SERVICE MANUAL

TRANSMISSION

MT Series

PRICE $3.50

FORM
SM-MT Series
NOVEMBER 1962

SAY "HUFF"
HOUGH®
THE FRANK G. HOUGH CO., LIBERTYVILLE, ILL.
A SUBSIDIARY OF INTERNATIONAL HARVESTER COMPANY

SERVICE MANUAL

MT SERIES TRANSMISSION
(This manual includes MT Models 30, 40 and 41)

as used in

"PAYMOVER" MODELS

T-180F · TD-180F · T-225SL · TD-225SL

· T-245S · T-300SL · TD-300SL

Prepared by

ALLISON DIVISION
General Motors Corporation
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in cooperation with

THE FRANK G. HOUGH CO.
Libertyville, Illinois

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Section I INTRODUCTION

1. GENERAL

This manual contains information for the operation, maintenance and overhaul of the 6-speed fully automatic transmission. The manual is divided into 17 sections. Each section begins with page 1, prefixed by the section number, for example, I-1, II-1, etc.

2. SECTIONS

Section I is introductory; sect. II covers general information applicable to the overall application of the transmission to specific vehicles and engines; sect. III describes the transmission and explains its operation; sect. IV covers general maintenance and operating instructions; sect. V gives troubleshooting information; sect. VI covers general overhaul information; sect. VII covers the disassembly of the transmission; sect. VIII through XIV cover rebuild procedures for subassemblies; sect. XV covers assembly of the transmission; sect. XVI outlines tests and adjustments; sect. XVII contains torque specifications and wear limits information.

3. PICTORIAL METHOD

Sections VII and XV (disassembly and assembly of the transmission) are covered by the pictorial step method. Other sections are in the usual paragraph-outline style. All illustrations are numbered from 1 on in sequence within each section and prefixed by the section number, for example I-1, I-2, and III-1, etc.

4. FOLDOUT ILLUSTRATIONS

Nine foldout illustrations in the back of the manual include a cross-section view of the transmission, a schematic diagram of the hydraulic system and seven exploded parts views

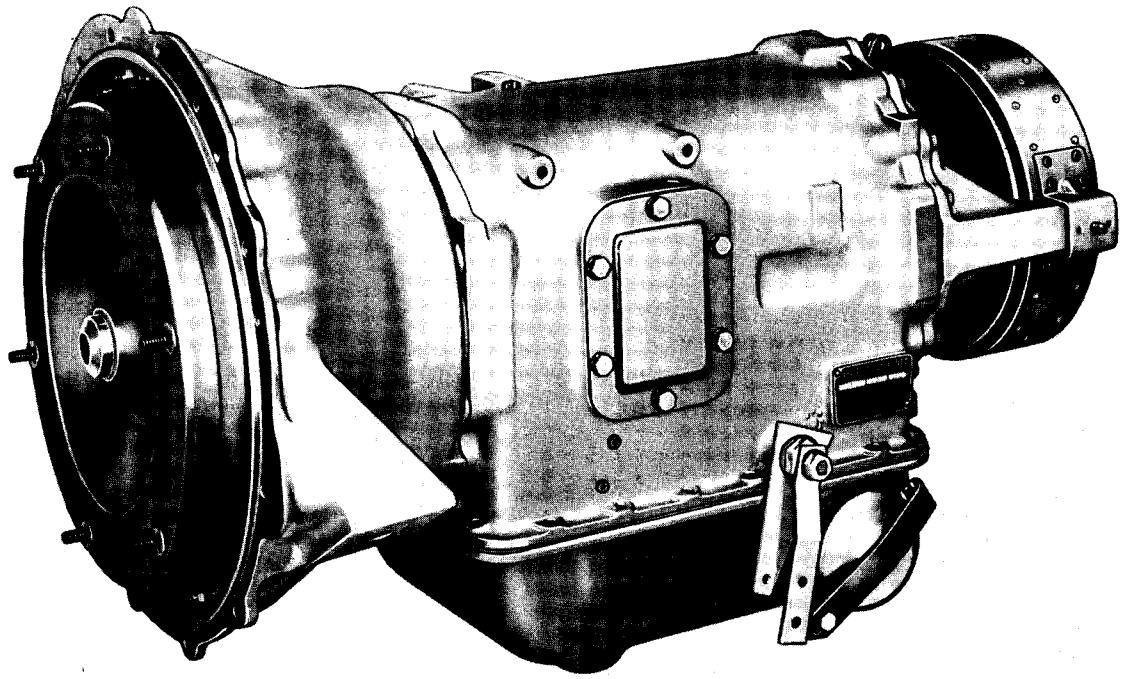


Fig. I-1 1962 MT transmission, left-front view

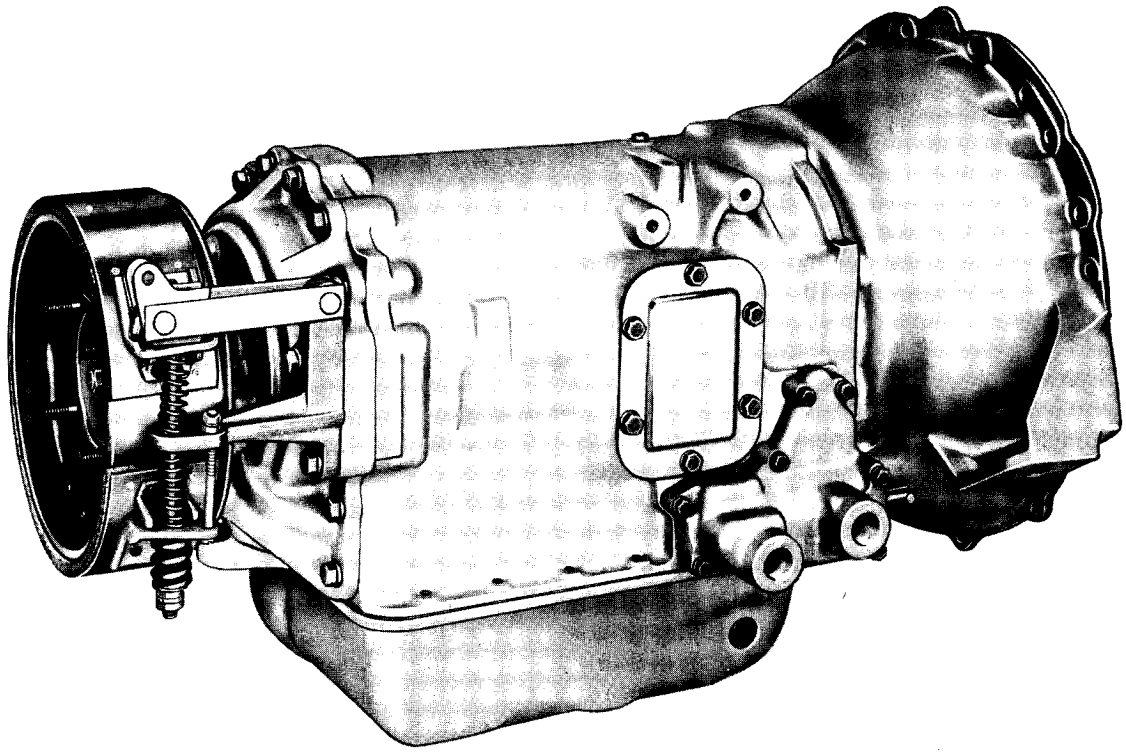


Fig. I-2 1962 MT transmission, right-rear view

of transmission component groups. These may be unfolded for reference simultaneously with the use of any section of the manual.

5. MODELS ILLUSTRATED

Foldout 1 illustrates typical models of the transmission. Driven by the engine flywheel, the combined hydraulic torque converter and planetary transmission replace the conventional disconnect clutch and transmission units. In addition, an automatic lockup clutch and a hydraulic vehicle retarder are included as integral components of the transmission.

6. RANGE AND SPEED

The 3-element torque converter multiplies engine torque, making an auxiliary transmission or 2-speed rear axle unnecessary. The torque converter output drives the planetary type splitter which makes two ratios available to the range gearing. Thus, low-, intermediate- and high-ranges are "split" to give six forward speeds. One reverse speed is available. The manual selector provides neutral, a "creeper" gear, a choice of three drive ranges and reverse. See sect. III.

7. HYDRAULIC OPERATED CLUTCHES

All clutches are hydraulic-operated and concentric with their range gearing. All gearing is of the planetary, constant-mesh type. Lockup of the torque converter and all shifting is automatic within each range. A control valve body assembly continually senses and coordinates all conditions of engine speed, vehicle speed and throttle position, and responds instantly with the proper shift to meet the demand. See sect. III.

8. POWER TAKEOFF

Two SAE regular duty power takeoff mountings are located on the sides of the transmission. The power takeoff drive gear is driven through the torque converter and will operate while the vehicle is moving or in neutral. See sect. III.

9. HYDRAULIC RETARDER

The hydraulic retarder is operated by depressing a foot treadle. The speed of the vehicle can be effectively reduced on straight roads, curves and downgrades without use of the service brakes. Safety and greatly increased service brake life are the advantages of the retarder. A parking brake at the transmission output is optional. See sect. III.

10. GENERAL SPECIFICATIONS AND DATA

Rating:

Max input torque, lb-ft – Model -30	300
– Model -40	400
Max input speed	4000 rpm
Dry weight	525 lb (approx)
Oil capacity (less external system)	17 qt (approx)

Max oil temperature:

Sump	250° F
To cooler – Converter	300° F
– Retarder	380° F
Clutches	Oil wet, hydraulic actuated, self-compensating for wear
Gearing	Planetary, straight cut spur, constant mesh
Output location	In-line with input

Power takeoff (2)

Mounting	SAE regular duty, 6-bolt
Drive gear	57 tooth, 6-8 pitch
Drive gear speed (max)	Engine speed
Oil filter	AC type PF133-1, full flow, replaceable element
Hydraulic retarder	Bladed rotor, vaned stators
Range selector positions (6)	Reverse, neutral, 1-2 range, 3-4 range, 3-5 range, 3-6 range

Hydraulic torque converter

Type	Single-stage, multiphase, 3-element
Torque multiplication ratio: 30H	2.8:1
40H, 40H2, 41H	2.5:1

11. TRANSMISSION RATIOS (mechanical*)

Range	Gear	Ratio	Splitter Clutch	Ratio	Final Ratio
Neutral	--	--	Low	1.39:1	--
First	Low	3.8:1	Low	1.39:1	5.296:1
Second	Low	3.8:1	High	1:1	3.8:1
Third	Int.	1.936:1	Low	1.39:1	2.69:1
Fourth	Int.	1.936:1	High	1:1	1.936:1
Fifth	High	1:1	Low	1.39:1	1.39:1
Sixth	High	1:1	High	1:1	1:1
Reverse	Reverse	4.35:1	Low	1.39:1	6.04:1

*Overall torque multiplication ratio of transmission (output stalled) is the product of the converter torque multiplication ratio and the final mechanical (gear) ratio.

