front end of spring and position bracket to floor pan.

NOTE: Guide spring into position so that it will index in the axle bracket and also make sure that the tab on spring bracket is indexed in slot provided in the floor pan.

5. Loosely install spring front bracket attaching screws.

6. Place upper and lower spring cushion pads on spring so that cushions are indexed on spring center locating bolt and nut.

NOTE: Upper cushion and lower cushion will be aligned if installation is correct.

7. Place spring and shock absorber anchor plate over locating dowel on lower spring cushion and loosely install attaching nuts.

8. Position shock absorber to anchor plate and loosely install lock washer and stud nut.

9. Remove jack stands and lower car so that weight of car rests on suspension components.

10. Tighten anchor plate attaching nut to 40 lb. ft torque. Tighten spring front bracket attaching screws to 25 lb. ft. torque. Tighten spring eye bolt nut to 75 lb. ft. torque. Tighten shackle nuts to 50 lb. ft. torque. Tighten shock absorber lower stud nut to 60 lb. ft. torque.

MAIN LEAF OF LEAF SPRING--FIREBIRD

REMOVE

NOTE: The main leaf (Fig. 4-4) is the only leaf of this spring that is replaceable. If any of the smaller leafs require replacement, the entire spring assembly must be replaced.

1. Remove spring (see LEAF SPRING AND SPRING EYE BUSHING - FIREBIRD - REMOVE. Steps 1 through 5 and steps 7 through 9).

2. With the spring placed on a work bench, pry the tabs of the spring leaf clips up with a screwdriver and remove clips and clip liners from spring.

3. Remove the center locating nut and bolt.

NOTE: Keep spring leafs compressed together with a C-clamp placed near the center locating nut and bolt while removing the nut and bolt, then carefully release the C-clamp.

4. Separate the smaller leafs of the spring from the main leaf.

CAUTION: Be sure to note the position of each leaf in regard to the front of the spring. If a leaf is installed backwards, the spring will be damaged and the designed strength of the spring effected.

INSTALL

1. Reverse the above steps for reassembly.

NOTE: If any leaf clips or clip liners are damaged or worn, they must be replaced.

2. Tighten spring center locating bolt nut to 23 lb. ft. torque.

3. Install spring (see LEAF SPRING AND SPRING EYE BUSHING - FIREBIRD - INSTALL).

LEAF SPRING TIP INSERTS - FIREBIRD

REMOVE

1. Raise rear of car until wheel and tire assembly is off of ground.

NOTE: Spring must be able to hang in rebound position. On some leafs, the leaf spring clip may have to be removed prior to separating the leaf for insert removal.

2. Using a suitable pry bar placed between spring leafs, separate leafs enough to allow removal of insert.

INSTALL

1. Install by reversing above steps.

UPPER CONTROL ARM - EXCEPT FIREBIRD

REMOVE

CAUTION: If both control arms are to be replaced, remove and replace one control arm at a time to prevent the axle from rolling or slipping sideways as this might occur with both upper control arms removed, making replacement difficult.

1. Raise rear of car.

2. Support nose of axle housing with a jack stand.

3. Remove pivot bolt at axle housing and lift upper control arm to clear boss on axle housing.

4. Remove pivot bolt at frame cross-member and remove upper control arm.

NOTE: Clean and inspect rubber bushings. If worn, replace as outlined in this section.

INSTALL

1. Install by reversing above steps.

2. While holding nut, tighten pivot bolt to 110 lb. ft. torque or while holding pivot bolt, tighten nut to 80 lb. ft. torque.

NOTE: Car must be at curb height when tightening pivot bolts.

UPPER CONTROL ARM BUSHING - EXCEPT FIREBIRD

REMOVE (IN AXLE HOUSING)

1. Support nose of axle housing with a jack stand.

2. Remove pivot bolt at axle housing and lift upper control arm to clear boss on axle housing.

3. Arrange tools as shown in Fig. 4-5 and press bushing from axle housing.

INSTALL

1. Install bushing in axle housing by arranging tools as shown in Fig. 4-6 and press into place.

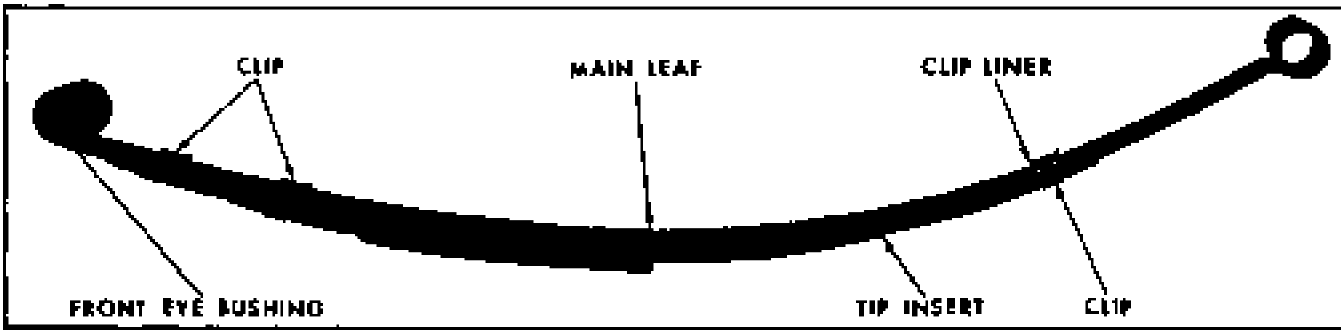


Fig. 4-4 Main Leaf of Leaf Spring - Firebird

NOTE: Use care to keep bushing properly aligned.

2. Position control arm in place and install pivot bolt.

3. While holding nut, tighten pivot bolt to 110 lb. ft. torque or while holding pivot bolt, tighten nut to 80 lb. ft. torque.

NOTE: Car must be at curb height when tightening pivot bolts.

4. Remove jack stand and lower car.

REMOVE (IN CONTROL ARM)

1. Remove upper control arm (see UPPER CONTROL ARM -EXCEPT FIREBIRD - REMOVE).

2. Arrange tools as shown in Fig. 4-7 and press bushing from control arm.

INSTALL

1. Install bushing in control arm by arranging tools as shown in Fig. 4-8 and press into place.

2. Install upper control arm (see UPPER CONTROL ARM -EXCEPT FIREBIRD - INSTALL).

3. Install bushing in control arm by arranging tools as shown in Fig. 4-8 and press into place.

NOTE: Use care to keep bushing properly aligned.

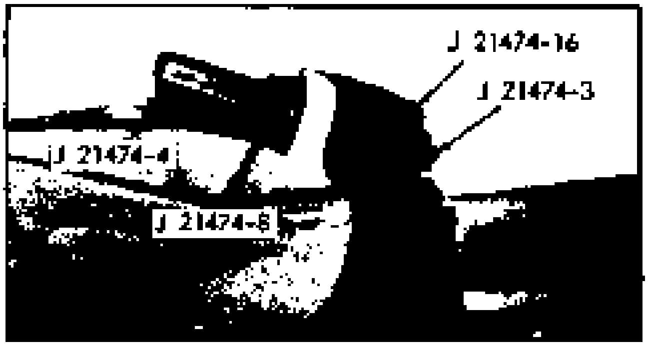


Fig. 4-5 Removing Upper Control Arm Rear Bushing Except Firebird

4. Position control arm in place and install pivot bolts. While holding nut, tighten pivot bolt to 110 lb. ft. torque or while holding pivot bolt, tighten nut to 80 lb. ft. torque.

NOTE: Car must be at curb height when tightening pivot bolts.

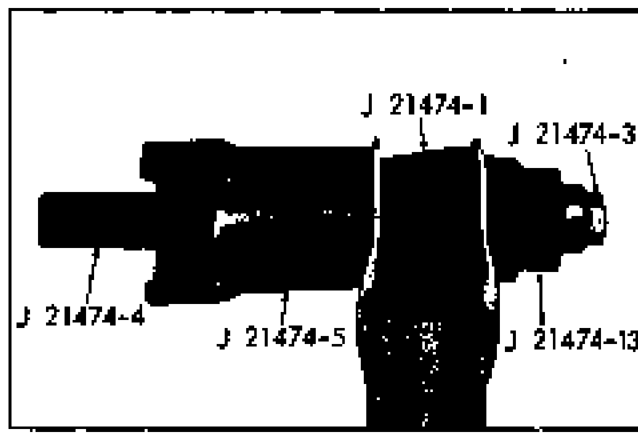


Fig. 4-6 Installing Upper Control Arm Rear Bushing - Except Firebird

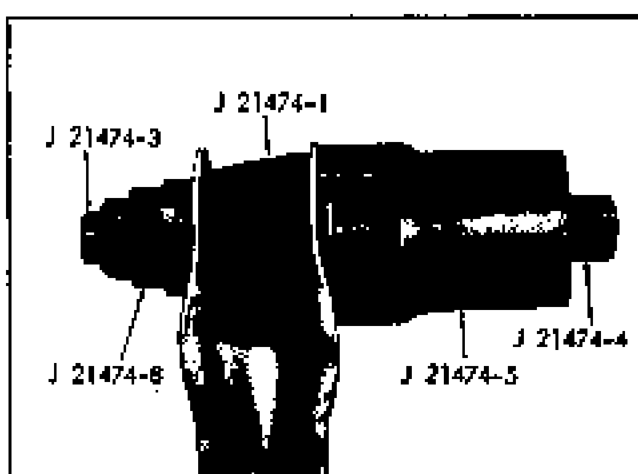


Fig. 4-7 Removing Upper or Lower Control Arm Bushing-Except Firebird

LOWER CONTROL ARM - EXCEPT FIREBIRD

REMOVE

CAUTION: If both control arms are to be replaced, remove and replace one control arm at a time to prevent the axle from rolling or slipping sideways as might occur with both lower control arms removed, making replacement difficult.

1. Raise rear of car.

2. Support nose of axle housing with a jack stand.

3. Remove pivot bolt at axle housing bracket.

4. Remove pivot bolt at frame side rail and remove control arm.

NOTE: Clean and inspect rubber bushing and if worn, replace as outlined in this section.

INSTALL

1. Install by reversing above steps.

2. While holding nut, tighten pivot bolt to 110 lb. ft. torque or while holding pivot bolt, tighten nut to 80 lb. ft. torque.

NOTE: Car must be at curb height when tightening pivot bolts.

LOWER CONTROL ARM BUSHING

REMOVE

1. Remove lower control arm (see LOWER CONTROL ARM -REMOVE - EXCEPT FIREBIRD).

2. Remove bushing, using components of tool J 21474 as shown in Fig. 4-7.

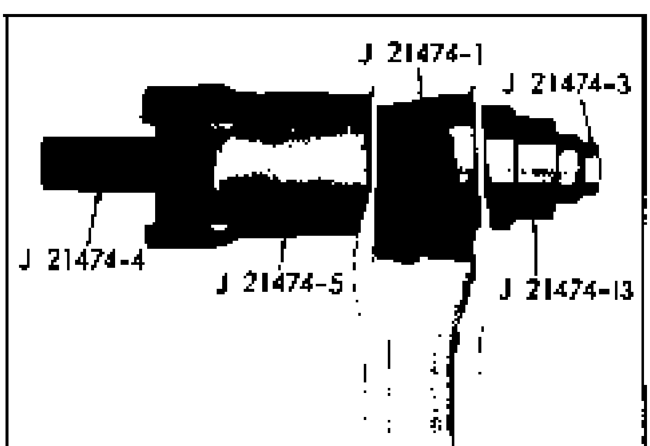


Fig. 4-8 Installing Upper or Lower Control Arm Bushing Except Firebird

INSTALL

1. Install bushing using components of tool J 21474 as shown in Fig. 4-8.

2. Install lower control arm (see LOWER CONTROL ARM -INSTALL - EXCEPT FIREBIRD).

PONTIAC AND GRAND PRIX AUTOMATIC LEVEL CONTROL SYSTEM

PRECAUTIONS

The precautions outlined below should be heeded to insure satisfactory function of the system:

MINIMUM PRESSURE - For best ride characteristics with an empty car, a minimum pressure of 10 psi should be maintained.

MAXIMUM PRESSURE - The pressure may be varied to a maximum of 90 psi to level the car with loads.

LINES AND FITTINGS - The air lines cannot withstand exhaust system temperatures. At least 1 1/2" clearance should be maintained between the air lines and any portion of the exhaust system.

Flexible air lines are used throughout the system and are 1/8" diameter tubing. Each fitting consists of a rubber seal, metal sleeve and nut (Fig. 4-11). These parts are intended specifically for the 1/8" diameter line and must be used to affect a reliable seal.

While the lines are flexible for easy routing and handling, care should be taken not to kink them and to keep them from coming in contact with the exhaust system (Fig. 4-12 and 4-13).

TUBING

REMOVE

Tubing may be removed by simply unscrewing the nut.

NOTE: Be sure system is deflated through service valve before separating air lines. When installing tubing at any fitting, be careful not to kink line (Figs. 4-12 and 4-13).

INSTALL

1. Preassemble metal sleeve and rubber seal.

2. Place nut on tubing.

3. Insert tube into metal sleeve and rubber seal until tube bottoms.

4. Holding tube in bottomed position, tighten the tube nut to 70 lb. in. torque.

NOTE: Tubing may be reinstalled at its connections. If tubing is cracked at end, it will be necessary to cut flush and use a new metal sleeve and rubber seal to assemble as described above. Be careful not to remove too much or tubing may be kinked or broken at full suspension travel. Care should be taken that proper routing is followed in areas close to the exhaust system to prevent burning the tubing. Note particularly the areas at rear suspension crossmember.

COMPRESSOR, RESERVOIR AND REGULATOR VALVE ASSEMBLY

REMOVE

1. Deflate system through service valve (Figs. 4-12 and 4-13).

2. Disconnect high pressure line at pressure regulator valve. Also disconnect vacuum line at compressor.

3. Remove upper bracket screw securing assembly to car and withdraw assembly.

DISASSEMBLY OF COMPRESSOR INTO MAJOR COMPONENTS

The compressor (Fig. 4-14) 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.

NOTE: This unit must not be lubricated as it is designed to operate dry.

1. Remove compressor as outlined above.

2. Remove two adapters and flexible mounts on compressor end of assembly.

3. Remove nuts from three reservoir retaining (long) bolts. The bolts enter from reservoir flange side of unit.

4. Remove nuts from three compressor retaining (short) bolts. These bolts enter from compressor side of

CAUTION: DO NOT attempt to turn short bolts as they have a second nut hidden between reservoir flange and second stage housing. Always remove nuts from bolts while holding bolts stationary.

5. Separate compressor assembly and reservoir. Discard reservoir sealing O-ring.

6. Remove cover retaining screw. Remove cover and discard cover gasket.

7. Remove three compressor retaining (short) bolts that hold first and second stage housings together.

8. Separate first and second stage housings by sliding second stage housing straight off piston.

9. Remove two pressure regulator valve assembly retaining screws. 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.

DISASSEMBLY OF PISTON--DIAPHRAGM ASSEMBLY

1. Remove diaphragm retainer with diagonal pliers and discard retainer (Fig. 4-15).

2. Remove diaphragm plate, diaphragm, second diaphragm plate and corprene washer can be discarded.

3. Remove and discard piston seals and O-rings from piston.

CAUTION: Be careful not to damage piston.

4. Remove check valve in second stage end of piston by inserting a suitable punch or piece of 3/32" welding rod through air passage from first stage end and taping.

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 and Arm Package. If action is free and positive and upon disassembly there are no damaged parts, parts may be re-used.

1. Remove screw, washer, distributor arm assembly, washer and distributor valve bushing (Fig. 4-16).

2. Remove two arm assembly stop bushing and two distributor valve stop bushings

3. Remove distributor valve, being careful not to distort valve tension spring.

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

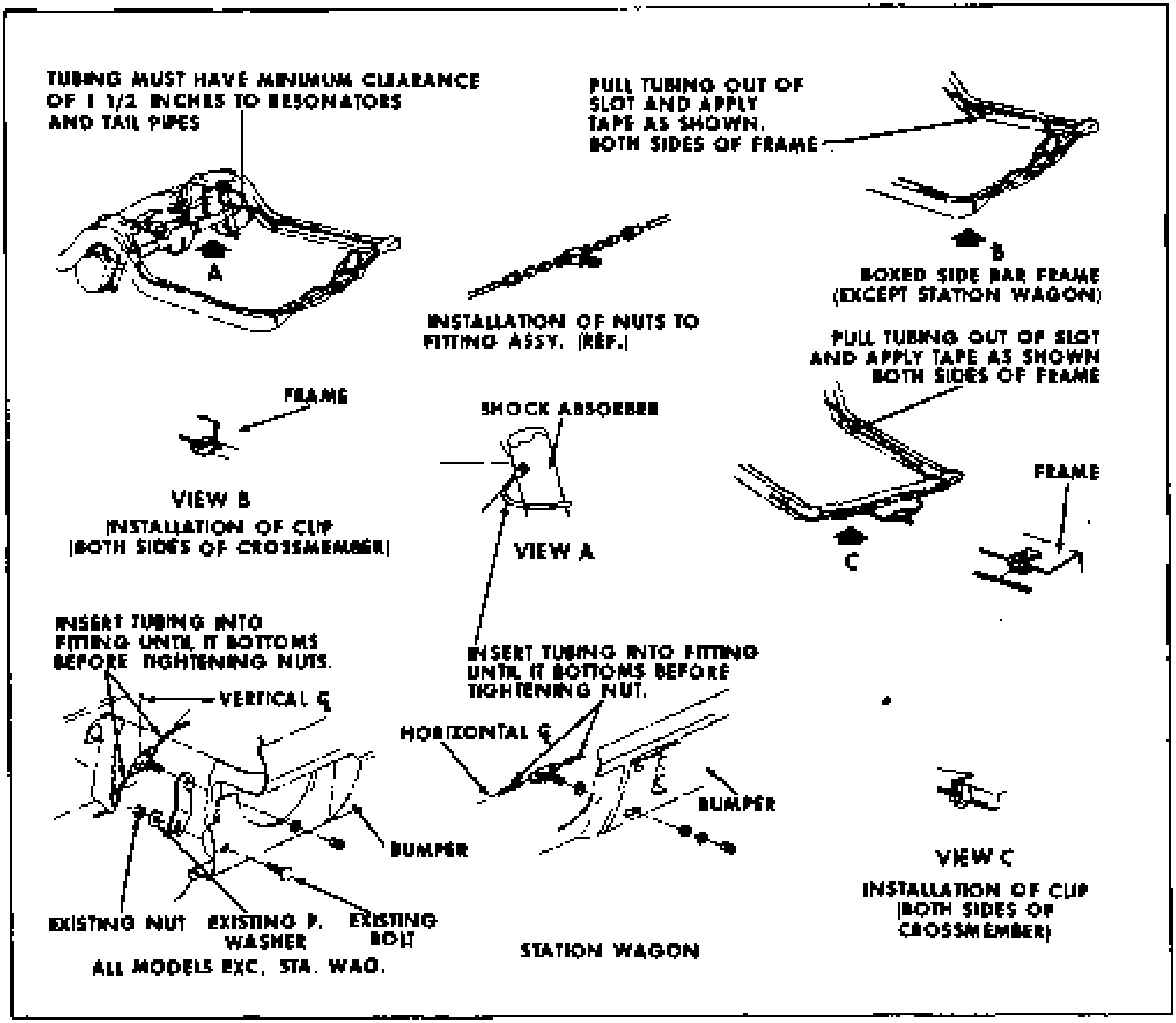


Fig. 4-9 Pontiac Superlift Shock Absorber

the long foot fits into a hole drilled at an angle in the boss (see Figs. 4-19 and 4-20).

5. Remove intake check valve retaining spring, intake check valve and washer, using a pocket knife.

6. If necessary, remove rocker and swivel arms. Grip pin with pliers and remove pin (Fig. 4-17).

DISASSEMBLY OF SECOND STAGE HOUSING

1. Remove check valve in second stage housing by inserting a suitable punch or piece of 3/32" welding rod through air passage and tapping.

CLEANING AND INSPECTION OF PARTS

All metal parts should be cleaned in clean solvent and blown dry with compressed air.

PISTON AND DIAPHRAGM ASSEMBLY

1. Inspect piston for scoring. Replace if necessary.

2. Inspect check valve seat. Seat should be smooth and clean.

3. Inspect diaphragm for holes, looseness or other defects. Replace if necessary.

FIRST STAGE HOUSING AND VALVE MECHANISM

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.

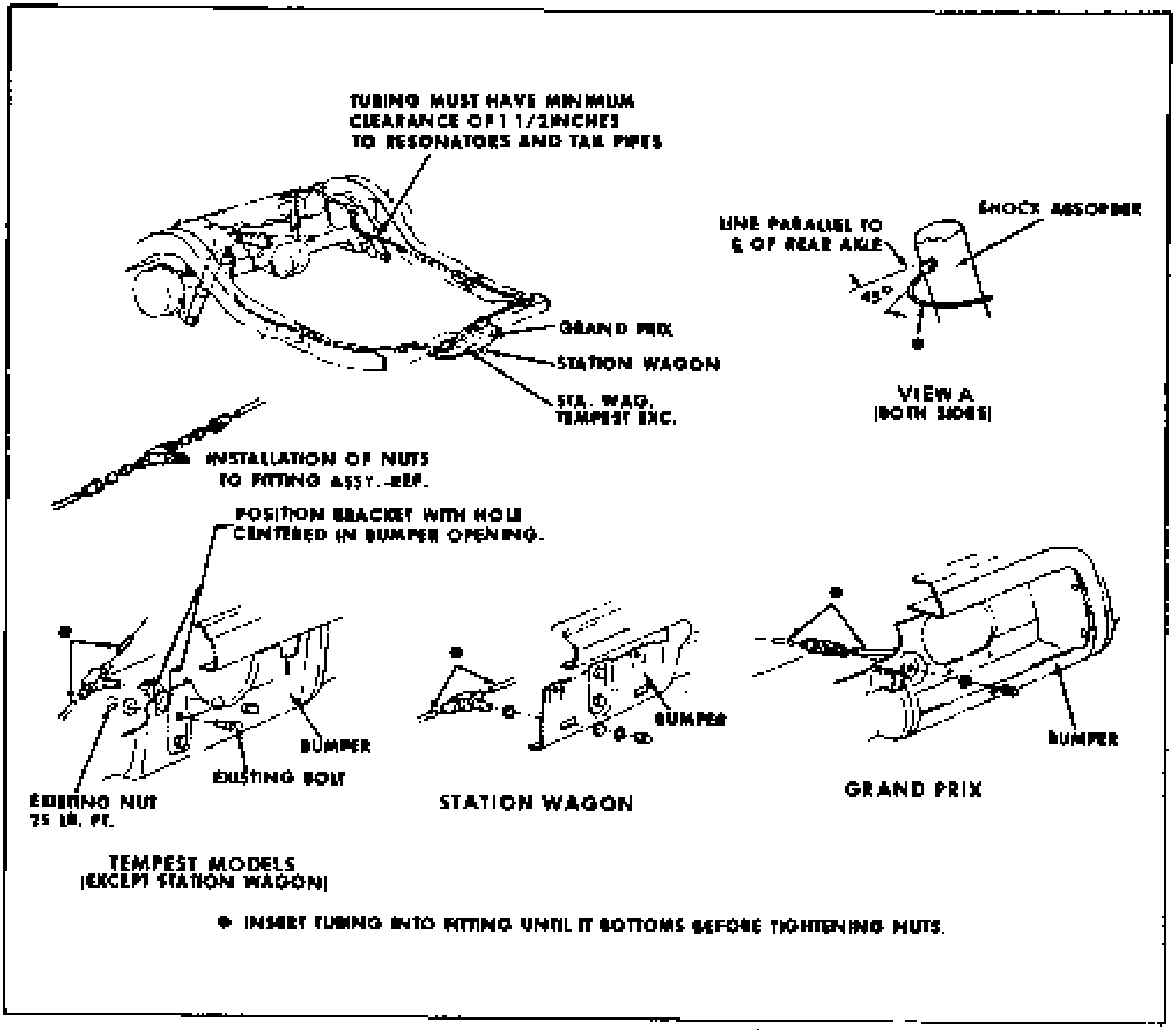


Fig. 4-10 Tempest and Grand Prix Superlift Shock Absorber

4. Inspect distributor valve parts for wear and replace if necessary.

5. Inspect distributor valve seat on housing for wear. Replace housing if necessary.

SECOND STAGE HOUSING

1. Inspect piston bore, replace housing if scored.

2. Inspect check valve seat. Seat should be smooth and clean.

3. Inspect housing for cracks or damage and replace if necessary.

ASSEMBLY OF SECOND STAGE HOUSING

1. Install new check valve and spring.
2. Insert new expansion plug retainer and tap in until it bottoms (Fig. 4-18).

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 (Fig. 4-19).

4. Position distributor valve so that short foot of tension spring fits under valve and vertical leg is in slot (Fig. 4-20).

5. Install distributor valve bushing, washer, distributor arm assembly, washer and secure with screw (Fig. 4-21). Tighten screw to 12 lb. in. torque.

6. Install two distributor valve stop bushings and two arm assembly stop bushings.

NOTE: Do not install actuating arm, arm tension spring or arm pivot screw at this time as rocker arm must be free to permit entrance of piston into first stage housing.

ASSEMBLY OF PISTON-DIAPHRAGM ASSEMBLY

1. Install new corprene washer, old plate.

2. Using a 13/16" deep socket as a retainer installer, press against the piston shoulder on the first stage housing side with wood blocks to seat retainer. The wood blocks used in the illustration are each 3/4" x 3/4" x 12" (Fig. 4-22).

NOTE: Be sure retainer is securely seated in order to affect an air tight seal against the coprene seal.

3. Install new O-rings by rolling into groove. Relieve any resulting twist.

4. Install new seals, using a piece of .020" shim stock (Fig. 4-23).

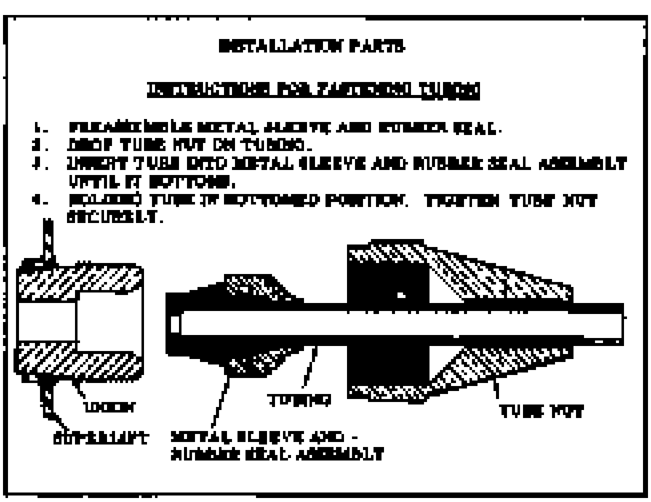


Fig. 4-11 Instructions for Fastening Tubing

CAUTION: Make sure shim stock has no sharp edges that may cut seal. Do not stretch seal more than is necessary to install. Seals must be installed so they are not twisted.

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. torque.

3. Connect arm tension spring to swivel arm.

4. Rotate piston in first stage housing to align elongated hole in diaphragm with vent port in housing.

5. Install second stage housing by sliding straight onto second stage piston.

6. Install three compressor retaining (short) bolts from the first stage housing side, through the second stage housing hex shaped, recessed holes. The first and second stage housings will align one way only. Position three small nuts in hex recesses and tighten bolts to 28 lb. in. torque.

7. Install new O-ring on second stage housing. Install reservoir on second stage housing with three large nuts. Tighten to 28 lb. in. Install the two reservoir retaining (long) bolts, from reservoir side, that do not go through cover. Tighten to 28 lb. in. torque.

8. Install new gasket and cover and secure with retaining screw. Tighten screw to 35 lb. in. Install third reservoir retaining (long) bolt. Tighten to 28 lb. in.

9. Install new O-ring on pressure regulator and secure with two retaining screws with high pressure fitting toward reservoir. Tighten to 35 lb. in. torque.

10. Install two adapters and flexible mounts on the two reservoir (long) bolts that do not go through cover. Tighten to 28 lb. in. torque.

11. Compressor should be output tested before installation on car (see COMPRESSOR OUTPUT TEST ON CAR).

12. If compressor passes output test, install Compressor, Reservoir and Regulator Valve Assembly on car.

COMPRESSOR, RESERVOIR AND REGULATOR VALVE ASSEMBLY

INSTALL

1. Install assembly in bracket and tighten nuts to 30 lb. in. torque.

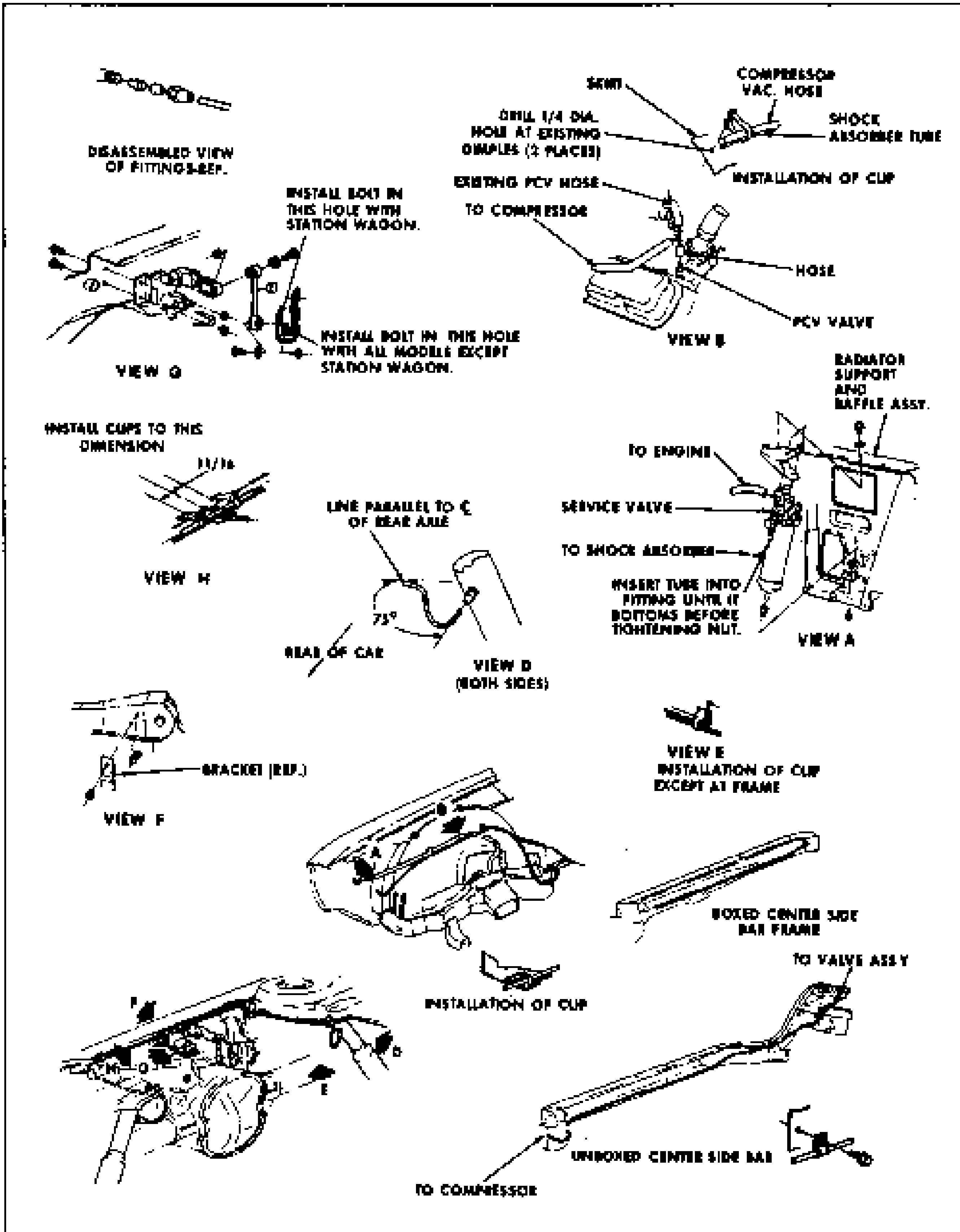


Fig. 4-12 Pontiac Automatic Level Control System

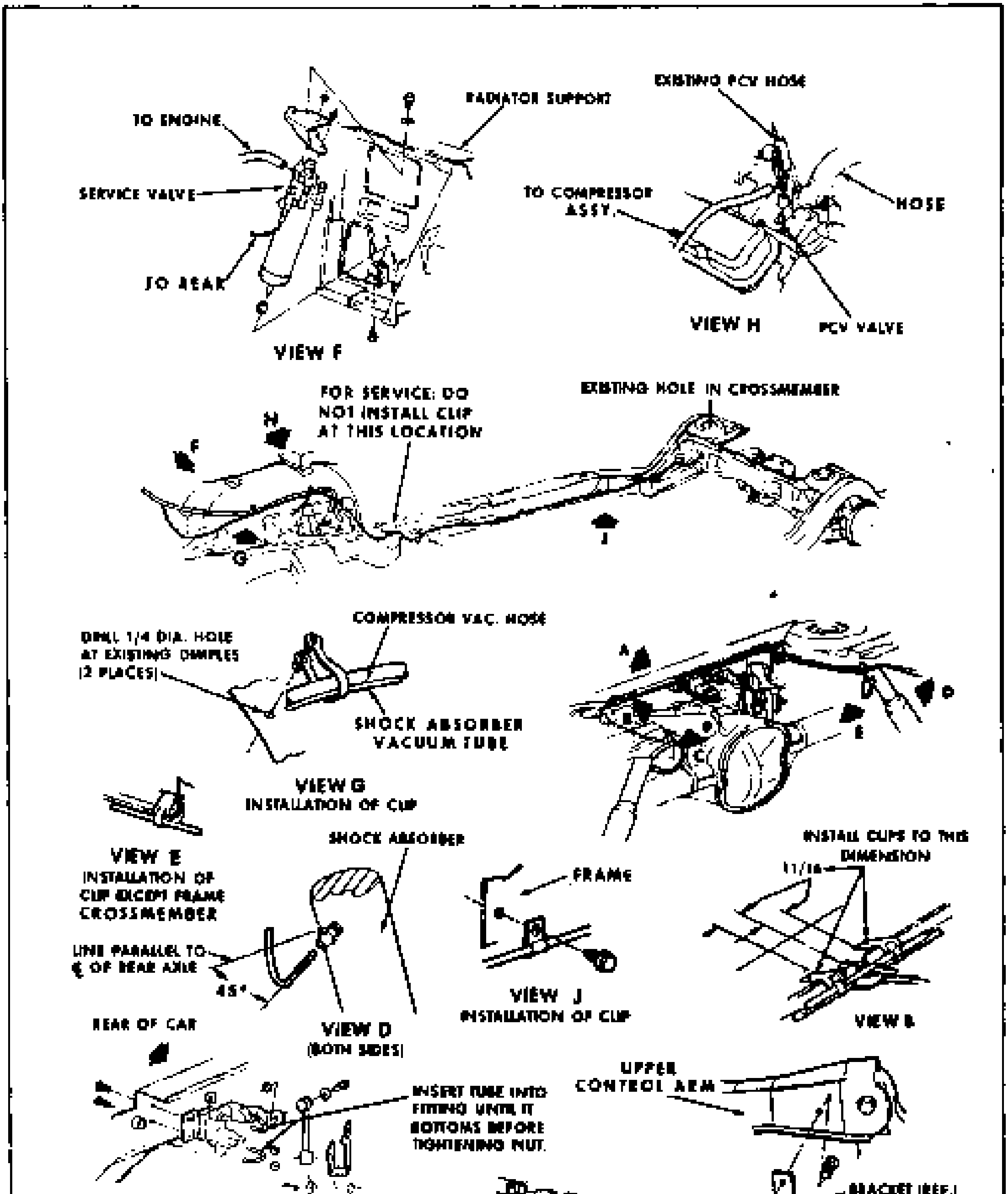


Fig. 4-13 Grand Prix Automatic Level Control System

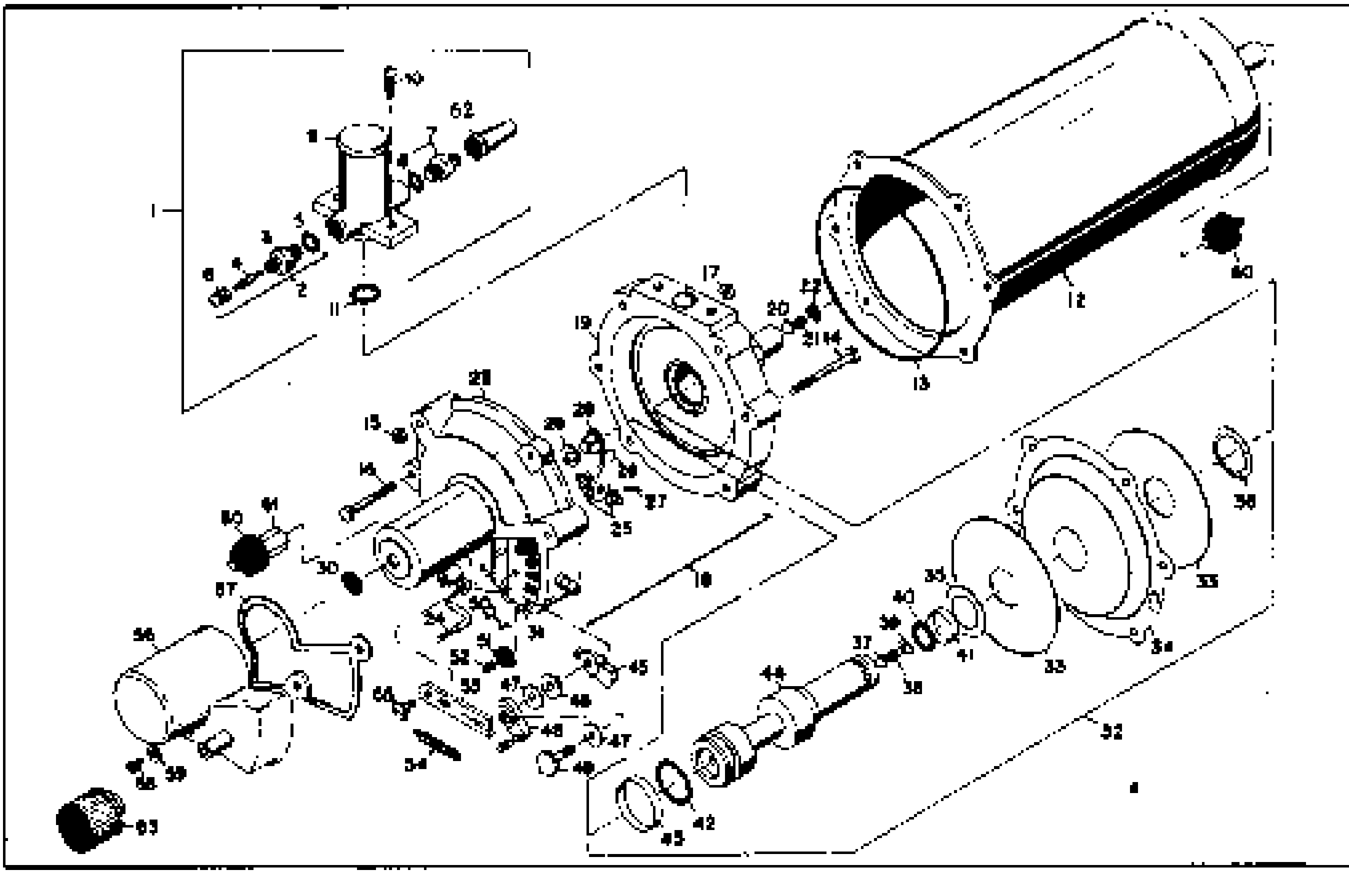


Fig. 4-14 Exploded View of Compressor

1. Regulator Assy.
2. Adapter Assy.
3. Adapter
4. Valve Core
5. O-Ring
6. Cap
7. Adapter Assy.
8. O-Ring
9. Seal
10. Screw, Regulator Retaining
11. O-Ring, Regulator to Compressor
12. Reservoir
13. O-Ring, Reservoir to Compressor
14. Thru Bolt, Reservoir Retaining
15. Nut, Thru Bolt Reservoir
16. Thru Bolt, Compressor Retaining
17. Nut, Thru Bolt Compressor
18. Compressor Assy.
19. Housing, 2nd Stage
20. Check Valve
21. Spring
22. Expansion Plug Retainer
23. Housing, 1st Stage
24. Arm, Swivel
25. Bushing
26. Arm, Rocker
27. Pin, Rocker Arm Ret.
28. Intake Valve
29. Washer
30. Spring, Intake Valve Ret.
31. Pin, Bushing Retaining
32. Piston Assy.
33. Plate, Diaphragm
34. Diaphragm
35. Washer (.760-.765 I.D.)
36. Retainer, Diaphragm
37. Check Valve
38. Spring
39. Expansion Plug Retainer
40. O-Ring (.357-.367 I.D.)
41. Seal (.569-.571)
42. O-Ring (.732-.742 I.D.)
43. Seal (.943-.945)
44. Piston
45. Distributor Valve
46. Bushing, Distributor Valve
47. Washer (.160-.163 I.D.)
48. Arm Assy., Distributor
49. Screw
50. Spring, Valve Tension
51. Bushing, Distributor Valve Stop
52. Bushing, Arm Assy. Stop
53. Arm Actuating
54. Spring, Arm Tension
55. Screw, Arm Pivot
56. Cover
57. Gasket
58. Screw, Cover Retaining
59. Gasket, Cover
60. Mount, Flexible
61. Adapter
62. Tube Fitting
63. Filter

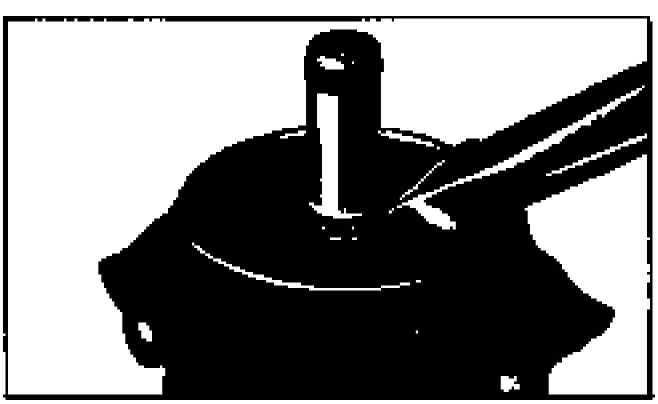


Fig. 4-15 Removing Diaphragm Retainer

Fig. 4-16 Distributor Valve Assembly

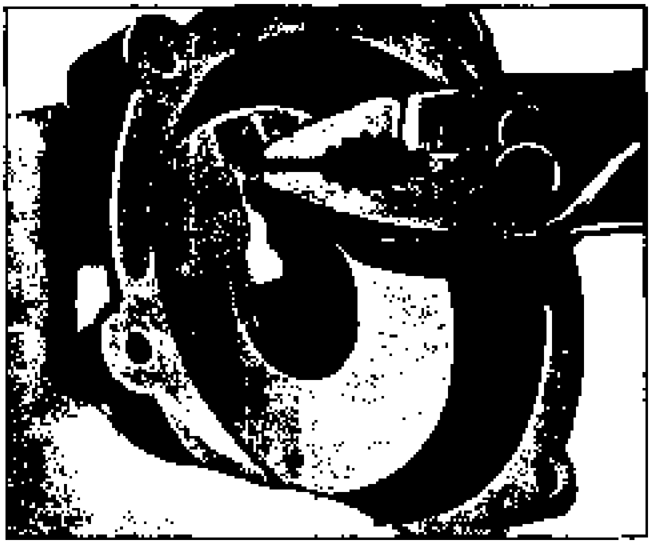


Fig. 4-17 Removing Rocker Arm Pin

2. Install assembly in car and tighten upper bracket attaching screw to 9 lb. ft. torque.

3. Connect high pressure line to regulator valve and tighten fitting nut to 70 lb. in. torque. Install vacuum line to compressor.

4. Inflate system through service valve to maximum available pressure (Fig. 4-24).

NOTE: If available pressure is less than 140 psi, start engine to build up reservoir to this pressure.

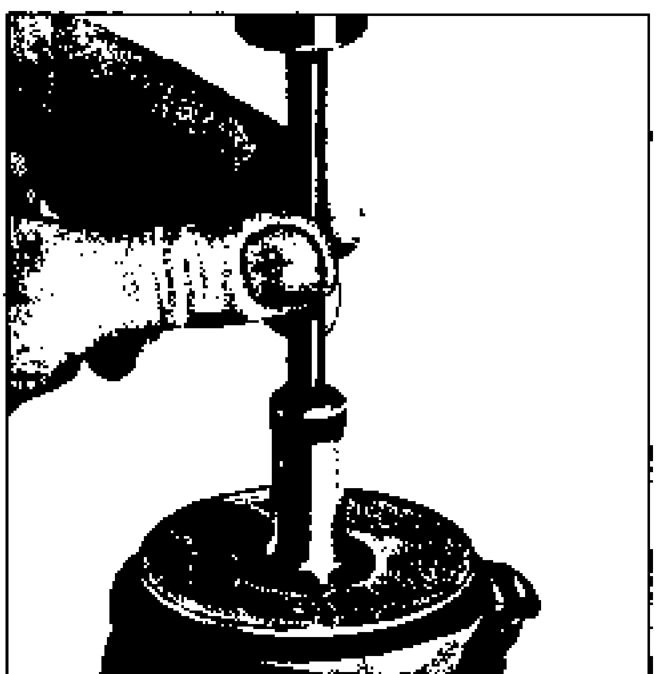


Fig. 4-18 Installing Check Valve

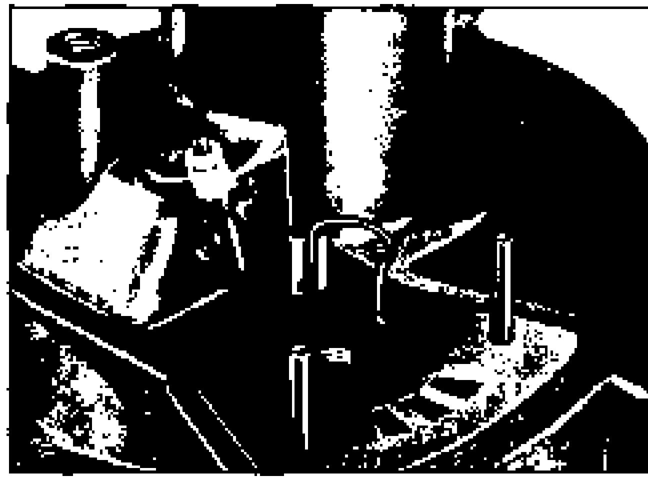


Fig. 4-19 Installing Valve Tension Spring in Boss

TROUBLE DIAGNOSIS TESTS

QUICK CHECK OF AUTOMATIC LEVEL CONTROL SYSTEM

1. Record rear trim height of empty car (measure from center of rear bumper to ground).

NOTE: Fill compressor through service valve with air at available line pressure.

2. Add weight equivalent to two passenger load (300 lbs.) to rear bumper or tailgate. Car should begin to level in 4-18 seconds. Final position should be within 1" of original measurement.

3. Remove weight. Car should begin to settle in 4-18 seconds. Final position should be within 1" of original measurement.

AUTOMATIC LEVEL CONTROL TEST GAGE

To properly service the Automatic Level Control, it

Fig. 4-20 Positioning Distributor Valve

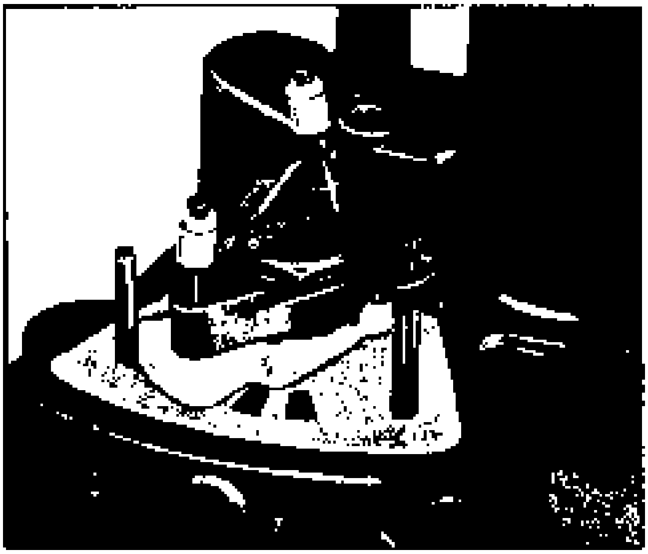


Fig. 4-21 Installing Distributor Arm

will be necessary to obtain Test Gage J 5907 with adaptor package J 22695 or equivalent. A test gage can be made up by collecting and assembling the following parts:

PARTS REQUIRED

1. Fill valve.

2. A tee, which has three 1/8" female taper pipe threads.

3. One adapter, which has a 1/4" female taper pipe thread on one end and a 1/8" male taper pipe thread on the other end.

4. Air Pressure Gage J 5907.

5. One male connector, which has a 1/8" male taper pipe thread on one end and a 3/8"-24 straight thread male thread on the other end.

6. Two metal sleeves, rubber seals and tube nuts.

7. A length of 1/8" tubing.

ASSEMBLE

1. Install adapter in tee.

2. Install connector in one end of tee.

3. Install fill valve in other end of tee.

4. Install Pressure Gage J 5907 in adapter.

5. Install fitting nut on tubing, then install metal sleeve and rubber seal over end of tubing until tubing bottoms in rubber seal. Tubing, nut and seal assembly can now be installed on connector opposite the fill valve. Tighten fitting nut to 70 lb. in. torque.

NOTE: Make certain all fittings are air tight.

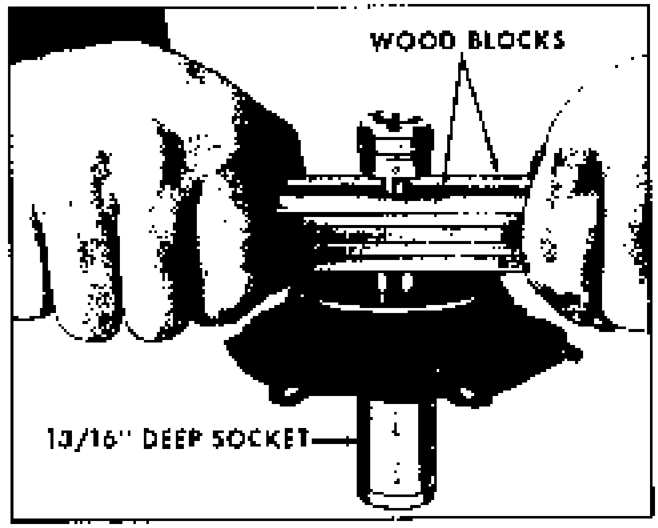


Fig. 4-22 Installing Diaphragm Retainer

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 (Fig. 4-25).

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 the compressor, reservoir and regulator as outlined below. If not leaking, continue with this test.

5. With engine running at slow idle, observe reservoir build-up for five minutes. Reservoir pressure should build up to a minimum of 90 psi.

6. If compressor fails to cycle, make sure the vacuum line and filter is open and unobstructed before removing compressor for repair.

7. If build-up is too slow, proceed to repair compressor as outlined in Service Procedures.

8. Satisfactory build-up indicates system problem to be in the control section. However, again observe the test gage for evidence of an air leak and proceed accordingly.

PRESSURE REGULATOR TEST

Performance test the regulator with a known good compressor on the car.

1. Deflate system through service valve and disconnect line at pressure regulator valve. Install test gage on regulator valve high pressure fitting (Fig. 4-25).

2. Inflate system through service valve to maximum available pressure (Fig. 4-24).

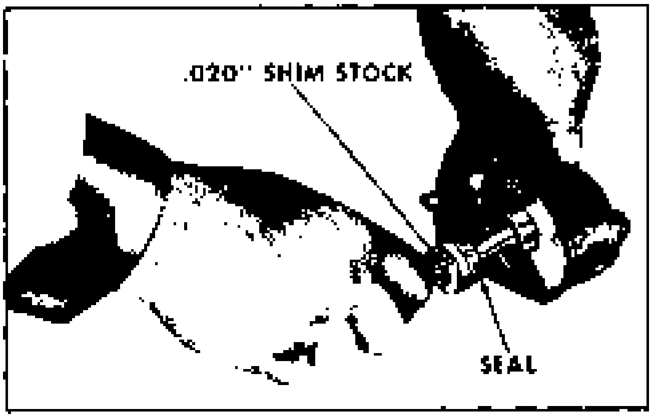


Fig. 4-23 Installing Piston Seal

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.

HEIGHT CONTROL VALVE TEST--ON CAR

EXHAUST (SUPERLIFTS INFLATED)

1. Disconnect overtravel lever from link.

2. Hold lever down in exhaust position until Superlifts deflate or for a minimum of 15 seconds.

3. If Superlifts deflate, perform Intake Check.

4. If Superlifts do not deflate, remove exhaust adapter from control valve and hold lever down as in Step 2. Replace adapter, O-ring and filter if this deflates Superlifts.

5. Replace control valve if none of the above steps corrects problem.

INTAKE (RESERVOIR PRESSURE 125 PSI MINIMUM)

1. Disconnect overtravel lever from link.

2. Hold lever up in intake position until Superlifts inflate or for a minimum of 15 seconds.

3. If Superlifts inflate and hold, proceed to TIME DELAY CHECK.

4. If Superlifts inflate and then leak down, perform leak test on lines and fittings and then on Superlifts. Also check and, if necessary, replace HCV intake and exhaust screens and O-rings. If Superlifts still do not inflate, perform leak test on valve. Repair as indicated and proceed to TIME DELAY CHECK.

TIME DELAY CHECK

1. Disconnect overtravel lever from link.

2. Disconnect lines at Superlift and intake port.

3. Connect test gage to intake valve port and open air pressure (95 psi). Move overtravel lever approximately 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 4-18 seconds. 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.

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 4-18 seconds. Repeat check.

If either delay is not within specification, there has

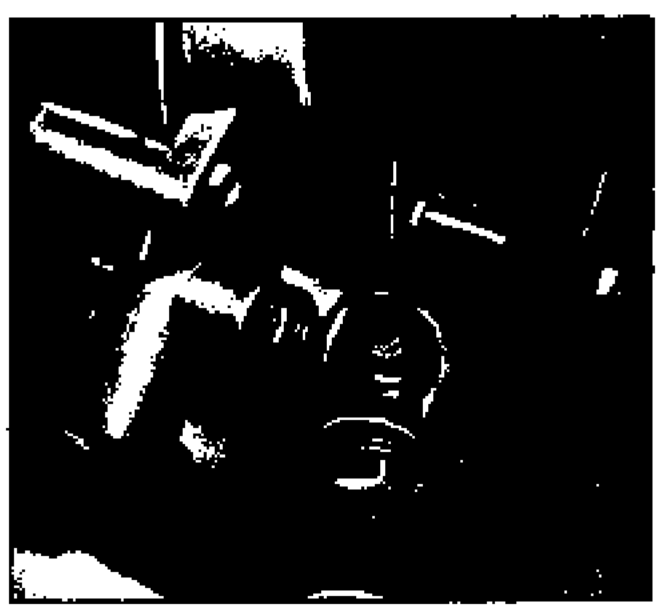


Fig. 4-24 Filling System through Service Valve

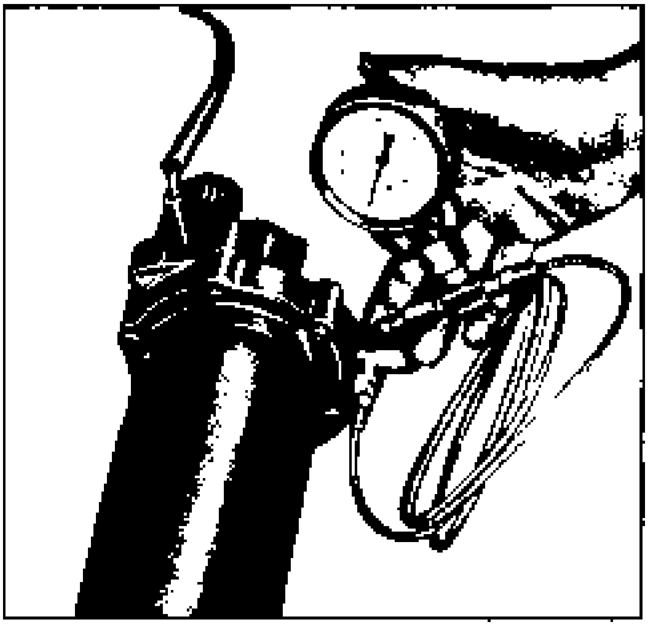


Fig. 4-25 Test Gage Installed on Regulator Valve

either been a loss of silicone fluid or valve has lost its adjustment due to damage or wear. Valve must be replaced.

COMPRESSOR, RESERVOIR AND REGULATOR - LEAK TEST

1. Remove assembly intact.

2. Connect test gage to regulator. Inflate reservoir through service valve to 80-110 psi.

3. Route an 8" piece of rubber hose between vacuum and vent ports (Fig. 4-26).

4. While holding assembly in a vertical position with reservoir end down, immerse in water until diaphragm is just submerged. Observe for air leaks at:

CAUTION: Do not submerge completely, as water can enter around the cover gasket.

a. Reservoir weld seam.

b. Reservoir to compressor O-ring. A stream of bubbles may appear in this area and then cease. The bubbles are caused by atmospheric air being purged from air pockets in the second stage housing. If the bubbles stop, there is no leak.

c. Regulator to compressor O-ring.

d. Regulator boot -- defective internal O-ring.

e. Diaphragm between first and second stage housings tightening through-bolts may correct the leak.

f. Service valve.

g. Test gage connections.

5. Remove hose from vacuum port and submerge disconnected end in water. Cover vacuum port with finger. Do not permit water to enter through vacuum port. If bubbles are evident, the probable cause is a defective second stage housing check valve.

6. Correct any leaks by either tightening screws or replacing parts.

7. If the cover gasket area is 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 needs to be overhauled.

HEIGHT CONTROL VALVE TEST--OFF CAR

1. Remove control valve from car.

2. Clean exterior of control valve thoroughly.

3. Connect test gage and air pressure source to intake adapter and open air pressure (80-110 psi).

4. Submerge unit in water. No air should escape if overtravel lever is in neutral position. If bubbles escape from Superlift port, replace control valve.

5. Shut off air pressure and detach test gage from air intake port. Plug intake port with fill valve from J 22695 adaptor package.

6. Connect test gage to Superlift port and open air pressure.

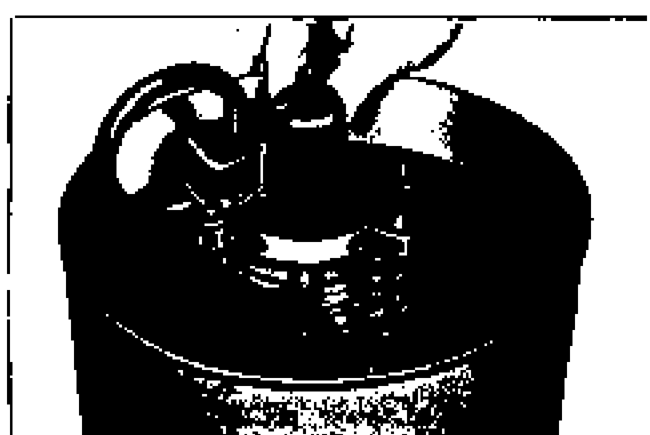


Fig. 4-26 Checking Compressor, Reservoir and Regulator for Leaks

7. With overtravel lever in neutral position, no air should escape. If bubbles escape from exhaust port, replace control valve.

8. If air escapes around edge of cover plate, the gasket must be replaced.

9. Remove control valve from water. Actuate overtravel lever to expel any water from unit.

10. Shut off air pressure and remove line from Superlift port.

LINES AND FITTINGS - LEAK TEST

1. Disconnect overtravel lever from link.

2. Hold lever up in intake position for maximum Superlift inflation and release.

3. Leak check all connections with a soap and water solution.

SUPERLIFT - LEAK TEST

1. See SHOCK ABSORBER - EXCEPT FIREBIRD.

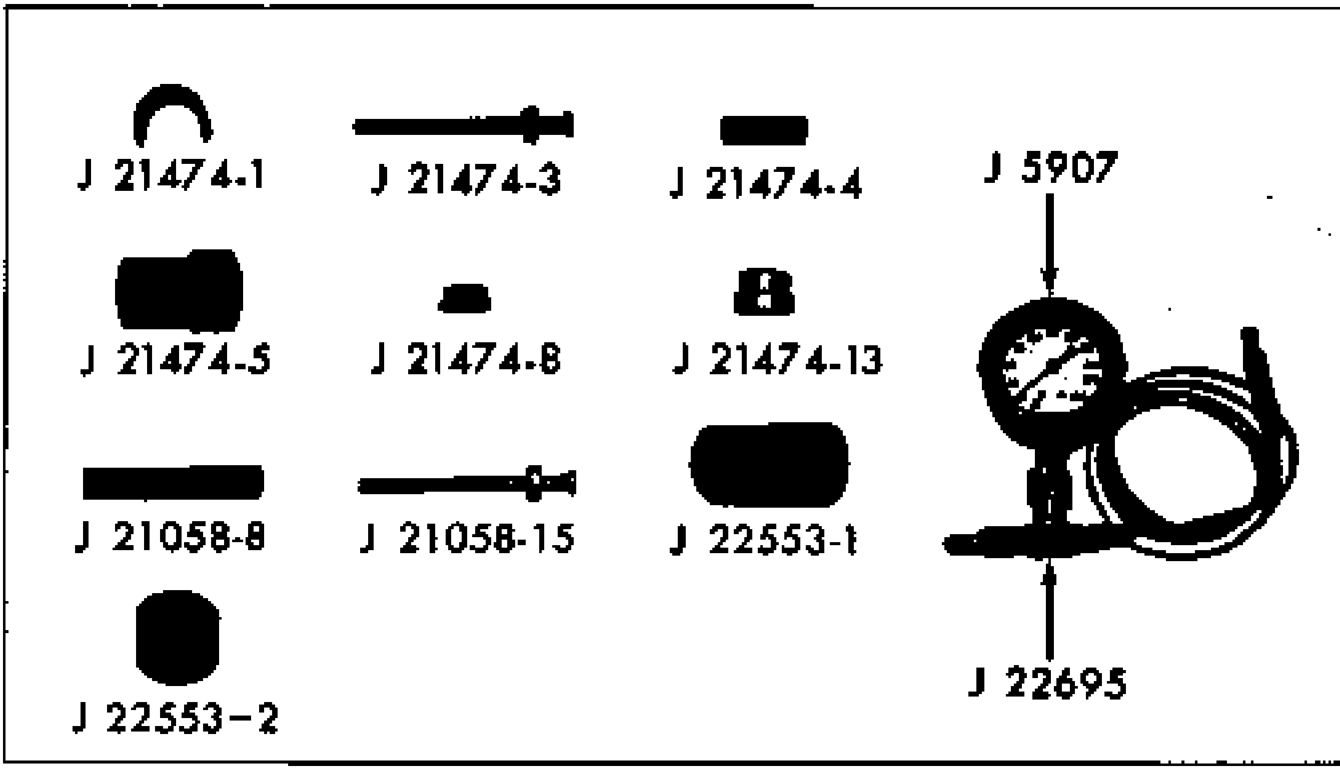


Fig. 4-27 Special Tools

Tool No.	Name
J 5907	Universal Pressure Checking Gage
J 21474-1	Rear Upper & Lower Control Arm Spacer
J 21474-3	Screw Assembly
J 21474-4	Nut
J 21474-5	Receiver
J 21474-8	Upper & Lower Control Arm Bushing Remover
J 21474-13	Upper & Lower Control Arm Bushing Installer
J 21058-8	Nut
J 21058-15	Screw Assembly
J 22553-1	Rear Spring Bushing Receiver
J 22553-2	Rear Spring Bushing Installer
J 22695	Automatic Level Control Pressure Gage Assembly

TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise shown

APPLICATION	TORQUE
Bolt, Upper or Lower Control Arm (Except Firebird)	110
Nut, Upper or Lower Control Arm (Except Firebird)	80
Nut, Shock to Lower Mount	
Pontiac, Tempest & Grand Prix	65
Firebird	60
Screw, Shock Absorber Upper Mount	20
Screw, Shock Absorber Bracket to Floor Pan (Firebird)	8
Nut, Upper Shock Absorber Mount to Bracket (Firebird)	8
Nut, Spring and Shock Absorber Anchor Plate Attaching (Firebird)	40
Nut, Spring Front Eye Bolt (Firebird)	75
Screw, Spring Front Bracket to Frame (Firebird)	25
Nut, Spring Rear Shackle (Firebird)	50
Nut, Air Line Fitting (Superlift and Auto. Level Control)	70 (Lb. In.)
Nut, Height Control Valve (Auto. Level Control)	60 (Lb. In.)
Screw, Compressor Bracket to Fender Panel (Auto. Level Control)	9
Nut, Upper & Lower Link (Auto. Level Control)	60 (Lb. In.)
Nut, Compressor Mounting Stud to Compressor Bracket (Auto. Level Control)	20 (Lb. In.)

STANDARD DIFFERENTIAL

CONTENTS OF THIS SECTION

AXLE RATIOS

PONTIAC

Eleven different axle ratios are available for the various car models, Fig 4A-4A. They can be identified by the code stamepd on the rear of the L.H. axle tube adjacent to the carrier (Fig. 4A-1).

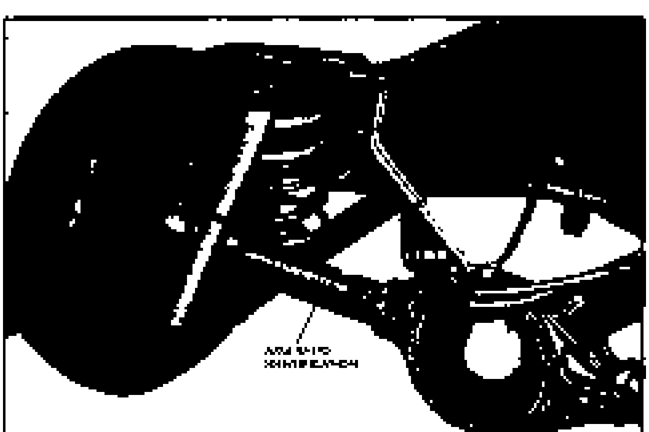


Fig. 4A-1 Rear Axle View - Pontiac, Tempest and Grand Prix

Three different cases, which differ in ring gear mounting dimensions, are used: one for 2.29, 2.41 and 2.56 ratios, one for the 2.73, 2.93 and 3.08 ratios and one for the 3.23, 3.42, 3.55, 3.73 and 4.11 ratios. When changing axle ratios, be sure to use the proper differential case.

TEMPEST AND FIREBIRD

Nine different axle ratios are available for the various car models, Fig. 4A-4B and 4A-4C. They can be identified by the code stamped on the rear of the L.H. axle tube adjacent to the carrier (Fig. 4A-1), or on the left rear brake drum surface. Three differential cases, which differ in ring gear mounting dimensions, are used: one for 2.56 and 2.78 ratios, one for 2.93, 3.08 and 3.23 ratios and one for 3.36, 3.55, 3.90 and 4.33 ratios. When changing axle ratios, be sure to use the proper differential case.

GRAND PRIX

Six ratios are available for the Grand Prix: 2.93, 3.08, 3.23, 3.36, 3.55 and 3.90. They can be identified by the code stamped on the rear of the L.H. axle tube adjacent to the carrier (Fig. 4A-1), or on the left rear brake drum surface. Three different cases, which differ in ring gear mounting dimensions and/or in material are used. The case usage is affected by engine transmission combinations. When changing ratios, be sure to use the proper differential case and axle shafts (SEE Fig. 4A-4D).

NEW CAR PRE-DELIVERY INSPECTION

TORQUE

Check torque specifications at rear axle.

1. Tighten all rear suspension control arm bolts to 110 lb. ft. torque and nuts to 80 lb. ft. torque (Pontiac, Tempest and Grand Prix).

2. Tighten rear shock absorber to axle housing nut to 65 lb. ft. torque and shock absorber to frame bolt to 20 lb. ft. torque.

3. Tighten universal joint U-bolt nuts to 12 lb. ft torque (with lock plates) or 14 lb. ft. torque (with lock washers).

LUBRICATION

Check differential oil level and, if necessary, add sufficient amount of multi-purpose hypoid gear lubricant.

PERIODIC SERVICE

LUBRICATION

Lubricant change in the differential is not recommended unless repair work is being done. The differential should be checked for leaks at each chassis lubrication. If there is evidence of leakage, the leak should be corrected and lubricant added if needed. Lubricant level should be even with bottom of filler plug hole. Rear axle capacity is 4 1/2 pints for Pontiac: 3 pints for Tempest, Firebird and Grand Prix.

Use multi-purpose hypoid gear lubricant in the standard differential. Because of the importance of using factory recommended lubricant, a container of this lubricant is furnished with each service ring gear and pinion set or differential carrier assembly. This lubricant is also available through regular parts channels. See Section 4B for Safe-T-Track Lubricant Recommendations

SHOCK ABSORBERS

Give visual inspection for leaks and jounce car at each lubrication period to see that shock absorbers are in an operative condition. If inoperative or if leaks are

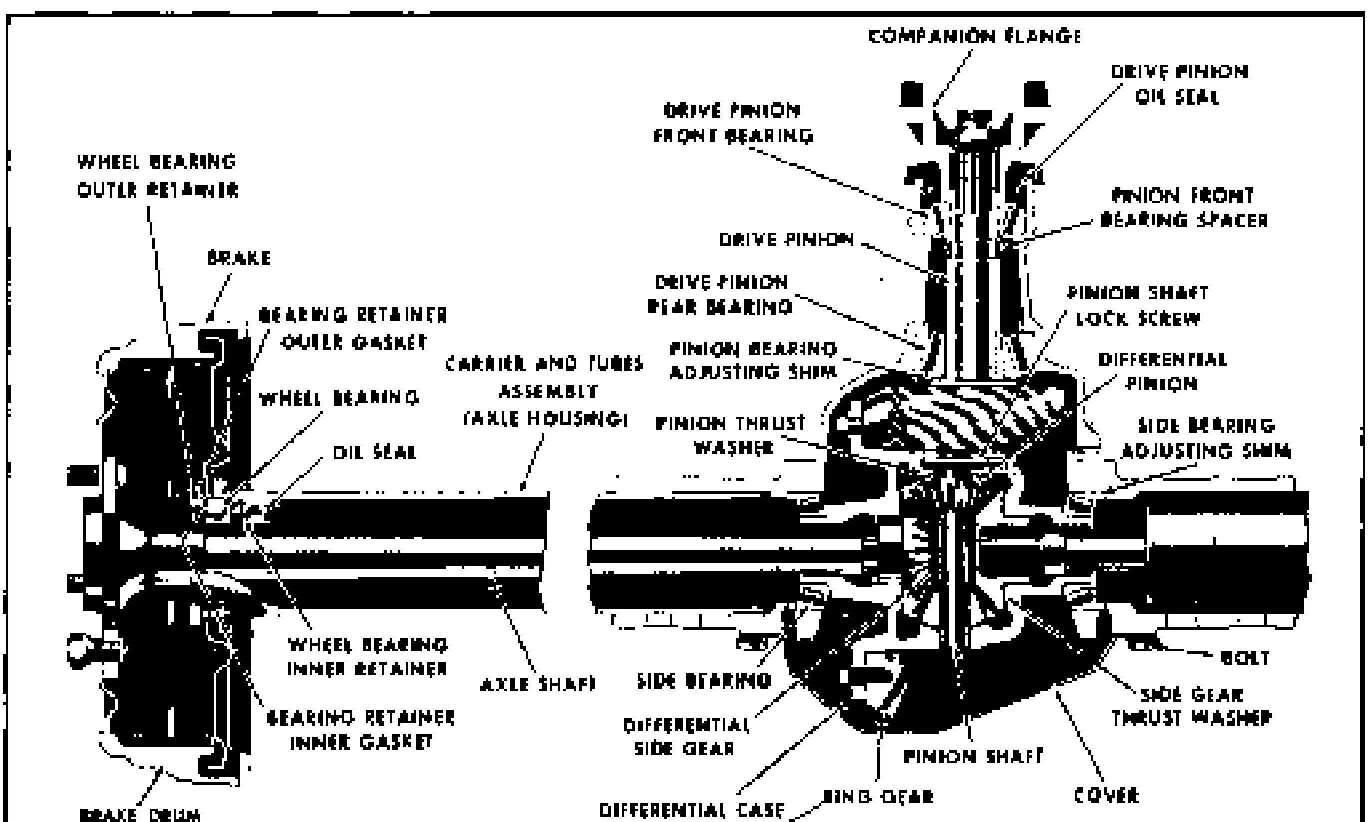
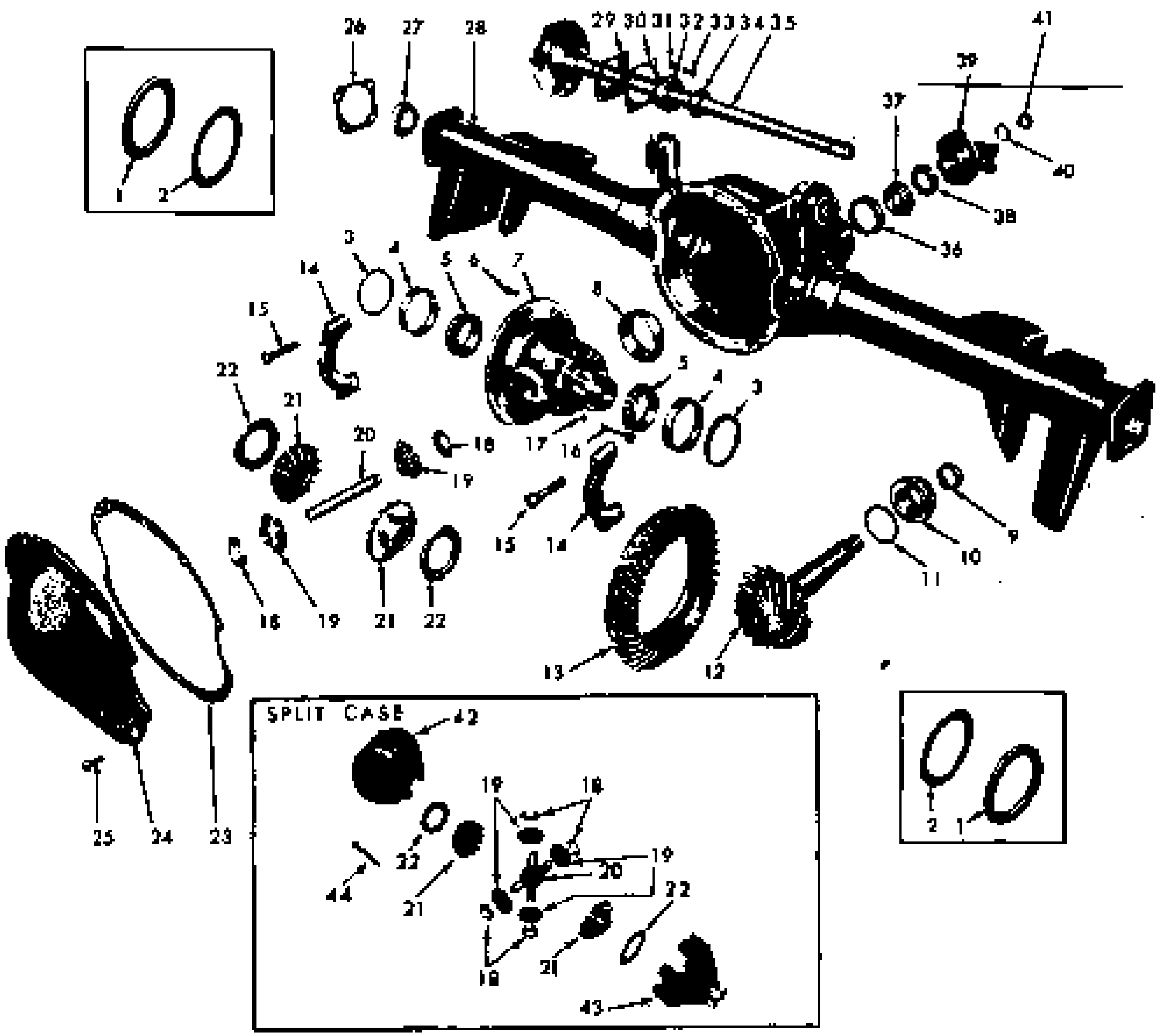


Fig. 4A-2 Cross Section of Typical Rear Axle and Differential



1. Spacer
2. Differential Side Bearing Shim (Service)
3. Side Bearing Shim (Production)
4. Side Bearing Race
5. Differential Side Bearing
6. Ring Gear to Differential Case Bolt
7. Differential Case
8. Rear Pinion Bearing Outer Race
9. Bearing Spacer
10. Drive Pinion Bearing
11. Bearing Shim
12. Drive Pinion Gear
13. Ring Gear
14. Differential Side Bearing Cap
15. Cap Bolt
16. Pinion Shaft Lock Bolt
17. Washer
18. Pinion Gear Thrust Washer
19. Differential Pinion Gear
20. Differential Pinion Shaft
21. Differential Side Gear
22. Side Gear Thrust Washer
23. Cover Gasket
24. Cover
25. Cover Bolt
26. Inner Retainer Gasket
27. Axle Shaft Oil Seal
28. Carrier & Tube Assy.
29. Outer Retainer
30. Outer Retainer Gasket
31. Nut
32. Axle Shaft Bearing
33. Brake Assy. to Housing Bolt
34. Inner Retainer
35. Axle Shaft
36. Front Pinion Bearing Outer Race
37. Front Pinion Bearing
38. Pinion Oil Seal
39. Companion Flange
40. Washer
41. Pinion Nut
42. Flange Half of Case
43. Cap Half of Case
44. Case Half Bolts

Fig. 4A-3 Exploded View of Typical Differential Assembly

Rear Axle Gear		Model									Stagecoach		Police			Trans			Axle Release			Engine				Trailer Provisions				Air Cond		Std. Diff. Code	Lock Diff. Code
Combination	Ratio	Cat. 2 Dr. Sedan, Cat. 4 Dr. Sedan	Cat. 2 Dr. Hardtop, Cat. Convertible	Cat. 4 Dr. Hardtop	Cat. Sta. Wag. - 2 Seat, Cat. Sta. Wag. - 3 Seat	Executive	Bonne 2 Dr. Hardtop, Bonne 4 Dr. Hardtop	Bonne Convertible	Bonne. Sta. Wag. - 3 Seat	H.D. Chassis (Barnet)	7 Pass.	9 & 12 Pass.	Standard	Highway Patrol	Freeway Enforcer	3 Speed Manual	4 Speed Manual	Turbo Hydra-Matic	Economy	Standard	Performance	400 Economy	400 2 BBl.	428 4 BBl.	428 4 BBl. H.O.	Without	Class I Light	Class II Medium	Class III Heavy	Without	With	Located on L.H. Axle Tube And on L.H. Brake Drum	
39:17	2.29	X																X	X				X			X				X		UA	VA
41:17	2.41	X																X		X			X			X				X			
			X		X	X												X	X				X			X				X	X		
							X											X	X							X	X				X			
41:16	2.56	X	X	X	X	X	X	X	X										X		X		X				X				X	X		
		X	X	X	X	X												X	X						X		X				X	X		
								X	X										X	X						X		X				X			
		X																X		X			X			X					X	UC	VC
41:15	2.73		X	X	X	X												X		X			X			X				X	X	UD	VD
41:14	2.93	X	X	X	X	X	X	X	X										X		X		X					X			X	X		
		X	X	X	X	X												X		X					X		X					X		
		X	X	X	X	X	X											X		X			X				X			X	X	UE	VF
40:13	3.08						X	X	X										X		X					X		X				X	X		
										X									X		X			X								X	X		
		X	X	X	X	X												X		X					X			X	X		X	X		
		X	X	X	X	X	X	X	X										X			X	X				X	X			X	X		
		X	X	X	X	X								X				X		X					X		X				X			
							X	X	X										X		X					X			X	X		X	X		
		X	X	X	X	X	X	X	X										X		X		X						X		X	X		
		X	X	X	X	X												X		X			X					X		X	X		
							X	X	X								X			X					X		X				X	X		
		X	X	X	X	X												X			X		X			X	X			X	X		
															X				X		X			X							X	X	UF	VF
42:13	3.23	X	X	X	X	X							X	X		X				X		X			X				X	X		
		X	X	X	X	X								X		X							X		X				X	X		
		X	X	X	X	X												X			X			X		X	X	X		X			
							X	X	X										X		X		X		X						X	X	X		
																	X			X		X					X						X			
		X	X	X	X	X												X		X		X	X	X						X	X	X		
							X	X	X										X			X			X		X				X		UG	VG
41:12	3.42															X	X				X				X		X				X	X		
		X	X	X		X	X	X											X		X						X	X	X	X	X	X	X		
																X	X		X		X						X	X							
		X	X	X		X	X	X								X		X				X						X	X	X							
							X	X	X								X				X				X			X			X	X		
		X	X	X	X	X										X				X			X	X			X			X	X	UH	VH
39:11	3.55										X						X		X			X								X	X		VJ
41:11	3.73	X	X	X		X										X				X			X	X	X			X	X	X	X		
					X											X				X			X	X				X	X	X	X		
							X	X									X				X				X	X			X	X	X	X		
									X							X				X				X					X	X	X	X		VK
37:9	4.11									X						X				X			X								X	X		
											X					X				X			X								X	X		VM
41:15	2.73	X	X	X	X	X												X	SPECIAL ORDER					X		X	X	X	X	X	X		
		X																X					X			X	X	X	X	X	X		
								X	X										X					X		X	X	X	X	X	X	UD	VD
41:14	2.93						X	X	X										X					X		X	X	X	X	X	X		
		X	X	X	X	X												X				X			X		X	X	X	X	UE	VF
42:13	3.23	X	X	X		X	X	X											X							X	X		X	X				
		X	X	X	X	X																	X			X	X	X		X		UG	VG
41:12	3.42	X	X	X	X	X										X						X			X		X	X	X			
							X	X	X								X							X		X		X	X	X			
		X	X	X	X	X	X	X	X								X							X		X		X	X	X			
		X	X	X	X	X												X				X			X	X	X	X	X			
							X	X	X										X					X		X	X	X	X	X			
		X	X	X	X	X												X					X		X	X	X	X	X		UH	VH
39:11	3.55	X	X	X	X	X										X						X			X	X	X	X	X			
		X	X	X	X	X												X				X			X	X	X	X	X			
							X	X	X								X							X		X	X	X	X	X			
		X	X	X		X	X	X								X								X	X	X	X	X					
									X										X					X		X	X	X	X	X			
							X	X											X					X	X	X	X	X	X	X			
		X	X	X	X	X										X							X		X	X	X	X	X			
		X	X	X		X												X					X	X	X	X	X	X	X			
					X												X					X		X	X	X	X	X			VJ
41:11	3.73	X	X	X		X										X						X	X	X	X	X			X			
							X	X									X							X	X	X	X			X			
		X	X	X	X	X												X				X			X	X	X	X	X			
		X	X	X	X	X	X	X	X										X					X		X	X	X	X	X			
		X	X	X		X	X	X											X						X	X	X	X	X					
					X				X							X						X	X		X	X			X			VK
37:9	4.11	X	X	X		X	X	X								X								X	X	X	X	X					
		X	X	X	X	X	X	X	X									X							X		X	X	X	X	X			VM

NOTE: ¦ – Special Radiator Required

Fig. 4A-4A Pontiac - Rear Axle Usage and Identification

Rear Axle Gear: Combination	Ratio	Model: Standard 2 Dr. Coupe	Standard 4 Dr. Sedan	Custom 2 Dr. Coupe / Custom 2 Dr. Hardtop / Custom Convertible	Custom 4 Dr. Sedan / Custom 4 Dr. Hardtop	Custom Station Wagon / Safari Station Wagon	Lemans	G.T.O.	Sprint Option	Transmission: 3 Speed Manual	4 Speed Manual	4 Speed Manual Close Ratio	2 Speed Automatic	Turbo Hydra-Matic M38	Turbo Hydra-Matic M40	Ratio Release: Economy	Standard	Performance	Engine: 6 Cylinder 1 BBL.	6 Cylinder 4 BBL.	350 2 BBL	350 4 BBL. H.O.	400 2 BBL.	400 4 BBL.	400 4 BBL. H.O.	Trail. Prov.: Without	Class I/II Weight	Air Cond.: Without	With	Std. Diff. Code*	Lock Diff. Code*: 2 Pinions	4 Pinion
43:16	2.56	X	X	X	X	X	X						X	X	X		X				X					X		X		WB	XB	
		X	X	X	X	X	X						X	X		X			X							X		X				
									X					X		X				X						X						
								X							X	X							X			X		X	X			
39:14	2.78	X	X	X	X	X	X						X		X		X				X					X			X	WC	XC	
								X							X		X						X			X			X			
41:14	2.93	X	X	X	X	X	X						X	X	X			X			X					X		X	X	WD	XD	
								X							X		X						X			X		X				
40:13	3.08	X	X	X	X	X	X			X						X					X					X		X	X	WE	XE	
42:13	3.23	X	X	X	X	X	X			X							X		X							X		X	X	WF	XF	
		X	X	X	X	X	X			X	X						X				X					X		X	X			
		X	X	X	X		X			X	X						X					X				X			X			
									X					X			X			X						X						
		X	X	X	X	X	X						X	X			X		X							X		X	X			
								X							X			X					X			X		X	X			
								X		X	X						X							X	X	X			X			
								X							X		X								X	X	X		X			
								X							X		X							X		X			X			
								X							X		X						X	X			X	X	X			
37:11	3.96	X	X	X	X	X	X						X	X	X		X				X						X	X	X	WG		XG
								X							X		X							X		X		X				
39:11	3.55	X	X	X	X		X			X	X						X				X						X	X	X	WH		XH
		X	X	X	X	X	X						X	X			X		X								X	X	X			
		X	X	X	X		X			X	X				X		X					X				X	X	X	X			
						X				X	X						X				X						X	X	X			
									X					X			X			X							X					
								X		X	X						X							X			X	X	X			
								X		X	X						X							X		X		X				
								X							X		X								X	X		X				
									X	X	X						X			X						X						
									X					X				X		X						X						
								X		X	X						X								X	X	X	X				
39:10	3.90	X	X	X	X	X	X			X							X		X								X	X	X	WK		XK
									X	X		X					X			X							X					
								X				X			X		X								Xr							
40:13	3.08							X		X	X						SPECIAL ORDER							X	X	X	X	X	X			
42:13	3.23							X		X	X													X	X	X	X	X		WF	XF	
								X							X									X		X		X				
37:11	3.30	X	X	X	X	X	X			X	X										X					X	X	X$	X	WG		XG
		X	X	X	X	X	X						X	X					X							X	X	X				
		X	X	X	X	X	X						X	X	X						X					X		X$				
								X		X	X													X		X	X	X				
								X		X	X				X										X	X	X	X				
39:11	3.55	X	X	X	X	X	X			X									X							X	X	X$		WH		XH
								X							X									X		X	X	X				
39:10	3.90	X	X	X	X		X			X		X										X				X	X	X$				XK
									X	X		X								X						X		X$				
								X		X		X			X									X	X	X	X	X$				
39:9	4.33							X		X		X			X									X	X	X	X	X$				XM
								X				X			X										Xr							

NOTES: * - Located on L.H. Axle Tube and L.H. Rear Brake Drum
r - Ram Air Engine Only
$ - Special Radiator required

Fig. 4A-48 Tempest - Rear Axle Usage and Identification

Rear Axle Gear		Transmission						Ratio Release			Engine							Air Cond.		Std. Diff. Code*	Lock Diff. Code*	
Combination	Ratio	3 Speed Manual	4 Speed Manual	4 Speed Man. Close Ratio	2 Speed Automatic	Turbo Hydra-Matic M38	Turbo Hydra-Matic M40	Economy	Standard	Performance	6 Cyl. - 1 BBL.	6 Cyl. - 4 BBL.	350 - 2 BBL.	350 - 4 BBL. H.O.	400 - 4 BBL.	400 - 4 BBL. H.O.	400 - Ram Air	Without	With		2 Pinion	4 Pinion
41:16	2.56				X	X		X			X							X		YB	ZB	
					X	X	X		X				X					X				
39:14	2.78					X		X				X								YC	ZC	
					X		X		X				X						X			
							X		X						X	X			X			
						X	X		X						X				X			
41:14	2.93				X	X	X			X			X					X		YD	ZD	
40:13	3.08	X						X			X							X	X	YE	ZE	
		X	X					X					X					X	X			
							X		X						X	X		X				
42:13	3.23	X	X						X		X							X		YF	ZF	
						X			X			X										
		X	X						X				X					X	X			
					X	X			X		X							X	X			
							X			X					X			X				
37:11	3.36	X	X						X						X	X				YG	ZG	
39:11	3.55	X	X						X		X							X		YH	ZH	
		X	X						X			X						X				
						X				X		X										
		X	X							X					X	X		X				
							X			X						X		X				
		X	X	X			X		X					X				X	X			
					X	X		Special Order			X							X	X			
39:10	3.90			X			X		X							X	X	X				ZK
				X				Special Order						X				X$†				
				X			X								X	X		X†				
39:9	4.33			X											X	X		X†				ZM

NOTES: $ - Special Radiator Required
† - Special Engine Fan Required
* - Located on L.H. Axle Tube and L.H. Brake Drum

Fig. 4A-4C Firebird - Rear Axle Usage and Identification

Rear Axle Gear		Transmission			Ratio Release			Engine				Trailer Prov.		Air Cond.		Std. Diff. Code		Lock Diff. Code	
Combination	Ratio	3 Speed Manual	4 Speed Manual	Turbo Hydra-Matic M40	Economy	Standard	Performance	400 - 4 Bbl.	428 - 4 Bbl.	428 - H.O.	400 - 2 Bbl. Econ.	Exc. V82	With V82	Without	With	Regular Duty	Medium Duty	Medium Duty 4 Pinion	Heavy Duty 4 Pinion
41:14	2.93			X	X			X				X	X	X	X	2D	4D	5D	
				X	X				X	X		X	X	X	X				
				X		X					X	X		X	X				
42:13	3.23		X			X		X				X			X	2F	4F	5F	
				X		X					X		X	X	X				
				X			X				X	X		X	X				
				X		X		X				X	X	X	X				
				X		X				X			X	X	X				
		X				X		X				X	X	X	X				
				X					X			X	X	X	X				
		X	X			X			X			X			X				
				X		X				X		X			X				
37:11	3.36			X		X				X		X		X			4G		7G
39:11	3.55	X	X			X			X			X	X	X			4H		7H
		X	X			X			X				X		X				
		X	X			X				X		X	X	X					
				X			X	X	X			X	X	X					
			X			X		X				X		X					
			X			X		X					X	X	X				
40:13	3.08		X			SPECIAL ORDER		X				X		X	X	2E	4E	5E	
		X	X						X	X		X		X	X				
42:13	3.23			X						X		X		X		2F	4F	5F	
			X					X				X		X					
		X	X						X	X		X		X					
37:11	3.36	X	X	X					X			X	X	X			4G		7G
		X	X							X		X	X	X					
			X					X				X	X	X					
39:11	3.55			X				X				X	X	X			4H		7H
39:10	3.90			X				X				X	X	X					7K
			X					X				X	X	X					
		X	X	X					X	X		X	X	X					

TYPES OF AXLES

Type Axle	Type Diff.	Diff. Carrier	Axle Shafts	Diff. Asm.
Regular Duty	Standard	Gray Iron	Cold Extruded	2 Pinion Non-lock
Medium Duty	Standard	Gray Iron	Cold Extruded	4 Pinion Non-lock
Medium Duty	Safe-T-Track	Gray Iron	Cold Extruded	4 Pinion Lock
Heavy Duty	Safe-T-Track	Nodular Iron	Hot Forged	4 Pinion Lock

Fig. 4A-4D Grand Prix - Rear Axle Usage and Identification found, refer to suspension section of manual and thoroughly diagnose problem before replacing units.

MINOR SERVICE AND REPAIRS

NOTE: Most rear-axle service repairs can be made with the rear axle assembly in the car by raising the rear end, with the rear axle hanging on the shock absorbers. Rear axle lubricant may be drained by backing out all cover bolts and breaking cover loose at the bottom.

COMPANION FLANGE

REMOVE

NOTE: When replacing companion flange, it is important that new flange be properly installed to provide correct pinion bearing preload. The following procedure must be used to ensure correct pinion bearing adjustment:

1. With rear wheels off floor, turn wheels and tap brake backing plates with a soft hammer to ensure that brakes are free.

2. Remove U-bolts which hold rear universal joint to companion flange. Use a heavy rubber band or tape to hold bearings onto journal to prevent loss of bearing rollers when joint is disconnected if tie wire has been removed (Fig. 4A-5).

3. Attach a 1/2" drive adapter and socket to a lb. in. torque wrench. Place socket over drive pinion nut and turn pinion two or three revolutions to ensure free movement. Then take a torque reading while rotating pinion to measure bearing preload (Fig. 4A-6). Record reading.

NOTE: Additional clearance to check preload can be obtained between differential and body by raising body a few inches by means of a jack or stand placed under frame at rear.

4. Hold companion flange with tool J 8614-1 (Fig. 4A-7) and remove drive pinion nut and washer using heavy duty socket.

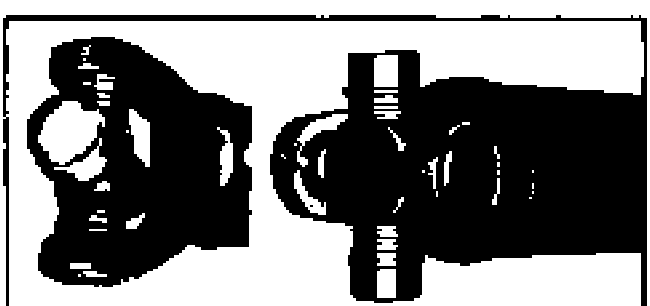


Fig. 4A-5 Bearings Held in Place by Tie Wire

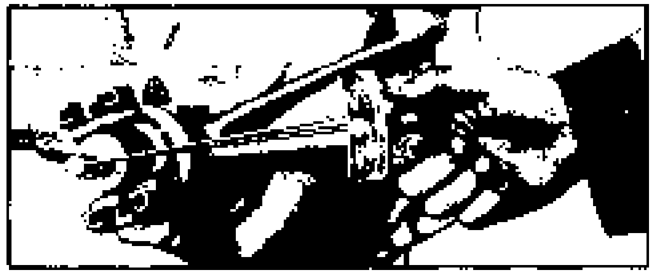


Fig. 4A-6 Checking Pinion Bearing Preload

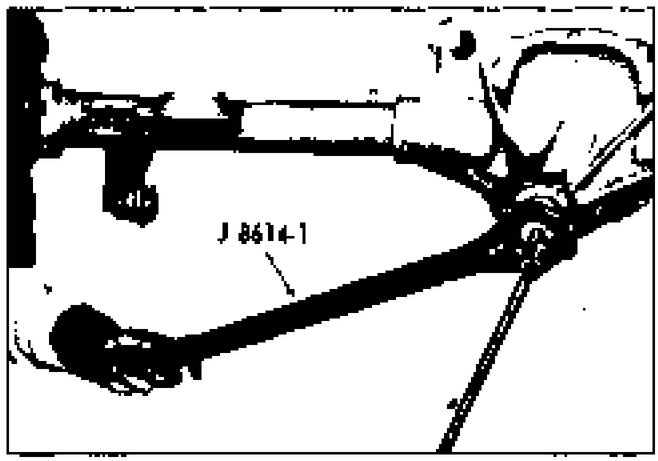


Fig. 4A-7 Removing Drive Pinion Nut

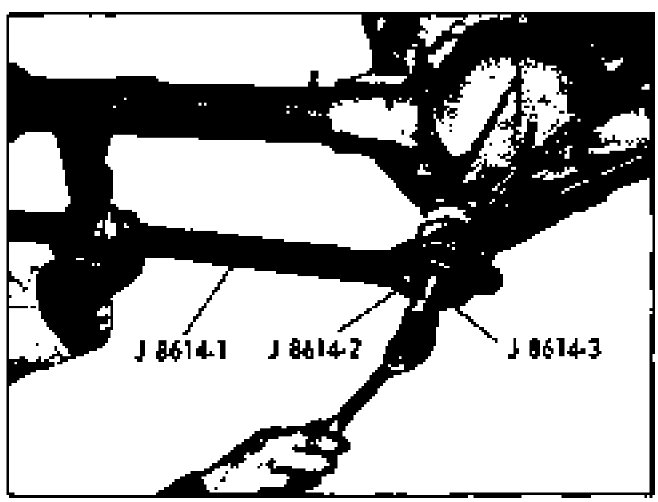


Fig. 4A-8 Removing Companion Flange

5. Remove companion flange, using puller J 8614-2 and 3 (Fig. 4A-8).

REPLACE

1. Replace companion flange and washer and nut. Hold companion flange with tool J 8614-1 and tighten nut only a little at a time, stopping frequently to check preload (step 3). Tighten nut to reading noted in step

3; however, if reading obtained in step 3 was less than 12 lb. in., increase preload to 16 lb. in.

2. Connect universal joints. Install lock plates and tighten U-joint to companion flange U bolt nuts to 12 lb. ft. torque. If lockwashers are used, tighten U-bolts nuts to 14 lb. ft. torque.

PINION BEARING OIL SEAL

REMOVE

NOTE: Check pinion bearing preload before removing companion flange. Proper preload can then be maintained if inspection of the flange after removal shows damage requiring replacement.

1. With rear wheels off floor, turn rear wheels and tap brake backing plates with a soft hammer to ensure that brakes are free.

2. Remove U-bolts which hold rear universal joint to companion flange. Use a heavy rubber band or tape to hold bearings onto journal to prevent loss of bearing rollers when joint is disconnected if tie wire has been removed (Fig. 4A-5).

3. Scribe a line on end of pinion stem, extending down along side of stem threads and onto companion flange nut.

4. Punch a small mark on the line at pinion stem end and at top of lock nut, close to pinion stem threads.

5. Using a lb. in. torque wrench with a 1/2" drive adapter and socket placed over drive pinion nut, turn two or three revolutions to ensure free movement. Then, take a torque reading while rotating pinion to measure bearing preload (Fig. 4A-6). Record reading.

NOTE: Additional clearance to check preload can be obtained between differential and body by raising body a few inches by means of a jack or stand placed under frame at rear.

6. Count the number of exposed threads from top of pinion stem to lock nut. Remove lock nut with a heavy duty socket, while holding companion flange with J 8614-1 (Fig. 4A-7).

7. Remove companion flange, using puller J 8614-2 and 3 (Fig. 4A-8).

8. Remove oil seal by prying it out of carrier with a pointed tool, using care to keep tool away from the exposed front bearing. Discard seal.

CAUTION: Use care to keep dirt and other foreign matter out of exposed front pinion bearing.

REPLACE

1. Lubricate lip of new seal with clean gear lube. Coat outer diameter of seal case with suitable sealer. Install seal by tapping into place, using J 21285-01 (Fig. 4A-9).

2. Before installing companion flange, inspect for nicks, scratches or burred surfaces that may damage the seal. If any such damage is evident, hone carefully or install new flange.

a. If a new companion flange is installed, refer to step 2 under COMPANION FLANGE - REPLACE

b. Inspection shows the original companion flange to be satisfactory, replace by holding companion flange with J 8614-1 and install nut to exactly the same position as before. Make sure punched holes and scribe line are in alignment. Tighten lock nut an additional 1/32" beyond this alignment.

CAUTION: DO NOT exceed the additional tightening of the nut by a distance of more than 1/32" from its original position, as tightening the nut in excess of this amount will disturb the pinion and ring gear tooth contact pattern.

3. Connect rear universal joint. Install lock plates and tighten U-joint to companion flange U-bolt nut to 12 lb. ft. torque. If lockwashers are used, tighten U-bolt nuts to 14 lb. ft. torque.

AXLE SHAFT, AXLE SHAFT BEARING, BEARING OIL SEAL AND/OR WHEEL BOLT-REMOVE

REMOVE AXLE SHAFT ASSEMBLIES

Design allows for axle shaft end play up to .032". This end play can be checked with the wheel and brake drum removed by measuring the difference between the end of the housing and the axle shaft flange while moving the axle shaft in and out by hand.

End play over .032" is excessive. Inserting a shim inboard of the bearing to compensate for the end play

Fig. 4A-9 Installing Pinion Oil Seal

is not recommended. This ignores end play of the bearing itself and may result in improper seating of the gasket or backing plate against the housing. If the end play is excessive, the axle shaft and bearing assembly should be removed and the cause of excessive end play determined and corrected

1. Remove wheels. (Both right and left wheels have right hand threads.)

2. Remove brake drums.

3. Remove nuts holding retainer plates and brake backing plates. Pull retainers clear of bolts and reinstall two lower nuts finger tight to hold brake backing plate in position.

4. Pull out axle shaft assemblies, using puller J 21579 and adapter J 2619-4 with slide hammer J 2619

CAUTION: While pulling axle shaft out through oil seal, support the shaft carefully in center of seal to avoid cutting the seal lip.

AXLE SHAFT BEARING

REMOVE

Press axle shaft bearing and inner retainer off, using plate J 6407-P, J 8916-1-T, F, or G.P and remover J 21858 (Pontiac only) (Fig. 4A-10).

REPLACE

1. Press new axle shaft bearing against shoulder on axle shaft, using plate J 6407-1 and 2 with installer J 6783-P, J 21002-T, F, or G.P. (Fig. 4A-11).

NOTE: DO NOT press bearing and inner retainer on in one operation.

CAUTION: The outer retainer plate, which retains bearing in housing, must be on axle shaft before bearing is installed. A new outer retainer gasket can be installed after bearing. Use care not to wedge outer retainer between bearing and shoulder of shaft.

2. Press new inner retainer ring against bearing, using installer J 6783-P, J 21022-T, F, or G.P. (Fig. 4A-12).

REAR WHEEL BOLT

REMOVE

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.

REPLACE

Install new rear wheel bolt by pressing through axle flange. Check new bolt for looseness; if bolt is loose, axle shaft must be replaced.

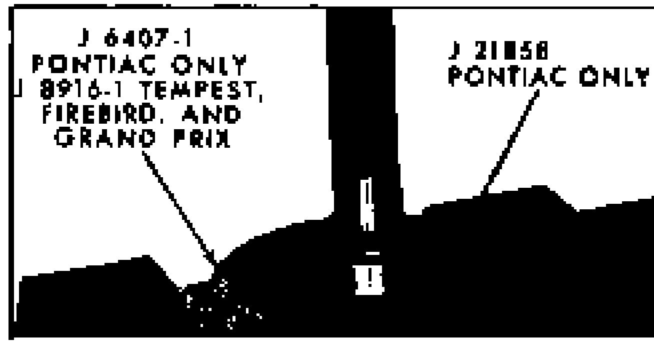


Fig. 4A-10 Removing Axle Shaft Bearing (Typical)

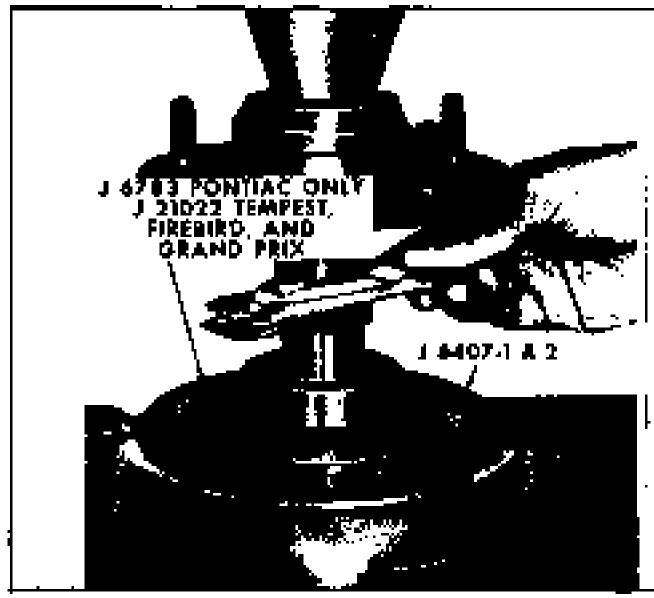


Fig. 4A-11 Installing Axle Shaft Bearing (Typical)

AXLE SHAFT SEAL

REMOVE

1. Insert tongs J 943 (Fig. 4A-13) behind seal and pull straight out to remove seal. Discard seal

2. Apply sealer to O.D. of new seal

REPLACE

Position seal over installer J 21796-P, J 21129-T or F and drive straight into axle housing until tool bottoms on bearing shoulder in housing (Fig 4A-14).

REPLACE AXLE SHAFT ASSEMBLIES

1. Apply a coat of wheel bearing grease in bearing recess of housing. Lightly lubricate axle shaft with axle lubricant, from sealing surface to approximately six inches inboard. This will help prevent damage to lip of wheel bearing seal when installing axle shaft and ensure lubricant on the seal lip during the first few miles of operation.

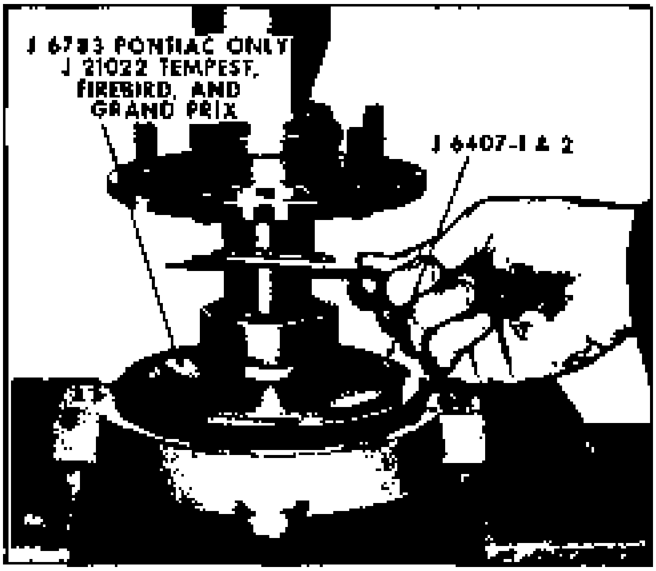


Fig. 4A-12 Installing Inner Retainer (Typical)

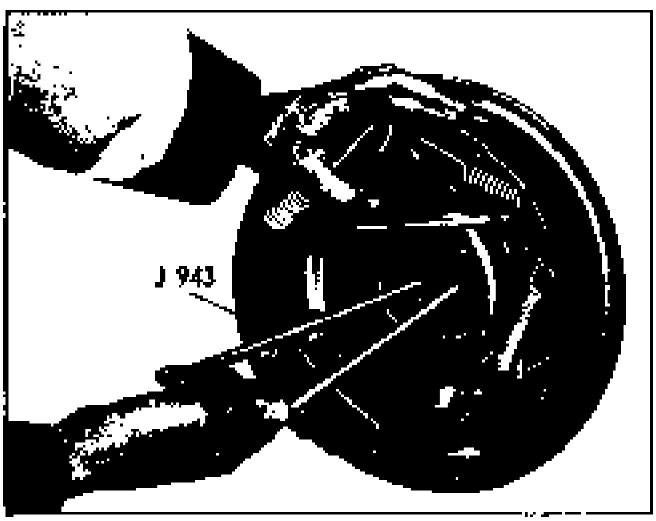


Fig. 4A-13 Removing Axle Shaft Seal

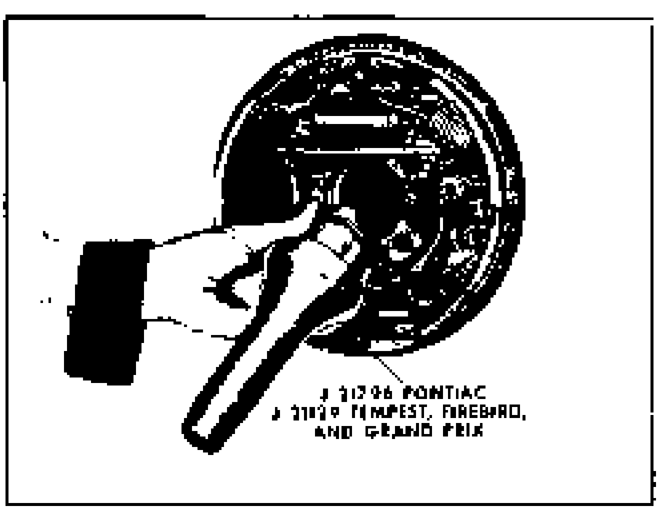


Fig. 4A-14 Installing Axle Shaft Seal (Typical)

IMPORTANT: Install new axle housing to brake backing plate gasket.

2. Install brake assembly to axle housing bolts and place brake backing plate in proper position.

3. With a new outer retainer gasket in proper position, carefully insert axle shaft assembly into housing until splines engage differential.

CAUTION: Do not let shaft drag on oil seal.

4. Drive axle shaft assembly into position with soft faced hammer.

5. Place the new outer retainer gasket (Fig. 4A-3) and retainer over studs and install nuts. Tighten nuts to 35 lb. ft. torque.

6. Install brake drums over wheel bolts.

7. Install wheels and tighten wheel nuts to 80 lb. ft. torque (Pontiac) or 65 lb. ft. torque (Tempest, Firebird and Grand Prix)

MAJOR REPAIRS

REAR AXLE ASSEMBLY

It is not necessary to remove the rear axle assembly for any normal repairs. However, if the housing is damaged, the rear axle assembly may be removed and installed using the following procedure:

REMOVE

1.Raise rear of car high enough to permit working underneath. Place a floor jack under center of axle housing so it just starts to raise rear axle assembly. Place car stands solidly under frame members on both sides.

2. Disconnect rear universal joint from companion flange by removing two U-bolts. Use a heavy rubber band or tape to hold bearings onto journal, to prevent loss of bearing rollers when joint is disconnected if tie wire has been removed (Fig. 4A-5). Support propeller shaft out of the way.

3. Remove both axle shafts.

4. Support both brake backing plates out of the way.

5. Disconnect rear brake hose bracket by removing top cover bolt. Remove brake line from housing by bending back tabs.

6. Loosen remaining cover bolts, break loose cover about 1/8" and allow lubricant to drain.

7. Disconnect shock absorbers at axle housing.

8. Pontiac, Tempest and Grand Prix - Lower jack under axle housing until rear springs can be removed.

Firebird - Disconnect rear spring from its shackles and brackets and remove rear axle assembly from under car.

9. Pontiac, Tempest and Grand Prix - Disconnect upper control arms at axle housing.

10. Pontiac, Tempest and Grand Prix - Disconnect lower control arms at axle housing and remove rear axle assembly from under car.

REPLACE

1. Rest car solidly on stands placed under frame side members, with rear end of car high enough to permit working underneath. Position axle assembly under car.

2. Pontiac, Tempest and Grand Prix - Connect lower control arms to axle housing but do not torque.

Firebird - Connect leaf spring front eyes to their frame brackets but do not torque.

3. Pontiac, Tempest and Grand Prix - Connect upper control arms to axle housing but do not torque.

Firebird - Connect leaf spring rear eyes to their shackles but do not torque.

4. Pontiac, Tempest and Grand Prix - Place rear springs in position and jack axle housing upward until shock absorbers will reach.

Firebird - Jack axle housing upward until shock absorbers will reach.

5. Connect shock absorbers and tighten nuts to 65 lb. ft.

6. Pontiac, Tempest and Grand Prix - Tighten upper and lower control arm bolts to 110 lb. ft. or nuts to 80 lb. ft.

Firebird - Tighten bracket bolt nuts to 100 lb. ft. and shackle pin nuts to 50 lb. ft.

NOTE: Upper and lower control arms (Pontiac, Tempest and Grand Prix), leaf springs (Firebird) and lower shock absorber nuts must be torqued at curb position.

7. Install new axle housing to brake backing plate and outer retainer gaskets, then place backing plates in proper position and install axle shafts and wheels.

8. Connect rear universal joint to companion flange. Install lock plates and nuts. Tighten nuts evenly to 12 lb. ft. torque. If lockwashers are used, tighten U-bolt nuts to 14 lb. ft. torque.

CAUTION: U-bolt nuts must be torqued as specified, as over-tightening will distort bearings and cause early failure.

9. Connect rear brake hose to top of housing and bend tabs over brake lines on housing.

10. Fill rear axle with specified gear lubricant.

11. Bleed rear brakes as outlined in Section 5.

PRE-REPAIR INVESTIGATION

A close examination of the differential prior to disassembly will often reveal valuable information as to the extent and type of repairs or adjustments necessary. The information thus gained, coupled with the report of malfunctioning, will provide a basis for determining the degree of disassembly required. Since the frequent causes of axle noise are improper backlash or side bearing preload, or both, a few simple adjustments may be all that is necessary to correct a problem.

Therefore, before removing the differential from the housing, the following checks should be made, with the results recorded and analyzed.

A. Backlash

B. Pinion Bearing Preload

C. Red Lead Test

Use care at all times to keep dirt and other foreign matter, such as grinder dust, soot or sand away from differential to prevent possibility of subsequent failure.

GEAR TOOTH NOMENCLATURE

The side of the ring gear tooth which curves outward, or is convex, is referred to as the drive side. The concave side is the coast side. The end of the tooth nearest center of ring gear is referred to as the toe end. The end of the tooth farthest away from center is the heel end. Toe end of tooth is smaller than heel end. It is very important that tooth contact be tested before the differential carrier assembly is disassembled and before it is installed. Allowable variations in the carrier or pinion rear bearing may cause the pinion to be too far away from, or close to, the ring gear. Thus, the tooth contact must be tested and corrected, if necessary, or the gears may be noisy.

RED LEAD TEST

1. Mix a small amount of powdered red lead (available from paint manufacturers and suppliers) with a drop of engine oil 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.

2. Tighten bearing cap bolts to 70 lb. ft. torque, tapping heads of bolt intermittently while tightening, to ensure proper seating of caps and sufficient tightness.

3. Insert crank (Fig. 4A-15) in companion flange and, pinion head and inner race of rear bearing. The shim pack is used in the differential to compensate for manufacturing tolerances. Increasing shim pack thick-

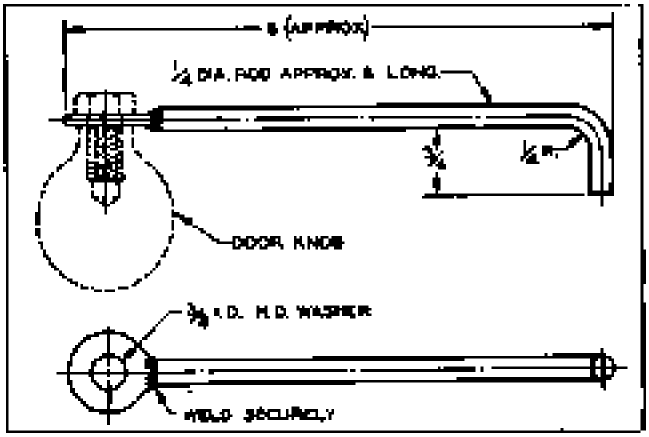


Fig. 4A-15 Differential Cranking Tool

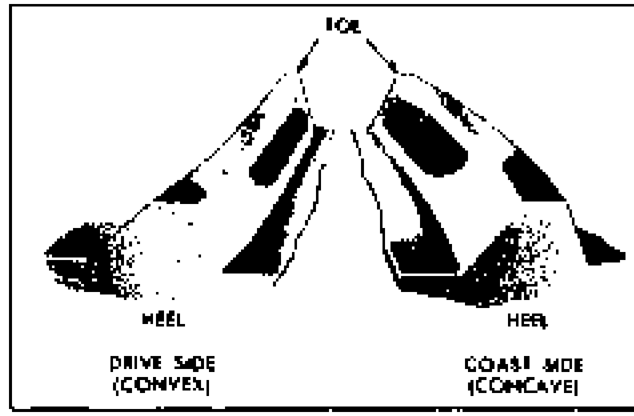


Fig. 4A-16 Desired Tooth Contact Under Light Load

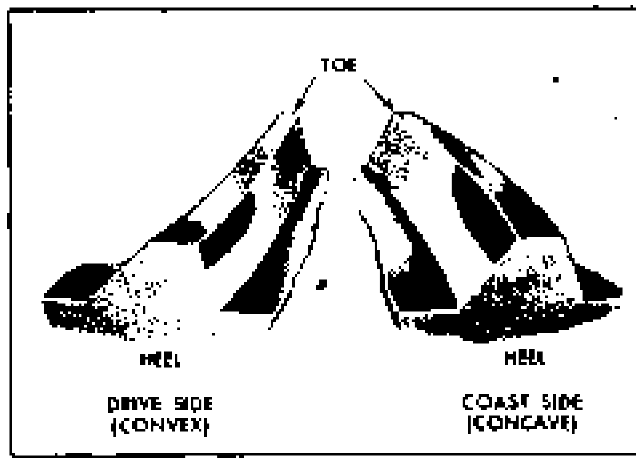


Fig. 4A-17 Tooth Pattern - Excessive Backlash

while turning, apply pressure to back side of ring gear by hand (a leather glove can be used). A test made without loading the gears will not give a satisfactory pattern. Turn companion flange so that ring gear rotates one full revolution, then reverse rotation so that ring gear rotates one revolution in opposite direction. Excessive turning of ring gear may indicate good tooth pattern because one or two teeth are making proper contact.

NOTE: The crank in Fig. 4A-15 may be easily made as follows: a. Weld a 3/8" heavy duty flat washer to a piece of 1/4" diameter rod, approximately 8" long, and form as shown. b. Tap door knob for 3/8" bolt and attach knob to crank as shown. Leave bolt loose enough to permit knob to turn

4. Closely inspect tooth pattern on ring gear to determine whether pressure lines are apparent.

NOTE: If observation reveals pressure lines are present (dark narrow band at edge of pattern), examine for pressure line position on drive and coast sides of ring gear. If lines on drive side are too deep and those on coast side are too high (near heel and toe respectively), additional shims to bring pinion gear out (providing a more centrally located tooth pattern on ring gear) will result in a noisy tooth contact. This occurs because the pressure line has been moved deeper into the tooth on the drive side and farther out on the coast side. It does not follow that the ring gear and pinion are not good or should be destroyed. It only means they will not operate quietly in the carrier in which they are presently installed. These same parts may operate quietly in another carrier when tooth pattern is checked.

Removing backlash moves ring gear into pinion gear, driving the pinion deeper into the ring gear. Whenever pressure lines are noted, as explained above, install another ring gear and pinion set.

5. Observe pattern on ring gear teeth and compare with Fig. 4A-16

EFFECTS OF INCREASING LOAD ON TOOTH CONTACT PATTERN

When "load" on ring and pinion gear is increased, such as when car is accelerated from standstill or from normal drive, the tooth contact will tend to spread out and under very heavy load will extend from near toe to near heel. The entire contact also tends to shift toward heel under increasingly heavier loads and will become somewhat broader with respect to tops and bottoms of teeth. The patterns obtained by red lead tests, dependent upon degree of "loading", approximate a normal light load. For this reason, they will extend only about halfway (Fig. 4A-16). The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will effect tooth contact pattern: backlash and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on (hand loaded) red lead tests:

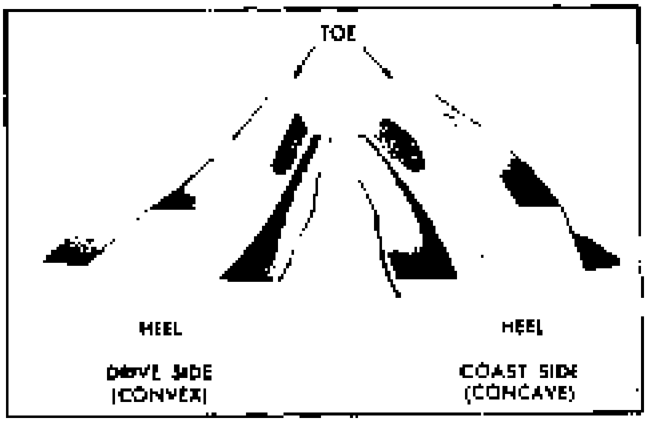


Fig. 4A-18 Tooth Pattern - Insufficient Backlash

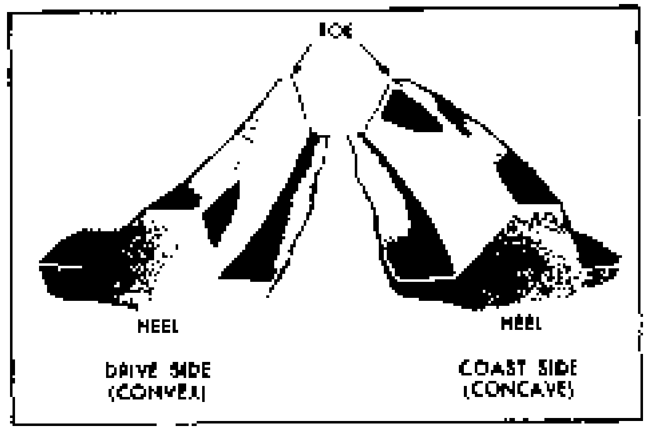


Fig. 4A-19 Tooth Pattern - Pinion Too Far Away From Ring Gear (Shim Thickness Insufficient)

however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

Backlash is adjusted by means of the side bearing adjusting shims which move the entire case and ring gear assembly closer to, or farther from, the drive pinion. (The adjusting shims are also used to set side bearing preload.)

The position of the drive pinion is adjusted by increasing or decreasing the shim pack between the ness will move the pinion closer to centerline of the ring gear; decreasing shim pack thickness will move pinion farther away from centerline of the ring gear

EFFECTS OF BACKLASH ON TOOTH PATTERN

The terms "excessive" and "insufficient" refer to settings which are greater than .009" or less than .005" as specified. With respect to tooth contact patterns, "excessive" refers to backlash which, although less than .009", is more than necessary to provide the desired pattern. Similarly, "insufficient" refers to backlash which, although .005" or more, is less than necessary to provide the desired pattern.

Provided the pinion is properly positioned, excess backlash will give a high heel pattern on both drive and coast sides (Fig. 4A-17). Decreasing backlash by moving the case and ring gear assembly closer to the pinion will cause the pattern to move toward the toe end and down toward center of the tooth on both drive and coast sides.

Insufficient backlash, provided the pinion is properly positioned, will give a low toe pattern on both drive and coast sides (Fig. 4A-18). Increasing backlash will cause the pattern to move toward the heel end and up toward top of the tooth on both drive and coast sides.

EFFECTS OF PINION POSITION ON TOOTH PATTERN

When the drive pinion is too far away from centerline of the ring gear, the pattern will be a high heel contact

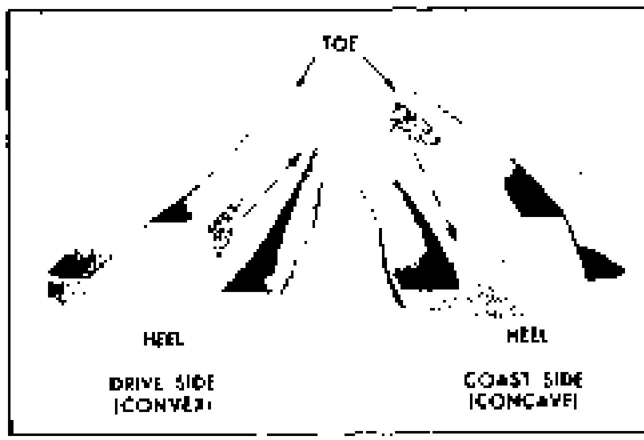


Fig. 4A-20 Effect on Pattern - As Shim Thickness is Increased

on drive side and a high toe contact on coast side (Fig. 4A-19), provided backlash is within specifications of .005" to .009". Moving the pinion closer to center line of the ring gear by increasing shim pack thickness will cause the high heel contact on drive side to lower and move toward the toe; the high toe contact on coast side will lower and move toward the heel (Fig. 4A-20).

When the pinion is too close to the ring gear, the pattern will be a low toe contact on drive side and a low heel contact on coast (Fig. 4A-21), provided backlash is within specifications of .005" to .009". Moving the pinion farther away from the ring gear by decreasing shim pack thickness will cause low toe contact on drive side to raise and move toward the heel; low heel contact on coast will raise and move toward the toe (Fig. 4A-22).

OVERHAUL DIFFERENTIAL

DIFFERENTIAL CASE

REMOVE

NOTE: Before removing case from housing, be sure the

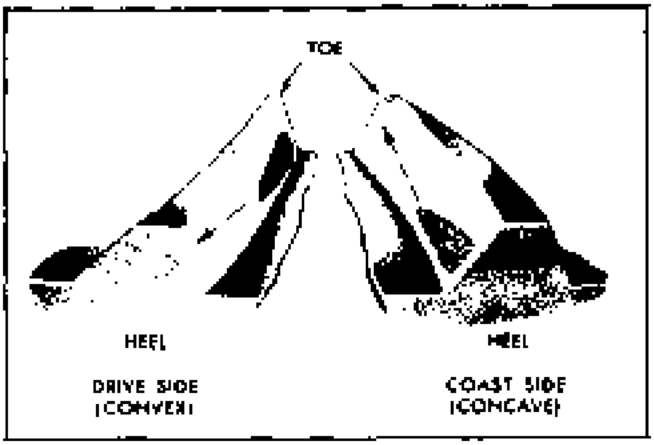


Fig. 4A-21 Tooth Pattern - Pinion Too Close to Ring Gear (Shim Thickness Excessive)

checks under pre-repair investigation have been completed.

1. With rear wheels off floor, rotate rear wheels and tap brake backing plates with a soft hammer to ensure that brakes are free.

2. Remove both axle shafts.

3. Remove U-bolts which hold rear universal joint to companion flange. Use a heavy rubber band or tape to hold bearings onto journal to prevent loss of bearing rollers when joint is disconnected if tie wire has been removed (Fig. 4A-5).

4. Thoroughly clean differential housing cover and surrounding area of axle housing to avoid dirt entering housing or falling on the gears.

5. Drain oil by loosening all cover attaching bolts and then break loose cover about 1/8".

6. Allow oil to drain thoroughly, then remove attaching bolts and cover from housing.

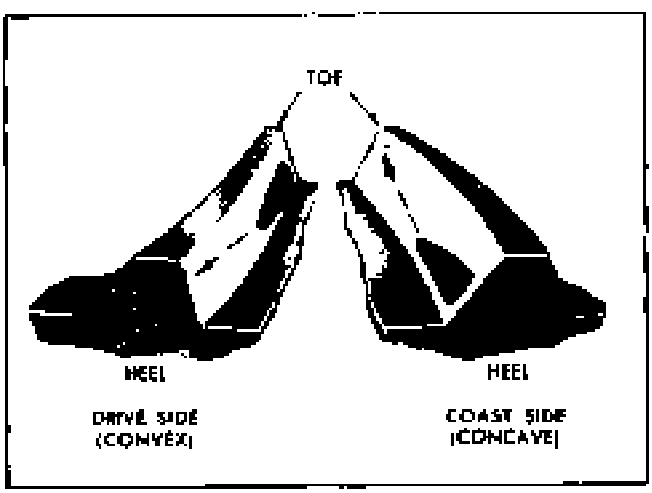


Fig. 4A-22 Effect on Pattern - As Shim Decreased

7. Remove the four bearing cap bolts and reinstall bearing caps, using four (7/16"-14 x 4 1/2") bolts finger tight as a safety precaution.

NOTE: Bearing caps are not marked for identification. Use daub of paint to identify, as the caps are not interchangeable.

8. Pontiac-Remove two ring gear to case assembly bolts. Install ring gear and case remover J21322, left hand bolt and sleeve set J 22042 and slide hammer J 2619 (Fig. 4A-23).

NOTE: Ring gear to case bolts have left hand threads.

Tempest, Firebird and Grand Prix - Remove two ring gear to case bolts. Install ring gear and case remover J 21322 and slide hammer J 2619 (Fig 4A-23)

NOTE: Attach remover J 21322 to case and ring gear by using two 3/8"-24 x 1 5/8" bolts.

9. Loosen case from housing with slide hammer until it falls free. Safety bolts installed in step 7 will catch assembly.

10. Support case assembly in one hand and remove safety bolts. CAREFULLY remove case so as not to let bearing races or shims fall from housing.

NOTE: Place right and left bearing outer race and shim in sets with marked bearing caps. Measure thickness of each shim and record.

DISASSEMBLE

1. All models except where noted before disassembling differential case, inspect differential side bearings for visible damage of rollers and outer races.

2. Place one outer race onto its matching inner race and roller assembly and turn slowly, applying hand load.

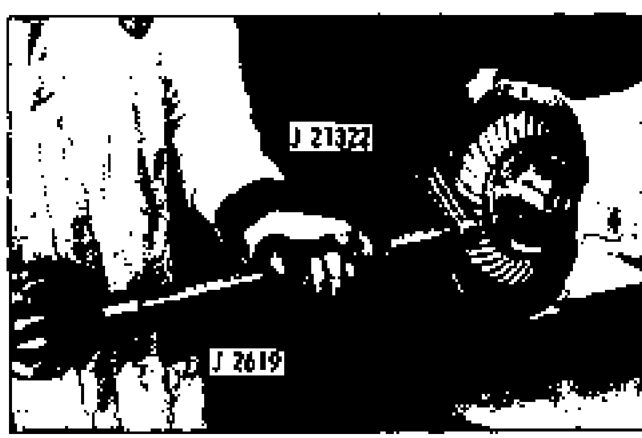


Fig. 4A-23 Removing Differential Case

3. If bearing outer race turns smoothly and no visible damage is found, bearing can probably be reused

4. Repeat above operation with other outer race and matching bearing.

NOTE: Both side bearings and their outer races are matched parts. If either bearing is to be replaced, its matching outer race must also be replaced.

5. Inspect fit of inner races on case hubs by prying against shoulders at puller recesses. Bearing inner races must be tight on case hubs

NOTE: If either bearing is loose on case, the entire case must be replaced.

6. If bearing inspection indicates that bearings should be replaced, insert differential case in vise and remove side bearing, using side bearing puller J 8107 and adapter J 8107-4-P, J 8107-2-T, F, or G.P. or a suitable puller (Fig. 4A-24).

7. Turn differential case in vise and remove other side bearing in same manner

8. All except Grand Prix medium duty - remove pinion shaft locking bolt and washer.

9. All except Grand Prix medium duty - drive pinion shaft out of case, using brass drift (Fig. 4A-26).

10. All except Grand Prix medium duty - remove differential pinion gears, thrust washers and side gears. Place them in sets so they may be reinstalled in their original position.

11. If ring gear is to be removed, clamp case in vise so jaws are 90° to pinion shaft holes. Remove twelve ring gear retaining bolts for Pontiac; ten retainer bolts for Tempest, Firebird, or Grand Prix.

NOTE: Ring gear to case bolts have left hand threads, Pontiac only

12. Partially reinstall two bolts on opposite sides of ring gear.

13. Remove ring gear from case by alternately tapping on bolts.

CAUTION: Do not pry between case and ring gear

14. Grand Prix medium duty - scribe mark or paint differential case halves (Fig. 4A-25) to aid in alignment of case when assembling.

15. Grand Prix medium duty - remove differential case attaching bolts and lift flange half of case from cap half. Remove side gear and thrust washer and keep these parts with flange half of case assembly.

16. Grand Prix medium duty - remove corresponding parts from cap half and keep them with cap half of case assembly.

CLEAN AND INSPECT

1. Thoroughly clean differential case and inspect, paying particular attention to ring gear mounting flange, ring gear pilot, side bearing hubs, thrust washer surfaces, pinion shaft bore and side gear hub bores.

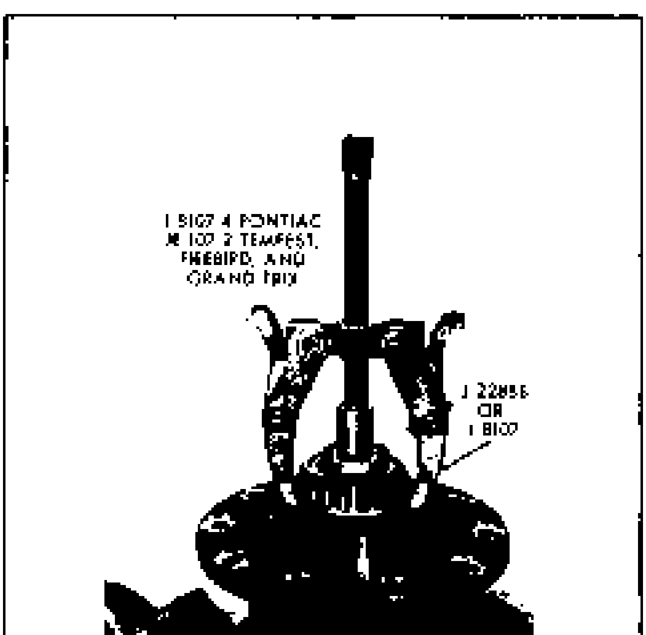


Fig. 4A-24 Removing Differential Side Bearing

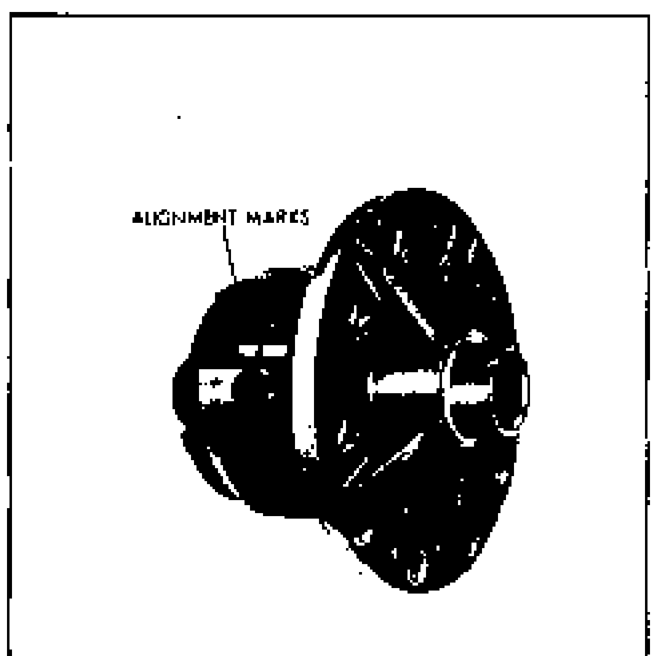


Fig. 4A-25 Alignment Marks - Grand Prix Medium Duty

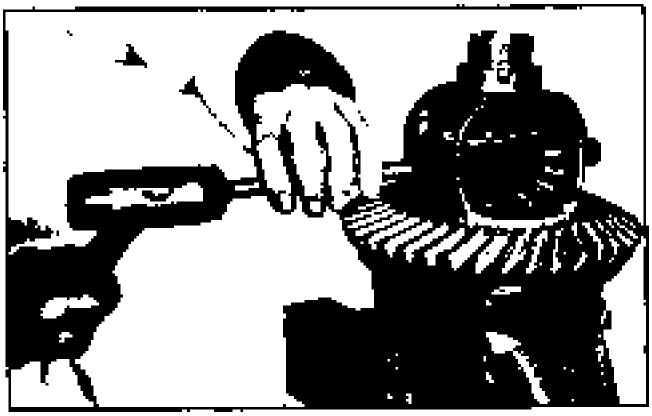


Fig. 4A-26 Removing Pinion Shaft

2. Remove nicks and burrs with mill file.

NOTE: When using a new case, thoroughly clean new case in suitable solvent, making certain all holes and bores are clean of steel filings and foreign material.

3. Clean side gears, pinion gears, pinion shaft and thrust washers with suitable solvent. Inspect for excessive wear.

4. Thoroughly clean ring gear and inspect back side for any adhering material which may cause runout.

5. Position ring gear on case and check fit of gear on flange and pilot. It should be from .002" tight to .001" loose. If ring gear easily falls into position, it must be replaced.

NOTE: If ring gear is replaced, pinion gear must also be replaced as they are only serviced in matched sets.

6. Replace parts as necessary and coat with clean gear lube before installing in case.

ASSEMBLE

ALL EXCEPT GRAND PRIX MEDIUM DUTY

1. After making sure that mating surfaces are clean and free of burrs, position ring gear on case so holes are in line.

2. Lubricate attaching bolts with clean engine oil and install.

3. Pull ring gear onto case by alternately tightening bolts around case. When all bolts are snug, tighten bolts evenly and alternately across diameter to 90 lb. ft. torque for Pontiac; 60 lb. ft. torque for Tempest, Firebird, or Grand Prix.

CAUTION: Do not use hammer to force ring gear on case.

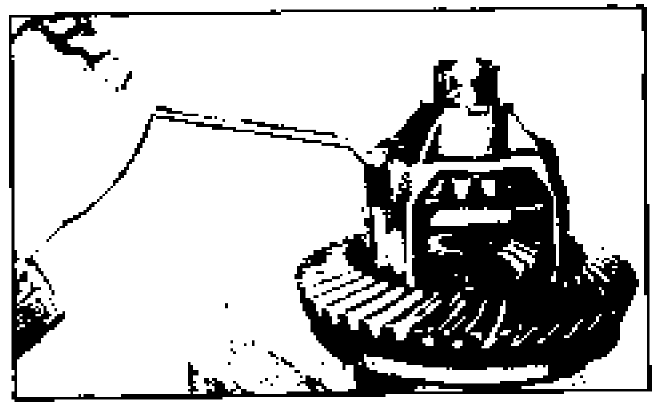


Fig. 4A-27 Installing pinion Shaft Locking Bolt

4. Place side gear thrust washers over side gear hubs and install side gears in case. Replace any reused parts in original sides.

5. Position one pinion (without washer) between side gears and rotate gears until pinion is directly opposite from loading opening in case. Place other pinion between side gears so that pinion shaft holes are in line, then rotate gears to make sure holes in pinions will line up with holes in case.

6. When holes line up, rotate pinions back toward loading opening just enough to permit sliding in pinion thrust washers.

7. Install pinion shaft and pinion shaft locking bolt. Torque to 15 lb. ft. (Fig. 4A-27).

GRAND PRIX MEDIUM DUTY

1. Clamp cap half of case in vise and install proper side gear and thrust washer (Fig. 4A-28) in cap half.

2. Assemble the four pinions and the four thrust washers onto the pinion cross shaft and place in position in the cap half of the differential case (Fig. 4A-29).

3. Install second side gear and thrust washer, face down so that side gear will mesh with pinion gears.

4. Install flange half of differential case, in proper position to match alignment marks.

5. Insert case bolts and tighten to 30 lb. ft. (Fig. 4A-30).

6. After making sure that mating surfaces are clean and free from burrs, position ring gear on case so that holes are in line.

7. Lubricate attaching bolts with clean engine oil and install.

8. Pull ring gear onto case by alternately tightening bolts around case. When all bolts are snug, tighten

bolts evenly and alternately across diameter to 60 lb. ft.

INSTALL DIFFERENTIAL CASE SIDE BEARINGS

1. Remove differential case from vise and lubricate outer bearing surfaces.

2. Using installer J 5292-P, J 21028-T, F, or G.P. press on right side bearing with arbor press. Support opposite bearing with J 8901-P, J 8980-T, F, or G.P. if already installed (Fig. 4A-31).

3). Reverse differential case, support previously installed side bearing with J 8901-P, J 8980-T, F, or G.P. and press on other side bearing, using J 5292 for Pontiac, J 21028 for Tempest, Firebird, or Grand Prix (Fig. 4A-32).

REMOVE PINION ASSEMBLY

1. Check pinion bearing preload. If there is no preload reading, check for looseness of pinion assembly by shaking. Looseness indicates need for bearing replacement. If assembly is run with loose bearings for any extended period, ring gear and pinion will also need to be replaced.

2. Install holder J 8614-1 on pinion flange by using two 5/16" bolts with flat washers. Remove pinion nut and washer (Fig. 4A-33).

3. Pull companion flange from pinion, using puller J 8614-2 and 3 in holder J 8614-1. To install puller, back out puller screw, insert puller through holder and rotate 1/8 turn (Fig. 4A-34).

4. Remove pinion assembly. If necessary, tap pinion out with soft hammer, being careful to guide pinion with hand to avoid damage to bearing outer races.

DISASSEMBLE PINION ASSEMBLY

NOTE: Both front bearing and outer race, and rear bearing and outer race, are matched parts. If either bearing is to be replaced, its matching outer race must also be replaced.

1. If replacing rear pinion bearing or changing pinion depth setting, remove rear pinion bearing from pinion shaft, using remover J 9746-P, J 21493-T, F, or G.P. with holder J 6407-1 (Fig. 4A-35).

2. If replacing rear pinion bearing, drive outer race from carrier, using a drift.

3. Pry pinion oil seal from carrier and remove front pinion bearing. If replacing this bearing, drive its outer race from carrier, using a drift.

CLEANING AND INSPECTION

1. Check drive pinion stem and gear for excessive wear.

NOTE: Ring gears and pinions are matched at the factory and are serviced only in sets. Never attempt to replace either a ring gear or pinion without its matching member.

2. Thoroughly clean and inspect carrier for cracks or other damage.

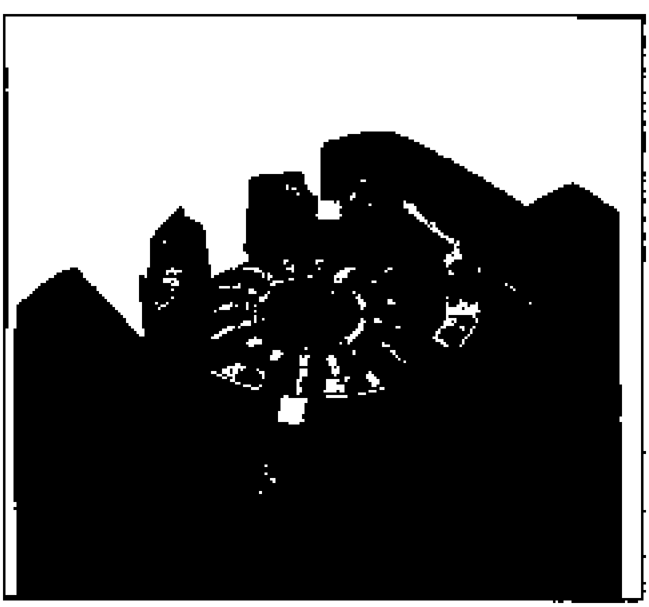


Fig. 4A-28 Side Gear Installed in Cap Half of Case - Grand Prix Medium Duty

Fig. 4A-29 Pinion Gears Installed in Cap Half of Case - Grand Prix Medium Duty

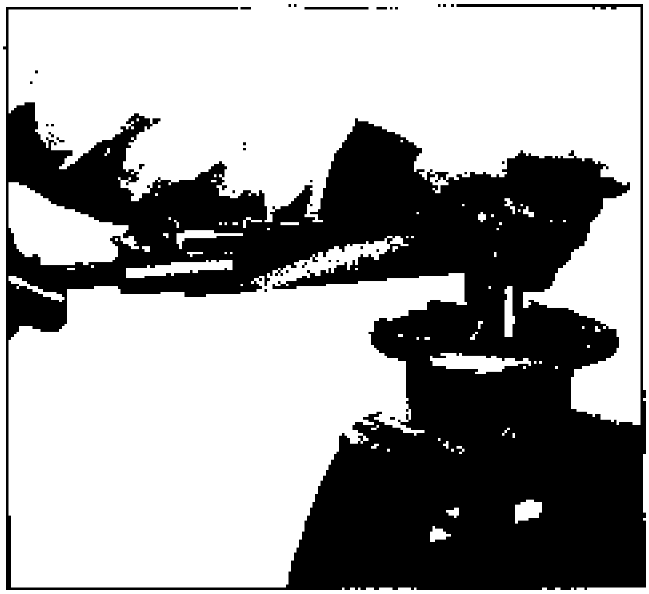


Fig. 4A-30 Torquing Case Half Bolts - Grand Prix Medium Duty

3. Be sure oil passage in carrier is clean and clear.

4. Inspect bearing cap and bolt threads in carrier. Clean out metal filings and chips.

5. Carefully inspect pinion bore and shoulders against which pinion bearing outer races seat. They must be free of burrs, nicks or material which would prevent proper seating of bearing outer races.

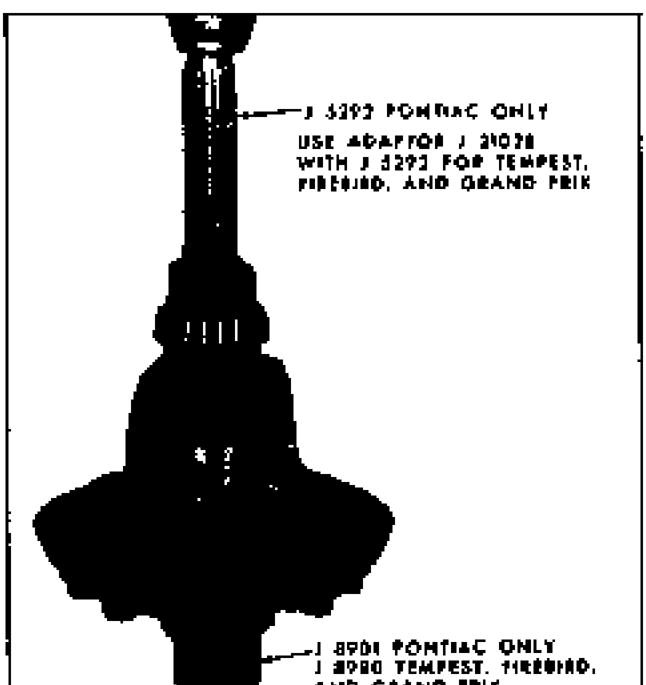


Fig. 4A-31 Installing Right Differential Side Bearing

NOTE: If axle housing (carrier and tube assembly) is being replaced, thoroughly clean and inspect new housing, paying particular attention to machined surfaces in bearing caps and carrier. Be sure all metal filings and foreign material are removed from the bearing cap bolt holes in the carrier. Be sure bearing caps seat squarely on carrier. Use mill file lightly to remove nicks and burrs.

REPLACE PINION BEARING OUTER RACES

1. If replacing rear pinion bearing, install new outer race by using installer J 9745-P, J 6197-T, F, or G.P. with driver handle J 8092 (Fig. 4A-36).

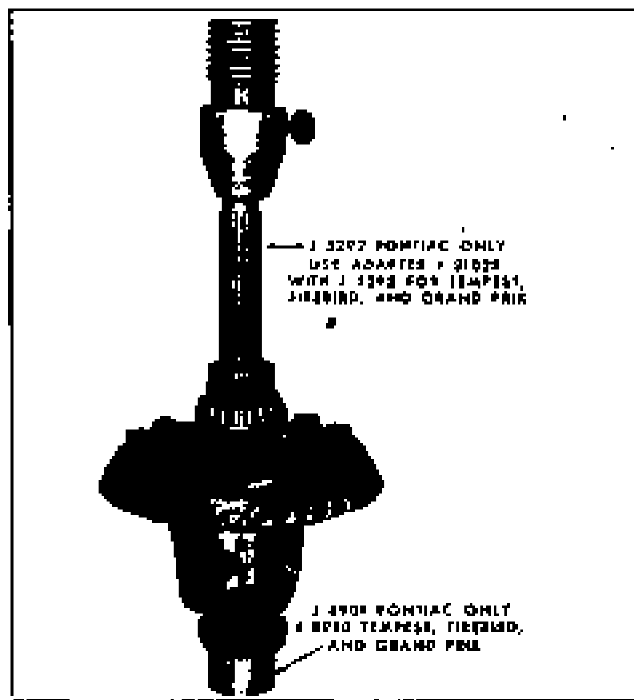


Fig. 4A-32 Installing Left Differential Side Bearing

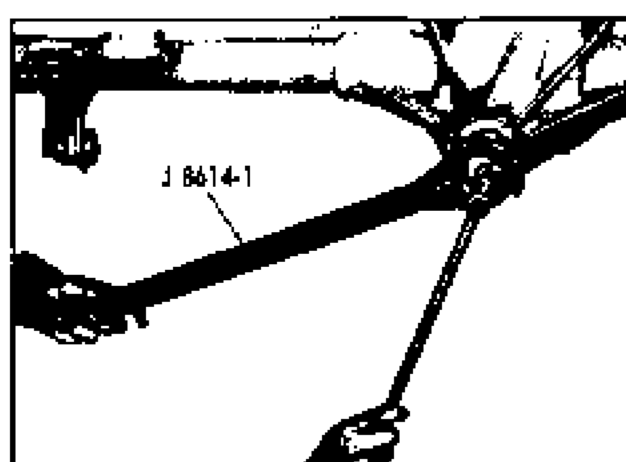


Fig. 4A-33 Removing Pinion Nut

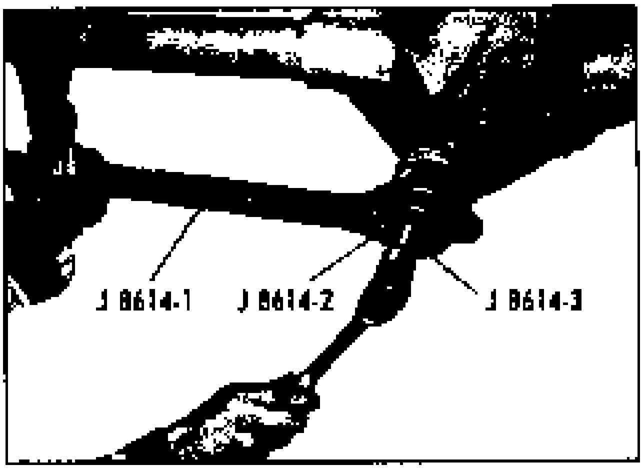


Fig. 4A-34 Removing Companion Flange

2. If replacing front pinion bearing, install new outer race by using installer J 8611-01-P, J 7817-T, F, or G.P. with driver handle J 8092 (Fig. 4A-37).

SETTING PINION DEPTH

The pinion bearing shim thickness (pinion depth) must be determined:

a. whenever a new housing (carrier and tube assembly) is to be used,

and/or b. new bearings and races are installed.

or c. the pre-repair investigation indicates the drive pinion bearing shim should be changed.

Ring and pinion gear sets are matched in a special test machine. All production pinions are marked on face of pinion gear in thousandths of an inch if they vary from a "nominal" setting. When a pinion is marked "+" (plus), it means that the pinion is located too far away from the centerline of the ring gear. Shims must be added to move the pinion closer to the ring gear and position the pinion at the nominal setting. When a pinion is marked "-" (minus), it means the pinion shims must be removed to move the pinion away from the ring gear and position the pinion at the nominal setting. All pinions produced for service are "nominal" or "zero" pinions and are unmarked.

Pinion depth is set with pinion depth setting gauge J 21777 which consists of the following: one J 21777-1 cross shaft assembly, two J 21777-3 discs (Pontiac), one J 21777-2 "A" & "B" gauge plate, one J8619-12 pilot, one J 21777-8 washer (Pontiac only) and one J 8619-13 bolt and nut. A J 8001 dial indicator must also be used with the cross shaft. The pinion depth setting gauge provides in effect a "nominal" or "zero" pinion as a gauging reference.

1. Make certain all gauge parts are clean. Check particularly the discs, gauge pin ends, dial indicator tip and gauge plate surface.

2. Lubricate front and rear pinion bearings and position them in their respective races in carrier. Bearings used with gauge must be those to be installed in car, in order to ensure accurate reading.

3. Pontiac - Thread J 21777-8 washer onto J 8619-13 bolt to end of thread. Thread J 8619-13 bolt into J 21777-2 gauge plate, so plate rests against J 21777-8 washer. Insert assembled gauge plate and bolt through front and rear bearings with underside of plate against J 21777-8 washer (Fig. 4A-38). Slip J 8619-12 pilot over bolt end, with underside against front bearing. Tighten nut finger tight while rotating gauge plate to

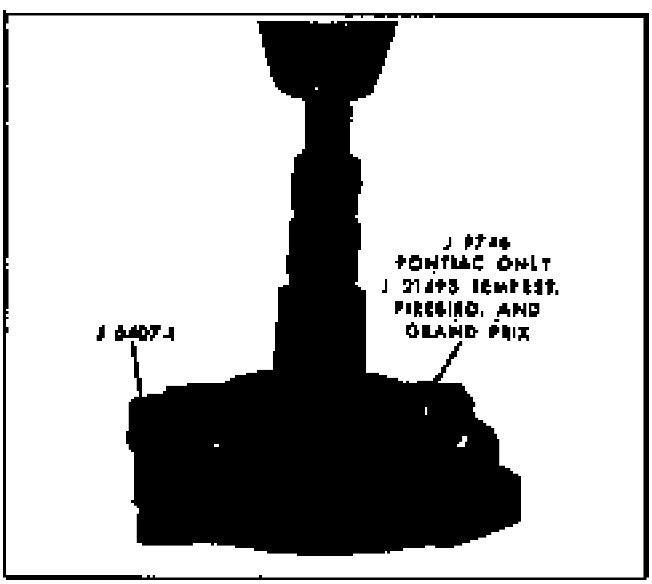


Fig. 4A-35 Removing Rear Pinion Bearing

Fig. 4A-36 Installing Rear Pinion Bearing Outer Race

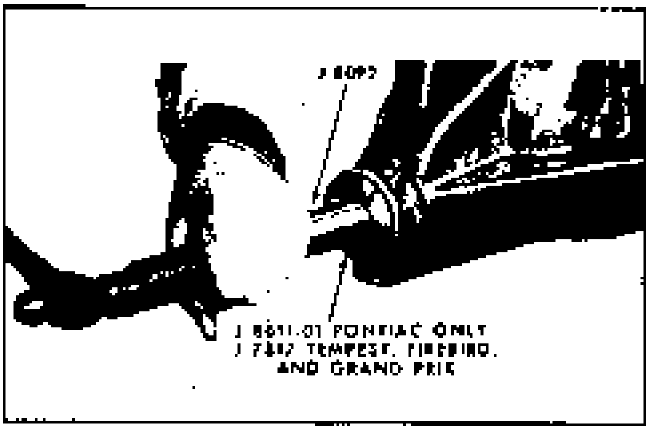


Fig. 4A-37 Installing Front Pinion Bearing Outer Race

ensure proper seating. Check to be sure gauge plate is centered over bearing (Fig. 4A-39), then torque nut to obtain a bearing preload reading of 20 in. lbs. (obtained with gauge plate assembly rotation). It may be necessary to hold stud stationary with a wrench on flats at end of stud.

Tempest, Firebird, or Grand Prix - Thread nut on J 8619-13 bolt to end of thread. Thread J 8619-13 bolt into J 21777-2 gauge plate so plate rests against nut. Insert assembled gauge plate and bolt into carrier through front and rear bearings with underside of plate against rear bearing (Fig. 4A-38). Slip J 8619-12 pilot over bolt end with underside against front bearing. Tighten another nut fingertight while rotating gauge plate to ensure proper seating. Check to be sure gauge plate is centered over bearing (Fig. 4A-39), then torque nut to obtain a bearing preload reading of 20 in. lbs. (obtained with gauge plate assembly rotating). It may be necessary to hold stud stationary with a wrench on flats at end of stud.

4. Install a stem on the J 8001 dial indicator and mount loosely on cross shaft. Position stem of indicator on head of gauge pin so that stem is slightly depressed (causing a low indicator reading). Tighten thumb screw on indicator and set at zero

5. Make certain bearing support bores are free of burrs and dirt. Place discs J 21777-3-P, J 8619-10-T, F, or G.P. cross shaft assembly. Position assembly in the carrier with the discs resting on the bearing support bores and gauge pin facing in toward guage plate. Rotate discs to insure firm seating.

6. Position gauge plate so that, as cross shaft is rotated (pressing firmly), the arc of the spherical end of gauge pin scribes across the "B"-P, "A"-T, F, or G.P. surface of the gauge plate (Fig. 4A-40).

7. Record maximum reading of dial indicator throughout arc. When indicator scale is less than .100", be sure to note if indicator completes more than one revolution.

8. Subtract recorded reading from .100". This figure will be used to select correct shim in step 10.

NOTE: The pinion depth setting tool is designed so that a perfect dial indicator reading of .100" would require no shim. This is why the reading obtained must be subtracted from .100".

9. Examine ring gear and pinion for nicks, burrs or scoring. Any of these conditions will require replacement of gear set.

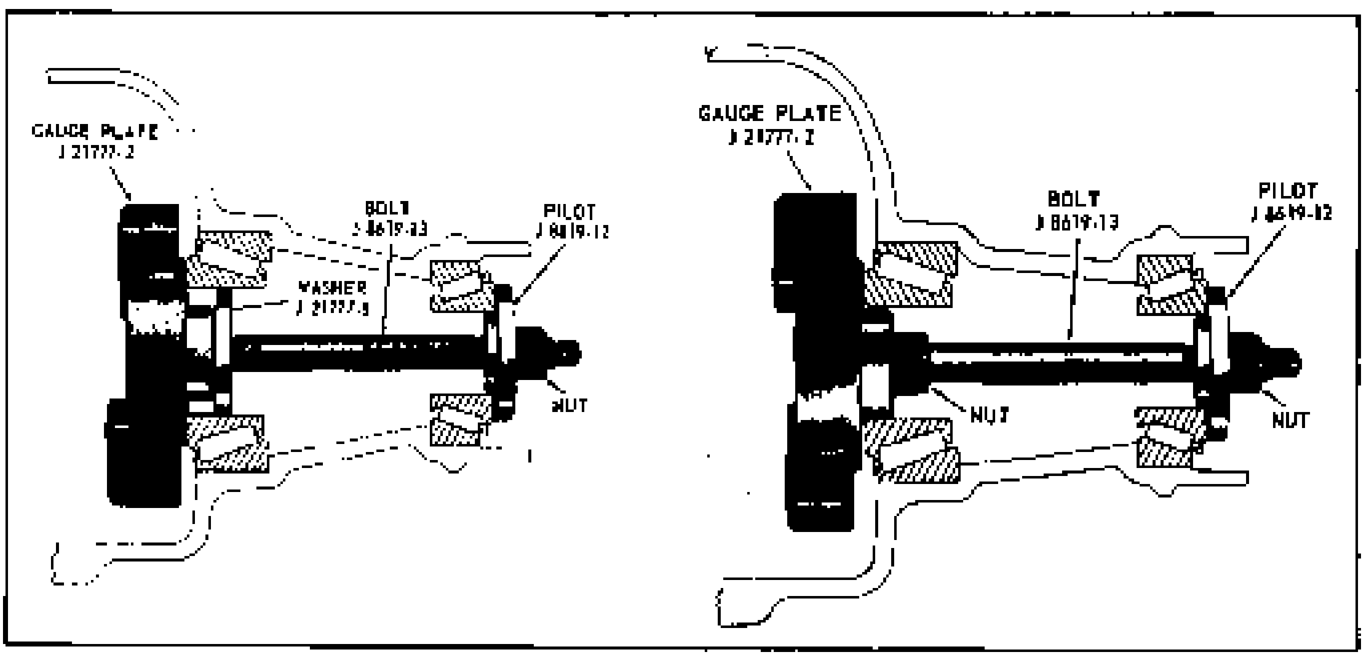


Fig. 4A-38 Securing Gauge Plate in Carrier

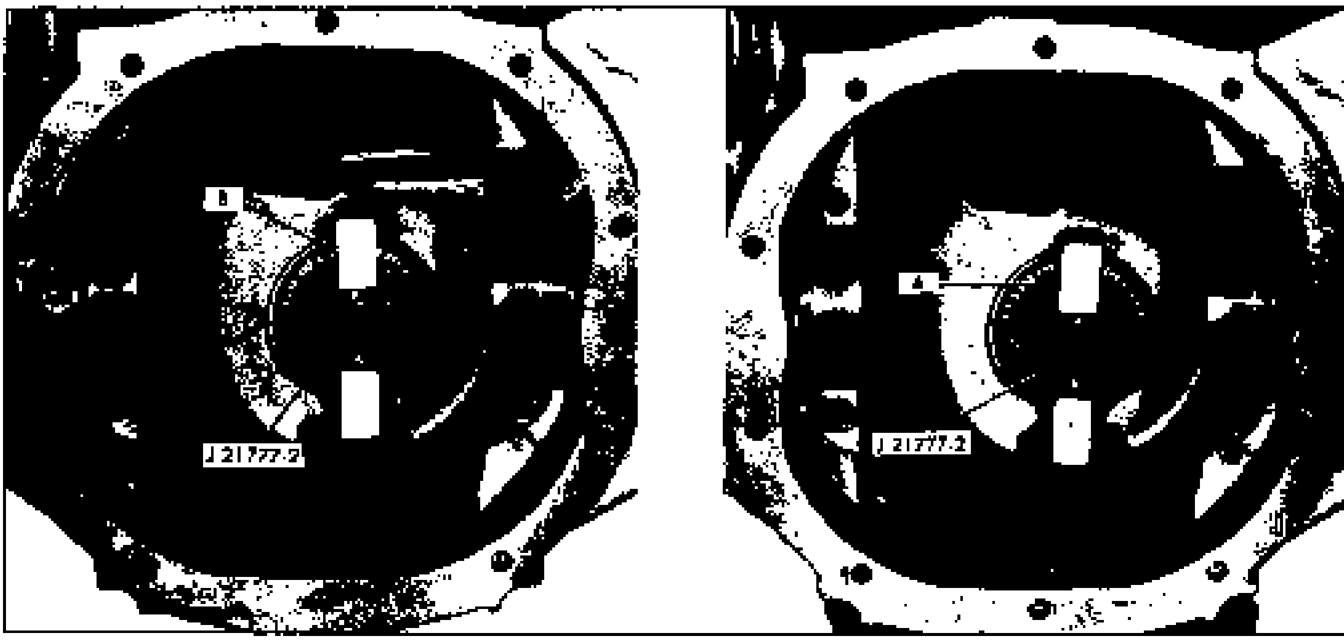


Fig. 4A-39 Gauge Plate Installed

10. Select correct pinion shim to be used during pinion reassembly on the following basis:

NOTE: Pontiac - Fifteen (15) shims are available in increments of (.002") two thousandths from .020" to .050" (Fig. 4A-41).

Tempest, Firebird, or Grand Prix - Ten (10) shims are available in increments of (.002") two thousandths from .020" to .038" (Fig. 4A-41).

a. If reusing production pinion, and pinion is marked "+" (plus), correct shim will have a thickness equal to gauge reading found in step 7, plus the amount specified on pinion.

b. If production pinion is marked "-" (minus), correct shim will have a thickness equal to gauge reading found in step 7, less the amount specified on pinion.

c. If using production or service pinion which has no marking, the correct shim will have a thickness equal to the gauge reading found in step 8.

11. Loosen stud J 8619-13 and remove gauge plate J 21777-2, washer J 21777-8 (Pontiac only), pilot J 8619-12 and both bearings from case.

12. Slide pinion shim onto pinion shaft and install rear pinion bearing on pinion, using installer J 6547-P, J 21022-T, F, or G.P. and holder J 6407-1 and 2 in a press, as shown in Fig. 4A-42.

REPLACE PINION ASSEMBLY AND ADJUST PINION PRELOAD

1. Position pinion assembly in carrier and install new collapsible spacer.

NOTE: Tap rear of pinion assembly with soft hammer to assure seating of rear pinion bearing to its outer race in carrier.

2. Place front pinion bearing in position on pinion. Hold pinion fully forward and drive bearing over pinion until seated, using installer J 21285-01.

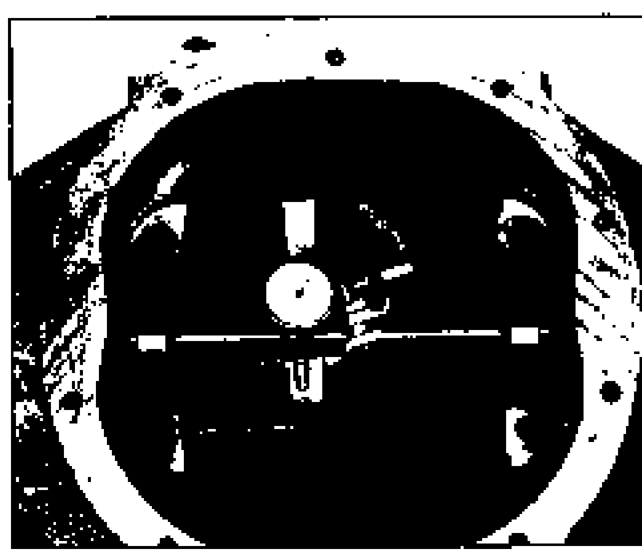


Fig. 4A-40 Checking Pinion Depth

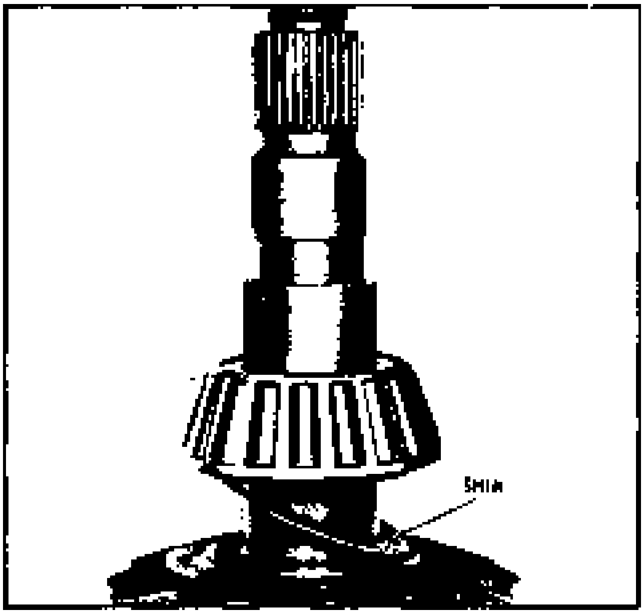


Fig. 4A-41 Pinion Shim

3. Coat O.D. of pinion oil seal with sealing compound and install in carrier, using installer J 21285-01 (Fig. 4A-9).

4. Coat lips of pinion oil seal and seal surface of companion flange with gear lube. Install companion flange on pinion, by tapping with a soft hammer until a few pinion threads project through flange.

5. Install pinion washer and nut. Hold companion flange with holder J 8614-1. While intermittently rotating pinion to seat bearings, tighten pinion nut until end play begins to be taken up.

CAUTION: When no further end play can be determined, and holder J 8614-1 will no longer pivot freely as pinion is rotated, preload is being applied. Further tightening should be done only after preload has been checked.

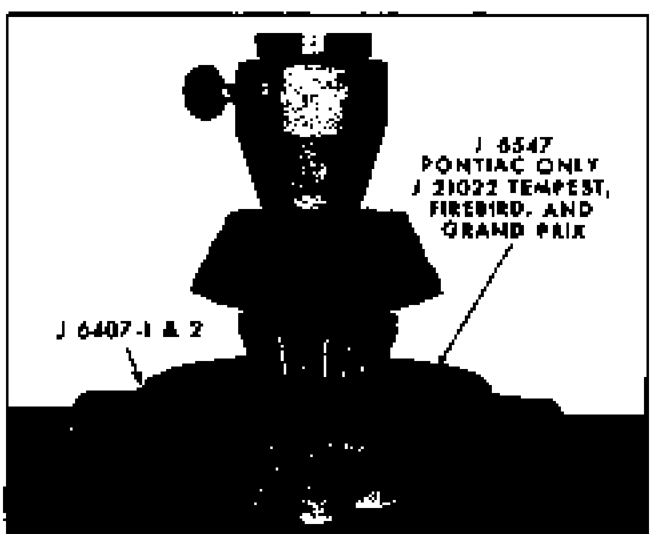


Fig. 4A-42 Installing Rear Pinion Bearing

6. Check preload by using a lb. in. torque wrench (Fig. 4A-43).

CAUTION: After preload has been checked, final tightening should be done very cautiously. Tighten the pinion nut further, only a little at a time, and check preload after each slight amount of tightening. Exceeding preload specifications will compress the collapsible spacer too far and require its replacement. Backing off nut to correct excessive preload will unload the front bearing and pinion nut, allowing bearing to turn on shaft.

7. While observing the preceding caution, carefully set preload drag to 25 lb. in. on new bearings or 17 lb. in. on used 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.

REPLACE DIFFERENTIAL CASE AND ADJUST SIDE BEARING PRELOAD

Production shims are cast iron and vary in thickness from .210" to .272", in increments of .002".

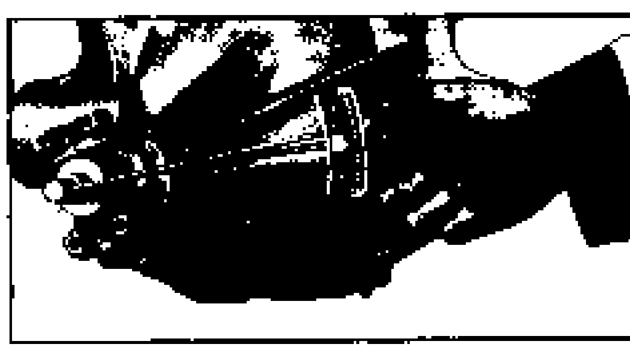


Fig. 4A-43 Checking Pinion Bearing Preload

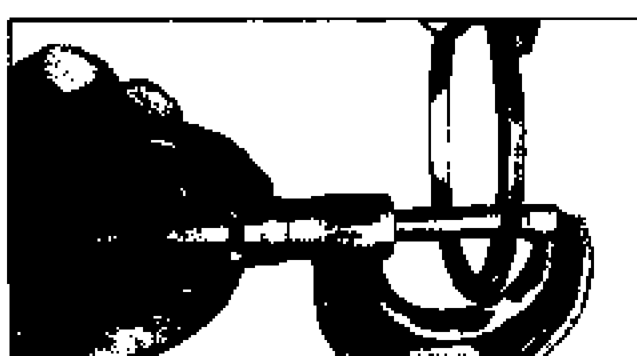


Fig. 4A-44 Measuring Original Production Shim

NOTE: Whenever a case assembly is removed from the housing, measure the production shims for thickness and discard them (Fig. 4A-44).

This figure will be used to determine the approximate shim pack needed in step 4 (below). Use standard .170" service spacers and steel service shims (available from .040" to .082", in increments of .002") for all service repairs.

NOTE: Do not attempt to reinstall the production shims as they may break when tapped into place. If service shims were previously installed, they can be reused, but (whether using new or old bearings) adhere to the following procedure in all cases:

To adjust differential side bearing preload, change the thickness of the right and left shims equally, thus leaving the original backlash undisturbed.

1. Before installation of case assembly, make sure side bearing surfaces are clean and free of burrs. Lubricate side bearings with gear lube. If reusing original bearings, the original outer races must also be used.

2. Place differential case, with bearing outer races in position, in carrier.

3. Slip one .170" service spacer between each bearing race and carrier housing, with flat edge against housing (Fig. 4A-45).

NOTE: As a safety precaution, install the left bearing cap loosely so that the case may be moved while checking adjustments (one 7/16"-14 x 4 1/2" bolt can be added as an extra safety precaution in the lower right bearing cap hole). This will prevent the case from dropping while making shim adjustments.

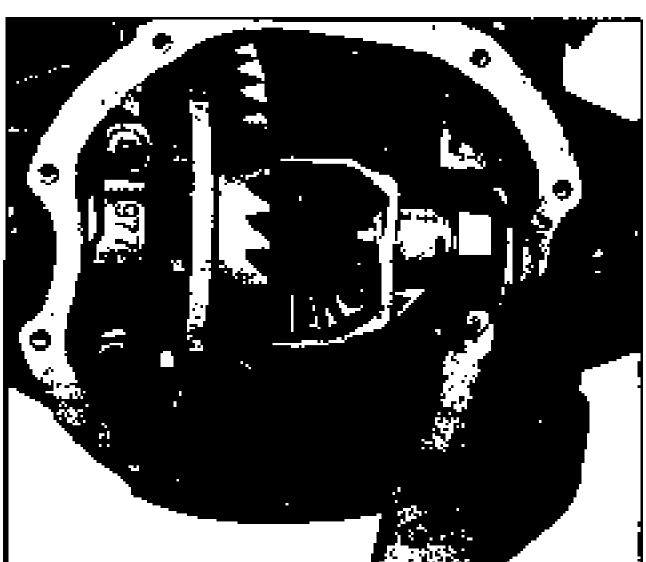


Fig. 4A-45 Installing Service Spacer

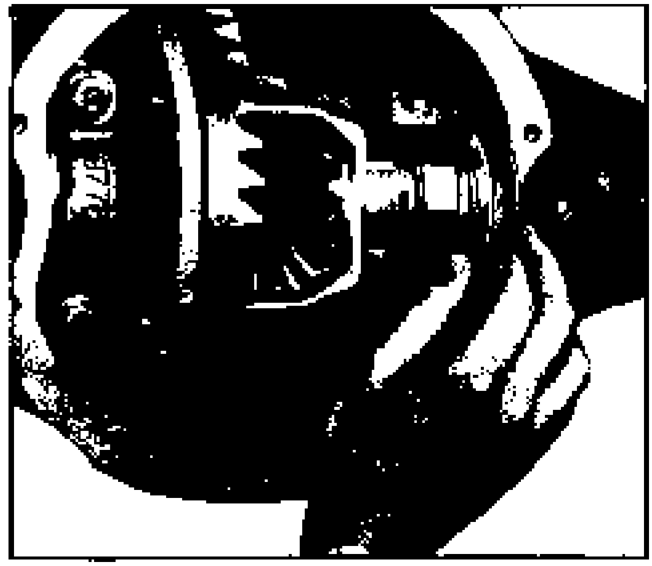


Fig. 4A-46 Installing Two Service Shims

4. Subtract .365" (total of two .170" service spacers plus .025" gauging space) from total shim pack removed on disassembly. Select two shims totaling this amount and position both between right bearing race and service spacer. Be sure left bearing race and spacer are against left housing of carrier (Fig. 4A-46).

5. Insert a feeler gauge of less than .100" between right shim and service spacer (Fig. 4A-47).

NOTE: It will be necessary to work the case in and out and to the left in order to insert the gauge. The gauge must be inserted in order to judge the drag. Be sure to locate the gauge at the centerline of the bearing.

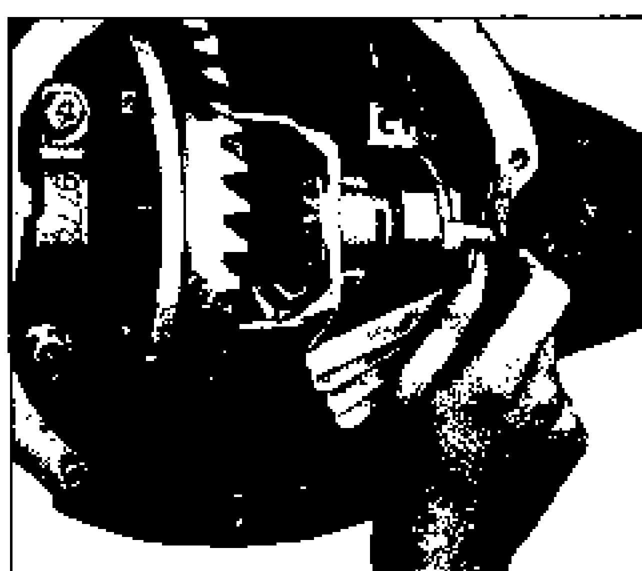


Fig. 4A-47 Inserting Feeler Gauge

Insert progressively larger sizes (.010", .012", .014", etc.) until there is a noticeably increased drag. The point just before additional drag begins is correct gauge thickness. Rotate case while using gauge to insure an even reading.

NOTE: The original light drag was caused by weight of the case against the carrier while additional drag is caused by side bearing preload. By starting with a thin feeler gauge, a sense of "feel" is obtained so that the beginning of preload can be recognized.

6. Remove left bearing cap and all shims from carrier. The total shim pack needed (with no preload on side bearings) is feeler gauge reading found in step 5 plus thickness of shims installed in step 4.

NOTE: The object of step 6 is to reach the equivalent of a "slip fit" of the case in the carrier. For convenience in setting backlash and tooth contact, the preload will not be added until the final step.

7. Select two shims of approximately equal size, whose total thickness is equal to the value obtained in step 6. Install one of these shims between each side bearing race and service spacer.

CAUTION: If insertion of second shim causes excessive pinion to ring gear contact (noticeable by difficulty in rotation of the case), select thinner left shim and add difference to the right side. Keep total shim thickness at a value equal to that obtained in step 6.

8. Check backlash and tooth pattern as described in the following section. The bearing caps must be installed and the bolts torqued to 70 lb. ft.

9. When backlash and tooth pattern operations are complete, remove shim pack installed in step 7. Select two shims each .004" thicker than those removed and install one on each side. This additional thickness will provide proper bearing preload. It will be necessary to tap the final shim into place with a soft hammer (Fig. 4A-48).

ADJUSTING DIFFERENTIAL BACKLASH

1. Rotate differential case several times to seat bearings, then mount dial indicator (Fig. 4A-49). Use a small button on indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that stem is, as nearly as possible, in line with gear rotation and perpendicular to tooth angle for accurate backlash reading.

2. With pinion locked to carrier, check gear lash at 3 or 4 points around ring gear. Lash must not vary over .002" around ring gear. If variation is over .002", check for burrs, uneven bolting conditions or distorted case flange and make corrections as necessary.

3. Gear lash, at the point of minimum lash, should be .005" to .009" for all new gears. If original gear set having a wear pattern is being reinstalled, original gear lash should be maintained.

4. If gear backlash is not within specifications, correct by increasing thickness of one differential shim and decreasing thickness of other shim the same amount. In this way, correct differential bearing preload will be maintained. Shift .002" in shim thickness for each .001" change in backlash desired. If backlash is .001" too much, decrease thickness of right shim .002" and increase thickness of left shim .002". If backlash is .002" too little, increase thickness of right shim .004" and decrease thickness of left shim .004".

5. When backlash is adjusted to specifications, tighten bearing cap bolts to 70 lb. ft. torque.

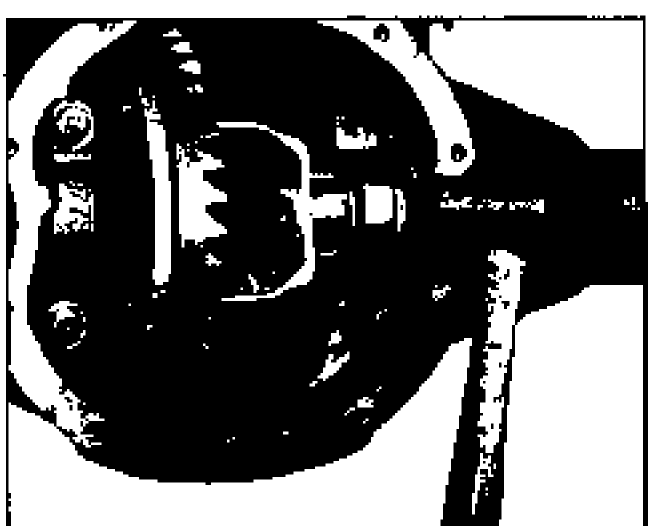


Fig. 4A-48 Tapping Final Shim into Place

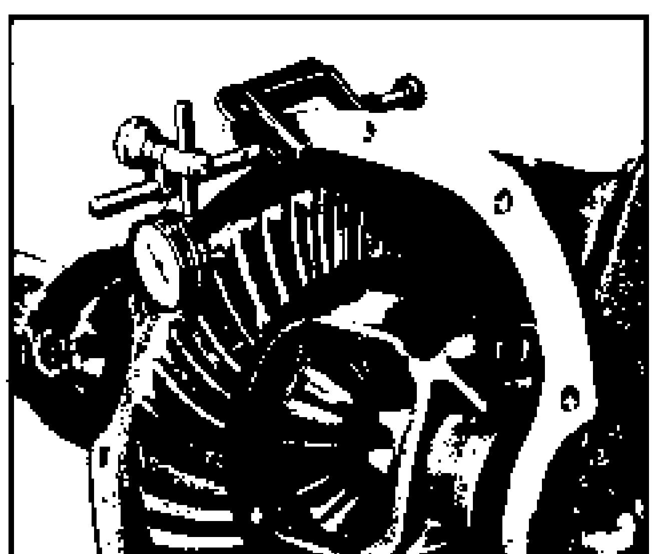


Fig. 4A-49 Checking Ring Gear to Pinion Backlash

6. Check tooth contact pattern with red lead test.

NOTE: It may be necessary to readjust the backlash to obtain the correct tooth contact pattern. On high mileage gear sets where a definite wear pattern has been established, it may be necessary to exceed .009" backlash to obtain the desired tooth contact. It is important, however, not to exceed .009" backlash on new gear sets.

If readjusting the backlash does not give the correct tooth contact pattern, the pinion depth must be readjusted.

7. When correct tooth contact pattern is obtained, install cover with new gasket on housing. DO NOT USE GREASE TO RETAIN GASKET. Insert two upper cover bolts carefully through cover and gasket. Be sure gasket is flat and not twisted between cover and housing. Be sure all cover bolts pass through gasket holes. Torque to 25 lb. ft.

OIL LEAKS

It is difficult to determine the source of some oil leaks. Even after the point of leakage has been determined, it is hard to tell whether the oil is leaking past the lip of the seal or past the O.D. of the seal. Therefore, it is a good idea to make sure the leak is stopped by using a nonhardening sealing compound around the O.D. of the new seal.

SPECIFICATIONS

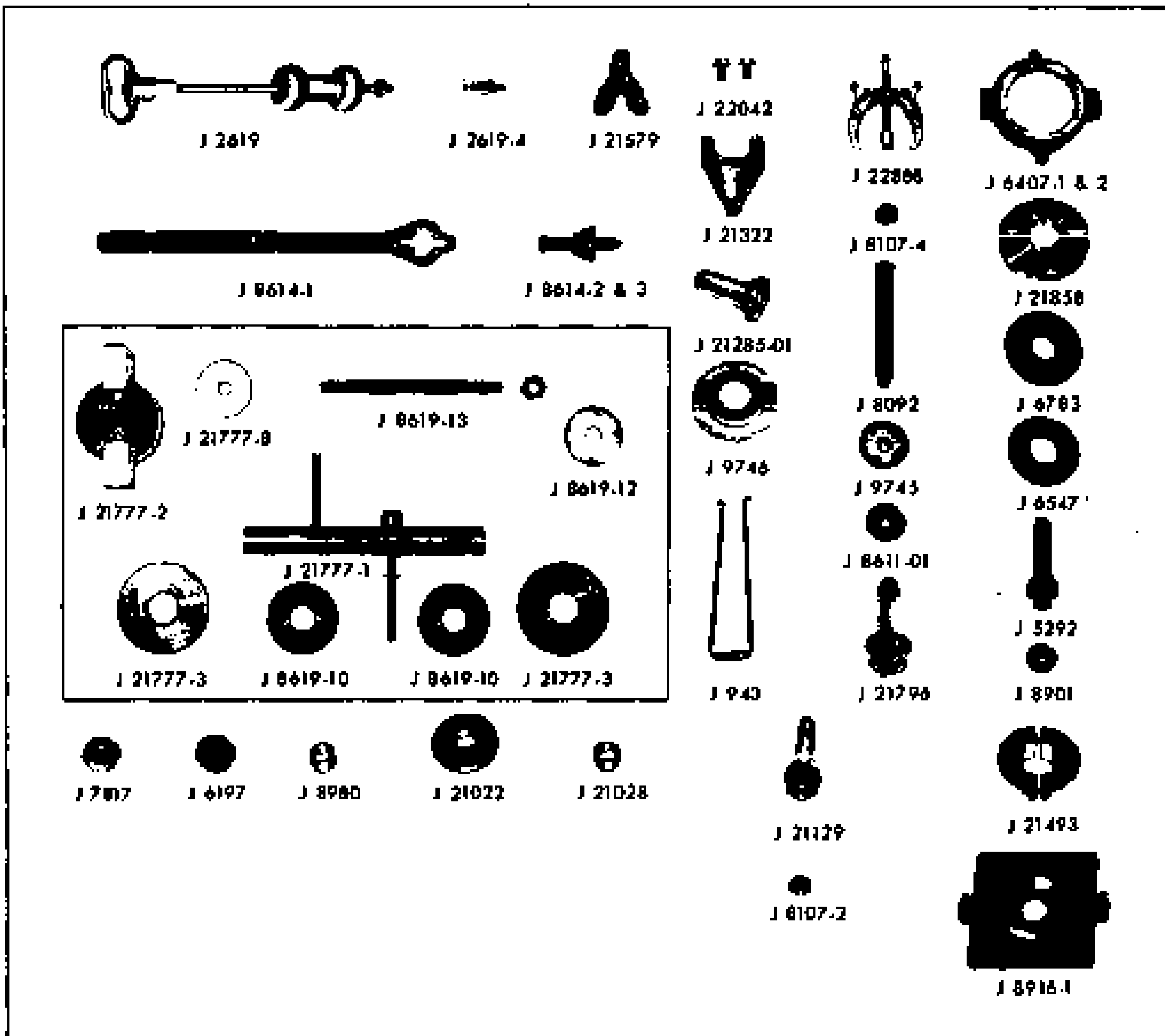
REAR AXLE

Type	Semi-Floating
Type of Drive	Modified Hotchkiss
Drive—Final	Hypoid Gear
Lubricant Capacity	Pontiac-72 oz. or 4½ pints Tempest, Firebird or Grand Prix—48 oz. or 3 pints
Lubricant	Multi-purpose Hypoid Gear Lubricant
Lubricant Level	Bottom of Filler Plug Hole

RING AND PINION GEAR

Backlash	.005"-.009"
Ring gear run-out maximum	.002"
Ratios	See Fig. 4A-4A for Pontiac. See Fig. 4A-4B for Tempest. See Fig. 4A-4C for Firebird. See Fig. 4A-4D for Grand Prix.
Pinion Bearing Preload (with Ring Gear)	
New Bearings (New Seal)	25 lb. in.
Old Bearings (New Seal)	17 lb. in.
Side Bearing Preload	Slip Fit Plus .008"

Torque	Lb. Ft.
Differential Cover to Carrier Bolts	25
Differential Bearing Caps to Carrier Bolts	70
Differential Ring Gear to Case Bolts—Pontiac	90
Differential Ring Gear to Case Bolts—Tempest, Firebird or Grand Prix	60
Differential Pinion Shaft Lock Screw	15
Rear U-Joint Companion Flange Nut with Lock Plates	12
Rear U-Joint Companion Flange Nut with Lockwashers	14
Rear Axle Upper Control Arm Assy. to Axle Housing Bolt—Pontiac Tempest or Grand Prix	110
Rear Axle Upper Control Arm Assy to Axle Housing Nut—Pontiac, Tempest or Grand Prix	80
Rear Axle Lower Control Arm Assy to Axle Housing Bolt—Pontiac, Tempest or Grand Prix	110
Rear Axle Lower Control Arm Assy to Axle Housing Nut—Pontiac, Tempest or Grand Prix	80
Rear Axle Bumper Spacer to Axle Housing Bracket Bolt and Nut (Station Wagon)—Tempest	50
Rear Axle Upper Control Arm Assy to Frame Bolt—Pontiac, Tempest or Grand Prix	110
Rear Axle Upper Control Arm Assy to Frame Nut—Pontiac, Tempest or Grand Prix	80
Rear Axle Lower Control Arm Assy to Frame Bolt—Pontiac, Tempest or Grand Prix	110
Rear Axle Lower Control Arm Assy to Frame Nut—Pontiac, Tempest or Grand Prix	80
Leaf Spring Front Eye to Frame Bracket Nuts—Firebird	100
Leaf Spring Rear Eye to Shackle Nuts—Firebird	50
Rear Shock Absorber to Axle Housing Bracket Nut	65
Shock Absorber to Frame Bolt—Pontiac, Tempest or Grand Prix	20
Shock Absorber to Frame Bolt—Firebird	8
Rear Wheel and Drum to Axle Shaft Nut—Pontiac	80
Rear Wheel and Drum to Axle Shaft Nut—Tempest, Firebird or Grand Prix	65
Rear Brake Assy to Axle Housing Bolt and Nut	35
Pinion Nose Bumper—Pontiac, Tempest or Grand Prix	8
Differential Case Bolts—Grand Prix Medium Duty	30



J 8107-4	Adapter
J 8611-01	Front Pinion Bearing Outer Race Installer
J 8614-1	Companion Flange Holding Tool
J 8614-2 & 3	U-Joint Companion Flange Puller
J 8619-10	Pinion Depth Gauge Discs
J 8619-12	Pilot
J 8619-13	Pinion Depth Gauge Bolt & Nut
J 8901	Side Bearing Support
J 943	Oil Seal Remover
J 2619	Slide Hammer
J 2619-4	Adapter
J 5292	Side Bearing Installer
J 6197	Rear Pinion Bearing Outer Race Installer
J 6407-1 & 2	Press Plate Holder & Insert
J 6547	Rear Pinion Bearing Installer
J 6783	Axle Shaft Bearing Installer
J 7817	Front Pinion Bearing Outer Race Installer
J 8092	Drive Handle
J 8107	Side Bearing Puller (Not Shown)
J 8916-1	Split Plate
J 8980	Differential Side Bearing Installer
J 9745	Rear Pinion Bearing Outer Race Installer
J 9746	Rear Pinion Bearing Remover
J 21022	Axle Shaft Bearing Installer
J 21028	Differential Side Bearing Installer
J 21129	Axle Shaft Oil Seal Installer
J 21285-01	Pinion Oil Seal Installer
J 21322	Case Remover
J 21493	Rear Pinion Bearing Remover
J 21579	Axle Shaft Remover
J 21777	Pinion Depth Gauge
J 21777-1	Cross Shaft Assy.
J 21777-2	Gauge Plate
J 21777-3	Discs
J 21777-8	Washer
J 21796	Axle Shaft Oil Seal Installer
J 21858	Axle Bearing Remover
J 222042	Left Hand Bolt and Sleeve Set
J 22888	Side Bearing Puller (Four Pinion Differential)

Fig. 4A-50 Special Tools

SAFE-T-TRACK DIFFERENTIAL

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

The Safe-T-Track differential can be identified by a tag attached to the lower right section of axle cover. It is designed to direct the major driving force to the wheel with greater traction, thereby reducing the possibility of the car becoming stuck while driving under adverse conditions.

PONTIAC

The Safe-T-Track differential (Fig. 4B-1) is similar to, and interchangeable with, the standard differential case assembly (the ring gear and side bearings are identical).

TEMPEST AND FIREBIRD

All rear axle parts of cars equipped with the Safe-T

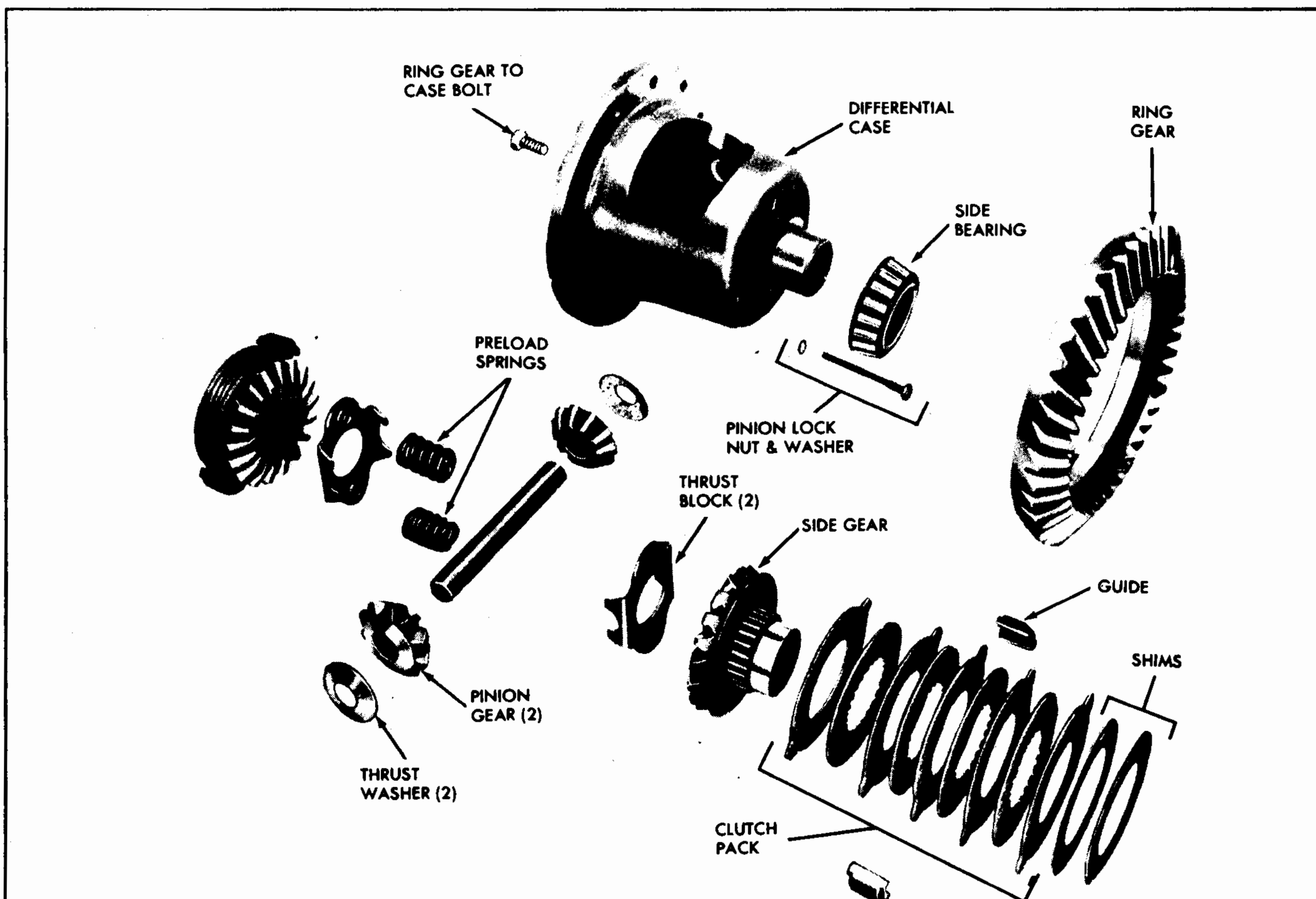


Fig 4B-1 Exploded View of Pontiac Safe-T-Track

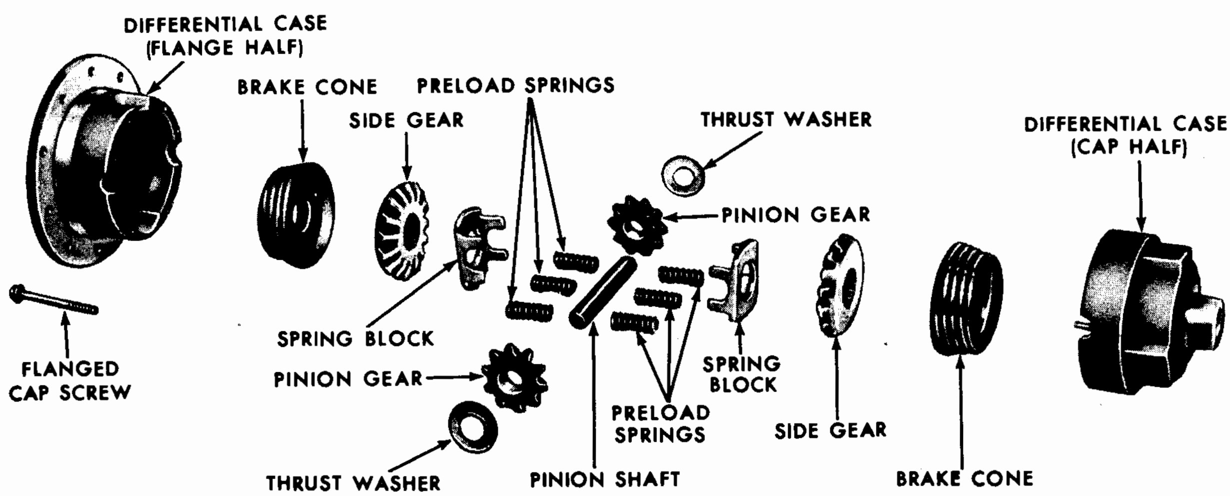


Fig. 4B-2 Exploded View of Tempest and Firebird 2 Pinion Safe-T-Track

Track two pinion differential (Fig. 4B-2) or the Safe-T Track four pinion differential (Fig. 4B-3) are interchangeable with those equipped with the conventional differential, except for the case assembly. It is similar in all respects to the conventional case assembly, with the addition of cone clutches behind each side gear.

GRAND PRIX

The Grand Prix has two types of Safe-T-Track differentials - medium duty and heavy duty - the usage depending upon the engine - transmission combination and the axle ratio. The medium duty Safe-T-Track

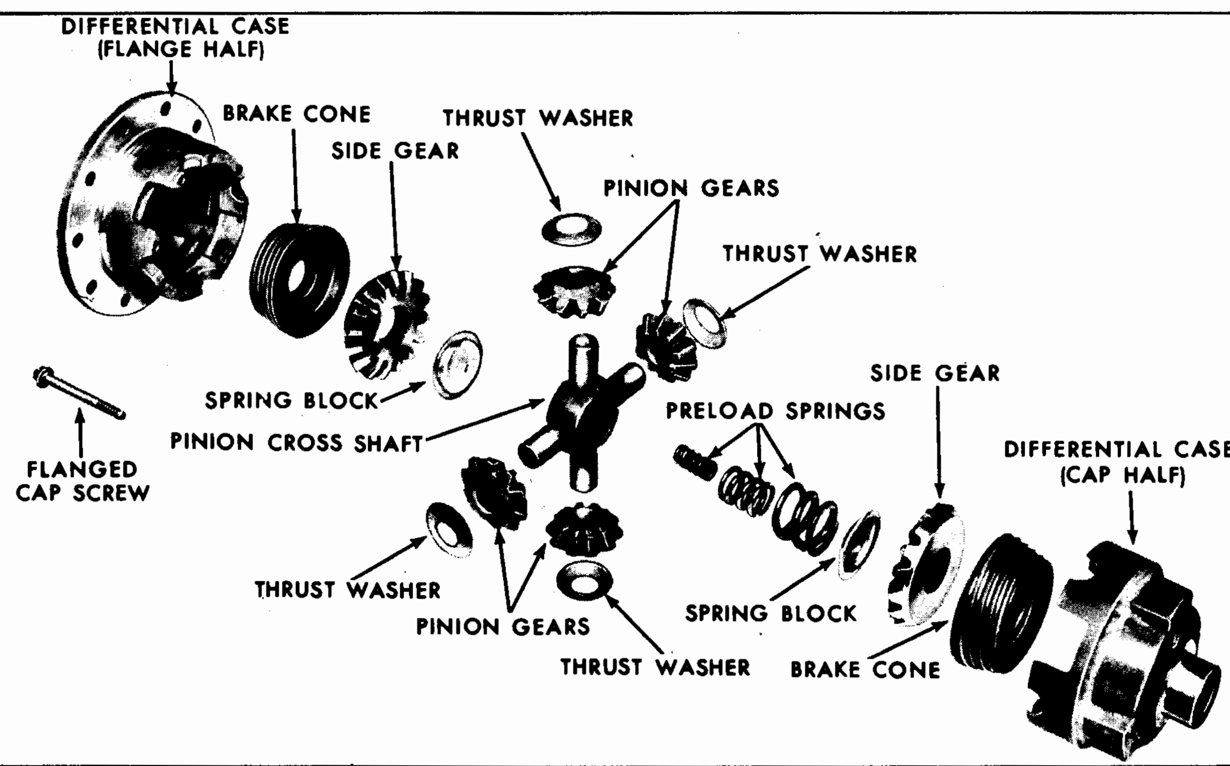


Fig. 4B-3 Exploded View of Tempest, Firebird and Grand Prix Pinion Safe-T-Track differential has four pinion gears and a gray iron carrier. Cold extruded axle shafts are used with the medium duty Safe-T-Track. The heavy duty Safe-T--Track (Fig. 4B-3) also has four pinion gears but the carrier is nodular iron. The heavy duty axle shafts are hot forged.

IMPORTANT: Due to the material or manufacturing differences in the medium duty and heavy duty axle parts, they should NEVER be interchanged.

LUBRICATION

The differential should be checked for leaks and level every 6000 miles. Maintain level to bottom of the filler plug opening. No periodic lubricant change is recommended. However, if necessary to add lubricant, use only specially formulated lubricant for Safe-T-Track differentials.

IMPORTANT: Never use any other lubricant in a Safe T-Track differential or a severe chatter may result, especially when turning corners. If the wrong lubricant is added, drain it from housing and flush with special lubricant. Then add the proper amount of lubricant. It may be necessary to drive the car several miles to allow the lubricant to work through the clutches and eliminate the chatter. If chatter persists, drain and refill again to eliminate contamination. It may require 2 or 3 flushings to correct. An alternate procedure is disassembly and cleaning with solvent. Capacity is 4 1/2 pints of lubricant for Pontiac; capacity for Tempest, Firebird and Grand Prix is 3 pints of lubricant.

SERVICE PROCEDURES

All rear axles service procedures are the same for the Safe-T-Track as for the conventional differential, except for servicing the case assembly.

NOTE: Two precautions must be observed when working on cars with Safe-T-Track differentials:

1. NEVER raise one wheel and run the engine with the transmission in gear. The driving force to the wheel on the floor will cause the car to move.

2. Do not use "on the car" type wheel balancers on the rear wheels, unless BOTH wheels are off the floor.

TESTING FOR CORRECT OPERATION

If there is any doubt as to the proper functioning of the Safe-T-Track differential, the following simple test should be performed:

1. Place the car on a hoist with engine off and the transmission selector lever in PARK if automatic, or in LOW gear if manual.

2. Attempt to turn either wheel.

3. The average man will find it extremely difficult, if not impossible, to manually turn either wheel. This is because one wheel will provide approximately 400 lbs. draw bar pull, with zero traction at the opposite wheel.

MAJOR REPAIRS

DIFFERENTIAL CASE-DISASSEMBLE

PONTIAC-

NOTE: Keep side bearing outer races with side bearings, so these matched parts can be correctly replaced during build-up.

1. Before disassembling differential case, inspect differential side bearings for visible damage of rollers and outer races.

2. Place one outer race onto its matched inner race and roller assembly and turn slowly, applying hand load.

3. If bearing outer race turns smoothly and no visible damage is found, bearing can probably be reused.

4. Repeat above operations with other outer race and matched bearing and check for smoothness.

NOTE: Both side bearings and their races are matching parts. If either bearing is to be replaced, its matching outer race must also be replaced.

5. Inspect fit of inner races on case hubs by prying against shoulders at puller recesses. Bearing inner races must be tight on case hubs.

NOTE: If either is loose on case, the entire case must be replaced.

6. If bearing inspection indicates that bearings should be replaced, insert differential case in vise and, using side bearing puller J 8107 and adapter J 8107-4, remove side bearing (Fig. 4B-4).

CAUTION: Make certain ends of puller arms are firmly seated in recesses in sides of hubs and fully against inner race of bearing.

7. Turn differential case in vise and remove other side bearing in same manner.

8. If removing ring gear, clamp case in vise so jaws are 90° to pinion shaft holes and remove ring gear retaining bolts.

NOTE: Ring gear to case bolts have left hand threads.

9. Partially install two bolts on opposite sides of ring gear.

10. Remove ring gear from case by alternately tapping on bolts.

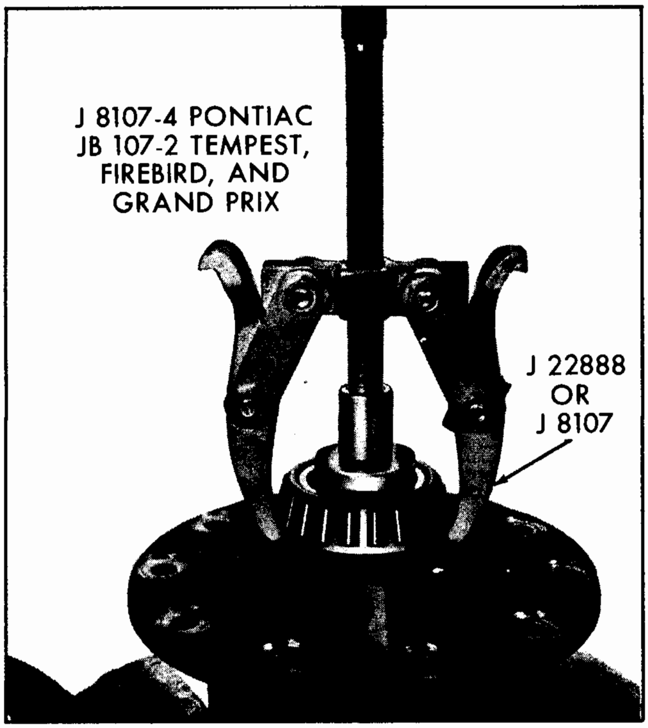


Fig. 4B-4 Removing Differential Side Bearing

CAUTION: Do not pry between case and ring gear.

11. Remove pinion shaft lock screw and washer and tap out pinion shaft from case.

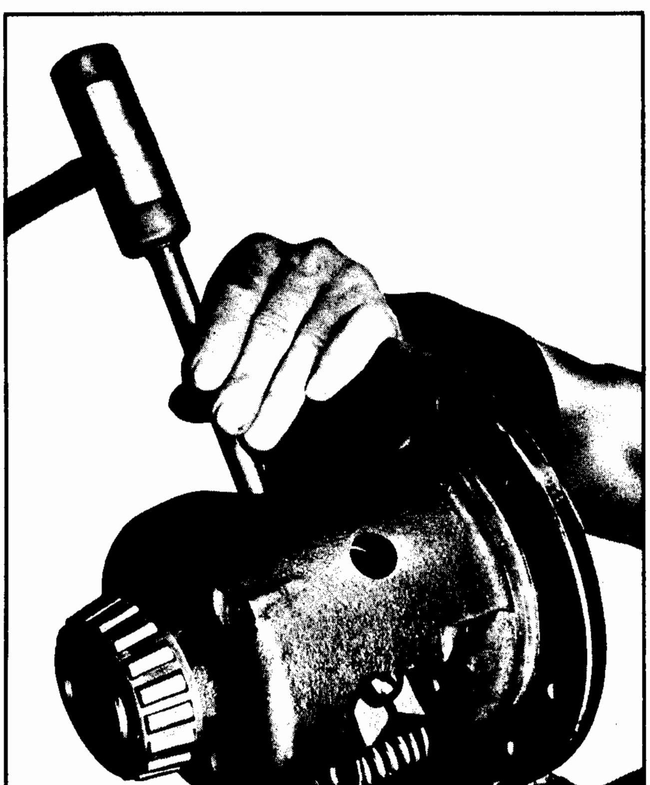


Fig. 4B-5 Removing Preload Springs and Retainer Pontiac

Fig. 4B-6 Driving Out Clutch Pack - Pontiac

12. Remove preload spring retainer and springs from case (Fig. 4B-5).

13. Rotate side gears until pinions are in open area of case. Remove pinions and thrust washers.

14. Remove a side gear, clutch pack and shims from case. Note location in case to aid in reassembly. Remove side gear clutch pack and shims from opposite side.

NOTE: If a side gear or clutch pack cannot be readily removed from case, drive out with brass drift (Fig. 4B-6).

15. Remove clutch plate guides and separate shims and clutch plates from side gears.

NOTE: Keep clutch plates in their original location in clutch pack.

TEMPEST AND FIREBIRD (2 pinion or 4 pinion) AND GRAND PRIX (4 pinion)

1. Before disassembling differential case, inspect differential side bearings for visible damage of rollers and outer races.

2. Place one outer race onto its matched inner race and roller assembly and turn slowly, applying hand load.

3. If bearing outer race turns smoothly and no visible damage is found, bearing can be reused.

4. Repeat above operation with other race and matched bearing and check for smoothness.

NOTE: Both side bearings and their outer races are *matched parts. If either bearing is to be replaced, its matching outer race must also be replaced.*

5. Inspect fit of inner races on case hubs by prying against shoulders at puller recesses. Bearing inner races must be tight on case hubs.

NOTE: If either bearing is loose on case, entire case must be replaced.

6. If bearing inspection indicates that bearings should be replaced, remove side bearings by using side bearing puller J 8107 (two pinion) or J 22888 (four pinion) and adapter J 8107-2 (Fig. 4B-4).

CAUTION: Make certain that ends of puller arms are fully against inner race of bearing.

7. Turn differential case in vise and remove other side bearing in same manner.

8. If removing ring gear, clamp case in vise so jaws are 90° to pinion shaft holes and remove ten ring gear retaining bolts.

9. Partially install two bolts on opposite sides of ring gear.

10. Remove ring gear from case by alternately tapping on bolts.

CAUTION: Do not pry between case and ring gear.

11. Scribe mark or paint differential case halves (Fig. 4B-7) to aid in alignment of case when assembling.

12. Remove differential case half attaching bolts.

13. Lift cap half of case from flange half. Remove clutch cone, side gear, spring block, preload springs and shims, if provided.

NOTE: Shims are used in some units between the side gear and cone to maintain proper backlash between pinion gears and side gears. Keep these parts with cap half of case assembly.

14. Remove corresponding parts from flange half of case and keep them with flange half of case assembly.

CLEANING AND INSPECTION OF CASE

PONTIAC-

1. Thoroughly clean differential case and inspect, paying particular attention to ring gear mounting flange, ring gear pilot and side bearing hubs.

2. Remove nicks and burrs with mill file.

NOTE: If using new case, thoroughly clean case in suitable solvent, making certain bolt holes and bolts are clean of steel filing and foreign material.

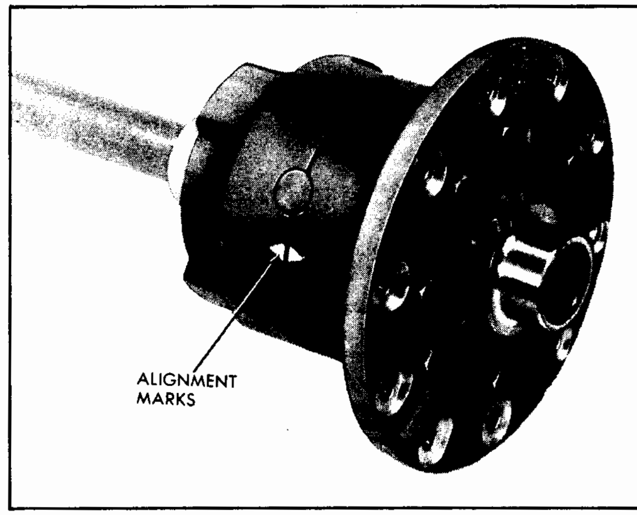


Fig. 4B-7 Alignment Marks - Tempest, Firebird and Grand Prix

3. Clean side gears, pinion gears and thrust washers with suitable solvent and inspect for excessive wear.

4. Clean side bearings thoroughly in clean solvent (do not use a brush). Examine bearings visually and by feel. Bearings should feel smooth when oiled and rotated, while applying as much hand pressure as possible.

NOTE: Minute scratches and pits that appear on rollers and races at low mileage are due to the initial preload. Bearings having these marks should not be rejected.

5. Thoroughly clean ring gear and inspect back side for any adhering material which may cause runout.

6. Examine ring gear and drive pinion teeth for nicks, burrs or scoring. Any of these conditions will require replacement of gear set.

7. Position ring gear on case and check fit of gear on flange and pilot. It should be .002″ tight to .001″ loose. If ring gear easily falls into position, it must be replaced.

NOTE: If ring gear is replaced, pinion gear must also be replaced as they are only serviced in matched sets.

8. Check press fit of side bearing inner race on differential case. Side bearings must be a tight press fit on hub.

9. Inspect clutch plates for scored, worn, cracked or a distorted condition. If any of these conditions exist, new clutch plates must be installed.

10. Replace parts as necessary and coat with clean engine oil before installing in case.

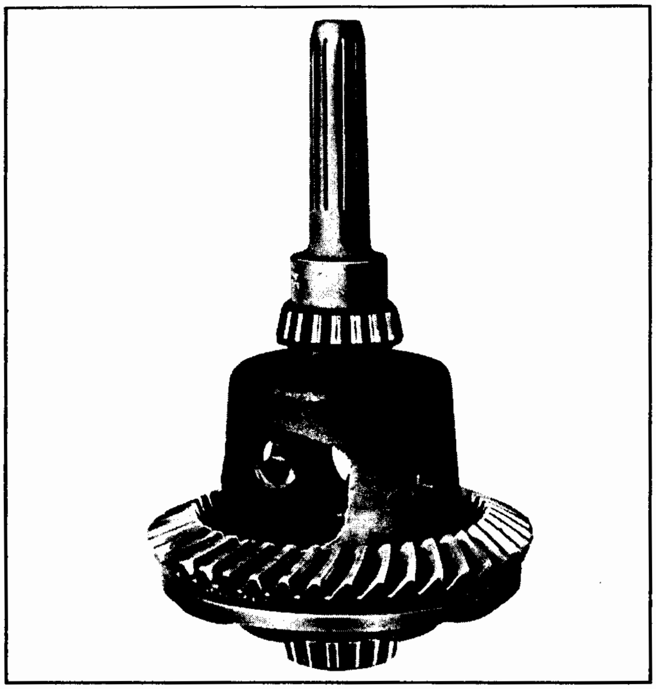


Fig. 4B-8 Installing Differential Side Bearing

TEMPEST AND FIREBIRD (2 pinion or 4 pinion) AND GRAND PRIX (4 pinion)

1. Make certain all parts are absolutely clean and dry.

2. Inspect pinion shaft, pinion and side gears, brake cone surfaces and corresponding cone seats in case.

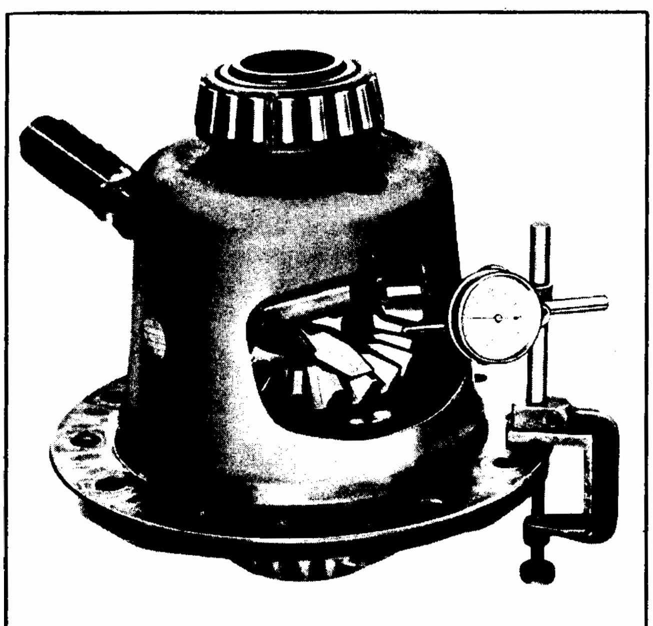


Fig. 4B-9 Checking Pinion Gear to Side Gear Clearance - Pontiac

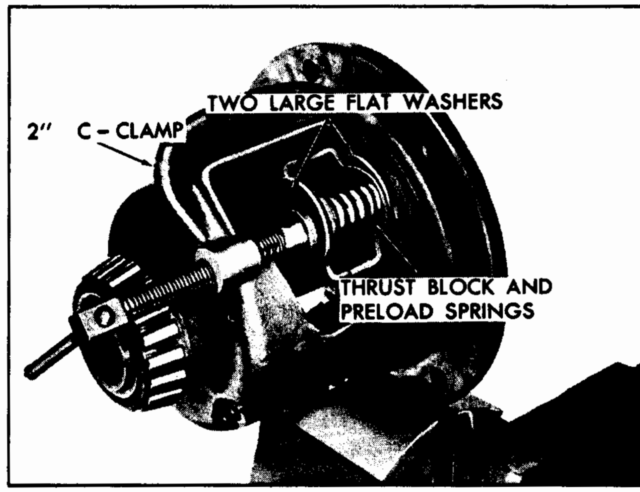


Fig. 4B-10 Compressing Preload Springs - Pontiac

The cone seats in case should be smooth and free of any excessive scoring. Slight grooves or scratches, indicating passage of foreign material, are permissible and normal. The land surface on the heavy spirals of male cones will duplicate case surface condition. Replace any parts which are excessively scored, pitted or worn. Both halves of case must be replaced if one half is damaged or worn.

DIFFERENTIAL CASE-ASSEMBLE

PONTIAC-

1. After making sure that matching surfaces are clean and free of burrs, position ring gear on case so holes are in line.

2. Lubricate attaching bolts with clean engine oil and install.

3. Pull ring gear onto case by alternately tightening bolts around case. When all bolts are snug, tighten bolts evenly and alternately across diameter to 90 lb. ft. torque.

CAUTION: Do not use hammer to force ring gear on case.

4. If side bearings were removed, lubricate the bearings and install on case hubs, as shown in Fig. 4B-8, using tool J 5292.

5. Apply special lubricant to the clutch plates.

6. Assemble the clutch packs as follows:

a. Alternately position nine clutch plates on the side gear, starting and ending with a clutch plate having external lugs.

b. Install the two clutch guides over the clutch plate lugs.

c. Install the same shims which were removed, or an equal amount, on the clutch plate.

d. Repeat steps a, b, and c on the other clutch pack.

7. Check the pinion to side gear clearance as follows:

a. Install one side gear with clutch pack and shims in the case.

b. Position the two pinion gears and thrust washers on the side gear and install the pinion shaft.

c. Compress the clutch pack by inserting a screwdriver or wedge between the side gear and the pinion shaft.

d. Install dial indicator with the contact button against the pinion gear (Fig. 4B-9).

e. Rotate pinion gear. Clearance should be .001" to .006". Add or subtract necessary shims to reach this figure.

f. Remove side gear and repeat procedure with opposite clutch pack on the side of case.

8. Remove pinion shaft, pinions and thrust washers.

9. Install remaining side gear and clutch pack with correct shims in case.

10. Place pinion gears on side gears and rotate into correct position.

11. Compress the preload springs with a 2" C clamp, as shown in Fig. 4B-10, and drive the preload retainer and springs between side gears.

12. Insert thrust washers behind pinion gears.

13. Install pinion shaft and retain with lock screw.

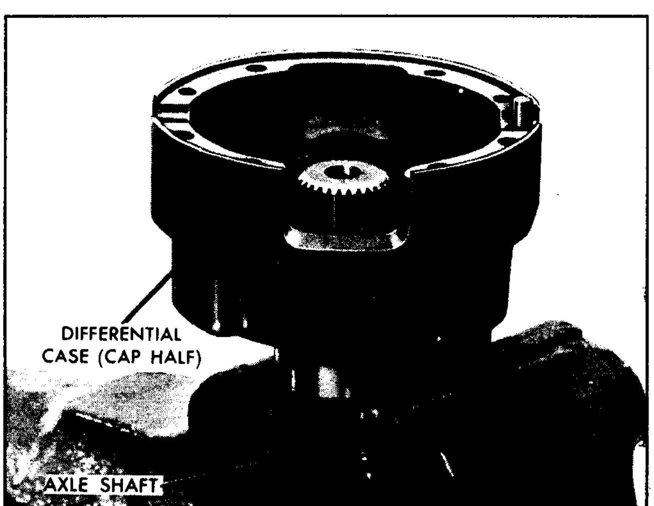


Fig. 4B-11 Axle Shaft and Cap Half of Case - Two or Four Pinion Tempest, Firebird and Grand Prix

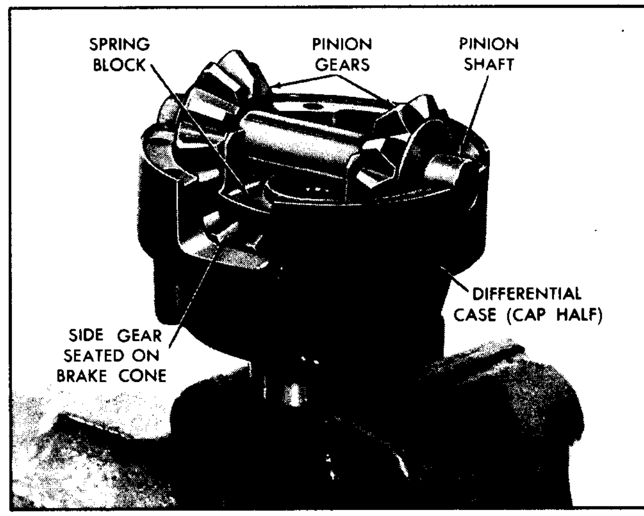


Fig. 4B-12 Installing Parts in Cap Half - Two Pinion Tempest and Firebird

14. Check side gear splined hole to be certain it is in line with hole in the preload spring retainer. The spring retainer can be moved slightly to correct misalignment.

TEMPEST, FIREBIRD AND GRAND PRIX -

The following procedure is to be used in assembling both the two pinion differential and the four pinion differential. Slight differences are noted in steps 4 and 5.

CAUTION: When assembling unit, use axle shafts as mounting tools to assure proper gear and cone spline alignment. Do not ignore this procedure or it will be impossible to install shafts at final assembly. Attempting to force shafts into position may result in damage to spring thrust blocks.

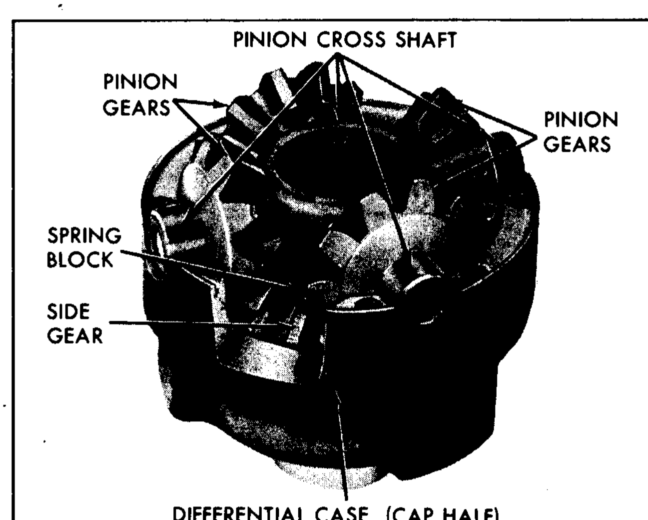


Fig. 4B-13 Installing Parts in Cap Half - Four Pinion Tempest, Firebird and Grand Prix

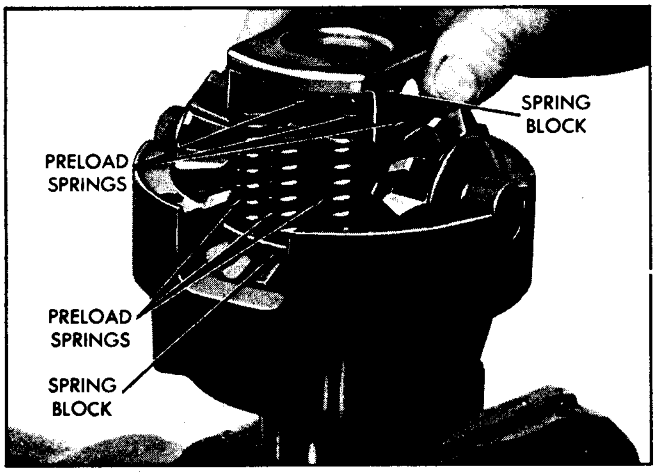


Fig. 4B-14 Installing Second Spring Block - Two Pinion Tempest and Firebird

1. Clamp one axle shaft in vise, allowing three inches to extend above vise jaws. Then place cap half of differential case over extended axle shaft, with interior of case facing up (Fig. 4B-11).

2. Install proper cone over axle shaft splines, seating it into position in cap half of case.

NOTE: Be certain that each cone is installed in proper case half, since tapers and surfaces become matched and their positions should not be changed.

3. If unit was originally assembled with shims located between side gears and cones for backlash adjustment, reinstall side gear with shim so that gear may seat on shim. If unit was originally assembled without shims, reassemble same way.

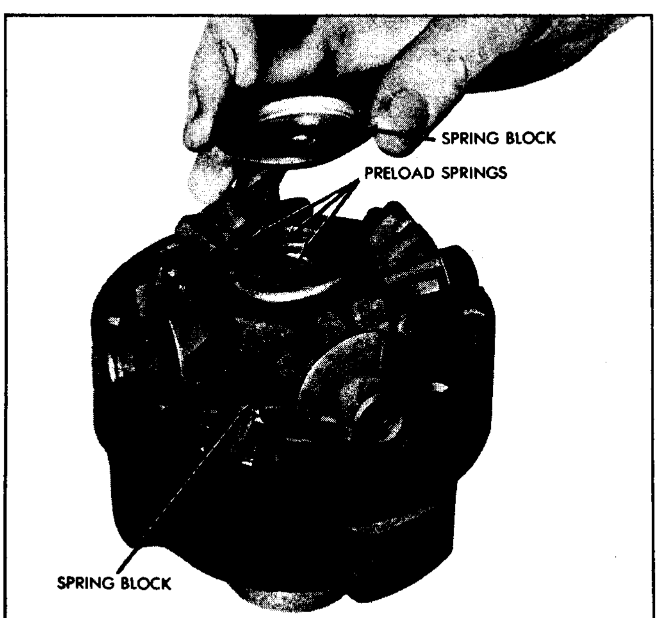


Fig. 4B-15 Installing Second Spring Block - Four Pinion Tempest, Firebird and Grand Prix

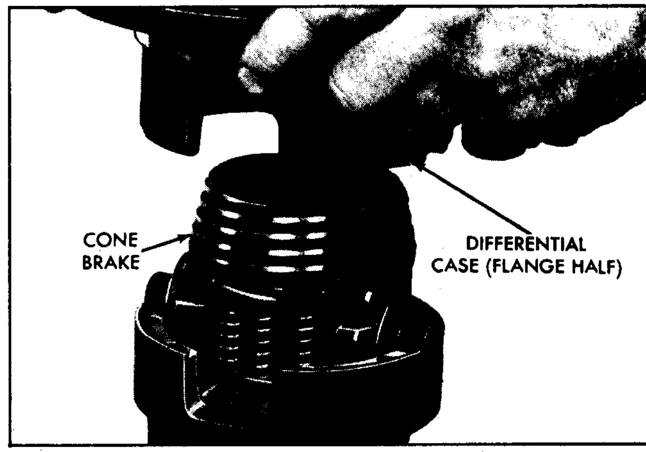


Fig. 4B-16 Installing Flange Half of Differential Case - Two or Four Pinion Tempest and Firebird - Four Pinion Grand Prix

4. (2 pinion) Place one spring block in position over gear face, in alignment with pinion gear shaft grooves. Install pinion shaft, pinion gears and thrust washers into cap half of differential case in such a manner that pinion shaft retaining dowel can be inserted through pinion gear shaft into differential case. This prevents pinion shaft from sliding out and causing damage to carrier (Fig. 4B-12).

(4 pinion) Place one spring block in central position over gear face. Assemble the four pinions and four thrust washers onto the pinion cross shaft and place in position in the cap half of the differential case (Fig. 4B-13).

5. (2 pinion) Insert six springs into spring block that is already installed into case, then place second spring block over springs. Note offset construction of spring block tabs (Fig. 4B-14).

(4 pinion) Insert three springs through center of pinion cross shaft onto spring block that is already installed

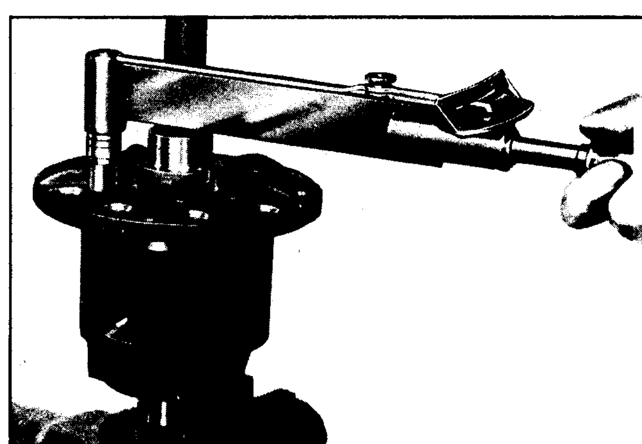


Fig. 4B-17 Torquing Case Half Bolts - Two or Four Pinion Tempest and Firebird - Four Pinion Grand Prix into case, then place second spring block on top of springs (Fig. 4B-15).

6. Install second side gear, face down on spring block so that side gear will mesh with pinion gears.

7. Place shim, if provided, and remaining cone over side gear.

8. Install flange half of differential case over cone, in proper position to match alignment marks; insert two case half bolts finger tight, 180° apart (Fig. 4B-16).

9. Install other axle shaft through flange half of differential case, rotating axle to enter cone splines and then side gear splines. Leaving the axle shaft in this position, insert remaining bolts and tighten to 30 lb. ft. (Fig. 4B-17).

10. Remove axle shafts (A slight tapping on the shafts with a soft hammer may be necessary to align the splines during assembly. The shafts can then be readily reinstalled without spline interference during final assembly).

11. If side bearings were removed, lubricate outer bearing surfaces and press on bearings as described in (standard) Assemble Differential Case.

12. After making sure that matching surfaces are clean and free of burrs, position ring gear on case so holes are in line.

13. Lubricate attaching bolts with clean engine oil and install.

14. Pull ring gear onto case by alternately tightening bolts around case. When all bolts are snug, tighten bolts evenly and alternately across diameter to 60 lb. ft. torque.

CAUTION: Do not use hammer to force ring gear on case.

15. Install unit into axle carrier following instructions given for Standard Differential.

TROUBLE DIAGNOSIS

OIL LEAKS

It is difficult to determine the source of some oil leaks. Even after the point of leakage has been determined, it is hard to tell whether the oil is leaking past the lip of the seal or past the O.D. of the seal. Therefore, it is a good idea to make sure the leak is stopped by using a nonhardening sealing compound around the O.D. of the new seal.

SPECIAL TOOLS

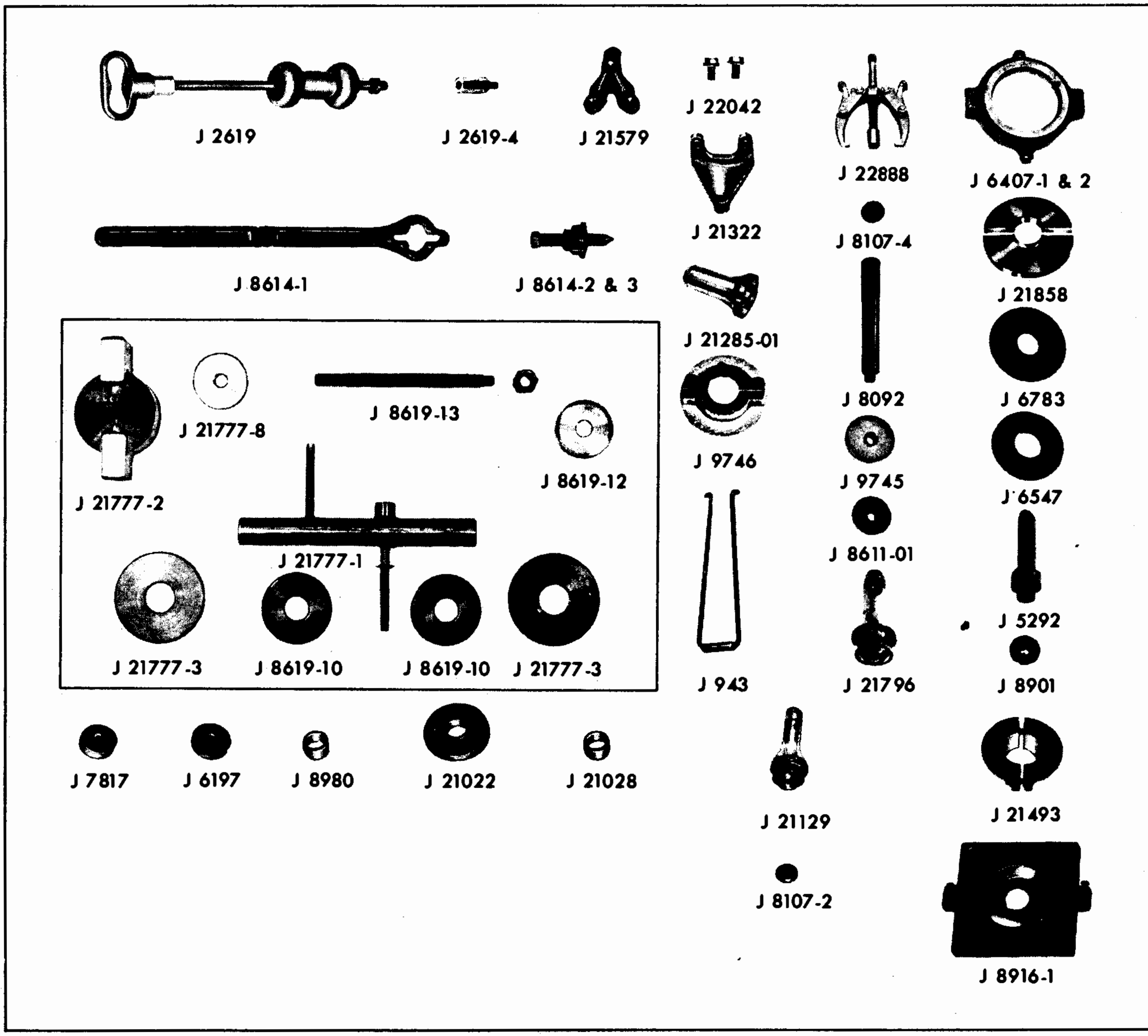


Fig. 4B-18 Special Tools

J 943	Oil Seal Remover
J 2619	Slide Hammer
J 2619-4	Adapter
J 5292	Side Bearing Installer
J 6197	Rear Pinion Bearing Outer Race Installer
J 6407-1 & 2	Press Plate Holder & Insert
J 6547	Rear Pinion Bearing Installer
J 6783	Axle Shaft Bearing Installer
J 7817	Front Pinion Bearing Outer Race Installer
J 8092	Drive Handle
J 8107	Side Bearing Puller (Two Pinion)—Not Shown
J 8107-2	Adapter
J 8107-4	Adapter
J 8611-01	Front Pinion Bearing Outer Race Installer
J 8614-1	Companion Flange Holding Tool
J 8614-2 & 3	U-Joint Companion Fldnge Puller
J 8619-10	Pinion Depth Gauge Discs
J 8619-12	Pilot
J 8619-13	Pinion Depth Gauge Bolt & Nut
J 8901	Side Bearing Support
J 8916-1	Split Plate
J 8980	Differential Side Bearing Installer
J 9745	Rear Pinion Bearing Outer Race Installer
J 9746	Rear Pinion Bearing Remover
J 21022	Axle Shaft Bearing Installer
J 21028	Differential Side Bearing Installer
J 21129	Axle Shaft Oil Seal Installer
J 21285-01	Pinion Oil Seal Installer
J 21322	Case Remover
J 21493	Rear Pinion Bearing Remover
J 21579	Axle Shaft Remover
J 21777	Pinion Depth Gauge
J 21777-1	Cross Shaft Assy.
J 21777-2	Gauge Plate
J 21777-3	Discs
J 21777-8	Washer
J 21796	Axle Shaft Oil Seal Installer
J 21858	Axle Bearing Remover
J 222042	Left Hand Bolt and Sleeve Set
J 22888	Side Bearing Puller (Four Pinion)

SPECIFICATIONS

REAR AXLE

Type....Semi-Floating
Type of Drive....Modified Hotchkiss
Drive—Final....Hypoid Gear
Lubricant Capacity....Pontiac-72 oz. or 4½ pints
Tempest, Firebird and Grand Prix-48 oz. or 3 pints
Lubricant....Multi-purpose Hypoid Gear Lubricant
Lubricant Level....Bottom of Filler Plug Hole

RING AND PINION GEAR

Backlash....005"-.009"
Ring gear run-out maximum....002"

Ratios....See Fig. 4A-4A for Pontiac.
See Fig. 4A-4B for Tempest.
See Fig. 4A-4C for Firebird.
See Fig. 4A-4D for Grand Prix.
Pinion Bearing Preload (with Ring Gear)
New Bearings (New Seal)....25 lb. in.
Old Bearings (New Seal)....17 lb. in.
Side Bearing Preload....Slip Fit Plus .008"

TORQUE	LB. FT.
Differential Cover to Carrier Bolts	25
Differential Bearing Caps to Carrier Bolts	70
Differential Ring Gear to Case Bolts—Pontiac	90
Differential Ring Gear to Case Bolts—Tempest, Firebird or Grand Prix	60
Differential Pinion Shaft Lock Screw	15
Rear U-Joint Companion Flange Nut with Lock Plates	12
Rear U-Joint Companion Flange Nut with Lockwashers	14
Rear Axle Upper Control Arm Assy to Axle Housing Bolt—Pontiac, Tempest or Grand Prix	110
Rear Axle Upper Control Arm Assy to Axle Housing Nut—Pontiac, Tempest or Grand Prix	80
Rear Axle Lower Control Arm Assy to Axle Housing Bolt—Pontiac, Tempest or Grand Prix	110
Rear Axle Lower Control Arm Assy to Axle Housing Nut—Pontiac, Tempest or Grand Prix	80
Rear Axle Bumper Spacer to Axle Housing Bracket Bolt and Nut (Station Wagon)—Tempest	50
Rear Axle Upper Control Arm Assy to Frame Bolt—Pontiac, Tempest or Grand Prix	110
Rear Axle Upper Control Arm Assy to Frame Nut—Pontiac, Tempest or Grand Prix	80
Rear Axle Lower Control Arm Assy to Frame Bolt—Pontiac, Tempest or Grand Prix	110
Rear Axle Lower Control Arm Assy to Frame Nut—Pontiac, Tempest or Grand Prix	80
Rear Shock Absorber to Axle Housing Bracket Nut	65
Shock Absorber to Frame Bolt—Pontiac, Tempest or Grand Prix	20
Rear Wheel and Drum to Axle Shaft Nut—Pontiac	80
Rear Wheel and Drum to Axle Shaft Nut—Tempest, Firebird or Grand Prix	65
Rear Brake Assy to Axle Housing Bolt and Nut	8
Pinion Nose Bumper—Pontiac Tempest or Grand Prix	8
Differential Case Bolts (Safe-T-Track)—Tempest, Firebird or Grand Prix	30
Leaf Spring Front Eye to Frame Bracket Nuts—Firebird	100
Leaf Spring Rear Eye to Frame Bracket Nuts—Firebird	50
Shock Absorber to Frame Bolt—Firebird	8
Spring and Shock Absorber Anchor Plate Attaching Nut—Firebird	40

PROPELLER SHAFT

CONTENTS OF THIS SECTION

INSPECTION

No periodic inspection of propeller shaft assembly is required. Since propeller shaft assembly is a balanced unit, it should be kept free of undercoating and other foreign material which could upset shaft balance. It is essential that locating mark on companion flange be in alignment with mark on propeller shaft yoke for optimum balance.

MINOR SERVICES AND REPAIRS

ALIGNMENT OF ENGINE AND PROPELLER SHAFT

All necessary differential pinion angle requirements are designed and built into rear upper and lower control arm geometry. Slots in the engine support rear crossmember provide for fore and aft movement of engine-transmission assembly to provide for variation in positioning.

MAJOR REPAIRS

REMOVE PROPELLER SHAFT

1. Mark propeller shaft rear yoke and differential companion flange to insure their correct alignment on re-assembly.

2. Remove U-bolt nuts, lockplates (or lockwashers) and U-bolts from rear axle drive pinion companion flange.

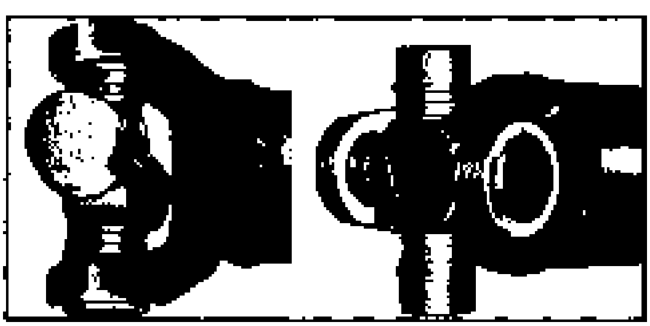


Fig. 4C-1 Bearings Held in Place by Tie Wire

3. If bearing tie wire has been removed, use suitable rubber band or tape to hold bearings onto journal, thus preventing loss of bearing rollers while rear universal joint is being disconnected (Fig. 4C-1).

4. Remove complete propeller shaft assembly by sliding it rearward and downward to disengage splined yoke from splines on transmission output shaft.

DISASSEMBLE UNIVERSAL JOINTS

NOTE: Because of elastic properties of nylon retainers used on the universal joint bearings, they must be pressed out which shears nylon retainers in half, rendering bearings and journal unsuitable for re-use. Therefore, upon re-assembly, new bearing and journal assemblies employing conventional snap ring retainers must be used. Consult parts book for repair kit part number.

A. Differential End

1. Support journal on a press bed in manner that will

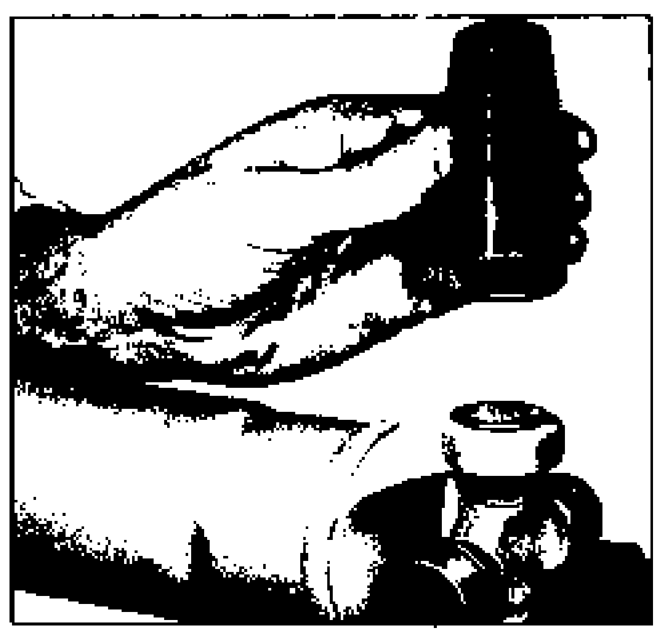


Fig. 4C-2 Removing Bearing from Yoke with 1-1/8" Dia. Pipe

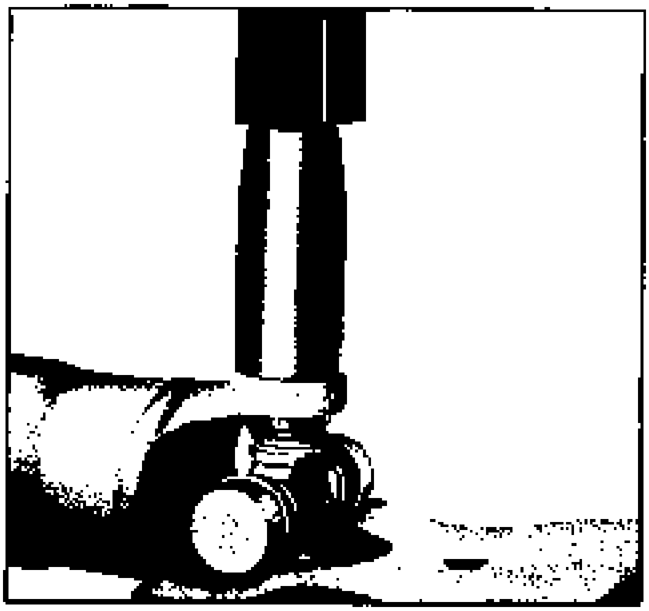


Fig. 4C-3 Pressing Out Bearing

allow propeller shaft yoke to be moved downward. Support front of propeller shaft on stand so that propeller shaft is horizontal (Fig. 4C-2)

2. Using piece of pipe or similar tool with diameter sufficiently large (slightly larger than 1 1/8") to encircle the bearing shell, apply force on yoke (Fig. 4C-3) until downward movement of yoke and stationary position of journal forces the bearing assembly almost out top of yoke (Force applied on yoke will shear nylon retainers which hold bearings in place).

3. Rotate propeller shaft 180° and repeat preceding step to partially remove opposite bearing.

4. Complete removal of these bearings by tapping around circumference of exposed portion of bearing with small hammer (Fig. 4C-4).

5. Remove journal from propeller shaft rear yoke

B. Transmission End

1. Support splined yoke on a press bed in manner that

Fig. 4C-4 Tapping Out Bearing

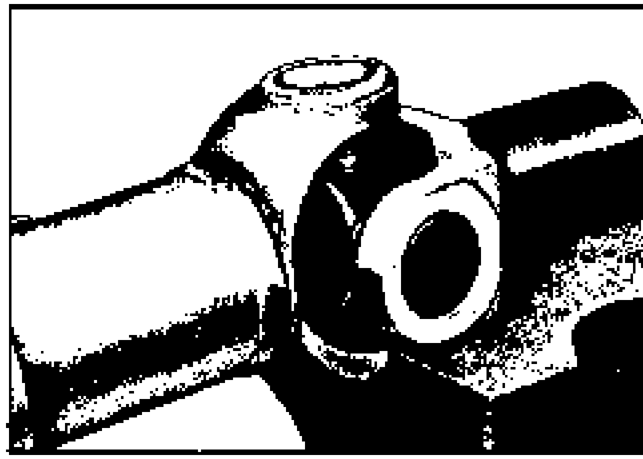


Fig. 4C-5 Supporting Splined Yoke

will allow propeller shaft fixed yoke to be moved downward (Fig. 4C-5). Support rear of propeller shaft on a stand so that propeller shaft is horizontal. Be sure weight is evenly distributed on each side of splined yoke.

2. Using piece of pipe or similar tool with diameter sufficiently large (slightly larger than 1 1/8") to encircle the bearing shell, apply force on propeller shaft fixed yoke until downward movement of propeller shaft fixed yoke and stationary position of journal forces the bearing assembly almost completely out top of yoke (Force applied on fixed yoke will shear nylon retainers which hold bearings in place).

3. Rotate propeller shaft 180° and repeat preceding step to partially remove opposite bearing.

4. Complete removal of these bearings by tapping around circumference of exposed portion of bearing with small hammer (Fig. 4C-4).

5. Remove splined yoke and journal from propeller shaft front fixed yoke.

6. Remove bearings and journal from splined yoke in a similar manner.

CLEANING AND INSPECTION

Clean and inspect outer surface of propeller shaft splined yoke to ensure that it is not burred, since burrs will damage transmission seal. Also, inspect splines of yoke for freedom from dirt.

ASSEMBLE UNIVERSAL JOINTS

NOTE: If universal joints are disassembled, new bearing and journal assemblies must be used for reassembly. Consult parts book for repair kit part number.

A. Transmission End

1. Install one bearing one-quarter way in one side of splined yoke, using soft-faced hammer. Check for proper alignment.

2. Insert journal into splined yoke so that arm of journal seats in bearing and complete installation of bearing (Fig. 4C-6).

3. Install opposite bearing, ensuring that bearing rollers do not jam on journal. Check for free movement of journal in bearings.

4. Install snap ring retainer in each journal with gaps toward splined yoke (Fig. 4C-7).

5. Install bearings and splined yoke to front fixed yoke of propeller shaft in a similar manner and install two snap ring retainers with gaps toward fixed yoke.

B. Differential End

1. Install one bearing one-quarter way in one side of propeller shaft rear yoke, using soft-faced hammer. Check for proper alignment.

2. Insert journal into rear yoke so that arm of journal seats in bearing and complete installation of bearing (Fig. 4C-6).

3. Install opposite bearing, ensuring that roller bearings do not jam on journal. Check for free movement of journal in bearings.

4. Install snap ring retainer in each journal with gaps toward rear fixed yoke (Fig. 4C-7).

5. Install two remaining trunnion bearings onto journal arms, using suitable rubber band or tape to hold bearings to journal.

INSTALL PROPELLER SHAFT ASSEMBLY

1. Inspect outer diameter of splined yoke to ensure that it is not burred, as this will damage transmission seal.

2. Apply engine oil to inside spline and outside diameter of yoke and slide propeller shaft splined yoke onto transmission output shaft.

3. Position rear universal joint to rear axle companion

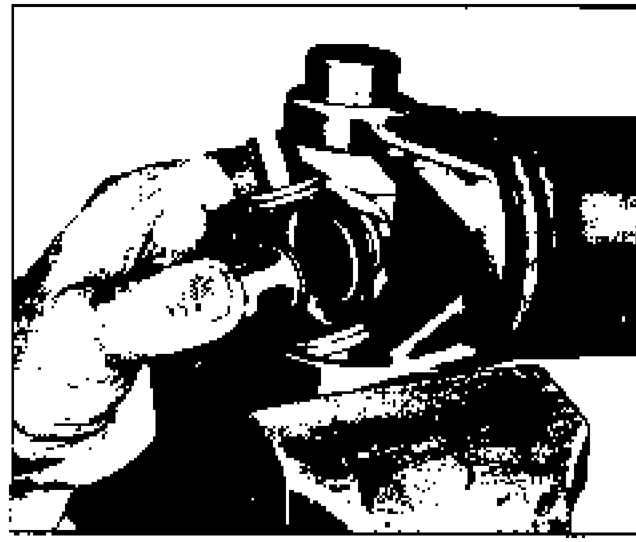


Fig. 4C-6 Installing Journal to Yoke

flange, making sure trunnion bearings are properly aligned in companion flange yoke.

NOTE: Be sure to align mark on companion flange with mark on propeller shaft rear yoke.

4. Install U-bolts, lockplates (or lockwashers), nuts and tighten U-bolt nuts to 12 lb. ft. torque (If lockwashers are used, tighten nuts to 14 lb. ft. torque).

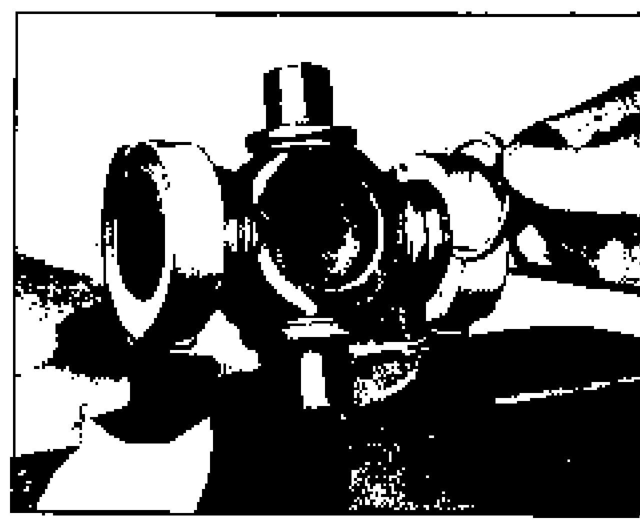


Fig. 4C-7 Installing Snap Ring Retainer

TORQUE SPECIFICATIONS

	LB. FT.
U-Bolt Nuts	12 (with lockplates)
	14 (with lockwashers)

Usage	Transmission	Color Band Code	Wheelbase (Inches)	Length (Inches)	Diameter (Inches)	Type Insulator
Firebird	3 & 4 Speed Manual 2 Speed Automatic Turbo Hydra-Matic M38	1 Blue	108.1	49.96	2.75	SOLID
	3 Speed H.D. Manual	1 White, 1 Green		49.96		
	Turbo Hydra-Matic M40	1 Red, 1 Pink		49.30		
2 Door Tempest Models & GTO	3 & 4 Speed Manual 2 Speed Automatic Turbo Hydra-Matic M38	1 Black, 1 Purple	112	56.00	3.00	
	3 Speed H.D. Manual	1 Brown, 1 Green		56.00		
	Turbo Hydra-Matic M40	1 Red, 2 White		55.34		
4 Door Tempest Models & Station Wagon	3 & 4 Speed Manual 2 Speed Automatic Turbo Hydra-Matic M38	1 Red, 1 White	116	60.00	3.25	
	3 Speed H.D. Manual	1 Red, 1 Yellow		60.00		
	Turbo Hydra-Matic M40	1 Pink		59.34		
Grand Prix	3 Speed H.D. Manual	1 Brown, 1 Green	118	56.00	3.00	
	4 Speed Manual	1 Black, 1 Purple		56.00		
	Turbo Hydra-Matic M40	1 Red, 2 White		55.34		
Catalina & Pontiac Station Wagons	3 Speed H.D. Manual	1 Black, 1 Yellow	121	56.68	3.00	
	Turbo Hydra-Matic M40	2 Pink				
Executive & Bonneville Except Station Wagon	3 Speed H.D. Manual	1 Brown, 1 Pink	124	59.58	3.25	
	Turbo Hydra-Matic M40	1 Black, 1 Green			3.38	

Fig. 4C-8 Propeller Shaft Comparison and Usage Information

STANDARD BRAKES

CONTENTS OF THIS SECTION

SERVICE OPERATIONS

Each time the car is serviced for any reason there is an opportunity and obligation to check the operation of the brake system. If the brake pedal has excessive travel when brakes are applied, or if pulls, grabs, or other irregularities are noted, a need for brake service exists. No car should leave the Service Department with brakes that are not safe. Corrections should be made as outlined in this section.

The braking system should be visually checked periodically; for example, each time the car is lubricated. When the car is raised on a lift, for inspection, brake lines, hoses, and cables should be inspected for signs of chafing, deterioration, or other damage. A careful check for leaks should also be made. Repairs as necessary should be performed as outlined in this section.

BRAKE PEDAL

REMOVE

NOTE: Refer to Section 1A for removal of air conditioning components if necessary.

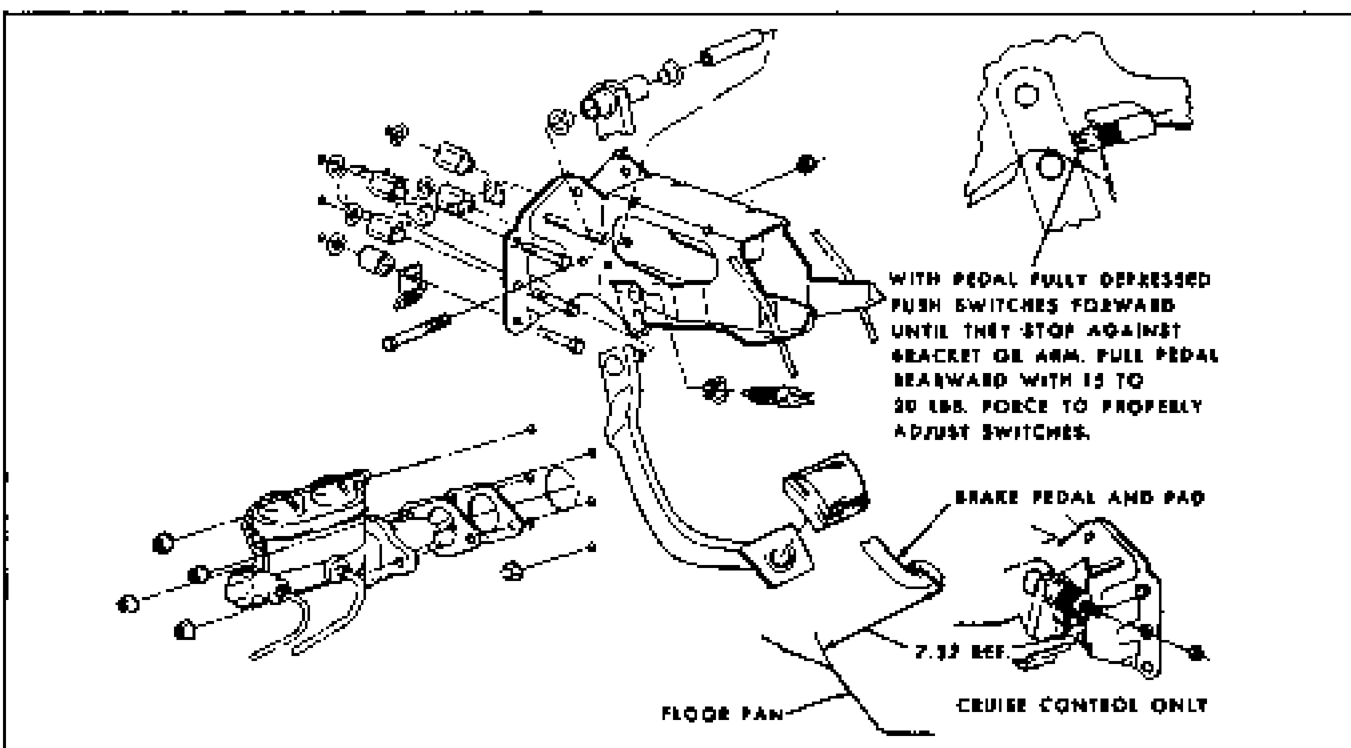


Fig. 5-1 Pontiac Manual Brake System

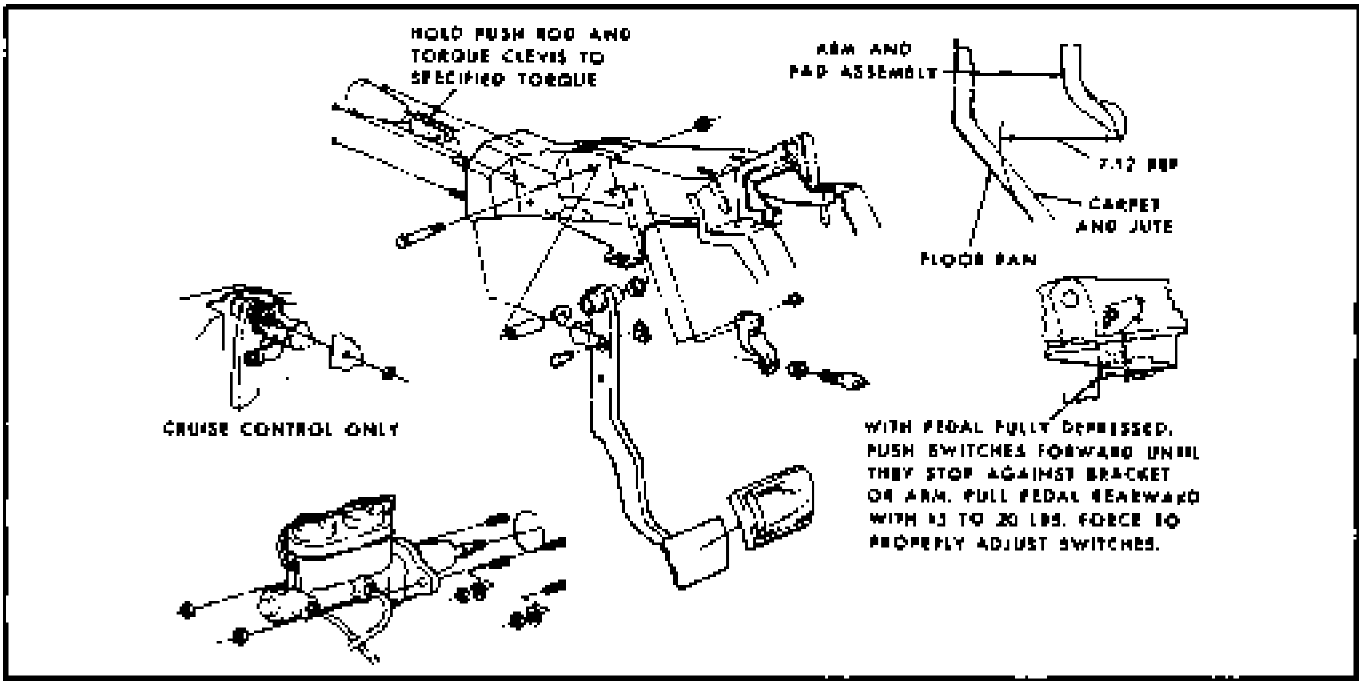


Fig. 5-2 Tempest and Grand Prix Manual Brake System

1. Firebird, Tempest and Grand Prix - Remove brake pedal clevis pin retainer and pin.

Pontiac - Clevis pin is part of pedal assembly.

2. Remove nut from brake pedal pivot bolt.

3. Slide pedal pivot shaft bolt to left enough to clear brake pedal.

NOTE: This is also the clutch pedal pivot shaft bolt with manual transmission on all models. A separate bolt, located at top of mounting bracket, is used on Pontiac with power brakes.

4. Withdraw brake pedal, spacer and nylon bushings.

NOTE: All manual brake pedals with cruise control have a return spring on the pedal hub.

REPLACE

1. Lubricate and install nylon bushings and spacer in pedal hub. (All manual brakes with cruise control control - install return spring on pedal hub.)

2. Install brake pedal in support brace.

3. Slide pedal pivot shaft bolt through support brace and pedal hub.

4. Install nut on pedal pivot shaft bolt and torque to specifications.

5. Install clevis pin (Tempest, Grand Prix and Firebird), and retainer, (all models).

NOTE: Retainer must scribe end of pin as installed.

PEDAL HEIGHT

Pedal height is not adjustable, and no attempt should be made to change this factory setting. Tempest, Firebird and Grand Prix - Clevis should be torqued against pushrod stop to 90 lb. in.

CAUTION: If pedal bracket prevents full return of brake pedal and master cylinder push rod, the master cylinder pistons may be prevented from returning to their stops. This can block off the compensating ports which prevents brake shoes from returning fully when the pedal is released. A further complication which follows a blocked compensating port is lining drag and complete brake burnup on the first prolonged drive. It is necessary that the primary cups be entirely clear of the compensating ports to provide a safety factor against normal rubber swell and expansion and deflection of body parts and pedal linkage.

BRAKE WARNING LIGHT CHECKING PROCEDURE

1. Determine if bulb is functioning by depressing parking brake.

2. Check to make sure both master cylinder reservoirs are full.

3. Open one wheel cylinder bleed screw in rear brake system. (Leave front system secure).

4. Depress brake pedal. Do not release pedal. The

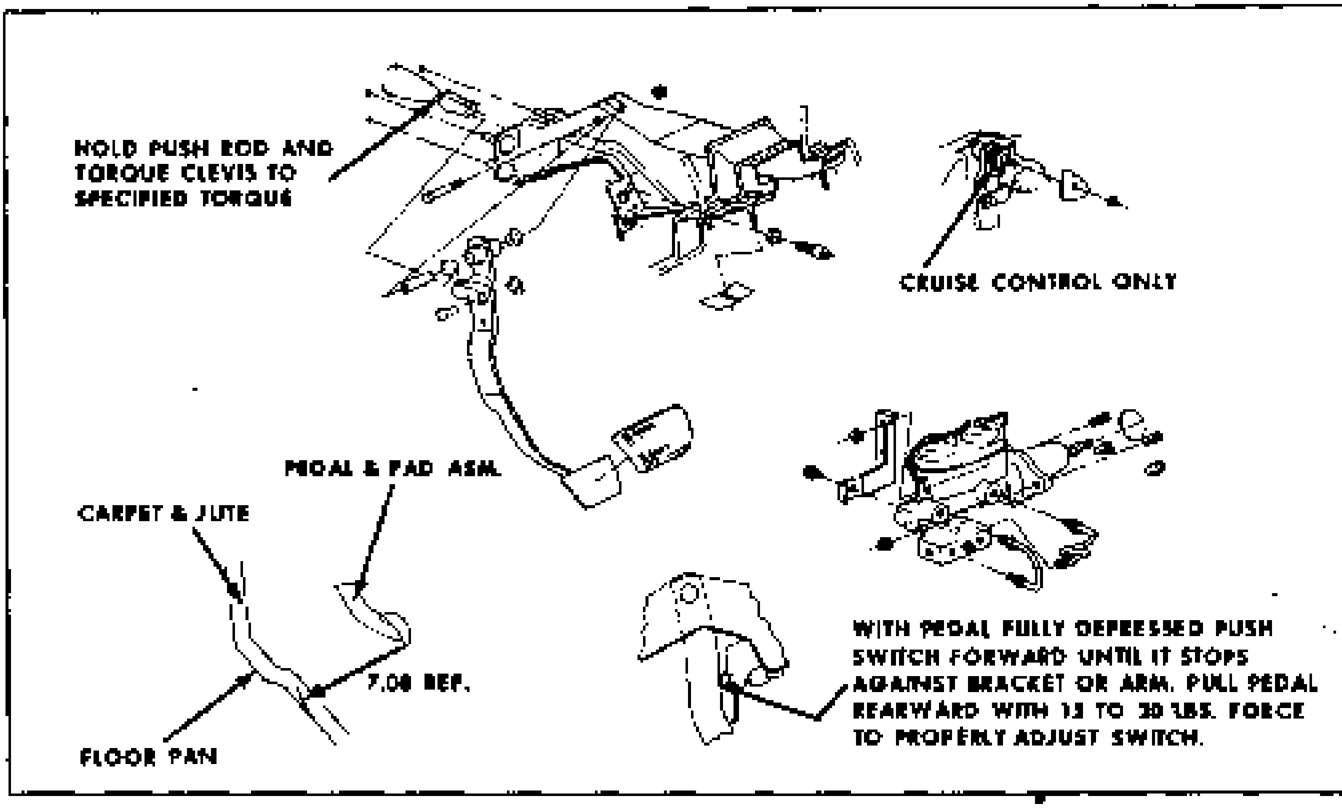


Fig. 5-3 Firebird Manual Brake System

light should come on due to pressure difference between front and rear systems. Approximately 150-250 psi differential is needed to operate brake light.

5. Close bleed screw. Release brake pedal. Refill rear reservoir, if needed.

6. Repeat by opening one front brake bleed screw. (Leave rear system secure).

NOTE: Caution should be taken to prevent air from entering hydraulic system during checks on switch.

The recommended checking interval should be 24 months or 24,000 miles, any time major brake work is done or any time a customer complains of excessive pedal travel.

STOP LIGHT SWITCH

REMOVE

1. Disconnect wires from switch.

2. Remove switch by pulling out of retainer.

REPLACE

1. Position stop light switch in retainer and push in to maximum distance.

2. Connect wires to switch.

3. Lift brake pedal pad with 15-20 lb. effort, brake pedal arm will automatically position switch correctly.

BRAKE ASSEMBLY MECHANISM AND DRUMS

ADJUSTMENT

All four brake assemblies incorporate a self-adjusting mechanism to automatically adjust the brake shoes when the car is operated in reverse.

NOTE: Normally, the self-adjusting feature of the brake system provides the proper shoe-to-drum clearance, but if a need for adjustment exists, it is recommended that the shoes be adjusted with the drums removed, using tool number J 22364, not only to give a more accurate clearance, but also to allow a thorough inspection of the brake mechanism for possible defects which may have caused the need for adjustment.

A manual adjustment is usually required when brake shoes are replaced or the length of the star wheel adjuster has been changed during some other service operation.

NOTE: This mechanism is designed so the brake assembly cannot be over-adjusted.

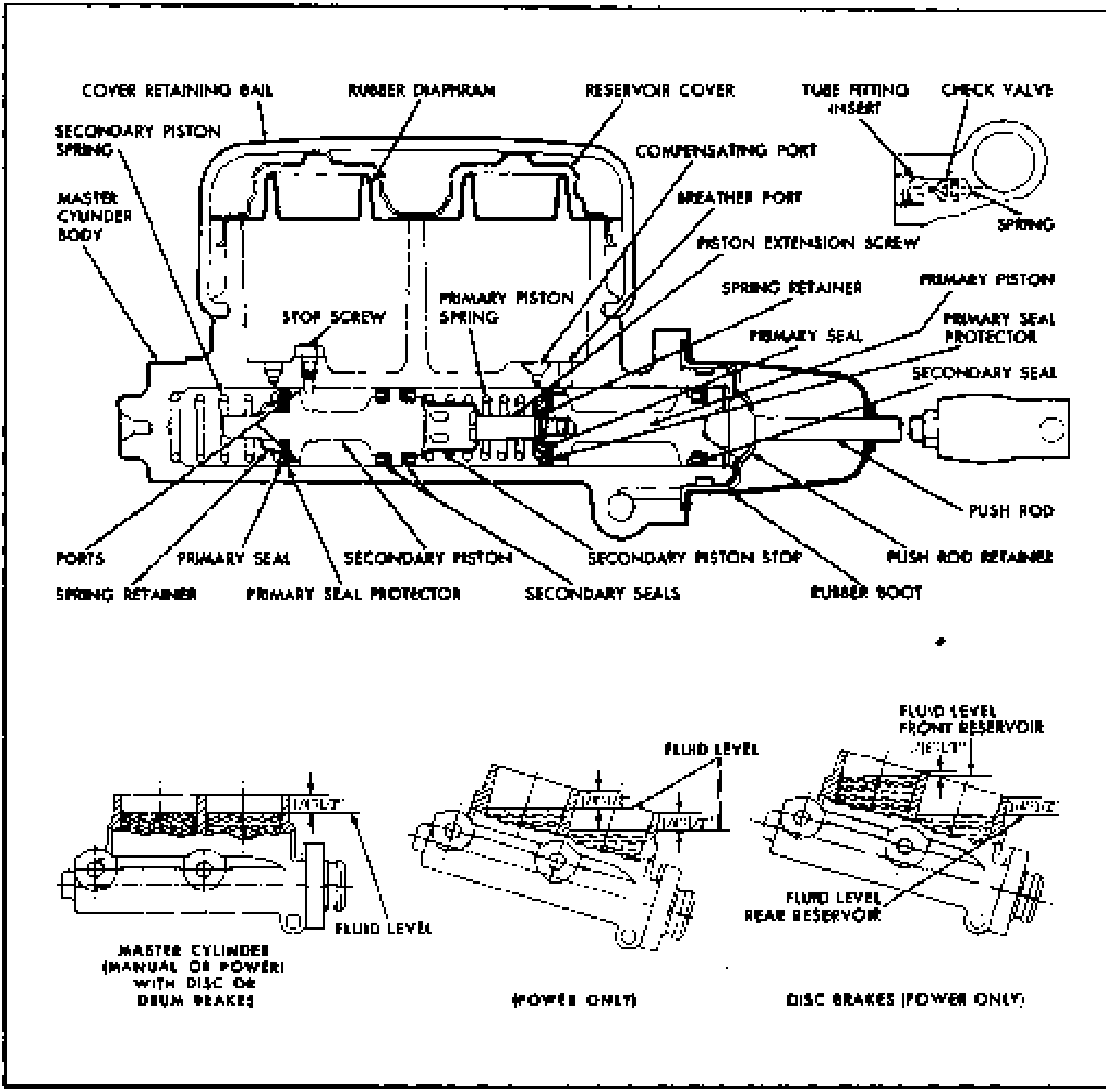


Fig. 5-4 Fluid levels and Master Cylinder Details

1. Remove wheels and brake drums. It may be necessary to back off the brake shoe adjustment before the brake drums can be removed. If this is the case, insert a small rod or screwdriver through the adjusting screw slot in the backing plate and hold automatic adjuster lever away from adjusting screw star wheel and rotate adjusting screw downward (Fig. 5-5 and 5-6).

2. Remove ridge at open end of drum with #40 grit sandpaper, or equivalent. Using tool J 22364, adjust tool to diameter of drum, then adjust brake shoes to fit opposite side of tool (Fig. 5-7).

3. Install wheels and drums, making certain that front wheel bearings are adjusted to specifications given in Section 3 of this manual.

NOTE: At completion of adjustment, drum must rotate without any drag. Replace any parts that prevent free rotation.

Proper clearance can also be obtained by lengthening the star wheel adjuster screw until a heavy drag is felt on the outer diameter of the brake drum (with wheel removed). Back-off adjusting screw one complete turn (Pontiac - 30 notches; Tempest, Grand Prix and Firebird - 26 notches).

4. Check to make certain parking brake mechanism and linkage are properly adjusted.

5. Check fluid level in master cylinder. The level should be within 1/4 inch from top of reservoir (Fig. 5-4).

6. Drive car alternately forward and backward, lightly applying brakes in each direction to check for proper operation.

DISASSEMBLY

1. Raise all four wheels off ground.

2. Remove front wheels, front hub and drum assemblies, rear wheels and rear drums.

NOTE: It may be necessary to back off the brake shoe adjustment before the brake drums can be removed. To back off shoe adjustment insert a small rod or screwdriver through the adjusting screw slot in the backing plate and hold automatic adjuster lever away from adjusting screw star wheel and rotate adjusting screw downward (Figs. 5-5 and 5-6).

3. Remove the primary and secondary shoe return springs.

4. Remove the brake shoe hold-down springs, pins and washers, and the adjuster lever and return spring (Fig. 5-8).

5. Spread shoes to clear wheel cylinder links, then remove the primary and secondary shoes as an assembly. On rear brakes spread shoes slightly and remove the parking brake lever strut and spring, then disconnect the parking brake cable from the operating lever.

CAUTION: Extreme care must be taken to prevent oil, grease or brake fluid from getting on linings. Even oily fingerprints on linings may affect the operation of brakes.

6. Remove the primary to secondary shoe spring and the adjusting screw.

7. On rear brakes, remove the parking brake lever from the secondary shoe.

8. Remove the actuating links from the wheel cylinder boots only if necessary (Fig. 5-8).

INSPECTION AND CLEANING

1. Inspect linings for wear or cracks. Clean brake shoes, drums and backing plates, removing any foreign particles that may have become imbedded in lining surface. Examine shoes for loose rivets which must be replaced. Install new shoes or reline if linings are badly burned or worn nearly flush with rivets or if linings show evidence of oil, grease or brake fluid on the surface.

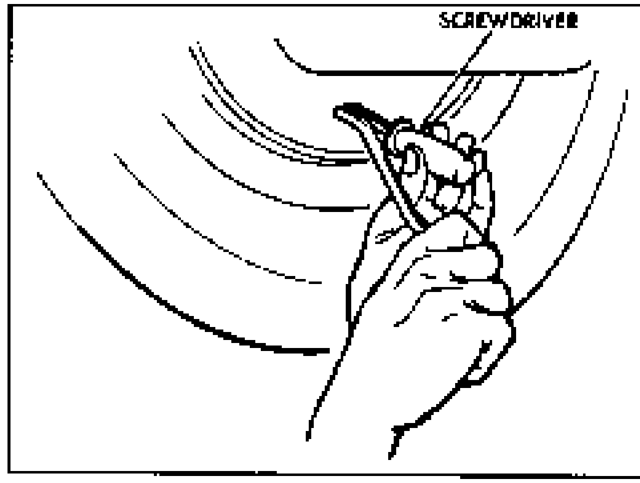
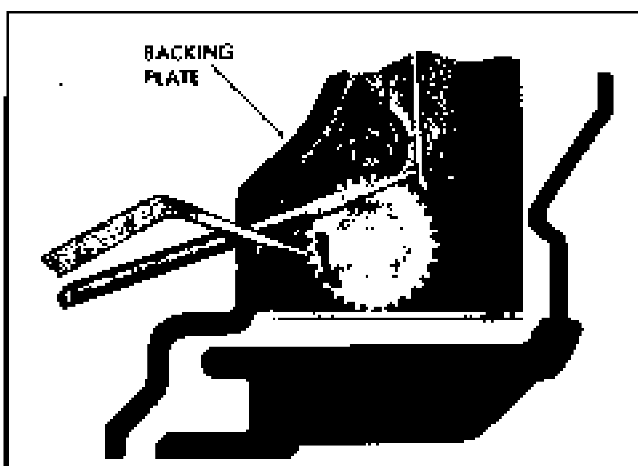


Fig. 5-5 Preparing to Back Off Adjusting Screw

2. Carefully pull wheel cylinder links out of the boots. Excessive fluid at this point indicates leakage past piston cups. A slight amount of fluid is nearly always present and acts as lubricant for the piston, but if an excessive amount of fluid is present, overhaul wheel cylinder. See Hydraulic System.

3. Clean inner surfaces of brake backing plates and all shoe contacting points. Sand shoe pads if necessary to remove grooves.

4. Disassemble the adjusting screw assembly and inspect as follows:



INSERT SMALL SCREW DRIVER OR AWL THROUGH BACKING PLATE SLOT AND HOLD ADJUSTER LEVER AWAY FROM SPROCKET BEFORE BACKING OFF BRAKE SHOE ADJUSTMENT

Fig. 5-6 Backing Off Adjusting Screw

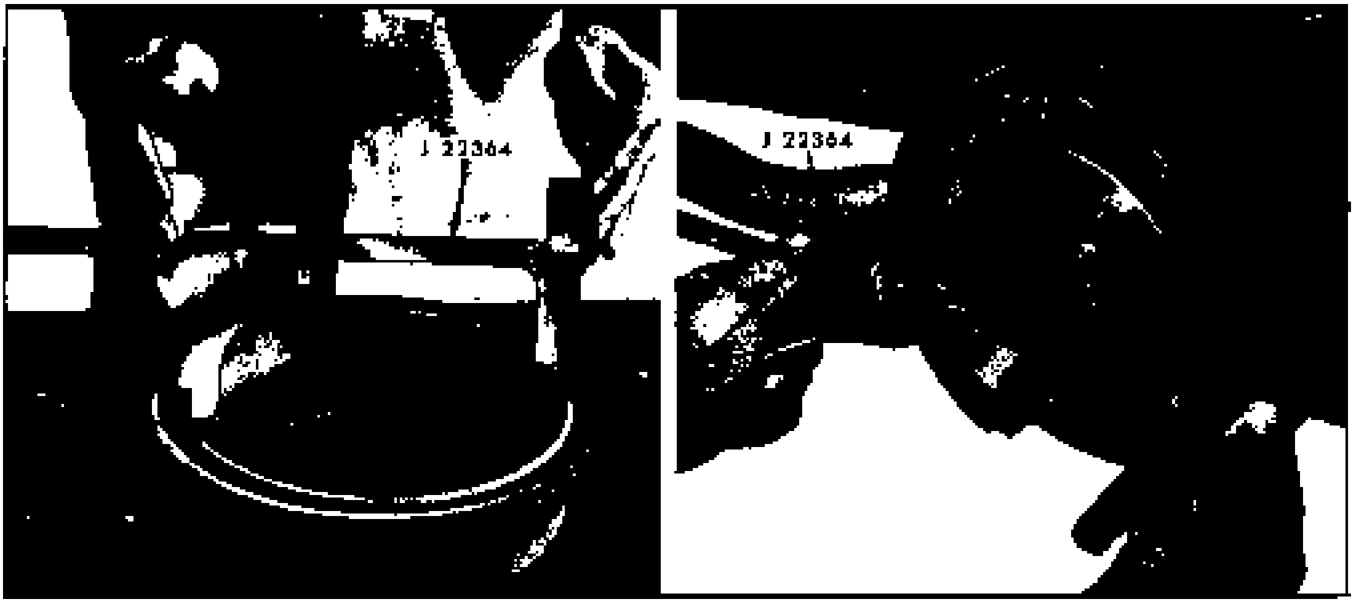


Fig. 5-7 Gauging Shoe to Drum Clearance

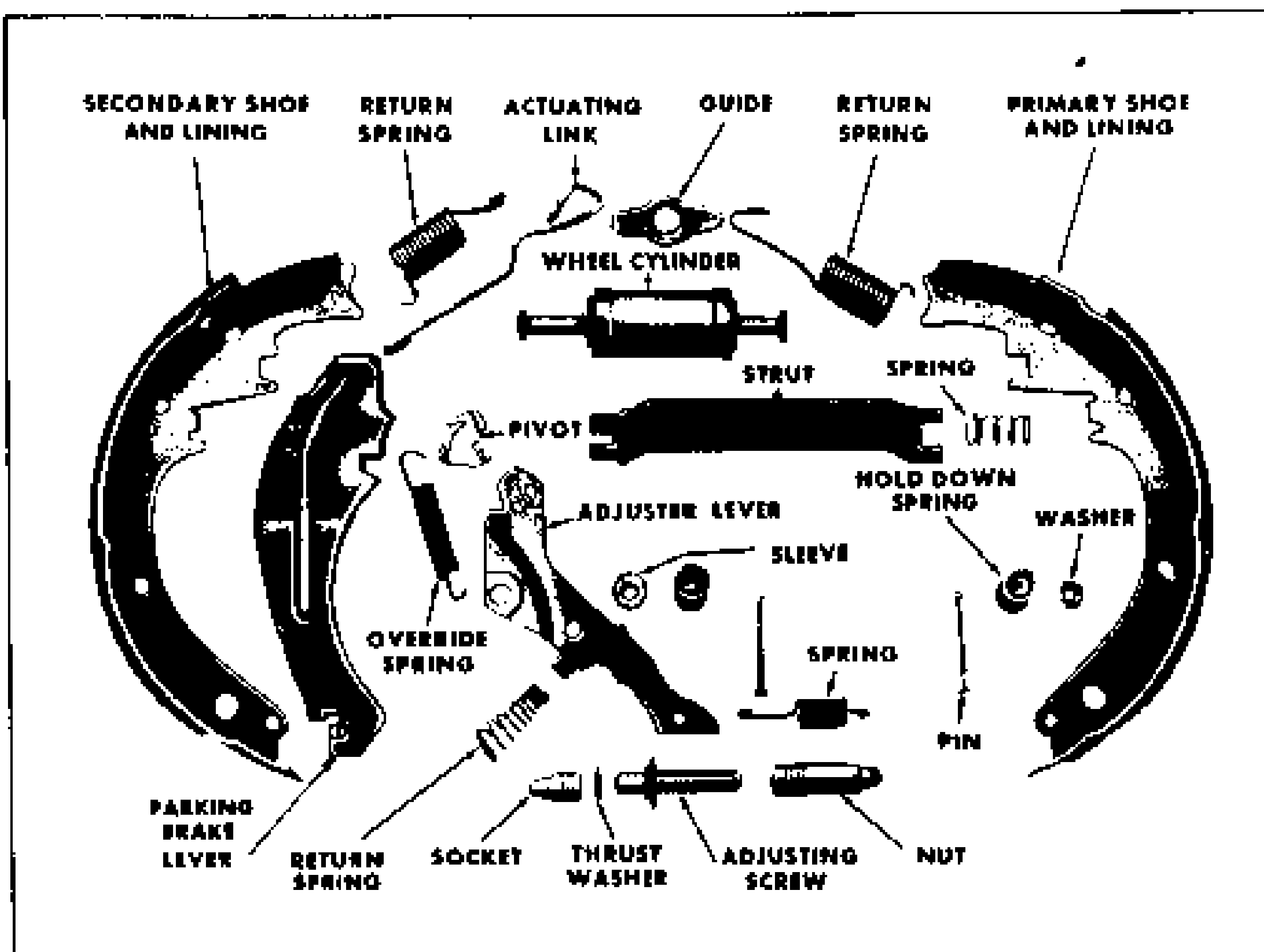


Fig. 5-8 Typical Self Adjusting Brake Assembly
Exploded View - Right Hand Side Rear

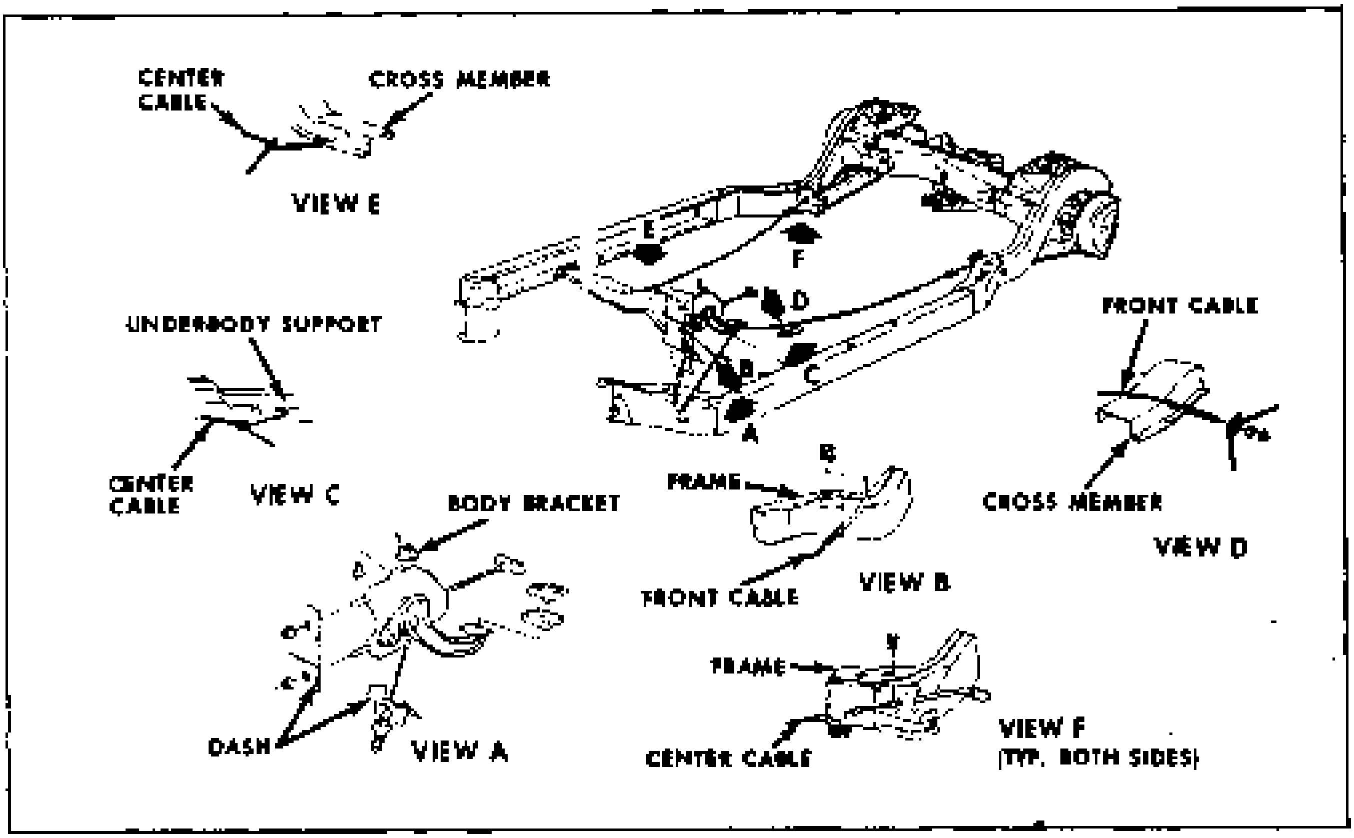


Fig. 5-9 Pontiac Parking Brake System

a. Inspect teeth on star wheel for wear.

b. Remove all foreign material from adjusting screw and nut. Nut must rotate freely on threads.

5. Check adjuster lever to be certain it is not bent or distorted, and that foot is not worn excessively. Replace if necessary.

6. Check the override pivot for wear or deformed parts.

7. Inspect brake drums for scoring. Road dirt frequently cuts grooves in drums which do not impair operation of brakes unless grooving is extremely severe. When drums are badly scored (deeper than .020") inspect brake shoe linings carefully for imbedded foreign material. Replace or recondition only if drums are badly scored.

NOTE: If drums are not scored deeper than .020" or do not exceed maximum out-of-round tolerances (see Specifications), they should be cross-sanded, rather than turned. Cross-sanding of drums may be accomplished using a 90 degree offset 1/4" or 3/8" drill adapter, with a 1" sanding disc (No. 40 grit). The drums should show a uniform finish after cross-sanding. This method of refinishing drums will allow the proper drum surface necessary to burnish new linings.

CAUTION: Removing material from brake drum reduces the strength of the drum and also its ability to transfer heat. Never remove more than is absolutely necessary and in no case remove more than 0.030" (increasing diameter by 0.060"). After a drum is turned, be sure it is free of all metal particles. Whenever a drum is turned, the drum on the opposite side should also be turned. If the drum diameter is less than 0.030" oversize (11.030") after refinishing, standard linings may be installed. If drum diameter is 11.030-11.060", oversize linings must be installed.

NOTE: If new linings are installed on one wheel, they must also be installed on the opposite side of the car.

8. Check brake drum for build-up of rust and dirt at outer circumference. Remove build-up so that drums can be installed over pre-adjusted linings.

9. Inspect front wheel bearings and oil seals and replace as necessary.

10. Inspect hoses and hydraulic lines for wear, kinks, or damage and replace as necessary.

11. Clean exposed portions of parking brake cables and examine for broken strands.

12. Check to make sure all bolts and nuts securing backing plate to suspension are tightened to 100 lb. ft. torque at upper plate to knuckle bolt, 75 lb. ft. torque at lower bolt and 35 lb. ft. torque on all rear plate to axle flange bolts.

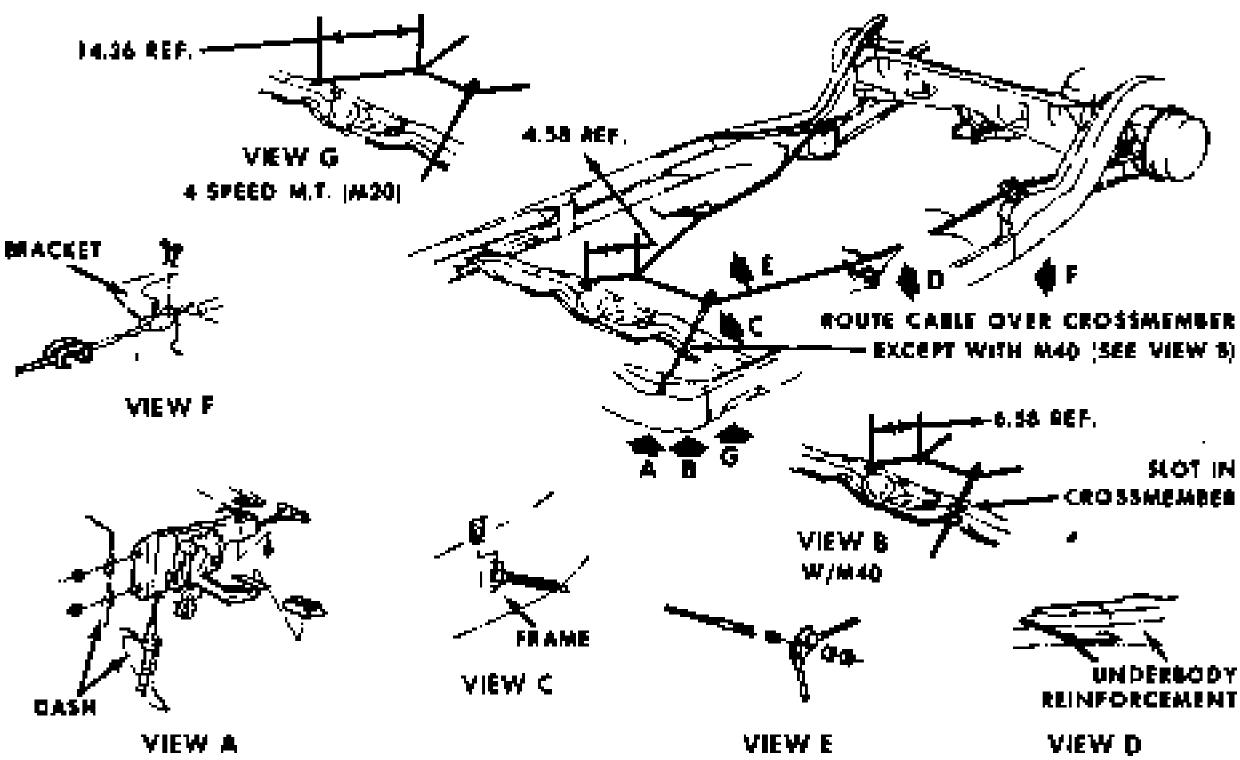


Fig. 5-10 Tempest and Grand Prix Parking Brake System

ASSEMBLY

1. Lubricate the adjusting screw threads, shoe pads on backing plate and all other contacting surfaces with a small amount of brake lubricant or wheel bearing lubricant. Do not lubricate teeth of star wheel.

2. Pull parking brake cable forward and rearward through conduit and lubricate freely with light grease or chassis lubricant. Remove any excess lubricant.

3. Assemble the adjusting screw.

4. Attach the adjusting screw tension spring to the shoes and install the adjusting screw. The spring must not contact the adjusting screw star wheel.

NOTE: The right front and right rear adjusting screws have left hand threads and can be identified as follows:

PONTIAC

Right front - 3 wide grooves.

Right rear - 1 wide groove.

Left front - 3 V grooves.

Left rear - 1 V groove.

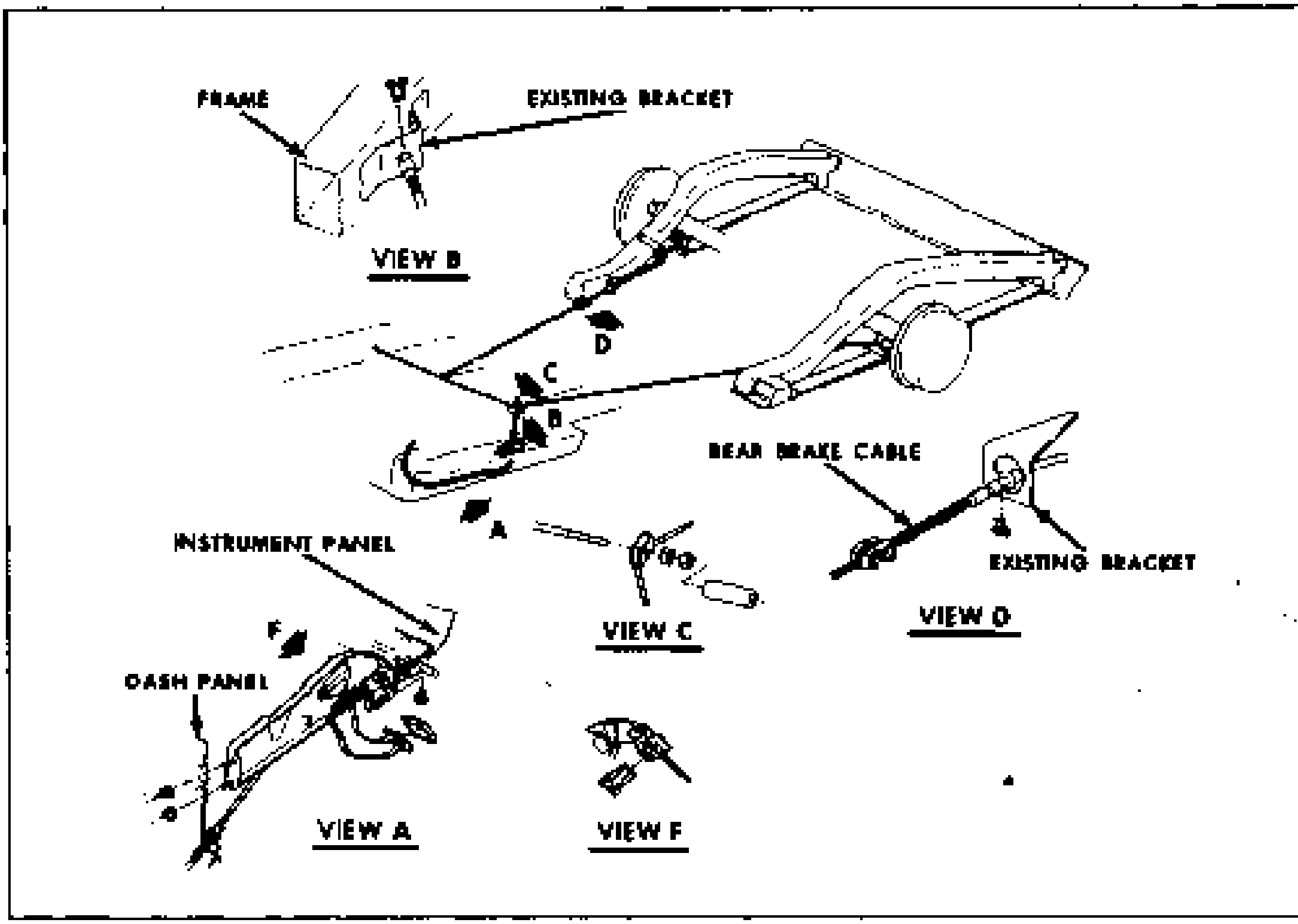


Fig. 5-11 Firebird Parking Brake System

TEMPEST, GRAND PRIX, AND FIREBIRD

Right front and rear - 2 wide grooves.

Left front and rear - 2 V grooves.

All adjusting screws must be installed with the star wheel end of the screw toward the rear of the car.

5. On rear brake assemblies, install the parking brake lever to the secondary shoe and connect cable.

6. Position shoe assembly on the backing plate. Be sure wheel cylinder links are properly positioned in the shoe notches.

NOTE: When replacing shoes, always be certain to assemble secondary shoes to the rear and primary shoes to the front. Note that linings of primary shoes are usually shorter than secondary linings.

On rear brakes, install strut and spring between lever and primary shoe.

7. Position the upper end of actuating link over anchor pin.

8. Engage the adjuster lever with the override pivot, then position the adjuster lever and override spring assembly on the secondary shoe. Fasten with the hold down spring assembly (Fig. 5-8).

NOTE: THE FRONT BRAKE SPRING RETAINING PINS ARE IDENTIFIED WITH THE NUMERAL 6 (PONTIAC) OR 4 (TEMPEST, GRAND PRIX AND FIREBIRD) STAMPED ON THE OUTER FACE. THE REAR BRAKE RETAINING PINS ARE IDENTIFIED WITH THE NUMERAL 8 (PONTIAC) OR 2 (TEMPEST, GRAND PRIX AND FIREBIRD) STAMPED ON THE OUTER FACE. INSTALL THE PRIMARY HOLD-DOWN SPRING.

9. Install the primary and secondary brake shoe return springs.

NOTE: New brake shoe return springs should be installed if old springs have been overheated or strength is doubtful. Overheated springs may be indicated by burned paint, and coils opened up, or failure of shoes to return to anchor pin.

10. Sand linings lightly to remove any trace of dirt.

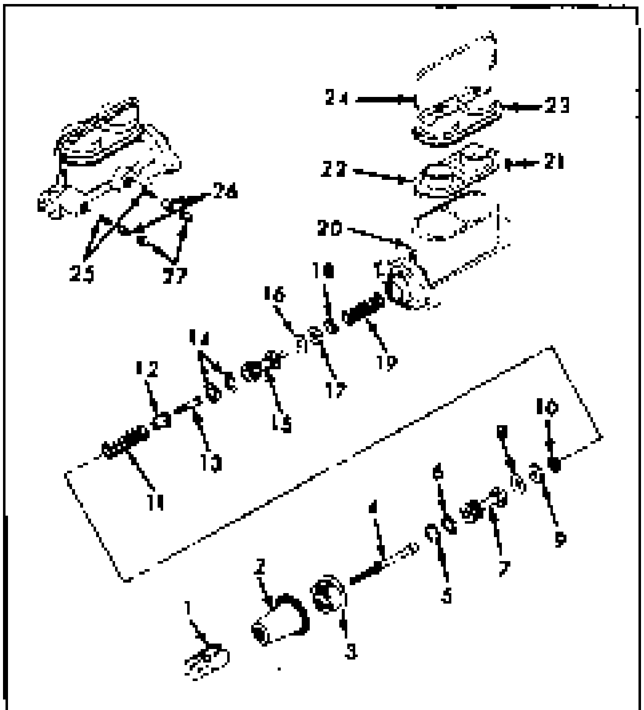


Fig. 5-12 Master Cylinder - Exploded View

11. Check to see that adjuster lever can turn adjusting screw star wheel with minimum of effort.

12. Adjust brake shoe-to-drum clearance as outlined under ADJUSTMENT.

13. Install drums, observing instructions for front wheel bearing adjustment as outlined in Section 3 of this manual.

14. If wheel cylinder has been replaced or repaired, or hydraulic line has been replaced, bleed brakes as described in this section on BLEEDING BRAKES.

15. Check parking brake cable adjustment and, if necessary, adjust as outlined under PARKING BRAKE -ADJUSTMENT.

16. Check fluid level in master cylinder as shown in Fig. 5-4.

17. Install wheels. Tighten nuts (Pontiac) 75 lb. ft. (Tempest, Grand Prix and Firebird) 70 lb. ft. torque.

18. Check brake pedal travel to be sure it is within specifications, then road test car for proper operation of the brake system.

CAUTION: New linings must be protected from severe usage for several hundred miles. This should be conveyed to owner, along with instructions to follow proper burnishing procedure as outlined in Owner's Manual.

HYDRAULIC SYSTEM

The dual master cylinder is designed and built to satisfy individual brake system displacement requirements (Fig. 5-4). Therefore, it is necessary that the following basic rules be used when replacing either a complete master cylinder or parts.

1. The two-letter identification stamp on the end of master cylinder indicates displacement capabilities of a particular cylinder. The master cylinder should only be replaced with another cylinder bearing the same two-letter identification (see Master Cylinder Usage Chart), Fig. 5-14.

2. The lengths of component pistons in a master cylinder are critical factors in displacement capabilities of a master cylinder. Pistons are coded, using rings or grooves in shank of piston. When pistons are replaced, replacement piston must contain same identification marks and same contour at push rod end as piston which was removed.

3. The dual master cylinder, used with standard brakes, contains a rubber check valve and check valve spring in each outlet boss. No check valve is required for disc brakes and, therefore, the outlet boss to the front brakes will not contain a check valve and spring.

MASTER CYLINDER

REMOVE

1. Disconnect master cylinder push rod from brake pedal.

2. Disconnect brake lines from two outlets on master cylinder and cover end of lines and outlet ports to prevent entrance of dirt.

3. Remove master cylinder from dash.

DISASSEMBLE

1. Remove master cylinder reservoir cover and drain fluid. Pump fluid from master cylinder by depressing push rod.

2. A retained push rod is used on all standard brake

applications. Pull back boot to uncover push rod retainer. The retainer has a small, depressed tab in the side and may be pried up to release retainer. Tab serves to hold retainer and push rod on master cylinder while it is being shipped and it is not necessary to bend tab down at reassembly. Retainer is held in place between master cylinder and dash when master cylinder is bolted in place.

3. Remove small secondary piston stop bolt from bottom of front fluid reservoir of master cylinder.

4. Place master cylinder in soft jaws of vise. Remove lock ring from small groove in inside diameter of bore. Remove primary piston (rear). Remove secondary (front) piston, piston spring and retainer by applying air pressure through front piston stop bolt hole. Do not attempt to disassemble rear piston since complete new assembly is provided in repair kit.

NOTE: If air is not available, a piece of wire may be used. Bend one fourth inch of one end of wire into right angle and hook end under edge of floating piston to remove.

5. For your convenience, in the event they are needed, repair kits contain replacement check valves and springs. Following are the conditions under which the check valves should be replaced:

a. Whenever fluid in brake system is contaminated.

b. Whenever foreign material or sediment is found inside reservoir.

c. If vehicle is 5 years old, or has 50,000 miles or more on it.

d. If hydraulic brake master cylinder was subjected to excessive heat such as fire due to accident, etc.

NOTE: In most cases, it will not be necessary to install new check valves unless conditions above exist; therefore, unless they do exist, it is not recommended that the check valves be replaced. If check valves do require replacement, carefully follow the service procedure outlined below.

6. With master cylinder in vise (outlet holes up), drill out the tube fitting insert with a 13/64" drill and then tap the hole, using a 1/4" x 20 tap. Place a 1/2" to 3/4" long, 1/4" x 20 bolt through a thick washer and then thread the bolt into the insert. Tighten the bolt against the washer until the insert is removed.

7. Remove check valves and springs from cavities beneath tube seats and discard.

8. Remove master cylinder from vise and inspect bore for corrosion, pits and foreign matter. Make sure outlet ports are clean and free of brass cuttings from tube-seat removal operation. Inspect fluid reservoirs for foreign matter. Check bypass and compensating ports to master cylinder bore to insure they are not restricted.

9. Remove primary seal, primary seal protector and secondary seals from front piston.

CLEANING

Use alcohol or clean brake fluid to clean all metal brake parts thoroughly. Immerse parts in cleaning fluid using a bristle brush to remove foreign matter. Blow out all passages, orifices and valve holes. Air dry and place cleaned parts on clean paper or lint free cloth.

NOTE: Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean until reassembly. Rewash at reassembly if there is any occasion to doubt cleanliness.

ASSEMBLE

1. Place master cylinder in vise, with outlet holes up. Place check valve springs in outlet holes, so they will seat in depression in bottom of holes. Place new rubber check valves over springs, being careful not to displace springs from their seat.

2. Place new brass tube seat in outlet holes in position to be pressed into outlet hole. Be sure that it is not cocked, as this would cause burrs to be turned up when the tube seat is pressed in. Recommended method of inserting tube seat is to thread a spare brake line tube nut into outlet hole and turn nut down until tube seat bottoms. (Remove tube nut and check outlet hole for loose burrs, which might have been turned up when the tube seat was pressed down.)

3. Put new secondary seals in the two grooves in the end of front piston. Seal which is nearest the end of the piston will have its lips facing toward that end. The second groove seal should have its lips facing toward the portion of front piston which contains small compensating holes (Fig. 5-4).

4. Assemble a new primary seal and protector over end of front piston with flat side of seal seating against seal protector and protector against flange of piston which contains the small compensating holes (Fig. 5-4).

5. All master cylinder overhaul kits contain assembled primary piston, making it unnecessary to assemble any primary piston component parts.

6. Coat bore of master cylinder, primary and secondary seals on front piston with clean brake fluid. Insert secondary piston spring retainer into secondary piston spring. Place retainer and spring down over end of front piston locating retainer inside lips of primary cup.

7. Holding master cylinder with open end of bore

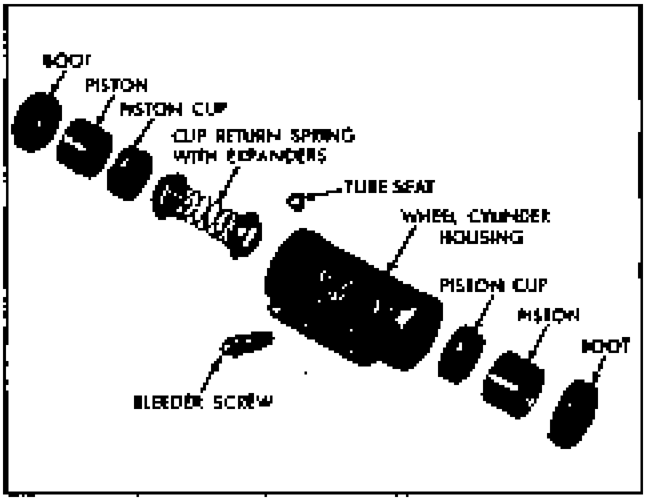


Fig. 5-13 Wheel Cylinder - Exploded View

down, push front piston into bore, seating spring against closed end of bore.

8. Place master cylinder in vise with open end of bore up. Coat primary and secondary seal on rear piston with clean brake fluid. Push rear piston assembly, spring end first, into bore of master cylinder. Hold piston down and snap lock ring into position in small groove in I.D. of bore.

9. Continue to hold rear piston down, which will move front piston forward far enough to clear stop screw hole located in bottom of front fluid reservoir. Position stop screw in its hole and tighten to a torque of 33 lb in.

10. Install a new reservoir diaphragm in reservoir cover, if needed. Install cover on master cylinder. Beaded side faces casting to insure positive sealing. Push bail wires into position to hold reservoir cover.

11. Assemble push rod through push rod retainer, if disassembled.

12. Push retainer over end of master cylinder. Assemble new boot over push rod and press it down over push rod retainer.

REPLACE

1. Mount and secure master cylinder to dash, tighten fasteners to 25 lb. ft. torque. The flange on the push rod retainer and flange on boot will be held between the dash and master cylinder.

2. Connect push rod to brake pedal and attach brake lines to appropriate bosses on master cylinder. Outlet boss thread sizes and brake line fittings for front and rear are different, to assure that correct connections are made, providing original brake lines have not been changed.

3. Fill and bleed master cylinder as though it were two separate units. See section on bleeding brakes. After bleeding, fill reservoirs with brake fluid to within 1/4" of top of reservoir.

MASTER CYLINDER USAGE CHART

USAGE	MASTER CYL. IDENT. STAMP	BORE SIZE	PRIMARY* PISTON IDENT.	SECONDARY PISTON IDENT.
DELCO-MORAINE Pontiac—Power Drum & Manual Drum	HU	1"	—	No Rings or Grooves
Grand Prix & Tempest—Power Drum & Manual Drum	CT	1"	—	1 Ring or 1 Groove
Firebird—Power Drum & Manual Drum	CT	1"	—	1 Ring or 1 Groove
Grand Prix & Tempest—Power Disc	EA	1⅛"	—	6 Rings or 6 Grooves
Firebird—Power Disc	OA	1⅛"	—	3 Rings or 3 Grooves
Pontiac—Power Disc	RA	1⅛"	—	2 Rings or 2 Grooves
BENDIX Pontiac—Power Drum	HU	1"	716	—
Pontiac—Power Drum (Heavy Duty)	PP	1"	6213	—
Pontiac—Power Disc	YM	1⅛"	794	—

**Number stamped on side of piston.*

Fig. 5-14 Master Cylinder Usage Chart

WHEEL CYLINDER

REMOVE

1. Raise wheels of vehicle and remove wheel and drum assembly.

2. Remove brake shoes to protect them from dripping fluid.

3. Disconnect hose from wheel cylinder on Firebird and Pontiac.

On Tempest and Grand Prix remove brake pipe.

4. Remove wheel cylinder.

The internal wheel cylinder boots should be removed from cylinder body only when they are visibly damaged or leaking fluid.

Wheel cylinders having torn, cut or heat-cracked boots should be completely overhauled.

Inspection for leakage may be accomplished at the boot center hole after removal of the link pin. Fluid coatings on the piston within the cylinder and on the end of the link pin removed from the boot are normal, as the cylinder contains a porous piston which is impregnated with a corrosion-inhibiting fluid. Fluid spilling from the boot center hole, after the link pin is removed, indicates cup leakage and the necessity for completely overhauling the cylinder

DISASSEMBLE (Fig. 5-13)

1. Pull boots from cylinder ends with pliers and discard boots.

2. Extract and discard pistons and cups.

3. Inspect cylinder bore. Check for staining or corrosion. It is best to discard a corroded cylinder.

NOTE: Staining is not to be confused with corrosion. Corrosion can be identified as pits or excessive bore roughness.

4. Polish any discolored or stained area with crocus cloth by revolving the cylinder on the cloth supported by a finger. Do not slide the cloth in a lengthwise manner under pressure. Do not use any other form of abrasive or abrasive cloth.

5. Rinse the cylinder in alcohol or brake fluid.

6. Shake excess rinsing fluid from the cylinder. Do not use a rag to dry the cylinder, as lint from the rag cannot be kept from the cylinder bore surfaces.

ASSEMBLE

1. Lubricate the cylinder bore and counterbore with brake fluid and insert spring-expander assembly.

2. Install new cups making sure cups are lint and dirt free. Do not lubricate cups prior to assembly.

3. Install new pistons in the "as received" condition to insure proper corrosion inhibiting properties. Do not lubricate pistons with brake fluid.

4. Press new boots into cylinder counterbores by hand. Do not lubricate boots prior to assembly.

REPLACE

1. Install wheel cylinder on backing plate with screws and lock washers. Tighten screws to 14 1/2 lb. ft. torque (Pontiac) 8 lb. ft. torque (Tempest, Grand Prix and Firebird).

2. Replace wheel cylinder connecting links.

3. Install brake shoes and springs.

4. Connect hose or pipe to wheel cylinder. (Use new gasket with hose.)

5. Install brake drums. Adjust front wheel bearings (as described in Section 3, SUSPENSION).

6. Bleed all brake lines affected as described under BLEEDING BRAKES in this section.

7. Adjust and test brakes as previously described in this section.

BLEEDING BRAKES

Depressing the pedal with a low fluid level in master cylinder reservoir or disconnecting any part of the hydraulic system permits air to enter the system. Air may also enter the system occasionally when brake shoes are replaced. This air must be removed by bleeding.

Bleeding may either be done by using pressure bleeding equipment or by manually pumping the brake pedal using bleeder tube as outlined below.

CAUTION: Always clear away any dirt around master cylinder reservoir cover before removing cover for any reason. Never depress pedal while brake drums are removed unless bleeder valve is open.

When using pressure bleeding equipment, follow instructions of the equipment manufacturer and always use bleeder tube attached to wheel cylinder to prevent brake fluid from running inside the brake assembly and ultimately on the brake linings.

When bleeding by operating pedal, proceed as outlined below:

1. Fill master cylinder reservoirs with recommended brake fluid.

CAUTION: Never use an inferior or reclaimed brake fluid as this will positively result in brake trouble. Even though reclaimed fluid may look clear, tests have shown such fluid to be corrosive. If there is doubt as to the grade of fluid in the system, flush out system and fill with recommended brake fluid complying with SAE 70-R-3 specifications such as Delco Supreme II.

2. On models equipped with master cylinder bleeder screws (Tempest, Grand Prix and Firebird Power Brake units), bleed master cylinder by following procedure. Attach bleeder tube to valve and allow tube to hang submerged in brake fluid in a clean quart glass jar. Using brake bleeder wrench or equivalent, unscrew bleeder valve three-quarters of a turn. Depress pedal full stroke and allow it to return slowly making sure end of bleeder tube is under surface of liquid in container. Continue operating pedal, refilling reservoir after each five strokes (unless an automatic filling device is used), until liquid containing no air bubbles emerges from bleeder tube.

3. Close bleeder valve assembly and bleed other master cylinder bleeder valve.

NOTE: If a power brake unit has been installed on a Tempest, Grand Prix or Firebird and the original manual master cylinder (without bleeder valves) is used, these units may be bled by unscrewing the master cylinder brake line three-quarters of a turn, depressing brake pedal, tightening brake line, then releasing brake pedal.

4. After master cylinder has been bled, wheel cylinders may be bled in the following order using the above procedure: left front, right front, left rear and right rear.

CAUTION: Bleeder tube should always be used when bleeding brakes, and end of tube must be below level of brake fluid in glass jar when bleeding other than by pressure.

5. When bleeding operation is completed, refill reservoirs as shown in Fig. 5-4, then replace reservoir cover.

FLUSHING HYDRAULIC SYSTEM

It may sometimes become necessary to flush out the brake hydraulic system due to the presence of mineral oil, kerosene, gasoline, carbon tetrachloride, etc., which will cause swelling and/or deterioration of rubber piston cups and valves so they become inoperative.

NOTE: If it becomes necessary to replace brake fluid lines, use only steel lines with double-flared ends.

To flush hydraulic system, proceed as follows:

1. Attach bleeder tube and open bleeder valve at left front wheel.

2. Flush out system thoroughly with clean denatured alcohol, pumping the fluid from master cylinder reservoir and out of wheel cylinder bleeder valve.

3. Repeat steps 1 and 2 at remaining wheel cylinders. To ensure thorough flushing, approximately 1/2 pint of alcohol should be bled through each wheel cylinder.

4. Replace all rubber parts in master and wheel cylinders. Thoroughly clean cylinders and pistons in alcohol before installing new parts.

5. After installing parts, fill system with recommended brake fluid and follow steps 2 through 4 under BLEEDING BRAKES to flush system of cleaning solution and to bleed brakes. In doing this, pump brake fluid from wheel cylinder bleeder valves until clear fluid flows from bleeder tube and then continue until no air bubbles emerge from bleeder tube.

PARKING BRAKE

The rear brake assemblies serve a dual purpose in that they are utilized both as a hydraulically operated brake and a mechanically operated parking brake. In view of this dual purpose, the hydraulic brake must be properly adjusted as a base for parking brake adjustment.

NOTE: Automatic brake adjusters normally keep the parking brake adjusted correctly. However, there may be a condition where the parking brake system will require additional adjustment even though the service brakes are perfectly satisfactory.

INSPECTION, CLEANING AND LUBRICATION

If complete release of the parking brake pedal is not obtained unless the pedal is forcibly returned to its position, or if the application effort is high, check parking brake pedal assembly for free operation. If operation is sticky or a bind is experienced, correct as follows:

1. Clean and lubricate cables (within conduits) and cable contact areas with lithium soap grease (front bearings) or equivalent.

2. Inspect parking brake pedal assembly for straightness and alignment.

3. Clean and lubricate parking brake pedal assembly with bearing or chassis grease.

4. Check routing of cables for kinks, binds and broken strands.

ADJUSTMENT

CAUTION: It is very important that parking brake cables are not adjusted too tightly causing brake drag.

With automatic brake adjusters, a tight cable causes brake drag and also positions the secondary brake shoe, hence the adjuster lever, so that it continues to adjust to compensate for wear caused by the drag. The result is a cycle of wear and adjustment that can wear out linings very rapidly.

1. Jack up both rear wheels.

2. Push parking brake pedal five to seven notches from fully released position.

3. Loosen the equalizer rear lock nut. Adjust the forward nut until a light to moderate drag is felt when rear wheels are rotated.

4. Tighten lock nut.

5. Fully release parking brake and rotate rear wheels; no drag should be present.

PARKING BRAKE PEDAL REMOVAL

NOTE: Remove positive cable from battery to eliminate the possibility of creating short circuits under dash.

1. Place parking brake pedal in released position.

2. Remove two attaching nuts from mounting studs located in engine compartment.

3. Remove pedal to dash brace attaching screw.

4. Remove brake pedal switch wire.

5. Remove front cable retainer from clevis.

6. Remove pedal assembly by lowering rear slightly to avoid scratching instrument panel.

PARKING BRAKE PEDAL INSTALLATION

1. Place pedal in position with the two mounting studs protruding through the holes provided in the firewall.

2. Position front cable retainer into pedal clevis.

3. Install and tighten pedal to dash brace attaching screw.

4. Install parking brake switch wire

5. Install and tighten two attaching nuts on mounting studs located in engine compartment.

6. Connect positive battery cable.

FRONT CABLE REMOVAL

NOTE: Remove positive cable from battery to eliminate the possibility of creating short circuits under dash.

1. Place parking brake pedal in released position.

2. Remove equalizer check nut, and separate cable stud from equalizer.

3. Remove clip from cable at inner side of frame rail.

4. Remove end of cable from pedal clevis.

5. Pontiac, Tempest and Grand Prix - Position left fender and inner fender panel to allow access to cable.

6. Compress expanded conduit locking fingers at toe pan and withdraw cable from under car.

FRONT CABLE INSTALLATION

1. Position cable and conduit tip through cutout in firewall. Make sure conduit locking fingers are fully expanded and secured in cutout, then position cable retainer into pedal clevis.

2. Feed threaded end of cable through frame rail and secure with retainer on inner side of frame.

3. Replace inner fender panel and left fender.

4. Place one check nut on cable stud and insert stud through equalizer (make sure center cable is in position), then place check nut on stud

5. Adjust parking brake as outlined under Parking Brake Adjustment.

6. Connect positive battery cable.

CENTER CABLE REMOVAL AND INSTALLATION

1. Place parking brake pedal in released position.

2. Remove equalizer check nut and remove equalizer from cable.

3. Remove cable from cable guides.

4. Disconnect center cable from rear cables at connectors.

5. To install, reverse above procedures and adjust as outlined under Parking Brake Adjustment.

REAR CABLES REMOVAL AND INSTALLATION

1. Place parking brake pedal in released position.

2. Remove equalizer jam nut and remove equalizer from cable.

3. Remove rear cable from connector

4. Remove retainer from rear cable at frame bracket. Pull cable out of bracket.

5. Remove rear brake drums.

6. Remove rear brake shoes.

7. Remove cable end from parking brake actuating lever.

8. Tempest, Grand Prix and Firebird - Compress expanded conduit locking fingers at flange plate entry hole and withdraw cable.

Pontiac - Remove cable anchor screws at backing plate and withdraw cable.

9. To install, reverse above procedure and adjust as outlined under Parking Brake Adjustment.

PONTIAC SPECIFICATIONS

NEW DRUMS

GEOMETRY:
Inside diameter—Front .... 11"
—Rear .... 11"
Out-of-round maximum .... .002"
Eccentricity—Front .... .005"
—Rear .... .006"
Rapid change of runout:
Indicator shall not change more than .0005" in any inch of circumference.
REVERSALS: Only one indicator reversal in excess of .0008".
SURFACE FINISH: 60-120 micro-inch with a non-directional lay.

FLUID

Fluid which complies with heavy duty standards of SAE 70-R-3 specifications.

LINING

Width—Front .... 2¼"
—Rear .... 2"
Thickness (front and rear) .... .220" PRI.
.260" SEC.
Effective braking surface area .... 187.0 sq. in.

MASTER CYLINDER BORE

Standard system .... 1"
Disc Brake system .... 1.125"

PEDAL HEIGHT

(Underside of standard pedal pad to floor pan) ... 7⅝"

WHEEL CYLINDER BORE

Front .... 1⅛"
Rear .... 15/16"

PONTIAC TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise specified

APPLICATION	TORQUE
Bolt—Wheel Cylinder to Backing Plate	14½
Bolt and Nut—Front Brake to Strg. Knuckle Lower	75
Bolt—Front Brake to Strg. Knuckle Upper	100
Bolt and Nut—Rear Brake to Axle Housing	35
Screw—Wheel Cylinder Bleeder	75 lb. in.
Bolt and Nut—Brake and Clutch Pedal Shaft	30
Nut—Brake and Clutch Pedal Mtg. Bracket to Dash	24
Bolt—Parking Brake Lever to Instrument Panel	8
Nut—Parking Brake Lever to Dash	8
Nut—Brake Master Cylinder to Dash	24
Bolt—Parking Brake Rear Cable Anchor to Brake	25
Screw—Front Brake Hose Bracket to Frame	8
Screw—Rear Brake Hose Bracket to Axle Housing	8
Screw—Brake Pipe Distributor Block Bracket to Frame	8
Nut—Brake Pipe Connector	18

TEMPEST, GRAND PRIX AND FIREBIRD SPECIFICATIONS

NEW DRUMS

GEOMETRY:

Inside diameter—Front and Rear . . . . . 9½"
Out-of-round maximum . . . . . .002"
Eccentricity—Front . . . . . .005"
—Rear . . . . . .006"
Rapid change of runout:
Indicator reading shall not vary more than .0005" per inch of circumference.
REVERSALS: Only one indicator reversal in excess of .0008".

LINING

Width—Front . . . . . 2½"
—Rear . . . . . 2"
Thickness (Front and Rear)—Primary . . . . . 0.196"
—Secondary . . . . . 0.265"
Effective braking surface area . . . . . 149.4 sq. in.

MASTER CYLINDER BORE

Standard system . . . . . 1"
Disc brake system . . . . . 1.125"

FLUID

Fluid that complies with heavy-duty standards of SAE 70-R-3 specifications.

PEDAL HEIGHT

Underside of Pedal Pad to Floor Pan—Tempest . . 7½"
—Firebird . . . 6¾"

WHEEL CYLINDER BORE

Front . . . . . 1⅛"
Rear . . . . . ¾"

TEMPEST, GRAND PRIX AND FIREBIRD TORQUE SPECIFICATIONS

Torque in lb. ft. unless otherwise specified

APPLICATION	TORQUE
Front brake to steering knuckle—lower bolt and nut	75
Front brake to steering knuckle—upper bolt (bolt lubricated)	100
Rear brake to axle housing bolt and nut	35
Brake master cylinder to dash nut	24
Wheel cylinder to backing plate bolt	8
Wheel brake cylinder bleeder screw	75 lb. in.
Parking brake lever to dash nut	8
Parking brake front cable to equalizer nut	6
Parking brake lever to instrument panel bolt	8
Screw—Front brake hose bracket to frame	8
Screw—Rear brake hose bracket to axle housing	8
Screw—Brake pipe distributor block bracket to frame	8

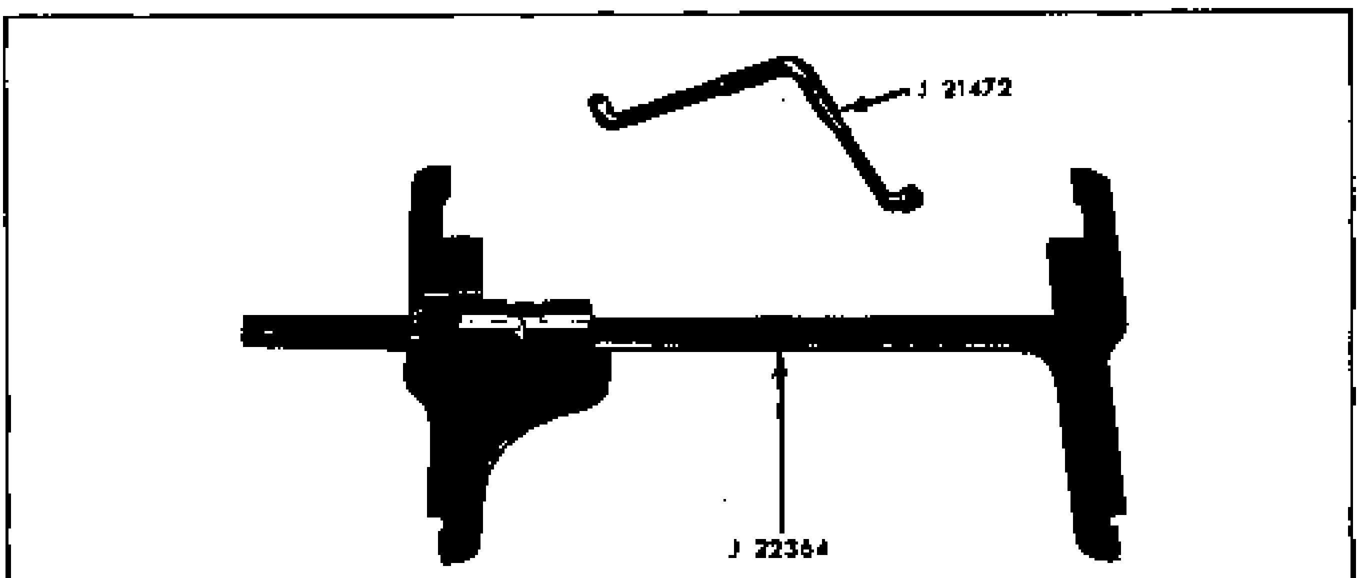


Fig. 5-15 Special Tools

DELCO-MORAINE POWER BRAKE

CONTENTS OF THIS SECTION

CHECKS AND ADJUSTMENTS ON CAR

1. Check for free operation of brake pedal. If binding exists, check pivot points for binding and lubricate as required.

2. Check stop light switch for proper setting and operation.

3. Check fluid level in hydraulic cylinder reservoirs. Fluid level should be as shown in Section 5

4. Check vacuum hose, check valve grommet and carburetor vacuum fitting for possible air leaks.

5. Check engine for good stall-free idle. Correct as required.

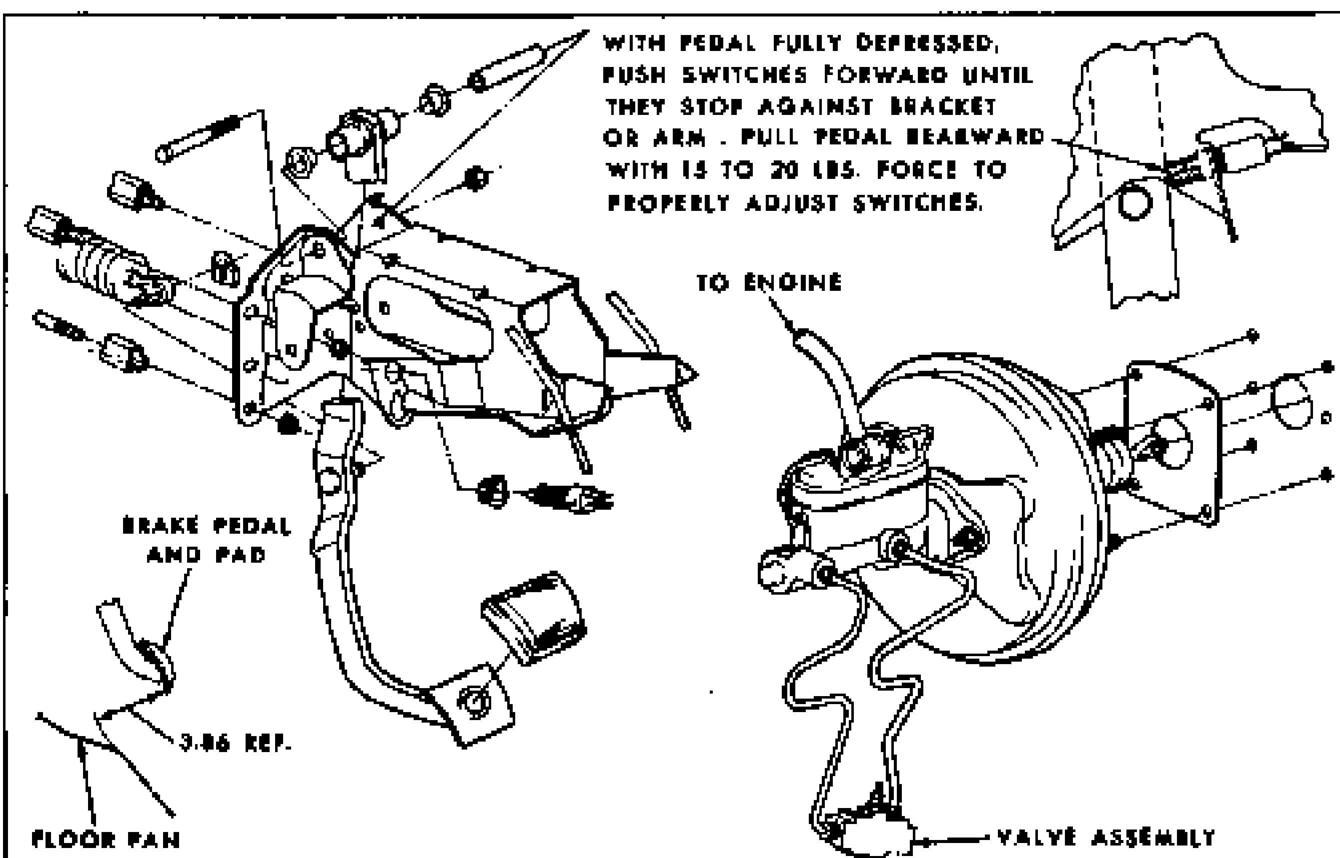


Fig. 5A-1 Pontiac Power Brake System

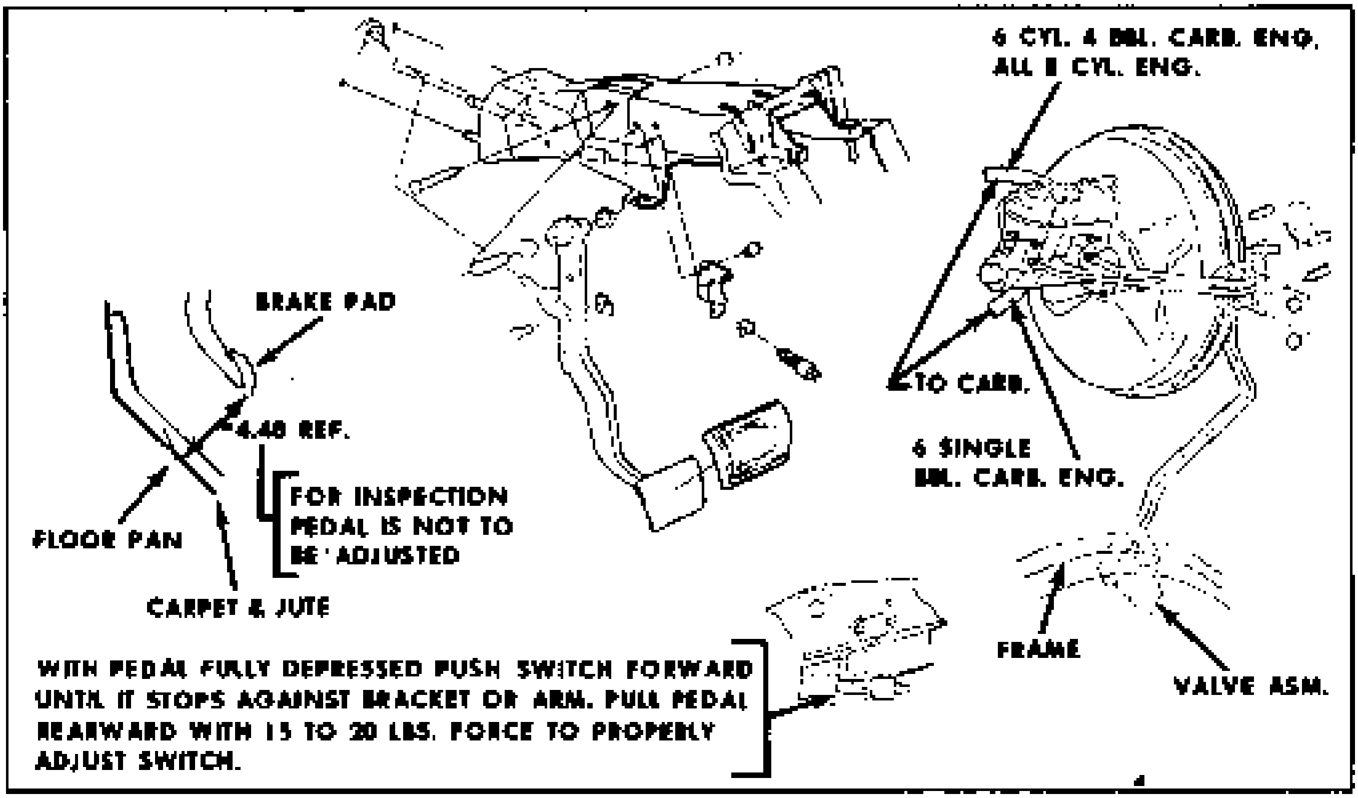


Fig. 5A-2 Tempest and Grand Prix Power Brake System

MINOR REPAIRS

BLEEDING BRAKES

Brakes should be bled in the same manner as standard brakes, unless a disc brake balance valve is incorporated in the system.

STOP LAMP SWITCH

(See Section 5 for service.) All models use the same switch for both standard and power brakes.

OVERHAUL DELCO-MORAINE POWER BRAKE

MASTER CYLINDER ONLY - REMOVE

Certain repair operations, such as replacement of master cylinder internal parts, permits the master cylinder to be removed by itself, leaving the power cylinder, pedal and brackets in the car.

1. Disconnect hydraulic lines at master cylinder, pump fluid from cylinder into a container and dispose of fluid. Cover cylinder openings and ends of both pipes to exclude dust, dirt, etc.

2. Remove master cylinder attaching nuts and remove master cylinder from vacuum power section.

FRONT HOUSING

REMOVE

1. Remove vacuum check valve from front housing and discard grommet.

2. Remove master cylinder and position it away from the vacuum cylinder.

3. Scribe a line across front and rear housings to facilitate reassembly.

4. Install tool J 22805-01 at front housing. Insert a 22" long x 1 1/4" square channel tube in end of tool.

5. Using a 14" crescent wrench or equivalent, twist the square channel tube counterclockwise enough to separate front housing from rear housing (Fig. 5A-4).

6. Remove front housing and power piston return spring.

POWER PISTON - REMOVE (Fig 5A-7)

1. Tempest, Grand Prix and Firebird - remove clevis pin retainer and pin at brake pedal.

Pontiac - remove clevis pin retainer.

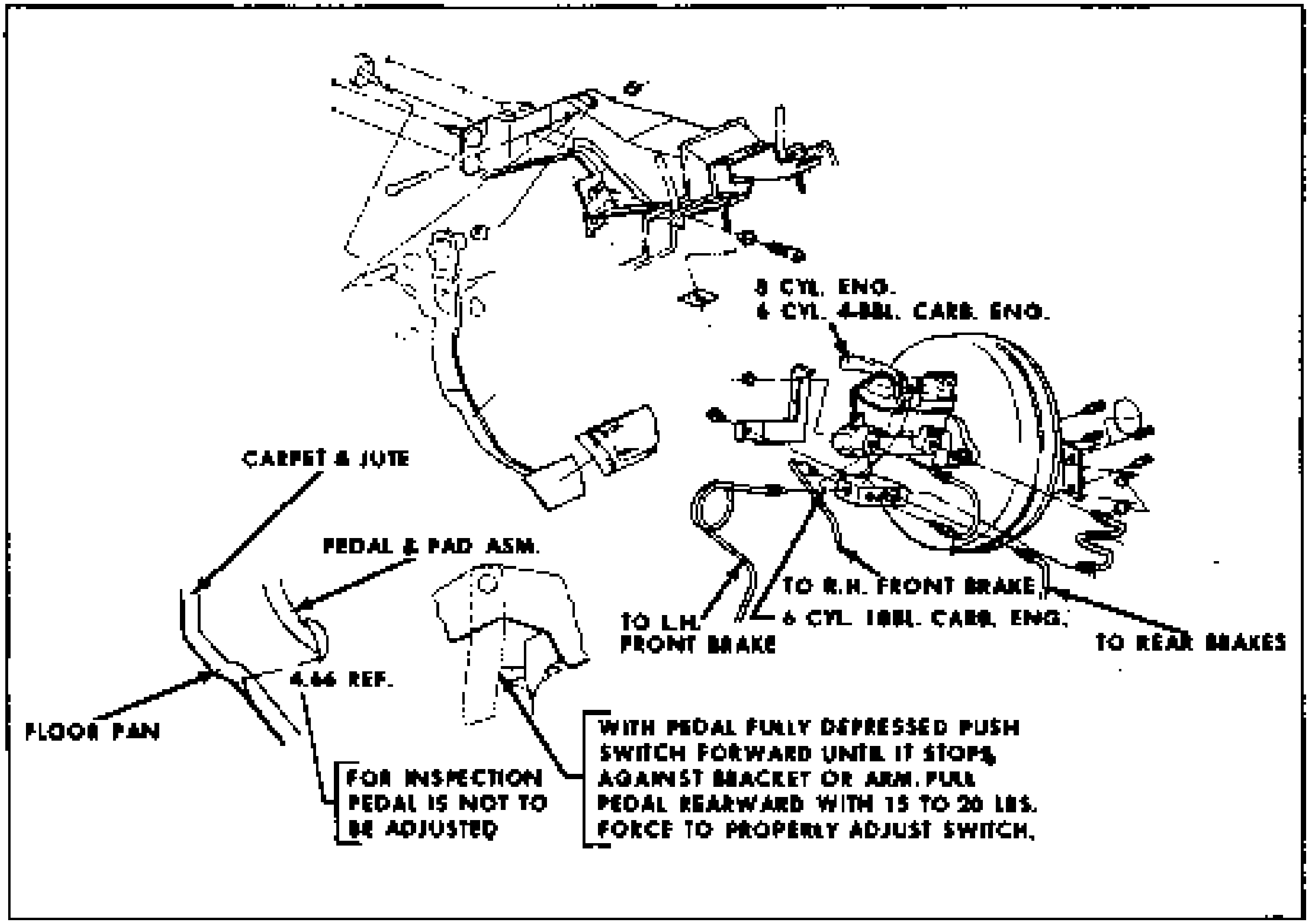


Fig. 5A-3 Firebird Power Brake System

2. Tempest, Grand Prix and Firebird - remove clevis and lock nut from push rod.

3. Slowly pull power piston assembly out from the rear housing, being careful not to damage the power piston bearing or push rod boot.

POWER PISTON - DISASSEMBLE (Fig. 5A-7)

CAUTION: Care must be taken in handling diaphragm of power piston group. Diaphragm should be guarded against grease, oil and foreign matter and must be protected from nicks or cuts that might be caused by rough surfaces, damaged tools or dropping the piston.

1. Place power piston in vise, as shown in Fig. 5A-8. Remove lock ring from power piston by prying from under locking lugs.

2. Remove reaction retainer, vacuum cylinder push rod, reaction plate, three reaction levers and air valve spring (Fig. 5A-9).

3. Remove hydraulic cylinder push rod from center of reaction retainer and O-ring seal from groove on the rod.

4. Remove small reaction bumper and air valve spring retainer from air valve. Remove power piston from vise.

5. Place square end of tool J 21524 in vise holding support plate and power piston with push rod facing up.

6. Pull diaphragm edges away from support plate and position assembly on tool J 21524 so that three lugs on tool fit into three notches in power piston (Fig. 5A-10).

7. Press down on support plate and rotate counterclockwise until support plate separates from power piston (Fig. 5A-11).

8. Remove diaphragm from support plate.

9. Remove foam air filter ring from outside of power piston hub.

10. Position power piston in vise padded with shop towels with hub end down.

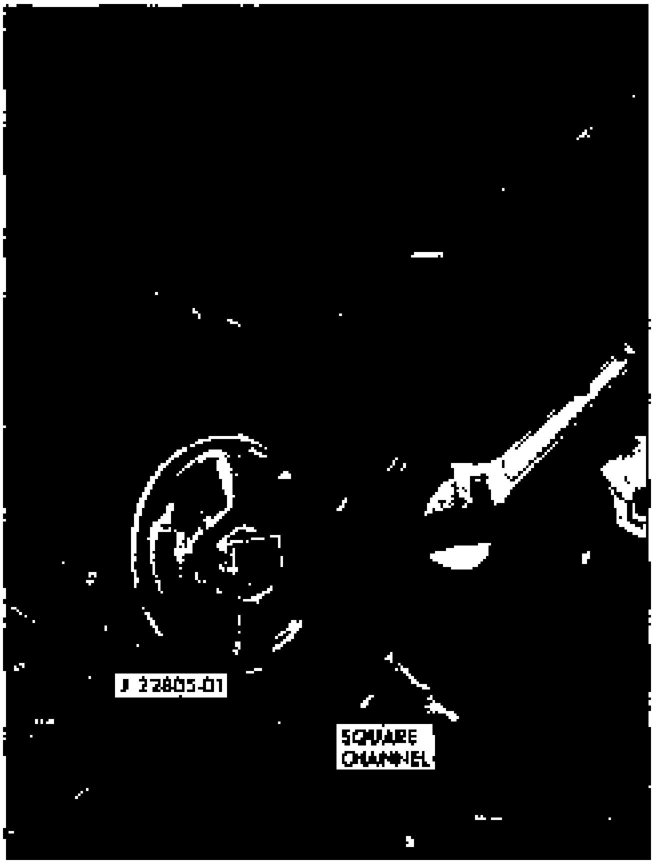


Fig. 5A-4 Removing Front Housing

CAUTION: Do not clamp on hub as outside surface serves as bearing and sealing surface.

11. Remove snap ring on air valve using Truarc Pliers and place power piston with tube end down in arbor press.

12. Press air valve from power piston hub using rod not exceeding 1/2" diameter. Removal of valve releases floating control valve, floating valve retainer, push rod limiter washer and air filter materials (Fig. 5A-12).

NOTE: On Pontiac models, the floating control valve cannot be removed from push rod. It will be necessary to service complete push rod air valve assembly.

13. Remove O-ring seal from the air valve in second groove from air valve operating rod end.

14. Remove power piston bearing from rear housing.

MASTER CYLINDER - DISASSEMBLE (Fig. 5A-13)

Refer to Section 5 - Standard Brakes for disassembly procedures.

INSPECTION AND CLEANING

Thoroughly wash all parts in alcohol and air dry. Blow dust and cleaning fluid out of all internal passages.

CAUTION: It is important that all parts be placed on a clean paper after being cleaned to prevent the possibility of dirt being assembled into unit or grease contacting any rubber parts.

POWER BRAKE

Inspect all metal parts for scoring, pitting, dents or nicks. Small imperfections can be smoothed out with fine emery cloth. Replace if badly nicked, scored or otherwise damaged. Do not attempt to repair any plastic part.

MASTER CYLINDER

Use a reputable cleaner (alcohol) or clean brake fluid to clean all metal brake parts thoroughly. Immerse parts in cleaning fluid and use a bristle brush to remove foreign matter. Blow out all passages, orifices and valve holes. Air dry and place cleaned parts on clean paper or lint free cloth.

NOTE: Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean until reassembly. Rewash at time of assembly if there is any reason to doubt cleanliness.

AIR FILTER

Replace air filter elements if dirty. Do not clean.

ASSEMBLE BRAKE UNIT

MASTER CYLINDER - ASSEMBLE

Refer to Section 5 - Standard Brakes for assembly procedures.

POWER PISTON - ASSEMBLE

1. Place a new O-ring seal in groove on hydraulic cylinder push rod. Wipe thin coat of power brake lubricant on O-ring.

2. Insert hydraulic cylinder push rod through reaction retainer so that end of rod with small pilot protrudes from flat side of reaction retainer.

3. Place power piston installer, J 21524, in vise and position power piston with three lugs fitting into notches in piston.

4. Install new O-ring seal on air valve in second groove from valve operating rod end.

NOTE: On Pontiac models, a new air valve assembly must be installed since floating control valve is a

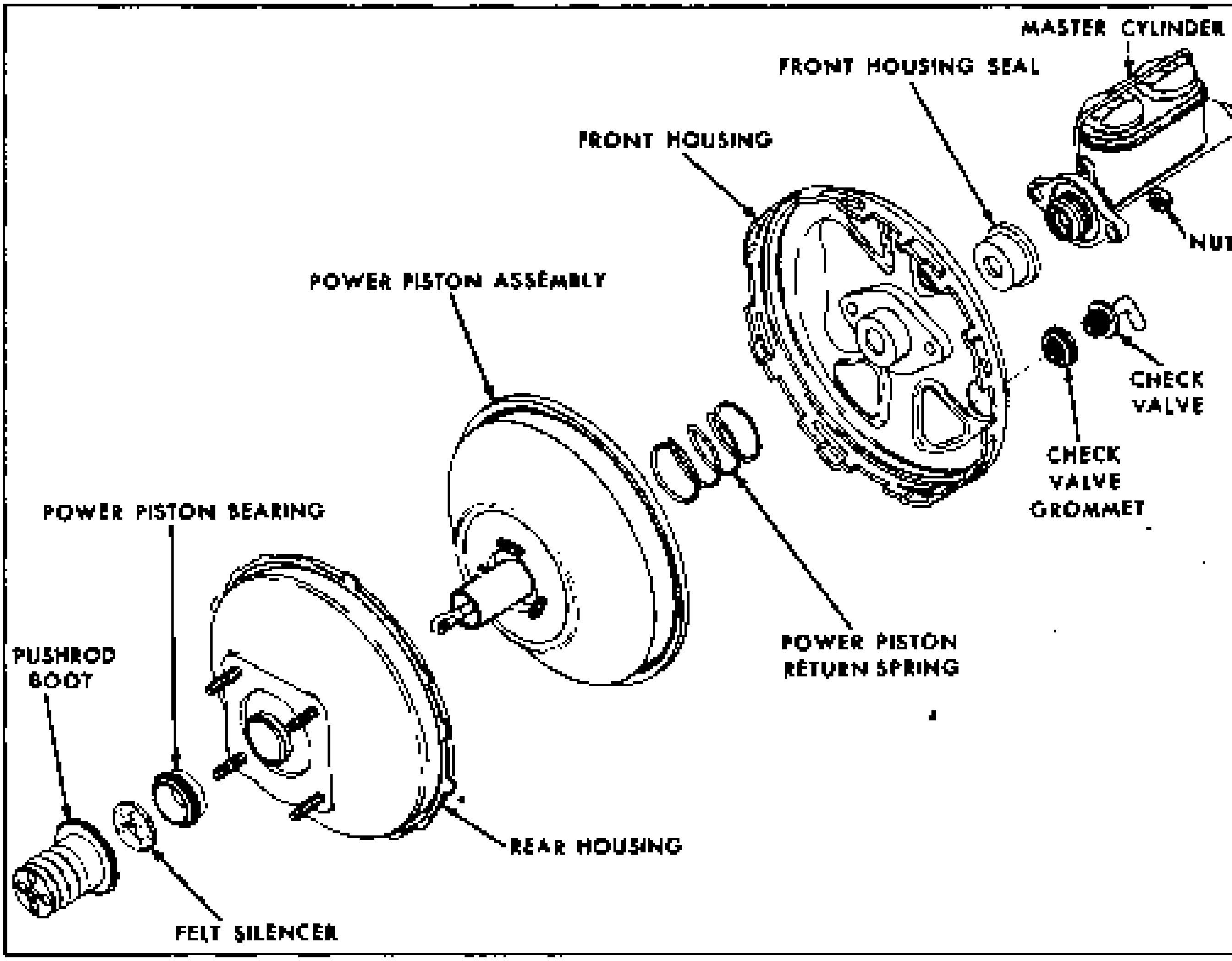


Fig. 5A-5 Exploded View of Pontiac Power Brake Unit

component part of this assembly and cannot be disassembled.

5. Wipe thin film of power brake lube on large O.D. of floating control valve and on O-ring of air valve.

6. Press air valve - push rod - floating control valve assembly, air valve first, to its seat in tube of power piston.

7. Place floating control valve retainer over push rod so that flat side seats on floating control valve.

8. Start floating control valve and its retainer into power piston hub. Use tool J 21601 to press floating valve to seat in tube by placing tool on top of retainer and pressing down.

9. Position push rod limiter washer over push rod to floating control valve and install air filter element over end of push rod and into power piston hub.

10. Install felt silencer and retaining clip in end of power piston hub.

11. Assemble power piston diaphragm to support plate from side of plate opposite locking tangs and press raised flange of diaphragm through hole in center of plate.

NOTE: Be sure that edge of center hole fits into groove in flange of diaphragm.

12. Pull diaphragm away from O.D. of support plate so that the plate can be gripped with hands. Wipe power brake lubricant on all surfaces of small bead of diaphragm which contacts power piston.

13. Holding support plate on bare metal, with locking tangs down, place support plate and diaphragm assembly down over hub of power piston. Flange of diaphragm will fit into groove on power piston.

14. Press down and rotate support plate clockwise until lugs on power piston come against stops on support plate.

15. Invert assembly and place in padded vise with power piston hub end down and insert snap ring on air valve using Truarc Pliers.

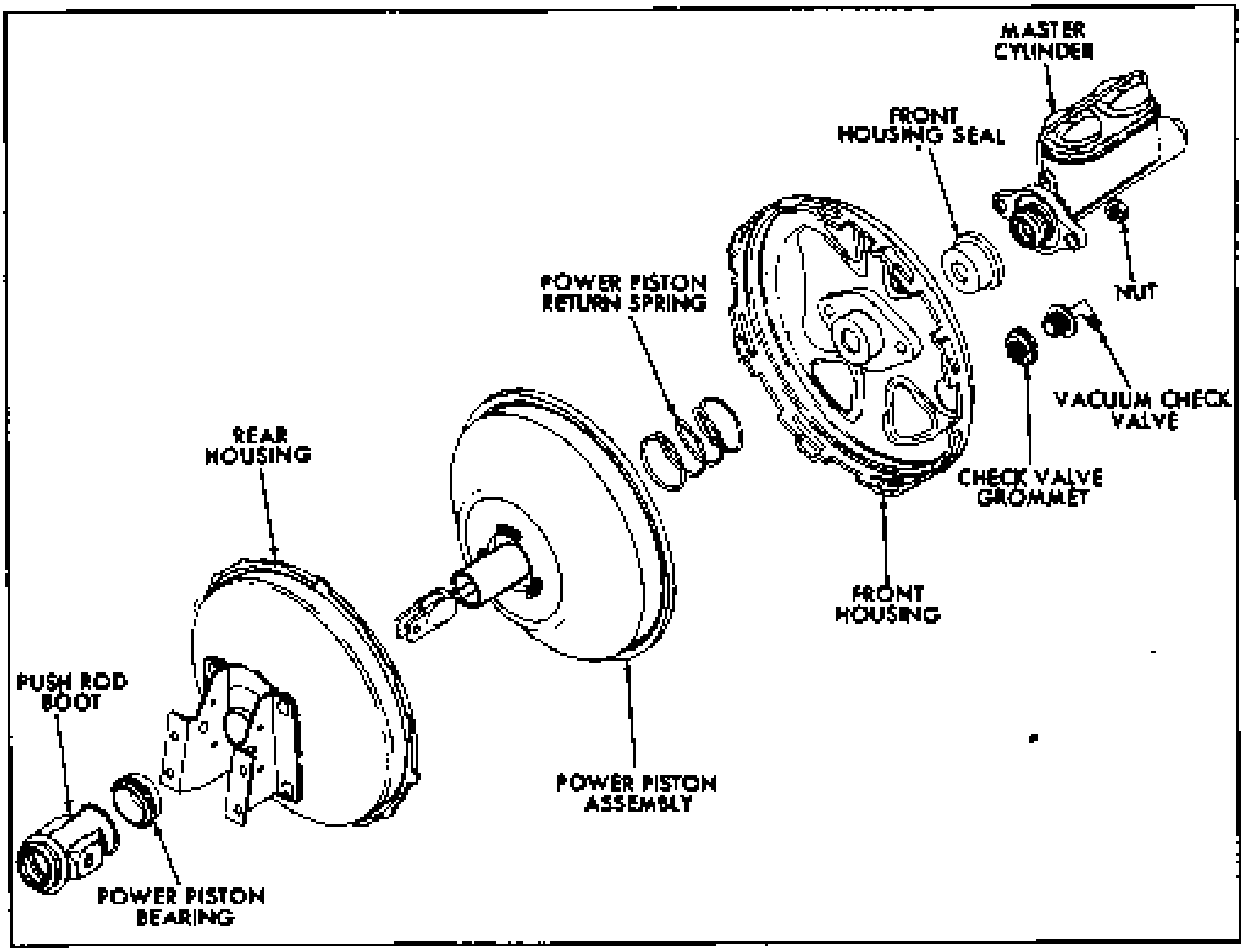


Fig. 5A-6 Exploded View of Firebird, Grand Prix and Tempest Power Brake Unit

16. Install air valve spring retainer so it seats on snap ring and assemble reaction bumper into groove in end of air valve.

17. Position reaction spring on spring retainer

18. Position three reaction levers in slots on power piston. Narrow ends will rest on reaction spring.

19. Position reaction plate, with numbered side up, on top of reaction levers and press down on plate until large ends of reaction levers pop up and plate rests flat on levers. Be sure that reaction plate is centered.

20. Place small end of hydraulic push rod in hole in center of reaction plate and line up ears on reaction retainer with notches in power piston and push reaction retainer down until ears seat in notches.

21. Maintain pressure on reaction retainer and position large lock ring down over master cylinder push rod so that one end of lock ring goes under lug on power piston raised divider.

NOTE: Lock ring is positioned around power piston so that it goes alternately over ear of reaction retainer and under lug of power piston until end of ring is seated under lug with raised divider.

CAUTION: Make sure that both ends of lock ring are securely under large lug.

22. Remove power piston assembly from vise. Install large foam air filter ring over neck of power piston hub.

POWER PISTON - INSTALL

1. Place new power piston bearing in center of rear housing so that flange on center hole of housing fits into groove of power piston bearing. Large flange on power piston bearing will be on stud side of housing.

2. Liberally coat inside of power piston bearing with power brake lube.

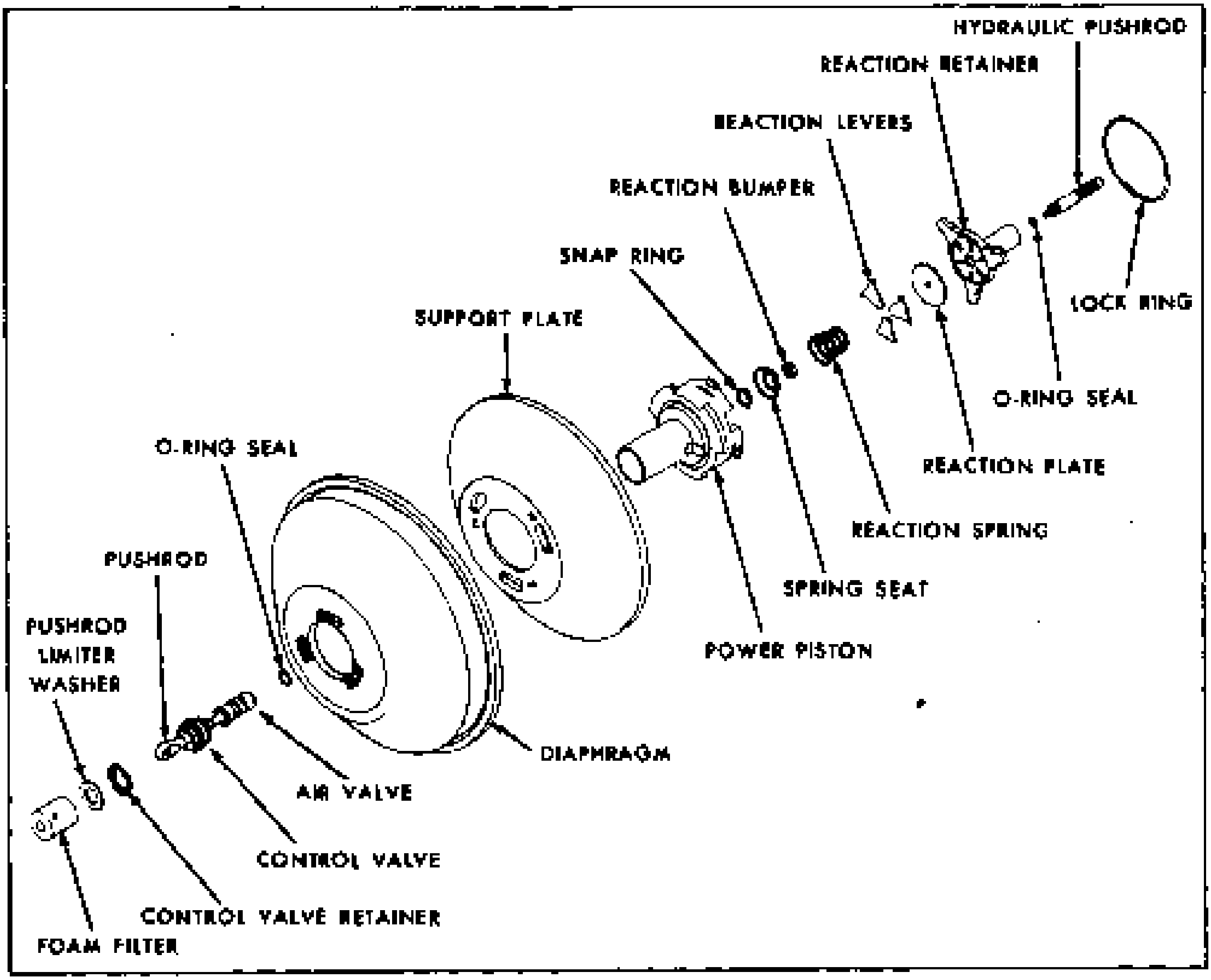


Fig 5A-7 Exploded View of Power Piston

3. Wipe power piston hub with power brake lube.

4. Push hub of power piston through rear housing seal.

5. Wipe O.D. of reaction retainer with power brake lube.

FRONT HOUSING - REPLACE

1. Place new front housing seal in center of front housing so that flat surface of cup lies against bottom of depression in housing.

2. Install new vacuum check valve grommet.

3. Attach tool J 22805-01 to front housing. Lubricate I.D. of support plate seal with power brake lube.

4. Hold power piston return spring in position between front housing and power piston, then start front housing into final position with hands, making sure that scribe marks align on front and rear shells (Fig. 5A-14).

NOTE: It is important that the front shell be started using only the hands, in order to make sure the housings will be completely mated after assembly, and to eliminate any possibility of cutting the diaphragm.

5. Insert square channel tube in end of tool J 22805-01, and using a crescent wrench, turn front housing clockwise until fully locked.

6. Remove all tools.

GAGING PROCEDURE (Fig. 5A-15)

NOTE: GAGING IS TO BE PERFORMED WITHOUT VACUUM.

1. Place the gage J 22647 over the piston rod in a position which will allow the gage to be slipped to the left or right without contacting the studs (Fig. 5A-15).

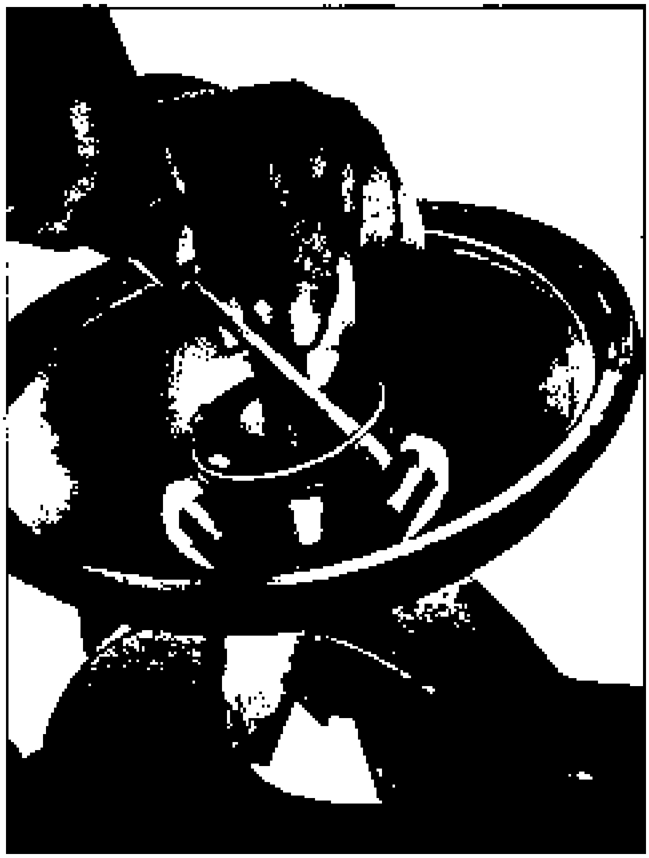


Fig. 5A-8 Removing Locking Ring From Power Piston

Fig. 5A-9 Removing Reaction Retainer

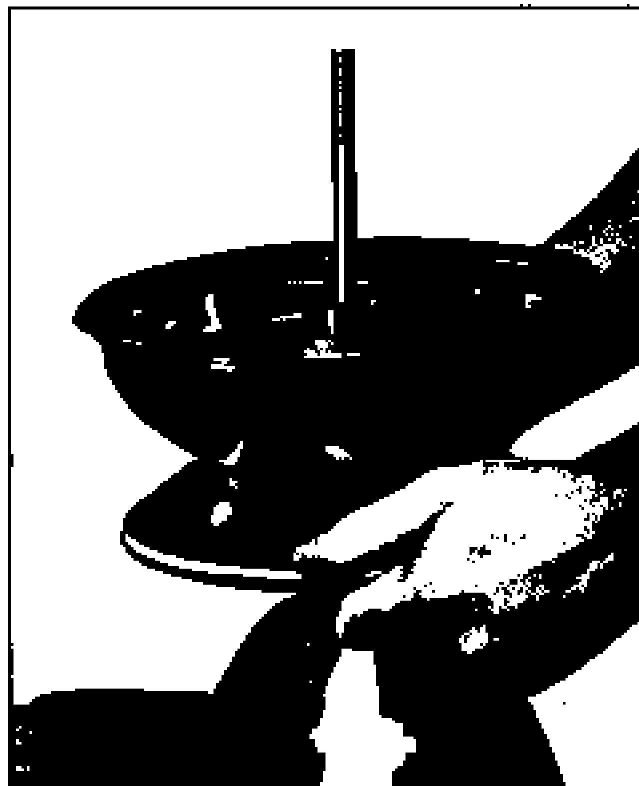


Fig. 5A-10 Positioning Power Piston on Support Plate Remover

The center section of the gage has two levels. The piston rod end should always touch the longer section of the gage which extends into the front housing. The piston rod end should never touch the shorter section of the gage.

NOTE: Any variation beyond these limits must be compensated for by obtaining service adjustable push rod and adjusting screw in end to match height of gage. Variation beyond these limits can cause the primary cup to overlap the compensating port of the master cylinder which will trap fluid in the hydraulic system causing brake drag.

2. Replace master cylinder on front housing studs. Install attaching nuts on studs. Torque to 25 lb. ft.

3. Install vacuum check valve.

4. Tempest, Grand Prix and Firebird - install clevis lock nut to push rod, finger tight. Attach clevis and tighten clevis against lock nut to 90 lb. in.

NOTE: Do not omit lock nut or pedal height will be too low.

5. Tempest, Grand Prix and Firebird - attach clevis pin and retainer at brake pedal. Pontiac - attach push rod eye to pivot pin on brake pedal and install retainer clip.

6. Check stop light switch adjustment.

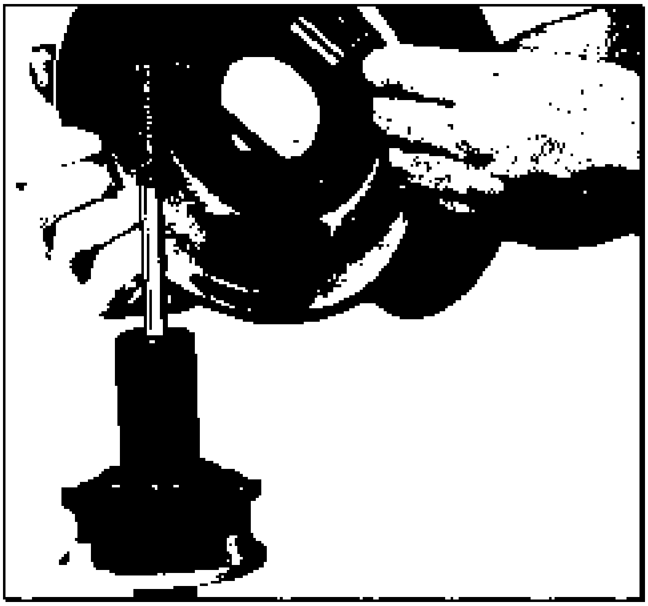


Fig. 5A-11 Removing Support Plate

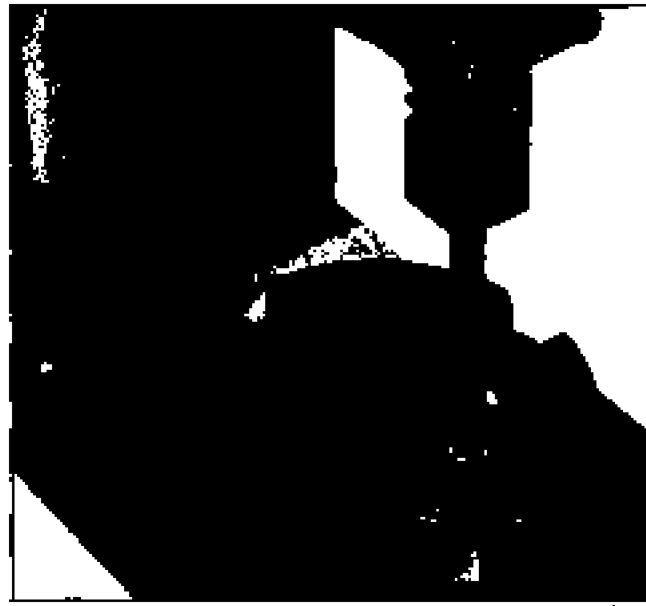


Fig. 5A-12 Removing Air Valve

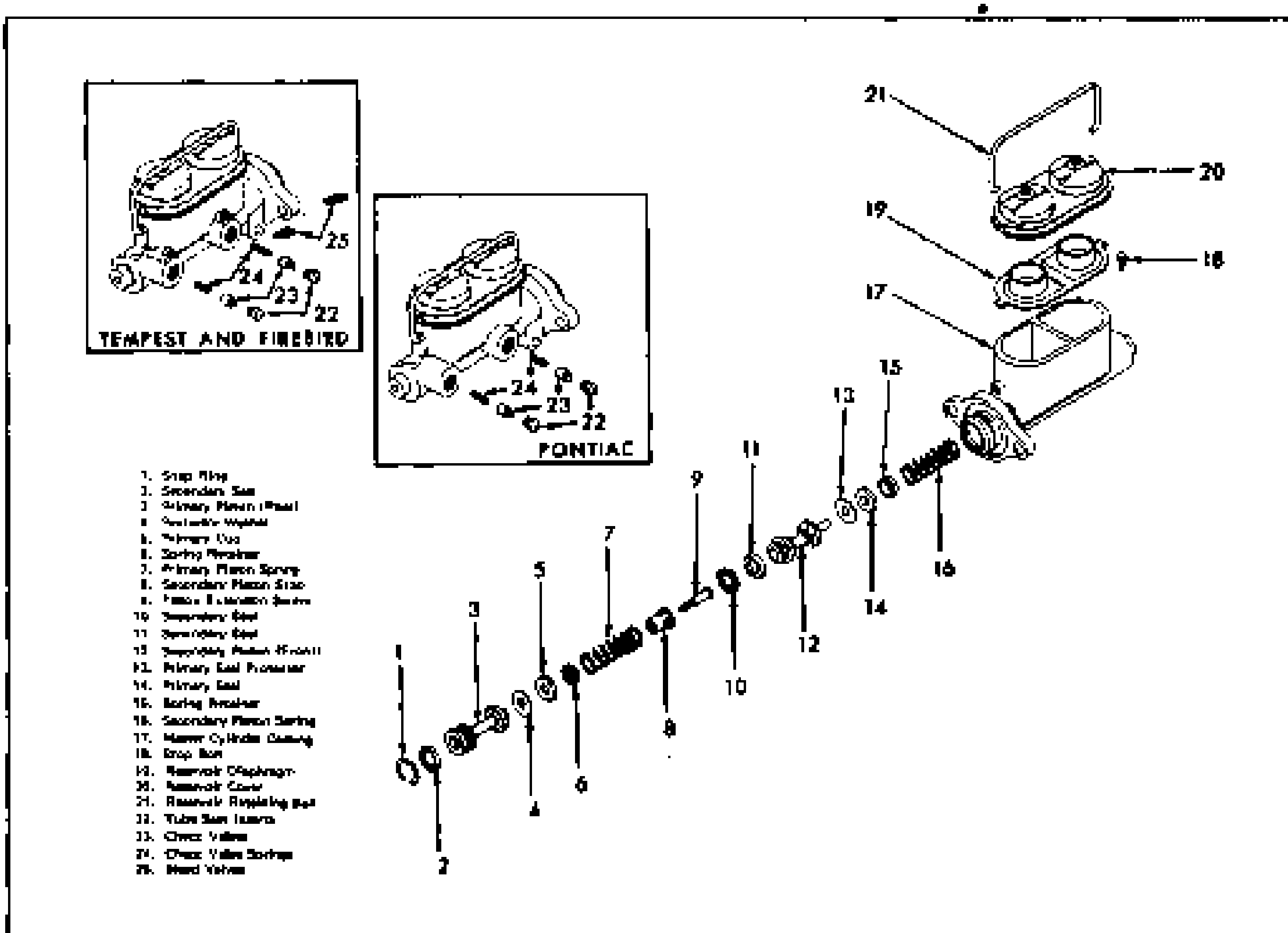


Fig. 5A-13 Exploded View of Master Cylinder

Fig. 5A-14 Installing Front Housing

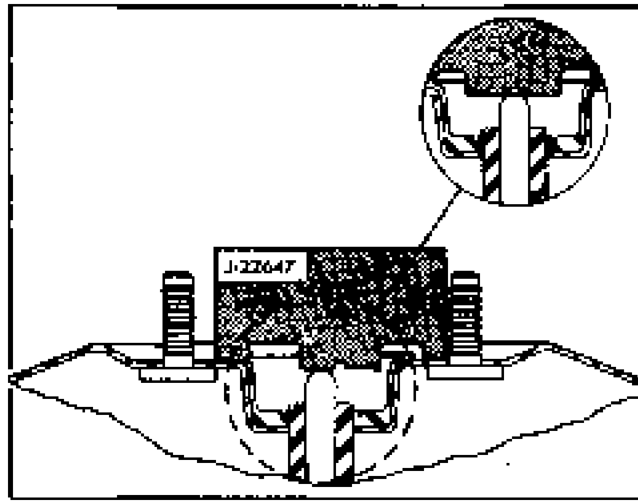


Fig. 5A-15 Push Rod Adjustment

TORQUE SPECIFICATIONS

	LB. FT.
Power Cylinder Housing to Master Cylinder Nuts	25
Rear Housing to Pedal Bracket Nuts	24
Push Rod Clevis (Tempest, Grand Prix and Firebird)	90 in. lb.

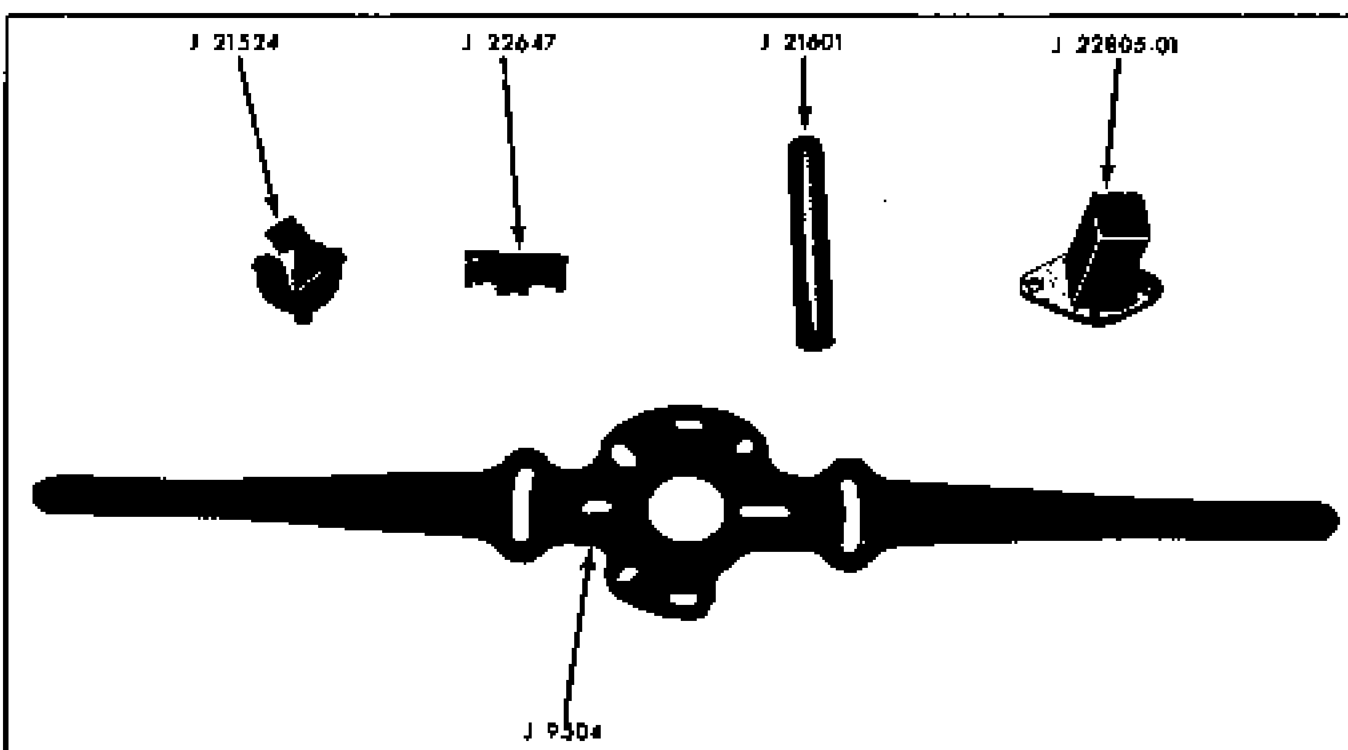


Fig. 5A-16 Special Tools

BENDIX POWER BRAKE

CONTENTS OF THIS SECTION

CHECKS AND ADJUSTMENTS ON CAR

1. Check for free operation of brake pedal. If binding exists, check all pivot points for binding and lubricate as required.

2. Check stop light switch for proper setting and operation.

3. Check fluid level in hydraulic cylinder reservoirs. Fluid level should be as shown in Fig. 5-4.

4. Check vacuum hose, check valve grommet and carburetor vacuum fitting for possible air leaks.

5. Check engine for good stall-free idle, and correct as required.

MINOR REPAIRS

BLEEDING BRAKES

Brakes should be bled in the same manner as standard brakes.

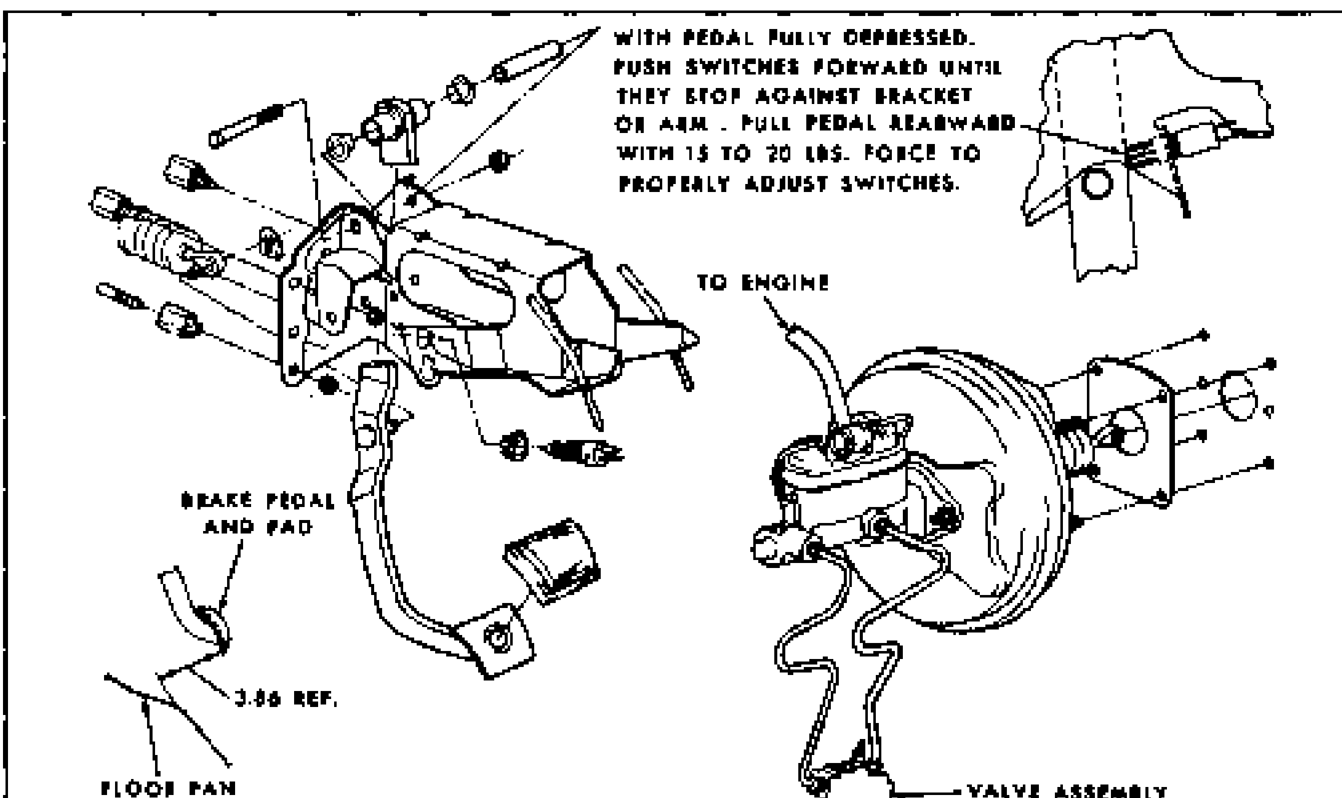


Fig. 5B-1 Power Brake System

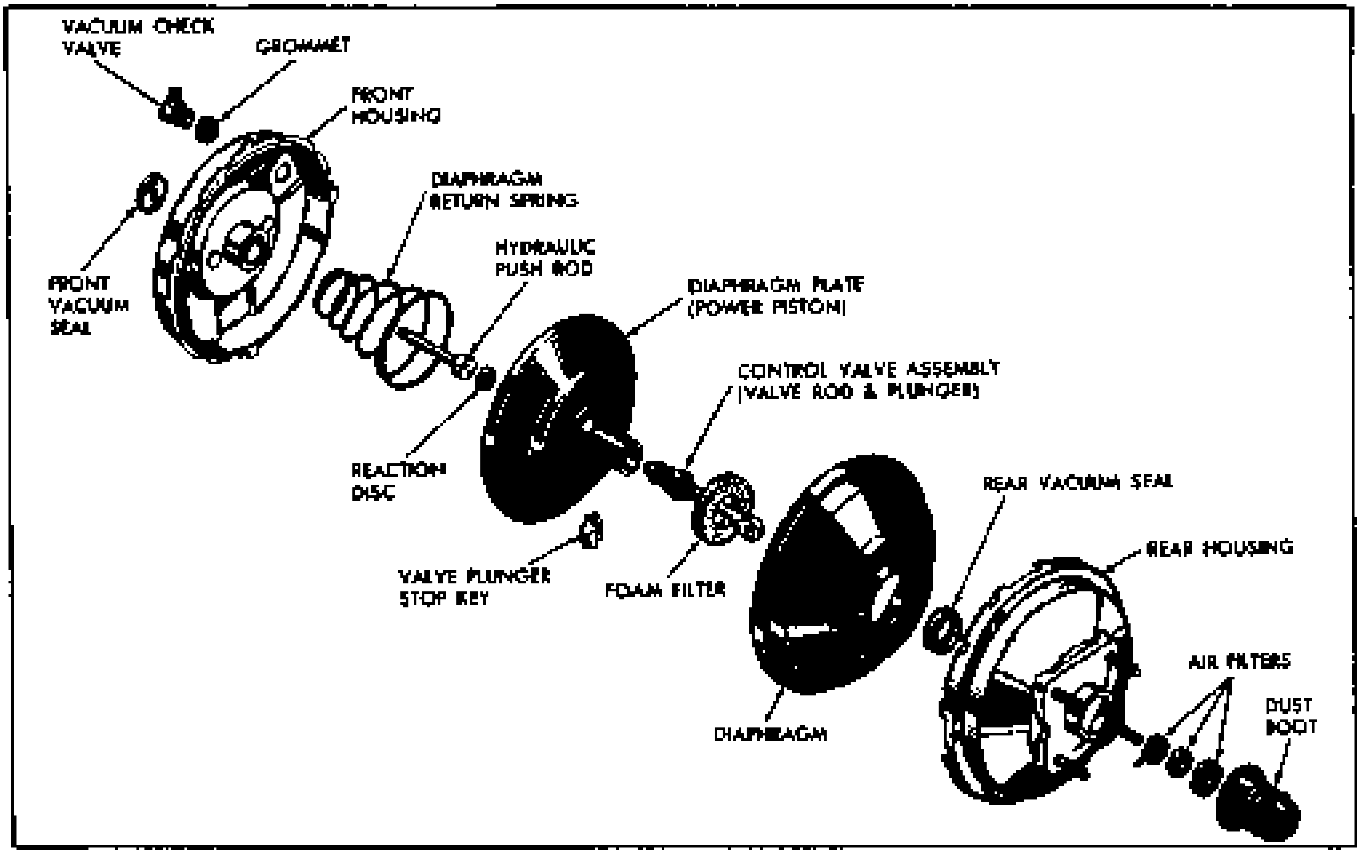


Fig. 5B-2 Power Brake - Exploded View

STOP LAMP SWITCH

See Section 5 for service.

OVERHAUL BENDIX POWER BRAKE

MASTER CYLINDER ONLY - REMOVE

Certain repair operations, such as replacement of master cylinder internal parts, permit the master cylinder to be removed by itself, leaving the power cylinder on the car.

1. Disconnect hydraulic lines at master cylinder, pump fluid from cylinder into a container and dispose of fluid. Cover openings in master cylinder and ends of both pipes to prevent entry of dust, dirt, etc.

2. Remove master cylinder attaching nuts and lock washers. Remove master cylinder from vacuum power section.

POWER BRAKE VACUUM CYLINDER - REMOVE

1. Remove vacuum hose from front housing and discard grommet. Remove master cylinder and position away from power section. DO NOT disconnect fluid lines.

2. Remove clevis pin retainer from brake pedal inside the car.

3. Remove nuts from vacuum cylinder studs under dash and remove vacuum power section.

4. Clean exterior of power brake.

POWER UNIT - DISASSEMBLE (Fig. 5B-2)

1. Using tool J 22805-01, mount power brake assembly in vise, clamping on tool so that valve operating rod is up.

2. Scribe a line across the front and rear housings to facilitate reassembly

3. Using tool J 9504, press down firmly and rotate tool and housing clockwise so that cut-outs in rear housing line up with indentation of front housing.

CAUTION: Remove rear housing carefully as it is spring-loaded and will tend to fly away from the front housing.

4. Remove tool, housing, hydraulic push rod from diaphragm plate (power piston) and return spring from front housing.

5. Remove assembly from vise and remove tool J 22805-01 from front housing.

6. Remove front vacuum seal with a blunt tool.

POWER PISTON - DISASSEMBLE (Fig. 5B-4)

CAUTION: Exercise extreme care in handling power piston, rubber surfaces and metal parts in this assembly. They should be guarded against grease, oil and foreign matter and must be protected from nicks or cuts that might be caused by rough surfaces or damaged tools.

1. Remove boot and foam filter from power unit.

2. Remove the foam air silencers. Be careful not to chip plastic housing.

3. Remove diaphragm plate (power piston) from rear housing.

4. Carefully remove rubber diaphragm from diaphragm plate.

5. Tilt diaphragm plate and depress valve operating rod slightly to remove valve assembly retainer (valve plunger stop key). See Fig. 5B-3.

6. Pull control valve assembly straight out from diaphragm plate and with a blunt tool, push reaction disc out front of plate. Do not disassemble control valve assembly.

7. Inspect rear shell vacuum seal. Remove only if necessary to replace by driving out with a screwdriver or punch.

MASTER CYLINDER - DISASSEMBLE (Fig. 5B-5)

1. Pry splash seal and retainer out of shallow cavity around master cylinder hub.

2. Press in against rear piston with round-end rod to relieve spring load on piston stop screw under master cylinder bore. Use 3/8" wrench to remove stop screw and O-ring seal. Maintain pressure on rear piston and use Tru-Arc pliers to remove snap ring from groove in master cylinder bore.

3. Remove rear piston and spring assembly and discard. Do not attempt to disassemble it since complete new assembly is provided in repair kit.

4. Remove from piston assembly, front return spring and retainer. Slide primary cup and protector off nose of front piston. Use dull scribe to lift both secondary seals from the grooves at rear end of front piston. Discard all old rubber parts.

NOTE: Check valves should not be replaced unless one or more of conditions exist as outlined in Section 5 under Master Cylinder Disassemble.

5. With master cylinder in vise, (outlet holes up) drill out the tube fitting insert with a 13/64" drill and then tap the hole, using a 1/4" x 20 tap. Place a 1/2" to 3/4" long, 1/4" x 20 bolt through a thick washer and then thread the bolt into the insert. Tighten the bolt against the washer until the insert is removed.

6. Remove check valves and springs from cavities beneath tube seats and discard.

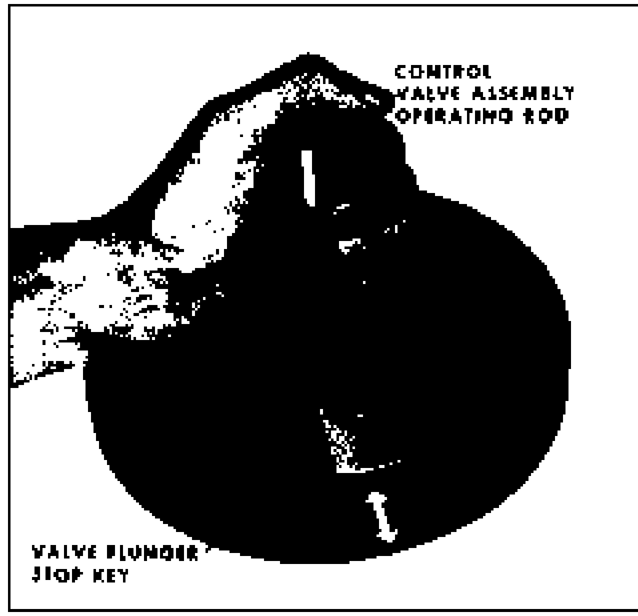


Fig. 5B-3 Valve Plunger Stop Key - Remove and Install

INSPECTION - CLEANING

Thoroughly wash all parts in alcohol and air dry. Blow dust and cleaning fluid out of all internal passages. If

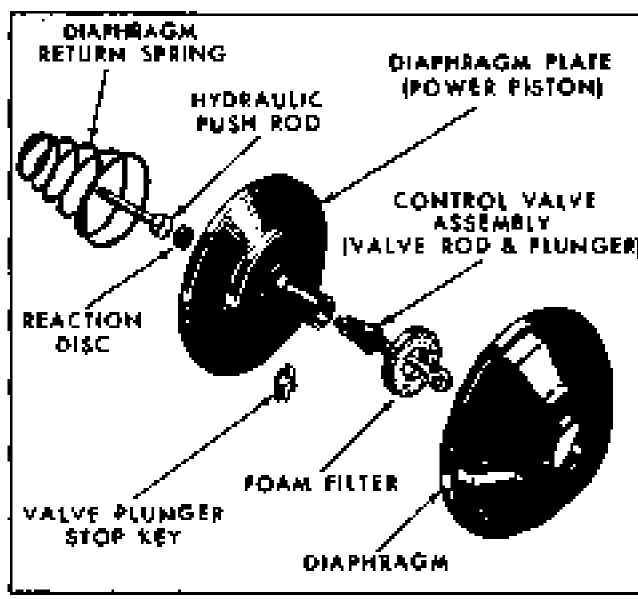


Fig. 5B-4 Power Piston - Exploded View

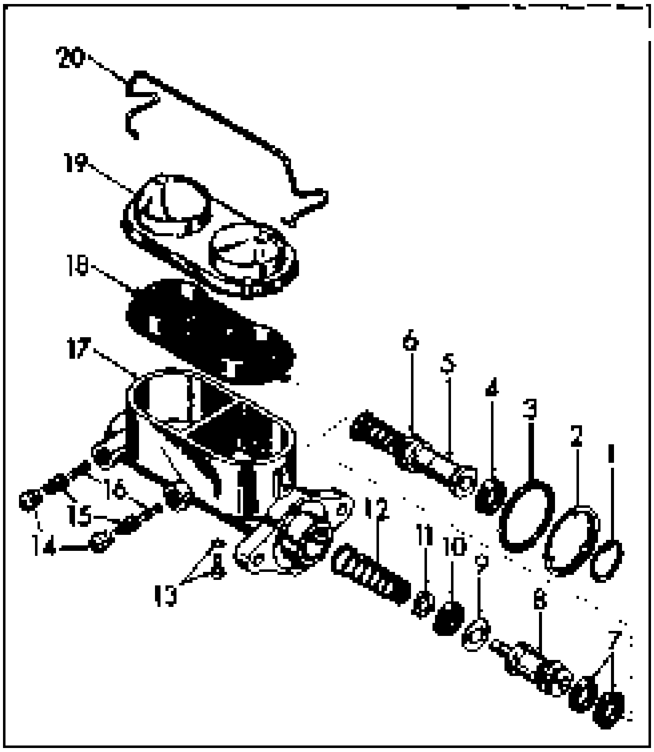


Fig. 5B-5 Master Cylinder—Exploded View

1. Snap Ring
2. Splash Shield Retainer
3. Splash Seal
4. Secondary Seal
5. Rear Piston and Spring Assembly
6. Primary Cup
7. Secondary Seals
8. Front (Floating) Piston
9. Protector
10. Primary Cup
11. Retainer
12. Front Piston Return Spring
13. Piston Stop Screw and Seal
14. Tube Seats
15. Check Valves
16. Springs
17. Master Cylinder Casting
18. Hermetic Diaphragm
19. Reservoir Cover
20. Bale-Type Retainer

inside of front housing is slightly scored or scratched, clean with crocus cloth or fine emery cloth. If scratches cannot be removed, replace housing.

All rubber parts should be replaced, regardless of condition, and those parts which come in contact with brake fluid should be rewashed in clean alcohol before reassembly

CAUTION: It is important that all parts be placed on a clean paper or cloth after being cleaned to prevent the possibility of dirt being assembled into unit or grease contacting any rubber parts.

INSPECT POWER BRAKE ASSEMBLY

Inspect all parts for scoring, pitting, dents or nicks. Small imperfections can be smoothed out with fine emery cloth or parts replaced if badly nicked, scored, or otherwise damaged.

INSPECT HYDRAULIC MASTER CYLINDER ASSEMBLY

Inspect bore from the open end. The bore should be free of scoring, rust pitting or etching. If any of these are apparent, master cylinder must be replaced. If it appears that contaminants have damaged the bore, replace damaged parts and flush out entire brake system including wheel cylinders

The sealing surfaces should be clean and smooth Check for cracks and damaged threads. Be sure that the by-pass and compensating ports to the master cylinder reservoir are not restricted.

Check for distortion of all springs and deterioration of all rubber parts Any evidence of soft or swollen rubber parts indicates contaminated brake fluid requiring flushing of the entire brake system and replacement of wheel cylinder cups as well as all rubber parts in master cylinder.

INSPECT AIR FILTERS

Replace air filters if dirty. Do not clean.

POWER UNIT AND MASTER CYLINDER - ASSEMBLE

MASTER CYLINDER - ASSEMBLE (Fig. 5B-5)

1. Clamp master cylinder in vise with open end slightly above horizontal.

2. Install new secondary seals, back to back, in grooves on rear end of front piston. Dip seals in brake fluid and lift them carefully into grooves with dull scribe. Slide protector and primary cup onto nose of front piston.

3. Stack front piston return spring and retainer on nose of front piston and dip assembly in brake fluid. Press and twist piston to ease cups past snap ring groove into bore. Slide assembly to bottom of bore.

4. Dip new rear piston and spring assembly in brake fluid and slide assembly into bore. Use scribe and press piston to ease cups into bore.

5. Press in against rear piston with round-end rod to compress return springs. Do NOT use screwdriver or other sharp-edged tool since this will damage the push rod seat inside the piston. Maintain pressure on piston and use Tru-Arc pliers to install snap ring in groove inside bore. Make certain that snap ring is securely seated in groove.

6. Maintain pressure on rear piston while installing piston stop screw and new O-ring seal in port

underneath bore. Torque screw with 3/8" wrench to 40 lb. in.

7. Install new spring and check valve in both outlet ports. Press new tube seat into port using spare tube nut. Torque tube nut to 40 lb. in. to be sure tube seat is bottomed-in port.

8. Remove master cylinder assembly from vise.

POWER PISTON - ASSEMBLE (Fig. 5B-4)

1. If rear vacuum seal was removed, place rear housing on bench with studs down and press new seal carefully into cavity in housing, plastic side first, using tool J 22677. (Fig. 5B-6) Use hands to press seal about 7/16" below inner housing surface or until metal shoulder bottoms. DO NOT CRACK PLASTIC.

2. Lubricate outside diameter of diaphragm plate hub, bearing surfaces of the valve plunger, and outer edge of valve poppet with power brake lubricant.

3. Insert control valve assembly into diaphragm plate hub. Push on valve enough to insert the valve plunger stop key (Fig. 5B-3).

4. Assemble diaphragm on diaphragm plate, making sure the inner bead of the diaphragm is seated in the groove in plate.

5. Install silencers over valve operating rod. Be careful not to chip the plastic.

6. Apply power brake lubricant to seal in rear housing and around hub of diaphragm plate. Install rear housing over hub of diaphragm plate.

7. Install large foam air filter and boot. Press boot onto housing until it bottoms.

8. Coat all surfaces of reaction disc with power brake lubricant and install disc, button side first, in hub cavity of diaphragm plate.

9. Apply power brake lubricant to piston end and shaft of hydraulic push rod and install firmly against reaction disc in diaphragm plate. DO NOT LUBRICATE ADJUSTING NUT END OF PUSH ROD.

POWER UNIT - ASSEMBLE (Fig. 5B-2)

1. Coat front vacuum seal with power brake lubricant and install in cavity of front housing, rubber side toward master cylinder. Make certain rubber portion does not separate from metal plate.

2. Install tool J 22805-01 on front housing. Torque bolts to 25 lb. ft.

3. Install check valve and grommet in front housing if they were removed. Lubricate with alcohol for easier assembly.

4. Place tool J 22805-01 in vise with front housing up.

5. Place diaphragm return spring in front housing, small end down.

6. Apply silicone grease or talcum powder to all surfaces of outer bead of diaphragm that bear against front and rear housings.

7. Place rear housing assembly over diaphragm return spring and, using tool J 9504 press down firmly on rear housing, guiding push rod into front housing seal making certain scribe marks will align when housings are locked together. Rotate tool counterclockwise to lock the two housings. Vacuum may be applied to the check valve to help draw the housings together.

CAUTION: Do not release pressure on rear housing until the housings are fully locked.

NOTE: Be sure diaphragm is not pinched during assembly.

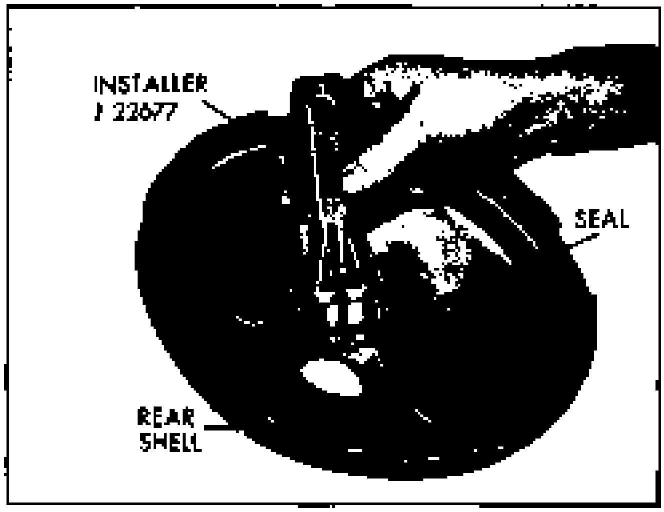


Fig. 5B-6 Installing Rear Vacuum Seal

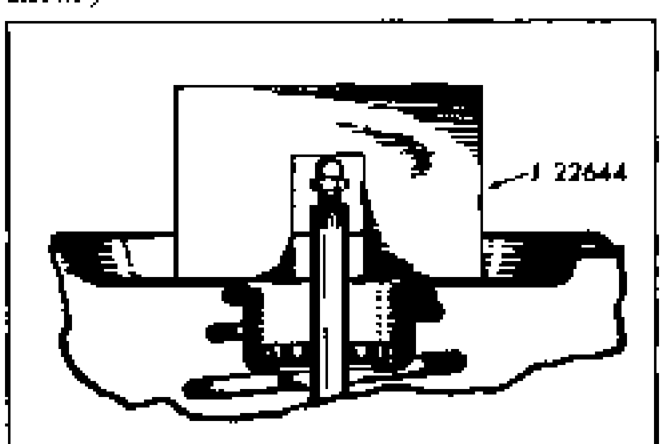


Fig. 5B-7 Gauging Push Rod Length

Remove power brake assembly from vise and remove tool J 22805-01.

NOTE: Before reassembling master cylinder to power section, the distance from the outer end of the push rod to the master cylinder must be measured as explained under PUSH ROD ADJUSTMENT below.

PUSH ROD ADJUSTMENT

The push rod is designed with a self-locking adjustment screw to provide the correct relationship between the vacuum power piston and master cylinder piston. The adjustment screw is set to the correct height at the time of original assembly of the power unit. Under normal service conditions the adjustment screw does not require any further attention providing the push rod assembly remains in the original unit.

Whether a new push rod is used or the push rod assembly is transferred to a unit other than the original one, the distance from the end of the adjustment screw to the mounting face of the power cylinder should be rechecked either with a micrometer depth gage to a dimension of 1.225 to 1.210" or with height gage J 22644. Place gage over the push rod on the front housing. Cutout portion of the gage should never be lower than the adjustment screw end of the push rod and the gap between the cutout and edge of the push rod end should never exceed .010" (Fig. 5B-7)

To adjust push rod, grip splined area of push rod with pliers, being careful not to scratch machined shaft. (DO NOT REMOVE PUSH ROD FROM POWER CYLINDER SINCE REACTION DISC MIGHT BE PULLED OUT OF DIAPHRAGM PLATE AND FALL INTO FRONT VACUUM CHAMBER.) Use a 5/16" wrench to turn adjusting nut "in" to shorten, or "out" to lengthen push rod.

After assembly of the master cylinder to the power unit, the primary cups of the master cylinder must clear the compensating hole when the unit is in the released position. This can be checked by partially filling the reservoirs, and then stroking the power unit. If fluid spurts, the compensating ports are clear. If the primary cups overlap the compensating ports, there will be no flow of air or fluid through the compensating port when stroked. If this condition exists, the adjusting screw should be turned into the push rod a slight amount, or until the compensating port is open. Failure to clear the compensating port in the released position traps fluid in the hydraulic lines and wheel cylinders and causes brake drag when the fluid warms up.

If compensating port is blocked, fluid from pressure bleeder will flow thru bypass main metering port behind primary cup and then thru holes in piston, around lip of primary cup to wheel cylinders.

POWER BRAKE ASSEMBLY - INSTALL

1. Place power brake into position and install four rear housing to dash attaching nuts from inside of car. Tighten nuts to 24 lb. ft. torque.

2. Install clevis pin retainer.

3. Adjust stop light switch if necessary. See section 5 for Service.

4. Attach vacuum hose to vacuum check valve.

5. Attach master cylinder to power section. Torque nuts to 25 lb. ft.

6. Bleed brakes as necessary and fill fluid reservoirs. Fluid level should be as shown in Section 5.

TORQUE SPECIFICATIONS

Piston Stop Screw	40 lb. in.
Power Cylinder Housing to Master Cylinder Nuts	25 lb. ft.
Rear Housing to Dash Nuts	24 lb. ft.

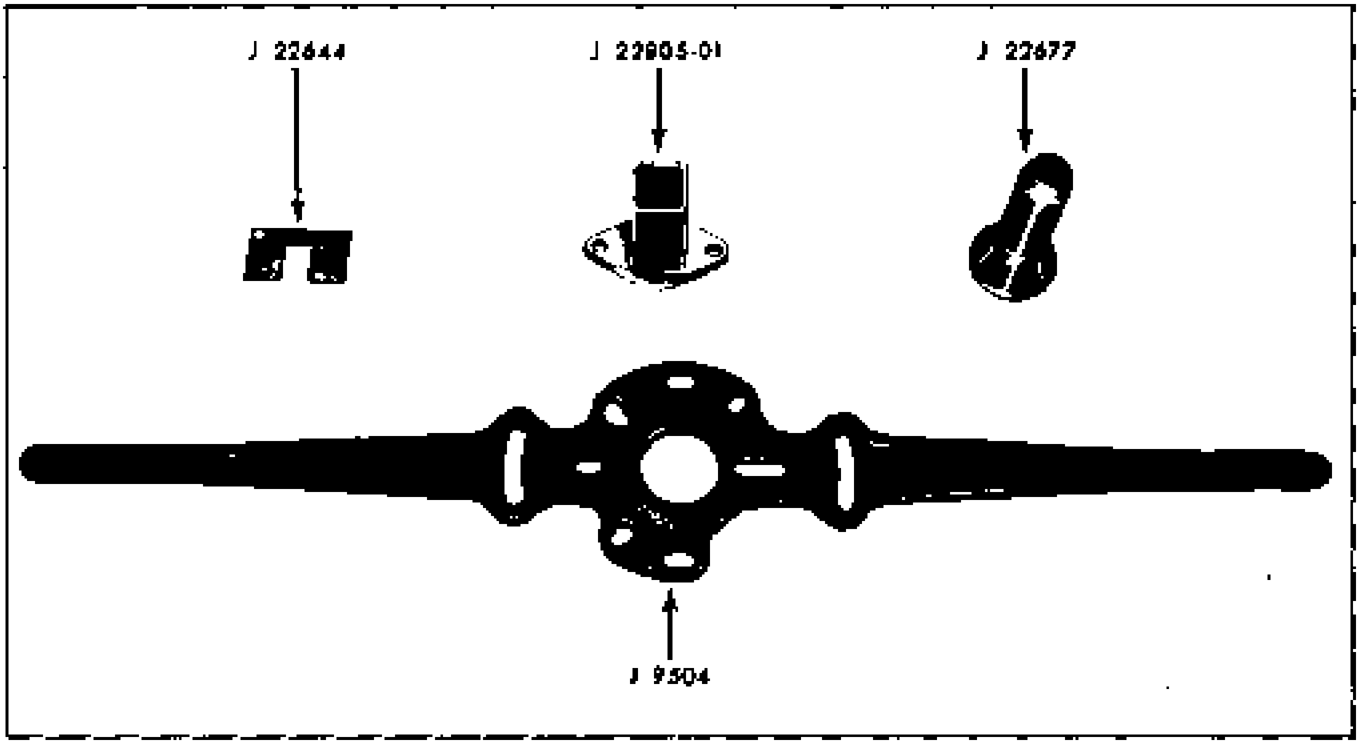


Fig. 5B-8 Special Tools

HEAVY DUTY POWER BRAKES

BENDIX TANDEM DIAPHRAGM TYPE

CONTENTS OF THIS SECTION

CHECKS AND ADJUSTMENTS ON CAR

1. Check for free operation of brake pedal. If binding exists, check all pivot points for binding and lubricate as required.

2. Check stop light switch for proper setting and operation.

3. Check fluid level in hydraulic cylinder reservoirs. Fluid level should be as shown in Section 5.

4. Check vacuum hose, check valve grommet and carburetor vacuum fitting for possible air leaks.

5. Check engine for good stall-free idle and correct as required.

MINOR REPAIRS

BLEEDING BRAKES

Brakes should be bled in the same manner as standard brakes.

STOP LAMP SWITCH

See Section 5 for service.

MAJOR REPAIRS

POWER BRAKE AND MASTER CYLINDER ASSEMBLY - REMOVE

1. Remove vacuum check valve from front housing and discard grommet.

2. Disconnect pipes from master cylinder hydraulic ports and cover openings in master cylinder and ends of pipes to prevent entry of dust, dirt, etc.