12. OIL PRESSURE SCHEDULE (MAIN)

	30H		40H, 40H2		41H	
	*CT PSI	**FT PSI	CT PSI	FT PSI	CT PSI	FT PSI
First converter	182	239	214	263	214	250
First lockup	72	93	86	104	91	105
Second lockup	72	93	86	104	91	105
Third converter	182	239	214	263	214	250
Third lockup	88	114	104	126	111	128
Fourth lockup	72	93	86	104	91	105
Fifth lockup	72	93	86	104	91	105
Sixth lockup	72	93	86	104	91	105
Reverse converter	182	239	214	263	214	250

*Closed throttle
**Full throttle

1. TRANSMISSION NAMEPLATE

A nameplate on the left side of the transmission, just above the oil filter cover, carries a serial number and an assembly number. Both of these numbers are necessary to correctly identify individual transmission assemblies. Only by supplying this information when parts are ordered can the customer be assured that parts furnished are correct for his model.

2. TRANSMISSION MODEL DESIGNATION

A number and letter prefix to the serial number indicates the year model and transmission configuration for Frank G. Hough Co. as follows:

a. 9F or 9H indicates a 1959 MT-40H.
b. 0H indicates a 1960 MT-40H.
c. 1H indicates a 1961 MT-40H.
d. 2H indicates a 1962 MT-40H.

3. TRANSMISSIONS IDENTIFIED BY MACHINE SERIAL NUMBERS

The machine serial number, transmission assembly part number, transmission year, and model are as follows:

Machine Serial Number	F. G. H. Co. Transmission Assembly P/N	Transmission Year and Model
70AH-101 thru 107	156 888	1959 MT-40H
70AH-108 thru 110	152 971	1959 MT-40H
70AH-111	156 888	1959 MT-40H
70AH-112 thru 140	152 971	1959 MT-40H
70AH-144 thru 156	152 971	1959 MT-40H
70AH-157	152 971H2	1960 MT-40H
70AH-158 thru 165	152 971	1959 MT-40H
70AH-166 thru 174	152 971H2	1960 MT-40H
70AH-181 thru 186	152 971H2	1960 MT-40H
70AH-189 thru 193	152 971H2	1960 MT-40H
70AH-194	152 971H2	1961 MT-40H
70AH-196 thru 198	152 971H2	1960 MT-40H
70AH-199 thru 200	152 971H2	1961 MT-40H
70AH-201	152 971H2	1960 MT-40H
70AH-202 thru 203	152 971H2	1961 MT-40H
70AH-204 thru 208	152 971H2	1960 MT-40H
70AH-210 thru 211	152 971H2	1961 MT-40H
70AH-212	152 971H2	1960 MT-40H
70AH-216	152 971H2	1961 MT-40H
70AH-217 thru 218	152 971H2	1960 MT-40H
70AH-219 thru 220	152 971H2	1961 MT-40H
70AH-221	152 971H2	1960 MT-40H
70AH-222	152 971H2	1961 MT-40H
70AH-223	152 971H2	1960 MT-40H
70AH-224	152 971H2	1961 MT-40H
70AH-226 thru 227	152 971H2	1960 MT-40H
70AH-228 and up	152 971H2	1960 MT-40H
66AB-101 thru 109	181 415	1962 MT-40H
93AG-101 and up	180 052	1962 MT-40H
92AH-101 and up	178 450	1962 MT-40H
71AG-101 and up	180 052	1962 MT-40H

4. ORDERING PARTS

Instructions for ordering parts are found at the beginning of the Parts Manual for the specific "PAYMOVER" model. Refer to para 1, above.

5. PART NUMBERS FOR FILTERS, KITS, GASKETS, SEALS, ETC.

For part numbers for filter elements, kits, gaskets, seals, etc. which require replacement at normal service intervals, refer to the Parts Manual covering the specific "PAYMOVER" model.

6. OIL RECOMMENDATIONS

For oil recommendations under various temperature and operating conditions, refer to the Operator's Manual covering the specific "PAYMOVER" model.

7. OIL CHANGE AND OIL FILTER CHANGE INTERVALS

For oil change and oil filter change intervals under various conditions, refer to Operator's Manual covering specific "PAYMOVER" model.

8. OIL COOLER CIRCUIT

For oil cooler circuit information, refer to fig. II-1, and also para 18, below.

9. VEHICLE OPERATING INSTRUCTIONS

For operating instructions as related to driving the vehicle, refer to the Operator's Manual covering the specific "PAYMOVER" model.

10. SPECIFICATIONS FOR IDLE SPEED, OIL TEMPERATURE, ETC.

This information is found in the Operator's Manual covering the specific "PAYMOVER" models.

11. BREATHER AND CONNECTING LINES

Refer to the Operator's Manual covering the specific "PAYMOVER" model.

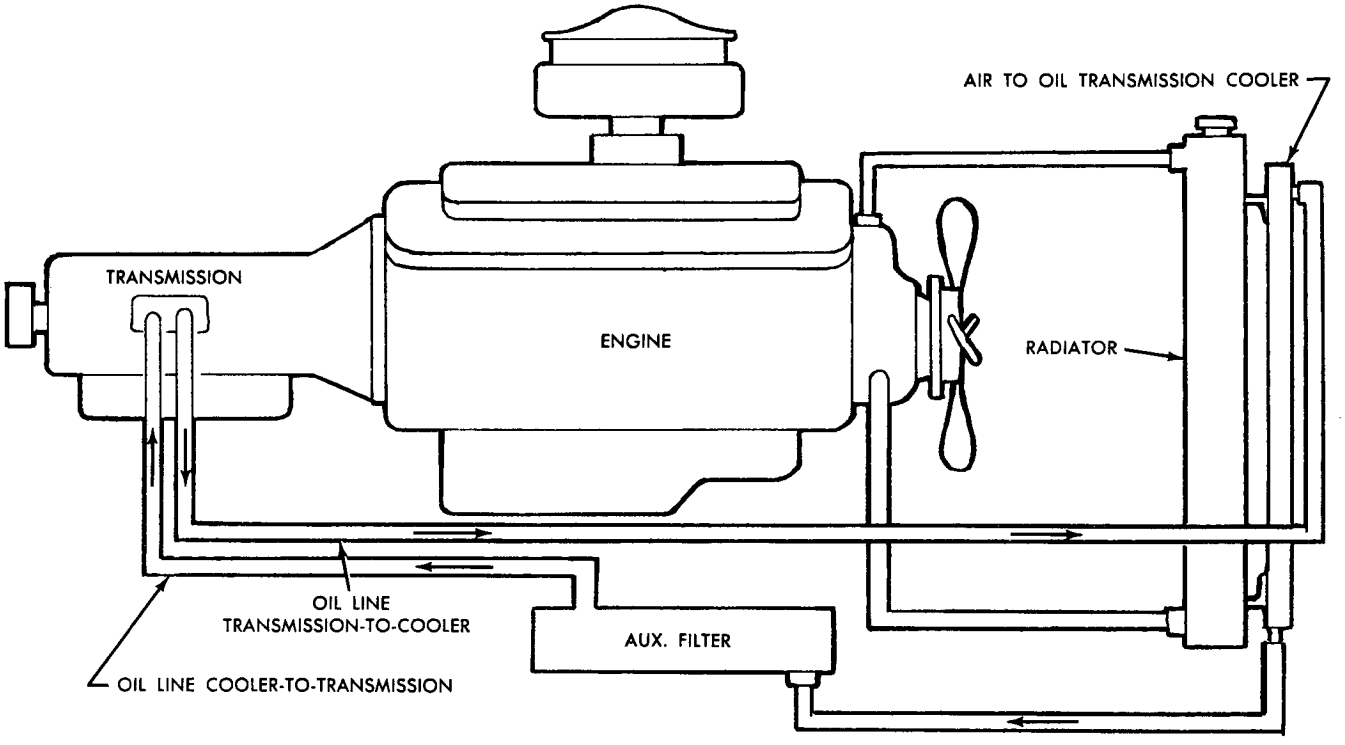


Fig. II-1 Schematic diagram, showing relative position of auxiliary filter

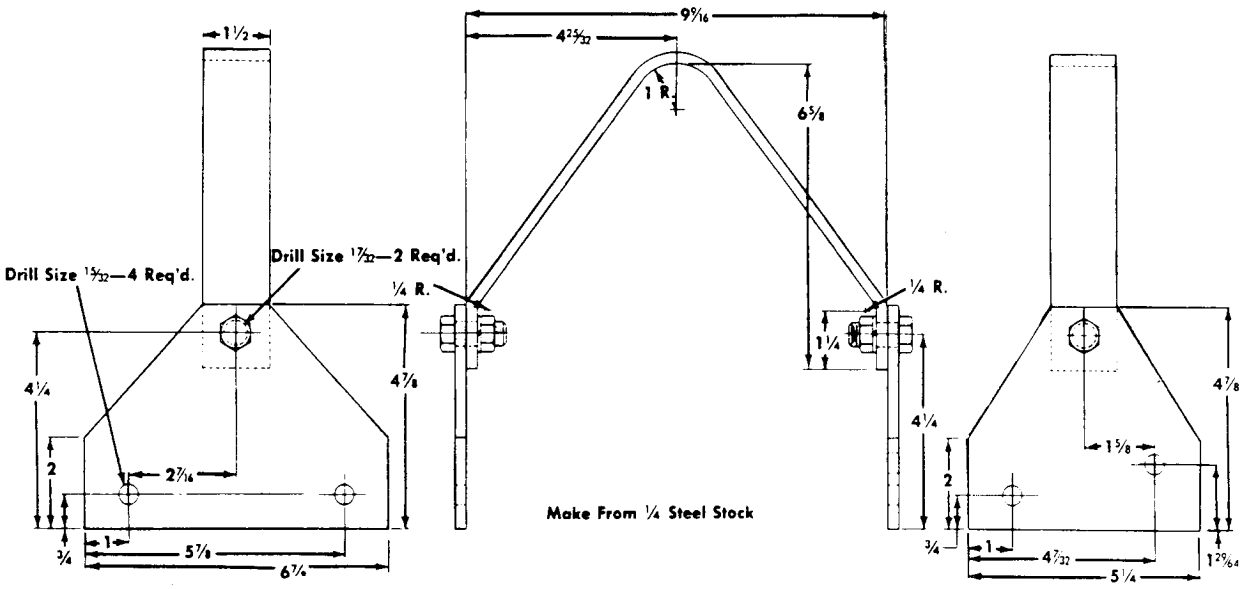


Fig. II-2 Improvised sling dimensions

12. SPECIAL TOOLS AND EQUIPMENT

Reference is made to special tools in some sections of the service manual. These tools, or their equivalent, are necessary and recommended to efficiently accomplish certain service operations. These tools are not supplied by The Frank G. Hough Co. The name and address of a tool vendor is shown only as a reference. Information regarding availability of tools, their price and delivery, should be obtained by contacting the reference vendor. Other tool vendors in your immediate area may be able to supply comparable special tools. The following tools are supplied by Kent Moore Organization, 1501 S. Jackson Street, Jackson, Michigan.