3. Remove clevis pin retainer from brake pedal inside the car.

4. Remove nuts from power cylinder studs and remove power cylinder.

5. Clean exterior of power brake assembly and drain reservoirs of hydraulic fluid.

DISASSEMBLY

MASTER CYLINDER AND EXTERNAL PARTS - REMOVE

1. Remove the two master cylinder attaching nuts and lockwashers and remove master cylinder. Remove hydraulic push rod by pulling it straight out of front shell.

2. Carefully remove push rod boot and air filter from valve rod.

VALVE ROD, RETAINERS, FILTER AND POPPET PARTS -REMOVE (Fig. 5C-2)

1. Carefully remove stamped steel hub protector and foam air filter from valve hub. USE CARE TO AVOID DAMAGING PLASTIC HUB.

2. With valve rod in vertical position, squirt alcohol

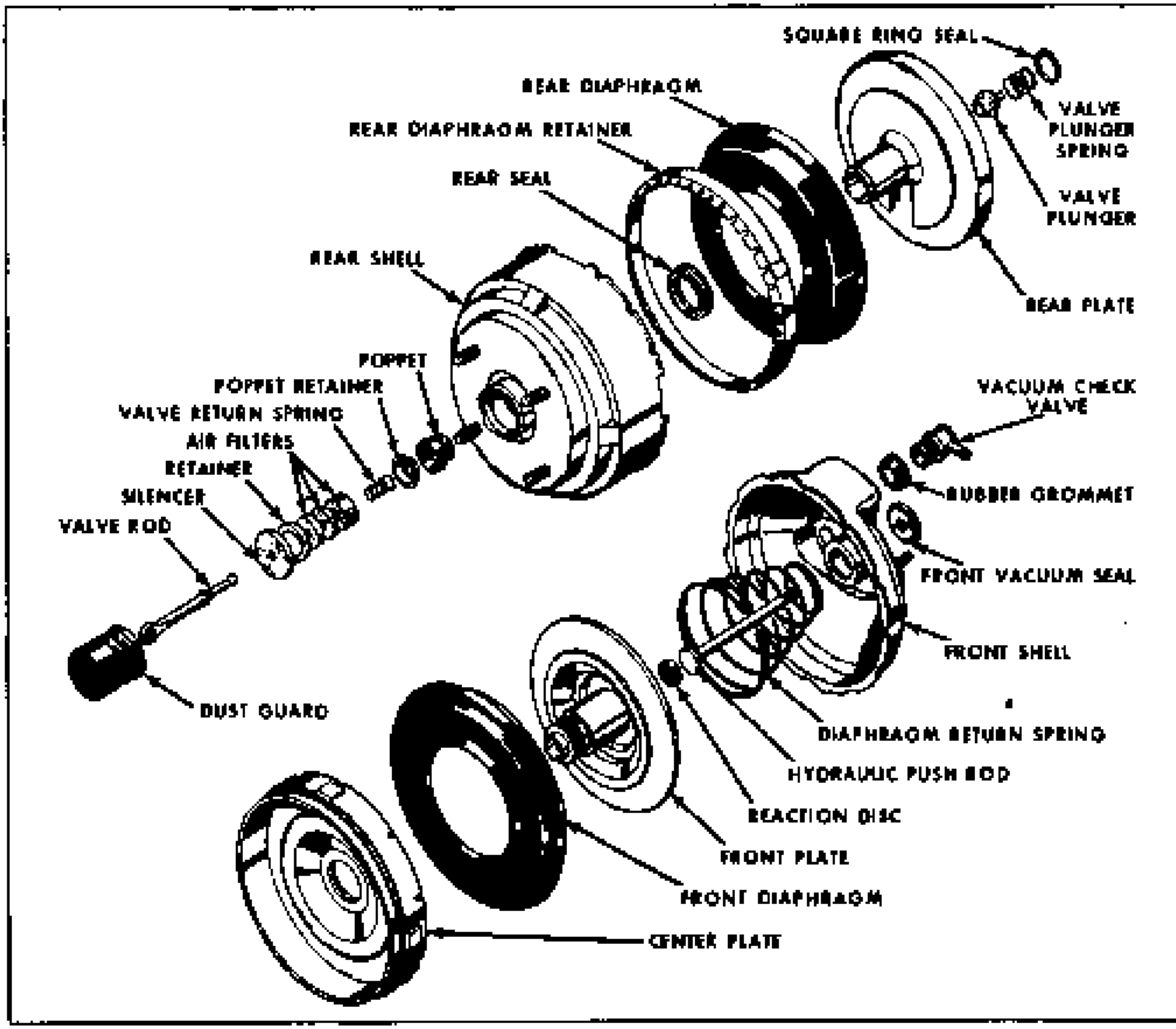


Fig. 5C-1 Power Unit - Exploded View

down rod to wet rubber grommet in valve plunger on ball end of valve rod.

3. Reinstall hub protector. Position two small blocks of wood on either side of eye and clamp this assembly securely in vise (see Fig. 5C-2 inset). Leave just enough space between steel retainer on plastic valve hub and side of vise jaw to insert two medium-sized open end wrenches. Use wrench nearest vise as a pry to force the valve plunger grommet (and power section) off the ball end of the valve rod.

CAUTION: When separating valve rod from plunger, hold power unit to prevent it from falling to floor. Use care when prying with wrenches to avoid damaging plastic valve housing.

4. Remove valve rod from vise. Carefully remove hub protector, valve return spring, poppet retainer and poppet.

POWER SECTION DISASSEMBLY (Fig. 5C-5)

1. Assemble special tool combination as shown in Fig. 5C-3.

2. Place assembly in arbor press (Fig. 5C-3A) with rear shell and spanner wrenches up. Secure tool J 8433 to press to prevent tilting of front shell.

NOTE: On some models it will be necessary to pry open the four tangs located at the seam, to allow shell separation.

3. Compress assembly sufficiently enough to allow rotation of tools J 9504.

CAUTION: Do not compress assembly to the point of damaging power unit.

4. Scribe a mark across front and rear shell to facilitate assembly.

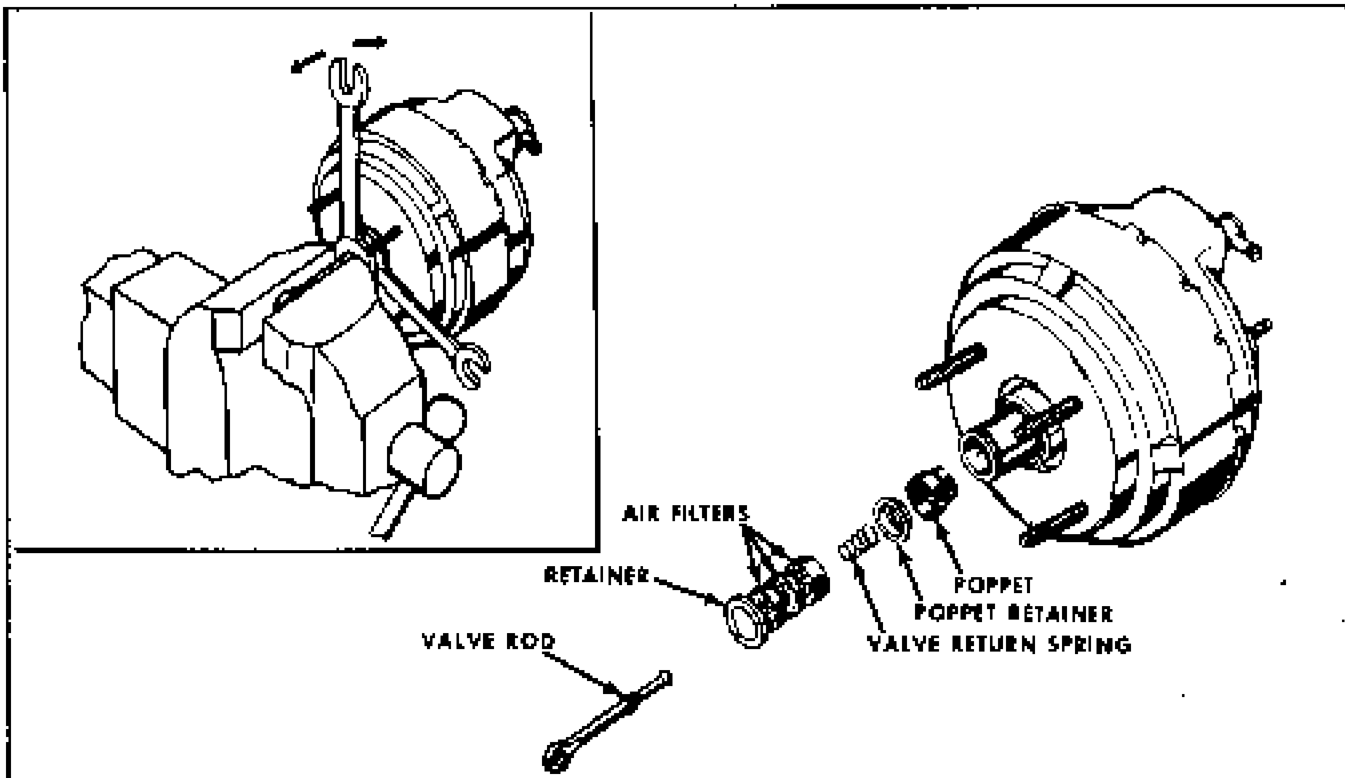


Fig. 5C-2 Valve Rod, Retainers, Filters and Poppet

5. Rotate spanner wrenches (J 9504) counterclockwise to release position (to point where cutouts in front shell are in line with lances in rear shell).

6. Slowly release pressure on assembly.

CAUTION: Diaphragm return spring is under pressure. Use care in separating shells to avoid the spring flying out.

7. Using fingers, remove diaphragm assembly from rear shell (Fig. 5C-4).

REMOVAL OF REAR SHELL VACUUM SEAL (Fig. 5C-1)

NOTE: Do NOT remove rear seal unless seal is defective.

Place rear shell on bench with studs up and drive out seal with punch or screwdriver.

DIAPHRAGMS, PLATES, RETAINER AND PLUNGER - DISASSEMBLE (Fig. 5C-5)

1. Wet rear diaphragm spring retainer with alcohol and remove, using fingers only. Remove rear diaphragm from rear plate.

2. Set 1-1/16" hex bar stock about 2" long or tool J 22839 in bench vise. Set Diaphragm and Plate assembly on hex stock with hex opening in center of front plate on bar. Twist rear plate counterclockwise, using hand leverage only either on atmospheric pressure channel or on outside circumference of rear plate.

After plates have been loosened, remove assembly from vise and complete disassembly on bench, front plate down.

3. Unscrew rear plate completely and carefully lift it off front plate hub, grasping valve plunger and spring with other hand and remove them from bore of front plate hub.

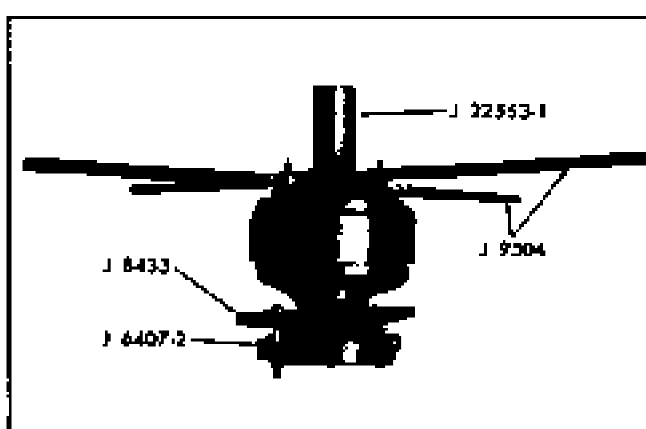


Fig. 5C-3 Power Unit Special Tool Combination

4. Remove square ring seal from shoulder of plate.

NOTE: Seal may stick to shoulder of either front or rear plate.

5. Using small rod or screwdriver through center bore of front plate, push out reaction disc.

6. Loosen front diaphragm from center plate and slide center plate carefully off front plate hub.

CAUTION: DO NOT DAMAGE OR REMOVE SEAL FROM CENTER BORE OF CENTER PLATE.

DISASSEMBLY OF MASTER CYLINDER (Fig. 5C-6)

Always use the correct master cylinder repair kit when overhauling the master cylinder. Always replace all rubber parts. Metal parts cleaner should NOT be used on any parts used in the hydraulic section. Gasoline and kerosene also should never be used. Rinse all hydraulic parts in clean alcohol. If the bore contains rust, corrosion or pitted areas, clean with crocus cloth only.

1. Pry water and dirt seal and retainer out of shallow cavity around master cylinder hub.

2. Move rear piston with round-end rod to relieve spring load on piston stop screw under master cylinder bore. Use a 3/8" wrench to remove stop screw and O-ring seal. Maintain pressure on rear piston and use Tru-Arc pliers to remove snap ring from groove in master cylinder bore.

3. Remove rear piston and spring assembly and discard. Do NOT attempt to disassemble it since a complete new assembly is provided in the repair kit.

4. Remove front piston assembly, front return spring and retainer. Slide primary cup and protector off nose of front piston. Use dull scribe to lift both secondary seals from the grooves at the rear end of the piston. Discard all old rubber parts.

NOTE: Check valves should not be replaced unless one or more of conditions exist as outlined in Section 5 under Master Cylinder Disassembly.

NOTE: On master cylinder used with disc brakes, outlet for front wheels does not incorporate a check valve and spring. Tube seat should only be removed when the tube seat, itself, is damaged and requires replacement.

CLEANING

Wash all hydraulic system parts in alcohol. Remove spots, deposits or pitted areas inside the master cylinder bore with crocus cloth. Discard all old rubber parts, except reservoir diaphragm.

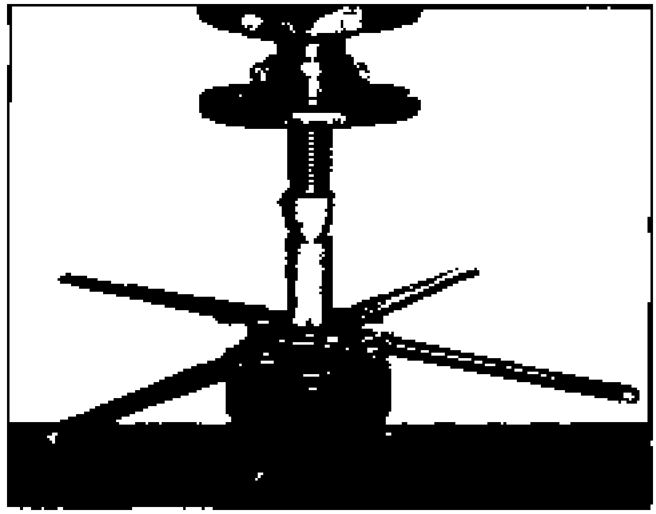


Fig. 5C-3A Power Unit Mounted in Press

INSPECTION

Inspect all metal parts for damage or excessive wear. Replace any damaged or worn parts.

ASSEMBLY

ASSEMBLY OF MASTER CYLINDER (Fig. 5C-6)

1. Clamp master cylinder in vise with open end tilted slightly upward.

Fig. 5C-4 Removing Center Plate From Rear Shell

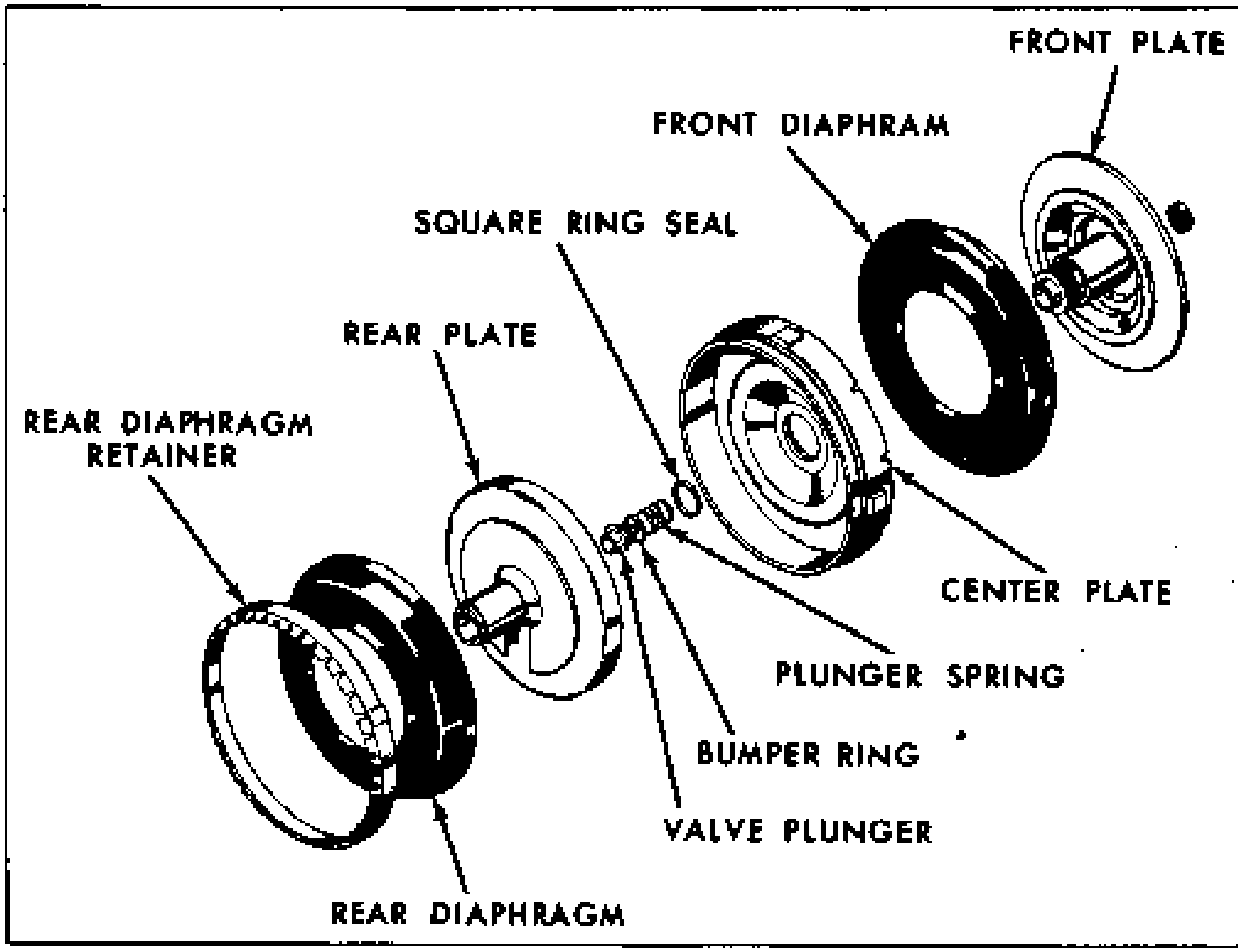


Fig. 5C-5 Diaphragms, Plates, Retainer and Plunger

2. Install new secondary seals, back to back, in grooves on rear end of front piston. Dip seals in brake fluid and lift them carefully into grooves with dull scribe. Slide protector and primary cup onto nose of front piston.

3. Stack front piston return spring and retainer on nose of front piston and dip assembly in brake fluid. Slide assembly to bottom of master cylinder bore. Press and twist piston to ease cups past snap ring groove.

4. Dip new rear piston and spring assembly in brake fluid and slide assembly into bore. Use scribe and press piston to ease cups into bore.

5. Press in against rear piston with round-end rod to compress return springs. Do NOT use screwdriver or other sharp-edged tool since this will damage the push rod seat inside the piston. Maintain pressure on piston and use Tru-Arc pliers to install snap ring in groove inside bore. Make sure snap ring is seated securely in groove.

6. Maintain pressure on rear piston while installing piston stop screw and new O-ring seal in port underneath bore. Torque screw with 3/8" wrench to 40 lb. in.

7. Remove master cylinder from vise. Install reservoir diaphragm and cover and plug ports, temporarily, to prevent entry of dust or dirt.

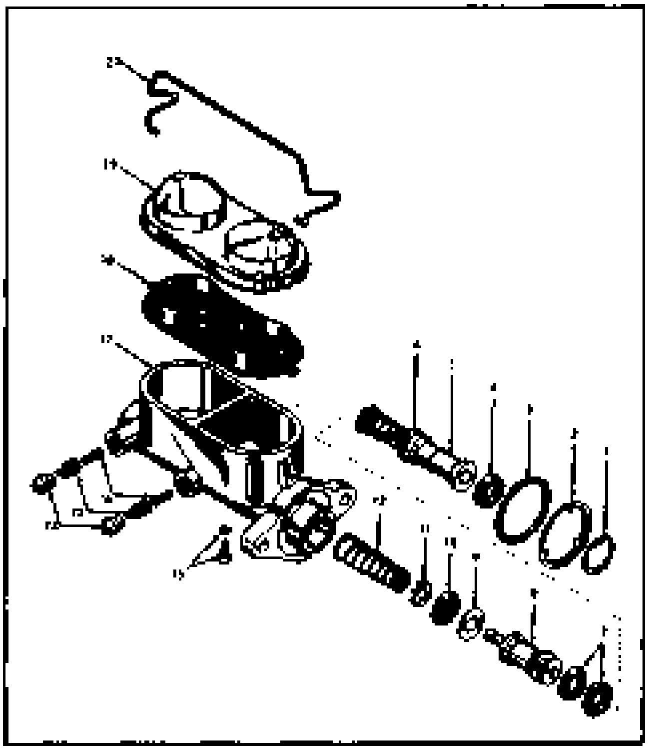
ASSEMBLY OF VACUUM SEAL IN REAR SHELL

Place rear shell on block of wood, studs down, and using seal installer J 22677, press new seal, plastic bearing face first, into recess in rear shell. Top outside flange of seal should be pressed .305" (approximately 5/16") below flat shell surface next to seal cavity (Fig. 5C-7).

ASSEMBLY OF PLATES PLUNGER AND DIAPHRAGM (Fig. 5C-8)

1. Install front diaphragm on front plate.

2. Apply a light film of power brake lubricant to outside surface of front plate and hub and liberally to the seal in the center plate bore. Carefully guide center plate and seal assembly, seal side first, onto front plate hub using tool J 22733. (See Fig. 5C-8).



1. Snap Ring
2. Splash Shield Retainer
3. Splash Seal
4. Secondary Seal
5. Rear Piston and Spring Assembly
6. Primary Cup
7. Secondary Seals
8. Front (Floating Piston)
9. Protector
10. Primary Cup
11. Retainer
12. Front Piston Return Spring
13. Piston Stop Screw and Seal
14. Tube Seats
15. Check Valves
16. Springs
17. Master Cylinder Casting
18. Hermetic Diaphragm
19. Reservoir Cover
20. Bale-Type Retainer

Fig. 5C-6 Master Cylinder - Exploded View

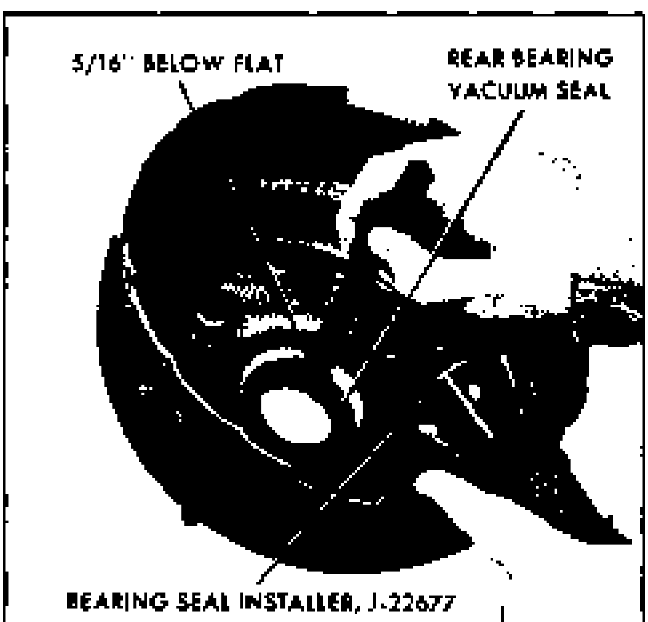


Fig. 5C-7 Installing Rear Shell Vacuum Seal

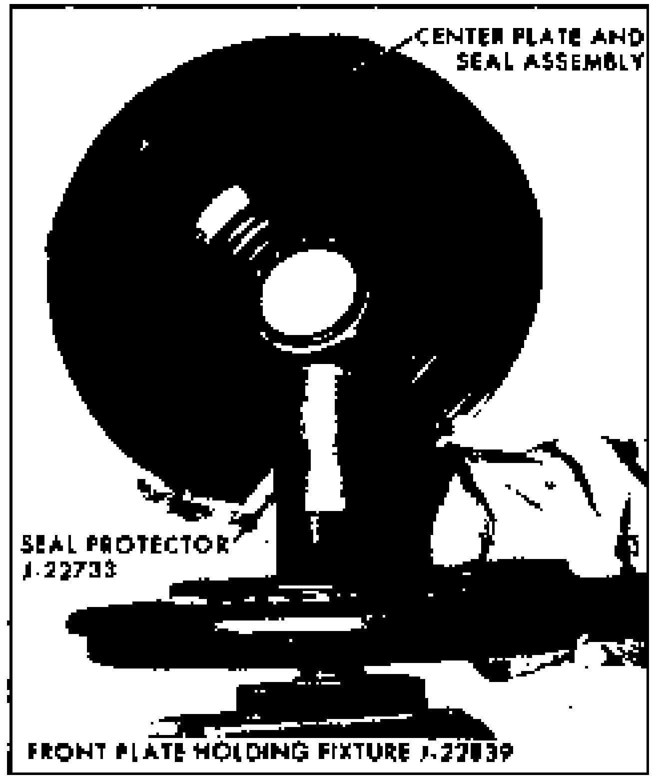


Fig. 5C-8 Installing Center Plate

3. Install square ring seal firmly against shoulder of front plate hub.

4. Apply power brake lubricant lightly to front and rear bearing surfaces of valve plunger, being careful NOT to get any lubricant on rubber grommet inside plunger. Assemble valve plunger return spring on valve plunger as shown and set spring and plunger in recess of front plate hub, grommet side up.

5. Set rear plate, threaded bore down, over valve plunger and, using hands only, screw rear plate onto front plate hub. To tighten plates, place 1-1/16" hex bar stock or tool J 22839 in vise and set plate assembly, front plate down, on hex bar. Using air channel slot or rear plate edges, hand torque plates to 12 1/2 lb. ft.

6. Remove plate assembly from vise.

7. Install rear diaphragm on rear plate and over lip of center plate. Assemble rear diaphragm spring retainer over rear diaphragm and lip of center plate. Using fingers, press retainer onto center plate until it seals against shoulder of center plate.

ASSEMBLY OF DIAPHRAGMS AND PLATES IN FRONT AND REAR SHELLS

1. Apply power brake lubricant liberally to bearing seal in rear shell.

2. Apply power brake lubricant liberally to scalloped cut-outs on edge of front shell.

3. When assembling diaphragm and plate assembly in rear shell, the rear diaphragm and center plate lugs must be aligned between lances on rear shell.

4. Carefully guide valve housing sleeve through bearing seal in rear shell, keeping diaphragm and plates in correct alignment. Work outer rim of front diaphragm into rear shell so that outer rim of front diaphragm is under each of retaining lances on rear shell.

5. Secure power section front shell to tool J 8433 and J 6407-02 as in Fig. 5C-3.

6. Assemble rear shell to spanner wrenches J 9504 as shown in Fig. 5C-3.

7. Secure front shell to arbor press.

8. Place power diaphragm return spring in front shell, small coil first.

9. Position rear shell, spanner wrenches, and tool J 22553-1 over spring so that scribe marks will be aligned when the shells are locked together

10. Slowly compress assembly keeping in a parallel plane.

CAUTION: Do not compress assembly to the point of damaging power unit.

11. When front and rear shells are mated, rotate spanner wrenches until the two shells are locked together. Bend locking tangs "in" on rear shell, if so equipped.

12. Release pressure from assembly and remove all tools from front and rear shells.

ASSEMBLY OF REACTION DISC, PUSH ROD AND VACUUM CHECK VALVE GROMMET (Fig. 5C-1).

1. Apply power brake lubricant liberally to entire surface of rubber reaction disc and to piston end of hydraulic push rod.

2. Place reaction disc on piston end of push rod.

CAUTION: Under NO condition should lubricant be allowed to get on adjustment screw or threads.

3. Insert push rod with reaction disc on piston end into cavity in front plate hub. Twist push rod to make certain reaction disc is seated in front plate hub and to eliminate air bubbles between hub, disc and push rod piston.

4. Assemble seal, support plate side first, over adjustment screw end of push rod. Press seal into recess in front shell until seal bottoms against shell.

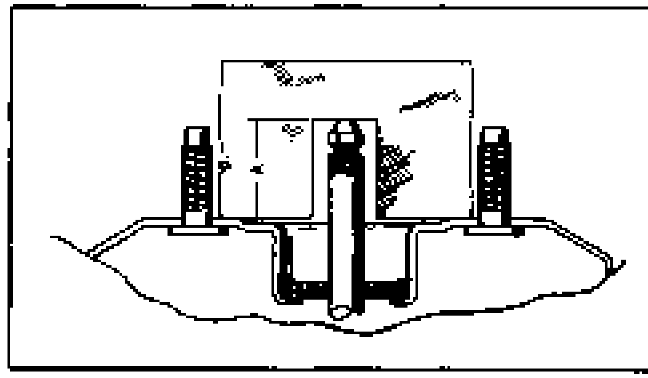


Fig. 5C-9 Gaging Push Rod Length

5. Wet new vacuum check valve grommet in alcohol and press grommet into front shell, beveled side first. Make certain grommet is seated in shell.

ASSEMBLY OF VALVE ROD, AIR FILTER, RETAINER AND POPPET PARTS (FIG. 5C-2)

1. Wet poppet valve in alcohol and assemble poppet in valve housing, small diameter end of poppet first; wet poppet retainer in alcohol and assemble in housing with flange out. Press in against retainer to make certain shoulder on retainer is positioned inside poppet.

2. Assemble retainer, air filter and valve return spring over ball end of valve rod as shown.

3. Wet rubber grommet in valve plunger inside valve hub and ball end of valve rod with alcohol.

4. Guide spring, filters and silencers into hub and assemble ball end of valve rod in valve plunger.

5. Tap end of valve rod with soft hammer to lock ball end of rod in valve plunger grommet.

6. Press foam air filter into position inside hub and

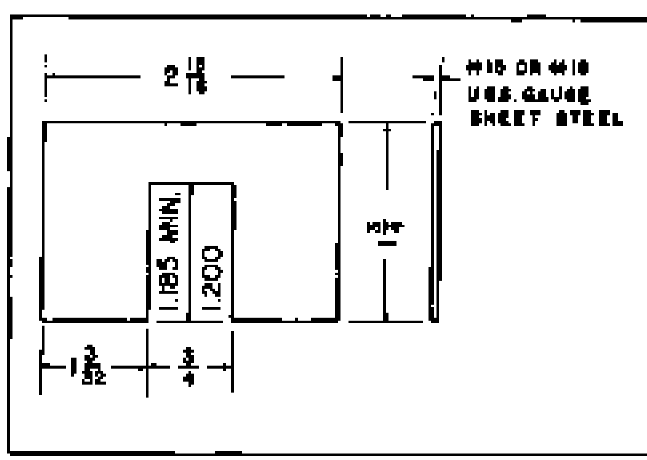


Fig. 5C-10 Push Rod Gage

assemble retainer on end of hub, being careful not to chip plastic.

ASSEMBLY OF PUSH ROD BOOT AND MASTER CYLINDER TO POWER UNIT (Fig. 5C-1)

1. Install air filter in push rod boot and assemble boot over end of valve rod, using care to avoid tearing. Press boot against rear shell.

2. Before mounting master cylinder, check distance A (Fig. 5C-9) from hydraulic push rod to master cylinder mounting face on front shell. This dimension A, as shown in Figure 5C-9, should be 1.200". If push rod length is not correct, follow adjustment procedure below. When push rod length is correct, attach master cylinder to power section with lockwashers and nuts. Tighten nuts to 24 lb. ft. torque.

PUSH ROD ADJUSTMENT

The self-locking adjustment screw is set to correct dimension at time of original assembly of power unit. Under normal service, no further adjustment should be needed provided push rod assembly remains in original unit. If, however, push rod is transferred to another unit or new push rod is used, adjustment will be necessary. To adjust push rod, hold serrated end of push rod with pliers and turn adjusting screw IN to shorten or OUT to lengthen push rod. Measure push rod height with push rod installed in unit, using either a height gage or tool J 7723-01. See Figure 5C-10 for details for making height gage.

POWER BRAKE ASSEMBLY - INSTALL

1. Place power brake assembly into position and install four rear housing to dash attaching nuts from inside of car. Tighten nuts to 24 lb. ft. torque.

2. Install clevis pin retainer.

3. Adjust stop light switch if necessary. See Section 5 for service.

4. Install vacuum check valve.

5. Attach hydraulic lines.

6. Bleed brakes as necessary and fill fluid reservoirs. Fluid level should be as shown in Section 5.

TORQUE SPECIFICATIONS

	LB. FT.
Power cylinder housing to master cylinder nuts	24
Rear housing to dash nuts	24

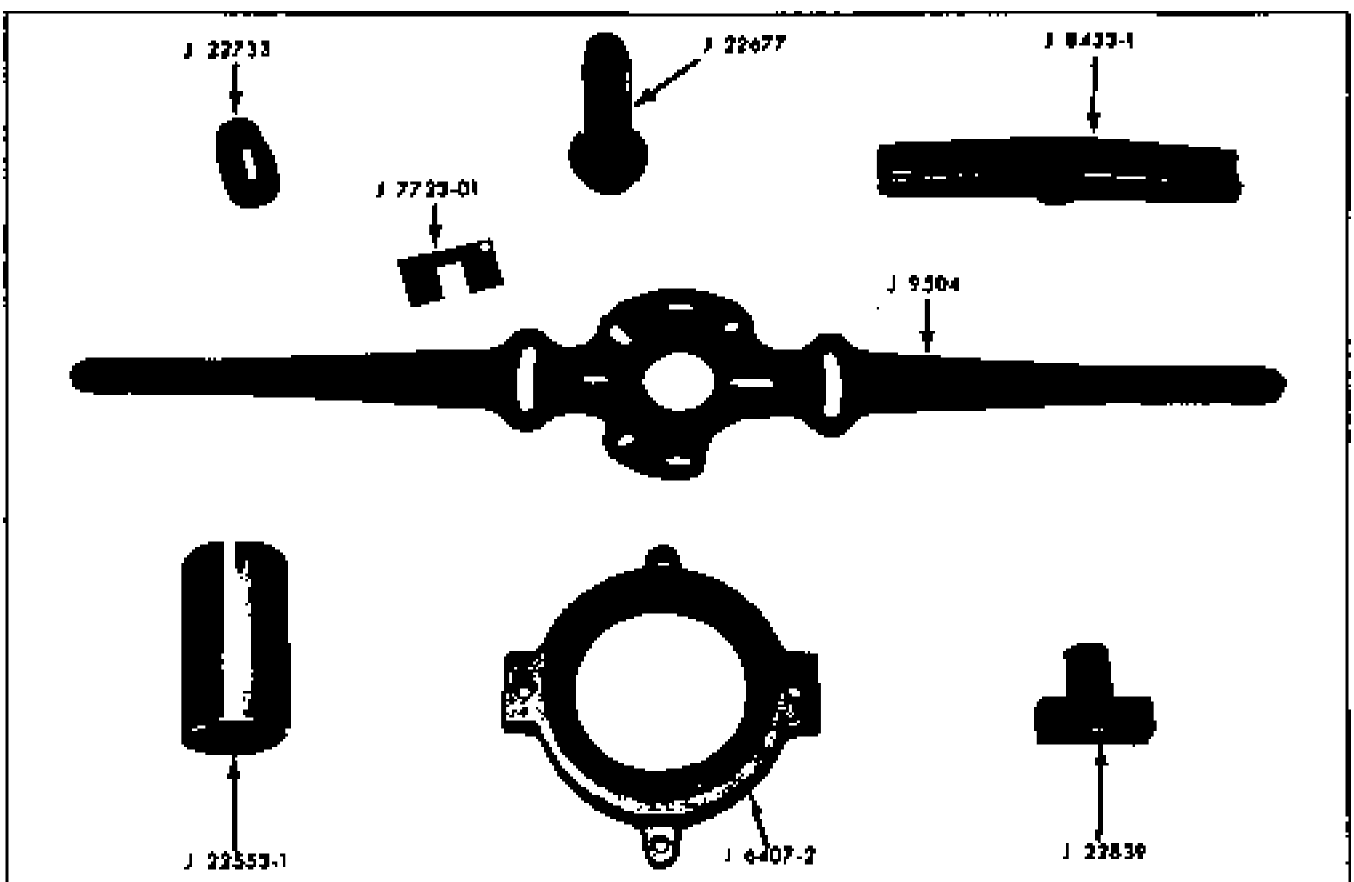


Fig. 5C-11 Special Tools

HEAVY DUTY POWER BRAKES

DELCO-MORAINE TANDEM DIAPHRAGM TYPE

CONTENTS OF THIS SECTION

CHECKS AND ADJUSTMENTS ON CAR

1. Check for free operation of brake pedal. If binding exists, check all pivot points for binding and lubricate as required.

2. Check stoplight switch for proper setting and operation.

3. Check fluid level in hydraulic cylinder reservoirs. Fluid level should be as shown in Section 5.

4. Check vacuum line and connections at carburetor and vacuum check valve for possible vacuum leaks.

5. Check engine for good stall - free idle and correct as required.

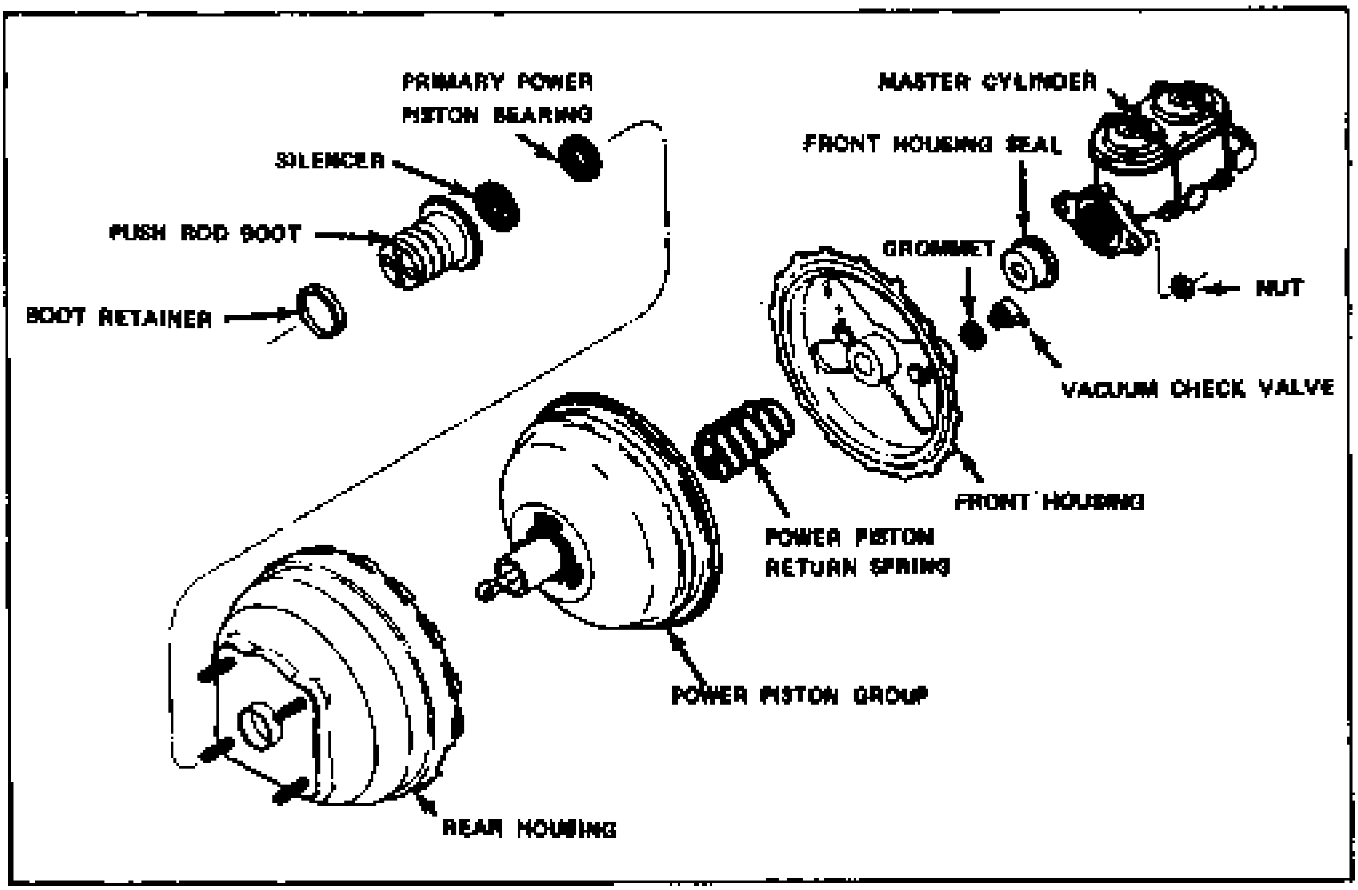


Fig. 5D-1 Power Cylinder - Exploded View

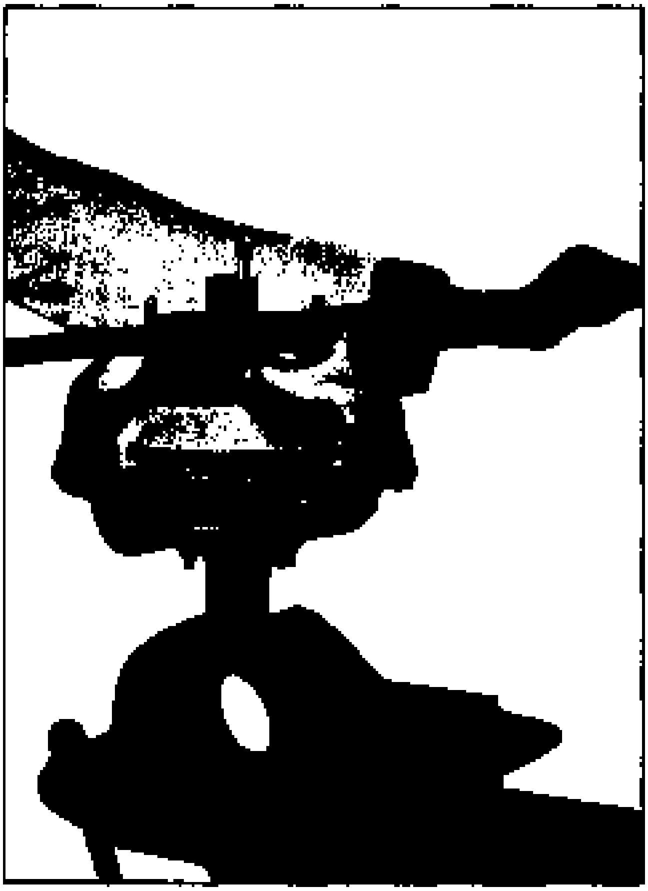


Fig. 5D-2 Separating Front and Rear Shells

MINOR REPAIRS

BLEEDING BRAKES

Brakes should be bled in the same manner as standard brakes, unless a disc brake balance valve is incorporated in the system (see Section 5E).

STOP LAMP SWITCH

See Section 5 for service.

MAJOR REPAIRS

MASTER CYLINDER ONLY - REMOVE

Certain repair operations, such as replacement of master cylinder internal parts, permit the master cylinder to be removed by itself, leaving the power cylinder, pedal, and brackets in the car.

1. Remove hydraulic connections from master cylinder, pump fluid from cylinder into a container and dispose of fluid. Cover openings at cylinder and pipes to exclude dust, dirt, etc.

2. Remove master cylinder attaching nuts and remove master cylinder from power section.

POWER CYLINDER ONLY - REMOVE

1. Remove vacuum check valve.

2. Remove master cylinder and position it away from power cylinder.

NOTE: Do not disconnect hydraulic fluid lines; be careful not to bend or kink lines.

3. Remove clevis pin retainer at brake pedal.

4. Remove four power unit to dash attaching nuts.

5. Remove power cylinder.

OVER-ALL BRAKE UNIT - DISASSEMBLE

POWER CYLINDER - DISASSEMBLE (Fig. 5D-1)

1. Clean exterior of power cylinder.

2. Scribe a line across front and rear housings to facilitate reassembly.

3. Remove front housing seal.

4. Attach tool J 22805-01 to master cylinder studs of power cylinder with two nuts.

5. Place assembly in vise. Attach tool J 9504 over rear housing studs. (Fig. 5D-2)

6. Applying downward pressure, rotate rear housing counterclockwise to unlock housings. It is normal for this operation to require heavy pressure to unlock housings.

NOTE: Rotate slowly as housing is under spring tension.

7. Remove rear housing and power piston assembly by lifting straight up slowly and lay it aside on a clean smooth surface.

8. Remove power piston return spring and retainer plate.

9. Dispose of vacuum check valve grommet in front housing.

10. Remove boot retainer and boot from rear housing. The boot and felt silencer must be pulled over the pushrod "eye" to remove.

11. Remove power piston group from rear housing and

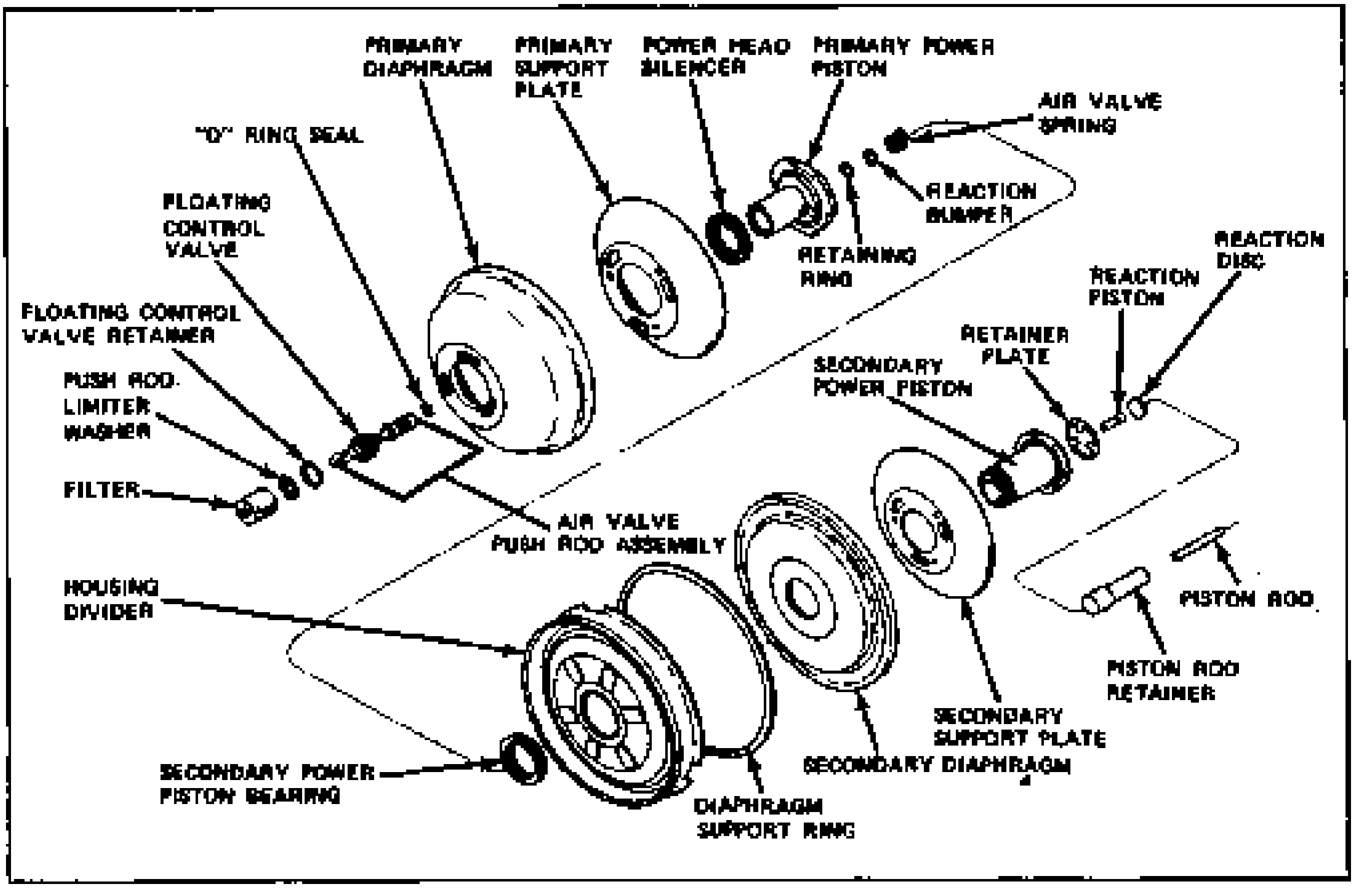


Fig. 5D-3 Power Piston - Exploded View

remove primary piston bearing from center opening of rear housing.

POWER PISTON - DISASSEMBLE (Fig. 5D-3)

CAUTION: Exercise extreme care in handling power piston, rubber surfaces and metal parts in this assembly. They should be guarded against grease, oil and foreign matter and must be protected from nicks or cuts that might be caused by rough surfaces or damaged tools.

1. Lift bead on O.D. of secondary diaphragm and remove diaphragm support ring.

2. Remove piston rod retainer and piston rod from secondary piston.

3. Mount double-ended tool J 23101 (with large diameter end up) in a vise. Position the secondary power piston so that the two radial slots in piston fit over ears of tool (Fig. 5D-4).

4. Fold back primary diaphragm from O.D. of primary support plate. Grip edge of support plate with hands and rotate counterclockwise to unscrew primary power piston from secondary power piston. (Fig. 5D-5).

NOTE: It is possible that the primary support plate will unlock from the primary piston before the primary piston unscrews from the secondary piston. If this happens, continue to turn primary support plate counterclockwise. Tabs ("stops") on primary support plate will temporarily lock primary support plate to primary power piston and permit continued counterclockwise rotation to unscrew primary power piston from secondary power piston.

5. Remove housing divider from secondary power piston. Remove secondary power piston bearing from housing divider.

6. The secondary power piston should still be positioned on tool J 23101. Fold back secondary diaphragm from O.D. of secondary support plate. Grip edges of support plate with hands and rotate clockwise to unlock secondary support plate from secondary power piston.

7. Remove secondary diaphragm from secondary support plate.

8. Remove reaction piston and rubber reaction disc from center of secondary power piston by pushing down on end of reaction piston with a small object, such as a pencil, wooden dowel, or metal rod.

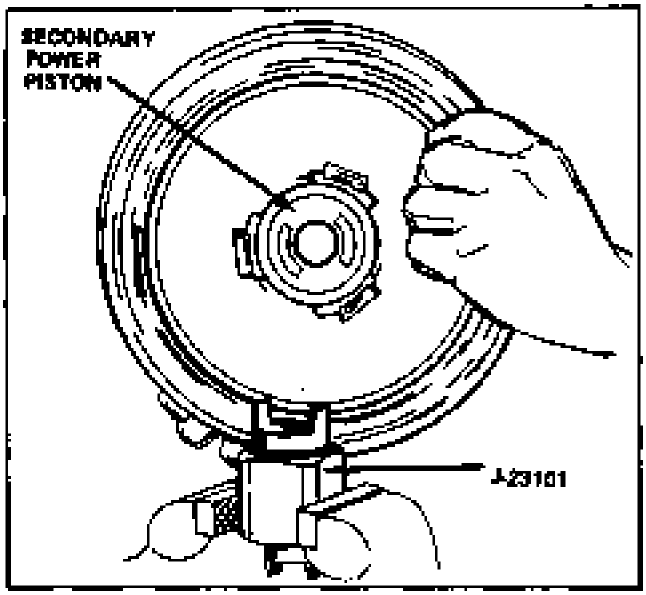


Fig. 5D-4 Preparing to Separate Primary and Secondary Pistons

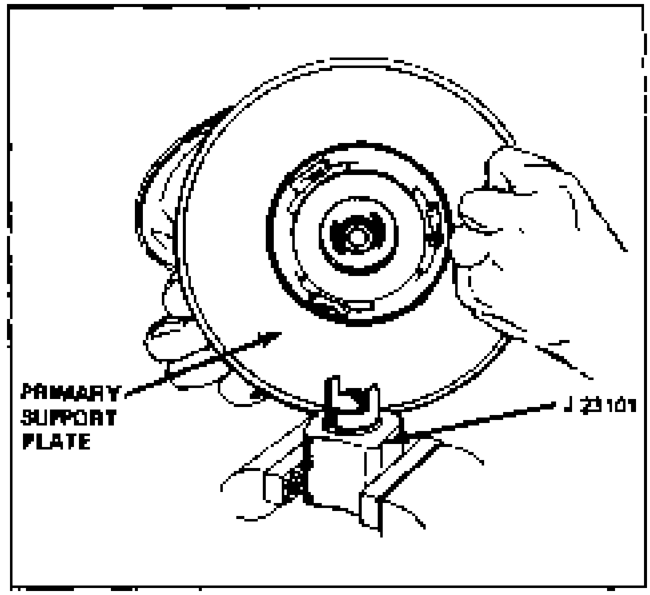


Fig. 5D-6 Preparing to Remove Primary Support Plate

9. Remove air valve spring from end of air valve (if it did not come off during disassembly of power piston).

10. Mount tool J 23101 in vise (with small diameter end up). Position primary power piston so that the two radial slots in piston fit over ears of tool. (Fig. 5D-6)

11. Remove power head silencer from neck of power piston tube.

12. Fold back primary diaphragm from support plate. Grip edge of support plate with hands and rotate in a counterclockwise direction to unlock support plate from power piston.

13. Remove primary diaphragm from primary support plate.

14. Remove air filter and pushrod limiter washer from tubular section of primary piston.

15. Remove rubber reaction bumper from end of air valve.

16. Using Truarc No. 2 pliers, remove retaining ring from air valve.

17. Remove air valve-pushrod assembly from tube end of primary piston. It is recommended that a round-

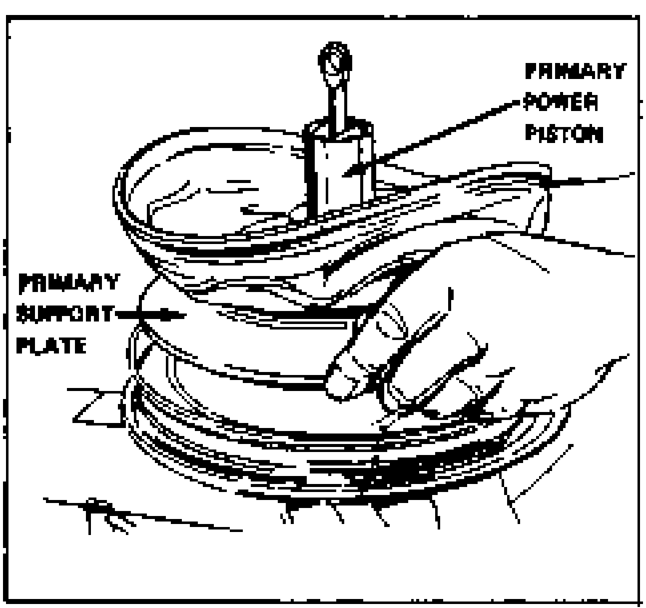


Fig. 5D-5 Removing Primary Power Piston

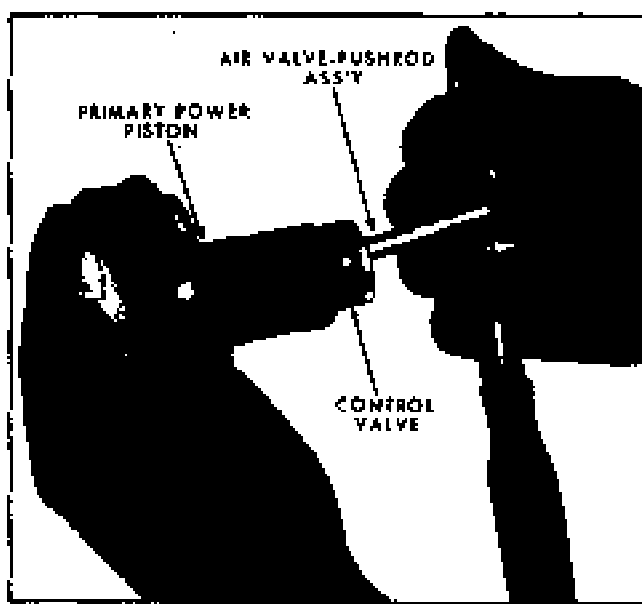


Fig. 5D-7 Removing Air Valve-Pushrod Assembly

-shanked screwdriver be inserted through the pushrod eye, and using the screwdriver as a handle, pull the air valve-pushrod assembly straight out (Fig. 5D-7).

NOTE: Removal of the air valve-pushrod assembly will also release the control valve and retainer.

18. Remove "O" ring seal from air valve.

NOTE: The floating control valve cannot be removed from the pushrod - hence, the air valve-pushrod assembly is serviced as a complete assembly.

MASTER CYLINDER - DISASSEMBLE (FIG. 5D-8)

Refer to Section 5 - STANDARD BRAKES for disassembly procedures.

NOTE: On disc-brake equipped vehicles, only the rear outlet contains a check valve. For this reason, do not remove front outlet tube seat unless tube seat is damaged and requires replacement.

INSPECTION AND CLEANING

Thoroughly wash all parts in alcohol and air dry. Blow dust and cleaning fluid out of all internal passages.

CAUTION: It is important that all parts be placed on a clean paper after being cleaned to prevent the possibility of dirt being assembled into unit or grease contacting any rubber parts.

POWER BRAKE

Inspect all parts for scoring, pitting, dents or nicks. Small imperfections can be smoothed out with fine emery cloth. Replace if badly nicked, scored or otherwise damaged.

MASTER CYLINDER

Inspect bore from the open end. The bore should be free from scores, deep scratches and corrosion. If it appears that corrosive brake fluid has damaged the bore, replace damaged parts and flush out entire brake system including wheel cylinders.

The sealing surfaces should be clean and smooth. Check for cracks and damaged threads. Be sure that the by-pass and compensating ports to the master cylinder are not restricted.

Check for distortion of all springs and deterioration of all rubber parts. Any evidence of soft or swollen rubber parts indicates contaminated brake fluid requiring flushing of the entire brake system and replacement of wheel cylinder cups, as well as all rubber parts in master cylinder.

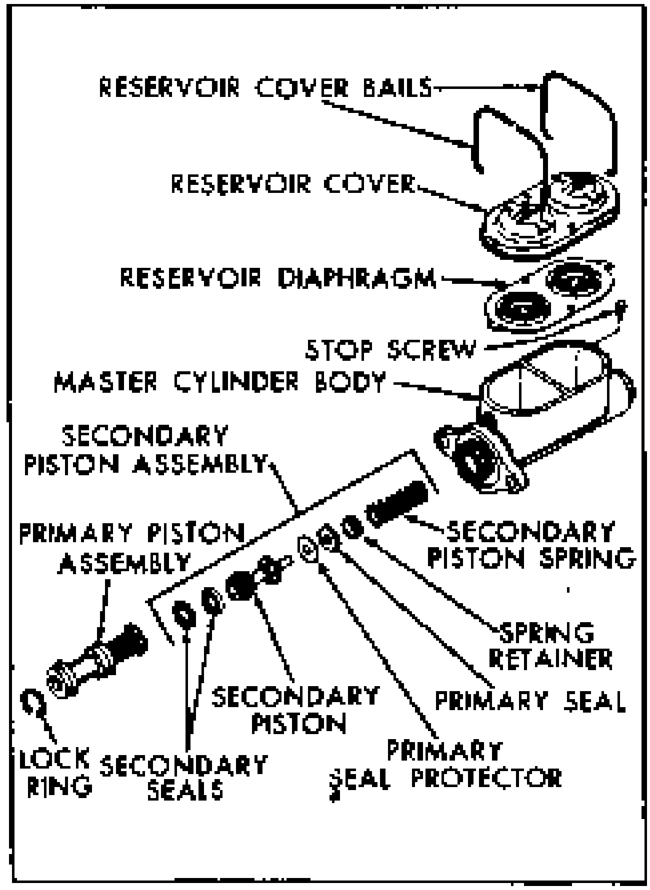


Fig. 5D-8 Master Cylinder - Exploded View

AIR FILTER

Replace air filter element if dirty. Do not clean.

ASSEMBLE BRAKE UNIT

MASTER CYLINDER - ASSEMBLE

Refer to Section 5 - STANDARD BRAKES for assembly procedures.

POWER PISTON - ASSEMBLE (Fig. 5D-3)

1. Lubricate the "O" ring seal with silicone lubricant and place in groove on air valve.

2. Wipe a thin film of silicone lubricant on large and small O.D. of floating control valve.

NOTE: If floating control valve requires replacement, it will be necessary to replace the complete air valve pushrod assembly, since the floating control valve is a component part of this assembly and cannot be removed.

3. Place the air valve end of the air valve-pushrod assembly into the tube of the primary piston. Manually push the air valve-pushrod assembly until the air

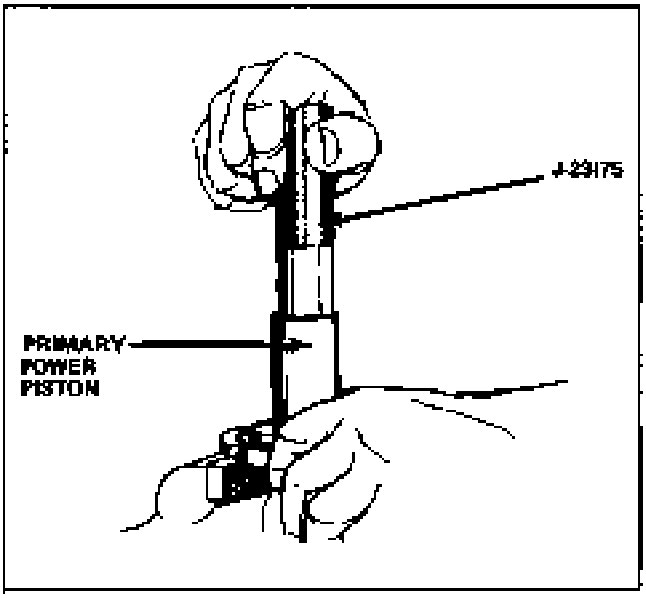


Fig. 5D-9 Installing Control Valve and Retainer

valve starts into its bore. Push the control valve assembly into the tube so that the complete control valve is just inside the tube.

4. Insert control valve retainer over end of control valve so that closed side of retainer rests against control valve.

5. Installer tool J 23175 fits the I.D. of the floating control valve retainer. Push floating control valve assembly to its seat in tube of power piston (Fig.5D-9).

6. Place pushrod limiter washer over pushrod and position against floating control valve retainer.

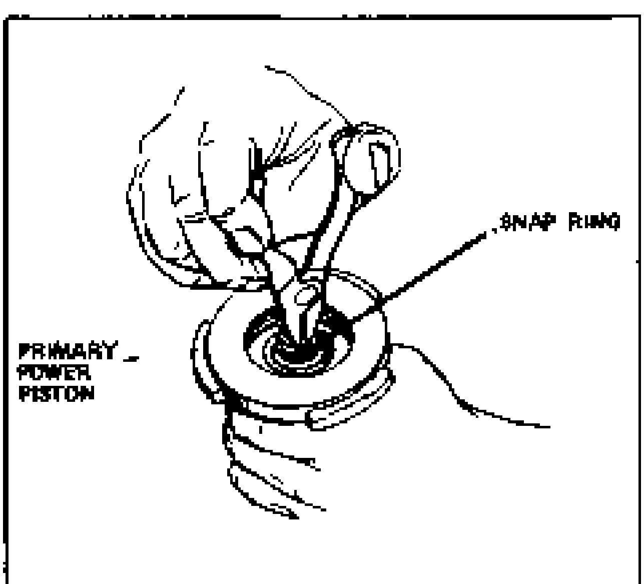


Fig. 5D-10 Installing Snap Ring on Air Valve

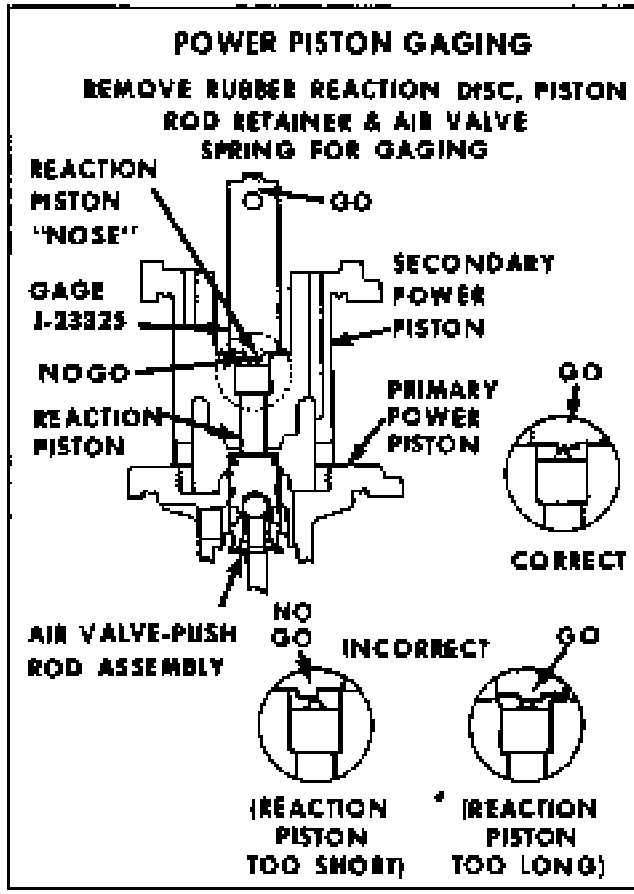


Fig. 5D-11 Gaging Reaction Piston

7. Stretch the foam filter element over pushrod eye and press into primary power piston tube.

8. Using Truarc No. 2 pliers, place the retaining ring into groove on air valve. (Fig. 5D-10)

9. Position the rubber reaction bumper on end of air valve.

NOTE: Tolerances of the component parts affecting output of the tandem power brake are very critical. In order to maintain correct power brake output, the power piston assembly must be gaged for selective fit of reaction piston whenever the primary power piston and/or secondary power piston are replaced during servicing. This gaging operation is not required if if neither power piston is replaced during servicing.

10. The gaging procedure is to be performed as follows: (Fig. 5D-11)

a. Hand-tighten the secondary power piston to the primary power piston without installing the air valve spring. (The air valve-pushrod assembly should be secured to the primary power piston as described in step #8.)

b. Insert the reaction piston into its cavity in the secondary power piston. This is accomplished by placing reaction piston, small diameter first, through large cavity and into smaller cavity.

c. With secondary power piston up, push on reaction piston to insure that it is seated on air valve.

d. Place gage J 23337 in secondary power piston so that outer edges rest on bottom of large cavity, and center section of gage rests over "nose" of reaction piston. Both ends of gage must be used to perform gaging operation.

e. Move gage to left or right of "nose" on reaction piston. Reaction piston is correct length if "nose" of piston hits "NO GO" level of gage and clears "GO" level of gage, while permitting outer edges of gage to remain seated on larger cavity of secondary power piston.

NOTE: If reaction piston is too long, "GO" level of gage will not clear "nose" without moving outer edges of gage off the seat in large cavity of power piston. If reaction piston is too short, both levels of gage will clear "nose" of reaction piston. If either condition exists, a separate kit of three selective reaction pistons (differing in length and color) must be obtained to permit use of piston that meets correct size requirements of step (e).

Care must be taken to insure that gage is not "cocked".

11. After determination of correct reaction piston, apply a light film of silicone lubricant to O.D. of rubber reaction disc, place disc in large cavity of secondary power piston and push disc down to seat on reaction piston.

12. Unlock secondary power piston from primary power piston.

13. Assemble primary diaphragm to primary support plate from side of support plate opposite locking tangs. Press raised flange on I.D. of diaphragm through center hole of support plate. Be sure that edge of support plate center hole fits into groove in raised flange of diaphragm. Lubricate diaphragm I.D. and raised surface of flange (that fits into groove in primary power piston) with light coat of silicone lubricant.

14. Mount Tool J 23101 (small diameter end up) in a vise. Position primary power piston so that the two radial slots in piston fit over ears of tool.

15. Fold primary diaphragm away from O.D. of primary support plate.

16. Holding edges of support plate, with locking tangs down, place primary support plate and diaphragm assembly over tube of primary power piston. Flange on I.D. of primary diaphragm will fit into groove in primary power piston.

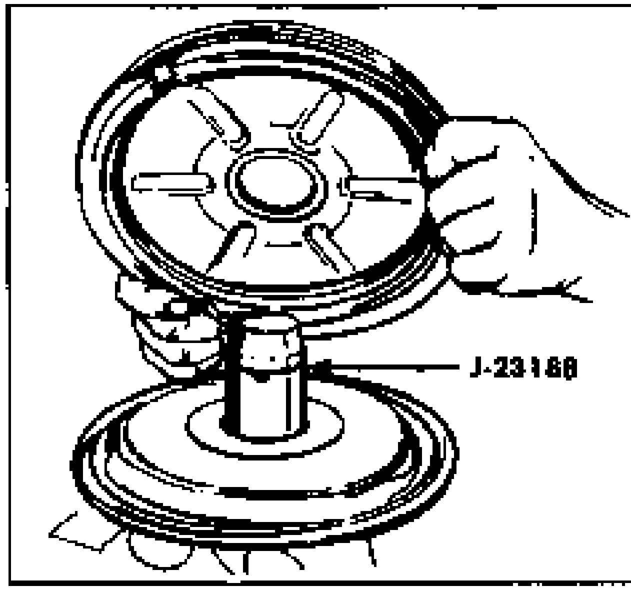


Fig. 5D-12 Installing Housing Divider

17. Grip edges of primary support plate, press down, and rotate clockwise until tabs on primary power piston contact the stops on support plate.

18. Place power head silencer on tube of primary power piston so that holes at base of tube are covered.

19. Apply silicone lubricant to O.D. of primary power piston tube.

20. Remove primary piston assembly from Tool J 23101 and lay it aside.

21. Assemble secondary diaphragm to secondary support plate from side of support plate opposite locking tangs. Press raised flange on I.D. of diaphragm through center hole of support plate. Be sure that edge of support plate center hole fits into groove in raised flange of diaphragm. Apply thin coat of silicone lubricant to I.D. of secondary diaphragm and raised surface of flange (that fits into groove in secondary power piston).

22. Mount Tool J 23101 (with large diameter end up) in vise. Position secondary power piston so that radial slots in piston fit over ears of tool. Apply light coat of silicone lubricant to tube of secondary power piston

23. Fold secondary diaphragm away from O.D. of secondary support plate.

24. Holding edges of support plate, with locking tangs down, place secondary diaphragm and support plate assembly over tube of secondary power piston. Flange on I.D. of secondary diaphragm will fit into groove in secondary piston.

25. Grip edges of secondary support plate, press down, and rotate counterclockwise until tabs on secondary

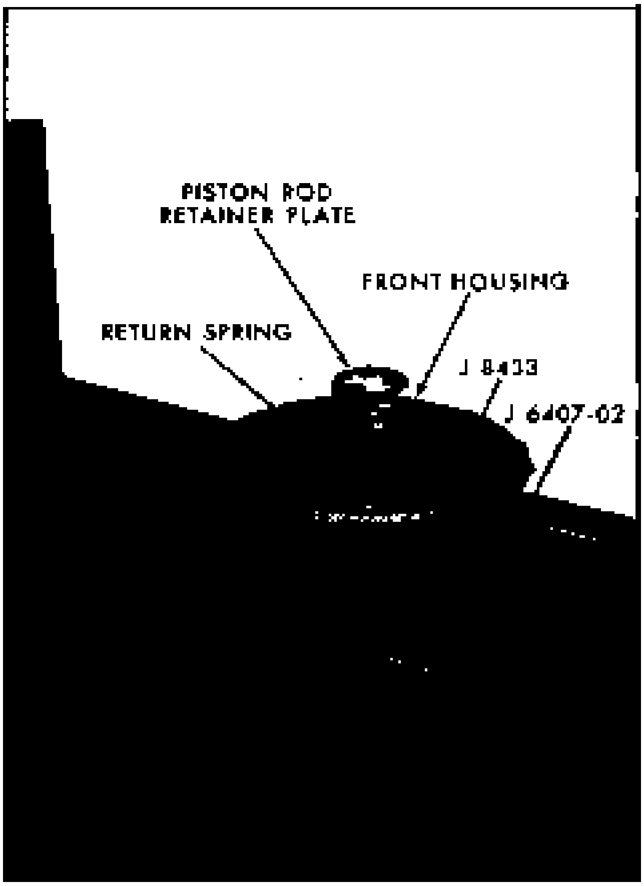


Fig. 5D-13 Securing Front Housing to Arbor Press

power piston contact stops on support plate. Fold secondary diaphragm back into position on secondary support plate. Leave the secondary power piston assembly on Tool J 23101 in vise.

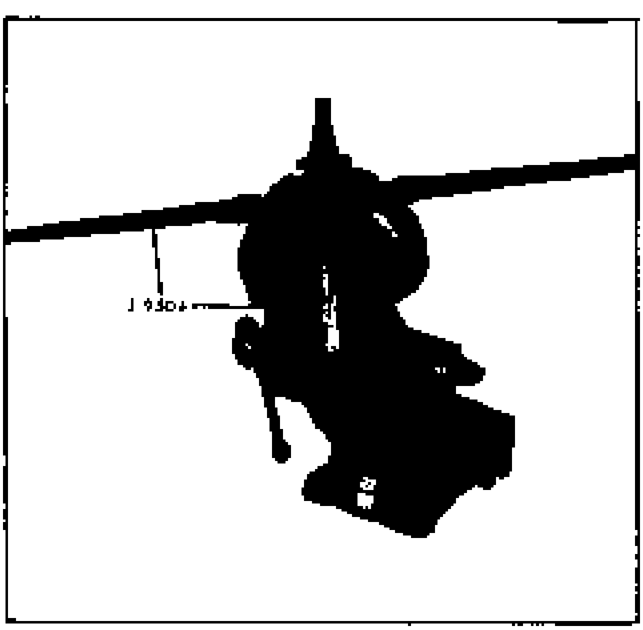


Fig. 5D-14 Securing Rear Housing to Tools

26. Apply light coat of talcum powder or silicone lubricant to bead on O.D. of secondary diaphragm. This will facilitate reassembly of front and rear housings.

27. Place secondary diaphragm support ring on secondary power piston assembly so that it rests on edge of diaphragm.

28. Hold housing divider so that formed over flange (that holds the primary diaphragm) of divider faces down. Place secondary bearing in I.D. of divider so that extended lip of bearing faces up.

29. Lubricate I.D. of secondary bearing with silicone lubricant.

30. Position secondary bearing protector Tool J 23188 on threaded end of secondary power piston.

31. Hold housing divider with formed flange (that holds the primary diaphragm) facing up. Press divider down over tool and onto secondary power piston tube where it will rest against diaphragm support ring (Fig. 5D-12). Remove Tool J 23188 from secondary power piston, however, do not remove secondary power piston subassembly from Tool J 23101.

32. Pick up primary power piston assembly and position small end of air valve return spring on air valve so that it contacts air valve retaining ring.

33. Fold primary diaphragm away from O.D. of primary support plate.

34. Position primary power piston on tubular portion of secondary power piston, making sure that air valve return spring seats down over raised center section of secondary piston.

35. Grip edge of primary support plate with hands, press down, and start threads on secondary power piston into threaded portion of primary power piston by rotating in a clockwise direction.

36. Continue to tighten primary power piston until it is securely attached to secondary power piston.

37. Fold primary diaphragm back into position on primary support plate and pull diaphragm O.D. over formed flange of housing divider. Check that bead on diaphragm is seated evenly around the complete circumference. Remove assembly from tool.

38. Wipe thin film of silicone lubricant on O.D. of piston rod retainer. Insert master cylinder piston rod retainer into cavity in secondary power piston so that flat end bottoms against rubber reaction disc in bottom of cavity.

39. Place primary power piston bearing in rear housing center hole so that formed flange of housing center hole fits into groove of primary power piston bearing.

Thin lip of bearing will protrude to outside of housing.

40. Coat I.D. of primary power piston bearing with silicone lubricant.

41. If check valve grommet was removed during servicing, replace with new grommet in front housing.

POWER CYLINDER - ASSEMBLE

1. Secure power section front housing to tools J 8433 and J 6407-02 as shown in Fig. 5D-13

2. Secure front housing to arbor press.

3. Position power piston return spring over inset in front housing.

4. Place piston rod retainer plate on end of power piston return spring in front housing

5. Assemble power piston group to rear housing by pressing tube of primary power piston through rear housing bearing. Press down until housing divider seats in rear housing and primary power piston bottoms against housing.

6. Assemble rear housing to spanner wrenches J 9504 as shown in Fig. 5D-14.

7. Hold rear housing assembly (with mounting studs up) over front housing, so that scribe marks will be aligned when housings are locked together

NOTE: While joining the housings, care must be taken to assure that the piston rod retainer plate is centered on the piston rod retainer.

8. Slowly compress assembly keeping in a parallel plane. (Fig. 5D-15).

CAUTION: Do not compress assembly to the point of damaging power unit.

9. When front and rear housings are mated, rotate spanner wrenches until housings are locked together.

10. Release pressure from assembly and remove all tools from unit.

11. Place front housing seal in cavity of front housing, making sure flat surface of cup lies against bottom of depression in housing.

12. Place felt silencer in dust boot, and push to closed end. Insert boot retainer over boot. Stretch boot over pushrod and over flange in center of rear housing

GAGING PROCEDURE (FIG. 5D-16).

1. Place power cylinder assembly in padded vise (front housing up). DO NOT CLAMP TIGHT.

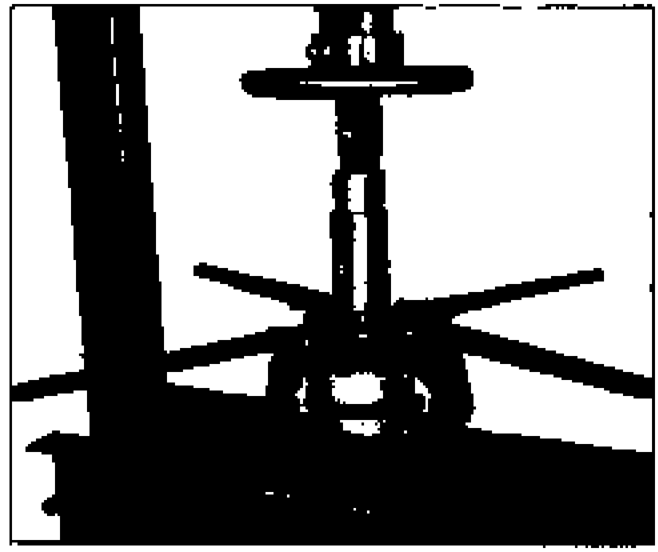


Fig. 5D-15 Joining Front and Rear Housings

2. Insert master cylinder piston rod, flat end first, into piston rod retainer.

3. Press down on master cylinder piston rod to assure that it is properly sealed.

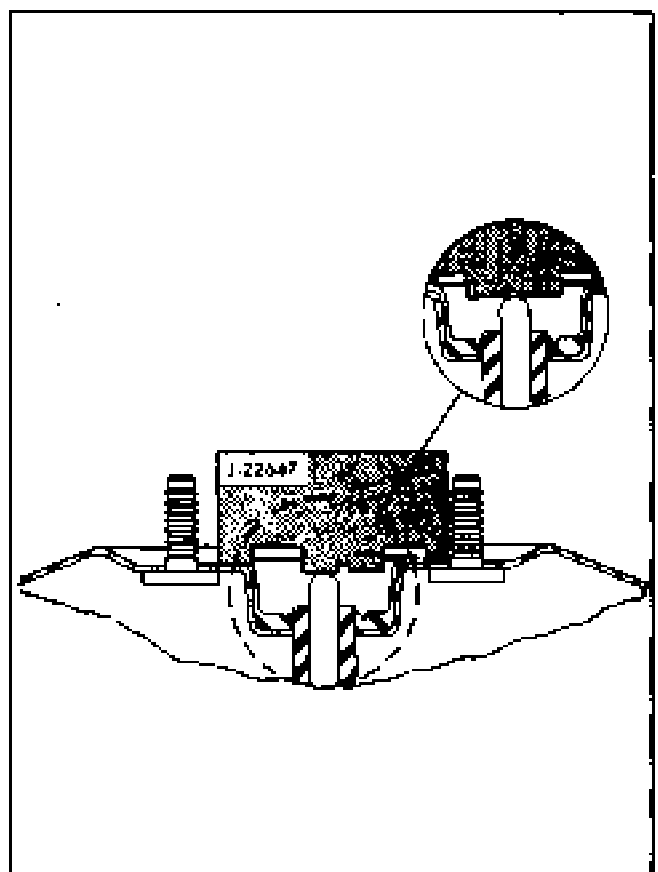


Fig. 5D-16 Gaging Master Cylinder Piston Rod

4. Place gage J 22647 over piston rod in a position which will allow gage to be slipped to the right or left without contacting the studs. (Fig. 5D-16)

NOTE: GAGING IS TO BE PERFORMED WITHOUT VACUUM.

The center section of the gage has two levels. The piston rod should always never contact the longer section (lower level) of the gage. The piston rod should never contact the shorter section (higher level) of the gage. Move gage from side to side to check piston rod height.

Any variation beyond these two limits must be compensated for by obtaining the service adjustable pushrod, and adjusting the self-locking screw to meet gaging specifications.

POWER CYLINDER ONLY - INSTALL

1. Mount power cylinder to dash. Install four power unit to dash attaching nuts. Torque nuts to 24 lb. ft.

2. Attach pushrod "eye" to pedal arm pin with retainer clip.

3. Position master cylinder over attaching studs and install two nuts. Torque nuts to 25 lb. ft.

4. Install vacuum hose and vacuum check valve.

5. Check stop light switch adjustment (see Section 5).

MASTER CYLINDER ONLY - INSTALL

1. Position master cylinder on power cylinder studs. Secure master cylinder with two nuts; torque to 25 lb. ft.

2. Attach hydraulic fluid lines.

3. Fill master cylinder reservoirs and bleed brakes as described in Section 5.

TORQUE SPECIFICATIONS

	LB. FT.
Power Cylinder to Master Cylinder Attaching Nuts	25
Power Cylinder to Dash Attaching Nuts	24

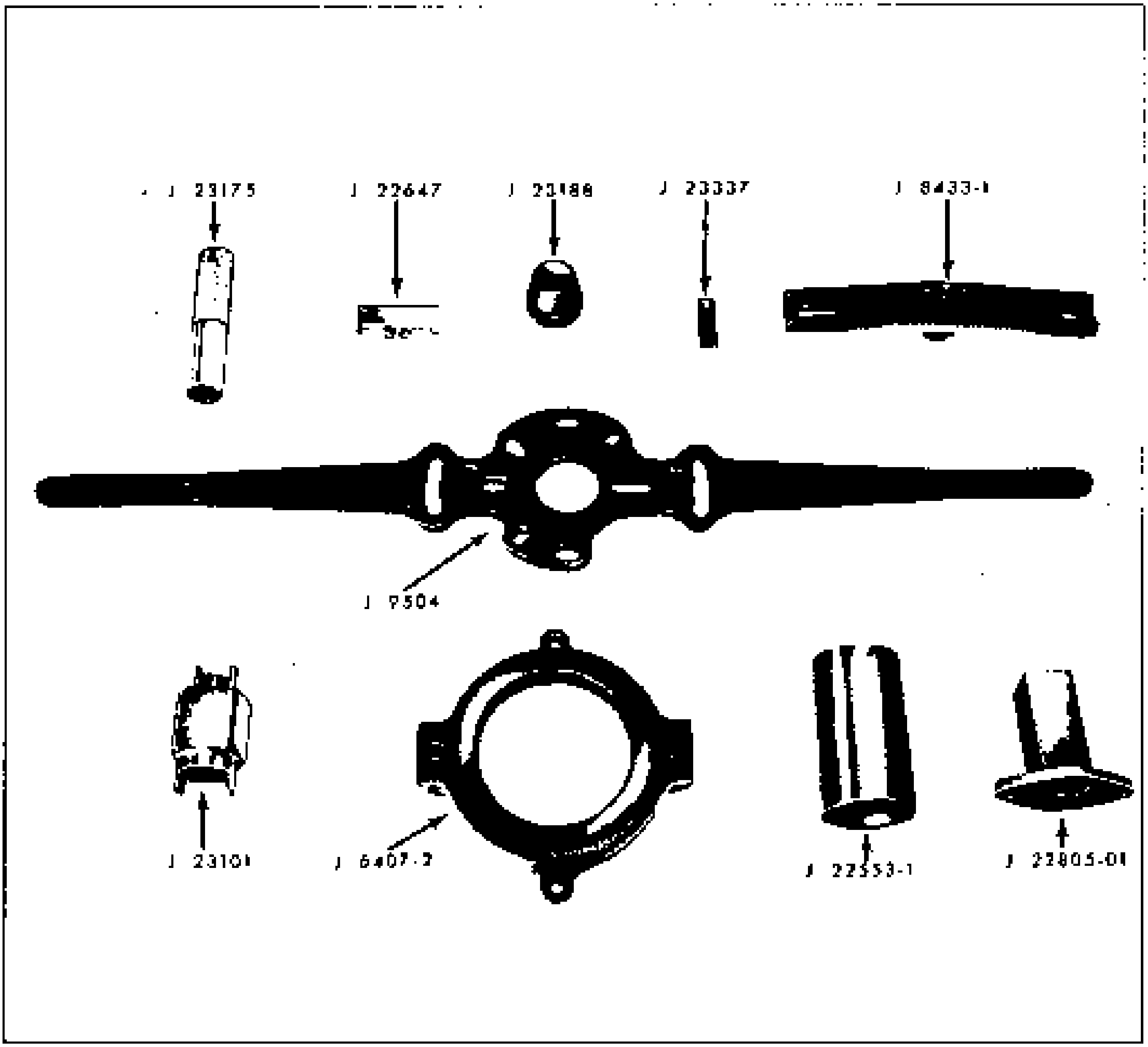


Fig. 5D-17 Special Tools

DISC BRAKES

CONTENTS OF THIS SECTION

LINING INSPECTION

Inspect the brake linings any time that the wheels are removed (tire rotation, etc.). Check both ends of the outboard shoe by looking in at each end of the caliper (Fig. 5E-2). These are the points at which the highest rate of wear normally occurs. However, at the same time, check the lining thickness on the inboard shoe to make sure that it has not worn prematurely. Look down through the inspection hole in the top of the caliper to view the inboard shoe. Whenever the thickness of any lining is worn within 1/8" of of the metal shoe, all shoe and lining assemblies on the axle set should be replaced (Fig. 5E-3).

NOTE: Wheel must be removed to inspect lining.

SHOE AND LINING REPLACEMENT

CALIPER - REMOVE

1. Remove two thirds of the total fluid capacity from the front master cylinder reservoir. This may be done by breaking the front line connection at the master cylinder and bleeding down the fluid level. Do not remove the brake line or completely empty the reservoir or it will be necessary to bleed the hydraulic system. Discard -- do not attempt to reuse -- the brake fluid removed.

NOTE: Removal of the fluid is necessary to prevent reservoir overflow when the caliper piston is pushed back in its bore during lining replacement.

2. Raise the car and remove the wheel covers and wheel assemblies.

3. Using hand pressure, move caliper outboard as far as possible. This will push the piston to the bottom of the piston bore.

4. Remove the two mounting bolts which attach the caliper to the support bracket (Fig. 5E-4).

NOTE: It is not necessary to disconnect the brake hose for shoe and lining replacement.

5. Lift the caliper off the rotor using equal force on each end to prevent it from binding at the mounting bracket flanges. Do not force caliper if it becomes cocked. Dislodge both shoes and position the caliper on the front suspension arm so that the brake hose will not support the weight of the caliper.

6. Transfer the inboard shoe anti-rattle spring to the new shoe and lining assembly.

7. Using hand pressure, push the sleeves from the inboard ears of the caliper. Next, remove the rubber bushings from the grooves in each of the four caliper ears (Fig. 5E-5). Discard these parts, new ones are provided with new linings.

CLEANING AND INSPECTION

Thoroughly clean the holes and the bushing grooves in the caliper ears. Wipe all dirt from the mounting bolts. Do not use abrasives on the bolts since this will damage the plating. If the bolts are corroded or damaged, they must be replaced.

Examine the piston boot for evidence of fluid leakage. If leakage is noted, the caliper should be overhauled. (See Caliper - Overhaul.) Wipe the inside of the caliper clean, including the exterior of the dust boot. Check the boot for cuts, cracks or other damage. Make sure that the boot is properly engaged in the groove in the piston and also in the caliper counter-bore (Fig. 5E-6).

CAUTION: Do not use compressed air to clean the inside of the caliper since this may cause the dust boot to become unseated.

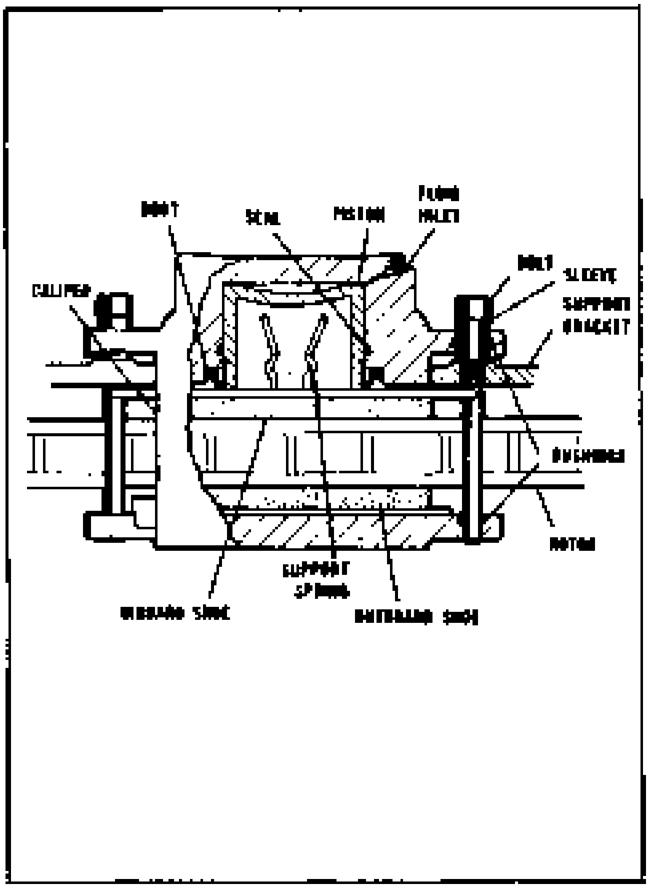


Fig. 5E-1 Disc Brake Assembly

If the vehicle has a brake problem and diagnosis points to the rotor, it should be inspected and checked for runout at this time (See Rotor Service).

CALIPER - INSTALL

1. Using a high quality silicon lubricant, lubricate the new sleeves on all surfaces. Lubricate the new rubber bushings, bushing grooves and the small ends of mounting bolts (Fig. 5E-7). Install rubber bushings in all four caliper ears.

CAUTION: It is essential that new sleeves and rubber bushings be used and that lubrication instructions be followed in order to insure the proper functioning of the sliding caliper design.

2. Use hand pressure to install the sleeves. Position the sleeves so that the end toward the shoe and lining assemblies is flush with the machined surface of the ear.

3. Position the inboard shoe and lining assembly in the caliper so that the top edge of the shoe contacts the caliper bridge. Push shoe toward piston making sure top and bottom ears of spring enter piston simultaneously.

4. Position the outboard shoe in the caliper, with the ears at the top of the shoe over the caliper ears and the tab at the bottom of the shoe engaged in the caliper cut-out (Fig. 5E-10).

5. With both shoes installed, position the caliper so it will enter the mounting bracket without binding. Do not force caliper if it becomes cocked. Allow the bottom edge of the outboard lining to rest on the outer edge of the rotor and make sure that there is no clearance between the tab at the bottom of the outboard shoe and the caliper abutment. Clamp the outboard shoe to the caliper with moderate pressure using a 1/4" thick metal bar to bridge the caliper cut-out (Fig. 5E-11). Use a clean C clamp to avoid contamination of the brake lining and do not use excessive force which may deform the lining face.

Using vise-grip pliers, clinch both upper ears of the outboard shoe. Locate the pliers 1/8 to 1/4 inch from the outer edge of the shoe ear (Fig. 5E-11). After clinching, the tangential and radial clearance between the caliper and the shoe ears should not exceed 0.005 inch in either direction. Re-adjust the pliers and repeat the clinching procedure if necessary.

6. After clinching, remove the C clamp and position the caliper over the rotor, lining up the holes in the caliper ears with the holes in the mounting bracket.

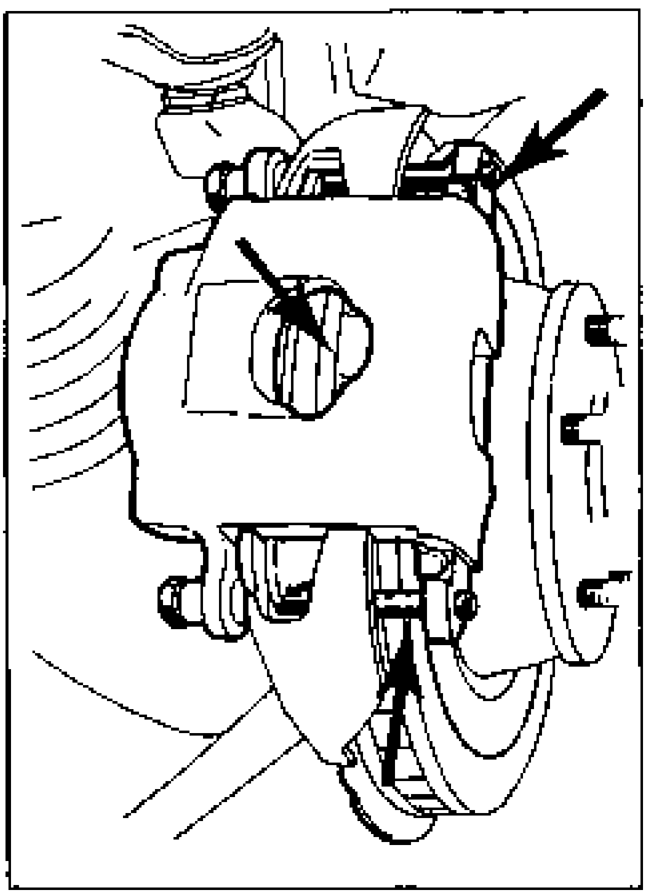


Fig. 5E-2 Lining Inspection

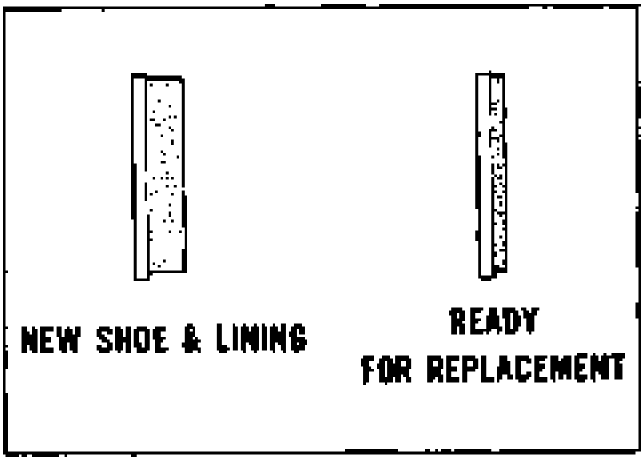


Fig. 5E-3 New and Worn Linings

NOTE: Make sure that the brake hose is not twisted or kinked.

7. Start the bolts through the sleeves in the inboard caliper ears and the mounting bracket, making sure that the ends of the bolts pass under the retaining ears on the inboard shoe (Fig. 5E-12).

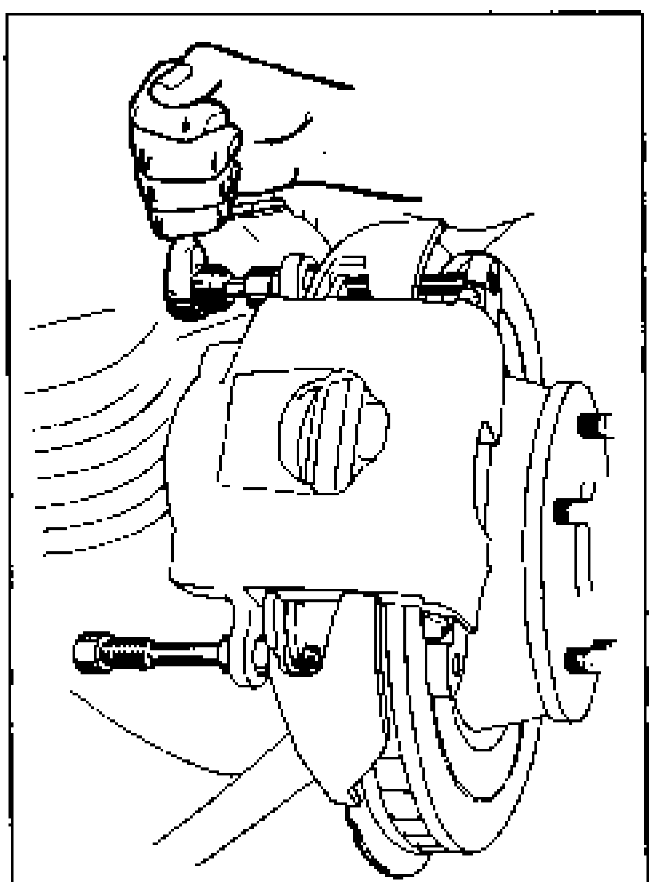


Fig. 5E-4 Removing Mounting Bolts

8. Push the bolts through to engage the holes in the outboard caliper ears, at the same time threading the bolts into the mounting bracket. Torque bolts to 35 lb. ft.

NOTE: Replace the shoe and linings on the other front wheel disc brake in exactly the same manner as just described. Relining must be performed in full axle sets only.

9. Install wheel and tire assemblies, and torque lug nuts to 75 lb. ft. (Pontiac) and 70 lb. ft (Tempest, Grand Prix and Firebird)

10. Master cylinder fluid level should be as shown in Section 5. Fill to prescribed level.

11. Pump the brake pedal several times. Check fluid level and replenish, if necessary.

CAUTION: Do not move car until a firm brake pedal is obtained.

NOTE: Whenever the front wheel disc brakes are relined, the rear drum brakes should be checked also.

CALIPER - OVERHAUL

CALIPER - REMOVE

Removal of the caliper for overhaul is the same as for shoe and lining replacement except that it will be necessary to disconnect the brake hose at the caliper. Discard the copper gasket on each side of the brass hose fitting.

CALIPER - DISASSEMBLE

1. Before beginning disassembly, thoroughly clean the exterior of the caliper using alcohol.

2. Remove the bleeder valve from the caliper and drain brake fluid from interior. Place caliper on a clean work surface.

3. Use clean shop towels to pad the interior of the caliper and remove the piston by directing compressed air into the caliper inlet hole (Fig. 5E-13).

CAUTION: Use just enough air pressure to ease the piston out of the bore. If the piston is blown out --even with padding provided -- it may become damaged. Do not place the fingers in front of the piston in an attempt to catch or protect it when applying compressed air; this could result in serious injury.

4. Use a screwdriver to pry the boot out of the caliper. Extend the screwdriver across the caliper bore, under the boot, and pry up. Be careful not to scratch the caliper bore.

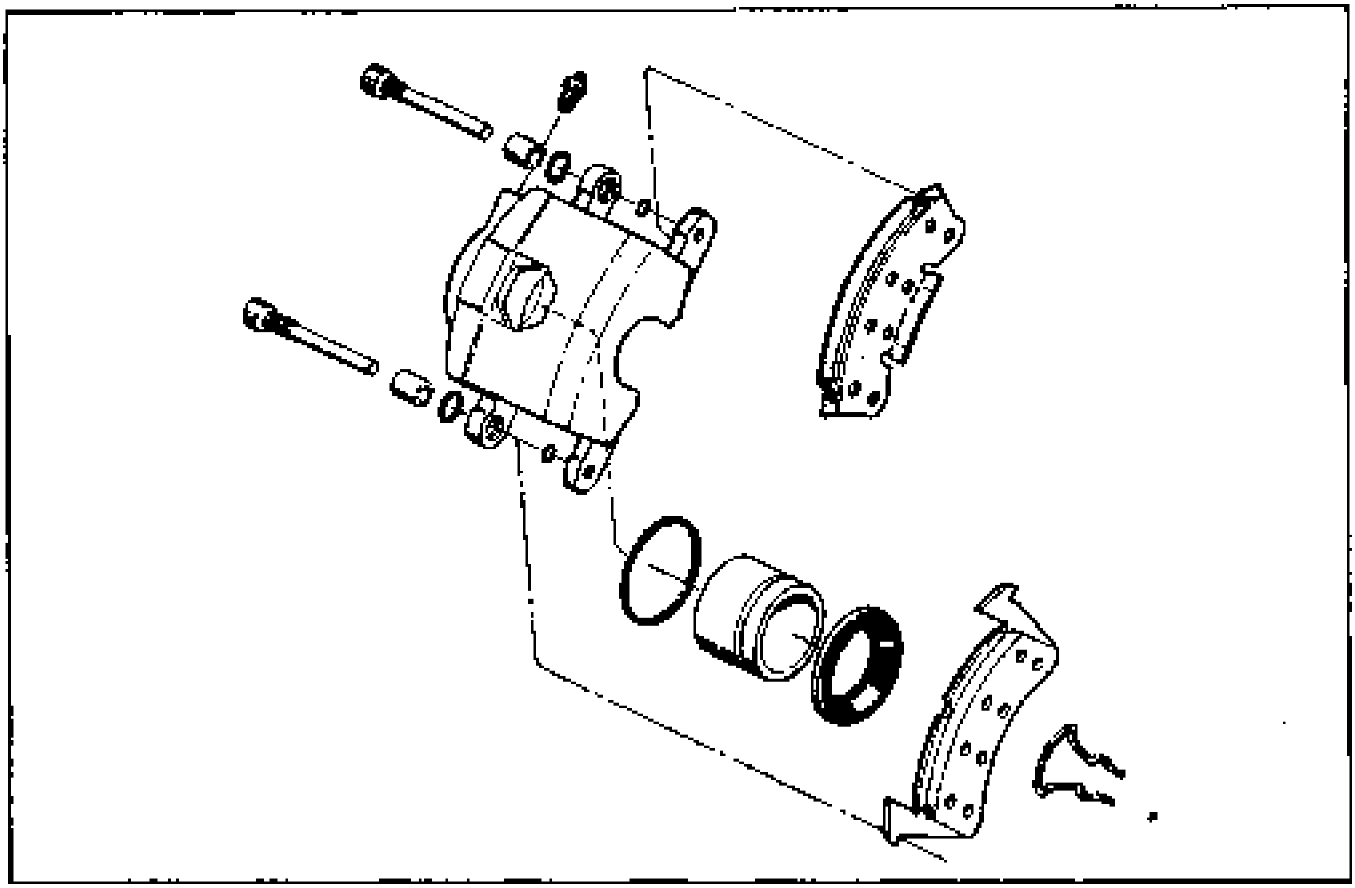


Fig. 5E-5 Exploded View of Caliper

5. Use a piece of wood or plastic -- a plastic toothpick is ideal -- to remove the piston seal from its groove in the caliper bore. DO NOT USE A METAL TOOL OF ANY TYPE FOR THIS OPERATION.

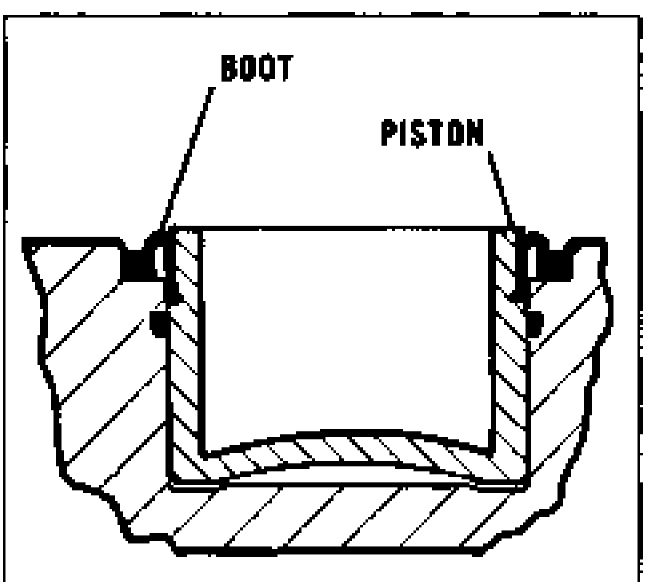


Fig. 5E-6 Boot Installation

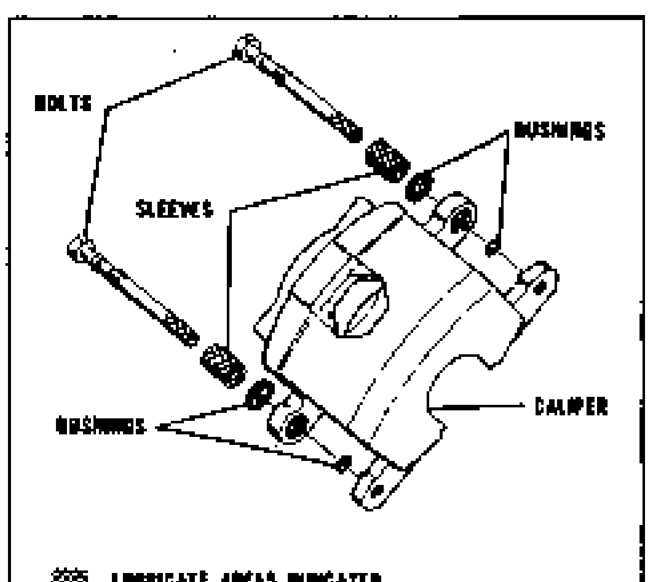


Fig 5E-7 Lubrication Points

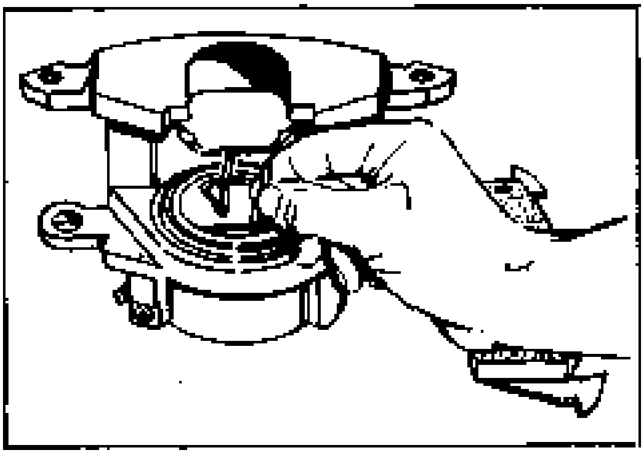


Fig. 5E-8 Inserting Shoe Support Spring

CLEANING AND INSPECTION

The boot, piston seal, rubber bushings and sleeves are to be replaced each time the caliper is overhauled. Discard -- do not bother to clean and inspect -- these parts.

Clean all other parts in alcohol or brake fluid. Use dry, filtered compressed air to dry parts and blow out all passages in the caliper and bleeder valve.

CAUTION: The use of lubricated shop air will leave a film of mineral oil on the metal parts. This may damage rubber parts when they come in contact after reassembly.

1. Check the mounting bolts for corrosion, breaks in the plating or other damage. Do not use abrasives in an attempt to clean the bolts -- replace them.

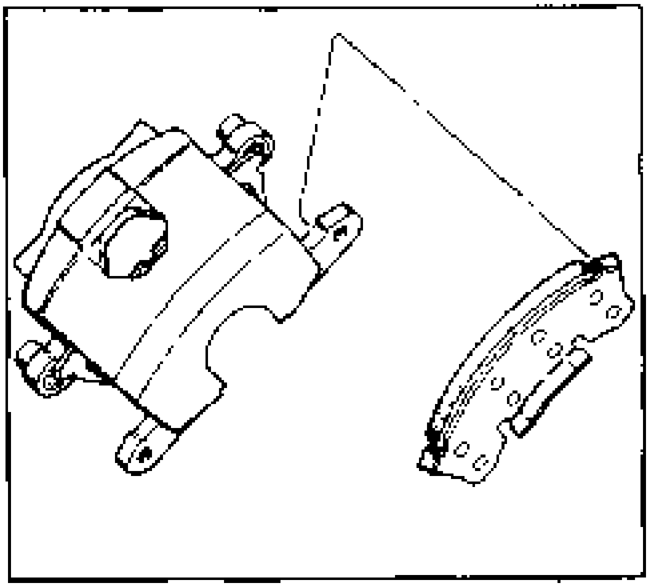


Fig. 5E-10 Installing Outboard Shoe

2. Carefully examine outside of piston for scoring, nicks, corrosion and worn or damaged chrome plating. If any surface defects are detected, replace the piston.

CAUTION: The piston OD is the primary sealing surface in the caliper assembly. It is manufactured and plated to close tolerances. It cannot be refinished or repaired in the field.

3. Check the bore in the caliper for major defects with the exception of plating damage. The piston bore is not plated and stains or minor corrosion can be polished with abrasive cloth. Thoroughly clean the caliper after the use of any abrasive. If the bore cannot be cleaned up in this manner, replace the caliper.

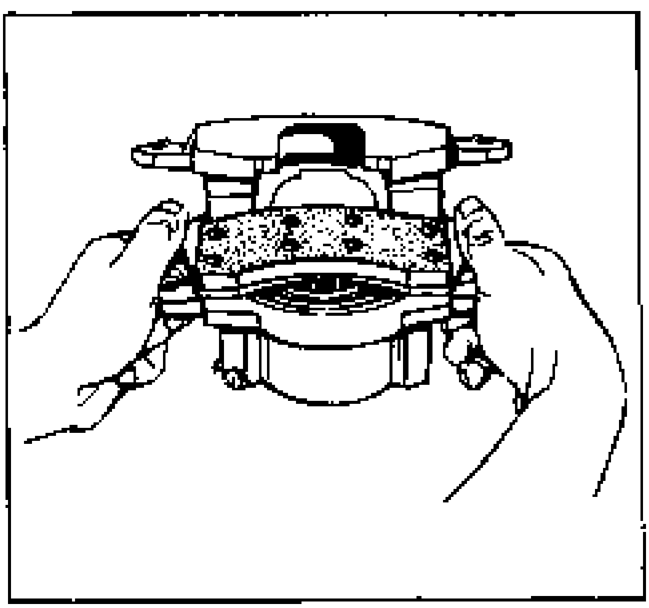


Fig. 5E-9 Installing Inboard Shoe

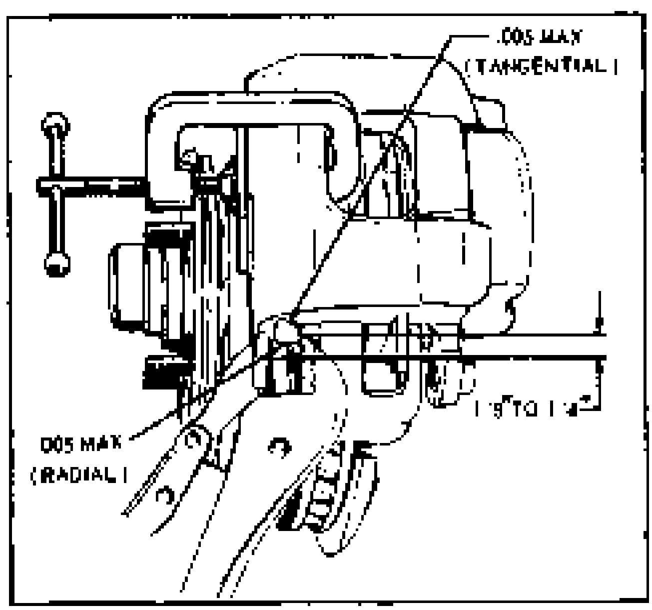


Fig. 5E-11 Clinching Outboard Shoe

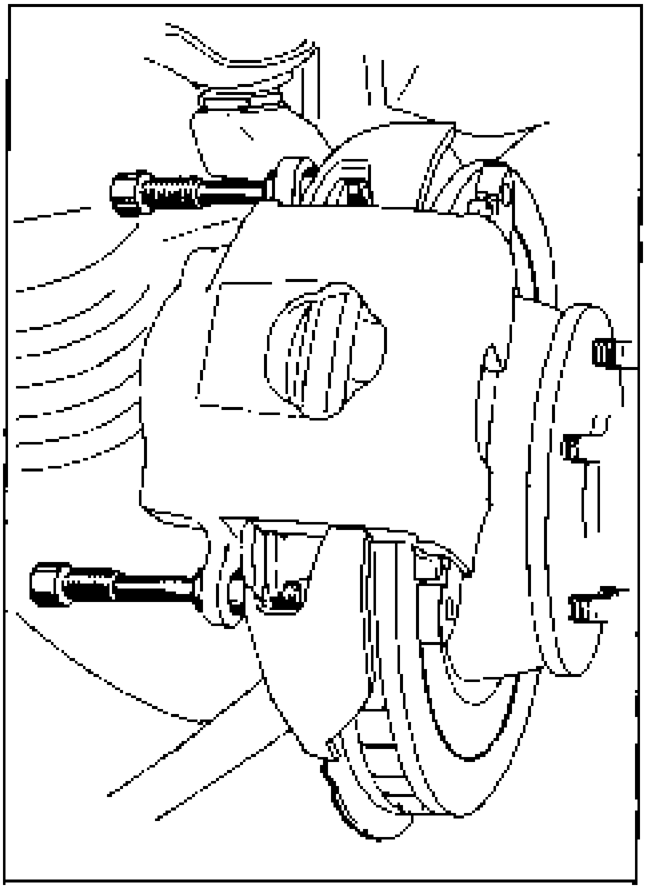


Fig. 5E-12 Installing Mounting Bolts

CALIPER - ASSEMBLE

1. Lubricate the seal groove in the caliper and the new piston seal with clean brake fluid. Position the seal in the caliper bore groove. Lubricate the piston with clean brake fluid and assemble a new boot into the groove in the piston so that the fold faces the open end of the piston. Insert the piston into the caliper bore, using care not to unseat the seal, and move piston until it bottoms in the bore. This will require a force of 50 to 75 pounds.

2. Position the boot in the caliper counterbore and seat with tool J 22904 (Fig. 5E-14). Check the boot installation to make sure that the retaining ring molded into the boot is not bent and that the boot is installed fully -- below the caliper face -- and evenly all around (Fig. 5E-6). Otherwise dirt or moisture may enter the bore and cause damage or corrosion.

CALIPER - INSTALL

Installation of the caliper and mounting parts (rubber bushings, sleeves, shoe and lining assemblies, and bolts) is the same as for lining replacement except for the following:

1. Check the hose for worn spots, cracks or other signs of deterioration. Discard the hose, if damaged, and replace with a new part. Bolt the brake hose to the caliper using a new copper gasket on each side of the brass fitting.

NOTE: Make certain hose is not twisted or kinked. The hose used on Pontiac has a special brass fitting with raised corners; this surface must face bolt head to properly orient hose.

2. After overhaul -- or any time that the brake hose or line is disconnected -- the calipers must be bled. Use either the manual or pressure tank method. (See Bleeding Disc Brakes.)

BLEEDING DISC BRAKES

The bleeding operation for disc brakes is the same as for drum brakes. The only exception is that the metering valve must be held open. This is done by depressing and holding in the plunger in the end of the valve with Tool J 22793.

BRAKE ROTOR

REMOVE

1. Raise car and remove front wheels.

2. Remove caliper assembly and rest on front suspension, as described in Caliper - Remove.

3. Remove spindle nut and hub and rotor assembly.

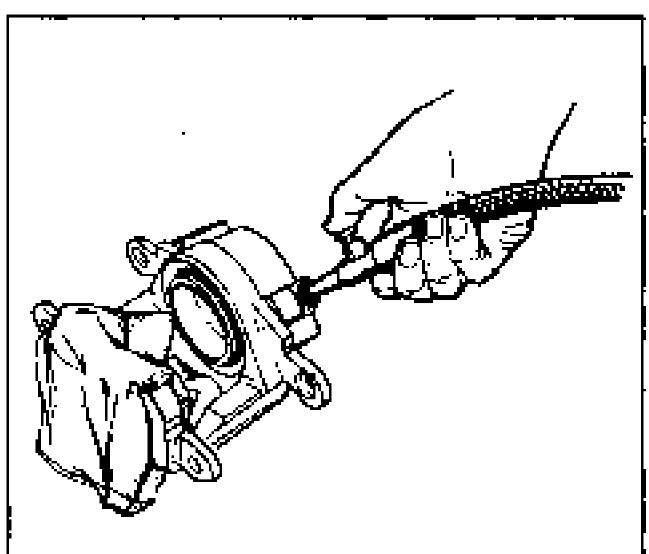


Fig. 5E-13 Removing Piston

REPLACE

1. Install new bearings or seal as necessary.

2. Install hub and rotor assembly on spindle. See Section 3 for proper Wheel Bearing Adjustment Procedure.

3. Install caliper assembly and torque mounting bolts to 35 lb. ft. (See Caliper - Install).

4. Install wheel and tire assemblies, and torque lug nuts to 75 lb. ft. (Pontiac), and 70 lb. ft. (Tempest, Grand Prix, and Firebird).

5. Depress brake pedal several times to seat linings on rotor.

CAUTION: Do not move car until a firm brake pedal is obtained.

ROTOR SERVICE

LATERAL RUNOUT CHECK

(CHECK ROTORS ONLY WHEN A SPECIFIC COMPLAINT POINTS TOWARD A PROBLEM IN THIS AREA.)

Lateral runout is the movement of the rotor from side to side as it rotates. This could be described as "rotor wobble".

The movement of the rotor from side to side in the lateral plane causes the brake shoe and lining and pistons to be knocked back into their bores. This results in additional pedal travel required and a vibration during the braking action.

To check lateral runout (Fig. 5E-15) first adjust the wheel bearings until all of the end play is eliminated. Fasten a dial indicator to some portion of the suspension so the stylus contacts the rotor face approximately one inch from the rotor edge. Set the dial at zero. Move the rotor one complete rotation, checking the indicator as the rotor moves.

For lateral runout specifications see - SPECIFICATIONS.

PARALLELISM CHECK

Parallelism is the measurement of the thickness of the rotor at any point around the circumference of the rotor. Measurements must be made at the same distance from the edge of the rotor and an indicator which reads .0001" must be used.

A rotor that varies beyond the recommended specifications (see - SPECIFICATIONS) causes pedal vibration, as well as front end vibration during brake applications. A rotor that does not meet the specifications must be discarded and replaced with a new rotor. Field equipment cannot machine the rotor to specification.

SURFACE TOLERANCE AND FINISH

In manufacturing the brake rotor, tolerances of the rubbing surfaces for flatness, for parallelism and for lateral runout are held very close. The maintenance of these close controls on the shape of the rubbing surfaces is necessary to prevent brake roughness.

In addition to these tolerances the surface finish must be held to a specified range. The control of the rubbing surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

The rotor tolerances are listed in the Specification Section.

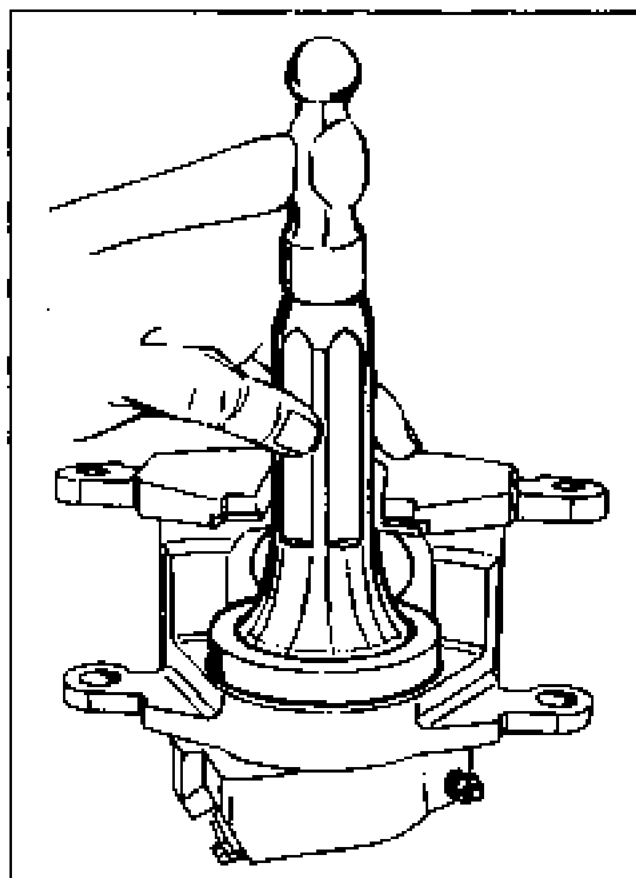


Fig. 5E-14 Seating Boot

Light scoring of the rotor surfaces not exceeding 0.015" in depth, which may result from normal use, is not detrimental to brake operation.

Since accurate control of the rotor tolerances is necessary for proper performance of the disc brakes, machining of the rotor in field service is not recommended.

NOTE: When total rotor thickness is less than .960" (Tempest, Grand Prix and Firebird) or 1.195" (Pontiac), rotor should be replaced.

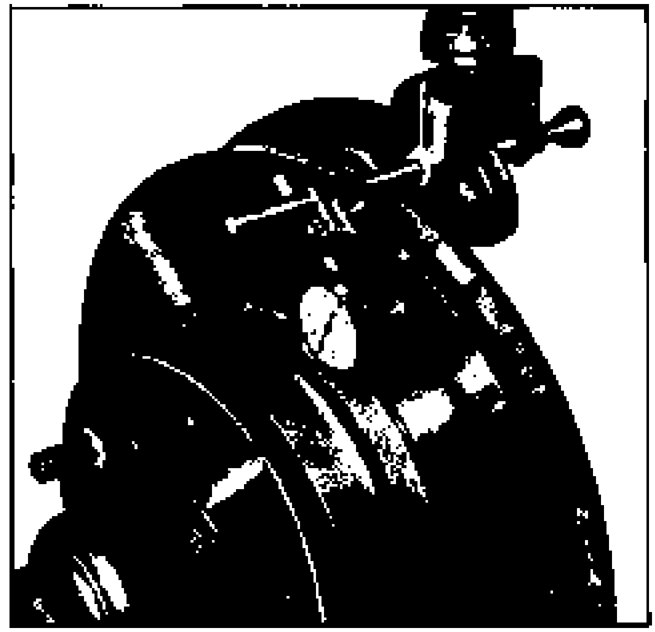


Fig. 5E-15 Checking Rotor for Lateral Runout

PROPORTIONING VALVE—USED ONLY ON FIREBIRD WITH DISC BRAKES, V-8 ENGINE AND A/C.

REMOVAL AND INSTALLATION

1. Disconnect hydraulic brake lines from both sides of switch. Cover open lines with clean, lint free material to prevent foreign matter from entering the system.

2. Remove mounting screw and remove switch from vehicle.

3. To install, reverse above procedure and bleed brakes as outlined below.

SPECIFICATIONS

Disc Brake Type	Fixed Rotor
	Sliding Caliper
Location	Front Wheels Only
Rotor Type	Ventilated—Cast Iron
Rotor Diameter	Pontiac—11.75"
	Tempest, Grand Prix, Firebird—11"
Rotor Runout (Maximum)	.004"—Total
Rotor Surface Finish	20-60 Micro-Inch (w/Non-Directional Lay)
Rotor Thickness (New)	Pontiac 1.240"
	Tempest, Grand Prix, Firebird 1.000"
Rotor Thickness (Minimum)	Pontiac 1.195"
	Tempest, Grand Prix, Firebird .960"
Rotor Parallelism (Thickness Variation)	.0007"
Brake Shoe and Lining Type	Riveted
Brake Shoe and Lining Thickness (New)	.635"—Inner
	.545"—Outer
Brake Shoe and Lining Minimum Thickness Before Replacement	.300"—Inner
	.250"—Outer
Master Cylinder Diameter	1.125"

TORQUE SPECIFICATIONS

Bolt—Caliper to Mounting Bracket	35 lb. ft.
Bolt—Splash Shield and Mounting Bracket to Knuckle (Upper)	125 lb. ft.
Bolt and Nut—Splash Shield and Mounting Bracket to Knuckle (Lower)	75 lb. ft.
Screw—Caliper Bleeder	65 lb. in.

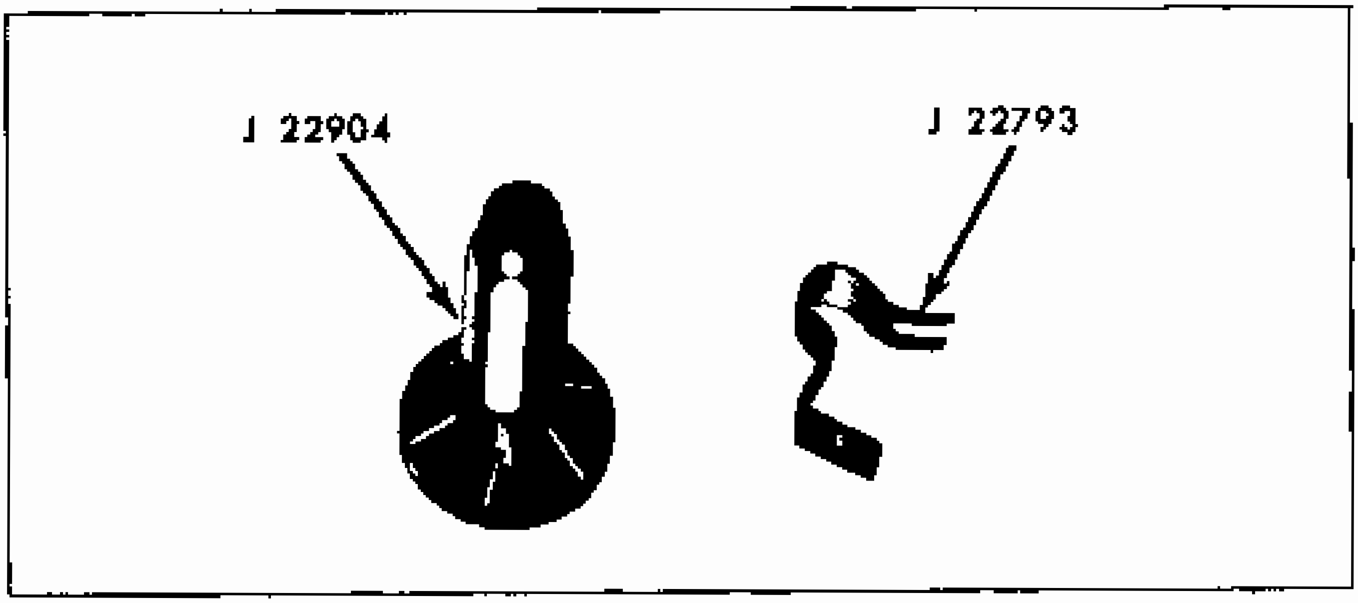


Fig. 5E-16 Special Tools

ENGINE MECHANICAL

SIX CYLINDER ENGINE

V-8 ENGINE

GENERAL DESCRIPTION

TEMPEST AND FIREBIRD ENGINES

The Pontiac Tempest and Firebird uses a 250 cubic inch inline overhead camshaft six-cylinder engine as standard equipment. This engine has a 3 7/8" bore and 3 17/32" stroke with a compression ratio of 9.0:1. An optional overhead camshaft engine equipped with a four-barrel carburetor has a compression ratio of 10.5:1 with the same bore and stroke.

Six optional V-8 engines are available on special order, two having 350 cubic inch displacement with 3 7/8" bore and 3 3/4" stroke. The compression ratios are 9.2:1 and 10.5:1. Four 400 cubic inch displacement engines available in the G.T.O. have a 4.120" bore and 3 3/4" stroke. These engines have compression ratios of 8.6:1 and 10.75:1. One of these engines is for use in Ram-Air cars only and incorporates block, cylinder heads, camshaft and valve train specifically for the Ram-Air engine.

Thirty-one different engine transmission combinations are available. These combinations and their usages are shown on the engine chart (Figs. 6-2 and 6-3).

Engine identification is facilitated by a letter code stamped below the production engine serial number on V-8 engines (Fig. 6-5). The code is stamped on the block in front of the right bank of cylinders. The engine code for 6-cylinder engines is stamped on the cylinder head contact surface of the block behind the oil filler pipe (Fig. 6-4). By referring to the identification code and the engine chart, each engine may be readily identified.

The vehicle identification number is stamped on the right rear lower side of the six-cylinder engine block and to the right of the timing chain cover on V-8 engines (Fig. 6-6).

PONTIAC and G.P. ENGINE CHART

	HORSEPOWER	ENGINE CODE	DISPLACEMENT		TRANS.		CARB.		COMP. RATIO			CAMSHAFT				DISTRIBUTOR						VALVE SPRINGS		CYL. HEAD	
			400	428	MANUAL	AUTOMATIC	2 BBL (2GV)	4 BBL (4MV)	8.6:1	10.5:1	10.75:1	9777254	9779066	9779067	9779068	1111253	1111940	1111946 (b)	1111952 (b)	1111960	1111959	H.D. - DUAL	H.D. SPEC. - DUAL	SMALL VALVE	LARGE VALVE
	290	WD	X		X		X			X			X						X			X		X	
	265	YB	X			X	X		X			X					X					X		X	
	265	WE	X		X		X			X			X						X			X		X	
	290	YD	X			X	X			X		X				X						X		X	
	360	WG		X	X			X		X				X						X		X			X
	360	YH		X		X		X		X			X								X	X		X	
	390	WJ		X	X			X			X				X				X				X		X
(c)	360	XK		X		X		X		X				X							X	X			X
(d)	360	XJ		X		X		X		X				X							X	X		X	
	390	YK		X		X		X			X			X				X				X			X
G.P.	350	WN	X		X			X		X				X					X			X			X
G.P.	350	XM	X			X		X		X			X			X						X			X
G.P.	370	WF		X	X			X		X				X						X		X			X
G.P.	370	XF		X		X		X		X			X								X	X			X
G.P.	390	WL		X	X			X			X				X				X				X		X
G.P.	390	XG		X		X		X			X			X				X				X			X
G.P.	265	YF	X			X	X		X			X					X					X		X	
	340	XZ	X			X		X		X		X				X						X		X	

(a) Early Production (small valve) Engines with 30° intake valve seat angle. Later Production (small valve) Engines use 45° intake valve seat.
NOTE: All large valve engines use 30° intake valve seat.
(b) Uses hardened drive gear for use with 60 p.s.i. oil pump and high tension distributor points.
(c) Police Freeway Enforcer.
(d) Police Highway Patrol.

Fig. 6-1 Pontiac and G.P. Engine Chart

TEMPEST and G.T.O. ENGINE CHART

	Horsepower	Engine Code	Displacement 250	Displacement 350	Displacement 400	Trans. Manual	Trans. Automatic	Carb. 1 BBL (MV)	Carb. 2 BBL (2GV)	Carb. 4 BBL (4MV)	Comp. Ratio 8.6:1	Comp. Ratio 9.0:1	Comp. Ratio 9.2:1	Comp. Ratio 10.5:1	Comp. Ratio 10.75:1	Camshaft 9790826	Camshaft 9792539	Camshaft 9796327	Camshaft 9777254	Camshaft 9785744	Camshaft 9779067	Camshaft 9779068	Camshaft 9794041	Distributor 1110474	Distributor 1110475	Distributor 1111940	Distributor 1111945 (b)	Distributor 1111942	Distributor 1111952 (b)	Distributor 1111941 (b)	Distributor 1111960	Valve Springs Single	Valve Springs Std. - Dual	Valve Springs H.D. - Dual	Valve Springs H.D. Spec. - Dual	Valve Springs Ram Air IV - Dual	Cyl. Head Small Valve	Cyl. Head Large Valve
	175	ZC	X			X		X				X				X									X							X					X	
	175	ZF	X				X	X				X				X									X							X					X	
	230	ZH	X			X				X				X				X						X									X				X	
	215	ZL	X				X			X				X			X							X									X				X	
	265	XS		X			X		X				X						X									X						X			X	
(c)	265	YL		X			X		X				X						X									X						X			X	
	265	WU		X		X			X				X						X												X			X			X	
	330	XU		X			X			X				X							X						(d)								X		X	
	330	WV		X		X				X				X								X							(e)						X		X	
	350	YS			X		X			X					X						X						X							X				X
	330	WT			X	X				X					X							X							X					X				X
	366	YZ			X		X			X					X							X					X								X			X
	366	WS			X	X				X					X					X									X						X			X
	265	XX			X		X		X		X								X							X								X			X	
	370	XP			X		X			X					X								X							X						X		X
	370	WW			X	X				X					X								X							X						X		X

(a) Early Production (small valve) Engines with 30° intake valve seat angle. Later Production (small valve) Engines use 45° intake valve seat.
NOTE: All large valve engines use 30° intake valve seat.
(b) Uses hardened drive gear for use with 60 p.s.i. oil pump and high tension distributor points.
(c) Two speed (M31) if equipped with A/C; Turbo-Hydramatic (M38) optional without A/C.
(d) Uses distributor 1111965
(e) Uses distributor 1111966

Fig. 6-2 Tempest Engine Chart

FIREBIRD ENGINE CHART

	Horsepower	Engine Code	Displacement 250	Displacement 350	Displacement 400	Trans. Manual	Trans. Automatic	Carb. 1 BBL (MV)	Carb. 2 BBL (2GV)	Carb. 4 BBL (4MV)	Comp. Ratio 9.0:1	Comp. Ratio 9.2:1	Comp. Ratio 10.5:1	Comp. Ratio 10.75:1	Camshaft 9790826	Camshaft 9792539	Camshaft 9796327	Camshaft 9777254	Camshaft 9779067	Camshaft 9779068	Camshaft 9794041	Distributor 1110474	Distributor 1110475	Distributor 1111941 (b)	Distributor 1111940	Distributor 1111945	Distributor 1111946 (b)	Distributor 1111952 (b)	Distributor 1111960	Valve Springs Single	Valve Springs Std. - Dual	Valve Springs H.D. - Dual	Valve Springs H.D. Spec. - Dual	Valve Springs Ram Air IV - Dual	Cyl. Head Small Valve	Cyl. Head Large Valve
	175	ZC	X			X		X			X				X								X							X					X	
	175	ZF	X				X	X			X				X								X							X					X	
	230	ZH	X			X				X			X				X					X									X				X	
	215	ZL	X				X			X			X			X						X									X				X	
	265	WM		X		X			X			X						X											X			X			X	
	265	XB		X			X		X			X						X							X							X			X	
(c)	265	YL		X			X		X			X						X							X							X			X	
	325	WN		X		X				X			X							X								(e)					X			X
	325	XC		X			X			X			X						X								(d)						X			X
	330	WZ			X	X				X				X					X									X					X			X
	330	YT			X		X			X				X					X								X					X				X
	335	WQ			X	X				X				X						X								X					X			X
	335	YW			X		X			X				X					X								X					X				X
	345	WH			X	X				X				X							X			X										X		X
	345	XN			X		X			X				X							X			X										X		X

(a) Early Production (small valve) Engines with 30° intake valve seat angle. Later Production (small valve) Engines use 45° intake valve seat.
NOTE: All large valve engines use 30° intake valve seat.
(b) Uses hardened drive gear for use with 60 p.s.i. oil pump and high tension distributor points.
(c) Two speed (M31) if equipped with A/C; Turbo-Hydramatic (M38) optional without A/C.
(d) Uses distributor 1111965
(e) Uses distributor 1111966

Fig. 6-3 Firebird Engine Chart

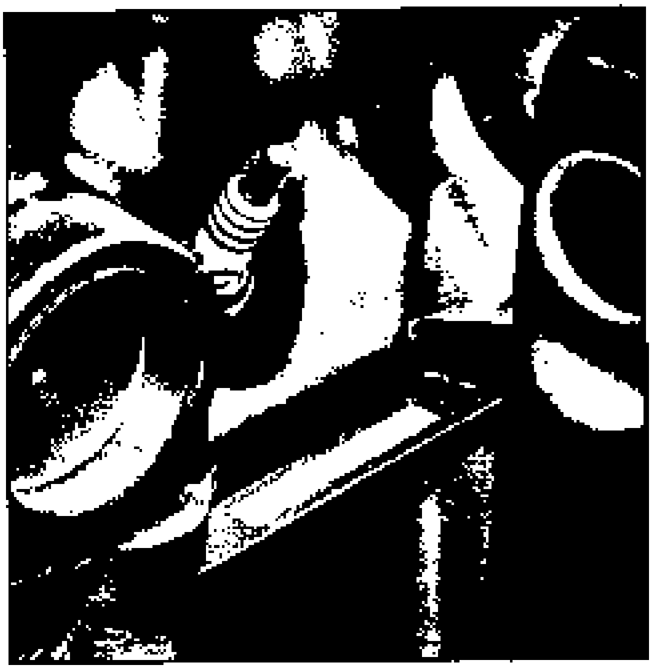


Fig. 6-4 Engine Number and Code Location - 6 Cyl.

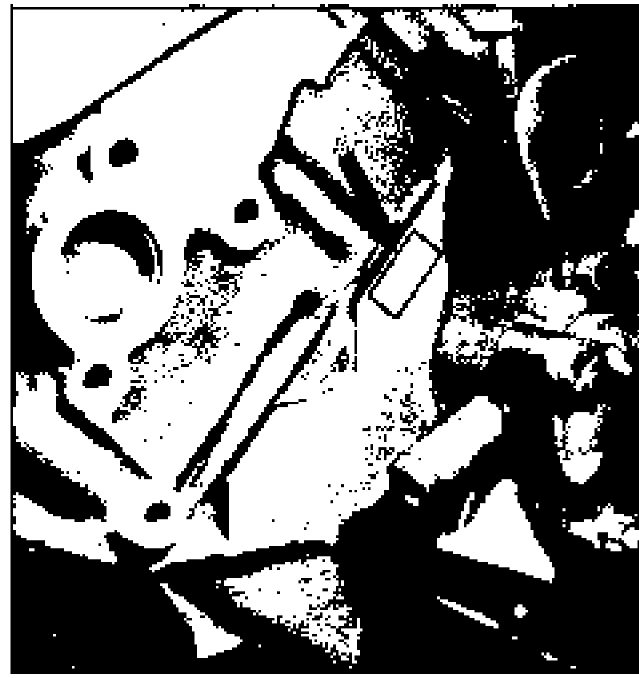


Fig. 6-5 Engine Number and Code Location - V-8

PONTIAC AND GRAND PRIX ENGINES

The V-8 400 engine is used in all models except Bonneville series which uses a 428 cubic inch (small valve) engine and the Grand Prix "S.J." models which also uses a 428 cu. in. (large valve) engine as standard. Displacement of the 400 cubic inch engine is provided by 4.120" bore and 3 3/4" stroke. The 428 and 428 (large valve) High Output are available on special order. Displacement in the 428 cubic inch engine is provided by 4.120" bore and 4" stroke.

Three compression ratios are available: 8.6:1 on regular fuel engines, 10.5:1 on premium engines, and 10.75:1 on 428 High Output.

Eight different Pontiac engine-transmission combinations are available: these combinations and the major components of each are shown in Fig. 6-1.

Seven different Grand Prix engine-transmission combinations are available as shown on the engine chart (Fig. 6-1). The standard engine is of 400 cubic inch displacement with large valve heads (10.5:1 C.R.) and a 4 Bbl. carburetor. Engine identification is facilitated by a letter code stamped below the production engine number. By referring to Fig. 6-1 and using the identification letters, major engine components can be determined.

All V-8 engines feature completely machined combustion chambers, overhead valves, ball pivot rocker arm construction, harmonic balancer, hydraulic lifters, aluminum pistons, straight valve guides, superior crankcase ventilation and lubrication systems, and large displacement combined with high compression ratio for utmost performance and economy.

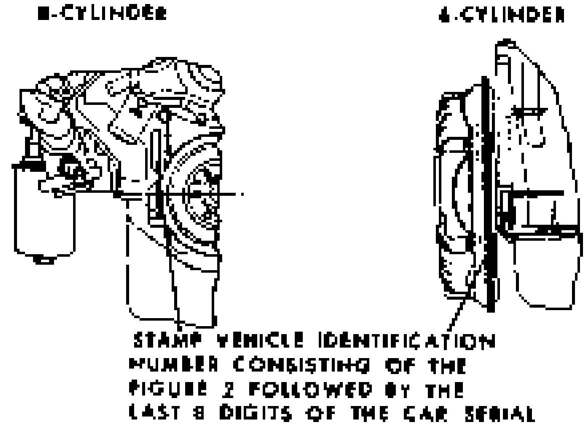


Fig. 6-6 Vehicle Identification Number Location

SIX-CYLINDER ENGINE

CONTENTS OF THIS SECTION

SIX CYLINDER ENGINE

PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services connected with the engine consist of tune-up, lubrication, replacing oil filter, PCV valve, fuel filter, etc. Procedures and recommendations for these services will be found in appropriate sections of this book.

SERVICE OPERATIONS ON CAR

ENGINE INSULATORS

REMOVE

1. Rotate harmonic balancer until timing mark is at bottom.

2. Bolt J 22773 (Firebird) or J 22345 (Tempest) Engine Support Bracket to front of harmonic balancer (Fig. 6-10).

3. Remove insulator to bracket bolts (Fig. 6-8).

4. With suitable equipment, raise engine at lifting tool until insulator clears brackets.

CAUTION: Safety bracket must be bolted to Firebird engine lifting tool whenever in use to prevent engine from moving while in the raised position (Fig. 6-10).

5. Raise engine approximately 1" above front insulators.

6. Remove insulators by removing two insulators-to block bolts. On manual trans 4 Bbl. Overhead Cam engine, remove two bolts and two spacers.

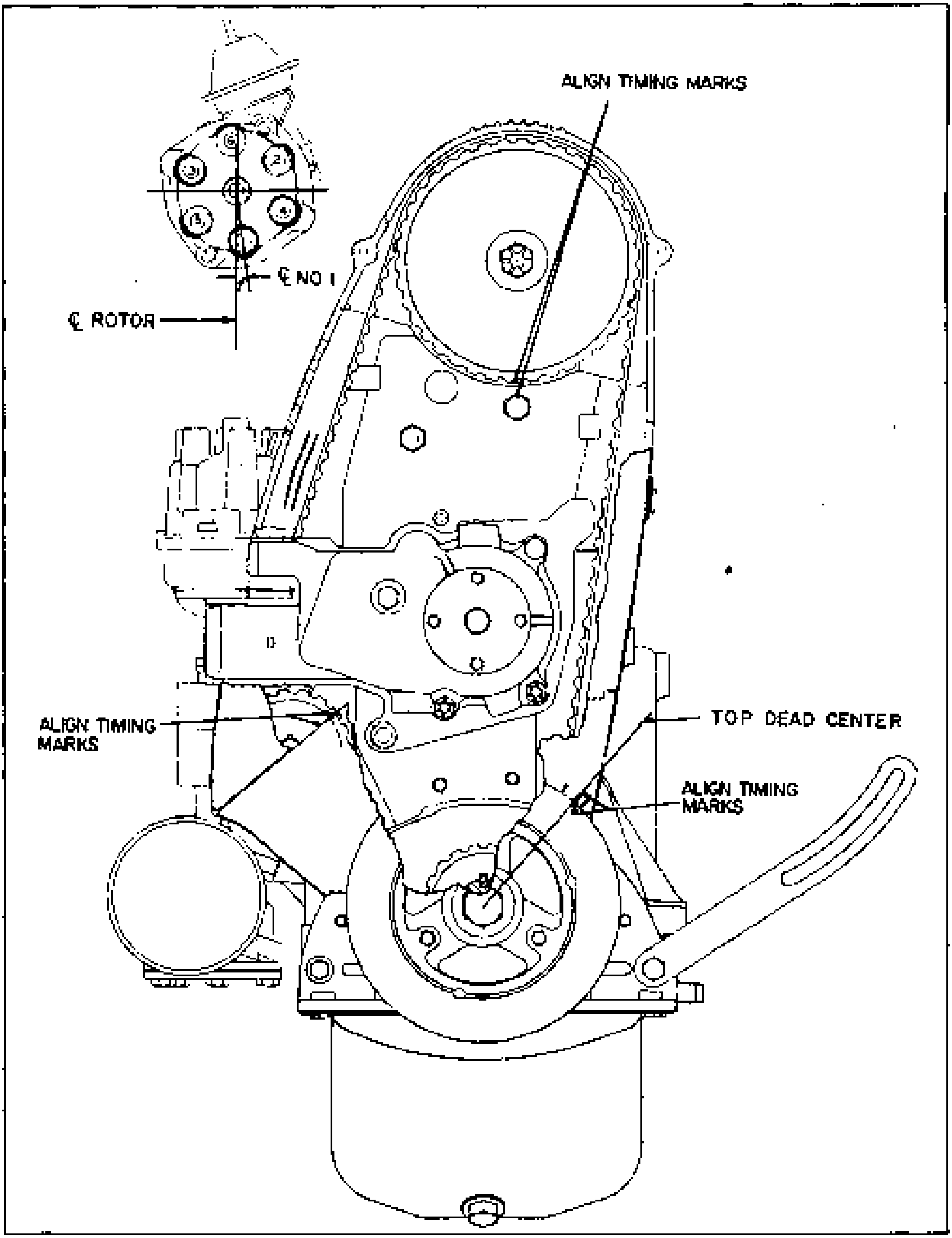


Fig. 6-7 Valve Timing Marks

REPLACE

1. Install new insulator reversing procedure number six and tighten bolts to 65 lb. ft.

2. Lower front of engine into position and install insulator-to-engine bracket bolts and tighten to 50 lb. ft.

DRIVE BELTS-ADJUST (EXCEPT TIMING BELT)

Engine, fan and accessory drive belts may be adjusted by use of the Burroughs Belt Tension Gauge, or equivalent. Belt Tension Specifications are given in Section 6A.

ENGINE

REMOVE

1. Disconnect battery cables at battery.

2. Drain cooling system.

3. Scribe alignment marks on hood around hood hinges and remove hood from hinges.

5. Remove air cleaner.

6. Remove fan shield or shroud.

7. Disconnect radiator and heater hoses at engine attachment.

8. If equipped with manual transmission, remove radiator.

9. If equipped with power steering or air conditioning, remove pump and compressor from mounting brackets and set aside. Do not disconnect hoses.

10. Remove engine fan and pulley.

11. Disconnect accelerator control linkage.

12. Disconnect transmission vacuum modulator line and power brake vacuum line at carburetor and fold back out of way.

13. Raise vehicle and drain crankcase.

14. Disconnect gas tank lines at fuel pump.

15. Disconnect exhaust pipes from manifolds.

16. Disconnect starter wires.

17. If equipped with automatic transmission, remove convertor cover, remove three convertor retaining bolts and slide convertor to rear.

18. If equipped with manual transmission, disconnect clutch linkage and remove clutch cross shaft.

19. Remove four lower bell housing bolts (two each side).

20. Disconnect transmission filler tube support and starter wire harness shield from cylinder head.

21. Remove two front motor mount to frame bracket bolts.

22. Lower vehicle.

23. Using jack and block of wood, support transmission.

24. Remove two remaining bell housing bolts.

25. Raise transmission slightly.

26. Using suitable lifting equipment, remove engine.

REPLACE

1. Install engine lifting equipment to engine and lower engine into chassis, guiding engine to align engine with bell o housing.

2. With engine supported by lifting equipment, install two upper bell housing bolts.

CAUTION: Do not lower engine completely while jack is supporting transmission. (Automatic transmission.)

3. Remove transmission support jack.

4. Lower engine and remove lifting equipment.

5. Raise vehicle.

6. Install remaining bell housing bolts.

7. Replace two front motor to frame bracket thru bolts.

8. For remaining installation procedures, reverse steps 1 thru 18.

INTAKE AND EXHAUST MANIFOLD OR GASKETS

REMOVE

1. Remove air cleaner.

2. Disconnect throttle cable at bell crank and remove throttle return spring.

3. Disconnect fuel and vacuum lines from carburetor.

4. Depending upon accessories remove necessary drive belts and mounting brackets.

5. Remove carburetor for intake manifold replacement.

6. Disconnect exhaust pipe at manifold flange.

7. Remove manifold to cylinder head attaching bolts and clamps and remove manifolds as an assembly.

REPLACE

1. Clean gasket flanges on cylinder head and manifolds.

2. Check for cracks on manifold castings.

3. If necessary to replace either intake or exhaust manifold, separate them by removing one attaching bolt and two nuts at center of assembly. Reassemble manifolds using new gasket. Tighten finger tight and torque nuts to 25 lb. ft. and bolt to 22 lb. ft. after assembly to cylinder head.

4. Position new gasket over manifold studs on cylinder head and carefully install the manifold in position, making sure the gasket is in place.

5. Coat face of manifolds liberally with a solution of graphite in alcohol.

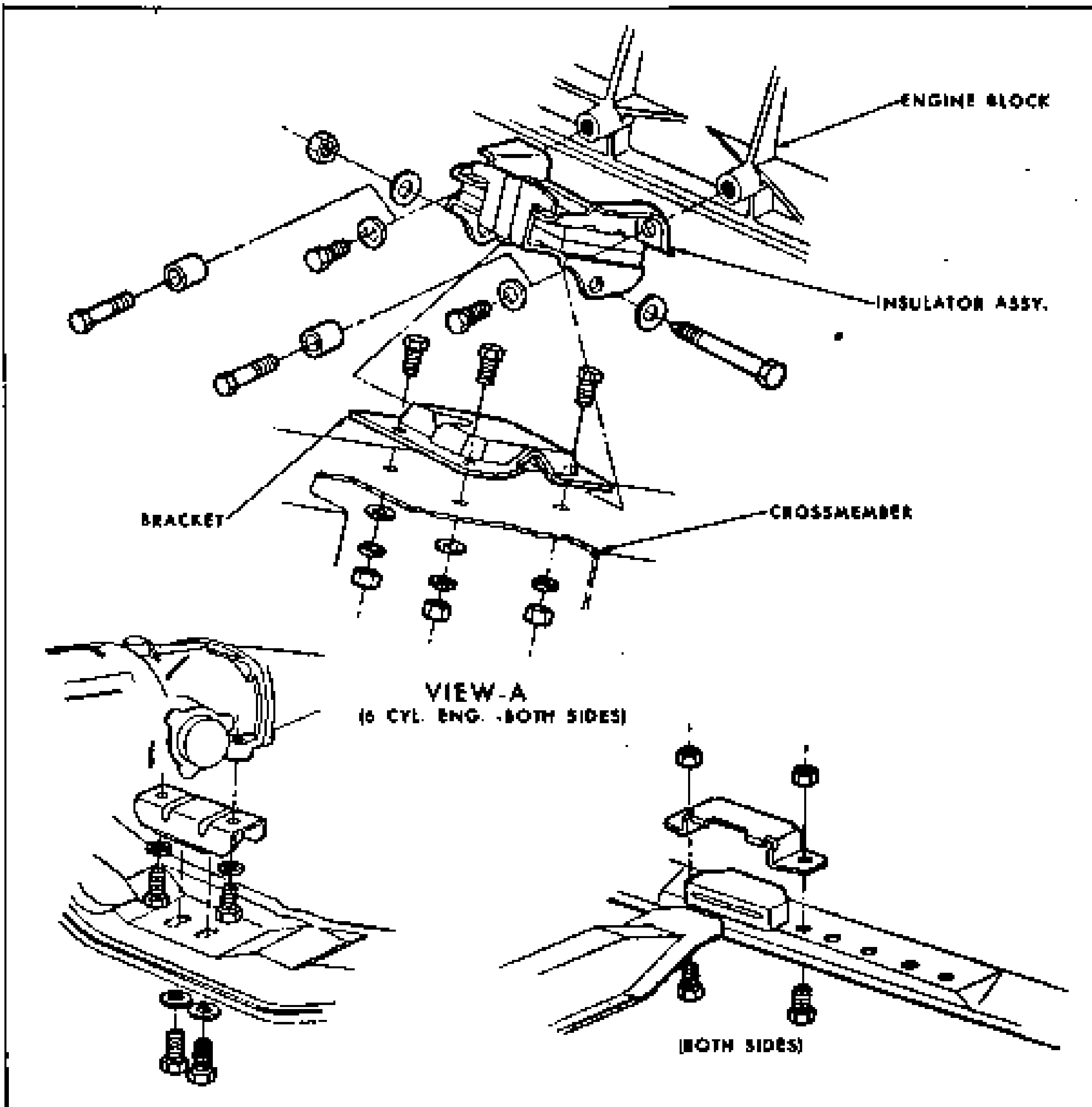


Fig. 6-8 6 Cyl. Engine Mounting-Tempest

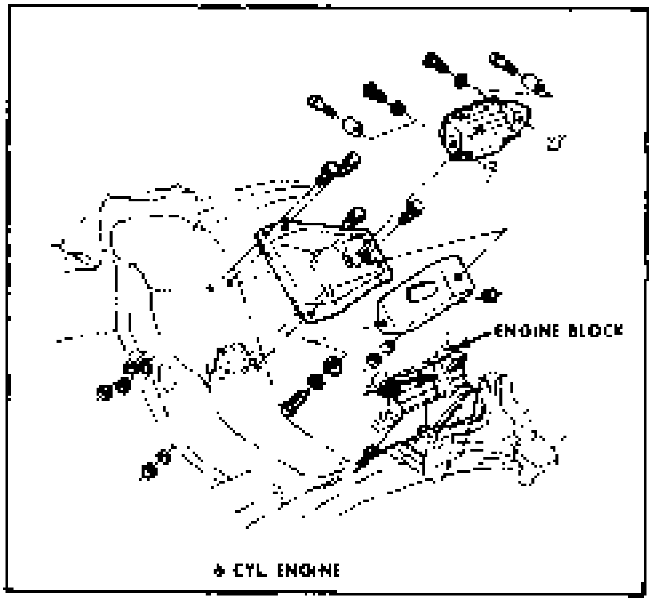


Fig. 6-9 6 Cyl. Engine Mounting-Firebird

6. Install bolts and clamps while holding manifold in place with one hand.

7. Tighten bolts to 30 lb. ft.

8. Connect exhaust pipe to manifold.

9. Reverse steps 1-5 of Removal to complete installation procedure.

TIMING BELT TOP FRONT COVER

REMOVE

1. Remove two retaining screws on front of cover.

Fig. 6-10 J 22773 Installed

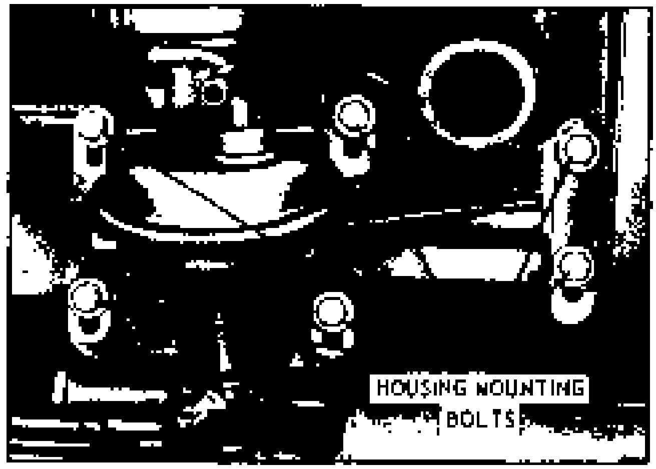


Fig. 6-11 Accessory Drive Hosuing Mounting Bolts

2. Lift up cover to disengage side clips.

3. Remove retaining clips from cover.

REPLACE

1. Place cover in position and install two attaching screws. Tighten to 12 lb. ft.

TIMING BELT ADJUSTMENT PROCEDURE

TIMING BELT ADJUSTMENT

NOTE: Engine should be at room temperature whenever timing belt tension is checked.

1. Remove timing belt top front cover.

2. Using J 22232-2 calibration bar as shown in Fig. 6-12 *set pointer of tension fixture J 22232-1 to line up with mark on minus side.*

NOTE: This calibration must be performed prior to each use of the J 22232 fixture to insure an accurate timing belt adjustment.

3. Remove the camshaft sprocket to camshaft bolt and washer and install J 22232-1 tension fixture on the belt with the rollers on the outside (smooth) surface of belt. Thread the fixture mounting bolt into camshaft sprocket bolt location finger-tight.

4. Squeeze indicator end (upper) of fixture and quickly release, so that fixture assumes released or relaxed position.

5. With J 22232-1 installed as above, adjust accessory drive housing (Fig. 6-11) up or down as required to obtain a tension adjustment indicator centered in the green range with drive housing mounting bolts torqued to 15 lb. ft.

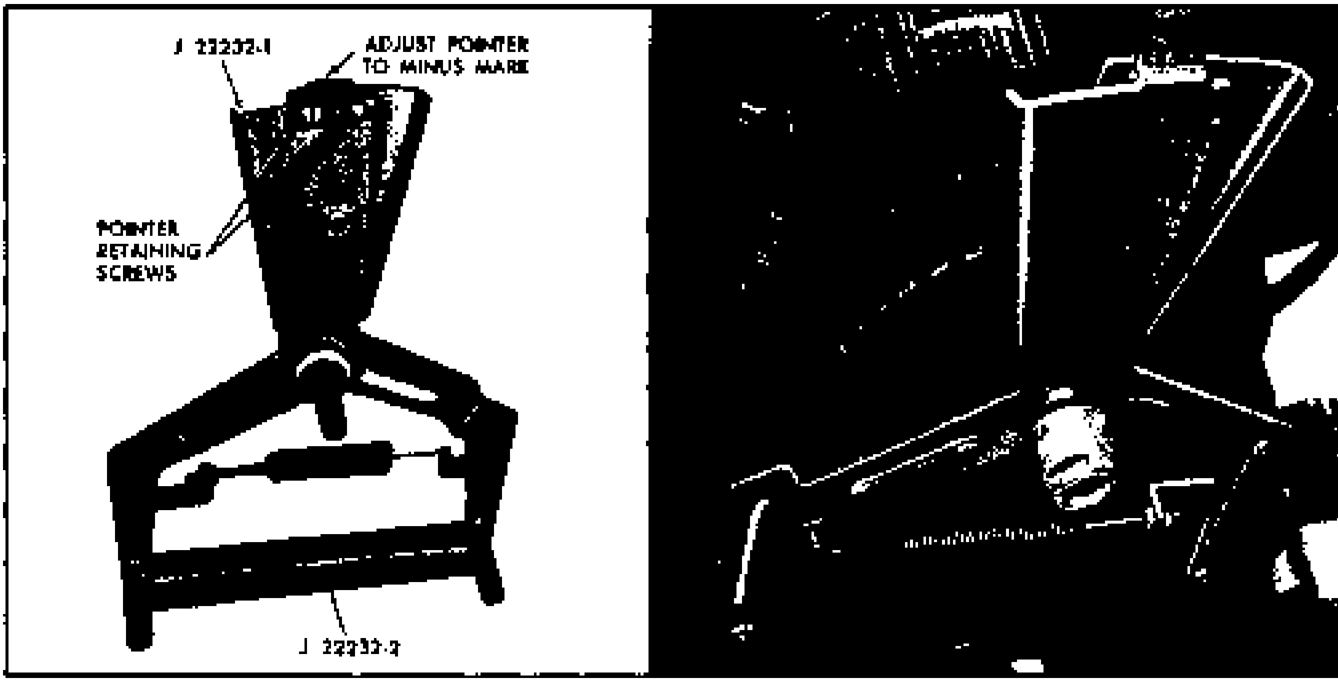


Fig. 6-12 Adjusting Timing Belt Tension

NOTE: Belt to be taut on carburetor side of engine when checking tension.

6. Align belt on pulley by rotating engine 1/2 turn using socket and bar on harmonic balancer retaining bolt, and recheck tension.

CAUTION: Be certain ignition is off.

7. Remove tension fixture and replace sprocket retaining bolt making sure threads and washer are free from dirt.

8. Install upper front timing belt cover.

CAMSHAFT SPROCKET OR SEAL

CAUTION: Do not use tools of any type, other than hands, to pry on the timing belt during belt removal or replacement or during other service operations.

REMOVE

1. Remove timing belt top front cover.

2. Remove sprocket to camshaft retaining bolt (Fig. 6-7).

NOTE: For ease of reassembly, index three timing marks as shown in Fig. 6-7.

3. Loosen six accessory drive to engine block mounting bolts (Fig. 6-11).

4. Remove timing belt from camshaft sprocket.

5. Remove camshaft sprocket.

6. If necessary to replace camshaft seal, reinstall camshaft sprocket retaining bolt.

7. Thread tool J 22261-2 into camshaft seal (Fig. 6-13).

8. Tighten center bolt on tool J 22261-1 until seal is extracted

REPLACE

1. Remove camshaft sprocket retaining bolt.

2. Install J 22262-2 seal protector and pilot on end of camshaft.

3. Position camshaft seal on pilot J 22262-2 (Fig 6-14).

4. Drive seal into position using J 22262-1 seal installer (Fig. 6-14).

5. Install camshaft sprocket indexing pin on sprocket with hole in camshaft.

6. Install sprocket retaining bolt. Tighten finger tight.

7. Align timing marks (Fig. 6-7) and install timing belt.

NOTE: Timing marks differ from previous models in that the camshaft sprocket timing mark is to be lined up with the notch in the uppermost timing belt cover mounting stud.

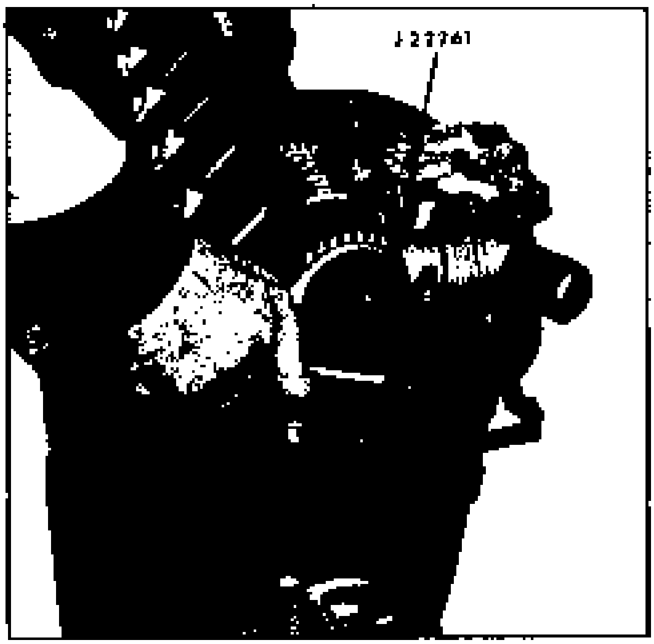


Fig. 6-13 Removing Camshaft Seal

8. Adjust timing belt tension

9. Tighten camshaft sprocket retaining bolt to 40 lb. ft.

10. Install top front cover.

ROCKER ARM COVER ASSEMBLY AND GASKET

REMOVE

1. Drain cooling system

2. Remove water outlet fitting from rocker arm cover assembly, leaving hose attached, and position out of way. Remove thermostat.

3. Remove timing belt top front cover.

4. Loosen accessory drive housing bolts.

5. Align timing marks (Fig. 6-7) and remove timing belt from camshaft sprocket.

6. Disconnect necessary fuel and vacuum lines.

7. Remove rocker arm cover assembly to cylinder head attaching bolts and nuts.

8. Lift rocker arm cover assembly up to clear four mounting studs.

9. Remove rocker arm cover to cylinder head gasket and clean gasket flanges.

REPLACE

1. Install new rocker arm cover gasket on cylinder head.

2. Check all rocker arms for correct position on hydraulic valve lash adjusters and valves.

3. Install rocker arm cover assembly on four mounting studs.

4. Install rocker arm cover assembly retaining bolts and nuts. Tighten to 15 lb. ft.

5. Reverse steps one through five of Removal to complete installation procedure.

NOTE: Install camshaft belt following procedure as previously outlined.

CAMSHAFT, ROCKER ARM COVER AND/OR ROCKER ARM COVER CORE PLUG

REMOVE

1. Remove camshaft sprocket and seal.

2. Remove rocker arm cover assembly.

3. Using J 22284 adapter and slide hammer J 2619 carefully drive camshaft rearward* from rocker arm cover (Fig. 6-15).

CAUTION: Do not allow camshaft to damage bearing surfaces of rocker arm cover.

4. Remove slide hammer and adapter using the above caution, remove camshaft from rocker arm cover.

5. Remove thrust washer, retaining washer and bolt from rear of camshaft.

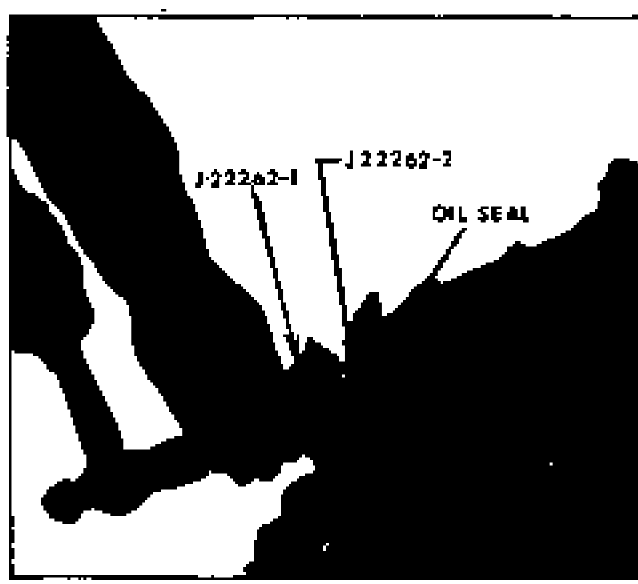


Fig. 6-14 Installing Camshaft Seal

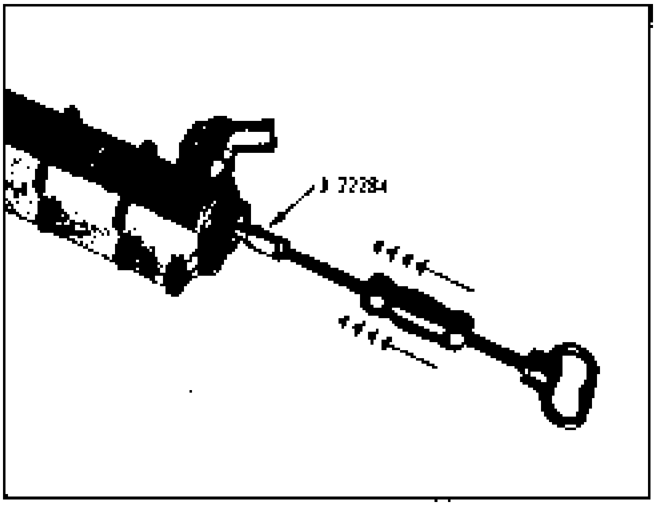


Fig. 6-15 Removing Camshaft From Cover

6. Clean all parts in a suitable solvent.

7. Inspect rocker arm cover for cracks or porosity.

8. Inspect gasket surface and front seal area

9. Inspect bearing surface for excessive wear or scoring.

NOTE: Minor nicks and scratches on edge of bearing surface can be corrected using a suitable scraper or file.

10. Inspect rear camshaft plug opening and thrust washer retaining slot for wear.

11. Inspect camshaft finished surfaces for wear and scoring.

12. Inspect camshaft oil passages for restrictions.

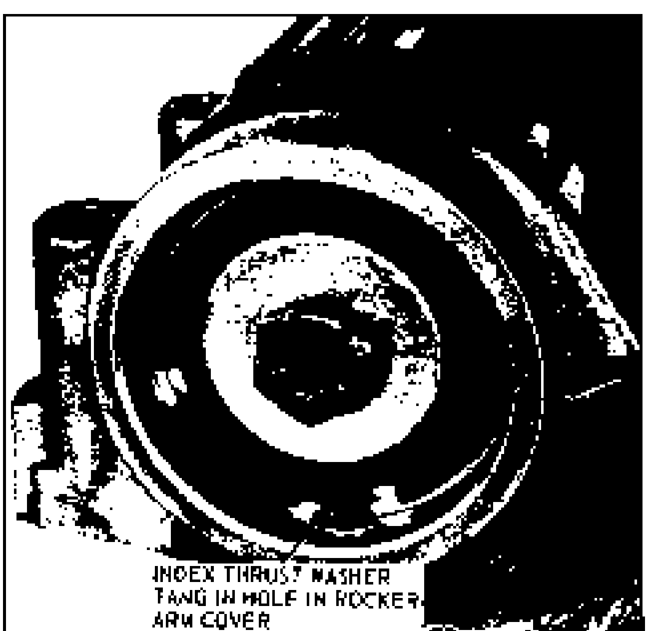


Fig. 6-16 Thrust Washer Installation

13. Remove all foreign deposits, sludge, metal particles, etc. from area of cylinder head and clean oil reducer tube using air pressure or pipe cleaner.

REPLACE

1. Install camshaft from the rear, in rocker arm cover using caution not to damage bearing surfaces in rocker arm cover.

2. Install thrust washer in rocker arm cover as shown (Fig. 6-16).

3. Install retaining washer and bolt. Tighten to 40 lb. ft.

4. Using J 8894 install new oversize camshaft bore plug until fully seated (Fig. 6-17).

IMPORTANT: A camshaft bore plug not fully seated could result in excessive camshaft end play. Correct end play is .003"-.009" when read at the sprocket end with a dial indicator. Fig. 6-18.

NOTE: Lubricate camshaft lobes and rocker arm pads with Engine Oil Supplement (E.O.S.) before replacing camshaft and cover assembly. Installation of new camshaft requires the use of new rocker arms.

5. Replace thermostat and water outlet fitting. Tighten to 25 lb. ft.

6. Install rocker arm cover assembly and adjust camshaft belt as previously outlined. Camshaft cover bolts and nuts should be tightened evenly (15 lb. ft.) (from center outwards) to avoid possible warping of cover. A torque wrench must be used to avoid over tightening.

NOTE: Engine must be run at idle for five minutes after installing camshaft. This will ensure adequate lubrication to the camshaft and rocker arm mating surfaces.

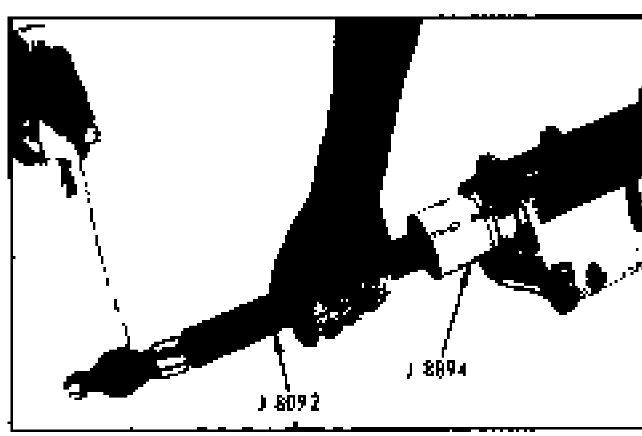


Fig. 6-17 Installing Camshaft Rear Plug

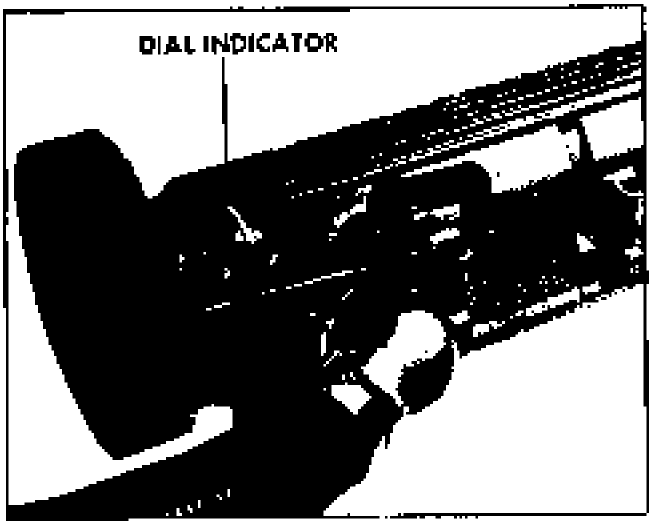


Fig. 6-18 Measuring Camshaft End Play

NOTE: Owner should be advised to follow recommended running-in procedure following camshaft replacement.

ROCKER ARM OR HYDRAULIC VALVE LASH ADJUSTER

REMOVE

1. Remove rocker arm cover assembly.

2. Remove rocker arm and hydraulic lash adjuster assembly and store so that each assembly can be installed in its original location.

If a lash adjuster becomes stuck in the cylinder for some reason and normal methods of removal are unsuccessful, proceed as follows:

a. Remove rocker arm.

b. Fill the vent hole adjacent to the lifter with engine oil (see Fig. 6-24).

3. Insert a 4" length of 3/16" diam. rod into the vent hole and strike the end of the rod with a hammer.

The hydraulic effect of the oil on the base of the adjuster will break it free from the locating bore in the cylinder head.

REPLACE

NOTE: If new lash adjuster is to be installed, it will be necessary to check the leak down rate and prime before installation.

1. Place hydraulic lash adjuster in original location.

2. Install rocker arms and cover assembly

HYDRAULIC LASH ADJUSTER-RECONDITION

NOTE: Because of the important part hydraulic lash adjusters play in the operation of an engine and the close tolerances to which they are manufactured, proper handling, and above all, cleanliness, cannot be overstressed when servicing these parts.

New adjusters are serviced as individual units packaged with a plastic coating. Leave the coating on until ready to check leak-down rate. It is necessary to remove the oil from new adjusters prior to checking leak-down rate since special oil is in new adjusters. Fill adjusters with SAE 10 oil before checking leak-down rate.

Wash tank and tray, J 5821, is recommended for cleaning lash adjusters. This tank should be used only for lash adjusters and should be kept covered when not in use. All servicing should be done in an area removed from grinders or other sources of dust and foreign material.

Adjusters should at all times be stored in a covered box which will aid in keeping them clean. The box should be kept dry and as free of oil as possible.

LASH ADJUSTER-DISASSEMBLE (Fig. 6-20)

1. Remove plunger retainer with small screwdriver.

2. Remove plunger, ball, ball retainer and spring.

NOTE: It may be necessary to soak an adjuster having a stuck plunger in cleaning solvent for several minutes in order to remove the plunger.

3. Drain oil out of adjuster body and place all lash adjuster parts in separate compartment of tray from wash tank.

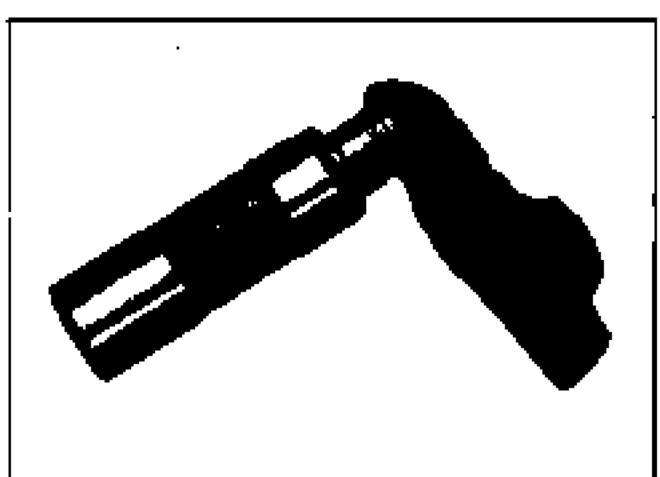


Fig. 6-19 Rocker Arm and Lash Adjuster

CAUTION: Lash adjuster body and plunger are selectively fitted and must not be interchanged with parts of other adjusters. Keeping all parts of adjusters together will aid in trouble diagnosis.

LASH ADJUSTER-CLEAN AND INSPECT

Wash tank, J 5821, is recommended for cleaning lash adjuster parts. This tank consists of two chambers, a tray and a cover. One chamber is for cleaning solvent and the other is for kerosene. Whenever the tank is not being used (and when parts are soaking), the cover should be closed.

1. Before placing tray of parts in cleaning solvent, first immerse it in kerosene chamber to remove as much engine oil as possible. (This reduces contamination of solvent, thus prolonging its useful life.)

2. Submerge tray in cleaning solvent and allow to soak for approximately one hour. More time may be required, depending on varnish condition and effectiveness of solvent. Light agitation of tray in solvent at 10-15 minute intervals will hasten cleaning action.

3. After varnish has dissolved or has been sufficiently softened to permit removal by wiping, suspend tray above solvent, utilizing hooks on tray handles. Allow tray and parts to drain for a brief period.

4. Rinse tray of parts in kerosene chamber to cut solvent and to avoid injury to hands (from solvent).

5. Wipe out tank cover and place tray of parts on cover in front of tank. A shop towel under tray and clean paper on remainder of cover will ensure cleanliness.

6. Working on one adjuster at a time and using clean, lint-free cloths, thoroughly wipe off adjuster parts.

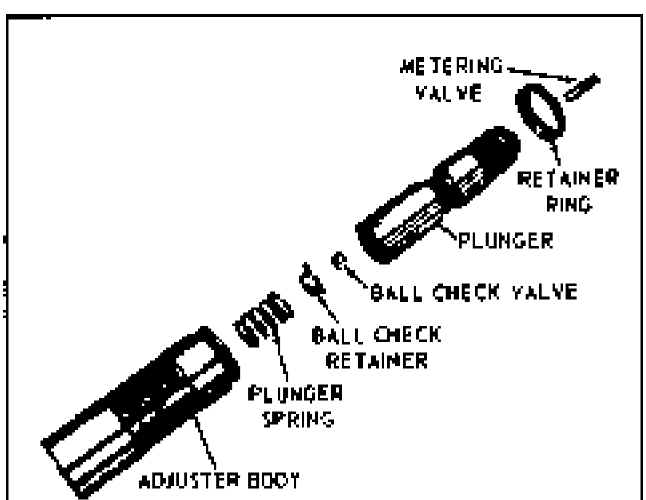


Fig. 6-20 Lash Adjuster-Exploded View

Clean plunger and external and internal surfaces of body with a hard wiping action. A bristle brush may be used to clean internal surface of adjuster body.

CAUTION: Do not use wire brush or sand paper, as these may damage machined surfaces.

NOTE: Absolute cleanliness can be assured if each adjuster is inspected and assembled after cleaning but before proceeding to the next adjuster.

7. Inspect adjuster body. Both inner and outer surfaces of adjuster body should be inspected for scoring. Adjuster assembly should be replaced if body is roughly scored, grooved, or galled.

8. Inspect adjuster plunger. Using a magnifying glass, inspect check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with a rough satiny finish will cause the plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with a fingernail are causes for replacing the adjuster 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 body. This edge is not detrimental unless it is sharp or burred.

A blackened appearance is not a defective condition. Sometimes discoloration serves to highlight slight grinder chatter marks and give the outer surface of plunger a ridge or fluted appearance. This condition will not cause improper operation, therefore, it may be disregarded.

9. Inspect lash adjuster ball. Carefully examine ball for nicks, embedded material or other defects which would prevent proper seating. Such defects may cause intermittently noisy adjuster operation. Also inspect plunger face of ball retainer for excessive wear.

LASH ADJUSTER-ASSEMBLE (Fig. 6-20)

NOTE: All parts must be absolutely clean when assembling a hydraulic lash adjuster. Since lint and dust may adhere to parts, they should not be blown off with air or wiped with cloths. All parts should be rinsed in clean kerosene and assembled without drying. A small container with clean kerosene (separate from cleaning tank) should be used for each set of adjusters being overhauled.

Fig 6-20 shows the relative position of component parts of lash adjusters. The recommended procedure for assembly is given in the following steps.

1. Rinse plunger spring and ball retainer and position retainer in spring.

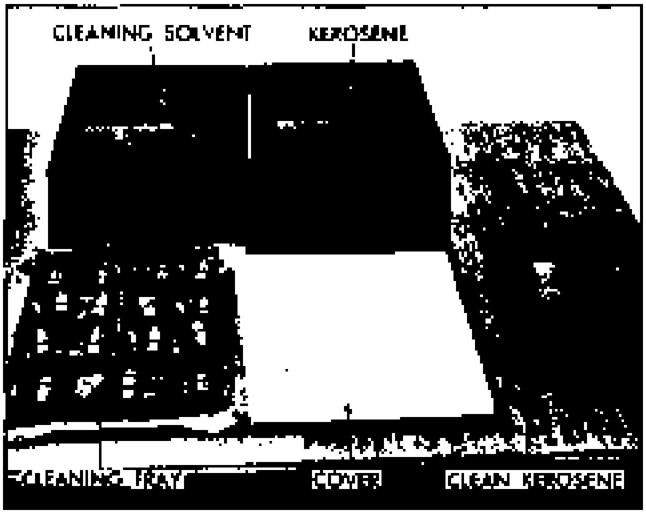


Fig. 6-21 Lash Adjuster Wash Tank and Tray

2. Rinse check ball and place in retainer.

3. Rinse plunger and place on retainer so that seat on plunger mates with ball.

4. Invert plunger with parts assembled thus far and after rinsing adjuster body, install body over spring and plunger

5. Place adjuster body on clean paper, rinse and install retainer ring.

6. After adjuster has been assembled, place in adjuster box and close lid to preserve cleanliness.

LASH ADJUSTER TEST LEAK-DOWN RATE

After all adjusters have been assembled, the leak-down rate must be checked before they are installed in the engine. Valve lifter leak-down tester, J 5790 (Fig. 6-22), is designed to test leak-down rate of adjusters to determine whether or not they are within specified limits. As with previous service operations concerned with lifters, cleanliness is paramount. The tester cup and ram should be thoroughly cleaned, and testing should be done in an area free of dust and dirt. The testing procedure is described in the following steps:

1. Fill tester cup to approximately one inch from top with SAE 10 engine oil.

2. Swing weight arm up out of the way, raise ram, and position adjuster into boss in center of tester cup.

3. Adjust ram (with weight arm clear of ram) so that the pointer is positioned on the set line (marked S). Tighten jam nut to maintain setting.

4. Operate adjuster through full travel of plunger by pumping weight arm to fill adjuster with test fluid and force out air. (Adjuster must be completely submerged at all times.) Continue pumping for several strokes after definite resistance is detected.

5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram.

Time indicator travel from lower line (first line above set line) to line marked .125" or 1/8". Lifter is satisfactory if rate is 34 seconds or above when temperature is between 70°-90°.

VALVE SPRINGS, SHIELD OR SEAL

REMOVE

1. Remove rocker arm cover assembly.

2. Rwmove rocker arm of valve to be serviced. .

3. Remove spark plug from cylinder of valves to be serviced and install J 22278 (Fig. 6-23).

CAUTION: If piston is not in its full down position, fan will turn.

4. Connect air hose with a constant source of compressed air to J 22278.

5. Install hook end of tool J 22263-2 into oil feed hole in lash adjuster bore (Fig. 6-23).

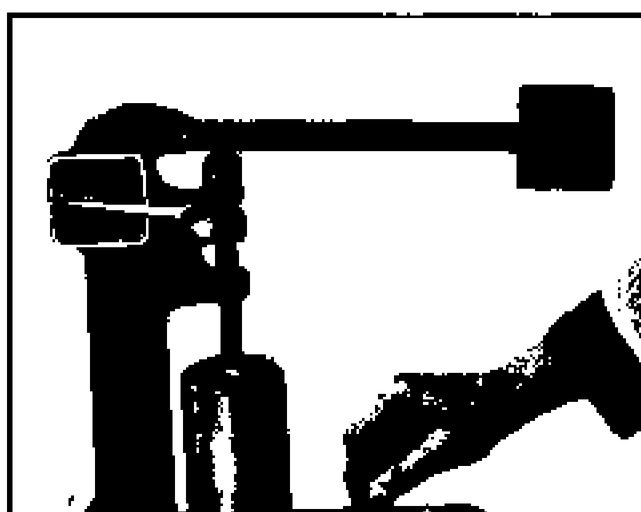


Fig. 6-22 Testing Leak Down Rate

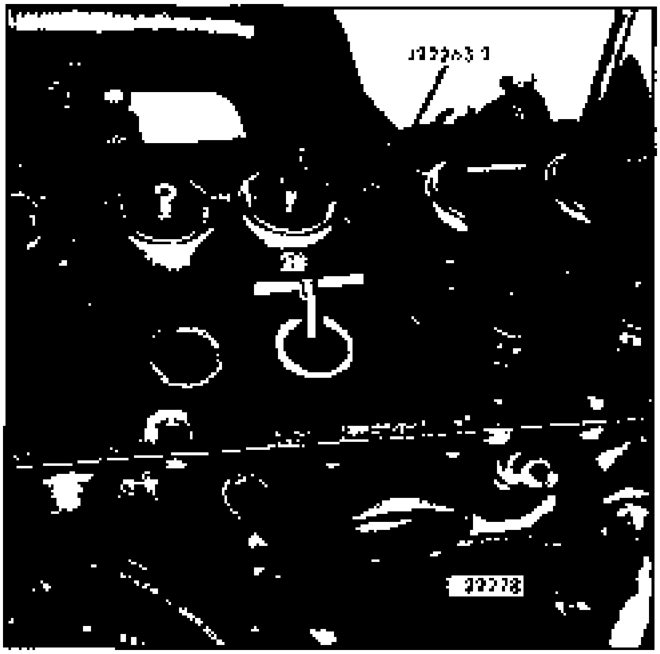


Fig. 6-23 Valve Spring Removal Hook-Up

6. Hold J 22263-2 in place and install fork end of compressor J 22263-1 on J 22263-2 (Fig. 6-24).

7. Pivot J 22263 so that the recessed side of the disc contacts the valve spring retainer cup shield.

8. Depress valve spring using compressor J 22263-1 and remove valve spring retainer cup locks, then both pieces of the valve spring compressor, valve spring and retainer cup shield, valve stem seal, and intake valve quick seal.

REPLACE

1. Install valve spring and valve spring retainer cup and compress spring with both pieces of J 22263 (while holding valve up with compressed air and J 22278).

2. Install valve stem seal, intake valve guide seal and retainer cup locks. Remove both pieces of valve spring compressor, then test valve stem seal using J 22330.

When replacing intake valve guide seals, place plastic installation cap over valve stem and push valve guide seal into place using a seal installing tool VSIT-1 (Fig. 6-25).

3. Replace spark plug.

4. Install rocker arm

5. Install rocker arm cover assembly.

CYLINDER HEAD OR GASKET

REMOVE

1. Drain cooling system and remove air cleaner.

2. Disconnect accelerator pedal cable at bell crank on manifold and fuel and vacuum lines at carburetor.

3. Disconnect exhaust pipe at manifold flange, then remove manifold bolts and clamps and remove manifolds and carburetor as an assembly.

4. Remove rocker arm cover assembly.

5. Remove timing belt upper front cover mounting support bracket and rear lower cover.

6. Disconnect spark plug wires.

7. Remove rocker arms and hydraulic valve lash adjusters. Store rocker arms and hydraulic lash adjusters so that they can be replaced in exactly the same location.

8. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

9. Clean gasket surfaces of cylinder head and block.

REPLACE

When installing new head, transfer all serviceable parts to new head using new seals on intake and exhaust valve stems and new manifold gaskets.

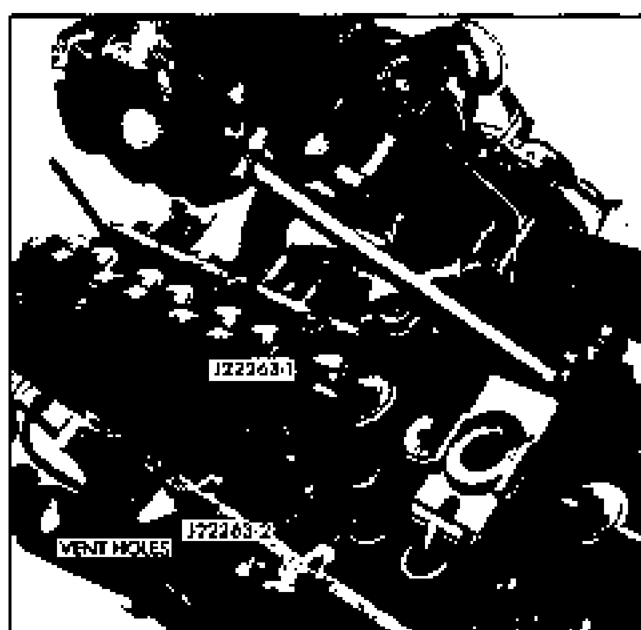


Fig. 6-24 Valve Spring Removal

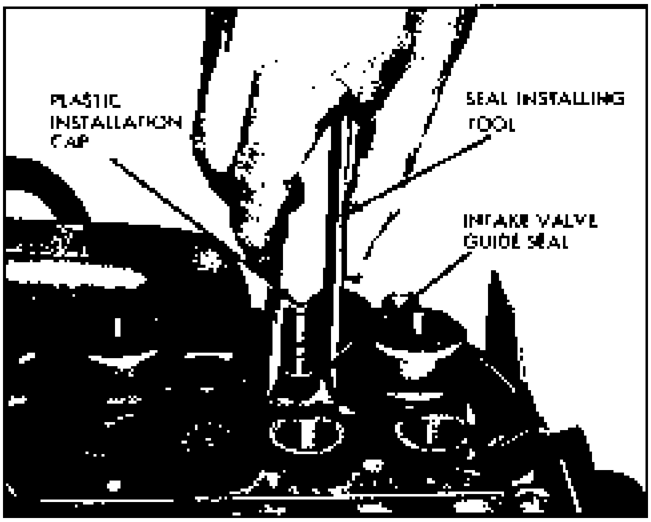


Fig. 6-25 Intake Valve Guide Seal Installation

1. After applying sealer, place a new cylinder head gasket in position over dowel pins in cylinder block (Fig 6-26)

2. Carefully guide cylinder head into place over dowel pins and gasket.

3. Start all bolts in threads.

NOTE: Bolts are of two different lengths. When inserted in proper holes, all bolts will project an equal distance from head. Do not use sealer of any kind on threads.

4. Tighten cylinder head a little at a time with a torque wrench. Tighten center bolts and then end bolts (Fig. 6-27). The final torque should be 95 lb. ft.

Reverse steps 1-7 of Removal to complete installations procedure using new gaskets and seals as required

CYLINDER HEAD AND VALVES

RECONDITION

The condition of the cylinder head and valve mechanism significantly determines power, performance and economy of a valve-in-head engine. Extreme care should be exercised when conditioning the cylinder head and valves to maintain correct valve stem-to--guide clearance, correctly ground valves, valve seats of correct width and correct valve adjustment

DISASSEMBLE

1. Remove cylinder head and gasket as previously described. Place cylinder head on two blocks of wood to prevnet damage.

2. Using tool J 8062, compress the valve springs and remove valve keys. Remove spring caps, spring seats, oil seals, and springs.

3. Remove valves from bottom of cylinder head and place them in a rack in their proper sequence so they can be assembled in their original positions.

CLEAN AND INSPECT

1. Clean all carbon from combustion chambers and valve ports.

2. Thoroughly clean the valve guides using tool J 8101 (Fig. 6-28).

3. Clean all carbon and sludge from rocker arms.

4. Clean valve stems and heads on a buffing wheel.

5. Clean carbon deposits from head gasket mating surfaces.

6. Wash all parts in cleaning solvent and dry them thoroughly.

7. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.

8. Inspect the valves for burned heads, cracked faces or damaged stems.

9. Check fit of valve stems in their respective bores.

NOTE: Excessive valve stem to bore clearance will cause lack of power, rough idling and noisy valves, and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness of operation. Intake valve stem-to-bore clearance should be .0016" to .0033" while exhaust stem clearance should be .0021" to .0038". By using a micrometer and suitable telescope hole gauge, check the diameter of valve stem in three places; top, center and bottom. Insert telescope hole gauge in valve guide bore, measuring at center. Subtract highest reading of valve stem diameter from valve guide bore center diameter to obtain valve to valve guide clearance.

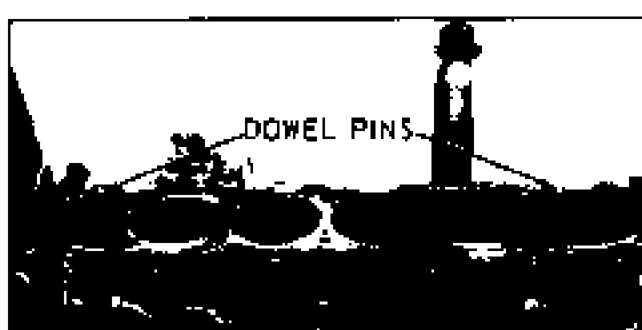


Fig. 6-26 Cylinder Head Locating Dowel Pins

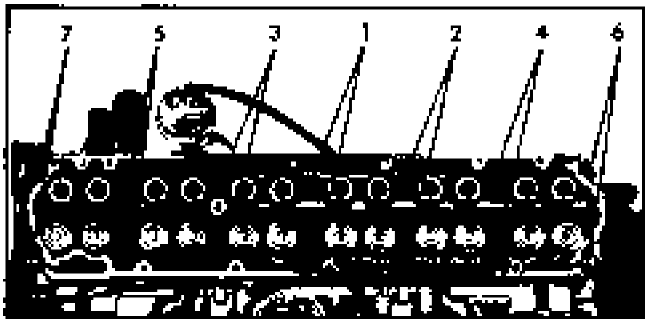


Fig. 6-27 Cylinder Head Bolt Tightening Sequence

If clearance is not within limits, use next oversize valve and ream bore to fit using suitable reamer.

FITTING VALVE STEMS TO GUIDES

Correct valve stem clearance for valve guides is .0016" to .0033" for the intake valve and .0021" to .0038" for the exhaust valve.

Valves with oversize stems are available in .001", .003" and .005" larger than standard. The same valve stem to guide clearance applies for oversize stems.

Oversize reamers are required to enlarge valve guide holes to fit the oversize stems. When reamer is turned through valve guide, it will size the hole to fit valve stem according to above limits

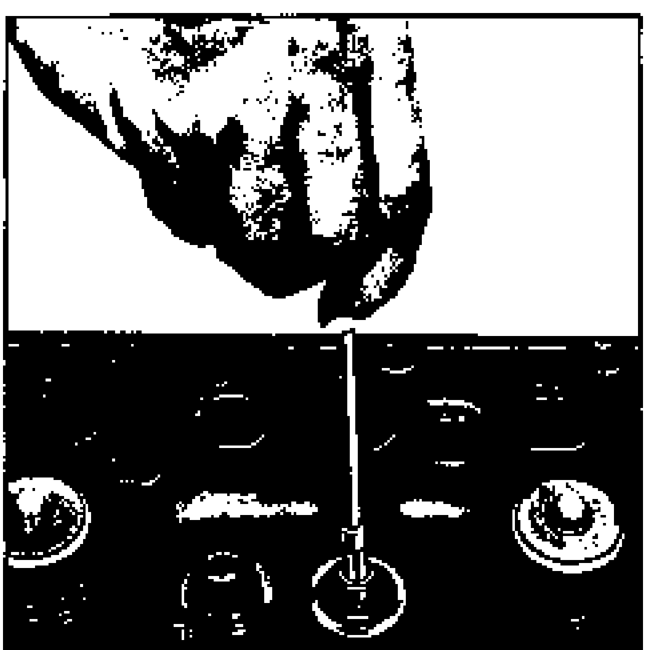


Fig. 6-28 Cleaning Valve Guide Bore

Carefully ream the valve guide using valve guide reamer J 5830-1 for .003" oversize stems and valve guide reamer J 6621 for .005" oversize stems (Fig 6-29). For best results when installing .005" oversize valve stem use the .003 oversize reamer first and then ream the .005" oversize. Always reface the valve seat after reaming valve guide.

NOTE: Valves are marked .001, .003 or .005 with colored ink.

VALVES AND SEATS-RECONDITION

1. Reface valves and seats as follows:

Valves should be ground on a special bench grinder designed specifically for this purpose and built by a reputable manufacturer. Valve seats should be ground with reputable power grinding equipment having stones of the correct seat angle and a suitable pilot which pilots in the valve stem guide. To ensure positive sealing of the valve face to its seat, the grinding stones should be carefully refaced before any grinding is done.

and intake valves have a seat angle of 46° with a face angle of 45° (Fig. 6-30). This provides hairline contact between valve and seat to provide positive sealing and reduce build-up of deposits on seating surfaces.

DO NOT USE REFACING EQUIPMENT EXCESSIVELY; only enough material should be removed to true up surfaces and remove pits. The valve head will

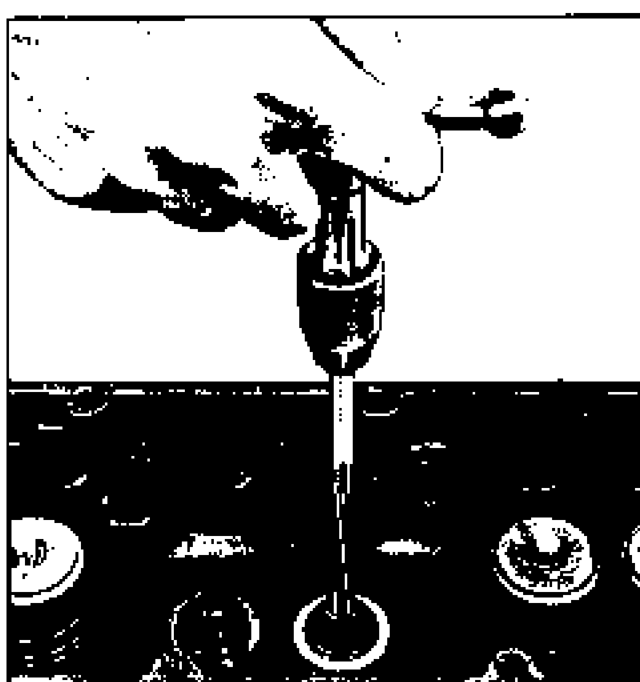


Fig. 6-29 Reaming Valve Guide Bore

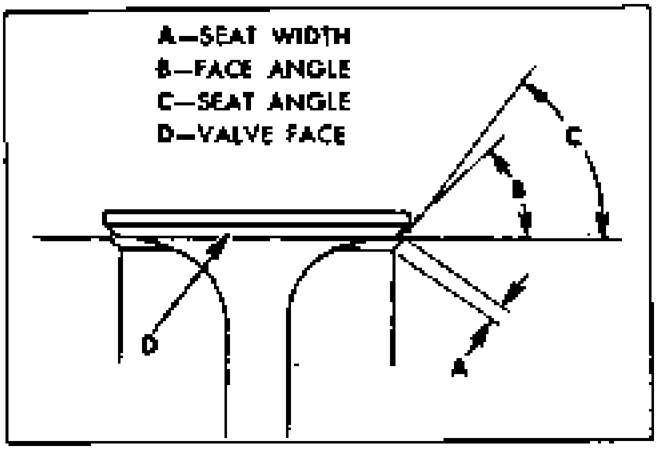


Fig. 6-30 Valve Seat and Face Angle

run hotter as its thickness is diminished; therefore, if valve face cannot be cleaned up without grinding to point where outside diameter of valve has a sharp edge, the valve should be replaced. Whenever it is necessary to replace a valve, the new valve should be of same stem diameter as valve removed (unless the valve guide is reamed to provide proper fit).

Width of exhaust valve seats should be 1/16" to 3/32". Intake valve seats should be 1/32" to 1/16" wide. If seat width is excessive, it should be narrowed by grinding with a flat stone. This is the only method that should be used to narrow seat.

2. Check concentricity of valve seat and valve guide. Concentricity of valve seat and valve guide can be checked by using a suitable dial indicator or prussian blue. When using dial indicator, total runout should not exceed .002".

When prussian blue is used, a light coat should be applied to face of valve only and valve rotated in its seat. If blue appears all the way around valve seat, valve seat and valve guide are concentric with one another.

3. Check concentricity of valve stem and face of valve. After cleaning prussian blue from valve and seat, lightly coat valve seat with prussian blue again and rotate valve in guide. If blue appears all the way around valve, valve stem and valve face are concentric with one another.

NOTE: Both tests in steps 2 and 3 are necessary to insure proper valve seating.

IMPORTANT: If it is necessary to grind any pit from rocker arm end of valve stem, feed end squarely against grinding wheel. Only the extreme end of the valve stem is hardened to resist wear. Do not grind end excessively.

ASSEMBLE

1. Starting with No. 1 cylinder place exhaust valve in the port and place valve spring and cap in position. Place spring and cap on exhaust valves. Then using J 8062 spring compressor, compress spring and install oil seal with J 22330 and valve keys. See that seal is flat and not twisted in the valve stem groove and that keys seat properly in valve stem groove.

NOTE: Place valve springs in position with closed coil end toward cylinder head.

2. Assemble remaining valves, valve springs, shields, spring caps, oil seals and valve locks in cylinder head. Check seals by placing vacuum cup of J 22330 over stem and cap, squeeze vacuum cup to make sure no oil leaks past oil seal.

3. Install cylinder head as previously described.

HARMONIC BALANCER

REMOVE

1. Loosen generator at adjusting bracket and pivot bolt and remove fan belt from harmonic balancer. On cars equipped with power steering, also remove power steering pump belt from harmonic balancer.

2. Position fan so wide angles will be at top and bottom, allowing access to balancer.

3. Remove harmonic balancer attaching bolt and retainer washer.

4. Remove harmonic balancer using puller J 6978. Use of a washer (manifold bolt washer) in end of shaft will prevent tool damaging threads in crankshaft.

Fig. 6-31 Lower Front Timing Cover Retaining Bolts

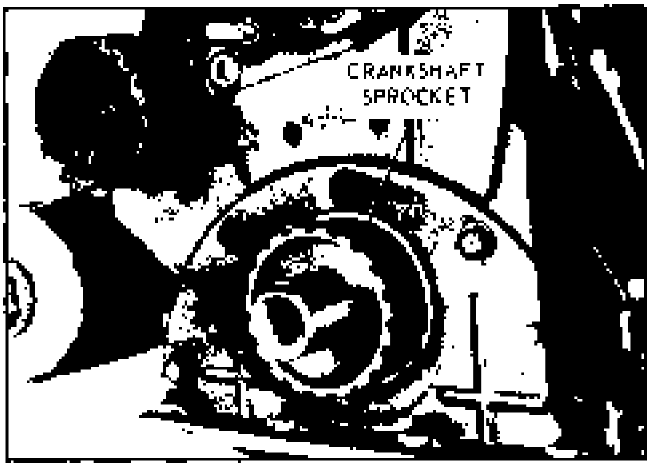


Fig. 6-32 Crankshaft Sprocket

NOTE: Clean threads in pulley using a 3/16" - 16 UNC tap and a light application of oil, to assure puller bolts seat fully.

REPLACE

1. Install new harmonic balancer by tightening attaching bolt until balancer is fully seated on end of crankshaft lining up keyway in balancer with key on crankshaft

2. Tighten harmonic balancer attaching bolt to 160 lb. ft. torque.

NOTE: Remove flywheel cover and lock flywheel before tightening balancer bolt.

LOWER FRONT TIMING BELT COVER

REMOVE AND REPLACE

1. Remove harmonic balancer, fan and water pump pulley.

2. Remove two attaching bolts and remove cover (Fig. 6-31).

3. Install cover by reversing above steps. Tighten cover attaching bolts to 20 lb. ft.

CRANKSHAFT TIMING BELT SPROCKET OR CRANKCASE COVER SEAL

REMOVE

1. Remove upper front timing cover.

2. Align timing marks (Fig. 6-7)

3. Remove fan and water pump pulley.

4. Remove harmonic balancer.

5. Remove timing belt lower front cover (Fig. 6-31).

6. Loosen accessory drive mounting bolts to provide slack in timing belt.

7. Remove timing belt.

8. Remove crankshaft timing belt flange and sprocket (Fig. 6-32).

9. Pry seal from crankcase cover (Fig. 6-33) using care not to distort the cover.

REPLACE

1. Install new seal with lip of seal inward using seal installer J 22260 (Fig. 6-34)

2. Replace crankshaft timing belt sprocket and flange.

3. Align timing marks (Fig. 6-7) and replace timing belt.

4. Replace timing belt lower front cover and harmonic balancer.

5. Adjust timing belt tension.

6. Replace water pump pulley and fan

7. Replace timing belt upper front cover.

FRONT CRANKCASE COVER AND GASKET-REMOVE AND REPLACE

1. Remove crankshaft timing belt sprocket as shown above.

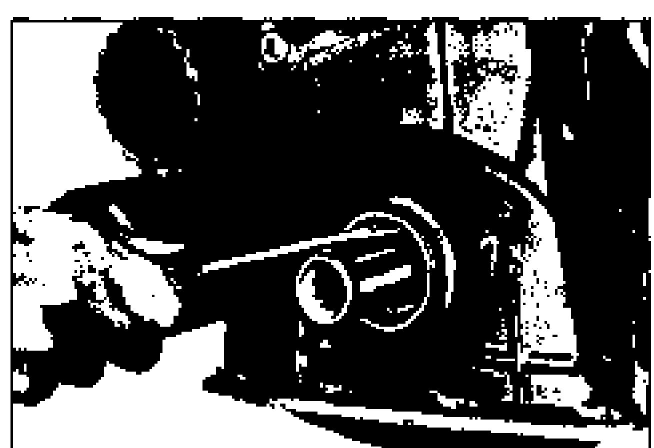


Fig. 6-33 Removing Crankshaft Front Seal

Fig. 6-34 Installing Crankshaft Front Seal

2. Remove four front oil pan to crankcase cover retaining bolts

3. Loosen remaining oil pan bolts as necessary to provide clearance between crankcase cover and oil pan.

NOTE: It may be necessary to jar the oil pan to gain the necessary clearance.

4. Remove five front crankcase cover attaching bolts.

5. Remove front crankcase cover and gasket and clean gasket surface, using care that gasket particles do not fall into oil pan.

6. Inspect cover seal for signs of wear or distortion.

7. Using new gasket installed over dowels (Fig. 6-35) and if necessary, new seal, reverse removal procedures tightening oil pan and crankcase cover bolts to 12 lb. ft.

HOUSING ASSEMBLY-OIL PUMP, DISTRIBUTOR AND FUEL PUMP (Fig. 6-36)

PRESSURE REGULATOR VALVE-OIL PUMP

REMOVE AND REPLACE

1. Remove cap washer and spring from housing assembly.

2. Using magnet, remove valve from housing assembly.

3. Install valve on spring and install as an assembly.

4. Install cap and washer.

OIL PUMP

REMOVE AND REPLACE

1. Remove oil pump cover and gasket.

2. Remove drive gear and driven gear (Fig. 6-37).

3. Inspect gears for wear and pump cover for excessive scoring.

4. Install gears

5. Replace cover using new gasket. Tighten bolts to 20 lb. ft.

HOUSING ASSEMBLY

REMOVE

1. Remove timing belt top front cover.

2. Align timing marks (Fig. 6-7).

3. Loosen six housing assembly to cylinder block retaining bolts.

4. Remove timing belt from camshaft sprocket and distributor drive.

5. Disconnect fuel lines from fuel pump

6. Remove distributor cap, vacuum lines and wires from distributor.

7. Remove housing assembly by removing six retaining bolts (Fig. 6-38).

REPLACE

1. Using new gaskets, loosely install housing assembly

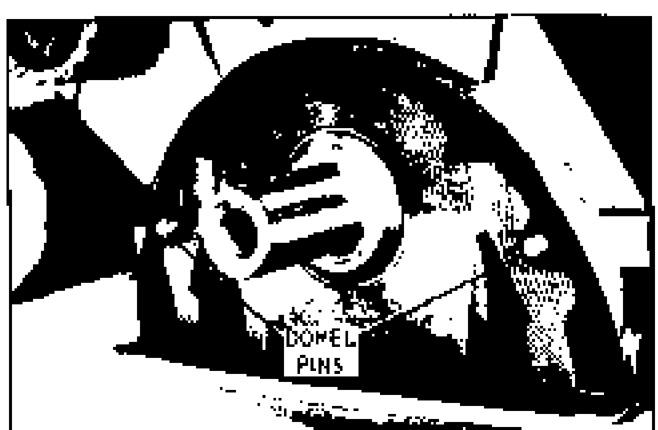


Fig. 6-35 Crankcase Front Cover Gasket and Dowel Pins

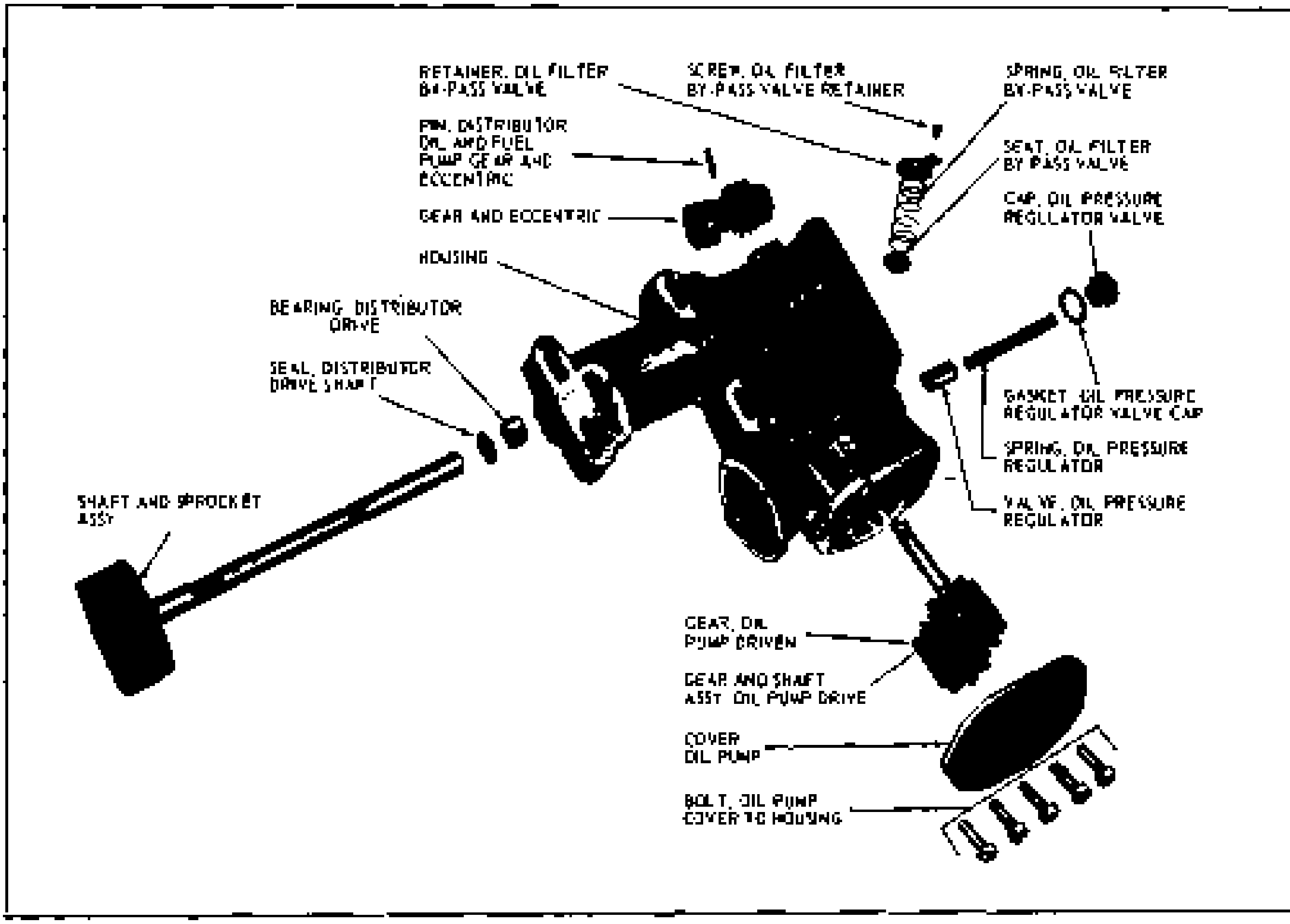


Fig. 6-36 Accessory Drive Housing-Exploded View

to cylinder block using six retaining bolts.

2. Align timing marks (Fig. 6-7) and install timing belt.

3. Connect fuel lines to fuel pump.

4. Replace distributor cap, vacuum lines and wires.

5. Adjust timing belt tension. See Fig. 6-12.

6. Replace timing belt top front cover.

OIL FILTER BY-PASS VALVE

REMOVE AND REPLACE

1. Remove housing assembly.

2. Remove by-pass valve retaining screw (Fig. 6-39).

3. Remove by-pass valve.

4. Replace by reversing the above procedures.

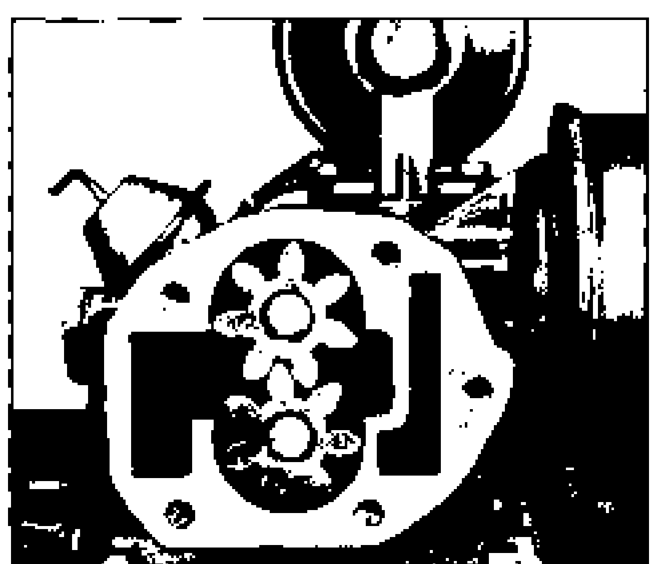


Fig. 6-37 Oil Pump Gears

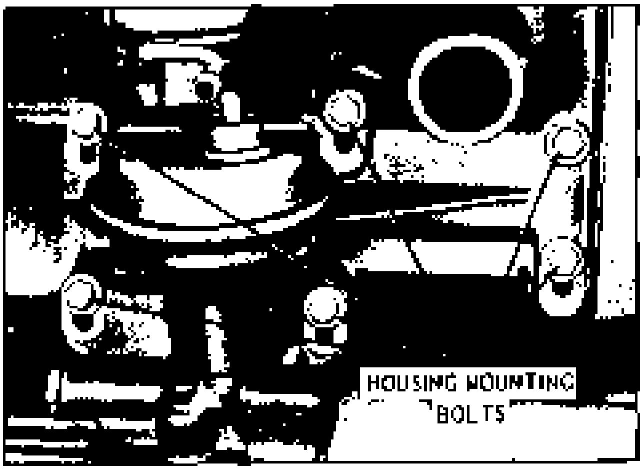


Fig. 6-38 Housing Mounting Bolts

SHAFT AND SPROCKET ASSEMBLY - SHAFT SEAL AND/OR BEARING - FUEL PUMP - ECCENTRIC AND DISTRIBUTOR DRIVE GEAR

1. Remove housing assembly.

2. Observing and recording location of sprocket timing mark and direction of distributor rotor, remove distributor.

3. Remove fuel pump eccentric and distributor drive gear retaining pin (Fig. 6-40).

NOTE: Position shaft assembly so as to allow adequate clearance in housing body for pin removal.

4. Remove shaft and sprocket assembly from housing.

5. Inspect shaft assembly seal and bearing.

6. If necessary to replace bearing or seal, use J 22264 and slide hammer to remove seal or bearing and seal together (Fig. 6-41).

7. Use tool J 22267-1 and install bearing (Fig. 6-42).

8. Use tool J 22267-1 and -2 and install seal (Fig. 6-43).

9. Reassemble by reversing steps 1 thru 4.

OIL PAN

REMOVE

1. Disconnect battery cable.

2. Remove air cleaner assembly.

3. On air-conditioned cars, remove compressor from mounting brackets and position to one side.

4. Inspect all water hoses and wiring harness for proper routing to prevent excessive binding when engine is raised.

NOTE: Before raising vehicle prop hood open at least 6" to insure adequate clearance between timing belt cover and inner hood panel.

5. Raise vehicle and drain crankcase.

6. Remove starter assembly and flywheel cover.

7. Reroute or disconnect any wiring between bellhousing and floor pan to insure against damage when bellhousing contacts floor pan.

8. Loosen transmission insulator to crossmember retaining bolts.

9. Remove right and left engine insulator to frame bracket thru-bolts.

10. Rotate harmonic balancer until timing mark is at bottom. (This puts the crankshaft counterweights in the proper position.)

11. Bolt J 22345 (Tempest) or J 22773 (Firebird) engine support bracket to front of harmonic balancer.

NOTE: Safety bracket on Firebird tool must engage in crossmember reinforcement bar (Fig. 6-10).

12. With suitable equipment, raise engine at J 22345 or J 22773 until insulators clear frame brackets.

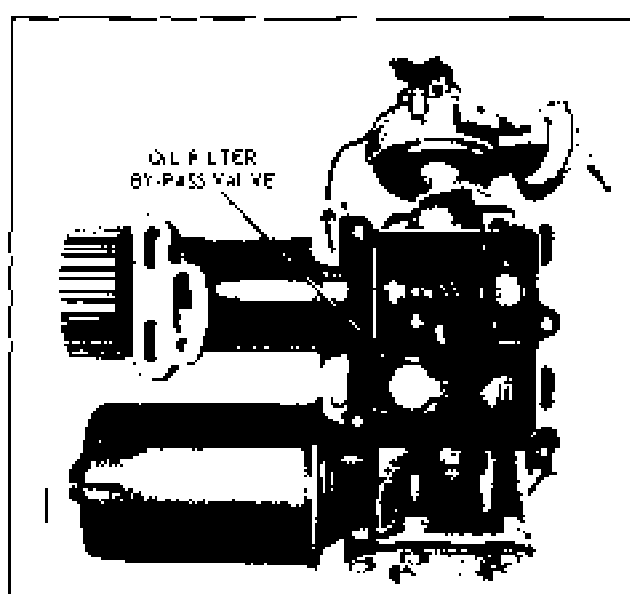


Fig. 6-39 Oil Filter Bypass Valve

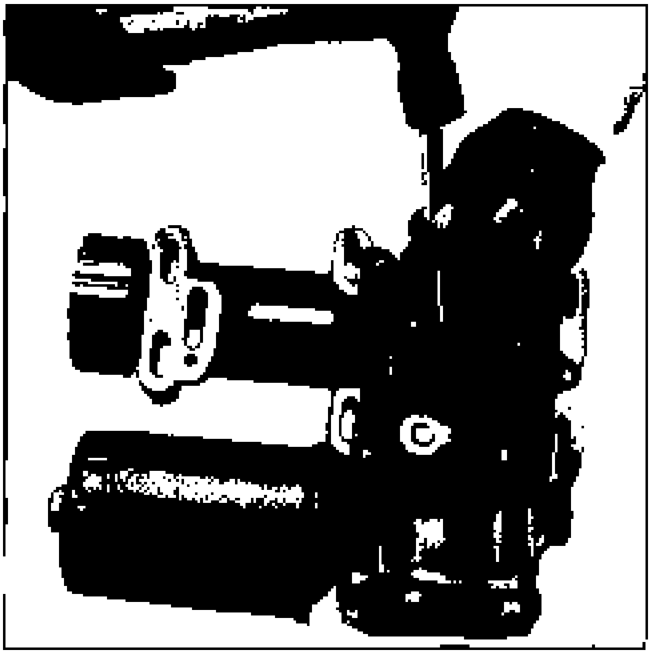


Fig. 6-40 Removing Eccentric and Distributor Drive Gear Pin

13. Remove oil pan bolts

14. On Tempest raise engine approximately 4 1/2". Apply a rearward force on the engine-transmission assembly until oil pan clears the flywheel housing and remove oil pan.

On Firebird raise engine approximately 2" or until oil pan clears the flywheel housing and remove oil pan.

REPLACE

1. Install new gasket on oil pan.

2. Apply rearward force to engine-transmission assembly sufficient to allow oil pan to clear flywheel housing (Tempest).

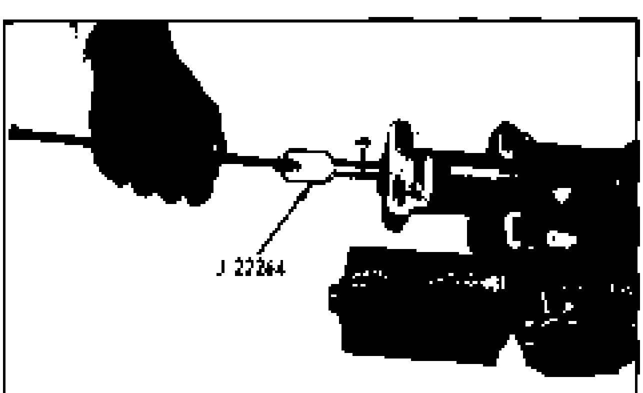


Fig. 6-41 Removing Bearing and Seal

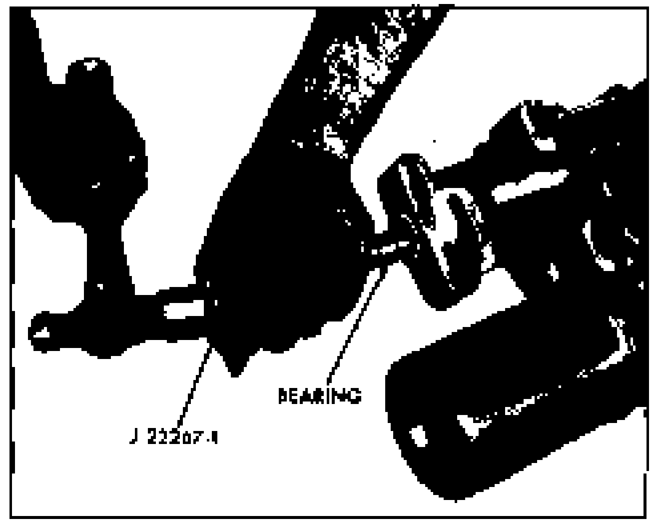


Fig. 6-42 Installing Bearing

3. Install oil pan and tighten retaining bolts to 12 lb. ft.

4. Lower engine, remove engine support bracket and install engine insulator bracket to frame thru bolts.

5. Tighten transmission insulator to crossmember bolts to 30 lb. ft.

6. Replace flywheel cover and starter assembly.

7. Lower vehicle

8. On air-conditioned vehicles, replace compressor and adjust belt tension.

9. Replace air cleaner assembly.

10. Refill crankcase.

11. Connect battery cable.

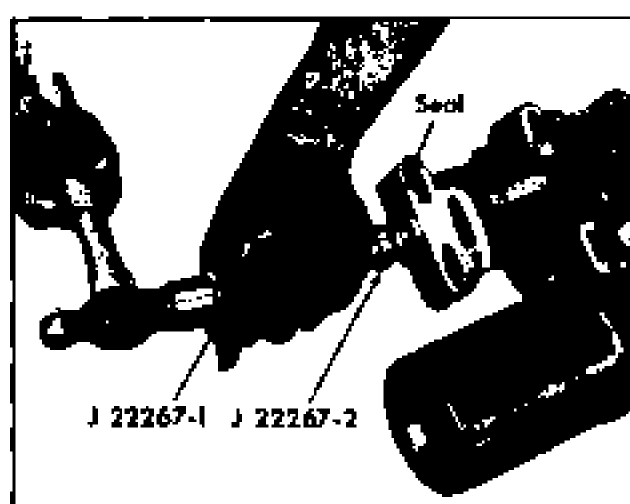


Fig. 6-43 Installing Seal

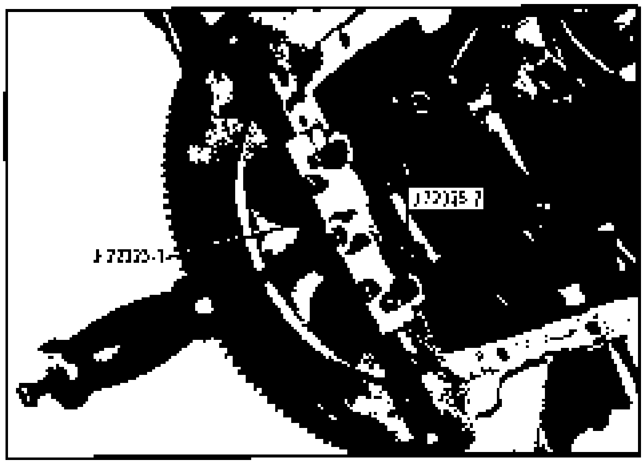


Fig. 6-44 Removing Rear Main Bearing Cap

REAR MAIN BEARING OIL SEAL-REMOVE AND REPLACE

The rear main bearing oil seal can be removed (both halves) without removal of the crankshaft

NOTE: Always replace upper and lower seal as a unit.

1. Remove oil pan. (See "Oil Pan-Remove and Replace".)

2. Remove rear bearing cap using J 22325 (Fig. 6-44).

3. Remove oil seal from groove, prying from bottom, using a small screwdriver.

NOTE: Always clean crankshaft surface before installing a new seal.

4. Remove rear bearing cap side oil seals. Place new seals in position and place bearing cap in vise and compress seals into place (Fig. 6-45).

5. Insert a new seal will lubricated with engine oil in bearing cap groove; gradually push with a hammer handle until seal is rolled into place.

6. To replace the upper half of seal, use a small hammer and brass pin punch to tap one end of oil seal (Fig. 6-46) until it protrudes far enough to be removed with pliers. Push new seal into place.

NOTE: Avoid scraping seal on edge of cap and block seal locating grooves.

7. Install bearing cap using J 22325 (Fig. 6-44) and torque bearing cap bolts 100 lb. ft.

8. Install oil pan. Do not overtighten.

MAIN BEARINGS-REMOVE AND REPLACE

The main bearings are of precision insert type and do not utilize shims for adjustment. If the clearances are found to be excessive, a new standard or undersize bearing insert, both upper and lower halves, will be required.

NOTE: To replace the upper half of the rear main bearing, it will be necessary to loosen all main bearing caps. Slowly rotate the crankshaft and force bearing out with a putty knife or similar tool.

REMOVE

1. Remove oil pan. (See - "Oil Pan-Remove and Replace".)

2. Remove cap on main bearing requiring replacement and remove bearing from shell.

NOTE: A cotter pin may be bent as required to remove the bearing (Fig. 6-47).

3. Rotate the crankshaft clockwise as viewed from front of engine. This will roll upper bearing shell out of engine.

REPLACE

1. Oil new upper bearing shell and insert plain (unnotched) end of shell between crankshaft and indented or notched side. Rotate the bearing into place.

2. Install new bearing shell in bearing cap.

3. Check bearing clearance using Plastigage, or equivalent, method as outlined below.

4. Install oil pan using new gaskets and seals.

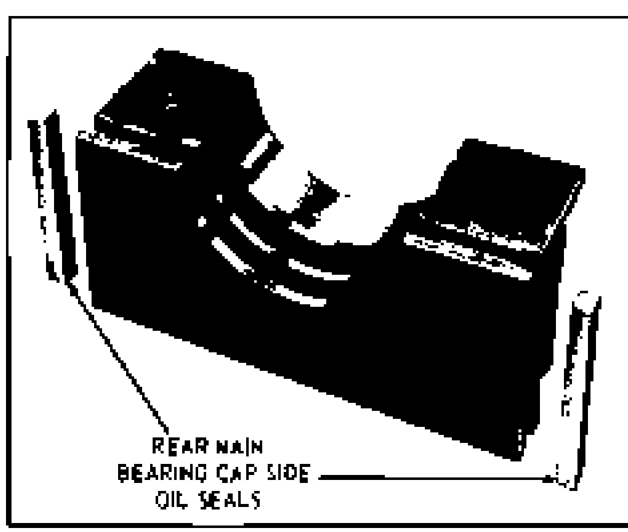


Fig. 6-45 Rear Main Bearing Cap Side Oil Seals

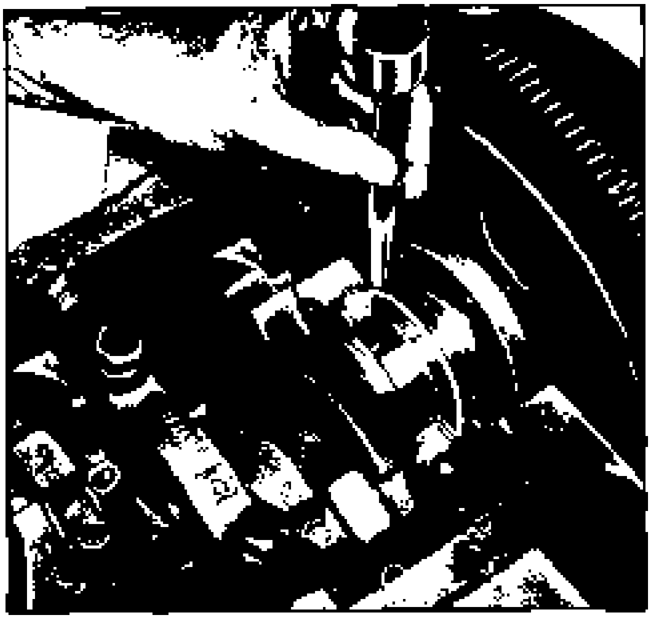


Fig. 6-46 Removing Upper Rear Main Oil Seal

PLASTIGAGE (OR EQUIVALENT) METHOD OF DETERMINING MAIN BEARING CLEARANCE

1. Place a .002" brass shim between the crankshaft journal and lower bearing in each bearing cap next to that being checked. Tighten all cap bolts to 100 lb. ft. This causes the crankshaft to be forced against the upper bearing and insures an accurate measurement of total clearance.

2. Remove the bearing cap of bearing to be checked. Wipe bearing and journal free of oil.

3. Place a piece of Plastigage, the length of bearing (parallel to crankshaft), on journal or bearing surface (Fig. 6-48). Install cap and tighten cap bolts to proper torque.

NOTE: Do not turn crankshaft with Plastigage, or equivalent, in place.

4. Remove bearing cap and using Plastigage, or equivalent, scale on envelope measure width of compressed Plastigage, or equivalent, before removing it from the bearing or journal (Fig. 6-49). If bearing clearance is between .0003" and .002", the clearance is satisfactory. If clearance is more than .002", replace bearing with next undersize bearing and recheck clearance. Bearings are available in standard size .001" and .002" undersize.

5. Install a new rear main bearing oil seal in cylinder block and main bearing cap if rear main bearing was checked and/or replaced.

6. Check crankshaft end play with feeler gauge at No. 7 main bearing (Fig. 6-52). If end play is over .006, replace bearing.

CONNECTING ROD BEARINGS-REMOVE AND REPLACE

Connecting rod bearing inserts are available in standard size and undersizes of .001 and .002". These bearings are not shimmed and when clearances become excessive the next undersized bearing insert should be used. DO NOT FILE ROD OR ROD CAPS.

REMOVE

1. Remove oil pan. (See Oil Pan-Remove and Replace.)

2. Rotate crankshaft as necessary to bring crankpin carrying bearing to be replaced straight toward bottom of block.

3. Remove bearing cap.

4. Install connecting rod bolt guide set J 5239 on connecting rod bolts. Push piston and rod assembly up far enough to remove upper bearing.

5. Remove bearings from cap and rod.

6. Inspect crankpin for damage, out-of-round and taper.

REPLACE

1. Reassemble cap and rod with new bearings and check clearance with Plastigage, or equivalent, as outlined below.

2. Install oil pan using new gaskets and seals.

PLASTIGAGE METHOD (OR EQUIVALENT) OF DETERMINING CONNECTING ROD BEARING CLEARANCE

1. Remove cap of bearing to be checked. Wipe the bearing and the crankpin free of oil.

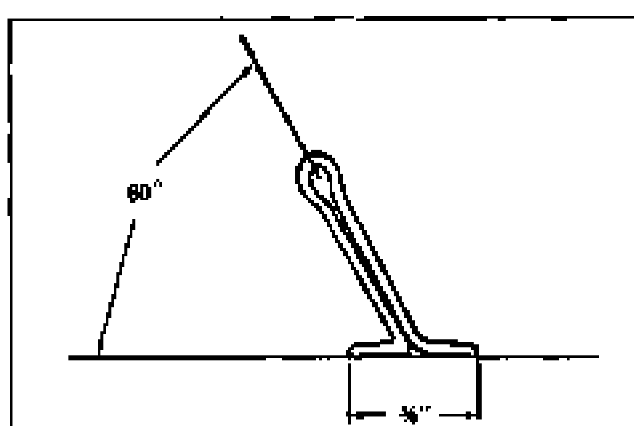


Fig. 6-47 Tool For Removing Upper Half of Main Bearing

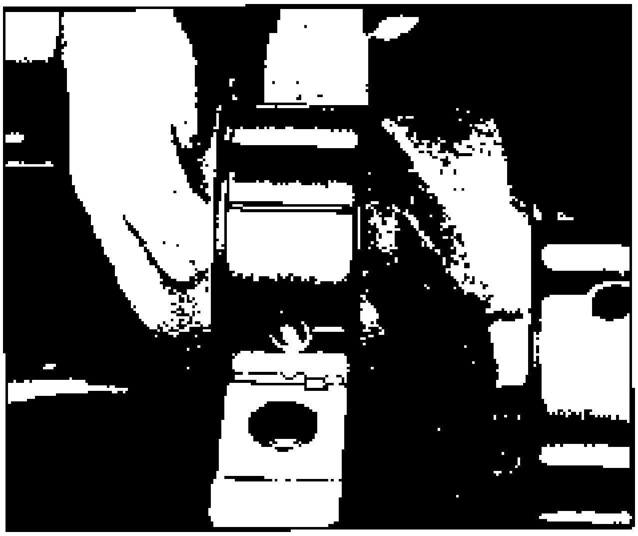


Fig. 6-48 Plastigage (or equivalent) in Place

2. Place a piece of Plastigage, or equivalent, the length of bearing (parallel to crankshaft), on the crankpin or bearing surface (Fig. 6-48). Install the cap and tighten cap bolts to 33 lb. ft.

NOTE: Do not turn crankshaft with Plastigage, or equivalent, in place.

3. Remove bearing cap and using Plastigage scale, or equivalent, on envelope measure width of compressed Plastigage, or equivalent, before removing it from the crankpin or bearing (Fig. 6-49). If bearing clearance is between .0005" and .0028", clearance is satisfactory. If clearance is more than .0028", replace bearing with next size undersize bearing and recheck clearance. Bearings are available in .001", and .002" undersize.

4. Rotate the crankshaft after bearing adjustment to be sure bearings are not tight.

5. Check connecting rod end clearance between connecting rod cap and side of crankpin (Fig. 6-50). Clearance should be .008" - .014". If clearance is more than .014", replace connecting rod.

CONNECTING ROD AND PISTON ASSEMBLY-REMOVE AND REPLACE

REMOVE

1. Remove rocker arm cover.

2. Disconnect fuel line and vacuum lines at carburetor.

3. Remove cylinder head, intake and exhaust manifolds as an assembly.

4. Remove ring ridge using a suitable ring ridge remover (Fig. 6-51).

5. Remove oil pan.

6. Check connecting rod and piston for cylinder number identification and if necessary, mark them.

7. Remove bearing cap and install connecting rod bolt guide set J 5239

8. Carefully remove connecting rod and piston assembly by pushing out with knurled handle of long guide.

CONNECTING ROD AND PISTON-DISASSEMBLE

NOTE: Use care at all times when handling and servicing connecting rods and pistons. To prevent possible damage to these units, do not clamp rod or piston in vise since they may become distorted. Do not allow pistons to strike against one another, against hard objects or bench surfaces, since distortion of piston contour or nicks in the soft aluminum material may result.

Step A (Fig. 6-53)

1. Remove piston rings using J 8021.

2. Install J 9510-5 pilot on piston pin

3. Place spring and J 9510-2 into base J 9510-1 and index J 9510-2 with piston pin.

4. Place spring and J 9510-2 as a guide, press piston pin out approximately 1/4".

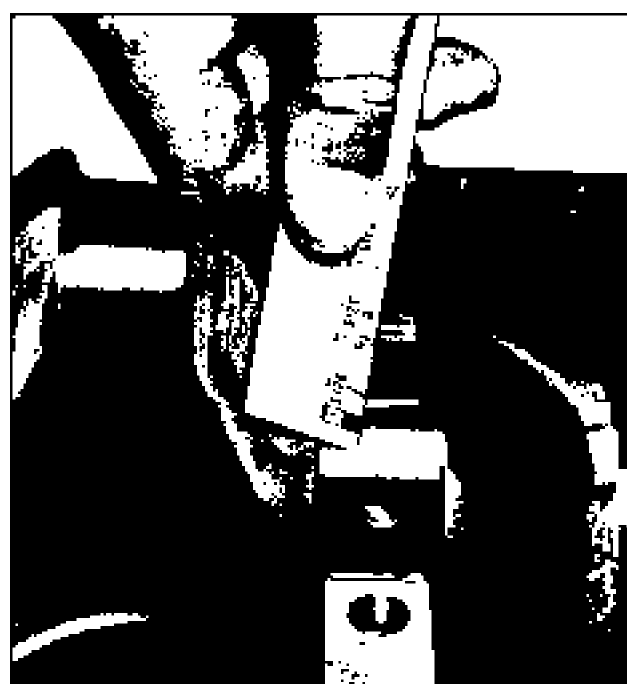


Fig. 6-49 Measuring Plastigage (or Equivalent)

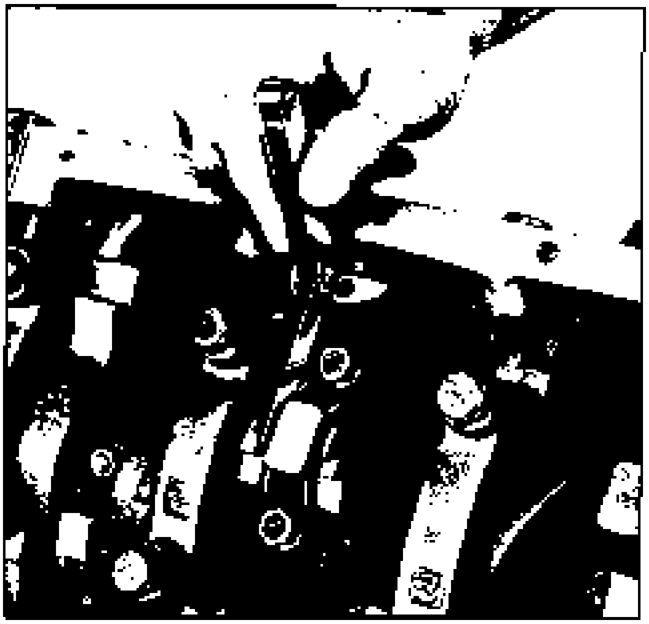


Fig. 6-50 Checking Connecting Rod Side Clearance

Step B (Fig. 6-54)

1. Remove J 9510-2 and spring from support J 9510-1.

2. Press piston pin rest of way out of piston.

CONNECTING ROD AND PISTON-CLEAN AND INSPECT

1. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

2. Clean piston pin, rod, cap, bolts and nuts in suitable solvent. Reinstall cap on connecting rod to assure against subsequent mixing of caps and connecting rods.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; and scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

4. Inspect piston pin for scoring, roughness, or uneven wear and proper fit.

5. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is assembled.

PISTON PIN FIT

The piston pin fit in piston is .0003" to .0005" loose with pin and bosses clean and dry.

NOTE: Piston and pin must be at room temperature when checking fit and pin must be able to fall from piston by its own weight (Fig. 6-55).

Piston pins are available separately in .001 and .003 oversizes. If the pin fit becomes loose it should be replaced with a new oversized pin.

CYLINDER BORES-INSPECT

Inspect cylinder bores for out-of-round or excessive taper with an accurate cylinder gauge J 8087 or comparable, at top, middle and bottom of bore. (Fig. 6-56). Measure cylinder bore parallel and at right angles to the centerline of the engine to determine out-of-round. Variation in measure from top to bottom of cylinder indicates the taper in cylinder. Fig. 6-57,

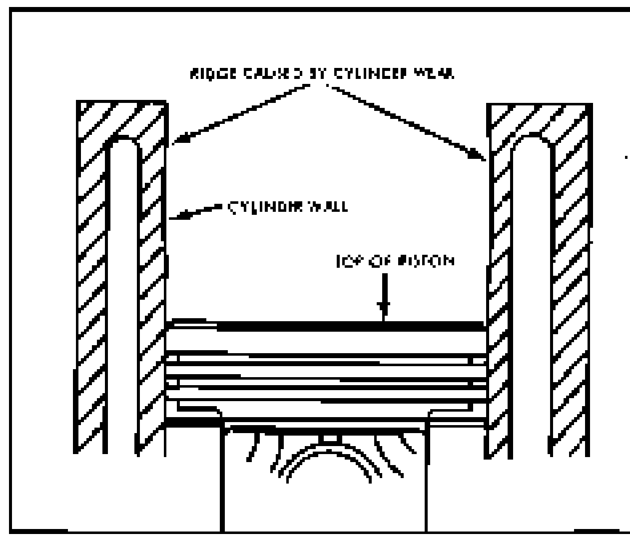


Fig. 6-51 Cylinder Ring Ridge

Fig. 6-52 Checking Crankshaft End Play

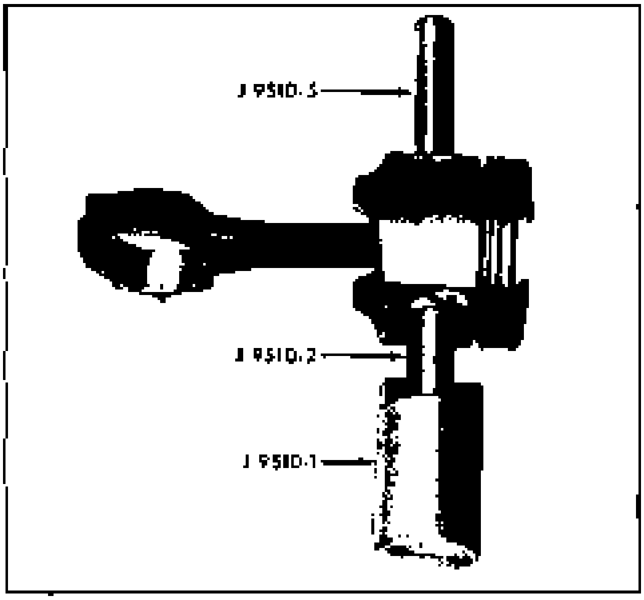


Fig. 6-53 Removing Piston Pin-Step A

although exaggerated, illustrates area in cylinder where normal wear occurs. Cylinder bores can be measured by setting cylinder gauge dial at zero in the cylinder at the point of desired measurement. Lock dial indicator at zero before removing from cylinder, and measure across gauge contact points with outside micrometer, with the gauge at same zero setting when removed from the cylinder (Fig. 6-58)

Take several measurements parallel and at right angles to the crankshaft, between 1/2" and 4" from

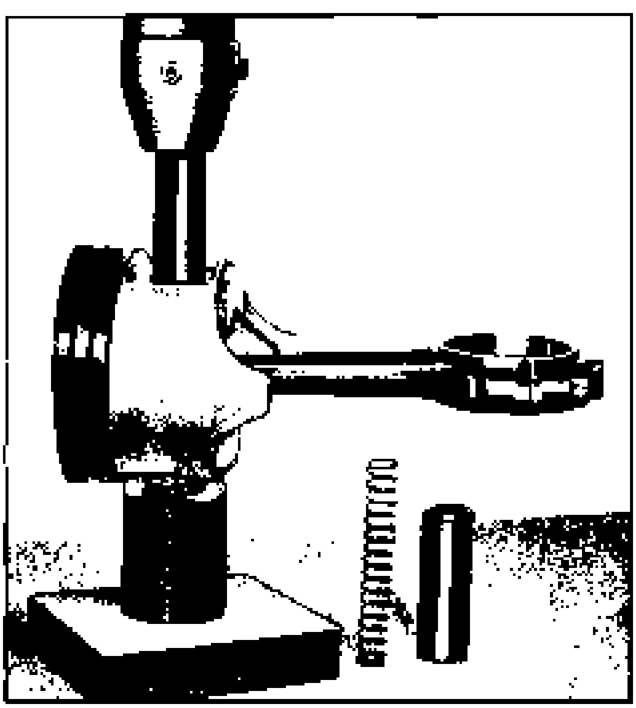


Fig. 6-54 Removing Piston Pin-Step B

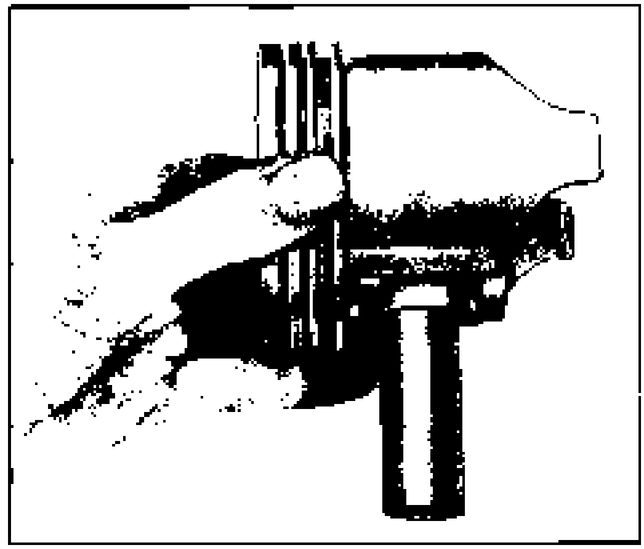


Fig. 6-55 Checking Piston Pin Fit

the top of the cylinder. Subtract the smallest measurement found from the largest. If this figure exceeds .0006", a piston cannot be fitted properly, and the cylinder must be honed. New rings and a new oversized piston must be fitted.

Fine vertical scratches made by ring ends will not cause excessive oil consumption, therefore, honing to remove is unnecessary.

HONING OR BORING

If a piston in excess of .005" oversize is to be installed, cylinder should be bored, rather than honed, to effect a true bore.

To eliminate the possibility of honing taper into the cylinder, full strokes of the hone should be made in addition to checking measurement at top, middle and bottom of bore repeatedly.

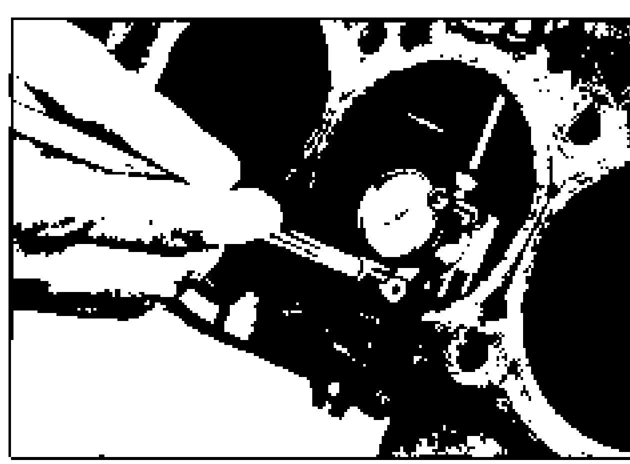


Fig. 6-56 Measuring Out of Round Taper

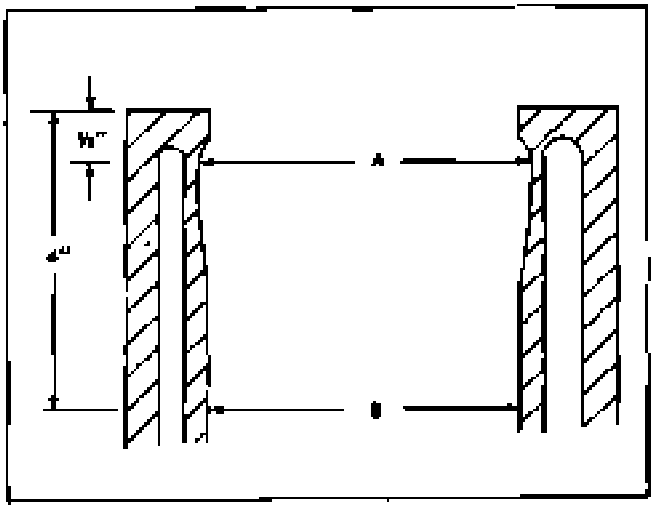


Fig. 6-57 Normal Cylinder Wear Pattern

When boring, always be sure crankshaft is out of way of boring cutter when boring each cylinder. Crankshaft bearings and other internal parts must be covered or taped to protect them during d boring or honing operation. When taking final cut with a boring bar, leave .001" on the diameter for finish honing to give required piston to cylinder clearance specifications.

NOTE: Honing or boring operation must be done under close supervision so that specified clearance between pistons, rings, and cylinder bores is maintained.

By measuring the piston to be installed at sizing points (Fig. 6-59) and adding the means of clearance specification, the finish hone cylinder measurement can be determined. It is important that both block and piston be measured at normal room temperature, 60°-90°F.

After final honing and before piston is checked for fit, each cylinder bore must be thoroughly cleaned. Use

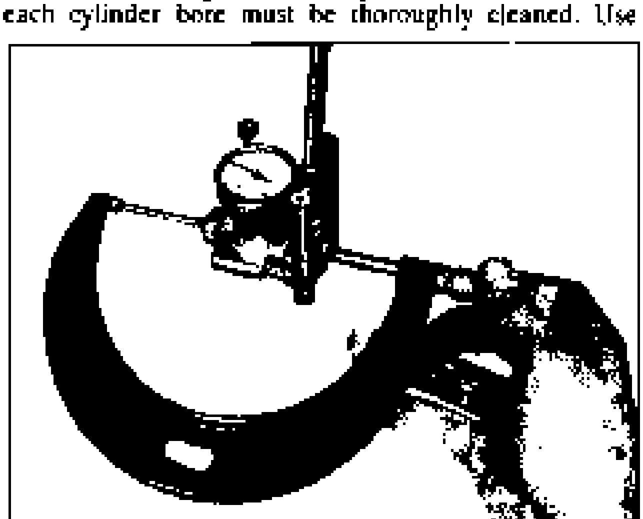


Fig. 6-58 Measuring Cylinder Gauge

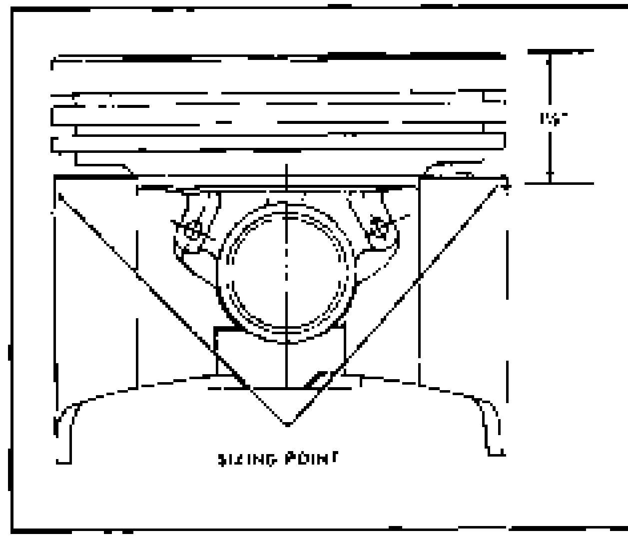


Fig. 6-59 Piston Sizing Points

soapy water solution and wipe dry to remove all traces of abrasive. If all traces of abrasive are not removed, rapid wear of new rings and piston will result.

Intermixing different size pistons has no effect on engine balance as all Pontiac pistons from standard size, up to .030" oversize, weigh exactly the same. Pontiac does not recommend boring beyond .010" during warranty period so that if necessary, engine can be serviced at high mileage without cylinder block replacement.

PISTON-FIT AND REPLACE

Pistons should be fitted in bores by actually measuring fit. Clearance between the piston and the cylinder bore should be .0022" to .0028".

If cylinder bores have been reconditioned or if pistons are being replaced, reconditioning of bores and fitting of pistons should be closely coordinated.

If bore has been honed, it should be washed thoroughly with hot soapy water and stiff bristle brush.

Using a cylinder checking gauge, measure the cylinder bore crosswise of block to find smallest diameter. Record smallest diameter of each bore.

NOTE: When measuring cylinder bores and pistons, it is very important that block and pistons be at room temperature. If any or all parts are hotter or colder than normal room temperature, improper fitting will result.

Measure piston skirt perpendicular to piston pin boss (piston pin removed) at sizing point indicated in Fig. 6-59.

Make sure the micrometer is in full contact.

As pistons are measured they should be marked for size identification and measurements recorded.

If there is excessive clearance between a cylinder bore and piston which was installed in that bore, a new piston should be used.

New pistons are serviced in standard size and .001", .002", .005", .010", .020" and .030" oversize.

NOTE: Since these are nominal or basic sizes, it is important that new pistons be measured to ensure proper fit. All new pistons are serviced with selectively fitted piston pins.

After all measurements have been made, match new pistons with cylinders where they will fit with proper clearance. Honing cylinder bore may be necessary to effect a proper fit. When properly mated, mark pistons with cylinder numbers they fit so they will not become mixed.

CONNECTING ROD TO PISTON - ASSEMBLE

There is a notch cast in top of all piston heads to facilitate proper installation. The piston assemblies should always be installed with notch toward front of engine.

1. Lubricate piston pin holes in piston and connecting rod lightly with graphite lubricant.

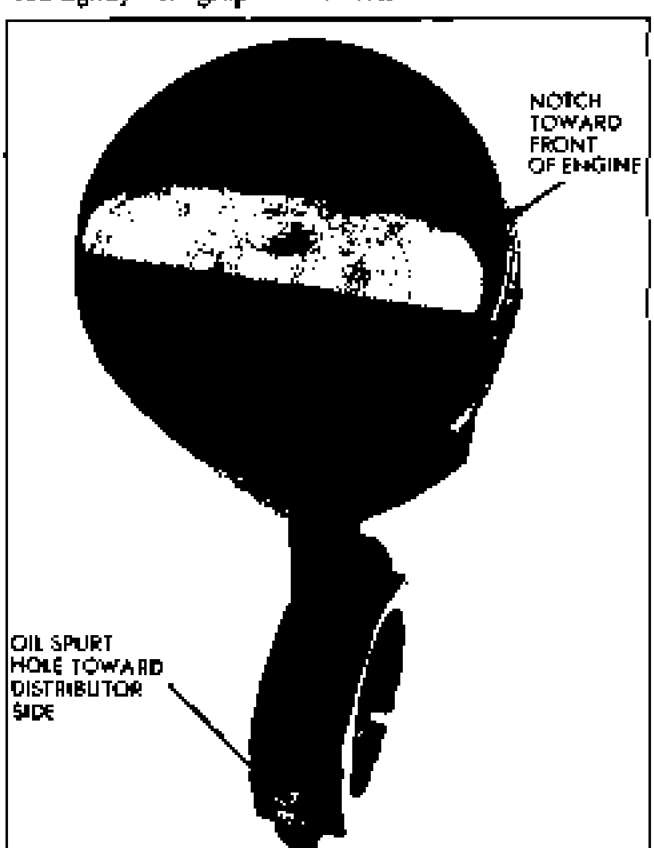


Fig. 6-60 Piston and Rod Assembly

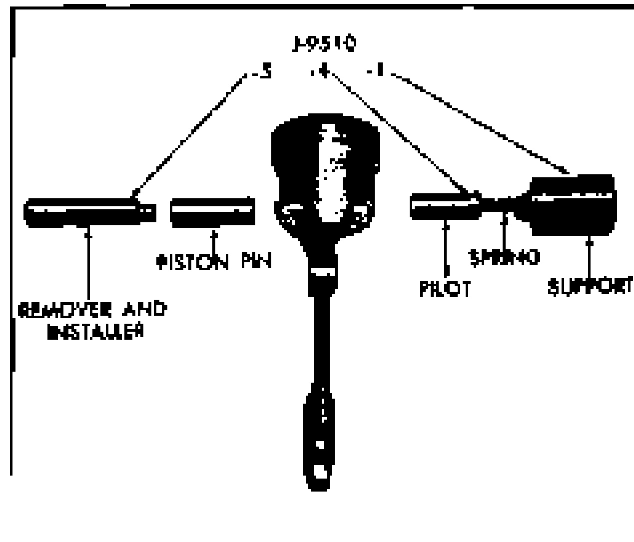


Fig. 6-61 Piston Pin Replacement

2. Position connecting rod in its respective piston so that oil squirt hole faces toward distributor side of engine, Fig. 6-60.

3. Install piston pin on installer and pilot spring and pilot (J 9510-4) in support (Fig. 6-61). Use piston pin removing and installing tool J 9510.

4. Install piston and rod on support, indexing pilot through piston and rod.

5. Place support on arbor press, start pin into position and press on installer until pin pilot bottoms.

6. Remove installer and support assembly from piston and connecting rod assembly.

7. Check piston pin for freedom of movement in piston bore.

PISTON RINGS - REPLACE

1. Remove connecting rod and piston assembly (see CONNECTING ROD AND PISTON ASSEMBLY - REMOVE AND REPLACE in this section).

2. Remove piston rings using J 8021.

3. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

4. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

5. Inspect bearing shells to see that they are service-

able. Fit of bearings should be checked when engine is being assembled.

6. Inspect cylinder bores for out-of-round or excessive taper. See CYLINDER BORES - INSPECT.

PISTON RINGS - INSTALL

Two compression rings and one 3-piece oil control ring, all above piston pin, are used on pistons for both standard and premium fuel engines. The compression rings are taper faced and also have either a step or a chamber on the inside diameter of the bottom side. The top compression ring is molybdenum filled, which results in the center section of the ring sealing edge appearing porous or grainy. The lower compression ring is lubrite finished (black).

Always install compression rings with the stamped markings toward the top of the piston.

New rings are serviced for the standard size pistons, and for .005", .010", .020" and .030" oversize pistons. When selecting rings be sure they match size of piston on which they are to be installed, i.e. standard rings for standard pistons, .010" oversize rings for .010" oversize pistons, etc. Ring gap and side clearance should be checked while installing rings as follows:

1. Check pistons to see ring grooves and oil return holes have been properly cleaned.

2. Place ring down at bottom of ring traveled part of cylinder bore in which it will be used. Square ring in bore by pushing it into position with head of piston.

3. Measure gap between ends of ring with feeler gauge (Fig. 6-62). Gaps should be as follows:

Fig. 6-62 Checking Ring Gap

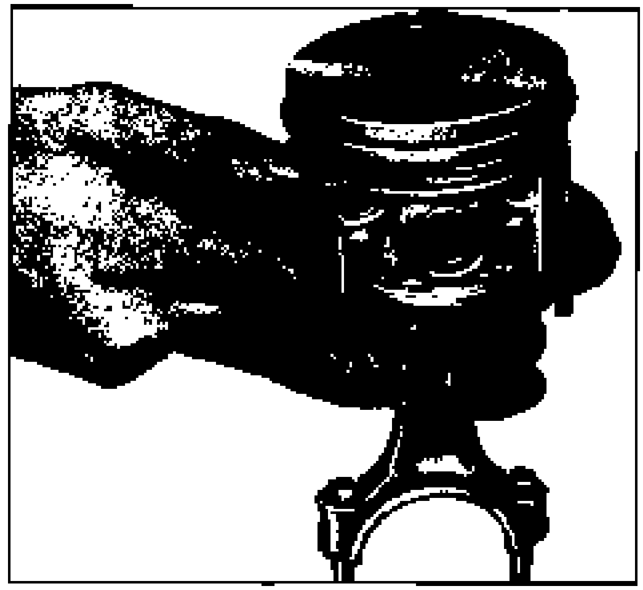


Fig 6-63 Checking Ring Side Clearance

Compression Rings .... .005"-.025"
Oil Ring .... .005"-.055"

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore (standard .005", oversize, etc.) they should have proper gap. It should not be necessary to alter ring gap by filing.

4. Install rings on piston using J 8021 to prevent breakage or fracture of rings, or damage to pistons.

5. Measure side clearance of rings in ring groove (Fig. 6-63) as each ring is installed. Clearance with new pistons and rings should be .0015-.0050.

If side clearance is excessive, piston should be replace.

CONNECTING ROD AND PISTON ASSEMBLY - REPLACE

1. Install connecting rod bolt guide set J 5239 on connecting rod bolts (fig. 6-64).

2. Using piston ring compressor J 6647, insert rod and piston assembly into cylinder so notch in top of piston is facing front of engine (Fig. 6-65).

3. From beneath engine, pull connecting rod with bearing into place against crankpin.

4. Remove guide set J 5239 and install bearing cap. Tighten cap nuts to 33 lb. ft.

5. Install oil pan.

6. Install cylinder head, intake and exhaust manifold as an assembly.

7. Connect fuel line and vacuum lines to carburetor.

8. Install rocker arm cover.

CRANKSHAFT - REMOVE AND REPLACE

REMOVE

1. Remove engine from vehicle.

2. Remove clutch from engine.

3. Mount engine on suitable stand.

4. Remove spark plugs.

5. Remove fan and fan pulley.

6. Remove harmonic balancer.

7. Remove oil pan and crankcase front cover.

8. Remove connecting rod bearing caps with bearings and identify each for reinstallation.

9. Push connecting rod and piston assemblies away from crankshaft.

10. Remove main bearing caps with bearings and identify for reinstallation.

11. Remove crankshaft.

REPLACE

1. With upper bearings installed, position crankshaft in block.

2. Using new seals in rear main bearing cap, install main bearing caps (with lower bearings), but do not tighten cap bolts.

3. Pull connecting rods (with upper bearings installed) and pistons into place.

4. Install rod bearing caps (with bearings), but do not tighten nuts.

5. With rubber mallet, hit both ends of crankshaft to center thrust bearing.

6. Tighten main bearing caps 100 lb. ft.

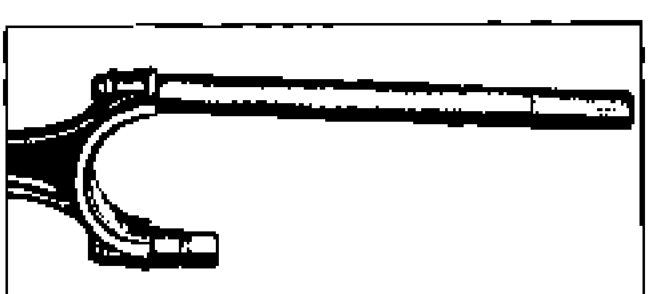


Fig. 6-64 Connecting Rod Guide Tool

7. Tighten connecting rod bearing caps 33 lb. ft.

8. Install key from old crankshaft keyway in new crankshaft.

9. Install crankcase front cover using new seal and gaskets.

10. Install oil pan.

11. Install harmonic balancer.

12. Install fan pulley and fan.

13. Install spark plugs.

14. Remove engine from stand.

15. Attach clutch to engine.

16. Install complete assembly in vehicle.

FITTED BLOCK ASSEMBLY - REPLACE

Fitted block assembly contains pistons, rings, pins and main bearing caps.

DISASSEMBLE

1. Remove engine from vehicle.

2. Remove clutch and flywheel from engine.

3. Install engine in suitable stand.

4. Remove ground straps and dipstick.

5. Remove harmonic balancer.

6. Remove front timing belt covers.

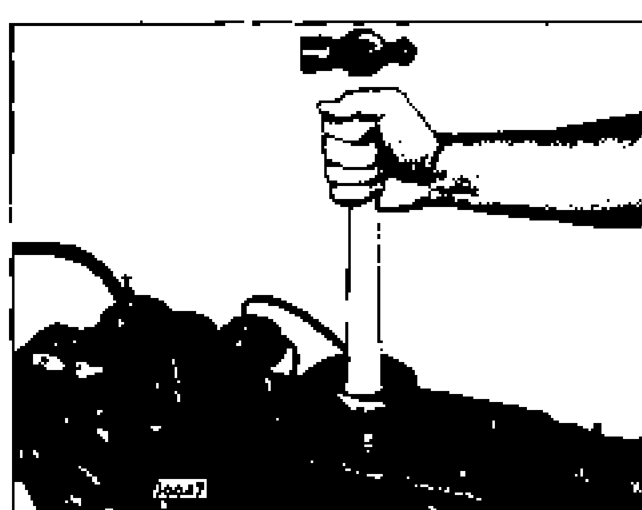


Fig. 6-65 Installing Piston in Cylinder

7. Remove fuel and oil pump housing assembly and timing belt.

8. Remove water pump.

9. Remove remaining accessory mounting brackets and engine mounts.

10. Remove rocker arm cover assembly.

11. Remove cylinder head and manifolds.

12. Remove crankshaft flange, sprocket and front crankcase cover.

13. Remove oil pan.

14. Remove oil pump pick-up tube and crankcase splash baffles.

15. Remove crankshaft.

16. Remove all connecting rod and piston assemblies and identify each connecting rod according to cylinder from which it was removed.

17. Remove connecting rods from pistons.

18 Remove old block from stand and mount new block on stand.

19. Remove new piston and pin assemblies from new block and identify each according to cylinder from which it was removed.

This completes disassembly for block assembly replacement. Use new gaskets and pay special attention to torque requirements.

ASSEMBLE

1. Assemble old connecting rods to new piston and pin assemblies according to cylinders from which they were removed.

2. Install crankshaft and plastigage main bearings.

3. Install connecting rod and piston assemblies in proper cylinders.

4. Install crankcase splash baffles and oil pump pick up tube.

5. Install oil pan.

6. Install front crankcase cover, crankshaft sprocket and flange.

7. Install cylinder head and manifolds.

8. Install rocker arm cover assembly.

9. Install accessory mounting brackets and engine mounts.

10. Install water pump.

11. Install fuel and oil pump housing assembly and timing belt.

12. Install lower front timing belt cover.

13. Install harmonic balancer.

14. Align timing marks and adjust timing belt tension.

NOTE: It will be necessary to remove distributor cap to make certain that the rotor arm points toward number one cylinder spark plug contact. See Fig. 6-7.

15. Install upper front timing belt cover.

16. Install ground straps and dipstick.

17. Remove engine from stand and install flywheel and clutch. Tighten flywheel to crankshaft bolts 60 lb. ft.

18. Install engine in vehicle.

6 CYLINDER ENGINE WRENCH TORQUE SPECIFICATIONS

NOTE: Torque in lb. ft. unless otherwise shown.

APPLICATION	TORQUE
Bolt—Main Bearing Cap to Block	100
Bolt—Rear Main Bearing Cap to Block	100
Bolt—Cylinder Head	95
Bolt—Flywheel to Crankshaft	60
Nut—Connecting Rod Bearing Cap	33
Bolt—Accessory Drive Housing to Block	15
Bolt—Fuel Pump Attaching	15
Bolt (& Nut)—Intake and Exhaust Manifold to Head	30
Bolt—Oil Pan to Block	12
Bolt—Camshaft Thrust Washer	40
Bolt—Camshaft to Sprocket	40
Spark Plug to Head	20
Bolt—Rocker Arm Cover to Head	15
Bolt—Harmonic Balancer	160

6 CYLINDER ENGINE SPECIFICATIONS

Type	In-Line 6, Overhead Cam
Bore and Stroke	$3\frac{7}{8} \times 3\frac{17}{32}$
Displacement	250 cu. in.
Taxable Horsepower	36.0

6 CYLINDER ENGINE SPECIFICATIONS—Continued

HORSEPOWER AND TORQUE

ENGINE	CARBURETOR	COMPRESSION RATIO	HORSEPOWER	TORQUE
250	1-Bbl.	9.0	175 @ 4800	240 @ 2600
250	Q'Jet	10.5	230 @ 5400	260 @ 3600

Compression Pressure at Cranking Speed:	
1 Bbl.	150-170 PSI @ 155-165 RPM
Q'Jet	185-205 PSI @ 155-165 RPM
Firing Order	1-5-3-6-2-4
Engine Number Location	Pad Behind Oil Filler Neck
Cylinder Nos.—Front to Rear	1-2-3-4-5-6
Cylinder Block	
Material	Alloy Cast Iron
Installation Angle	4°19'
Cylinder Head	
Material	Alloy Cast Iron
Combustion Chamber	Wedge Type-Fully Machined
Pistons	
Material	Tin-Plated Aluminum Alloy
Type	Cam and Contour Ground-Slipper Skirt
Measurement Taken At	Top of Skirt
Clearance in Cylinder	.0022"-.0028"
Piston Rings	
Compression Rings	Two Cast Iron, Reverse Twist, Barrel Face Moly Channel
Material—Upper	Channel Moly Filler
—Lower	Lubrite Finish
Oil Ring	Three-Piece
Material—Rails (2)	Chrome Plated Steel
—Expander	Stainless Steel
Ring Gap	
Compression	.015"
Oil	.035"
Side Clearance (Ring to Groove)	.0015"-.005"
Piston Pin	
Material	Extruded SAE 5015 Steel
Diameter	.9272"
Wall Thickness	.37"
Length	3.00"
Fit in Piston	.0003"-.005"
Fit in Rod	Press
Connecting Rod	
Material	SAE 1037 or 1038 Steel
Weight (oz.)	20.5
Length (Center to Center)	5.70"

Bearings
- Length .... .84"
- Clearance .... .0005"-.0028"
- Material—1 Bbl. .... Moraine 100-A
- —Q'Jet .... Moraine 400-A

Endplay on Crankshaft .... .008"-.014"

Crankshaft
- Material .... Nodular Iron
- No. of Bearings 7
- Main Bearing Material—1 Bbl. .... Durex 100-A
- —Q'Jet .... Moraine 400
- Thrust Taken On .... No. 7
- Crankshaft Endplay .... .002"-.006"
- Journal Diameter .... 2.30"
- Main Bearing Length—1-6 .... .80"
- —Rear .... 1.01"
- Clearance .... .0003"-.0020"
- Crankpin Diameter .... 2.00"

Flywheel and Sprockets
- Flywheel—Material—Manual .... Cast Iron
- —Automatic .... Stamped Steel
- —No. of Teeth 155
- Starter Motor Drive—No. of Teeth 9
- Crankshaft Sprocket—Material .... Hardened Cast Iron
- —No. of Teeth 19
- Camshaft Sprocket—Material .... Hardened Cast Iron
- —No. of Teeth 38
- Timing Chain .... Neoprene Belt with Fiber Glass Cord Reinforcement
- —No. of Teeth 98
- Harmonic Balancer .... Cast Iron Weight with Rubber Floated Cast Pulley

Camshaft
- Material .... Hardened Alloy Cast Iron
- Bearings—Number 7
- —Type .... Integral with Aluminum Cover
- —Diameter—All .... 2.22"

Valve System
- Valve Lifter .... None
- Lash Taken Up By .... Stationary Hydraulic Lash Adjuster
- Leak-Down Rate .... 34 Sec. Min. With 50 Lb. Load
- Plunger Travel (For Gauging Purposes) .... .125"
- Pushrod .... None
- Rocker Arm—Type .... Cam Follower
- —Material .... Hardened Alloy Cast Iron
- —Ratio 1.5:1
- Rocker Arm Pivot Point .... Lash Adjuster

Timing

—Camshaft			1-Bbl.	Q'Jet (A.T.)	Q'Jet (M.T.)
—Intake	Opens	(BTC) (DEG)	14	14	22
	Closes	(ABC) (DEG)	46	50	58
	Duration	(DEG)	240	244	260
	Lift	(IN)	.400"	.438"	.438"
—Exhaust	Opens	(BBC) (DEG)	46	52	60
	Closes	(ATC) (DEG)	14	12	20
	Duration	(DEG)	240	244	260
	Lift	(IN)	.400"	.438"	.438"
—Valve Overlap		(DEG)	28	26	42

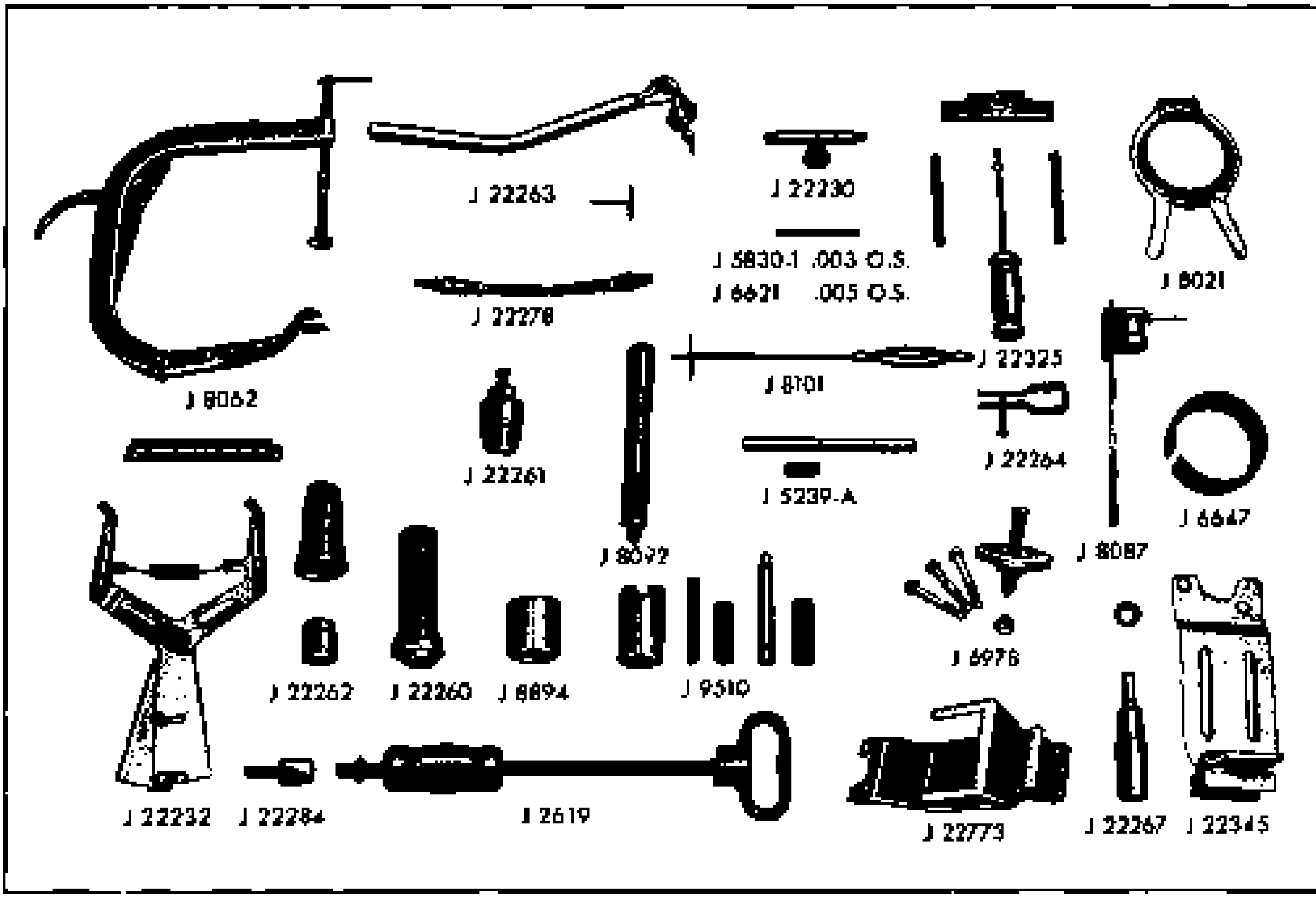
	1-Bbl.	Q'Jet
Valve Springs		
Pressure @ Length	PSI	PSI
Outer	164-175 @ 1.233"	116-128 @ 1.103"
	94-100 @ 1.663"	62-68 @ 1.633"
Inner	—	58-64 @ 1.173"
	—	29-35 @ 1.613"

Valves
- Material—Intake 4 Bbl. . . . GM 8440 Steel and Aluminized Face and Chrome-Plated Stem
- Material—Intake 1 Bbl. . . . GM 8440 Steel with Aluminized Face and Chrome-Plated Stem
- —Exhaust . . . 21-2N Steel with Aluminized Face and Chrome-Plated Stem
- Diameter of Head—Intake . . . 1.92"
- —Exhaust . . . 1.60"
- Overall Length—Intake—1 Bbl. . . . 4.81"
- —Q'Jet . . . 4.90"
- —Exhaust—1 Bbl. . . . 4.80"
- —Q'Jet . . . 4.89"
- Diameter of Stem . . . .34"
- Stem to Guide Clearance—Intake . . . .0016"-.0033"
- —Exhaust . . . .0021"-.0038"
- Valve Seat Angle—Intake . . . 46°
- —Exhaust . . . 46°
- Valve Face Angle—Intake . . . 45°
- —Exhaust . . . 45°

Lubrication System
- Type of Lubrication—Main Bearings . . . Pressure
- —Connecting Rods . . . Pressure
- —Piston Pins . . . Splash
- —Camshaft Bearings . . . Pressure
- —Lash Adjusters and Cam Followers . . . Pressure
- —Timing Gears and Belt . . . None
- —Cylinder Walls . . . Metered Jet
- Oil Pump—Type . . . Spur Gear—Externally Mounted
- —Oil Pickup . . . Stationary Screen
- —Pressure . . . 26-36 PSI @ 2800 rpm
- Oil Capacity . . . 4½ Qts.
- —With Filter . . . 5 Qts.

Fuel System
- Fuel Pump Pressure (PSI) . . . 4.5-5.5
- Fuel Filter . . . Pleated Paper in Carburetor Inlet
- Carburetor—Type—1 Bbl. . . . Rochester Monojet
- —4 Bbl. . . . Rochester Quadrajet
- —Barrel Size—1 Bbl. . . . 1.75"
- —Q'Jet . . . 1.38 Primary, 2.25 Secondary

Cooling System
- Radiator Cap Pressure (PSI) . . . 14-17
- Thermostat Opens At . . . 190°F
- Water Pump Rate (GPM) . . . 16



J 2619 Camshaft Puller
J 5239-A Connecting Rod Bolt Guide Set
J 5830 Valve Guide Reamer
J 6621 Valve Guide Reamer
J 6647 Piston Ring Compressor
J 6978 Harmonic Balancer Puller
J 8021 Piston Ring Remover and Installer
J 8062 Valve Spring Compressor
J 8087 Cylinder Bore Gauge
J 8092 Camshaft Rear Bore Plug Installer
J 8101 Valve Guide Cleaner
J 8894 Adapter—Bore Plug Installer
J 9510 Piston Pin Remover and Installer Set
J 22230 Valve Seal Installer and Tester
J 22232 Timing Belt Adjustment Fixture
J 22260 Crankshaft Front Cover Seal Installer
J 22261 Camshaft Oil Seal Remover
J 22262 Camshaft Oil Seal Installer
J 22263 Valve Spring Compressor
J 22264 Bearing and Seal Remover—Housing
J 22267 Bearing and Seal Installer—Housing
J 22278 Adapter—Air Line
J 22284 Adapter—Camshaft Remover
J 22325 Main Bearing Cap—Remover and Installer
J 22345 Engine Lifting Tool—Tempest
J 22773 Engine Lifting Tool—Firebird

Fig. 6-66 6 Cylinder Special Engine Tools

V-8 ENGINE—SERVICE

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

V-8 engine is standard equipment on Pontiac, Grand Prix and G.T.O. models, and optional on all Firebird and Tempest models. The optional Tempest V-8 has displacement of 350 cubic inches with 3 7/8" bore and 3 3/4" stroke. This engine is available in two compression ratios: 9.2:1 and 10.5:1.

A 400 cubic inch V-8 engine is standard on the G.T.O., Grand Prix and all Pontiacs except Bonneville. This engine has 4.120" bore and 3 3/4" stroke and is available in three compression ratios: 8.6:1, 10.5:1 and 10.75:1.

Both the 350 and 400 cubic inch V-8 engines are optional on the Firebird model.

A large valve 428 cubic inch V-8 engine is standard on all Bonneville models (with manual transmission) and the Grand Prix "SJ". The large valve 428 cubic inch V-8 engine is optional on all other Pontiac models, as well as the Bonneville with automatic transmission. A small valve version of the 428 cubic inch engine is standard on Bonneville models with automatic transmission. These engines have a 4.120" bore and 4" stroke. The compression ratio is 10.5:1 with a 428 high output engine, optional on all Pontiacs and the Grand Prix, at 10.75:1.

CYLINDER BLOCK

The cylinder block used for 400 and 428 engines has three core hole plugs on each side and is more rigid with improved machining. Cylinder blocks for the 350, 400 and 428 engines are shown in Figs. 6-67, 6-68.

Except for the small valve 428 engine standard in Bonneville models with automatic transmission, all 428 cubic inch and 400 cubic inch Ram-Air engines have four attaching bolts in the three center main bearing caps as compared to two bolts per cap in other engines. The standard Bonneville small valve 428 cubic inch engine also has only 2 attaching bolts. Fig. 6-68 shows the four-bolt cap installation.

CYLINDER HEAD

Two types of cylinder heads differing in valve sizes and valve seat angle are used (Figs. 6-69 and 6-70). Both types have fully machined combustion chambers. Valve guides are cast integral with the cylinder head and valve heads are surrounded by water jackets.

All small valve cylinder heads are new for 1969. The small valve cylinder heads in each cubic inch displacement have been redesigned to reflect the use of revised valve face angles. The valve seat angle in the head has

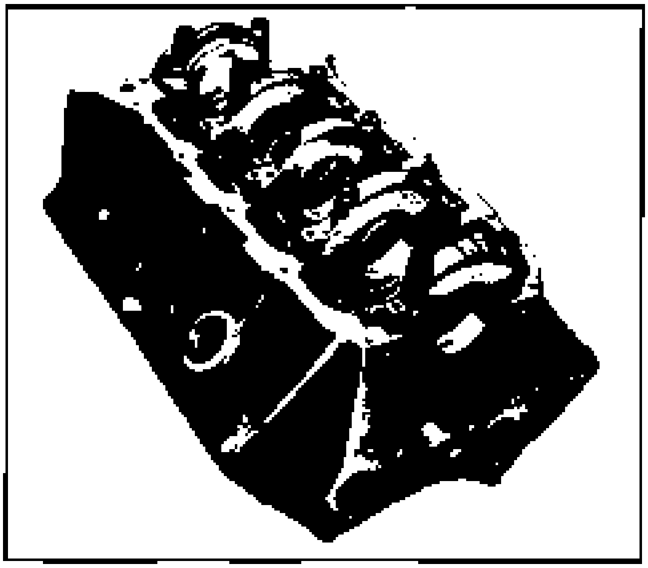


Fig. 6-67 Cylinder Block - 350, 400 and 428 Bonneville Engines

been revised to 45° for increased durability and efficiency. Some early 1969 engines will, however, still retain the 30° seat angle.

CAMSHAFT AND DRIVE

Six different camshafts are used. The engine charts (Figs. 6-1, 6-2 and 6-3) show the application of each. Camshafts can be identified by a letter stamped on the front end of the shaft.

PISTONS AND CONNECTING RODS

The pistons used in all compression ratio engines are flat on top as shown in Fig. 6-71. The top of the piston has a relief machined into it for valve clearance.

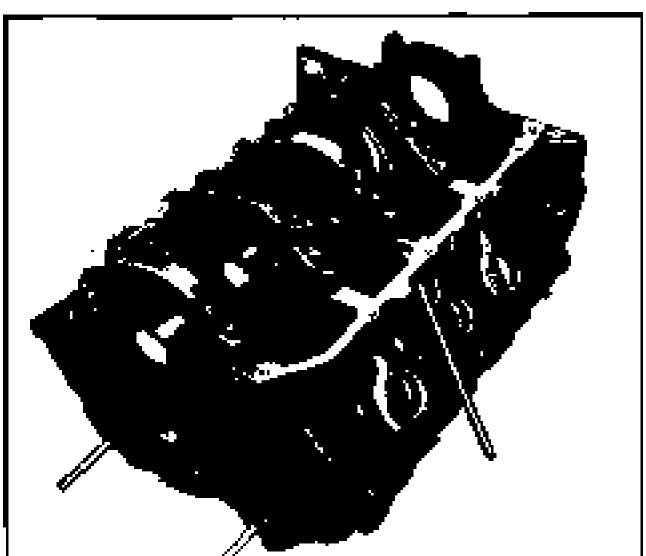


Fig. 6-68 Cylinder Block - 400 Ram Air and 428, Except Standard 428 Bonneville

Fig. 6-69 Combustion Chamber - Standard Head

VALVE TRAIN

All V-8 engines utilize the simple ball pivot-type valve train, consisting of the valve, rocker arm, push rod, and valve lifter.

All valve lifters are of the hydraulic type, except that those used in ram air engines are of the limited travel design.

Rocker studs are pressed into the cylinder head on the standard engines and are screwed in on G.T.O., Grand

Fig. 6-70 Combustion Chamber - Large Head

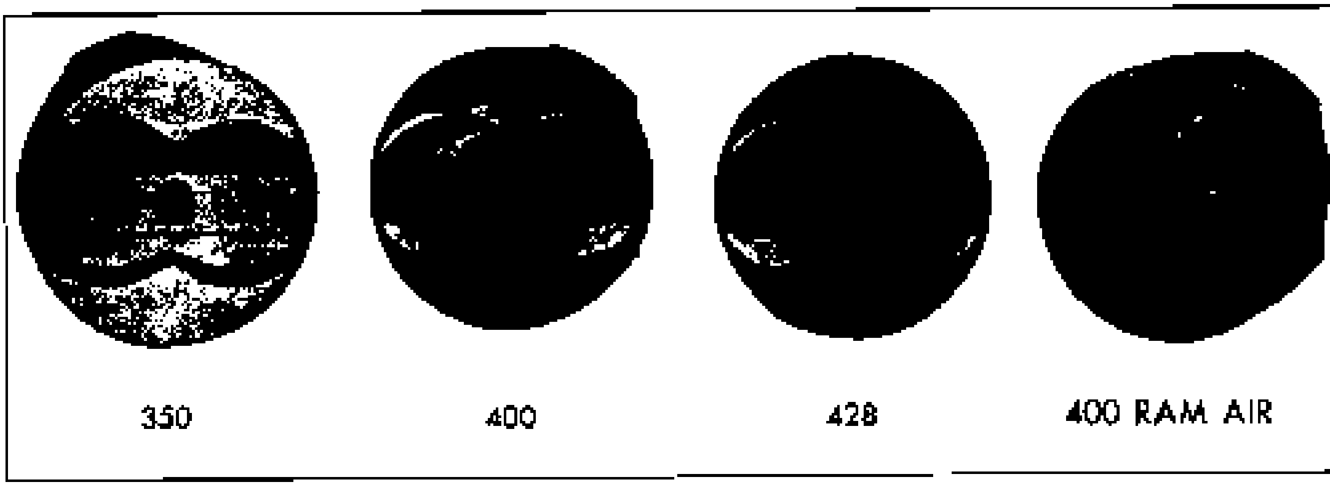


Fig. 6-71 Piston Identification

Prix, and 428. All heads use stamped steel push rod guide plates to minimize push rod guide wear (Fig. 6-72).

Umbrella type valve guide seals are used on 350 H.O., 400 H.O., 428 H.O., G.T.O. and Firebird 400 4-bbl. intake valves in addition to the "O" ring seals (Fig. 6-72).

Double valve springs are used on all engines.

PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services connected with the engine consist of tune-up, lubrication, replacing oil filter, etc. Procedures and recommendations for these services will be found in appropriate sections of this manual, and the Owner's Manual.

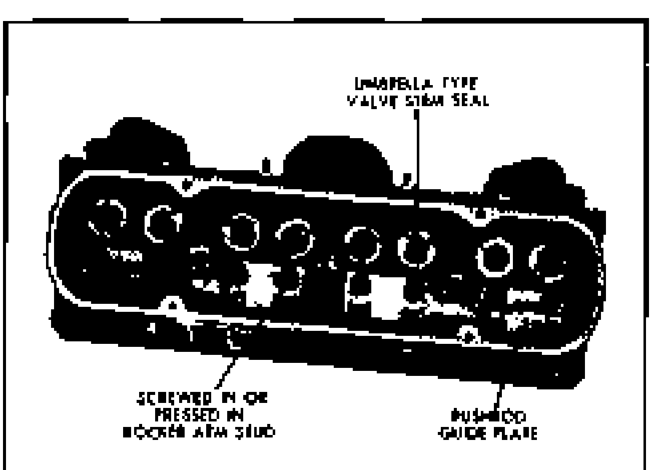


Fig. 6-72 Cylinder Head - Typical

SERVICE OPERATIONS ON CAR

ENGINE INSULATORS

PONTIAC (Fig. 6-73) AND GRAND PRIX (Fig. 6-74)

FRONT INSULATORS - REMOVE AND REPLACE

NOTE: If a new rear insulator is also to be installed, it should be installed first since the engine locates from the rear insulator.

1. Raise hood and, using J 22603 engine lifting tool, (Fig. 6-75), take weight of engine off front insulators.

CAUTION: Disconnect battery ground strap before raising engine. When engine is raised, the starting motor solenoid terminals may contact the steering gear which could energize the starting motor if ground cable is not disconnected.

2. Remove bolts fastening engine insulators to engine.

3. Remove bolt which fastens insulators to frame.

4. Raise engine just clear of insulator.

5. Remove insulator.

6. Position new insulator against engine and install attaching screws and washers. Tighten to 70 lb. ft. torque.

7. Lower engine.

8. Install frame to insulator bolt with lockwasher and plain washer and tighten to 50 lb. ft.

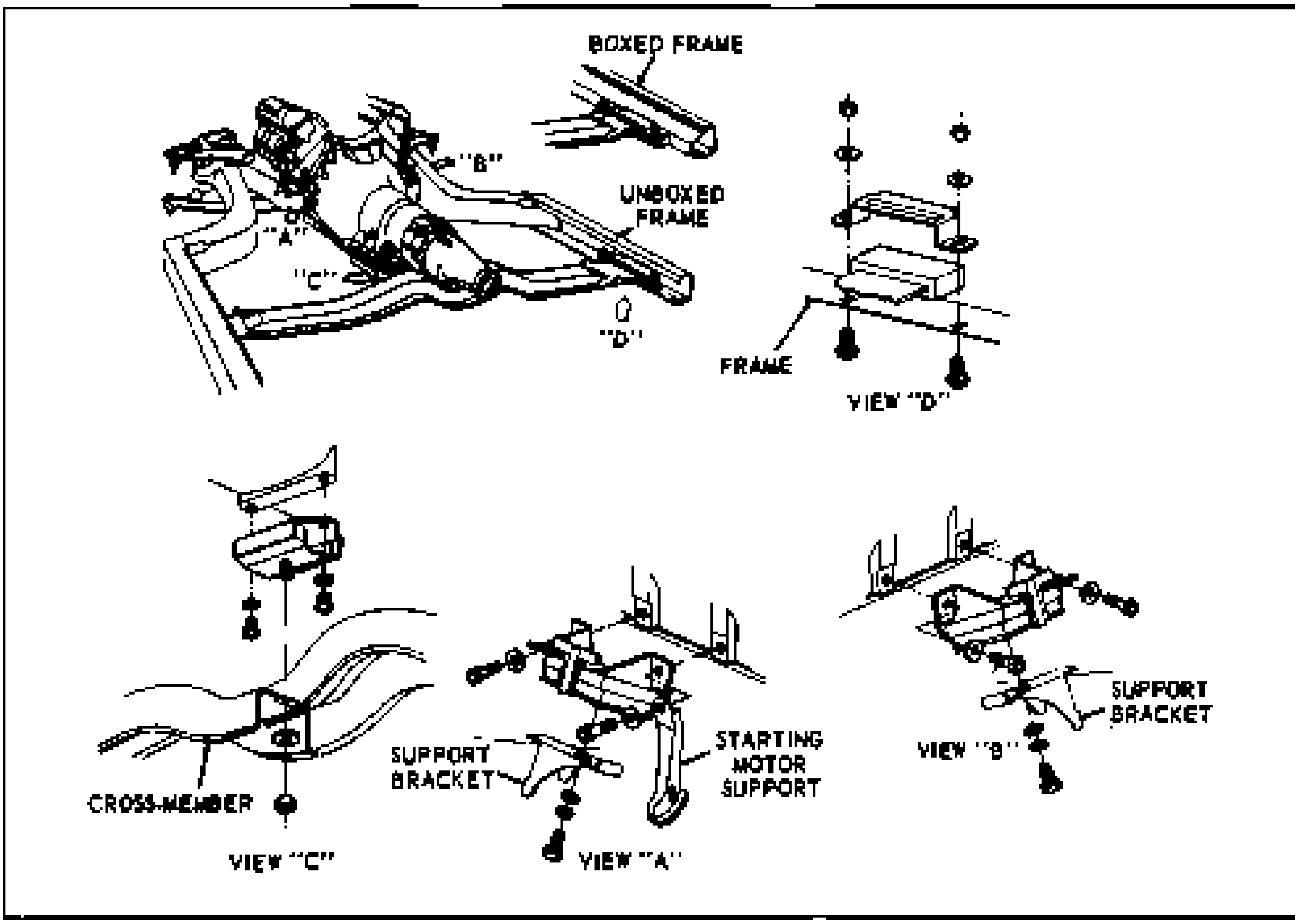


Fig. 6-73 Pontiac Engine Insulators

REAR INSULATOR - REMOVE AND REPLACE

1. Support transmission at rear to remove engine weight from rear insulator, using suitable lifting equipment.

2. Remove transmission engine rear mounting insulator lower retainer cross member support nut and raise transmission until retainer stud is disengaged from lower cross member support.

3. Remove engine rear mounting insulator upper retainer bolts from transmission extension.

4. Remove insulator assembly.

5. Install new insulator between transmission extension and cross member support.

6. Install upper retainer to transmission extension bolts. Tighten to 30 lb. ft. torque.

7. Lower transmission until lower retainer stud engages lower cross member support. Install flat washer, lockwasher and nut and tighten to 30 lb. ft. torque.

ENGINE INSULATORS TEMPEST (Fig. 6-76) AND FIREBIRD (Fig. 6-77)

FRONT INSULATORS - REMOVE AND REPLACE

1. Raise hood and, using J 22603 engine lifting tool, Fig. 6-75, take weight of engine off front insulators.

NOTE: Disconnect battery ground strap before raising engine. When engine is raised, the starting motor solenoid terminals may contact the steering gear which could energize the starting motor if ground cable is not disconnected.

2. Loosen rear insulator by removing cross member to insulator bolts and raise rear of engine.

3. Remove bolts which fasten front insulators to frame bracket.

4. Raise engine just clear of insulators.

5. Remove insulator to engine bolts and remove insulators.

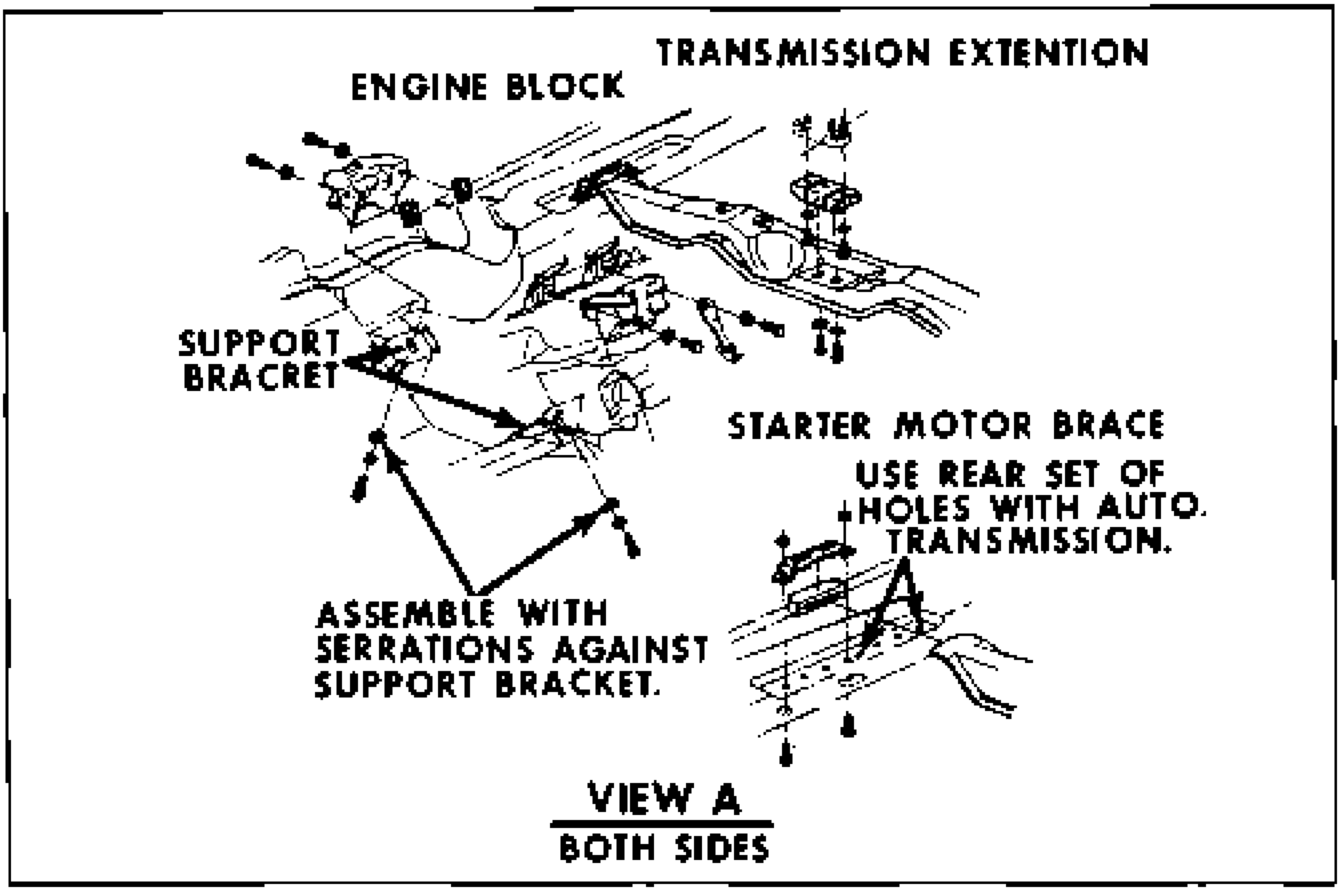


Fig. 6-74 Grand Prix Engine Insulators

6. Position new insulators against engine and install attaching bolts and washers. Tighten to 70 lb. ft. torque.

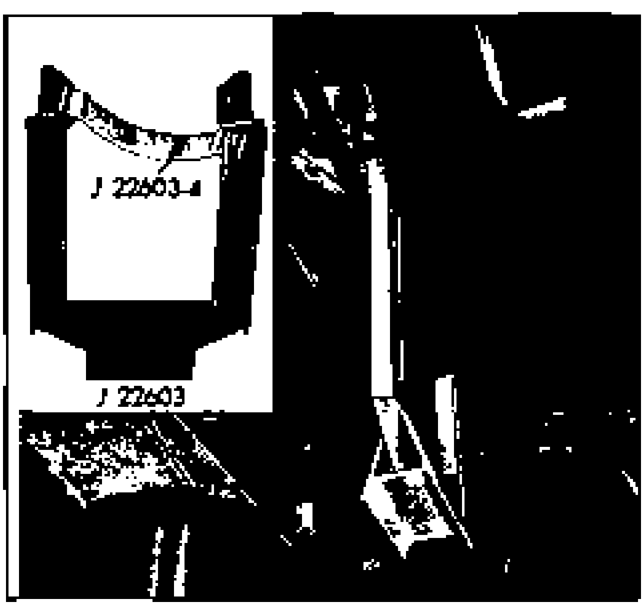


Fig. 6-75 Engine Lifting Tool Installed - Pontiac and Tempest

7. Lower engine.

8. Install frame bracket to insulator bolts with lockwashers and tighten to 30 lb. ft. torque.

9. Lower rear of engine and transmission so that rear insulator positions on cross member. Install two cross member to insulator bolts and washers and tighten to 30 lb. ft. torque.

REAR INSULATOR - REMOVE AND REPLACE

1. Remove two cross member to insulator bolts.

2. With suitable lifting equipment, raise transmission at rear to provide clearance for removing insulator to transmission housing bolts.

3. Remove two insulator to transmission bolts and remove insulator.

4. Install new insulator with two insulator to transmission housing bolts and washers and tighten to 30 lb. ft. torque.

5. Lower rear of transmission so that insulator positions are above cross member.

6. Install two cross member to insulator bolts with washers and tighten to 30 lb. ft. torque.

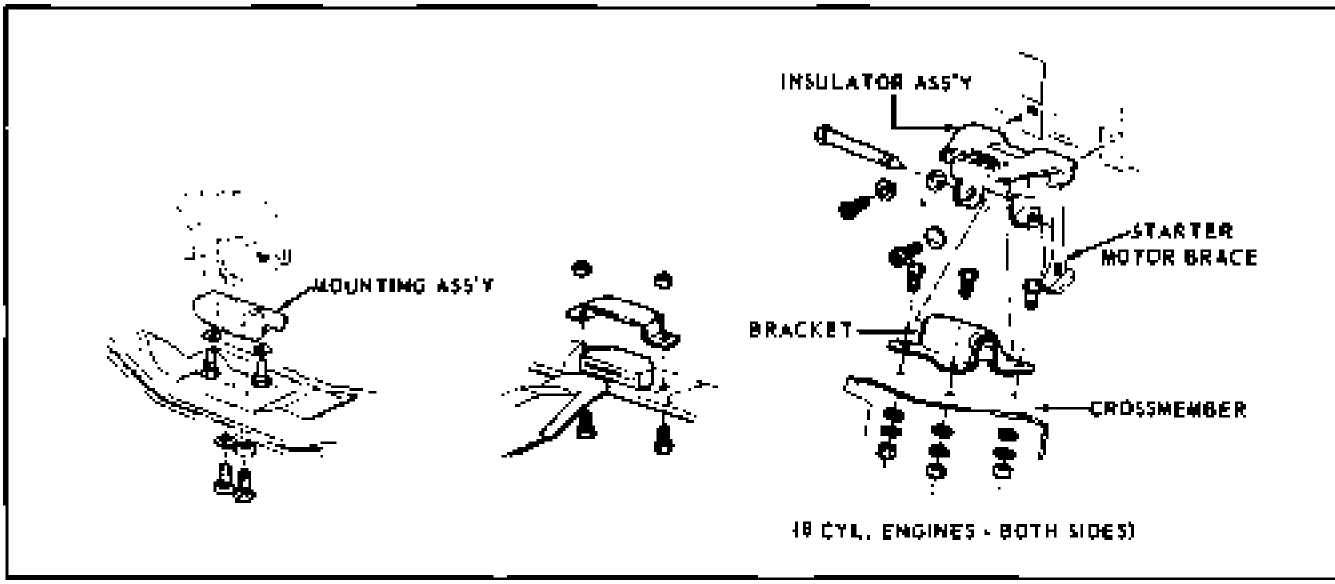


Fig. 6-76 Tempest Engine Insulators

DRIVE BELTS - ADJUST

Engine fan and accessory drive belts may be adjusted by use of the Borroughs Belt Tension gauge, or equivalent. Section 6A gives the correct specifications.

ENGINE ASSEMBLY

REMOVE

1. Disconnect battery cables at battery.

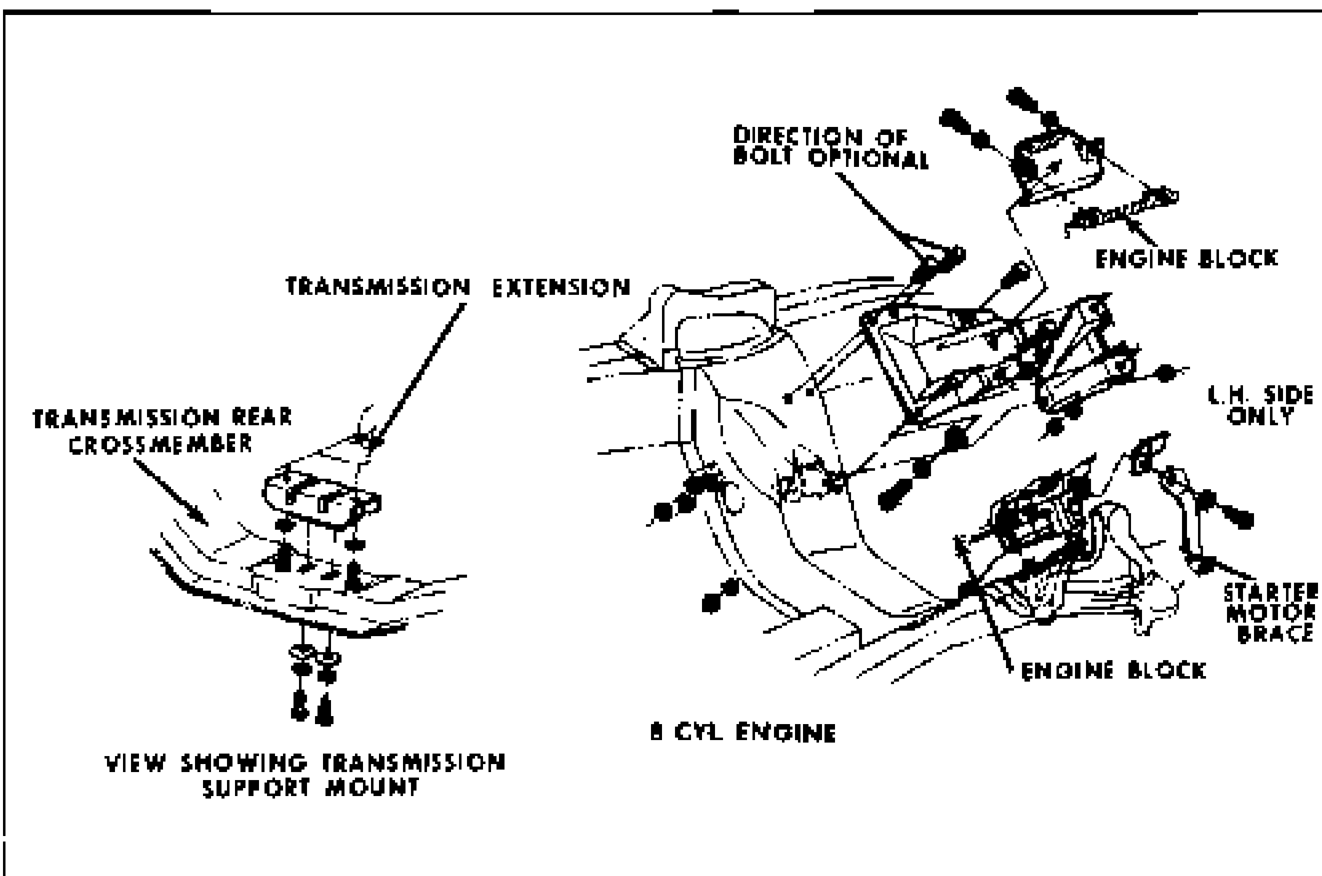


Fig. 6-77 Firebird Engine Insulators

2. Drain cooling system.

3. Scribe alignment marks on hood around hood hinges and remove hood from hinges.

4. Disconnect engine wire harness and engine to body ground straps.

5. Remove air cleaner.

6. Remove fan shield.

7. Disconnect radiator and heater hoses at engine attachment.

8. If equipped with manual transmission, remove radiator.

9. If equipped with power steering or air conditioning, remove pump and compressor from mounting brackets and set aside. Do not disconnect hoses.

10. Remove engine fan and pulley.

11. Disconnect accelerator control linkage and remove accelerator linkage support bracket.

12. Disconnect transmission vacuum modulator line and power brake vacuum line at carburetor and fold back out of way.

13. On Firebird equipped with A/C, remove windshield wiper motor

14. Raise vehicle and drain crankcase.

15. Disconnect gas tank lines at fuel pump.

16. Disconnect exhaust pipes from manifolds.

17. Disconnect starter wires.

18. If equipped with automatic transmission, remove convertor cover, remove three convertor retaining bolts and slide convertor to rear.

19. If equipped with manual transmission, disconnect clutch linkage, remove clutch cross shaft, starter and lower flywheel cover.

20. Remove four lower bell housing bolts (two each side).

21. Disconnect transmission filler tube support and starter wire harness shield from cylinder heads.

22. Remove two front motor mount bolts at frame.

23. Lower vehicle.

24. Using jack and block of wood, support transmission (automatic transmission).

25. Remove two remaining bell housing bolts (automatic transmission).

26. Raise transmission slightly.

27. Using suitable lifting equipment, remove engine.

INSTALL

1. Install engine lifting equipment to engine and lower engine into chassis, guiding engine to align engine with bell housing.

2. With engine supported by lifting equipment, install two upper bell housing bolts.

CAUTION: Do not lower engine completely while jack is supporting transmission.

3. Remove transmission support jack.

4. Lower engine and remove lifting equipment.

5. Raise vehicle.

6. Install remaining bell housing bolts.

7. Replace two front motor mount to frame bolts.

8. For remaining installation procedures, reverse steps 1 thru 19.

MANIFOLD - VALVE TRAINS - CYLINDER HEADS

RIGHT SIDE EXHAUST MANIFOLD OR GASKET

REMOVE

1. Disconnect exhaust pipe from manifold.

2. Straighten tabs on manifold front and rear individual bolt locks and remove manifold attaching bolts, manifold, and gaskets

NOTE: Locks are used on front and rear pairs of bolts only.

REPLACE

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold. Check condition of heat control valve and related parts.

2. Replace exhaust manifold and new gasket. Use new individual manifold bolt locks on front and rear pairs of bolts.

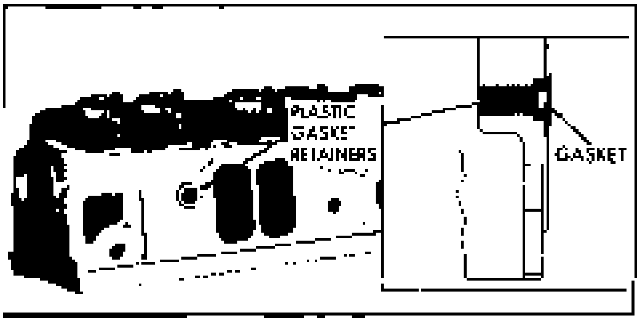


Fig. 6-78 Intake Manifold Gasket Retainers

NOTE: Place manifold outlet in position over end of exhaust pipe but do not permit weight of manifold to rest of exhaust pipe. Since the end holes of gasket are slotted, installation of gasket may be simplified by first installing manifold, using only the front and rear bolts to retain manifold. Allow clearance of about 3/16" between cylinder head and exhaust manifold. After inserting gasket between head and manifold, the remaining bolts may be installed.

3. Tighten all bolts evenly and securely to 30 lb. ft. torque. Bend tab of screw locks against bolt heads.

NOTE: Be sure tabs are bent against sides of bolt heads, not on top of bolt heads.

4. Attach exhaust pipe to manifold with bolts and tighten to 30 lb. ft.

LEFT SIDE EXHAUST MANIFOLD OR GASKET

REMOVE

1. Remove generator belt and remove generator and mounting bracket as an assembly.

2. Disconnect exhaust pipe from manifold

3. Remove carburetor air pre-heater shroud.

4. Straighten tabs on manifold individual bolt locks. (Tabs can be straightened from beneath car by using long-handled screwdriver.)

NOTE: Locks are used on front and rear pairs of bolts only.

5. Remove manifold attaching bolts and remove manifold.

REPLACE

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold.

2. Place manifold in position against cylinder head and install two end bolts, finger tight.

3. Slide gasket between manifold and cylinder head.

4. Install remaining bolts and new bolt locks.

5. Tighten all bolts evenly and securely to 30 lb. ft. torque. Bend tabs of bolt lock against bolt heads.

6. Install carburetor air pre-heater shroud.

7. Attach exhaust pipe to manifold and tighten to 30 lb. ft. torque.

INTAKE MANIFOLD OR GASKET

REMOVE

1. Drain water from radiator and from each side of cylinder block.

NOTE: Most water can be drained from the block through radiator drain by raising rear end of car approximately 15" to 18" off floor.

2. Remove air cleaner and disconnect closed ventilation pipe at air cleaner, air cleaner vacuum source at manifold and hot air duct by loosening clamp holding elbow to snorkel.

3. Remove water outlet fitting bolts and position fitting out of way, leaving radiator hose attached

4. Disconnect heater hose from fitting.

5. Disconnect wire from thermogauge unit.

6. Remove spark plug wire brackets from manifild.

7. On cars equipped with power brakes, remove power brake vacuum pipe from carburetor.

8. Disconnect distributor to carburetor vacuum hose.

9. Disconnect fuel line connecting carburetor and fuel pump.

10. Disconnect crankcase vent hose from intake manifold.

11. Disconnect throttle rod from carburetor.

12. Remove screws retaining throttle control bracket assembly.

13. Remove intake manifold retaining bolts and nuts, and remove manifold and gaskets.

NOTE: Make certain O-ring seal between intake manifold and timing chain cover is retained and installed during assembly if not damaged.

REPLACE

NOTE: When a new manifold is to be installed, transfer carburetor, thermostat, heater hose fitting and thermogauge fitting. Use new gaskets on those units *requiring gaskets and new O-ring seal between manifold and timing chain cover.*

1. Install new gaskets on cylinder heads, positioning them with plastic retainers (Fig. 6-78).

2. Install intak manifold on engine.

3. Install O-ring seal.

4. Install cap bolts and nuts loosely.

5. Position throttle control bracket assembly on manifold and install cap bolts.

6. Tighten timing chain cover to intake manifold bolt until both units are metal-to-metal (15 lb. ft. torque).

7. Tighten all nuts and bolts evenly to 40 lb. ft. torque.

8. Connect throttle rod to carburetor.

9. On cars equipped with power brakes, install vacuum pipe to carburetor.

10. Install fuel pipe connecting carburetor to fuel pump.

11. Install crankcase vent hose to intake manifold fitting.

12. Connect heater hose to fitting.

13. Install water outlet fitting.

14. Connect wire to thermogauge unit terminal.

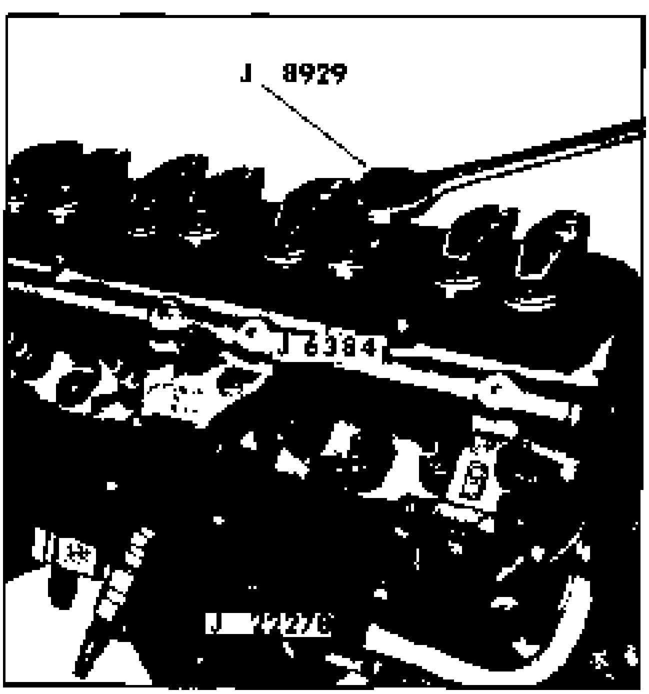


Fig. 6-79 Compressing Valve Spring

15. Install vacuum hoses, connecting distributor vacuum advance unit to carburetor.

16. Install spark plug wire bracket.

17. Replace air cleaner, attaching closed ventilation pipe, vacuum source and hot air duct.

18. Close drain plug and fill radiator to proper level.

19. Check accelerator linkage adjustments.

PUSH ROD COVER OR GASKET

REMOVE

1. Remove intake manifold, retaining O-ring seal.

2. Remove crankcase ventilator hose.

3. Remove screws from push rod cover and remove cover.

REPLACE

1. Cement new gasket on push rod cover.

2. Replace push rod cover and tighten screws.

3. Replace positive crankcase ventilation hose.

4. Install intake manifold and O-ring seal.

VALVE SPRINGS, SHIELD OR SEAL

REMOVE

1. Remove rocker arm cover, spark plug and distribu-

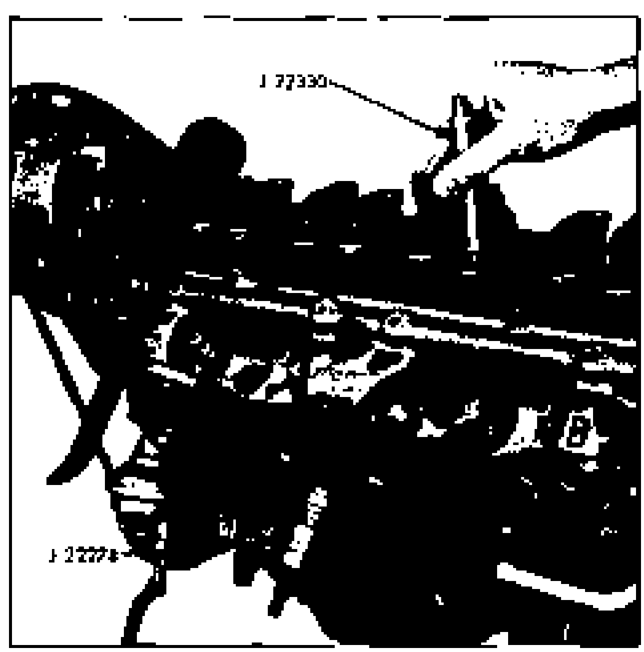


Fig. 6-80 Installing Valve Stem Seal

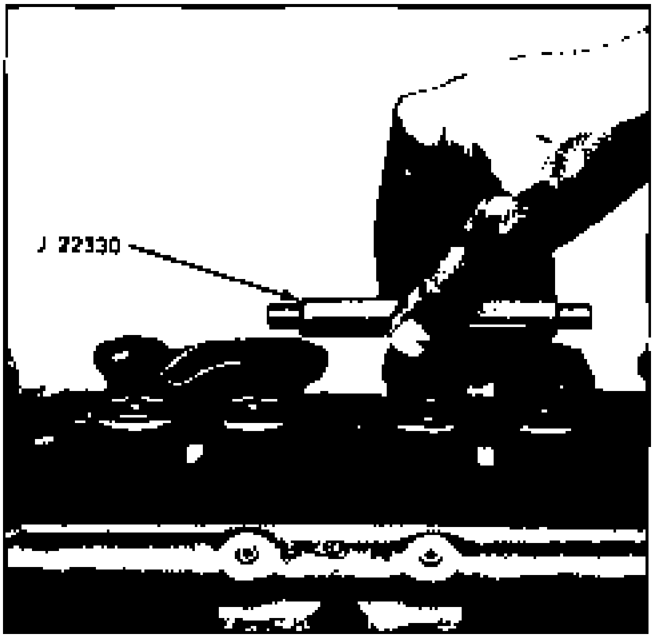


Fig. 6-81 Checking Valve Stem Seal

tor cap. (Remove rear compressor bracket on right side on cars equipped with A/C.)

2. Install air fitting J 22278 in spark plug hole and attach air line.

3. Remove rocker arm.

4. After removing rocker arm, thread valve spring compressor stud J 8929-1 on rocker arm stud and compress valve spring, using compressor J 6384-1 and nut J 8929-2 (Fig. 6-79). Remove valve spring retainer cup locks and then remove valve spring compressor, valve spring retainer cup shield and valve stem seal.

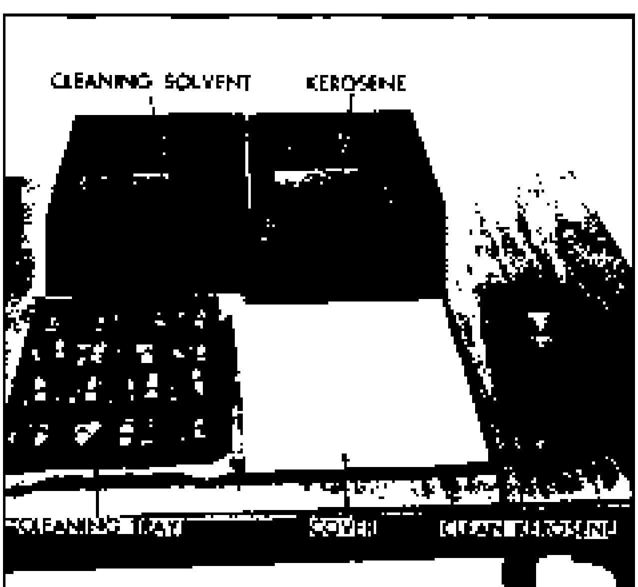


Fig. 6-82 Lifter Wash Tank and Tray

REPLACE

1. Install new part or parts, compress springs with valve spring compressor J 6384-1 and nut J 8929-2. Install valve stem seal (Fig. 6-80) and retainer cup locks. Remove spring compressor and valve holder, then test valve stem seal, using suction cup end of tool J 22330 (Fig. 6-81).

2. Install rocker arm, tighten rocker arm ball retaining nut to 20 lb. ft. torque.

3. Remove air fitting J 22278.

4. Replace rocker arm cover, spark plug, distributor cap and connect spark plug wire.

PUSH ROD OR VALVE LIFTER

REMOVE

1. Remove intake manifold, retaining O-ring seal.

2. Remove push rod cover.

3. Remove rocker arm cover.

4. Loosen rocker arm ball nut and move rocker arm off push rod.

5. Remove push rod.

6. Remove lifter. Hydraulic valve lifter remover J 3049 may facilitate removal of lifter.

NOTE: If more than one lifter is to be replaced, store push rods in a stand and lifters in a lifter box so they can be re-installed in exactly the same place and position. See GENERAL INFORMATION ON ENGINE SERVICE.

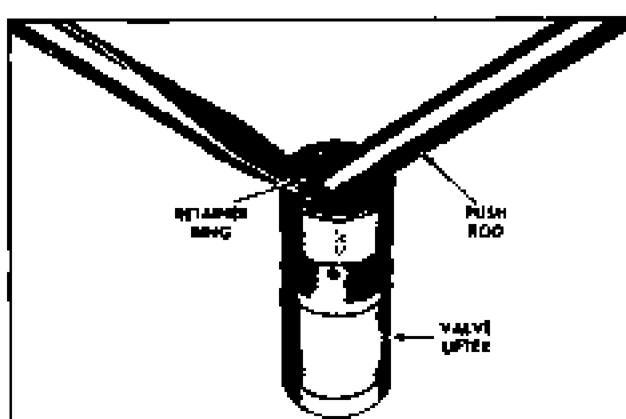


Fig. 6-83 Removing Push Rod Seal Retainer

REPLACE

NOTE: If new lifter is to be installed, be sure to remove all sealer coating from inside of new lifter and check leak-down rate.

1. Place new lifter in lifter boss

2. Replace push rod exactly as removed (same end against rocker arm).

3. Position rocker arm on push rod and tighten rocker arm ball retaining nut to 20 lb. ft. torque.

4. Replace rocker arm cover.

5. Inspect condition of push rod cover gasket and replace if necessary; replace push rod cover and tighten screws. New gasket must be cemented securely to push rod cover before installation.

6. Replace intake manifold using new gaskets and replace O-ring seal.

VALVE LIFTER-RECONDITION

NOTE: Because of the important part hydraulic valve lifters play in the operation of an engine and the close tolerances to which they are manufactured, proper handling, and above all, cleanliness, cannot be overstressed when servicing these parts.

New lifters are serviced as individual units packaged with a plastic coating. Leave the coating on until ready to check leak-down rate. It is not necessary to remove the oil from new lifters prior to checking leak-down rate since special leak-down oil is already in new lifters.

Wash tank and tray J 5821 (Fig. 6-82) is recommended for cleaning valve lifters. This tank should be used only for valve lifters and should be kept covered when not in use. All servicing should be done in an area removed from grinders or other sources of dust and foreign material.

Lifters should at all times be stored in a covered box which will aid in keeping them clean. The lifter box should be kept dry and as free of oil as possible.

VALVE LIFTER - DISASSEMBLE

1. Remove push rod seat retainer ring by holding seat down with push rod while dislodging spring from lifter body with a pointed tool (Fig. 6-83).

2. Invert lifter and allow push rod seat and plunger to slide out of body. If plunger sticks in body, place lifter in large end of hydraulic valve lifter plunger remover J 4160-A, with push rod end of lifter downward. Hold tool firmly in hand with thumb over lifter body and sharply strike the tool against a block of wood (Fig. 6-84) until plunger falls out.

NOTE: It may be necessary to soak a lifter having a stuck plunger in cleaning solvent for several minutes in order to remove the plunger.

3. Drain oil out of lifter body and place all valve lifter parts in separate compartment of tray from wash tank J 5821 (Fig. 6-82).

CAUTION: Valve lifter body and plunger are selectively fitted and must not be interchanged with parts of other lifters. (Keeping all parts of lifters together will also aid in trouble diagnosis.)

VALVE LIFTER - CLEAN AND INSPECT

Wash tank J 5821 is recommended for cleaning valve lifter parts. This tank consists of two chambers, a tray and a cover. One chamber is for cleaning solvent and the other is for kerosene. Whenever the tank is not being used (and when parts are soaking), the cover should be closed

1. Before placing tray of parts in cleaning solvent, first immerse it in kerosene chamber to remove as much engine oil as possible. (This reduces contamination of solvent, thus prolonging its useful life.)

2. Submerge tray in cleaning solvent and allow to soak for approximately one hour. More time may be required depending on varnish condition and effectiveness of solvent. Light agitation of tray in solvent at 10-15 minute intervals will hasten cleaning action.

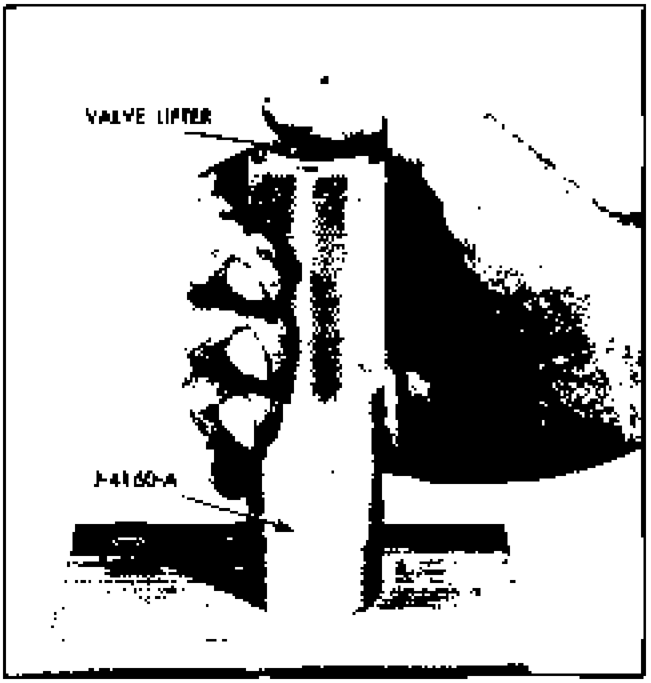


Fig. 6-84 Removing Stuck Plunger

3. After varnish has dissolved or has been sufficiently softened to permit removal by wiping, suspend tray above solvent, utilizing hooks on tray handles. Allow tray and parts to drain for a brief period.

4. Rinse tray of parts in kerosene chamber to cut solvent and to avoid injury to hands (from solvent).

5. Wipe out tank cover and place tray of parts on cover in front of tank (Fig. 6-82). A shop towl under tray and clean paper on remainder of cover will enhance cleanliness.

NOTE: Absolute cleanliness can be assured if each lifter is inspected and assembled after cleaning before proceeding to the next lifter.

6. Working on one lifter at a time and using clean, lint-free cloths, thoroughly wipe off lifter parts. Clean plunger and external and internal surfaces of body with hard wiping action. A bristle brush may be used to clean internal surface of lifter body.

CAUTION: Do not use wire brush or sand paper, since damage to machined surface is likely.

7. Inspect lifter body. Both inner and outer surfaces of lifter body should be inspected for scoring. Lifter assembly should be replaced if body is roughly scored, grooved, or galled. Inspect cam contact surface on lower end of lifter body. Replace lifter assembly if this surface is excessively worn, galled or otherwise damaged.

8. Inspect lifter plunger. Using magnifying glass, inspect check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with rough, satiny finish will cause plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with fingernail are causes for replacing lifter assemby. This rule does not apply to slight edge which may sometimes be present where lower end of plunger extends below the ground inner surface of body. This edge is not detrimental unless it is sharp or burred.

A blackened appearance is not a malfunctioning condition. Sometimes discoloration serves to highlight slight grinder chatter marks and give the outer surface of plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore, it may be disregarded.

9. Inspect push rod seat. Inspect push rod seat for roughness and make sure that hole in center is open.

10. Inspect valve lifter ball. Carefully examine ball for nicks, imbedded material or other defects which would prevent proper seating. Such defects may cause intermittently noisy lifter operation. Also inspect plunger face of ball retainer for excessive wear.

VALVE LIFTER - ASSEMBLE

NOTE: All parts must be absolutely clean when assembling a hydraulic lifter. Since lint and dust may adhere to parts they should not be blown off with air or wiped with cloths. All parts should be rinsed in clean kerosene and assembled without drying. A small container with clean kerosene (separate from cleaning tank) should be used for each set of lifters being overhauled.

Fig 6-85 shows the relative position of component parts of valve lifters. The recommended procedure for assembly is given in the following steps.

1. Rinse plunger spring and ball retainer and position retainer in spring.

2. Rinse lifter ball and place in retainer.

3. Rinse plunger and place on retainer so that seat on plunger mates with ball

4. Invert plunger with parts assembled thus far and, after rinsing lifter body, install body over spring and plunger.

5. Place orifice feed plate in plunger.

6. Place lifter body on clean paper, rinse and install push rod seat and retainer ring.

7. After lifter has been assembled, place in lifter box and close lid to preserve cleaniness.

TEST VALVE LIFTER LEAK-DOWN RATE

After all lifters have been assembled, the leak-down rate must be checked before they are installed in the engine. Valve lifter leak-down tester J 5790 *(Fig. 6-86)* is designed to test leak-down rate of lifters to determine whether or not they are within specified limits. As with previous service operations concerned with lifters, cleanliness is important. The tester cup and ram should be thoroughly cleaned, and testing should be done in an area free of dust and dirt. The testing procedure is described in the following steps:

1. Fill tester cup to approximately one inch from top with special fluid which is available from your lifter tester dealer.

NOTE: No other type fluid is recommended.

2. Swing weight arm up out of the way, raise ram, and position lifter into boss in center of tester cup.

3. Adjust ram (with weight arm clear of ram) so that the pointer is positioned on the set line (marked "S"). Tighten jam nut to maintain setting.

4. Operate lifter through full travel of plunger by pumping weight arm to fill lifter with test fluid and

force out air. (Lifter must be completely submerged at all times.) Continue pumping for several strokes after definite resistance is detected.

5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and commence turning crank slowly (1 revolution every 2 seconds). Time indicator travel from lower line (first line above set line) to line marked .125 or 1/8", while still rotating cup with crank (Fig. 6-86). Lifter is satisfactory if rate is between 20 and 90 seconds.

A doubtful lifter should be tested three or four times. Disassemble, inspect and re-test doubtful lifters. If leak-down still is not within specifications, replace lifter.

6. After each lifter is tested, replace in lifter box to insure cleanliness. Leave lifters in box until ready for installation in cylinder block.

7. When all lifters have been tested, empty cup, clean, and place cover over tester to maintain its cleanliness.

CYLINDER HEAD OR GASKET

REMOVE

1. Remove intake manifold, push rod cover, and rocker arm cover.

2. Loosen all rocker arm retaining nuts and move rocker arms off push rods

3. Remove push rods and place in a support stand so they can be replaced in exactly the same position from which they were removed. See GENERAL INFORMATION ON ENGINE SERVICE.

4. Remove exhaust pipe to manifold attaching bolts.

5. On Firebird models, remove compressor attaching bolts, if equipped with A/C, and move compressor to one side when removing head.

6. Remove battery ground strap and engine ground strap on left head or engine ground strap and automatic transmission oil level indicator tube bracket on right head.

7. Remove cylinder head bolts (dowel pins will hold head in place) and remove head with exhaust manifold attached, using lifting hooks J 4266

CAUTION: Extreme care should be taken when handling or storing cylinder heads as the rocker arm studs are hardened and may crack if struck.

NOTE: If left head is being removed, it will be necessary to raise head off dowel pins, move it forward and maneuver the head in order to clear the power steering and power brake equipment if car is so equipped.

NOTE: On Firebird models, when removing the right head on V-8's equipped with A/C, it is necessary to remove the right insulator to frame bolt and raise engine approximately 2" to gain access to the right rear valve cover bolt and right rear cylinder head bolt. Care must be taken to avoid the fan contacting the fan shroud.

9. Remove cylinder head gasket.

REPLACE

NOTE: Right and left cylinder heads are the same. New heads are complete with rocker arm studs (exc. heads with screwed in studs) and all plugs.

When installing new head, transfer all serviceable parts to new head, using new seals on intake and exhaust valve stems, and new exhaust manifold gasket.

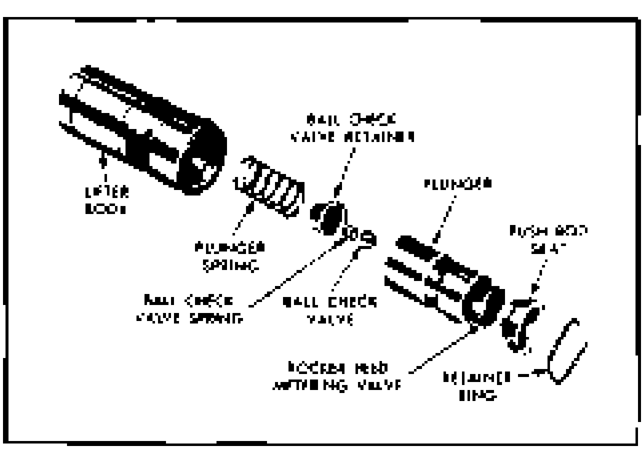


Fig. 6-85 Hydraulic Valve Lifter - Exploded View

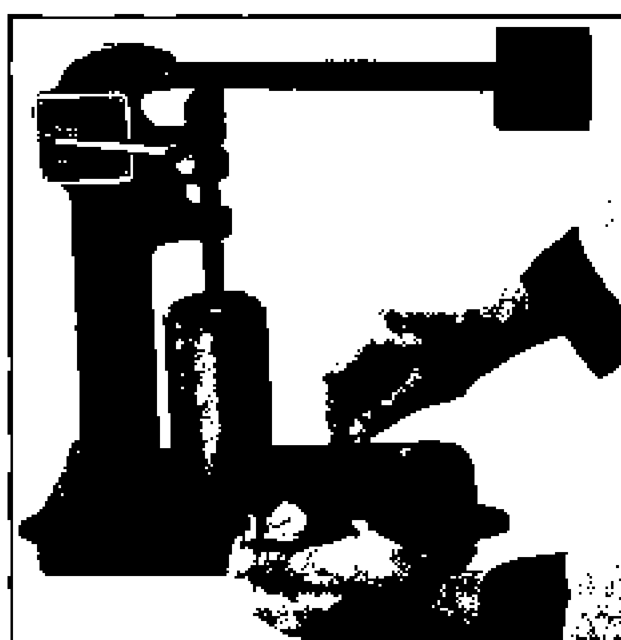


Fig. 6-86 Testing Leak-Down Rate

Install new intake manifold gasket plastic retainers. Check rocker arm stud height with stud gage J 23342 as shown in Fig. 6-89.

1. Thoroughly clean gasket surfaces of head and block. Place new gasket on block and replace cylinder head.

NOTE: On Firebird models, when replacing right cylinder head on V-8 equipped with A/C, it will be necessary to insert the right rear bolt into the head before replacing the head on the block.

2. Start all bolts.

NOTE: Bolts are three different lengths. When inserted in proper holes all bolts will project an equal distance from the head. Do not use sealer of any kind on the threads.

3. Tighten bolts evenly to 95 lb. ft. torque.

4. Install push rods in same location from which they were removed and with the same end up against rocker arm.

5. Reposition rocker arms and tighten rocker arm ball retaining nuts to 20 lb. ft. torque.

6. Replace rocker arm cover and tighten screws.

7. Replace push rod cover and tighten screws.

8. Replace battery ground strap and engine ground strap on left hand or engine ground strap and automatic transmission oil level indicator tube bracket on right head. Also replace the engine oil level indicator on right side.

9. Replace intake manifold using new gaskets.

10. Install exhaust-pipe-to-manifold attaching nuts.

11. On Firebird models, replace right side insulator to-bracket bolt on A/C equipped V-8's

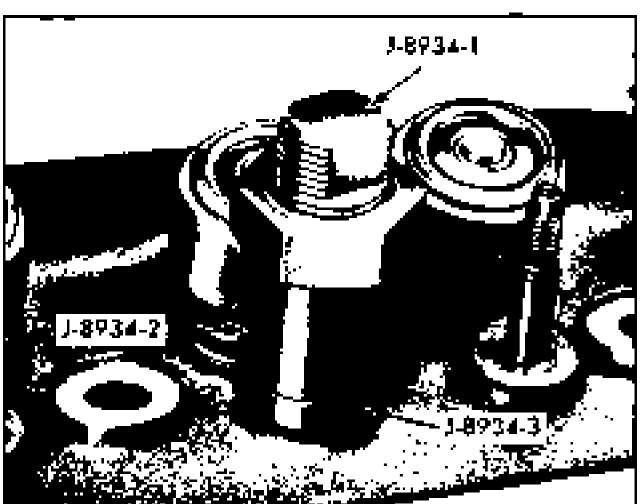


Fig. 6-87 Rocker Arm Stud Removal

ROCKER ARM STUDS

PRESSED IN STUDS - REMOVE AND REPLACE

NOTE: Only .003" oversize studs are available. This stud is to be used if stud has become loose, broken or because of faulty threads.

The procedures shown are for replacement without removal of cylinder head. If it is found necessary to remove the cylinder head for another reason, this procedure can be used with slight modification.

1. Disconnect battery and drain radiator.

2. Remove rocker arm cover.

3. Pack oily rags around stud and engine openings.

4. With rocker arm removed, file two slots 3/32" to 1/8" deep on opposite sides of rocker arm stud (Fig. 6-88). Top of slots should be 1/4" to 3/8" below thread travel.

5. Place washer at bottom of rocker arm stud.

6. Position rocker arm stud remover J 8934 on rocker arm stud and tighten screws securely with 5/32" allen wrench.

7. Place spacer over stud remover J 8934.

8. Thread 7/8" standard nut on stud remover and turn nut until rocker arm stud is out of cylinder head (Fig. 6-87).

9. After removing stud, carefully ream stud hole using reamer J 22126. Stud hole must first be reamed with pilot shaft attached to reamer. Pilot shaft should then be removed and stud hole must be reamed again.

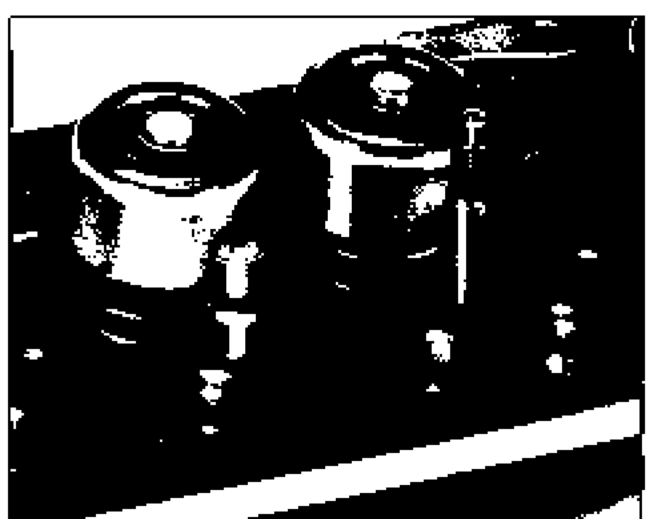


Fig. 6-88 Slots Filed in Rocker Arm Stud

10. Clean stud hole and surrounding area.

NOTE: Inspect stud hole. If reamer did not clean up completely, it will be necessary to replace cylinder head.

11. Coat rocker arm stud with white lead and oil and place rocker arm stud installer J 23342 on stud in place of rocker arm and ball.

12. Carefully drive stud into cylinder head until tool J 23342 has seated on machined rocker stud boss (Fig. 6 89).

13. Install push rod, rocker arm, ball and rocker arm ball retaining nut.

14. Replace push rod cover, intake manifold and rocker arm cover.

15. Connect battery cable and refill radiator.

SCREWED IN STUDS - REMOVE AND REPLACE

1. Remove rocker arm cover.

2. Remove rocker arm and nut.

3. Using a deep well socket, remove rocker stud.

4. Install new stud and tighten to 50 ft. lbs. torque.

5. Install rocker arm and tighten nut to 20 ft. lbs.

6. Install rocker arm cover using new gasket.

CYLINDER HEAD AND VALVES - RECONDITION

CYLINDER HEAD AND VALVES - DISASSEMBLE

1. Remove valve spring retainer cup locks (keepers), valve stem oil seals, valve spring retainer cups, valve stem shields, valve springs, and valves, using valve spring compressor J 8062. Valve stem oil seals must be discarded and replaced with new seals any time they are removed.

2. Place valves in valve and valve train holding stand.

CYLINDER HEAD AND VALVES - CLEAN AND INSPECT

Efficient engine performance depends to a great degree upon the condition of engine valves. Close inspection of intake valves is especially important as excessive clearance of valve stems in guides will permit oil to be pulled into the combustion chamber, causing fouled spark plugs and clogged piston rings. Oil deposited on valve heads will carbonize and burn, causing valves to leak with resultant loss of engine power. Therefore, valves must operate properly and if inspection discloses any malfunction of valves, the trouble must be corrected to avoid future damage to valves or related engine parts.

1. Inspect valves and seats to determine condition before cleaning. Also water passage plugs for evidence of leakage.

2. Clean valves thoroughly to remove deposits from head and stem.

3. Clean and inspect cylinder head as follows:

a. Clean carbon deposits from combustion chambers and all sludge or foreign matter from other areas of cylinder head. If a scraper or wire brush is used for cleaning, use care to prevent damage to valve seats.

CAUTION: To prevent damage to valve seat, it is good practice to keep wire brush well away from seat.

b. Clean cylinder head thoroughly, using suitable cleaning equipment.

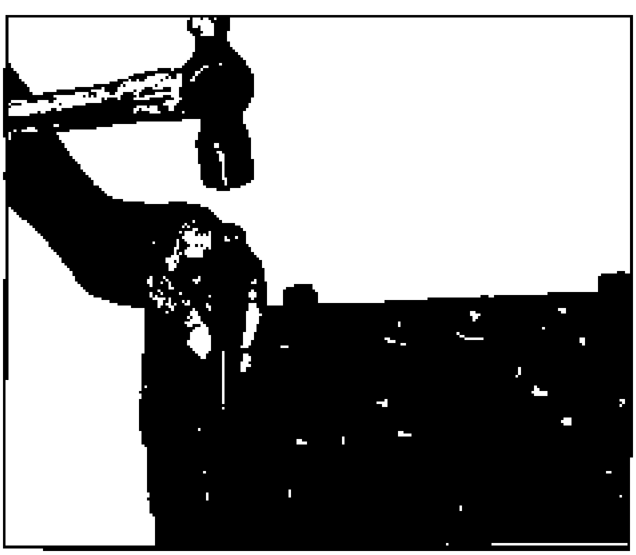


Fig. 6-89 Installing Rocker Arm Stud

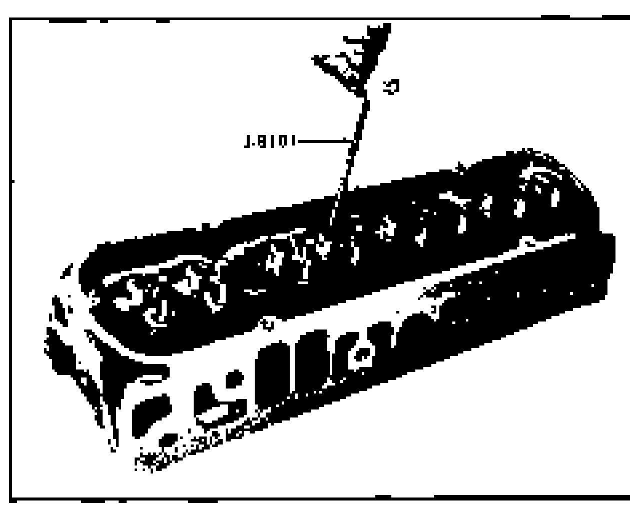


Fig. 6-90 Cleaning Valve Guide

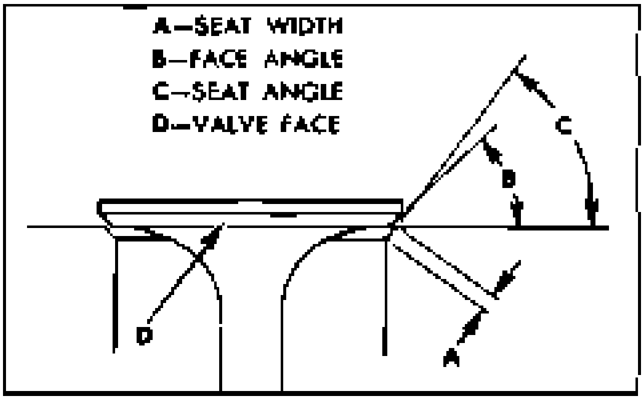


Fig. 6-91 Valve Seat and Face Angles

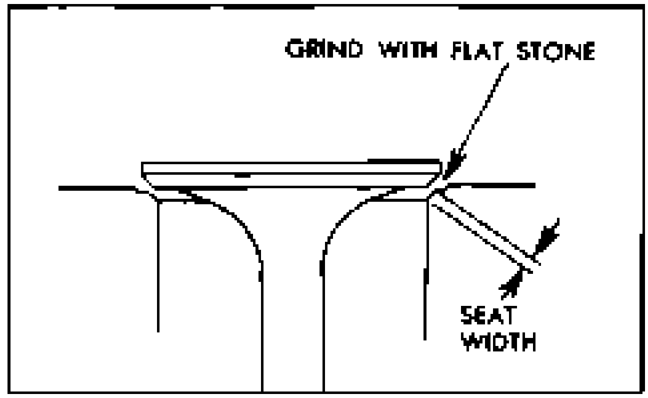


Fig. 6-92 Valve Seat After Grinding with Flat Stone

4. Clean valve guides thoroughly, using valve guide cleaner J 8101 (Fig. 6-90).

5. Visually inspect valve guides for evidence of wear, especially the end toward the spring seat. If a guide is scored or galled, install valve with proper oversize stem according to procedure.

6. Clean valve springs and inspect to see that they meet specifications.

7. Clean push rods and thoroughly clean out oil passage through center of rod. Inspect to see that the rod is straight.

8. Clean rocker arms and rocker arm balls, and visually inspect for evidence of wear.

9. Clean spark plugs as outlined in ELECTRICAL SECTION.

10. Clean and inspect valve lifters.

VALVES AND SEATS - RECONDITION

1. Reface valves and seats as follows:

Valves should be ground on a special bench grinder designed specifically for this purpose and built by a reputable manufacturer. Valve seats should be ground with reputable power grinding equipment having stones of the correct seat angle and a suitable pilot which pilots in the valve stem guide. To ensure positive sealing of the valve face to its seat, the grinding stones should be carefully refaced before any grinding is done. Intake valve seat angle is 30° on all large valve heads, 45° on all small valve heads and exhaust valve seat angle is 45° on all cylinder heads. Intake valve face angle is 29° on large valves, 44° on small valves and exhaust valve face angle is 44° on all valves. This will provide hairline contact between valve and seat to provide positive sealing and reduce build-up of deposits on seating surfaces (Fig. 6-91).

NOTE: Some early production small valve heads will still have 30° angle seats.

DO NOT USE REFACING EQUIPMENT EXCESSIVELY; only enough material should be removed to true up surfaces and remove pits. The valve head will run hotter as its thickness is diminished; therefore, if valve face cannot be cleaned up without grinding to point where outside diameter of valve has a sharp edge, the valve should be replaced. Whenever it is necessary to replace a valve, the new valve should be of the same stem diameter as the valve removed (unless the valve guide is reamed to provide proper fit).

Width of exhaust valve seats should be 1/16" (.048"-.070"). Intake valve seat should be between 3/64" and 1/16" (.045"-.071"). If seat width is excessive, it should be narrowed by grinding with a flat stone (Fig. 6-92). This is the only method that should be used to narrow the seat.

NOTE: Lapping of valve seats is not required or recommended.

Fig. 6-93 Reaming Valve Guide

2. Check concentricity of valve seat and valve guide. Concentricity of valve seat and valve guide can be checked by using a suitable dial indicator or prussian blue. When using a dial indicator, total runout should not exceed .002".

When prussian blue is used, a light coat should be applied to the face of the valve only and the valve rotated in its seat. If blue appears all the way around valve seat, the valve seat and valve guide are concentric with one another.

3. Check concentricity of valve stem and face of valve. After cleaning prussian blue from valve and seat following preceding check, lightly coat valve seat with prussian blue and rotate valve in guide. If blue appears all the way around valve, the valve stem and valve face are concentric with one another.

NOTE: Both tests in steps 2 and 3 are necessary to insure proper valve seating.

FITTING VALVE STEMS TO GUIDES

Correct valve stem clearance for valve guides is .0016" to .0033" for intake valve and .0021" to .0038" for exhaust valve.

Valves with oversize stems are available in .001", .003" and .005" larger than standard. The same valve stem to guide clearance applies for oversize stems.

Oversize reamers are required to enlarge valve guide holes to fit the oversize stems. When the reamer is turned through valve guide, it will size hole to fit valve stem according to above limits.

Carefully ream valve guide using valve guide reamer J 5830-1 for .003" oversize stems and valve guide reamer J 6621 for .005" oversize stems (Fig. 6-93). For best results when installing .005" oversize valve stem, use .003" oversize reamer first and then ream to .005" oversize. Always reface valve seat after reaming valve guide.

NOTE: Valves are marked .001, .003 or .005 with colored ink.

CYLINDER HEAD AND VALVES - ASSEMBLE

1. Install valves, valve springs, valve stem shields, valve spring retainer cups, valve stem seals and retainer cup locks, using suitable spring compressor. The valve stem seals must be installed in the second groove (from end of stem). Valve stem seal installer and tester J 22330 can be used to install this seal (Fig. 6-80). Where necessary, install new umbrella type seal using suitable plastic protector over end of valve stem.

After valves have been installed, the suction cup end of special tool J 22330 should be used to test for leaks between the valve spring retainer cup and valve stem seal (Fig. 6-81). The suction cup will tend to be held to the valve spring retainer cup by suction when seal is satisfactory. If a leak is detected, replace seal or valve spring retainer cup as necessary. It is important to have a positive seal between the valve spring retainer cup and valve stem seal to prevent excessive amounts of oil from being drawn down the valve stem which will cause exhaust smoke and oil consumption.

2. Install spark plugs.

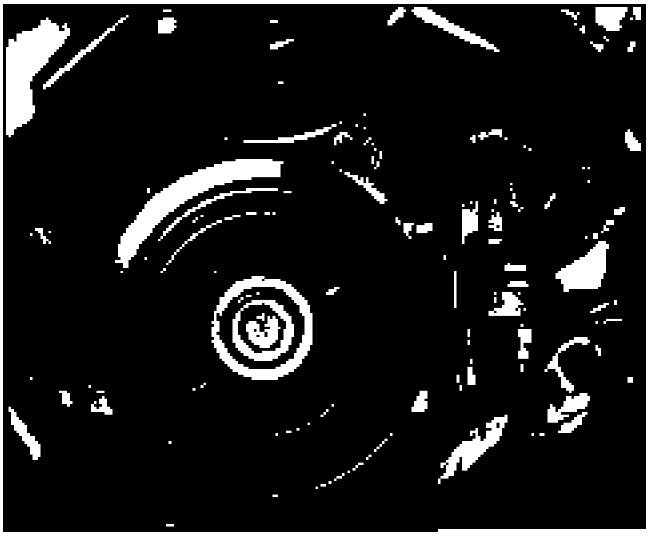


Fig. 6-94 Harmonic Balancer

HARMONIC BALANCER - TIMING CHAIN COVER AND GASKET - TIMING CHAIN AND SPROCKETS - OIL SEAL - FUEL PUMP ECCENTRIC

HARMONIC BALANCER - REMOVE AND REPLACE

1. Loosen generator at adjusting strap and lower pivot bolt and remove fan belt from harmonic balancer. On cars equipped with power steering, also remove power steering pump belt from harmonic balancer.

2. Position fan so wide angles will be at top and bottom allowing access to balancer (Fig. 6-94).

3. Remove crank pulleys and reinforcing plate.

4. Remove harmonic balancer attaching bolt and retainer washer.

5. Remove harmonic balancer by sliding it off end of crankshaft.

NOTE: Do not pry on O.D. of harmonic balancer. Harmonic balancer is a rubber mounted inertia member and balance could be affected.

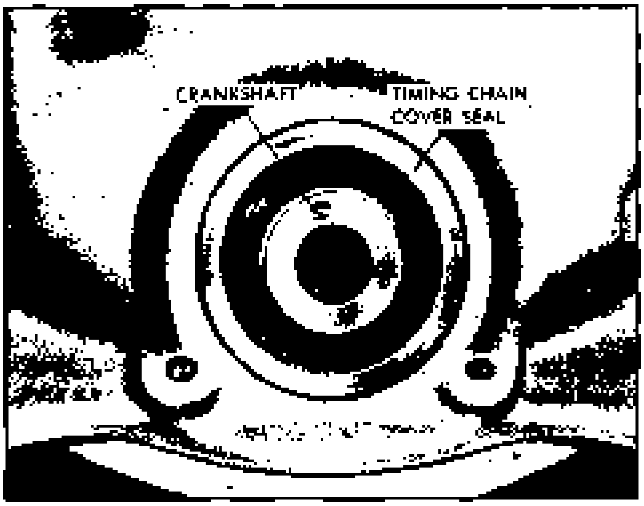


Fig. 6-95 Timing Chain Cover Seal

6. Install new harmonic balancer by reversing above steps, lining up keyway in balancer with key on crankshaft.

7. Tighten harmonic balancer attaching bolt to 160 lb. ft. torque

NOTE: Remove flywheel cover and lock flywheel before tightening balancer bolt.

TIMING CHAIN COVER SEAL - REMOVE AND REPLACE

1. Loosen generator adjusting bolts.

2. Remove fan and accessory drive belts.

3. Remove harmonic balancer.

4. Remove timing chain cover seal by prying out of bore with a pry bar (Fig. 6-95).

5. Install new seal with lip of seal inward, using seal installer J 21147.

6. Replace harmonic balancer.

7. Install drive belts and adjust to proper tension.

TIMING CHAIN COVER, GASKET, OR FUEL PUMP ECCENTRIC -REMOVE AND REPLACE

1. Drain radiator and cylinder block.

2. Loosen generator adjusting bolts.

3. Remove fan belt and accessory drive belt.

4. Remove fan and pulley from hub of water pump

5. Disconnect lower radiator hose.

6. Remove fuel pump

7. Remove harmonic balancer.

8. Remove front four oil pan-to-timing chain cover screws.

9. Remove timing chain cover to block attaching bolts and nuts and timing chain cover to intake manifold bolt.

10. Pull timing chain cover forward to clear studs and remove.

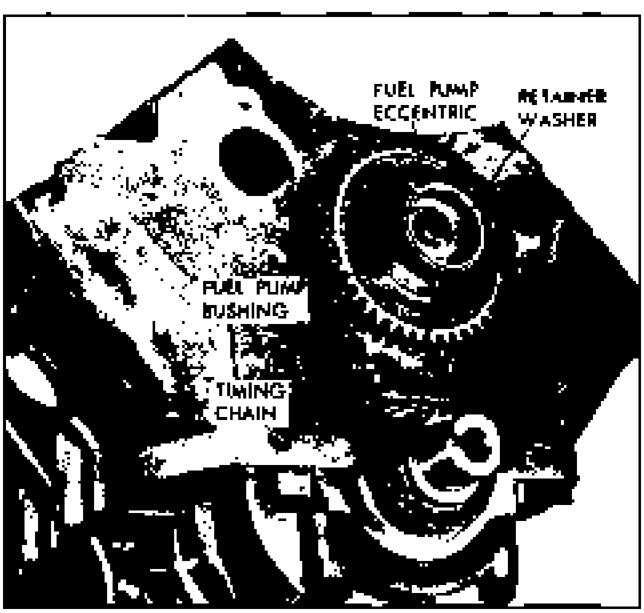


Fig. 6-96 Front of Engine with Timing Chain Cover Removed

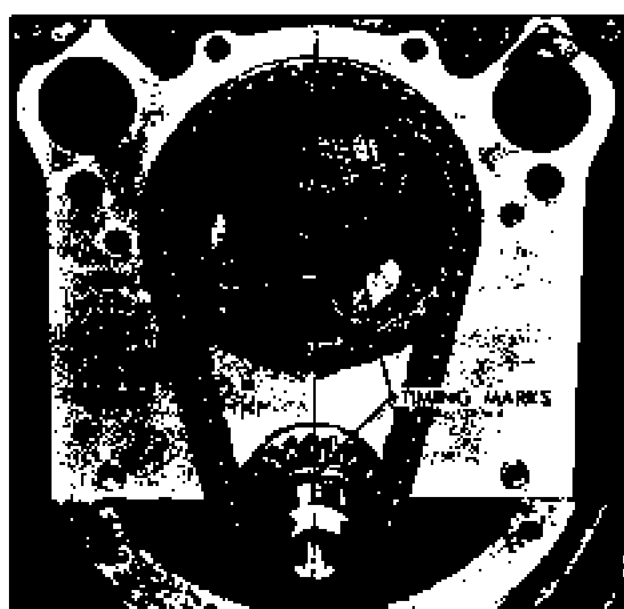


Fig. 6-97 Aligning Timing Marks

11. Remove O-ring seal from recess in intake manifold water recirculation passage.

12. Remove timing chain cover gasket and thoroughly clean gasket surfaces on block and cover. Use care to prevent gasket particles and other foreign material from falling into oil pan.

13. Inspect front oil pan gasket and replace if damaged. If new gasket is installed, it should be cemented to oil pan.

14. If new fuel pump eccentric and bushing are to be installed, remove camshaft sprocket retainer bolt and retaining washer and remove the eccentric and bushing. Place fuel pump bushing over eccentric with rolled flange toward camshaft sprocket (Fig. 6-96).

NOTE: Bushing retaining flange should be between eccentric and sprocket for retention of bushing in operation.

Install bushing and eccentric, indexing tang on eccentric with keyway cutout in camshaft sprocket. Insert retaining screw with retainer washer and tighten securely.

15. Position new timing chain cover gasket over studs and dowels against block.

16. Transfer water pump to new timing chain cover if new cover is to be installed.

17. Install new O-ring seal in water recirculation passage of intake manifold.

18. Position timing chain cover on engine indexing over dowels, install bolts and nuts and tighten securely.

19. Install four oil pan to timing chain cover screws and tighten to 12 lb. ft. torque.

20. Install harmonic balancer, retainer bolt with retainer, and tighten to 160 lb. ft. torque.

21. Connect lower radiator hose to pump inlet.

22. Position pulley and fan on water pump hub and install attaching bolts. Tighten to 20 lb. ft. torque.

23. Install power steering pump and belt on cars so equipped.

24. Install generator adjusting strap.

25. Install fan belt and accessory drive belts. Adjust to proper tension.

26. Install fuel pump.

27. Refill cooling system and check for leaks.

TIMING CHAIN AND SPROCKETS - REMOVE AND REPLACE

1. Remove timing chain cover, making certain O-ring seal and hollow dowels are retained for installation at assembly.

2. Remove fuel pump eccentric, bushing and timing chain cover oil seal.

3. Align timing marks to simplify proper positioning of sprockets during reassembly (Fig. 6-97).

4. Slide timing chain and sprockets off ends of crankshaft and camshaft.

5. Install new timing chain and/or sprockets, making sure marks on timing sprockets are aligned exactly on a straight line passing through the shaft centers (Fig. 6-97). Camshaft should extend through sprocket so that hole in fuel pump eccentric will locate on shaft.

6. Install fuel pump eccentric and bushing, indexing tab on eccentric with keyway cut-out in sprocket. Install retainer bolt with retainer washer and tighten securely.

7. Making certain hollow dowels are in place in block, place timing chain cover gasket over studs and dowels.

8. Install timing chain cover, making sure O-ring seal is in place.

CAMSHAFT AND/OR CAMSHAFT BEARING

The camshaft and camshaft bearings can be replaced with engine installed in car or with engine removed and disassembled for overhaul; however, to replace the rear camshaft bearing without removing and completely disassembling engine, the propeller shaft, transmission and clutch housing must first be removed.

To replace the camshaft and/or the rear center, center, front center or front camshaft bearing without removing and completely disassembling the engine, proceed as follows:

CAMSHAFT - REMOVE

1. Drain radiator.

2. Remove carburetor air cleaner.

3. Disconnect all water hoses, vacuum hose and spark plug wires.

4. Disconnect carburetor linkage, fuel lines and wires to thermogauge unit.

5. Remove hood latch brace.

6. On air-conditioned cars, remove generator mounting bracket and generator.

7. Remove crankcase ventilator hose, and remove both rocker arm covers and gaskets.

8. Remove distributor hold-down clamp and remove distributor.

9. Remove intake manifold and gaskets.

NOTE: Make certain O-ring seal between intake manifold and timing chain cover is retained and installed during assembly.

10. Remove push rod cover.

11. Loosen rocker arm ball retaining nuts so that rocker arms can be disengaged from push rods and turned sideways.

12. Remove push rods and hydraulic lifters. Store push rods in stand and lifters in a lifter box so they can be reinstalled in original positions.

13. Remove harmonic balancer.

14. Remove fuel pump.

15. Remove four oil-pan-to-timing-chain-cover screws.

16. Remove timing chain cover and gasket.

17. Remove fuel pump eccentric and fuel pump bushing.

18. Align timing marks on timing chain sprockets and remove timing chain and sprockets.

19. Remove camshaft thrust plate.

20. Carefully pull camshaft from engine, exercising caution so as not to damage bearings in block.

NOTE: The clearance for camshaft removal is very limited and, in cases where engine mounts are worn excessively, it may be necessary to raise the front of the engine to permit removal.

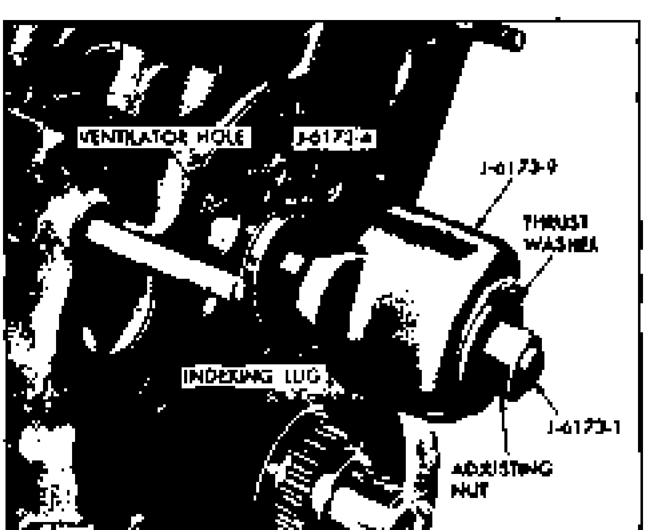


Fig. 6-98 Positioning Index Collar

21. Stuff clean rags through openings in engine block as an aid in preventing foreign material or parts of bearing remover tool from dropping into block.

CAUTION: It is imperative that operator exercise extreme caution when inserting bearing remover adapters or key through openings in engine block to prevent them from dropping into engine.

CAMSHAFT BEARING - REMOVE

1. Insert remover adapter J 6173-4 into front bearing to act as a support for shaft J 6173-1 (Fig. 6-98).

NOTE: If front bearing is to be replaced, insert installer adapter in center bearing to act as support for shaft.

2. Insert replacer adapter J 6173-3 into rear of bearing to be removed so that shoulder on remover bears against rear edge of bearing.

NOTE: If rear bearing is to be removed, it will be necessary to remove camshaft rear plug.

3. Place indexing collar J 6173-6 on threaded end of shaft with open side toward unthreaded end and start thrust washer and nut on shaft (Fig. 6-98).

4. Insert shaft and indexing collar through remover and replacer adapters and position lug on indexing collar in ventilator hole in front of block (Fig. 6-98). This indexes shaft so that it cannot rotate.

5. Slip key J 6173-5 into notches in shaft behind bearing to be removed (Fig. 6-99).

6. Turn nut on front of shaft to pull key against remover adapter J 6173-4, then continue to turn nut until bearing is pulled out of its hole.

CAMSHAFT BEARING - REPLACE

1. Place a clean rag against each side of transverse member just below bearing hole to catch any shavings

Fig. 6-99 Removing Camshaft Bearing

and carefully clean up hole. All scratches or nicks in cast iron should be smoothed with an scraper or file. Chamfer the rear edge of hole slightly to reduce possibility of shaving down the outer diameter of bearing when it is installed.

2. Insert remover adapter J 6173-4 into front bearing to act as a support for the shaft.

NOTE: If front bearing is being replaced, insert remover adapter in center bearing to act as support for the shaft.

3. Insert pilot J 6173-7 into hole in which bearing is to be installed.

4. Coat outside of new bearing with oil and place it over replacer adapter J 6173-3, indexing notch in edge of bearing with pin on replacer adapter.

NOTE: The notch in edge of bearing is used to properly position the bearing, with respect to oil holes, when it is installed. When bearings are installed in production, notches all face front except the one in rear bearing. In service it is necessary to install bearings with notch facing the rear.

5. Position replace adapter J 6173-3, with bearing in position against shoulder, against rear of hole in which bearing is to be installed (Fig. 6-100). Index mark on shoulder of replacer must point down (toward crankshaft side) to properly position bearing.

6. Insert shaft with indexing collar, thrust washer, and nut through remover, pilot and replacer adapters. Index lug on collar with ventilation hole in front of block (Fig. 6-98).

7. Slip key J 6173-5 into notches in shaft behind replacer adapter J 6173-3 and tighten nut to start bearing into hole (Fig. 6-100). Continue to tighten nut until bearing has been pulled completely into its hole. When properly positioned, it will be approximately flush with both sides of the transverse member.

NOTE: Rear bearing should be pulled in until front edge is flush with block. This will leave shoulder at end of counter bore for camshaft rear plug visible behind bearing.

8. Remove remover and replacer set J 6173.

9. Visually observe that holes in bearing line up with drillings in block.

10. Carefully remove rags used to catch particles of metal and use magnet or vacuum cleaner to make sure that all metal particles are removed from block surfaces and oil drillings.

CAMSHAFT - REPLACE

1. Coat inner diameters of all camshaft bearings with oil. Coat camshaft lobes with heavy oil. Carefully install camshaft. Rotate camshaft through several revolutions to make sure it is completely free. If any tight spots are found, remove camshaft and very carefully polish down the center journal slightly. If still not free, polish the front and rear journals slightly. If any particular bearing causes binding of the camshaft, replace that bearing also.

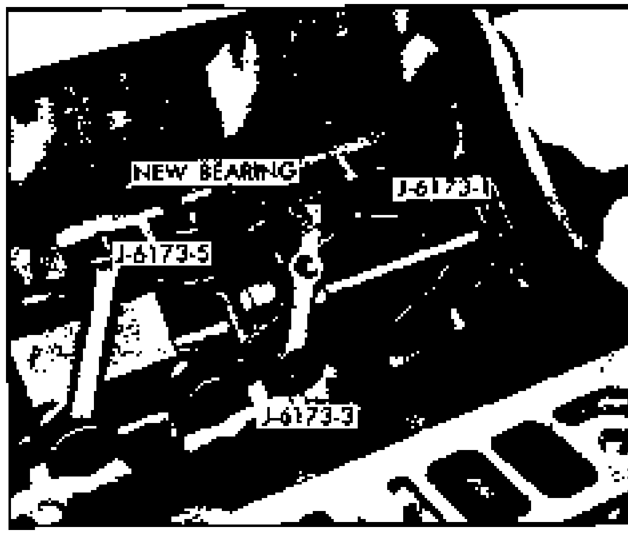


Fig. 6-100 Installing Camshaft Bearing

NOTE: Front center and rear center journals should not be polished except to remove slight roughness or scratches. Slight warpage of the camshaft is not harmful, provided the journals are polished down until the camshaft rotates freely in its bearings.

2. With camshaft properly seated, install camshaft thrust plate and tighten bolts 20 lb. ft. torque.

3. Install timing chain sprockets and timing chain, making sure marks on sprockets are aligned properly (Fig. 6-97).

4. Install fuel pump eccentric and bushing. Tighten camshaft sprocket retaining bolt 40 lb. ft. torque.

5. Install timing chain cover dowels and new gasket and tighten cover to cylinder block bolts and cover to block stud nuts 30 lb. ft. torque.

6. Insert four oil-pan-to-timing-chain-cover screws and tighten 12 lb. ft. torque.

7. Install fuel pump and tighten bolts 25 lb. ft. torque.

8. Install harmonic balancer. Tighten bolt 160 lb. ft. torque.

9. Coat base of lifters with heavy oil. Install hydraulic lifters and push rods, making certain they are replaced in their original positions.

10. Engage rocker arms on push rods and tighten rocker arm ball retaining nuts 20 lb. ft. torque.

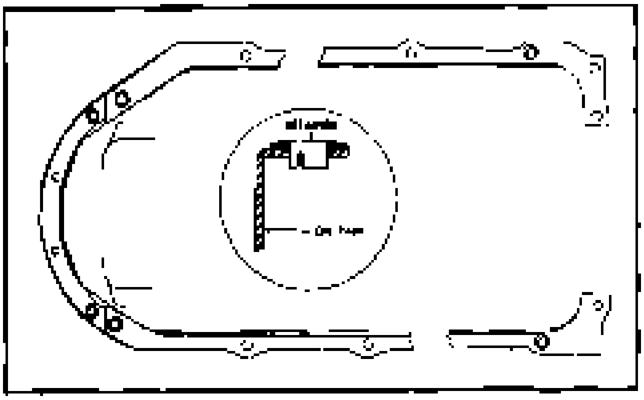


Fig. 6-101 Oil Pan Gasket Retainers

11. Install push rod cover.

12. Install intake manifold and gasket. Tighten bolts 40 lb. ft. torque.

NOTE: O-ring seal must be installed between intake manifold and timing chain cover before manifold is securely positioned.

13. Install distributor, positioning rotor pointer to number six cylinder, and install distributor hold-down clamp. Tighten clamp retaining screw 30 lb. ft. torque.

14. Install crankcase ventilator outlet pipe and both rocker arm covers and gaskets. Tighten cover bolts 65 lb. in. torque.

15. If generator bracket and generator were removed, install and tighten bolts 30 lb. ft. torque.

16. Install fan and pulleys.

17. Install radiator, tightening all bolts securely.

18. Install hood latch bracket and tighten bolts.

19. Connect carburetor linkage, fuel lines and thermogauge unit.

20. Connect all water hoses, vacuum hose and spark plug wires.

21. Install carburetor air filter.

22. Refill cooling system and check for leaks.

OIL PAN AND/OR OIL PAN GASKET - PONTIAC AND FIREBIRD MODELS

REMOVE

1. Disconnect battery cable.

2. On Firebird models, remove distributor cap.

3. Remove fan shield.

4. On air-conditioned cars, remove fan and pulley assembly.

5. Disconnect engine ground cables.

6. On air-conditioned cars, remove compressor from mounting brackets and position to one side.

7. Inspect all water hoses and wiring harnesses for proper routing to avoid excessive bind when engine is raised approximately 4 1/2".

8. Raise vehicle and drain crankcase.

9. Disconnect steering idler arm from frame.

10. Remove exhaust crossover pipe. When equipped with dual exhausts, disconnect exhaust pipes from manifolds.

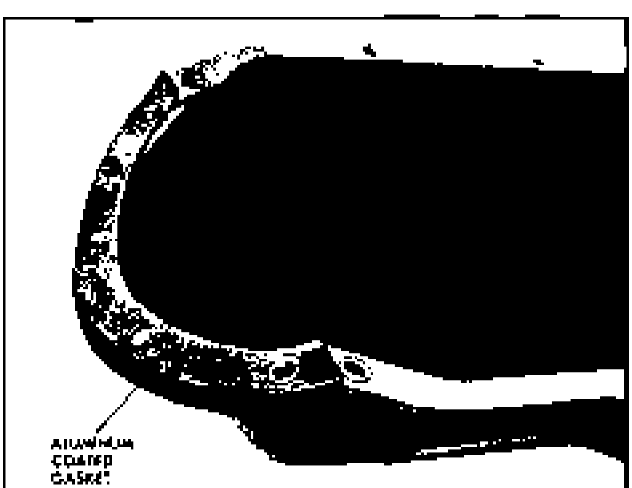


Fig. 6-102 Front Oil Pan Gasket Overlapping Side Gaskets

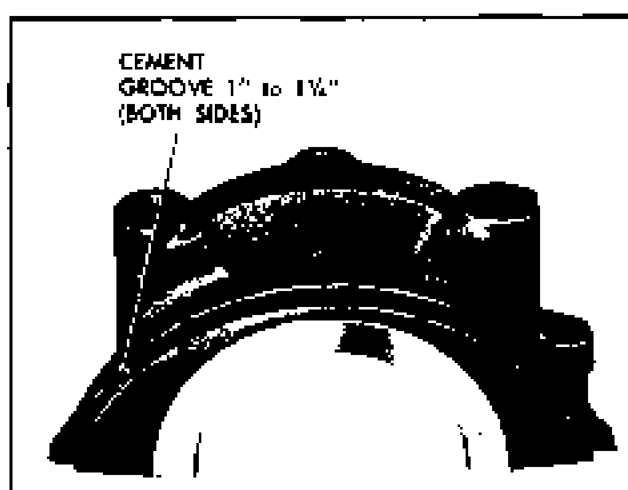


Fig. 6-103 Rear Oil Pan Gasket Positioned in Bearing Cap

11. Remove starter assembly, starter motor bracket and flywheel cover.

12. Position J 22603 ENGINE LIFTING TOOL to engine and place J 22603-8 CROSS BAR in position on lifting tool (Fig. 6-75). Bolt tool to timing chain cover with bolts provided with tool.

13. Using frame jack or hydraulic transmission jack, support engine at J 22603, remove motor mounts.

14. Loosen rear transmission mount.

NOTE: It may be necessary to remove this mount and rest rear of transmission on cross member to obtain necessary clearance.

15. Remove oil pan bolts and raise engine straight up approximately 4 1/2" and forward approximately 1 1/2".

16. Remove oil pan by first rotating clockwise (facing forward) to clear oil pump.

NOTE: If work other than oil pan gasket replacement is to be performed, remove jack and support engine with suitable blocks of wood.

REPLACE

1. Install new gasket on oil pan (Fig. 6-101, 6-102, 6-103).

2. Replace oil pan. Tighten retaining bolts to 12 lb. ft.

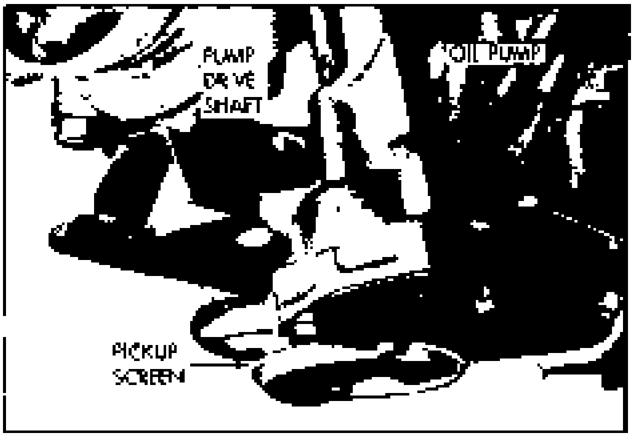


Fig. 6-104 Oil Pump and Oil Pump Drive Shaft

3. Install left motor mount to cylinder block and tighten right motor mount to block bolts.

4. Lower engine and remove J 22603 Engine Support Bracket.

5. Replace motor mount to frame bolts.

6. Replace flywheel cover, starter bracket and starter.

7. Replace exhaust crossover pipe.

8. Connect steering idler arm to frame.

9. Lower vehicle.

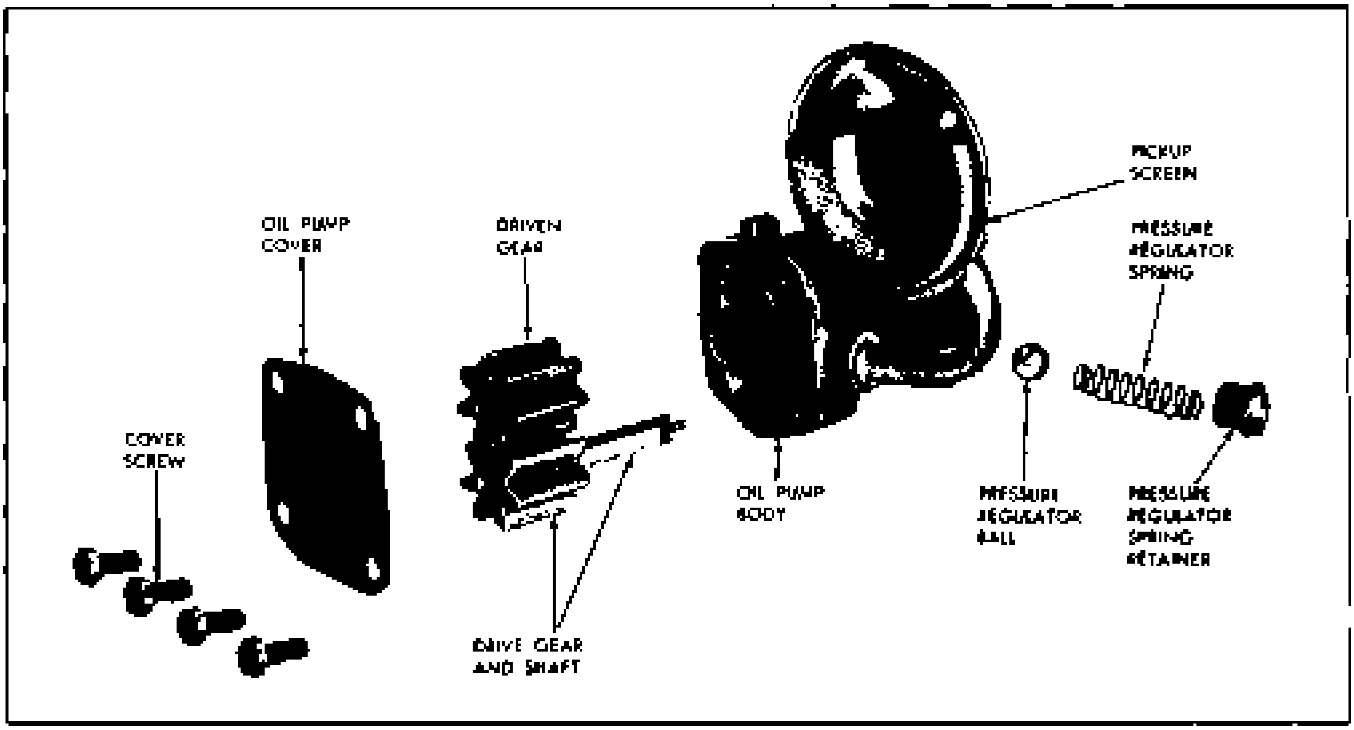


Fig. 6-105 Oil Pump - Exploded View

10. On air-conditioned cars, replace compressor, fan and pulley assembly and adjust belt tensions

11. Replace fan shield.

12. Connect engine ground cables and battery cable.

13. On Firebird models, replace distributor cap.

14. Refill engine crankcase.

OIL PAN AND/OR OIL PAN GASKETS - TEMPEST MODELS

REMOVE

1. Remove engine, and clutch (SM) from vehicle.

2. Place engine on a suitable stand.

3. Remove oil pan.

REPLACE

1. Install new gasket on oil pan using gasket retainers (Figs. 6-101 and 6-102).

2. Install new oil pan gasket in rear main bearing cap (Fig. 6-103).

3. Install oil pan into position and torque retaining bolts 12 lb. ft.

4. Remove engine from stand

5. Install engine in vehicle.

OIL PUMP

REMOVE

1. Remove engine oil pan (See "Oil Pan - Remove and Replace"). Remove splash baffle.

2. Remove oil pump attaching bolts while holding oil pump in place. Carefully lower oil pump away from block with one hand while removing oil pump drive shaft with other hand (Fig. 6-104).

REPLACE

1. Position drive shaft in distributor and oil pump drive gears. Place pump against block, using new gasket between pump and block. Index drive shaft with pump drive gear shaft. Install two attaching screws with lockwashers and tighten securely.

NOTE: Removal and installation of pump does not affect ignition timing, since the oil pump and distributor drive gear is mounted on the distributor shaft.

2. Install oil pan.

OIL PUMP - RECONDITION

DISASSEMBLE

1. Remove pressure regulator spring retainer, spring, and pressure regulator ball.

2. Remove screws retaining cover to oil pump body and remove cover.

3. Remove driven gear and drive gear with shaft.

NOTE: Oil pump screen should not be removed from pump body. Be careful not to loosen screen.

CLEAN AND INSPECT

1. Clean all parts thoroughly. Screen must be thoroughly cleaned by using a fluid such as used for carburetor cleaning

2. Inspect pressure regulator spring (Fig. 6-105) for distortion, cracks, and wear on sides.

3. Inspect pressure regulator ball to see that is is not nicked or otherwise damaged

4. Inspect pump body, driven gear shaft and cover for evidence of wear.

5. Inspect pump gears and end of drive gear shaft for wear (Fig. 6-105).

6. Inspect oil pump drive shaft (distributor to pump shaft) for evidence of wear and cracks.

ASSEMBLE

1. Install drive and driven gears.

2. Install cover and turn drive shaft by hand to ensure that it turns freely

3. Install pressure regulator ball, spring and retainer.

IMPORTANT: Oil pressure regulator spring on GTO or 428 may be identified by noting appearance of distributor drive gear. If gear is cadmium plated, oil pump spring will be 60 psi pressure. Engines with unplated gear will have 30 psi spring. The 60 psi spring must not be used without cadmium plated gear.

CAUTION: Do not attempt to change oil pressure by varying length of pressure regulator valve spring.

REAR MAIN BEARING OIL SEAL

REMOVE

1. Remove oil pan (see Oil Pan - Remove and Replace).

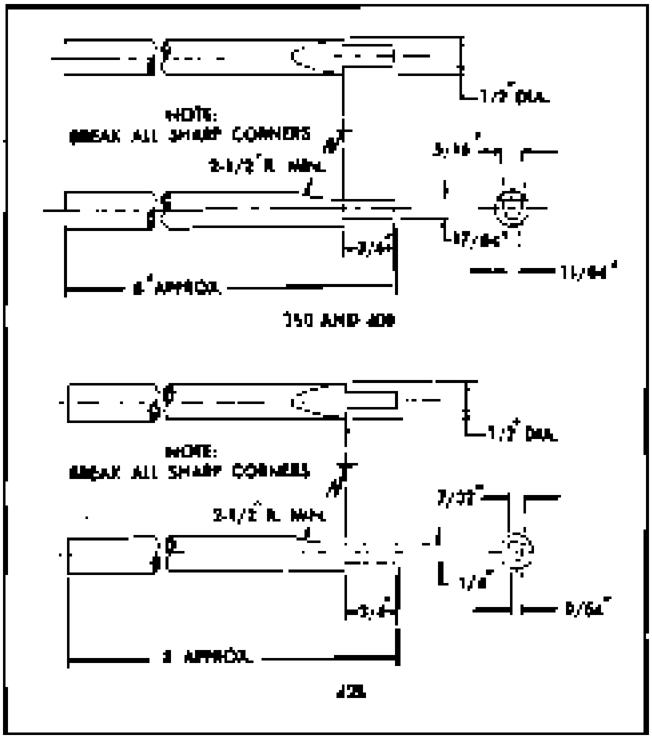


Fig. 6-106 Rear Main Bearing Seal Tool

2. Remove oil pump and baffle (Fig. 6-108).

3. Remove rear main bearing cap.

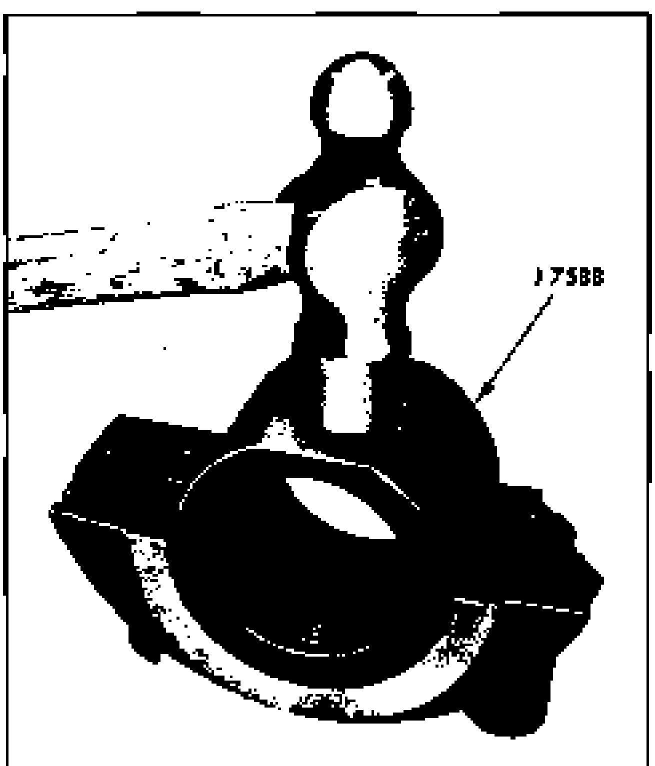


Fig. 6-107 Forming New Seal in Cap

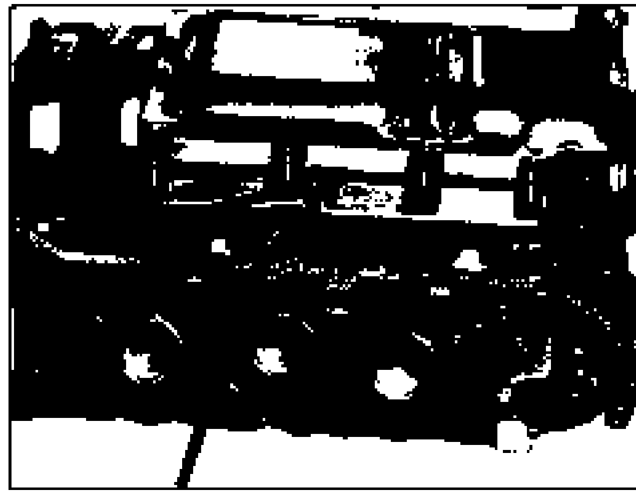


Fig. 6-108 Engine Oil Pan Baffle and Dipstick Tube

4. Use tool shown in Fig. 6-106 made from brass bar stock to pack upper seal as follows:

a. Insert tool against one end of the oil seal in the cylinder block and drive the seal gently into the groove until the tool bottoms.

b. Remove the tool and repeat at the other end of the seal in the cylinder block.

5. Clean the block and bearing cap parting line thoroughly.

6. Form a new seal in the cap (Fig. 6-107).

7. Remove the newly formed seal from the cap and cut four (4) pieces approximately 3/8" long from this seal.

8. Work two 3/8" pieces into each of the gaps which have been made at the end of the seal in the cylinder block. Without cutting off the ends, work these seal pieces in until flush with the parting line and until no fibers are protruding over the metal adjacent to the groove.

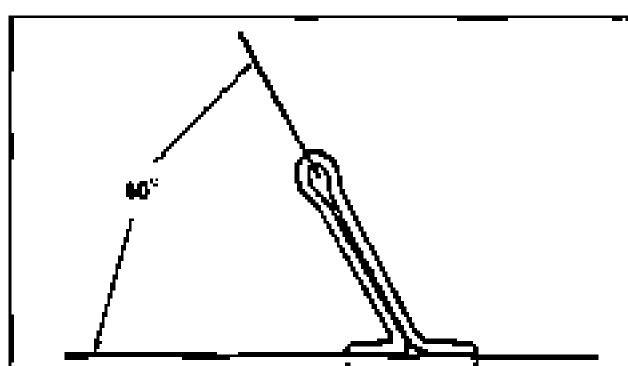


Fig. 6-109 Tool For Removing Upper Half of Main Bearing

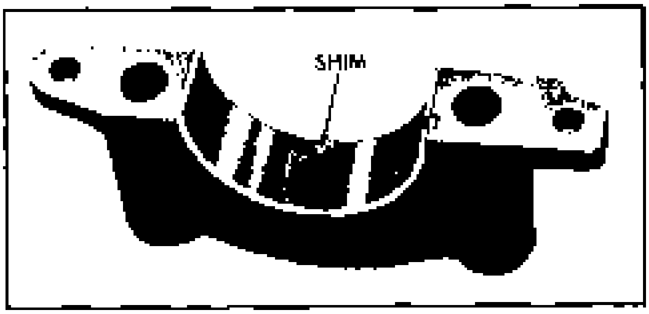


Fig. 6-110 .002 Shim Positioned in Cap for Checking Bearing Clearance

9. Form another new seal in the cap (Fig. 6-107).

10. Assemble the cap to the block and tighten to 120 lb. ft. torque.

11. Remove the cap and inspect the parting line to insure that no seal material has been compressed between the block and the cap. Clean as necessary.

12. Apply a 1/16" bead of sealer from the center of seal across to the external cork groove.

13. Reassemble the cap. Tighten to 120 lb. ft. torque.

14. Install baffle and oil pump.

15. Install oil pan (see Oil Pan - Remove and Replace).

MAIN BEARINGS

REMOVE

1. Remove oil pan (see Oil Pan - Remove and Replace).

2. To gain access to bearing caps, remove oil baffle. To gain access to rear main, remove oil pump in addition to oil baffle.

3. Remove bearing cap of main bearing to be replaced.

4. Make a tool for removing upper half of bearing shell as shown in Fig. 6-109.

5. Insert tool in oil hole of crankshaft and rotate crankshaft in usual direction of rotation. This will cause bearing to be moved from between shaft and bearing seat.

6. Oil bearing surface of shell and install by inserting plain end of bearing shell at indented side of bearing seat and gently rotating shell into place by turning shaft.

7. Install new bearing lower half by inserting in bearing cap so indentation in shell and cap coincide.

Fig. 6-111 Measuring Plastigage

8. Install bearing cap and check fit of bearing, using Plastigage as outlined below.

CAUTION: Under no circumstances should bearing caps be filed or shimmed in an effort to effect a fit.

PLASTIGAGE METHOD FOR DETERMINING MAIN BEARING CLEARANCE

When checking main bearing clearance with engine in the car, place a .002" brass shim between the crankshaft journal and the lower bearing in each bearing cap next to the one being checked (Fig. 6-110).

Tighten all cap bolts to proper torque as follows: rear - 120 lb. ft., all others 100 lb. ft. This causes the crankshaft to be forced against the upper bearing and insures an accurate measurement of the total clearance.

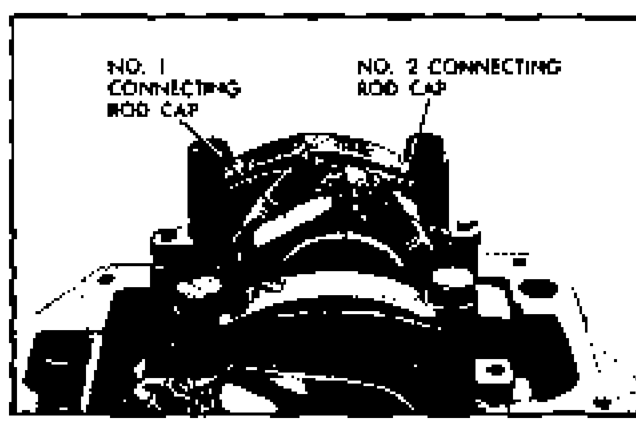


Fig. 6-112 Crankshaft Positioned For Removal of No 1 and No. 2 Connecting Rod Caps

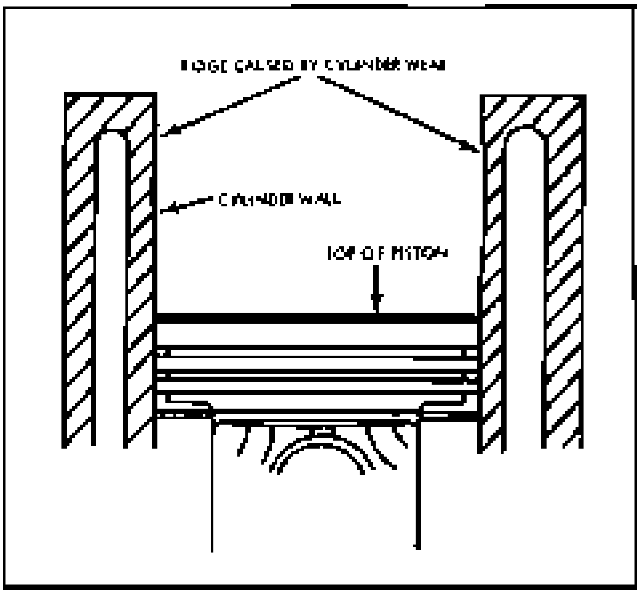


Fig. 6-113 Cylinder Ring Ridge

1. Remove the bearing cap of the bearing to be checked. Wipe the bearing and the journal free of oil.

2. Place a piece of type PG-1 Plastigage, or equivalent, the length of the bearing (parallel to the crankshaft) on the journal or bearing surface. Install the cap and tighten cap bolts to proper torque.

NOTE: Do not turn crankshaft with Plastigage, or equivalent, in place.

3. Remove bearing cap and using Plastigage scale, or equivalent, on envelope (Fig. 6-111), measure width of compressed Plastigage, or equivalent, before removing it from the bearing or journal. If the bearing clearance is between .0002" and .0020", the clearance is satisfactory. If the clearance is more than .0020", replace the bearing with the next size undersize bearing and recheck clearance. Bearings are available in standard size, .001" and .002" undersize.

4. Install a new rear main bearing oil seal in the cylinder block and main bearing cap if the rear main bearing was checked and/or replaced.

5. Replace oil pump, cylinder block to oil baffle tube, and oil baffle if they were previously removed.

6. Replace oil pan, using new gaskets.

CONNECTING ROD BEARINGS

REMOVE

1. Remove oil pan (see OIL PAN - REMOVE AND REPLACE).

2. To gain access to numbers 5, 6, 7 or 8 connecting rod caps, it will be necessary to remove oil pump screen and oil baffle. Pump must be removed as an assembly. Screen tube is a press fit in pump body and must not be rotated or removed.

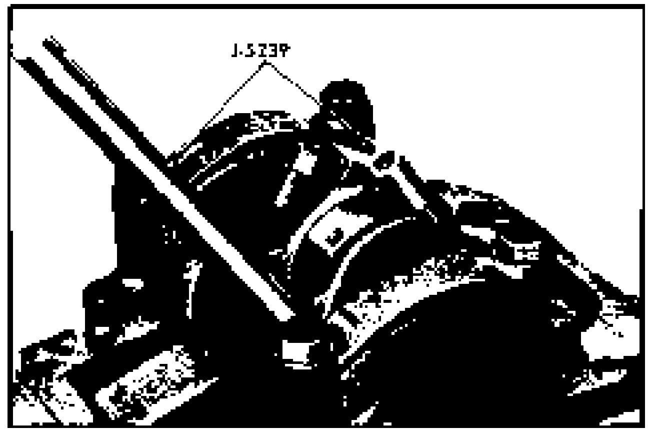


Fig. 6-114 Connecting Rod Bolt Guide Set Installed

3. Rotate crankshaft as necessary to bring crank pin carrying bearing to be replaced straight down (Fig. 6-112).

4. Remove bearing cap of bearing to be replaced.

5. Install connecting rod bolt guide set J-5239 on connecting rod bolts (Fig. 6-114).

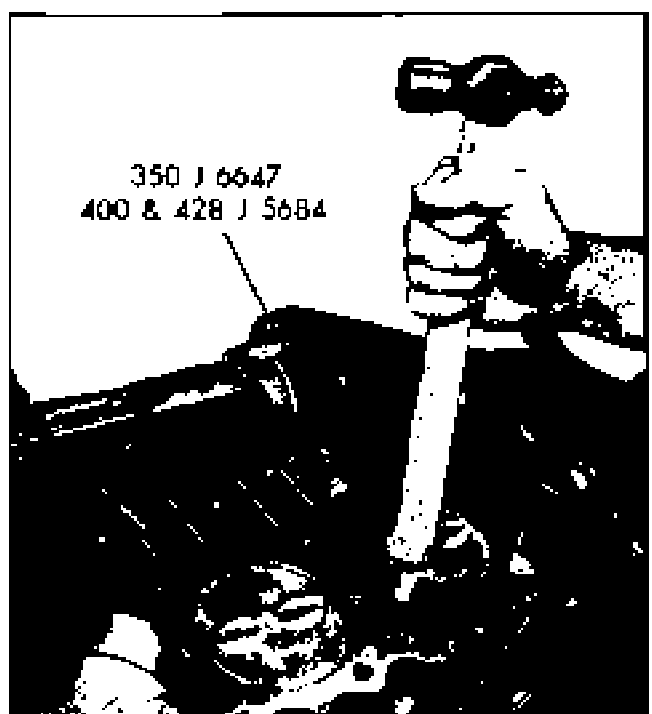


Fig. 6-115 Installing Piston Assembly

6. Push piston and rod assembly up far enough to allow removal of bearing shell. Remove bearing shells from rod and cap.

7. Inspect crank pin for damage, out-of-round, and taper.

8. Reassemble cap and rod with new bearing shells and check fit, using Plastigage, or equivalent, as outlined below.

CAUTION: Under no circumstances should a bearing cap be filed or shimmed in an effort to affect a fit.

NOTE: In 1969, a number of 2 bbl. equipped V-8's will have .010" undersize crankpins. These crankshafts may be identified by a .010" U.S. stamp on the front of the No. 1 counterweight and the rear of No. 8 counterweight. A check should be made for this undersize crankshaft before replacing rod bearings.

PLASTIGAGE, OR EQUIVALENT, METHOD FOR DETERMINING CONNECTING ROD BEARING CLEARANCE

1. Remove the cap of the bearing to be checked. Wipe the bearing and the crank pin free of oil.

2. Place a piece of type PG-1 Plastigage, or equivalent, the length of the bearing (parallel to the crankshaft) on the crankpin or bearing surface. Install the cap and tighten cap bolts to 43 lb. ft.

NOTE: Do not turn crankshaft with Plastigage, or equivalent, in place.

3. Remove bearing cap and using Plastigage scale, or equivalent, on envelope (Fig. 6-111), measure width of compressed Plastigage, or equivalent, before removing it from the crank pin or bearing. If the bearing clearance is between .0006" and .0026", the clearance is satisfactory. If clearance is more than .0026", replace bearing with the next size undersize bearing and recheck clearance. Bearings are available in .001" and .002" undersize.

4. Rotate the crankshaft after bearing adjustment to be sure bearings are not tight.

CONNECTING ROD AND PISTON ASSEMBLY

REMOVE

1. Remove oil pan, oil baffle and oil pump (see OIL PAN - REMOVE AND REPLACE).

2. Remove intake manifold and cylinder head on bank from which piston is to be removed.

3. Rotate crankshaft so crank pin carrying assembly to be replaced projects straight downward (Fig. 6-112).

4. Remove ring ridge (Fig. 6-113) using suitable ring ridge remover.

5. Remove bearing cap and install connecting rod bolt guide set J 5239.

6. Carefully remove connecting rod and piston assembly by pushing out with knurled handle of long guide (Fig. 6-114).

REPLACE

1. Install connecting rod bolt guide set on connecting rod bolts with long handle guide on same side as oil groove in rod.

2. Using J 8037 (Fig. 6-115) ring compressor, insert piston connecting rod assembly into cylinder so that notch in top of piston is toward front of engine. Be certain oil spurt hole (Fig. 6-122) in connecting rod is toward camshaft.

3. From beneath engine, pull connecting rod, with bearing shell in place, into position against crank pin.

4. Remove guide set J 5239. Install bearing cap and cap nuts and tighten to 43 lb. ft. torque.

5. Replace oil pump and oil baffle, if they were removed.

6. Install cylinder head and intake manifold.

CONNECTING ROD AND PISTON ASSEMBLY - RECONDITION

NOTE: Use care at all times when handling and servicing connecting rods and pistons. To prevent possible damage to these units, do not clamp rod or piston in vise since they may become distorted. Do not allow pistons to strike against one another, against hard objects, or bench surfaces, since distortion of piston contour or nicks in soft aluminum material may result.

DISASSEMBLE

1. Remove piston rings, using J 8021 or J 7117 piston ring remover.

NOTE: It is important that rings be removed carefully to prevent scratching or burring of ring grooves and lands.

2. Using a suitable arbor press, place the spring and plunger into the bore of the base support and position on an arbor press with the pilot plunger indexed in the bottom of piston pin bore. See insert in Fig. 6-116 for correct base support and pilot plunger for the type pistons being serviced.

3. Using the pilot plunger (or plate) indicated in Fig. 6-116, the pin may be pressed out far enough to index with the bore in the base.

4. Remove pilot plunger and spring from base.

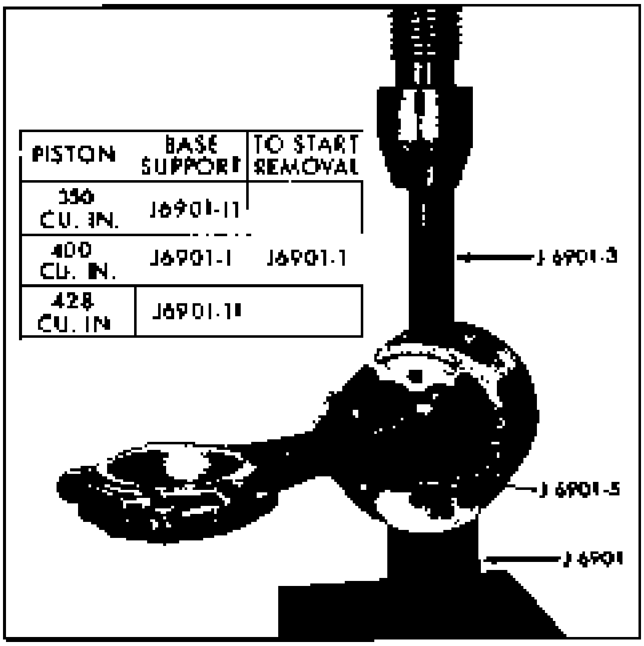


Fig. 6-116 Removing Piston Pin

5. Complete removal of pin using pin driver J 6901-3 and base alone.

6. Remove bearing cap and bearings.

CLEAN AND INSPECT

1. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil slots in oil ring groove, using suitable cleaning tools and solvent.

2. Clean piston pin, rod, cap, bolts and nuts in suitable solvent. Reinstall cap on connecting rod to assure against subsequent mixing of caps and connecting rods.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

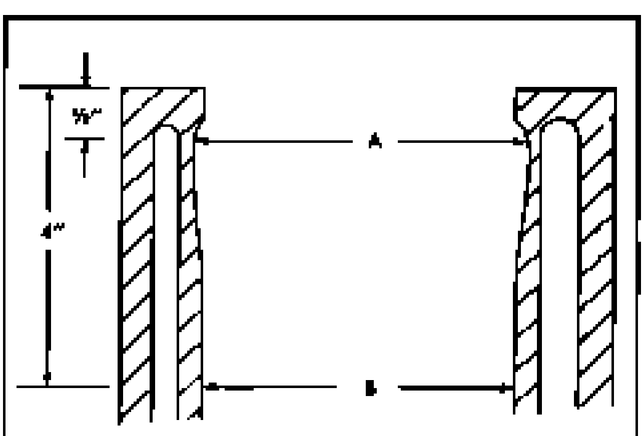


Fig. 6-117 Normal Cylinder Wear Pattern

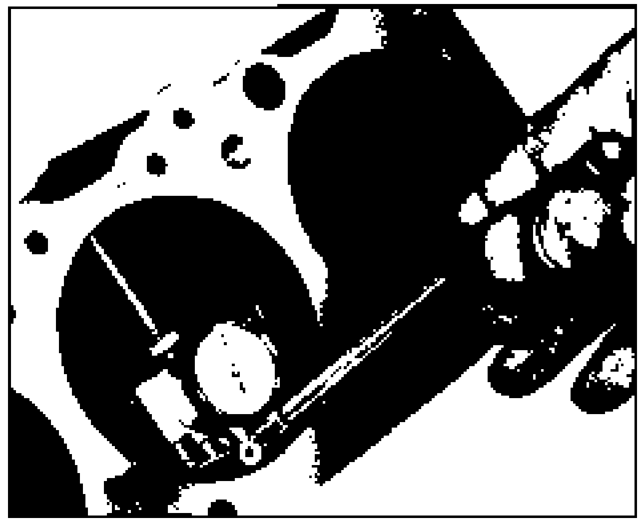


Fig. 6-118 Measuring Cylinder Bore

NOTE: If piston pin bosses are rough or worn out of-round and the piston is otherwise serviceable, the pin bosses may be honed for oversize pins. Before fitting oversize pins, however, it is advisable to check fit of piston in bore.

4. Inspect piston pin for scoring, roughness, or uneven wear.

5. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is being assembled.