Tool Number	Name of Tool
J 6438	Piston return spring compressor
J 3387-2	Guide bolts (front and rear oil pumps)
J 6430	Lifting hook
J 6467	Clutch clearance checking fixture
J 6795	Input drive pump cover assy remover
J 6889-1	Guide bolts (front pitot tube)
J 6889-2	Guide bolts (rear pitot)
KMO-630	Snap ring pliers

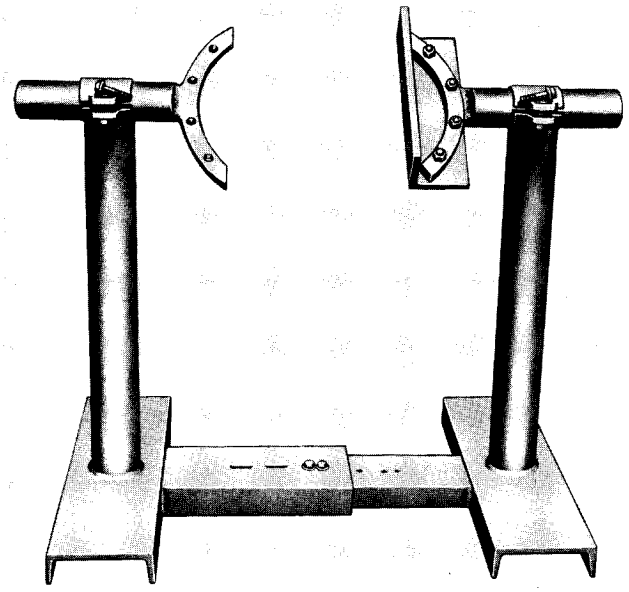


Fig. II-3 Transmission repair stand

Figure II-2 illustrates an improvised sling. The photograph and drawings in figs. II-3 through II-3B illustrate a transmission repair stand. Both can be fabricated.

13. TRANSMISSION REMOVAL FROM MODELS T-225SL AND T-300SL "PAYMOVER"

a. The MT-40H transmission weighs approximately 550 pounds. An adequate over-

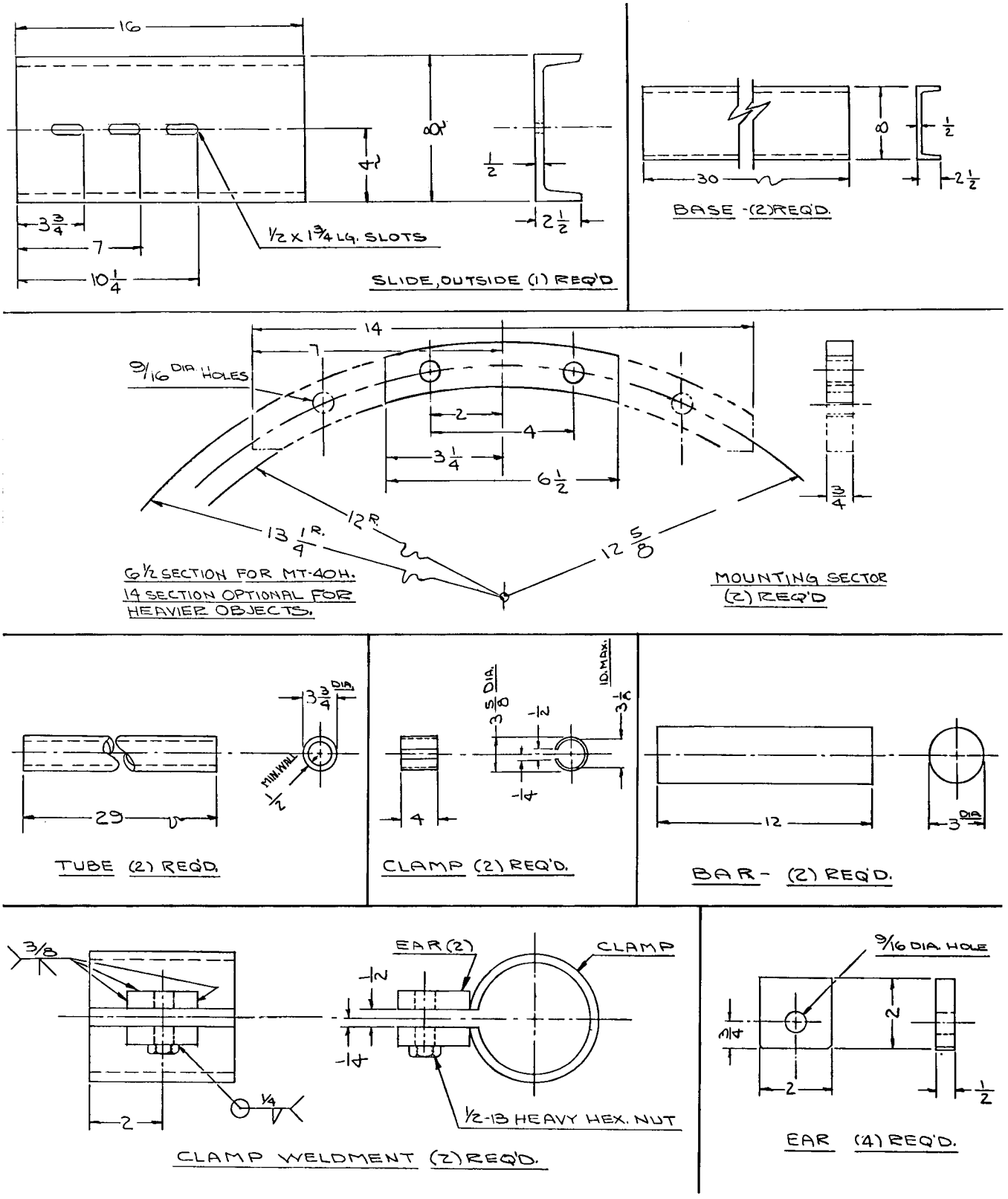


Fig. II-3A Transmission repair stand—detail parts

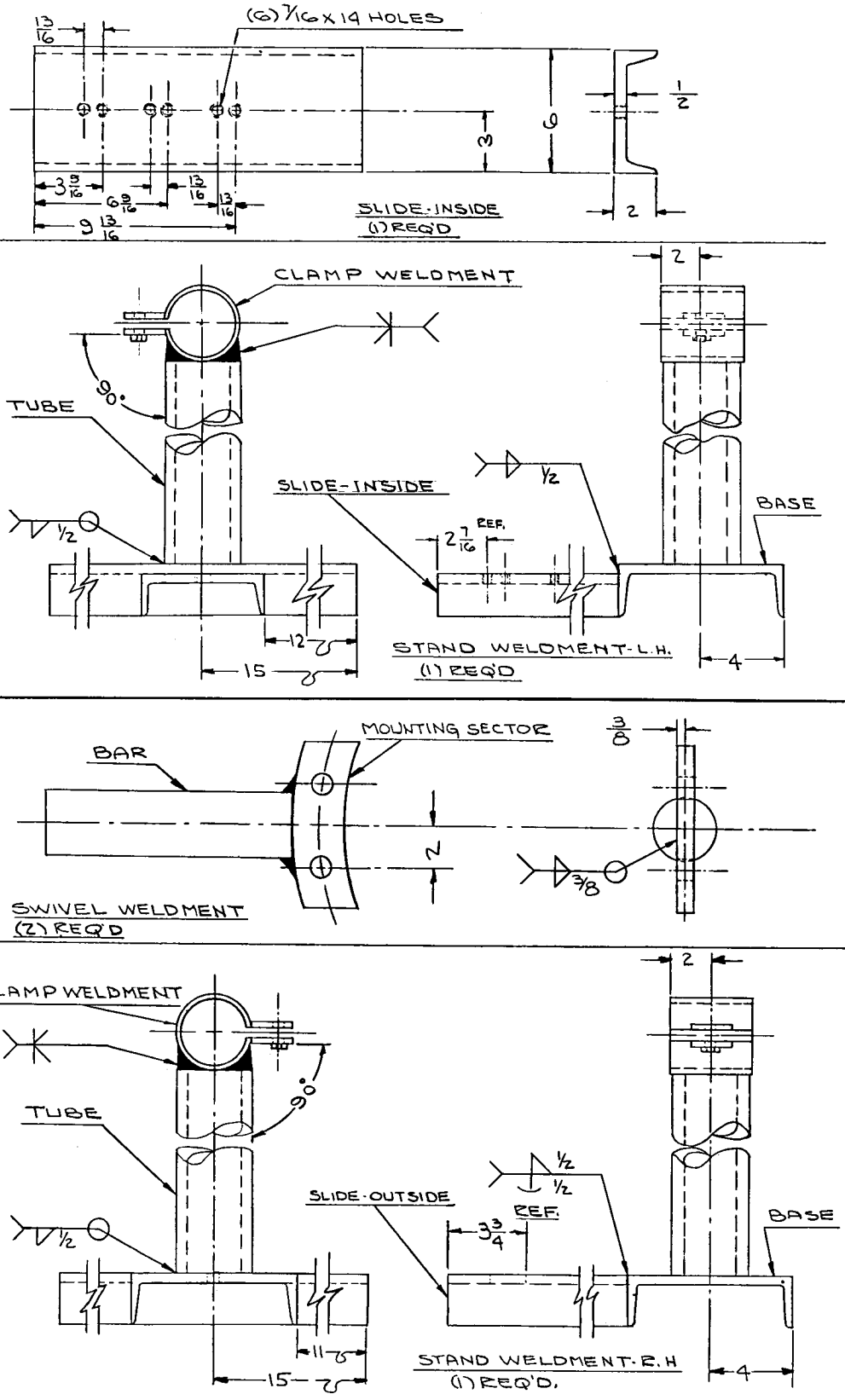


Fig. II-3B Transmission repair stand—detail parts

head hoist, a roll-away, A-frame or a mobile hydraulic lift should be used.

b. A roll-away, A-frame or an overhead crane may be utilized to best advantage on machines without a cab. The roll-away mobile hydraulic lift can be used to best advantage on machines with cabs, where cab lifting facilities are not available. Place the lift through the door of the cab and hoist the transmission up into the cab area. Remove the transmission through the cab door.

c. Block the "PAYMOVER" wheels and disconnect the batteries in the operator's compartment.

d. Drain the oil from the transmission (refer to sect. IV, para 7). Let the oil drain while work is being done on the various parts necessary for transmission removal.

e. If the machine utilizes a heater, the two water lines to and from the heater should be disconnected and plugged. Remove the air intake to the heater. Remove the clevis pins holding the TV rod and the selector valve rod. Remove two plates covering the top of the transmission.

f. Remove the drive shaft between the transmission and transfer case by sliding the yoke on the input shaft of the transfer case as far to the rear as possible.

g. By rotating the drive shaft and parking brake drum, the short drive shaft can be worked out.

h. Remove the speedometer cable at the rear of the transmission.

i. Remove the bellcrank for the parking brake and the parking brake handle from the transmission.

j. Remove the small rectangular plate secured by two capscrews on the bottom of the engine bellhousing.

k. Remove the six elastic stop nuts used to secure the converter input drive to the flywheel flex plate drive with a ratcheting 9/16-inch box-end wrench and a flashlight. (By reconnecting the batteries temporarily and using the starter button, the engine can be slightly rotated to position the elastic stop nuts at the rectangular hole in the bellhousing.)