CYLINDER BORES - INSPECT

Inspect cylinder bores for out-of-round or excessive taper with an accurate cylinder gauge J 8087 or

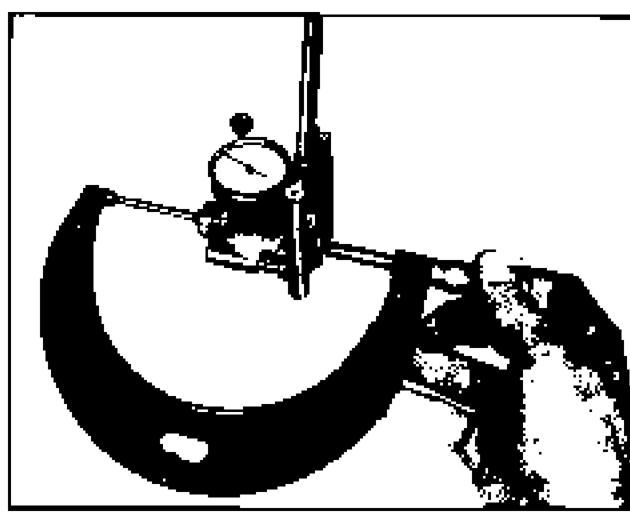


Fig. 6-119 Measuring Cylinder Gauge

comparable, at top, middle and bottom of bore. Measure cylinder bore parallel and at right angles to the centerline of engine to determine out-of-round. Variation in measure from top to bottom of cylinder indicates taper in cylinder.

Fig. 6-117 illustrates area in cylinder where normal wear occurs. Cylinder bore can be measured by setting cylinder gauge dial at zero in cylinder at the point of desired measurement. Lock dial indicator at zero before removing from cylinder, and measure across the gauge contact points with outside micrometer with gauge at the same zero setting when removed from cylinder (Figs. 6-118 and 6-119)

Take several measurements parallel and at right angles to the crankshaft, between 1/2" and 4" from the top of the cylinder. Subtract the smallest measurement found from the largest. If this figure exceeds .0006", a piston cannot be fitted properly, and the cylinder must be honed. New rings and a new oversized piston must then be fitted.

Fine vertical scratches made by ring ends will not cause excessive oil consumption, therefore, honing to remove is unnecessary.

HONING OR BORING

If a piston in excess of .005" oversize is to be installed, the cylinder should be bored, rather than honed, to effect a true bore.

To eliminate the possibility of honing taper into the cylinder, full strokes of the hone should be made in addition to checking measurement at top, middle and bottom of bore repeatedly.

Always be sure the crankshaft is out of way of boring cutter when boring each cylinder. Crankshaft bearings and other internal parts must be covered or taped to protect them during boring or honing operation. When taking final cut with a boring bar, leave .001" on the diameter for finish honing to give required piston-to cylinder clearance specifications.

NOTE: Honing or boring operation must be done under close supervision so that specified clearance between pistons, rings, and cylinder bores is maintained.

By measuring the piston to be installed at the sizing points (Fig. 6-120) and adding the mean of the clearance specification, the finish hone cylinder measurement can be determined. It is important that both block and piston be measured at normal room temperature, 60° - 90°F.

After final honing and before the piston is checked for fit, each cylinder bore must be thoroughly cleaned. Use soapy water solution and wipe dry to remove all traces of abrasive. If all traces of abrasive are not removed, rapid wear of new rings and piston will result.

Intermixing different size pistons has no effect on engine balance as all Pontiac pistons from standard size up to .030" oversize weigh exactly the same. Pontiac does not recommend boring beyond .010" during warranty period so that if necessary, engine can be serviced at high mileage without cylinder block replacement.

FIT AND REPLACE PISTON

Pistons should be fitted in the bores by actually measuring the fit. Clearance between the piston and the cylinder bore should be .0025" to .0031" on standard engines: and .0030" to .0036" on 428 engines.

If cylinder bores have been reconditioned, or if pistons are being replaced, reconditioning of bores and fitting of pistons should be closely coordinated. If bore has been honed, it should be washed thoroughly with hot soapy water and a stiff bristle brush.

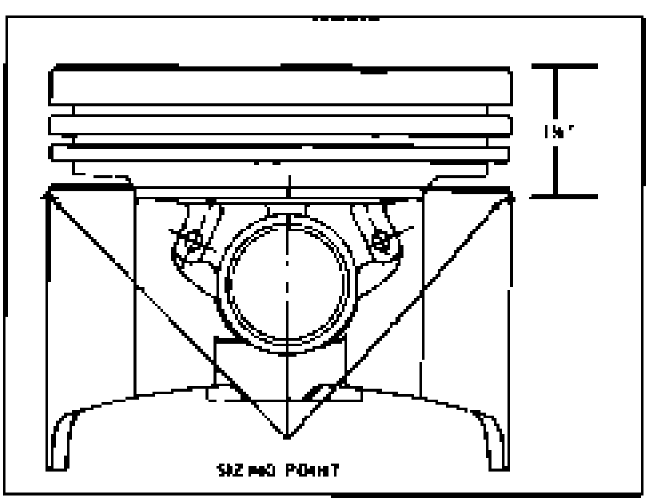


Fig. 6-120 Piston Sizing Point

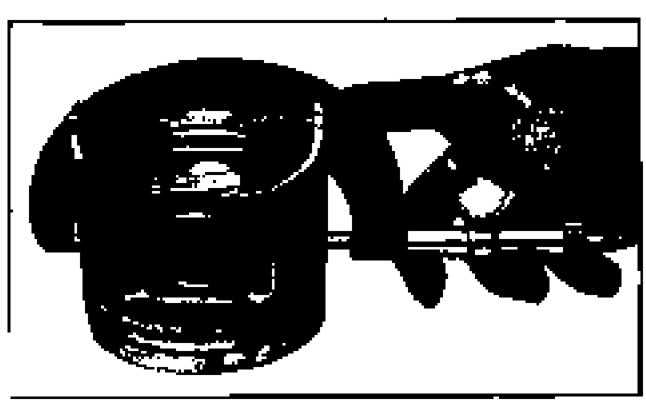


Fig. 6-121 Measuring Piston

Using a cylinder checking gauge, measure the cylinder bore crosswise of the block to find the smallest diameter. Record the smallest diameter of each bore.

NOTE: When measuring cylinder bores and pistons, it is very important that the block and pistons be at room temperature. If any or all of the parts are hotter or colder than normal room temperature, improper fitting will result.

Measure the piston skirt perpendicular to the piston pin boss (piston pin removed) and at sizing point indicated in Fig. 6-120.

Make sure the micrometer is in full contact (Fig. 6-121).

As the pistons are measured, they should be marked for size identification and the measurements recorded.

If there is excessive clearance between a cylinder bore and the piston which was installed in that bore, a new piston should be used.

New pistons are serviced in standard size and .001", .002", .005", .010", .020" and .030" oversize.

NOTE: Since these are nominal or basic sizes, it is important that new pistons be measured to ensure proper fit. All new pistons are serviced with selectively fitted piston pins.

After all measurements have been made, match the new pistons with cylinders where they will fit with proper clearance. Honing of cylinder bore may be necessary to effect a proper fit. When properly mated, mark pistons with cylinder numbers they fit so they will not become mixed.

FITTING PIN IN PISTON

The piston pin fit in the piston is .0005" to .0007" loose with pin and bosses clean and dry.

NOTE: Piston and pin must be at room temperature when checking fit and pin must be able to fall from piston by its own weight.

FITTING OVERSIZE PINS IN PISTONS AND CONNECTING ROD PIN BORES

In case the standard size piston pin does not fit properly in the piston, an oversize piston pin must be fitted. Piston pins are available in .001" and .003" oversize.

When oversize pins are used, the piston pin bosses must be honed to give required fit. It will also be necessary to hone the connecting rod pin bore to fit the oversize pin, using a Sunnen hone or similar accurate equipment.

NOTE: A special grit hone is used for honing the connecting rod pin bore. The piston pin size should be .0008" to .0016" larger than connecting rod pin bore for proper press fit. The piston pin should not show any movement under 1500 lb. minimum load after assembly in rod.

ASSEMBLE CONNECTING ROD TO PISTON

There is a notch cast in the top of all piston heads to facilitate proper installation. The piston assemblies should always be installed with notch toward front of engine. Position rod in piston so that oil squirt hole (Fig. 6-122) is toward camshaft.

REPLACE PISTON PIN

1. Place pilot plunger and spring in the support base to be used as a pilot end stop. See Fig. 6-123 insert for correct base support and pilot plunger for type pistons being serviced.

2. Place pilot plunger of tool J 6901 in piston pin bore and place on arbor press.

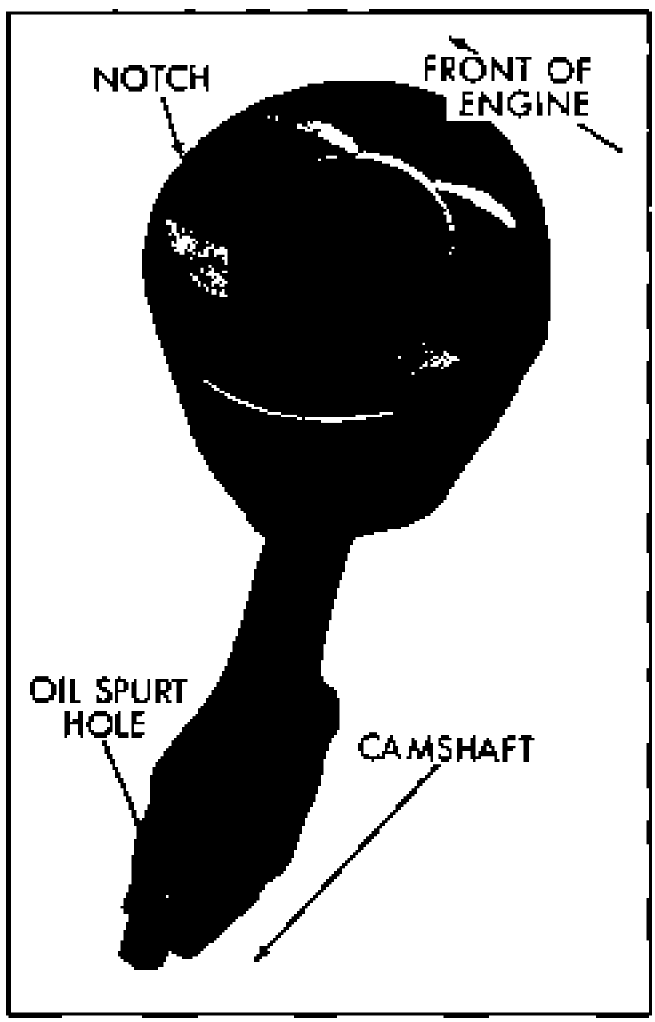


Fig. 6-122 Piston and Rod Assembly

3. Coat piston pin and rod lightly with graphite lubricant.

4. Place tool J 6901-3 in piston pin and press pin into piston and connecting rod (Fig. 6-123) until piston pin bottoms against plunger of tool J 6901. Piston must turn freely on pin. If piston binds on pin, disassemble, hone piston pin bosses slightly and reassemble.

PISTON RINGS

REMOVE

1. Remove piston and rod assembly. See CONNECTING ROD AND PISTON ASSEMBLY - REMOVE AND REPLACE.

2. Remove piston rings using J 7117 or J 8021.

3. Clean carbon, varnish, and gum from piston surfaces, including under side of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

4. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

5. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is being assembled.

6. Inspect cylinder bores for out-of-round or excessive taper. See CYLINDER BORES-INSPECT.

PISTON RING CHECK AND INSTALL ON PISTON

Two compression rings and one 3-piece oil control ring, all above the piston pin, are used on pistons for both standard and premium fuel engines. The compression rings are taper faced and also have either a step or chamfer on the inside diameter of the bottom side. The top compression ring is molybdenum filled, which results in the center section of ring sealing edge appearing porous or grainy. The lower compression ring varies depending upon the engine. See specifications at the end of this section.

Regardless of engine type, always install compression rings with the stamped markings toward the top of piston.

New rings are serviced for the standard size pistons, and for .005", .010", .020", and .030" oversize pistons. When selecting rings, be sure they match the size of the piston on which they are to be installed, i.e., standard rings for standard pistons, .010" oversize rings for .010" oversize pistons, etc. Ring gap and side clearance should be checked while installing as follows:

1. Check pistons to see that ring grooves and oil return holes have been properly cleaned.

2. Place ring down at the bottom of the ring traveled part of the cylinder bore in which it will be used. Square ring in bore by pushing it into position with head of piston.

3. Measure gap between ends of ring with feeler gauge (Fig. 6-124). Gaps should be as follows:

Compression Ring .010"-.030"

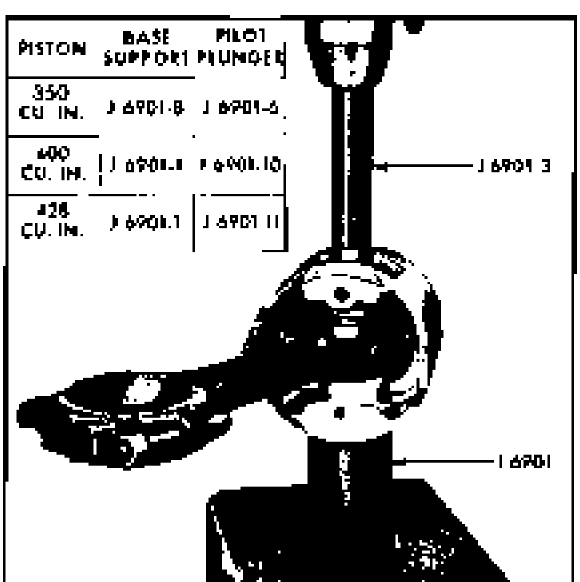


Fig. 6-123 Installing Piston Pin

Fig. 6-124 Checking Ring Gap

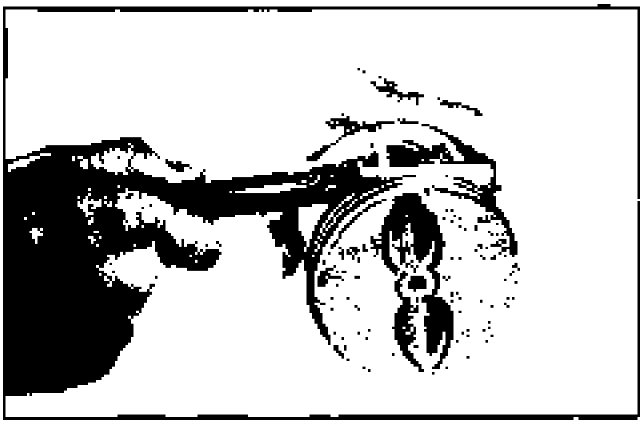


Fig. 6-125 Measuring Side Clearance of Ring in Groove

Oil Ring .015"-.055"

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore (standard, .005" oversize, etc.), they should have the proper gap. It should not be necessary to alter ring gap by filing.

4. Install rings on piston, using J 8021 or J 7117 to prevent breakage or fracture of rings, or damage to pistons.

5. Measure side clearance of rings in ring groove (Fig. 6-125) as each ring is installed. Clearance with new pistons and rings should be .0015"-.0050".

If side clearance is excessive, piston should be replaced.

CRANKSHAFT

CHECK

These checks are to be made with oil pan and baffle removed and with all main caps and rods installed and properly torqued.

1. Check end play (Fig. 6-126). Using hammer, tap end of crankshaft at rear until it is tight against front of thrust bearing (No. 4 main bearing). Measure clearance between crankshaft counterweight and thrust bearing. Proper clearance is .003" to .009". If clearance is outside these limits, a new thrust bearing is required.

2. Check connecting rod side clearance. Using hammer, gently tap lower end of connecting rod toward front of engine. Measure clearance between rear of connecting rod and crankpin. Proper clearance is .006" to .011". If clearance is outside these limits, a new rod or rods is required.

REMOVE

In order to remove the crankshaft, the engine assembly must be removed from the vehicle.

The crankshaft can then be removed and replaced with cylinder heads, pistons, rods, manifolds and other upper engine components installed, but the flywheel clutch and transmission assemblies must be removed.

1. Remove engine and clutch (SM) as an assembly. See ENGINE - REMOVE AND INSTALL.

2. Remove clutch (SM) and install engine on suitable stand.

3. Remove spark plugs.

4. Remove engine oil pan.

5. Remove oil pump assembly and oil pump drive shaft (Fig. 6-104).

6. Remove oil baffle and oil baffle tube.

7. Remove harmonic balancer.

8. Remove fuel pump.

9. Remove timing chain cover, gasket and O-ring seal.

10. Remove fuel pump eccentric and bushing (Fig. 6-96).

11. Remove sprockets and timing chain (Fig. 6-97).

12. Remove connecting rod caps.

Fig. 6-126 Measuring Crankshaft End Play

NOTE: Mark connecting rod caps for proper reinstallation.

13. Remove main bearing caps from block.

NOTE: Before removing crankshaft, tape threads of Depress pistons until connecting rods are free of crankshaft.

14. Lift crankshaft from block.

REPLACE

1. With upper bearings installed, position crankshaft in block

2. Install main bearing caps (with bearing shells in place) but do not tighten retaining bolts.

3. Pull connecting rods and piston assemblies into place, rotating crankshaft as necessary to properly seat rods.

NOTE: Make sure upper bearings remain in proper position.

4. Remove tape from connecting rod threads and install connecting rod caps (with bearings) and retaining nuts, but do not tighten.

5. Check fit of all main and rod bearings with plastigage and install proper sized new bearings.

6. Tighten rear main bearing cap to 120 lb. ft. torque and all remaining bearing caps 100 lb. ft. torque. Tighten connecting rod bearing cap retaining nuts 43 lb. ft. torque.

7. Install sprockets and timing chain, making sure timing marks on sprockets are aligned properly (Fig. 6-97).

8. Install fuel pump eccentric and bushing and insert sprocket retaining bolt with washer. Tighten securely.

9. Install timing chain cover, new cover gasket and new O-ring seal.

10. Install fuel pump.

11. Install harmonic balancer.

12. Install oil baffle and oil baffle tube.

13. Install oil pump drive shaft and oil pump assembly.

14. Install engine oil pan.

15. Install spark plugs.

16. Remove engine from stand and install clutch (SM) to engine.

17. Install complete assembly in vehicle.

ENGINE BLOCK CORE HOLE PLUGS AND OIL PASSAGE PLUGS, INSPECT AND REPLACE

Engine moving part failures may be caused by lack of proper lubrication. In such case it may be necessary to trace oil supply in the block to determine area of obstruction. Oil pressure drop may be caused by leaking oil passage plugs. For these reasons the following procedures and block illustrations are provided.

NOTE: Oil circulation diagram is provided in the engine lubrication section. Figs. 6-128, 6-129 and 6-130 also show the various location of water jacket core hole plugs.

1. With cylinder block inverted, use pen light to see that passage from oil pump to filter is open (Fig. 6-130).

2. Check passage from filter outlet to rear main bearing by inserting wire in oil filter outlet passage and using pen light to see that wire is visible in passage to rear main bearing (Fig. 6-129).

3. Visually check passage from each main bearing to corresponding camshaft bearing (Fig. 6-130).

4. Check passage from filter outlet (through left oil gallery) to main bearings. Use rubber hose to blow smoke in oil filter outlet while observing to see that smoke passes out passages leading to all main bearings.

5. With cylinder block right side up, check oil passages to left bank lifter bosses. Use rubber hose to blow smoke in oil filter outlet while observing for smoke passing out oil passages from left main oil gallery to lifter bosses (Fig. 6-128).

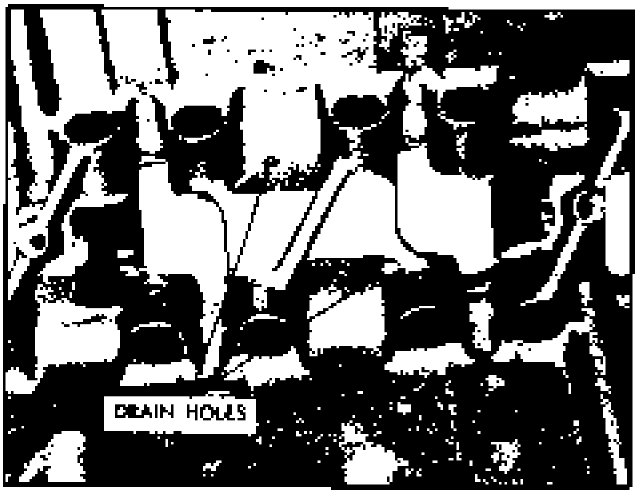


Fig. 6-127 Drain Holes In Lifter Gallery

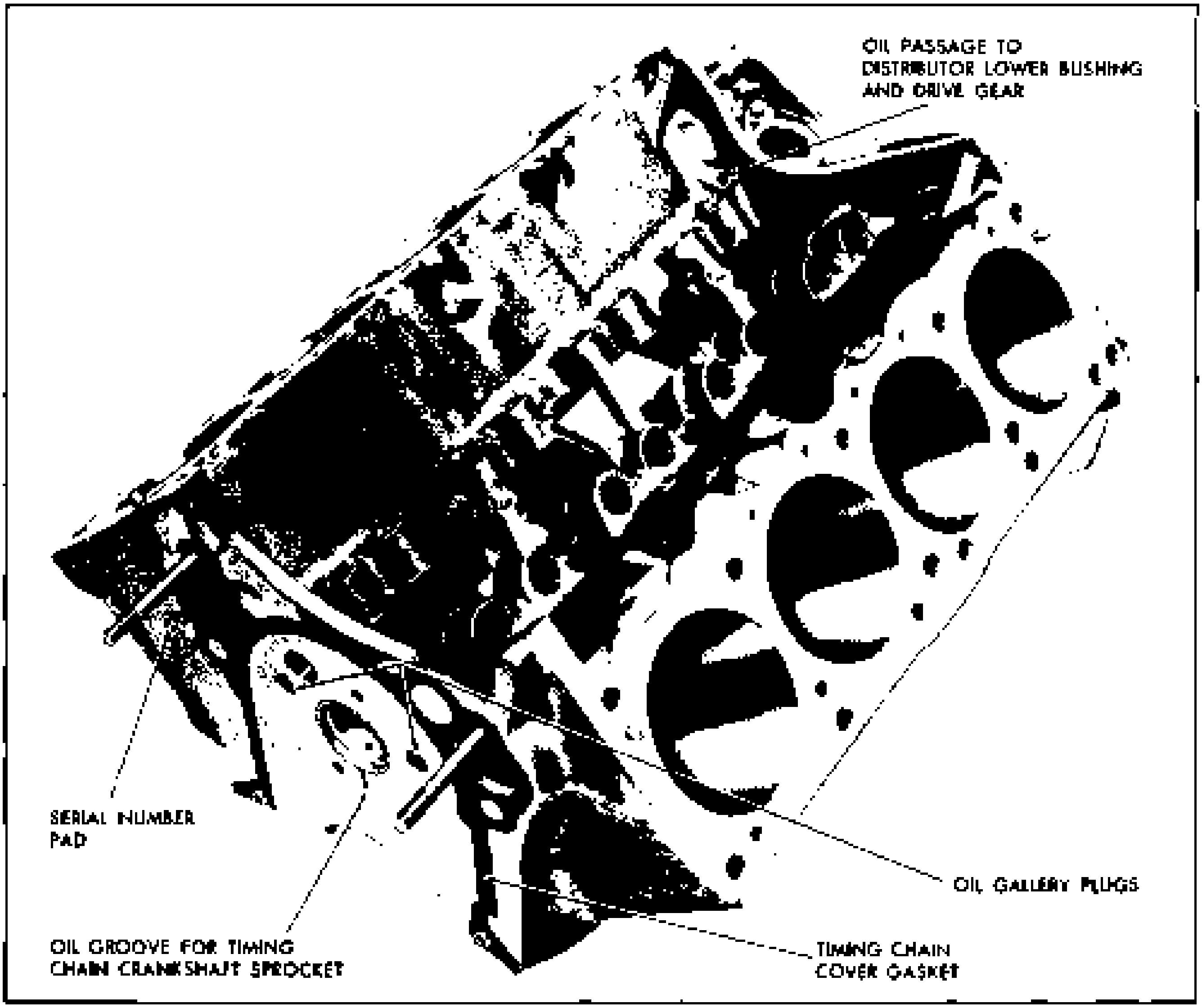


Fig. 6-128 Cylinder Block - View From Left Front

6. Check oil passages to right bank lifter bosses. Use rubber hose to blow smoke in passage from front main bearing to right main oil gallery while observing for smoke passing out passages from right gallery to lifter bosses (Fig. 6-129).

7. Use wire to check two drain holes in lifter gallery (Fig. 6-127).

INSTALL NEW PLUGS

The following plugs can be installed by driving into place, using a flat piece of metal or hard wood bearing against the outer surface- Camshaft plug, water jacket plugs, rear oil gallery plug in block, cylinder head and core hole plugs.

Front oil gallery plugs in the block must be driven into place, using a tool which bears against the bottom of the plug. A 1/2" x 3" bolt will make a satisfactory tool for this purpose.

The camshaft rear plug should be driven in to a depth of 3/10" from the rear surface of the block.

All other plugs should be driven in until the outer edge is flush with the surrounding surface.

FITTED BLOCK ASSEMBLY

Fitted block contains pistons, rings, pins and camshaft bearings.

DISASSEMBLE

1. Remove flywheel housing and clutch assembly.

2. Remove flywheel and mount engine in holding stand.

3. Remove motor mounts and linkage bracket.

4. Remove generator and mounting bracket.

5. Remove fuel pump.

6. Remove harmonic balancer.

7. Remove timing chain cover, fan and pulley. Remove timing cover mounting studs.

8. Remove fuel pump eccentric and bushing.

9. Slide timing chain and sprockets off end of camshaft and crankshaft.

10. Remove camshaft thrust plate.

11. Remove distributor and high tension wires.

12. Remove coil.

13. Remove starter assembly.

14. Remove intake manifold.

15. Remove push rod cover.

16. Remove oil level indicator.

17. Remove rocker arm covers.

18. Loosen rocker arm nuts, rotate rocker arms and remove push rods. Store push rods so that they may be reinstalled in the same position as removed.

19. Remove cylinder heads and exhaust manifolds.

20. Remove cylinder head gaskets.

21. Remove oil filter assembly.

22. Remove valve lifters; use J 3049 if necessary.

Place valve lifters in a storage box so lifters can be reinstalled in original location.

23. Remove camshaft.

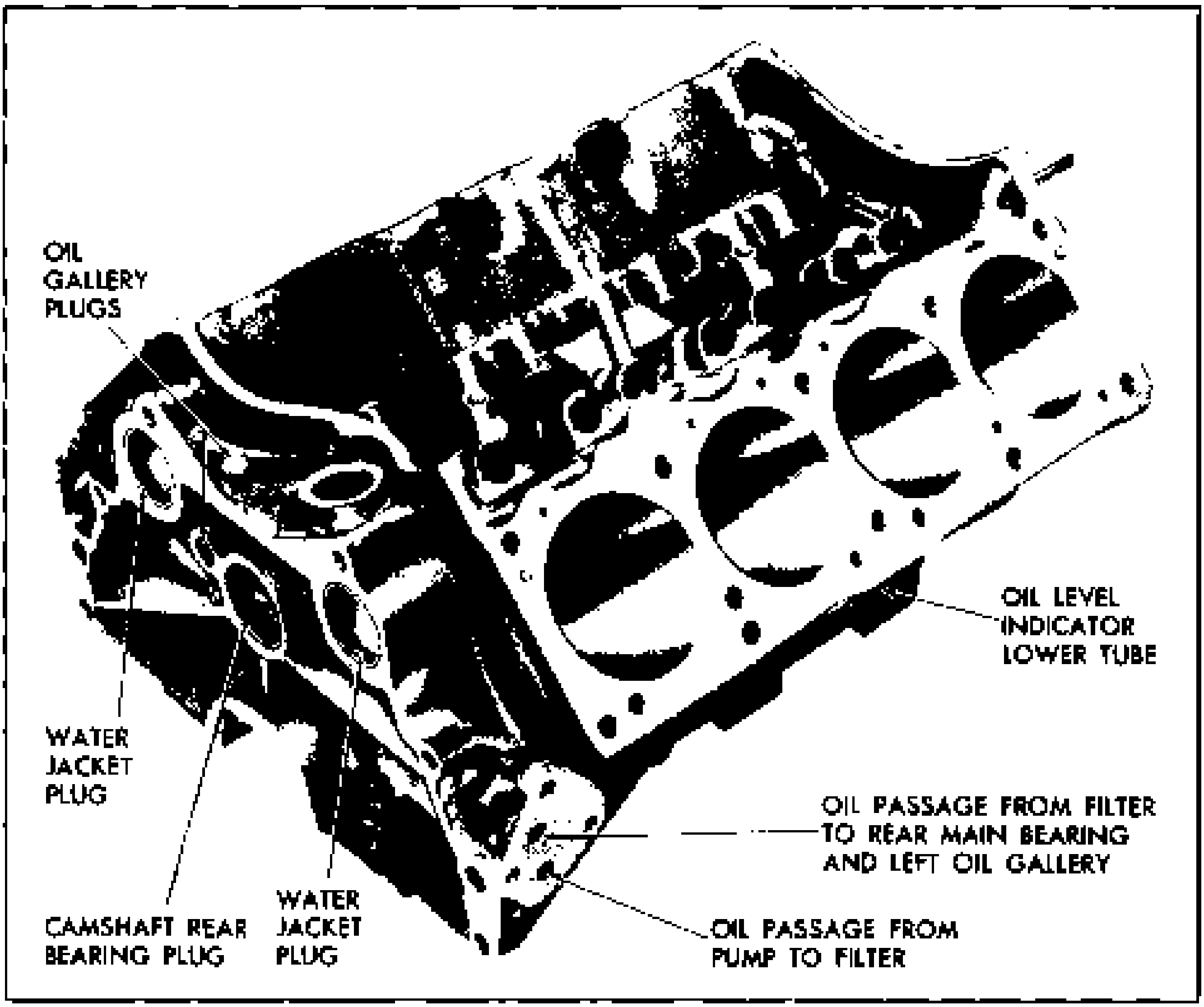


Fig. 6-129 Cylinder Block - View From Right Rear

24. Invert engine and remove oil pan and flywheel front cover.

25. Remove oil pump assembly and drive shaft.

26. Remove baffle and oil indicator tube extension.

27. Remove crankshaft.

28. Remove all connecting rod and piston assemblies.

29. Remove connecting rods from pistons and identify for installation in original location.

30. Remove old block from stand and mount new fitted block on stand.

31. Remove each piston and pin assembly from new block and a identify for installation in original position.

This completes disassembly for fitted block replacement. Proceed with assembly operations. Use new gaskets throughout and pay special attention to torque requirements.

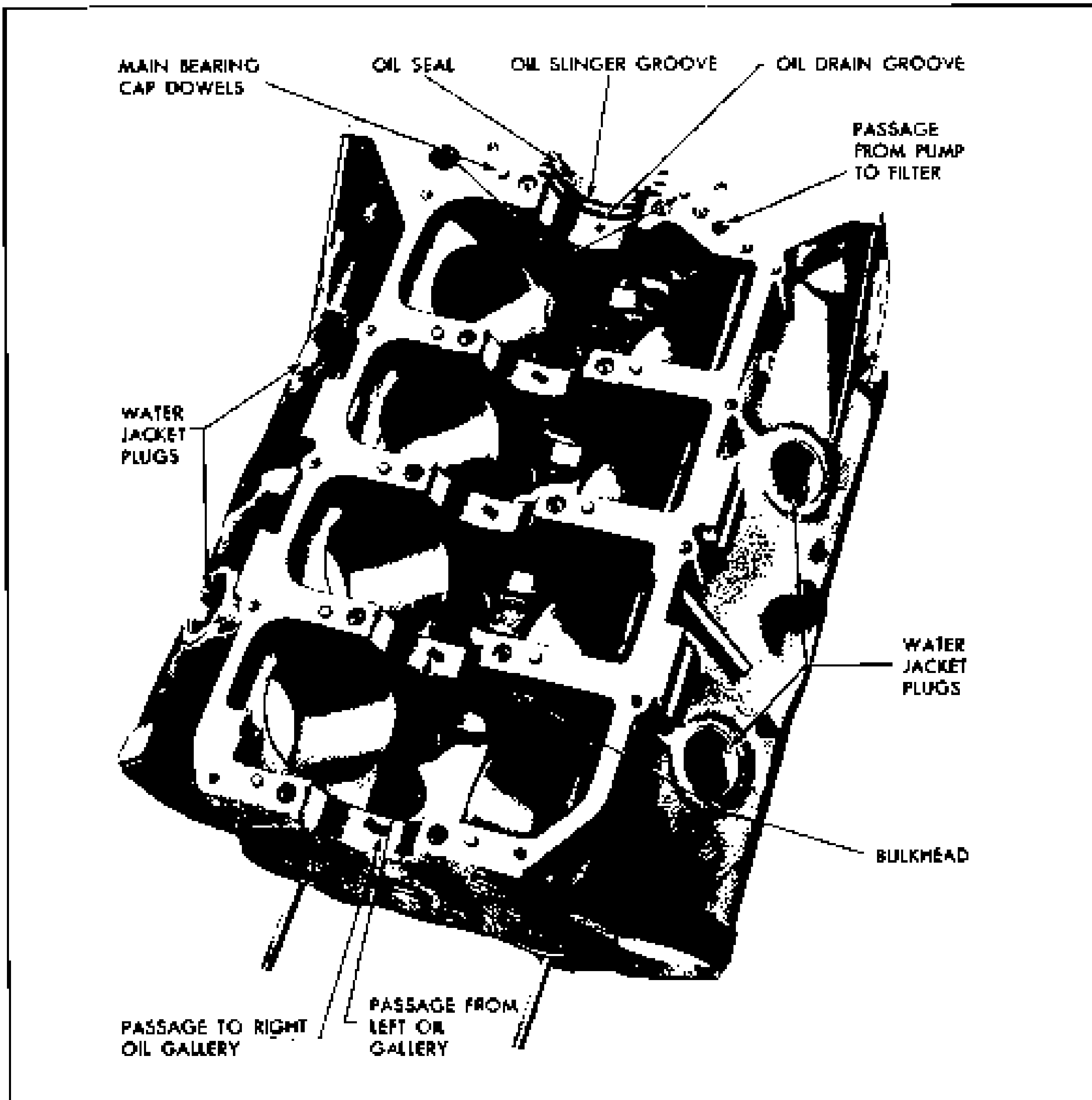


Fig. 6-130 Cylinder Block - View From Bottom

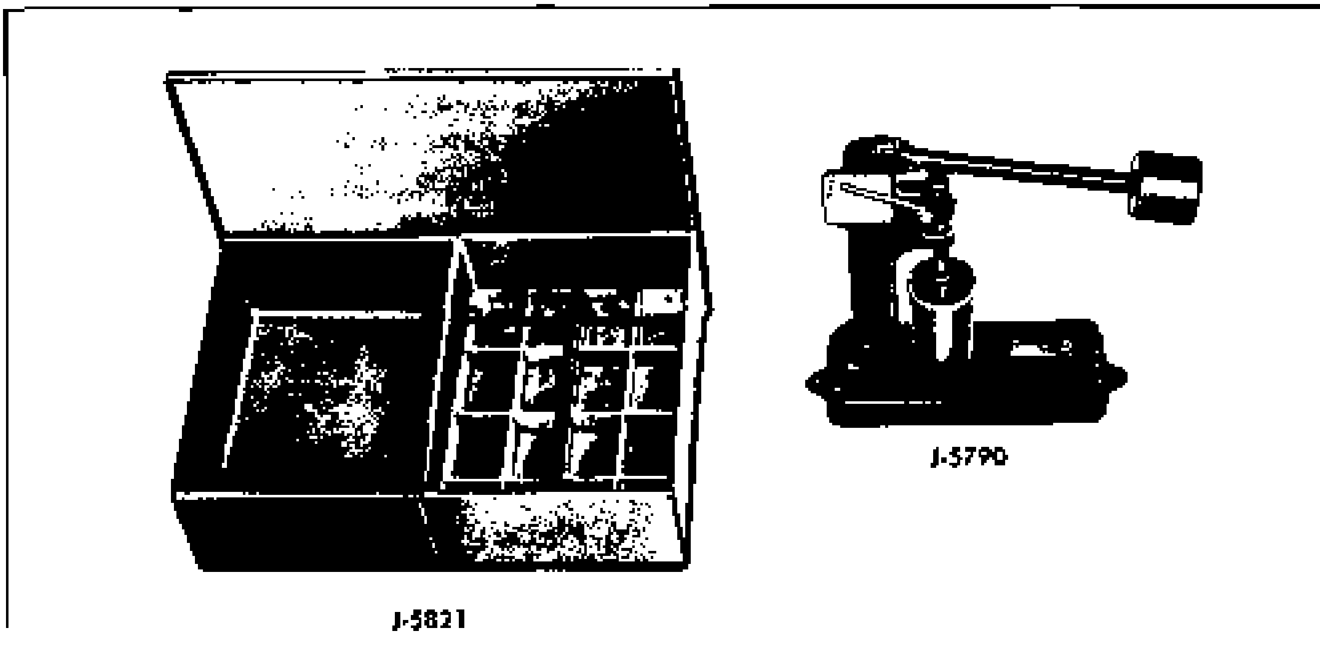


Fig. 6-131 Hydraulic Lifter Equipment

ASSEMBLE

1. Install old connecting rods to proper piston and pin assemblies and install in cylinder from which pistons were removed.

2. Install crankshaft and plastigage bearings.

3. Install two timing cover mounting studs.

4. Install camshaft, using care not to damage bearings.

5. Install camshaft thrust plate indexing oiling slot in plate with oil groove in block.

6. Make sure keys are in place in crankshaft and camshaft. Install timing chain and sprockets, making sure marks in sprockets are aligned exactly on a straight line passing through shaft centers (Fig. 6-97). Alignment can be simplified by first installing sprockets without chain to align timing marks. If timing chain is excessively loose, new chain or new chain and sprockets should be used.

NOTE: Number one cylinder is now at T.D.C. in its firing position. When installing distributor, position so that rotor is in position to fire number one cylinder.

7. Position fuel pump eccentric bushing over eccentric with flange toward camshaft sprocket.

8. Install fuel pump eccentric and bushing on camshaft sprocket, indexing tang on eccentric with keyway cut-out in camshaft sprocket.

9. Position timing cover gasket over mounting studs and dowels on block.

10. Install timing cover, water pump, fan and pulley. Do not install stud nuts at this time.

11. Slide harmonic balancer onto crankshaft, and install harmonic balancer to crankshaft bolt and washer. Place hammer handle between block and crankshaft counterweight to keep crankshaft from turning and tighten harmonic balancer to crankshaft bolt 160 lb. ft. torque.

12. Install baffle and oil indicator tube extension.

13. Insert oil pump drive shaft with dimpled end towards block.

14. Install oil pump gasket.

15. Cement new gaskets to oil pan and rear main bearing cap; use retainers to hold gasket. Install oil pan except for two rear screws. Position flywheel housing front shield and gasket against oil pan and install two rear oil pan bolts.

16. Position new cylinder head gasket on block.

17. Position cylinder heads and exhaust manifolds on locating pins. Install head bolts and torque to 95 lb. ft.

NOTE: Three different length bolts are used. When inserted in proper holes, all will project an equal amount from their respective bosses.

18. Install lifters in bosses from which they were removed.

19. Install push rods in same location as originally removed and with same end facing valve lifter.

20. Tighten rocker arm ball retaining nuts to 20 lb. ft. torque.

21. Install distributor as follows:

a. If not already done as explained in Step number 6, turn crankshaft to firing position of number one cylinder (number one exhaust and intake valve lifters both on base circles of their cams and timing mark on harmonic balancer indexed with pointer). NOTE: Number one intake must have just closed.

b. Position new distributor to block gasket on block.

c. Install distributor (without cap and wires) so that vacuum diaphragm faces left side of engine and rotor arm points toward contact in cap for number one cylinder. It will also be necessary to turn the oil pump drive shaft so it will index with distributor shaft.

22. Install distributor hold-down clamp and special bolt and tighten enough to hold distributor in place.

23. Install coil.

24. Cement new gasket to push rod cover and install push rod cover.

25. Cement new gaskets to rocker arm covers and install covers.

26. Install intake manifold gasket with plastic locating sleeves in cylinder head as shown in Fig. 6-78

27. Start intake manifold to timing cover draw bolt into intake manifold.

28. Position intake manifold and install retaining screws finger-tight.

29. Tighten draw bolt to 15 lb. ft. torque to obtain metal to metal contact between manifold and timing cover.

30. Tighten manifold screws to 40 lb. ft. torque.

31. INSTALL OIL FILTER ASSEMBLY AND GASKET.

32. Install oil level indicator

33. Install throttle linkage

34. Install starter assembly.

35. Install fuel pump.

36. Install generator and bracket.

37. Install fan belt and adjust belt tension as covered in Section 6A.

V-8 ENGINE WRENCH TORQUE SPECIFICATIONS

NOTE: Torque in lb. ft. unless otherwise shown.

APPLICATION	TORQUE LB. FT.
Bolt—Main Bearing Cap to Block	100
Bolt—Rear Main Bearing Cap to Block	120
Bolt—Cylinder Head	95
Bolt—Flywheel to Crankshaft	95
Nut—Connecting Rod Bearing Cap	43
Bolt—Oil Pan to Block	12
Bolt—Oil Pump to Block	30
Bolt—Harmonic Balancer to Crankshaft	160
Bolt—Exhaust Manifold to Head	30
Bolt—Intake Manifold to Head	40
Bolt—Camshaft to Sprocket	40
Nut—Rocker Arm to Stud	20
Stud—Rocker Arm	50
Spark Plug to Head	20
Bolt—Rocker Cover	8

V-8 ENGINE SPECIFICATIONS

Type........90° V-8 O.H. Valve

Bore and Stroke
- (350 cu. in.)........3-7/8" x 3-3/4"
- (400 cu. in.)........4.120" x 3-3/4"
- (428 cu. in.)........4.120" x 4"

Taxable Horsepower
- (350 cu. in.)........44.3
- (400 cu. in.)........54.3
- (428 cu. in.)........54.3

HORSEPOWER AND TORQUE

ENGINE	CARBURETOR	COMPRESSION RATIO	HORSEPOWER	TORQUE
350	2-Bbl	9.2	265 @ 4600	355 @ 2800
350 (Firebird)	Q'Jet	10.5	325 @ 5100	380 @ 3200
350 (Tempest)	Q'Jet	10.5	330 @ 5100	380 @ 3200
400 GTO	2-Bbl	8.6	265 @ 4600	397 @ 2400
400 GTO	Q'Jet	10.75	350 @ 5000	445 @ 3000
400 Ram-Air GTO	Q'Jet	10.75	366 @ 5100	445 @ 3600
400 Ram-Air IV GTO	Q'Jet	10.75	370 @ 5500	445 @ 3900
400 (Firebird)	Q'Jet	10.75	330 @ 4800	430 @ 3300
400 HO (Firebird)	Q'Jet	10.75	335 @ 5000	430 @ 3400
400 Ram-Air IV (Firebird)	Q'Jet	10.75	345 @ 5400	430 @ 3700
400	2-Bbl	8.6	265 @ 4400	397 @ 2400
400	2-Bbl	10.5	290 @ 4600	428 @ 2500
400 MT & AT	Q'Jet	10.5	340 @ 4800	445 @ 2900
400 GP MT & AT	Q'Jet	10.5	350 @ 5000	445 @ 3000
428	Q'Jet	10.5	370 @ 4800	472 @ 3200
428 (Bonneville)	Q'Jet	10.5	360 @ 4600	472 @ 3400
428 HO	Q'Jet	10.75	390 @ 5200	465 @ 3400

Compression Pressure at Cranking Speed
- (8.6:1 and 9.2:1 Compression Ratio-Regular Fuel)........150-170 PSI @ 155-165 RPM

Compression Pressure at Cranking Speed
(10.5:1 Compression Ratio-Premium Fuel)
(10.75:1 Compression Ratio-GTO & 428 HO) .... 185-210 PSI @ 155-165 RPM
Firing Order 1-8-4-3-6-5-7-2
Car-Engine Serial No. Location .... Front Face of Right Cylinder Bank
Production Engine No. Location .... Front Face of Right Cylinder Bank

Cylinder Nos.-Front to Rear
Left Bank 1-3-5-7
Right Bank 2-4-6-8

Cylinder Block
Material .... Alloy Cast Iron
Installation Angle
Pontiac .... 4°
Tempest .... 4° 42′
Firebird .... 3° 35′

Cylinder Heads
Material .... Alloy Cast Iron
Combustion Chamber .... Quenchless Type—Fully Machined

Pistons
Material-All Except Ram Air .... Tin-Plated Aluminum Alloy
Ram-Air .... Forged Aluminum
Type .... Cam and Contour Ground—Slipper Skirt
Measurement Taken At .... Top of Skirt

Clearance in Cylinder
350 and 400 .... .0025″—.0031″
428 .... .0030″—.0036″
400 Ram Air IV .... .0055″—.0061″

Piston Rings
Compression Rings .... Two Cast Iron, Reverse Twist, Taper Face

Material	Upper	Lower
350	Channel Moly Filled	Tin-Plated
400 GTO, Firebird		
400 and R.A.	Channel Moly Filled	Channel Moly Filled
400 Pontiac	Channel Moly Filled	Tin-Plated
428	Channel Moly Filled	Tin-Plated
428 H.O.	Channel Moly Filled	Channel Moly Filled

Oil Ring .... Three-Piece
Material
Rails (2) .... Chrome-Plated Steel
Expander .... Stainless Steel

Ring Gap
Compression .... .020″
Oil .... .035″
Side Clearance (Ring to Groove) .... .0015″—.005″

Piston Pin
Material .... Extruded SAE 1016 Steel
Diameter .... .9802″
Wall Thickness .... .38″
Length .... 3.25″
Fit in Piston .... .0005″—.0007″
Fit in Rod .... Press

Connecting Rod
- Material .... Arma Steel
- Weight (oz.) 31.7
- Length (Center to Center) .... 6.625"
- Bearings
  - Length .... .88"
  - Clearance .... .0005"-.0025"
  - Material
  - Standard .... Moraine 100-A
  - GTO Firebird 400 and 428 .... Moraine 400-A

End Play on Crankshaft .... .006"-.011"

Timing

Camshaft	9777254	9779067	9779066	9779068	9794041
Intake					
Opens (BTC)	22°	23°	30°	31°	42°
Closes (ABC)	67°	70°	63°	77°	86°
Duration	269°	273°	273°	288°	308°
Lift—Standard	.375"	.407"	.407"	—	—
GTO, GP, 428	—	.410"	.410"	.414"	.516"
Exhaust					
Opens (BBC)	72°	78°	77°	90°	95°
Closes (ATC)	25°	31°	25°	32°	45°
Duration	277°	289°	282°	302°	320°
Lift					
Standard	.410"	.411"	.412"	—	—
GTO, GP, 428	—	.413"	.414"	.413"	.516"
Valve Overlap	47°	54°	55°	63°	87°

Valve Springs

	Standard PSI	GTO MT PSI	GTO & Firebird Ram-Air PSI	428 H.O. MT PSI
Outer	135-145 @ 1.134"	135-145 @ 1.134"	180-190 @ 1.299"	135-145 @ 1.134"
	59-65 @ 1.586"	59-65 @ 1.586"	93-99 @ 1.712"	59-65 @ 1.586"
Inner	99-105 @ 1.114"	118-128 @ 1.114"		118-128 @ 1.114"
	28-34 @ 1.566"	48-53 @ 1.566"		48-53 @ 1.566"

Valves
- Material
  - Intake .... GM 8440 Steel with aluminized Face and Flash Chrome Stem
  - Exhaust (Standard) .... 21-2N Steel with Aluminized Face and Flash Chrome-Plated Stem
  - Exhaust (H.O. and R.A.) .... 21-2N Steel with Aluminized-Swirl Polished Face and Chrome Plated Stem
- Diameter of Head
  - Intake
    - Standard and 428 Bonneville Automatic transmission .... 1.91"
    - GTO, GP, 428 (Except 428 Bonneville Automatic Transmission), H.O. and R.A. .... 2.06"
  - Exhaust
    - Standard and 428 Bonneville Automatic Transmission .... 1.61"
    - GTO, GP, 428 (Except 428 Bonneville Automatic Transmission), H.O. and R.A. .... 1.72"
- Overall Length
  - Intake
    - 350 2-Bbl. .... 5.02"
    - 350 4-Bbl. .... 5.12"
    - GTO and H.O. .... 5.09"
  - 400 Reg. Fuel .... 4.99"
  - 400 Prem. Fuel and R.A. .... 5.08"
  - GP & 428 and H.O. .... 5.09"

Exhaust
- 350 2-Bbl. .... 5.01"
- 350 4-Bbl. .... 5.19"
- GTO and H.O. .... 5.08"
- 400 Reg. Fuel .... 4.98"
- 400 Prem. Fuel and R.A. .... 5.07"
- GP and 428 and H.O. .... 5.08"

Diameter of Stem .... .34"

Stem to Guide Clearance
- Intake .... .0016"-.0033"
- Exhaust .... .0021"-.0038"

Valve Seat Angle
- Intake—Large Valves .... 30°
- Intake—Small Valves .... 45°
- Exhaust .... 45°

Valve Face Angle
- Intake—Large Valves .... 29°
- Intake—Small Valves .... 46°
- Exhaust .... 44°

Crankshaft

Material
- 350 and 400 .... Nodular Iron
- 428 .... Pearlitic Malleable Iron

No. of Bearings 5

Crankshaft

Main Bearing Material
- 350 .... Moraine 100-A
- GTO and Firebird 400 Upper and #5 Lower .... Moraine 100-A
- GTO and Firebird 400 Lower Exc. #5 .... Moraine 400-A
- Pontiac 400 Exc. #4 Lower .... Moraine 100-A
- Pontiac 400 #4 Lower .... Moraine 400-A
- 428 .... Moraine 400-A

Thrust Taken On .... No. 4

Crankshaft Endplay .... .003"-.009"

Journal Diameter
- 350 and 400 .... 3.00"
- 428 .... 3.25"

Main Bearing Length
- Nos. 1, 2, 3 .... .94"
- No. 4-350 & 400 .... 1.13"
- No. 4-428 .... 1.19"
- No. 5 .... 1.59"

Clearance .... .0002"-.0020"

Crankpin Diameter 2.25

Flywheel and Sprockets

Flywheel
- Material
- Manual .... Cast Iron
- Automatic .... Stamped Steel
- No. of Teeth 166

Starter Motor Drive
- No. of Teeth 9

Crankshaft Sprocket
- Material .... Carburized and Hardened Steel
- No. of Teeth 21

Camshaft Sprocket
- Material .... Aluminum Alloy with Nylon Covered Teeth
- No. of Teeth 42

Timing Chain .... Link Type—Single Side Guide
- No. of Links 60

Harmonic Balancer .... Cast Iron with Bolt on Stamped Pulley

Camshaft
- Material . . . . Hardened Alloy Cast Iron
- Bearings
  - Number 5
  - Type . . . . Steel Backed Babbitt
  - Diameter—All . . . . 1.9"

Valve System
- Valve Lifter
  - Type . . . . Hydraulic
  - Leak-Down Rate . . . . 20-90 Sec. with 50 Lb. Load
  - Plunger Travel (For Gaging Purposes)
  - Standard . . . . .125"
  - Ram-Air . . . . .030"
- Pushrod
  - Material . . . . Steel Tubing
  - Length
  - Standard . . . . 8.72"
  - GTO, & Firebird 400 GP, & 428 . . . . 9.16"

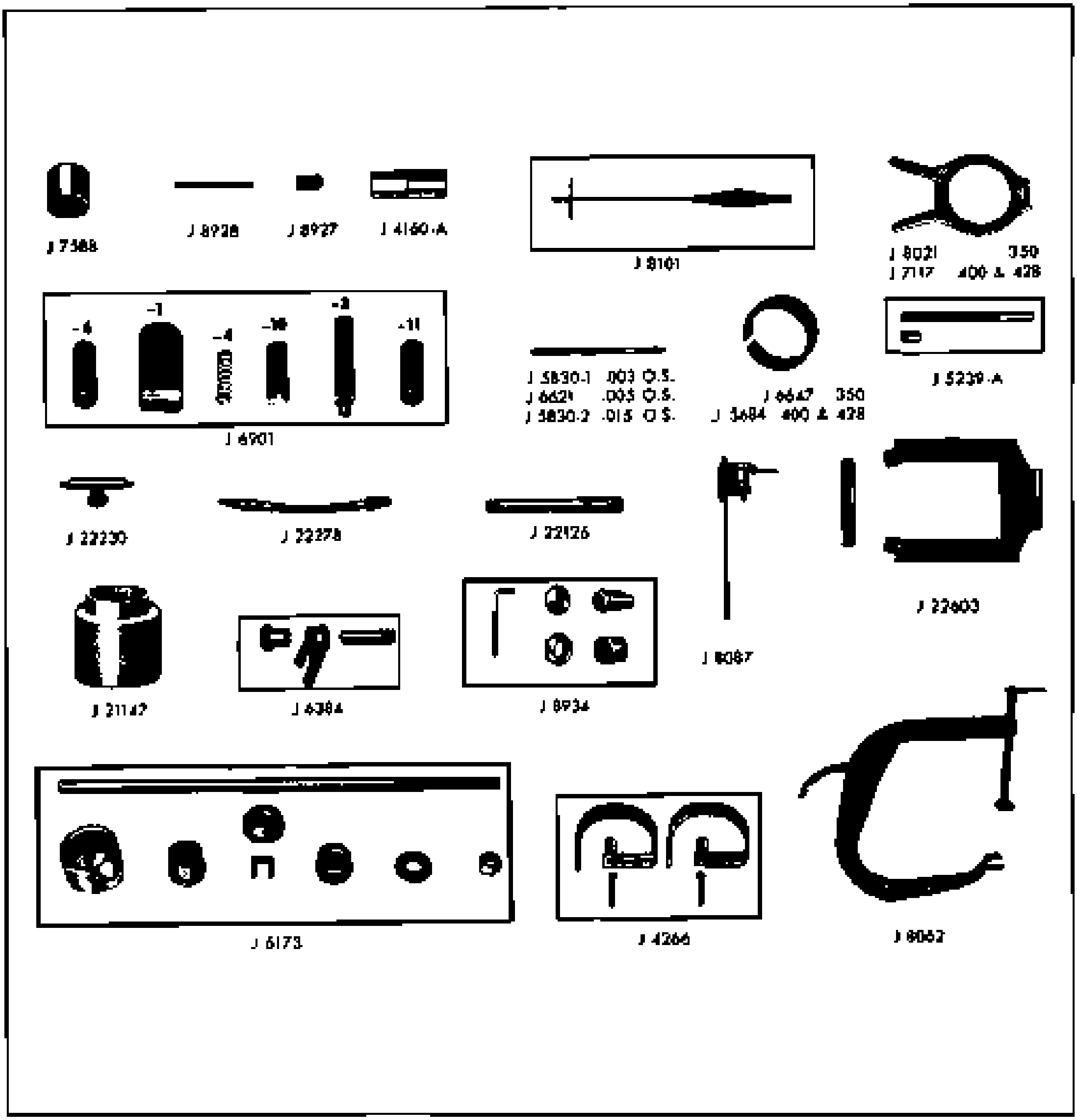
Camshaft
- Rocker Arm
  - Material . . . . Stamped Steel
  - Ratio (All Except Ram Air) . . . . 1.5 to 1
  - Ram Air . . . . 1.65 to 1
- Rocker Arm Stud
  - Standard . . . . Pressed in to Head
  - GTO, & Firebird 400, GP, & 428 & 400 R.A. . . . . Screwed in to Head

Lubrication System
- Type of Lubrication
  - Main Bearings . . . . Pressure
  - Connecting Rods . . . . Pressure
  - Piston Pins . . . . Splash
  - Camshaft Bearings . . . . Pressure
  - Lifters & Rocker Arms . . . . Pressure
  - Timing Gears & Chain . . . . Metered Jet
  - Cylinder Walls . . . . Metered Jet

Oil Pump
- Type . . . . Spur Gear
- Oil Pickup . . . . Stationary Screen
- Pressure
  - Standard . . . . 30-40 @ 2600 RPM
  - GTO & 428 . . . . 45-50 @ 2600 RPM
- Oil Capacity . . . . 5 Qts.
  - with Filter . . . . 6 Qts.

Fuel System
- Fuel Pump Pressure (PSI) . . . . 5.0-6.5 PSI
- Fuel Filter . . . . Sintered Bronz on 2 BBL
  Pleated Paper on Q'Jet
- Carburetor
  - Type
  - 2-Bbl . . . . Rochester 2 GC
  - 4-Bbl . . . . Rochester Quadrajet
- Barrel Size
  - 2-Bbl . . . . 1.688"
  - Q'Jet . . . . 1.375" Primary, 2.250 Secondary

Cooling System
- Radiator Cap Pressure (PSI) 14-17
- Thermostat Opens At . . . . 190°F
- Water Pump Rate (GPM) 17



J 4160-A Hydraulic Valve Lifter Plunger Remover
J 4266 Cylinder Head Lifting Tools
J 5239-A Connecting Rod Bolt Guide Set
J 5684 Piston Ring Compressor - 400-428
J 5830-1 Valve Guide Reamer .003 O.S.
J 5830-2 Valve Guide Reamer .015 O.S.
J 6173 Camshaft Bearing Remover and Replacer
J 6384 Valve Spring Compressor Set
J 6621 Valve Guide Reamer .005 O.S.
J 6647 Piston Ring Compressor - 350
J 6901 Piston Pin Remove and Replace Set
J 7117 Piston Ring Remove and Replace Tool 400-428
J 7588 Rear Main Bearing Oil Seal Installer
J 8021 Piston Ring Remove & Replace Tool—350
J 8062 Valve Spring Compressor
J 8087 Cylinder Bore Gauge
J 8101 Valve Guide Cleaner
J 8927 Rocker Arm Stud Installer
J 8928 Valve Train Gauge
J 8934 Rocker Arm Stud Remover
J 21147 Timing Chain Cover Seal Installer
J 22126 Rocker Arm Stud Remover .005 O.S.
J 22230 Valve Seal Installer and Tester
J 22278 Adaptor—Air Line
J 22603 Engine Lifting Tool

Fig. 6-132 V-8 Special Engine Tools

ENGINE COOLING AND LUBRICATION

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

ENGINE COOLING SYSTEM

The cooling system consists of the radiator, cap, radiator hoses, water pump, cooling fan, pellet type thermostat and suitable passages for water circulation through the engine.

RADIATOR-ALL MODELS

A cross-flow radiator is used on all 1964 Pontiacs instead of the conventional down-flow type. The cross-flow radiator differs in the fact that water flows horizontally and the tanks are on the left and right side of the core instead of above and below the core.

The cross-flow radiator offers improved cooling capabilities while making possible a lower front end silhouette due to its reduced height. The low, wide shape of the cross-flow radiator matches the grille opening more efficiently, providing greater radiator exposure and more effective cooling surface.

Radiators used with automatic transmission have oil coolers built into the right tank with inlet and outlet fittings for circulation of transmission fluid. The Pontiac radiator used with automatic transmission is equipped with heavy duty oil cooler when used on police cars, trailer options, etc., and as optional equipment where extreme cooling conditions must be met.

The radiator used with the synchromesh transmission is a cross-flow without oil cooler. Cars equipped with air conditioning and performance options use a radiator which has more cooling capacity for greater cooling demands.

A drain cock is located at inside lower left corner of radiator.

RADIATOR CAP

A pressure-vent cap is used on the radiator to allow a build-up of 15 psi of pressure in the cooling system. This pressure raises the boiling point of coolant to approximately 258°F. at sea level.

CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in radiator without causing the solution to boil. Removal of the radiator cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine, fenders, and person removing cap. If the solution contains inflammable anti freeze, such as alcohol, there is also the possibility of causing a serious fire. When removing filler cap, rotate cap toward left very slowly; if hissing of vapor is encountered, tighten cap immediately and wait for system to cool sufficiently to allow removal of cap. After pressure in system has been relieved, turn cap more forcibly to left and remove. Turn cap all the way to right when installing. It should not be necessary to check coolant level unless temperature gauge shows over-heating, and then not until engine is stopped and allowed to cool to normal.

The pressure type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring of pre-determined strength which protects the radiator by relieving the pressure if an extreme case of internal pressure should exceed that for which the cooling system is designed. The vacuum valve is held against its seat by a light spring which permits opening of the valve to relieve vacuum created in the system when it cools off and which otherwise might cause the radiator to collapse.

WATER PUMP-8 CYLINDER

The centrifugal-type water pump, divider, internal housing and aluminum timing chain cover are all part of the coolant circulation system.

The water pump impeller turns on a steel shaft mounted on a double row of permanently lubricated, sealed ball bearings. A bellows-type seal is seated in the water pump body between bearing and impeller. The seal surface is a phenolic washer which is held by the spring-loaded bellows against a ceramic seal seat which seals the pump shaft via a rubber boot.

The water pump on 1969 V-8 engines has been redesigned by positioning the bearing forward to provide improved bearing loads and better durability.

The inlet side of the pump is connected to the lower radiator tank by means of a hose. A water leg in intake manifold connects to the timing chain cover to provide recirculation of water when the thermostat is closed. The timing chain cover also has a heater water return connection.

WATER PUMP-6 CYLINDER

The centrifugal-type water pump contains an impeller which turns on a steel shaft which rotates in a ball bearing. A bellows-type seal is seated in the water pump body between the bearing and impeller.

The inlet side of the pump is connected to the right radiator tank by a hose. Above the pump inlet from the radiator is the inlet from the heater core. Coolant passages in the block and water pump index with each other to permit a completely full flow coolant internal recirculation system. This provides a more positive engine temperature regulation.

FAN

The fan is used to increase the air flow through the radiator at all speeds.

All cars except Firebird 400, G.T.O., 428 H.O. and air conditioned cars have a fan which has four blades which are unevenly spaced and have curled tips to provide minimum noise. Cars equipped with the Ram Air IV option use a special four bladed fan. See fan usage specifications for proper application of power flex and thermo clutch fans.

A fan shroud is used on all V-8 equipped cars. This greatly assists the cooling characteristics by preventing the recirculation of air around the fan.

SERVICE OPERATIONS

CHECKING AND FILLING COOLING SYSTEM

The cooling system requires little care except for maintaining an adequate coolant level. If GM glycol-type inhibited engine coolant is used, it is not necessary to drain the coolant for summer driving because this coolant has been especially formulated to last 24 months in the cooling system. After service for 24 months, drain the system, flush it with water, and refill with an inhibited year-round coolant meeting the GM 1899M specification. If other than Pontiac-approved inhibited glycol-type antifreeze solution is used, the cooling system should be drained, flushed and refilled for the summer months. When water is used, a good corrosion inhibitor must be added to the system. Failure to use an inhibited coolant may result in severe corrosion damage to the cooling system components.

FLUSHING COOLING SYSTEM

1. Drain radiator and block by opening drain plug on radiator left tank and removing plug on left side of 6 cylinder engine block and on both sides of 8 cylinder engine block.

2. After system is empty, with drains open, run water into radiator. Engine should be running and occasionally accelerated to aid in circulating water and dislodge rust and scale.

CAUTION: Do not introduce cold water into a hot engine or block may be cracked. Allow engine to cool, then add water with engine running.

3. Where there is difficulty in getting water to run clear or there is an excessive amount of rust and scale, the cooling system should be cleaned with a cleanser (reputable source) supplied for that purpose. If force flushing equipment is used, it should be used on the radiator only (engine to radiator inlet and outlet hoses removed) as any reverse flushing of the block with the water pump in place may cause the water pump seal to leak, if flushing pressure is excessive.

PREPARING COOLING SYSTEM FOR COOLANT

The cooling system should be properly prepared for the addition of coolant every two years.

To properly prepare cooling system:

1. Bring engine up to operating temperature.

2. Flush out cooling system as indicated previously.

3. Tighten all hose connections on radiator, engine, heater and defroster. Replace any deteriorated hose. Check to see that radiator hold-down bolts are tightened properly.

4. Fill system with water and operate engine, checking for water leaks at radiator core, hose connections, water pump seal and gaskets, heater and defroster connections, and head to block joint.

3. Drain sufficient water to allow addition of proper quantity of coolant.

Do not overfill. Coolant should be 1" below filler neck opening with hot engine. 3" below filler neck with cold engine for all models.

CAUTION: A pressure radiator cap is used to provide the best cooling. When removing, rotate cap to left very slowly. If hissing noise is heard, stop and allow pressure to decrease before removing cap completely.

To assure most effective heater performance, all models are equipped with a 190°F. thermostat. Therefore, the use of Pontiac-approved inhibited glycol-type engine coolant gives best heater performance.

Non-glycol base coolant should not be used.

INHIBITORS

When only water is in the system, a cooling system corrosion inhibitor must be used.

TESTING COOLANT

In using a hydrometer to determine the freezing point of radiator solution, make sure correct hydrometer markings are read. Unless hydrometer is provided with means for temperature correction, test should be made at temperature at which hydrometer is calibrated, for if the solution is warmer or colder large errors may result (in some cases as much as 30°F). Most good hydrometers are equipped with a thermometer and temperature correction scale which allows an accurate test of freezing point over a range of temperatures.

THERMOSTAT-REMOVE AND REPLACE

1. Drain radiator level to below thermostat and remove water outlet assembly from rocker arm cover (6 cyl.), intake manifold (8 cyl.).

2. Remove thermostat. Unless obviously defective, test thermostat as follows before replacing with new one:

a. Immerse unit and thermometer in container of water over a heater. While heating water do not rest either thermometer or thermostat on bottom of container as this will cause them to be at higher temperature than the water.

b. Agitate water to insure uniform temperature of water, thermostat and thermometer.

A new thermostat (190°) valve should start to open (.002") at a temperature of 187°F. to 193°F., and should be fully open (3/8") or more at a temperature not in excess of 222°F. A used thermostat can be about 7°F. above or below this setting (283° - 197°.) without adverse effect and should not be replaced. If thermostat does not operate at specified temperatures, it should be replaced as it cannot be adjusted.

3. Install thermostat with pellet or cartridge projecting down into water passage.

4. Using new gasket, install water outlet fitting. Tighten bolts to 21 lb. ft. (6 cyl.), 28 lb. ft. (8 cyl).

5. Refill radiator to approximately 3" below filler neck for all models.

WATER PUMP-8 CYLINDER

NOTE: Water pump is serviced only as an assembly.

1. Drain radiator.

2. Loosen generator at adjusting strap and remove fan belt from fan pulley.

3. Remove fan and pulley.

4. Remove water pump retaining bolts and remove pump.

5. Install pump by reversing above steps. Tighten water pump attaching bolts to 15 lb. ft. torque. Adjust belt for proper tension on chart at end of this section.

WATER PUMP-6 CYLINDER

REMOVE

1. Drain cooling system and remove water inlet and heater hoses.

2. Remove all fan and accessory drive belts.

3. Remove fan and pump pulley.

4. Remove upper front timing belt cover.

5. Remove two front bolts attaching accessory drive housing to block.

6. Remove water pump to cylinder block attaching nuts and bolts and remove pump from engine.

REPLACE

1. Install pump and attaching nuts and bolts. Tighten to 20 lb. ft. torque

2. Replace cover and two front accessory drive attaching bolts. Tighten bolts to 15 lb. ft. torque.

3. Replace timing belt cover.

4. Replace fan and pump pulley.

5. Install all fan and accessory drive belts.

6. Install water inlet and heater hoses on water pump.

7. Refill cooling system with coolant.

RADIATOR - PONTIAC, TEMPEST AND GRAND PRIX - REMOVE AND REPLACE (Figs. 6A-1 & 6A-2)

1. Drain radiator

2. Remove fan shield assembly (6-cylinder-Tempest).

3. Disconnect upper and lower radiator hoses.

4. On vehicles equipped with automatic transmission, disconnect and plug transmission cooler lines.

5. Remove fan blade.

6. Remove radiator and shroud assembly by lifting straight up.

NOTE: The radiator assembly is held at bottom by two cradles secured to the radiator support.

7. If installing new radiator, transfer fittings from old radiator to new radiator.

8. Replace radiator assembly by reversing the above steps checking to assure radiator lower cradles are located properly in radiator recess.

9. Refill radiator. Run engine for a short period of time and check for leaks. If Automatic transmission radiator, recheck transmission oil level.

RADIATOR-FIREBIRD-REMOVE AND REPLACE (Fig. 6A-3)

REMOVE

1. Disconnect positive battery cable.

2. Open drain cock at bottom of radiator and drain radiator and cylinder block. Remove filler cap so coolant will flow freely.

NOTE: To save coolant remove radiator overflow hose and connect to drain cock.

3. Loosen hose clamps and disconnect upper and lower radiator hoses at radiator inlet and outlet pipes.

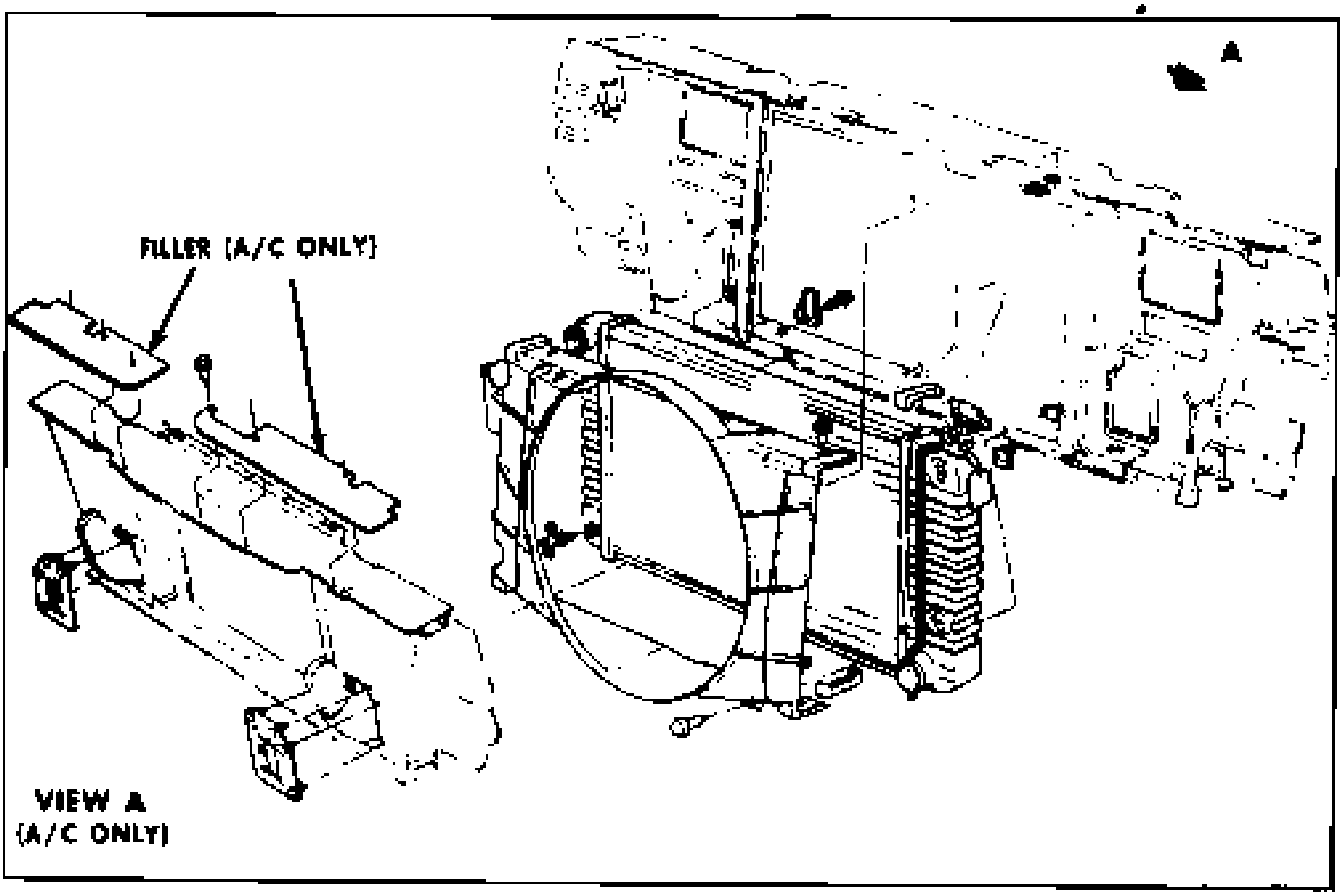


Fig. 6A-1 Radiator Support and Baffle Assembly
Pontiac

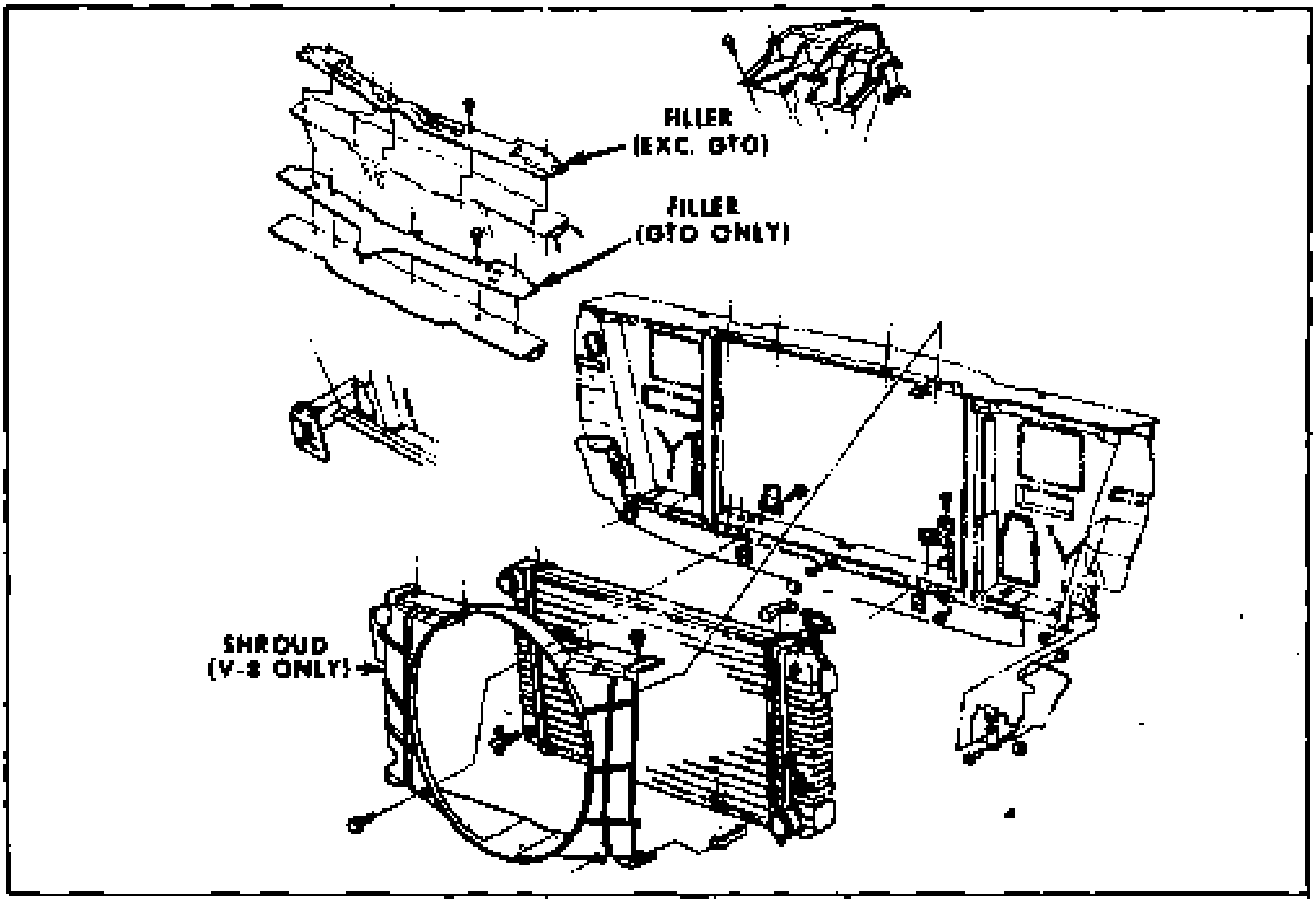


Fig. 6A-2 Radiator Support and Baffle Assembly
Tempest

4. On cars equipped with automatic transmissions, disconnect and plug the transmission cooler lines.

5. Remove upper fan shield (six cylinder) or upper shroud bracket (V-8).

6. Remove radiator attaching screws and lift radiator and shroud out of vehicle.

REPLACE

1. Replace radiator by reversing the above procedure.

2. Torque all mounting screws to 12 lb. ft.

3. Refill radiator with enough coolant to ensure all weather corrosion protection (-20°F protection).

ENGINE OIL

See GENERAL LUBRICATION SECTION.

OIL PUMP

See SECTION 6 (ENGINE MECHANICAL)

OIL FILTER

A full flow filter is standard on all engines and is mounted on the front side of the accessory drive housing on six cylinder engines and the right rear of the engine block on V-8 engines.

6 CYL. AND 8 CYL.-REMOVE AND REPLACE

Install a new oil filter at the first oil change and then every other oil change thereafter.

1. Turn the filter counterclockwise to unscrew filter from base (Fig. 6A-4 and 5).

NOTE: This operation can be done from above on the 6 cylinder.

2. Wipe filter base with clean cloth.

3. Make sure filter base attaching screws are tight.

4. Apply light application of grease or oil on gasket.

5. Hand tighten filter on hollow oil filter connector until gasket contacts filter base, then complete tightening with additional 2/3 turn of filter. Do not over-tighten. Use care when tightening to prevent

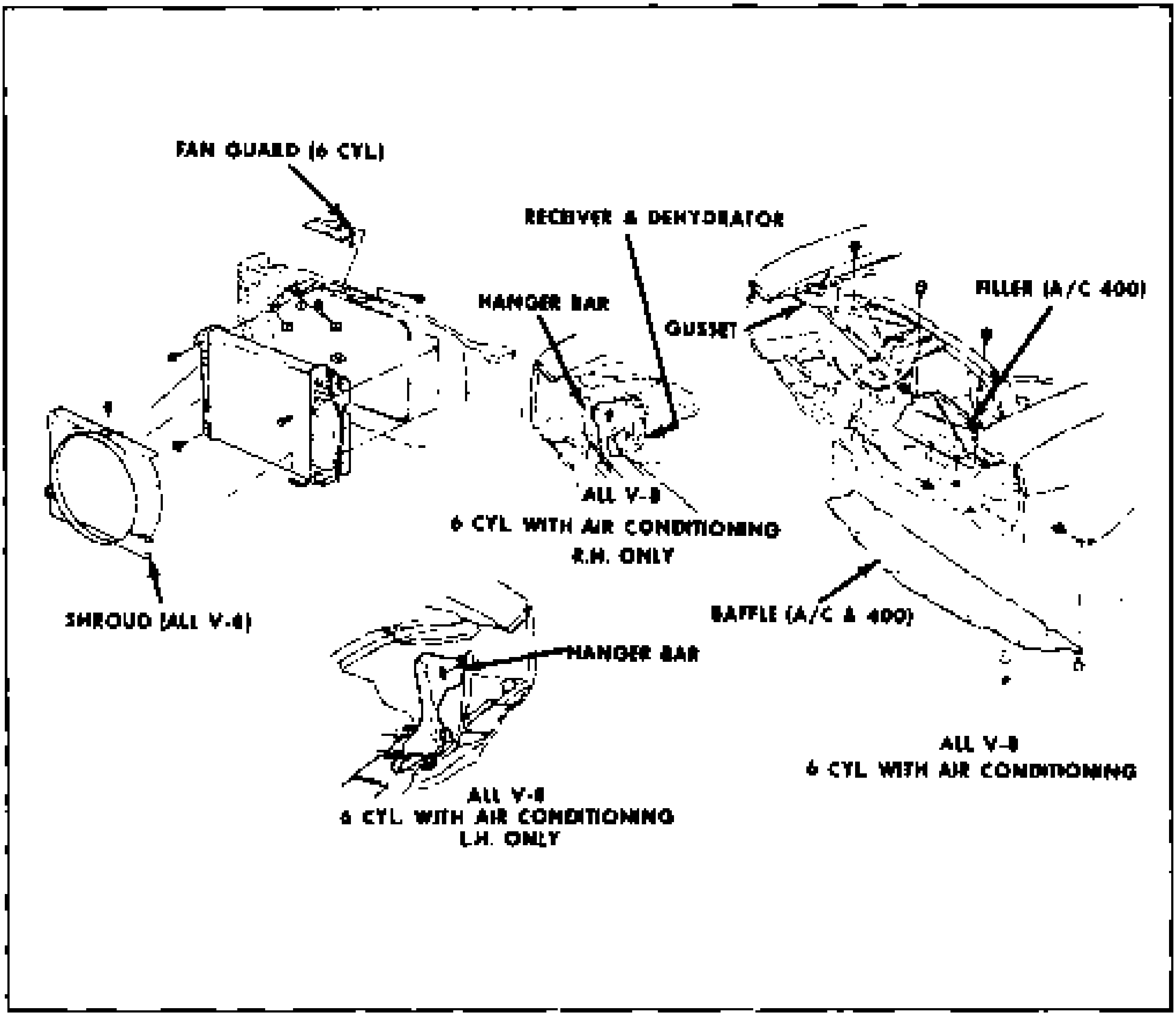


Fig. 6A-3 Radiator Support and Baffle Assembly
Firebird

pinching of gasket. Do not use wrench to tighten filter.

6. Add oil to bring to FULL mark on dipstick.

7. Run engine and check for leaks at filter to base gaskets. Re-check crankcase oil level. If necessary, add oil to bring level to FULL mark on dipstick.

OIL FILTER

REMOVE AND REPLACE (FIREBIRD 400 H.O. AND RAM AIR)

1. Place new filter cartridge in engine compartment near filter location.

2. Raise vehicle.

3. Disconnect old filter cartridge using filter wrench J 22775.

4. Hand tighten filter until gasket contacts filter base, then tighten a further 2/3 of a turn using J 22775 for convenience. Do not over-tighten.

5. Lower vehicle.

6. Remove old cartridge from engine compartment.

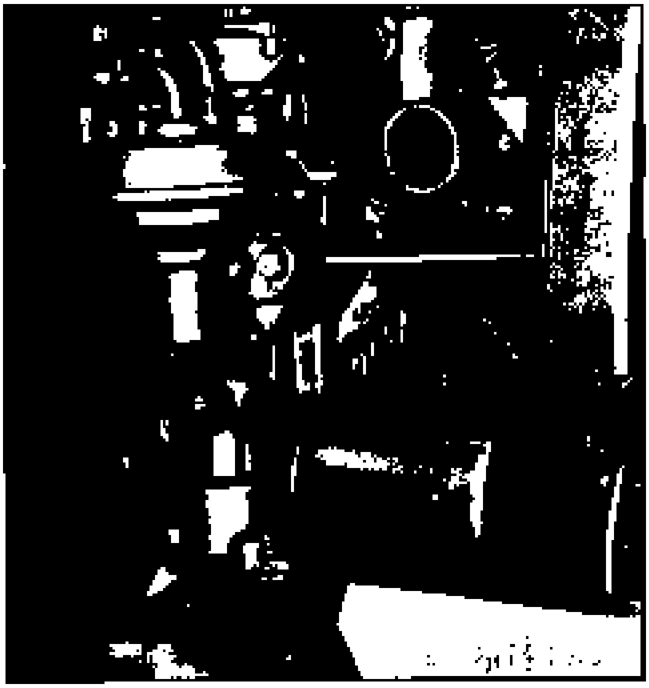


Fig. 6A-4 6 Cylinder Oil Filter Location

Fig. 6A-5 8 Cylinder Oil Filter Location

DRIVE BELTS FOR PONTIAC, TEMPEST & FIREBIRD ENGINE AND ACCESSORY DRIVE COMBINATIONS

BELT WIDTH	BELT NAME	BORROUGHS GAUGE NEW	USED
3/8"	Water Pump and Generator Belt (All 6 Cyl. and 8 Cyl.)	120 Lbs	75 Lbs.
15/32"	Power Steering Pump Belt (6 Cyl w/o A.C.)	145 Lbs	105 Lbs.
15/32"	Power Steering Pump Belt (All 8 Cyl. and 6 Cyl. with A.C.)	145 Lbs	105 Lbs.
3/8"	Generator to Power Steering Belt (6 Cyl.)	60 Lbs	50 Lbs.
15/32"	A.C. Compressor Belt (All 6 Cyl. and 8 Cyl.)	145 Lbs.	105 Lbs
15/32"	Power Steering Belt (V-8)	145 Lbs.	105 Lbs.

TORQUE SPECIFICATIONS

(Torque in lb. ft. unless otherwise specified)

APPLICATION	TORQUE (LB. FT.)
Bolt—Oil Baffle to Bearing Cap	15
Bolt—Pan to Cylinder Block	12
Bolt—Pan to Cyl. Blk. & Clutch Hsg. Shield	15
Screw—Pan Drain	22
Bolt—Oil Pump Cover	15
Retainer—Oil Pump Reg. Spring	13
Bolt—Oil Pump Assy. to Block	30
Bolt—Oil Filter Pad Cover	30
Bolt—Push Rod Cover	3.5

APPLICATION	TORQUE (LB. FT.)
Bolt—Cylinder Block	30
Stud—Block (Block End)	*
Nut—Block (Stud)	30
Bolt—Fan and Pulley to Water Pump	20
Stud—Timing Chain Cover	*
Nut—Timing Chain Cover	15
Bolt—Intake Man. Water Outlet Fitting	30

(*) Check for alignment, bottoming, height and/or leaks.

COOLING SYSTEM

Type	Pressure with vent
Operating Pressure	14-17 PSI
Pump Type	Centrifugal
Pump and Fan Drive	V-Belt
Pump Bearings	Sealed Ball Bearings
Radiator	Tube and Center
Core Area—Pontiac (All)	480 Sq. in.
Core Area—6-Cyl. Std	353 Sq. in.
Core Area—6-Cyl.—Firebird	353 Sq. in.
Core Area—6-Cyl. A/C (Tempest only)	480 Sq. in.
Core Area—V-8 (Tempest only)	353 Sq. in.
Core Area—V-8—Firebird	390 Sq. in.
Core Area—400	480 Sq. in.
Thermostat	190°F
Cooling System Cap.—400 Pont.—All	18 qts.
Cooling System Cap.—G.P. 400	18.6 qts.
Cooling System Cap.—428	17.2 qts.
*Cooling System Cap.—400	17.8 qts.
*Cooling System Cap.—500-A/C	19.4 qts.
*Cooling System Cap.—350	18.6 qts.
*Cooling System Cap.—350-A/C	20.2 qts.
Cooling System Cap.—6-Cyl.	12.1 qts.
Cooling System Cap.—6-Cyl. with A/C	12.7 qts.

(*) Tempest & Firebird V-8

LUBRICATION SYSTEM

Type	Pressure
Oil Pressure—Pontiac exc. H.O.	35 psi above 2600 rpm
Oil Pressure—Pontiac with H.O.	60 psi above 2600 rpm
Oil Pressure—6-Cyl.	30 psi above 2800 rpm
Oil Pressure—350	35 psi above 2600 rpm
Oil Pressure—G.T.O. and Firebird 400	60 psi above 2600 rpm
Engine Lubricant Capacity When Refilling—8 Cyl.	5 qts. (6 qts. if filter element is changed)
Engine Lubricant Capacity When Refilling—6 Cyl.	4½ qts. (5 qts. if filter element is changed)
Oil Pump Type	Spur Gear

FAN TYPES AND USAGE

FAN	USAGE
4 Blade—17½" Diameter	6 cylinder w/o A/C
4 Blade—19" Diameter (2.3" Pitch)	350 engines w/o A/C Firebird 400 Ram Air G.T.O. Ram Air and 2 Bbl. option Catalina and Executive (A.T.) (Exc. 428 H.O.)
4 Blade, 19" Diameter (2.0" Pitch)	Bonneville (Exc. 428 H.O.)
5 Blade—Power Flex—19" Diameter	Tempest 6 cylinder with A/C or KB2 Firebird 400 (Exc. Ram Air) Pontiac and Grand Prix 428 H.O. G.T.O. (Exc. 2 Bbl. or Ram Air) All 350 engines with KB2 w/o A/C Grand Prix w/o A/C G.T.O. (2 Bbl.) with KB2 Catalina and Executive with KB2 w/o A/C (Exc. 428 H.O.) Bonneville (Exc. 428 H.O.)
7 Blade—Power Flex—18" Diameter	Firebird 6 cylinder with A/C or KB2
7 Blade—Power Flex—19½" Diameter	Firebird V-8 (M.T.) with A/C Firebird 400 (Exc. Ram Air) with KB2 G.T.O. (Exc. Ram Air and 2 Bbl. option) with KB2 Grand Prix with KB2 All 350 engines with A/C with KB2 Firebird 400 (A.T.) Exc. Ram Air with A/C with KB2 Grand Prix and G.T.O. with A/C with KB2 Bonneville Heavy Duty Chassis Bonneville with A/C with KB2 428 H.O. Engine with KB2 (w/o A/C) Catalina and Executive with A/C with KB2
7 Blade—THERMO Clutch—19½" Diameter	All Pontiacs (Exc. 428 H.O.) with A/C Optional on all V-8 engines with or without A/C except Firebird V-8 (M.T.) and 350 H.O. when equipped with A/C

A/C—Air Conditioning
KB2—Heavy Duty Power Flex Fan Option
A/C—Not available with 400 Ram Air, 6 cylinder (4 Bbl.) and 428 H.O. (M.T.)

RADIATOR USAGE

SERIES	ENGINE SIZE	ENGINE DESCRIPTION	BASIC CAR MAN. TR.	BASIC CAR AUTO. TR.	HEAVY DUTY RADIATOR MAN. TR.	HEAVY DUTY RADIATOR AUTO. TR.	AIR CONDITIONING RADIATOR MAN. TR.	AIR CONDITIONING RADIATOR AUTO. TR.	SUPER COOLING RADIATOR MAN. TR.	SUPER COOLING RADIATOR AUTO. TR.
FIREBIRD										
223	L6 250	1 BBL.	UE	ZA	ZC	ZC	ZC	ZC	N/A	N/A
		4 BBL.	UE	ZA	ZC	ZC	N/A	N/A	N/A	N/A
	V8 350	2 BBL.	UU	UW	UM	UX	UQ	UP	N/A	N/A
		4 BBL.	UM	UX	UQ	UP	UQ	UP	N/A	N/A
	V8 400	4 BBL.	UM	UW	UQ	UP	UQ	UP	N/A	N/A
		HO	UM	UW	UQ	UP	UQ	UP	N/A	N/A
		RAM AIR IV	UQ	UP	N/A	N/A	N/A	N/A	N/A	N/A
TEMPEST										
233, 235, 237, 239	L6 250	1 BBL.	VC	VD	SX	SX	SX	SX	N/A	N/A
		4 BBL.	VC	VD	SX	SX	N/A	N/A	N/A	N/A
	V8 350	2 BBL.	BE	BG	BO	BK	PA	BI 5	N/A	N/A
		4 BBL.	BE	BN	BO	BK	PA	PB	N/A	N/A
242	V8 400	4 BBL.	BO	BS	PA	PB	PA	PB	N/A	N/A
		2 BBL.	N/A	BN	N/A	BI	N/A	PB	N/A	N/A
		RAM AIR	BO	BS	PA	PB	PA	PB	N/A	N/A
		RAM AIR IV	PA	PB	N/A	N/A	N/A	N/A	N/A	N/A
PONTIAC										
252 256	V8	ALL 400	BE	BN	BO	BS	PA	BI	PA	PD
		ALL 428	BO	BK	BI	PD	PA	PD	PA	PD
262 EXC. H.D. CHASSIS	V8	428 EXC.	BO	BU	BI	BI	PA	PP	PA	PD
	V8	428 HO	BO	BK	BI	PD	PA	PD	PA	PD
26240 & H.D. CHASSIS	V8	ALL 400	BO	BK	N/A	N/A	PA	PD	PA	PD
POLICE	V8	ALL 400	BE	BK	BO	PD	PA	PD	PA	PD
		ALL 428	N/A	N/A	BI	PD	PA	PD	PA	PD
GRAND PRIX										
276	V8	ALL 400	BO	BS	BI	BI	PA	PB	N/A	N/A
		ALL 428	BO	BK	BI	PD	PA	PD	N/A	N/A

NOTE 5: USE PB RADIATOR WHEN TRAILER PROVISION IS ORDERED.

NOTE : PONTIAC, FIREBIRD & G.P. CARS REQUIRE HEAVY DUTY RADIATOR WITH AXLE RATIOS ABOVE 3.55.

Fig. 6A-6 Radiator Usage Chart

ENGINE FUEL

Section 6B - Engine Fuel

CONTENTS OF THIS SECTION

CARBURETOR AIR CLEANER AND SILENCER

A combined air cleaner-silencer and air preheater, with an oil wetted paper element is standard on all models.

A dual snorkel air cleaner is used on all standard GTO's.

An optional heavy duty dual stage air cleaner is available on all models except the 428 H.O. engine, GTO, and Tempest Sprint.

This air cleaner consists of a replaceable oil wetted paper inner filter surrounded by a glycol wetted polyurethane foam outer filter.

The polyurethane element and crankcase ventilation filter should be washed in solvent and re-oiled using SAE 30 engine oil at 12,000 miles or 12 months.

NOTE: Clean and re-oil after each occasion of driving under severe dust conditions. Allow excess oil to drain out of filter prior to installation.

INTAKE SYSTEMS - RAM AIR

RAM AIR (Fig. 6B-7)

The Ram Air system, available on GTO Ram Air and Ram Air IV (exc. 2 Bbl.) and Firebird 400 H.O. and Ram Air IV, is designed to allow the driver to make available two sources of air to the carburetor.

Control of the source is made by a valve mounted behind the hood scoops, which is operated by a cable from inside the car. Air enters either through the hood scoops or from under the hood as determined by the position of the valve. The air is then routed to a plenum where it is directed to the carburetor intake via the air cleaner.

HEAT RISER VALVE

Use of the carburetor air pre-heater has resulted in improved engine warm-up characteristics and consequently, eliminated the need for the heat riser valve on all V-8 and six cylinder 1 Bbl. applications. Six cylinder 4 Bbl. engines are not affected by this change and continue to use the heat riser valve.

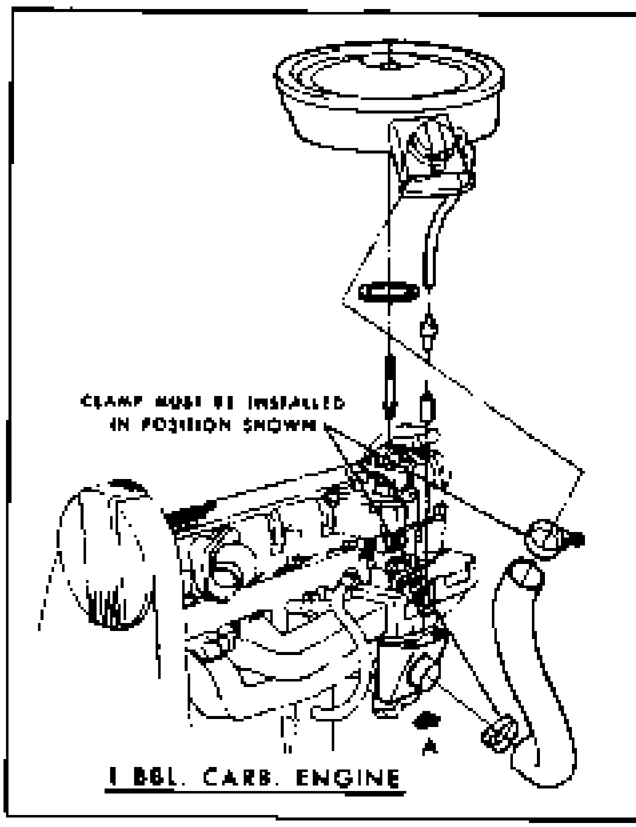


Fig. 6B-1 Air Cleaner Installation - 6 Cyl.

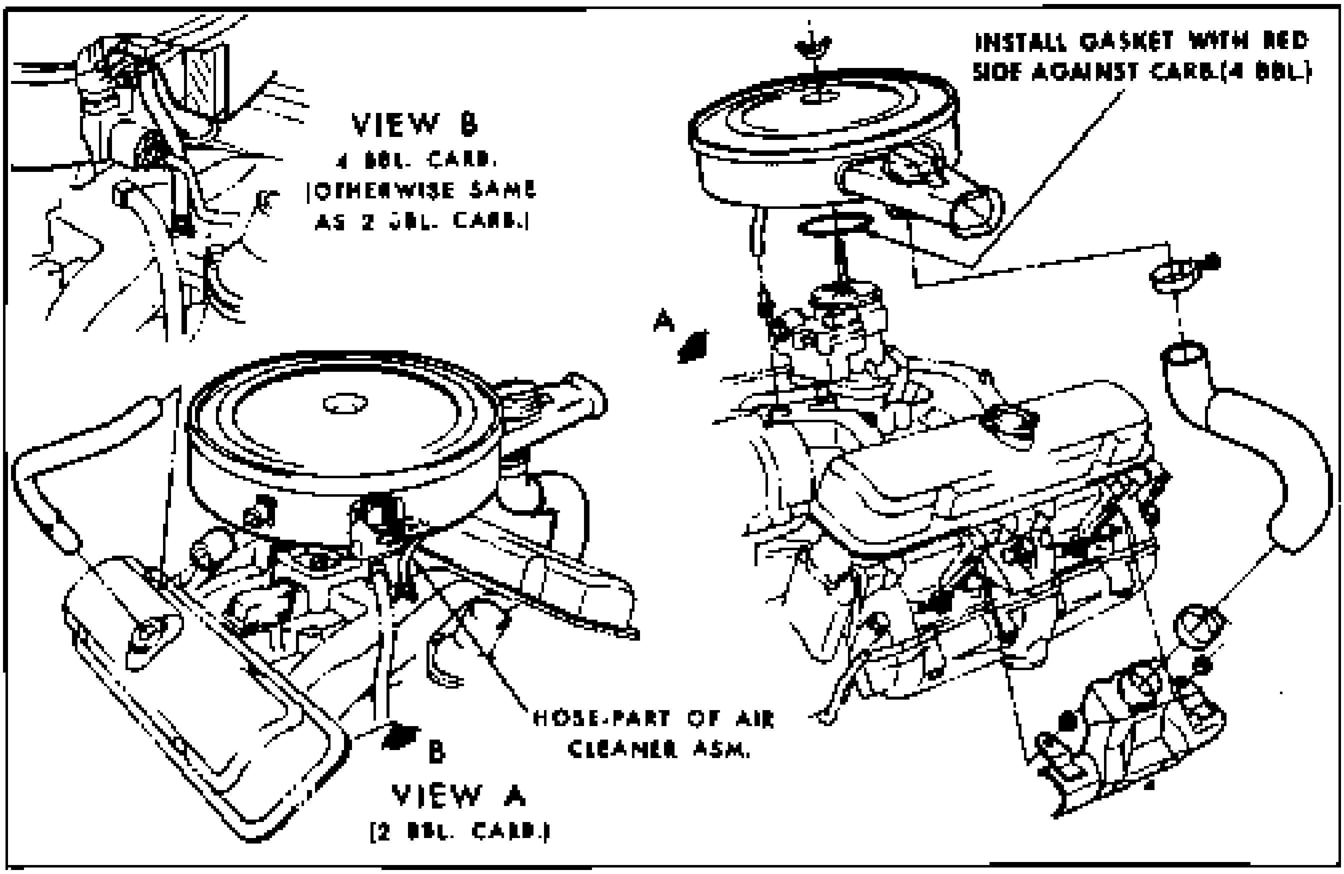


Fig. 6B-2 Air Cleaner Installation - 8 Cyl.

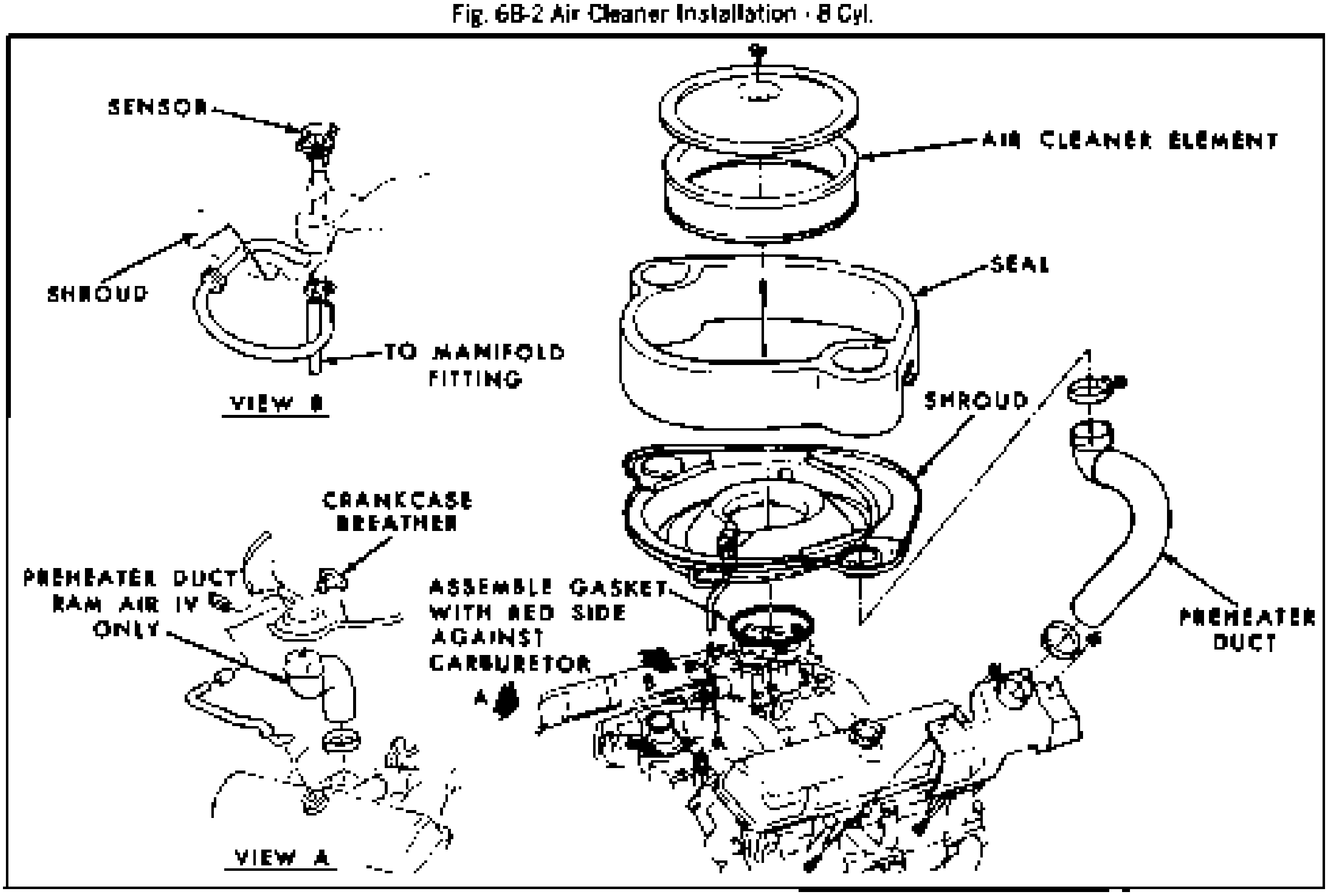


Fig. 6B-3 Air Cleaner and Seal Installation - GTO Ram Air

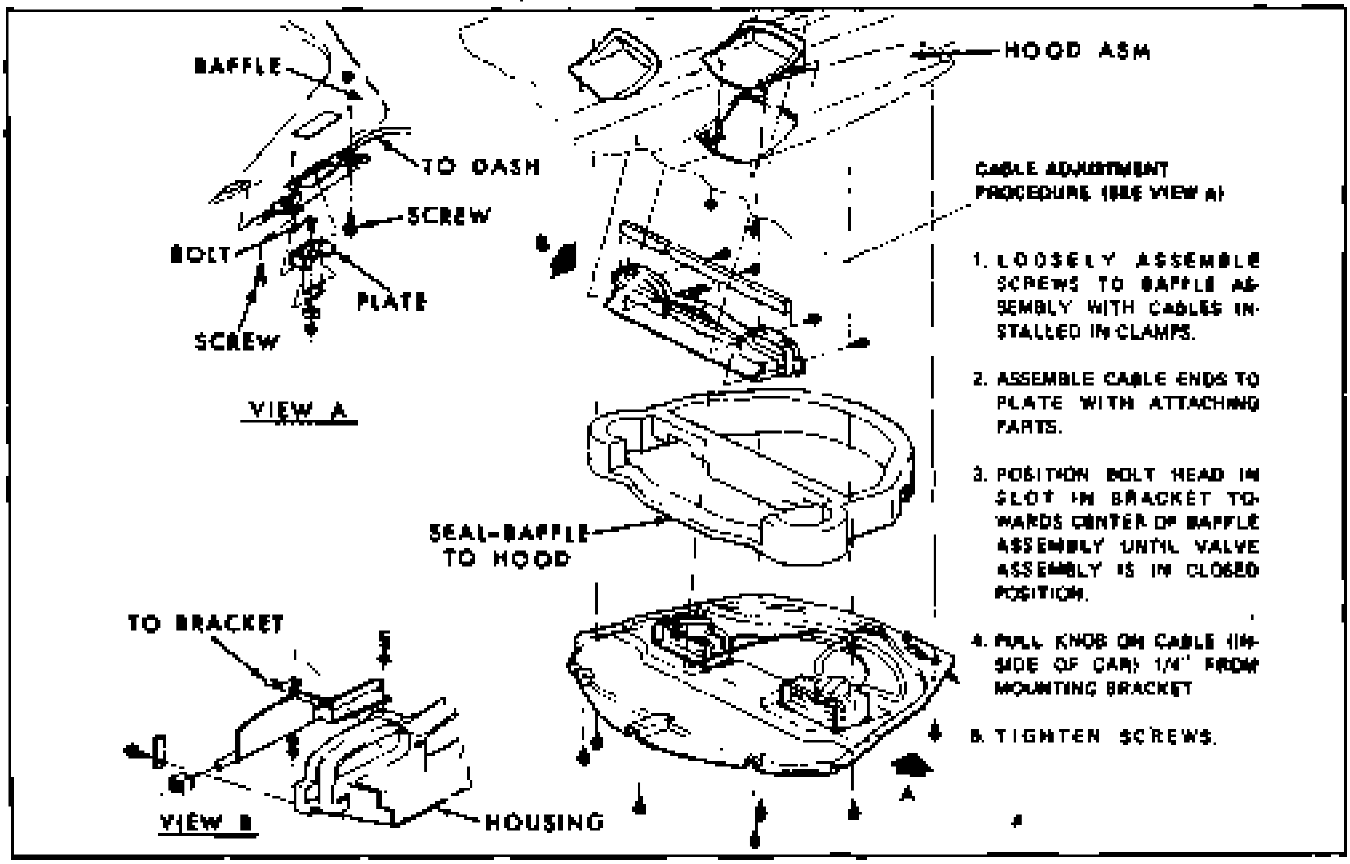


Fig. 6B-4 Baffle and Hood Scoop Installation GTO Ram Air

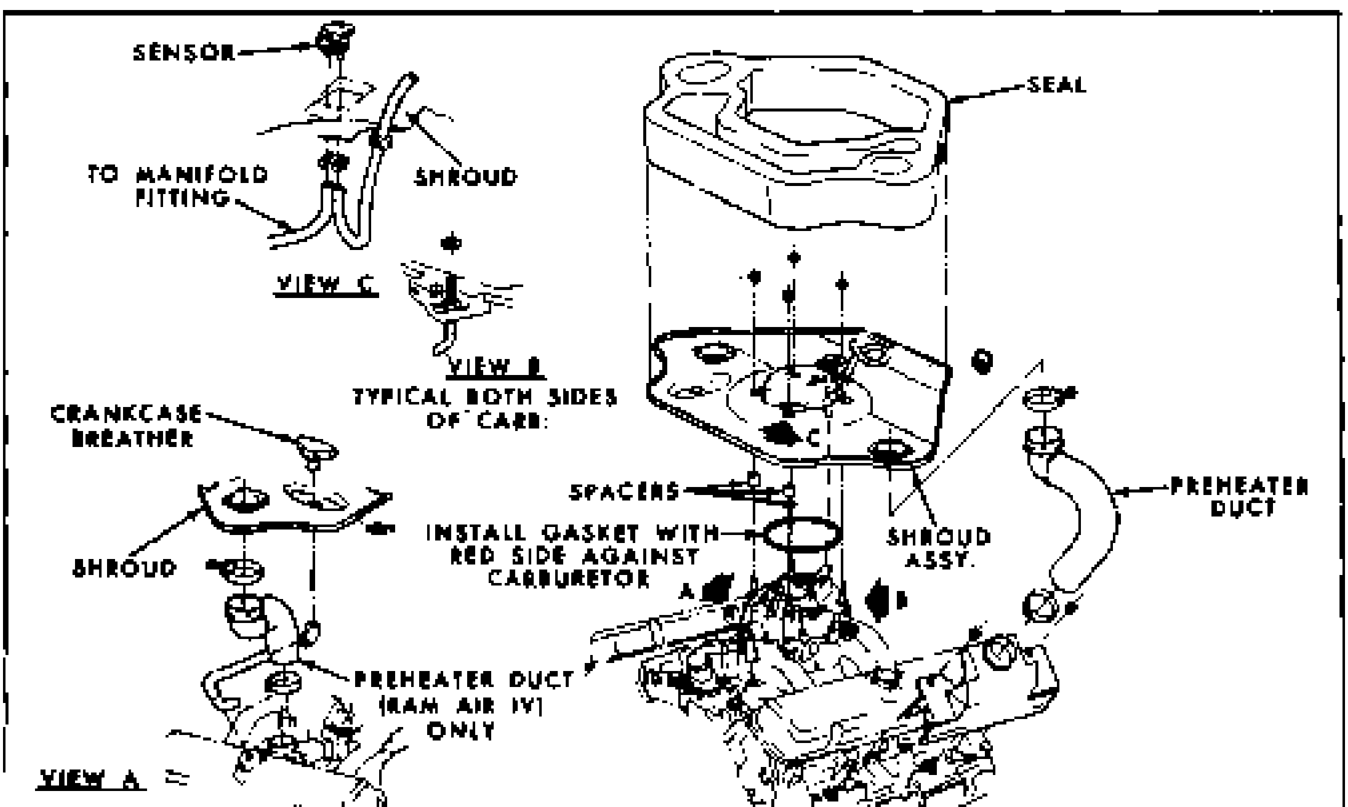


Fig. 6B-5 Air Cleaner & Seal Installation Firebird Ram Air

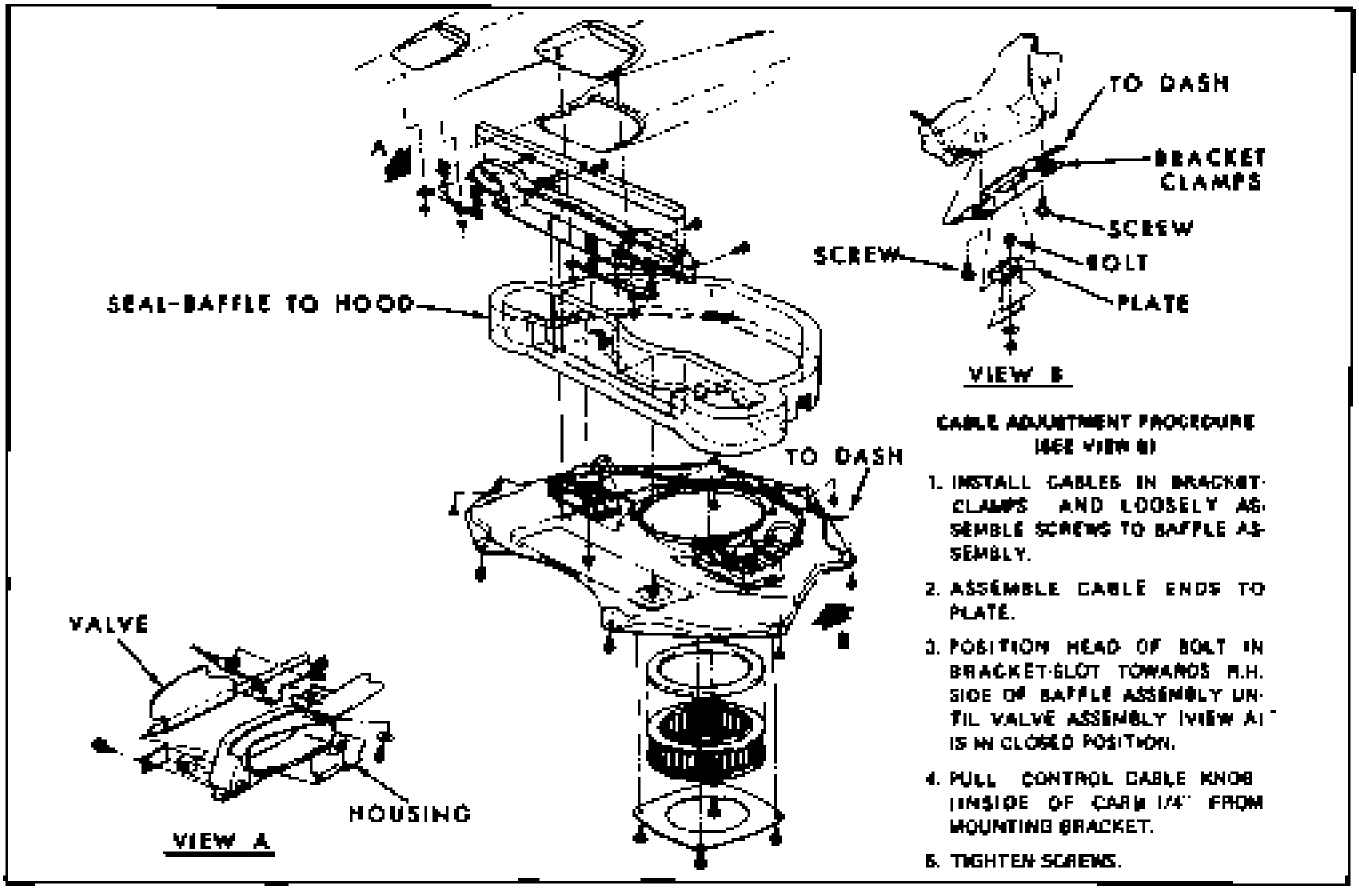


Fig. 6B-6 Baffle & Hood Scoop Installation Firebird Ram Air

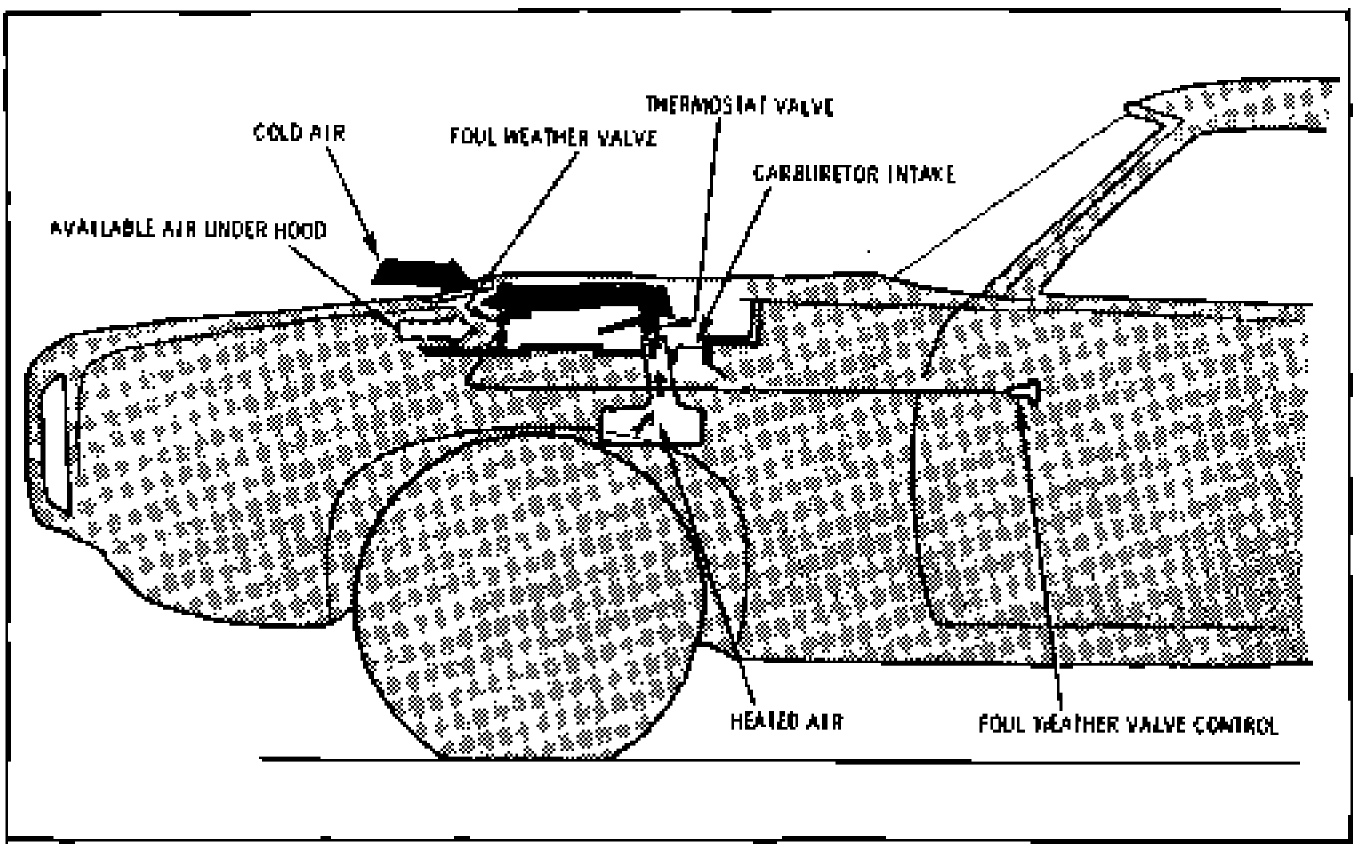


Fig. 6B-7 Ram Air Intake - Schematic

IDLE STOP SOLENOID (FIG. 6B-9)

ADJUSTMENT

The idle stop solenoid, used on six-cylinder and Ram Air engines, is adjusted as follows:

Adjust plunger in or out to obtain specified solenoid energized idle speed (see idle specification chart, section 6D). Observe operation of solenoid by disconnecting lead. With engine running at specified hot idle speed, the plunger should drop back allowing the carburetor idle screw to contact the idle cam. In this position the engine speed should drop to the specified lower "solenoid inactive" speed.

Fig. 6B-9 Idle Stop Solenoid - (6 Cyl. Shown)

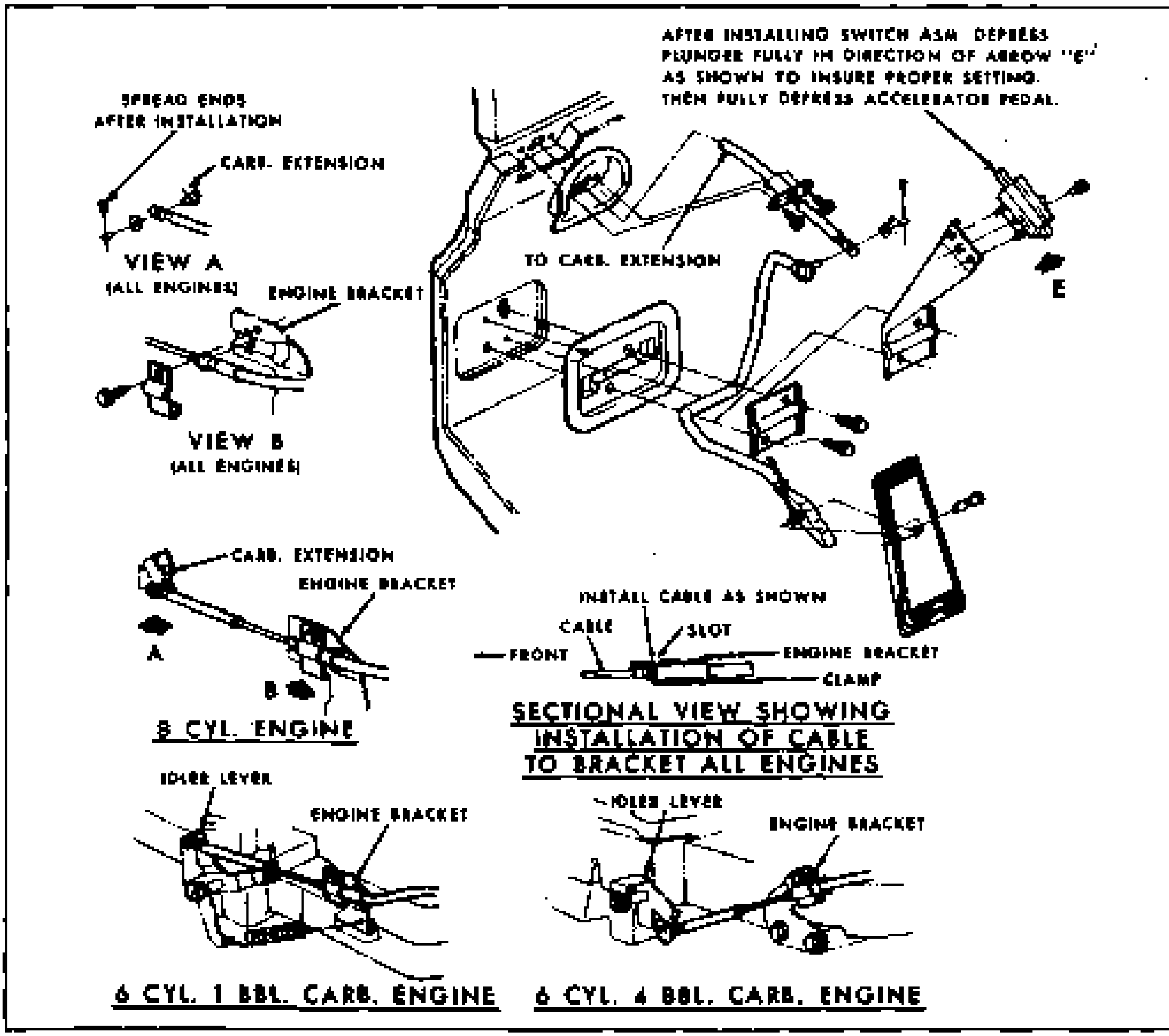


Fig. 6B-10 Accelerator Linkage - Tempest and Grand Prix

ACCELERATOR CONTROLS

TEMPEST, GRAND PRIX AND FIREBIRD

The throttle control system is of the cable type. There are no throttle linkage adjustments, a reference dimension of 1 9/16" between the bottom of the accelerator pedal roller and floor pan (Fig. 6B-4) should be used only as a check for bent bracket assemblies. Check for correct opening and closing positions by operating accelerator pedal in car.

NOTE: If any binding is present, check for correct routing of cable or pedal interference with carpets.

PONTIAC

The Pontiac throttle control system is of the rod and lever type. The throttle control rod is attached to the carburetor linkage by means of a threaded trunnion.

NOTE: No binding should be felt in linkage.

VAPOR DIVERTER

The vapor diverter is incorporated in the fuel pump on all 1969 models, where applicable. Air conditioning is not available on 4Bbl. 6 cylinder engines, therefore no vapor diverters are used with 6 cylinder engines.

ROCHESTER MV "MONOJET" CARBURETOR

CARBURETOR MODEL NUMBER	USAGE
7029165	250 Manual Trans.
7029166	250 Auto. Trans.
7029167	250 Manual Trans. A/C
7029168	250 Auto. Trans. A/C

All Rochester M.V. adjustments can be performed on the car. With the exception of idle speed and mixture adjustments, outlined in Section 6D., all adjustments

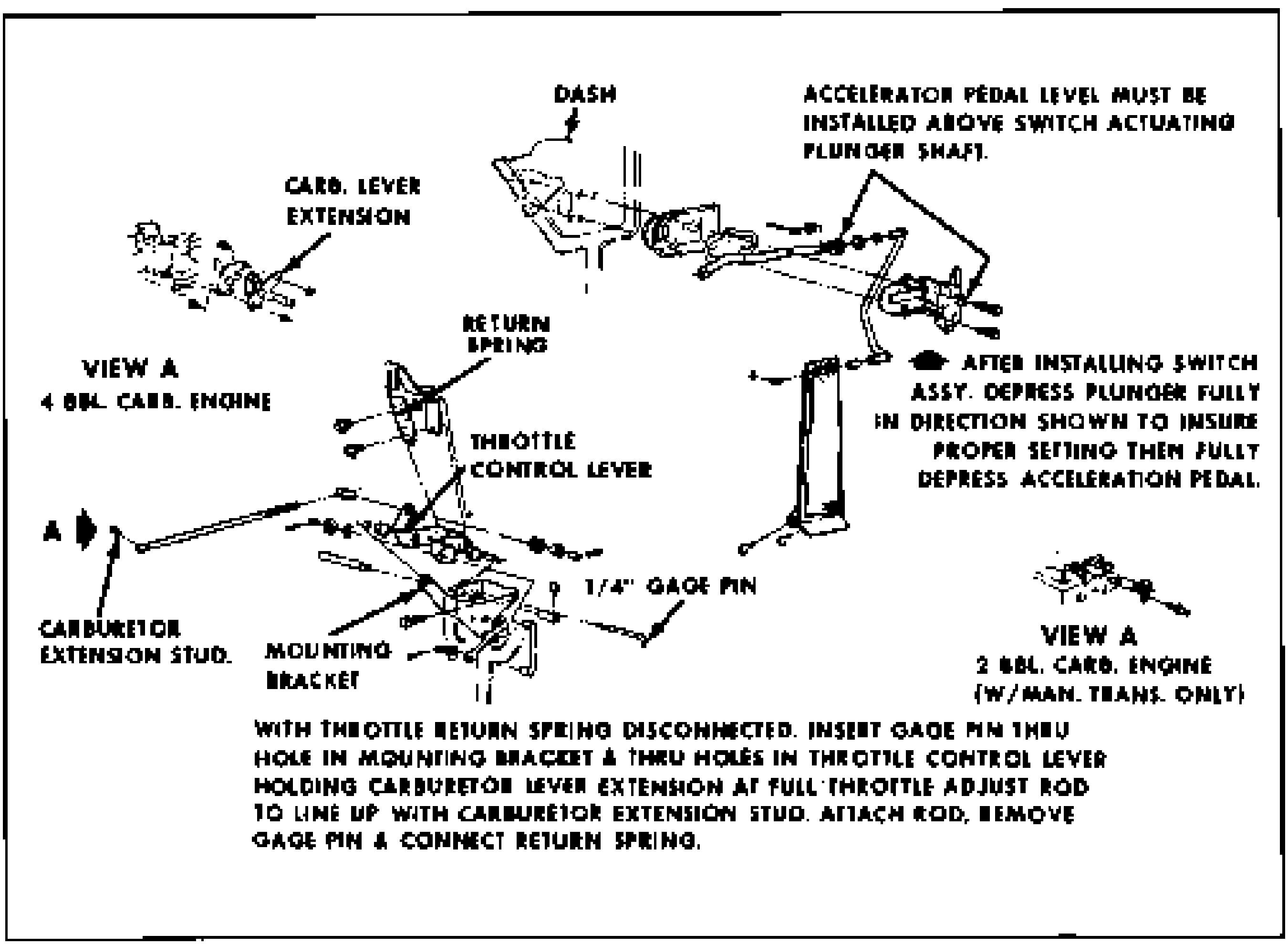


Fig. 6B-11 Accelerator Linkage - Pontiac

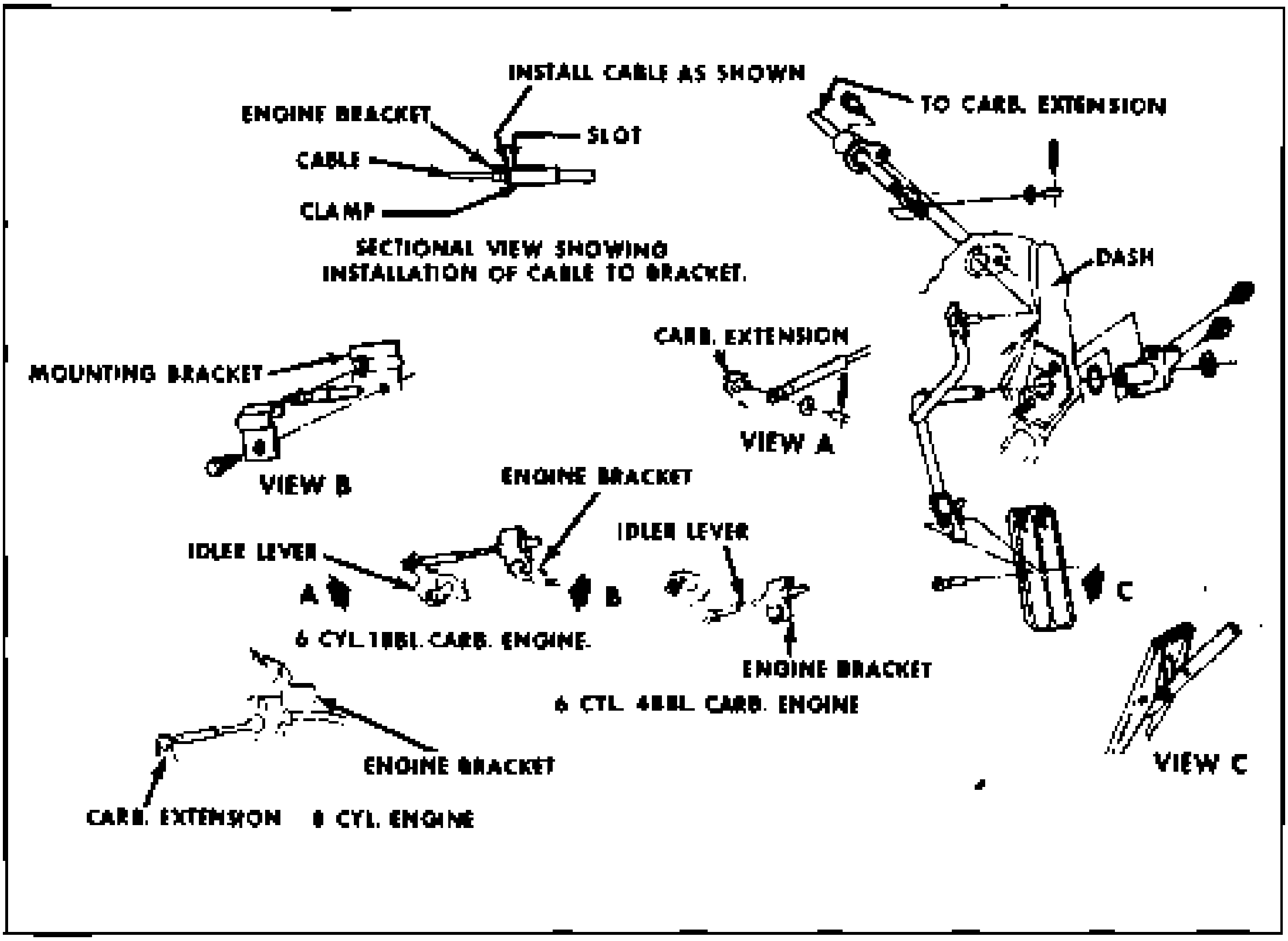


Fig. 6B-12 Accelerator Linkage - Firebird

are included in the Overhaul and Adjustments procedure.

OVERHAUL AND ADJUSTMENTS

AIR HORN REMOVAL (Fig. 6B-13)

1. Remove upper choke lever retaining screw at end of choke shaft. Then remove choke lever from shaft.

2. Remove choke rod from fast idle cam by rotating rod. Remove upper lever from other end of choke rod. Note position of rod in relation to levers for ease in reassembly.

3. Remove six air horn to float bowl attaching screws (three long and three short screws).

4. Remove air horn by lifting straight up, invert and place on clean bench. Air horn to bowl gasket can remain on bowl for removal later.

AIR HORN DISASSEMBLY (Fig. 6B-27)

1. Remove two vacuum break diaphragm cover screws. Then carefully remove diaphragm cover retainer.

2. To remove vacuum break diaphragm and plunger rod, hold choke valve open. Then push upward on diaphragm rod until the looped end of rod slides out off of wire lever attached to choke valve. Then remove diaphragm plunger rod through hole in air horn.

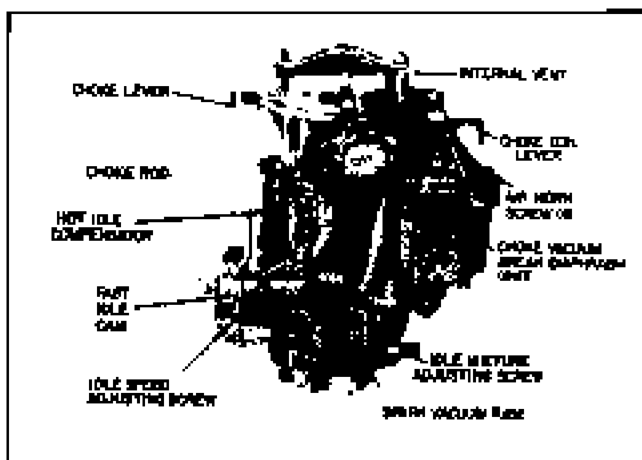


Fig. 6B-13 Rochester MV Carburetor

3. If desired, the choke valve, vacuum break lever and choke shaft can be removed from air horn by removing two choke valve screws. Staking on choke valve screws should be filed off before removing so as not to ruin threads and distort choke shaft.

4. No further disassembly of the air horn is necessary. The idle vent valve can be removed by turning screw head out of plastic guide. A repair kit is available if replacement parts are needed.

NOTE: The cranking enrichment valve is not removable. Make sure after cleaning that cleaning solution is completely removed from valve cavity and bleed hole in valve retainer is open.

FLOAT BOWL DISASSEMBLY (Fig. 6B-28)

1. Remove air horn to float bowl gasket. Gasket is slit next to metering rod lever so that it can be slid over lever for ease in removal.

2. Remove float from float bowl by lifting upward on float hinge pin. Remove hinge pin from float arm.

3. Remove float needle, then remove float needle seat and gasket.

4. Remove fuel inlet nut and gasket, then remove filter element and pressure relief spring.

5. Using long nosed pliers, remove 'T' pump discharge guide. Pump discharge spring and ball may be removed by inverting bowl.

6. The idle tube can be removed at same time by inverting bowl.

7. To remove accelerating pump plunger and power piston - metering rod assemblies, remove actuating lever on throttle shaft by removing attaching screw in end of shaft.

8. Hold the power piston down in float bowl, then remove power piston drive link by sliding out of hole

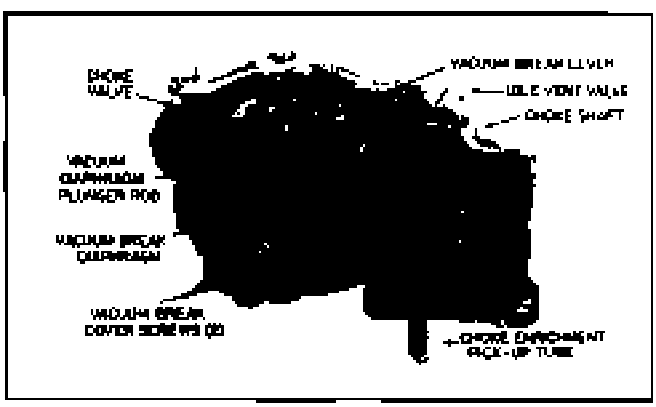


Fig. 6B-14 Air Horn Disassembly

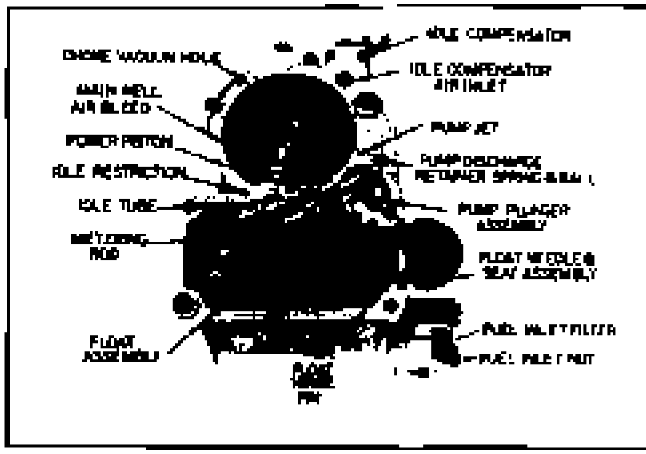


Fig. 6B-15 Float Bowl Disassembly

in power piston plunger rod. The power piston - metering rod can now be removed from float bowl.

NOTE: The metering rod can be removed from holder on power piston by pushing downward on end of rod against spring tension. Then slide narrow neck of rod out of slot in rod holder.

9. Remove power piston spring from power piston cavity.

10. Remove power piston drive link from throttle actuating lever by aligning lip on rod and notch in lever.

11. Remove actuating lever from accelerator pump drive link in same manner. Note position of actuating lever for ease in reassembly.

12. Hold the pump plunger down in bowl cavity and remove drive link from pump plunger shaft by rotating link until lip on link aligns with notch in plunger shaft.

13. Remove pump plunger from float bowl.

14. Remove pump return spring from pump well.

15. Remove main metering jet from bottom of float bowl.

16. Remove two screws from idle compensator cover. Then remove cover, hot idle compensator and seal from recess in bowl beneath compensator.

17. Idle screw and fast idle cam can be removed at this time if desired.

No further disassembly of the float bowl is required.

THROTTLE BODY REMOVAL AND DISASSEMBLY (Fig. 6B-16)

1. Invert carburetor bowl on bench and remove two

throttle body to bowl attaching screws. Throttle body and insulator gasket may now be removed.

2. Remove idle mixture needle and spring.

NOTE: Due to the close tolerance fit of the throttle valve in the bore of the throttle body, do not remove the throttle valve or shaft.

CLEANING AND INSPECTION

The carburetor should be cleaned in a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner such as carbon-X (X-55) or its equivalent

CAUTION: Any rubber parts, plastic parts, diaphragms, pump plungers, should not be immersed in carburetor cleaner. However, the air horn which has the plastic vent valve guide and cranking enrichment valve will withstand normal cleaning in carburetor cleaner. Make sure the cleaner is thoroughly removed from choke enrichment valve cavity.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.

3. Inspect idle mixture need for damage.

4. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.

5. Inspect upper and lower casting sealing surfaces for damage.

6. Inspect holes in levers for excessive wear or out of-round condition. If levers or rods are worn, they should be replaced

7. Examine fast idle cam for excessive wear or damage.

8. Check throttle and choke levers and valves for binds and other damage.

9. Check all spring for distortion or loss in tension, replace if necessary.

CARBURETOR ASSEMBLY AND ADJUSTMENT PROCEDURES

THROTTLE BODY ASSEMBLY AND INSTALLATION (Fig. 6B-16)

1. Install idle mixture needle and spring until lightly seated. Back out five turns as a preliminary idle adjustment.

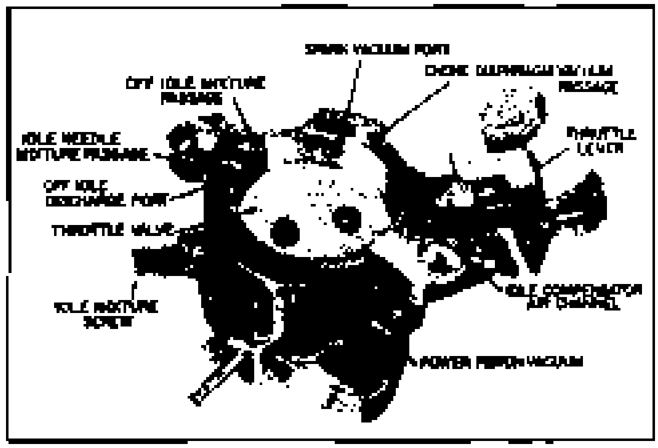


Fig. 6B-16 Throttle Body Disassembly

2. Invert float bowl and install new throttle body to bowl insulator gasket making sure all holes in gasket align with holes in float bowl.

3. Install throttle body on bowl gasket so that all holes in throttle body are aligned with holes in gasket.

4. Install two throttle body to bowl attaching screws. Tighten evenly and securely (12-15 lb. ft.).

FLOAT BOWL ASSEMBLY (Fig. 6B-17)

1. Install fast idle cam to boss on float bowl, attaching with fast idle cam screw. Tighten securely. Part number on cam faces outward.

2. Install slow idle adjustment screw, if removed.

3. Install seal into recess in idle compensator cavity in float bowl, then install idle compensator.

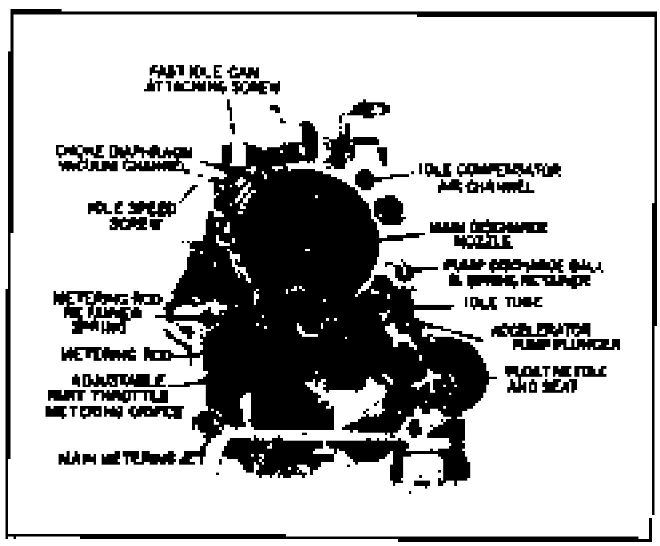


Fig. 6B-17 Float Bowl Assembly

4. Install idle compensator cover, retaining with two attaching screws. Tighten securely.

5. Install main metering jet into bottom of float bowl. Tighten securely.

6. Install pump return spring into pump well. Make sure spring is properly seated in bottom of well.

7. Install pump plunger into pump well with actuating shaft protruding through bottom of bowl casting. Push downward on pump plunger and install pump drive link into hole in lower end of plunger shaft. Ends of drive link point toward carburetor bore. Lip on upper end of link retains link to pump shaft.

8. Install pump actuating lever to lower end of pump drive link by aligning lip on rod with notch in lever. Projection on actuating elver points downward. Install power piston actuating link into opposite end of actuating lever. Lower end of link has retaining lip and faces outward (away from throttle bore).

9. Install end of power piston actuating rod into groove on side of power piston. Then install power piston spring, power piston, metering rod assembly and actuating rod into float bowl. End of metering rod must enter jet orifice.

10. Hold complete assembly downward in bowl, then install power piston drive link into hole in lower end of power piston actuating rod (beneath bowl). Align D hole in actuating lever with flats on throttle shaft and install lever on end of throttle shaft. Install retaining screw in end of throttle shaft and tighten securely.

11. Install idle tube into cavity in float bowl.

12. Install pump discharge ball, spring and spring retainer. Make sure spring retainer is in flush with top of bowl casting.

13. Install fuel filter relief spring, fuel inlet filter, filter nut and gasket. Tighten to 25 lb. ft.

NOTE: Open end of filter should face hole in fuel inlet nut.

14. Install float needle seat and gasket and tighten securely using care not to damage needle seat

15. Install float needle valve into needle seat.

16. Insert float hinge pin into float arm. Then install float and hinge pin into float bowl.

17. FLOAT LEVEL ADJUSTMENT (Fig. 6B-18)

a. Hold float retaining pin firmly in place and push down on float arm at top of float needle.

b. With adjustable T-scale, measure distance from top of float at index point on toe, to float bowl gasket surface (gasket removed).

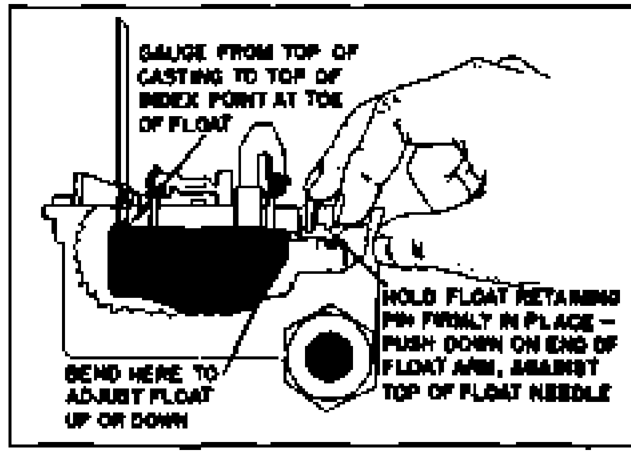


Fig. 6B-18 Float Level Adjustment

NOTE: Gauge index point is raised portion on top of float at toe.

c. To adjust, bend the float pontoon up or down at float arm junction as shown.

18. METERING ROD ADJUSTMENT (Fig. 6B-19)

a. Remove metering rod by holding throttle valve wide open. Push downward on metering rod against spring tension, then slide metering rod out of slot in holder and remove from main metering jet.

b. To check adjustment, back out slow idle screw and rotate fast idle cam so that fast idle cam follower is not contacting steps on cam.

c. With throttle valve completely closed, apply pressure to top of power piston and hold piston down against its stop.

d. Holding downward pressure on power piston, swing metering rod holder over flat surface of bowl casting next to carburetor bore.

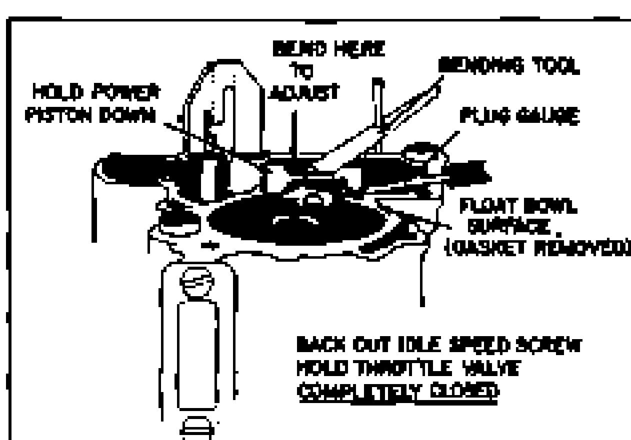


Fig. 6B-19 Metering Rod Adjustment

e. Use specified gauge (.085) and insert between bowl casting sealing bead (gasket removed) and lower surface of metering rod holder. Gauge should have a slide fit between both surfaces, as shown.

f. To adjust, carefully bend metering rod holder up or down at point shown.

g. After adjustment, install metering rod and tension spring.

19. Install air horn gasket on float bowl by carefully sliding slit portion of gasket over metering rod holder. Then align gasket with dowels provided on top of bowl casting and press gasket firmly in place.

AIR HORN ASSEMBLY AND INSTALLATION (Fig. 6B-14)

1. Install idle vent valve, if removed.

2. Install choke shaft, choke valve and vacuum break lever, if removed. Align choke valve, tighten two retaining screws and stake securely.

3. Install vacuum break diaphragm and plunger into cavity at side of air horn. With choke valve in the open position, slide eyelit of plunger rod over end of vacuum break lever on choke valve.

4. Seat vacuum break diaphragm over sealing bead on air horn casting. With diaphragm held in place, carefully install diaphragm cover and two retaining screws. Tighten screws securely.

5. Install air horn to float bowl by lowering gently on to float bowl until seated. Install three long and three short air horn-to-float bowl attaching screws and tighten securely.

6. Assemble choke rod to the choke shaft lever. End of rod points away from air horn casting when installed properly.

7. Install lower end of choke rod into fast idle cam. Steps on fast idle cam should face fast idle tang on throttle lever.

8. Install upper choke lever to choke shaft. End of lever faces towards vacuum break diaphragm. (See Fig. 6B-13) Install choke lever screw Tighten securely.

IDLE VENT ADJUSTMENT (Fig. 6B-21)

Set engine idle rpm to specification (solenoid inactive) and hold choke valve wide open so that the fast idle cam follower is not hitting the fast idle cam. Initial idle setting can be made by turning idle screw in 1 1/2 turns from closed throttle position.

With throttle lever held against the idle screw, the idle vent valve should be open as specificed. To measure,

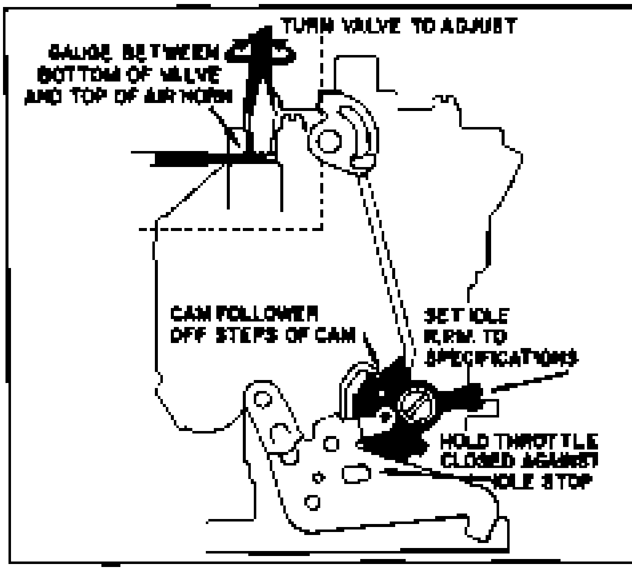


Fig. 6B-21 Idle Vent Adjustment

insert plug gauge between top of air horn casting and bottom of vent valve.

To adjust, turn slotted vent valve head with screwdriver, clockwise (inward) to decrease clearance and counterclockwise (outward) to increase clearance as needed.

FAST IDLE ADJUSTMENT (ON CAR) Fig. 6B-22

1. Set normal engine idle speed. (Initial idle speed setting off car is 1 1/2 turns in on idle speed screw from closed throttle valve position).

2. Place fast idle cam follower tang on highest step of cam.

3. To adjust insert end of screwdriver in slot provided in fast idle cam follower tang and bend inward (towards cam) or outward (away from cam) to obtain specified fast idle speed.

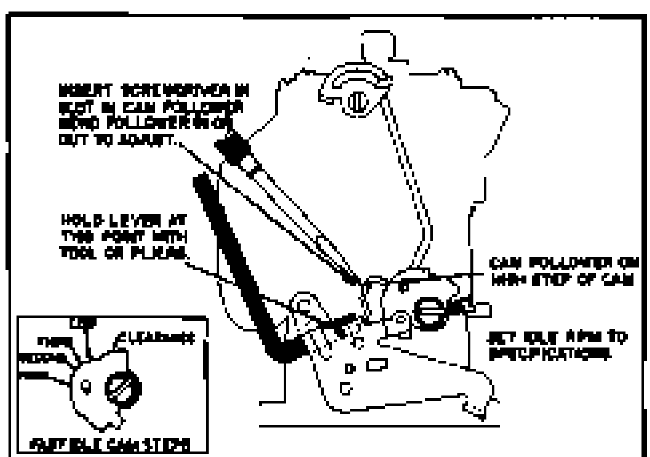


Fig. 6B-22 Fast Idle Adjustment

CHOKE ROD ADJUSTMENT

With fast idle adjustment made (Fig. 6B-23)

1. Place fast idle cam follower on second step of the fast idle cam and hold firmly against the rise to the high step.

2. Rotate choke valve towards direction of closed choke by applying force to choke coil lever.

3. Bend choke rod at point shown to give specified opening between the lower edge of choke valve (at center of valve) and inside air horn wall.

VACUUM BREAK ADJUSTMENT (Fig. 6B-24)

1. Open throttle valve so that cam follower on throttle lever will clear highest step on fast idle cam.

2. Rotate choke valve to closed position. If thermostatic coil is warm, hold choke valve closed with rubber band or spring attached between choke shaft lever and stationary part of carburetor.

3. Grasp vacuum breaker plunger rod with needle nose pliers and push straight inward until diaphragm seats.

4. With specified plug gauge, measure clearance between lower edge of choke valve and inside air horn wall at center of valve as shown.

5. Bend end of vacuum break lever at point shown to adjust.

UNLOADER ADJUSTMENT (Fig. 6B-25)

1. Hold choke valve in closed position by applying a light force to the choke coil lever.

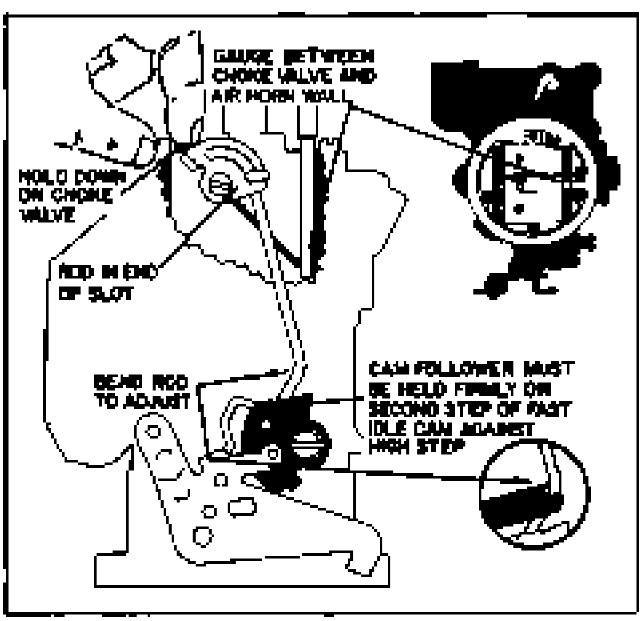


Fig. 6B-23 Choke Rod Adjustment

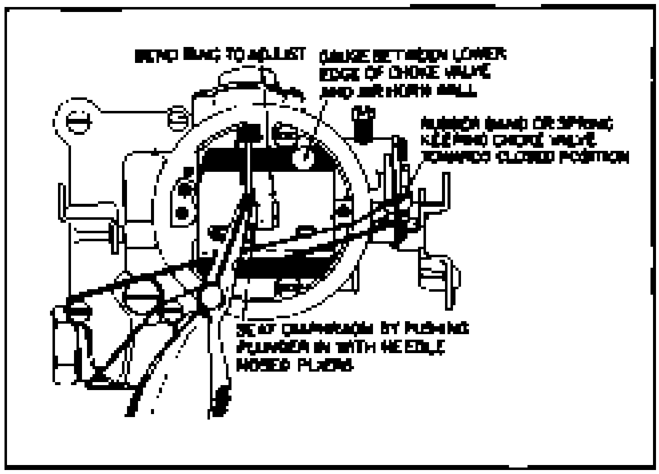


Fig. 6B-24 Vacuum Break Adjustment

2. Rotate throttle lever to wide open throttle valve position.

3. Bend unloader tang on throttle lever to obtain specified dimension between lower edge of choke valve (at center) and air horn wall.

CHOKE COIL ROD ADJUSTMENT (Fig. 6B-26)

1. Hold choke valve closed.

2. Pull upward on coil rod to end of travel.

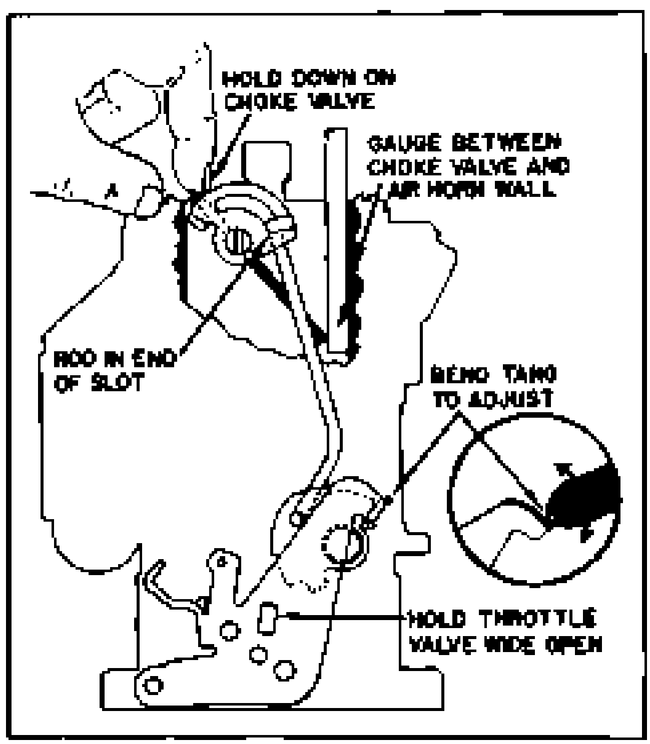


Fig. 6B-25 Unloader Adjustment

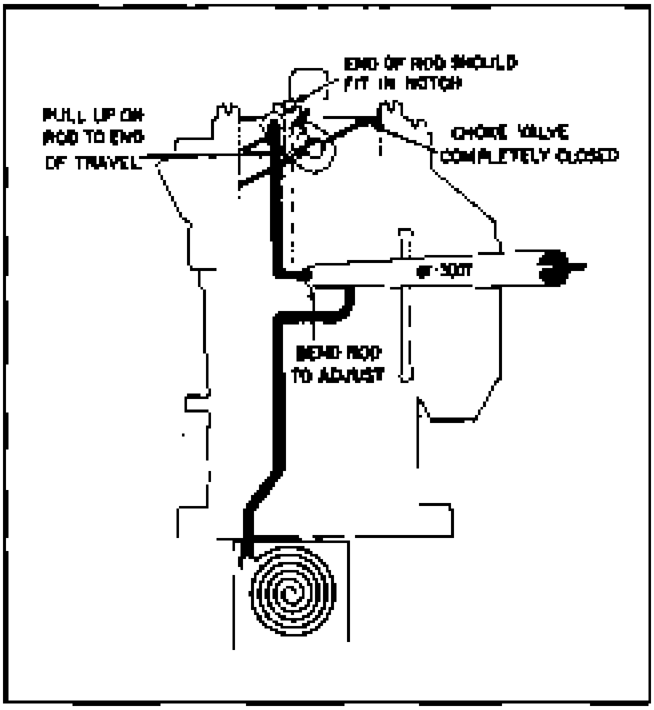


Fig. 6B-26 Choke Coil Rod Adjustment

3. Bottom of rod end which slides into hole in choke lever should lay freely in notch on the choke lever.

4. Bend choke coil rod at point shown to adjust.

5. Connect coil rod to choke lever and install retaining clip.

ROCHESTER 2GV CARBURETOR

V-8 ENGINE

CARBURETOR MODEL NUMBER	ENGINE AND TRANSMISSION USAGE
7029060	400 Auto. Trans.
7029062	350 Auto. Trans.
7028066	400 Manual Trans.
7028071	350 Manual Trans.

ADJUSTMENTS ON CAR

All Rochester 2GV adjustments can be performed on the car. With the exception of idle speed and mixture adjustment all adjustments are included in the OVERHAUL AND ADJUSTMENTS procedure. Following are idle speed and mixture adjustments.

IDLE SPEED AND MIXTURE ADJUSTMENT

With engine at operating temperature adjust idle speed following the procedure at the end of Section 6D.

Whenever the idle screw is turned to adjust idle, the throttle should be opened slightly, then closed to seat throttle lever extension on the screw.

The idle mixture should be adjusted to give best lean idle at specified idle speed. Missing is a sign of too lean an idle mixture while rolling or loping indicates too rich a mixture. Turning idle mixture screw in, leans out mixture; four turns out from lightly seated position may be used as a premilinary setting fo mixture screws: mixture to be leaned out from this setting to achieve best lean idle.

PERIODIC SERVICE

There are no periodic services required on the Rochester 2GV carburetor; however, choke linkage, choke valve and levers and pump linkage should be kept free of dirt and gum so that they will operate freely. DO NOT OIL CHOKE VALVE SHAFT OR ANY PART OF THE LINKAGE.

OVERHAUL AND ADJUSTMENT

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by presence of dirt, water or other foreign matter in carburetor. To aid in diagnosing the cause of complaint, the carburetor should be carefully removed from engine without draining fuel from bowl. The contents of fuel bowl may then be examined for contamination as carburetor is disassembled.

The following is a step-by-step sequence by which the Rochester 2GV carburetor may be completely disassembled and reassembled. Adjustments may be made and various parts of the carburetor may be serviced without completely disassembling the entire unit.

DISASSEMBLY OF BOWL COVER

1. Remove fuel inlet filter retainer nut and gasket (Fig. 6B-27) and remove filter.

2. Disconnect pump link (Fig. 6B-28) from pump lever by removing spring clip. Remove lower end of pump rod from throttle lever by removing clip.

3. Detach choke coil rod (Fig. 6B-27) from choke shaft lever after removing retaining clip.

4. Remove retaining screw at end of choke shaft and remove choke trip lever and fast idle link and lever (Fig. 6B-28). Lever can be removed from link by turning until slot in lever will pass over tang on link. The link and fast idle lever are retained by a Truarc washer. Disassembly of these pieces will destroy Truarc washer.

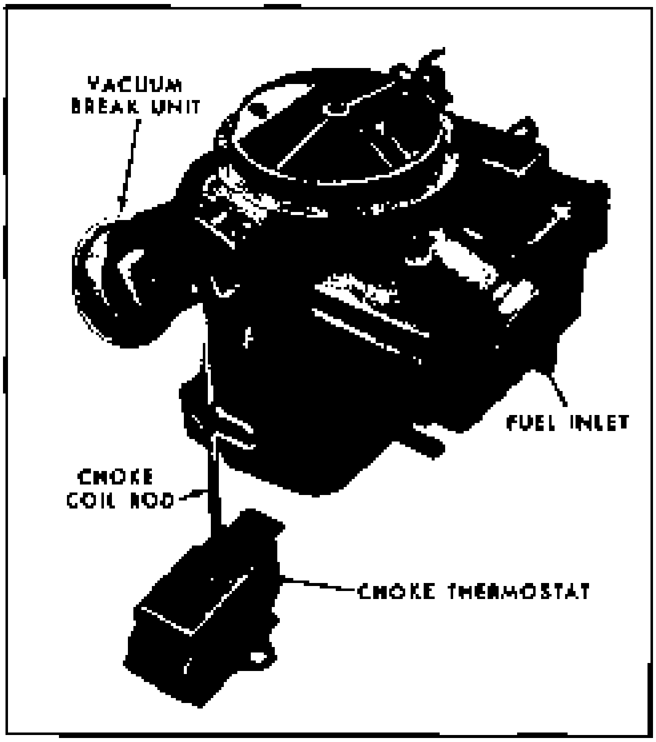


Fig. 6B-27 Rochester 2GV Carburetor

5. Remove eight cover screws and lift cover from bowl (Fig. 6B-29).

6. Remove vacuum break unit and hose.

7. Place cover on flat surface. Remove float hinge pin and lift float from cover (Fig. 6B-30). Float needle may now be removed from seat.

8. Remove float needle seat, screen (Fig. 6B-30) and gasket with wide blade screwdriver.

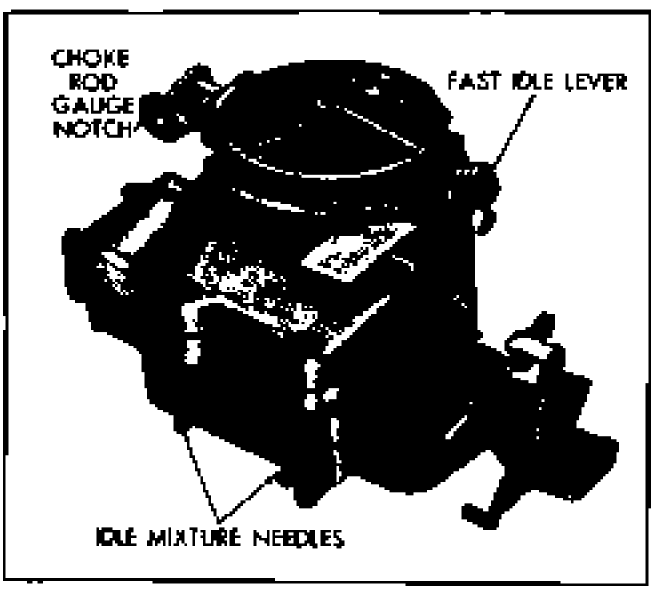


Fig. 6B-28 Rochester 2GV Carburetor

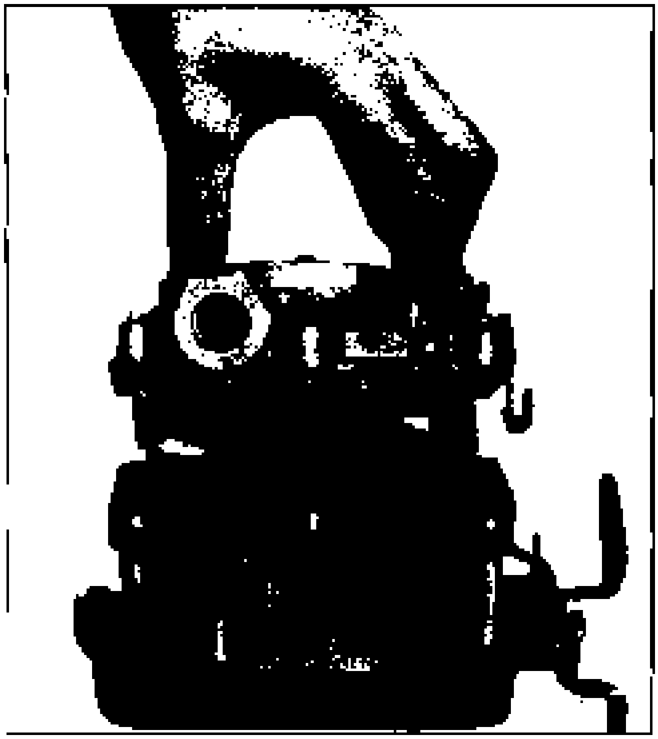


Fig. 6B-29 Air Horn Removal

8. Remove power piston (Fig. 6B-30) by depressing piston stem and allowing it to snap free or by holding stem and tapping lightly on air horn with a nonmetallic object. Use car not to bend piston stem.

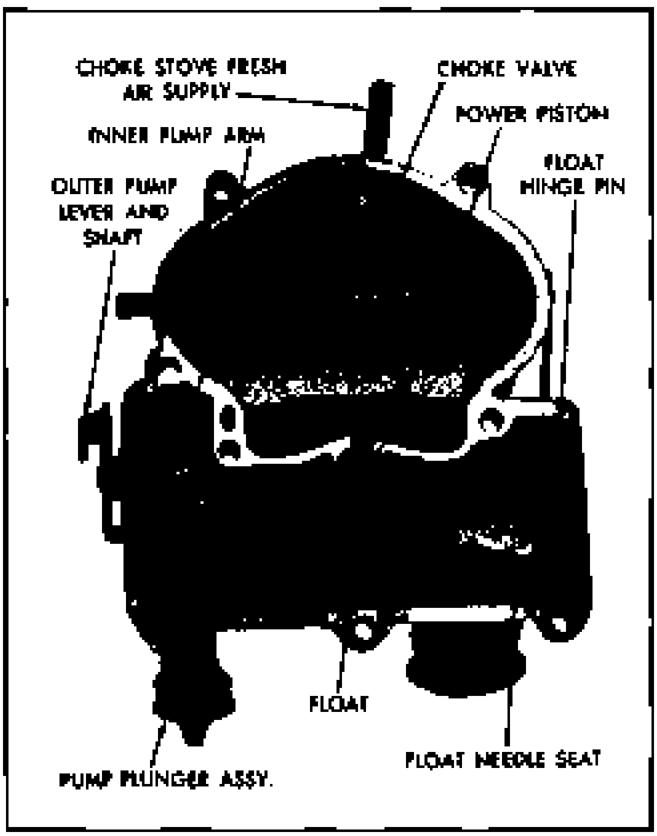


Fig. 6B-30 Bowl Cover Attaching Parts

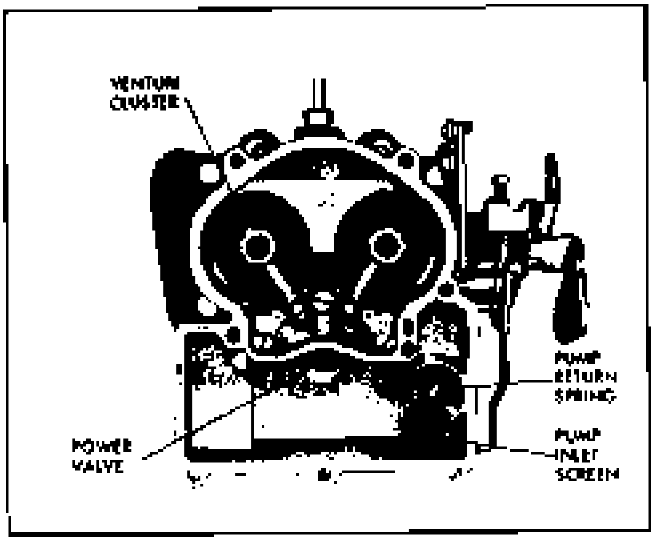


Fig. 6B-31 Float Bowl Assembly

9. Remove retainer on pump plunger shaft, remove plunger assembly from pump arm. The pump lever and shaft may be removed by loosening set screw on inner arm and removing outer lever and shaft.

10. The cover gasket may now be removed.

11. Remove two choke valve attaching screws, then remove choke valve.

12. Remove choke valve shaft from bowl cover.

DISASSEMBLY OF BOWL

1. Remove pump inlet filter screen and pump plunger return spring, and remove aluminum check ball from bottom pump well (Fig. 6B-31).

2. Remove main metering jets and power valve (Fig. 6B-31).

3. Remove three screws holding cluster to bowl and remove cluster and gasket.

4. Using a pair of long nose pliers, remove pump discharge spring retainer (Fig. 6B-32). Then spring and check ball may also be removed.

5. Invert carburetor and remove three large bowl to throttle body attaching screws. Throttle body and gasket may now be removed.

6. Remove fast idle cam and fast idle link as an assembly. DO NOT disassemble.

DISASSEMBLY OF THROTTLE BODY

1. Remove idle adjusting needles and springs.

2. Remove fast idle screw from throttle lever if necessary to replace.

CLEANING AND INSPECTION

Dirt, gum, water or carbon contamination in or on exterior moving parts of a carburetor are often responsible for unsatisfactory performance. For this reason, efficient carburetion depends upon careful cleaning and inspection while servicing.

1. Thoroughly clean carburetor casting and metal parts in clean cleaning solvent.

CAUTION: Vacuum break unit, gaskets, and pump plunger should not be immersed in solvent. Clean pump plunger in clean gasoline only.

2. Blow all passages in castings (Fig. 6B-33 through 6B-47) dry with compressed air and blow off all parts until they are dry.

CAUTION: Do not pass drills or wires through calibrated jets or passages as they may enlarge orifices and seriously affect carburetor calibration.

3. Check all parts for wear. If wear is noted, defective parts must be replaced. Note especially the following:

a. Check float needle and seat for wear. If wear is noted, the assembly must be replaced.

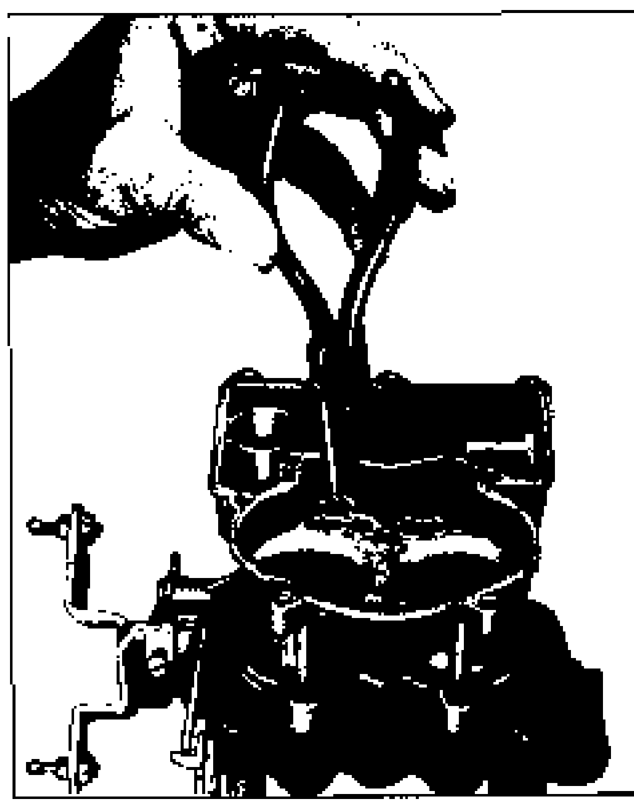


Fig. 6B-32 Removing Pump Discharge Spring Retainer

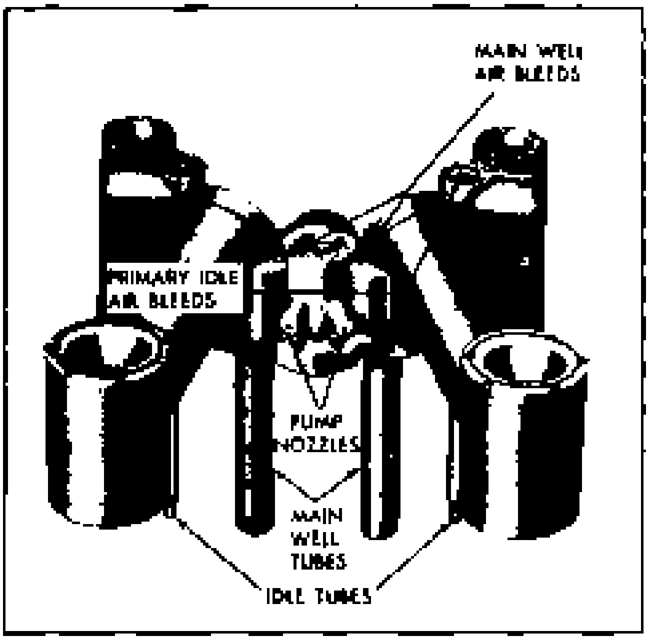


Fig. 6B-33 Venturi Cluster Passage Identification

b. Check float lip for wear and float for damage.

c. Check throttle and choke shaft bores in throttle body and cover castings for wear or out of round.

d. Inspect idle adjusting needle for burrs or ridges. Such a condition requires replacement.

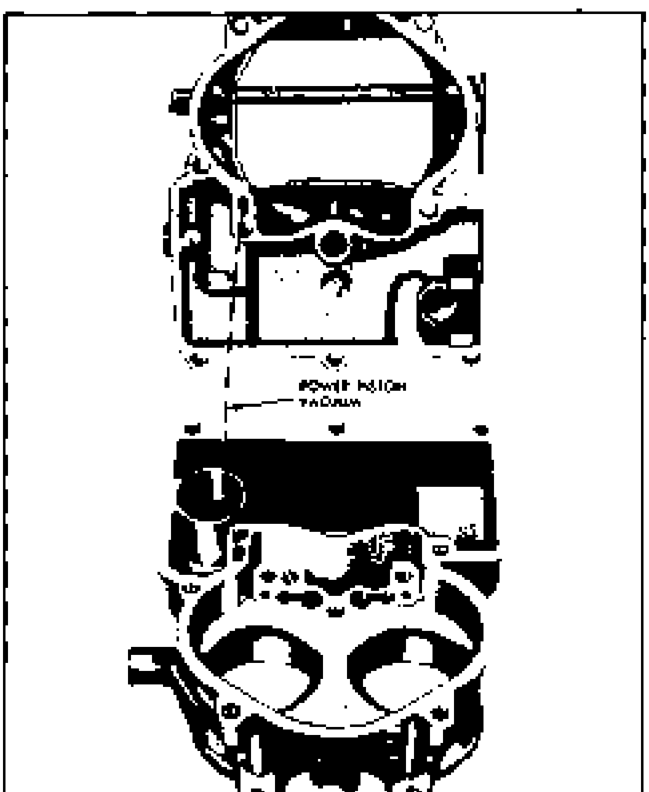


Fig. 6B-34 Body to Bowl Cover Passage Identification

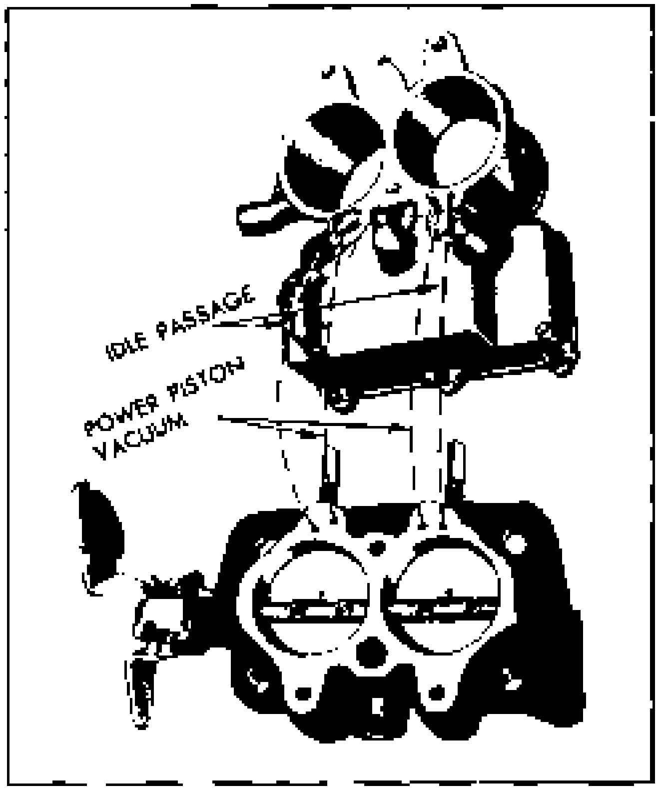


Fig. 6B-35 Flange - Bowl Passage Identification

e. Inspect fast idle cam. If wear is noted on steps of cam, it should be replaced as it may upset engine idle speed during the warm-up period.

f. Inspect pump plunger cup. Replace plunger if cup is damaged.

g. Inspect power piston and spring for burrs or distortion. Replace if necessary.

4. Check all filter screens for dirt or lint. Clean and, if they are distorted or plugged, replace with new parts.

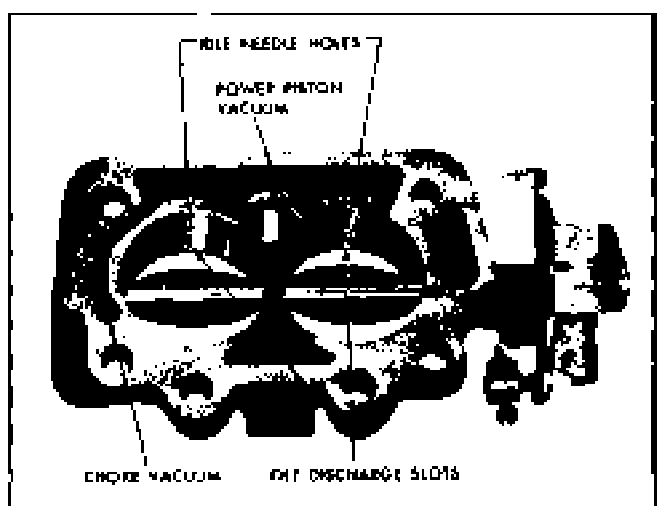


Fig. 6B-36 Throttle Flange Passage Identification

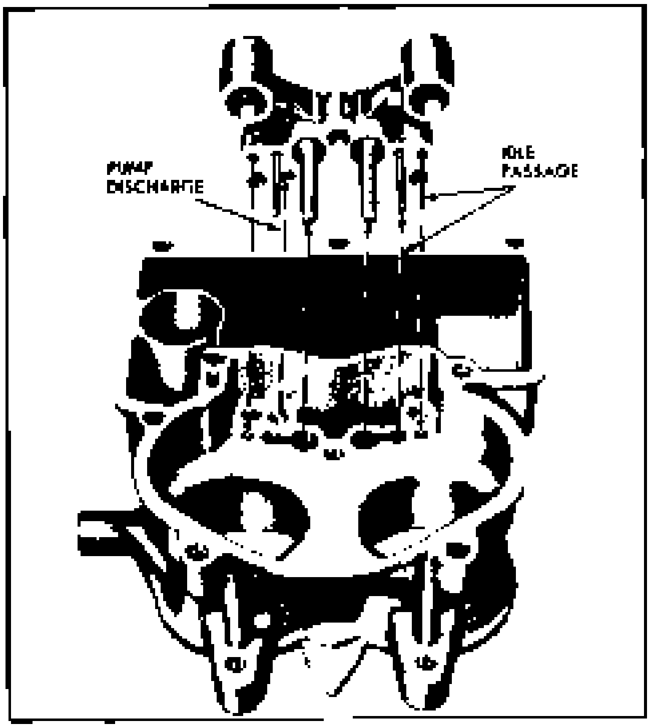


Fig. 6B-37 Body to Cluster Passage Identification

5. Inspect cluster casting. If any parts in castings are loose or damaged, cluster addembly must be replaced.

6. Use new gaskets in reassembly.

ASSEMBLY OF THROTTLE BODY

1. Install idle screw in throttle lever if removed.

2. Screw idle mixture adjusting needles and springs into throttle body until finger tight. Back out screw 4 turns as a preliminary idle adjustment.

3. Upend bowl, place new throttle body gasket in positon and attach throttle body. Tighten screws evenly and securely.

ASSEMBLY OF BOWL

1. Drop steel pump discharge check ball into pump discharge hole. Ball is 3/16" diameter (do not confuse with aluminum inlet ball). Install pump discharge spring and retainer.

2. Replace cluster and gasket, tighten screws evenly and securely. Make certain center screw is fitted with gasket to prevent pump discharge leakage.

3. Replace main metering jets and power valve.

4. Drop aluminum inlet ball check into hole in pump well. Install pump return spring, pressing with finger to center it in pump well.

5. Replace pump inlet strainer, pressing carefully into position.

ASSEMBLY OF BOWL COVER

1. Install choke shaft in air horn, then install choke valve on choke shaft, using two attaching screws. Letters RP on choke valve should face towards top of air horn. Center choke valve before tightening screws, by installing the fast idle lever and choke trip lever. Maintain approximately .020" clearance between the fast idle lever and air horn casting. Then tighten choke valve screws and stake lightly. Then install choke trip lever and fast idle lever. Choke valve should move freely in housing.

2. Replace pump outer lever and shaft assembly and inner lever, tighten retaining screw on inner lever.

3. Install float needle seat screen and gasket, using wide blade screwdriver.

4. Install pump plunger assembly with shaft end pointing inward towards center of air horn casting and install clip

5. Install cover gasket.

6. Insert needle in seat, carefully position float and insert hinge pin.

7. Check float level and float drop adjustments.

FLOAT LEVEL ADJUSTMENT (Fig. 6B-50)

With air horn inverted, gasket in place and needle seated, there should be 9/16" clearance between the lip of the float at toe end and air horn gasket.

Use gauge set J 8556. To adjust, bend float arm at rear of float. Visually check float alignment after adjusting float.

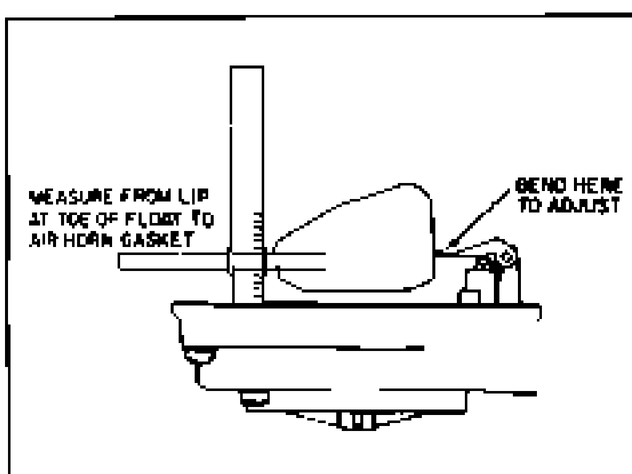


Fig. 6B-38 Float Level Adjustment

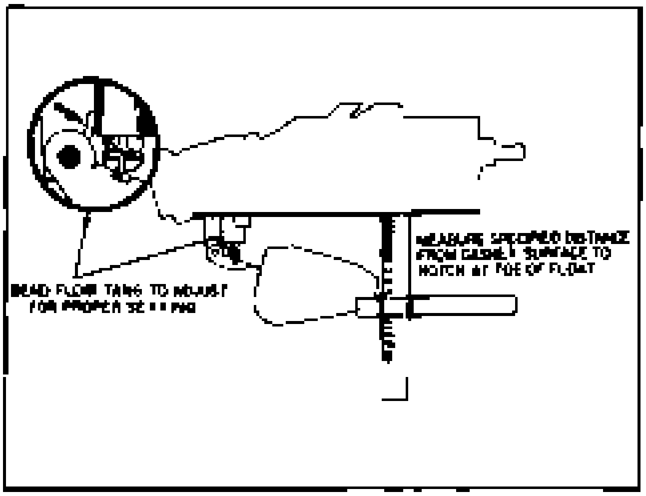


Fig. 6B-39 Float Drop Adjustment

1. Install power piston in vacuum cavity: piston should travel freely in cavity. Stake vacuum piston retainer washer.

2. Place cover on bowl, making certain that accelerator pump plunger is correctly positioned and will move freely.

3. Install and tighten eight cover screws evenly and securely.

4. Install inlet filter, pressure relief spring and tighten nut to 25 lb. ft.

5. Install pump link and retainer.

6. Check pump rod adjustment

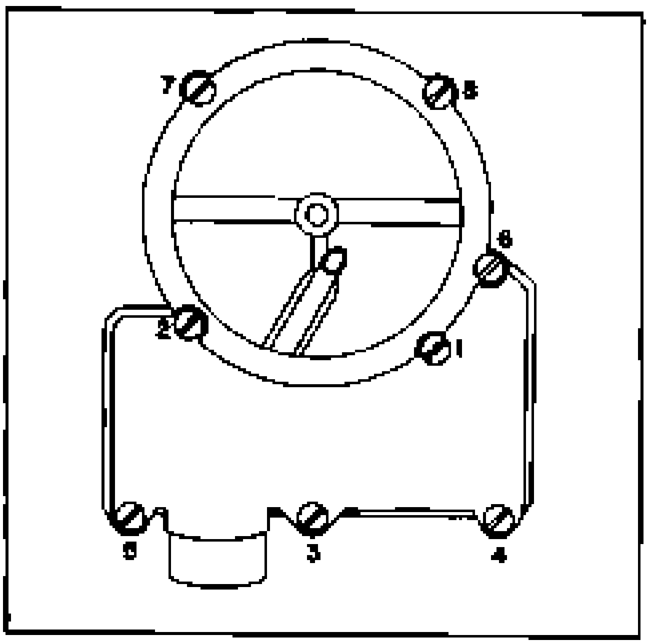


Fig. 6B-40 Air Horn Tightening Sequence

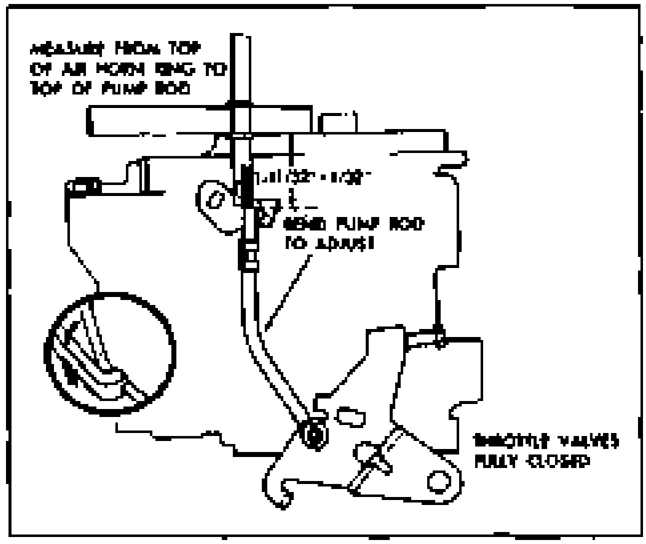


Fig. 6B-41 Pump Rod Adjustment

PUMP ROD ADJUSTMENT (Fig. 6B-41)

Place tool on top of cleaner mounting ring as shown. Then with throttle valves fully closed, the top surface of pump rod should just touch the end of gauge. Measurement should be 1 11/32". Bend pump rod to adjust.

1. Install fast idle link and fast idle cam as an assembly and install fast idle lever on other end of fast idle link. Place fast idle lever on choke shaft with the tang facing outward and toward the pump lever. Install trip lever so that tang of trip lever is under tang of choke lever, and install retaining screw (Fig. 6B-42).

2. Connect vacuum hose at flange, and at vacuum break unit.

3. Check choke rod adjustment.

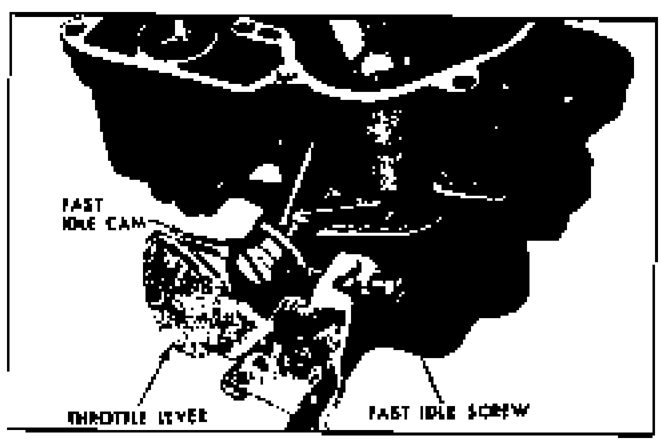


Fig. 6B-42 Fast Idle Cam Installed

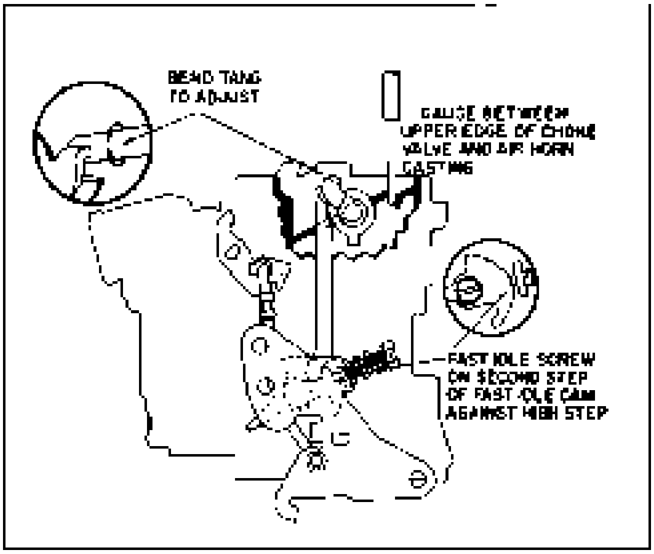


Fig. 6B-43 Choke Rod Adjustment

CHOKE ROD ADJUSTMENT (Fig. 6B-43)

Place idle screw on second step of fast idle cam against shoulder of high step. While holding screw in this position, gauge between upper edge of choke valve and air horn wall. Adjust to specified dimension by bending tang on choke lever and collar assembly.

After the carburetor is assembled, the following adjustments must be checked.

VACUUM BREAK ADJUSTMENT (Fig. 6B-44)

With vacuum break diaphragm seated and choke valve closed so the vacuum break rod is at the end of the slot in the choke shaft lever, gauge between the upper edge of the choke valve and inside wall of the air horn casting. To adjust, bend the vacuum break rod.

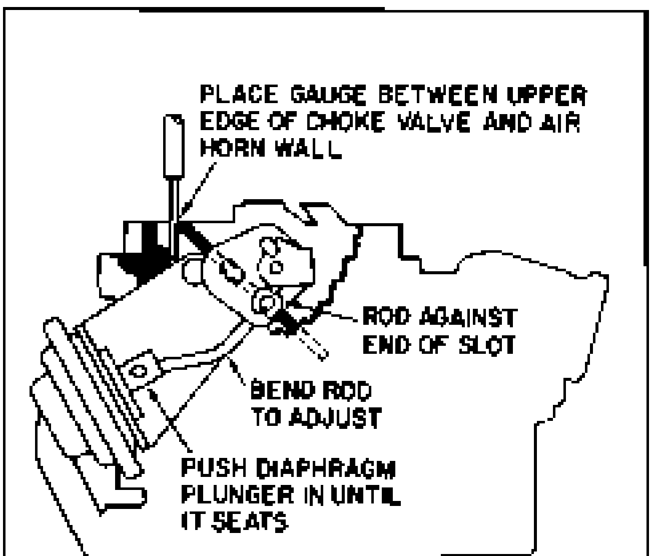
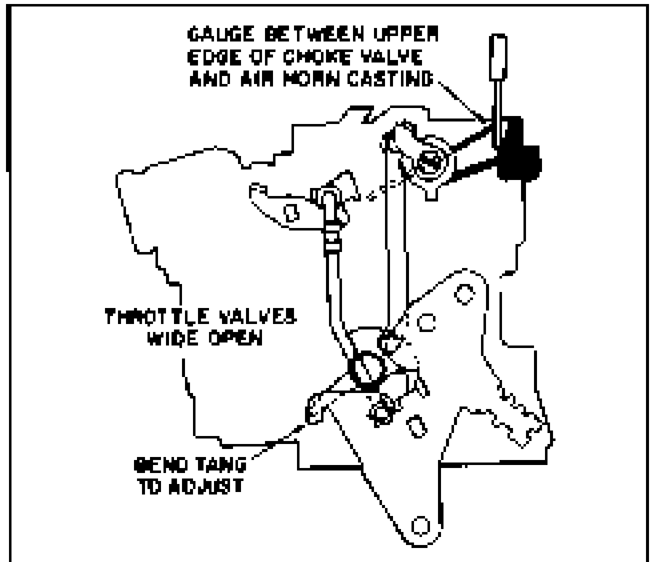


Fig. 6B-44 Vacuum Break Adjustment



(1 column x 3")

Fig. 6B-45 Unloader Adjustment

UNLOADER ADJUSTMENT (Fig. 6B-45)

With the throttle valves held wide open the choke valve should be open enough to admit the specified gauge between the upper edge of the choke valve and inner air horn wall. Bend tang on throttle lever to adjust.

CHOKE COIL ROD ADJUSTMENT (Fig. 6B-46)

To adjust, disconnect the upper end of the choke coil rod from the choke lever. With choke valve completely

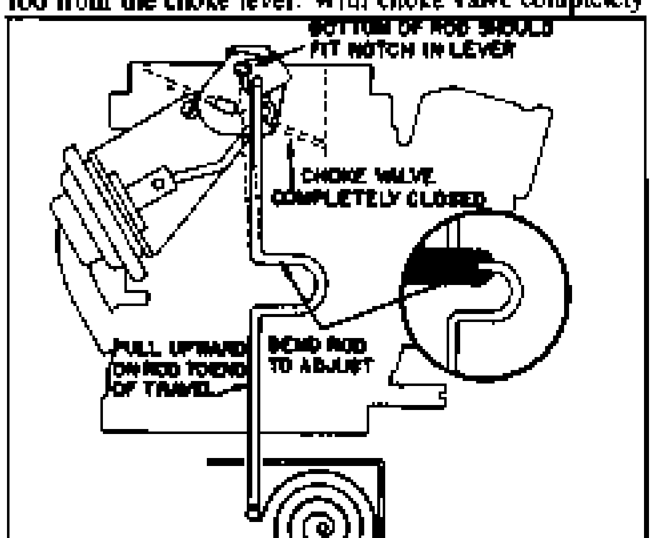


Fig. 6B-46 Choke Coil Rod Adjustment

closed, pull upward on the choke coil rod to the limit of its travel. The end of the rod should fit the guage notch on the choke lever.

To adjust, Bend rod as shown.

ROCHESTER 4MV QUADRAJET CARBURETOR

CARBURETOR MODEL NUMBER	ENGINE AND TRANSMISSION USAGE
7029260	350 A.T
7029261	350 M.T
7029262	428 Bonneville A.T
7029263	350-400 & 428 M.T.
7029268	350 400 & 428 A.T.
7029270	400 Ram Air IV A.T
7029273	400 Ram Air IV M.T.
7028270	400 Ram Air A.T
7028273	400 Ram Air M.T

Carburetor identification and change code is stamped on the throttle lever side of the float bowl.

ADJUSTMENTS ON CAR

All Rochester 4MV adjustments can be performed on the car. With the exception of the idle speed and mixture adjustment and the unloader adjustment, all adjustments are included in the OVERHAUL AND ADJUSTMENTS procedure.

The idle mixture should be adjusted to give a smooth idle at the specified idle speed. Missing is a sign of too lean an idle mixture while rolling or loping indicates too rich a mixture. Turning the idle mixture screw in leans out the mixture; five turns out from the lightly seated position may be used as a preliminary setting of the mixture screws on six-cylinder engine, and six turns out on V-8 engines. The mixture is to be leaned out from this initial setting to achieve the best lean idle.

PERIODIC SERVICE

ROCHESTER 4MV CARBURETOR

There are no periodic services required on the Rochester 4MV carburetor; however, choke linkage, choke valve and levers and pump linkage should be kept free of dirt and gum so that they will operate freely. DO NOT OIL LINKAGE

OVERHAUL AND ADJUSTMENT

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water or other foreign matter in the carburetor. To aid in diagnosing the cause of the complaint, the carburetor should be carefully removed from the engine without draining the fuel from the bowl. The contents of the fuel bowl may then be examined for contamination as the carburetor is disassembled.

The following is a step-by-step sequence by which the Rochester 4MV carburetor may be completely disassembled and reassembled. Adjustments may be made and various parts of the carburetor may be serviced without completely disassembling the entire unit.

NOTE: Place carburetor on proper holding fixture (Fig. 6B-47).

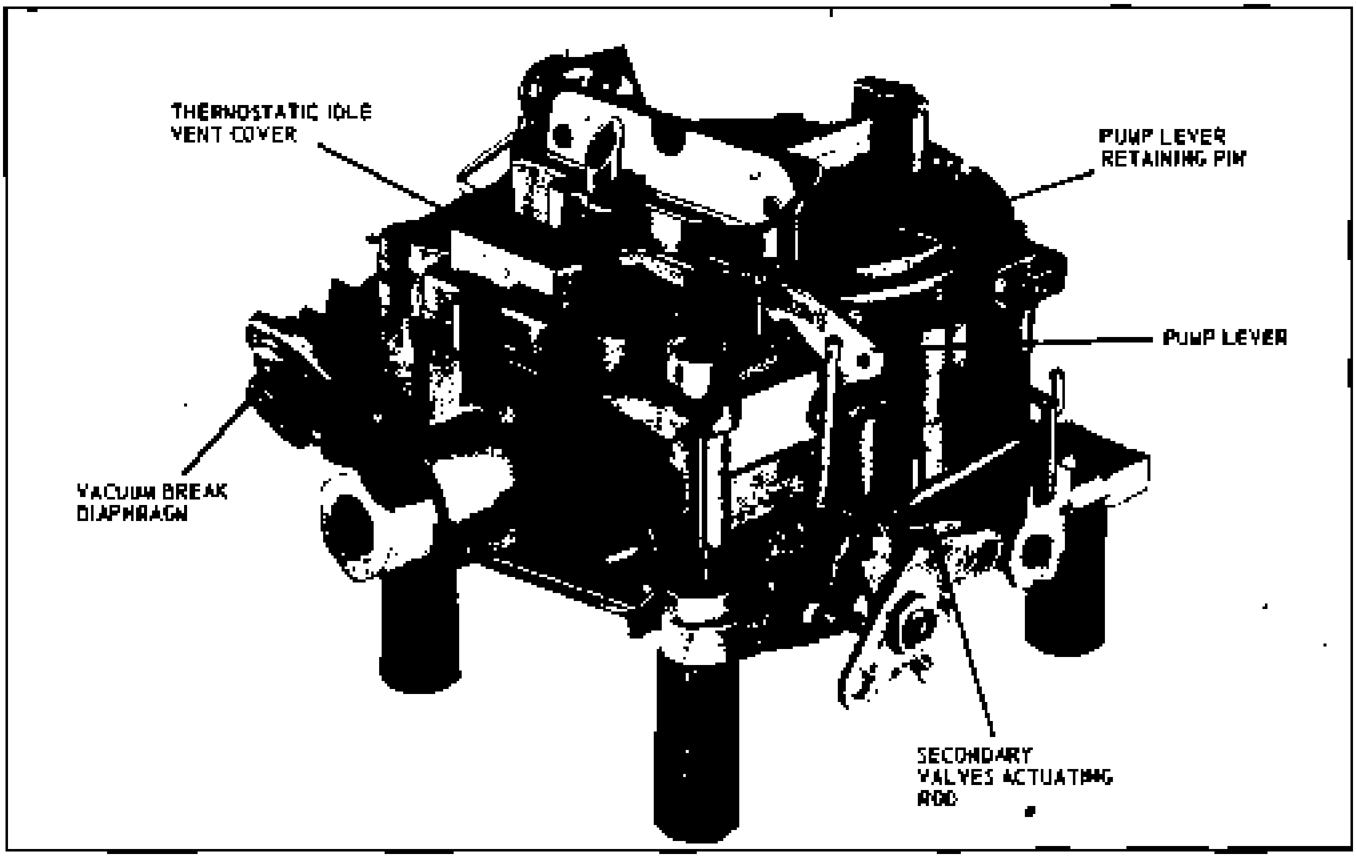


Fig. 6B-47 Rochester 4MV Carburetor

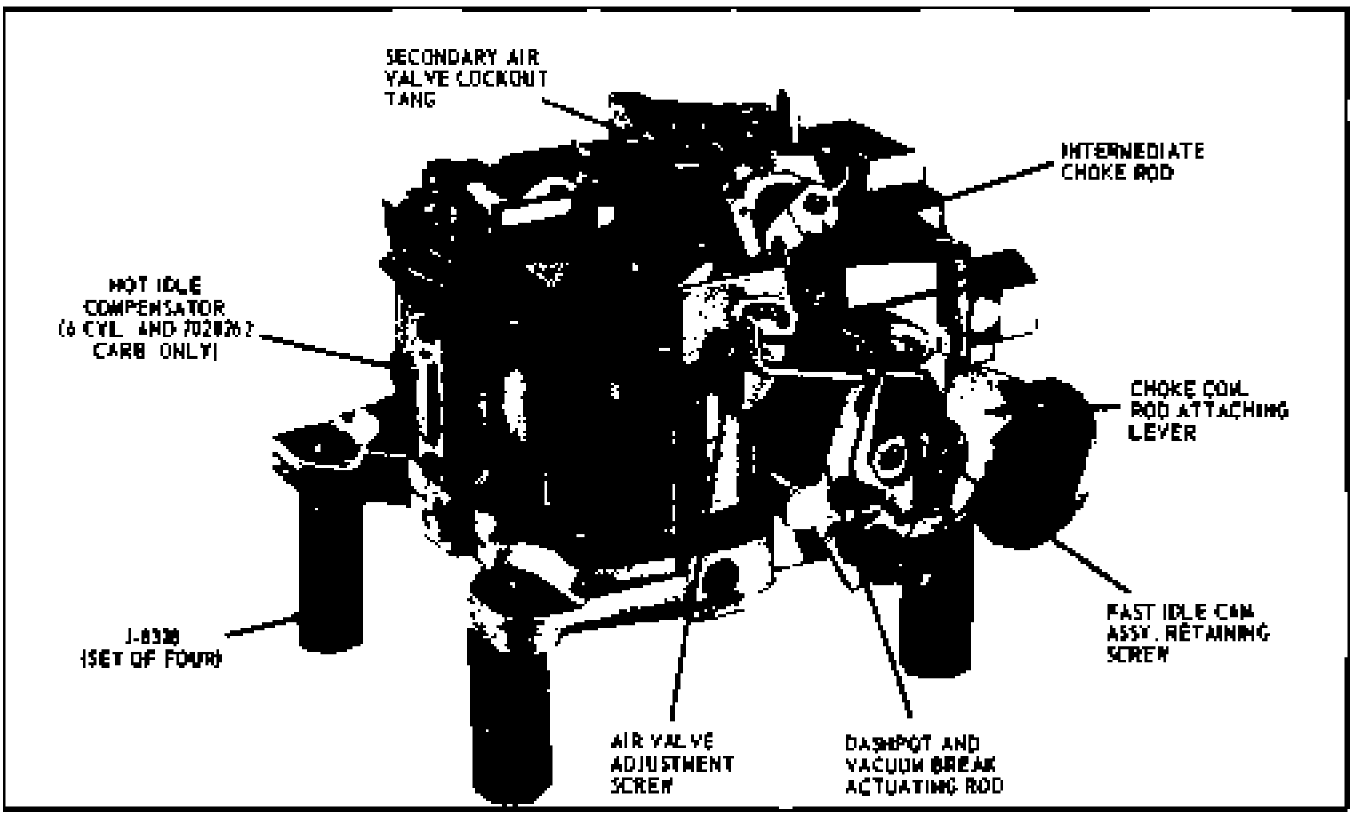
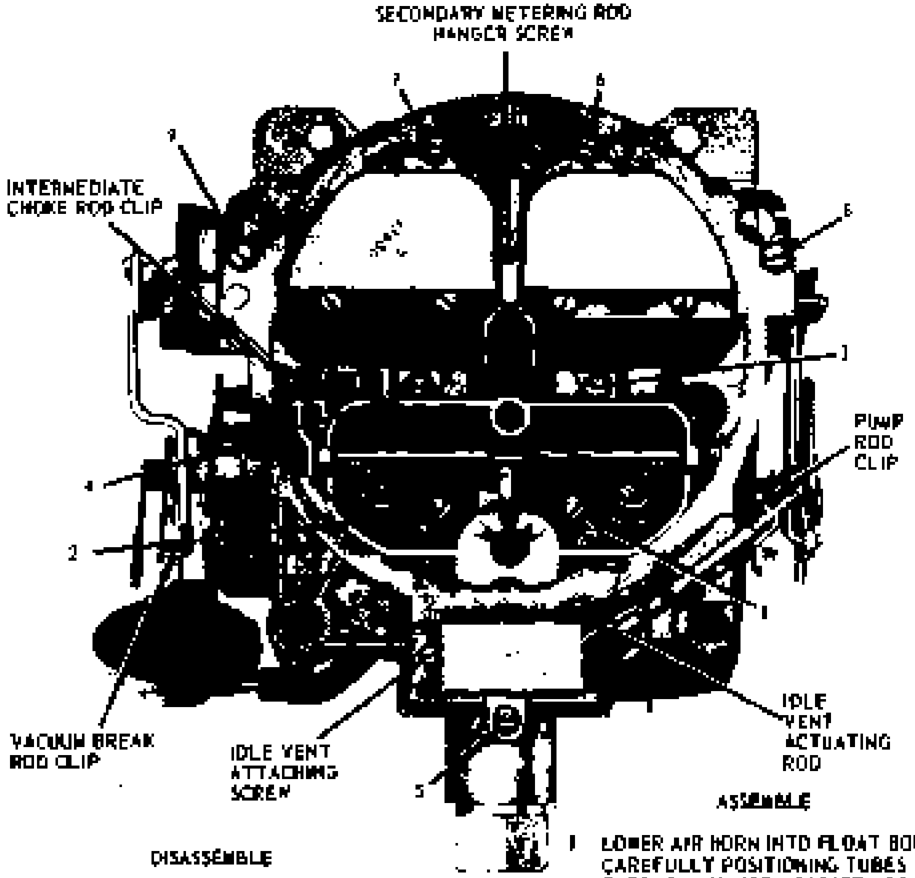


Fig. 6B-48 Rochester 4MV Carburetor

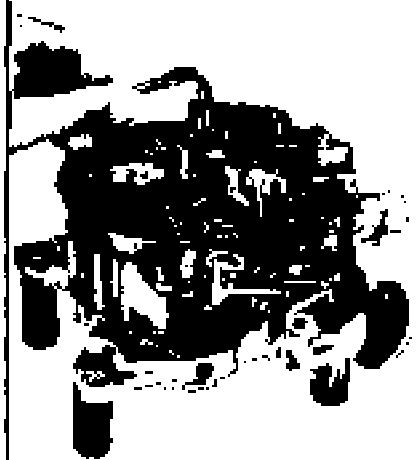


DISASSEMBLE

1. REMOVE PUMP ROD ATTACHING CLIP
2. REMOVE VACUUM BREAK ROD CLIP.
3. REMOVE SECONDARY METERING RODS (INSERT A).
4. REMOVE NINE AIR HORN ATTACHING SCREWS (NUMBERED).
5. REMOVE INTERMEDIATE CHOKE ROD CLIP AND REMOVE ROD.
6. REMOVE IDLE VENT AND COVER ASSY.
7. REMOVE AIR HORN BY LIFTING STRAIGHT UP. USE CARE TO AVOID DAMAGING PICK UP TUBES (INSERT B).

ASSEMBLE

1. LOWER AIR HORN INTO FLOAT BOWL CAREFULLY POSITIONING TUBES THROUGH AIR HORN GASKET. DO NOT FORCE AIR HORN INTO BOWL.
2. REPLACE NINE ATTACHING SCREWS. ALL SCREWS SHOULD BE TIGHTENED EVENLY AND SECURELY IN SEQUENCE AS NUMBERED.
3. INSTALL SECONDARY METERING RODS AND HANGER (INSERT A)
4. REPLACE INTERMEDIATE CHOKE ROD AND CLIP
5. REPLACE VACUUM BREAK ROD AND CLIP.
6. REPLACE PUMP ROD AND CLIP.



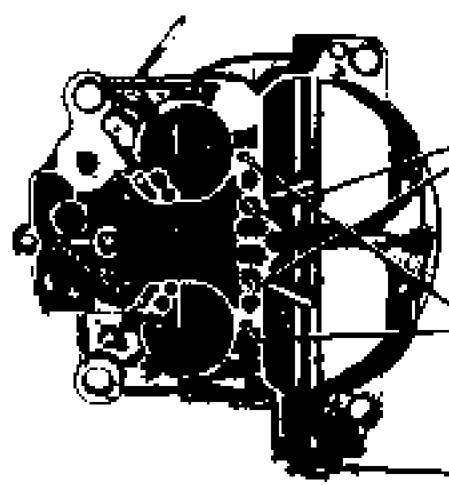
INSERT A

REMOVE

1. REMOVE RETAINING SCREW AND LIFT METERING RODS AND HANGER STRAIGHT UP
2. SLIDE RODS FROM HANGER

REPLACE

1. INSERT RODS IN HANGER.
2. HOLD HANGER AS SHOWN. SLIDE RODS INTO LOCATING HOLES IN AIR HORN AND REPLACE SCREW
3. CHECK FOR FREE OPERATION OF RODS IN METERING DISCS BY OPENING AND CLOSING AIR VALVE.



INSERT B

Fig. 6B-49 Air Horn Remove & Replace

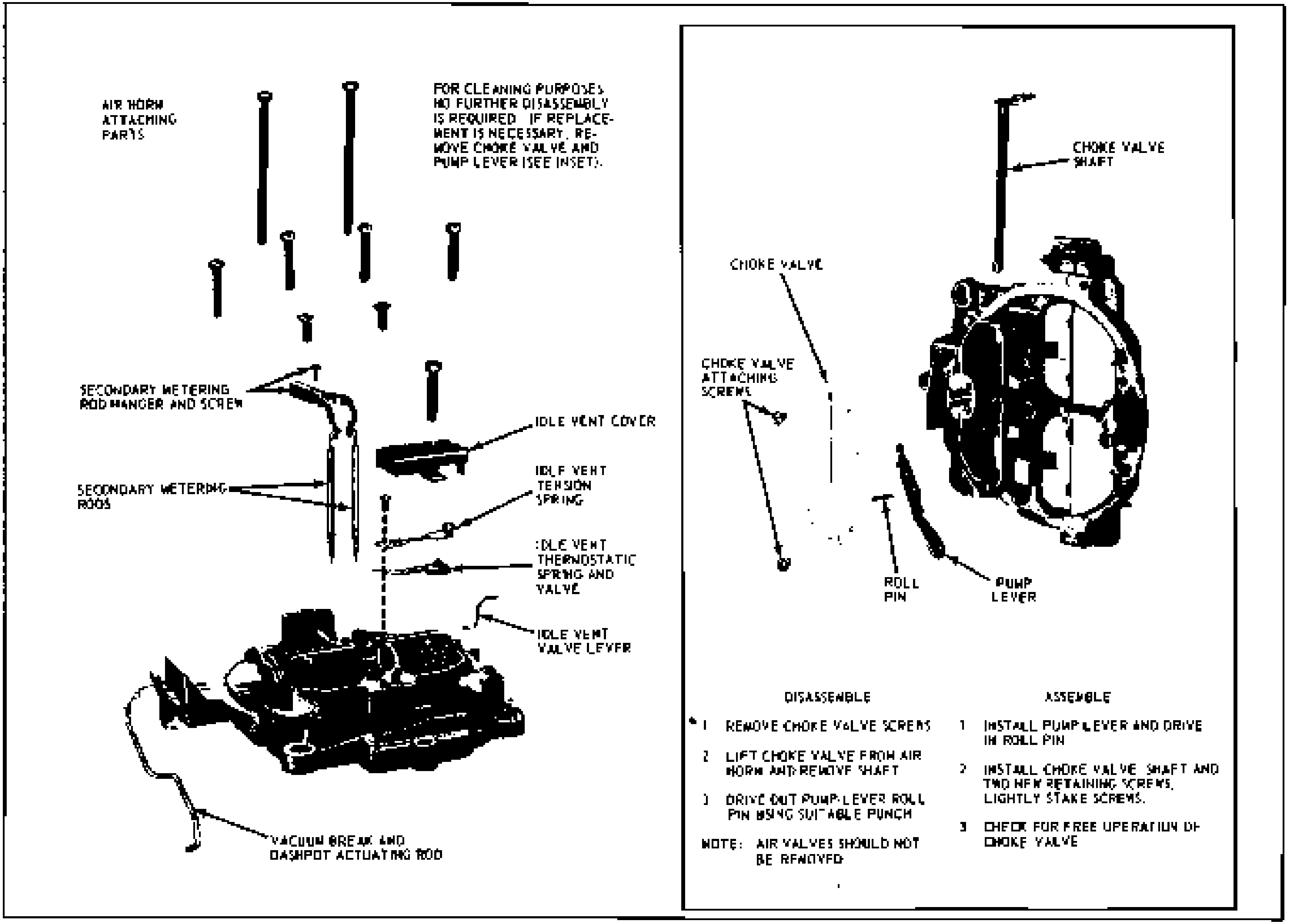
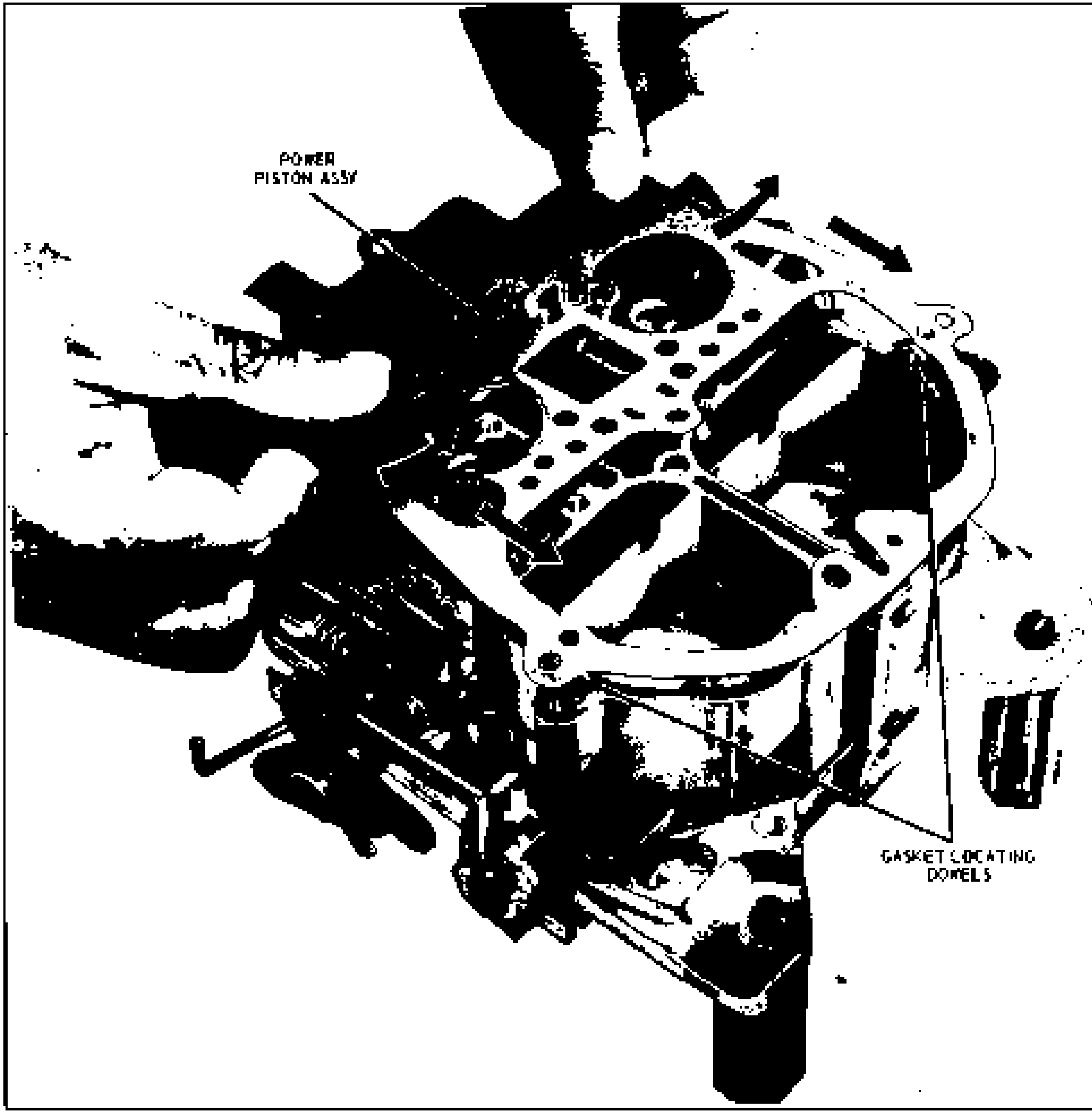


Fig. 6B-50 Air Horn Disassembly and Assembly



DISASSEMBLE

1. REMOVE ACCELERATOR PUMP
2. LIFT AIR HORN GASKET FROM LOCATING DOWELS.
3. SLIDE GASKET FORWARD TO CLEAR POWER PISTON AND LIFT OFF

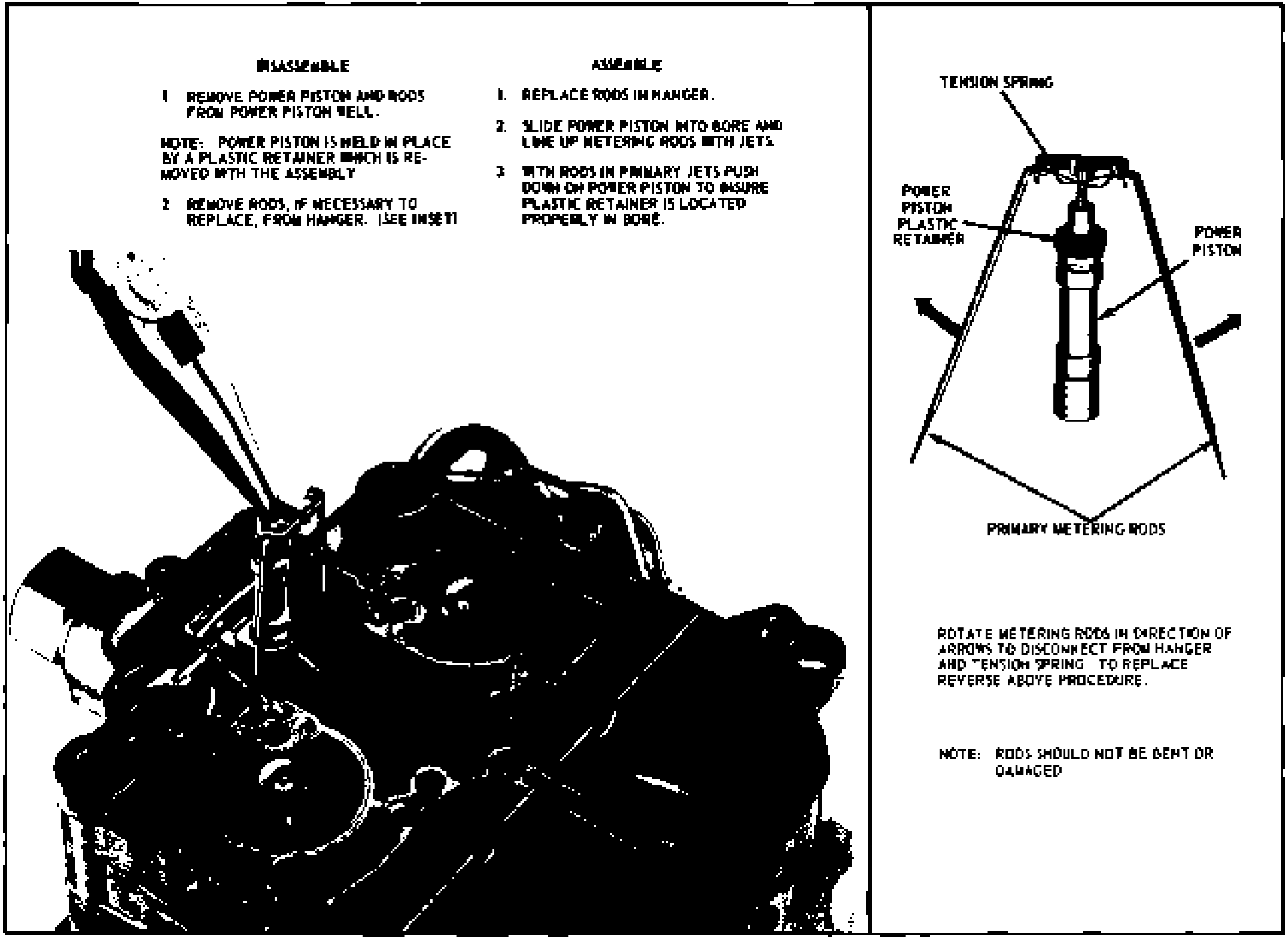
NOTE: GASKET IS CUT AWAY IN AREA OF POWER PISTON FOR EASE OF REMOVAL AND REPLACEMENT

ASSEMBLE

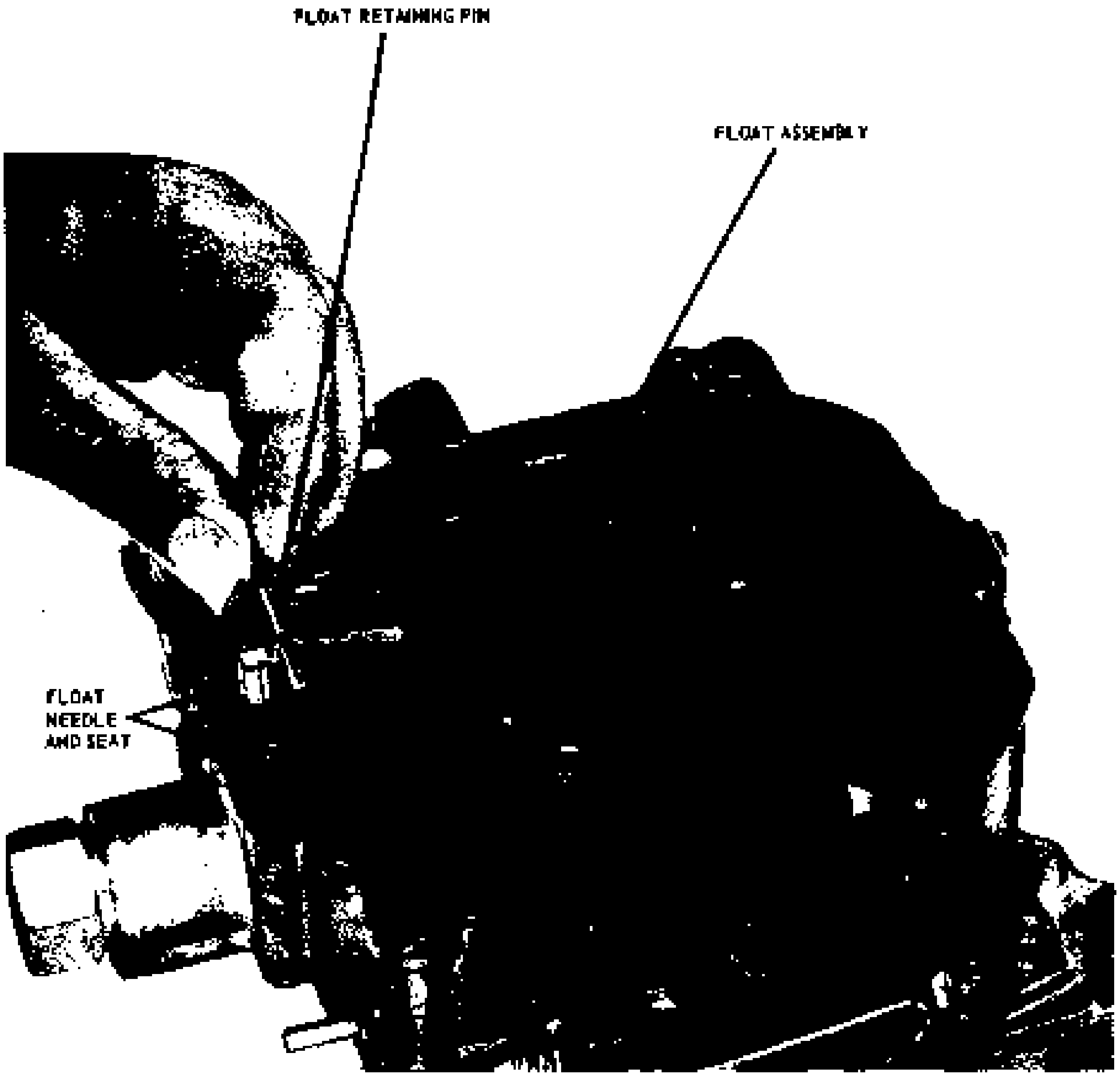
1. INSTALL AIR HORN GASKET AROUND PRIMARY METERING RODS AND POWER PISTON. POSITION GASKET OVER DOWELS
2. REPLACE ACCELERATOR PUMP.

Fig. 6B-51 Air Horn Gasket - Remove & Replace

Fig. 6B-52 Plastic Filler & Pump Spring R&R



6B-53 Power Piston & Primary Rods R&R



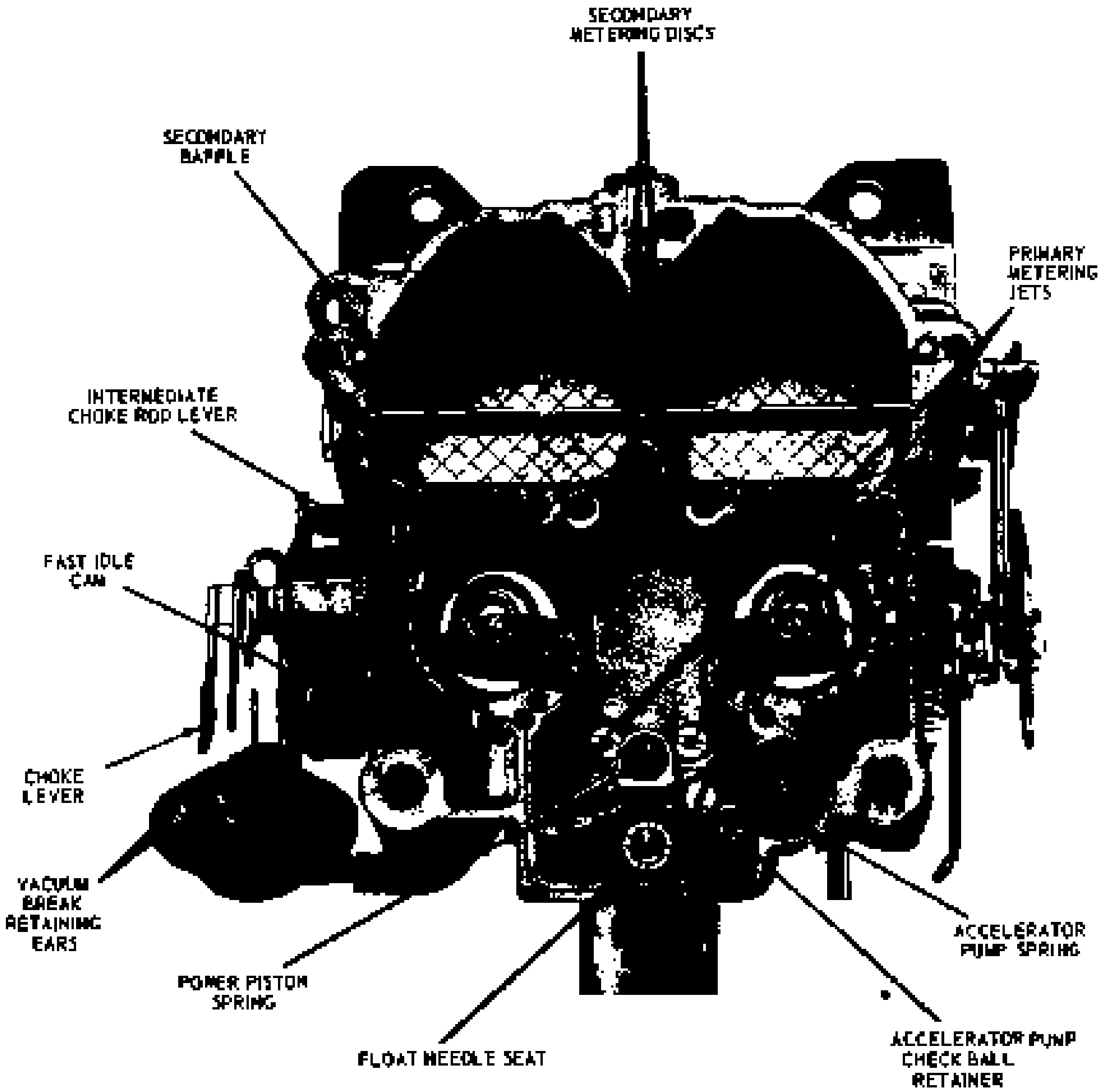
DISASSEMBLE

1. LIFT FLOAT AND NEEDLE FROM BOWL.
2. DISCONNECT NEEDLE PULL CLIP AND REMOVE NEEDLE.

ASSEMBLE

1. INSERT NEW NEEDLE AND PULL CLIP IN FLOAT PIN.
2. INSTALL FLOAT BY HOLDING FLOAT AT TOE AND INSTALL RETAINING PIN FROM PUMP WELL SIDE.
3. ADJUST FLOAT LEVEL (FIG. 6B-59)

Fig. 6B-54 Float & Float Needle Remove & Replace



DISASSEMBLE

1. REMOVE PUMP PLUNGER SPRING
2. REMOVE POWER PISTON SPRING
3. REMOVE FLOAT NEEDLE SEAT
4. REMOVE PRIMARY METERING JETS

CAUTION: SECONDARY METERING DISCS ARE NOT REMOVABLE

5. REMOVE ACCELERATOR PUMP CHECK BALL RETAINER AND BALL
6. REMOVE SECONDARY BAFFLE.
7. SPREAD RETAINING EARS WITH PLIERS TO REMOVE VACUUM BREAK ASSEMBLY.

ASSEMBLE

1. REPLACE VACUUM BREAK UNIT CLOSE EARS TO RETAIN.
2. REPLACE SECONDARY BAFFLE WITH NOTCHES TOWARD TOP.
3. REPLACE ACCELERATOR PUMP CHECK BALL AND RETAINER
4. REPLACE PRIMARY JETS
5. REPLACE FLOAT NEEDLE SEAT
6. REPLACE POWER PISTON SPRING.
7. REPLACE PUMP RETURN SPRING

Fig. 6B-55 Float Bowl Disassembly & Assembly

DISASSEMBLE

1. REMOVE CHOKE ASSY ATTACHING SCREW
2. REMOVE CHOKE ASSY. AND FAST IDLE CAM.
3. REMOVE INTERMEDIATE CHOKE ROD AND LEVER ASSY.

ASSEMBLE

1. POSITION INTERMEDIATE CHOKE ROD AND LEVER IN FLOAT WELL.
2. INSTALL CHOKE ASSY LINING UP FLATS ON INTERMEDIATE CHOKE SHAFT WITH CUT-OUTS IN CHOKE ROD LEVER.
3. INSTALL RETAINING SCREW AND TIGHTEN SECURELY.
4. REMOVE INTERMEDIATE CHOKE ROD FOR INSTALLATION LATER

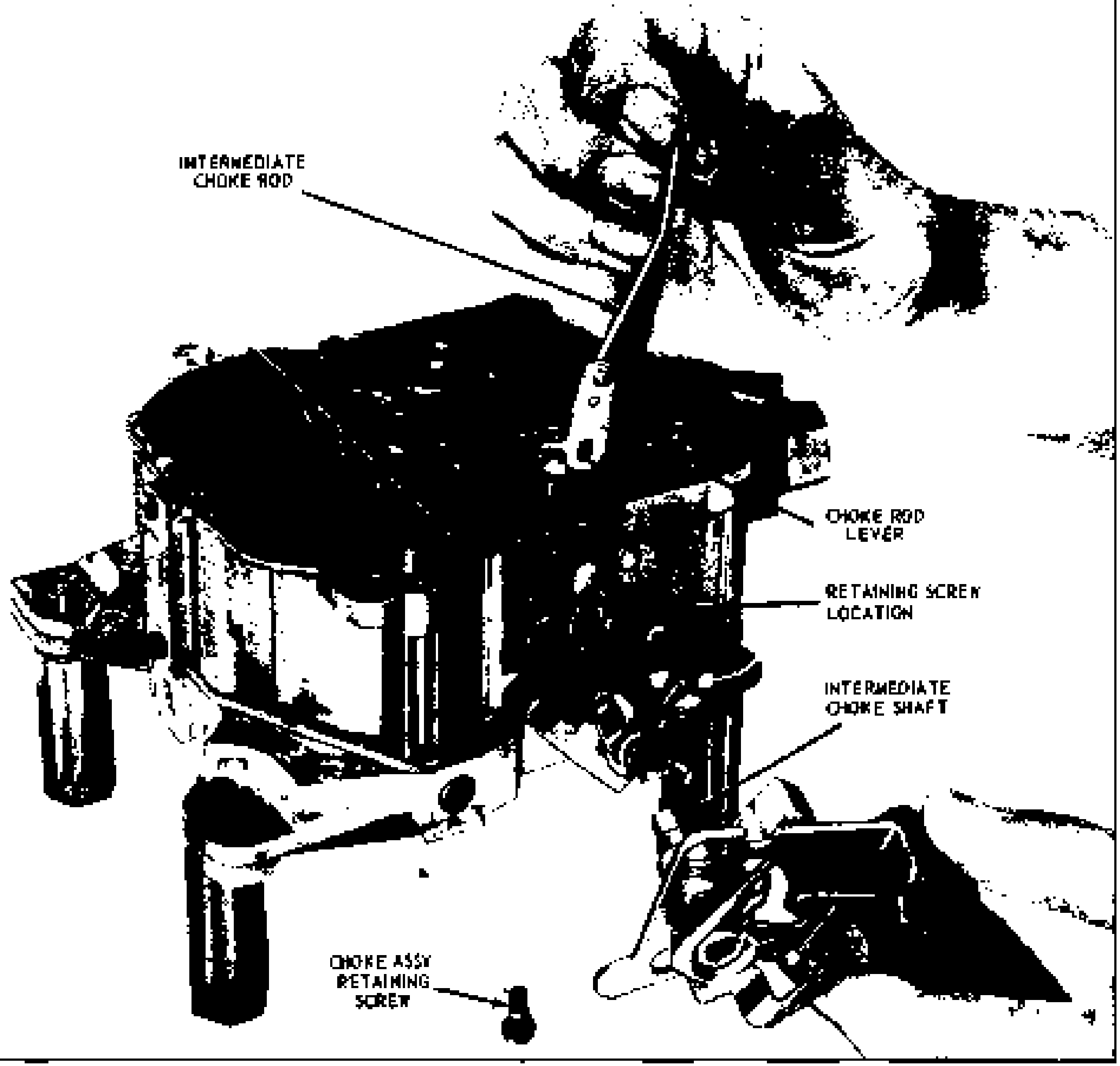
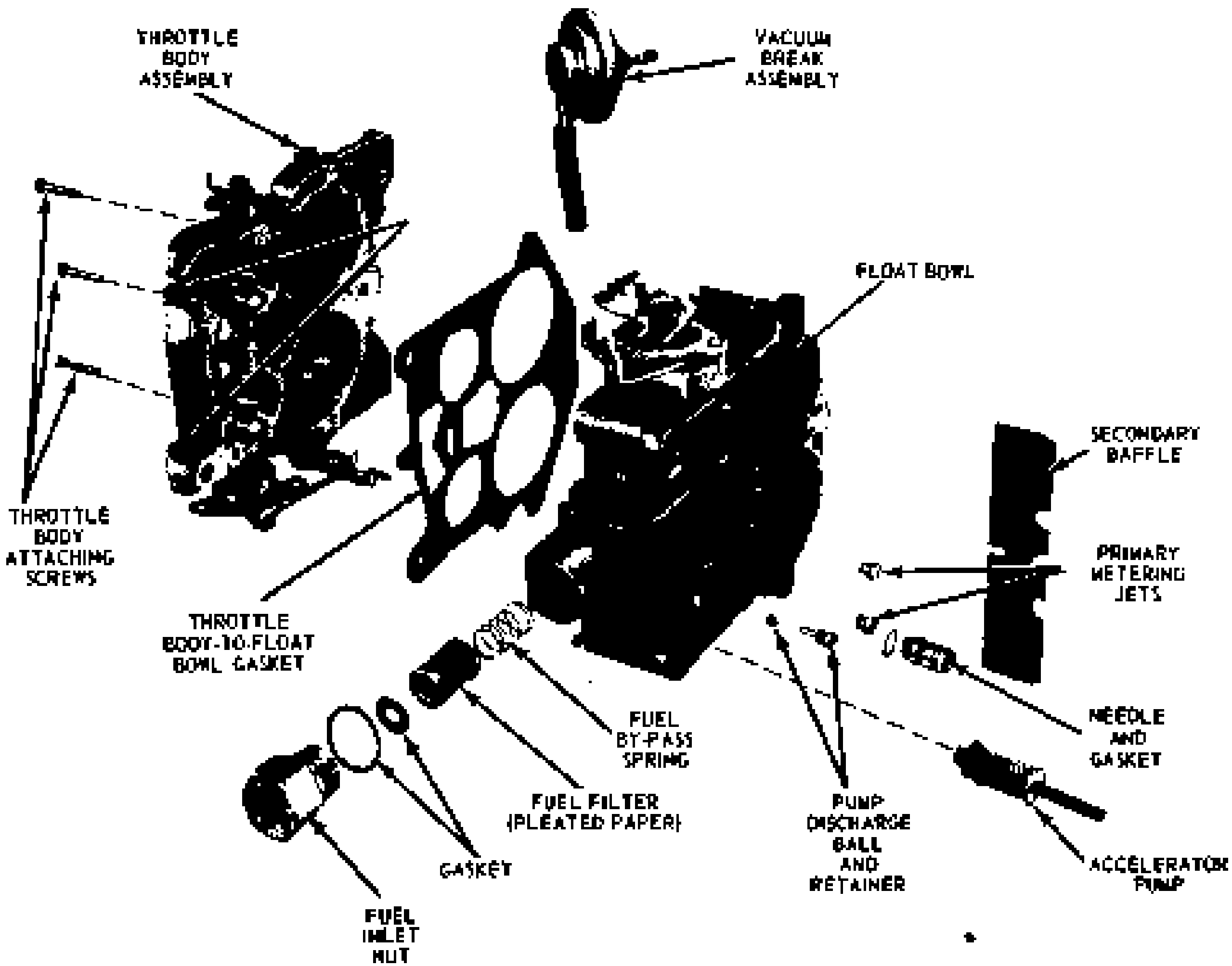


Fig. 6B-56 Throttle Body & Float Bowl Disassembly & Assembly



DISASSEMBLE

1. REMOVE FUEL INLET NUT, FILTER AND SPRING
2. REMOVE THREE THROTTLE BODY TO-FLOAT BOWL ATTACHING SCREWS
3. REMOVE THROTTLE BODY AND GASKET.
4. REMOVE IDLE MIXTURE SCREWS AND SPRINGS

NO FURTHER DISASSEMBLY OF THE THROTTLE BODY IS REQUIRED

ASSEMBLE

1. INSTALL IDLE MIXTURE SCREWS AND SPRINGS. BACK OUT SCREWS FIVE TURNS FROM LIGHTLY SEATED POSITION AS A PRELIMINARY ADJUSTMENT
2. INSTALL NEW THROTTLE BODY-TO-BOWL GASKET
3. INSTALL THROTTLE BODY GASKET OVER DOWELS ON FLOAT BOWL, INSERT THREE ATTACHING SCREWS, TIGHTEN EVENLY AND SECURELY.
4. PLACE CARBURETOR ON HOLDING FIXTURE
5. INSTALL FUEL INLET SPRING, NEW FUEL FILTER, GASKET AND RETAINING NUT

Fig. 6B-57 Choke & Fast Idle Mechanism R&R

CLEANING AND INSPECTION

NOTE: The carburetor should be cleaned in a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner such as Carbon-X (X-55) or its equivalent.

CAUTION. Any rubber parts, plastic parts, diaphragms, pump plungers, should not be immersed in carburetor cleaner. However, the delrin cam on the air valve shaft will withstand normal cleaning in carburetor cleaner.

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.

3. Inspect idle mixture needles for damage.

4. Examine float needle and seat for wear. Replace if necessary with new float needle assembly.

5. Inspect upper and lower surfaces of carburetor castings for damage.

6. Inspect holes in levers for excessive wear or out-of-round conditions. If worn, levers should be replaced.

7. Examine fast idle cam for wear or damage.

8. Check air valve for binding conditions. If air valve is damaged, air horn assembly must be replaced.

9. Check all throttle levers and valves for binds or other damage.

Fig. 6B-58 Cleaning & Inspection Procedure

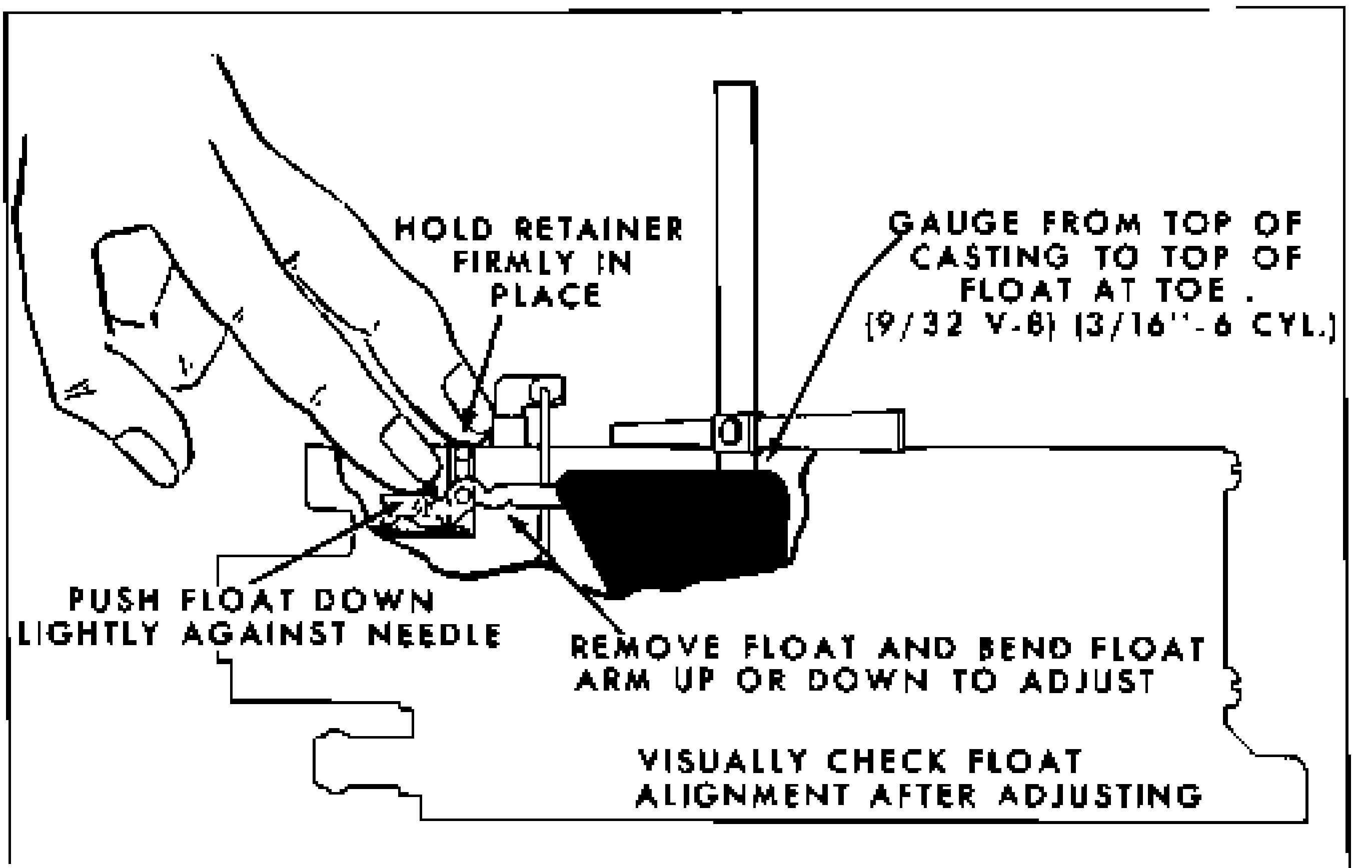


Fig. 6B-59 Float Level Adjustment

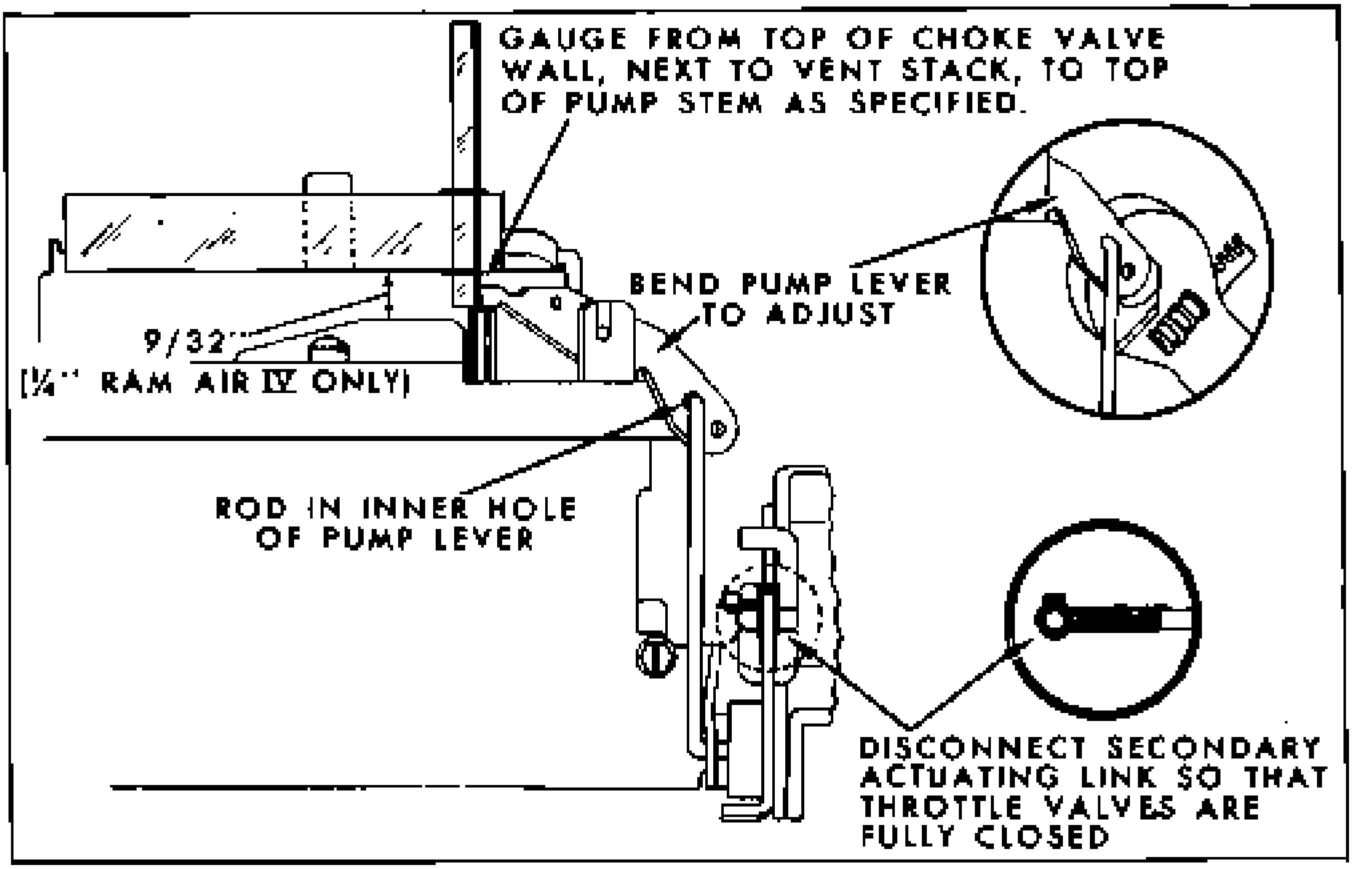
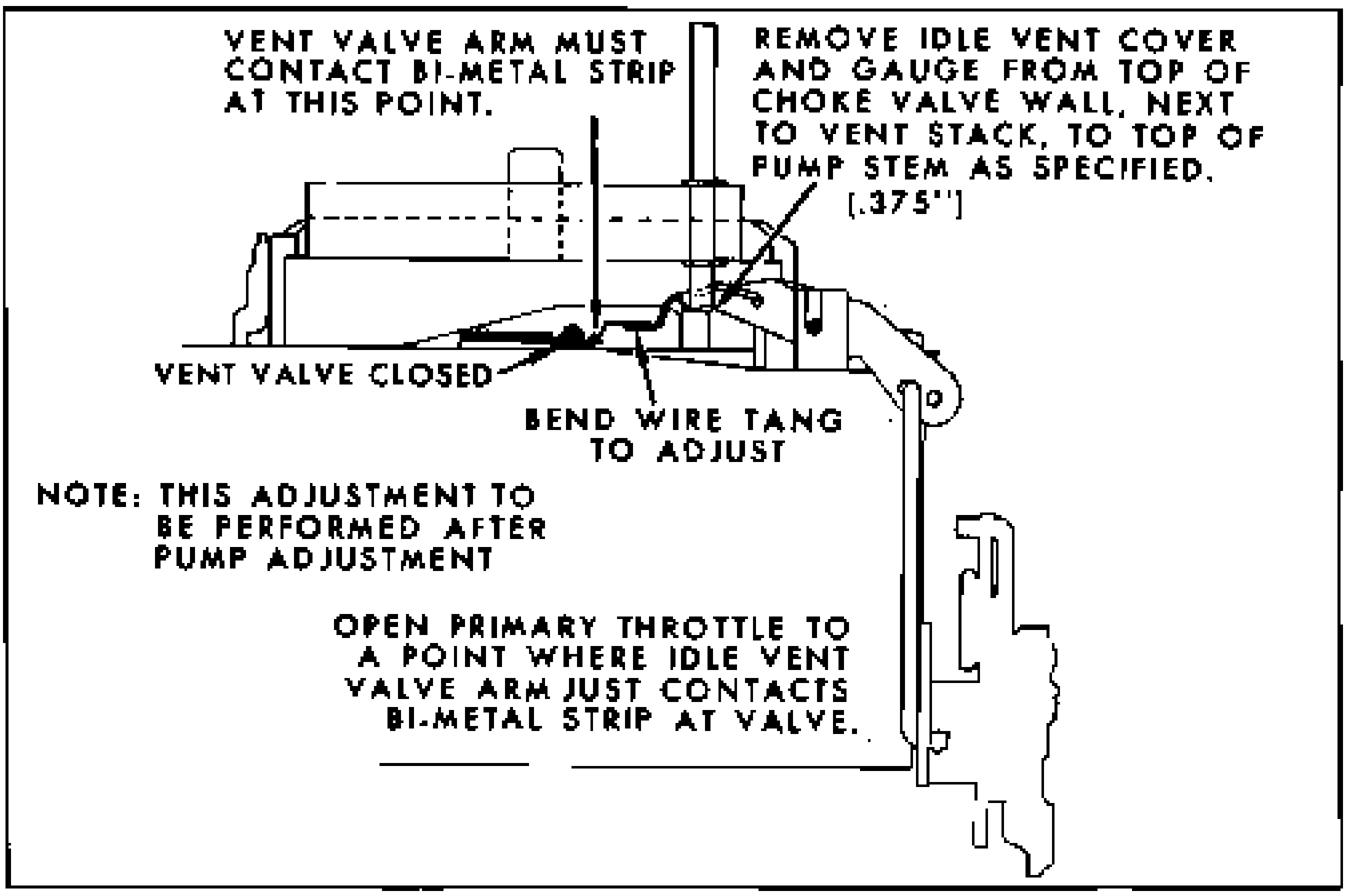


Fig. 6B-60 Pump Adjustment



6B-61 Idle Vent Adjustment

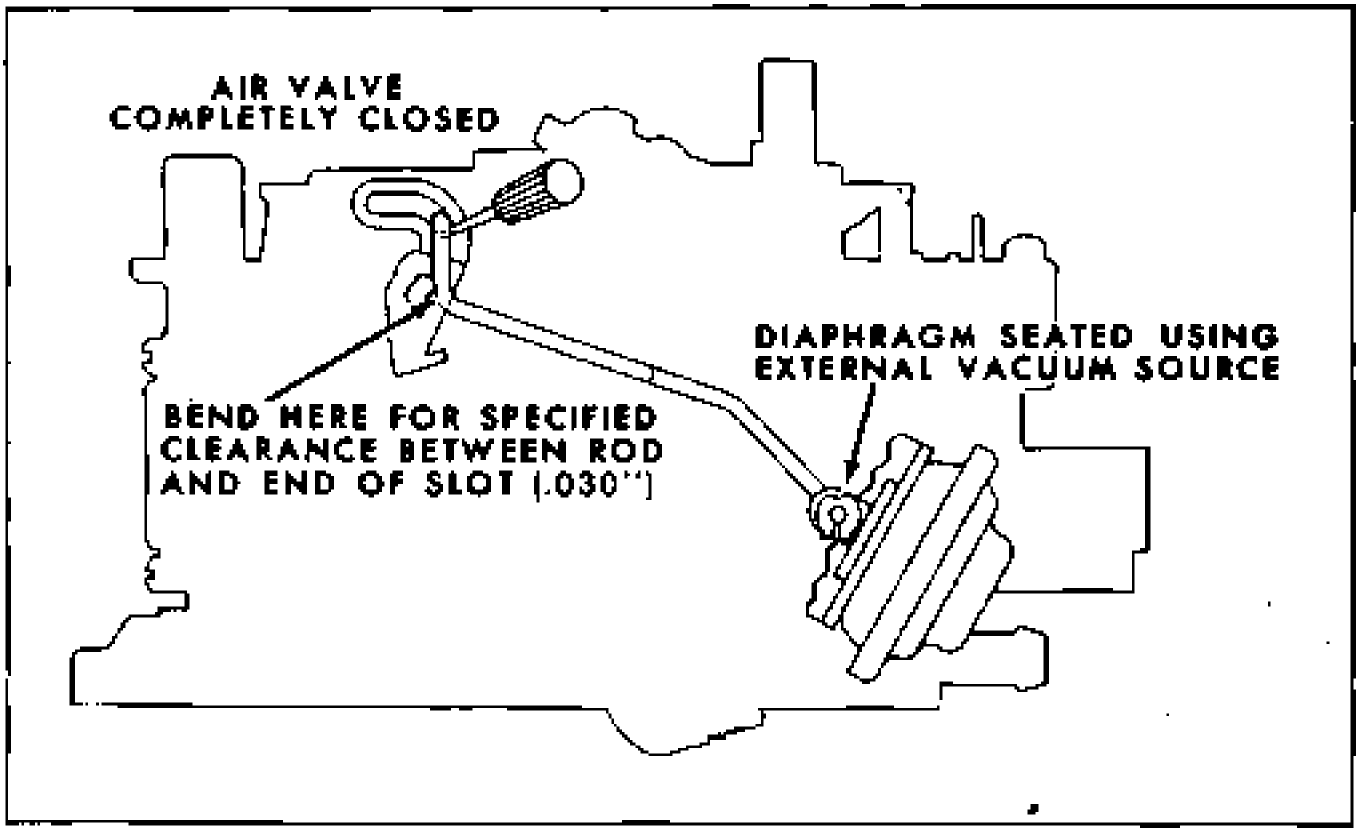


Fig. 6B-62 Air Valve Dashpot Adjustment

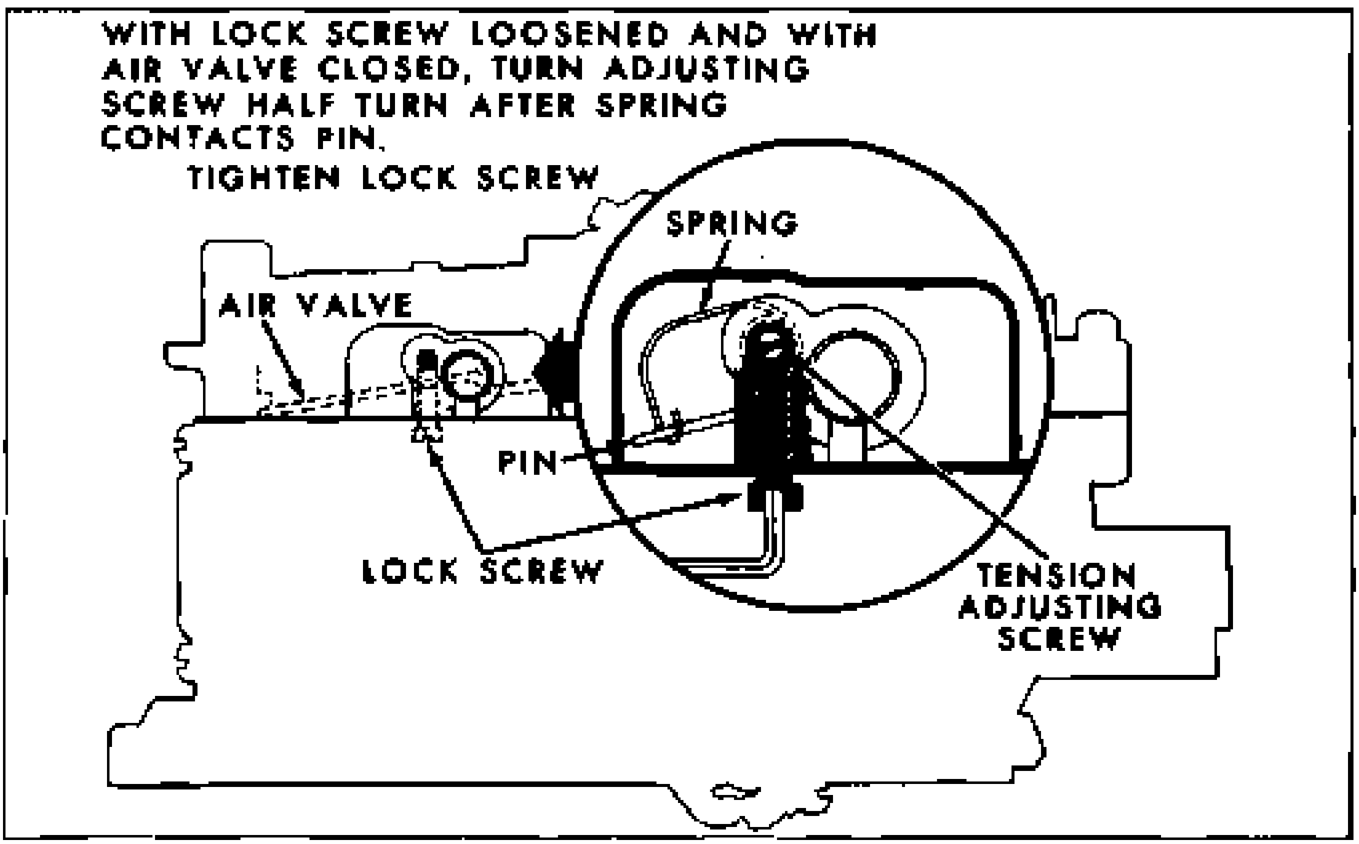


Fig. 6B-63 Air Valve Spring Adjustment

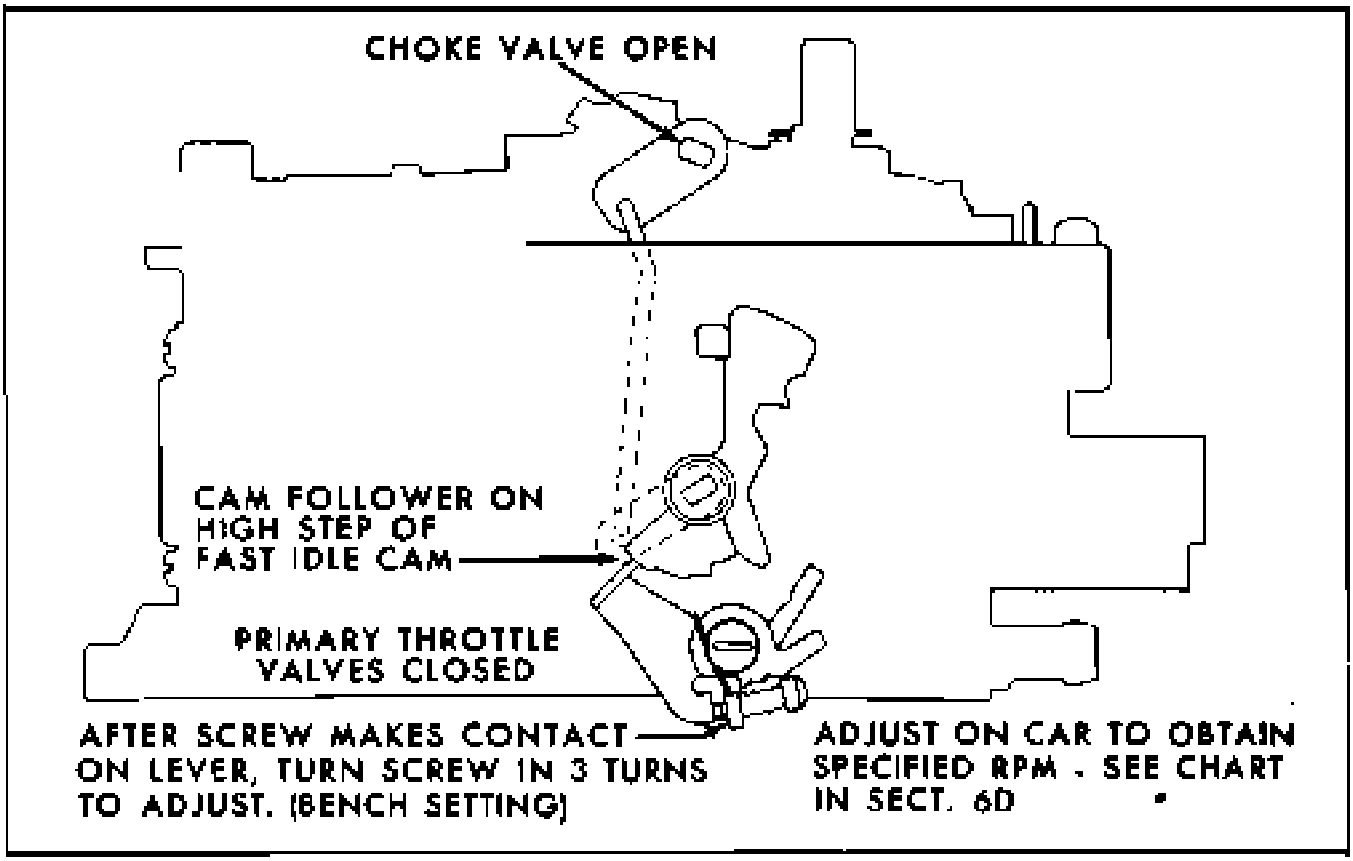


Fig. 6B-64 Fast Idle Adjustment

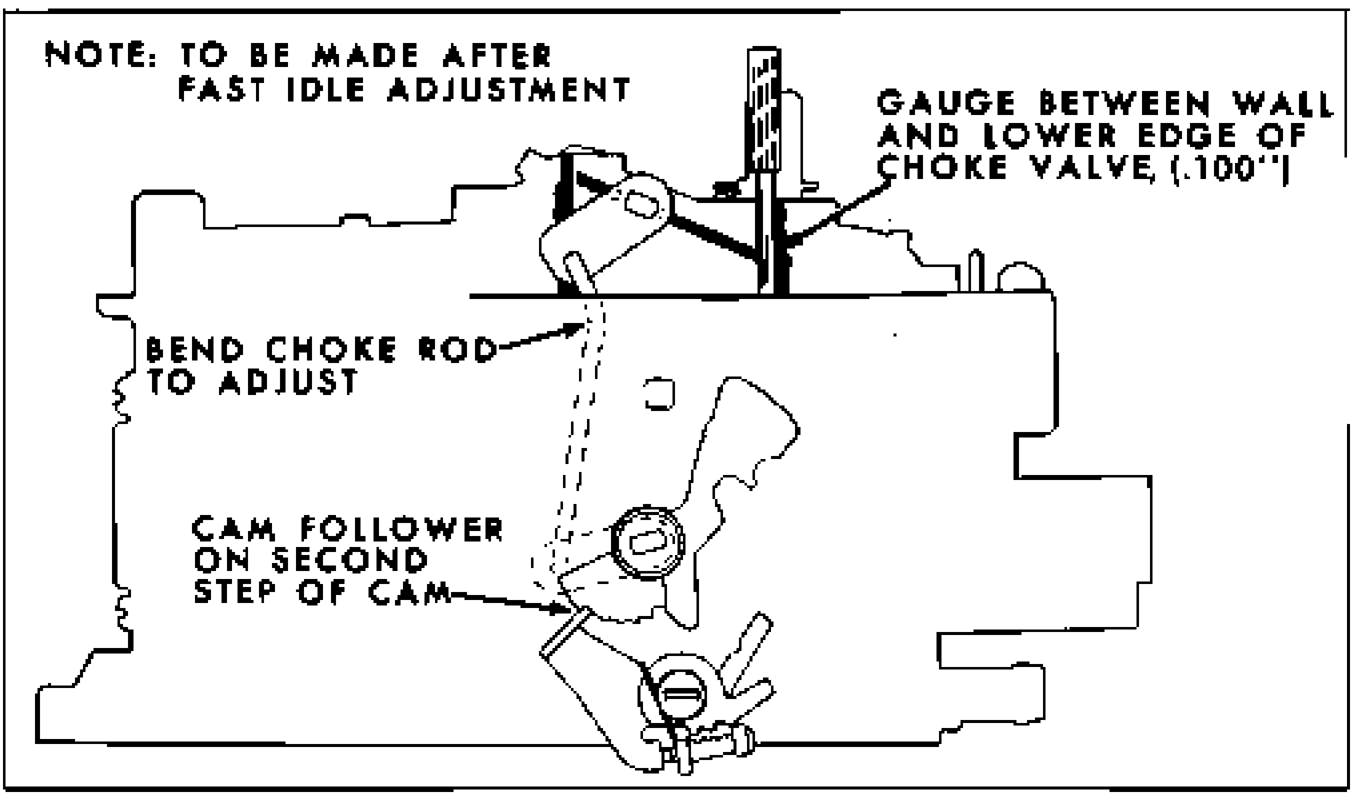


Fig. 6B-65 Choke Rod Adjustment

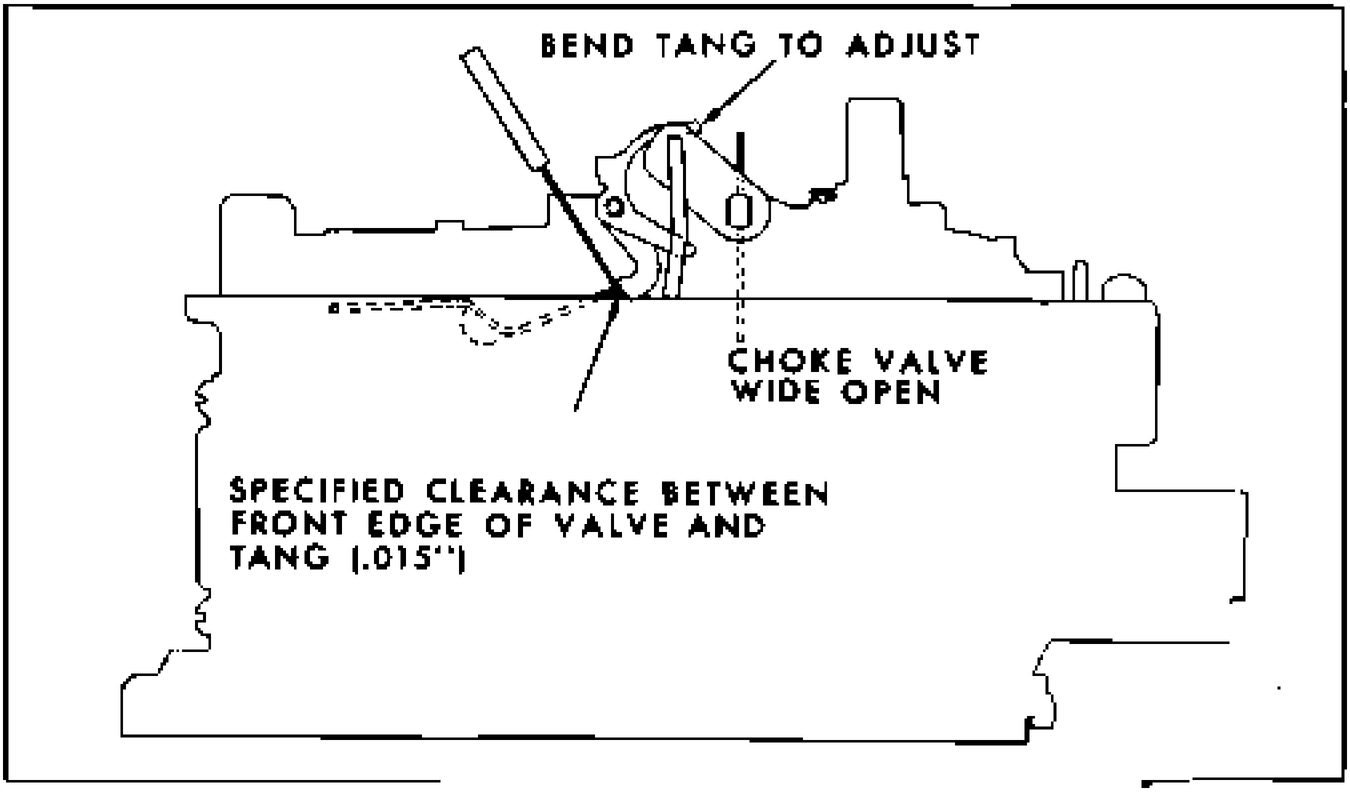


Fig. 6B-72 Air Valve Lockout Adjustment

SERVICE SPECIFICATIONS

Carburetor Model	Application	Float Setting	Float Drop	Pump Rod	Choke Rod	Idle Vent	Vacuum Break	Air Valve Lock Out	Dash-Pot	Un-Loader	Metering Rod	Choke Coil Rod
Rochester MV												Refer To
7029185	250 MT				.200"		.275"					Choke
7029187	250 MT A/C	9/32"	.	. .	.200"	.040"	.275"	. .	. .	.450"	.085"	Adjust
7029188	250 AT				.180"		.360"					ment
7029188	250 AT A/C				.180"		.280"					
Rochester 2 GV												Refer
7029060	400 AT						.160"					To
7029062	350 AT	9/16"	1-3/4"	1 11/32"	.085"	. .	.150"		.	.180"	.	Choke
7029066	400 MT						.170"					Adjust
7029071	350 MT						.180"					ment
Rochester 4 MV												
7029780	250 AT	3/16"					.160"					
7029781	250 MT	3/16"		9/32"			.180"					Center
7029262	428 Bonneville AT			Inner								Notch
7029263	350 · 400 · 428 MT			Hole	.100"	3/8"		.015"	.030"	.300"	Second-	
7029268	350 · 400 · 428 AT	9/32"	.								ly	
7029270	400 · Ram Air IV AT			1/4"			.245"				63/64"	
7029273	400 · Ram Air IV MT			1/4"								
7028270	400 · Ram Air AT	1/4"		9/32"								
7028273	400 · Ram Air MT	1/4"		9/32"								

Fig. 6B-73 Service Specifications

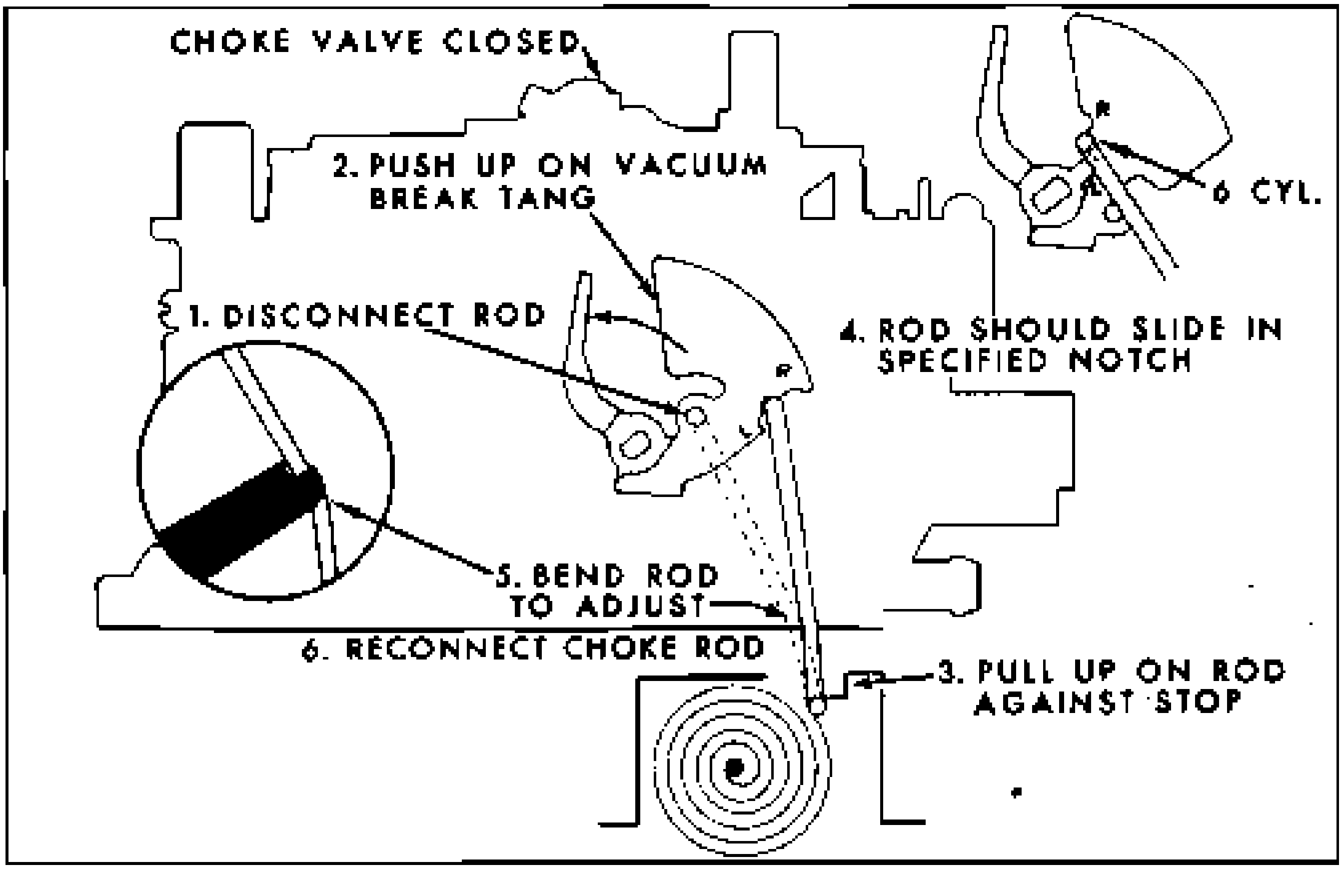


Fig. 6B-66 Choke Coil Rod Adjustment

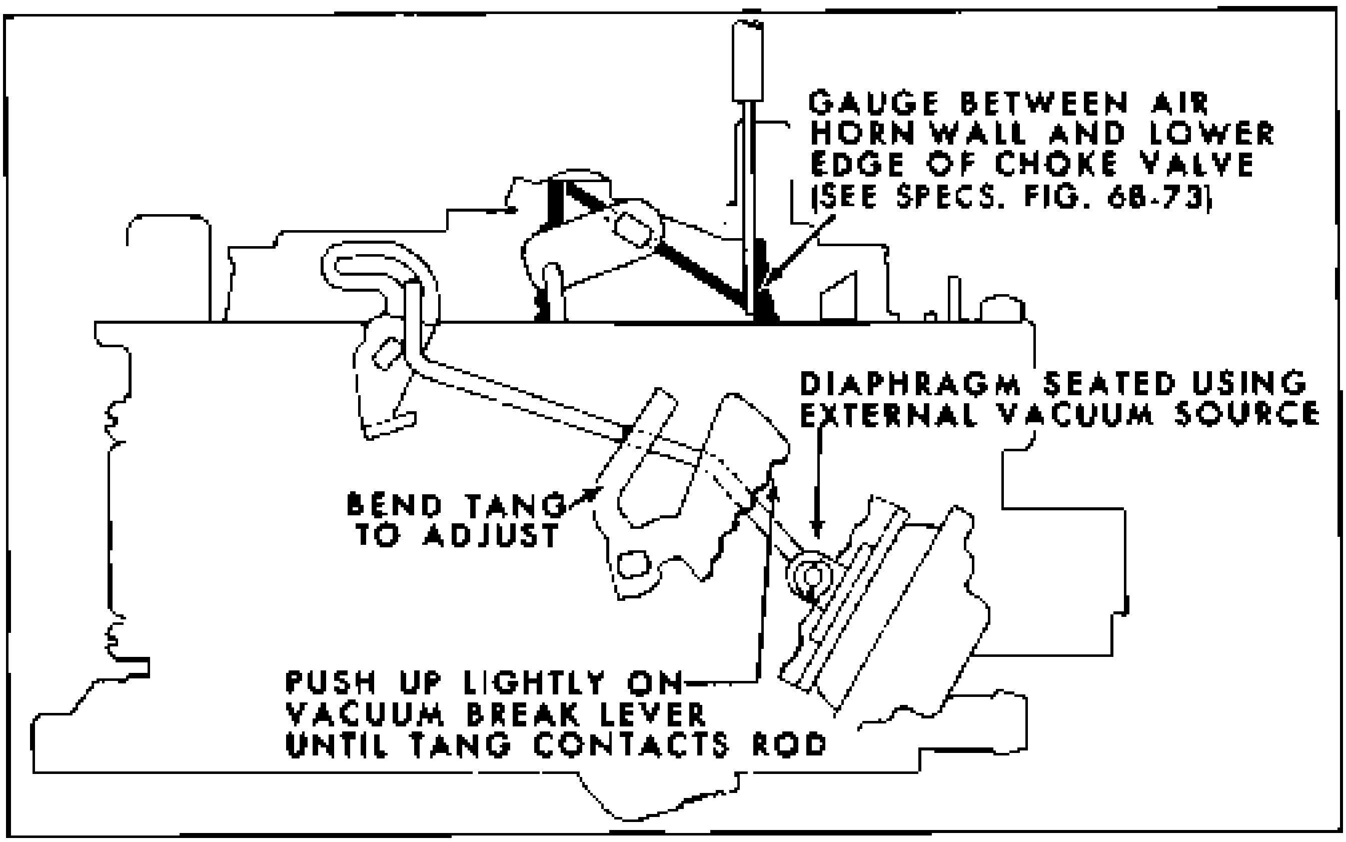


Fig. 6B-67 Vacuum Break Adjustment

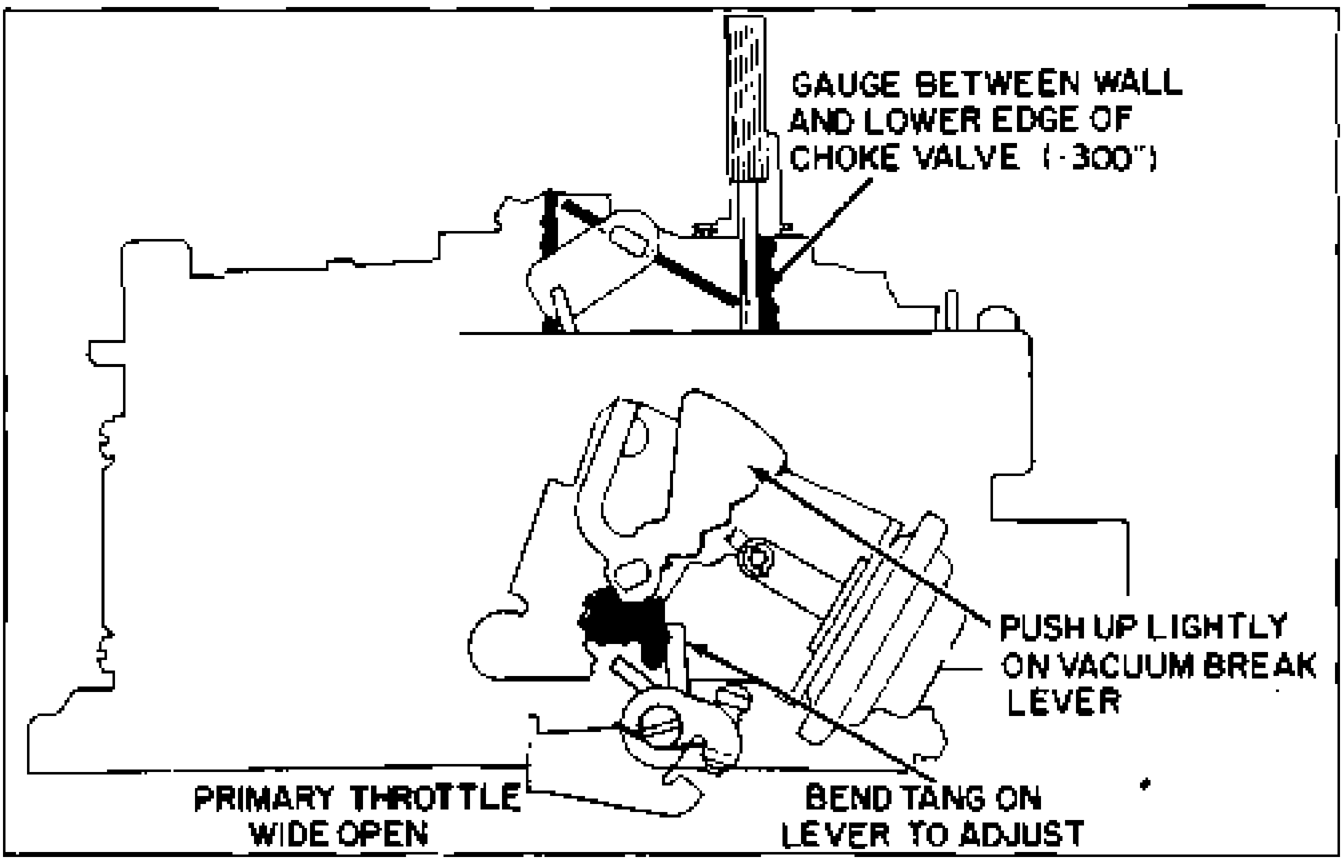


Fig. 6B-68 Unloader Adjustment

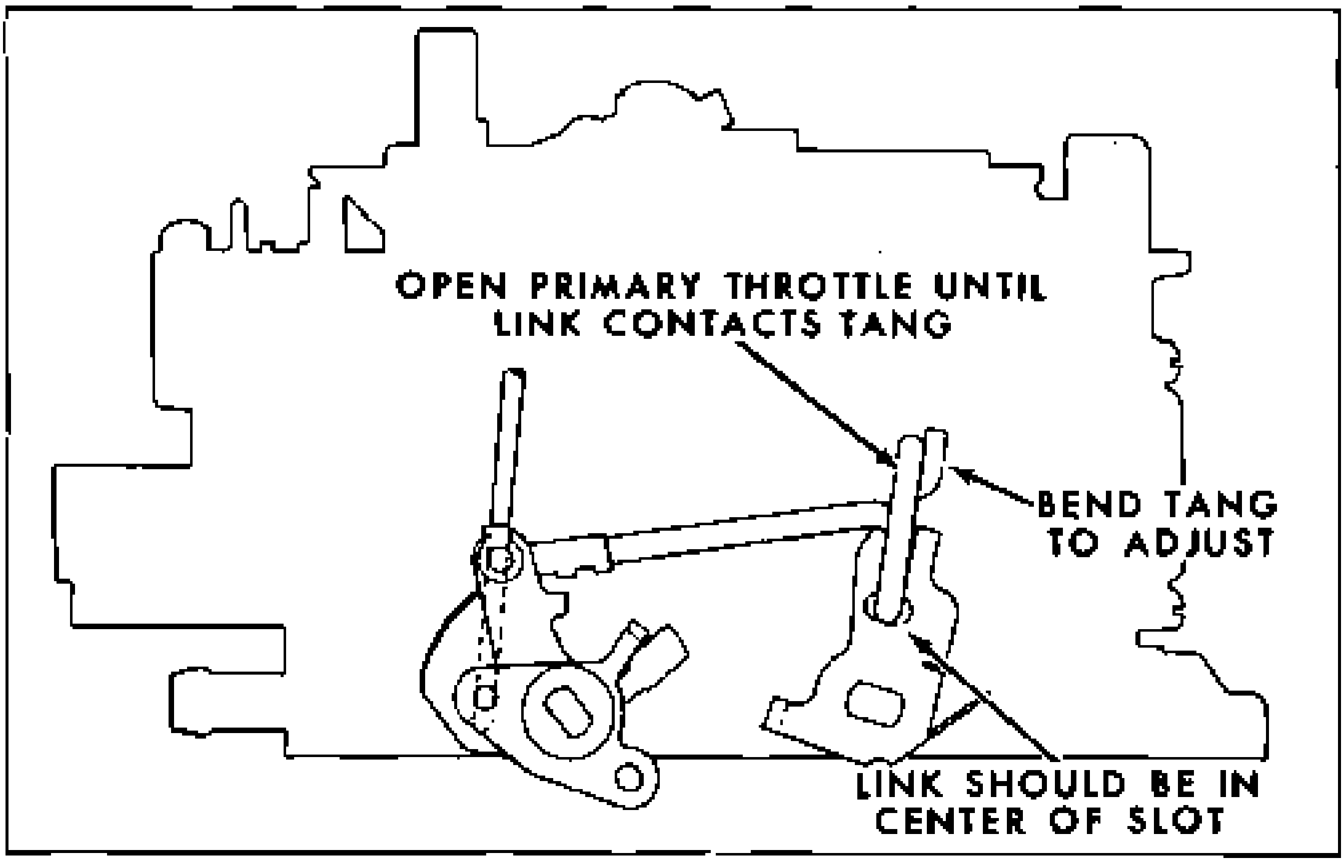


Fig. 6B-69 Secondary Opening Adjustment

ENGINE TUNE-UP

TUNE-UP SEQUENCE INDEX

INTRODUCTION

Engine tune-up is diagnosis and preventative maintenance performed at regular intervals to restore maximum performance and economy in an engine.

It is advisable to follow a definite and thorough procedure of analysis and correction as suggested by the sequence-index above.

A quality tune-up is recommended every 12 months or 12,000 miles in order to assure proper engine performance and complete effectiveness of exhaust emission systems.

SPARK PLUG REMOVAL

Remove any foreign matter from around spark plugs by blowing out with compressed air, then disconnect wires and remove plugs.

COMPRESSION TEST

Test compression with engine warm, all spark plugs removed and throttle and choke wide open. Crank engine through at least five compression strokes to obtain highest possible reading. No cylinder should be less than 80% of the highest cylinder (see examples). Excessive variation between cylinders, accompanied by low speed missing of the cylinder or cylinders which are low, usually indicates a valve not properly seating, a burned valve or broken piston ring. Low pressures, even though uniform, may indicate worn rings. Thsi will usually be accompanied by excessive oil consumption.

NOTE: Low compression pressures on ram air, 400 H.O. or 428 H.O. engines are not a valid indication of engine condition. Due to the long valve overlap period with camshafts used in these engines compression readings (at cranking speeds) as low as 120 psi are considered normal.

6 CYL.

EXAMPLE 1.

Cyl.	1	2	3	4	5	6
Press.	139	137	140	131	126	112

80% of 140 (highest) is 112. Thus cylinder No. 6 is less than 80% of No. 3. This condition, accompanied by low speed missing, indicates a burned valve or broken piston ring.

EXAMPLE 2.

Cyl.	1	2	3	4	5	6
Press.	95	106	100	97	95	101

80% of 106 is 85. While all cylinders are well above 85, they are all excessively low. This indicates all poor valves or, if accompanied by oil consumption, worn rings or low crank speed.

If compression is subnormal, tune-up will probably not be satisfactory.

V-8

EXAMPLE 1.

Cyl.	1	2	3	4	5	6	7	8
Press.	146	148	145	154	112	147	150	151

80% of 154 (highest) is 123. Thus cylinder No. 5 is less than 80% of No. 4. This condition, accompanied by low speed missing, indicates a burned valve or broken piston ring.

Example 2

EXAMPLE 2.

Cyl.	1	2	3	4	5	6	7	8
Press.	95	101	100	97	106	103	97	99

80% of 106 is 85. While all cylinders are well above 85, they are all excessively low. This indicates all poor valves or, if accompanied by oil consumption, worn rings or low crank speed. If compression is subnormal, tune-up will probably not be satisfactory. (See specifications at end of section 6 for correct compression pressures.)

NOTE: The compression check is important because an engine with low or uneven compression cannot be tuned successfully to give peak performance. Therefore, it is essential that improper compression be corrected before proceeding with an engine tune-up.

CLEAN, TEST AND INSTALL SPARK PLUGS

1. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelains and replace plugs where necessary. For optimum engine performance and economy, it is recommended that spark plugs be replaced every 12000 miles. Refer to spark plug diagnosis information presented in Engine Electrical for an analysis of plug conditions.

2. Clean serviceable spark plugs thoroughly, using an abrasive-type cleaner. File the center electrode flat.

3. Inspect each spark plug for make and heat range. All plugs must be of the same make and number of heat range. (See section 6E for correct spark plug usage.)

4. Adjust spark plug gaps to .035" using a round feeler gauge.

CAUTION: Never bend the center electrode to adjust gap. Always adjust by bending ground or side electrode.

5. If available, test plugs with a spark plug tester.

6. Inspect spark plug hole threads and clean before installing plugs. Corrosion deposits can be removed with a 14 mm. x 1.25 SAE spark plug tap (available through local jobbers) or by using a small wire brush in an electric drill. Use plenty of grease on tap to catch any chips.

CAUTION: Use extreme care when using tap to prevent cross threading. Also crank engine several times to blow out any material dislodged during cleaning operation.

7. Install spark plugs in engine with new gaskets and tighten to 25 lb. ft. torque.

Improper installation is one of the greatest single causes of unsatisfactory spark plug performance. Improper installation is the result of one or more of the following practices:

- Installation of plugs with insufficient torque to fully seat the gasket.
- Installation of the plugs using excessive torque which changes gap settings.
- Installation of plugs on dirty gasket seal.
- Installation of plugs to corroded spark plug hole threads.

Failure to install plugs properly will cause them to operate at excessively high temperatures and result in reduced operating life under mild operation or complete destruction under severe operation where the intense heat cannot be dissipated rapidly enough.

Always remove corrosion deposits in hole threads before installing plugs. When corrosion is present in threads, normal torque is not sufficient to compress the plug gasket and early failure from overheating will result.

Always use a new gasket and wipe seats in head clean. The gasket must be fully compressed on clean seats to complete heat transfer and provide a gas tight seal in the cylinder. For this reason as well as the necessity of maintaining correct plug gap, the use of correct torque is extremely important during installation.

IGNITION SYSTEM SERVICE AND REPAIRS

1. Replace brittle or damaged spark plug wires. Install all wires to proper spark plug. Proper positioning of spark plug wires in supports is important on V-8 engines to prevent cross-firing.

2. Tighten all ignition system connections.

3. Replace or repair any wires that are frayed, loose or damaged.

4. Remove distributor cap, clean cap and inspect for cracks, carbon tracks and burned or corroded terminals. Replace cap where necessary.

5. Clean rotor and inspect for damage or deterioration. Replace rotor where necessary.

6. Check the distributor centrifugal advance mechanism by turning the distributor rotor as far as possible, then releasing the rotor to see if the springs return it to its original position. If the rotor does not return readily, the distributor must be disassembled and the cause of the trouble corrected.

7. Check to see that the vacuum advance control operates freely by turning the movable breaker plate to see if the spring returns to its original position. Any stiffness in the operation of the spark control will affect the ignition timing. Correct any interference or binding condition noted.

8. Examine distributor points and clean or replace if necessary.

- Contact points with an overall gray color and only slight roughness or pitting need not be replaced.
- Dirty points should be cleaned with a clean point file.

Use only a few strokes of a clean, fine-cut contact file. The file should not be used on other metals and should not be allowed to become greasy or dirty. Never use emery cloth or sandpaper to clean contact points since particles will embed and cause arcing and rapid burning of points. Do not attempt to remove all roughness nor dress the point surfaces down smooth. Merely remove scale or dirt.

- Replace points that are burned or badly pitted.

Where burned or badly pitted points are encountered, the ignition system and engine should be checked to determine the cause of trouble so it can be eliminated. Unless the condition causing point burning or pitting is corrected, new points will provide no better service than the old. See section 6E for condenser check.

- On 6 cyl. engines, adjust distributor point gap to .019" (new points) or .016" (used points), using a flat feeler gauge. Breaker arm rubbing block must be on high point of lobe during adjustment.

NOTE: Used contact points should be cleaned before adjusting with feeler gauge.

9. Lubricate distributor breaker cam sparingly with distributor cam lubricant.

10. Install rotor and distributor cap. Press all wires firmly into cap towers.

SERVICE BATTERY AND BATTERY CABLES

State of Charge Test

1. Measure the specific gravity of the electrolyte in each cell. If it is below 1.230 (corrected to 80°F.), recharge with a slow rate charger, and recheck battery.

2. Connect a voltmeter across the battery terminals and measure the terminal voltage of the battery during cranking (remove the coil secondary lead during this check to prevent engine from firing). If the terminal voltage is less than 9.0 volts at room temperature, approximately 80°F.), the battery should be further checked. See section 12 for battery checking procedure using the "421" Tester.

Inspect for signs of corrosion on battery, cables and surrounding area, loose or broken carriers, cracked or bulged cases, dirt and acid, electrolyte leakage and low electrolyte level. Fill cells to proper level with distilled water or water passed through a demineralizer.

The top of the battery should be clean and the battery hold-down bolts properly tightened. Particular care should be taken to see that the top of the battery is kept clean of acid film and dirt because of the high voltage between the battery terminals. For best results when cleaning batteries, wash first with a dilute ammonia or soda solution to neutralize any acid present and then flush off with clean water. Care must be taken to keep vent plugs tight so that the neutralizing solution does not enter the cell. The hold-down clamp should be kept tight enough to prevent the battery from shaking around in its holder, but it should not be tightened to the point where the battery case will be placed under a severe strain.

To insure good contact, the battery cables should be tight on the battery posts. If the battery posts or cable terminals are corroded, the cables should be cleaned separately with a soda solution and a wire brush. A thin coating of petrolatum to the posts and cable clamps to help retard corrosion.

If the battery has remained undercharged, see Charging Circuit - Preliminary Checks, section 6E.

If the battery has been using too much water, the voltage regulator setting is too high.

GENERATOR AND REGULATOR

Unsatisfactory results obtained during battery testing may indicate further tests and adjustments to the generator and regulator as outlined in Engine Electrical (Section 6E).

FAN BELT

1. Inspect fan belt condition.

2. Check and adjust if necessary for correct tension of belt, as follows:

a. Using a Burroughs tension gauge, check the fan belt midway between the water pump pulley and generator pulley.

b. Adjust generator on its mounting bracket to proper fan belt tension. See section 6A.

CHECK OPERATION OF MANIFOLD HEAT VALVE

Check manifold heat control valve (six-cyl. 4 Bbl. engine only) for freedom of operation. If shaft is sticking, free it up with heat valve lubricant Pt. No. 1050422 or equivalent.

CHECK INTAKE MANIFOLD BOLTS

To check for a possible leak at the intake manifold, apply some heavy oil around the suspected area. Tighten all bolts to specification and sequence as outlined in section 6. If gasket is bad, replace.

AIR CLEANER ELEMENT

Wash polyurethane element (heavy duty) in solvent and re-oil with SAE 30 engine oil. Paper element should be replaced if clogged. Do not attempt to clean with an air hose.

NOTE: Air cleaner should be serviced after each occasion of driving under severe dust conditions.

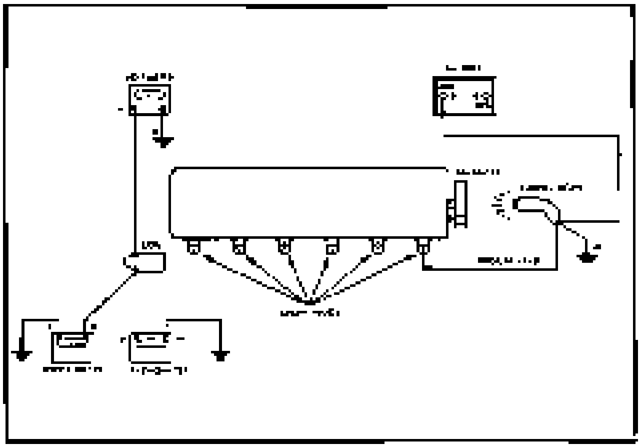


Fig. 6C-1 Schematic of Tune-Up Instrumentation

CHECK FUEL LINES AND SERVICE FUEL FILTER

1. Inspect fuel lines for kinks, bends or leaks and correct any defects found. If necessary to replace fuel line, use only steel double flared end lines.

2. Replace filter in carburetor inlet.

NOTE: If a complaint of poor high speed performance exists on the vehicle, fuel pump tests should be performed.

INSPECT AND SERVICE COOLING SYSTEM

Inspect cooling system for leaks, weak hoses, loose hose clamps and correct coolant level, and service as required.

NOTE: A cooling system pressure test may be performed to detect internal or external leaks within the cooling system.

CHECK LUBRICANT LEVEL AND INSPECT FOR OIL LEAKS

Check level of lubricant in crankcase and inspect engine for oil leaks.

CHECK CARBURETOR CHOKE AND UNLOADER OPERATION AND ADJUSTMENT

The specified choke setting provides ideal choke operation in all climates. No seasonal changes are necessary. For setting, see ENGINE FUEL, section 6B.

Choke linkage and fast idle cam must operate freely. Do not lubricate linkage since this will collect dust and cause sticking.

Check unloader adjustment, see section 6B.

IDLE STOP SOLENOID - 6-CYL. AND RAM AIR ENGINES

Adjust idle stop solenoid to obtain correct idle speed (solenoid active speed). Observe operation of idle stop solenoid by disconnecting lead, with engine running at specified hot idle speed, the plunger should drop back allowing the idle screw to contact the carburetor idle cam. In this position the engine speed should drop to the specified lower solenoid inactive idle speed. (See Section 6D for proper idle setting and procedures.)

CONNECT TUNE-UP EQUIPMENT

Follow manufacturer's recommendations for the use of testing equipment. Fig. 6C-1 shows a basic schematic for instrumentation which will apply to many types of test equipment and may be used as a rough guide if equipment manufacturer's instructions are not available.

Connections shown in Fig. 6C-1 are made as follows:

1. Timing light
2. Tachometer
3. Dwell Meter

TEST DWELL AND DWELL VARIATION

Two methods are offered for dwell or point gap adjustment on the vehicle. Whenever possible, a dwell meter should be used for better accuracy.

V-8

1. With engine running at idle, raise the adjusting screw window and insert an Allen wrench in the socket of the adjusting screw.

2. With dwell meter connected, adjust dwell angle to 30 degrees for all V-8 engines. A 2-degree variation is allowable for wear. If a dwell meter is not available, turn adjusting screw clockwise until engine starts to misfire, then turn screw one-half turn in the opposite direction to complete adjustment.

3. Close access cover fully to prevent the entry of dirt into the distributor.

6 CYL.

On 6 cyl., adjust point gap with a flat feeler gauge to .019" (new) or .016" (used).

TEST IGNITION TIMING AND ADVANCE

1. Attach a timing light and tachometer as shown in Fig. 6C-1.

NOTE: Disconnect hose from distributor vacuum control unit.

2. Set parking brake, start engine and run at idle speed (solenoid inactive where fitted).

3. Aim timing light at marks on lower timing chain cover and harmonic balancer.

4. Adjust timing as required by loosening clamp bolt and rotating distributor until correct timing is indicated, then tighten clamp bolt.

5. Disconnect timing light.

6. Reconnect distributor spark advance hose, then perform idle speed and mixture adjustment. (See Section 6D.)

6 Cyl. (4 Bbl.) ....5° BTDC
6 Cyl. (1 Bbl.) ....0° TDC
V-8 ....9° BTDC
Ram Air IV ....15° BTDC

IDLE SPEED AND MIXTURE ADJUSTMENT

1. Connect tachometer to engine. Set parking brake. Start engine, allow to idle.

2. With a thoroughly warmed-up engine, check to see that choke is fully open and carburetor is on slow idle.

3. Adjust idle speed and mixture screws to give proper idle speed.

NOTE: Depress or plug hot idle compensator valve while adjusting all engines so equipped.

Follow procedures outlined in EMISSION CONTROL SECTION and adjust idle speeds to settings given at end of that section.

POSITIVE CRANKCASE VENTILATION

All 1969 engines have the closed positive ventilation systems utilizing manifold vacuum to draw fumes and contaminating vapors into the combustion chamber where they are burned. The crankcase ventilation system has an important function and should be understood and serviced properly.

In the closed crankcase ventilation system, air is drawn through the engine, through a regulating valve and into the manifold, drawing crankcase vapors and fumes with it to be burned. The closed positive ventilation system draws the clean air from the carburetor air cleaner and has a nonvented oil filler cap.

The P.C.V. valves are designed specifically for each engine to control the amount of flow from the crankcase to manifold. VALVES SHOULD NEVER BE INTERCHANGED BETWEEN 6 AND 8 CYLINDER ENGINES.

The crankcase ventilation valve should be checked at regular intervals, otherwise it will become plugged and ineffective.

The P.C.V. system should be serviced at 12,000 miles or 12 months, as follows:

1. Disconnect all hoses and blow them out with compressed air. If any hose cannot be freed of obstructions, replace with new hose.

2. Remove crankcase ventilation valve assembly from rubber grommet, and discard.

3. Clean crankcase and intake manifold connectors; using care not to allow dirt to enter openings.

4. Clean and re-oil ventilation filter in air cleaner.

5. Reinstall Crankcase Ventilation System, using a new P.C.V. valve.

6. Adjust carburetor idle to specifications, Section 6D.

ROAD TEST

TEST PERFORMANCE OF CAR

Observe performance of engine at low speed, during acceleration, and at constant speed. Check for missing, stalling, surging, poor acceleration or flat spots on acceleration. If any irregularity is found, a complete diagnosis should be conducted to find and correct trouble.

TEST OPERATION OF:

BRAKES - Pedal should not go closer than 2" from floor mat (1" with power brakes) and car should not pull to either side. Fluid level in master cylinder should be as shown in Fig. 5-4 (Brake Section).

PARKING BRAKE - Should hold the car without excessive movement of parking brake pedal.

AUTOMATIC TRANSMISSION - Observe shift pattern at minimum and full throttle and test forced downshifts. Watch for any indications of slipping or unusual shift characteristics that may indicate need for adjustment.

STEERING GEAR - See that steering operates normally and that steering wheel does not have excessive play. Also observe for alignment of steering wheel, pull, wander, or other irregularity that might indicate need for front end alignment.

WINDSHIELD WIPER - Wiper operation should be tested with windshield wet in order to properly judge the action.

CLUTCH - See that clutch engages smoothly and that lash is correct. Follow procedure for adjusting clutch pedal height and lash in the clutch section. Hard pedal or lack of pedal return may indicate need for overcenter spring adjustment.

LIGHTS AND HORNS - Test operation of headlights, taillights, stop lights, parking lights, direction signals, hazard flasher and all other lights, as well as the horns.

INSTRUMENTS - Observe operation of all instruments. Observe especially for possible abnormal reading which may indicate trouble.

ACCESSORIES - Test operation of radio, heater, defroster, cigar lighter, other accessories.

EMISSION CONTROL SYSTEMS

CONTENTS OF THIS SECTION

SERVICE PROCEDURES

PERIODIC SERVICE

CLOSED P.C.V. SYSTEM

Once a year or at 12,000 miles, the Closed Positive Crankcase Ventilation System should be serviced as follows:

1. Disconnect all hoses and blow them out with compressed air. If any hose cannot be freed of obstructions, replace with new hose

2. Remove crankcase ventilation valve.

3. All engines are equipped with a crimped-type valve, thus no further disassembly is possible and a new valve should be installed.

4. Clean crankcase and intake manifold connectors using care not to allow dirt to enter openings.

5. Clean and re-oil ventilation filter in air cleaner.

6. Clean or replace air filter element.

7. Reinstall positive crankcase ventilation system.

8. Adjust carburetor idle to specifications.

CONTROLLED COMBUSTION SYSTEM

In order to provide efficient engine operation of cars equipped with the Controlled Combustion System, all normal tune-up items should receive careful and thorough attention every 12 months or 12,000 miles. Adherence to these items will assure that exhaust emissions are kept to the desired level.

Essential services included in the tune-up items are:

1. Check engine idle speed.

2. Check ignition timing (distributor advance hose disconnected and plugged and idle stop solenoid inactive - 6 cylinder and Ram Air).

3. Check operation of distributor advance unit.

NOTE: Engine idle speed must be set following the correct procedure.

VACUUM ADVANCE VALVE (2 Bbl. Manual Transmission Only)

No adjustments are necessary to the vacuum advance valve.

THERMOSTATIC VACUUM SWITCH (Automatic Transmission V-8 Only)

No maintenance is necessary on the thermostatic vacuum switch.

AUTO-THERM AC AIR CLEANER

MOTOR REPLACEMENT

REMOVE

1. Drill out two spot welds initially with a 1/16" drill, then enlarge as required to remove the retaining strap. Do not damage snorkel tube. (Fig. 6D-1).

2. Raise motor strap retainer.

3. Lift motor, cocking it to one side to unhook linkage at the control damper.

INSTALL

1. Assemble in reverse order adhering to the following notes.

a. Drill a 7/64" hole in snorkel tube at point A as shown in Fig. 6D-1.

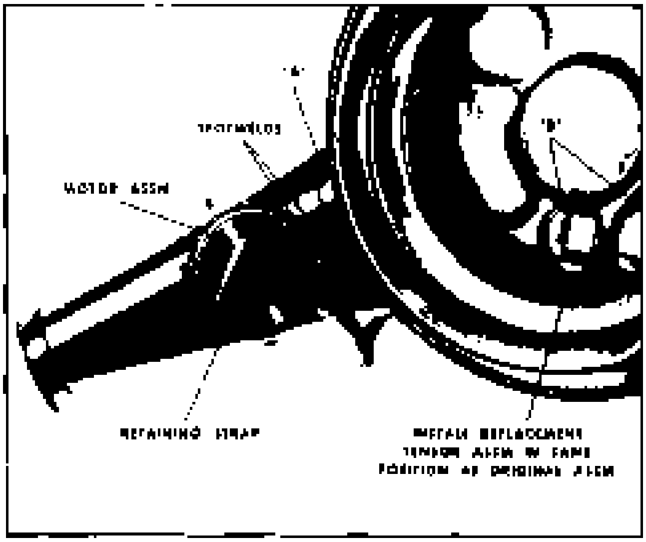


Fig. 6D-1 Therm-AC Motor and Sensor

b. Use motor strap retainer and sheet metal screw provided in the motor service package to secure the retainer and motor to snorkel tube.

c. If screw interferes with operation of the damper, shorten screw.

SENSOR REPLACEMENT

REMOVE

1. Detach hoses at sensor.

2. Pry up tabs of sensor retaining clip.

3. Remove clip and sensor from air cleaner, after noting the installed position of the sensor.

INSTALL

1. Install sensor and gasket assembly in original holes in air cleaner.

2. Support sensor at position B as shown in Fig. 6D-1 and press clip on sensor being careful not to damage sensor.

3. Install hoses and connections.

CURB IDLE SETTING PROCEDURE V-8 (Except Ram Air)

1. Back out idle mixture screws four turns (2 Bbl.) or six turns (4 Bbl.) from lightly seated position.

2. Adjust mixture screws to best lean carburetor setting using idle screw for idle speed adjustment.

IDLE SPEED CHART—V-8

V-8 ENGINE IDLE SPEEDS			
	CURB IDLE (RPM)		
ENGINE	MANUAL TRANSMISSION	AUTOMATIC TRANSMISSION To be set in Drive with Air Cond. turned off	FAST IDLE (RPM)
350 2-BBL.	850	650	——
350 4-BBL.	1000	650	2300
400 2-BBL.	850	650	——
400 4-BBL. (Exc. Ram Air)	1000	650	2300
400 4-BBL. (Ram Air)	1000 (Sol. Energized)	650 (Sol. Energized)	2800
	650 (Sol. Inactive)	500 (Sol. Inactive)	
428 4-BBL.	1000	650	2300

CURB IDLE SETTING PROCEDURE (RAM AIR)

1. With idle stop solenoid energized, adjust mixture screws to best lean carburetor setting using solenoid stop screw for idle speed adjustment.

2. With idle stop solenoid disconnected, adjust idle speed screw on carburetor to attain the lower solenoid inactive idle speed. Do not re-adjust carburetor mixture screws.

3. Reconnect idle solenoid wire.

To set fast idle speed, run engine in neutral, choke valve full open and fast idle lever on top step of fast idle cam, and adjust fast idle speed screw for proper speed setting (4 Bbl.).

NOTE: Curb idle on automatic transmission cars to be set in drive with air conditioning turned off.

CURB IDLE SETTING PROCEDURE 6 CYL.

Choke fully open, and hot idle compensator closed on one barrels with air conditioning and all four barrels.

1. With carburetor mixture screws backed out 5 turns

IDLE SPEED CHART—6 CYL.

6 CYL. ENGINE IDLE SPEEDS					
ENGINE	TRANS.	ALL VALUES ARE GIVEN IN RPM			
		A	B	C	FAST IDLE
1 BBL.	M.T.	730	700	500	2400
1 BBL.	A.T.	610	600	500	2800
4 BBL.	M.T.	880	850	600	2600
4 BBL.	A.T.	610	600	500	2800

and idle stop solenoid energized, set the idle stop solenoid screw to obtain "A" rpm. (Fig. 6D-2).

2. Turn mixture screws clockwise to obtain "B" rpm, idle stop solenoid still energized. Do not readjust idle stop solenoid screw.

3. With idle stop solenoid inactive, adjust the idle speed screw on the carburetor to obtain "C" rpm (solenoid inactive speed). Do not readjust mixture or solenoid screws.

4. Reconnect idle solenoid wire.

Procedure for setting fast idle - with transmission in neutral, choke valve fully open and fast idle lever on the top step of the fast idle cam.

1. Bend fast idle tang on throttle lever for adjustment (1 Bbl. carburetor).

2. Adjust fast idle screw on four barrel carburetor.

NOTE: Curb idle on automatic transmission cars to be set in drive with A/C turned off (where fitted).

NOTE: It is important that the idle and timing specifications are strictly adhered to in order to ensure proper control of exhaust emissions.

The accuracy of the tachometer used for idle adjustments should be checked periodically by an authorized representative.

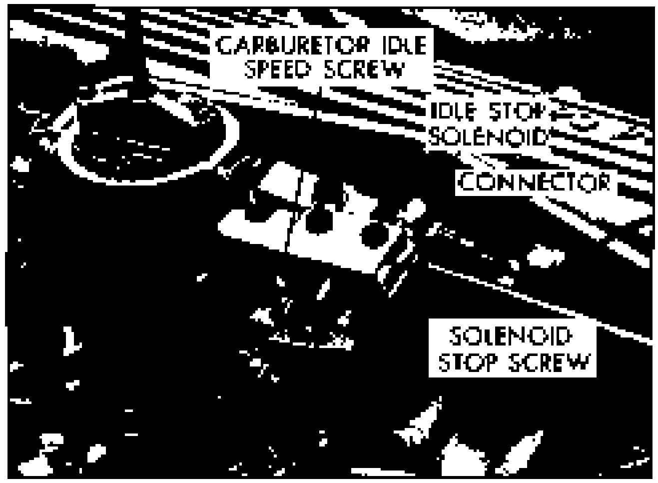


Fig. 6D-2 Idle Stop Solenoid (6 Cyl. and Ram Air only)

DWELL AND IGNITION TIMING SPECIFICATIONS

	DWELL	POINT GAP	IGNITION TIMING
6 Cyl. (1 Bbl.)	33°	All engines—	0° TDC
6 Cyl. (4 Bbl.)	33°	.019" New	5° BTDC
V-8	30°	.016" Used	9° BTDC
Ram Air IV	30°		15° BTDC

NOTE: Ignition timing to be checked with hose to distributor vacuum unit disconnected and idle stop solenoid disconnected on engines so equipped.

ENGINE ELECTRICAL

NOTE: Information pertaining to chassis electrical will be found in Section 12.

CONTENTS OF THIS SECTION

CRANKING CIRCUIT

STARTING MOTOR

PERIODIC SERVICE

No periodic lubrication of the starting motor or solenoid required. The motor and brushes cannot be inspected without disassembling the unit, so no service is required on the motor or solenoid between overhaul periods.

CHECKS AND ADJUSTMENTS ON CAR

Although the starting motor cannot be checked against specifications on the car, a check can be made for excessive resistance in the cranking circuit. To check for excessive resistance in the cranking circuit, measure:

1. The voltage drop, during cranking, between the positive battery post and battery terminal of solenoid.

2. The voltage drop, during cranking, between the battery terminal of solenoid and the motor terminal of solenoid.

3. The voltage drop, during cranking, between the negative battery post and the starting motor frame.

CAUTION: To prevent the engine from firing during the above checks, disconnect the primary lead to the distributor at the coil.

If the voltage drop for any one of the above three checks exceeds 0.2 volt, excessive resistance is indicated in that portion of the cranking circuit being checked. Locate and eliminate the cause for any excessive voltage drop in these circuits in order to obtain maximum efficiency of the cranking system.

When the solenoid fails to pull in, the trouble may be due to excessive voltage drop in the solenoid control circuit. To check for this condition, close the starting switch and measure the voltage drop between the battery terminal of the solenoid and the switch terminal of the solenoid. Excessive resistance in the solenoid control circuit is indicated and should be corrected if the voltage drop exceeds 3.5 volts.

If the voltage drop does not exceed 3.5 volts and the solenoid does not pull in, measure the voltage available at the switch terminal of the solenoid. If the solenoid does not feel warm, it should pull in whenever the voltage available at the switch terminal is 7.7 volts or more (when the solenoid feels warm, it will require a somewhat higher voltage to pull in).

REMOVE FROM CAR - 6-CYL. ENGINE

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.

REMOVE FROM CAR - V-8 ENGINE

1. Disconnect battery to starting motor cable from battery post.

2. Raise front of car and place car stand under front suspension.

3. Pull battery cable and solenoid wire loom down so they hang free of surrounding parts.

4. Remove starting motor mounting screws and remove starting motor with cable and solenoid wire loom.

5. Remove wires from solenoid and cable from clamp or solenoid bracket.

SOLENOID

REMOVE AND REPLACE

1. Disconnect field strap.

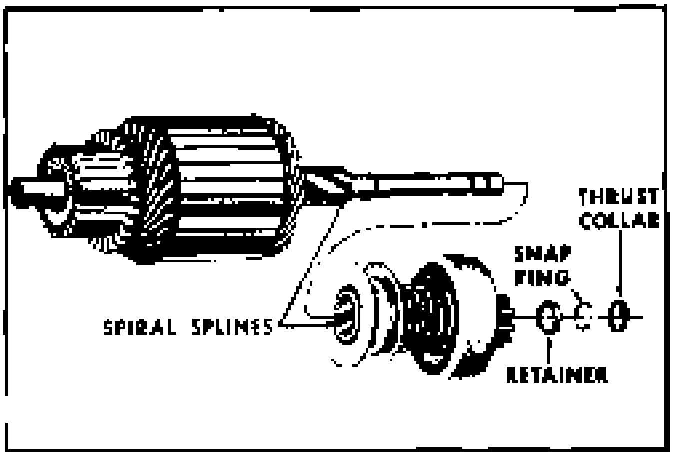


Fig. 6E-1 Armature and overrunning Clutch Assembly

2. Remove solenoid to drive housing attaching screws, motor terminal bolt, and remove solenoid.

3. Remove solenoid return spring.

4. Remove shift lever pivot pin.

5. Remove shift lever.

6. Replace by reversing above procedures.

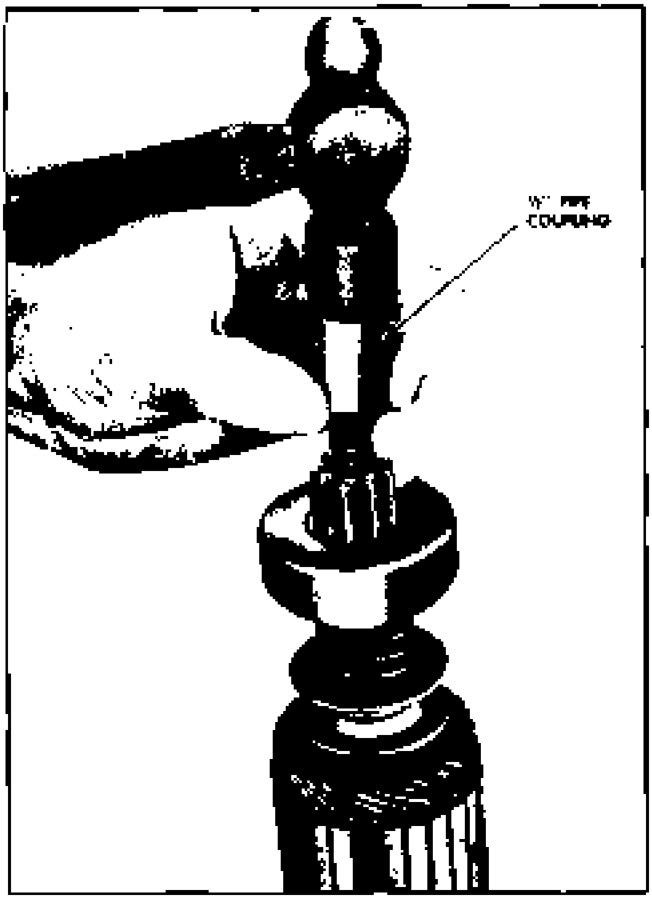


Fig. 6E-2 Driving Retainer Off Snap Ring

CHECK CURRENT DRAW

Check current draw of hold-in winding by connecting a variable source of voltage (in series with an ammeter) to the switch terminal of solenoid and ground. Ammeter should read 14.5-16.5 amps. 10 volts. To check the current draw of both windings, ground the solenoid motor terminal and connect a source of voltage (in series with an ammeter) to the switch terminal of solenoid and ground. The ammeter should read 41-47 amps. 10 volts.

CAUTION: Either of the above checks must be completed in a minimum length of time to prevent overheating solenoid windings. Heating will cause the current draw readings to be below specifications which are based on a temperature of 80°F.

DISASSEMBLE

1. Remove nuts from motor terminal (marked "B") and switch terminal.

2. Remove two screws securing cover and carefully remove cover.

CAUTION: Terminal studs have welded lead connections; therefore be extremely careful not to twist during removal of nuts.

If solenoid contacts are slightly burned or dirty, contacts should be cleaned. When contacts are badly burned, burned parts should be replaced.

ASSEMBLE

1. When assembling cover on solenoid, make sure the terminal studs are properly positioned in cover. The cover gasket must be centered under cover to insure proper sealing.

2. Secure cover with screws and install nuts on motor and switch terminals.

CAUTION: Be sure to install all insulator washers under attaching screws and nuts.

DISASSEMBLE STARTER

1. Disconnect field straps from terminal on solenoid.

2. Remove through bolts

3. Remove commutator end frame, field frame and armature from drive housing.

4. Remove overrunning clutch from armature shaft as follows:

a. Slide thrust collar (Fig. 6E-1) off end of armature shaft.

b. Slide a standard half-inch pipe coupling or other metal cylinder of suitable size (an old pinion of suitable size can be used if available) onto shaft so end of coupling or cylinder butts against edge of retainer (Fig. 6E-2). Tap end of coupling with hammer, driving retainer towards armature and off snap ring.

c. Remove snap ring from groove in shaft, using pliers or other suitable tool. If snap ring is too badly distorted during removal, it will be necessary to use a new one when reassembling clutch.

d. Slide retainer and clutch from armature shaft.

CLEAN AND INSPECT

1. Test overrunning clutch action. The pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked, or excessively worn. Replace assembly if necessary. Badly chipped pinion teeth may indicate chipped teeth on the ring gear. This should be checked under such conditions and replaced if necessary.

2. Inspect brushes for wear. Replace if worn to one half their original length. Check brush holders to see that they are not deformed or bent, but will properly hold brushes against the commutator.

3. Check fit of armature shaft in bushing of drive housing. Shaft should fit snugly in the bushing. If the bushing is worn, it should be replaced.

4. The overrunning clutch, armature and fields should not be cleaned in any degreasing tank, or with grease dissolving solvents, since these would dissolve the lubricants in the clutch mechanism and would damage the insulation in the armature and field coils. It is suggested that all parts except the clutch, be cleaned with oleum spirits and a brush. The clutch can be wiped with a clean cloth.

If the commutator is dirty, it may be cleaned with No. 00 sandpaper. Never use emery cloth to clean commutator.

SERVICE

ARMATURE

If the armature commutator is worn, dirty, out of round or has high insulation, the armature should be put in a lathe so the commutator can be turned down. The starter motor commutator in all 1969 model cars is of the molded type and should not be undercut, since undercutting will reduce the bonding of the molding material. When turning the modled commutator, only a very light clean-up cut should be made. The minimum diameter of the commutator after turning should not be less than 1.650 inches. As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper to remove any burrs left as a result of the undercutting procedure.

The armature should be checked for opens, short circuits and grounds as follows:

1. Open - The most likely place for an open to occur is at the commutator riser bars as a result of excessively long cranking periods. Inspect the points where the conductors are joined to the commutator bars for loose connections. The poor connections cause arcing and burning of the commutator bars as the starting motor is used. If the bars are not too badly burned, repair can often be effected by resoldering the leads in the riser bars (using rosin flux), and turning down the commutator in a lathe to remove the burned material.

2. Short Circuit - Short circuits in the armature are located by use of a growler. When the armature is rotated in the growler with a steel grip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eleminated by cleaning out the slots.

3. Ground - Grounds in the armature can be detected by the use of 110-volt test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft (Fig. 6E-3), the armature is grounded. Grounds occur as a result of insulation failure which is often brought about by overheating of the starting motor produced by excessive long cranking periods or by accumulation of brush dust between the commutator bars and the steel commutator ring.

FRAME AND FIELD

The field winding can be checked for an open or a ground by using a test lamp as follows:

1. Using a 110-volt test lamp, place one lead on each

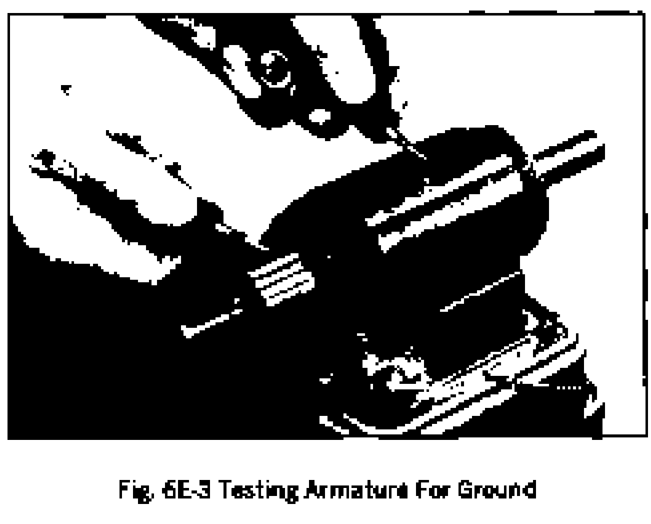


Fig. 6E-3 Testing Armature For Ground

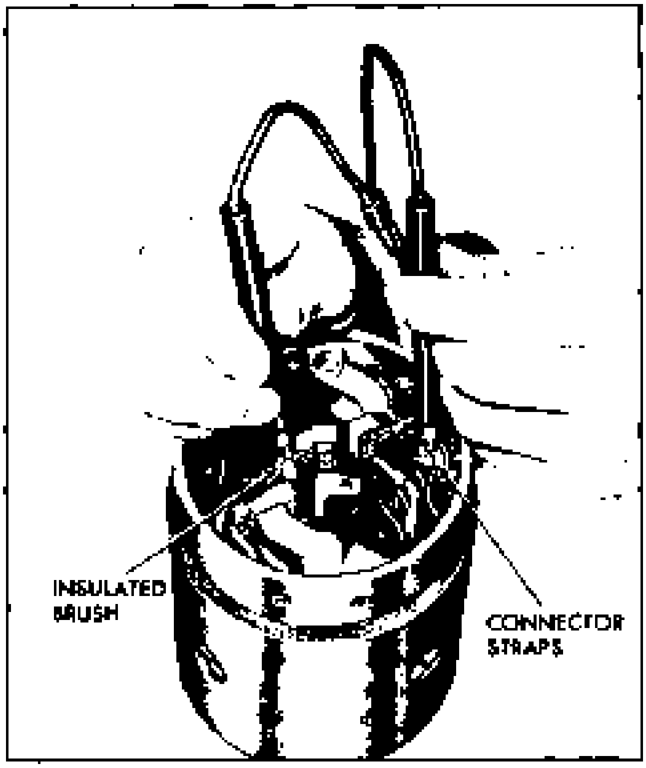


Fig. 6E-4 Testing Field Coils For Open

end of the field coils connected in series (Fig. 6E-4). If lamp does not light, the field coils are open and must be repaired or replaced.

2. Using a 110-volt test lamp, place one lead on the connector strap and the other on the field frame (Fig.

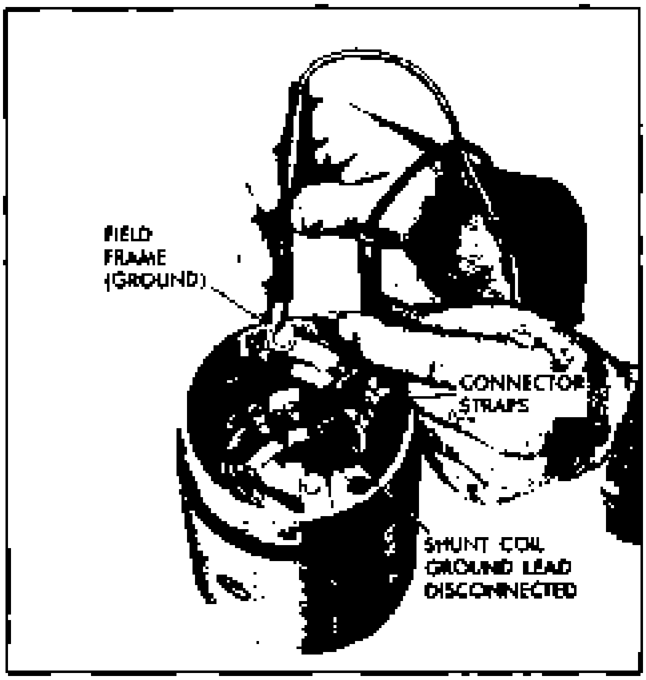


Fig. 6E-5 Testing Field Coils For Ground

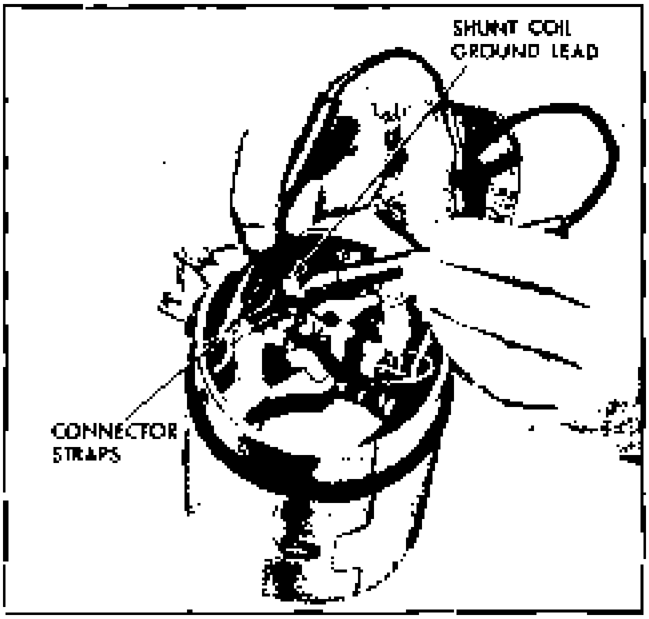


Fig. 6E-6 Testing Shunt Coil For Open

6E-5). Disconnect the shunt coils ground before check is made. If lamp lights, the field coils are grounded and defective coils must be repaired or replaced.

3. Using a 110-volt test lamp, place one lead on each end of shunt coils (Fig. 6E-6). Disconnect shunt coil grounds before check is made. If lamp does not light, the shunt coil is open and must be replaced.

FIELD COIL

Field coils can be removed from the field frame easily by use of a pole shoe screwdriver. A pole shoe spreader should also be used since this prevents distortion of the field frame. Careful installation of field coils is necessary to prevent shorting or grounding of field coils as the pole shoes are tightened into place. Formed insulators are used to protect the field leads from grounding to frame. These must be replaced on assembly.

REPLACE BRUSHES

1. Remove brush holder pivot pin which positions one insulated and one grounded brush.

2. Remove brush spring.

3. Replace brushes as necessary.

ASSEMBLE STARTER

1. Assemble overrunning clutch to armature shaft as follows:

a. Lubricate drive end of armature shaft with high melting point grease.

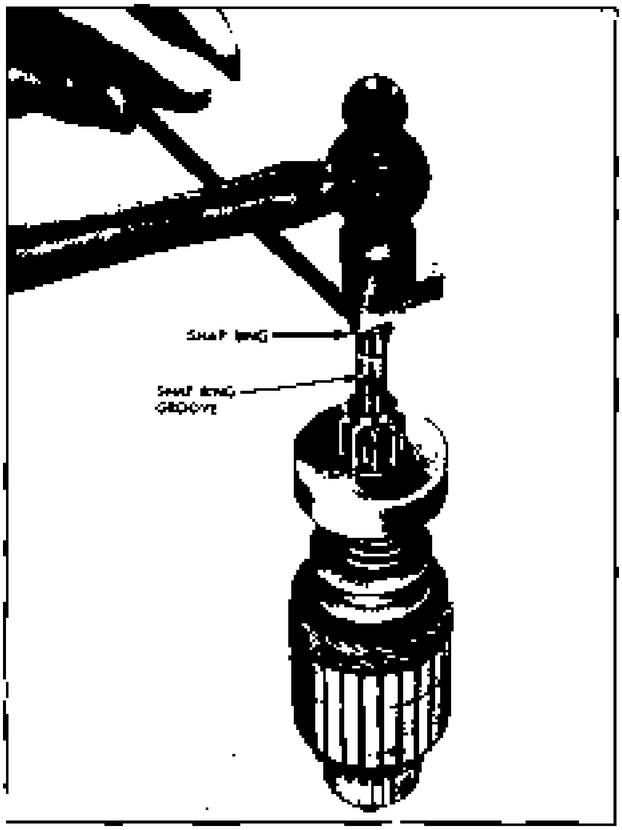


Fig. 6E-7 Forcing Snap Ring Onto Armature Shaft

b. Slide clutch onto armature shaft with pinion outward.

c. Slide retainer onto shaft with cupped surface facing end of shaft.

d. Stand armature on end on wood surface with commutator down. Position snap ring on upper end of shaft and hold in place with a block of wood. Hit wood block a blow with hammer, forcing snap ring over end of shaft. Slide snap ring past the grease groove to the snap ring groove (Fig. 6E-7).

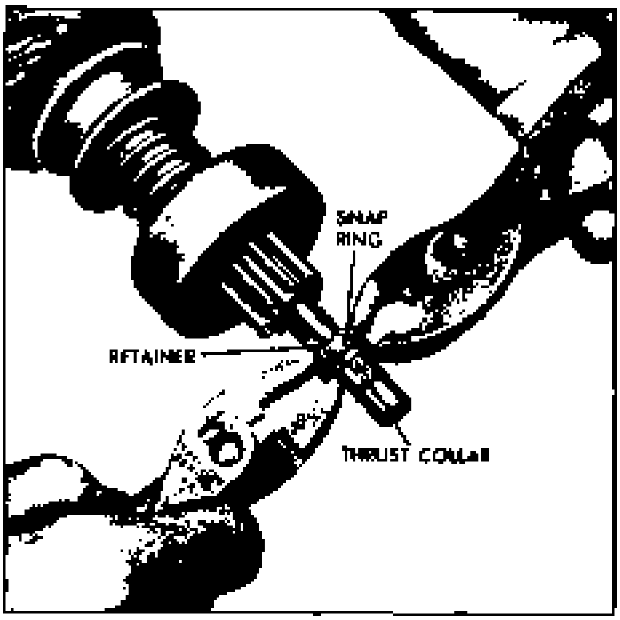


Fig. 6E-8 Forcing Retainer Over Snap Ring

e. Assemble thrust collar on shaft with shoulder next to snap ring (Fig. 6E-8).

f. Place armature flat on work bench, and position retainer and thrust collar next to snap ring. Then, using two pairs of pliers at same time (one pair on either side of shaft), grip retainer and thrust collar and squeeze until retainer is forced over snap ring (Fig. 6E-8).

2. Place a small amount of high melting point grease in drive housing bushing. Make sure thrust collar is in place against snap ring and retainer and slide armature and clutch into place in drive housing, engaging shift lever with clutch.

3. Position field frame over armature, apply sealing compound between frame and solenoid case. Position frame carefully against drive housing to prevent damage to brushes.

4. Place a small amount of high melting point grease in bushing in commutator end frame. Place leather thrust washer on armature shaft and slide commutator end frame onto shaft.

5. Install through bolts and tighten securely.

6. Reconnect field coil leads to solenoid terminal.

PINION CLEARANCE CHECK

There is no provision for adjusting pinion clearance on the enclosed shift lever cranking motor. When the shift lever mechanism is correctly assembled, the pinion clearance should fall within the specified limits (.010"-.040"). When clearance exceeds these limits, it may indicate excessive wear of solenoid linkage or shift lever yoke buttons.

Pinion clearance should be checked after motor has been disassembled and reassembled.

Check pinion clearance in following manner:

1. Disconnect the motor field coil connector from the solenoid motor terminal and insulate it carefully.

2. Connect one battery lead to the solenoid switch terminal and the other to the solenoid frame (Fig. 6E-9).

3. Flash a jumper lead momentarily from the solenoid motor terminal to the solenoid frame. This will shift the pinion into cranking position and it will remain so until the battery is disconnected.

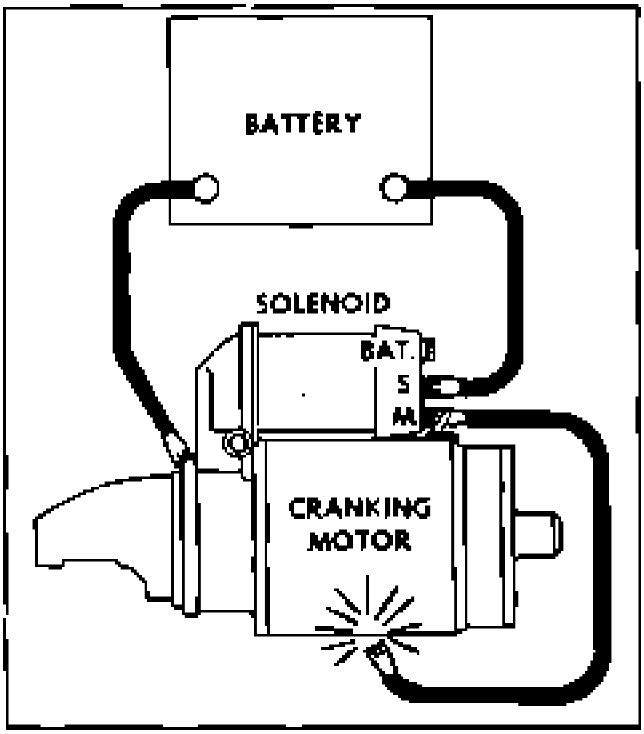


Fig. 6E-9 Circuit For Checking Pinion Clearance

4. Push pinion back towards the commutator end to eliminate slack movement.

5. Measure the distance between pinion and pinion stop (Fig. 6E-10).

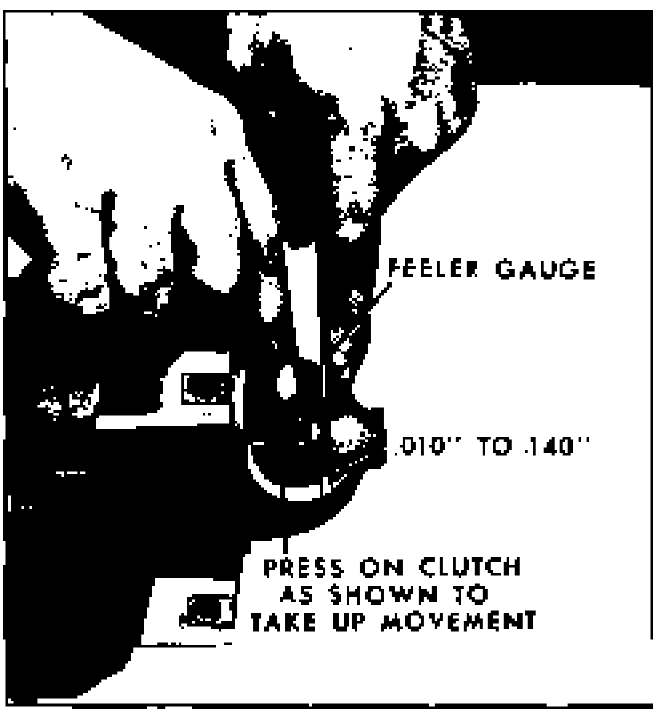


Fig. 6E-10 Measuring Pinion Clearance

INSTALL IN CAR - 6-CYL. ENGINE

1. Install starting motor.

NOTE: Make sure that the shim has been installed if the is car is equipped with automatic transmission.

2. Connect battery positive cable and wiring harness leads to starting motor solenoid.

3. Connect battery ground cable at battery terminal post.

INSTALL IN CAR - V-8 ENGINE

1. Connect battery cable and solenoid wires to solenoid.

NOTE: Connect purple (or violet) wire to terminal marked S.

2. Install starting motor on engine and tighten mounting screws securely.

NOTE: Make sure that the shims have been installed if this car is equipped with an automatic transmission.

3. Push cables up where they can be reached from above car, then lower car.

4. Route battery cable and connect cable to battery post.

CHARGING CIRCUIT

GENERATOR

PERIODIC SERVICE

The generator does not require periodic lubrication. The rotor shaft is mounted on ball bearings at drive end and roller bearing at slip ring end, and each has a permanent grease supply which eliminates need for periodic lubrication. At periodic intervals, check mounting bolts for tightness and belt for proper alignment, wear and tension.

CAUTION: When applying belt tension, apply pressure at center of generator, never against either end frame.

SERVICE PRECAUTIONS

Since both the generator and regulator in the standard system and the C.S.I. generator-regulator in the integrated circuit are designed for use on only one polarity system (negative ground) the following precautions must be observed when working on charging circuit. Failure to observe these precautions will result in serious damage to electrical equipment.

1. Do not attempt to polarize generator. It is not necessary since there are no permanent magnets.

2. Do not short across or ground any terminals on generator.

3. Never operate generator on open circuit (with field terminal connected and output terminal disconnected). Make absolutely certain all connections in circuit are secure. If generator is operating on open circuit, extremely high voltages may result that are both dangerous and damaging to generator.

4. When installing battery, make absolutely sure negative post is attached to ground strap.

CAUTION: Never reverse battery leads, even for an instant, as reverse polarity current flow will damage diodes in generator.

5. When connecting booster battery, make certain to connect negative battery terminals together and positive battery terminals together.

6. When connecting charger to battery, connect charger positive lead to battery positive terminal and charger negative lead to battery negative terminal.

CHECK IN CAR

If electrical system is not charging properly, follow the in-car checks outlined in Charging Circuit Preliminary Checks, Figs. 6E-19 and 6E-21 in the Diagnosis Manual, prior to removing generator. Remove generator as follows.

REMOVE FROM CAR

1. Disconnect positive battery terminal

CAUTION: Failure to observe this step may result in an injury from hot battery lead at generator.

2. Remove two leads at generator.

3. Loosen adjusting bolts.

4. Remove generator drive belt.

5. Remove bolts which retain generator.

6. Remove generator from car.

DISASSEMBLE GENERATOR

1. If rotor, drive end frame bearings or pulley and fan need replacement, remove and replace shaft nut using Allen wrench.

2. Scribe a mark between two halves of generator to help locate parts in same position during assembly.

3. Remove four through bolts.

4. Separate drive end frame and rotor assembly from stator assembly by prying apart with screwdriver at stator slot. The fit between the two is not tight and the two can be separated easily.

NOTE: The separation is to be made between stator assembly and drive end frame.

CAUTION: As rotor and drive end frame assembly is separated from slip ring frame assembly, the brushes will fall down onto shaft and come in contact with lubricant. Brushes which come in contact with shaft should be cleaned immediately to avoid contamination by oil, or they will have to be replaced.

INSPECTION AND REPAIR

ROTOR

The rotor may be checked electrically for grounded, open or short-circuited field coils as follows

1. To check for grounds, connect a 110-volt test lamp or ohmmeter from either slip ring to rotor shaft, or to rotor poles. If lamp lights or ohmmeter reading is low, the field winding is grounded (Fig. 6E-11).

2. To check for opens, connect test lamp or ohmmeter to each slip ring. If lamp fails to light or if the ohmmeter reading is high (infinite), winding is open (Fig. 6E-11).

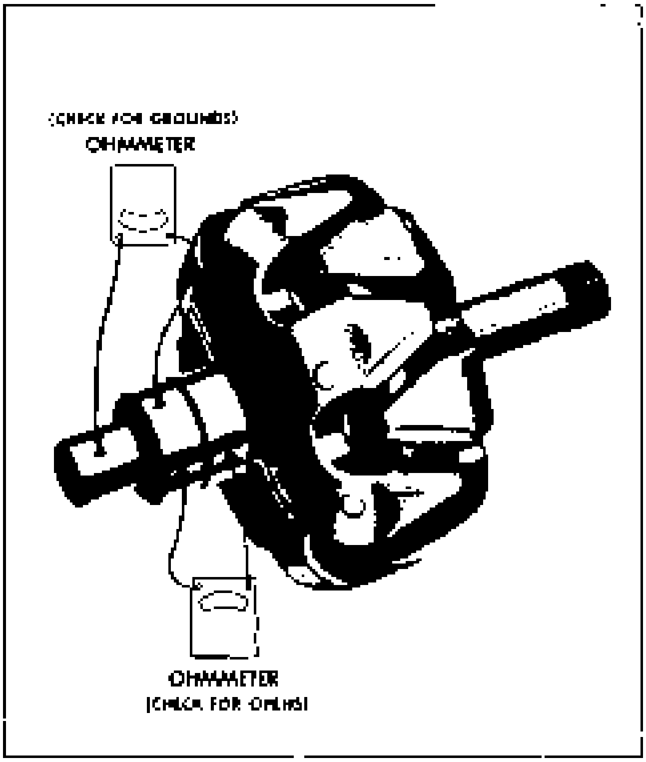


Fig. 6E-11 Checking Rotor

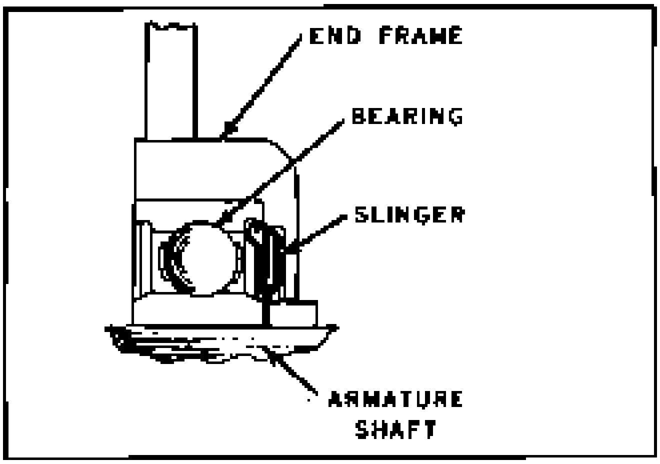


Fig. 6E-12 Proper Installation of Drive End Frame Bearing

3. The winding is checked for short circuits by connecting a battery and ammeter in series with two slip rings. The field current at 12 volts and 80°F should be between 2.2 - 2.6 amperes on standard regulator cars and 4.0 - 4.5 on cars equipped with 62 amp alternators. Any ammeter reading above these values indicates shorted windings.

4. Rotor assemblies which fail above test should be replaced.

The rotor may be cleaned and inspected as follows:

a. If magnetic poles or rotor need cleaning, they may be cleaned by brushing with oleum spirits.

CAUTION: Do not clean with degreasing solvent.

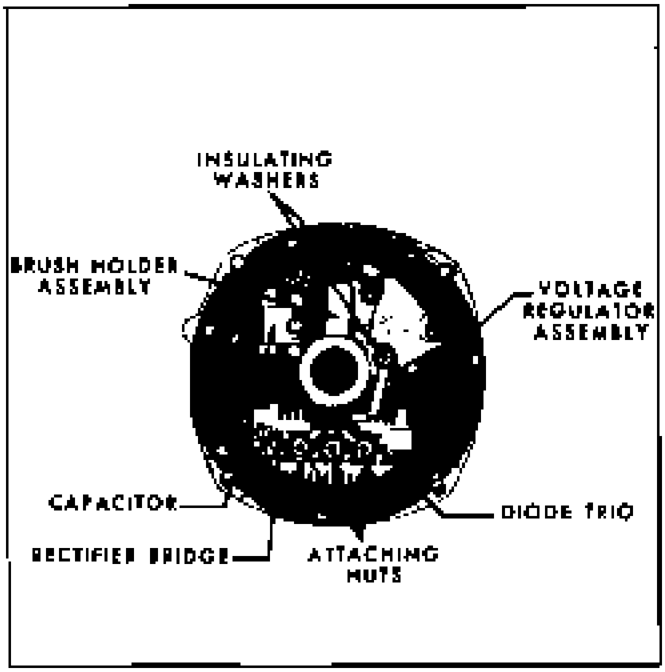


Fig. 6E-13 Slip Ring End Frame C.S.I. Generator

b. Inspect slip rings for dirt and roughness. These may be cleaned with solvent, if necessary. They may also be cleaned and finished with 400 grain or finer polishing cloth. Do not use sandpaper. Spin rotor in lathe or otherwise spin rotor, and hold polishing cloth against rings until they are clean.

CAUTION: The rotor must be rotated in order that slip rings will be cleaned evenly. Cleaning slip rings by hand, without spinning rotor, may result in flat spots on slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in lathe to .002" maximum indicator reading. Remove only enough material to make rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

DRIVE END FRAME BEARING

1. Remove three screws from retainer plate and remove retainer plate inner collar and gasket.

2. Press out bearing and oil slinger.

3. The bearings in generator are permanently lubricated and require no lubrication during life of bearing. If a dry bearing is encountered, do not attempt to lubricate, as an improper lubricant or excessive amount of lubricant may burn bearing, or be thrown off and contaminate inside of generator. Replace dry, worn or rough bearings with new bearings, which are prepacked with proper amount and type of lubricant.

4. To install, press in bearing and grease slinger with tube or collar that just fits over outer race. Install bearing and slinger as shown in Fig. 6E-12.

5. Install retainer plate gasket and inner collar with three screws. It is recommended that new retainer plate be installed if felt seal is hardened or excessively worn.

STATOR

If stator is to be checked and/or replace:

1. Remove 3 stator lead attaching nuts and washers (Figs. 6E-13 or 6E-14).

2. Separate stator from end frame. The fit between stator frame and end frame is not tight, and two can be separated easily.

3. The stator windings may be checked with 110-volt test lamp or ohmmeter as follows:

a. To check for grounded windings, connect lamp or ohmmeter from any stator lead to frame. If lamp lights or ohmmeter reading is low the stator is grounded (see Fig. 6E-15).

b. To test for opens, successively connect 110-volt test

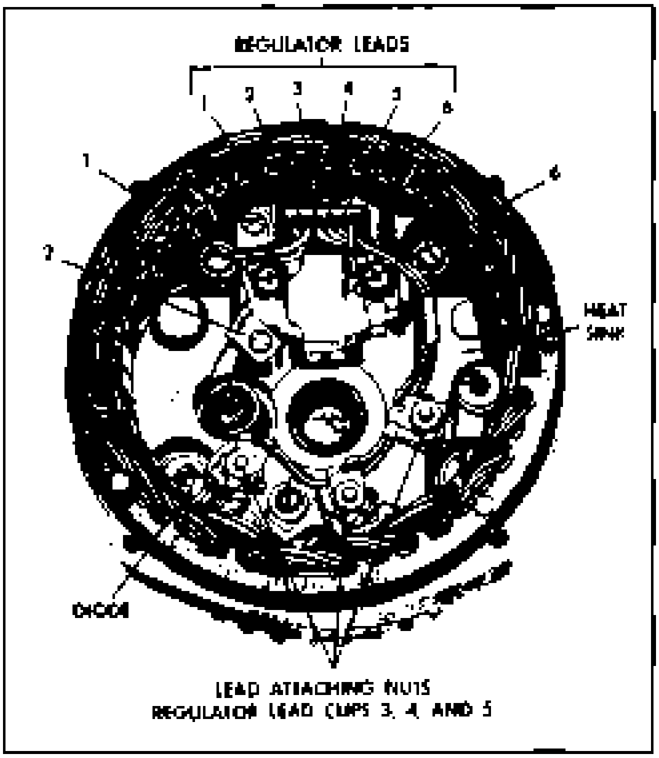


Fig. 6E-14 Slip Ring End Frame - Standard Generator

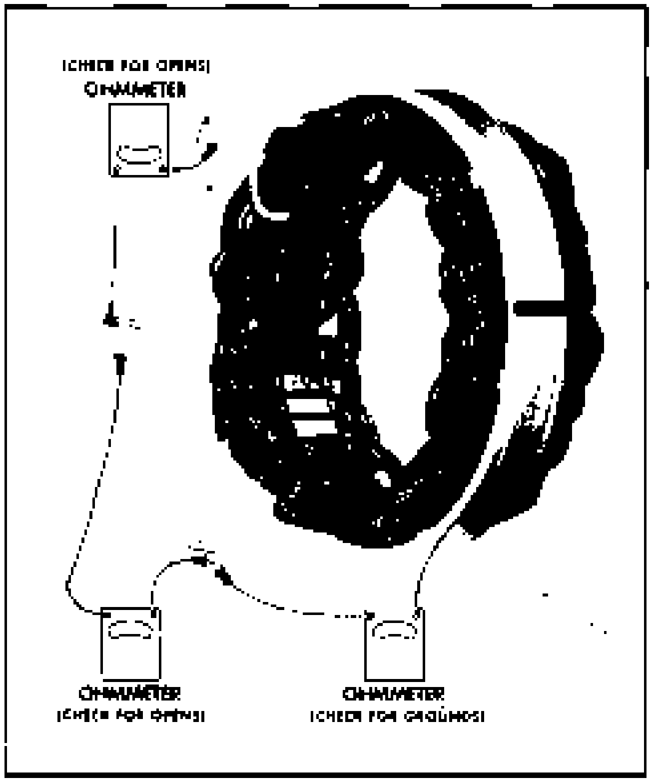


Fig. 6E-15 Checking Stator

lamp or ohmmeter between stator leads. If lamp fails to light and if ohmmeter reading is high, there is an open in stator windings (see Fig. 6E-15).

c. A short circuit in stator windings is difficult to locate without laboratory test equipment, due to low resistance of windings. However, if all other electrical checks are normal and alternator fails to supply rated output, shorted stator windings are indicated.

d. Stator which fails above test should be replaced.

4. If necessary, stator may be cleaned by brushing with oleum spirits.

CAUTION: Do not clean in solvent.

5. The stator can be installed by reversing steps 1 and 2.

DIODE TRIO - C.S.I. GENERATOR

The diode trio is identified in Fig. 6E-13. Before removing the diode trio, connect an ohmeter, using lowest range scale, from brush lead clip to end frame as shown in Fig. 6E-16, then reverse lead connections. If both readings are zero, check for grounded brush lead clip caused by omission of insulating washer (Fig. 6E-16), omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve.

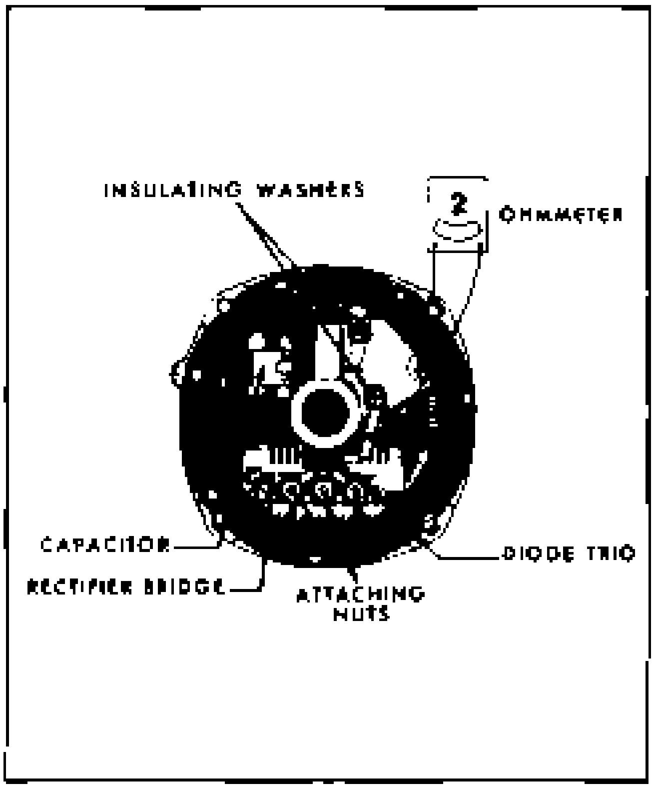


Fig. 6E-16 Check for Grounded Brush Lead Clip C.S.I. Generator

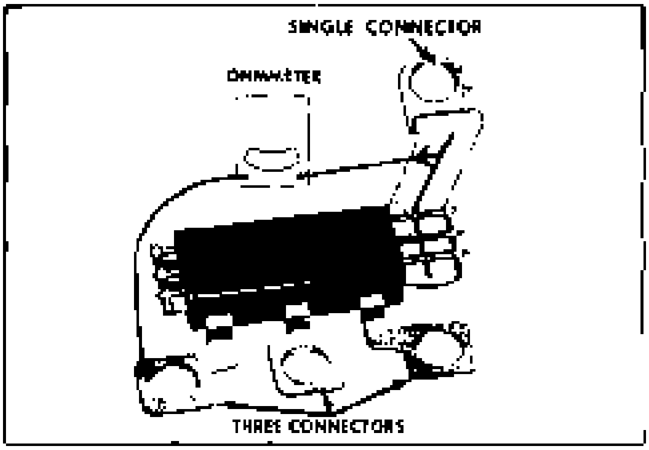


Fig. 6E-17 Checking Diode Trio - C.S.I. Generator

To remove diode trio, proceed as follows:

1. Remove three stator attaching nuts

2. Remove stator.

3. Remove diode trio lead clip attaching screw and remove diode trio. Note that the insulating washer on the screw is assembled over the top of the diode trio connector.

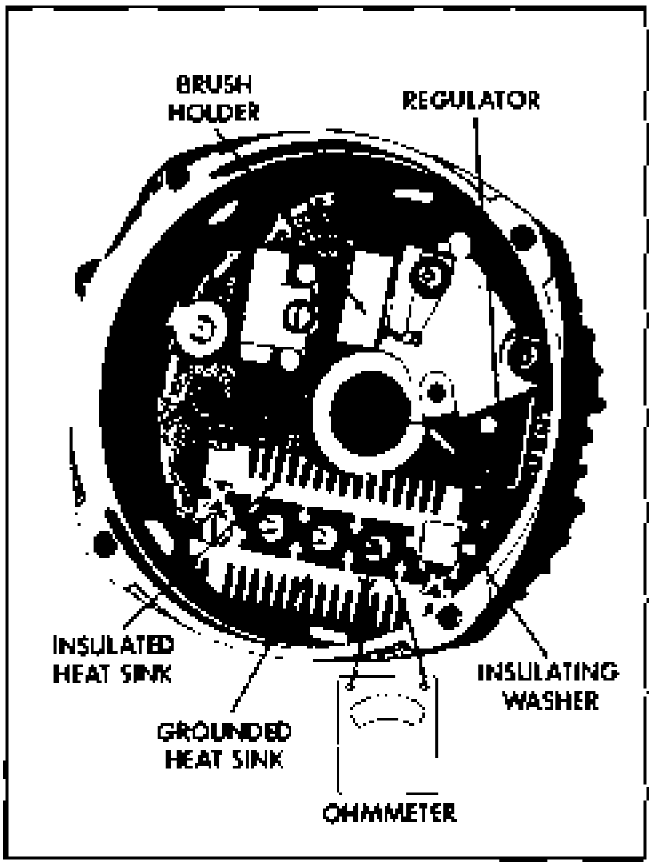


Fig. 6E-18 Checking Rectifier Bridge Diodes-C.S.I. Generator

NOTE: Two diode trios differing in appearance are used in the 1969 C.S.I. generator. Either one of these diode trios may be used in any C.S.I. generator, as the two are completely interchangeable.

To check the diode trio, after removing it from the end frame assembly, connect an ohmeter having a 1 1/2 volt cell, and using the lowest range scale, to the single brush connector and one of the stator lead connectors (Fig. 6E-17). Observe the reading. Then reverse the leads to the same two connectors. Repeat this test with each of the other two stator lead connectors. If any or all give readings when reversing connections which are the same, replace the diode trio. A good diode trio will give one high and one low reading.

CAUTION: Do not use high voltage, such as a 110 volt test lamp, to check this unit.

RECTIFIER BRIDGE-C.S.I. GENERATOR

The rectifier bridge of the C.S.I. generator contains all of the diodes found in the heat sink and slip ring end frame of the standard generator. If one diode is defective, the entire rectifier bridge must be replaced.

To check the rectifier bridge, connect an ohmeter to the ground heat sink and base of one of the three terminals (Fig. 6E-18). Then reverse the connections to the grounded heat sink and base of the same terminal. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading.

Repeat this same procedure between the grounded heat sink and the other two terminals, and between the insulated heat sink and each of the three terminals. If at least one pair of readings is the same, the rectifier bridge must be replaced.

CAUTION: Do not use high voltage, such as a 110 volt test lamp, to check this unit. NOTE: Two rectifier bridges, differing in appearance are used in the 1969 C.S.I. generator. Either one of these rectifier bridges may be used in any C.S.I. generator, as the two are completely interchangeable.

To replace the rectifier bridge, proceed as follows:

1. Remove the attaching screw and the "BAT" terminal screw.

2. Disconnect the capacitor lead

3. Remove rectifier bridge. Note the insulator between the insulated heat sink and end frame (Fig 6E-18).

BRUSHES - STANDARD GENERATOR

BRUSHES AND/OR VOLTAGE REGULATOR - C.S.I. GENERATOR

1. Remove two brush holder screws and stator lead to strap attaching nut and washer (Fig. 6E-13 or 6E-14).

brush holder screws and one diode trio lead strap attaching screw. Note the position of all insulator washers for reassembly.

2. Remove brush holder and brushes. In the C.S.I. Generator, the voltage regulator may also be removed at this time. Carefully note stack-up of parts (Fig. 6E-19 and 6E-20) for reassembly.

3. Inspect brush spring for evidence of damage or corrosion.

4. Inspect brushes for wear or contamination.

5. If old brushes are to be reused, they must be thoroughly cleaned with soft dry cloth and must be completely free of oil.

6. If there is any doubt about condition of brush springs, they should be replaced.

7. Install spring and brushes into brush holder (they should slide in and out without binding). Insert straight wood or plastic toothpick (to prevent scratching brush face) into hole at bottom of holder to retain brushes.

NOTE: In the C.S.I. Generator, should any of the brush holder assembly parts require replacement, it will be necessary to replace the entire brush holder assembly. Individual parts are not serviced for this particular assembly in the C.S.I. Generator.

8. In the C.S.I. Generator, replace voltage regulator.

9. Attach brush holder into end frame, noting carefully stack-up of parts as shown in Fig. 6E-19 and 6E-20. Allow wood or toothpick to protrude through hole in end frame and install stator or diode trio lead to strap attaching nut or screw and washer.

VOLTAGE REGULATOR - C.S.I. GENERATOR

For removal and replacement of voltage regulator in the integrated circuit generator, see BRUSHES AND/OR VOLTAGE REGULATOR - C.S.I. GENERATOR.

The voltage regulator test for the C.S.I. generator must be made before the generator is removed from the car. Proceed as follows:

1. Disconnect battery ground strap.

2. Connect an ammeter in the circuit at the "BAT" terminal of the generator

3. Reconnect energizer ground strap.

4. Turn on radio, windshield wipers, lights high beam and blower motor high speed. Connect a carbon pile across the energizer.

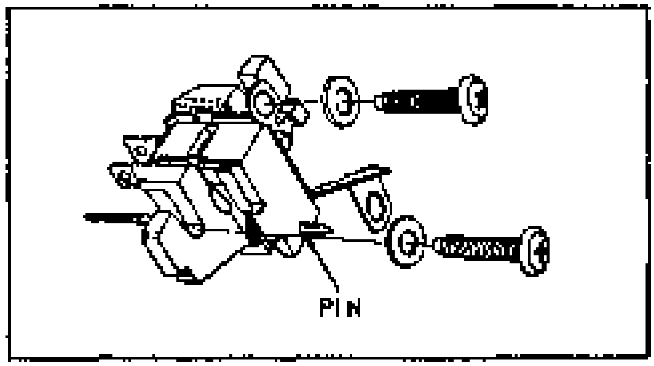


Fig. 6E-19 Brush Holder - Standard Generator

5. Ground the field winding by inserting a screwdriver into the test hole (Fig. 6E-21).

CAUTION: Grounding tab is within 3/4" of the casting surface (Fig. 6E-21). Do not force screwdriver deeper than 1" into end frame.

6. Operate engine at moderate speed and adjust carbon pile to obtain maximum current output.

7. If output is within 10% of rated output of generator, replace regulator.

SLIP RING END FRAME BEARING AND SEAL

1. With stator removed, press out bearing and seal with tube or collar that just fits inside end frame housing. Press from outside of housing toward inside. Support inside of frame with hollow cylinder to allow seal and bearing to pass through.

2. The bearings in generator are permanently lubricated and require no lubrication during life of bearing. If a dry bearing is encountered, do not attempt to lubricate, as improper lubricant or excessive amount of lubricant may burn bearing, or be thrown off and contaminate inside of generator. Replace dry, worn or

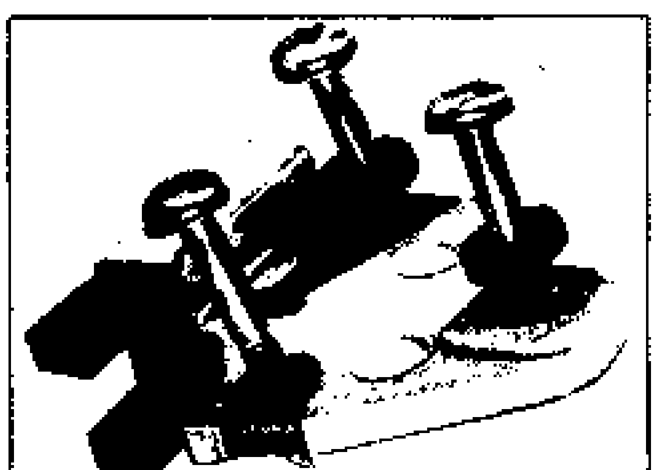


Fig. 6E-20 Brush Holder - C.S.I. Generator

Fig. 6E-21 Grounding Tab in Slip Ring End Frame C.S.I. Generator

rough bearings with a new bearing which will be prepacked with proper amount and type of lubricant.

3. Place flat plate over bearing and press in from outside toward inside of frame until bearing is flush with outside of end frame. Support inside of frame with hollow cylinder to prevent breakage of end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on bearing.

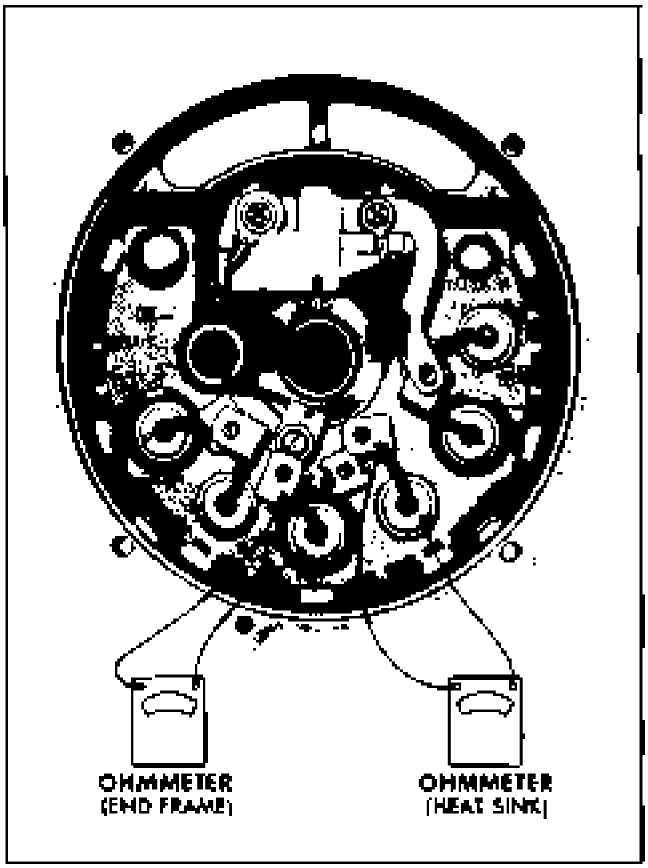


Fig. 6E-22 Checking Diodes - Standard Generator

4. From inside of frame, insert seal flush against bearing.

5. Install stator and connect leads.

DIODES - STANDARD GENERATOR

Diodes are checked by making use of their use of their principles of allowing electricity to pass through in only one direction. Two methods are available:

OHMMETER METHOD

The lowest range scale on ohmmeter should be used and it should have 1 1/2 volt cell. To determine cell voltage, turn selector to lowest scale, then connect ohmmeter leads to voltmeter. The voltmeter will indicate cell voltage.

HEAT SINK DIODES

1. With stator disconnected, check a diode in heat sink by connecting one of ohmmeter leads to heat sink, and other ohmmeter lead to diode lead and note reading (Fig. 6E-22).

2. Reverse ohmmeter leads and note reading.

3. If both readings are very low or very high (read the same), the diode is defective. A good diode will give one low reading and one high reading.

4. Check other two diodes in heat sink in same manner.

END FRAME DIODES

1. To check a diode mounted in end frame, connect one of ohmmeter leads to end frame and other ohmmeter lead to diode lead and note reading (Fig. 6E-22).

2. Reverse ohmmeter leads and note readings.

3. If both readings are very low or very high (read the same), the diode is defective. A good diode will give one low reading and one high reading.

4. Check other two diodes in end frame in same manner.

TEST LAMP METHOD

An alternate method of checking diodes is to use a test lamp of not more than 12 volts in place of ohmmeter.

CAUTION: Do not use 110 volt test lamp to check diodes.

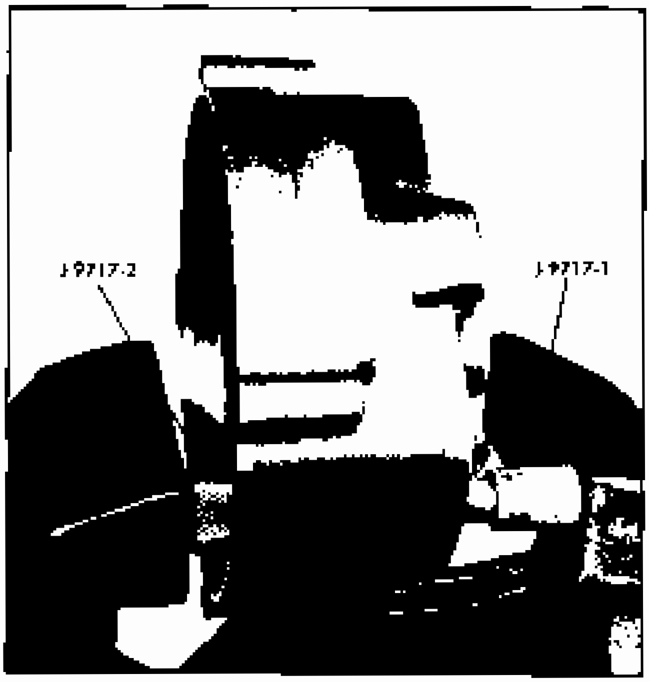


Fig. 6E-23 Removing Diodes - Standard Generator

With stator disconnected, connect test lamp across each diode as previously described, first in one direction and then other.

If lamp lights in both checks or fails to light in both checks, the diode is defective. When checking a good diode, the lamp will light in only one of two checks.

Diodes which fail the electrical tests should be replaced. To replace diodes in the C.S.I. generator, see DIODE TRIO or RECTIFIER BRIDGE replacement. If diodes must be replaced in standard generator:

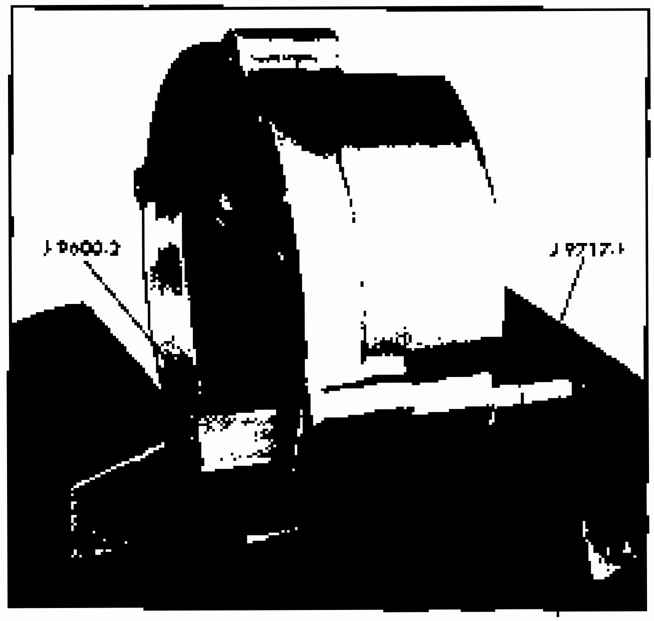


Fig. 6E-24 Installing Diodes - Standard Generator

1. With stator removed, support slip ring end frame in vise or arbor press with J 9717-2 against casting and position remover J 9717-1 against diode as shown in Fig. 6E-23.

2. Tighten vise to remove diode.

CAUTION: Never attempt to remove diode by striking it, as shock may damage other diodes.

3. To install a diode, place new diode in installer J 9600-2.

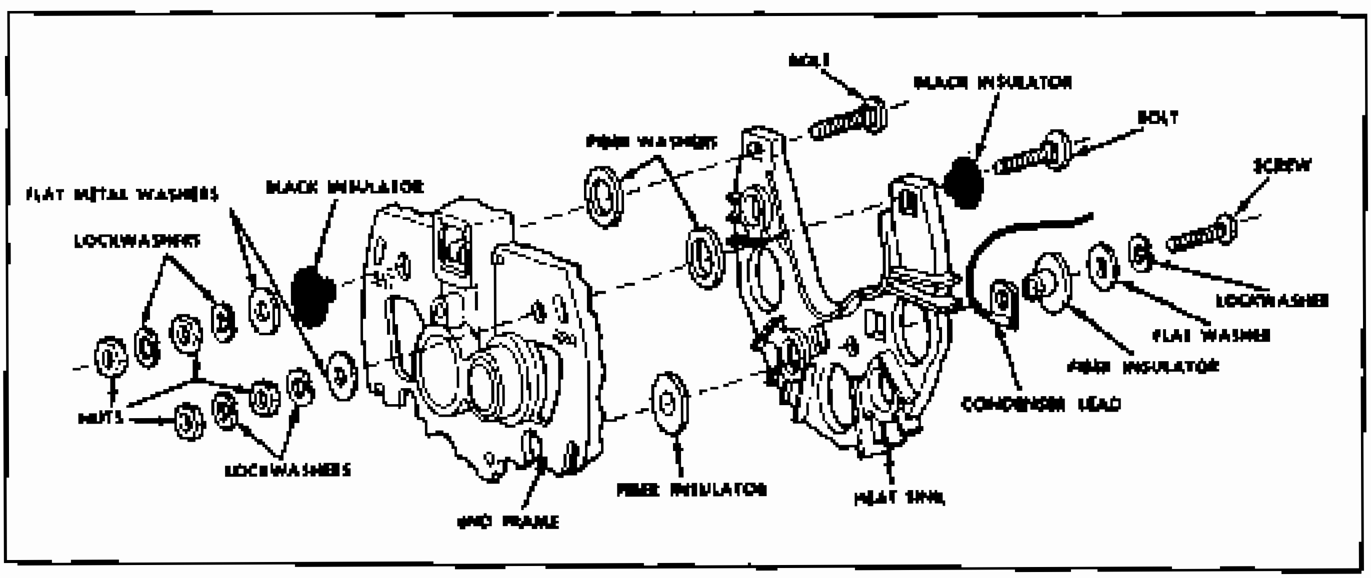


Fig. 6E-25 Heat Sink (Standard Generator) - Exploded View

4. Place slip ring end frame in vise so that new diode is in position and remover J 9717-1 supports casting (Fig. 6E-24).

5. Tighten vise to install diode.

CAUTION: Never attempt to install diode by striking it, as shock may damage it and other diodes.

6. Install stator and connect leads.

HEAT SINK - STANDARD GENERATOR

NOTE: Do not disassemble unless absolutely necessary. The heat sink must be completely insulated from end frame

1. With stator removed, remove screw retaining condenser lockwasher, flat washer, fiber insulator and condenser lead.

2. Remove BAT and GRD terminals and respective washers and insulators from end frame.

3. Remove heat sink and washers.

4. Replace heat sink assembly, noting stack-up of parts shown in Fig. 6E-25

5. Attach condenser lead to heat sink with washer and screws. Be sure insulating washer is between heat sink and end frame.

6. Install stator and connect leads.

ASSEMBLE GENERATOR

1. Before assembling rotor and drive end frame to slip ring end frame, make sure bearing surfaces of shaft are perfectly clean.

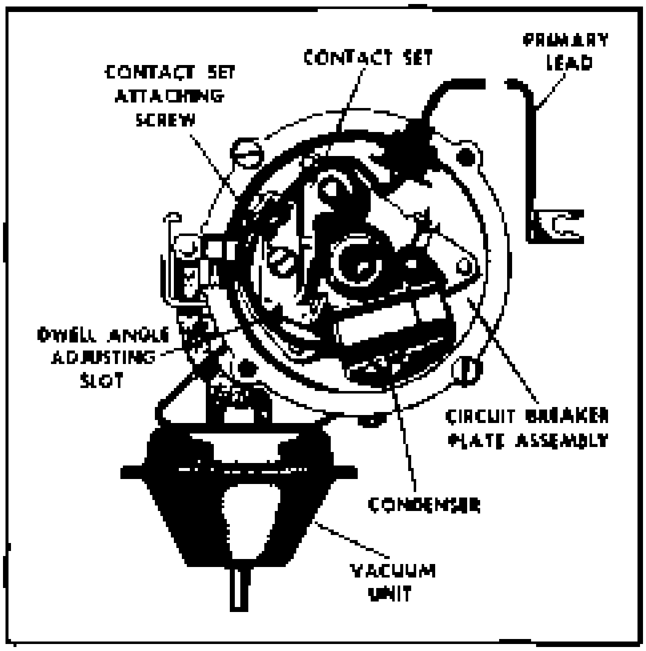


Fig. 6E-26 Top View of Distributor (Cap and Rotor Removed)

2. Join together two end frames, matching scribe marks.

3. Install four through bolts.

4. Remove wood or toothpick from brush holder assembly.

INSTALL IN CAR

1. If removed from car, install generator to mounting bracket with bolts, washers, and nuts. Do not tighten.

2. Install generator drive belt.

3. Tighten belt to 120 lb. ft. for new belt, or 75 lb. ft. for used belt. See Section 6A for proper belt tensioning procedures.

4. Tighten bolts to 30 lb. ft., except bolt at sliding slot on bracket used for other than air conditioned cars, which is 20 lb. ft.

5. Install field and battery leads to generator.

6. Connect positive battery terminal.

CAUTION: Take care not to reverse polarity.

STANDARD AND TRANSISTOR VOLTAGE REGULATORS

See Diagnosis Manual for servicing and checks of standard and transistor voltage regulators.

IGNITION CIRCUIT

DISTRIBUTOR - 6 CYLINDER ENGINE

CHECKS AND ADJUSTMENTS ON VEHICLE

REPLACING CONTACT SET

The contact set is replaced as a complete assembly. To remove contact set, merely lift condenser lead clip and primary lead clip from between breaker lever spring and insulator, and then remove the contact set attaching screw (Fig. 6E-26). The service replacement contact set has breaker lever spring and point alignment preadjusted at factory. Only point opening requires adjusting after replacement.

ADJUSTING POINT OPENING

Loosen distributor clamp bolt and turn distributor until point set fiber block is on high point of cam. Measure point opening with feeler gauge. To change setting, loosen contact set attaching screw (Fig. 6E-26), insert screwdriver in adjusting screw slot, and pry to adjust to .016" with used points and .019" with new. Retighten screw securely after setting is made. Reset timing and tighten distributor clamp bolt.

CHECKS AND ADJUSTMENTS OFF VEHICLE

REMOVE

1. Disconnect distributor-to-coil primary wire.

2. Remove distributor cap.

3. Crank engine so rotor is in position to fire No. 1 cylinder and timing mark on harmonic balancer is indexed with the proper mark on the lower timing belt cover (Fig. 6E-33).

4. Remove vacuum line from distributor.

5. Remove distributor clamping nut and hold-down clamp from stud.

6. Remove distributor. It will be noted that rotor will rotate as distributor is pulled out of block. Note relationship of rotor and distributor housing after removal so that rotor can be set in the same position when distributor is being installed.

NOTE: It is NOT necessary to remove compressor mounting bracket in engines equipped with air conditioning.

CAUTION: Always set distributor in upright position so oil from distributor shaft will not run out onto breaker plate and points.

The distributor may be placed in a distributor testing machine or synchroscope to check for variation of spark and centrifugal and vacuum advance.

IMPORTANT: When checking dwell angle, the vacuum advance must be in full retard or no vacuum advance position, since the dwell angle may vary with vacuum advance on these types of distributors. The procedure for replacing contact set, and adjusting point opening is covered under CHECKS AND ADJUSTMENTS OF DISTRIBUTOR ON VEHICLE.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLE (Fig. 6E-27).

1. Remove rotor.

2. Disconnect primary and condenser leads from between plastic retainer and breaker set spring. Remove breaker points adjusting hold-down screw and remove breaker points assembly.

3. Remove primary lead and retainer.

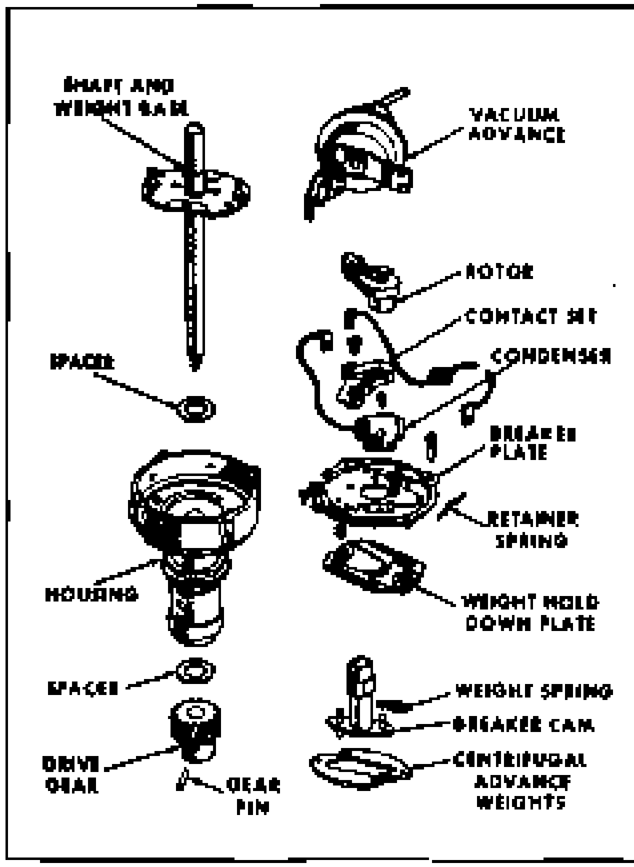


Fig. 6E-27 Exploded View of 6-Cylinder Distributor

4. Remove condenser and bracket.

5. Remove screws from vacuum advance diaphragm bracket. With slight downward pressure to disengage lever, remove vacuum advance assembly.

6. Remove screws securing breaker plate and remove breaker plate.

7. Remove roll pin from driven gear and remove driven gear and washer.

8. Pull shaft and weight base assembly and washer out of distributor housing and remove screws and washers securing centrifugal advance upper plate.

9. Remove weight control springs, weights from base plate and pull breaker cam assembly from main shaft.

ASSEMBLE

Assembly of the distributor is the reverse of the disassembly procedure outlined above. Coat upper end of shaft with grease before installing breaker cam. When installing the gear on shaft, use a new roll pin. The pin must be tight in hole to prevent any movement between gear and shaft.

INSTALL

1. Check to see that engine is at firing position for No.

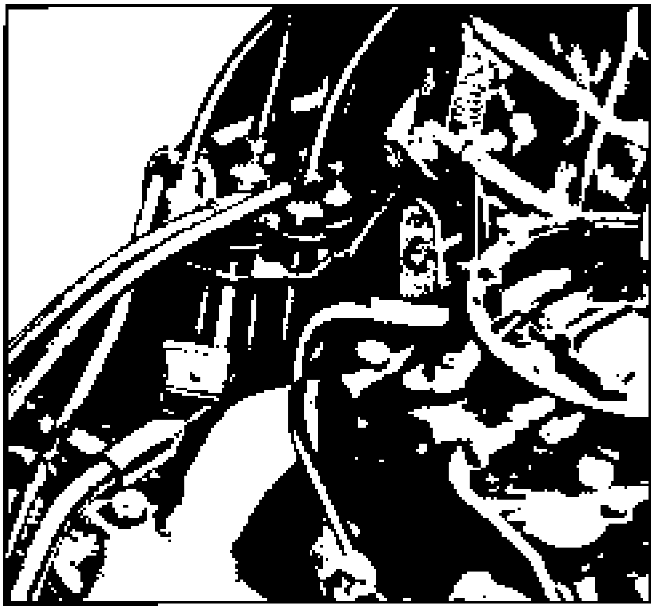


Fig. 6E-28 Adjusting Dwell Angle

1 cylinder (No. 1 piston at top of compression stroke) and timing mark on harmonic balancer is indexed with the proper mark on the lower timing belt cover (Fig. 6E-33).

2. Position new distributor to block gasket on block.

3. Before installing distributor, index rotor with housing as noted when distributor was removed, Fig. 6E-32. This will simplify indexing the distributor shaft and gear with oil pump drive shaft and distributor drive gear. Distributor and rotor will be positioned properly when installed with No. 1 piston in firing position.

4. Replace distributor clamp leaving nut loose enough to allow distributor to be turned for timing adjustment.

5. Attach distributor to coil primary wire.

6. Replace distributor cap.

7. Adjust timing and then tighten distributor clamp nut.

8. Attach vacuum line to distributor.

DISTRIBUTOR - 8 CYLINDER ENGINE

PERIODIC SERVICE

A permanent lubricant reservoir is built into the distributor housing to lubricate upper end of shaft. No periodic lubrication is required.

When replacing contact set assembly, apply a trace of petrolatum to breaker cam. No other lubrication is required. The movable breaker plate is lubricated by lubricant from the upper shaft bushing.

This distributor also requires periodic inspection of cap and rotor, wiring, and point condition, and a check for correct spark timing. This should be done at each tune up and at least every spring and fall.

ADJUSTMENT

1. With engine operating, raise window provided in cap.

2. Insert Hex type wrench into head of adjusting screw as shown in Fig. 6E-28.

3. Turn screw to adjust point opening by one of the following methods:

Preferred Method:

Turn adjusting screw until 30° dwell is obtained as measured by dwell meter. (When using dwell meter, be sure to test distributor resistance before testing dwell angle.)

NOTE: Providing dwell meter is accurate and is used correctly, points can be set very accurately. Several design features such as use of upper shaft bushing as a bearing for breaker plate and construction of advance mechanism have made this possible.

Alternate Method:

Turn adjusting screw (clockwise) until engine begins to misfire. Then turn screw one-half turn in opposite direction (counterclockwise). This will give proper dwell angle.

REMOVE

1. Disconnect distributor-to-coil primary wire.

2. Remove distributor cap.

3. Crank engine so rotor is in position to fire No. 1 cylinder and timing mark on harmonic balancer is indexed with the proper mark on the timing chain cover, Fig. 6E-31 and 6E-34.

4. Remove vacuum line from distributor.

5. Remove distributor clamping screw and hold-down clamp.

6. Remove distributor and distributor to block gasket. It will be noted that rotor will rotate as distributor is pulled out of block. Note relationship of rotor and distributor housing after removal, so that rotor can be set in same position when distributor is being installed.

NOTE: Always set distributor in upright position so oil *from distributor shaft will not run out onto breaker plate and points.*

INSPECT

With distributor removed from vehicle it is advisable to place distributor in a distributor testing machine or synchroscope. When mounting distributor in tester, first secure gear in drive mechanism, then push distributor housing down toward gear to take up end play between gear and housing, and finally secure housing in tester. Test distributor for variation of spark, correct centrifugal and vacuum advance, and condition of contacts. This test will give valuable information on distributor condition and indicate parts replacement which may be necessary.

REPLACE CONTACT SET

The contact point set is replaced as one complete assembly. The breaker lever spring tension and point alignment of service contact set have been pre-adjusted at factory. Only point opening requires adjusting after replacement.

Replace contact set as follows:

1. Remove two attaching screws which hold base of contact set assembly in place.

2. Remove condenser lead and primary lead from nylon insulated connection (Fig. 6E-29) in contact set.

3. Replacement is reverse of removal.

CAUTION: Make sure condenser lead and primary lead are located as in Fig. 6E-29. Leads must be properly located to eliminate interference between leads and cap, weight base or breaker plate.

4. Apply trace of petrolatum to breaker cam.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLE (Fig. 6E-30)

1. Remove rotor by removing two attaching screws, lockwashers, and flatwashers (Fig. 6E-30).

NOTE: It will be observed that rotor is doweled to weight base so that it can be installed in only one position.

2. Remove both weight springs and both advance weights.

3. Remove retaining pin from gear by driving it out of gear with a drift and hammer.

CAUTION: Distributor should be supported in such a way that distributor shaft will not be damaged when driving pin out.

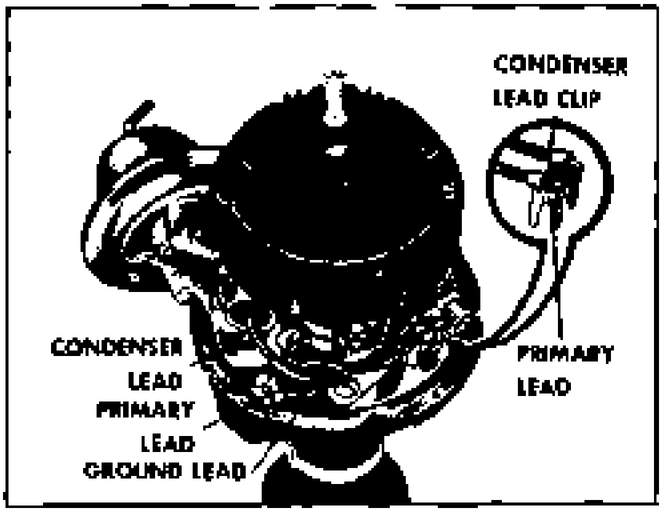


Fig. 6E-29 Arrangement of Leads

4. Slide gear and washer off shaft.

5. Pull shaft and cam-weight base assembly from the housing.

6. Remove contact set assembly.

7. Remove condenser hold-down screw, condenser and bracket from the breaker plate.

8. Remove spring retainer and raise plate from housing.

9. Remove two attaching screws and lock washers and plate ground lead, and remove vacuum advance unit.

10. Remove felt washer from around bushing in housing.

NOTE: No attempt should be made to service shaft bushings in housing, as housing and bushings are serviced as a complete assembly.

ASSEMBLE

Assembly of the distributor is reverse of disassembly procedure outlined above. When installing gear on shaft, use a new retaining pin. The pin must be tight in hole to prevent any movement between gear and shaft.

Note that rotor can be installed in only one position. It will be broken if an attempt is made to install it backwards.

NOTE: Some GTO, Firebird and 428 HO distributors will have cadmium plated, hardened drive gears. Whenever one of these distributors or gears is replaced, an identical replacement part must be used. Engines

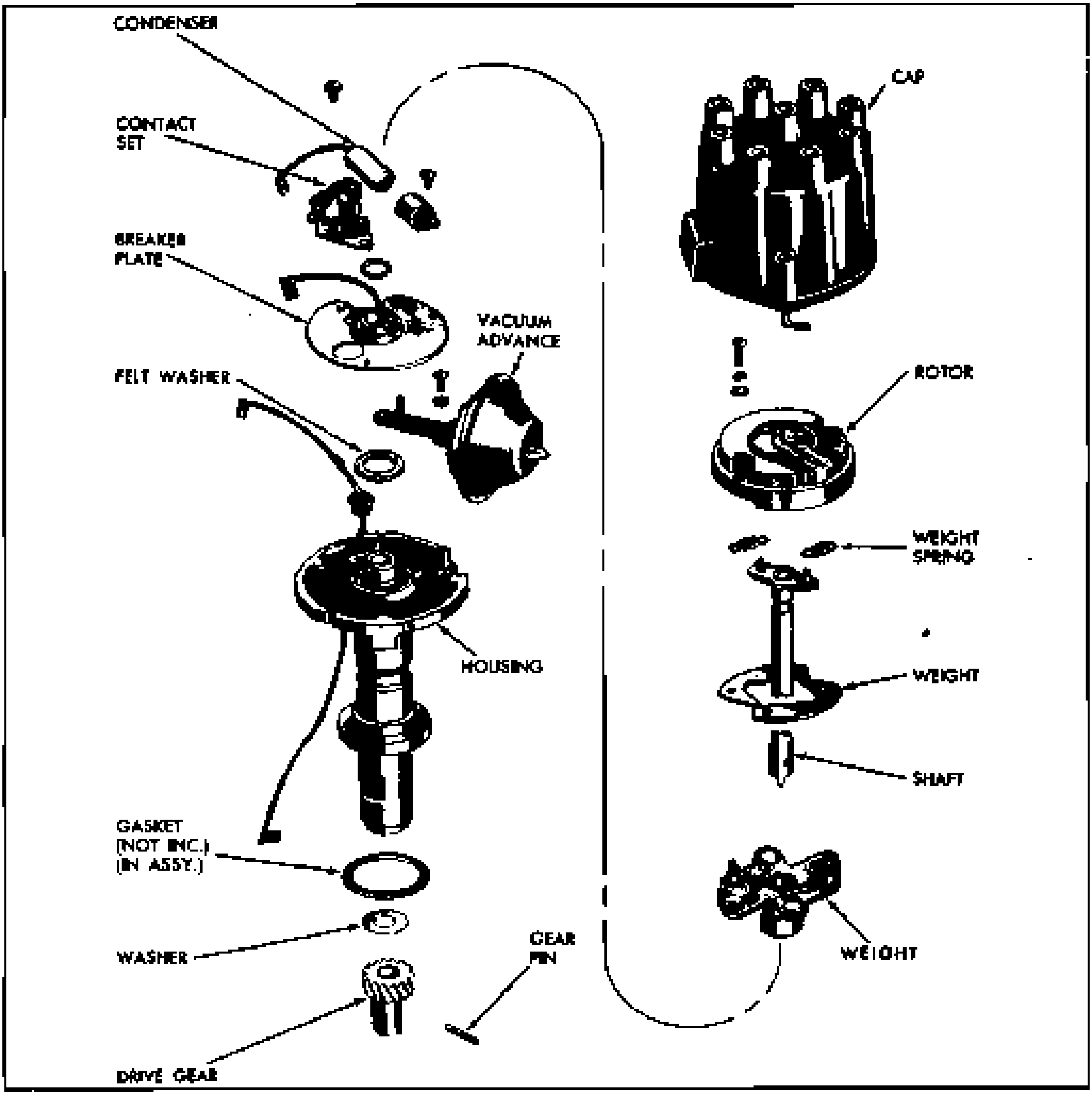


Fig. 6E-30 Exploded View of V-8 Distributor

built with hardened gears have a 60 psi oil pump spring, and early failure will result if a normal gear is used.

INSTALL

1. Check to see that engine is at firing position for No. 1 cylinder (No. 1 piston at top of compression stroke) and timing mark on harmonic balancer is indexed with the proper mark on the timing chain cover (Fig. 6E-34)

2. Position new distributor to block gasket on block.

3. Install distributor in block so that vacuum diaphragm faces left side of engine and rotor points toward contact in cap for No. 1 cylinder. Before installing distributor, index rotor with housing as noted when distributor was removed. This will simplify indexing distributor shaft and gear with oil pump drive shaft and drive gear on camshaft. Distributor and rotor will be positioned as shown in Fig. 6E-31 when properly installed with No. 1 piston in firing position.

4. Replace distributor clamp, leaving screw loose enough to allow distributor to be turned for timing adjustment.

5. Attach distributor to coil primary wire.

6. Replace distributor cap.

7. Adjust dwell and timing and then tighten distributor clamp screw.

8. Attach vacuum line to distributor.

If engine was turned with distributor removed and/or position of rotor was not noted upon removal of distributor, it may be installed by the following method.

1. Remove No. 1 spark plug (forward plug on left bank on V-8).

2. Place finger in spark plug hole and turn engine over until timing mark is at index (see Fig. 6E-34).

NOTE: As engine approaches timing mark, a pressure should be felt with the finger in the spark plug hole. If no pressure is felt, it will be necessary to turn the engine one complete revolution and again index with timing marks.

3. Install distributor in position as shown in Fig. 6E-31. It will be necessary to rotate rotor slightly to the right for a V-8 and to the left for a 6-cyl. when attempting installation so that final position will be correct.

NOTE: If distributor does not drop into position fully, hold down on housing and rotate engine until distributor drops into position.

IGNITION TIMING

Correct timing marks are on the front engine covers and harmonic balancer (Figs. 6E-33, 6E-34).

Due to vacuum advance at idle, it is imperative to disconnect distributor vacuum advance line before setting ignition timing.

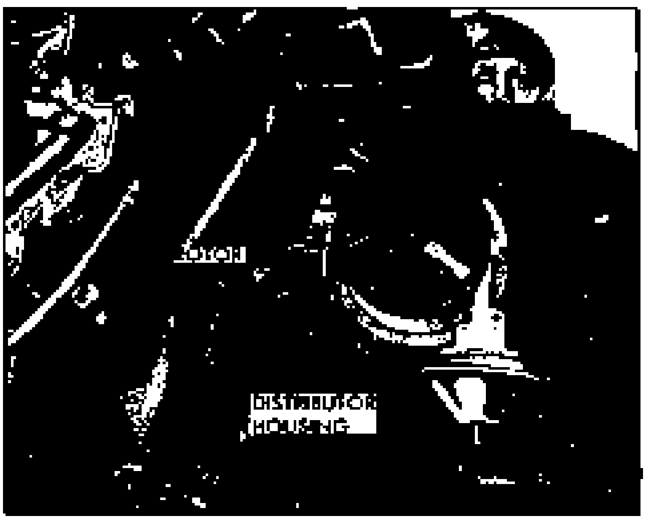


Fig. 6E-31 Rotor in No. 1 Firing Position - V-8

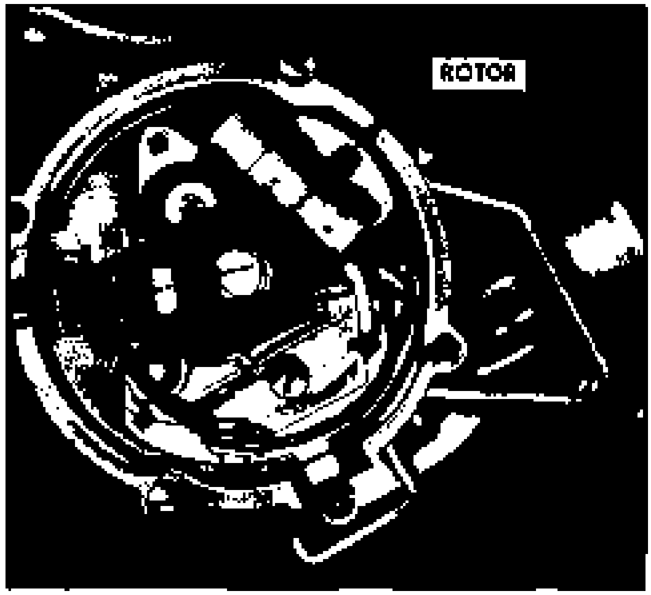


Fig. 6E-32 Rotor in No. 1 Firing Position - 6 Cylinder

At time spark is adjusted, the general appearance of breaker points should be observed. If smudge line appears on point support and breaker plate just beneath points, burned points (from oil or crankcase vapor between points) are very probable. Points which have gone several thousand miles will have a rough surface, but this does not mean points are worn out. The roughness between points matches so that a large contact area is maintained and points will continue to provide satisfactory service. If dirt or scale is present, points should be cleaned with a few strokes of a clean, fine-cut, contact file. Do not attempt to remove all roughness or dress point surfaces down smooth. Never use emery cloth or sandpaper to clean points. If points are burned or badly pitted, they should be replaced and cause of this condition found and corrected. If this is not done, new points will also burn and pit in a short time.

Fig. 6E-33 Timing Marks on 6 Cylinder Engine

Adjust ignition timing as follows:

1. Adjust breaker point gap.

2. Connect power timing light.

3. Loosen distributor clamp screw and rotate distributor until power timing light shows that the proper mark on the cover lines up with the mark on the harmonic balancer. Tighten distributor clamp screw. The timing specifications for various engines are listed below:

6 cyl 4 bbl.	5° BTDC
6 cyl 1 bbl.	0° TDC
V-8	9° BTDC
Ram Air IV	15° BTDC

IGNITION AND STARTING SWITCH

The ignition and starting switch is completely new for 1969. The switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly. For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEERING, Section 9.

The ignition and starting switch is key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

The ignition switch used on all cars has five positions, one more than switches used in previous model years.

Fig. 6E-34 Timing Marks on V-8 Engine

There are currently two OFF positions, one being the familiar OFF position found on previous model switches, and a new position known as the OFF-LOCKED position. OFF is the center position of the key-lock cylinder, and OFF-LOCKED is the next position to the left. ACCESSORY is located one more detent to the left of OFF-LOCKED. Turning the key to the right of the OFF position until spring pressure is felt will put the ignition switch in the RUN position, and when turned fully to the right against spring pressure, the switch will be in the START position.

With the switch in the ACCESSORY (A) position, the following electrical circuits are activated: stop lights, directional signals, parking brake warning light, radio, power antenna, power windows and seats, back-up lights, and electric windsheild wipers. In the RUN position, the ignition primary circuit is activated through the resistance and the air conditioning and heater and defroster circuits are activated.

There are seven terminals on the back of the switch (Fig. 6E-35). The Bat terminals (B1, B2 and B3), which are connected so as to form one common terminal, are connected to the battery and supply power to the switch. The ACCESSORY terminal (A) supplies power to all of the accessories except air conditioning, heater and defroster when the switch is in the ACCESSORY position. The SOLENOID terminal (S) supplies power to the solenoid to activate the starter in the start position. The GROUND terminal (G) completes the test circuit for the temperature HOT indicator bulb when the switch is turned to the start position.

The A terminal is activated only when the ignition switch is in the ACCESSORY position, and the S and G terminals are activated only in the START position. All circuits are cut off in either the OFF or OFF-LOCKED positions.

When the ignition switch is turned to the START position, the ignition primary circuit is activated directly, by-passing the resistance, and the starting motor circuit is activated to crank the engine. Three IGNITION terminals, marked I1, I2 and I3, will be found on the back of the switch. The I1 and I3 terminals are energized when the ignition switch is in the normal operating position (RUN position). The I1 directs current to the ignition coil through the resistance. I3 energizes the air conditioning, heater and defroster circuits. The I2 terminal is energized when the ignition switch is turned to the start position and directs current to the coil around the resistance to provide full battery voltage to the coil when starting.

When the ignition switch is in the RUN position, current can be traced from the battery through the battery terminals (B1, B2 and B3), through the voltage regulator to the field terminal of the genrator, and finally through the rotor field coil windings to ground.

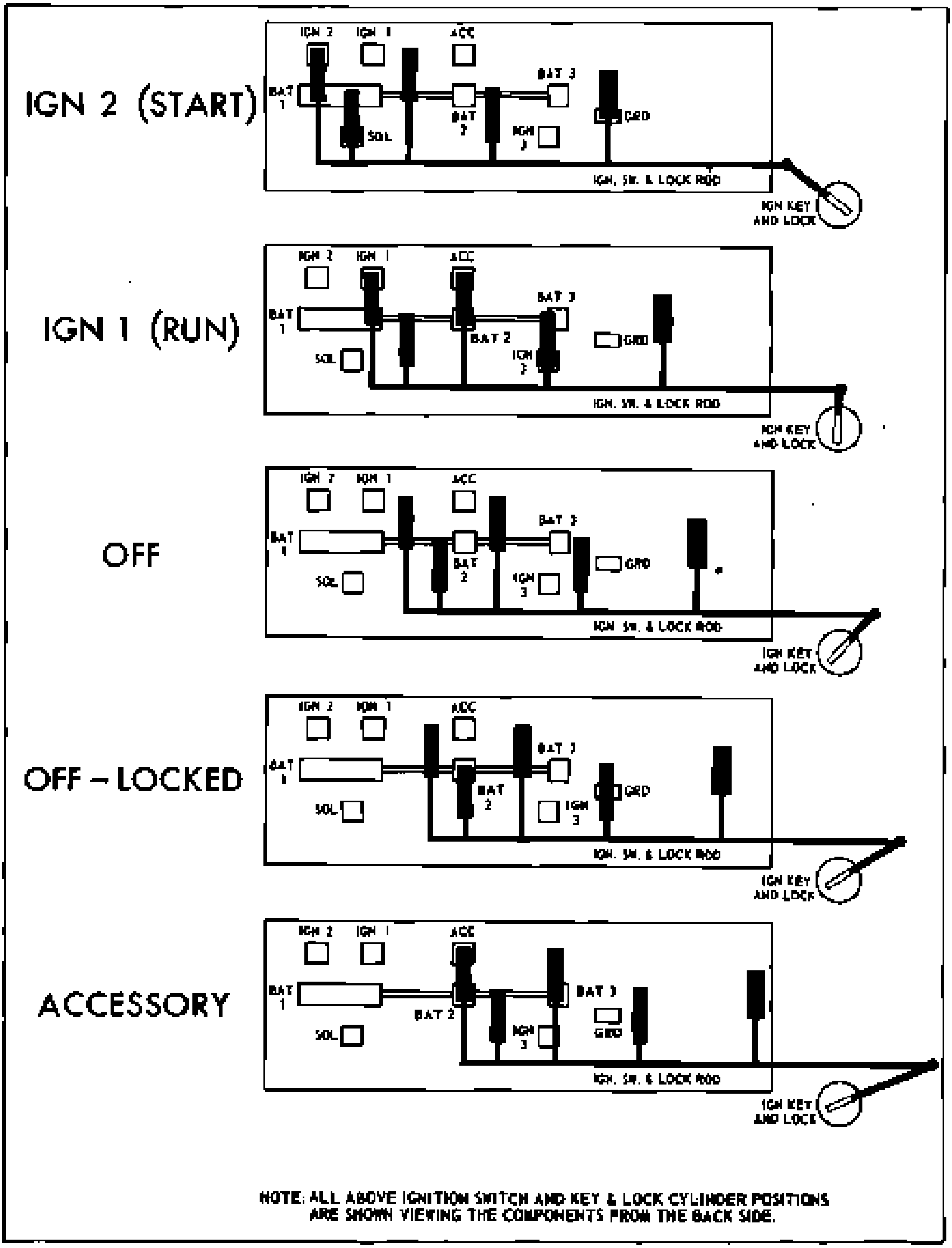


Fig. 6E-35 Ignition Switch

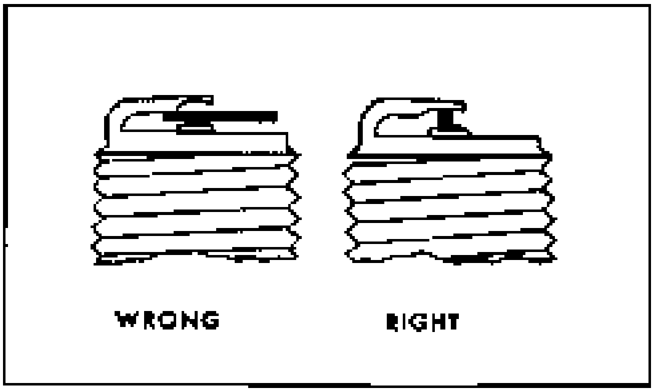


Fig. 6E-36 Measuring Spark Plug Gap

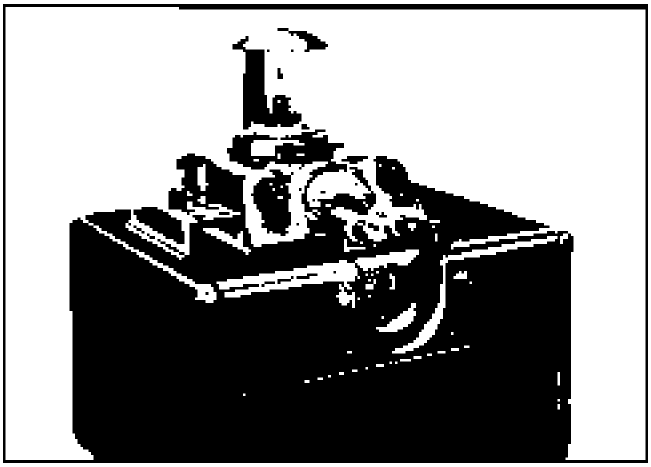


Fig. 6E-37 Spark Plug Cleaner and Indicator

REPLACE SWITCH, LOCK CYLINDER OR FREE UP LOCK CYLINDER

Refer to STEERING SECTION, Section 9, for ignition switch and lock cylinder repair procedures.

SPARK PLUGS

PERIODIC SERVICE

Periodically (actual time depending on operating conditions) plugs should be removed for cleaning, inspection and regapping.

REMOVE

1. Remove spark plug wires.

2. Remove any foreign matter from around spark plugs by blowing out with compressed air.

3. Using a 13/16" spark plug socket, remove the spark plugs.

INSPECT

Spark plug life is governed to a large extent by operating conditions and plug life varies accordingly. To insure peak performance, spark plugs should be checked, cleaned and regapped every 12 months or 12,000 miles.

Worn or dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are evident in a number

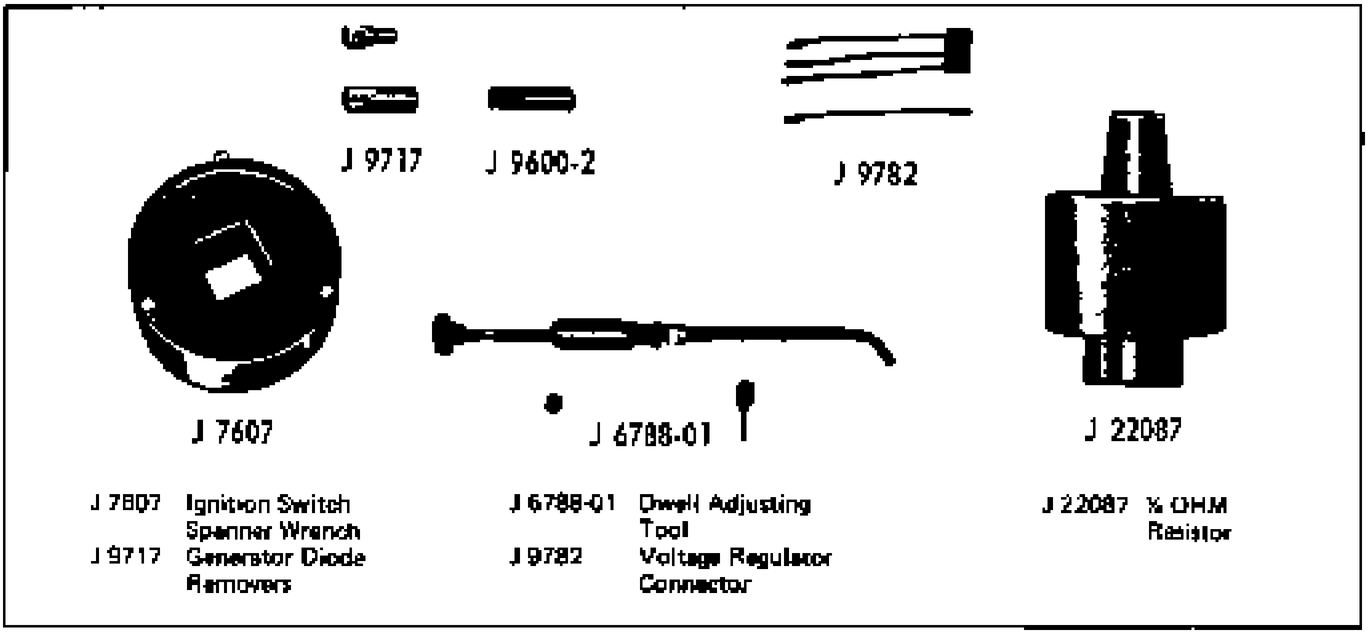


Fig. 6E-38 Special Tools

of ways such as wasting gas, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear may be due to dirty or leaded plugs, excessive gap or broken insulator.

CLEAN AND REGAP

Clean spark plugs thoroughly using an abrasive-type cleaner. All spark plugs must be of the same make and number or heat range. Use a round feeler gauge to adjust the spark plug gaps to .035" (Fig. 6E-36).

CAUTION: Before adjusting gap, file center electrode flat. In adjusting spark plug gap, never bend center electrode which extends through porcelain center. Always make adjustments by bending ground (side) electrode.

INSTALL

1. Inspect spark plug hole threads and clean before installing plugs. Corrosion deposits can be removed with a 14 mm. x 1.25 SAE spark plug tap (available through local jobbers) or by using a small, soft wire brush in an electric drill. If a tap is used, coat it with plenty of grease to catch any chips.

CAUTION: Use extreme care when using tap to prevent cross threading. Also, crank engine several times to blow out any material dislodged during cleaning operation.

2. Install spark plugs in engine, using new gaskets, and tighten to 23 lb. ft. torque.

	PONTIAC				TEMPEST AND GRAND PRIX									FIREBIRD						
					6 CYL.			V-8						6 CYL.			V-8			
	STD	A/C	OPT	H.O.	STD.	A/C OR H.D.	AUTO. TRANS.	2 BBL. REG. FUEL	STD	A/C OR H.D.	R.A.	OPT.	GRAND PRIX W/ A/C AND HEATER	STD.	A/C OR H.D.	AUTO. TRANS.	STD 350	350 H.O.	A/C OR H.D.	STD RAM AIR OPT.
BATTERY MODEL	R-59			R-69	Y-55	R-59		Y-59	R-59					Y55	R59		Y59	R59		
Wattage	2900			5150	2300	2900		2350	2900					2300	2900		2350	2900		
Amps.	61			70	44	61		53	61					44	61		53	61		
GENERATOR																				
Amps-Cold Rating	42	55	*55	62	37	55		37		55		*55	*61	37	55		37		55	*55
Output @ Eng. R.P.M.	28 @ 730	30 @ 640	30 @ 2000	20 @ 520	25 @ 730	32 @ 660		25 @ 730		32 @ 660		30 @ 2000	30 @ 2000	25 @ 730	32 @ 660		25 @ 730		32 @ 640	30 @ 2000
Output @ Eng. R.P.M.	40 @ 1825	50 @ 1660	55 @ 5000	55 @ 1200	35 @ 1825	50 @ 1660		35 @ 1825		50 @ 1660		55 @ 5000	55 @ 5000	35 @ 1825	50 @ 1660		35 @ 1825		50 @ 1660	55 @ 5000
Field Current Draw	2.2-2.6	2.2-2.6	4.0-4.5	4.1-4.6	2.2-2.6	2.2-2.6		2.2-2.6		2.2-2.6		4.0-4.5	4.0-4.5	2.2-2.6	2.2-2.6		2.2-2.6		2.2-2.6	4.0-4.5
REGULATOR MODEL	1119515				1119515									1119515						
Transistor	‡ 1116368				1116368									1116368						
Normal Range	13.5-16V				13.5-16V									13.5-16V						
STARTER MOTOR MODEL	1107353				1107498		1107594	1108793	1107355		1108355	1107356		1107499			1107295	1107355		
No. of shunt winds	2				0		0	0	7		7	7		0			0	2		
SOLENOID MODEL	1114358				1114358			1114356						1114354			1114356			
Hold in winding amps @ 80F	14.5-16.5				14.5-16.5			14.5-16.5						14.5-16.5			14.5-16.5			
Both windings amps @ 80F	41-47				41-47			41-47						41-47			41-47			

IGNITION COIL	MODEL	PRIM. RESIST. (Ohms) (75F)	SEC. RESIST. (Ohms) (75F)
PONTIAC	1115410	1.7-2.0	3000-20000
TEMP. AND FIREBIRD 6-Cyl.	1115414	1.4-1.7	3000-20000
TEMP. AND FIREBIRD 8-Cyl.	1115410	1.7-2.0	3000-20000

SPARK PLUGS	
6-Cyl. All	- R46TS
8-Cyl. 350	- R45S
GTO (Ram Air)	- R44S
400	- R45S
Trailer Pkge.	- R44S
Economy Spec.	- R43S

*Integrated Circuit Generator Regulator (C.S.I.) - No External Regulator Used.

‡ Transistor Regulator Standard With 62 Amp Generator.

Fig. 6E-39 Engine Electrical Specifications

PONTIAC

MODEL	1111253		1111940		1111946		1111952		1111960		1111959	
Rotation viewed from top	c-c		c-c		c-c		c-c		c-c		c-c	
Dwell set to	30°		30°		30°		30°		30°		30°	
Condenser cap (MFD)	.18-.23		.18-.23		.18-.23		.18-.23		.18-.23		.18-.23	
CENT. ADV. (DIST. DEG.)	DEG.	RPM	DEG	RPM	DEG	RPM	DEG	RPM	DEG	RPM	DEG	RPM
Start	0-2	500	.5-2.5	500	0-2	500	1-3	700	1-3-3.3	700	0-2.2	550
Intermediate	5-7	1000	7.5-9.5	950	5-7	1000	5-7	1000	6-8	1000	4.5-6.5	1200
Maximum	9-11	2300	15-17	2275	9-11	2300	9-11	2300	10-12	2300	10-12	2300
VACUUM CONTROL MODEL	1115365		1115365		1115374		1115365		1115365		1115365	
In. H.G. to start advance	10-12		8-10		10-12		10-12		10-12		8-10	
In. HG. for full advance	17-18.8		15-17		17-18.8		17-18.8		17-18.8		15-17	
Max. advance (dist. deg.)	10°		10°		10°		10°		10°		10°	

TEMPEST AND FIREBIRD

MODEL	1110474		1110473		1111940		1111941		1111942		1111946		1111952		1111960	
Rotation viewed from top	c		c		c-c		c-c		c-c		c-c		c-c		c-c	
Dwell set to	32°		32°		30°		30°		30°		30°		30°		30°	
Condenser cap (MFD)	.18-.23		.18-.23		.18-.23		.18-.23		.18-.23		.18-.23		.18-.23		.18-.23	
CENT. ADV. (DIST. DEG.)	DEG	RPM	DEG	RPM	DEG	RPM	DEG	RPM	DEG	RPM	DEG	RPM	DEG	RPM	DEG	RPM
Start	0-2	550	0-4.5	500	.5-2.5	500	0-2	660	1-3	550	0-2	500	1-3	700	1-3-3.3	700
Intermediate	6-8	875	9-11	1050	7.5-9.5	950	5-7	1100	6.5-8.5	975	5-7	1000	5-7	1000	6-8	1000
Maximum	11.5-13.5	2375	13-15	2200	15-17	2275	10-12	2300	11-13	2400	9-11	2300	9-11	2300	10-12	2300
VACUUM CONTROL MODEL	1973419		1973419		1115365		1115365		1115365		1115365		1115365		1115365	
In. HG. to start advance	5-7		5-7		8-10		8-10		6-8		8-10		10-12		8-10	
In. HG. for full advance	10.5-11.5		10.5-11.5		15-17		15-17		13-14.75		15-17		17-18.8		15-17	
Max. adv. (dist. deg.)	7.5		7.5		10°		10°		10°		10°		10°		10°	

Fig. 6E-40 Distributor Specifications

CLUTCH, MANUAL TRANSMISSIONS

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

Several clutches are being used, depending on the engine option. The clutches differ in diaphragm spring design, damper spring calibration and driven disc diameter. Clutch usages are shown in Fig. 7-1.

A clutch safety switch is standard on all models with manual transmission. Designed to prevent cranking "in gear", this switch will not permit the starter to operate unless the clutch pedal is depressed far enough to completely disengage the clutch.

While the steering column lock requires that manual transmission be in "Reverse" gear before removing the ignition key, the clutch safety switch prevents engine cranking "in gear" when the steering column is unlocked while starting.

PERIODIC SERVICE

LUBRICATION

Every 6,000 miles, lubricate all pivot points with engine oil. Use light grease at push rod to clutch fork pin joint and chassis grease at high pressure lubrication fitting. The ball type release bearing is lubricated and sealed for life and requires no lubrication.

CLUTCH PEDAL ADJUSTMENT (Figs. 7-2, 7-3, 7-4)

Wear on the clutch parts necessitates occasional lash adjustment. No other adjustment is made. Lash adjustment should be made as follows:

1. Remove the return spring.

2. With clutch pedal against stop, loosen jam nut sufficiently to allow the clutch fork push rod to be turned out of swivel and rearward against the clutch fork until the release bearing contacts pressure plate fingers lightly.

3. Rotate clutch fork push rod into swivel 3 1/2 turns and tighten jam nut to 30 lb. ft. torque.

4. Reinstall spring. Approximately 1" of lash should be at the pedal.

	DIAPHRAGM SPRING DESIGN	DRIVEN DISC DIAMETER	NUMBER AND COLOR OF DAMPER SPRINGS
Pontiac			
400 cu. in. 2 Bbl.	Flat Finger	10.4"	6 red springs.
400 cu. in. 4 Bbl.	Bent Finger	11.0"	5 yellow inner and 5 plain outer springs
428 cu. in. All	Bent Finger	11.0"	5 aluminum inner and 5 pink outer springs.
Tempest and Firebird			
6 cyl. 1 Bbl.	Flat Finger	10.0"	6 orange springs.
6 cyl. 4 Bbl.	Bent Finger	10.4"	5 dark gray springs.
350 cu. in. 2 Bbl.	Flat Finger	10.4"	6 red springs.
350 cu. in. H.O.	Bent Finger	10.4"	6 red springs.
400 cu. in. All	Bent Finger	10.4"	5 yellow inner and 5 black outer springs.
Grand Prix			
400 cu. in. 4 Bbl.	Bent Finger	10.4"	5 yellow inner and 5 black outer springs.
428 cu. in. All	Bent Finger	11.0"	5 aluminum inner and 5 pink outer springs.

Fig. 7-1 Clutch Usage

SERVICE AND REPAIRS

CLUTCH CONTROL LINKAGE

REMOVE

1. Remove return spring and anti-rattle spring.

2. Disconnect retainer from each end of the clutch push rod

3. Loosen nut and lockwasher from ball stud at frame bracket and remove countershaft assembly.

REPLACE

1. Reverse removal steps. Tighten ball stud nut to 21 lb. ft. torque

2. Adjust lash. See Clutch Pedal Adjustment under Periodic Service.

CLUTCH

REMOVE

1. Disconnect battery to starter lead at battery.

2. Remove propeller shaft and transmission. See TRANSMISSION SECTION. Exercise care to avoid damaging transmission front bearing retainer (release bearing support) when transmission is pulled back to free main drive (clutch) gear from flywheel housing.

3. Remove clutch release bearing through rear opening in clutch housing. Do not place bearing in any degreasing or cleaning solvent.

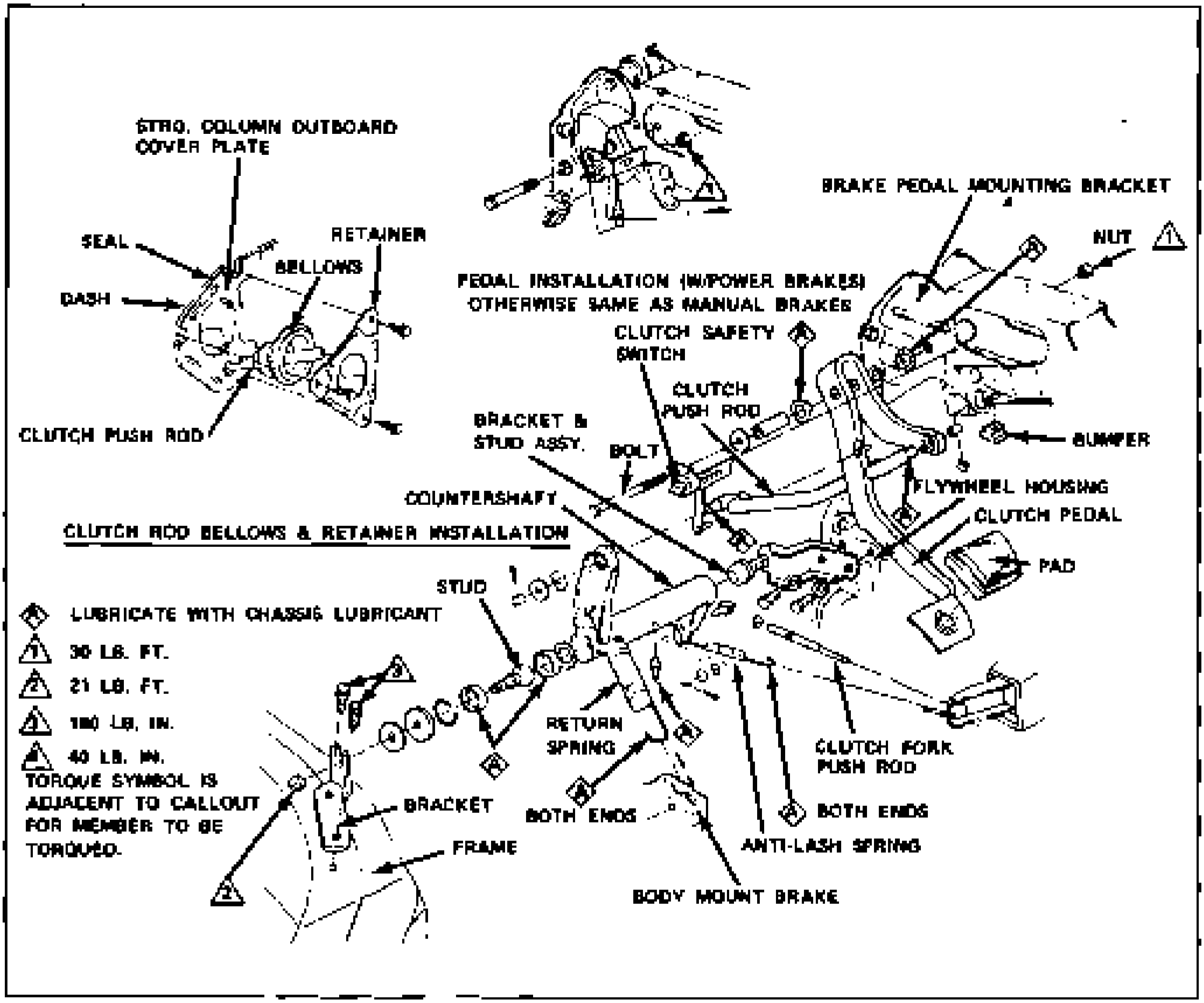


Fig. 7-2 Pontiac Clutch Controls

4. Remove return spring.

5. Remove starter.

6. Remove front flywheel housing shield.

7. Remove flywheel housing bolts and pull housing off of dowels.

8. Remove flywheel housing.

9. Disconnect clutch release fork from ball stud by forcing it toward the center of the vehicle. Remove fork through inside of flywheel housing.

10. Mark clutch pressure plate cover and flywheel to insure reassembly in the same position as balanced at factory.

11. Loosen bolts holding clutch cover to flywheel one turn at a time until tension if relieved

12. Remove all but top bolt and move clutch assembly away from flywheel at bottom so as to permit removal of clutch driven plate.

13. Remove remaining bolt to remove clutch cover plate assembly.

INSPECTION

1. Inspect clutch driven plate for broken or distorted torsion springs, worn or loose facings, oil on facings or damaged spline which could cause binding. If any of the above defects are present, replace driven plate with new assembly.

2. Inspect pressure plate and cover assembly to see that

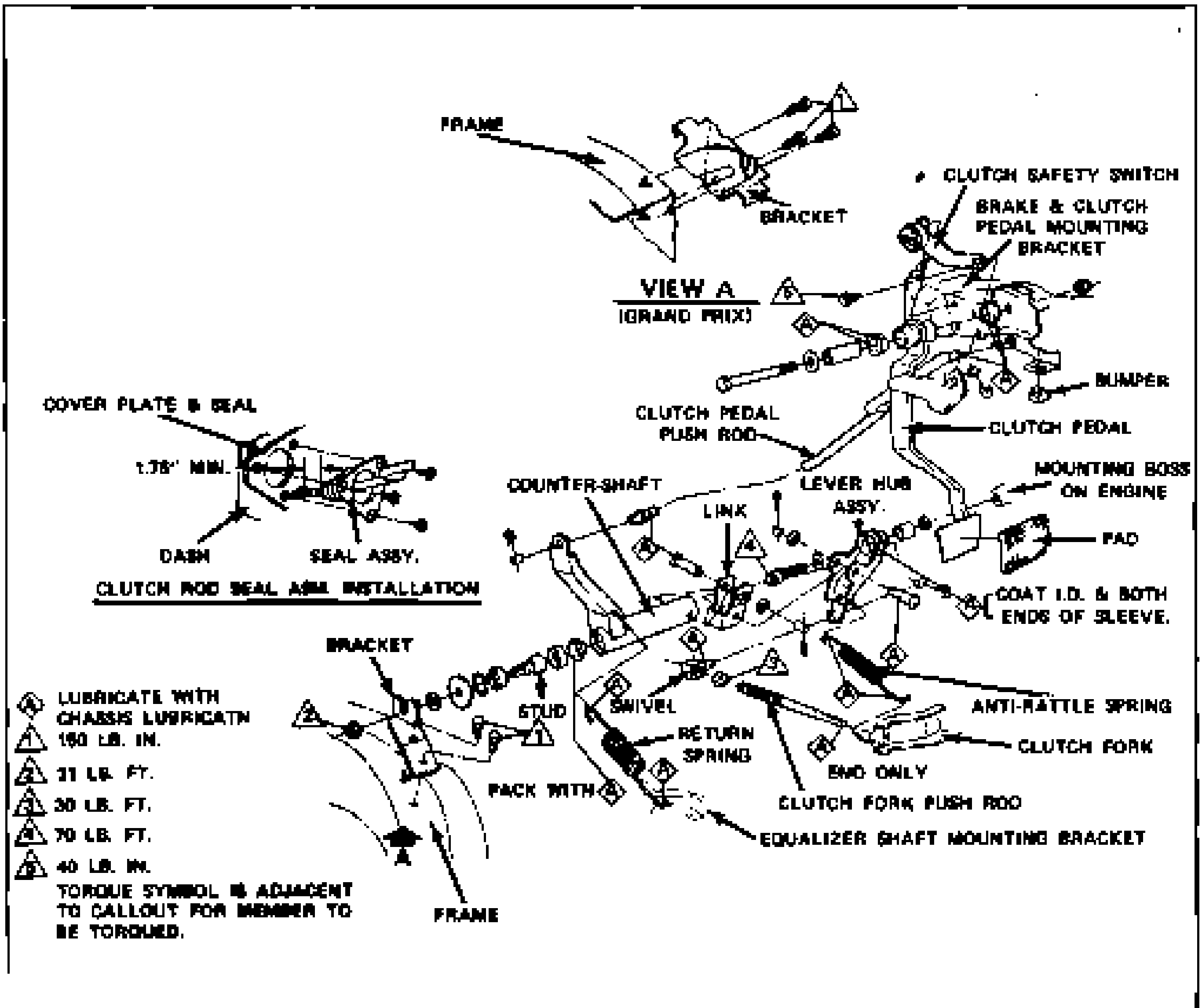


Fig. 7-3 Tempest and Grand Prix Clutch Controls

it is free of oil and grease. Check pressure plate for scores or cracked surface.

NOTE: Servicing of clutch driven plate or pressure plate and cover assembly must be made by replacement of assemblies only.

3. Examine transmission bearing retainer carefully to be certain there are no burrs on outer surface which pilots clutch release bearing.

4. Try clutch release bearing on transmission bearing retainer to make sure no binding exists.

5. Check clutch release bearing by placing thrust load on bearing by hand and turning bearing race. Replace if bearing feels rough or seems noisy when turning.

6. Clean flywheel face with cleaning solvent, sandpaper or steel wool. Inspect pilot bearing in crankshaft for roughness.

REPLACE

1. Position clutch driven plate so that long end of hub is in flywheel and install clutch driven plate and cover assembly on flywheel but do not tighten bolts (install lock washer under each cover to flywheel bolt).

NOTE: Align marks placed on flywheel and on cover during disassembly.

2. Use a spare transmission main drive gear, inserted in spline of clutch driven disc, to move disc into correct alignment so pilot on end of drive gear will enter clutch pilot bearing. Tighten clutch cover and pressure plate to flywheel bolts one at a time until snug, then

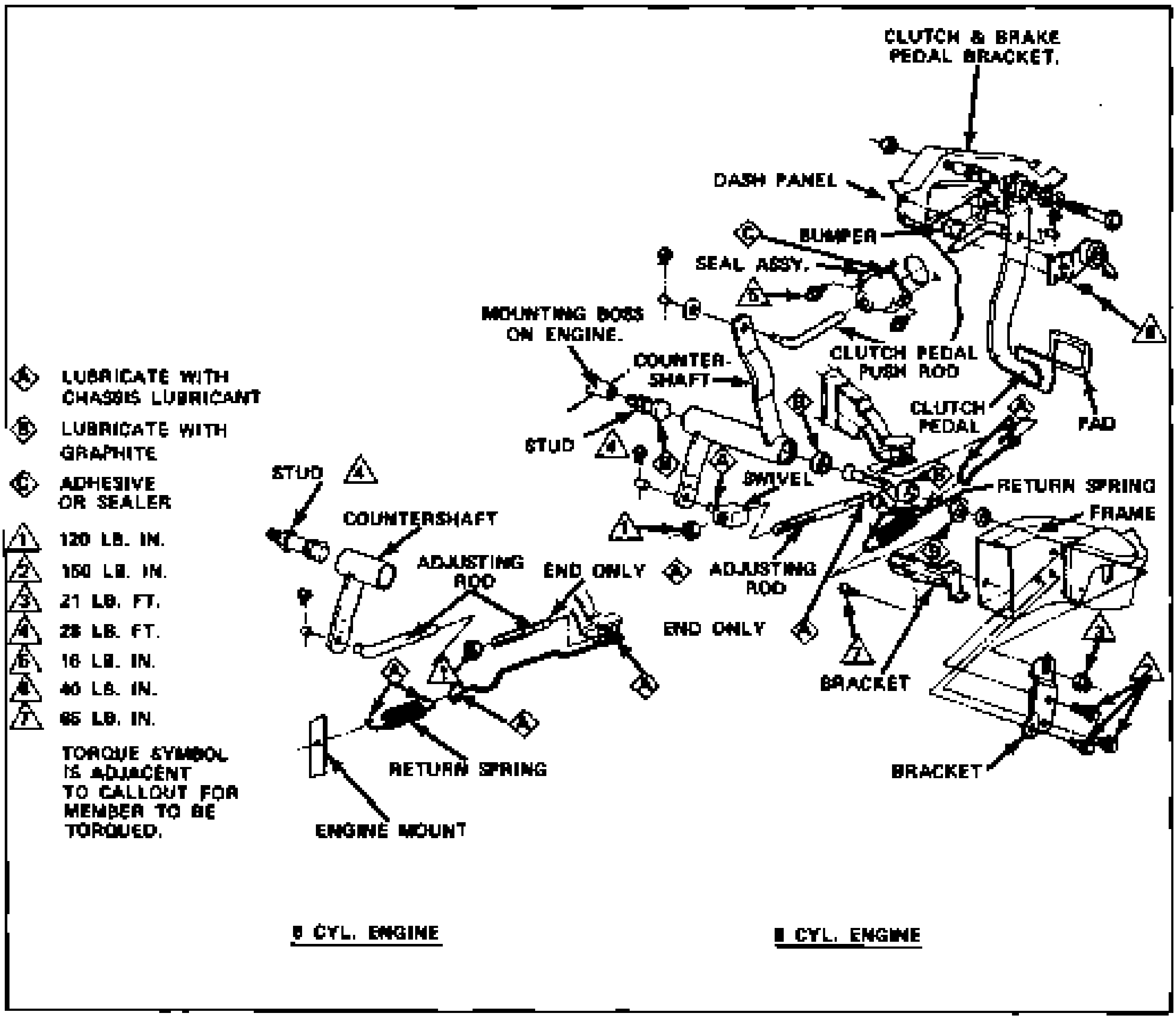


Fig. 7-4 Firebird Clutch Controls

tighten to 25 lb. ft. torque. Remove spare main drive gear used to align clutch disc.

3. Lubricate surface of release fork fingers which contact release bearing, sides of pressure plate lugs protruding through cover plate stamping and release fork ball fulcrum with high melting point wheel bearing lubricant and install release fork.

4. Apply a light coat of grease to inner diameter of clutch release bearing and fill recess in inner diameter of bearing.

5. Install clutch release bearing to fork in flywheel housing.

NOTE: When installing a new bearing, be sure the same length bearing is installed as was removed.

6. Apply a light coat of high melting point wheel bearing lubricant to full length of outer diameter of transmission release bearing support (retainer).

CAUTION: Do not over lubricate.

7. Install flywheel housing and tighten bolts to 40 lb. ft. torque.

8. Install transmission. See TRANSMISSION SECTION.

CAUTION: Use two transmission guide pins in upper holes in clutch housing.

9. Connect clutch linkage to release fork.

10. Adjust pedal lash. See lash adjustment under Periodic Service.

NOTE: If interference is encountered with the clutch fully engaging, the transmission shift linkage should be adjusted as outlined in sections 7A thru 7D, because the shift linkage interlock mechanism is controlled by clutch action.

FLYWHEEL OR CLUTCH PILOT BEARING

REMOVE AND REPLACE

1. Remove transmission.

2. Remove clutch assembly.

3. If clutch pilot bearing is to be replaced, use cold

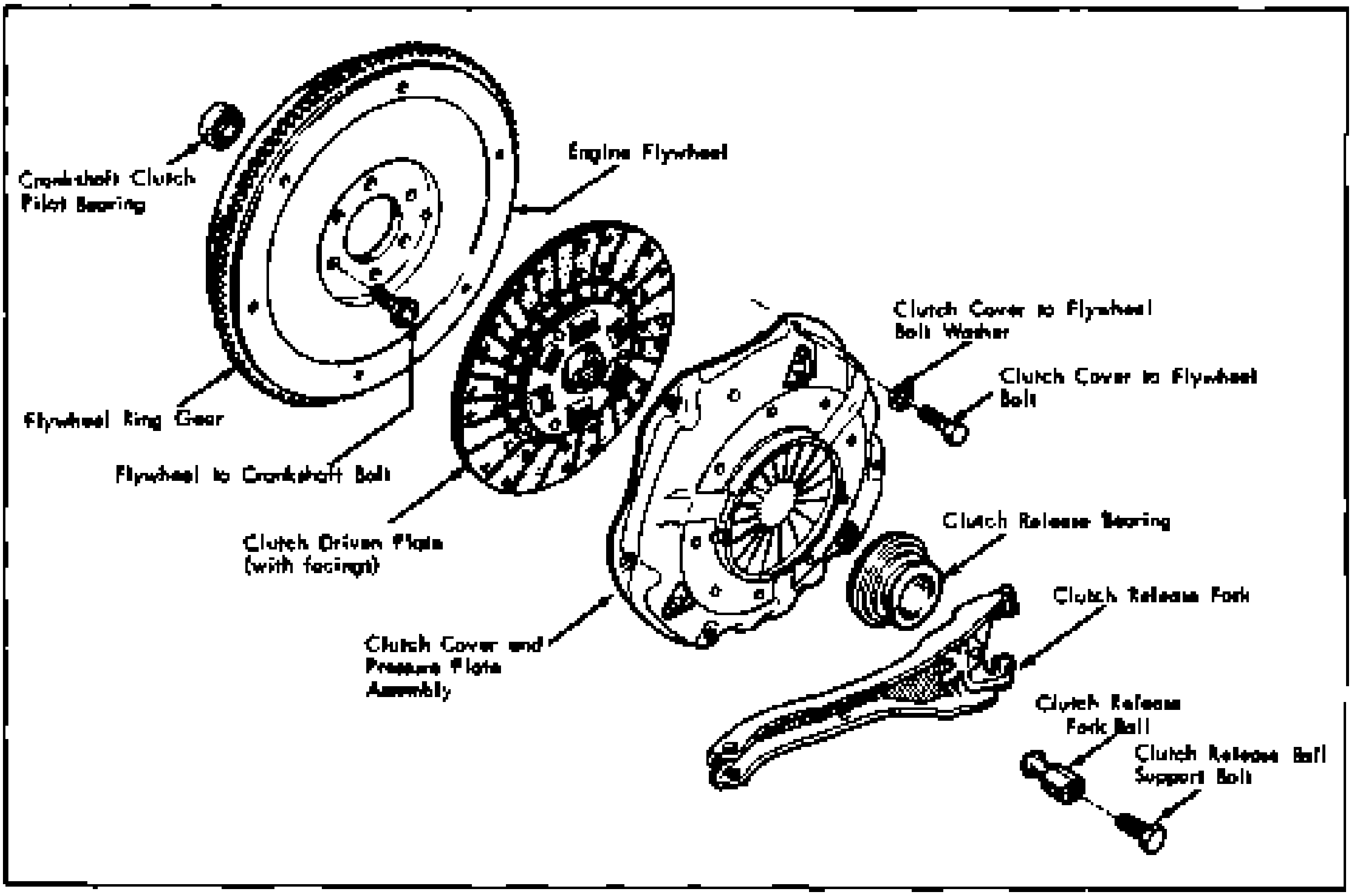


Fig. 7-5 Exploded View of Clutch and Flywheel Assembly

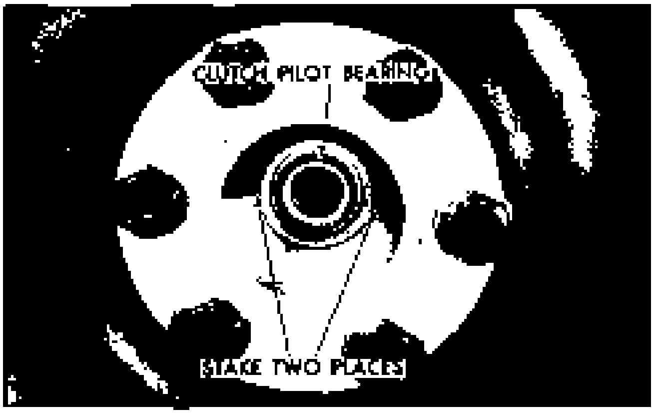


Fig. 7-6 Clutch Pilot Bearing Staked

chisel to remove staking in end of crankshaft which keeps bearing in place when transmission is removed (Fig. 7-6). Remove clutch pilot bearing from hole in crankshaft.

4. If bearing is a snug fit in crankshaft, use Puller J 4383 and Slide Hammer J 2619-A to remove bearing. When installing new bearing, see that hole in crankshaft is thoroughly clean. Install new bearing with shielded side toward transmission. Start bearing into hole and tap into place. Stake slightly, as shown in Fig. 7-6, to keep bearing in place in case transmission is removed in the future.

5. If flywheel is to be removed and reinstalled, scribe marks on flywheel and crankshaft flange, remove flywheel to crankshaft bolts and remove flywheel. When reinstalling, clean the mating flanges of flywheel and crankshaft carefully, making sure there are no burrs on either mounting face. Position flywheel on crankshaft flange with scribe marks in alignment and install flywheel to crankshaft bolts and tighten evenly to 95 lb. ft. torque.

NOTE: Flywheel bolts do not require lock washers.

6. Install clutch and transmission.

STARTER RING GEAR

REMOVE

1. With flywheel removed from vehicle, place the flywheel, crankshaft side down, on a solid flat surface or block which is slightly smaller in diameter than the flywheel.

2. Drive the ring gear off the flywheel, using a suitable drift and hammer.

NOTE: Keep working around the circumference of the ring gear to avoid binding the ring gear on the flywheel.

3. Remove all burrs and rough spots from flywheel.

REPLACE

1. Support flywheel in a level position with cylinder block side facing up.

2. Support ring gear on metal surface and, using a blowtorch or acetylene torch, heat ring gear uniformly on the inside diameter, keeping the torch moving around the circumference of the ring gear to avoid localizing hot spots. Under no circumstances should the ring gear be heated over 400°F., as excessive heating may destroy the original heat treatment.

3. Pick ring gear up with tongs and place it in position on flywheel, with ring gear facing the same direction as the one just removed.

4. Tap ring gear down into place against shoulder on flywheel. If the ring gear can not be tapped into place readily, it may be necessary to remove it and apply additional heat, heeding the caution about overheating given in step 2.

5. Reinstall flywheel in vehicle.

SPECIFICATIONS

CLUTCH

Pedal Lash—3½ turns of adjusting rod from zero position.
Type Disc Facings ....Single Plate Dry
Diameter of Disc. ....Pontiac—Std.—10.4"
Pontiac—H.D.—11.0"
Grand Prix—Std.—10.4"
Grand Prix—H.D.—11.0"
Firebird and Tempest—6 Cyl.—Single Bbl. 10.00"
Firebird and Tempest—All-V-8 & 6 Cyl.-4Bbl. 10.40"
Release Bearing..................Sealed Ball Bearing
Diaphragm Springs.......V-8 2-Bbl. & 6-Cyl. 1-Bbl.—
Flat-finger disc spring
V-8 4-Bbl. & 6-Cyl. 4-Bbl.—
Bent-finger disc spring

TORQUE

	LB. FT.
Clutch Pressure Plate to Flywheel Bolts	25
Flywheel Housing to Engine Block Bolts	40
Clutch Fork Ball Stud	40
Transmission to Flywheel Housing Bolts.....All except Dearborn Transmission	55
Transmission to Flywheel Housing Bolts.....With Dearborn Transmission	40
Clutch Fork Rod Adjustment Lock Nut	30
Flywheel to Crankshaft Bolts	95
Countershaft Stud Assembly to Cylinder Block	
Tempest	70
Firebird	28
Countershaft Stud to Side Rail Nut	21

THREE-SPEED DEARBORN MANUAL TRANSMISSION

CONTENTS OF THIS SECTION

DESCRIPTION

This transmission is of the fully synchronized type with all gears, except the reverse gear, being in constant mesh.

It is used as the standard 3-speed for Pontiac and Grand Prix and the heavy duty 3-speed for Tempest and Firebird.

For all models, the steering column lock requires that the transmission be in "Reverse" gear before the ignition key may be removed. Also, the clutch safety switch will not permit engine cranking unless the clutch pedal is depressed far enough to completely disengage the clutch.

PERIODIC SERVICE

TRANSMISSION

No periodic service of the transmission is required except checking for leaks and proper lubrication level every 6000 miles.

If there is evidence of leakage, leak should be corrected and lubrication added as needed. Refill capacity is 2 3/4 pints.

Use SAE 90 Multi-purpose Gear Lubricant. No special additive to this lubrication is required or recommended.

SHIFT CONTROL

No periodic service of the shift control is required. Certain parts are lubricated on assembly and require further lubrication only when parts become dry and sticky.

ON CAR ADJUSTMENTS

COLUMN SHIFT AND BACK DRIVE LINKAGE (Fig. 7A-1)

1. Set gearshift lever in Reverse position and lock ignition.

2. Loosen swivel clamp screws "C" at transmission shifter lever (Reverse and 1st) and "D" at cross shaft assembly (view B).

3. Position front transmission shifter lever (2nd and 3rd) in Neutral position and rear transmission shifter lever (Reverse and 1st) in Reverse position.

4. Tighten swivel clamp screw "C" to 20 lb. ft., unlock steering column and shift into Neutral.

5. Align gearshift lower control levers "E" and "F" in Neutral position and insert a .186-.185" diameter gage pin through hole in lower control levers (view A).

6. Tighten swivel clamp screw "D" to 20 lb. ft., remove gage pin and check complete shift pattern.

FLOOR SHIFT AND BACK DRIVE LINKAGE (Figs. 7A-2 or 7A-3 and 7A-4A or 7A-4B).

1. Position floor shift control lever in Neutral position.

2. Loosen adjusting swivel clamp on gearshift control rod (Fig. 7A-4A or -4B), loosen trunnion jam nuts on 1st-Reverse and 2nd-3rd transmission control rods and insert a .250-.249" diameter gage pin into shifter assembly (view "B" of Figs. 7A-2 or 7A-3).

NOTE: Gage pin in place will maintain shifter levers in Neutral position.

3. If shifter control lever is misaligned to its floor pan (console) opening (View "C" of Figs. 7A-2 or 7A-3):

a. With console - loosen two attaching bolts, shifter assembly to shifter support, align shifter assembly to specification shown in view "C" and tighten attaching bolts to specified torque (view "B").

b. Except console - loosen two attaching bolts, shifter assembly to shifter support, align shifter assembly centrally in floor boot and tighten attaching bolts to specified torque (view "B").

4. Position both transmission shifter levers in Neutral and torque the trunnion jam nuts to 30 lb. ft. (view "A" of Figs. 7A-2 or 7A-3).

5. Remove gage pin and check complete shift pattern for freeness of operation.

6. Position floor shift control lever in Reverse position, set steering column lower lever in Lock position and lock ignition.

7. Push up on gearshift control rod (Fig. 7A-4A or 4B) to take up clearance in steering column lock mechanism and tighten nut (or screw) of adjusting swivel clamp to 20 lb. ft. torque.

MINOR REPAIRS

EXTENSION HOUSING BUSHING AND OIL SEAL

REMOVE AND REPLACE

1. Remove propeller shaft.

2. Insert Tool J 4830-02 over output shaft and tighten set screw.

3. Attach Slide Hammer J 2619. Using hammer, pull bushing and seal from extension housing.

4. Start new bushing into extension housing.

5. Using Tool J 6403-1 and soft hammer, tap bushing into place.

6. Install new seal, using Tool J 6403-1 and Collar J 6403-2.

7. Reinstall propeller shaft.

MAJOR REPAIRS

TRANSMISSION

REMOVE

1. Disconnect speedometer cable.

2. Disconnect transmission shifter levers (1st. & Rev. and 2nd & 3rd) from transmission shifter shafts (Fig. 7A-1). On floor shift control cars, also remove two (2) shifter assembly-to-extension support bolts (Figs. 7A-2 and 7A-3).

3. Remove propeller shaft.

4. Support rear of engine and remove transmission mount.

5. Remove four (4) crossmember bolts and slide member rearward.

6. Remove two (2) upper transmission to flywheel housing bolts and insert guide pins.

7. Remove two (2) lower transmission to flywheel housing attaching bolts.

8. Slide transmission straight back on guide pins until the main drive gear splines are free of splines in clutch friction plate.

9. Remove transmission.

INPUT SHAFT SEAL

REMOVE AND REPLACE

1. Remove transmission from car.

2. Remove input shaft bearing retainer.

3. Remove seal from retainer by prying out with screwdriver.

4. Center new seal in opening. Place a suitable size socket (approximately 1 1/4") on the seal and, using a soft hammer, tap the seal into place.

5. Reinstall input shaft bearing retainer.

6. Reinstall transmission in car.

TRANSMISSION

DISASSEMBLE

1. Drain lubricant.

2. Remove input shaft bearing retainer and gasket.

3. Remove access cover and gasket.

4. Remove extension housing and gasket.

5. Remove filler plug and, through filler plug hole, drive out countershaft to case retaining pin (Fig. 7A-6).

6. Remove detent plug retaining set screw, spring and detent plug (Fig. 7A-7).

7. With transmission in neutral, remove both shift fork to rail locking set screws.

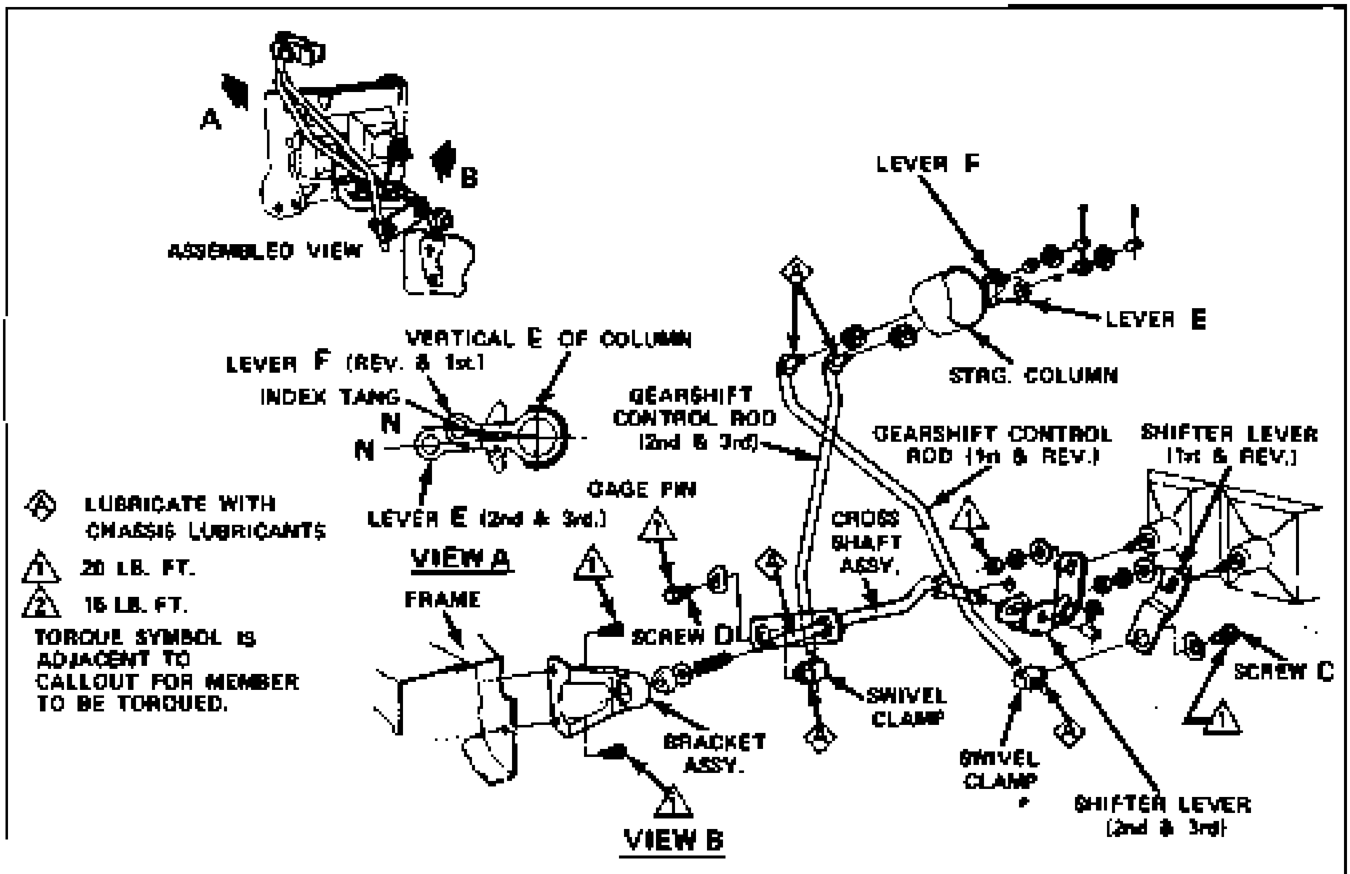


Fig. 7A-1 Pontiac Column Shift Controls

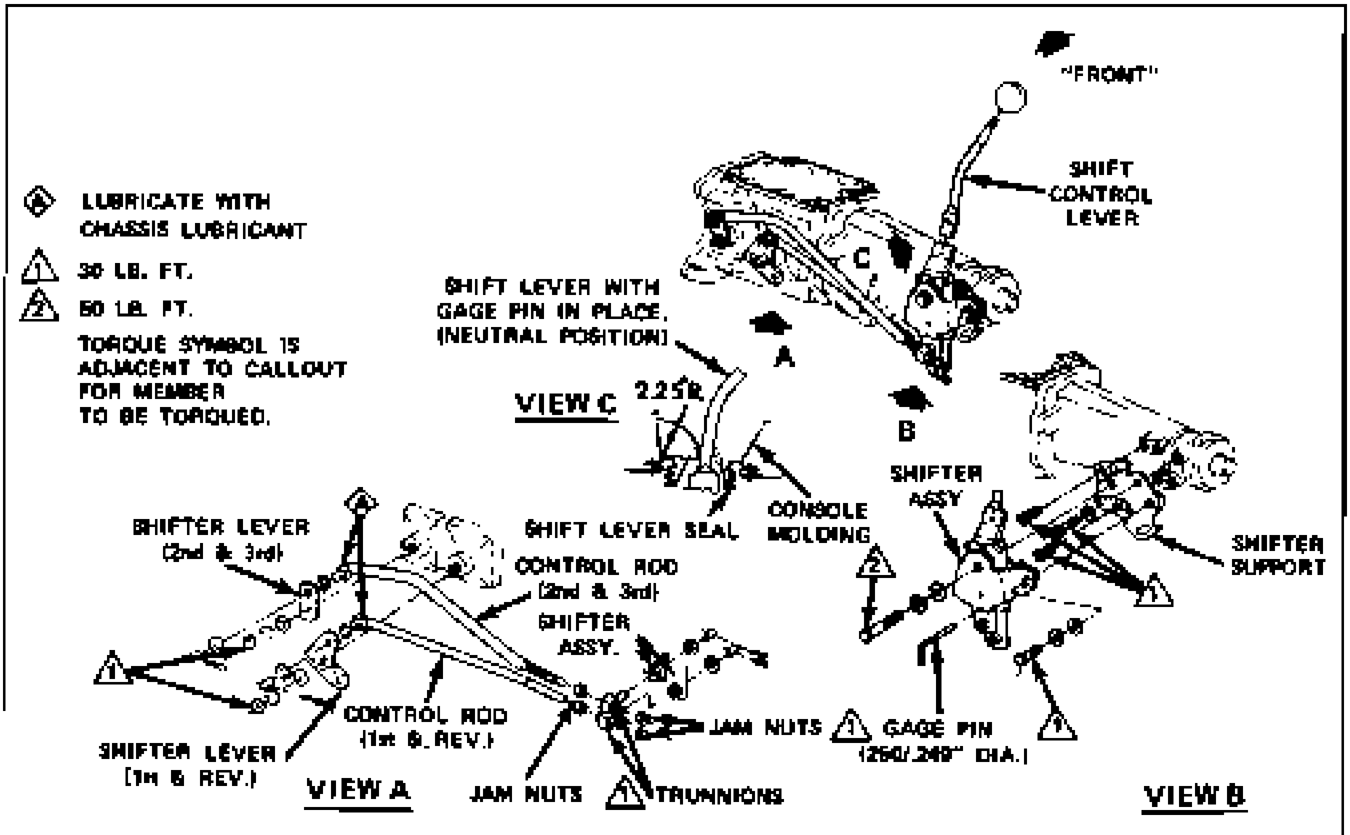


Fig. 7A-2 Tempest and Grand Prix Floor Shift Controls

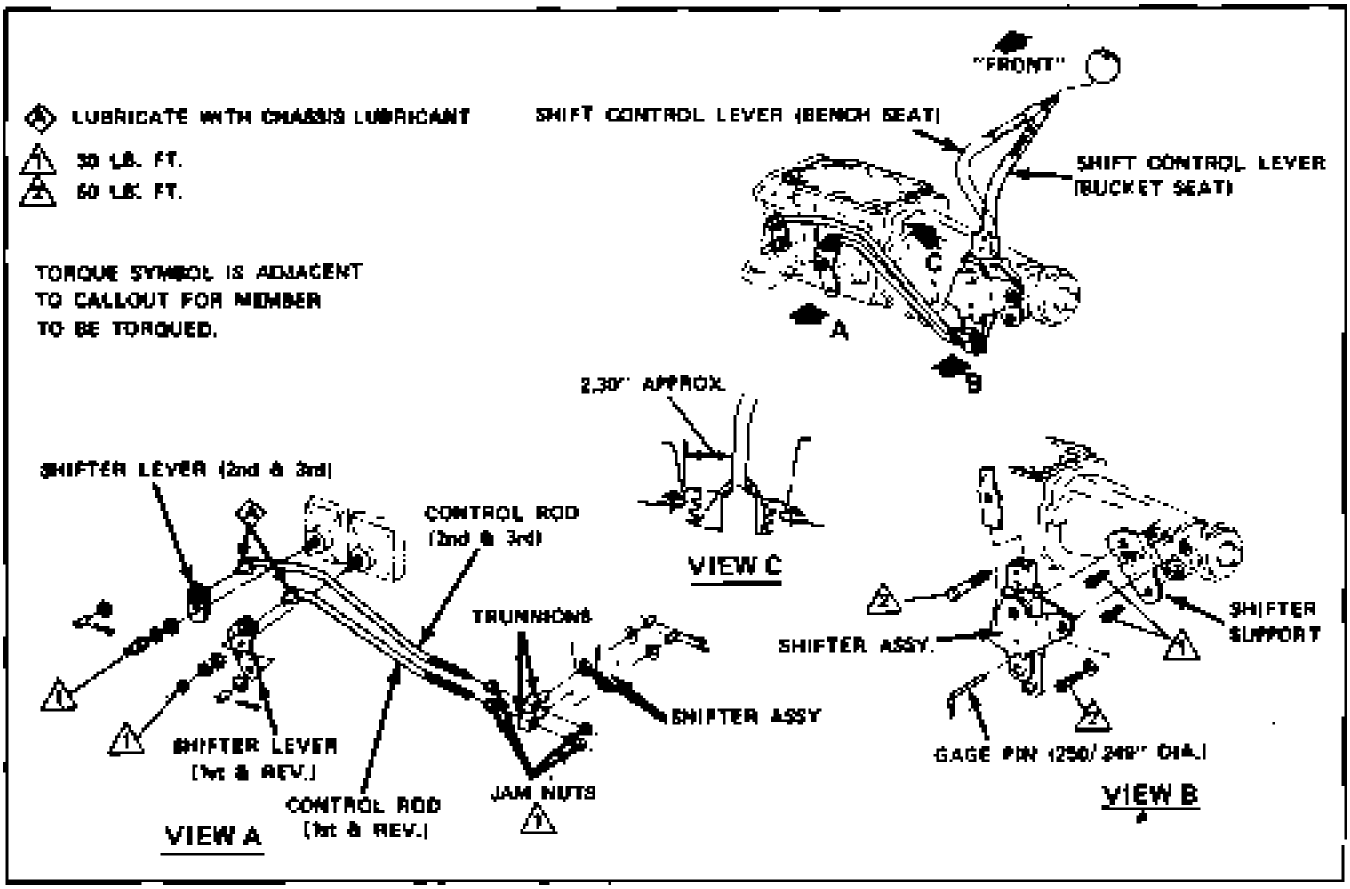


Fig. 7A-3 Firebird Floor Shift Controls

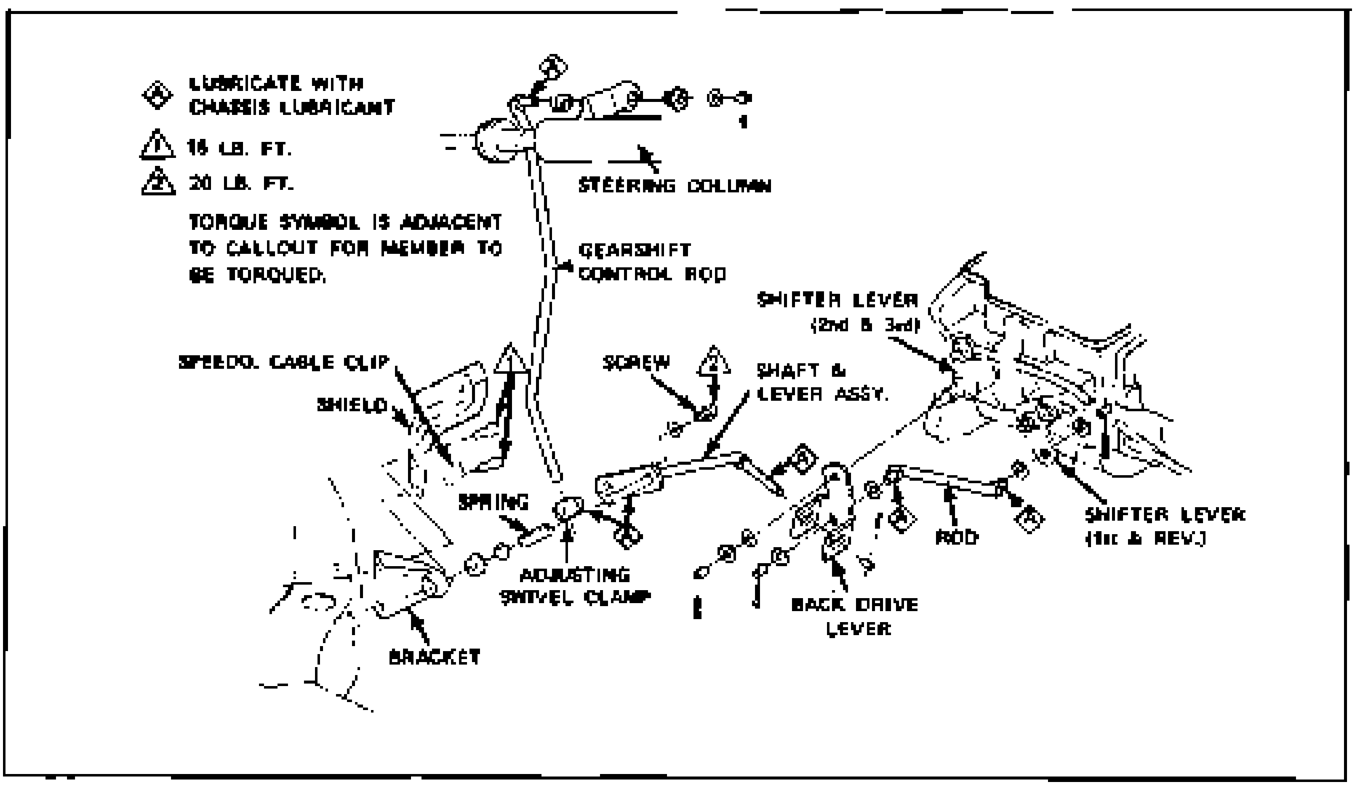


Fig. 7A-4A Tempest and Grand Prix Back Drive Linkage

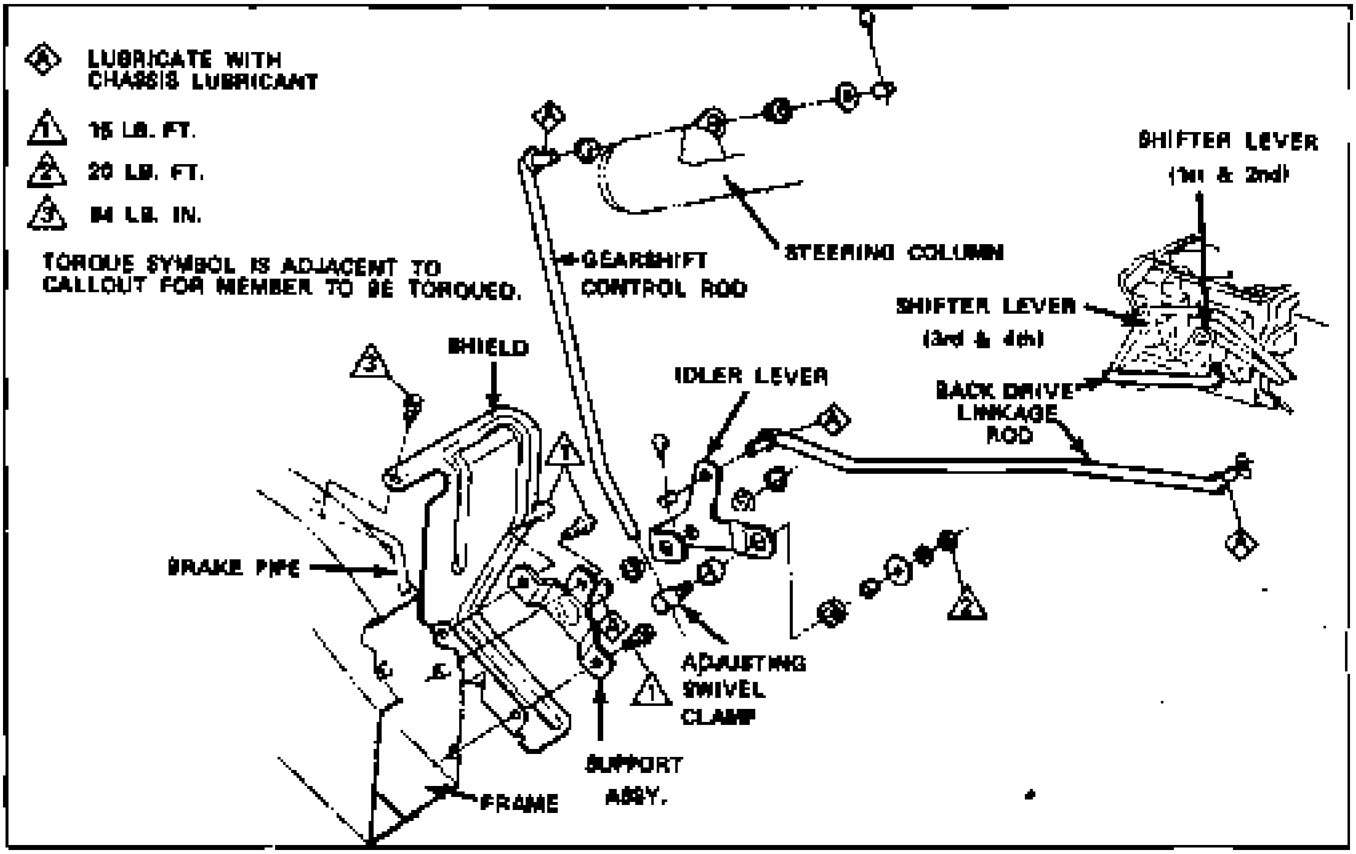


Fig. 7A-4B Firebird Back Drive Linkage

8. Push first and reverse shift rail out rear of case.

9. Using Tool J 3049, rotate 2nd and 3rd shift rail 90° (Fig. 7A-8).

NOTE: Rail must be rotated 90° to disengage detent plug.

10. Using brass drift, drive 2nd and 3rd shift rail and welch plug out front of case.

11. Using Countershaft Alignment Tool J 21775-01, drive countershaft out rear of case (Fig. 7A-9). After removing countershaft, lower countergear to bottom of case.

12. Remove speedometer drive gear snap ring, drive gear and retaining ball.

13. Remove rear bearing retaining snap ring.

14. Remove large snap ring from rear bearing.

15. Slide Tool J 21774-1 up over bearing and install snap ring (in tool) in snap ring groove in bearing (Fig. 7A-10).

16. Install speedometer drive gear snap ring on output shaft.

PONTIAC:

17. a. Slide Tool J 21774-2 onto output shaft and thread it into J 21774-1.

b. While holding Tool 21774-1 from turning, thread J 21774-2 into J 21774-1 with Handle J 8614-1 until bearing becomes free of output shaft.

GRAND PRIX, TEMPEST OR FIREBIRD:

17. a. Install Tool J 21774-5 over output shaft and position against speedometer drive gear snap ring.

b. Slide Tool J 21774-2 onto output shaft and thread it into J 21774-1 until bearing becomes free of output shaft.

18. Remove bearing, snap ring and tools.

19. Slide input shaft forward until input gear rests against the case.

20. Remove shift forks.

21. Remove main shaft through top of case.

22. Remove large snap ring from input shaft bearing and lift input shaft out through top of case.

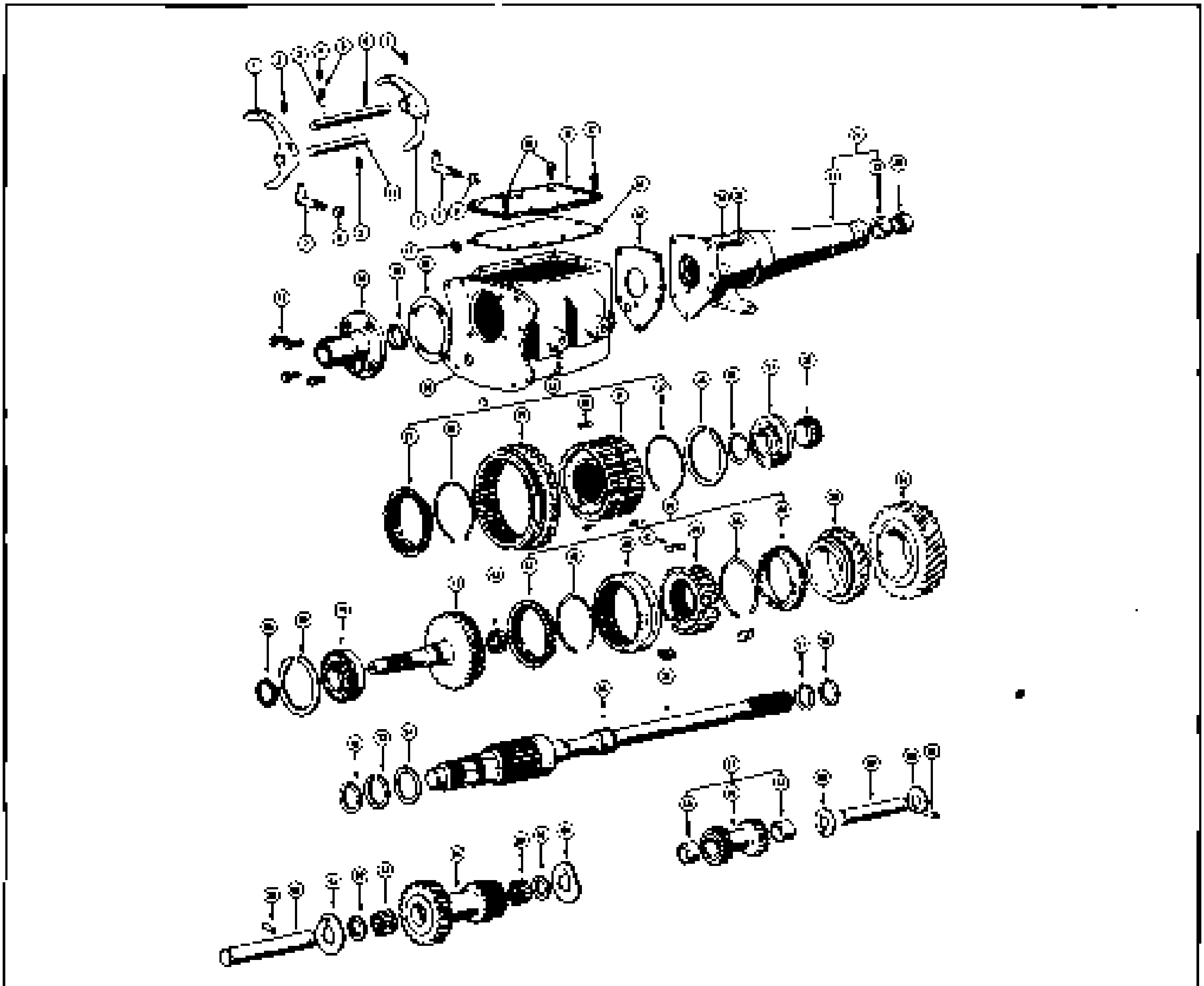


Fig. 7A-5 Exploded View of Transmission

1. 2nd & 3rd Gear Shifter Fork
2. Shifter Fork-to-Rail Set Screw
3. Shift Rail Interlock Pin
4. Shift Rail Interlock Pin Spring Set Screw
5. Shift Rail Interlock Spring
6. 1st & Rev. Shift Rail
7. Shift Lever
8. Shift Lever Oil Seal
9. 1st & Rev. Shifter Fork
10. Access Cover Screw
11. Access Cover
12. Access Cover Screw
13. Drive Gear Bearing Retainer Bolt
14. Drive Gear Bearing Retainer
15. Input Shaft Oil Seal
16. Bearing Retainer Gasket
17. Filler Plug
18. Access Cover Gasket
19. Extension Housing Gasket
20. Lock Washer
21. Extension Housing Bolt
22. Extension Housing
23. Extension Housing Bushing
24. Extension Housing Assembly
25. Extension Housing Seal
26. Case
27. Synchronizer Blocking Ring
28. 1st & Rev. Synchronizer Front Spring
29. 1st & Rev. Sliding Gear
30. Synchronizer Hub Insert
31. 1st & Rev. Synchronizer Hub
32. 1st & Rev. Synchronizer Rear Spring
33. 1st & Rev. Synchronizer Assy.
35. Drive Gear Rear Bearing Retaining Snap Ring
36. Drive Gear Rear Bearing-to-Shaft Snap Ring
37. Drive Gear Rear Bearing
38. Speedometer Drive Gear
39. Front Bearing-to-Shaft Snap Ring
40. Front Bearing Retaining Snap Ring
41. Front Bearing
42. Input Shaft
43. Input Shaft Roller Bearings
44. 2nd & 3rd Synchronizer Blocking Ring
45. 2nd & 3rd Synchronizer Spring
46. 2nd & 3rd Synchronizer Sleeve
47. 2nd & 3rd Synchronizer Insert
48. 2nd & 3rd Synchronizer Hub
49. 2nd & 3rd Synchronizer Assembly
50. Second Gear
51. First Gear
52. 2nd & 3rd Synchronizer Hub-to-Shaft Snap Ring
53. Synchronizer Blocking Ring-to-Shaft Snap Ring
54. Low Gear Thrust Washer
55. Speedometer Drive Gear Retaining Ball
56. Output Shaft
57. Main Drive Gear-to-Shaft Snap Ring
58. Speedometer Drive Gear-to-Shaft Snap Ring
59. Retaining Pin
60. Countershaft
61. Thrust Washer
62. Countershaft Washer
63. Roller Bearings
64. Countershaft Gear
65. Idler Gear Bushing
66. Reverse Idler Gear
67. Idler Gear Assembly
68. Idler Gear Thrust Washer
69. Idler Gear Shaft
70. Idler Gear Retainer Pin
71. 2nd & 3rd Shift Rail

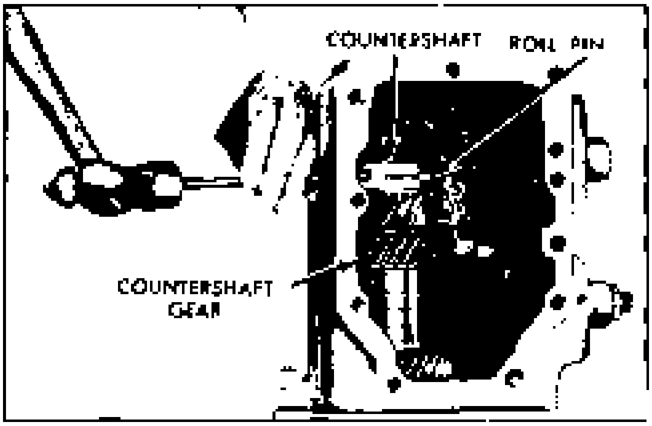


Fig. 7A-6 Removing Countershaft Retaining Pin

23. Remove countergear and thrust washers.

24. Using a brass drift, drive reverse idler gear shaft out of rear of case (Fig. 7A-11) and lift gear and thrust washers from case.

25. Remove intermediate and high detent plunger and spring.

SHIFT LEVER SHAFT OR SEAL REPLACEMENT

1. Remove nut, lockwasher and flat washer.

2. Remove shift lever.

3. Slide shift lever shaft out of case and discard O-ring seal.

4. Lubricate new seal and slide on shaft.

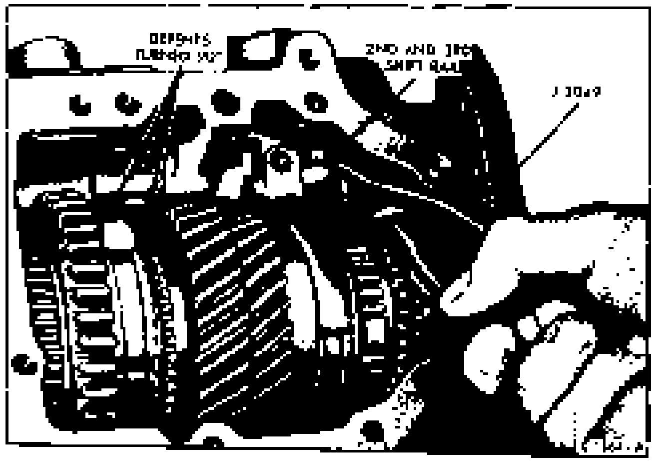


Fig. 7A-8 Rotating Second and Third Shift Rail

5. Install shaft in case.

6. Install shift lever and secure with nut, lockwasher and flat washer.

INPUT SHAFT BEARING REPLACEMENT

1. Re-install input shaft in case.

2. Install large snap ring on bearing.

3. Remove bearing to shaft retaining snap ring.

4. Position case in press (Fig. 7A-12) and press input shaft out of bearing.

5. Remove shaft from case.

6. Place new bearing on input shaft.

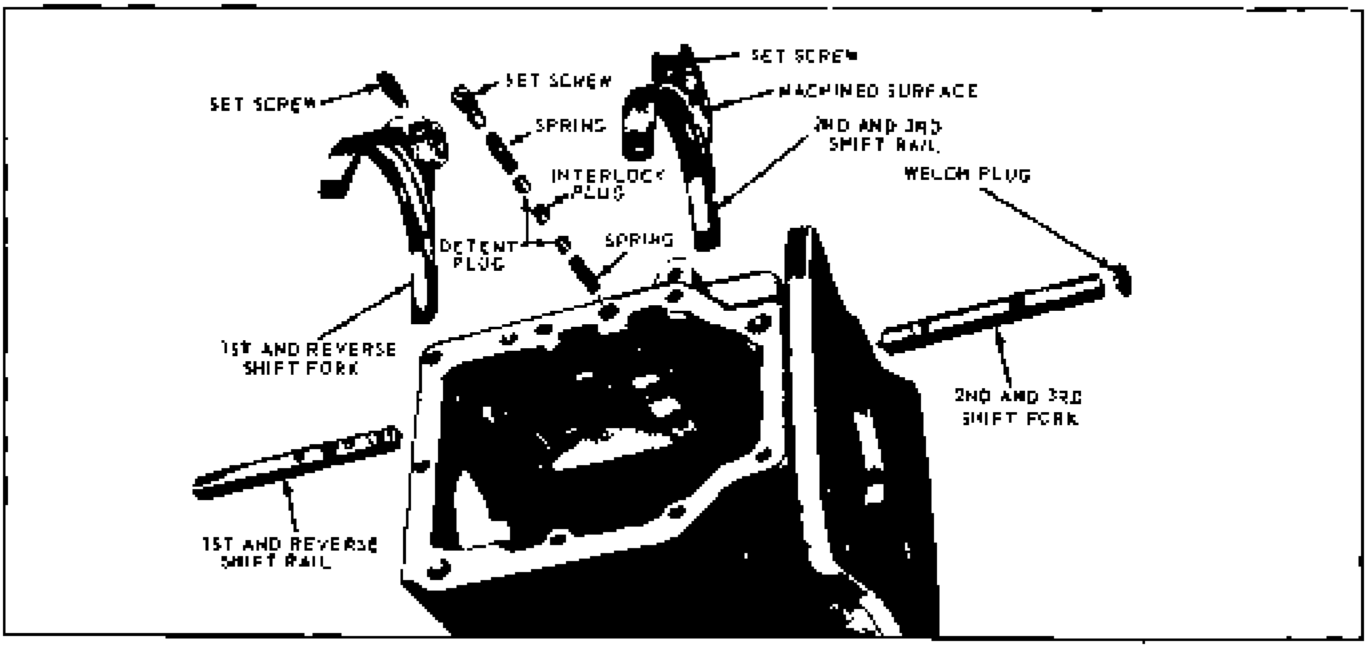


Fig. 7A-7 Shift Rails, Forks, Detent Plugs and Detent Springs

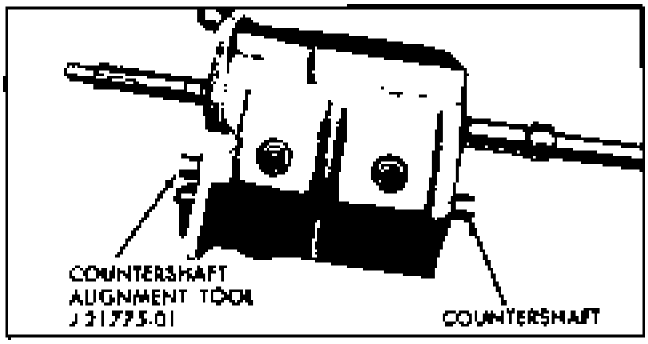


Fig. 7A-9 Removing Countershaft

7. Position input shaft in press (Fig. 7A-13), support the bearing by the inner race and press the shaft into the bearing.

MAINSHAFT - DISASSEMBLE

1. Remove front blocking ring (Fig. 7A-14).

2. Remove synchronizer insert retaining spring.

3. Mark hub and sleeves so they can be matched on reassembly and remove 2nd and 3rd gear synchronizer sleeve.

4. Remove synchronizer hub retaining snap ring, hub and blocking ring.

5. Remove 2nd gear (Fig. 7A-15).

6. Remove 1st gear retaining snap ring, thrust washer, 1st gear and blocking ring.

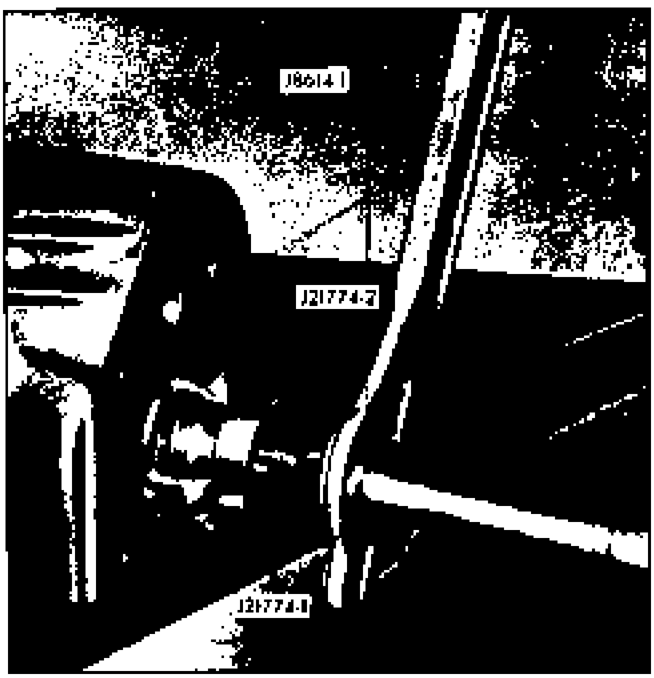


Fig. 7A-10 Removing Rear Bearing

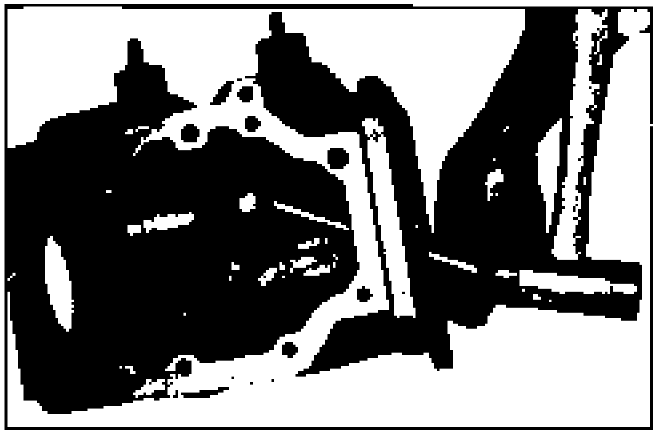


Fig. 7A-11 Removing Reverse Idler Gear Shaft

7. Remove reverse gear retaining snap ring.

8. Mark hub and gear so they can be matched on reassembly and, using an arbor press as shown in Fig. 7A-16, remove reverse gear synchronizer hub and sliding gear.

9. Clean and inspect all parts except countergear.

10. Disassemble, clean and inspect countergear and bearings.

MAINSHAFT - ASSEMBLE

1. Install rear insert spring in the groove in 1st and reverse synchronizer hub (Fig. 7A-17). Make sure spring covers all insert grooves.

NOTE: If the tip of rear insert spring is less than 0.120" in length, replace spring.

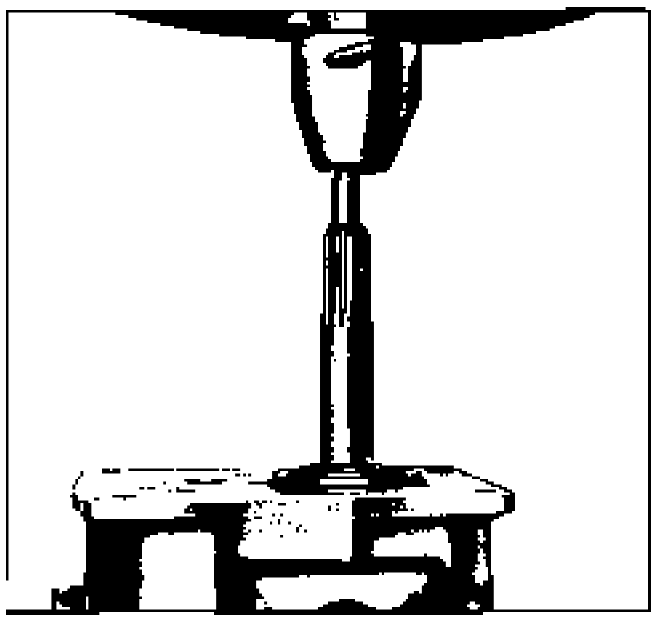


Fig. 7A-12 Pressing Input Shaft Out of Bearing

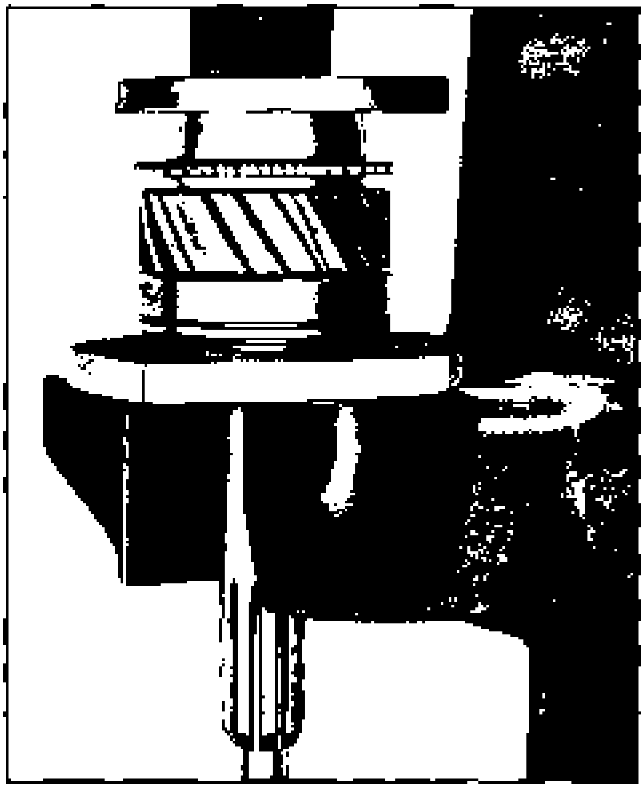


Fig. 7A-13 Installing Input Shaft Bearing

2. Start hub in the sleeve, making sure alignment marks are indexed

3. Position the three inserts in the hub with the small end over the spring and the shoulder on the inside of the hub.

4. Slide the sleeve onto the hub until the detent is engaged.

5. Install the front insert spring in the hub.

6. Install one insert spring (Fig. 7A-14) into the groove of the second and third speed synchronizer hub, making sure that all three insert slots are fully covered (Fig. 7A-18).

7. With alignment marks on the hub and sleeve aligned, start the hub into the sleeve.

8. Place the three inserts, in the slots, on top of the retaining spring and push the assembly together.

9. Install the remaining insert spring so that the spring ends cover the same slots as does the other spring.

NOTE: Do not stagger the springs.

10. Place a synchronizer blocking ring on each end of the synchronizer sleeve.

11. Lubricate main shaft splines and machined surfaces with transmission lubricant.

12. Using an arbor press, install the first and reverse synchronizer hub and sliding gear onto the mainshaft, with the teeth end of the gear facing toward the rear of the shaft (Fig. 7A-19). When pressed into place, install the snap ring (Fig. 7A-15).

13. Coat the tapered machine surface of the first gear with grease. Place the blocking ring on the greased surface.

14. Slide the first gear onto the main shaft, with the blocking ring toward the rear of the shaft. Rotate the gear as necessary to engage the three notches in the blocking ring with the synchronizer inserts. Secure the first gear with thrust washer and snap ring.

15. Coat the tapered machine surface of the second gear with grease and slide the blocking ring onto it.

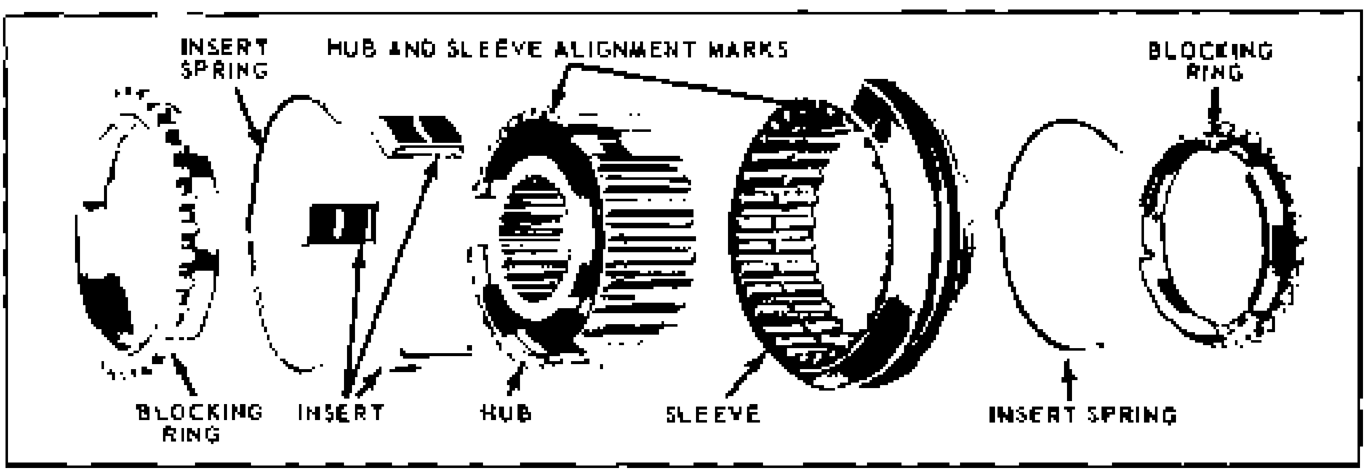


Fig. 7A-14 Exploded View of Second and Third Synchronizer

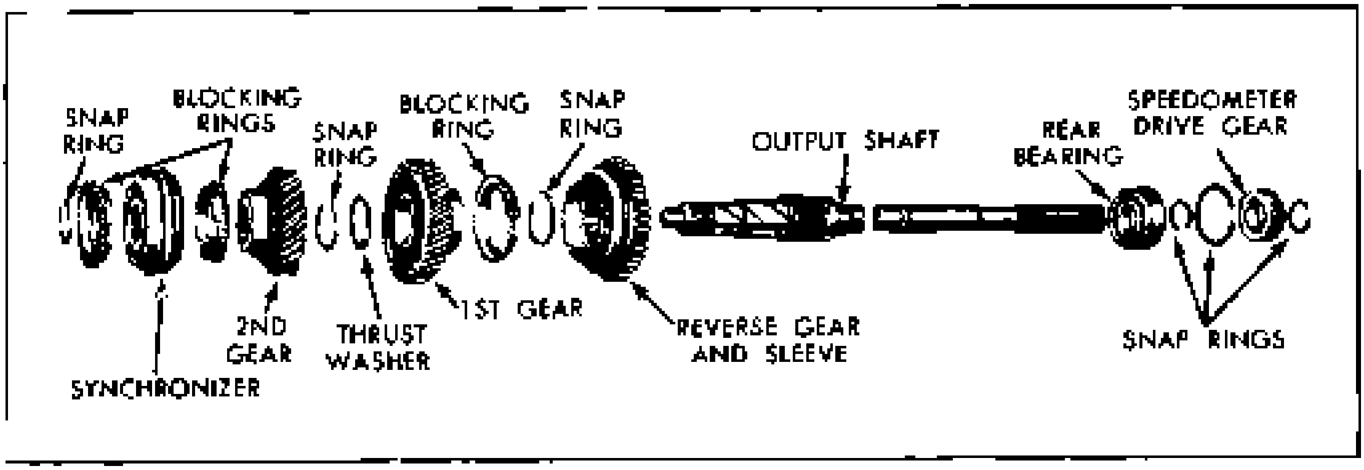


Fig. 7A-15 Exploded View of Mainshaft

16. Slide the second gear with blocking ring and the second and third gear synchronizer onto the main shaft. The tapered machined surface of the second gear must be toward the front of the shaft. Make sure the notches in the blocking ring engage the synchronizer inserts. Secure the synchronizer with a snap ring.

ASSEMBLE

1. Install reverse idler gear, with a thrust washer on each end in case. Make sure that roll pin (Fig. 7A-20) is seated in slot in back face of case.

2. Assemble the countergear, countershaft alignment tool, bearings, thrust washers and place in bottom of case. The countergear will remain in the bottom of the case until the main and input shafts have been installed (Fig. 7A-21).

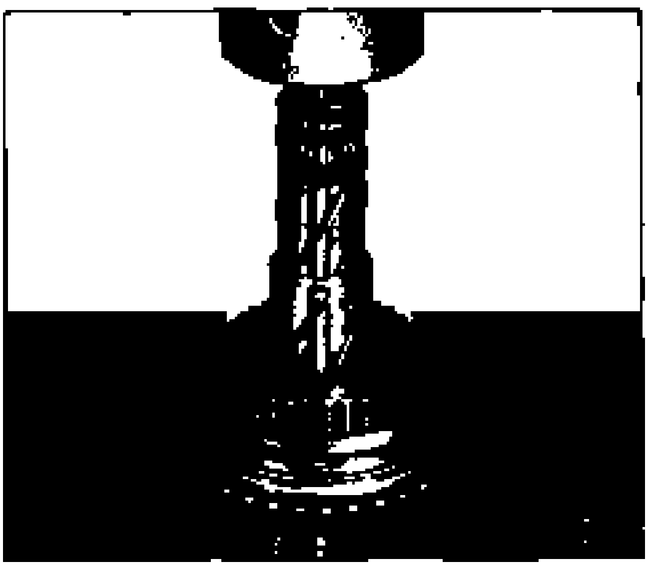


Fig. 7A-16 Removing Reverse Synchronizer Hub and Sliding Gear

3. Coat the bore of the input shaft and gear (Fig. 7A-22) with a thin film of grease and install the 15 bearings in the bore.

NOTE: A thick film of grease will plug the lubricant holes and prevent lubrication of the bearings.

4. Install the input shaft and bearing through the top of the case into the bore in the front of the case. Install the large snap ring on the bearing and slide input shaft fully forward.

5. Position the mainshaft assembly in the case.

6. Install the second and third speed shift fork on the second and third speed synchronizer.

7. Place a detent plug spring and detent plug in the case.

NOTE: Detent plug and spring installation can be facilitated by the use of Tool J 22239 or a similar tool fabricated from 1/2" round bar stock (Fig. 7A-23).

8. Place second and third speed synchronizer in second speed position (toward rear of case).

9. Align the shift fork and install second and third speed shift rail.

NOTE: It will be necessary to depress detent plug to install the rail in the bore. Move the rail in until the detent plug engages the forward notch.

10. Secure the second and third shift fork to the shift rail with set screw

11. Move the synchronizer to the neutral position.

12. Install the interlock plug in the case. If the second and third speed shift rail is in the neutral position, the

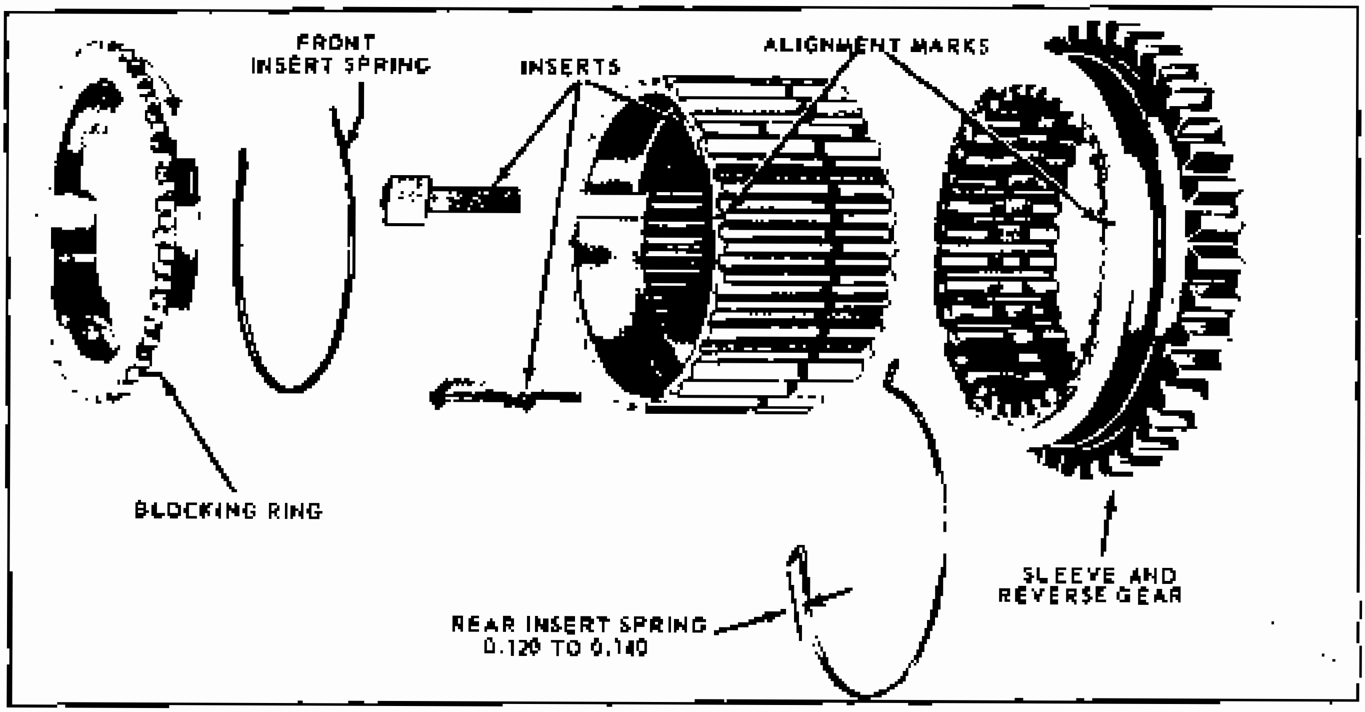


Fig. 7A-17 Exploded View of First and Reverse Synchronizer

top of the interlock will be slightly lower than the surface of the first and reverse shift rail bore.

13. Move the first and reverse synchronizer forward and place the first and reverse shift fork in the groove of the synchronizer

14. Align the shift fork and install the first and reverse shift rail. Move the rail in until the center notch is aligned with the detent bore.

15. Install the remaining detent plug and spring. Secure the spring with the slotted head set screw Turn screw in until the head is flush to 0.020 inches below the top of the case.

16. Secure the first and reverse shift fork to the shift rail with set screw.

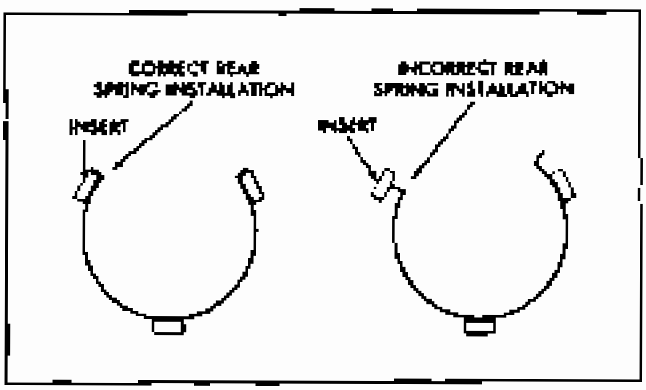


Fig. 7A-18 Synchronizer Insert Spring Installation

17. Install a new shift rail expansion plug in front of the case.

18. While holding the input shaft and blocking ring in position, move the main shaft forward to seat the main shaft pilot in the roller bearings of the input shaft.

19. Tap the input shaft bearing into place in the case

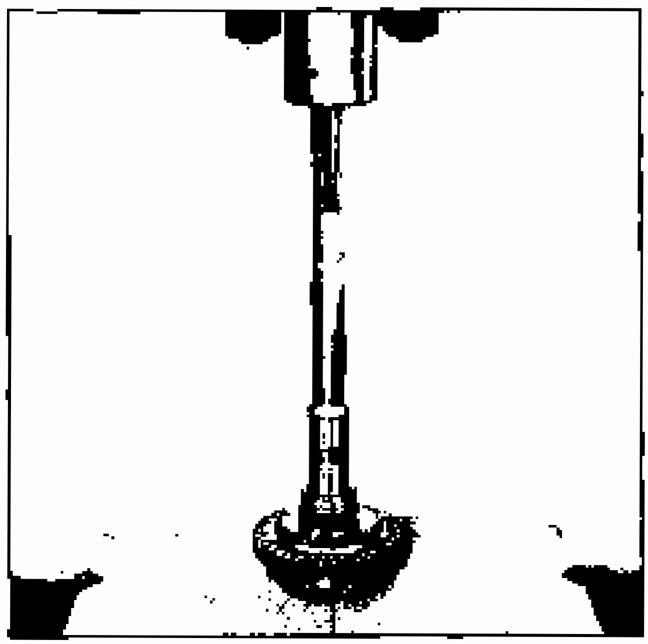


Fig. 7A-19 Installing Reverse Synchronizer Hub

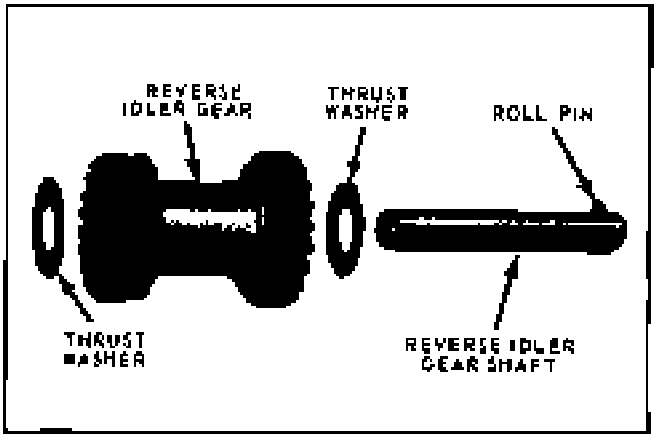


Fig. 7A-20 Exploded View of Reverse Idler

while holding the main shaft to prevent the roller bearings from dropping out.

20. Install the front bearing retainer and new gasket, making sure the oil return slot is toward bottom of the case. Torque the attaching screws to 22 lb. ft.

21. Install the large snap ring on the rear bearing.

22. Position the bearing on the output shaft, with the snap ring toward the rear of the shaft.

23. Thread Tool J 21774-2 all the way into J 21774-1 and place tools on output shaft next to bearing.

PONTIAC:

24. a. Install speedometer drive gear snap ring on output shaft.

b. Back Tool J 21774-2 out of J 21774-1, using Handle J 8614-1, until bearing is positioned correctly on output shaft.

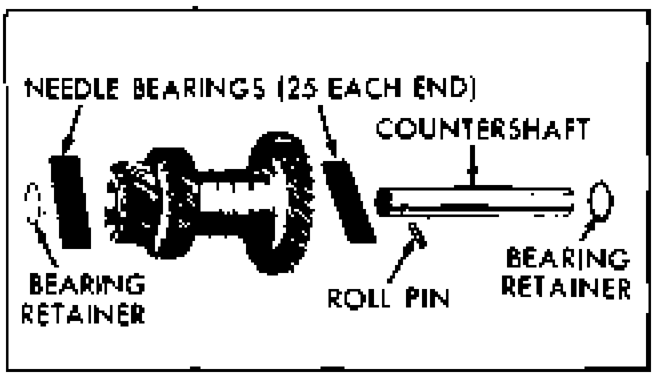


Fig. 7A-21 Exploded View of Countergear

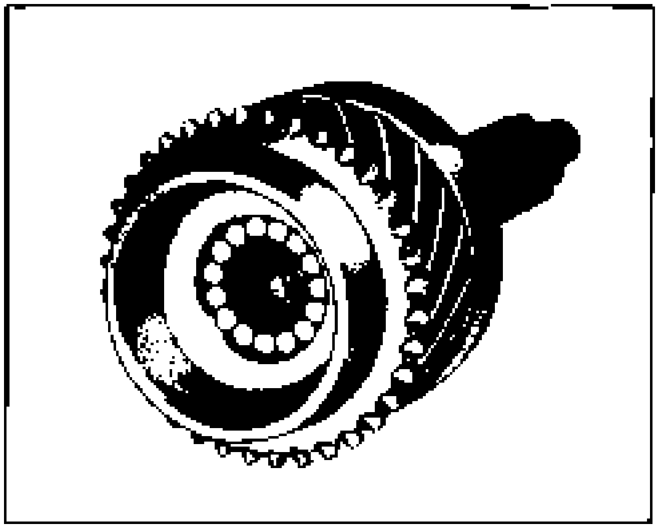


Fig. 7A-22 Input Shaft Roller Bearing Installation

c. Remove speedometer drive gear snap ring and tools and install rear bearing retaining snap ring.

GRAND PRIX, TEMPEST OR FIREBIRD

24. a. Install Tool J 8614-1 on lugs of J 21774-2 and place J 6135 on output shaft.

Secure J 6235 in position against J 21774-2 and J 8614-1 and lock in place by tightening the set screw against the non-finished surface of the output shaft (Fig. 7A-24).

NOTE: A bench vise may be used in lieu fo J 6135.

b. Back Tool J 21774-2 out of J 21774-1 until bearing is positioned correctly on output shaft.

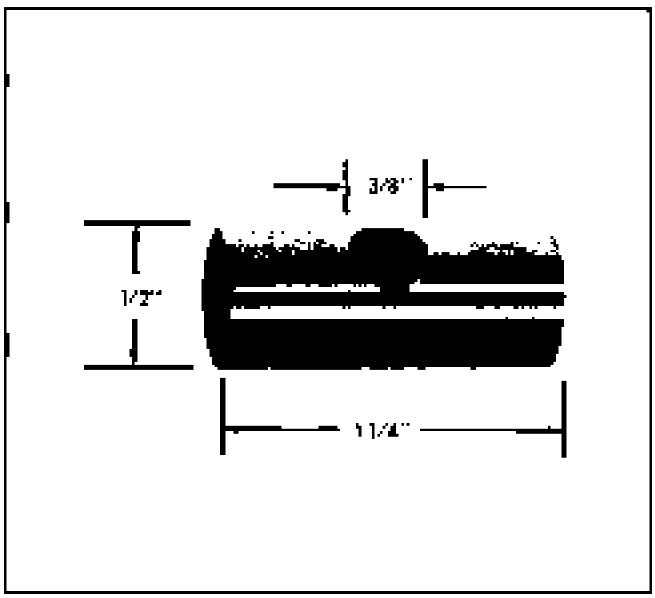


Fig. 7A-23 Detent Pin Installer

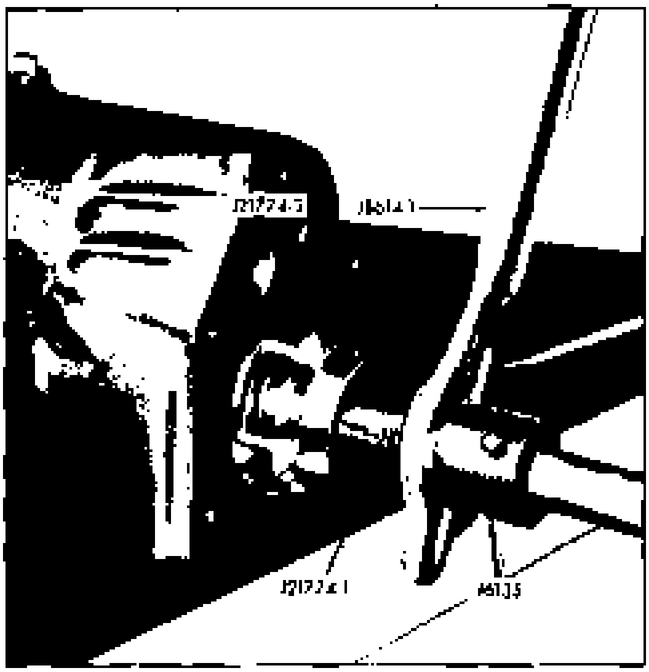


Fig. 7A-24 Installing Rear Bearing

c. Loosen J 6135 set screw, remove tools and install rear bearing retaining snap ring.

25. Place speedometer drive gear locking ball in the detent on the output shaft and slide speedometer drive gear into place. Secure gear with snap ring.

26. Using a hook or your hand, lift the countergear from the bottom of the case and align it and the thrust washers with the bore in the case.

27. Working from the rear of the case, push the countershaft alignment tool out of the countergear with the countershaft. Before the countershaft is completely inserted, make sure that the locking pin hole in the shaft will line up with the locking pin hole in the case.

28. Drive the shaft into place and insert the locking pin.

29. Coat a new extension housing gasket with sealer and install it on the case.

30. Dip the threads of the extension housing screws in sealer.

31. Install the extension housing and torque the screws to 46 lb. ft.

32. Install the filler and drain plugs in case, making sure the magnetic plug is installed in bottom of case.

33. Place the transmission in gear and put lubricant over the entire gear train while rotating the input shaft.

34. Coat a new access cover gasket with sealer and install it on the case.

35. Install access cover and torque screws to 17 lb. ft.

TRANSMISSION

REPLACE

1. Install guide pin in upper right transmission to flywheel housing bolt hole for alignment and place transmission on guide pin. Rotate transmission, as necessary, to start main drive gear splines into clutch friction plate. Slide transmission forward.

NOTE: Make certain splines of clutch friction plate are concentric with pilot bearing in crankshaft and release bearing is properly installed.

2. Install two (2) lower transmission mounting bolts. Remove guide pin and install two (2) upper bolts. Torque bolts to 40 lb. ft.

3. Slide crossmember forward and install four (4) bolts. Torque to 25 lb. ft.

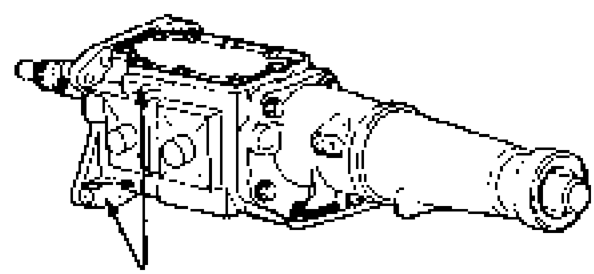
4. Install transmission mount and lower engine. Torque mount bolts to 30 lb. ft.

5. Install propeller shaft.

6. Connect linkage and adjust as described in ON CAR ADJUSTMENTS.

7. Connect speedometer cable.

8. Refill transmission with recommended lubricant.



STAMP VEHICLE IDENTIFICATION NUMBER CONSISTING OF THE FIGURE 2 FOLLOWED BY THE LAST 8 DIGITS OF CAR SERIAL NUMBER.

Fig. 7A-25 Vehicle Identification Number Location

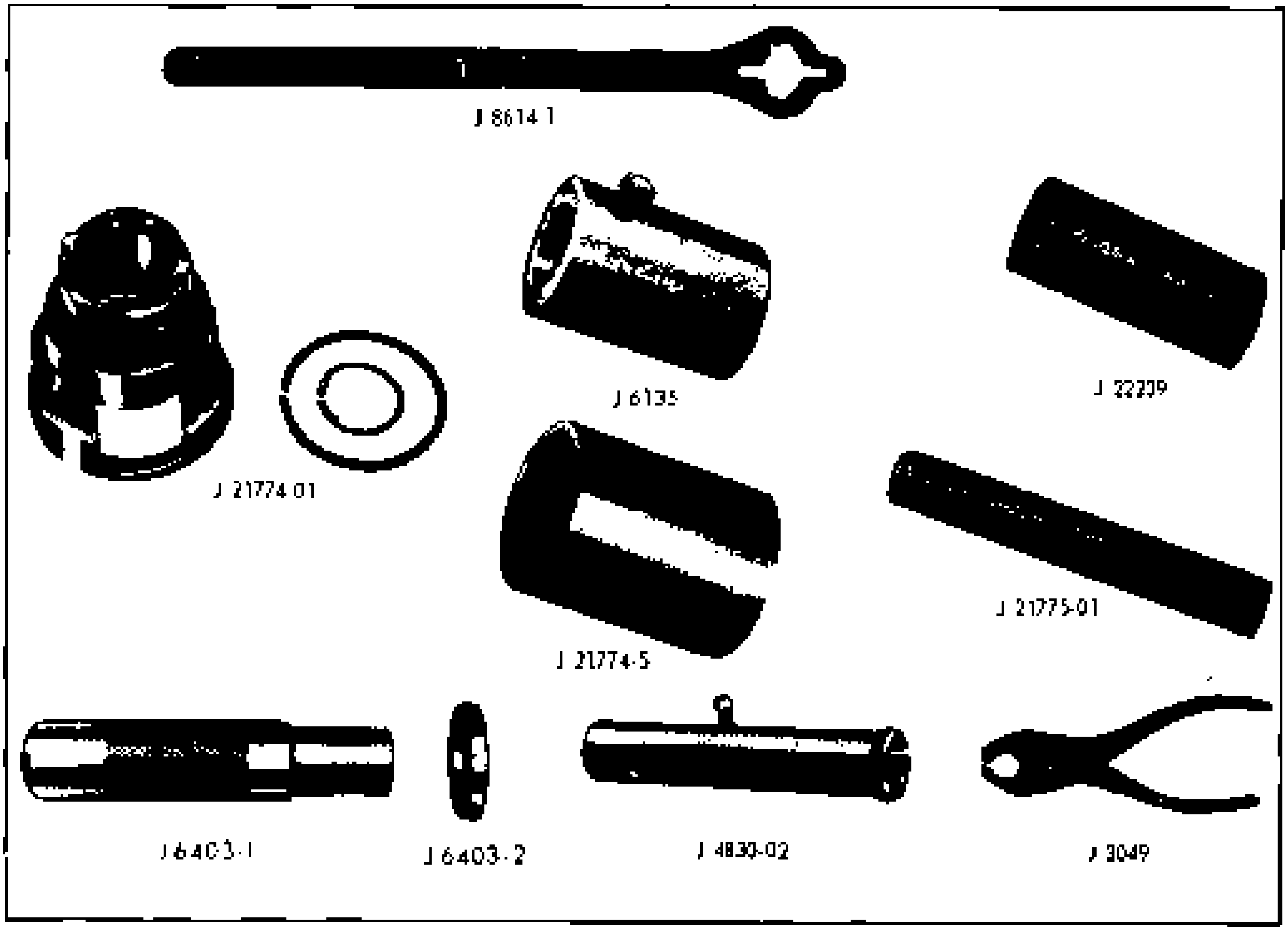


Fig. 7A-26 Special Tools

J 2619	Slide Hammer (Not Shown)
J 3049	Shift Rail Rotating Pliers
J 4830-02	Extension Housing Bushing and Seal Remover
J 6135	Adapter (Rear Unit Clutch Retainer)
J 6403-1	Extension Housing Bushing Installer
J 6403-2	Oil Seal Installer
J 8614-1	Companion Flange Holding Tool
J 21774-01	Transmission Output Shaft Rear Bearing Remover & Replacer
J 21774-5	Sleeve
J 21775-01	Countershaft Alignment Tool
J 22239	Detent Pin Installer

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

An identifying code is marked in yellow paint on all three speed manual transmissions. This code consists of two letters, 2 inches high, on the R.H. side of the case. The letters "DA" identify the standard Pontiac or Grand Prix three speed manual (Dearborn) transmission and "DB" identifies a heavy duty Tempest or Firebird three speed manual (Dearborn) transmission.

A number derived from the vehicle identification number is also stamped on the transmission case as shown in Fig. 7A-25.

GEAR RATIOS

First Speed	2.42:1
Second Speed	1.61:1
Third Speed	1.00:1
Reverse	2.33:1

LUBRICANT

Capacity .... 2¾ pints

CLEARANCES

Countershaft Gear End Play	0.004"-0.018"
Reverse Idler Gear End Play	0.004"-0.018"

TORQUE LIMITS

	LB. FT.
Input Shaft Bearing Retainer Bolts	22
Extension Housing to Transmission Bolts	46
Transmission to Flywheel Housing Bolts	40
Access Cover Bolts	17
Shift Fork to Shift Rail Set Screw	14
Filler Plug	25
Trunnion Jam Nuts	30
Clamp Screws	20

THREE-SPEED SAGINAW MANUAL TRANSMISSION

CONTENTS OF THIS SECTION

DESCRIPTION

The Saginaw three speed manual transmission is used as the standard equipment transmission on all Tempest and Firebird models except those equipped with the 400 cu. in. V-8 engine.

Gear ratios for the 6-cylinder engines are 2.85:1 in first, 1.68:1 in second, 1.00:1 in high and 2.95:1 in reverse. The 8-cylinder engine gear ratios are 2.54:1 in first, 1.50:1 in second, 1.00:1 in high and 2.63:1 in reverse.

For all models, the steering column lock requires that the transmission be in "Reverse" gear before the ignition key may be removed. Also, the clutch safety switch will not permit engine cranking unless the clutch pedal is depressed far enough to completely disengage the clutch.

PERIODIC SERVICE

TRANSMISSION

No periodic service of the transmission is required except checking for leaks and proper lubrication level every 6000 miles.

If there is evidence of leakage, leak should be corrected and lubrication added as needed. Refill capacity is 3-1/2 pints.

Use SAE 90 multi-purpose Gear Lubricant. No special additive to this lubrication is required or recommended.

SHIFT CONTROL

No periodic service of the shift control is required. Certain parts are lubricated on assembly and require further lubrication only when parts become dry and sticky.

ON CAR ADJUSTMENTS

COLUMN SHIFT AND BACK DRIVE LINKAGE (Fig. 7B-1 or 7B-2).

1. Set gearshift lever in Reverse and lock ignition.

2. TEMPEST - Loosen swivel clamp screw "C" at rear transmission shifter lever (1st and Reverse) and screw "D" at equalizer shaft and lever assembly (view "B").

FIREBIRD - Loosen swivel clamp nut "C" at rear transmission shifter lever (1st and Reverse) as shown in view "C" and loosen nut "D" at idler lever (view "B" and "C").

3. Position front transmission shifter lever (2nd and 3rd) in Neutral positon and rear transmission shifter lever (1st and Reverse) in Reverse position.

4. Tighten swivel clamp screw "C" or nut "C" to 20 lb. ft., unlock steering column and shift into Neutral.

5. Align gearshift lower control levers "E" and "F" in Neutral position and insert a .185" diameter gage pin through hole in lower control levers (view "A").

6. Tighten swivel clamp screw "D" or nut "D" to 20 lb. ft., remove gage pin and check complete shift pattern.

FLOOR SHIFT AND BACK DRIVE LINKAGE (Figs. 7B-3 or 7B-4 and 7B-5A or 7B-5B)

1. Position floor shift control lever in Neutral position.

2. Loosen adjusting swivel clamp on gearshift control rod (Fig. 7B-5A or 5B), loosen trunnion jam nuts on 1st-Reverse and 2nd-3rd transmission control rods and insert a .250-.249" diameter gage pin into shifter assembly (view "B" of Fig. 7B-3 or 7B-4).

NOTE: Gage pin in place will maintain shifter levers in Neutral position.

3. If shift control lever is misaligned to its floor pan (console) opening (view "C" of Fig. 7B-3 or 7B-4):

a. With console - loosen two attaching bolts, shifter assembly to shifter support, align shifter assembly to specification shown in view "C" and tighten attaching bolts to specified torque (view "B").

b. Except console - loosen two attaching bolts, shifter assembly to shifter support, align shifter assembly centrally in its floor boot and tighten attaching bolts to specified torque (view "B").

4. Position both transmission shifter levers in Neutral and torque the trunnion jam nuts to 30 lb. ft. (view "A" of Figs. 7B-3 or 7B-4).

5. Remove gage pin and check complete shift pattern for freeness of operation.

6. Position floor shift control lever in Reverse position, set steering column lower lever in Lock positon and lock ignition.

7. Push up on gearshift control rod (Fig. 7B-5A or -5B) to take up clearance in steering column lock mechanism and tighten nut (or screw) of adjusting swivel clamp to 20 lb. ft. torque.

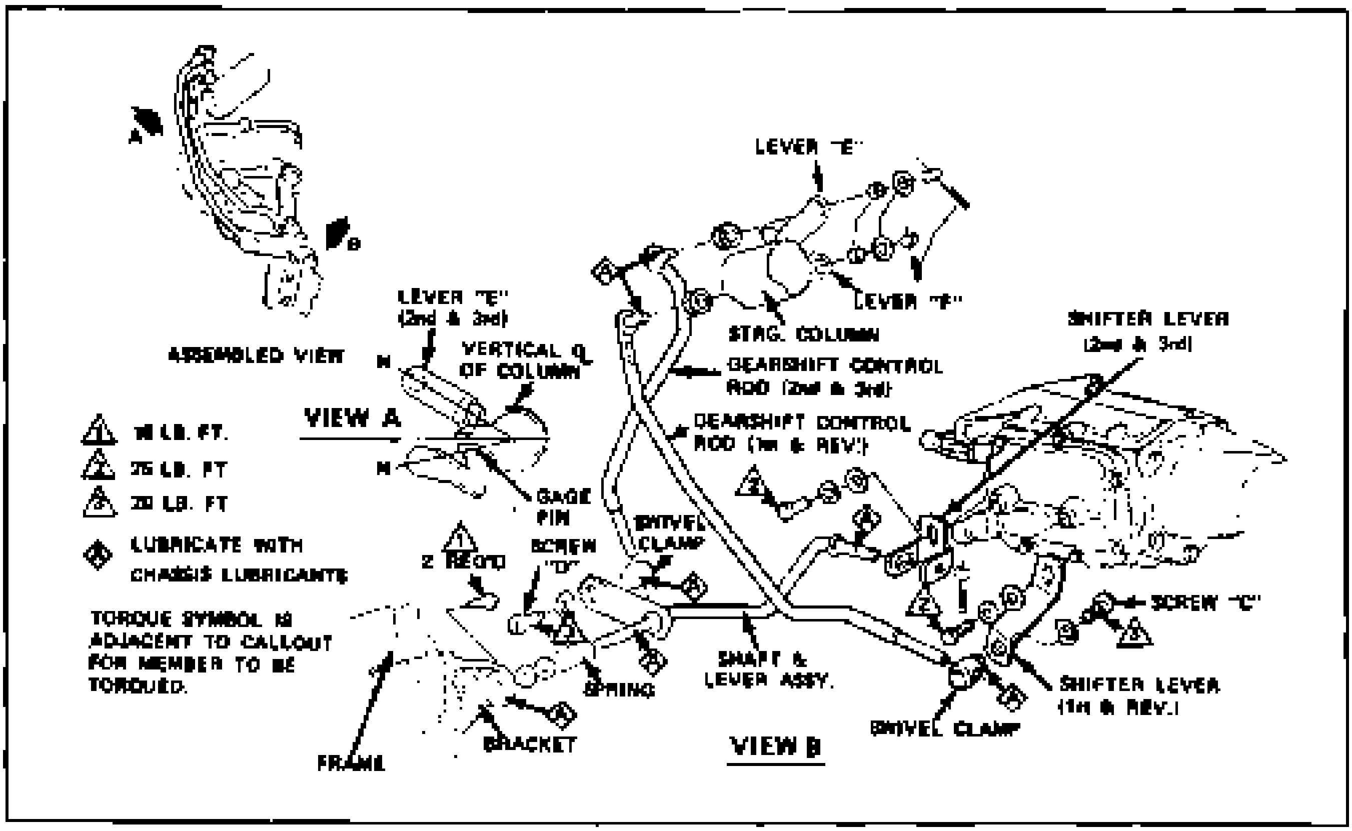


Fig. 7B-2 Tempest Column Shift Controls

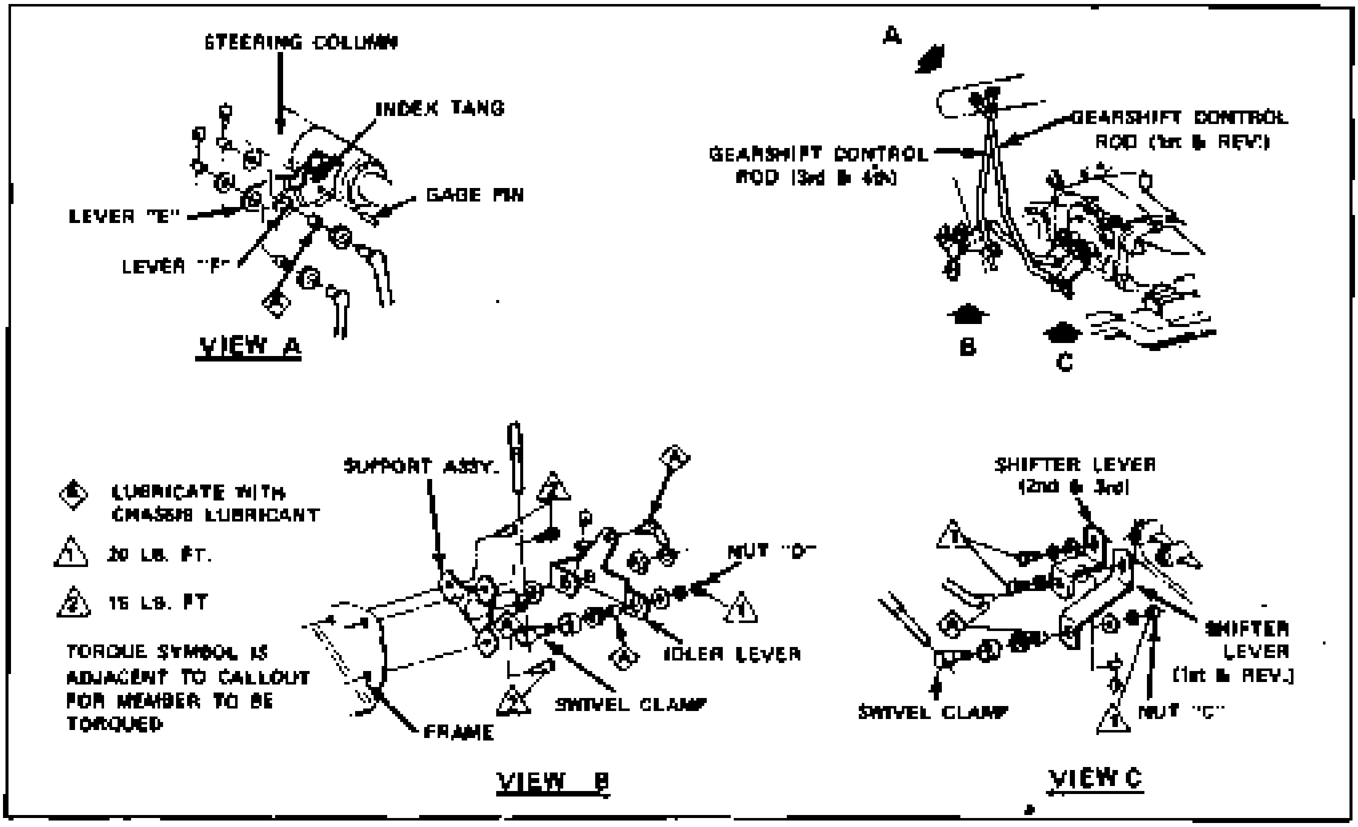


Fig. 7B-2 Firebird Column Shift Controls

MINOR REPAIRS

EXTENSION HOUSING SEAL

REMOVE AND REPLACE

1. Remove propeller shaft as outlined in Section 4C.

2. Remove seal by prying out with screwdriver.

3. Wash counterbore with cleaning solvent and inspect for damage.

4. Inspect propeller shaft yoke for nicks, burrs or scratches which would cut new seal or cause seal to leak or damage bushing.

5. Coat new seal with sealing compound and start new seal in opening.

6. Place Collar J 6403-2 onto Tool J 6403-1 (Fig. 7B-6).

NOTE: Flat side of J 6403-1 must be toward rear of J 6403-1.

7. Place Tool J 6403-1 over end of output shaft.

8. Tap end of tool with soft hammer to seat seal.

9. Reinstall propeller shaft.

EXTENSION HOUSING SEAL AND BUSHING

REMOVE AND REPLACE

1. Remove propeller shaft.

2. Insert Tool J 4830-02 over output shaft and tighten screw.

3. Attach Slide Hammer J 2619. Using hammer, pull bushing and seal from extension housing (Fig. 7B-7).

4. Start new bushing into extension housing.

5. Using Tool J 6403-1 and soft hammer, tap bushing into place (Fig. 7B-8).

6. Install new seal, using Tool J 6403-1 and Collar J 6403-2 (Fig. 7B-6) and tapping end of tool with soft hammer to seat the seal.

7. Reinstall propeller shaft.

TRANSMISSION SIDE COVER

REMOVE

It is not necessary to remove transmission from vehicle for inspection or replacement of parts in transmission side cover assembly, but cover itself must be removed from transmission case (Fig. 7B-9).

1. Loosen side cover bolts to allow transmission fluid to drain.

2. Disconnect control rods from levers.

3. Remove side cover from transmission case.

4. Disassemble side cover by removing detent cam spring, shifter forks and shafts, detent cam retainer and detent cams.

5. Inspect and replace necessary parts.

6. Inspect shifter shaft O-rings and replace if necessary.

REPLACE

1. Install shifter shaft O-rings if removed.

2. Install detent cams, detent cam retainer, shifter shafts and forks and detent cam spring.

3. Attach side cover to transmission case.

4. Connect control rods to levers.

5. Refill transmission.

NOTE: Detent cams, shifter shafts and forks are interchangeable.

MAJOR REPAIRS

TRANSMISSION

REMOVE

1. Disconnect speedometer cable.

2. Disconnect transmission shifter levers (1st & Reverse and 2nd & 3rd) from transmission shifter shafts (Figs. 7B-1 and 7B-2). On floor shift control cars, also remove two (2) shifter assembly-to-extension support bolts (Figs. 7B-3 and 7B-4).

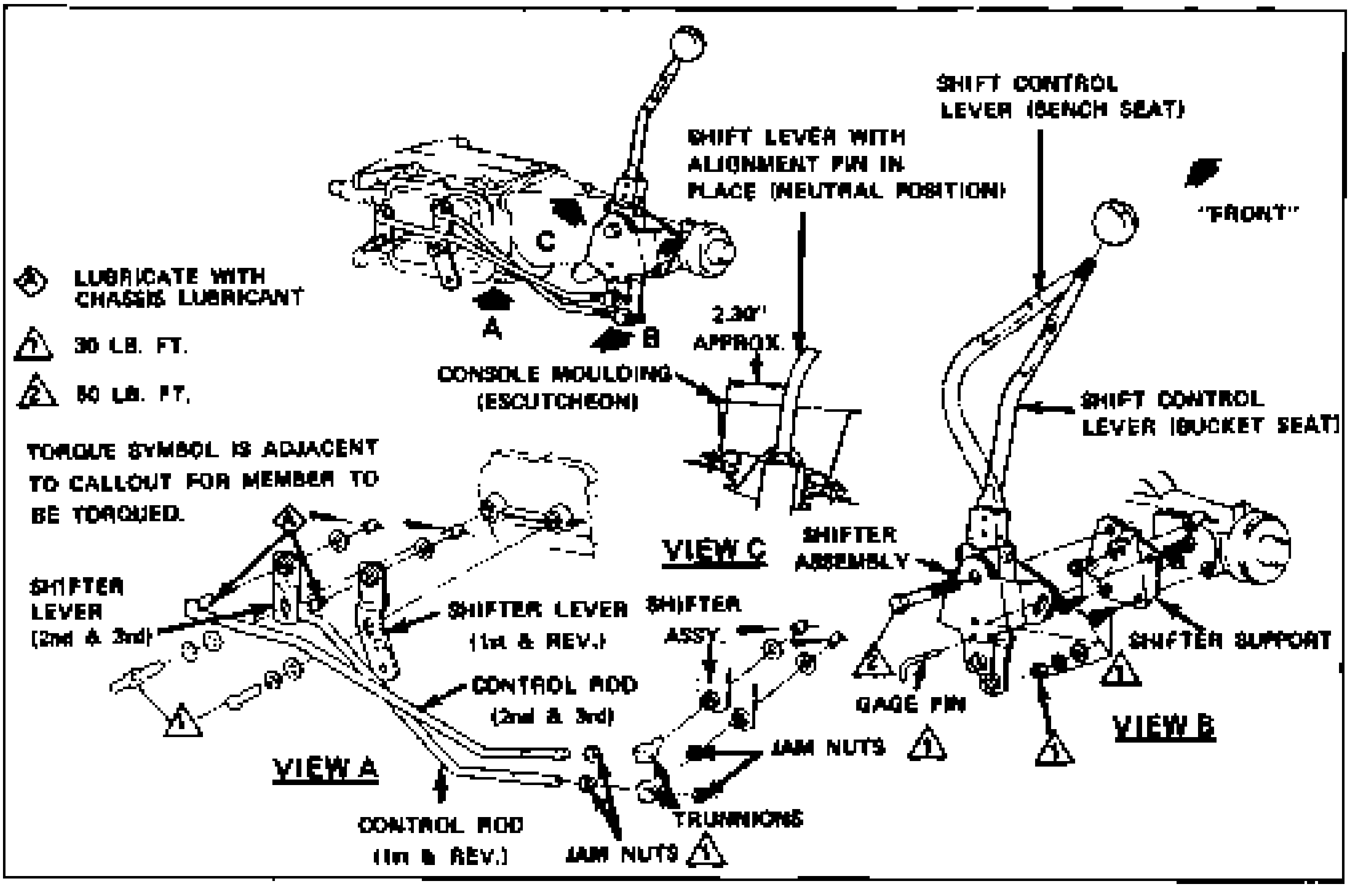


Fig. 7B-3 Tempest Floor Shift Controls

3. Scribe a mark on companion flange and shaft yoke to assure proper reassembly and remove propeller shaft.

4. Support rear of engine and remove transmission mount.

NOTE: On Firebird 6-cyl., remove driveline damper (Fig. 7B-27).

5. Remove four (4) crossmember bolts and slide member rearward.

6. Remove two (2) upper transmission to clutch housing bolts and insert Guide Pins J 1126.

7. Remove two (2) lower transmission to clutch housing bolts.

8. Slide transmission straight back on guide pins until main drive gear splines are free of splines in clutch friction plate.

9. Remove transmission.

DISASSEMBLY

1. Remove side cover attaching bolts, drain lubricant and remove side cover and gasket.

2. Remove front bearing retainer and gasket.

3. Remove front bearing to main drive gear snap ring.

4. Pull main drive gear out of case as far as possible and remove front bearing (Fig. 7B-10).

NOTE: Although front bearing is a slip fit on main drive gear, it may be necessary to aid removal with screwdriver.

5. Remove extension housing to case attaching bolts.

6. Remove reverse idler shaft to gear snap ring (Fig. 7B-11). Slide reverse idler gear forward on shaft.

7. From rear of case, remove extension housing and mainshaft assembly (Fig. 7B-12).

8. Remove main drive gear and third speed blocking ring from inside of case and remove 14 bearing rollers from mainshaft drive gear.

9. Using snap ring pliers, expand snap ring at front of extension housing, which retains extension housing to mainshaft (Fig. 7B-13), and remove extension housing.

10. Using Countershaft Alignment Tool J 22246, tap out countershaft and its woodruff key through rear of

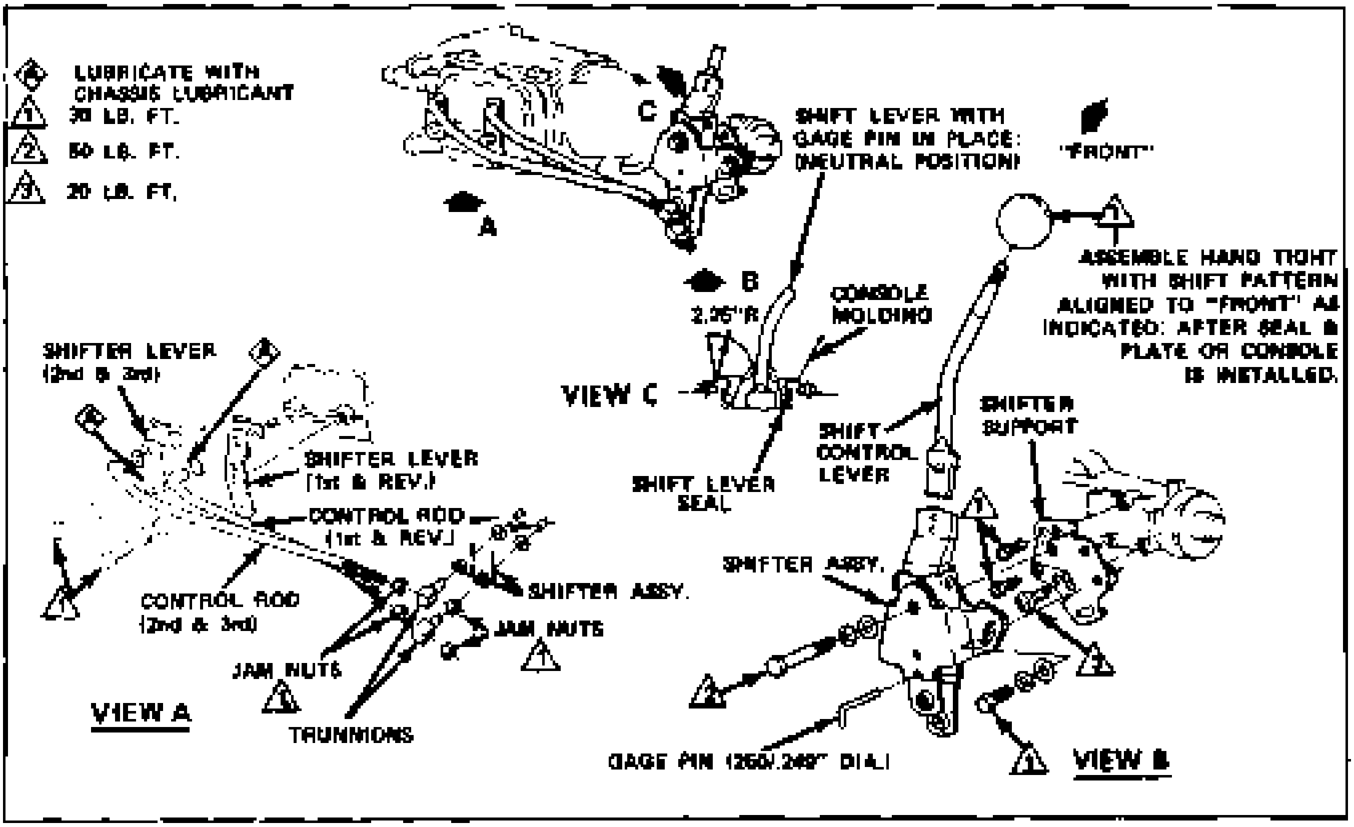


Fig. 7B-4 Firebird Floor Shift Controls

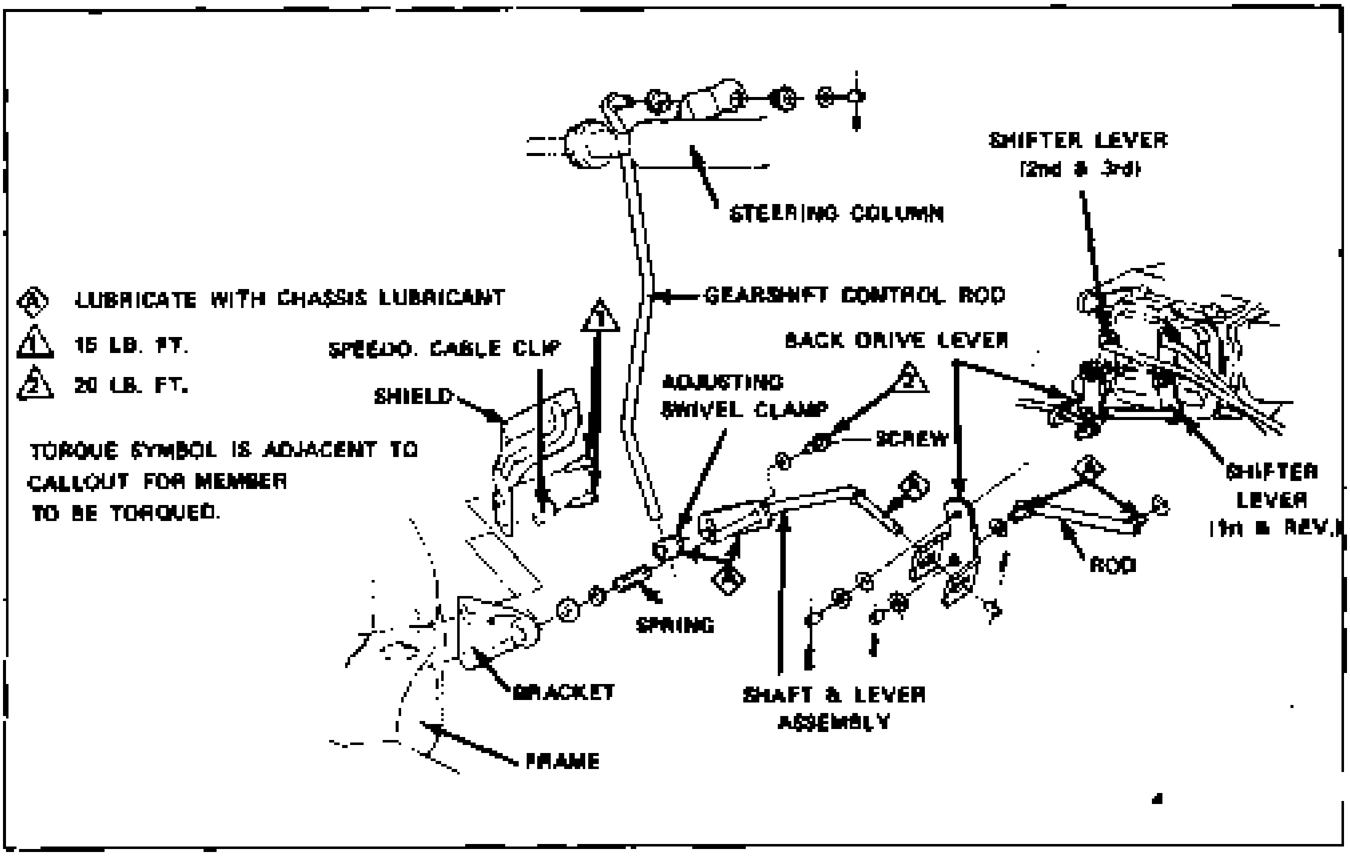


Fig. 7B-5A Tempest Back Drive Linkage

case (Fig. 7B-14). Remove countergear and two (2) tanged thrust washers.

11. Remove Countershaft Alignment Tool J 22246.

12. From each end of countershaft, remove spacer and 27 bearing rollers

13. Using a long brass drift or punch, drive reverse idler shaft and woodruff key through rear of case (Fig. 7B-15).

14. Remove reverse idler gear and tanged steel thrust washer.

15. Remove second-third synchronizer sleeve (Fig. 7B-16)

16. Remove rear bearing snap ring (Fig. 7B-16).

17. Remove speedometer drive gear by depressing retainer clip and sliding off output shaft.

18. Using hydraulic or arbor press, press off rear bearing, spring washer, thrust washer and reverse gear (Fig. 7B-17).

19. Remove first speed synchronizer snap ring (Fig. 7B 15).

20. Support first speed gear on press plate, using two (2) pieces of stock 6" x 1 7/8" x 1/4" (Fig. 7B-18). Remove first speed synchronizer assembly and first speed gear.

21. Remove second-third speed synchronizer snap ring (Fig. 7B-16).

22. Support second speed gear on press plate, using two (2) pieces of stock 6" x 1 7/8" x 1/4" (Fig. 7B-19). Remove second-third speed synchronizer assembly and second speed gear.

CLEANING AND INSPECTION

1. Check synchronizer hubs, sliding keys and springs and, if necessary, replace.

NOTE: The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled.

a. Mark hub and sleeve so they can be reassembled in same position.

b. Remove sliding sleeve from synchronizer hub Remove keys and springs from hub.

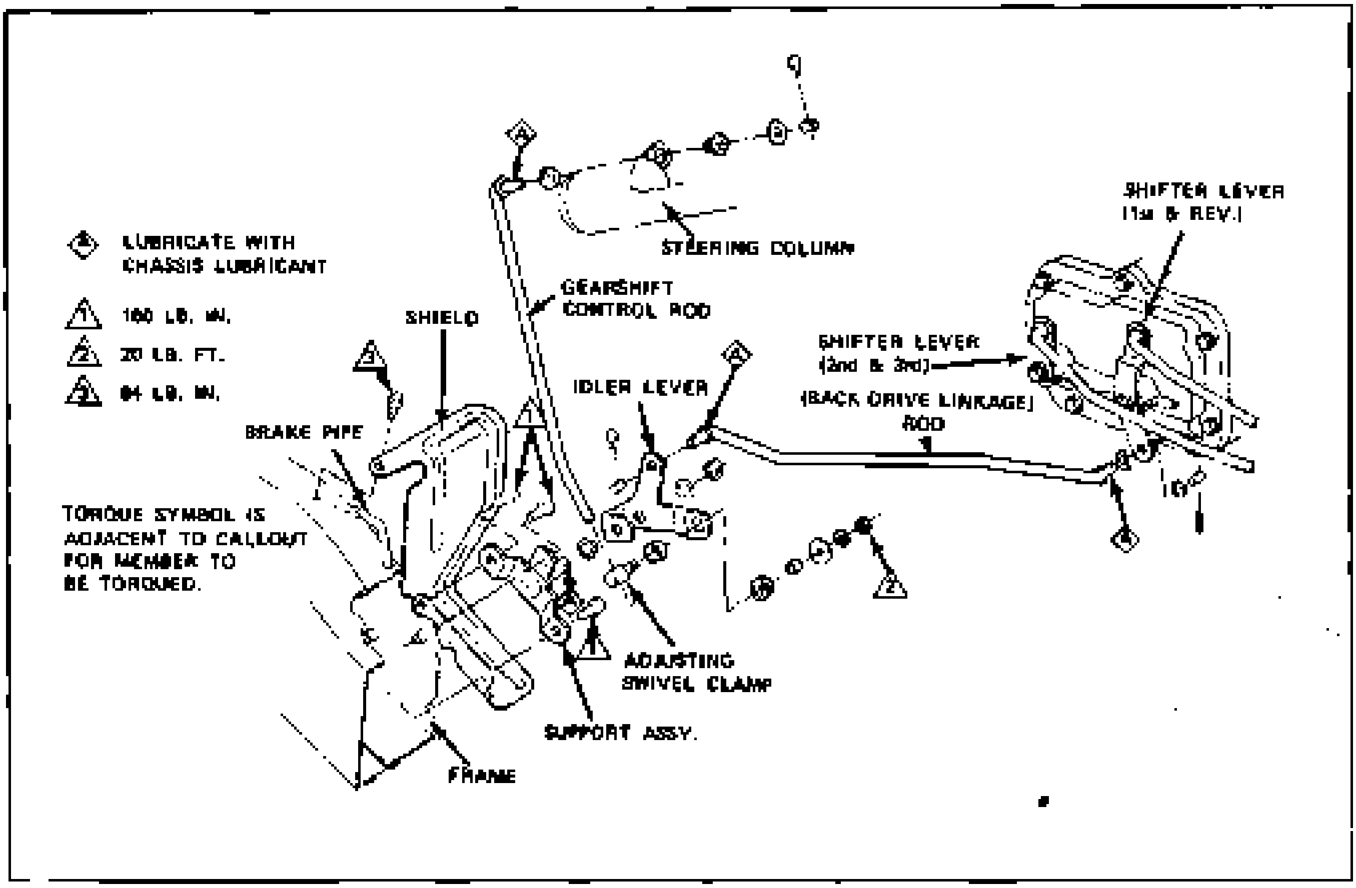


Fig. 7B-5B Firebird Back Drive Linkage

c. Replace the three (3) keys and two (2) springs in position (one on each side of hub) so all three keys are engaged by both springs (Fig. 7B-20).

d. The tanged end of each synchronizer spring should be installed in different key cavities on either side of hub. Slide sleeve onto hub, aligning marks made before disassembly.

NOTE: A groove around the outside of synchronizer hub identifies the end that must be opposite fork slot in sleeve when assembled. This groove indicates the end of the hub with a greater recess.

2. Wash front and rear bearings thoroughly in cleaning solvent. Blow out bearing with compressed air.

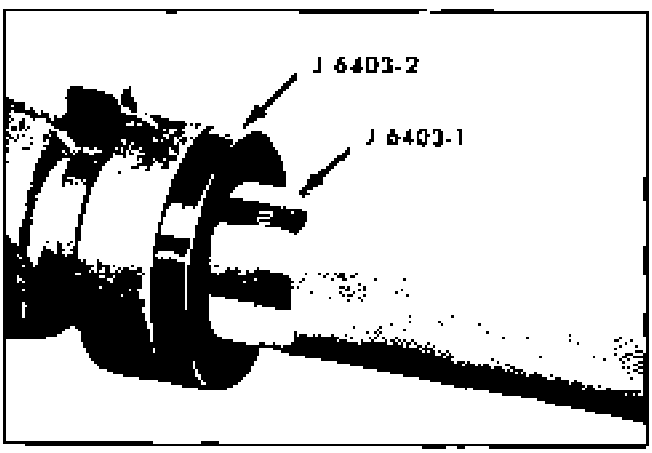


Fig. 7B-6 Installing Extension Housing Seal

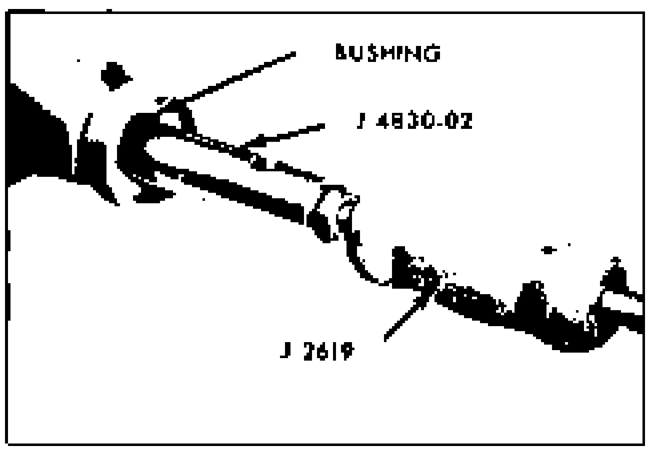


Fig. 7B-7 Removing Extension Housing Bushing

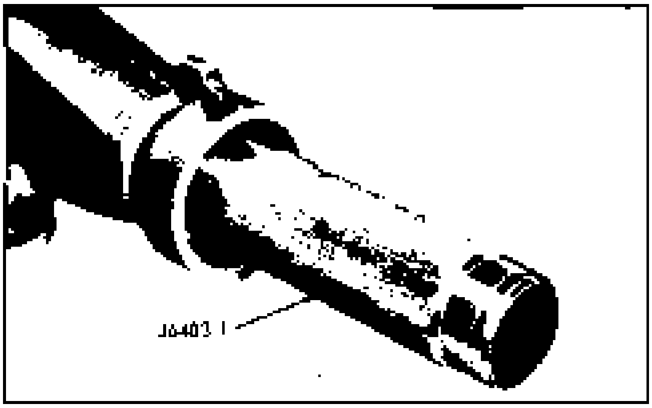


Fig. 7B-8 Installing Extension Housing Bushing

CAUTION: Do not allow bearings to spin; turn them slowly by hand. Spinning bearings will damage race and balls. Make certain bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning race by hand.

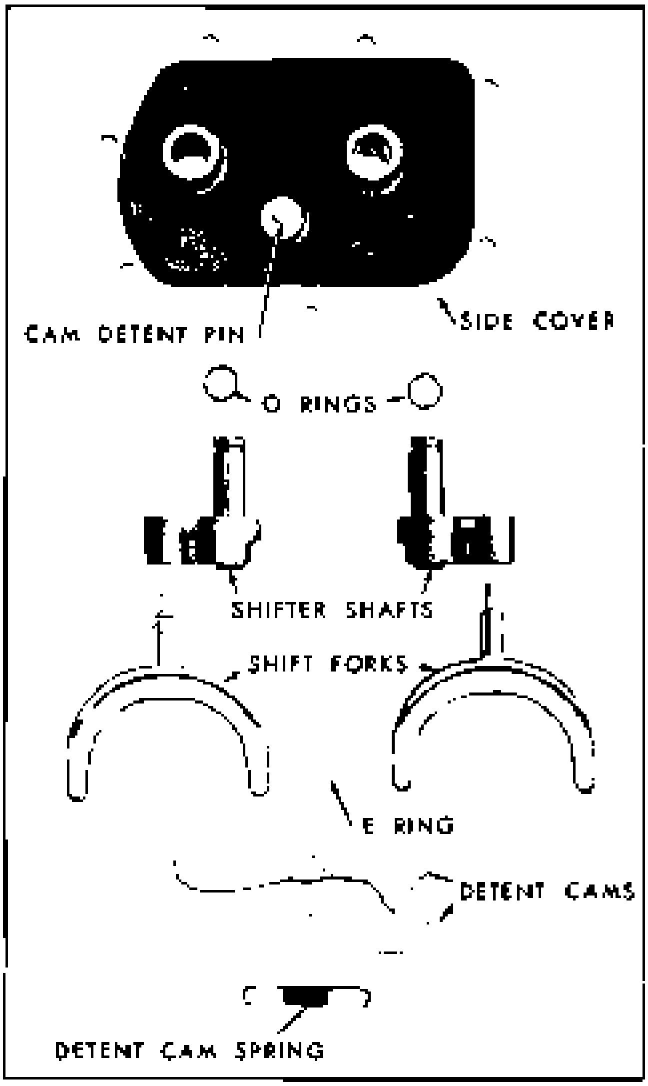


Fig. 7B-9 Exploded View of Transmission Side Cover

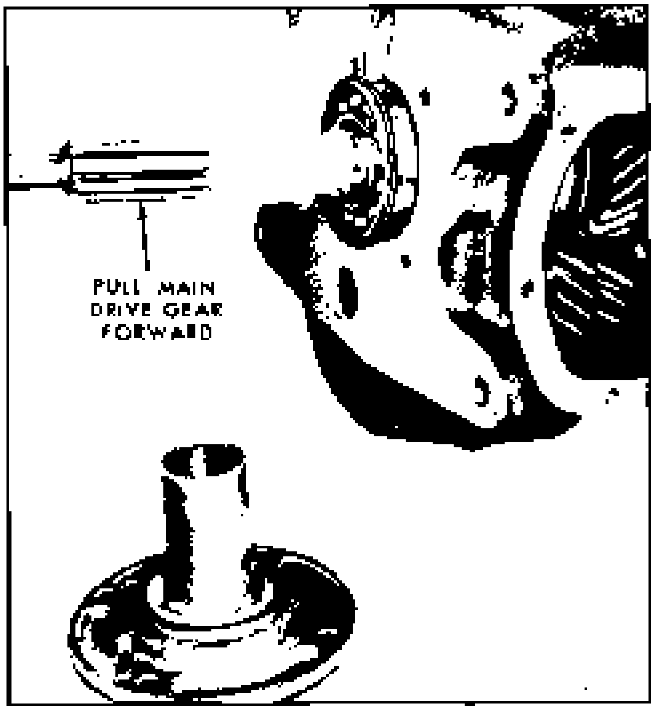


Fig. 7B-10 Removing Front Bearing

3. Check for cracks in blocking rings. *

4. Wash transmission case thoroughly inside and outside with suitable cleaning solvent; then inspect case for cracks.

a. Check front and rear case faces for burrs and, if present, remove with a fine mill file.

b. Check and clean magnet in bottom of transmission case.

5. All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show

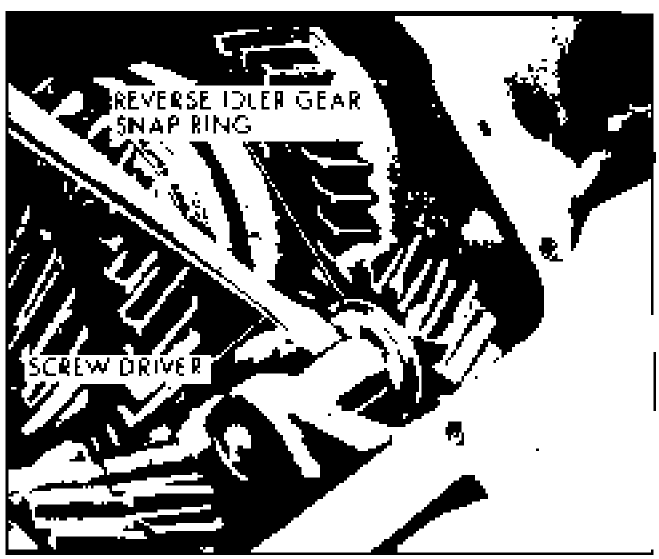


Fig. 7B-11 Removing Reverse Idler Gear Snap Ring

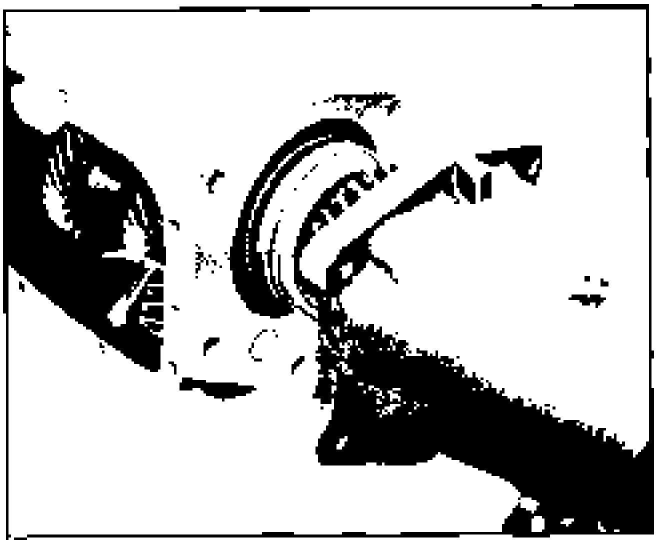


Fig. 7B-12 Removing Mainshaft

6. Inspect all gears for excessive wear, chips or cracks.

7. Inspect reverse gear bushing and, if worn or damaged, replace entire gear.

NOTE: Reverse gear bushing is not serviced separately.

8. Inspect reverse idler gear bushing and, if worn or damaged, replace entire gear.

9. Check for broken bearing rollers in countergear assembly.

a. Inspect anti-rattle plate teeth for wear or other damage.

b. Check for broken anti-rattle springs.

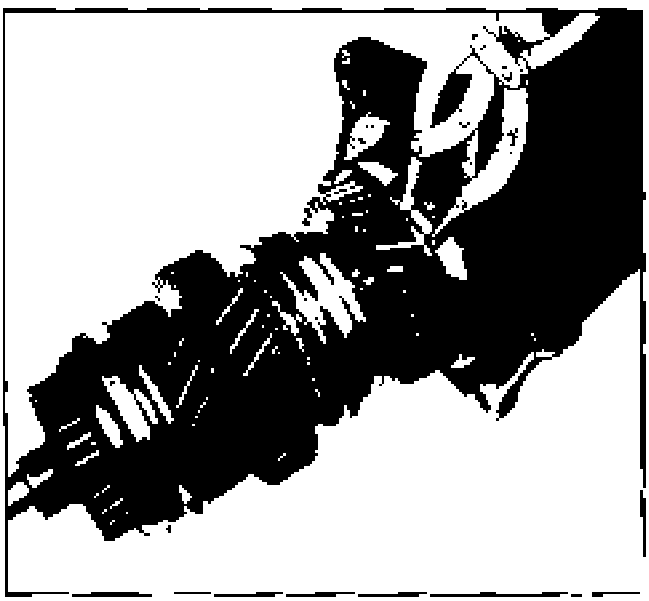


Fig. 7B-13 Expanding Extension Housing Snap Ring

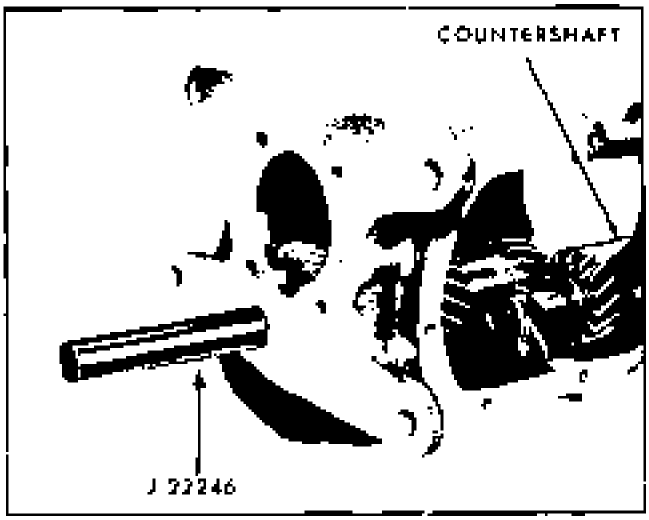


Fig. 7B-14 Removing or Installing Countergear

NOTE: The anti-rattle plate is riveted to the countergear in three (3) places. Disassembly is not recommended (Fig. 7B-21).

10. If lip seal in front bearing retainer needs replacement, pry out oil seal with screwdriver. Replace with new seal, using flat plate, and tap until seal is seated in its bore (Fig. 7B-22).

NOTE: Lip of seal must face rear of bearing retainer.

ASSEMBLE

1. Turn the front of the mainshaft upward and install second speed gear and synchronizer on mainshaft. Using hydraulic or arbor press and Press Plate J 21858, press second-third speed synchronizer assembly (with chamfer toward rear of transmission) onto mainshaft (Fig. 7B-23). Install retaining snap ring.

Gear Details *CAUTION: Make certain notches in* blocking ring align with keys in synchronizer.

2. Install first speed gear and synchronizer on mainshaft (Fig. 7B-24). Using hydraulic or arbor press and Press Plate J 21858, press first speed synchronizer assembly onto mainshaft. Install retaining snap ring.

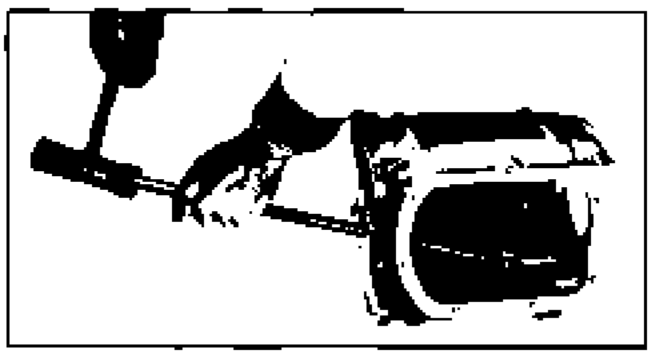
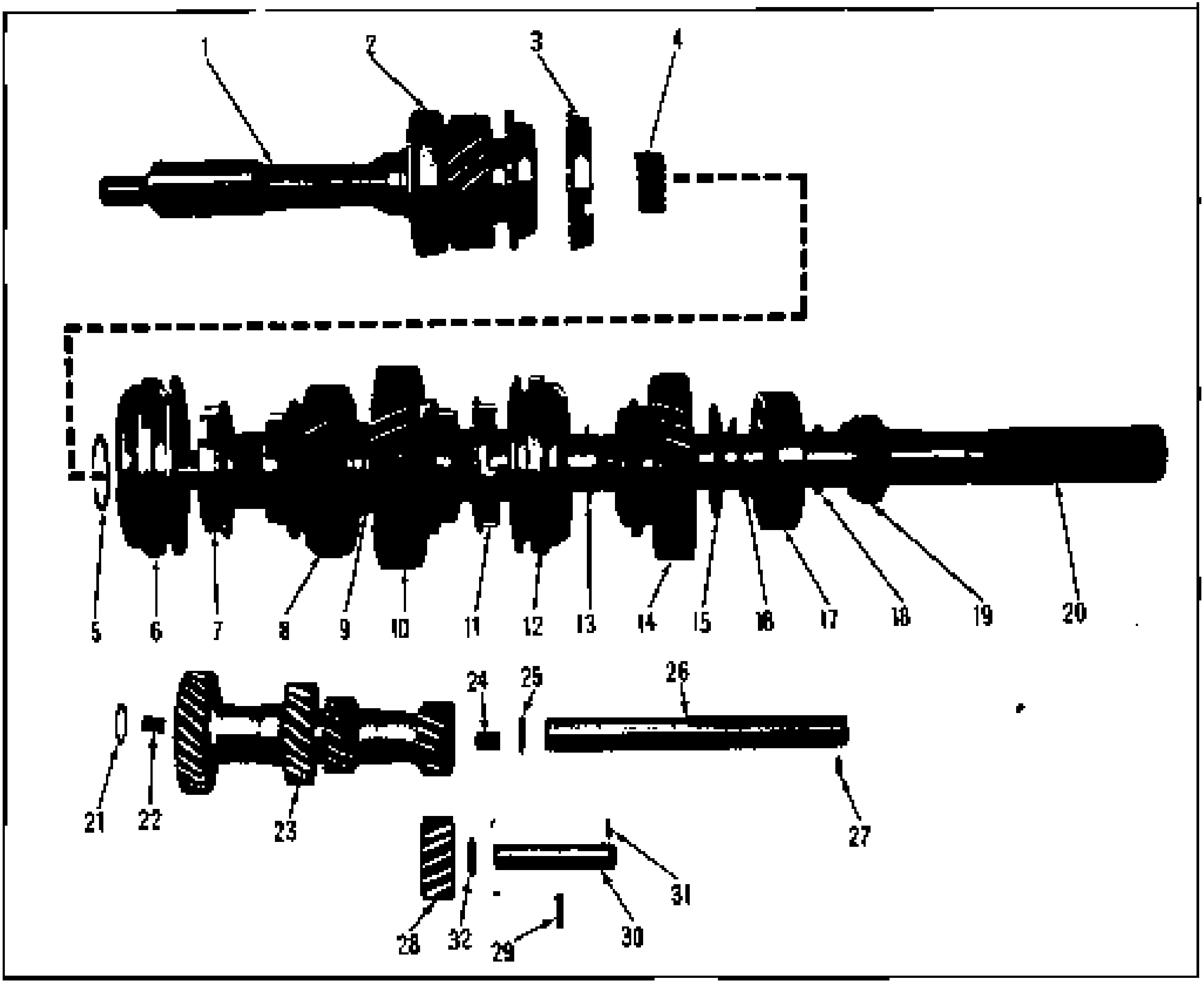


Fig. 7B-15 Removing Reverse Idler Gear Shaft



1. Main Drive Gear
2. Front Bearing
3. Third Speed Blocking Ring
4. Main Drive Gear Bearing Rollers (14)
5. Second-Third Synchronizer Snap Ring
6. Second-Third Synchronizer Assembly
7. Second Speed Blocking Ring
8. Second Speed Gear
9. Shoulder (Part of Mainshaft)
10. First Speed Gear
11. First Speed Blocking Ring
12. First Speed Synchronizer Assembly
13. First Speed Synchronizer Snap Ring
14. Reverse Gear
15. Reverse Gear Thrust Washer
16. Spring Washer (Reverse Gear)
17. Rear Bearing
18. Rear Bearing Snap Ring
19. Speedometer Drive Gear
20. Mainshaft
21. Thrust Washer - Front
22. Countergear Bearing Rollers (27)
23. Countergear
24. Countergear Bearing Rollers (27)
25. Thrust Washer - Rear
26. Countershaft
27. Woodruff Key
28. Reverse Idler Gear
29. Reverse Idler Gear Snap Ring
30. Reverse Idler Shaft
31. Woodruff Key
32. Reverse Idler Gear Thrust Washer

Fig. 7B-16 Mainshaft, Countergear and Reverse Idler Gear Details

CAUTION: Make certain notches in blocking ring align with keys in first speed synchronizer.

3. Turn the rear of the mainshaft upward and install reverse gear, thrust washer, spring washer and rear bearing (Fig. 7B-15).

NOTE: Groove on bearing must be toward reverse gear. Using hydraulic or arbor press and Press Plate J 8904, press rear bearing into position (Fig. 7B-25). Install retaining snap ring.

4. Place speedometer gear retainer into hole in output shaft.

5. Align slot in speedometer drive gear with retainer clip and slide gear into place.

6. Install second-third synchronizer sleeve (Fig. 7B-16).

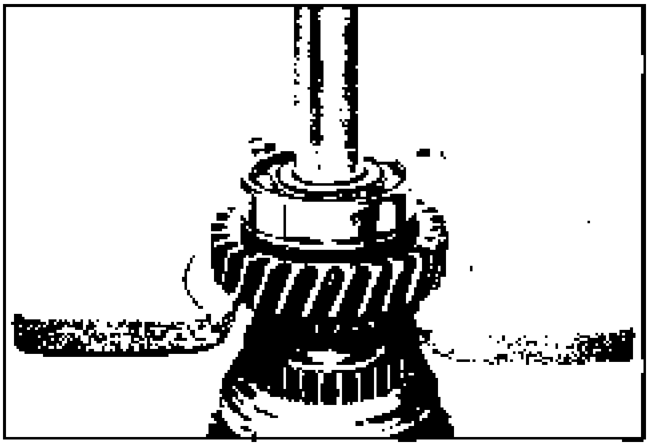


Fig. 7B-17 Removing Rear Bearing

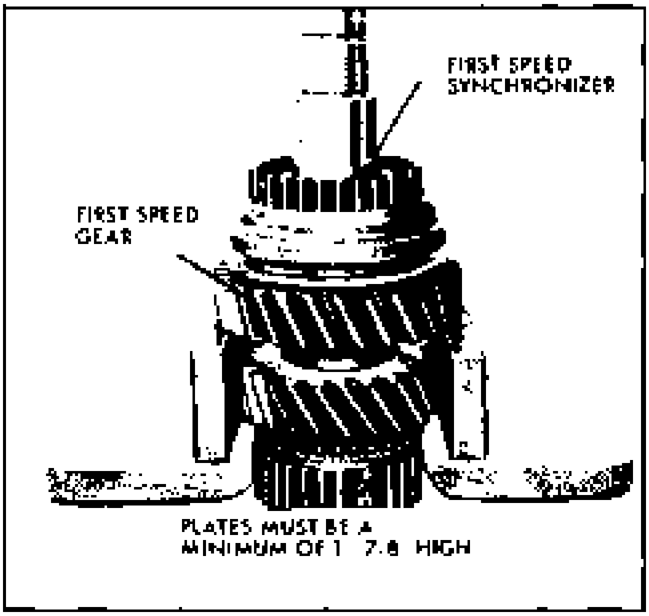


Fig. 7B-18 Removing First Speed Synchronizer and Gear

7. Install Countershaft Alignment Tool J 22246.

8. From each end of countergear, install 27 bearing rollers and spacer (Fig. 7B-21).

NOTE: Coat needle bearings with heavy grease before installing.

9. Install countergear to case bronze thrust washers.

10. Install countergear assembly into case. Install countergear shaft from rear of case. Make certain woodruff key is in position.

11. Install reverse idler gear tanged steel thrust washer. Install reverse idler gear, shaft and woodruff key.

NOTE: Reverse idler gear snap ring will be installed after installation of mainshaft.

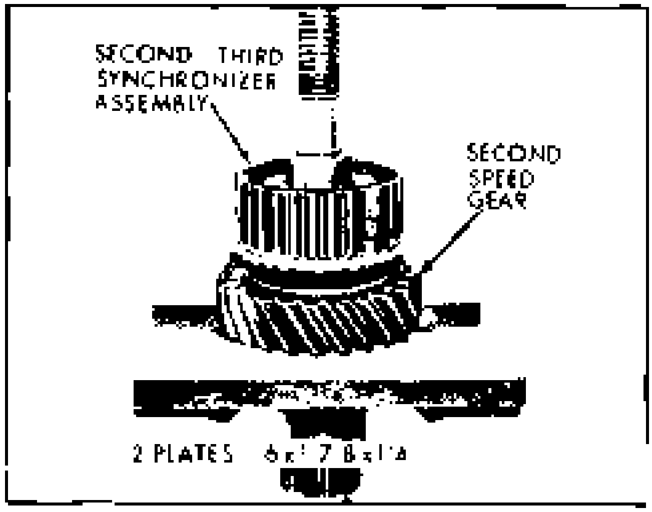


Fig. 7B-19 Removing Second - Third Synchronizer and Gear

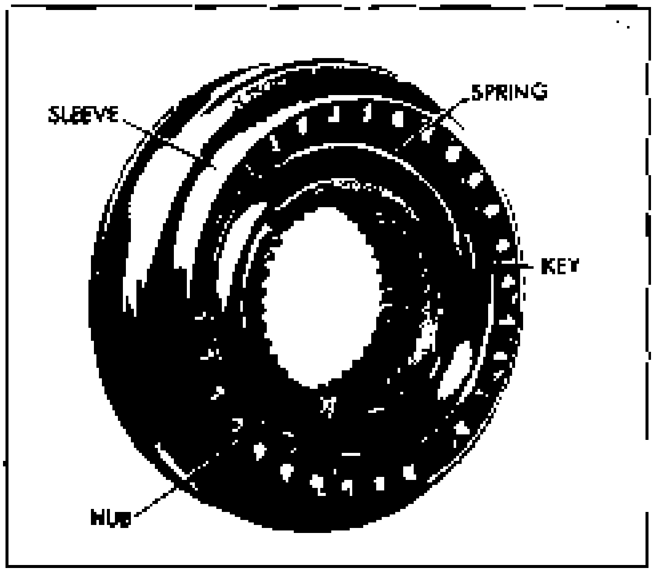


Fig. 7B-20 Synchronizer Assembly

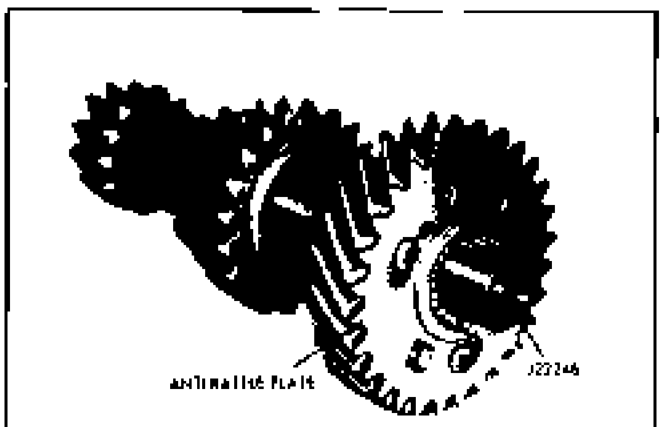


Fig. 7B-21 Loading Bearings into Countergear

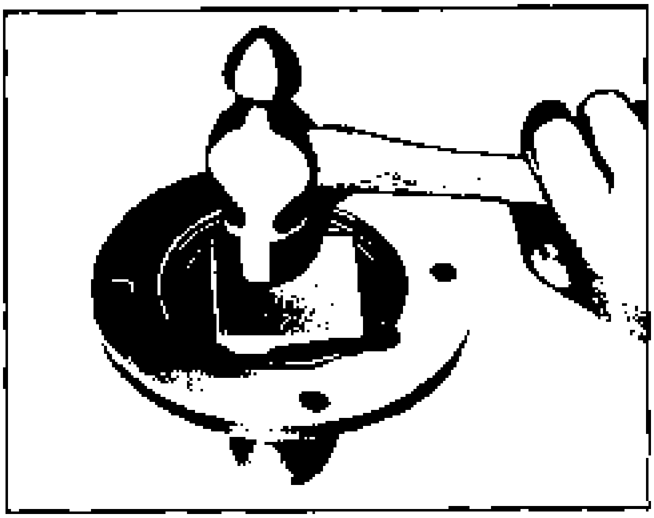


Fig. 7B-22 Installing Front Bearing Retainer Oil Seal

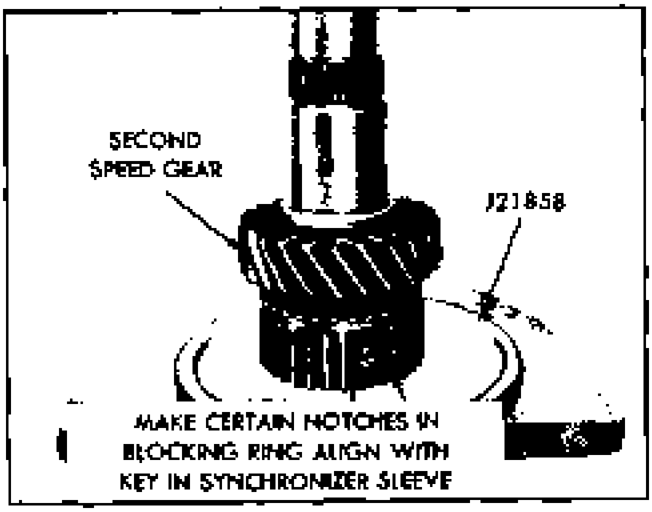


Fig. 7B-23 Installing Second - Third Speed Synchronizer and Gear

12. Install extension housing. Spread snap ring in housing to allow snap ring to drop around rear bearing (Fig. 7B-13). Press on end of mainshaft until snap ring engages groove in rear bearing.

13. Install fourteen (14) bearing rollers in the main drive gear, using heavy grease to hold bearings in place (Fig. 7B-26).

14. Assemble third speed blocking ring on main drive gear.

15. Pilot main drive gear and third speed blocking ring over front of mainshaft.

16. Using heavy grease, install extension housing to case gasket.

17. Install extension housing and mainshaft assembly

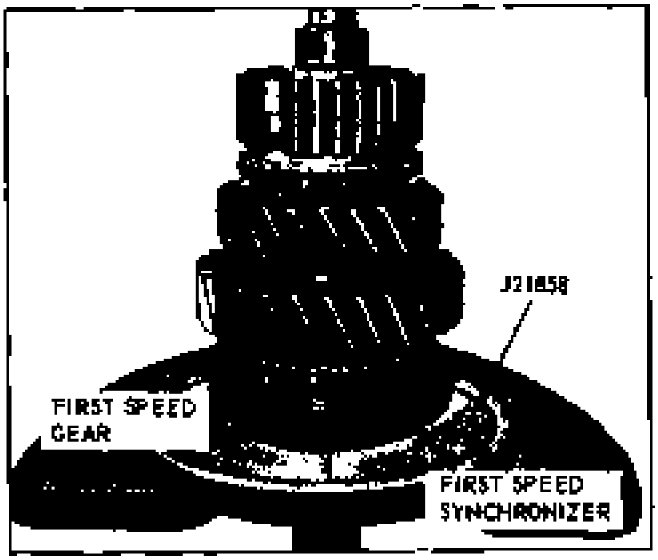


Fig. 7B-24 Installing First Speed Gear and Synchronizer

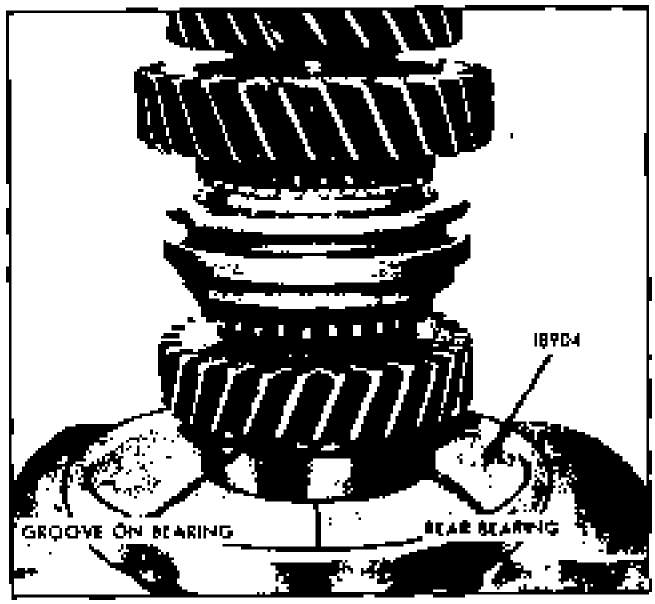


Fig. 7B-25 Installing Rear Bearing

into case. Install extension housing to case bolts. Torque to 45 lb. ft.

CAUTION: Make certain that notches in blocking ring align with keys in second-third synchronizer.

18. Install front bearing onto main drive gear. Outer snap ring groove must be toward front of gear.

19. Install retaining snap ring.

20. Install front bearing retainer, gasket and four attaching bolts, torquing bolts to 10 lb. ft.

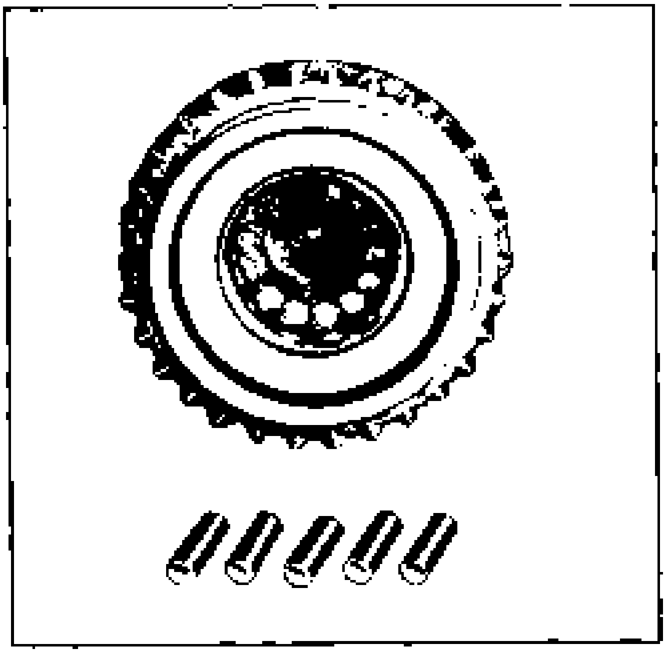


Fig. 7B-26 Loading Bearings Into Main Drive Gear

NOTE: The retainer oil return hole must be at bottom of case.

21. Install reverse idler gear snap ring.

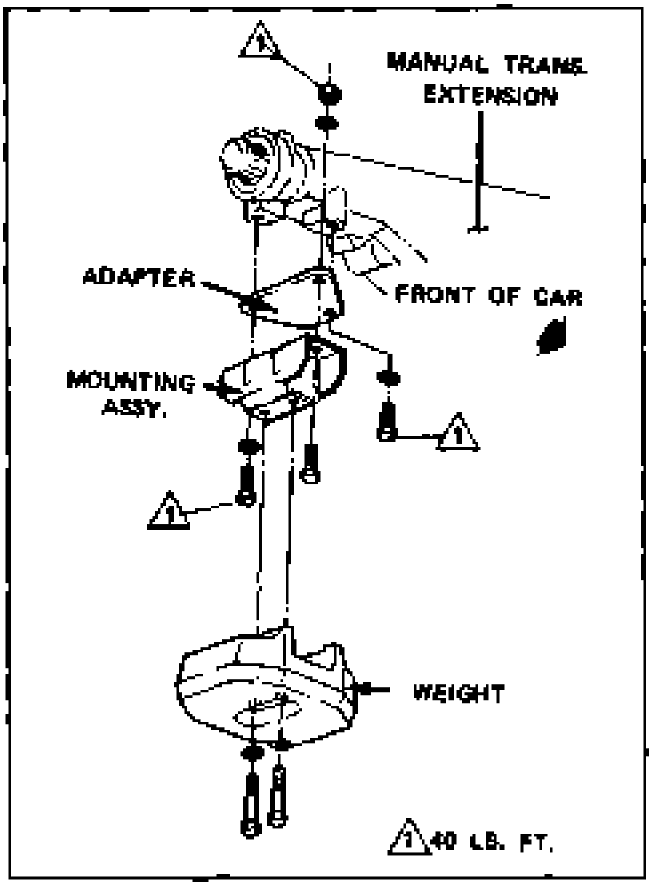


Fig. 7B-27 Drive Line Damper

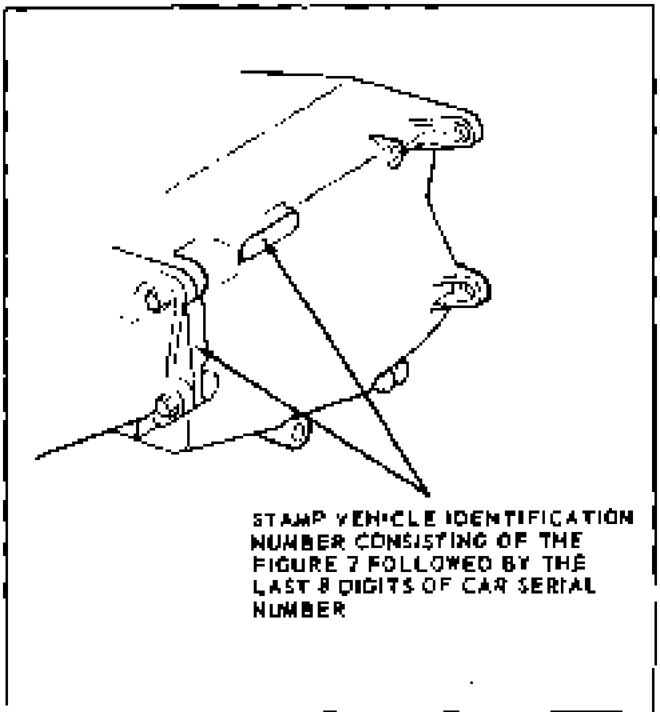


Fig. 7B-28 Vehicle Identification Number Location

22. Install new side cover gasket. Place transmission in neutral and install side cover. Secure with attaching bolts and torque evenly to 10 lb. ft. to avoid side cover distortion.

INSTALL

1. Install guide pin in upper right transmission to flywheel housing bolt hole for alignment and place transmission on guide pin. Rotate transmission as necessary to start main drive gear splines into clutch friction plate. Slide transmission forward.

NOTE: Make certain splines of clutch friction plate are concentric with pilot bearing in crankshaft and release bearing is properly installed.

2. Install two (2) lower transmission mounting bolts. Remove guide pins and install two (2) upper bolts. Torque bolts to 55 lb. ft.

3. Slide crossmember forward and install four (4) bolts. Torque to 25 lb. ft.

4. Install transmission mount and lower engine. Torque mount bolts to 30 lb. ft.

5. Install propeller shaft.

NOTE: On 6-cyl. Firebirds, install driveline damper (Fig. 7B-27).

6. Connect linkage and adjust as described in ON CAR ADJUSTMENTS.

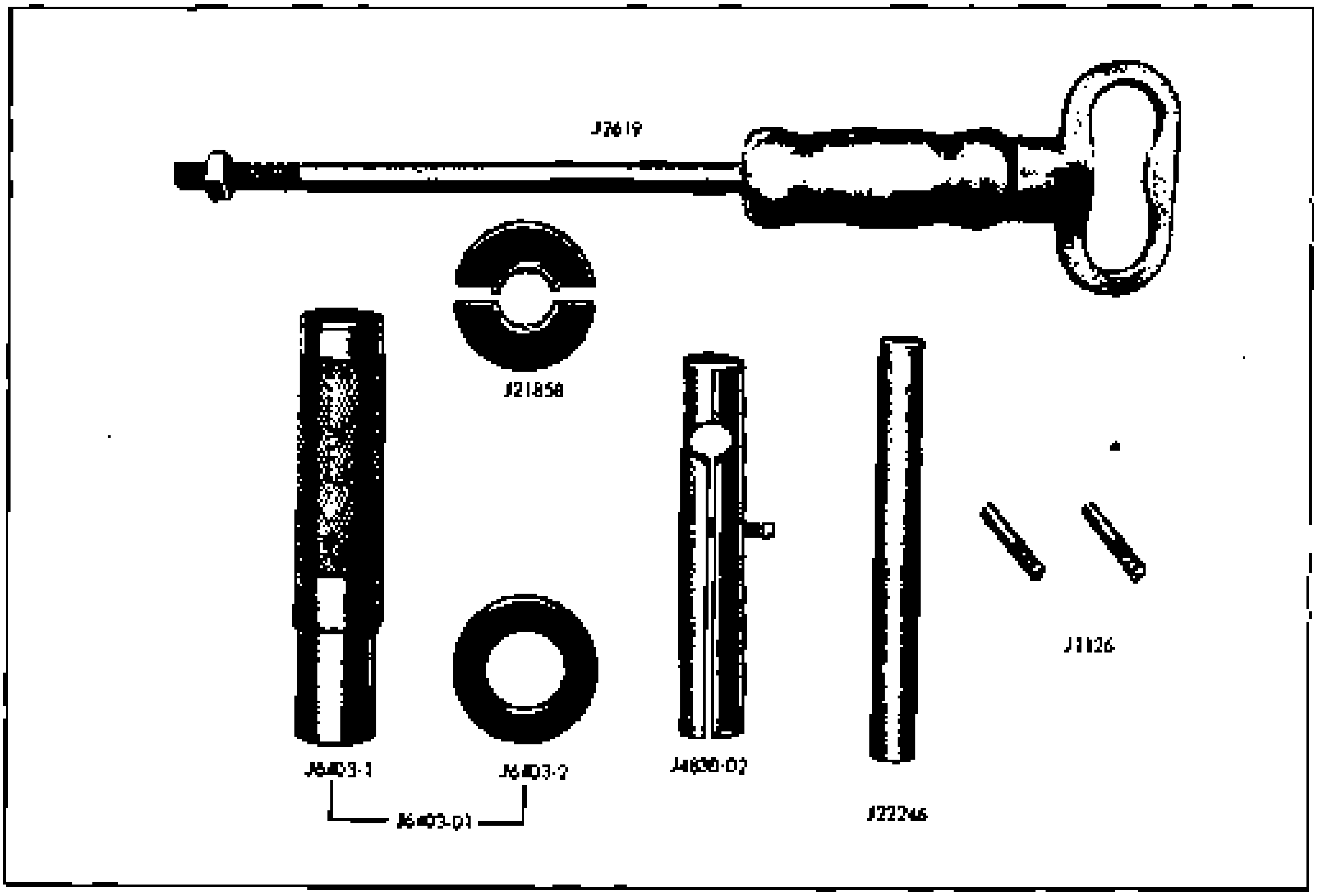
7. Connect speedometer cable.

8. Refill transmission with recommended lubricant.

FIREBIRD DRIVELINE DAMPER

A driveline damper is used to reduce power train vibration to an acceptable level. The damper is mounted under the rear of the transmission extension and consists of a weight retained by a mounting which, in turn, is attached to the underside of the transmission extension through an adapter (Fig. 7B-27).

SPECIAL TOOLS



J 1126	Aligning Studs	J 8904	Press Plate (Not Shown)
J 2619	Slide Hammer	J 21858	Adapter (Axle Shaft Bearing Remover)
J 4830-02	Extension Housing Bushing and Oil Seal Remover	J 22246	Countershaft Alignment Tool
J 6403-01	Extension Housing Bushing and Oil Seal Installer		

Fig. 7B-29 Special Tools

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

An identifying code is marked in yellow paint on all three speed manual transmissions. This code consists of two letters, 2 inches high, on the R.H. side of the transmission case.

TEMPEST	CODE
6-cyl. (column shift)	FA
6-cyl. (floor shift)	FB
8-cyl. (350 cu. in.)	FB

FIREBIRD	CODE
6-cyl. (column shift)	FK
6-cyl. (floor shift)	FY
8-cyl. (350 cu. in.)	RJ

A number derived from the vehicle identification number is also stamped on the transmission case as shown in Fig. 7B-27.

GEAR RATIOS

	6-CYL.	8-CYL.
First Speed		2.54:1
Second Speed	1.68:1	1.50:1
Third Speed	1.00:1	1.00:1
Reverse	2.95:1	2.63:1

LUBRICATION

Capacity . . . . 3½ pints

TORQUE SPECIFICATIONS

APPLICATION	LB. FT.
Front Bearing Retainer to Case Bolts	10
Side Cover to Case Bolts	10
Extension Housing to Case Bolts	45
Shift Lever to Shifter Shaft Bolts	15
Lubrication Filler Plug	15
Transmission Case to Flywheel Housing Bolts	55
Linkage Swivel Clamp Screws	20
Trunnion Jam Nuts	30
Damper Weight to Mounting Assembly Bolts	30
Mounting Assembly and Adapter to Extension Housing Bolts and Nut	30

FOUR-SPEED SAGINAW MANUAL TRANSMISSION

CONTENTS OF THIS SECTION

DESCRIPTION

The Saginaw 4-speed transmission is used on Firebirds when a 4-speed is ordered with the 6-cyl. engine. It has all forward gears synchronized with a constant mesh reverse idler.

Since the Saginaw 4-speed is very similar to the Saginaw 3-speed transmission, many operation procedures are the same. In such cases, a note will be made to refer to the Three Speed Saginaw Manual Transmission Section, Section 7B.

For all models, the steering column lock requires that the transmission be in "Reverse" gear before the ignition key may be removed. Also, the clutch safety switch will not permit engine cranking unless the clutch pedal is depressed far enough to completely disengage the clutch.

PERIODIC SERVICE

REFER TO SECTION 7B

ON CAR ADJUSTMENTS

FLOOR SHIFT AND BACK DRIVE LINKAGE (Fig. 7C-1 or 7C-2).

1. Position floor shift control lever in Neutral position.

2. Loosen adjusting swivel clamp on gearshift control rod (Fig. 7C-2).

3. Loosen trunnion jam nuts "X" and "Z" on transmission control rods (1st & 2nd and Reverse) and disconnect trunnion "Y" from its shifter assembly lever (view "A" of Fig. 7C-1).

4. Insert a .250-.249" diameter gage pin into shift assembly (view "B" of Fig. 7C-1).

NOTE: Gage pin in place will maintain shifter assembly in Neutral position.

5. If shift control lever is misaligned to its floor pan (console) opening (view "C" of 7C-1):

a. With console - loosen two attaching bolts, shifter assembly to shifter support, align shifter assembly to specifications shown in view "C" and tighten attaching bolts to specified torque (view "B").

b. Except console - loosen two attaching bolts, shifter assembly to shifter support, align shifter assembly centrally in its floor boot and tighten s attaching bolts to specified torque (view "B").

6. Position transmission shifter levers (1st and 2nd, 3rd and 4th and Reverse) in Neutral position and tighten trunnion jam nuts "X" and "Z" to 30 lb. ft. Align trunnion "Y" to hole in 3rd & 4th shifter assembly lever, insert trunnion in lever and retain with washer and cotter pin.

7. Remove gage pin and check complete shift pattern for freeness of operation.

8. Position floor shift control lever in Reverse position, set steering column lower lever in Lock position and lock ignition.

9. Push up on gearshift control rod (Fig. 7C-2) to take up clearance in steering column lock mechanism and tighten nut of adjusting swivel clamp to 20 lb. ft.

MINOR REPAIRS

EXTENSION HOUSING SEAL

Refer to Section 7B.

EXTENSION HOUSING SEAL & BUSHING

Refer to Section 4B.

TRANSMISSION SIDE COVER

REMOVE

The following procedure may be performed with the transmission in or out of the car:

1. Disconnect linkage from shift levers on transmission, leaving it in neutral.

2. Loosen side cover bolts and allow transmission to drain.

3. Remove side cover from case.

4. Remove outer shifter levers.

5. Remove shift forks from shifter shaft assemblies. Remove all three shifter shaft assemblies. Remove reverse shifter shaft detent ball and spring (Fig. 7C-3).

6. Remove detent cam spring and pivot retainer C-ring. Mark to identify both detent cams and remove.

7. Inspect O-ring seals on shifter shafts. Replace any damaged parts.

REPLACE

1. Install shifter shaft O-rings if removed.

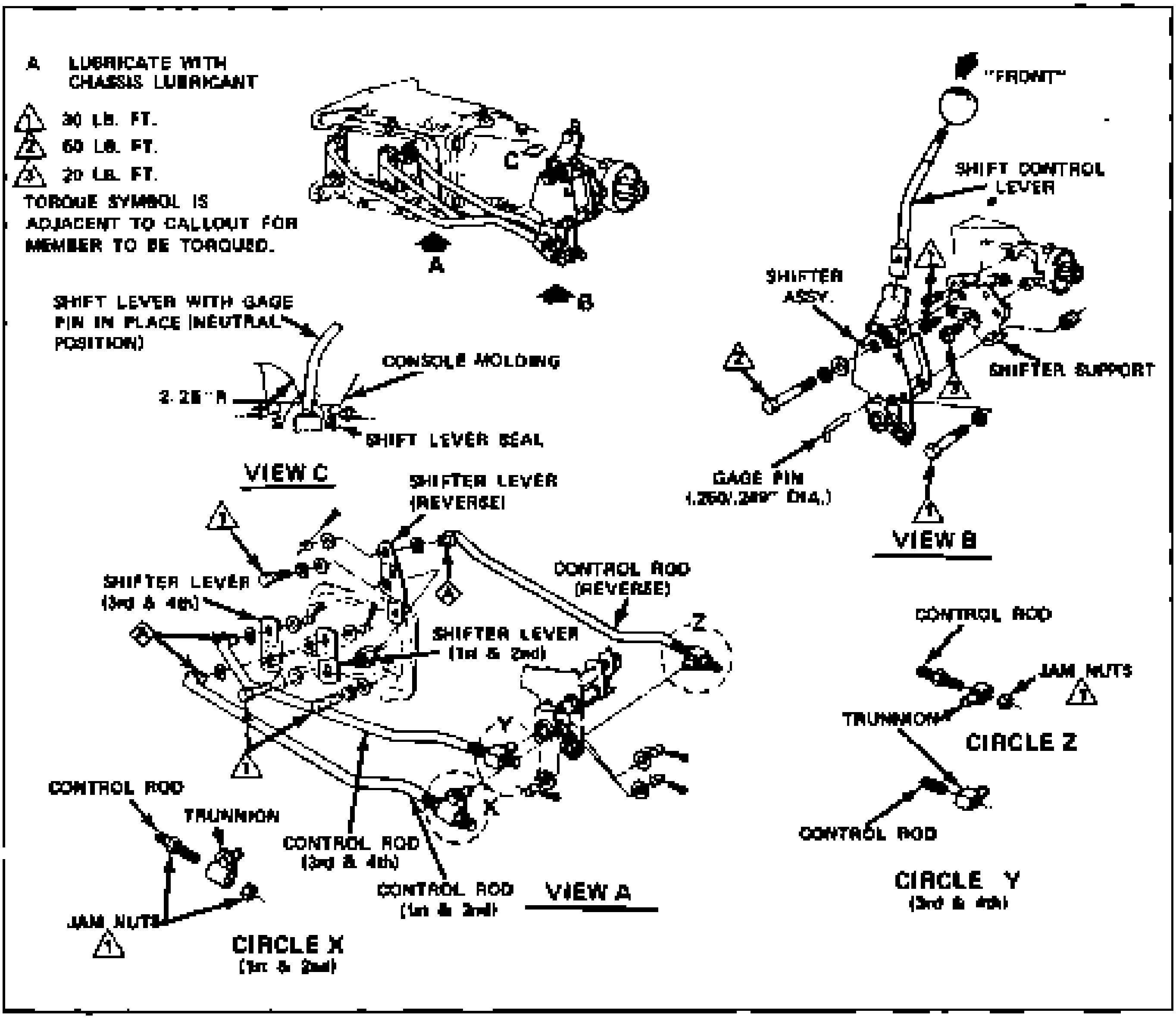


Fig. 7C-1 Firebird Shift Control

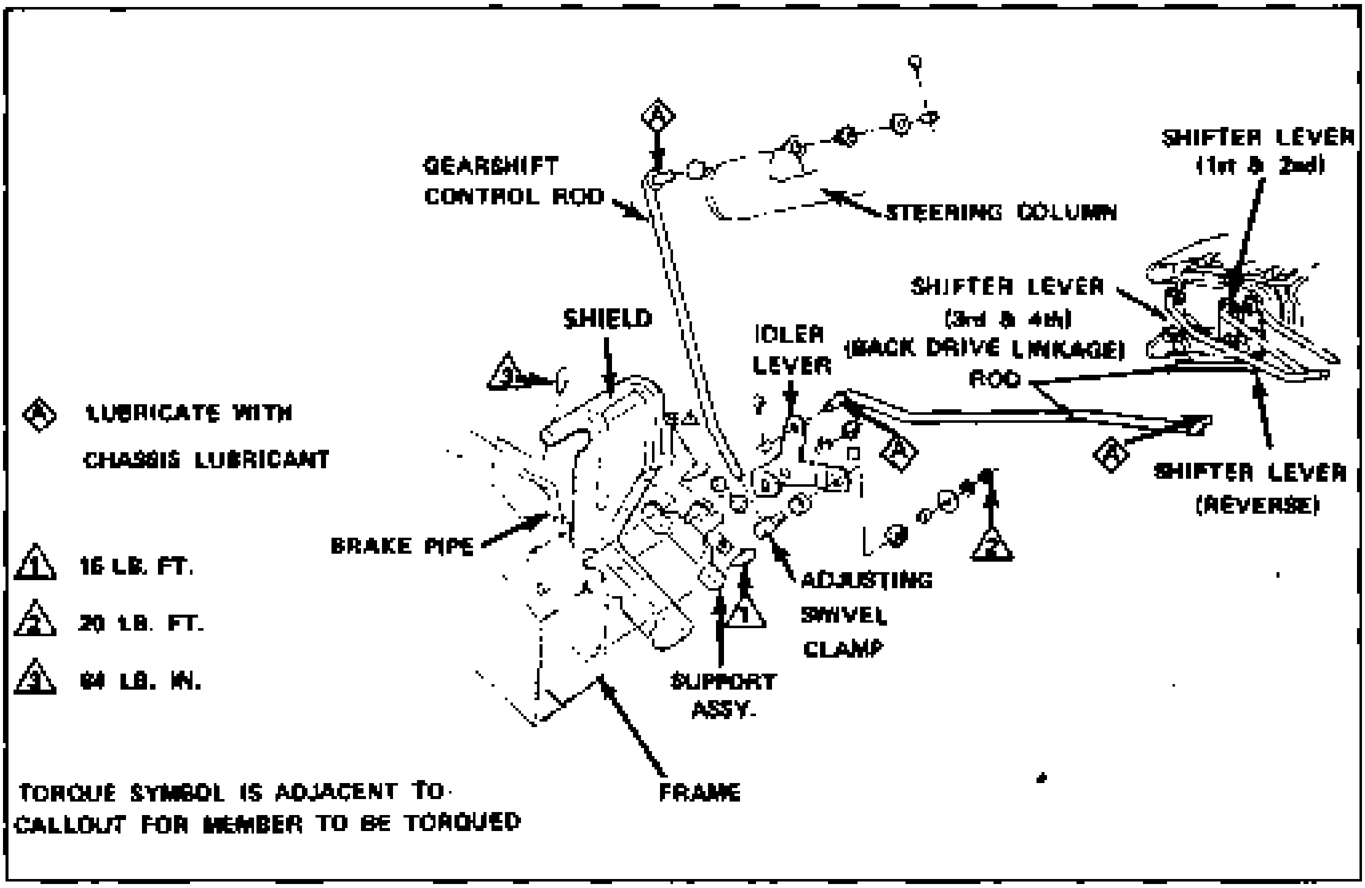


Fig. 7C-2 Firebird Back Drive Linkage

2. Install the lst and 2nd detent cam onto the detent cam pivot pin, with the detent cam spring tang projecting up over the 3rd and 4th shifter shaft opening. Install the 3rd and 4th detent cam onto the detent cam pivot pin, with the detent cam spring tang up over the lst and 2nd shifter shaft opening.

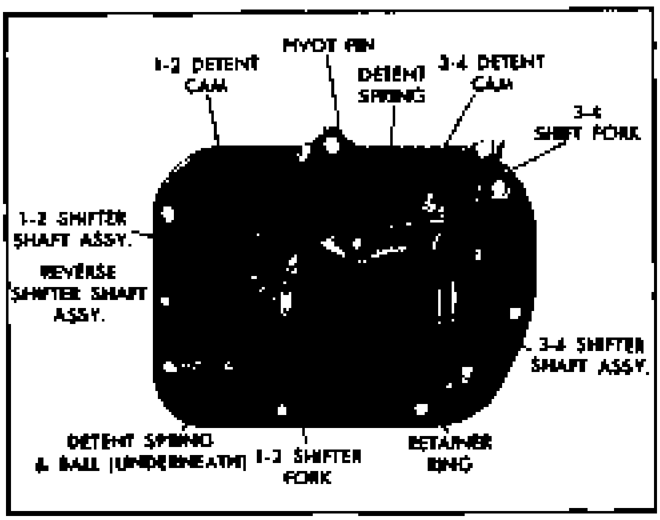


Fig. 7C-3 Side Cover Assembly

NOTE: Detent cams are not interchangeable.

3. Install pivot retainer C-ring to pivot shaft and hook spring into notches in detent cam spring tangs.

4. Install lst-2nd and 3rd-4th shifter shaft assemblies in cover, being careful not to damage seals. Install shift forks to shifter shafts, lifting up on detent cams to allow forks to seat fully.

NOTE: Shift forks are not interchangeable.

5. Install reverse detent ball and spring to cover, then install reverse shifter shaft to cover.

6. Install outer shifter levers, flat washer, lock washers and bolts.

7. Position shift forks in neutral position.

8. Position cover gasket on case and carefully position side cover into place, making sure the shift forks align with their respective sliding sleeves.

9. Install cover attaching bolts and torque evenly to 20 lb. ft.

10. Remove filler plug and add 3 1/2 pints of SAE 80 or 90 multi-purpose gear lubricant.

MAJOR REPAIRS

TRANSMISSION

REMOVE

Refer to Section 7B.

DISASSEMBLE

1. Remove side cover attaching bolts, drain lubricant and remove side cover and gasket.

2. Remove front bearing retainer and gasket.

3. Remove front bearing to main drive gear snap ring.

4. Pull main drive gear out of case as far as possible and remove front bearing (Fig. 7C-5).

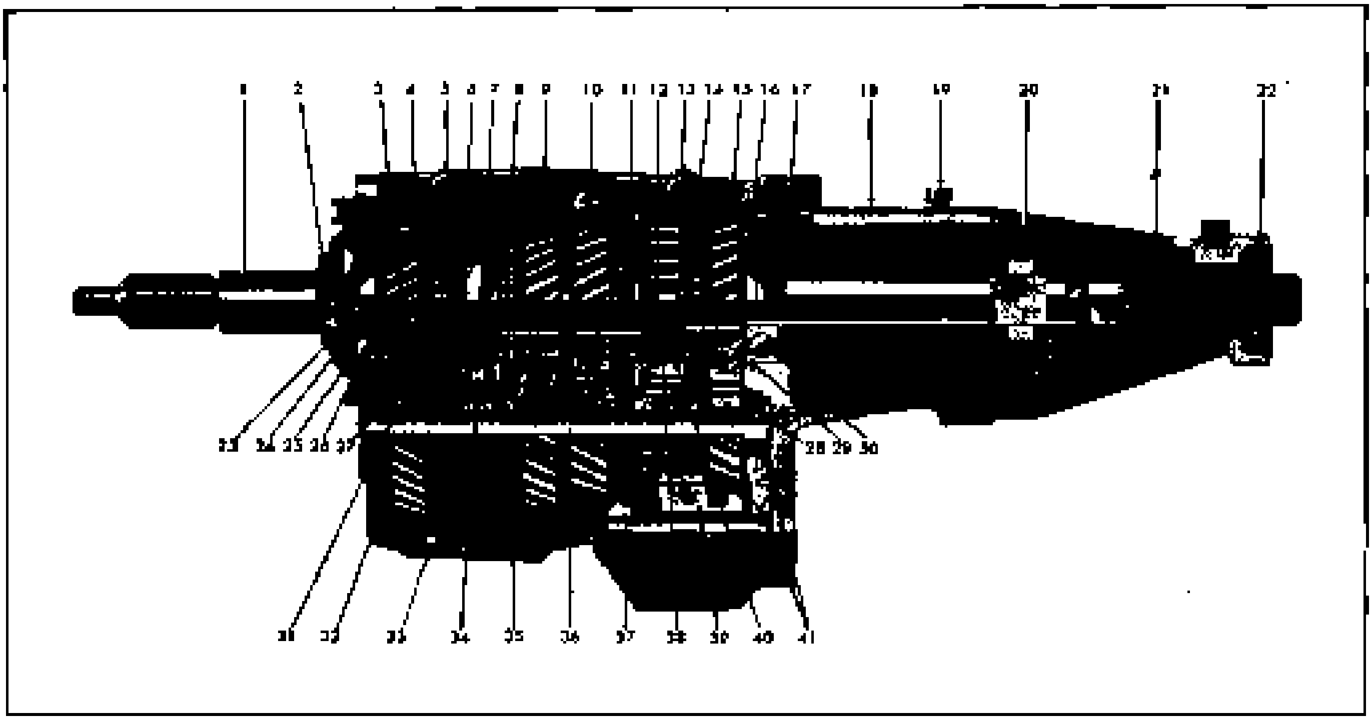
NOTE: Although front bearing is a slip fit on main drive gear, it may be necessary to aid removal with screwdriver.

5. Remove extension housing to case attaching bolts.

6. From rear of case, remove extension housing and mainshaft assembly (Fig. 7C-6).

7. Remove main drive gear and fourth speed blocking ring from inside of case and remove 14 bearing rollers from main drive gear.

8. Using snap ring pliers, expand snap ring at rear of extension housing which retains extension housing to mainshaft (Fig. 7C-7) and remove extension housing.



1. Main Drive Gear
2. Front Bearing Retainer
3. Bearing Roller
4. Case
5. 4th Speed Blocking Ring
6. 3rd & 4th Synchronizer Snap Ring
7. 3rd & 4th Synchronizer Hub
8. Blocking Ring
9. Third Speed Gear
10. Second Speed Gear
11. Blocking Ring
12. 1st & 2nd Synchronizer Hub
13. 1st & 2nd Synchronizer Snap Ring
14. 1st Speed Blocking Ring
15. First Speed Gear
16. Reverse Gear Thrust and Spring Washers
17. Bearing-to-Mainshaft Snap Ring
18. Extension Housing
19. Vent
20. Speedometer Drive Gear
21. Mainshaft
22. Rear Oil Seal
23. Bearing Retainer Oil Seal
24. Bearing-to-Gear Snap Ring
25. Front Bearing
26. Bearing-to-Case Snap Ring
27. Front Thrust Washer
28. Rear Thrust Washer
29. Bearing-to-Extension Snap Ring
30. Rear Bearing
31. Countergear Bearing Roller
32. Anti-Rattle Plate Assembly
33. Magnet
34. 3rd & 4th Synchronizer Sleeve (Sliding)
35. Countergear Assembly
36. Countershaft
37. Reverse Idler Shaft
38. 1st & 2nd Speed Synchronizer Sleeve and Reverse Gear
39. Reverse Idler Gear
40. Clutch Keys
41. Woodruff Key

Fig. 7C-4 Side View of Transmission

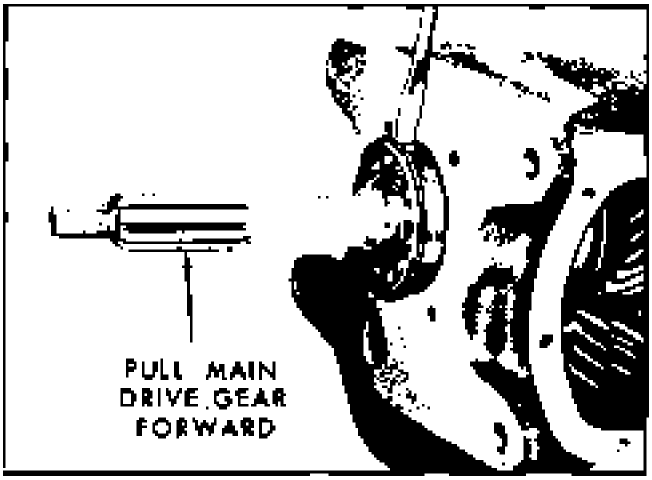


Fig. 7C-5 Removing Front Bearing

9. Using Countershaft Alignment Tool J 22246, tap out countergear shaft and its woodruff key through rear of case (Fig. 7C-8) and remove countergear and 2 tanged thrust washers.

NOTE: At this point, Tool J 22246 may be left in to hold the roller bearings in place or be taken out in which case 27 roller bearings and a spacer must be removed from each end of the shaft.

10. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and woodruff key through rear of the case (Fig. 7C-9).

11. Remove 3rd and 4th synchronizer snap ring (Fig. 7C-4).

12. Support third speed gear with press plates and press on front of mainshaft to remove synchronizer assembly, third gear blocker ring and third speed gear from mainshaft (Fig. 7C-10).

13. Remove rear bearing snap ring from mainshaft (Fig. 7C-3).

Fig. 7C-6 Removing Mainshaft

Fig. 7C-7 Expanding Extension Housing Snap Ring

14. Remove speedometer gear by depressing retainer clip and sliding gear off output shaft.

15. Support first gear with press plates and press on rear of main shaft to remove first gear, thrust washer, spring washer, rear bearing and snap ring (Fig. 7C-11).

16. Remove the 1st and 2nd synchronizer snap ring from mainshaft and press synchronizer assembly, 2nd speed blocker ring and second speed gear off end of mainshaft (Fig. 7C-12).

CLEANING AND INSPECTION

Refer to Section 7B.

ASSEMBLE

Turn the front of the mainshaft upward and install the following components:

1. Install third speed gear with clutching teeth upward; rear face of gear will butt against the flange on the mainshaft.

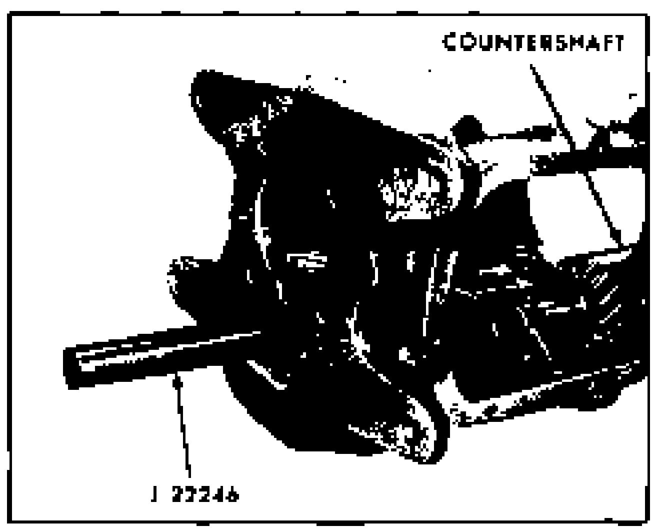


Fig. 7C-8 Removing or Installing Countershaft

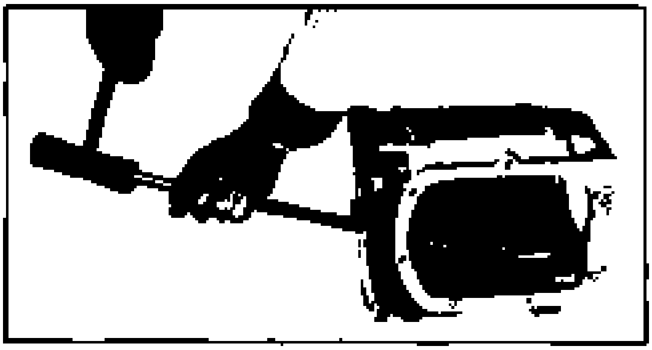


Fig. 7C-9 Removing Reverse Idler Gear Shaft

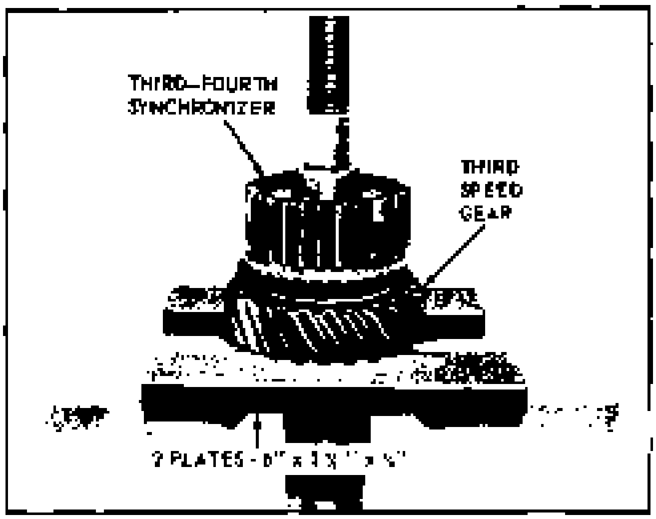


Fig. 7C-10 Removing 3rd and 4th Synchronizer and Gear

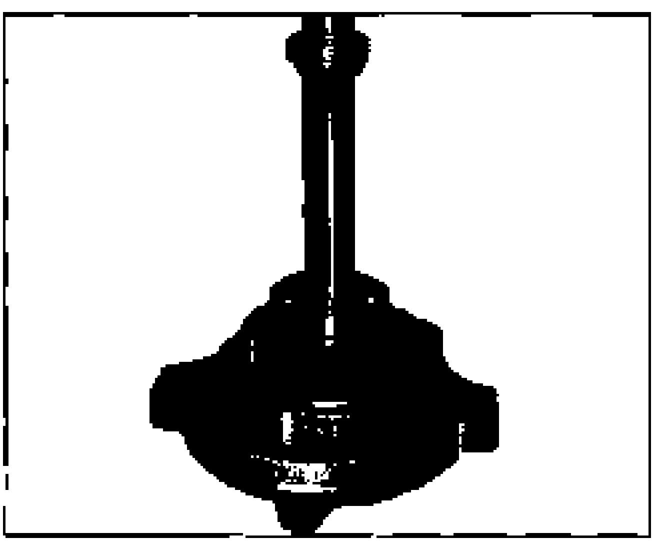


Fig. 7C-11 Removing Rear Bearing and First Speed Gear

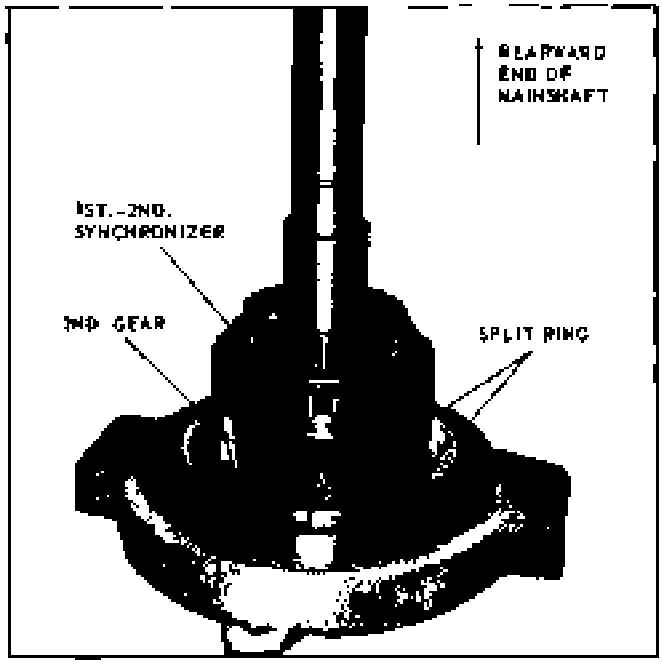


Fig. 7C-12 Removing 1st and 2nd Synchronizer and Second Gear

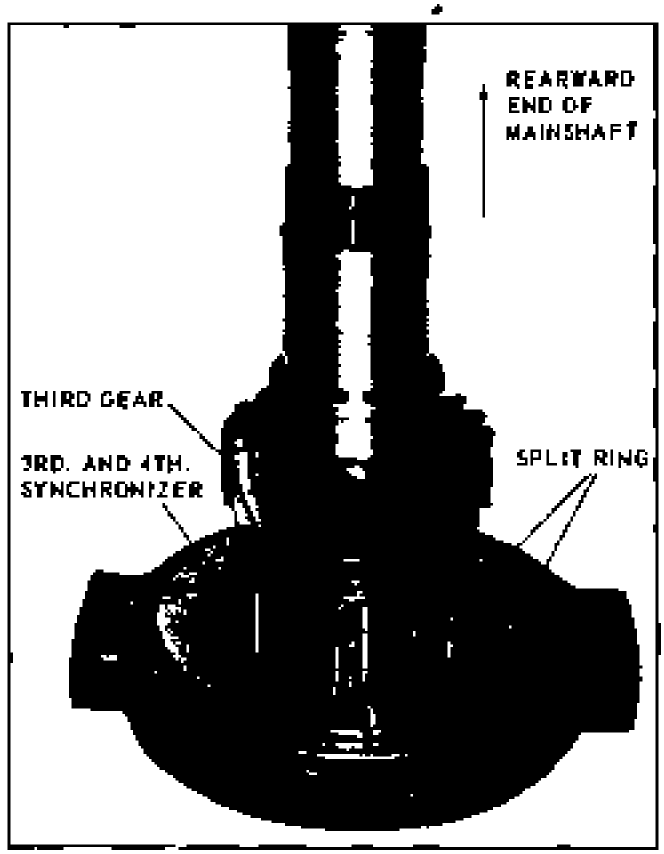


Fig. 7C-13 Installing 3rd and 4th Synchronizer and Third Gear

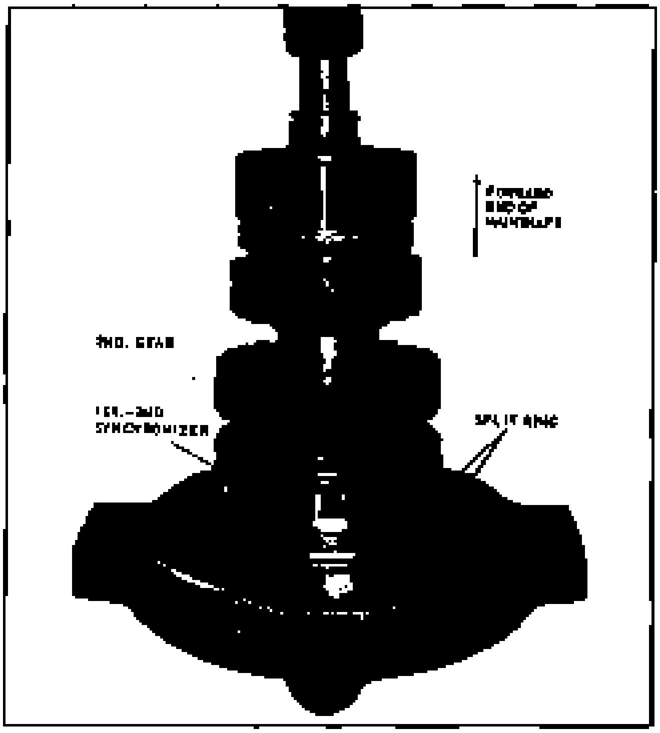


Fig. 7C-14 Installing 1st and 2nd Synchronizer and Second Gear

2. Install a blocking ring with clutching teeth downward over synchronizing surface of the third speed gear.

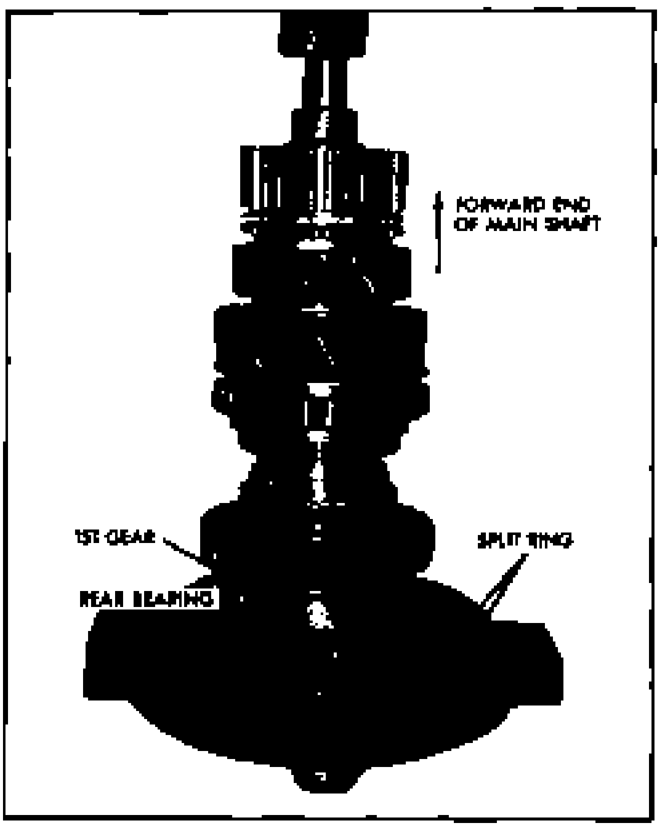


Fig. 7C-15 Installing Rear Bearing

NOTE: All 4 blocking rings in the transmission are the same and interchangeable.

3. Install 3rd and 4th synchronizer assembly with the fork slot downward, pressing it onto splines on the mainshaft until it bottoms out (Fig. 7C-13).

CAUTION: Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

4. Install 3rd and 4th synchronizer snap ring. Both synchronizer snap rings are the same.

5. Turn the rear of the mainshaft upward and install second speed gear with clutching teeth upward; front of gear will butt against flange on mainshaft.

6. Install blocker ring with clutching teeth downward over synchronizing surface of second gear.

7. With fork slot downward, press 1st and 2nd synchronizer assembly onto splines of mainshaft (Fig. 7C-14).

CAUTION: Be sure notches of blocker ring align with keys of synchronizer assembly.

8. Install 1st and 2nd synchronizer snap ring (Fig. 7C-3).

9. Install blocker ring with notches downward so they align with keys of 1st and 2nd synchronizer assembly.

Fig. 7C-16 Loading Bearings into Main Drive Gear

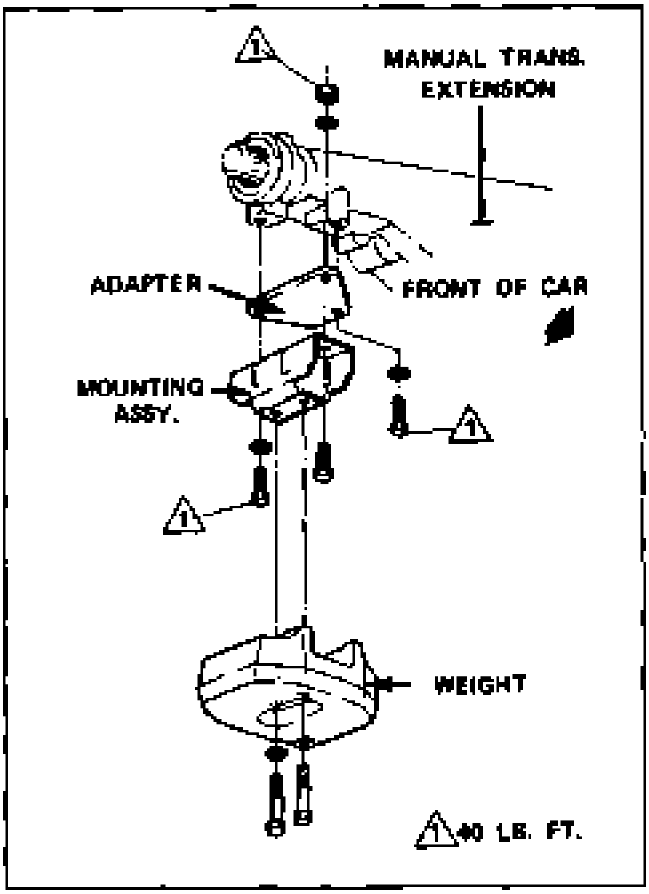


Fig. 7C-17 Drive Line Damper

10. Install first gear with clutching teeth downward.

11. Install first gear thrust washer (steel) and spring washer.

12. With snap ring slot downward, press rear bearing onto mainshaft (Fig. 7C-15).

13. Install rear bearing snap ring (Fig. 7C-4).

14. Place speedometer gear retainer in output shaft.

15. Align slot in speedometer drive gear with retainer clip and slide gear into place.

16. Install Countershaft Alignment Tool J 22246.

17. From each end of countergear, install 27 bearing rollers and spacer.

NOTE: Coat needle bearings with heavy grease before installing.

18. Install countergear to cast bronze thrust washer.

19. Install countergear assembly into case. Install countergear shaft from rear of case, making certain woodruff key is in position.

20. Install reverse idler gear, shaft and woodruff key from rear of case.

21. Install extension housing. Spread snap ring in housing to allow snap ring to drop around rear bearing (Fig. 7C-7). Press on end of mainshaft until snap ring engages groove in rear bearing.

22. Install fourteen (14) bearing rollers in main drive gear, using heavy grease to hold bearings in place (Fig. 7C-16).

23. Assemble fourth speed blocking ring on main drive gear.

24. Pilot main drive gear and fourth speed blocking ring over front of mainshaft.

CAUTION: Make certain notches in blocking ring align with keys in third-fourth synchronizer.

25. Using heavy grease, install rear bearing retainer to case gasket.

26. Install extension housing and mainshaft assembly into case. Install extension housing to case bolts, torquing to 45 lb. ft.

27. Install front bearing onto main drive gear. Outer snap ring groove must be toward front of gear.

28. Install retaining snap ring.

29. Install front bearing retainer, gasket and four attaching bolts, torquing bolts to 10 lb. ft.

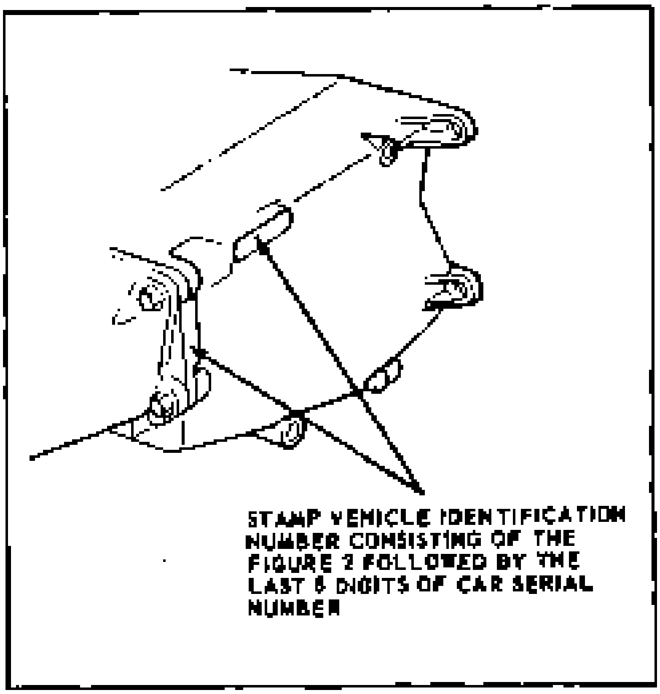


Fig. 7C-18 Vehicle Identification Number Location

NOTE: The retainer oil return hole must be at bottom of case.

30. Install new side cover gasket, place transmission in neutral and install side cover. Secure with attaching bolts and torque evenly to 10 lb. ft. to avoid side cover distortion.

INSTALL

Refer to Section 7B.

DRIVELINE DAMPER

A driveline damper is used to reduce power train vibration to an acceptable level. The damper is mounted under the rear of the transmission extension and consists of a weight retained by a mounting which, in turn, is attached to the underside of the transmission extension through an adapter (Fig. 7C-17).

SPECIFICATIONS

TRANSMISSION IDENTIFICATION

An identifying code is marked in yellow paint on all four speed manual transmissions. This code consists of two letters, one inch high, on the RH side of the case.

The letters FH identify the Firebird Saginaw four-speed transmission.

The vehicle identification number is also stamped on the transmission case as shown in Fig. 7C-17.

GEAR RATIOS

Firebird	
3.11:1	First
2.20:1	Second
1.47:1	Third
1.00:1	Fourth
3.11:1	Reverse

LUBRICATION

Capacity .... 3½ pints

TORQUE SPECIFICATIONS

APPLICATION	LB. FT.
Front Bearing Retainer to Case Bolts	10
Side Cover to Case Bolts	20
Extension Housing to Case Bolts	45
Shift Lever to Shifter Shaft Bolts	30
Lubrication Filler Plug	15
Transmission Case to Flywheel Housing Bolts	55

SPECIAL TOOLS

Refer to Section 7B.

FOUR-SPEED MUNCIE MANUAL TRANSMISSION

CONTENTS OF THIS SECTION

DESCRIPTION

The Muncie 4-speed transmission is used with all eight cylinder engines and Tempest six cylinder engines when a 4-speed transmission is specified. It can be distinguished from the Saginaw 4-speed in that the reverse lever on the Muncie is mounted in the extension housing, where on the Saginaw it is mounted in the side cover.

For all models, the steering column lock requires that the transmission be in "Reverse" gear before the ignition key may be removed. Also, the clutch safety switch will not permit engine cranking unless the clutch pedal is depressed far enough to completely disengage the clutch

PERIODIC SERVICE

TRANSMISSION

No periodic service of the transmission is required except checking for leaks and proper lubricant level every 60 days.

If there is evidence of leakage, the leak should be corrected and lubricant added, if needed. Refill capacity is 2 1/2 pints

Remove filler plug at side of case and add SAE 90 multi-purpose gear lubricant. Lubricant level should be approximately level with bottom of filler plug hole. Install plug.

SHIFT CONTROL

No periodic service of the shift control is required. Certain parts are lubricated on assembly and require further lubrication only when parts become dry and sticky.

ON CAR ADJUSTMENTS

FLOOR SHIFT AND BACK DRIVE LINKAGE (Figs. 7D-1 or 7D-2 and 7D-3A or -3B)

1. Position floor shift control lever in Neutral position.

2. Loosen adjusting swivel clamp on gearshift control rod (Fig. 7D-3A or -3B).

3. Tempest and Grand Prix - Loosen trunnion jam nuts "X", "Y" and "Z" on transmission control rods (view "A" of Fig. 7D-1).

Firebird - Loosen trunnion jam nuts "X" and "Z" on transmission control rods (1st and 2nd and Reverse) and disconnect trunnion "Y" from its shifter assembly lever (view "A" of Fig. 7D-2).

4. Insert a .250-.249" diameter gage pin into shifter assembly (view "B" of Figs. 7D-1 or 7D-2).

5. If shift control lever is misaligned to its floor pan (console) opening (view "C" of Figs. 7D-1 or 7D-2):

a. With console - Loosen attaching bolts, shifter assembly to shifter support, align shifter assembly to specifications shown in view "C" and tighten attaching bolts to specified torque (view "B").

b. Except console - Loosen attaching bolts, shifter assembly to shifter support, align shifter assembly centrally in its floor boot and tighten attaching bolts to specified torque (view "B").

6. Tempest and Grand Prix - Position transmission shifter levers (1st and 2nd, 3rd and 4th and Reverse) in Neutral position and tighten jam nuts "X", "Y" and "Z" to 30 lb. ft.

Firebird - Position transmission shifter levers (1st and 2nd, 3rd and 4th and Reverse) in Neutral position and

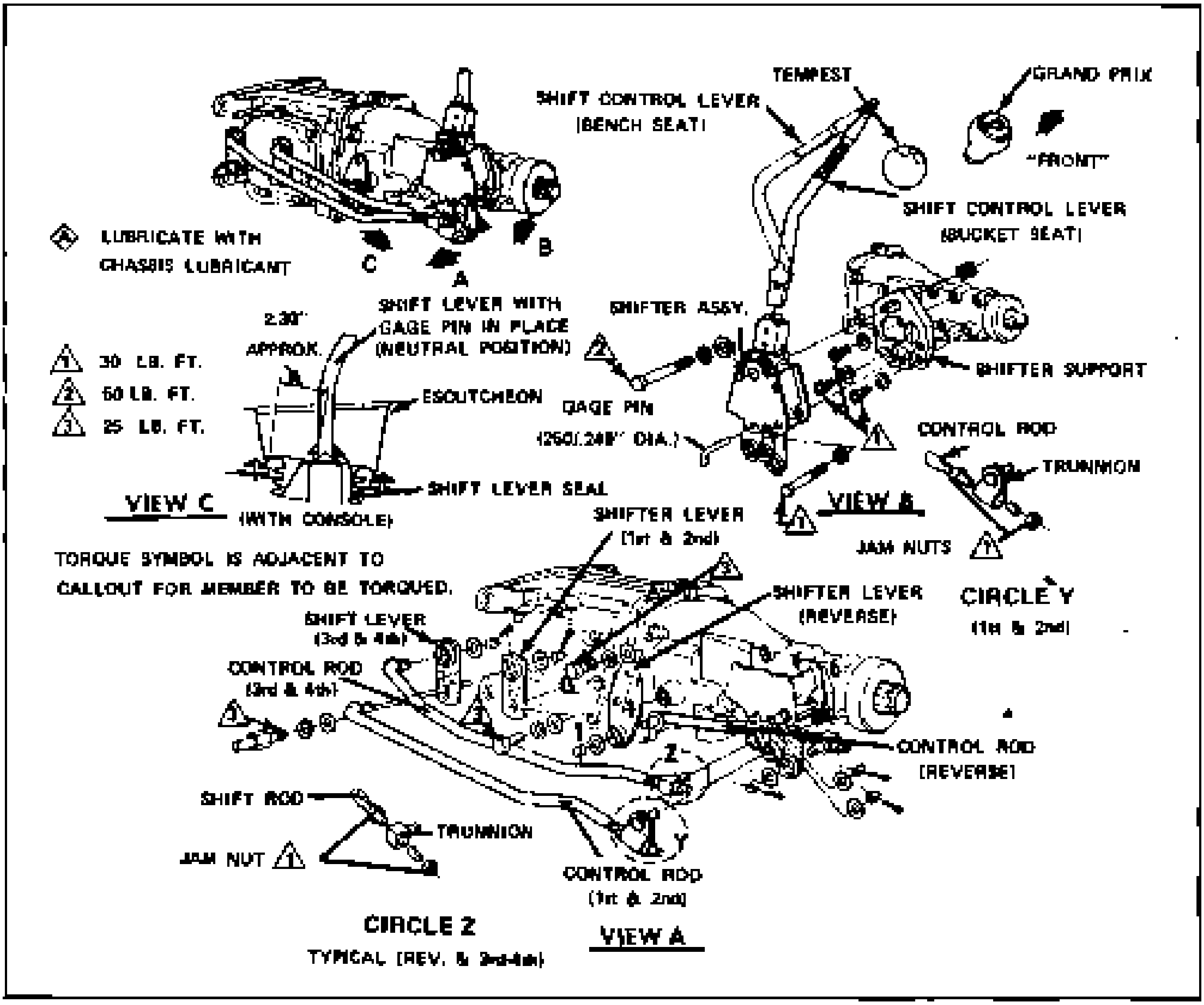


Fig. 7D-1 Tempest and Grand Prix Shift Controls

tighten trunnion jam nuts "X" and "Z" to 30 lb. ft. Align trunnion "Y" to hole in 3rd and 4th shifter assembly lever, insert trunnion in lever and retain with washer and cotter pin.

7. Remove gage pin and check complete shift pattern for freeness of operation.

8. Position floor shift control lever in Reverse position, set steering column lower lever in Lock position and lock ignition.

9. Push up on gearshift control rod (Fig. 7D-3A or -3B) to take up clearance in steering column lock mechanism and tighten nut (or screw) of adjusting swivel clamp to 20 lb. ft.

MINOR REPAIRS

SPEEDOMETER DRIVEN GEAR

REMOVE

1. Disconnect speedometer cable.

2. Remove retainer to housing bolt and lockwasher and remove retainer.

3. Insert screwdriver in slot in fitting and pry fitting, gear and shaft from housing.

4. Pry O-ring from groove in fitting and discard.

5. Check gear, shaft and fitting for wear and replace, if necessary.

NOTE: Check for correct usage by referring to speedometer drive and driven gear usage chart in Section 0.

REPLACE

1. Install new O-ring in groove and insert shaft.

2. Hold the assembly so slot in fitting is toward boss on housing and install in housing.

3. Push fitting into housing until retainer can be inserted into slot.

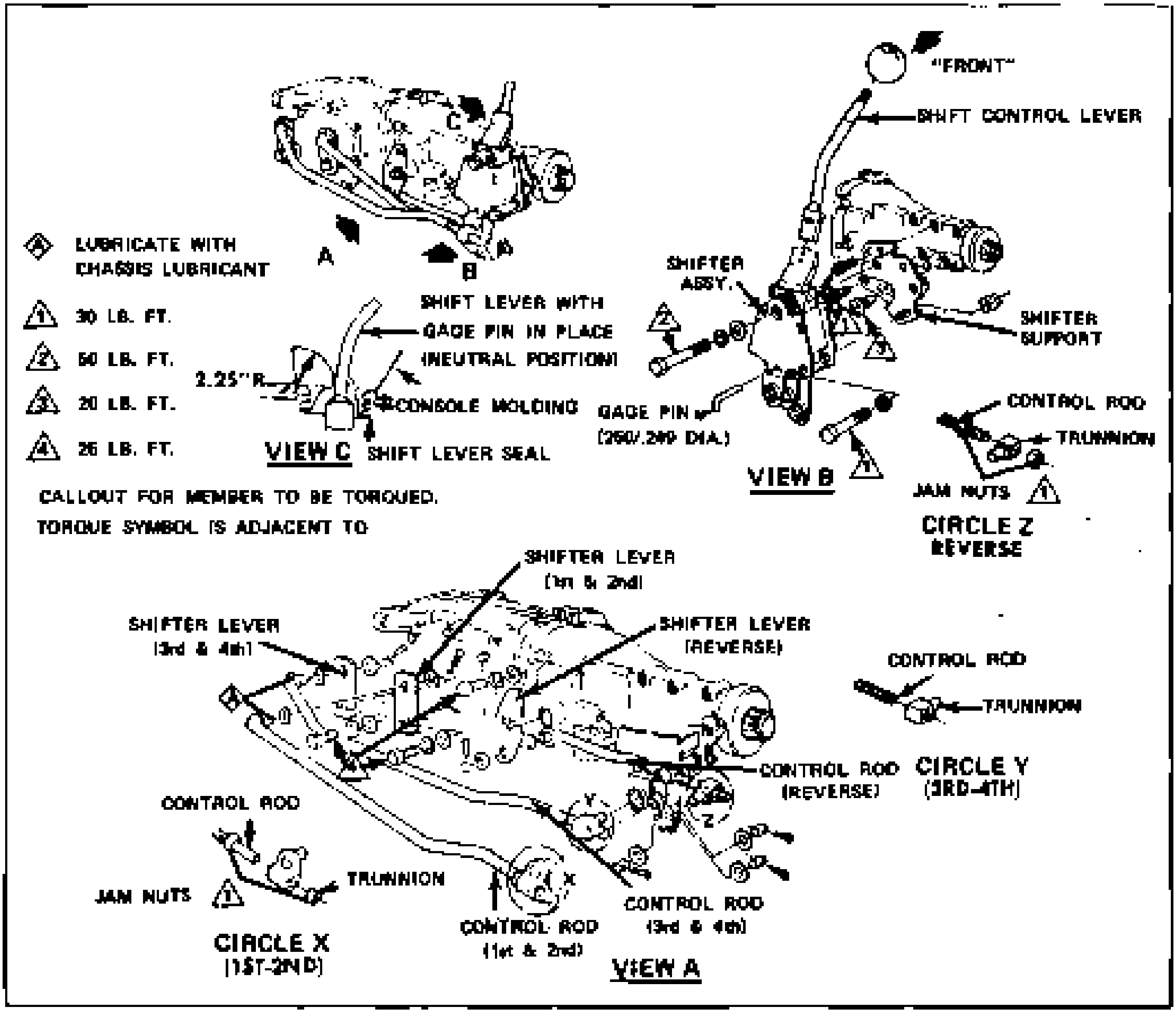


Fig. 7D-2 Firebird Shift Controls

4. Install retainer bolt and lockwasher and tighten to 4 lb. ft. torque.

5. Connect speedometer cable to speedometer driven gear and sleeve assembly.

TRANSMISSION EXTENSION OIL SEAL

REMOVE AND REPLACE

1. Remove U-bolt nuts, lock plates (or lockwashers) and U-bolts from rear axle drive pinion flange.

NOTE: If tie wire has been removed, use rubber band to hold bearings onto journals to prevent loss of needle bearings when rear joint is disconnected.

2. Slide propeller shaft assembly rearward to disengage yoke from splines on transmission mainshaft.

3. Use punch or other suitable tool to loosen oil seal from extension, remove and discard (Fig. 7D-4).

4. Wash counterbore with cleaning solvent and inspect for damage.

5. Inspect propeller shaft yoke for nicks, burrs or scratches which would cut new seal or cause seal to leak or damage bushing.

6. Coat new seal with sealing compound and press straight into bore of case extension with J 5154-A (Fig. 7D-5).

CAUTION: Do not excessively force the seal against the seat in the extension.

7. Install propeller shaft assembly by reversing steps 1 and 2 above. Coat outside diameter of yoke with gear lubricant before assembly.

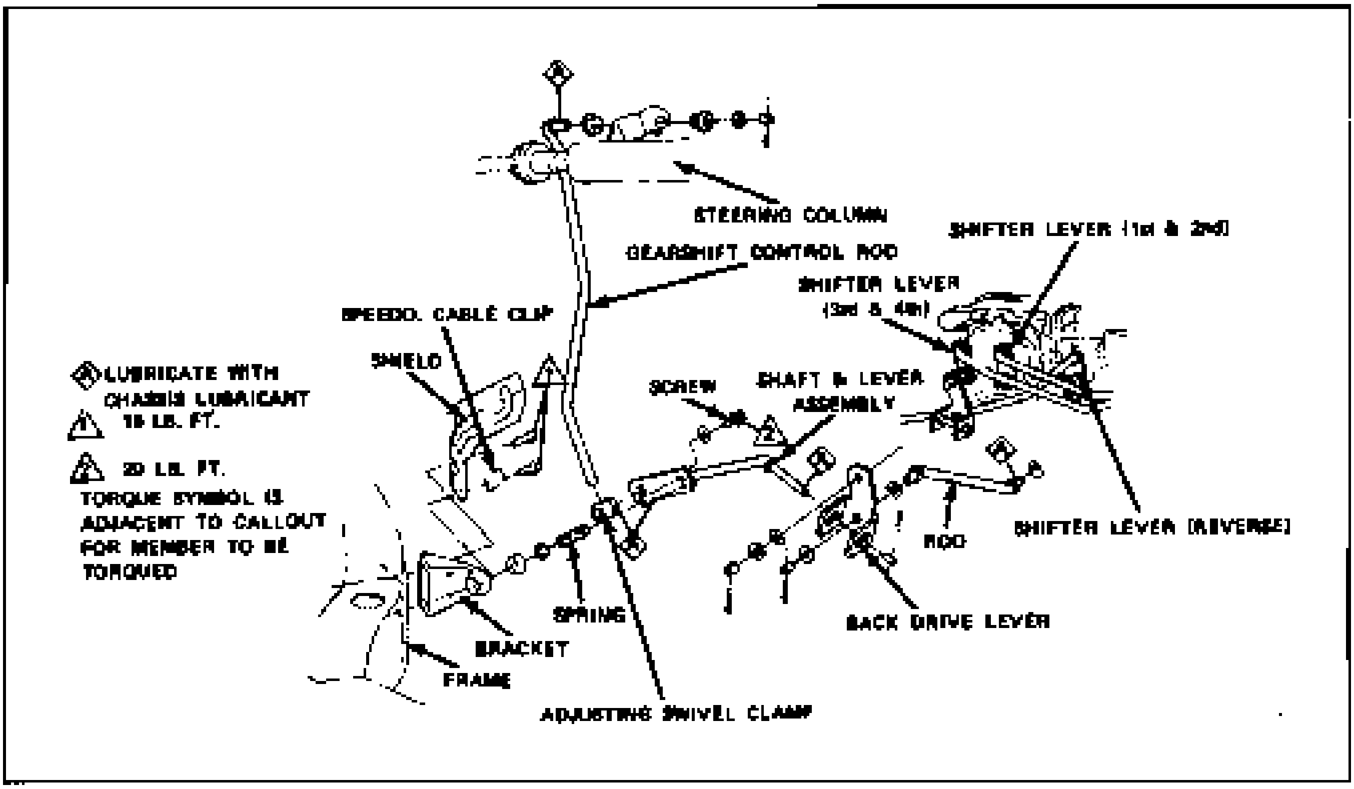


Fig. 7D-3A Tempest and Grand Prix Back Drive Linkage

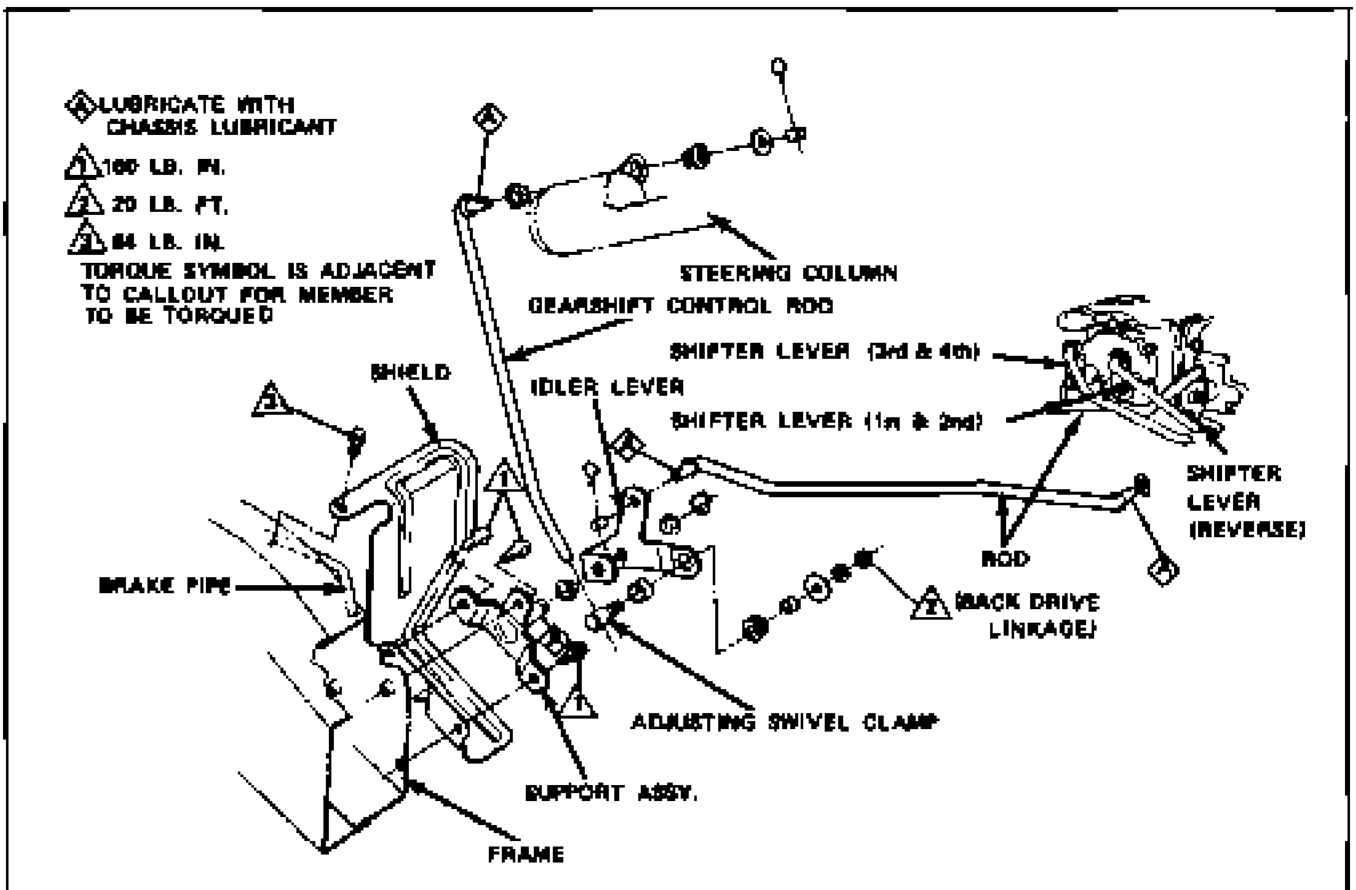


Fig. 7D-3B Firebird Back Drive Linkage

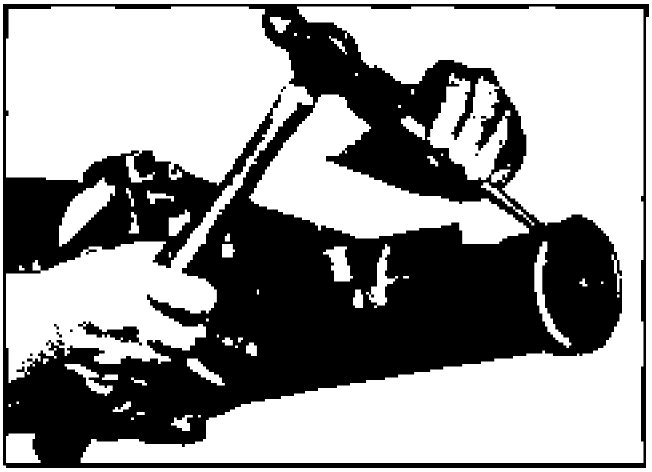


Fig. 7D-4 Removing Extension Oil Seal

TRANSMISSION SIDE COVER

REMOVE

1. Disconnect control rods from levers.

2. Shift transmission into second speed, before removing cover, by moving 1-2 (rear) shifter lever into forward detent position.

3. Loosen side cover bolts and allow transmission to drain.

4. Remove transmission side cover assembly from transmission case (Fig. 7D-6).

5. Remove outer shifter lever nuts, lockwashers and flat washers. Pull levers from shafts.

6. Remove both shift forks from the shifter shaft and detent plate assemblies. Remove both shifter shaft assemblies from cover. Lip seals in side cover may now be pryed out if replacement is required because of damage (Fig. 7D-7).

7. Remove detent cam spring and pivot retainer C-ring. Remove both detent cams.

8. Inspect and replace necessary parts.

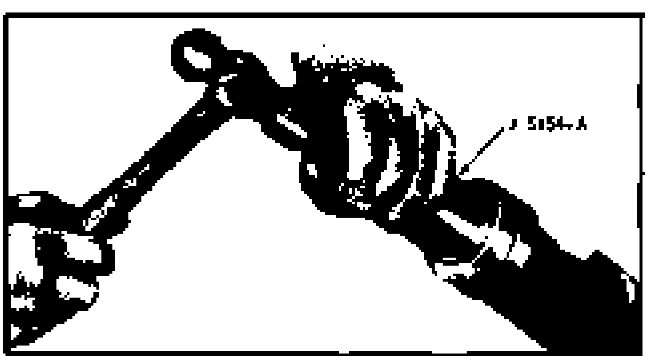


Fig. 7D-5 Installing Extension Oil Seal

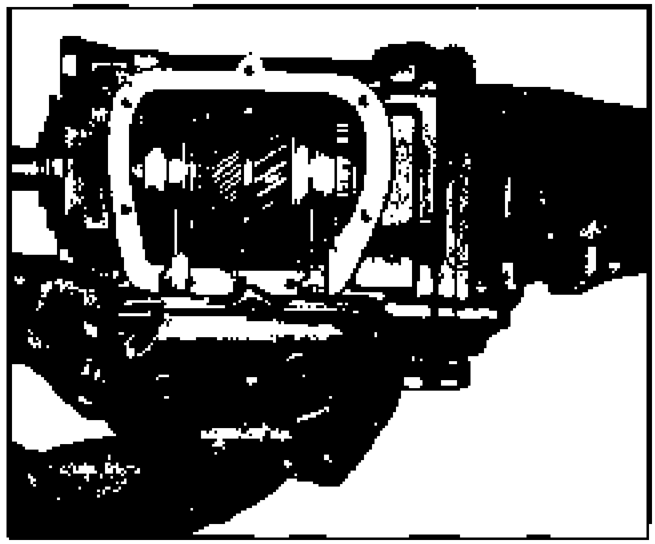


Fig. 7D-6 Removing and Installing Side Cover

REPLACE

1. Install 1-2 detent cam to cover pivot pin first, then install 3-4 detent cam so the detent spring notches are offset or opposite each other. Detent cam notches must be facing downward.

2. Install detent cam retaining C-ring to pivot shaft and hook spring into detent cam notches.

3. Install both shifter shaft assemblies in cover, being careful not to damage lip seals. Install both shift forks to detent plates, lifting up on detent cam to allow forks to fully seat into position.

4. Install outer shift levers, flat washers, lockwashers and nuts, torquing to 30 lb. ft.

5. Shift 1-2 shifter lever into second speed (forward) position. Position cover gasket on case.

NOTE: When installing new gasket, do not coat with grease.

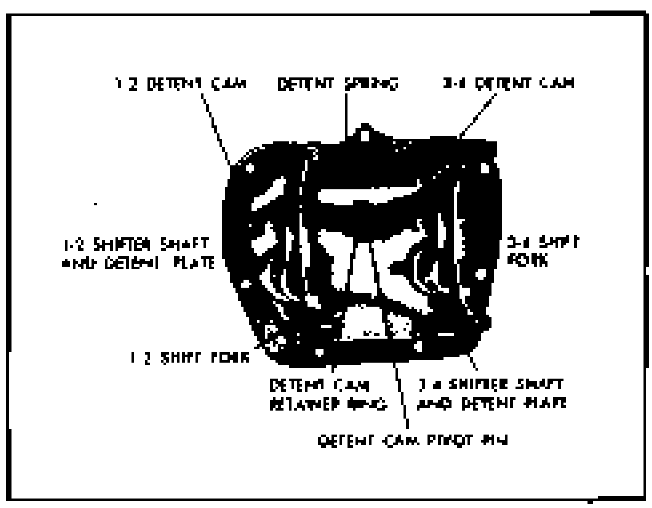
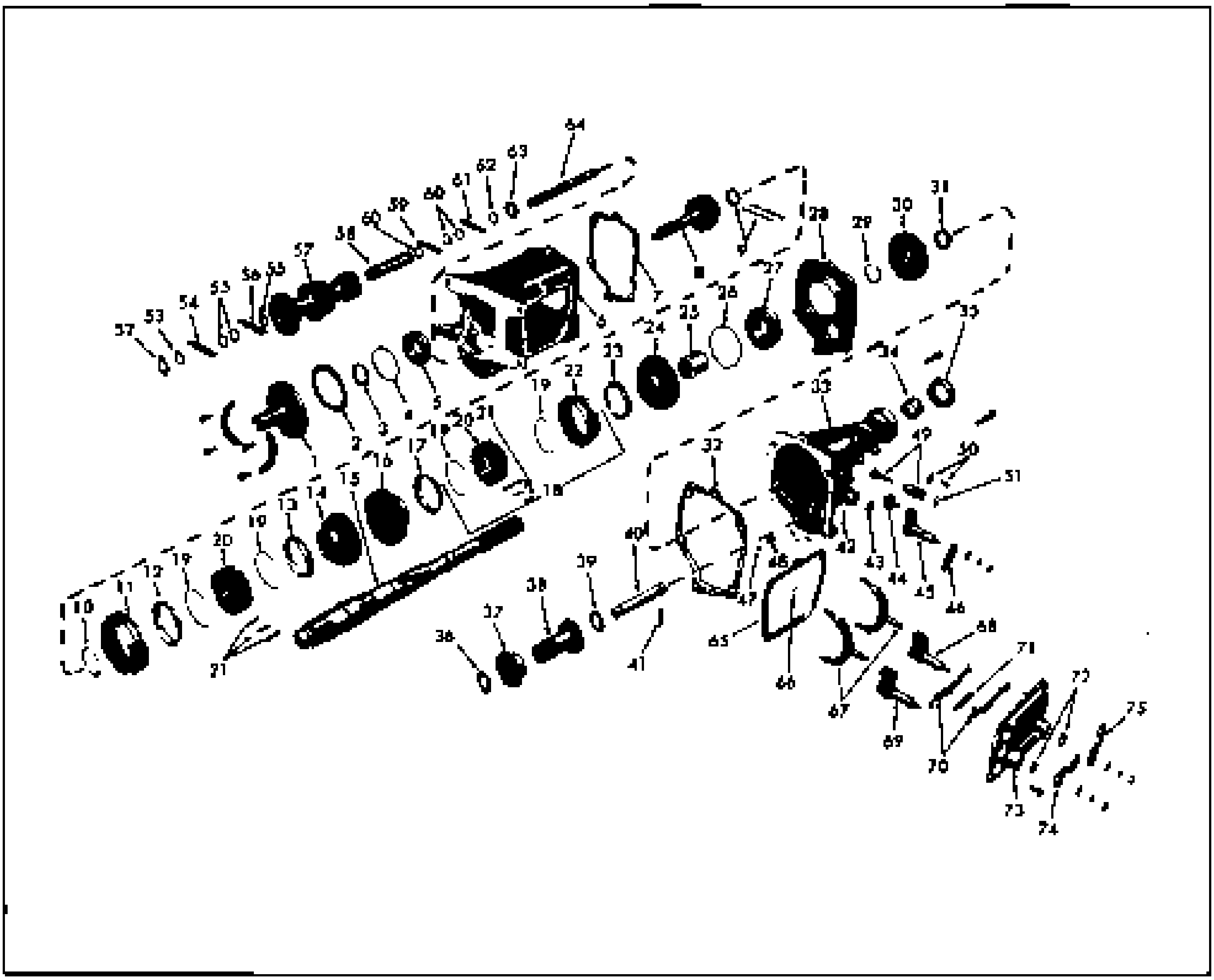


Fig. 7D-7 Side Cover Assembly



1. Bearing Retainer
2. Gasket
3. Bearing Retainer Nut
4. Bearing Snap Ring
5. Main Drive Gear Bearing
6. Transmission Case
7. Rear Bearing Retainer Gasket
8. Main Drive Gear
9. Bearing Rollers and Cage
10. Snap Ring
11. 3rd & 4th Speed Clutch Sliding Sleeve
12. 4th Speed Gear Synchronizing Ring
13. 3rd Speed Gear Synchronizing Ring
14. Third Speed Gear
15. Mainshaft
16. Second Speed Gear
17. 2nd Speed Gear Synchronizing Ring
18. 1st & 2nd Speed Clutch Assy.
19. Clutch Key Springs
20. Clutch Hubs
21. Clutch Keys
22. 1st & 2nd Speed Clutch Sliding Sleeve
23. 1st Speed Gear Synchronizing Ring
24. First Speed Gear
25. First Speed Gear Sleeve
26. Rear Bearing Snap Ring
27. Rear Bearing
28. Rear Bearing Retainer
29. Selective Snap Ring
30. Reverse Gear
31. Speedometer Drive Gear
32. Rear Bearing Retainer-to-Case
33. Case Extension
34. Extension Bushing
35. Rear Oil Seal
36. Reverse Idler Front Thrust Washer (Tanged)
37. Reverse Idler Gear (Front)
38. Reverse Idler Gear (Rear)
39. Reverse Idler Rear Thrust Washer (Flat)
40. Reverse Idler Shaft
41. Reverse Idler Shaft Roll Pin
42. Reverse Shifter Shaft Lock Pin
43. Reverse Shifter Shaft Lip Seal
44. Reverse Shift Fork
45. Reverse Shifter Shaft and Detent Plate
46. Reverse Shifter Lever
47. Reverse Shifter Shaft Detent Ball
48. Reverse Shifter Shaft Ball Detent Spring
49. Speedometer Driven Gear and Fitting
50. Retainer and Bolt
51. O-Ring Seal
52. Tanged Washer
53. Spacer
54. Bearing Rollers
55. Spacers
56. Bearing Rollers
57. Countergear
58. Countergear Roller Spacer
59. Bearing Rollers
60. Spacers
61. Bearing Rollers
62. Spacer
63. Tanged Washer
64. Countershaft
65. Gasket
66. Detent Cams Retainer Ring
67. Forward Speed Shift Forks
68. 1st & 2nd Speed Gear Shifter Shaft and Detent Plate
69. 3rd & 4th Speed Gear Shifter Shaft and Detent Plate
70. Detent Cams
71. Detent Cam Spring
72. Lip Seals
73. Transmission Side Cover
74. 3rd & 4th Speed Shifter Lever
75. 1st & 2nd Speed Shifter Lever

Fig. 7D-8 Exploded View of Transmission

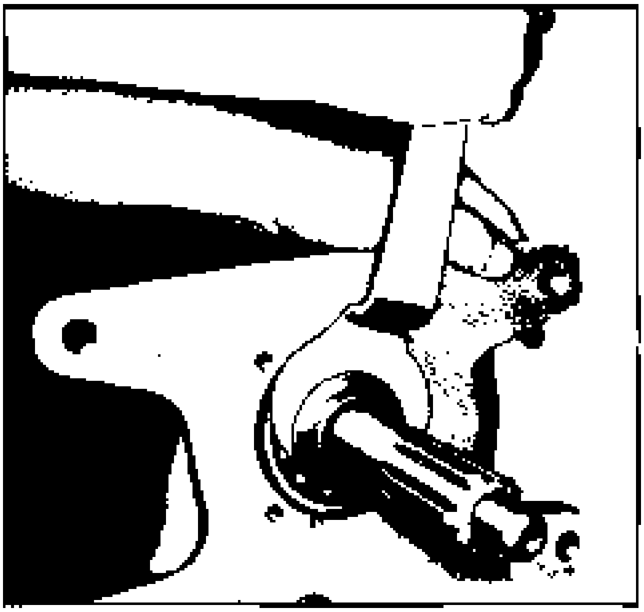


Fig. 7D-9 Removing Main Drive Gear Retaining Nut

6. Carefully position side cover into place, making sure the shift forks are aligned with their respective mainshaft clutch sliding sleeves (Fig. 7D-6).

7. Install cover attaching bolts, tighten evenly to 18 lb ft. torque and connect control rods to levers.

8. Remove filler plug at side of transmission and add 2 1/2 pints of SAE 90 multi-purpose gear lubricant. Lubricant level should be approximately level with bottom of filler hole. Install and tighten plug to 30 lb. ft. torque.

MAJOR REPAIRS

TRANSMISSION

REMOVE

1. Disconnect the speedometer cable from speedometer

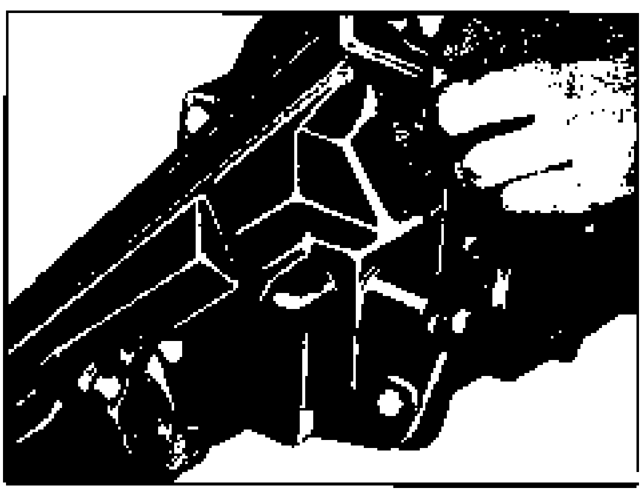


Fig. 7D-10 Removing Reverse Shifter Shaft Lock Pin

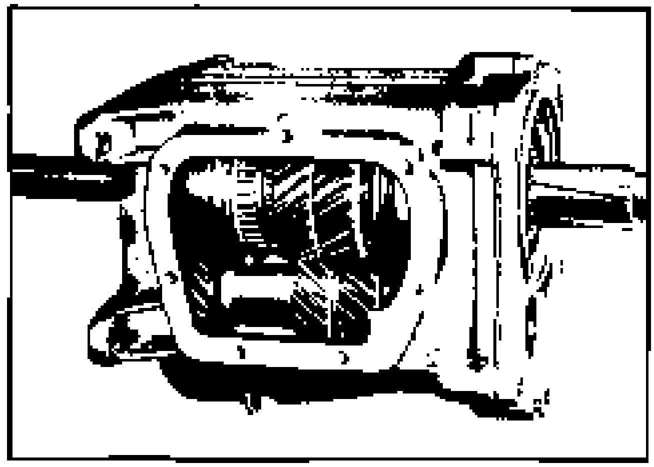


Fig. 7D-11 3rd and 4th Speed Synchronizer Sleeve in 4th Gear Position

driven gear fitting and disconnect back-up light leads from back-up light switch.

2. Disconnect transmission shifter levers (1st-2nd and 3rd-4th and Reverse) from transmission shifter shafts (Figs. 7D-1 and 7D-2). Remove two (2) shifter assembly-to-extension support bolts and, if shifter assembly removal is not required, it may be left hanging in its floor seal.

3. Remove propeller shaft assembly:

a. Remove U-bolts, lock plates and U-bolts from rear axle drive pinion flange.

b. Use rubber band to hold bearing onto journals, if the wire has been removed, to prevent loss of needle bearings when rear joint is disconnected.

c. Remove complete drive line assembly by sliding

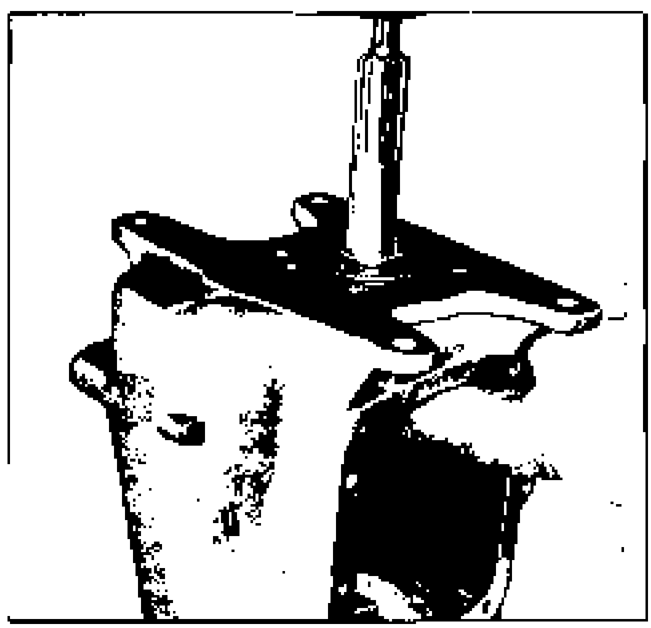


Fig. 7D-12 Removing Main Drive Gear

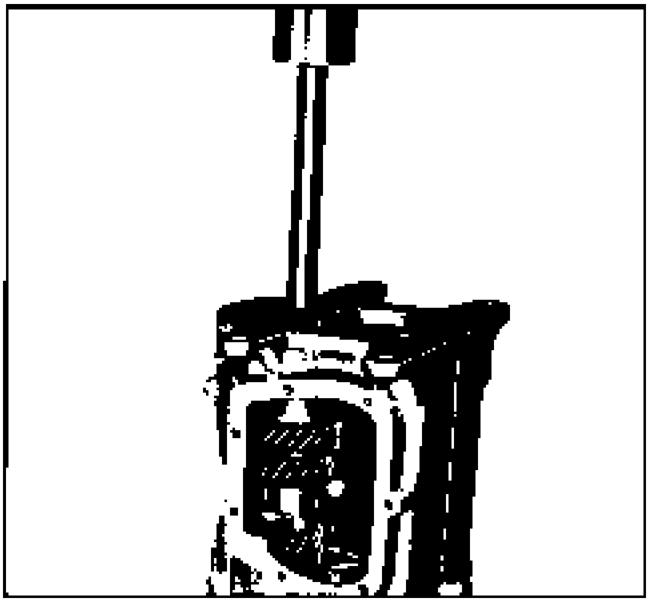


Fig. 7D-13 Removing Countershaft with J 22379

rearward to disengage yoke from splines on transmission mainshaft.

4. Support rear of engine and remove two transmission extension insulator to cross member support retaining bolts (see Section 6).

5. Remove the two top transmission to clutch housing bolts and insert two Transmission Aligning Studs J 1126 in these holes.

NOTE: The use of two aligning studs during this operation will support the transmission and prevent damage to the clutch disc through springing.

6. Remove the two lower transmission to clutch housing bolts.

7. Tilt rear of extension upward to disengage bracket studs from cross member support and withdraw transmission from clutch housing.

8. Remove the transmission.

DISASSEMBLE

1. Remove transmission side cover assembly from transmission case and drain lubricant.

NOTE: If cover assembly is to be disassembled for inspection or replacement of worn parts, follow procedures 5 through 8 under TRANSMISSION SIDE COVER - REMOVE.

2. Remove insulator assembly from transmission rear extension.

3. Remove four bolts from front bearing retainer and remove retainer and gasket.

4. Remove the main drive gear retaining nut (Fig. 7D-9), using Tool J 933 after locking up transmission by shifting into two gears.

NOTE: Nut has left hand threads.

5. With transmission gears in neutral, drive lock pin from bottom side of reverse shifter lever boss and pull shaft out about 1/8". This disengages the reverse shift fork from reverse gear (Fig. 7D-10).

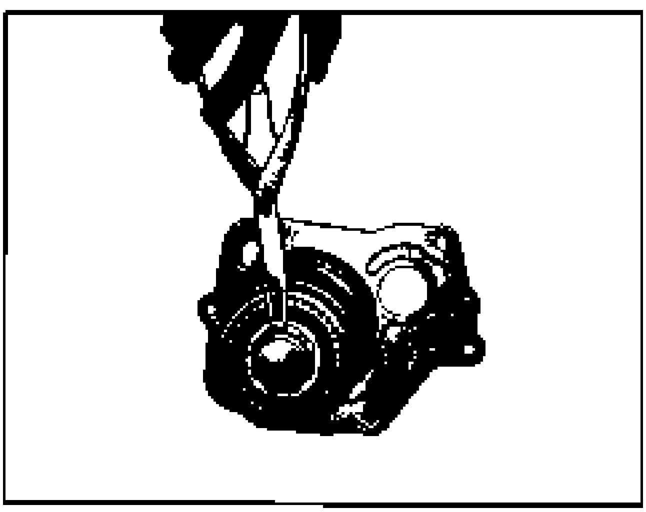


Fig. 7D-14 Removing Mainshaft Front Snap Ring using J 932

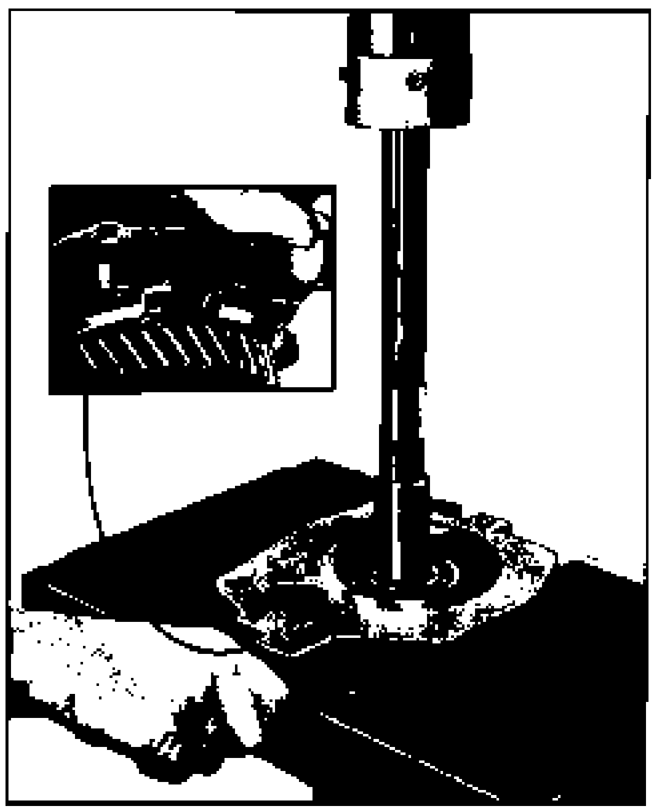


Fig. 7D-15 Pressing Mainshaft from Rear Bearing Retainer

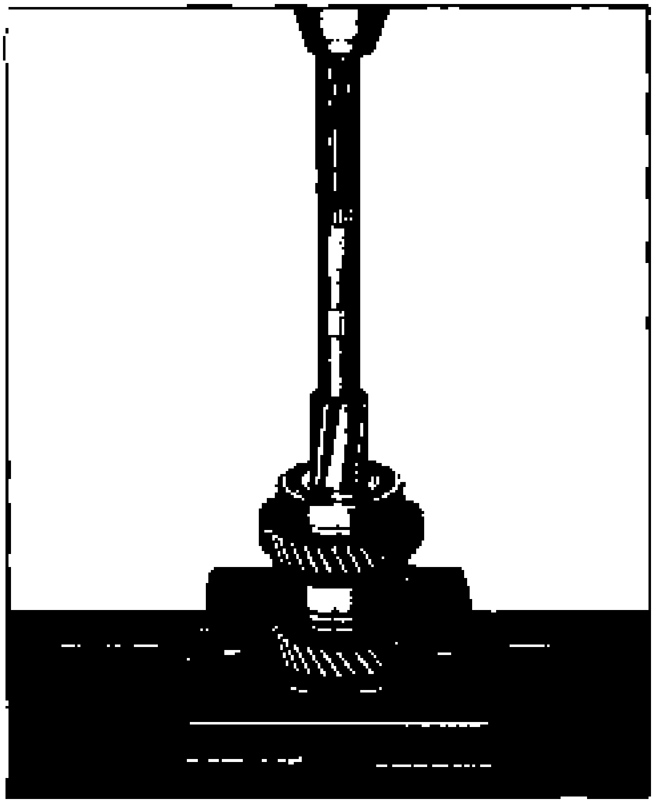


Fig. 7D-16 Pressing Mainshaft from First and Second Speed Gears

6. Remove six bolts attaching the case extension to the rear bearing retainer. Tap extension with soft hammer in a rearward direction to start. When the reverse idler shaft is out as far as it will go, move extension to left so reverse fork clears reverse gear and remove extension and gasket.

7. Remove the rear reverse idler gear, roll pin, shaft and flat thrust washer from the extension.

8. Depress the speedometer gear retaining clip, slide the gear off the output shaft and remove the reverse gear.

9. Slide 3-4 synchronizer clutch sleeve to 4th speed position (forward) before trying to remove mainshaft assembly from case (Fig. 7D-11)

10. Carefully remove the rear bearing retainer and mainshaft assembly from the case by tapping bearing retainer with a soft hammer.

11. Unload 17 bearing rollers and cage from main drive gear and remove fourth speed synchronizing ring.

12. Lift the front reverse idler gear and thrust washer from case.

13. With soft hammer, tap main drive gear down from front bearing as shown in Fig 7D-12.

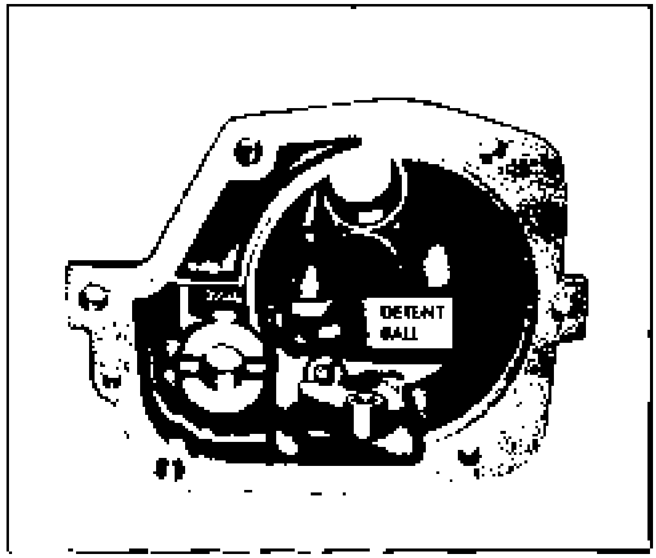


Fig. 7D-17 Installing Reverse Shifter Shaft and Detent Ball

14. From inside case, tap out front bearing and snap ring.

15. From the front of the case, tap out the countershaft, using Loader J 22379 as shown in Fig. 7D-13. Remove the countergear and both tanged washers. Remove Loader J 22379 from countergear.

16. Remove the 112 rollers, six .050" spacers and roller spacer from countergear (Fig. 7D-8).

17. Remove mainshaft front snap ring, using J 932 as shown in Fig 7D-14, and slide third and fourth speed clutch assembly, third speed gear and synchronizing ring from front of mainshaft.

18. Spread rear bearing retainer snap ring and press mainshaft out of the retainer (Fig. 7D-15).

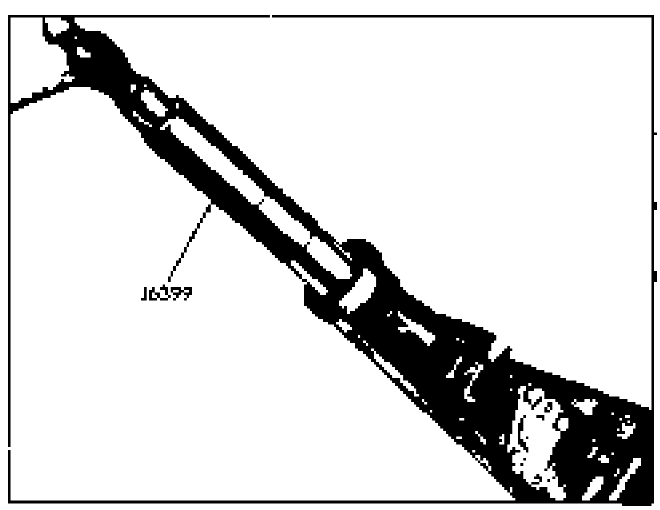


Fig. 7D-18 Removing or Installing Extension Case Bushing

19. Remove mainshaft rear snap ring. Support second speed gear and press on rear of mainshaft to remove rear bearings, first speed gear and sleeve, first speed synchronizing ring, 1-2 synchronizer clutch assembly, second speed synchronizing ring and second speed gear from the mainshaft (Fig. 7D-16).

REVERSE SHIFTER SHAFT AND SEAL

REMOVE AND REPLACE

1. With case extension removed from transmission, the reverse shifter shaft lock pin will already be removed (see step 5 under TRANSMISSION - DISASSEMBLE).

2. Remove shift fork.

3. Carefully drive the shifter shaft into case extension, allowing ball detent to drop into case. Remove shaft, ball detent spring and ball detent.

4. Place ball detent spring into detent spring hole and, from inside of extension, install shifter shaft fully into its opening until the detent plate is butted against inside of extension housing.

5. Place detent ball on spring and, holding ball down with a suitable tool, push shifter shaft into place and turn until ball drops into place in detent on the shaft detent plate (Fig. 7D-17).

6. Install shift fork.

NOTE: Do not drive the shifter shaft lock pin into place until the extension has been installed on the transmission case.

EXTENSION CASE BUSHING AND OIL SEAL

REMOVE AND REPLACE

1. Remove oil seal with punch or other suitable tool and discard seal (Fig. 7D-4).

2. Using Tool J 6399, drive bushing forward into case extension (Fig. 7D-18).

3. Drive new bushing in from rear of case extension with same tool (J 6399), until end of bushing is slightly below counterbore for oil seal.

4. Coat I.D. of bushing with transmission oil, new seal with sealing compound and start straight into bore of case extension. Using Installer J 5154-A, tap seal into extension case (Fig. 7D-5).

CAUTION: Do not excessively force the seal against the seat in the extension.

CLUTCH KEYS AND SPRINGS

REMOVE AND REPLACE

NOTE: The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the three keys and two springs may be replaced if worn or broken.

1. Push the hub from the sliding sleeve. The keys will fall free and the springs may be easily removed.

2. Place the two springs in position (one on each side of the hub), so a tanged end of each spring falls into the same keyway in the hub. Place the keys in position and, holding them in place, slide the hub into the sleeve.

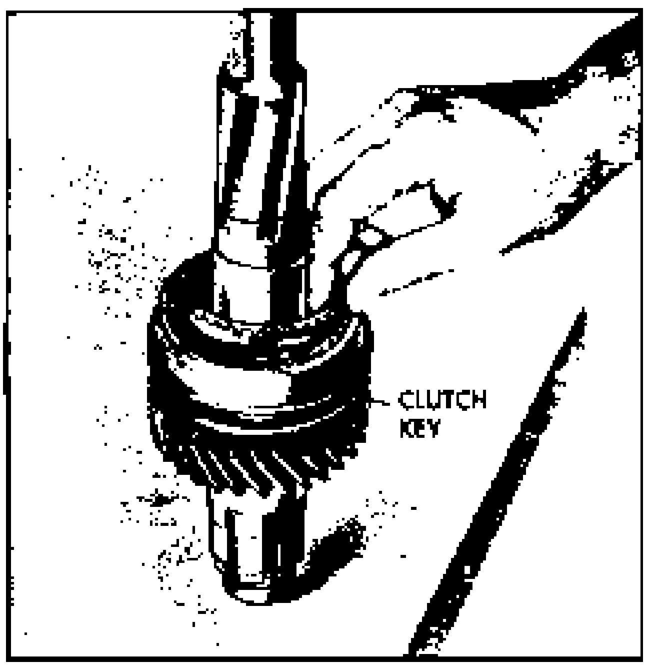


Fig. 7D-19 Installing First Speed Synchronizing Ring

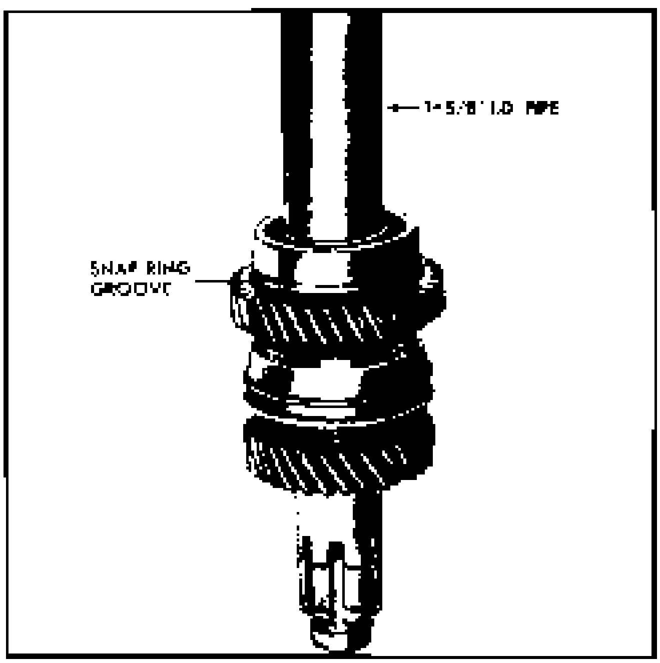


Fig. 7D-20 Installing Rear Bearing

TRANSMISSION

CLEANING AND INSPECTION

1. Wash the transmission case inside and out with a cleaning solvent and inspect for cracks. Inspect the front face, which fits against clutch housing, for burrs. If any are present, dress them off with a fine cut mill file.

2. Wash the front and rear bearings thoroughly in a cleaning solvent and blow out bearings with compressed air.

CAUTION: Do not allow the bearings to spin; turn them slowly by hand. Spinning bearings will damage the race and balls.

Make sure the bearings are clean, then lubricate them with light engine oil and check them for roughness. Roughness may be determined by slowly turning the outer race by hand.

3. All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft at the same time and replace if necessary. Replace all worn spacers.

4. Inspect all gears and first speed gear bushing and, if necessary, replace all that are worn or damaged.

5. The bushings used in the idler gear are pressed into the gear, then peened into holes in the bores and are bored in place. This insures the positive alignment of the bushings and their shafts, as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushings are not serviced separately.

Check bushings for excessive wear by using a narrow feeler gauge between the shaft and bushing or use a micrometer. The proper clearance is from .003" to .005".

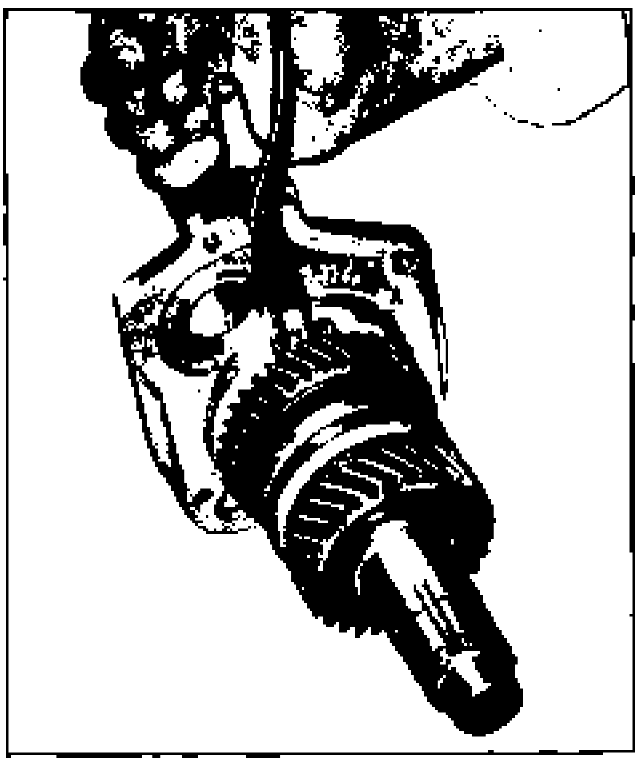


Fig. 7D-21 Installing Rear Bearing Retainer

ASSEMBLE

1. From the rear of mainshaft, assemble the second speed gear (with hub of gear toward rear of shaft).

2. Install 1-2 synchronizer clutch assembly to mainshaft (sliding clutch sleeve taper toward the rear, hub to the front), together with a synchronizing ring on either side so their keyways line up with the clutch keys (Fig. 7D-19).

3. Press first gear sleeve onto mainshaft, using a 1 3/4" I.D. pipe cut to convenient length.

4. Install the first speed gear (with hub toward front) and, using a 1-5/8" I.D. pipe cut to a suitable length, press on the rear bearing (snap ring groove toward front of transmission). Firmly seat the bearing (Fig. 7D-20).

5. Choose the correct selective fit snap ring (.087", .090", .093" or .096") and install it in the groove in mainshaft behind rear bearing. With proper ring, maximum distance between snap ring and rear face of bearing will be from zero to .005".

NOTE: Always use new snap rings when reassembling transmission and do not expand the snap ring further than is necessary for assembly.

6. Install the third speed gear (hub to front of transmission) and the third speed gear synchronizing ring (notches to front of transmission).

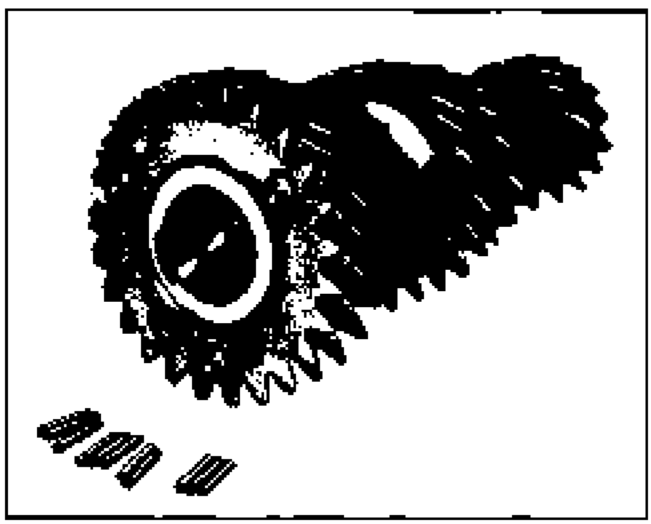


Fig. 7D-22 Loading Countergear Bearing using J 22379.

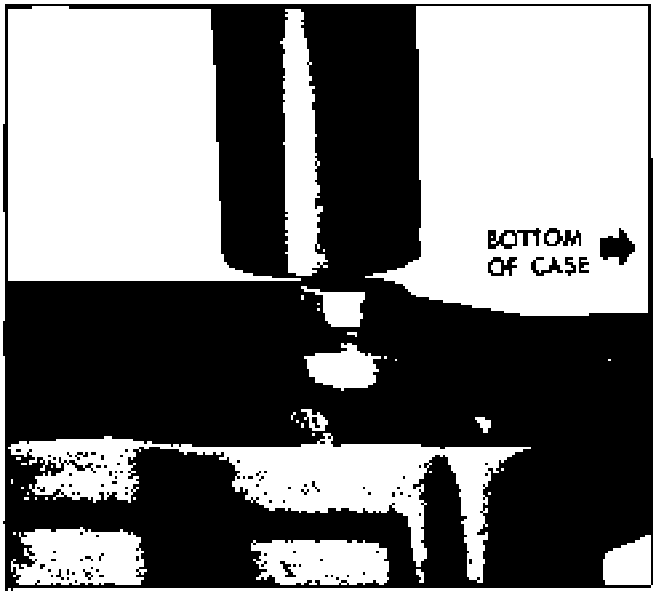


Fig. 7D-23 Installing Countershaft

7. Install the third and fourth speed gear clutch assembly (hub and sliding sleeve) with both sleeve taper and hub toward front, making sure keys in hub correspond to notches in the third speed gear synchronizing ring.

8. Install snap ring in groove in mainshaft in front of the third and fourth speed clutch assembly, with ends of snap ring seated behind spline teeth.

9. Install the rear bearing retainer (Fig. 7D-21). Spread the snap ring in the retainer to allow the snap ring to drop around the rear bearing. Press on the end of the mainshaft until snap ring engages groove in the rear bearing.

10. Install the reverse gear (shift collar to rear).

11. Place speedometer gear retainer in output shaft.

12. Align slot in speedometer drive gear with retainer clip and slide gear into place.

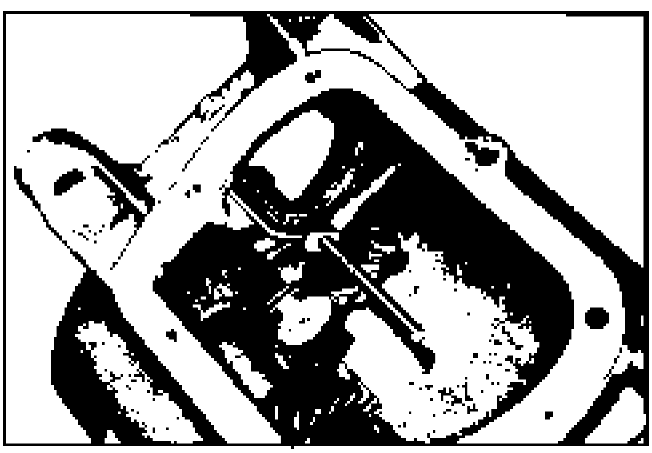


Fig. 7D-24 Checking Countergear End Play

CAUTION: Make certain correct speedometer drive gear is installed. Refer to Speedometer Gear Usage Chart in Section 0.

13. Install seam-type roller spacer in countergear and insert Tool J 22379 into countergear.

14. Using heavy grease to retain the rollers, install a .050" spacer and 28 rollers in either end of the countergear, a .050" spacer, 28 more rollers and another .050" spacer (Fig. 7D-22).

15. Follow the same procedure for the opposite end of the countergear.

16. Rest the transmission case on its side, with the side cover opening toward the assembler. Put countergear tanged thrust washers in place, retaining them with heavy grease and making sure the tangs are resting in the notches of the case.

17. Set countergear in place in bottom of transmission case, making sure that tanged thrust washers are not knocked out of place.

18. Position the transmission case, resting on its front face.

19. Lubricate and insert countershaft in rear of case. Turn countershaft so flat on end of shaft is horizontal and facing bottom of case.

NOTE: The flat on shaft must be horizontal and toward the bottom to mate with rear bearing retainer when installed.

20. Align countergear with shaft in rear and hole in front of case and press countershaft into case (pushing Tool J 22379 out front of case) until flat on shaft is flush with rear of case. Be sure thrust washers remain in place (Fig. 7D-23).

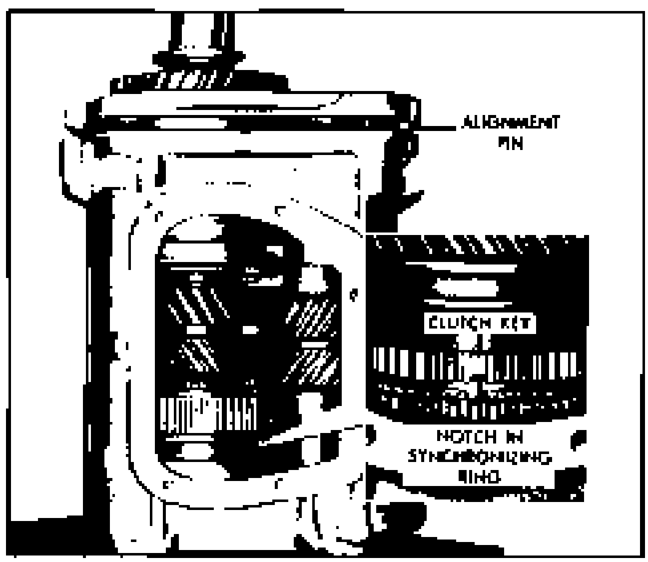


Fig. 7D-25 Installing Mainshaft Assembly

21. Attach a dial indicator as shown in Fig. 7D-24 and check end play of the countergear. If end play is greater than .025", new thrust washers must be installed.

22. Install cage and the seventeen (17) roller bearings into main drive gear, using heavy grease to hold the bearings and cage in place.

23. Install main drive gear and pilot bearings through the side cover opening and into position in transmission front bore.

24. Place gasket in position on front face of rear bearing retainer.

25. Install the fourth speed synchronizing ring on main drive gear with the notches toward the rear of the transmission.

26. Position the reverse idler gear thrust washer (tanged) on the machined face of the ear cast in the case for the reverse idler shaft and hold with heavy grease. Position the front reverse idler gear next to the thrust washer, with the hub facing toward rear of the case.

CAUTION: Before attempting to install mainshaft assembly to case, slide the 3-4 synchronizing clutch sleeve forward into fourth speed detent position (Fig. 7D-11).

27. Lower the mainshaft assembly into case, making certain notches on the fourth speed synchronizing ring correspond to keys in the clutch assembly (Fig. 7D-25).

28. With the guide pin in rear bearing retainer aligned with hole in rear of case, tap rear bearing retainer into position with a soft hammer.

29. From rear of the case, insert the rear reverse idler gear, engaging the splines with the portion of the front gear inside the case.

30. Using heavy grease, place gasket in position on rear face of rear bearing retainer.

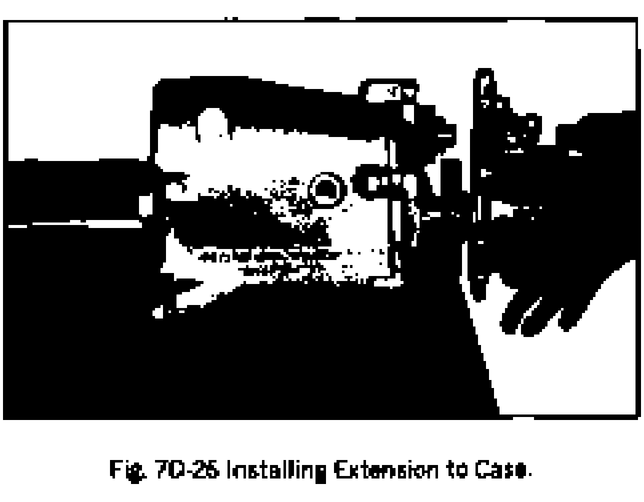


Fig. 7D-26 Installing Extension to Case.

31. Install the remaining flat thrust washer on reverse idler shaft. If new idler shaft is being used, drive out the roll pin and press it into new shaft.

32. Install reverse idler shaft, roll pin and thrust washer into gears and front boss of case. Make sure to pick up front tanged thrust washer.

NOTE: Roll pin should be in a vertical position.

33. Position reverse gear at rear of spline, pull reverse shifter shaft to left side of extension and rotate shaft to bring reverse shift fork forward in extension (reverse detent position). Start the extension onto the transmission case (Fig. 7D-26), while slowly pushing in on the shifter shaft to engage the shift fork with the reverse gear shift collar. Then pilot the reverse idler shaft into the extension housing, permitting the extension to slide onto the transmission case.

34. Install 6 extension and retainer-to-case attaching bolts. Torque upper 3 bolts to 20 lb. ft.; lower 3 bolts to 30 lb. ft.

35. Push or pull reverse shifter shaft to line up groove in the shaft with holes in the boss and drive in the lock pin. Install shifter lever.

36. Press front bearing onto main drive gear (snap ring groove to front) and into case, until several main drive gear retaining nut threads are exposed.

37. Lock transmission up by shifting into two gears. Install main drive gear retaining nut on the gear shaft and draw it up tight, using Tool J 933. Be sure bearing fully seats against shoulder on gear, torque retaining nut to 40 lb. ft. and lock in place by staking securely into main drive gear shaft hole with a center punch.

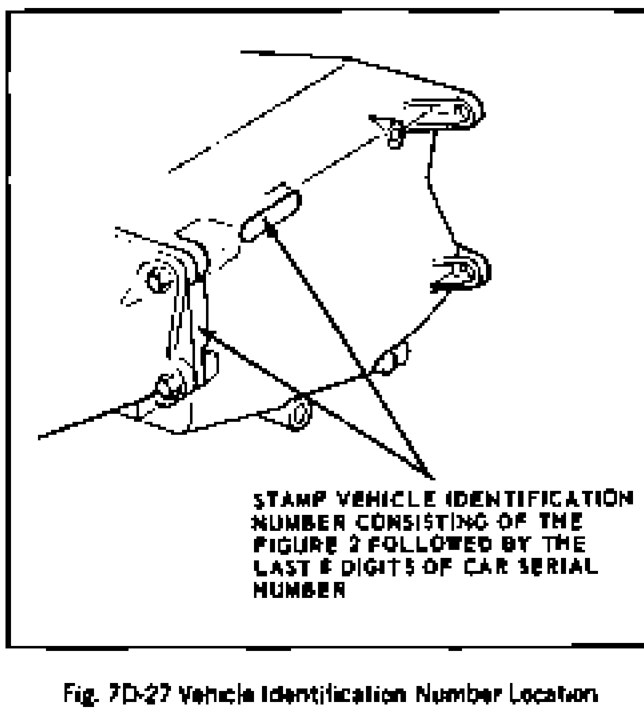


Fig. 7D-27 Vehicle Identification Number Location

Care must be used to avoid damaging the threads on the shaft.

38. Install the main drive gear bearing retainer, gasket and four attaching bolts, using a suitable sealer on bolts. Torque to 20 lb. ft.

39. Shift mainshaft 3-4 sliding clutch sleeve into neutral position and 1-2 sliding clutch sleeve into second gear (forward) detent position. Shift side cover 3-4 shifter lever into neutral detent and 1-2 shifter lever into second gear (forward) detent position.

40. Install side cover gasket and carefully position side cover into place. There is a dowel pin in cover to assure proper alignment with case. Install attaching bolts and tighten evenly to avoid side cover distortion. Torque to 18 lb. ft.

NOTE: When installing new gasket, do not coat with grease.

41. Install insulator assembly on rear extension. Torque bolts to 30 lb. ft.

42. If lever and bracket support to extension was removed, reinstall, tightening 3 bolts to 30 lb. ft. torque.

INSTALL

1. Raise transmission until rear extension can be moved rearwards over center cross member support.

NOTE: If it was necessary to remove cross member support before removing transmission, install support while transmission is held in a raised position.

2. Move transmission forward until extension bracket studs engage holes in cross member support and main drive gear shaft enters clutch housing. Care should be taken to make certain clutch release bearing remains seated.

3. Install Aligning Stud J 1126 in lower right transmission to clutch housing bolt hole for alignment.

4. Install two upper transmission to clutch housing mounting bolts and washers and tighten securely to 55 lb. ft. torque. Remove aligning stud and install two lower mounting bolts and washers and tighten to 55 lb. ft. torque.

5. Install rear extension to cross member support insulator and tighten bolts to 30 lb. ft. torque.

6. Install propeller shaft drive line assembly by reversing steps 3a. through 3c. under TRANSMISSION --REMOVE.

7. Install shifter assembly and secure it to transmission rear extension support with two shifter to extension support bolts. Tighten upper bolt to 50 lb. ft. torque. Tighten lower bolt to 30 lb. ft torque.

8. Connect linkage and adjust as described in ON CAR ADJUSTMENTS.

9. Connect speedometer cable to speedometer driven gear and tighten securely.

10. Connect back-up light leads to back-up light switch leads, using female connectors.

11. If rubber boot or console was removed, slide rubber boot with metal boot retainer over shift stick and secure to floor plate with six metal screws. Install console.

12. Remove filler plug at side of transmission and add 2 1/2 pints of SAE 90 multi-purpose gear lubricant. Lubricant level should be approximately level with bottom of filler plug hole. Install plug.

13. Check shift pattern and adjust as required.

SPECIFICATIONS

TRANSMISSION IDENTIFICATIONS

An identifying code is marked in yellow paint on all four-speed manual transmissions. This code consists of two letters, one inch high, on the top of the case.

Tempest and Grand Prix	
Std.	FO
Close Ratio	FT
Firebird	
Std.	FF
Close Ratio	FX

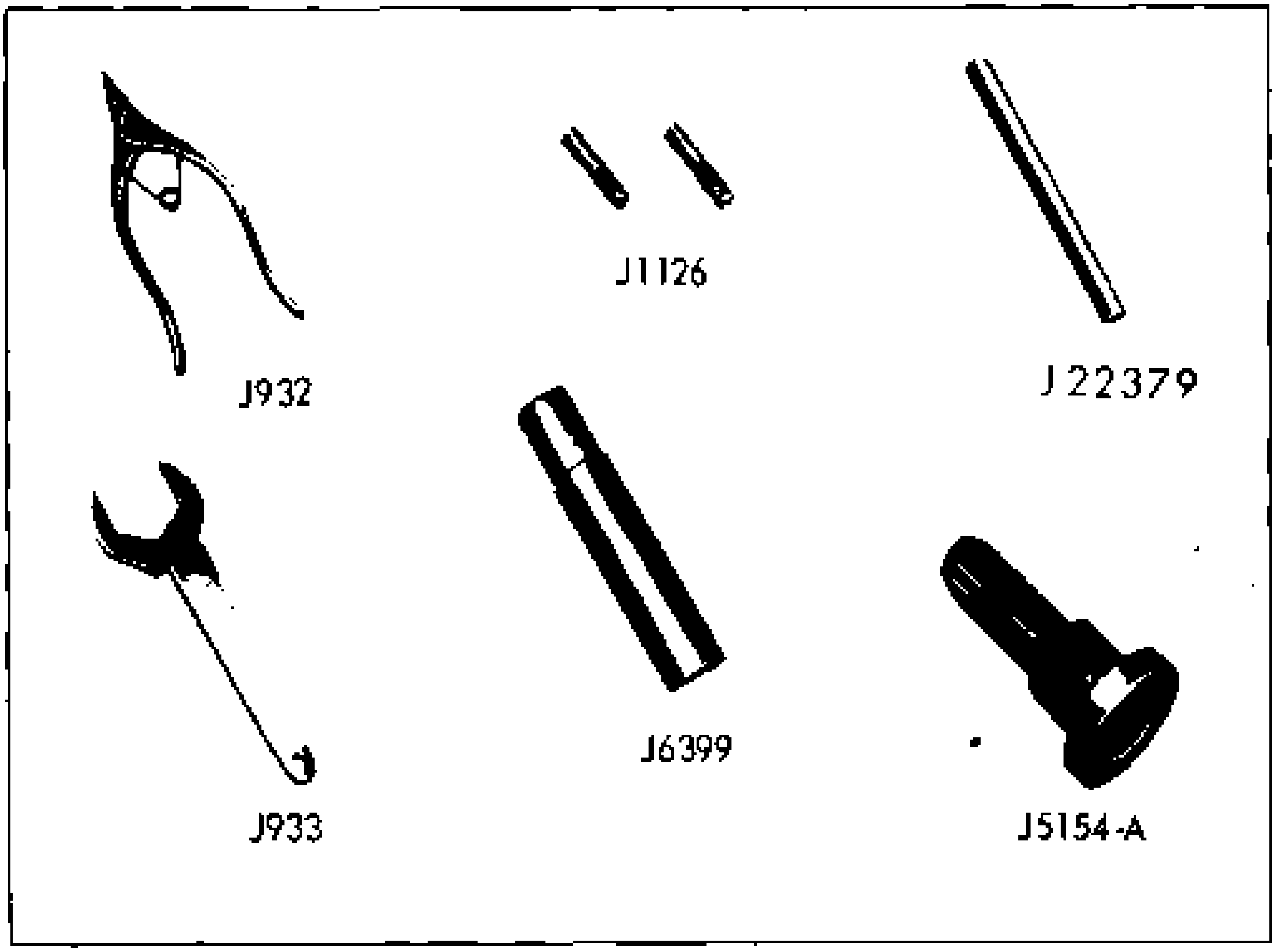
The vehicle identification number is also stamped on the transmission case, as shown in Fig. 7D-27.

GEAR RATIOS

	STD.	CLOSE
First	2.52	2.20
Second	1.88	1.64
Third	1.46	1.28
Fourth	1.00	1.00
Reverse	2.59	2.27

TORQUE SPECIFICATIONS

APPLICATION	LB. FT.
Main Drive Gear Bearing Retaining Nut	40
Main Drive (Clutch) Gear Retaining Bolts	20
Side Cover Bolts	18
Extension to Case Bolts (3 Upper)	20
Extension to Case Bolts (3 Lower)	30
Shift Lever to Shifter Shaft Nuts	30
Transmission Filler Plug	30
Lever and Bracket Support to Extension Bolts	30
Lever and Bracket Assembly to Support Bolt (Upper)	50



J 932	Snap Ring Pliers
J 933	Clutch Gear Retainer Nut Wrench
J 1126	Aligning Studs
J 5154-A	Transmission Extension Oil Seal Installer
J 6399	Rear Bearing Extension Bushing Remover and Installer
J 22379	Countershaft Bearing Loader

Fig. 7D-28 Special Tools

Lever and Bracket Assembly to Support Bolt (Lower)	30
Support Insulator to Extension Housing and to Cross Member Bolts	30
Transmission to Clutch Housing Bolts	55
Transmission Control Rod to Transmission Lever Nuts	30
Speedometer Gear Retainer Bolts	4
Speedometer Cable to Driven Gear Nut	4

TURBO HYDRA-MATIC (M-40) TRANSMISSION

CONTENTS OF THIS SECTION

TOWING

If the transmission, drive line or axle do not have a malfunction, the vehicle may be towed in neutral, with steering column unlocked, at speeds up to 45 mph. The distance should not exceed 50 miles.

For higher speeds or extended distances, it is recommended that the propeller shaft be disconnected or the rear wheels be off the ground.

TRANSMISSION SERIAL NUMBER

The serial number plate on the Turbo Hydra-Matic (M-40) is located on the right side of the transmission, just forward of the governor. The serial numbers are all preceded by either PA, PB, PC, PH, PQ, PR, PS, PT, PV, PW or PX. The application of each transmission is as follows:

PA-428 cu. in. 4 barrel engine (Pontiac)

PB-400 cu. in. 2 barrel regular fuel engine (Pontiac)

PC-428 cu. in. H.O. engine (Pontiac)

PH-428 cu. in. Bonneville engine (Pontiac)

PQ-400 cu. in. Ram Air engine (GTO and Firebird)

PR-428 cu. in. 4 barrel and 428 cu. in. H.O. engines (Grand Prix)

PS-350 cu. in. H.O. engine (Tempest and Firebird)

PT-400 cu. in. 2 barrel regular fuel engine (GTO and Grand Prix)

PV-350 cu. in. 2 barrel regular fuel engine (Tempest and Firebird) with A/C

PW-400 cu. in. 4 barrel engine (Grand Prix)

PX-400 cu. in. 4 barrel c engine (GTO and Firebird)

It is very important that any communications concerning Turbo Hydra-Matic (M-40) always contain the transmission serial number and the vehicle identification number (Fig. 73-2). All transmission parts returned to Pontiac Motor Division must always be tagged with the transmission serial number.

PERIODIC SERVICE RECOMMENDATIONS

TRANSMISSION Fluid

Transmission fluid level should be checked (with transmission hot) every time engine oil level is checked or every 6000 miles when engine oil is changed.

CAUTION: Since the Turbo Hydra-Matic (M-40) transmission is very sensitive to oil level, special precautions should be taken when checking the oil level, to ensure against an overfill (see Checking Procedure, page 7E-4).

Transmission fluid should be changed every 24,000 miles or 24 months. When the car is in heavy duty service (police, taxi, fleet service, or constant use in heavy metropolitan area traffic), it is recommended that the fluid be changed at 12,000 mile intervals.

ADJUSTMENTS WITH TRANSMISSION IN CAR

SHIFT CONTROL AND BACK DRIVE LINKAGE ADJUSTMENT

COLUMN SHIFT CONTROLS

NOTE: For Pontiac models, see Fig. 7E-3; for Tempest and Grand Prix models, see Fig 7E-4; for Firebird models, see Fig. 7E-5.

1. Loosen screw (nut - Firebird) on adjusting swivel clamp.

2. Set transmission range selector lever in PARK detent.

NOTE: Obtain PARK position by rotating transmission range selector lever clockwise (View A).

3. Set upper gearshift lever in PARK position and lock ignition.

4. Push up on gear shift control rod to take up clearance in steering column lock mechanism and tighten screw on adjusting swivel clamp to 20 lb. ft. (except Firebird); tighten nut on adjusting swivel clamp to 30 lb. ft. (Firebird only).

CONSOLE SHIFT CONTROLS

NOTE: For Tempest and Grand Prix models, see Fig. 7E-6; for Firebird models, see Fig. 7E-7.

1. Disconnect shift cable from transmission selector lever by removing nut from pin.

2. Adjust back drive linkage by following the procedures under COLUMN SHIFT CONTROLS.

3. After adjusting column controls, unlock ignition and rotate transmission range selector lever counterclockwise two detent positions.

4. Set console gearshift lever in NEUTRAL range and move it forward against its stop in NEUTRAL.

5. Assemble shift cable and pin to transmission range

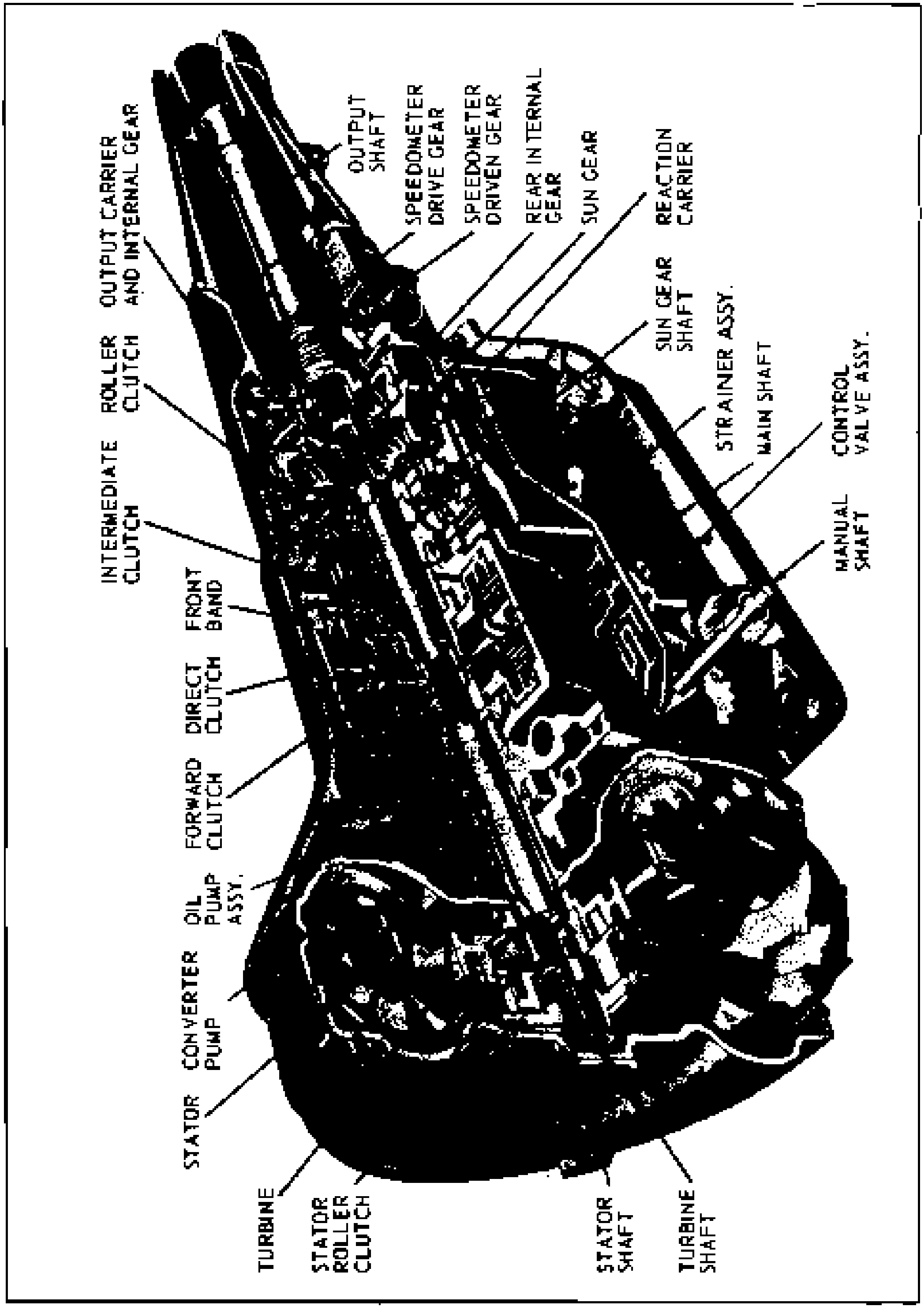


Fig. 7E-1 Side Cross Section of Turbo Hydra-Matic (M-40) Transmission

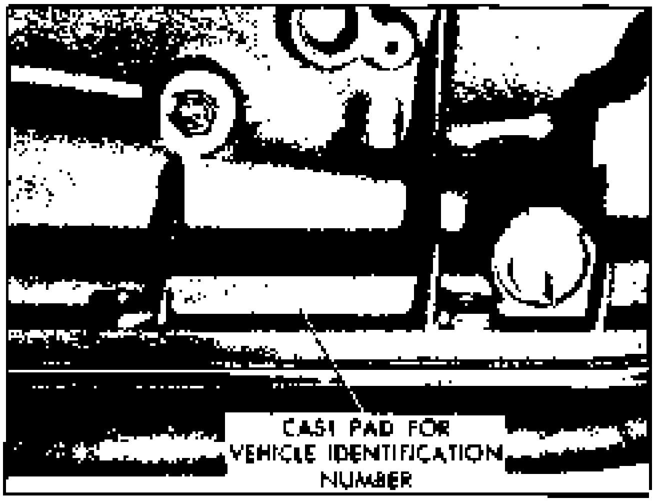


Fig. 7E-2 Vehicle Identification Number on Transmission Case

selector lever, allowing cable to position pin in slot of lever and then install and tighten nut to 30 lb. ft. torque.

NEUTRALIZER SWITCH ADJUSTMENT

Refer to Chassis Electrical Service, Section 12.

MINOR SERVICE AND REPAIR

Services outlined in this section can be performed without removing the transmission from the car. Complete procedures are not given for all of these services, since they are covered in detail under disassembly and reassembly.

FLUID LEVEL

The fluid level indicator is located in the filler pipe at the right rear of the engine. To bring the fluid level from the ADD mark to the FULL mark requires one pint.

Fluid level should be to the FULL mark with transmission at normal operating temperature (180-190°F). With warm fluid (room temperature), the level should be approximately 7/10" below the ADD mark.

NOTE: In checking the oil, insert the dipstick in the filter tube with the markings up (toward center of car).

CHECKING PROCEDURE

To determine proper fluid level, proceed as follows:

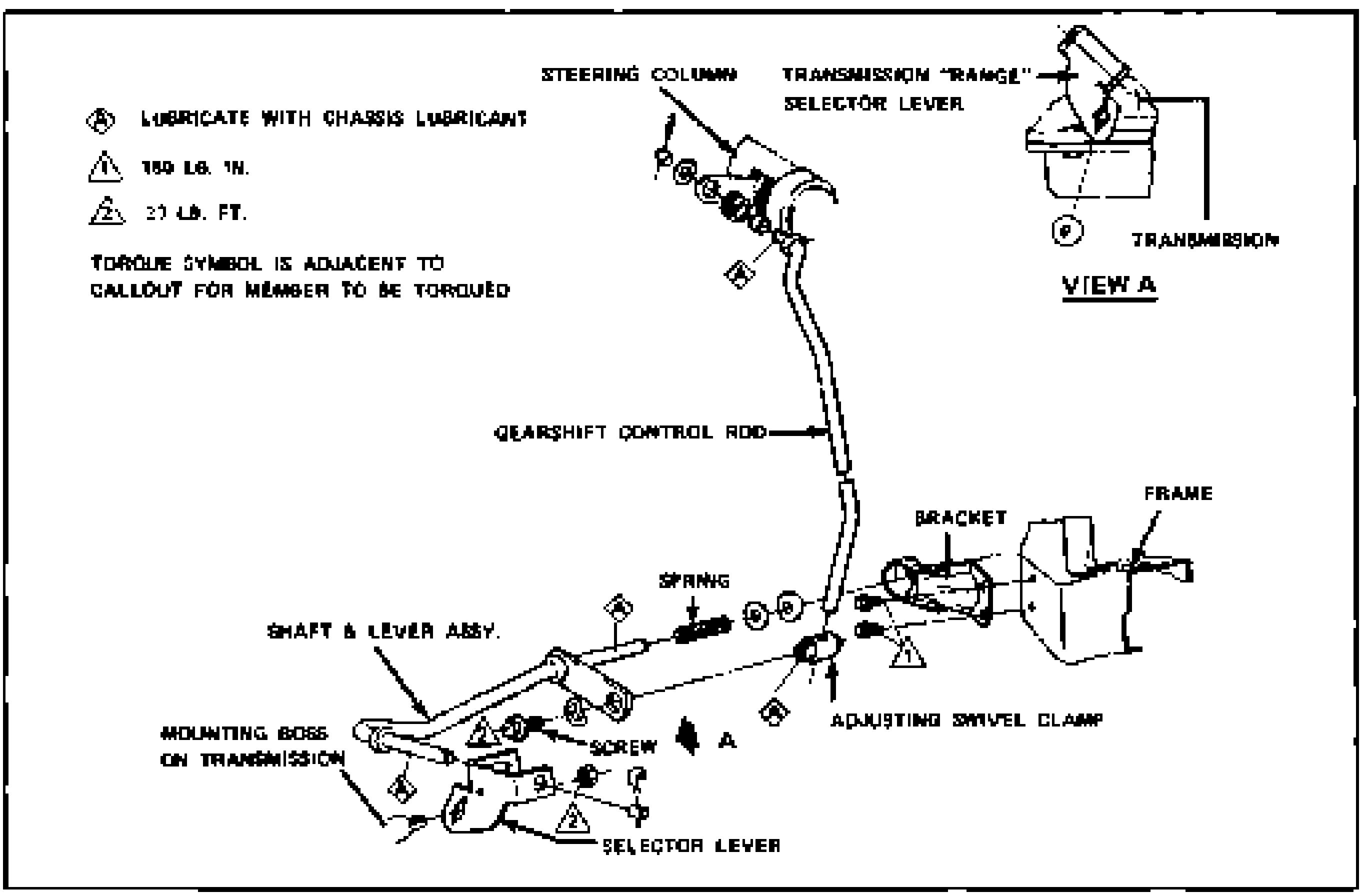


Fig. 7E-3 Column Shift Controls - Pontiac

CAUTION: The full mark on the dipstick is an indication of transmission fluid at normal operating temperature of 180°F. This temperature is only obtained after at least 15 miles of highway driving or equivalent of city driving.

1. With manual control lever in Park position, start engine. DO NOT RACE ENGINE. Move manual control lever through each range.

2. Immediately check fluid level with selector lever in Park, engine running and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be at the FULL mark.

3. If additional fluid is required, add enough fluid to bring level to the FULL mark on the dipstick.

If vehicle is not driven 15 expressway miles, or its equivalent, and it becomes necessary to check fluid level, the transmission fluid must be at room temperature (70°F).

With fluid at room temperature (70°F), follow steps 1, 2 and 3 below:

1. With manual control lever in Park position, start engine. DO NOT RACE ENGINE. Move manual control lever through each range.

2. Immediately check fluid level with selector lever in Park, engine running and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be 7/10" below the ADD mark.

3. If additional fluid is required, add fluid to bring level to 7/10" 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°F, it will appear at the FULL mark on the dipstick when the transmission reaches normal operating temperature (180°F). IMPORTANT: When adding fluid, use only DEXRON automatic transmission fluid, or equivalent. The difference in oil level between ADD and FULL is one pint.

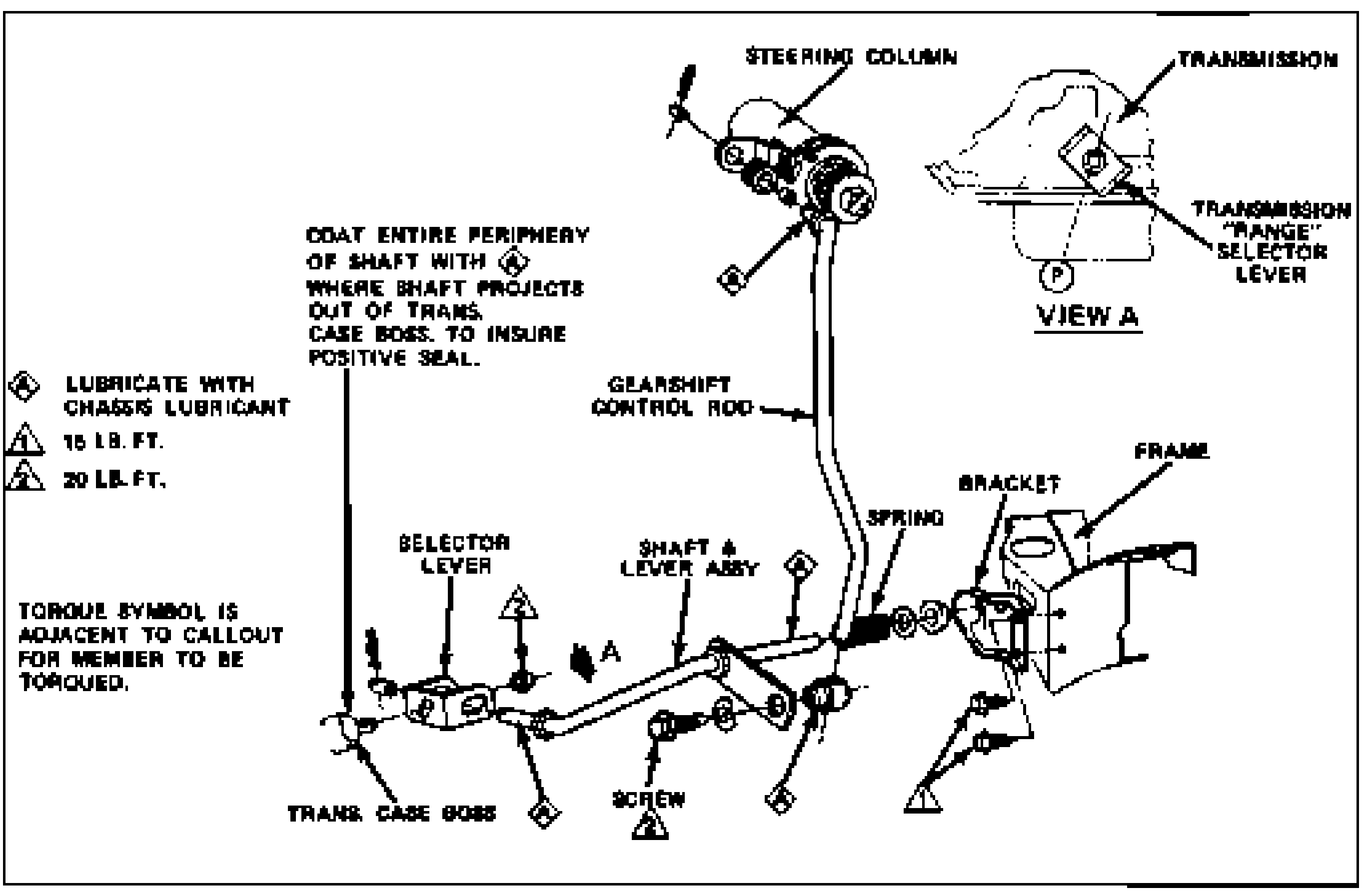


Fig. 7E-4 Column Shift Controls - Tempest and Grand Prix

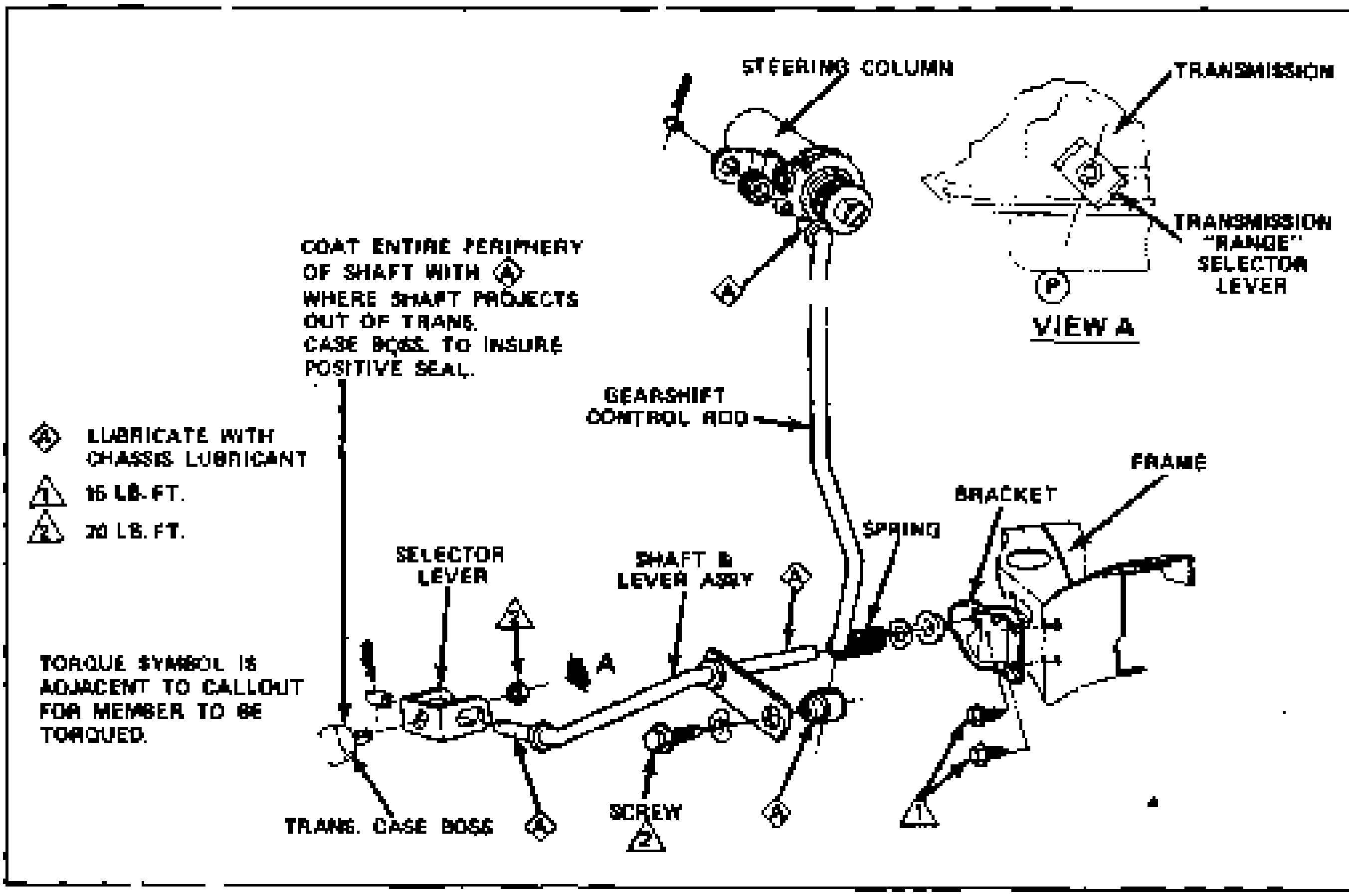


Fig. 7E-5 Column Shift Controls - Firebird

In all 1969 and earlier model automatic transmissions, *use either DEXRON automatic transmission fluid or Type A automatic transmission fluid identified by the mark "AQ-ATF," followed by a number and the suffix letter "A" (AQ-ATF-XXXXA).*

FLUID CAPACITY, DRAINING AND REFILLING

CAPACITY

Approximately 7 1/2 pints of fluid are required to refill transmission after oil pan has been drained. When unit has been disassembled and rebuilt, approximately 19 pints will be required to refill. Use only DEXRON, or equivalent, automatic transmission fluid.

DRAINING AND REFILLING TRANSMISSION

Drain oil immediately after operation before it has had an opportunity to cool.

To drain oil, proceed as follows:

1. Remove bottom pan attaching screws, pan and gasket. Discard gasket.

2. Remove oil strainer retainer bolt, oil strainer assembly, O-ring seal from intake pipe and discard the strainer and O-ring seal.

3. Install new O-ring seal on intake pipe and install new strainer on pipe assembly.

4. With O-ring seal on intake pipe, install pipe and strainer assembly, attaching strainer to the control valve assembly with its retainer bolt.

5. Thoroughly clean bottom pan.

6. Affix new gasket to bottom pan with petrolatum.

7. Install bottom pan with attaching screws and torque to 12 lb. ft.

8. Pour approximately 7 1/2 pints of fluid into the transmission (If the valve body has also been removed, use 9 1/2 pints). After a complete overhaul, approximately 19 pints are required. Be sure container, spout or funnel is clean.

9. Start engine and let idle (carburetor off fast idle step). Place selector lever in Park position and apply hand brake.

10. With transmission hot (approximately 180-190°F), add fluid to bring level to FULL mark on indicator.

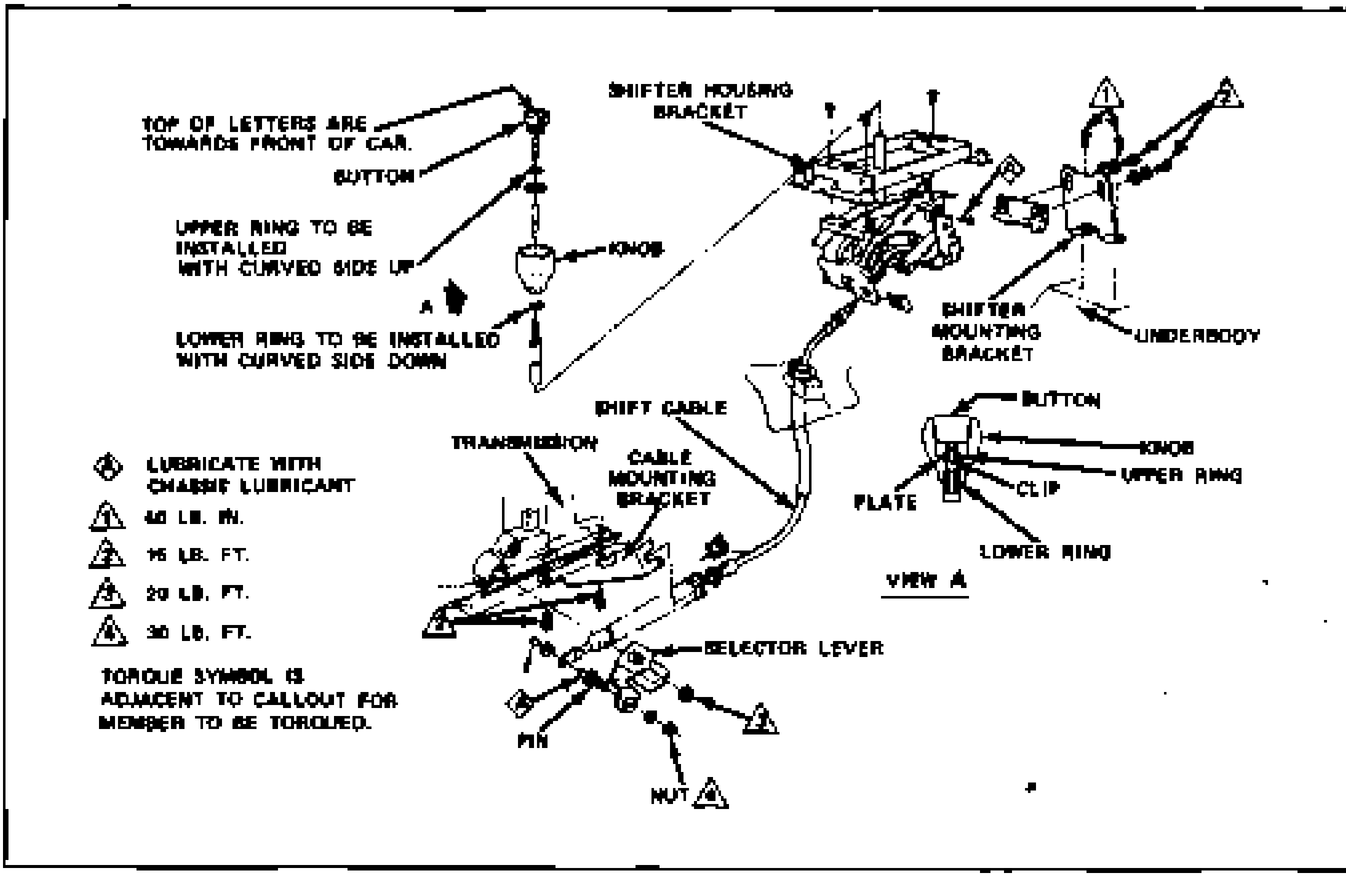


Fig. 7E-6 Console Shift Controls - Tempest and Grand Prix

With transmission at room temperature (70°F), add fluid to bring level to 7/10" below the ADD mark.

CAUTION: Do not overfill. Foaming will result.

PRESSURE REGULATOR VALVE

REMOVAL

1. Remove bottom pan and strainer. Discard gasket.

2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using snap ring pliers and tool as shown in Fig. 7E-8.

3. Remove regulator boost valve bushing and valve.

4. Remove pressure regulator spring.

5. Remove regulator valve, spring retainer and spacer(s) if present.

INSTALLATION

Installation of the pressure regulator valve is the reverse of the removal. Affix new gasket to bottom pan and adjust oil level.

CONTROL VALVE BODY

REMOVAL

1. Remove bottom pan and strainer. Discard gasket.

2. Disconnect solenoid lead from connector terminal.

3. Remove control valve body attaching screws and detent roller spring assembly.

NOTE: Do not remove solenoid attaching screws.

4. Remove control valve body assembly and governor pipes. If care is taken in removing control valve body, the six (6) check balls will stay in place above the spacer plate.

CAUTION: Do not drop manual valve.

5. Remove the governor pipes and manual valve from control valve body.

INSTALLATION

Installation of the control valve body is the reverse of the removal. Affix new gasket to bottom pan and adjust oil level.

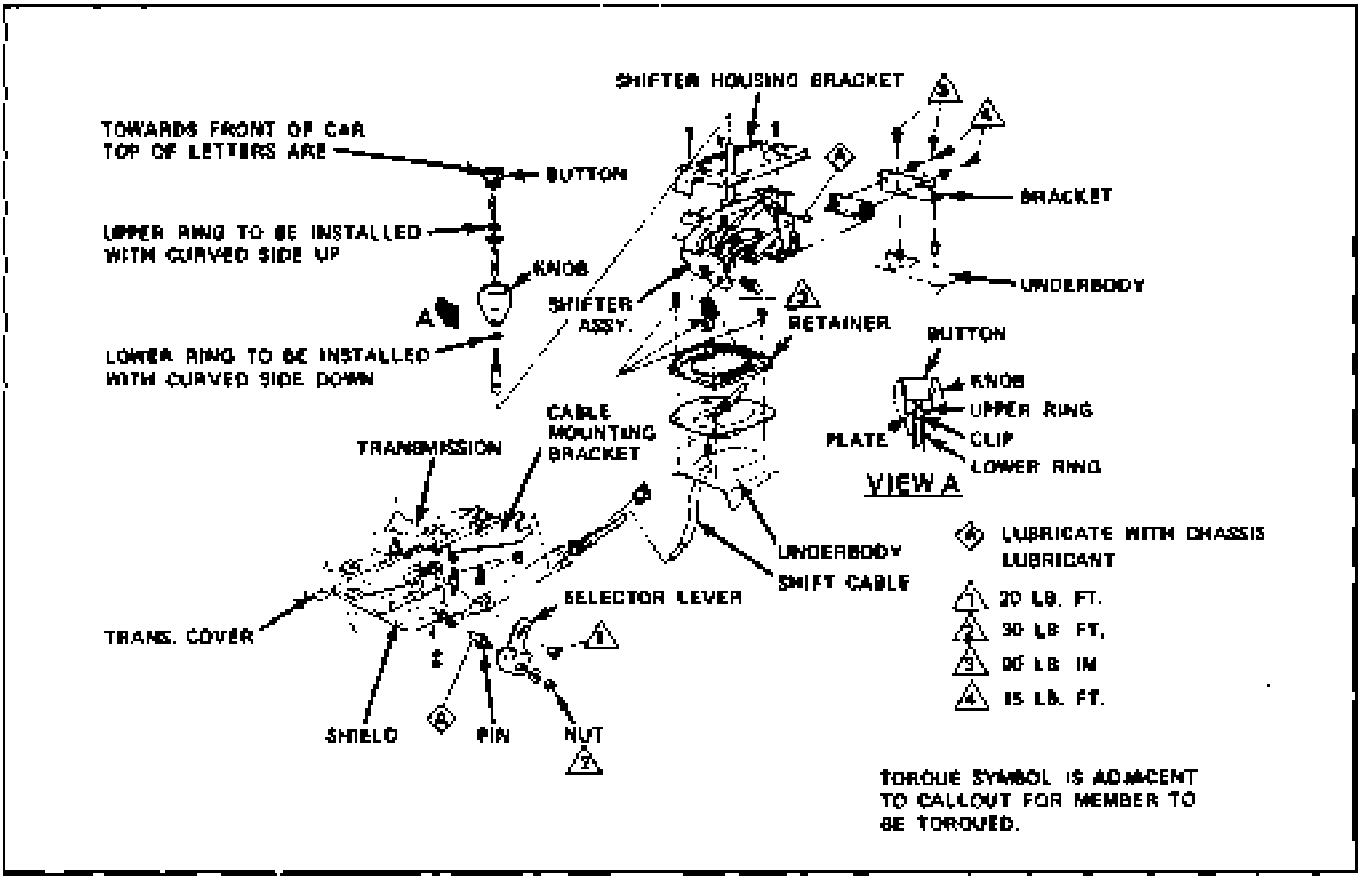


Fig. 7E-7 Console Shift Controls - Firebird

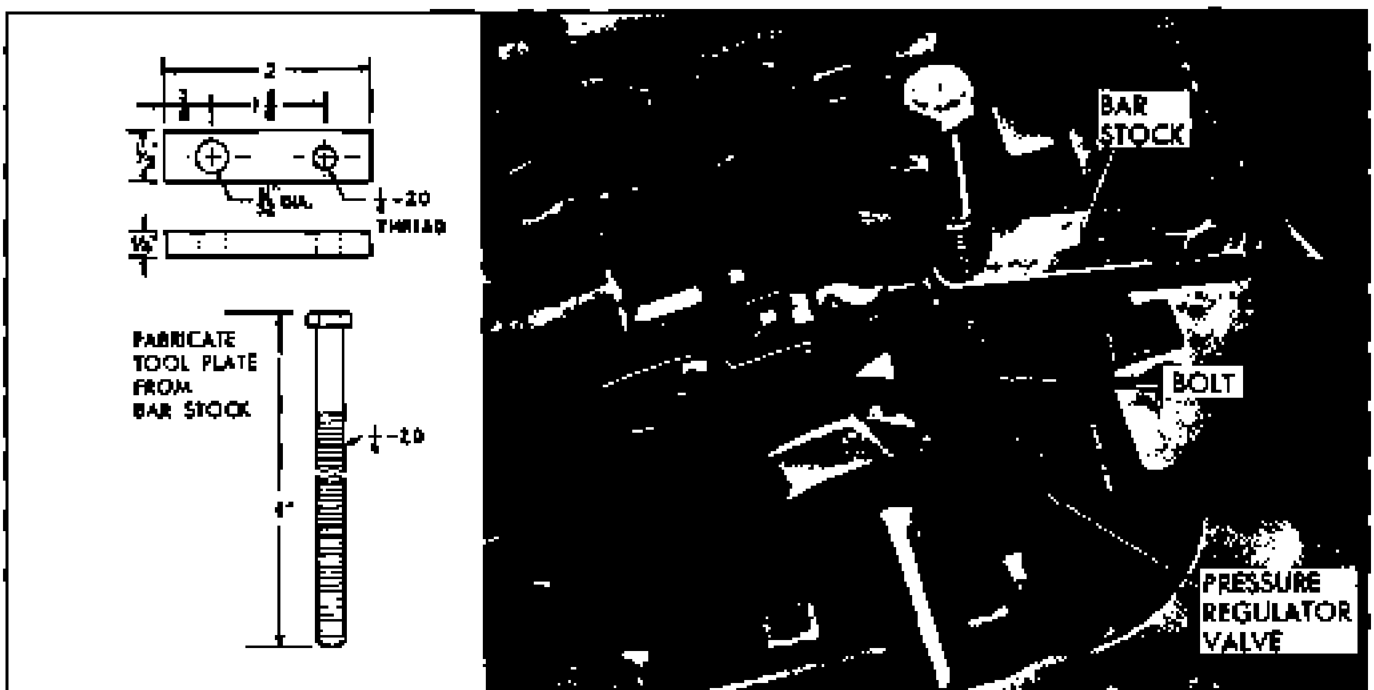


Fig. 7E-8 Removing Pressure Regulator Valve

GOVERNOR

REMOVAL

1. Remove governor cover attaching screws, cover and gasket.

2. Discard gasket.

3. Withdraw governor assembly from case.

INSTALLATION

Installation of the governor assembly is the reverse of the removal. Use a new gasket under the governor cover. Adjust oil level.

MODULATOR AND MODULATOR VALVE

REMOVAL

1. Remove modulator assembly attaching screw and retainer.

2. Remove modulator assembly from case. Discard O-ring seal.

3. Remove modulator valve from case.

INSTALLATION

Installation of the modulator assembly and modulator valve is the reverse of the removal. Use a new O-ring seal on the modulator assembly. Adjust oil level

PARKING LINKAGE

REMOVAL

1. Remove bottom pan and strainer. Discard gasket.

2. Unthread jam nut holding detent lever to manual shaft.

3. Remove manual shaft retaining pin from case.

4. Remove manual shaft and jam nut from case.

NOTE: Do not remove manual shaft seal unless replacement is required

5. Remove parking actuator rod and detent lever assembly.

6. Remove parking pawl bracket attaching screws and bracket.

7. Remove parking pawl return spring.

NOTE: The following steps should not be completed unless part replacement is required:

a. Remove parking pawl shaft retainer.

b. Remove parking pawl shaft plug, parking pawl shaft and parking pawl

INSTALLATION

Installation of the parking linkage is the reverse of the removal. Use new seal plug (if required) and new gasket. Adjust oil level

REAR SEAL

REMOVAL

1. Remove propeller shaft.

2. Pry seal out with screwdriver or small chisel.

INSTALLATION

1. Using Tool J 21359, install new seal.

2. Re-install propeller shaft.

REMOVAL OF TRANSMISSION

Before raising the car, disconnect the battery and release the parking brake.

1. Remove propeller shaft.

2. Disconnect speedometer cable, electrical lead to case connector, vacuum line at modulator and oil cooler pipes.

3. Disconnect shift control linkage.

4. Support transmission with jack.

5. Disconnect rear mount from transmission and frame crossmember.

6. Remove two bolts at each end of frame crossmember and remove crossmember.

7. Remove converter dust shield.

8. Remove converter to flex plate bolts.

9. Loosen exhaust pipe to manifold bolts approximately 1/4" and lower transmission until jack is barely supporting it.

10. Remove transmission to engine mounting bolts.

11. Raise transmission to its normal position, slide rearward from engine and lower it away from car.

CAUTION: When lowering transmission, keep rear of transmission lower than front so as not to lose converter, or retain converter by using Converter Holding Clamp J 21366.

The installation of the transmission is the reverse of the removal.

TRANSMISSION DISASSEMBLY AND REASSEMBLY

REMOVAL OF CONVERTER AND MODULATOR

1. With transmission in cradle on portable jack, remove J 21366 and remove converter assembly by pulling straight out.

NOTE: Converter contains a large amount of oil.

2. Install Holding Fixture J 8763-01 on transmission so that modulator will be located on side of holding fixture nearest bench (Fig. 7E-9).

NOTE: Do not over-torque holding screw. This will bind center support.

3. Install fixture and transmission into holding tool Base J 3289-20 with bottom pan facing up.

4. Remove modulator attaching screw and retainer (Fig. 7E-10).

5. Remove modulator assembly and O-ring seal from case (Fig. 7E-11).

6. Remove modulator valve from transmission case.

REMOVAL OF GOVERNOR, SPEEDOMETER DRIVEN GEAR, PAN, STRAINER AND INTAKE PIPE

1. Remove attaching screws, governor cover and gasket. Discard gasket (Fig. 7E-12).

2. Withdraw governor assembly from case.

3. Remove speedometer driven gear attaching screw and retainer (Fig. 7E-13).

4. Withdraw speedometer driven gear assembly from case.

5. Remove bottom pan attaching screws, bottom pan and bottom pan gasket. Discard gasket (Fig. 7E-14).

Fig. 7E-10 Removing Modulator Retainer

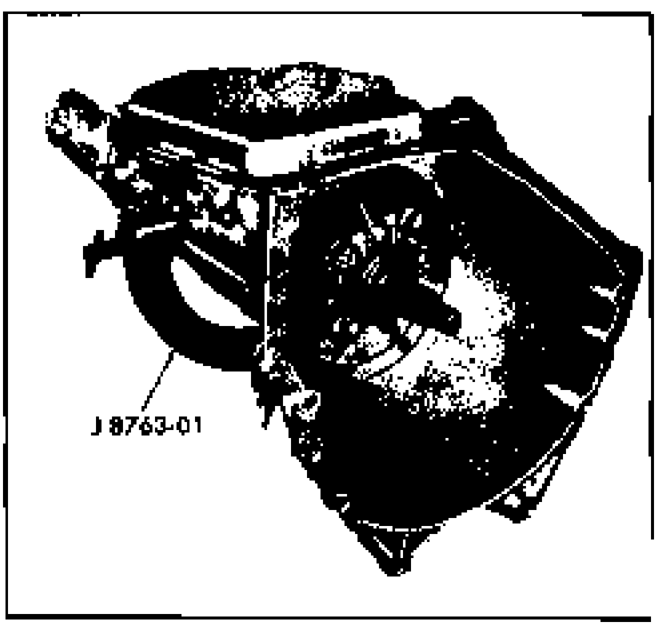


Fig. 7E-9 Transmission in Holding Fixture

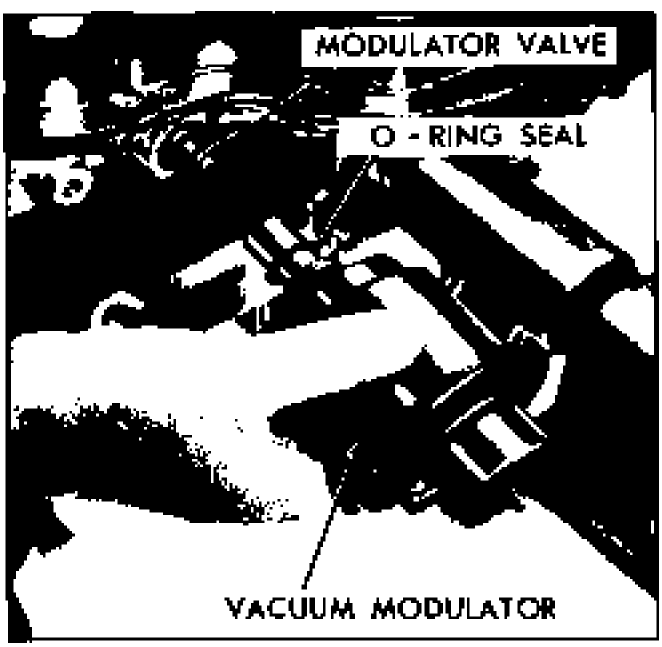


Fig. 7E-11 Removing Vacuum Modulator and Valve

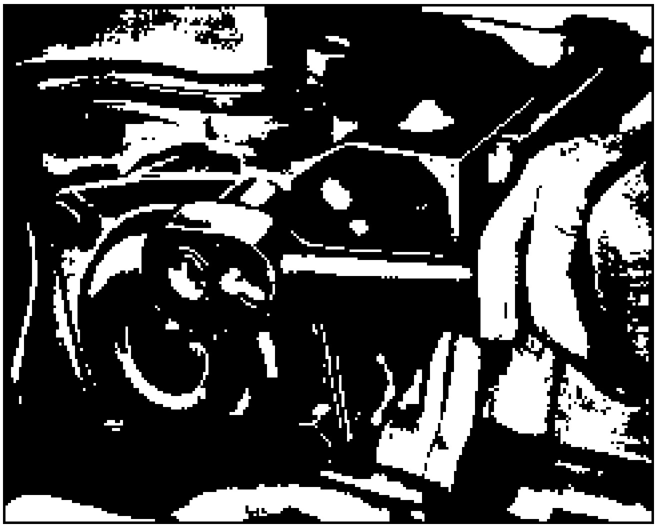


Fig. 7E-12 Removing Governor Cover Attaching Screws

6. Remove the strainer retainer bolt (Fig. 7E-15).

7. Remove the strainer and intake pipe assembly (Fig. 7E-16)

8. Remove intake pipe to case O-ring seal from intake pipe or case and discard.

REMOVAL OF CONTROL VALVE ASSEMBLY, SOLENOID CONNECTOR, GOVERNOR PIPES AND DETENT SPRING ASSEMBLY

1. Remove control valve body attaching screws and detent roller spring assembly (Fig. 7E-17).

Fig. 7E-13 Removing Speedometer Driven Gear Retainer

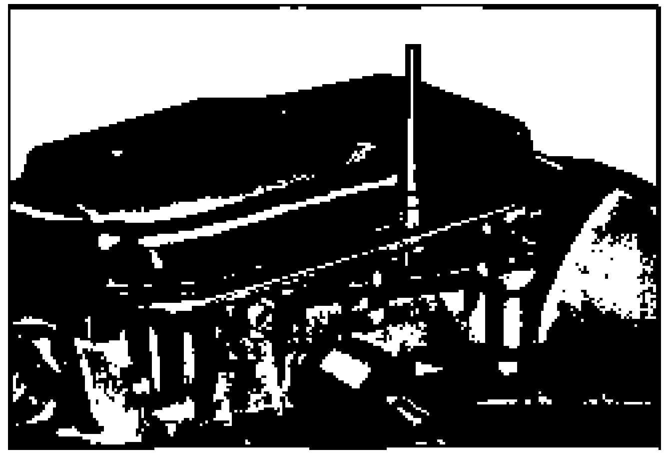


Fig. 7E-14 Removing Transmission Oil Pan Attaching Screws

NOTE: Do not remove solenoid attaching screws.

2. Disconnect solenoid lead from connector terminal.

3. Remove control valve body assembly and governor pipes (Fig. 7E-18).

CAUTION: Do not drop manual valve.

4. Remove governor pipes from control valve assembly.

5. Remove control valve assembly to spacer gasket.

REMOVAL OF REAR SERVO, VALVE BODY SPACER, GASKET AND FRONT SERVO

1. Remove rear servo cover attaching screws, servo cover and gasket. Discard gasket (Fig. 7E-19).

2. Remove rear servo from case (Fig. 7E-20).

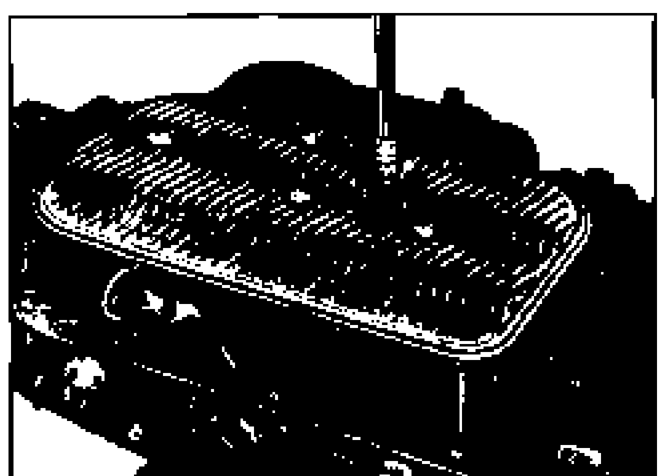


Fig. 7E-15 Removing Strainer Bolt

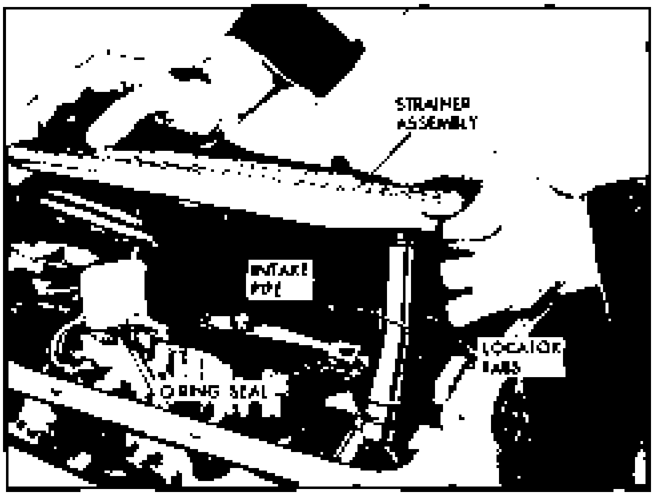


Fig. 7E-16 Removing Strainer and Intake Pipe Assembly

3. Remove rear servo accumulator spring.

4. Make band apply pin selection check to determine possible cause of malfunction (Fig. 7E-21).

BAND APPLY PIN SELECTION

a. Attach Band Apply Pin and Fixture J 21370-5 and J 21370-6 to transmission case with attaching screws.

b. Apply 25 ft. lb. torque and select proper pin to be used during assembly of transmission.

There are three selective pins identified as follows:

a. If both steps of J 21370-5 are below the gage surface, the long pin, identified by 3 rings, should be used.

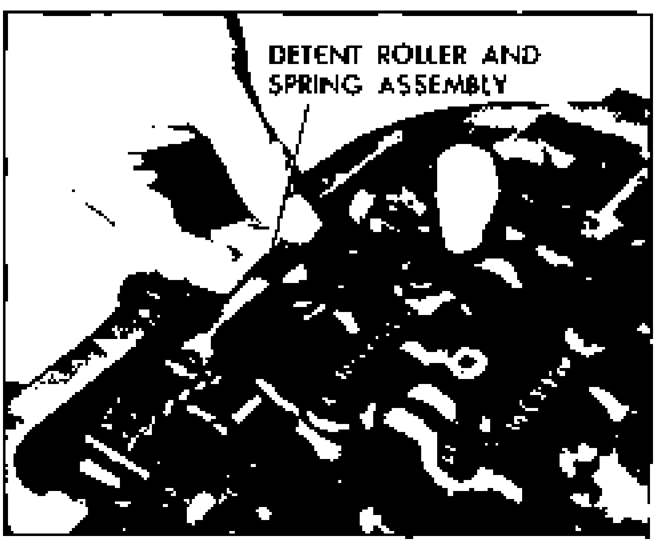


Fig. 7E-17 Removing Detent Roller and Spring Assembly

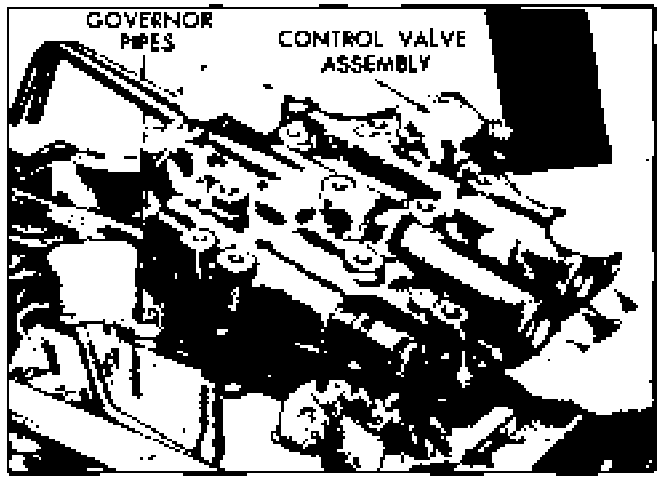


Fig. 7E-18 Removing Control Valve Assembly and Governor Pipes from Case

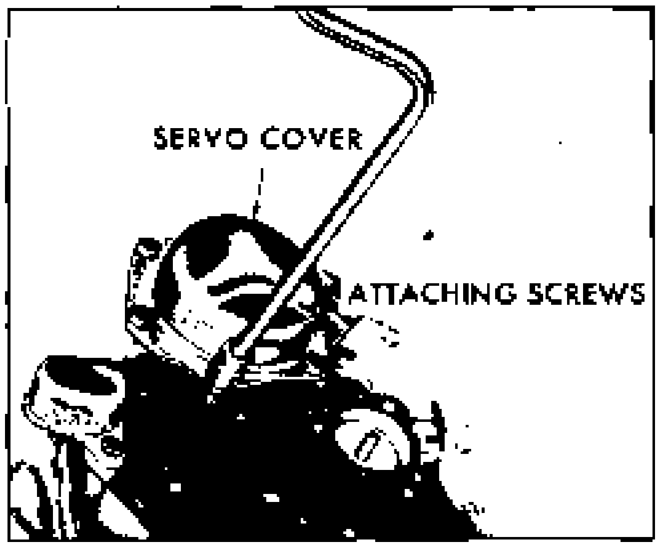


Fig. 7E-19 Removing Rear Servo Cover Attaching Screws

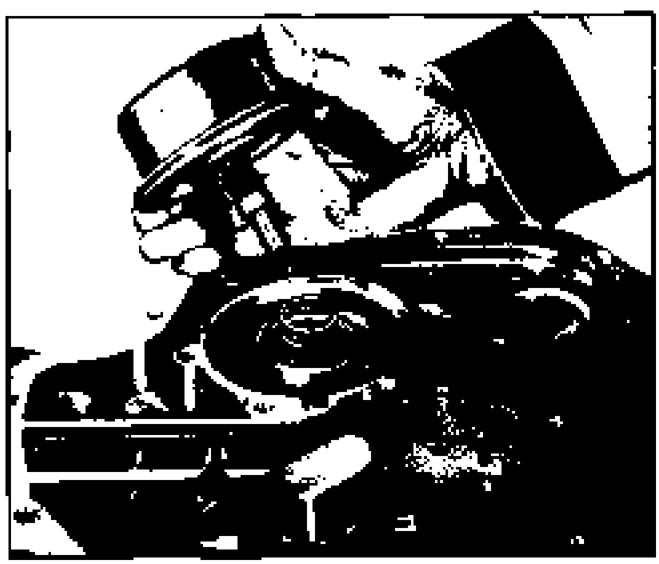


Fig. 7E-20 Removing Rear Servo

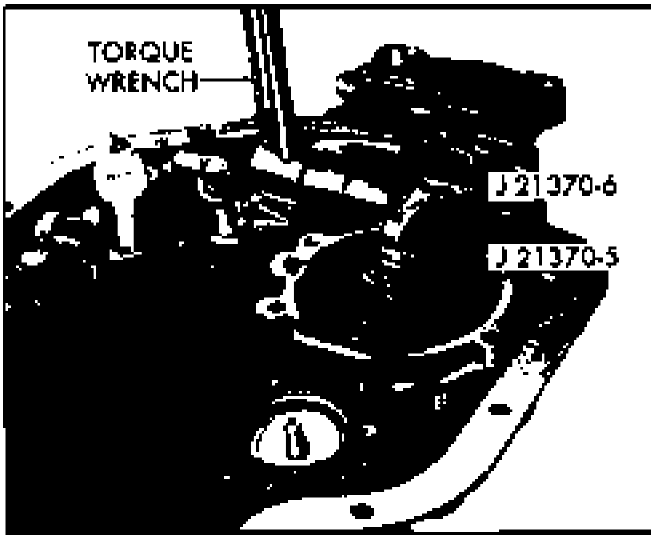


Fig. 7E-21 Checking Rear Band Pin

b. If the gage surface is between the steps, the medium pin, identified by 2 rings, should be used.

c. If both steps are above the gage surface, the short pin, identified by 1 ring, should be used

Identification rings are located on band lug end of the pin. Selecting the proper pin is equivalent of adjusting the band.

5. Remove solenoid attaching screws, solenoid assembly and gasket (Fig. 7E-22).

6. Withdraw detent solenoid case connector sleeve and O-ring seal (Fig. 7E-23).

7. Remove control valve assembly spacer plate and gasket.

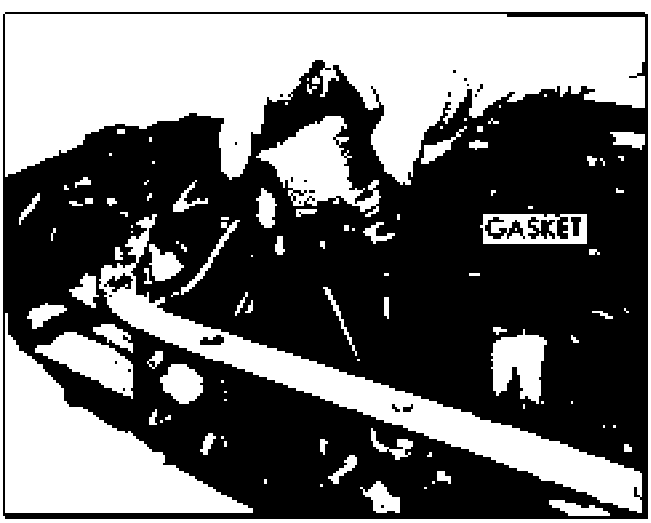


Fig. 7E-22 Removing Detent Solenoid and Gasket

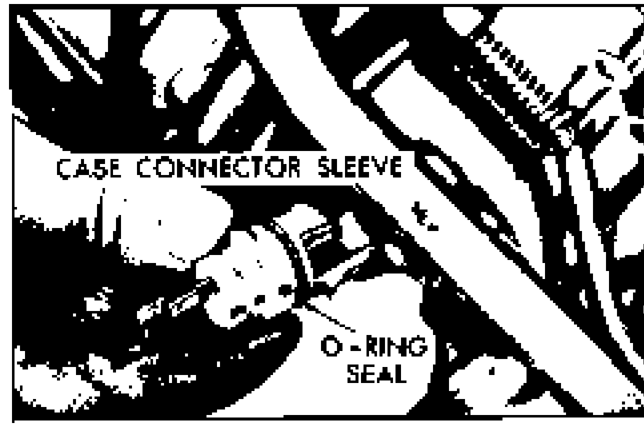


Fig. 7E-23 Removing Case Connector Sleeve and O Ring Seal

8. Remove six (6) check balls from cored passages in transmission case (Fig. 7E-24).

NOTE: Mark location of balls for aid in reassembly.

9. Remove front servo piston, washer, pin, retainer and spring from transmission case (Fig. 7E-25)

REMOVAL OF REAR OIL SEAL AND EXTENSION HOUSING

1. If necessary to replace, pry rear oil seal from extension housing (Fig. 7E-26).

2. Remove extension housing to case attaching bolts.

3. Remove extension housing and extension housing to case gasket (Fig. 7E-27).

FRONT END PLAY CHECKING PROCEDURE

1. Remove one front pump attaching bolt and bolt seal.

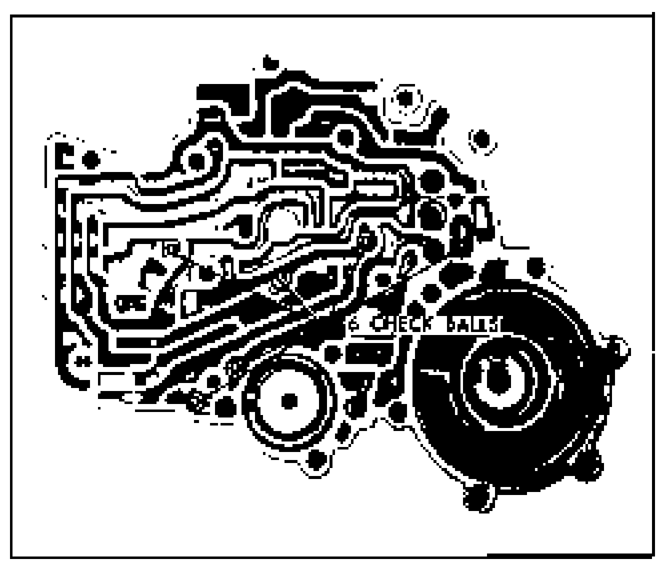


Fig. 7E-24 Location of Check Balls

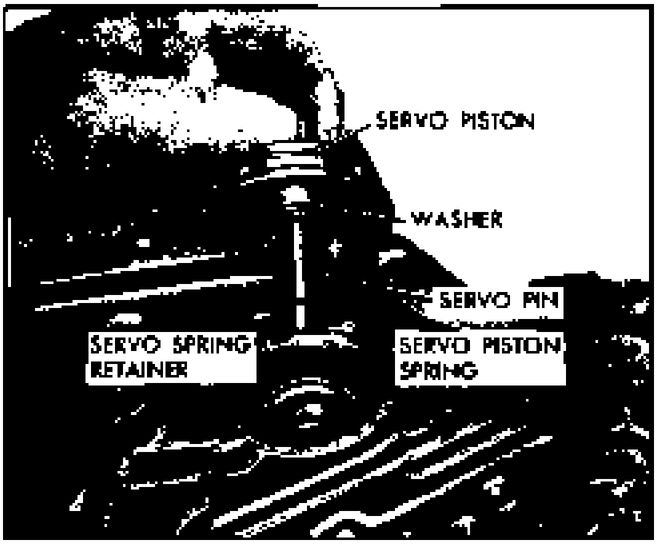


Fig. 7E-25 Removing Front Servo Piston, Washer and Pin

2. Install a 5/16"-18 threaded slide hammer bolt or J 21904-1 into bolt hole (see Fig. 7E-28 for location).

3. Mount Dial Indicator J 8001 on rod and index indicator to register with end of turbine shaft.

4. Push turbine shaft rearward

5. Push output shaft forward.

6. Set dial indicator to Zero.

7. Pull turbine shaft forward

8. Read resulting travel or end play. Should be .003"-.024".

9. Selective washer controlling this end play is the washer located between pump cover and forward clutch housing. If more or less washer thickness is

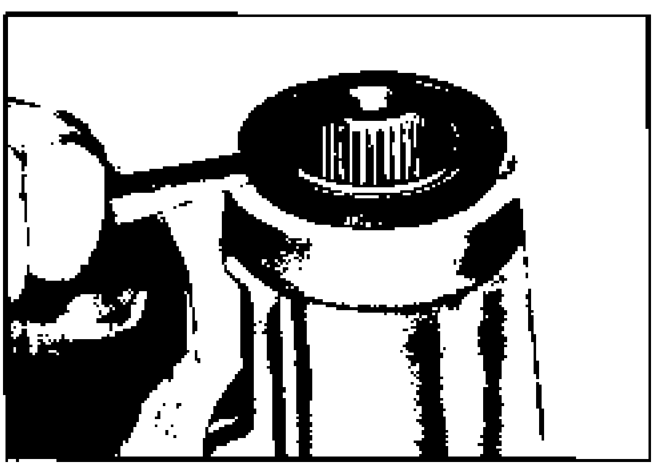


Fig. 7E-26 Removing Rear Oil Seal from Case Extension

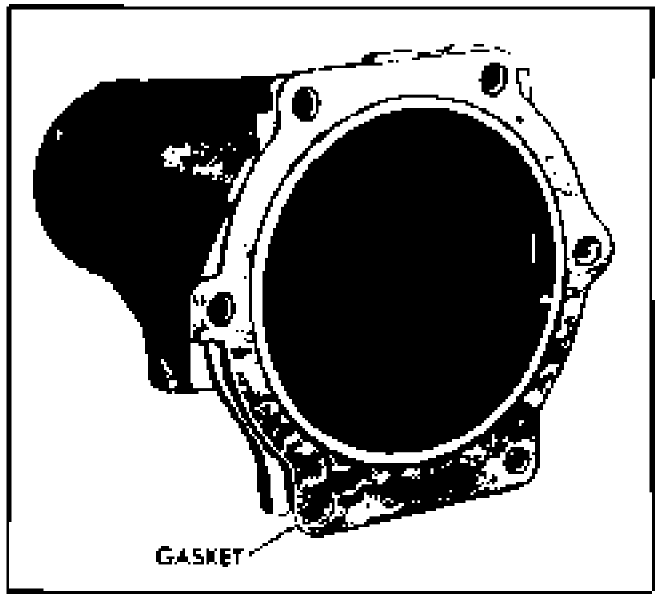


Fig. 7E-27 Location of Case Extension Gasket

required to bring end play within specifications, select proper washer from the following chart:

THICKNESS (IN INCHES)	COLOR
.060—.064	Yellow
.071—.075	Blue
.082—.086	Red
.093—.097	Brown
.104—.108	Green
.115—.119	Black
.126—.130	Purple

NOTE: An oil soaked washer may tend to discolor, so it will be necessary to measure washer for its actual thickness.

Fig. 7E-28 Checking Front Unit End Play

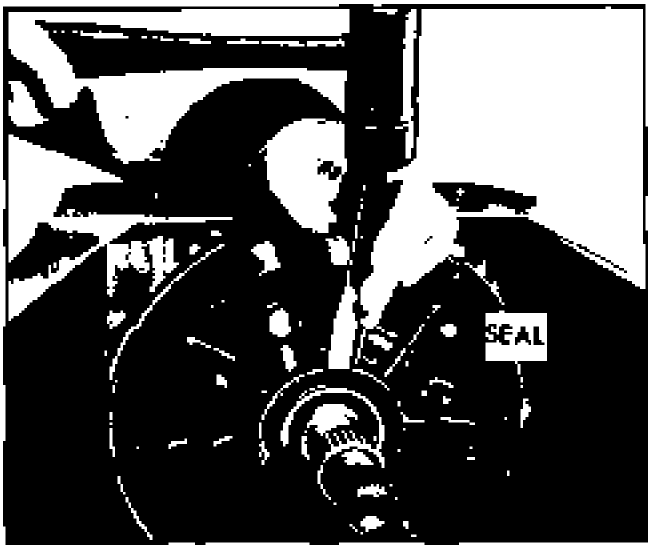


Fig. 7E-29 Removing Front Seal

REMOVAL OF OIL PUMP

1. If necessary to replace, pry front seal from pump (Fig. 7E-29)

2. Remove pump attaching bolts.

3. Install 3/8"-16 threaded slide hammer Adapters J 6125-2 into bolt holes in pump body, attach Slide Hammers J 6125-1 and remove pump assembly from case (See Fig. 7E-30 for location of threaded holes)

4. Remove and discard pump to case seal ring and gasket.

5. Remove forward clutch assembly and turbine shaft from transmission (Fig 7E-31)

6. Remove forward clutch hub to direct clutch housing

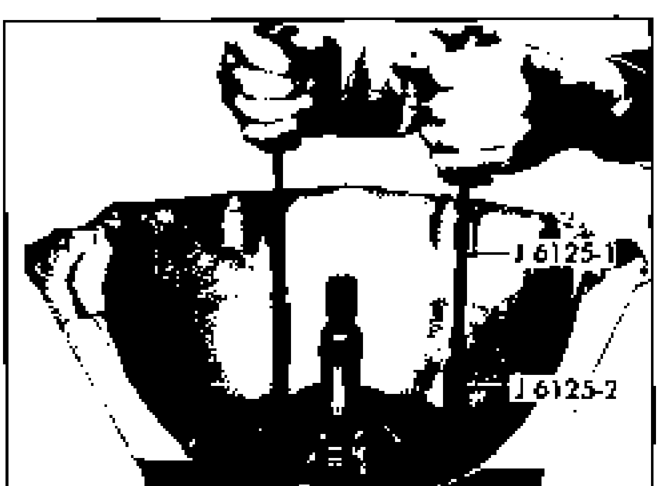


Fig. 7E-30 Removing Pump Assembly

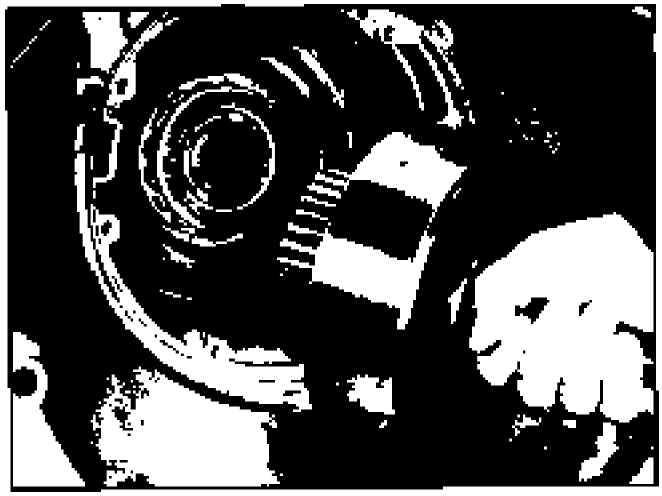


Fig. 7E-31 Removing Forward Clutch Assembly and Turbine Shaft

thrust washer if it did not come out with forward clutch housing.

7. Remove direct clutch assembly (Fig. 7E-32)

NOTE: If necessary, remove manual linkage as follows:

a. Unthread jam nut holding detent lever to manual shaft.

b. Remove manual shaft retaining pin from case (Fig. 7E-33).

CAUTION: Do not lose jam nut as it becomes free from manual shaft.

c. Remove manual shaft and jam nut from case (Fig. 7E-34).

d. Remove parking actuator rod and detent lever assembly.

e. Remove attaching screws and parking bracket (Fig. 7E-35).

Fig. 7E-32 Removing Direct Clutch Assembly

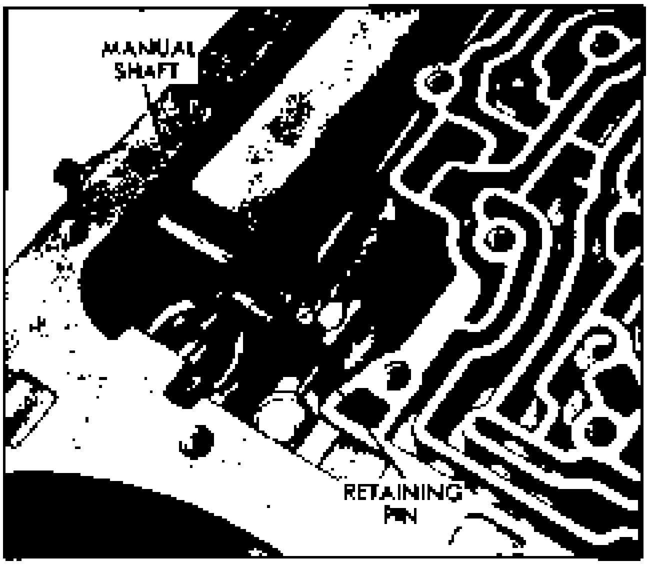


Fig. 7E-33 Removing Manual Shaft Retaining Pin from Case

f. Remove parking pawl return spring (Fig. 7E-36).

NOTE: The following steps are to be completed only if one or more of the parts involved require replacement.

g. Remove parking pawl shaft retaining spring (Fig. 7E-37).

h. Remove parking pawl shaft cup plug by inserting a screwdriver between the parking pawl shaft and the transmission case rib (Fig. 7E-38).

i. Remove parking pawl shaft and parking pawl (Fig. 7E-39).

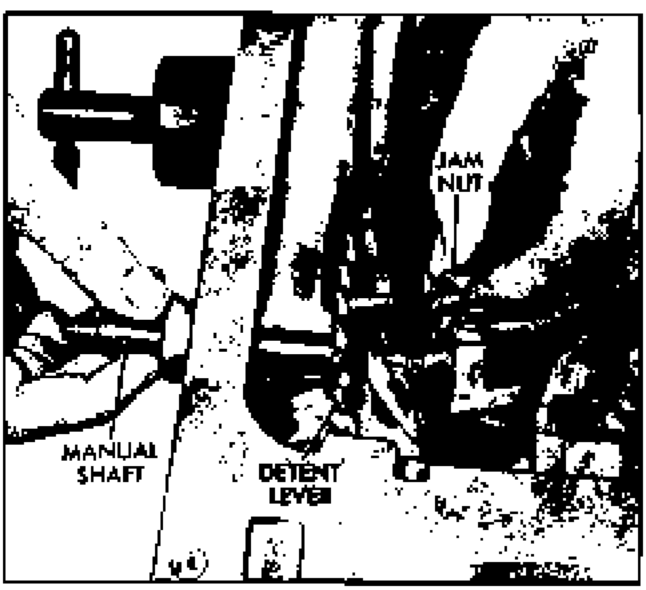


Fig. 7E-34 Removing Detent Lever and Jam Nut from Manual Shaft

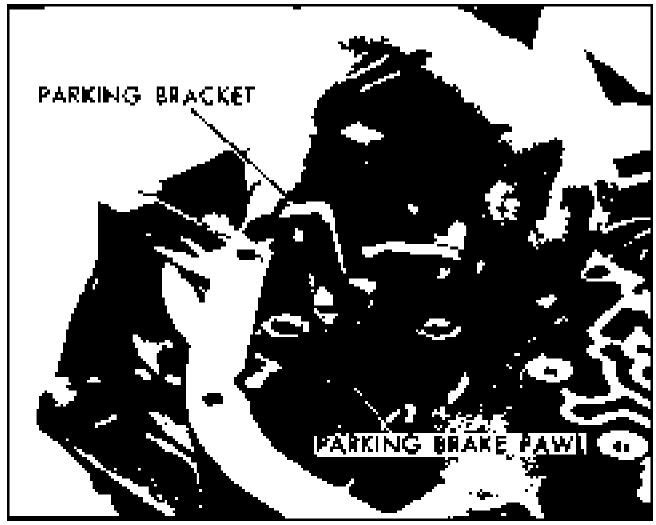


Fig. 7E-35 Removing Parking Bracket

8. Remove front band (Fig. 7E-40).

9. Remove sun gear shaft (Fig. 7E-41).

REAR END PLAY CHECKING PROCEDURE

10. Check end play as follows

a. Install J 21904 into an extension housing attaching bolt hole.

b. Mount Dial Indicator J 8001 on rod and index with end of output shaft (Fig. 7E-42).

c. Move output shaft in and out to read end play. End play should be from .003" to .019". Selective washer controlling this end play is steel washer having 3 lugs. It is located between thrust washer and rear face of transmission case.

Fig. 7E-36 Removing Parking Pawl Return Spring

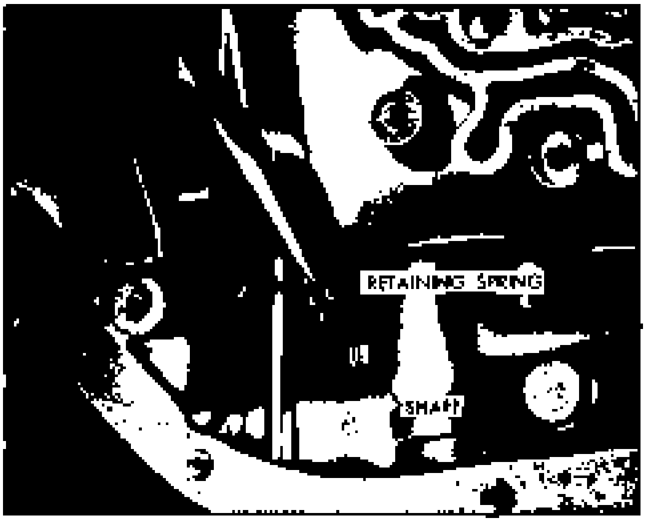


Fig. 7E-37 Removing Parking Shaft Retaining Spring

d. If a different washer thickness is required to bring end play within specification, it can be selected from the following chart:

THICKNESS (IN INCHES)	NOTCHES	AND/OR STAMPED NO.
.074—.078	None	1
.082—.086	1 Tab Side	2
.090—.094	2 Tab Side	3
.098—.102	1 Tab O.D.	4
.106—.110	2 Tabs O.D.	5
.114—.118	3 Tabs O.D.	6

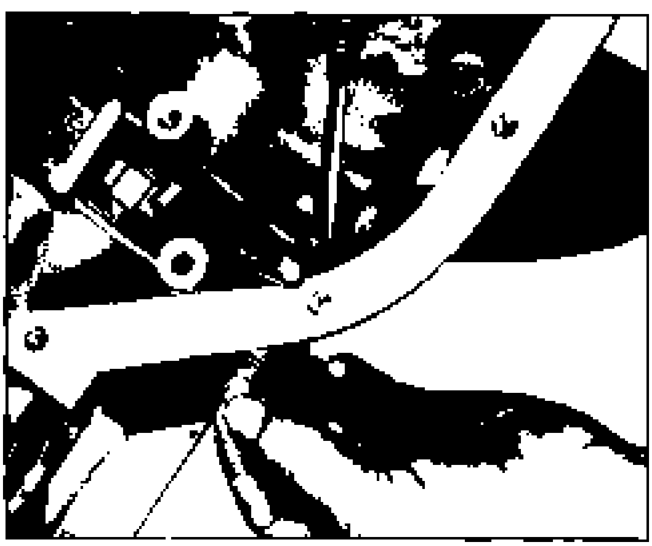


Fig. 7E-38 Removing Parking Pawl Shaft Cup Plug

Fig. 7E-39 Removing Parking Pawl and Shaft with O Ring

11. Remove case center support to case bolt, using a 3/8" 12 point thin wall deep socket (Fig. 7E-43).

12. Remove intermediate clutch backing plate to case snap ring.

13. Remove intermediate clutch backing plate, three (3) composition and three (3) steel clutch plates (Fig. 7E-44).

14. Remove center support to case retaining snap ring (Fig. 7E-45).

15. Remove entire gear unit assembly by lifting with Gear Assembly Installing and Removing Tool J 21795 with J 6125-1 Slide Hammer (Fig. 7E-46).

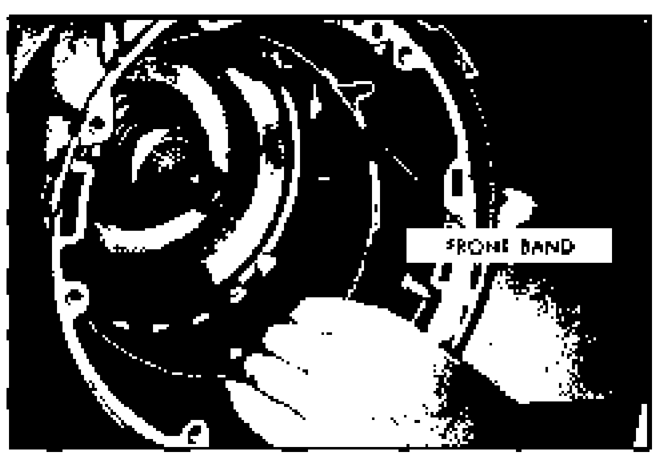


Fig. 7E-40 Removing Front Band

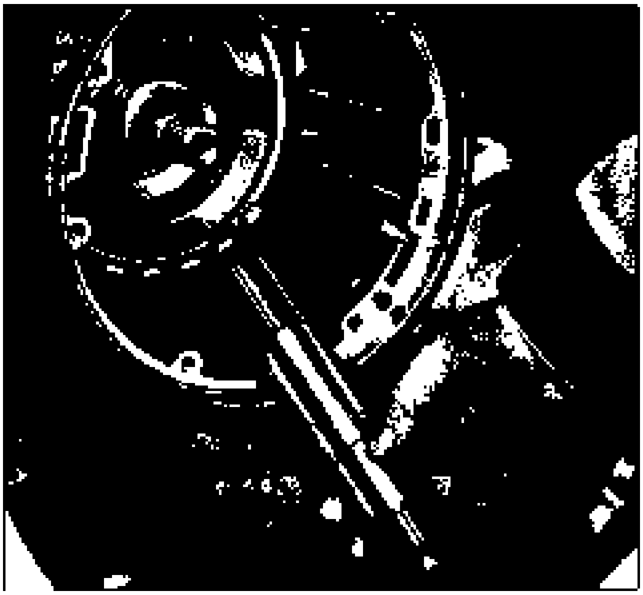


Fig. 7E-41 Removing Sun Gear Shaft

16. Remove output shaft to case thrust washer from rear of output shaft or from inside of case.

17. Place gear unit assembly, with output shaft facing down, in hole in work bench or Holding Fixtures J 6116 and J 21364.

18. Remove rear unit selective washer from transmission case (Fig. 7E-47).

19. Remove rear band assembly (Fig. 7E-48).

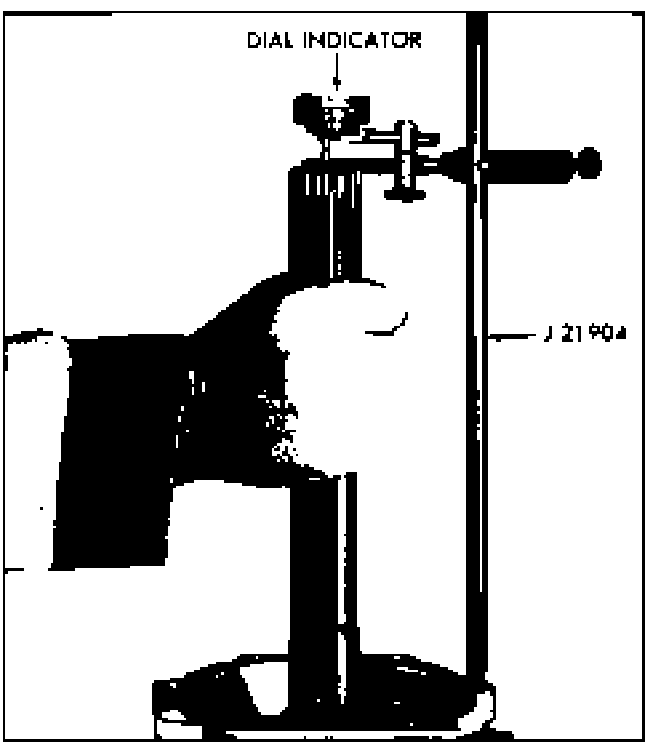


Fig. 7E-42 Checking Rear Unit End Play

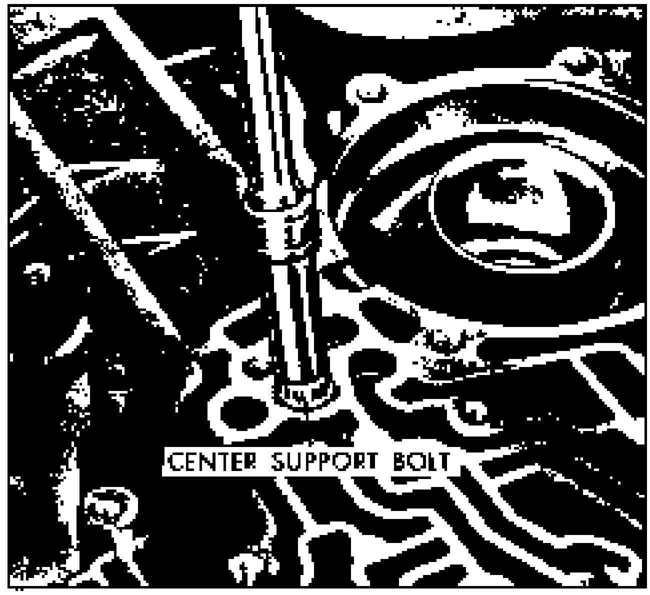


Fig. 7E-43 Removing Center Support Bolt

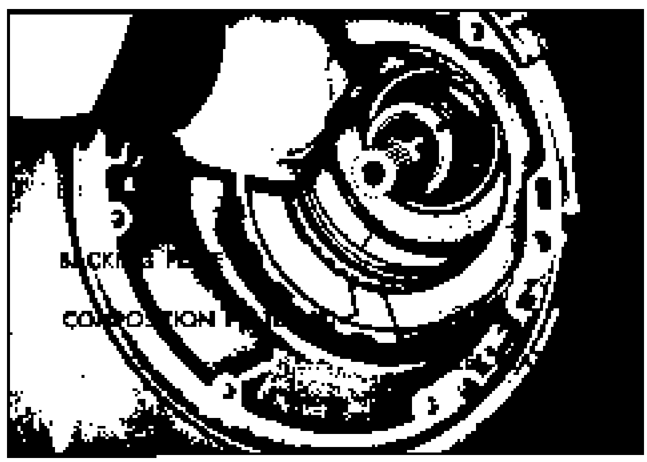


Fig. 7E-44 Removing Intermediate Clutch Backing Plate and Clutch Plates

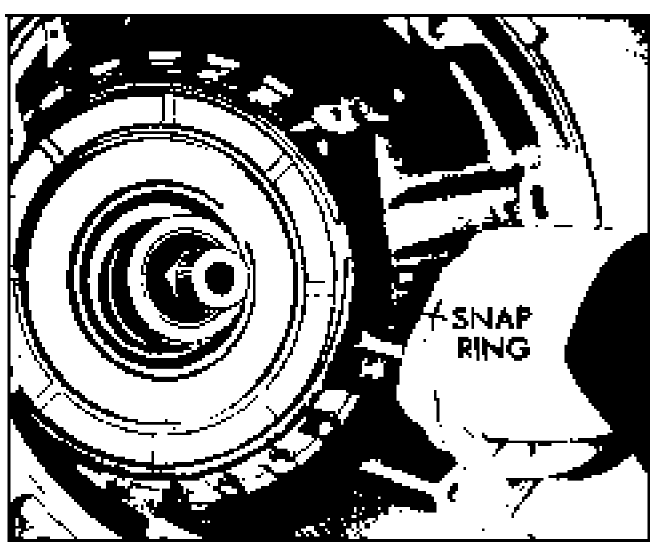


Fig. 7E-45 Removing Center Support to Case Snap Ring

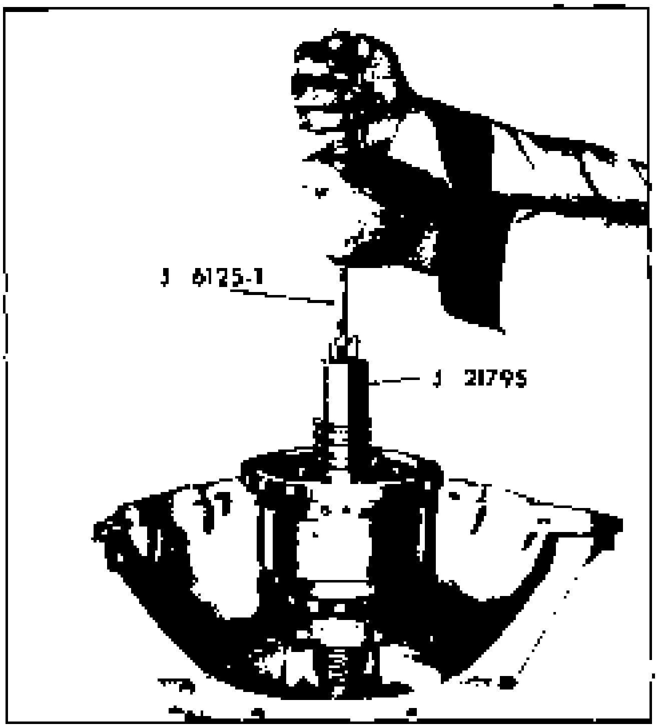


Fig. 7E-46 Removing Center Support and Gear Unit from Case

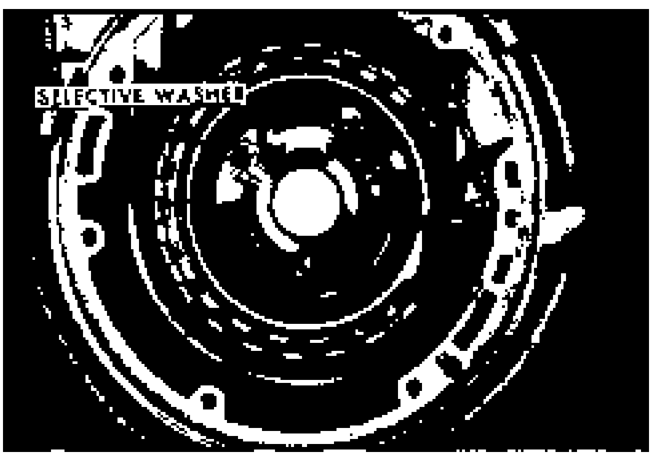


Fig. 7E-47 Removing Selective Washer

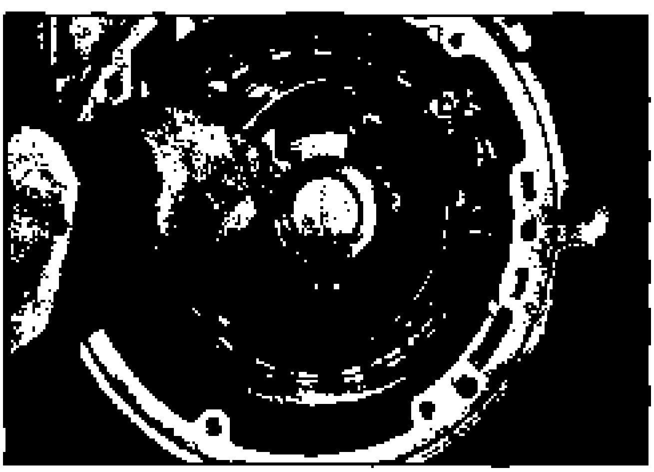


Fig. 7E-48 Removing Rear Band

DISASSEMBLY OF GEAR UNIT

1. Remove center support assembly (Fig. 7E-49).

2. Remove center support to reaction carrier thrust washer (Fig. 7E-50)

3. Remove center support to sun gear races and thrust bearing.

NOTE: One race may have been removed with center support.

4. Remove reaction carrier and roller clutch assembly (Fig. 7E-51).

5. Remove front internal gear ring from output carrier assembly.

6. Remove sun gear (Fig. 7E-52)

7. Remove reaction carrier to output carrier thrust washer.

8. Turn carrier assembly over.

9. Remove output shaft to output carrier snap ring (Fig. 7E-53).

10. Remove output shaft

11. If removal and installation or replacement of the

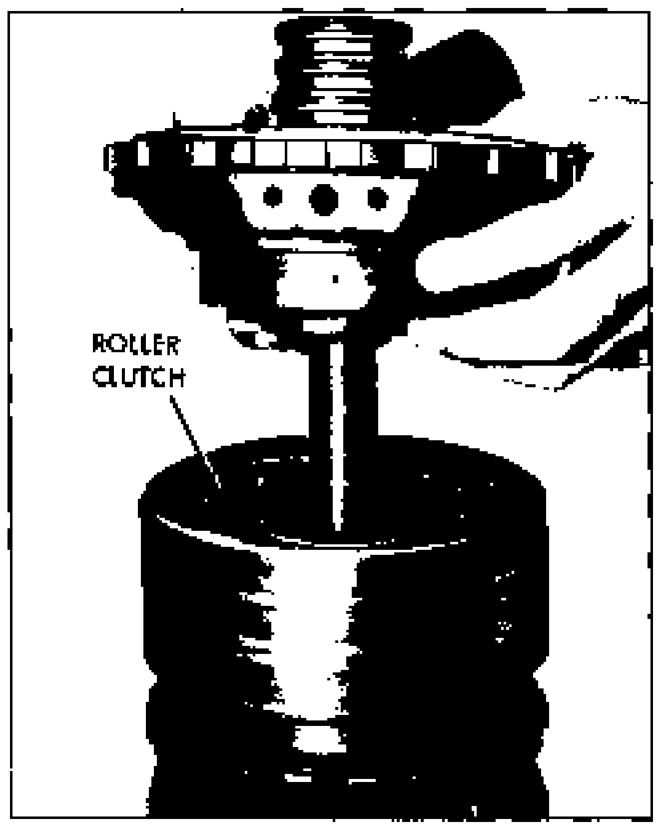


Fig. 7E-49 Removing Center Support Assembly

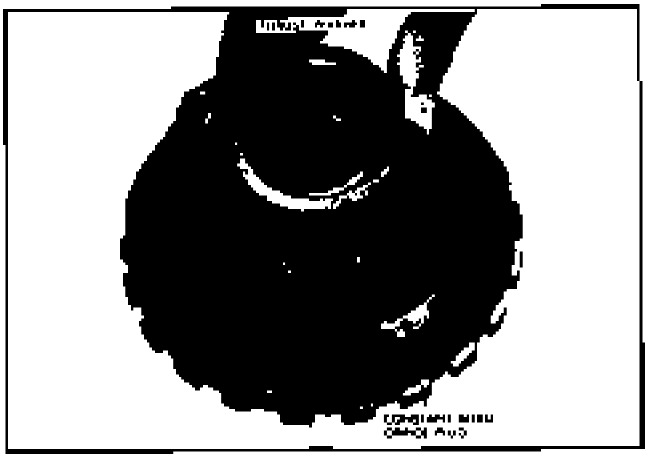


Fig. 7E-50 Removing Center Support Thrust Washer

speedometer drive gear is necessary, proceed as follows:

TRANSMISSIONS WITH NYLON SPEEDOMETER DRIVE GEAR

a. Depress retaining clip and slide gear off the output shaft (Fig. 7E-54).

b. To install, place retaining clip (square end toward flange of shaft) into hole in output shaft (Fig. 7E-55. Align slot in speedometer drive gear with retaining clip and install gear.

NOTE: The nylon speedometer drive gear is installed at the factory only. ALL service replacement speedometer drive gears are STEEL. When replacing the nylon speedometer drive gear with a steel gear, discard the retaining clip and proceed as indicated in step "b" below.

TRANSMISSIONS WITH STEEL SPEEDOMETER DRIVE GEAR

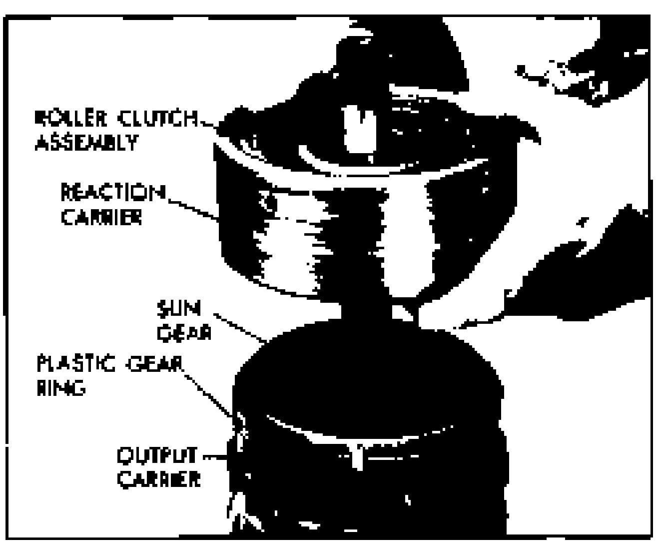


Fig. 7E-51 Removing Reaction Carrier and Roller Clutch from Output Carrier

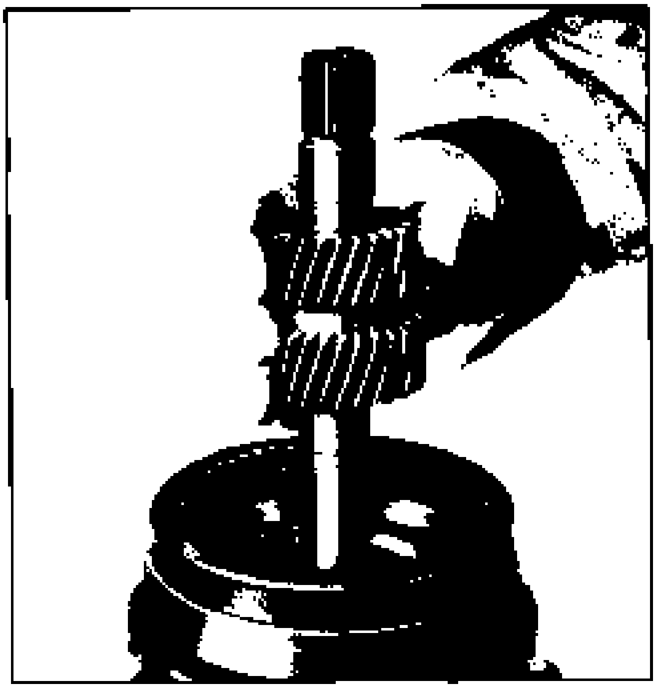


Fig. 7E-52 Removing Sun Gear

a. Installing Speedo Gear Removing Tools J 21427 and J 8433 and Bolts J 21904 on the output shaft, remove the speedometer drive gear (Fig. 7E-56).

b. Install a new STEEL speedometer drive gear and drive to location 11 29/64" from end of output shaft to rear face of gear for models PA, PB, PC and PH and to location 5 21/32" from end of output shaft to rear face of gear for models PQ, PR, PS, PT, PV, PW and PX, using J 21028 (cup side up) and J 6133 (Fig. 7E-57).