> Caution: Remove ignition coil wires, or other devices to prevent engine starting. (Removal of high voltage ignition coil wire only, can cause damage to coil.)

l. Disconnect and remove the two batteries from the "PAYMOVER" and the battery box support to allow access to the transmission mounting bolts that attach the transmission to the engine bellhousing.

m. Remove the breather hose and oil filler pipe from the transmission. Disconnect the oil cooler "in" and "out" lines on the right side of the transmission. (Tag the "in" line to insure proper replacement; plug the openings to keep clean.)

n. Remove the single capscrew holding the rear transmission mount to the main frame.

> Note: If improvised sling (fig. II-2) is not available, two chains should be used to support the transmission while it is being removed per following step.

o. Install one chain by using capscrews in the parking brake linkage holes near the front of the transmission. Wrap one chain around the rear bearing retainer housing so it will not interfere with the parking brake linkage. The transmission should be as level as possible.

> Note: If the transmission does not have a removable rear mount, it is necessary to remove the transmission oil pan, the oil filter can assembly, the main control valve body assembly, the downshift timing valve assembly and the oil transfer plate assembly. (Refer to sect. VII, steps 13 through 18.) A piece of smooth, clean sheet metal or aluminum stock approximately 1/16-inch thick must be cut and used to cover and protect the finished bottom surface of the transmission while it is being removed without oil pan in place. Secure

this plate to the transmission with four oil pan bolts. If the transmission has a removable mount, it is not necessary to remove oil pan, etc., until disassembly in sect. VII.

p. Place a slight tension on the hoist and remove the 16 capscrews used to hold the converter housing to the engine bellhousing. Care should be taken when the transmission is pulled away from the flex plate so the threads on the converter input drive studs do not catch and damage the flex plates.

q. When studs are free of the flex plates, pull the transmission backward and lift it out of the "PAYMOVER."

14. TRANSMISSION REMOVAL FROM MODEL T-180F "PAYMOVER"

Items a through o (except Note) are identical to those of Models T-225SL and T-300SL "PAYMOVER." For these two models, substitute in item o the following:

> Note: It is not necessary to remove the transmission oil pan, etc., to remove the transmission from the T-180F "PAYMOVER." Remove the capscrews holding the rear transmission mount. With this mount removed, sufficient clearance is available to proceed with items p and q to complete removal of transmission.

15. TRANSMISSION REMOVAL FROM MODEL T-245S "PAYMOVER"

On machines without a cab, the roll-away, A-frame, or an overhead crane, may be utilized to best advantage. On machines with cabs, the cab should be removed before removal and disassembly begins. Follow instructions of para 13 for Models T-225SL and T-300SL, except in item o, substitute the Note of item o, para 14. In item l it is necessary to disconnect batteries only.

16. TORQUE CONVERTER DRIVE – INSPECTION AND REPLACEMENT

a. Inspect Flex Plates. If for any reason the flex plates are found to be damaged upon removal of the transmission, the crankshaft end play must be checked and shimmed as required. When a change in the shim pack is required, 0.005-inch and 0.010-inch shims should be used. Inspect the three flex plates for cracks or ripples in the plate. Use retainer (fig. II-4) under the long capscrews used to hold flex plates and adapter to the engine crankshaft.

> Caution: The flex plate drive must be checked and shimmed properly to prevent damage to the engine bearings and/or front oil pump in transmission. (Refer also to sect. XV, para 2, steps 70 and 71.)

b. Transmission Flex Plate Drive Check. Before mounting the hub, pull the engine crankshaft outward toward transmission and measure the distance from Surface "A" (fig. II-4) to the transmission mounting flange surface. This nominal dimension should be 4.812 inches. If the measurement coincides with this, the nominal shim pack of 0.030 inches should be placed under the flex plates in the assembly as shown. If the measured dimension is greater than 4.812 inches, shims (equal to the difference between the measured dimension and 4.812 inches) should be added to the nominal 0.030-inch shim pack. If the dimension is less than 4.812 inches, subtract the difference from the nominal 0.030-inch shim pack. Figure II-4 shows the torque value to apply to the capscrew holding the retainer, flex plates, shims, and hub to the engine crankshaft.

c. Stack Height Measurements. For torque converter input drive stack height measurements, refer to sect. XV, para 2, steps 70 and 71.

17. REINSTALLING TRANSMISSION "PAYMOVER"

a. For units with the removable rear transmission mount, the transmission may be assembled completely and prepared for reinstallation into the machine. For units that do not have the removable rear transmission mount, the transmission oil pan, oil filter can assembly, main control valve body assembly, the downshift timing valve assembly and oil

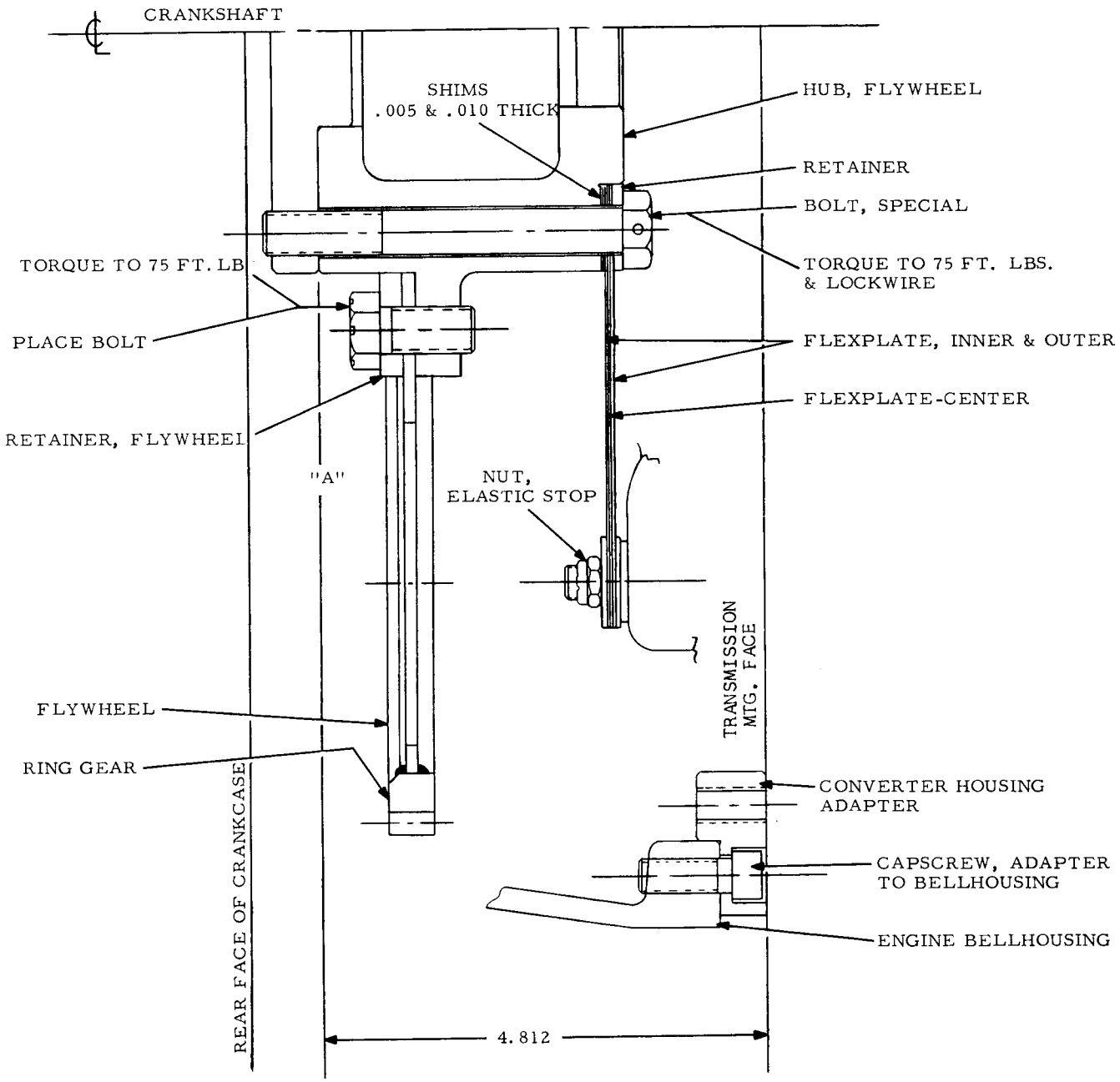


Fig. II-4 Torque converter drive—cross section

transfer plate assembly should be left off transmission. The sheet metal plate (used in removal, para 13o Note, above) should be bolted to the bottom of the transmission.

b. Assuming that the flex drive plate spacing is correct (para 16b), and the converter input drive stack height is proper (sect. XV, steps 70 and 71), the transmission should be rigged, using the same method as in removal, and lowered into the machine.

Note: The transmission must be as level as possible.

c. Two men are needed – one to push the transmission into the bellhousing, the other under the vehicle with a flashlight and screwdriver to rotate the converter input drive until drive studs line up with flex plate holes. All studs must be alined with flex plate holes and started at the same time to prevent binding.

d. With all converter input drive studs in their holes in the flex plate, install the 16 bolts used to mount the converter housing to the engine bellhousing. Install rear mount, (if removed) and the long capscrew used to hold the rear of the transmission to the main frame mount.

e. Using a flashlight and a ratcheting 9/16 box end wrench, install the elastic stop nuts (fig. II-4) to hold the flex plate drive to the converter input drive.