12. Remove output shaft to rear internal gear thrust bearing and two (2) races.

13. Remove rear internal gear and mainshaft (Fig. 7E-58).

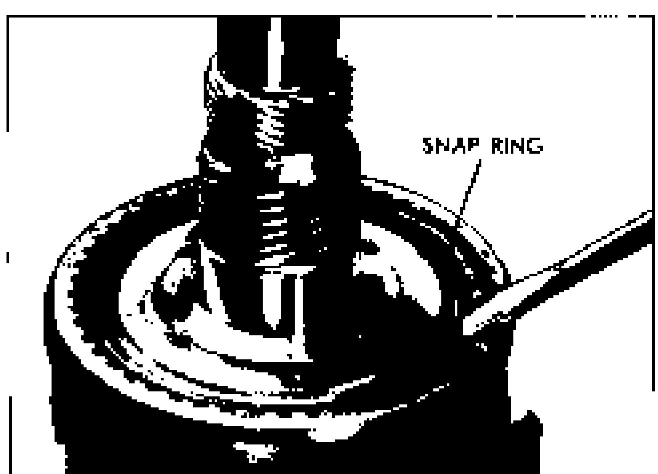


Fig. 7E-53 Removing Output Shaft to Carrier Snap Ring

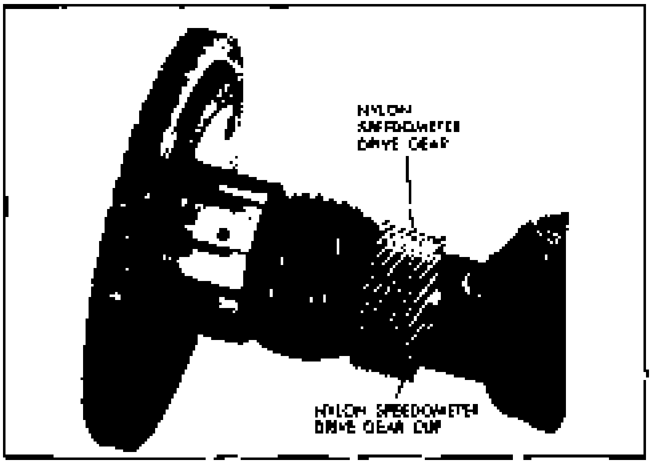


Fig. 7E-54 Removing Retaining Clip

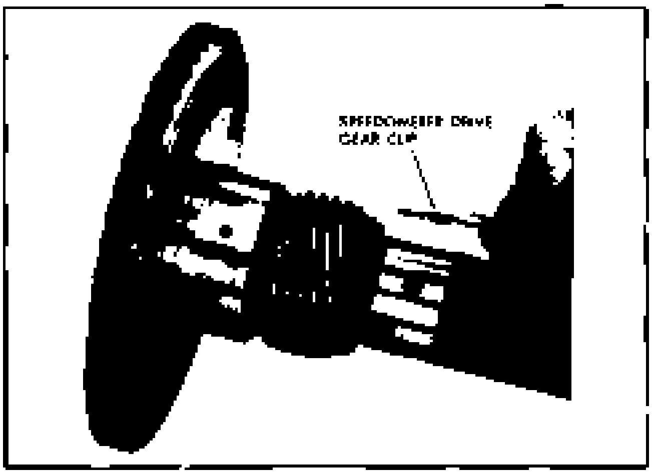


Fig. 7E-55 Installing Retaining Clip

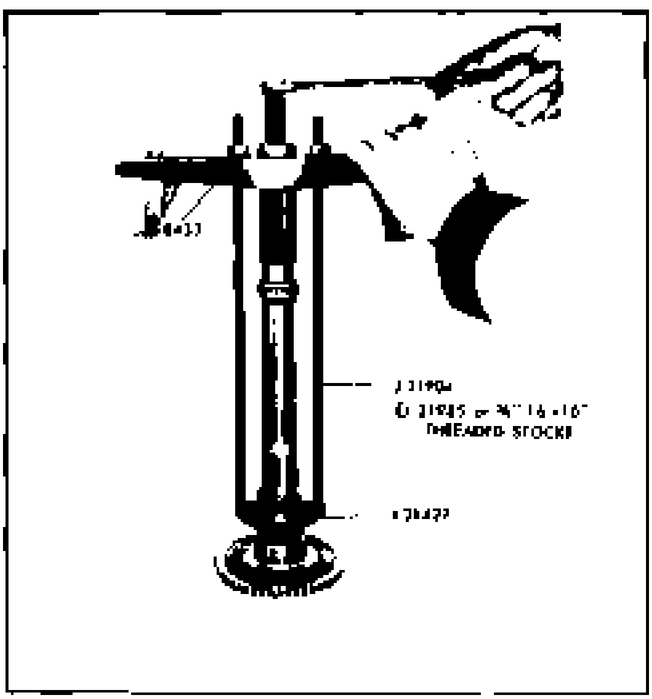


Fig. 7E-56 Removing Speedometer Drive Gear

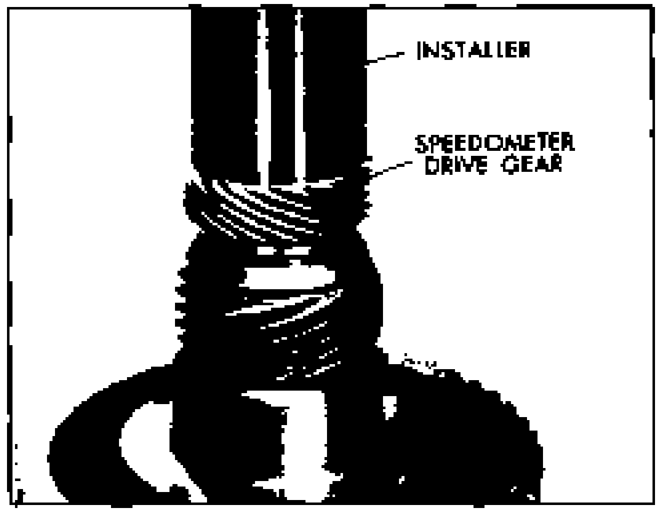


Fig. 7E-57 Installing Speedometer Drive Gear

NOTE: Do not drop bearings.

14. Remove rear internal gear to sun gear thrust bearing and two (2) races.

15. Remove rear internal gear to mainshaft snap ring to remove mainshaft (Fig. 7E-59).

GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is

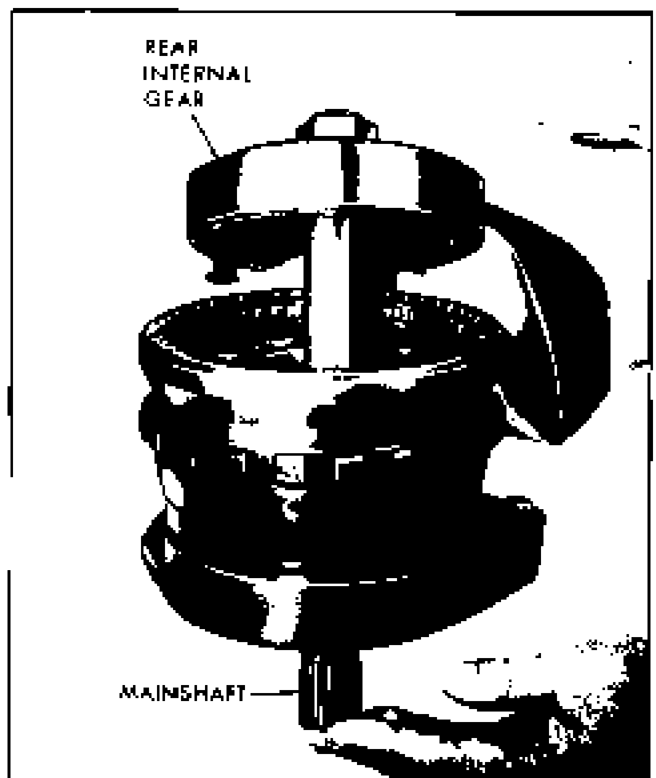


Fig. 7E-58 Removing Rear Internal Gear and Mainshaft

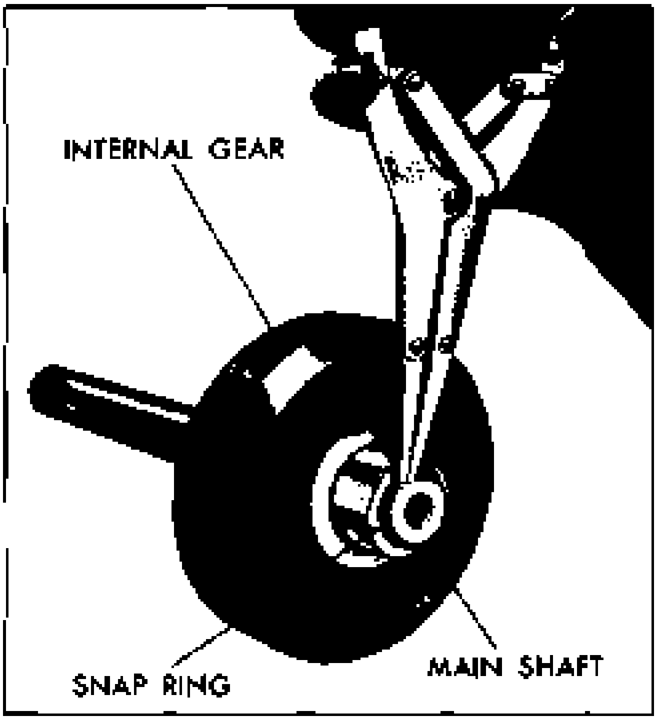


Fig. 7E-59 Removing Rear Internal Gear to Mainshaft Snap Ring

calibrated. The governor, including the driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

It is necessary to disassemble governor assembly in order to replace driven gear. Disassembly may also be necessary due to foreign material causing improper operation. In such cases, proceed as follows:

DISASSEMBLY OF GOVERNOR

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights and springs. Governor weights are interchangeable from side to side and need not be identified (Fig. 7E-60).

2. Remove governor valve from governor sleeve. Be careful not to damage valve or sleeve.

3. Perform the following inspections and replace governor driven gear, if necessary:

INSPECTION OF GOVERNOR

1. Wash all parts in cleaning solvent, air dry and blow out all passages.

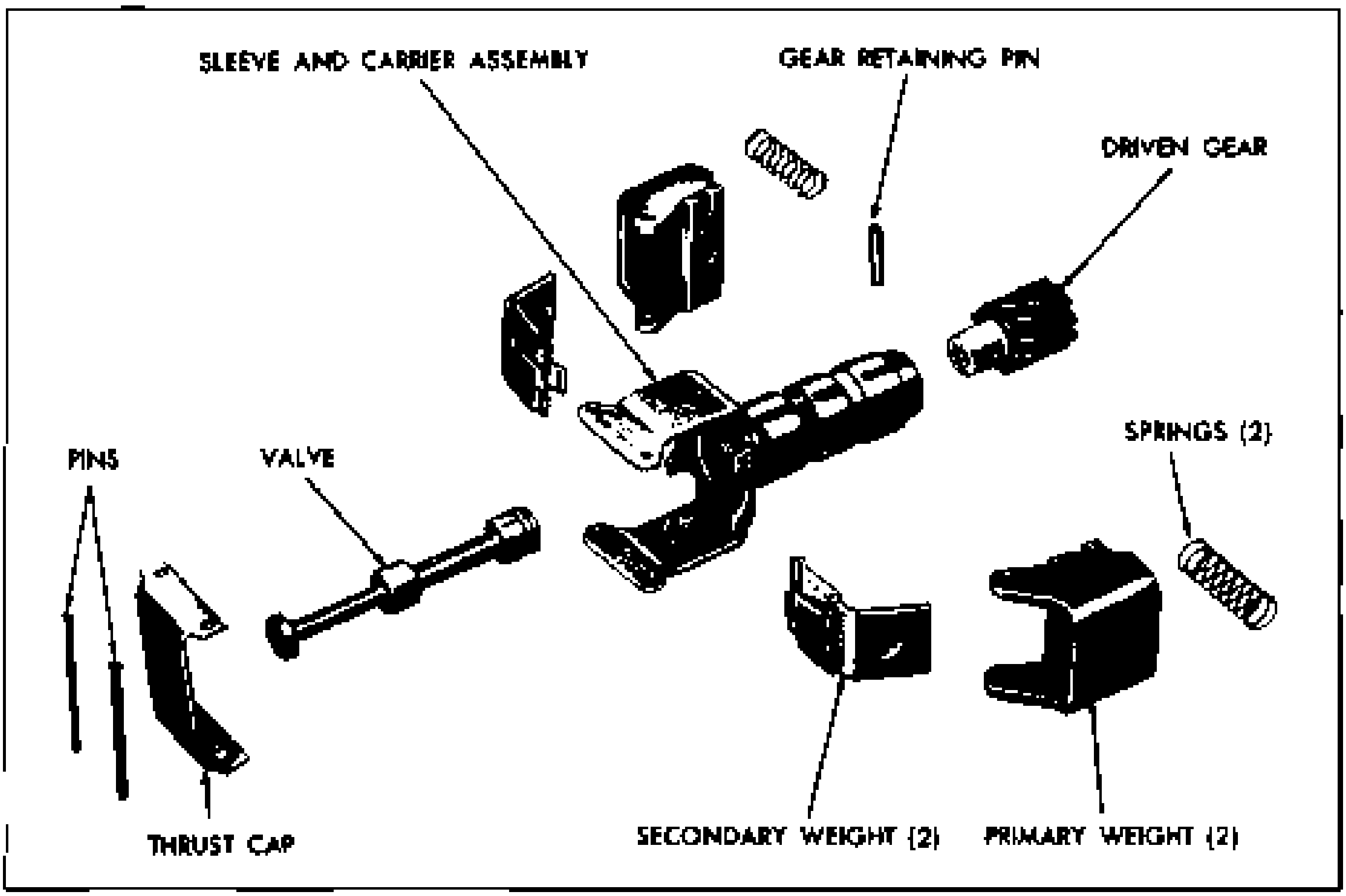


Fig 7E-60 Exploded View of Governor

2. Inspect governor sleeve for nicks, burrs, scoring or galling.

3. Check governor sleeve for free operation in bore of transmission case.

4. Inspect governor valve for nicks, burrs, scoring or galling.

5. Check governor valve for free operation in bore of governor sleeve

6. Inspect governor driven gear for nicks, burrs or damage.

7. Check governor driven gear for looseness on governor sleeve.

8. Inspect governor weight springs for distortion or damage.

9. Check governor weights for free operation in their retainers.

10. Check for valve opening at entry (feed) and exhaust parts of governor as follows

a. Check valve opening at entry (feed) with a feeler gage, holding governor as shown with governor weights extended completely outward (Fig. 7E-61A).

b. Check valve opening at exhaust with feeler gage, holding governor as shown with governor weights completely inward (Fig. 7E-61B).

c. If less than .020" minimum opening is found, governor assembly must be repaired.

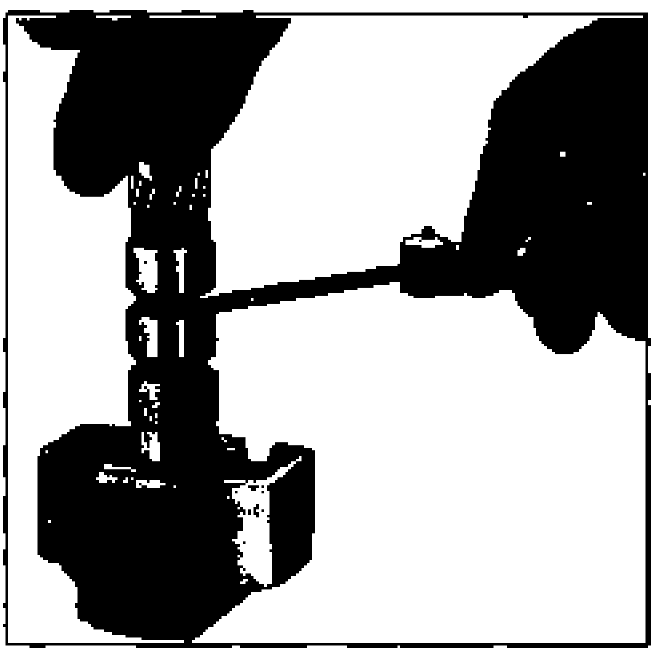


Fig. 7E-61A Checking Feed Port Opening

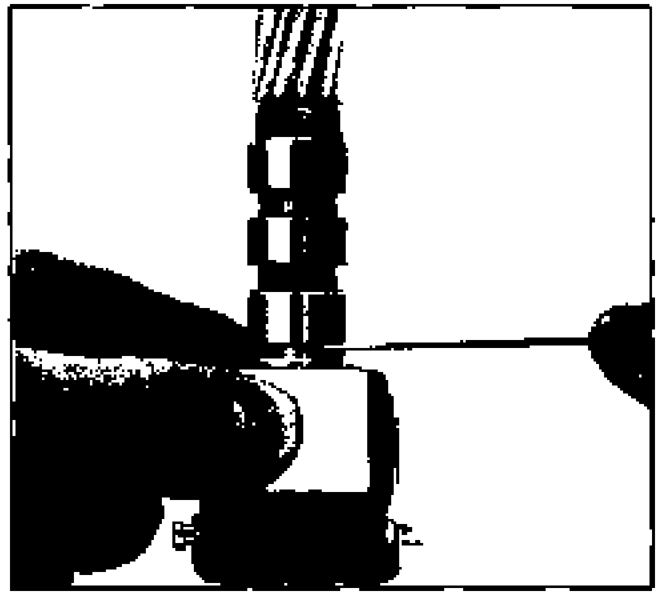


Fig. 7E-61B Checking Exhaust Port Opening

GOVERNOR DRIVEN GEAR REPLACEMENT

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use. The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner.

1. Drive out governor gear retaining split pin, using small punch (Fig. 7E-62).

2. Support governor on 3/16" plates installed in

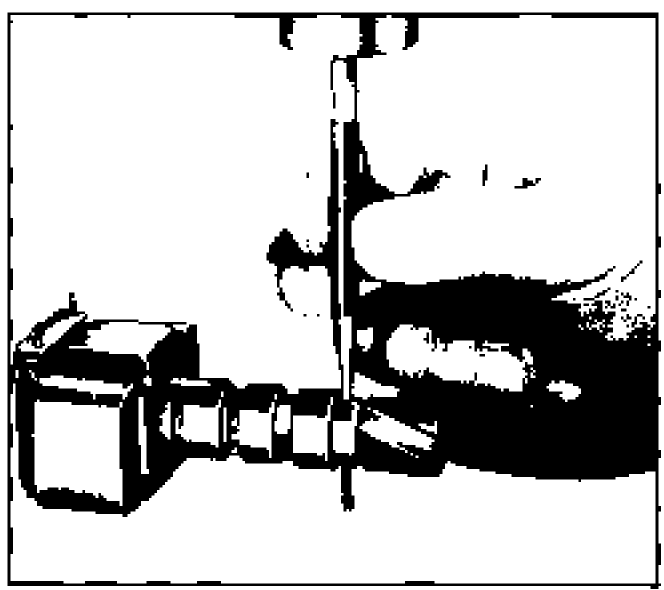


Fig. 7E-62 Removing Governor Gear Retaining Pin exhaust slots of governor sleeve, place in arbor press, and with long punch, press gear out of sleeve.

3. Carefully clean governor sleeve of chips that remain from original gear installation.

4. Support governor on 3/16" plates installed in exhaust slots of sleeve, position new gear in sleeve and, with suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.

5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90° from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard 1/8" drill.

6. Install retaining pin.

7. Wash governor assembly thoroughly to remove any chips that may have collected.

ASSEMBLY OF GOVERNOR

1. Install governor valve in bore of governor sleeve.

2. Install governor weights and springs and thrust cap on governor sleeve.

3. Align pin holes in thrust cap, governor weight assemblies and governor sleeve and install new pins. Crimp both ends of pins to prevent them from falling out.

4. Check governor weight assemblies for free operation on pins and governor valve for free movement in governor sleeve.

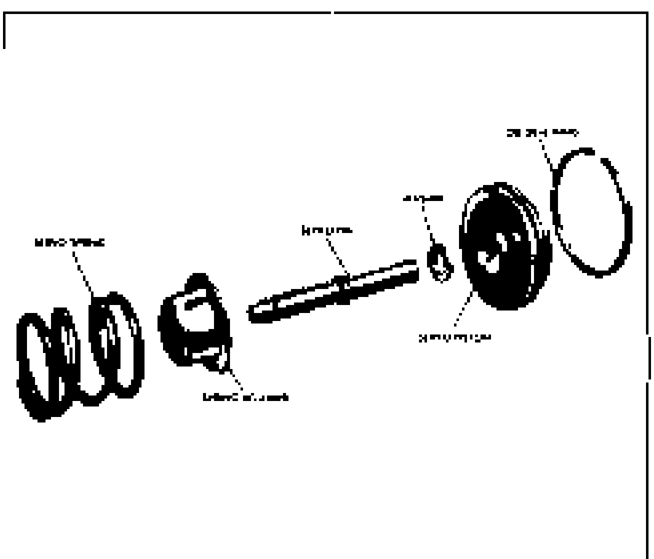


Fig. 7E-63 Exploded View of Front Servo

FRONT SERVO

INSPECTION OF FRONT SERVO (Fig. 7E-63)

1. Inspect servo pin for damage.

2. Inspect servo piston for damaged oil ring groove and check freedom of ring in groove.

3. Inspect piston for cracks or porosity.

4. Check fit of servo pin in piston.

REAR SERVO

DISASSEMBLY OF REAR SERVO

1. Remove rear accumulator piston from rear servo piston (Fig. 7E-64).

2. Remove E-ring retaining rear servo piston to band apply pin (Fig. 7E-65).

3. Remove rear servo piston and seal from band apply pin (Fig. 7E-66).

4. Remove washer, spring and retainer.

INSPECTION OF REAR SERVO

1. Inspect freedom of accumulator rings in piston.

2. Inspect fit of band apply pin in servo piston.

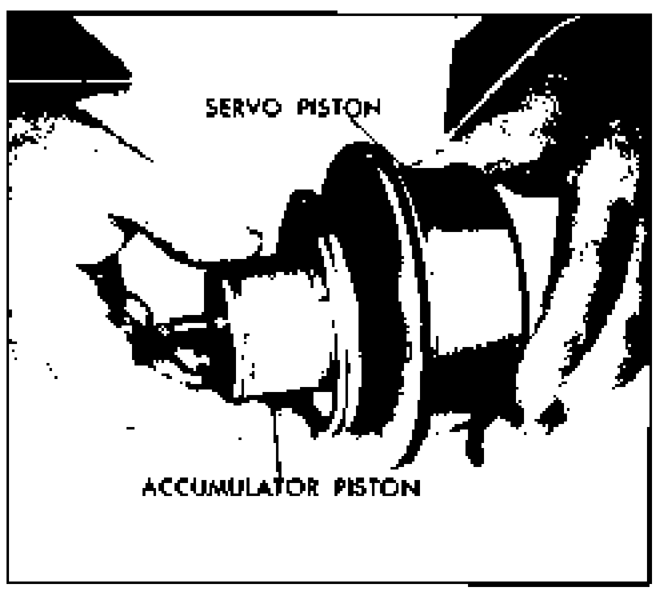


Fig. 7E-64 Removing Rear Accumulator Piston from Rear Servo

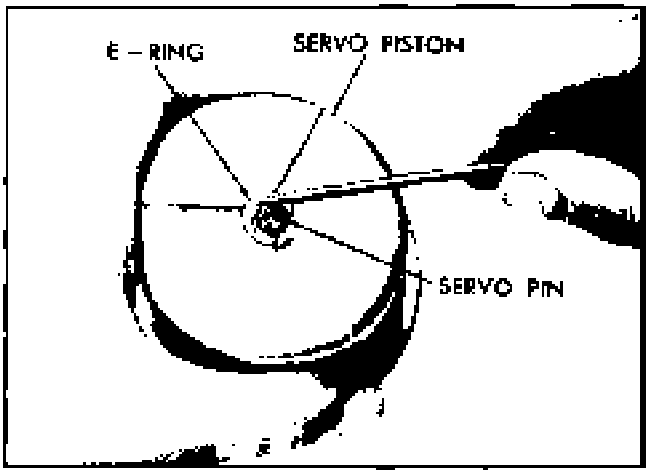


Fig. 7E-65 Removing Retaining E-Ring from Rear Servo Pin

3. Inspect band apply pin for scores or cracks.

4. Inspect accumulator and servo pistons for cracks or porosity.

ASSEMBLY OF REAR SERVO

1. Install spring retainer, spring and washer on band apply pin

2. Install band apply pin, retainer, spring and washer into bore of servo piston and secure with E-ring.

3. Install oil seal on servo piston, if removed.

4. Install outer and inner oil rings on accumulator piston, if removed, and assembly into bore of servo piston.

CONTROL VALVE ASSEMBLY

DISASSEMBLY OF CONTROL VALVE ASSEMBLY

1. Position control valve assembly with cored face up and accumulator pocket toward operator.

2. Remove manual valve from upper bore.

3. Install Special Tool J 21885 on accumulator piston valve and remove retaining ring (Fig. 7E-67).

4. Remove from accumulator piston and spring (Fig. 7C-68).

5. From the top right hand bore, remove the 1-2 valve train as follows (Fig. 7E-69)-

a. (All models except PA, PC and PR) Remove roll pin, 1-2 modulator bushing, 1-2 regulator valve, 1-2 regulator spring, 1-2 detent valve and 1-2 shift valve.

b. (Models PA, PC and PR) Remove roll pin, 1-2 modulator bushing, 1-2 modulator spring, 1-2 modulator valve and 1-2 shift valve.

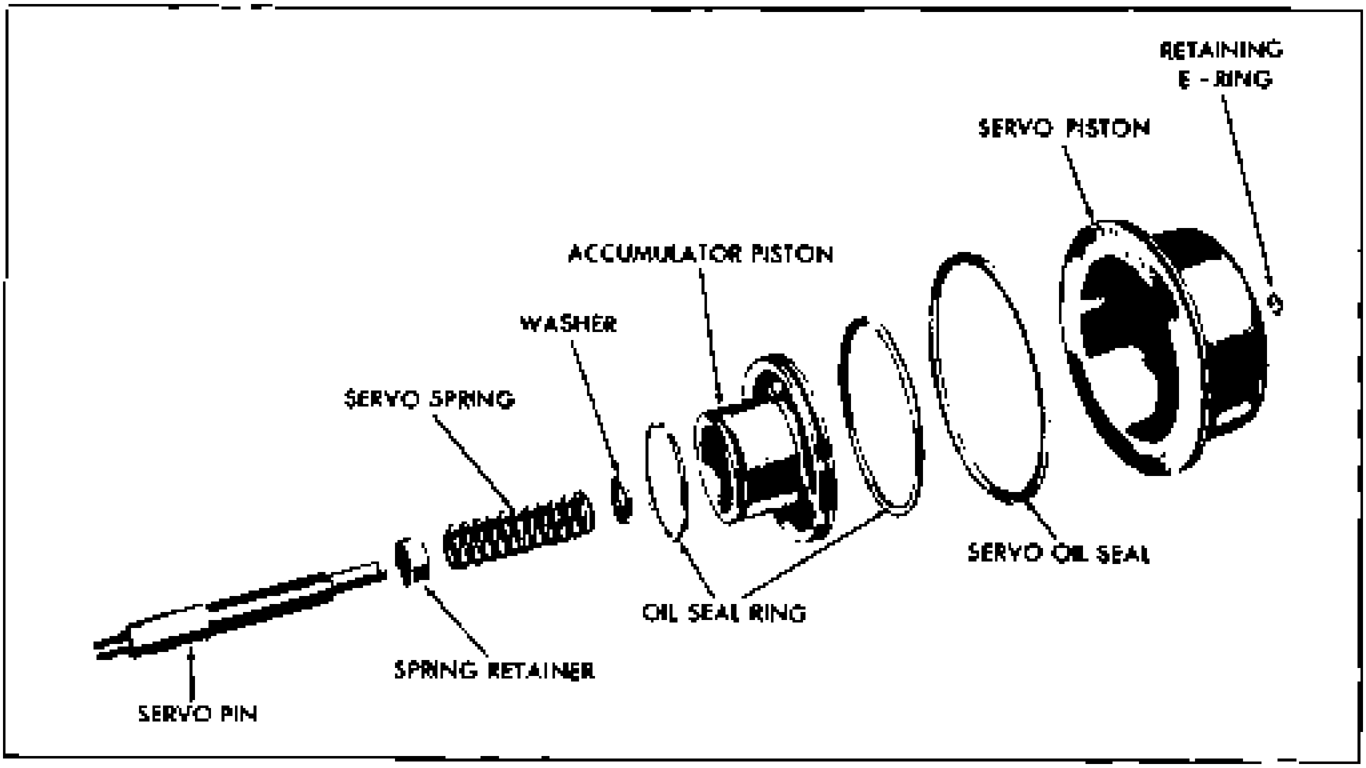


Fig. 7E-66 Exploded View of Rear Servo and Accumulator

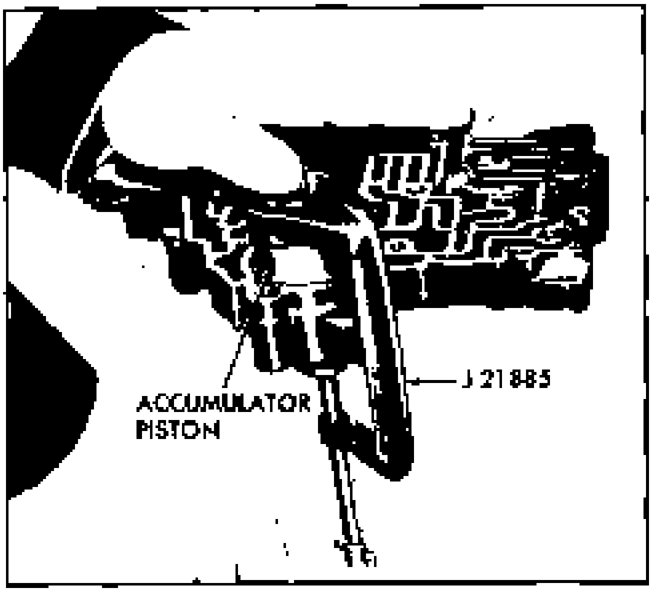


Fig. 7E-67 Installing Compressor Tool to Front Accumulator Piston

6. From next bore, remove roll pin, 2-3 shift valve spring, modulator valve bushing, 2-3 modulator valve, 3-2 intermediate spring and 2-3 shift valve.

7. From next bore remove roll pin, bore plug, spring, spacer and 3-2 valve.

8. At other end of assembly, top bore, remove roll pin and bore plug, detent valve, detent regulator valve, spring and spacer.

9. Remove the grooved retaining pin from the next bore down, the bore plug, 1-2 secondary accumulator spring, 1-2 accumulator valve, 1-2 accumulator bushing, 1-2 primary accumulator valve and the 1-2 primary accumulator spring.

10. Remove the governor oil screen from the governor oil feed hole (Fig. 7E-70).

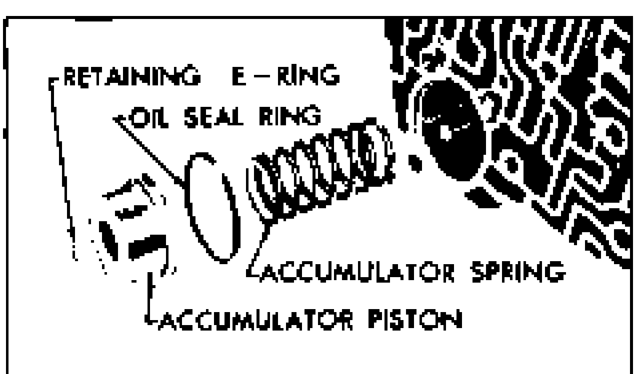


Fig. 7E-68 Removing Front Accumulator Piston and Spring

INSPECTION OF CONTROL VALVE

1. Inspect all valves for scoring, cracking and free movement of their respective bore.

2. Inspect bushing for cracks, scratches or distortion.

3. Inspect body for cracks or scored bores.

4. Check all springs for distortion or collapsed coils.

5. Clean governor oil screen in clean solvent.

ASSEMBLY OF CONTROL VALVE

1. Install front accumulator spring and piston into valve body.

2. Install special tool J 21885 and compress spring and piston and secure with retaining E-ring.

3. Install 1-2 primary accumulator spring in lower left bore.

4. Install 1-2 primary accumulator valve.

5. Install 1-2 accumulator valve with stem end out into the 1-2 accumulator bushing and install the bushing into the bore.

6. Install 1-2 secondary accumulator spring and bore plug. Compress plug and install grooved retaining pin from cast surface side fo the valve body, with the grooves entering the pin hole last. Tap pin with hammer until flush with cast surface.

7. In next bore up, install detent spring and spacer. Compress spring and secure with small screwdriver (Fig. 7E-71).

8. Install detent regulator valve, wide land first.

9. Install detent valve, narrow land first.

10. Install bore plug (hole out), depress spring by pressing in on plug and install roll pin. Remove screwdriver.

11. In lower right hand bore, install 3-2 valve.

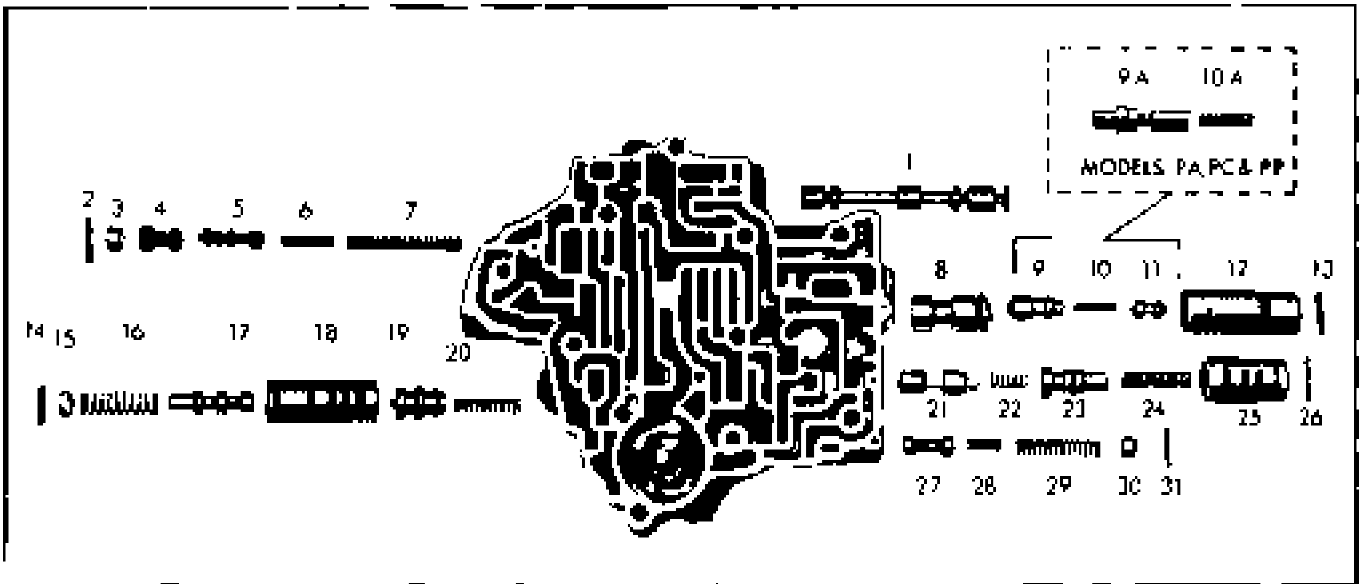
12. Install 3-2 spring, spacer, bore plug (hole out) and roll pin.

13. In next bore up, install 2-3 valve, stem end out, and 3-2 intermediate spring.

14. Install 2-3 modulator valve into bushing and install both parts into valve body bore.

15. Install 2-3 valve spring and roll pin.

16. In next bore up, install 1-2 valve, stem end out.



1. Manual Valve
2. Roll Pin
3. Bore Plug
4. Detent Valve
5. Detent Regulator Valve
6. Spacer
7. Detent Regulator Valve Spring
8. 1-2 Shift Valve
9. 1-2 Detent Valve
9A 1-2 Modulator Valve (PA, PC and PR only)
10. 1-2 Regulator Valve Spring
10A. 1-2 Modulator Valve Spring (PA, PC and PR only)
11. 1-2 Regulator Valve
12. 1-2 Modulator Bushing
13. Roll Pin
14. Grooved Retaining Pin
15. Bore Plug
16. 1-2 Secondary Accumulator Spring
17. 1-2 Accumulator Valve
18. 1-2 Accumulator Valve Bushing
19. 1-2 Primary Accumulator Valve
20. 1-2 Primary Accumulator Spring
21. 2-3 Shift Valve
22. 3-2 Intermediate Spring
23. 2-3 Modulator Valve
24. 2-3 Shift Valve Spring
25. 2-3 Modulator Bushing
26. Retaining Pin
27. 3-2 Valve
28. Spacer
29. 3-2 Valve Spring
30. Bore Plug
31. Retaining Pin

Fig. 7E-69 Exploded View of Control Valve

17. Install the 1-2 regulator valve train as follows:

a. (All models except PA, PC and PR) Install the 1-2 regulator valve, spring and detent valve into bushing, aligning spring in bore of detent valve and install parts into valve body bore.

b. (Models PA, PC and PR) Install the 1-2 modulator spring and 1-2 modulator valve into the 1-2 modulator bushing. Install parts into valve body bore.

18. Compress bushing against spring and install roll pin.

19. Install the governor oil screen in the governor oil feed hole (Fig. 7E-70).

NOTE: Screen is held in place by the governor feed pipe when installed on the transmission case.

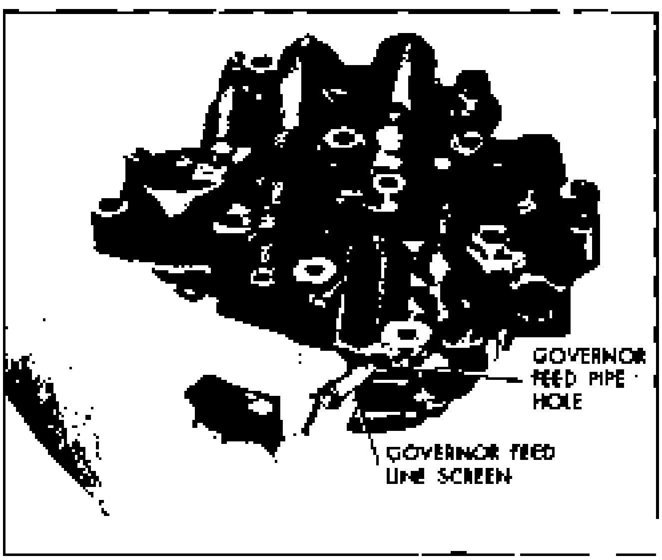


Fig. 7E-70 Removing Governor Feed Line Screen

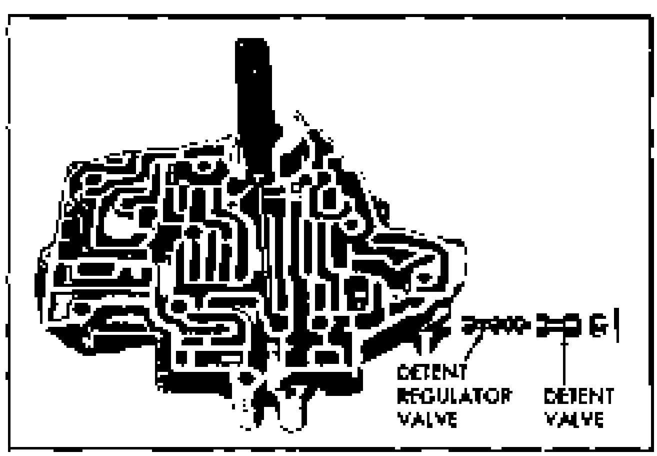


Fig. 7E-71 Installing Detent Regulator and Valve

20. Install manual valve with detent pin groove to the right.

OIL PUMP

DISASSEMBLY OF OIL PUMP (Fig. 7E-72)

1. Place oil pump assembly in hole in bench or Holding Fixture J 6116 and J 21364 Adapter.

2. Compress regulator boost valve bushing against pressure regulator spring and remove snap ring, using snap ring pliers (Fig. 7E-73).

3. Remove regulator boost valve bushing and valve.

4. Remove pressure regulator spring.

5. Remove regulator valve, spring retainer and spacer(s), if present (Fig. 7E-74).

6. Remove pump cover to body attaching bolts.

7. Remove pump cover from body.

8. Remove retaining pin and bore plug from pressure regulator bore (Fig. 7E-75).

9. Remove hook type oil rings from pump cover.

10. Remove pump to forward clutch housing selective washer.

11. Mark drive and driven gears for reassembly and remove gears (Fig. 7E-76).

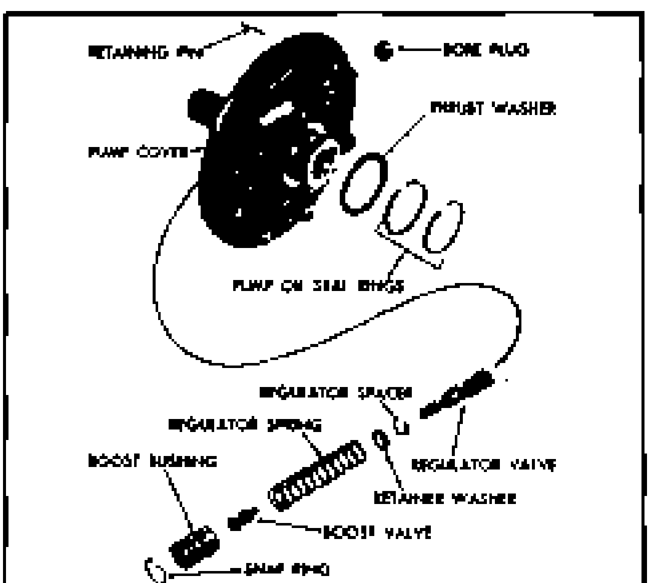


Fig. 7E-72 Exploded View of Pump Cover

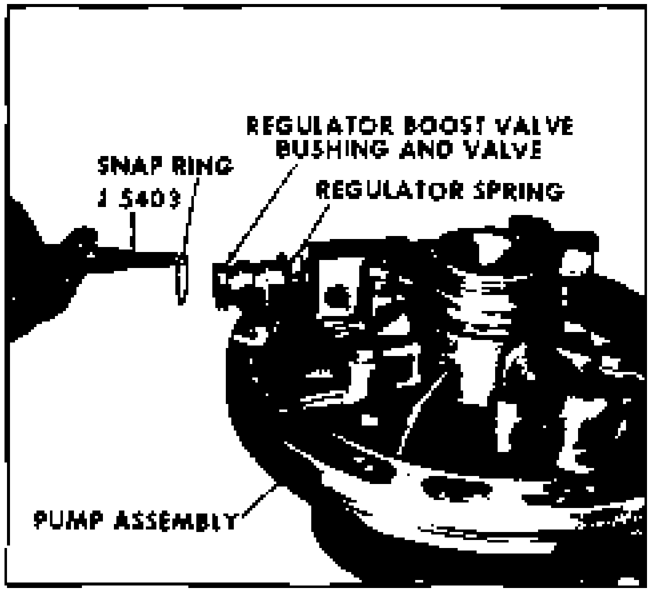


Fig. 7E-73 Removing Pump Regulator Valve Snap Ring

INSPECTION OF PUMP BODY AND COVER

1. Inspect drive gear, driven gear, gear pocket and crescent for scoring, galling or other damage.

2. Place pump gears in pump and check pump body face to gear face clearance, should be .0008"-.0035" (Fig. 7E-77).

3. Check face of pump body for scores or nicks.

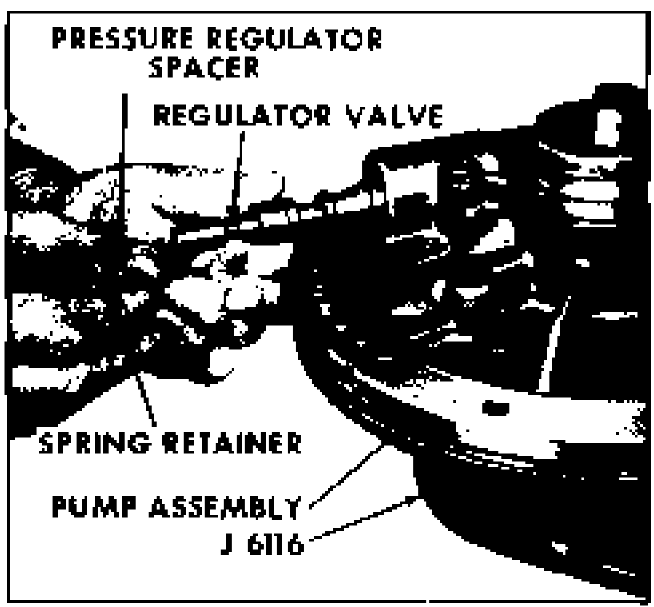


Fig. 7E-74 Removing Pressure Regulator Valve

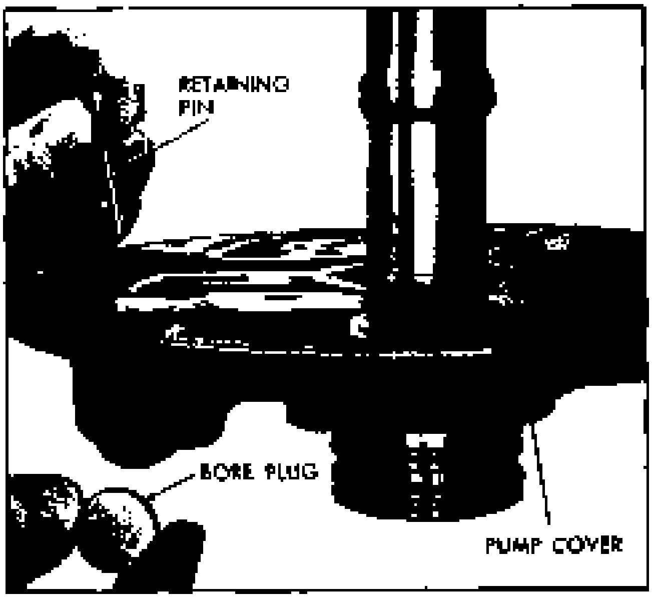


Fig. 7E-75 Installing Pressure Regulator Retaining Pin and Bore Plug

4. Check oil passages in pump body (Fig. 7E-78).

5. Check for damaged cover bolt attaching threads.

6. Check for overall flatness of pump body face.

7. Check bushing for scores or nicks. If replacement is necessary, proceed as follows:

a. Using Tool J 21465-17, with Driver Handle J 8092, remove bushing.

b. From gear pocket side of pump and, using J 21465-17 with Driver Handle J 8092, install new bushing flush to .010" below gear pocket face.

8. Inspect pump attaching bolt seals for damage, replace if necessary.

9. Inspect pump cover face for overall flatness.

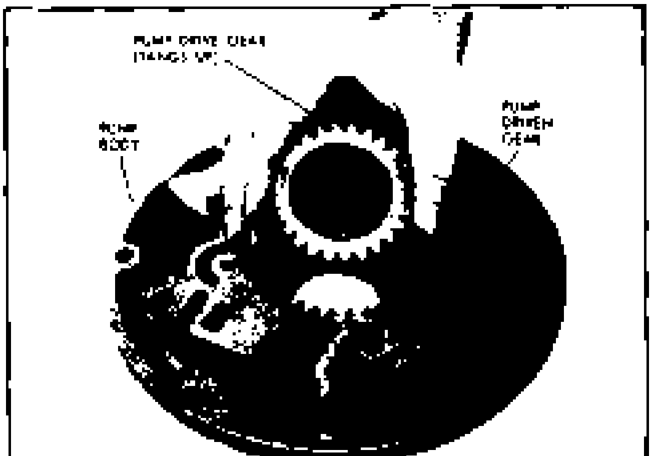


Fig. 7E-76 Removing and Installing Pump Drive Gear

Fig. 7E-77 Checking Pump Body Face to Gear Face Clearance

10. Check for scores or chips in pressure regulator bore.

11. Check that all passages are open and inter-connected in pump cover (Fig. 7E-79).

12. Check for scoring and damage at pump gear face.

13. Inspect stator shaft for damaged splines or scored bushings. If replacement of bushings is necessary, proceed as follows:

a. Thread J 21465-15 into stator shaft bushing. Thread Slide Hammer J 2619 into remover. Clamp Slide Hammer handle into vise. Grasp stator shaft and remove.

b. Using Installer J 21465-3 (front) or J 21465-2 (rear) with Driver Handle J 8092, press on drive bushing until tool bottoms.

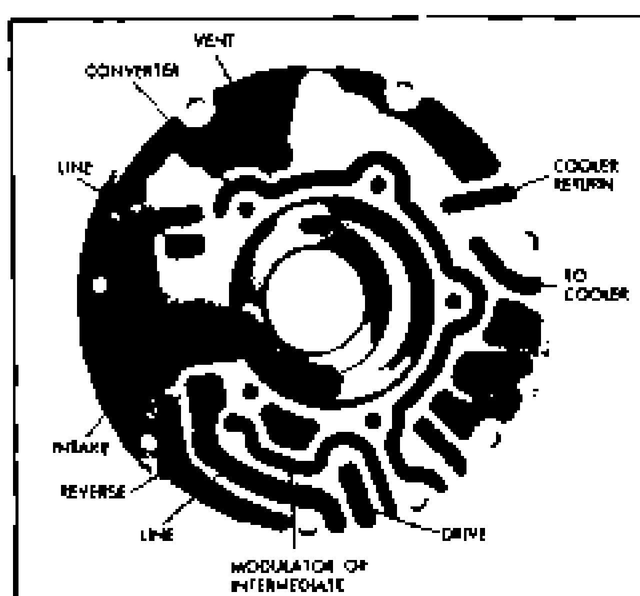


Fig. 7E-78 Pump Body Oil Passages

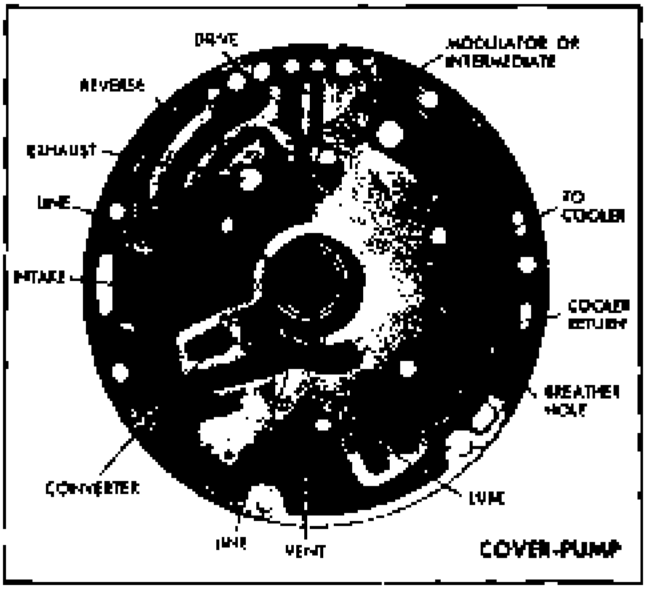


Fig. 7E-79 Pump Cover Oil Passages

14. Inspect oil ring grooves for damage or wear.

15. Inspect selective washer thrust face for wear or damage.

16. Inspect pressure regulator and boost valve for free operation.

17. Inspect pump cover for open 1/8" diameter breather hole (Fig. 7E-79)

ASSEMBLY OF OIL PUMP

1. Install drive and driven pump gears into pump body with alignment marks up (Fig. 7E-76).

NOTE: Install drive gear with drive tangs up.

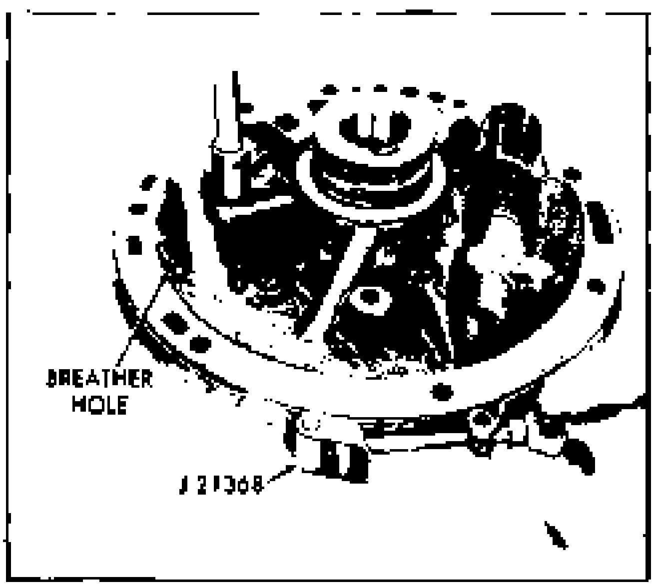


Fig. 7E-80 Installing Pump Cover to Pump Body

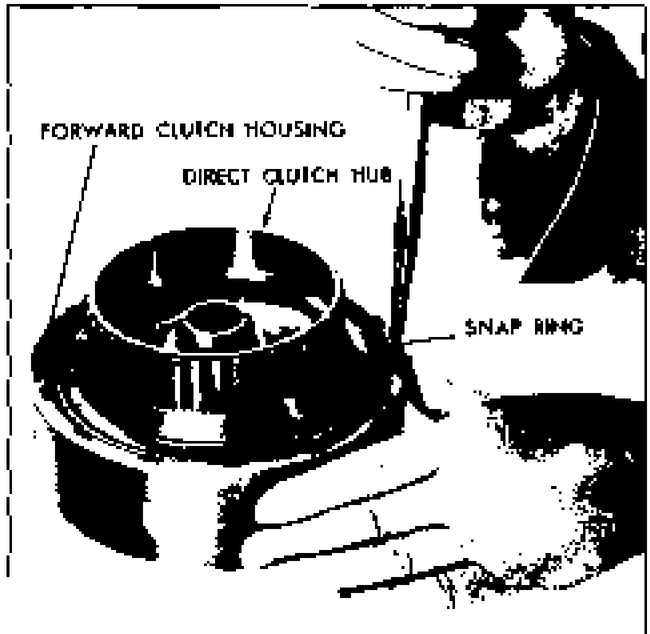


Fig. 7E-81 Removing Forward Clutch Housing to Direct Clutch Hub Snap Ring

2. Protect stator shaft and install pump in vise

3. Install spacer(s) if used, retainer and spring into pressure regulator bore (Fig. 7E-74).

4. Install pressure regulator valve from opposite end of bore, stem end first.

5. Install boost valve into bushing, stem end out, and install both parts into pump cover by compressing bushing against spring

6. Install retaining snap ring.

7. Install pressure regulator valve bore plug and retaining pin into opposite end of bore.

8. Install previously selected front unit selective thrust washer over pump cover delivery sleeve.

9. Install two (2) hook type oil seal rings.

10. Assembly pump cover to pump body with attaching bolts.

NOTE: Leave bolts one turn loose at this time.

11. Place Pump Aligning Strap J 21368 over pump body and cover and tighten tool (Fig. 7E-80).

12. Tighten pump cover bolts (18 lb. ft. torque).

13. Install and align pump to case gasket.

14. Install pump to case O-ring seal

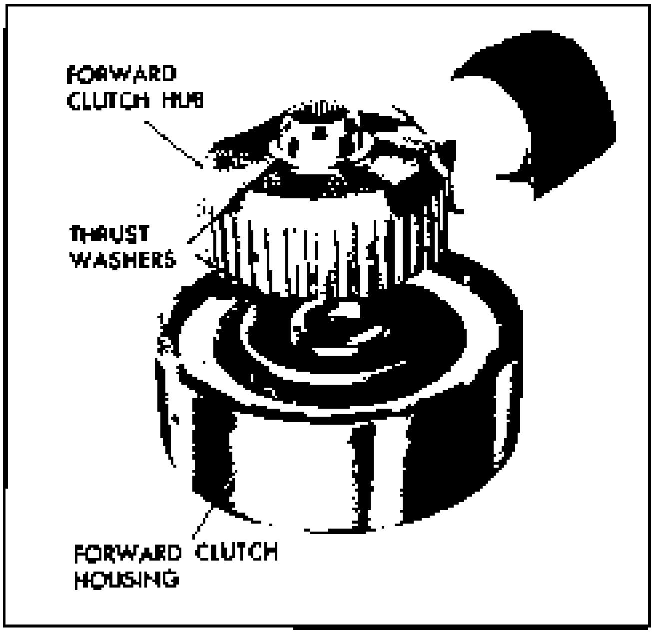


Fig. 7E-82 Removing Forward Clutch Hub and Thrust Washers

FORWARD CLUTCH

DISASSEMBLY OF FORWARD CLUTCH

1. Place forward clutch and turbine shaft in hole in bench or Holding Fixture J 6116 and remove forward clutch housing to direct clutch hub snap ring (Fig. 7E-81).

2. Remove direct clutch hub.

3. Remove forward clutch hub and thrust washers (Fig. 7E-82).

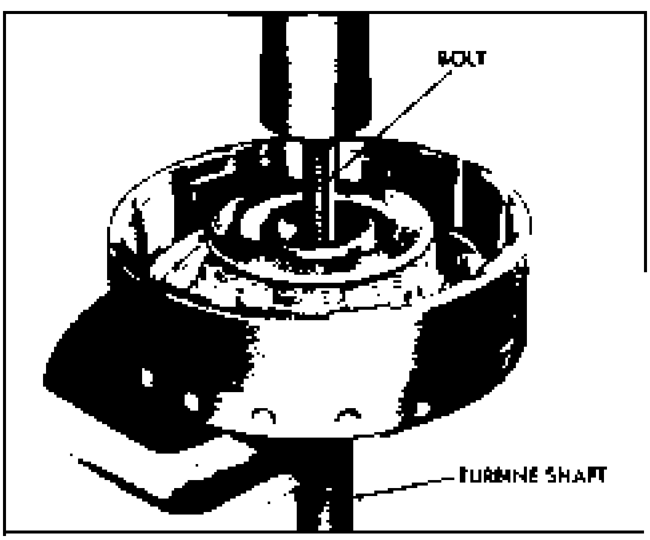


Fig. 7E-83 Removing Turbine Shaft from Forward Clutch Housing

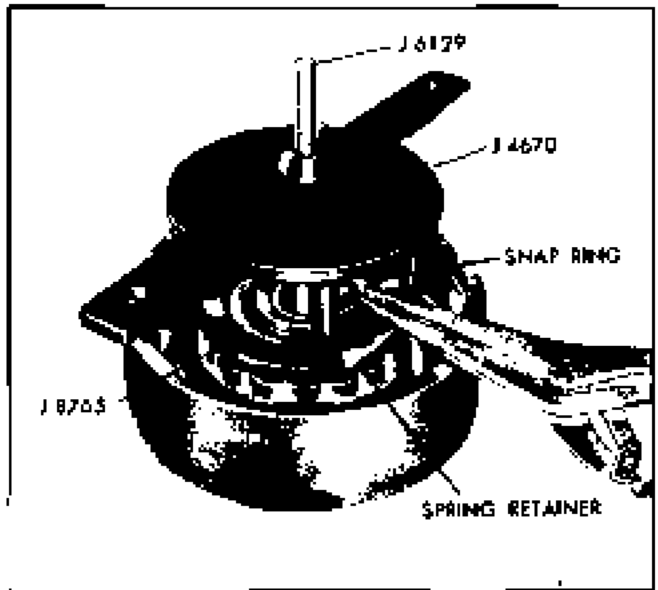


Fig. 7E-84 Removing and Installing Forward Clutch Spring Retainer Snap Ring

4. Remove five (5) radial grooved composition and five (5) steel clutch plates.

5. Place forward clutch and turbine shaft in arbor press and remove turbine shaft (Fig. 7E-83).

6. Using Clutch Spring Compressor J 4670 with Adapters J 6129 and J 8765, compress spring retainer and remove shop ring (Fig. 7E-84).

7. Remove snap ring, spring retainer and sixteen (16) clutch release springs.

8. Remove forward clutch piston.

9. Remove inner and outer clutch piston seals (Fig. 7E 85).

10. Remove center piston seal from forward clutch housing (Fig. 7E-86).

INSPECTION OF FORWARD CLUTCH

1. Inspect composition and steel clutch plates for signs of burning, scoring or wear.

2. Inspect sixteen (16) springs for collapsed coils or sings of distortion.

3. Inspect clutch hubs for worn splines, proper lubrication holes, thrust faces.

4. Inspect piston for cracks.

5. Inspect clutch housing for wear, scoring, open oil passages and free operation of ball check.

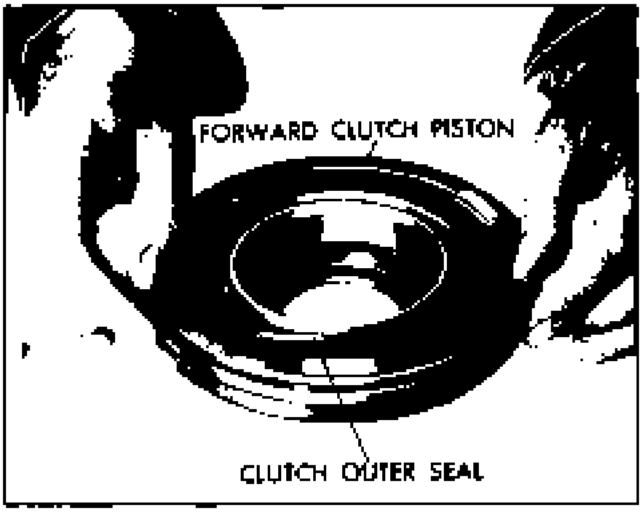


Fig. 7E-85 Removing and Installing Forward Clutch Piston Outer Seal

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.

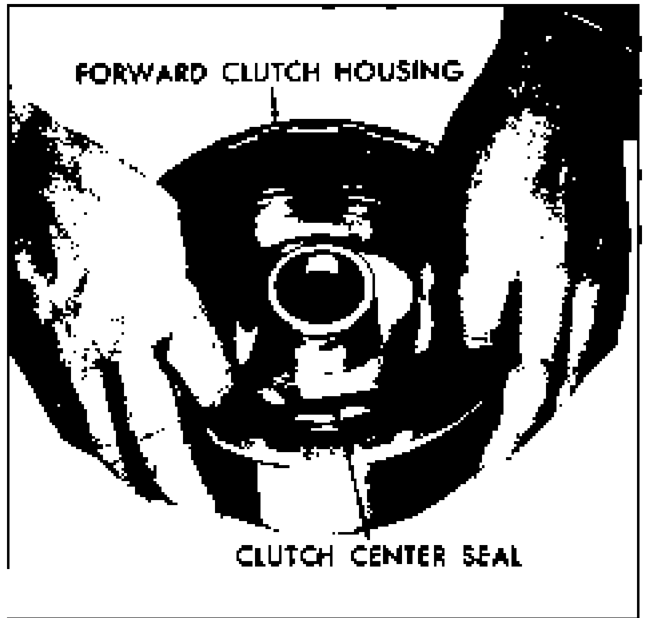


Fig. 7E-86 Removing and Installing Forward Clutch Center Seal

ASSEMBLY OF FORWARD CLUTCH

NOTE: Apply automatic transmission oil to all seals and clutch plates before re-assembly.

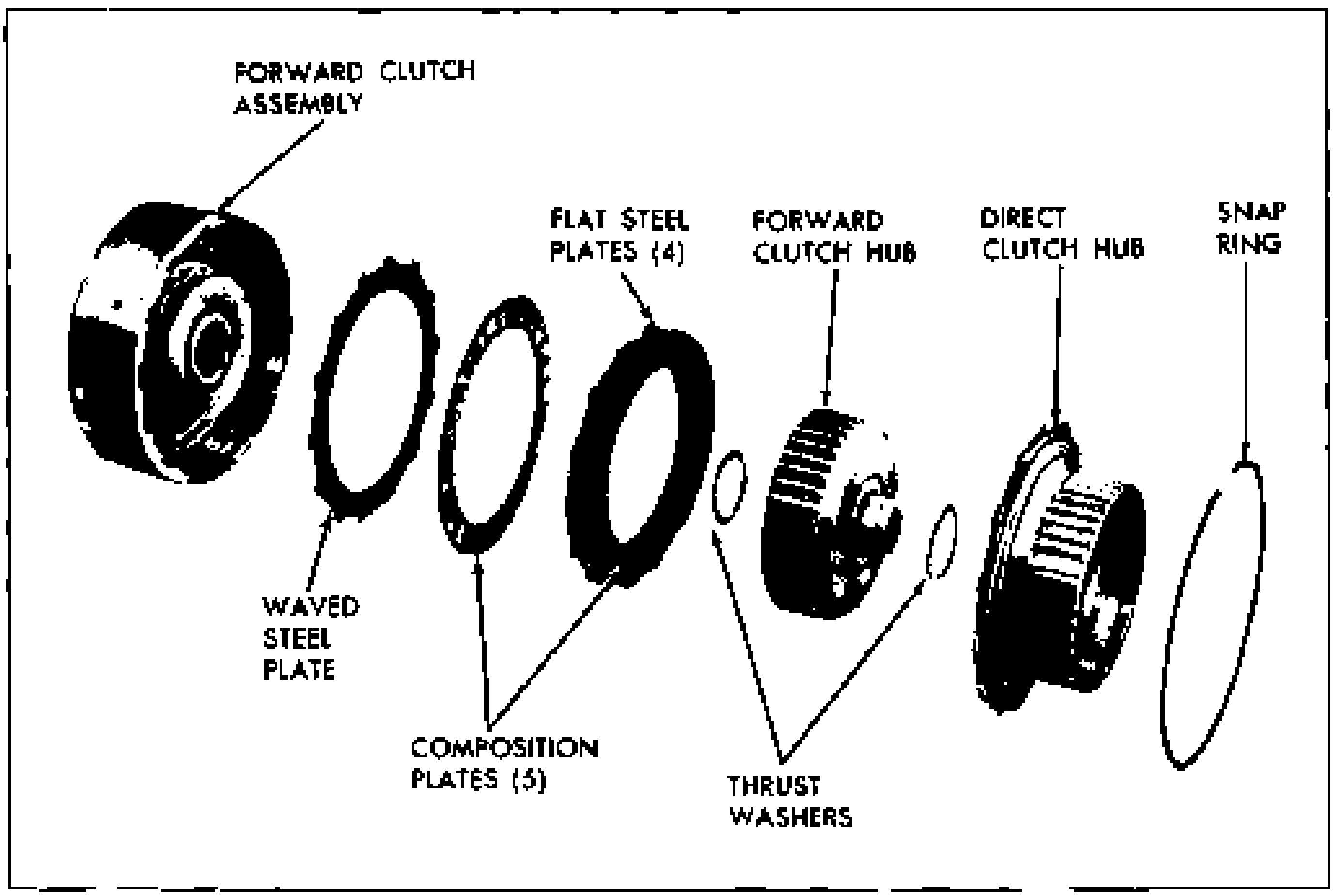


Fig. 7E-87 Exploded View of Forward Clutch

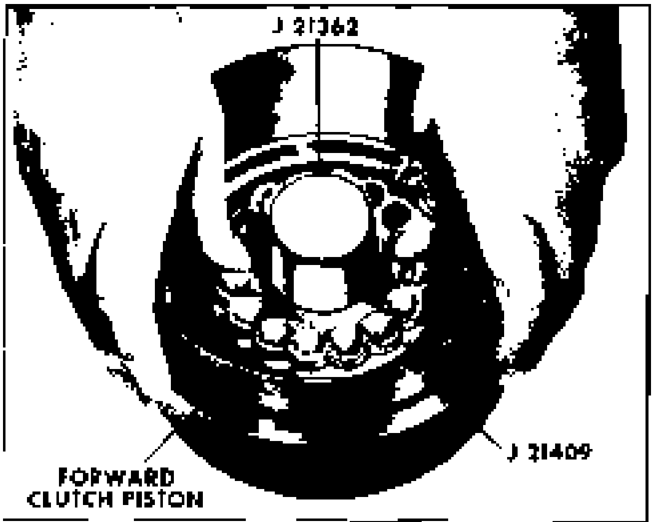


Fig. 7E-88 Installing Forward Clutch Piston

1. Place new inner and outer oil seals on clutch piston, lips face away from spring pockets (Fig. 7E-85).

NOTE: The forward and direct clutch pistons have identical inside and outside diameters. It is possible to reverse the pistons during reassembly, therefore care should be exercised to make certain the proper piston be installed in the clutch assemblies.

As shown in Fig. 7E-102, the forward clutch piston can be identified by the blind hole in the clutch apply face of the piston.

2. Place a new center seal on clutch housing, lip faces up (Fig. 7E-86).

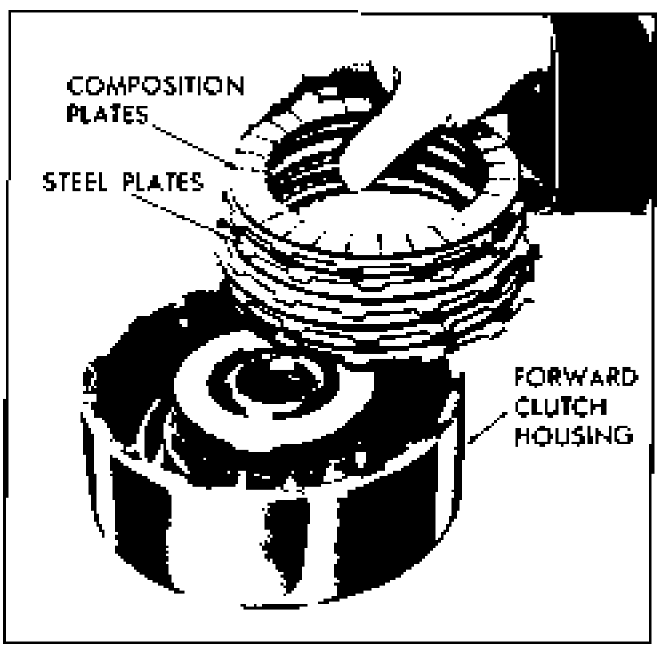


Fig. 7E-89 Installing Forward Clutch Composition and Steel Plates

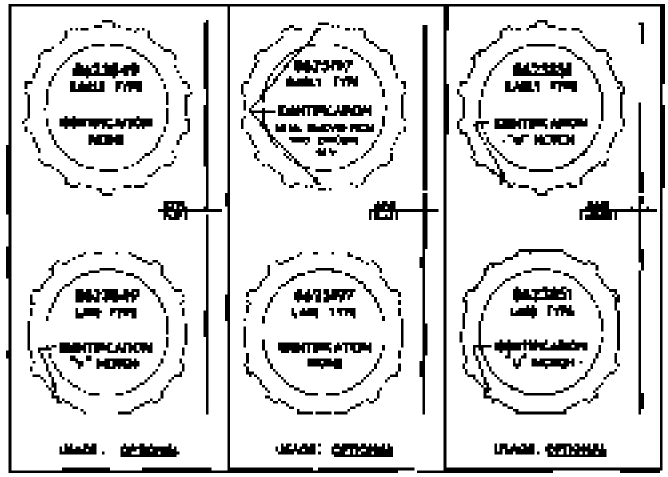


Fig. 7E-90 Clutch Plate Identification

3. Place Seal Protector Tool J 21362 over clutch hub and install outer clutch piston Seal Protector J 21409 into clutch drum and install piston, rotating piston on drum until seated (Fig. 7E-88).

4. Install sixteen (16) clutch release springs into pockets in piston.

5. Place spring retainer and snap ring on springs.

6. Compress springs, using Clutch Compressor Tools J 4670, J 6129 and J 8765 and install snap ring (Fig. 7E 84).

7. Install turbine shaft in forward clutch housing, using arbor press.

8. Install forward clutch hub washers on forward clutch hub. Retain with petrolatum.

9. Place forward clutch hub into forward clutch housing.

10. Oil and install five (5) radial grooved composition and four (4) flat steel and one (1) waved steel clutch plate (plate with "U" notches) starting with waved steel and alternating composition and steel clutch plates (Fig. 7E-89).

NOTE: Radially grooved composition clutch plates are installed at the factory only. ALL service composition plates have the smooth surface configuration.

CAUTION. Do not confuse the flat steel plate (plate with "V" notch) with the waved steel clutch plate (plate with "U" notch). See Fig. 7E-90.

11. Install direct clutch hub and retaining snap ring (Fig. 7E-91).

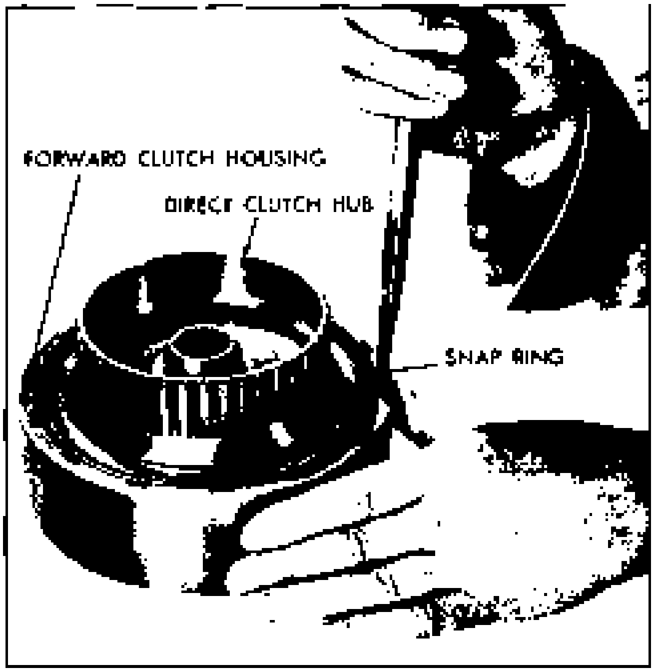


Fig. 7E-91 Installing Forward Clutch Housing to Direct Clutch Hub Snap Ring

12. Place forward clutch housing on pump delivery sleeve and air check clutch operation (Fig. 7E-92).

DIRECT CLUTCH AND INTERMEDIATE SPRAG

DISASSEMBLY OF DIRECT CLUTCH AND INTERMEDIATE SPRAG

1. Remove intermediate clutch retainer snap ring and retainer (Fig. 7E-93)

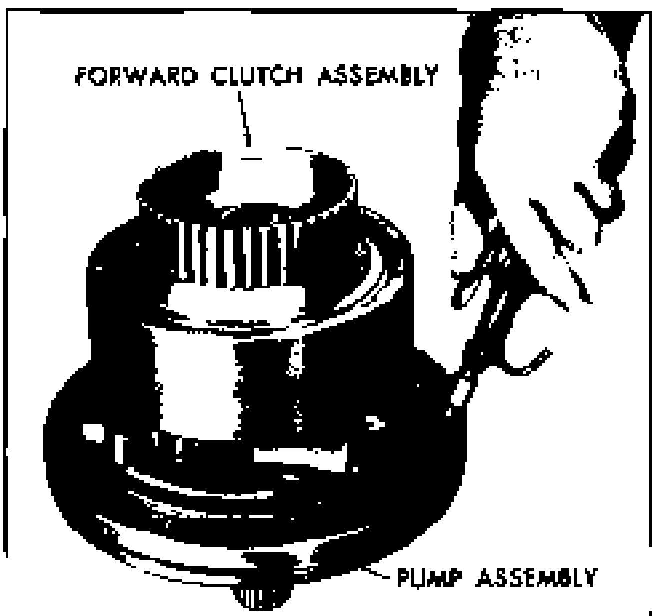


Fig. 7E-92 Air Checking Forward Clutch

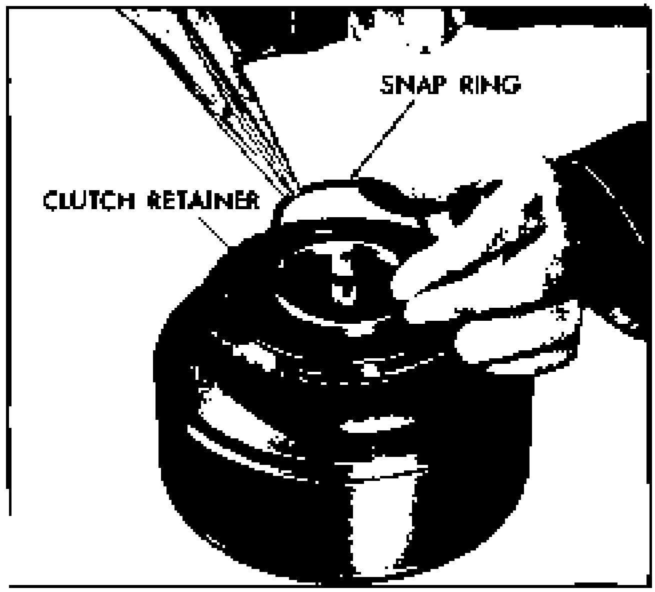


Fig. 7E-93 Removing Intermediate Clutch Retainer Snap Ring

2. Remove clutch outer race, bushings and sprag assembly

3. Turn unit over and remove backing plate to direct clutch housing snap ring (Fig. 7E-94).

4. Remove direct clutch backing plate, five (5) composition and five (5) steel clutch plates.

5. Using Clutch Compressor Tools J 4670, J 6129 and J 8765, compress spring retainer and remove snap ring (Fig. 7E-95)

6. Remove retainer and sixteen (16) piston release springs.

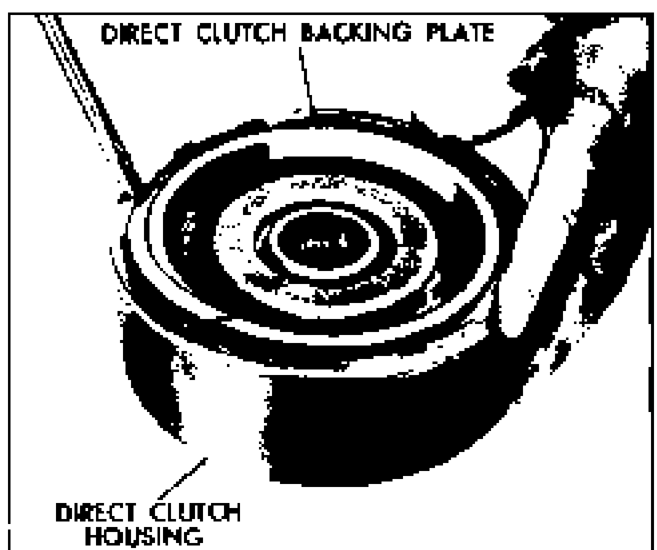


Fig. 7E-94 Removing Direct Clutch Backing Plate Snap Ring

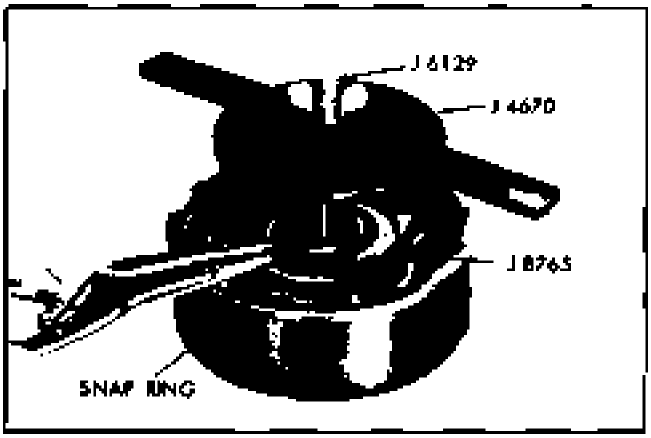


Fig. 7E-95 Removing Direct Clutch Piston Snap Ring

7. Remove direct clutch piston (Fig. 7E-96).

8. Remove outer seal from piston.

9. Remove inner seal from piston.

10. Remove center piston seal from direct clutch housing.

INSPECTION OF DIRECT CLUTCH AND INTERMEDIATE SPRAG (Fig. 7E-97 and 7E-98)

1. Inspect sprag assembly for popped or loose sprags.

2. Inspect sprag bushings for wear or distortion.

3. Inspect 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.

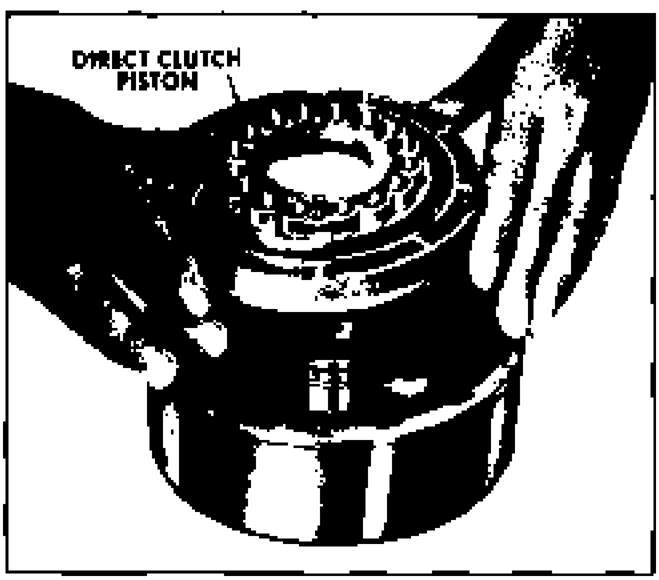


Fig. 7E-96 Removing Direct Clutch Piston

5. Inspect composition and steel clutch plates for sign of wear or burning.

6. Inspect backing plate for scratches or other damage

7. Inspect clutch piston for cracks and free operation of ball check.

ASSEMBLY OF DIRECT CLUTCH AND INTERMEDIATE SPRAG

1. Install a new inner clutch piston seal on piston, with lip facing away from spring pockets (Fig. 7E-99).

NOTE: Apply Hydra-Matic oil to all seals.

2. Install a new outer clutch piston seal with lip facing away from spring pockets (Fig. 7E-100).

NOTE: Care should be exercised, when installing the piston, to make certain the proper piston is used.

The direct clutch piston can be identified by the ball *check installed in the casting (Fig. 7E-102).*

4. Place seal protectors, Tools J 21362 Inner and J 21409 Outer, over hub and clutch housing and install clutch piston with a rotating motion (Fig. 7E-103).

5. Install sixteen (16) springs into piston.

6. Place spring retainer and snap ring on retainer.

7. Using Clutch Compressor Tool J 4670, J 6129 and J 8765, install snap ring (Fig. 7E-104).

8. Lubricate with transmission oil and install five (5) composition and five (5) steel clutch plates, starting with the waved steel plate and alternating composition and steel clutch plates (Fig. 7E-105).

NOTE: No waved steel plate is used in the PQ and PS models. Five (5) flat steel plates are used.

CAUTION: Do not use radial groove composition plates here.

NOTE: See Fig. 7E-90 for clutch plate identification.

9. Install clutch backing plate.

10. Install backing plate snap ring (Fig. 7E-106).

11. Turn unit over and install one spring bushing, cup side up, over inner race.

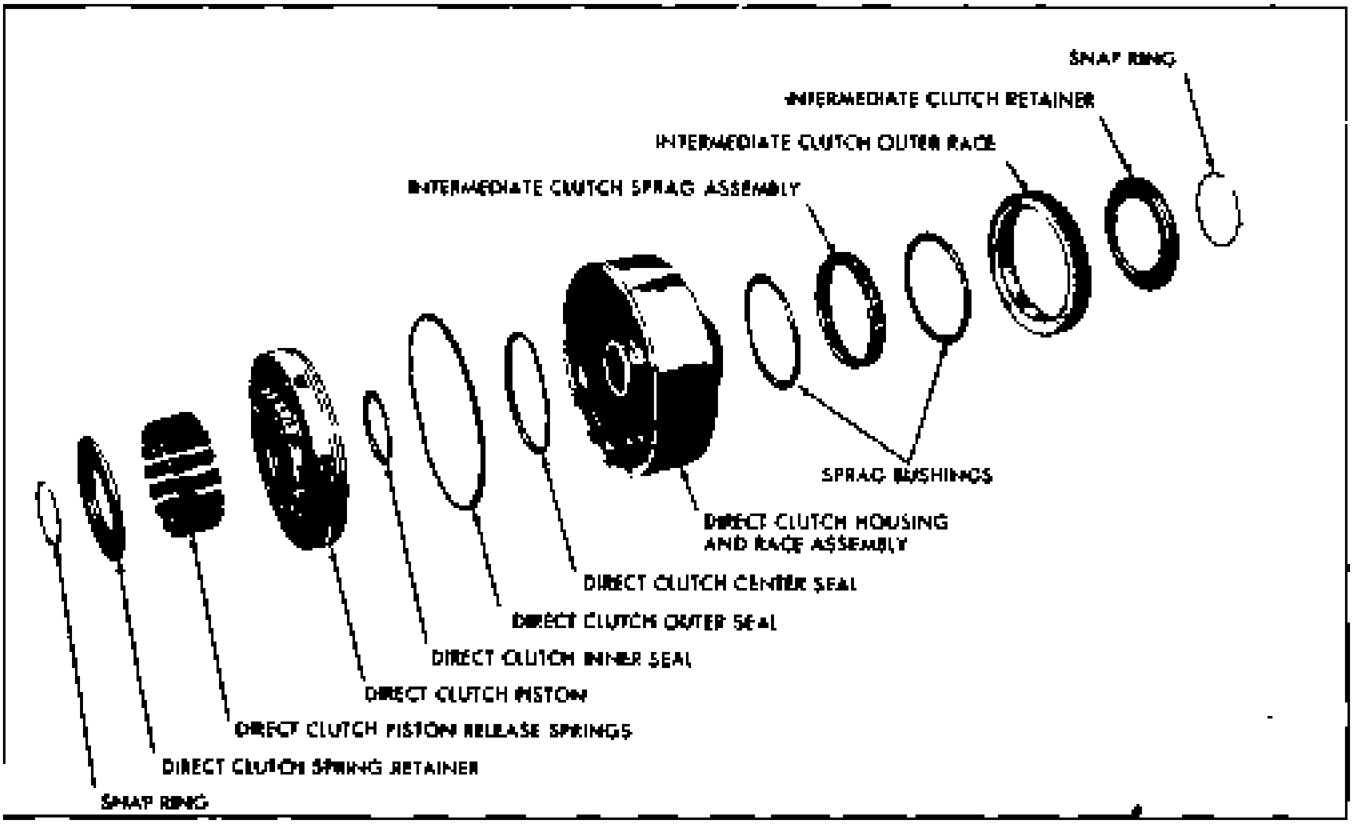


Fig. 7E-97 Exploded View of Direct Clutch and Intermediate Sprag

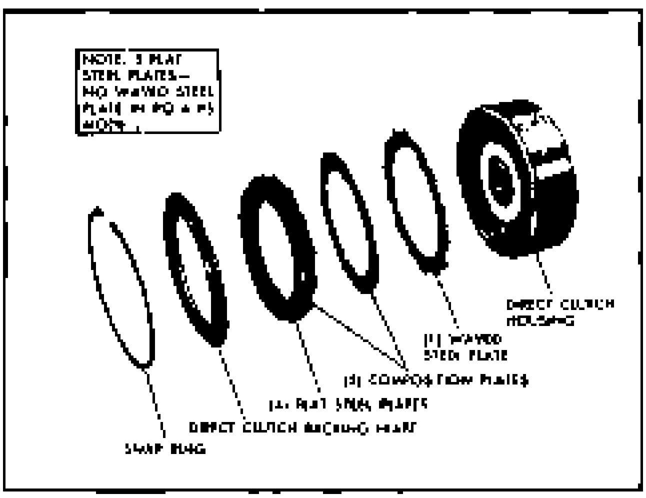


Fig. 7E-98 Exploded View of Direct Clutch

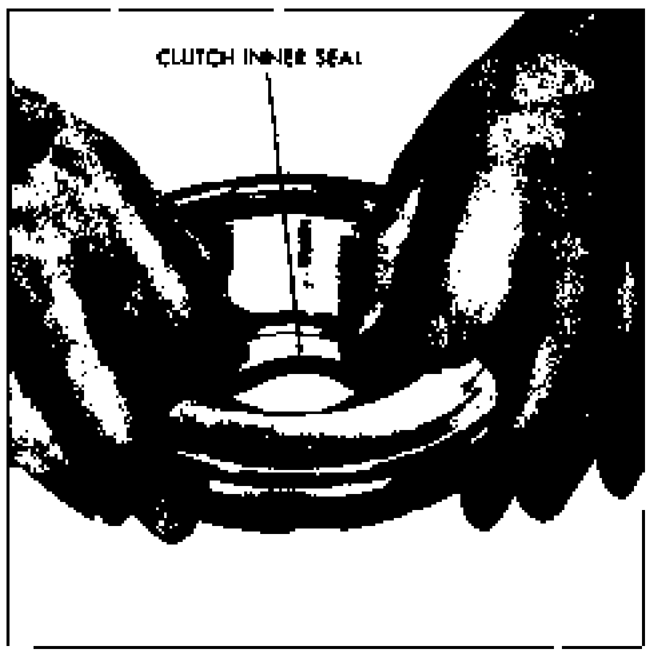


Fig. 7E-99 Installing Direct Clutch Piston Inner Seal

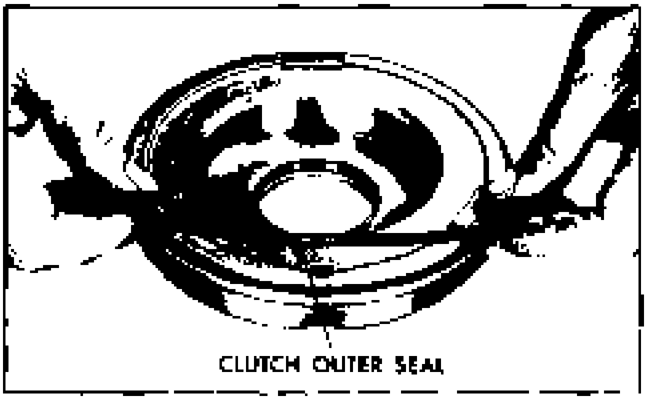


Fig. 7E-100 Installing Direct Clutch Piston Outer Seal

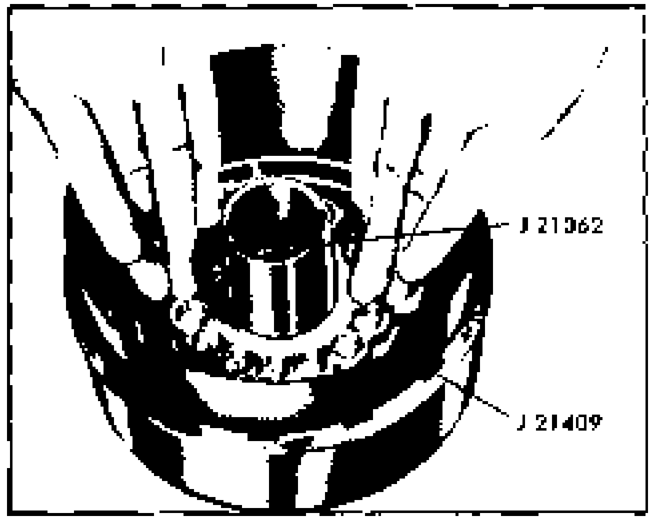


Fig. 7E-103 Installing Direct Clutch Piston

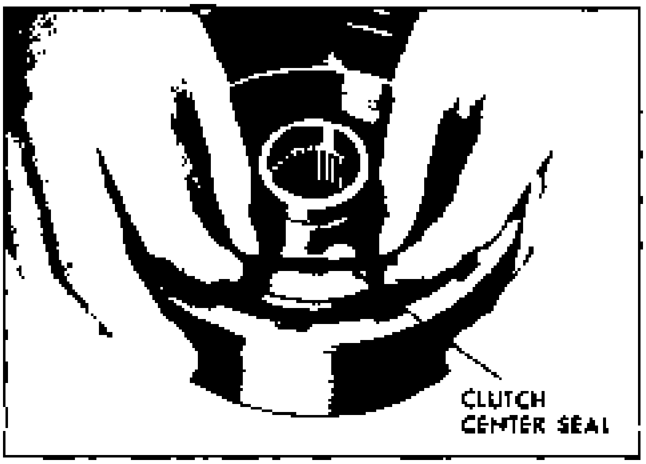


Fig. 7E-101 Installing Direct Clutch Center Seal

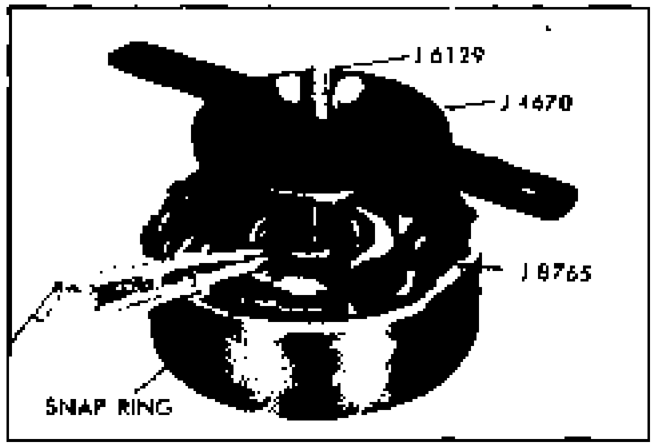


Fig. 7E-104 Installing Direct Clutch Spring Retainer and Snap Ring

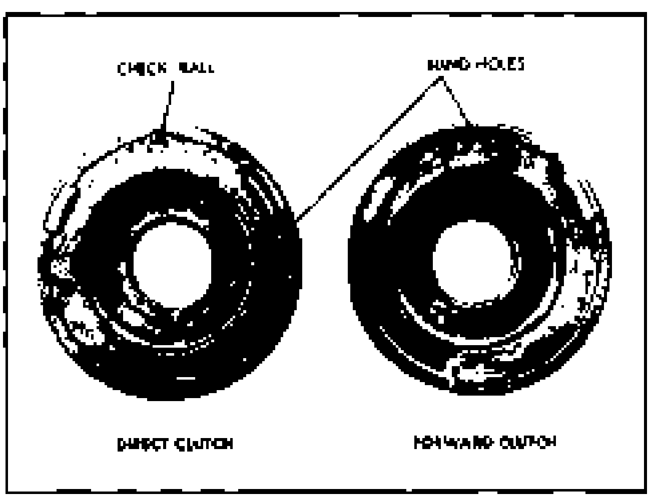


Fig. 7E-102 Identifications of Clutch Pistons

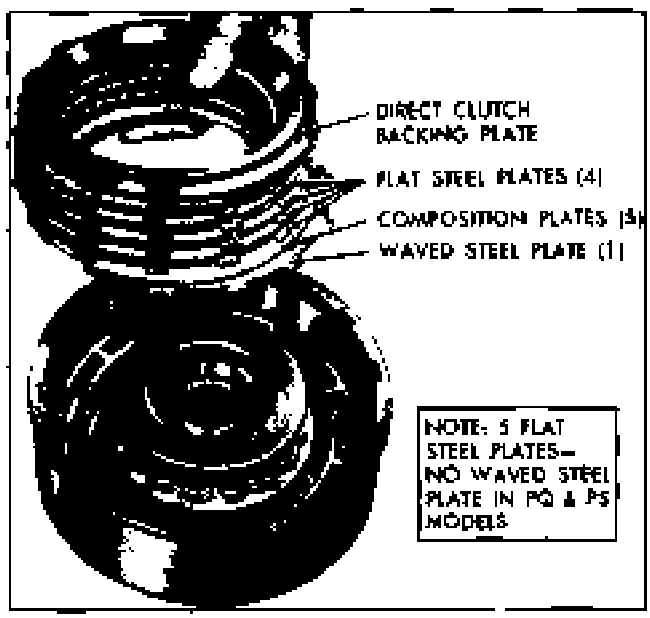


Fig. 7E-105 Installing Direct Clutch Backing Plate, Composition and Steel Plates

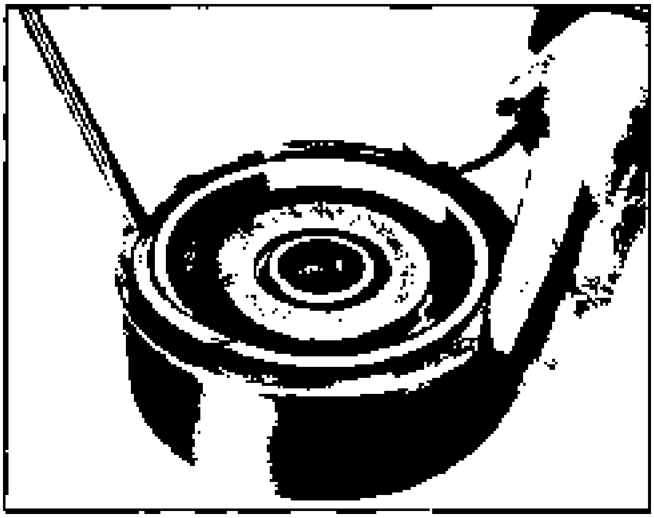


Fig. 7E-106 Installing Direct Clutch Housing to Backing Plate Snap Ring

12. Install sprag assembly into outer race.

13. With ridge or shoulder on inner cage down, start sprag and outer race over inner race with clockwise turning motion (Fig. 7E-107).

NOTE: Outer race should not turn counterclockwise after installation (Fig. 7E-108).

14. Install sprag bushing over sprag, cup side down.

15. Install clutch retainer (Fig. 7E-109) and snap ring (Fig. 7E-110).

16. Place direct clutch assembly over center support and air check operation of direct clutch (Fig. 7E-111).

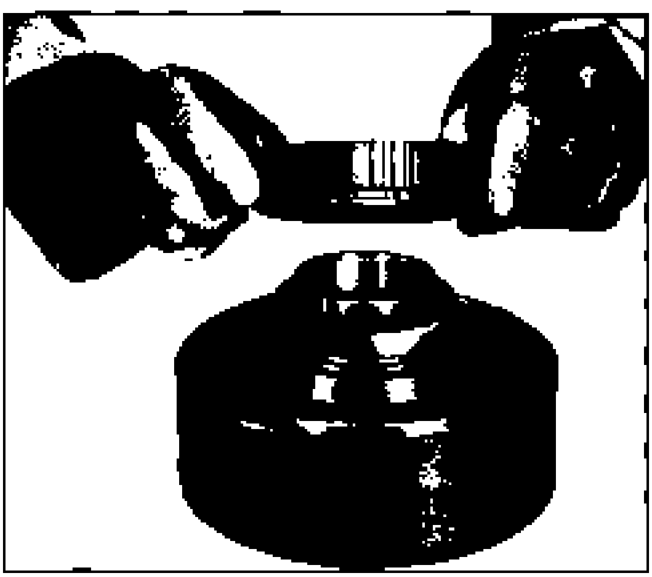


Fig. 7E-107 Installing Intermediate Sprag to Direct Clutch

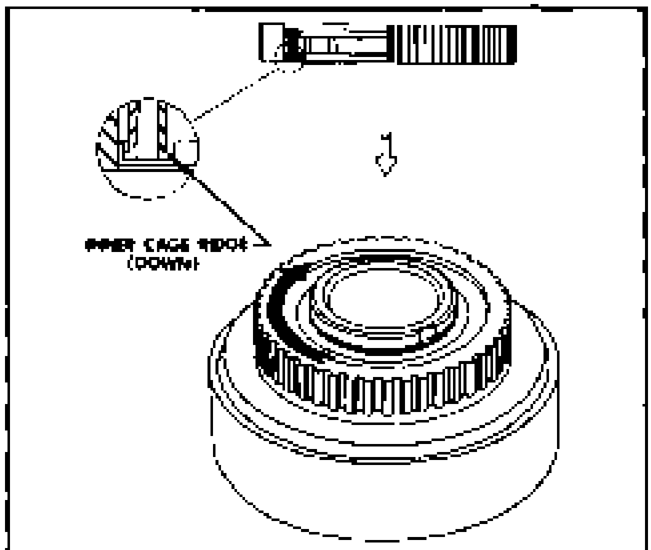


Fig. 7E-108 Correct Sprag Clutch Rotation

NOTE: If air is applied through reverse passage (right oil feed hole), it will escape from direct clutch passage (left oil feed hole). This is considered normal. Applying air through direct clutch passage (left oil feed hole) will activate piston and move direct clutch.

CASE CENTER SUPPORT

DISASSEMBLY OF CENTER SUPPORT

1. Remove four (4) hook type oil seal rings from center support.

2. Using your fingers, compress spring retainer and remove snap ring.

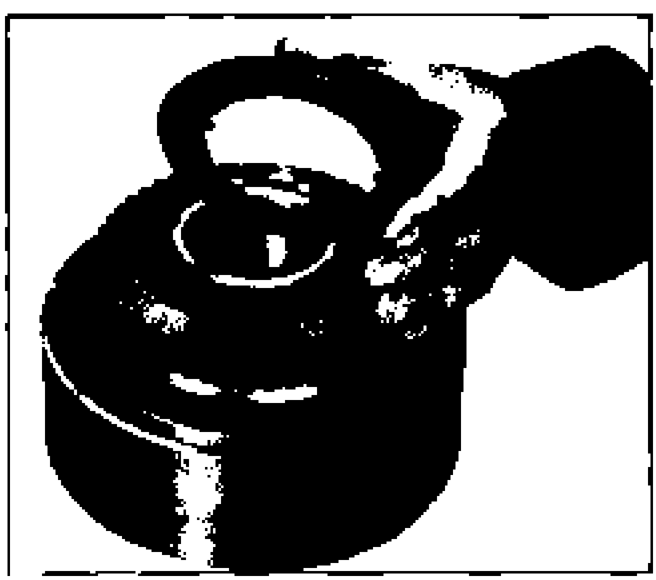


Fig. 7E-109 Installing Intermediate Clutch Retainer

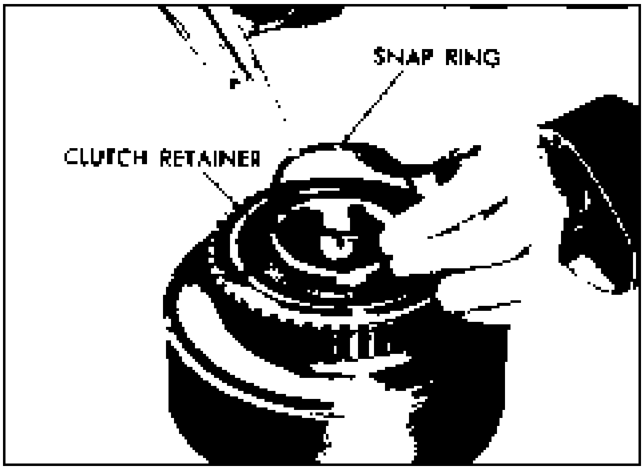


Fig. 7E-110 Installing Intermediate Clutch Retainer Snap Ring

3. Remove spring retainer and three (3) clutch release springs.

4. Remove intermediate clutch piston.

5. Remove inner and outer piston seal.

NOTE: Do not remove three (3) screws retaining roller clutch inner race to center support.

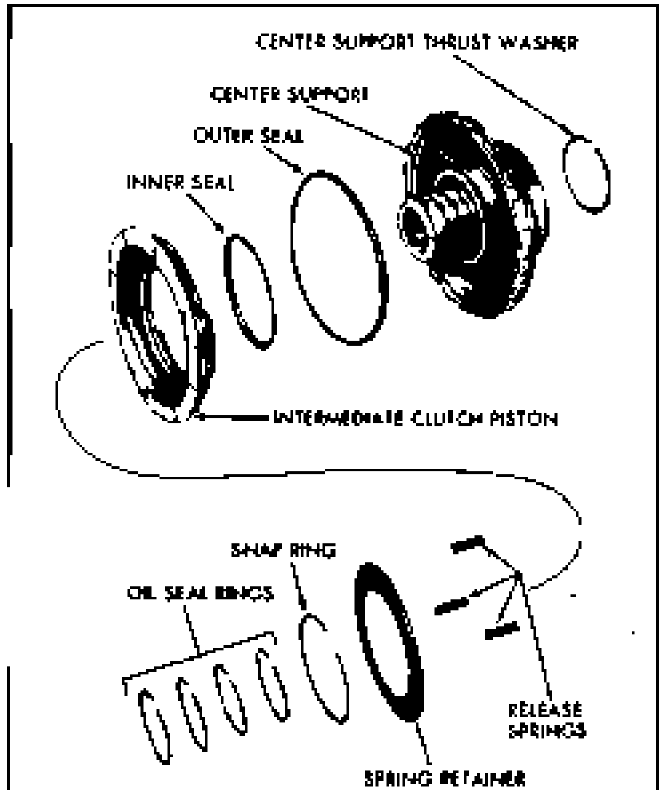


Fig. 7E-112 Exploded View of Center Support

INSPECTION OF CENTER SUPPORT (Fig. 7E-112)

1. Inspect roller clutch inner race for scratches or indentations. Be sure lubrication hole is open.

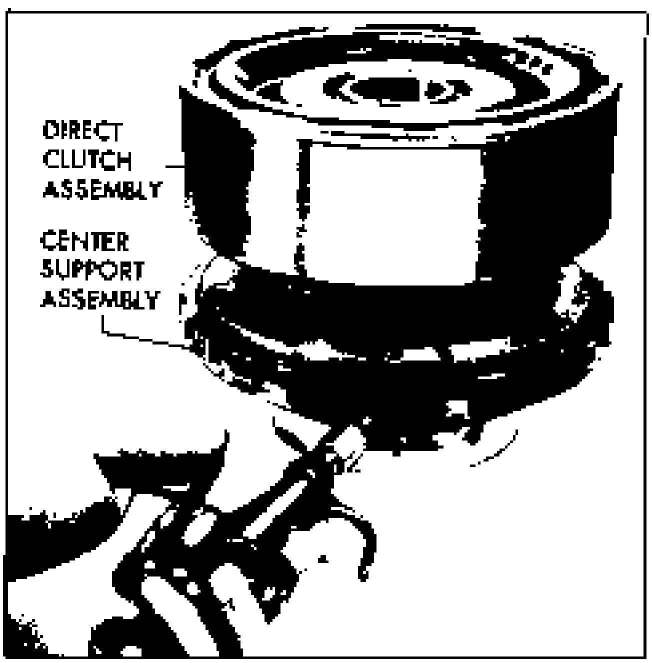


Fig. 7E-111 Air Checking Direct Clutch

NOTE: Be sure constant bleed plug orifice (approx. .020 dia.) is open (Fig. 7E-50).

2. Inspect bushing for scoring, wear or galling. If replacement is necessary, proceed as follows:

a. Using Tool J 21465-6 with Driver Handle J 8092, remove bushing.

b. From front side of center support, align thre elongated slot in bushing with the drilled hole in the oil delivery sleeve closest to piston.

c. Using tool J 21465-6 and Driver Handle J 8092, drive bushing squarely into the bore until bushing is flush to .010" below top of oil delivery sleeve.

3. Check oil ring grooves for damage.

4. Air check oil passages to be sure they are not interconnected.

5. Inspect piston sealing surfaces for scratches.

6. Inspect piston seal grooves for nicks or other damage.

7. Inspect piston for cracks or porosity.

8. Inspect release springs for distortion.

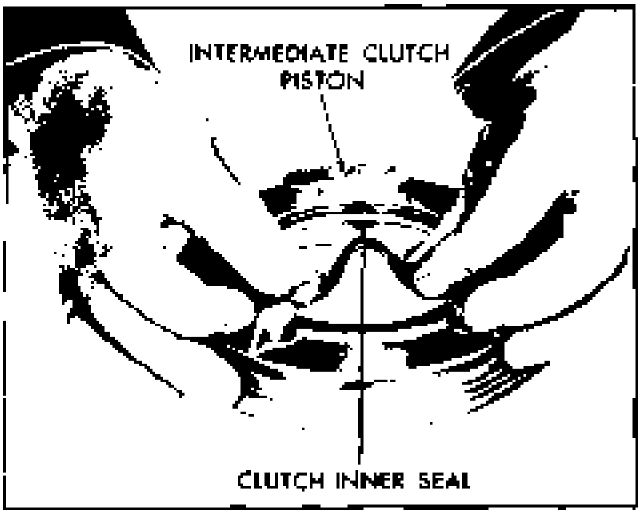


Fig. 7E-113 Installing Intermediate Clutch Inner Seal

ASSEMBLY OF CENTER SUPPORT

1. Install new inner and outer seals on piston with lip of seal facing away from spring pocket (Fig. 7E-113 and 7E-114).

2. Install Inner Seal Protector Tool J 21363 on center support hub and install piston, indexing spring pockets of piston into cored areas of center support (Fig. 7E-115).

3. Install three (3) release springs into counterbores of piston. Space equally during assembly.

4. Place spring retainer and snap ring over springs.

5. Compress springs and install snap ring.

6. Install four (4) hook type oil rings.

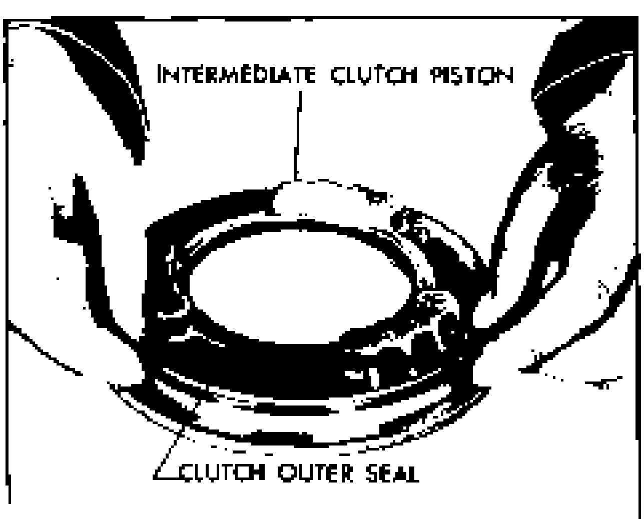


Fig. 7E-114 Installing Intermediate Clutch Outer Seal

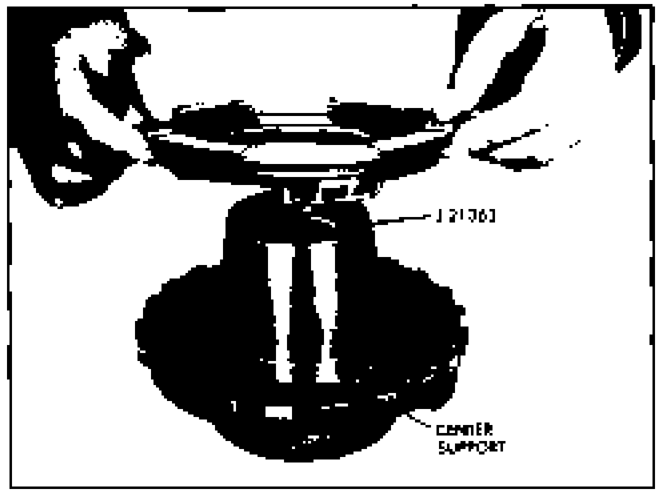


Fig. 7E-115 Installing Intermediate Clutch Piston

7. Air check operation of intermediate clutch piston (Fig. 7E-116).

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.

3. Inspect thrust washer surfaces for signs of scoring or wear.

4. Inspect bushing for damage. If bushing is damaged, reaction carrier must be replaced.

5. Inspect reaction carrier pinions for damage, rough bearings or excessive tilt.

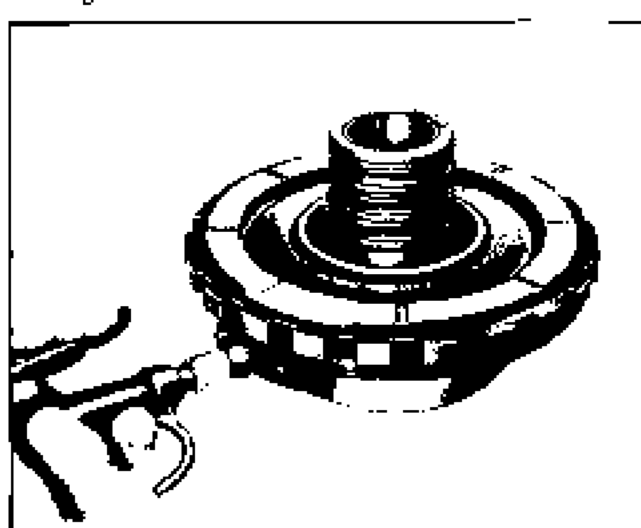


Fig. 7E-116 Air Checking Intermediate Clutch Piston

6. Check reaction carrier pinion end play. Should be .009"-.024" (Fig. 7E-117).

7. Inspect roller clutch for damaged members

8. Inspect roller clutch cage for damage.

9. Inspect front internal gear (output carrier) for damaged teeth.

10. Inspect output carrier pinions for damage, rough bearings or excessive tilt

11. Check output carrier pinion end play. Should be .009"-.024" (Fig. 7E-118).

12. Inspect parking pawl lugs for cracks or damage.

13. Inspect output locating splines for damage.

14. Inspect front internal gear ring for flaking.

PINION REPLACEMENT PROCEDURE

(Reaction Carrier Shown)

1. Support carrier assembly on its front face.

2. Using a 1/2" diameter drill, remove stake marks from end of the pinion pin or pins to be replaced. This will reduce the probability of cracking the carrier when pinion pins are pressed out

CAUTION: Do not allow drill to remove any stock from the carrier as this will weaken the part and future failure would be probable.

3. Using a tapered punch, drive or press pinion pins out of carrier (Fig. 7E-119).

4. Remove pinions, thrust washers and roller needle bearings.

5. Inspect pinion pocket thrust faces for burrs and remove if present.

Fig. 7E-117 Checking Reaction Carrier Pinion End Play

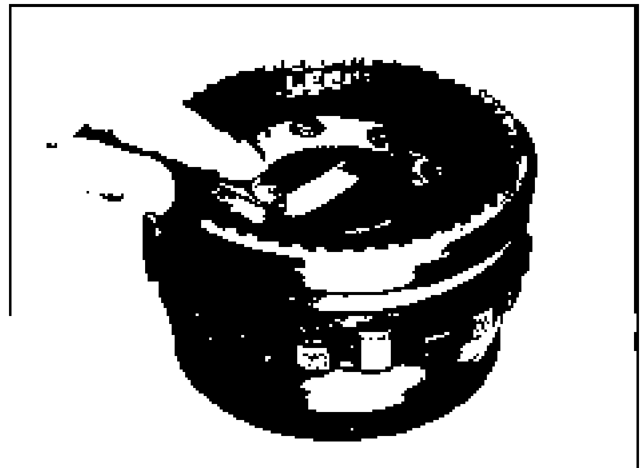


Fig. 7E-118 Checking Output Carrier Pinion End Play

6. Install eighteen (18) needle bearings into each pinion, using petrolatum to hold bearings in place. Use pinion pin as guide (Fig. 7E-120).

7. Place a bronze and steel washer on each side of pinion so steel washer is against pinion and hold them in place with petrolatum.

8. Place pinion assembly in position in carrier and install a pilot shaft through rear face of assembly to hold parts in place.

9. Drive a new pinion pin into place while rotating pinion from front, being sure that headed end is flush or below face of carrier (Fig. 7E-121).

10. Place a large punch in a bench vise to be used as an anvil while staking opposite end of pinion pin in three places.

NOTE: Both ends of pinion pins must lie below face of carrier or interference may occur.

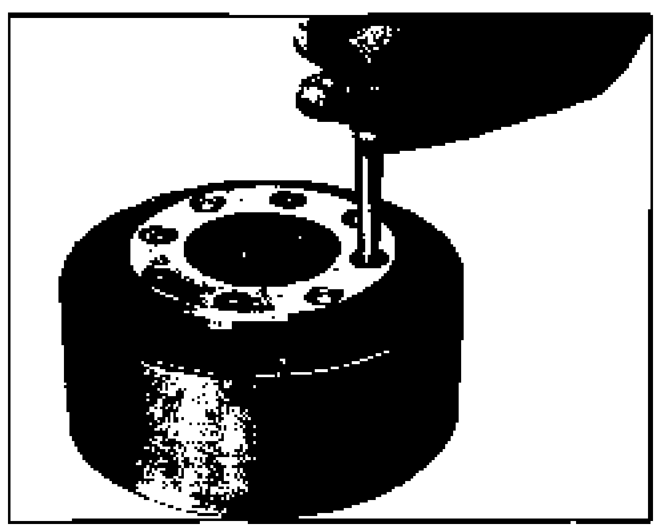


Fig. 7E-119 Removing Planet Pinion Pin

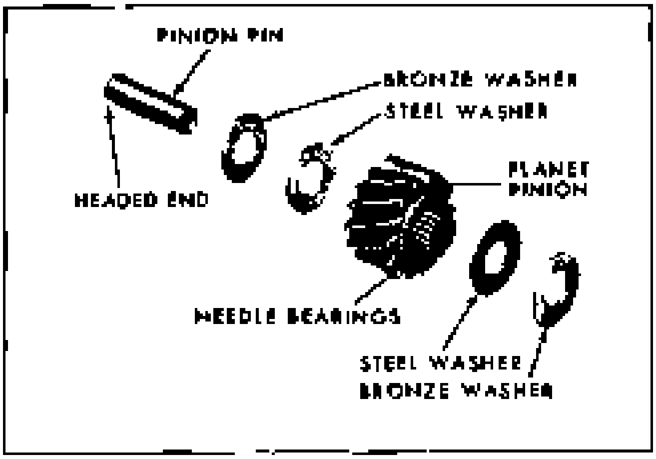


Fig. 7E-120 Exploded View of Planet Pinion

INSPECTION OF MAJOR UNITS

A. OUTPUT SHAFT

1. Inspect bushing for wear or galling. If replacement is necessary, proceed as follows:

a. Thread Tool J 21465-16 into bushing and, using Slide Hammer J 2619 and Adapter J 2619-4, remove bushing.

b. Using Tool J 21465-1 with Driver Handle J 8092, install bushing into place until tool bottoms.

2. Inspect bearing and thrust washer surfaces for damage.

3. Inspect governor drive gear for rough or damaged teeth.

4. Inspect splines for damage.

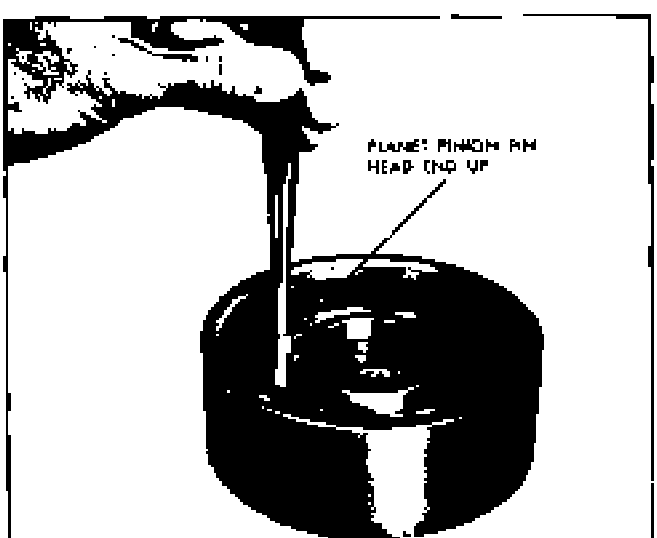


Fig. 7E-121 Installing Planet Pinion Pin

5. Inspect orificed cup plug in lubrication passage.

6. Inspect drive lugs for damage.

B. REAR INTERNAL GEAR

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Inspect gear for cracks.

C. SUN GEAR

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Be sure oil lubrication hole is open.

D. SUN GEAR SHAFT

1. Inspect shaft for cracks or splits.

2. Inspect splines for damage.

3. Inspect bushings for scoring or galling. If necessary to replace, proceed as follows:

A. SUN GEAR SHAFT BUSHING, FRONT -

With sun gear shaft properly supported, thread Tool J 21465-14 into bushing and, using Slide Hammer J 2619 and Adaptor J 2619-4, remove bushing.

Replace

Using Tool J 21465-5 with Drive Handle J 8092, press or drive replacement bushing into place until tool bottoms.

B. SUN GEAR SHAFT BUSHING, REAR -

Remove

With sun gear shaft properly supported, and using Tool J 21465-15 with Slide Hammer J 2619, remove bushing.

Replace

Using Tool J 21465-5 with Drive Handle J 8092, press or drive replacement bushing into place until tool bottoms.

4. Inspect ground bushing journals for damage.

5. Be sure oil lubrication hole is open.

E. MAIN SHAFT

1. Inspect shaft for cracks or distortion.

2. Inspect splines for damage.

3. Inspect ground bushing journals for damage.

4. Inspect snap ring groove for damage.

5. Inspect orificed cup plug pressed into one end of mainshaft. Be sure it is not plugged and oil lubrication holes are open.

F. FRONT AND REAR BANDS

1. Inspect lining for cracks, flaking, burning or looseness.

2. Inspect bands for cracks or distortion.

3. Inspect end for damage at anchor lugs or apply lugs.

G. CASE EXTENSION

1. Inspect bushing for excessive wear or damage. If replacement is necessary, proceed as follows:

a. Install Tool J 21465-17 and remove bushing.

b. Using Tool J 21465-17 with Drive Handle J 8092, install new bushing flush to .010" below oil seal counterbore.

c. Stake bushing in place, using Tool J 21465-10 in diamond area of bushing lube groove.

2. Inspect gasket mounting face for damage.

3. Inspect housing for cracks or porosity.

4. Be sure rear seal drain back port is not obstructed.

H. MODULATOR AND VALVE

1. Inspect modulator assembly for any signs of bending or distortion (Fig. 7E-122).

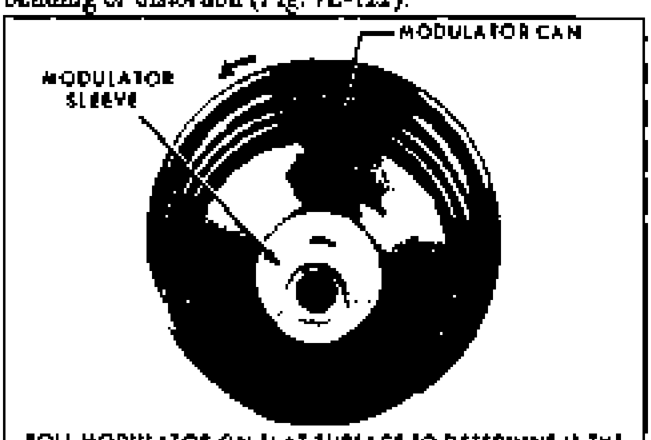


Fig. 7E-122 Checking Concentricity of Sleeve

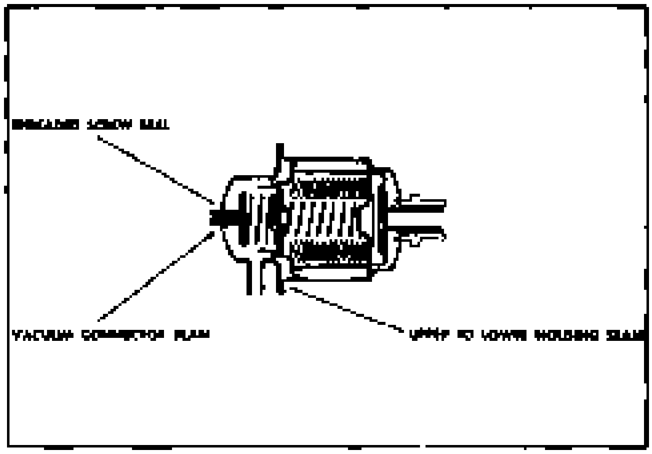


Fig. 7E-123 Vacuum Modulator Seams and Seal

a. Roll main body of modulator on a flat surface and observe the sleeve for concentricity to the body.

b. If sleeve is concentric and the modulator valve is free within the sleeve, the modulator is acceptable.

2. Atmospheric Leak Check (Fig. 7E-123) -

a. Apply a liberal coating of soap bubble solution (available at 5c-10c store) to vacuum connector pipe seam, crimped upper to lower housing seam and to the threaded screw seal

b. Using a short piece of rubber tubing, apply air pressure to the vacuum pipe by blowing into tubing and observe for leak bubbles.

c. If bubbles appear, replace the modulator.

CAUTION: Do not use any method other than human lung power for applying air pressure as pressures over 6 psi may damage the modulator.

3. Inspect O-ring seal seat for damage.

4. Vacuum Diaphragm Leak Check (Fig. 7E-124)

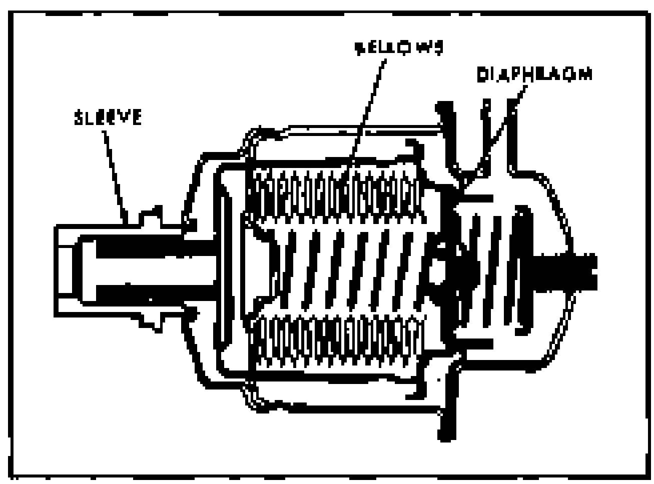


Fig. 7E-124 Cross Section of Vacuum Modulator

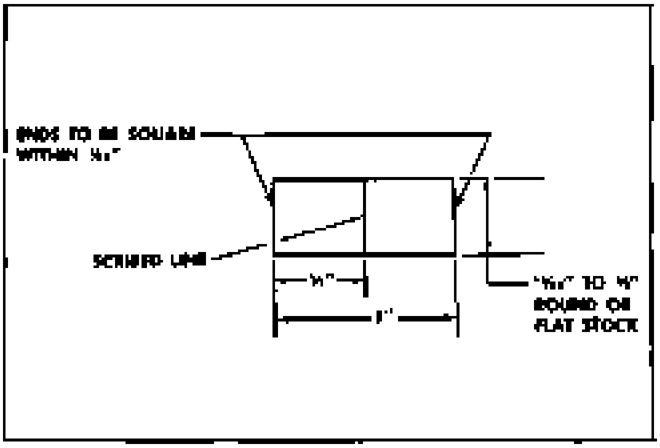


Fig. 7E-125 Comparison Gauge

a. Insert a pipe cleaner into vacuum connector pipe as far as possible and check for presence of transmission fluid.

b. If transmission fluid is found on pipe cleaner, replace the modulator.

NOTE: Gasoline or water vapor may settle in vacuum side of diaphragm. If this is found without presence of transmission fluid, modulator should not be changed.

5. Bellows Comparison Check Using a comparison gauge (as shown in Fig. 7E-125), compare the load of a known good modulator of the same part number with the modulator in question, as follows:

a. Install known good modulator on either end of the gauge.

b. Install modulator in question on opposite end of the gauge

c. Holding modulators in a horizontal position, bring them together under pressure until either modulator sleeve just touches the line in the center of the gauge (Fig. 7E-126).

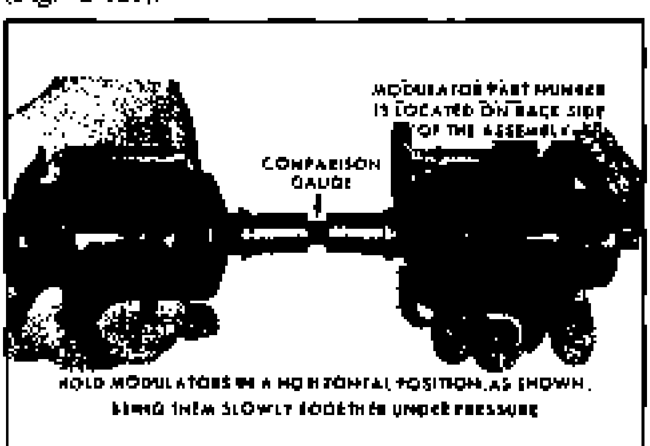


Fig. 7E-126 Bringing Modulators Together

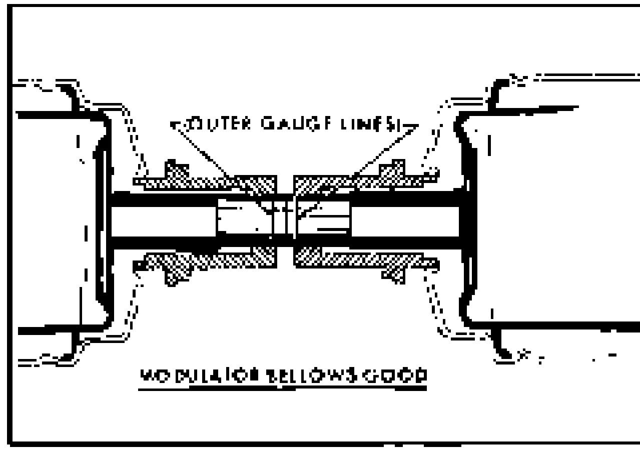


Fig. 7E-127 Modulator Bellows Good

d. The gap between the opposite modulator sleeve ends and gauge line should be 1/16" or less (Fig. 7E-127). If gap is greater than 1/16", the modulator in question should be replaced (Fig. 7E-128).

6. Inspect modulator valve for nicks or damage.

7. Check freeness of valve operation in case bore.

Once the modulator assembly passes all of the above tests, it is an acceptable part and should be re-used.

I. MANUAL AND PARKING LINKAGE

1. Inspect parking actuator rod for cracks or broken spring retainer lugs (Fig. 7E-129).

2. Inspect actuator spring for damage.

3. Inspect actuator for free fit on actuator rod.

4. Inspect parking pawl for cracks or wear, if removed.

5. Inspect manual shaft for damaged threads, rough oil seal surface or loose lever.

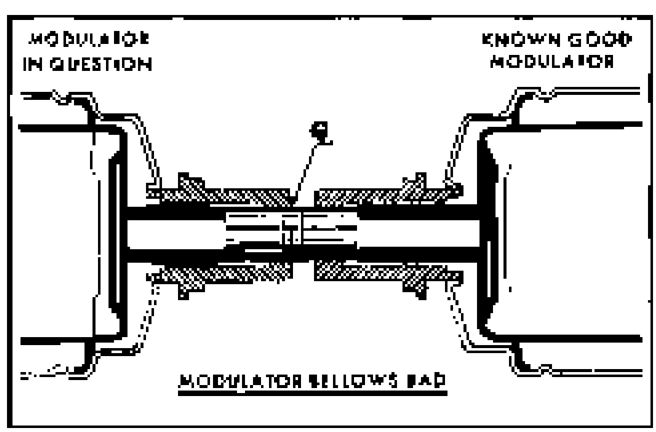


Fig. 7E-128 Modulator Bellows Bad

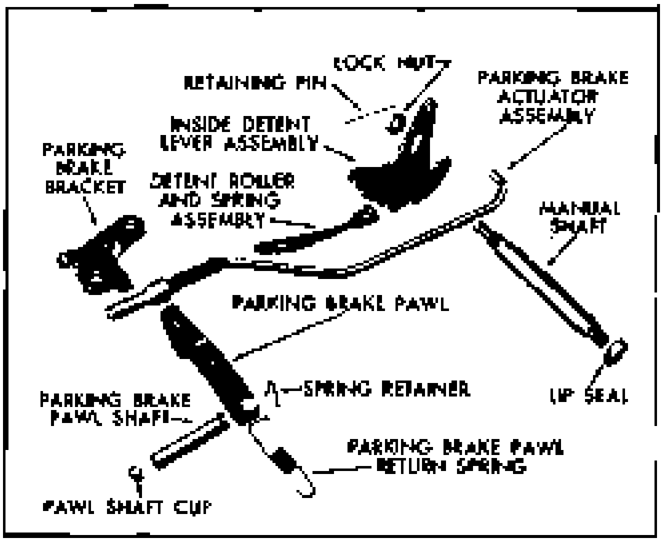


Fig. 7E-129 Exploded View of Manual and Parking Linkage

6. Inspect inside detent lever for cracks or a loose pin.

7. Inspect parking pawl shaft for damaged retainer groove, if removed.

8. Inspect parking pawl return spring for deformed coils or ends.

9. Inspect parking bracket for cracks or wear.

10. Inspect detent roller and spring assembly

J. CASE ASSEMBLY

1. Inspect case for cracks, porosity or inter-connected passages (Figs. 7E-130 and 7E-131).

2. Check for good retention of band anchor pins.

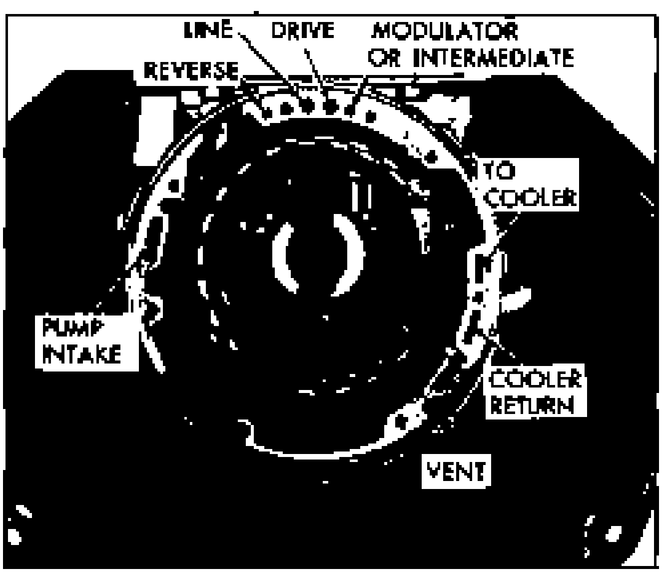


Fig. 7E-130 Case Passage Identification - Front View

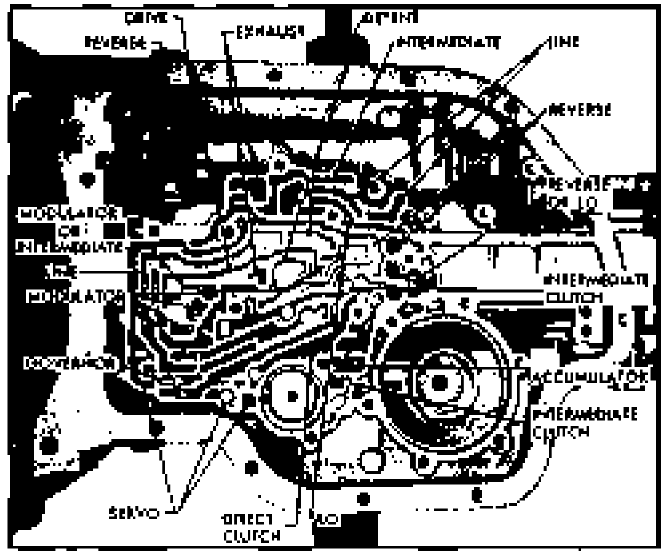


Fig. 7E-131 Case Passage Identification - Bottom View

3. Inspect all threaded holes for thread damage.

4. Inspect intermediate clutch driven plate lugs for damage or brinneling.

5. Inspect snap ring grooves for damage.

6. Inspect governor assembly bore for scratches or scoring.

7. Inspect modulator valve bore for scoring or damage.

8. Inspect cup plug, inside case, for good staking and sealing

9. Inspect case bushing. If necessary to replace, proceed as follows:

a. Remove

With case properly supported, using Tool J 21465-8 with Handle J 8092, remove bushing.

b. Replace

Use Tool J 21465-8, Adapter Ring J 21465-9, Drive Handle J 8092 and Extension J 21465-13. With its lube passage facing front of case, drive the bushing into case until it is .040"-.055" above the selective thrust washer face. Stake bushing with Staking Tool J 21465-10, stake marks in the lube grooves.

K. CONVERTER

1. Check converter for leaks as follows:

a. Install Tool J 21369 and tighten.

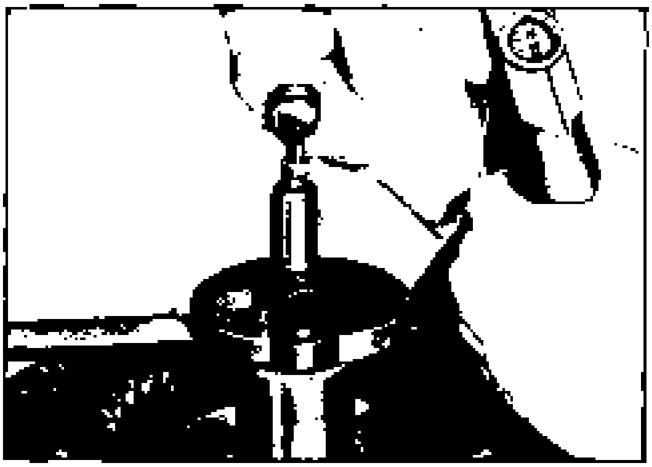


Fig. 7E-132 Air Checking Converter

b. Fill converter with 80 psi of air (Fig. 7E-132).

c. Submerge in water and check for leaks.

2. Check converter hub surfaces for signs of scoring or wear.

3. Check converter end play as follows:

a. Fully release collet end of Tool J 21371-2 by turning its brass nut clockwise.

b. Install collet end of Tool J 21371-2 into converter hub until it bottoms, then tighten its brass nut to 5 lb. ft. (Fig. 7E-133).

c. Install Tool J 21371-3 and tighten the hex nut to 3 lb. ft. (Fig. 7E-134).

d. Install Dial Indicator J 8001 and set it for "zero" while its plunger rests on the brass nut of Tool J 21371 2.

e. Loosen hex nut while holding brass nut stationary,

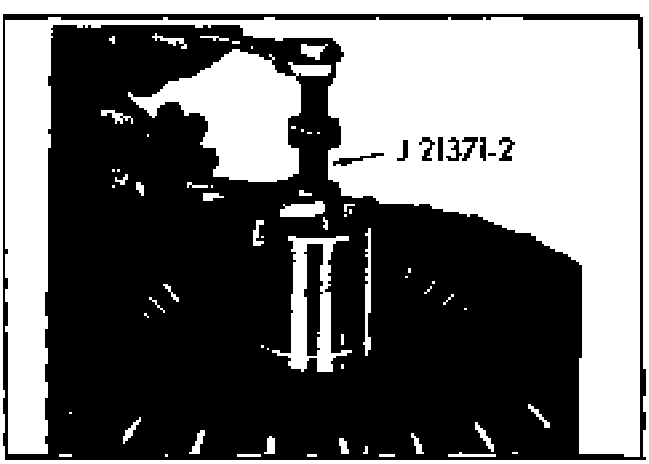


Fig. 7E-133 Installing Tool J 21371-2

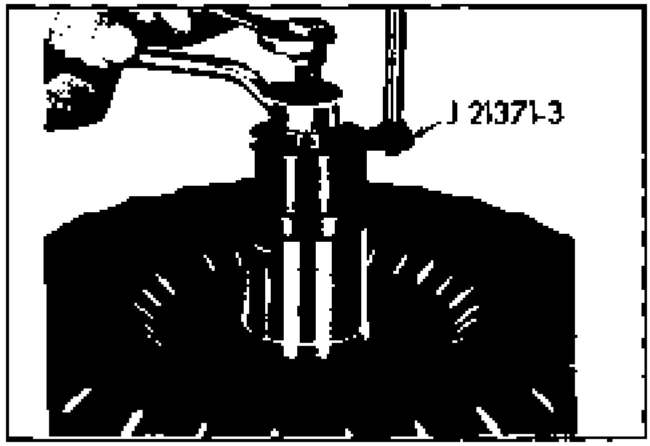


Fig. 7E-134 Installing Tool J 21371-3

allowing converter internal assembly to lower, until dial indicator shows that internal assembly has bottomed (Fig. 7E-135).

f. The reading obtained on dial indicator represents converter end clearance. If clearance is under .050", the converter is acceptable. If clearance is .050" or over , replace the converter.

ASSEMBLY OF REAR UNIT FIG: 7E-136.

1. Install rear internal gear on end of mainshaft.

2. Install internal gear retaining snap ring (Fig. 7E 137)

3. Install sun gear to internal gear thrust races and bearings against inner face of rear internal gear as follows, and retain with petrolatum:

a. Place large race against internal gear, with flange facing forward or up (Fig. 7E-138).

b. Place thrust bearing against race.

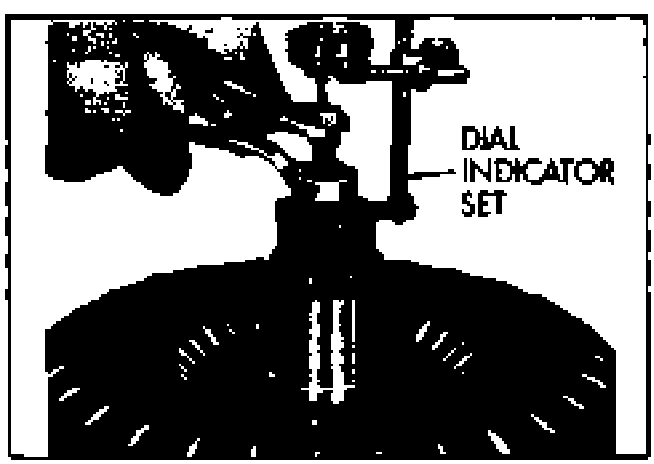


Fig. 7E-136 Checking End Play

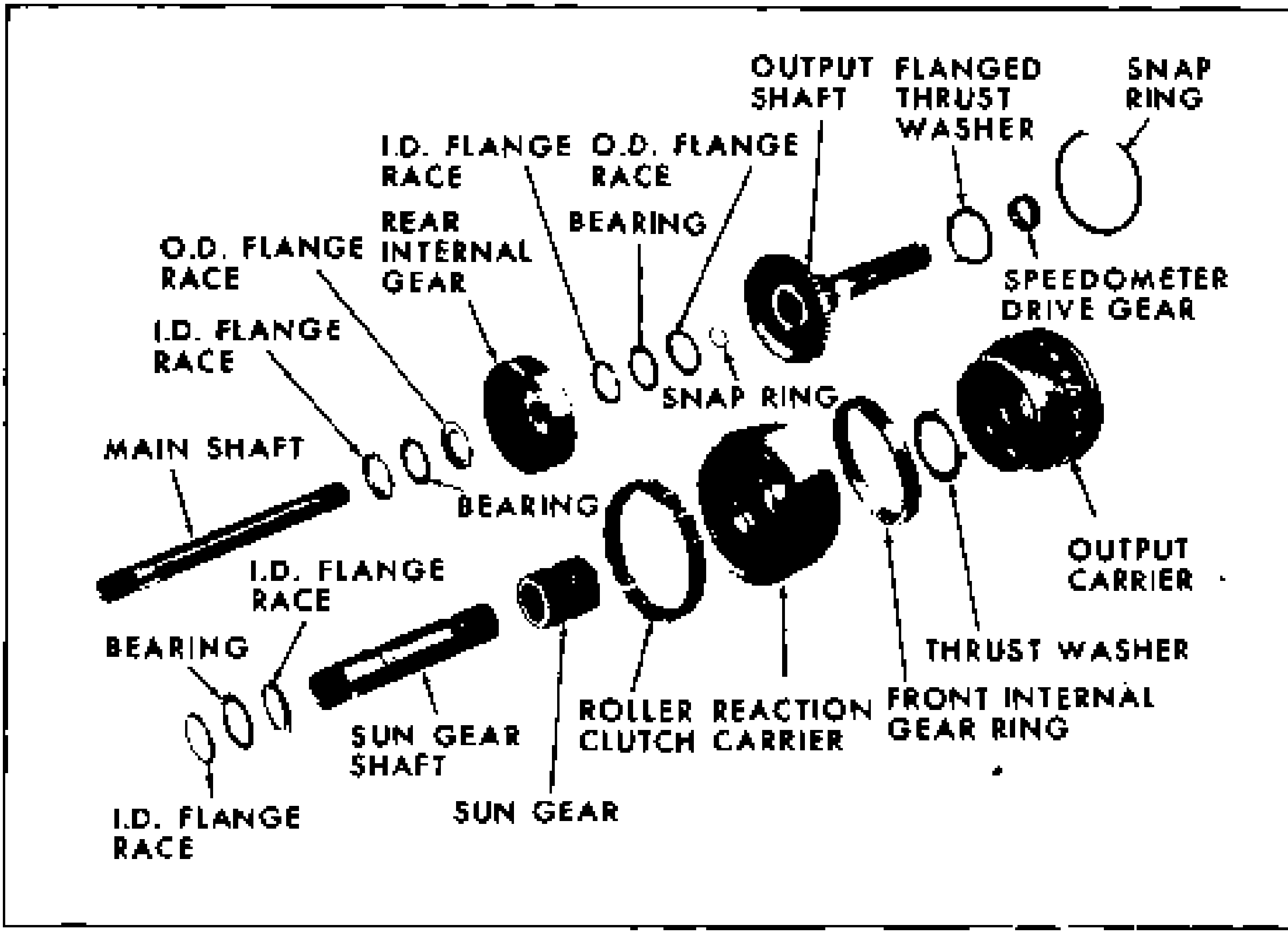


Fig. 7E-136 Exploded View of Rear Unit

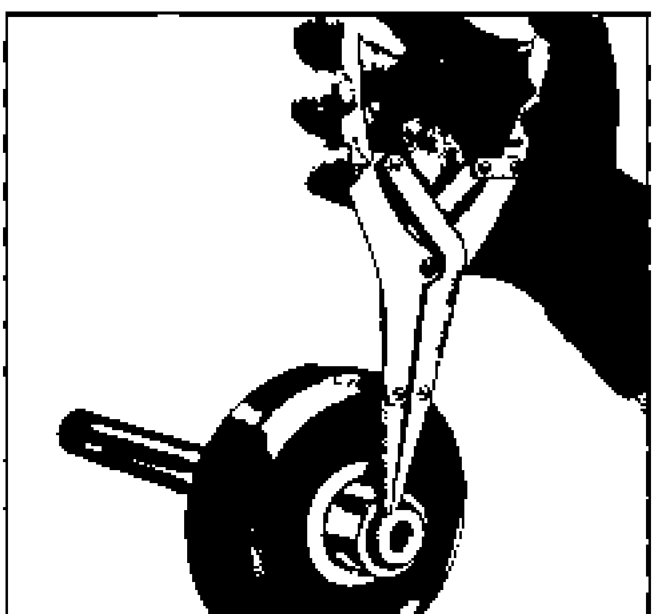


Fig. 7E-137 Installing Rear Internal Gear to Main Shaft Snap Ring

c. Place small race against bearing, with inner flange facing into bearing or down

4. Install output carrier over mainshaft so that pinions mesh with rear internal gear.

5. Place above portion of build-up through hole in bench so that mainshaft hangs downward.

6. Install rear internal gear to output shaft thrust races

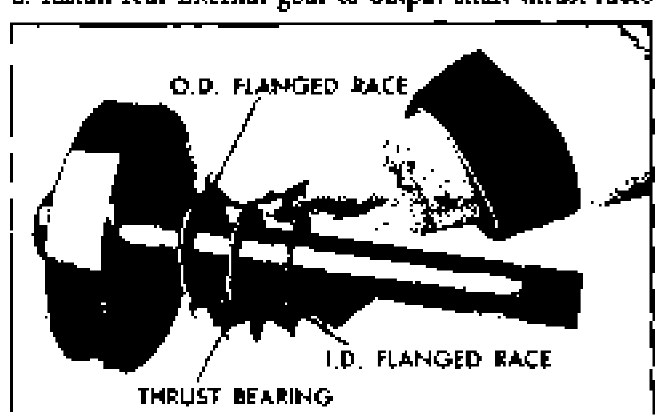


Fig. 7E-138 Installing Rear Internal Gear to Sun Gear Bearing and Races

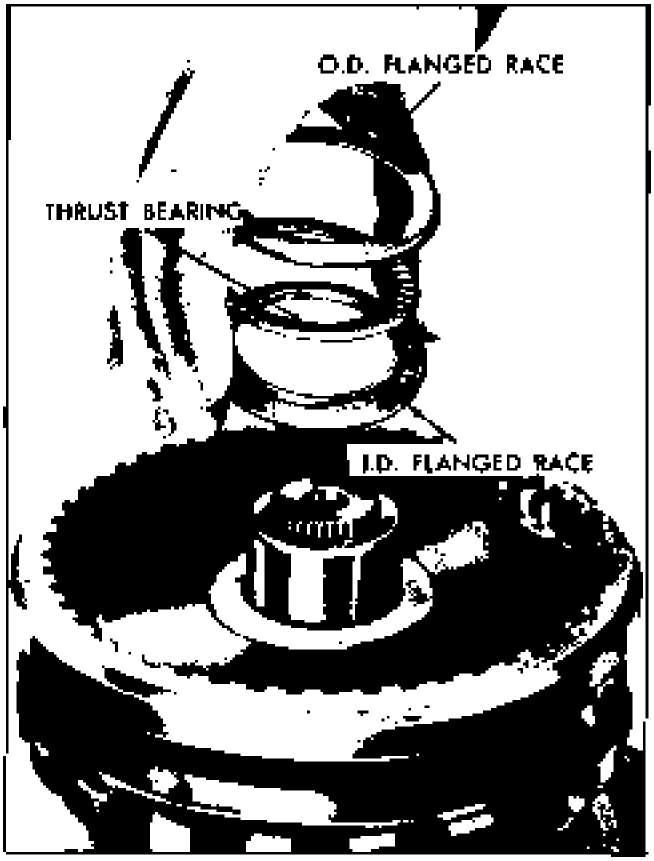


Fig. 7E-139 Installing Rear Internal Gear to Output Shaft Bearing and Races

and bearings as follows and retain with petrolatum (Fig. 7E-139).

a. Place small diameter race against internal gear, with center flange facing up.

b. Place bearing on race.

c. Place second race on bearing, with outer flange cupped over bearing.

7. Install output shaft into output carrier (Fig. 7E-140).

8. Install output shaft to output carrier snap ring.

CAUTION: The 1969 output shaft to output carrier snap ring is flat and thinner then pre-1969 snap rings. The change in design of the 1969 snap ring required a change in the groove of the output carrier. The 1969 flat snap ring and the pre-1969 snap ring (with one side beveled) are not interchangeable.

9. Turn assembly over and support so that output shaft hangs downward.

10. Install reaction carrier to output carrier plastic thrust washer, with tabs facing down in pockets and retain with petrolatum.

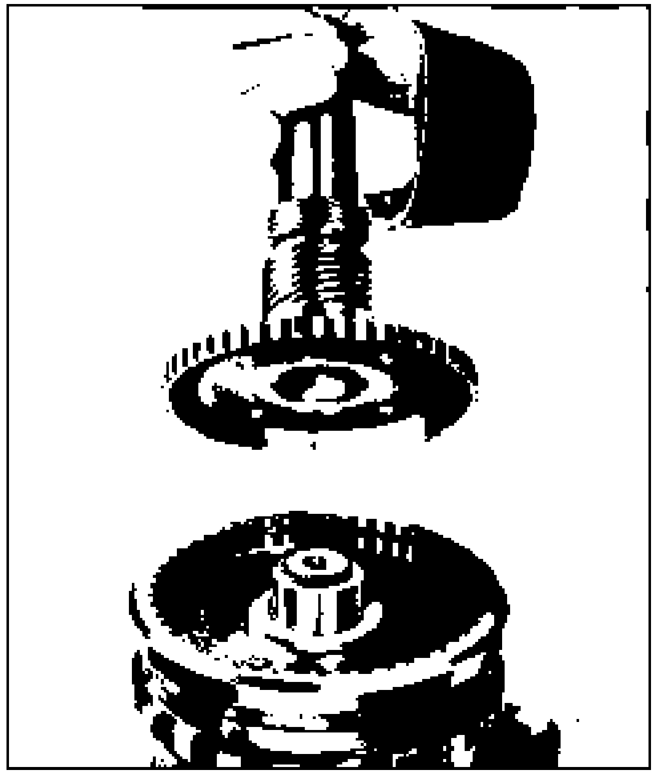


Fig. 7E-140 Installing Output Shaft

11. Install sun gear, splines with chamfer down.

12. Install composition ring over output carrier (Fig. 7E-141).

13. Install sun gear shaft, with long splined end down.

14. Install reaction carrier (Fig. 7E-142).

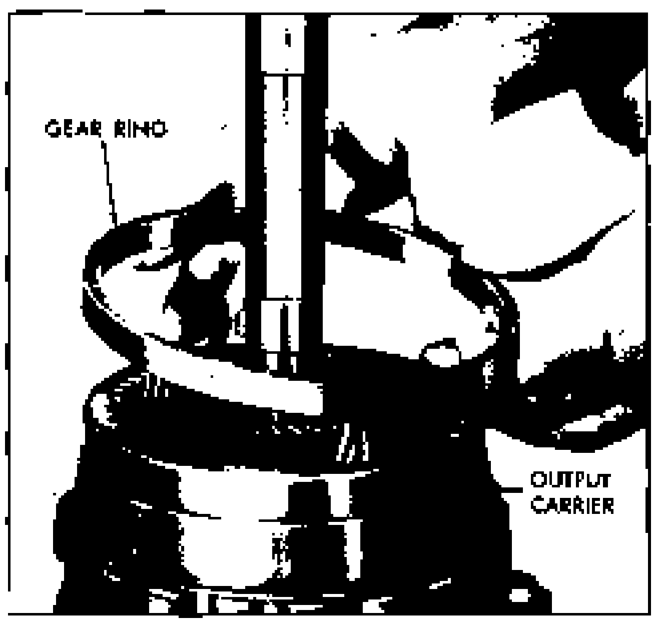


Fig. 7E-141 Installing Front Internal Gear Ring to Output Carrier

Fig. 7E-142 Installing Reaction Carrier

NOTE: When a new output carrier and/or reaction carrier is being installed and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the service gear ring.

15. Install center support to sun gear thrust races and bearings, retaining with petrolatum, as follows:

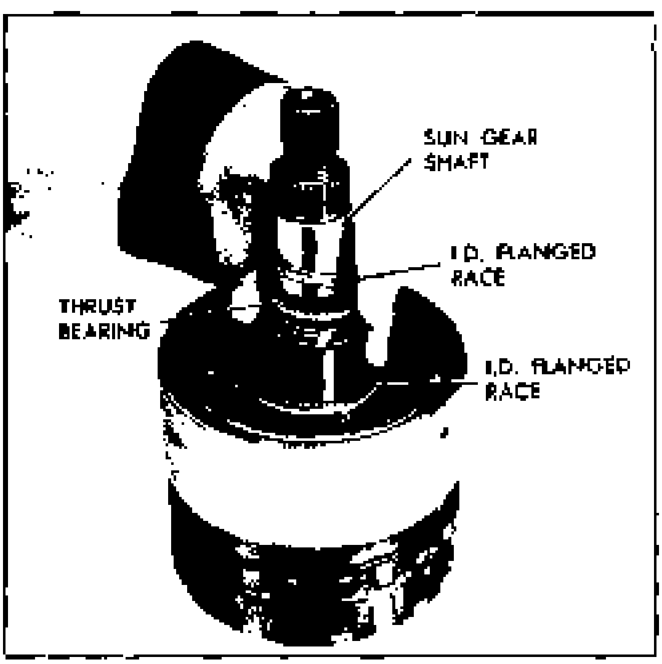


Fig. 7E-143 Installing Center Support to Sun Gear Thrust Bearing and Races

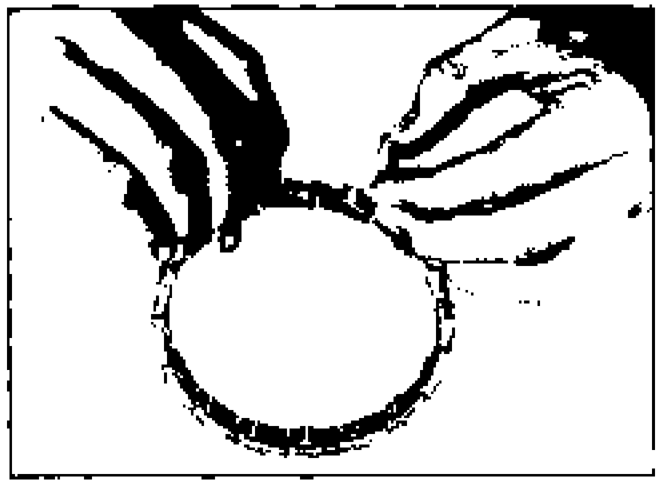


Fig. 7E-144 Installing Roller in Roller Clutch

a. Install large race, center flange up over sun gear shaft.

b. Install thrust bearing against race.

c. Install second race, center flange up (Fig. 7E-143).

16. Install rollers that may have come out of the roller cage by compressing the energizing spring with forefinger and inserting roller from the outer side (Fig. 7E-144).

17. Install roller clutch into reaction carrier outer race (Fig. 7E-145).

18. Install center support to reaction carrier thrust washer into recess in center support. Retain with petrolatum (Fig. 7E-146).

19. Install center support into reaction carrier and roller clutch assembly (Fig. 7E-147).

NOTE: With reaction carrier held, center support should only turn counterclockwise.

20. Install J 21795 on gear unit to hold units in place.

21. Install output shaft to case thrust washer tabs in pockets and retain with petrolatum (Fig. 7E-148).

ASSEMBLY OF UNITS INTO TRANSMISSION CASE

NOTE: The first 3 steps can be omitted if the parts involved were not removed on disassembly.

1. Install parking pawl, tooth toward inside of case, and parking pawl shaft (Fig. 7E-149).

2. Install parking pawl shaft retaining spring (Fig. 7E-150).

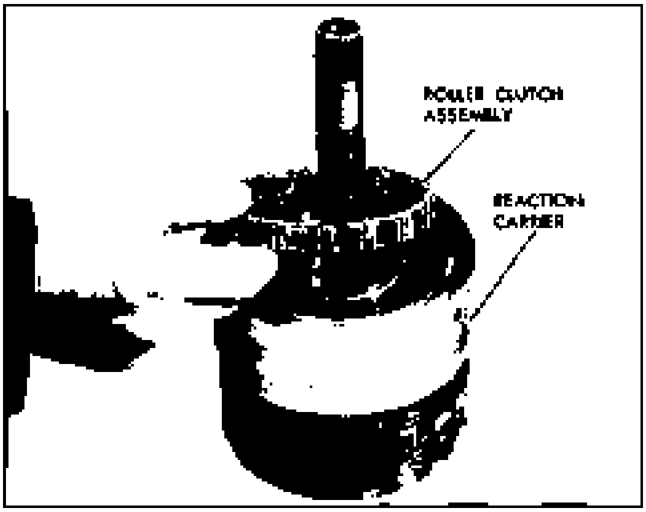


Fig. 7E-145 Installing Roller Clutch

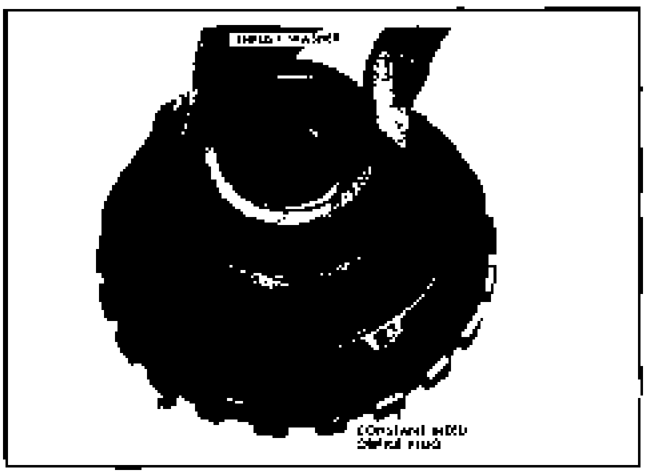


Fig. 7E-146 Installing Center Support to Reaction Carrier Thrust Washer

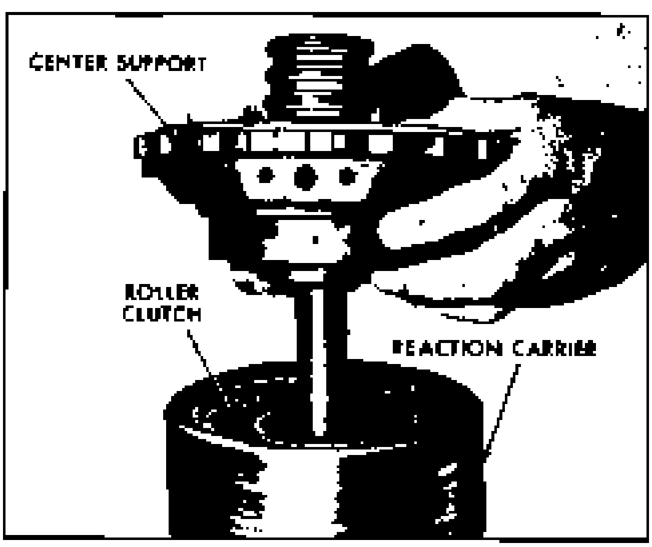


Fig. 7E-147 Installing Center Support into Reaction Carrier and Roller Clutch

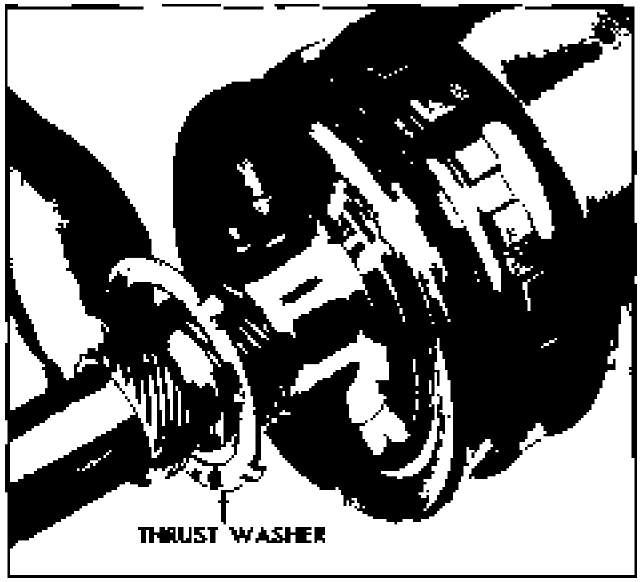


Fig. 7E-148 Installing Case to Output Shaft Thrust Washer

3. Install new cup plug, using a 3/8" dia. rod, and drive into transmission case until parking pawl shaft bottoms on case rib (Fig. 7E-151).

4. Install parking pawl return spring, square end hooked on pawl and other end on case (Fig. 7E-152).

5. Install parking brake bracket guides over parking pawl, using two attaching bolts. Torque to 18 lb. ft.

Fig. 7E-149 Installing Parking Pawl and Shaft with O-Ring

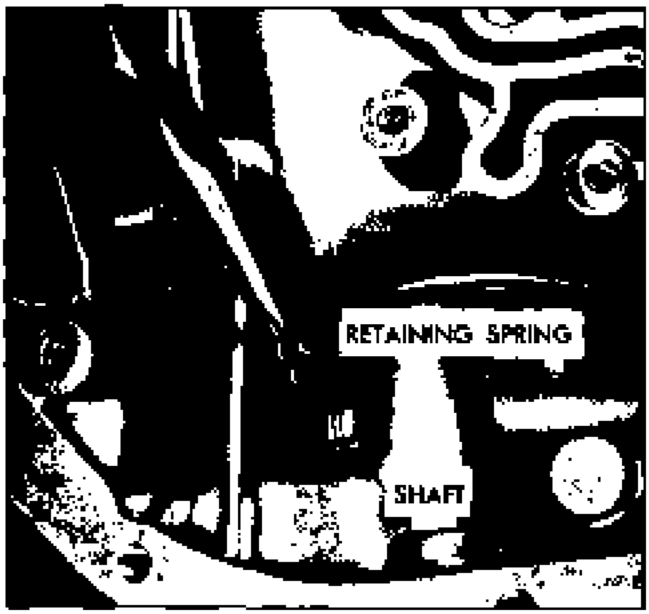


Fig. 7E-150 Installing Parking Shaft Retaining Spring

6. Install rear band so that two lugs index with two anchor pins. Check to make sure band is seated on lugs (Fig. 7E-153).

7. Install proper rear selective washer (proper washer determined by previous end play check) into slots provided inside rear of transmission case.

NOTE: Dip washer in transmission oil before installation.

8. Install complete gear unit assembly into case, using Tool J 21795 (Fig. 7E-154) and making certain center support bolt hole is properly aligned with hole in case.

9. Install center support to case retaining snap ring, with its bevel side up and locating gap adjacent to band anchor pin. Make certain ring is properly seated in case (Fig. 7E-155).

10. Install the case to center support bolt by placing the Center Support Locating Tool J 23093 into case direct clutch passage, with handle of tool pointing to right as viewed from front of transmission and parallel to the bell housing mounting face (Fig. 7E-156).

Apply pressure downward on tool handle, which will tend to rotate the center support counterclockwise as viewed from front of transmission. While holding center support firmly counterclockwise against the case splines, torque the case to center support bolt to 20-25 ft. lbs.

CAUTION: When using the locating tool, use care not to raise burrs on the case valve body mounting face.

11. Lubricate with transmission oil and install three (3) steel and three (3) composition intermediate clutch plates. Start with the waved steel and alternate composition and steel clutch plates (Fig. 7E-157).

12. Install intermediate clutch backing plate, ridge up.

13. Install backing plate to case snap ring, locating gap opposite band anchor pin.

Fig. 7E-152 Installing Parking Pawl Return Spring

Fig. 7E-151 Installing New Cup Plug

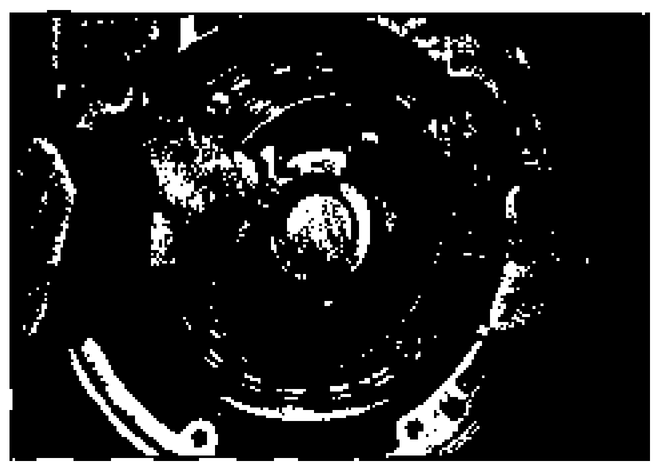


Fig. 7E-153 Installing Rear Band

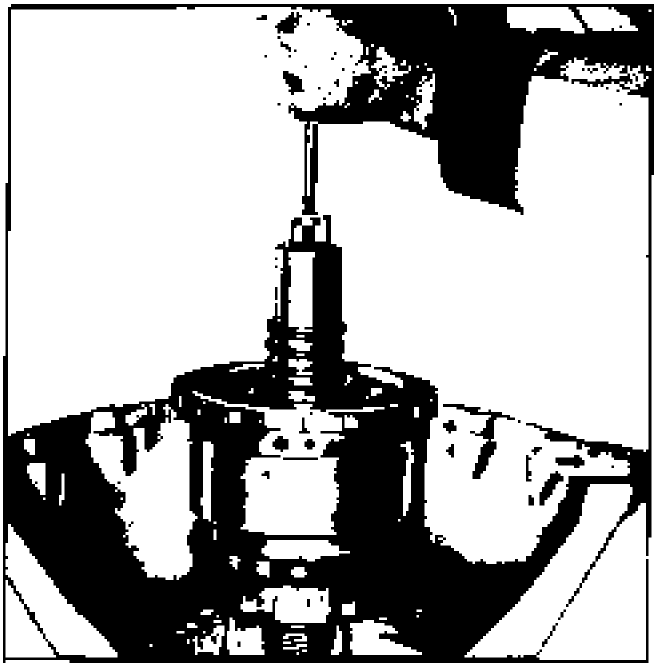


Fig. 7E-154 Installing Center Support and Gear Unit

NOTE: Both sides of this snap ring are flat.

14. Check rear end play as follows:

a. Install J 21904 with 3/8" adapter into an extension housing attaching bolt hole (Fig. 7E-158).

b. Mount Dial Indicator J 8001 on rod and index with end of output shaft.

c. Move output shaft in and out to read end play. End play should be from .003"-.019". The selective washer controlling this end play is a steel washer having 3 lugs and is located between thrust washer and rear face of transmission case.

If a different washer thickness is required to bring end

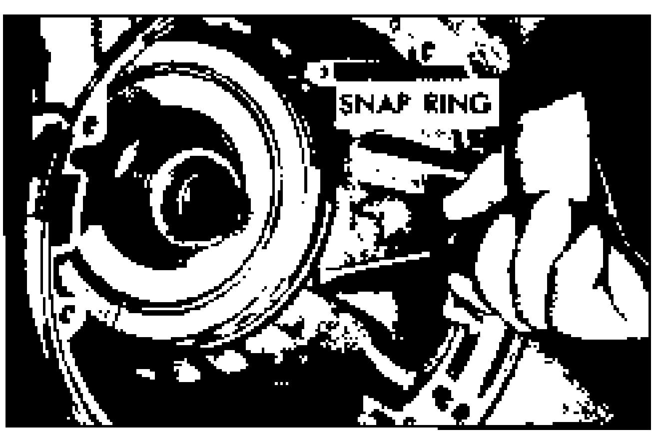


Fig. 7E-155 Installing Center Support to Case Snap Ring

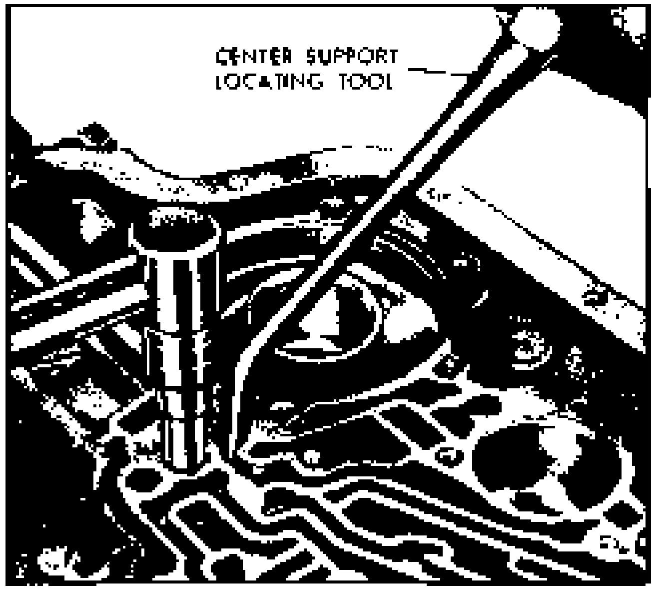


Fig. 7E-156 Installing Center Support Bolt

play within specifications, it can be selected from the following chart.

THICKNESS	NOTCHES	▲ AND/OR STAMPED NO.
.074—.078	None	1
.082—.086	1 Tab Side	2
.090—.094	2 Tab Side	3
.098—.102	1 Tab O.D.	4
.106—.110	2 Tabs O.D.	5
.114—.118	3 Tabs O.D.	6

15. Install front band with anchor hole placed over band anchor pin and apply lug facing servo hole (Fig. 7E-159).

16. Install manual linkage as follows:

a. If necessary, install a new manual shaft seal into

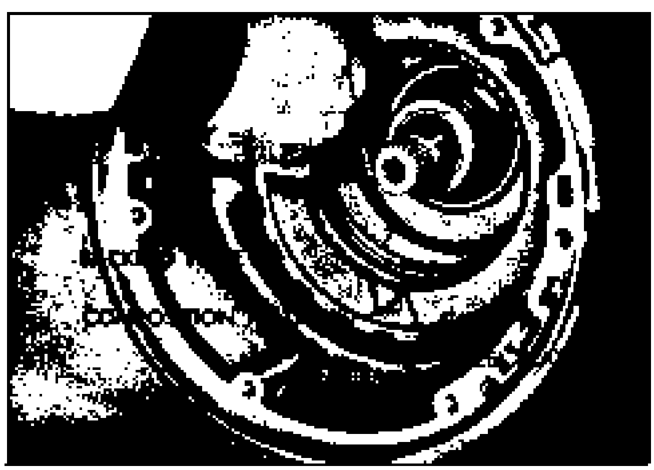


Fig. 7E-157 Installing Intermediate Backing Plate and Clutch Plates

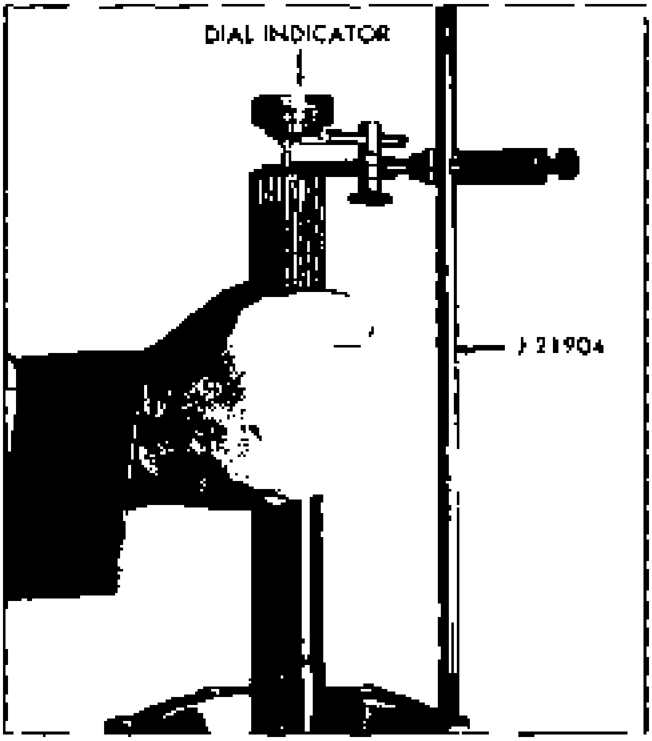


Fig. 7E-158 Checking Rear Unit End Play

transmission case, using a 3/4" dia. rod to seat the seal.

b. If removed, insert actuator rod into manual detent lever from side opposite pin.

c. Install actuator rod plunger under parking bracket and over parking pawl (Fig. 7E-160).

d. Install manual shaft through case and detent lever.

e. Install detent retaining hex lock nut on manual shaft and tighten to 20 lb. ft. (Fig. 7E-161).

f. Install retaining pin, indexing with groove in manual shaft. Rotate transmission to vertical position and remove J 21795.

17. Install direct clutch and intermediate sprag assem-

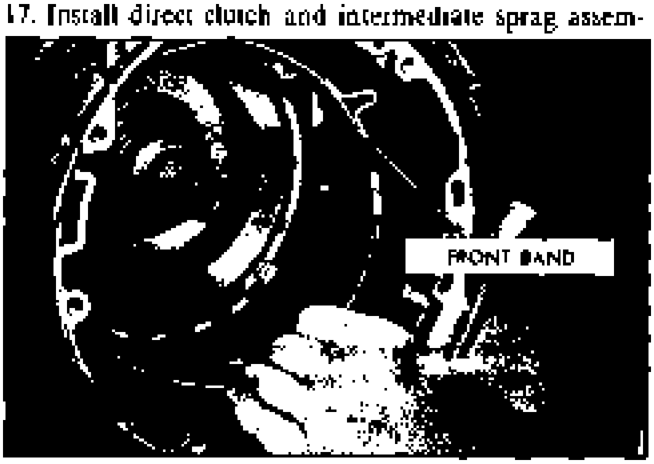


Fig. 7E-159 Installing Front Band

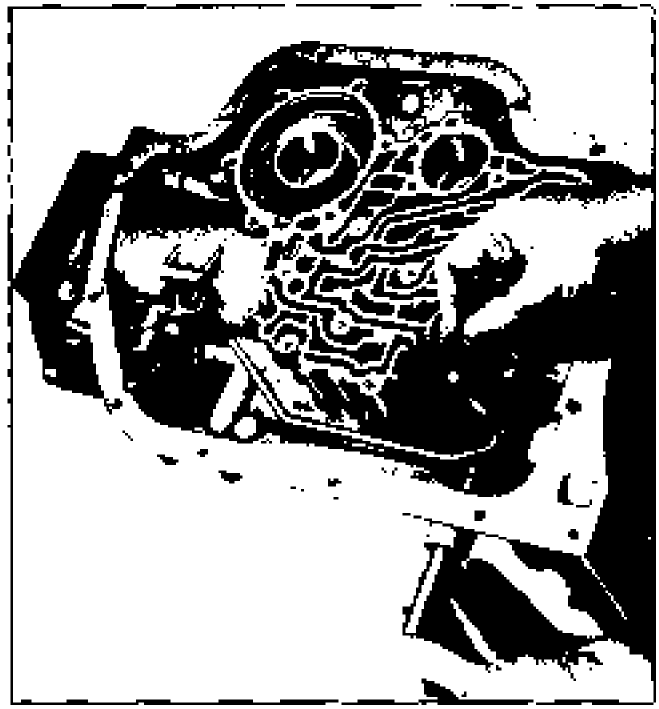


Fig. 7E-160 Installing Manual Shaft to Case

bly. It will be necessary to twist housing to allow sprag outer race to index with composition clutch plates. Housing hub will bottom on sun gear shaft (Fig. 7E-162).

NOTE: Removal of direct clutch composition and steel plates may be helpful.

18. Install forward clutch hub to direct clutch housing thrust washer on forward clutch hub. Retain with petrolatum.

19. Install forward clutch and turbine shaft, indexing direct clutch hub so end of mainshaft will bottom on end of forward clutch hub. When forward clutch is

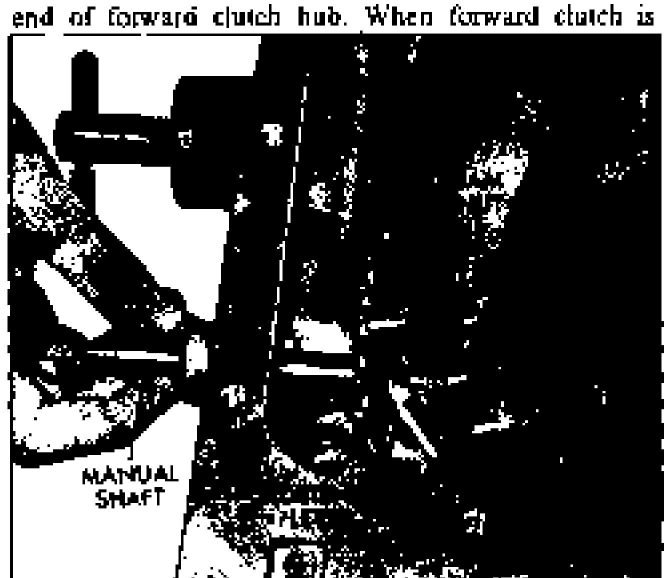


Fig. 7E-161 Installing Detent Lever and Jam Nut to Manual Shaft

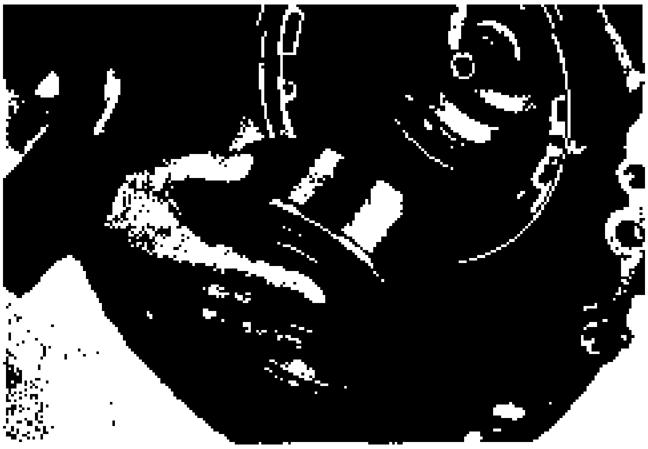


Fig 7E-162 Installing Direct Clutch Assembly

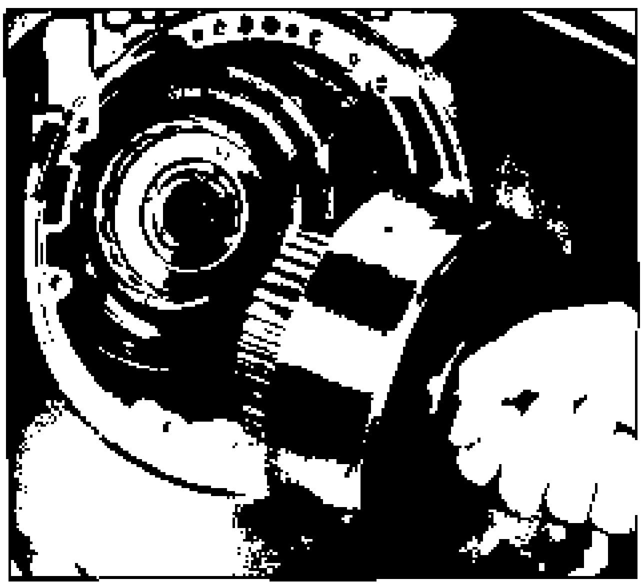


Fig. 7E-163 Installing Forward Clutch and Turbine Shaft

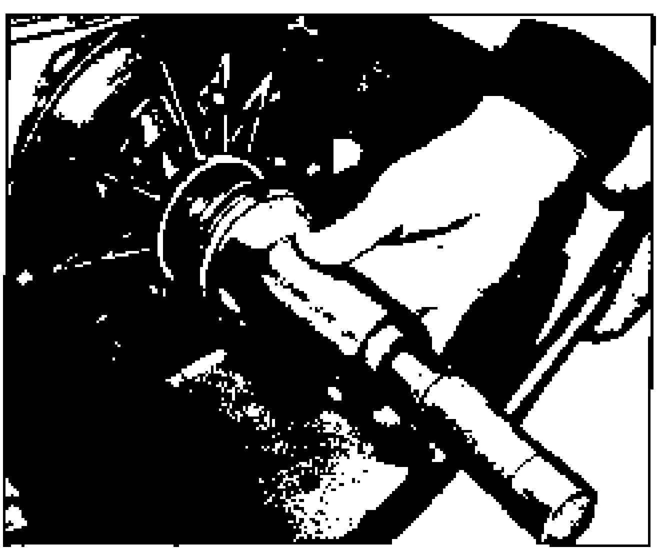


Fig. 7E-164 Installing Pump Seal

Fig. 7E-165 Checking Front Unit End Play

seated, it will be 1 1/4" from pump face in case (Fig. 7E-163).

20. Install gasket and front pump.

21. Install all but one pump attaching bolt and seal. Torque to 18 lb. ft.

NOTE: If turbine shaft can not be rotated as pump is being pulled into place, forward or direct clutch housing has not been properly installed in index with all clutch plates. This condition must be corrected before pump is pulled fully into place

22. If necessary, install a new front seal, using Tool J 21359 to drive seal in place (Fig. 7E-164).

23. Check front unit end play as follows (Fig. 7E-165):

a. Install a 5/16"-18 threaded slide hammer or J 6125 into bolt hole in pump.

b. Mount a dial indicator on rod and index indicator to register with end of turbine shaft.

c. Push turbine shaft rearward.

d. Push output shaft forward.

e. Set dial indicator to zero.

f. Pull turbine shaft forward.

Read resulting travel or end play - should be .003" to .024". Selective washer controlling this end play washer located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the cahrt below:

NOTE: An oil soaked washer may tend to discolor. It will be necessary to measure washer for its actual thickness.

24. Install remaining front pump attaching bolt and seal. Torque 18 lb. ft.

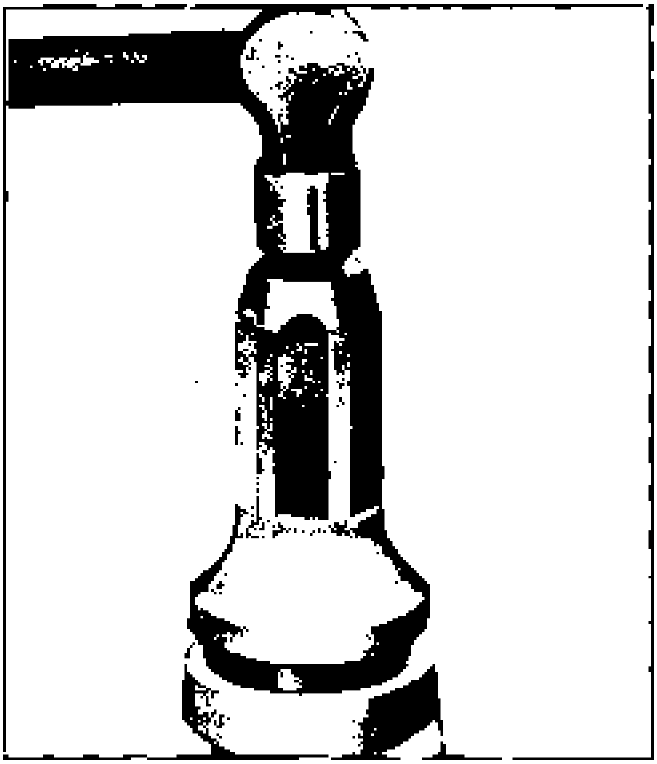


Fig. 7E-166 Installing Rear Extension Seal

REAR EXTENSION HOUSING ASSEMBLY

1. Install extension housing to case gasket on extension housing.

2. Attach extension housing to case, using attaching bolts. Torque bolts to 22 lb. ft.

3. If necessary, install new seal with Tool J 21359 (Fig. 7E-166).

INSTALLATION OF CHECK BALLS, FRONT SERVO, GASKETS, SPACER AND SOLENOID

1. Install front servo spring and retainer into transmission case.

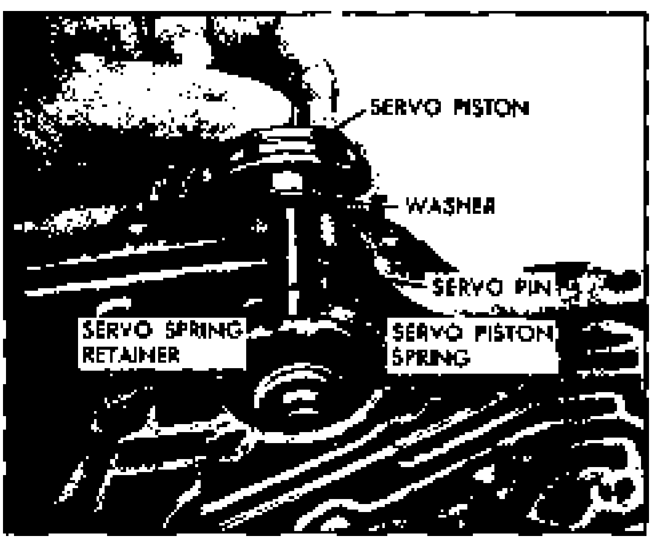


Fig. 7E-167 Installing Front Servo Piston, Washer and Pin

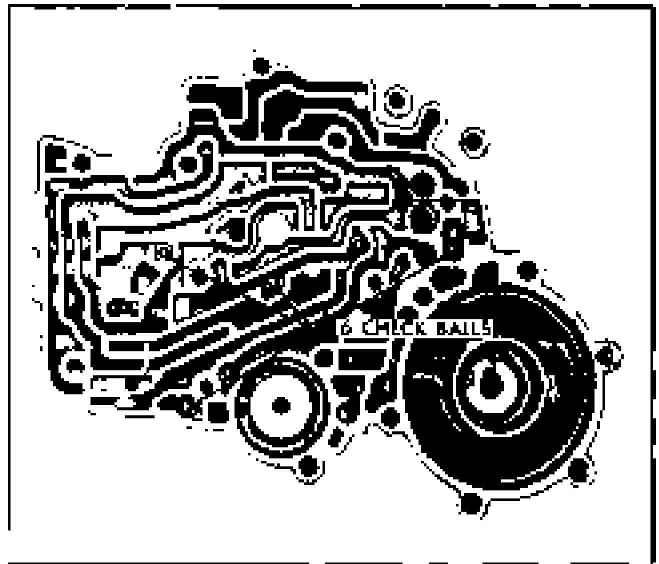


Fig. 7E-168 Location of Check Balls

2. Install flat washer on front servo pin, on end opposite taper.

3. Install pin and washer into case so that taper end is contacting band.

4. Install oil seal ring on front servo piston, if removed, and install on apply pin so that identification numbers on shoulders are exposed (Fig. 7E-167).

5. Check freeness of piston by stroking piston in bore.

6. Install six (6) check balls into transmission on case pockets (Fig. 7E-168).

7. Install valve body spacer to case gasket (gasket with extension for solenoid) (Fig. 7E-169).

8. Install valve body to case spacer plate.

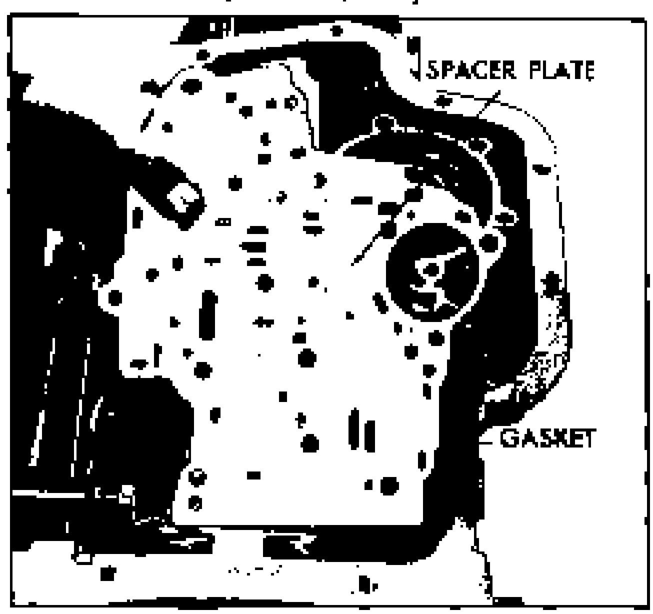


Fig. 7E-169 Installing Control Valve Spacer Plate and Gasket

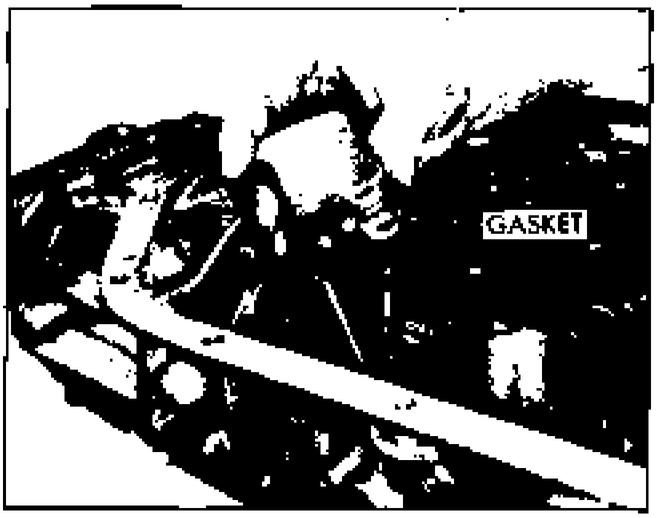


Fig. 7E-170 Installing Detent Solenoid and Gasket

9. Install detent solenoid and gasket, with connector facing outer edge of case (Fig. 7E-170).

NOTE: Do not tighten bolts at this time.

10. Install O-ring seal on solenoid connector.

11. Lubricate and install case connector with lock tabs facing into case, positioning locator tab in notch on side of case (Fig. 7E-171)

12. Install detent connector into case sleeve connector.

INSTALLATION OF REAR SERVO ASSEMBLY

NOTE: Before installing rear servo, check band apply pin, using Tools J 21370-5 and 6 as follows (Fig. 7E 170):

a. Attach Band Apply Pin Selection Gage J 21370-6 and J 21370-5 to transmission case (lever pivot pin to rear), with rear servo cover attaching screws.

Fig. 7E-171 Installing Case Connector Sleeve and O-Ring Seal

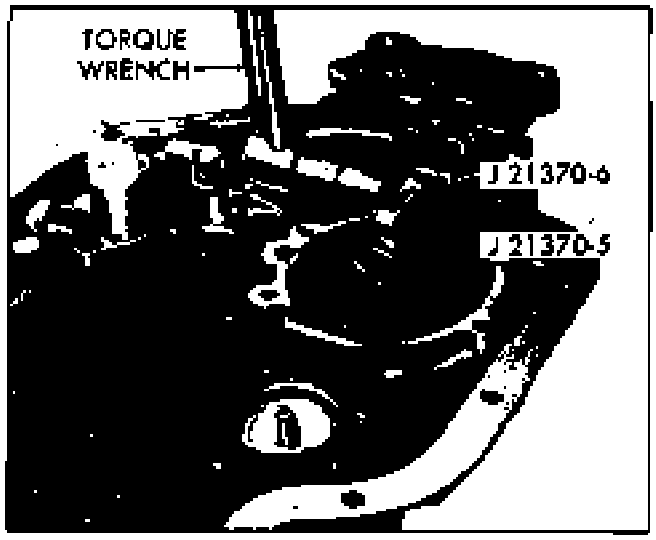


Fig. 7E-172 Checking Rear Band Pin

NOTE: Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws to 15 ft. lbs. and recheck pin to make certain it does not bind.

b. Apply 25 lb. ft. torque and select proper servo pin to be used from scale on tool

c. Remove tool and make note of proper pin to be used during assembly of transmission

There are three selective pins identified as follows:

a. If both steps are below the gage surface, the long pin, identified by 3 rings, should be used.

b. If the gage surface is between the steps, the medium pin, identified by 2 rings, should be used.

c. If both steps are above the gage surface, the short pin, identified by 1 ring, should be used

Identification ring is located on band lug end of pin. Selecting proper pin is equivalent to adjusting band.

1. Install rear accumulator spring into case (Fig. 7E 173).

2. Lubricate and install rear servo assembly into case (Fig. 7E-174).

3. Install rear servo gasket and cover (Fig. 7E-175).

4. Install attaching screws. Torque bolts to 18 lb. ft.

INSTALLATION OF CONTROL VALVE ASSEMBLY AND GOVERNOR PIPES

1. Install control valve to spacer gasket (Fig. 7E-176).

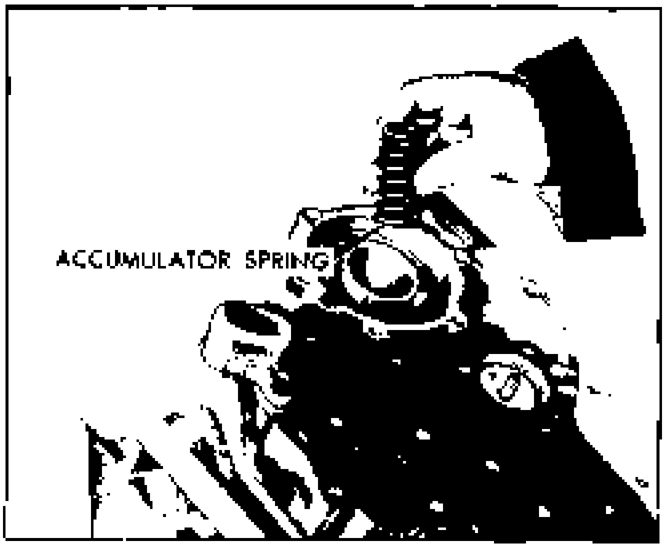


Fig. 7E-173 Installing Rear Accumulator Spring

2. Install governor pipes into valve body.

3. Install two guide pins (control valve assembly attaching screws with heads removed) (Fig. 7E-177)

4. Install control valve and governor pipes to transmission.

NOTE: Be sure manual valve is properly indexed with pin on manual detent lever and governor pipes are properly installed in case.

5. Install control valve assembly attaching bolts and detent roller and spring assembly (Fig. 7E-178).

6. Tighten detent solenoid and control valve attaching bolts. Torque valve body bolts to 8 lb. ft and solenoid bolts to 8 lb. ft.

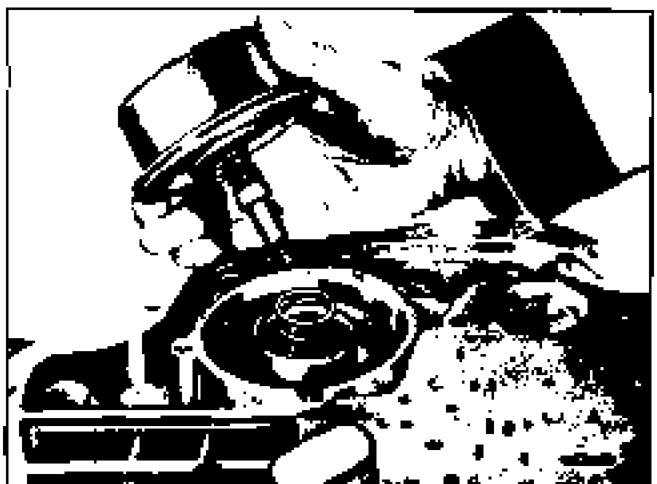


Fig. 7E-174 Installing Rear Servo

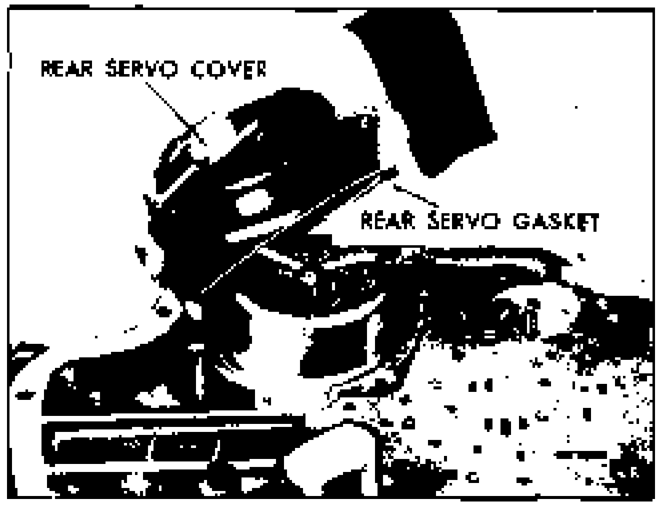


Fig. 7E-175 Installing Rear Servo Cover and Gasket

INSTALLATION OF STRAINER AND INTAKE PIPE

1. Install case to intake pipe O-ring seal on intake pipe and assemble new strainer to intake pipe (Fig. 7E-16)

2. Install strainer and intake pipe assembly, attaching strainer to control valve assembly with the retainer bolt (Fig. 7E-15)

NOTE: After any major repair, the strainer must be replaced and oil cooler and cooler lines must be flushed.

3. Install new bottom pan gasket and bottom pan with attaching screws. Torque to 12 lb. ft

INSTALLATION OF MODULATOR VALVE AND VACUUM MODULATOR

1. Install modulator valve into case, stem end out

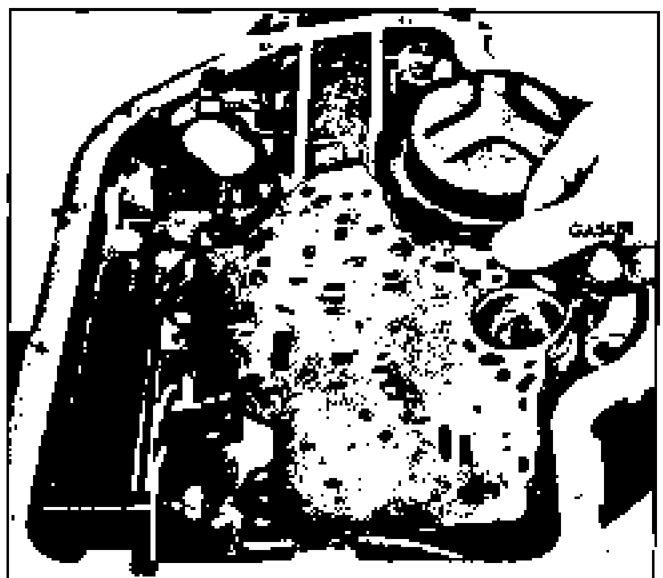


Fig. 7E-176 Installing Control Valve to Spacer Gasket

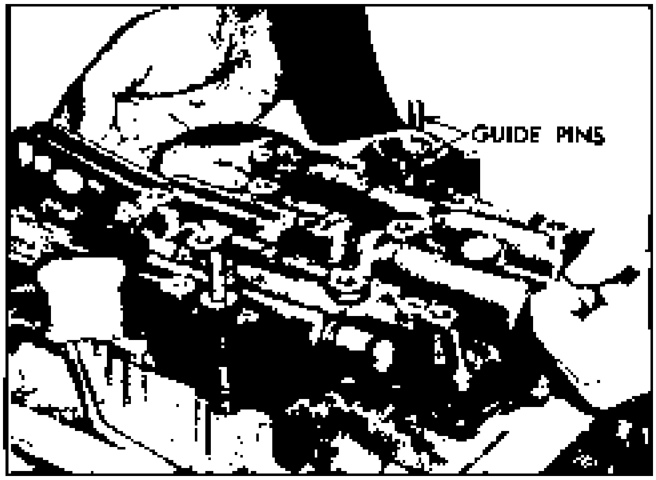


Fig. 7E-177 Installing Control Valve Assembly and Governor Pipes

2. Install O-ring seal on vacuum modulator.

3. Install vacuum modulator into case (Fig. 7E-179).

4. Install modulator retainer and attaching bolt. Torque bolt to 18 lb. ft.

INSTALLATION OF GOVERNOR

1. Install governor into case (Fig. 7E-180).

2. Attach governor cover and new gasket with four (4) attaching bolts. Torque bolts to 18 lb. ft.

INSTALLATION OF SPEEDOMETER DRIVEN GEAR

1. Install speedometer driven gear (Fig. 7E-181). 2.

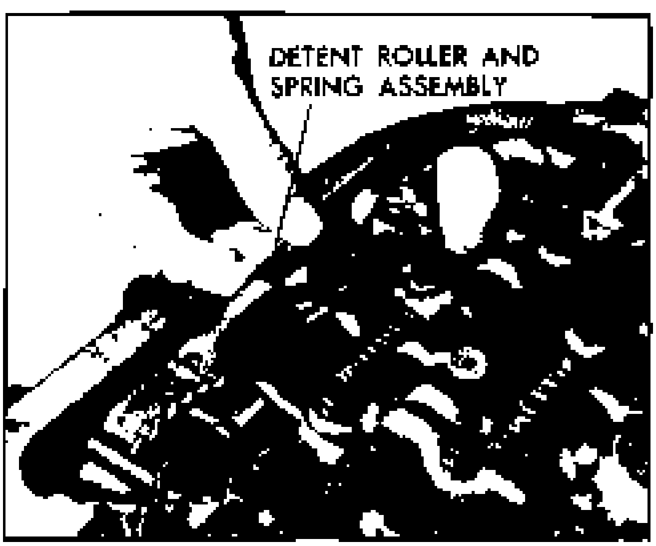


Fig. 7E-178 Installing Detent Roller and Spring Assembly

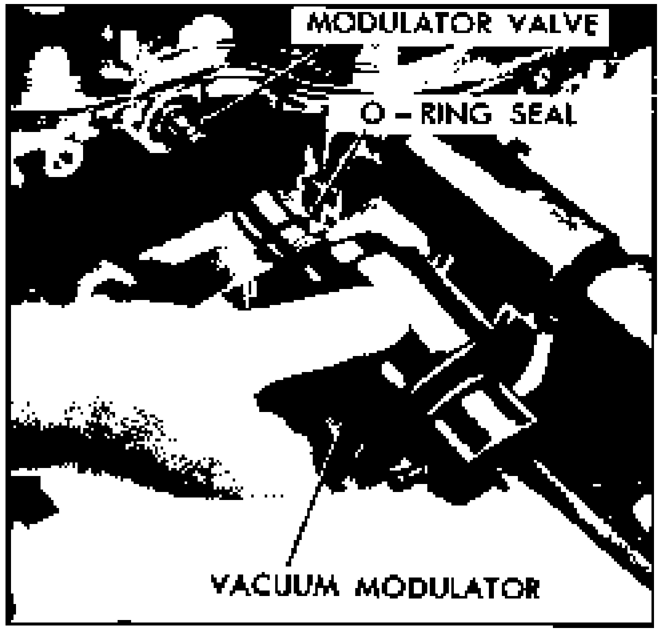


Fig. 7E-179 Installing Vacuum Modulator and Valve

Install speedometer driven gear retainer and attaching bolt.

INSTALLATION OF CONVERTER ASSEMBLY

With the transmission in cradle or portable jack, install the converter assembly into the pump assembly, making certain that the converter hub drive slots are fully engaged with the pump drive gear tangs and the converter installed fully towards the rear of the transmission.

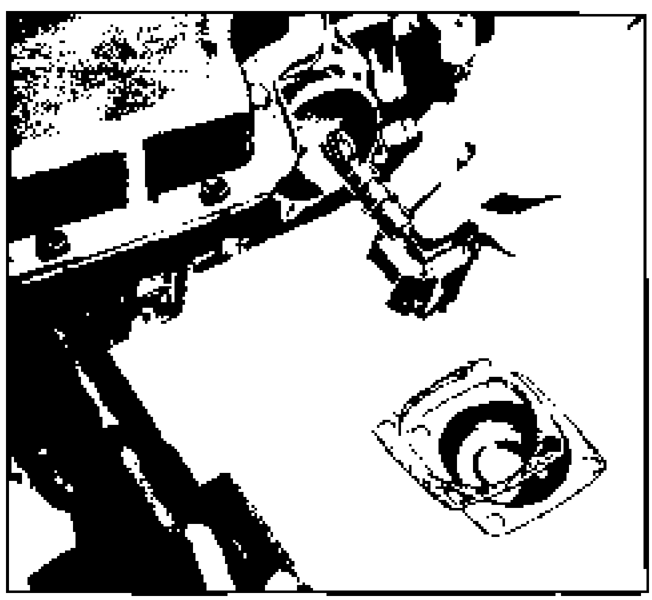


Fig. 7E-180 Installing Governor

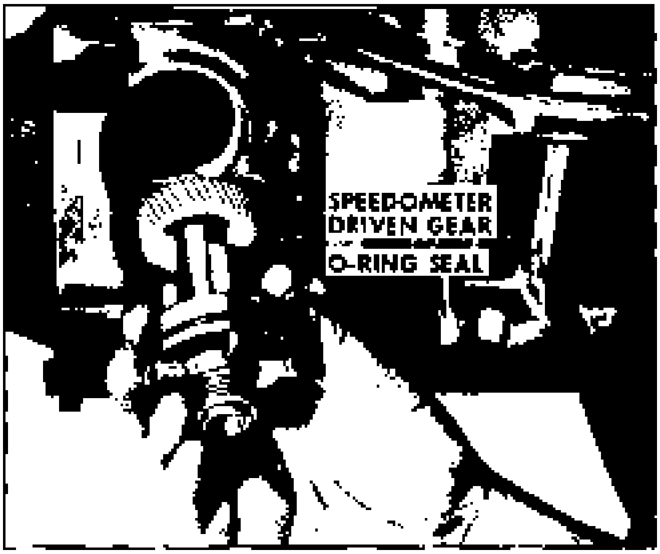


Fig 7E-181 Installing Speedometer Drive Gear and Sleeve

INSTALLATION OF TRANSMISSION ASSEMBLY

Reverse the procedure for transmission removal as stated on page 7E-12

MANUAL LINKAGE

Manual linkage adjustment and the associated neutral safety switch are important from a safety stand point. The neutral safety switch should be adjusted so that the engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage and prevent the vehicle from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

ROAD TEST (ATTACH PRESSURE GAUGE TO TRANSMISSION)

The car owner should accompany the tester and the complaint analyzed under the same or simulated conditions.

SHIFT PATTERN CHECK

Check all the shifts in the following manner:

Drive Range:

Position selector lever in Drive Range, accelerating the vehicle from 0 mph. A 1-2 and 2-3 shift should occur at all throttle openings. The shift points will vary with the throttle opening. As the vehicle decreases in speed to 0 mph, the 3-2 and 2-1 shifts should occur.

Super Range:

Position the selector lever in Super Range and accelerate the vehicle from 0 mph. A 1-2 shift should occur at all throttle openings. No 2-3 shift can be obtained in this range. The 1-2 shift point will vary with throttle opening. As the vehicle decreases in speed to 0 mph, a 2-1 shift should occur.

Lo Range:

Position the selector lever in Lo Range. No upshift should occur in this range, regardless of throttle opening.

2nd Gear Overrun Braking:

Position the selector lever in the drive Range and, with the car speed at approximately 35 mph, move the selector lever to Super Range. The transmission should downshift to 2nd. An increase in engine rpm and an engine braking effect should be noticed. Line pressure should change from 60 psi to approximately 150 psi in 2nd

1st Gear - Downhill or Overrun Braking:

With the selector lever in Super at approximately 30 mph at constand throttle, reposition the selector lever into Lo Range. An increase in engine rpm and a braking effect should be noticed. Line pressure should be approximately 150 psi (Figs. 180 and 181).

TURBO HYDRA-MATIC TRANSMISSION-OIL PRESSURE CHECKS

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 shown in Fig. 7E-182.

2. Oil Pressure Check — With Car Stationary and Engine at 1200 rpm

With the transmission oil pressure gage attached and the vacuum modulator tube disconnected , the transmission pressures should check approximately as shown in Fig. 7E-183.

3. Oil Pressure Check — With Car Stationary and Engine at 1000 rpm

With the transmission oil pressure gage attached and

Super Range		Minimum	Maximum
2nd Gear - Steady road load at approximately 25 mph		145 psi	155 psi
Gear	**Selector Lever Position**	**Minimum**	**Maximum**
1st 2nd 3rd	Drive ("Zero" throttle to full throttle)	60	150
3rd	Drive Range, Zero Throttle at 30 mph	60	
Reverse	Rev. (Zero to full throttle)	95	260

Fig. 7E-182 Oil Pressure Check - Road or Normal Operating Conditions

Approximate Altitude (Ft. above sea level)	D,N,P	S or L	R
0	150	150	244
2,000	150	150	233
4,000	145	150	222
6,000	138	150	212
8,000	132	150	203
10,000	126	150	194
12,000	121	150	186
14,000	116	150	178

Fig. 7E-183 Oil Pressure Check - Car Stationary, Vacuum Tube Disconnected

Drive, Neutral, Park	Super or Lo	Reverse
60	150	107

Fig. 7E-184 Oil Pressure Check - Car Stationary, Vacuum Tube Connected the vacuum modulator tube connected for normal modulator operation, the transmission pressures should check approximately as shown in Fig. 7E-184.

NOTE: Pressures are not significantly affected by altitude or barometric pressure when the vacuum modulator tube is connected.

OIL LEAKS

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to wind flow around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a black light to identify the oil at the source of leak is also helpful. Comparing the oil from the leak to that on the engine or transmission dipstick (when viewed by black light) will determine the source of the leak.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission oil filler tube to case leak will sometimes appear as a leak at the rear of the transmission. In determining the source of an oil leak, it is most helpful to keep the engine running.

POSSIBLE POINTS OF OIL LEAKS

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. REAR EXTENSION LEAK

a. Attaching bolts not correctly torqued.

b. Rear seal assembly - damaged or imporperly installed.

c. Extension to case gasket-damaged or improperly installed.

d. Porous casting.*

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 O-ring seal-damaged or improperly installed.

c. Governor cover, gasket and bolts-damaged, loose; case face leak.

d. Speedo gear O-ring damaged.

e. Manual shaft seal-damaged, improperly installed.

f. Line pressure tap plug-stripped, shy sealer compound.

g. Parking pawl shaft cup plug-damaged, improperly installed.

h. Vent pipe (refer to item 5).

i. Porous case.*

4. FRONT END LEAK

a. Front seal - damaged (check converter neck for nicks, etc., also for pump bushing moved forward); garter spring missing from pump to converter hub seal.

b. Pump attaching bolts and seals-damaged, missing, bolts loose.

c. Converter-leak in weld.

d. Pump O-ring seal-damaged. Also check pump groove and case bore.

e. Porous casting (pump or case).*

5. OIL COMES OUT VENT PIPE

a. Transmission over-filled.

b. Water in oil.

c. Pump to case gasket mispositioned.

d. Foreign material between pump and case, or between pump cover and body.

e. Case-porous, pump face improperly machined.*

f. Pump-shy of stock on mounting faces, porous casting, breather hole plugged in pump cover.

g. Incorrect dipstick.

h. Cut O-ring or grommet on strainer.

*CASE POROSITY REPAIR

Turbo Hydra-Matic transmission leaks caused by case porosity (not cracks) may be repaired with the transmission in the car by using epoxy cement and following this recommended procedure:

1. Road test car to bring transmission fluid to operating temperature, approximately 180°.

2. Raise car on hoist or jack stand, engine running with rear wheels free to turn, and locate source of oil leak. Check for leaks with transmission in "LOW" and "SUPER" ranges.

NOTE: Use of a mirror is helpful in locating leaks.

3. Shut engine off and thoroughly clean area to be repaired with cleaning solvent and a brush, then air dry.

NOTE: A clean, dry soldering acid brush may be used to clean the area and also to apply the epoxy cement.

4. Following the instructions of the manufacturer, mix a sufficient amount of epoxy cement, Part No. 1360016 (Z), Grp. No. 0.423, or equivalent, to make the repair.

NOTE: Observe manufacturer's cautions in handling.

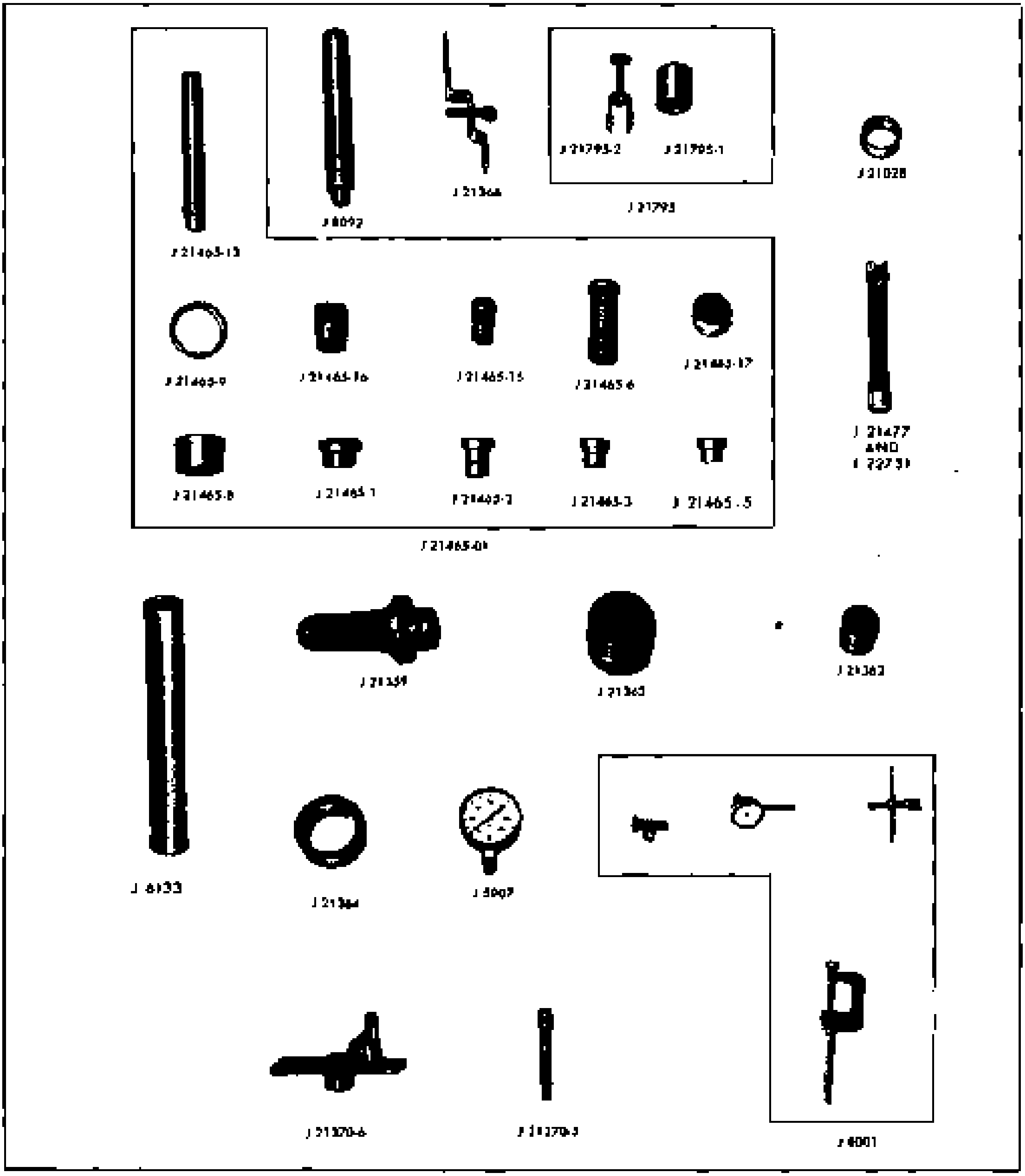
5. While transmission case is still hot, apply epoxy cement to the area to be repaired. Be sure the area to be repaired is completely covered.

6. If 1360016 (Z) epoxy is used, allow THREE (3) hours to cure before starting engine.

7. Road test car to bring transmission fluid to operating temperature of 180° and re-check transmission for leaks.

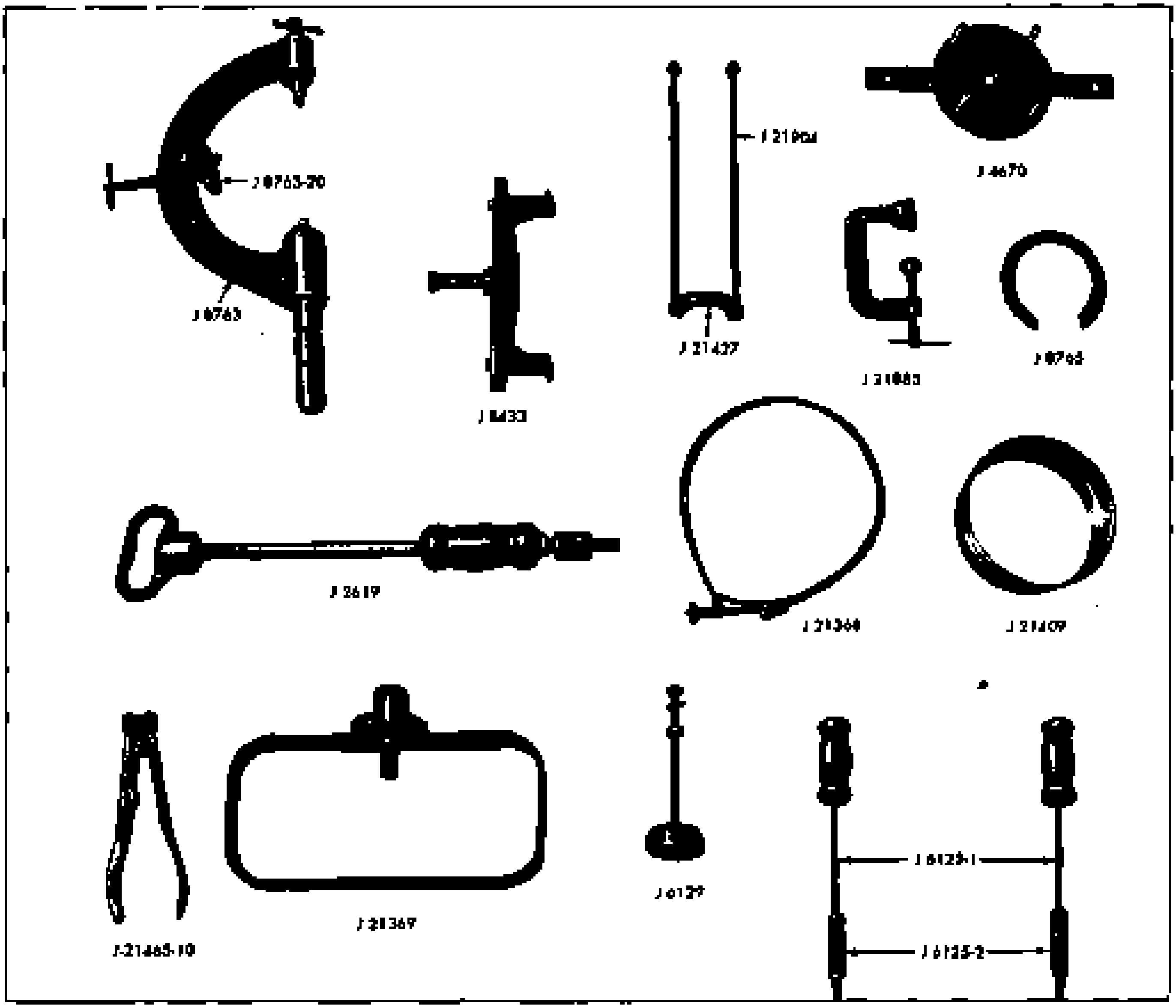
TORQUE SPECIFICATIONS

	LB. FT.
Pump Cover Bolts	18
Parking Pawl Bracket Bolts	18
Case Center Support Bolt	22
Pump to Case Attaching Bolts	18
Extension Housing to Case Attaching Bolts	22
Rear Servo Cover Bolts	18
Detent Solenoid Bolts	8
Control Valve Body Bolts	8
Bottom Pan Attaching Screws	12
Modulator Retainer Bolt	18
Governor Cover Bolts	18
Manual Lever to Manual Shaft Nut	20
Linkage Swivel Clamp Nut (Firebird)	30
Linkage Swivel Clamp Screw (Except Firebird)	20
Transmission to Engine Mounting Bolts	40
Rear Mount to Transmission Bolts	40
Rear Mount to Crossmember Bolt (Pontiac and Firebird)	40
Rear Mount to Crossmember Bolt (Tempest and Grand Prix)	55
Crossmember Mounting Bolts (Tempest and Grand Prix)	30
Crossmember Mounting Bolts (Pontiac)	18
Oil Cooler Line	16
Strainer Retainer Bolt	10



J 5907 Pressure Gage
J 6133 Speedo Gear Installer
J 6198 Rear Planet Carrier Bushing Installer
J 8001 Dial Indicator Set
J 8092 Driver Handle
J 21028 Speedo Gear Installer Spacer
J 21359 Pump Oil Seal Installer
J 21362 Seal Protector—Forward and Direct Clutch—Inner
J 21363 Seal Protector—Immediate Clutch—Inner
J 21364 Rear Unit Holding Fixture Adapter
J 21366 Converter Holding Clamp
J 21370-5 Rear Band Apply Pin
J 21370-6 Rear Band Apply Fixture
J 21465-01 Bushing Tool Set
J 21477 Oil Cooler Pipe Wrench—Pontiac Only
J 21795 Gear Unit Assembly Holding Tool
J 22731 Oil Cooler Pipe Wrench—Tempest and Firebird

Fig. 7E-185 Special Tools



J 2619	Slide Hammer
J 4670	Clutch Spring Compressor
J 6125-1	Slide Hammer
J 6125-2	Adapter
J 6129	Clutch Spring Compressor
J 8400-1	Chisel (Not Shown)
J 8433	Speedo Gear Remover
J 8763	Holding Fixture
J 8763-20	Holding Fixture Adapter
J 8765	Clutch Spring Compressor Adapter Ring
J 21368	Pump Body and Cover Alignment Strap
J 21369	Converter Pressure Check Fixture
J 21409	Forward Clutch Outer Seal Protector
J 21427	Speedo Gear Remover
J 21465-10	Staking Tool
J 21885	Accumulator Piston Installer
J 21904	Speedo Gear Remover Bolts

Fig. 7E-186 Special Tools

TWO-SPEED AUTOMATIC TRANSMISSION

CONTENTS OF THIS SECTION

TRANSMISSION IDENTIFICATION

The identification data is located on the right side of the transmission (Fig. 7F-2). The transmission model, model year and the assembly date code appear on the low servo cover. Whenever the servo cover is replaced, it will be necessary to stamp all of the above information on the new cover. Model numbers are as follows:

LA L-6 1-Bbl. - Tempest LD L-6 1-Bbl. - Tempest with A/C LF L-6 1-Bbl. - Firebird LH L-6 1-Bbl. - Firebird with A/C MA 350 2-Bbl. - Tempest & Firebird MC 350 2-Bbl. - Tempest & Firebird with A/C The car serial number is stamped on the left side of all 1969 Tempest and Firebird transmissions (Fig. 7F-1).

It is very important that any communication concerning a transmission contains all information from the low servo cover and that all transmission parts returned to Pontiac Motor Division be tagged with this information.

ADJUSTMENTS WITH TRANSMISSION IN CAR

NEUTRALIZER SWITCH ADJUSTMENT

Refer to CHASSIS ELECTRICAL SERVICE, Section 12.

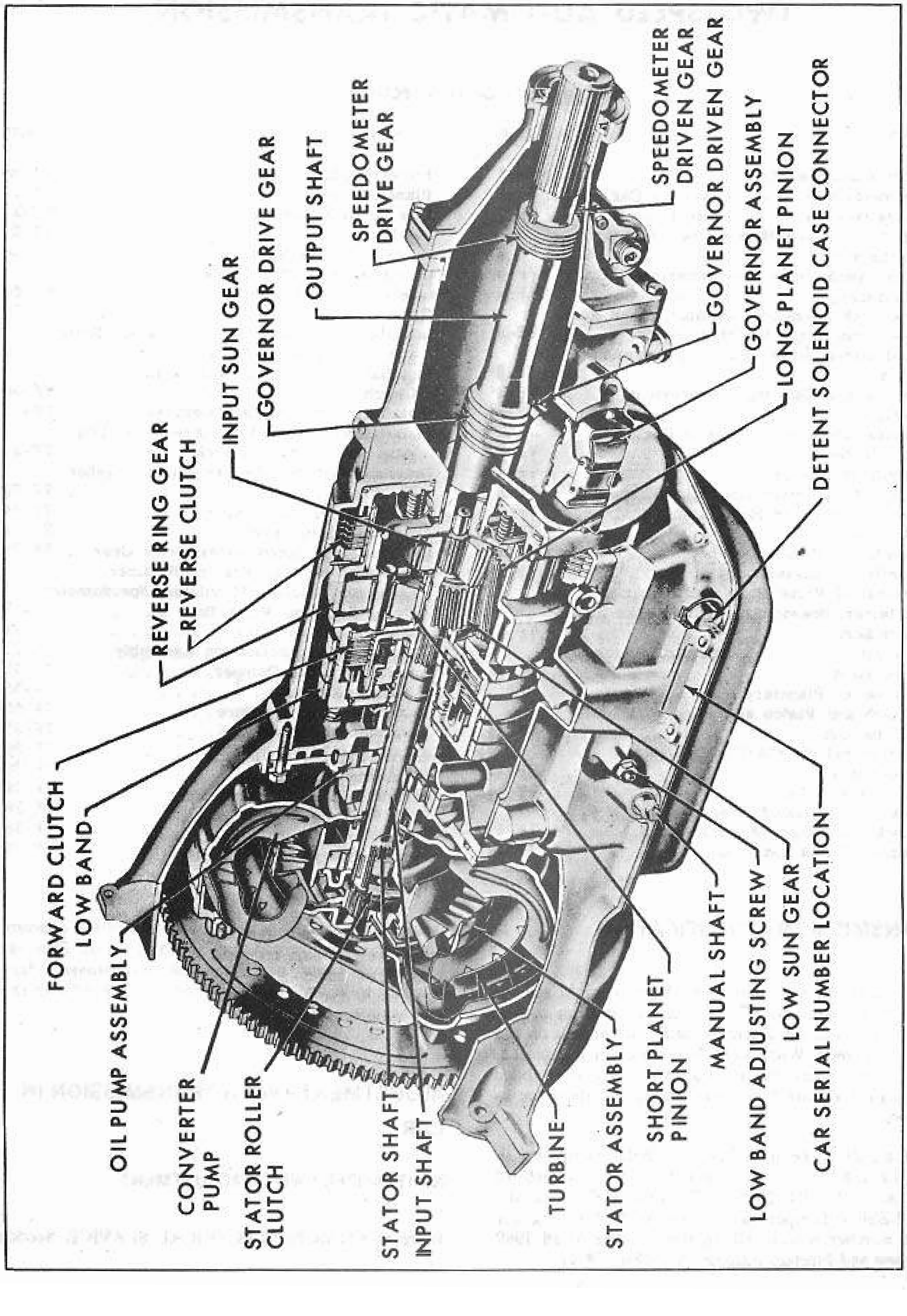


Fig. 7F-1 Cross Section of Two Speed Automatic Transmission

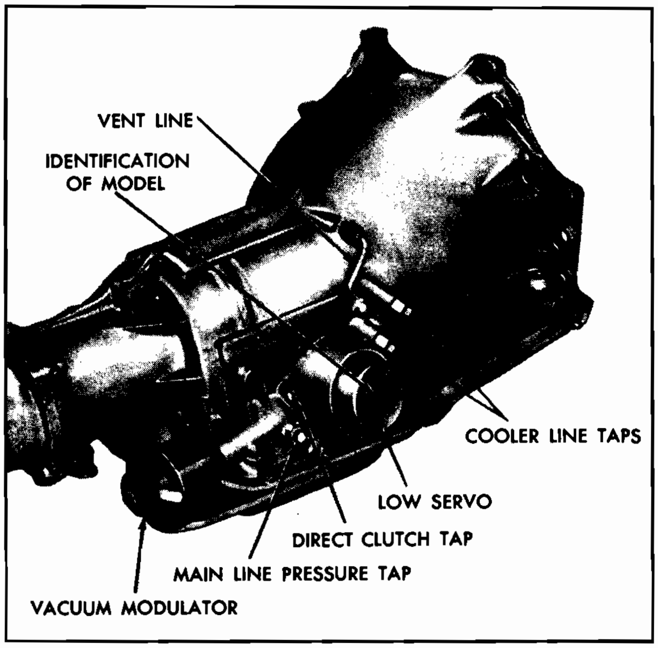


Fig. 7F-2 Transmission Model Identification

SHIFT CONTROL AND BACK DRIVE LINKAGE ADJUSTMENT

COLUMN SHIFT CONTROLS (Figs. 7F-3 and 7F-4)

1. Loosen screw (nut - Firebird) on adjusting swivel clamp.

2. Set transmission range selector lever in PARK detent.

NOTE: Obtain PARK position by rotating transmission range selector lever clockwise (View A).

3. Set upper gearshift lever in PARK position and lock ignition.

4. Push up on gearshift control rod to take up clearance in steering column lock mechanism and tighten screw on adjusting swivel clamp to 20 lb. ft. (Tempest); tighten nut on adjusting swivel clamp to 30 lb. ft. (Firebird).

CONSOLE SHIFT CONTROLS (Figs. 7F-5 and 7F-6)

1. Disconnect shift cable from transmission range selector lever pin.

2. Set console gearshift lever in PARK position and lock ignition.

3. Rotate transmission range selector lever clockwise to PARK position and adjust pin on selector lever to dimension shown in View A.

4. Torque selector pin nut to 30 lb. ft. and connect shift cable to pin.

SERVICE OPERATIONS - TRANSMISSION IN CAR

The 2-speed automatic transmission service operations, that can be performed while transmission is in car, are covered below:

SHIFT LINKAGE

If any components are worn or damaged so that replacement is necessary, refer to the Master Parts Catalog to determine which items are serviced separately and which are serviced in assembly.

PARK LOCK ACTUATOR ASSEMBLY, INNER PARK LOCK AND RANGE SELECTOR LEVER

REMOVAL

1. Drain oil and remove pan.

2. Remove oil strainer.

3. Remove park lock bracket and range selector shaft retainer.

4. Fully loosen nut that retains outer range selector lever to inner park lock and range selector lever.

5. Slide outer range selector lever out of case.

NOTE: Exercise care, when removing lever from case, so that nut doesn't drop down into gear train.

6. Remove inner park lock and range selector lever.

INSTALLATION

1. Installation is the reverse of removal.

SPEEDOMETER DRIVE GEAR, REAR BEARING RETAINER OIL SEAL OR BUSHING REPLACEMENT

Oil Seal

1. Remove propeller shaft (see Section 4C).

2. Pry out old seal (Fig. 7F-7).

3. Coat outer casing of new oil seal with gasket sealing compound and drive it into place with Installer J 5154 (Fig. 7F-8).

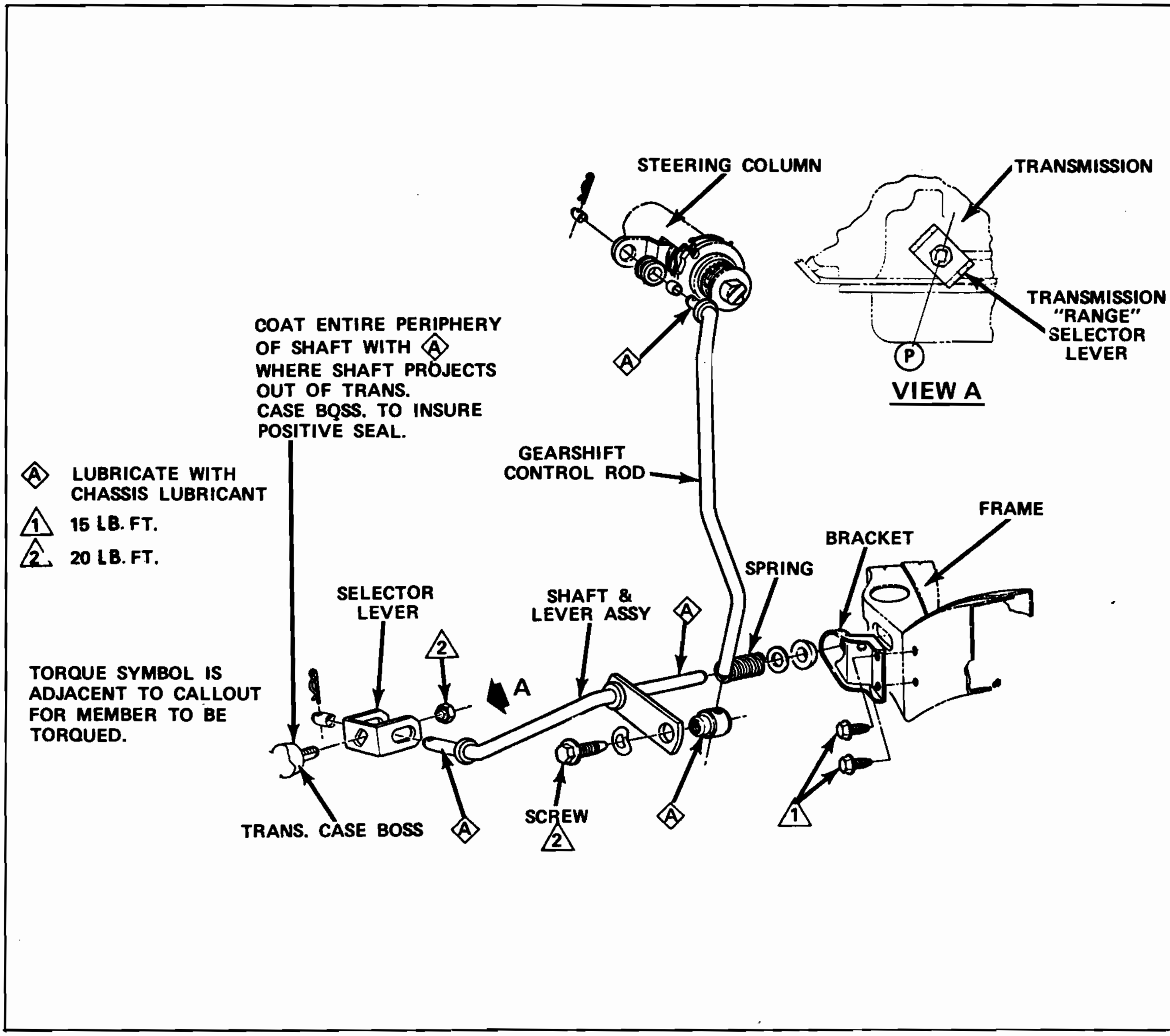


Fig. 7F-3 Tempest Column Shift Linkage

4. Install propeller shaft (see Section 4C).

Bushing and/or Drive Gear

1. Remove propeller shaft (see Section 4C).

2. Remove speedometer cable and speedometer driven gear assembly.

3. Remove rear bearing retainer.

4. If necessary, replace speedometer drive gear. Remove by depressing clip (Fig. 7F-17). Install new gear.

5. Pry out old oil seal.

6. Remove old case to rear bearing retainer oil seal.

7. Remove old rear bearing retainer bushing, using Bushing Chisel J 8400-1 or J 21424-9 with Drive Handle J 8092 (Fig. 7F-9).

8. Install new bushing from rear, using Installer J 21424-9 and Drive Handle J 8092 (Fig. 7F-10).

9. Coat outer casing of new oil seal with gasket sealing compound and drive it into place with Installer J 5154 (Fig. 7F-8).

10. Install new case to rear bearing retainer oil seal.

11. Install rear bearing retainer. Tighten bolts to 30 lb. ft. torque.

12. Install propeller shaft (see Section 4C).

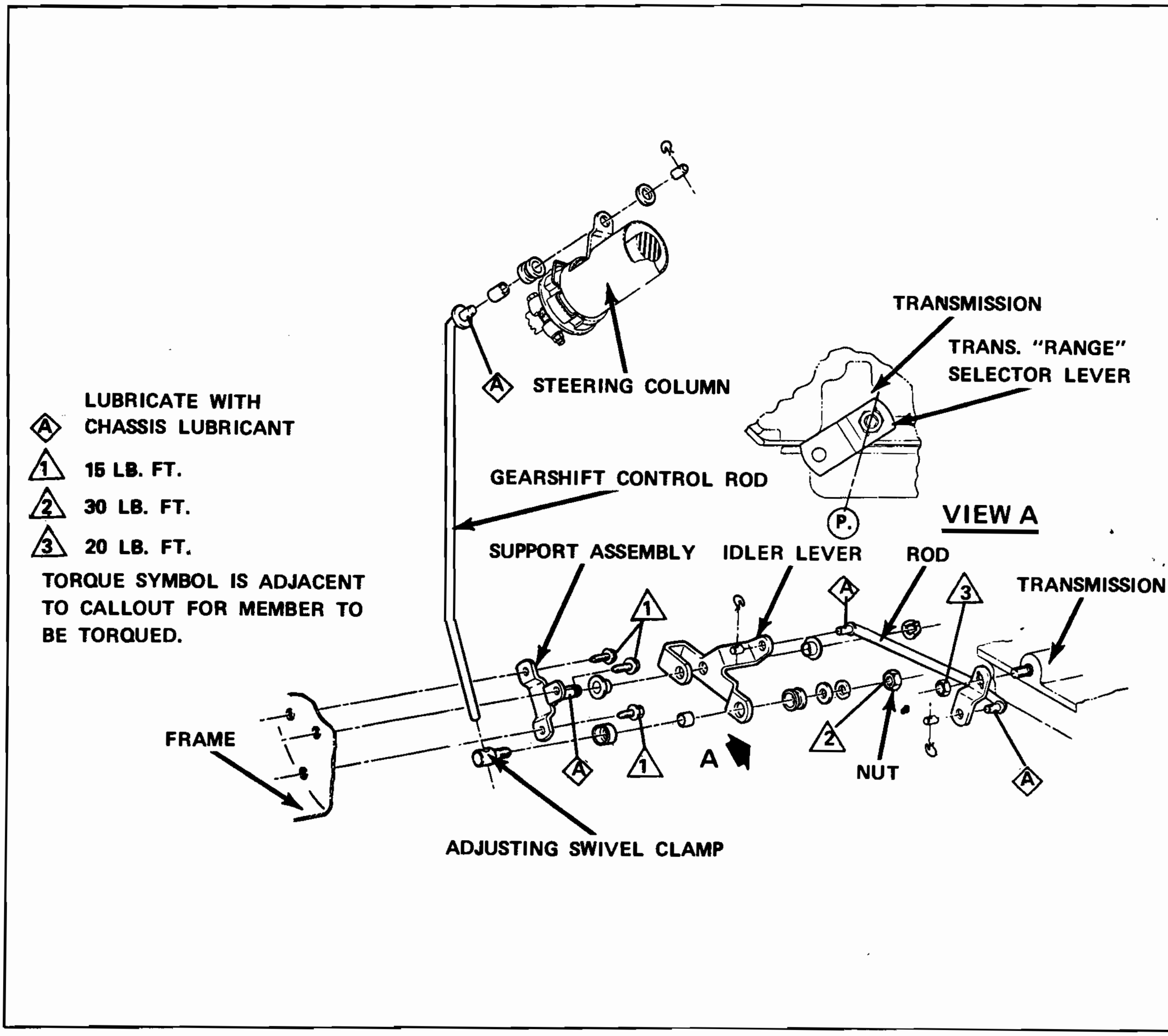


Fig. 7F-4 Firebird Column Shift Linkage

13. Install speedometer driven gear and connect cable.

GOVERNOR

REMOVAL

1. Remove three bolts retaining governor cover to case. Remove cover and gasket.

2. Pull governor out of case bore, allowing governor to twist as driven gear disengages from drive gear teeth machined into output shaft (Fig. 7F-11).

INSPECTION

Check for sticking governor valve, broken or missing governor weight springs, damaged driven gear or worn weight pins.

REMOVAL AND REPLACEMENT OF GOVERNOR DRIVEN GEAR

1. Support governor sleeve on wood block. Remove roll pin with a 1/8" drill rod (Fig. 7F-12).

CAUTION: If wood block is placed under nylon gear, breakage of gear inside governor sleeve will result. Exercise extreme care not to damage machine surfaces of governor sleeve.

2. Remove driven gear. Remove any chips or burrs from inside governor sleeve.

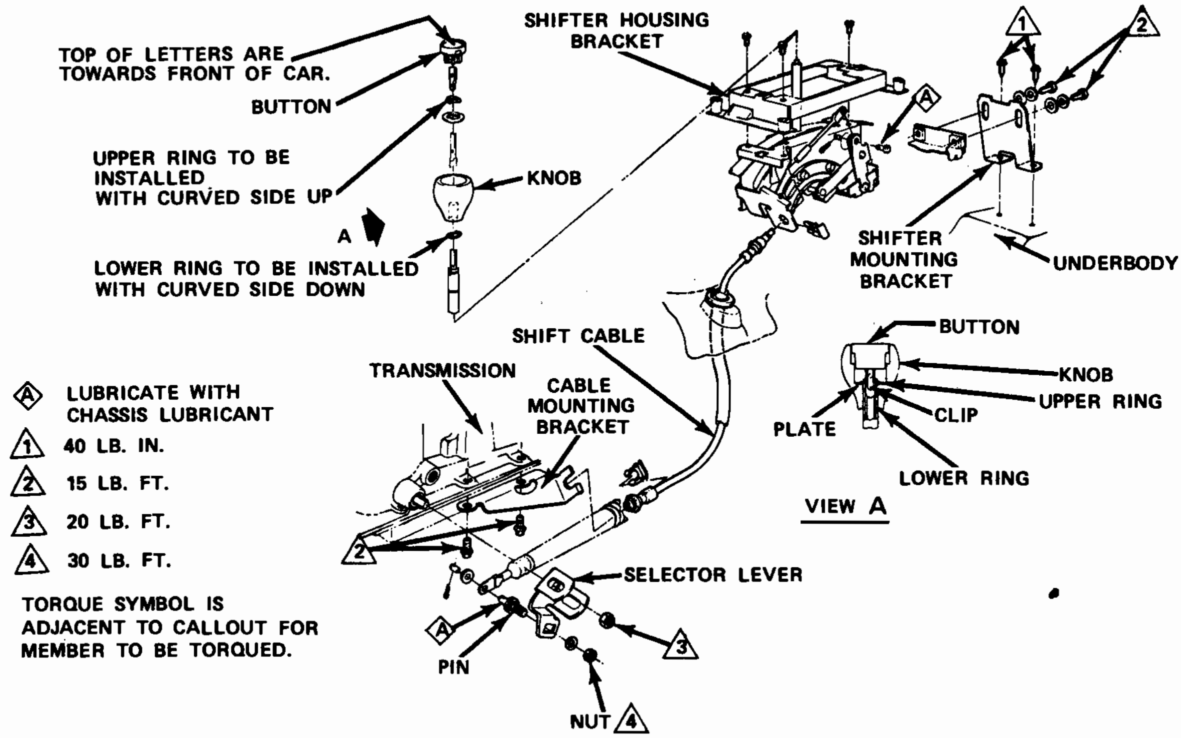


Fig. 7F-5 Tempest Console Shift Linkage

3. Install replacement gear by carefully pressing new gear into sleeve as follows:

a. Use Press Plate J 8904, with adapters J 6407-1 and J 6407-2, and place two 3/16" shims between second and third lands of government sleeve (Fig. 7F-13).

b. Make certain new gear is positioned squarely on sleeve and press gear onto sleeve. Gear must be seated against sleeve.

CAUTION: Do not support or hammer on rear of governor.

4. Through existing hole in governor sleeve, drill a 1/8" hole half-way through from each end.

NOTE: It is important that hole for roll pin be drilled straight as possible to insure proper retension and installation of roll pin and gear. This can be best accomplished by above method.

5. Support end of governor sleeve (not gear) on a wood block. Install new roll pin; then using small chisel, stake pin in place at both ends of pin to prevent pin from becoming loose.

6. Check for burrs on sleeve and to assure valve is free in bore. Any burrs left on governor sleeve will damage case.

INSTALLATION

1. Insert governor into case bore with slight counter-clockwise twist to engage gear teeth.

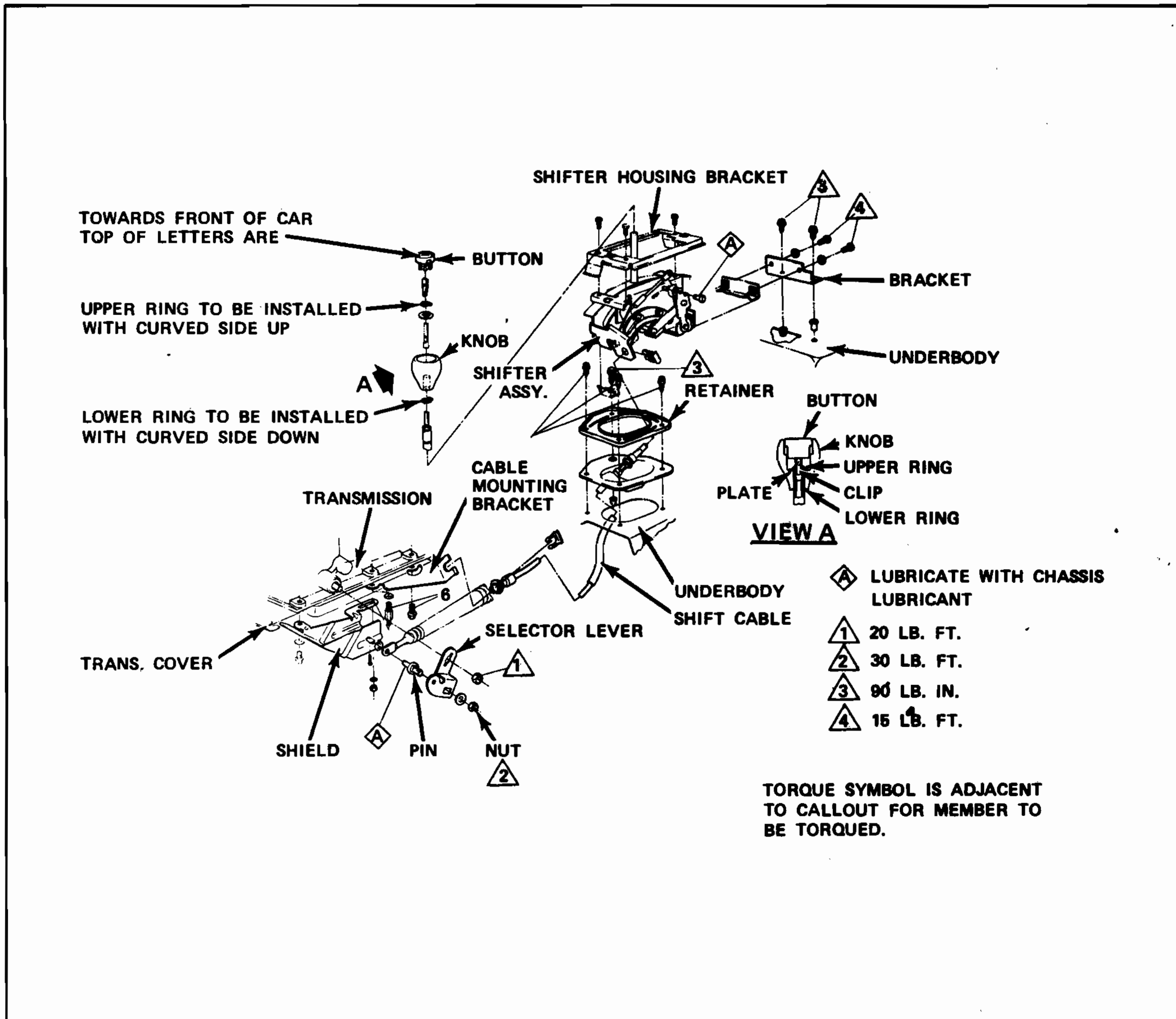


Fig. 7F-6 Firebird Console Shift Linkage

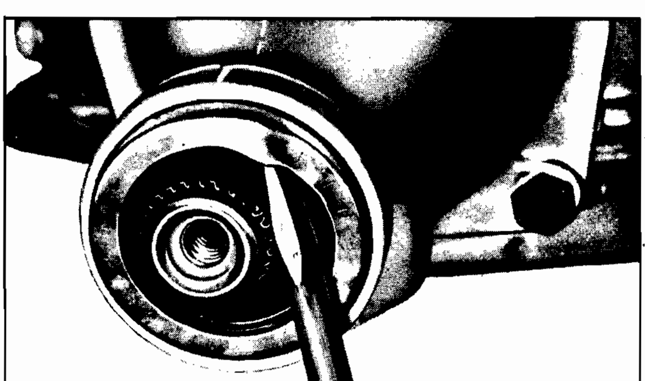


Fig. 7F-7 Removing Rear Bearing Retainer Oil Seal

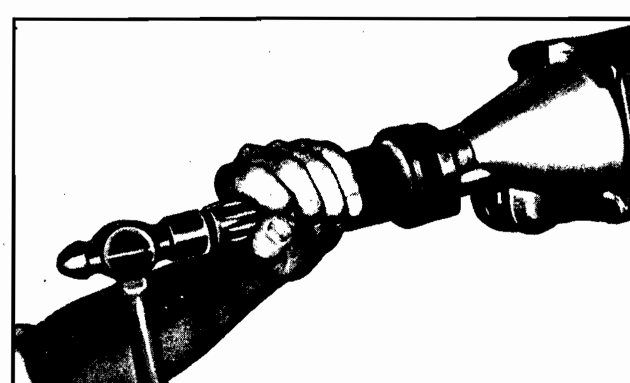


Fig. 7F-8 Installing Rear Bearing Retainer Oil Seal

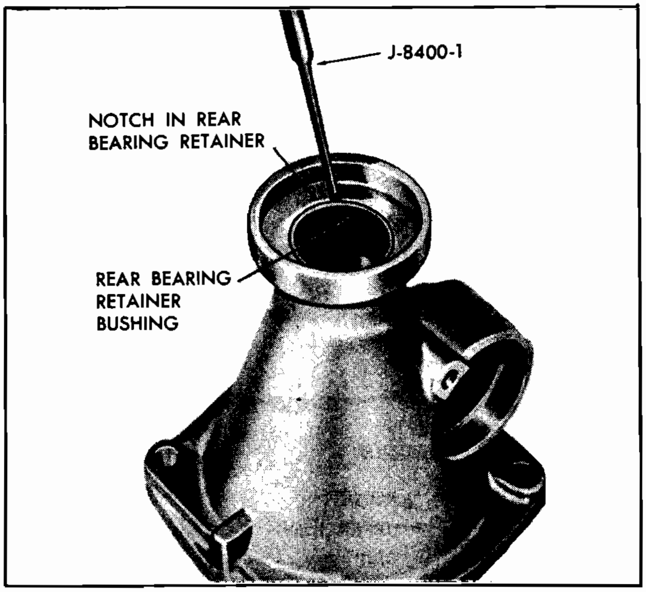


Fig. 7F-9 Removing Rear Bearing Retainer Bushing

2. Using new gasket, install cover and retain with three bolts. Tighten bolts to 10 lb. ft. torque.

VACUUM MODULATOR (Fig. 7F-14)

Do not replace vacuum modulator before making the pressure check described in OIL PRESSURE CHECKS at the end of Section 7F.

NOTE: Vacuum modulator is not adjustable.

REMOVAL

1. Remove vacuum hose at vacuum modulator.

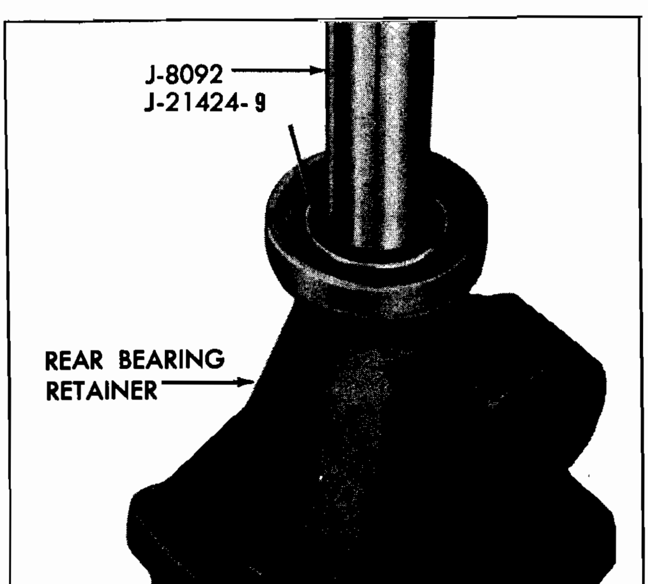


Fig. 7F-10 Installing Rear Bearing Retainer Bushing

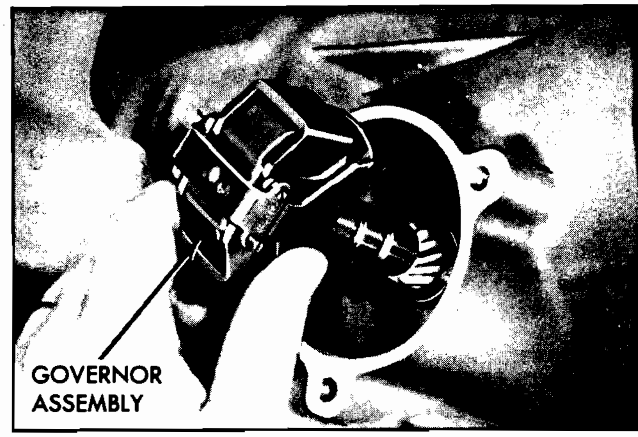


Fig. 7F-11 Removing Governor

2. Remove vacuum modulator retainer bolt and retainer.

3. Pull vacuum modulator (Fig. 7F-15) and valve assembly (Fig. 7F-16) out of case bore.

NOTE: To remove front modulator valve, it may be necessary to use a magnet or "retriever".

INSPECTION AND REPAIRS

Check modulator valves for burrs. If such minor imperfections cannot be removed with a slip stone, replace valve.

The modulator diaphragm can be checked with vacuum source for leakeage. However, diaphragm leakage normally premits transmission oil pull-over, which is evident as smoky exhaust and continually low transmission oil level. No modulator repairs are possible; replace as an assembly.

Inspect case to vacuum modulator oil seal. Discard seal if it is nicked, cut or deteriorated.

INSTALLATION

1. Install modulator valve assembly into case bore. Refer to Fig. 7F-16 for correct assembly sequence.

2. Assemble oil seal on vacuum modulator and install assembly into case bore.

3. Secure modulator assembly with retainer and bolt and tighten bolt 10 lb. ft. torque. Connect vacuum hose.

SPEEDOMETER DRIVEN GEAR AND SLEEVE

REMOVAL

1. Disconnect speedometer cable.

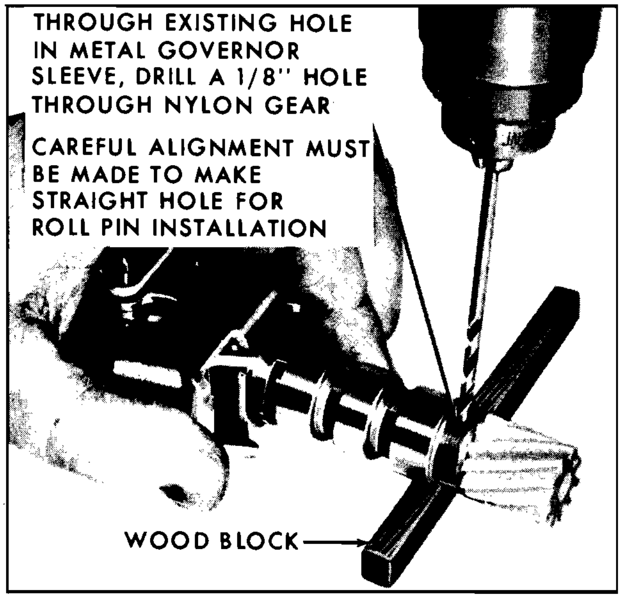


Fig. 7F-12 Removing Governor Roll Pin

2. Remove speedometer driven gear sleeve retainer bolt.

3. Remove retainer and speedometer driven gear assembly.

INSPECTION AND REPAIRS (Fig. 7F-17)

Inspect both oil seals for nicks, cuts or deterioration. Discard damaged seals. Check driven gear for wear or damage; replace if necessary.

INSTALLATION

1. Assemble speedometer gear and sleeve assembly (Fig. 7F-17). Driven gear shaft oil seal lip must face driven gear.

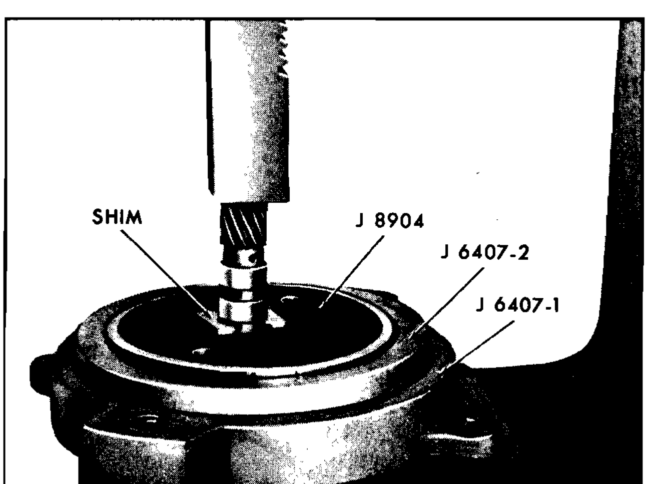


Fig. 7F-13 Installing Governor Driven Gear

2. Install assembly into case bore and secure with retainer and bolt.

NOTE: Assembly must be rotated to align with retainer.

3. Connect speedometer cable.

DOWNSHIFT SOLENOID REPLACEMENT

1. Remove oil pan, gasket and oil strainer.

2. Disconnect solenoid connector from case connector (Fig. 7F-25).

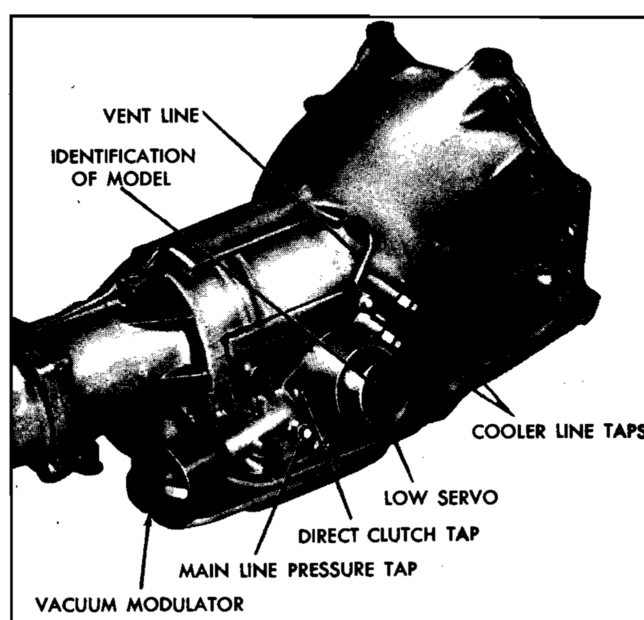


Fig. 7F-14 Right Side of Transmission

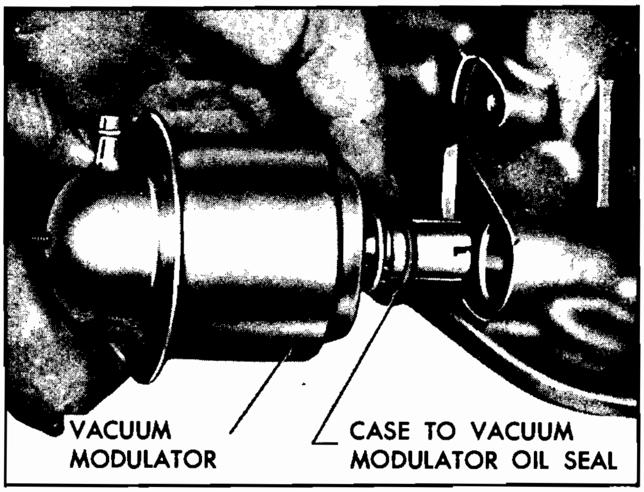


Fig. 7F-15 Removing Vacuum Modulator

3. Remove solenoid attaching bolts. Remove solenoid and gasket.

4. Install new gasket on solenoid so that gasket notch will face bottom of valve body.

5. Install solenoid on valve body and secure connector to case connector.

6. Install oil strainer (make certain grommet is in good condition) and tighten retaining bolt to 10 lb. ft. torque. Install oil pan, using a new gasket. Tighten oil pan bolts to 12 lb. ft. torque.

VALVE BODY

REMOVAL

1. Remove oil pan and gasket.

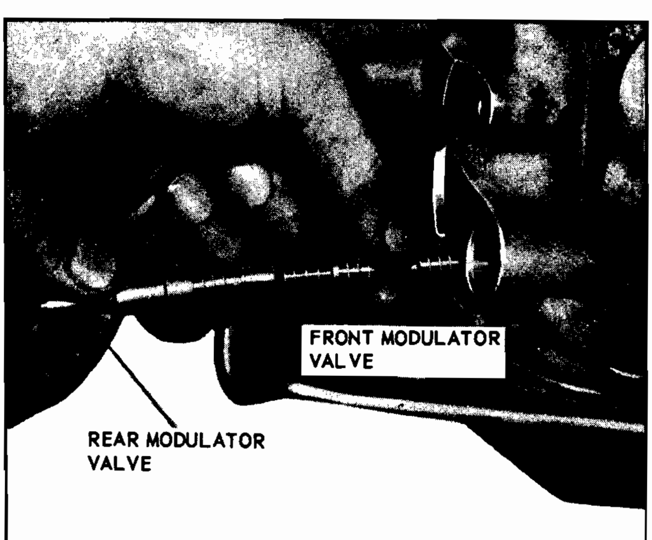


Fig. 7F-16 Removing Vacuum Modulator Valve Assembly

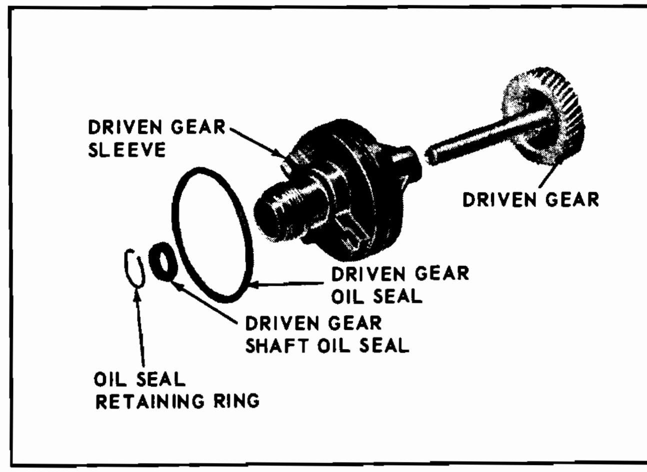


Fig. 7F-17 Speedometer Driven Gear Assembly

2. Remove oil strainer retaining bolt and remove strainer assembly (Fig. 7F-18), using a twisting motion. Discard oil seal.

3. Disconnect solenoid connector from case (Fig. 7F 25).

4. Remove detent spring from valve body (Fig. 7F-25).

5. Remove remaining valve body bolts and hold valve body in position.

6. Disengage manual control valve link from park lock and range selector inner lever by rotating valve body (Fig. 7F-19).

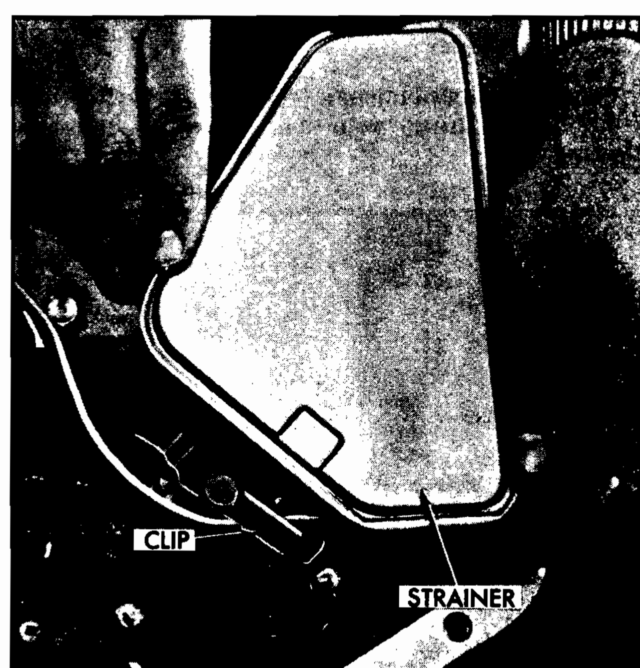


Fig. 7F-18 Removing Oil Strainer Assembly

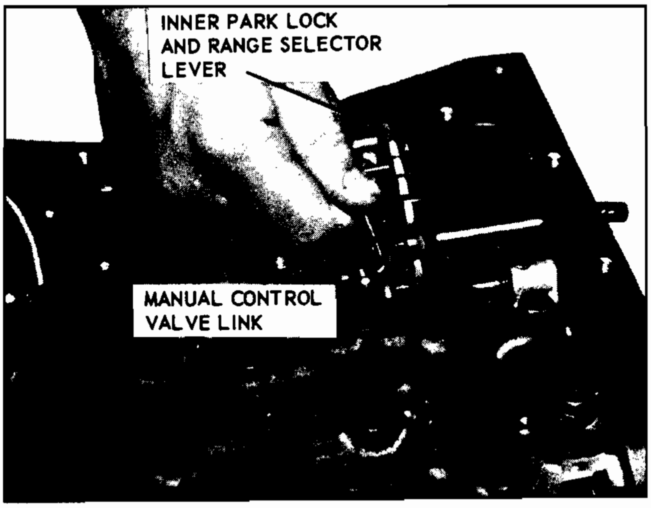


Fig. 7F-19 Disengaging Manual Control Valve Link

7. Remove valve body. Remove manual control valve and link from valve body.

8. Remove oil channel support plate (Fig. 7F-25), valve body plate and plate to case gasket.

DISASSEMBLY

1. Remove downshift solenoid, gasket, spring and detent valve (Fig. 7F-20).

2. Depress shift control valve sleeve and remove retaining pin by turning valve body over so pin can fall free (Fig. 7F-21). Remove shift control valve sleeve, shift control valve, spring, washer and shift valve.

NOTE: Modulator limit valve spring is under moderate pressure. Care should be exercised during removal during step 3 below.

3. Depress modulator limit valve spring and turn valve body over so that retaining pin falls free. Remove

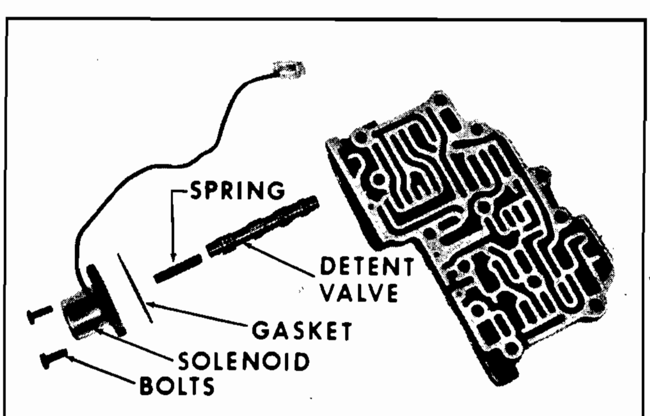


Fig. 7F-20 Downshift Solenoid and Detent Valve

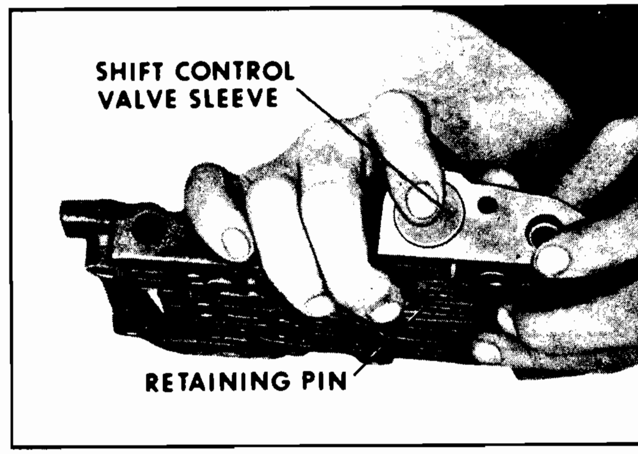


Fig. 7F-21 Removing Shift Control Valve Sleeve

spring and valve (Fig. 7F-22). Needle nose pliers can be used to depress spring and work out pin.

4. Depress high-speed downshift timing valve spring and remove retaining pin by turning valve body over so that pin can fall free. Remove springs, washer and valve (Fig. 7F-23). Needle-nose pliers can be used to depress spring and work out pin.

INSPECTION

As most valve body failures are initially caused by dirt or other foreign material, a thorough cleaning of all parts in clean solvent is mandatory. Check all valves and their operating bores for burrs or other deformities that could cause valve "hang-up".

ASSEMBLY

1. Install high-speed downshift timing valve, washer and springs (Fig. 7F-23). Depress spring with needle nose pliers and install retaining pin.

2. Install modulator limit valve and spring (Fig. 7F 22). Depress spring with needle-nose pliers and install retaining pin.

3. Install spring and shift control valve into sleeve (Fig. 7F-24). Depress spring and valve and insert retainer in

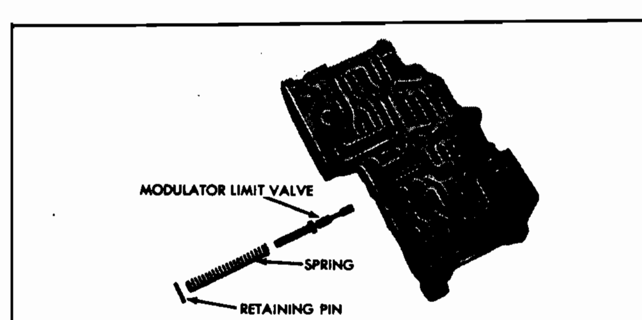


Fig. 7F-22 Modulator Limit Valve

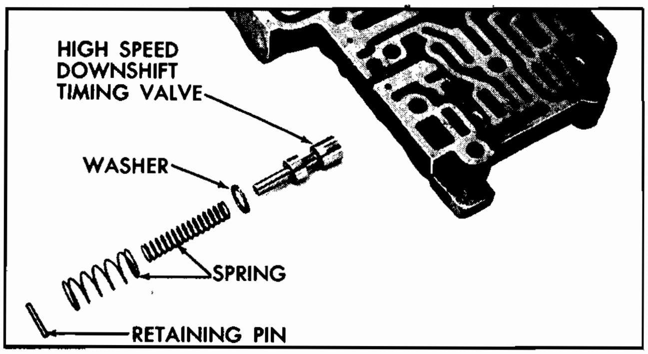


Fig. 7F-23 High-Speed Downshift Timing Valve

groove. Install shift valve and sleeve assembly in valve body and install retaining pin.

4. Install detent valve and spring. Install gasket on downshift solenoid with notch facing bottom of valve body and install downshift solenoid. Tighten bolts to 10 lb. ft. torque (Fig. 7F-20).

INSTALLATION

1. Install new valve body plate to case gasket, using petrolatum to hold it in positon. Install valve body plate and oil channel support plate. Install bolts finger tight.

2. Install manual control valve and link into valve body.

3. Engage manual control valve link in park lock and range selector inner lever (Fig. 7F-19).

4. Install detent spring assembly on valve body (Fig. 7F-25) (Note routing of solenoid wire and wire retaining clip position).

5. Install remaining valve body to case bolts (except oil strainer retaining bolt) and tighten all bolts to 10 lb. ft. torque.

6. Connect solenoid connector to case terminal (Fig. 7F-25). Make certain that case terminal retaining finger engages connector and wire is retained by clip.

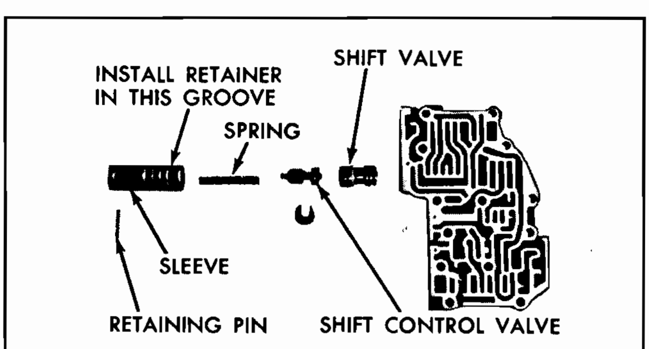


Fig. 7F-24 Shift Valve and Shift Control Valve

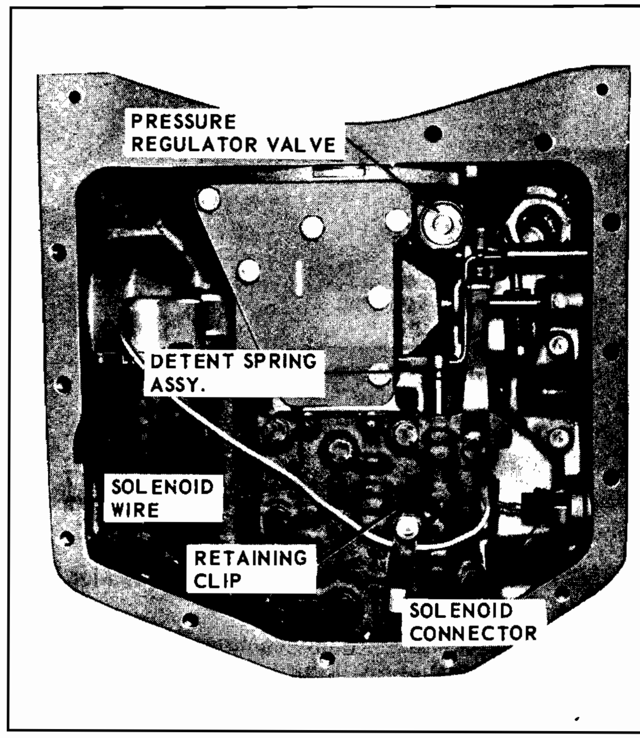


Fig. 7F-25 Transmission - Oil Pan and Strainer Removed

7. Install new oil strainer pipe to case seal on oil strainer pipe and lubricate.

8. Install oil strainer assembly and tighten oil strainer bolt to 10 lb. ft. torque.

9. Install oil pan, using a new gasket. Tighten oil pan bolts to 12 lb. ft. torque.

TRANSMISSION REMOVAL

1. Disconnect speedometer cable and remove speedometer drive gear to allow oil to drain during removal procedure.

2. Remove propeller shaft (see Section 4C).

3. Disconnect vacuum line and downshift switch lead.

4. Disconnect shift control linkage from outer shift lever.

5. Remove flywheel housing bottom cover.

6. Remove flywheel to converter mounting bolts. After bolts are removed, make certain converter hub is free of crankshaft.

7. Support transmission and remove frame crossmember.

NOTE: On Firebird 6 cylinder, remove driveline damper (Fig. 7F-114).

8. Lower transmission and engine assembly to gain access to cooler line fittings. Disconnect cooler lines, using a crow foot adapter and suitable extension or using Oil Cooler Pipe Wrench J 22731.

NOTE: On some cars it may be necessary to loosen exhaust system.

9. With transmission in lowered position, remove case to engine bolts.

10. Move transmission down to the rear and install Converter Holding Strap J 21366 to hold converter in position until transmission is to be disassembled.

To install transmission, reverse the above procedure.

TRANSMISSION DISASSEMBLY

Service procedures for rear bearing retainer, speedometer drive gear, governor vacuum modulator, speedometer driven gear assembly, downshift solenoid, pressure regulator and valve body are covered under SERVICE OPERATIONS -TRANSMISSION IN CAR,

REMOVAL OF VALVE BODY, REAR BEARING RETAINER, SPEEDOMETER DRIVE GEAR AND LOW SERVO

1. Mount transmission in Holding Fixture J 8763-01 (Fig. 7F-26).

2. With transmission in horizontal position, pull out converter.

3. Remove valve body (see page 7F-10).

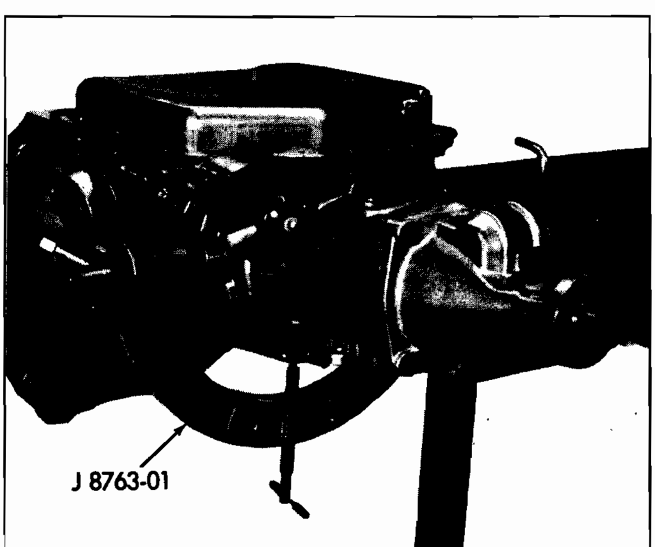


Fig. 7F-26 Transmission Mounted in Holding Fixture

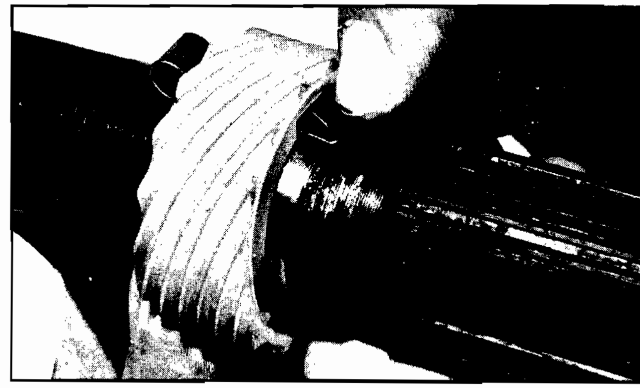


Fig. 7F-27 Removing Speedometer Drive Gear

4. Remove speedometer driven gear (see page 7F-5).

5. Remove governor assembly (see page 7F-5).

6. Remove vacuum modulator (see page 7F-8).

7. Remove rear bearing retainer (see page 7F-4).

8. Remove speedometer drive gear by depressing retainer clip and sliding gear off output shaft (Fig. 7F-27).

REMOVAL OF OIL PUMP, FORWARD CLUTCH AND LOW BAND

NOTE: Oil pump seal can be replaced without removing pump from case:

Fig. 7F-28 Removing Oil Pump

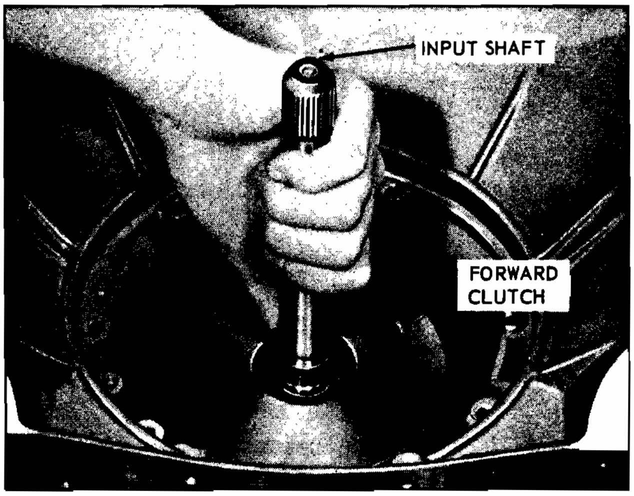


Fig. 7F-29 Removing Input Shaft

a. Pry out old seal.

b. Coat outer casing of new oil seal with gasket sealing compound and drive it into place with Installer J 21359.

1. With transmission in vertical position, remove eight oil pump attaching bolts. Install Slide Hammers J 6125 and Adapters J 6125-2 into threaded holes in pump, loosen pump and remove pump and gasket (Fig. 7F-28).

2. Remove input shaft from forward clutch drum (Fig. 7F-29).

3. Remove forward clutch assembly by pulling straight out of case (Fig. 7F-30).

4. Remove low band, struts and band adjusting screw from case.

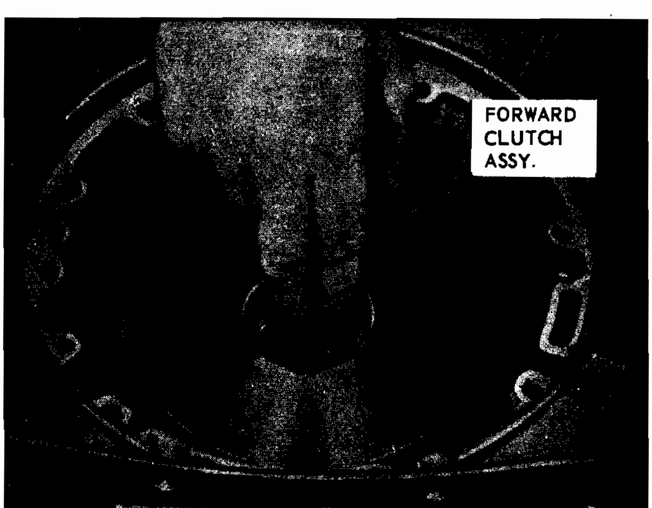


Fig. 7F-30 Removing Forward Clutch Assembly

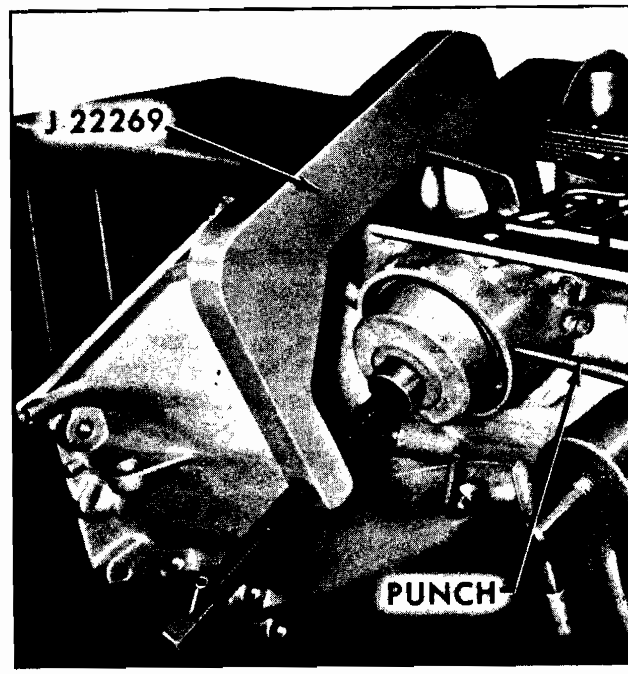


Fig. 7F-31 Removing Low Servo Cover Snap Ring

5. Remove low servo cover snap ring, using Tool J 22269 to compress low servo cover so that snap ring can be removed with the aid of a punch or screwdriver (Fig. 7F-31).

6. Remove Tool J 22269 from case and remove low servo cover. If necessary, tap lightly on low servo assembly piston rod to assist in removal of cover. Discard cover oil seal.

7. Remove low servo assembly from case.

REMOVAL OF PLANETARY GEAR SET, REVERSE CLUTCH AND PISTON AND PARK LOCK MECHANISM

1. Pull planet carrier assembly from case, using care to avoid damaging case bushing (Fig. 7F-32) and remove reverse ring gear (Fig. 7F-33), thrust bearing and races (Fig. 7F-34).

2. With transmission in vertical position, remove reverse clutch pack snap ring with a screwdriver (Fig. 7F-35).

3. Lift reverse clutch pressure plate and clutch pack from case.

4. Compress reverse piston return springs, using Clutch Spring Compressor J 23327 and Compressor Pilot J 21420-2 (Fig. 7F-36).

NOTE: Position spring compressor so that reverse piston return seat snap ring gap is accessible.

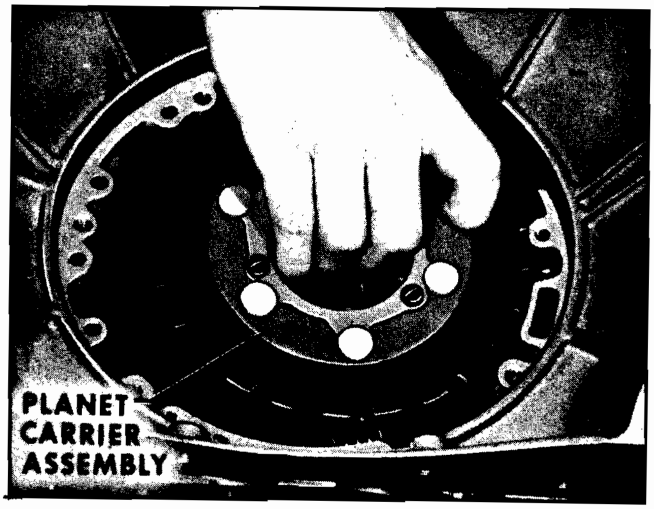


Fig. 7F-32 Removing Planet Carrier Assembly

5. With return spring fully compressed, remove snap ring.

6. Release pressure on the return springs, being careful that piston return seat does not catch in snap ring groove. Remove return seat, springs and tools.

7. With transmission in horizontal position, apply compressed air to reverse piston apply port to force out reverse piston (Fig. 7F-37).

8. Remove parking lock bracket (Fig. 7F-38).

9. Remove range selector shaft retainer (Fig. 7F-39).

10. Fully loosen nut that retains outer range selector lever shaft to inner park lock and range selector lever (Fig. 7F-40).

NOTE: Before sliding range selector lever shaft out of case, remove any burrs on inner end of shaft that could

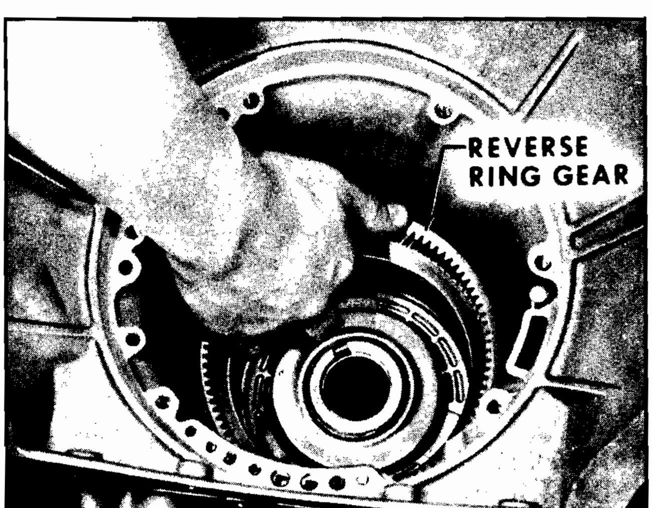


Fig. 7F-33 Removing Reverse Ring Gear

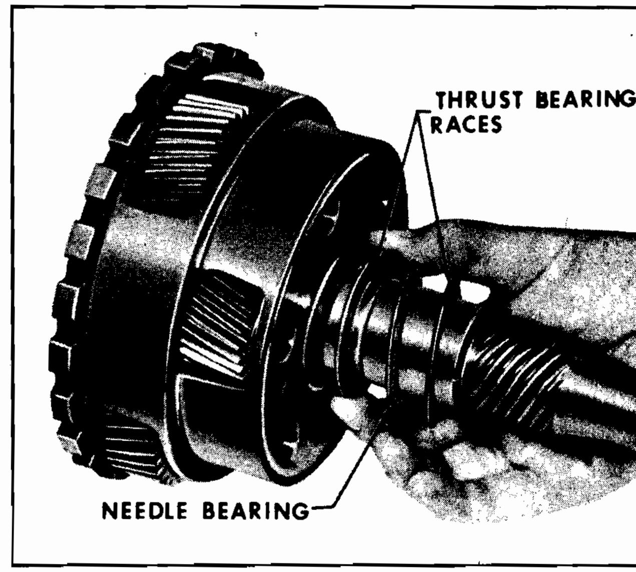


Fig. 7F-34 Removing Planet Carrier Thrust Bearing and Races

score case bore or make removal difficult.

11. Slide range selector lever shaft out of case (see NOTE above). Remove nut and inner park lock and range selector lever.

12. Slide parking lock pawl shaft out of parking lock pawl (Fig. 7F-41). Remove parking lock pawl and spring.

INSPECTION AND OVERHAUL OF INDIVIDUAL COMPONENTS

Service procedures for the rear bearing retainer, governor, vacuum modulator, speedometer driven gear assembly, downshift solenoid, valve body and pressure

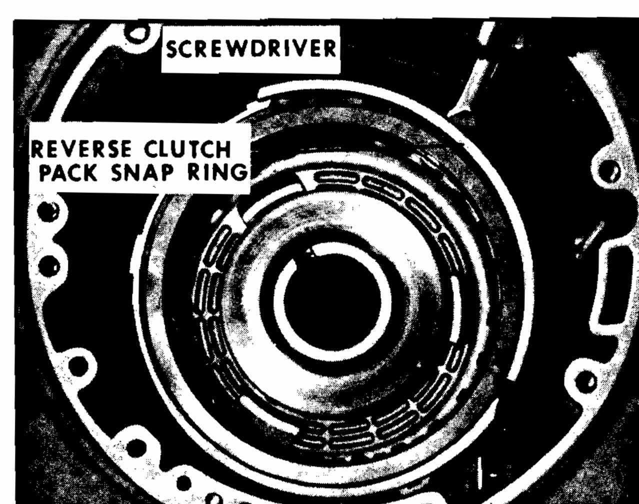


Fig. 7F-35 Removing Reverse Clutch Pack Snap Ring

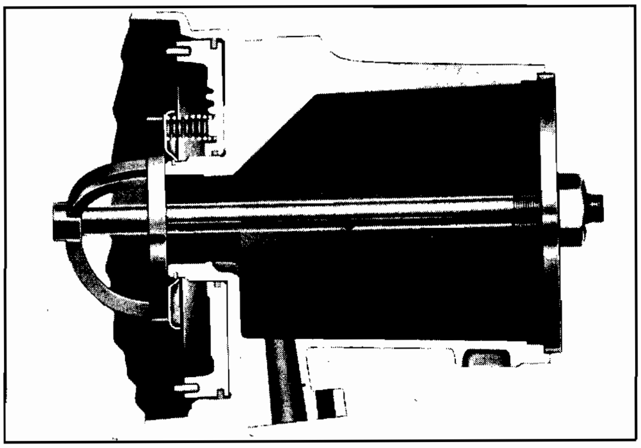


Fig. 7F-36 Compressing Reverse Piston Return Springs

regulator are covered under SERVICE OPERATIONS - TRANSMISSION IN CAR.

TRANSMISSION CASE

INSPECTION

1. Inspect for hairline cracks or oil leaks.

2. Check for interconnected oil passages, using air gun or smoke.

3. Check bolt hole threads for cross threading or stripped condition.

4. Check case bushing for nicks, excessive scoring or wear. If replacement is required, proceed as follows:

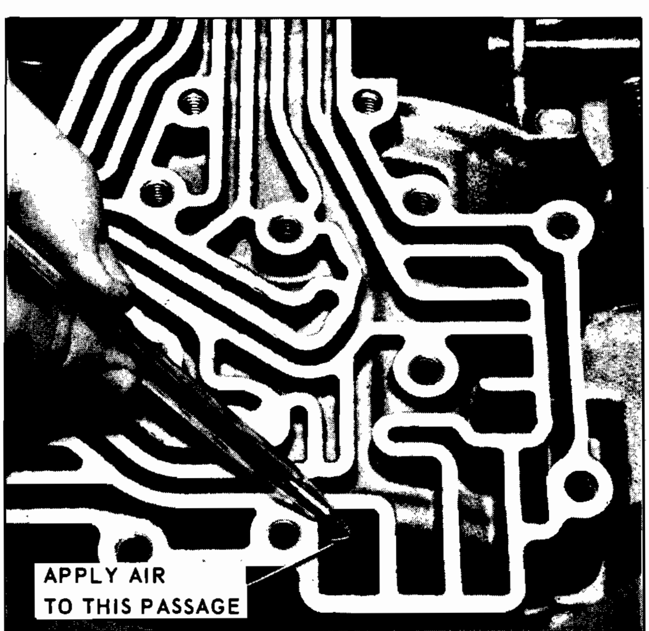


Fig. 7F-37 Reverse Piston Apply Port

Fig. 7F-38 Removing Parking Lock Bracket

a. Remove bushing by placing screwdriver in notch in case. Tap screwdriver with hammer to collapse bushing and remove (Fig. 7F-42).

b. Install new bushing, using Installer J 21424-2 and Drive Handle J 8092. Make certain that split on bushing is opposite notch in case (Fig. 7F-43).

5. Examine manual shaft oil seal. If nicked, torn or worn, replace as follows:

a. Pry out old seal (Fig. 7F-44).

b. Tap new seal gently until it bottoms in case bore. Use a piece of flat metal or wood to avoid damaging seal.

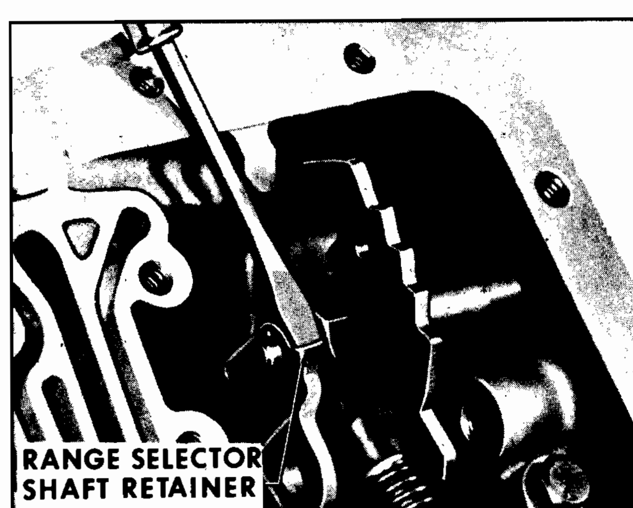


Fig. 7F-39 Removing Range Selector Shaft Retainer

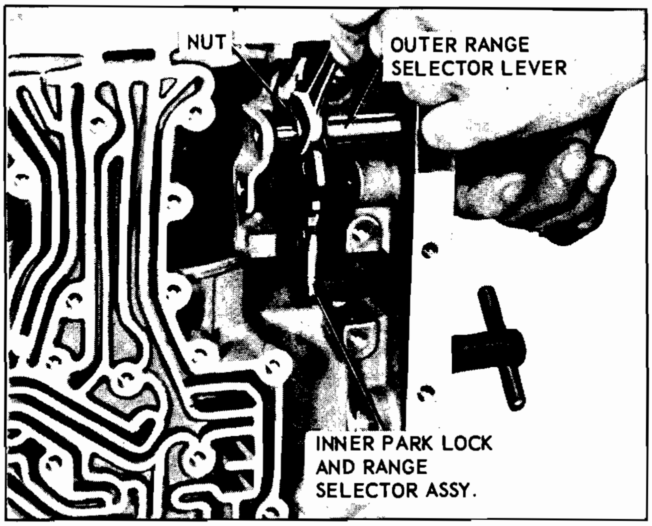


Fig. 7F-40 Removing Range Selector Shaft Nut

PARK LOCK ACTUATOR ASSEMBLY, INNER PARK LOCK AND RANGE SELECTOR LEVER

DISASSEMBLY

Remove retainer ring that holds inner park lock and range selector to park lock actuator assembly (Fig. 7F-45).

INSPECTION

Check for worn or damaged parts and replace as required.

ASSEMBLY

Engage park lock actuator assembly in inner park lock and range selector lever and secure with retainer ring (Fig. 7F-45).

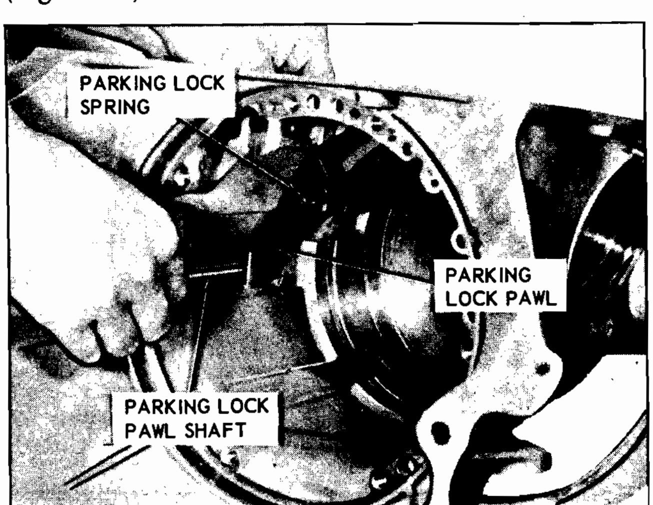


Fig. 7F-41 Removing Parking Lock Pawl Shaft

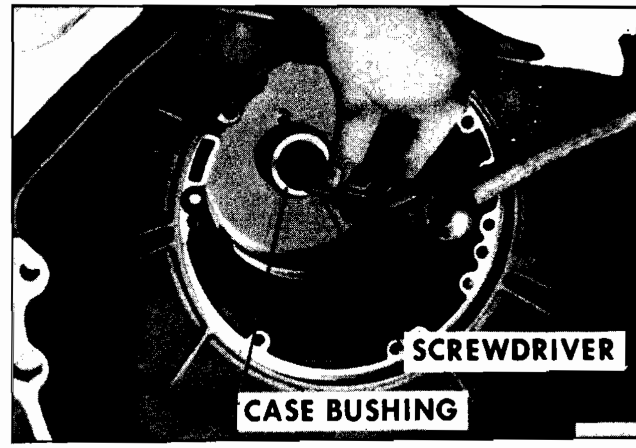


Fig. 7F-42 Removing Case Bushing

REVERSE CLUTCH AND PISTON

DISASSEMBLY AND INSPECTION

1. Remove and discard reverse piston inner and outer seals.

2. Check for broken piston return springs and make a comparative check of spring heights by standing all springs in a row. If there is appreciable difference in spring height, replace springs.

3. Examine clutch plates for evidence of wear or burning. Discard damaged plates. L-6 clutch pack contains 4 steel and 4 faced plates; V-8 contains 5 steel and 5 faced plates.

4. Check piston for cracks or distortion.

ASSEMBLY

1. Check reverse piston thickness. L-6 piston is 1" thick; V-8 piston is 13/16" thick.

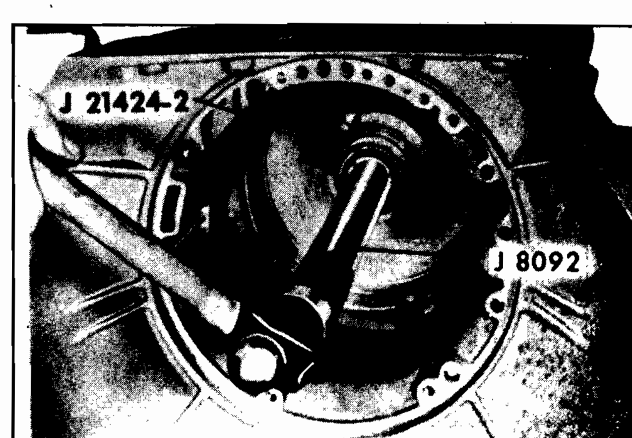


Fig. 7F-43 Installing Case Bushing

Fig. 7F-44 Removing Manual Shaft Oil Seal

2. Lubricate with transmission oil and install inner and outer seals in reverse piston grooves.

FORWARD CLUTCH

DISASSEMBLY

1. Remove low sun gear and flange assembly snap ring (Fig. 7F-46).

2. Remove low sun gear and flange assembly (Fig. 7F 47).

3. Remove clutch hub rear thrust washer (Fig. 7F-48).

4. Remove clutch hub (Fig. 7F-49).

5. Remove clutch hub front thrust washer (Fig. 7F-50).

6. Remove clutch pack.

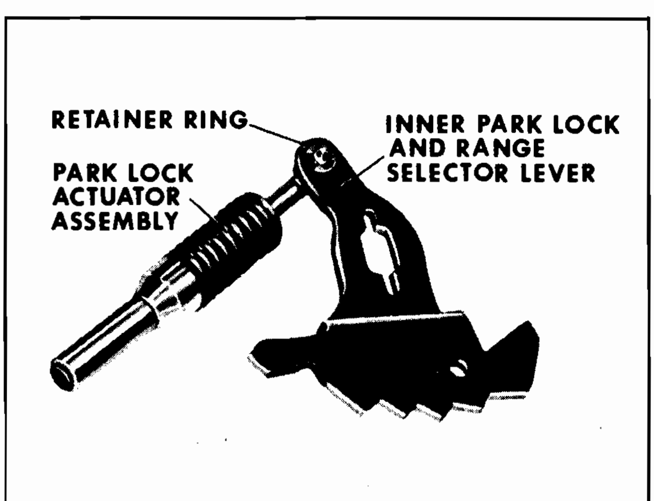


Fig. 7F-45 Park Lock Actuator and Range Selector Lever

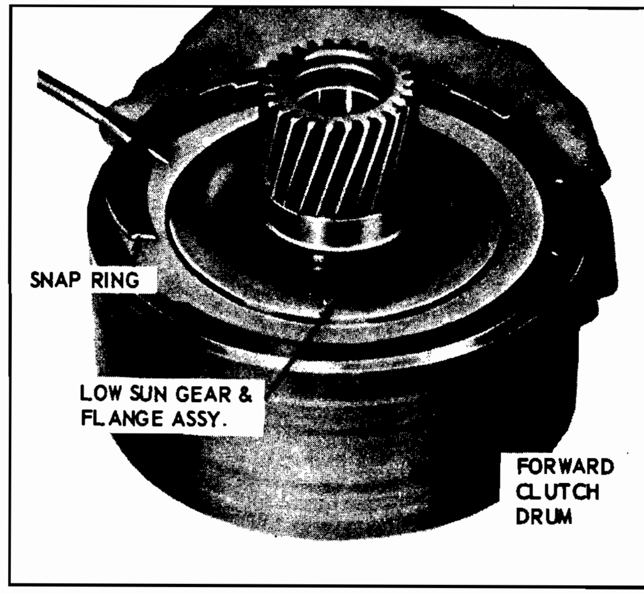


Fig. 7F-46 Removing Low Sun Gear and Flange Assembly Snap Ring

7. Using Spring Compressor J 23327 with Pilot J 9542 4, compress piston return springs (Fig. 7F-51). Remove snap ring.

8. Carefully release pressure, then remove spring retainer, return springs and tools.

9. Remove clutch piston with twisting motion. Remove and discard outer seal on piston and inner seal on clutch drum hub.

INSPECTION

1. Wash all parts in cleaning solvent and air dry.

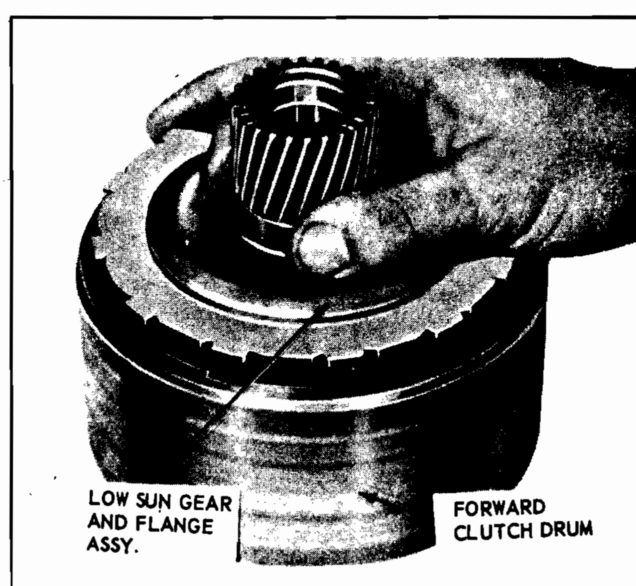


Fig. 7F-47 Removing Low Sun Gear and Flange Assembly

Fig. 7F-48 Removing Clutch Hub Rear Thrust Washer

2. Inspect low band surface of clutch drum for excessive scoring or burning. Check clutch drum bushing for scoring or excessive wear. If bushing replacement is necessary, see Clutch Drum Bushing Replacement below.

3. Check steel ball in clutch drum that acts as a relief valve. Be sure that it is free to move and that orifice in front face of drum is open. If check ball is loose enough to come out, or not loose enough to rattle, replace clutch drum as an assembly. Replacement or restaking of ball should not be attempted.

NOTE: When drum is rotating at high speed with enough fluid trapped in piston apply area, centrifugal force acting on fluid could partially apply the piston and burn clutch pack unless the relief orifice is open. During normal piston application, oil pressure seats the ball and prevents loss of pressure.

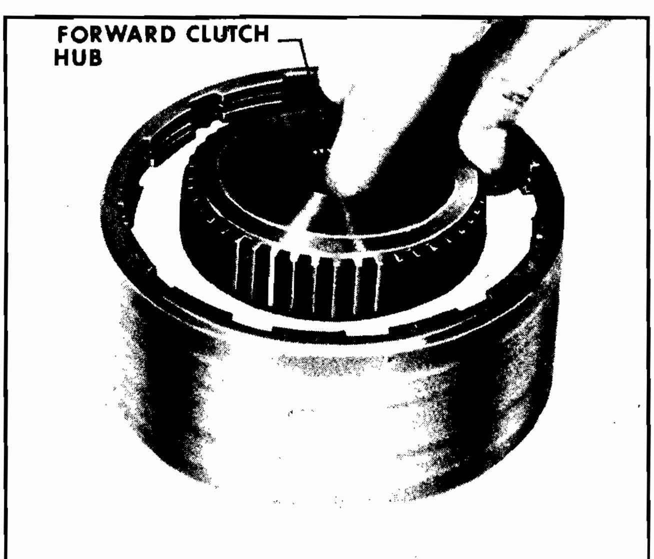


Fig. 7F-49 Removing Clutch Hub

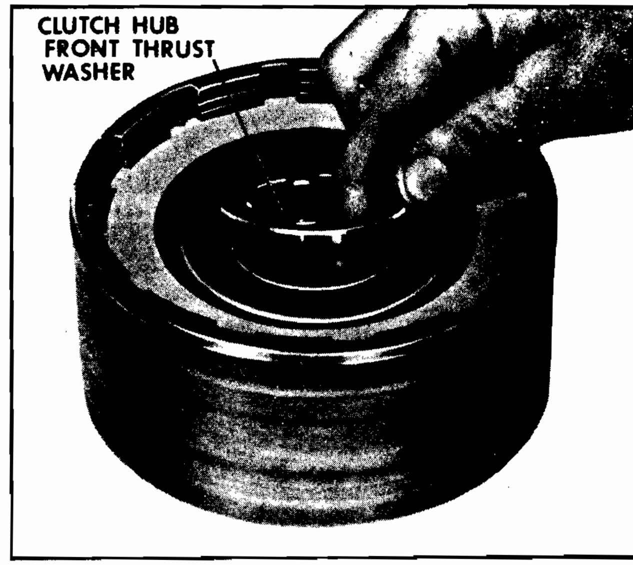


Fig. 7F-50 Removing Clutch Hub Front Thrust Washer

4. Check fit of low sun gear and flange assembly in drum slots. There should be no appreciable radial play. Inspect low sun gear for damage and bushing for wear.

5. Check clutch plates for burning, pitting or metal pick-up. Also, check to see that faced plates are a free fit over clutch hub and that steel plates are a free fit in clutch drum slots. Check for excessive wear on friction facing of drive plates. Examine condition of clutch hub splines and mating splines on faced plates.

6. Check piston for cracks or distortion.

CLUTCH DRUM BUSHING REPLACEMENT

1. Remove old bushing, using Drive Handle J 8092

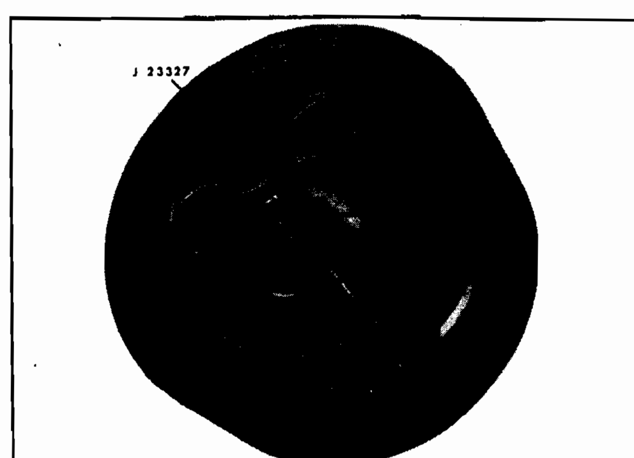


Fig. 7F-51 Compressing Forward Clutch Piston Return Springs

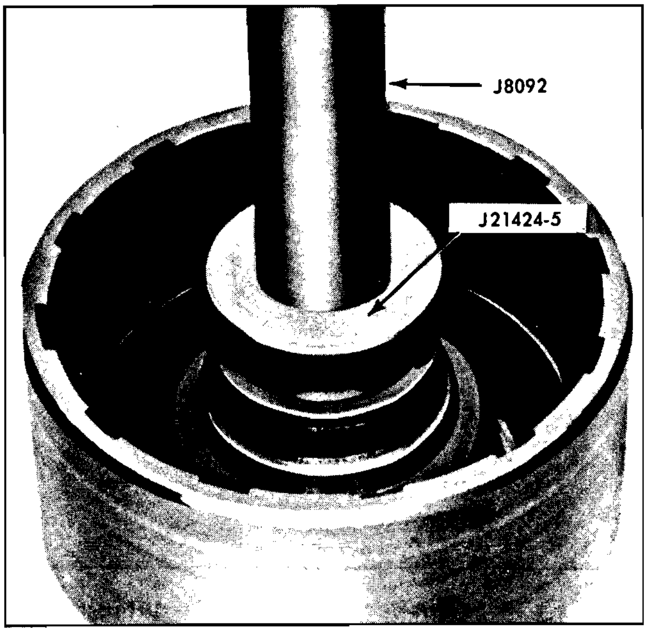


Fig. 7F-52 Removing Clutch Drum Bushing

with Tool J 21424-5 (Fig. 7F-52). Avoid damaging bushing bore.

2. Install new bushing, using Tool J 24124-5 (Fig. 7F-53). Press bushing in until tool touches front face of drum.

LOW SUN GEAR BUSHING REPLACEMENT

1. Remove old bushing, using Drive Handle J 8092

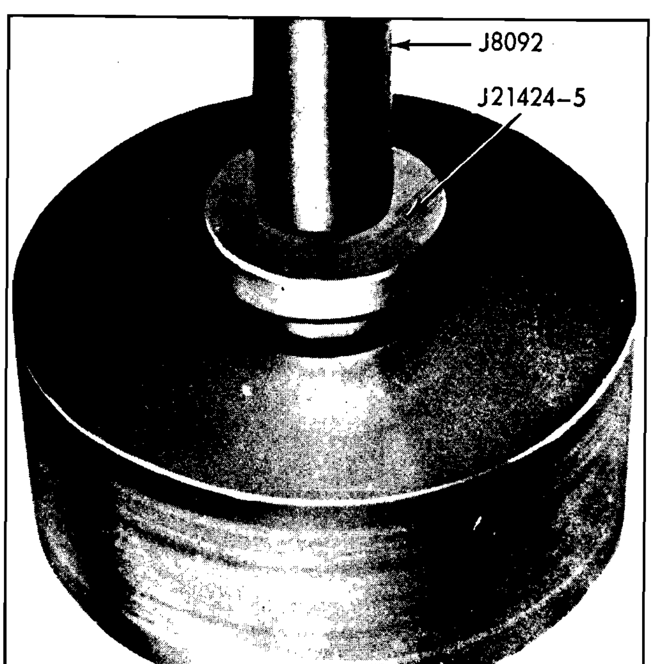


Fig. 7F-53 Installing Clutch Drum Bushing

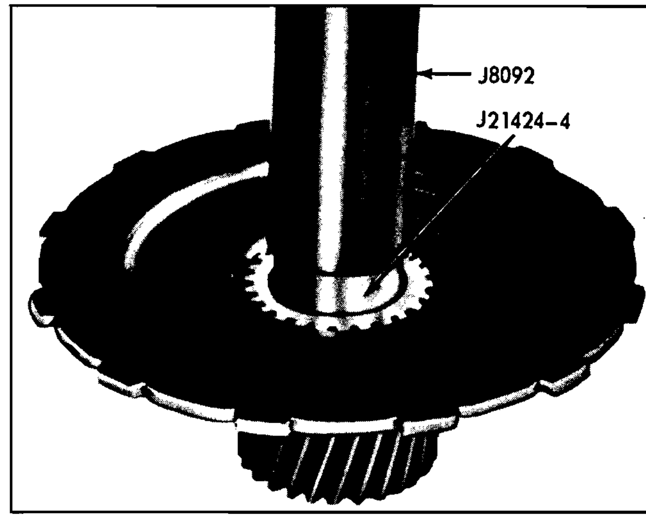


Fig. 7F-54 Removing Low Sun Gear Bushing

with Tool J 21424-4 (Fig. 7F-54). Avoid damaging bushing bore.

2. Install new bushing, using Tool J 21424-4 (Fig. 7F 55). Press in bushing until tool is flush with face of sun gear.

ASSEMBLY

1. Lubricate a new piston inner seal with transmission oil and install in clutch hub groove with seal lip down (Fig. 7F-56). A satisfactory tool for this operation can be made by crimping a loop of .020" music wire in a short length of copper tubing.

NOTE: Run fingers around seal after it is installed to verify that seal is fully in groove.

2. Check forward clutch piston thickness. L-6 piston is 1-5/16" thick; V-8 piston is 29/32 thick.

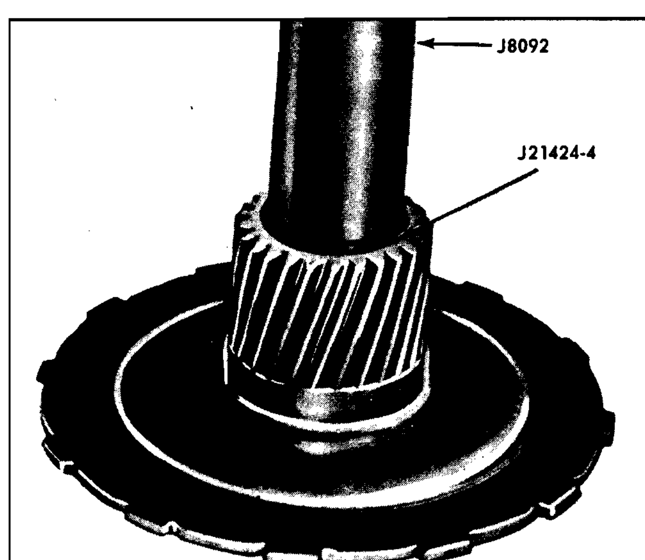


Fig. 7F-55 Installing Low Sun Gear Bushing

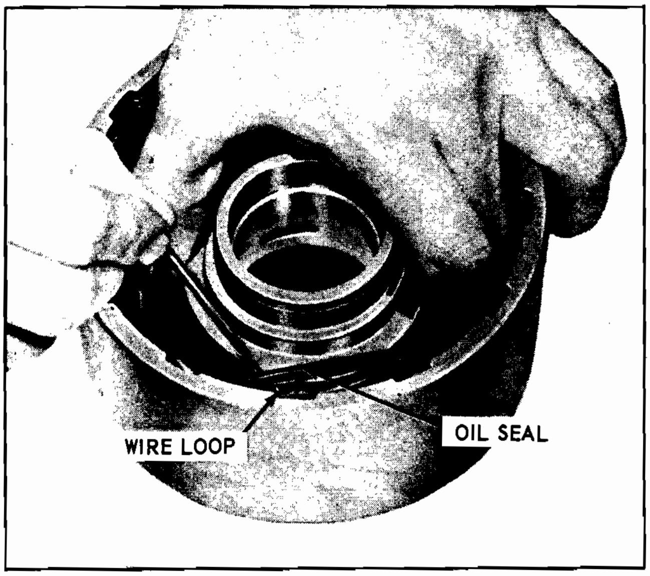


Fig. 7F-56 Installing Clutch Piston Inner Oil Seal

3. Lubricate a new piston outer seal with transmission oil and install in piston groove. Seal lip must face down.

4. Install forward clutch piston into clutch drum, using a loop of smooth wire to start lip of seal into bore.

5. Install piston return springs and spring retainer (Fig. 7F-57). Place snap ring in position on top of retainer.

6. Compress return springs, as shown in Fig. 7F-51, to expose snap ring groove. Install snap ring in clutch drum hub and remove compressor tools.

7. Install clutch hub front thrust washer on clutch hub (retain with petrolatum), aligning tangs in clutch hub with grooves in thrust washer (Fig. 7F-58). Install clutch hub.

NOTE: Notches on steel driven plates must be aligned in step 8 below.

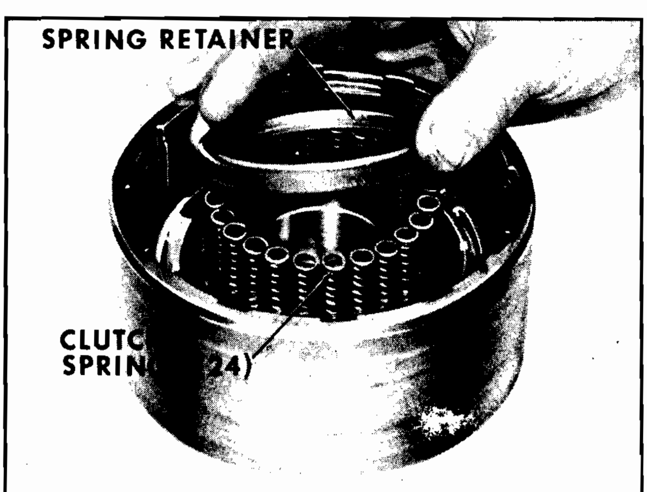


Fig. 7F-57 Installing Spring Retainer

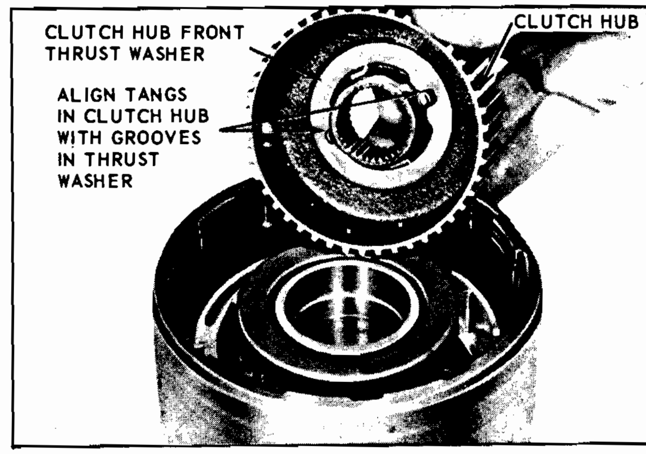


Fig. 7F-58 Installing Clutch Hub Front Thrust Washer

8. Install steel driven plates and faced drive plates alternately, beginning with a steel driven plate (Fig. 7F-59).

NOTE: Number of plates used are: LA, LD, LF, LH -5 steel and 4 faced MA, MC - 6 steel and 5 faced

9. Install clutch hub rear thrust washer with flange in bore of low sun gear (Fig. 7F-60).

10. Install low sun gear and flange assembly and secure with snap ring. Position snap ring so that gap is centered between slots in drum.

PLANET CARRIER

PRELIMINARY INSPECTION

1. Wash planet carrier assembly in cleaning solvent and air dry.

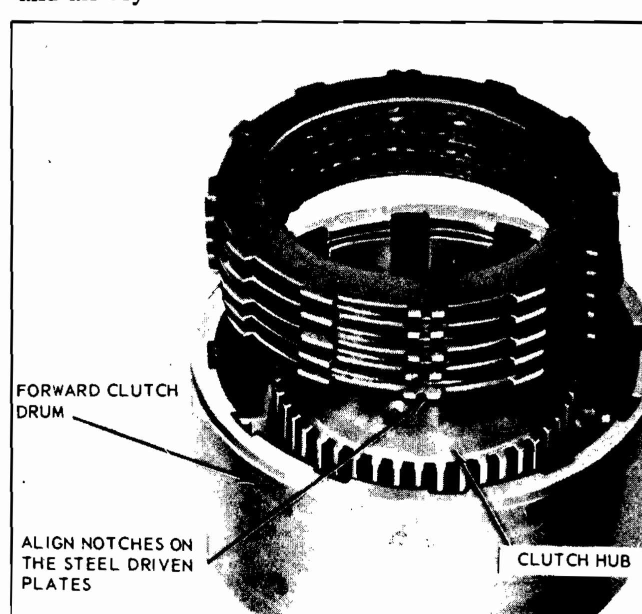


Fig. 7F-59 Installing Clutch Pack

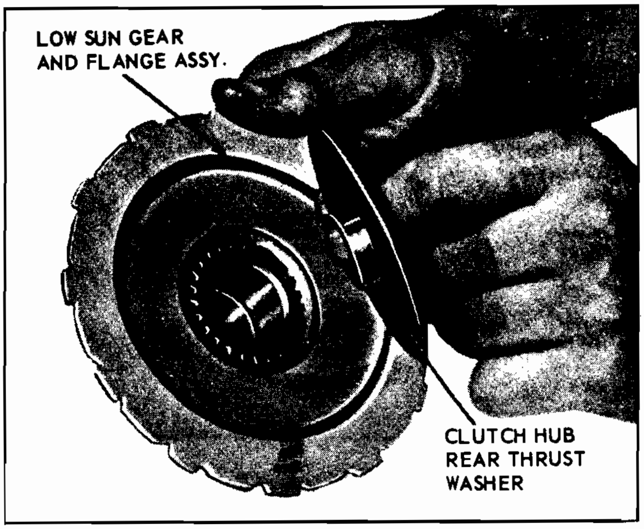


Fig. 7F-60 Installing Clutch Hub Rear Thrust Washer

2. Inspect planet pinions for nicks or other tooth damage.

3. Check end clearance of planet pinions. This clearance should be .006"-.030" (Fig. 7F-61).

4. Check input sun gear for tooth damage.

5. Inspect output shaft bearing surface for nicks or scoring.

6. Inspect output shaft splines for nicks or damage. To disassemble the planet carrier to replace worn or damaged parts, proceed as follows:

DISASSEMBLY

1. Remove planet pinion shaft lock plate screws and lockwashers (Fig. 7F-62).

2. Rotate lock plate clockwise and remove.

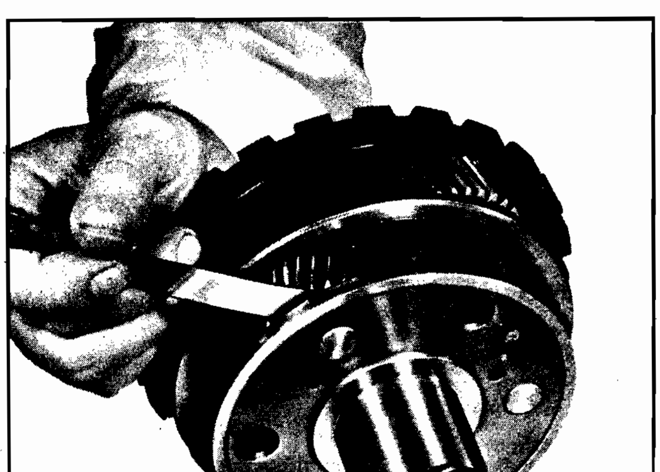


Fig. 7F-61 Checking Planet Pinion End Clearance

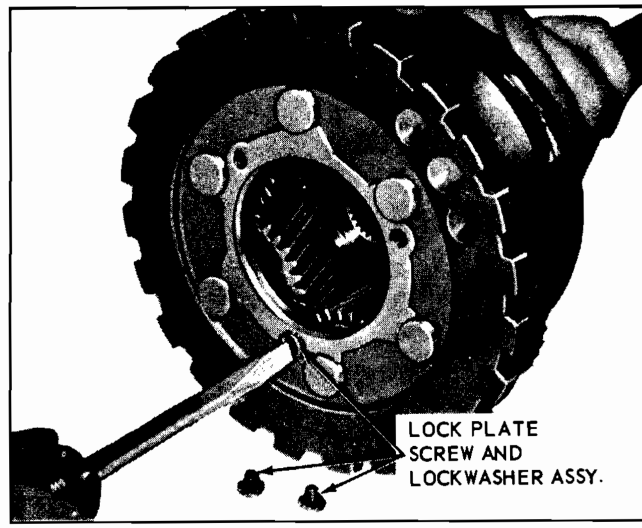


Fig. 7F-62 Removing Lock Plate screws

NOTE: If gears are to be reused, mark them in some convenient way so that they can be reinstalled in their original position, facing original direction. If this is not done, the gear set may be noisy.

3. Starting with a short planet pinion, push out pinion shaft. Remove pinion, needle bearings and thrust washers.

4. Repeat Step 3 to remove the remaining two short pinions.

5. Remove low sun gear needle thrust bearing (Fig. 7F-63).

6. Remove input sun gear (Fig. 7F-64).

7. Remove input sun gear thrust washer (Fig. 7F-65).

8. Remove three long pinion shafts, pinions, bearings and thrust washers.

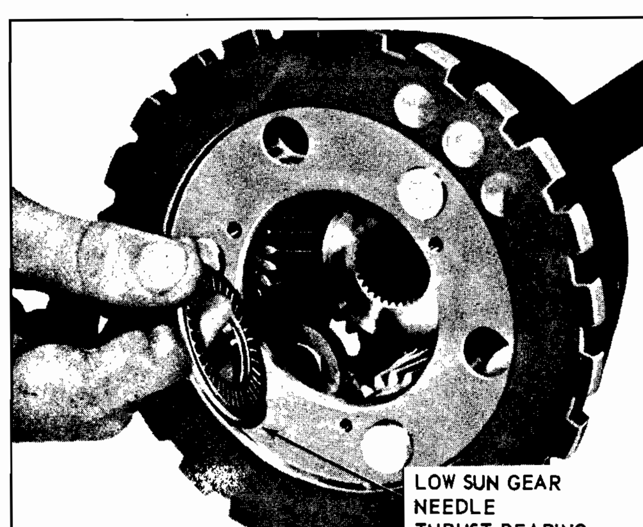


Fig. 7F-63 Removing Low Sun Gear Needle Thrust Bearing

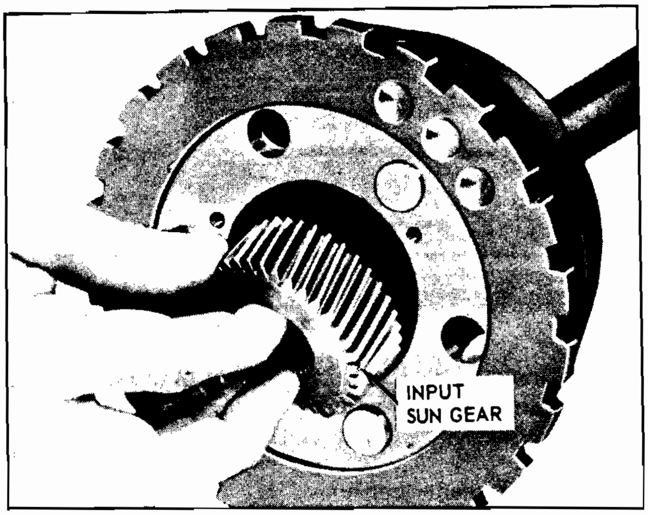


Fig. 7F-64 Removing Input Sun Gear

INSPECTION

1. Wash all parts in cleaning solvent and air dry.

2. Recheck pinions and input sun gear for nicks or other tooth damage. Check needle thrust bearing and all thrust washers for wear. Replace worn or damaged parts.

3. Inspect pinion needle bearings carefully. If worn, all needle bearings must be replaced. Replace worn pinion shafts.

4. Check output shaft bushing for nicks, severe scoring or wear. If replacement is required, proceed as follows:

OUTPUT SHAFT BUSHING REPLACEMENT

1. Install Bushing Remover J 9534 into bushing. Install slide hammer into J 9534 and remove bushing (Fig. 7F-66).

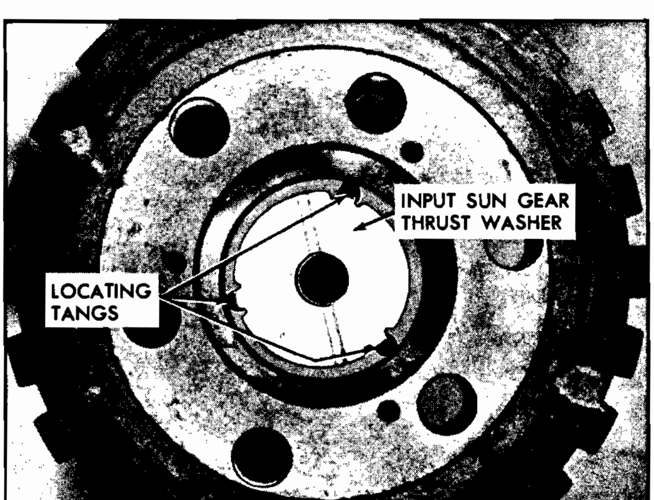


Fig. 7F-65 Input Sun Gear Thrust Washer

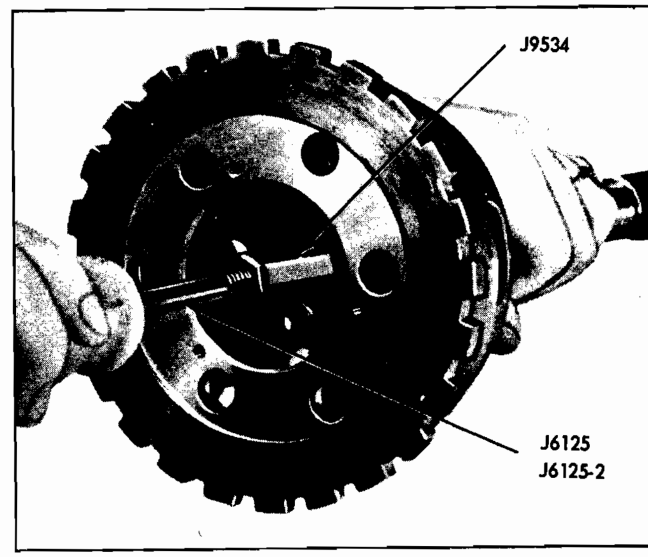


Fig. 7F-66 Removing Output Shaft Bushing

2. Using Installer J 21424-3 and Handle J 8092, press new bushing into output shaft until installer touches machined surface of carrier assembly (Fig. 7F-67).

ASSEMBLY

1. Install long pinions first. Install pinion rear thrust washer, retaining it with petrolatum. Oil grooves must face pinion; engage washer tang in hole (Fig. 7F-68).

2. Install pinion front thrust washer ("paired" washer), retaining it with petrolatum. Oil grooves must face pinion (Fig. 7F-69).

3. Install 20 needle bearings, spacer, 20 more needle bearings, and two thrust washers into long pinion (Fig. 7F-70). A small amount of petrolatum will aid in holding needle bearings and washers in place.

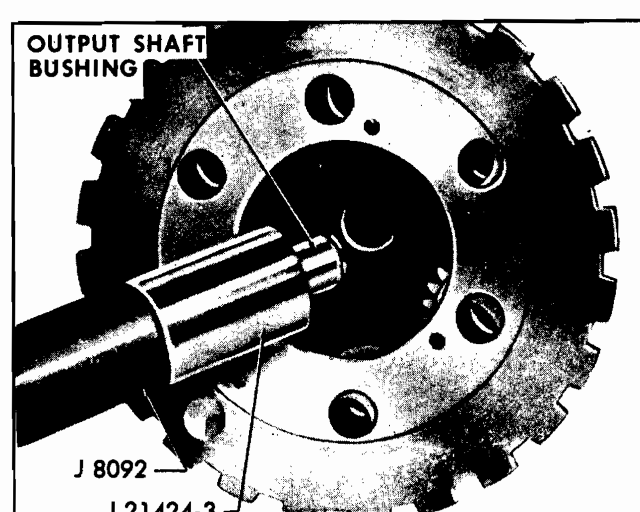


Fig. 7F-67 Installing Output Shaft Bushing

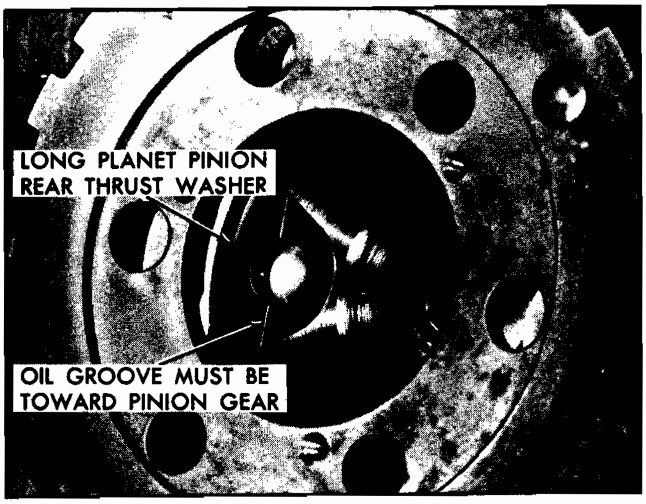


Fig. 7F-68 Long Pinion Rear Thrust Washer

4. Hold long pinion and needle bearing assembly in position and install long pinion shaft from front of planet carrier. As shaft is pushed in, make certain that it picks up thrust washers. Turn pinion shaft so that lock plate slot faces center of planet carrier.

NOTE: Repeat steps 1 through 4 above to install remaining two long pinions.

5. Install input sun gear thrust washer with oil groove facing gear (Fig. 7F-71).

6. Install input sun gear.

7. Install low gear needle thrust bearing with bearings facing input sun gear (Fig. 7F-72).

8. Install short pinion thrust washer with oil grooves facing pinion and retain with petrolatum. Position short pinion half of adjacent "paired" thrust washer and retain with petrolatum.

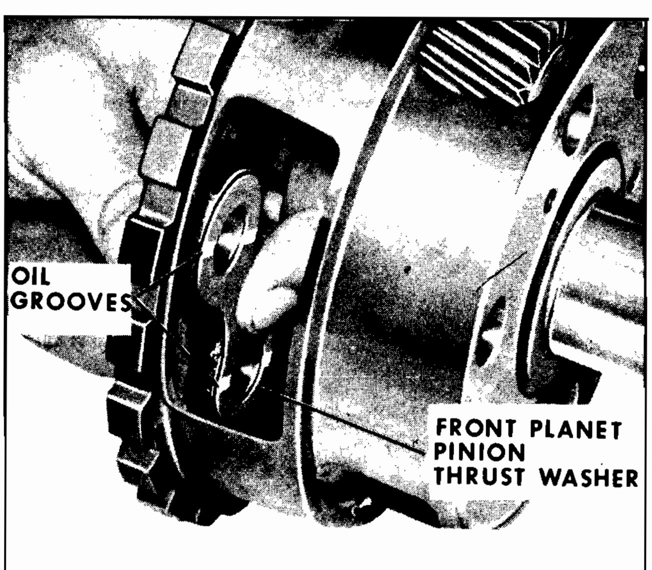


Fig. 7F-69 Installing Long Pinion Front Thrust Washer

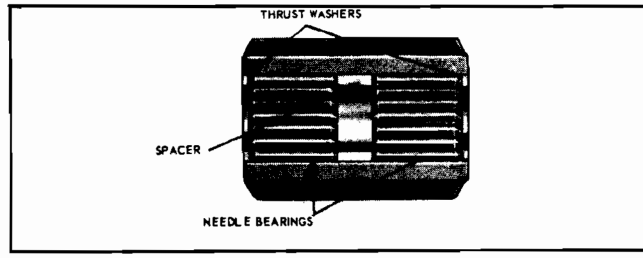


Fig. 7F-70 Long Pinion and Bearing

9. Install 20 needle bearings and 2 thrust washers, one washer at each end, in short planet pinion. Retain with petrolatum.

10. Hold short pinion and needle bearing assembly in position and install short pinion shaft from front of planet carrier. As shaft is pushed in, make certain that it picks up thrust washers. Turn pinion shaft so that lock plate slot faces center of planet carrier.

NOTE: Repeat steps 8 through 10 above to install remaining two short pinions.

11. Install planet pinion lock plate. Rotate plate so that tabs align with slots in planet pinion shafts and the three attaching screw holes. Install three screws with lockwashers and tighten securely.

LOW SERVO ASSEMBLY

DISASSEMBLY

CAUTION: The low servo assembly spring force is very high. Use extreme care when disassembling or assembling.

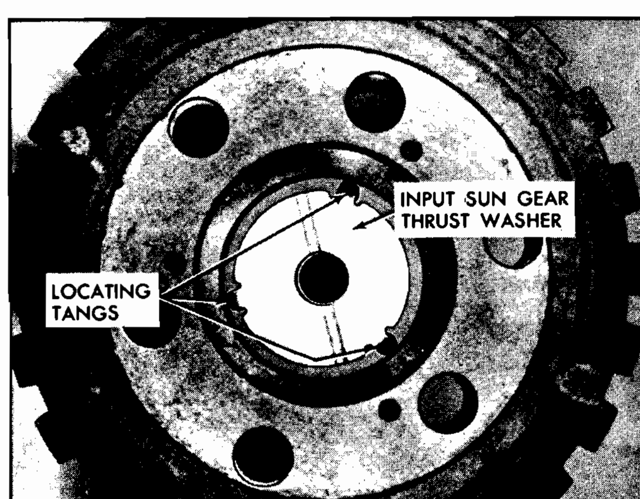


Fig. 7F-71 Input Sun Gear Thrust Washer

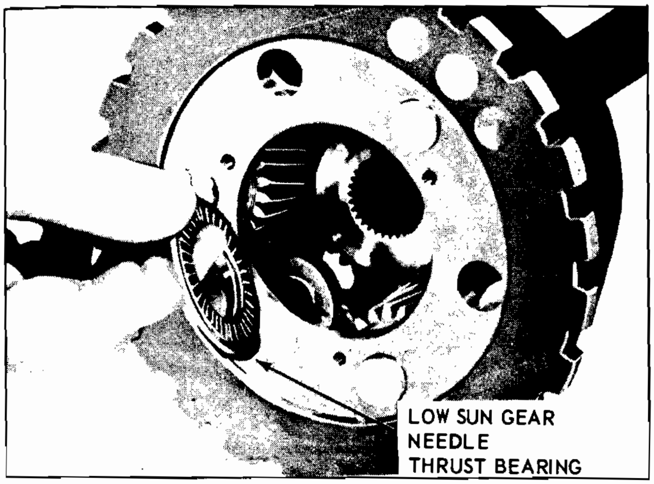


Fig. 7F-72 Installing Low Sun Gear Needle Thrust Bearing

1. Remove low servo piston oil seal from secondary piston assembly.

2. Mount J 22269 in vise, compress primary piston in J 22269 (Fig. 7F-73) and remove retaining ring. Remove primary piston, two springs, apply pin and washer from secondary piston assembly.

NOTE: Secondary piston assembly is to be serviced as a unit.

INSPECTION AND REPAIR

Visually examine parts for damage or wear. Discard worn or damaged parts. Remove and discard low servo piston oil seal.

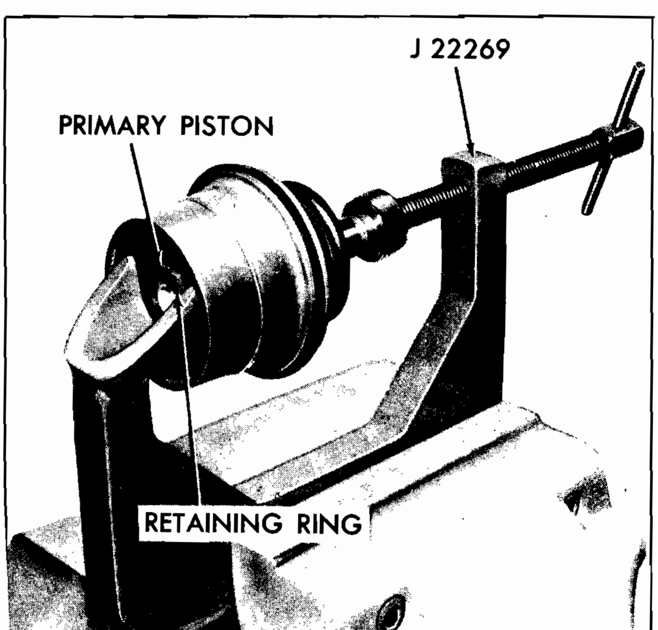


Fig. 7F-73 Compressing Low Servo

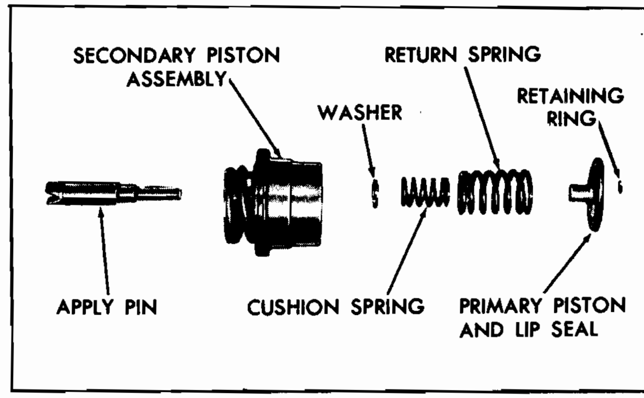


Fig. 7F-74 Low Servo Assembly

ASSEMBLY

1. Install washer into secondary piston assembly and install cushion and return springs into secondary piston assembly (Fig. 7F-74).

2. Install apply pin to primary piston by compressing in J 22269 (Fig. 7F-73). Install retaining snap ring.

3. Remove tool and install new low servo piston oil seal on secondary piston assembly.

OIL PUMP

DISASSEMBLY

1. Remove the two hook-type oil seal rings from pump hub (Fig. 7F-75).

2. Remove pump cover to forward clutch drum thrust washer.

3. Remove and discard oil pump to case seal.

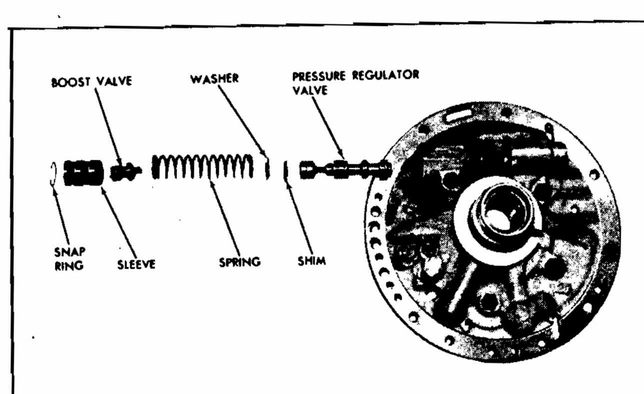


Fig. 7F-75 Removing Oil Seal Rings

4. Support oil pump on wood blocks. Remove five pump cover bolts and remove pump cover.

5. Identify gear faces so that gears can be reassembled in their original position and remove drive and driven gears.

6. If necessary, remove converter blow off valve. Depress converter blow off valve spring (Fig. 7F-76). Remove retaining pin, spring and valve.

7. On MA and MC models, remove downshift timing valve from pump cover (Fig. 7F-77).

8. Compress main pressure regulator valve spring by pressing on boost valve sleeve with thumb and remove retaining snap ring (Fig. 7F-78).

CAUTION: Valve spring is under high force. Use extreme after snap ring has been removed.

9. Remove boost valve sleeve, valve, spring, washer and pressure regulator valve (Fig. 7F-79).

10. Remove oil pump seal with a small pry bar and discard seal (Fig. 7F-80).

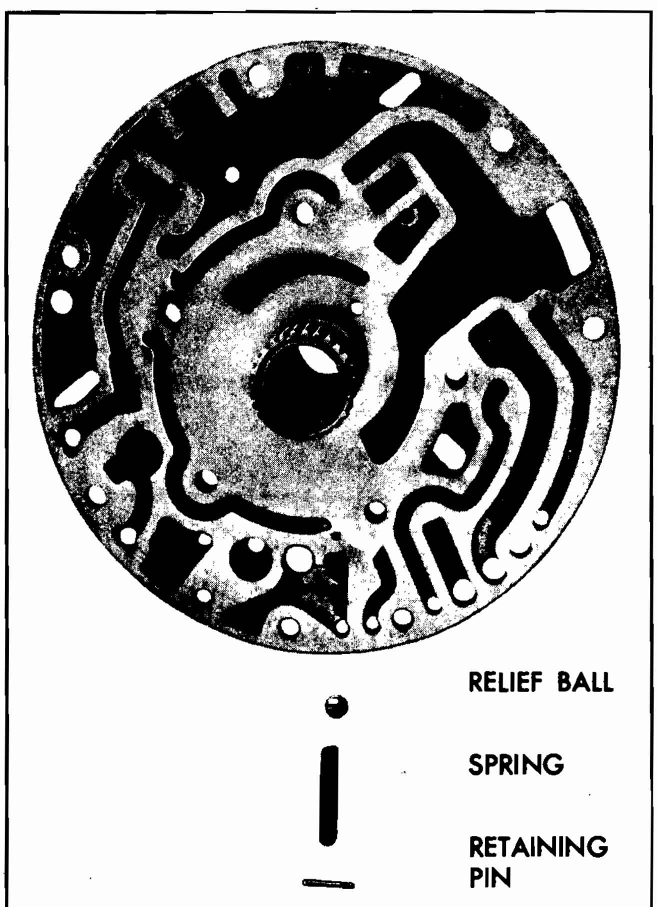


Fig. 7F-76 Converter Blow Off Valve

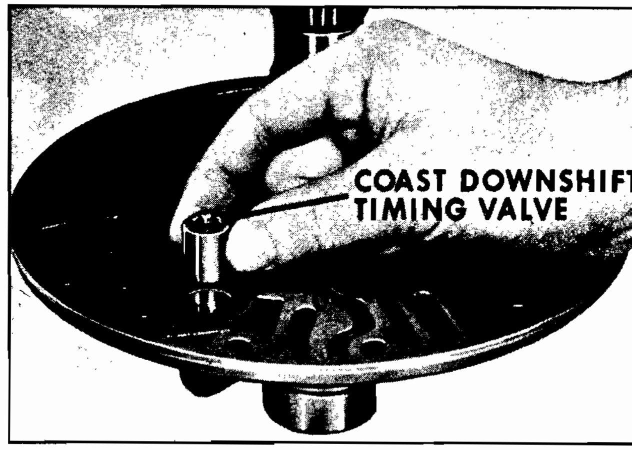


Fig. 7F-77 Removing Timing Valve

INSPECTION

1. Check oil pump bushing for nicks, severe scoring or wear. If bushing replacement is necessary, remove as follows:

a. Support pump body on wood blocks and, using Tool J 21465-17 and Drive Handle J8092, press bushing out of pump body (Fig. 7F-81).

b. Install new bushing, using Tool J 21465-17 and Drive Handle J 8092 by pressing bushing into pump body from its gear pocket face until bushing is flush to .010" below the opposite side (pump seal side).

2. Check stator shaft bushing for nicks, severe scoring or wear. If replacement is necessary, see STATOR SHAFT BUSHING REPLACEMENT below.

3. Inspect pump gears for nicks or damage.

4. Inspect pump body for nicks or scoring.

5. Place pump body, with gears installed, on converter hub and, with dial indicator set, check for clearance

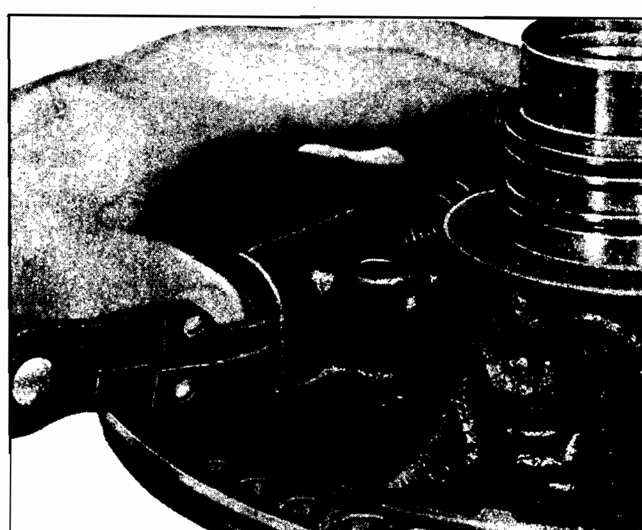


Fig. 7F-78 Removing Boost Valve Sleeve Snap Ring

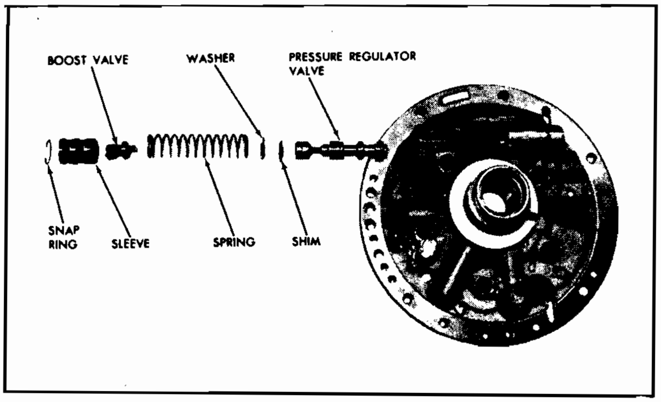


Fig. 7F-79 Pressure Regulator Assembly

(Fig. 7F-82). Correct end clearance is .0005" to .0035".

6. Inspect pressure regulator valve and boost valve ans sleeve for nicks or burrs.

STATOR SHAFT BUSHING REPLACEMENT

1. Assemble Bushing Remover J 21424-7 to Extension J 21465-13, and extension to Drive Handle J 8092. Grasp stator shaft with one hand and, with assembled tools in other hand, drive bushing out of front end of stator shaft (Fig. 7F-83).

2. Install stator shaft bushing as follows: Support pump assembly on J 21424-3 before installing bushing. Install bushing into the front end of stator shaft. Using Installer J 21424-7 and Drive Handle J 8092, tap bushing into shaft until it bottoms on shoulder in top of stator shaft (Fig. 7F-84).

CAUTION: Extreme care must be taken so bushing is not driven past shoulder.

ASSEMBLY

1. Using Tool J 21359, install new oil seal (Fig. 7F-85).

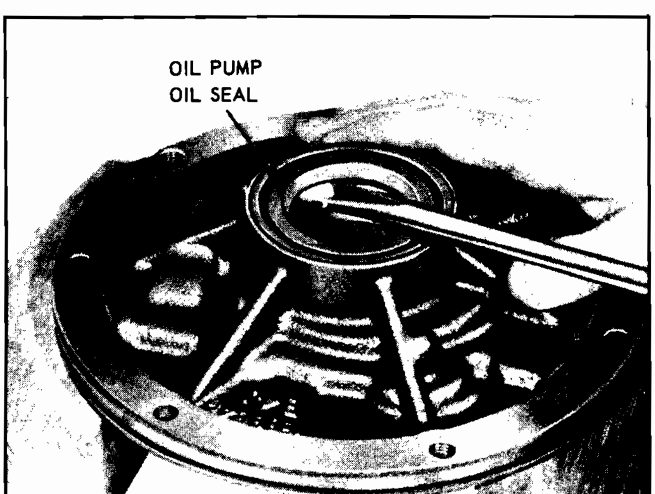


Fig. 7F-80 Removing Oil Pump Oil Seal

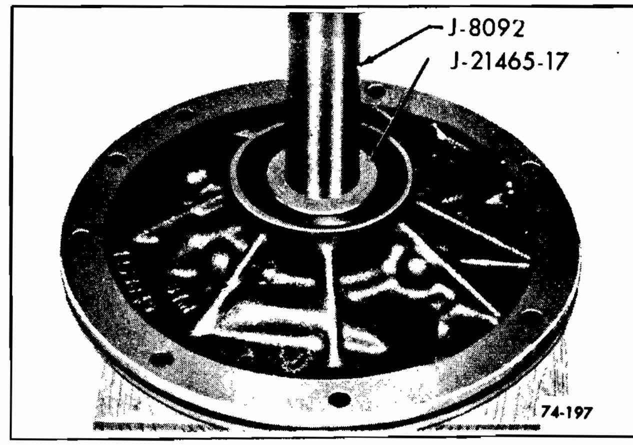


Fig. 7F-81 Removing Pump Body Bushing

2. Install new oil pump to case seal.

3. Assemble pressure regulator valve, washer spring, boost valve and sleeve (Fig. 7F-79).

NOTE: Some transmissions incorporate a C type spring washer and may have one or two C type spacers behind the washer. Install the same number of spacers originally removed.

4. Compress pressure regulator valve spring by pressingon boost valve sleeve. Install snap ring.

5. Install downshift timing valve in pump cover (models MA and MC).

6. If previously removed, install converter blow off valve and spring in the pump cover. Depress spring and install retaining pin (Fig. 7F-76).

NOTE: Thrust washer and oil pump oil sealing rings will be installed during a later operation.

7. Assemble pump body and cover. Install five retaining bolts, but do not tighten. Align pump body and cover with Tool J 21368 (Fig. 7F-86). Tighten bolts to 20 lb. ft. torque. Remove Tool J 21368.

Fig. 7F-82 Checking Gear End Clearance

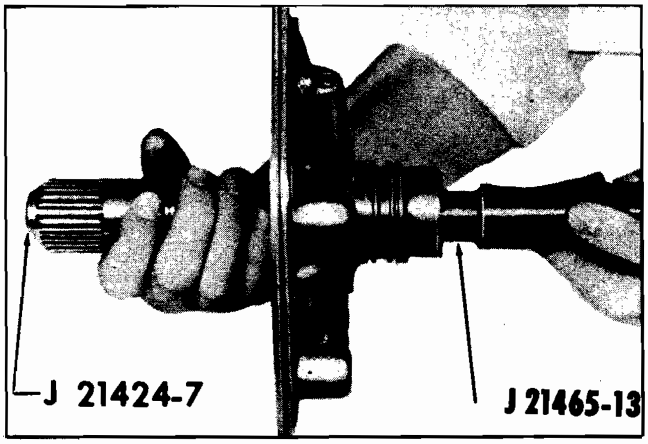


Fig. 7F-83 Removing Stator Shaft Bushing

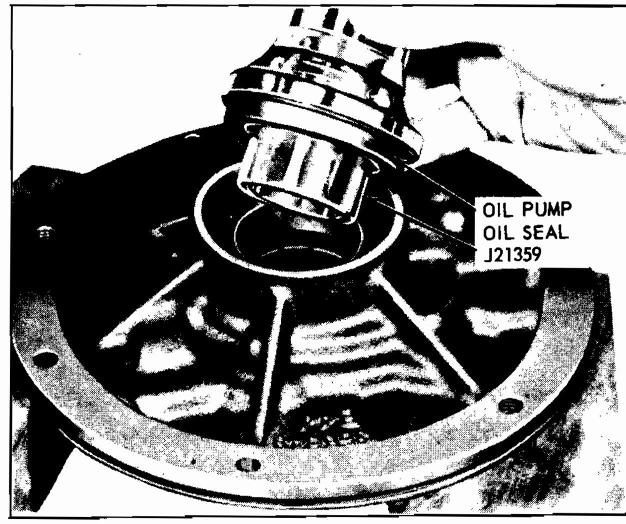


Fig. 7F-85 Installing Oil Pump Oil Seal

CONVERTER LEAK TEST

1. Install Tool J 21369 and tighten (Fig. 7F-87).

2. Fill converter with air at a pressure of 80 psi.

3. Submerge in water and check for leaks.

CONVERTER END PLAY CHECK

1. Fully release collet end of Tool J 21371-2 by turning its brass nut clockwise.

2. Install collet end of J 21371-2 into converter hub until it bottoms, then tighten brass nut to 5 lb. ft. (Fig. 7F-88).

3. Install Tool J 21371-3 and tighten hex nut to 3 lb. ft. (Fig. 7F-89).

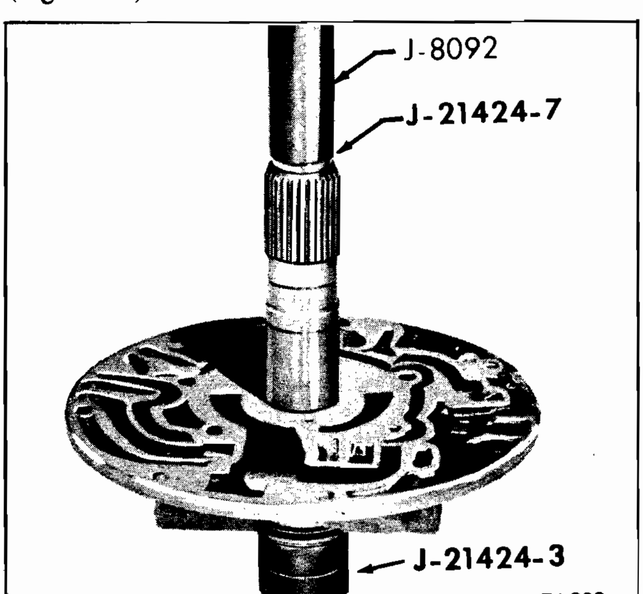


Fig. 7F-84 Installing Stator Shaft Bushing

4. When hex nut of J 21371-2 has been tightened firmly, install dial indicator and adjust for zero reading while plunger rests on brass nut of Tool J 21371-2.

5. Loosen hex nut while holding brass nut stationary, allowing converter internal assembly to lower, until dial indicator shows that internal assembly has bottomed (Fig. 7F-90).

6. The reading obtained on dial indicator represents converter and clearance. If clearance is under .050", the converter is acceptable. If clearance is .050" or over, replace the converter.

TRANSMISSION REASSEMBLY

GENERAL

Before starting to assemble transmission, make certain that all parts are absolutely clean. Keep hands and

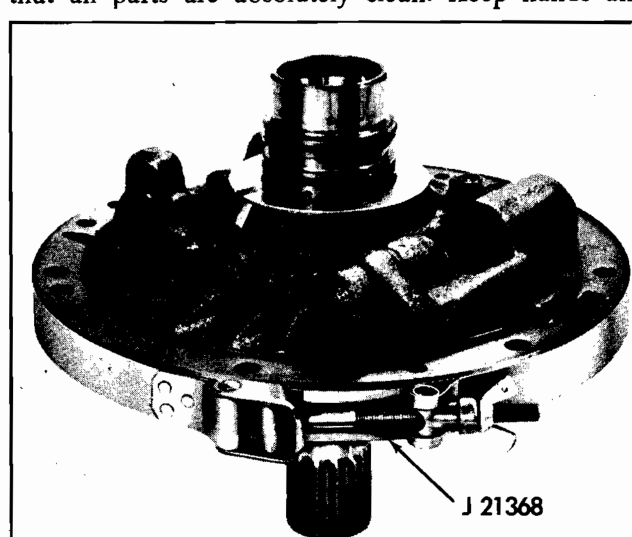


Fig. 7F-86 Aligning Oil Pump and Cover

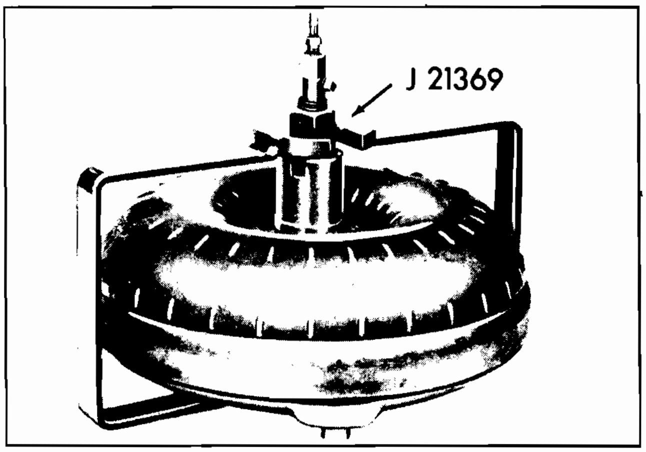


Fig. 7F-87 Air Checking Converter

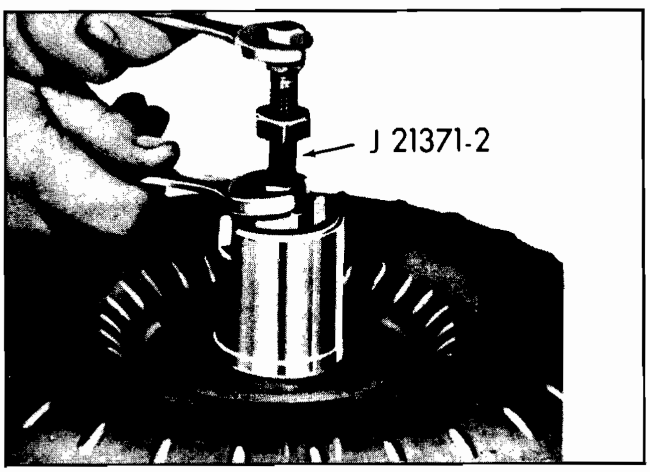


Fig. 7F-88 Installing Tool J 21371-2

tools clean to avoid getting dirt into assembly. If work is stopped before assembly is completed, cover all openings with clean cloths.

Lightly coat all moving parts with transmission oil before installation. Thrust washers may be held in place with petrolatum sparingly applied.

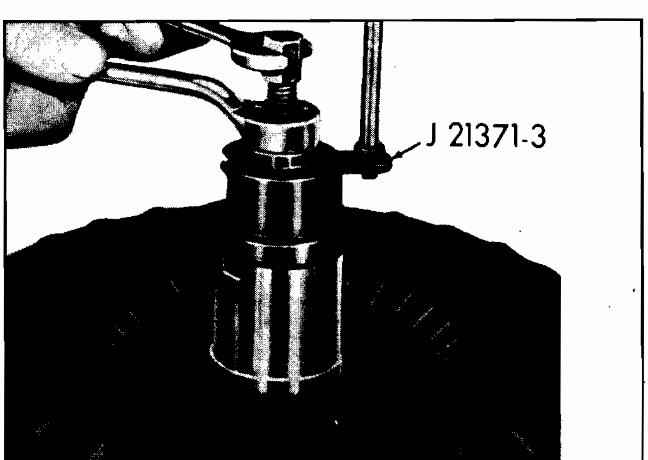


Fig. 7F-89 Installing Tool J 21371-3

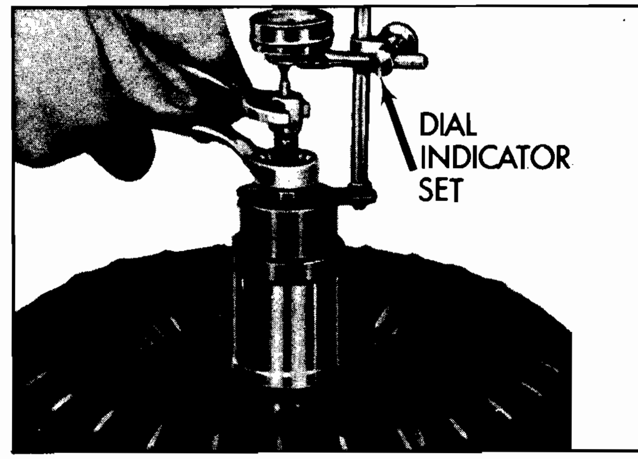


Fig. 7F-90 Checking Converter End Clearance

Do not take a chance on used gaskets and seals - use new ones to avoid oil leaks.

Use care to avoid making nicks or burrs on parts, particularly at bearing surfaces and surfaces where gaskets are used.

It is extremely important to tighten all parts evenly to avoid distortion of parts and leakage at gaskets and other joints. Use a reliable torque wrench to tighten all bolts and nuts to specified torque.

INSTALLATION OF RANGE SELECTOR LEVER, SHAFT AND PARKING LOCK ACTUATOR

1. Hold parking lock pawl and spring in position and retain with parking lock pawl shaft (Fig. 7F-91).

2. Install range selector shaft into case with a twisting motion.

3. Install inner park lock and range selector assembly on range selector shaft and secure with nut (Fig. 7F-92).

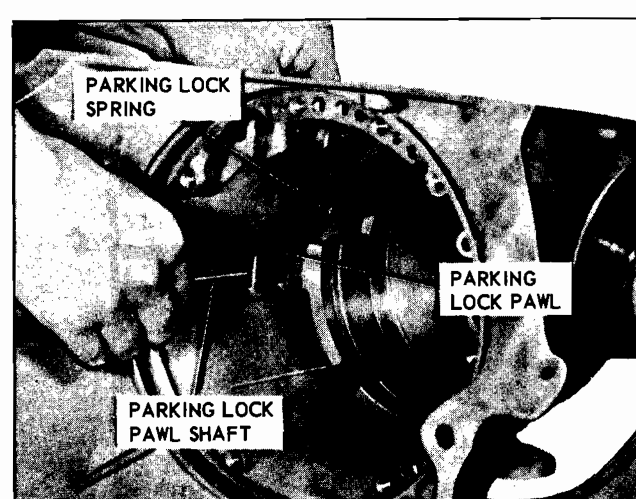


Fig. 7F-91 Installing Parking Lock Pawl Shaft

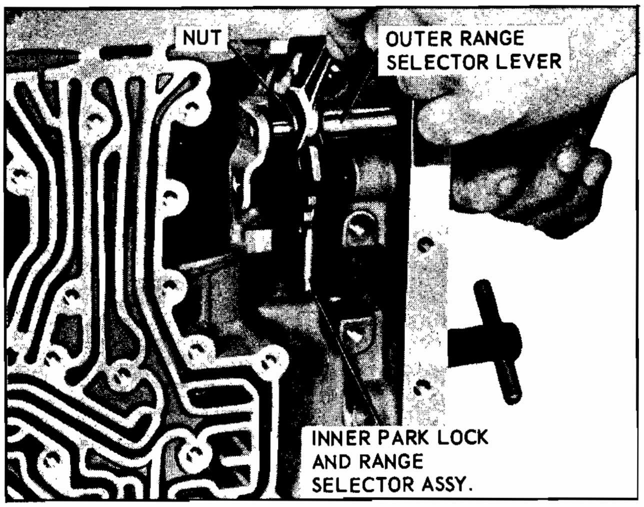


Fig. 7F-92 Installing Inner Park Lock and Range Selector

NOTE: Make certain that shorter end of outer lever is to bottom of transmission.

4. Install range selector shaft retainer (Fig. 7F-93).

5. Install parking lock bracket in case and tighten bolts to 10 lb. ft. torque (Fig. 7F-94).

INSTALLATION OF REVERSE PISTON AND CLUTCH

1. Install cushion ring if it was removed (Fig. 7F-95) and with transmission in vertical position, install reverse clutch piston into case, making certain it bottoms in case.

2. Install clutch piston return springs.

3. Position piston return seat on piston return springs. Place snap ring in position on return seat so that ring can be easily installed when seat is compressed with tool.

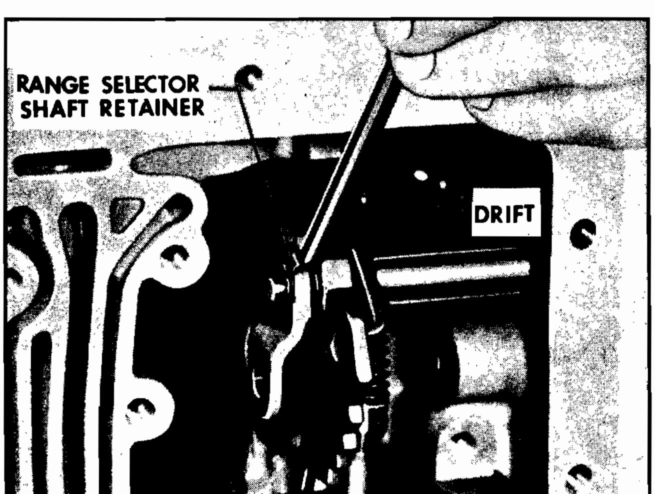


Fig. 7F-93 Installing Range Selector Shaft Retainer

Fig. 7F-94 Installing Parking Lock Bracket

4. Compress reverse piston return springs, using Spring Compressor 223327 and Pilot J 21420-2 until snap ring groove is exposed (Fig. 7F-96). Install snap ring and remove tool.

NOTE: As spring retainer is compressed, make certain inner edge of seat does not hang up on snap ring groove.

5. Install reverse clutch reaction plates and drive plates as shown in Fig. 7F-97. Notched lug in each steel reaction plate is installed so that it is at top of groove at 5 o'clock position in case (Fig. 7F-98).

NOTE: Number of plates used are: LA, LD, LF, LH -4 steel and 4 faced; MA, MC - 5 steel and 5 faced.

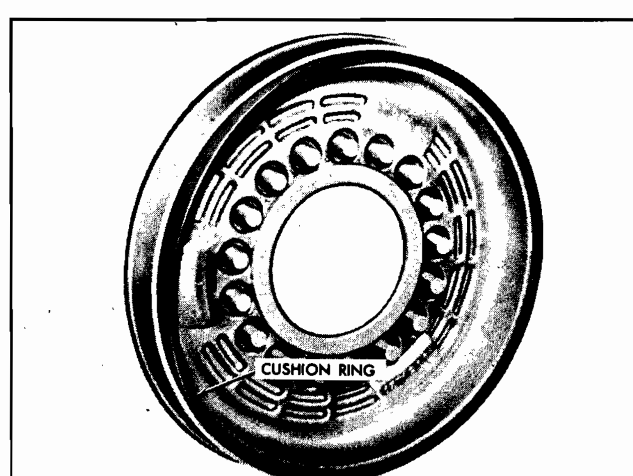


Fig. 7F-95 Reverse Clutch Cushion Ring

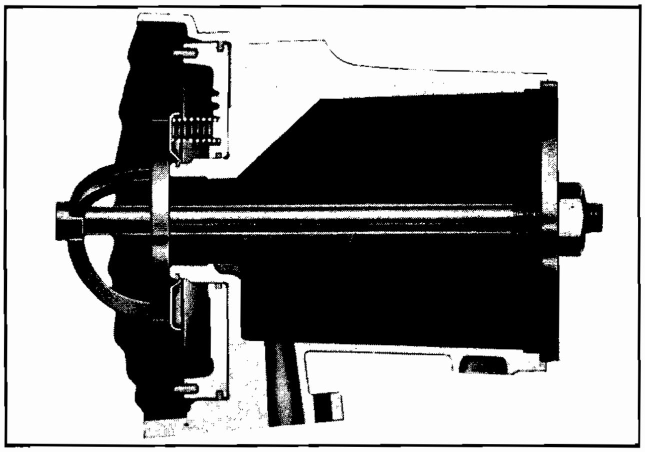


Fig. 7F-96 Compressing Reverse Piston Return Springs

6. Install pressure plate (Fig. 7F-99) with the identification mark in the 5 o'clock groove in case.

7. Install reverse clutch pack snap ring.

INSTALLATION OF PLANETARY GEAR SET

1. Install thrust bearing race with lip, needle bearing and plain race on output shaft (Fig. 7F-100). Retain on rear face of planet carrier with petrolatum (Bearing and races can be installed on case reverse clutch piston hub, if desired).

2. Install reverse ring gear (Fig. 7F-101).

3. Install planetary gear set.

INSTALLATION OF LOW SERVO ASSEMBLY, LOW BAND AND FORWARD CLUTCH

LOW SERVO ASSEMBLY

1. Install low servo assembly into case. Position notch to receive low band apply strut.

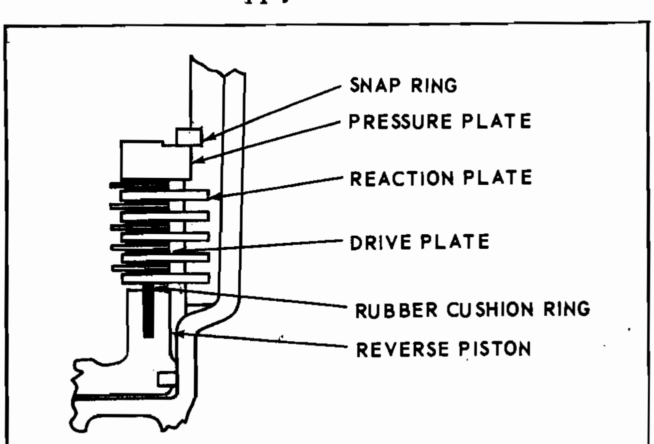


Fig. 7F-97 Reverse Clutch Pack Assembly Sequence

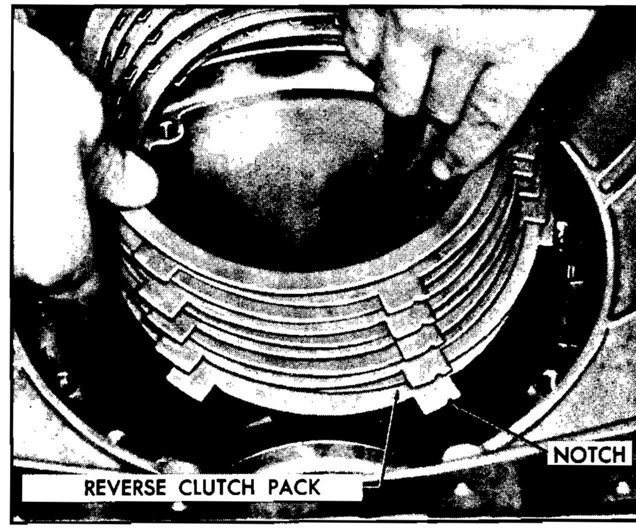


Fig. 7F-98 Installing Reverse Clutch Pack

2. Install new low servo cover oil seal and install cover. Whenever a new servo cover is installed, it will be necessary to stamp the transmission code and model on the new cover.

3. Compress low servo cover with J 22269 and install snap ring (Fig. 7F-102).

4. Remove Tool J 22269.

LOW BAND

1. With transmission in vertical position, install band adjusting screw.

2. Install low band (Fig. 7F-103).

3. Install low band apply strut and band adjusting screw strut (Fig. 7F-104). After both struts have been installed, tighten low band adjusting screw enough to prevent struts from falling out.

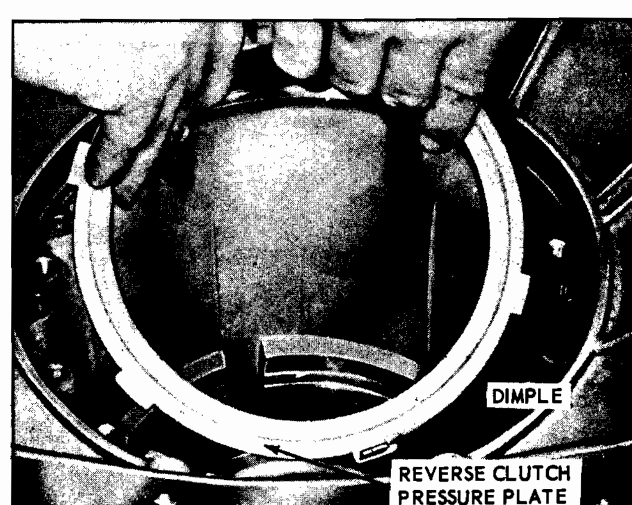


Fig. 7F-99 Installing Reverse Clutch Pressure Plate

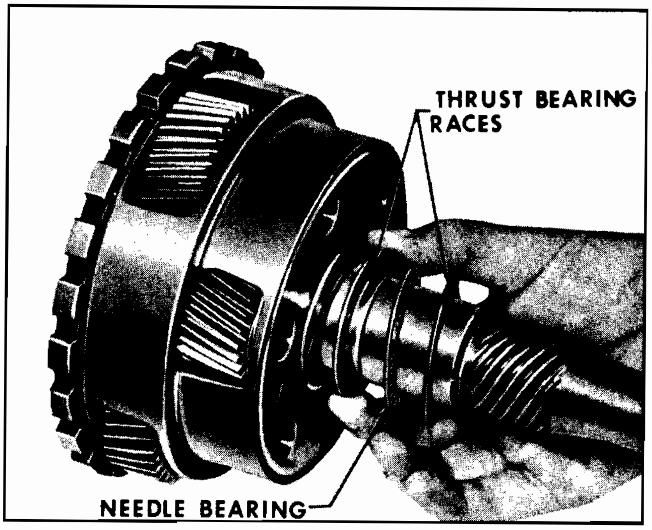


Fig. 7F-100 Installing Planet Carrier Thrust Bearing and Races

FORWARD CLUTCH

Install forward clutch assembly (Fig. 7F-105). Turn slightly to engage low sun gear with planet pinions.

CAUTION: Make certain that the low sun gear needle thrust bearing assembly and the input sun gear rear thrust washer in the planet carrier are centered before installing the forward clutch assembly.

DETERMINATION OF SELECTIVE THRUST WASHER THICKNESS

The thickness of the oil pump to forward clutch assembly thrust washer is determined as follows:

1. Install guide pins and new pump gasket (Fig. 7F 106).

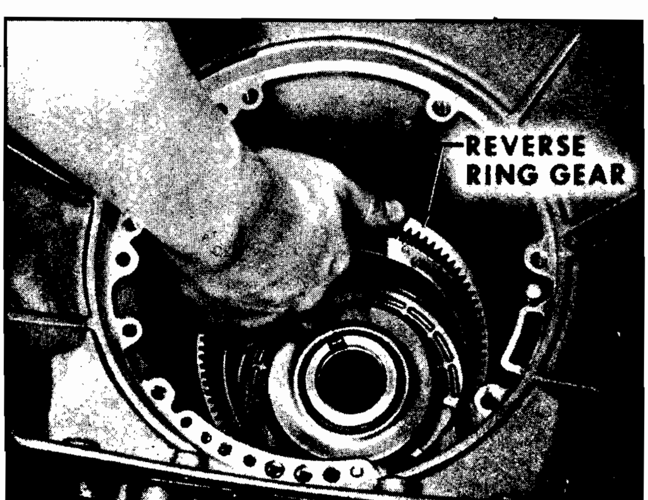


Fig. 7F-101 Installing Reverse Ring Gear

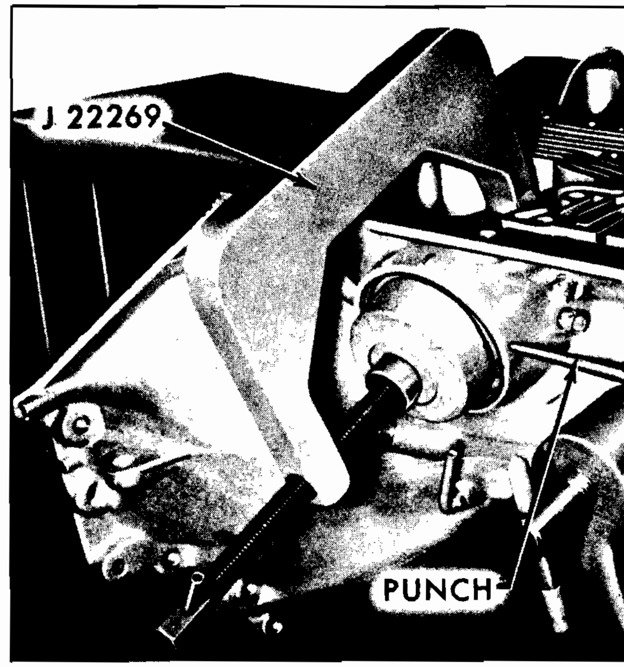


Fig. 7F-102 Installing Low Servo Cover Snap Ring

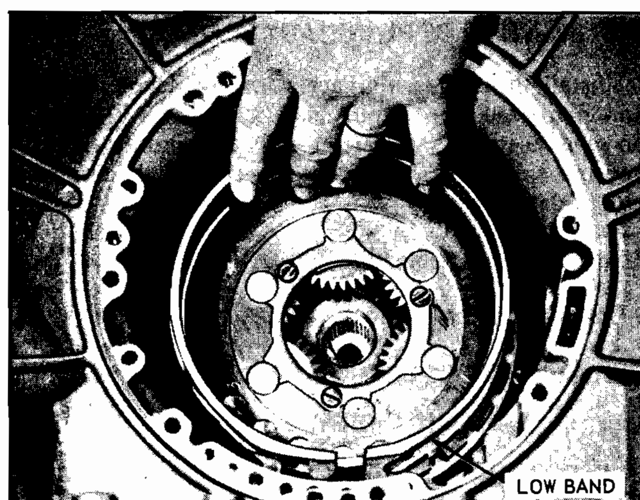


Fig. 7F-103 Installing Low Band

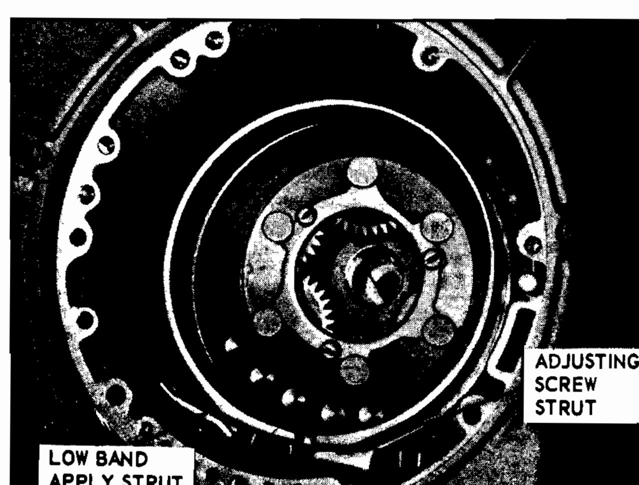


Fig. 7F-104 Low Band Struts Installed

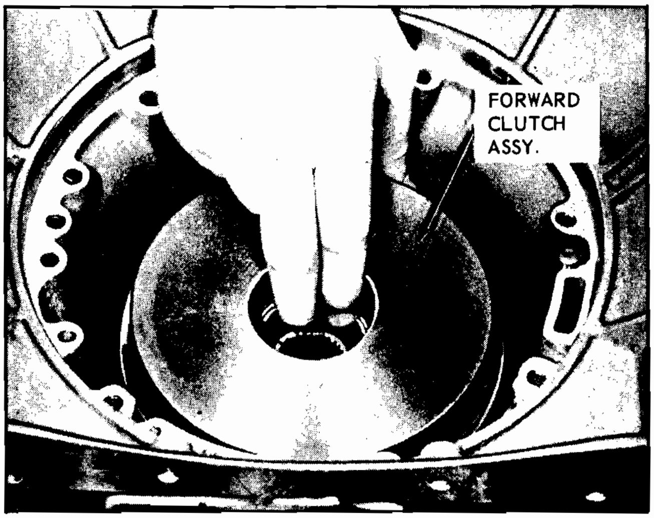


Fig. 7F-105 Installing Forward Clutch

2. Install input shaft into oil pump (Fig. 7F-107) and install oil pump (less oil seal rings, but with old or .061" thrust washer) into case.

3. Remove guide pins and install at least three oil pump retaining bolts. Tighten bolts to 20 lb. ft. torque.

4. With transmission in a vertical position, install a dial indicator so that its plunger bears on end of input shaft and zero the indicator (Fig. 7F-108).

5. Push up on output shaft and record amount of end play registered on dial indicator.

NOTE: If end play is less than .008", check for improper assembly of parts.

6. Refer to chart (Fig. 7F-109) and select correct thickness of thrust washer to establish a running clearance of .008"-.051" (If end play is more than .051" with .097" thrust washer installed, check for excessive wear of assembled parts or omitted thrust washers, races or bearings in or behind planet carrier).

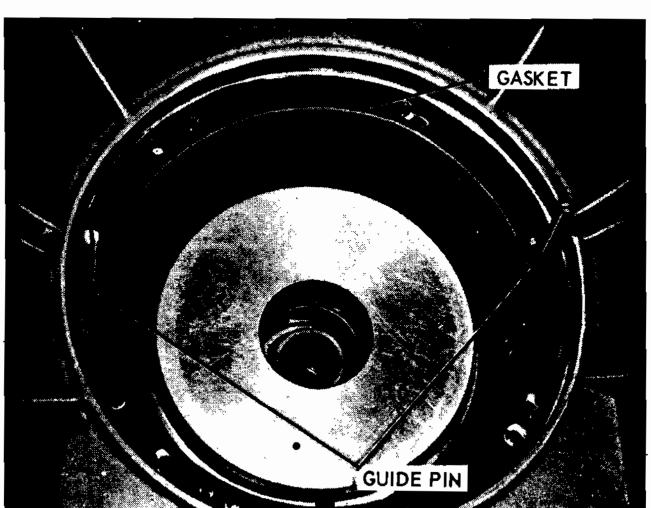


Fig. 7F-106 Guide Pins and Gasket Installed

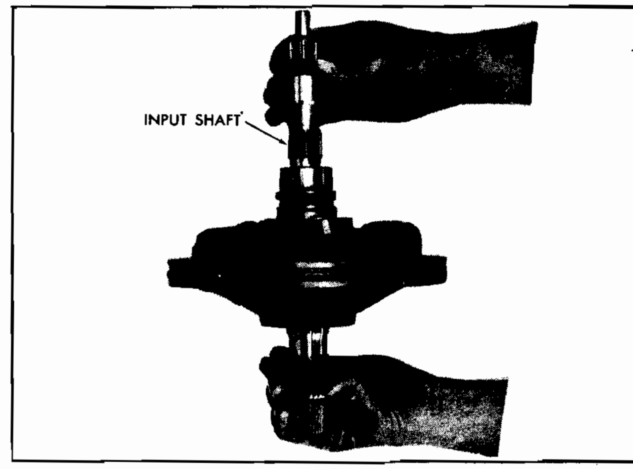


Fig. 7F-107 Installing Input Shaft Into Pump

NOTE: Selective thrust washers are available in three thicknesses: .061", .079" and.097". Since there are no identifying marks on these thrust washers, it will be necessary to measure thickness with a micrometer if thickness is in doubt.

7. Remove oil pump and input shaft.

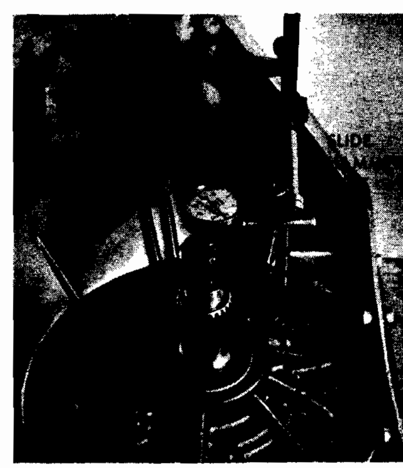


Fig. 7F-108 Checking Front Unit End Play

IF END PLAY IS:	CORRECT THRUST WASHER THICKNESS IS:
.008" to .038"	.061"
.039" to .079"	.079"
.061" to .085"	.097"

Fig. 7F-109 Selective Thrust Washer Chart

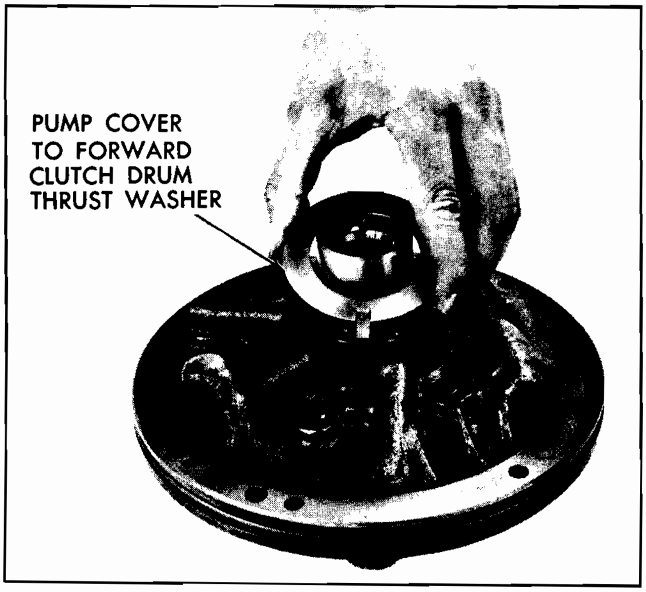


Fig. 7F-110 Installing Thrust Washer

INSTALLATION OF OIL PUMP

1. Install selective thrust washer on pump hub with tang down and in slot (Fig. 7F-110). See chart for determination of selective thrust washer thickness (Fig. 7F-109).

2. Install two hook type oil seal rings on pump hub (Fig. 7F-111). Make certain rings are free to move in grooves.

3. Reinstall guide pins.

4. Install two input shaft hook type oil seal rings. Make certain two rings are free to move in grooves.

5. Install input shaft into oil pump (Fig. 7F-107) and install oil pump into case. Make certain input shaft turns freely in pump before tightening pump to case.

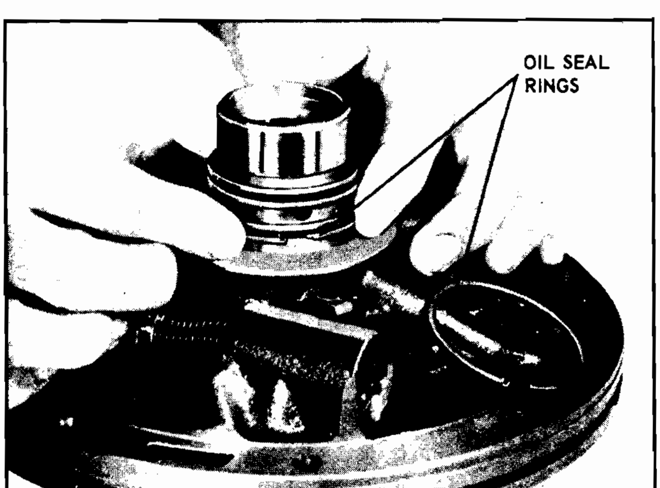


Fig. 7F-111 Installing Oil Seal Rings

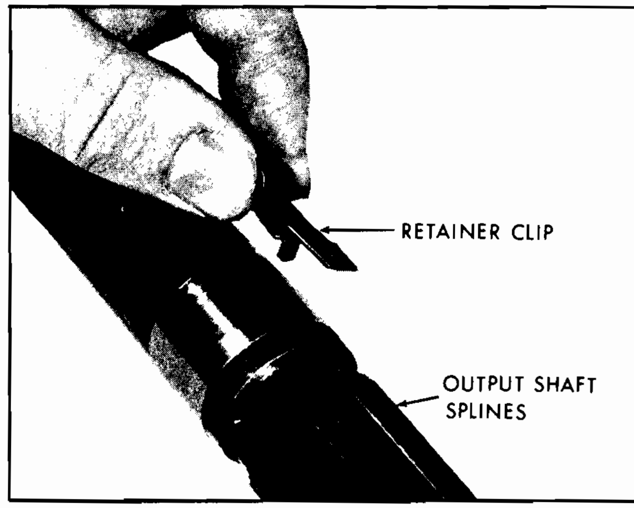


Fig. 7F-112 Installing Speedometer Drive gear Retaining Clip

6. Remove guide pins and install oil pump retaining bolts with new washer type seals under each bolt head. Tighten bolts to 20 lb. ft. torque.

LOW BAND ADJUSTMENT

1. Tighten low band adjusting screw to 40 lb. in. torque.

2. Back off adjusting screw four turns.

3. Hold adjusting screw and tighten lock nut.

4. Install adjusting screw cap.

INSTALLATION OF SPEEDOMETER DRIVE GEAR

1. Place retainer into hole in output shaft (Fig. 7F 112).

Fig. 7F-113 Installing Speedometer Drive Gear

2. Align slot in speedometer drive gear with retainer clip and slide gear into place (Fig. 7F-113).

INSTALLATION OF REAR BEARING RETAINER, GOVERNOR, VACUUM MODULATOR, SPEEDOMETER DRIVE GEAR AND VALVE BODY

See SERVICE OPERATIONS - TRANSMISSION IN CAR (page 7F-3).

INSTALLATION OF CONVERTER

1. Install converter into transmission, engaging drive lugs of oil pump drive gear.

2. Install Converter Holding Strap J 21366.

INSTALLATION OF TRANSMISSION ASSEMBLY

Reverse the procedure for transmission removal as stated on page 7F-12.

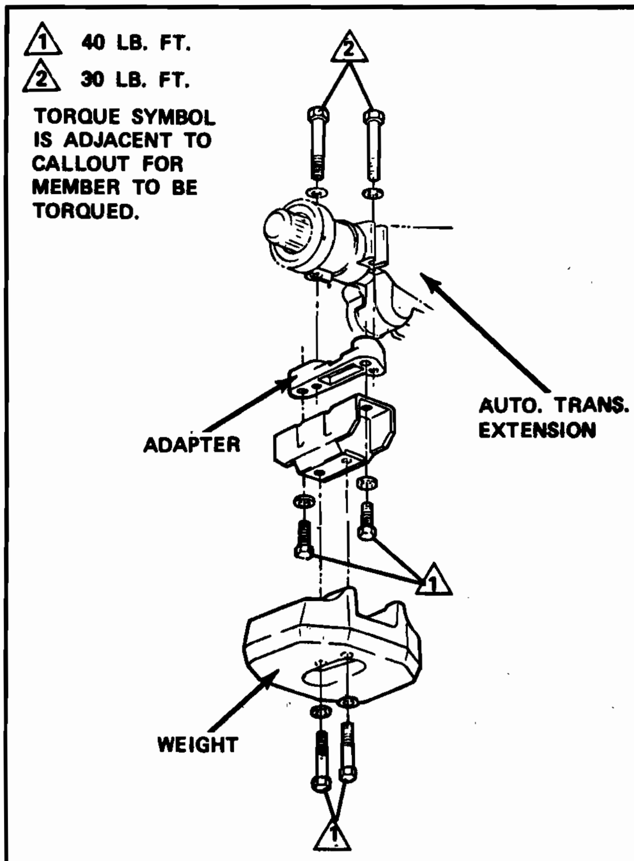


Fig. 7F-114 Driveline Damper

FIREBIRD DRIVELINE DAMPER

A driveline damper is used to reduce power train vibration to an acceptable level. The damper is mounted under the rear of the transmission extension and consists of a weight retained by a mounting assembly which, in turn, is attached to the under side of the transmission extension through an adapter (Fig. 7F-114).

OIL PRESSURE CHECKS

Pressure checks are a useful part of trouble diagnosis. The pressure tap for checking mainline pressure is located above the oil pan rail on the right side of the transmission and to the rear of the low servo.

Tests can be made without driving the vehicle by simply raising rear wheels 3-5 inches from floor on jack stands. With pressure gauge installed, perform following preliminary steps:

1. Establish pressure gage indicator needle rest position at zero pressure.
2. Thoroughly warm up transmission.
3. Check transmission oil level.
4. Make sure vacuum line connections are tight.
5. Check linkage adjustment.
6. Mainline pressure will vary from one transmission to another but following statements apply in general:

a. Line pressure should increase as engine manifold vacuum decreases, at a constant speed.

b. Line pressure should decrease as car speed increases, at a constant engine manifold vacuum (for example, about 13 psi between 40-60 mph).

c. Reverse pressure should be about 85 psi at idle to over 200 psi at stall (wide open throttle with brakes on).

NOTE: Do not operate at wide open throttle with brakes on longer than it is necessary to obtain a gage reading.

MAXIMUM LINE PRESSURE

Maximum line pressure checks are to be made in garage bay with vacuum modulator line disconnected and plugged and with engine speed set at 1000 rpm. See figure 7F-115 for pressures.

MINIMUM LINE PRESSURE

Minimum line pressure checks are to be made while road testing the car with the vacuum modulator line connected . Checks are to be made as follows:

1. Park, Neutral and Drive - 56 psi. Drive - coast at 20-40 mph with foot off throttle. Neutral and Park check at 1000 rpm.

2. Low - 92 psi; coast at 20-40 mph with foot off throttle.

3. Reverse - 84 psi; coast with foot off throttle.

NOTE: Pressure tap is located beside the low servo cover (Fig. 7F-2).

EXTERNAL OIL LEAKS

OIL LEAKS

Before attempting to correct an oil leak, the actual source of leak must be determined. In many cases, the source of 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 source of leak. Red dye is used in the transmission oil at the assembly plant and will indicate if oil leak is from transmission.

If available, the use of a "Black Light" to locate point at which oil is leaking is helpful. Comparing oil from leak to that on engine or transmission dipstick, when viewed by black light, will determine source of leak engine or transmission.

Oil leaks around engine and transmission are generally carried toward the rear of car by the air stream. For example, a transmission oil filler tube to case leak will sometimes appear as a leak at the rear of transmission. In determining source of leak, proceed as follows:

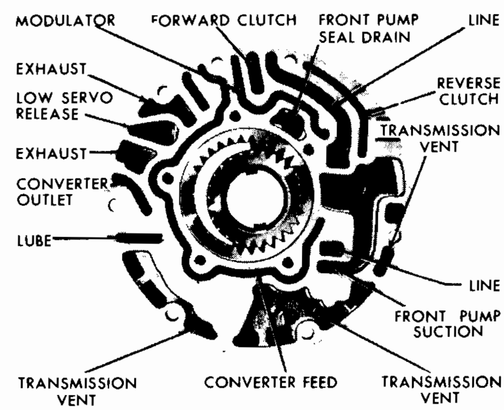


Fig. 7F-116 Oil Passages in Pump Body

1. Degrease underside of transmission.

2. Road test to get unit at operating temperature.

3. Inspect for leak with engine running.

4. With engine off, check for aoil leaks due to the raised oil lever caused by drain back.

POSSIBLE POINTS OF OIL LEAKS

1. Transmission Oil Pan Leak

a. Attaching bolts not correctly torqued.

b. Improperly installed or damaged pan gasket.

ALTITUDE	BAROMETRIC PRESSURE	MODEL			
		LA & LF	LD & LH	MA	MC
		D & L 4 PSI	D & L 4 PSI	D & L 4 PSI	D & L 4 PSI
Sea Level	29.92	155	147	165	163
2,000 ft.	27.82	147	140	157	155
5,000 ft.	24.89	134	128	144	144
Reverse Line Pressure should exceed Drive Pressure by at least 60 psi.					

Fig. 7F-115 Maximum Line Pressure

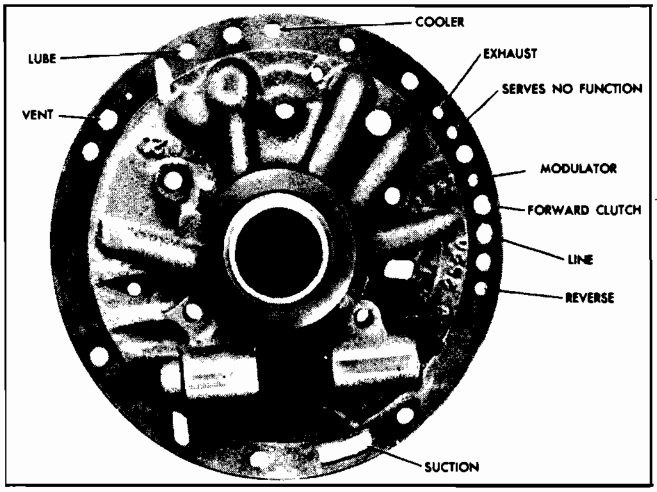


Fig. 7F-117 Oil Passages in Pump Cover

c. Oil pan gasket mounting face not flat.

2. Rear Bearing Retainer

a. Attaching bolts not correctly torqued.

b. Rear seal assembly damaged or improperly installed.

c. Square seal, extension to case, damaged or improperly installed.

d. Porous castings.

3. Case Leak

a. Filler pipe O-ring seal damaged or missing; misposition of filler pipe bracket to engine.

b. Modulator assembly O-ring seal damaged or improperly installed.

c. Solenoid connector O-ring seal damaged or improperly installed.

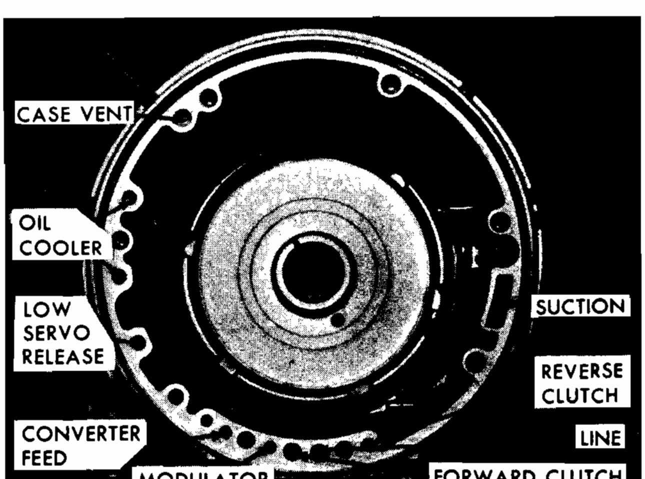


Fig. 7F-118 Oil Passages in Front of Transmission Case

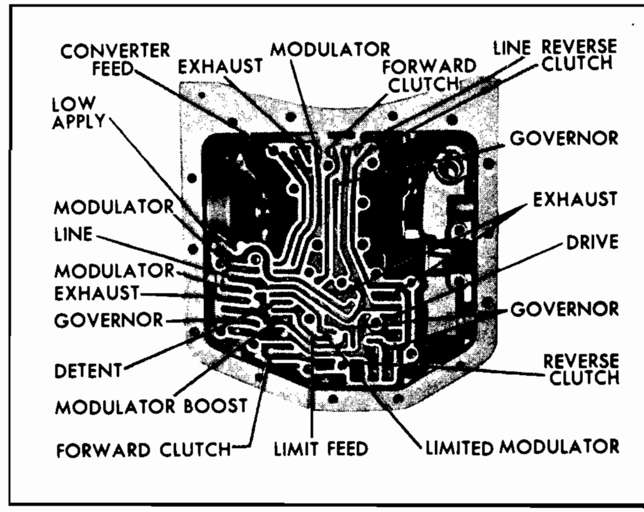


Fig. 7F-119 Oil Passages in Bottom of Transmission Case

d. Governor cover bolts not torqued, gasket damaged or leak between case face and gasket.

e. Speedometer gear O-ring damaged.

f. Manual shaft seal damaged or improperly installed.

g. Line pressure band release tap plug loose.

h. Vent pipe.

i. Porous castings.

4. Leak at Front of Transmission

a. Front pump seal leaks.

(1) Seal lip cut. Check converter hub, etc.

(2) Bushing moved and damaged. Oil return hole plugged.

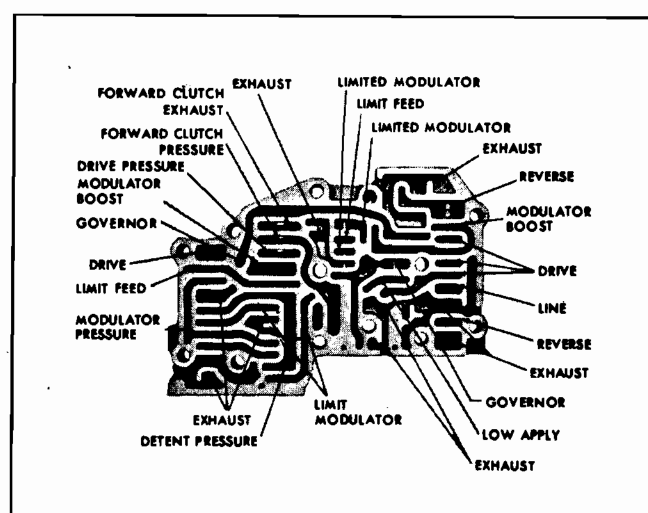


Fig. 7F-120 Oil Passages in Valve Body

(3) No oil return hole.

b. Front pump attaching bolts loose or 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 material between pump and case or between pump cover and body.

d. Case - porous near converter bosses. Front pump cover or housing oil channels shy of stock near breather.

e. Pump to case gasket mispositioned.

CASE POROSITY REPAIR

Transmission external oil leaks caused by case porosity (not cracks) have been successfully repaired with the transmission in the car by following the recommended procedure:

1. Road test and bring the transmission to operating temperature, approximately 180°F.

2. Place car on a hoist or jack stand, engine running and locate source of oil leak (see POSSIBLE POINTS OF OIL LEAKS). Check for oil leaks in DRIVE, LOW and **REVERSE** ranges.

NOTE: Use of a mirror is helpful in locating leak.

3. Shut engine off and thoroughly clean area to be repaired with a cleaning solvent and a brush, then air dry.

NOTE: A clean , dry soldering acid brush can be used to clean the area and also to apply the epoxy cement.

4. Using instructions of the manufacturer, mix a sufficient amount of epoxy cement, Group No. 4.103 (0.423), Part No. 1360016 (Z1) (or 3M-Scotch Weld-2216) to make the repair.

NOTE: Observe cautions of manufacturer in handling.