Caution: Check to see that engine is disabled from starting before rotating flex plate to reach studs.

f. Once the nuts are added to the flex plate drive, the capscrews on the bellhousing are secured and the rear mount capscrew is secured, the remainder of the installation is exactly the reverse of transmission removal for the specific "PAYMOVER" model.

g. For installations with oil pan, etc. removed, refer to sect. XV, steps 61 through 69 for pan, etc. installation.

18. INSTALLING AUXILIARY FILTER

a. The addition of an auxiliary filter in the transmission oil cooler oil return circuit can prevent a transmission failure.

b. Should a failure occur, debris from the failed parts usually is deposited in the oil cooler. If bits of this material get into the new or rebuilt transmission, they can cause immediate damage to seals and bearings, resulting in another failure. The cooler is then further contaminated and the trouble cycle goes on.

c. Such expensive and time-consuming repeat failures can be prevented by the installation of a relatively inexpensive auxiliary filter in the transmission oil cooler oil return line. (Various methods of cleaning contaminated coolers have been thoroughly investigated, but have proved ineffective.)

d. The filter used for this purpose must be equipped with a bypass valve set at 5 psi. This is the maximum restriction allowable. A filter assembly of this type is available from AC Distributors under AC P/N 5576622. The filter element used in this filter assembly is an AC filter, PF-132, P/N 5573014. Figure II-1 shows schematically the relative position of the auxiliary filter in the oil cooler circuit. The actual location of the filter in the vehicle oil cooler oil return line will have to be determined locally.

e. Since the addition of the auxiliary filter is the least troublesome and least expensive way of providing positive insurance against repeat failures caused by contamination, it is strongly recommended that this protective device be added to each vehicle that has had a transmission failure.

f. Change this filter element after 15 hours operation after transmission failure.

19. DESCRIPTION OF CONTROLS; LINKAGE ADJUSTMENT

The description of controls and instructions for adjustment of linkages are found in the Operator's Manual covering the specific "PAYMOVER" models.

20. PARKING BRAKE ADJUSTMENT

a. The parking brake handle operates an external band type mechanical brake on the rear output shaft of the transmission. Apply the brake when the vehicle is stopped or parked on an incline; release the brake before moving the tractor. It is essential that the parking brake is not used to stop the vehicle in any forward or reverse motion. Damage to the parking brake drum and the rear bearing retainer can result.

b. It is also essential that the proper clearance be held between the parking brake band and the parking brake drum to minimize the heat generated between the lining and the drum. Insufficient clearance will cause premature drum failure, or the parking brake may become inoperative.

c. Minor brake adjustments can be made by turning the knurled knob on the top of the

parking brake handle. When major adjustments are required, the knurled knob should be backed off completely. At this point, the adjustment of the parking brake band clearance at the transmission will be necessary.

d. Tighten (or loosen) slotted brake anchor adjusting screw 56 (foldout 7) until there is 0.015-inch (feeler gage) clearance between parking brake band assembly 38, and the brake drum 37 surface at the slotted screw location. Lock in position with lock wire 57.

e. Tighten slotted fillister-head screw 54 (foldout 7) on the right side of band assembly 38, until there is 0.030-inch clearance between the lower end of the band and drum 37 surface when a 0.010-inch shim is placed between the drum and band directly opposite the 0.030-inch measurement.

f. Tighten brake adjusting bolt 40, and nuts 52 on the right side of the band assembly until there is 0.030-inch clearance between the top end of band assembly 38 and drum 37 surface when a 0.010-inch shim is placed between the drum and band directly opposite the 0.030-inch measurements.

g. Tighten hexagon lock nuts 52 on adjusting bolt 40, and lock nuts 45 on adjusting screw 54 on the right side of band assembly 38.

21. FURTHER TRANSMISSION INFORMATION

For service information bulletins, part number changes or additional service information pertaining to the Allison Fully Automatic Transmission, MT 40H, used in "PAYMOVER" Towing Tractors, contact your local, authorized, "PAYLOADER" – "PAYMOVER" distributor.

Section III DESCRIPTION AND OPERATION OF COMPONENT PARTS

INPUT DRIVE, LOCKUP CLUTCH, TORQUE CONVERTER

1. KEYED TO FOLDOUTS

In the following description the reference numbers are keyed to the parts as shown in foldout 3 at the back of the manual. Exceptions are noted in the text.

2. CONVERTER COVER ASSEMBLY

The converter pump cover assembly 1 is the input member of the transmission. It connects to the engine through a flexible drive plate (furnished with vehicle). The cover contains lockup clutch piston 5. The cover and lockup clutch back plate 11 is bolted to and drives torque converter pump 48. Lockup clutch plate 7 is located between the friction faces of piston 5 and back plate 11. It is splined to the hub of torque converter turbine 12.

3. TURBINE AND STATORS

Turbine 12 is splined to shaft and rotor assembly 2 (foldout 4). Stator and cam assembly 13 (foldout 3) is located between pump 48 and turbine 12. It is mounted, free to rotate only in the direction of engine rotation, on freewheel roller race 15. Springs 16 and rollers 17 cause freewheel action. This complete group is mounted on stationary ground sleeve 29. The converter pump cover, lockup clutch parts and converter pump all rotate on ball bearing 23. Freewheel race 15 is splined to the ground sleeve.

4. CONVERTER HOUSING

Converter housing 40 encloses the converter components and provides a mounting by which the transmission is bolted to the engine flywheel housing. A positive displacement internal-external gear type pump 42 supplies oil pressure for all transmission functions. The pump is mounted in the converter housing and is driven by converter pump hub 24.

5. MULTIPLYING TORQUE HYDRAULICALLY

The enclosure formed by the converter pump cover 1 and converter pump 48 is constantly charged with oil in which the lockup clutch and torque converter operate. The rotation of the converter pump throws oil into the outer blades of the turbine 12, causing it to rotate. The oil returns to the pump by passing through the blades of the stator 13. When the transmission is operating under a heavy load, the stator locks up and directs the oil toward the direction of pump rotation – thus aiding the pump. This is the key to torque multiplication.

6. FLUID COUPLING AND FREEWHEELING

When the pump and turbine approach equal speeds, the angle of oil flow changes, the stator freewheels and the converter acts as a fluid coupling. The input pressure pump supplies pressure any time the engine is operating. A constant circulation of oil through the converter is maintained for cooling and lubrication.

7. AUTOMATIC LOCKUP

The lockup clutch is automatically charged with oil pressure when sufficient speed is attained. This locks the converter pump and turbine together for direct mechanical drive, eliminating slippage. The lockup clutch automatically releases during any shift regardless of speed.

FRONT GEAR AND CLUTCH GROUP

8. KEYED TO FOLDOUTS

In the following description the reference numbers are keyed to the parts as shown in foldout 4 at the back of the manual. Exceptions are noted in the text.

9. DESCRIPTION

The front gear and clutch group includes shaft and rotor assembly 2, splitter planetary carrier assembly 8, low-splitter clutch (7, 20 and 31), and high-splitter clutch (15 through 26, except 20), high-range clutch (39 through 54), high-range clutch diaphragm 35, splitter output shaft 59, intermediate-range sun gear 61 and low-range sun gear 62. All components and subassemblies in this group are located in the front of the transmission housing and are removed or installed from this position. The shaft and rotor assembly 2 includes the turbine output shaft, hydraulic retarder rotor and splitter ring gear. The shaft transmits torque from the converter turbine 12 (foldout 3) to splitter planetary carrier 8 (foldout 4). The remaining components in the group, except for the low-splitter reaction plate are included in the splitter and high-range clutch package assembly which is removed or installed as a unit. This package assembly transmits torque from the turbine output shaft to the range gearing and power takeoff. The speed ratio is direct drive (1:1, high splitter) or underdrive (1.39:1, low splitter), depending upon which splitter clutch is engaged.

10. OPERATION

When the engine is accelerated or when the lockup clutch is engaged, the converter turbine drives the turbine output shaft. The turbine output shaft drives the splitter planetary ring gear. When the low-splitter clutch is engaged, the splitter sun gear is held stationary. The ring gear drives the pinions around the stationary sun gear, producing a speed reduction of 1.39:1 (low splitter). When the high-splitter clutch is engaged, the sun gear and carrier are locked together and rotation is transmitted at 1:1 ratio (direct drive, high splitter). The splitter planetary carrier 8 (foldout 4) is splined to the splitter output shaft 59. The high-range clutch housing 40 and power takeoff drive gear, intermediate-range sun gear 61 and low-range sun gear 62 are splined to the rear end of the splitter output shaft. Thus the output of the splitter (direct or underdrive) is delivered to the range gearing.

TRANSMISSION HOUSING ASSEMBLY

11. KEYED TO FOLDOUTS

In the following description the reference numbers are keyed to the parts as shown in foldout 5 at the back of the manual. Exceptions are noted in the text.

12. DESCRIPTION

The transmission housing assembly includes the transmission housing 50, shift selector levers 24 and 49 and throttle valve levers 23 and 46. The housing is cast iron, machined to receive major parts of the transmission. The inside machining accommodates the splitter and splitter clutches and the range clutches and gearing. The front surface is machined to mount the converter housing. The rear surface is machined to mount the rear bearing retainer. The bottom surface is machined to mount the oil transfer plate and valve body assembly as well as the oil pan. Machining on the sides provides power takeoff mountings and a pad for the hydraulic retarder valve 1. A steel sleeve 51 at the rear, lower area of the left side of the housing supports the shift selector and throttle valve levers which have concentric shafts. The inside levers 23 and 24 connect to the valve body assembly. The outside levers 46 and 49 connect to the operating linkage.

13. FUNCTION

The housing encloses and supports all of the range clutches and gearing. It provides a mounting for the converter housing, rear out-

put components, valve body components and oil pan. The shift selector and throttle valve levers provide connection between the operator's controls and the valve body assembly.

REAR GEAR AND CLUTCH GROUP

14. KEYED TO FOLDOUTS

In the following description the reference numbers are keyed to the parts as shown in foldout 6 at the back of the manual. Exceptions are noted in the text.

15. DESCRIPTION

This group includes the intermediate-, low- and reverse-range clutches and planetary gear sets. Each of the clutches include a reaction housing 2, 12 and 51, friction 3, 4, 13, 14, 48 and 49 and apply plates 6, 15 and 47, a clutch piston 9, 35 and 39 and piston return springs 7, 33 and 46. The intermediate-range clutch piston 9 has its own housing 11 while another housing 37 jointly serves the low- 35 and reverse-range 39 clutch pistons. Each planetary gear set 16, 24 and 1 (foldout 7) includes a carrier, spindles, pinions, pinion needle bearings and thrust washers. The intermediate-range carrier assembly 16 is supported centrally within the intermediate-range ring gear 5 and by the low-range ring gear 23 and high-range clutch internal-splined plates 50 (foldout 4). The low-range planetary carrier 24 is integral with the transmission output shaft. The reverse-range planetary carrier 1 (foldout 7) is splined to the output shaft. The low- 12, intermediate- 2 and reverse-range 51 clutch reaction housings and piston housings 11 and 37 are stationarily anchored to the transmission housing. All of the rear gear and clutch components and subassemblies are removed or installed from the rear of the transmission housing.

16. OPERATION

When hydraulic pressure is directed to the low-, intermediate- or reverse-range clutch, the clutch piston moves outward in its housing and compresses the plates of that clutch. Engagement of the clutch holds the planetary ring gear stationary. Each planetary gear set has a driving member, driven member and a reaction member. The ring gear, when held stationary, is the reaction member. The driving member then imparts rotation to the driven member which, in turn, rotates the transmission output shaft. In low range, a simple reduction in the planetary gear set is employed. In intermediate and reverse ranges a compound coupling together of two planetary gear sets is employed. Intermediate range makes use of the intermediate and low range gear sets. Reverse range makes use of the reverse range and low-range gear sets.

OUTPUT DRIVE GROUP

17. GENERAL

In the following description the reference numbers are keyed to the parts as shown in foldout 7 at the back of the manual. Exceptions are noted in the text.

18. DESCRIPTION

The output drive group includes the rear bearing retainer 15 and bearing 23, speedometer drive gear 23, rear governor pitot tube 10, output drive flange 27 and flange seal 26. On models which include a parking brake and/or a rear oil pump 59, these components become part of the output drive group. The rear bearing retainer 15 is a casting which is bolted to the rear of the transmission housing. It houses the transmission output shaft rear bearing 23 (and rear-oil pump, when used) and provides a mounting pad for the rear of the transmission. The output flange 27 is splined to the transmission output shaft. The brake drum 37 (when used) is bolted to the output flange.

19. OPERATION

The output drive group houses and supports the components at the rear of the transmission. The output flange provides a coupling to the vehicle drive line. The brake acts on the vehicle drive shaft and is used for parking or emergency.

OIL PAN AND OIL FILTER

20. KEYED TO FOLDOUTS

In the following description the reference numbers are keyed to the parts as shown in foldout 5 at the back of the manual. Exceptions are noted in the text.

21. DESCRIPTION

The oil pan 33 is a pressed steel assembly providing openings for filling and draining the transmission, and an opening and retaining means for the oil filter element 36. The oil pan is the oil sump for the transmission. It bolts to the lower side of the transmission housing. The oil filter element 36 is contained within a pressed steel oil filter can assembly 56 installed before installing the oil pan. The can assembly includes oil pickup and distribution tubes by which the filtered oil is directed to the oil pump. The can is attached at three points to the oil transfer plate and valve bodies.

22. OPERATION

The oil pan holds the entire oil supply for the transmission and encloses the oil filter components. The oil filter cleans the entire oil supply continually before delivery to the oil pump. The element can be removed from the transmission by removing one bolt 43. The element is replaceable at specified intervals (refer to sect. II).

CONTROL VALVE GROUP

23. KEYED TO FOLDOUTS

In the following descriptions, the reference numbers are keyed to the parts as shown in foldouts 5, 8 and 9 at the back of the manual.

24. COMPONENTS AND LOCATION

The control valve group includes the hydraulic retarder control valve assembly 1 (foldout 5), oil transfer plate assembly 1 (foldout 9), downshift timing valve body assembly 15 (foldout 9) and control valve body assembly (foldout 8). The retarder valve assembly is located externally on the right side of the transmission housing. The remaining valve components are mounted on the bottom of the transmission housing within the oil pan.

25. RETARDER CONTROL VALVE

The hydraulic retarder control valve (foldout 5) is a spool-type valve, linked to a treadle in the operator's compartment. Depressing the treadle charges the hydraulic retarder; releasing the treadle evacuates the retarder.

26. TRANSFER PLATE

The oil transfer plate 4 (foldout 9) is a flat aluminum casting, channeled to distribute oil between the control valve body and passages in the transmission housing. The assembly includes a converter lubrication valve 10, 11 and 14, a converter pressure regulator valve 5, 8, 12 and 13 and an exhaust regulator valve 2 and 3.

27. DOWNSHIFT VALVE

The downshift timing valve 17 (foldout 9) is a spool-type valve actuated by the influence of spring 18 pressure at one end and a combination of low-range and throttle valve pressures at the other. The values of these pressures at any given time determine the rate of flow of oil to or from the intermediate-range clutch. The assembly is mounted on the oil transfer plate 4, behind the main control valve body assembly.

28. MAIN CONTROL VALVE

The control valve body assembly (foldout 8) is a group of valves in one main assembly. These valves control hydraulic pressures, automatic shifting, lockup of torque converter, exhausting and charging rate of clutches and range selection. All of these functions are automatic except range selection.

29. OPERATION

The hydraulic retarder control valve 1 (foldout 5) and the range selector and throttle valves 43 and 98 (foldout 8) in the control valve body assembly are actuated by the operator through controls in the operator's compartment. All other actions in the hydraulic system are completely automatic. Engine speed, transmission output speed, throttle position and range selector position all influence automatic operation. All pressures are automatically regulated and modulated to provide maximum efficiency in transmission operation.

HYDRAULIC SYSTEM

30. GENERAL

Refer to foldout 2 for schematic illustration of the hydraulic system.

31. DESCRIPTION

The hydraulic system includes all components in the transmission which pump, regulate, direct, control, filter, cool or use oil pressure or flow. By this definition, all clutches, the torque converter, the oil filter, the external oil-cooling system, the hydraulic retarder, the fluid velocity governors, the oil pump and all of the valve system are included in the hydraulic system. A single supply of oil lubricates the transmission, is pressurized to engage clutches, controls the transmission, serves as a coolant and as the torque transmitting medium in the torque converter. Essentially all of the components included in the hydraulic system have previously been described in this section under various headings. The operation of the principal valves is explained in para. 32 through 44, below.

HYDRAULIC SYSTEM OPERATION

32. MAIN PRESSURE REGULATOR VALVE (fig. III-1)

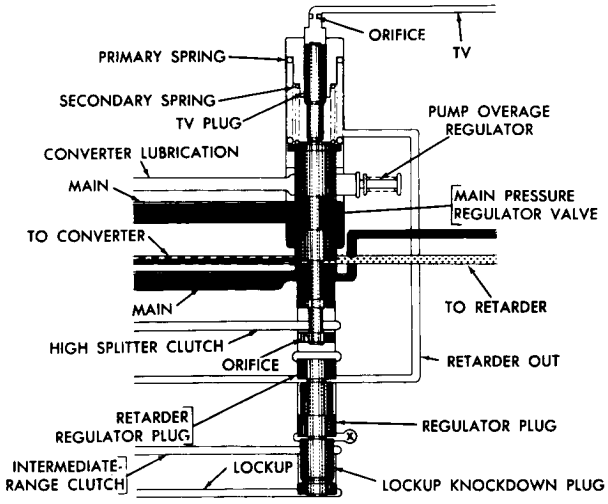
The main pressure regulator valve receives oil from the oil pump (or pumps) which is supplied, through the oil filter, by the transmission sump (oil pan). Main pressure is regulated by the action of various forces upon the components of the regulator. Figure III-1 shows the various forces which act under different conditions. Main pressure is increased when the main pressure regulator valve moves downward; it is reduced when the valve moves upward.

33. THROTTLE AND THROTTLE REGULATOR VALVES (fig. III-2)

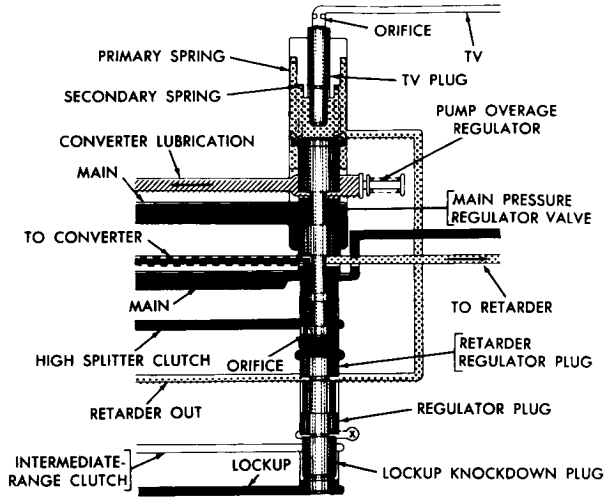
The throttle regulator valve receives main pressure and further regulates it to supply two control pressures – T and TV. Neither pressure exists at closed throttle. TV pressure begins as the throttle is opened (throttle valve moves upward). It increases with throttle opening. T pressure begins when the throttle reaches approximately 5/8 open. T and TV pressure are equal and at their peak when the throttle is fully open. Figure III-2 shows the throttle and throttle regulator valves in various positions.

34. RANGE SELECTOR VALVE (fig. III-3)

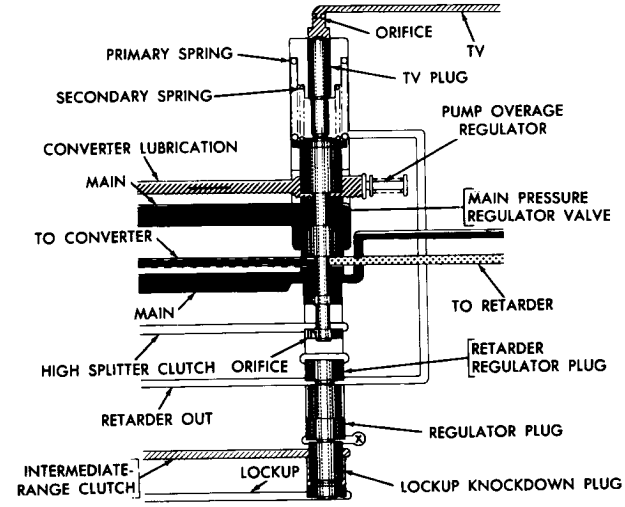
The range selector valve receives main pressure (through clutch feed line from lock-up cutoff valve) and directs it to the proper points for the range selected. All lines which are not being fed pressure exhaust to the transmission sump. The lower end of the selector valve is linked to the operator's range selector control. Figure III-3 shows the range selector valve in each range position.