5. While transmission case is still **HOT**, apply the epoxy cement to the area to be repaired.

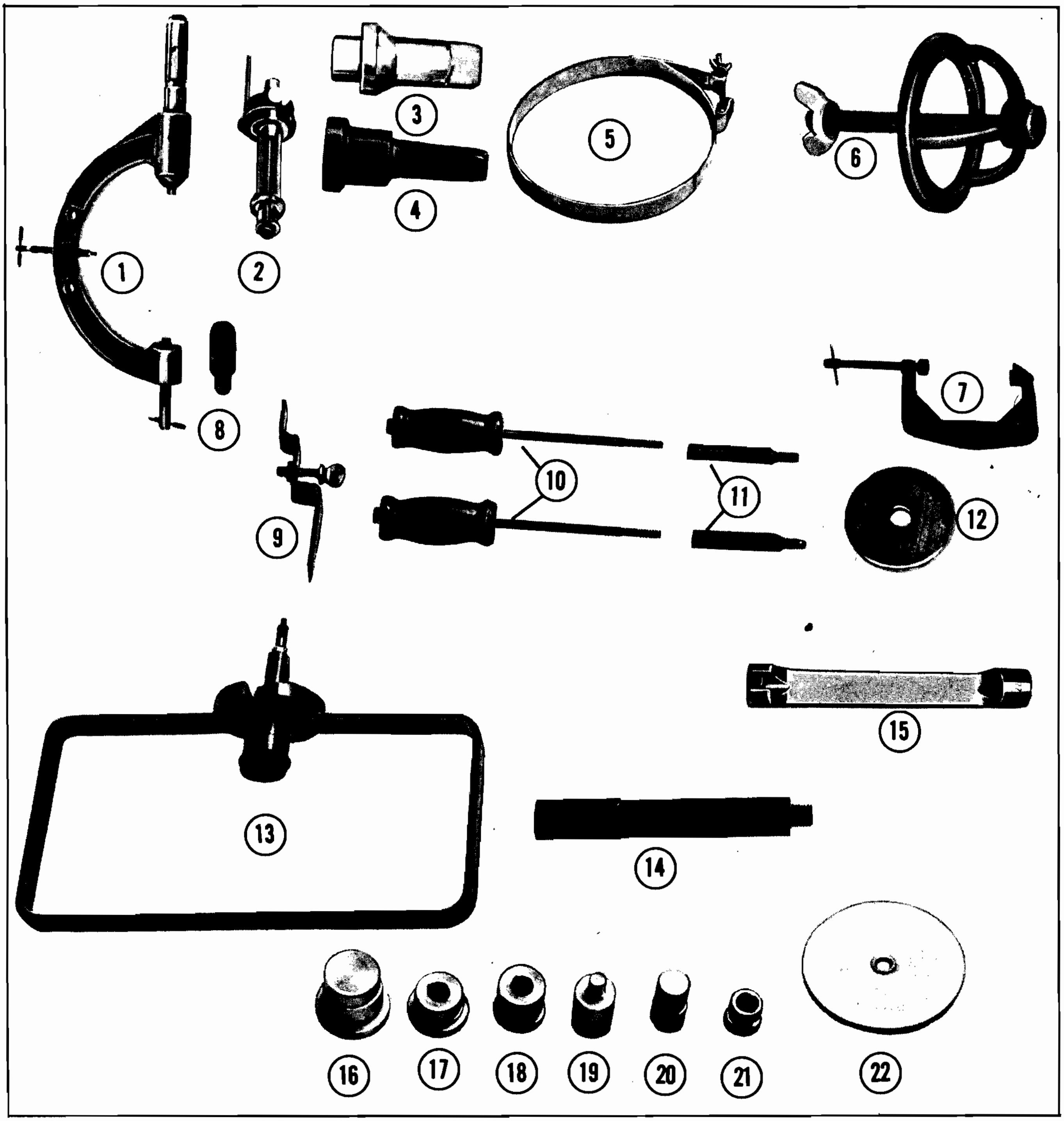
NOTE: Make sure area to be repaired is fully covered.

6. Allow epoxy cement to cure for 3 hours for 1360016 (1 hour for 3M-Scotch Weld) before starting engine.

7. Road test car to bring transmission to operating temperature of 180°F and recheck for leaks.

TORQUE SPECIFICATIONS

LOCATION	TORQUE LB. FT.
Case to Cylinder Block Bolts	40
Flywheel to Converter Bolts	30
Converter Cover Pan to Case Screws	6
Case Cooler Line Fittings	16
Low Band Adjusting Screw Lock Nut	25
Pump Body to Pump Cover Bolts	20
Valve Body to Case Bolts	10
Solenoid to Valve Body Bolts	10
Vacuum Modulator Clamp Bolt	10
Pump Assembly to Case Bolts	20
Rear Bearing Retainer to Case Bolts	30
Oil Pan to Case Bolts	12
Speedometer Sleeve Clamp Bolt	8
Governor Cover Bolts	10
Park Lock Bracket Bolts	10



1. J 8763-01 Transmission Holding Fixture
2. J 21371 Converter End Play Fixture
3. J 21359 Pump Oil Seal Installer
4. J 5154 Extension Housing Oil Seal Installer
5. J 21368 Pump Body and Cover Alignment Band
6. J 23327 Clutch Spring Compressor
7. J 22269 Low Servo Remover and Installer
8. J 9534 Output Shaft Bushing Remover
9. J 21366 Converter Holding Strap
10. J 6125 Slide Hammers
11. J 6125-2 Slide Hammer Adapters
12. J 9542-4 Forward Clutch Spring Compressor Pilot
13. J 21369 Converter Leak Test Fixture
14. J 8092 Drive Handle
15. J 22731 Oil Cooler Pipe Wrench
16. J 21424-5 Clutch Drum Bushing Remover & Installer
17. J 21424-2 Case Bushing Installer
18. J 21424-9 Rear Bearing Retainer Bushing Installer
19. J 21424-3 Output Shaft Bushing Installer
20. J 21424-7 Stator Shaft Bushing Installer
21. J 21424-4 Low Sun Gear Bushing Remover and Installer
22. J 21420-2 Reverse Clutch Spring Compressor Pilot

— NOT SHOWN —

J 6407-1 Press Plate Adapter (Fig. 7F-13)
J 6407-2 Press Plate Adapter (Fig. 7F-13)
J 8400-1 Chisel (Fig. 7F-9)
J 8904 Press Plate (Fig. 7F-13)
J 21465-13 Drive Handle Extension (Fig. 7F-83)
J 21465-17 Pump Body Bushing Remover (Fig. 7F-81)

Fig. 7F-121 Special Tools

TURBO HYDRA-MATIC (M-38) TRANSMISSION

CONTENTS OF THIS SECTION

TRANSMISSION

TOWING

If the transmission, drive line or axle do not have a malfunction, the vehicle may be towed in neutral, with steering column unlocked, at speeds up to 35 mph. The distance should not exceed 50 miles. For higher speeds or extended distances, it is recommended that the propeller shaft be disconnected or the rear wheels be off the ground.

TRANSMISSION IDENTIFICATION NUMBER AND VEHICLE IDENTIFICATION NUMBER

A production day and shift built number, transmission model and model year are stamped on the 1-2 accumulator cover, which is located on the middle lower right side of the transmission case (Fig. 7G-2). The vehicle identification number is stamped on the lower left side of the case, next to the manual shaft. The application of each transmission model is as follows:

JA - 250 OHC6 - 1 Bbl. (Tempest).

JB - 250 OHC6 - 1 Bbl. (Firebird).

JC - 250 OHC6 - 4 Bbl. (Tempest).

JD - 250 OHC6 - 4 Bbl. (Firebird).

JF - 350 cu. in. - 2 Bbl. (Tempest & Firebird) except A/C.

Whenever the 1-2 accumulator cover is replaced, it will be necessary to stamp transmission identification

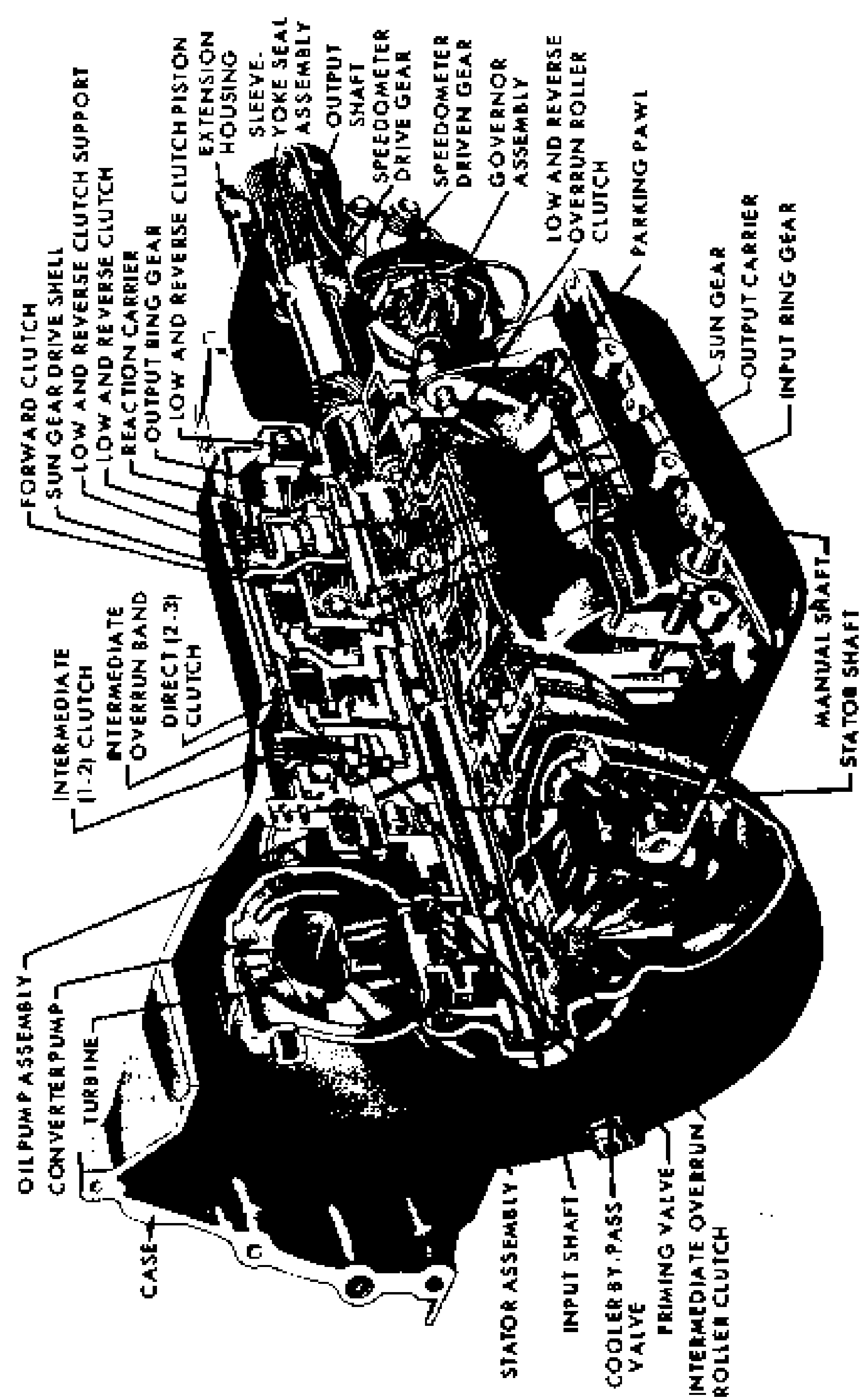


Fig. 7G-1 Side Cross Section of Turbo Hydra-Matic (M-38) Transmission

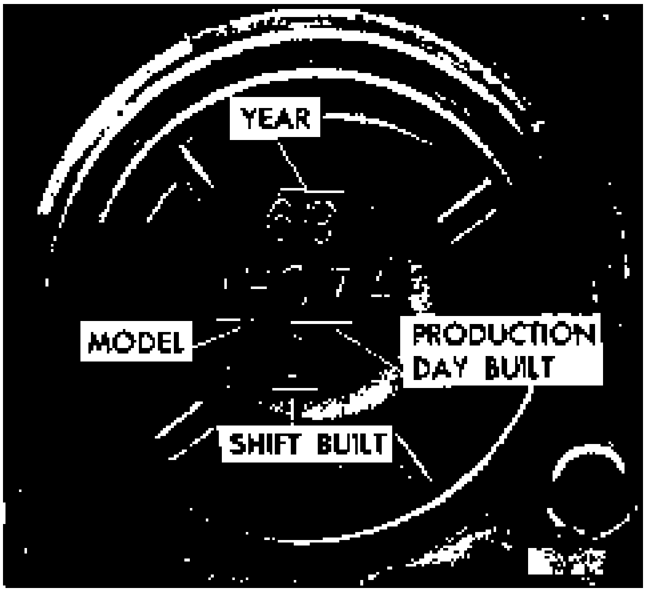


Fig. 7G-2 Transmission Model Identification

number from original cover to the new cover. All transmission parts returned to Pontiac Motor Division, and any communications concerning same, must be identified by transmission identification and vehicle identification numbers.

PERIODIC SERVICE RECOMMENDATIONS

TRANSMISSION FLUID

Transmission fluid level should be checked (with transmission hot) every time engine oil level is checked or every 6,000 miles when engine oil is changed.

CAUTION: Since the Turbo Hydra-Matic (M-38) transmission is very sensitive to oil level, special precautions should be taken when checking the oil level to ensure against an overfill (see Checking Procedure, page 7G-7).

Transmission fluid should be changed every 24,000 miles or 24 months. When the car is in heavy duty service (police, taxi, fleet service or for cars subjected to heavy city traffic during hot weather), it is recommended that the fluid be changed at 12,000 mile intervals.

ADJUSTMENTS WITH TRANSMISSION IN CAR

SHIFT CONTROL AND BACK DRIVE LINKAGE ADJUSTMENT

COLUMN SHIFT CONTROLS

NOTE: For Tempest models, see Fig. 7G-3; for Firebird models, see Fig. 7G-4.

1. Loosen screw (Tempest) or nut (Firebird) on adjusting swivel clamp.

2. Set transmission range selector lever in PARK detent.

NOTE: Obtain PARK position by rotating transmission range selector lever clockwise (view A).

3. Set upper gearshift lever in PARK position and lock ignition.

4. Push up on gearshift control rod to take up clearance in steering column lock mechanism and tighten screw on adjusting swivel clamp to 20 lb. ft. (Tempest); tighten nut on adjusting swivel clamp to 30 lb. ft. (Firebird).

CONSOLE SHIFT CONTROLS

NOTE: For Tempest models, see Fig. 7G-5; for Firebird models, see Fig. 7G-6.

1. Disconnect shift cable from transmission range selector lever by removing nut from pin.

2. Adjust back drive linkage by following the procedures under COLUMN SHIFT CONTROLS.

3. After adjusting column controls, unlock ignition and rotate transmission range selector lever counterclockwise two detent positions.

4. Set console gearshift lever in NEUTRAL range and move it forward against its stop in NEUTRAL.

5. Assemble shift cable and pin to transmission range selector lever, allowing cable to position pin in slot of lever and then install and tighten nut to 30 lb. ft. torque.

NEUTRALIZER SWITCH ADJUSTMENT

Refer to CHASSIS ELECTRICAL SERVICE, Section 12.

DETENT CABLE ADJUSTMENT

TEMPEST (Fig. 7G-7)

The detent cable is adjusted from inside the driver's compartment in the following manner:

1. With engine off and throttle valves closed (carburetor off fast idle, position the retainer (see view B) against the insert on the detent cable.

2. To adjust the cable, grasp the throttle pedal lever adjacent to the detent cable and pull the carburetor cable to the wide open throttle position.

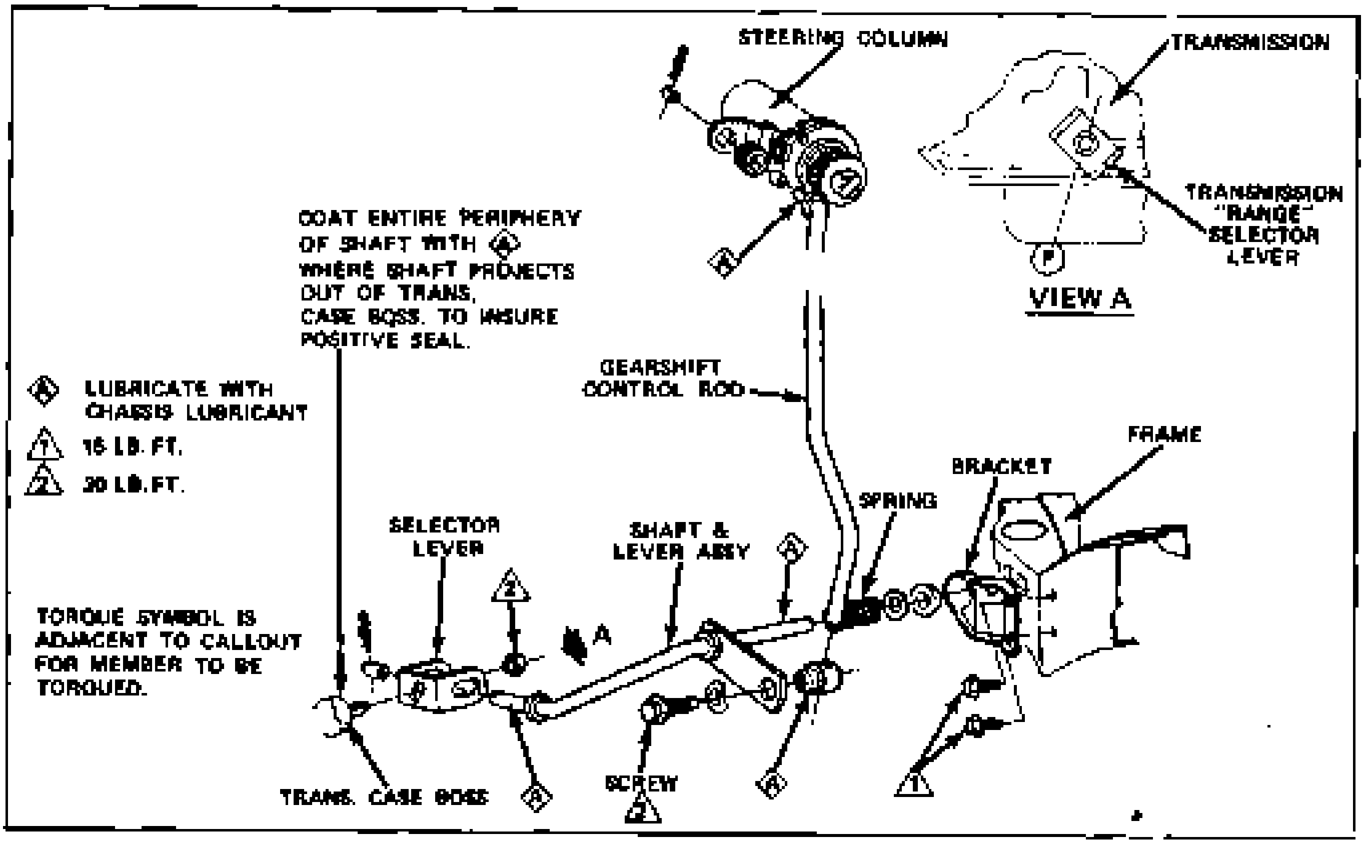


Fig. 7G-3 Column Shift Controls - Tempest

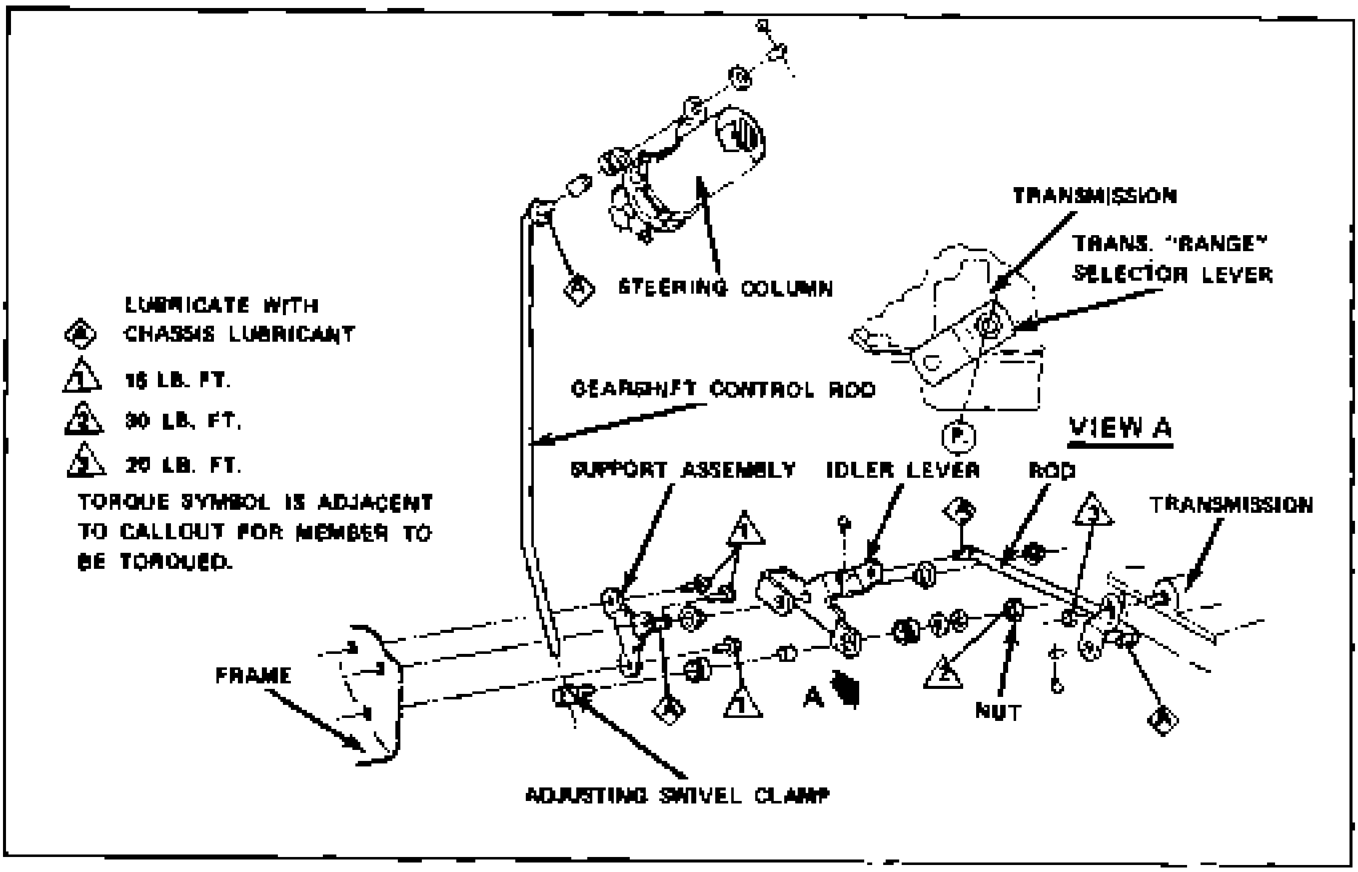


Fig. 7G-4 Column Shift Controls - Firebird

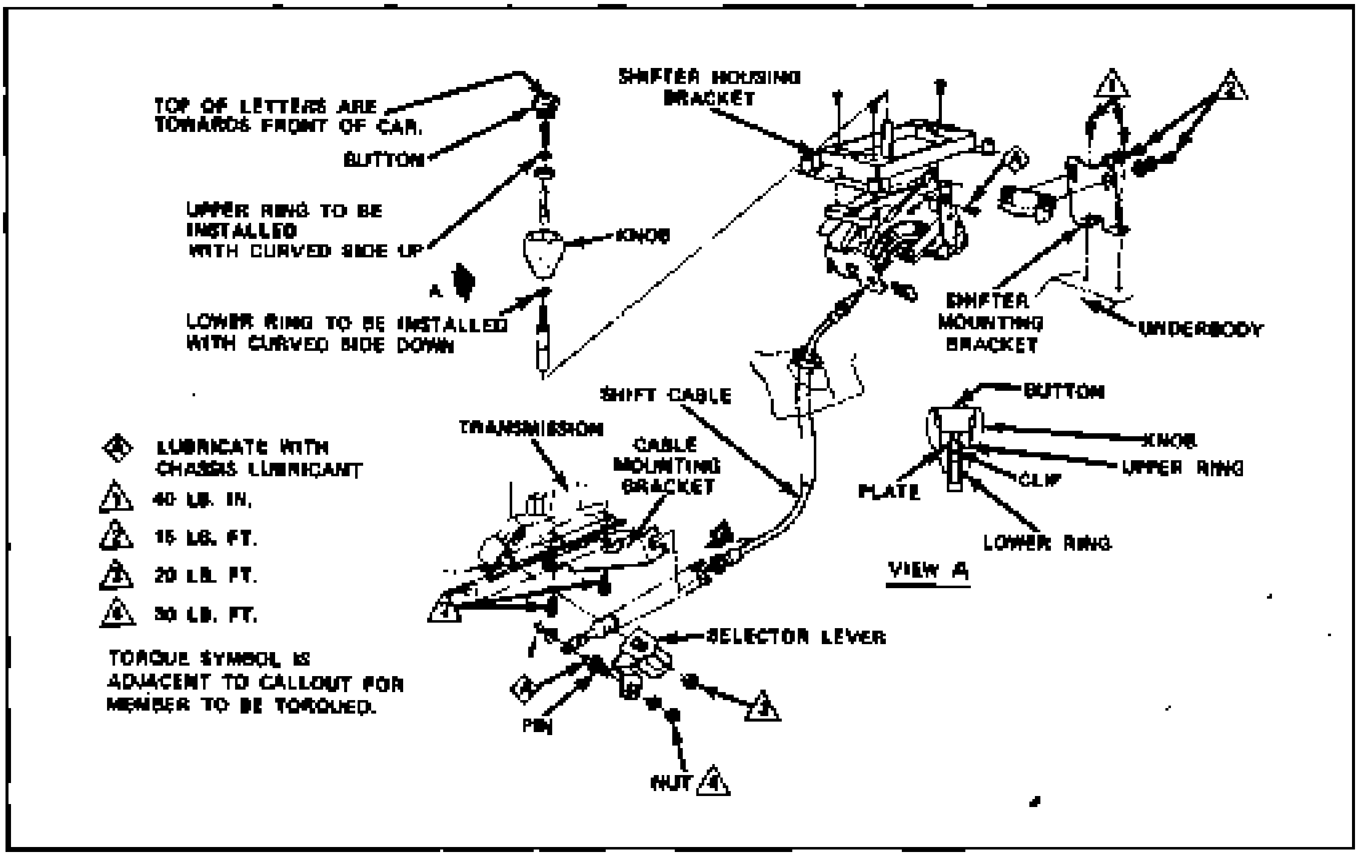


Fig. 7G-5 Console Shift Controls - Tempest

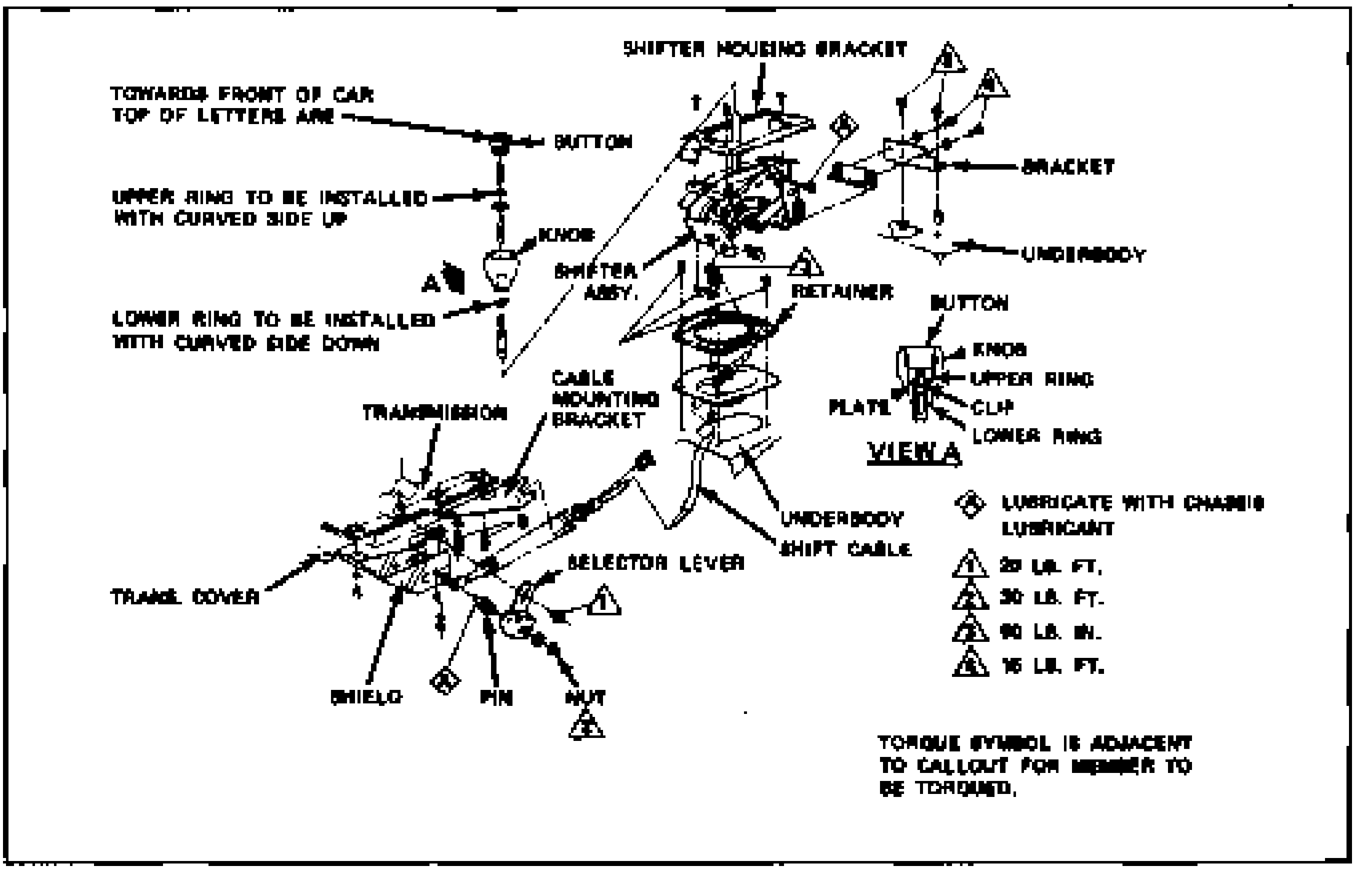


Fig. 7G-6 Console Shift Controls - Firebird

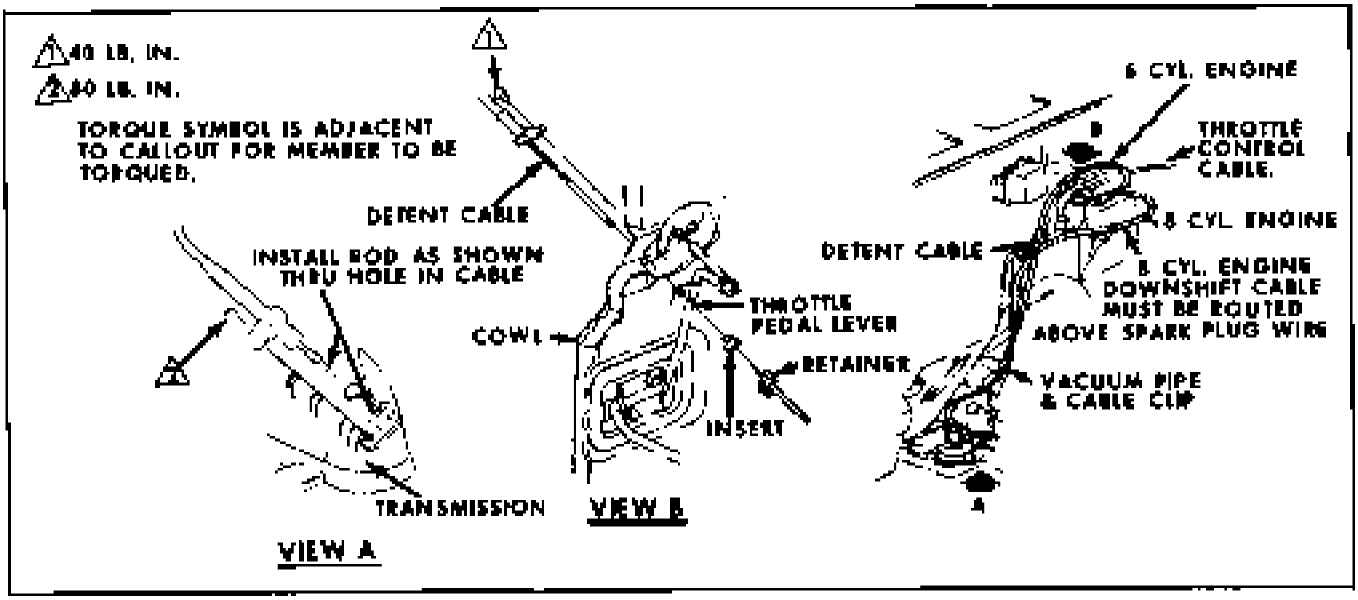


Fig. 7G-7 Tempest Detent Cable Adjustment

3. By following this procedure, the detent (downshift) cable will be adjusted properly.

FIREBIRD (Fig. 7G-8)

The detent cable is adjusted under the hood at the carburetor in the following manner.

1. With engine off and throttle valves closed (carburetor off fast idle), position the retainer (see view B) fully rearward against the washer and insert on the detent cable.

2. To adjust the cable, push the carburetor lever

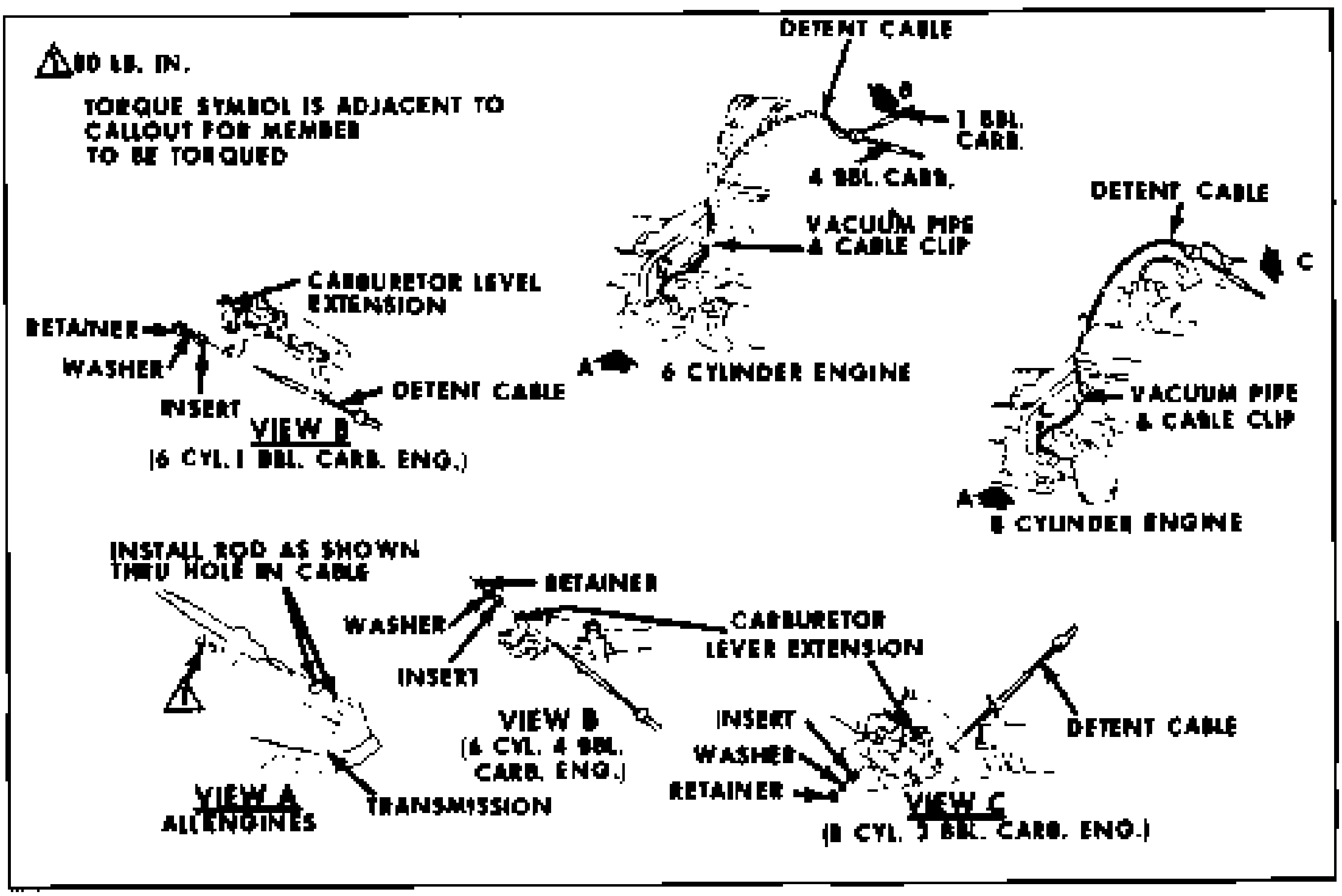


Fig. 7G-8 Firebird Detent Cable Adjustment extension to the wide open throttle position (defined by wide open throttle and full cable travel).

3. By following this procedure, the detent (downshift) cable will be adjusted properly.

MINOR SERVICE AND REPAIR

Services outlined in this section can be performed without removing the transmission from the car. Complete procedures are not given for all of these services, since they are covered in detail under disassembly, overhaul and reassembly.

FLUID LEVEL

The fluid level indicator is located in the filler tube at the right rear of the engine. To bring the fluid lever from the ADD mark to the FULL mark requires one pint of fluid.

Fluid level should be to the FULL mark with the transmission fluid at normal operating temperature (180-190°F). With warm fluid (room temperature - 70°F), the level will be as much as 7/10" below the ADD mark on the dipstick.

NOTE: In checking the oil, insert the dipstick in the filler tube with the markings toward center of car.

CHECKING PROCEDURE

To determine the proper fluid level, proceed as follows:

CAUTION: The FULL mark on the dipstick is an indication of transmission fluid at its normal operating temperature of 180°F. This temperature is only obtained after at least 15 miles of highway type driving or the equivalent of city driving.

1. With manual control lever in PARK position, start engine. DO NOT RACE ENGINE. Move manual control lever through each range.

2. Immediately check fluid level with selector lever in PARK, engine idling and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be at the FULL mark.

3. If additional fluid is required, add enough fluid to bring level to the FULL mark on the dipstick.

If vehicle is not driven 15 miles of highway type driving, or its equivalent, and it becomes necessary to check the fluid level, the transmission fluid level must be at room temperature (70°F).

With the fluid at room temperature (70°F), follow steps 1, 2 and 3 below:

1. With manual control lever in PARK position, start engine. DO NOT RACE ENGINE. Move manual control lever through each range.

2. Immediately check fluid level with selector lever in PARK, engine idling and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick will be as much as 7/10" below the ADD mark on the dipstick.

3. If additional fluid is required, add enough fluid to bring level to 7/10" below the ADD mark on the dipstick. If transmission fluid level is correctly established at 70°F, it will appear at the FULL mark on the dipstick when the transmission reaches its normal operating temperature of 180°F.

CAUTION: Do not overfill, as foaming and loss of fluid through the vent pipe might occur as fluid heats up. If fluid is too low, especially when cold, complete loss of drive may result which can result which can cause transmission failure.

IMPORTANT: When adding fluid, use only DEXRON automatic transmission fluid. The difference in oil level between ADD and FULL is one pint.

FLUID CAPACITY

Approximately 6 pints of fluid are required to refill transmission after oil pan has been drained. When unit has been disassembled and rebuilt, approximately 10 pints will be required to refill. Use only DEXRON automatic transmission fluid, or equivalent.

DRAINING AND REFILLING TRANSMISSION

Drain oil immediately after operation before it has had an opportunity to cool.

To drain oil, proceed as follows:

1. Raise car on hoist or place on jack stands and place container beneath transmission to collect draining fluid.

2. Remove thirteen (13) oil pan attaching bolt and washer assemblies, oil pan and gasket. Discard gasket.

3. Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.

4. Remove two (2) strainer-to-valve body screws, strainer and gasket. Discard gasket.

5. Thoroughly clean strainer assembly in solvent and dry thoroughly with clean compressed air.

6. Install new strainer-to-valve body gasket, strainer and two (2) screws.

7. Install new gasket on oil pan and install oil pan. Tighten its thirteen (13) attaching bolt and washer assemblies to 12 lb. ft. torque.

8. Lower car and add approximately 3 pints of transmission fluid through filler tube.

9. With selector lever in PARK position, apply hand brake, start engine and let idle (carburetor off fast idle step). DO NOT RACE ENGINE.

10. Move selector lever through each range and, with selector lever in PARK range, check the fluid level.

11. With transmission hot (approximately 180-190°F), add additional fluid to bring level to FULL mark on the dipstick.

12. With transmission fluid at room temperature (70°F), add additional fluid to bring level to 7/10" below the ADD mark on the dipstick.

CAUTION: Do not overfill. Foaming will result if overfull.

ADDING FLUID TO FILL DRY TRANSMISSION AND CONVERTER ASSEMBLY

The fluid capacity of the Turbo Hydra-Matic (M-38) transmission and converter assembly is approximately 20 pints, but correct level is determined by the mark on the dipstick rather than by amount added. In cases of transmission overhaul, when a complete fill is required, including a new converter proceed as follows:

1. Add 8 pints of transmission fluid through filler tube.

NOTE: The converter should be replaced only if the converter itself fails. On any major failure, such as a clutch or gearset, the strainer must be cleaned.

NOTE: If installation of a new converter is not required, add only 5 pints of transmission fluid.

2. With manual control lever in PARK position, start engine and place on cold idle cam. DO NOT RACE ENGINE. Move manual control lever through each range.

3. Immediately check fluid level with selector lever in PARK, engine running, and vehicle on LEVEL surface.

4. Add additional fluid to bring level to 7/10" below the "ADD" mark on the dipstick.

CAUTION: Do not overfill.

VALVE BODY ASSEMBLY

REMOVAL

1. Remove oil pan and strainer. Discard gaskets.

2. Remove retaining pin to disconnect downshift actuating lever from valve body actuating lever bracket, remove valve body attaching bolts and detent roller and spring assembly.

3. Remove valve body assembly while disconnecting manual control valve link from range selector inner lever.

CAUTION: Do not drop manual valve.

4. Remove manual valve and link assembly from valve body assembly.

INSTALLATION

Installation of the valve body assembly is the reverse of REMOVAL. Install new gaskets to strainer and oil pan and adjust the fluid level.

GOVERNOR ASSEMBLY

REMOVAL

1. Remove governor cover retaining clip, governor cover and O-ring seal from case.

2. Withdraw governor assembly from case.

INSTALLATION

Installation of the governor assembly is the reverse of REMOVAL. Install a new O-ring seal on governor cover and adjust the fluid level.

MANUAL SHAFT, RANGE SELECTOR INNER LEVER AND PARKING LINKAGE ASSEMBLIES

REMOVAL

1. Remove oil pan and strainer. Discard gaskets.

2. Remove manual shaft-to-case retainer and unthread jam nut holding range selector inner lever to manual shaft.

3. Remove jam nut and remove manual shaft from range selector inner lever and case.

NOTE: Do not remove manual shaft lip oil seal unless replacement is required.

4. Disconnect parking pawl actuating rod from range selector inner lever and remove both from case.

5. Remove bolts and parking lock bracket.

6. Remove parking pawl disengaging spring.

7. If necessary to replace parking pawl or shaft, clean up bore in case and remove parking pawl shaft retaining plug, parking pawl shaft and pawl.

INSTALLATION

Installation of parking linkage, selector lever and manual shaft is the reverse of REMOVAL. Install new plug (if required), new lip oil seal (if required) and new gaskets. Adjust the fluid level.

INTERMEDIATE CLUTCH ACCUMULATOR PISTON ASSEMBLY

REMOVAL

1. Remove two (2) oil pan bolts adjacent to accumulator piston cover, install Compressor J 23069 on oil pan lip and retain with these two (2) bolts.

2. Compress intermediate clutch accumulator piston cover and remove its retaining ring, piston cover and O-ring seal from case. Discard seal.

3. Remove spring and intermediate clutch accumulator piston.

INSTALLATION

Installation of the intermediate clutch accumulator piston assembly is the reverse of REMOVAL. Install new O-ring seal and adjust the fluid level.

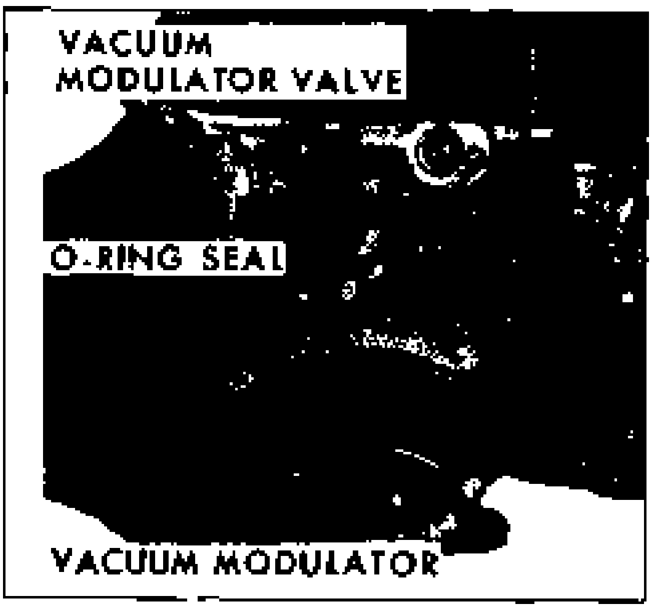


Fig. 7G-9 Removing Vacuum Modulator Assembly

VACUUM MODULATOR AND MODULATOR VALVE ASSEMBLY

REMOVAL

1. Disconnect vacuum hose from vacuum modulator stem and remove vacuum modulator attaching screw and retainer.

2. Remove modulator assembly and its O-ring seal from case.

3. Remove modulator valve from case.

INSTALLATION

1. Installation of the modulator and modulator valve is the reverse of REMOVAL. Install a new O-ring seal and adjust the fluid level.

EXTENSION HOUSING OIL SEAL

REMOVAL

1. Remove propeller shaft.

2. Pry out lip oil seal with screwdriver or small chisel.

INSTALLATION

1. Coat outer casing of new lip oil seal with a non hardening sealer and drive it into place with Seal Installer J 5154.

2. Install propeller shaft and adjust fluid level.

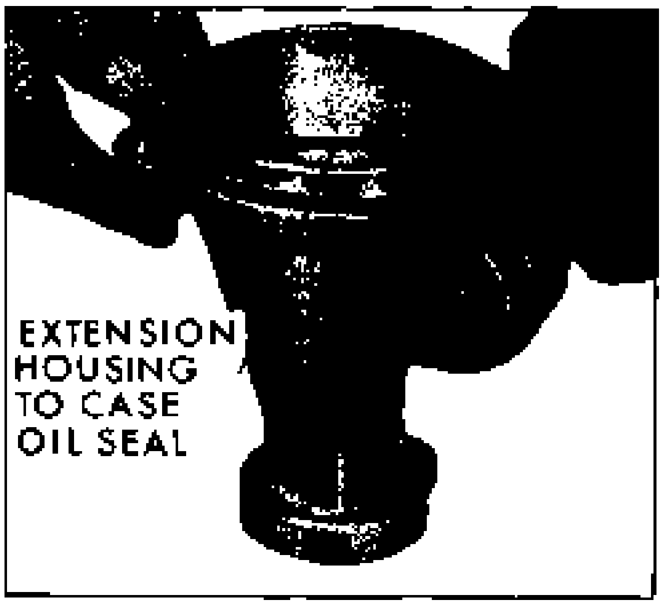


Fig. 7G-10 Removing Extension Housing Oil Seal

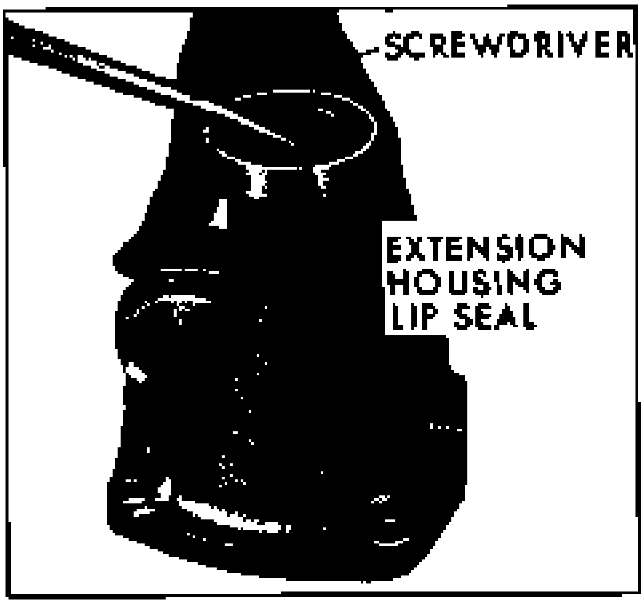


Fig. 7G-11 Removing Lip Oil Seal From Extension Housing

SPEEDOMETER DRIVEN GEAR ASSEMBLY

REMOVAL

1. Disconnect speedometer cable.

2. Remove speedometer driven gear sleeve retainer bolt, retainer, speedometer sleeve and driven gear assembly and O-ring seal

INSTALLATION

Installation of speedometer sleeve and driven gear assembly is the reverse of REMOVAL. Install new O-ring seal (if required) and adjust the fluid level.

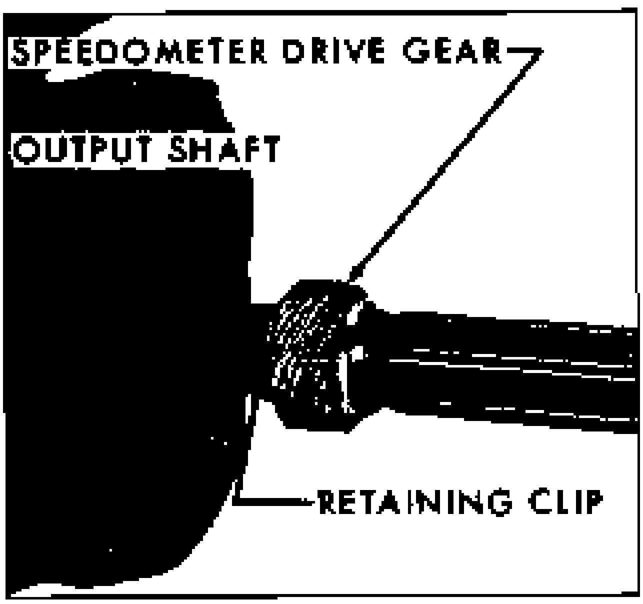


Fig. 7G-12 Speedometer Drive Gear

REMOVAL OF TRANSMISSION ASSEMBLY

1. Before raising the car, disconnect the battery and release the parking brake.

2. Remove the propeller shaft.

3. Disconnect speedometer cable, vacuum hose at modulator, downshift cable at transmission and shift control linkage.

CAUTION: When removing detent (downshift) cable from detent link, do not bend cable.

4. Support transmission with jack.

5. Disconnect rear mount and frame crossmember and remove crossmember.

NOTE: On Firebird 6-cylinder, remove driveline damper.

6. Remove converter dust pan, mark flywheel and converter for reassembly in same position and remove flywheel-to-converter bolts.

NOTE: After bolts are removed, make certain converter hub is free of crankshaft.

7. Disconnect transmission filler pipe at engine and remove pipe from transmission.

8. Lower transmission and engine assembly to gain access to cooler line fitting nuts and disconnect cooler lines.

NOTE: On some cars, it may be necessary to loosen the exhaust system.

9. With transmission in lowered position, remove transmission-to-engine bolts.

10. Raise transmission to its normal position, slide rearward from engine and lower it away from car

CAUTION: When lowering transmission, keep rear of transmission lower than front so as to not lose the converter.

NOTE: Converter can be held in position until transmission is to be disassembled by using Converter Holding Clamp J 21366.

Check and adjust the fluid level.

TRANSMISSION DISASSEMBLY

GENERAL

1. Before starting disassembly of the transmission, it should be thoroughly cleaned externally to avoid getting dirt inside.

2. Place transmission on a CLEAN work bench and use CLEAN tools during disassembly. Provide CLEAN STORAGE SPACE FOR PARTS AND UNITS MOVED FROM TRANSMISSION. An excellent working arrangement is provided by assembling the transmission to Holding Fixture J 8763-01.

3. The transmission contains parts which are ground and highly polished, therefore, parts should be kept separated to avoid nicking and burring surfaces.

4. When disassembling transmission, carefully inspect all gaskets at times of removal. The imprint of parts on both sides of an old gasket will show whether a good seal was obtained. A poor imprint indicates a possible source of oil leakage due to gasket condition, looseness of bolts or uneven surfaces of parts.

5. None of the parts should require forcing when disassembling or assembling transmission. Use a rawhide or plastic mallet to separate tight fitting cases - do not use a hard hammer.

REMOVAL OF CONVERTER AND MODULATOR

1. With transmission in portable jack, remove Converter Holding Clamp J 21366 (if installed) and remove converter assembly by pulling straight out.

2. Install Holding Fixture J 8763-01 and Adaptor J 8763-19 onto transmission and place transmission into Holding Tool Base J 3289-14 on bench. Position transmission vertically, with extension housing down and a drain pan on floor beneath transmission.

NOTE: Before installing Holding Fixture J 8763-01 onto transmission, it must be modified so that the intermediate accumulator will clear the fixture.

3. Remove vacuum modulator attaching screw and retainer clip, modulator, O-ring seal and modulator valve from case. Discard O-ring seal (Fig. 7G-9).

REMOVAL OF EXTENSION HOUSING, SPEEDO DRIVE GEAR AND GOVERNOR

1. Remove bolt, retainer and speedometer driven gear from side of extension housing.

2. Remove four (4) extension housing-to-case attaching bolts, extension housing and its square cut oil seal from case or housing (Fig. 7G-10).

3. If necessary to replace, pry lip oil seal from extension housing, using a screwdriver (Fig. 7G-11).

4. Depress speedometer drive gear retaining clip and slide speedometer drive gear off output shaft (Fig. 7G 12).

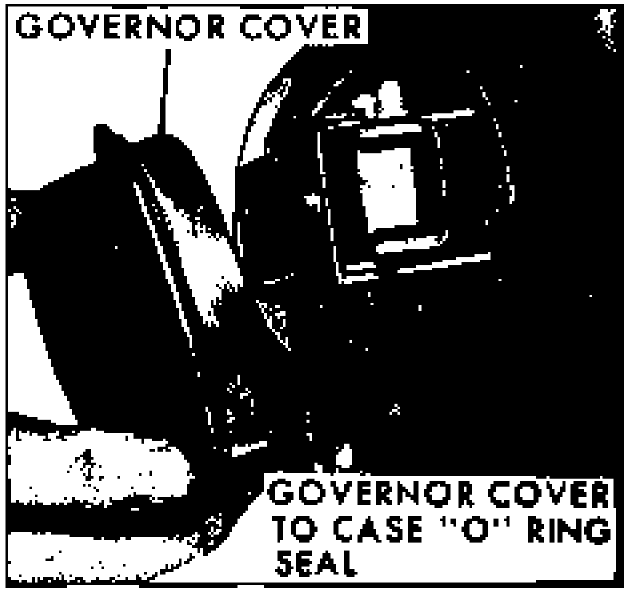


Fig. 7G-13 Removing Governor Assembly

5. Remove governor cover retaining clip with a screwdriver.

6. Pry governor cover and O-ring seal from case and withdraw governor assembly. Discard O-ring seal (Fig. 7G-13).

NOTE: Use extreme care not to damage cover.

REMOVAL OF VALVE BODY ASSEMBLY

1. Remove oil pan attaching bolt and washer assemblies (13), oil pan and oil pan gasket. Discard gasket.

2. Remove oil pump strainer-to-valve body attaching screws (2) and remove oil pump strainer and gasket.

3. Remove retaining bolt and detent roller and spring assembly from valve body.

4. Remove sixteen (16) of remaining seventeen (17) valve body-to-case attaching bolts, complete draining fluid from transmission, move transmission to horizontal position and remove last body-to-case bolt.

5. While removing valve body assembly, disconnect manual control valve link from range selector inner lever. Remove detent control valve link from detent actuating lever on valve body (Fig. 7G-14).

6. Remove valve body-to-spacer plate gasket.

7. Remove seven (7) spacer support plate bolts and remove spacer support plate from case (Fig. 7G-15).

8. Remove valve body spacer plate and valve body spacer plate-to-case gasket.

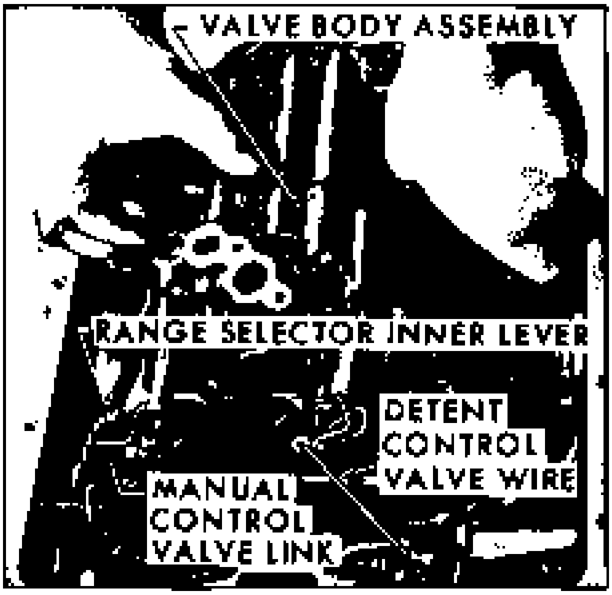


Fig. 7G-14 Removing Valve Body Assembly

9. Remove four (4) check balls from cored passages in case face (Fig. 7G-16).

10. Remove oil pump pressure screen from oil pump pressure passage in case and clean (Fig 7G-17).

11. Remove governor feed screen from governor feed passage in case and clean (7G-18).

12. Remove manual shaft-to-case retainer with a screwdriver (7G-19)

13. Loosen jam nut that holds range selector inner lever to manual shaft.

14. Remove jam nut and remove manual shaft from range selector inner lever and case.

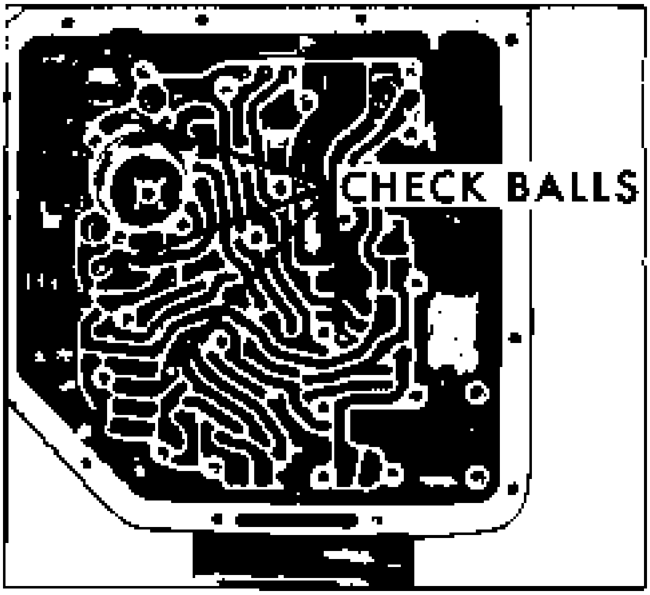


Fig. 7G-16 Location of Check Balls

15. Disconnect parking pawl actuating rod from range selector inner lever and remove both from case (Fig. 7G-20).

16. If necessary to replace, remove manual shaft-to-case lip oil seal, using a screwdriver (Fig. 7G-21).

17. Remove two (2) bolts and parking lock bracket.

18. Disconnect and remove parking pawl disengaging spring.

19. If necessary to replace parking pawl shaft or parking pawl, clean up shaft bore in case and, cocking parking pawl on shaft and using screwdriver and hammer, tap on screwdriver to force the parking pawl

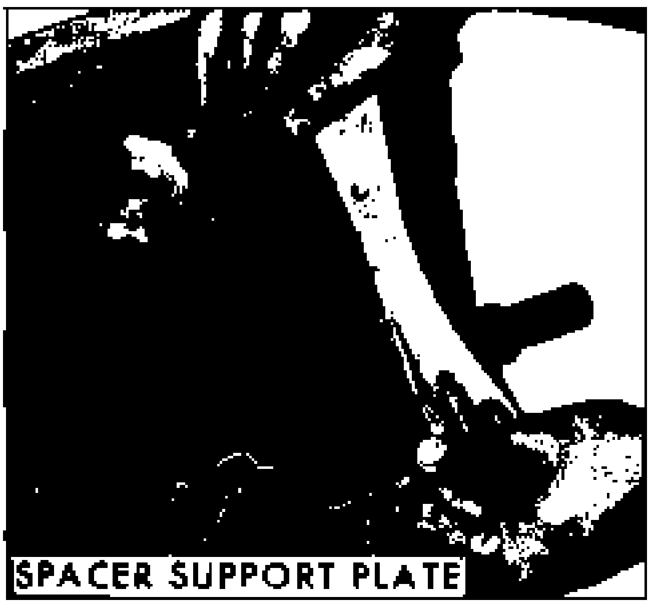


Fig. 7G-15 Removing Spacer Support Plate

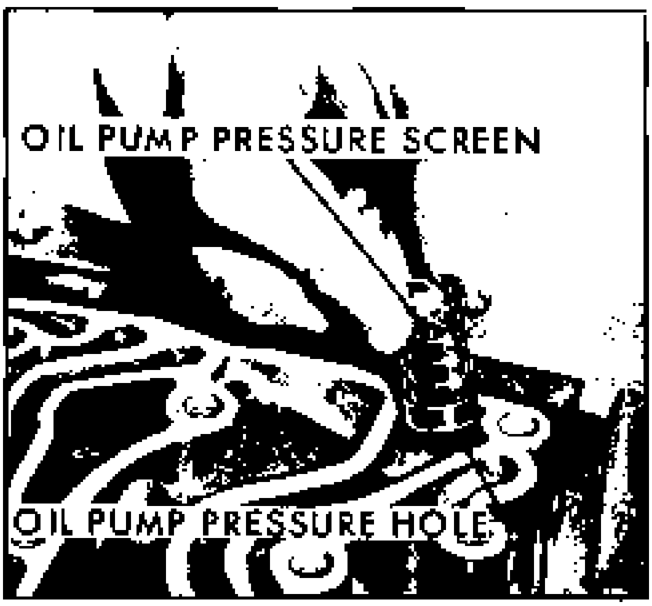


Fig. 7G-17 Removing Oil Pump Pressure Screen

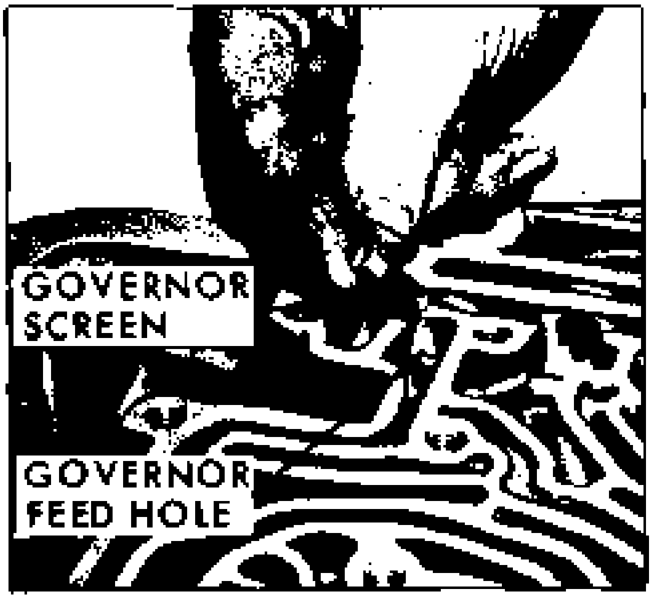


Fig. 7G-18 Removing Governor Feed Screen

shaft from the case and remove the parking pawl (Fig. 7G-22).

20. From valve body case face, remove intermediate servo piston, its aluminum oil seal ring, apply pin, washer, spring seat and spring (Fig. 7G-23).

REMOVAL OF OIL PUMP AND INTERNAL COMPONENTS

1. Move transmission to vertical position (oil pump face up), scribe a mark on pump body and transmission case face for aid in alignment on reinstallation and remove eight (8) pump attaching bolts with washer-type seals (Fig. 7G-24).

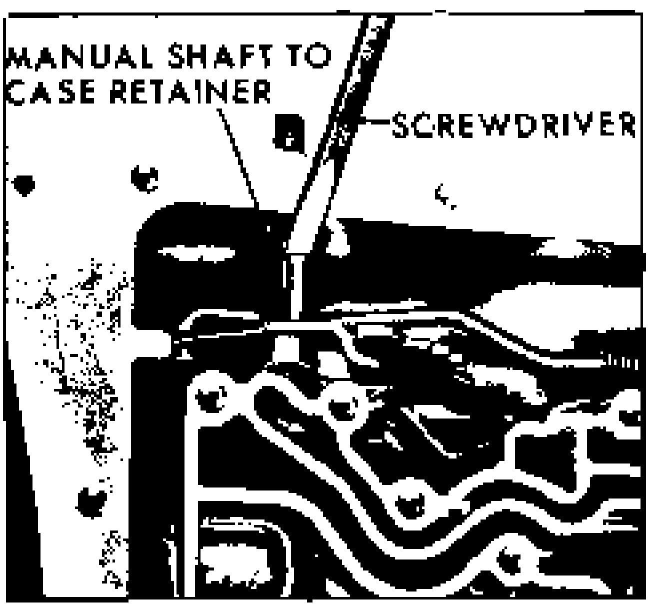


Fig. 7G-19 Removing Manual Shaft Retainer

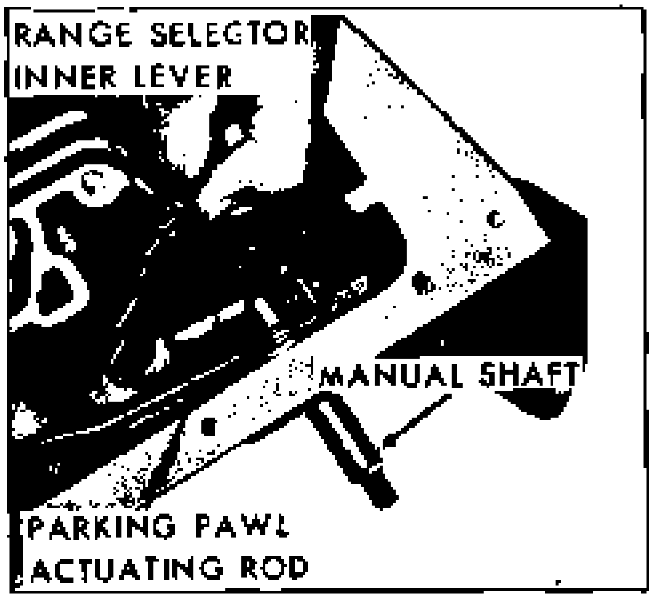


Fig. 7G-20 Removing Inner Lever and Actuating Rod

2. Install two (2) Slide Hammers J 6125-1 and Adapters J 6125-2 into threaded bolt holes in pump body (at approximately 4 and 11 o'clock) and remove pump assembly from case.

3. Remove pump-to-case gasket and tools from pump. Discard gasket.

4. On V-8 models, remove intermediate clutch cushion spring, three (3) intermediate clutch faced plates and three (3) steel separator plates; on 6 cylinder models, remove cushion spring, two (2) faced plates and two (2) separator plates (Fig. 7G-25).

5. Remove intermediate clutch pressure plate.

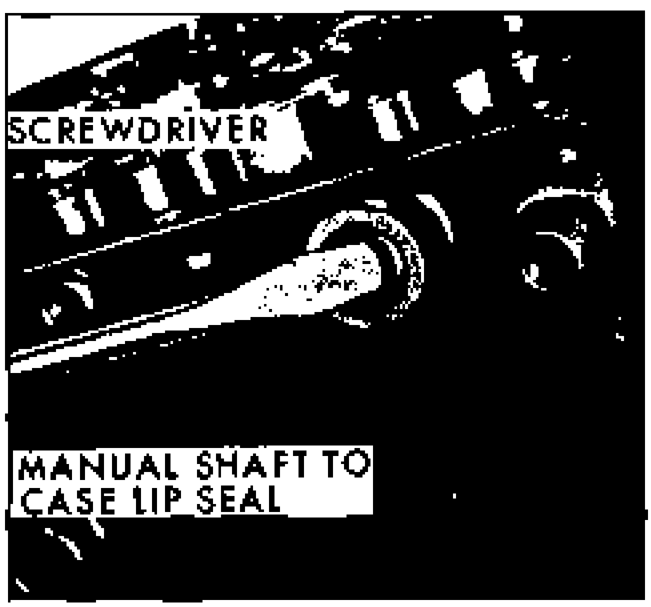


Fig. 7G-21 Removing Manual Shaft Oil Seal

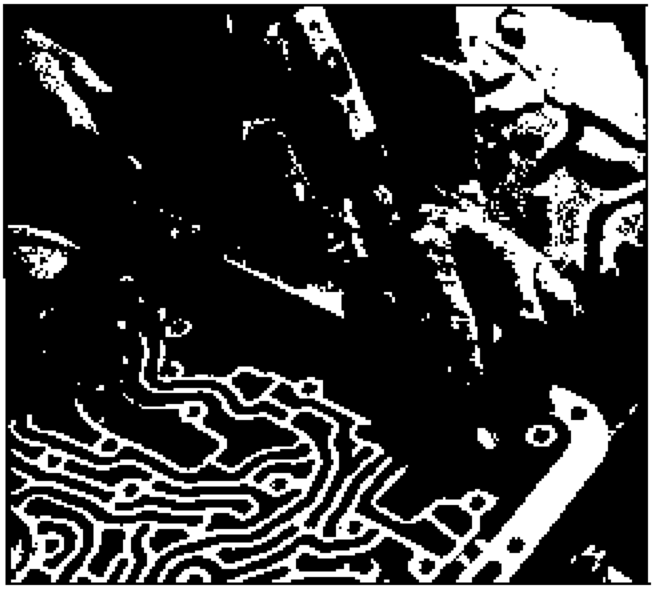


Fig. 7G-22 Removing Parking Pawl Shaft

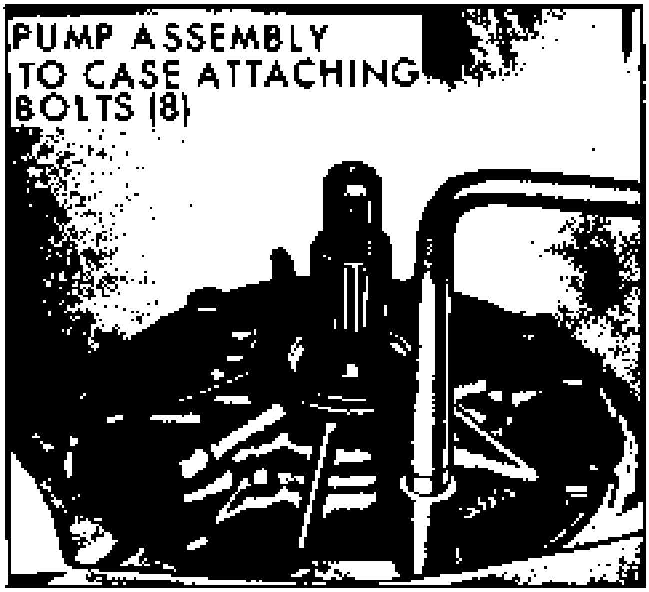


Fig. 7G-24 Removing Oil Pump Attaching Bolts

6. Remove intermediate overrun brake band, direct and forward clutch assemblies from case (Fig. 7G-26).

7. Remove forward clutch housing-to-input ring gear thrust washer from ring gear (or clutch housing).

NOTE: Washer has three (3) wide external tangs.

8. Remove input ring gear (Fig. 7G-27)

9. Remove input ring gear-to-output carrier thrust washer from ring gear (or output carrier).

NOTE: Washer has four (4) internal tangs.

10. Using a finely pointed awl and a small screwdriver, remove output carrier-to-output shaft snap ring. Discard ring.

11. Remove output carrier assembly (Fig. 7G-28).

12. Remove sun gear drive shell assembly (Fig. 7G-29).

13. Remove sun gear drive shell-to-low and reverse roller clutch inner race thrust washer from drive shell (or inner race).

NOTE: Washer has four (4) wide internal tangs.

14. Remove low and reverse roller clutch support-to-case retaining ring (Fig. 7G-30).

Fig. 7G-23 Intermediate Servo Piston Assembly

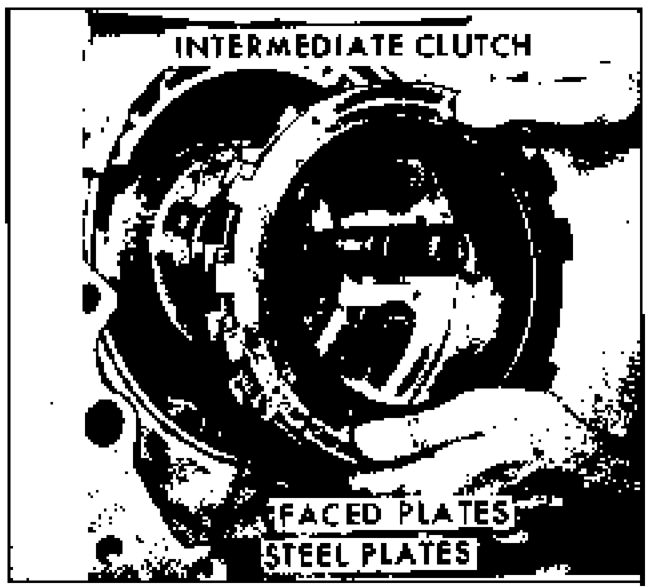


Fig. 7G-25 Removing Intermediate Clutch Plates

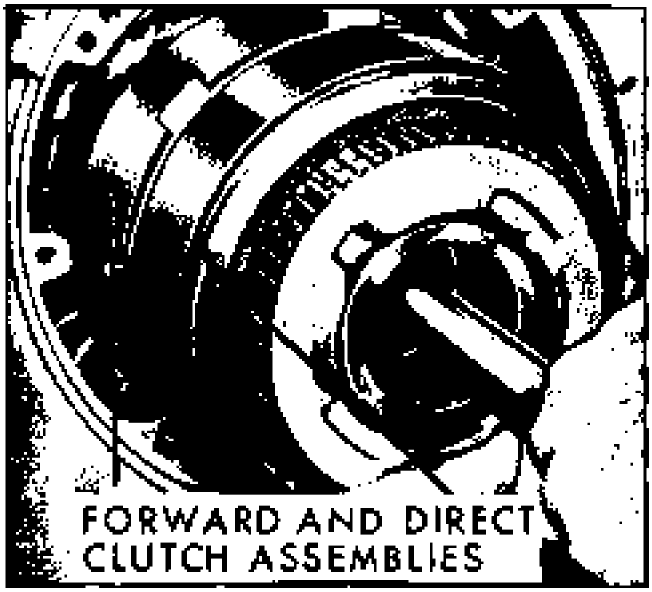


Fig. 7G-26 Removing Forward and Direct Clutch Assemblies

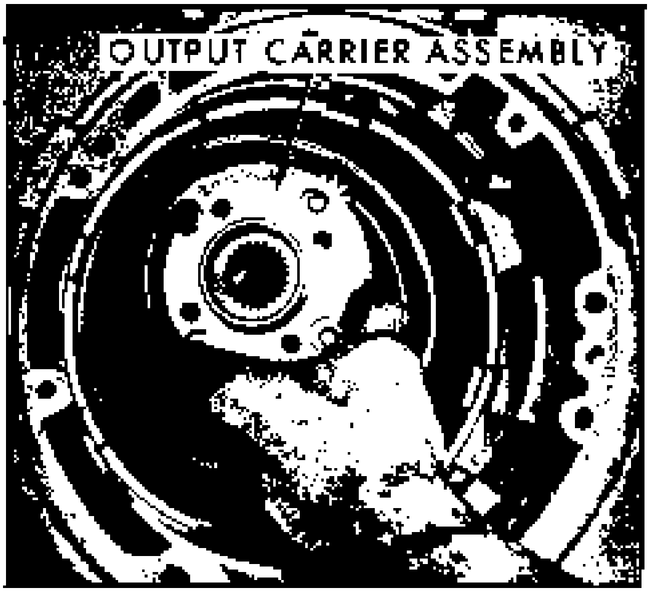


Fig. 7G-28 Removing Output Carrier Assembly

15. Push up on end of output shaft until the low and reverse clutch support assembly clears the low and reverse clutch support retainer spring. Then, remove the low and reverse clutch support assembly from the case (Fig. 7G-31).

16. Remove low and reverse clutch support retainer spring (Fig. 7G-32), push up on end of output shaft and remove output shaft assembly from case.

17. On V-8 models, remove five (5) low and reverse clutch faced plates and five (5) steel separator plates from reaction carrier assembly or case; on 6 cylinder models, remove four (4) faced plates and four (4) separator plates.

18. Remove reaction carrier assembly from output ring gear and shaft assembly (Fig. 7G-33).

19. Remove reaction carrier-to-output ring gear thrust washer from ring gear (or reaction carrier).

NOTE: Washer has three (3) narrow external tangs.

20. Remove output ring gear-to-case needle bearing from output shaft assembly or case (Fig. 7G-34).

21. If it is necessary to separate ring gear from output shaft, remove output ring gear-to-output shaft snap ring by using a finely pointed awl and a small screwdriver. Discard snap ring (Fig. 7G-35).

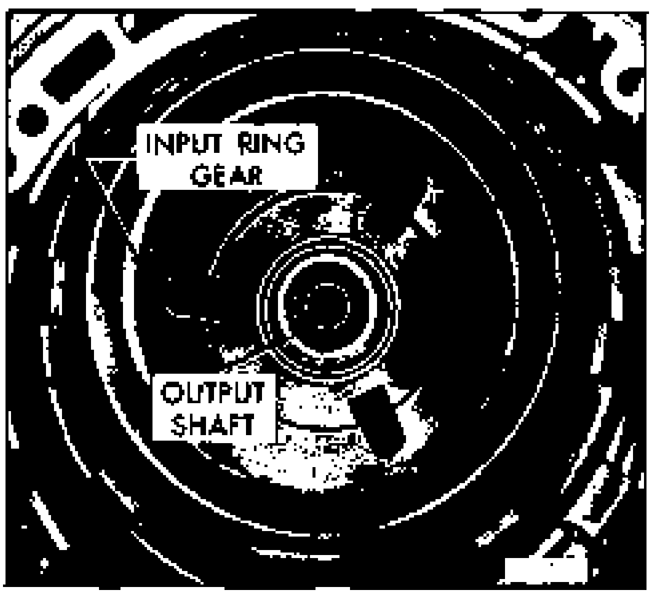


Fig. 7G-27 Removing Input Ring Gear

Fig. 7G-29 Removing Sun Gear Drive Shell Assembly

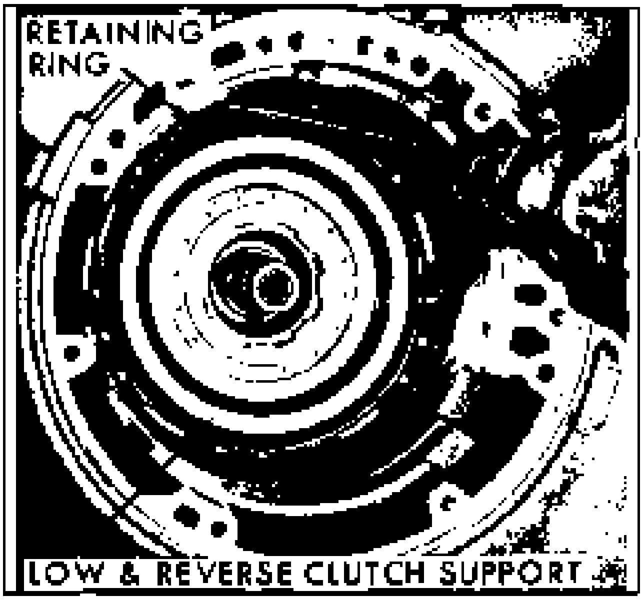


Fig. 7G-30 Removing Low and Reverse Clutch Support Retaining Ring

22. Using Clutch Spring Compressor Tools J 23327-1 and J 23327-2 and Pilot J 21420-2 in end of case, compress low and reverse clutch piston spring retainer and remove piston retaining ring (Fig. 7G-36).

23. Remove tools, spring retainer and seventeen (17) piston return springs from low and reverse clutch piston.

24. Remove low and reverse clutch piston assembly by applying compressed air to passage shown in Fig. 7G-37.

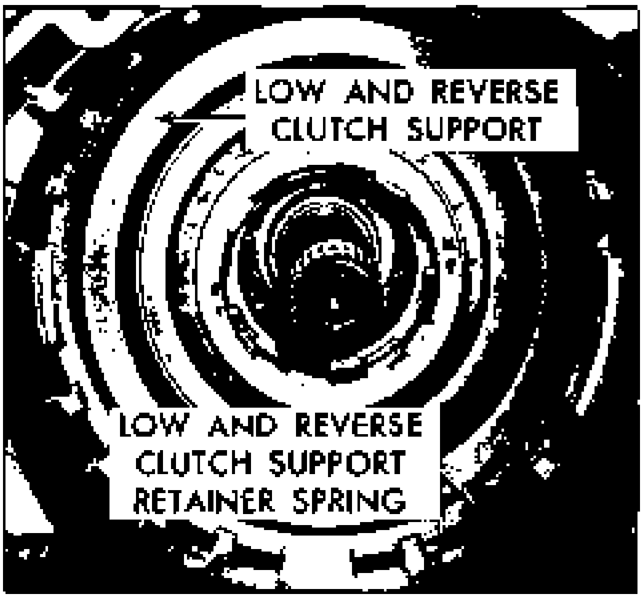


Fig. 7G-31 Location of Clutch Support Retainer Spring

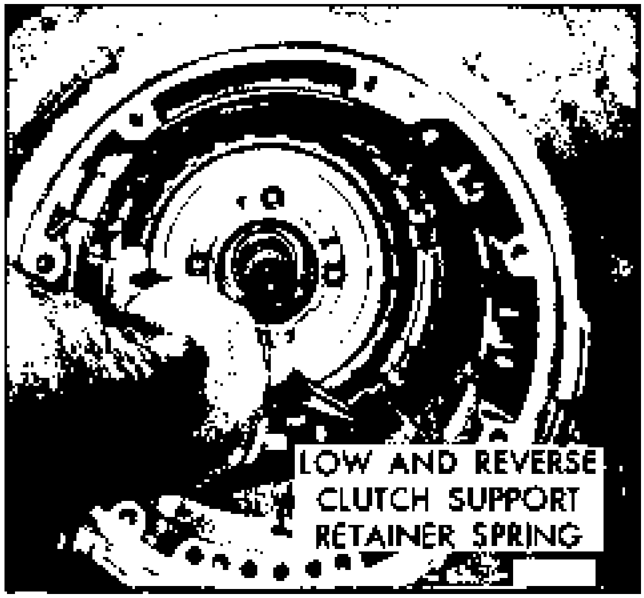


Fig. 7G-32 Removing Clutch Support Retainer Spring

25. Remove outer, center and inner flat seals from low and reverse clutch piston.

26. Move transmission to horizontal position and, using two (2) oil pan bolts, install Compressor J 23069 on oil pan face, compress intermediate clutch accumulator piston cover and remove its retaining ring. Remove tool (Fig. 7G-38).

27. Remove intermediate clutch accumulator piston cover and remove O-ring seal from case bore (or cover), intermediate clutch accumulator piston spring, intermediate clutch accumulator piston assembly and remove inner and outer hook-type seal rings from piston (Figs. 7G-39 and 7G-40).

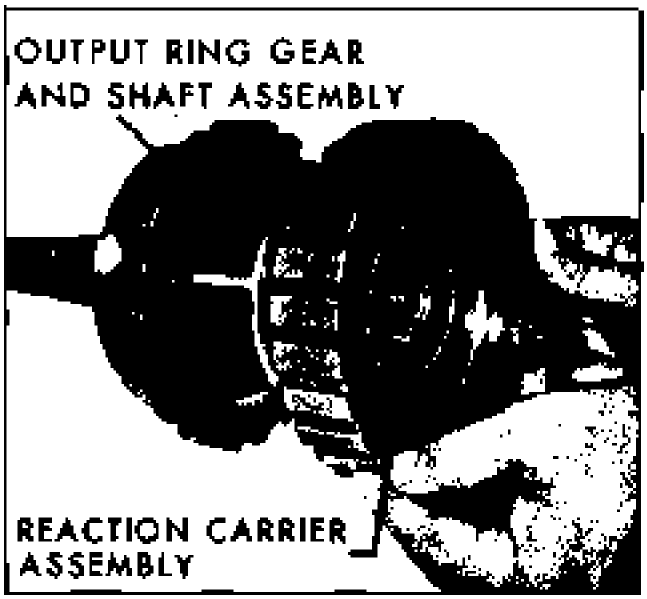


Fig. 7G-33 Removing Reaction Carrier Assembly

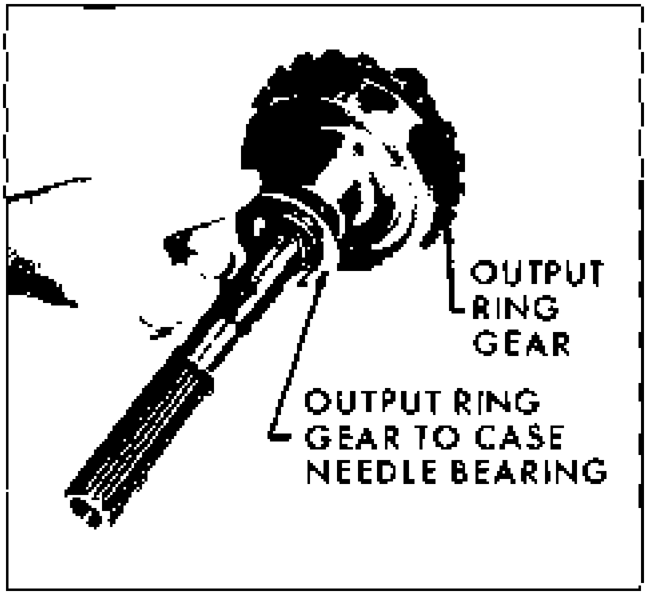


Fig. 7G-34 Removing Output Ring Gear Needle Bearing

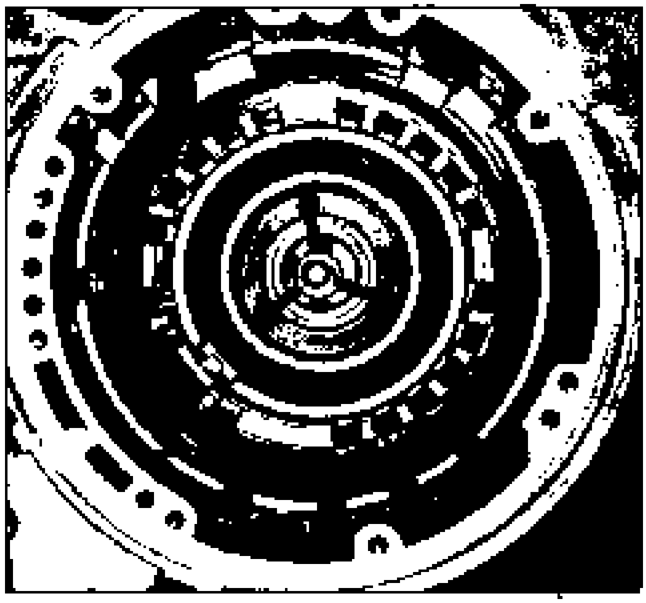


Fig. 7G-36 Compressing Low and Reverse Clutch Piston Assembly

OVERHAUL AND/OR INSPECTION

GOVERNOR ASSEMBLY

All components of governor assembly, with exception of driven gear, are a select fit and each assembly is calibrated. The governor, including driven gear, is serviced as a complete assembly. However, the driven gear can also be serviced separately.

While it is necessary to disassemble governor assembly in order to replace the driven gear, disassembly may also be necessary due to foreign material causing improper operation. To disassemble governor assembly, proceed as follows:

DISASSEMBLY

1. Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights and springs.

NOTE: Governor weights are interchangeable from side to side and need not be identified.

2. Remove governor valve from governor sleeve. Use care in not damaging valve.

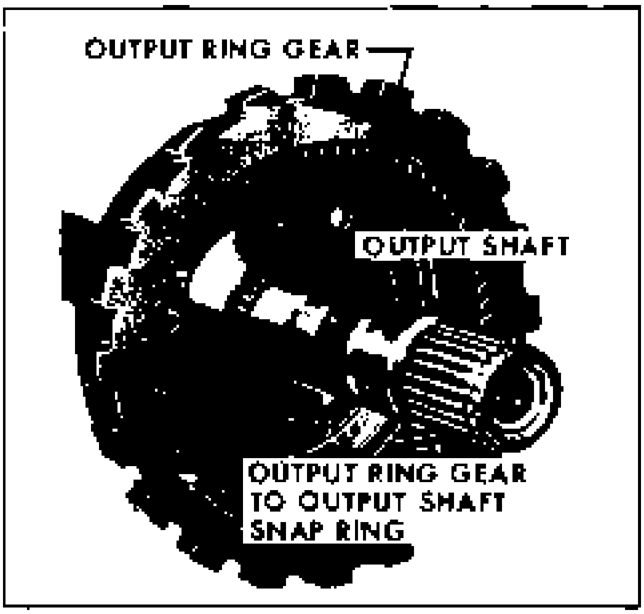


Fig. 7G-35 Output Ring Gear and Output Shaft Assembly

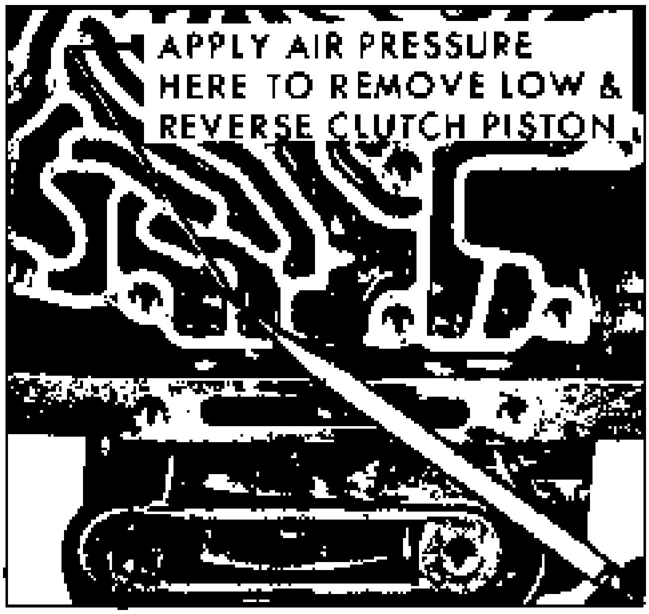


Fig. 7G-37 Using Air to Remove Low and Reverse Clutch Piston

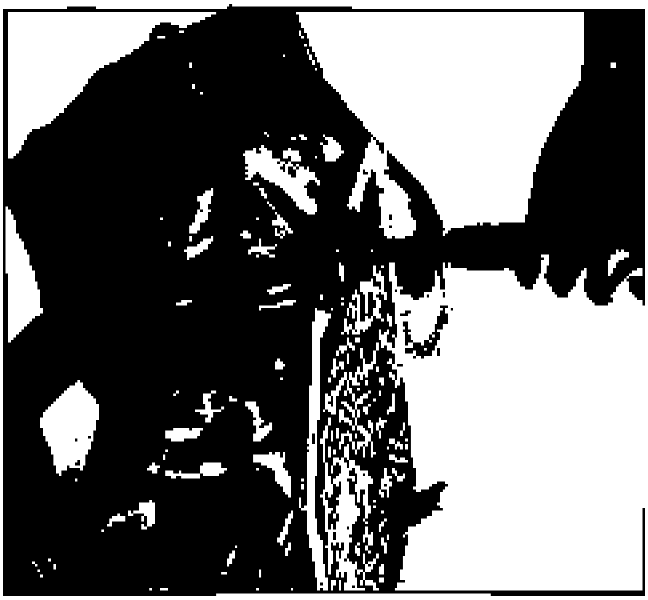


Fig. 7G-38 Compressing Intermediate Clutch Accumulator Piston Cover

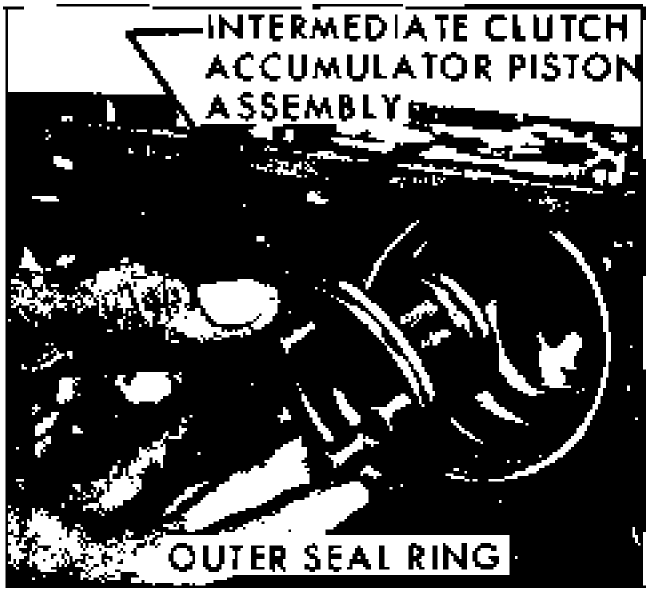


Fig. 7G-40 Removing Accumulator Piston Assembly

INSPECTION

1. Wash all parts in cleaning solvent, air dry and blow out all passages.

2. Inspect governor sleeve for nicks, burrs, scoring or galling.

3. Check governor sleeve for free operation in bore of transmission case.

4. Inspect governor valve for nicks, burrs, scoring or galling.

5. Inspect governor valve for free operation in bore of governor sleeve.

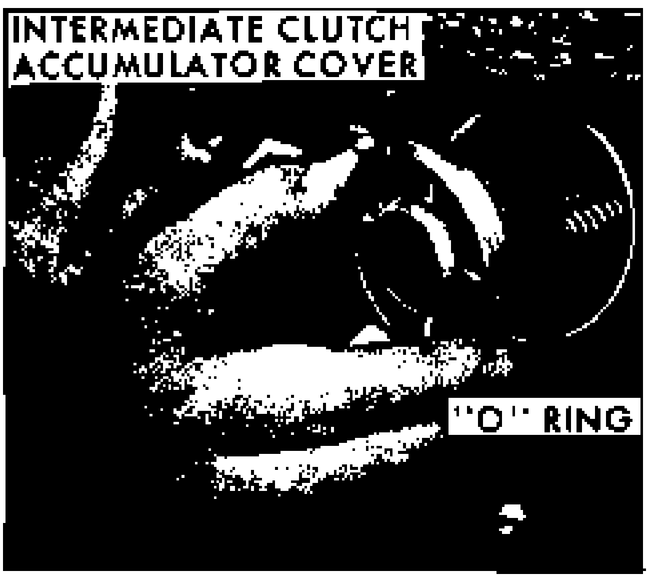


Fig. 7G-39 Removing Accumulator Cover and Spring

6. Inspect governor weights for free operation in their retainers.

7. Check governor weight springs for distortion or damage.

8. Check governor driven gear for looseness of governor sleeve, for nicks, burrs or damage. If replacement is necessary, follow replacement below.

GOVERNOR DRIVEN GEAR REPLACEMENT

To facilitate governor repair in the field, a governor driven gear and weight pin are available for service use. The service package consists of a driven gear, governor weight retaining pins (2) and a governor gear retaining split pin. Replacement of gear must be performed with care in the following manner:

1. Drive out governor gear retaining split pin, using a small punch.

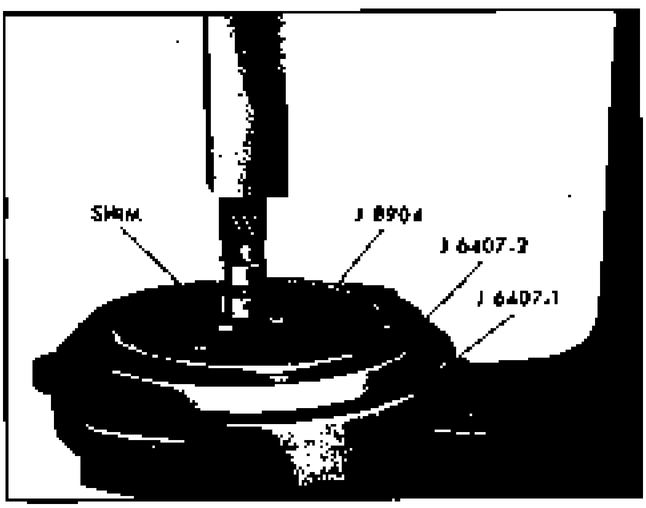


Fig. 7G-41 Installing Governor Driven Gear

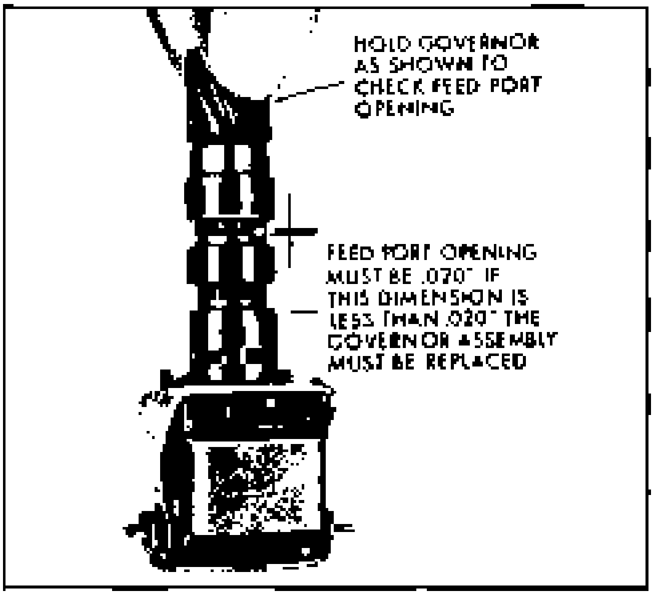


Fig. 7G-42 Checking Governor Feed Port Opening

2. Support governor on 3/16" plates installed in exhaust slots of governor sleeve, place in arbor press and, with a long punch, press gear out of sleeve.

3. Carefully clean governor sleeve of chips that remain from original gear installation.

4. Support governor on 3/16" plates installed in exhaust slots of sleeve, position new gear in sleeve and, with a suitable socket, press gear into sleeve until nearly seated. Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder (Fig. 7G-41).

5. A new pin hole must be drilled through sleeve and gear. Locate hole position 90 degrees from existing hole, center punch and, while supporting governor, drill new hole through sleeve and gear, using a standard (1/8") drill.

6. Install new retaining split pin.

7. Wash governor assembly thoroughly to remove any chips that may have collected.

ASSEMBLY

1. Install governor valve in bore of governor sleeve, large end first.

2. Install governor weights, springs and thrust cap on governor.

NOTE: Lip of secondary weight must be over end of valve.

3. Align pin holes in thrust cap, governor weights, governor sleeve and install new pins. After installing, crimp both ends of pins to prevent their falling out.

4. Check governor weight assemblies for free movement on pins.

5. Check governor valve for free movement in governor sleeve.

6. Suspending governor assembly by its driven gear (weights out), check valve opening at feed port. Opening must be .020" minimum (Fig. 7G-42).

7. Check governor valve opening at exhaust port while holding weights completely inward. Opening must be .020" minimum.

NOTE: If less than .020" minimum feed port or exhaust port is found, governor assembly must be replaced.

VALVE BODY ASSEMBLY

DISASSEMBLY (Fig. 7G-43)

1. Position valve body assembly with cored face up and accumulator piston assembly at upper left corner.

2. Remove manual valve and link assembly from lower left hand bore.

3. From next bore up, remove retaining pin, detent valve actuating lever, bolt, detent actuating lever bracket, detent valve stop, spring seat retainer, spring seat, spring and detent valve.

4. Using Accumulator Compressor J 21885 on direct clutch accumulator piston, compress piston and remove retainer "E" ring (Fig. 7G-44).

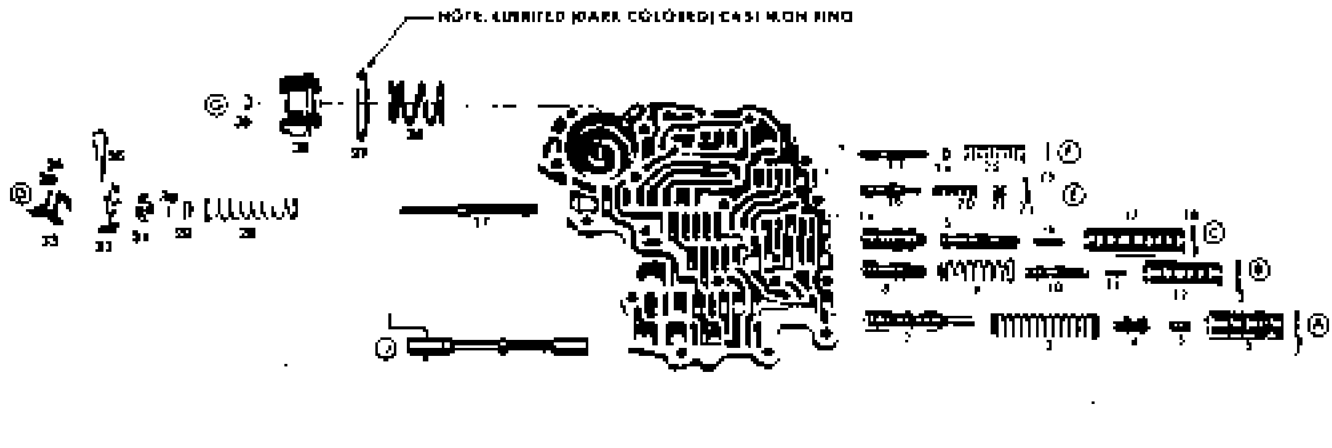
5. Remove tool, direct clutch accumulator piston, metal oil seal ring and direct clutch accumulator spring.

6. From lower right hand bore, compress boost valve sleeve and, turning valve body over, remove retaining pin, boost valve sleeve assembly, pressure regulator valve spring and pressure regulator valve. Then, remove reverse and modulator boost valve and intermediate boost valve from boost valve sleeve.

7. From next bore up, compress 2-3 shift control valve sleeve and remove retaining pin, 2-3 shift control valve sleeve assembly, 2-3 shift valve spring and 2-3 shift valve. Then, remove 2-3 shift control valve and control valve spring from 2-3 shift control valve sleeve.

8. From next bore up, compress 1-2 shift control valve sleeve and remove retaining pin, 1-2 shift control valve sleeve assembly and 1-2 shift valve. Then, remove 1-2 shift control valve and control valve spring from 1-2 shift control valve sleeve.

9. From next bore up, compress manual low control valve plug and remove retaining pin, plug, manual low control valve spring and manual low control valve.



J 1. Manual Valve & Link Assembly
2. Pressure Regulator Valve
3. Pressure Regulator Valve Spring
4. Reverse & Modulator Boost Valve
A 5. Intermediate Boost Valve
6. Boost Valve Sleeve
7. Retaining Pin
8. 2-3 Shift Valve
9. 2-3 Shift Valve Spring
10. 2-3 Shift Control Valve
11. 2-3 Shift Control Valve Spring
12. 2-3 Shift Control Valve Sleeve
13. Retaining Pin
14. 1-2 Shift Valve
15. 1-2 Shift Control Valve
C 16. 1-2 Shift Control Valve Spring
17. 1-2 Shift Control Valve Sleeve
18. Retaining Pin
19. Manual Low Control Valve
20. Manual Low Control Valve Spring
E 21. Plug
22. Retaining Pin
23. Detent Regulator Valve
F 24. Detent Regulator Valve Spring Seat
25. Detent Regulator Valve Spring
26. Retaining Pin
27. Detent Valve
28. Detent Valve Spring
28. Detent Valve Spring
29. Detent Valve Spring Seat
30. Detent Valve Spring Retainer
D 31. Detent Valve Stop
32. Detent Valve Actuating Lever Bracket
33. Detent Valve Actuating Lever
34. Retaining Bolt
35. Retaining Pin
36. Direct Clutch Accumulator Spring
G 37. Oil Seal Ring
38. Direct Clutch Accumulator Piston
39. Retainer "E" Ring

Fig. 7G-43 Exploded View of Valve Body Assembly

10. From top bore, remove retaining pin, detent regulator valve spring, valve spring seat and detent regulator valve.

INSPECTION

1. Wash all parts in cleaning solvent, air dry and blow out all passages.

2. Inspect all valves for scoring, cracks and free movement in their respective bores.

3. Inspect sleeves for cracks, scratches or distortion.

4. Inspect valve body for cracks, scored bores, interconnected oil passages and flatness of mounting face (Fig. 7G-45).

5. Check all springs for distortion or collapsed coils.

ASSEMBLY (Fig. 7G-43)

1. Position valve body with cored face up and accumulator piston bore at upper left corner.

2. Beginning at top right hand bore, install detent regulator valve spring seat onto stem end of valve and install detent regulator valve, seat and detent regulator valve spring into bore. Compress spring and install retaining pin below flush with machined face.

NOTE: Free length of spring is 1 7/8" by 9/16" diameter.

3. In next bore down, install manual low control valve with stem end out, manual low control valve spring and plug. Compress plug and install retaining pin below flush with machined face.

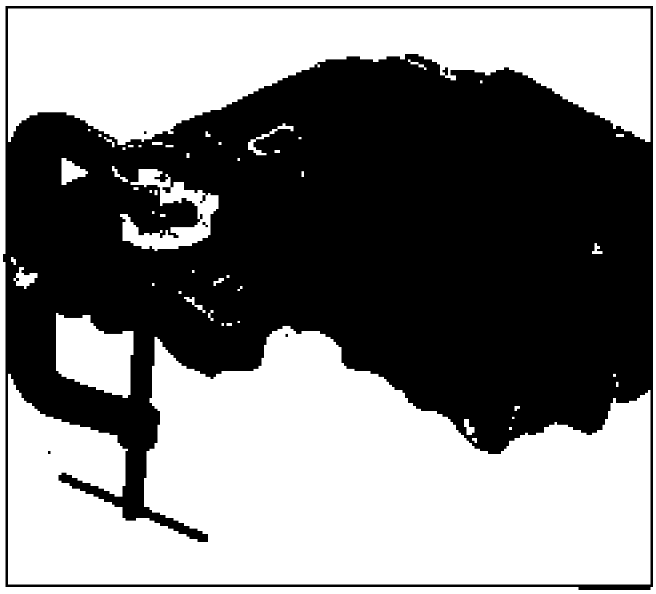


Fig. 7G-44 Compressing Direct Clutch Accumulator Piston

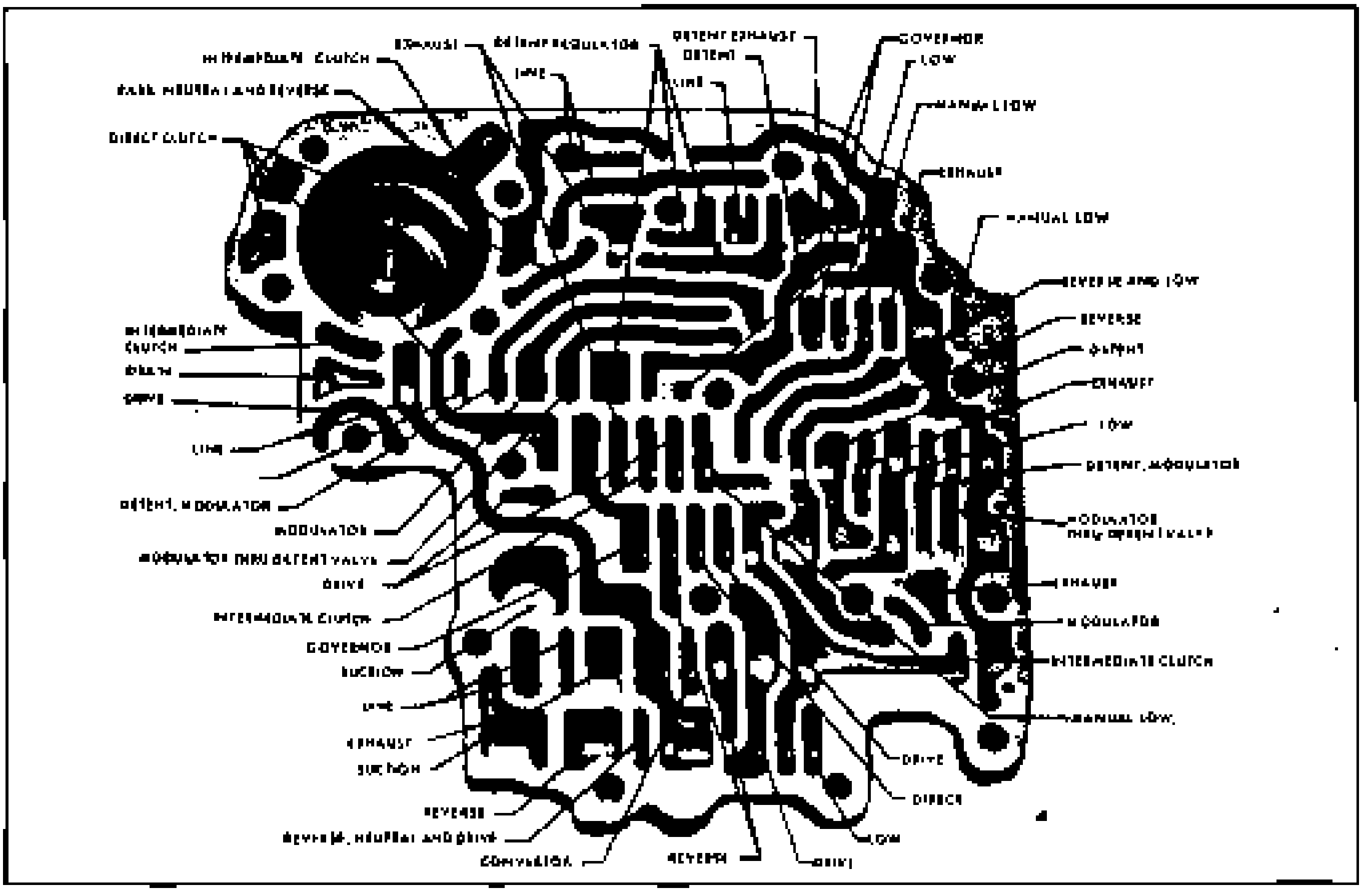


Fig. 7G-45 Identification of Oil Channels in Valve Body

NOTE: Free length of spring is 1 1/2" by 7/16" diameter.

4. In next bore down, install 1-2 shift valve with stem end out, install control valve spring into its bore in 1-2 shift control valve and both into 1-2 shift control valve sleeve. Install control valve sleeve assembly into bore, compress sleeve and install retaining pin below flush with machined face.

NOTE: Free length of spring is 1 15/16" by 1/4" diameter.

5. In next bore down, install 2-3 shift valve with stem end out and 2-3 shift valve spring with narrow end in. Install control valve spring into 2-3 shift control valve and install both into 2-3 shift control valve sleeve. Install sleeve assembly into bore, compress sleeve and install retaining pin below flush with machined face.

NOTE: Free length of shift valve spring is 2 1/16" by 7/8" diameter; free length of control valve spring is 11/16" by 3/16" diameter.

6. In last bore down, install pressure regulator valve with stem end out and pressure regulator valve spring with narrow end in. Install intermediate boost valve, then reverse and modulator boost valve with stem end out into boost valve sleeve. Install sleeve assembly into bore, compress sleeve and install retaining pin below flush with machined face.

NOTE: Free length of spring is 1 11/16" by 17/32" diameter.

7. If removed, install metal oil seal ring to direct clutch accumulator piston.

8. At upper left corner, install direct clutch accumulator spring and direct clutch accumulator piston into its core in valve body face.

NOTE: Free length of spring is 1 3/4" by 1 1/2" diameter.

9. Using Accumulator Compressor J 21885, compress spring and piston into body, install retainer "E" ring and remove tool (Fig. 7G-44).

10. On stem end of detent valve, install spring seat, seat retainer and detent valve stop.

11. In upper left bore, install detent valve spring, detent valve assembly, detent actuating lever bracket and its retaining bolt. Torque bolt to 16 lb. ft.

NOTE: Free length of spring is 1 7/8" by 3/4" diameter.

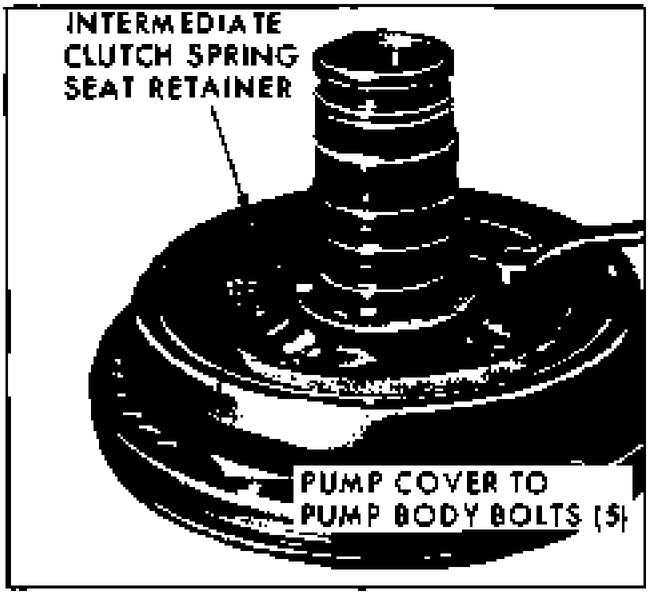


Fig. 7G-46 Removing Pump Attaching Bolts

12. Install manual valve and link assembly into lower left hand bore.

OIL PUMP ASSEMBLY

DISASSEMBLY

1. Remove pump body-to-case O-ring seal (square cut) from pump body. Discard seal.

2. Continue scribe mark, made earlier before removal of pump from case, down side of body and cover for aid in re-assembly.

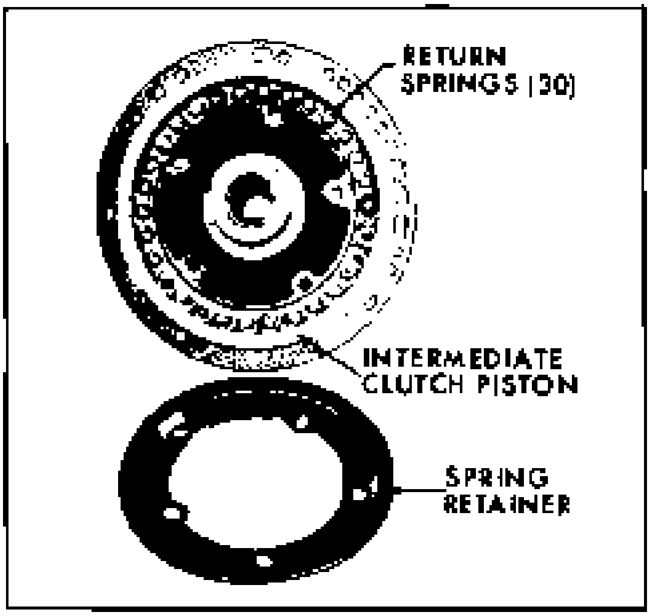


Fig. 7G-47 Removing Intermediate Clutch Return springs and Piston

Fig. 7G-48 Removing Oil Seal Rings and Selective Thrust Washer

3. Place pump assembly, stator shaft down, through hole in bench and remove five (5) pump cover-to-body attaching bolts (Fig. 7G-46).

4. Remove intermediate clutch spring seat retainer, thirty (30) clutch return springs and intermediate clutch piston assembly (Fig. 7G-47).

5. Remove intermediate clutch piston inner and outer seals from piston.

6. Remove two (2) forward clutch-to-pump b hub hook-type oil seal rings and three (3) direct clutch-to--pump hub hook-type oil seal rings from pump cover hub (Fig. 7G-48).

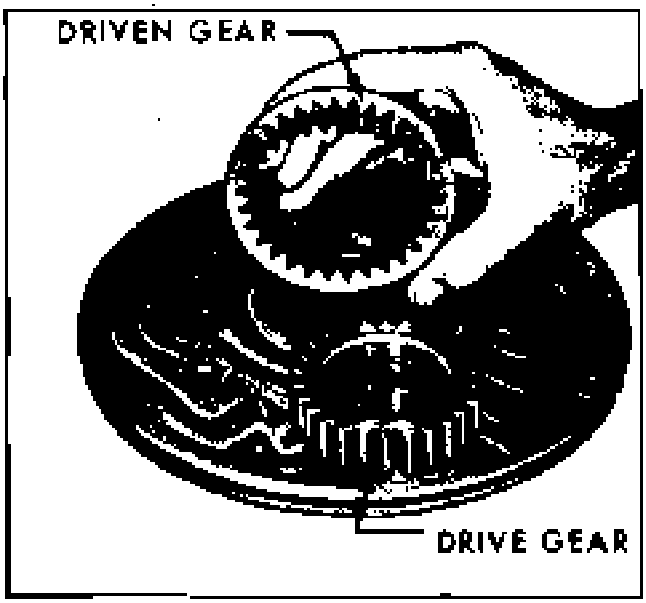


Fig. 7G-49 Removing Drive and Driven Gears

7. Remove pump cover-to-direct clutch drum selective thrust washer.

NOTE: Washer has one (1) large tang and controls end play of transmission.

8. Lift pump cover and stator shaft assembly from pump body.

9. Mark drive and driven gears for aid in re-assembly and remove gears from pump body (Fig. 7G-49).

10. Remove oil pump priming valve and spring from pump body face.(Fig. 7G-50).

11. If necessary to replace cooler by-pass valve, remove cooler by-pass valve seat, check ball and spring with the aid of a bolt extractor (Fig. 7G-51).

12. If necessary to replace oil pump body oil seal, place pump body on wood blocks so machined face surface is not damaged and remove pump body-to-converter hub lip oil seal with screwdriver or a small pry bar. Discard seal (Fig. 7G-52).

INSPECTION (Fig. 7G-53)

1. Wash all parts in cleaning solvent, blow out all oil passages and air dry.

2. Inspect pump drive and driven gears, gear pocket and crescent for nicks, galling or damage.

3. Inspect pump body and pump cover faces for nicks or scoring.

4. Inspect pump cover hub outer diameter for nicks or burrs which might damage direct clutch drum bushing.

5. Check three (3) pump cover and hub lubrication holes to make certain they are not restricted.

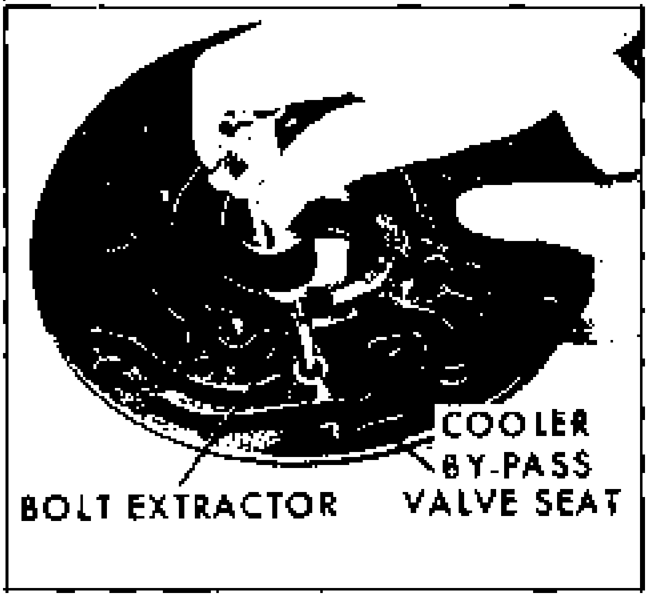


Fig. 7G-51 Removing Cooler By-Pass Valve Seat

6. Inspect pump body bushing for galling or scoring. Check clearance between pump body bushing and converter hub - maximum clearance is .005". If bushing is damaged, pump body should be replaced.

7. With parts clean and dry, install pump gears in pump body and check pump body face-to-gear face clearance. Should be .0008" minimum to .0035" maximum.

8. Inspect pump body-to-converter hub lip oil seal. If it was replaced as above, inspect converter hub for nicks or burrs which might have damaged pump lip oil seal or pump body bushing.

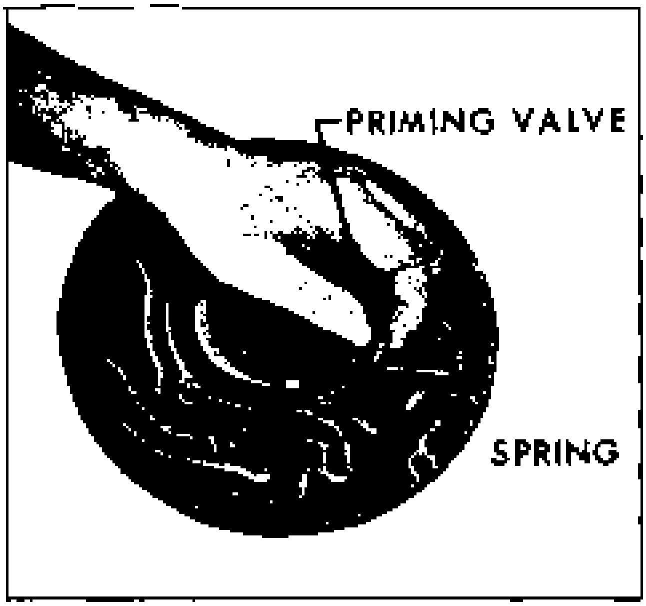


Fig. 7G-50 Removing Priming Valve and Spring

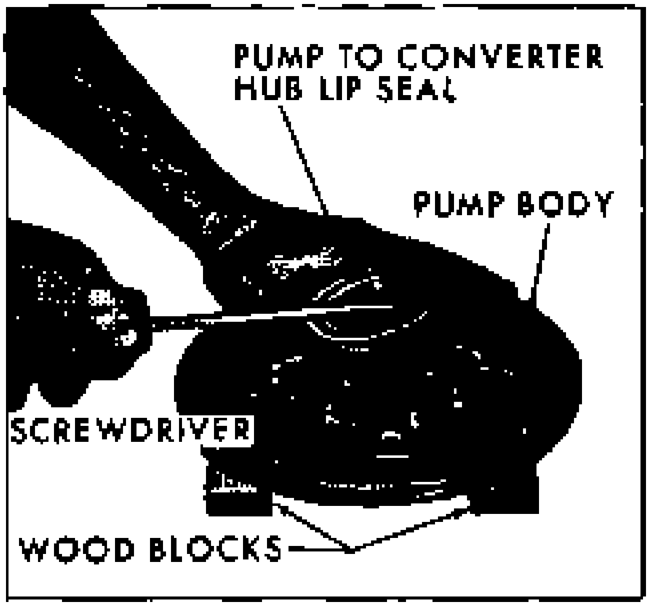


Fig. 7G-52 Removing Oil Pump Body Oil Seal

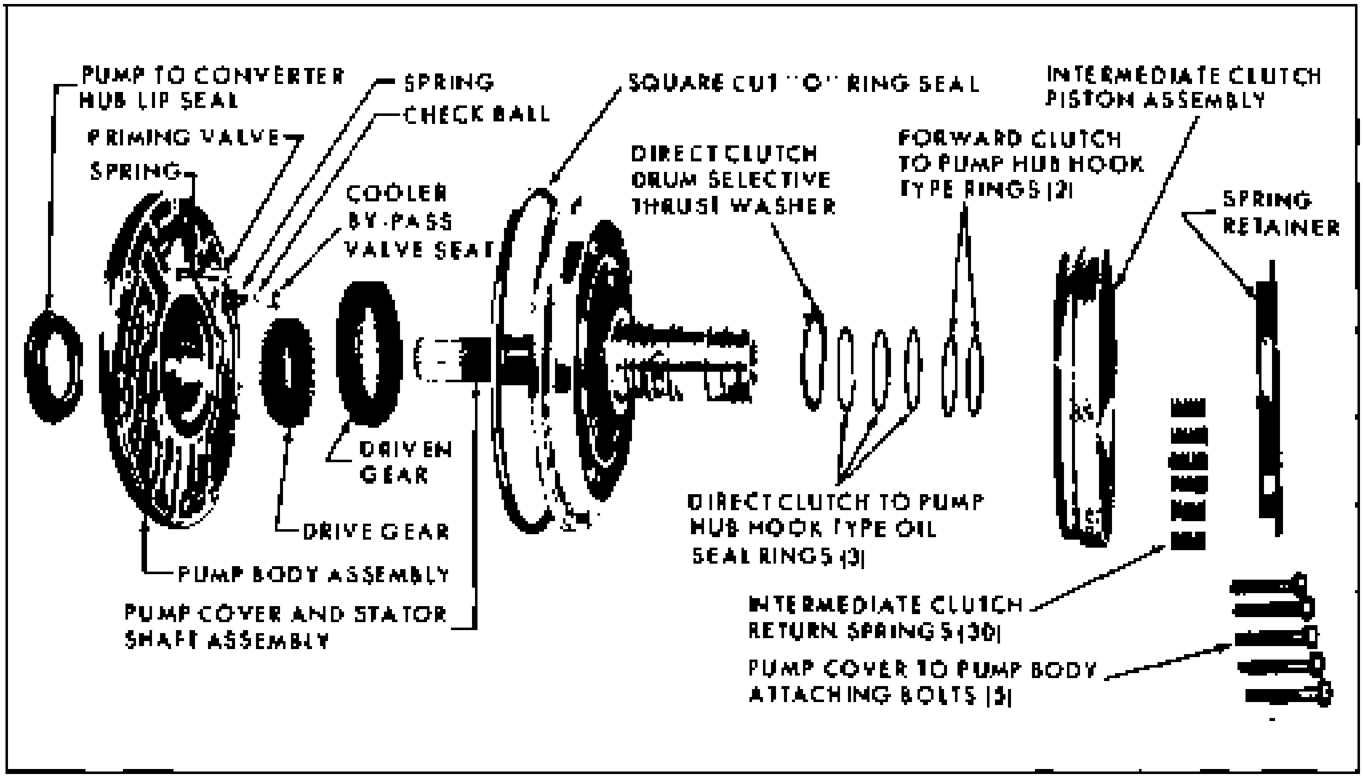


Fig. 7G-53 Exploded View of Oil Pump Assembly

9. Check for free operation of priming valve in pump body and replace if necessary.

10. Check condition of cooler by-pass valve and replace if valve leaks excessively.

11. Check all springs for distortion or collapsed coils.

12. Check oil passages in pump body (Fig. 7G-54) and in pump cover (Figs. 7G-55 and 7G-56).

13. Inspect three (3) pump cover stator shaft bushings for galling or scoring. If any of these bushings is damaged, replace bushing(s) as follows:

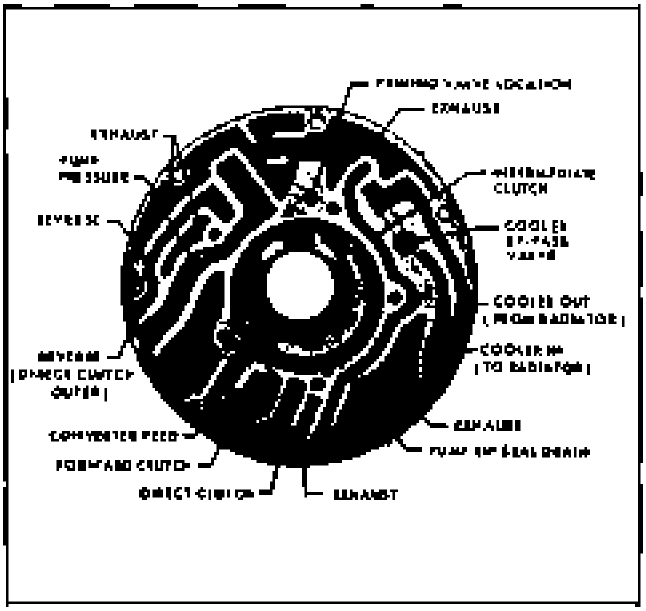


Fig. 7G-54 Pump Body Oil Passages

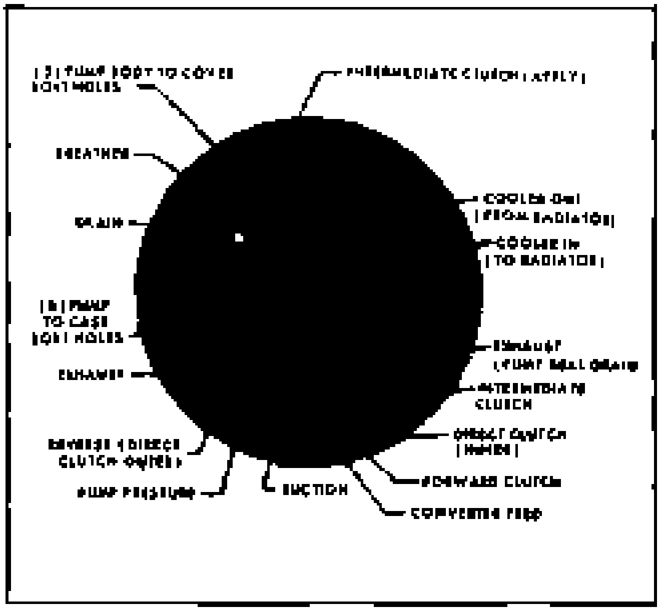


Fig. 7G-55 Pump Cover (Case Face) Oil Passages

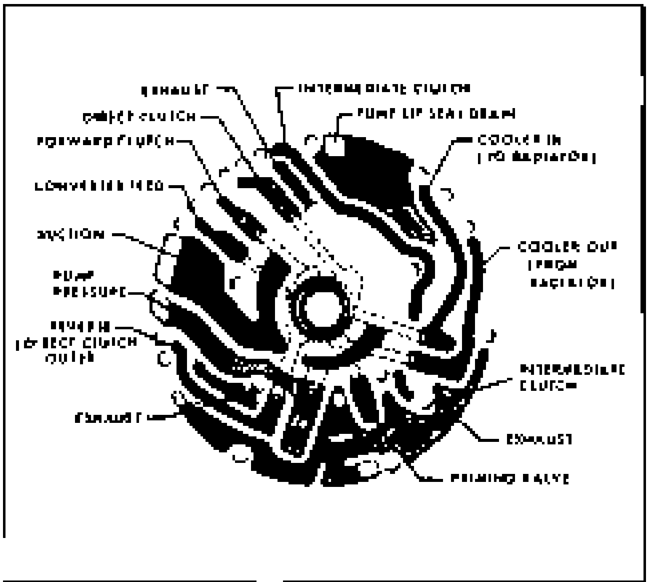


Fig. 7G-56 Pump Cover and Stator Shaft Oil Passages

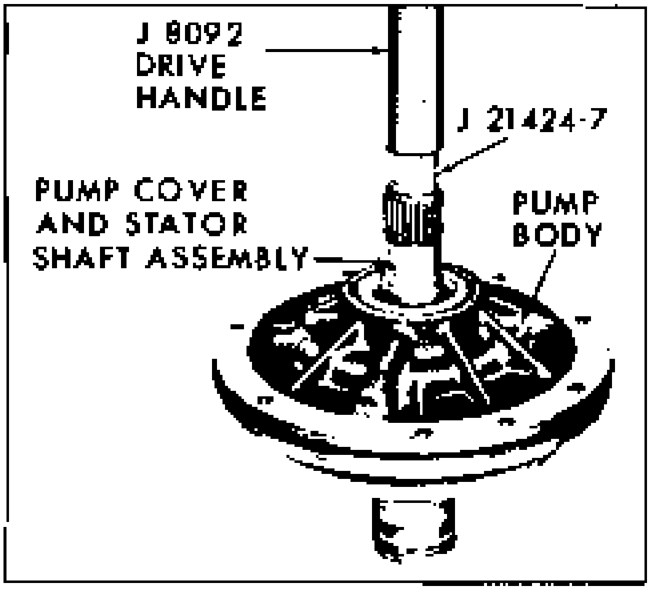


Fig. 7G-58 Installing Stator Shaft Front Bushing

STATOR SHAFT FRONT BUSHING

a. Thread Bushing Tool J 21465-15 into stator shaft front bushing, thread Slide Hammer J 2619 and Adapter J 2619-4 into Bushing Tool and clamp Slide Hammer handle into vise. Grasp pump cover hub and remove bushing. Discard bushing (Fig. 7G-57).

b. Install new bushing into front end of stator shaft by using Bushing Tool J 21424-7 and Drive Handle J 8092. Tap bushing into shaft to .250" below front face of shaft (Fig. 7G-58)

STATOR SHAFT REAR BUSHINGS

a. Remove front bushing as described above. Then, thread Bushing Tool J 21424-7 into Extension J 21465-13 and Drive Handle J 8092. Place tool assembly through front of stator shaft and drive out center and rear bushings.

b. Install new center bushing into hub end of pump cover by using Bushing Tool J 23062-2, Extension J 21465-13, Drive Handle J 8092 and drive bushing to approximately 1 1/32" below face of pump cover hub. Then, install new rear bushing in same manner flush to .010" below face of pump cover hub (Fig. 7G-59).

ASSEMBLY

1. If oil pump body oil seal was removed, place pump

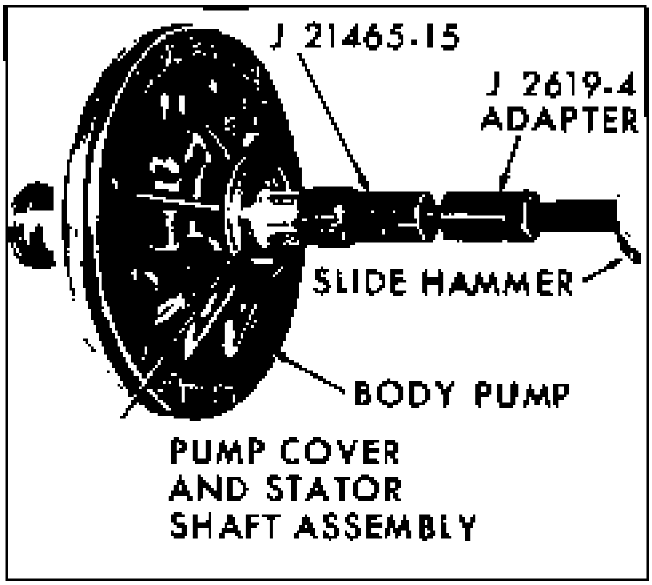


Fig. 7G-57 Removing Stator Shaft Front Bushing

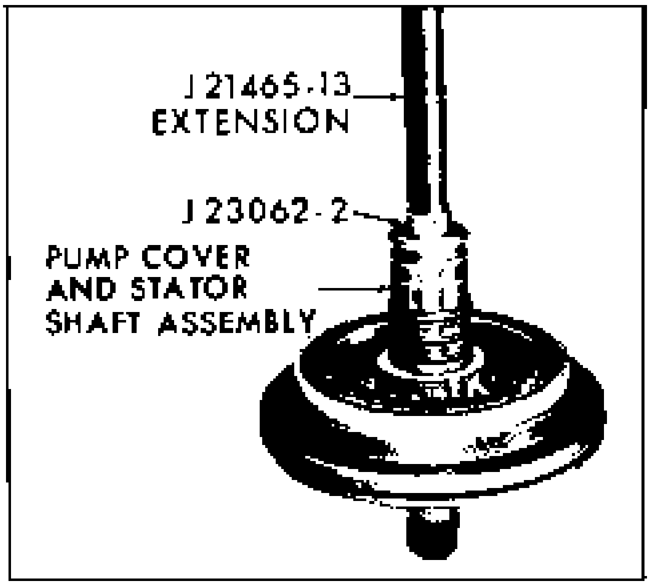


Fig. 7G-59 Installing Stator Shaft Rear Bushings

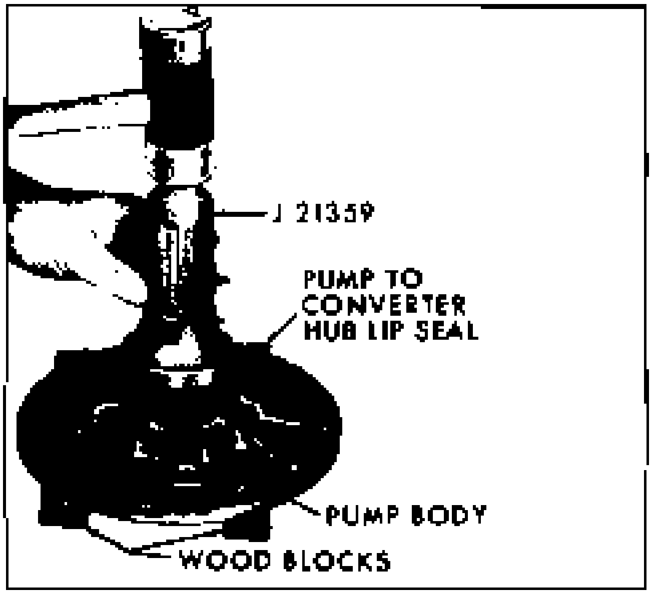


Fig. 7G-60 Installing Oil Pump Body Oil Seal

body on wood blocks and install new pump body-to-converter hub lip oil seal, using Seal Installer J 21359 to fully seat seal in its counterbore (Fig. 7G-52).

NOTE: Outer diameter of seal should be coated with a non-hardening sealer prior to installation.

2. If cooler by-pass valve was removed, install new cooler by-pass spring, check valve and valve seat by tapping seat into place with a soft hammer or brass drift so it is flush to .010" below face of pump body (Fig. 7G-61).

3. Install oil pump priming valve spring and priming valve (Fig. 7G-50).

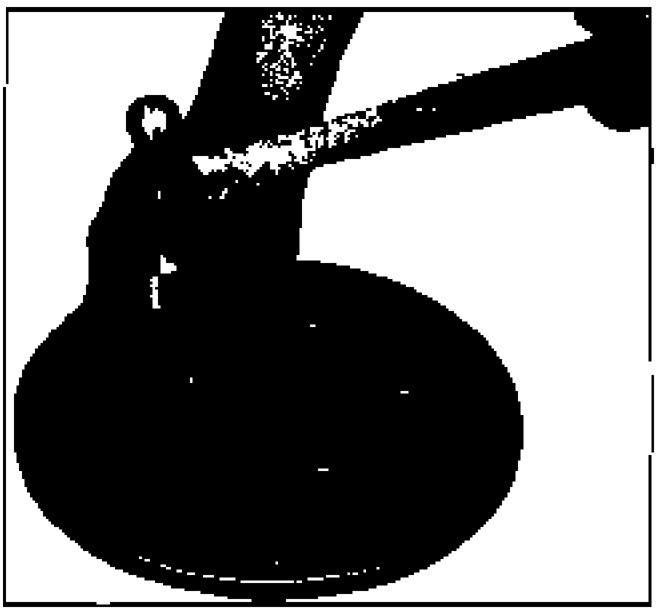


Fig. 7G-61 Installing New Cooler By-Pass Valve Seal

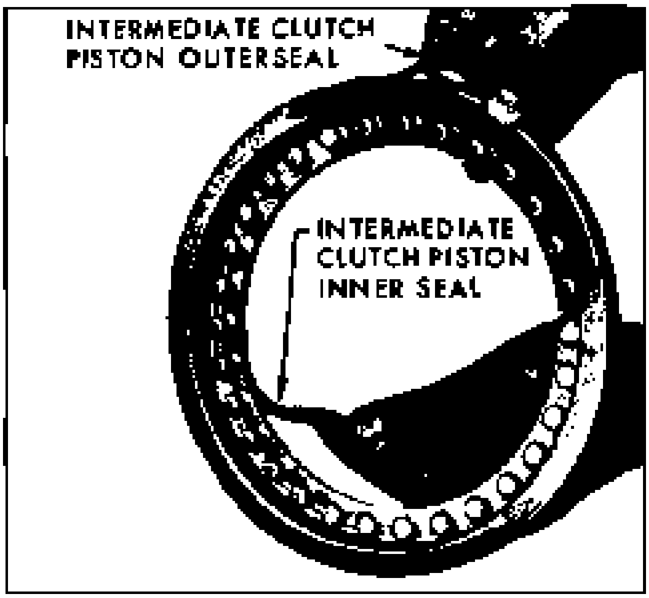


Fig. 7G-62 Installing Seals in Intermediate Clutch Piston

4. Install drive and driven gears into pump body with alignment marks up (Fig. 7G-49).

NOTE: Tang face of drive gear is up to prevent damage by converter.

5. Install pump cover to pump body, aligning marks made earlier.

NOTE: If alignment marks were not made, locate pump priming valve in pump body to priming valve cavity in pump cover.

6. Install pump cover-to-direct clutch drum selective

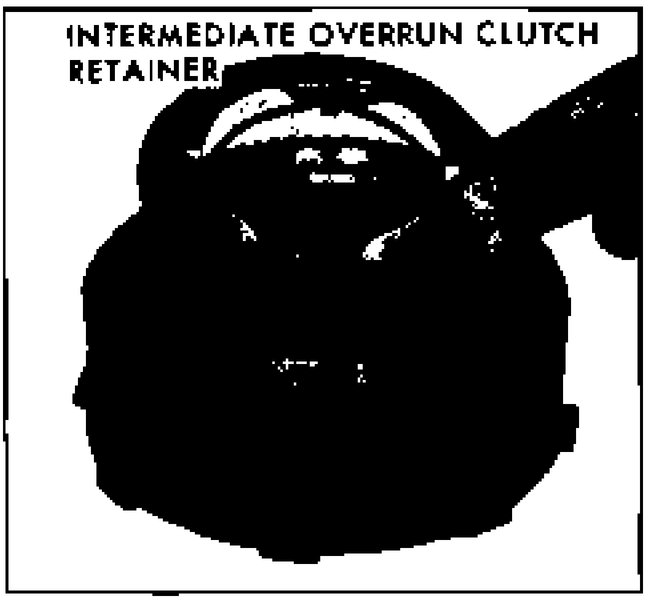


Fig. 7G-63 Removing Intermediate Overrun Clutch Retainer

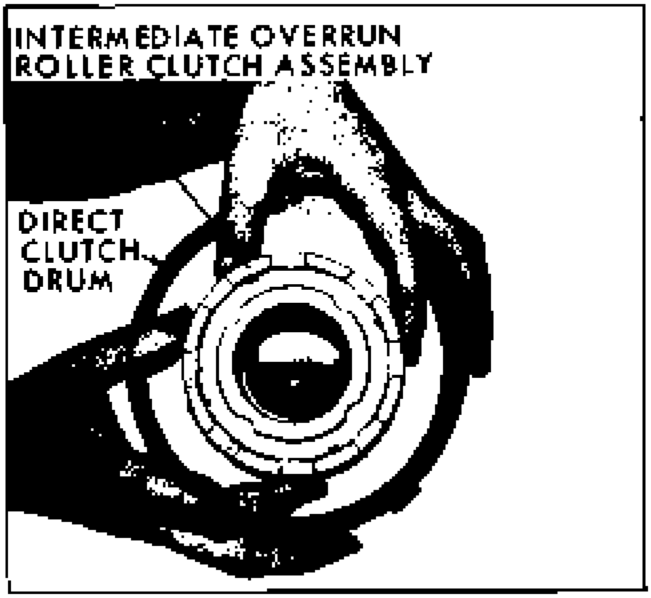


Fig. 7G-64 Removing Intermediate Overrun Roller Clutch Assembly

thrust washer over pump cover oil delivery sleeve (hub).

NOTE: Washer has one (1) external tang.

7. Install and engage three (3) direct clutch-to-pump hub hook-type oil seal rings and two (2) forward clutch-to-pump hub hook-type oil seal rings on pump cover oil delivery sleeve (Fig. 7G-48)

NOTE: Make certain that rings are free to move in grooves.

8. Install intermediate clutch piston inner and outer seals in clutch piston and install intermediate clutch

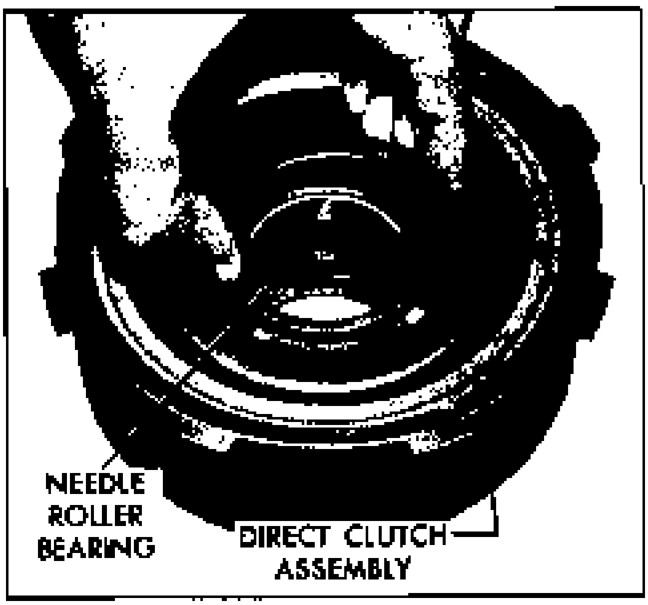


Fig. 7G-65 Removing Direct Clutch-To-Forward Clutch Thrust Bearing

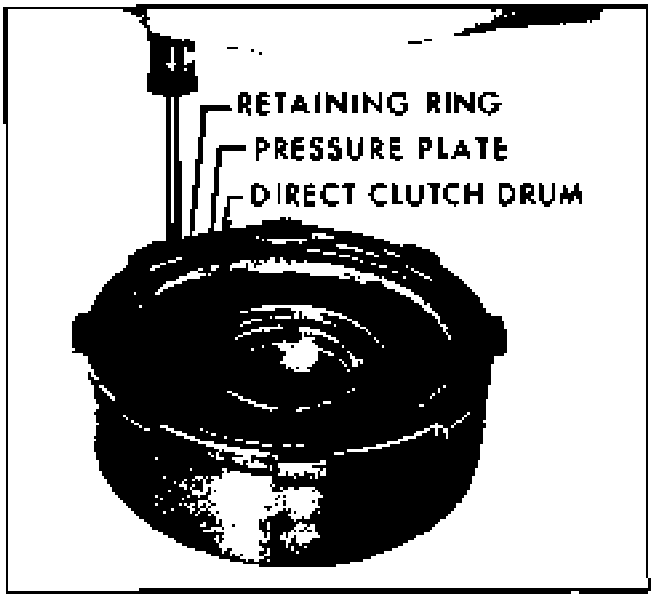


Fig. 7G-66 Removing Retaining Ring and Pressure Plate

piston assembly into pump cover (Fig. 7G-62).

NOTE: Lips of seals should be facing into pump cover when piston is installed. For aiding installation of piston into pump cover, use a piece of .020" music wire crimped into short section of copper tubing.

9. Install thirty (30) clutch return springs into piston and install spring seat retainer and five (5) attaching bolts, finger tight.

NOTE: Free length of springs is 31/32" by 1/2" diameter.

10. Place oil pump assembly upside down in transmission case and tighten five (5) pump cover-to-pump

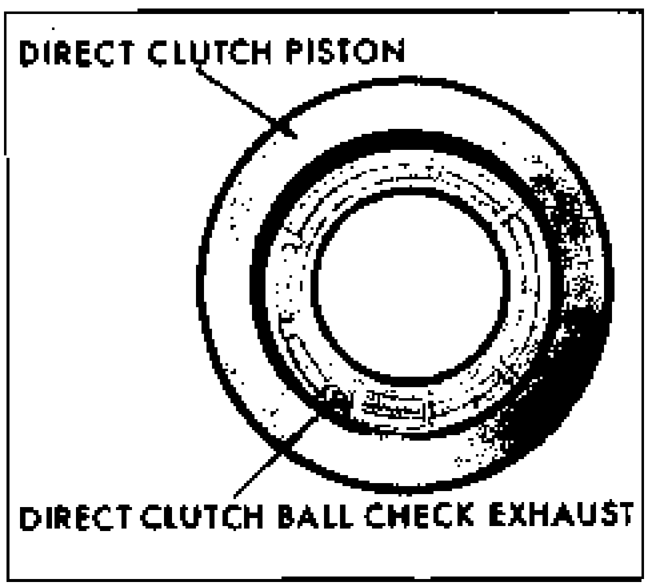


Fig. 7G-67 Identification of Direct Clutch Piston

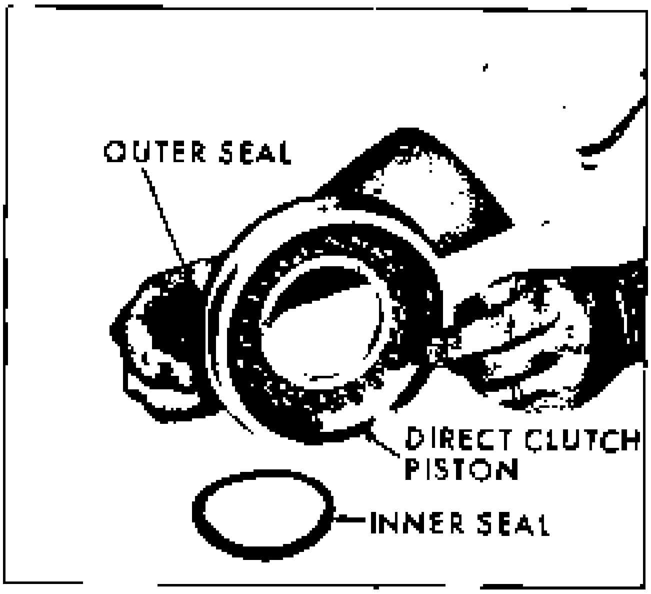


Fig. 7G-68 Removing Direct Clutch Piston Inner and Outer Seals

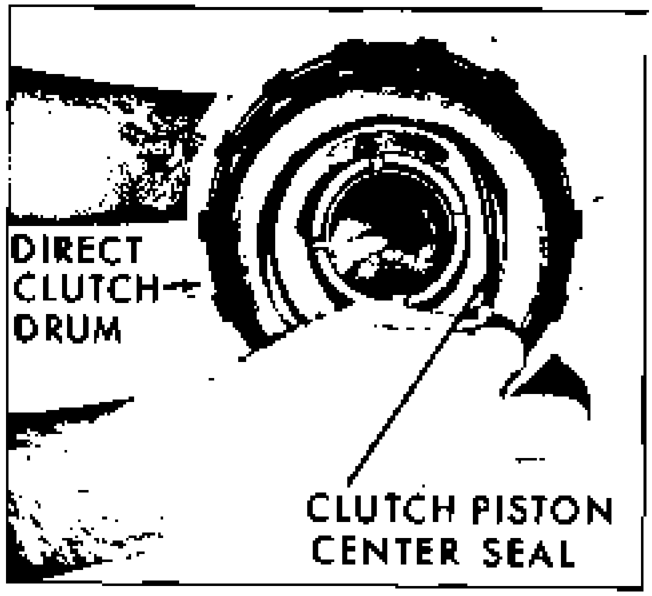


Fig. 7G-69 Removing Direct Clutch Piston Center Seal

body bolts to 18 lb. ft. and remove pump from case.

DIRECT CLUTCH ASSEMBLY

DISASSEMBLY

1. Separate direct clutch assembly from forward clutch assembly and remove intermediate overrun clutch retaining ring and retainer from direct clutch assembly (Fig. 7G-63).

2. Remove intermediate overrun clutch outer race.

NOTE: Before removal, check for correct assembly. Outer race should free wheel counterclockwise only.

3. Remove intermediate overrun roller clutch assembly from direct clutch drum (Fig. 7G-64).

4. Remove intermediate overrun clutch inner cam.

5. Turn over and remove direct clutch drum-to-forward clutch drum needle roller bearing (Fig. 7G-65).

6. Remove direct clutch pressure plate-to-clutch drum retaining ring and remove pressure plate (Fig. 7G-66).

7. On V-8 models, remove four (4) faced plates, four (4) steel separator plates and direct clutch housing cushion spring; on 6 cylinder models, remove three (3) faced plates, three (3) separator plates and cushion spring.

8. Using Clutch Spring Compress J 9542-1 and Pilot J 9542-4 (or J 23327-1 in arbor press), compress direct clutch piston return spring seat and remove piston retaining ring.

9. Remove tools, spring seat, seventeen (17) piston return springs and direct clutch piston assembly.

NOTE: Direct clutch piston contains a ball check (Fig. 7G-67).

10. Remove outer and inner seals from direct clutch piston and center seal from direct clutch drum hub (Figs. 7G-68 and 7G-69)

INSPECTION

1. Wash all parts in cleaning solvent, blow out all oil passages and air dry.

2. Inspect drive and driven clutch plates for signs of burning, scoring or wear.

3. Check all springs for collapsed coils or signs of distortion.

4. Inspect piston for cracks and free operation of ball check (Fig. 7G-67)

NOTE: Ball should be loose enough to rattle but not come out.

5. Inspect overrun clutch inner cam and outer race for scratches, wear or indentations (Fig. 7G-70).

6. Inspect overrun roller clutch assembly rollers for wear and roller springs for distortion.

7. Inspect clutch drum for wear, scoring, cracks, proper opening of oil passages, wear on clutch plate drive lugs and free operation of ball check (Fig. 7G-71).

8. Inspect direct clutch drum bushing for galling or scoring. If bushing is damaged, replace as follows:

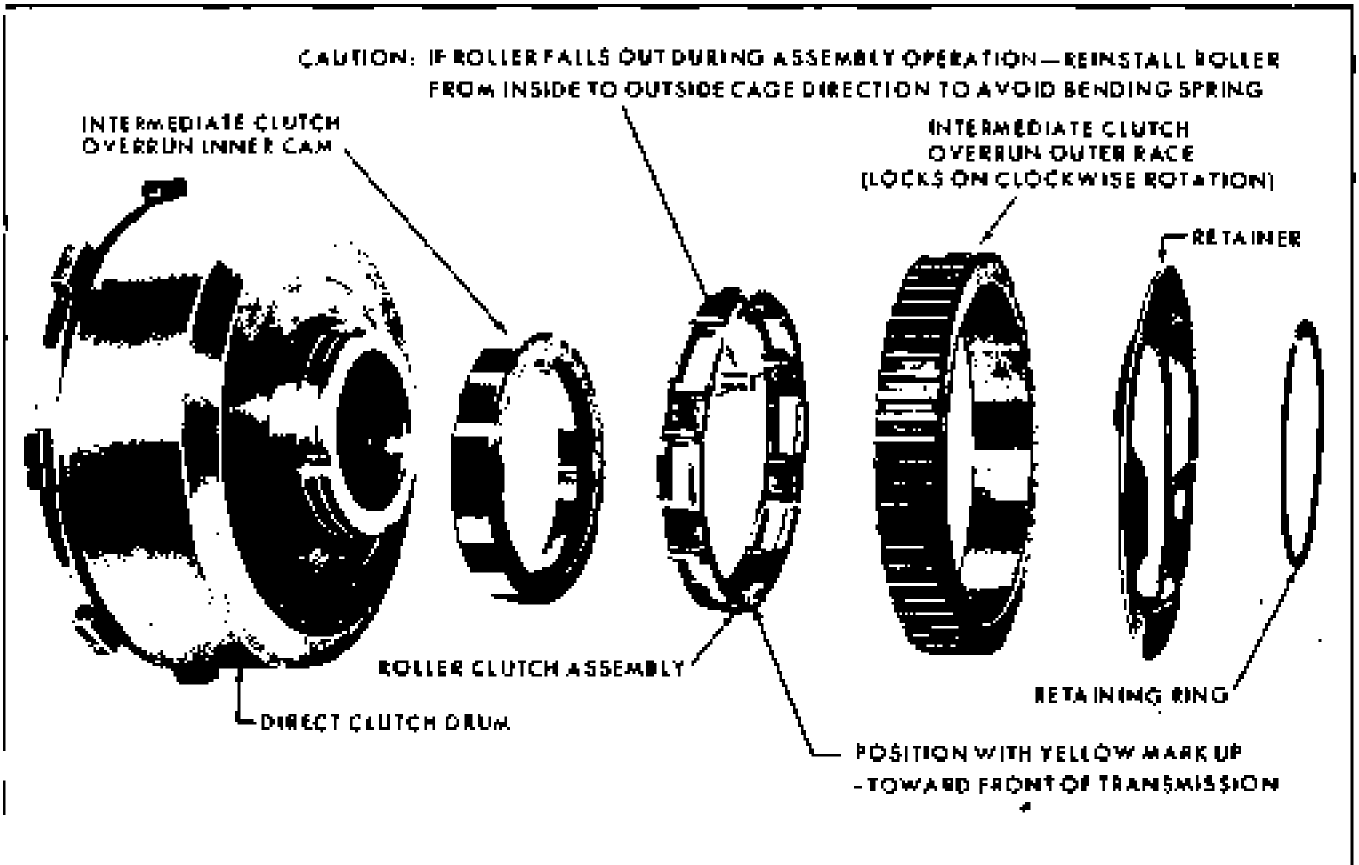


Fig. 7G-70 Exploded View of Intermediate Overrun Clutch Assembly

DIRECT CLUTCH BUSHING

a. With direct clutch drum properly supported, remove bushing (Fig. 7G-72).

NOTE: Use care not to score inner surface of direct clutch drum.

b. Using Bushing Tool J 23062-4 and Drive Handle J 8092, install new bushing 9/32" below clutch plate side of hub face (Fig. 7G-73).

NOTE: Bushing should be .010" below slot in hub face.

ASSEMBLY

1. Install direct clutch piston outer and inner seals (lips down) in clutch piston and direct clutch piston center seal (lip up) in clutch drum hub.

2. Install direct clutch piston assembly into clutch drum (Fig. 7G-74).

NOTE: For aiding installation of piston into drum, use a piece of .020" music wire crimped into short section of copper tubing.

3. Install seventeen (17) piston return springs and spring seat into piston.

NOTE: Free length of springs is 1 1/16" by 1/2" diameter.

4. Using Clutch Spring Compressor J 9542-1 and Pilot J 9542-4 (or J 23327-1 in arbor press), compress spring seat and install piston retaining ring.

5. Remove tools and lubricate plates with transmission fluid.

6. On V-8 models, install cushion spring, four (4) faced plates and four (4) steel separator plates, starting with cushion spring and alternating steel and faced plates; on 6 cylinder models, install cushion psring, three (3) faced and three (3) separator plates, staring with cushion spring and alternating steel and faced plates.

7. Install direct clutch pressure plate and retaining ring (Fig. 7G-66).

8. Install direct clutch drum-to-forward clutch drum needle roller bearing (Fig. 7G-65).

9. Turn over and index intermediate overrun clutch inner cam to direct clutch drum, with lugs up.

10. Install intermediate overrun roller clutch assembly, with paint daub up (Fig. 7G-64).

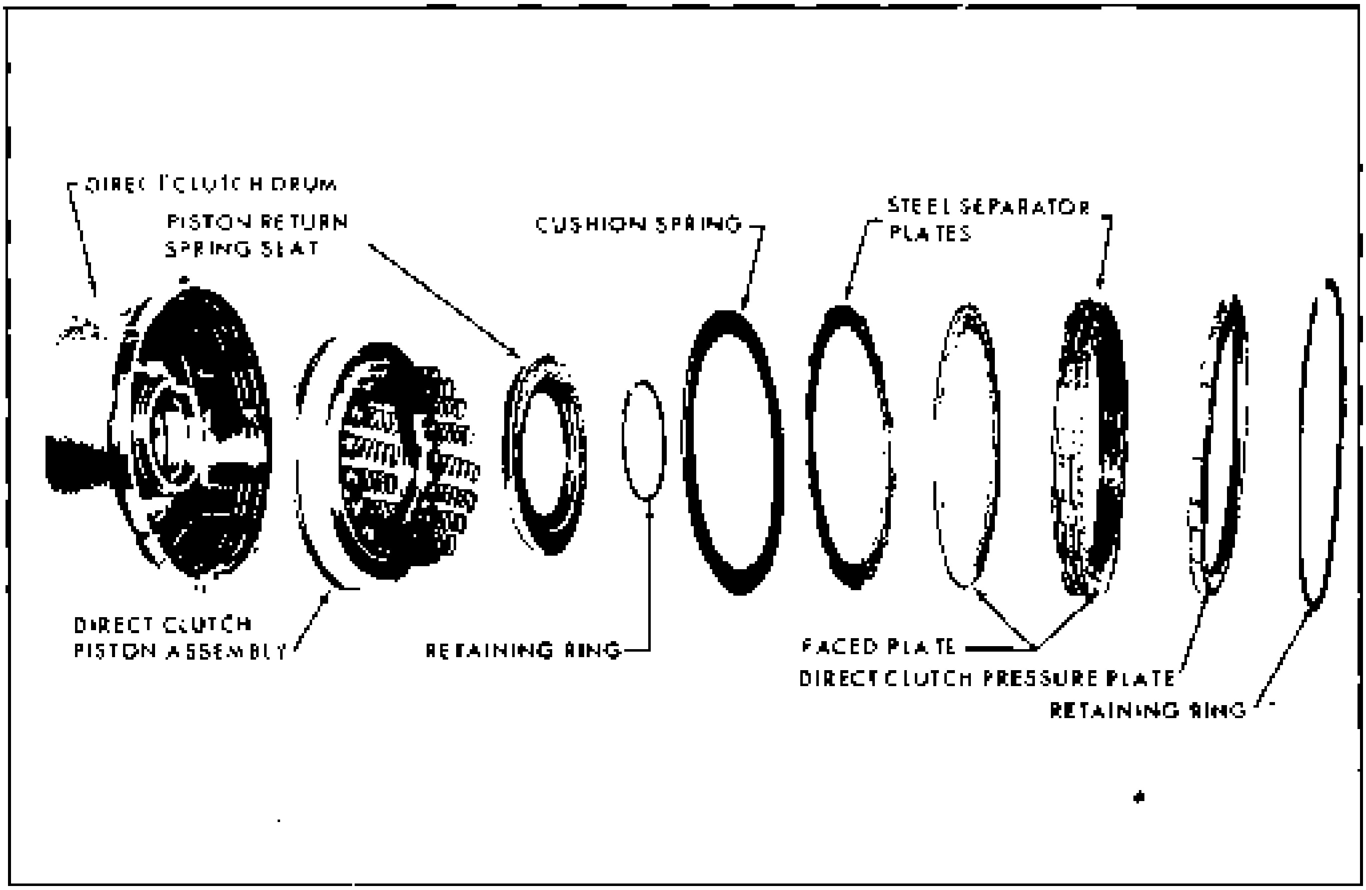


Fig. 7G-71 Exploded View of Direct Clutch Assembly

IMPORTANT: Roller clutch assembly must be installed with rollers up (toward front of transmission).

11. Install intermediate overrun clutch outer race, retainer and front retaining ring (Fig. 7G-63)

NOTE: When overrun roller clutch assembly is properly installed, outer race will free wheel counterclockwise only.

FORWARD CLUTCH ASSEMBLY

DISASSEMBLY

1. Place forward clutch assembly in hole in bench, with input shaft down, and remove forward clutch drum-to pressure plate retaining ring and forward clutch pressure plate (Fig. 7G-75).

2. On V-8 models, remove five (5) faced plates, five (5) steel separator plates and forward clutch housing cushion spring; on 6 cylinder models, remove four (4) faced and four (4) separator plates and cushion spring (Fig. 7G-76).

3. Using Clutch Spring Compressor J 23327-1 in arbor press, compress forward clutch piston return spring seat and remove retaining ring.

4. Remove tool, spring seat, twenty-one (21) piston return springs and forward clutch piston assembly (Fig 7G-77).

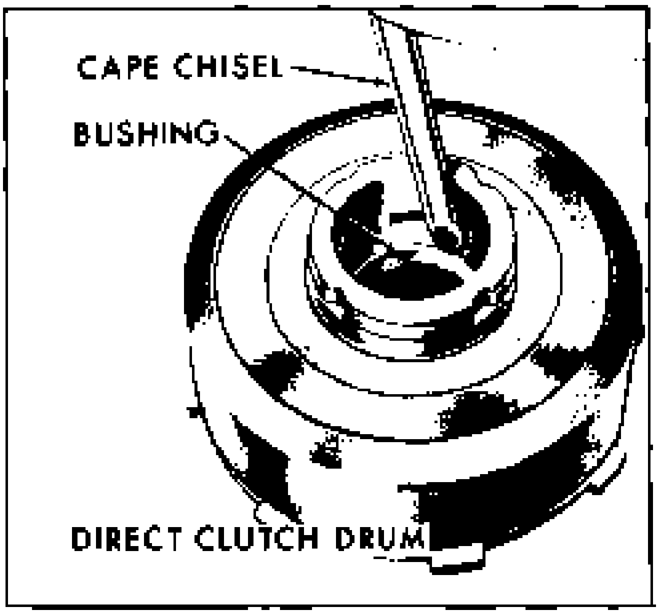


Fig. 7G-72 Removing Direct Clutch Drum Bushing

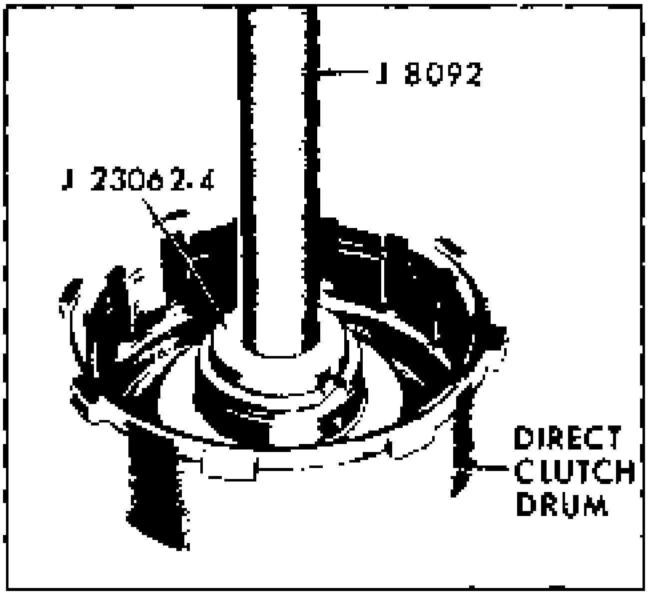


Fig. 7G-73 Installing Direct Clutch Drum Bushing

5. Remove inner and outer seals from forward clutch piston (Fig. 7G-78).

6. If required, remove input shaft from forward clutch drum, using a ram press or arbor press.

INSPECTION (Fig. 7G-79)

1. Wash all parts in cleaning solvent, blow out all oil passages and air dry.

2. Inspect drive and driven clutch plates for signs of burning, scoring or wear.

3. Inspect all springs for collapsed coils or signs of distortion.

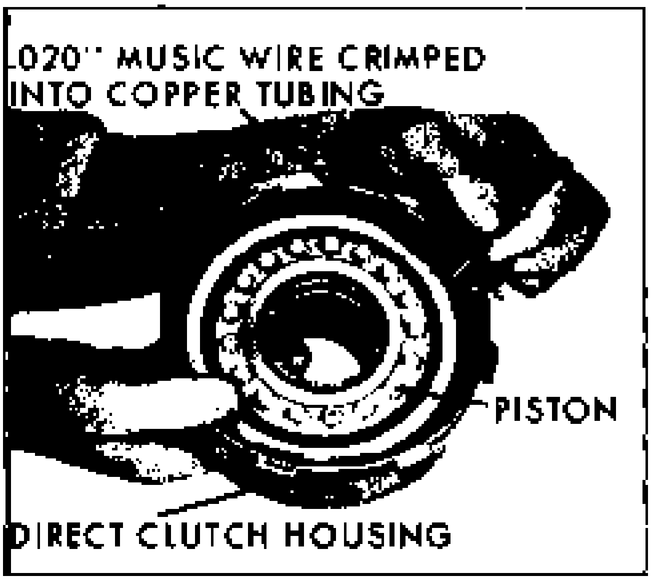


Fig. 7G-74 Installing Direct Clutch Piston Assembly

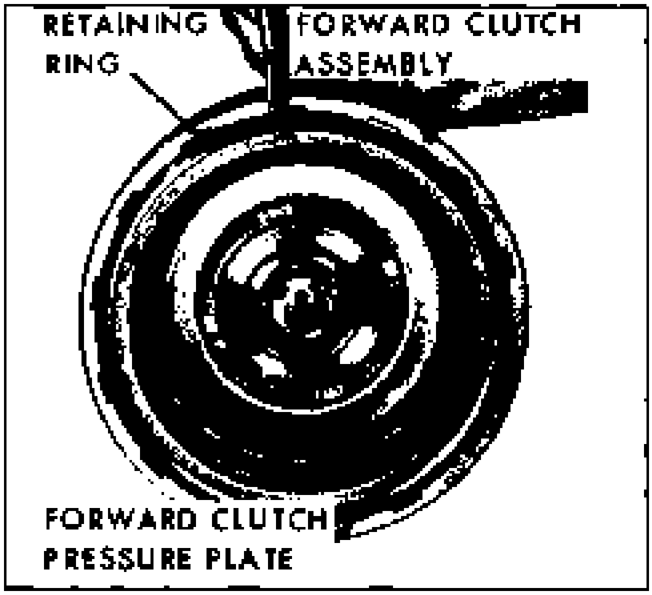


Fig. 7G-75 Removing Forward Clutch Retaining Ring and Pressure Plate

4. Inspect piston for cracks.

5. Inspect clutch drum for wear, scoring, cracks, proper opening of oil passages and free operation of ball check (Fig. 7G-80).

6. Inspect input shaft for:

a. Open lubrication passages at each end.

b. Damage to splines or shaft.

c. Damage to ground bushing journals.

d. Cracks or distortion of shaft.

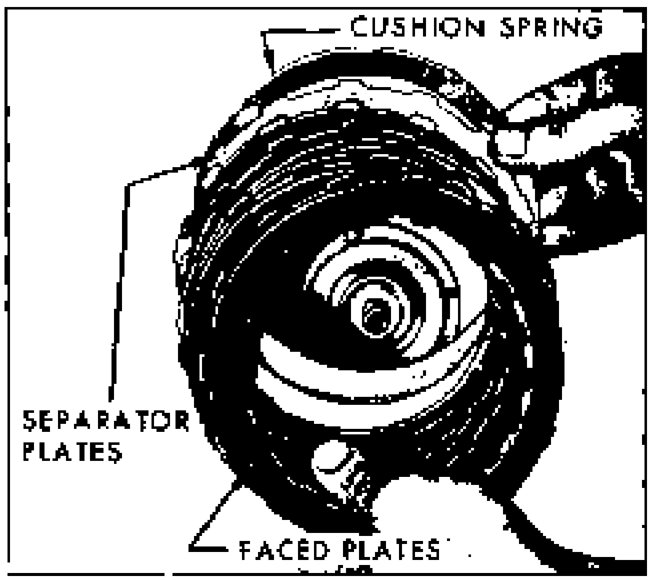


Fig. 7G-76 Removing Forward Clutch Plates

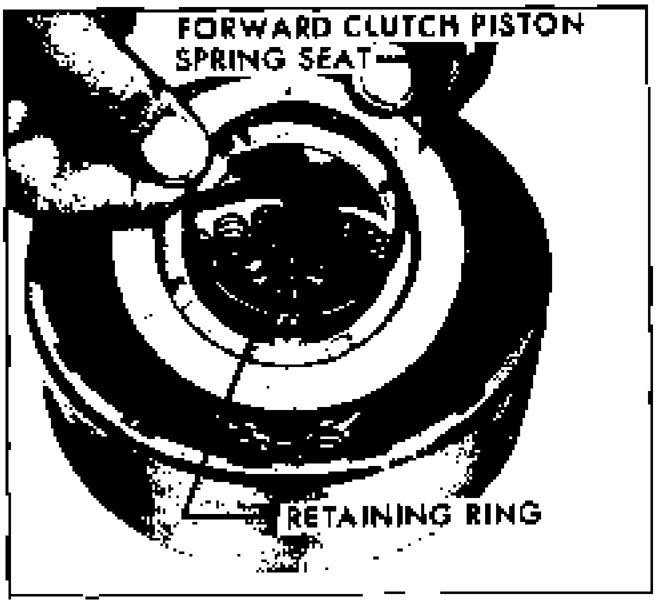


Fig. 7G-77 Removing Spring Seat and Return Springs

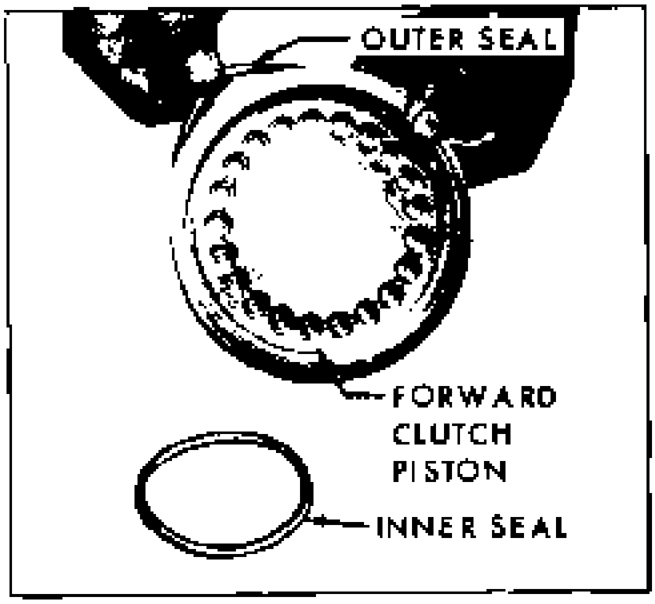


Fig. 7G-78 Clutch Piston Inner and Outer Seals

NOTE: Input shaft and clutch drum are not serviced separately.

ASSEMBLY

1. If input shaft was removed from clutch drum, re install, using a ram press or arbor press.

2. Install forward clutch piston outer and inner seals (lips down) in clutch piston (Fig. 7G-78).

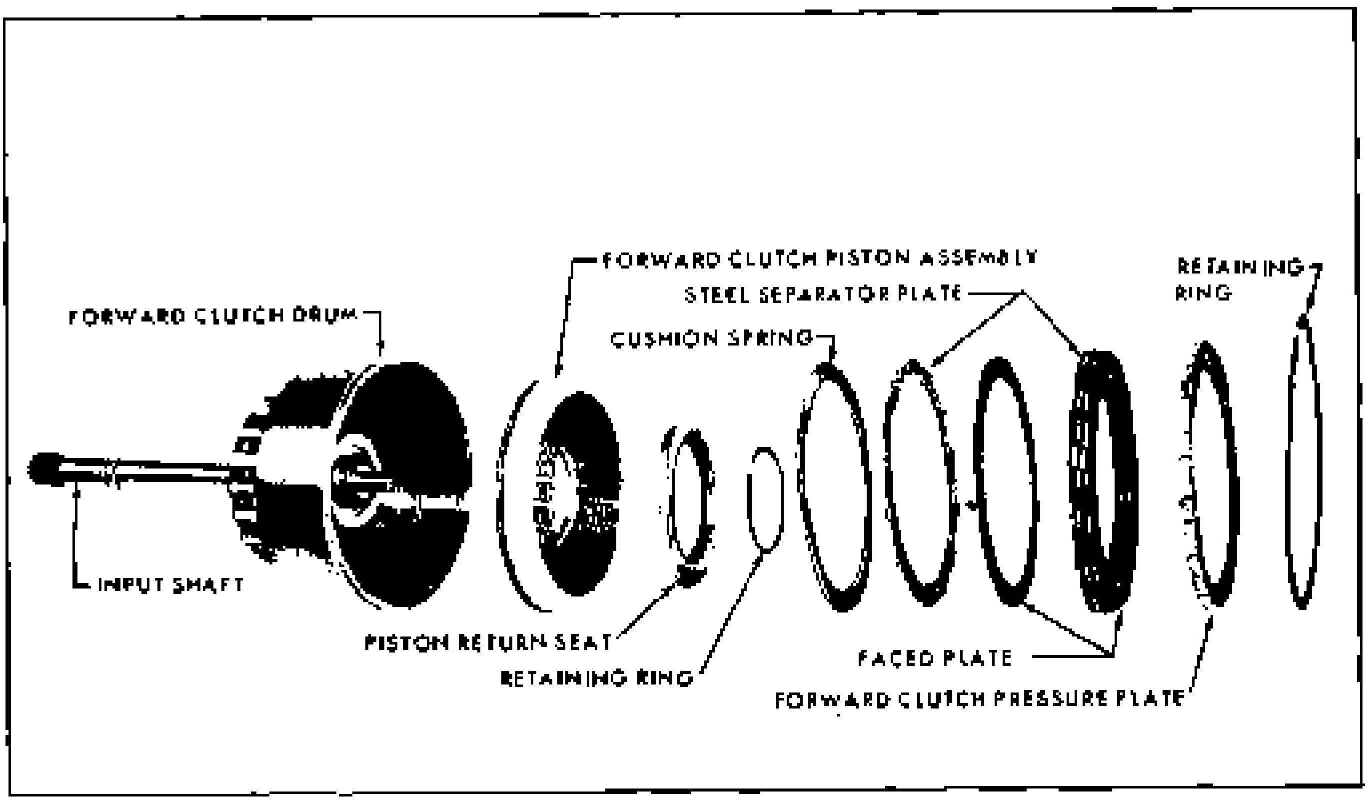


Fig. 7G-79 Exploded View of Forward Clutch Assembly

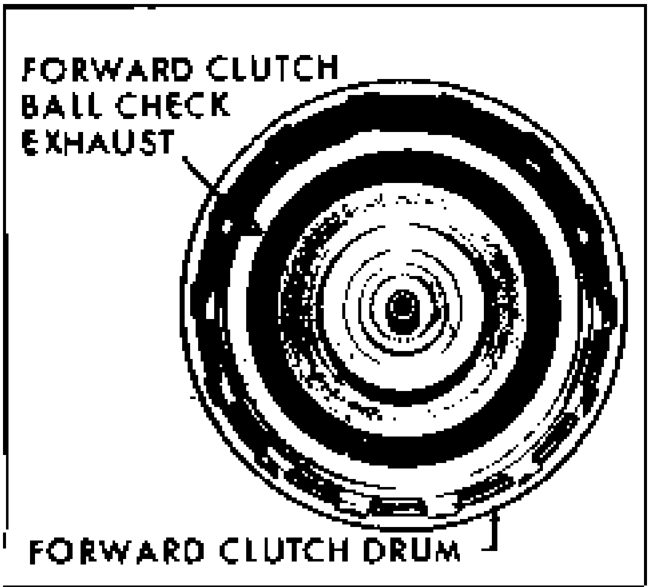


Fig. 7G-80 Forward Clutch Drum Ball Check

3. Install forward clutch piston assembly into drum (Fig. 7G-81).

NOTE: For aiding installation, use a piece of .020" music wire crimped into short section of copper tubing.

4. Install twenty-one (21) piston return springs and spring seat into piston.

NOTE: Free length of springs is 1 1/16" by 1/2" diameter.

5. Using Clutch Spring Compressor J 23327-1 in press, compress spring seat and install piston retaining ring.

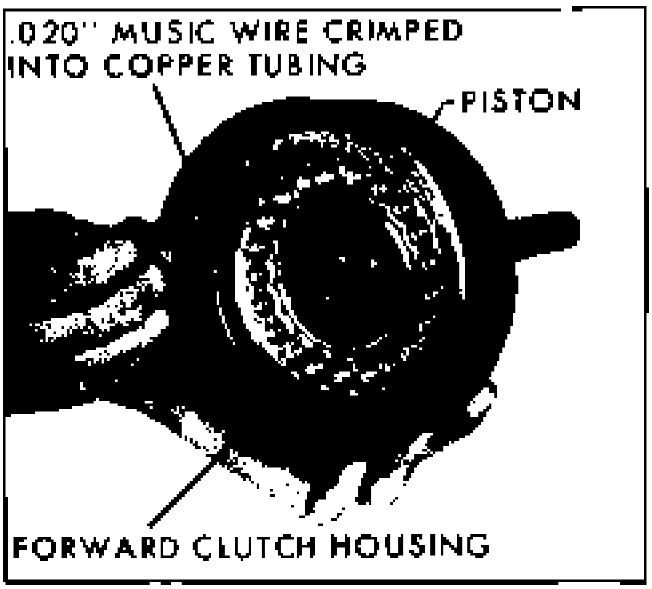


Fig. 7G-81 Installing Forward Clutch Piston Assembly

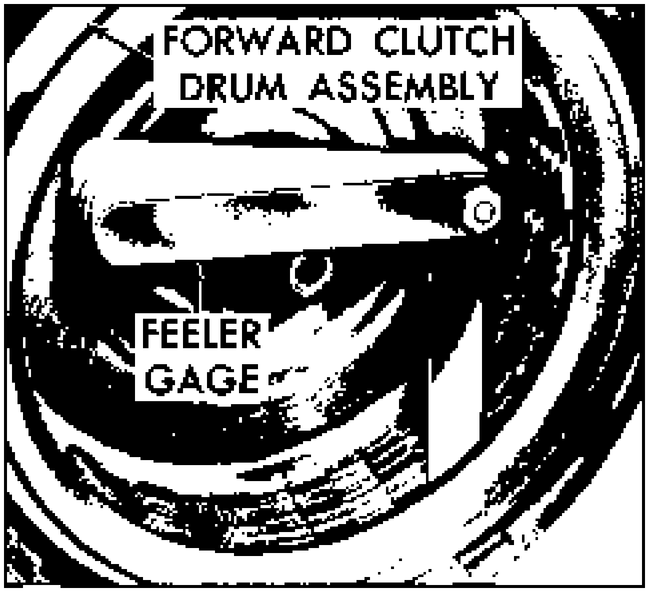


Fig. 7G-82 Checking Free Back Height

6. Remove tool and lubricate plates with transmission fluid.

7. On V-8 models, install cushion spring, five (5) faced plates and five (5) steel separator plates, starting with cushion spring and alternating steel and faced plates; on 6 cylinder models, install cushion spring, four (4) faced and four (4) separator plates, starting with cushion spring and alternating steel and faced plates (Fig. 7G-76).

8. Install forward clutch pressure plate and its retaining ring (Fig 7G-75).

9. Using a feeler gage, check free back height between

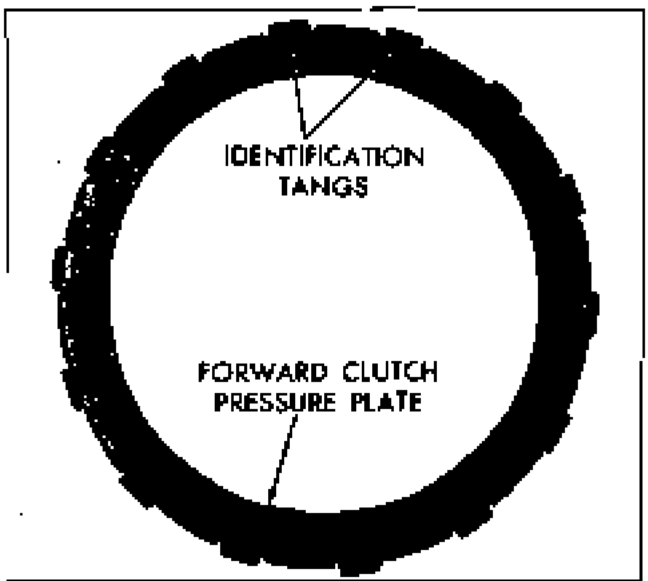


Fig. 7G-83 Forward Clutch Pressure Plate Identification

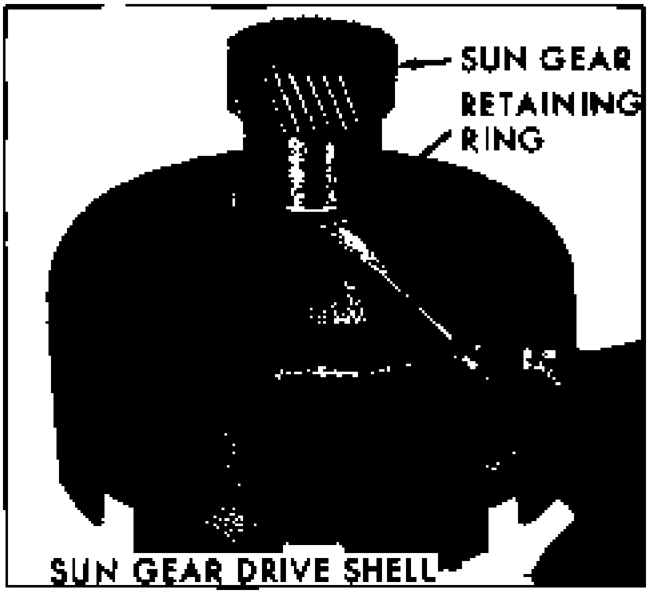


Fig. 7G-84 Removing Retaining Ring From Rear of Sun Gear Drive Shell

the forward clutch pressure plate and faced plate (Fig. 7G-82). There are three (3) pressure plates available which are identified by tangs adjacent to the source identification mark (Fig. 7G-83). If checking height is .0205"-.0560", use pressure plate with no tang; if height is .0560"-.0870", use pressure plate with one (1) tang; if height is .0870"-.1430", use pressure plate with two (2) tangs.

SUN GEAR AND SUN GEAR DRIVE SHELL ASSEMBLY

DISASSEMBLY

1. Remove sun gear-to-sun gear drive shell rear retaining ring. Discard ring (Fig. 7G-84).

Fig. 7G-85 Removing Rear Flat Thrust Washer

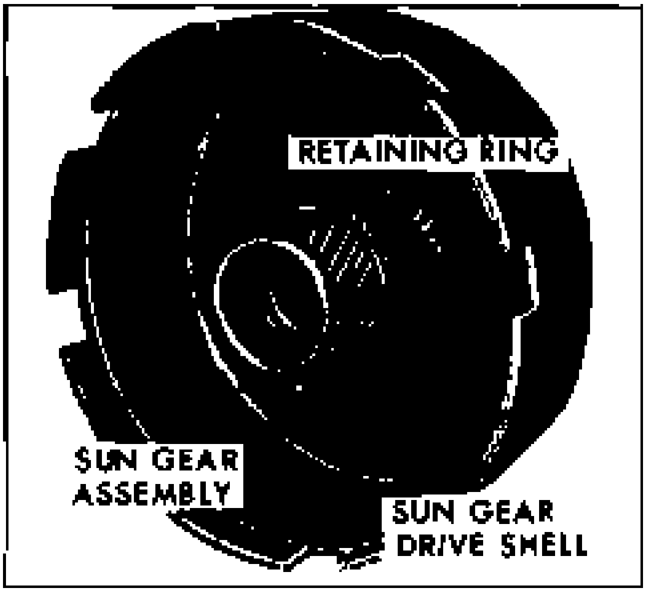


Fig. 7G-86 Removing Sun Gear From Sun Gear Drive Shell

2. Remove sun gear-to-drive shell rear flat thrust washer (Fig. 7G-85).

3. Remove sun gear from drive shell and remove front retaining ring from sun gear. Discard ring (Fig. 7G-86).

INSPECTION

1. Wash all parts in cleaning solvent and air dry.

2. Inspect sun gear and sun gear drive shell for wear or damage.

3. Inspect sun gear bushings for galling or scoring. If bushing(s) is damaged, replace as follows:

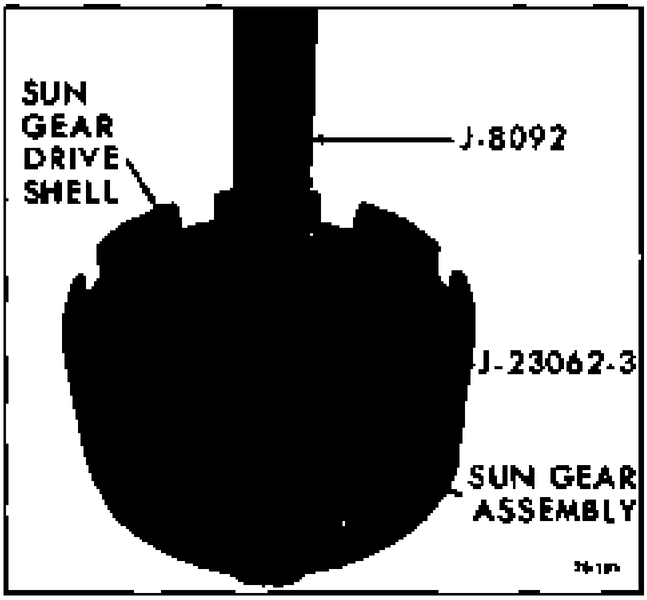


Fig. 7G-87 Installing Sun Gear Bushings

Sun Gear Bushings

a. Using Bushing Tool J 23062-3, Extension J 21465-13 and Drive Handle J-8092 and with sun gear properly supported, drive out bushings (2).

b. Using Bushing Tool J 23062-3 and Drive Handle J 8092, install each new bushing flush to .010" below surface of each counterbore (Fig. 7G-87).

ASSEMBLY

1. Install new front retaining ring on sun gear.

2. Install sun gear into sun gear drive shell (Fig. 7G-86).

3. Install sun gear-to-drive shell rear flat thrust washer (Fig. 7G-85).

4. Retain sun gear to drive shell with new rear retaining ring.

NOTE: Do not over stress front and rear retaining rings on installation.

LOW AND REVERSE ROLLER CLUTCH SUPPORT ASSEMBLY (Fig. 7G-88)

DISASSEMBLY

1. Remove low and reverse overrun clutch inner race from support assembly.

NOTE: Before removal, check for correct assembly. Inner race should free wheel clockwise only.

2. Remove low and reverse roller clutch front retaining ring and low and reverse roller clutch assembly from support.

INSPECTION

1. Wash parts in cleaning solvent and air dry.

2. Inspect roller clutch inner and outer races for scratches, wear or indentations.

3. Inspect roller clutch assembly rollers for wear and roller springs for distortion.

NOTE: If rollers are removed from assembly, install rollers from outside in to avoid bending springs.

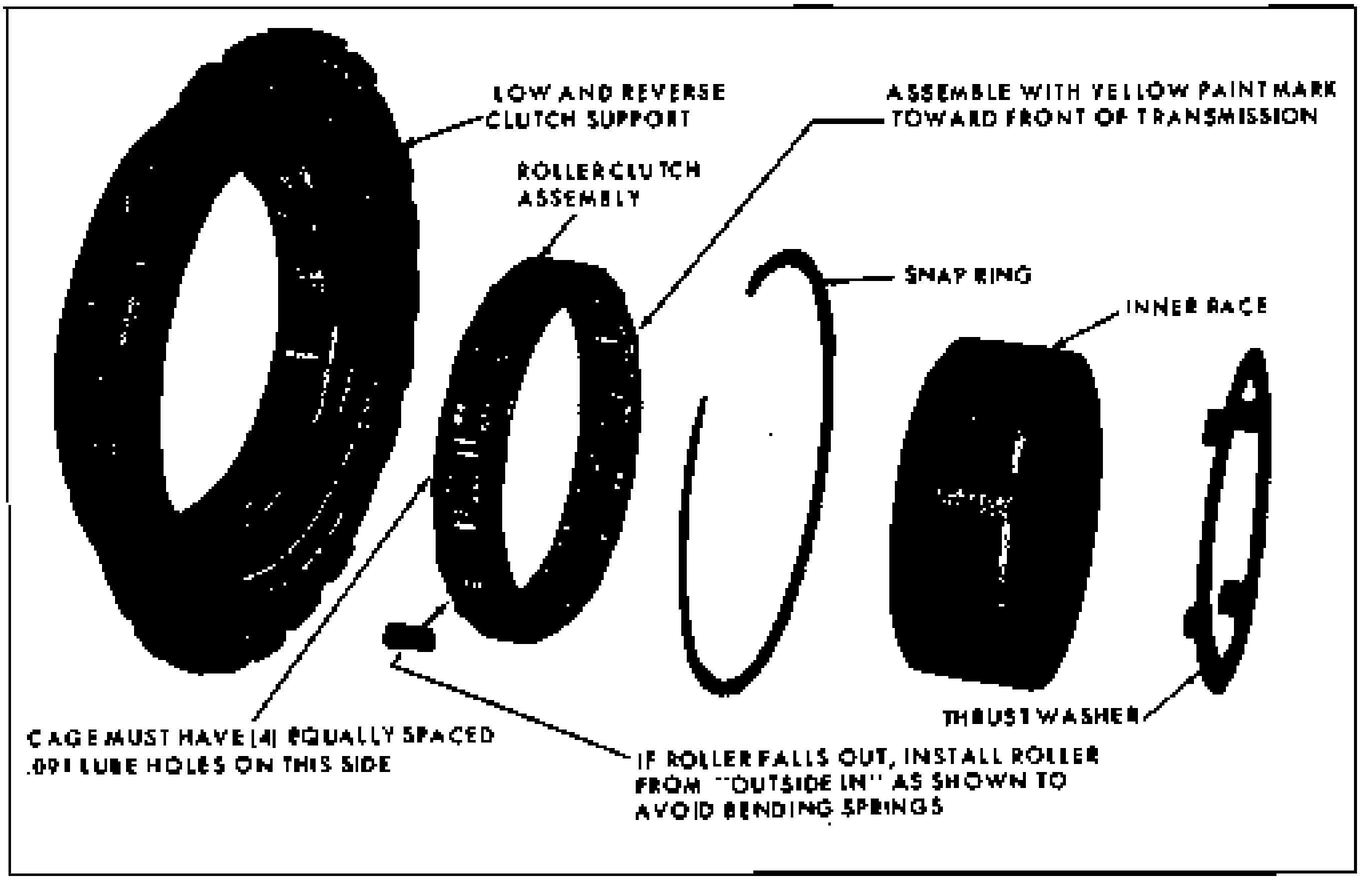


Fig. 7G-88 Exploded View of Low and Reverse Roller Clutch and Support Assembly

ASSEMBLY

1. Install low and reverse roller clutch assembly in support.

NOTE: Install roller clutch assembly with four (4) oil holes facing rear of transmission.

2. Install low and reverse roller clutch front retaining ring.

3. Install low and reverse overrun clutch inner race.

NOTE: When roller clutch assembly is properly installed, inner race will free wheel clockwise only.

INPUT RING GEAR

INSPECTION

1. Wash in cleaning solvent and air dry.

2. Check to see that forward clutch faced plates are a free fit over input ring gear hub.

3. Examine condition of hub splines and mating splines of forward clutch faced plates.

4. Inspect thrust washer surface for signs of scoring or wear.

5. Inspect input ring gear bushing for galling or scoring. If bushing is damaged, replace as follows:

Input Ring Gear Bushing (Fig 7G-89)

a. Using Bushing Tool J 23062-5 and Drive Handle J 8092 and with input ring gear properly supported, drive out bushing.

b. Using Bushing Tool J 23062-5 and Drive Handle J 8092, install new bushing to .050"-.060" below rear face, inside gear end.

OUTPUT CARRIER ASSEMBLY

INSPECTION

1. Wash in cleaning solvent and air dry.

2. Inspect output carrier internal splines for nicks or damage.

3. Inspect thrust washer surface for signs of scoring or wear.

4. Inspect planet pinions for damage, rough bearings or excessive tilt.

5. Check output carrier pinion end play. Should be .009" to .024".

REACTION CARRIER ASSEMBLY

INSPECTION

1. Wash in cleaning solvent and air dry.

2. Check to see that low and reverse clutch faced plates are a free fit over reaction carrier hub.

3. Examine condition of carrier hub splines and mating splines of low and reverse clutch faced plates.

4. Inspect thrust washer surface for signs of scoring or wear.

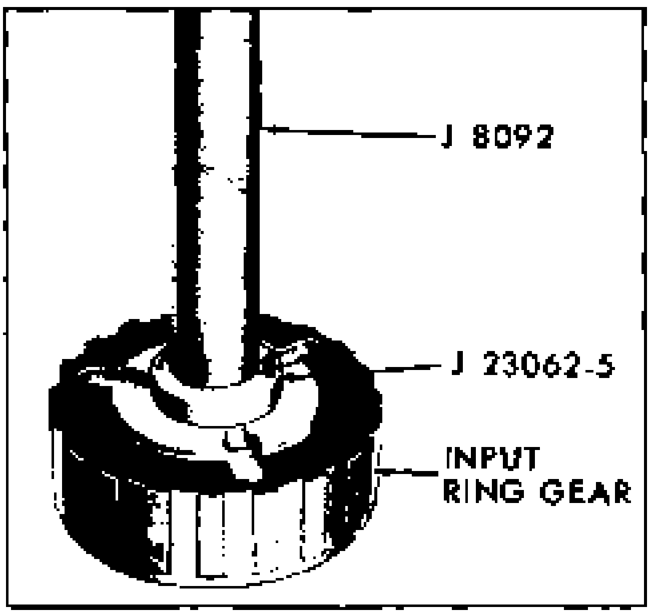


Fig. 7G-89 Removing or Installing Input Ring Gear Bushing

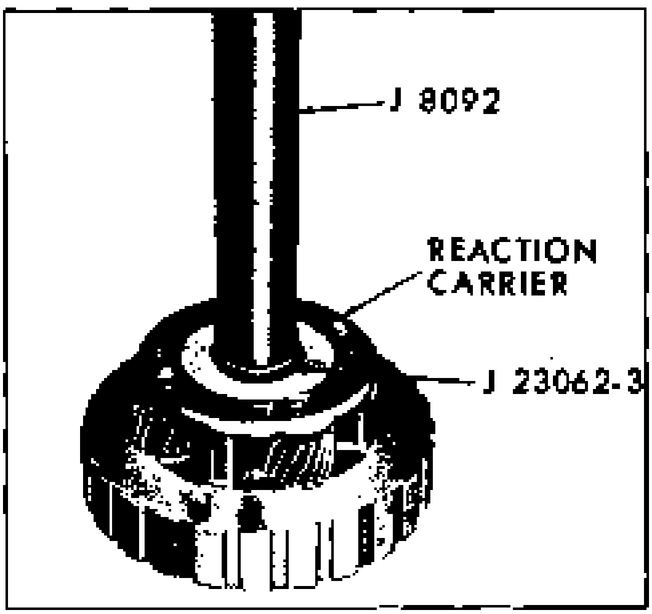


Fig. 7G-90 Removing or Installing Reaction Carrier Bushing

5. Inspect planet pinions for damage, rough bearings or excessive tilt.

6. Check reaction carrier pinion end play. Should be .009" to .024".

7. Inspect reaction carrier bushing for nicks, scoring or wear. If bushing is damaged, replace as follows:

Reaction Carrier Bushing (Fig. 7G-90)

a. Using Bushing Tool J 23062-3 and Drive Handle J 8092 and with reaction carrier properly supported, drive out bushing.

b. Using Bushing Tool J 23062-3 and Drive Handle J 8092, install new bushing flush to .010" below inside face.

OUTPUT RING GEAR AND OUTPUT SHAFT ASSEMBLY

INSPECTION

1. Wash in cleaning solvent and air dry.

2. Check output ring gear for tooth damage.

3. Inspect output ring gear and output shaft splines for nicks or damage.

4. Check output shaft bearing surface for nicks or scoring.

5. Check output shaft bushing for nicks, scoring or wear. If bushing is damaged, replace as follows:

Output Shaft Bushing

a. Thread Bushing Tool J 9534 into output shaft bushing, thread Adapter J 2619-4 and Slide Hammer J 2619 into Bushing Tool and remove bushing (Fig. 7G-91).

b. Install new bushing into front end of output shaft by using Bushing Tool J 23062-7 and Drive Handle J 8092. Tap bushing into shaft until tool bottoms (Fig. 7G-92).

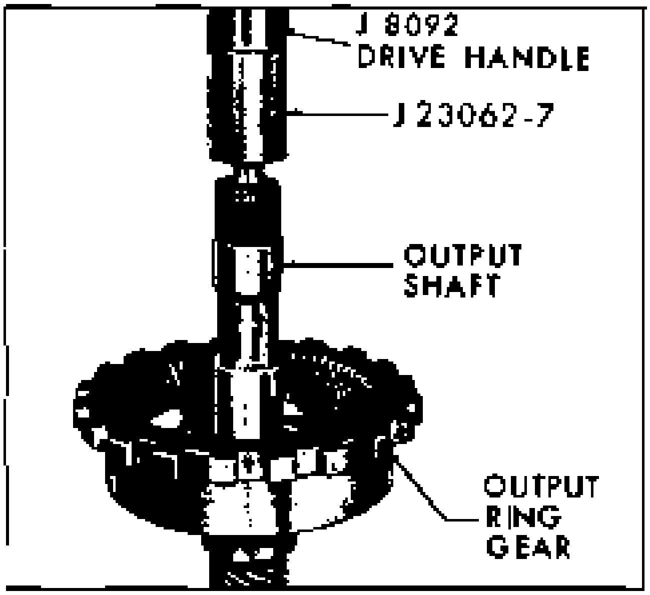


Fig. 7G-92 Installing Output Shaft Bushing

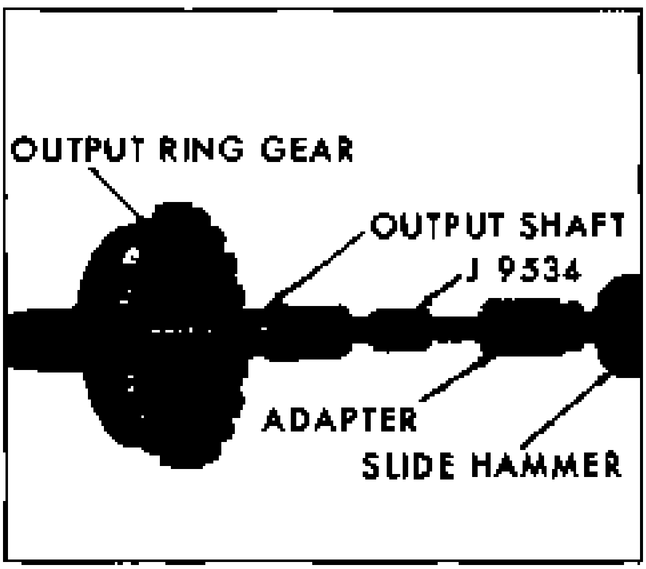


Fig. 7G-91 Removing Output Shaft Bushing

TRANSMISSION CASE

INSPECTION

1. Wash in cleaning solvent, blow out all oil passages and air dry.

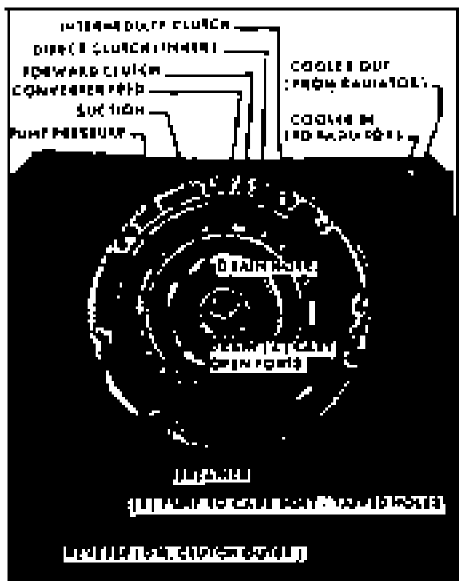


Fig. 7G-93 Case Passage Identification - Front View

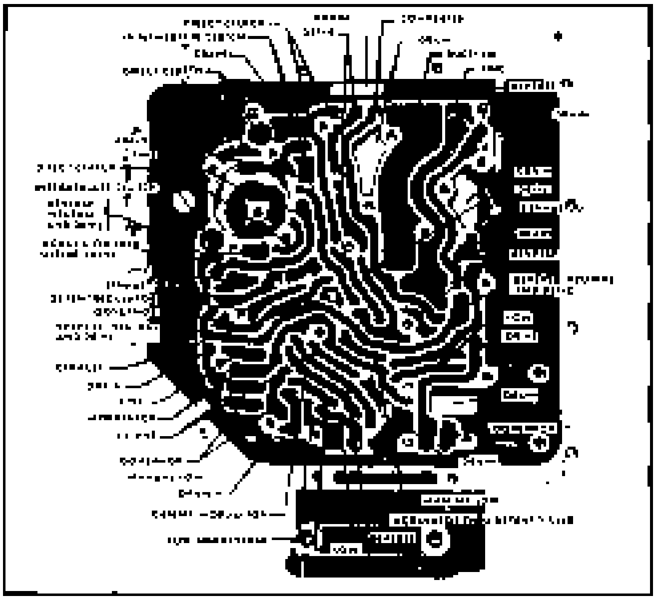


Fig. 7G-94 Case Passage Identification - Bottom View

2. Inspect case for cracks, porosity or interconnected passages, using air gun or smoke (Figs. 7G-76 and 7G-77).

3. Inspect threaded holes for thread damage.

4. Inspect ring grooves for damage.

5. Inspect governor bore for scoring or damage.

6. Inspect intermediate clutch accumulator bore for scoring or damage.

7. Check case bushing for nicks, scoring or wear. If bushing is damaged, replace as follows:

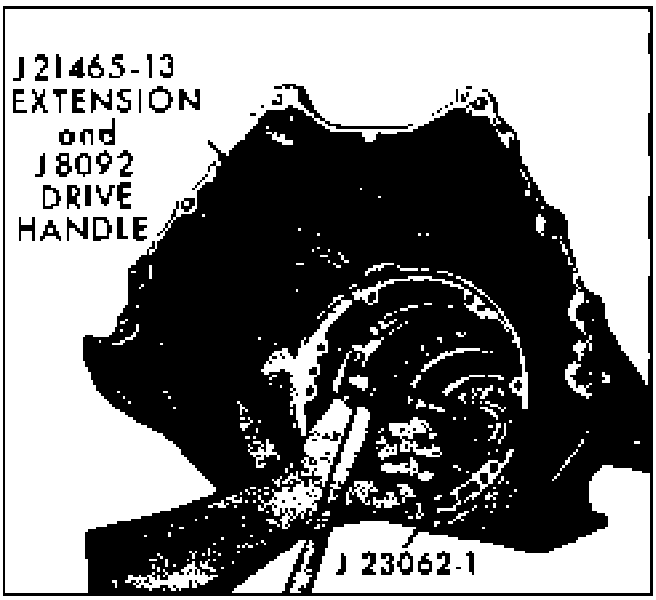


Fig. 7G-95 Installing Case Bushing

Case Bushing

a. Collapse bushing by using screwdriver in bore slot and remove bushing.

b. Using Bushing Tool J 23062-1, Extension J 21465-13 and Drive Handle J 8092, drive new bushing in from front of case to 3/16" below front surface of bore (Fig. 7G-95).

NOTE: Notches in bushing should be toward front of case.

EXTENSION HOUSING

INSPECTION

1. Wash in cleaning solvent and air dry.

2. Inspect housing for cracks or porosity

3. Inspect housing-to-case seal mounting face for damage.

4. Be sure that rear seal drain back port is not obstructed.

5. Inspect extension housing bushing for nicks, scoring or wear. If bushing is damaged, replace as follows:

Extension Housing Bushing (Fig. 7G-96)

a. Remove lip oil seal from extension housing if not done previously and, using Bushing Tool J 21424-9 and Drive Handle J 8092, drive bushing into housing and remove bushing.

b. Using Bushing Tool J 21424-9 and Drive Handle J

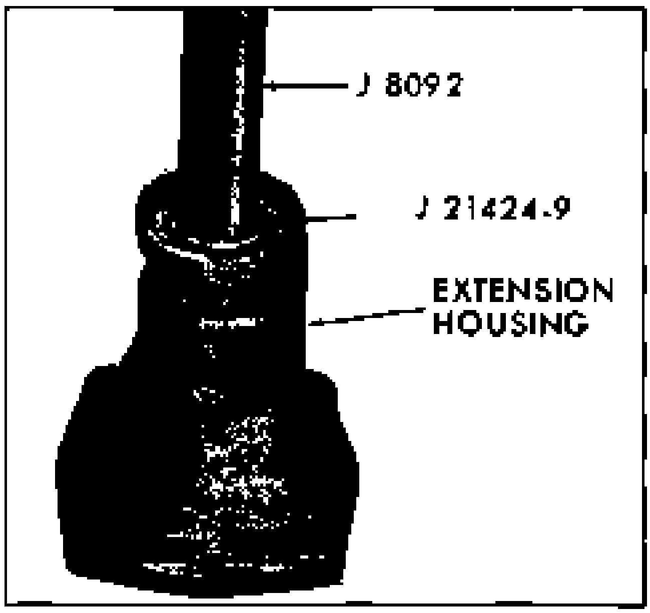


Fig. 7G-96 Removing or Installing Extension Housing Bushing

8092, drive new bushing flush to .010" below seal counterbore surface.

NOTE: Notches in bushing should be toward front of extension.

INTERMEDIATE OVERRUN BRAKE BAND

INSPECTION

1. Inspect lining for cracks, flaking, burning or looseness.

2. Inspect band for cracks or distortion

3. Inspect ends of band for damage at anchor lug or apply lug

VACUUM MODULATOR ASSEMBLY

INSPECTION

1. Inspect modulator assembly for any signs of bending or distortion -

a. Roll main body of modulator on a flat surface and observe sleeve for concentricity to body (Fig. 7G-97)

b. If sleeve is concentric and modulator valve is free within sleeve, modulator is acceptable

2. Atmospheric leak check -

a. Apply liberal coating of soap bubble solution (available at 5c - 10c store) to vacuum connector pipe seam, crimped upper-to-lower housing seam and to threaded screw seal (Fig. 7G-98).

b. Using a short piece of rubber tubing, apply air pressure to vacuum pipe by blowing into tubing and observe for leak bubbles.

c. If bubbles appear, replace modulator.

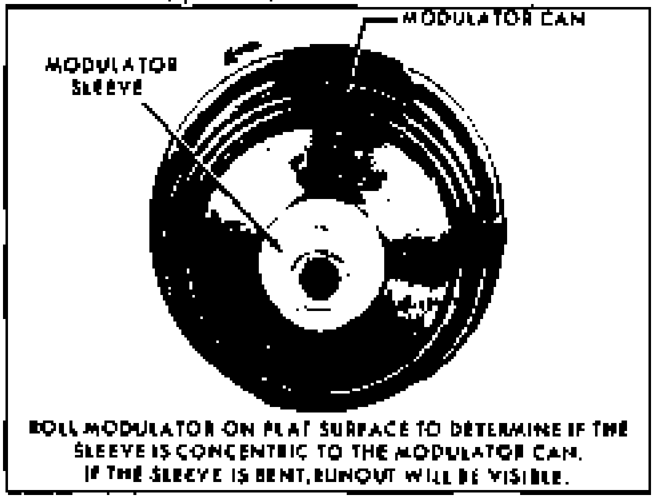


Fig. 7G-97 Checking Concentricity of Sleeve

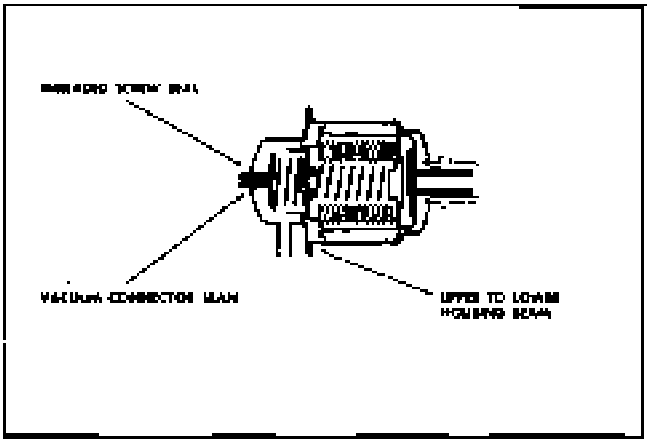


Fig. 7G-98 Vacuum Modulator Seams and Seal

CAUTION: Do not use any method other than human lung power for applying air pressure, as pressures over 6psi. may damage modulator.

3. Inspect O-ring seal seat for damage.

4. Vacuum diaphragm leak check (Fig. 7G-99) -

a. Insert pipe cleaner into vacuum connector pipe as far as possible and check for presence of transmission fluid.

b. If transmission fluid is found on pipe cleaner, replace modulator.

NOTE: Gasoline or water vapor may settle in vacuum side of diaphragm. If this is found without presence of transmission fluid, modulator should not be replaced.

5. Bellows comparison check -

a. Install known good modulator on either end of a comparison gage (Fig. 7G-100) and install modulator in question on opposite end.

b. Holding modulator in horizontal position, bring them together under pressure until either modulator

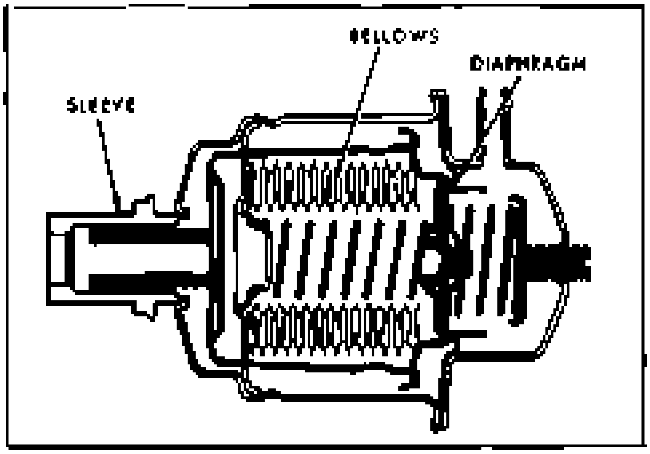


Fig. 7G-99 Cross Section of Vacuum Modulator

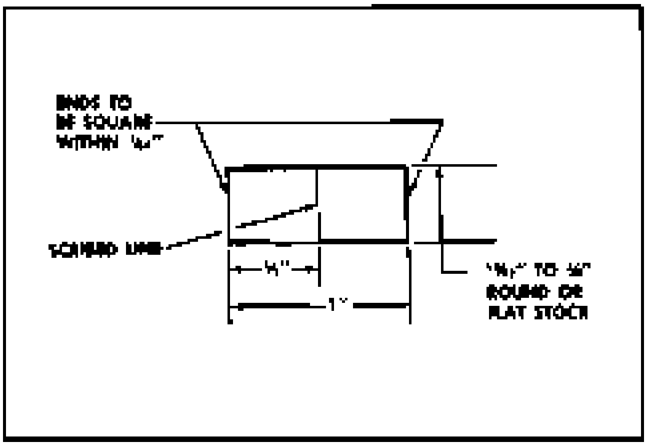


Fig. 7G-100 Comparison Gage

sleeve just touches line in center of gage (Fig. 7G-101).

c. Gap between opposite modulator sleeve ends and center line of gage should be 1/16" or less (Fig. 7G-102). If gap is greater than 1/16", modulator in question should be replaced (Fig. 7G-103).

6. Inspect modulator valve for nicks or damage.

7. Check freeness of valve operation in case bore.

8. If modulator assembly passes all of above checks, it is an acceptable part and should be re-used.

MANUAL AND PARKING LINKAGE

INSPECTION

1. Inspect manual shaft for damaged threads, rough oil seal surface or looseness of shaft on range selector inner lever.

2. Inspect range selector inner lever for cracks, looseness on manual shaft or other damage.

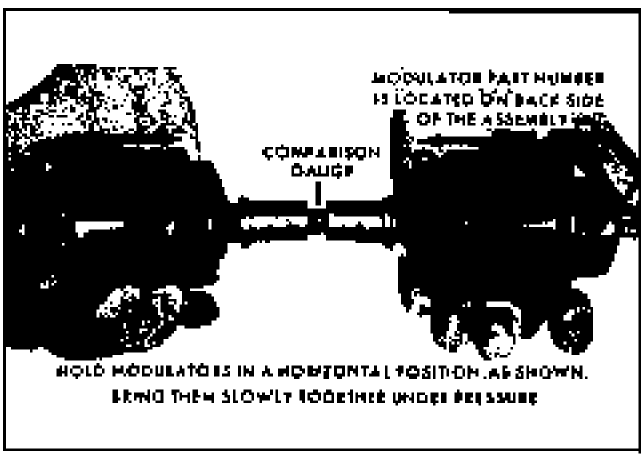


Fig. 7G-101 Bringing Modulators Together

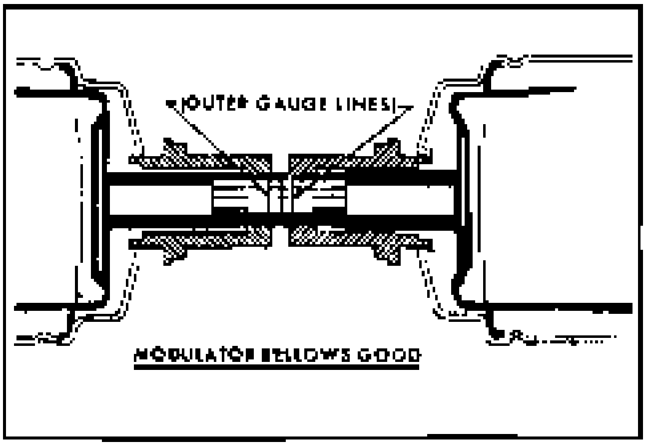


Fig. 7G-102 Modulator Bellows Good

3. Inspect detent roller and spring assembly for damage.

4. Inspect parking pawl actuating rod for cracks or broken retainer lugs.

5. Inspect actuator for free fit on parking actuator rod.

6. Inspect parking pawl disengaging spring for deformed coils or ends.

7. Inspect parking lock bracket for cracks or wear.

8. If removed, inspect parking pawl and parking pawl shaft for cracks, wear or other damage.

CONVERTER ASSEMBLY

INSPECTION

1. Check converter assembly for leaks -

a. Install Leak Test Fixture J 21369 on converter hub and tighten.

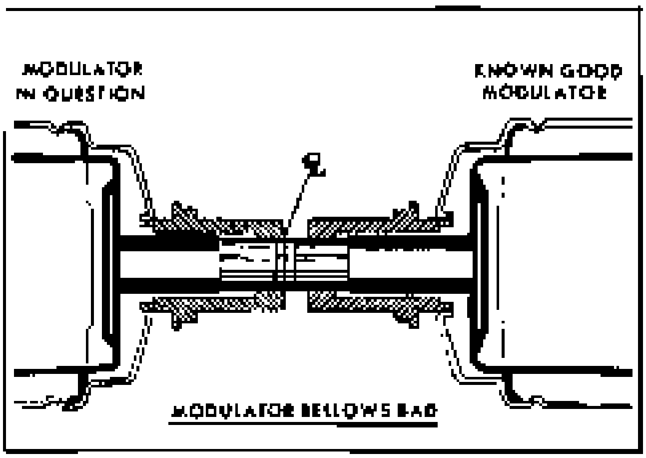


Fig. 7G-103 Modulator Bellows Bad

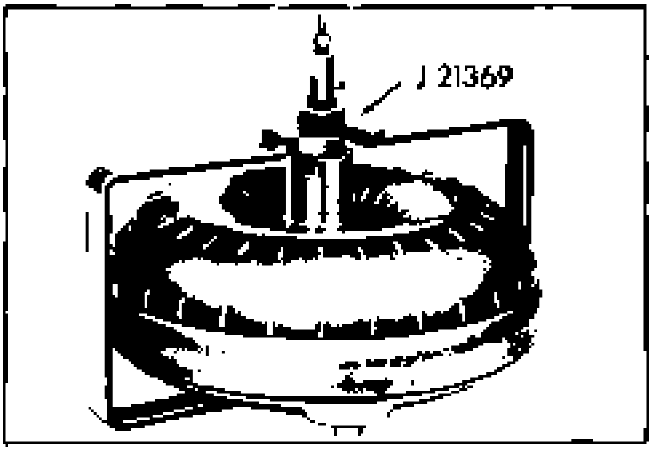


Fig. 7G-104 Air Checking Converter

b. Fill converter assembly with 80 psi. of air, submerge in water and check for leaks (Fig. 7G-104)

2. Check converter hub surfaces for signs of scoring or wear.

3. Check converter assembly end play -

a. Fully release collet end of End Play Tool J 21371-2 by turning its brass nut clockwise.

b. Install collet end of End Play Tool J 21371-2 into converter hub until it bottoms, then tighten its brass nut counterclockwise to 5 lb. ft. torque (Fig. 7G-105).

c. Install Tool J 21371-3 and, while preventing brass nut from turning, tighten hex nut to 3 lb. ft. torque (Fig. 7G-106).

d. Install Dial Indicator J 8001 and set it for "zero", while its plunger rests on brass nut.

e. While holding brass nut stationary, loosen hex nut, allowing converter internal assembly to lower, until dial indicator shows that internal assembly has bottomed (Fig. 7G-107).

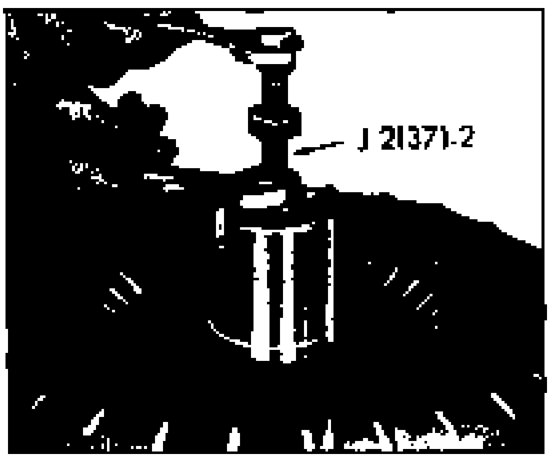


Fig. 7G-105 Installing Tool J 21371-2

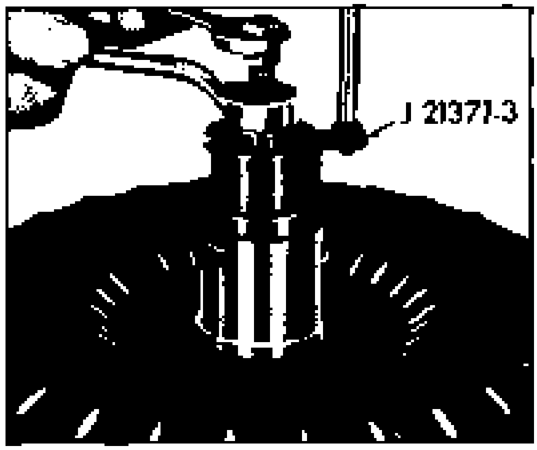


Fig. 7G-106 Installing Tool J 21371-3

f. Reading obtained on dial indicator will represent converter end clearance. If clearance is under .050", converter is acceptable; if clearance is .050" or over, replace converter.

g. Remove tools.

TRANSMISSION REASSEMBLY

GENERAL

Before starting to assembly transmission, make certain that all parts are absolutely clean. Keep hands and tools clean to avoid getting dirt into assembly. If work is stopped before assembly is completed, cover all openings with clean cloths.

Lubricate all bearings, seal rings, clutch plates and other moving parts with transmission fluid prior to re assembly. Thrust washers may be held in place with petroleum jelly, sparingly applied.

Do not take chances on used gaskets and seals - use new ones to avoid oil leaks.

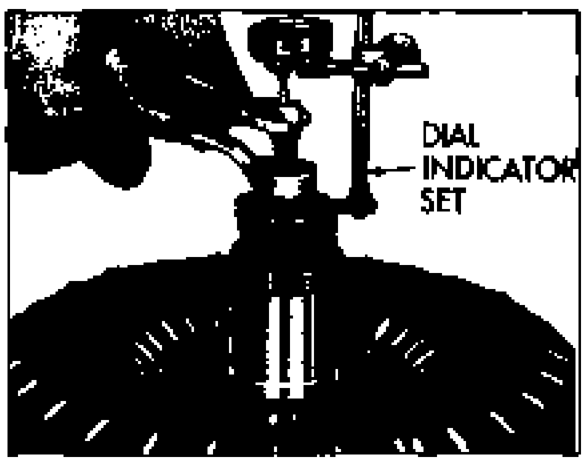


Fig. 7G-107 Checking Converter End Play

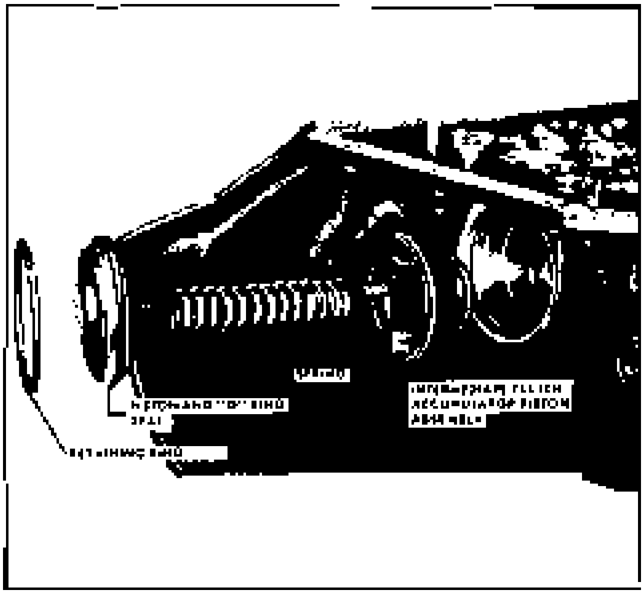


Fig. 7G-108 Exploded View of Intermediate Clutch Accumulator

Use care to avoid making nicks or burrs on parts, particularly at bearing surfaces and surfaces where gaskets are used.

It is extremely important to tighten all parts evenly to avoid distortion of parts and leakage at gaskets and other joints. Use a reliable torque wrench to tighten all bolts and nuts to specified torque.

INSTALLATION OF INTERNAL COMPONENTS AND OIL PUMP

1. Install inner and outer hook-type seal rings to intermediate clutch accumulator piston.

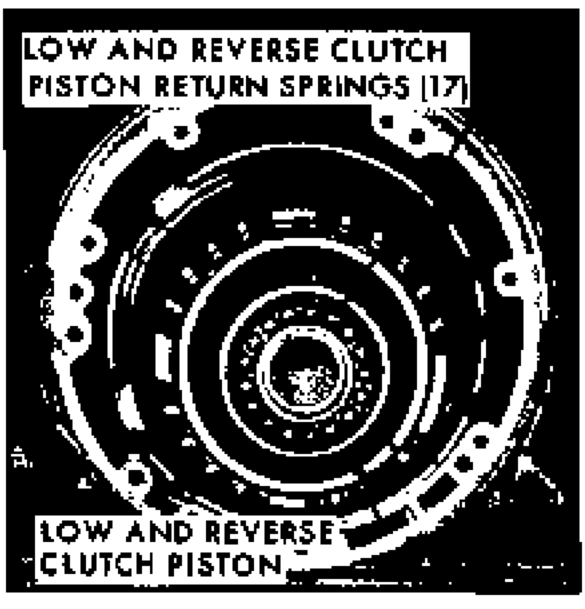


Fig. 7G-109 Low and Reverse Clutch Piston and Springs in Case

2. Install piston assembly into its bore in case (Fig. 7G-108).

3. Install piston spring into case and install O-ring seal to piston cover.

NOTE: Free length of spring is 1 3/16" by 15/16" diameter.

4. Install accumulator cover to its bore in case by installing Compressor J 23069 on oil pan face with two (2) oil pan bolts, compress intermediate accumulator cover and install its retaining ring. Remove bolts and tool (Fig. 7G-38).

NOTE: A production day and shift built number, transmission model and model year are stamped on the intermediate clutch accumulator piston cover. If cover is replaced, this information must be stamped on new cover (Fig. 7G-2).

5. Install outer, center and inner flat seals to low and reverse clutch piston and install piston assembly into case.

NOTE: Notch in low and reverse clutch piston must be installed adjacent to parking pawl and lug on back of piston aligned with its cavity in case.

6. Install seventeen (17) piston return springs and spring retainer in case (Fig. 7G-36).

NOTE: Free length of springs is 1 1/4" by 1/2" diameter.

7. Using Compressor Tools J 23327-1, J 23327-2 and Pilot J 21420-2 in end of case, compress low and reverse clutch piston and spring retainer, install

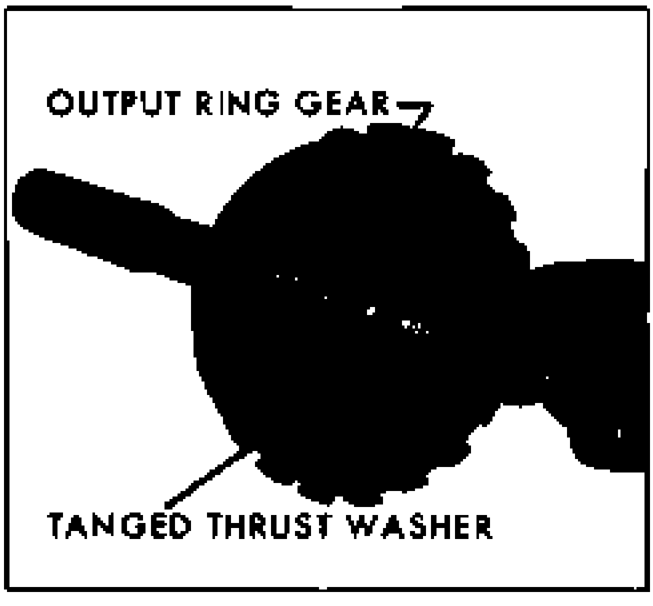


Fig. 7G-110 Installing Reaction Carrier-To-Output Ring Gear Thrust Washer

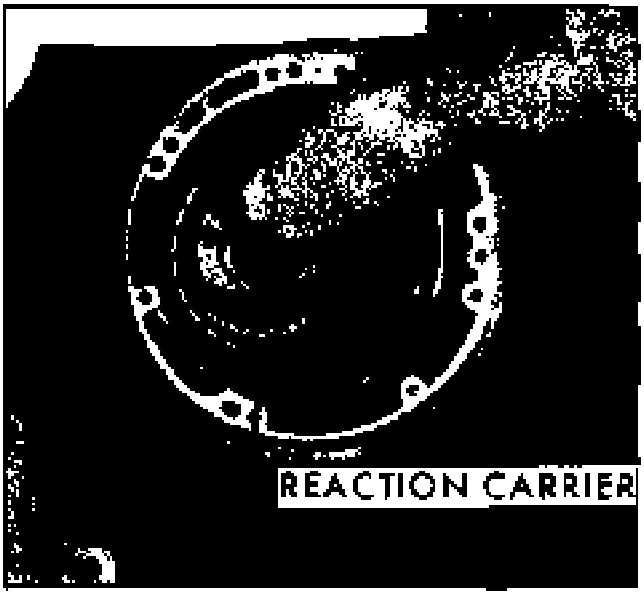


Fig. 7G-111 Installing Reaction Carrier into Case

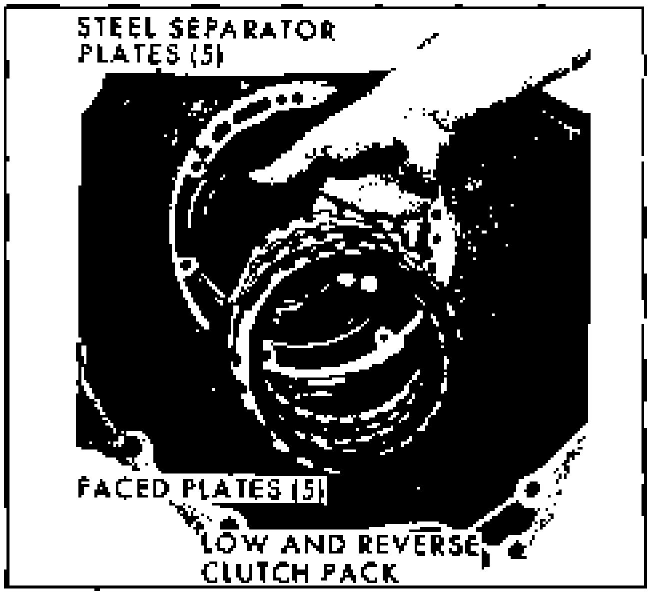


Fig. 7G-112 Installing Low and Reverse Clutch Pack (V-8 Model)

retaining ring and remove tools (Fig. 7G-36).

NOTE: If clearance for installing snap ring is not available, low and reverse clutch piston is probably not aligned properly in case.

8. If output ring gear was separated from output shaft, install ring gear to output shaft, retaining with a new snap ring (Fig. 7G-35).

9. Install reaction carrier-to-output ring gear thrust washer into output ring gear face (Fig. 7G-110).

NOTE: Washer has three (3) narrow external tangs.

10. Install output ring gear-to-case needle bearing onto output shaft and install output shaft assembly into case (Fig. 7G-34).

NOTE: Lip of needle bearing faces rear of case.

11. Install reaction carrier assembly onto output shaft assembly (Fig. 7G-111).

12. Lubricate plates with transmission fluid and:

a. On V-8 models, install five (5) low and reverse clutch faced plates and five (5) steel separator plates into reaction carrier assembly, starting with a steel separator plate and alternating with faced plates (Fig. 7G-112).

b. On 6 cylinder models, install four (4) faced and four (4) separator plates into reaction carrier, starting with a steel separator plate

NOTE: Notch in steel separator plates should be placed in bottom notch (5:30 o'clock position) of case.

13. Install low and reverse clutch support retainer spring (Fig. 7G-32)

14. Install low and reverse roller clutch and support assembly into case, pushing firmly until support assembly is seated past the top of low and reverse clutch support retainer spring (Fig. 7G-31).

IMPORTANT: Make certain splines on inner race of roller clutch align with splines on reaction carrier.

15. Install low and reverse roller clutch support-to-case retaining ring (Fig. 7G-30).

16. Install low and reverse roller clutch inner race-to sun gear drive shell thrust washer into roller clutch inner race (Fig. 7G-113).

NOTE: Washer four (4) wide internal tangs.

17. Install sun gear drive shell assembly into low and reverse roller clutch and support assembly (Fig. 7G-29).

18. Install output carrier assembly into drive shell (Fig. 7G-28).

19. Install new output carrier-to-output shaft snap ring.

CAUTION: Do not overstress snap ring.

20. Install input ring gear-to-output carrier thrust washer (Fig. 7G-114).

NOTE: Washer has four (4) internal tangs.

21. Install input ring gear (Fig. 7G-27).

22. Install forward clutch housing-to-input ring gear thrust washer into input ring gear face.

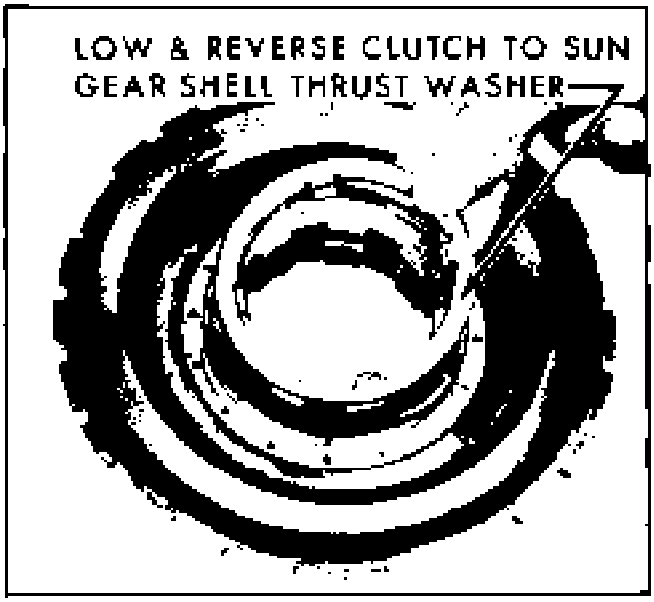


Fig. 7G-113 Installing Low and Reverse-To-Sun Gear Thrust Washer

NOTE: Washer has three (3) wide external tangs.

23. Install direct clutch drum-to-forward clutch drum needle roller bearing and install forward clutch assembly into direct clutch assembly.

24. Holding by input shaft, install clutch assemblies onto input ring gear (Fig. 7G-26).

CAUTION: Make certain that forward clutch faced plates are positioned over input ring gear and that tangs on direct clutch housing are installed into slots on sun gear drive shell. Make certain that clutch plates are indexed with their respective parts before going further.

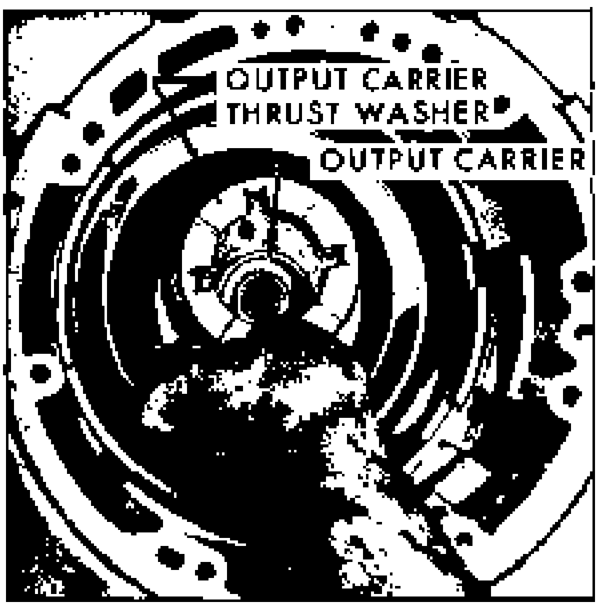


Fig. 7G-114 Installing Ring Gear-To Output Carrier Thrust Washer

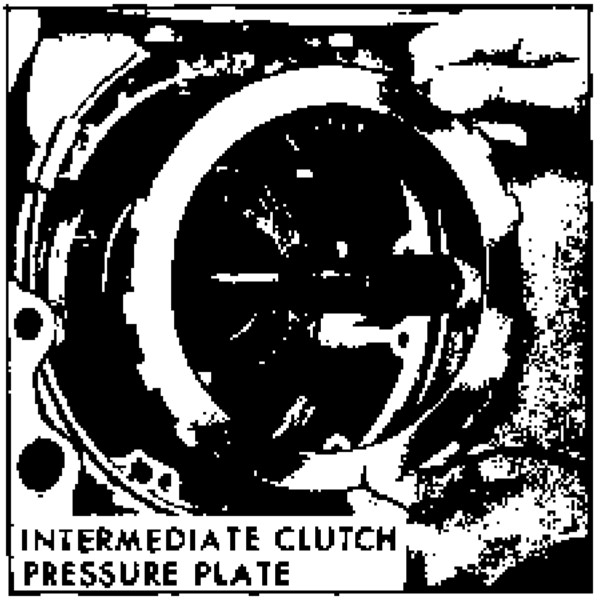


Fig. 7G-115 Installing Intermediate Clutch Pressure Plate

25. Install intermediate overrun brake band with anchor lug and apply lug positioned properly.

26. Install intermediate clutch pressure plate (Fig. 7G-115), lubricate with transmission fluid and:

a. On V-8 models, install three (3) intermediate clutch faced plates and three (3) steel separator plates, starting with a faced plate and alternating steel separator plates (Fig. 7G-25).

b. On 6 cylinder models, install two (2) faced and two (2) separator plates, starting with a faced plate.

NOTE: Notch in steel separator plates should be placed in case notch adjacent to selector lever inner bracket (4:00 o'clock position).

27. Install intermediate clutch cushion spring.

28. Install new pump-to-case gasket on face of case and install new pump body-to-case O-ring seal (square cut) on pump cover.

29. Aligning marks made on disassembly, install oil pump to case.

30. Install all but one (at 4 o'clock position) pump attaching bolts and tighten alternately to 20 lb. ft torque.

NOTE: Use new washer-type seals on pump bolts.

IMPORTANT: If the input shaft can not be rotated as the pump is being pulled into place or the pump can not be pulled down properly, the direct and forward clutch housings have not been installed properly to index the faced plates with their respective parts. This condition

Fig. 7G-116 Checking Front Unit End Play

must be corrected before pump is pulled into place.

31. Check front unit end play as follows (Fig. 7G-116):

a. Move transmission so that output shaft points down and install a 5/16"-18 threaded slide hammer bolt (or J 21904-1) into threaded bolt hole in pump body (at 4 o'clock position).

b. With flat of hand, move input shaft rearward and mount Dial Indicator J 8001 on bolt and index plunger of indicator on end of input shaft. 'Zero' the indicator.

c. Push up on output shaft and record the amount of end play registered by the dial indicator.

d. Indicator should read from .033" to .064". If reading is within these limits, proper selective thrust washer is being used.

NOTE: Front unit end play is controlled by thickness of pump cover-to-direct clutch drum selective thrust washer. This is the washer having one (1) tang (Fig. 7G-117).

Fig. 7G-117 Front Unit End Play Selective Thrust Washer

e. If reading is not within these limits, it is necessary to remove pump, change to a thicker or thinner selective thrust washer as required to obtain specified clearance, re-install pump and repeat the above checking procedure.

NOTE: There are three (3) selective washers available, .065-.067, .082-.084 and .099-.101.

32. When end play is within specifications, remove tools, install remaining pump attaching bolt with its new washer-type seal and torque bolt to 20 lb. ft.

IMPORTANT: Make sure input shaft can be rotated. If it cannot, this condition must be corrected.

SELECTING PROPER BAND APPLY PIN

1. Check for proper band apply pin selection in the following manner.

a. Using Band Apply Pin Gage J 23071 and a straightedge, apply firm downward pressure on the gage as shown in Fig. 7G-118.

NOTE: There are two (2) selective apply pins available for service. A longer pin is 2 31/32" in length and is identified by a groove located on the band lug end of the pin; whereas, the short pin is 2 27/32" in length and carries no identification.

b. If Gage J 23071 is below the straightedge surface, the long pin should be used.

c. If Gage J 23071 is above the straightedge surface, the short pin should be used.

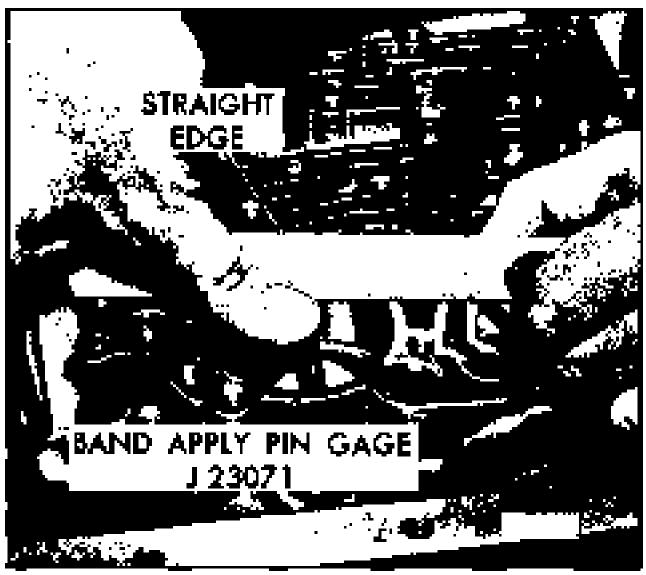


Fig. 7G-118 Checking for Proper Band Apply Pin

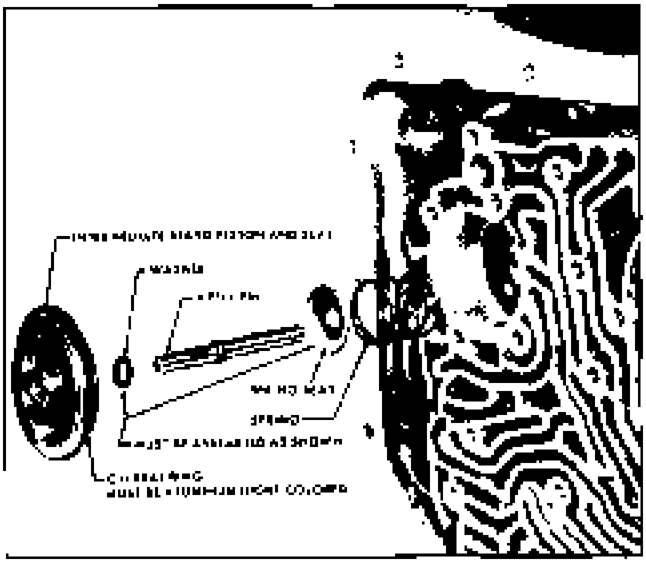


Fig. 7G-119 Exploded View of Intermediate Servo Assembly

d. Remove Gage J 23071 from transmission case.

Selecting the proper pin is the equivalent of adjusting the band.

2. Install spring, spring seat, washer and correct band apply pin and intermediate servo piston with its aluminum oil seal ring into its case bore (Fig. 7G-119).

INSTALLATION OF PARKING LINKAGE, VALVE BODY AND OIL PAN

1. If removed, install parking pawl in case, with tooth toward inside of case. Install parking pawl shaft into case and through parking pawl. Then, drive a new parking pawl shaft retainer plug into case, using a 3/8" diameter rod, until plug is flush to .010" below face of case. Stake plug in three (3) places to retain plug in case.

Fig. 7G-120 Installing Parking Pawl Disengaging Spring

2. Install parking pawl disengaging spring, square end hooked on pawl, other end hooked over lug in case (Fig. 7G-120).

3. Install parking lock bracket and its two (2) bolts, torquing to 29 lb. ft.

4. If removed, install a new manual shaft-to-case lip oil seal, using a 7/8" diameter rod to seat oil seal flush with case bore.

5. Connect range selector inner lever to parking pawl actuating rod and install actuating rod under parking lock bracket, between bracket and parking pawl.

6. Install manual shaft through case and range selector inner lever (Fig. 7G-20).

7. Install retaining jam nut on manual shaft and torque to 30 lb. ft.

8. Install manual shaft-to-case retainer

9. Insert governor feed screen into its governor feed passage in case, ring end of screen facing out (Fig. 7G 18).

NOTE: Clean before installing.

10. Insert oil pump pressure screen into its oil pump pressure passage in case, ring end facing in (Fig. 7G 17).

NOTE: Clean before installing.

11. Install four (4) check balls in case face (Fig. 7G 121).

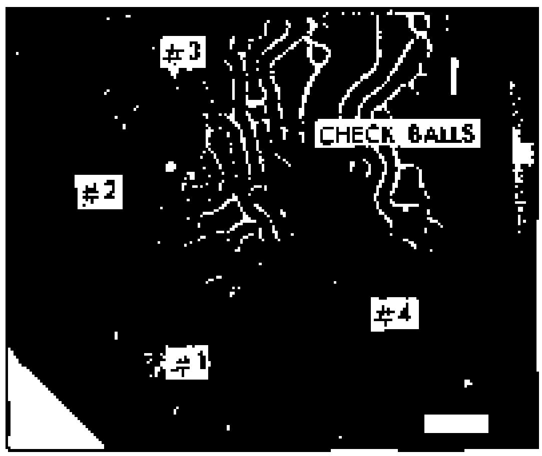


Fig. 7G-121 Location of Check Balls

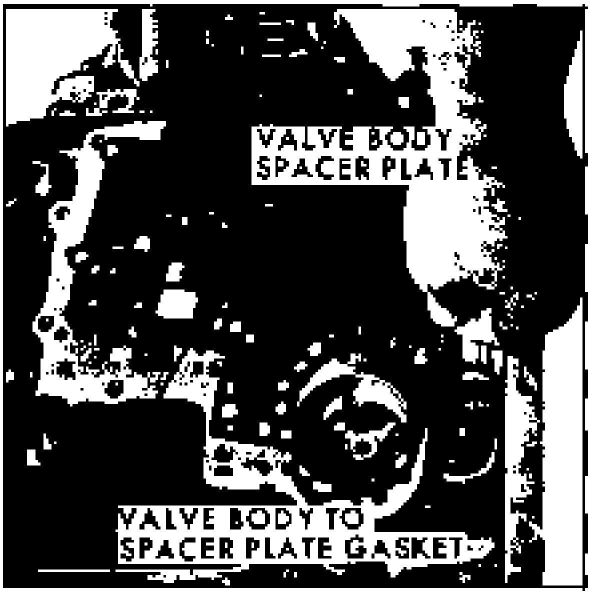


Fig. 7G-122 Installing Valve Body-to-Spacer Plate Gasket

CAUTION: If number one (#1) check ball is omitted or incorrectly placed, transmission failure will result due to minimum line pressure.

12. Install valve body spacer plate-to-case gasket and valve body spacer plate

13. Install spacer support plate and its seven (7) bolts loosely (Fig. 7G-15).

14. Install valve body-to-spacer plate gasket (Fig. 7G-122).

15. While connecting manual control valve link-to-range selector inner lever, install valve body assembly

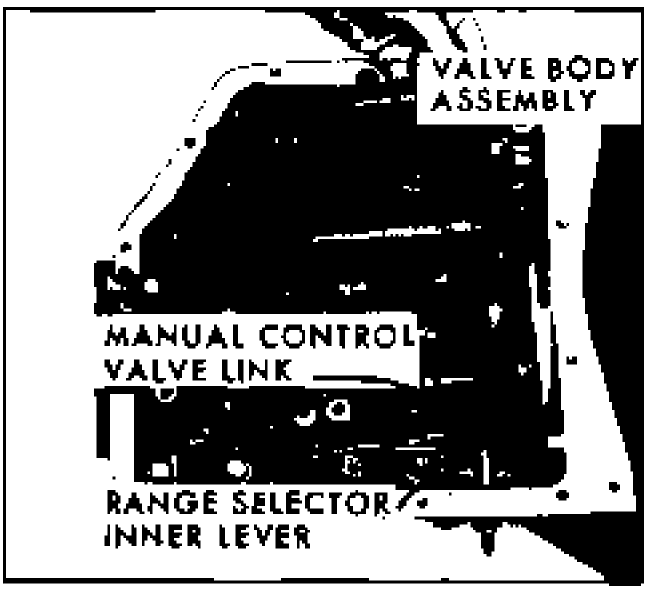


Fig. 7G-123 Installing Valve Body Assembly

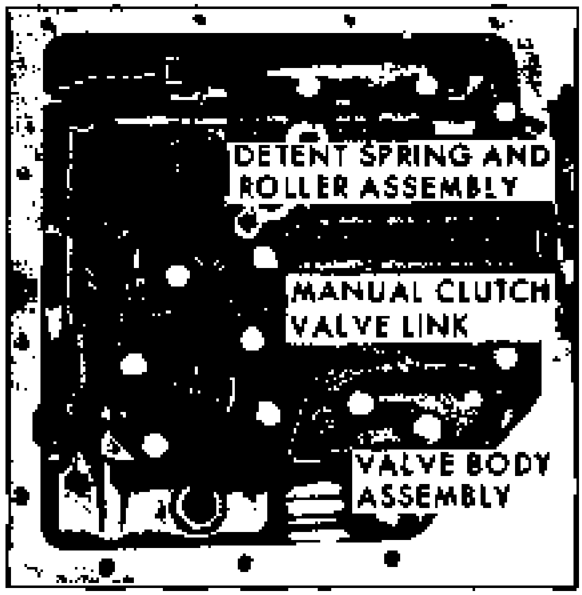


Fig. 7G-124 Installing Detent Spring and Roller to Valve Body

to its spacer plate gasket, install seventeen (17) valve body-to-case attaching bolts and torque these bolts and seven (7) spacer support plate bolts to 13 lb. ft. (Fig. 7G-123).

CAUTION: When handling valve body assembly, do not touch sleeves as retainer pins will fall into transmission.

16. Connect detent control valve link to detent valve actuating lever, insert free end of link into its case opening, connect actuating lever assembly to valve body actuating lever bracket and retain the lever assembly to the lever bracket with its retaining pin.

17. Install detent roller and spring assembly to valve body with the remaining valve body-to-case attaching bolt, torquing to 13 lb. ft. (Fig. 7G-124).

18. Install strainer assembly and new gasket, retaining it with two (2) screws.

NOTE: Flush out strainer and check for foreign material.

19. Install new oil pan gasket and oil pan. Install and torque its thirteen (13) bolt and washer assemblies to 12 lb. ft.

INSTALLATION OF GOVERNOR, SPEEDO DRIVE GEAR AND EXTENSION HOUSING

1. Install governor assembly, new O-ring seal, cover and retainer wire.

2. Place speedometer drive gear retaining clip into hole in output shaft, align slot in speedometer drive gear

with retaining clip, depress clip and install speedometer drive gear into position on output shaft (Fig. 7G-12).

3. Install extension housing-to-case square cut O-ring seal and attach extension housing to transmission case.

NOTE: Speedometer driven gear opening should be on L.H. side of housing.

4. Install four (4) extension housing-to-case bolts, torquing to 35 lb. ft.

5. If extension housing lip-oil seal was removed, install new extension housing lip oil seal by using Seal Installer J 5154

NOTE: Outer diameter of seal should be coated with a non-hardening sealer prior to installation.

6. Install speedometer driven gear, retainer and bolt. Torque bolt to 12 lb. ft.

INSTALLATION OF MODULATOR AND CONVERTER

1. Install vacuum modulator valve into its case bore, lubricate new O-ring seal with transmission fluid and install on modulator.

2. Install vacuum modulator assembly, with stem pointing up, install retaining clip, with tangs of retainer pointing toward modulator and install its attaching bolt to transmission, torquing to 12 lb. ft.

3. Install converter assembly into transmission, making certain that converter hub drive slots are fully engaged with oil pump drive gear tangs and converter is installed fully towards rear of transmission (Fig. 7G-125).

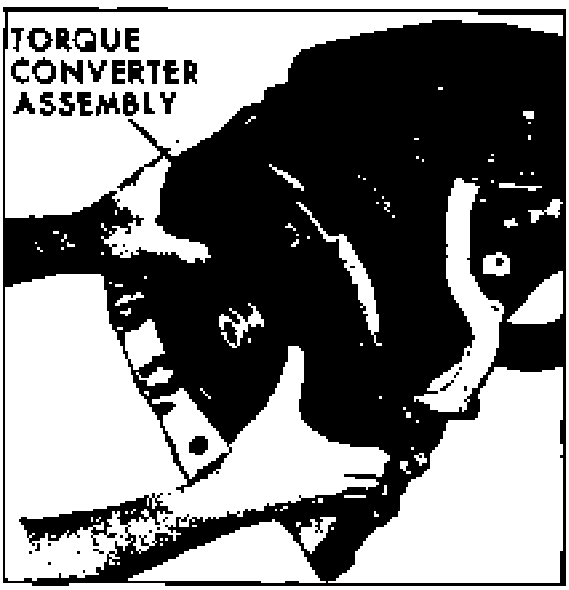


Fig. 7G-125 Installing Converter Assembly

4. Retain converter assembly to transmission with Converter Holding Clamp J 21366, remove transmission assembly from bench, place in portable jack and remove Transmission Holding Fixture and Adaptor.

FIREBIRD DRIVELINE DAMPER

A driveline damper is used to reduce power train vibration to an acceptable level. The damper is mounted under the rear of the transmission extension and consists of a weight retained by a mounting which, in turn, is attached to the underside of the transmission extension through an adapter (Fig. 7G-126).

INSTALLATION OF TRANSMISSION ASSEMBLY

Installation of the transmission assembly is the reverse of REMOVAL OF TRANSMISSION ASSEMBLY, as stated on page 7G-10. After installing, adjust the detent cable and check and adjust the fluid level.

MANUAL LINKAGE

Manual and back drive linkage adjustments and the associated neutralizer switch are important from a

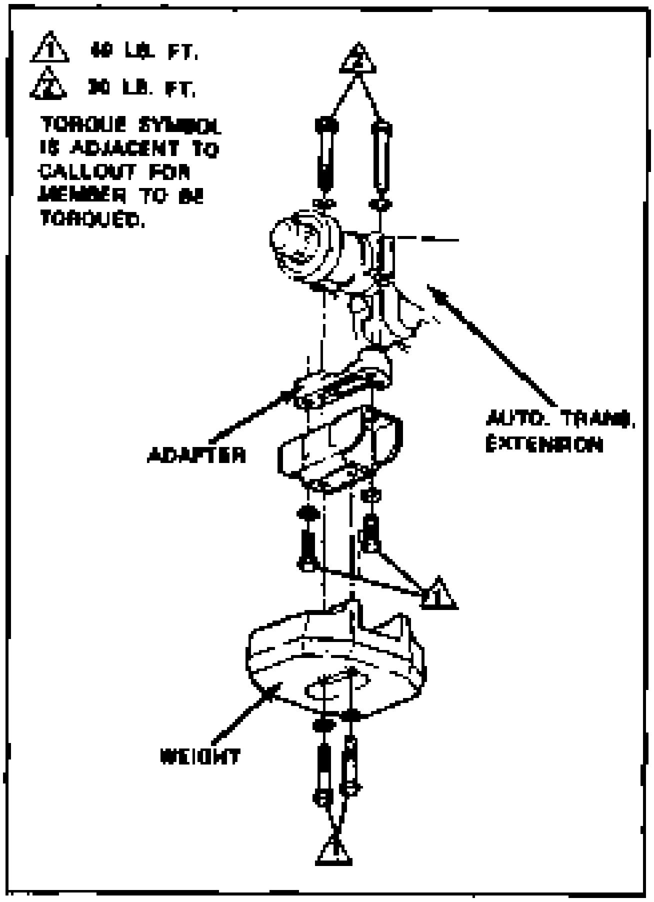


Fig. 7G-126 Driveline Damper

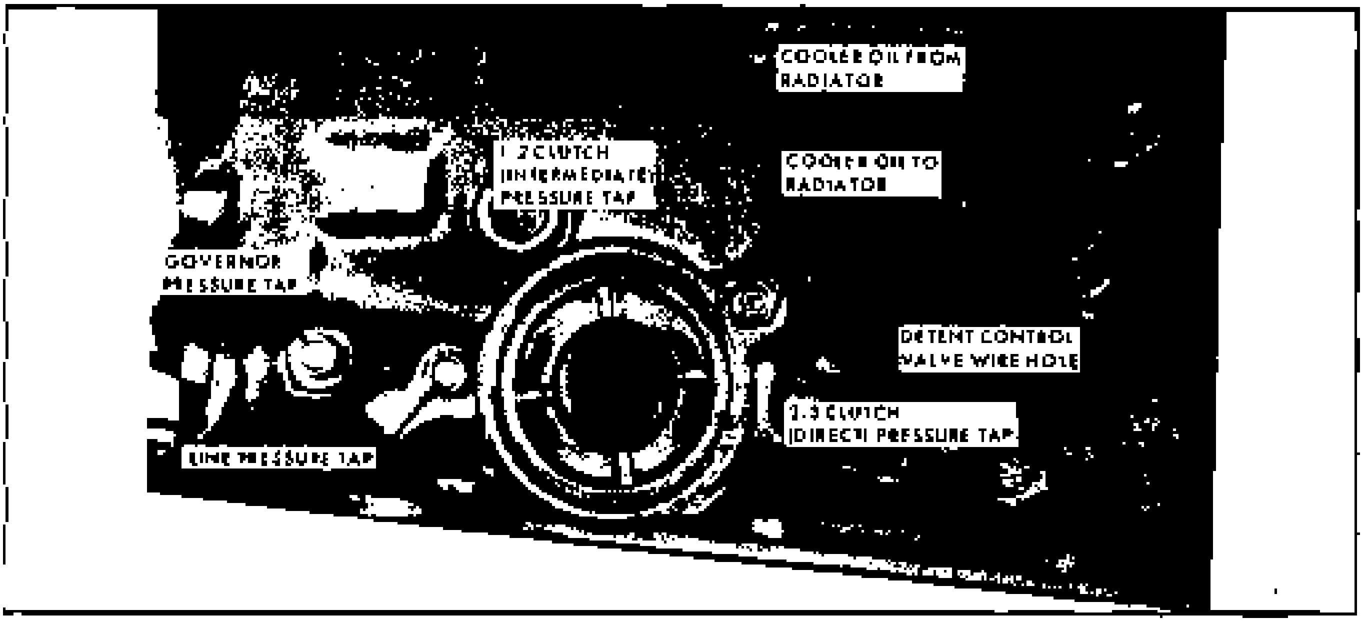


Fig. 7G-127 Side View of Transmission

safety standpoint. The neutralizer switch should be adjusted so that engine will start in the PARK and NEUTRAL positions only.

With the selector lever in PARK range, the parking pawl should freely engage and prevent vehicle from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

ROAD TEST

When road testing vehicle, a reliable pressure gage should be attached to the line pressure port on the right side of the transmission case, behind and adjacent to the intermediate clutch accumulator cover (Fig. 7G-127). Observe and record results of pressure checks, comparing results with transmission pressures shown under TRANSMISSION OIL PRESSURE CHECKS below.

Check all the shifts in the following manner:

DRIVE Range:

Position selector lever in DRIVE range, accelerating vehicle from 0 mph. A 1-2 and 2-3 shift should occur at all throttle openings, shift points varying with the throttle opening. As vehicle speed decreases to 0 mph, a 3-2 and 2-1 shift should occur (Fig. 7G-128).

The following shift points are APPROXIMATE and should be obtained as follows, providing *Engine Tune-up* is satisfactory:

SELECTOR LEVER IN—	UPSHIFTS (MPH)		DOWNSHIFTS (MPH)	
	1-2	2-3	3-2	3 OR 2-1
DRIVE				
Full Throttle	50	85	75	40
Part Throttle	12-50	22-85	50	—
Minimum Throttle	12	22	—	—
Coasting	—	—	22	9
SUPER	Engine Braking @ ANY SPEED			
LOW	Engine Braking @ 46 MPH OR BELOW			

Fig. 7G-128 Shift Point Information

With vacuum line *connected* and pressure gage installed:		
SELECTOR LEVER IN—	**MINIMUM PSI**	**MAXIMUM PSI**
DRIVE — 1st Gear (O to WOT)	67	175
— 2nd Gear (O to WOT)	67	175
— 3rd Gear (Coast @ 30 mph)	67	—
SUPER (Coast @ 30 mph)	95	—
LOW (Coast @ 30 mph)	95	—
REVERSE (O to WOT)	96	251
WOT—Wide Open Throttle		

Fig. 7G-129 Oil Pressure Checks—Road or Normal Operating Conditions

SUPER Range:

Position selector lever in SUPER range, accelerating vehicle from 0 mph. A 1-2 shift should occur at all throttle openings, the shift point varying with the throttle opening. No 2-3 shift should be obtained in this range. As vehicle speed decrease to 0 mph, a 2-1 shift should occur.

LOW Range:

Position selector lever in LOW range. No upshift should occur in this range, regardless of throttle opening.

Second Gear Engine Braking:

Position selector lever in DRIVE range and, with vehicle speed at approximately 30 mph and foot off accelerator, move selector lever to SUPER range. Transmission should immediately downshift to second gear. An increase in engine rpm and an engine braking effect should be noted. Line pressure should change from 55 psi to approximately 80 psi in second gear.

First Gear Engine Braking:

With selector lever in SUPER range and, with vehicle speed at approximately 30 mph at constant throttle, move selector lever to LOW range. Transmission should downshift to first gear. An increase in engine rpm and an engine braking effect should be noted. Line pressure should remain constant (approximately 80 psi).

TRANSMISSION OIL PRESSURE CHECKS

I. OIL PRESSURE CHECK - ROAD OR NORMAL OPERATING CONDITIONS

While road testing vehicle with the transmission oil pressure gage attached and the vacuum modulator tube connected , the transmission line pressures should check approximately as shown in Fig. 7G-129.

II. OIL PRESSURE CHECK - VEHICLE COASTING AT 25 MPH

While vehicle is coasting at 25 mph (foot off throttle), transmission oil pressure gage attached and the vacuum modulator tube connected , the transmission line pressures should check approximately as shown in Fig. 7G-130.

Vehicle coasting @ 25 mph, vacuum line *connected*, pressure gage installed and foot off throttle:	
SELECTOR LEVER IN—	**PRESSURE (PSI)**
NEUTRAL	67 ± 5
DRIVE	67 ± 5
SUPER	90 ± 5
LOW	90 ± 5
REVERSE	90 ± 5

Fig. 7G-130 Oil Pressure Checks—Vehicle Coasting

Oil pressures indicated are at 'zero' output speed, vacuum line ***disconnected*** and with engine speed set to 1200 rpm (service brake on):

APPROXIMATE ALTITUDE (FEET ABOVE SEA LEVEL)	DRIVE NEUTRAL PARK	SUPER OR LOW	REVERSE
0	176	175	251
2,000	164	166	234
4,000	159	162	227
6,000	151	157	215
8,000	144	151	205
10,000	137	146	195
12,000	130	141	188
14,000	124	137	177

NOTE: Pressures are approximate (± 5 psi).

Fig. 7G-131 Oil Pressure Checks—Vehicle Stationary

III. OIL PRESSURE CHECK - VEHICLE STATIONARY AND ENGINE AT 1200 RPM

While vehicle is stationary (service brake on), engine speed set to 1200 rpm, with transmission oil pressure gage attached and the vacuum modulator tube disconnected , the transmission line pressure should check approximately as shown in Fig. 7G-131.

EXTERNAL OIL LEAKS

DETERMINING SOURCE OF OIL LEAK

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to "wind flow" around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a "Black Light" to locate the point at which the oil is leaking is helpful. Comparing the oil from the leak to that on the engine or transmission dipstick, when viewed by black light, will determine the source of the leak - engine or transmission.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by air stream. For example, a transmission oil filler tube to case leak will cometimes appear as a leak at the rear of the transmission. In determining the source of a leak, proceed as follows:

1. Degrease underside of transmission.

2. Road test to get unit at operating temperature.

3. Inspect for leak with engine running.

4. With engine off, check for oil leaks due to the raised oil level caused by drain back.

POSSIBLE POINTS OF OIL LEAKS

1. Transmission Oil Pan Leak.

a. Attaching bolts not correctly torqued.

b. Improperly installed or damaged pan gasket.

c. Oil pan gasket mounting face not flat.

2. Extension Housing Leak.

a. Attaching bolts not correctly torqued.

b. Rear seal assembly damaged or improperly installed.

c. Square seal, extension to case, damaged or improperly installed.

d. Porous casting*.

3. Case Leak.

a. Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine.

b. Modulator assembly "O" ring seal damaged or improperly installed.

d. Governor cover not tight, gasket damaged or leak between case face and gasket.

e. Speedometer gear "O" ring damaged.

f. Manual shaft seal damaged or improperly installed.

g. Line pressure tap plug loose.

h. Vent pipe (refer to item 5).

i. Porous casting*.

4. Leak at Front of Transmission.

a. Front pump seal leaks.

(1) Seal lip cut. Check converter hub, etc.

(2) Bushing moved and damaged. Oil return hole plugged.

(3) No oil return hole.

b. Front pump attaching bolts loose or bolt washer type seals damaged or missing.

c. Front pump housing "O" ring damaged or cut.

d. Converter leak in weld area.

e. Porous casting (pump).

5. Oil Comes Out Vent Pipe.

a. Transmission over-filled.

b. Water in oil.

c. Foreign material between pump and case or between pump cover and body.

d. Case - porous near converter bosses*. Front pump cover or housing oil channels shy or stock near breather.

e. Pump to case gasket mis-positioned.

***CASE POROSITY REPAIR**

Turbo Hydra-Matic (M-38) transmission external oil leaks caused by case porosity can be repaired with the transmission in the car by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 180°F.

2. Raise car on a hoist or jack stand, engine running and locate source of oil leak. Check for oil leaks in LOW, DRIVE and REVERSE ranges.

3. Shut engine off and thoroughly clean area to be repaired with a suitable cleaning solvent and a brush, then air dry.

NOTE: A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement.

4. Using instructions of the manufacturers, mix a sufficient amount of epoxy, Group 0.423, Part No. 1360016, or equivalent, to make the repair.

NOTE: Make certain the area to be repaired is fully covered.

5. Allow cement to cure for 3 *hours* before starting engine.

6. Road test and check for leaks.

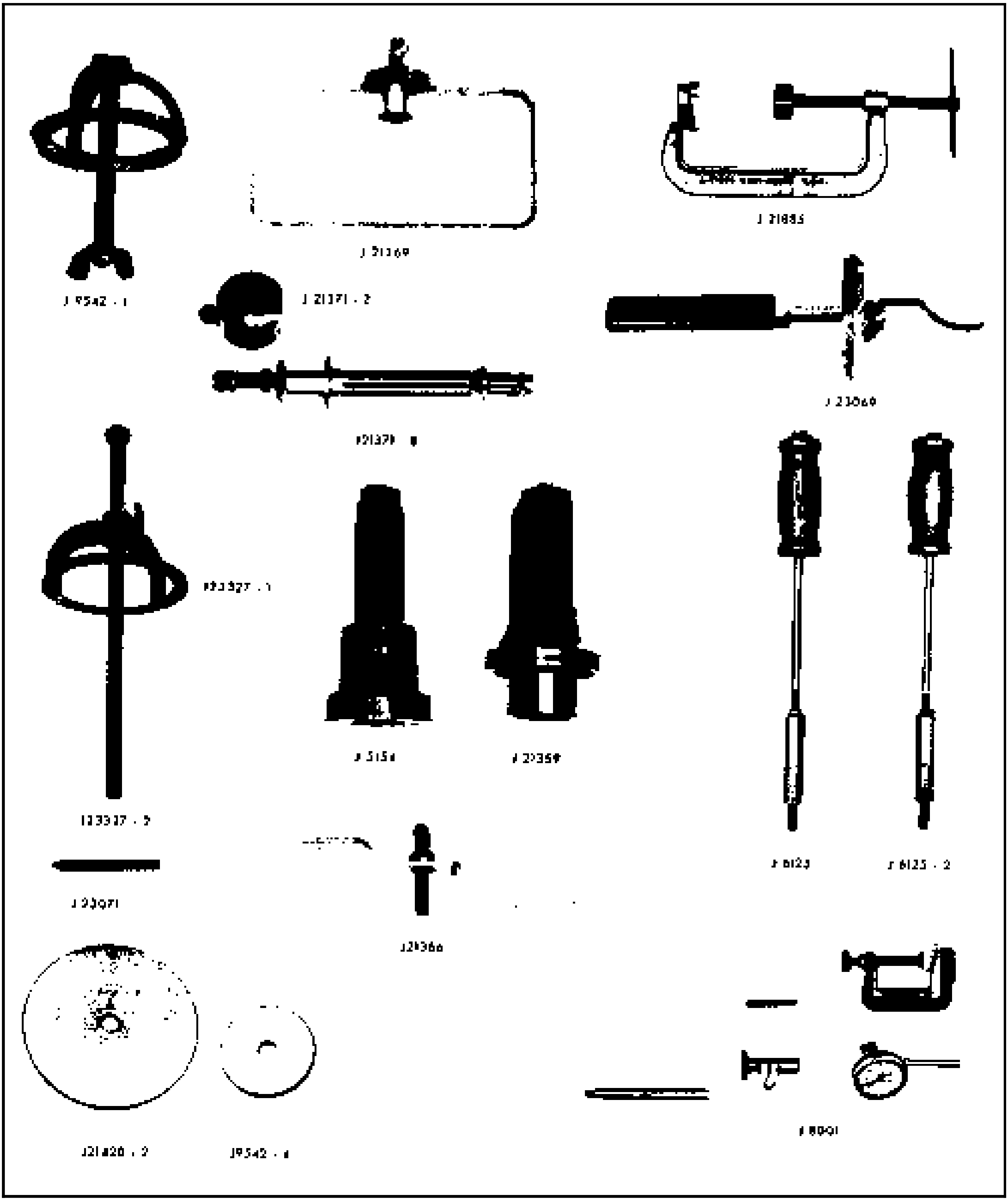
TORQUE SPECIFICATIONS

LOCATION	LB. FT.
Transmission-to-engine bolts	40
Converter-to-flex plate bolts	30
Crossmember-to-frame bolts	30
Rear mount-to-transmission bolts	40
Crossmember-to-rear mount bolts—Tempest	55
Crossmember-to-rear mount bolts—Firebird	40
Cooler Line Fitting Nuts	16
Range selector outer lever-to-manual shaft	20
Range selector outer lever pin nut	30
Linkage swivel clamp screw—Tempest	20
Linkage swivel clamp nut—Firebird	30
Oil pan-to-case bolts	12
Extension housing-to-case bolts	35
Vacuum modulator retainer bolt	12
Speedometer driven gear retainer bolt	12
Valve body-to-case bolts	13
Spacer support plate-to-case bolts	13
Manual shaft jam nut	30
Downshift detent lever bracket-to-valve body bolts	16
Parking lock bracket bolts	29
Oil pump-to-case bolts	20
Oil pump-cover-to-pump body bolts	18

	LB. IN.
Case-to-converter dust pan bolts	25
Converter dust pan-to-case bolts	75
Downshift cable-to-case bolt	75

J 2619	Slide Hammer
J 2619-4	Slide Hammer Adapter
J 3289-14	Holding Fixture Base (Note Shown)
J 8092	Drive Handle
J 8763-01	Holding Fixture
J 8763-19	Holding Fixture Adapter
J 9534	Output Shaft Bushing Remover
J 21424-7	Stater Shaft Front Bushing Installer Stator Shaft Center and Rear Bushing Remover
J 21424-9	Extension Housing Bushing Remover and Installer
J **21465-13**	Drive Handle Extension
J **21465-15**	Stator Shaft Front Bushing Remover
J **21904-1**	Slide Hammer Belt
J **23062-1**	Case Bushing Kastaller
J **23062-2**	Stator Shaft Center and Rear Bushing Installer
J **23062-3**	Sun Gear Bushing Remover and Installer Reaction Carrier Bushing Remover and **Installer**
J **23062-4**	Direct Clutch Bushing Installer
J **23062-5**	**Input** Ring Gear Bushing Remover and **Installer**
J **23062-7**	Output Shaft Bushing Installer

Fig. 7G-132 Special Tools



J 5154	Rear Oil Seal Installer
J 6125	Slide Hammer (2)
J 6125-2	Slide Hammer Adapter (2)
J 8001	Dial Indicator Set
J 9542-1	Clutch Spring Compressor (Direct Clutch)
J 9542-4	Clutch Spring Compressor Pilot
J 21359	Pump Oil Seal Installer
J 21366	Converter Holding Strap
J 21369	Converter Leak Test Fixture
J 21371-2&8	Converter End Play Fixture
J 21420-2	Clutch Spring Compressor Pilot
J 21885	Direct Clutch Accumulator Compressor
J 23069	Intermediate Accumulator Cover Compressor
J 23071	Band Apply Pin Gauge
J 23327-1&2	Clutch Spring Compressor (Forward, Low & Reverse Clutches)

Fig. 7G-133 Special Tools

FUEL TANK AND EXHAUST SYSTEM

CONTENTS OF THIS SECTION

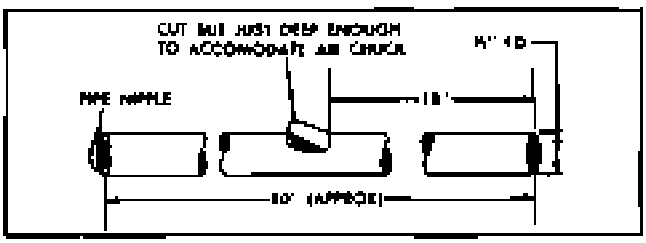


Fig. 8-1 Fuel Tank Drain Hose

MINOR AND MAJOR SERVICE

FUEL TANK DRAIN

1. Insert a length of hose (refer to Fig. 8-1 for details) into gas tank, pipe nipple end first, until weighted end of hose rests on bottom of tank.

2. With chuck of air hose inserted into hose slit, a short blast of air will cause gas to flow.

NOTE: The tank can be drained rapidly by raising the car several feet off the floor when performing the above operation.

FUEL TANK (EXCEPT STATION WAGON)

REMOVE

1. Drain tank.

2. Disconnect fuel hose and fuel vapor return hose at tank gage unit (Figs. 8-2 and 8-7).

3. Remove screw retaining ground wire (Fig. 8-10).

4. Disconnect tank gage unit lead wire from clip on Pontiac.

5. Disconnect rear vent tube hose from filler neck on all models and front vent hose on Tempest and Grand Prix (Fig. 8-3).

6. Disconnect support straps and partially lower tank.

7. Disconnect waterproof wire connector at tank gage unit.

8. Complete tank removal.

INSTALL

1. Install tank by reversing above steps.

2. Tighten fuel tank support strap nuts to 9 lb. ft. torque.

FUEL TANK (STATION WAGON)

REMOVE

1. Drain tank and remove left rear wheel.

2. Remove screws retaining baffle under left rear wheel well (Fig. 8-5 or 8-6).

3. Disconnect fuel hose and fuel vapor return hose at tank gage unit.

4. Remove screw retaining ground wire (Fig. 8-7 or 8-8).

5. Disconnect waterproof wire connector at tank gage unit.

6. Remove nut on Pontiac or bolt on Tempest holding front tank support strap to bracket.

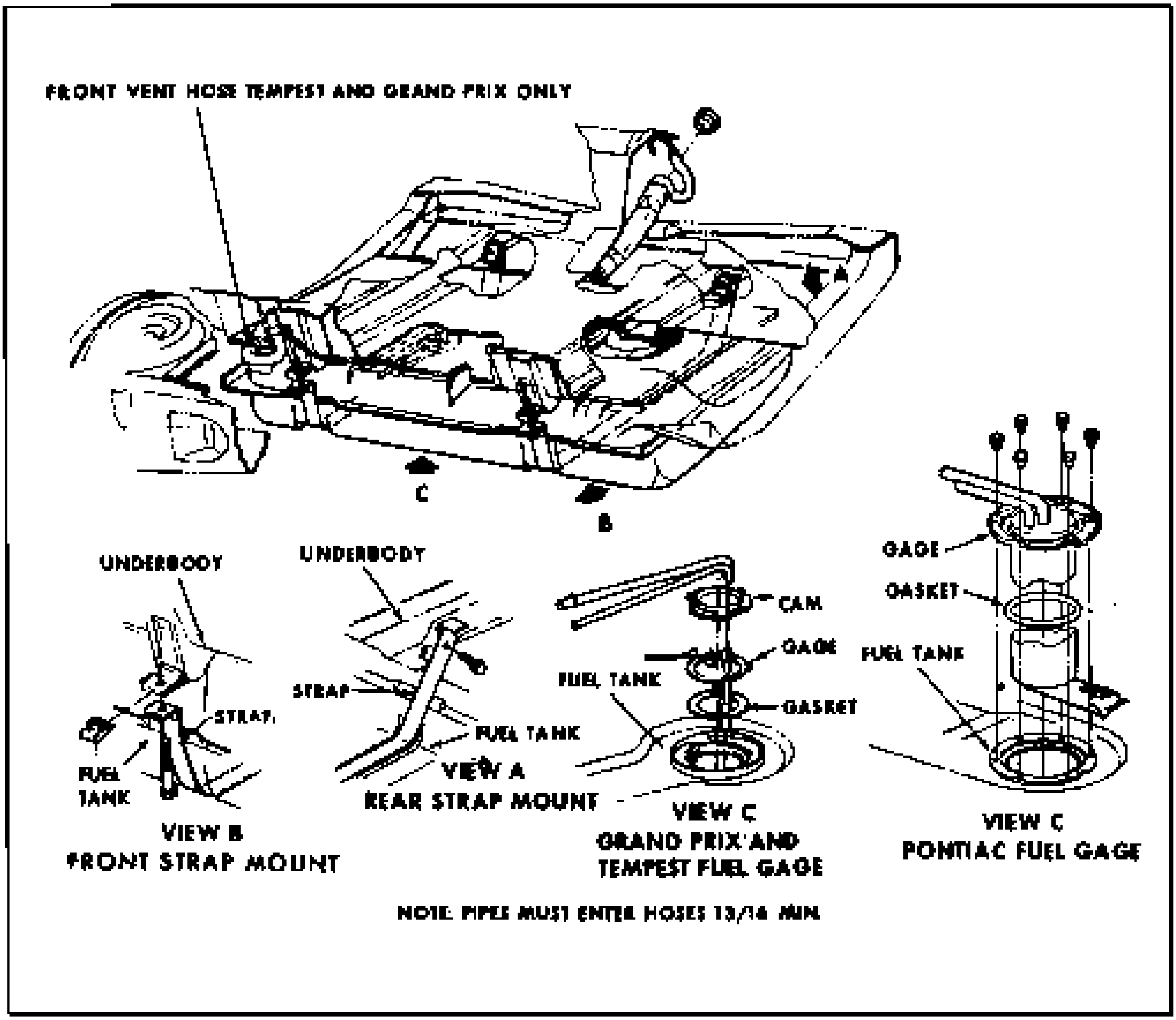


Fig. 8-2 Installation of Fuel Tank - except Firebird

7. Remove nut holding lower tank support strap to hook bolt and remove tank.

INSTALL

1. Install tank by reversing above steps

2. Tighten lower support strap nut to 9 lb. ft. torque on Pontiac and 8 lb. ft. torque on Tempest. Tighten front support strap nut on Pontiac to 9 lb. ft. torque and bolt on Tempest to 8 lb. ft. torque. Tighten baffle to wheel well screws to 17 lb. in. torque on Pontiac and 25 lb. in. torque on Tempest.

FUEL TANK GAGE UNIT (EXCEPT STATION WAGON)

NOTE: Before removing tank gage unit, be sure it is actually inoperative

1. Remove tank (see FUEL TANK - EXCEPT STATION WAGON - REMOVE).

2. Clean away any dirt that has collected around gage unit and terminal so it will not enter tank when gage unit is removed (Fig. 8-11).

3. Remove tank gage unit by using tool J 23346 on all models except Pontiac (Fig. 8-4). Remove six attaching hex head screws on Pontiac.

INSTALL

NOTE: Before the new unit is installed in the tank, the float arm should be checked for freedom of movement by

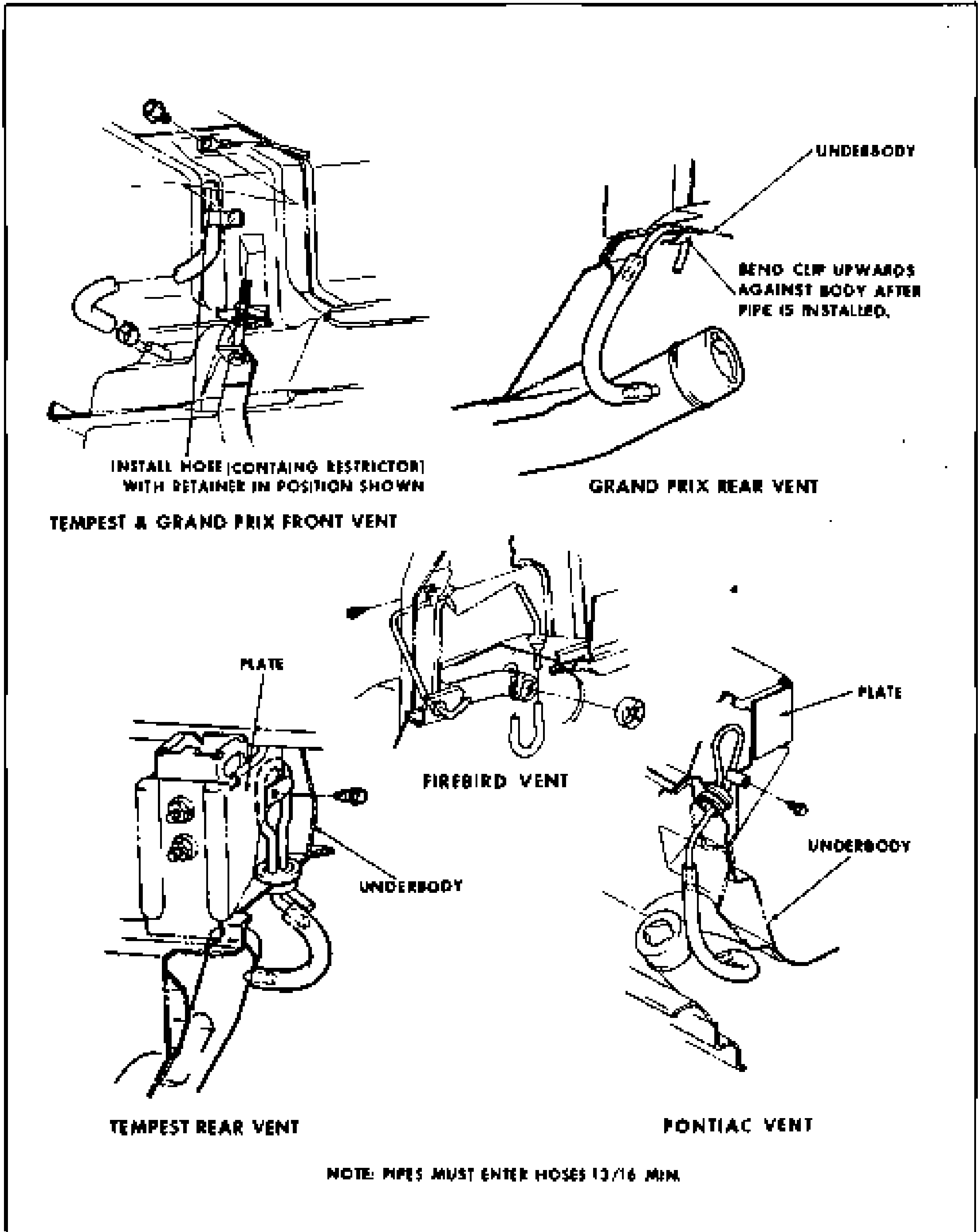


Fig. 8-3 Vent Hose Routing

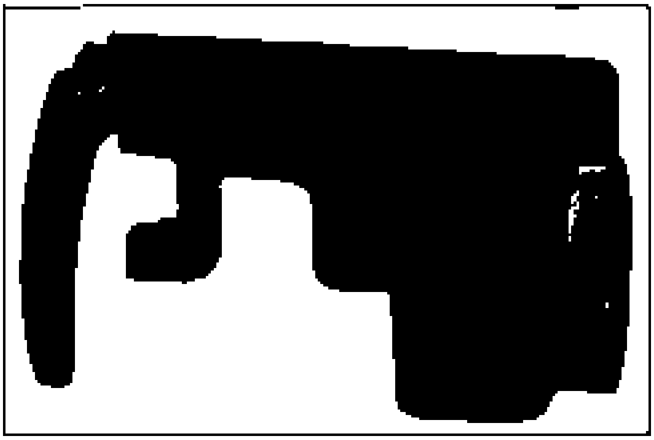


Fig. 8-4 Tank Gage Unit Tool J 23346

raising it to various positions and seeing if it will always fall to the "empty" position.

1. Install by reversing the above steps, making sure a new tank gage unit gasket is installed.

2. Install tank (see FUEL TANK - EXCEPT STATION WAGON - INSTALL).

FUEL TANK GAGE UNIT (STATION WAGON)

REMOVE

NOTE: Before removing tank gage unit, be sure it is actually inoperative

1. Remove tank (see FUEL TANK - STATION WAGON - REMOVE).

NOTE: Remove fuel filler cap and drain fuel tank as necessary to insure fuel level is below point where gage unit is installed in tank.

2. Clean away any dirt that has collected around gage unit and terminal so it will not enter tank when gage unit is removed (Fig. 8-11).

3. Remove tank gage unit by using tool J 23346 (Fig. 8-4).

INSTALL

NOTE: Before the new unit is installed in the tank, the float arm should be checked for freedom of movement by raising it to various positions and seeing if it will always fall to the "empty" position.

1. Install by reversing the above steps, making sure a new tank gage unit gasket is installed.

2. Install tank (see FUEL TANK - STATION WAGON -INSTALL).

FUEL LINES

The fuel pipe and fuel vapor return pipe from the tank to the engine run on the left side of the frame on Tempest 8-cylinder cars, and on the right side of the frame on Tempest 6-cylinder cars and all Firebirds. The Pontiac and Grand Prix fuel pipe and fuel vapor return pipe run on the left side of the frame. The fuel pipe and fuel vapor return pipe have a hose connection on both ends of each pipe.

All hoses should be secured to the pipes by adjustable screw type or flat spring type hose clamps.

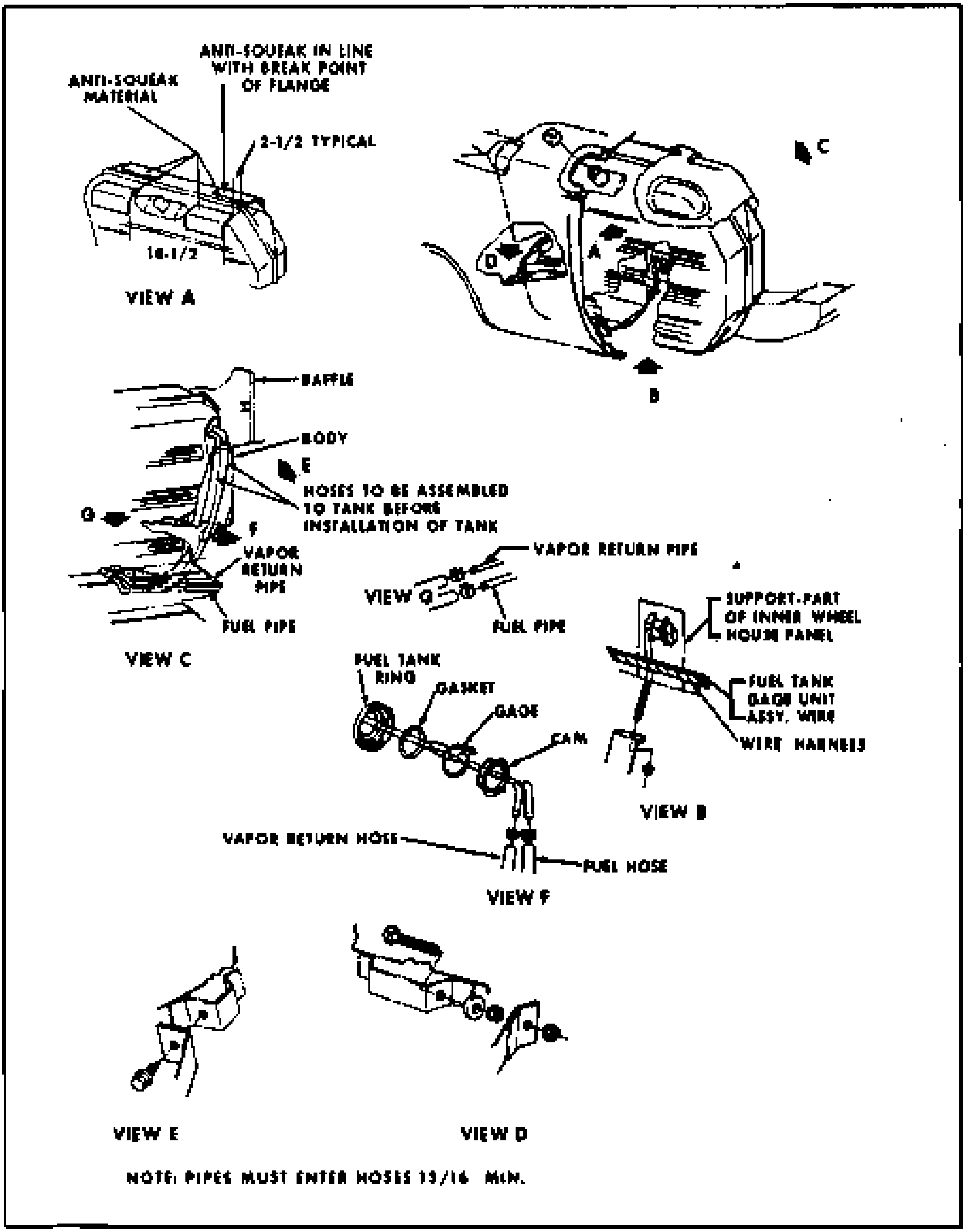


Fig. 8-5 Installation of Fuel Tank Pontiac Station Wagon

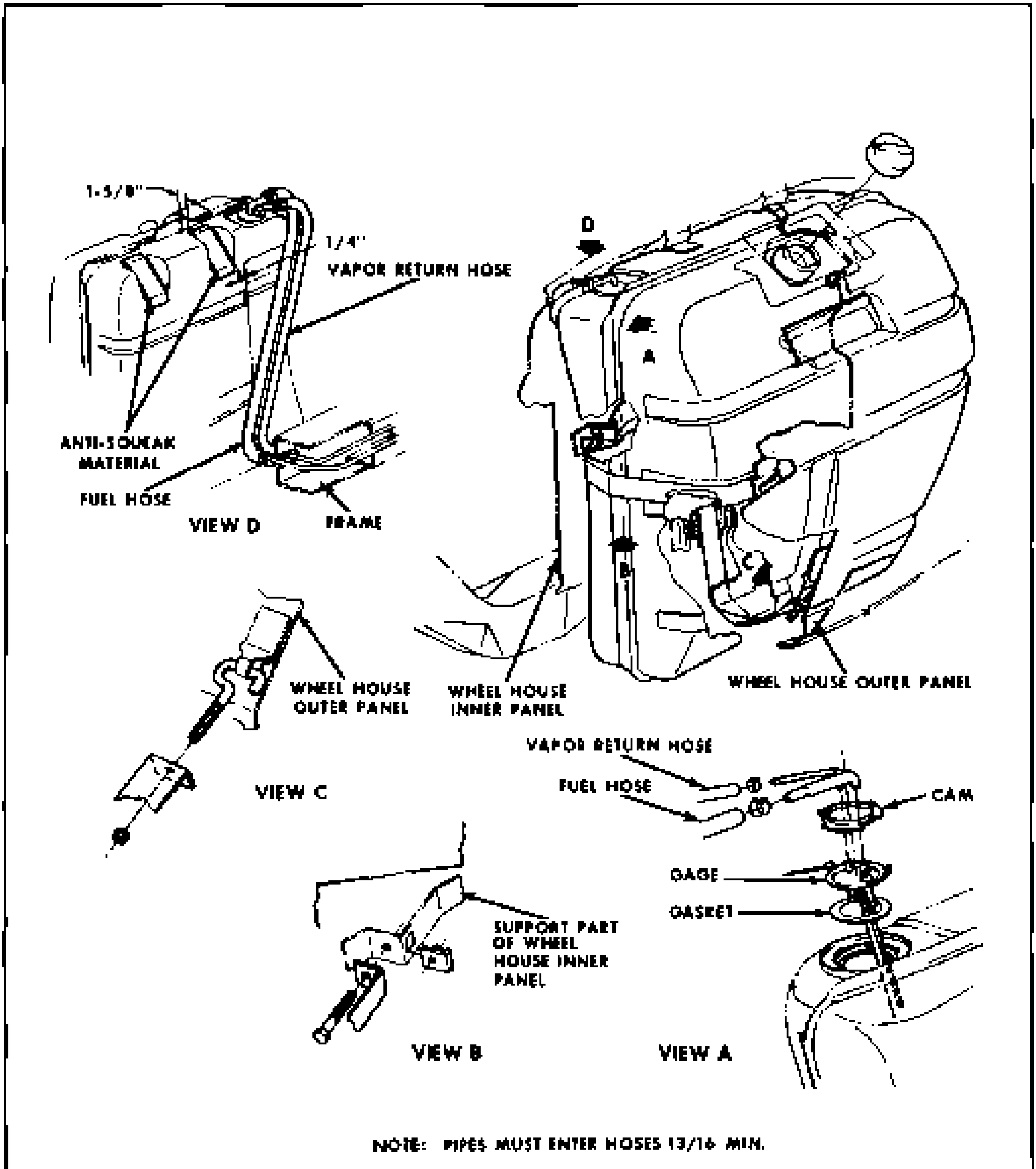


Fig. 8-6 Installation of Fuel Tank Tempest Station Wagon

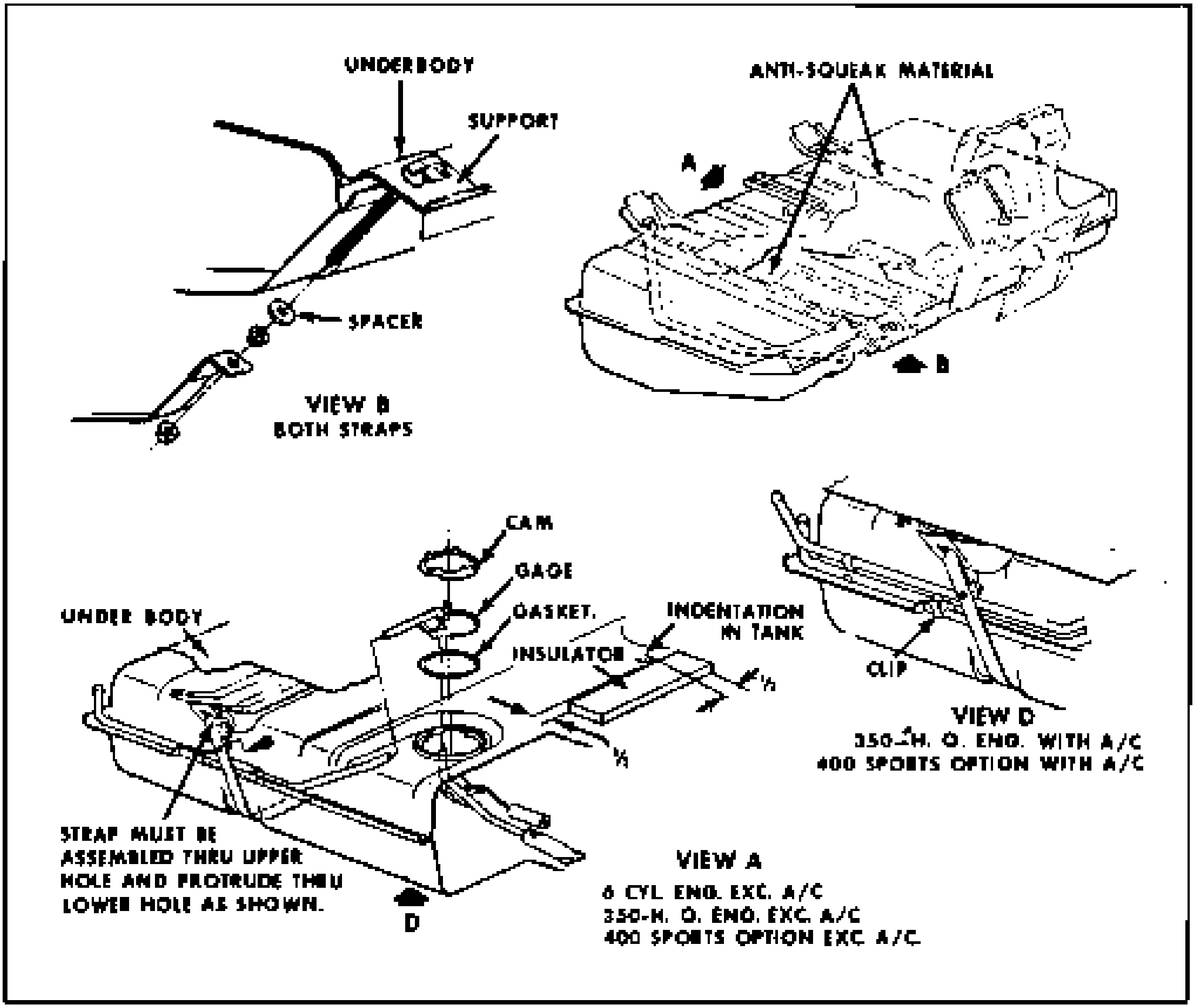


Fig. 8-7 Installation of Fuel Tank - Firebird

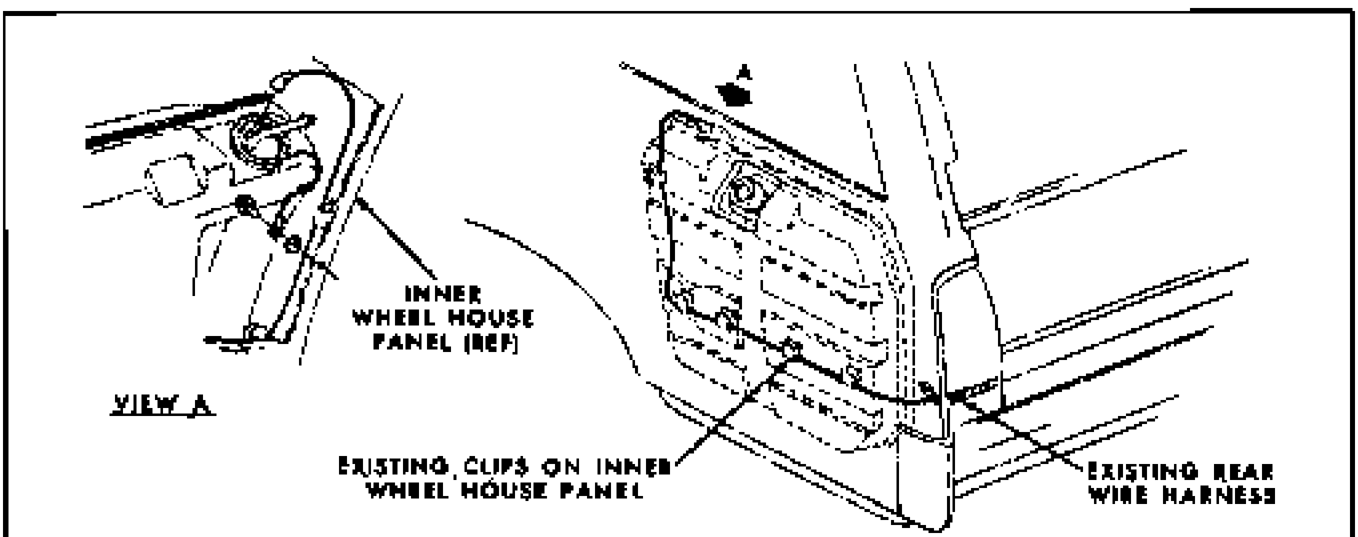


Fig. 8-8 Pontiac Fuel Gage Wiring - Station Wagon

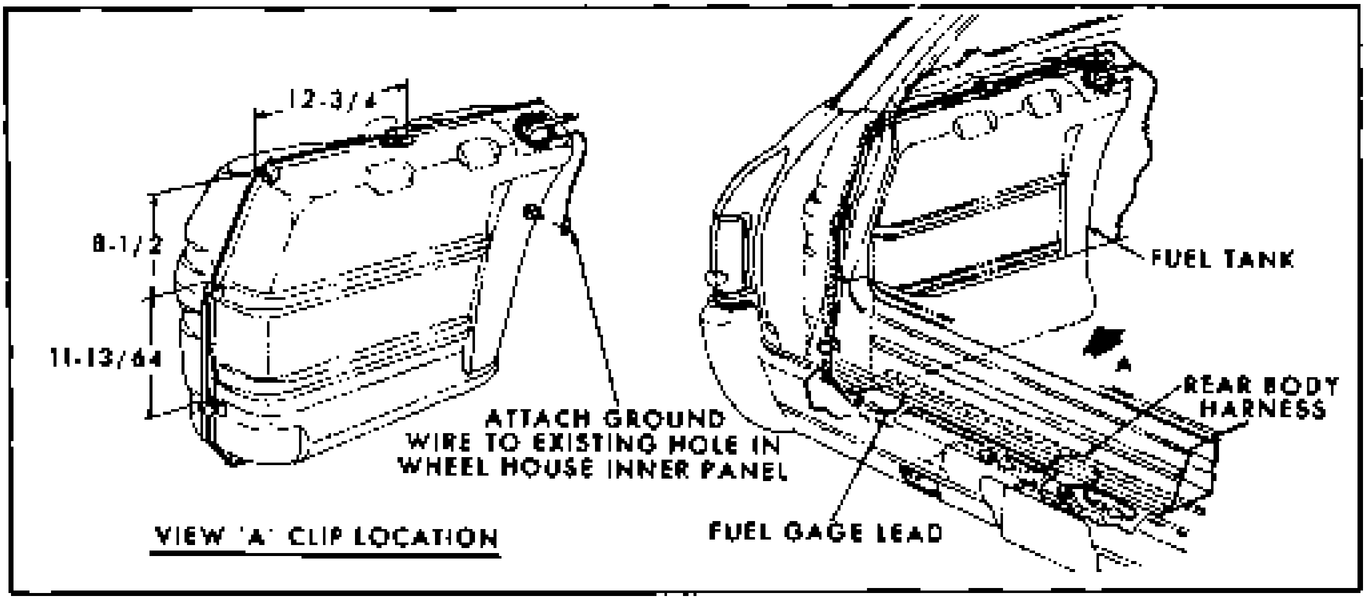


Fig. 8-9 Tempest Fuel Gage Wiring - Station Wagon

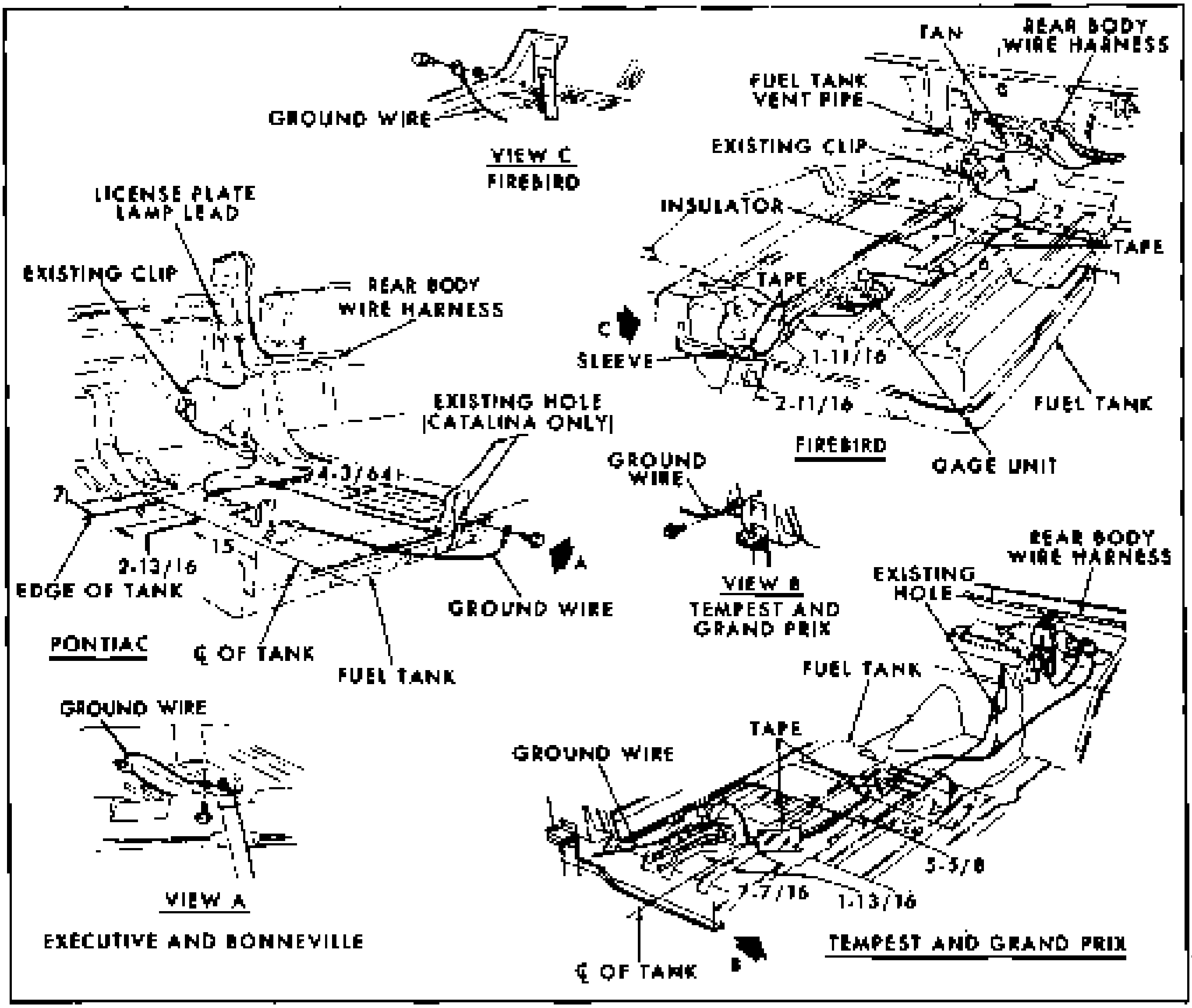


Fig. 8-10 Fuel Gage Wiring - except Station Wagon

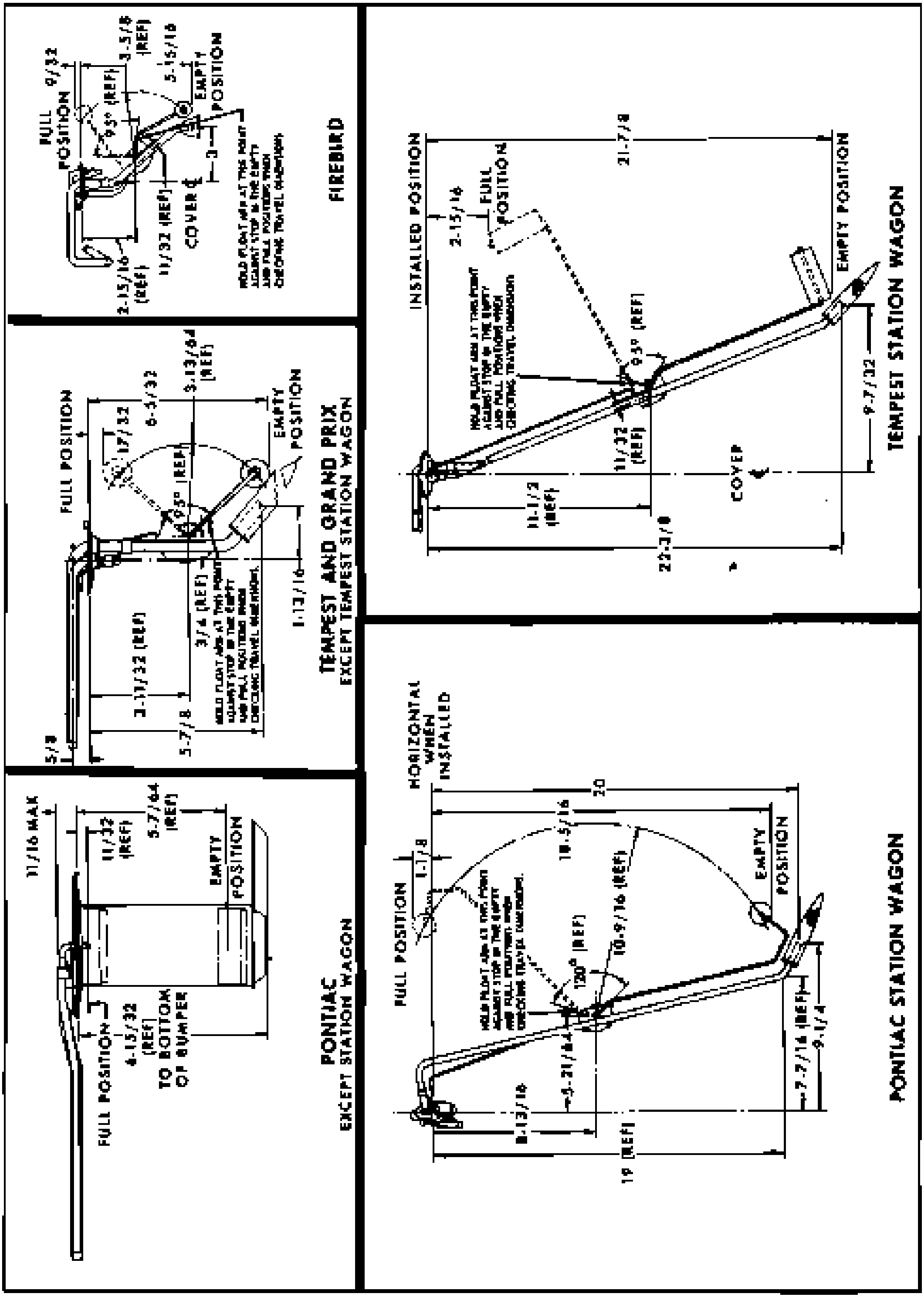


Fig. 8-11 Fuel Tank Gage Unit

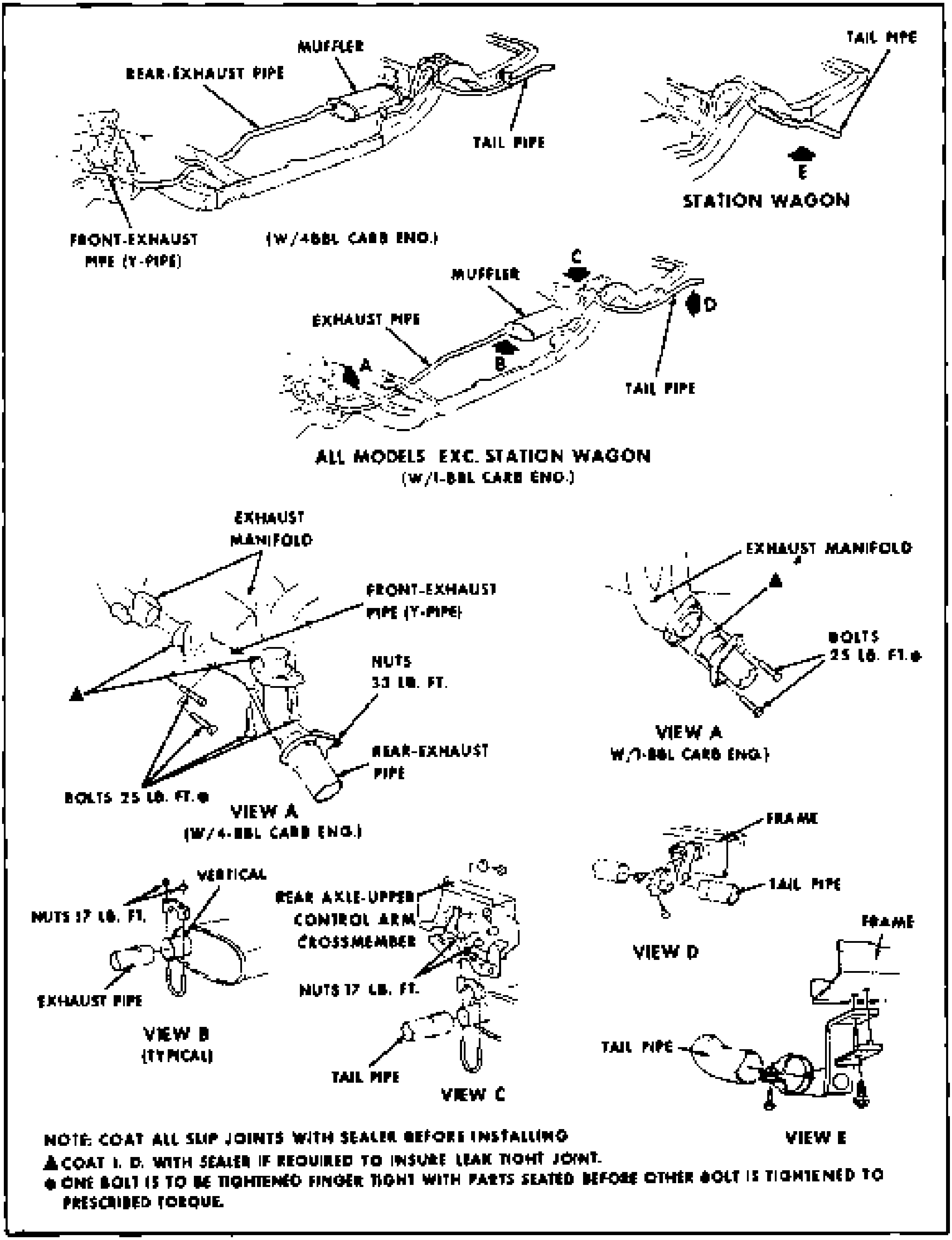


Fig. 8-12 Tempest 6-Cylinder Engine Exhaust System

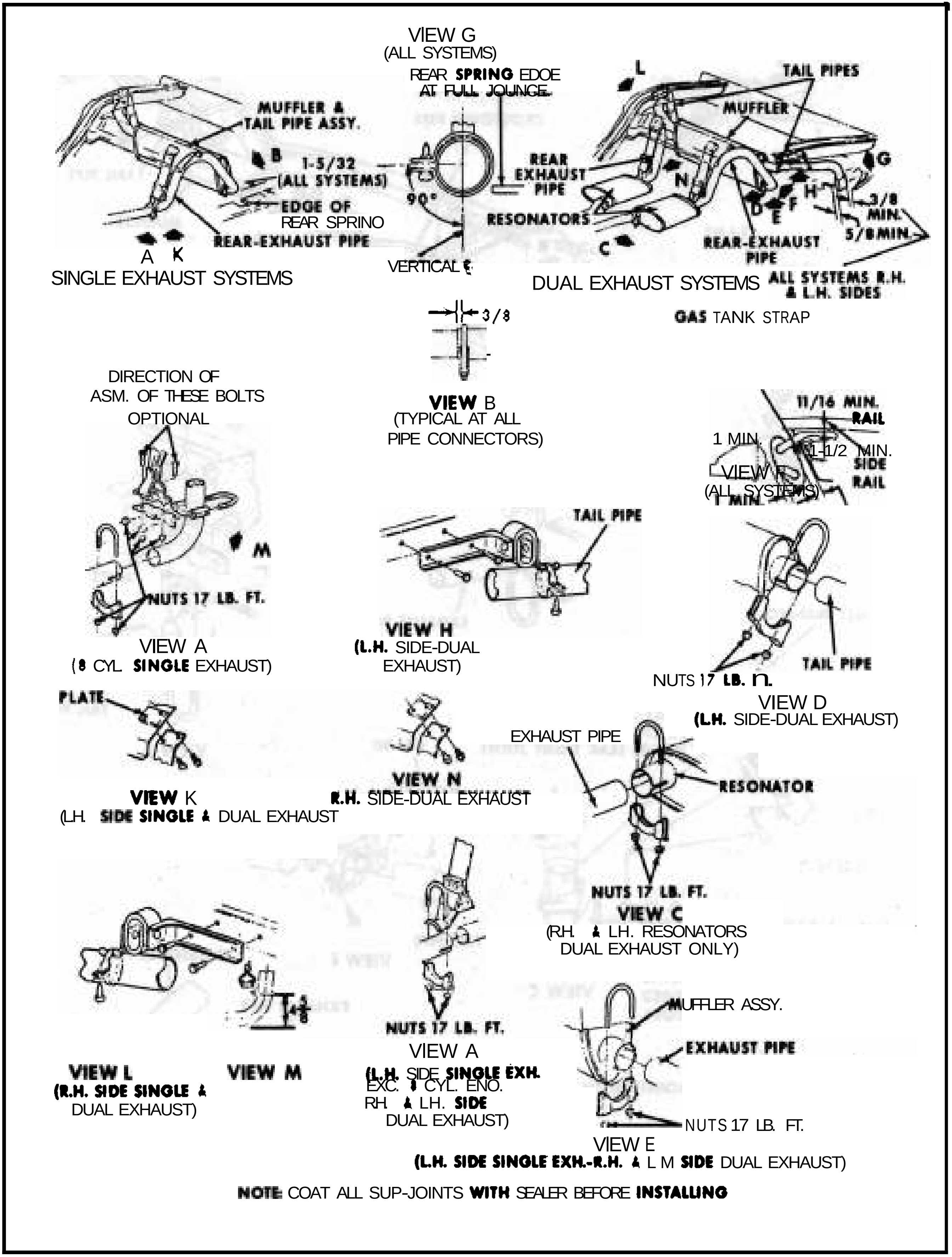


Fig. 8-13 Firebird Muffler and Tail Pipe Installation

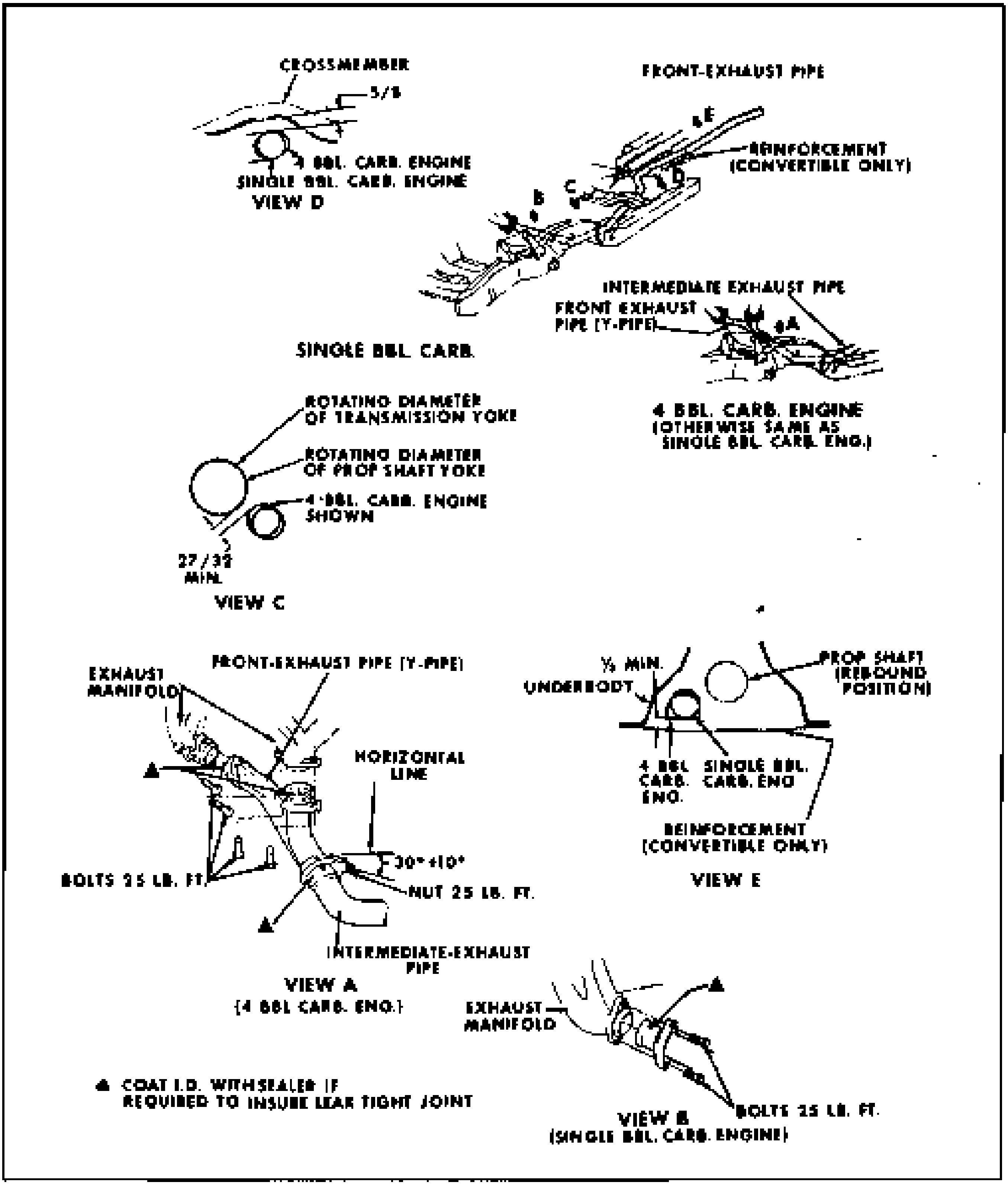


Fig. 8-15 Firebird 6-Cylinder Engine Exhaust System

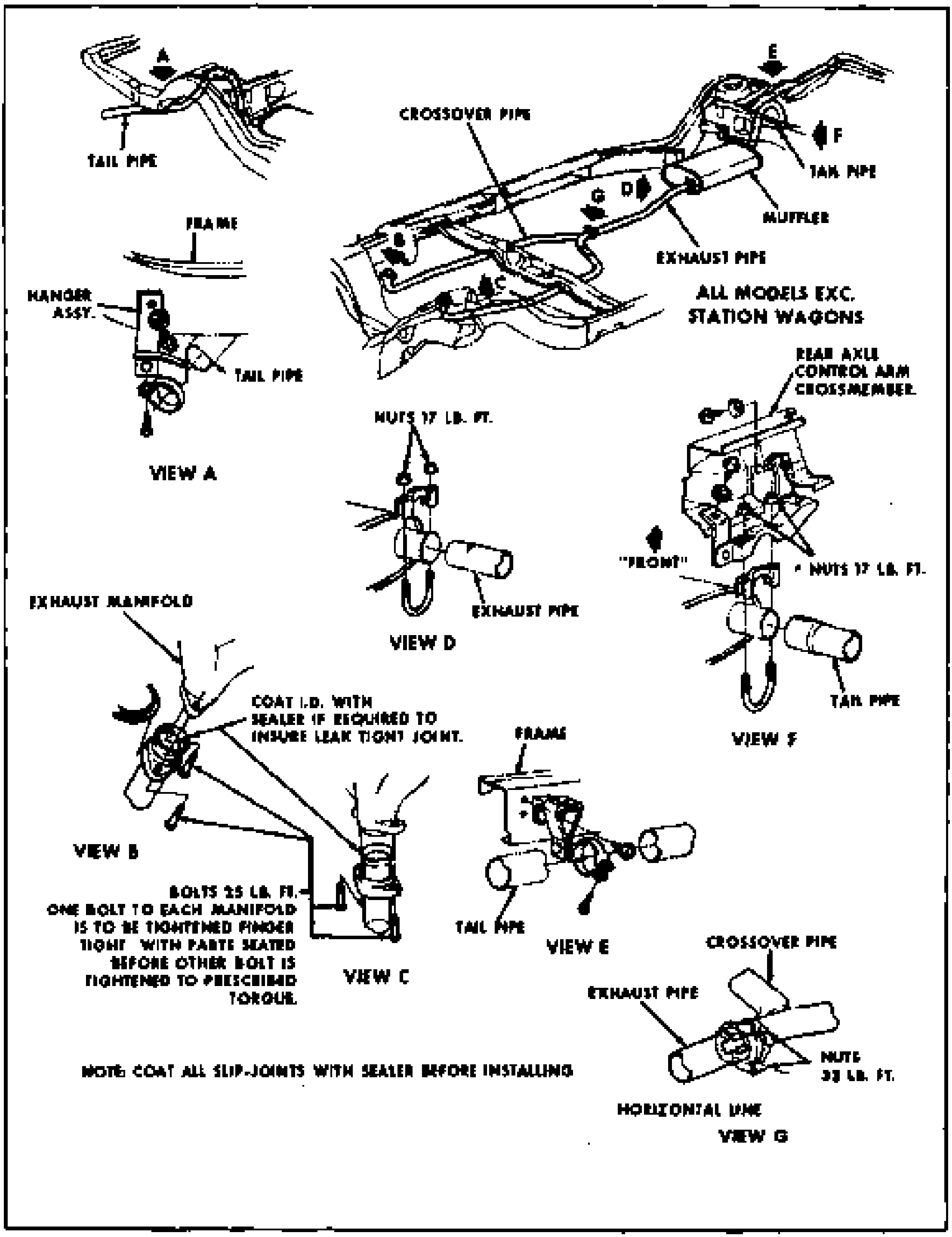


Fig. 8-14 Tempest V-8 Engine Single Exhaust System

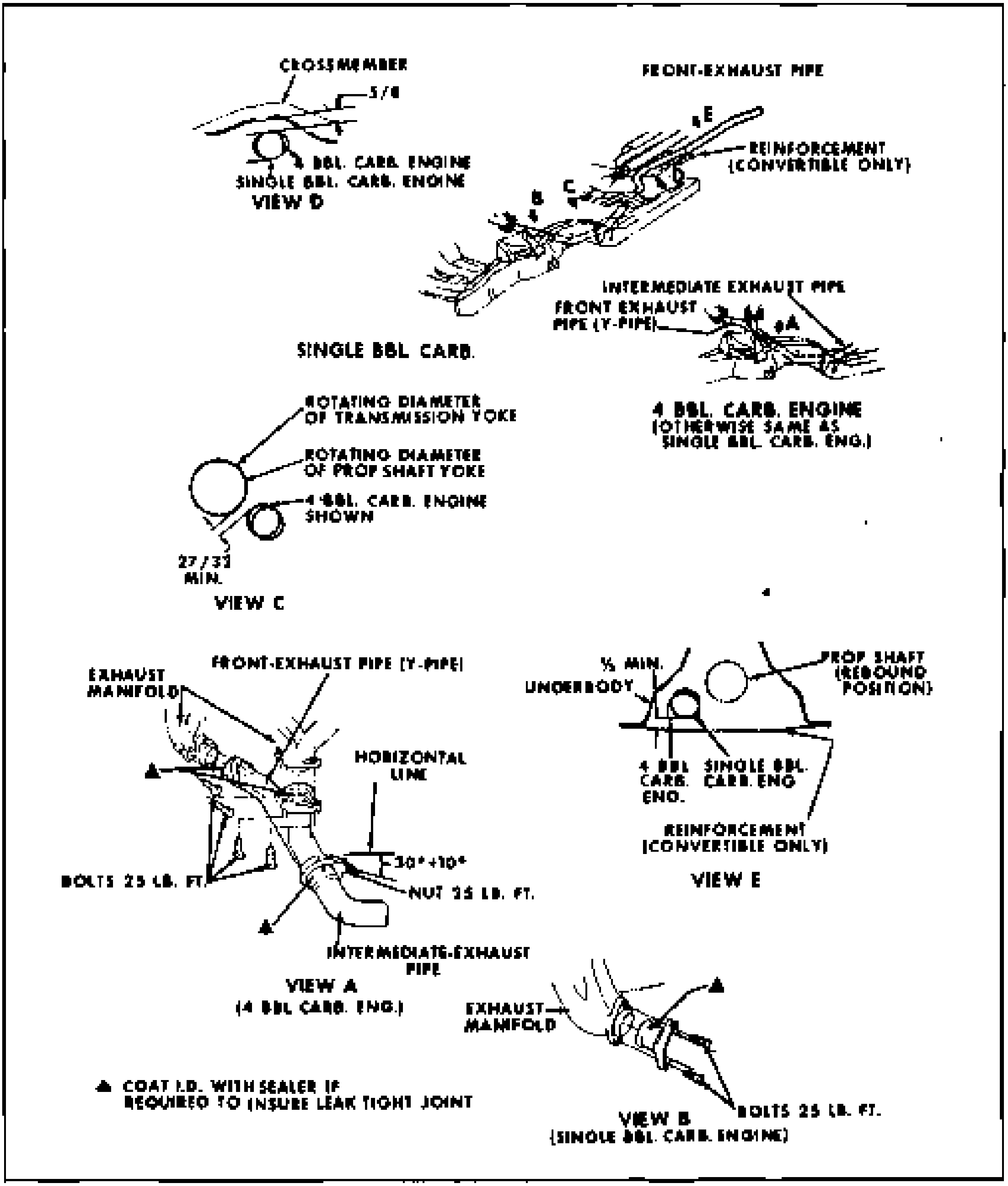


Fig. 8-15 Firebird 6-Cylinder Engine Exhaust System

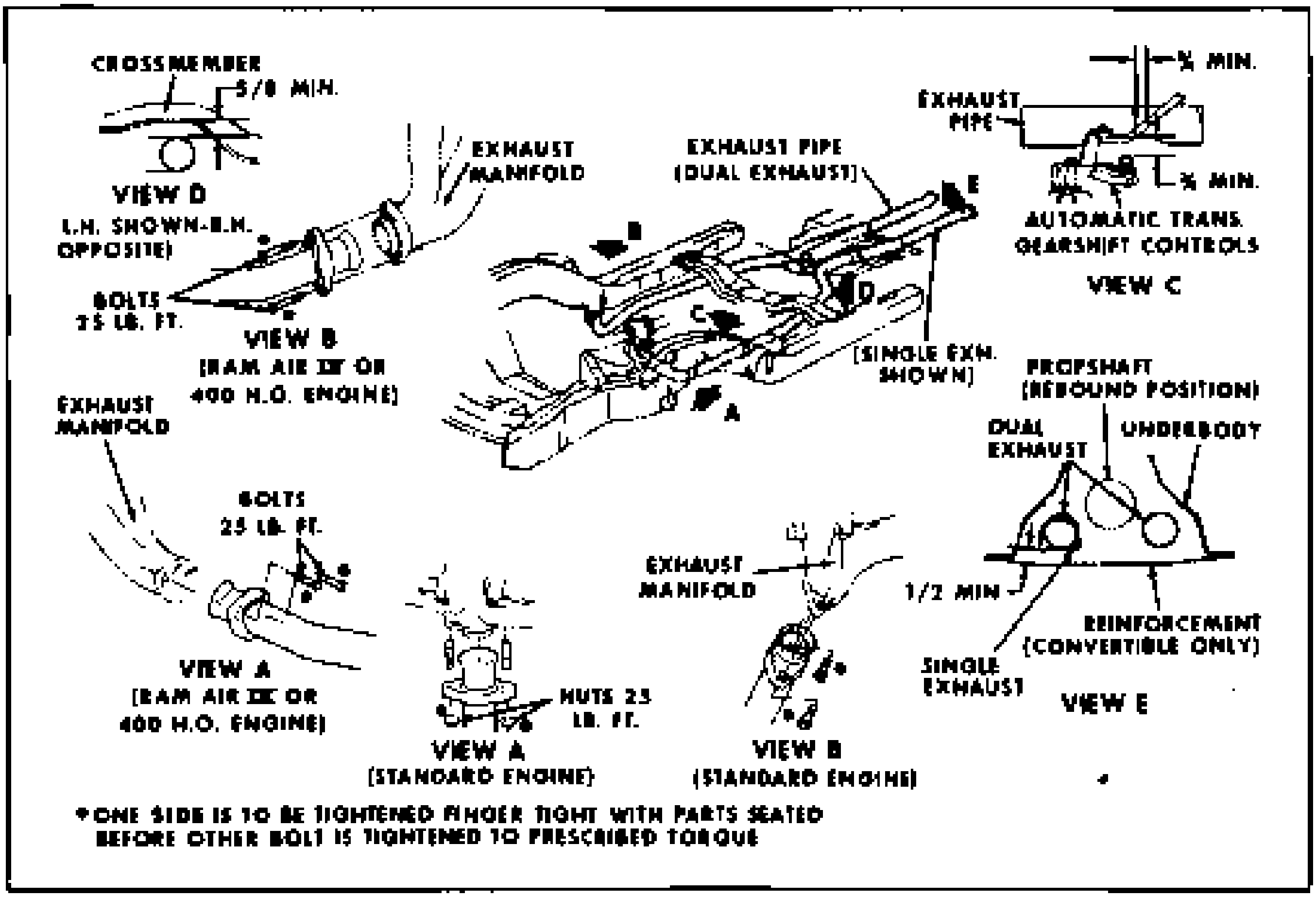


Fig. 8-16 Firebird V-8 Engine Single or Dual Exhaust System

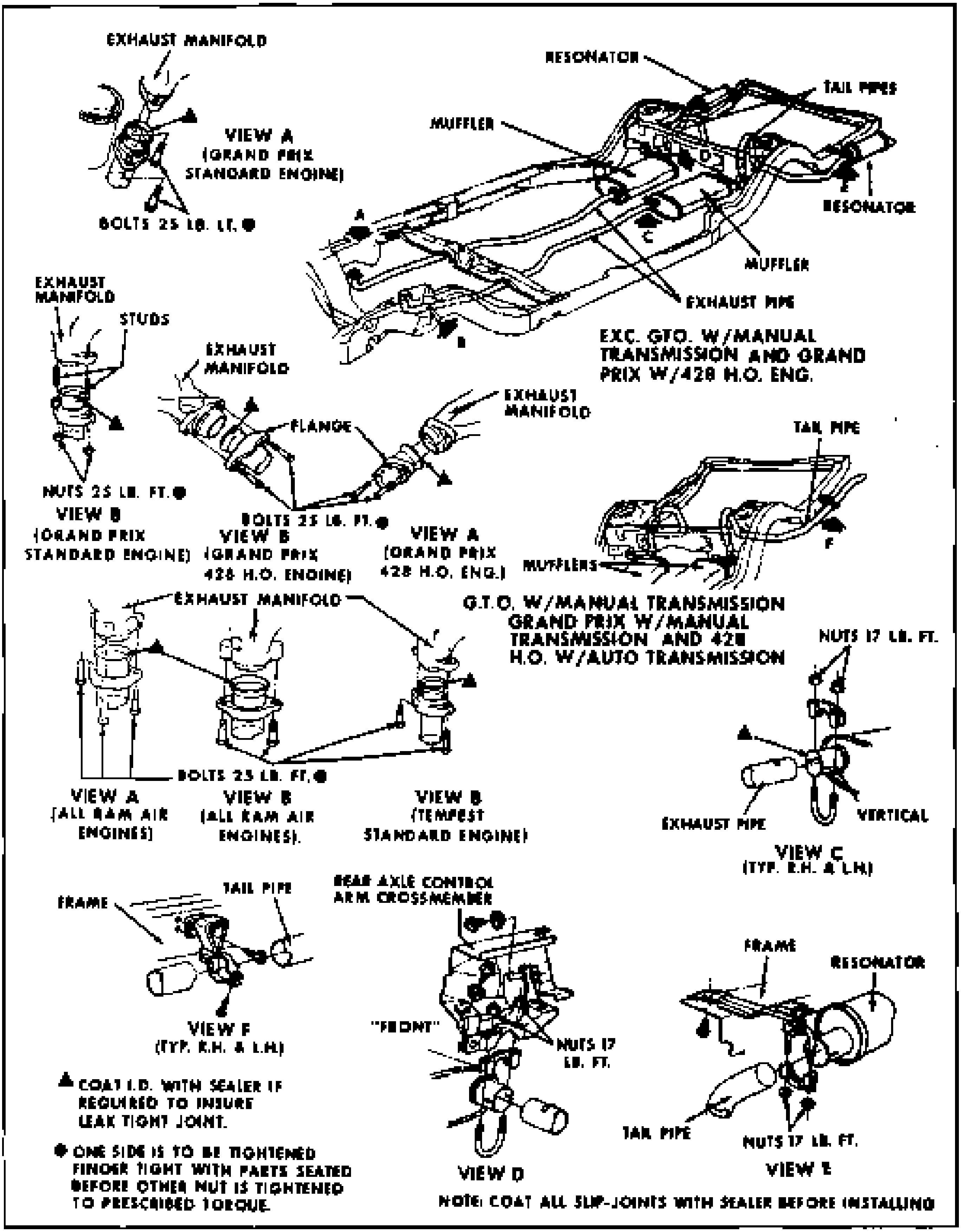


Fig. 8-17 Tempest and Grand Prix Dual Exhaust
System

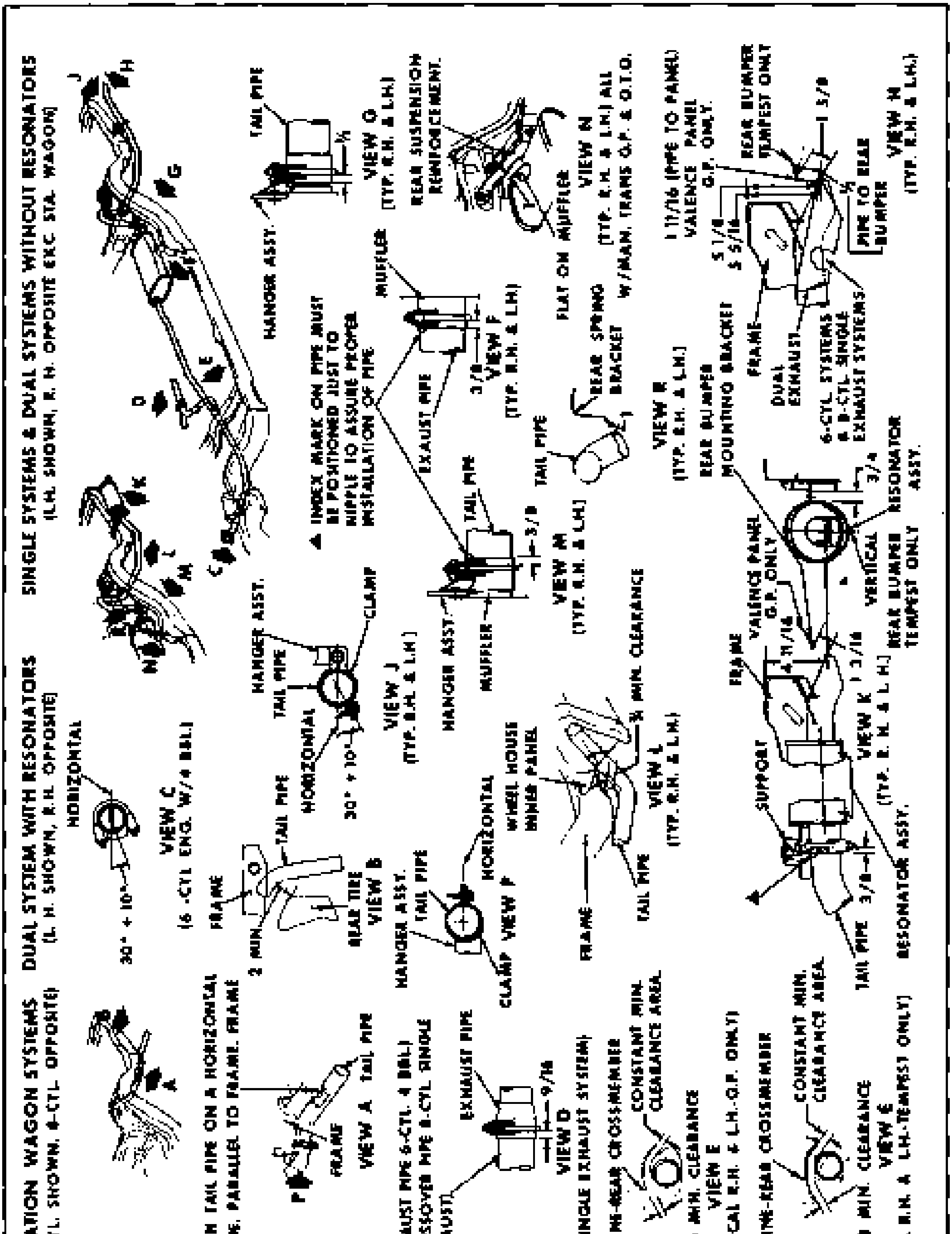


Fig. 8-18 Tempest and Grand Prix Exhaust System Clearance Requirements

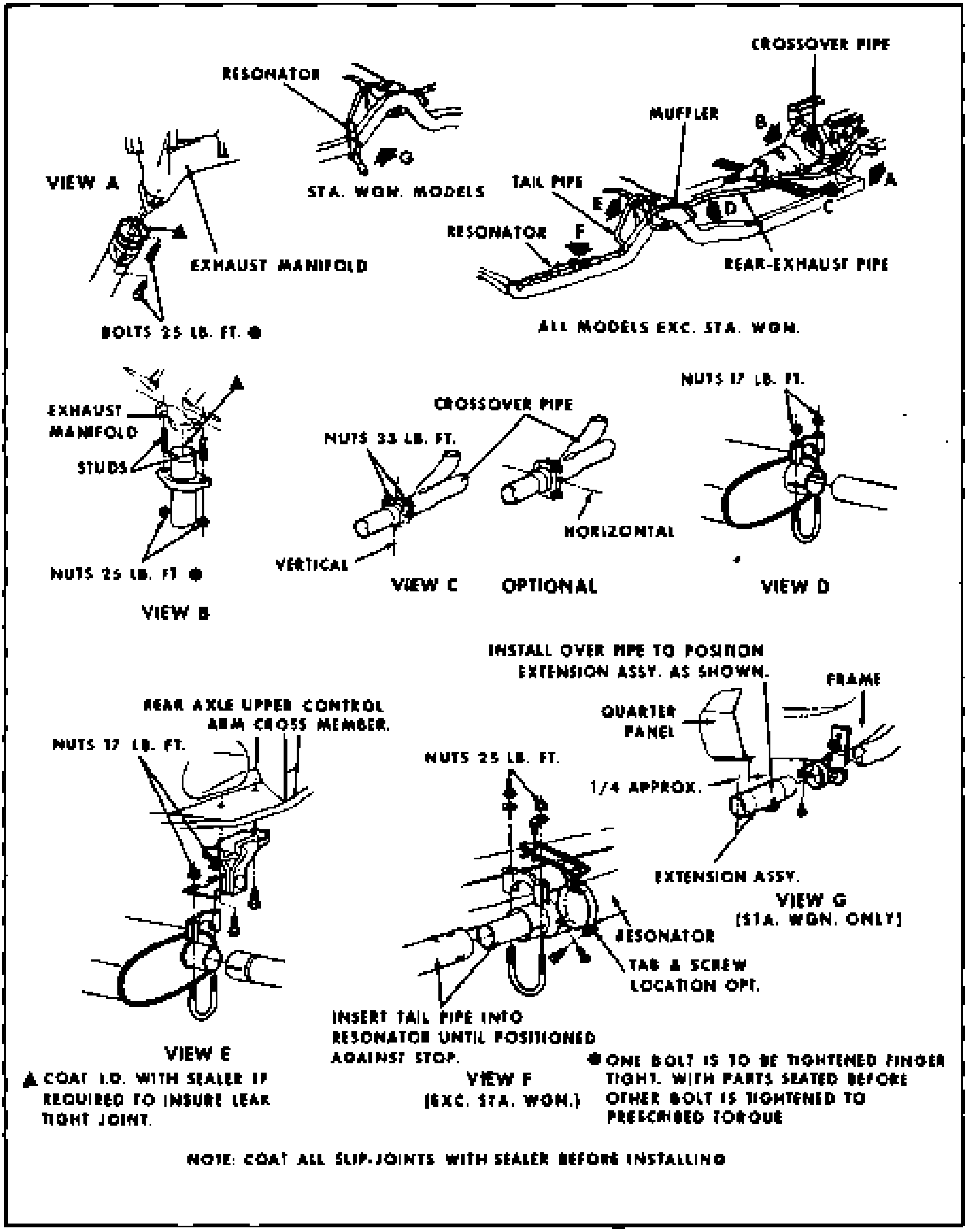


Fig. 6-19 Pontiac Single Exhaust System

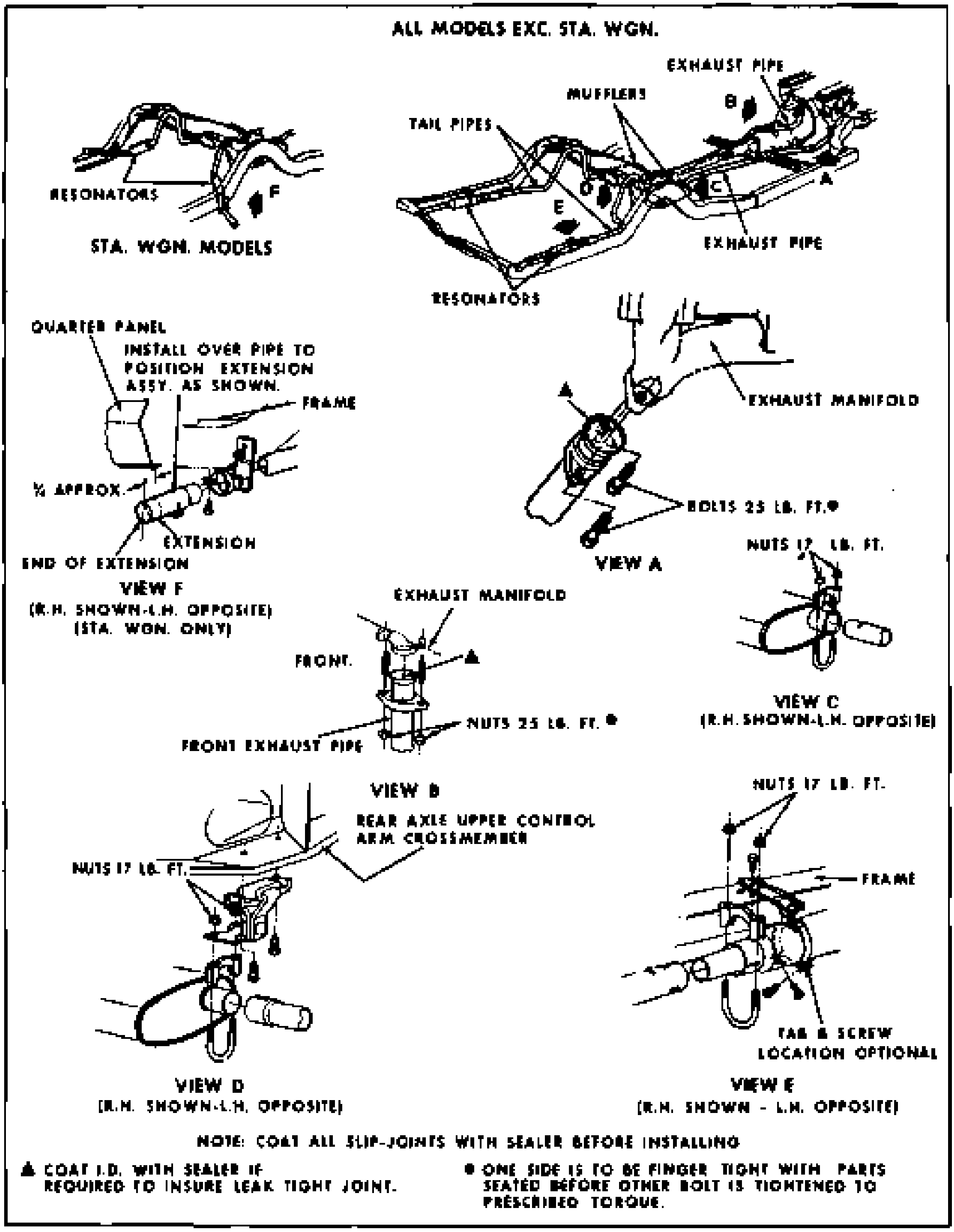


Fig. 8-20 Pontiac Dual Exhaust System except 428 H.O. Engine

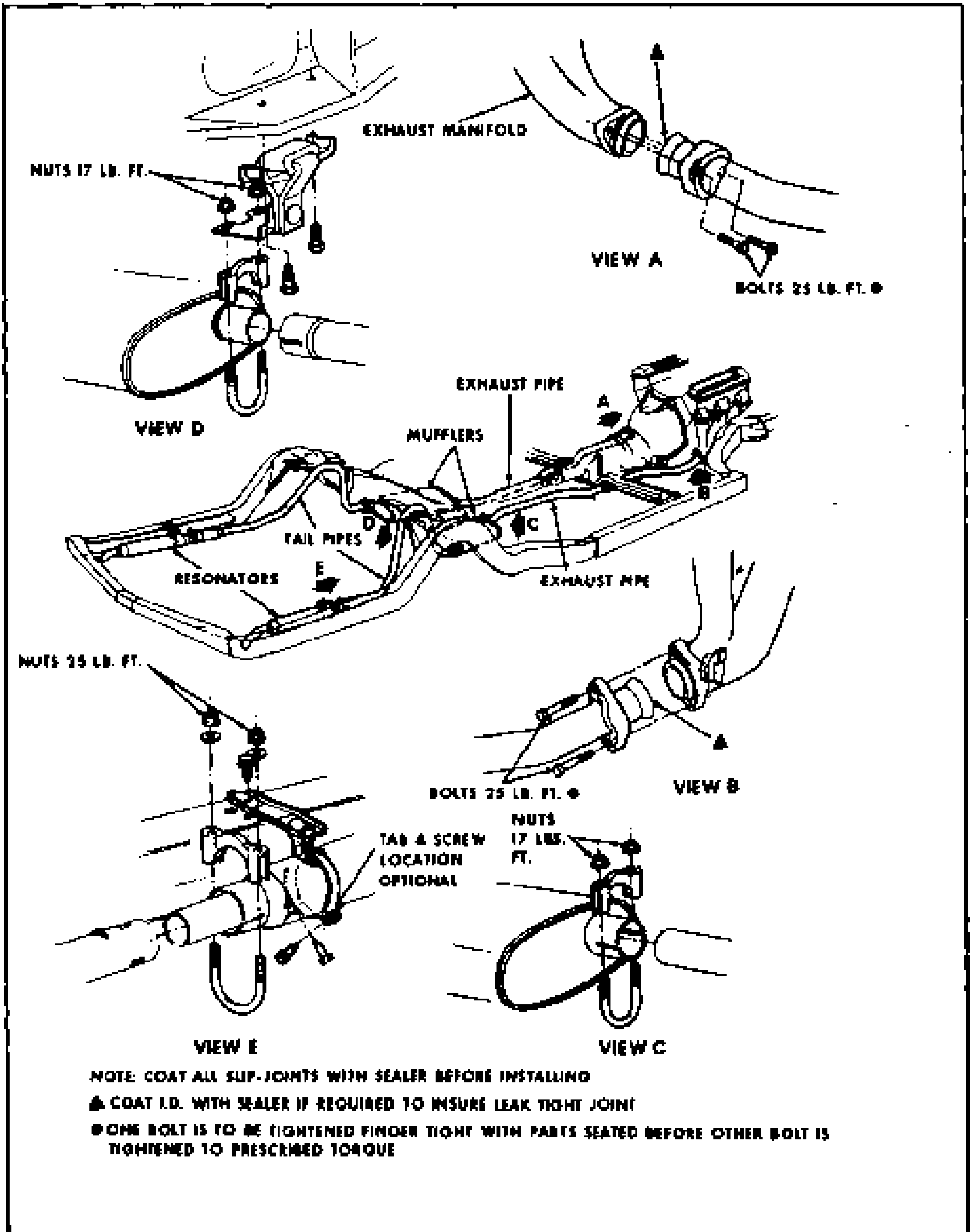


Fig. 8-21 Pontiac Dual Exhaust System 428 H.O. Engine

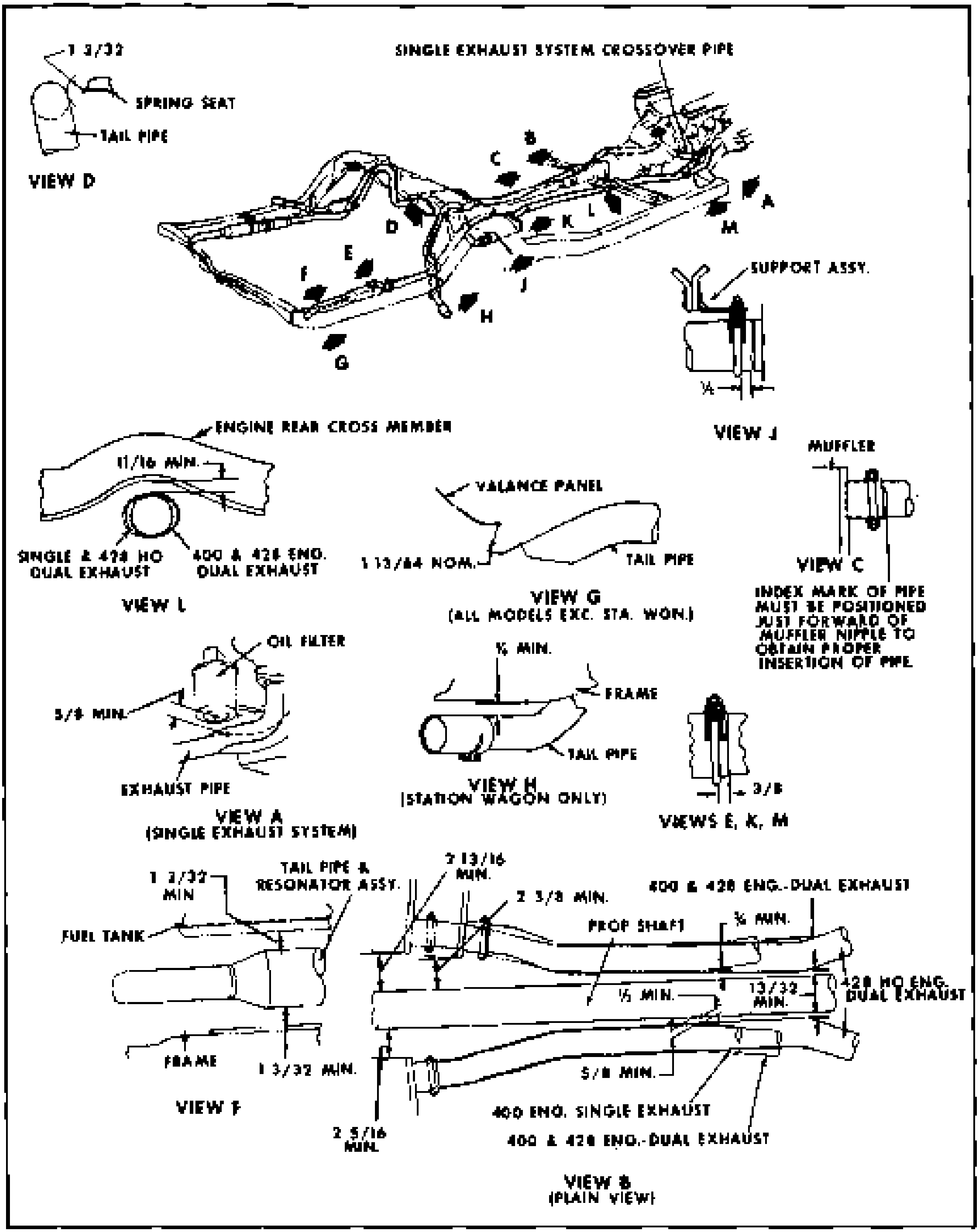


Fig. 8-22 Pontiac Exhaust System Clearance Requirements

GENERAL SPECIFICATIONS

FUEL TANK CAPACITY

	U.S. GALS.
Pontiac (except Station Wagon)	26½
Pontiac Station Wagon	24
Tempest (except Station Wagon)	21½
Tempest Station Wagon	20
Grand Prix	21½
Firebird	18½

STEERING

CONTENTS OF THIS SECTION

GENERAL INFORMATION

The steering system consists of a steering wheel, steering column, steering linkage and manual or power steering gear.

The new function locking energy absorbing steering column, in addition to steering the car, includes the ignition switch and lock cylinder assembly mounted on the column and the important function of locking the ignition system, steering and shifting mechanisms to inhibit theft of the car.

If it becomes necessary to tow a car with the column locked and the key is not available, a dolly should be placed under the rear wheels and the car towed with the front end raised. If a dolly is not available, tow the car by lifting the rear end, providing the front wheels are locked in essentially the straight ahead position (the use of a steering clamp should be continued for this type of towing). If neither of the above methods can be used, disconnect the shift linkage and shift the transmission into neutral, tow the car with the front end raised.

CAUTION: On automatic transmission cars with the shift lever located in a center console, the shift linkage, if it was disconnected, should be reconnected immediately after towing to eliminate the possibility of someone unknowingly starting the car in gear. This could occur because the neutral - start switch would not be reflecting actual transmission gear position. In the event the shift linkage is not reconnected, adequate warning should be posted on the car.

Manual steering with 24:1 gear ratio is basic equipment on all models except Firebird V-8 engine models with air conditioning. The gear ratio is 28:1 on Firebird V-8 engine models with air conditioning.

Power steering, available as an option on all models, has a constant ratio of 17.5:1 on Tempest, except GTO. A new lower constant ratio of 15:1 is used on the GTO. Variable ratio of 16:1 on center and 12.2:1 at full turn is used on all Pontiac, Grand Prix and Firebird models.

An oil pump is provided to supply the power steering system with pressurized oil. In order to provide proper

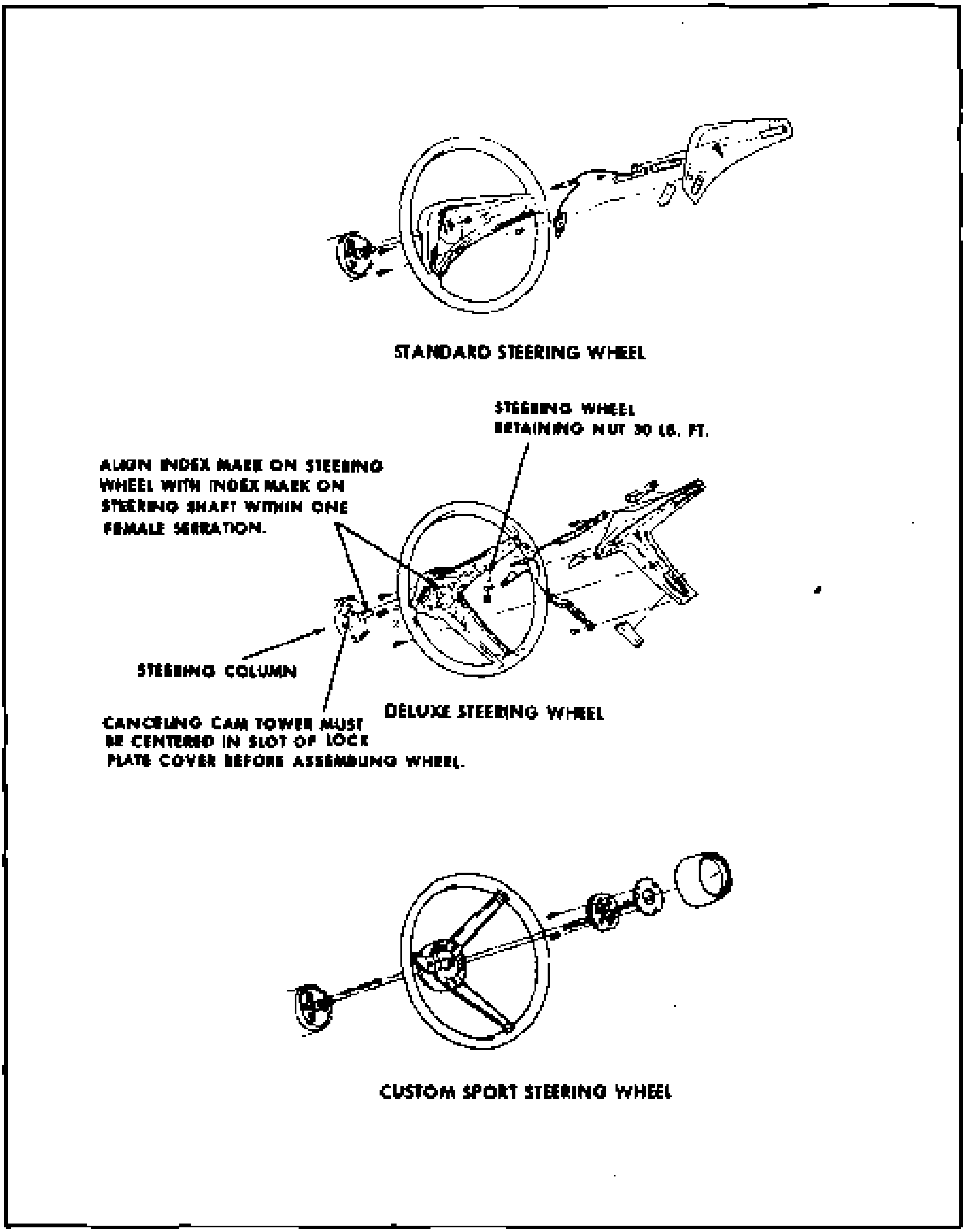


Fig. 9-1 Exploded View of Steering Wheel and Horn Button

power steering oil cooling, an oil cooler pipe with associated parts is used on some models except the constant ratio gears used on Tempest models.

MINOR SERVICE

STEERING WHEEL

REMOVE

1. Remove screws attaching cover to wheel or on custom sport wheel, remove bezel by lifting (Fig. 9-1).

2. Remove nut from shaft.

3. Remove steering wheel using puller J 3044-1

CAUTION: Do not hammer on end of steering shaft, as hammering could collapse steering shaft or otherwise loosen plastic injections which maintain column rigidity.

INSTALL

1. Install by reversing above steps, making sure steering wheel is in straight ahead position (Fig. 9-2). Tighten steering wheel nut to 30 lb. ft. torque and stake.

TURN SIGNAL SWITCH

REMOVE

1. Remove steering wheel (see STEERING WHEEL - REMOVE).

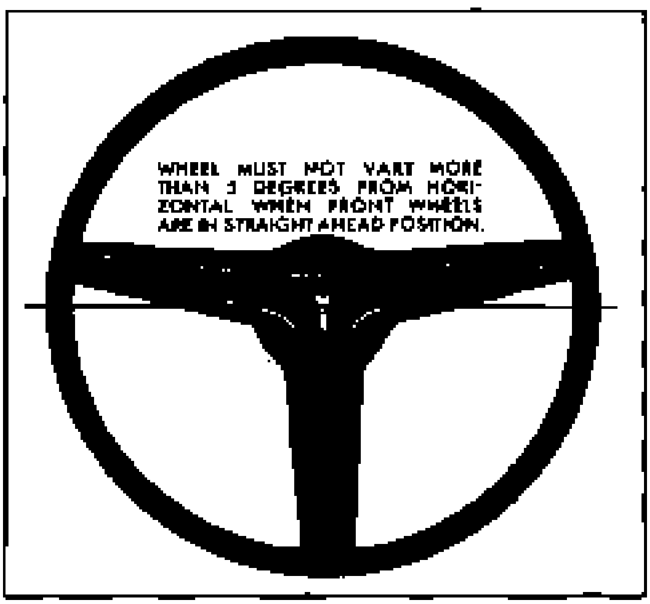


Fig. 9-2 Locating Steering Wheel Position

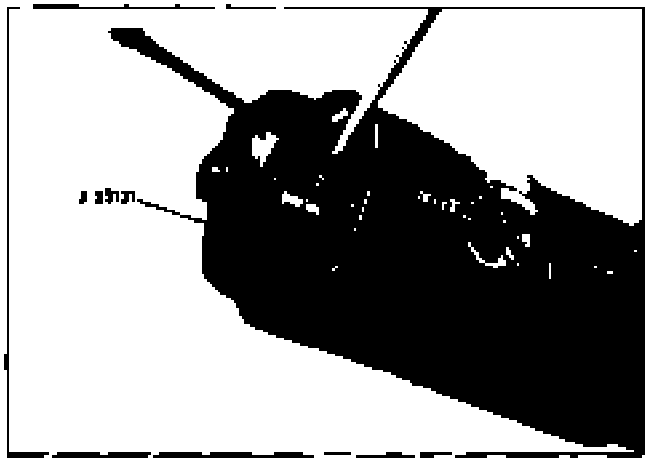


Fig. 9-3 Depressing Lock Plate

2. Remove the three cover screws and lift cover off the shaft.

NOTE: Screw retainers will be lost if screws are removed completely from cover

3. Depress lock plate downward as far as possible using J 23131. Pry the round wire snap ring out of the shaft groove (Fig. 9-3). Remove the snap ring and lock plate (Fig. 9-4). Discard snap ring.

CAUTION: With ring removed on non-tilt column shaft could slide out bottom of column causing damage t- shaft if column is removed from car.

NOTE: Use new snap ring when installing lock plate.

4. Slide upper bearing preload spring and turn signal cancelling cam off upper steering shaft

5. Slide thrust washer off upper steering shaft

6. Remove turn signal lever screw and lever.

7. Push hazard warning switch in and unscrew knob.

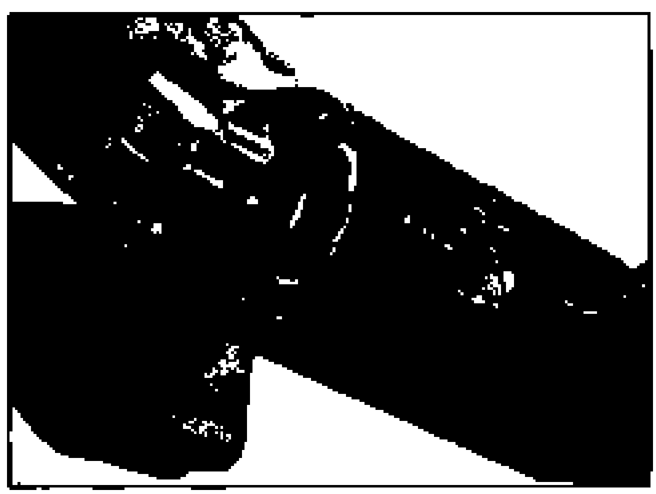


Fig. 9-4 Removing Snap Ring and Lock Plate

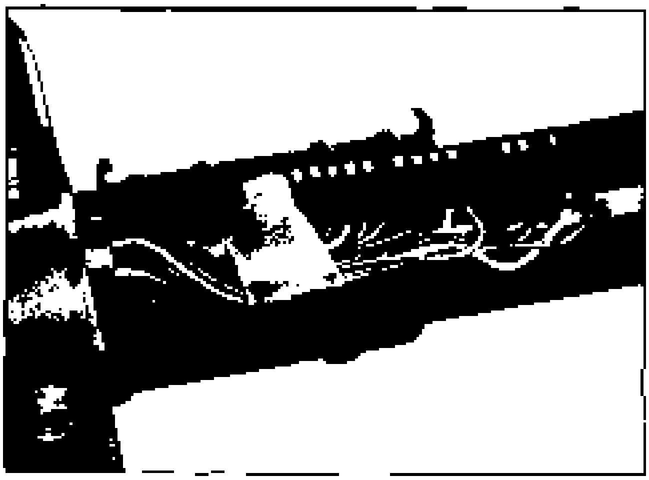


Fig. 9-5 Connector and Wires with Tape

8. Pull the turn signal wiring connector out of the bracket on the jacket and disconnect. Wrap a piece of tape around the upper part of the connector and wires to prevent snagging when removing switch (Fig. 9-5).

9. Remove three turn signal switch mounting screws.

10. Pull the switch straight up with wire protector and remove from housing (Fig. 9-6).

NOTE: On tilt column the column must be lowered from instrument panel to remove wire protector (Fig. 9-7) before pulling switch (see STEERING COLUMN REMOVE, steps 4 through 7). Never let column be unsupported when lowered from instrument panel.

INSTALL

1. Install turn signal switch by reversing above steps

NOTE: Be sure the hazard warning knob is pushed in to allow clearance for the cover and to avoid damage to switch.

CAUTION: On tilt column, play or slack should be left

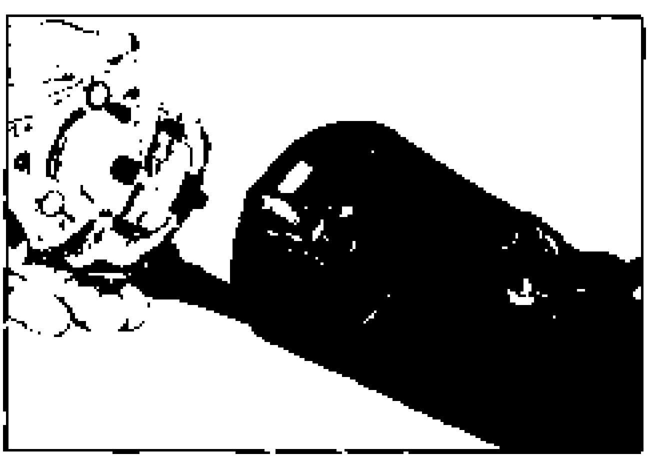


Fig. 9-6 Removing Turn Signal Switch

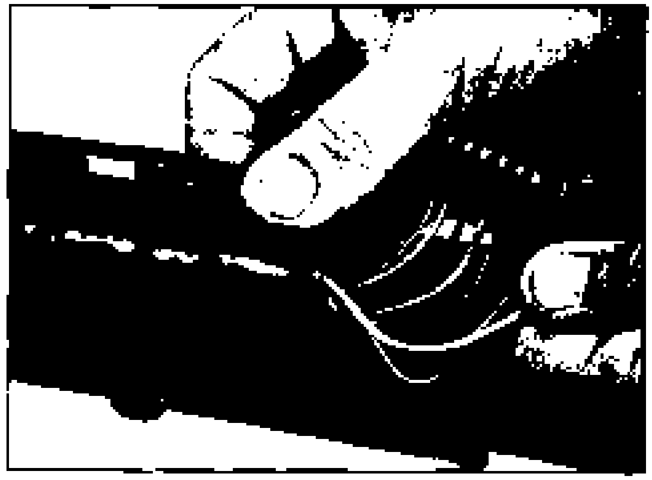


Fig. 9-7 Removing Wire Protector From Turn Signal Harness - Tilt Column

in signal switch wires when installed in wire protector so that the column head is free to move in full up position. Install column to instrument panel and check alignment (see STEERING COLUMN - INSTALL, steps 1 through 10).

2. Tighten three switch screws and three cover screws to 35 lb. in. torque.

3. Install steering wheel (see STEERING WHEEL - INSTALL)

LOCK CYLINDER

REMOVE

1. Remove steering wheel (see STEERING WHEEL - REMOVE).

2. Pull turn signal switch up far enough to allow access to lock cylinder spring latch slot (see TURN SIGNAL SWITCH - REMOVE, steps 2 through 9).

3. Remove lock cylinder in "RUN" position by inserting a thin tool (small screwdriver, 6" steel rule or knife blade) into the slot next to the switch mounting screw boss (right-hand slot) and depress spring latch at bottom of slot, which releases lock and remove lock by pulling out of housing (Fig. 9-8).

NOTE: If lock cylinder has never been removed before, the slot will be covered by thin casting "flash" which can easily be broken through when inserting thin tool.

INSTALL

1. Hold lock cylinder sleeve and rotate knob clockwise against stop when viewed from key end (Fig. 9-9).

2. Insert cylinder into housing bore with key on lock

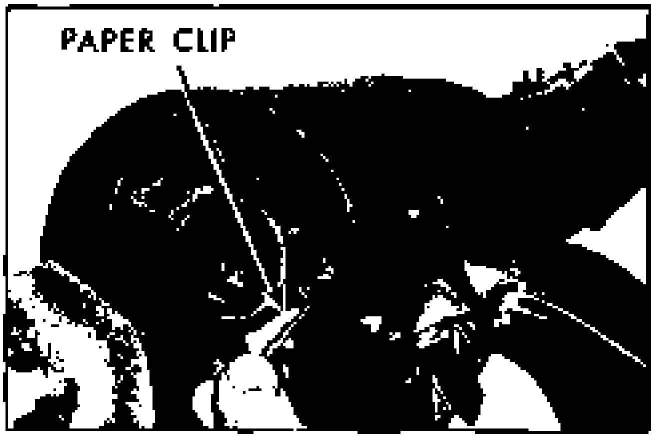


Fig. 9-10 Removing Buzzer Switch

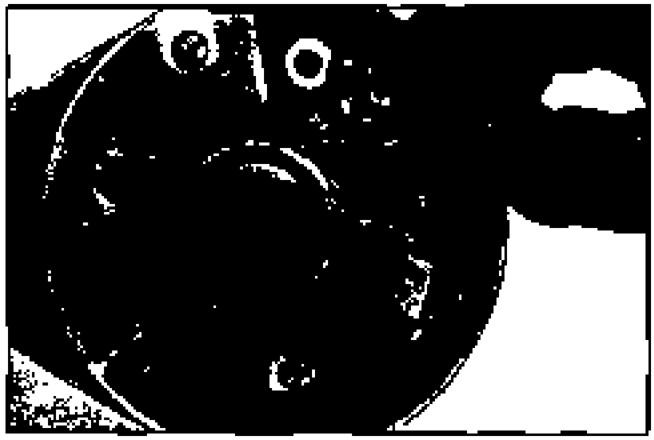


Fig. 9-11 Installing Buzzer Switch

NOTE: This may be done without the removal of the lock cylinder. If the lock cylinder is in the housing, it must be in the "RUN" position.

CAUTION: Be careful not to let flat spring fall down into housing and do not pull on switch contacts or plastic material of switch when removing.

INSTALL

1. Assemble buzzer switch to spring clip with formed end of clip around the lower end of switch and spring bowed away from switch.

NOTE: Spring should lay on the switch opposite the contacts.

2. Push switch and spring into hole with contacts toward the lock cylinder bore (Fig. 9-11).

3. Install turn signal switch (see TURN SIGNAL SWITCH -INSTALL).

4. Install steering wheel (see STEERING WHEEL - INSTALL).

STEERING COLUMN

REMOVE

NOTE: When the steering column is removed from the car, it is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic injections which maintain column rigidity. Leaning on the mast jacket could cause jacket to bend or deform. Such damages could impair the column's collapsible design. If it is necessary to remove the steering wheel, use standard wheel puller J 3044-1. Do not hammer on end of shaft, as hammering could loosen plastic injections which maintain column rigidity.

1. Remove both attaching nuts securing flexible coupling to steering shaft.

2. Disconnect transmission linkage from column shift levers.

3. Disconnect all electrical connectors from steering column.

4. Remove screws securing toe cover plate halves to dash panel and loosen cover clamping screws. On all models except Pontiac, remove the floor pan trim and insulator cover prior to removing the toe plate screws.

5. Remove instrument panel trim cover screws and remove cover.

6. Remove shift indicator wire and nut from shift bowl on Pontiac.

7. Remove two nuts securing mounting bracket to instrument panel and carefully withdraw column.

INSTALL

NOTE: Make sure this procedure is followed in exactly this order.

1. Install column into position and loosely attach mounting bracket to instrument panel with two mounting nuts.

2. Attach steering shaft flange to steering gear flexible coupling and torque attaching nuts to 20 lb. ft. (Fig. 9-12).

3. On Pontiac and Firebird, tighten two nuts securing mounting bracket to instrument panel. Torque nuts to 20 lb. ft.

CAUTION: Do not over-torque nuts because correct torque is necessary to ensure breakaway action of the bracket and capsules in event of a collision.

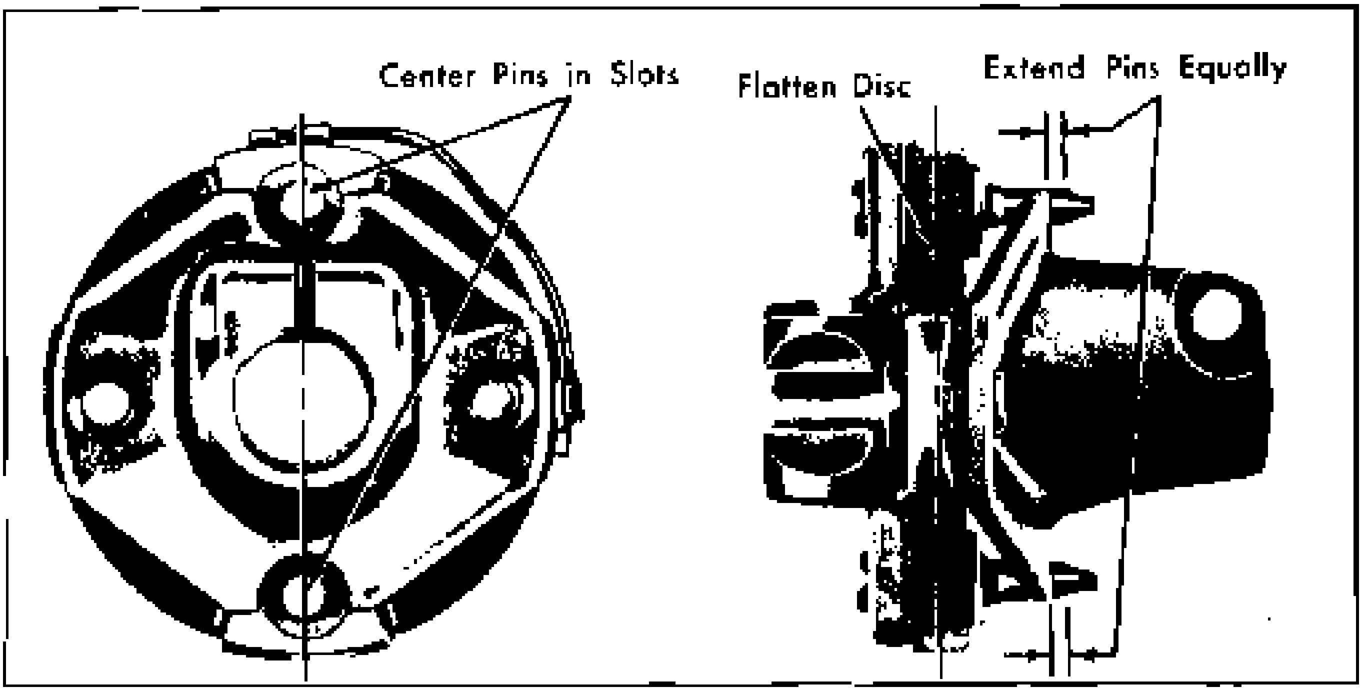


Fig. 9-12 Installing Steering Shaft To Flexible Coupling

4. a. Pontiac - Attach right (inboard) cover plate to dash panel with two cover plate screws while holding plate against dash panel and holding jacket clamp lightly against the jacket.

b. Tempest and Grand Prix - Position left (outboard) cover plate to dash panel and start screw through bottom hole in cover.

c. Firebird - Attach upper and lower cover plates to dash panel with cover plate screws. Install cover plate screws finger-tight.

CAUTION: Do not permit rolled section of the seal to reverse itself.

5. a. Pontiac - Hold left (outboard) cover plate tightly against dash panel and secure to right (inboard) cover plate with two clamp screws tightening to 40 lb. in torque.

CAUTION: Do not permit the rolled section of the seal to reverse itself.

b. Tempest and Grand Prix - Install second cover plate screw in upper slotted hole and tighten to 40 lb. in torque, thereby locating cover plates properly. Tighten previously installed bottom hole screw to 40 lb. in torque. Install third screw in left (outboard) cover plate and tighten to 40 lb. in. torque.

c. Firebird - Push upper and lower cover plates against dash to compress dash seal and tighten the two clamp screws to 40 lb. in. torque.

6. a. Pontiac - Loosen two right (inboard) cover plate screws from dash panel to allow steering column to take its normal position as determined by flexible coupling and instrument panel attachment.

b. Tempest and Grand Prix - Hold right (inboard) cover plate tightly against dash panel and secure to left (outboard) cover plate with two clamp screws and tighten to 40 lb. in. torque.

CAUTION: Do not permit rolled section of the seal to reverse itself.

c. Firebird - Tighten all cover plate screws to 40 lb. in torque.

7. a. Pontiac - Retighten two right (inboard) cover plate screws. Add remaining cover plate screws to cover plates tightening them to 40 lb. in. torque.

b. Tempest and Grand Prix - Attach right (inboard) cover plate to dash panel with two cover plate screws and tighten to 40 lb. in. torque.

8. On Tempest and Grand Prix, tighten two nuts attaching mounting bracket to instrument panel. Torque nuts to 20 lb. ft. torque.

CAUTION: Do not over-torque nuts because correct torque is necessary to insure breakaway action of the bracket and capsules in event of a collision.

9. Install shift indicator and nut to shift bowl on Pontiac.

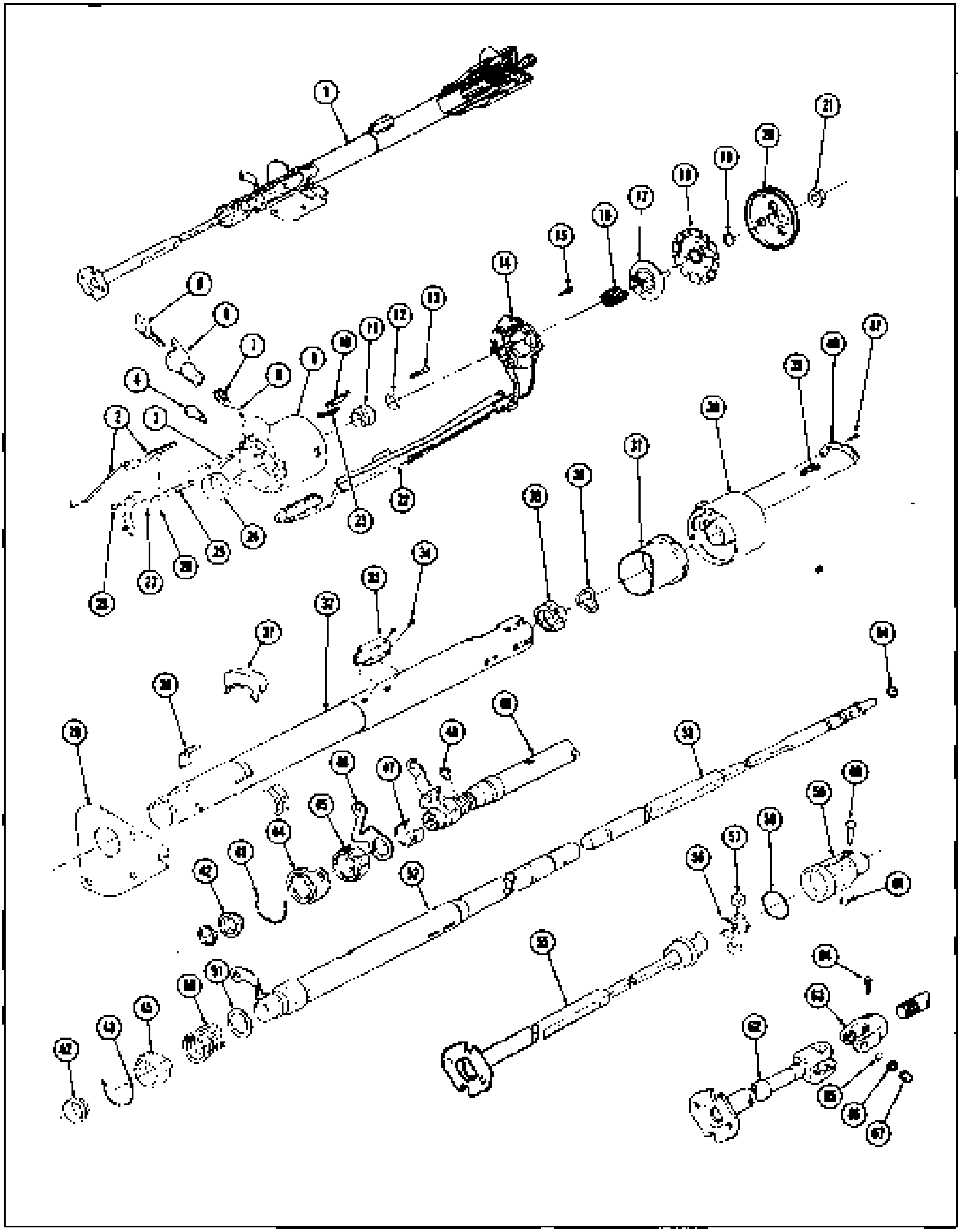


Fig. 9-13 Exploded View of Typical Regular Column - Automatic and Manual Transmission

1. Column Assy., Steering
2. Rod and Rack Assy., Steering Column Housing
3. Spring, Housing Rack Preload
4. Switch Assy., Hazard Flasher
5. Key, Ignition
6. Cylinder Assy., Ignition
7. Sector, Ignition Switch Actuator
8. Shaft, Ignition Switch Actuator Sector
9. Housing, Steering Column
10. Switch Assy., Ignition Buzzer
11. Bearing Assy., Steering Shaft Upper
12. Washer, Steering Shaft Upper Thrust
13. Screw, Upper Brg. Housing Support
14. Switch Assy., Directional Signal
15. Screw, Turn Signal Switch
16. Spring, Steering Shaft Upper Bearing
17. Cam Assy., Turn Signal Cancelling
18. Lock, Steering Shaft
19. Ring, Upper Steering Shaft Retaining
20. Cover and Screw Assy., Steering Column Lock Plate
21. Nut, Steering Shaft to Wheel
22. Protector, Turn Signal Control Wire
23. Clip, Ignition Buzzer Switch Retainer
24. Cup, Turn Signal Housing Thrust
25. Spring and Bolt Assy., Steering Column Housing
26. Washer, Housing Rack Spring Thrust
27. Gate, Turn Signal Housing Shift Lever
28. Screw, Turn Signal Housing Shift Lever Gate
29. Seal, Steering Column to Dash
30. Grommet, Neutral & Back-Up Lamp Retainer
31. Switch Assy., Trans. Neutralizer and Back-Up Lamp
32. Jacket Assy., Steering Column
33. Switch Assy., Ignition
34. Screw, Ignition Switch to Steering Column
35. Bearing, Steering Column Bowl Lower
36. Washer, Steering Column Bowl (Wave)
37. Shroud, Steering Column Bowl
38. Bowl, Gear Shift Lever
39. Spring, Upper Gearshift Lever
40. Plate, Gearshift Lever Bowl
41. Screw, Gearshift Lever Bowl Plate
42. Bearing, Steering Shaft Adapter—Lower
43. Clip, Steering Column Lower Brg. Adapter
44. Retainer, Steering Column Lower Brg. Adapter
45. Adapter, Steering Column Lower Brg.
46. Lever, Steering Column Lower Shift
47. Spacer, Steering Column Shift Lever
48. Screw and Washer to Shift Tube (¼—20 x ½)
49. Tube Assy., Gearshift
50. Spring, Steering Column Shift Tube Return
51. Washer, Steering Column Shift Tube Return Spring Thrust
52. Tube Assy., Gearshift
53. Shaft Assy., Steering
54. Ring, Upper Steering Shaft Retaining
55. Shaft Assy., Steering
56. Spring, Intermediate Steering Shaft Coupling
57. Bearing, Intermediate Steering Shaft Coupling
58. Ring, Intermediate Shaft Seal Retainer
59. Clamp, Plug and Coupling, Intermediate Shaft
60. Bolt, Coupling to Upper Shaft
61. Nut, Coupling to Upper Shaft
62. Shaft Assy., Steering—Intermediate
63. Yoke, Intermediate Shaft (part of Shaft Assy.)
64. Bolt, Intermediate Shaft
65. Seal, Intermediate Steering Shaft "U/J" Oil
66. Ring, Intermediate Steering Shaft "U/J" Retaining
67. Bearing, Intermediate Steering Shaft "U/J"

Fig. 9-13 Exploded View Of Typical Regular Column - Automatic And Manual Transmission

10. Reconnect all electrical connections and install any trim which has been removed.

11. Connect all transmission linkage. If linkage requires adjusting, see Section 7 for the procedure.

12. Adjust back-up light or neutral - start switch (see Section 12 for adjustment procedure).

MAJOR SERVICE

The following procedures cover the complete disassembly and assembly of steering columns after their removal from car and should only be used to the extent necessary for replacement of steering shaft, lower bearing, shift bowl bearing, shift tube, column jacket or other internal parts (Figs. 9-13 and 9-14).

NOTE: The removal and disassembly of upper bearing housing can be performed with steering column installed in car.

STEERING COLUMN (NON-TILTING)

DISASSEMBLE UPPER END

1. Remove four bolts attaching column mounting bracket. Set bracket aside to protect breakaway capsules (Fig. 9-15).

2. Mount column in vise by clamping two welded tapping nuts in vise (Fig. 9-16). On Tempest and Grand Prix columns, disconnect lower shaft with pot joint or universal joint from steering column shaft by removing clamping bolt (Fig. 9-13) if pot joint or universal joint is to be serviced.

CAUTION: Never clamp on the jacket.

Steps 3 thorugh 15 can be performed with column installed in car and lowered from instrument panel. Never let column be unsupported when lowered from instrument panel. Check alignment of column after attaching to instrument panel.

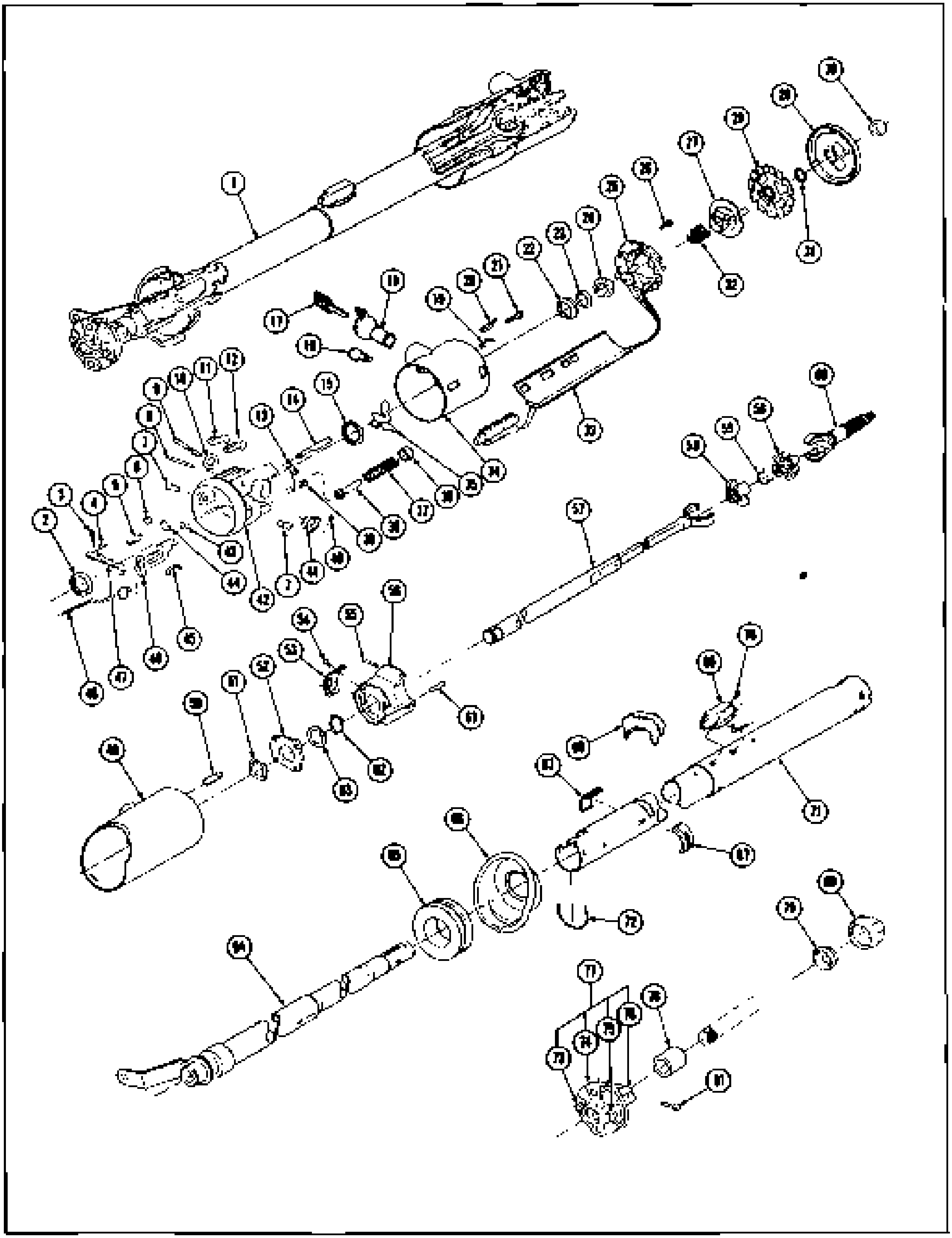


Fig. 9-14 Exploded View of Typical Tilt Column

1. Column Assy., Steering
2. Bearing Assy., Steering Shaft Upper ($1/32$" I.D.)
3. Pin, Tilt Shoe Release Lever ($1/16$" x $3/4$")
4. Spring, Tilt Release Lever
5. Spring, Strg. Wheel Tilt Shoe
6. Bumper, Bearing Housing
7. Pin, Bearing Housing Pivot
8. Pin, Bearing Housing Dowel ($3/16$" x $1\frac{11}{16}$")
9. Shaft, Steering Column Housing Drive
10. Washer, Steering Column Housing Drive Shear
11. Shoe, Steering Wheel Lock (3-Position)
12. Shoe, Steering Wheel Lock (4-Position)
13. Spring, Steering Column Housing Lock Bolt
14. Bolt, Steering Column Housing Lock
15. Bearing Assy., Steering Shaft Upper
16. Switch Assy., Hazard Flasher
17. Key, Ignition
18. Cylinder Assy., Ignition
19. Clip, Ignition Buzzer Switch Retainer
20. Switch Assy., Ignition Buzzer
21. Screw, Upper Brg. Housing Support
22. Race, Steering Shaft Upper Bearing —Inner
23. Seat, Steering Shaft Upper Bearing Inner Race
24. Nut, Steering Shaft Upper Bearing Lock
25. Switch Assy., Directional Signal
26. Screw, Directional Signal Switch
27. Cam Assy., Turn Signal Cancelling
28. Lock, Steering Shaft
29. Cover and Screw Assy., Steering Column Lock Plate
30. Nut, Steering Shaft to Wheel
31. Ring, Upper Steering Shaft Retaining
32. Spring, Turn Signal Cancelling Cam
33. Protector, Turn Signal Control Wire
34. Cover, Steering Housing
35. Shield, Tilt Lever Opening
36. Retainer, Bearing Housing Spring
37. Spring, Steering Column Housing Wheel Tilt
38. Guide, Bearing Housing Spring
39. Screw, Steering Column Housing Lock Bolt
40. Ring, Steering Column Housing Drive Shaft Ret.
41. Sector, Ignition Switch Actuator
42. Housing Assy., Steering Column (w/Bearings)
43. Bumper, Bearing Housing
44. Bumper, Bearing Housing
45. Spring, Steering Column Housing Rack Preload
46. Rack, Steering Column Housing Switch Actuator
47. Lever, Steering Shaft Shoe Release
48. Actuator Assy., Steering Column Housing Switch
49. Bow (Part of Cover)
50. Spring, Gearshift Lever Bowl
51. Washer, Steering Column Bowl-Wave
52. Plate, Steering Column Lock
53. Gate, Steering Shaft Housing Support
54. Screw, Steering Shaft Housing Support Gate or Detent Plate
55. Pin, Steering Column Housing Dowel
56. Support, Steering Column Housing
57. Shaft Assy., Steering—Lower
58. Sphere, Steering Shaft Centering
59. Spring, Steering Shaft Joint Preload
60. Shaft Assy., Steering—Upper
61. Screw, Upper Bearing Housing Support
62. Ring, Steering Column Shift Tube Retainer
63. Washer, Steering Column Bowl Thrust
64. Tube Assy., Steering Column Reaction and Shift
65. Seal, Grommet to Toe Pan
66. Grommet, Steering Column Toe Plate
67. Grommet, Neutral and Backup Lamp Switch Retaining
68. Switch Assy., Trans. Neutralizer and Backup Lamp
69. Switch Assy., Ignition
70. Screw, Ignition Switch to Steering Column
71. Jacket Assy., Steering Column
72. Clip, Steering Column Lower Brg. Adapter
73. Bolt, Flange to Coupling
74. Flange Assy., Steering Gear Lower—w/Coupling
75. Bolt, Flange to Coupling
76. Flange, Steering Shaft—Upper
77. Coupling Assy. (Service by Components)
78. Spacer, Steering Shaft
79. Bearing Assy., Steering Shaft Adaptor—Lower
80. Adapter, Steering Shaft Lower Brg.
81. Bolt, Steering Shaft Flange to Shaft Coupling

Fig. 9-14 Exploded View Of Typical Tilt Column

3. Remove shift indicator assembly if it needs to be serviced by removing retaining spring and lifting assembly off upper bearing housing on all models except Pontiac.

4. Remove steering wheel, if still attached (see STEERING WHEEL - REMOVE).

5. Remove turn signal switch (see TURN SIGNAL SWITCH - REMOVE, steps 2 through 10).

NOTE: It is recommended that the steering shaft be removed at this time to eliminate the possibility of it sliding out the lower end of the column and being damaged. Steps 6 through 16 are not required if steering shaft, lower bearing, and shift tube (step 9 is required on cars equipped with column shift manual transmission to remove shift tube) are the only parts to be replaced. (Remove back-up light and neutral-start switch on all cars before removing shift tube.)

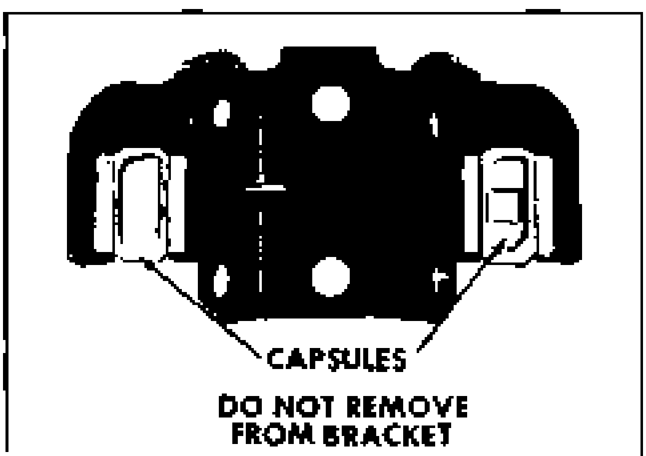


Fig. 9-15 Mounting Bracket Assembly

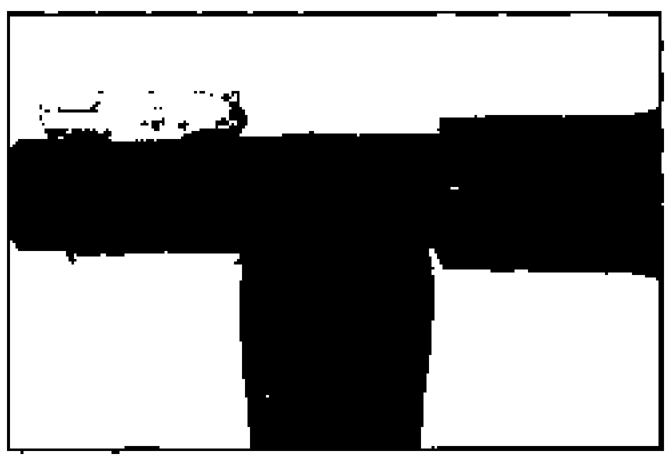


Fig. 9-16 Mounting Column In Vise By Welded Tapping Nuts

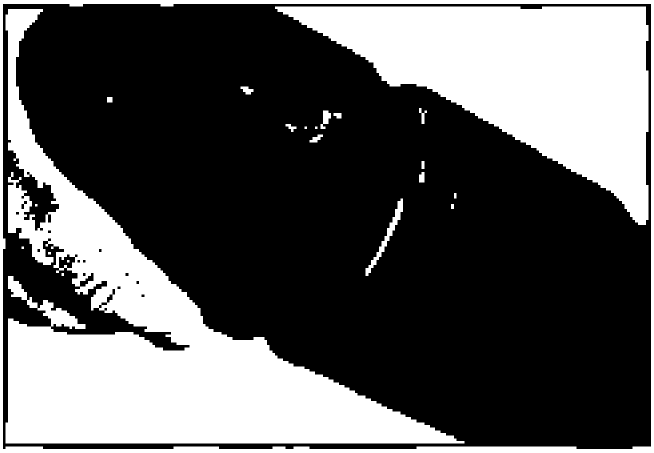


Fig. 9-17 Removing Upper Bearing Housing

6. Remove lock cylinder if it needs to be serviced (see LOCK CYLINDER - REMOVE, step 3).

NOTE: Lock cylinder does not have to be removed to remove upper bearing housing.

7. Remove buzzer switch if it needs to be serviced (see BUZZER SWITCH - REMOVE, step 3).

NOTE: Buzzer switch does not have to be removed to remove upper bearing housing.

8. To remove any further parts from the upper end, the ignition switch should be removed. Remove the two attaching screws and the switch.

9. Drive out upper shift lever pivot pin and remove upper shift lever.

10. Remove the four screws attaching the upper bearing housing to the jacket. Remove the upper housing assembly (Fig. 9-17).

11. Remove thrust cup if still attached to housing (Fig. 9-18)

Fig. 9-18 Removing or Installing Thrust Cup

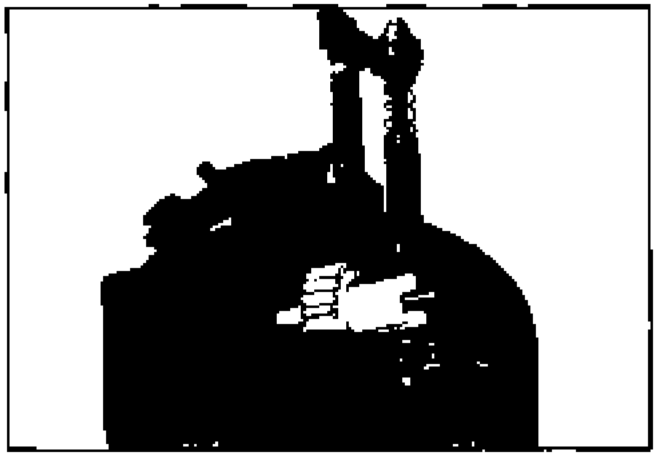


Fig. 9-19 Removing or Installing Rack and Lock Bolt

12. Remove the rack and lock bolt (Fig. 9-19).

13. Remove the rack load spring (Fig. 9-20).

14. Remove the shaft gate (Fig. 9-21).

15. Remove the sector through the lock cylinder hole by pushing firmly on the block tooth of the sector with a blunt punch (Fig. 9-22).

16. Remove shift bowl and shroud from the jacket.

DISASSEMBLE LOWER END

Steering wheel, cover, lock plate snap ring, spring cancelling cam and flat washer must be removed prior to disassembly of the lower end. Follow instructions in steps 4 and 5 above.

1. Pull steering shaft assembly from bottom of column.

2. Remove the two screws attaching the back-up light or neutral-start switch and remove switch (Fig. 9-23).

3. Remove bearing adapter retaining clip (Fig. 9-24).

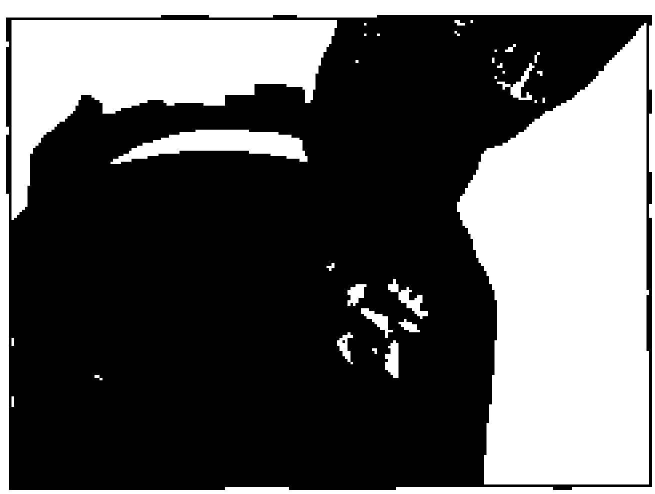


Fig. 9-20 Removing or Installing Rack Load Spring

Fig. 9-21 Removing or Installing Shift Gate

Perform step 4 on all cars not equipped with column shift manual transmission.

4. Remove bearing adapter, bearing and shift tube spring (Fig. 9-25).

NOTE: Bearing may be removed from adapter by a light press-out operation on the outer race.

Perform steps 5 and 6 on all cars equipped with column shift manual transmission

5. Remove bearing adapter, bearing and FIRST/REVERSE lever (Fig. 9-26).

NOTE: Bearing may be removed from adapter by a light press-out operation on the outer race.

6. Remove three screws from shift tube support at lower end (Fig. 9-27).

7. Remove both .005" maximum shims.

Fig. 9-22 Removing Sector

Fig. 9-23 Removing Back-Up Light or Neutral Start Switch

8. Remove wave washer and lower shift bowl bearing from top of jacket (Fig. 9-28).

ASSEMBLE LOWER END

Apply a thin coat of lithium soap grease to all friction surfaces.

1. Press the lower bearing assembly into the adapter assembly if removed.

2. Insert the shift tube assembly into the lower end of the jacket and rotate until the upper shift tube key slides into the bowl keyway.

NOTE: The shift bowl should be in place before the shift tube is assembled.

Perform steps 3 through 9 on all cars equipped with column shift manual transmission.

Fig. 9-24 Removing Bearing Adapter Retaining Clip

Fig. 9-25 Removing Bearing Adapter and Shift Tube Spring

3. Loosely attach three screws in jacket and shift tube support.

4. Assemble the FIRST/REVERSE lever and adapter assembly into the bottom of the jacket. Holding the adapter in place, insert the retaining clip in the jacket slots.

CAUTION: Friction surfaces of lower levers and mating bearing surfaces must be greased.

5. Place a .005" maximum shim on each side of steering shaft between either lever and the spacer (Fig. 9-29). By using two shims, the possibility of cocking the lever is eliminated.

6. Turn shift tube support down until levers are bottomed out.

7. Tighten the three bolts to 10 lb. ft. torque.

8. Remove both .005" maximum shims.

Fig. 9-26 Removing Bearing Adapter, Bearing and FIRST/REVERSE Lever - Manual Transmission

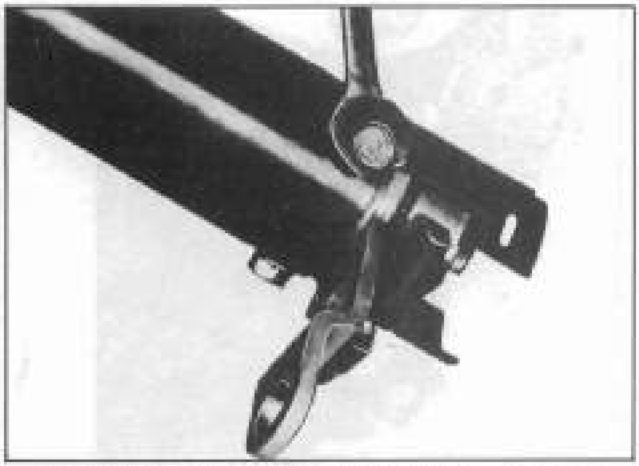


Fig. 9-27 Removing Lower Shift Tube Support Screws Manual Transmission

Perform step 9 on all models except cars equipped with column shift manual transmission.

9. Assemble the spring and adapter assembly into the bottom of the jacket. Holding the adapter in place, insert the retaining clip in the jacket slots.

10. Install the back-up light or neutral-start switch loosely to the jacket assembly. This will be tightened to the jacket after installing column in car and adjustment of switch.

NOTE: Use only the proper screws.

CAUTION: Screws must not be longer than 1/4" or damage to the shift tube will occur.

11. Slide steering shaft assembly into column.

NOTE: The upper housing should be in place before the shaft is assembled.

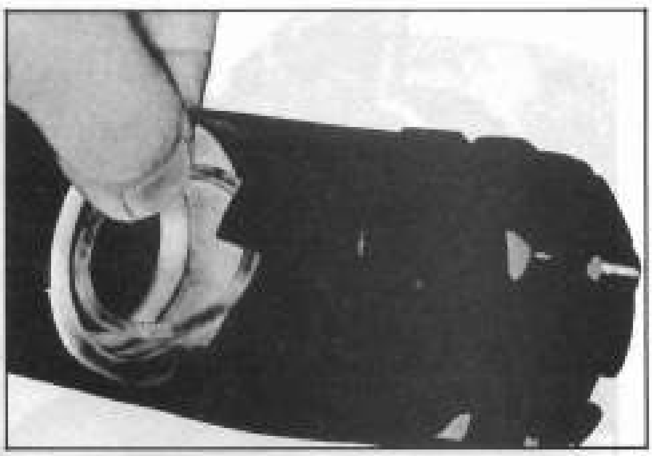


Fig. 9-28 Removing or Installing Wave Washer and Lower Shift Bowl Bearing

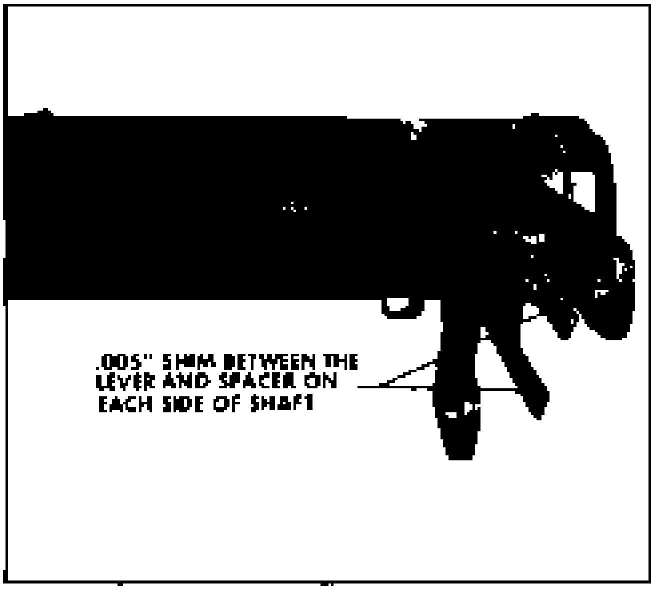


Fig. 9-29 Adjusting Lower Shift Lever Clearance

ASSEMBLE UPPER END

Apply a thin coat of lithium soap grease to all friction surfaces.

1. Install the sector in the lock cylinder hole over the sector shaft with the tang end to the outside of the hole. Press the sector over the pin with a blunt tool (Fig. 9-30).

2. Install the shift gate to the housing (Fig. 9-21).

3. Insert the rack load spring in the housing from the bottom side. The long section should be toward the sector and hook on the edge of the housing (Fig. 9-20).

4. Assemble the bolt to the cross-over arm of the rack (Fig. 9-31).

5. Insert the rack and lock bolt into the housing from

Fig. 9-30 Installing Sector

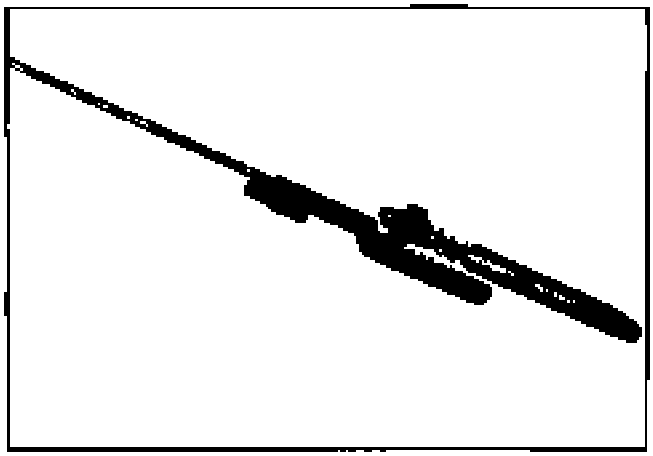


Fig. 9-31 Bolt and Rack Assembled

the bottom with the teeth up (toward sector) and toward the centerline of the column. Block tooth on rack to engage block tooth on sector (Fig. 9-19).

6. Install the thrust cup on the bottom hub of the housing (Fig. 9-18).

7. Install lower bowl bearing in jacket and place wave washer in bowl bearing (Fig. 9-28).

8. Install bowl and rotate it to be sure it is seated in bearing.

9. Position shift indicator assembly, if removed, to upper bearing housing and install retaining spring on all models except Pontiac.

10. With the bowl in place, install the upper bearing housing assembly on the jacket. The bowl should be in the "PARK" position and the rack pulled downward. Be sure the housing is seated on the jacket and tighten the four screws to 60 lb. in torque.

11. Install buzzer switch if removed (see BUZZER SWITCH - INSTALL, steps 1 and 2).

12. Install lock cylinder if removed (see LOCK CYLINDER - INSTALL, steps 1 through 5).

13. Install turn signal switch (see TURN SIGNAL SWITCH -INSTALL).

14. Install steering wheel (see STEERING WHEEL - INSTALL).

15. Reinstall column bracket with the four bolts previously removed. Do not use a different length. Torque bolts to 15 lb. ft. torque.

NOTE: On Tempest and Grand Prix, install lower steering shaft with pot joint or universal joint to steering column shaft if removed. Tighten clamping nut on Tempest or clamping bolt on Grand Prix to 30 lb. ft. torque (Fig. 9-13).

16. Install ignition switch by inserting the actuator rod into the slider and assemble to the column with two screws. Tighten attaching screws to 35 lb. in. torque.

CAUTION: Prevent switch from moving out of detent. Use only the correct screws.

NOTE: Before installing switch, place the lock cylinder in "OFF-LOCK" or detent position and position the ignition switch slider in "OFF-LOCK" (see Section 12 for ignition switch adjustment).

17. Install column in car (see STEERING COLUMN - INSTALL).

WARNING: Make certain that column is never unsupported when either the toe plate, instrument panel mounting, or gear mounting is connected.

18. Adjust back-up light or neutral-start switch (see Section 12 for adjustment procedure).

TILT STEERING COLUMN

DISASSEMBLE COLUMN

1. Remove four bolts attaching column mounting bracket. Set bracket aside to protect breakaway capsules (Fig. 9-15).

2. Mount column in vise by clamping two welded tapping nuts in vise (Fig. 9-16).

CAUTION: Never clamp on the jacket.

3. Remove ignition switch by removing two attaching screws.

4. Remove two screws attaching back-up light or neutral-start switch and remove switch (Fig. 9-23).

5. Remove shift indicator assembly, if it needs to be serviced, by removing retaining spring and lifting assembly off upper bearing housing on all models except Pontiac.

6. Remove steering wheel, if still attached (see STEERING WHEEL - REMOVE).

7. Remove turn signal switch (see TURN SIGNAL SWITCH -REMOVE, steps 2 through 10).

8. Remove lock cylinder (see LOCK CYLINDER - REMOVE, step 3).

9. Remove buzzer switch if it needs to be serviced (see BUZZER SWITCH - REMOVE, step 3).

NOTE: Buzzer switch does not have to be removed to remove upper bearing housing.

10. Remove tilt release lever.

Fig. 9-32 Removing or Installing Tilt Spring Retainer

11. Remove three housing cover screws and remove housing cover.

NOTE: Use 5/32" Allen wrench to remove Torx drive type screws.

12. Install tilt release lever and place column in full "UP" position. Remove tilt spring retainer using screwdriver blade that just fits into slot opening. Insert screwdriver in slit, press in approximately 3/16", turn approximately 1/8 turn counterclockwise until ears align with grooves in housing and remove spring and guide (Fig. 9-32).

WARNING: Care should be taken when releasing tilt spring due to high compression rate of spring.

13. Remove upper steering shaft bearing lock nut. Use J 23193 socket. Push upper steering shaft in sufficiently to remove steering shaft inner race seal and inner race.

14. Remove two pivot pins with tool J 21854-1 (Fig. 9-33).

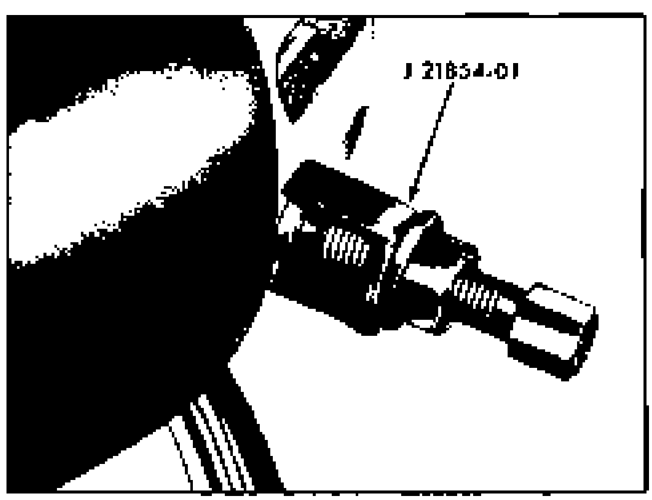


Fig. 9-33 Removing Pivot Pin

15. Install tilt release lever and disengage lock shoes. Remove bearing housing assembly by pulling upward to extend rack full down and moving housing assembly to the left to disengage rack from actuator.

16. Remove actuator rod assembly.

17. Remove lower steering shaft flange on Pontiac and Firebird, pot joint or universal joint on Tempest and Grand Prix.

18. Remove retaining clip, spacer, spring and bearing adapter assembly at lower end of the mast jacket

19. Remove steering shaft assembly from upper end

20. Disassemble steering shaft assembly by removing center spheres and anti-lash spring (Fig 9-13).

21. Remove four screws securing the support assembly to the lock plate and mast jacket and take off support assembly.

NOTE: Use 1/4"-6 point deep socket to remove Torx drive type screws.

22. Remove shift tube retaining ring with screwdriver and remove thrust washer.

NOTE: Care should be taken not to jam lower shift lever into "T" slot on lower end of mast jacket while forcing out shift tube.

CAUTION: Do not hammer or pull on lower or upper shift tube because plastic joint may be sheared.

23. Remove shift tube from bowl using tool J 23072, Fig. 9-34. Pilot sleeve in upper end of shift tube and force tube out of bowl.

24. Remove shift tube assembly from mast jacket lower end.

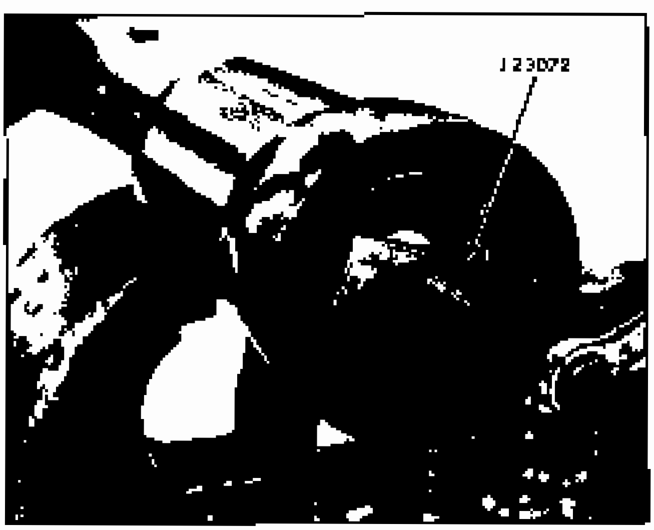


Fig. 9-34 Installation of Shift Tube Remover J 23072

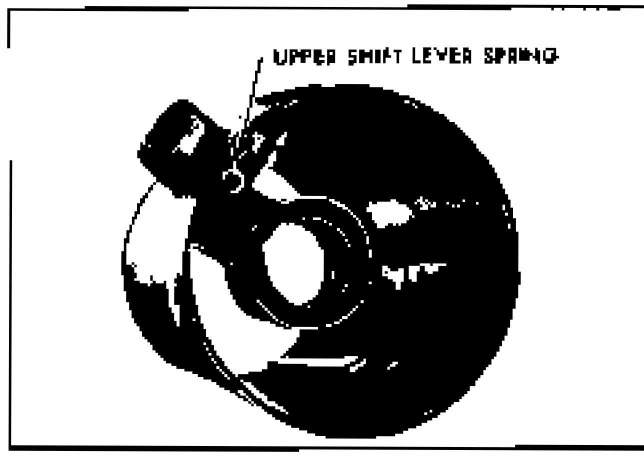


Fig. 9-35 Upper Shift Lever Spring

25. Remove lock plate by sliding out of jacket notches and tipping down toward bowl hub and 12 o'clock position and under jacket opening. Remove wave washer.

26. Remove shift bowl from mast jacket.

27. Remove upper shift lever spring from shift bowl by winding spring up with pliers and pulling out (Fig. 9-35).

DISASSEMBLE BEARING HOUSING

NOTE: Housing can be removed with column installed in car and lowered from instrument panel. Check alignment of column after attaching to instrument panel. See steps 5 through 15 outlined above.

1. Remove tilt lever opening shield from housing (Fig. 9-36).

2. Remove lock bolt spring by removing spring

Fig. 9-36 Removing or Installing Tilt Lever Opening Shield

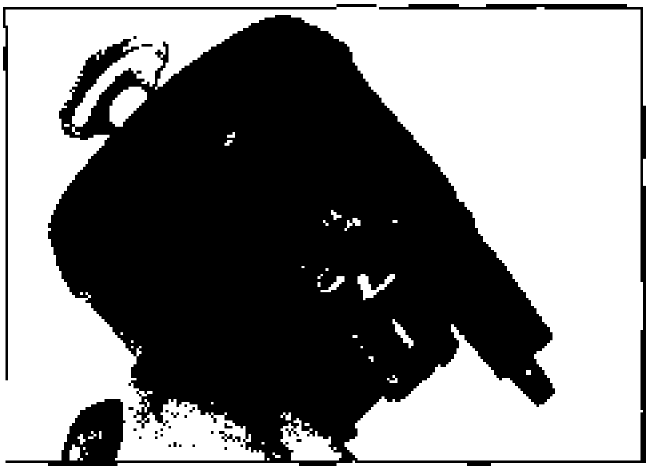


Fig. 9-37 Removing or Installing Lock Bolt Spring

retaining screw and moving spring clockwise to remove from bolt (Fig. 9-37).

3. Remove snap ring from sector drive shaft. With small punch, lightly tap drive shaft from sector. Remove drive shaft, washer, sector and bolt (Fig. 9-38).

4. Remove rack and rack spring.

5. Remove lock shoe release lever pin by driving out with J 22635. Remove lever and release lever spring (Fig 9-39).

NOTE: To relieve load on release lever, hold shoes inward and wedge screwdriver between top of shoes (over slots) and bearing housing.

6. Remove lock shoes and lock shoe springs by driving lock shoe pin out with J 22635.

7. Remove bearings from bearing housing only if they are to be replaced. Remove separator and balls from bearings. Place housing on work surface.

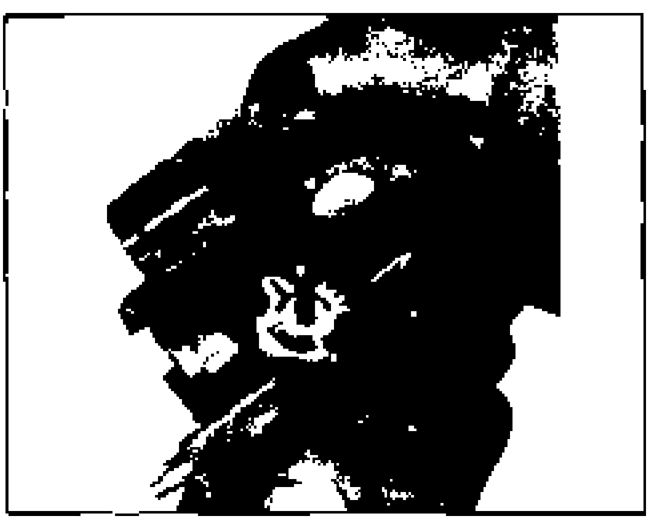


Fig. 9-38 Removing Sector Drive Shaft

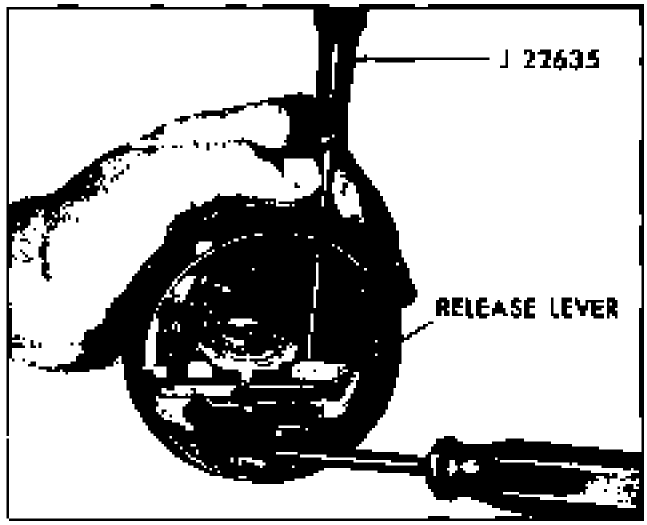


Fig. 9-39 Removing Tilt Release Lever Pin

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.

ASSEMBLE BEARING HOUSING

Apply thin coat of lithium grease to all friction parts.

1. Install bearings in bearing housing, if removed.

2. Install lock shoe springs, lock shoes and shoe pin in bearing housing. Use J 22635 or .180 diameter rod (approx.) to line up shoes for pin installation.

NOTE: With tilt lever opening on the left side, shoes facing up, the four slot shoe is on the left.

NOTE: Install shoe pin flush with housing face on release lever pin side.

3. Install release lever spring, release lever and pin in bearing housing.

NOTE: Again, relieve load on release lever as in step 5 of disassembly procedure (Fig. 9-39).

4. Install washer and sector drive shaft in housing. Lightly tap sector onto the shaft far enough to install snap ring.

5. Install lock bolt and engage with sector cam surface (Fig. 9-40).

6. Install rack and spring. Block tooth on rack to engage block tooth on sector (Fig. 9-40).

7. Install lock bolt spring and spring retaining screw. Tighten to 35 lb. in. torque (Fig. 9-37).

ASSEMBLE COLUMN

1. Install upper shift lever spring in shift bowl by winding up with pliers and pushing in.

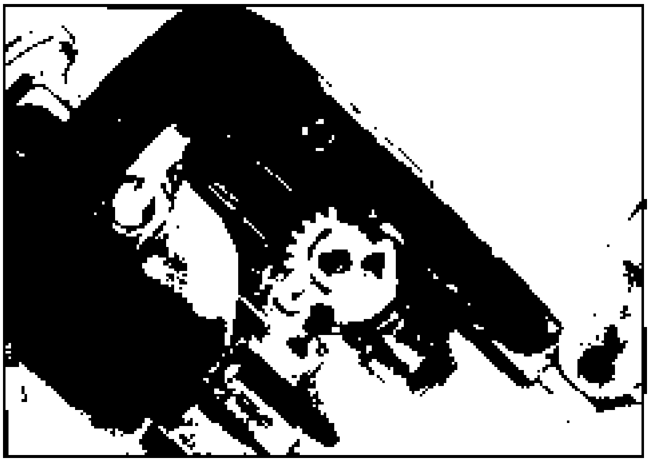


Fig. 9-40 Installing Lock Bolt to Sector

2. Slide shift bowl into mast jacket.

3. Install wave washer and lock plate in place. Work lock plate into notches in jacket by tipping lock plate toward bowl hub and 12 o'clock position and under jacket opening. Slide lock plate into notches in jacket.

4. Carefully install shift tube in lower end of mast jacket. Align keyway in tube with key in bowl and use tool J 23073 to pull shift tube into bowl (Fig. 9-41).

CAUTION: Do not push or tap on end of shift tube.

5. Install thrust washer and retaining ring by pulling bowl up to compress wave washer.

6. Install support by aligning "V" in support with "V" notch in jacket. Insert screws through support and into lock plate. Tighten screws to 60 lb. in. torque.

7. Align lower bearing adapter notches in jacket and push in lower end of mast jacket. Shift tube should pilot in adapter while this is done. Install retaining clip.

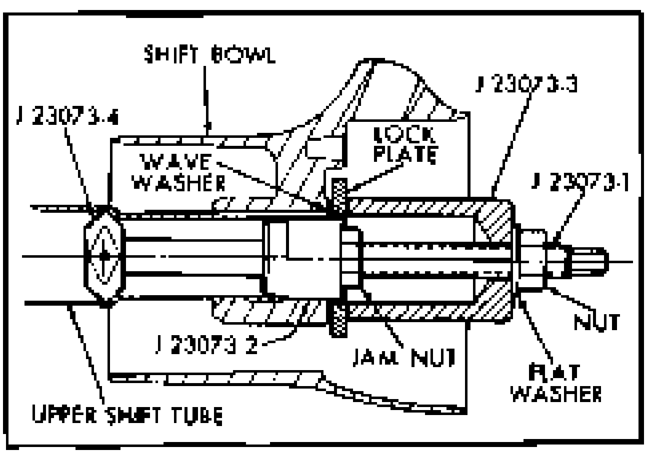


Fig. 9-41 Installation of Shift Tube Installer J 23073

8. Install the back-up light or neutral-start switch loosely to the jacket assembly. This will be tightened to the jacket after installing column in car and adjustment of switch.

NOTE: Use only the proper screws.

CAUTION: Screws must not be longer than 1/4" or damage to the shift tube will occur.

9. Install centering spheres and anti-lash spring in upper steering shaft. Install lower steering shaft from same side of spheres that spring ends protrude.

10. Install steering shaft assembly in shift tube from upper end. Carefully guide shaft through shift tube and bearing.

11. Install ignition switch actuator rod through bowl from bottom and insert in slot in support. Extend rack downward from bearing housing.

12. Install external tilt release lever and, holding lock shoes in disengaged position, assemble upper bearing housing over steering shaft, engage rack over end of actuator rod and line up the pivot pin holes (Fig. 9-42).

13. Install pivot pins.

14. Place housing in full "UP" position and install guide, tilt spring and tilt spring retainer, using screwdriver in retainer slot. Turn retainer clockwise to engage (Fig. 9-32).

15. Install inner race, inner race seat and bearing lock nut. Adjust steering shaft torque with column in straight-ahead position to 8 oz. in. over steering shaft torque determined prior to this adjustment.

NOTE: This specification may be obtained by placing the steering wheel on the shaft, attaching an ounce spring scale to a spoke 4" from center and obtaining a reading of 2 ounces.

Fig. 9-42 Installing Upper Bearing Housing - Tilt Column

16. Remove tilt release lever.

17. Install tilt lever opening shield in housing (Fig. 9-36).

18. Install housing cover and tighten three screws to 45 lb. in. torque.

19. Install tilt release lever.

20. Install buzzer switch, if removed (see BUZZER SWITCH - INSTALL, steps 1 through 3).

21. Install lock cylinder (see LOCK CYLINDER - INSTALL, steps 1 through 5).

22. Install the ignition switch by inserting the actuator rod into the slider hole and assemble to the column with two screws. Push the switch lightly down the column (away from the steering wheel), to take out lash in the actuator rod, and tighten attaching screws to 35 lb. in. torque.

CAUTION: Prevent switch from moving out of detent. Use only the correct screws.

NOTE: Before installing switch, place the lock cylinder in "OFF-LOCK" or detent position and position the ignition switch slider in "OFF-LOCK" (see Section 12 for ignition switch adjustment).

23. Position shift indicator assembly, if removed, to upper bearing housing and install retaining spring on all models except Pontiac.

24. Install turn signal switch (see TURN SIGNAL SWITCH - INSTALL).

25. Install lower flange to steering column shaft on Pontiac and Firebird or lower steering shaft with pot joint or universal joint to steering column shaft on Tempest and Grand Prix. Tighten clamping nut on Tempest and clamping bolt on all other models to 30 lb. ft. torque (Fig. 9-14).

26. Reinstall column bracket with the four bolts previously removed. Do not use a different length bolt. Torque bolts to 15 lb. ft. torque.

27. Install steering wheel (see STEERING WHEEL - INSTALL).

28. Install column in car (see STEERING COLUMN - INSTALL).

WARNING: Make certain that column is never unsupported when either the toe plate, instrument panel mounting, or gear mounting is connected.

29. Adjust back-up light or neutral-start switch (see Section 12 for adjustment procedure).

POT JOINT (LOWER STEERING SHAFT) - TEMPEST

NOTE: The pot joint need only be disassembled if there is looseness or binding in the assembly (Fig. 9-13).

DISASSEMBLE

1. Remove steering column from car (see STEERING COLUMN - REMOVE).

2. Scribe a mark on pot joint housing and lower steering shaft.

3. Remove wire retaining clip around inside of housing. Care must be taken not to cut rubber boot around lower shaft.

4. With slight pressure, pull on lower steering shaft; this will separate shaft from housing.

5. Remove bearing cups and clip from steering shaft.

NOTE: If the rubber boot or cross shaft in lower steering shaft is damaged, do not attempt to remove these parts from the steering shaft. These parts are serviced with the lower steering shaft.

ASSEMBLE

1. Assemble pot joint by reversing above steps.

NOTE: When assembling lower steering shaft into joint housing, be sure scribe marks are lined up. Also use care not to cut rubber boot when installing wire retaining clip.

NOTE: To provide proper lubrication of this assembly, coat all surfaces with lithium soap grease. Do not over fill assembly with grease.

2. Install steering column in car (see STEERING COLUMN - INSTALL).

UNIVERSAL JOINT (LOWER STEERING SHAFT) - GRAND PRIX

NOTE: The universal joint need only be disassembled if there is looseness or binding in the assembly.

DISASSEMBLE

1. Remove steering gear mounting bolts, flexible coupling bolts and swing gear away from frame.

2. Remove universal joint upper yoke clamping bolt and remove shaft assembly with joint from steering column shaft (Fig. 9-13).

3. Remove the two snap rings from the upper yoke of the joint and then remove the two yoke bushings and rubber washers, by tapping yoke shaft with plastic mallet.

4. Move the center cross as necessary, to separate the upper and lower portions of the coupling.

5. Disassemble lower yoke of joint by repeating steps 2 and 3.

ASSEMBLE

1. Position center cross in lower yoke of coupling.

2. Position bushing and new rubber washer on center cross. Install retaining snap ring.

3. Place a second bushing and new rubber washer on center cross and retain with snap ring.

4. With cross installed in lower yoke, assemble lower yoke to upper yoke as outlined in steps 2 and 3.

5. Install shaft assembly with joint on steering column shaft. Tighten upper yoke clamping bolt to 30 lb. ft. torque.

6. Install steering gear to frame and flexible coupling.

STEERING LINKAGE

REMOVE AND INSTALL

1. Steering intermediate rod may be removed from both the tie rods, pitman arm and idler arm by removing the ball shaft nut (Fig. 9-43, 9-44 and 9-45). Since intermediate rod is a solid shaft, it may be replaced by installing a new rod and connecting it to pitman arm, tie rods, and idler arm. Tighten pitman arm to intermediate rod nut to 35 lb. ft. torque on Tempest and Grand Prix and to 45 lb. ft. torque on Pontiac and Firebird. Tighten intermediate rod to tie rod nut to 40 lb. ft. torque on Tempest and Grand Prix and to 60 lb. ft. torque on Pontiac and Firebird. Tighten idler arm to intermediate rod nut to 35 lb. ft. torque.

2. After steering intermediate rod is removed, the pitman arm may be removed from pitman shaft by removing nut and lock washer and by using puller J 5504-1. To install pitman arm on pitman shaft, replace arm, lock washer and nut and tighten to 140 lb. ft. torque.

3. After steering intermediate rod is removed, idler arm may be removed by removing two bolts which retain idler support to frame. Install assembly on frame with two attaching bolts and washers and tighten to 35 lb. ft. torque.

4. Tie rod assembly may be removed from car by removing cotter pin and castellated nut on tie rod ends at steering arms. To separate tie rod and tie rod end, loosen two bolts on sleeve and clamp assembly, and thread out part to be replaced. To reassemble, thread new part into tube and clamp assembly to approximate original location, place tie rod end with dust cover in steering arm, tighten castellated nut securely, and install new cotter pin. Tighten nut to 35 lb. ft. torque on all models except Pontiac and tighten nut to 50 lb. ft. torque on Pontiac.

5. When new tie rods or tie rod ends are installed, it is necessary to check toe-in. Check clamp bolts on tie rod adjuster sleeve assembly for tightness, 17 lb. ft. torque. Assemble tie rod clamps as shown in Fig. 9-43 for Pontiac, Fig. 9-44 for Tempest and Grand Prix, and Fig. 9-45 for Firebird models.

6. Whenever work is done on steering linkage, it should be lubricated.

GENERAL INFORMATION

(MANUAL STEERING)

Periodic service consists of periodic lubrication as outlined in GENERAL LUBRICATION Section. The addition of the lubricant is to be made by moving the center side cover bolt.

ADJUSTMENT PROCEDURES

Correct adjustment on the steering gear is extremely important. Before any adjustments are made to the steering gear in an attempt to correct such conditions as shimmy, hard or loose steering and road shocks, a careful check should be made to determine that front end alignment, shock absorbers, wheel balance and tire pressure are correctly adjusted and/or operating satisfactorily.

There are two adjustments on the recirculating ball--type steering gear:

1. Worm bearing preload adjustment.

2. Overcenter or Pitman Shaft Adjustment

CAUTION: It is very important when adjusting steering gear that adjustments be made in above sequence. Failure to do so will result in damage to steering gear.

ADJUST WORM BEARING PRELOAD

1. Raise car and disconnect steering intermediate rod from pitman arm (Fig. 9-43, Fig. 9-44 and Fig. 9-45), using tool J 5504-1.

2. Loosen pitman shaft adjusting screw lock nut and back off adjusting screw a few turns (Fig. 9-46).

3. Remove wheel cover or bezel on steering wheel.

4. With a 7/8" socket attached to a pound inch torque wrench, measure and record torque readings at least 30° off center (Fig. 9-47).

NOTE: Do not use torque wrench having maximum torque reading of more than 100 pounds inch. When taking following torque readings, take reading pulling torque wrench to right and reading pulling torque wrench to left. Total both readings and take one-half of this total as average torque.

5. Torque required should be 7 lb. in. To correct, loosen worm bearing adjuster lock nut with brass drift

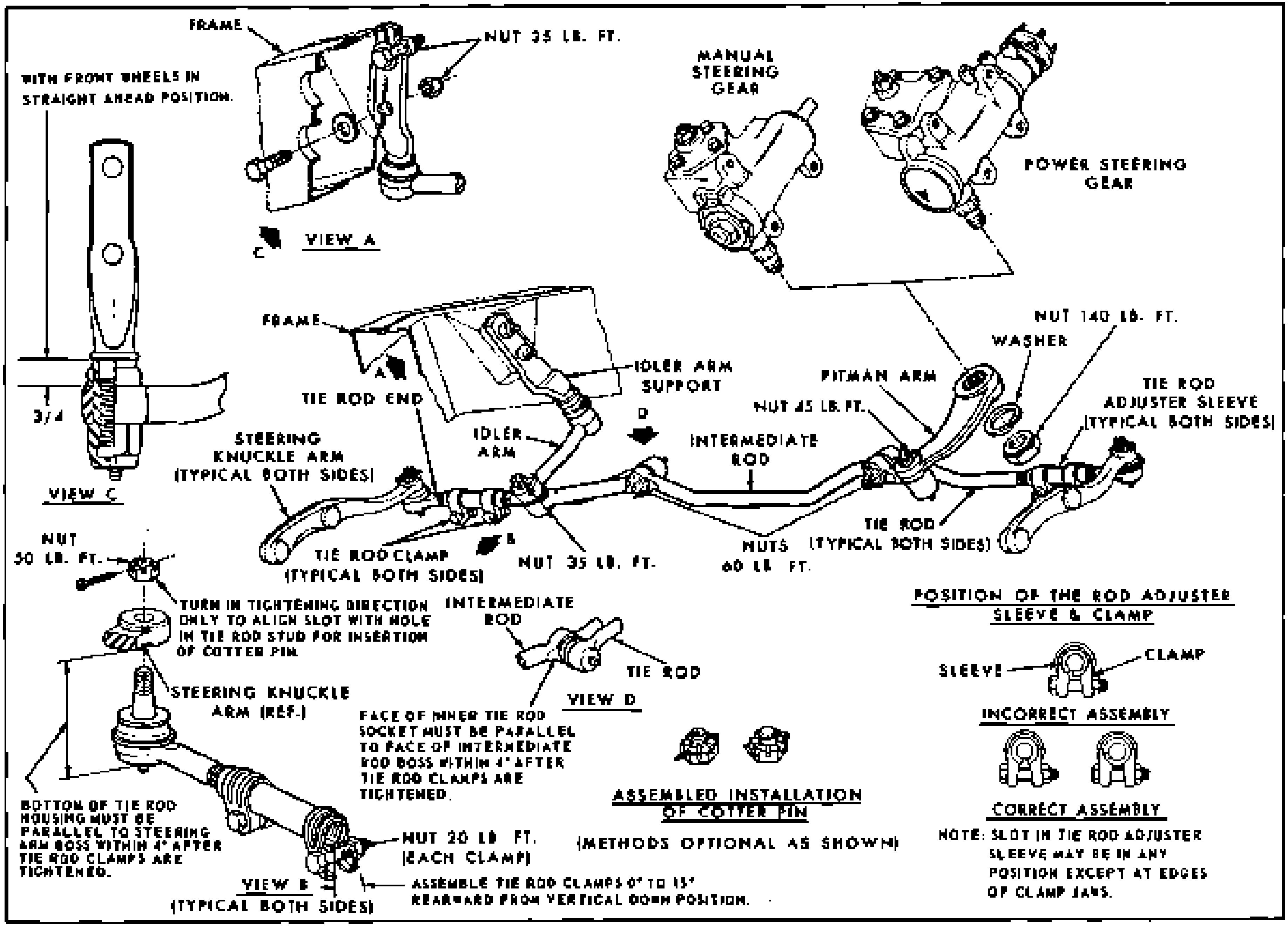


Fig. 9-43 Pontiac Steering Linkage

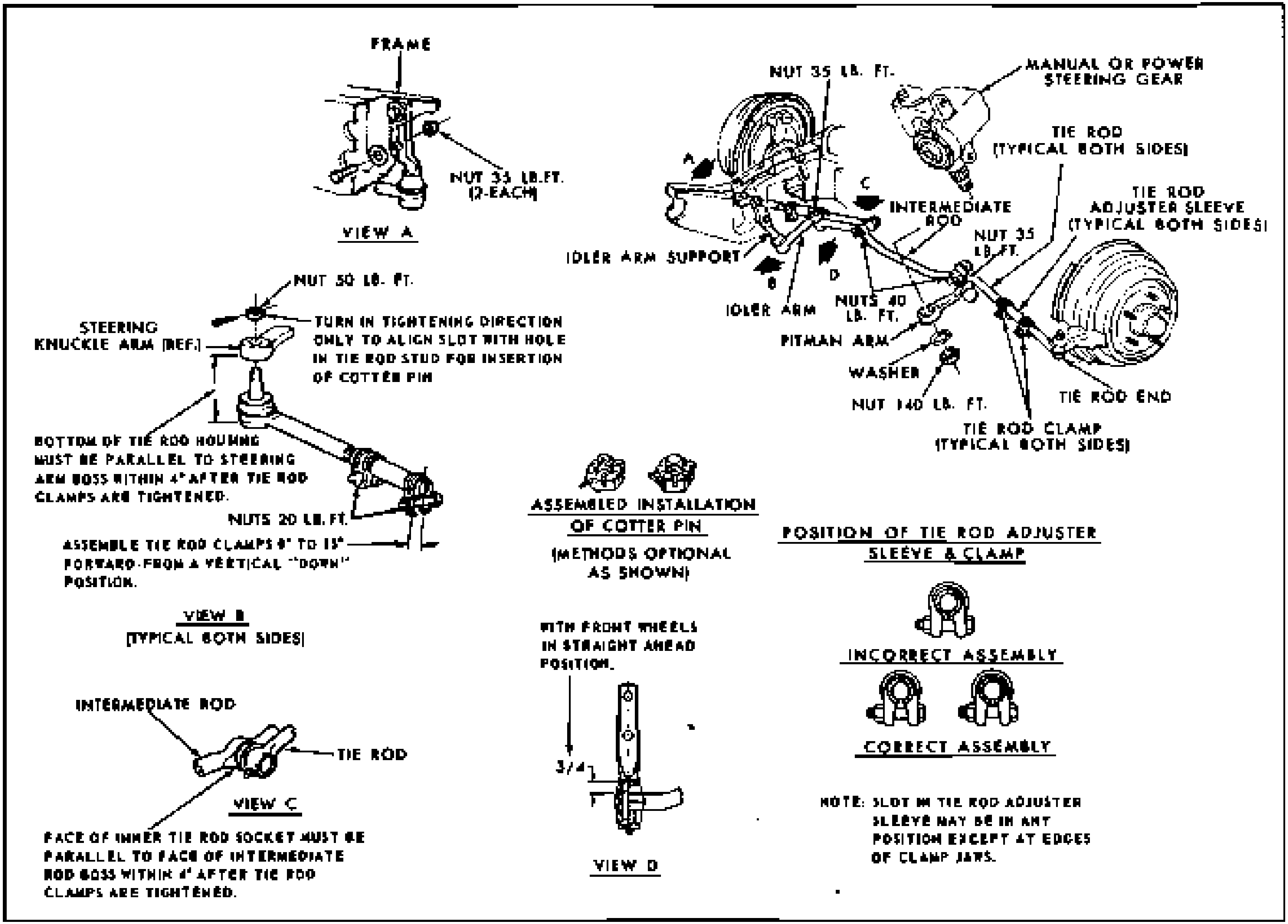


Fig. 9-44 Tempest and Grand Prix Steering Linkage

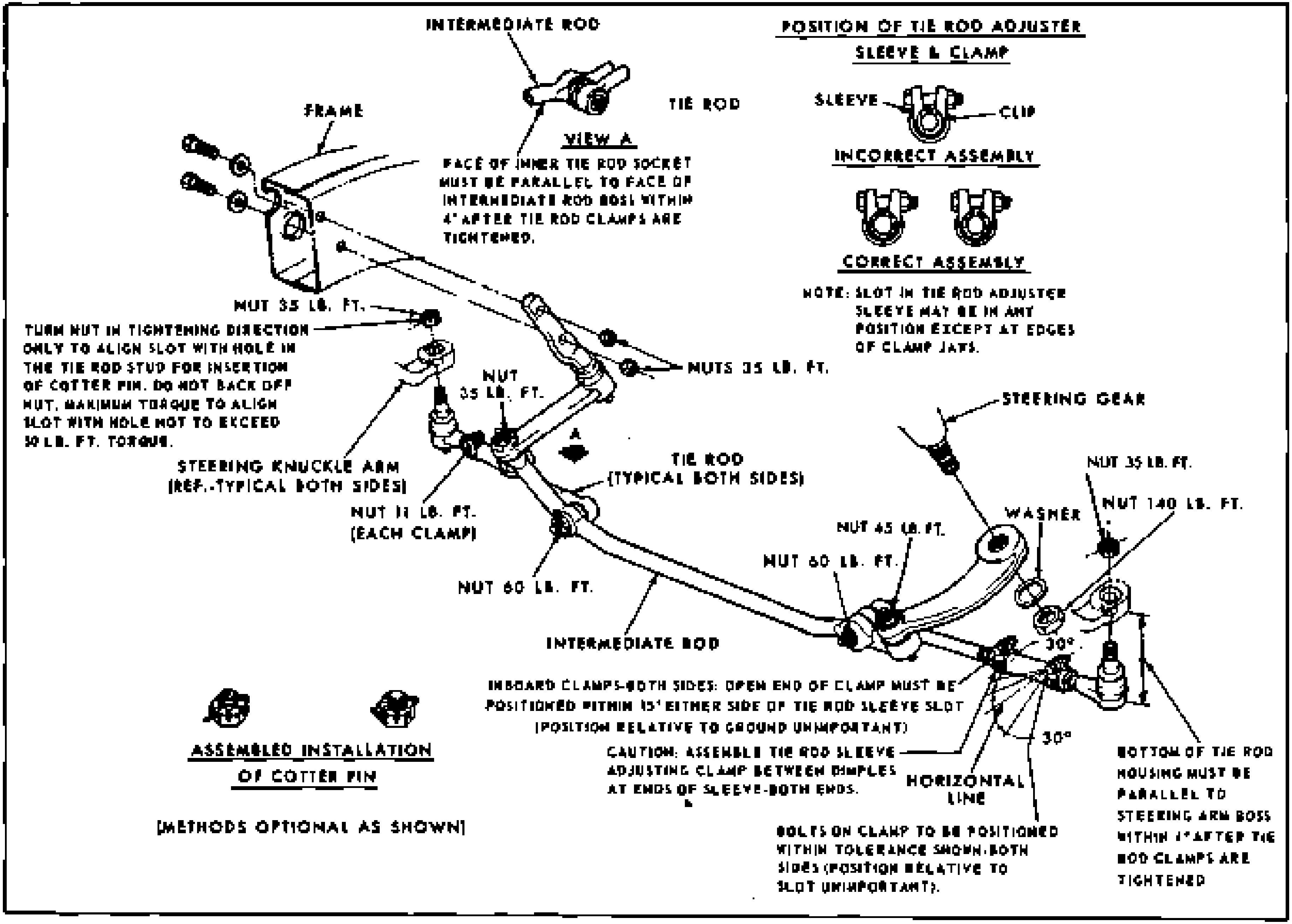


Fig. 9-45 Firebird Steering Linkage

and turn adjuster to bring torque within limits.

6. Retighten lock nut to 85 lb. ft. torque when adjustment is correct and recheck as in step 4 above.

OVERCENTER OR PITMAN SHAFT ADJUSTMENT

1. When worm bearing preload has been adjusted correctly, pitman shaft adjusting screw should be turned clockwise until a pull equal to worm bearing preload plus 7 lb. in. is required to turn the wheel through center.

Total thrust bearing adjustment, pitman shaft adjustment, and drag not to exceed 16 lb. in.

2. Tighten pitman shaft adjusting screw lock nut to 23 lb. ft. torque and recheck adjustment.

3. Reassemble steering intermediate rod to pitman arm. Set spokes of steering wheel in straight ahead position. If road wheels are not straight ahead, adjust steering tie rods.

STEERING GEAR

REMOVE

1. Raise car and disconnect pitman arm from pitman shaft, using tool 5504-1.

2. Disconnect lower steering shaft flange from flexible coupling.

3. Remove three steering gear housing to frame bolts and withdraw gear from car.

DISASSEMBLE

Disassemble and assemble steering gear and subassemblies (Fig. 9-48) on a clean work bench, preferably while the assembly is mounted on holding fixture (J 5205 or J 6448-1).

CAUTION: DO NOT clamp housing in vise. Cleanliness is of utmost importance; therefore bench, tools, and parts must be kept clean at all times.

Fig. 9-46 Overcenter or Pitman Shaft Adjustment

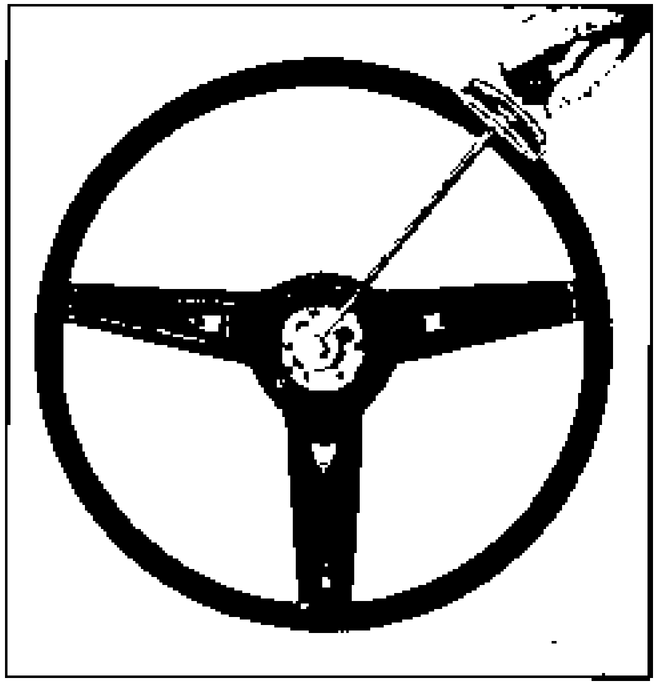


Fig. 9-47 Checking Steering Gear Adjustment

Before disassembling gear, thoroughly clean exterior with suitable solvent and drain as much fluid as possible.

1. Mount steering gear on holding fixture J 5205.

2. Rotate wormshaft with flexible coupling until coupling is in center of travel. Remove three side cover screws and adjusting screw nut.

3. Remove side cover and gasket by turning adjusting screw clockwise through cover (Fig. 9-49).

4. Remove adjusting screw from slot in end of pitman shaft. Make sure shim found on adjusting screw remains with screw (Fig. 9-50).

5. Remove pitman shaft from housing using care that threads do not damage seal in housing.

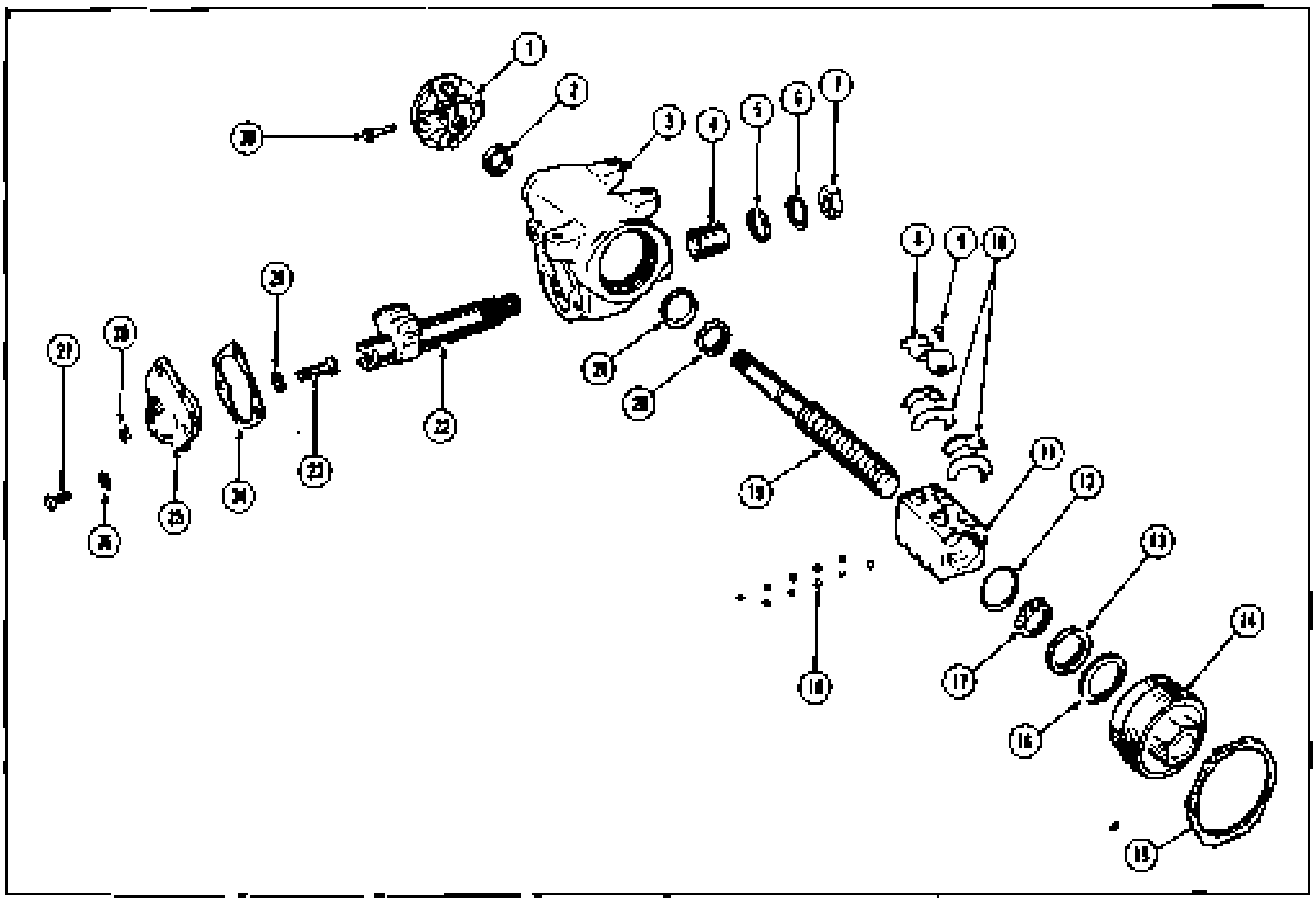
6. Loosen worm bearing adjuster lock nut with brass drift and remove adjuster and lower bearing.

7. Scribe a mark on flexible coupling and worm shaft. Remove coupling from shaft.

8. Push worm and shaft assembly, with ball nut assembly, through bottom of housing and remove upper bearing.

9. Clean grease from worm and shaft assembly and also from inside gear housing.

10. Remove ball nut return guide clamp by removing three screws, remove guides, turn ball nut over and remove balls. Rotating shaft slowly from side to side will aid in removing balls.



1. COUPLING & LOWER FLANGE, Strg. Gear
2. SEAL, Strg. Shaft Oil
3. HOUSING ASM., Strg. Gear
4. BUSHING Pitman Shaft
5. SEAL, Pitman Shaft
6. LOCKWASHER, Pitman Arm to Pitman Shaft (3/4")
7. NUT, Strg. Gear Pitman Arm (3/4"-14)
8. CLAMP, Worm Ball Return Guide
9. BOLT & WASHER ASM., Return Guide Clamp
10. GUIDE, Worm Ball Return
11. NUT, Steering Gear Worm Ball
12. RETAINER, Worm Thrust Adj. Lower Bearing
13. RACE, Strg. Gear Worm Thrust Bearing
14. ADJUSTER, Worm Thrust Bearing
15. NUT, Worm Bearing Adjusting
16. SPRING, Worm Thrust Bearing Preload
17. BEARING, Strg. Gear Thrust
18. BALL, Steering Gear Worm
19. SHAFT, Steering Gear (w/Balls & Nut)
20. BEARING, Strg. Gear Thrust
21. RACE, Strg. Gear Worm Thrust Bearing
22. SHAFT ASSY., Pitman
23. SCREW, Lash Adjuster
24. GASKET, Housing Side Cover
25. COVER, Housing Side
26. LOCKWASHER, Cover to Housing (3/8")
27. BOLT, Cover to Housing (3/8"-16 x 3/4")
28. NUT, Sector Adjusting Screw (7/16"-20 Check)
29. SHIM PKG., Lash Adjuster
30. BOLT, Shaft Flange to Shaft Clamping

Fig. 9-48 Exploded View of Manual Steering Gear

11. Remove ball nut from worm.

NOTE: Unless all balls are removed nut cannot be removed.

CLEANING AND INSPECTION

1. Remove gear housing from holding fixture.

2. Wash all parts in clean kerosene or other suitable solvent.

3. Inspect all bearings, bearing cups, worm groove, bushings, seals, teeth for scoring, wear, pitting which would necessitate replacement.

4. Inspect housing and cover for sand holes or cracks.

5. If pitman shaft bushing seal, upper and lower bearing cups, steering gear housing or flexible coupling are worn excessively or damaged, replace parts.

PITMAN SHAFT BUSHING

REMOVE

1. Remove pitman shaft seal by prying seal out of housing bore with screwdriver.

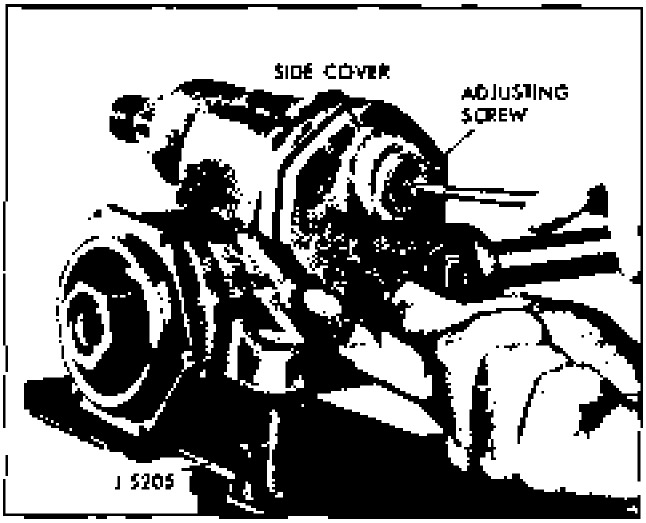


Fig. 9-49 Removing Side Cover

2. Drive out bushing with tool J 1614 (Fig. 9-51).

3. To install new bushing with same tool, drive bushing in towards center of gear housing. Inner end of bushing must be flush with inside surface of housing at seal seat.

4. Install new pitman shaft seal using suitable socket as driver.

PITMAN SHAFT SEAL

REMOVE

1. Remove pitman shaft seal by prying seal out of bore with screwdriver or suitable tool.

2. Install new seal using suitable socket as driver.

UPPER OR LOWER BEARING CUPS

REMOVE UPPER CUP

1. Remove gear housing upper seal assembly. Then using suitable punch, remove upper cup from gear housing.

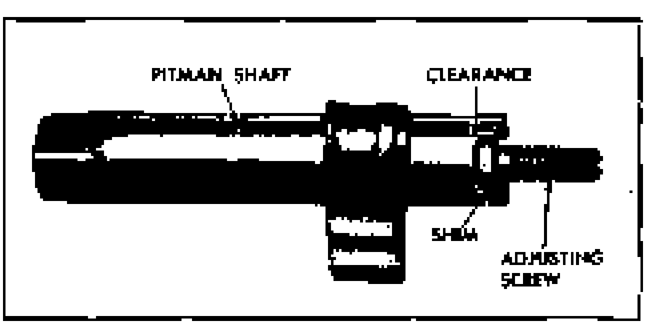


Fig. 9-50 Pitman Shaft and Adjusting Screw

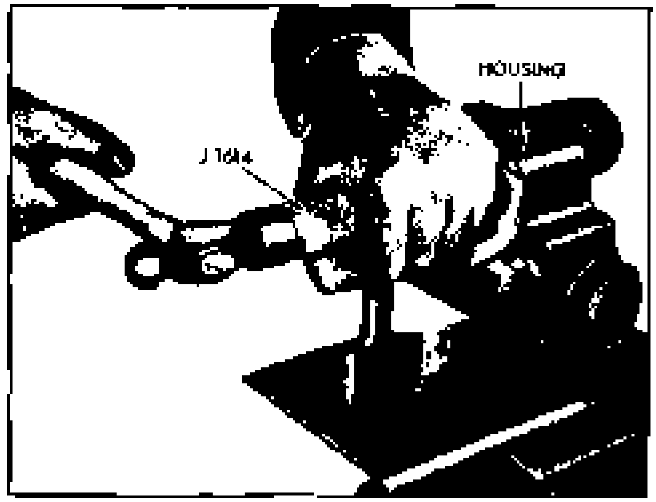


Fig. 9-51 Removing Pitman Shaft Bushing

INSTALL UPPER CUP

1. Install bearing cup in housing using tool J 5755, replace worm shaft seal.

REMOVE LOWER CUP

1. Remove lower bearing retainer from bearing adjuster. Bearing cup is a slip fit and will come out with lower bearing and Belleville washer.

INSTALL LOWER CUP

1. Install Belleville washer, bearing cup, lower bearing and retainer in worm bearing adjuster.

STEERING GEAR

ASSEMBLE

NOTE: All seals, bushings and bearings should be prelubricated before assembly.

1. Position ball nut on shaft so that deep side of teeth are located as shown in Fig. 9-52.

2. Install 19 balls in each circuit of ball nut (rock

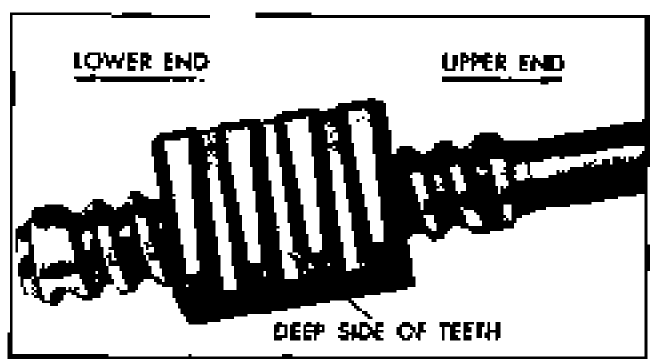


Fig. 9-52 Ball Nut Properly Installed on Shaft

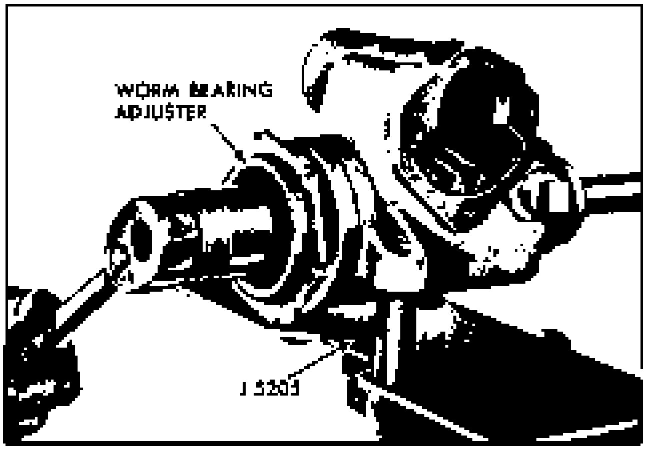


Fig. 9-53 Adjusting Worm Bearing Preload

steering shaft slightly to aid in installing balls) and insert 6 balls in each return guide using petrolatum to hold balls in place. Install return guide clamp and screw.

CAUTION: Do not rotate worm shaft while installing balls, since balls may enter crossover passage between circuits. This will cause improper operation of ball nut.

3. Place upper bearing on worm shaft. Center ball nut on worm, then slide worm shaft, bearing and nut into housing.

4. Install adjuster in housing.

NOTE: Adjuster should be installed just tight enough to hold bearing races in place. Install adjuster lock nut loosely.

5. Slip flexible coupling assembly on shaft and turn steering gear from one extreme to the opposite to make certain there is no unusual binds and remove coupling assembly.

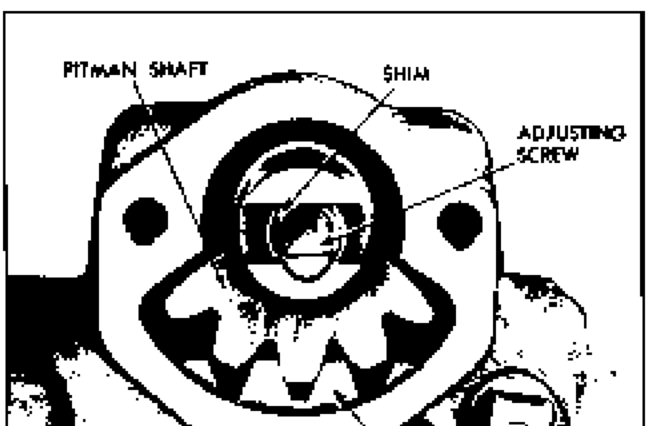


Fig. 9-54 Position of Pitman Shaft and Ball Nut

NOTE: Never allow ballnut to strike ends of ball races in worm due to possibility of damage to ball guides.

a. Using a 11/16"-12 point deep socket and inch pound torque wrench, measure torque required to turn worm shaft, keep wrench in motion when off high point of gear. Torque required should be 7 lb. in.

b. If torque does not meet above specifications loosen worm bearing adjuster lock nut (Fig. 9-53) and turn adjuster to bring torque within 7 lb. in. limits.

c. Tighten lock nut and recheck torque.

d. Remove 11/16" socket and torque wrench.

6. Install pitman shaft adjusting screw and selective shim in pitman shaft (Fig 9-50).

NOTE: Screw must be free to turn, but have no more than .002" end play. If end play of screw in slot is too tight or too loose, select new shim to give proper clearance. Shims are furnished in four thicknesses: .063", .065", .067", and .069".

7. Position pitman shaft seal on pitman shaft and seat seal using suitable socket as a driver.

8. Install pitman shaft and adjusting screw with sector and ball nut teeth positioned as shown in Fig. 9-54.

9. Install side cover and gasket on adjusting screw, turning screw counterclockwise until it projects through side cover 5/8" to 3/4".

10. Install two cover attaching bolts. Tighten to 35 lb. ft. torque.

11. Tighten pitman shaft adjusting screw so that teeth on shaft and ball nut engage but do not bind. Final adjustment will be made later.

12. Fill steering gear with all-season steering gear lubricant and install third cover attaching bolt. Tighten to 35 lb. ft. torque.

13. Adjust overcenter and/or pitman shaft backlash as follows:

a. Place a 11/16"-12 point socket and lb. in. torque wrench over end of worm shaft.

b. Tighten pitman shaft adjusting screw as necessary to obtain a reading of 7 lb. in. torque, in excess of total thrust bearing preload, and seal drag, when the worm gear is turned through the center (high point) (Fig. 9-55). Total thrust bearing adjustment, and seal drag not to exceed 16 lb. in. The highest reading should not fall outside 1/8 turn each side of center.

c. Tighten pitman shaft adjusting screw lock nut to 23 lb. ft. torque and recheck adjustment.

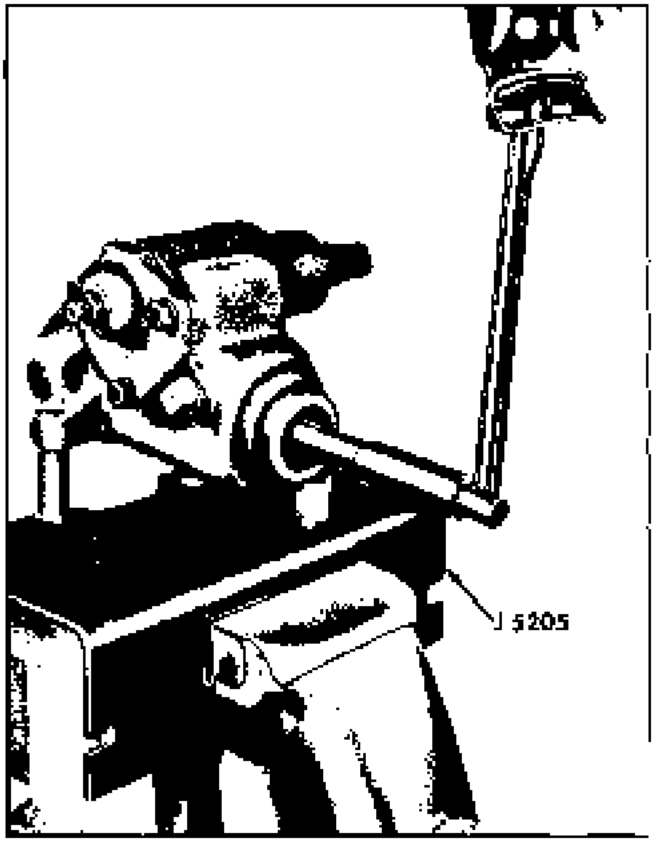


Fig. 9-55 Adjusting Worm Gear Through High Point (in Fixture J 5205) - Gear Mounted

14. Install flexible coupling on worm shaft and tighten clamping bolt to 30 lb. ft. torque. Be sure the scribe marks are aligned.

STEERING GEAR

INSTALL

1. Align scribe marks on steering and worm shaft flange with flexible coupling.

2. Position steering gear in car.

NOTE: Metal to metal contact between flanges on worm shaft and steering shaft assembly will transmit and amplify gear noise to drive.

3. Install steering housing to frame bolts and tighten housing to frame bolts to 70 lb. ft. torque.

4. Install pitman arm and secure with lock washer and nut. Tighten nut 140 lb. ft. torque.

5. Install two flange attaching nuts and lock washers and tighten to 20 lb. ft. torque.

6. Be sure pins are properly positioned (Fig. 9-12). If pins are not positioned properly, loosen flexible coupling at worm shaft and reposition or align steering column.

GENERAL INFORMATION (POWER STEERING)

Since the steering gear is constantly lubricated, it is only necessary to periodically check the level in the pump reservoir. See Specifications Section for system capacity.

MINOR SERVICE

STEERING GEAR

The following procedures may be performed with the steering gear in the car.

Before making adjustments to the power steering gear to correct conditions such as shimmy, hard or loose steering, road shock, wander or weave; a check should be made of front end alignment, shock absorbers, wheel balance, or for tight front wheel bearings, loose steering rod ends or loose pitman arm.

ADJUSTMENTS

CAUTION: Prior to checking gear make certain that the steering shaft is not binding or tight in the steering column. On cars with tilt column be sure steering is in straight position and not tilted.

1. Raise car and disconnect steering gear intermediate rod from pitman arm using tool J 5504-1.

2. Remove wheel cover or bezel from steering wheel.

3. Check gear adjustment torque readings by rotating steering shaft with a 7/8" socket attached to a pound inch torque wrench 1/2 turn each side of center (high point) (Fig. 9-47).

NOTE: DO NOT use torque wrench having maximum torque reading of more than 100 lb. in. When taking following torque readings, take a reading pulling torque wrench to right and reading pulling torque wrench to left. Total both readings and take one half of this total as average torque.

4. Position the steering gear in the center position (high point), measure the amount of torque required to rotate steering shaft through a 180° arc each side of center position (at least 1/2 of a turn each side of center). The torque reading should be from 14 to 18 lb. in.

5. If the reading in step 4 is not within specification, loosen the pitman shaft adjustment lock nut. Use a

7/32 Allen wrench and rotate adjusting screw (clockwise increases torque reading) while holding lock nut. When torque reading is within specification (14 to 18 lb. in.), tighten adjustment lock nut to 32 lb. ft. of torque and recheck adjustment.

NOTE: After performing adjustment, rotate steering wheel from lock to lock several times to be sure that it is not binding in any positions. If any binding is present, the steering gear must be disassembled and repaired as the internal parts of the gear are malfunctioning.

5. Reassemble wheel cover or bezel to steering wheel.

6. Reassemble intermediate rod to pitman arm. Tighten nut to 140 lb. ft. torque.

PITMAN SHAFT SEALS

INSTALL

NOTE: Removal of seals can be accomplished with steering gear in car, using hydraulic pressure from gear assembly to force seals out of pitman shaft bore.

1. Raise car and remove pitman arm retaining nut and lockwasher.

2. Remove pitman arm using tool J 5504-1.

3. Remove pitman shaft outer dust seal retaining ring, using Truarc pliers.

4. Remove outer dust seal, using screwdriver or similar tool and place a cloth around housing and pitman shaft to absorb oil leakage from seal bore.

5. Hold a clean dry pan under gear housing and with engine running, momentarily turn steering gear to extreme left position for not more than two seconds. This will build up pressure on upper side of piston and in pitman shaft chamber, forcing seals and inner back-up washer out of bore.

NOTE: If pressure of oil does not remove seals, turn off engine, remove steering gear from car, and disassemble gear, refer to procedures outlined farther in this section.

6. Clean seal bore of housing, pitman shaft and inspect housing bore for any burrs which might damage seals during installation.

7. Wrap a piece of thin tape around splines of pitman shaft, this will prevent damage of seals during installation. Use only one layer of tape to allow for clearance of seals to pass over taped area.

8. Lubricate seals thoroughly and install seals using tool J 6219. Install inner single lip seal, then backup washer and retaining ring. Be sure that inner seal does not bottom in housing bore. Install seals only far enough to provide clearance for backup washers and retaining ring.

10. Remove tape from pitman shaft and install pitman arm

MAJOR SERVICE

STEERING GEAR

REMOVE

1. Disconnect pressure and return hose assemblies from housing.

2. Raise car and disconnect pitman arm from pitman shaft, using tool J 5504-1.

3. Scribe mark on steering shaft worm shaft flange and disconnect flexible coupling from steering shaft.

4. Remove gear housing to frame bolts, noting number and location of gear to frame shims (if any).

NOTE: On Pontiac models a brake hose bracket must be removed prior to removing frame bolts.

5. Remove steering gear assembly.

STEERING GEAR

DISASSEMBLE

Disassemble and reassemble steering gear and sub assemblies on a clean work bench, preferably while the assembly is mounted on a holding fixture (J 5205 or J 6448-01) as shown in Fig. 9-56.

CAUTION: DO NOT clamp housing in vise.

Cleanliness is of utmost importance; therefore bench, tools, and parts must be kept clean at all times.

Fig. 9-56 Steering Gear Mounted on Tool J 5205

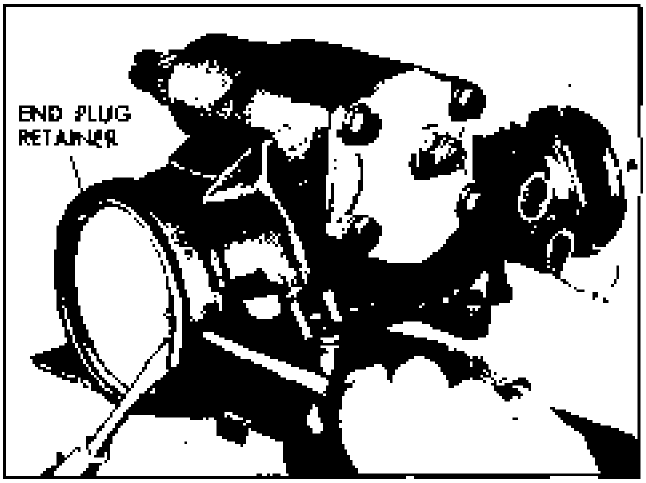


Fig. 9-57 Removing End Plug Retaining Ring

Before disassembling gear, thoroughly clean exterior with suitable solvent and drain as much fluid as possible. Assist draining by turning gear with flexible coupling installed through its entire range two or three times.

HOUSING LOWER END PLUG AND RACK-PISTON NUT END PLUG

REMOVE

1. Remove end plug retaining ring as shown in Fig. 9-57.

2. Rotate gear flexible coupling to left and force end plug out of housing and discard end plug O-ring seal.

CAUTION: DO NOT turn coupling any farther than absolutely necessary or balls from ball nut and worm circuit may escape from this circuit and lay loose inside rack-piston nut chamber.

3. Remove rack-piston nut end plug retainer, using 1/2" square driver (from socket set). To aid in loosening end plug, tap end plug with brass drift.

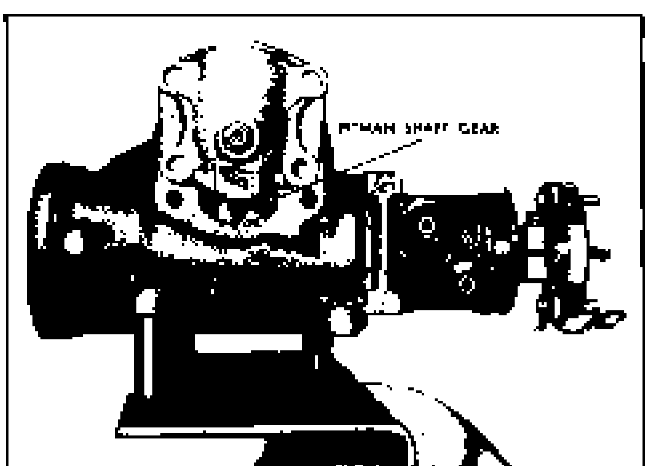


Fig. 9-58 Position of Pitman Shaft Gear for Removal

PITMAN SHAFT GEAR AND SIDE COVER

REMOVE

1. Remove side cover retaining screws and washers.

2. Rotate cover as necessary to see when pitman shaft is centered in gear housing opening while rotating gear coupling (Fig. 9-58)

3. Remove pitman shaft and cover assembly.

4. Remove side cover O-ring seal and discard.

RACK-PISTON NUT

REMOVE

1. Holding arbor tool J 7539 against end of steering worm, rotate stub shaft flexible coupling to left until rack-piston is free from worm (Fig. 9-59).

2. With arbor in rack-piston, withdraw rack-piston nut from housing bore.

NOTE: The arbor prevents balls from falling out of rack-piston nut.

ADJUSTER PLUG ASSEMBLY, ROTARY VALVE WITH WORM SHAFT AND PIN ASSEMBLY

REMOVE (AS AN INTEGRAL UNIT)

1. Remove flexible coupling clamping bolt and remove coupling.

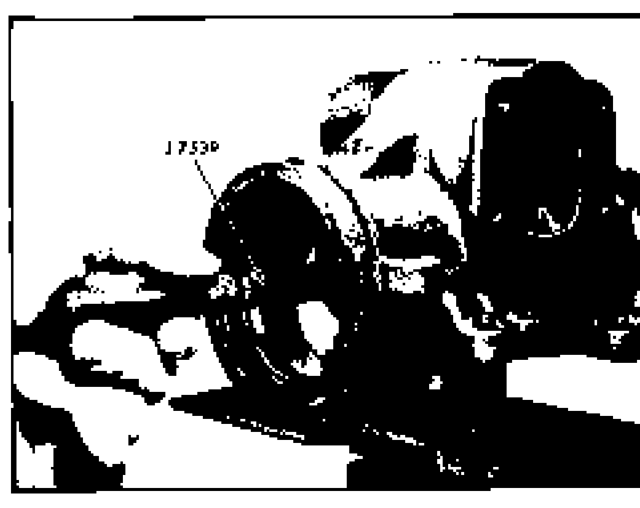


Fig. 9-59 Arbor J 7539 Against End of Steering Worm

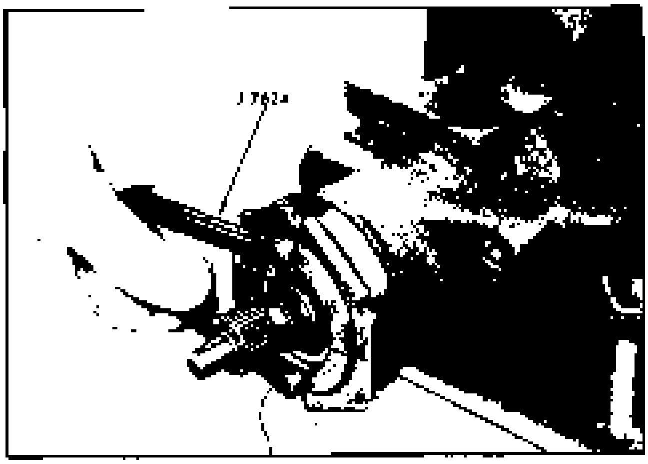


Fig. 9-60 Removing Adjuster Plug Assembly

2. Remove adjuster plug lock nut, using punch or suitable spanner wrench such as J 7624.

3. Remove adjuster plug assembly, using a spanner as shown in Fig. 9-60.

4. Push on end of worm shaft with a hammer handle while pulling on stub shaft with slight rotary motion. This will remove the entire upper unit.

5. Remove adjuster plug from rotary valve and torsion bar by pulling straight out (Fig. 9-61).

6. Separate worm shaft and valve assembly by pulling apart.

7. Remove lower bearing and discard torsion bar cap to worm O-ring (in the Rotary Valve). See Fig. 9-61.

8. Remove lower bearing races and bearing (these parts may come out with worm shaft or remain in housing).

9. Remove adjuster plug O-ring seal and discard.

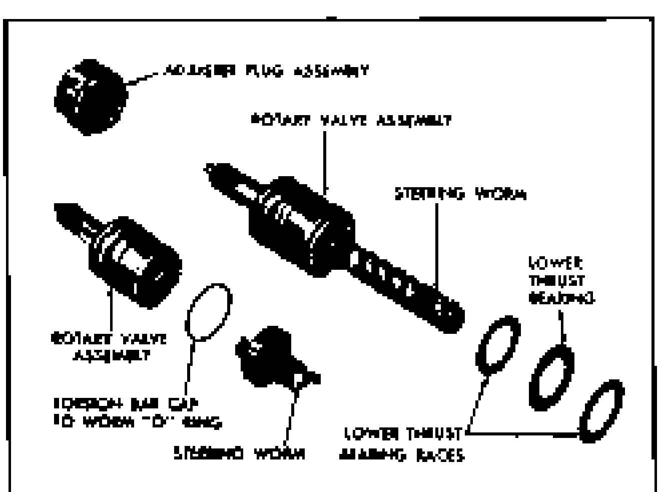


Fig. 9-61 Adjuster Plug and O-Ring Removal

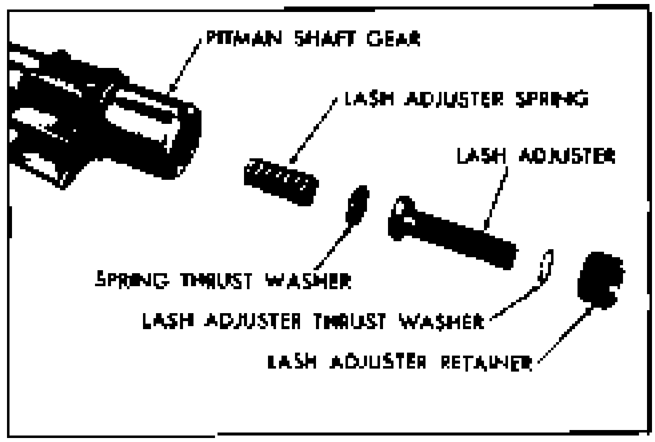


Fig. 9-62 Parts in End of Pitman Shaft Gear DO NOT DISASSEMBLE

PITMAN SHAFT GEAR AND SIDE COVER

DISASSEMBLE

1. Hold lash adjuster with 7/32" Allen wrench and remove lash adjuster nut and discard.

2. Screw lash adjuster out of side cover.

NOTE: Do not disassemble pitman shaft and component parts as these are serviced as an assembly (Fig. 9-62)

RACK-PISTON NUT

DISASSEMBLE

1. Place the rack-piston nut assembly on a clean cloth.

2. Remove arbor tool J 7539, ball return guide and balls, making sure all of the balls are caught on a cloth (constant ratio: 11 bright and 11 black or variable ratio: 12 bright and 12 black).

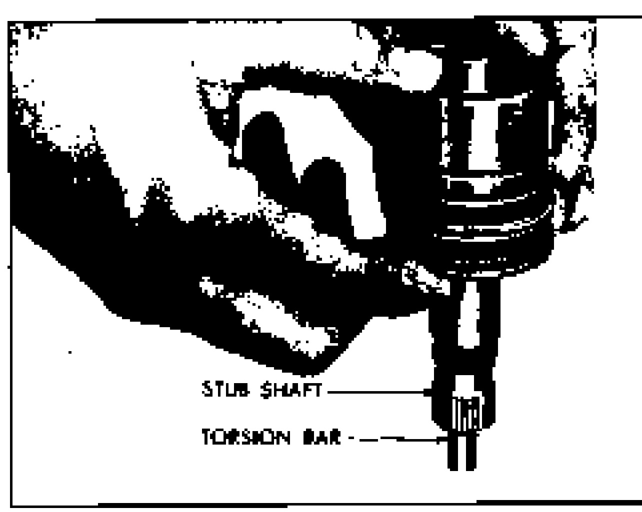


Fig. 9-63 Tapping to Loosen Valve Spool

3. Remove and discard Teflon ring and backup seal and rack-piston nut.

ROTARY VALVE

DISASSEMBLE

The rotary valve assembly includes the valve body, valve spool and the stub shaft assembly. All these parts are precision units and are hydraulically balanced at the factory.

Under no conditions are parts in this unit to be replaced or interchanged with other parts or units.

If unit parts are scored or damaged, the entire rotary valve assembly is to be replaced.

NOTE: If the valve spool dampener O-ring requires replacement (due to "squawk" in gear), perform the following operations.

1. Work spool spring onto bearing diameter of stub shaft and remove spool spring.

2. Tap end of stub shaft assembly gently against workbench to remove valve spool (Fig. 9-63).

CAUTION: The diametrical clearance between the valve body and spool may be as low as .0004". The slightest cocking of spool may jam it in valve body (Fig. 9-64).

NOTE: If slight sticking occurs, make a gentle attempt to reverse the removal procedure. If this does not free the spook, it has become cocked in valve body bore and may be removed later.

3. Remove and discard valve spool dampener O-ring.

4. Remove stub shaft, torsion bar (small diameter bar extending through stub shaft) and valve cap assembly

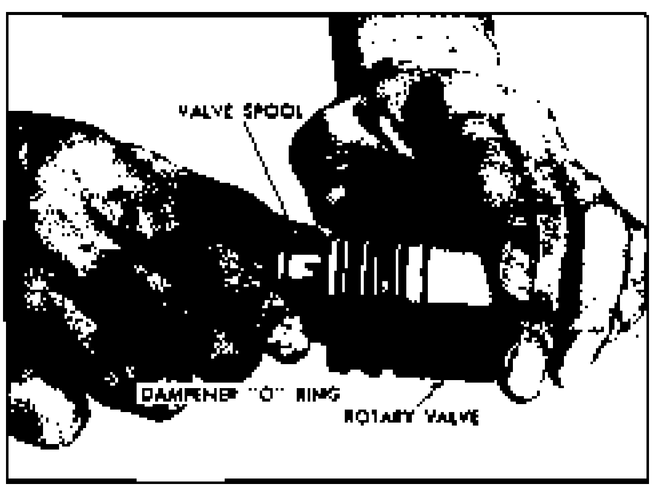


Fig. 9-64 Removing Valve Spool from Rotary Valve

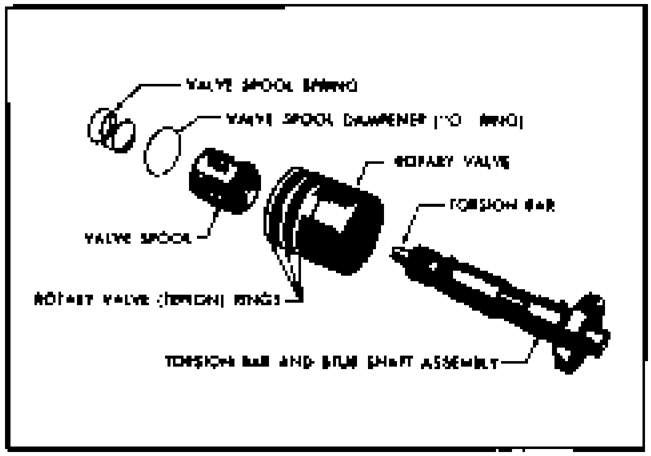


Fig. 9-65 Exploded View of Rotary Valve

by tapping end of torsion bar lightly with a plastic hammer. This will dislodge the cap from valve body cap in (Fig. 9-65). Do not disassemble stub shaft assembly. The parts are pinned together and are serviced as an assembly.

5. If valve spool has become cocked as described in step 2, it can now be freed as follows:

a. Inspect parts to determine in which direction the spool is cocked.

b. A few very light taps with a soft plastic or rawhide hammer should align and free the spool in the bore.

c. Remove and discard O-ring dampener seal from valve spool.

6. Carefully remove and discard valve body Teflon rings and ring backup O-ring seals.

HOUSING

DISASSEMBLE

1. Remove pitman shaft outer dust seal backup washer retaining ring, using Truarc pliers.

2. Remove outer dust seal backup washer.

3. Remove seal (double lip) by inserting offset screwdriver between seal and backup washer and prying out of housing.

CAUTION: Do not damage housing bore when removing seal.

4. Remove backup washer.

5. Remove seal (single lip) by cutting and collapsing seal.

CAUTION: Do not damage housing bore when removing seal.

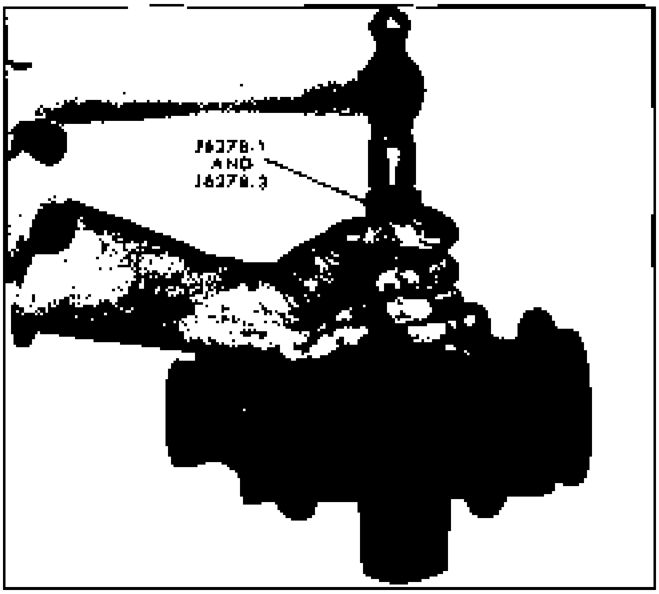


Fig. 9-66 Removing Pitman Shaft Needle Bearing

6. If pitman shaft needle bearings are to be replaced, remove bearing by driving out of housing, using tool J 6278-1 with adapter J 6278-3 (Fig. 9-66)

NOTE: Damage will result to flanged bearing used on variable ratio gears if an attempt is made to drive bearing into housing when removing.

7. If connectors are to be removed, tap threads in holes of connectors, using 5/16-18 NF tap (Fig. 9-67).

8. Remove connectors by using threaded bolt into tapped holes with washer and nut as extractor (Fig. 9-68).

9. If steering gear housing is to be replaced on Pontiac, Grand Prix or Firebird models, remove the large snap ring placed against the upper end of housing bore. This must be installed in new housing.

ADJUSTER PLUG

DISASSEMBLE

NOTE: Servicing of the adjuster plug need only be done if the stub shaft seal or needle bearing require replacement.

1. Remove thrust bearing retainer with a screwdriver, being careful not to score needle bearing bore. Remove thrust bearing spacer, thrust bearing and thrust bearing races.

2. Remove adjuster plug O-ring and discard.

3. Remove retaining snap ring and dust seal.

4. Using a screwdriver, pryout stub shaft seal, be careful not to score bore or adjuster plug.

5. Using tool J 6221 drive needle bearing out of adjuster plug.

6. If needle bearing was removed, install bearing using tool J 6221, position bearing on tool with letter side of bearing against tool. Drive bearing into plug until bearing is centered in bore.

7. Lubricate stub shaft seal and install seal using tool J 5188. Install seal only far enough to allow clearance for the dust seal and retaining snap ring.

8. Install dust seal and retaining snap ring, be sure lip of dust seal is facing outward.

9. Lubricate O-ring seal and install in groove in adjuster plug.

10. Assemble thrust bearing races, thrust bearing, bearing spacer, and bearing retainer on adjuster plug. Using a small brass drift tap retainer onto adjuster plug.

CLEANING AND INSPECTION

Carefully wash all parts in a suitable cleaning solvent.

CAUTION: Do not use solvent on oil seals and O-rings which are going to be replaced (Fig. 9-69).

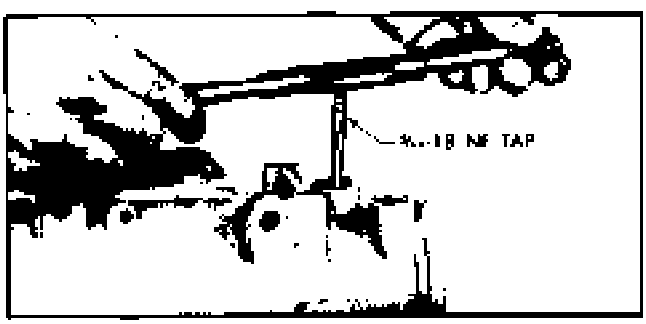


Fig. 9-67 Tapping Connector Hole

Fig. 9-68 Removing Connector

PITMAN SHAFT GEAR AND SIDE COVER

INSPECT

1. Inspect pitman shaft bearing surface in side cover for excessive wear or scoring. If badly worn or scored, replace side cover and bushing assembly.

2. Check pitman shaft sector teeth, bearing and seal surfaces and replace if badly worn, pitted or scored.

3. Check lash screw for end play.

NOTE: If end play is noticed in step 3, replace pitman shaft gear assembly.

RACK-PISTON NUT AND WORM

INSPECT

1. Inspect worm and rack-piston nut grooves and all of the balls for excessive wear or scoring. If either the worm or rack-piston nut needs replacing, both must be replaced as a matched assembly

2. Inspect ball return guides, making sure that ends where balls enter and leave guides are not damaged.

3. Inspect lower thrust bearing and races for excessive conditions of wear, pitting, scoring or cracking. If any of these conditions are found, replace the thrust bearing and races.

4. Inspect rack-piston nut teeth for pitting, wear, and scoring

5. Inspect outside surface of rack-piston nut for wear, scoring or burrs.

6. Inspect thrust bearing rollers and races for excessive conditions of wear, pitting, scoring, cracking, or brinelling. If any of these conditions are found, replace the thrust bearing assembly.

ROTARY VALVE

INSPECT

1. If there was evidence that the torsion bar to stub shaft O-ring seal has been leaking (oil leak between the stub shaft and torsion bar at the stub shaft coupling flange), the entire rotary valve assembly should be replaced.

2. If any part of parts of the rotary valve assembly (including stub shaft assembly) are badly worn, cracked, pitted or broken, the entire rotary valve assembly should be replaced. A slight polishing on the valving surfaces is normal.

GEAR HOUSING

INSPECT

1. Inspect gear housing for any defects in the piston bore or the rotary valve bore. Inspect all retaining ring grooves and seal surfaces for scratches or nicks. If any major defects are found, the housing should be replaced.

NOTE: A slight polishing of the cylinder bore by the piston is not uncommon and does not affect the operation of the gear.

2. Inspect ball plug in the housing, if leaking or raised above the housing surface, drive in flush to 1/16" below surface. The ball plug can be tightened by staking housing. Housing should be replaced only if leaks in this area cannot be properly sealed.

NOTE: Clean area of leak with solvent and/or a wire brush. Dry thoroughly and apply a liquid sealant which will flow into the area between the ball plug and the housing and then harden. Devcon "B" or equivalent (commercially available products) should seal such leaks.

3. Inspect the connectors. If badly brinelled or scored, replacement will be necessary.

4. Inspect pitman shaft gear needle bearing; if worn or pitted, replace.

PITMAN SHAFT GEAR AND SIDE COVER

ASSEMBLE

1. Screw lash adjuster through side cover until cover bottoms on pitman shaft gear.

2. Install lash adjuster lock nut while holding lash adjuster with 7/32" Allen wrench. Do not tighten lock nut.

ROTARY VALVE

ASSEMBLE

1. Assemble one valve body teflon ring back-up O-ring seal in each groove on valve body. Do not allow seals to become twisted.

2. Assemble valve Teflon rings in ring groove over O ring seals by carefully slipping rings over valve body. Rings may appear loose or twisted in grooves, but heat of oil after assembly will cause them to straighten.

3. Install valve spool dampener O-ring seal in valve spool groove, then lubricate seal in Type A hydraulic fluid. Do not allow seal to twist in groove.

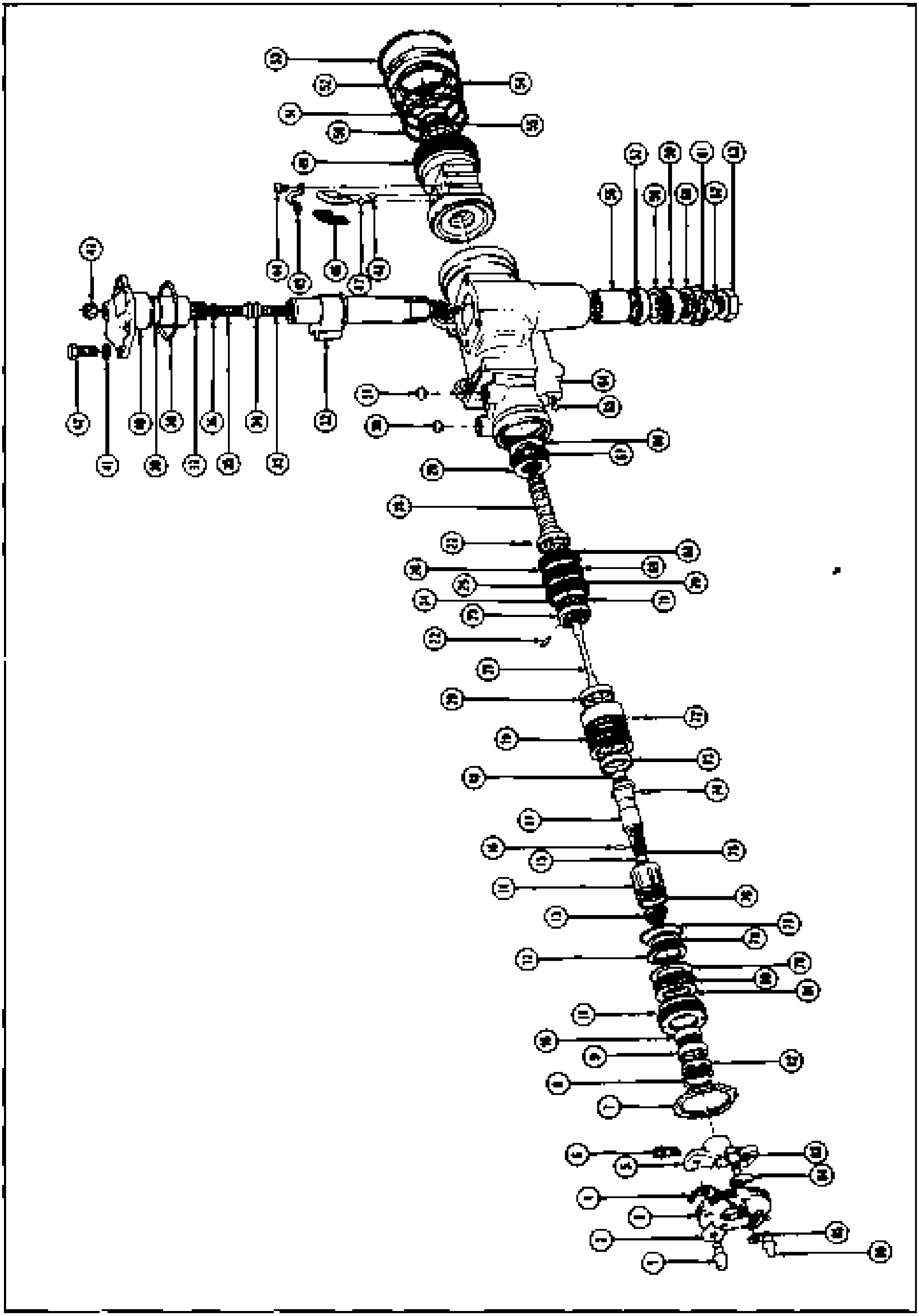


Fig. 9-69 Exploded View of Power Steering Gear Assembly

1. RIVET, Steering Shaft Coupling (Large)
2. REINFORCEMENT, Steering Gear Coupling
3. COUPLING, Steering Shaft Flange
4. CABLE ASSY., Horn Ground Strip
5. FLANGE, Steering Gear Shaft Lower
6. BOLT, Steering Gear Flange to Shaft Coupling
7. NUT, Strg. Gear Worm Bearing Adjusting
8. RING, End Plug Oil Seal Retaining
9. SEAL, End Plug Stub Shaft Oil
10. BEARING, Steering Gear Housing End Cover
11. PLUG, Housing Upper End Adjuster
12. SPACER, Thrust Bearing
13. SPRING, Spool Valve
14. SPOOL, Valve
15. SLEEVE, Torsion Bar
16. PIN, Torsion Bar
17. SHAFT, Stub
18. BEARING, Torsion Bar
19. BODY, Valve
20. SLEEVE, Valve Body
21. BAR, Torsion
22. PIN, Cap to Torsion Bar
23. CAP, Valve Body
24. SEAL, Valve Assy. Oil Ring Back-Up "O" Ring
25. SEAL, Valve Assy. Oil Ring Back-Up "O" Ring
26. SEAL, Valve Assy. Oil Ring Back-Up "O" Ring
27. PIN, Valve Body Drive
28. WORM, Steering
29. RACE, Lower Thrust Bearing
30. CONNECTOR, Hose Fitting to Hsg. (1/4" I.D. x 17/32" O.D.)
31. CONNECTOR, Hose Fitting to Hsg. (11/32" I.D. x 39/64" O.D.)
32. GEAR, Pitman Shaft
33. SPRING, Lash Adjuster
34. WASHER, Lash Adjuster Spring
35. ADJUSTER, Lash
36. WASHER, Lash Adjuster Thrust
37. RETAINER, Lash Adjuster
38. SEAL, Side Cover to Housing "O" Ring
39. BUSHING, Housing Side Cover
40. COVER, Housing Side
41. LOCKWASHER, Cover to Housing (3/8" med.)
42. BOLT, Cover to Housing (3/8"-16 x 1")
43. NUT, Pitman Shaft Gear Lash Adjuster
44. SCREW & LOCKWASHER ASSY., Clamp to Rack (1/4"-28 x 5/16")
45. CLAMP, Strg. Gear Ball Return Guide
46. GUIDE, Strg. Gear Ball Return
47. BALL PKG., Recirculating (Bright Finish) (Selective)
48. BALL PKG., Recirculating (Black Finish) (Selective)
49. RACK, Piston
50. RING, Strg. Gear Power Cylinder Piston
51. SEAL, Piston Ring Back-Up "O" Ring
52. COVER, Steering Gear Lower End
53. RING, Lower End Plug Retainer
54. SEAL, Steering Gear End Cover "O" Ring
55. PLUG, Rack Piston End
56. BEARING ASSY., Pitman Shaft Needle
57. SEAL, Strg. Gear Pitman Shaft Oil
58. WASHER, Pitman Shaft Seal Back-Up
59. SEAL, Strg. Gear Pitman Shaft Oil—Double Lip
60. WASHER, Pitman Shaft Seal Back-Up
61. RING, Pitman Shaft Seal Retaining
62. LOCKWASHER, Pitman Arm (7/8")
63. NUT, Steering Gear Pitman Arm (7/8"-14)
64. HOUSING, Steering Gear
65. BALL, Oil Passage Plug (11/16" dia.)
66. RACE, Lower Thrust Bearing
67. BEARING, Lower Thrust
68. RING, Valve Assy. to Housing
69. RING, Valve Assy. to Housing
70. RING, Valve Assy. to Housing
71. SEAL, Torsion Bar Cap to Worm "O" Ring
72. PIN, Valve Body to Cap
73. SLEEVE, Valve Body
74. PIN, Spool Drive
75. SEAL, Torsion Bar to Stub Shaft "O" Ring
76. "O" RING, Strg. Gear Valve Spool Dampener
77. SEAL, Adjusting Plug to Housing "O" Ring
78. RETAINER, Upper Thrust Bearing
79. RACE, Upper Thrust Bearing—Lower
80. BEARING, Valve Assy., Upper Thrust
81. RACE, Upper Thrust Bearing—Upper
82. BEARING, Stud Shaft Needle
83. BOLT, Strg. Shaft Coupling to Upper Flange
84. REINFORCEMENT, Steering Gear Coupling
85. WASHER, Strg. Gear Shaft Flange Bolt
86. RIVET, Steering Shaft Coupling (Small)

4. Assemble stub shaft assembly in valve body aligning groove in valve cap with pin in valve body (Fig. 9-65). Press on cap until cap is against shoulder in valve body with valve body pin in cap groove. Hold these parts together during remainder of assembly.

5. With notch end of spool towards valve body, install spool, aligning spool notch with pin in stub shaft.

CAUTION: Because of small clearance between valve spool and valve body, extreme care must be taken when assembling these parts. Push the spool evenly and slowly with a slight oscillating motion until spool reaches drive pin. Before pushing spool completely in, make sure dampener O-ring seal is evenly distributed in spool groove. Slowly push spool completely in, with extreme care taken not to cut or pinch O-ring seal.

6. Slide spool spring over stub shaft and work spring in position.

7. Lubricate cap to worm O-ring seal and install in valve assembly.

NOTE: If during assembly of valve, stub shaft and cap assembly is allowed to slip out of engagement with the valve body pin, spool will be permitted to enter valve body too far. Dampener O-ring seal may expand into valve body oil grooves preventing removal of spool.

a. Remove valve spool spring and disassemble rotary valve assembly.

b. Press on spool until O-ring seal is cut and spool can be removed.

c. Replace O-ring seal and proceed with assembly as before.

HOUSING

ASSEMBLE

1. With stamped end of pitman shaft needle bearing against shoulder of adapter J 6278-3, use remover and replacer J 6278-1 to drive bearing into bore from outside of housing until flush-to-1/32" below shoulder. Make sure needle bearings rotate freely.

CAUTION: Damage will result to flanged bearing used on variable ratio gears if driven into housing and bottomed out with too much force.

2. Lubricate cavity between lips of pitman shaft (double lip) seal with high melting point, water resistant wheel bearing lubricant.

3. Lubricate and install pitman shaft seals; single lip seal, inner back-up washer, double lip seal, outer dust seal and retaining ring in housing bore (Fig. 9-70). Use tool J 6219 (Fig. 9-71) for seals and Truarc pliers for retaining ring. Make sure seal lips are properly positioned, retaining ring is seated and that approximately 1/16" clearance is maintained between inner seal (single lip) and bearing.

4. If connectors were removed, install new connectors by driving into place with tool J 6217 (Fig. 9-72).

RACK-PISTON NUT AND WORM

ASSEMBLE

1. Lubricate and install new ring back-up seal and teflon piston ring on rack-piston nut being careful ring and seal do not twist during installation.

2. Insert worm into rack-piston nut to bearing shoulder (Fig. 9-73).

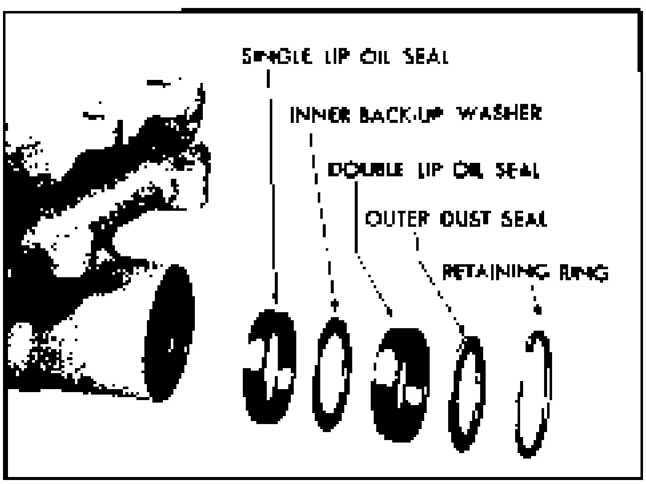


Fig. 9-70 Pitman Shaft Seals and Washers

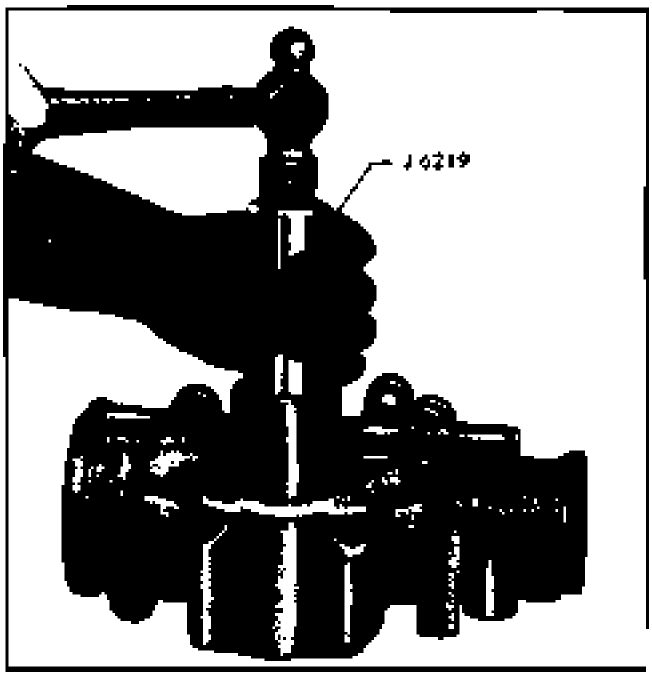


Fig. 9-71 Installing Pitman Shaft Seals Using J 6219

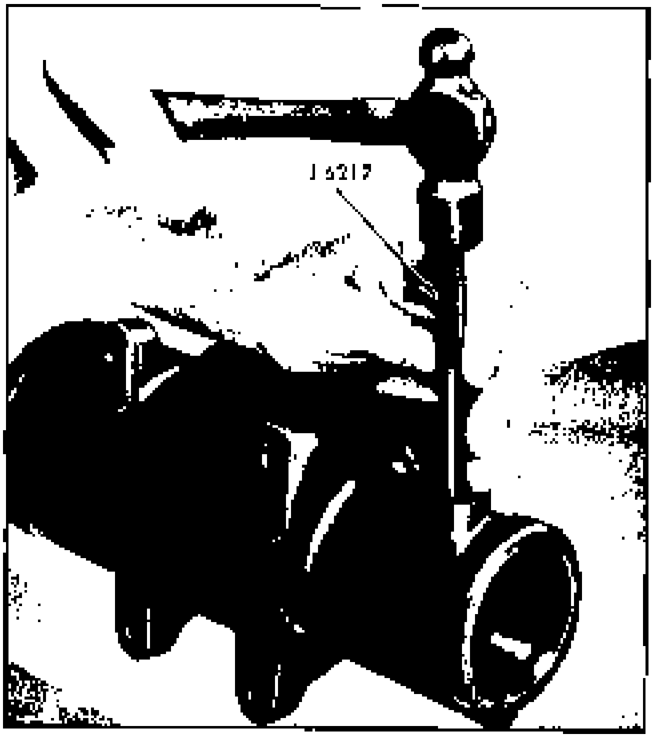


Fig. 9-72 Installing Connector Using J 6217

3. Align ball return guide holes with worm groove. Load 15 balls into the guide hole nearest Teflon piston ring on constant ratio gears and load 17 balls on variable ratio gears. While slowly rotating worm to left, feed balls through the circuit. Alternate black balls with silver balls. If balls are installed properly, worm should turn out of rack-piston nut.

4. Fill one-half of ball return guide with remaining 7 balls. Place other guide over balls and plug each end with heavy grease to prevent balls from falling out when installing guides into rack-piston nut (Fig. 9-74).

5. Insert guides into guide holes of rack-piston nut. Guides should fit loosely.

Fig. 9-73 Loading Rack Piston Nut

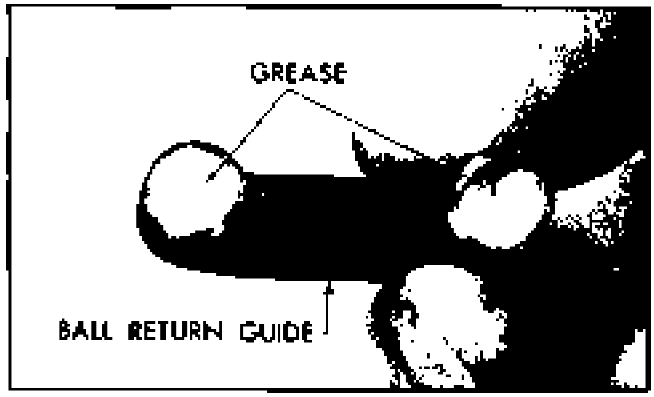


Fig. 9-74 Ball Return Guide

6. Place return guide clamp over guides and install two screw and lock washer assemblies and tighten to 10 lb. ft. torque.

CHECK WORM PRELOAD

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 0.5-3.0 lb. in. torque should be obtained with gears from Pontiac Catalina models without air conditioning and all Tempest and Firebird models or 1.5-4.5 lb. in. torque on all Pontiac and Grand Prix models except Pontiac Catalina models without air conditioning.

NOTE: DO NOT refit rack-piston balls unless a complaint of loose steering is received. Upon such a

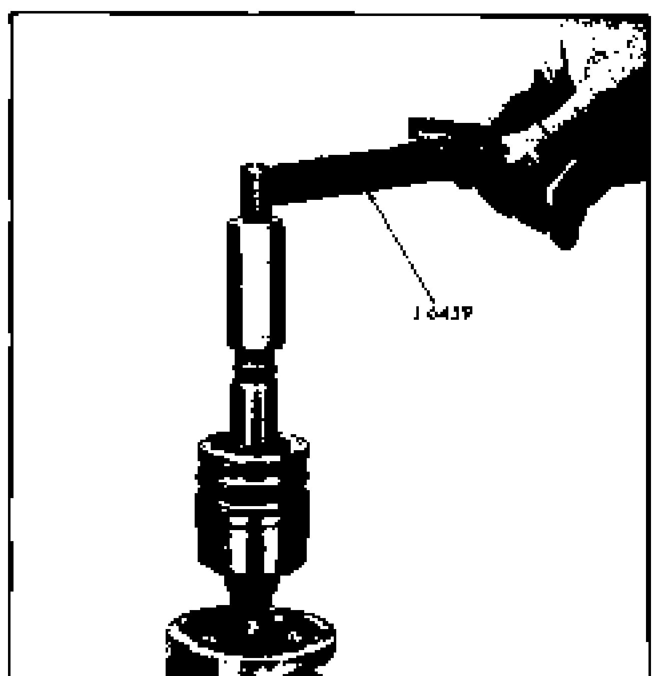


Fig. 9-75 Checking Worm Preload

complaint, a thrust bearing adjustment and over center (high point) adjustment should correct problem if it lies in steering gear.

1. With worm pointing up, lightly clamp rack-piston nut in a bench vise having brass jaws.

CAUTION: Do not hold rack-piston nut in area of Teflon ring.

2. Place valve assembly on worm, engaging worm drive pin.

3. Rotate worm until it extends 1 1/4" from rack-piston nut to thrust bearing face. This is center (high point) position.

4. Attach an inch-pound torque wrench with 3/4" 12-point socket to stub shaft (Fig. 9-75).

5. Oscillate wrench through a total arc of approximately 1/2 turn left and 1/2 turn right from center (high point) several times and take a reading. Highest reading obtained with worm rotating should be 0.5 to 3.0 lb. in. torque with gears from Pontiac Catalina models without air conditioning and all Tempest and Firebird models or 1.5-4.5 lb. in. torque on all Pontiac and Grand Prix models except Pontiac Catalina models without air conditioning. Record torque when in specifications.

NOTE: DO NOT use torque wrench having maximum torque reading of more than 100 lb. in. When taking following torque readings, take a reading pulling torque wrench to right and a reading pulling torque wrench to left. Total both readings and take one-half of this total as average torque.

NOTE: DO NOT refit rack-piston balls unless a complaint of loose steering is received. Upon such a complaint, a thrust bearing adjustment and over center (high point) adjustment should correct problem if it lies in steering gear. If balls were pitted or rough then select proper ball size for proper adjustment.

6. If reading is too high or low (on new balls only), disassemble and reassemble, using next size smaller (or larger) balls and recheck.

TABLE OF SELECTIVE SIZES OF STEERING NUT BALLS

6	.28117"	5695512
7	.28125"	5695513
8	.28133"	5695514
9	.28141"	5695515
10	.28149"	5695516
11	.28157"	5695517

A rack-piston nut with a ball size of 7 does not have a number stamped on flat surface. For ball sizes other than No. 7, ball size is stamped on flat surface of rack piston nut. In order to obtain proper worm bearing preload install proper new balls.

7. Remove rotary valve assembly from worm head.

8. Position arbor tool J 7539 against worm end. Turn worm out of rack-piston assembly following worm end with arbor. Do not allow arbor to separate from worm until rack-piston nut is fully on arbor. The arbor now keeps the balls from dropping out of ball nut.

WORM SHAFT, ROTARY VALVE ASSEMBLY AND ADJUSTER PLUG

ASSEMBLE

1. Assemble lower thrust bearing and races on worm (Fig. 9-76).

2. Be sure O-ring seal is between valve body and worm head and assemble valve assemble to worm by aligning slot in valve body with pin on worm head.

3. Install new O-ring on adjuster plug.

4. Install adjuster plug assembly on stub shaft so bearing rests against upper bearing assembly.

ADJUST WORM BEARING PRELOAD

1. Install worm valve assembly and adjuster plug in housing as integral unit.

2. Tighten adjuster plug snug in gear housing and back off slightly (1/8 turn maximum).

3. With torque wrench on stub shaft, read torque required to rotate worm, valve assembly, and stub shaft in housing (drag).

4. Turn adjuster plug in until torque reading increases 0.5-2.0 lb. in. above drag reading obtained in step 3 above with gears from Pontiac Catalina models without air conditioning and all Tempest and Firebird models or 1.0-3.0 lb. in. torque on all Pontiac and Grand Prix models except Pontiac Catalina models without air conditioning.

NOTE: Do not use torque wrench having maximum torque reading of more than 100 lb. in. When taking following torque readings, take reading pulling torque wrench to right and a reading pulling torque wrench to left. Total both readings and take one-half of this total as average torque.

5. Install adjuster plug lock nut and tighten to 80 lb. ft. torque.

6. Recheck thrust bearing preload. Total thrust bearing

adjustment plus drag should not exceed 7.0 lb. in. torque with gears from Pontiac Catalina without air conditioning and all Tempest and Firebird models or 8.0 lb. in torque on all Pontiac and Grand Prix models except Pontiac Catalina models without air conditioning.

RACK-PISTON

INSTALL

1. Slip stub shaft flexible coupling onto end of stub shaft.

2. Holding teflon ring compressor sleeve tool J 6947 or J 7576 tightly against the shoulder of gear housing, insert the rack-piston nut and arbor into housing holding the arbor (tool J 7539) until arbor contacts worm end. Use tool J 6947 on Pontiac Catalina models without air conditioning and all Tempest and Firebird models or tool J 7576 on all Pontiac and Grand Prix models except Pontiac Catalina models without air conditioning (Fig. 9-77).

CAUTION: Be certain that no balls drop out.

3. Remove arbor and sleeve.

PITMAN SHAFT GEAR AND SIDE COVER

INSTALL

1. Turn worm shaft until center groove of rack-piston is aligned with center of pitman shaft needle bearing.

2. Install new side cover O-ring seal.

3. Install pitman shaft gear so that center tooth of gear meshes with center groove of rack-piston. Make sure that side cover O-ring seal is in place before pushing cover against housing.

4. Install side cover screws and tighten to 30 lb. ft. torque.

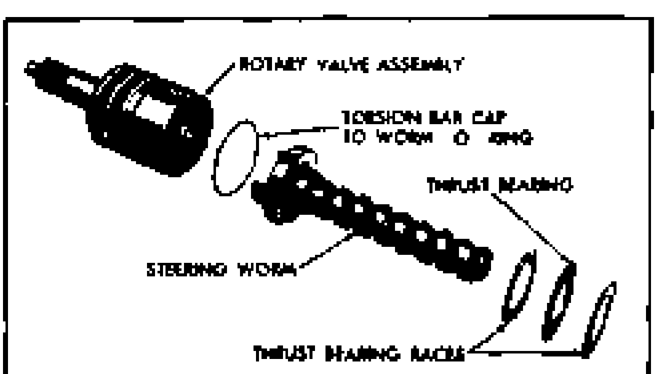


Fig. 9-76 Exploded View of Worm Shaft and Rotary Valve

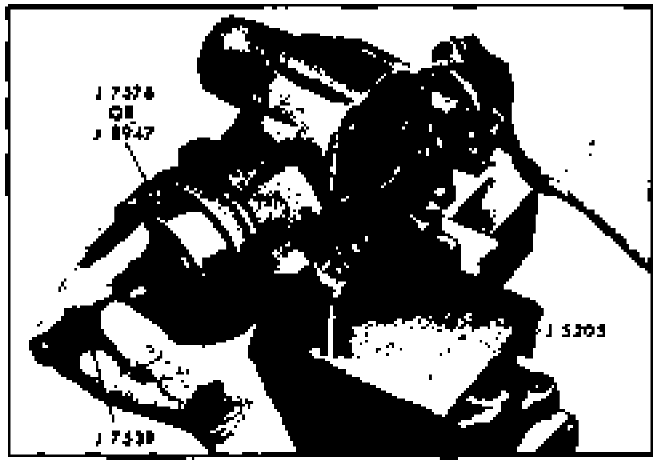


Fig. 9-77 Installing Rack Piston Nut

5. Install end plug in rack-piston nut, using 1/2" square drive. Tighten to 75 lb. ft. torque.

HOUSING LOWER END PLUG

INSTALL

1. Install new housing end plug O-ring seal.

2. Insert end plug into gear housing and seat against O-ring seal. Slight pressure may be necessary to seat end plug properly.

3. Install end plug retainer ring so end of ring extends over 1/2" beyond ring removal assist hold (Fig. 9-69).

OVERCENTER OR PITMAN SHAFT ADJUSTMENT

NOTE: DO NOT use a torque wrench having maximum torque reading of more than 100 lb. in. When taking

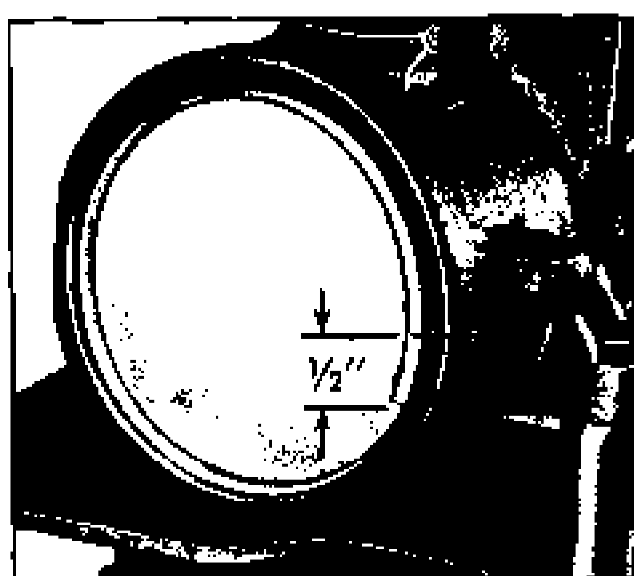


Fig. 9-78 Installing End Plug Retainer Ring

following torque readings, take reading pulling torque wrench to right 1/2 turn and reading pulling torque wrench to left 1/2 turn each side of center (high point). Total both readings and take one-half of this total as average torque.

Use a 3/4"-12 point deep socket and pound-inch torque wrench (Fig. 9-79), take a reading through center (high point) position to determine total drag, thrust bearing adjustment, and rack and worm preload. Adjust lash adjuster so torque is 4.0 to 8.0 in. lb. in excess of total reading found above.

Total over center (high point) preload must not exceed 18 lb. in. torque. Tighten lash adjuster lock nut to 25 lb. ft. torque. Recheck preload after lock nut has been tightened.

FLEXIBLE COUPLING

INSTALL

1. Install coupling on stub shaft aligning flat surface on the stub shaft serrations with flat section in flange hole.
2. Install coupling clamping bolt and tighten to 30 lb. ft. torque.

NOTE: Be sure to position coupling so that it clears end of adjuster plug by approximately 1/16" and rotates without interference with adjuster plug.

STEERING GEAR

INSTALL

1. Position steering gear assembly in car, aligning large head rivet in widest upper flange opening (Figs. 9-12, 9-80, 9-81, 9-82 and 9-83).

NOTE: Metal-to-metal contact between flanges on stub shaft assembly and steering shaft assembly will transmit and amplify gear noise to the driver.

2. Install steering housing to frame bolts finger-tight. Shift gear assembly to obtain best alignment with flange on steering shaft. Tighten housing to frame bolts to 70 lb. ft. torque.

3. Install pitman arm and secure with lock washer and nut. Tighten nut to 140 lb. ft. torque.

4. Connect pressure and return hose assemblies to gear assembly and tighten to 25 lb. ft. torque.

5. Install two flange flexible coupling attaching nuts and lock washers and tighten to 20 lb. ft. torque.

6. Check fluid level in pump reservoir. Fluid should be up to oil level mark in reservoir. Add GM power steering fluid or equivalent as necessary. DO NOT use type "A" automatic transmission fluid, except in an emergency if power steering fluid is not available. With front wheels off floor, start engine and bleed hydraulic system by manually steering through cycle several times until there is no evidence of air bubbles in reservoir. Re-check fluid level and lower car.

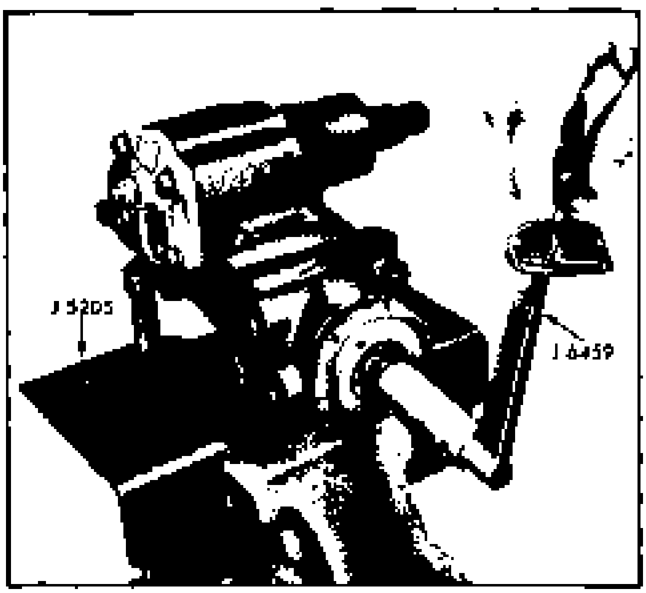


Fig. 9-79 Adjusting Pitman Shaft Preload

POWER STEERING PUMP

GENERAL INFORMATION

No periodic service of the pump is required except checking oil level in reservoir as outlined in GENERAL LUBRICATION Section.

ADJUSTMENT PROCEDURES

ADJUST PUMP BELT TENSION

1. Loosen pump plate (support) to bracket bolts two full turns.

2. Tighten belt with power steering pump to give 103 lbs. as indicated on Burroughs gage for used belt and 143 lbs. for new belt.

3. Holding adjustment, tighten pump plate to bracket bolts.

PUMP PRESSURE TEST

1. Disconnect pressure hose at union on pump, use a small container to catch any fluid which might leak.

2. Connect a spare pressure hose to pump union.

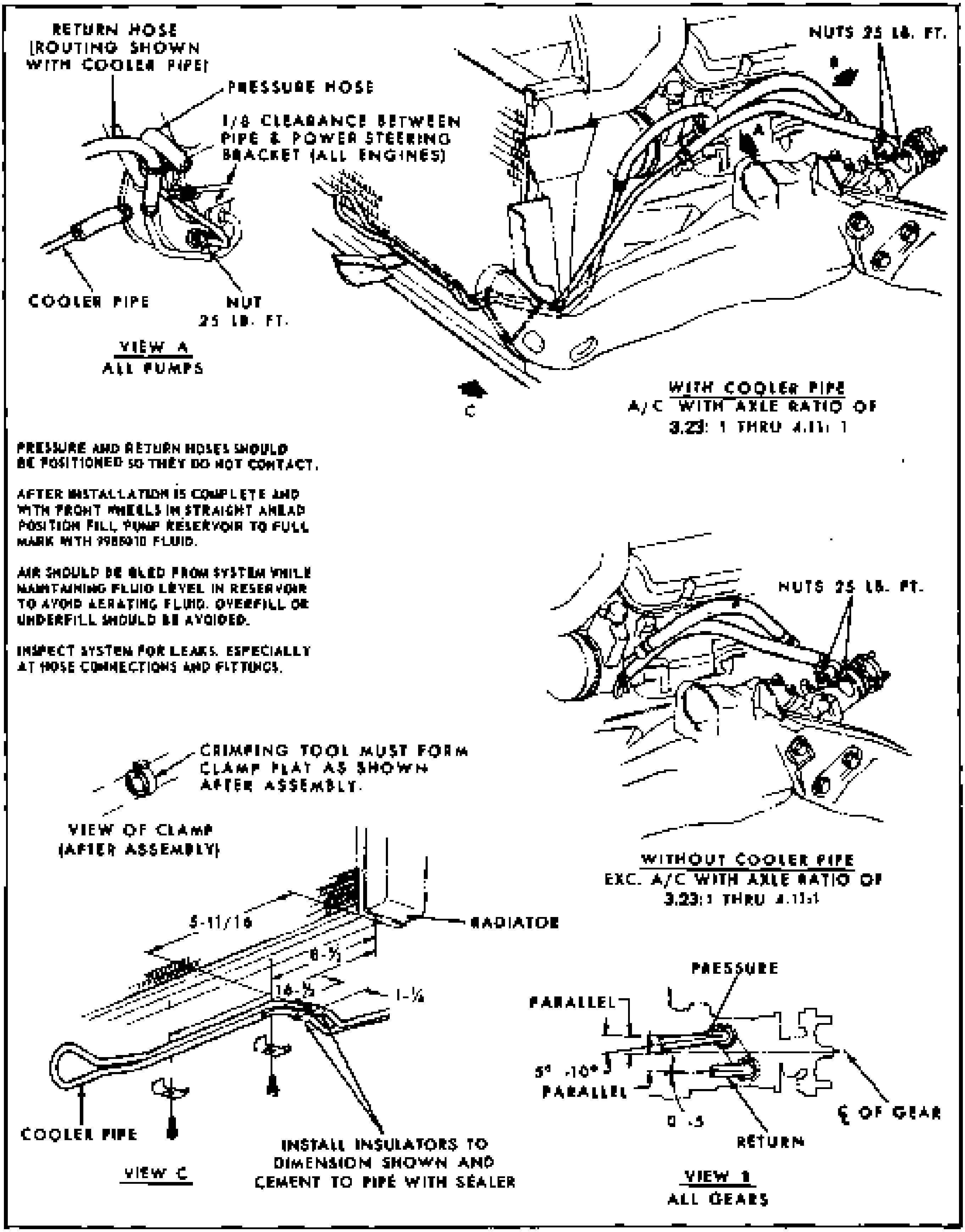


Fig. 9-80 Pontiac Installation of Power Steering Gear Assembly

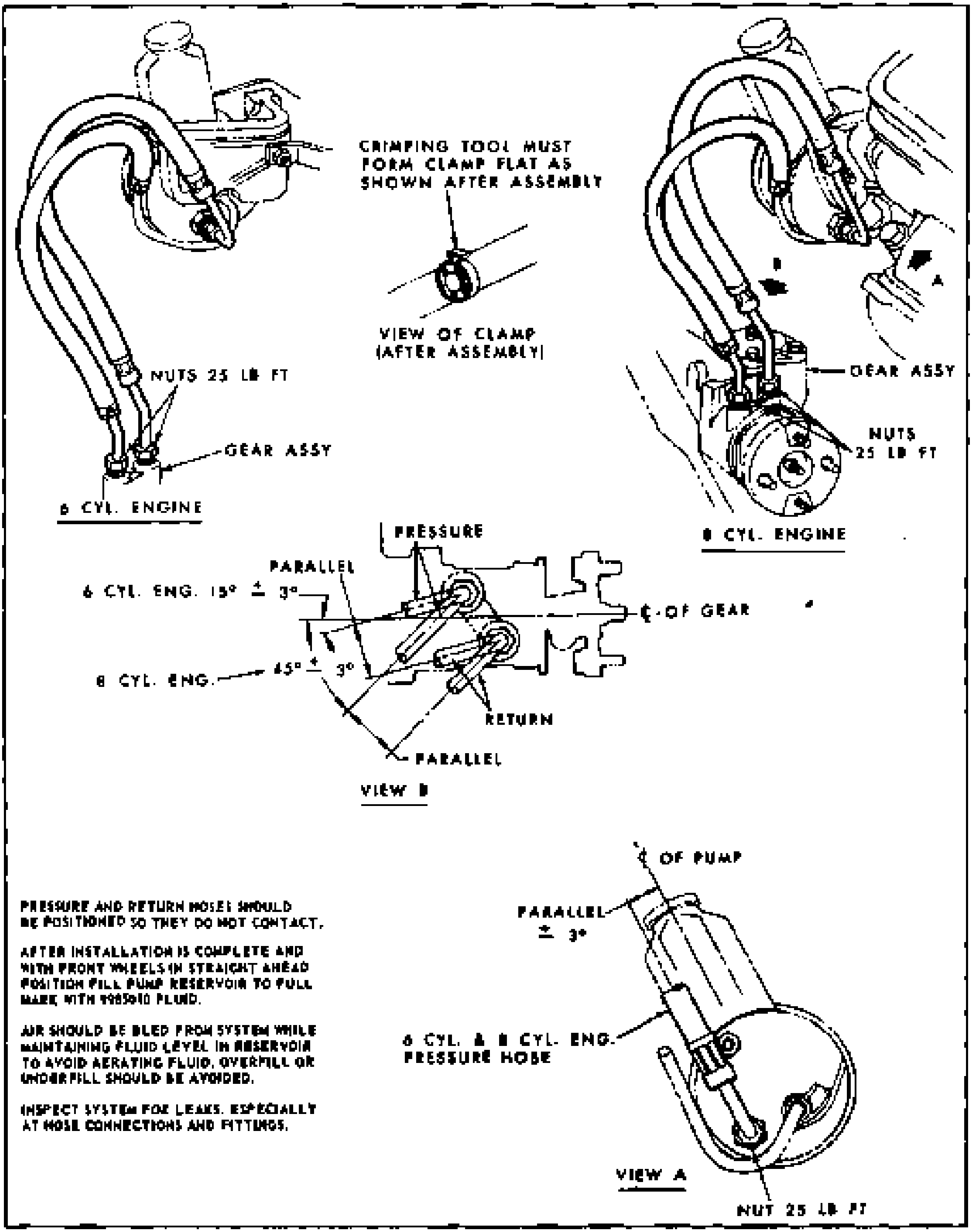


Fig. 9-81 Tempest Installation of Power Steering Gear Assembly

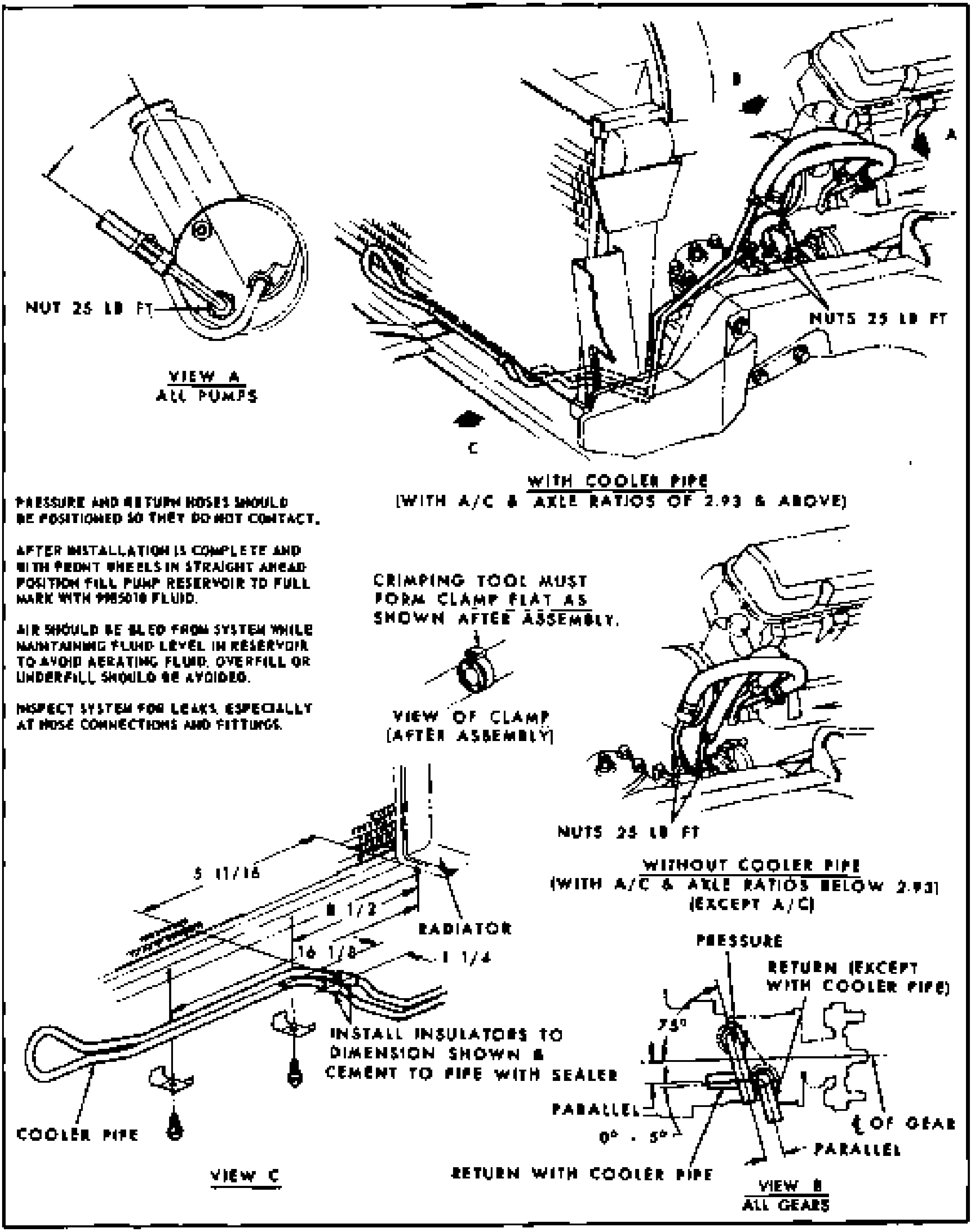


Fig. 9-82 Grand Prix Installation of Power Steering Gear Assembly

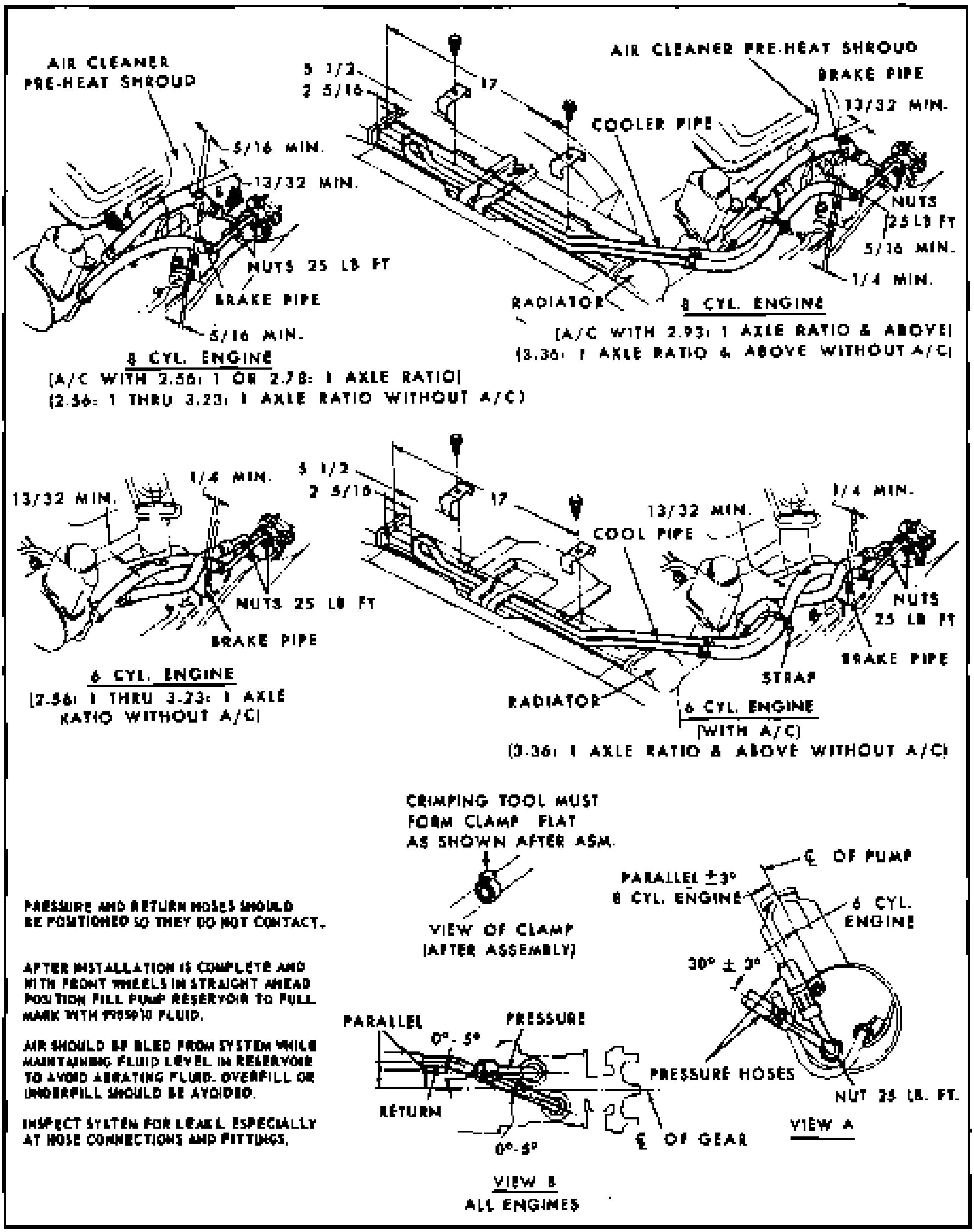


Fig. 9-83 Firebird Installation of Power Steering Gear Assembly

3. Using pressure gage J 5176-1, adapter fitting J 22326, connect gage to both hoses.

4. Open hand valve on gage.

5. Start engine, allow system to reach operating temperatures and check fluid level adding any fluid if required.

6. Turn steering wheel slowly to left or right until wheel is at full turn position. Holding wheel in this position, read pressure on gage, pressure should be at least 1100 psi on all Tempest models; 1250 psi on Pontiac Catalina models without air conditioning and all Firebird models; 1200 psi on all other Pontiac and Grand Prix models except Pontiac Catalina models without air conditioning. If pressure does not reach specification, there is either internal leakage in steering gear or pump is malfunctioning.

NOTE: Vehicle's front wheel must be on ground and supporting weight of vehicle. Do not hold steering wheel at full turn for over 5 seconds, this will prevent damage to pump.

7. To determine which problem exists, slowly close hand valve on gage, pressure should read 1100 to 1200 psi on all Tempest models; 1250 to 1350 psi on Pontiac Catalina models without air conditioning and all Firebird models; 1200 to 1300 psi on all other Pontiac and Grand Prix models except Pontiac Catalina models without air condition.

NOTE: Do not hold hand valve on gage closed for over 5 seconds during this test to prevent damage to pump.

8. If pressure does not reach specifications in step 7, pump is malfunctioning.

9. If pressure is within specifications in step 7, problem is due to internal leakage in steering gear.

10. Shut off engine, remove testing gage, spare hose, reconnect pressure, check fluid level or make needed repairs.

MINOR SERVICE

FLOW CONTROL VALVE

REPLACE (WITHOUT REMOVING PUMP FROM CAR)

1. Disconnect pressure hose from pump union and drain oil.

2. Remove union from pump.

3. Using a magnet, withdraw flow control valve then spring from pump.

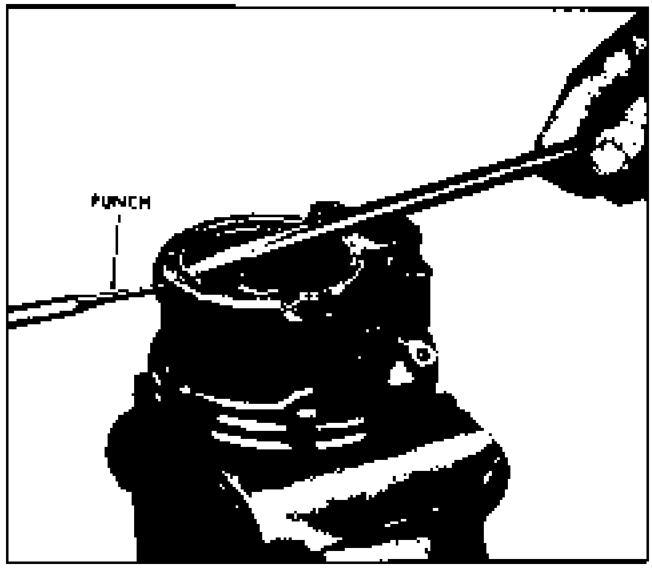


Fig. 9-84 Removing Retaining Ring

4. Install valve by reversing above steps, be sure that O-ring seal on union is replaced and flow control valve is installed in the proper direction.

MAJOR SERVICE

PUMP

REMOVE

1. Disconnect hoses at pump. When hoses are disconnected, secure ends in raised position to prevent drainage of oil.

2. Install two caps at pump fittings to prevent drainage of oil from pump.

3. Remove drive pulley attaching nut.

4. Loosen bracket to pump mounting bolts.

5. Remove pump belt.

6. Slide pulley from shaft. Do not hammer on rim of pulley as this will damage pulley or pump.

7. Remove bracket to pump bolts.

8. Drain pump of oil.

9. Clean exterior of pump.

PUMP

DISASSEMBLE

CAUTION: In clamping pump in vise, be careful not to exert excessive force on front hub of pump as this may distort bushing.

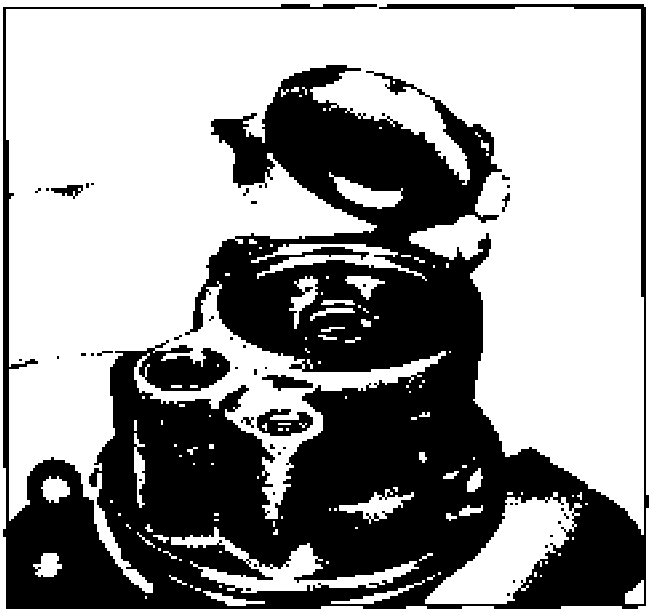


Fig. 9-85 Removing End Plate

1. Remove union and seal.

2. Remove pump rear mounting bolts.

3. Lift reservoir from housing by tapping reservoir at flange, rocking back and forth.

4. Remove mounting bolt and union O-ring seals.

5. Remove end plate retaining ring. Push end plate retaining ring out of groove, using a punch through 1/8" diameter hole in pump housing (Fig. 9-84) and remove with screwdriver. End of retaining ring should be next to hole to ease removal.

Fig. 9-86 Removing Flow Control Valve

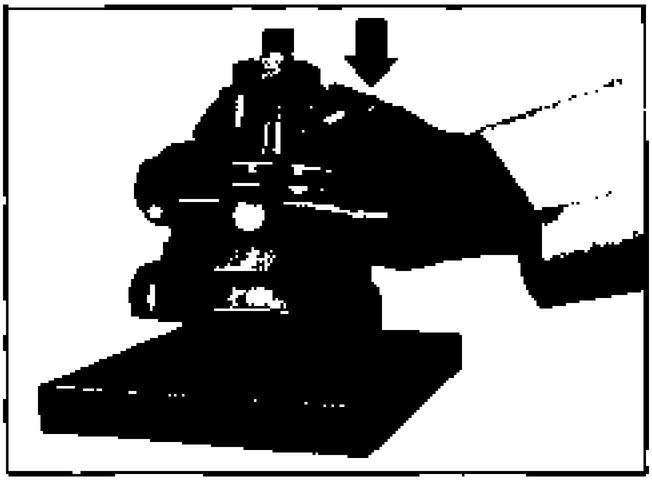


Fig. 9-87 Removing Pressure Plate

6. Remove end plate and spring. End plate is spring loaded and will generally sit above the housing level. If sticking should occur, a slight tapping action will free the plate (Fig. 9-85).

7. Remove end plate O-ring.

8. With pump housing turned over, remove flow control valve and spring (Fig. 9-86) and tap housing on wood block until pressure plate falls free (Fig. 9-87).

9. Remove pressure plate, pump ring and vanes, being careful not to drop parts (Fig. 9-88).

10. Remount housing in vise. Using a suitable tool, remove shaft retainer ring on end of drive shaft. Discard ring.

11. Remove rotor and thrust plate.

12. Remove shaft through front of housing (Fig. 9-89).

CLEANING AND INSPECTION

Carefully clean all parts, except O-ring seals which are to be replaced and should not be immersed in cleaning solvent. Lubricate all O-ring seals and the drive shaft seal with vaseline and install in proper location. Be sure not to immerse drive shaft seal in cleaning solvent as this could damage it. Fig. 9-90 shows an exploded view of the pump.

PUMP

ASSEMBLE

NOTE: Be sure all parts are clean during reassembly.

1. Insert shaft at hub end of housing, spline end entering mounting face side (Fig. 9-91).

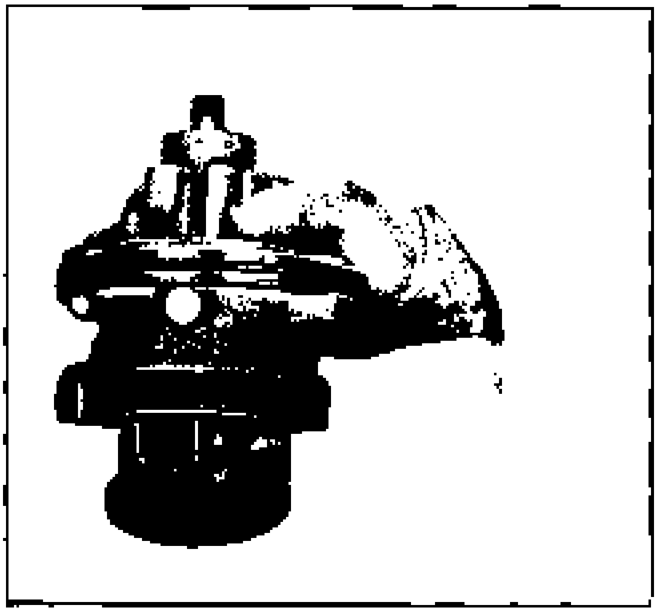


Fig. 9-88 Pressure Plate and Rotor Ring Removed

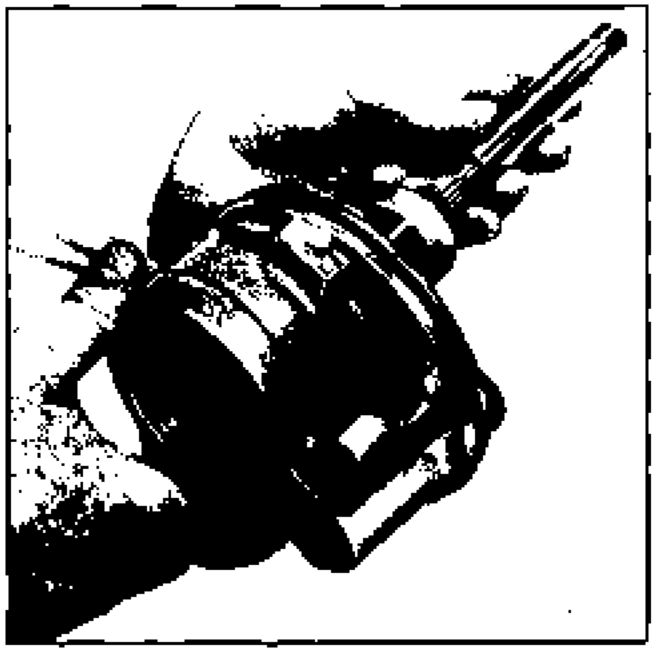


Fig. 9-89 Removing Pump Shaft

2. Install thrust plate on dowel pins with ported face to rear of pump housing (Fig. 9-92).

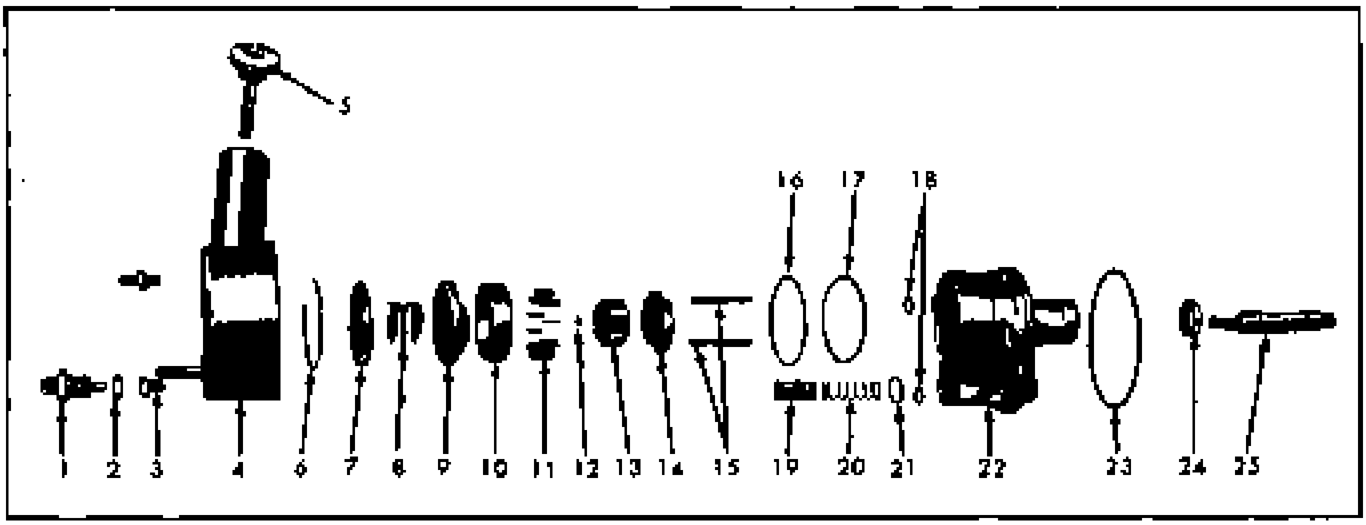
3. Install rotor (must be free on splines) on pump shaft at splined end

NOTE: Assemble rotor with flat side toward rear of pump (Fig. 9-93).

4. Using suitable tool, install new shaft retainer ring.

5. Install pump ring on dowel pins with rotation arrow facing to rear of pump housing (Fig. 9-94).

6. Install vanes in rotor slots with radius edge towards outside (Figs. 9-95 and 9-96).



1. Union
2. Seal
3. Mounting Bolts
4. Reservoir
5. Dip Stick and Cover
6. End Plate Retaining Ring
7. End Plate
8. Spring
9. Pressure Plate
10. Pump Ring
11. Vanes
12. C-Washer
13. Rotor
14. Thrust Plate
15. Dowel Pins
16. End Plate O-Ring
17. Pressure Plate O-Ring
18. Mounting Bolt O-Ring Seals
19. Flow Control Valve
20. Flow Control Valve Spring
21. Flow Control Valve O-Ring Seal
22. Pump Housing
23. Reservoir O-Ring Seal
24. Shaft Seal
25. Drive Shaft

Fig. 9-90 Exploded View of Power Steering Pump

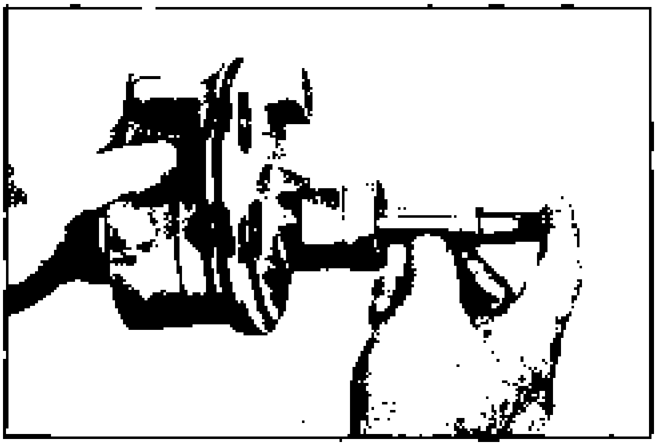


Fig. 9-91 Installing Pump Shaft

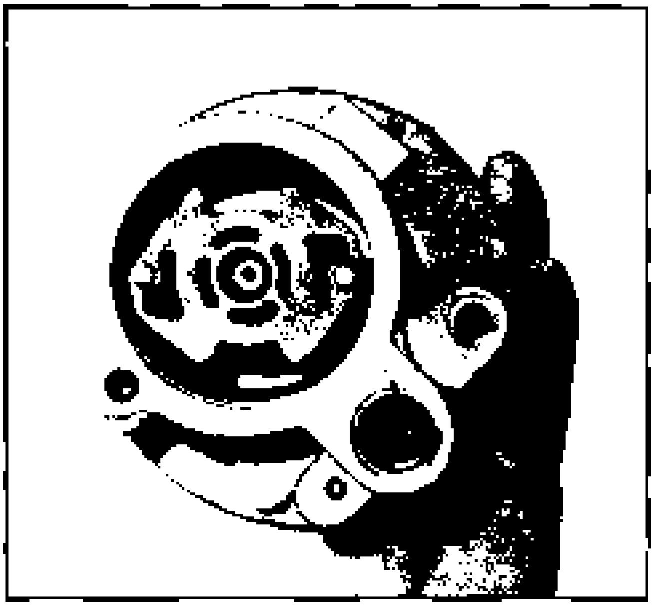


Fig. 9-92 Thrust Plate Installed

Fig. 9-93 Installing Rotor

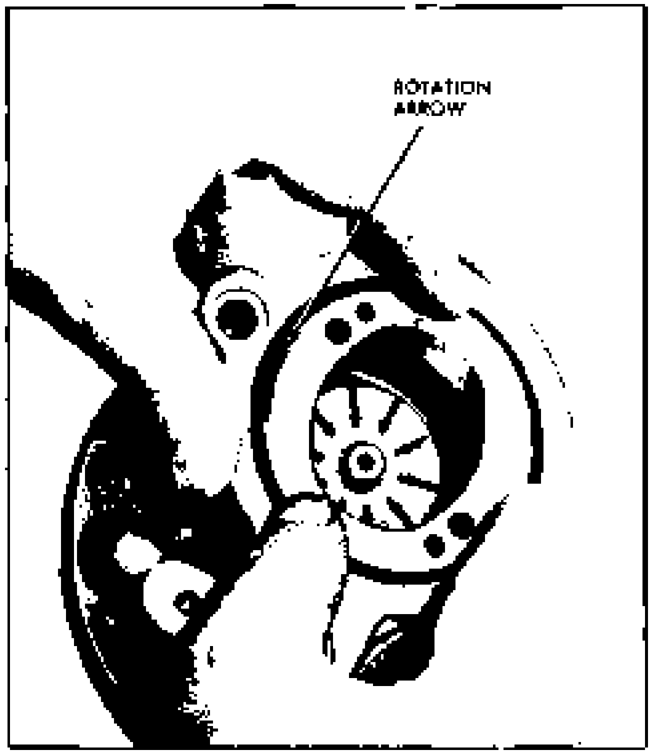


Fig. 9-94 Installing Pump Ring

7. Lubricate outside diameter and chamber of pressure plate with petroleum jelly to insure against damaging O-ring and install on dowel pins with ported face toward pump ring. Applying pressure to outer edge only, seat pressure plate. Never press or hammer on the center of the pressure plate as this will cause

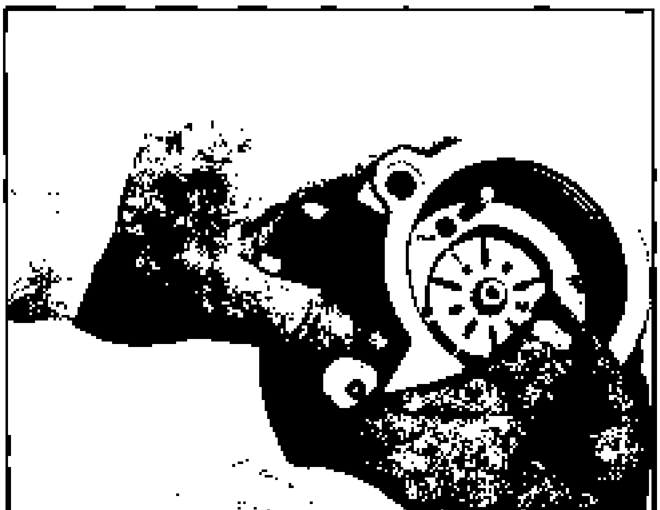


Fig. 9-95 Installing Pump Vanes

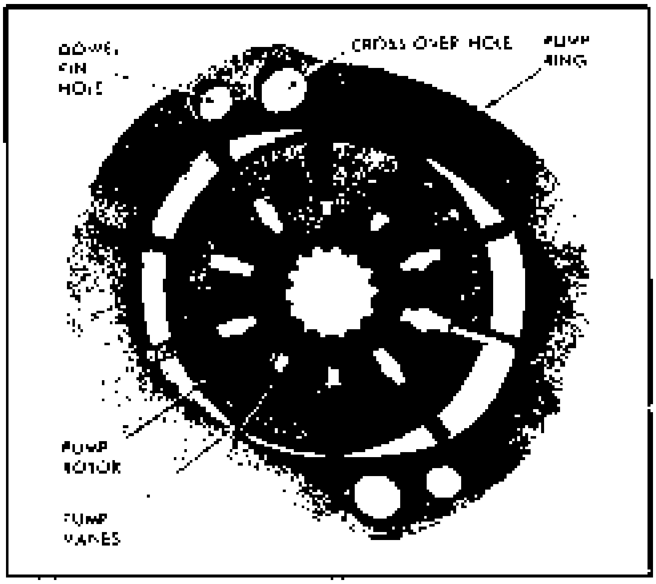


Fig 9-96 Pump Vanes Installed

permanent distortion with resulting pump failure. (Pressure plate will travel about 1/16" to seat.)

8. Install end plate O-ring

9. Install pressure plate spring in center groove of pressure plate (Fig. 9-97).

10. Lubricate outside diameter of end plate with petroleum jelly to insure against damaging O-ring and install in housing using an arbor press.

11. Install end plate retaining ring while pump is in

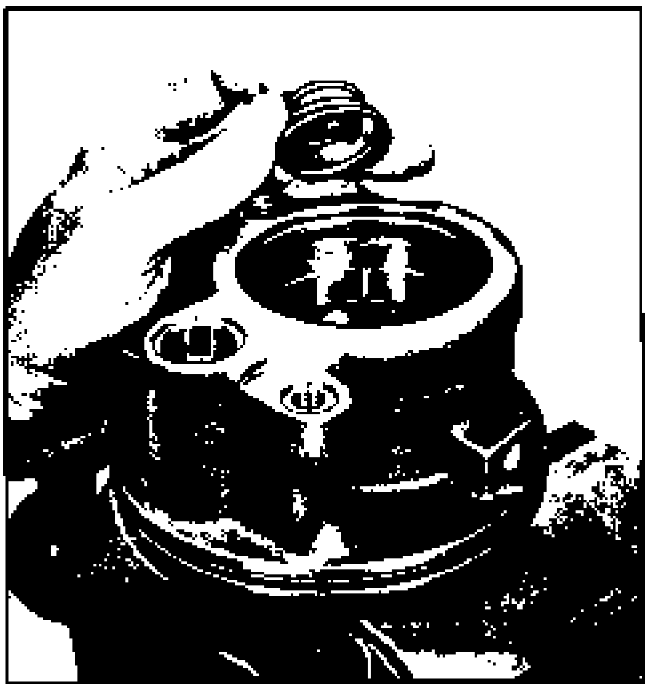


Fig. 9-97 Installing Pressure Plate Spring

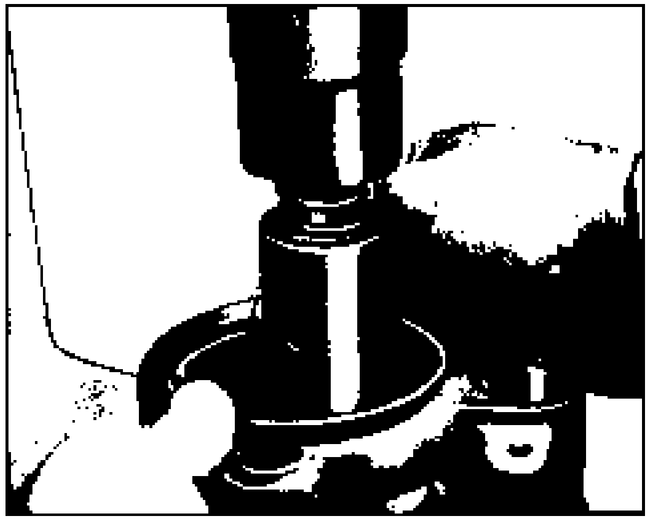


Fig. 9-98 Installing End Plate

arbor press. Be sure it is completely seated in the groove of the housing (Fig. 9-98)

12. Install flow control spring and flow control plunger. Be sure end with screen goes into bore first.

13. Install mounting bolt and union O-rings.

14. Drop reservoir into place and press down until reservoir seats on housing.

15. Install studs and outlet union, and torque to 35 lb. ft. Install drive shaft key. Support shaft on opposite side of key when installing key.

INSTALL

1. Position pump assembly on mounting bracket with holes lined up and install bolts loosely (Figs. 9-88 and 9-89).

2. Slide pulley on shaft. 3. Install pulley nut finger-tight.

4. Connect and tighten hose fitting. Tighten outlet fitting to 25 lb. ft. torque.

5. Install pump belt over pulley last to avoid damage to belt.

6. Move pump until belt has 143 lbs. as indicated on the Burroughs gage for initial tension of a new belt, tighten used belt to 103 lbs. Tighten mounting bolts to 30 lb. ft. torque.

7. Tighten pulley nut to 60 lb. ft. torque.

8. Fill reservoir with GM power steering fluid or equivalent. Bleed pump by turning pulley backward

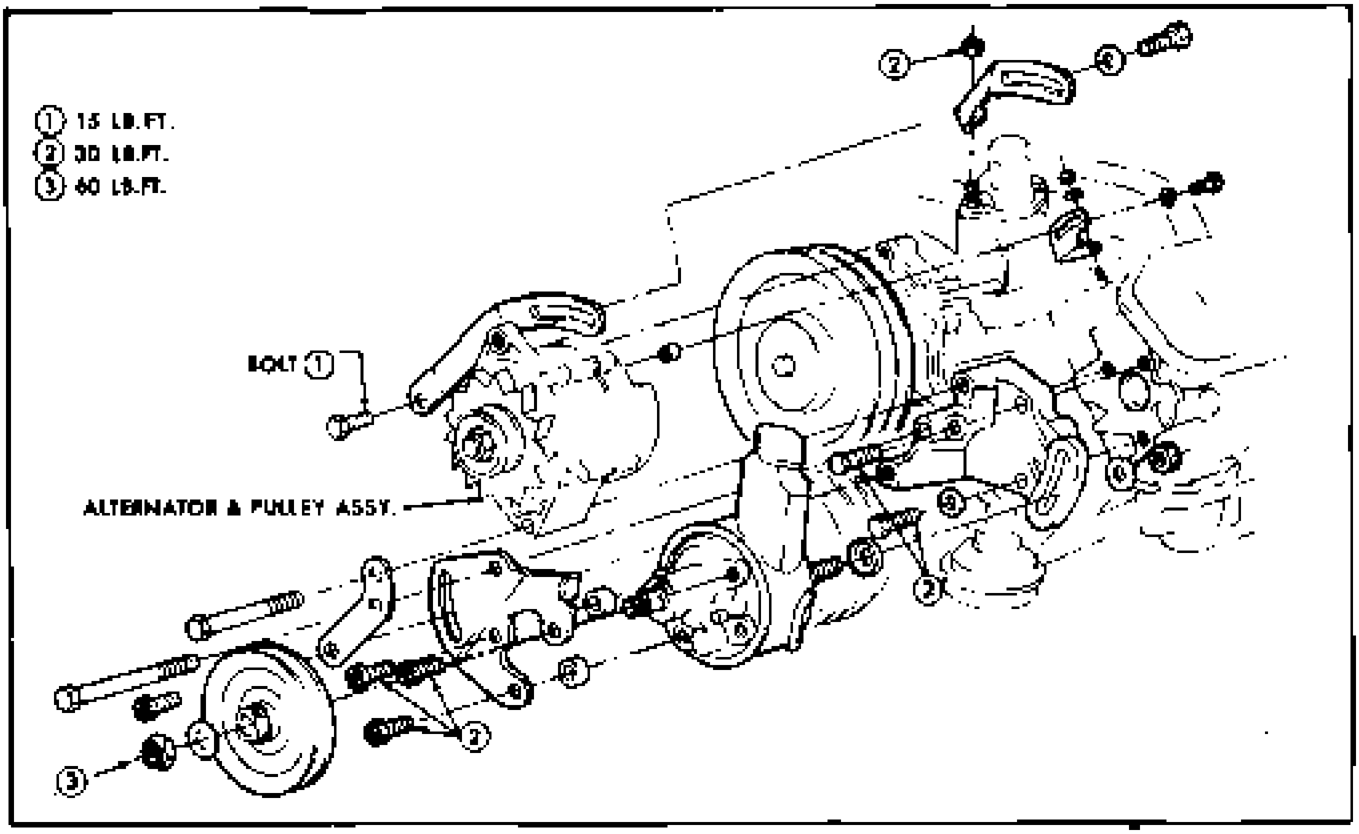


Fig. 9-99 Installation of Power Steering Pump for V-8 Engines

(counterclockwise as viewed from front) until air bubbles cease to appear.

COOLER PIPE - PONTIAC AND GRAND PRIX

REMOVE

1. Drain radiator.
2. Disconnect transmission cooler lines from radiator if car is equipped with automatic transmission.
3. Cut each clamp attaching each return hose to cooler pipe (Fig. 9-80 and 9-82). Discard clamps.
4. Disconnect upper and lower radiator hoses.
5. Remove fan blade.
6. Remove screws attaching shroud to radiator support.
7. Remove radiator with shroud from car.
8. Remove screws attaching two cooler pipe brackets to bottom of radiator and remove cooler pipe.

INSTALL

1. Install cooler pipe by reversing above steps.
2. Tighten fan blade bolts to 20 lb. ft. torque.
3. Fill radiator with coolant.
4. Check and correct transmission fluid level.
5. Check and correct power steering fluid level.
6. Check for fluid leaks at all hose and pipe connections that were disconnected.

GENERAL SPECIFICATIONS

MANUAL STEERING

Type: Saginaw Recirculating Ball Nut
Steering Gear Ratio
Pontiac, Tempest, Grand Prix, Firebird (except Firebird V-8 with A/C). . 24:1
Firebird V-8 with A/C 28:1

Lubricant Capacity . . . . 11 Fluid Ounces
Worm Bearing Preload. . . . . 7 lb. in.
Overcenter or Pitman Shaft Adjustment (in excess of Worm Bearing Preload) . . . . 4 to 10 lb. in.
(Total worm bearing adjustment, pitman shaft adjustment and drag not to exceed 16 lb. in.)

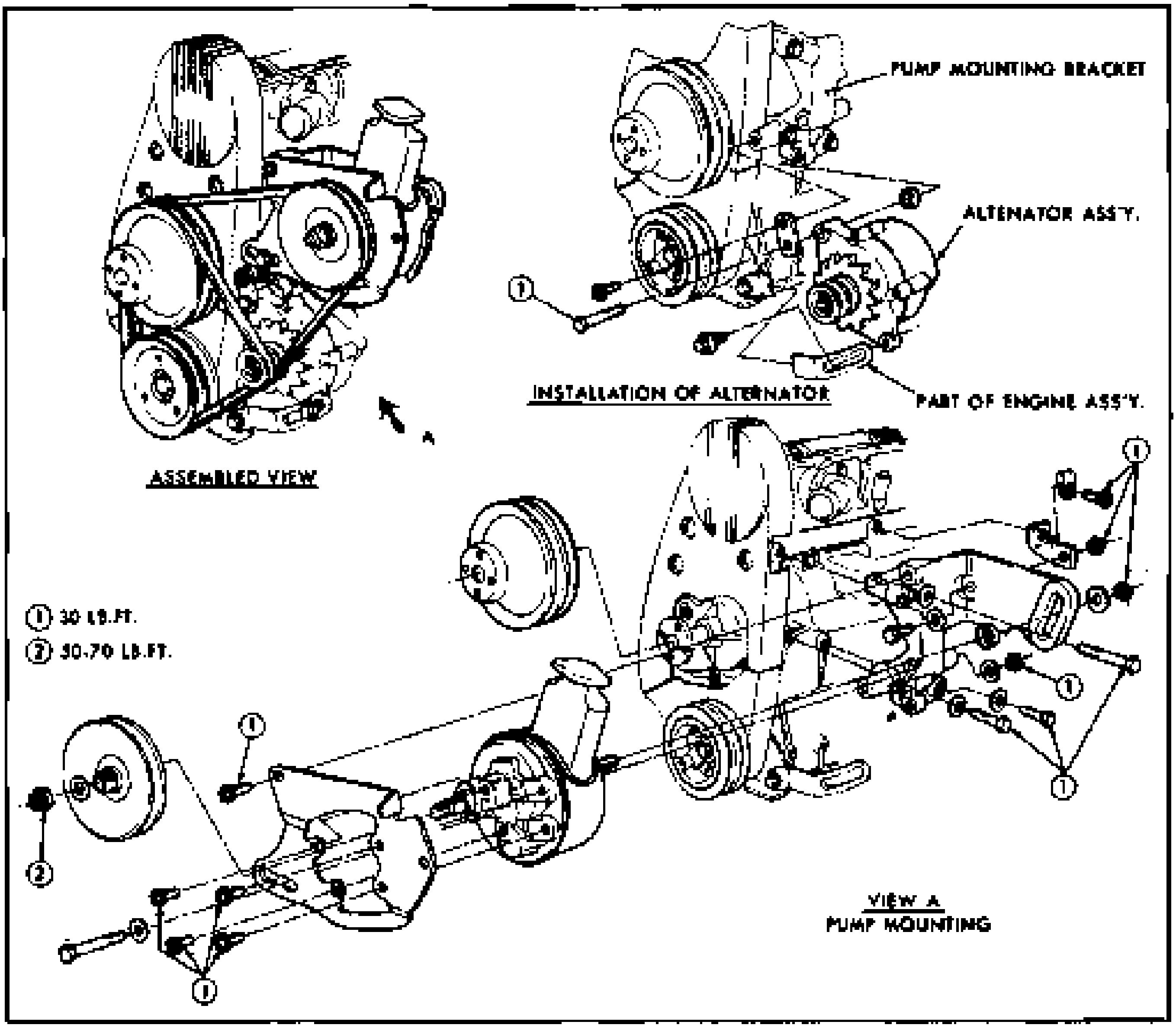


Fig. 9-100 Installation of Power Steering Pump for 6 Cyl. Engines

POWER STEERING

Type: Saginaw Rotary Valve
Steering Gear Ratio
Tempest (except G.T.O.) .... 17.5:1 (Constant Ratio)
G.T.O. .... 15:1 (Constant Ratio)
Pontiac, Grand Prix
and Firebird ..... 16:1 to 12.2:1 (Variable Ratio)
Number of Turns of Steering Wheel Stop to Stop
(Pitman Arm Disconnected)
17.5:1 Ratio .... 4.0 (approx.)
15:1 Ratio .... 3.5 (approx.)
Variable Ratio .... 3.0 (approx.)
Power Steering Pump Pressures
Tempest Models (all) .... 1100 to 1200 psi
Pontiac and Grand Prix Models
(except Pontiac Catalina
without A/C .... 1200 to 1300 psi
Firebird and Pontiac Catalina
without A/C .... 1250 to 1350 psi
Fluid Capacity .... 2.5 pints
Oil Cooler Pipe .... Variable Ratio Steering Only (some models)

Worm Bearing Preload
Pontiac and Grand Prix (except
Pontiac Catalina without A/C) .. 1.5 to 4.5 lb. in.
Tempest, Firebird and Pontiac
Catalina without A/C .... 0.5 to 3.0 lb. in.
Overcenter or Pitman Shaft Adjustment
(in excess of Worm Bearing Preload) .. 4 to 8 lb. in.
(Total worm bearing adjustment, pitman shaft adjustment and drag not to exceed 18 lb. in.)
Belt (Tension on Burroughs Gage):
New .... 143 lbs.
Used .... 103 lbs.

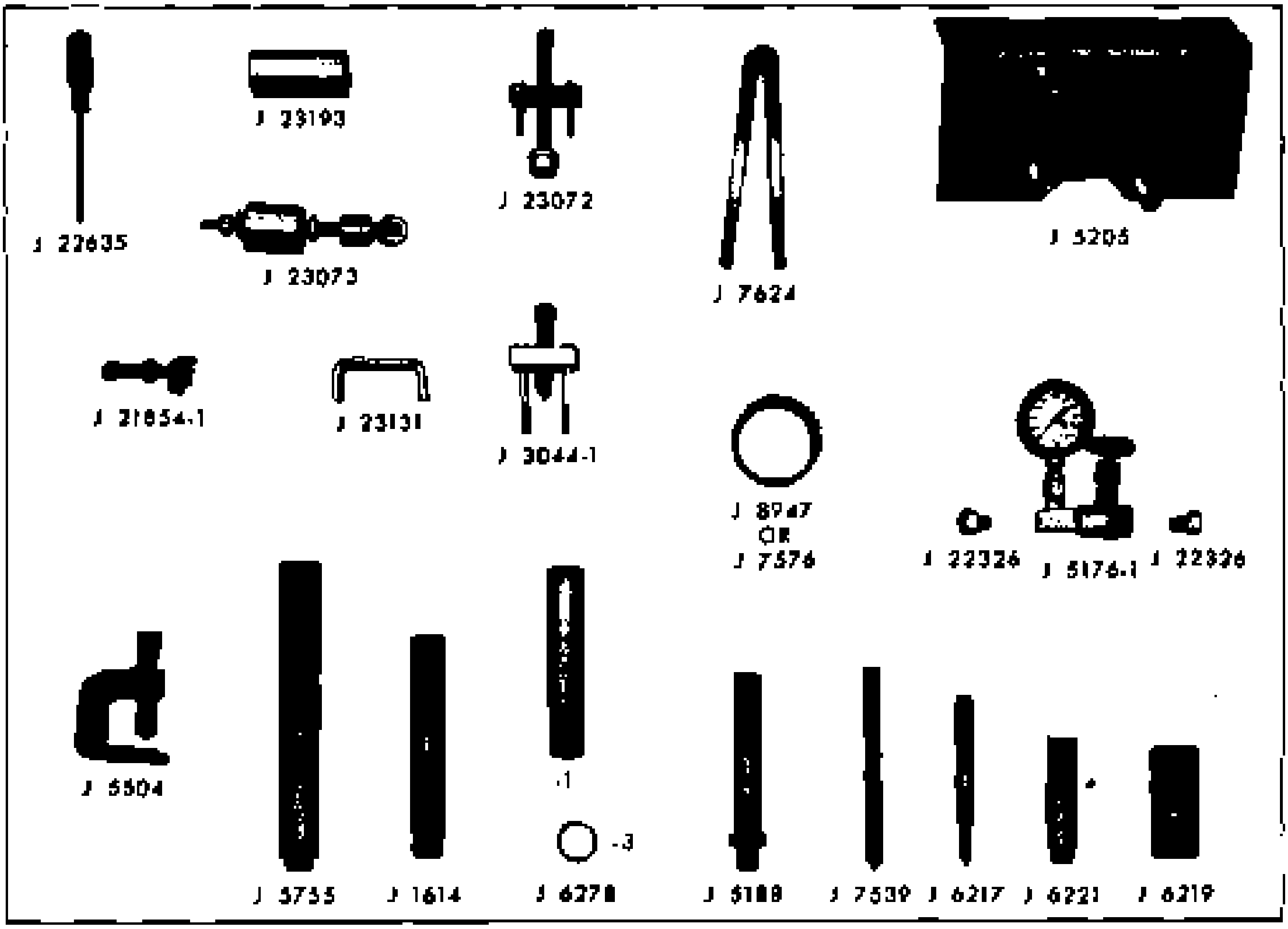


Fig. 9-101 Special Tools For Steering Columns And Steering Gears

Tool No.	Name
J 1614	Pitman Bushing Driver
J 3044-1	Steering Wheel Puller
J 5176-1	Power Steering Checking Gage 0-2000 Lbs.
J 5188	Valve Cover Seal Installer
J 5205	Steering Gear Mounting Fixture
J 5504	Pitman Arm Puller
J 5755	Steering Shaft Worm Bearing Cup Installer
J 6217	Valve Connector Seal Installer
J 6219	Steering Gear Pitman Shaft Oil Seal Installer
J 6221	Adjuster Plug Bearing Remover & Installer
J 6278	Pitman Shaft Bearing Remover & Installer
J 7539	Piston Rack Arbor
J 7576	Teflon Seal Installer
J 7624	Bearing Pre-Load Spanner Wrench
J 8747	Teflon Seal Installer
J 21854-1	Pivot Pin Remover
J 22326	Power Steering Checking Gage Adapter
J 22635	Lock Shoe & Release Lever Pin Remover & Replacer
J 23072	Tilt Column Shift Tube Remover
J 23073	Tilt Column Shift Tube Installer
J 23131	Upper Bearing Spring Compressor
J 23193	Tilt Column Pre-Load Nut Socket

TORQUE SPECIFICATIONS

(Torque in lb. ft. unless otherwise shown)

APPLICATION	TORQUE
Nut, Steering Knuckle to Tie Rod	
Pontiac (85 lb. ft. max. to insert cotter pin)	50*
Tempest, Grand Prix and Firebird	
(50 lb. ft. max. to insert cotter pin)	35*
Nut, Pitman Shaft to Pitman Arm	140
Nut, Pitman Arm to Intermediate Rod	
Tempest and Grand Prix	
(45 lb. ft. max. to insert cotter pin)	35*
Pontiac and Firebird	
(55 lb. ft. max. to insert cotter pin)	45*
Nut, Intermediate Rod to Tie Rod	
Tempest and Grand Prix	
(55 lb. ft. max. to insert cotter pin)	40*
Pontiac and Firebird	
(85 lb. ft. max. to insert cotter pin)	60*
Nut, Idler Arm to Intermediate Rod	
(45 lb. ft. max. to insert cotter pin)	35*
Nut, Tie Rod Clamp	17
Nut, Idler Arm Support to Frame	35
Nut, Steering Wheel to Steering Shaft	30
Nut, Steering Column Mounting Bracket to Instrument Panel	20
Bolt, Mounting Bracket to Steering Column	15
Bolt or Nut, Flexible Coupling Clamping to Steering Shaft	30
Bolt, Steering Gear to Frame	70
Screw, Toe Cover Plate to Dash Panel	40 lb. in.
Nut, Adjuster Plug Lock Nut	85
Nut, Pitman Shaft Adjusting Screw Lock Nut (Manual Gear)	23
Bolt, Side Cover to Housing (Manual Gear)	35
POWER STEERING ONLY:	
Nut, Hose Connector to Pump or Gear	25
Union, Pressure Hose Connector to Pump	35
Stud, Pump Mounting	35
Bolt, Pump Mounting Bracket to Engine	30
Bolt or Nut, Mounting Bracket to Pump or Bracket	30
Nut, Pump Pulley to Shaft	60
Bolt, Side Cover to Housing	30
Nut, Pitman Shaft Adjusting Screw Lock Nut	32

***NOTE: Turn nut in tightening direction only to align slot with hole to insert cotter pin. Do not back off nut.**

WHEELS AND TIRES

CONTENTS OF THIS SECTION

RECOMMENDED TIRE INFLATION PRESSURES

(Pounds Per Square Inch Cool)

MODELS	TIRE PLY	STANDARD INFLATION FOR ALL LOADS INCLUDING FULL RATED		OPTIONAL INFLATION FOR REDUCED LOADS	
All Except Station Wagons		1 to 6 passengers +200 lbs. luggage (1100 lbs. load)*		1 to 5 passengers (750 lb. load)	
		Front	Rear	Front	Rear
	4 ply rating—2 ply	24 lbs.	28 lbs.	24 lbs.	24 lbs.
Station Wagons		1 to 6 passengers +300 lbs. luggage (1200 lbs. load)		1 to 5 passengers (750 lb. load)	
		Front	Rear	Front	Rear
PONTIAC	4 ply rating—2 ply	24 lbs.	32 lbs.	—	—
	8 ply rating—4 ply	26 lbs.	36 lbs.	—	—
TEMPEST	4 ply rating—2 ply	24 lbs.	32 lbs.	24 lbs.	28 lbs.

*If equipped with bucket seats, load limit is 950 lbs. (5 passengers—2 front, 3 rear, and 200 lbs. luggage).

NOTES ON CHART:

1. Tire inflation pressures may increase as much as 6 pounds per square inch (psi) when hot.

2. For continuous high speed operation (over 75 mph) increase tire inflation pressures 4 pounds per square inch over the recommended pressures up to a maximum of 32 pounds per square inch cold for 4 ply rating tires, or 40 pounds per square inch 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 than maximum stated above.

3. Cold tire inflation pressure: after vehicle has been inoperative for 3 hours or more, or driven less than 1 mile. Hot tire inflation pressure: after vehicle has been driven 10 miles or more at 60-70 miles per hour.

4. Station Wagon loads should be distributed as far forward as possible.

5. Vehicles with luggage racks do not have a vehicle load limit greater than specified.

6. When towing trailers, the allowed passenger and cargo load must be reduced by an amount equal to the trailer tongue load on the trailer hitch.

MINOR REPAIRS

TEST FOR LEAKS

1. Use soapy water to check valve for leaks. In many cases air loss can be corrected by simply tightening the valve core.

2. If the reason for air loss is not immediately discernible, submerge the complete wheel assembly in a tank of water.

3. Mark the tire and rim at the point where air is escaping.

TIRE MOUNTING AND DISMOUNTING INSTRUCTIONS:

The wheel assembly has a flat hump bead seat on the outboard (valve hole) side of the rim. This design provides a tight tire fit, making it necessary to use a rubber lubricant or a vegetable oil soap solution for tire mounting and dismounting. This design also makes it mandatory that tire mounting and dismounting be done with the outboard side of the wheel up.

WHEEL STUD

REMOVE AND REPLACE

1. Support the hub and drum assembly with approximately 1" diameter by 5" long pipe or other suitable tool directly under and surrounding the stud to be removed and press out the stud.

CAUTION: If hub and drum are not supported underneath, pressure from the press may distort the drum or push the hub assembly away from the drum.

2. Clean out the existing hole by drilling through the hub and drum assembly. Use a 41/64" (.6406) drill on Pontiac and a 9/16" (.5625) drill on Tempest and Firebird.

3. Press in replacement stud.

REMOVE TIRE FROM WHEEL

1. Remove valve cap and valve core. Let out all the air.

2. With valve hole side of tire up, break beads away from rim. Use only conventional bead-breaker type machine.

CAUTION: During the entire operation of breaking beads away from rim and removing tire from rim, special care should be taken not to damage the tire beads.

PUNCTURE REPAIRS

Puncture repairs may be quickly and permanently performed, using one of several kits available through tire manufacturer's dealer outlets. "Hot patch" types are recommended for puncture repairs.

WHEEL LEAKS

Examine rim flanges for sharp dents. Any dent visible to the eye should be straightened. Never use heat when straightening a wheel.

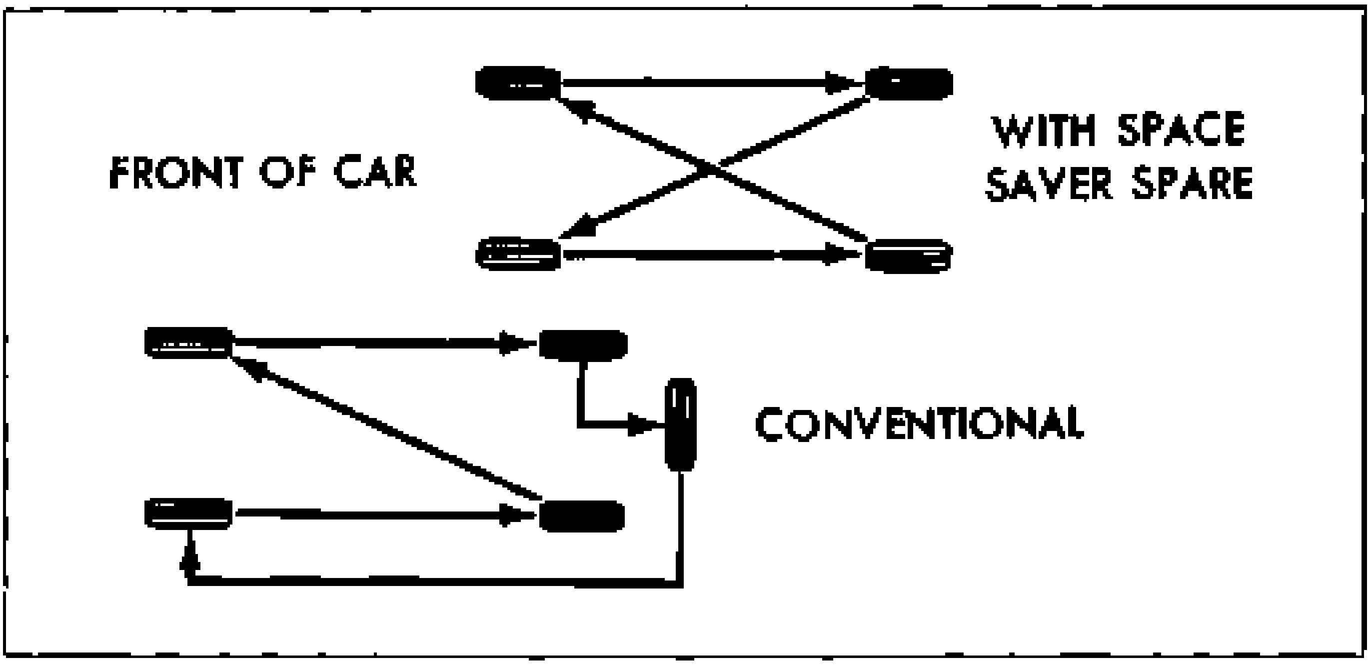


Fig. 10-1 Tire rotation Diagram

CAUTION: Under no circumstances should wheels be brazed, welded or peened. In the event the wheel is severely damaged, it should be replaced.

PREPARATION OF TIRE

Remove excess strings of rubber hanging from tire bead.

PREPARATION OF RIM

1. Clean rim flanges with small piece of No. 3 coarse steel wool or emery cloth to remove all oxidized rubber, soap solution or rust. If rim is badly pitted, use file to remove and paint with primer.

2. Straighten or replace rim if it is bent or damaged.

MOUNTING TIRE ON WHEEL

1. Install valve if valve was removed. Always install type T.R. 413 valve.

2. Apply liberal amounts of vegetable oil soap solution or approved rubber lubricant to rim edges and tire beads.

3. Mount tire on the wheel with valve hole side up, using the machine method.

4. Remove valve core from stem to increase flow of air.

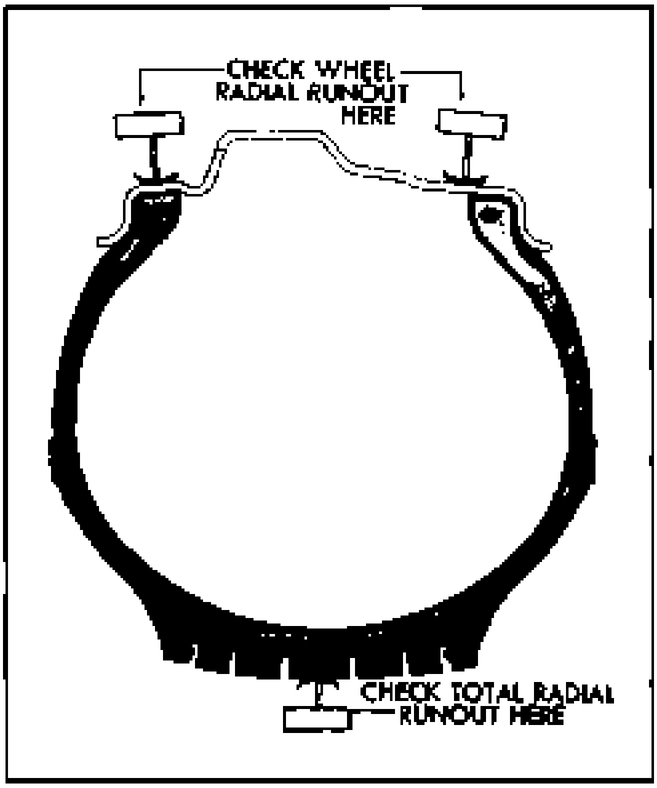


Fig. 10-2 Radial Runout Inspection

5. With casing on the rim so that the beads are resting uniformly on the bead ledge, quickly apply a large volume of air. This forces the bead on the bead seat and against the flanges where the air seal for the tire is obtained. Inflate tire until beads are completely forced against rim flanges.

CAUTION: Do not stand over tire when inflating. Bead wire may break when bead snaps over safety hump. Do not exceed 40 lb. air pressure when inflating. If 40 lbs. pressure will not seat beads properly, deflate, lubricate, and reinflate.

6. Once beads are seated against rim flanges, air pressure can be released.

7. Install valve core and inflate to proper specifications.

8. General precautions in mounting tires:

a. Use tire mounting and dismounting machine.

b. Do not use hammer or tire irons.

c. Work over rim flange so that the section nearest the valve stem will be applied last.

INSPECTION BEFORE BALANCING WHEELS AND TIRES

1. Check and if necessary, adjust front wheel bearings as outlined in Section 3.

2. Set tire pressure to cold specifications and drive car until tires are hot.

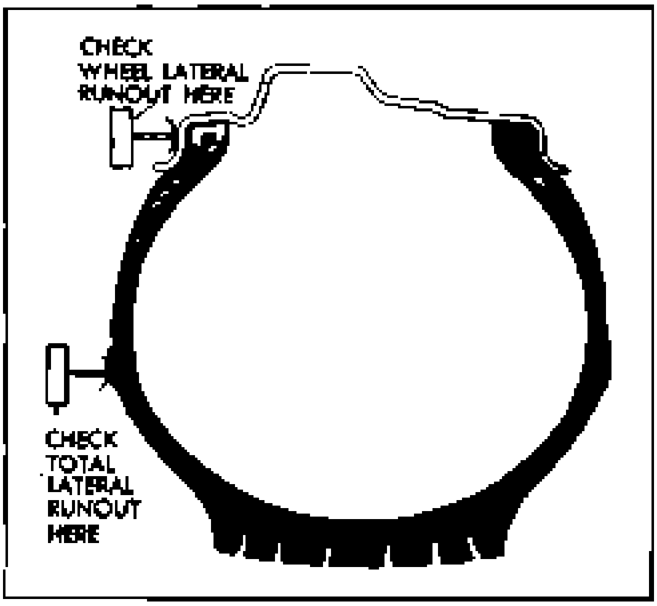


Fig. 10-3 Lateral Runout Inspection

3. Attach a dial indicator to the car body or stationary support. With indicator against tire (Fig. 10-2), slowly rotate wheel and check for total radial runout of wheel and tire. Maximum allowable total radial runout is .092". If total radial runout exceeds .092", then re-index tire to wheel as noted below and recheck runout of assembly. If still over .092", check radial runout of wheel only.

4. Attach a dial indicator to a stationary stand similar to step 3 above. Slowly rotate wheel and check for total lateral runout of wheel and tire. See Fig. 10-3. Maximum allowable total lateral runout is 1/8". If total lateral runout exceeds 1/8", then attach a dial indicator to the stationary object and check for lateral runout of wheel. Lateral runout of wheel should not exceed .045".

Excessive total lateral or radial runout of wheel and tire assemblies can sometimes be reduced within specifications by rotating the tire on the wheel until the high spot on the tire indexes with the low spot on the wheel. If this procedure fails to bring the total radial or lateral runout within specifications, check for damaged or improperly mounted tire, bent or distorted wheel, and variations in tread surface due to wear and correct as necessary. The following procedure may be followed to determine if excessive total lateral or radial runout is caused by wheel or tire:

1. Rotate tire on wheel.

2. Make total wheel and tire runout check.

3. Make wheel runout check if total lateral wheel and tire runout exceeds 1/8" after tire rotation or total radial runout exceeds .092".

4. If total wheel and tire assembly runout minus wheel runout is .057" or greater for radial runout, or .080" or greater for lateral runout, excessive runout is in the tire. If either occurs, the tire should be replaced. (Maximum wheel radial runout is .035", maximum wheel lateral runout is .045".)

BALANCE PROCEDURE

The preferred method of balancing wheels and tires is with on-the-car type equipment. But whether on or off car-type equipment is used, always follow the manufacturer's instructions for the equipment being used. In addition, pay particular attention to the following points.

1. Be sure tires are free of stones or other foreign objects that may become wedged in the tread. Be sure wheels are free of mud and brake drums do not drag on brake shoes.

2. Tires are at normal operating temperatures (hot).

NOTE: Always split weight evenly between inside and outside of wheel to avoid changing dynamic balance.

3. Wheels and tires must be balanced statically before being balanced dynamically. Recheck static balance after dynamic balance.

4. When balancing rear wheels on the car, always check to see if car is equipped with Safe-T-Track differential. Never balance Safe-T-Track-equipped car with one wheel on ground as car may move when engine is started and transmission is in drive gear.

If car is equipped with Safe-T-Track rear axle, the balancing of the rear wheels should be performed as follows:

a. Raise and block the rear of the vehicle with both wheels off the floor.

b. Remove one wheel.

c. Reinstall two (2) lug nuts and tighten securely to retain the brake drum.

d. Proceed with balancing operation on the remaining wheel using engine power to spin the wheel.

e. When proper balance has been achieved on first wheel, reinstall the second wheel and balance in the same manner.

5. When balancing rear wheels on the car, remember that: with one wheel on the ground, speedometer speed is one-half (1/2) rear wheel speed. With both wheels off the ground, speedometer speed is the same as rear wheel speed.

PONTIAC WHEEL CODES

Standard	KF
Station Wagons	I
Rally II	JJ

TEMPEST WHEEL CODES

Standard (Six Cylinder)	HJ
Standard (All V-8)	HF
Rally II	JA
Space Saver	KC

GRAND PRIX WHEEL CODES

Standard (7" Wide)	IF
Rally II (7" Wide)	JK
Standard (6" Wide)	HF
Rally II (6" Wide)	JA
Space Saver	KC

FIREBIRD WHEEL CODES

Standard (Six Cylinder) .... HK
Rally II (Six Cylinder) .... JC
Standard (V-8) .... JF
Rally II (V-8) .... JK
Space Saver (6" Wide) .... KC
Space Saver (5" Wide) .... HI

SPECIFICATIONS

WHEELS

Material .... Steel
Type .... Drop Center—with flat safety bump
Diameter .... Pontiac 15"
Tempest, Grand Prix, Firebird 14"
Width .... Tempest (6 Cyl.) 5"
Pontiac, Tempest (V-8), Grand Prix (manual brakes), Firebird (6 Cyl.) 6"
Grand Prix (power brakes), and Firebird (V-8) 7"
Tempest, Grand Prix, Firebird (exc. 6 cyl. 1-Bbl.), Space Saver Spare 6"
Firebird (6 cyl. 1-Bbl.), Space Saver Spare 5"

TORQUE SPECIFICATIONS

Pontiac Wheel to Drum Nut—Front and Rear 75 Lb. Ft.
Tempest, Grand Prix and Firebird Wheel to Drum Nut—Front and Rear .... 70 Lb. Ft.

TIRE USAGE CHART

PONTIAC

MODELS	EQUIPMENT	STANDARD*	OPTIONAL*
Catalina Executive Bonneville	All except station wagons, Bonneville Brougham, & Police Car	8.55 x 15	8.55 x 15 (4 ply rating—4 ply) 8.85 x 15 8.85 x 15 (4 ply rating—4 ply) J78 x 15
Bonne. Brougham	—	8.85 x 15	8.85 x 15 (4 ply rating—4 ply) J78 x 15
Station Wagons	2 or 3 seat	9.15 x 15	—
Police Option	—	8.55 x 15 (4 ply rating—4 ply)	8.85 x 15 8.85 x 15 (4 ply rating—4 ply) J78 x 15
TEMPEST & GRAND PRIX			
Tempest Custom S LeMans	All except LeMans 4-Dr. Hardtop with A/C, & Sta. Wagons	6-cyl. 7.75 x 14 8-cyl. 8.25 x 14	G70 x 14 (Fibreglas) G78 x 14 8.25 x 14 (6-cyl. only) G78 x 14 (Fibreglas) 7.75 x 14 (Space Saver)
LeMans 4-Dr. Hardtop with A/C	6-cyl. and 8-cyl.	8.25 x 14	G70 x 14 (Fibreglas) G78 x 14 G78 x 14 (Fibreglas) 7.75 x 14 (Space Saver)
Station Wagons	—	8.25 x 14	G70 x 14 (Fibreglas) G78 x 14 G78 x 14 (Fibreglas)
GTO	—	G78 x 14	G70 x 14 (Fibreglas) G78 x 14 (Fibreglas) 7.75 x 14 (Space Saver)
Grand Prix	Standard Model	G78 x 14	G70 x 14 (Fibreglas) G78 x 14 (Fibreglas) 7.75 x 14 (Space Saver)
	"SJ" Model	G78 x 14 (Fibreglas)	7.75 x 14 (Space Saver) G70 x 14 (Fibreglas)
FIREBIRD			
6-cyl.—1 Bbl.	—	E70 x 14	F70 x 14
All except 6-cyl.—1 Bbl.	—	F70 x 14	F70 x14 (Fibreglas)

CHASSIS SHEET METAL

Section 11 - Chassis Sheet Metal

CONTENTS OF THIS SECTION

HOOD

The hood (Fig. 11-1), of rigid sheet metal construction, is composed of a single sheet metal outer panel and a rugged inner panel reinforcement. Further rigidity is obtained by the insertion of reinforcement braces and brackets strategically located so as not to interfere with adjustment or service repair conditions.

A. ADJUSTMENT

Slotted holse are provided at all hood hinge attaching

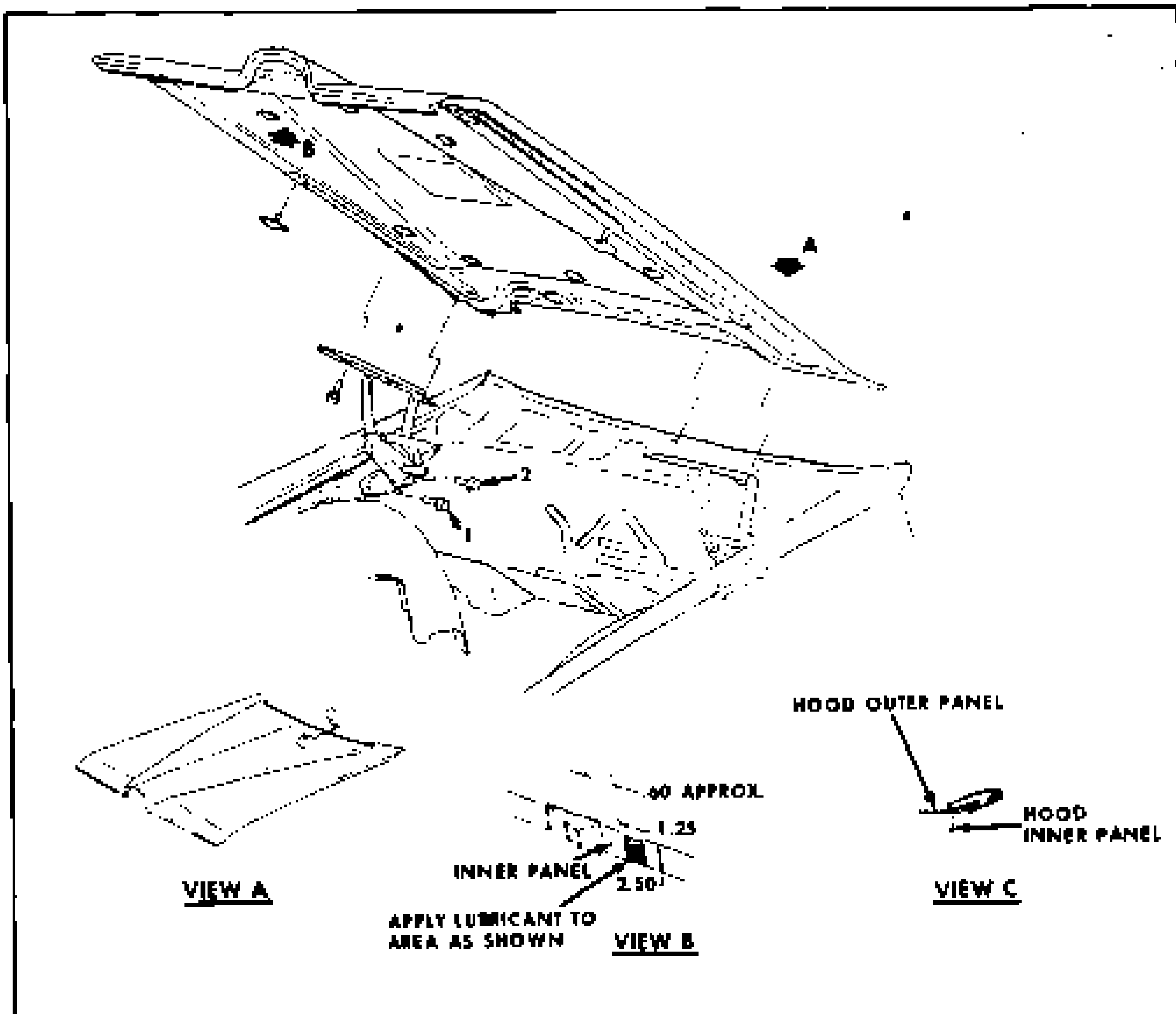


Fig. 11-1 Hood Attachment Typical

points for proper adjustment; both vertically and fore and aft.

NOTE: Adjust one side at a time.

To lower the REAR corners for proper alignment to the cowl and fenders, and to ensure contact with the hood side wedges, proceed as follows:

1. Loosen front end of hinge mounting bracket to fender at bolt no. 1 (Fig. 11-1).

2. Force hood open as high as possible to move front of hinge upward.

3. Tighten fender connection.

4. If further adjustment is required, loosen rear end of hinge mounting bracket to fenders at bolt no. 2 and repeat steps 2 and 3.

5. If necessary, repeat procedure on opposite side of hood.

To lower the FRONT corners for proper alignment, proceed as follows:

1. Close hood firmly.

2. Determine the amount of adjustment necessary.

3. Open hood.

4. Loosen jam nut on adjustable hood bumper (Figs. 11-9 thru 12) and raise or lower as required.

5. Tighten jam nut.

B. REMOVE

1. Open hood.

2. Scribe line on hood inner panel to indicate original hinge position.

3. Loosen hood hinge to hood attaching bolts.

4. With aid of a helper, hold hood securely and remove attaching bolts.

5. Lift hood assembly from sheet metal.

C. REPLACE

To replace simply reverse above procedure checking hood alignment, one hinge at a time as outlined in steps 4 and 5 under HOOD HINGE -- REPLACE.

HOOD LATCH

A positive locking hood latch, which incorporates a safety catch with the pilot assembly is used on all models. The hood latch being fastened to the support and baffle assembly locks securely with the latch plate mounted in the hood.

After proper positioning of the hood bumpers, hood height is automatically controlled by the vertically self adjusting hood latch. Proper hood alignment is essential for ease of latch operation.

To open the hood, pull the release handle under the center portion of the front bumper grille downward. A "pop-up" spring on the support and baffle provides initial opening of the hood upon release. To fully open the hood, pull the release handle past the detent position pushing down on hood slightly, then lift hood.

If hood latch binds severely, it may be adjusted laterally as follows:

1. Loosen latch attaching bolts (marked "X" in Figs. 11-2, 3 and 4) to finger-tight.

2. Push down on hood, holding the hood closed while pulling the release lever.

3. Let hood open and tighten bolts in new location.

HOOD HINGE

Hood hinges (Fig. 11-1) are mounted to the fender panel. Double assist overcenter springs are used (one at each hinge), one end of which is fastened to the front arm of hinge, the other end to the base plate. This construction provides hold open power. Fore and aft adjustment of hood is provided by slotted holes in the hinge bracket.

REMOVE

1. Open hood.

2. Scribe line on hood inner panel to indicate original hinge position.

3. Block hood on side where hinge is to be removed.

4. Prop hood open and pull front of spring off hinge.

5. Remove hinge-to-hood attaching screws and hinge to-fender attaching screws.

6. Carefully remove hinge.

REPLACE

1. Mount new hinge on fender and tighten attaching screws.

2. Position hinge to hood using scribed line for location, install attaching screws and tighten snug.

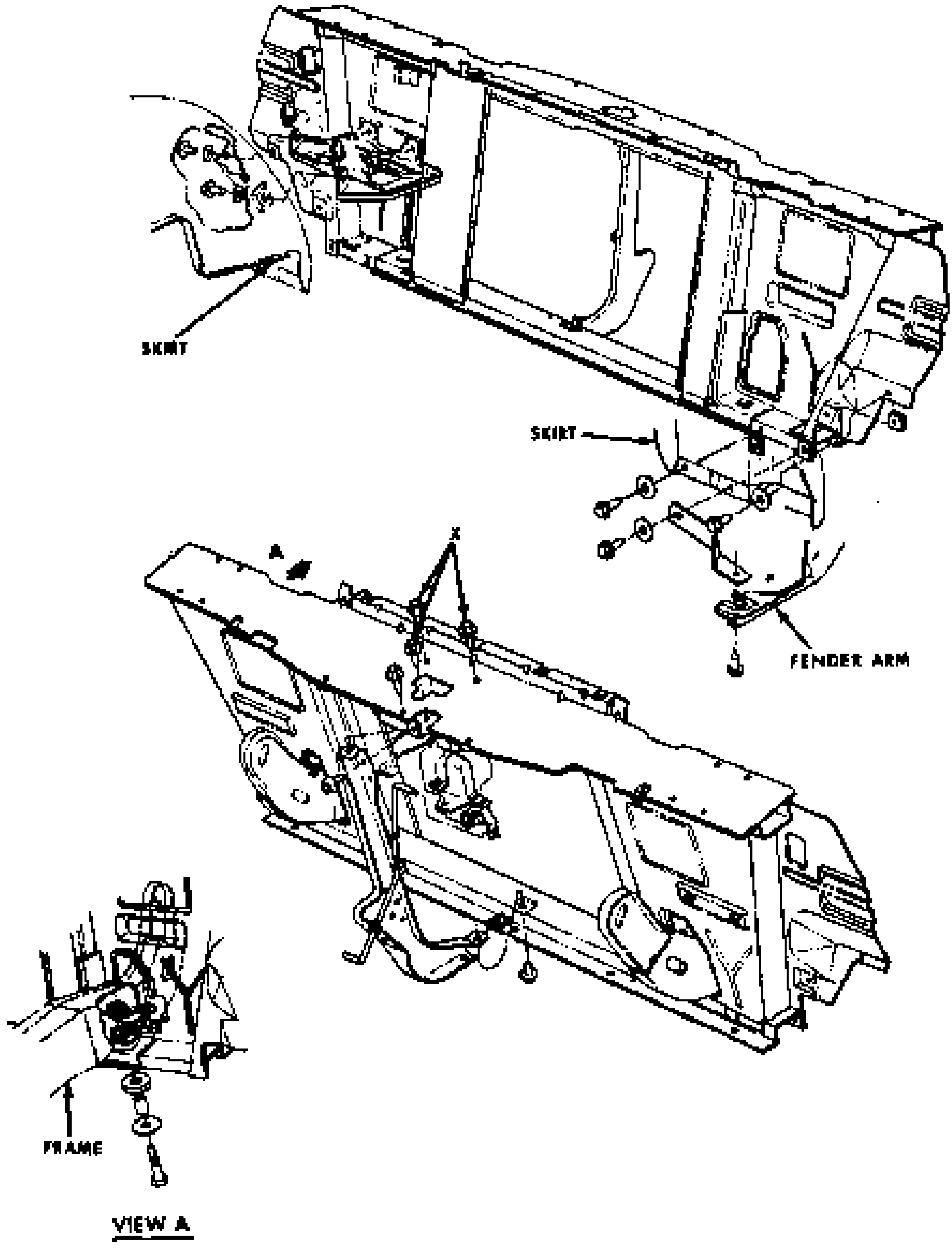


Fig. 11-2 Pontiac Hood Latch

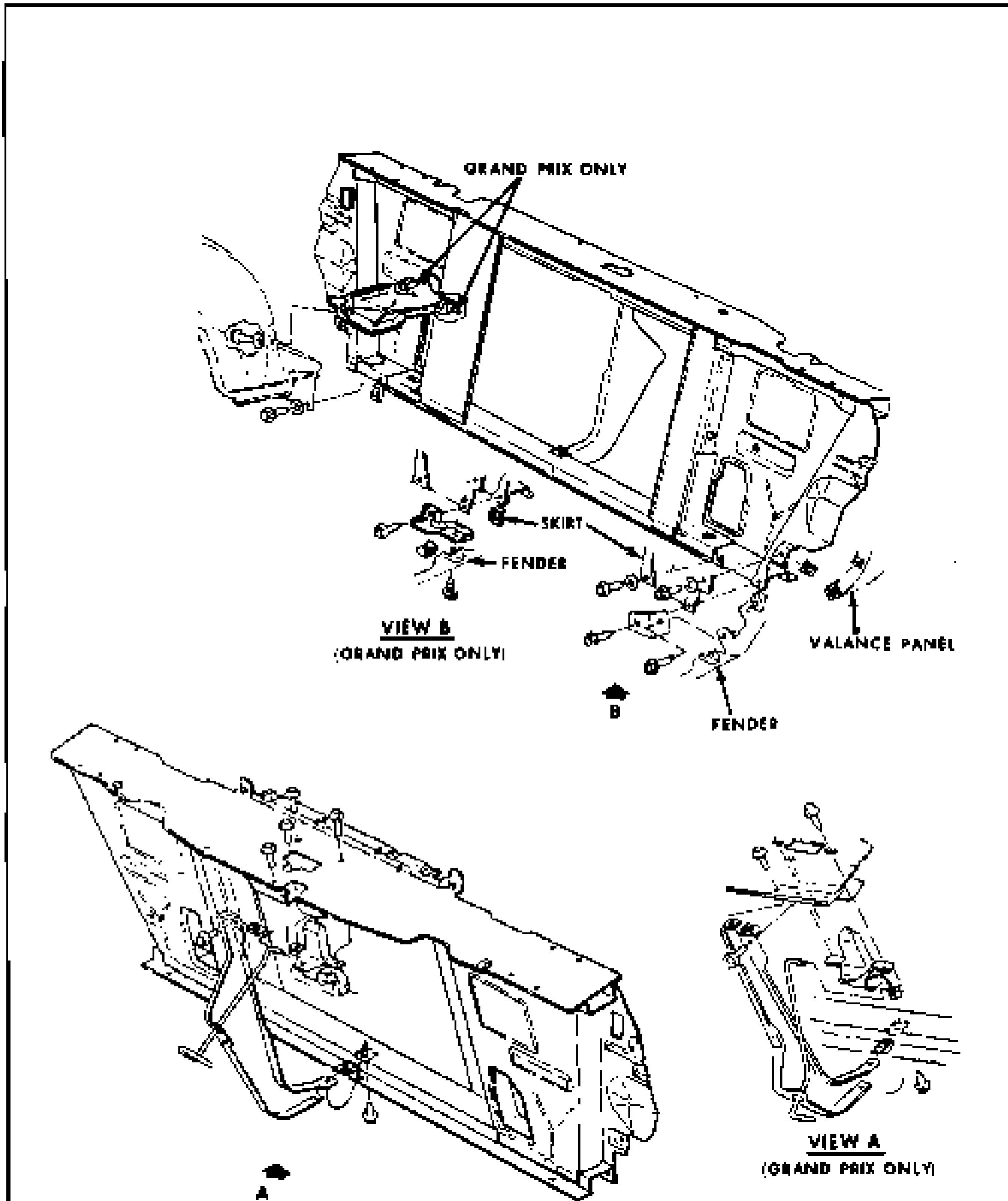


Fig. 11-3 Tempest and Grand Prix Hood Latch

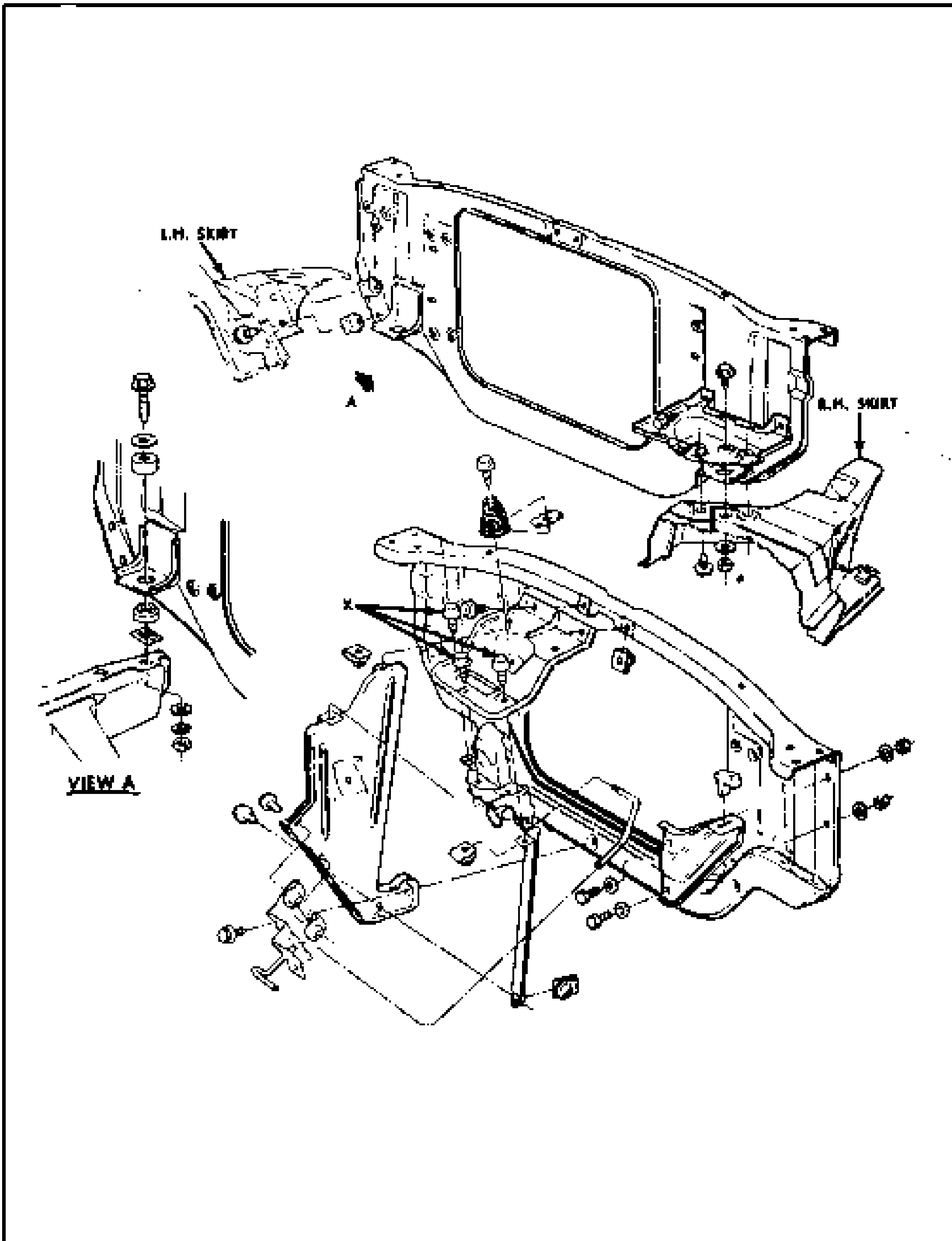


Fig. 11-4 Firebird Hood Latch

3. Replace spring.

NOTE: When replacing spring, hook rear end of spring on pin first, then stretch and hook at front.

4. Carefully close hood and check for proper alignment

5. If hood is misaligned, measure amount of misalignment.

a. Open hood.

b. Loosen hinge at hood and reposition to correct misalignment.

c. Tighten securely and recheck (torque 15 lb. ft.).

FENDERS

ALIGNMENT

Vertical, fore, aft and lateral adjustment is provided at the rear of fender by enlarged holes in the reinforcement at attaching points, and the use of shims at these points (Figs. 11-5 thru 11-8).

1. Check the space between the front door to fender rear edge and adjust as necessary to obtain a parallel opening, also adjusting for proper fender to windshield molding and cowl vent grille clearance.

2. Check to insure that all fender attaching bolts are secure.

FRONT FENDER

REMOVE

NOTE: Due to Firebird body-frame construction, it will be easier to align fenders if the car is supported between body mounts number 1 and 2 during fender removal and replacement.

NOTE: If the same fender is to be replaced, note position, location and number of alignment shims used.

1. Remove rocker modling to fender attachments.

2. Remove valance panel attachemnts to fender.

3. Remove fender to support and baffle assembly attaching screws.

4. Remove hood hinge to fender attaching screws.

5. Remove fender to inner skirt attaching screws at wheelhouse.

6. Disconnect fender from cowl at door opening and from rocker panel area.

7. Remove fender.

REPLACE

1. To install, reverse above procedure.

2. Align fender with other sheet metal and body parts.

3. Torque all fender to cowl and rocker panel attaching screws 30 lb. ft., all fender-to-fender inner skirt attaching screws 12 lb. ft.

FRONT INNER FENDER

REMOVE - PONTIAC AND TEMPEST

1. Lift front end on frame allowing front suspension to hang free.

2. Remove wheel.

3. Remove front fender wheel opening molding.

4. Remove inner fender skirt retaining screws.

5. Disconnect ground strap from right inner fender skirt

6. Remove lower fender attaching bolts and rocker panel molding.

7. Pry out and block fender away from frame.

CAUTION: Exercise care in pulling fender away from frame to avoid bending fender.

8. Disengage inner fender skirt lip from outer fender panel by pulling out and down on inner edge of skirt.

9. Move inner fender skirt toward rear of car in twisting downward motion.

REPLACE

1. To replace, reverse above procedure checking fender alignment with other sheet emtal and body parts.

2. Torque all fender inner skirt to fender attaching screws 12 lb. ft., and lower fender attaching screws 30 lb. ft.

REMOVE - FIREBIRD

1. Remove front fender.

2. Remove battery and battery tray to skirt attaching screw (right side only).

NOTE: On convertibles, remove vibration damper to skirt mounting bolts.

3. Remove firewall to skirt brace.

4. Disconnect any components attached to skirt such as cruise control, hoses, electrical harnesses, etc.

5. Remove skirt.

REPLACE

1. To replace, reverse above procedure checking fender alignment with other sheet metal and body parts.

2. Torque all fender inner skirt to fender attaching screws 12 lb. ft., and lower fender attaching screws 30 lb. ft.

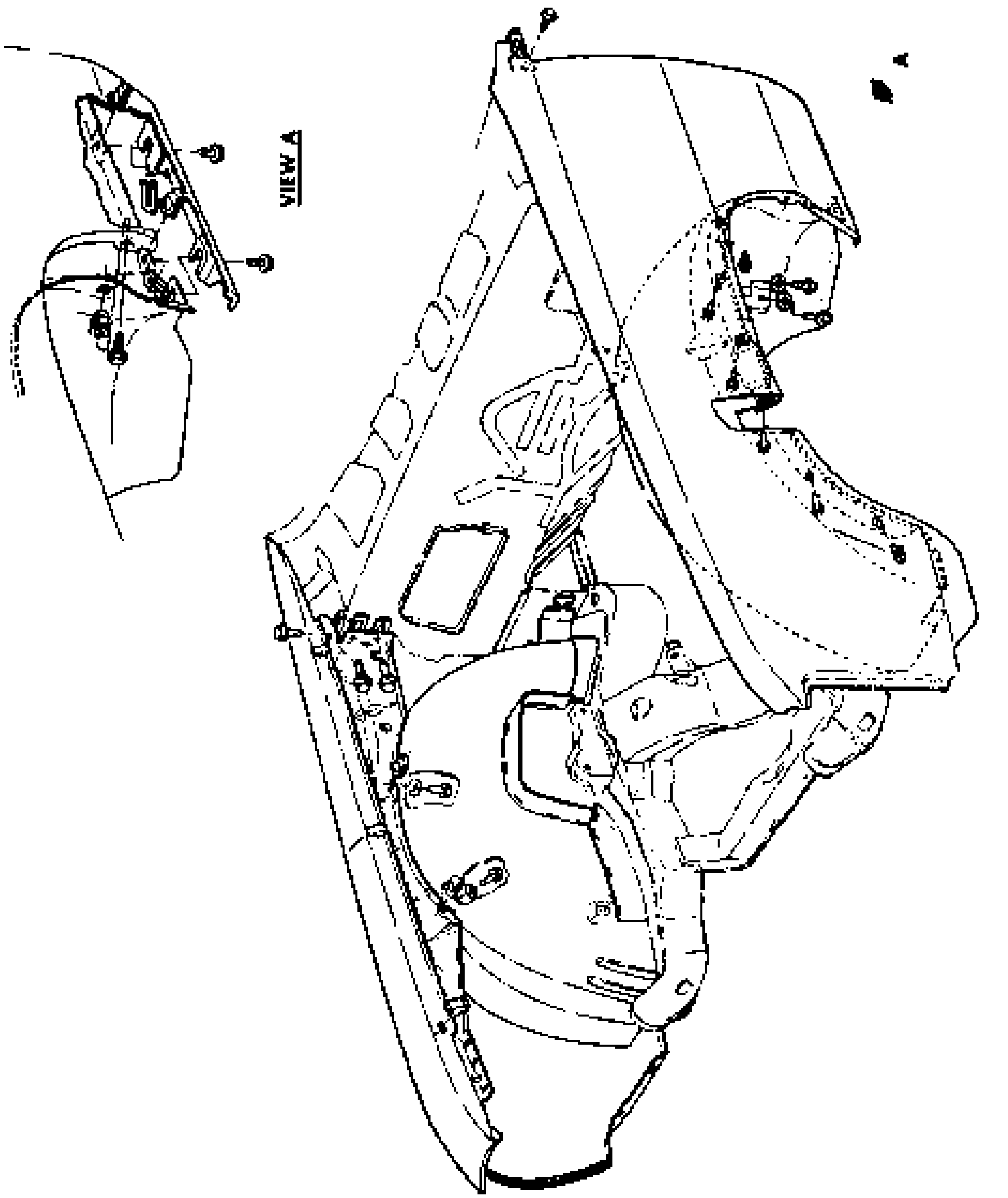


Fig. 11-5 Pontiac Front Fenders

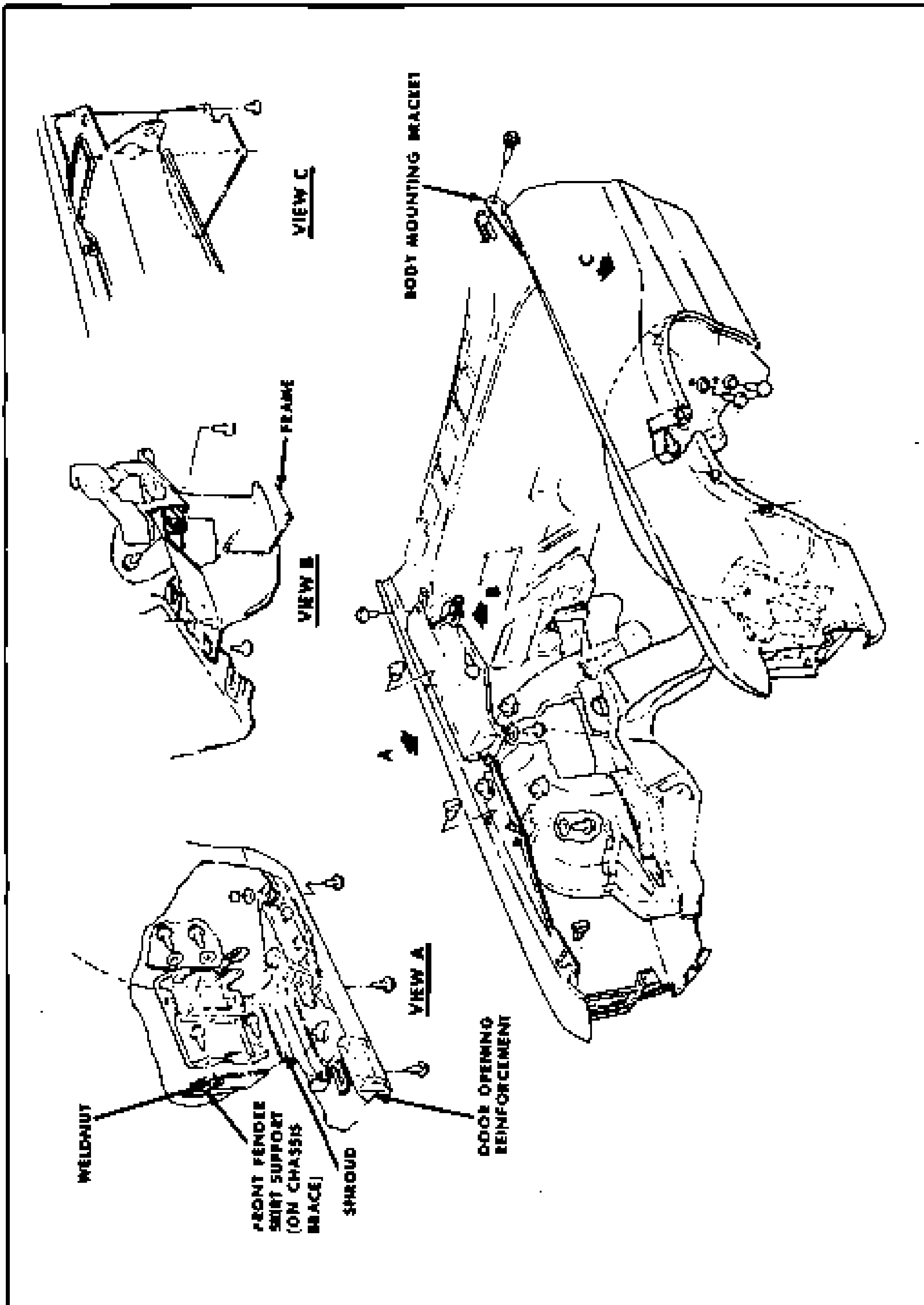


Fig. 11-6 Grand Prix Front Fenders

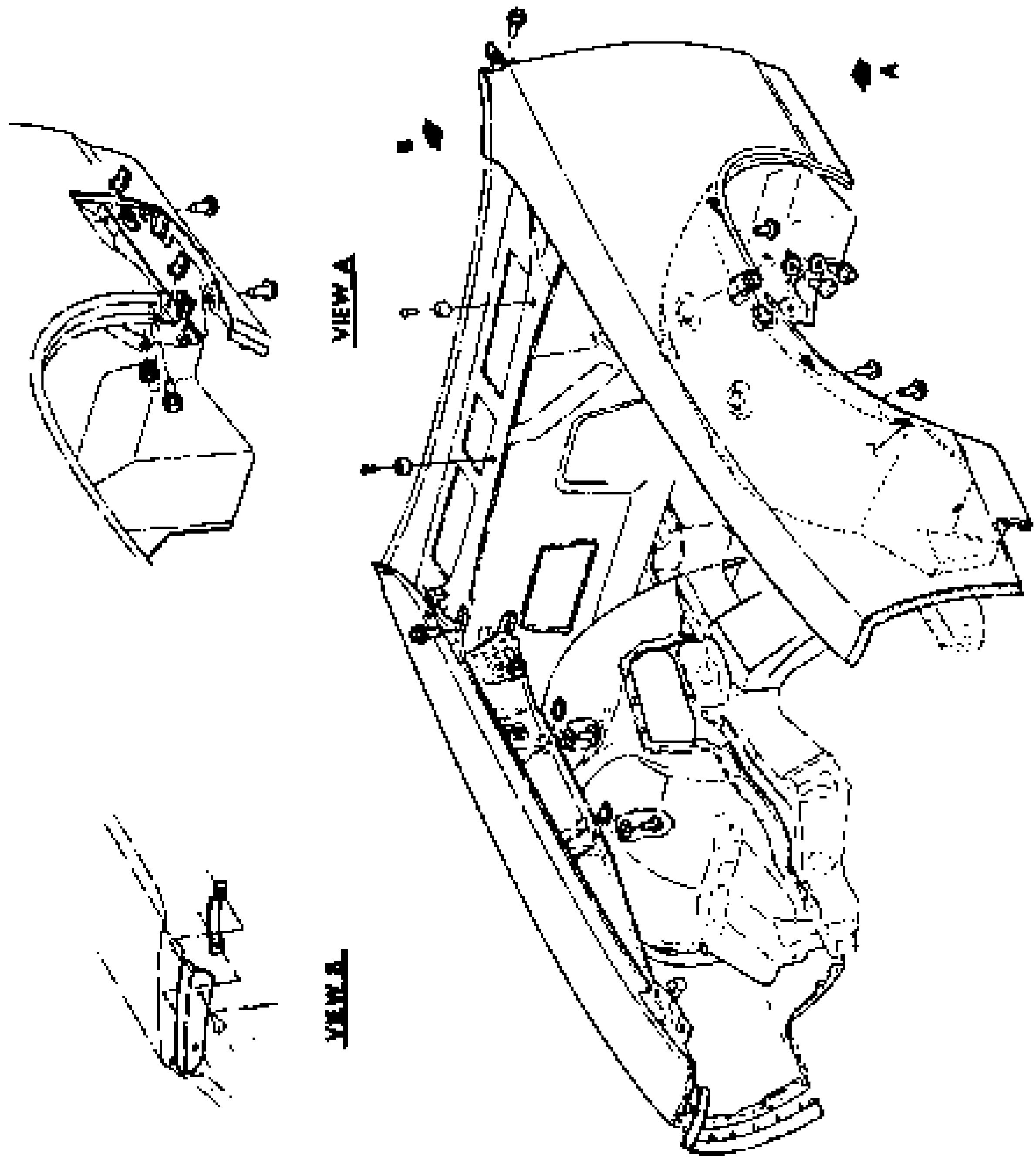


Fig. 11-7 Tempest Front Fenders

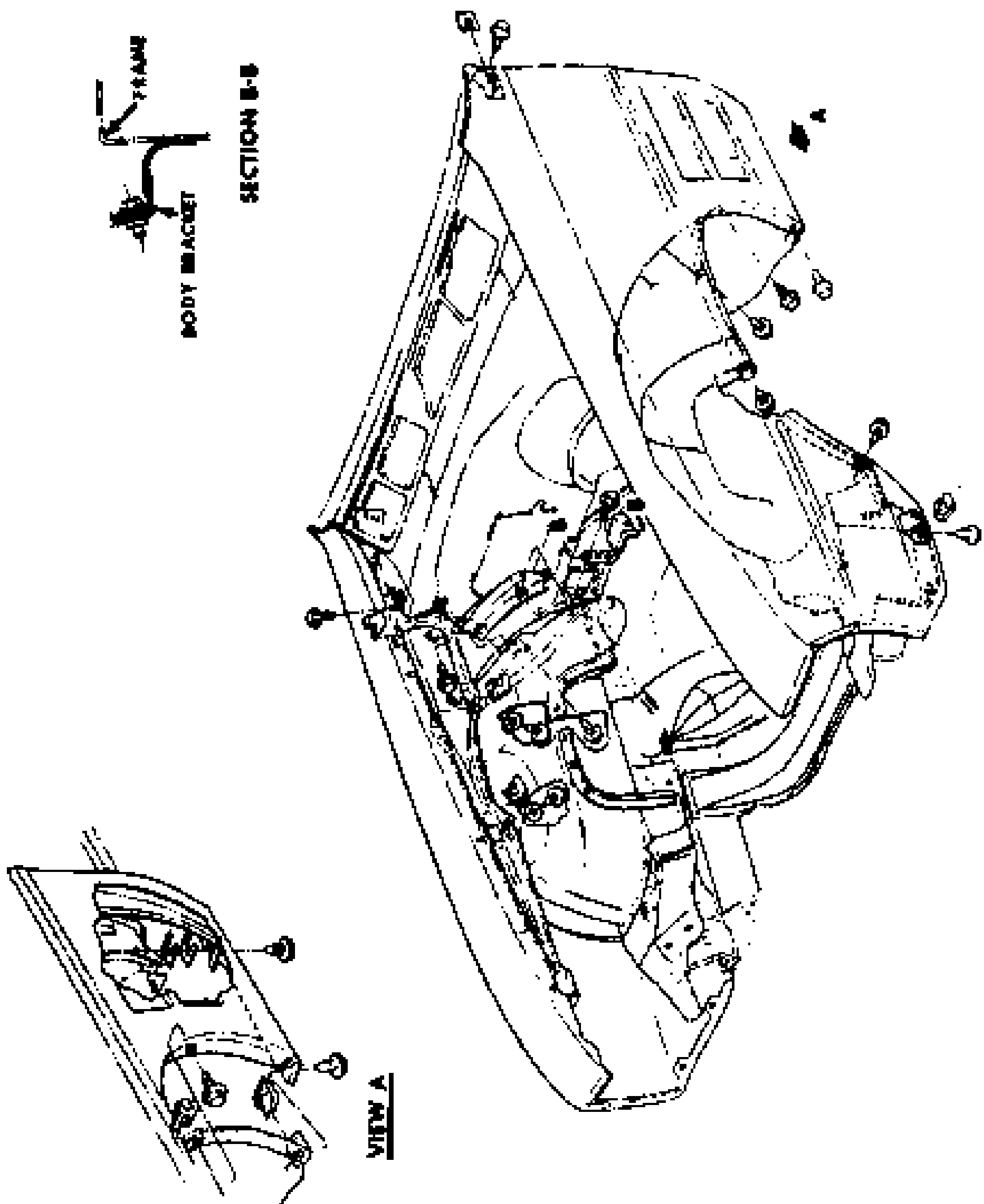


Fig. 11-8 Firebird Front Fenders

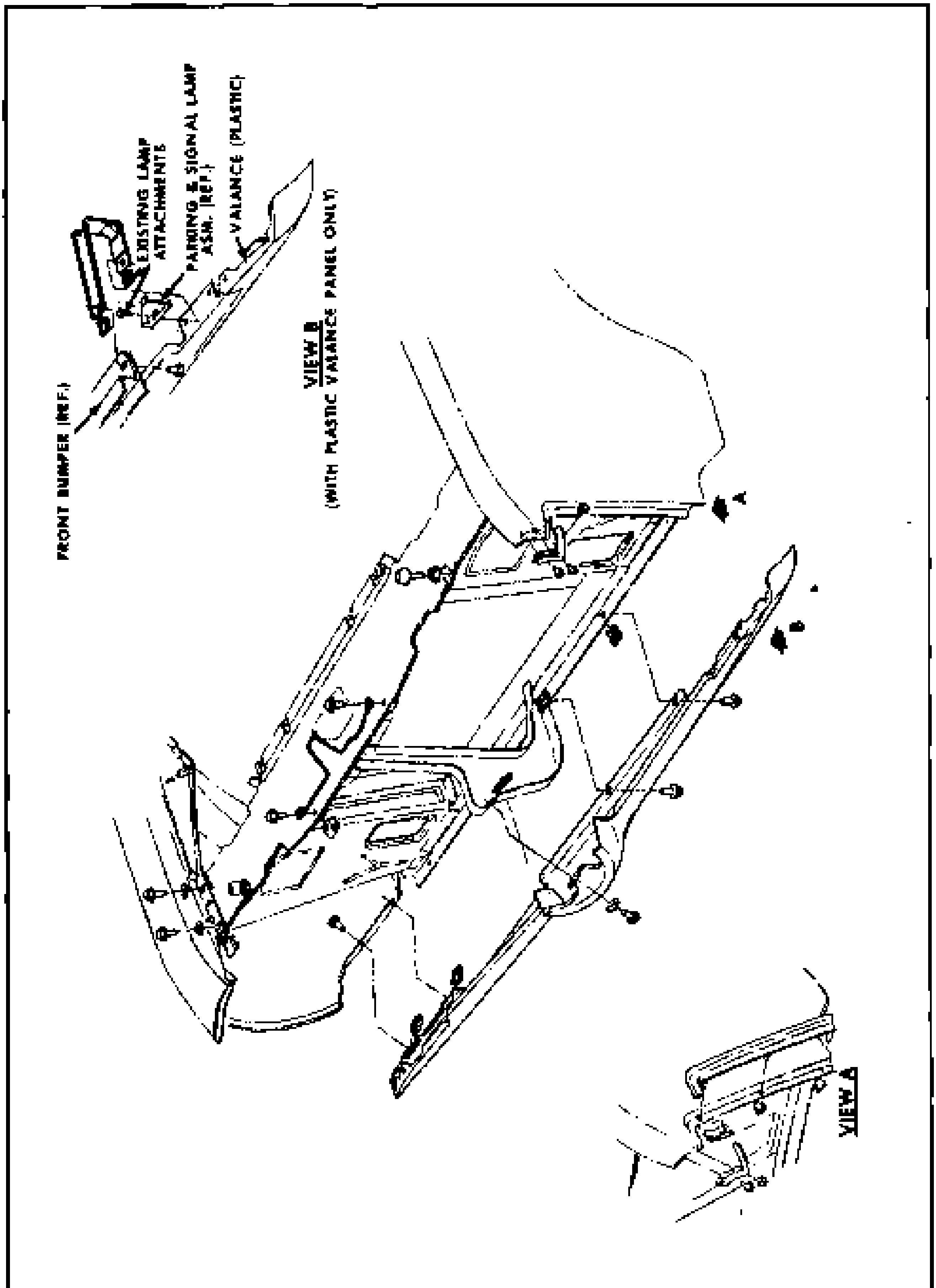


Fig. 11-9 Pontiac Valance Panel

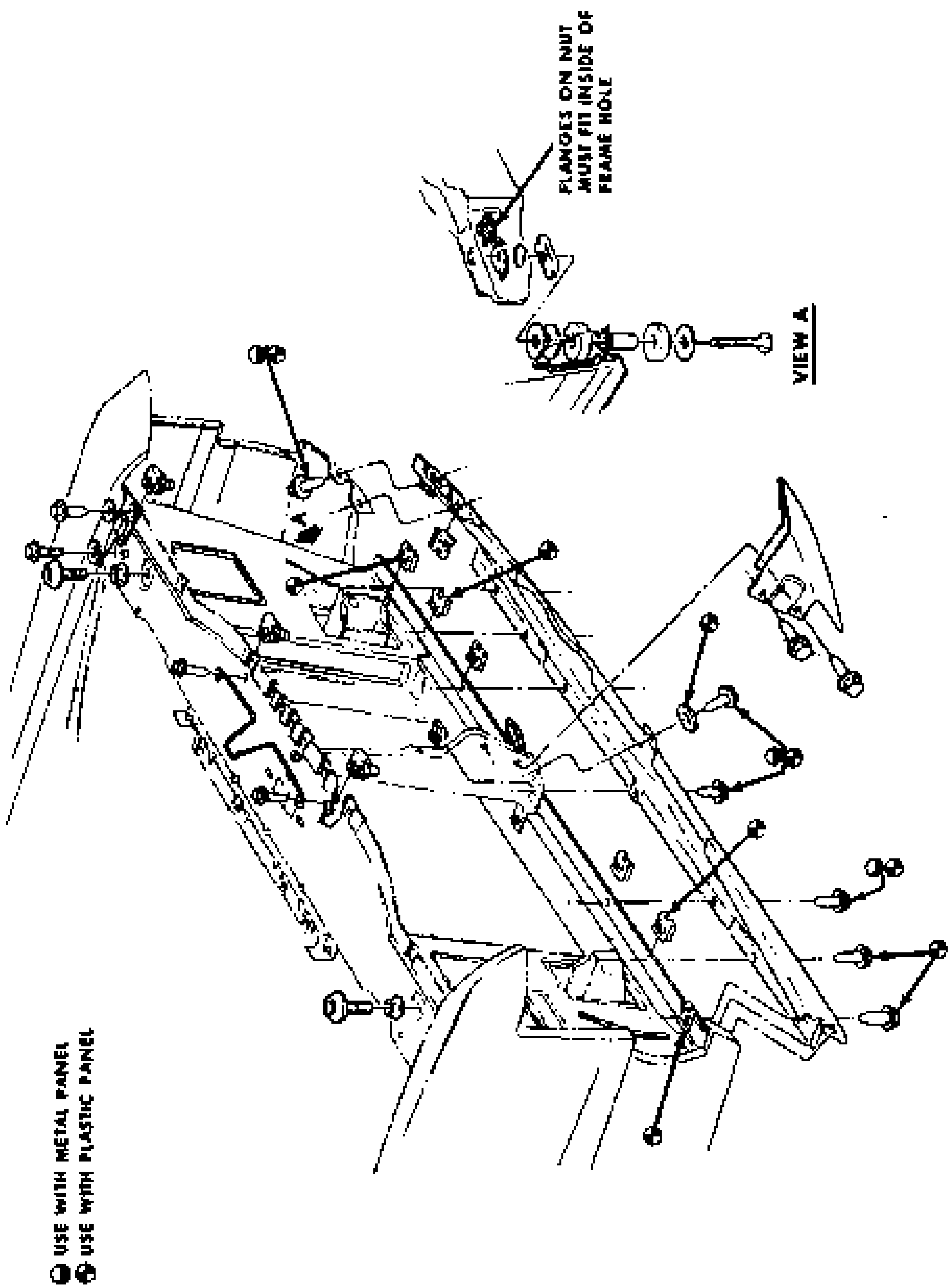


Fig. 11-10 Grand Prix Valance Panel

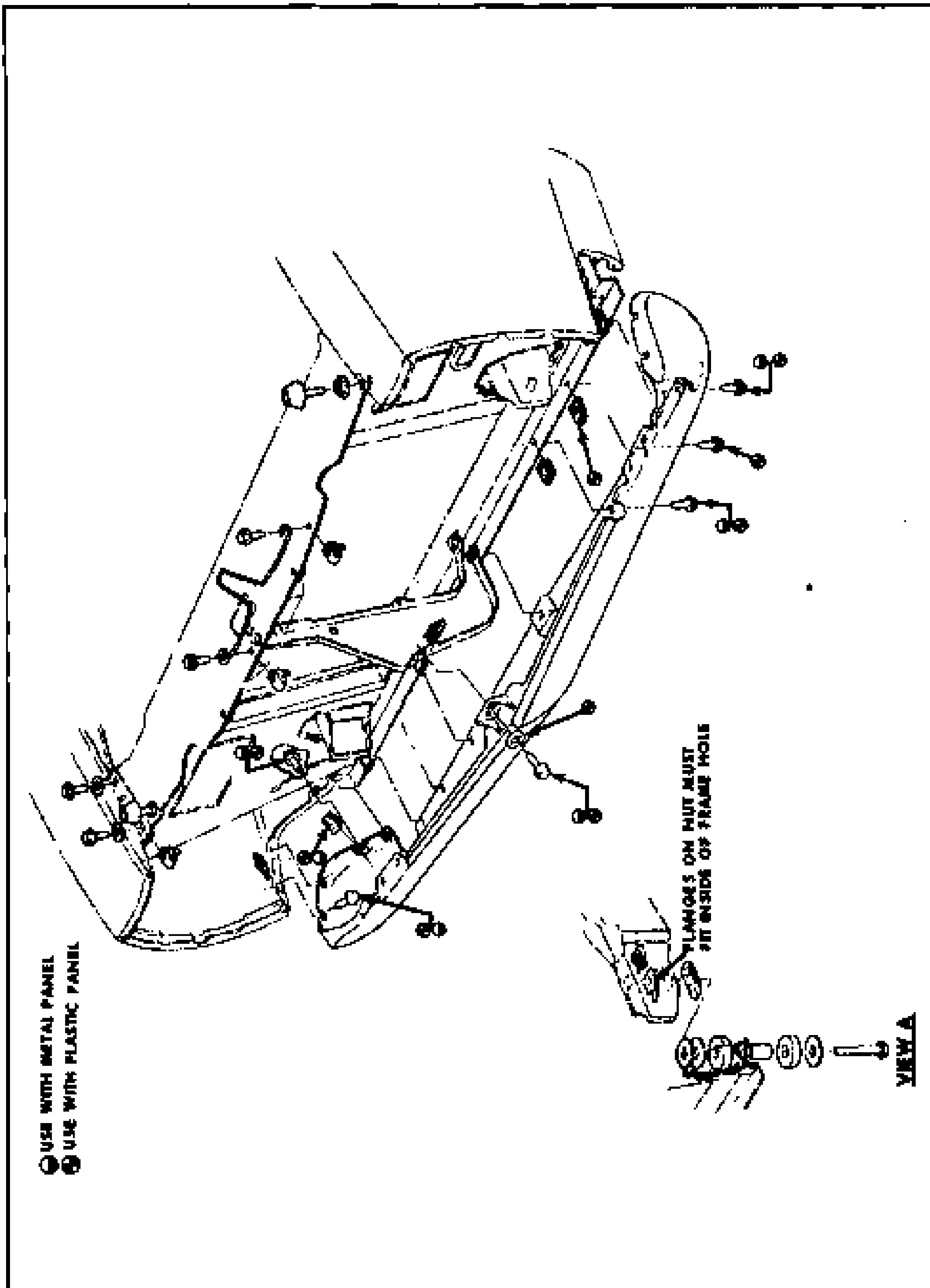


Fig. 11-11 Tempest Valance Panel

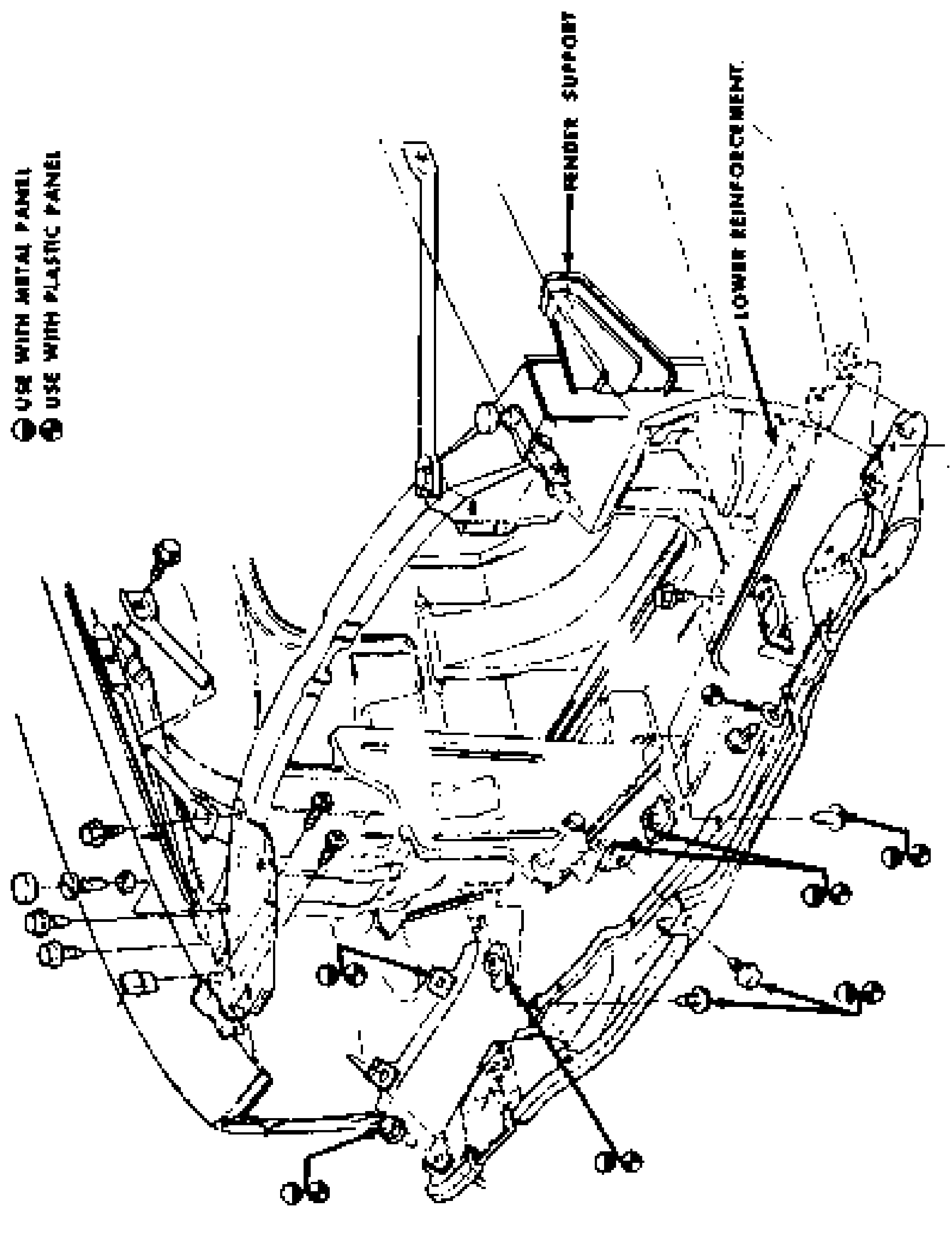


Fig. 11-12 Firebird Valance Panel

CHASSIS ELECTRICAL SERVICE

CONTENTS OF THIS SECTION

BATTERY

ALL-REMOVE AND REPLACE

1. Remove positive and negative battery cables using pliers.

2. Remove battery clamp.

3. Remove battery keeping in an upright position.

4. To replace, reverse removal procedures.

BATTERY CABLE

ALL-REMOVE AND REPLACE

Battery cable routing is shown in Figs. (whenever cables are removed use pliers and make sure connections are clean and tight when replacing) 12-18 for Pontiac and 12-19 for Tempest and Grand Prix and Fig. 12-20 for Firebird.

FUSIBLE LINK

ALL-REMOVE AND REPLACE

1. Disconnect battery.

2. Locate burned out link. Figs. 12-21 and 12-22 show location of fusible links.

NOTE: Link may be recognized on Pontiac or Tempest V-8 models as a loop of wire (approximately 5" in length) protruding from engine wiring harness along left rocker arm cover where harness breaks out for alternator. On Firebird or Tempest 6-cylinder models loop will be located at breakout for voltage regulator from engine wiring harness. 3. Strip away all melted harness insulation.

4. Cut burned link ends from circuit wire.

5. Strip (approximately 1/2") back circuit wire that new *link is to be soldered to.*

6. Using fusible link 4 gauges smaller than protected *circuit (approximately 10" long), solder new link into circuit.*

CAUTION: Use only resin core solder. Under no circumstances should an acid solder be used nor should link be connected in any other manner except by soldering.

7. Tape soldered ends securely using suitable electrical tape.

8. After taping wire, tape harness leaving an exposed loop of wire of approximately 5" in length.

9. Connect battery.

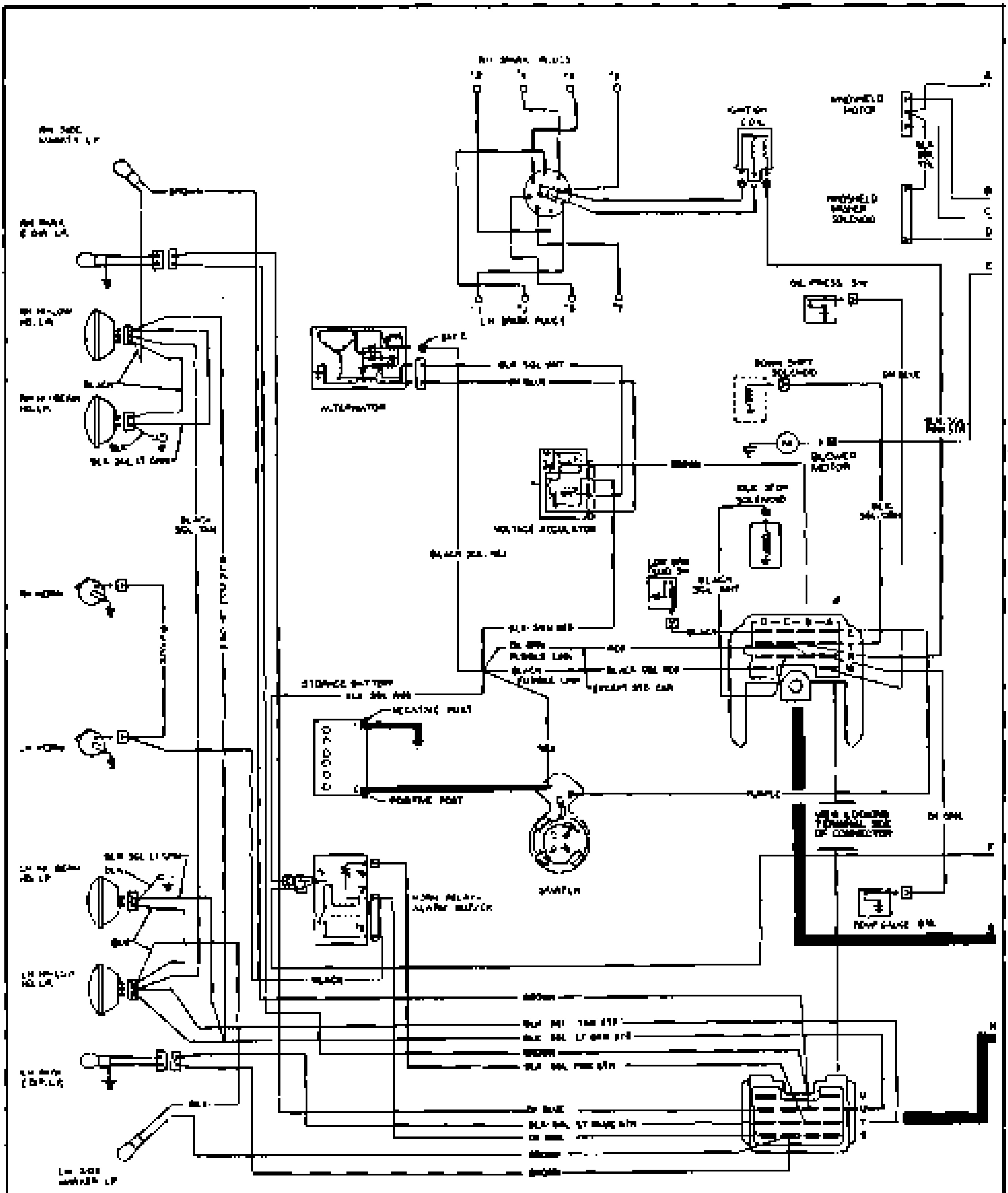


Fig. 12-1 Pontiac Engine Compartment Wiring

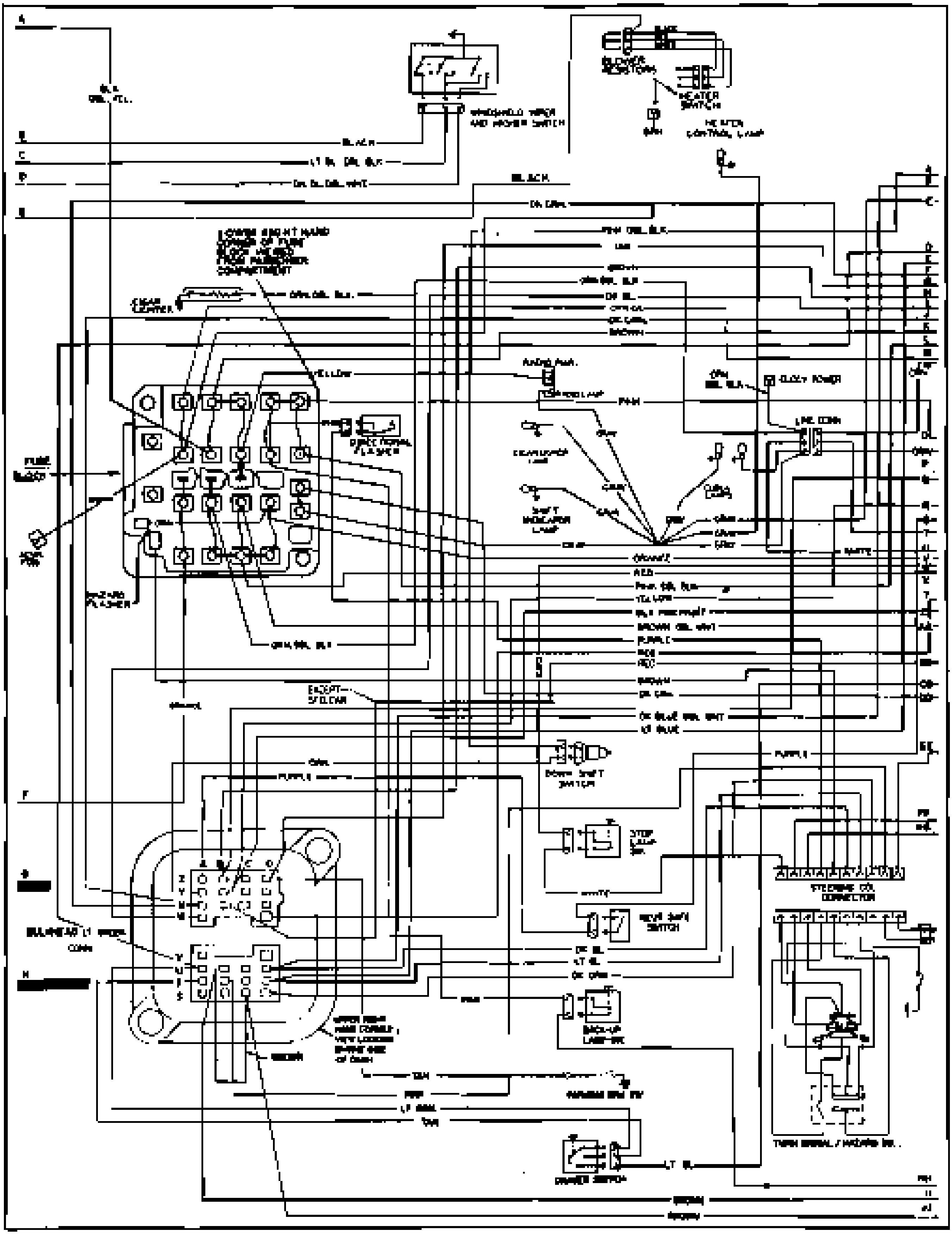


Fig. 12-2 Pontiac Passenger Compartment Wiring

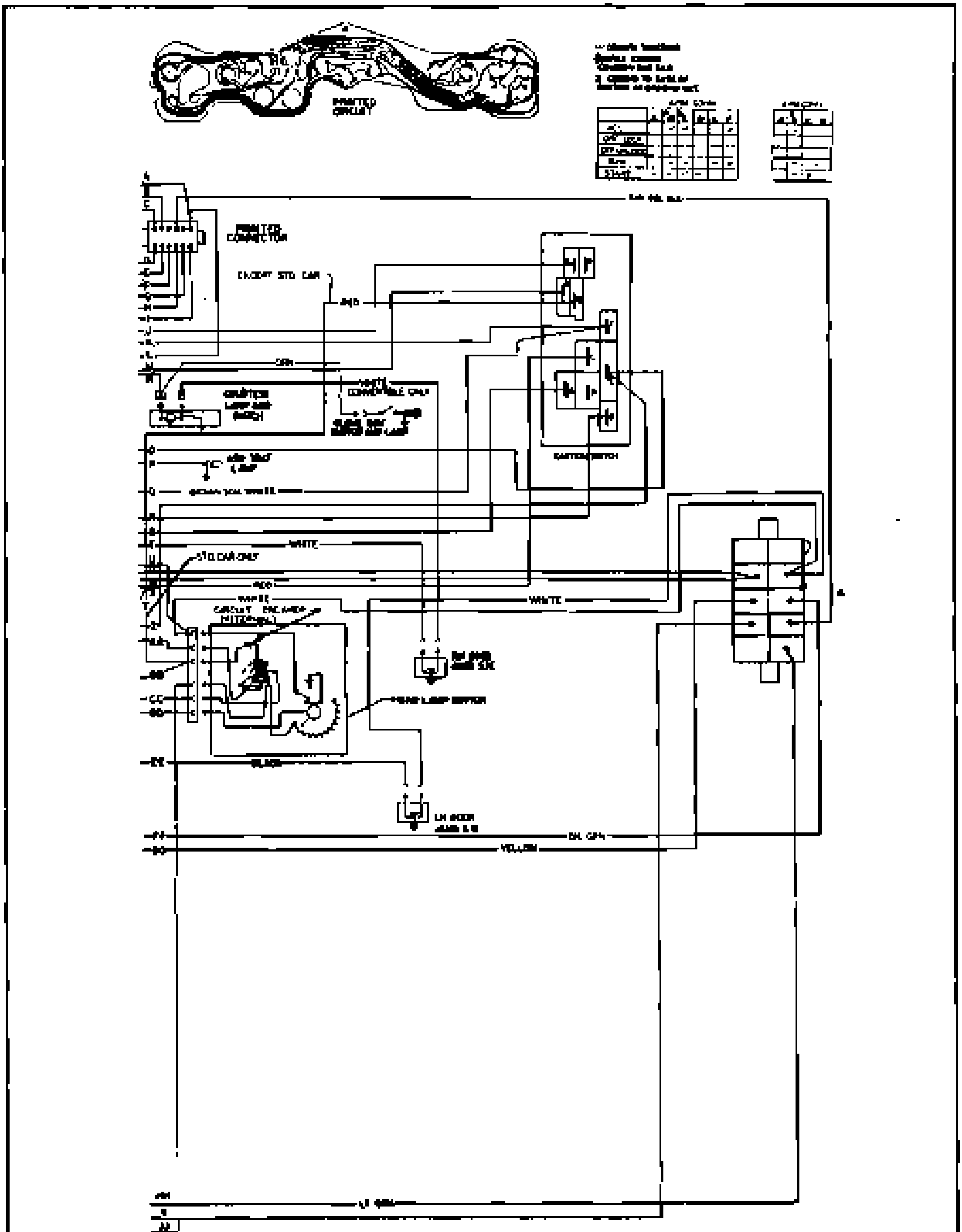


Fig. 12-3 Pontiac Passenger Compartment Wiring
(Continued)

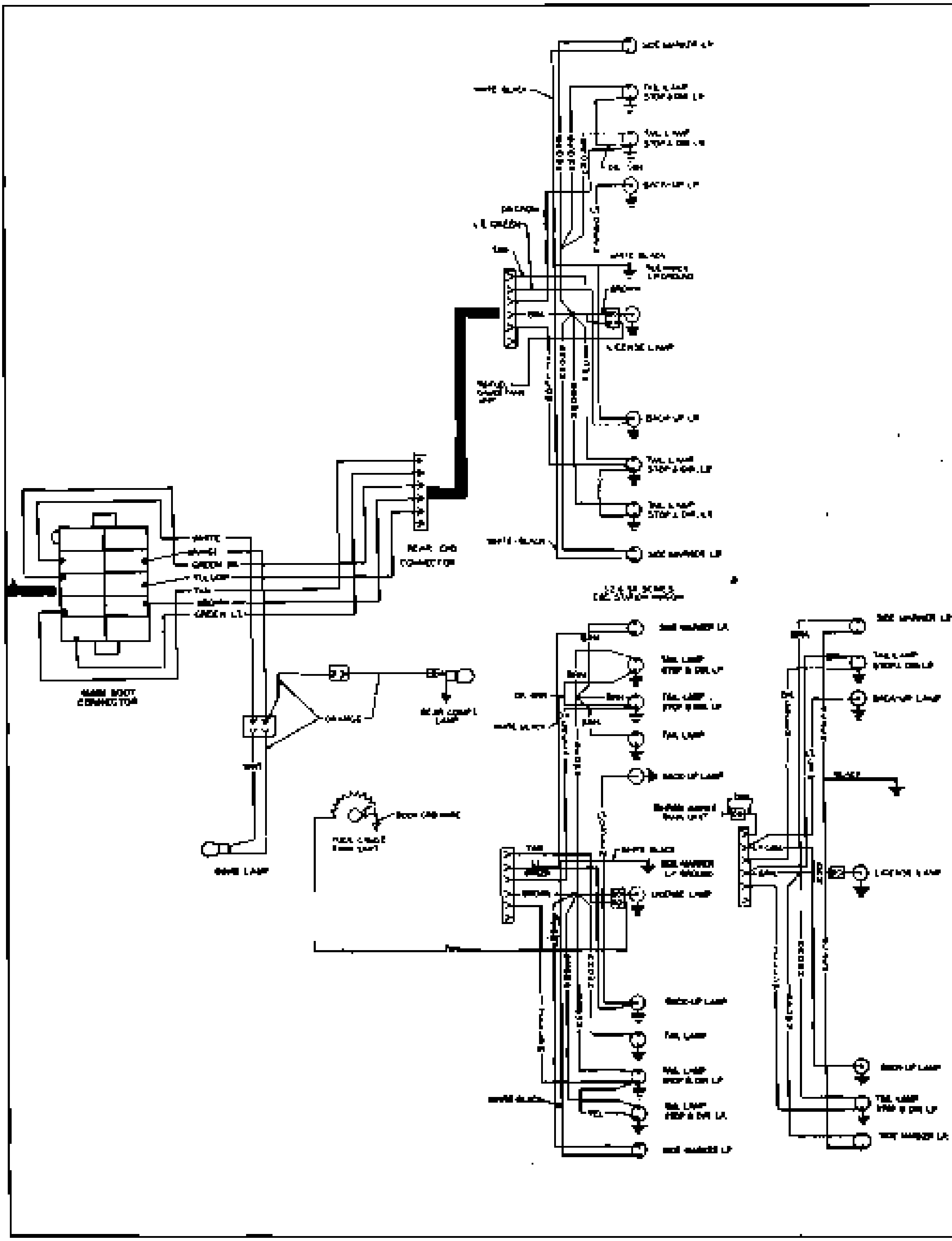


Fig. 12-4 Pontiac Rear End Wiring

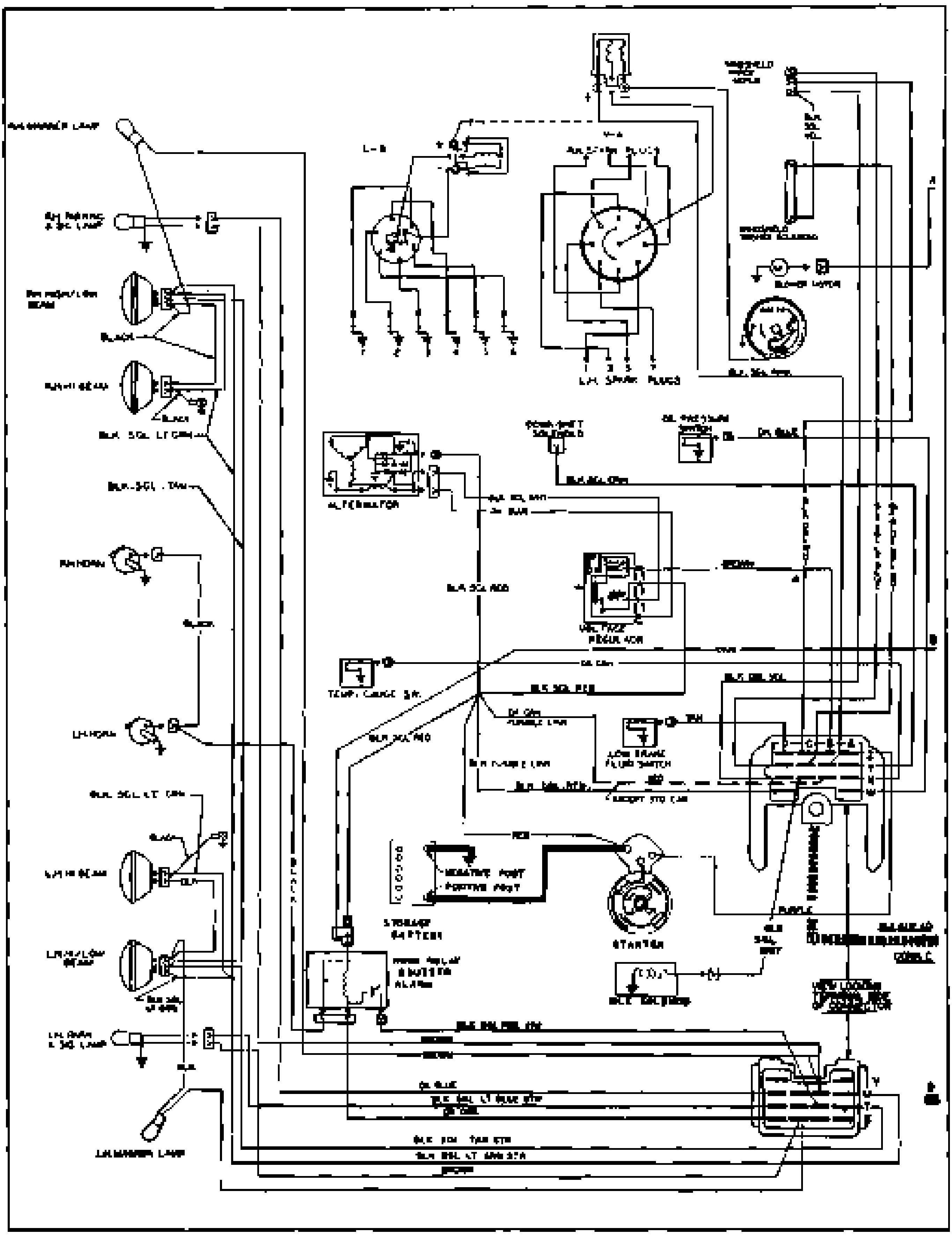


Fig. 12-5 Tempest Engine Compartment Wiring

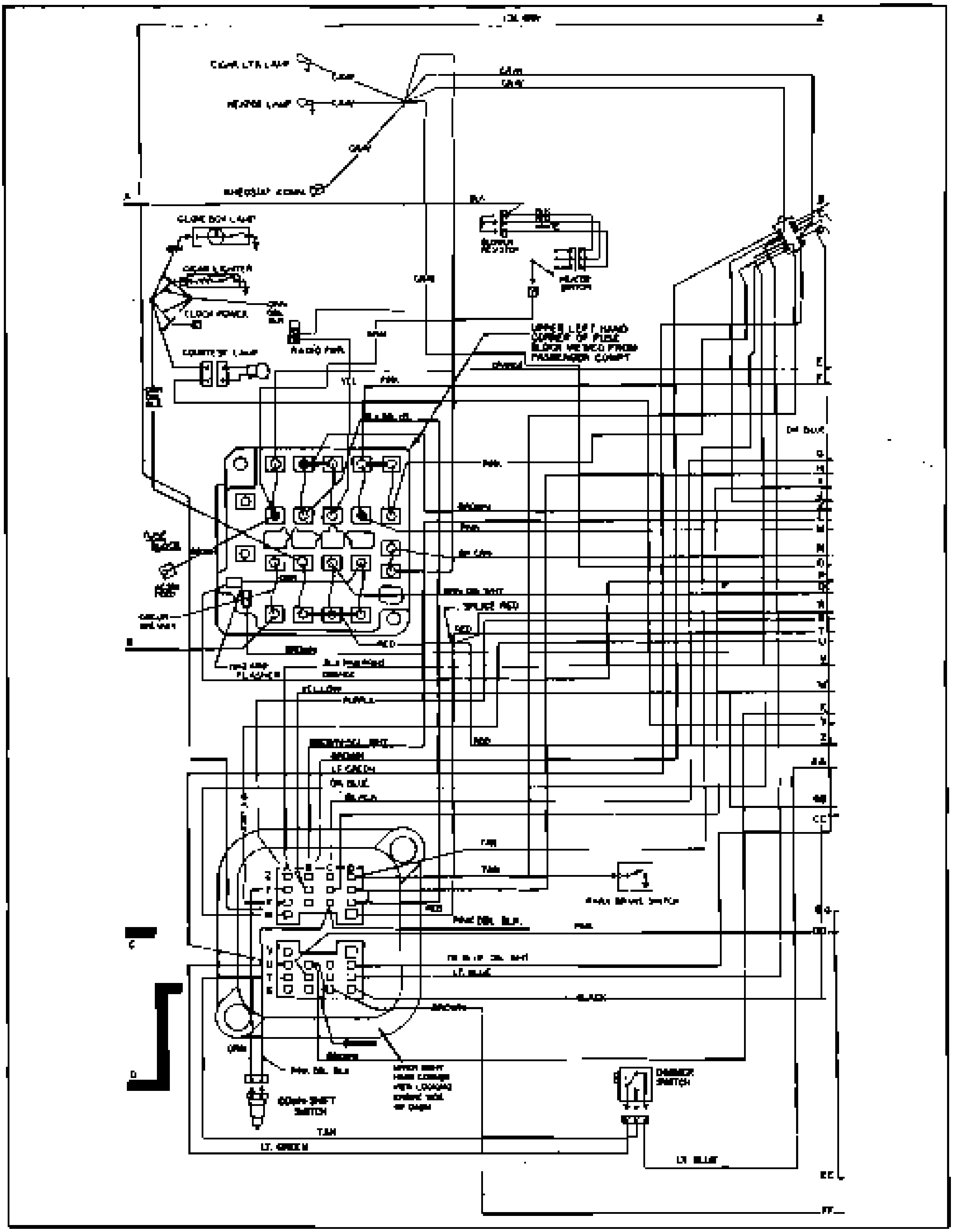


Fig. 12-6 Tempest Passenger Compartment Wiring

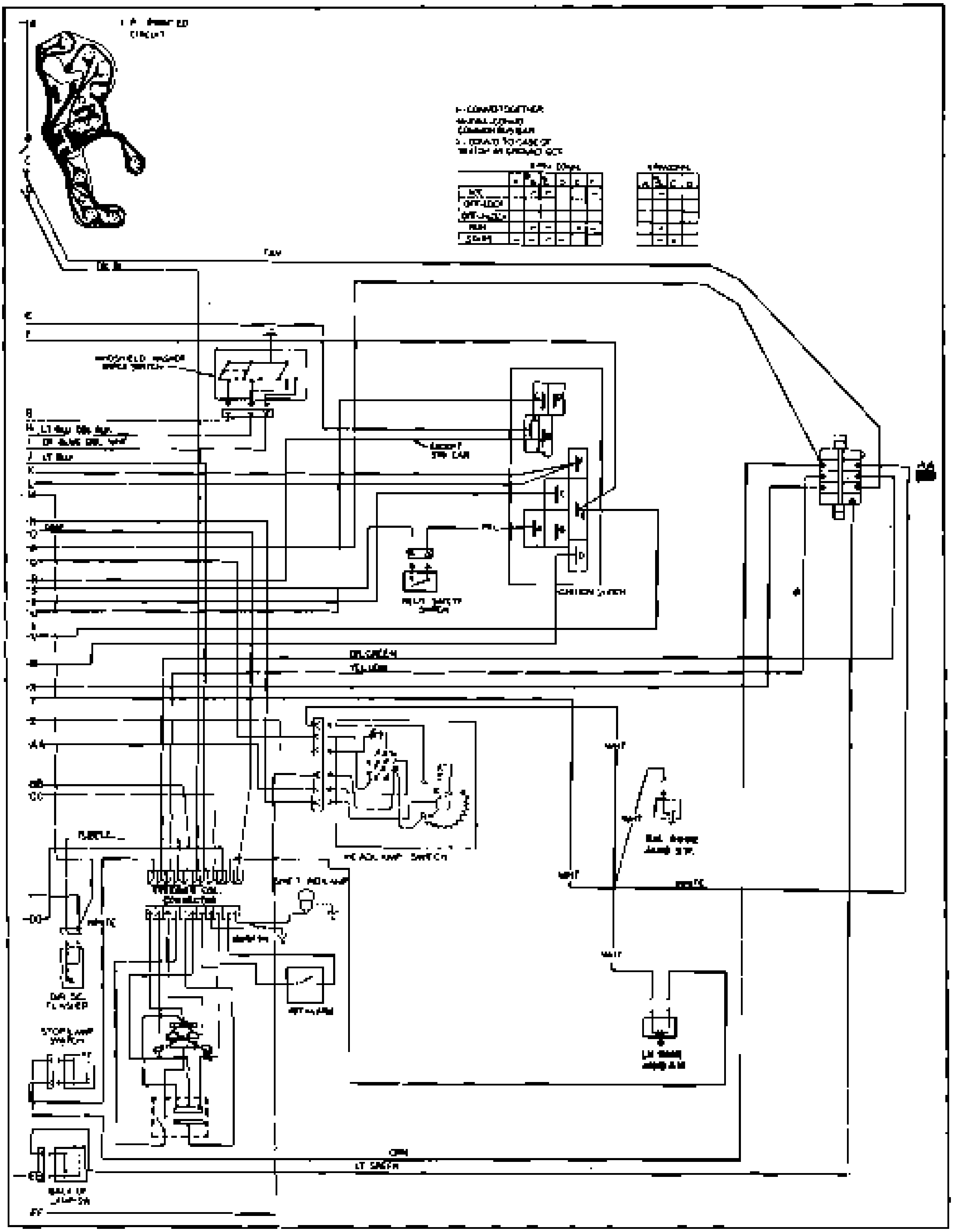


Fig. 12-7 Tempest Passenger Compartment Wiring
(Continued)

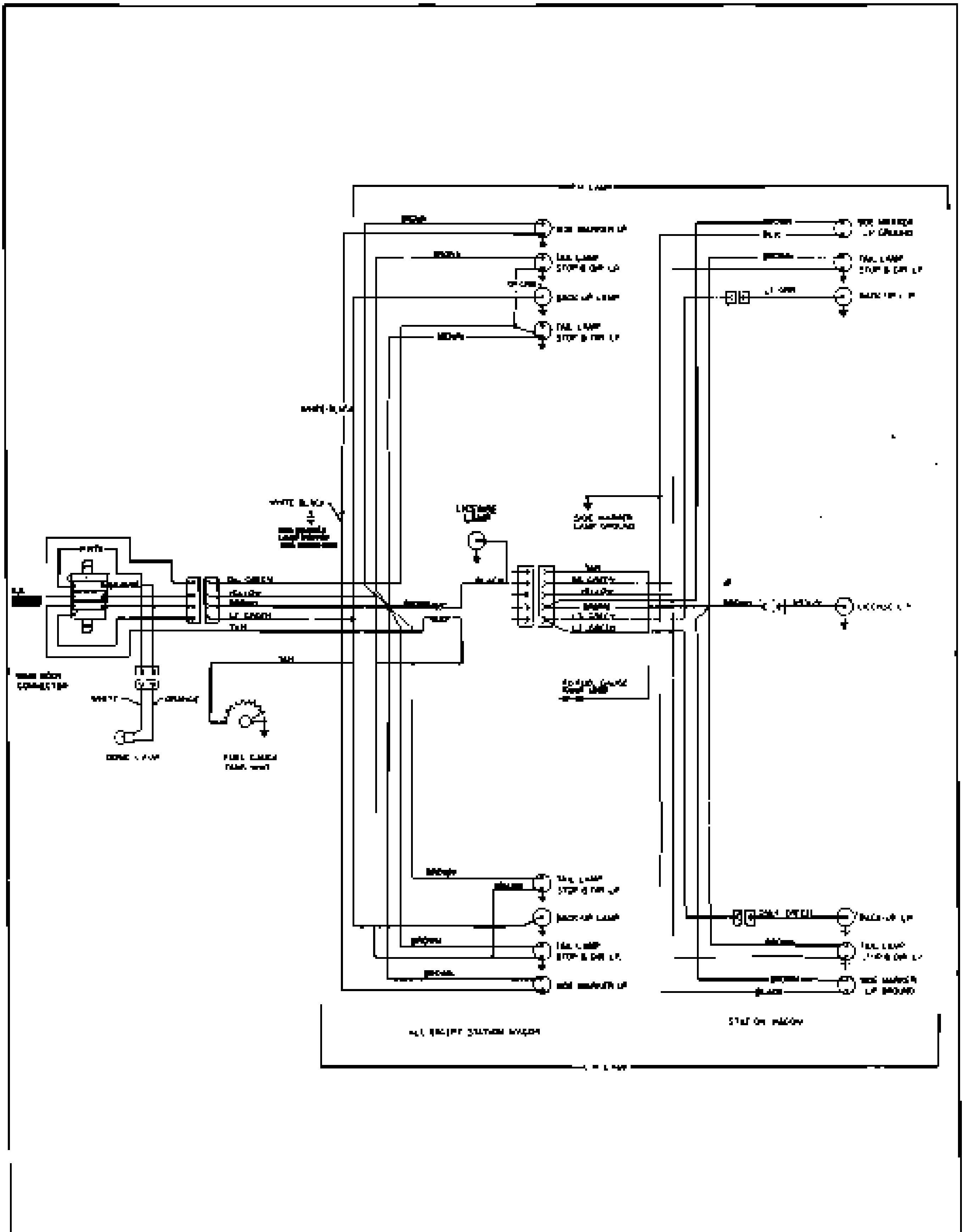


Fig. 12-8 Tempest Rear End Wiring

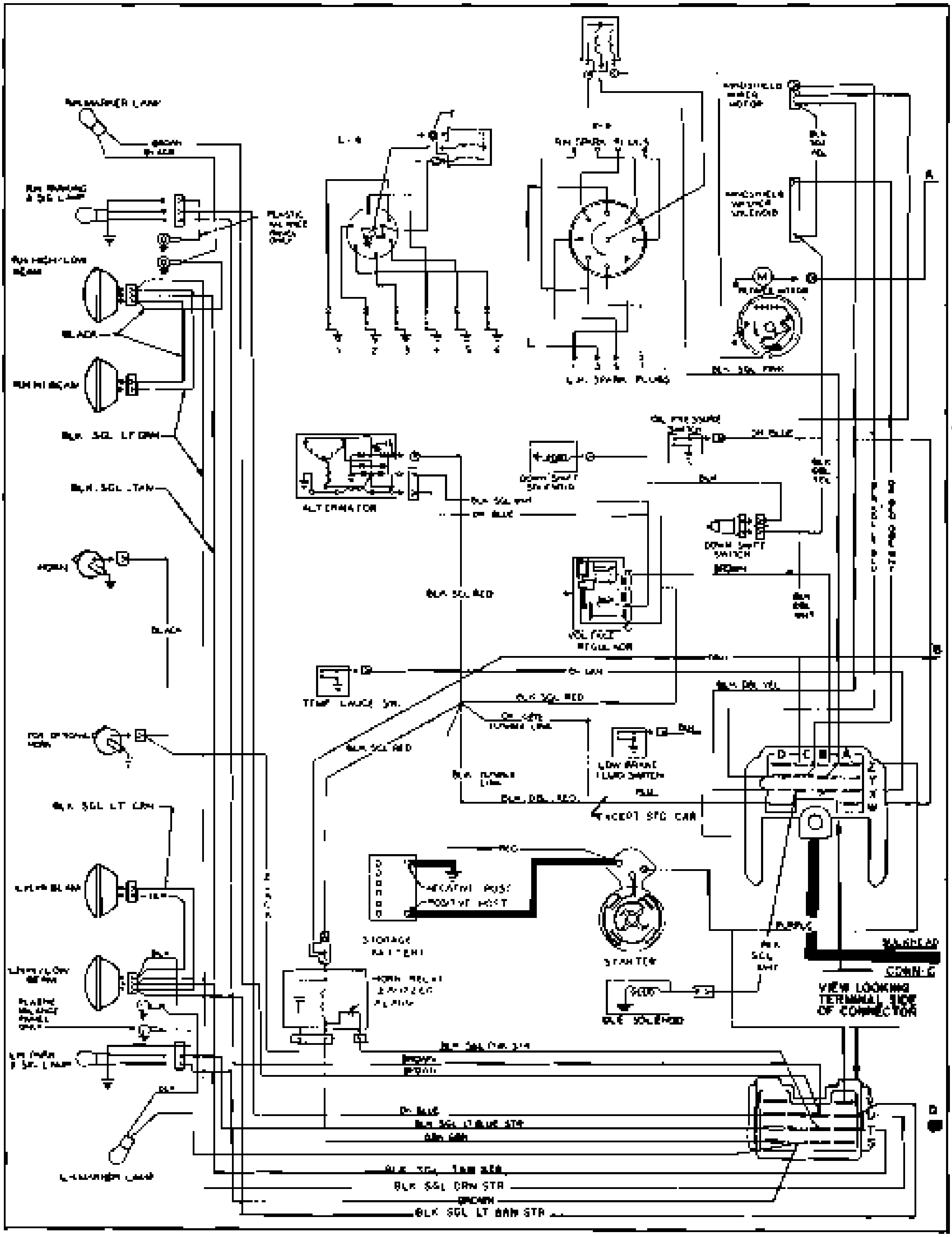


Fig. 12-9 Firebird Engine Compartment Wiring

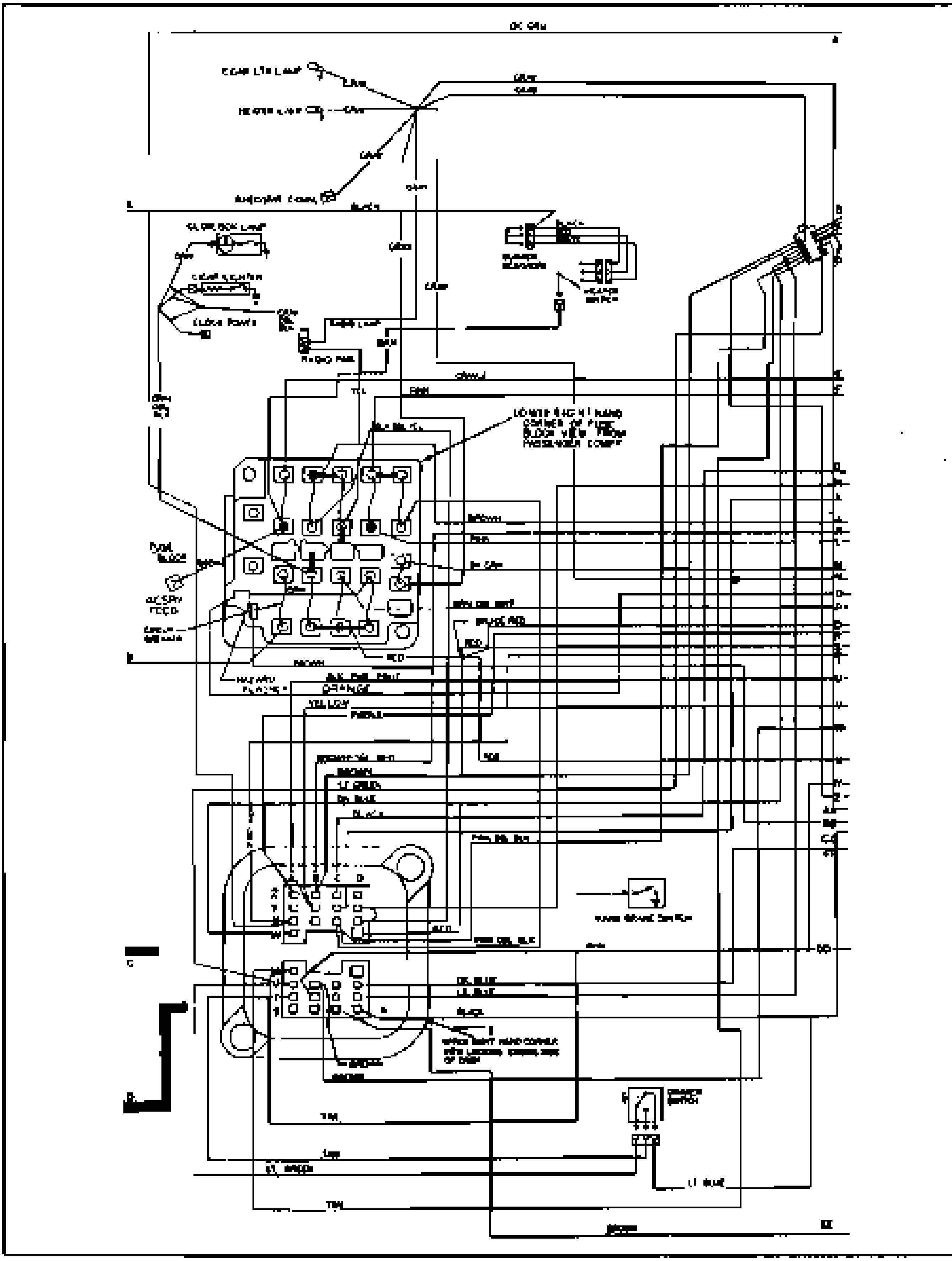


Fig. 12-10 Firebird Passenger Compartment Wiring

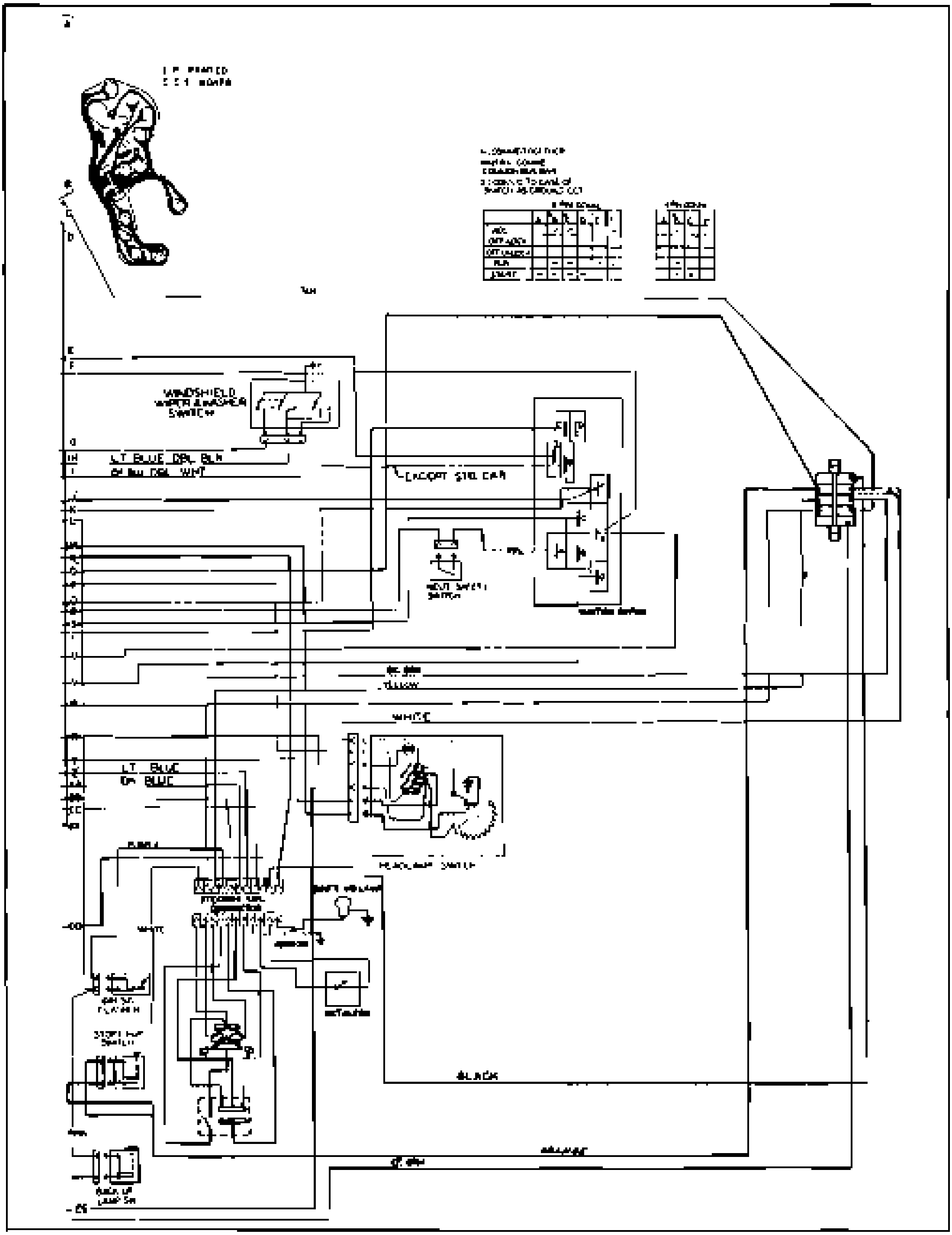


Fig. 12-11 Firebird Passenger Compartment
(Continued)

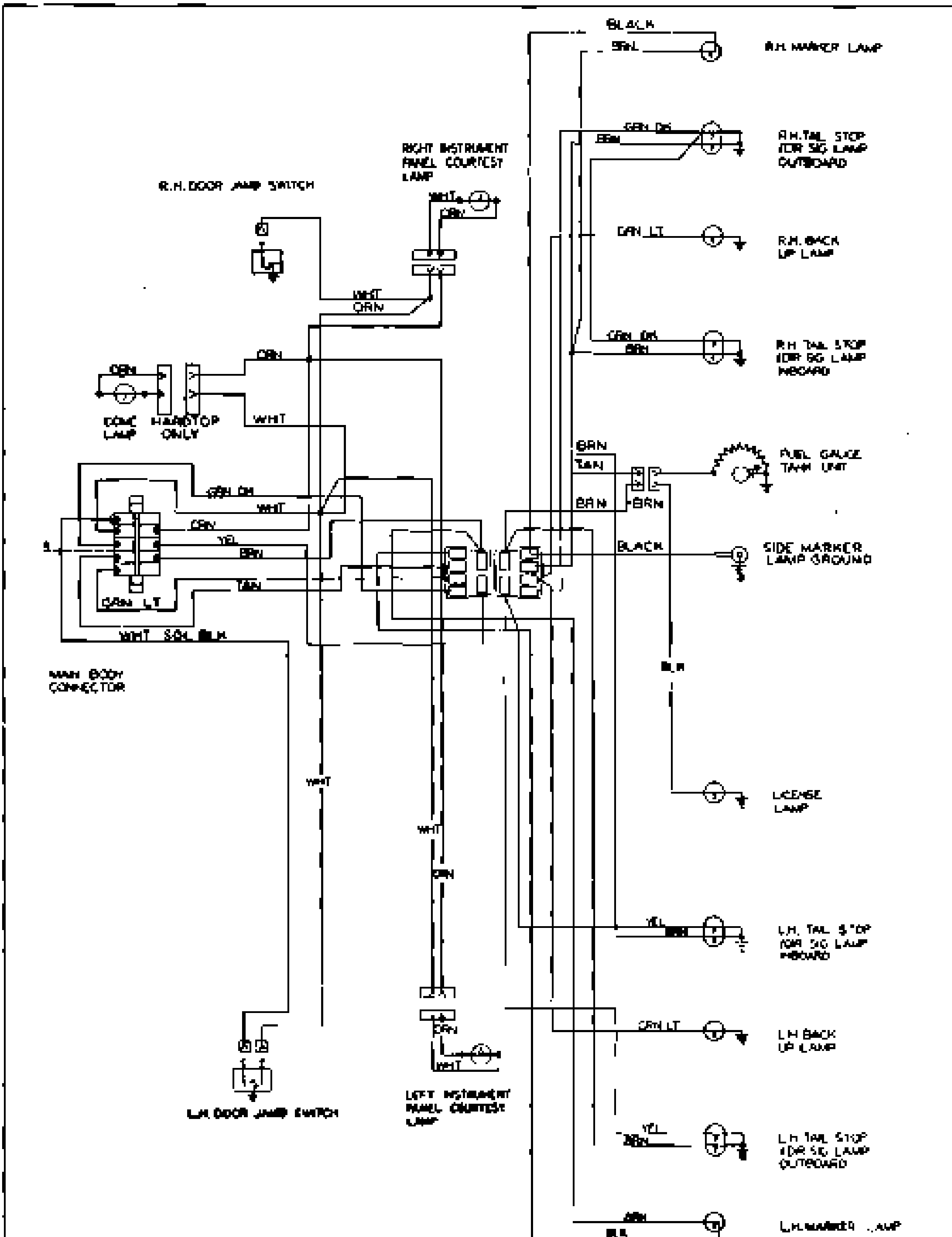


Fig. 12-12 Firebird Rear End Wiring

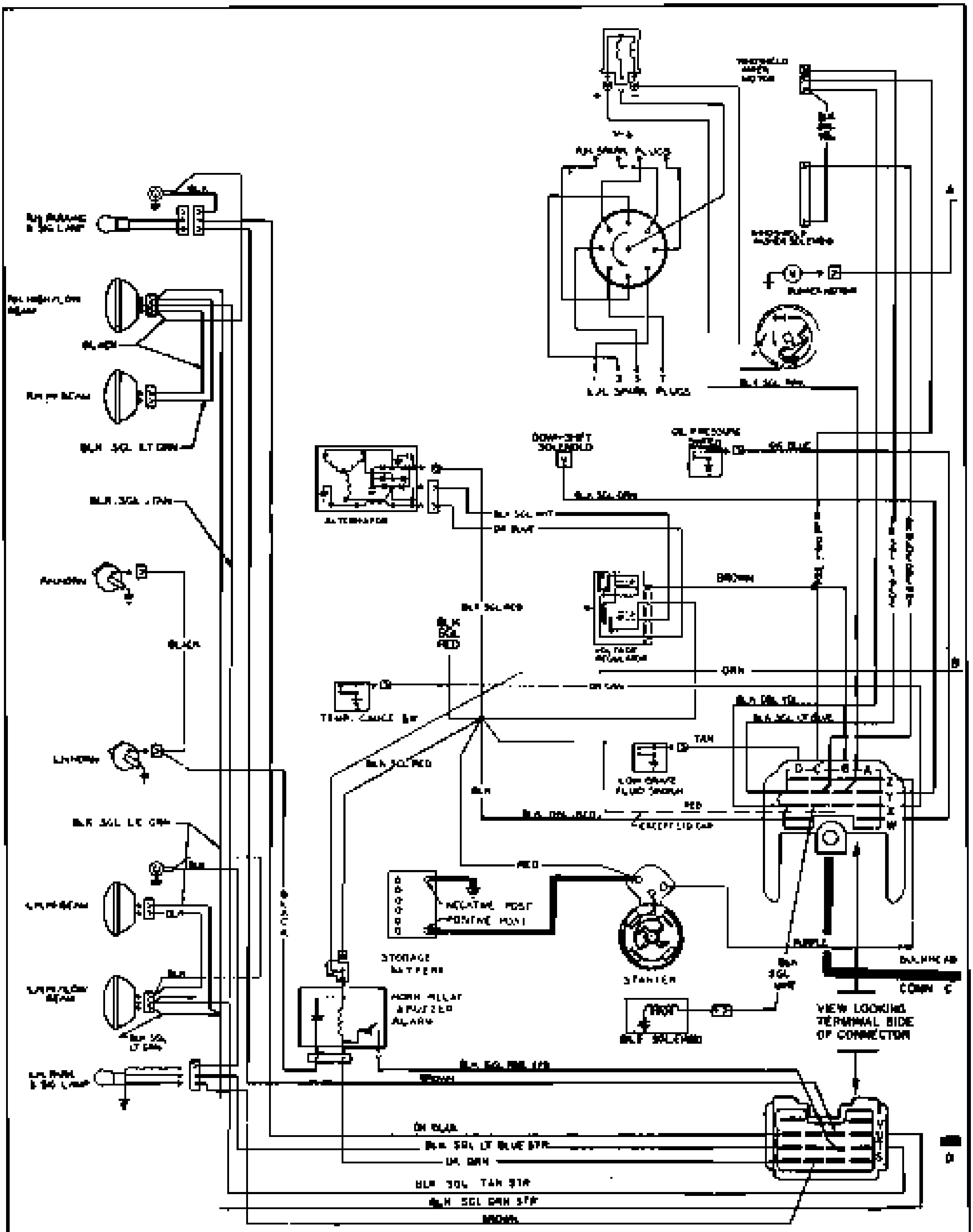


Fig. 12-13 Grand Prix Engine Compartment Wiring

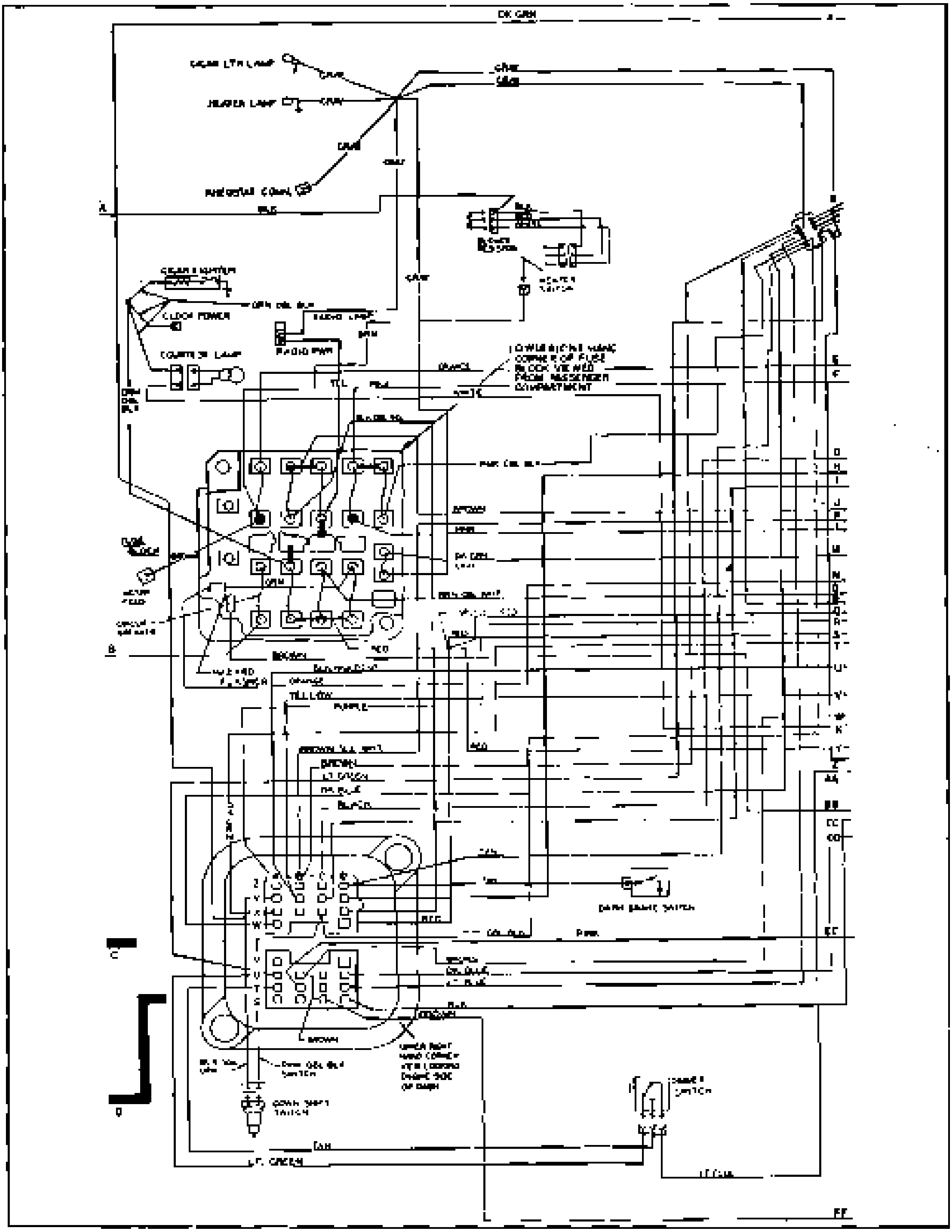


Fig. 12-14 Grand Prix Passenger Compartment Wiring

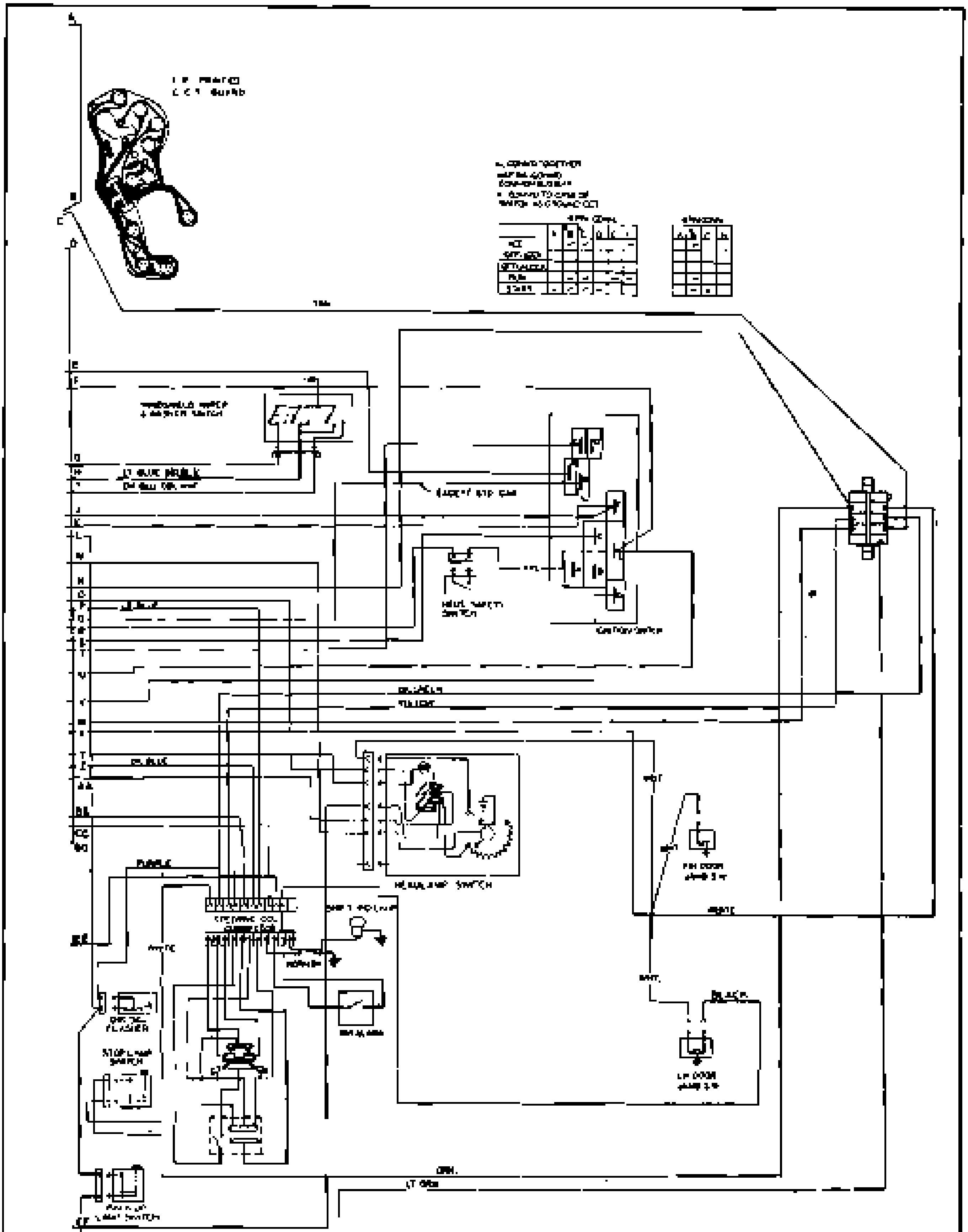


Fig. 12-15 Grand Prix Passenger Compartment Wiring (Continued)

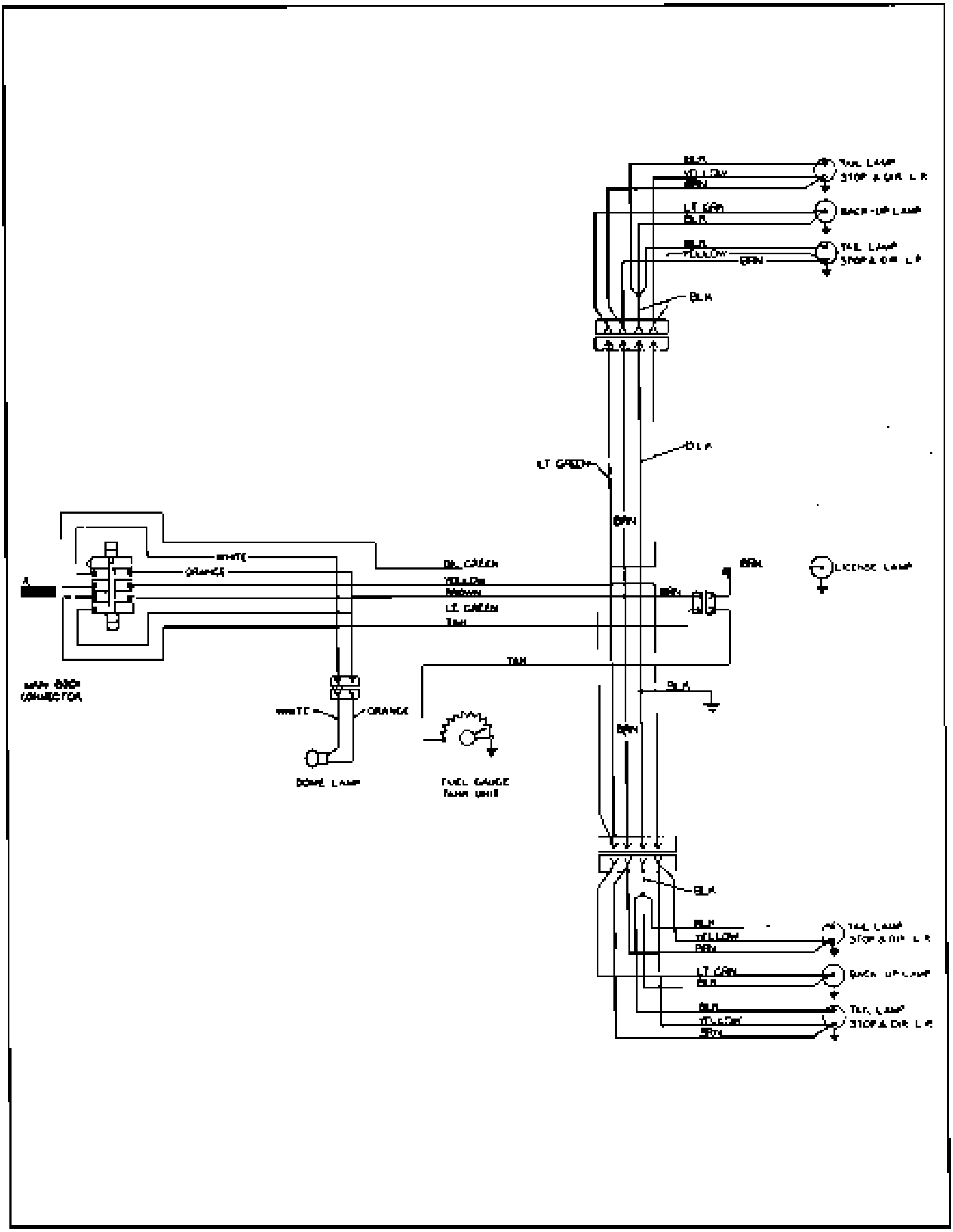


Fig. 12-16 Grand Prix Rear End Wiring

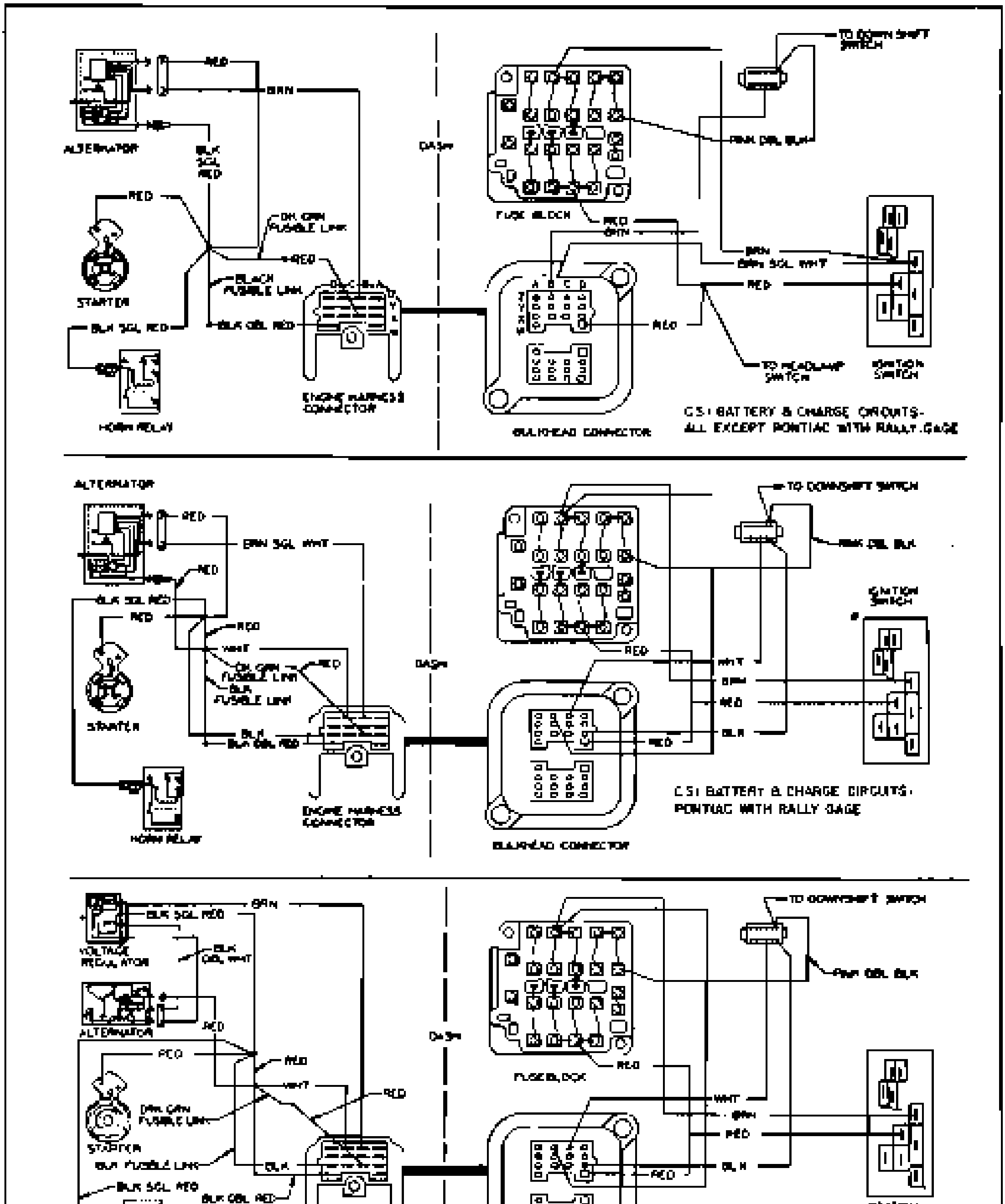


Fig. 12-17 Typical - Rally Gage Wiring

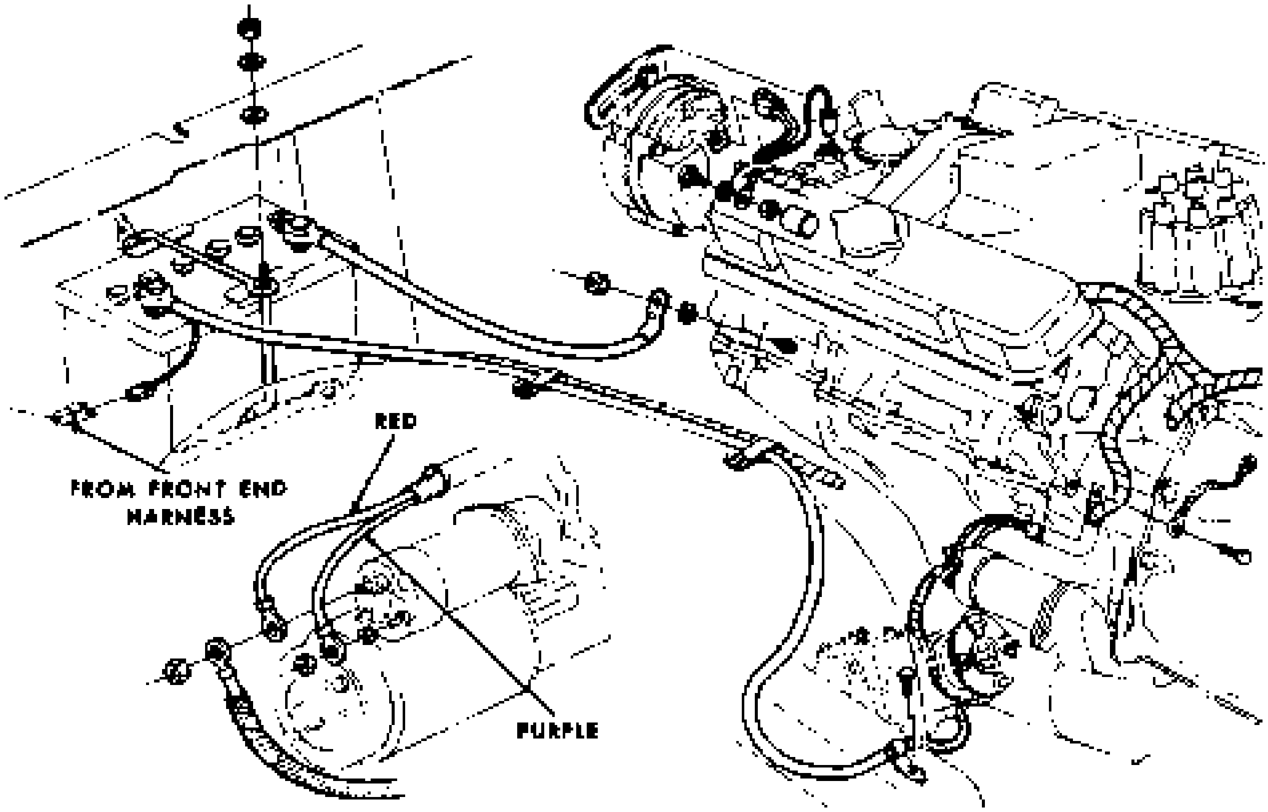


Fig. 12-18 Pontiac Battery Cable Routing

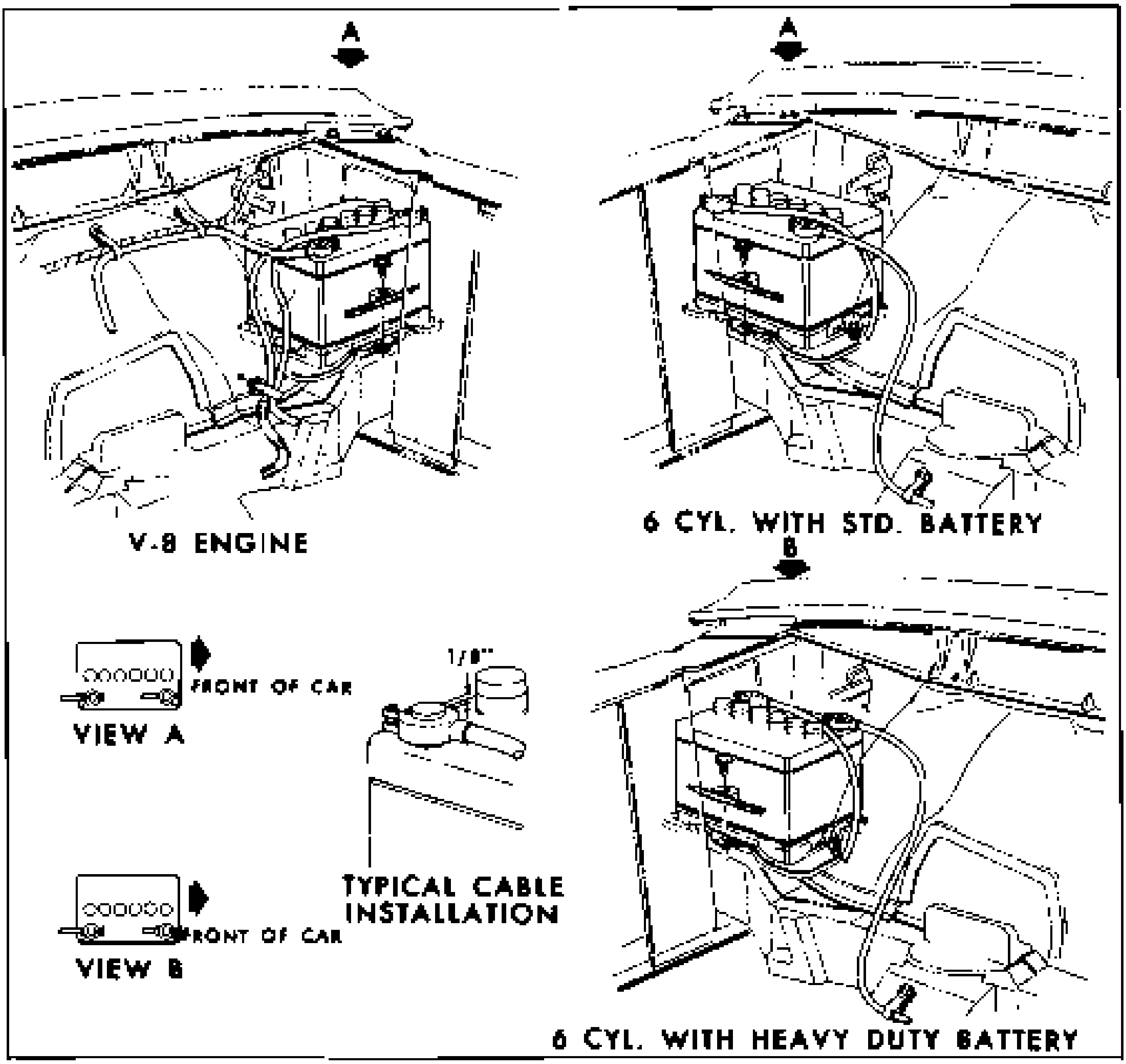


Fig. 12-19 Tempest and Grand Prix Battery Cable Routing

FUSE BLOCK AND BULKHEAD CONNECTOR

The fuse block and bulkhead connector are joined by two screws which retain the assembly to the lower left hand dash area. A circuit passing through a given terminal may be identified by using the embossed letters on the bulkhead connector. For example, Fig. 12-23 bulkhead connector cavity "DS" is the circuit to the horn relay operating coil circuit.

ALL-REMOVE AND REPLACE

1. Remove bolt holding front end and engine harness to fuse block. Separate harnesses.

2. Inside car, remove two screws retaining fuse block to dash.

3. Remove remaining in-car wire connectors and note position for reinstallation.

NOTE: Chassis wiring schematics will aid in identifying wires.

4. To replace, reverse removal procedure.

ENGINE WIRE HARNESS

ALL-REMOVE AND REPLACE

Engine wire harness routing and connection may be determined from Fig. 12-21 for 8 cylinder applications and Fig. 12-22 for 6 cylinder.

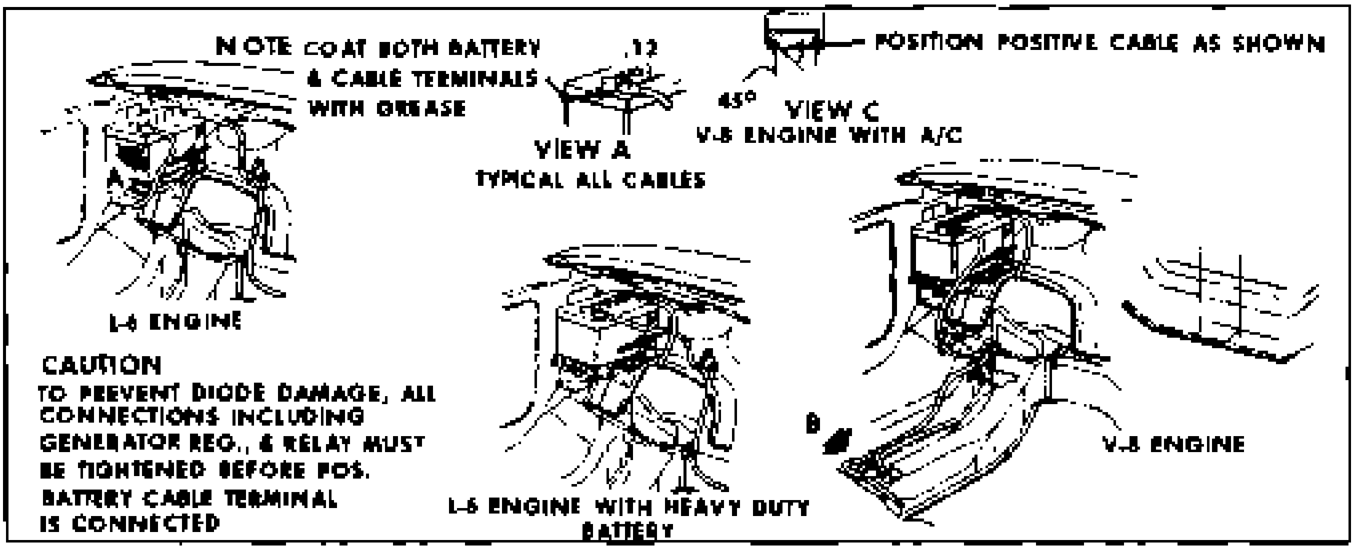


Fig. 12-20 Firebird Battery Cable Routing

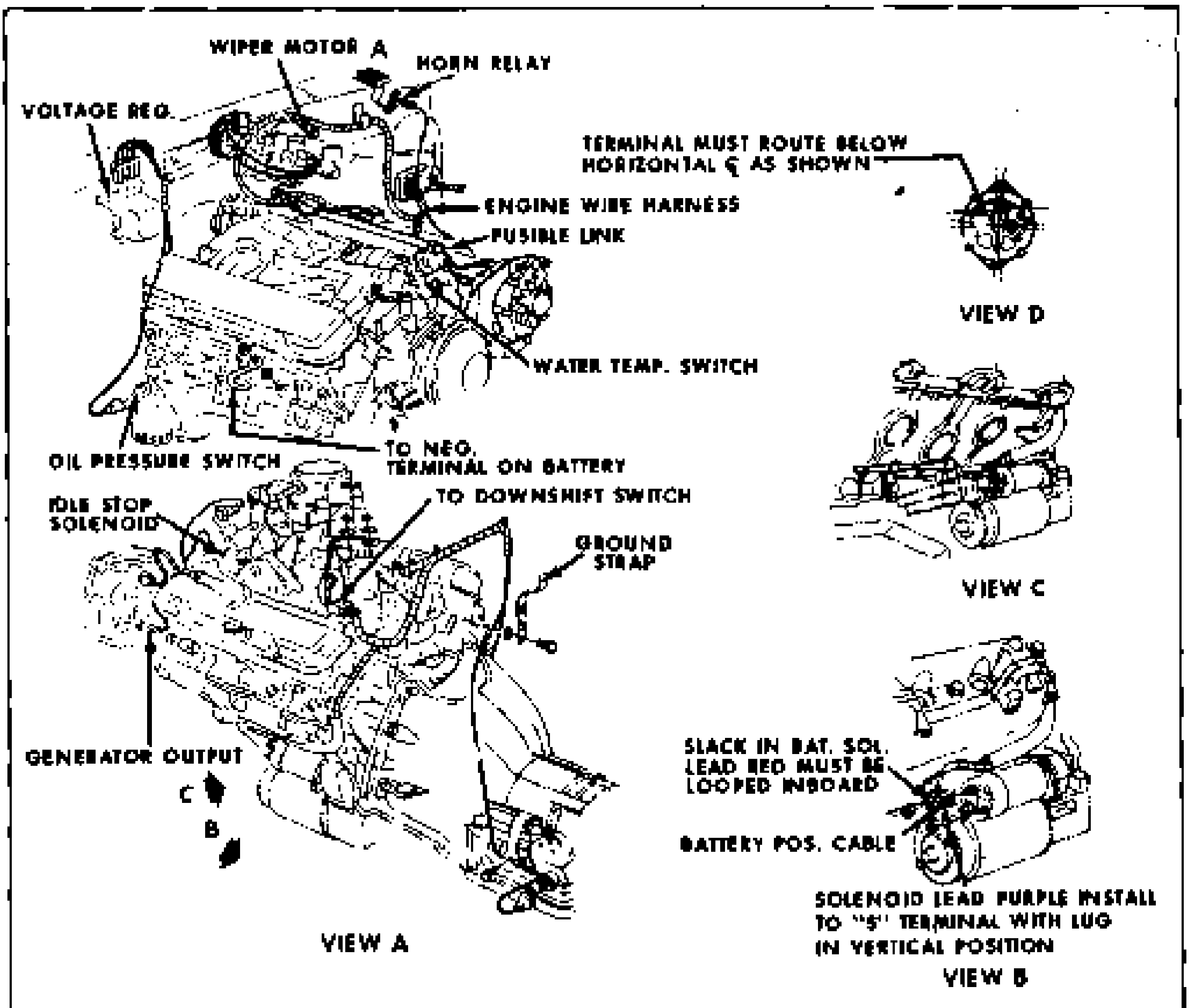


Fig. 12-21 Typical V8 ENgine Harness Installation

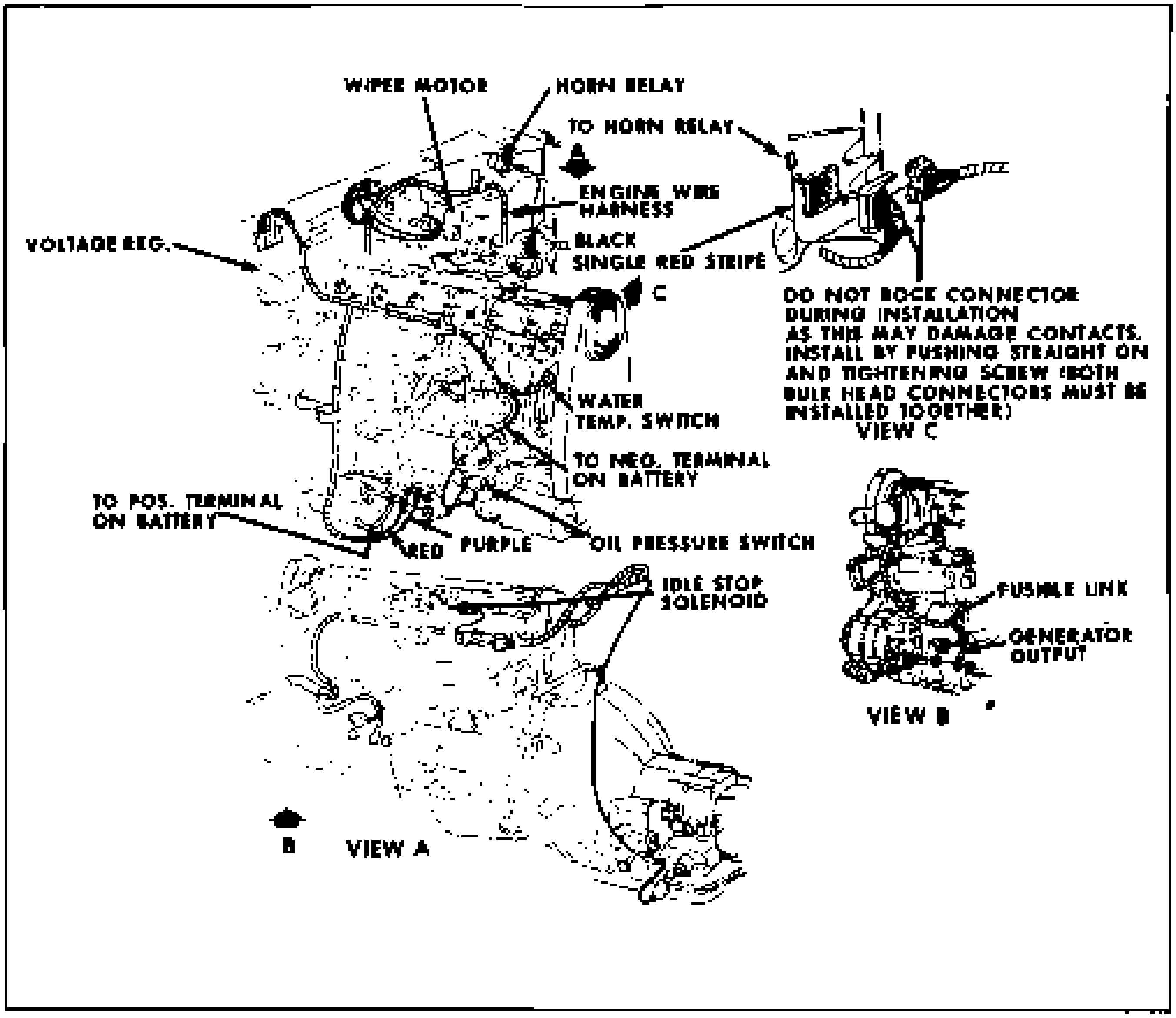


Fig. 12-22 Typical 6-Cylinder Engine Harness Installation

FRONT END WIRING HARNESS

Front end wire harness routing and connection may be determined from Fig. 12-24.

SEAL BEAM

ALL-REMOVE AND REPLACE (INCLUDES ADJUSTMENT)

1. Remove bezel.
2. Remove seal beam rim retaining screws.
3. Remove wire connector and remove seal beam.
4. To replace, reverse removal procedure.
5. Adjust headlights as shown in Fig. 12-25. If commercial aiming devices are used, follow manufacturer's instructions as well as local variations.

FRONT PARK AND SIGNAL LAMPS

PONTIAC AND TEMPEST - REMOVE AND REPLACE

1. To remove bulb, remove lens.
2. Remove retaining screws.
3. Disconnect electrical feed wire.
4. Remove lamp.
5. To replace reverse removal procedure.

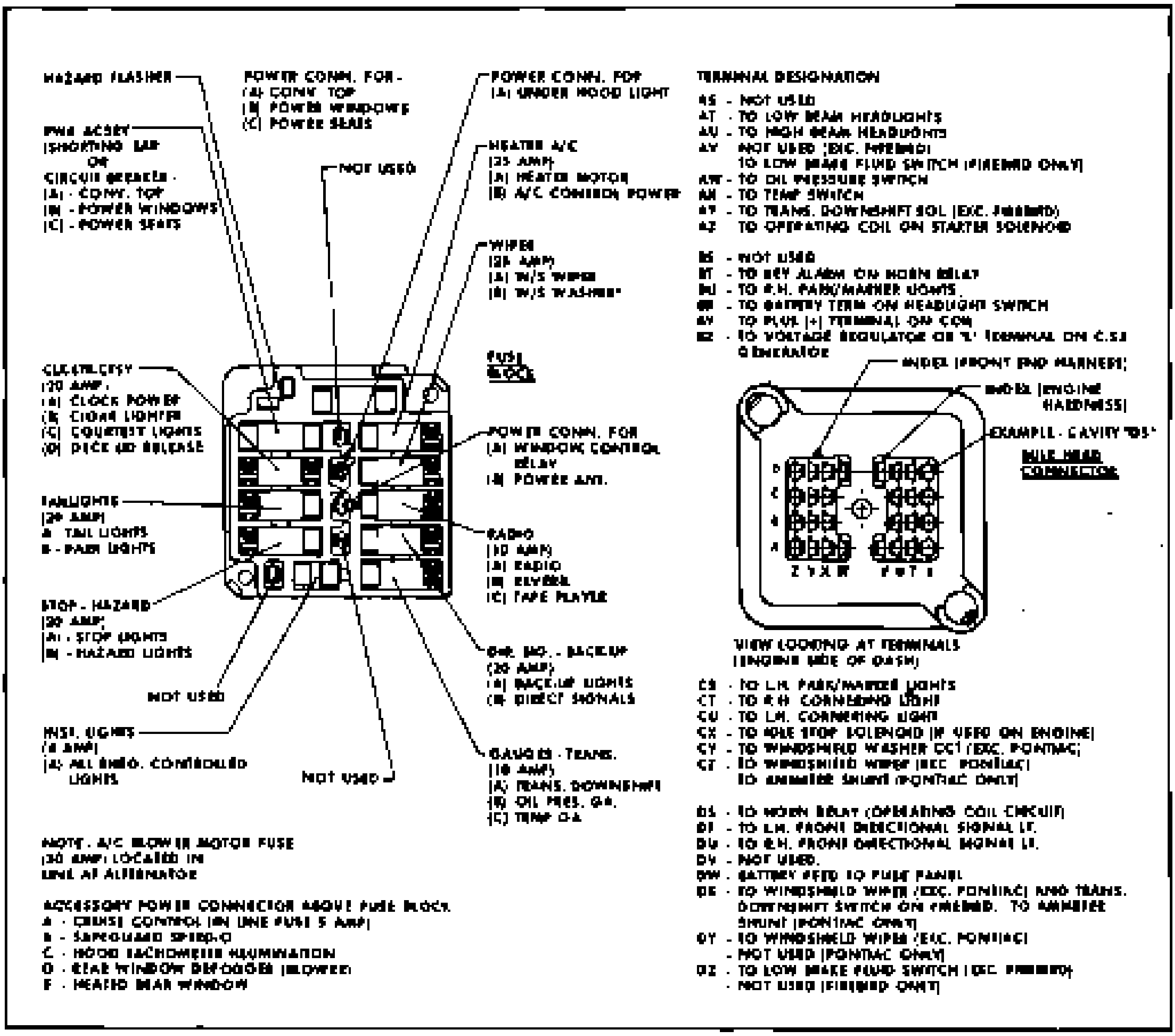


Fig. 12-23 Fuse Block and Bulkhead Connector Identification

G.T.O. AND FIREBIRD

1. Remove nuts and washers retaining lamp to panel
2. Pull lamp assembly and disconnect wires.
3. To replace reverse removal procedure.

GRAND PRIX

1. Remove lens.
2. Remove lamp retaining screws.
3. Pull lamp assembly and disconnect wires.
4. To replace reverse removal procedure.

HORNS

PONTIAC AND TEMPEST - REMOVE AND REPLACE

1. Remove lower valance panel.
2. Remove horn wire.
3. Remove horn retaining screw.
4. Remove horn or horns.

GRAND PRIX OR FIREBIRD

1. On Firebird models remove filler from grille to radiator support.

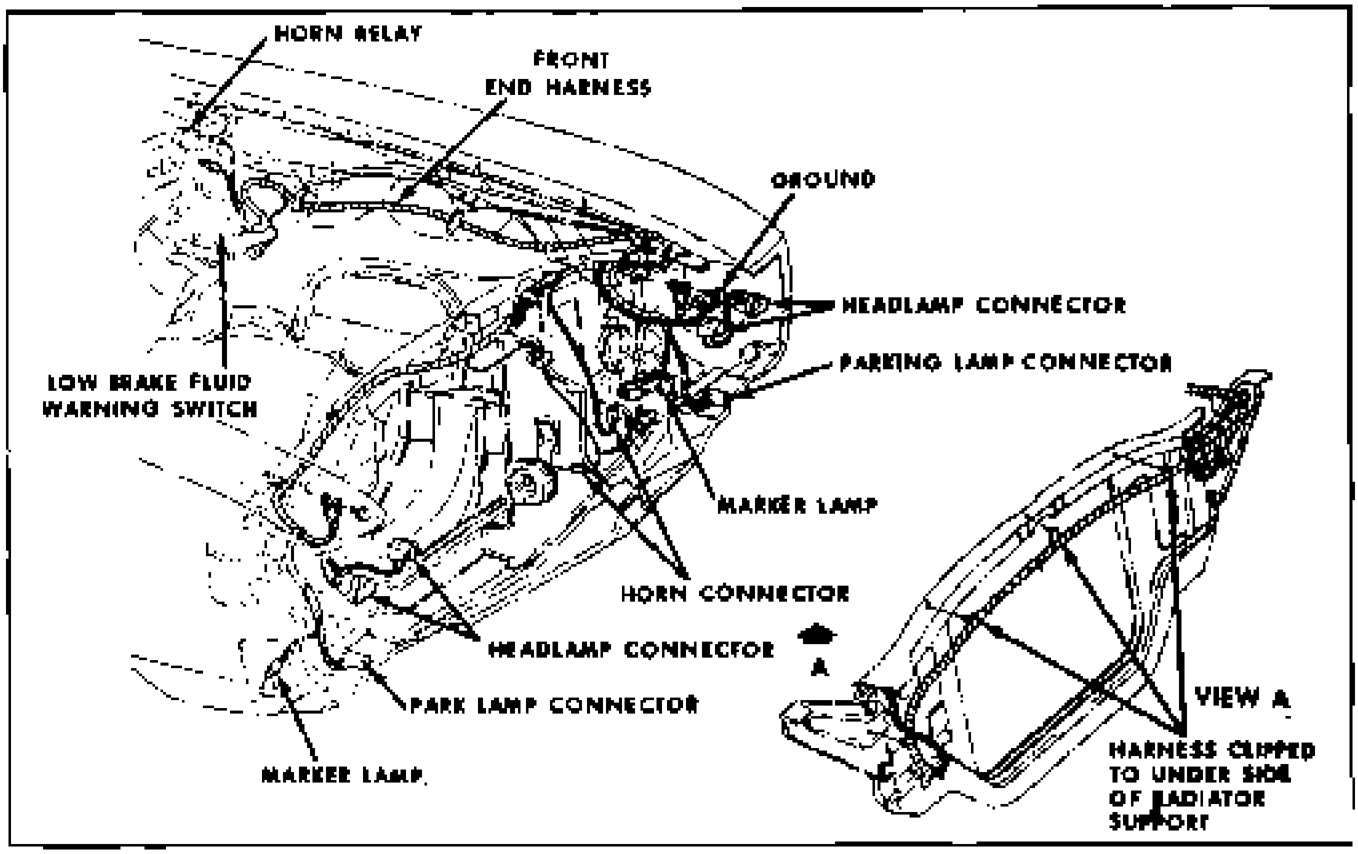


Fig. 12-24 Typical Front End Harness Installation

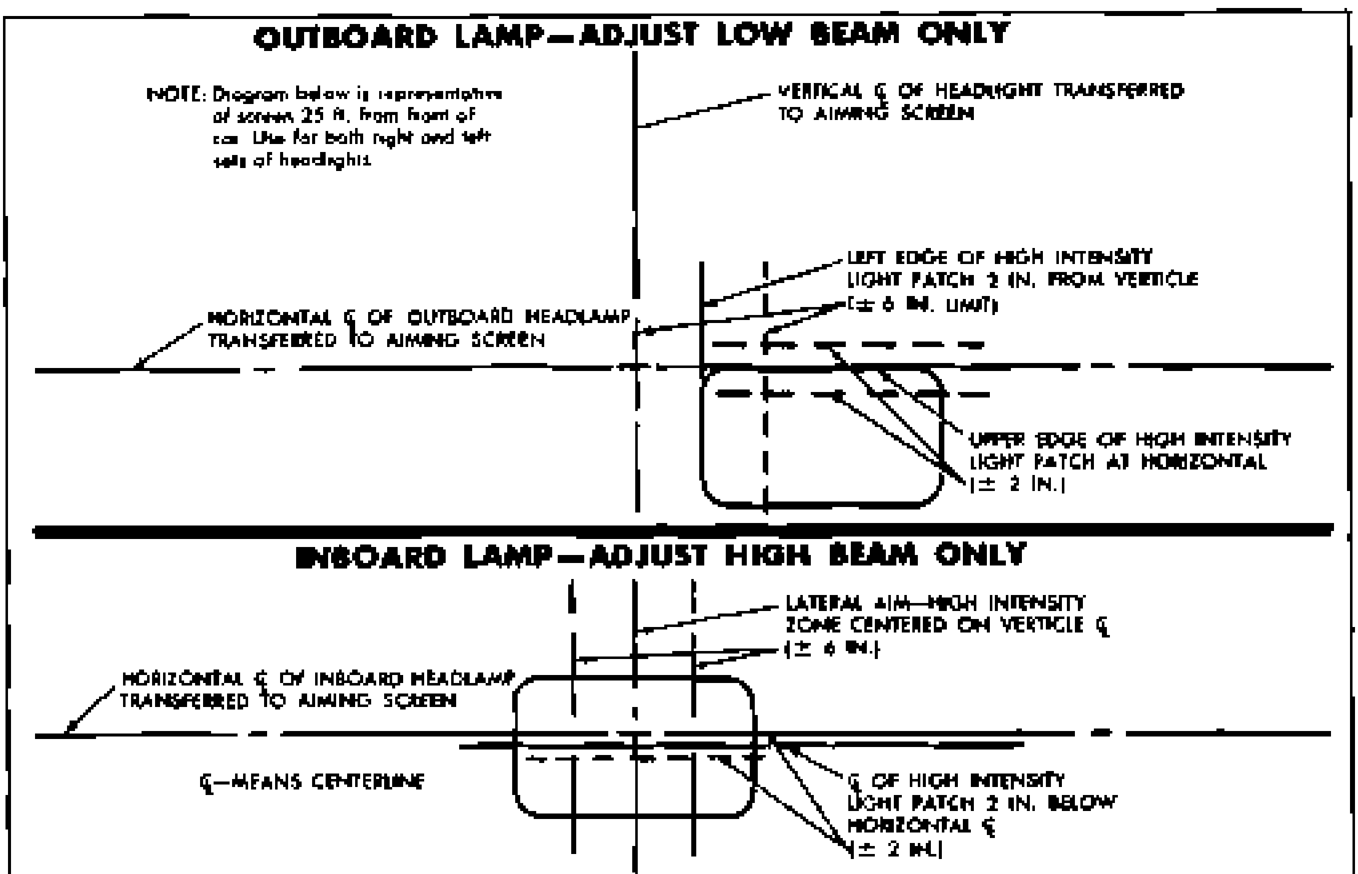


Fig. 12-25 Headlight Aiming Chart

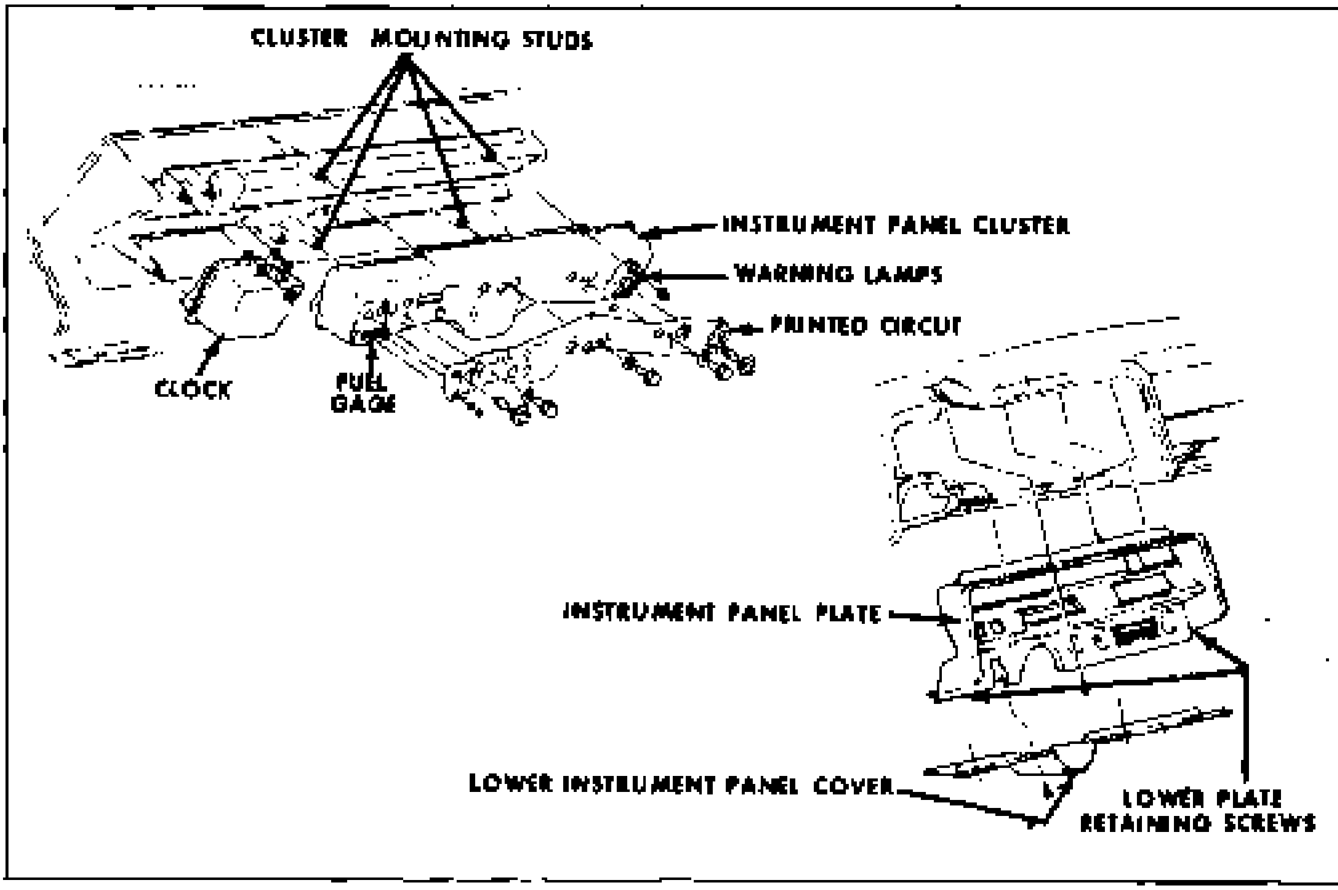


Fig. 12-26 Pontiac Instrument Panel Installation

2. Remove horn wire.

3. Remove retaining screw.

4. Remove horn.

5. To replace reverse removal procedure.

HORN RELAY AND BUZZER ALARM

ALL-REMOVE AND REPLACE

1. Remove wire connectors.

2. Remove relay retaining screw.

3. Remove relay.

4. To replace, reverse removal procedure.

BRAKE WARNING LIGHT SWITCH

ALL-REMOVE AND REPLACE

It is necessary to remove brake line distributor to replace brake warning light switch. Instructions for removal of the switch can be found in Section 5.

SIDE MARKER LAMPS

ALL-REMOVE AND REPLACE

Front side marker lamps on grand Prix models consist of a reflecting surface integral with the park lamp. All other models are equipped with a plastic lamp retained to the front fender by a steel retainer. Bulb and socket then twist into lamp. The marker lamp is of single filament type and has a single wire leading to it from the front end harness. The rear marker lamp, located in the quarter panel is also fed by a single wire contained in the rear harness.

INSTRUMENT PANEL CLUSTER

Removal of these units can be accomplished by using the following installation diagrams: Fig. 12-26, 12-27, 12-24, and by referring to the below procedures.

PONTIAC-REMOVE AND REPLACE

1. Disconnect battery.

2. Remove lower instrument panel cover.

3 Remove radio.

4. Remove heater or A/C control panel.

5. Disconnect speedometer, printed circuit connector, cigar lighter and instrument panel harness from rear of cluster.

6. Remove four cluster retaining screws.

7. Position ground straps so that cluster may be pulled from studs and removed towards center of car.

8. To replace, reverse removal procedure.

TEMPEST - REMOVE AND REPLACE

1. Disconnect battery.

2. Remove glove compartment.

3. Disconnect speedo cable and wire connectors at headlamp switch, windshield wiper, turn signal, ignition switch, printed circuit, heater and/or air conditioner control panel.

4. Remove lower column trim and disconnect air control cable at heater case.

5. Remove three (3) screws at instrument bombs, Fig. 12-27.

6. Remove two (2) instrument panel to column support screws, one screw at each outboard lower end of panel and three (3) nuts above glove compartment (inner).

7. Loosen two right hand toe plate screws and two screws clamping right toe plate to left toe plate.

8. Remove column to instrument panel bracket nuts and drop column. Place shop rags over column directly below instrument panel.

9. Pull entire instrument panel rearward far enough to gain access to cluster.

10. Remove ground strap retaining screws, and two instrument panel harness conduit retaining screws.

11. Remove instrument panel cluster retaining screws then cluster.

12. To replace, reverse removal procedure making sure that proper sequence of tightening is used at toe plate (Right hand to left hand toe plate clamping screws then left hand toe plate to dash.)

GRAND PRIX - REMOVE AND REPLACE

1. Disconnect battery.

2. Remove glove compartment.

3. Disconnect speedo cable and wire connectors at headlamp switch, windshield wiper, turn signal, ignition switch, printed circuit, heater and/or air conditioner control panel.

4. Remove lower column trim and disconnect air control cable at heater case.

5. Remove three (3) screws at instrument bombs, Fig. 12-27.

6. Remove two (2) instrument panel to column support screws.

7. Remove one screw at each outboard lower end of panel.

8. Remove screws retaining right and left side of instrument panel to body. To do this, remove the upper vent nozzles by inserting two thin blade screwdrivers on right and left side of nozzle to disengage metal retaining clip. Then pull nozzle towards rear of car to remove.

9. Remove upper instrument panel cover plate. (Studs pushed into retaining clips, pry up carefully to remove.)

10. Remove two upper panel retaining screws and upper speaker support bracket screw.

11. Remove console to instrument panel retaining screws.

12. Loosen toe plate screws.

13. Remove column to lower instrument panel retaining nuts and drop column.

14. Pull entire instrument panel rearward on left far enough to gain access to cluster.

15. Remove ground strap retaining screws, and two instrument panel harness conduit retaining screws.

16. Remove instrument panel cluster retaining screws then cluster.

17. To replace, reverse removal procedure referring to section 9 for column alignment procedure.

FIREBIRD - REMOVE AND REPLACE

1. Disconnect battery.

2. Remove lower instrument panel cover.

3. Remove ash tray bracket screws and radio retaining nuts and glove compartment.

4. Disconnect heater control cables and wire connectors.

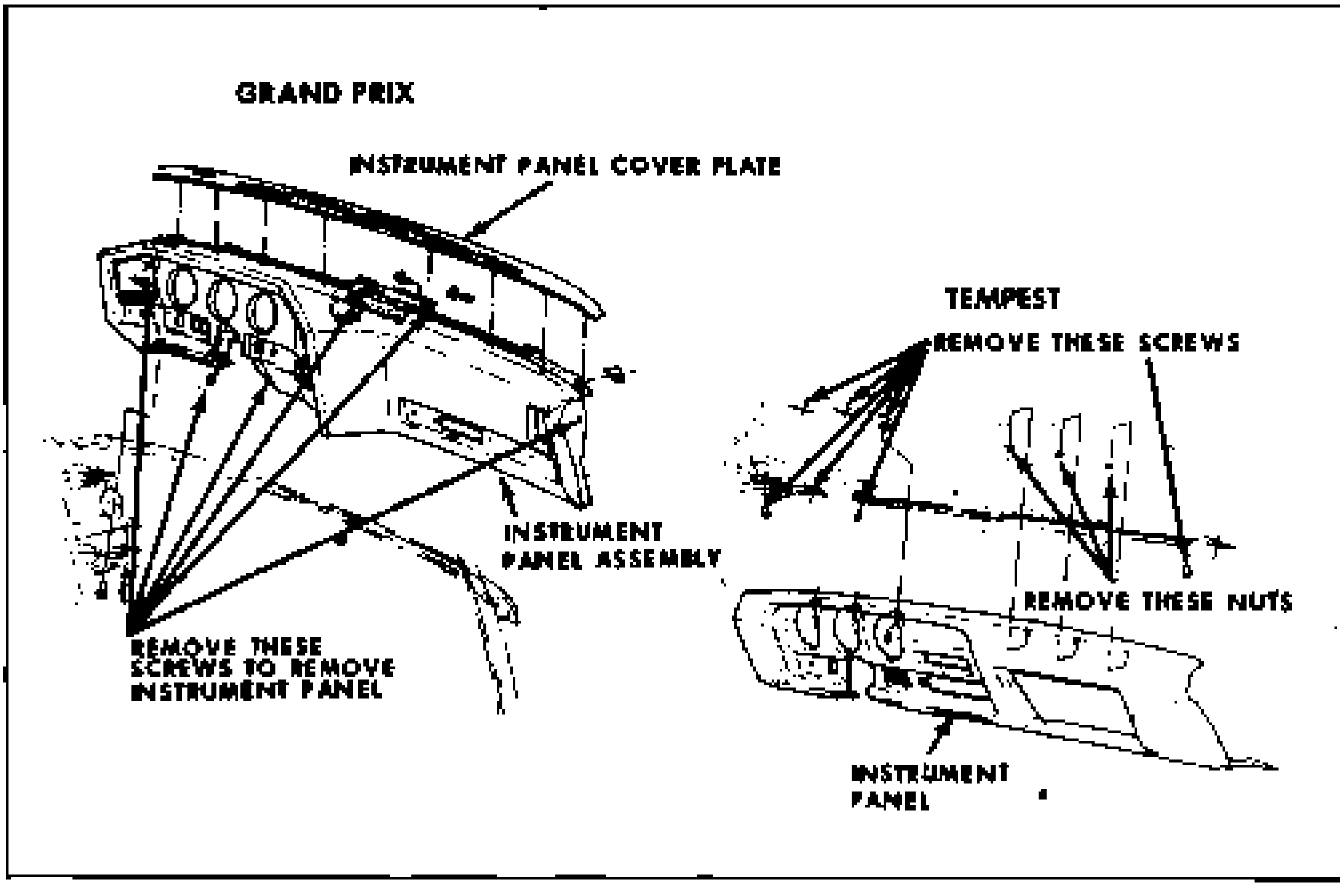


Fig. 12-27 Tempest and Grand Prix Instrument Panel Installation

5. Disconnect speedometer cable.

6. Remove upper L.H. vent duct connector.

7. Disconnect headlamp switch shaft.

8. Remove screws across top and bottom of instrument plate and the nut on right hand side, Fig. 12-28, (stud through steel portion of dash).

9. Drop steering column by loosening toe plate screws and removing lower column support nuts.

10. Place shop towels on top of column and then pull panel rearward to rest on column.

11. Disconnect printed circuit accessory, windshield wiper, cigar lighter.

12. Remove ground straps then cluster retaining screws.

13. Remove cluster carefully so as not to scratch face.

14. To replace, reverse removal procedure referring to Section 9 for steering column alignment.

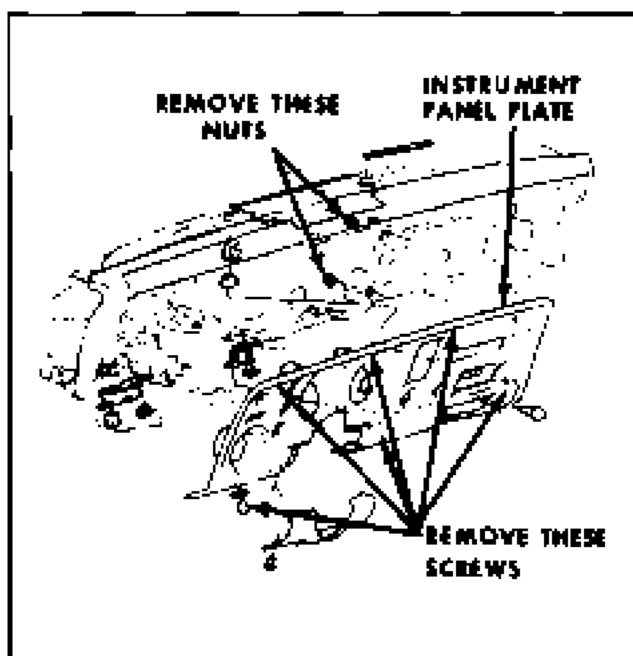


Fig. 12-28 Firebird Instrument Panel Installation

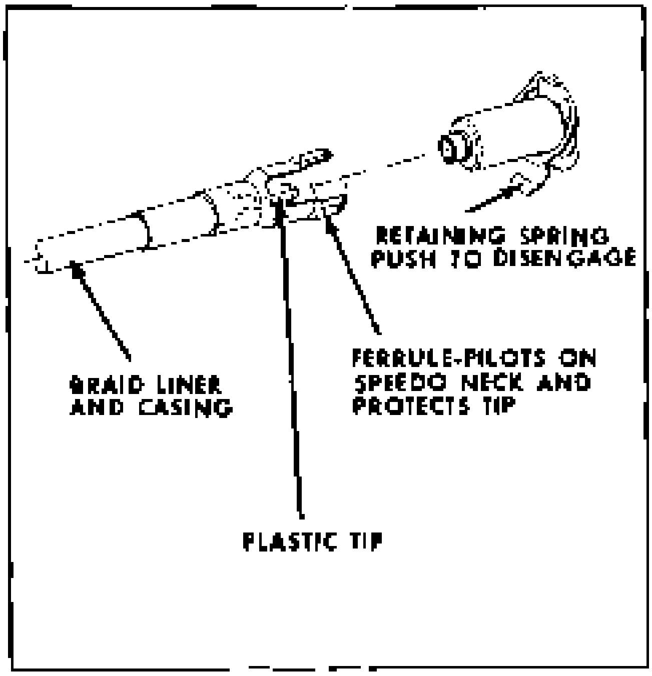


Fig. 12-29 Speedometer Cable Attachment

SPEEDOMETER CABLE

Speedometer cable connection at speedometer cluster is of quick disconnect design. Fig. 12-29 shows detail. Fig. 12-30 shows cable routing.

ALL-REMOVE AND REPLACE

1. Disconnect speedometer cable casing from speedometer head

2. Slide old cable out from upper end of casing, or if broken from both ends of casing.

3. Take short piece of speedometer cable with a tip to fit speedometer and insert it in speedometer socket. Spin short cable between fingers in direction that higher speed is indicated on speedometer dial and note if there is any tendency to bind. If binding is noted, there is trouble inside head and speedometer should be repaired.

4. Inspect cable casing, especially at transmission end, for sharp bends and breaks. If breaks are noted, replace casing.

5. To insure quiet operation, assemble cable in following manner:

a. Wipe cable clean, using lint free cloth. Flush bore of casing with oleum spirits or suitable solvent solution and blow dry with air under pressure.

b. Place an approved speedometer cable lubricant in palm of hand.

c. Feed cable through lubricant in hand and into casing until lubricant has been applied to lower two-thirds of cable. Do not over-lubricate and do not apply lubricant to upper third of cable, since operation of cable assures adequate lubrication of upper third and at same time prevents lubricant from seeping into speedometer head.

6. Seat upper cable tip in speedometer and snap retainer on casing.

PRINTED CIRCUIT

ALL - REMOVE AND REPLACE

All models utilize a printed circuit for instrument illumination and gage power. The printed circuit is

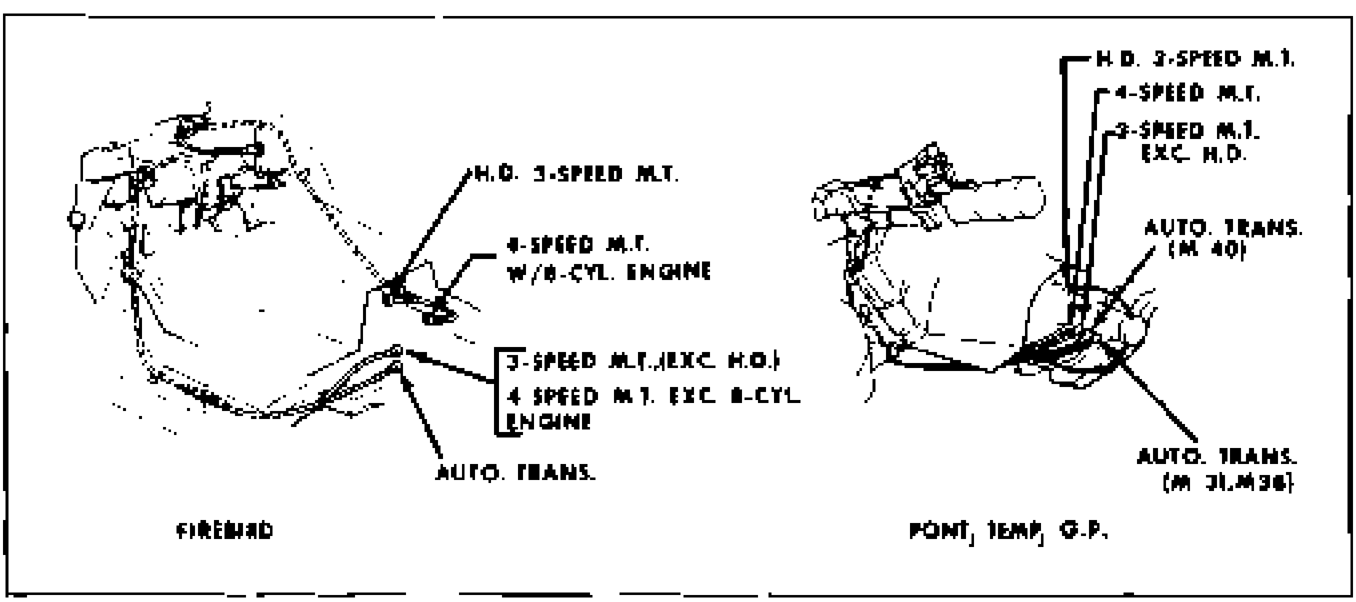


Fig. 12-30 Speedometer Cable Routing

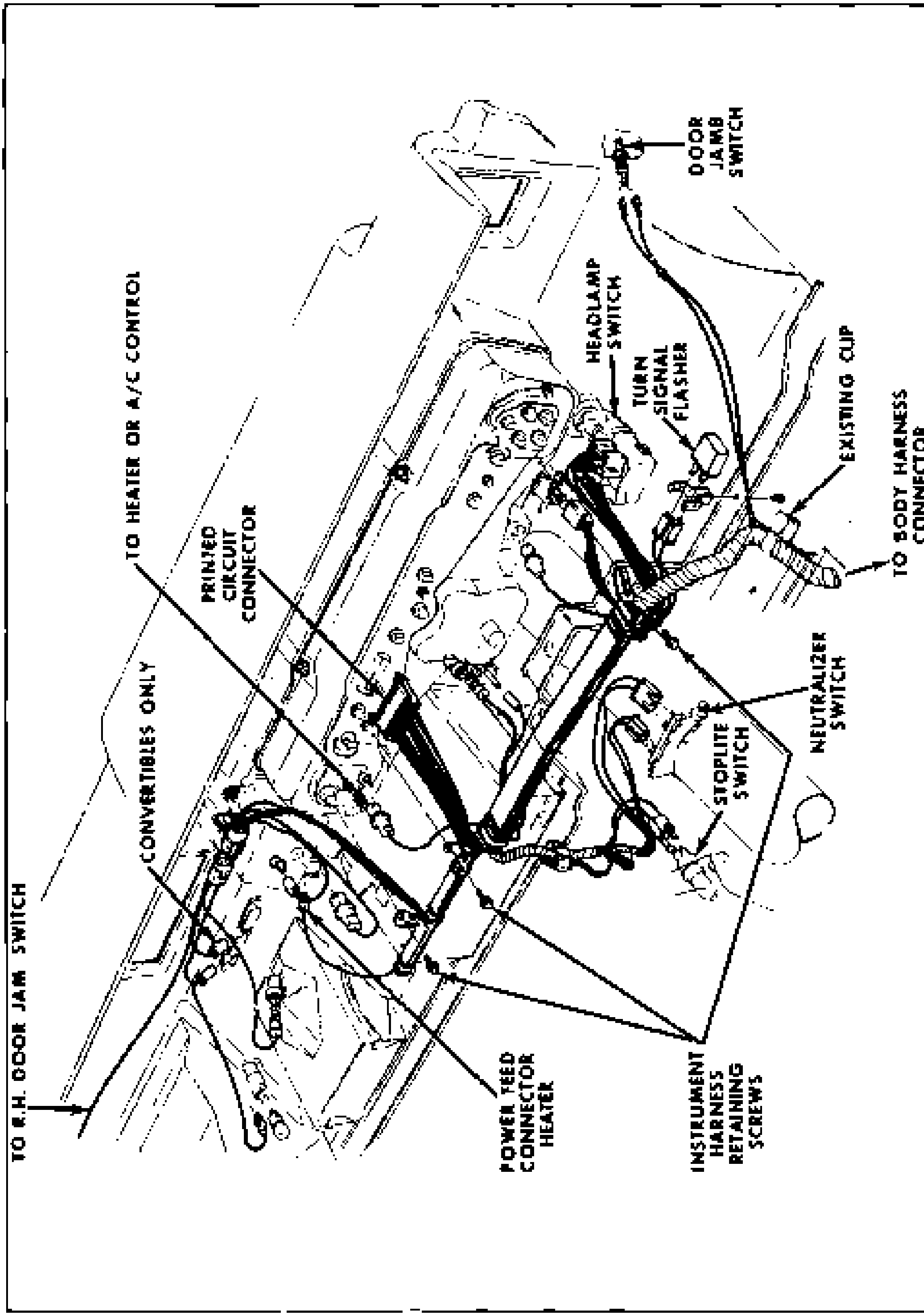


Fig. 12-31 Pontiac Instrument Panel Harness

retained to the rear of the instrument cluster by bulbs, nuts and retaining screws.

PONTIAC - REMOVE AND REPLACE

1. Disconnect battery.

NOTE: On Firebird models partially remove instrument panel as described earlier in SPEEDOMETER CLUSTER REMOVE.

2. Remove radio.

3. Remove headlamp switch and disconnect wiper switch.

4. Disconnect wire connector to printed circuit and disconnect instrument panel harness from cluster (three screws).

5. Remove bulbs, screws and nuts retaining printed circuit to instrument panel cluster (Fig. 12-31).

NOTE: Tool J 22646, Carburetor Adjusting Tool, is handy for removing nuts and screws from back of cluster.

6. Remove printed circuit.

7. To replace reverse removal procedure.

TEMPEST, FIREBIRD AND GRAND PRIX

1. Disconnect battery.

NOTE: On Firebird models, it is necessary to partially remove instrument panel as described in SPEEDOMETER CLUSTER REMOVE.

2. Disconnect printed circuit connector.

3. Remove bulbs, screws and nuts retaining printed circuit to instrument cluster (Fig. 12-32).

4. Remove printed circuit.

5. To replace reverse removal procedure.

FUEL GAUGE

The fuel gage, located in instrument cluster on the right hand side Pontiac and left hand side all others, can be removed by partially removing the printed circuit.

NOTE: Tool J 22646, Carburetor Adjusting Tool, is handy for removing nuts and screws from back of cluster.

PONTIAC - REMOVE AND REPLACE

1. Disconnect battery.

2. Remove radio.

3. Remove screws retaining instrument panel harness to cluster.

4. Disconnect printed circuit connector.

5. Remove nuts, screw and bulbs on right side of printed circuit and gently fold it back.

6. Remove screws retaining gage to cluster.

7. Remove gage.

8. To replace reverse removal procedure.

TEMPEST, FIREBIRD OR GRAND PRIX - REMOVE AND REPLACE

1. Disconnect battery.

2. Remove nuts, screws and bulbs retaining left side of printed circuit to instrument cluster.

3. Carefully fold back printed circuit so as not to crease, remove screw retaining gage to cluster and remove gage.

4. To replace reverse removal procedure.

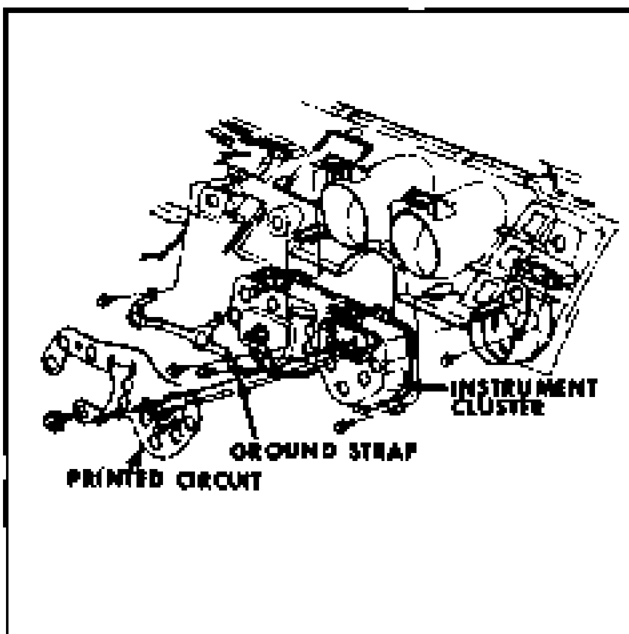


Fig. 12-32 Typical - Tempest, Firebird and Grand Prix Printed Circuit Installation

WINDSHIELD WIPER SWITCH

PONTIAC, TEMPEST AND GRAND PRIX - REMOVE AND REPLACE

1. Disconnect battery.

2. Disconnect wire connector.

3 Remove retaining nuts.

4. Position ground straps and remove switch.

5. To replace reverse removal procedure.

FIREBIRD - REMOVE AND REPLACE

1. Disconnect battery.

2. Remove upper vent duct

3. Remove switch retaining screws and reposition ground straps.

4. Remove switch.

5. To replace reverse removal procedure.

HEADLIGHT SWITCH

ALL-REMOVE AND REPLACE

1. Depress button on switch and remove knob and shaft.

2. Remove retaining nut.

3. Remove wire connector from switch and remove switch.

4. On vacuum operated headlight models, remove vacuum connector

5. To replace, reverse removal procedure.

CIGAR LIGHTER

ALL-REMOVE AND REPLACE

1. Remove lighter.

2. Remove bezel and case by pushing retainer clips together in case or by unscrewing.

3. Remove wire connector.

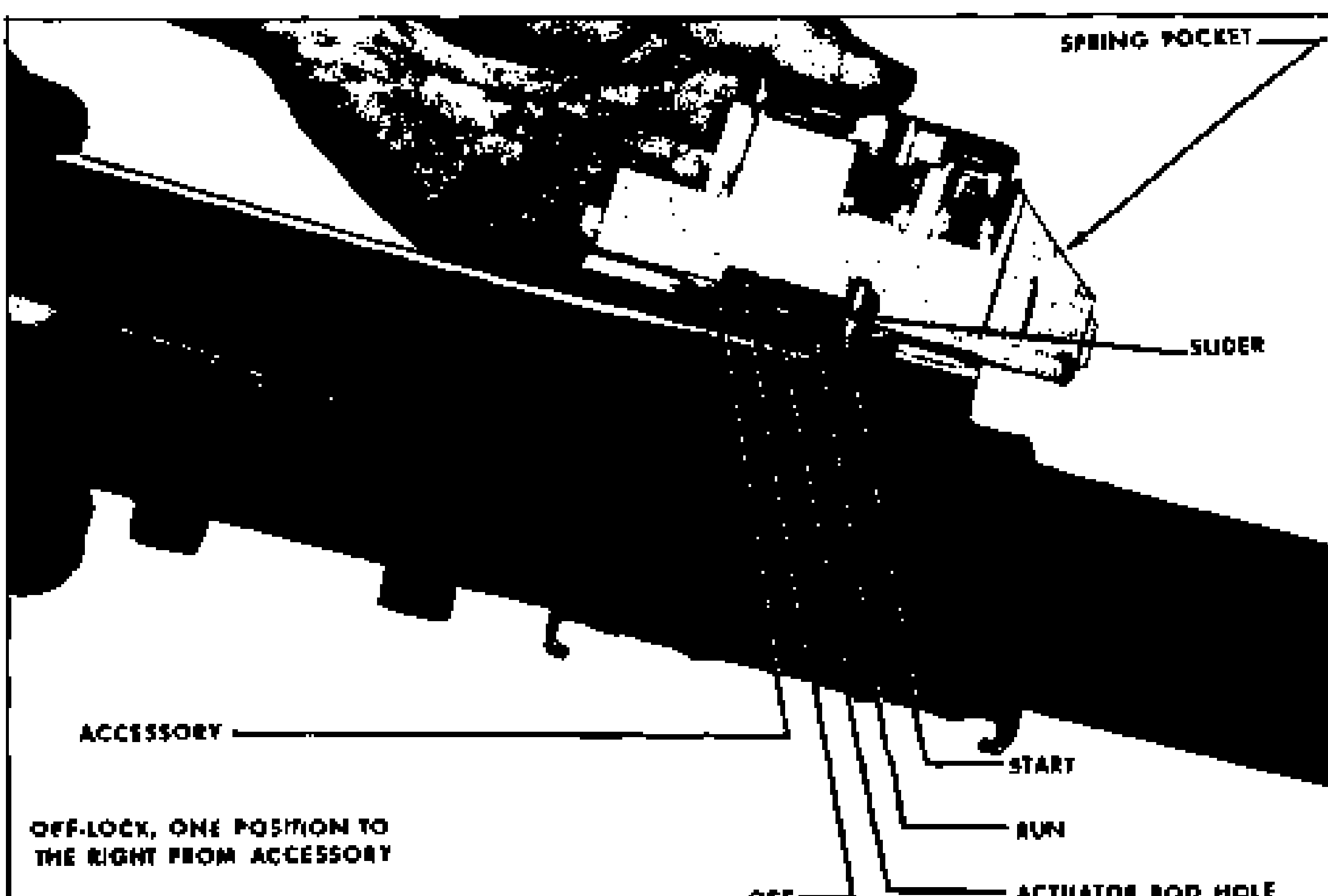


Fig. 12-33 Installing Ignition Switch

4. To replace, reverse removal procedure.

IGNITION SWITCH

The ignition switch is mounted on the lower steering column and is actuated by a rod from the ignition lock cylinder.

ALL - REMOVE AND REPLACE

1. Disconnect battery.

2. Loosen toe pan screws

3. Remove column to instrument panel attaching nuts.

4. Lower column and disconnect switch wire connectors

5. Remove switch attaching screws and remove switch.

6. To replace move key lock to OFF-LOCK position.

7. Move actuator rod hole in switch to OFF-LOCK position Fig. 12-33.

8. Install switch with rod in hole.

9. Reverse remaining procedure referring to section 9 for column alignment instructions

DIMMER SWITCH

ALL-REMOVE AND REPLACE

1. Fold back carpet in area of switch.

2. Remove wire connector.

3. Remove screws retainig ng switch to toe pan.

4. To replace, reverse removal procedure.

BACK UP LAMP & NEUTRALIZER SWITCH

REMOVE AND REPLACE MANUAL TRANSMISSION

1. Remove wire connector

2. Remove retaining screws.

3. Remove switch.

4. To replace, position gear selector in reverse, insert switch drive tang in shifter tube slot and assemble switch to steering column jacket.

ADJUST MANUAL TRANSMISSION

1. Loosen switch retaining screws and move lever to reverse position.

2. Align hole in drive tang with slot in switch and insert a .092 diameter pin.

3. Tighten screws and remove pin.

ALL - REMOVE AND REPLACE AUTOMATIC TRANSMISSION

1. Remove wire connector.

2. Remove retaining screws.

3. Remove switch.

4. To replace, position shift tube in drive position.

5. Insert switch drive tang in shifter tube slot and assemble switch to steering column jacket with retaining screws and adjust.

ADJUST - AUTOMATIC TRANSMISSION

1. Position and hold the shift lever in low range while inserting the blade of the reset gage J 23056-2 into the RESET slot of the switch, Fig. 12-34, exerting sufficient pressure to insure full penetration (approximately 9/16") of the blade, and remove gage.

2. Insert the blade of "O" gage J 22701-5 into the

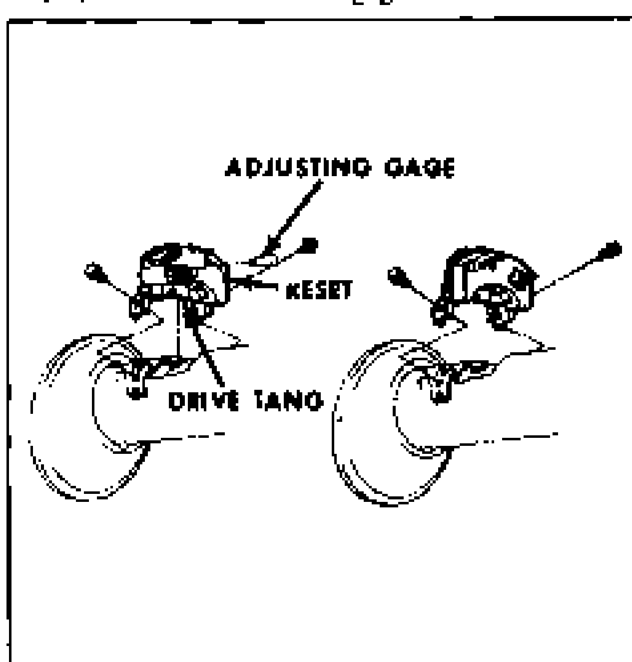


Fig. 12-34 Adjusting Back Up and Neutralizer

ADJUST slot of the switch, move the shift lever to PARK position and remove gage.

3. Check starter operation in all ranges.

4. If the starter operates in:

a. Reverse range - repeat steps 1-3 using the "1-" gage J 22701-4 or "2-" gage J 22701-3 in the adjust slot of the switch until starter will not operate in Reverse range. Repeat step 3.

b. Drive range - repeat steps 1-3 using the "1&" gage J 22701-6 or "2&" gage J 22701-7 in the adjust slot of the switch until the starter will not operate in Drive range. Repeat step 3.

CLUTCH START SWITCH

All cars equipped with manual transmission utilize a clutch start switch which is mounted to the brake bracket. The switch closes when the clutch is depressed and completes solenoid connection just like neutralizer switch.

ALL - REMOVE AND REPLACE

1. Remove wire connector.

2. Remove bracket retaining screw.

3. Remove switch

4. To replace, reverse removal procedure. No adjustment is necessary.

INSTRUMENT PANEL HARNESS

Instrument panel harness installation is shown in Fig. 12-35 for Pontiac and 12-36 for typical Tempest, Firebird and Grand Prix.

ALL - REMOVE AND REPLACE

1. Disconnect battery.

2. Disconnect bulkhead and fuse block pulling from dash.

3. Disconnect all harness connectors.

4. On Pontiac models, pull harness from conduit behind instrument panel cluster

5. On all other models, it is necessary to partially remove instrument panel plate (see instrument cluster remove) in order to remove harness from protective conduit.

6. Pull harness from conduit.

7. To replace, reverse removal procedure.

ACCESSORY SCHEMATICS

Accessory schematics are shown in Figs. 12-37, -38 and -39.

VACUUM OPERATED HEADLAMPS

Vacuum operated headlamp doors are offered on GTO models only. The system continues to use two power

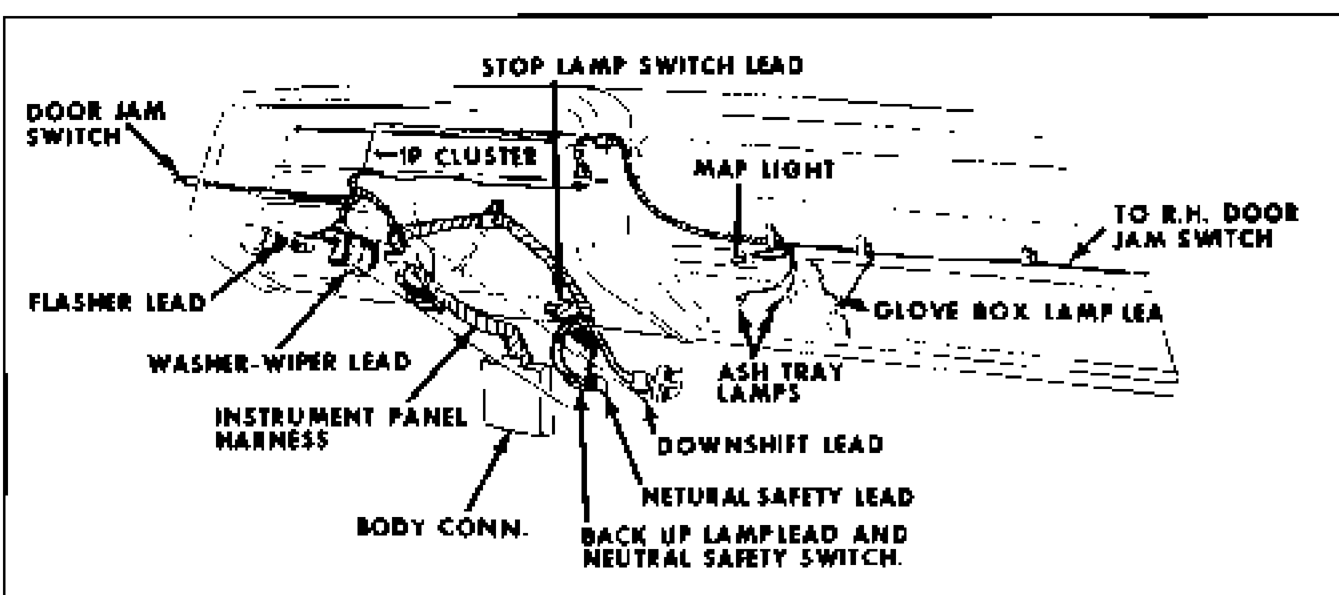


Fig. 12-35 Typical Pontiac Instrument Panel Harness Installation

servos and a vacuum harness integrated with the front end harness. The doors are equipped with an over-center spring and can be opened in case of vacuum failure.

POWER SERVO REMOVE AND REPLACE

1. Remove parking lamps and valence panel

2. Remove vacuum hoses to servo and servo cover.

3. Remove screws retaining vacuum actuator to bracket.

4. Remove "E" clips retaining actuator to pivot rod, Fig. 12-40.

5. To replace, reverse removal procedure.

6. Use Fig. 12-41 for connection of vacuum hoses.

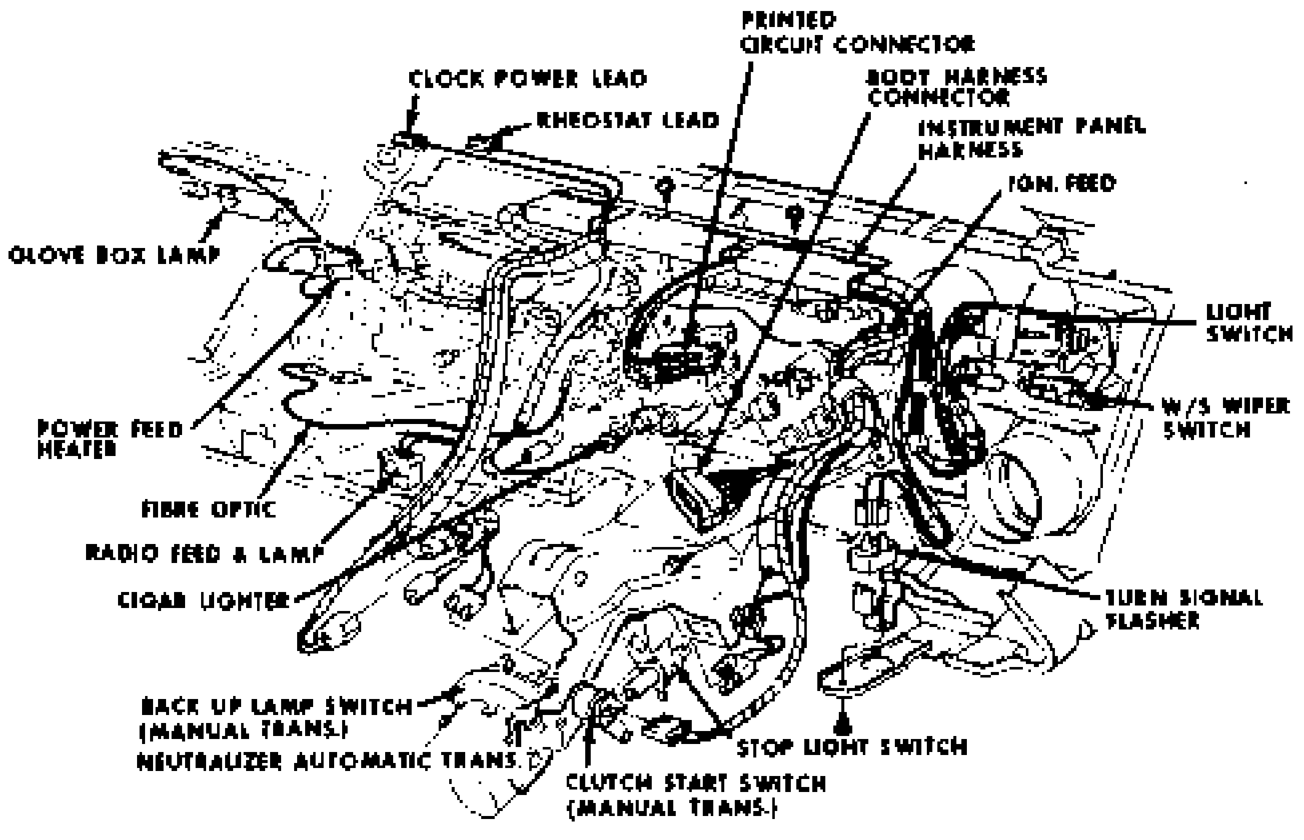


Fig. 12-36 Typical Firebird, Grand Prix and Tempest Instrument Panel Harness Installation

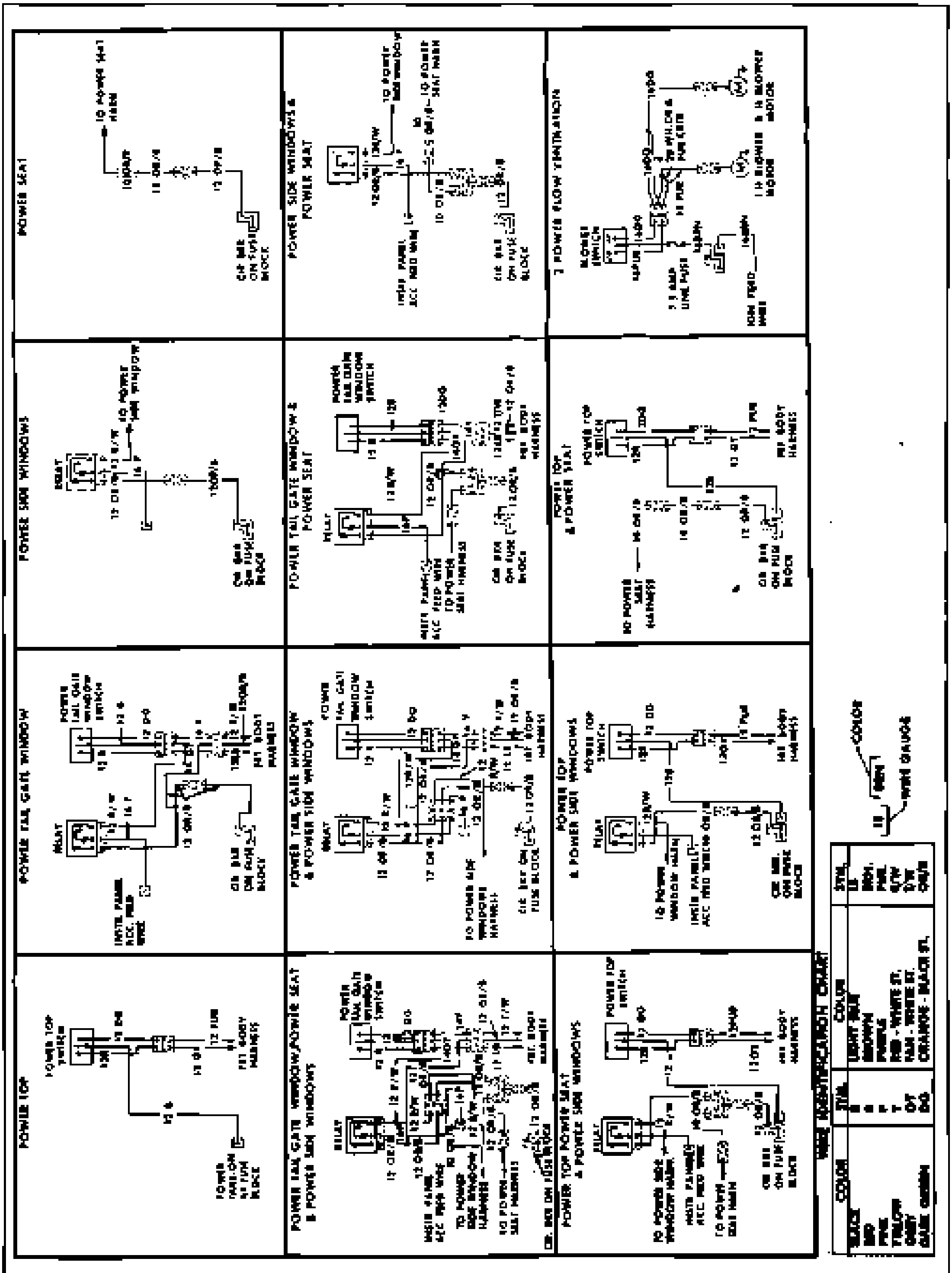


Fig. 12-37 Pontiac Accessory Schematic

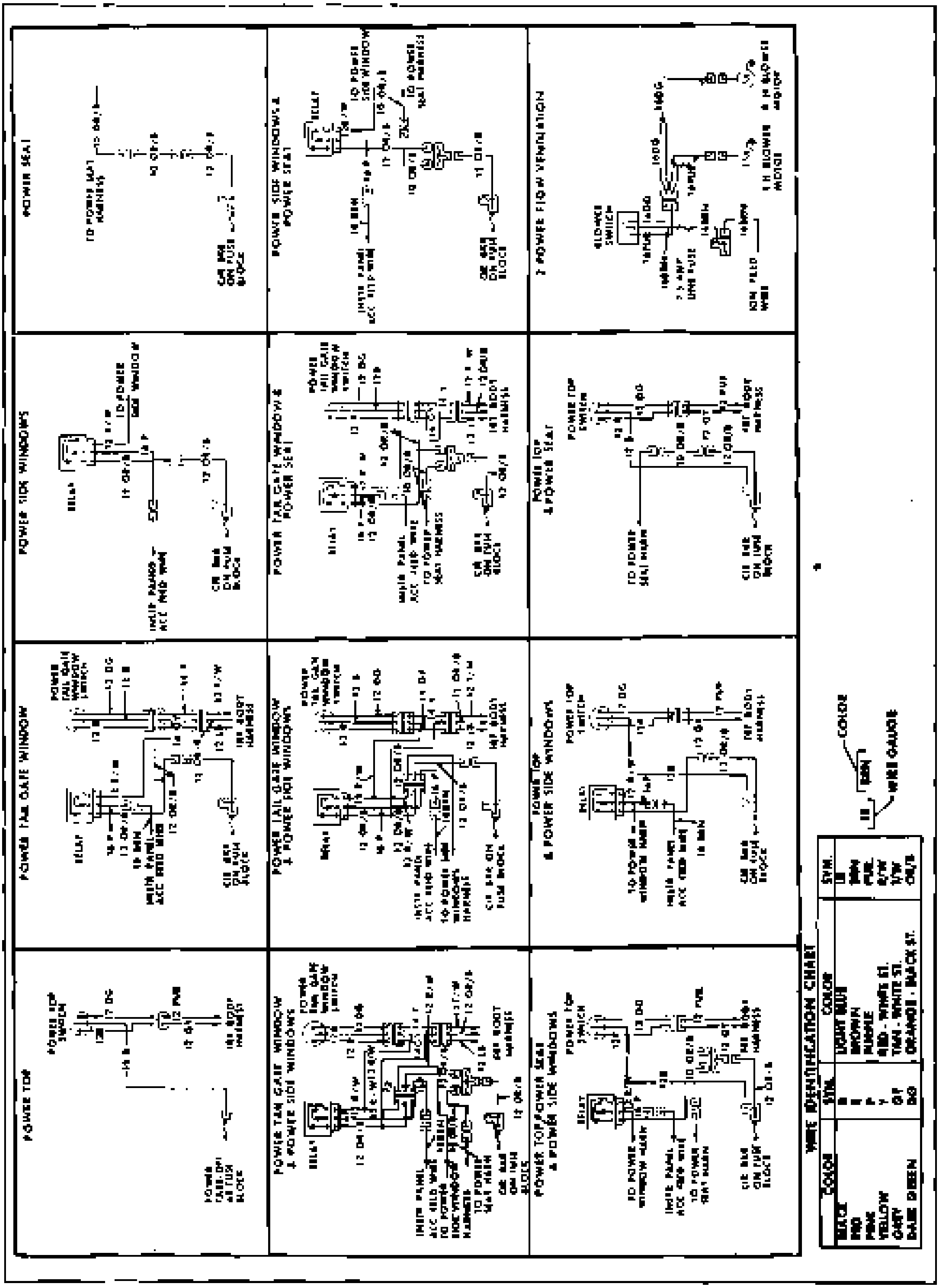
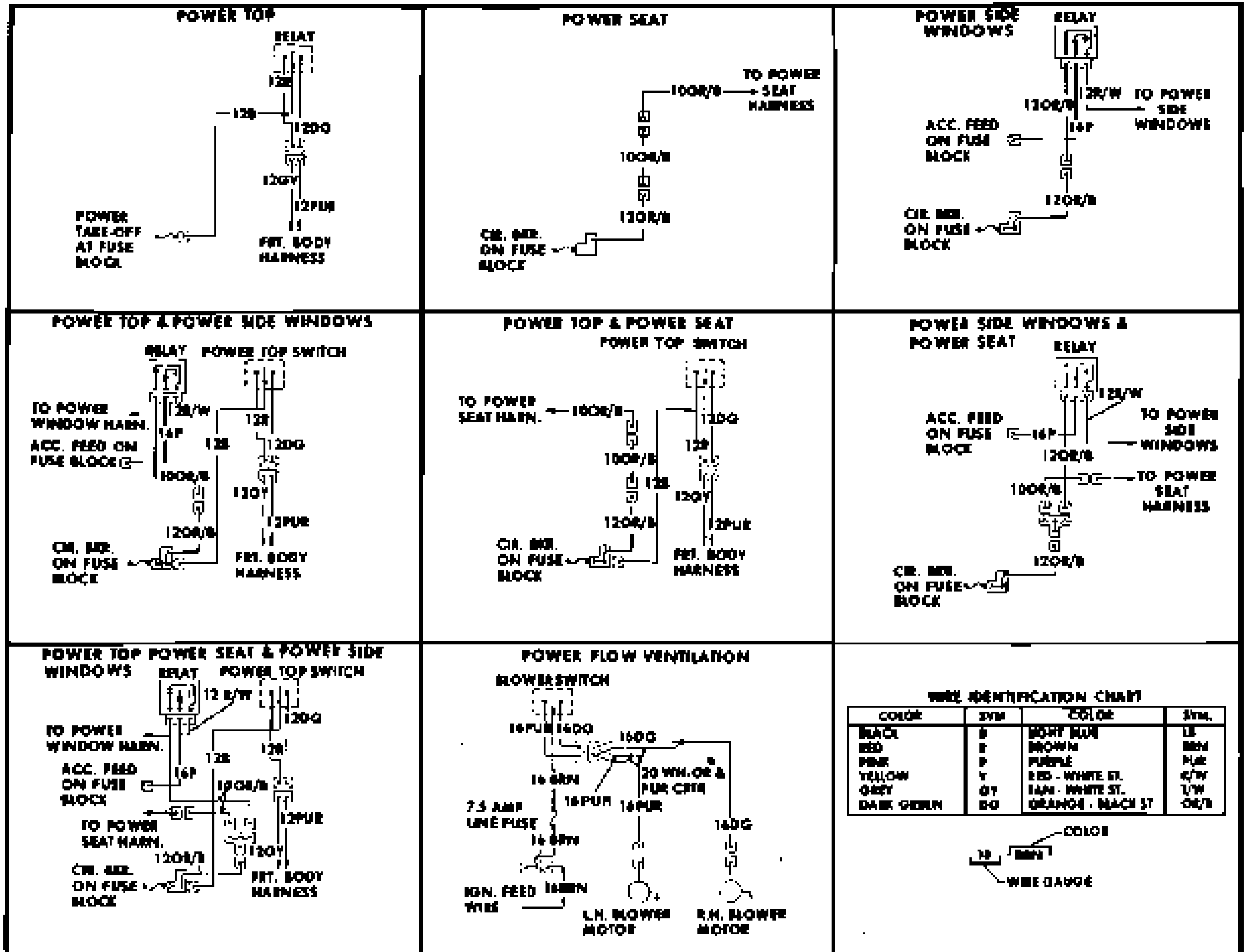


Fig. 12-38 Tempest and Grand Prix Accessory Schematic



WIRE IDENTIFICATION CHART

COLOR	SYM.	COLOR	SYM.
BLACK	B	LIGHT BLUE	LB
RED	R	BROWN	BRN
PINK	P	PURPLE	PUR
YELLOW	Y	RED - WHITE ST.	R/W
GREY	GY	TAN - WHITE ST.	T/W
DARK GREEN	DG	ORANGE - BLACK ST	OR/B

Fig. 12-39 Firebird Accessory Schematic

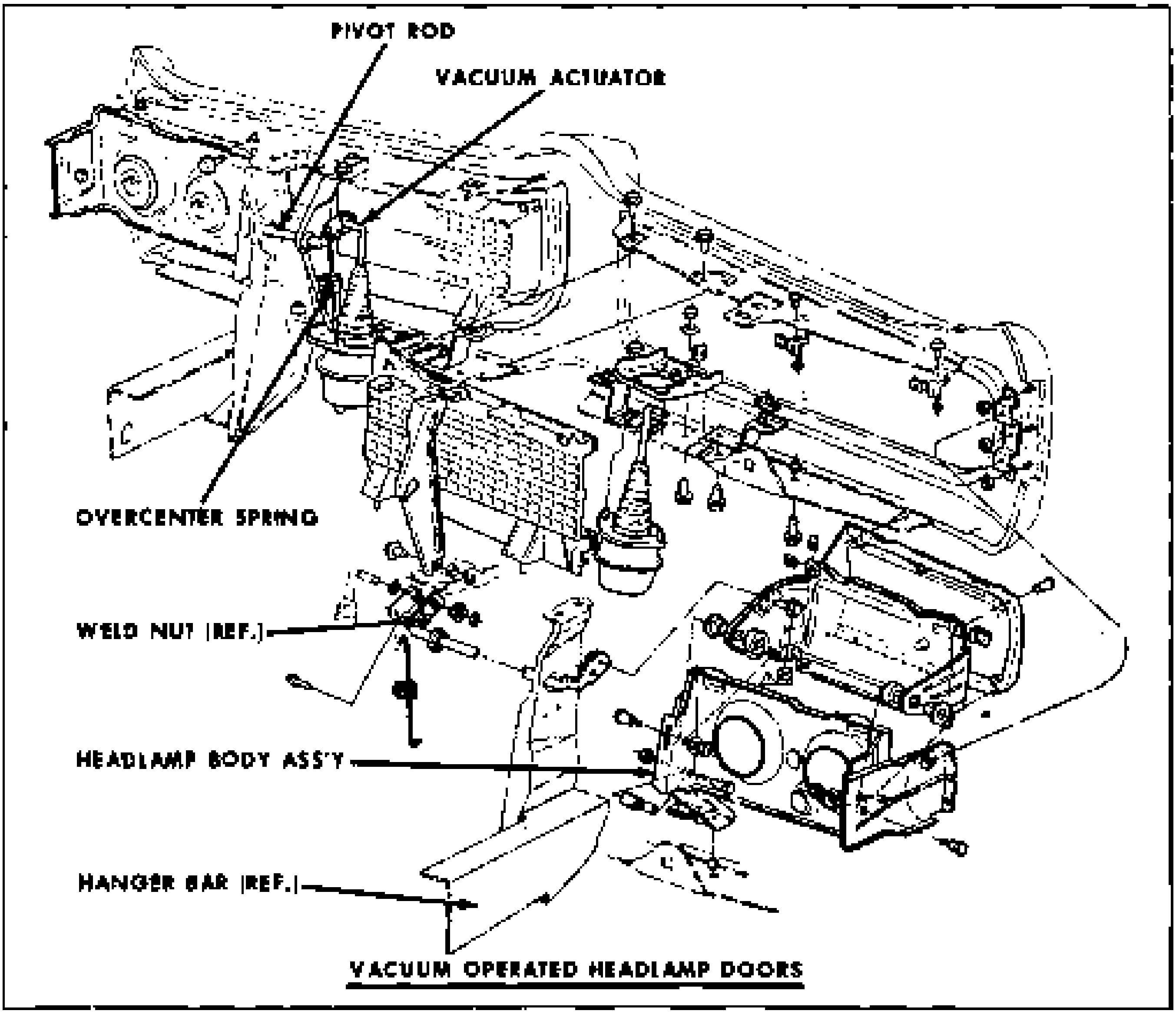


Fig. 12-40 Vacuum Operated Headlamp Doors—GTO

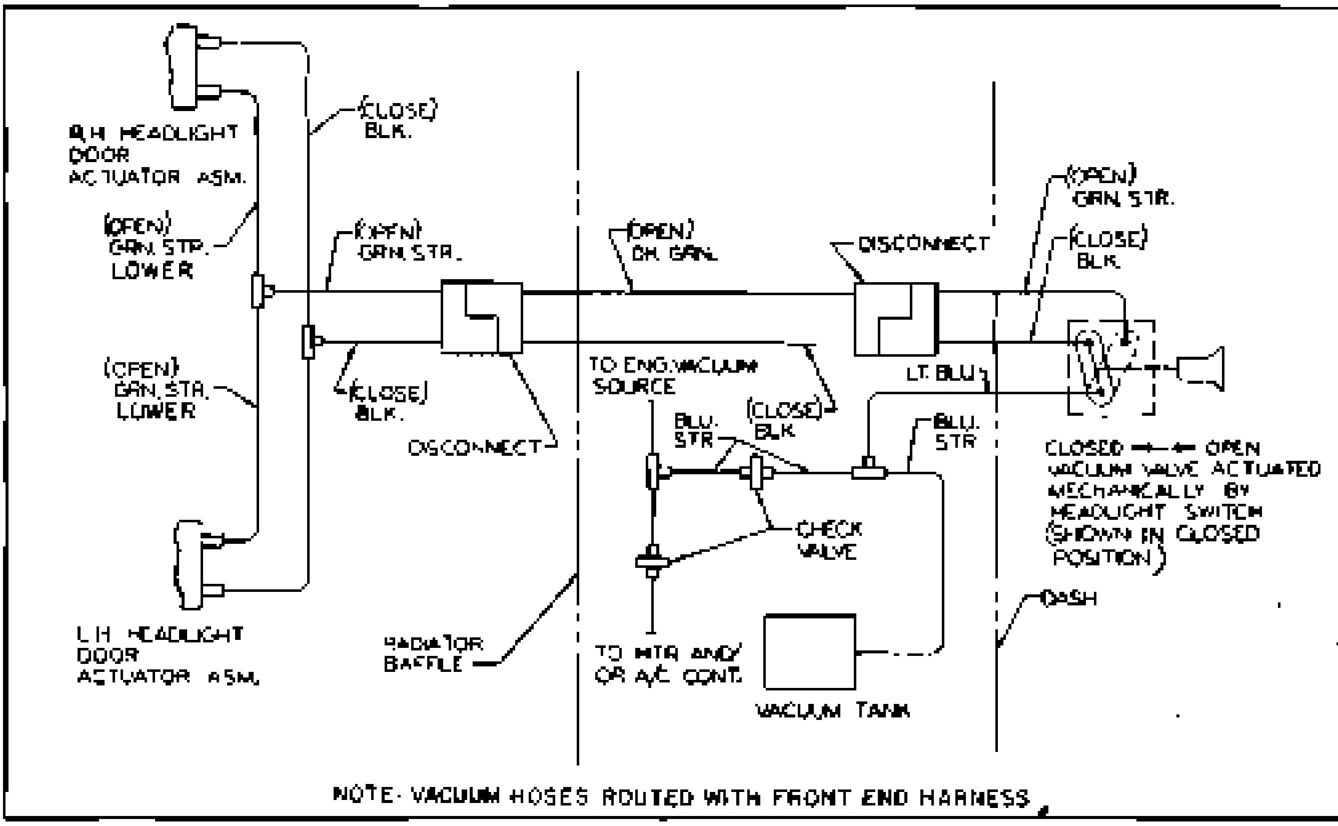


Fig. 12-41 Vacuum Operated Headlamp Door Schematic

WINDSHIELD WIPERS AND WASHERS

CONTENTS OF THIS SECTION

Pontiac models use a cylindrical wiper motor of depressed park design. A similar but slightly smaller motor is used on some Tempest and all Grand Prix models. A motor of rectangular design is used on Firebird and some Tempest models. All motors have two speeds and piston type washer pumps.