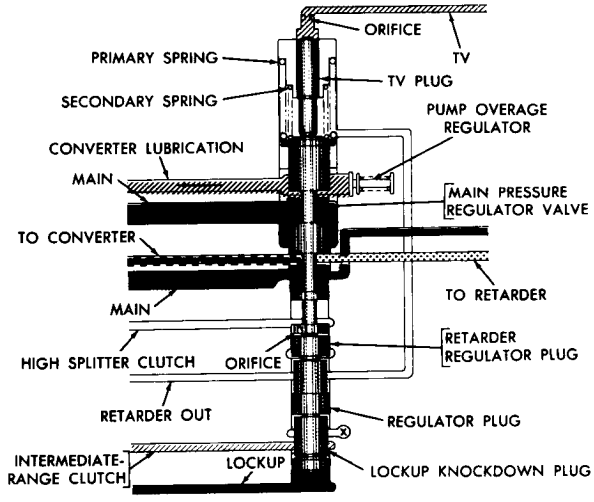
A—NEUTRAL, ENGINE IDLNG



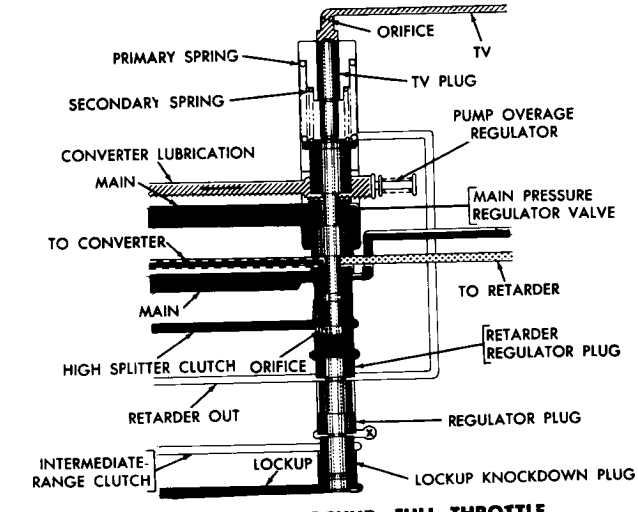
B—SECOND GEAR, LOCKUP, RETARDER APPLIED, CLOSED THROTTLE



C—THIRD GEAR, CONVERTER, FULL THROTTLE



D—THIRD GEAR, LOCKUP, FULL THROTTLE



E—SIXTH GEAR, LOCKUP, FULL THROTTLE

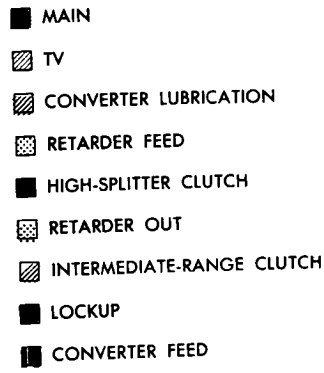


Fig. III-1 Action of main-pressure regulator valve

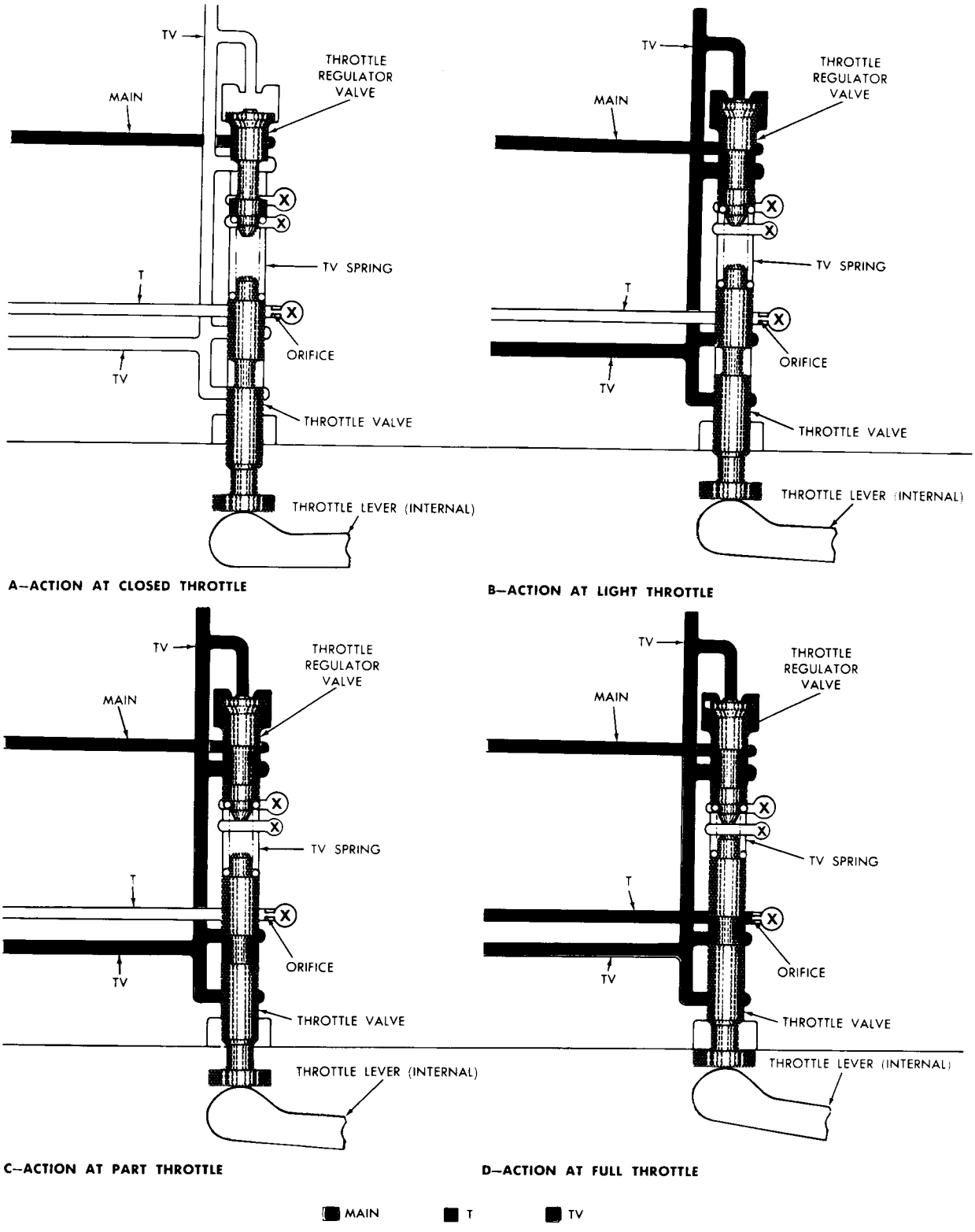


Fig. III-2 Action of throttle and throttle regulator valves

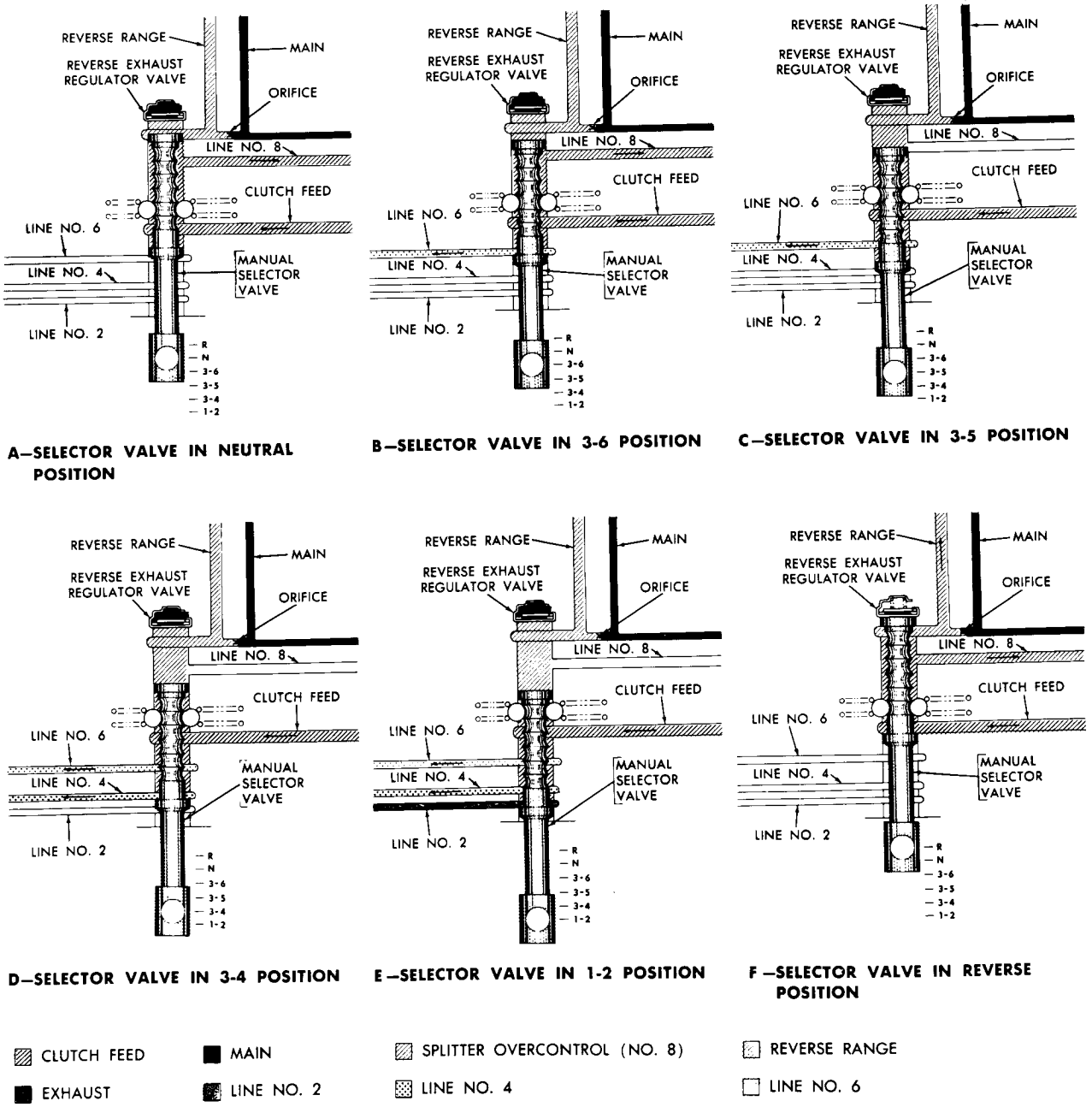
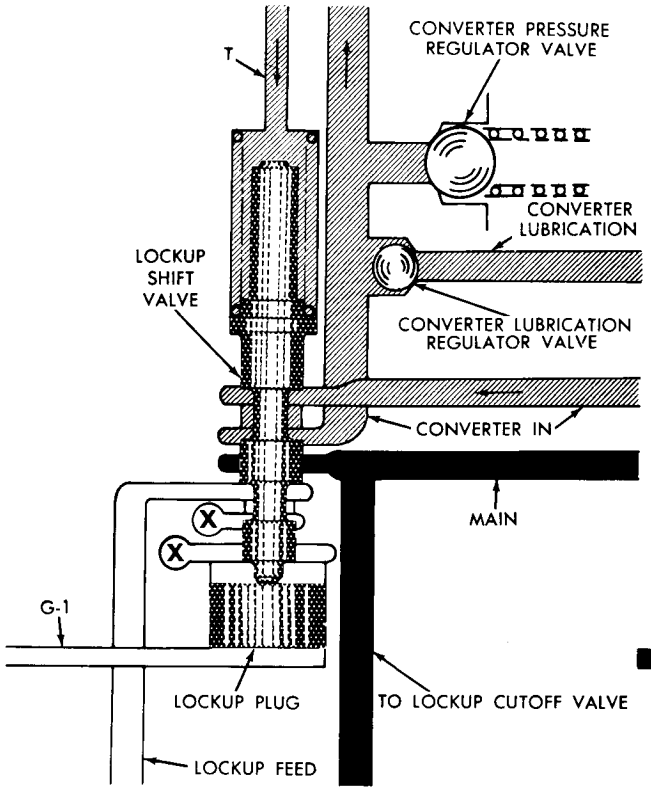