ARM BLADE ASSEMBLY

ALL-REMOVE AND REPLACE

Pontiac, Tempest and Grand Prix with Depressed Park - Remove and Replace

1. Unload wiper arm by installing pin on Pontiac models.

2. Remove arm from transmission driver, then remove clip from drag link retainer.

3. To replace, turn wiper switch to off position so that motor is in park position.

4. On Pontiac, Tempest and Grand Prix with depressed park, slide drag link over pin and slide retainer clip into position.

5. On Pontiac models, slide arm onto transmission as in Fig. 12A-1.

6. On Tempest and Grand Prix models with depressed park, slide over key in transmission on left and below molding stop on right. Fig. 12A-2.

7. On Firebird and standard Tempest models, install with blade one (1) inch above reveal molding. Fig. 12A-3 and 12A-3A.

8. Lift blades above molding stop tabs when necessary.

WIPER BLADE

ALL-REMOVE AND REPLACE

To remove blade from arm on Trico blades, insert small screwdriver in opening at center of blade with handle of screwdriver pointed toward outer end of blade. Raise handle only enough to force spring in blade down to allow blade to slip off on the pin. On Anco blades, depress black plastic button and remove blade.

WIPER TRANSMISSION AND LINKAGE

ALL-REMOVE AND REPLACE

1. Remove arm and blade assemblies (Figs. 12A-1, -2 and -3).

2. Remove fresh air intake grille or leaf screen

3. Remove wiper transmission retaining screws.

4. Pontiac models - Remove center support retaining screws.

5. Pontiac and Tempest and Grand Prix depressed park systems - Loosen clamp securing linkage to wiper motor crank.

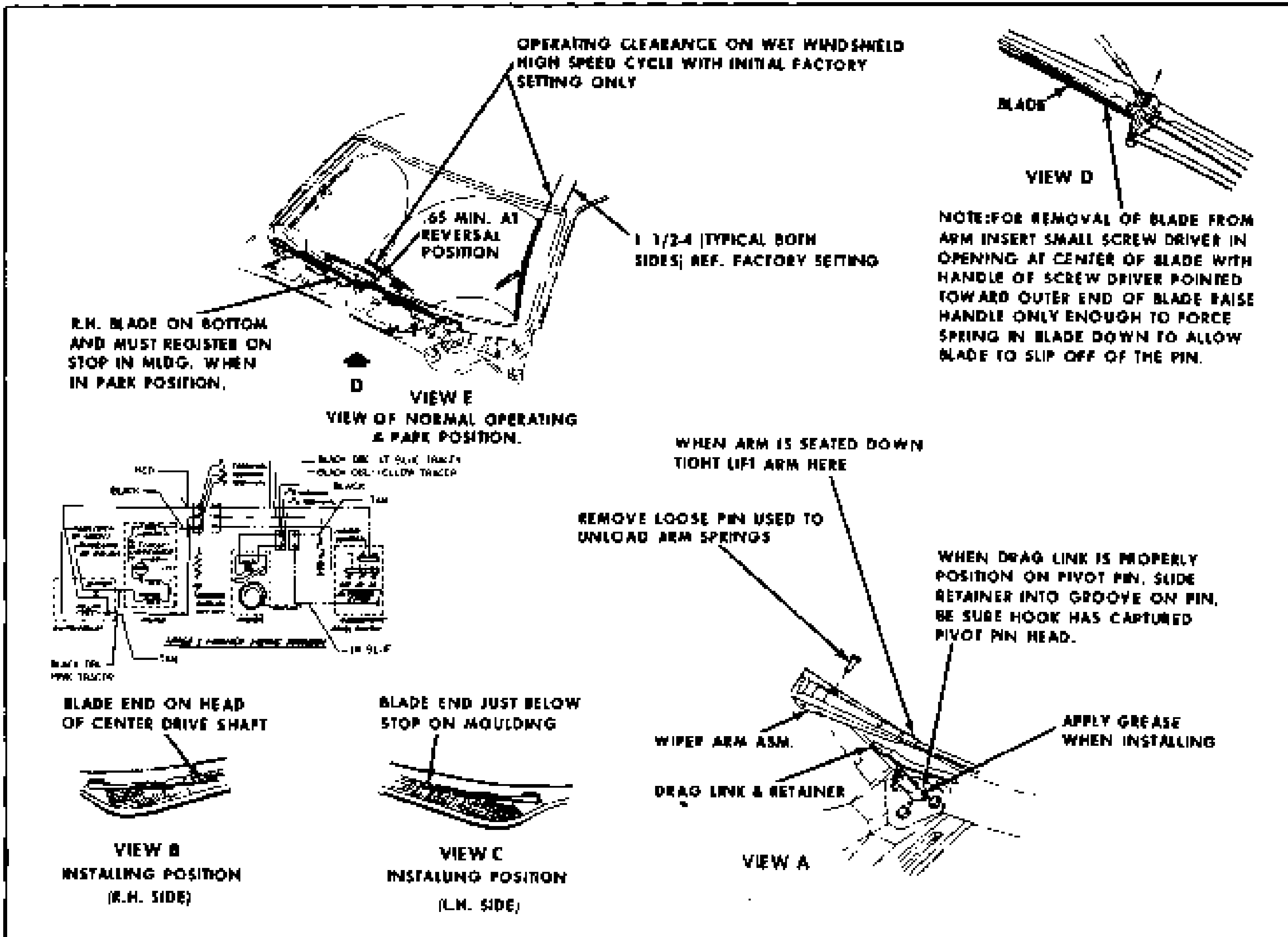


Fig. 12A-1 Pontiac Wiper Arm and Blade Installation

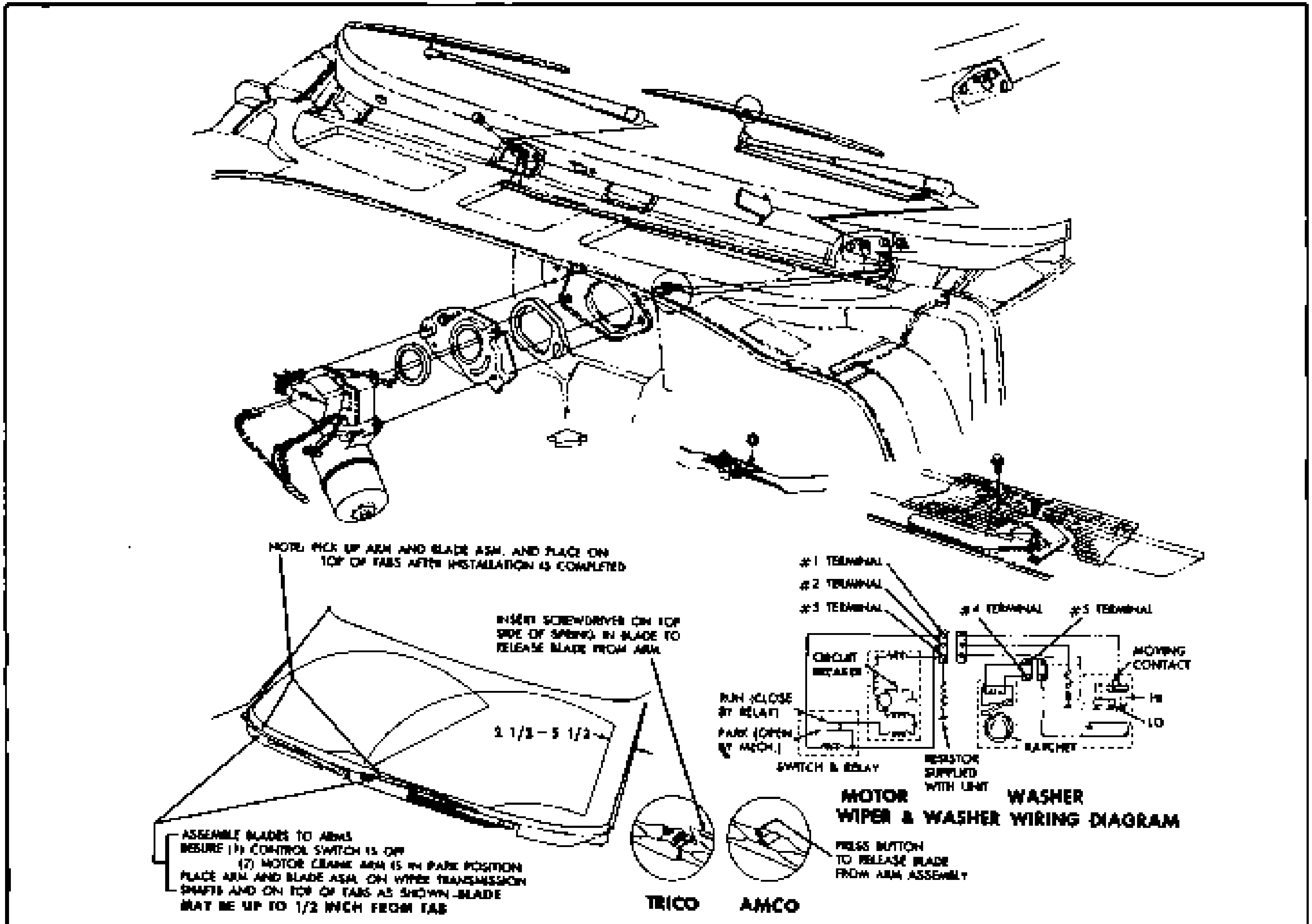


Fig. 12A-2 Tempest and Grand Prix Depressed Park Wiper Arm and Blade Installation

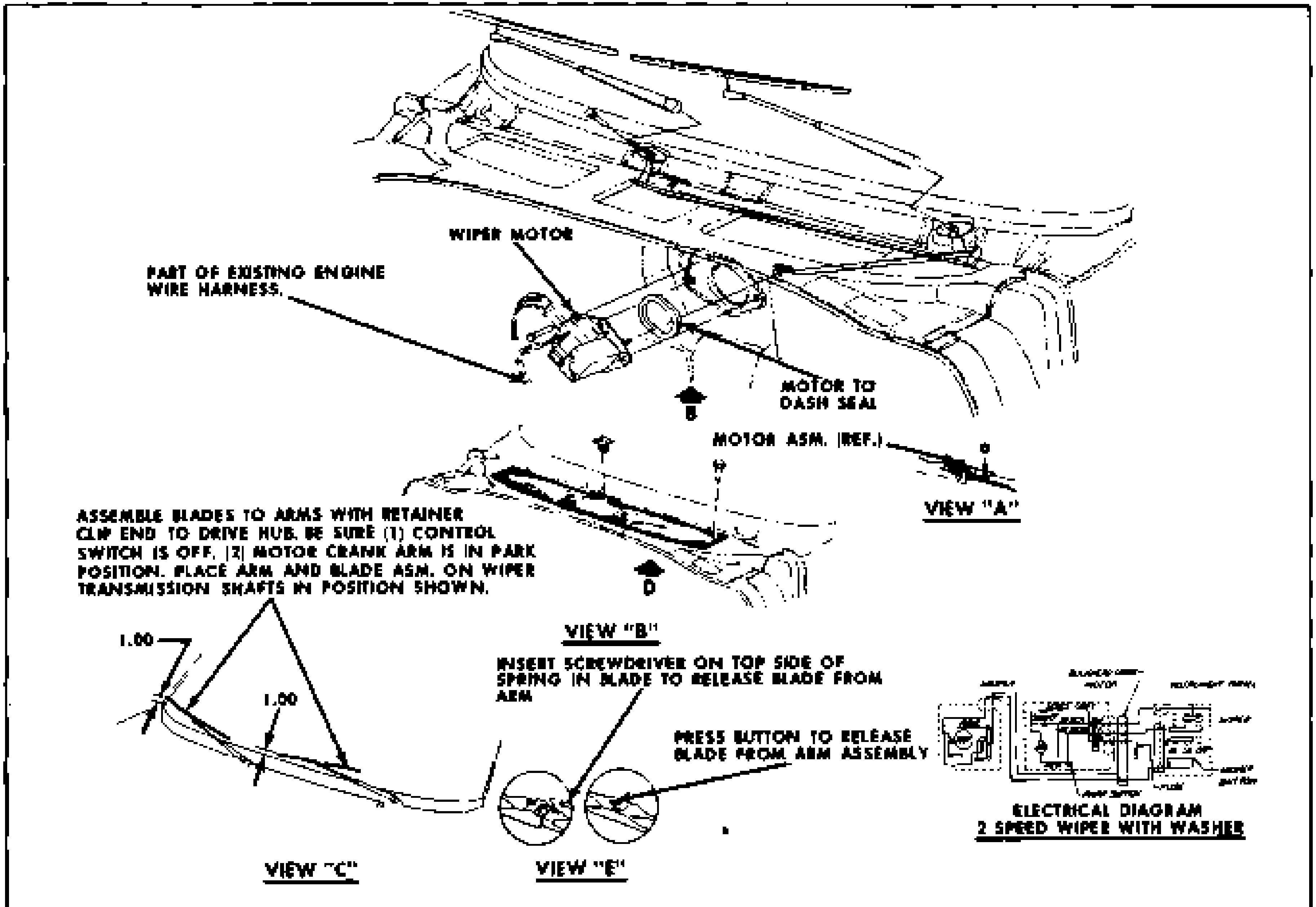


Fig. 12A-3 Tempest Non Articulated Wiper Arm and Blade Installation

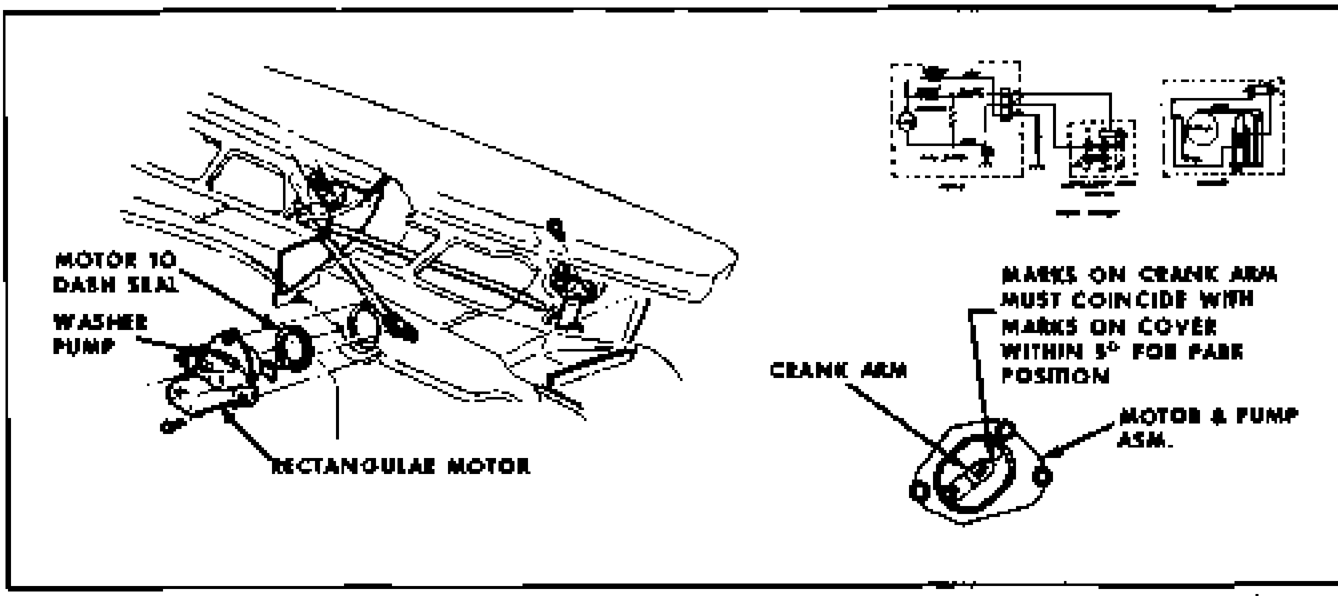


Fig. 12A-3A Firebird Wiper Motor Arm and Blade Installation

NOTE: On Pontiac Model this can be done by removing plastic plug from left side of upper shroud, directly above wiper motor.

6. Tempest non-articulated models - Loosen clamp securing right wiper transmission to wiper motor crank.

7. Remove wiper transmissions and linkage.

NOTE: Windshield wiper linkage components are to be serviced. Check master parts catalog for correct service packages. Service packages will include installation instructions.

8. To install linkage, reverse above procedure and follow proper adjustment procedure listed below.

ARM AND BLADE

PONTIAC-ADJUST

1. With motor in park position, and wiper switch off, place drag link of left arm and blade assembly on pin. With arm end in position as shown in view C, push head of arm on transmission shaft (Fig. 12A-1).

2. Place drag link of right arm and blade assembly on pin. Lock retainer on pin with blade pivot head in position shown in view B and push head of arm on transmission shaft

3. Locate blade ends on stop in position shown in view E. This positions the ends to the rear fo the stop on the lower edge of the moulding. The left blade must be on top of the right blade.

NOTE: When checking for correct wiper position always make tests with a wet windshield and motor running on high speed.

TEMPEST AND GRAND PRIX DEPRESSED PARK SYSTEM - ADJUST

NOTE: Motor must be in park position.

1. Remove leaf screen.

2. Remove right arm and blade assembly.

3. Loosen adjustable clamp at motor crank arm.

4. Position left blade and arm assembly against stop on moulding.

5. Tighten adjustable retainer.

6. Install right arm and blade assembly against stop on moulding.

7. Install screen.

TEMPEST STANDARD SYSTEM AND FIREBIRD-ADJUST

1. Allow motor to stop in park position.

2. Install both right and left arm and blade assemblies so that end of blade is 1" above lower reveal moulding.

NOTE: With non-depressed park (rectangular motor) system do not attempt to place arm and blade assemblies against stops on moulding.

WIPER MOTOR

ALL-REMOVE AND REPLACE

1. Remove hoses and wire terminals connected to wiper unit.

2. Pontiac models - Remove retainer securing wiper crank to wiper transmission linkage. Fig. 12A-4.

NOTE: This can be done by removing plastic plug from left side of upper shroud, directly above wiper motor.

3. Tempest and Grand Prix Systems - Remove screen and loosen clamp securing wiper crank to wiper transmission linkage.

4. Remove screws securing wiper assembly to dash.

5. Firebird models - Carefully pull wiper assembly away from firewall until retainer securing wiper crank to wiper transmission arm can be removed.

6. Remove wiper motor.

7. To replace, reverse removal procedure making certain that motor to dash seal is in place

WIPER SWITCH

The wiper switch used with depressed park system has an added "pulse" feature. Depressing the washer switch (center button) to the first detent completes the motor circuit. If quickly released, the system will make one cycle and park. With the exception of this feature, the switches operate the same:

1. Washer button - complete wash cycle and lo speed wiper.

2. Wiper button first position - lo speed wiper.

3. Wiper button second position - hi speed wiper.

See Section 12 WIPER SWITCH REMOVE AND REPLACE.

DEPRESSED PARK WIPER MOTOR OVERHAUL

BRUSH PLATE AND CIRCUIT BREAKER

DISASSEMBLY AND ASSEMBLY

1. Scribe reference line along side of rear housing and end cap to ensure proper re-assembly.

2. Remove two bolts thru motor.

3. Strike steel case lightly with mallet to partially loosen it from die cast housing and motor field.

4. Feed exposed excess length of motor leads through casting grommet and carefully separate end case and field assembly, plus armature, from gear housing.

5. Unsolder black ground lead from circuit breaker terminal. (Fig. 12A-5).

6. Straighten out legs that retain brush plate to field extensions.

NOTE: Be extremely careful not to break mounting tabs.

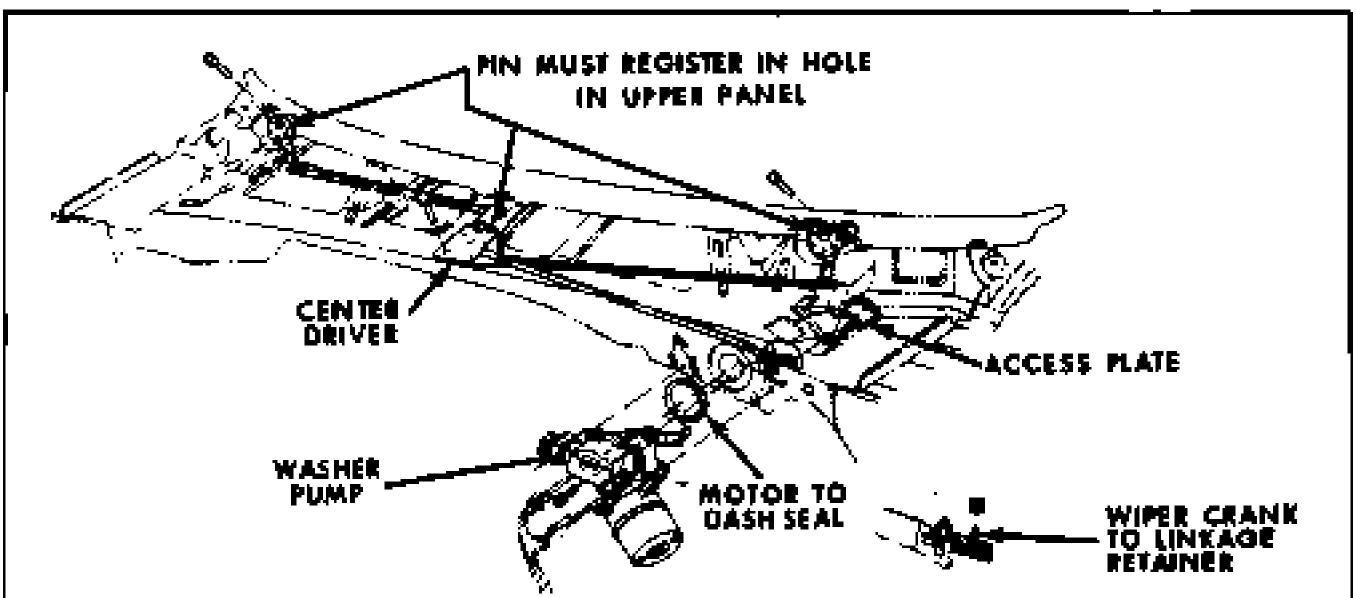


Fig. 12A-4 Pontiac Wiper Motor and Linkage Installation

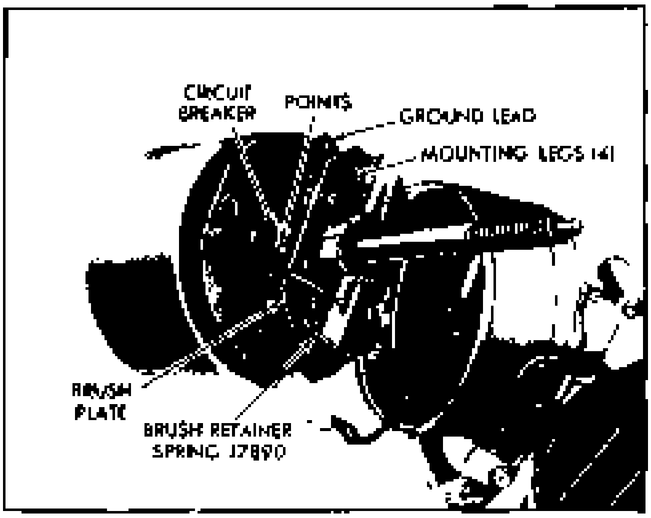


Fig. 12A-5 Retainer Holding Brush In Place

7. Install U shaped brush retainer clip J 7890 over brush holder that has brush lead attached to circuit breaker (Fig. 12A-5).

8. Holding opposite brush from that retained in step 7, carefully lift brush holder off mounting legs far enough to clear armature commutator.

9. Allow brush, held in step 8, to move out of its holder. Remove brush spring and lift brush holder off armature shaft.

10. Lift the brush plate circuit breaker assembly from the field coil retainers and off armature shaft.

ARMATURE - DISASSEMBLY AND ASSEMBLY

1. Follow steps 1 through 8 under BRUSH PLATE REMOVAL.

2. Lift armature out of case and field assembly

3. Remove thrust ball from end of armature shaft as required and save for reassembly.

NOTE: Thrust ball may be easily removed with a magnet.

CASE AND FIELD ASSEMBLY - DISASSEMBLY AND ASSEMBLY

1. Remove brush plate and armature.

2. The end case and field assembly is serviced as a unit. To free field and case assembly, cut solid black and black with pink stripe leads in a location convenient for splicing - preferably near field

3. Remove steel thrust disc and rubber disc from end cap bearing as required.

To reassemble motor, reverse the procedures as required.

DEPRESSED PARK GEAR BOX

RELAY SWITCH-LATCH ASSEMBLY AND TERMINAL BOARD -DISASSEMBLY

1. Remove washer pump.

2. If wiper gear drive pawl is in full park position, remove gear. If wiper gear mechanism is not in park position (drive pawl away from latch arm Fig. 12A-6), proceed to step 3.

3. If only relay-switch requires replacement, proceed as follows:

a. Remove relay-switch attaching screw (Fig. 12A-6) and carefully lift relay-switch out of gear box.

b. Cut red lead about 3 inches from relay.

c. Unsolder two leads from relay switch terminals.

4. If only terminal board requires replacement, proceed as follows

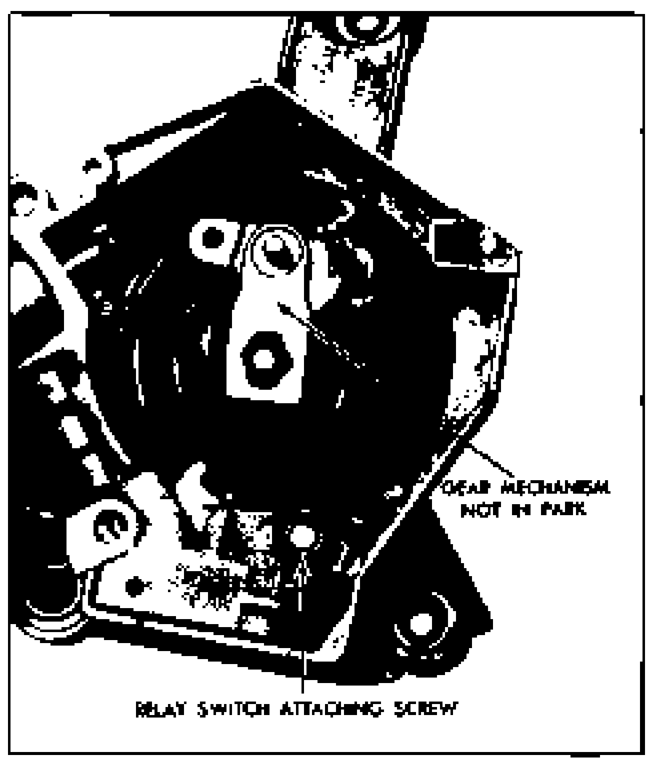


Fig. 12A-6 Checking Latch Arm Switch - Depressed Park

a. Slide terminal board out of gear box housing.

b. Unsolder three leads at terminal board.

5. If both relay-switch and terminal board require replacement, proceed as follows:

a. Remove relay-switch attaching screw (Fig. 12A-6) and carefully lift relay-switch out of gear box.

b. Unsolder two motor leads at relay.

c. Slide terminal board out of gear box housing.

d. Unsolder two leads (black and tan with yellow stripe) at terminal board.

RELAY-SWITCH LATCH AND TERMINAL BOARD - ASSEMBLY

1. If only relay-switch was replaced, solder red lead (shortened by approximately 3 inches) of new relay assembly to red lead from terminal board, and tape this splice.

2. If only terminal board was replaced, resolder three leads to new terminal board - solder red lead to terminal No. 1, solder tan with yellow-stripe lead to terminal No. 2, and solder black lead to terminal No. 3. Terminal identification shown in Fig. 12A-7.

3. If both terminal board and relay assemblies were replaced, resolder two motor leads to new relay and resolder three leads to new terminal board.

4. Slide terminal board into wiper housing, being careful to position terminal board resistor lead as shown in Fig. 12A-7.

NOTE: With relay-switch replaced in housing and washer pump reinstalled, the relay-switch plastic housing applies pressure against resistor lead to form a positive ground connection to wiper housing. Without this resistor ground, the wiper probably would have excessive speed in high while having a normal low speed.

5. Position relay-switch in housing.

CAUTION: Be very careful to route leads in such a manner as to avoid having them pinched between relay and wiper housing.

6. Install relay-switch mounting screw (Fig. 12A-6).

7. Assembly washer pump to wiper, being careful that ground strap is properly connected.

Fig. 12A-7 Position of Resistor Lead - Recess Park

DRIVE GEAR

DEPRESSED PARK SYSTEM - DISASSEMBLY AND ASSEMBLY

1. Remove crank arm retaining nut, crank arm, rubber seal cap, retaining ring, shim washers, shield and spacer washer in order indicated.

2. Slide gear out of housing (Fig. 12A-8).

3. Slide drive shaft and plate assembly out of gear and remove drive pawl, lock pawl and coil spring as required (Fig. 12A-9).

4. To reassemble, position drive pawl on drive shaft as shown in Fig. 12A-10.

5. Assemble lock pawl over drive pawl as shown in Fig. 12A-11.

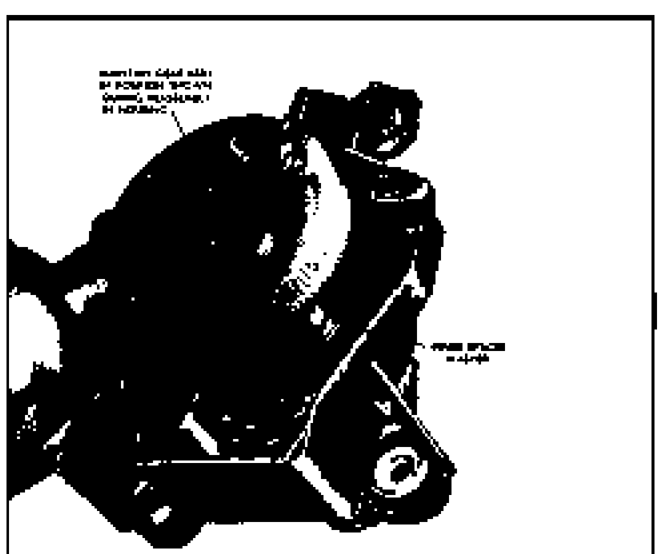


Fig. 12A-8 Removing Drive Gear - Depressed Park

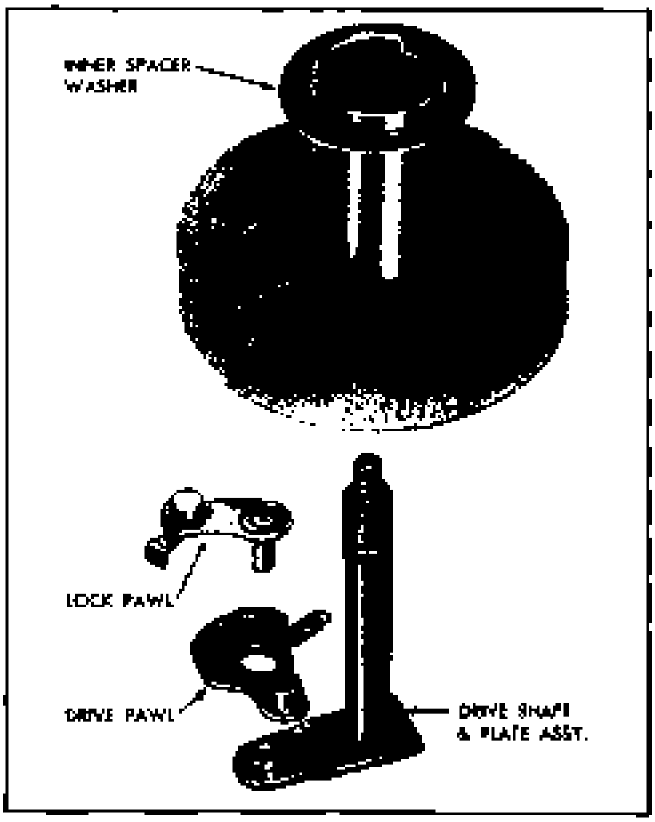


Fig. 12A-9 Drive Shaft and Gear Assembly - Depressed Park

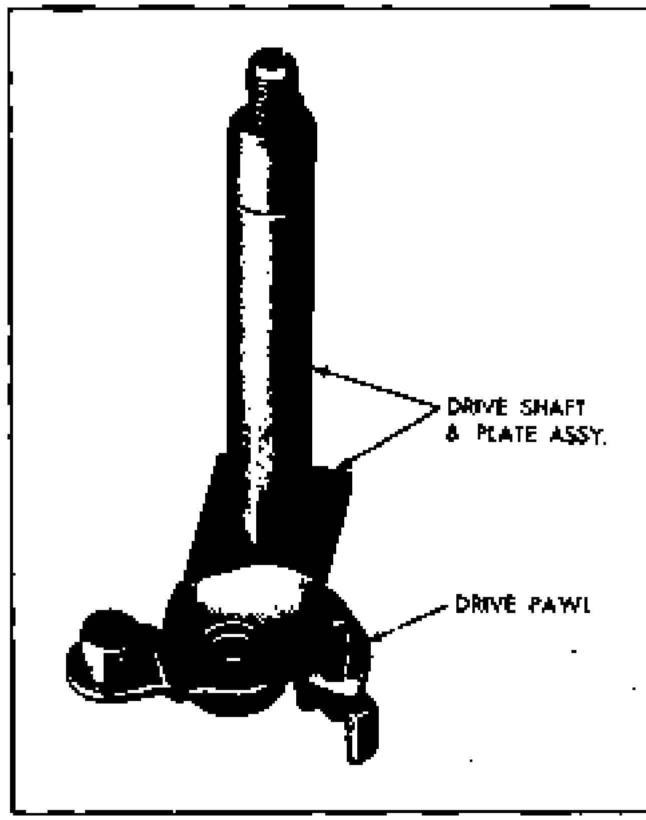


Fig. 12A-10 Assembly of Drive Pawl to Drive Shaft - Depressed Park

6. Slide gear and tube over the drive shaft (Fig. 12A 12). Make drive and lock pawls as required to allow their respective pins to fit in gear guide channel.

7. Holding gear, manually rotate drive plate in counterclockwise direction until drive and lock pawl guide pins move into their respective pockets in gear.

8. Reinstall coil spring between lock and drive pawls.

IMPORTANT: Be very careful to maintain lock and drive pawl guide pins in their respective pockets during step 9.

9. Assemble inner spacer washer over gear shaft and assembly gear mechanism in housing so that the pawls are approximately 180° away from the latch assembly (Fig. 12A-8).

10. Reassemble outer spacer washer, shield (shim washers are required to obtain .005" max. end-play), snap ring and rubber seal cap in order indicated.

11. Operate wiper to **PARK** or **OFF** position and install crank arm in approximate position.

12. Reassemble washer pump to wiper (Fig. 12A-12) using alignment pin.

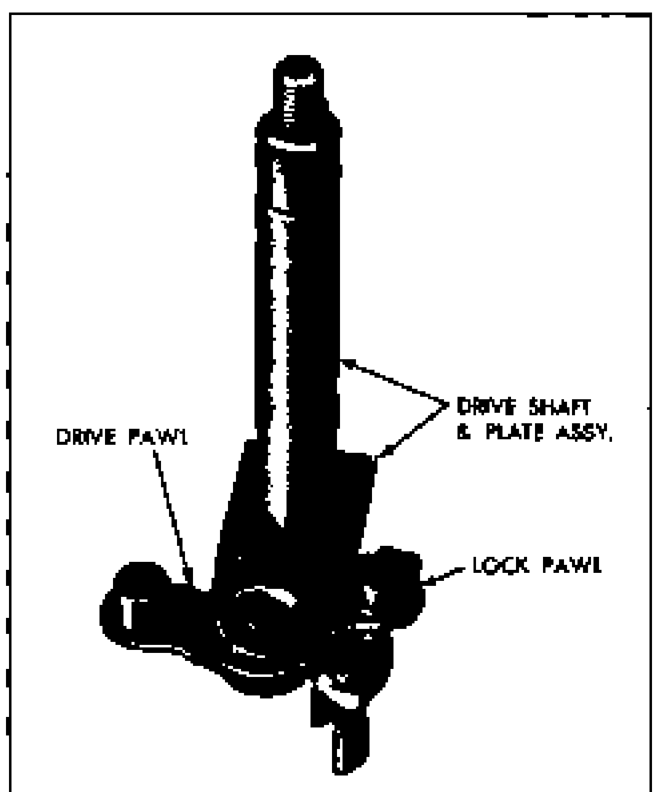


Fig. 12A-11 Installing Lock Pawl - Depressed Park

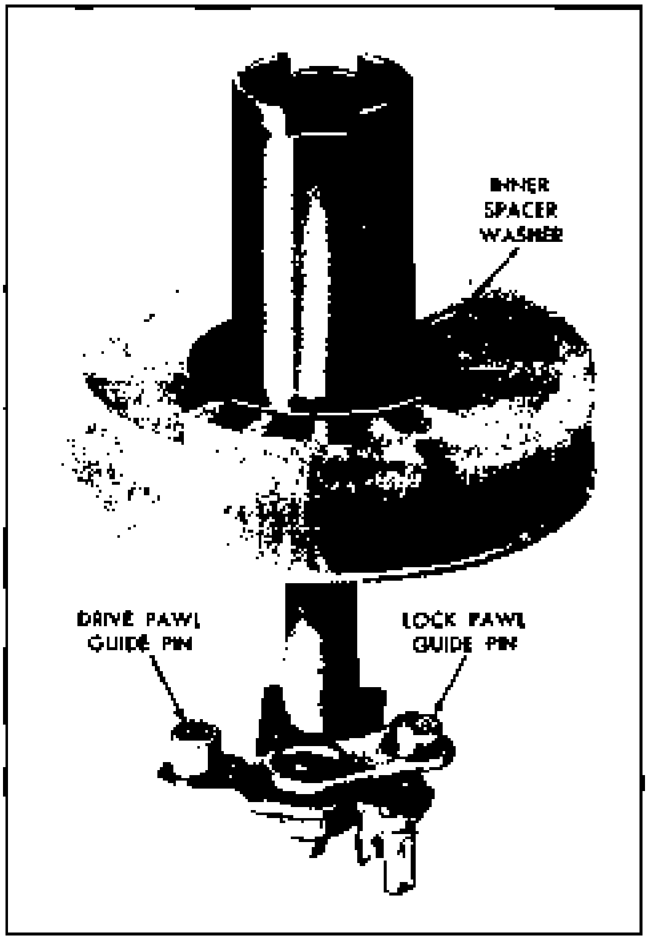


Fig. 12A-12 Installing Gear and Drive Shaft Depressed Park

WIPER MOTOR ARMATURE END-PLAY

DEPRESSED PARK - ADJUST

1. Loosen adjusting screw lock nut and tighten or loosen adjusting screw as required until end of screw barely touches end of armature.

2. Back off set screw 1/4 turn and tighten lock nut.

WIPER MOTOR GEAR END-PLAY

DEPRESSED PARK - ADJUST

1. Add or remove end-play washers as required to obtain .006" minimum end-play.

WIPER MOTOR GEAR BOX

RECTANGULAR MOTOR - DISASSEMBLY AND ASSEMBLY

1. Clamp crank arm in a vise and remove crank arm retaining nut, arm, seal cap, retainer ring, and end play washers. Fig. 12A-14.

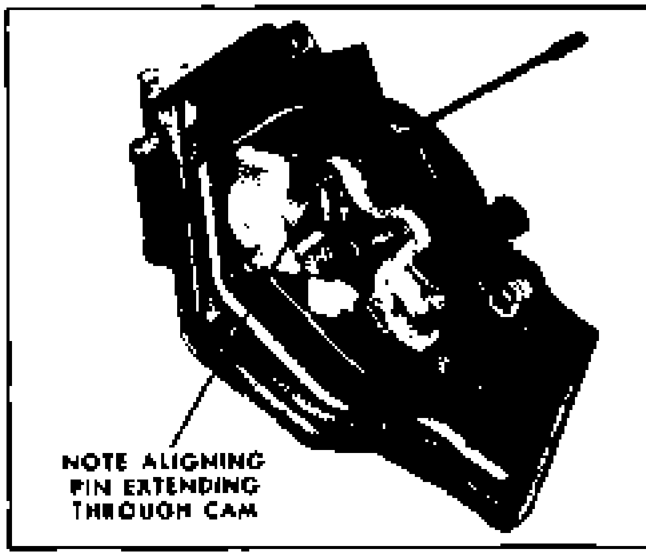


Fig. 12A-13 Assembling Washer Pump to Wiper Depressed Park

2. Drill out gear box cover staking using a 1/4" drill and remove cover from gear box.

CAUTION: Mark ground strap location for reassembly purposes.

NOTE: Screws, nuts and lockwashers for reassembling cover to wiper are contained in a service repair package.

3. Remove washer pump 4 lobe cam, output gear and shaft assembly, then slide intermediate gear and pinion and pinion spring washer off shaft.

4. Remove terminal board and park switch assembly as follows:

a. Unsolder motor leads from terminals.

b. Drill out rivets that secure terminal board and park switch ground strap to cover.

NOTE: Screws and nuts for attaching a replacement terminal board-park switch are included with replacement assembly.

For reassembly, reverse steps 1 through 4 above except as noted:

5. Reassembly of gear cover - be sure cover is located properly over locating dowel pins and be sure to reinstall ground strap.

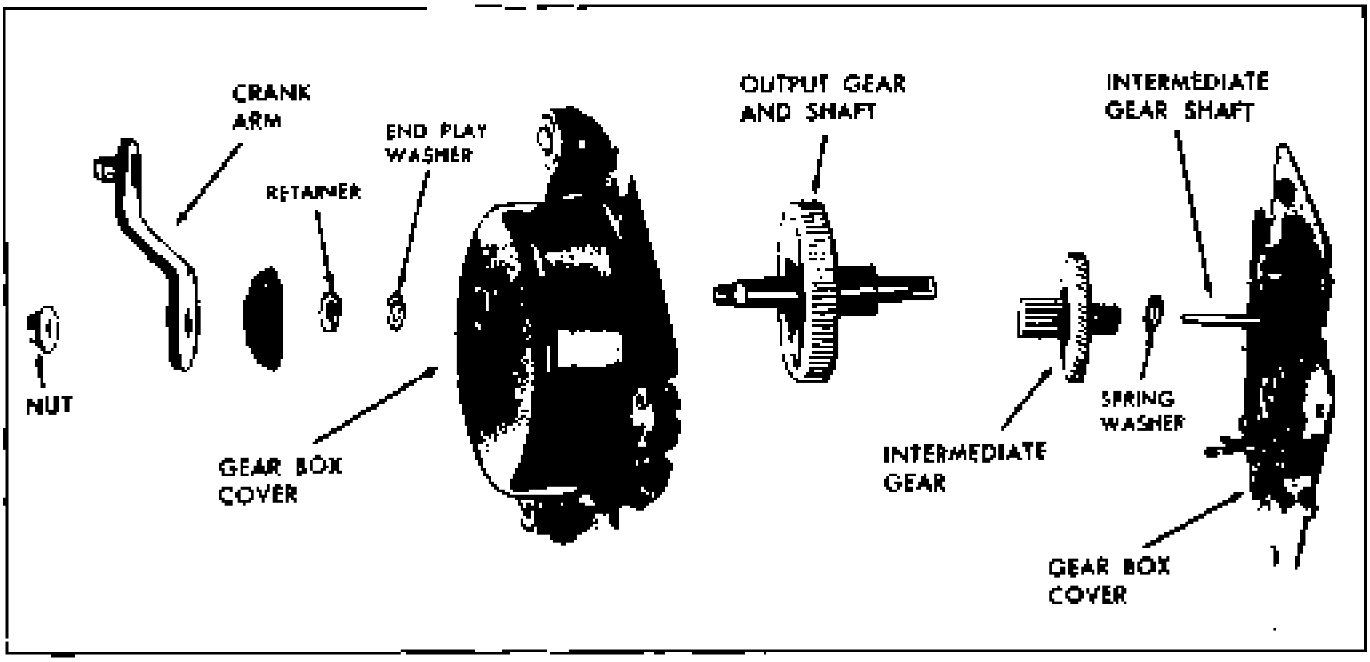


Fig. 12A-14 Gear Box - Exploded View Rectangular Motor

6. Reassembly of crank arm - operate wiper to park position and install crank arm on output shaft so that identification marks line up with those in cover (Fig. 12A-15). Clamp crank in vise before securing retaining nut.

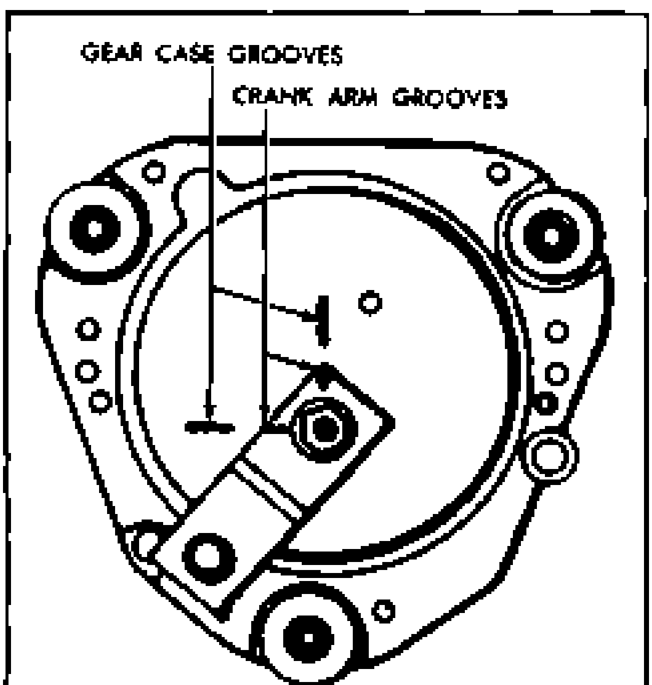


Fig. 12A-15 Crank Arm In Park Position

RECTANGULAR WIPER MOTOR SECTION

DISASSEMBLY AND ASSEMBLY

1. Follow steps 1 through 4(a) under GEAR BOX DISASSEMBLY (Fig. 12A-16).

2. Remove tie bolts, then work gear box off armature shaft.

3. Release brush spring pressure against brushes as shown in Fig. 12A-16.

4. Move brushes away from armature and slide armature out of frame and field assembly. Pull end plate assembly off armature.

CAUTION: Use care to insure that small thrust plug at end of armature shaft does not get lost.

5. Remove end play adjusting washers.

To reassemble motor, reverse steps 1 through 4 as required.

WIPER MOTOR LUBRICATION

RECTANGULAR MOTOR

Armature shafts and bearings: Light grade machine oil.

Gear Teeth (ALL): Delco cam and ball bearing lubricant or equivalent.

DPRESSED PARK MOTOR

Use Delco Remy cranking motor and distributor lubricant 1948792 or equivalent.

Lubrication:

Gear Teeth and Gear Clutch Mechanism

Gear Shaft

Seal Cap (inside)

Armature Worm

WINDSHIELD WASHER PUMP OVERHAUL

DEPRESSED PARK-WASHER PUMP - DISASSEMBLY AND ASSEMBLY

FOUR-LOBE CAM

Refer to Fig. 12A-18.

1. Remove E-ring, hold relay armature against relay coil and slide ratchet wheel off shaft.

CAUTION: When reassembling ratchet wheel, be careful not to damage ratchet dog.

RATCHET PAWL AND PAWL SPRING

1. Disengage pawl spring from pawl and slide off cam follower pin.

NOTE: Early production models are equipped with an "E" retaining ring. Later models have slots at both top and bottom of pin. When servicing, replace "E" ring if one is used.

RATCHET DOG

1. Remove attaching screw and lift ratchet dog off mounting plate.

RELAY-TERMINAL BOARD

1. Remove 4-lobe cam.
2. Remove ratchet pawl and pawl spring.
3. Remove relay armature and spring.
4. Chisel off the four bent-over tabs that secure the coil mounting bracket to the base. Remove and discard relay coil and terminal board assembly. To mount a replacement relay, hold it securely against the base mounting surface and bend locking tabs over.

CAUTION: Be careful not to damage coil winding or terminals.

5. To check the pump programming mechanism, manually rotate the 4-lobe cam through complete 12-tooth cycle (360°) and observe if pump is operating as explained in the PRINCIPLE OF OPERATION section of Diagnosis Manual.

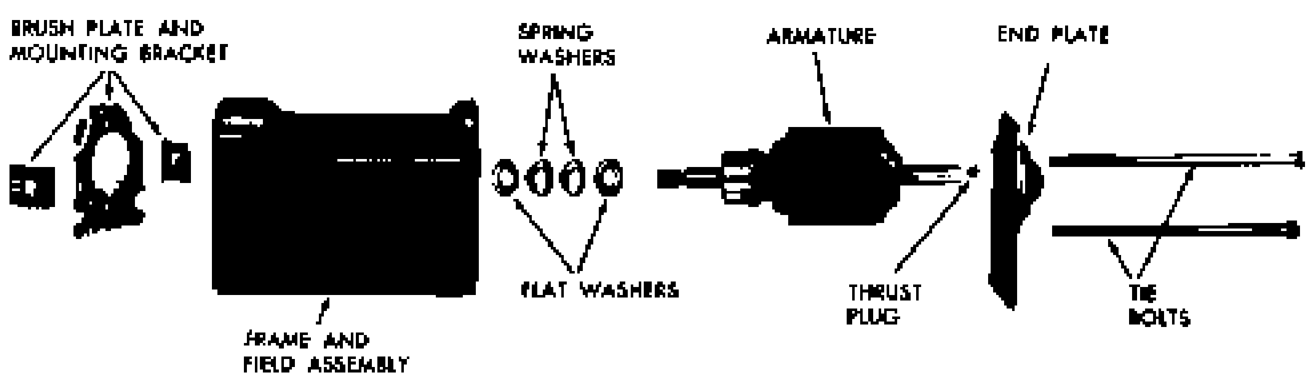


Fig. 12A-16 Motor Exploded View—Rectangular Motor

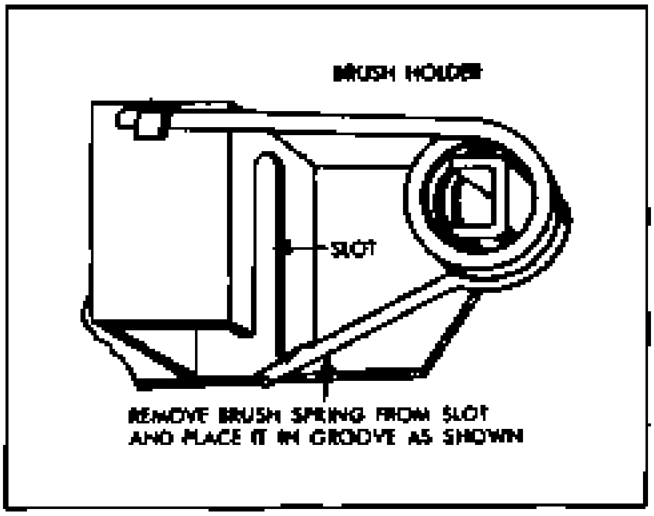


Fig. 12-17 Brush Spring Rectangular Motor

VALVE

1. Note position of valve relative to the pump housing for reassembly, then remove four screws that secure valve to housing.

2. Remove housing-to-valve-body gasket and save for reassembly.

PUMP

1. Remove ratchet wheel, ratchet wheel dog, ratchet pawl and spring.

2. To release the plastic pump housing from the sheet metal base, pull it in the direction toward the valve end until the housing grooves clear the sheet-metal base. Next, detach the assembly from the cam-follower pin (Fig. 12A-18).

PISTON

1. Remove valve.

2. Remove front of piston containing seal from housing.

3. Remove rear of piston and spring by turning 90° to separate from actuator plate

To reassemble, reverse above disassembly procedures.

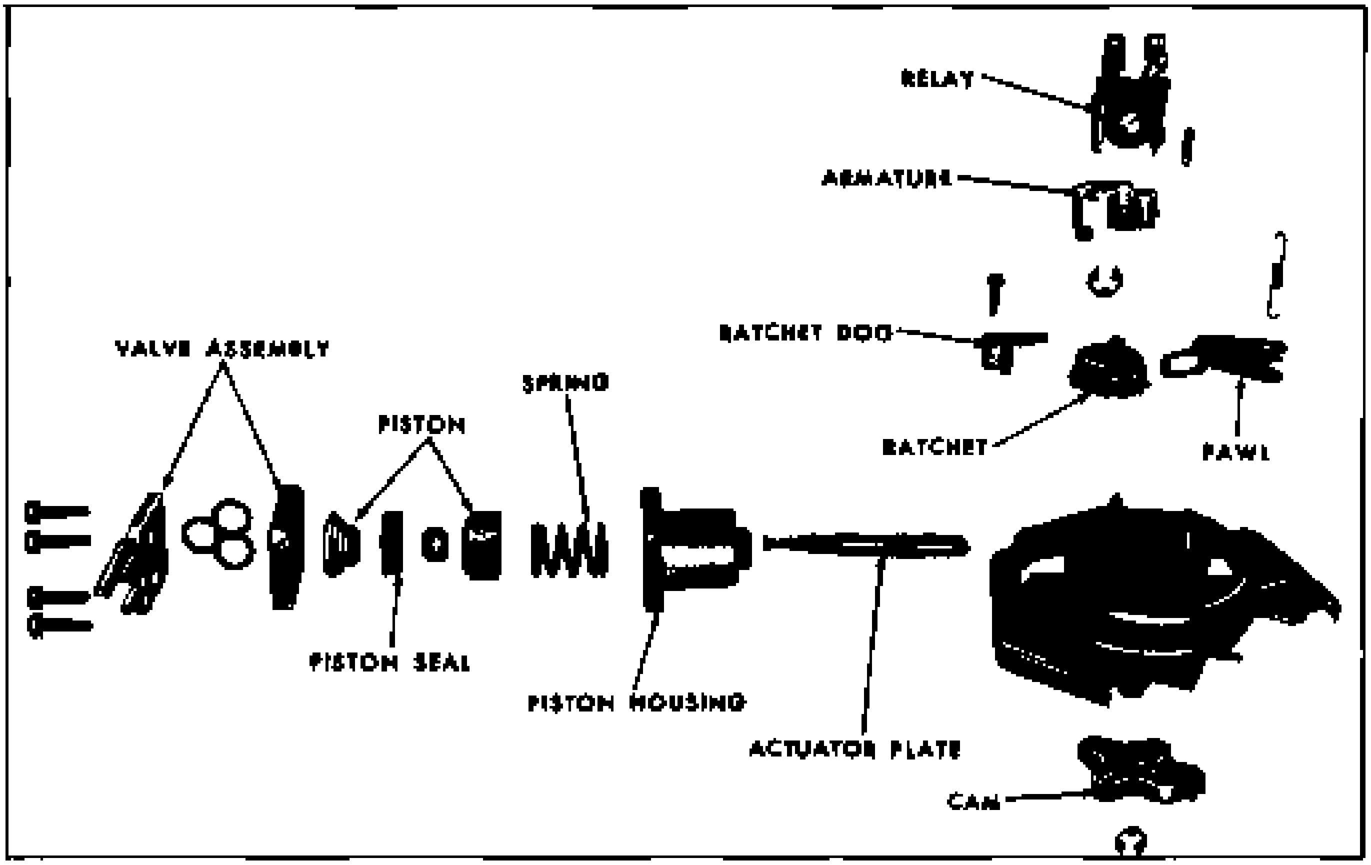


Fig. 12A-18 Exploded View Pump Assembly—Recess Park

RECTANGULAR MOTOR WASHER PUMP - DISASSEMBLY AND ASSEMBLY

To reassemble, reverse above disassembly procedures.

SOLENOID ASSEMBLY - RATCHET DOG (Fig 12A-19)

1. Remove the ratchet dog retaining screw. Hold the spring loaded solenoid plunger in position and carefully lift the solenoid plunger assembly and ratchet dog off the frame of the pump.

2. Separate the ratchet dog from solenoid mounting plate as required.

RATCHET PAWL

1 Disconnect ratchet pawl spring.

2. Remove ratchet pawl retaining ring and slide ratchet pawl off cam follower shaft.

RATCHET WHEEL

1. Follow step 1 under SOLENOID - RATCHET DOG DISASSEMBLY.

2. Move ratchet wheel spring out of shaft groove and slide ratchet wheel off shaft.

PUMP AND ACTUATOR PLATE ASSEMBLY

1. Remove solenoid assembly - ratchet dog, ratchet pawl and ratchet wheel as outlined in their respective procedures.

2. To separate the pump and pump actuator plate from the frame, pull the pump housing in the direction of the arrow until the grooves in the housing clear the frame. Then remove the actuator plate from the ratchet wheel and cam follower shafts.

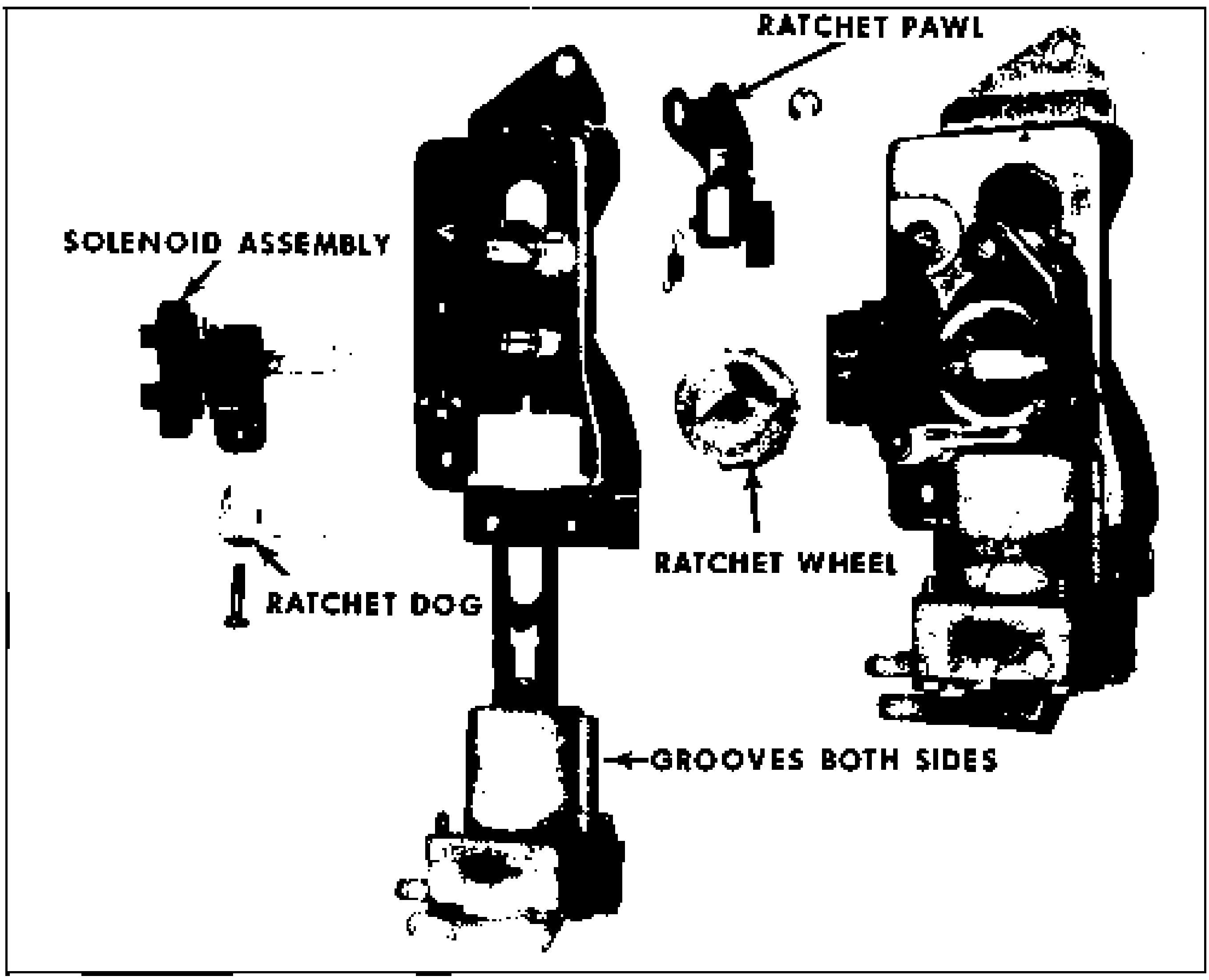


Fig. 12A-19 Exploded View Washer Pump—Rectangular Motor

VALVE ASSEMBLY

1. Remove the four (4) screws that attach the valve assembly to the pump housing.

CAUTION: During re-assembly be sure gasket between housing and valve plate is properly positioned in the housing and valve plate grooves. Also be sure triple O ring is properly installed between valve body and pipe assembly.

TORQUE SPECIFICATIONS

All specifications are in Lb. In. unless otherwise specified.

Washer pump mounting screws	18
Armature adjusting screw jam nut (Tempest or Firebird)	50
Motor tie bolts	30
Relay attaching screw (internal) Pontiac or Tempest Optional System	30
Crank arm nut	60
Wiper to firewall attaching bolts	25

WIPER SPECIFICATIONS

Operating Voltage Pontiac or Optional Tempest System		12-14 VDC
Operating Volts Tempest or Firebird		12 VDC
Crank Arm Rotation (looking at Crank Arm)		Counterclockwise
Crank Arm Speed (rpms) (No Load):		
LO		40 Min.
HI		70 Min.
Current Draw Recess Park—Tempest and Grand Prix		
Bench Check	LO Speed	6.0 Amps. Max.
	HI Speed	4.5 Amps. Max.
Installed in Car	LO Speed	5.5 Amps. Max.
	HI Speed	4.5 Amps. Max.
Stall		18 Amps. Max.
Current Draw Recess Park—Pontiac		
Bench Check	LO Speed	6.0 Amps. Max.
	HI Speed	4.5 Amps. Max.
Installed in Car	LO Speed	6.5 Amps. Max.
	HI Speed	5.0 Amps. Max.
Stall		28.0 Amps. Max.
Current Draw—Rectangular—Tempest		
Bench Check	LO Speed	4.5 Amps. Max.
	HI Speed	3.5 Amps. Max.
Installed in Car	LO Speed	4.5 Amps. Max.
	HI Speed	3.5 Amps. Max.
Stall		28 Amps. Max.

RADIATOR SUPPORT AND MOUNTING PARTS

GENERAL DESCRIPTION

All models are equipped with cross-flow radiators, which provide horizontal coolant flow for improved cooling characteristics. For specifications and usage, refer to the radiator charts in Section 6A.

Pontiac, Grand Prix and Tempest V-8 radiators are supported by insulators which are cradled in the fan shroud (Figs. 13-1 and 2). The fan shroud is firmly attached to the support and baffle assembly. Tempest 6 cylinder radiators are supported by insulated cradle type brackets (Fig. 13-3), which retain both the lower and upper ends of the radiator tanks. The two upper cradles are attached to the bottomside of the upper panel mounting assembly (Fig. 13-2) which, in turn, is fastened to the front end support and baffle assembly.

The Firebird radiator is attached by cap screws and insulating nuts on one side to the radiator support. The fan shroud on all V-8 models is mounted in two bottom clips and secured at the top by one center bolt (Fig. 13-4).

RADIATOR - REMOVE AND REPLACE PONTIAC, GRAND PRIX AND TEMPEST

REMOVE

1. Disconnect positive battery cable.

2. Open drain cock at bottom of radiator and drain radiator and cylinder block. Remove filler cap so coolant will flow freely.

NOTE: To save coolant, remove radiator overflow hose and connect to drain cock.

3. Loosen hose clamps and disconnect upper and lower radiator hoses at radiator inlet and outlet pipes.

4. On cars equipped with power steering remove power steering coolant lines from clips at bottom of radiator

NOTE: To prevent air from entering the power steering system do not separate coolant lines at hose clamps.

5. On cars equipped with V-8 engines and automatic transmissions. disconnect and plug the transmission cooler lines.

6. All V-8 Pontiac and Tempest - Remove fan shroud by removing attaching screws.

6 Cylinder Tempest - Remove upper panel mounting assembly by removing attaching screws.

7. Remove radiator by lifting straight up.

NOTE: Tempest 6 cylinder radiator is held at bottom by two cradle type brackets and insulators secured to support and baffle assembly (Fig. 13-3).

REPLACE

1. Replace radiator assembly by reversing the above procedure, making sure the lower insulators are properly located in the radiator bottom tank recesses.

2. Torque all upper panel mounting screws to 12 lb. ft., all fan shroud to upper panel mounting screws to 7 lb. ft., and all cradle type bracket attaching screws to 12 lb. ft.

3. Refill radiator with enough coolant to ensure all weather corrosion protection.

FIREBIRD

REMOVE

1. Disconnect positive battery cable.

2. Open drain cock at bottom of radiator and drain radiator and cylinder block. Remove filler cap so coolant will flow freely.

NOTE: To save coolant, remove radiator overflow hose and connect to drain cock.

3. Loosen hose clamps and disconnect upper and lower radiator hoses at radiator inlet and outlet pipes.

4. On cars equipped with V-8 engines and automatic transmissions, disconnect and plug the transmission cooler lines.

5. Remove upper fan shield (six cylinder) or upper shroud bracket (V-8).

6. On cars equipped with power steering, remove power steering coolant lines from clips at top of radiator.

NOTE: To prevent air from entering the power steering system, do not separate coolant lines at hose clamps.

7. Remove radiator attaching screws and lift radiator and shroud out of vehicle.

REPLACE

1. Replace radiator by reversing the above procedure.

2. Torque all mounting screws to 12 lb. ft.

3. Refill radiator with enough coolant to ensure all weather corrosion protection.

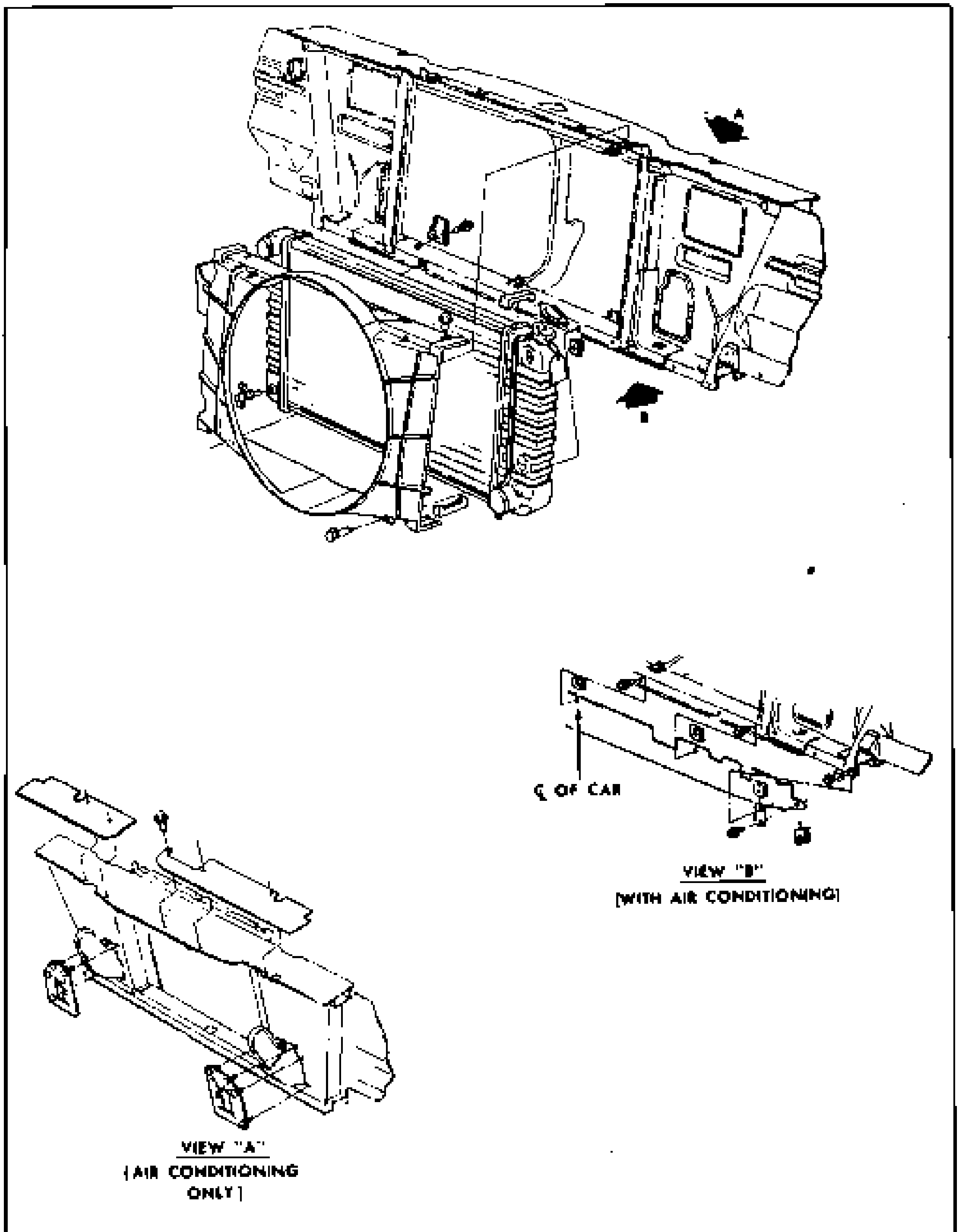


Fig. 13-1 Pontiac Support and Baffle Assembly

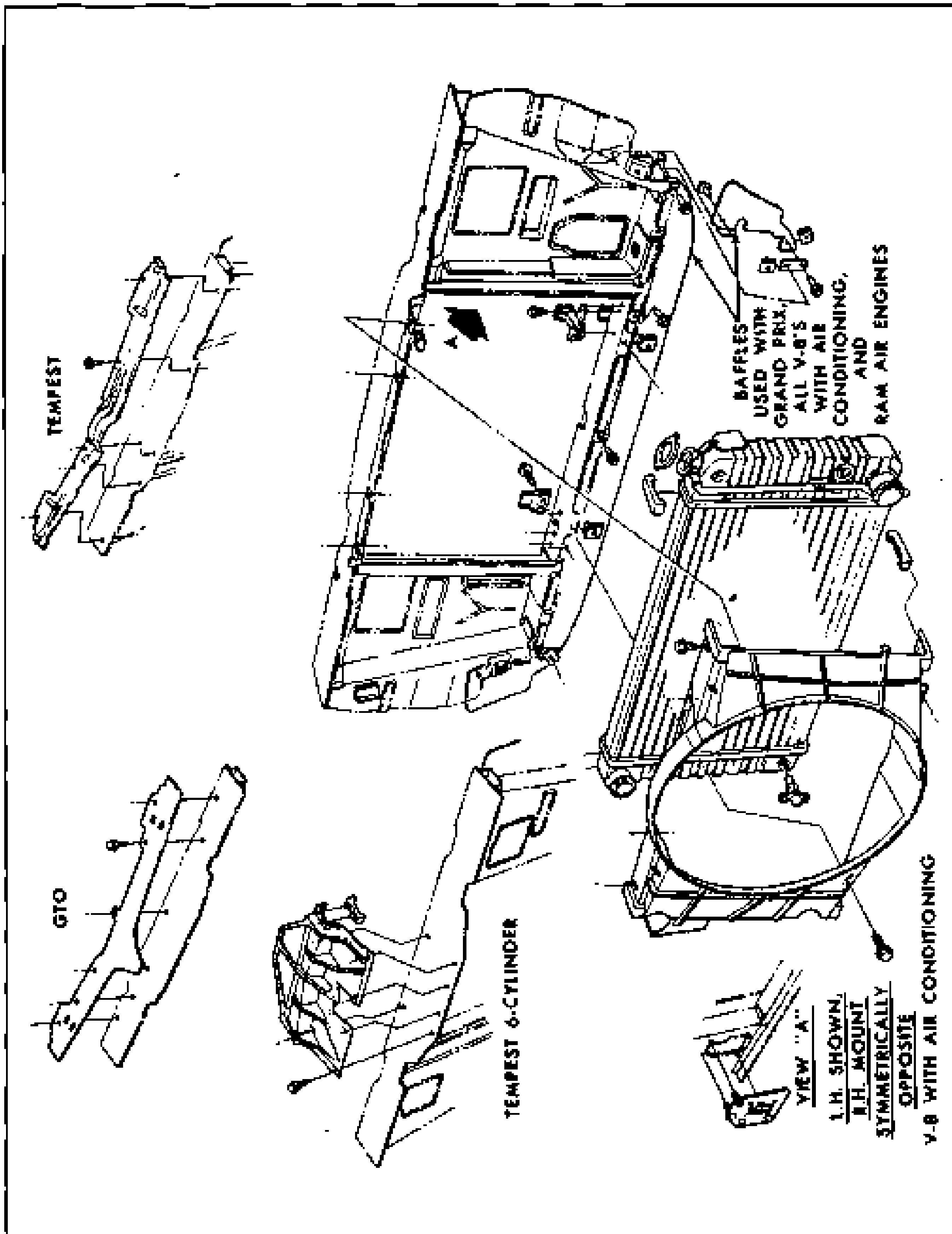


Fig. 13-2 Tempest, GTO and Grand Prix Support and Baffle Assembly

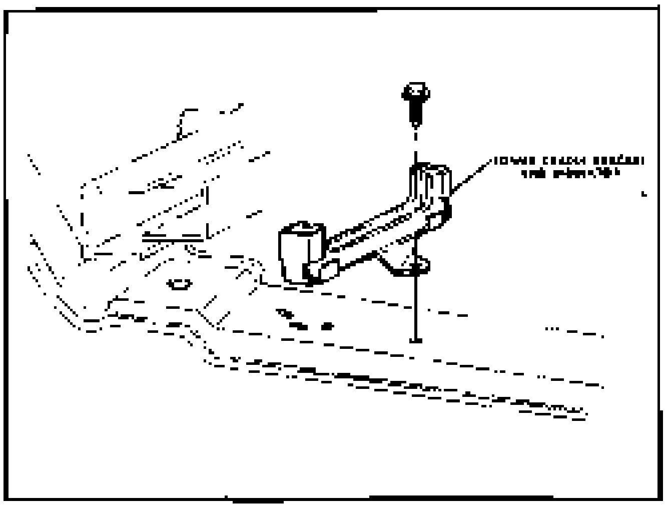


Fig. 13-3 Lower Cradle Bracket and Insulator
Tempest 6 Cylinder Only

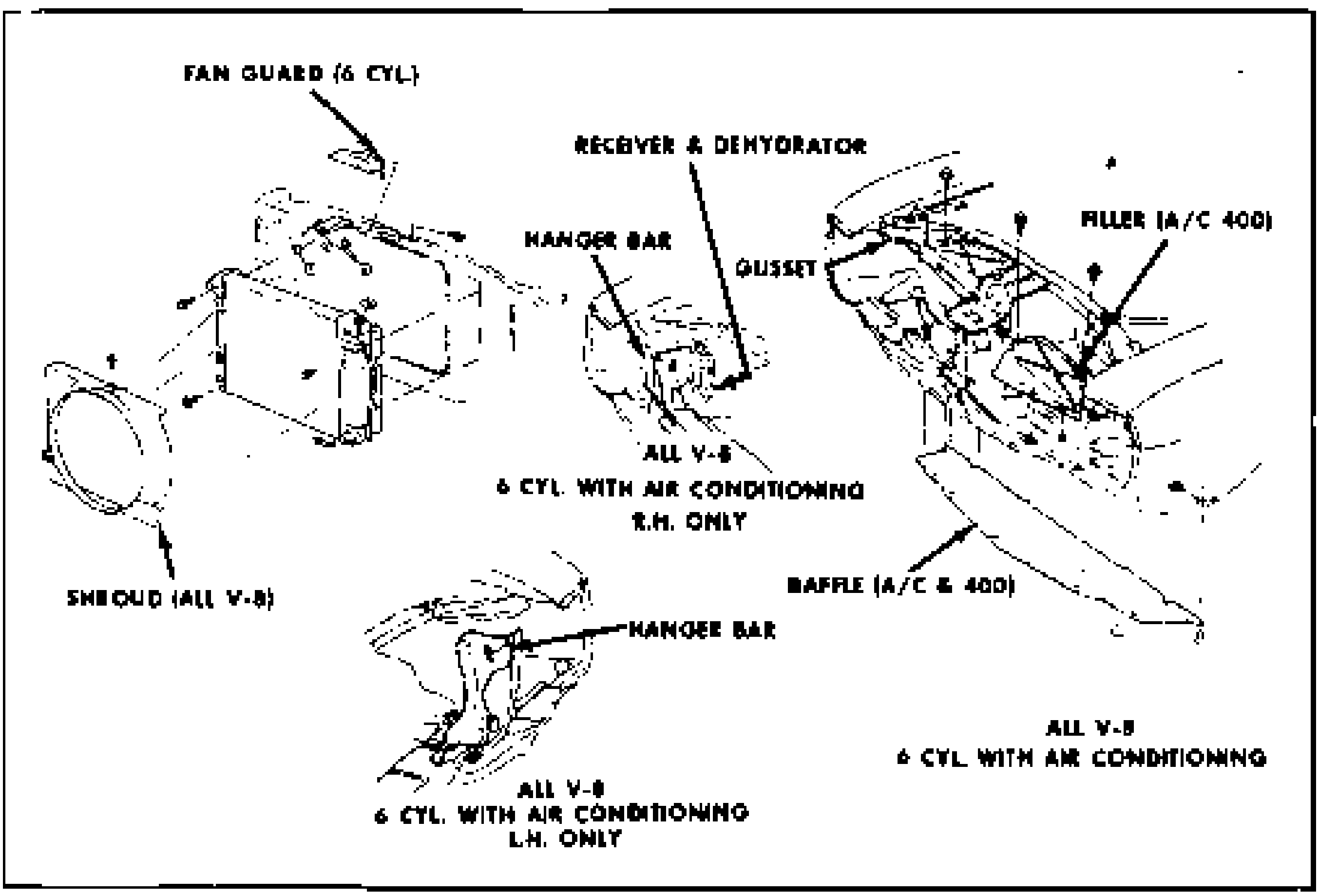


Fig. 13-4 Firebird Support and Baffle Assembly

FRONT AND REAR BUMPERS

CONTENTS OF THIS SECTION

GENERAL DESCRIPTION

Front and rear bumpers are of one piece construction except Pontiac's front vertical extension which is a separate piece. The reinforcements, attachment bars and braces provide maximum support and proper clearances between bumper and sheet metal. All front bumpers are peripheral in design incorporating the grille shells within the structure.

FRONT BUMPERS

BUMPER ADJUSTMENT

Attachment of bumpers is such that slotted holes in the frame and bumper to frame attachment bars provide fore and aft, lateral, as well as vertical adjustment

REMOVE PONTIAC BUMPER (Fig. 14-1)

1. Disconnect parking lights and headlights.

2. Remove valance panel. (See Section 11).

3. Remove upper filler panel.

4. Loosen front bumper stabilizers (Fig. 14-1).

5. Support bumper. Remove frame attaching bolts and loosen bumper at radiator baffle. With aid of helper, remove bumper from car.

6. Remove all reinforcement bar to frame attaching bars and braces.

7. Remove headlight assemblies.

8. Remove front vertical extension.

9. Remove grille shells (Fig. 14-13 and 14).

10. Remove face bar reinforcement.

REMOVE GRAND PRIX BUMPER (Fig. 14-2)

1. Remove valance panel. (See Section 11).

2. Remove upper reinforcement to bumper bolts.

3. Support bumper - remove frame attaching bolts With aid of helper, remove bumper from car.

4. Remove all reinforcement bar to frame attaching bars and braces.

5. Remove grille shells (Fig. 14-15).

6. Remove face bar reinforcement.

REMOVE TEMPEST BUMPER (Fig. 14-3 and 4)

1. Disconnect parking lights, headlights and vacuum hoses (GTO only).

2. Remove valance panel. (See Section 11).

3. Loosen front bumper stabilizers (Figs. 14-3 and 4). Support bumper and remove frame attaching bolts. With aid of helper, remove bumper assembly from car.

4. Remove all reinforcement bar to frame attaching bars and braces.

5. Remove headlight assemblies.

NOTE: To disassemble GTO headlight mechanism, see Fig. 14-18.

6. Remove grille shells (Fig. 14-16 and 18).

7. Remove face bar reinforcement.

REMOVE FIREBIRD BUMPER (Fig. 14-5)

1. Remove center bumper bar after removing upper and lower reinforcement to bumper bolts.

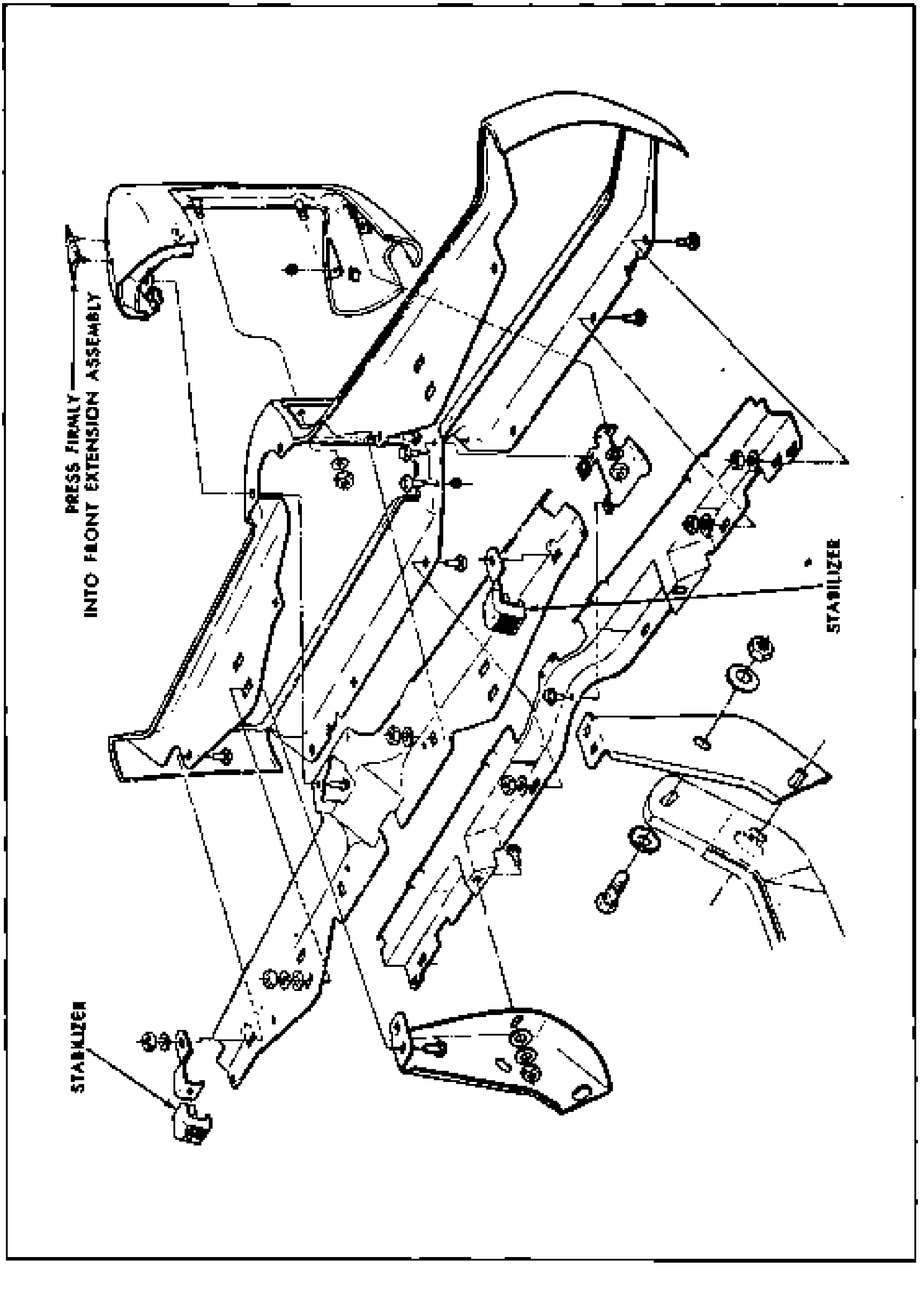


Fig. 14-1 Pontiac Front Bumper

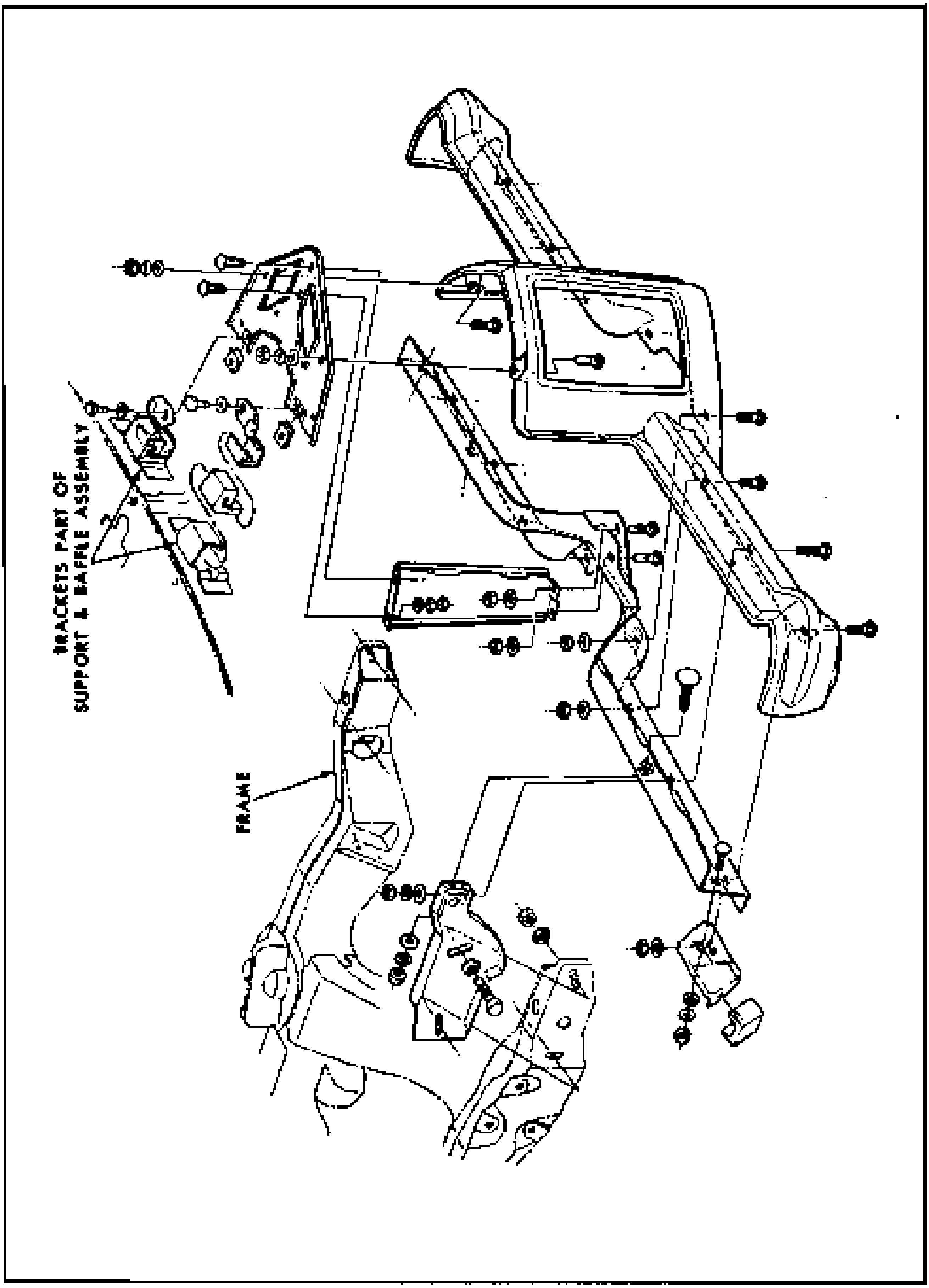


Fig. 14-2 Grand Prix Front Bumper

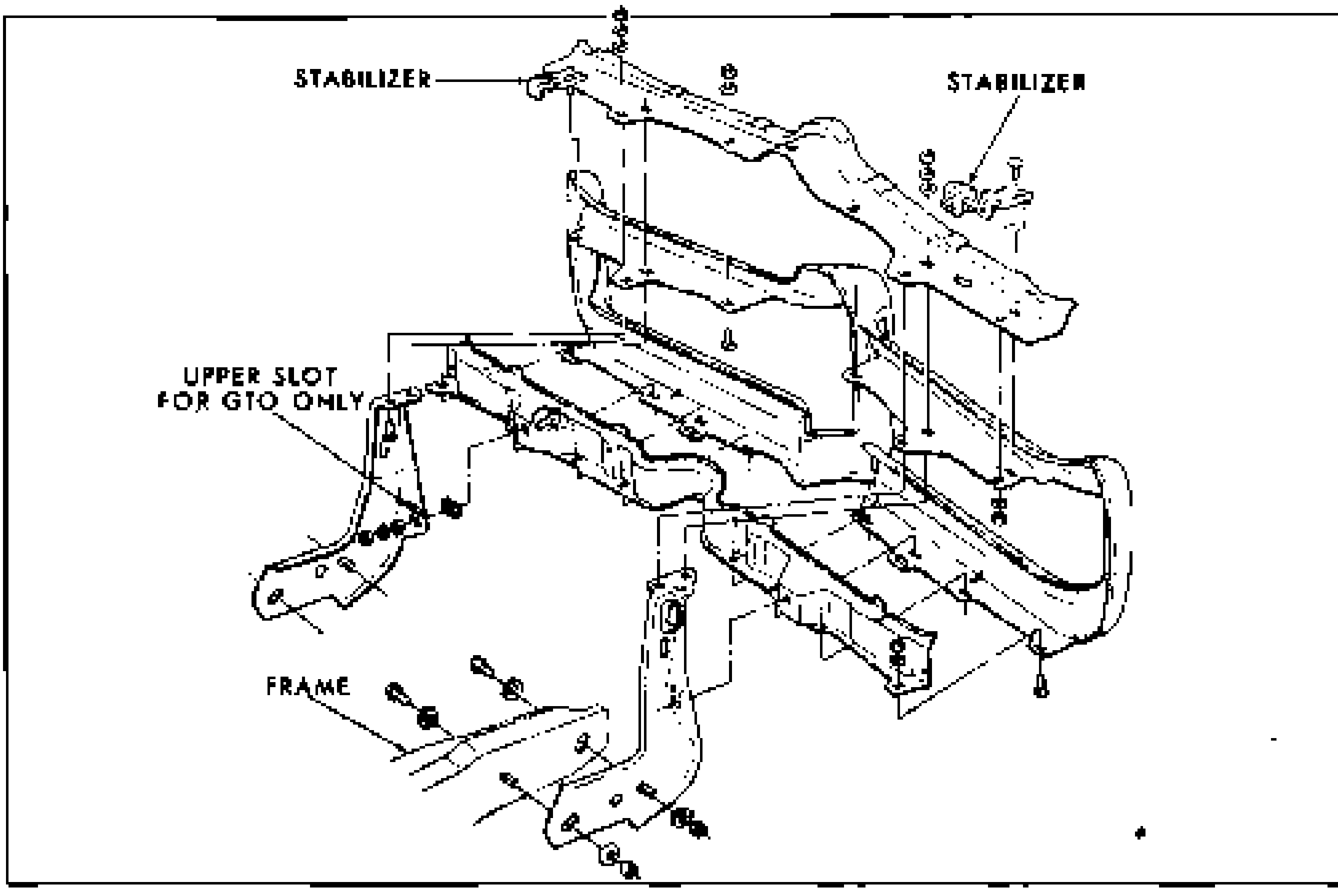


Fig. 14-3 Tempest Front Bumper

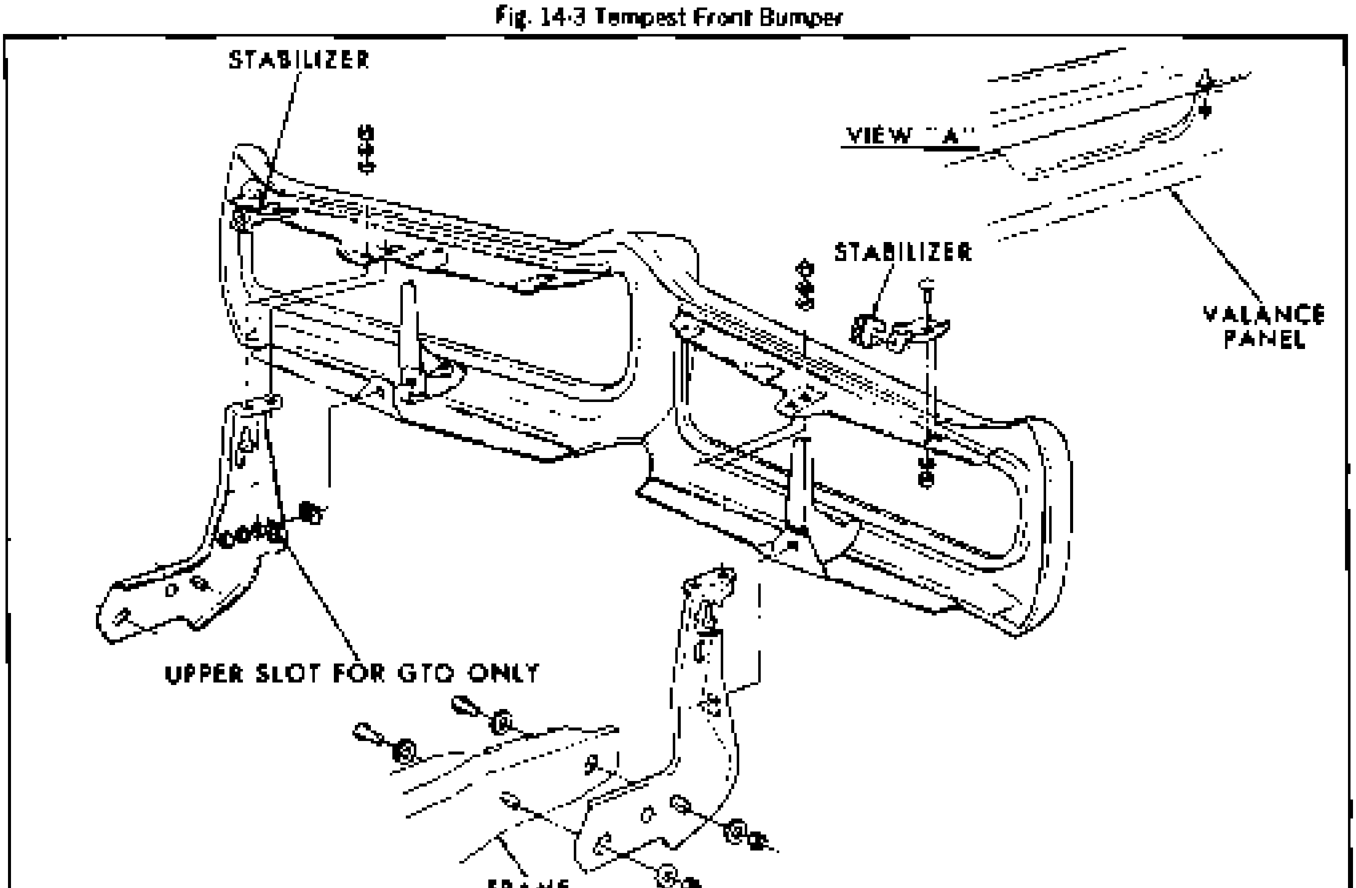


Fig. 14-4 GTO Front Bumper

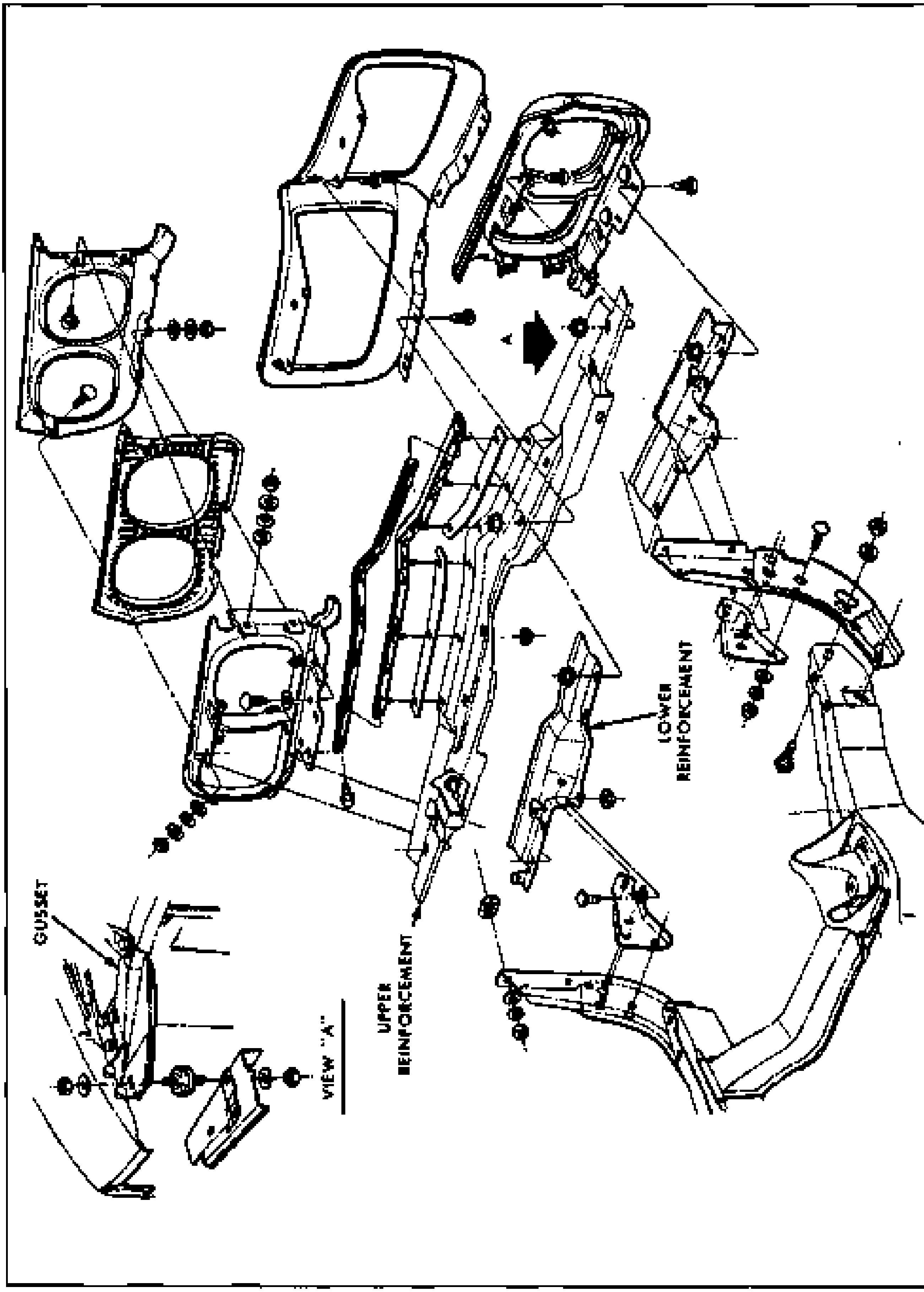


Fig. 14-5 Fleetwood Front Bumper

2. Disconnect headlights and parking lights.

3. Remove gussets and upper filler panels.

4. Remove outer bumper bars after removing upper and lower reinforcement to bumper bolts.

5. Remove headlight assemblies.

6. Remove outer bumper reinforcements.

REPLACE BUMPERS - ALL

1. To install, reverse above procedures making sure the front bumper is properly aligned with the front end sheet metal. Adjust front bumper stabilizers to contact sheet metal on Pontiac, Tempest and GTO.

2. Torque all face bar to attachment bar bolts 25 lb. ft. and all attachment bar to frame bolts 70 lb. ft.

NOTE: Always check headlight aim whenever any front bumper is removed or readjusted.

REAR BUMPERS

All rear bumpers except on station wagon and Firebird contain a center opening for access to the gasoline filler. Grand Prix taillight assemblies are mounted in the bumper. Bonneville has a resilient urethane applique. All station wagon bumpers have a step built in for easier access (optional on Tempest Custom).

Shims may be required at the center hanger bar bracket where the face bar is mounted to prevent possible rattles.

REMOVE PONTIAC REAR BUMPER (Fig. 14-6)

1. Remove valance panel.

2. Remove license lamp assembly.

3. Remove plugs in trunk area to gain access to bracket nuts.

4. Support bumper and remove bumper bracket nuts.

5. Remove all bumper brackets and fuel filler door.

6. Remove rear bumper applique (Bonneville only).

REMOVE PONTIAC STATION WAGON REAR BUMPER (Fig. 14-7 and 8).

1. Remove screws from step treads (Fig. 14-8).

2. Remove step treads.

3. Remove license lamp assembly.

4. Remove four bolts marked "X" from underneath car.

5. Support bumper and remove six bolts marked "Y" to remove bumper.

6. Remove the latch cover assembly from tailgate as follows:

a. Open tailgate.

b. Remove inner latch cover to expose outer latch cover bolts.

c. Remove outer latch cover.

NOTE: The bumper may be adjusted laterally only to align the right hand side of step opening with striker on body.

REMOVE GRAND PRIX REAR BUMPER (Fig. 14-9)

1. Remove valance panel.

2. Remove license lamp assembly.

3. Disconnect taillamps.

4. From underneath car, remove four bolts marked "X".

5. Remove two plugs in trunk to gain access to bracket nuts.

6. Support bumper and remove two bracket nuts.

7. Remove all bumper brackets and fuel filler door.

8. Remove taillamp assemblies.

REMOVE TEMPEST REAR BUMPER (Figs. 14-10 and 11)

1. Disconnect all lights contained in or attached to the bumper (station wagon only).

2. Support bumper and remove all four bumper bar to frame bolts.

3. Remove face bar after removing attaching bolts in license plate area.

4. Remove all face bar to frame attaching bars and brackets and fuel filler door.

5. Remove back-up light assemblies (station wagon only)

6. To remove the latch cover assembly from the station wagon tailgate proceed as follows:

a. Open tailgate.

b. Remove inner latch cover to expose outer latch cover bolts.

c. Remove outer latch cover.

NOTE: The bumper is fully adjustable to permit aligning the step opening with the striker on body.

REMOVE FIREBIRD REAR BUMPER (Fig. 14-12)

Remove bolts in trunk securing rear attachment bars to rear end sheet metal.

NOTE: Remove dampers on convertible styles.

REPLACE BUMPERS - ALL

1. To install, reverse the above procedures making sure rear bumper assembly is properly aligned.

NOTE: If splash shields were removed at any time during the above operations, they must be replaced before installing bumper.

Apply a medium bodied sealer to all Firebird rear bumper bolts to prevent leaks at the body attaching points.

2. Torque the attachment bolts as follows:

Face bar to attachment bar bolts - all . . . 20-30 lb. ft.

Attachment bar to frame bolts - Tempest only . . 60-80 lb. ft.

Attachment bracket to body bolts - Pontiac and Grand Prix . . 45-60 lb. ft.

Attachment bracket to body bolts - Firebird . . . 25-35 lb. ft.

POLYURETHANE AND LEXAN PARTS

DESCRIPTION OF POLYURETHANE PARTS

The polyurethane bumper material will withstand minor impacts and the resultant damage such as occur in parking lots by recovering its original shape. The paint film responds to impact in a similar manner without cracking or splitting. In addition, the paint finish may be polished for removal of surface marks as with an acrylic paint film. If, however, an area of damage in the bumper does not recover its shape, or the surface is gouged, a repair system has been developed to restore the original shape and appearance of the foam base material. The polyurethane material is used for GTO front bumpers, Pontiac front bumper center extension and Bonneville rear bumper applique.

The repair sequence amounts to a filling operation with a flexible epoxy resin. After curing, the patch is dressed to conform to the surrounding contour. The refinish operation includes application of a glazing compound which, after drying, is sanded smooth, followed by the color coats and clear top coats. The application and refinishing methods employed with this material conformed to generally known and accepted existing methods -- only the material is different.

REPAIR PROCEDURE - POLYURETHANE PARTS

FILLING

Material:

Part A - Flexible Resin

Part B - Resin Hardener

Equipment:

Putty Knife

Squeegee

Heat Lamp(s)

#220 & #400 Sandpaper

DA Sander w/#80 Discs

Body File w/Holder

1. Clean the repair area with a wax, grease and silicone removing solvent. With a DA sander adjusted to a feathering action and fitted with a #80 grit disc, remove the paint film in and surrounding the area to be filled. This is necessary because the patching compound will adhere only to the foam base material.

2. If the surface to be repaired is cut or gouged, use the DA sander and a clean disc to enlarge the cut or gouged area(s). This must be done to ensure removal of grease, oil, or dirt from the area to be contacted by the repair material. This action should also taper the edges of the cut to minimize the possibility of highlighting the repair.

3. Mix the patching compound and hardening agent at the prescribed portion (10 to 1). The patching compound and hardening agent should be mixed until a uniform color is achieved.

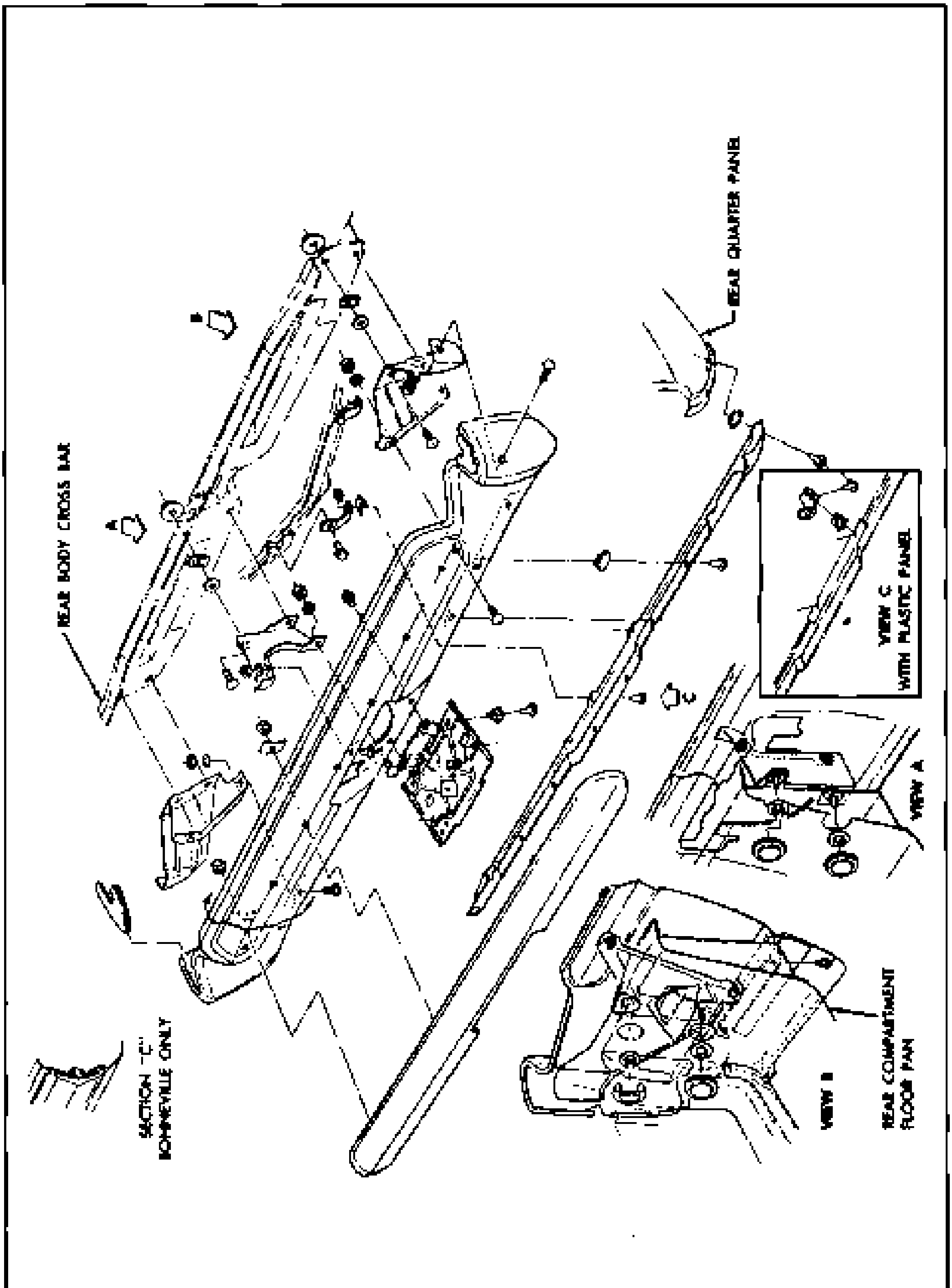


Fig. 14-6 Pontiac Rear Bumper (Except Station Wagon)

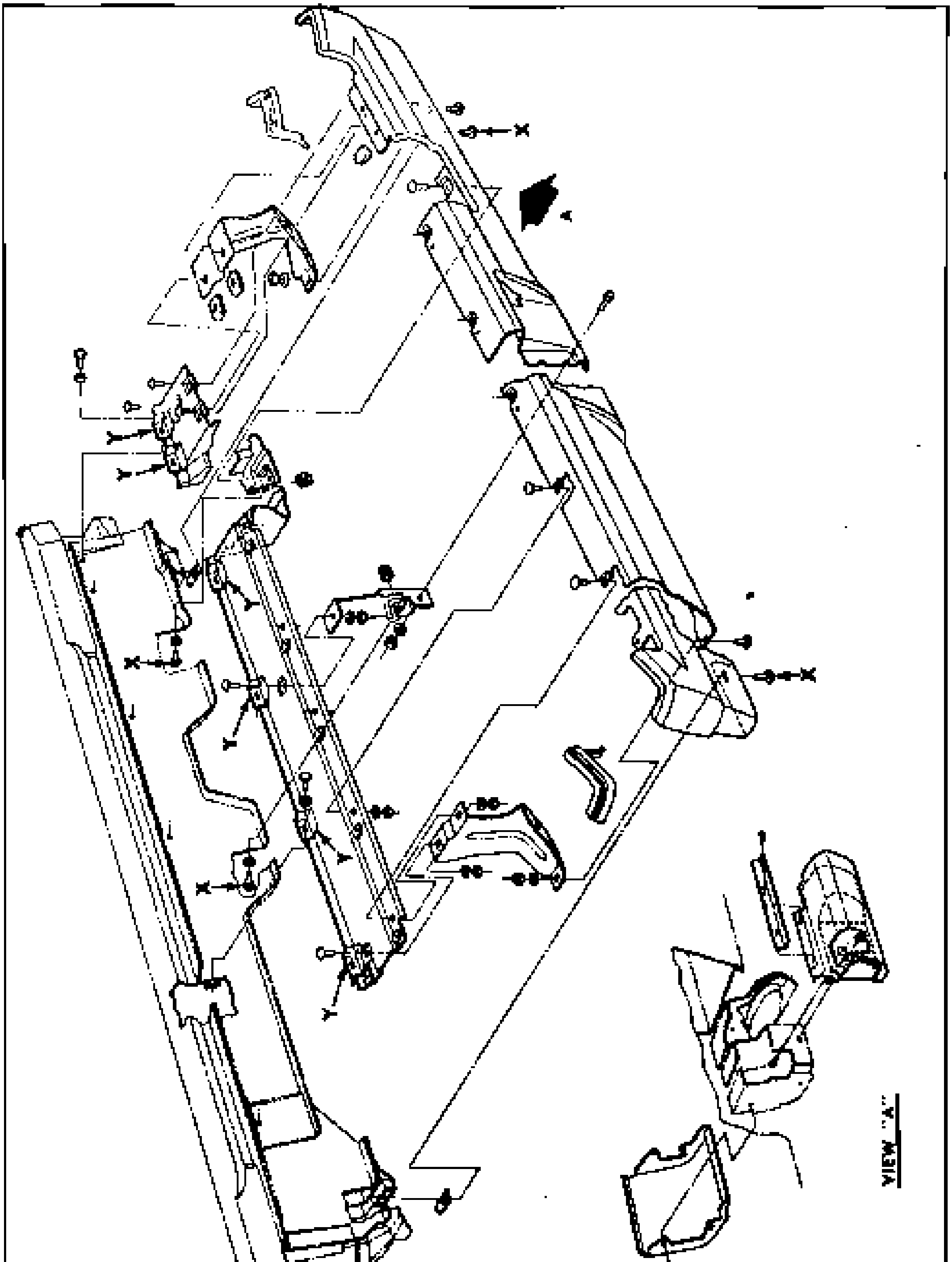


Fig. 14-7 Pontiac Station Wagon Rear Bumper

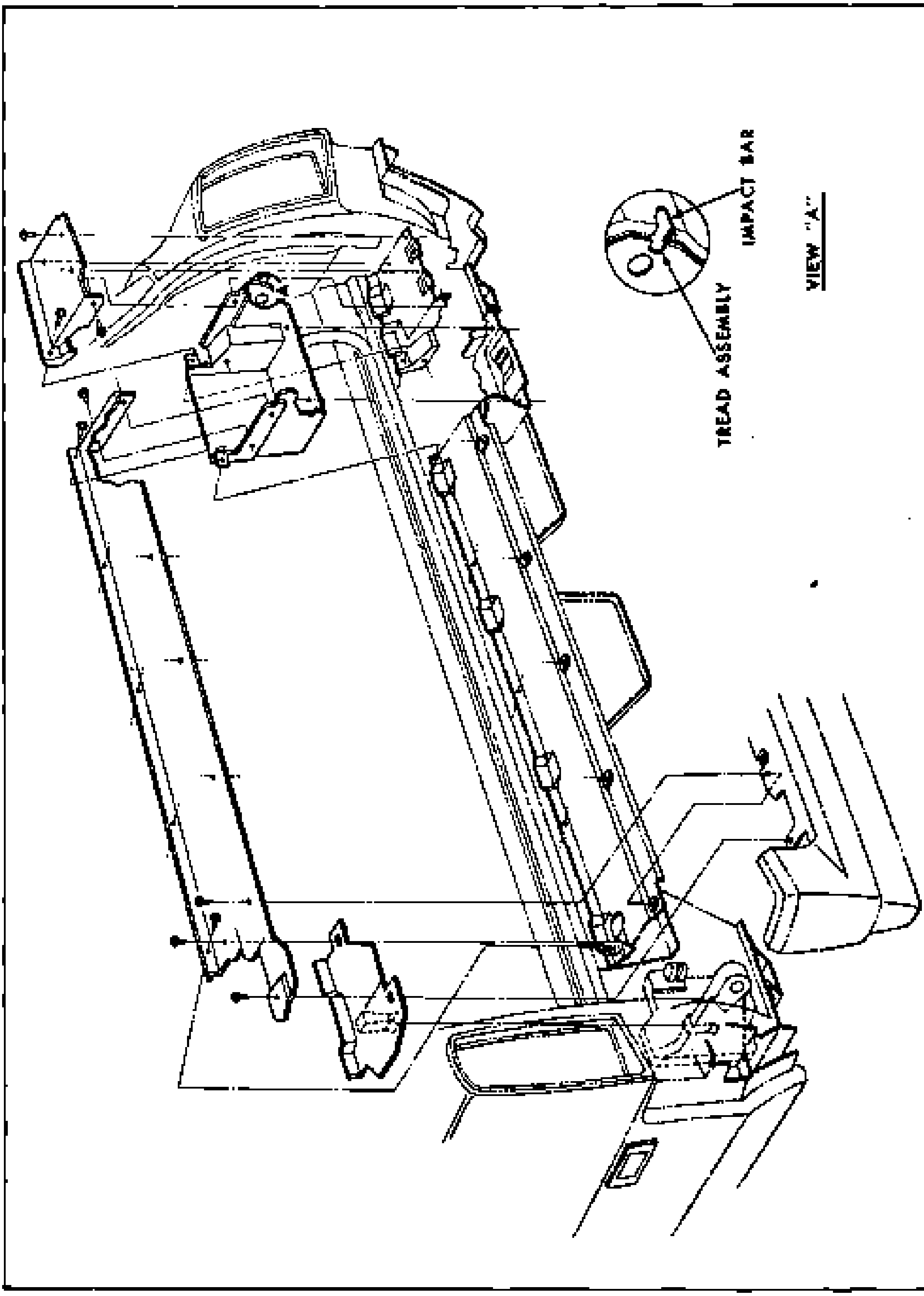


Fig. 14-8 Pontiac Station Wagon Tread Assembly

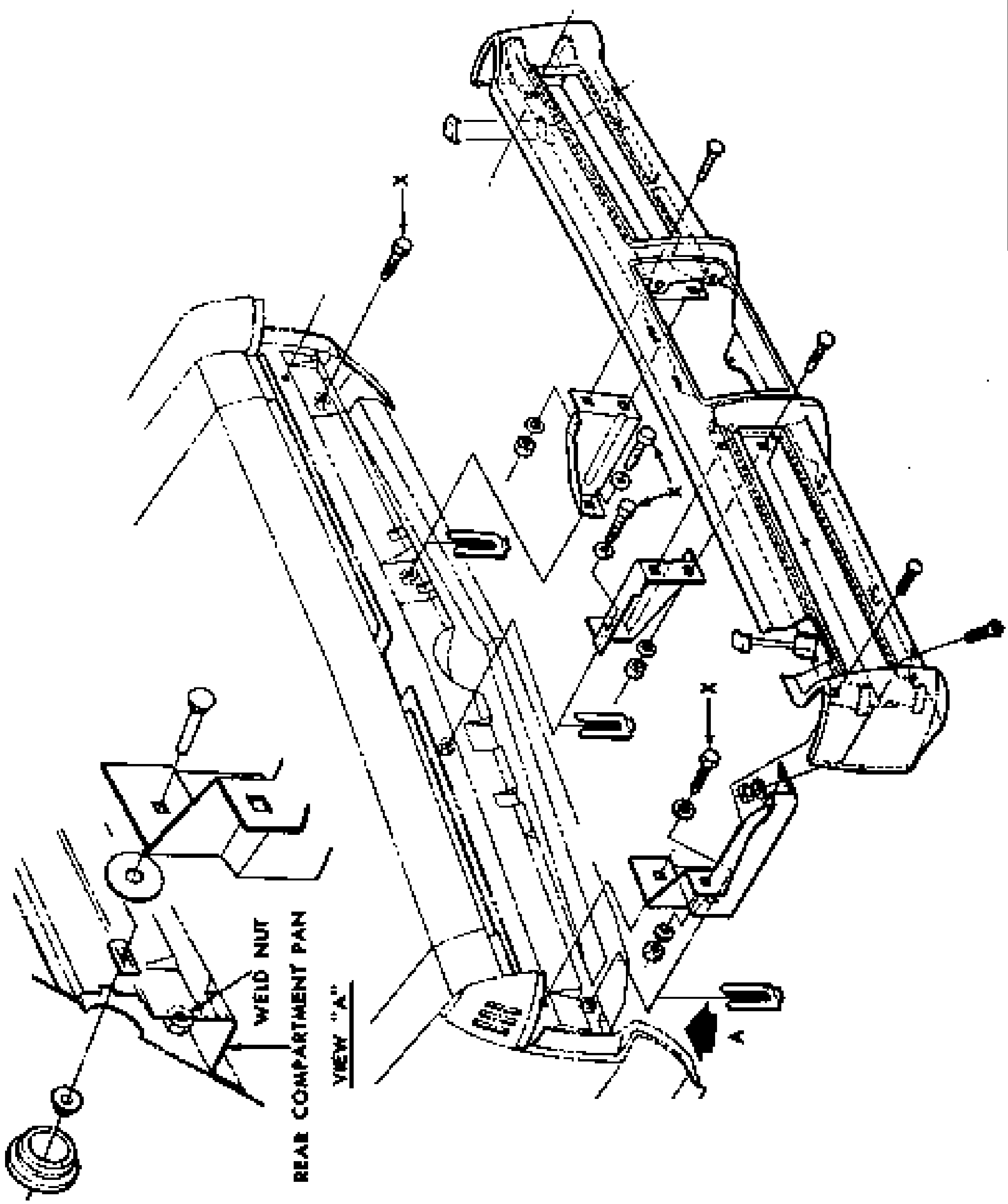


Fig. 14-9 Grand Prix Rear Bumper

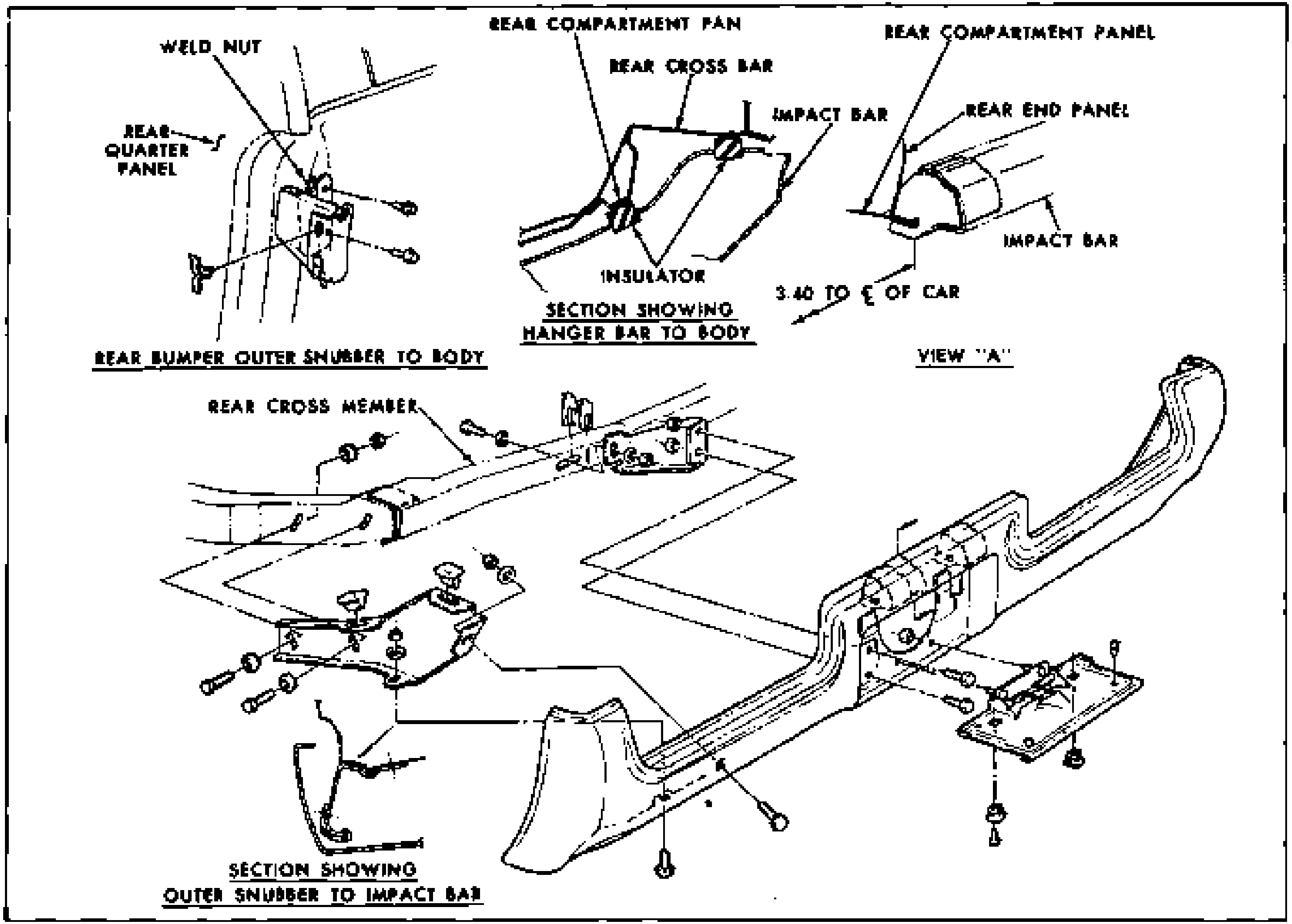


Fig. 14-10 Tempest Rear Bumper (Except Station Wagon)

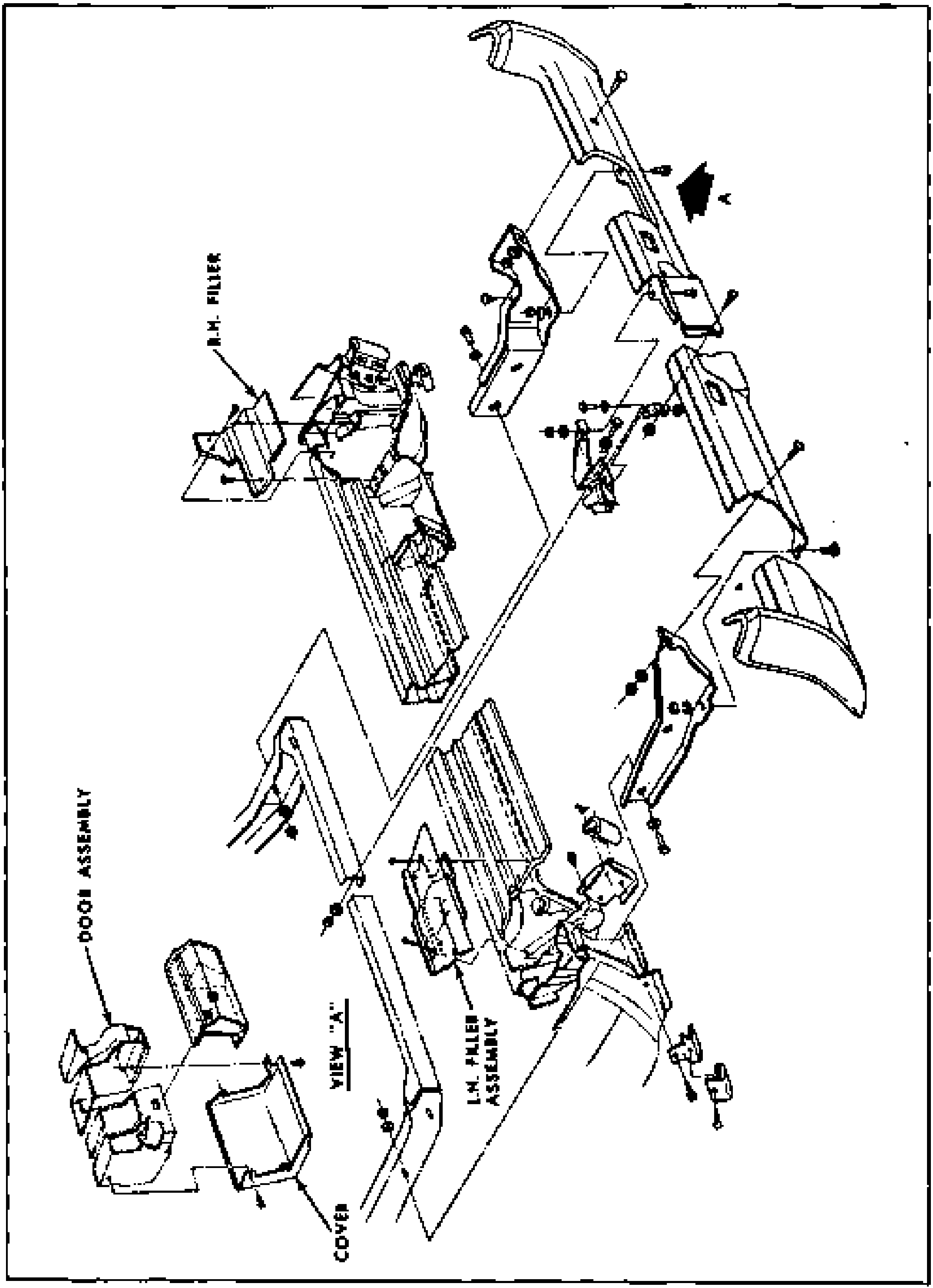


Fig. 14-13 Tempest Station Wagon Rear Bumper

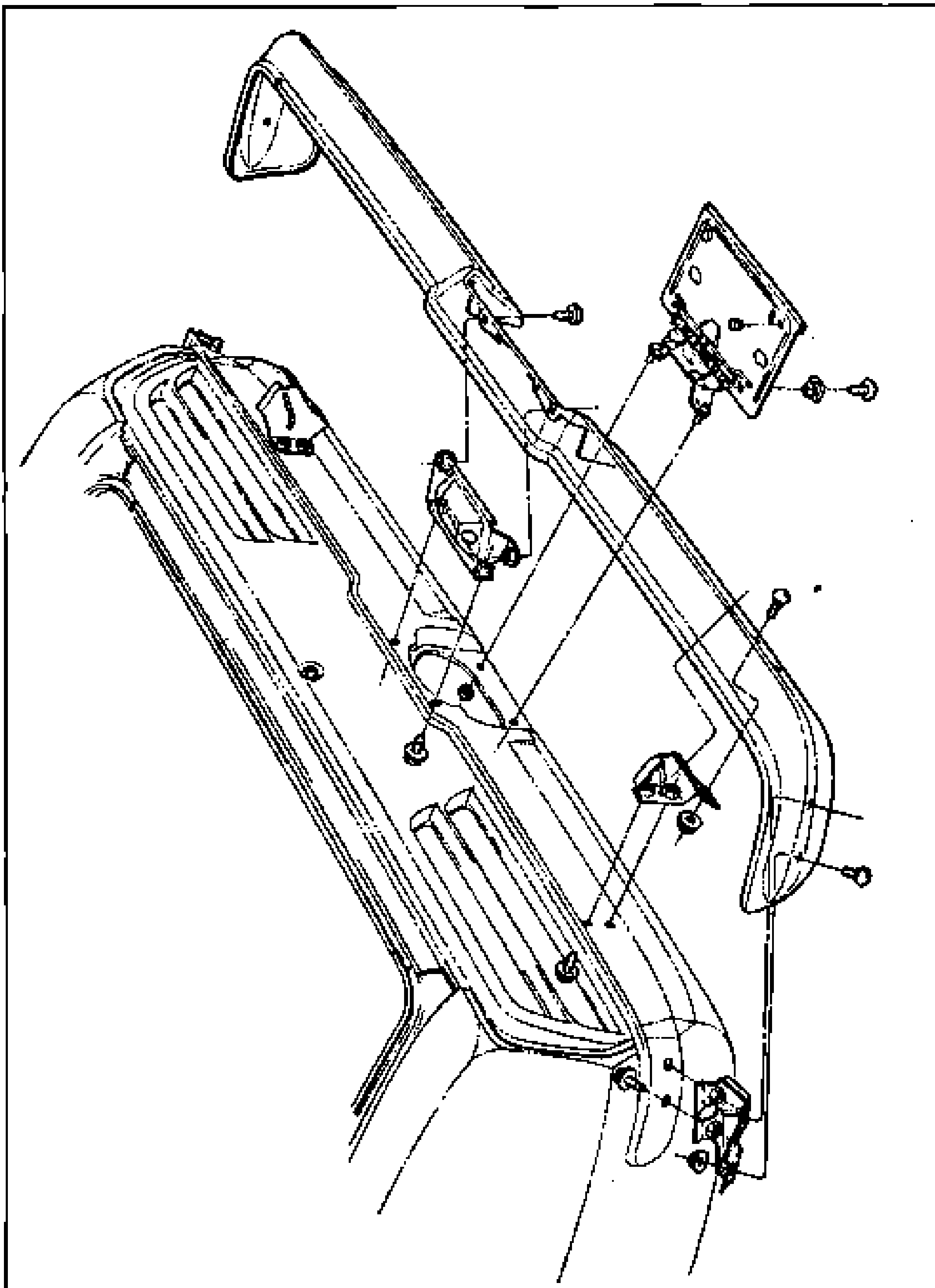


Fig. 14-12 Firebird Rear Bumper

4. Fill the repair area with the mixed compound to a height slightly above the surrounding contour. Work out air bubbles, if present.

NOTE: Thinly spread the remaining mixture on a clean, hard surface to lengthen pot life. This may be used later on the cured patch for repair of pin holes.

5. Place a heat lamp approximately 15 inches from the patched surface for 15 to 30 minutes, or until the repair material will not transfer to the touch.

6. Remove the heat lamp and allow the patch to return to room temperature. The repair mix will harden with cooling.

7. Dress the patch to contour with a curved-tooth body file, followed by sanding with #220 sandpaper and block.

CAUTION: The cured repair material is slightly harder than the original foam and may easily be undercut.

8. If the patch is uneven or porous, repeat steps 4 thru 7.

REFINISHING - POLYURETHANE AND LEXAN PARTS

Refinishing the patched area amounts to no more than a standard paint procedure. Under no circumstances, however, should regular paint materials be used in refinishing this bumper. As mentioned earlier, the glaze coat, color coats and clear top coats that are to be used are specially formulated with an elastomer vehicle so that the cured film may bend under impact without cracking or splitting. This procedure is to be used on GTO front bumpers, Pontiac front bumper center extension, Bonneville rear bumper applique, and Firebird front bumper.

Material:

Glazing Compound

Color

Top Coat Clear

Thinner

#220 and #400 Sandpaper

Equipment;

Suction Spray Gun with same nozzle and air cap combination used for acrylic application

1. Featheredge the repair area by dry-sanding with #220 sandpaper followed by #400 grit sandpaper.

2. Thoroughly mix the glazing compound and spray-apply the material in the same manner as PX primer-surfacer. Apply two or three coats, allowing flash-time between coats

3. Allow 15 to 30 minutes drying time at room temperature. When dry, water-sand the glazed area with #400 sandpaper. Block-sand for maximum leveling.

NOTE: Dry-sanding clogs the sandpaper due to the elastomer-type vehicle used in the compound.

4. Re-clean the repair area with a final solvent wash.

5. Thoroughly stir the color and apply in sufficient quantity to achieve hiding only--one dry coat followed by a wet coat.

NOTE: If mottling occurs, the metallic color control method of color application corrects this problem.

6. Blend the perimeter of the patch with the special thinner provided with the material. Use standard blending techniques after each color coat.

7. Allow the color to dry 5 to 10 minutes at room temperature.

8. Thoroughly mix and apply the top coat clear, using two coats as done previously with the color.

CAUTION: Wet application of clear coats causes considerable darkening of the color.

Wetness of clear coats is dependent upon the amount of color-darkening required to achieve a match. If application of clear coats over a spot repair creates an objectionable mis-match, the entire bar may be coated with clear material.

9. Air-dry of the clear coats require 8 hours at room temperature. Force-dry is recommended for 1/2 hour at 150°-170°F.

10. Compounding reduces the gloss, for this reason, rubbing compound should be used only if a reduction of gloss is desired.

NOTE: In using this material, the following cautions should be noted:

. . . All the bumper refinishing materials are packaged at spraying viscosity. Only if "veiling" occurs during application will additional reduction be necessary.

. . . Reduce these refinish materials with the special thinner only--never use acrylic thinner.

. . . The top coat clear material has a tendency to yellow if subjected to prolonged, elevated temperatures (300°F).

. . . The clear coat tends to soften the color over which it is applied. For this reason, premature featuring (within 24 hours) of air-dried film, as in overlap of a previously repaired area, will TEAR and PEEL the color off the surface.

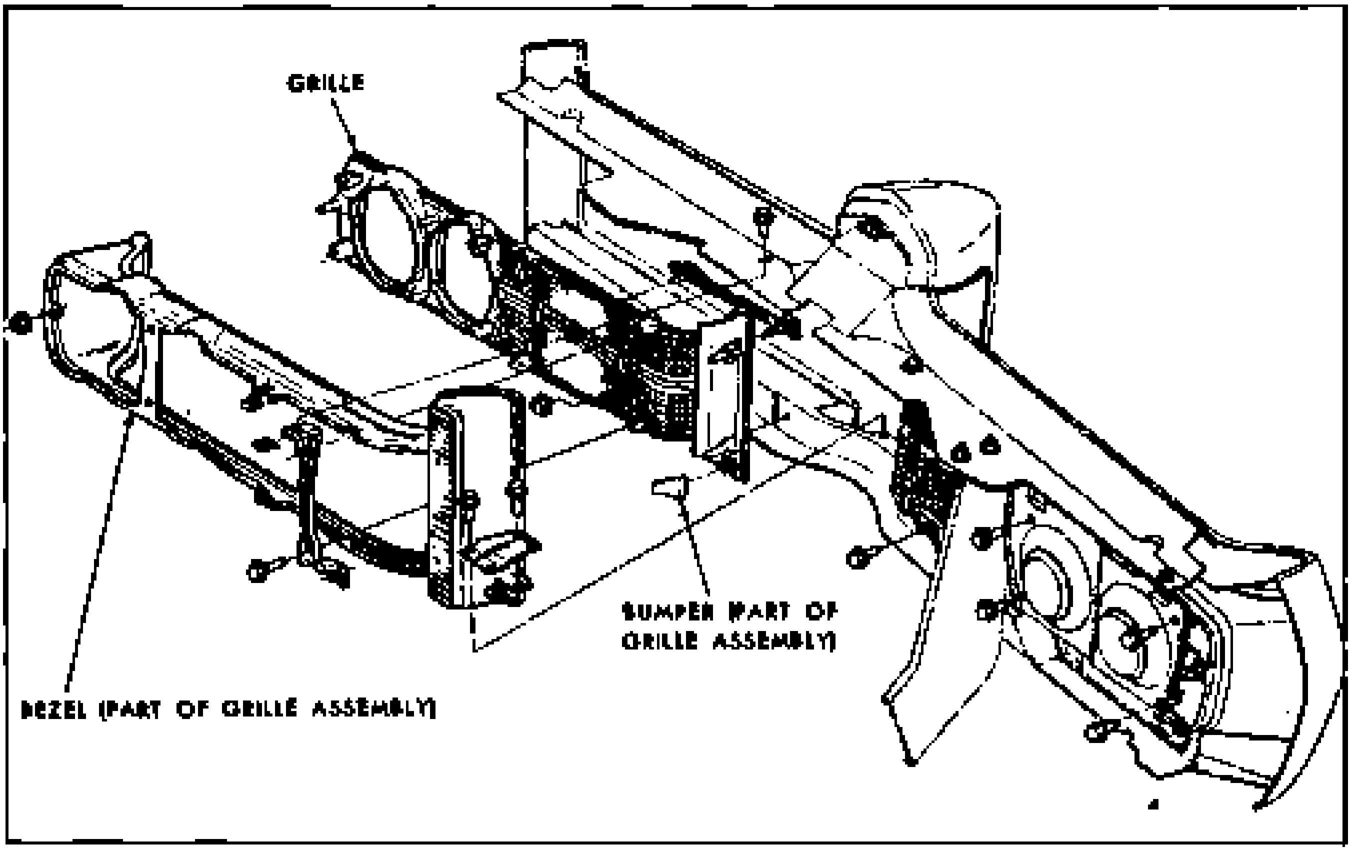


Fig. 14-13 Pontiac Bonneville Grille

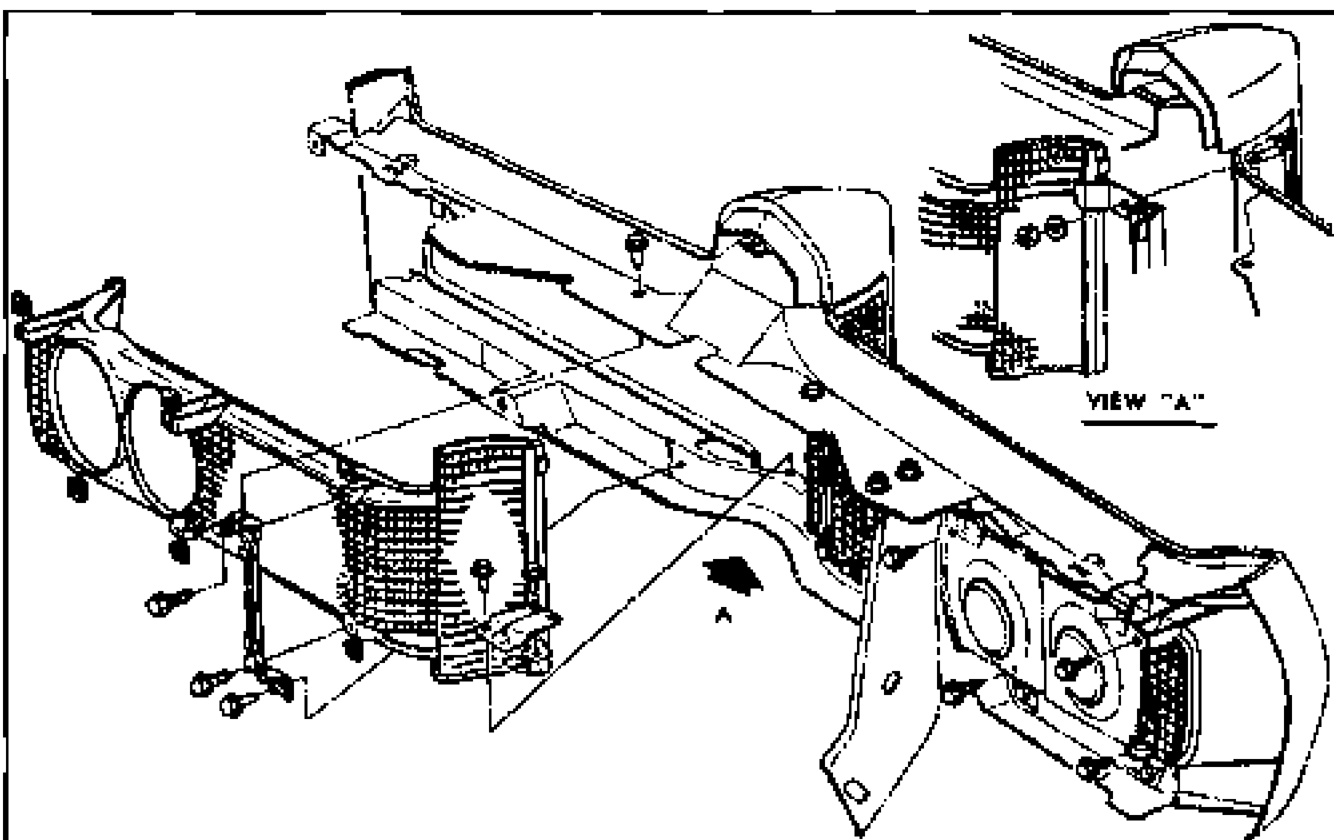


Fig. 14-14 Pontiac Catalina and Executive Grille

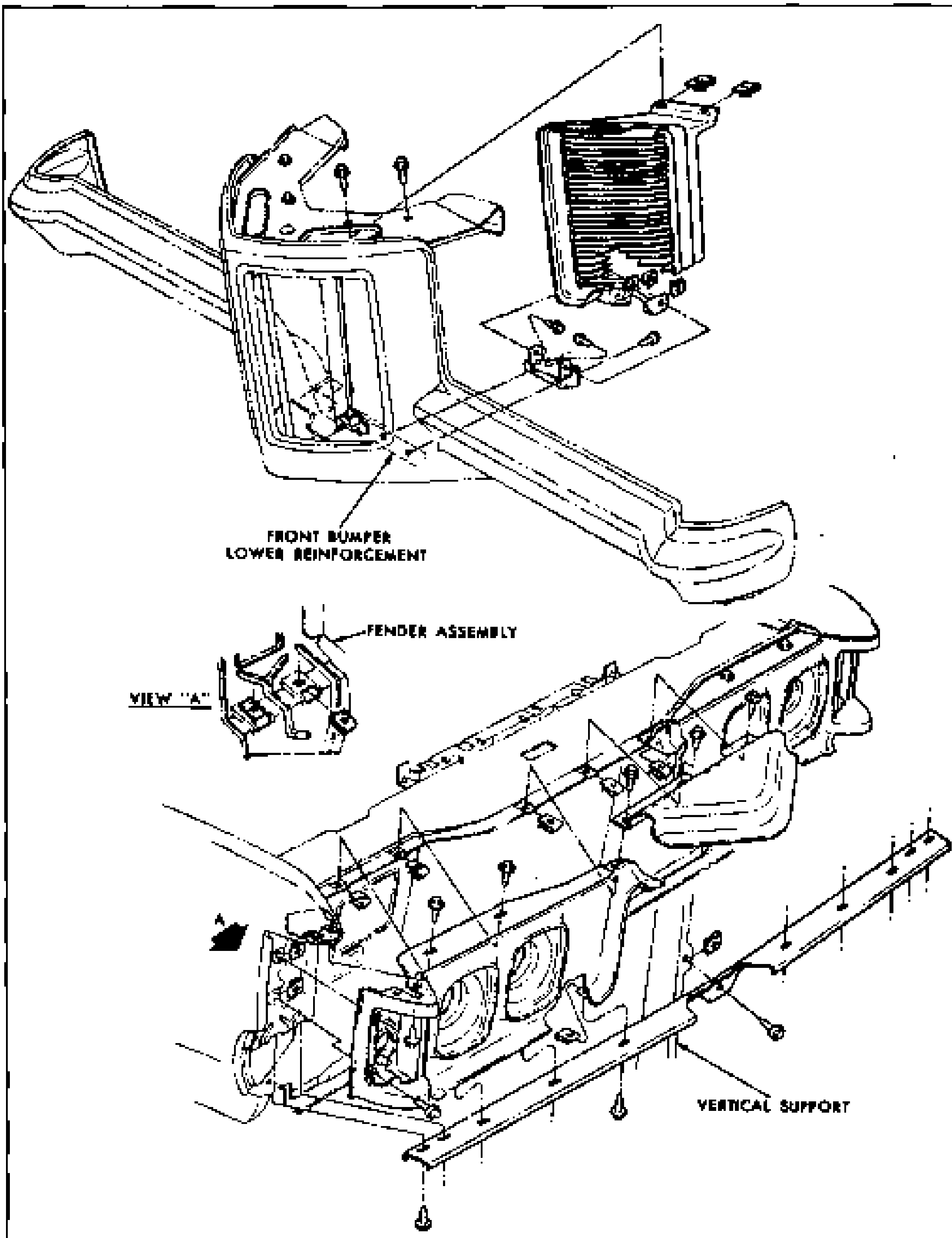


Fig. 14-15 Grand Prix Grille

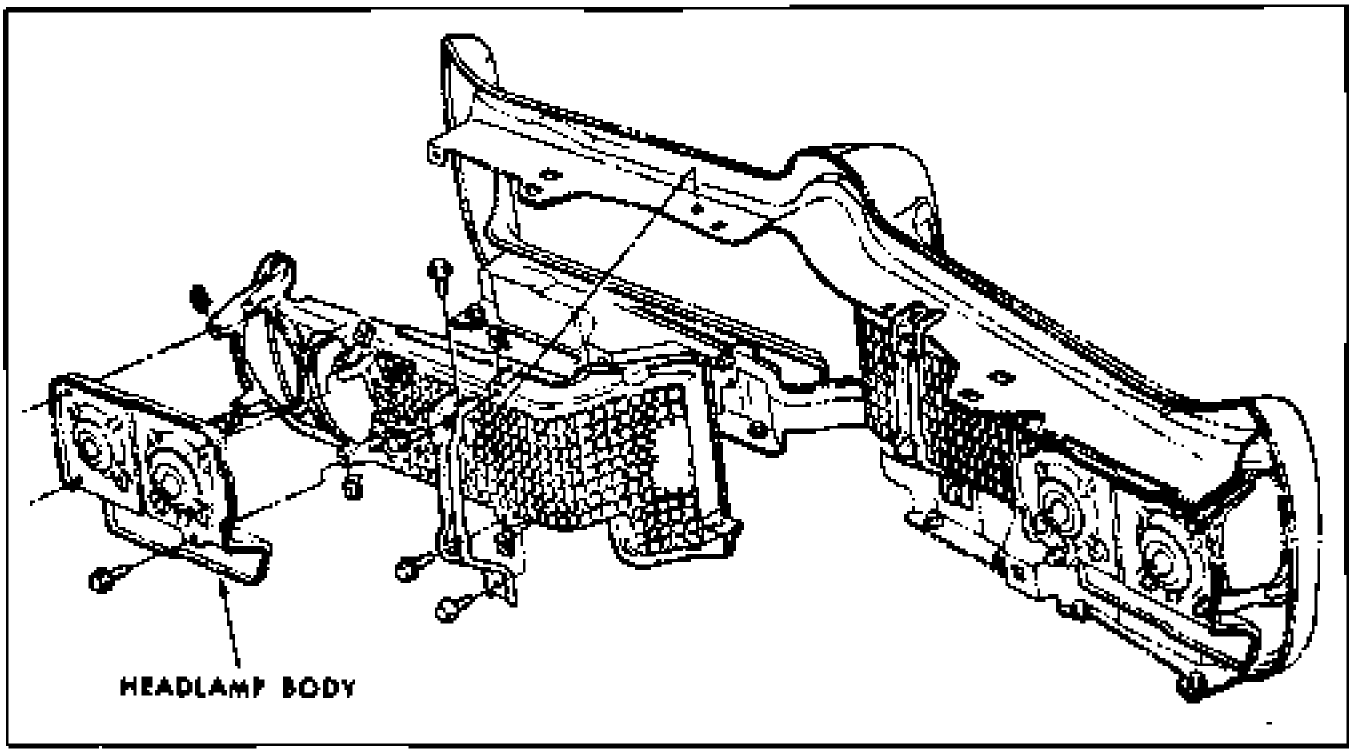


Fig. 14-16 Tempest Grille

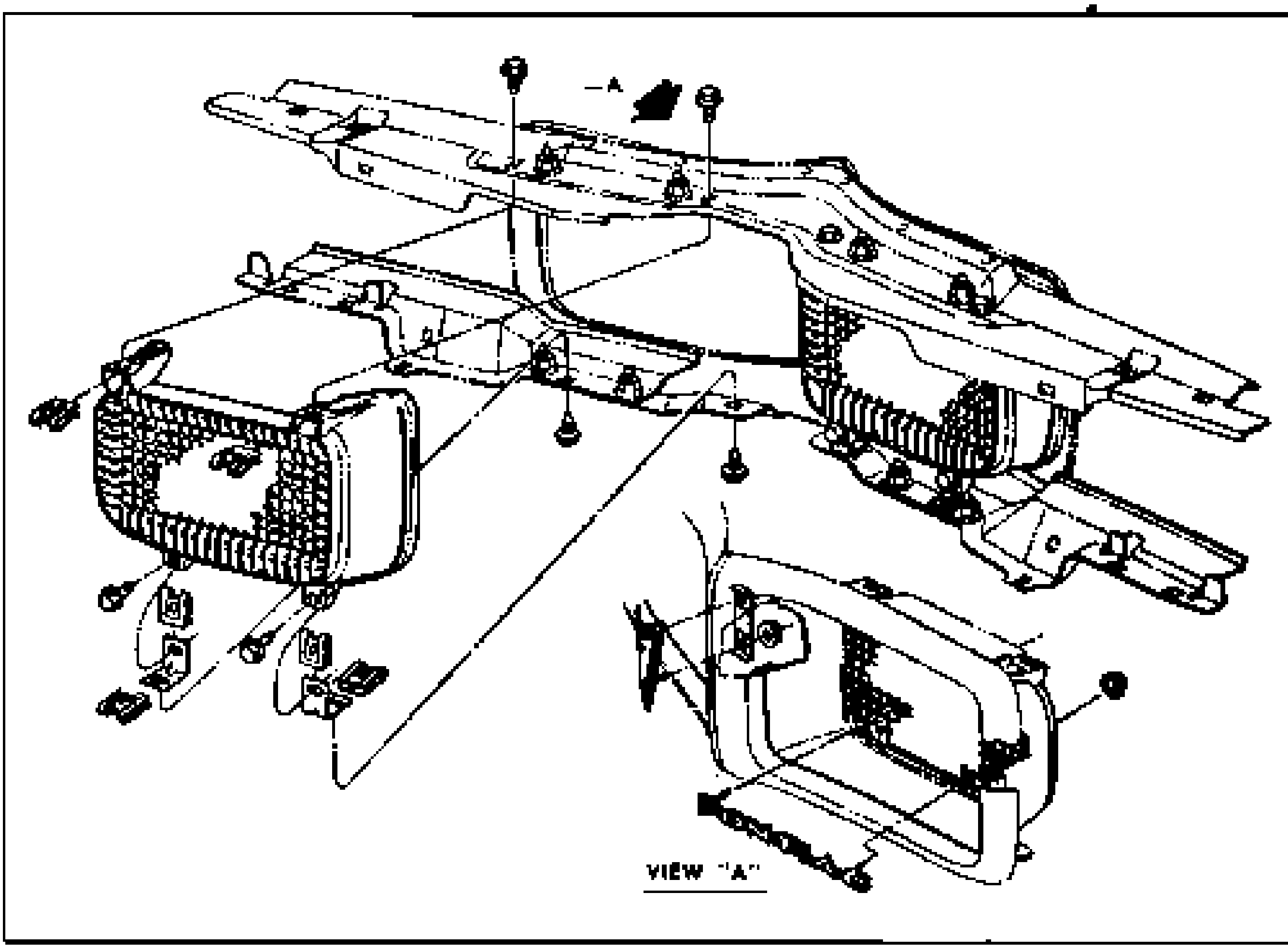


Fig. 14-17 Firebird Grille

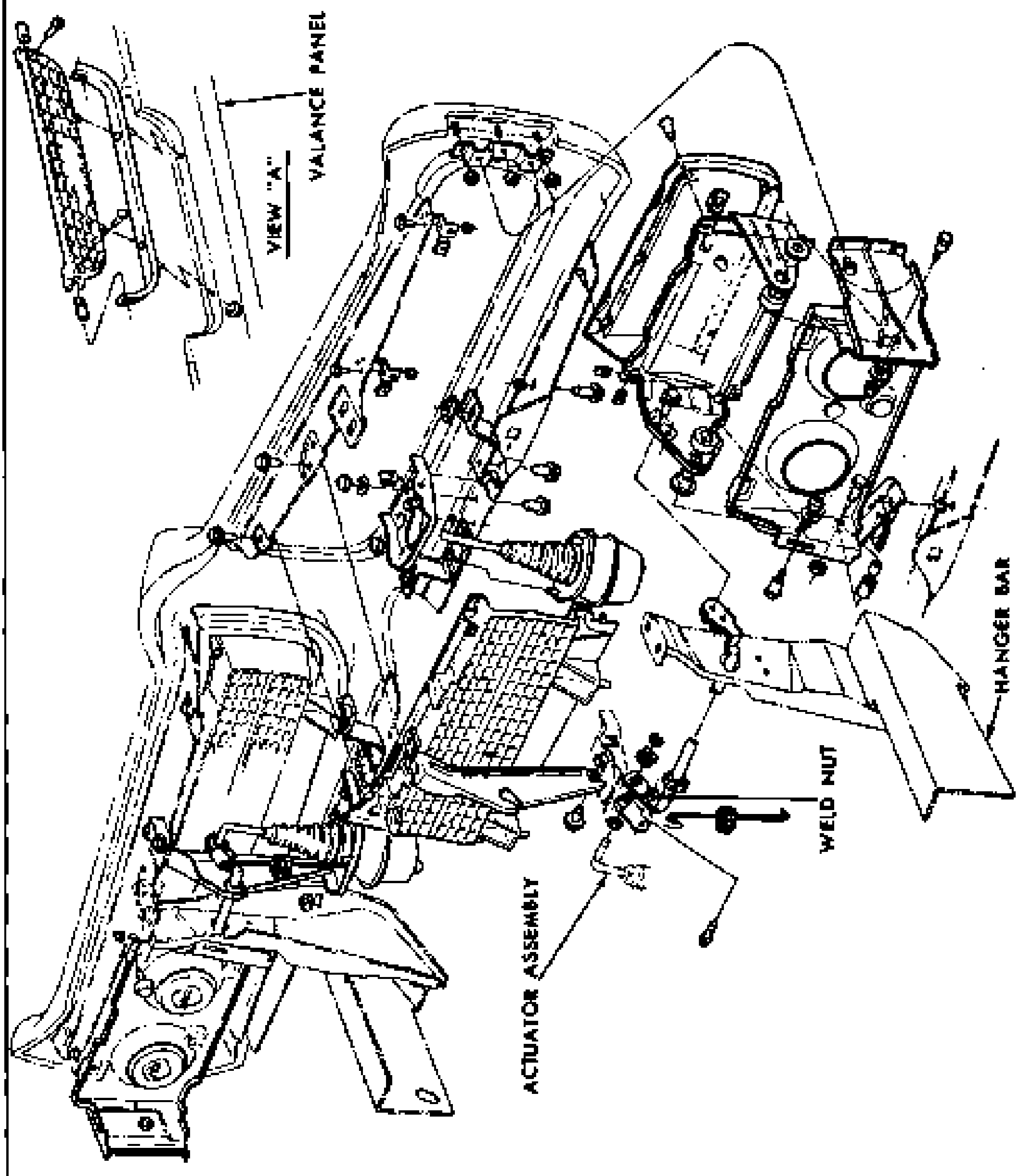


Fig. 14-18 GTO Grille and Headlight Mechanism

ACCESSORIES

CONTENTS OF THIS SECTION

ADJUSTMENT PROCEDURES

CHAIN LINKAGE ADJUSTMENT

1. Start engine and set carburetor to hot idle position.

2. Thread bead chain thru hole in carburetor lever extension (Fig. 15-2).

3. Adjust bead chain (at extension) to provide minimum chain slack and assemble clip to extension by straddling extension.

4. A minimum of two beads must extend outside of clip after adjustment of chain and installation of clip. Cut off excess chain.

BRAKE RELEASE SWITCH ADJUSTMENT (Fig. 15-3)

Apply brake pedal and push both switches forward as far as possible. Pull pedal forcibly rearward to adjust switches.

CENTERING SPRING ADJUSTMENT (Fig. 15-1)

1. If Cruise Control holds speed three or more mph higher than selected speed, turn centering spring adjusting screw (C) clockwise 1/8" turn or less.

2. If Cruise Control holds speed three or more mph below selected speed, turn centering spring adjusting screw (C) counterclockwise 1/8" turn or less.

CAUTION: Do not move adjustment screw (R). See below under DISASSEMBLY.

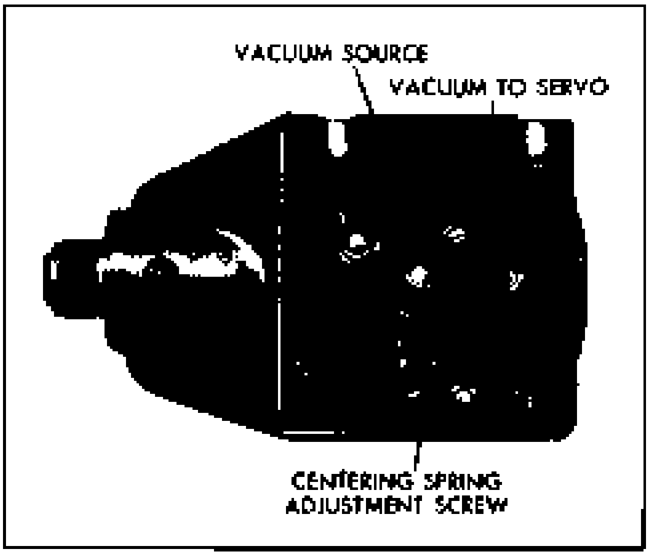


Fig. 15-1 Adjustment Screw Identification

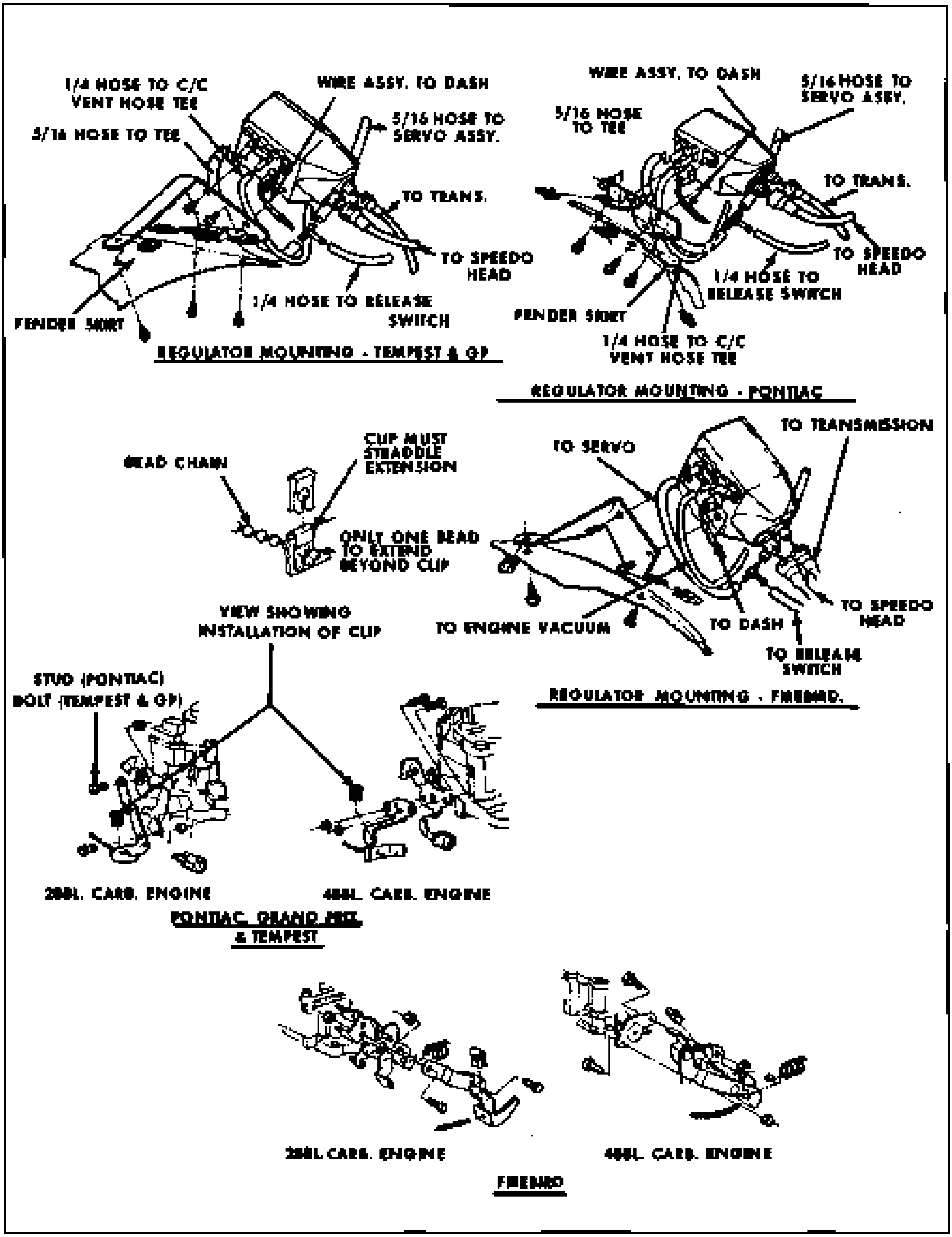


Fig. 15-2A Cruise Control Installation

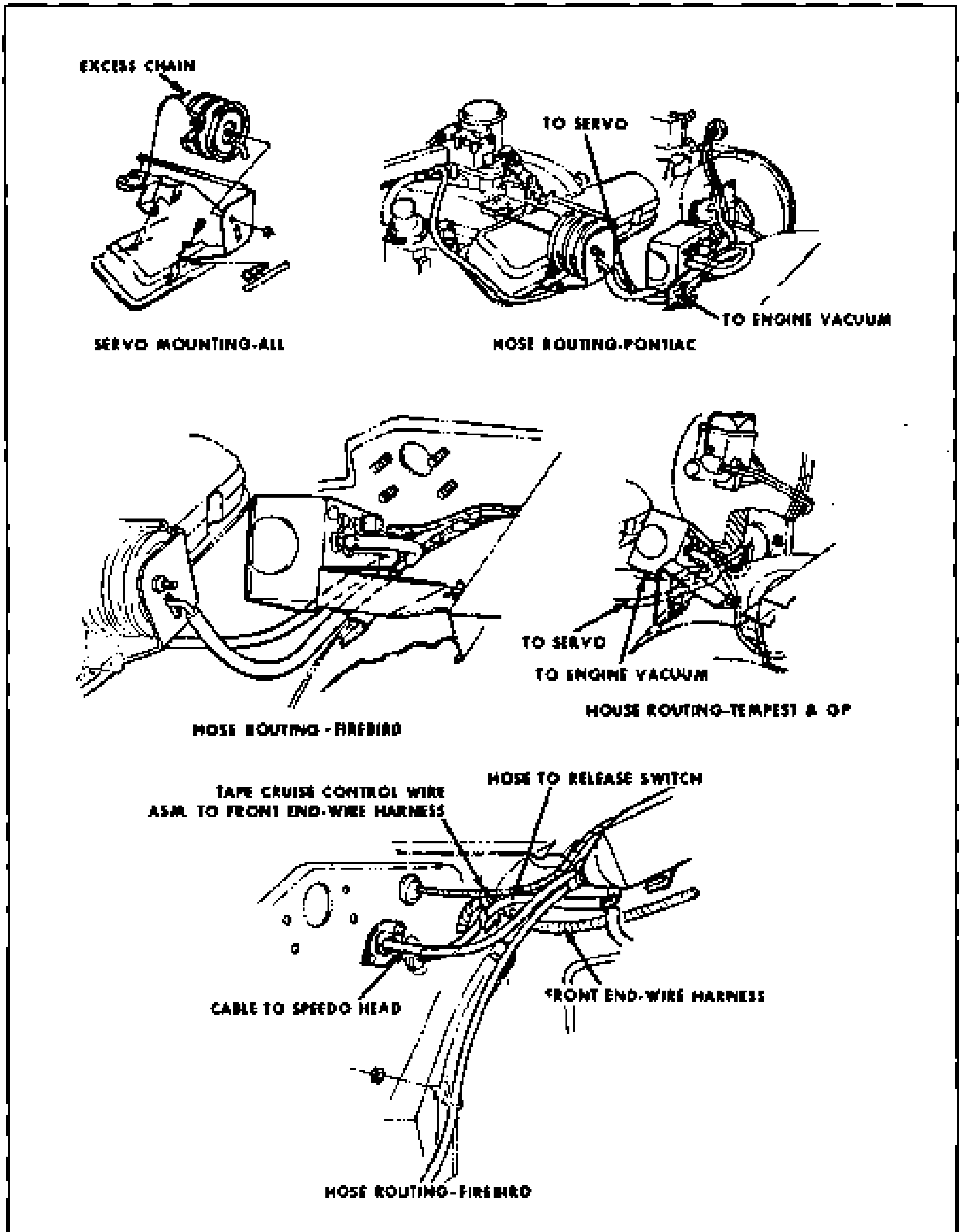


Fig. 15-28 Cruise Control Installation

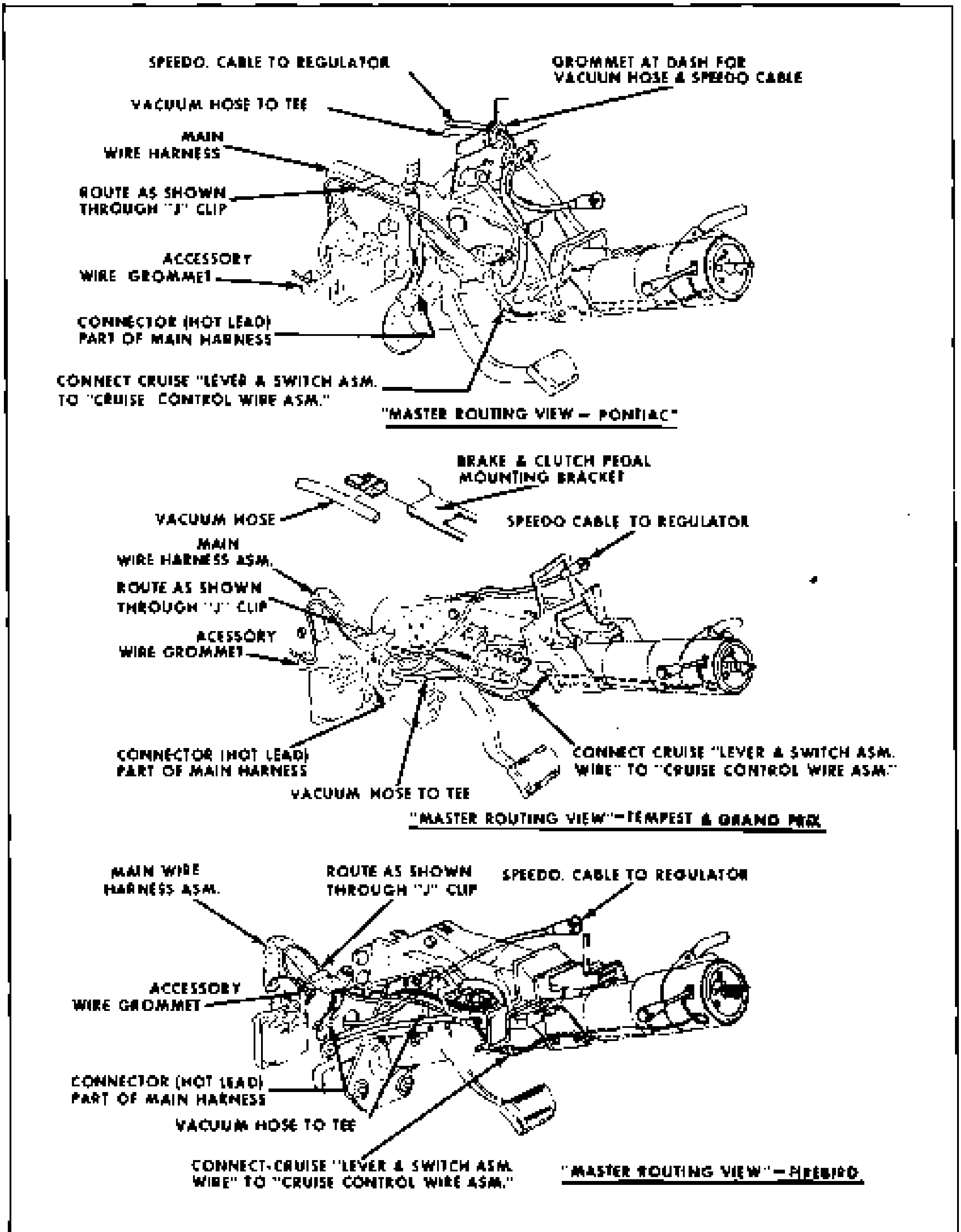


Fig. 15-3A Electrical Wiring and Vacuum Switch

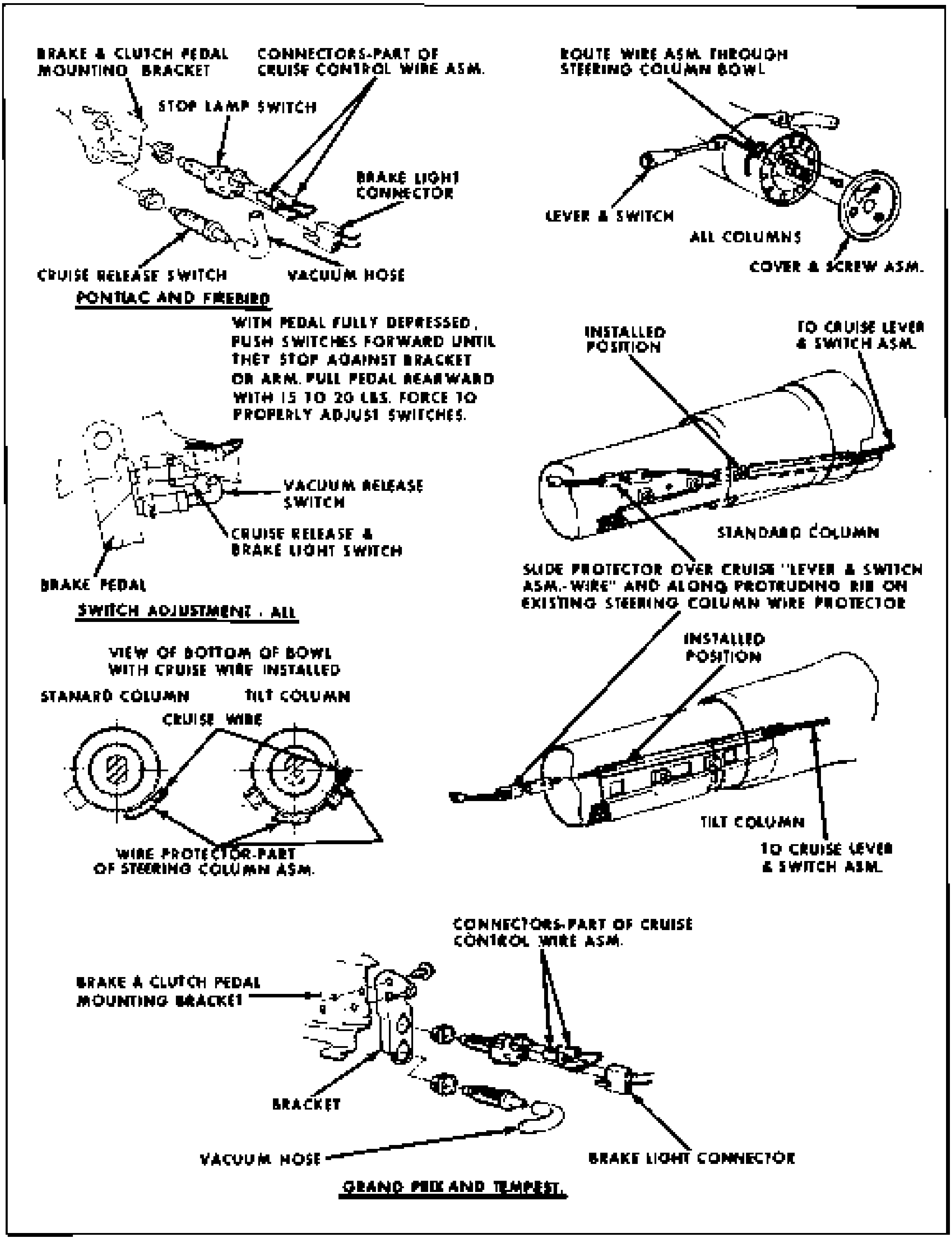


Fig. 15-38 Electrical Wiring and Vacuum Switch

MINOR SERVICE

CHECKING FOR DAMAGED CABLES AND GEARS

1. Raise rear of car and place on jack stands.

2. Start engine and move transmission shift lever to "Drive" range.

3. Remove input cable at regulator to determine if cable from transmission to regulator is turning. If cable is not turning, check for broken cable or stripped transmission speedometer gear.

4. If input cable is turning and speedometer was inoperative, cable to speedometer or regulator transfer gear is broken.

MAJOR SERVICE

REGULATOR - REMOVE AND REPLACE (Fig. 15-2)

1. Disconnect vacuum hoses and electrical connector.

2. Disconnect both speedometer cables.

3. Remove screws holding regulator to fender skirt and remove regulator.

4. To replace, reverse above steps. Note proper hookup of vacuum hoses shown in Fig. 15-2.

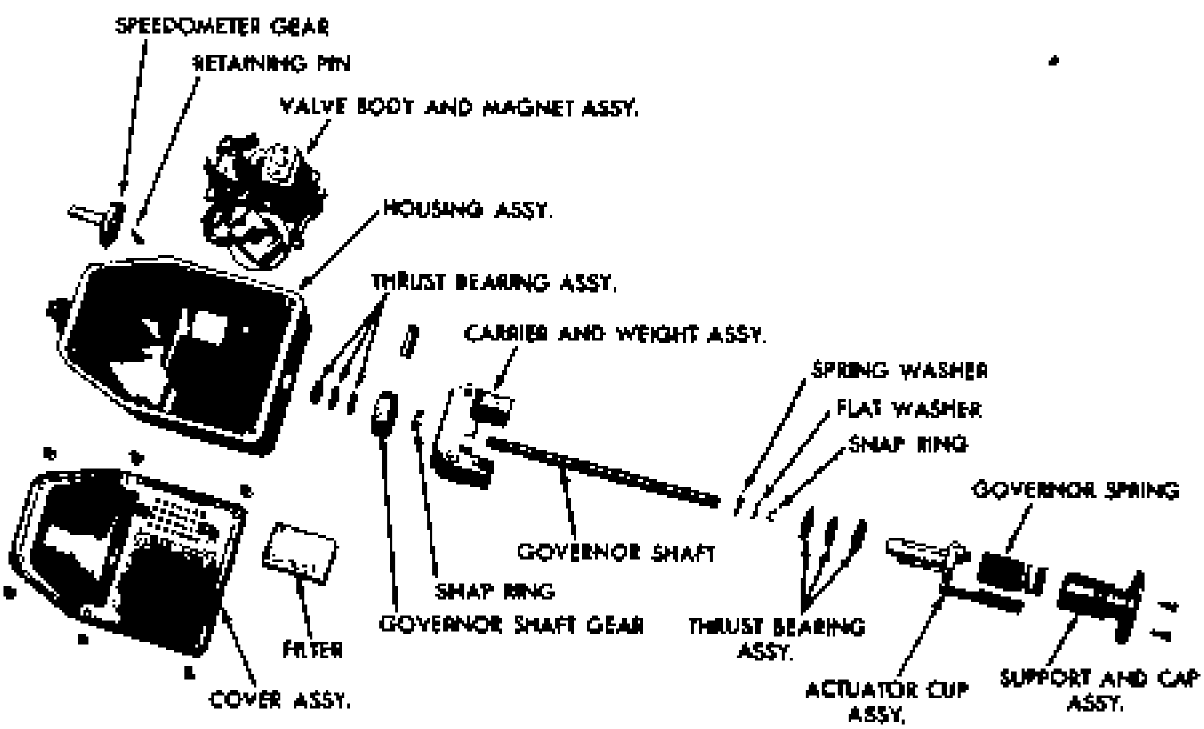


Fig. 15-4 Exploded View of Regulator

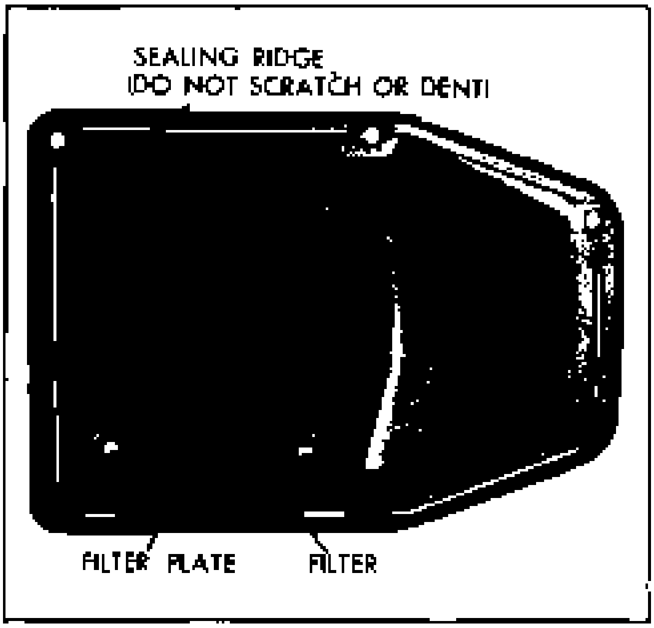


Fig. 15-5 Cover and Intake Filter Assembly

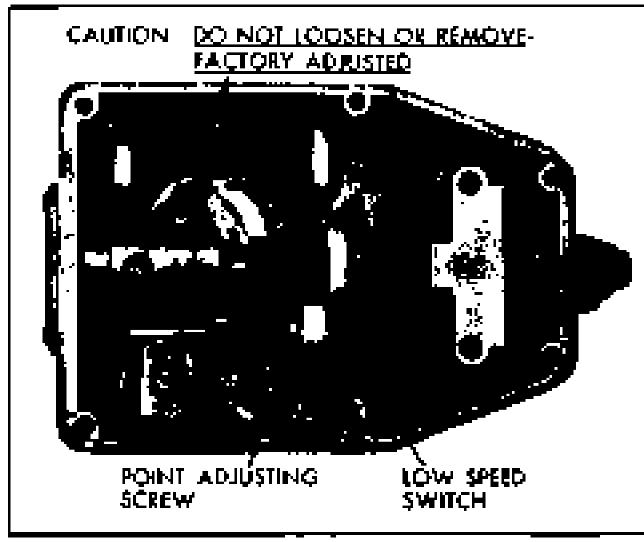


Fig. 15-6 Adjusting Low Speed Switch

REGULATOR - DISASSEMBLE (Fig. 15-4)

NOTE: Do not tamper with the following screws (Fig. 15-6).

a. Vacuum restriction screw in regulator housing.

b. The screw in the bearing support assembly.

c. The screw on top of the solenoid coil.

These screws are pre-adjusted at the factory.

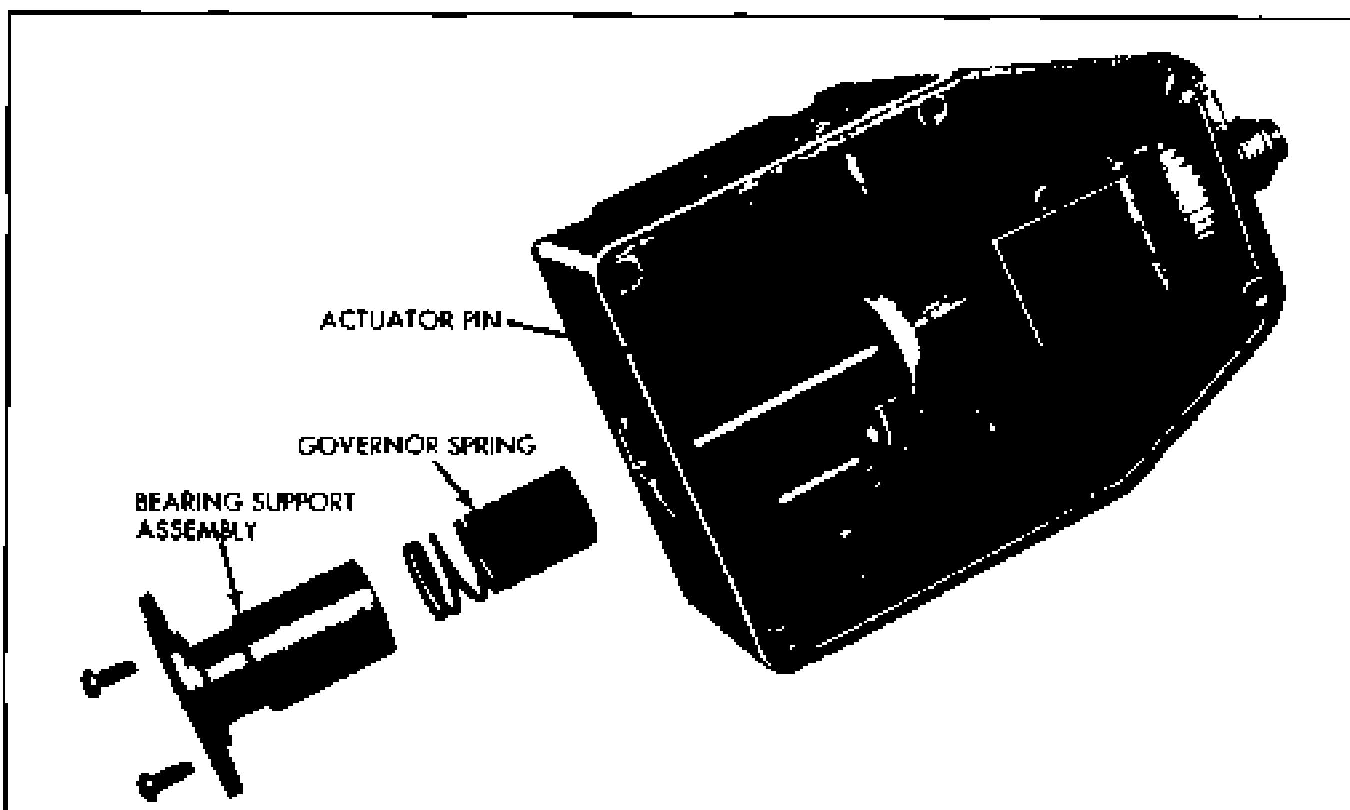


Fig. 15-7 Bearing Support - Removal

1. Remove screws and cover. To replace air filter in cover, push filter out from under filter plate (Fig. 15-5).

2. Remove two screws securing bearing support, rotate support 180° and slide out (Fig. 15-7).

NOTE: Do not tamper with screw on bearing support. This screw positions the governor spring and is pre-set at the factory.

3. Remove governor spring.

4. Spread governor weights in an up and down position and pry up on actuator coupling with a screwdriver until pin is disengaged from magnet assembly and can be rotated clockwise (Fig. 15-7). Rotate actuator cup 180° and hook the actuator coupling over the top of regulator housing (Fig. 15-8).

5. Slide the governor assembly away from the speedometer drive adapter end until the shaft is free of bearing. This will allow the governor assembly to be removed from the regulator. For further disassembly of governor, see Fig. 15-4.

6. Remove four screws (2 internal, 2 external) holding the valve body and magnet assembly. Remove valve body and magnet assembly from the regulator housing. (Fig 15-9).

7. Remove driven gear from regulator by pressing retaining pin out of regulator body.

REGULATOR - REASSEMBLE

1. Install driven gear and retaining pin in housing.

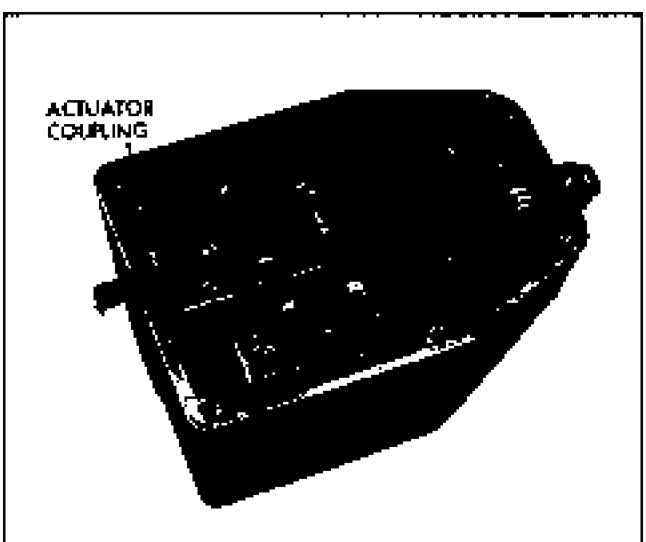


Fig. 15-8 Governor Assembly - Removal

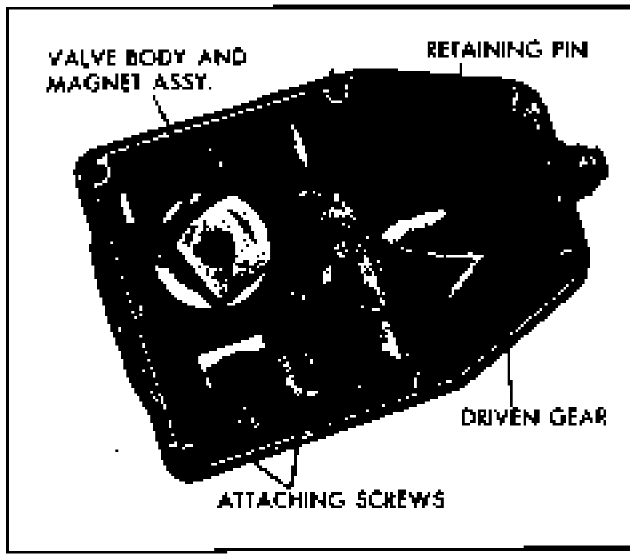


Fig. 15-9 Valve Body and Magnet Assy. - Removal

2. Insert valve body and magnet assembly into the regulator housing and install four screws.

NOTE: Make sure the rubber gasket on the bottom of the valve body and magnet assembly lies flat against the regulator housing. Under no circumstances should this gasket be glued to the valve body and magnet assembly.

3. With weights in an up and down position, insert the long end of the governor shaft through the bearing support mounting hole keeping the actuator coupling hooked over the regulator housing. Insert the shaft far enough to allow the short end of the governor to be inserted into its bearing. Slide the governor assembly into the bearing until it bottoms.

4. Move the actuator cup down the shaft until it bottoms and rotate 180°. Using a screwdriver, pry the actuator coupling up and rotate the magnet counterclockwise until the pin engages the actuator coupling hole.

5. Install governor spring over governor shaft with closed end of spring toward the actuator cup.

6. Install bearing support in regulator. Rotate 180° and secure with two (2) screws.

7. Secure cover with six (6) screws.

NOTE: When the valve body and magnet assembly or the governor assembly is replaced, the low speed switch must be adjusted. With the actuator cup held in the lowest speed position (governor weights in) turn point adjusting screw until the gap between the switch points is .025" (Fig. 15-6).

Refer to Section 9 of this manual for service of the engagement switch.

ELECTRIC CLOCK

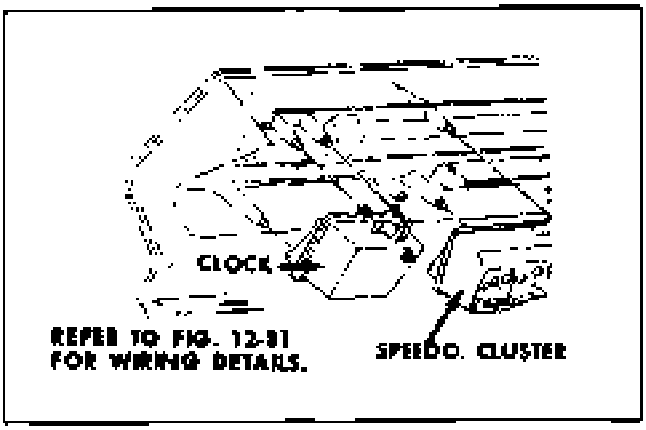


Fig. 15-10 Clock Installation - Pontiac

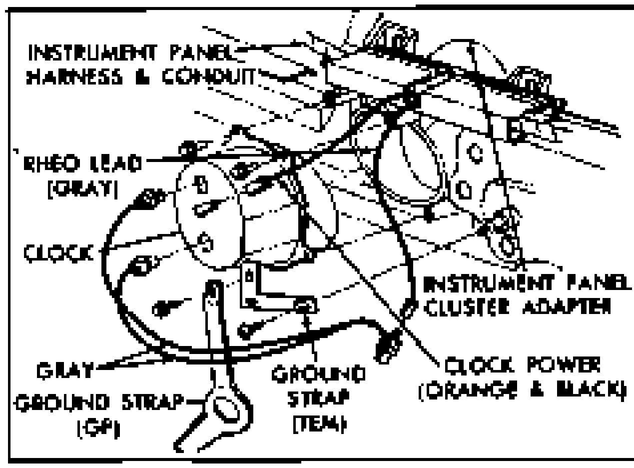


Fig. 15-11 Clock Installation - Tempest and Grand Prix

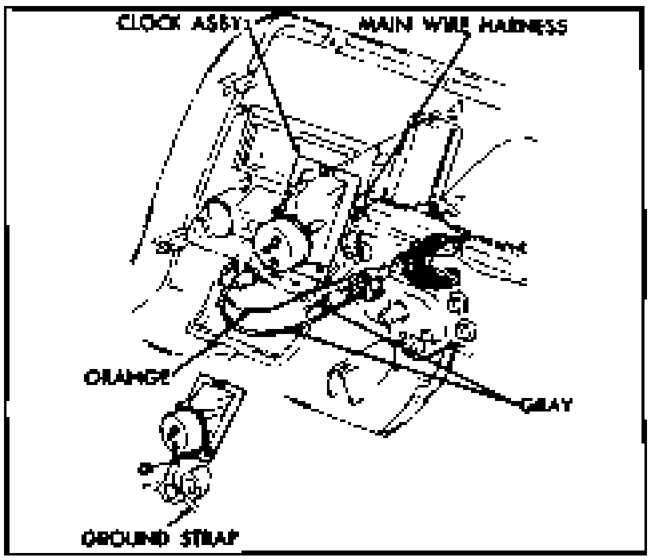


Fig. 15-12 Clock Installation - Firebird

SAFEGUARD SPEEDOMETER

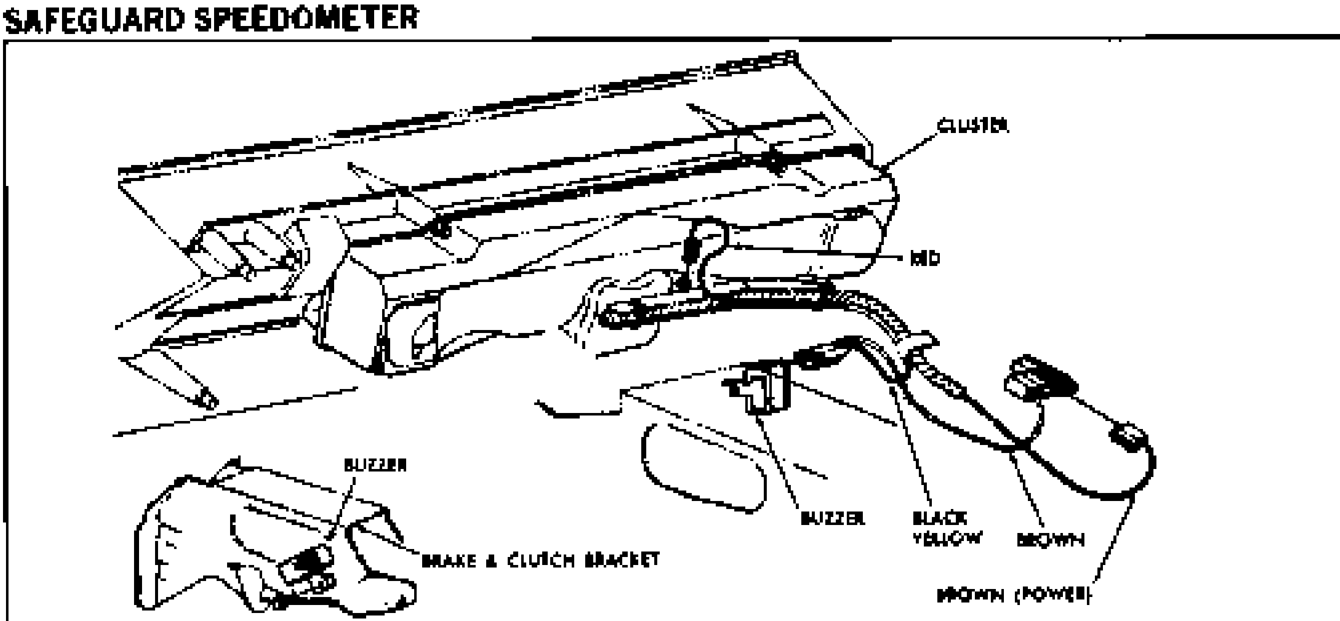


Fig. 15-13 Safeguard Speedometer - Pontiac

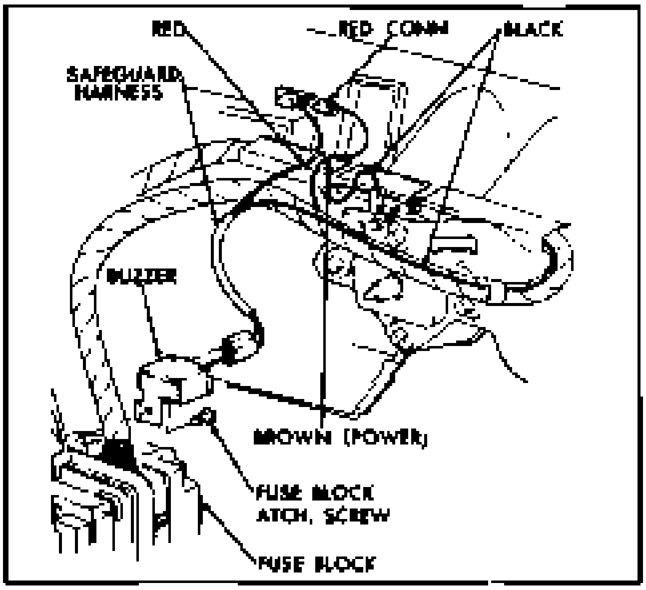


Fig. 15-14 Safeguard Speedometer - Except Pontiac

RALLY GAGES

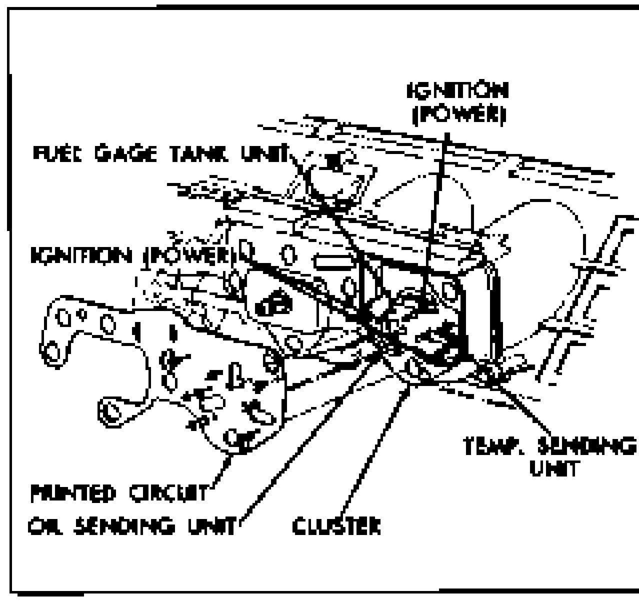


Fig. 15-15 Rally Gages - Firebird

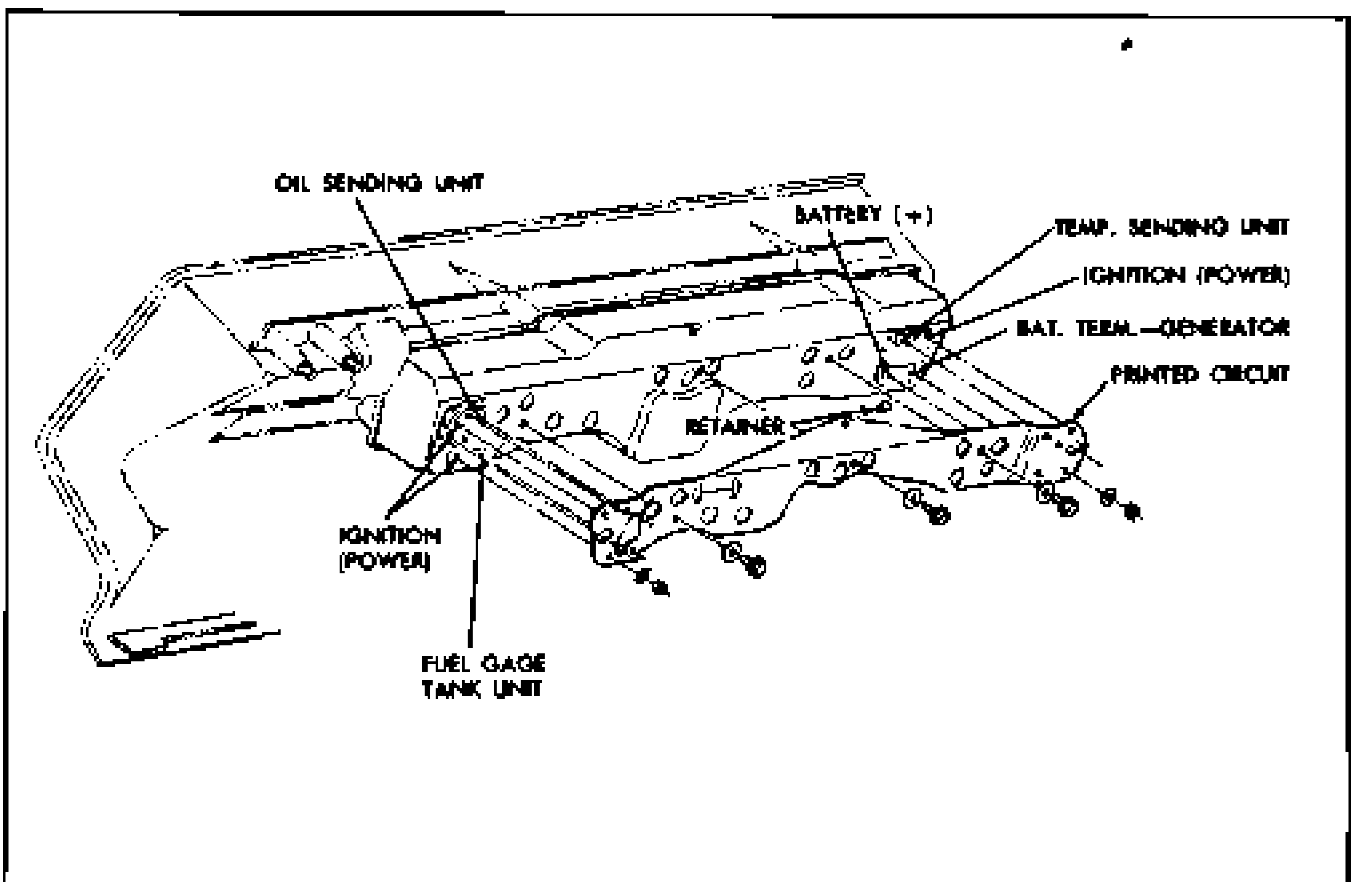


Fig. 15-16 Rally Gages - Pontiac

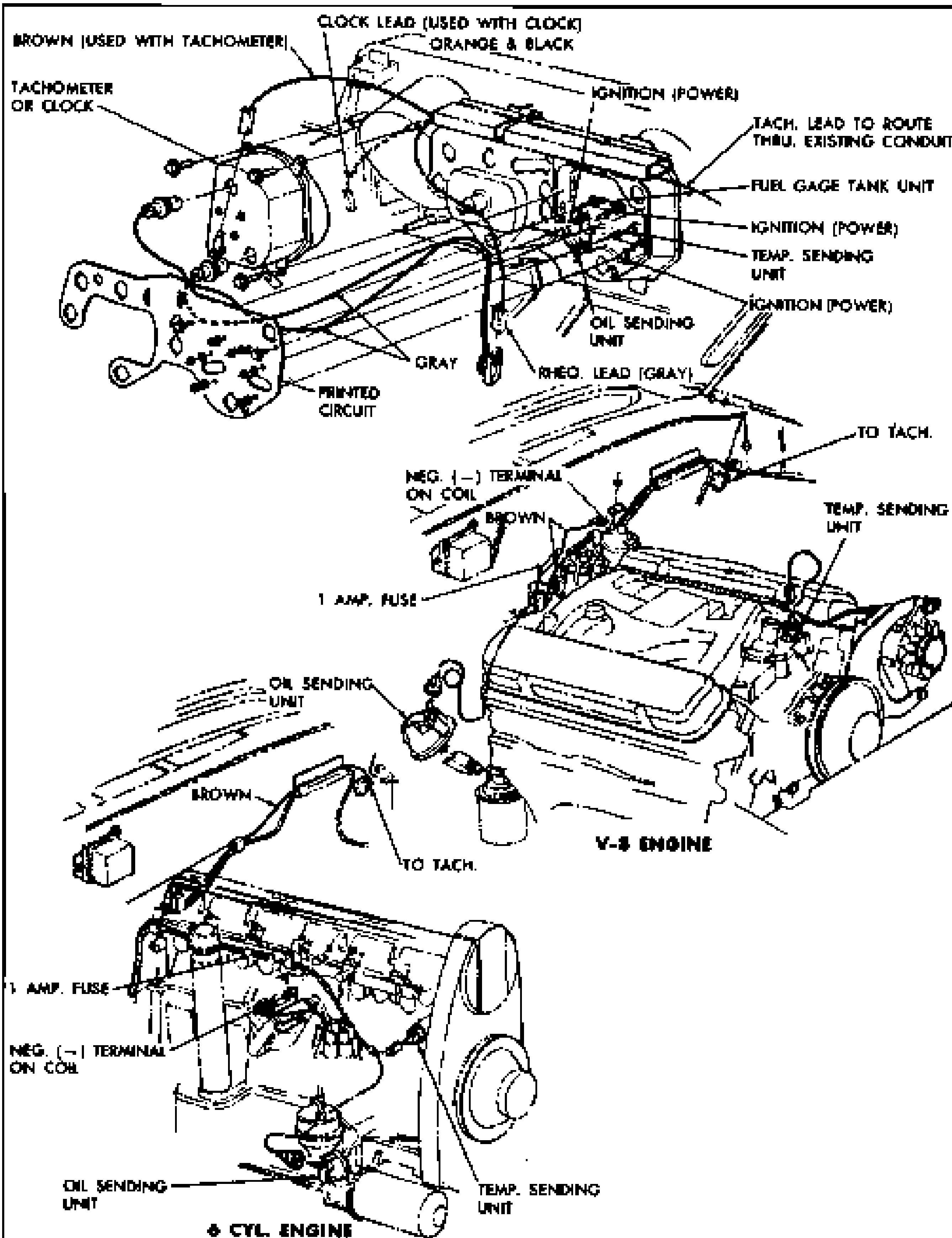


Fig. 15-17 Rally Gages - Tempest and Grand Prix

HOOD MOUNTED TACHOMETER

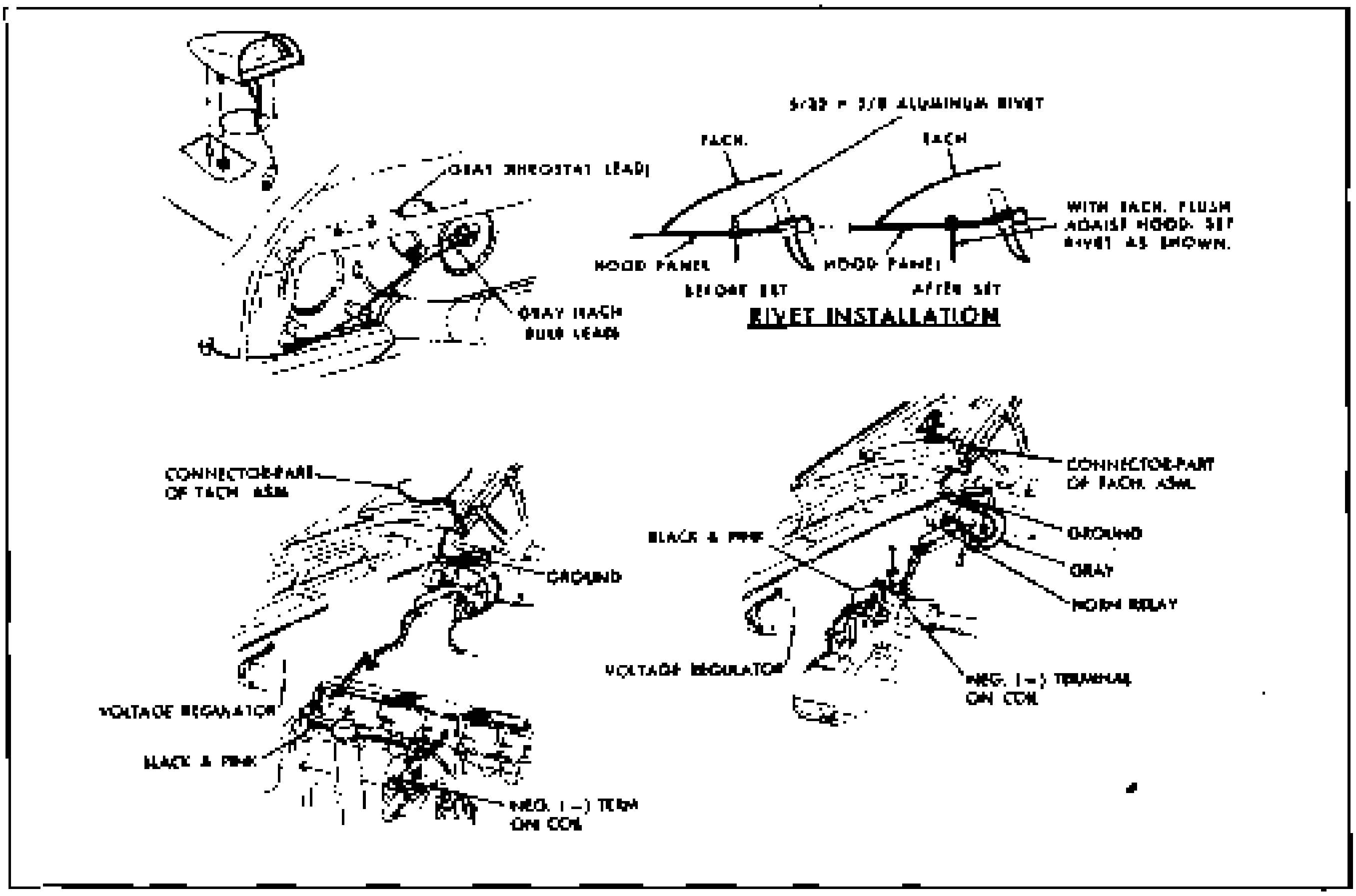


Fig. 15-18 Hood Mounted Tachometer - Tempest

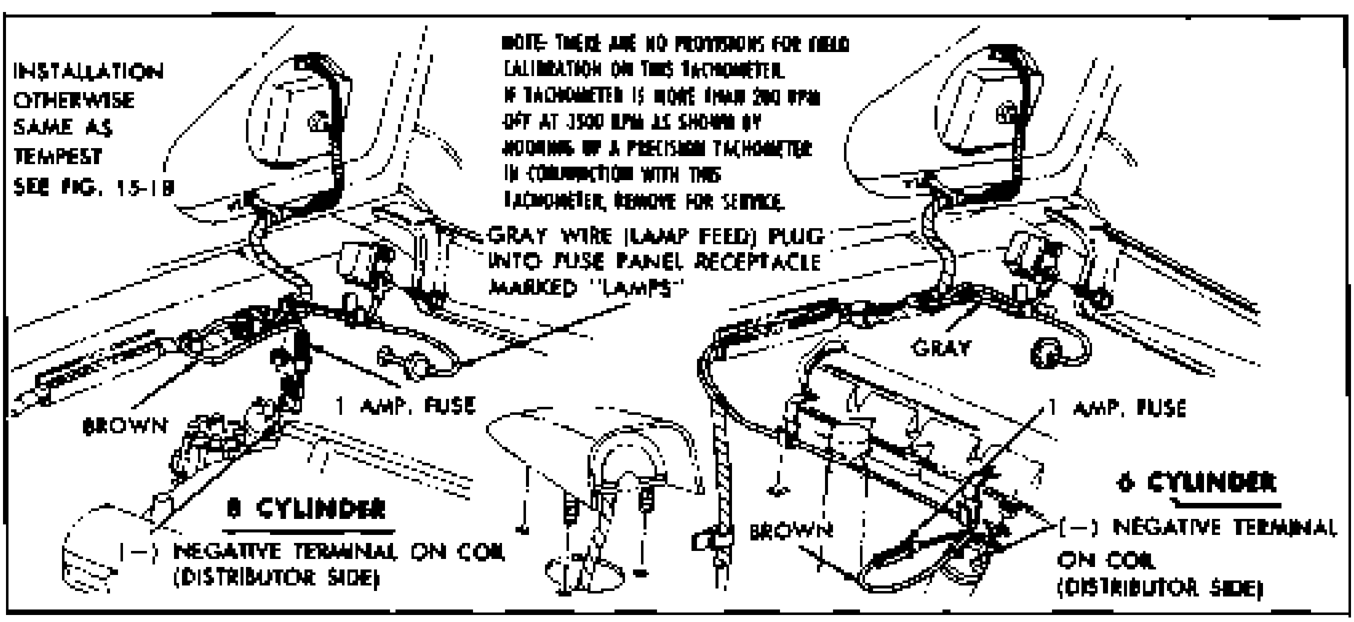


Fig. 15-19 Hood Mounted Tachometer - Firebird

DECK LID RELEASE

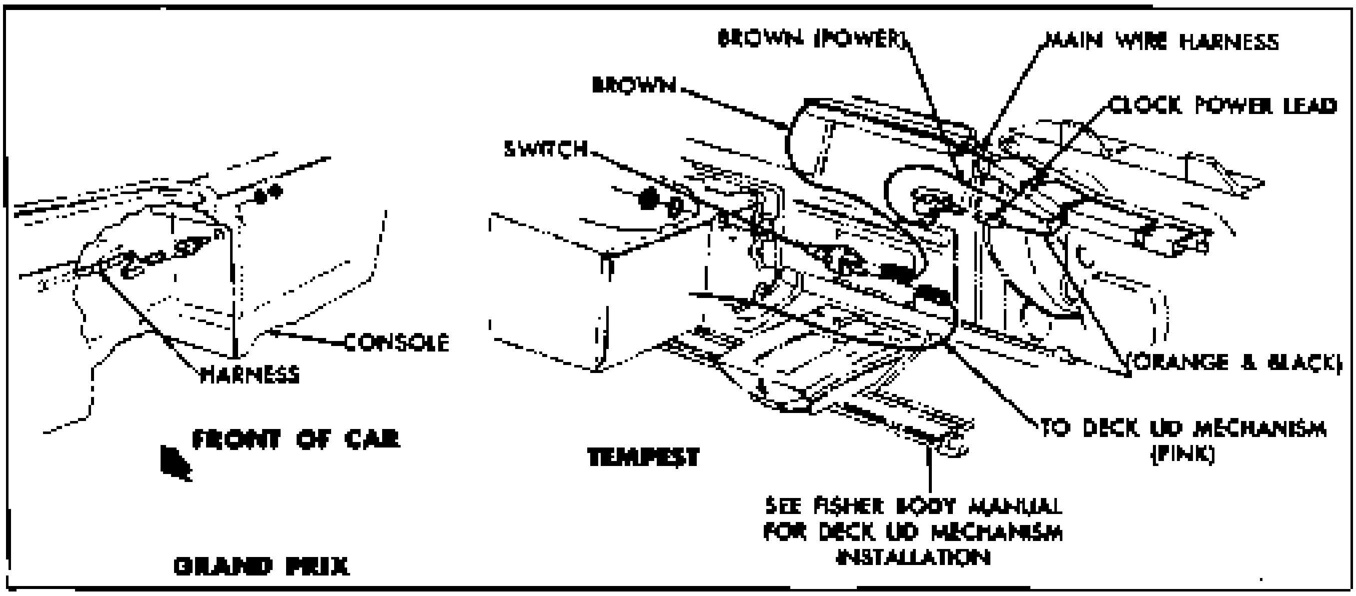


Fig. 15-20 Deck Lid Release - Tempest and Grand Prix

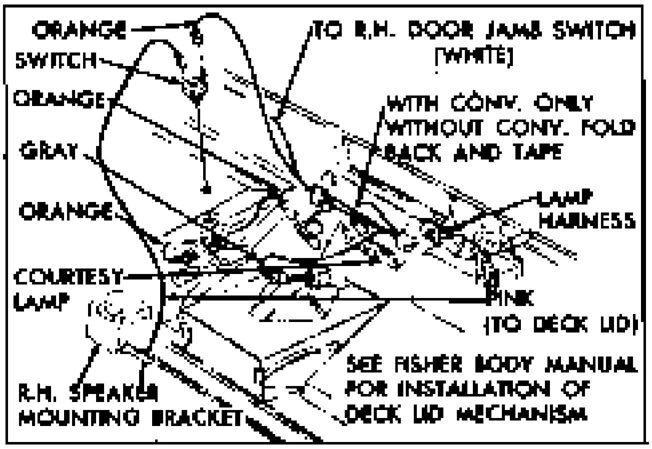


Fig. 15-21 Deck Lid Release - Pontiac

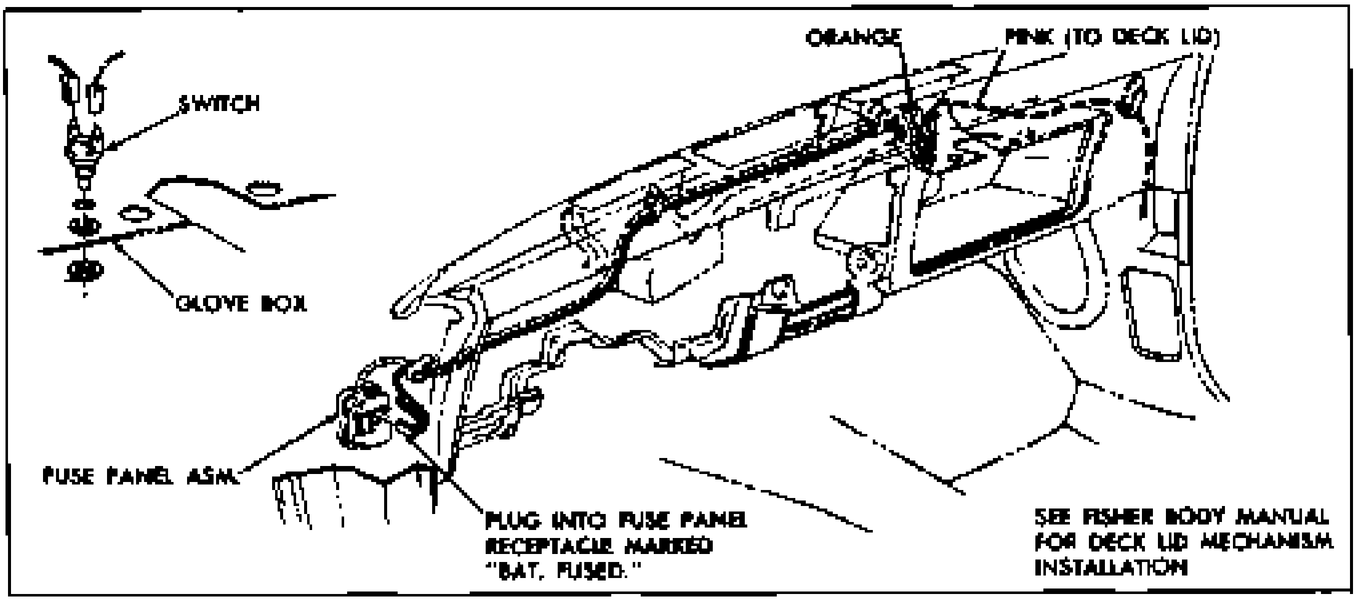


Fig. 15-22 Deck Lid Release - Firebird

VACUUM DOOR LOCKS

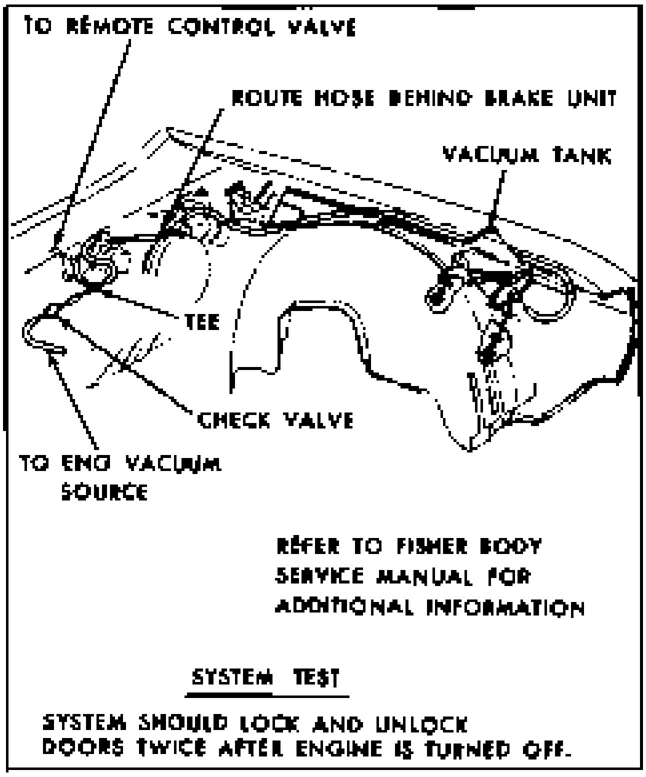


Fig. 15-23 Vacuum Door Locks - Pontiac

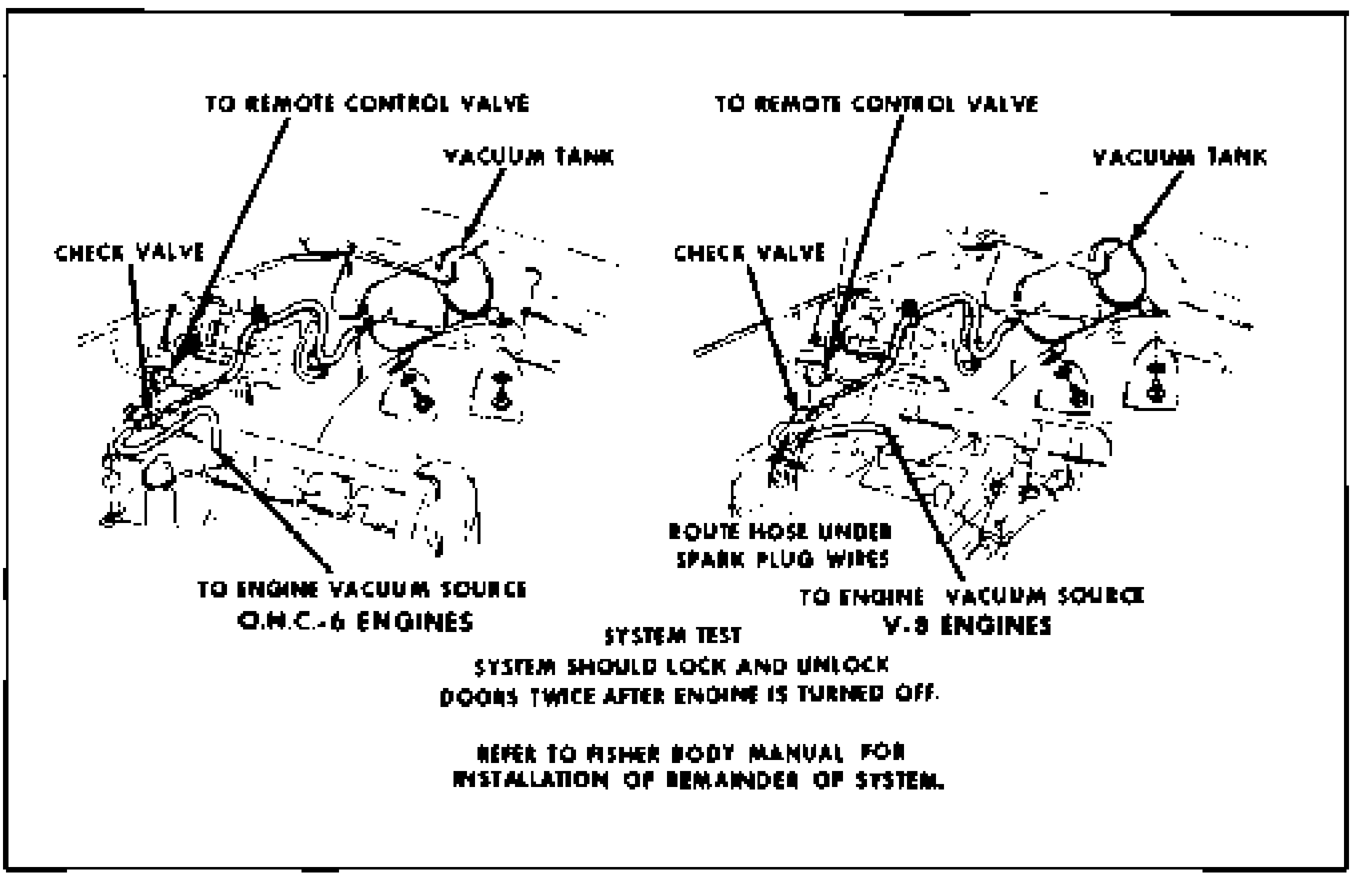


Fig. 15-24 Vacuum Door Locks - Tempest and Grand Prix

VACUUM TIRE PUMP

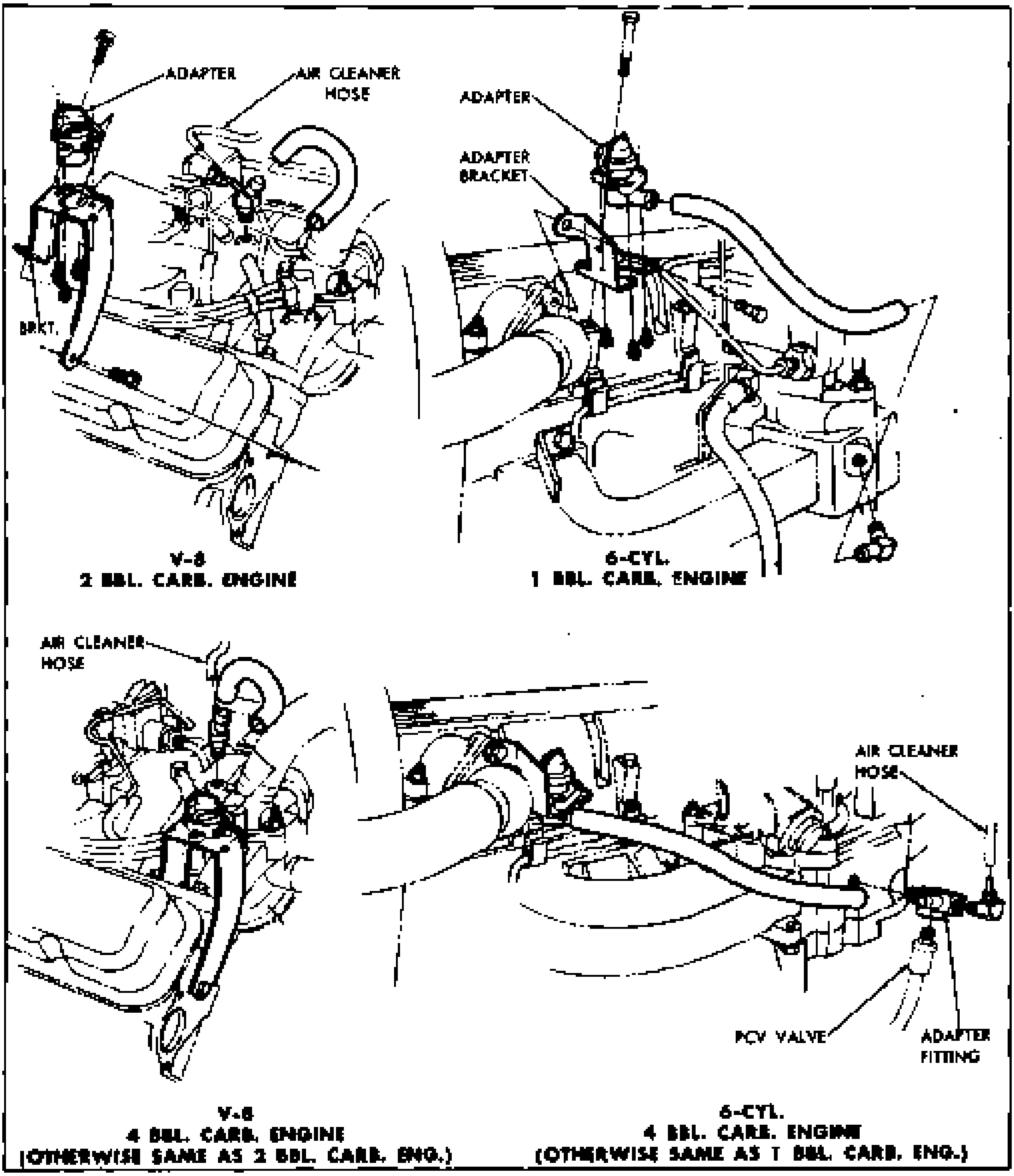


Fig. 15-25 Vacuum Tire Pump - All

REAR WHEEL OPENING COVER

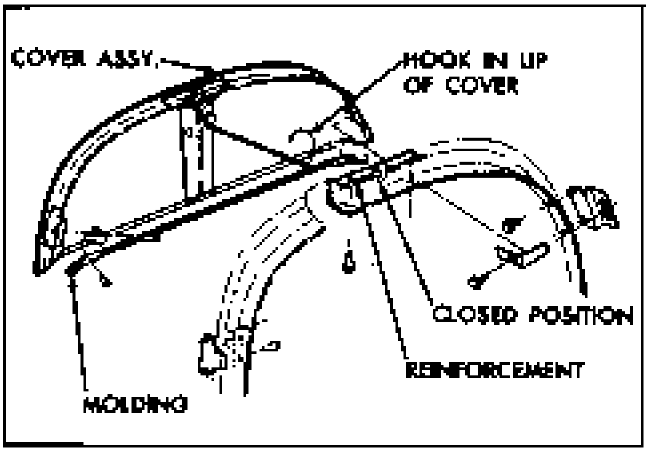


Fig. 15-26 Rear Wheel Opening Cover - Pontiac

ACCESSORY SWITCH CUTOUTS

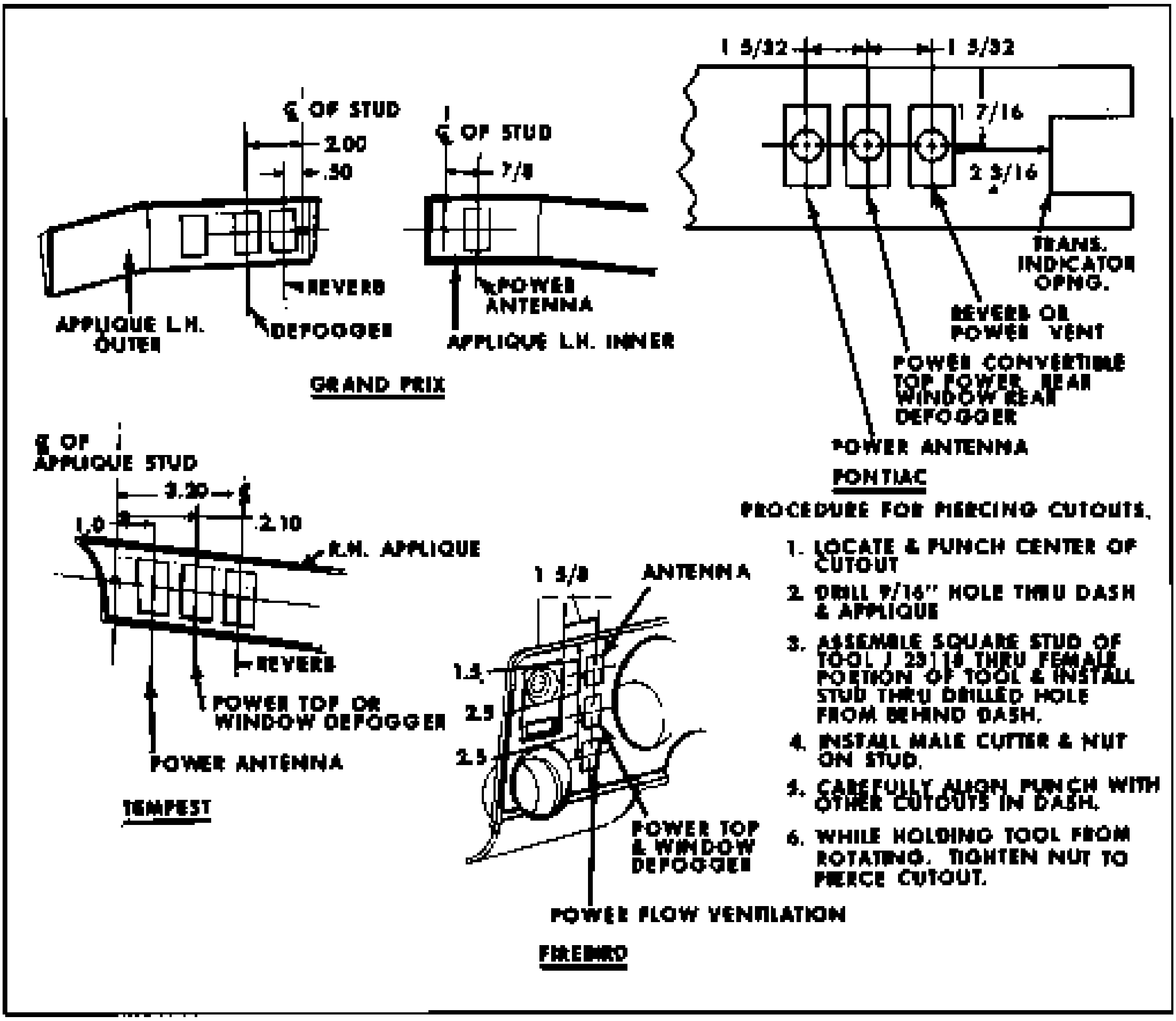


Fig. 15-27 Accessory Switch Cutouts - All

REAR WINDOW DEFOGGER

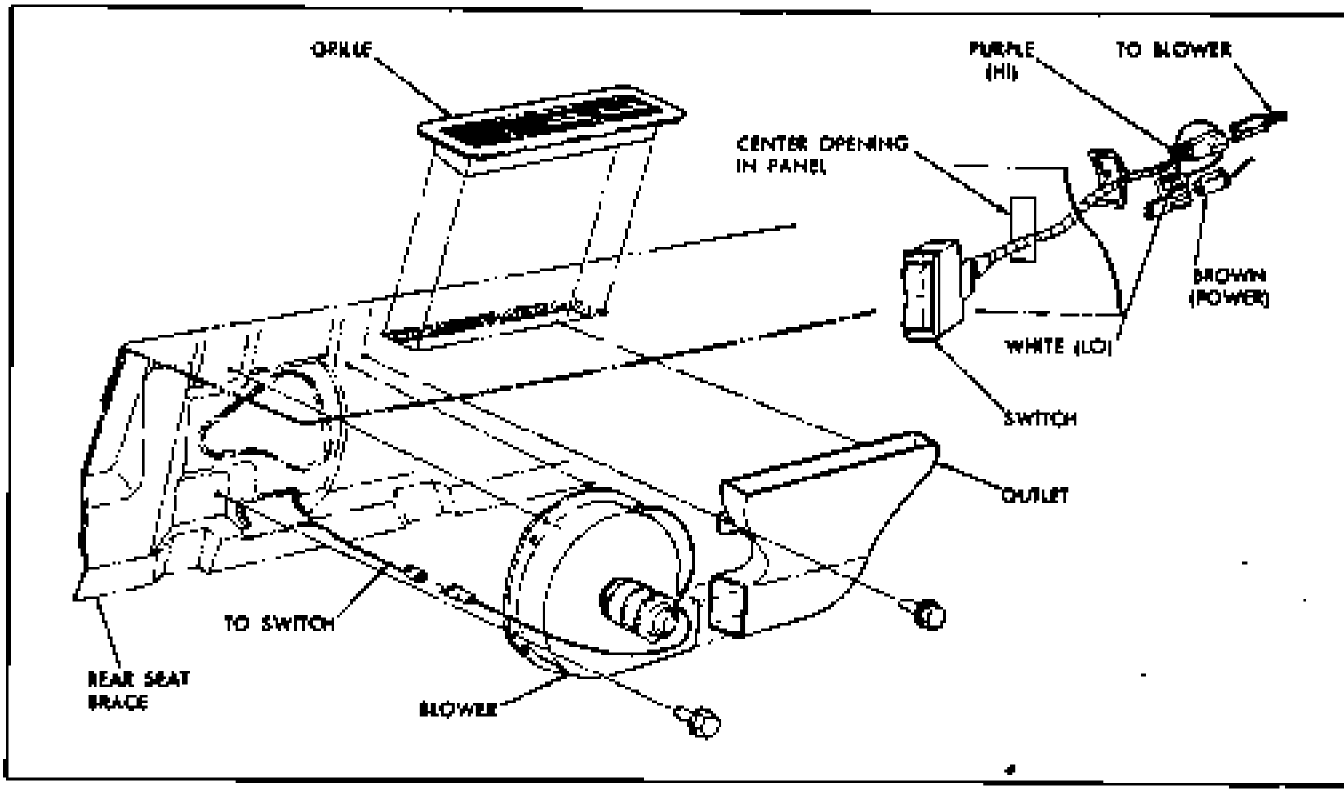


Fig. 15-28 Rear Window Defogger - Pontiac

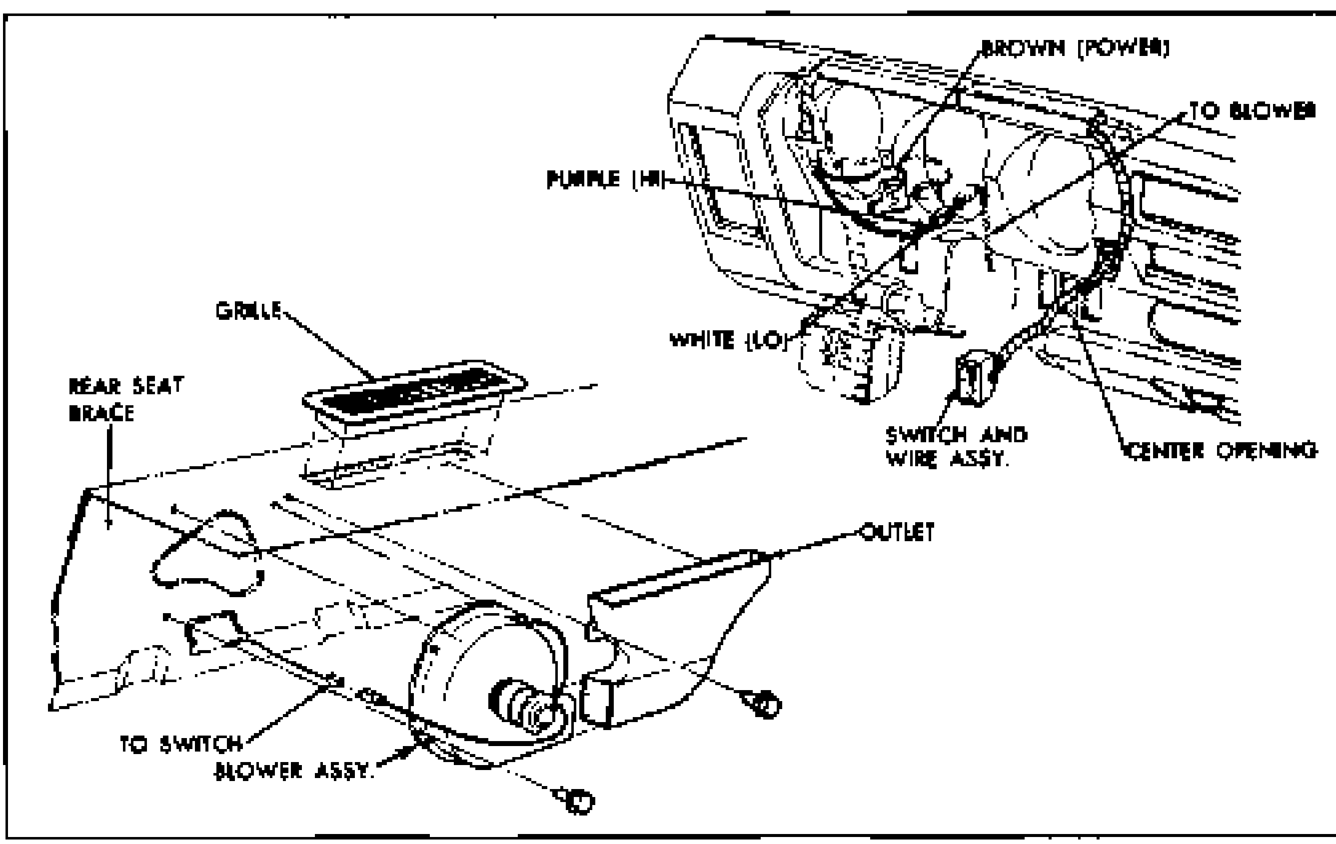


Fig. 15-29 Rear Window Defogger - Tempest

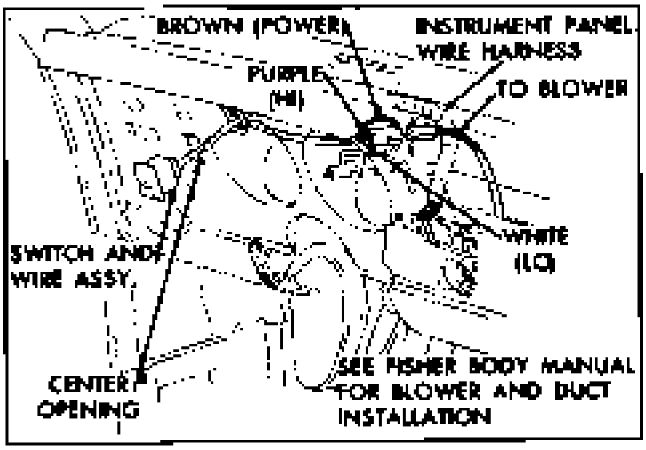


Fig. 15-30 Rear Window Defogger - Firebird

HEATED REAR WINDOW

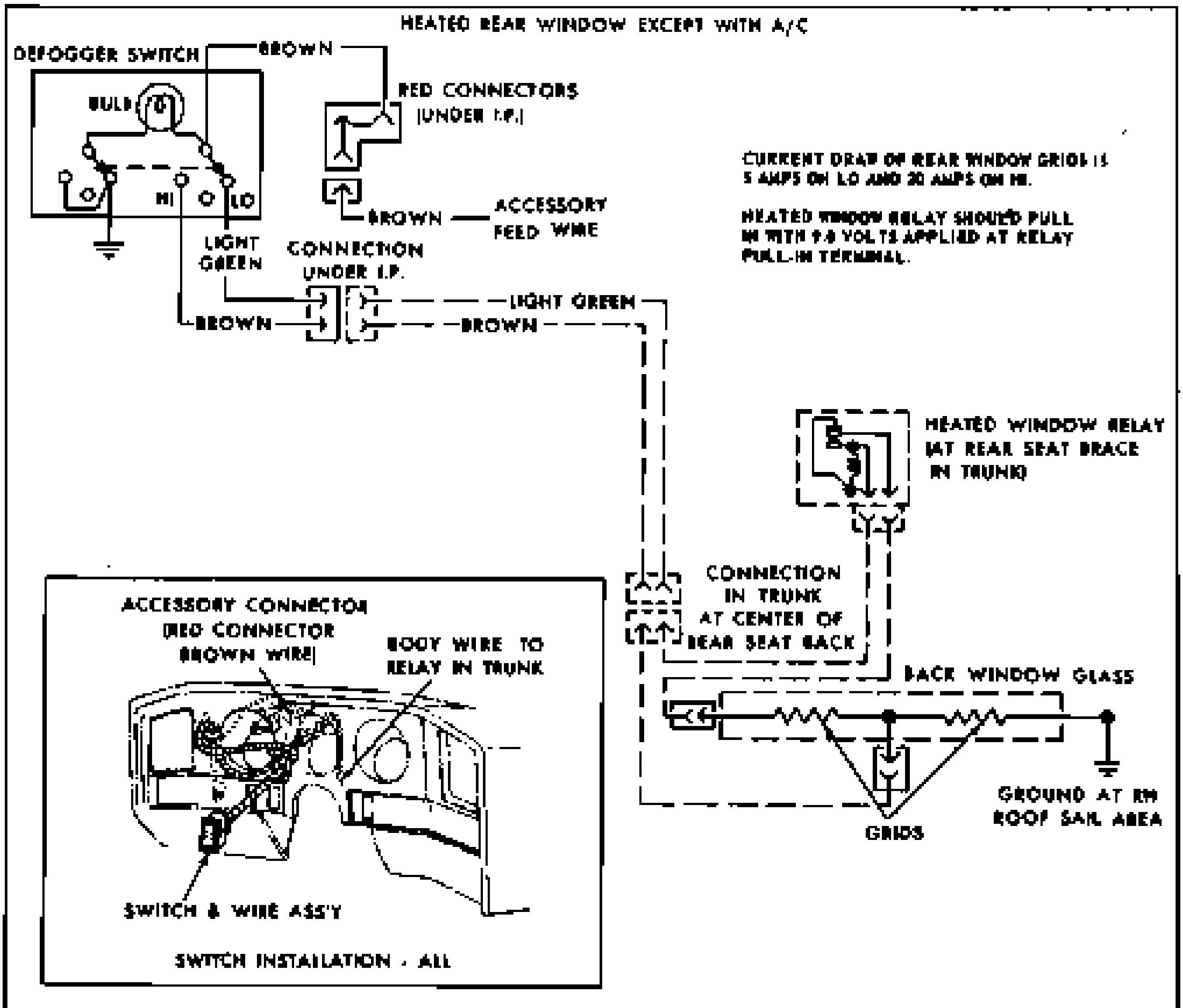


Fig. 15-31 Heated Rear Window - Grand Prix

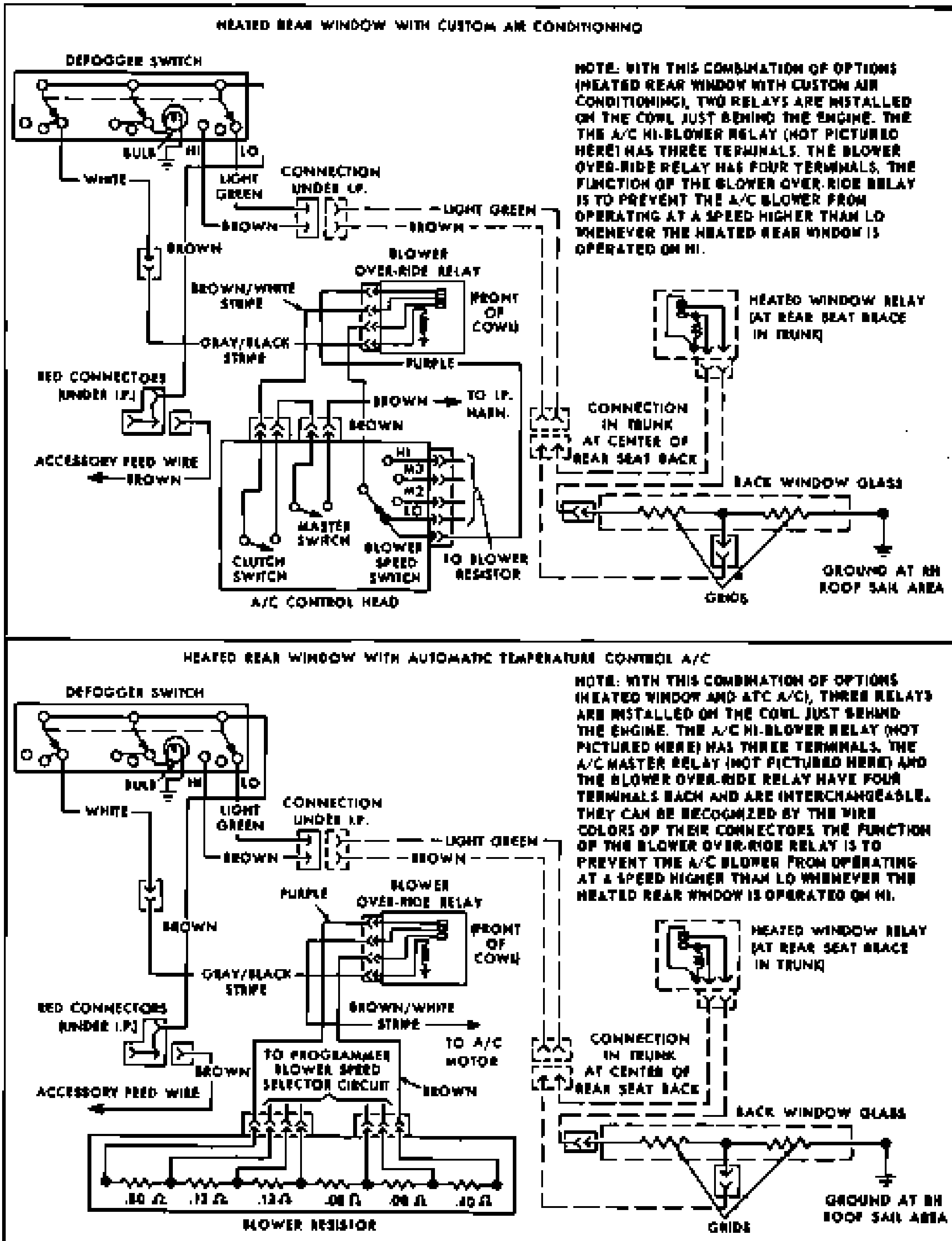


Fig. 15-32 Heated Rear Window - Grand Prix

CORNERING LAMPS

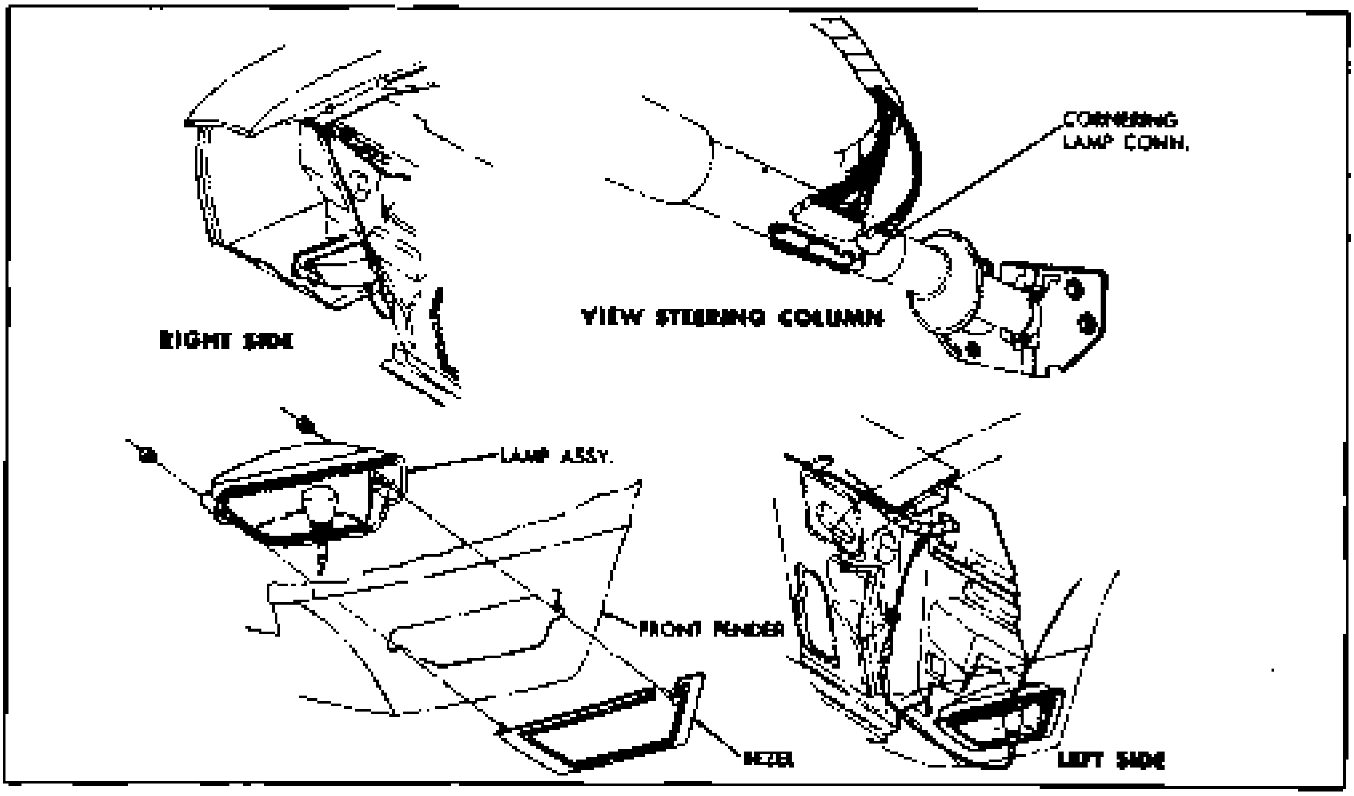


Fig. 15-33 Cornering Lamps - Pontiac

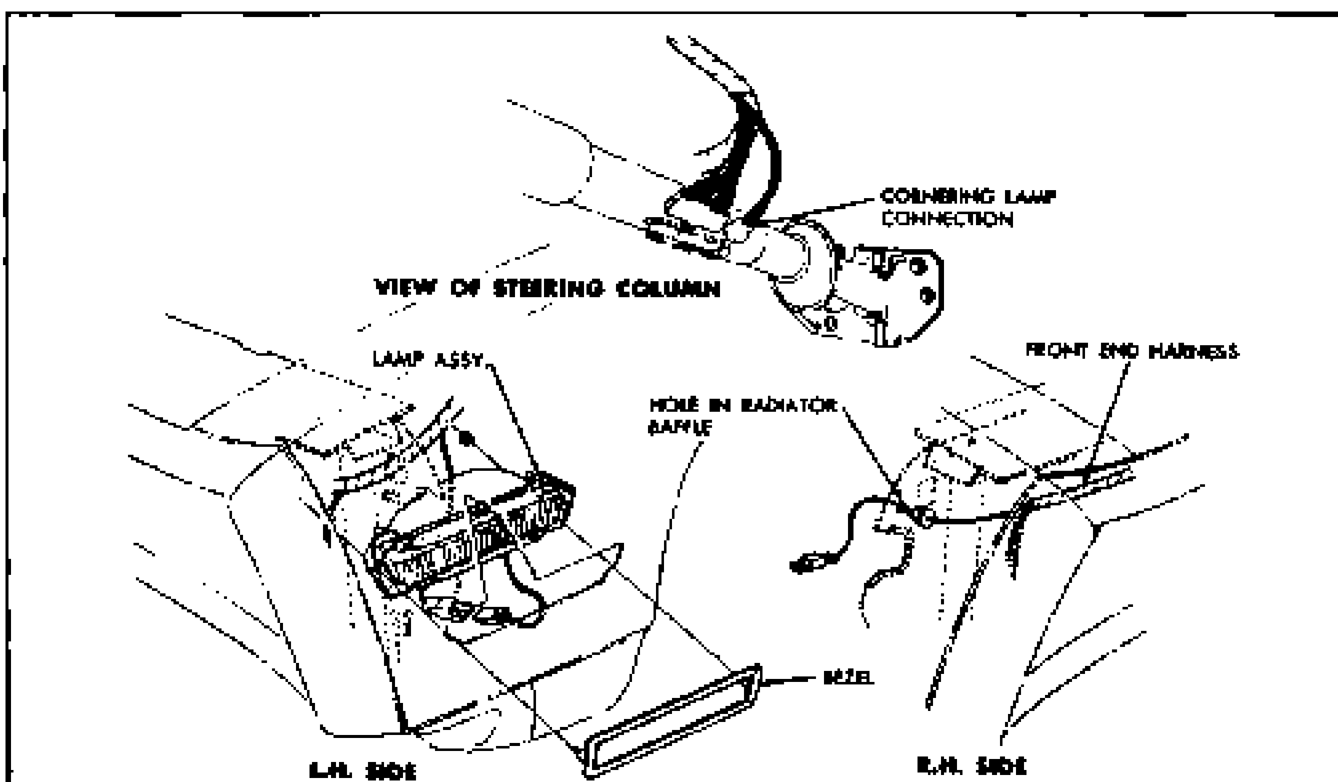


Fig. 15-34 Cornering Lamps - Tempest

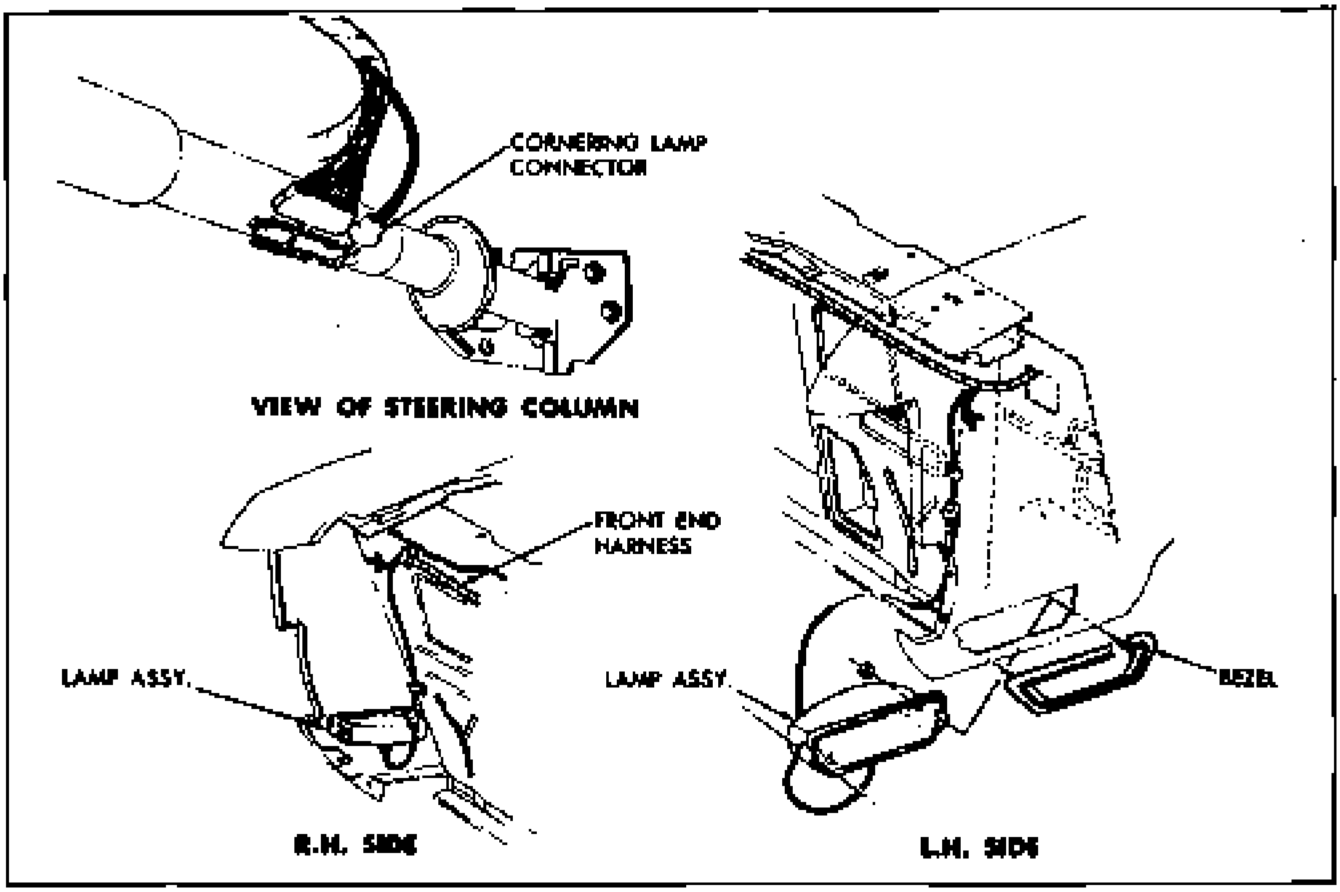


Fig. 15-35 Cornering Lamps - Grand Prix

UNDERHOOD LAMP

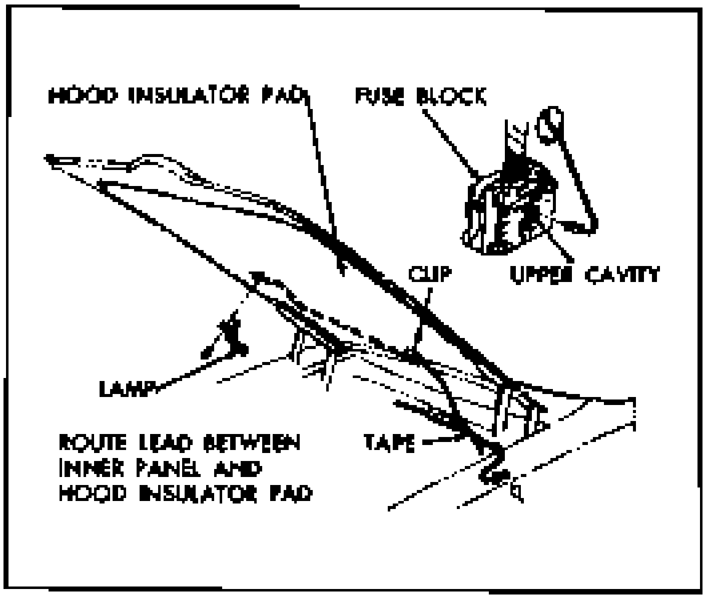


Fig. 15-36 Underhood Lamp - Firebird

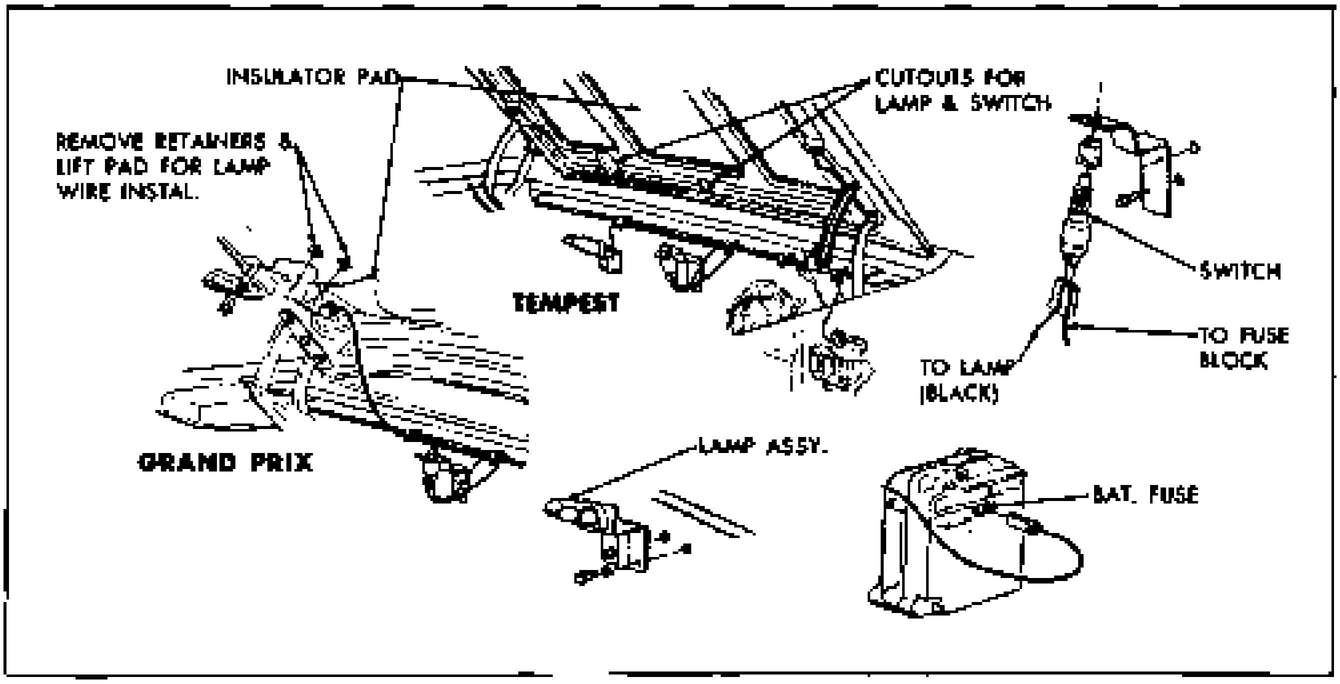


Fig. 15-37 Underhood Lamp - Tempest and Grand Prix

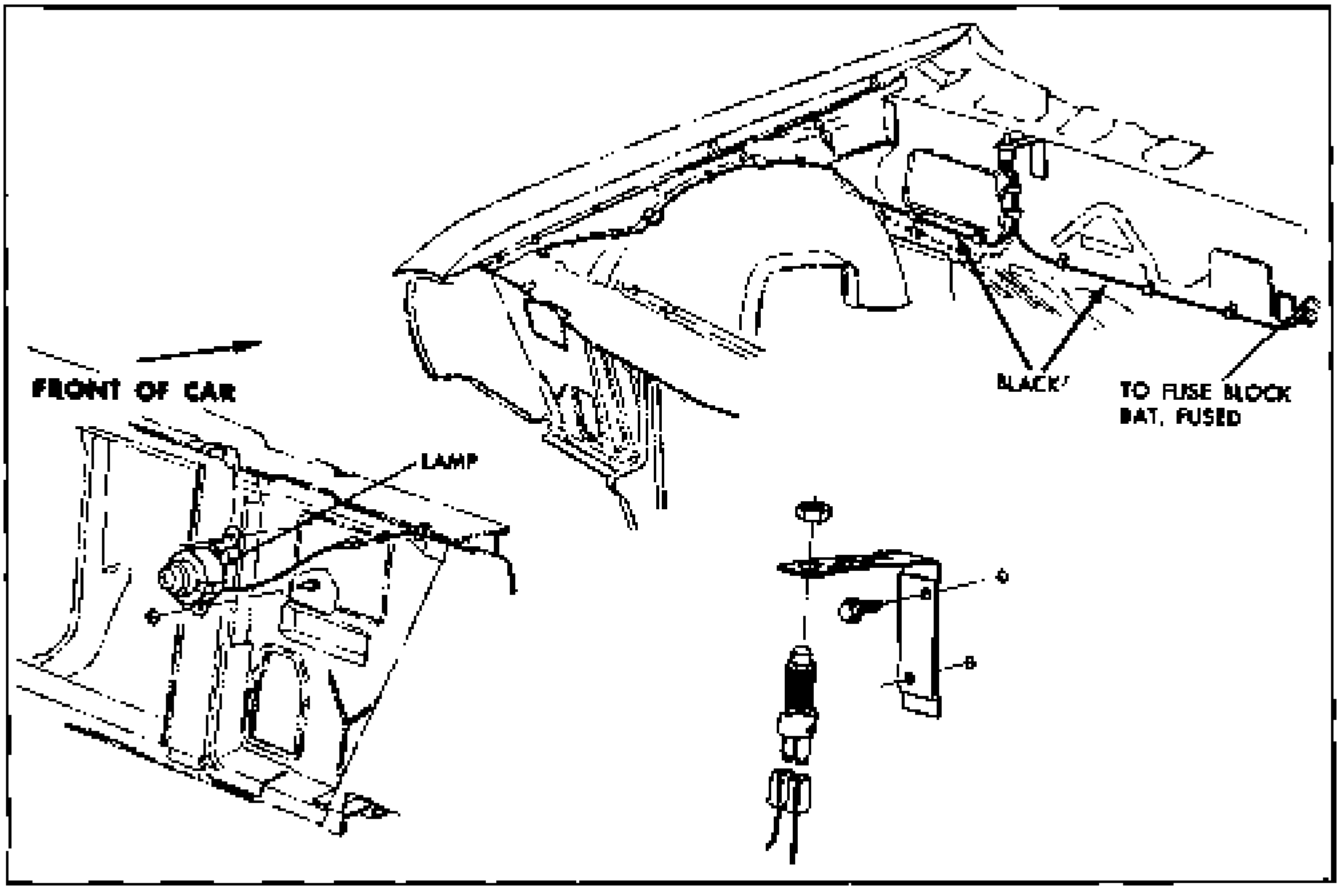


Fig. 15-38 Underhood Lamp - Pontiac

LUGGAGE LAMP

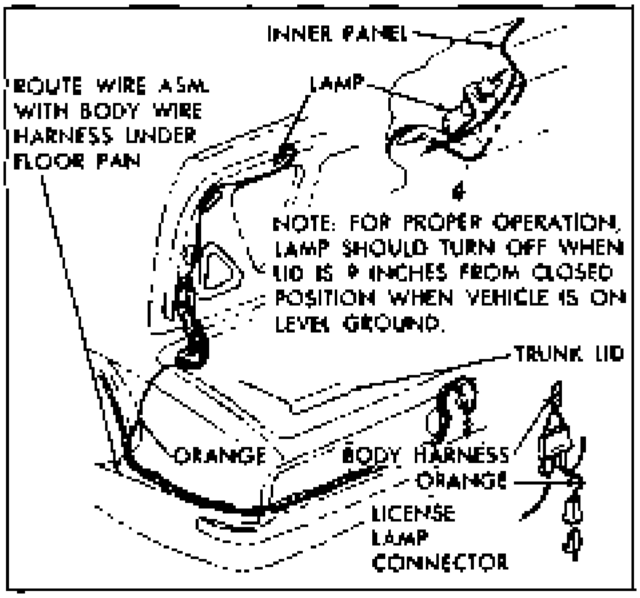


Fig. 15-39 Luggage Lamp - Firebird

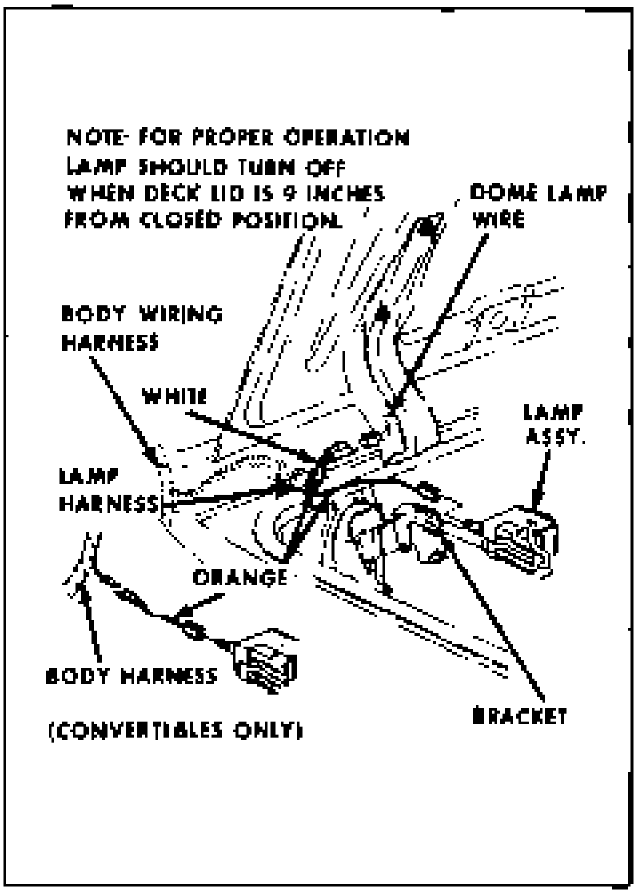


Fig. 15-40 Luggage Lamp - Tempest and Grand Prix

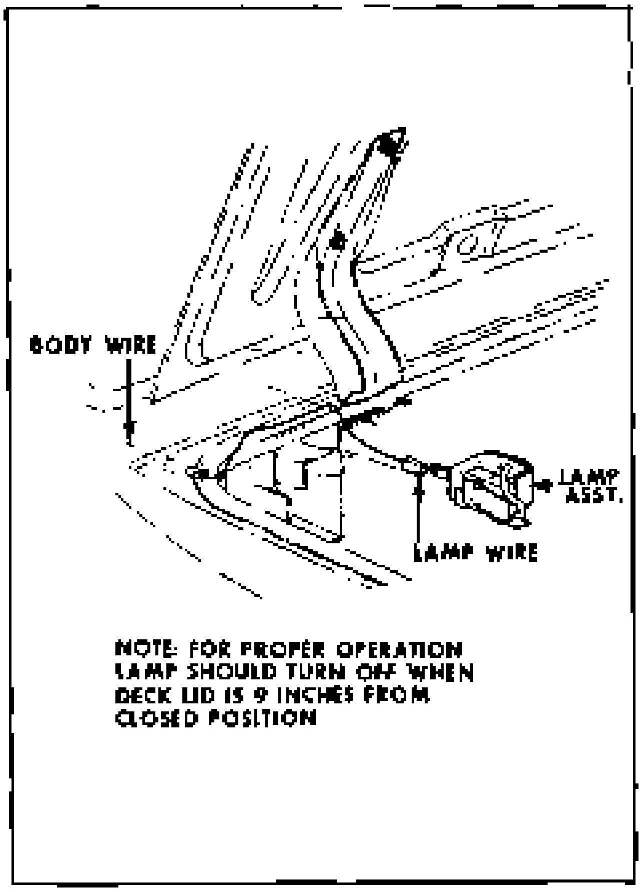


Fig. 15-41 Luggage Lamp - Pontiac

CONSOLE

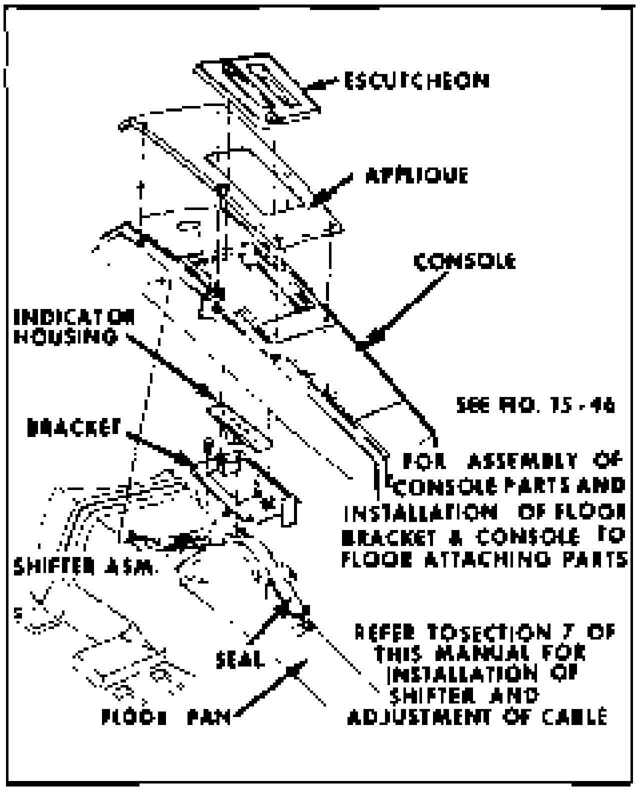


Fig. 15-43 Console - Firebird Automatic Transmission

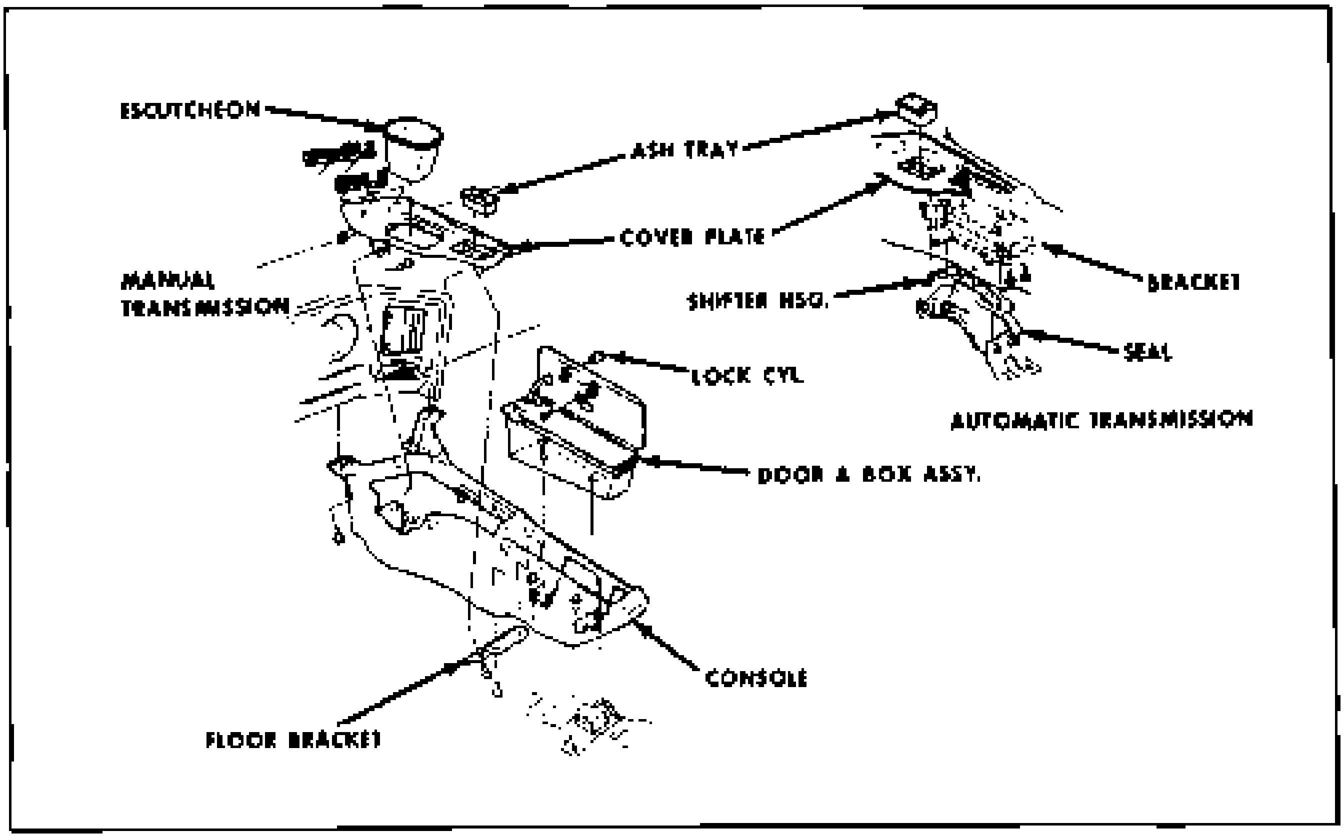


Fig. 15-44 Console - Grand Prix

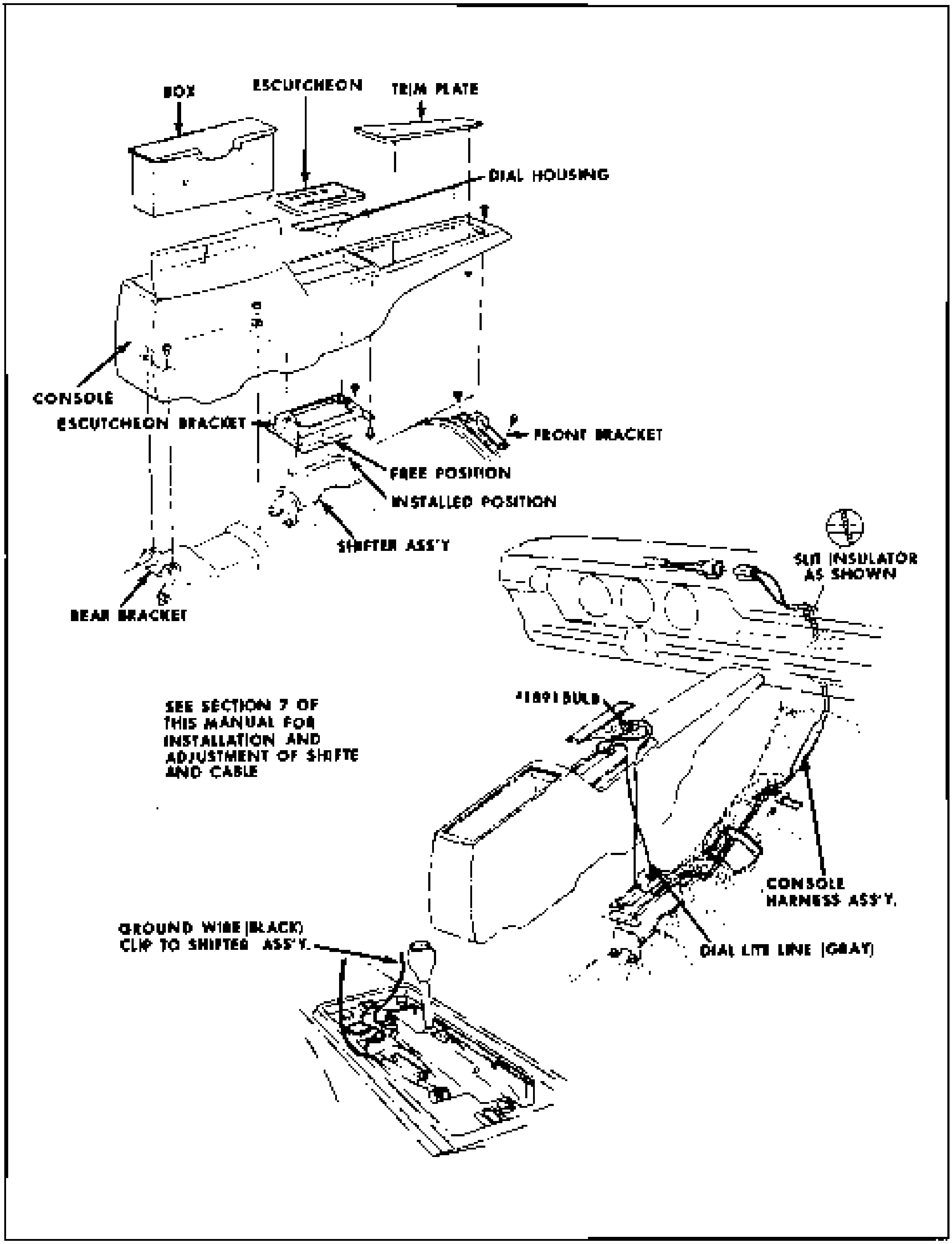


Fig. 15-42 Console - Tempest Automatic Transmission

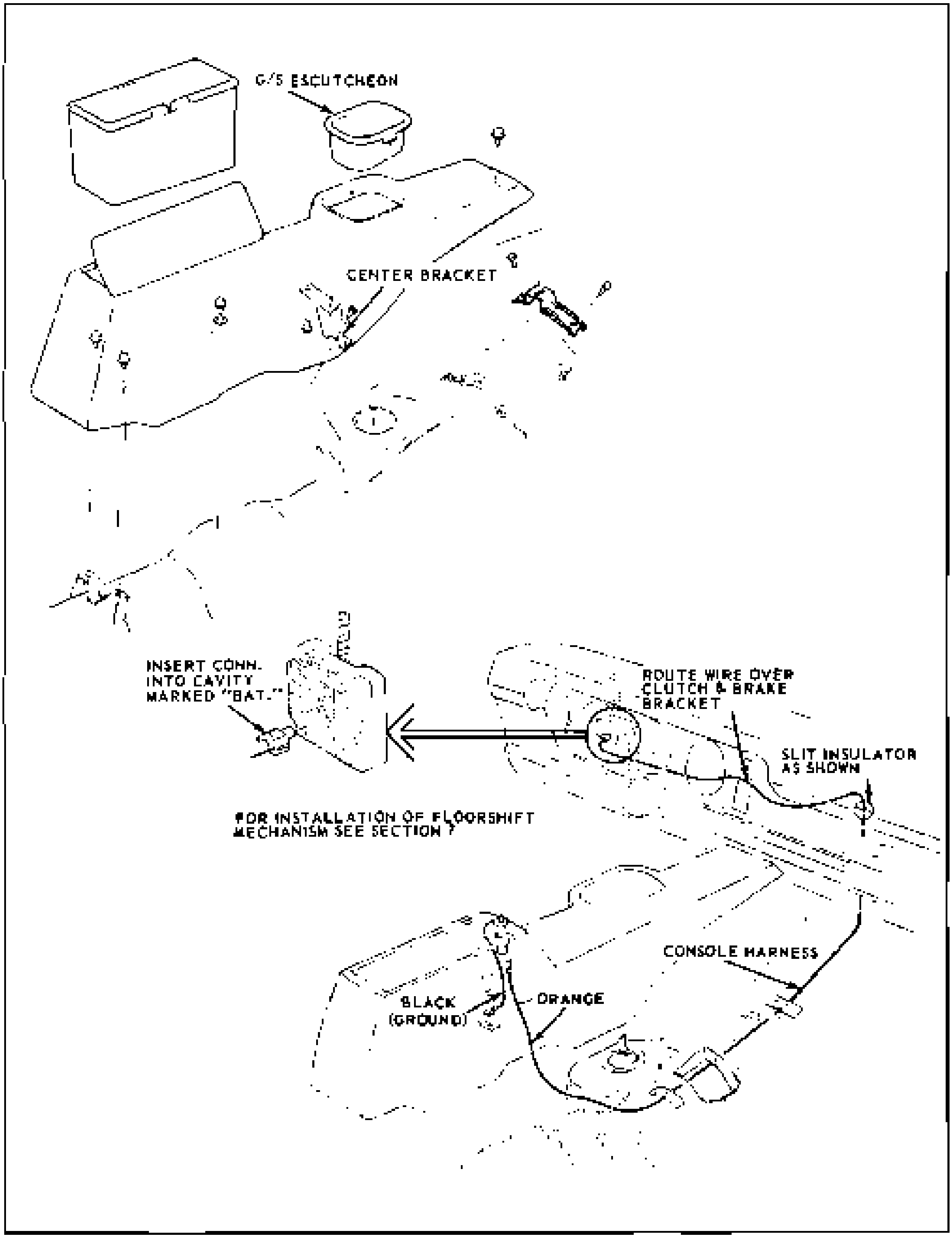


Fig. 15-45 Console - Tempest Manual Transmission

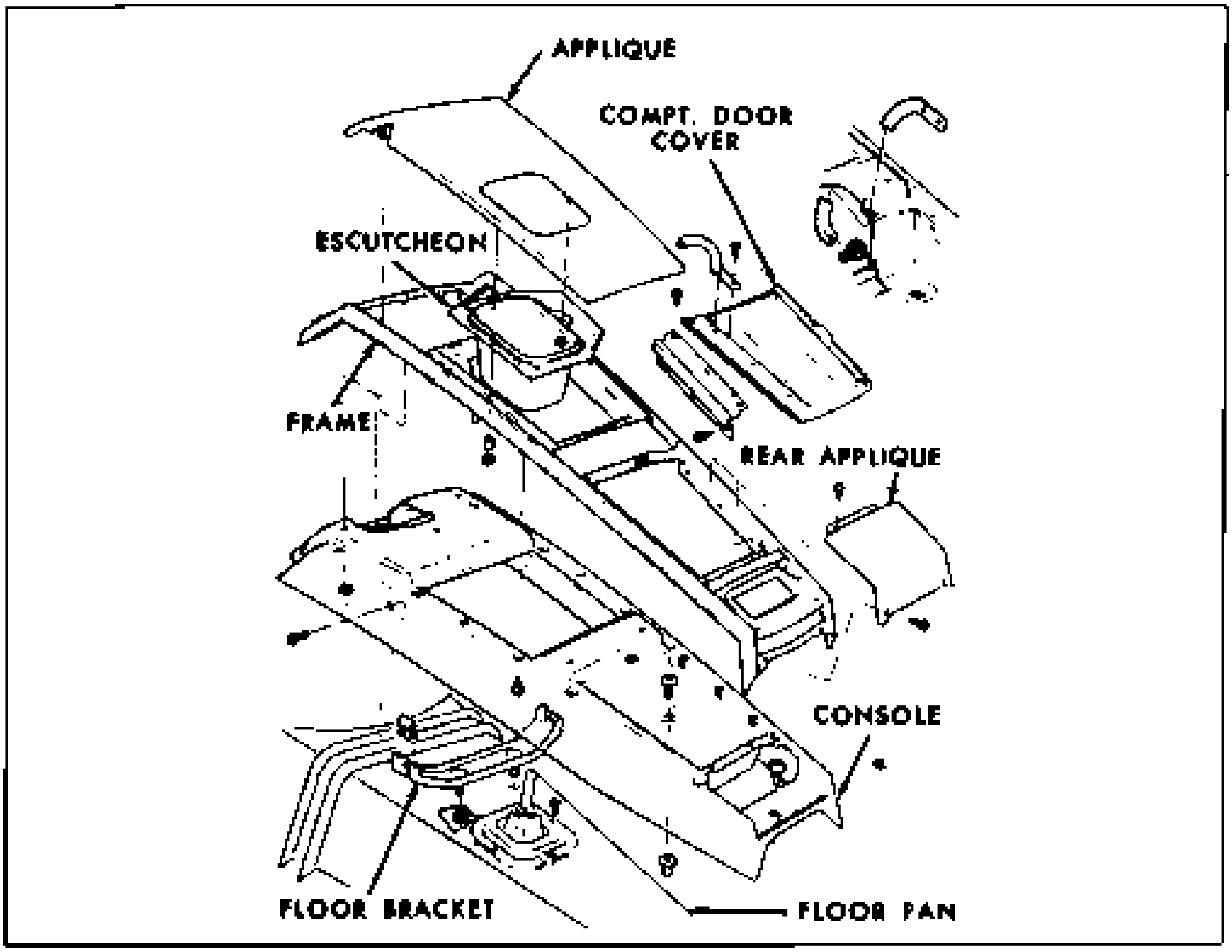


Fig. 15-46 Console - Firebird Manual Transmission

RADIO AND FRONT SPEAKER

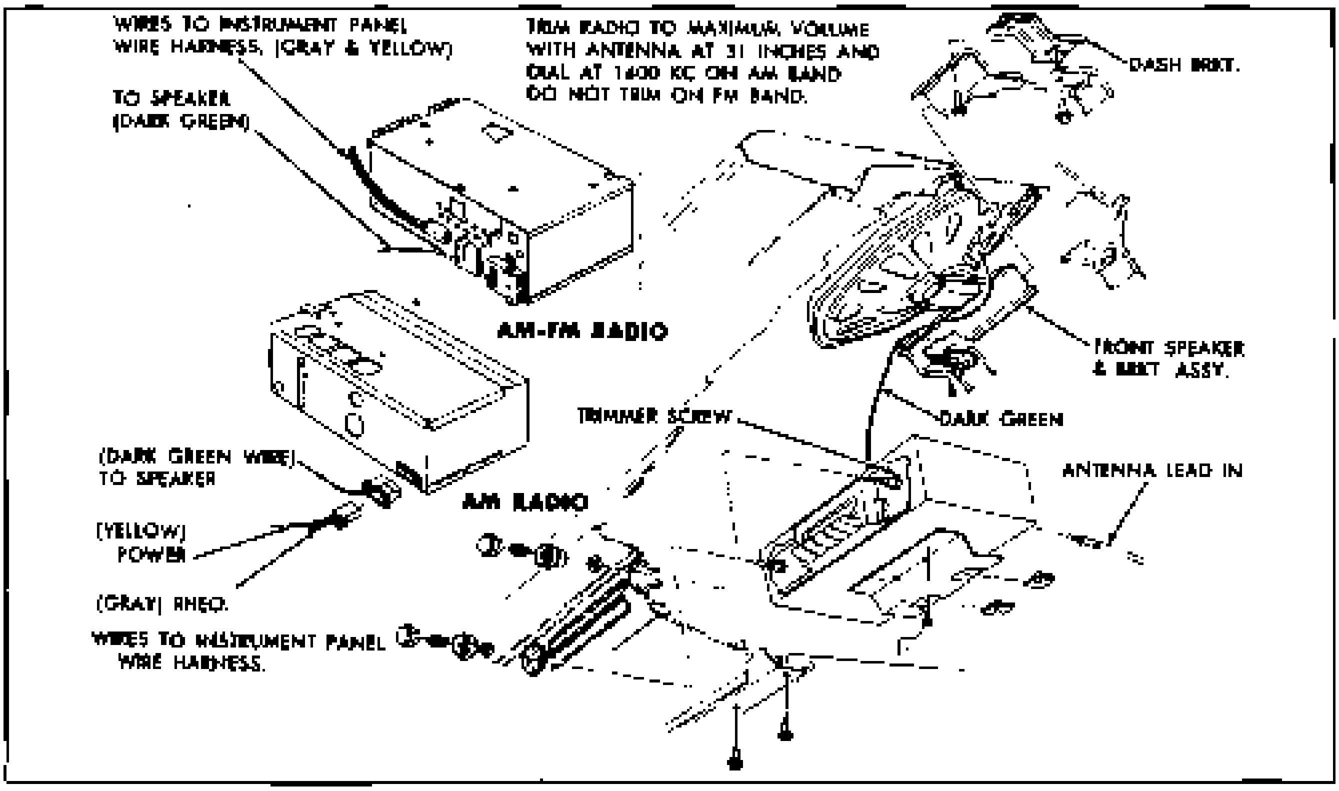


Fig. 15-47 Radio Receiver and Front Speaker - Pontiac

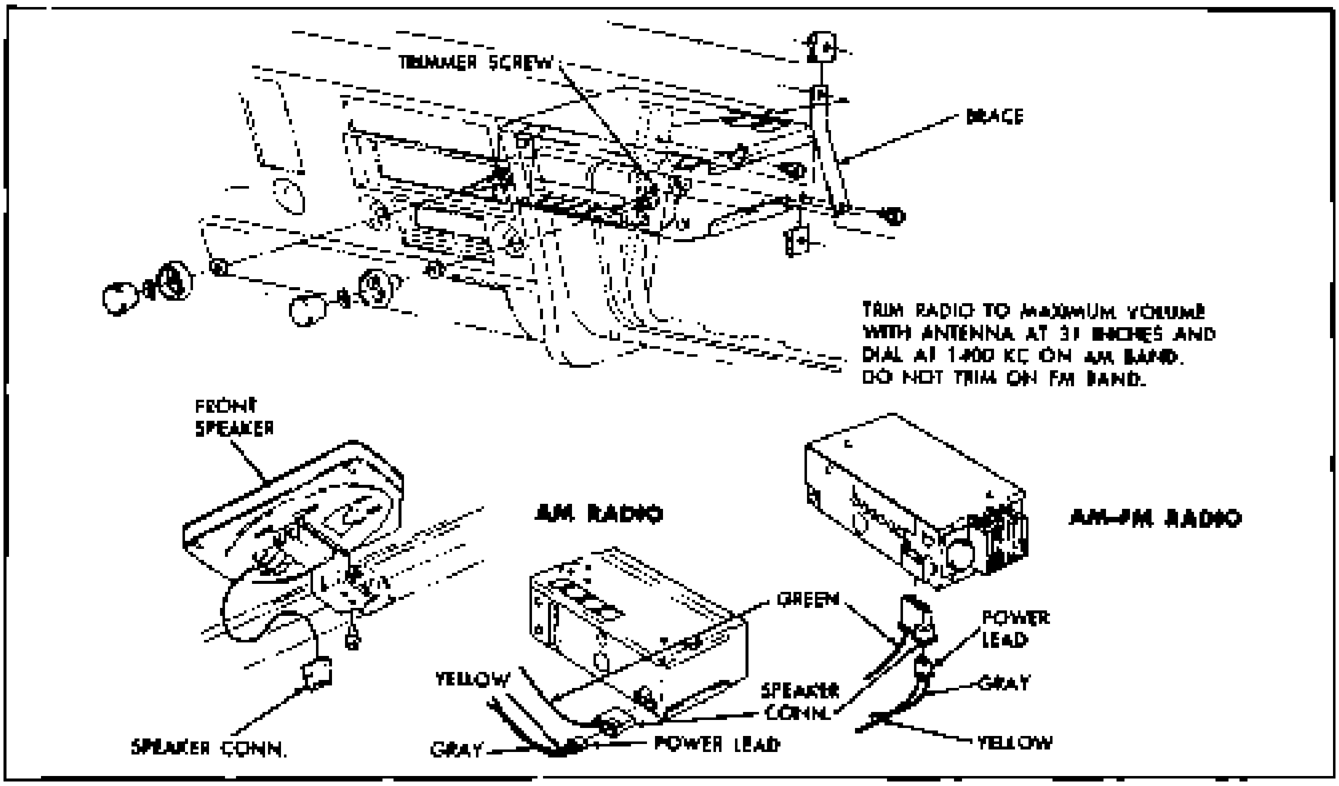


Fig. 15-48 Radio Receiver and Front Speaker Firebird

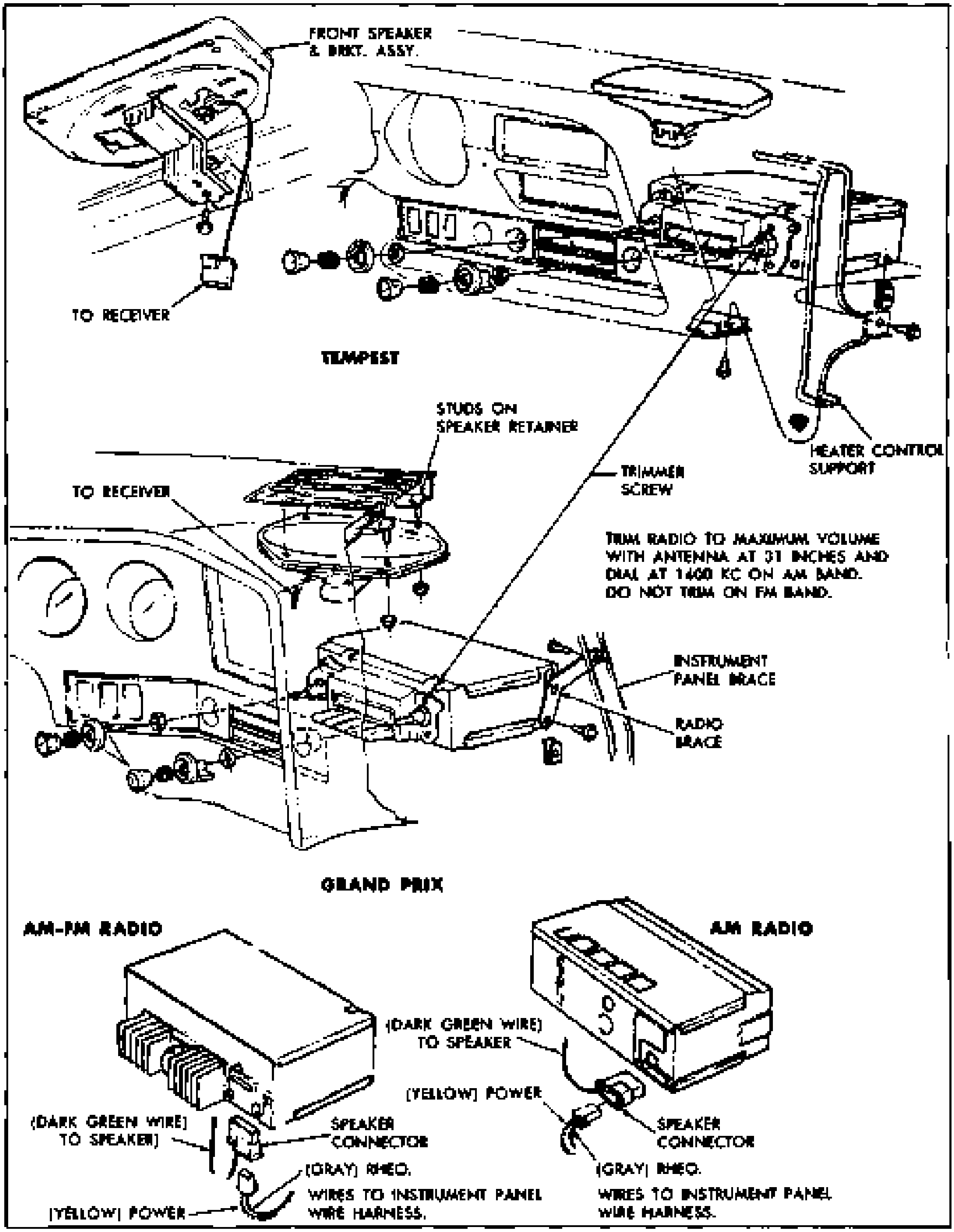


Fig. 15-49 Radio Receiver and Front Speaker - Tempest and Grand Prix

RADIO SUPPRESSION EQUIPMENT

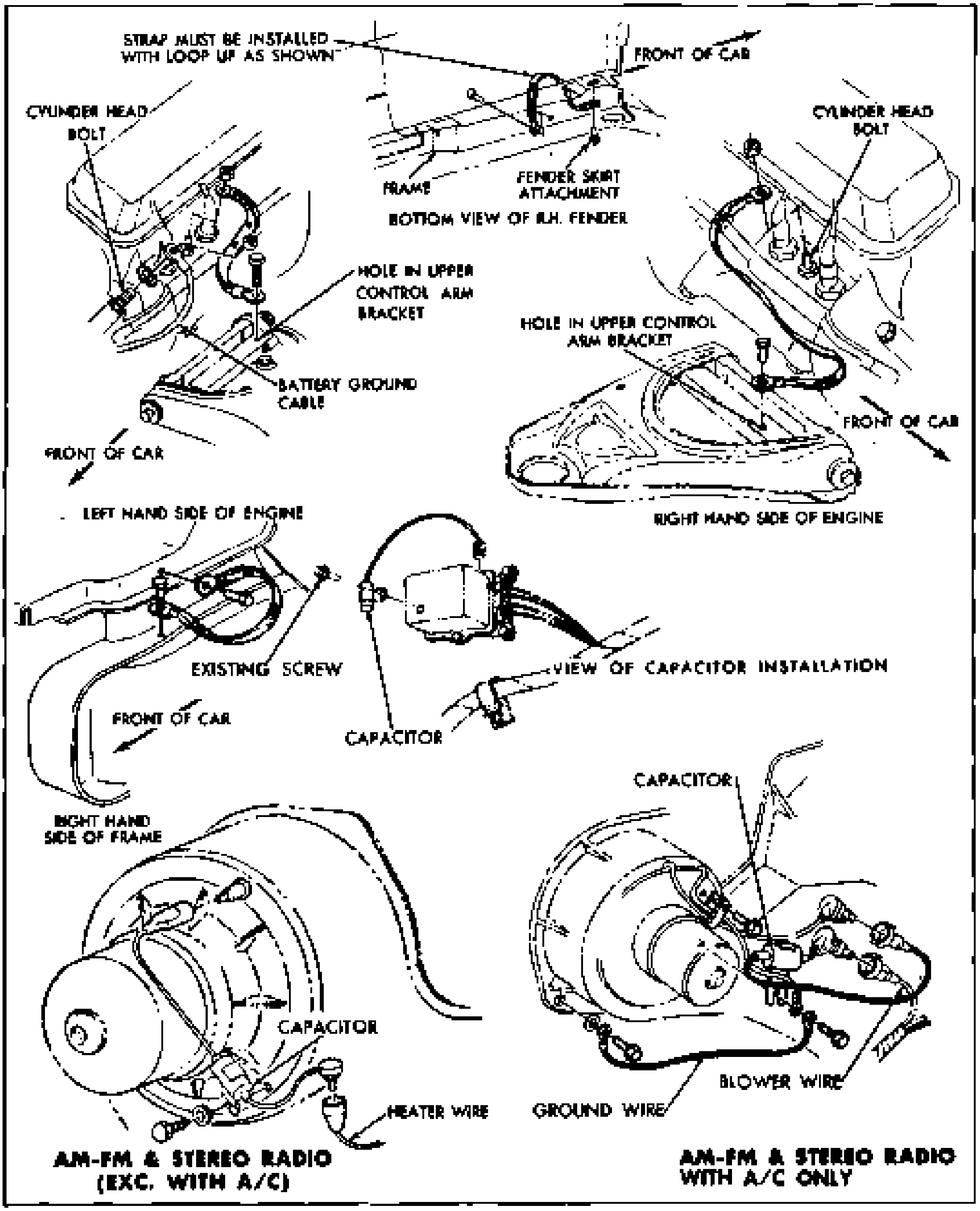


Fig. 15-50 Radio Suppression Equipment - Pontiac

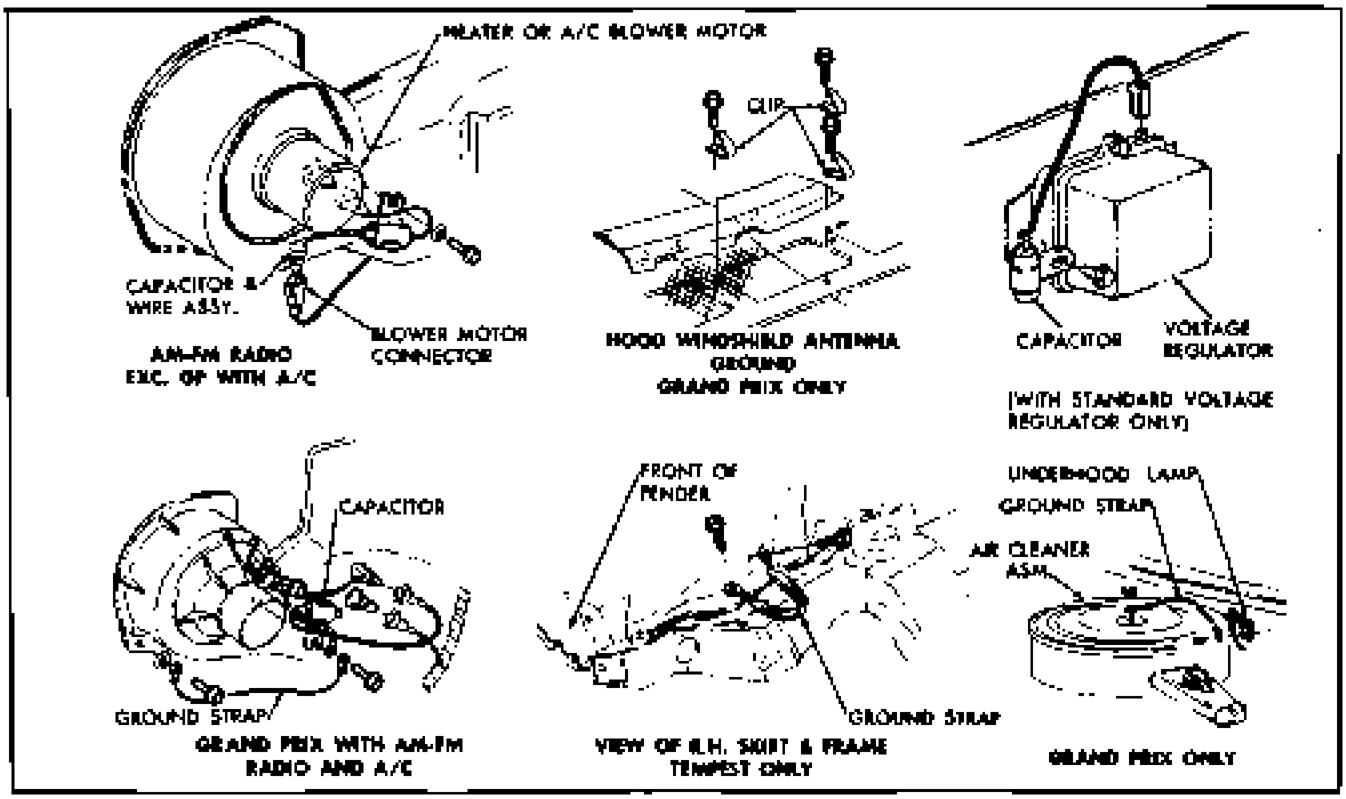


Fig. 15-51 Radio Suppression Equipment - Tempest and Grand Prix

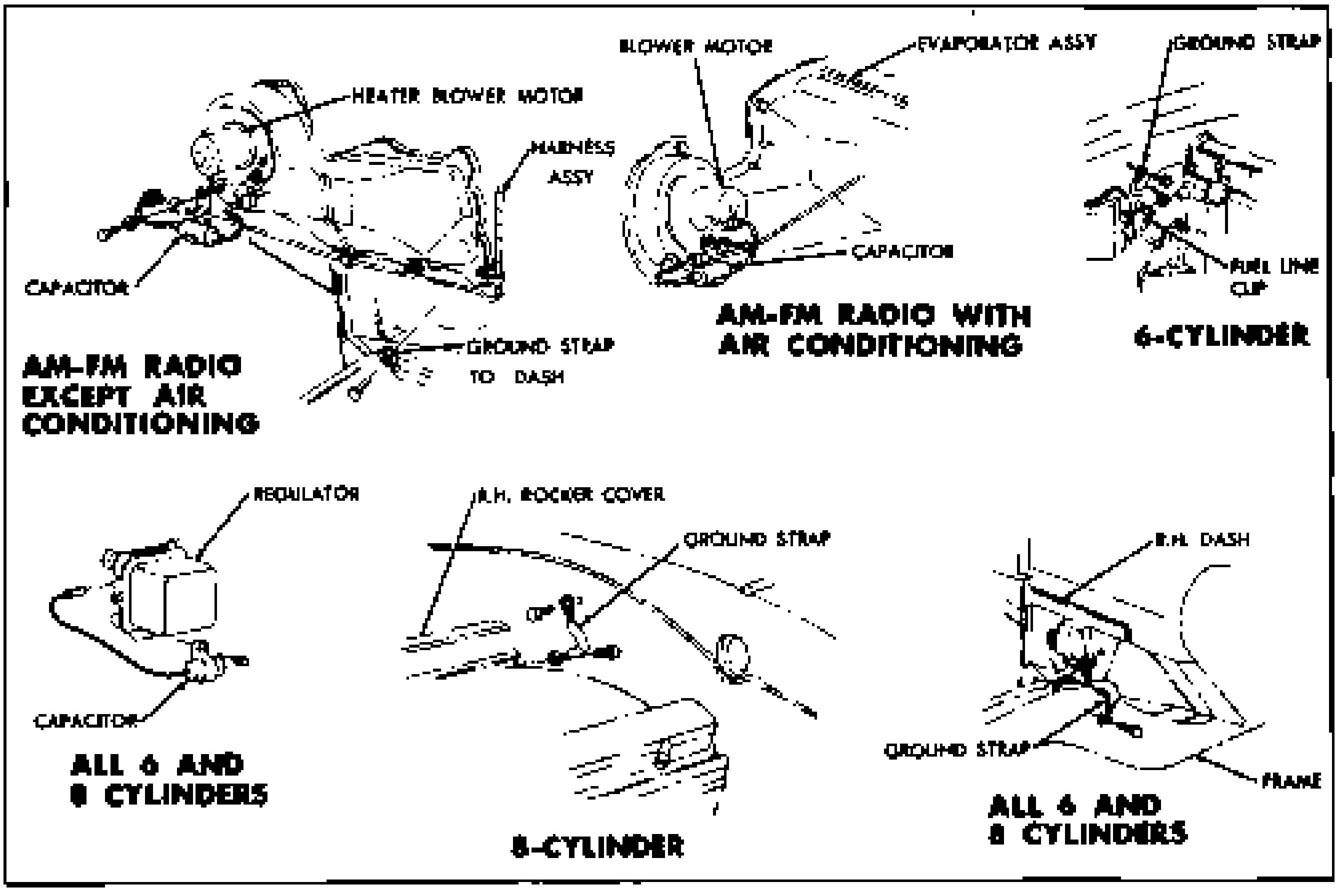


Fig. 15-52 Radio Suppression Equipment - Firebird

MANUAL ANTENNA

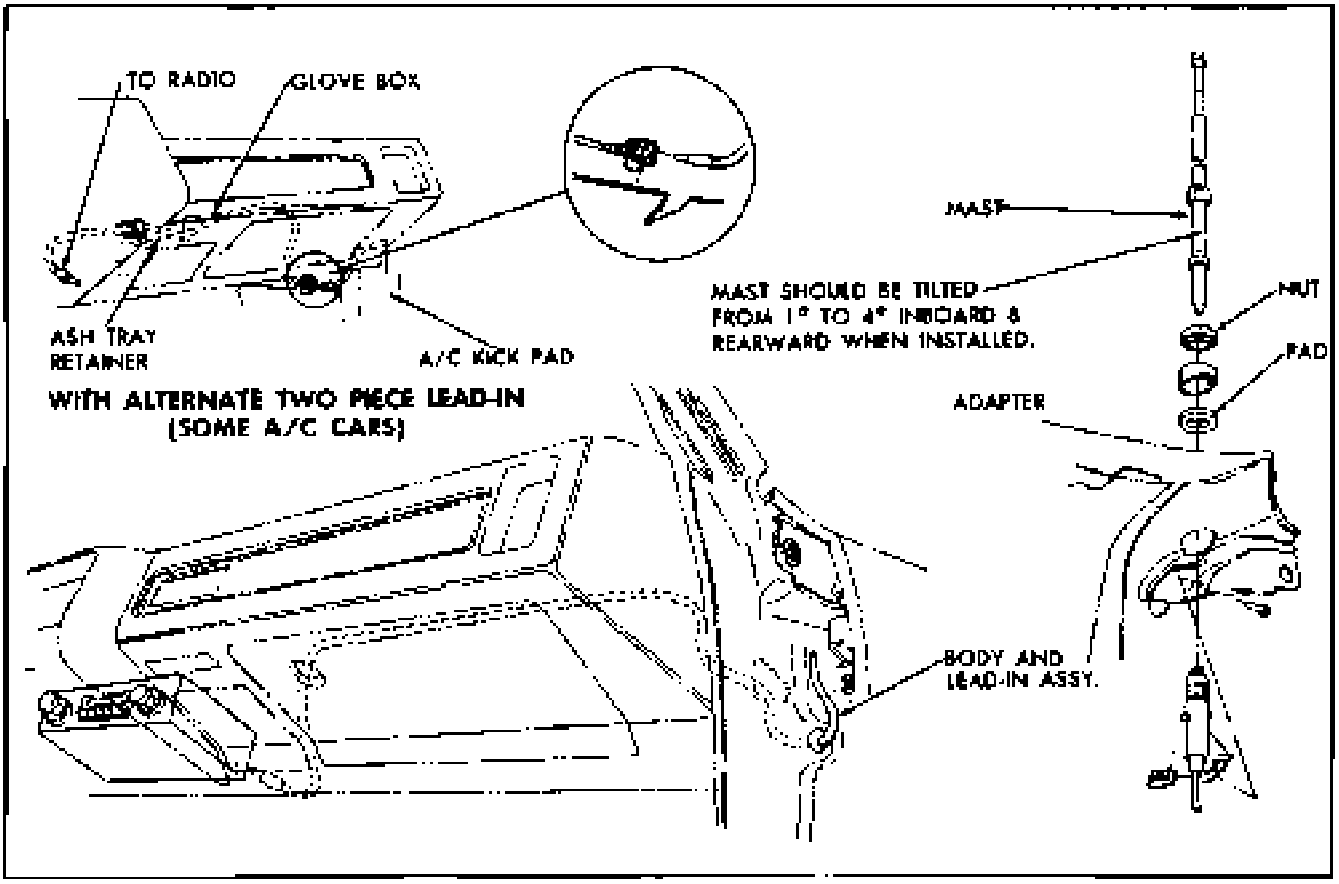


Fig. 15-53 Manual Antenna - Pontiac

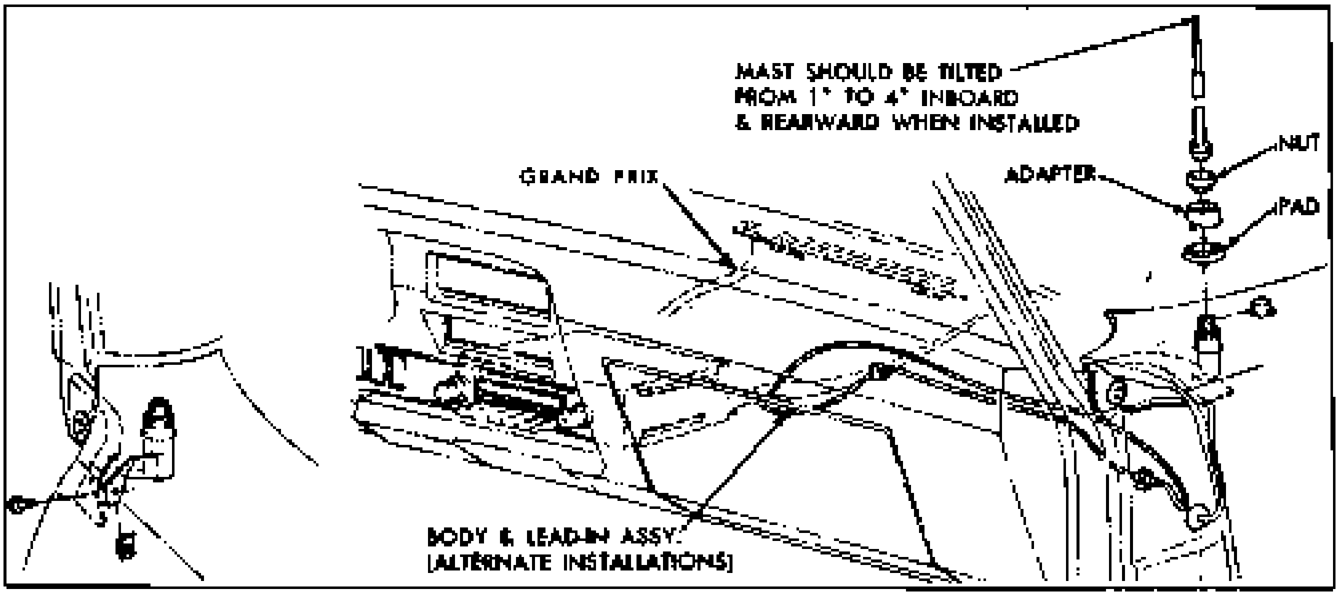


Fig. 15-54 Manual Antenna - Tempest and Grand Prix

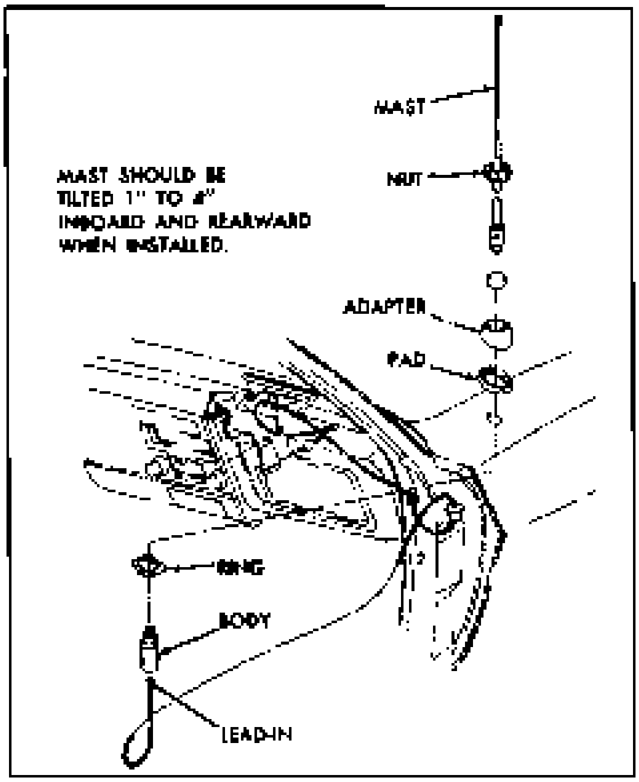


Fig. 15-56 Manual Antenna - Firebird

POWER ANTENNA

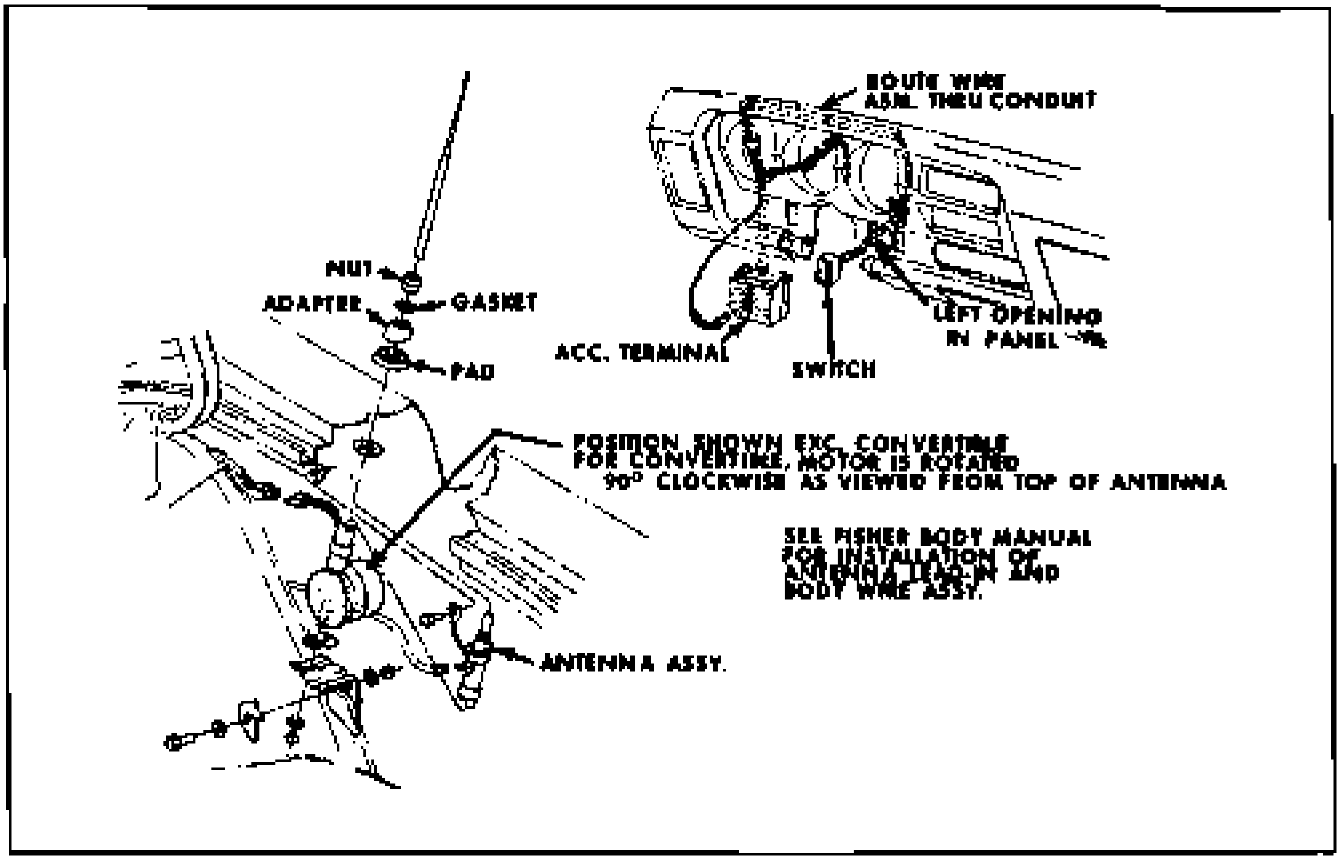


Fig. 15-56 Power Antenna - Tempest

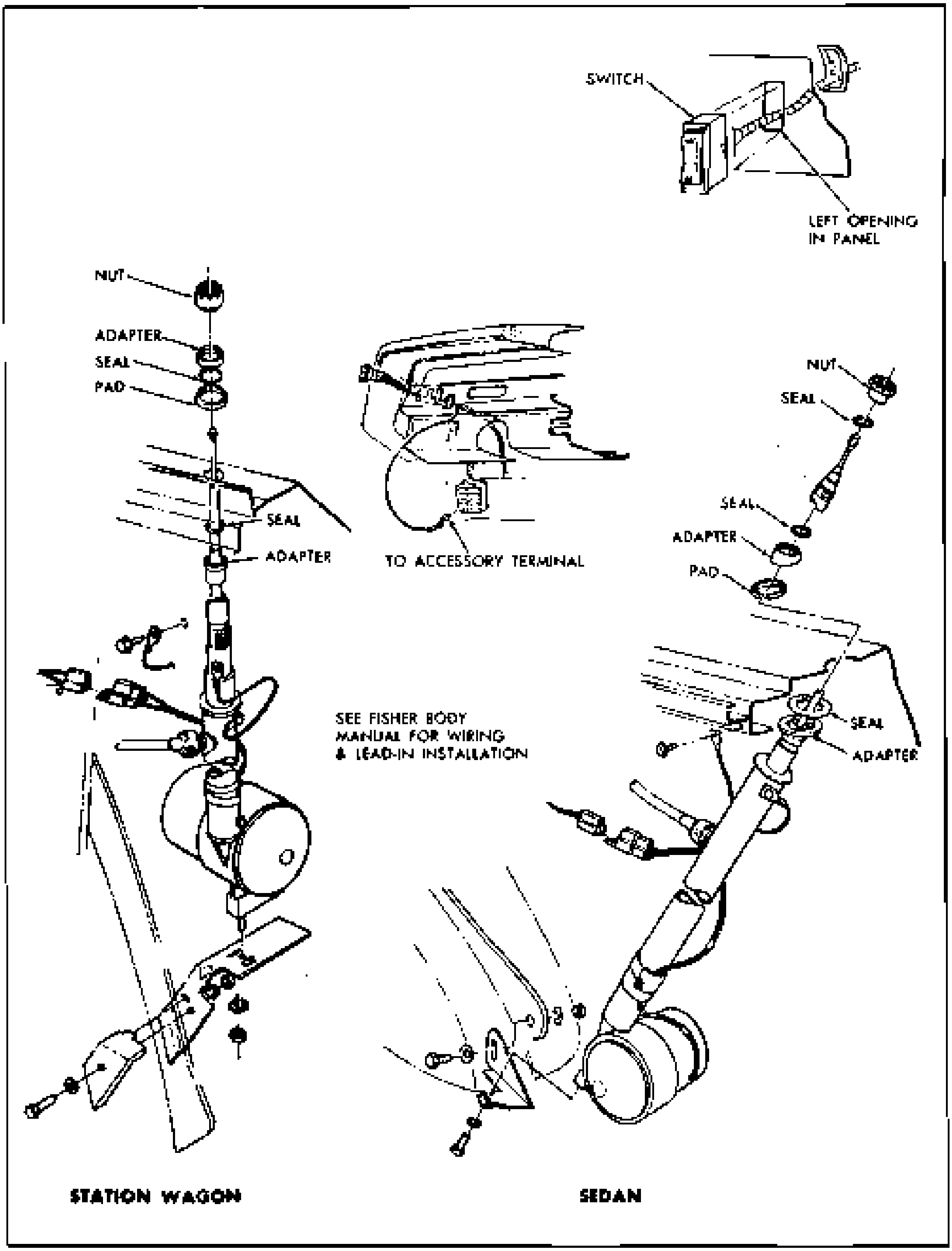


Fig. 15-57 Power Antenna - Pontiac

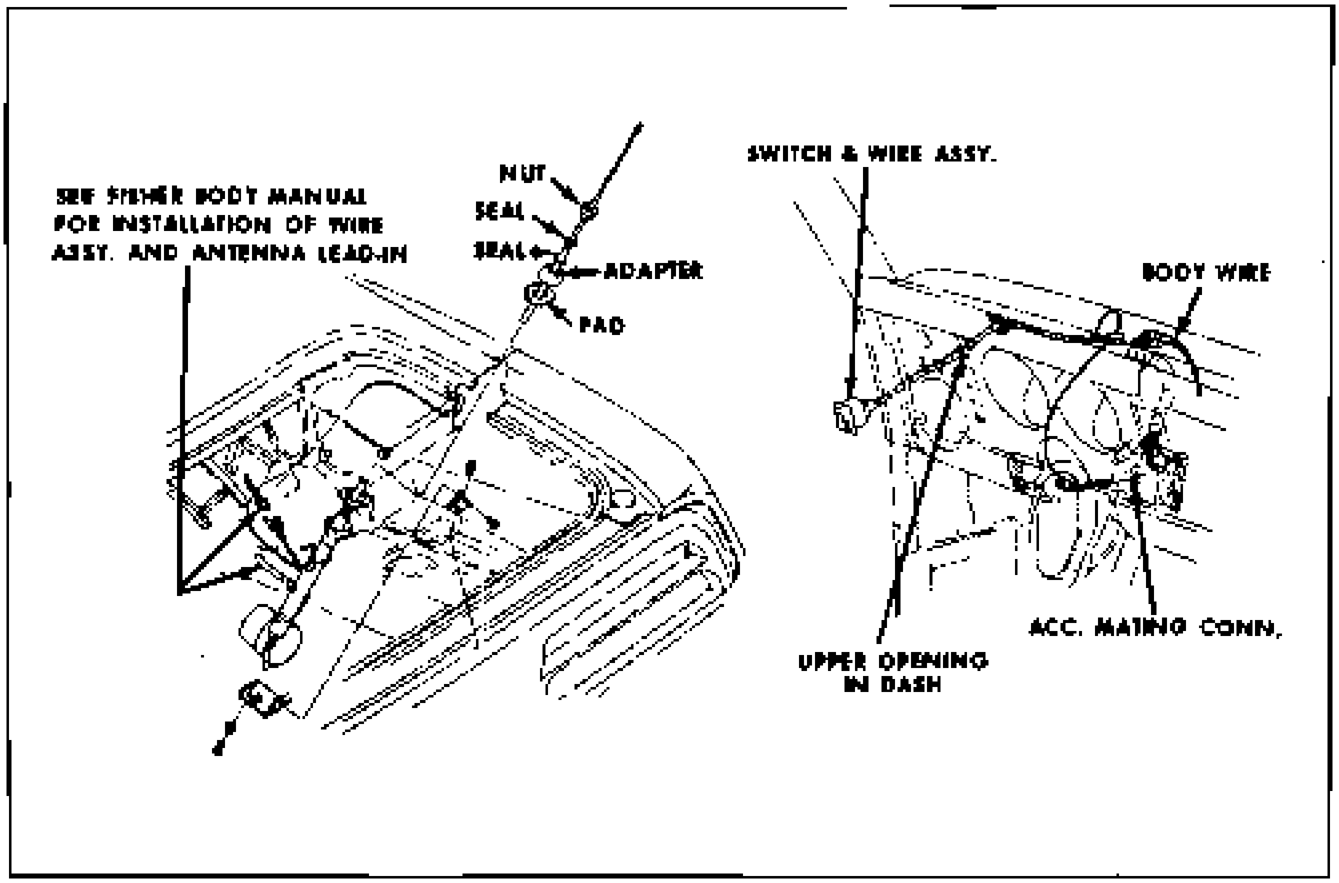


Fig. 15-58 Power Antenna - Firebird

OVERHAUL ANTENNA

Replace drive, mast or support tube as follows:

CAUTION: Before attempting replacement of any of three major sub-assemblies listed below, the hook-up wire should be removed from lead-in plug pin and insulator assembly to prevent this wire from being broken where it is soldered to .400 tube section of mast.

1. Remove two screws holding lead-in flange to support tube.

2. Remove flange from pin and insulator assembly

3. Unsolder hook-up pin from wire.

NOTE: Do not overheat pin by slow soldering as this will destroy pin insulator. Use needle-nose pliers to hold pin while soldering.

4. Remove pin and insulator assembly. If replacement of drive, support tube or mast is indicated, continue following steps as required.

5. Remove three screws which hold support tube to drive assembly.

6. Holding drive in one hand and supporting tube in other hand, pull (applying back-and-forth rotary motion at same time) until support tube is removed from antenna.

To replace support tube:

7. If only replacing a damaged support tube assembly, apply the reverse of steps 1 through 6, making sure that hook-up wire is extended through proper hole in support tube.

If replacement of drive or mast is indicated:

8. Holding drive in one hand and mast in other hand (grasp near bottom of mast), rock mast back and forth and pull at same time. This will remove insulator bushing and .400 tube section from tubular fitting on drive.

9. Apply 12 volts D.C. (up direction of mast) to power leads until entire length of nylon cord has been expelled from drive. To prevent kink or bend in nylon cord: keep it taut by pulling on mast.

NOTE: If drive assembly is inoperative, it will be necessary to manually remove nylon cord from drive. To remove nylon cord from disabled drive, place assembly in vise so normal plane of nylon cord is parallel with floor. Then, using both hands, pull on .300-diameter mast tube until nylon cord is removed completely from drive.

CAUTION: DO NOT attempt service on components of drive assembly. This must be serviced as a complete unit.

10. Remove bottom insulator and water seal washer from tubular fitting, using wire hook or long nose pliers

11. Thread nylon cord through bottom insulator with small diameter end down. Then thread nylon cord through water seal washer.

12. Apply 12 volts D.C. (down direction of mast) to power leads and feed nylon cord into drive assembly. Do not allow bend or kink to occur in nylon cord.

NOTE: Push water seal washer and bottom insulator all the way down into tubular fitting before nylon cord completely disappears into drive assembly. Remove power, if necessary, to seat these parts.

13. Push .400 tube section down into tubular fitting on drive. Make sure that upper edge of flange on insulator bushing is below center of 3 holes in tubular fitting.

14. Install support tube (minus lead-in flange, pin and insulator assembly) in proper position, making sure hook up wire is extended through proper hole in support tube.

15. Install three screws to hold support tube to drive assembly.

16. Solder hook-up wire to pin and insulator assembly.

CAUTION: Do not overheat by slow soldering.

17. Assemble flange over pin and insulator assembly and install two screws.

REAR SEAT SPEAKER

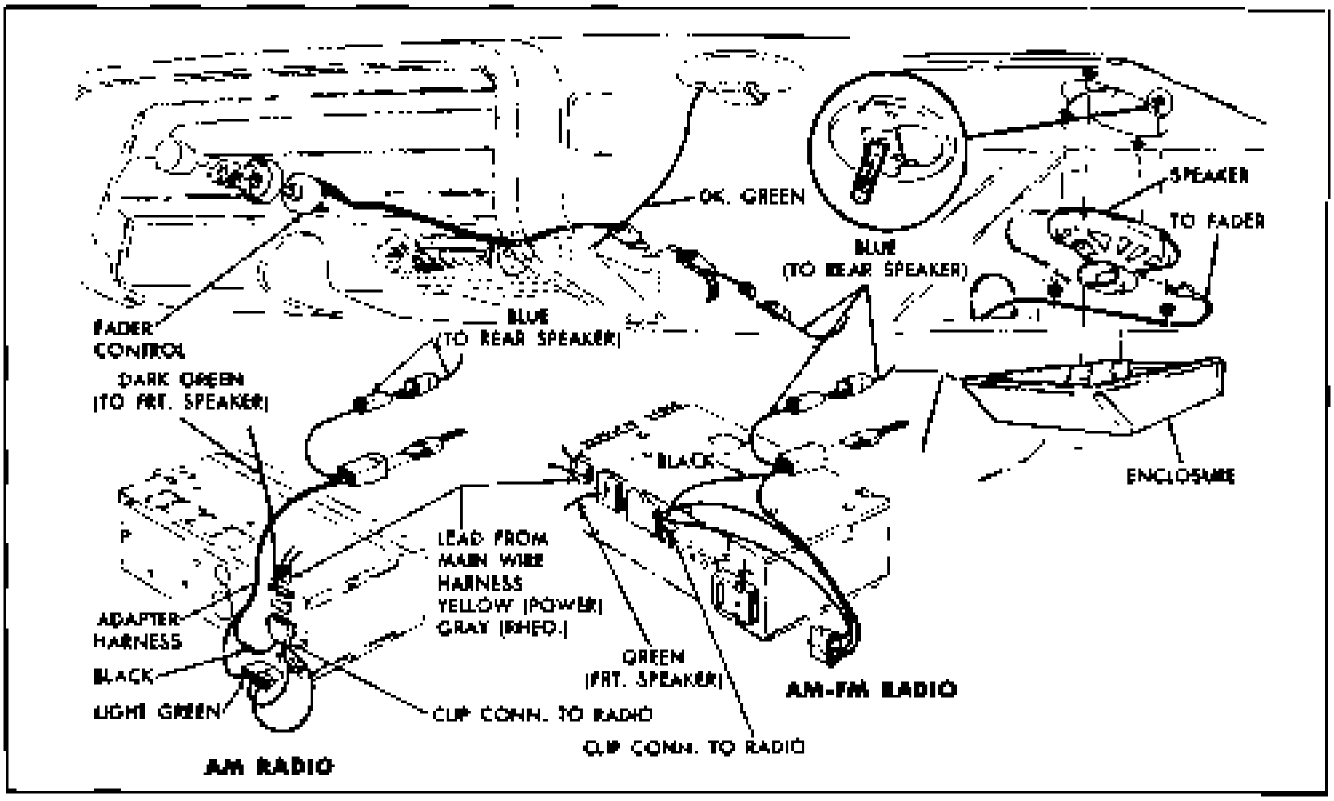


Fig. 15-59 Rear Seat Speaker - Pontiac

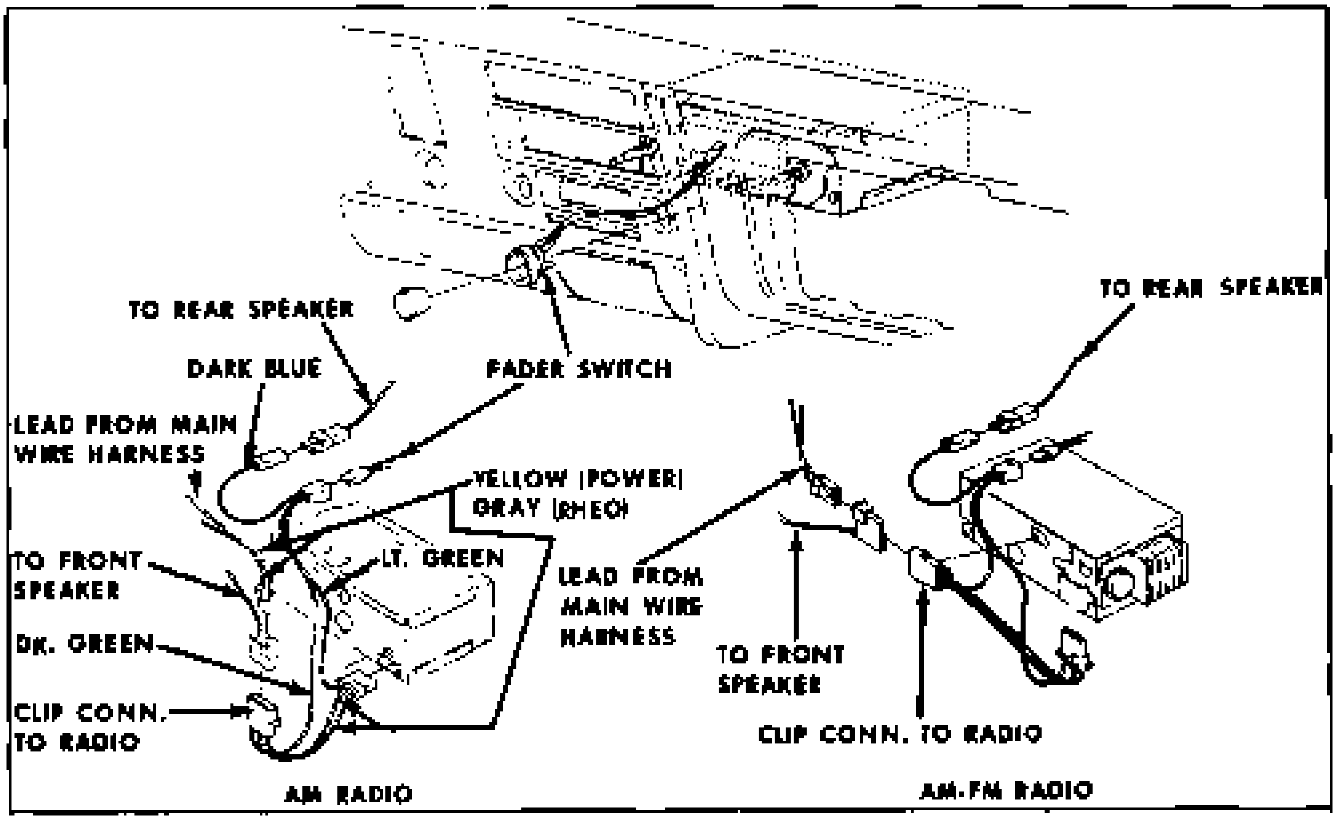


Fig. 15-60 Rear Seat Speaker - Firebird

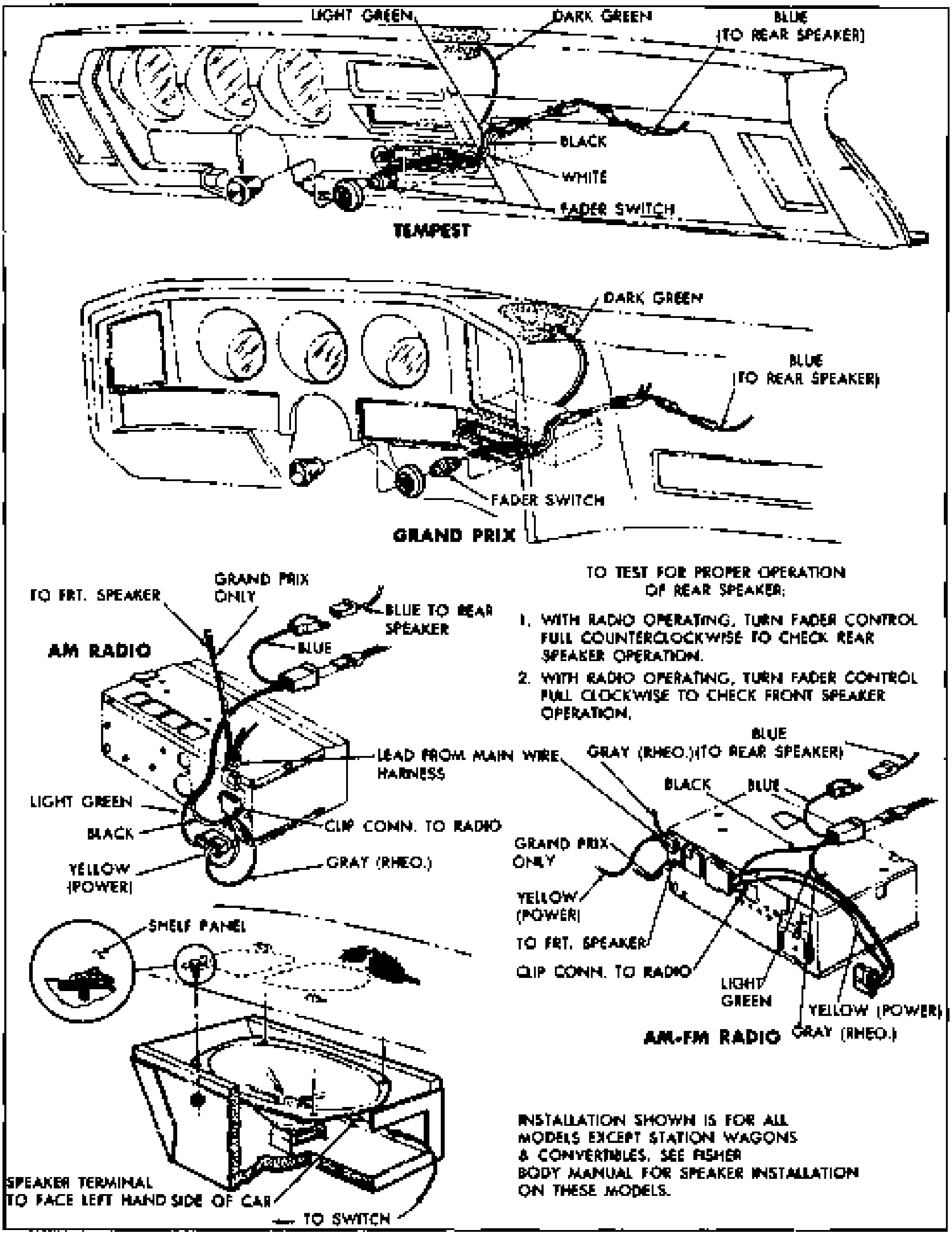


Fig. 15-61 Rear Seat Speaker - Tempest and Grand Prix

VERBRA-PHONIC SYSTEM

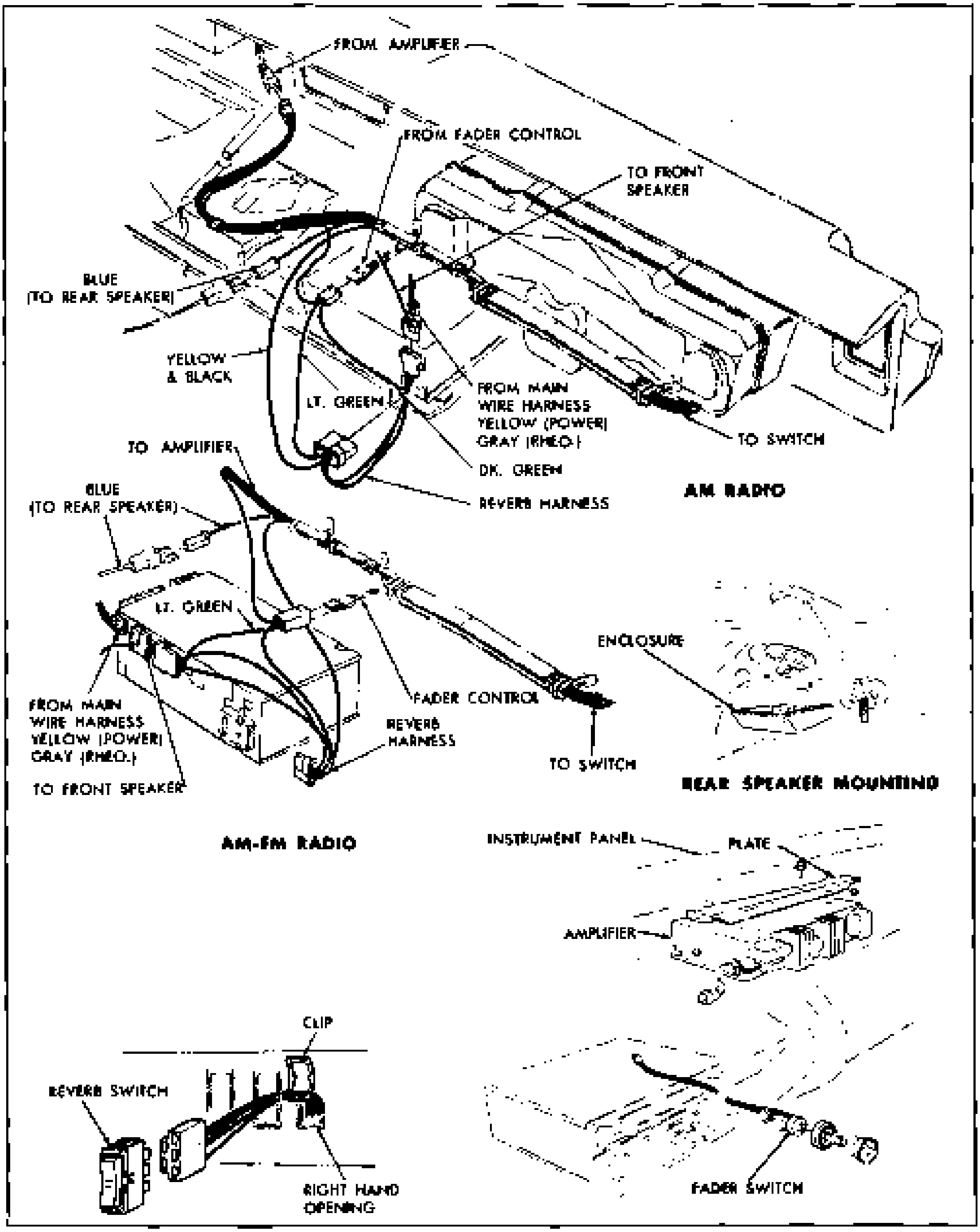


Fig. 15-62 Verbra-Phonic System - Pontiac

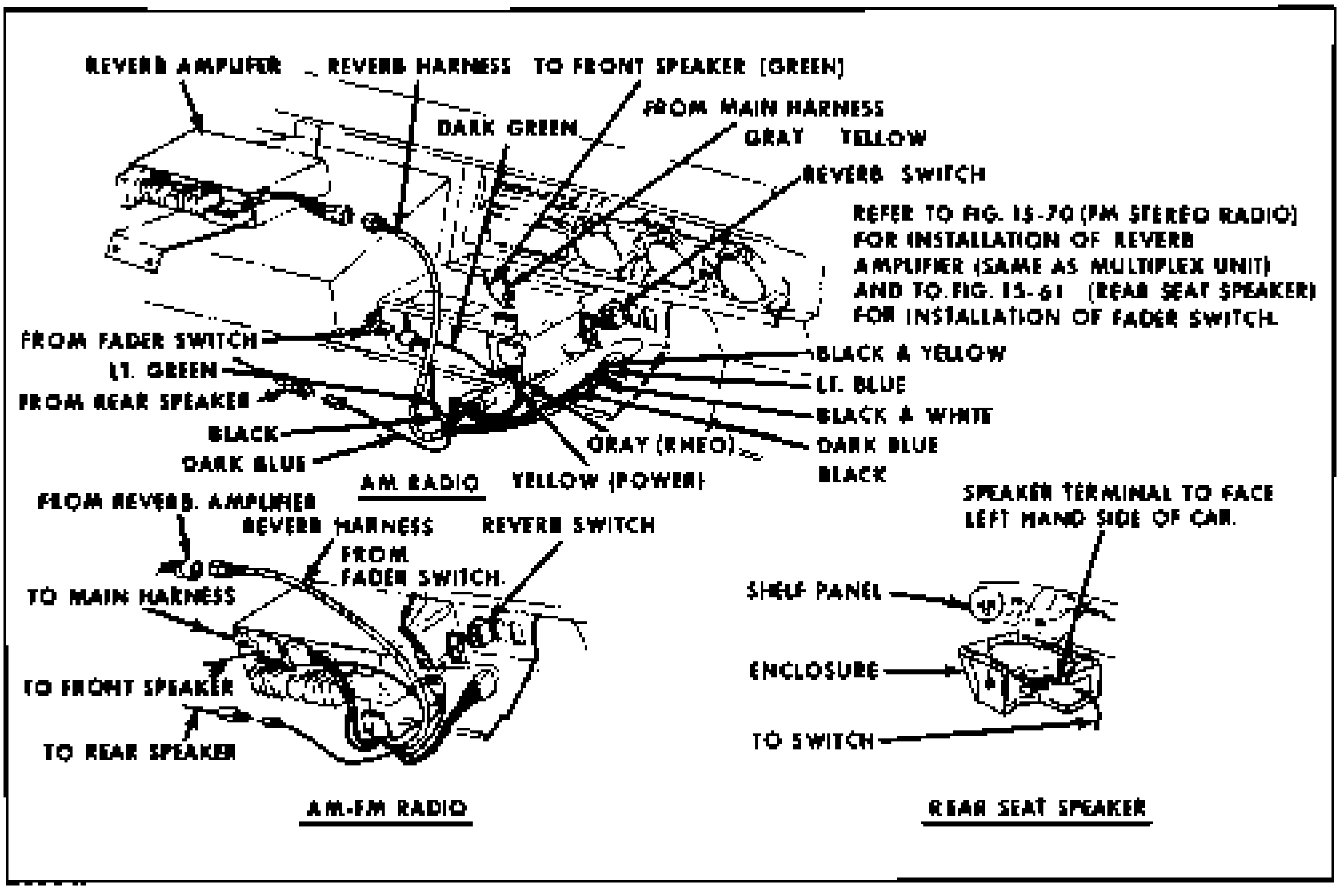


Fig. 15-63 Verbra-Phonic System - Tempest

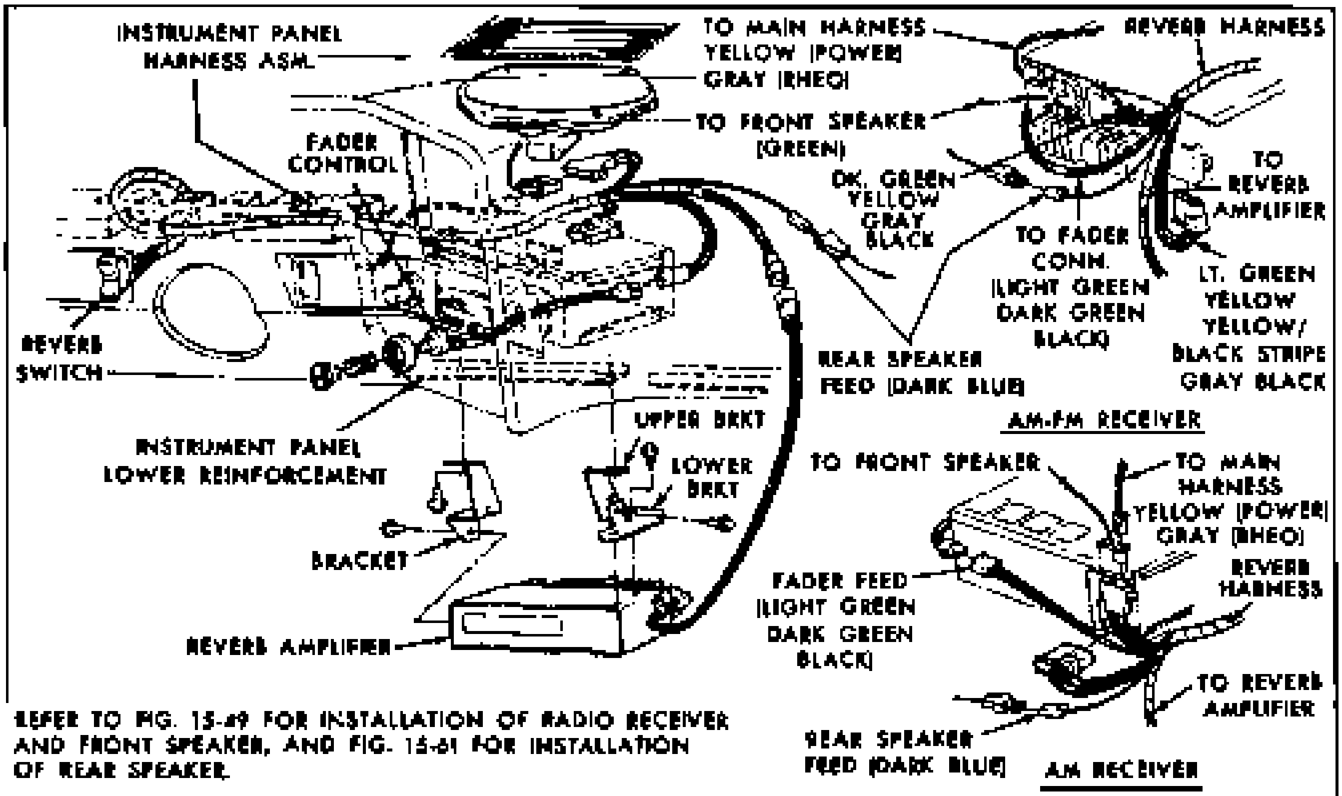


Fig. 15-64 Verbra-Phonic System Grand Prix

STEREO TAPE PLAYER

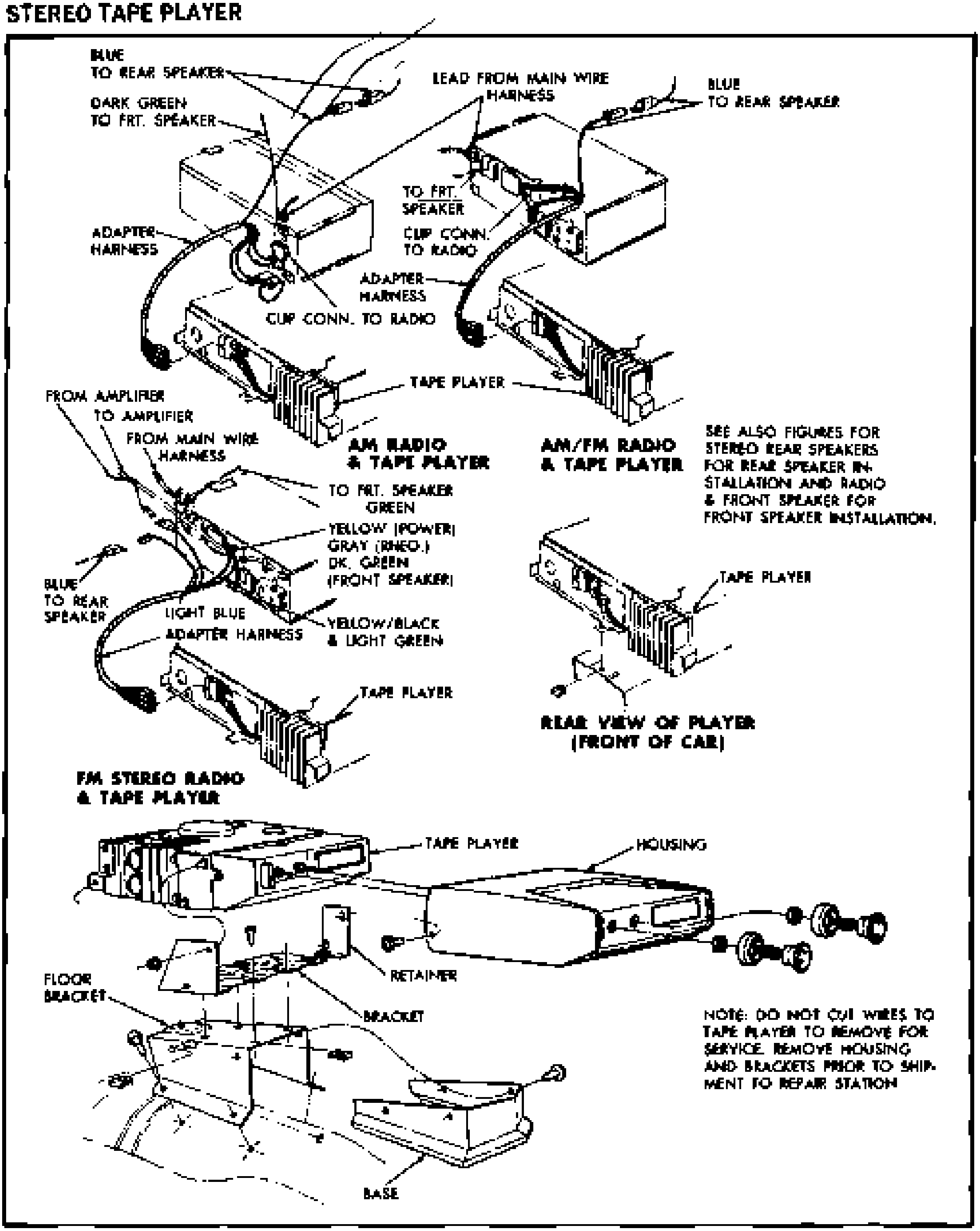


Fig. 15-65 Stereo Tape Player - Pontiac

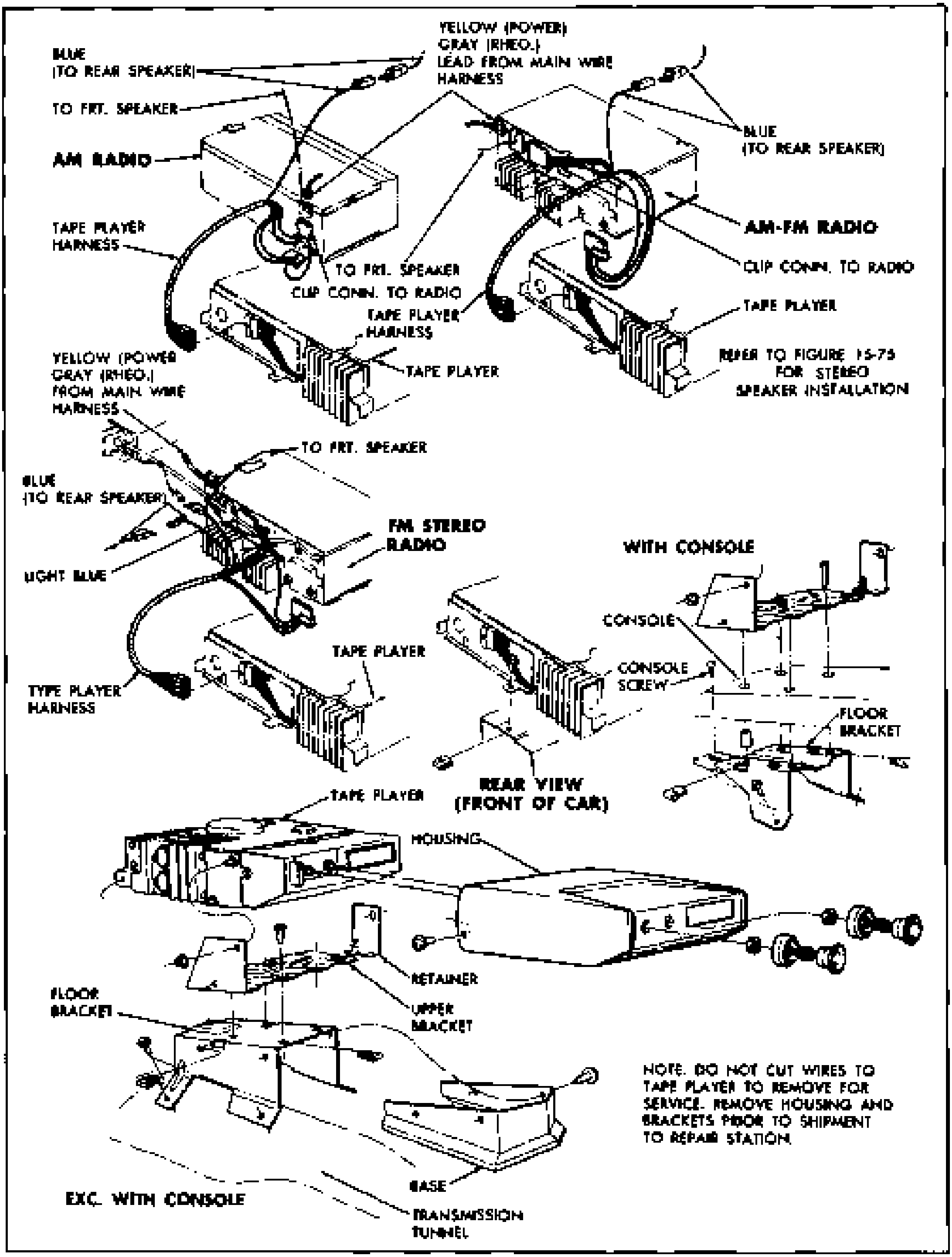


Fig. 15-66 Stereo Tape Player - Tempest

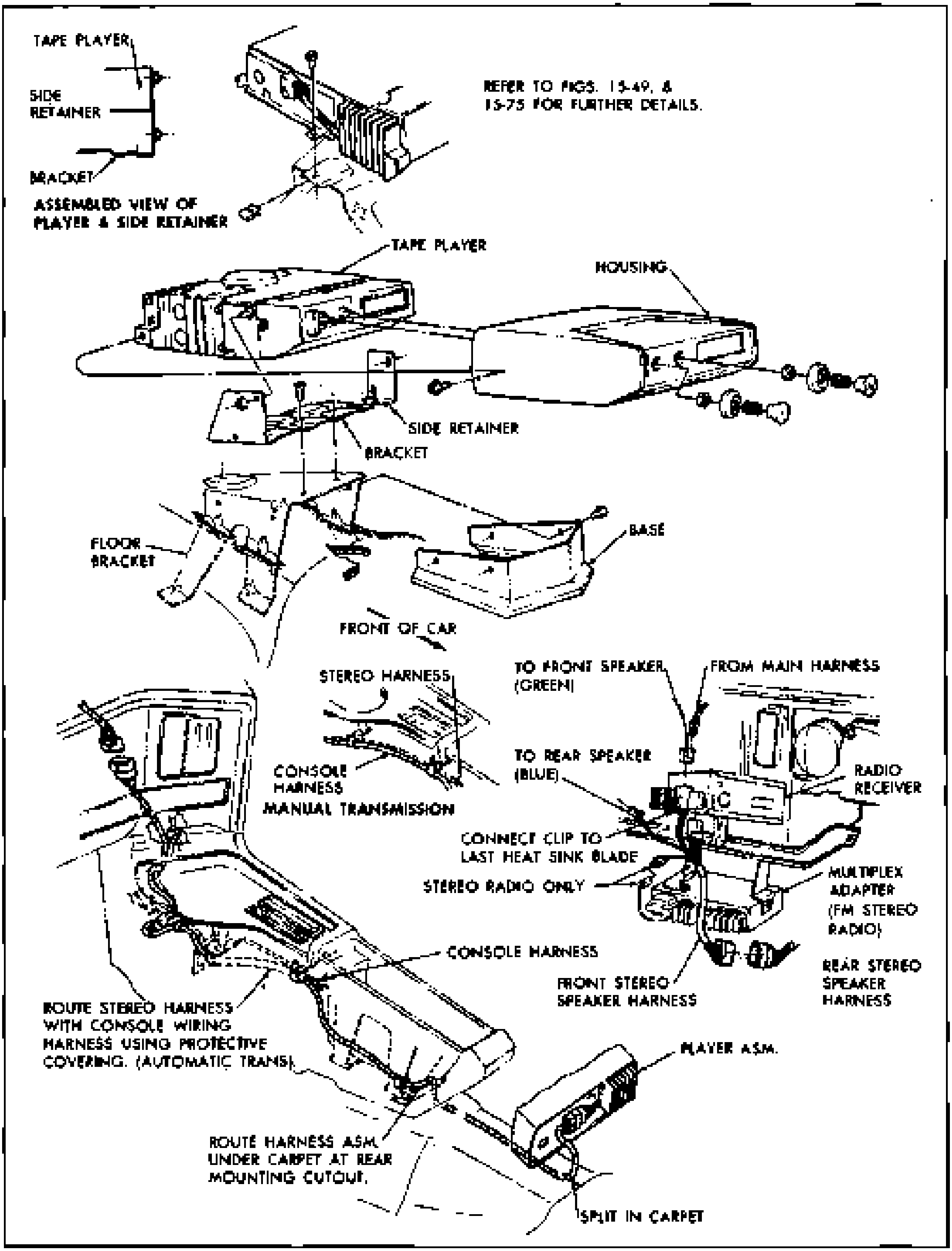


Fig. 15-77 Stereo Tape Player—Grand Prix

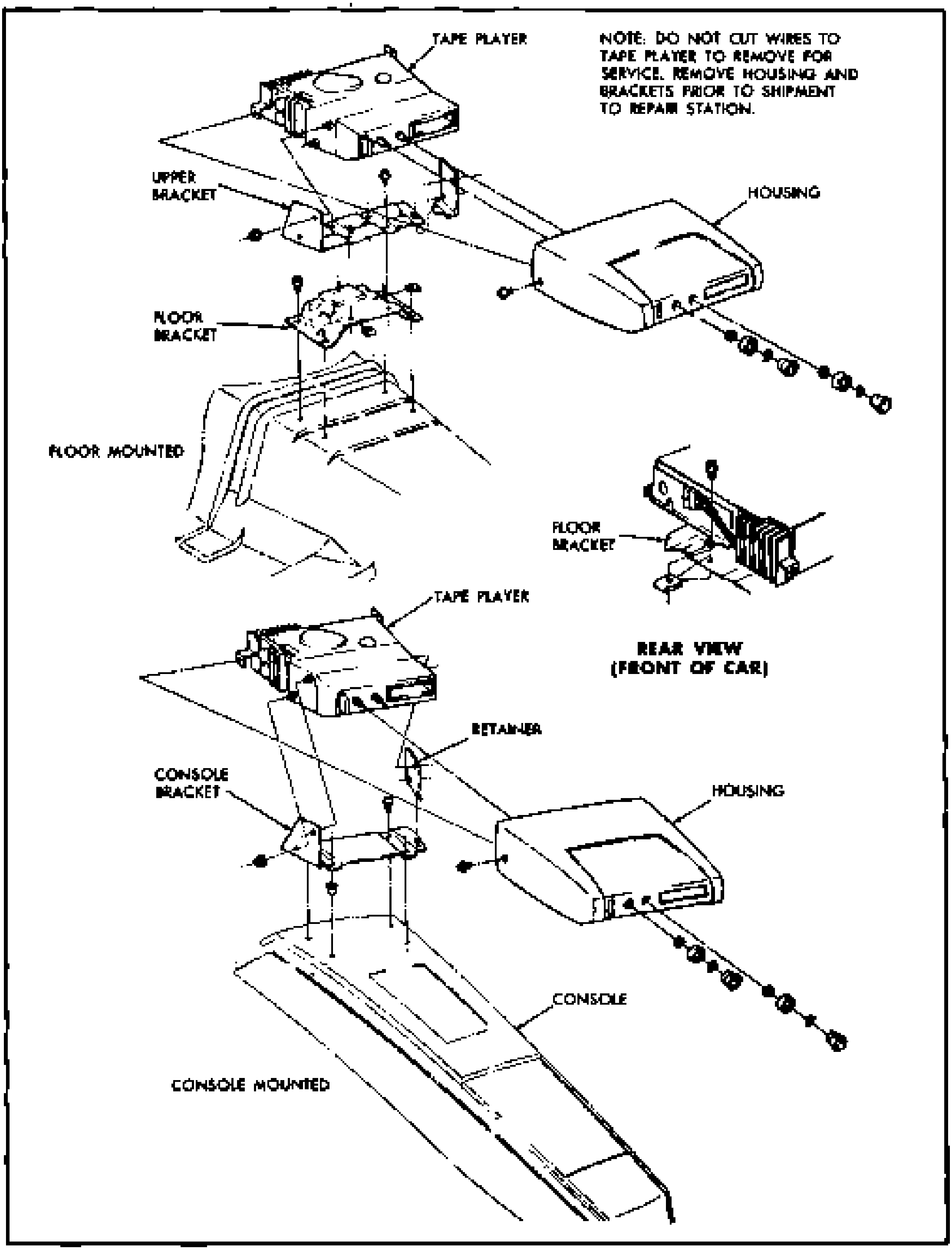


Fig. 15-67 Stereo Tape Player - Firebird

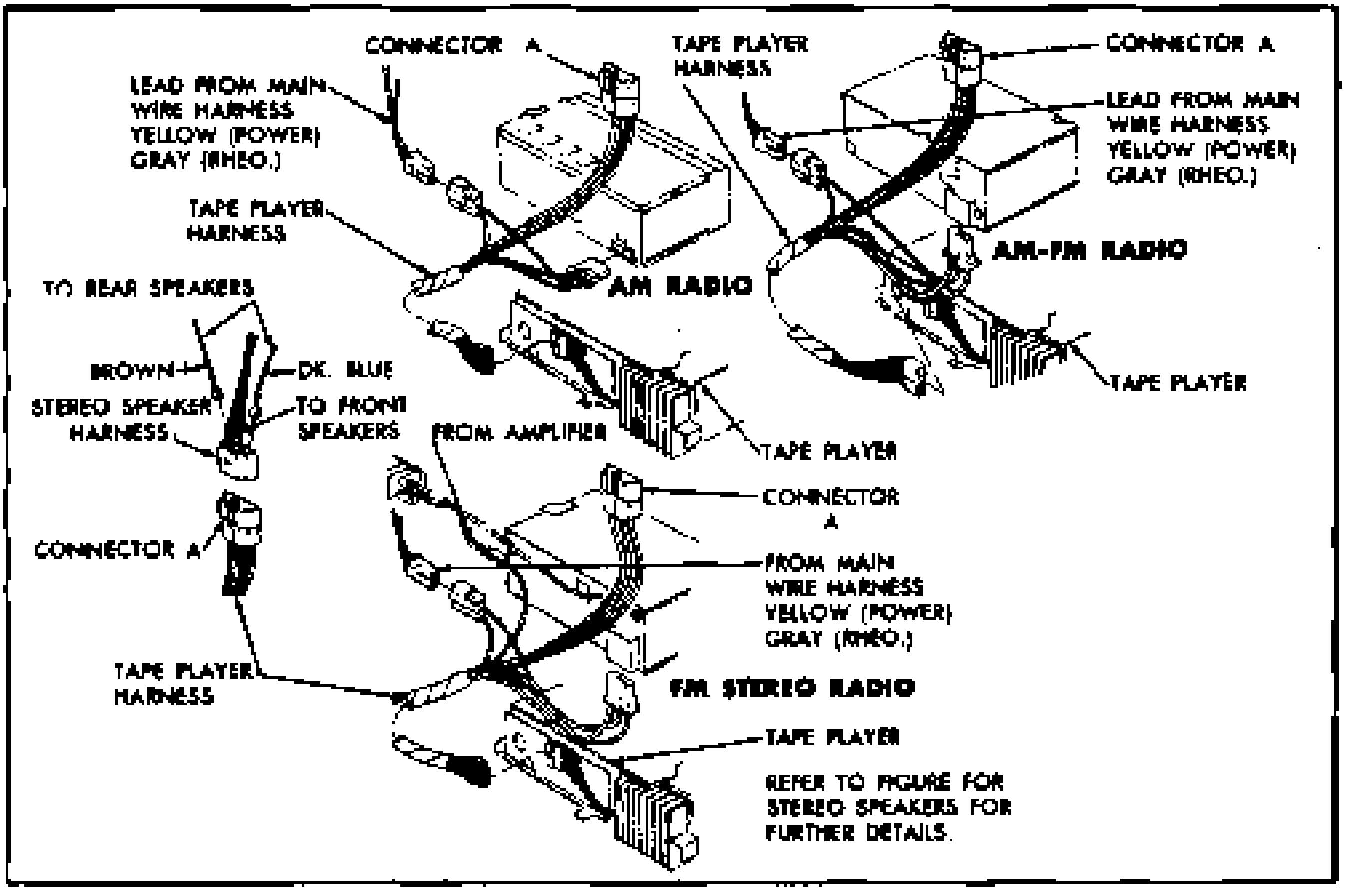


Fig. 15-68 Stereo Tape Player Wiring - Firebird

FM STEREO RADIO

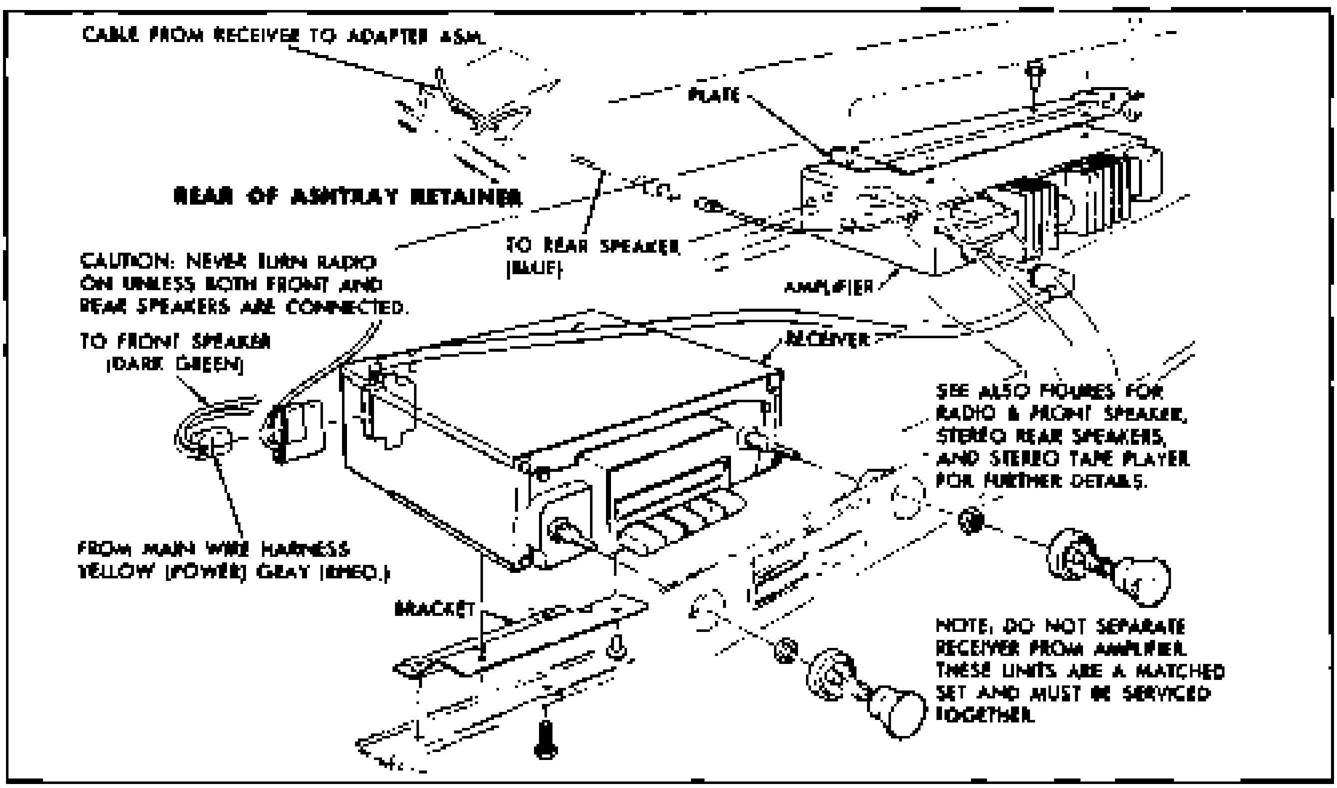


Fig. 15-69 FM Stereo Radio - Pontiac

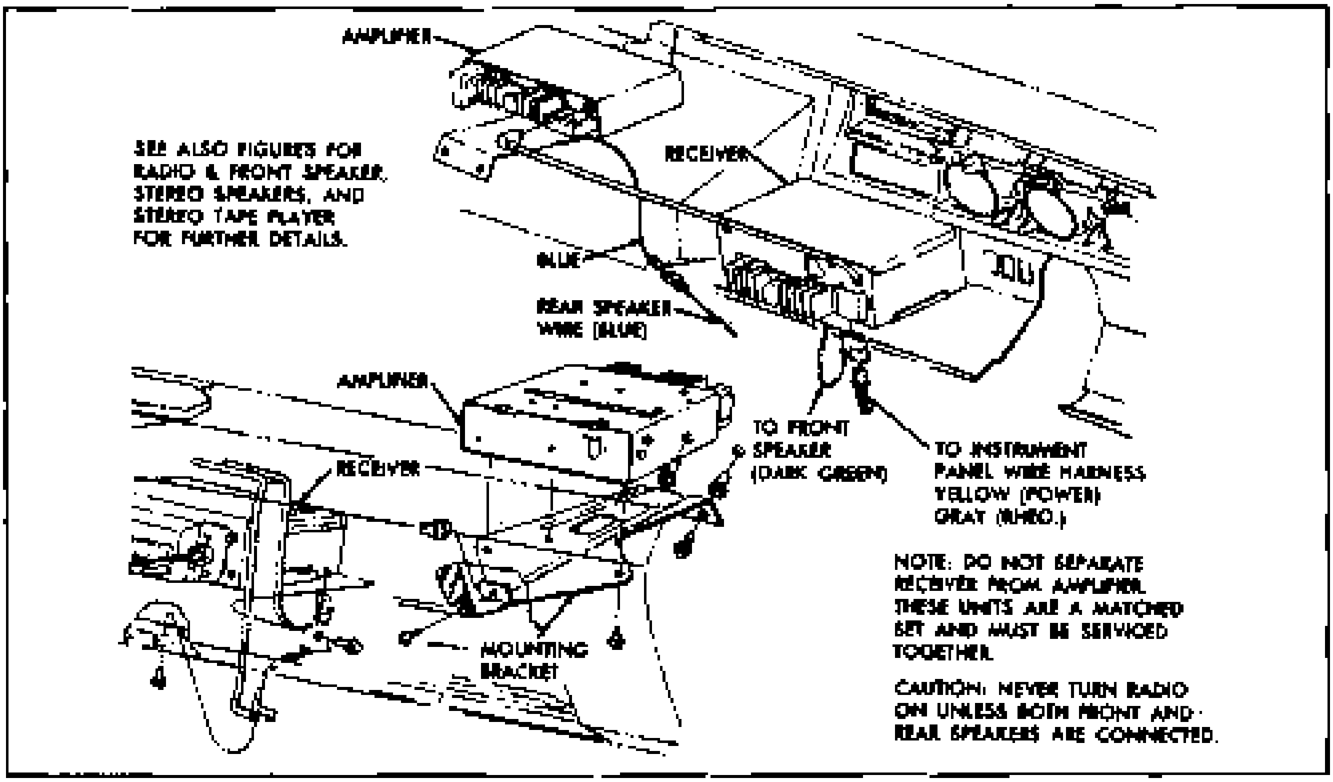


Fig. 15-70 FM Stereo Radio - Tempest

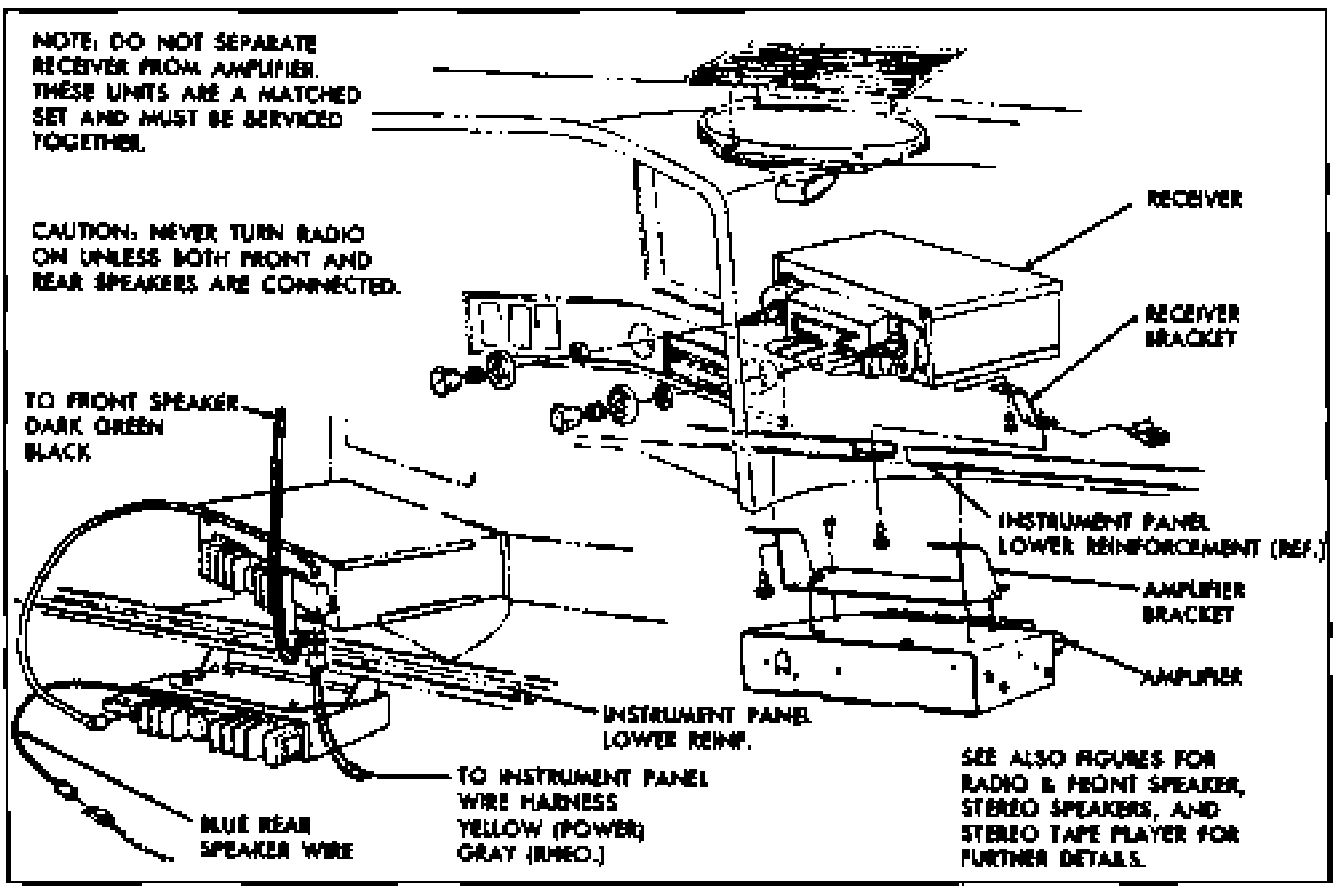


Fig. 15-71 FM Stereo Radio - Grand Prix

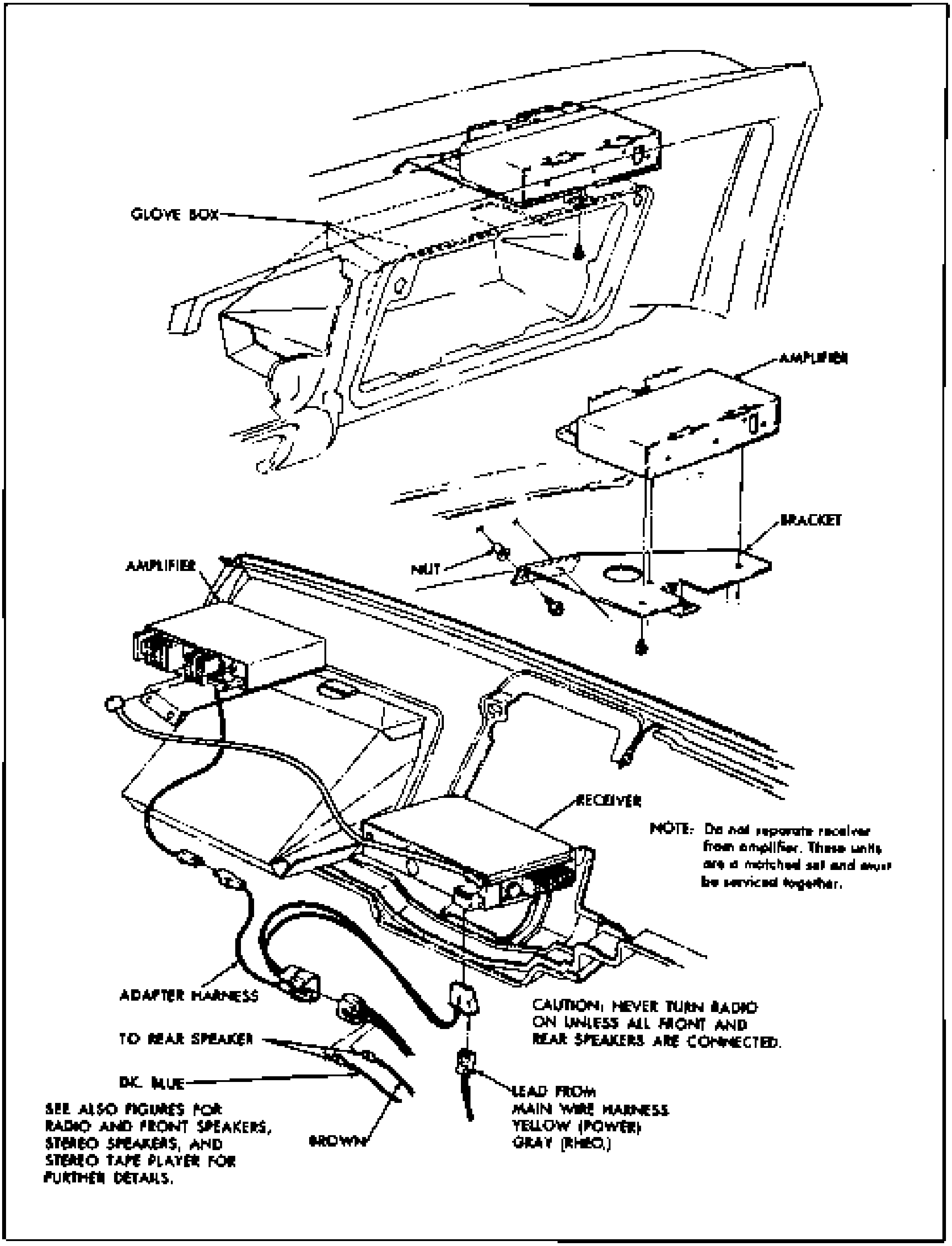


Fig. 15-72 FM Stereo Radio - Firebird

STEREO SPEAKERS

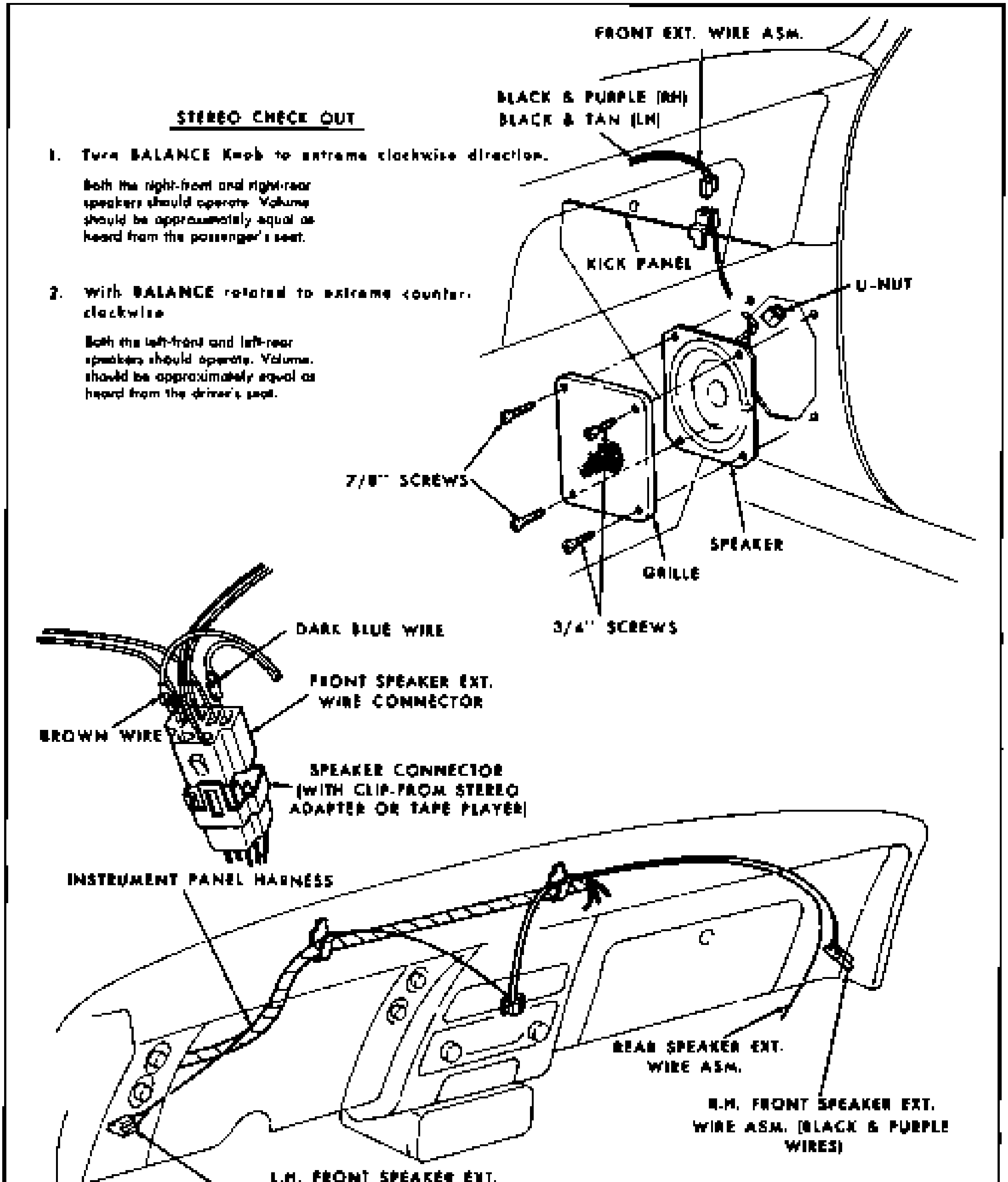


Fig. 15-73 Stereo Front Speakers - Firebird

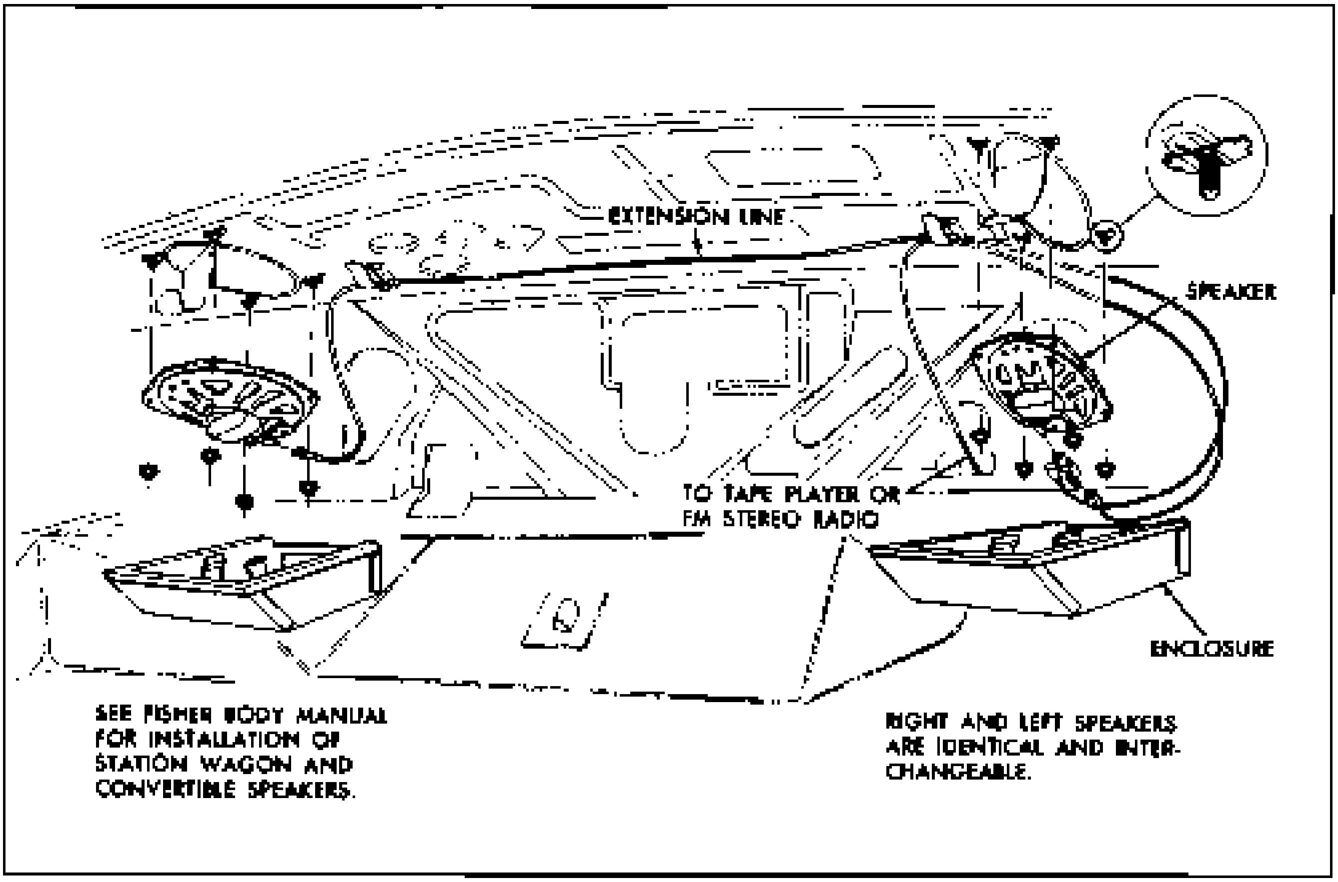


Fig. 15-74 Stereo Rear Speakers - Pontiac

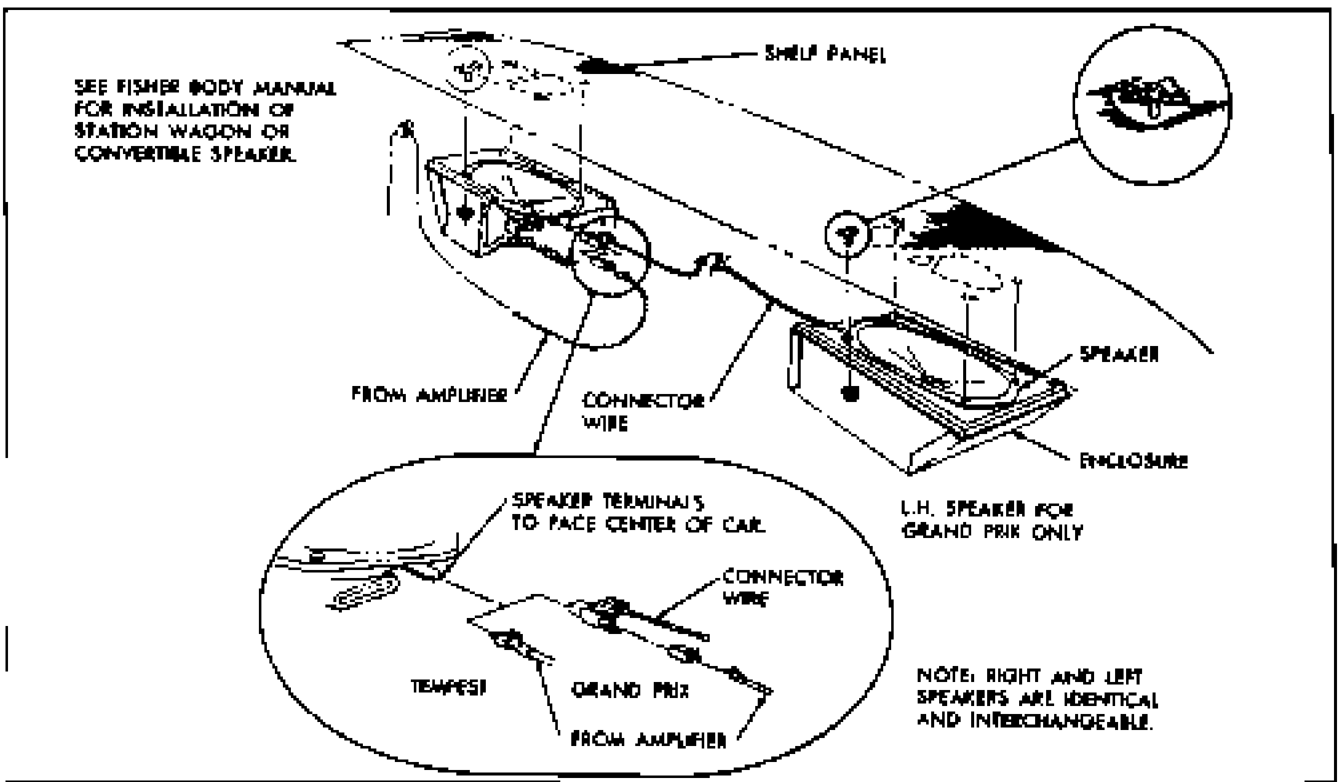


Fig. 15-75 Stereo Rear Speakers - Tempest and Grand Prix

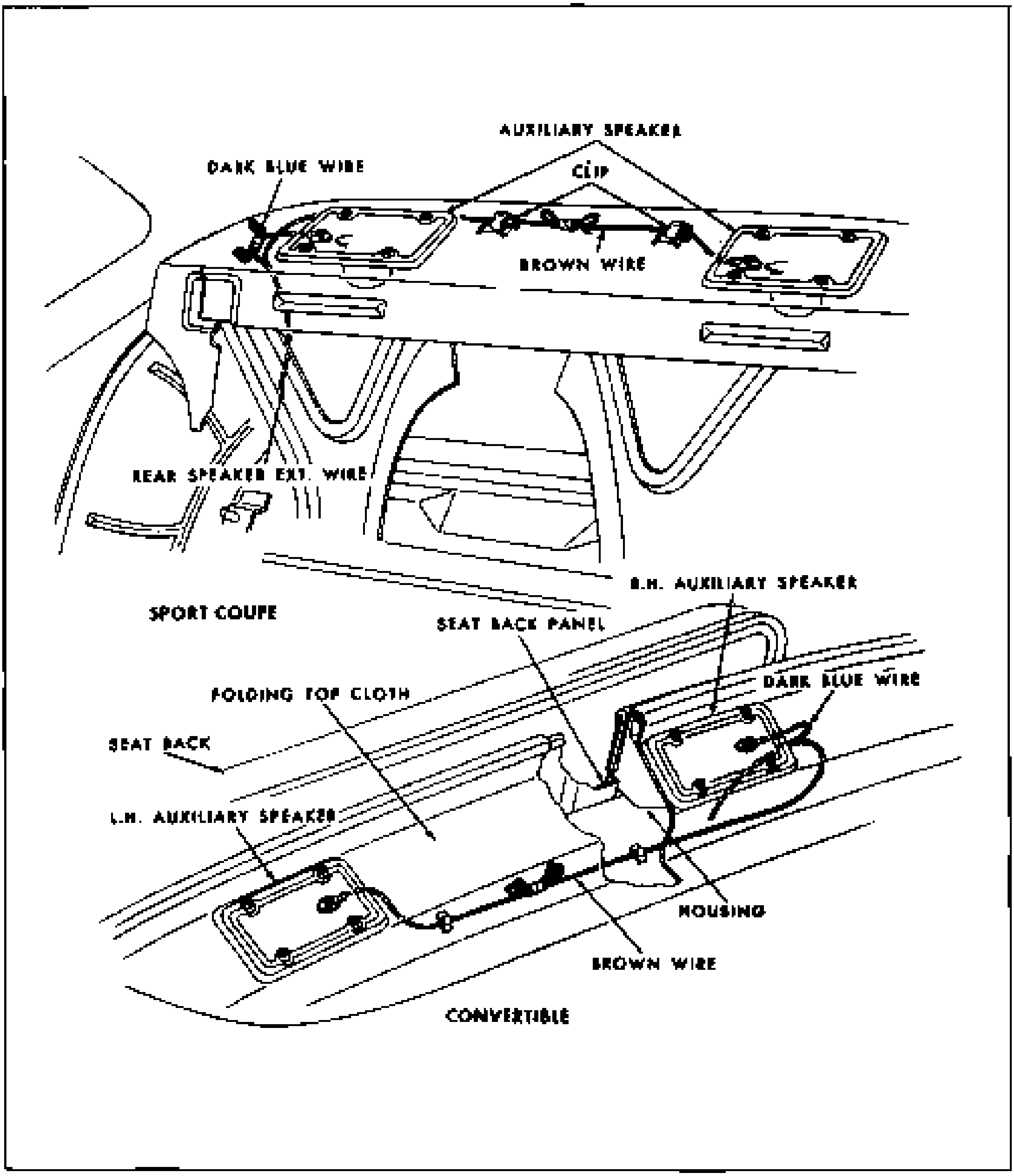


Fig. 15-76 Stereo Rear Speakers - Firebird

INDEX

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

U

V

W