Fig. III-3 Action of manual selector valve

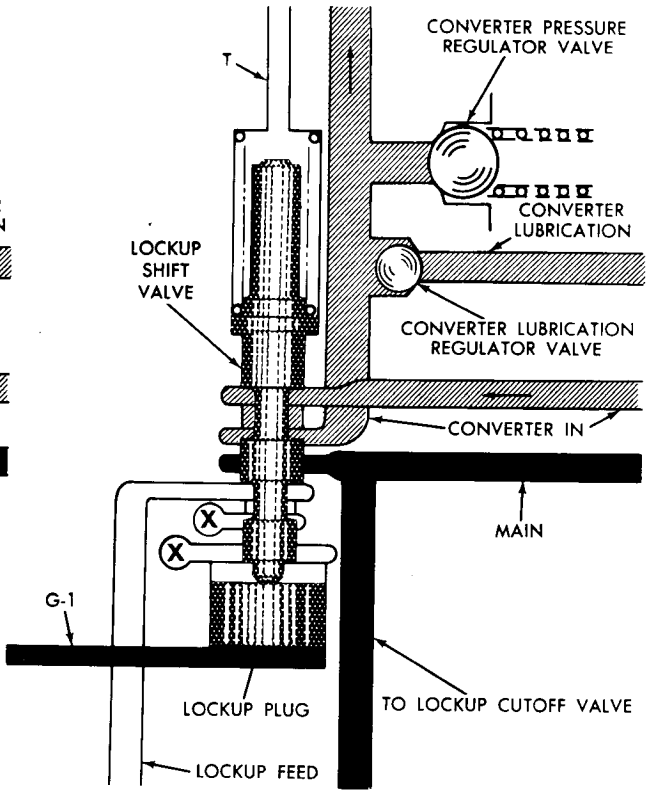
35. LOCKUP SHIFT VALVE (fig. III-4)

a. The lockup shift valve makes pressure available to engage the lockup clutch while, at the same time, controlling oil flow to the torque converter G1, spring and T pressure control the movement of this valve. When spring pressure or spring pressure plus T pressure hold the valve down, oil is directed to the converter. At a given speed, G1 pressure will overcome spring and T pressure and move the valve up, directing main oil to the lockup clutch feed line.

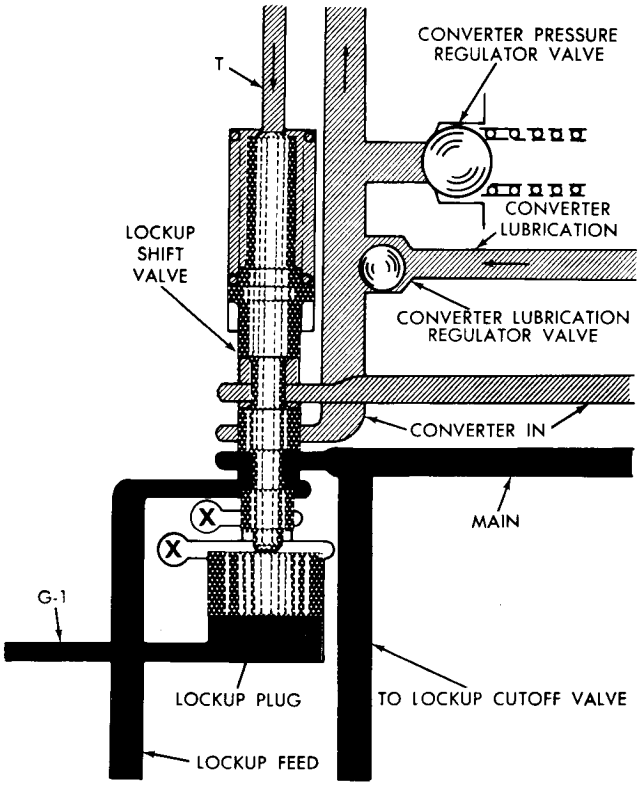
b. At the same time pressure is directed to the lockup clutch, oil flow through the lockup shift valve to the torque converter is stopped. A large oil flow through the converter is not necessary during lockup operation. However, a smaller flow (converter lubrication) is maintained. Figure III-4 illustrates the operation of the lockup shift valve.



A—NEUTRAL OR REVERSE, FULL-THROTTLE



B—FIRST OR THIRD GEAR, CONVERTER OPERATION, PART THROTTLE



C—SECOND, FOURTH, FIFTH, OR SIXTH GEAR, LOCKUP, FULL THROTTLE

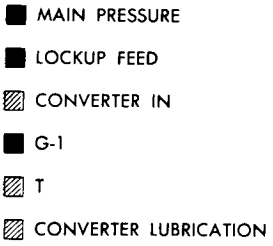


Fig. III-4 Action of lockup shift valve

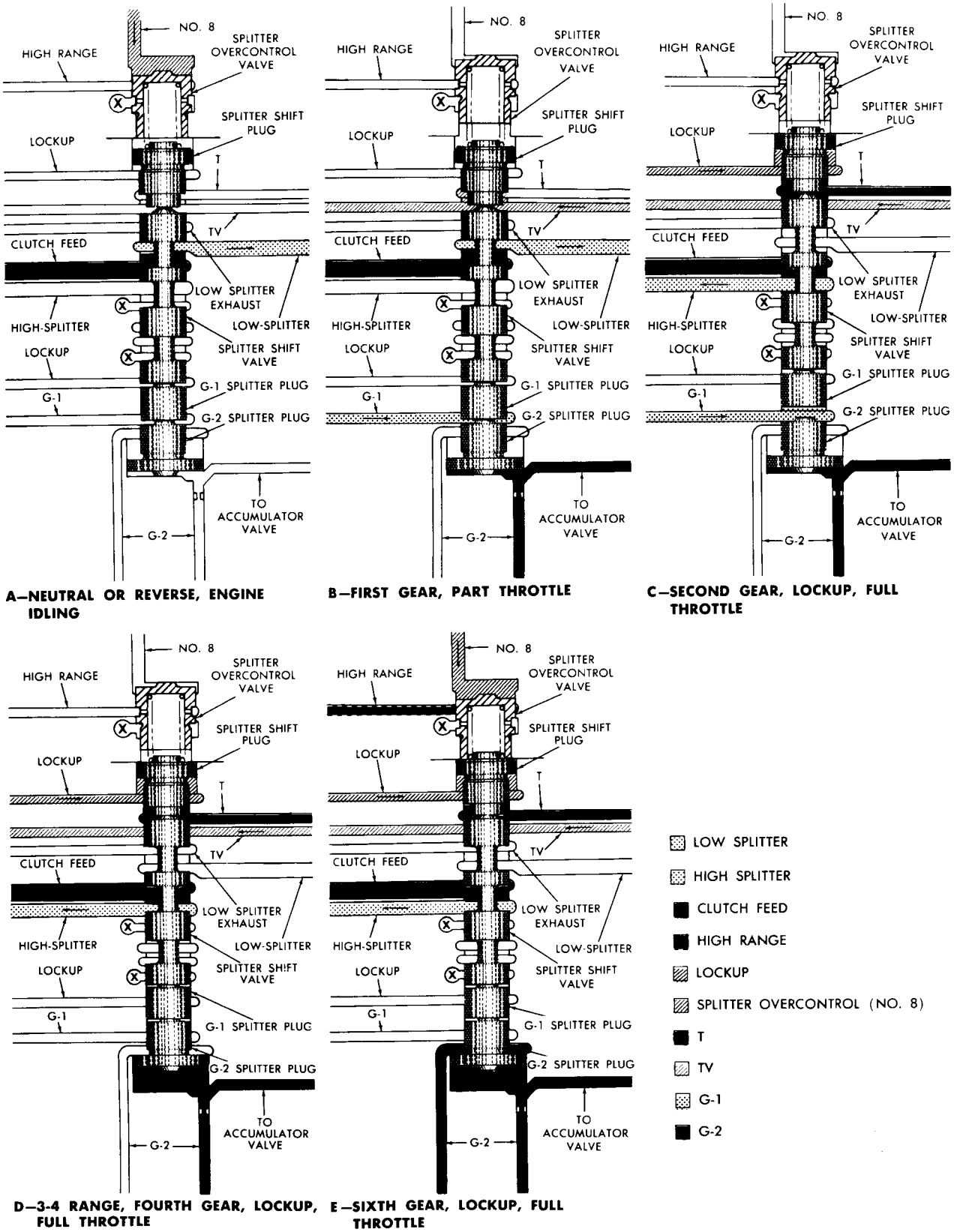


Fig. III-5 Action of splitter shift valve

36. SPLITTER SHIFT VALVE (fig. III-5)

a. The splitter shift valve directs hydraulic pressure to either the low-splitter clutch or the high-splitter clutch. In high-speed valve bodies, the splitter high-range clutch connects directly to the splitter shift valve bore (fig. III-5). In low-speed valve bodies, upshift of the splitter shift valve transmits a signal pressure to the splitter high valve which, in turn, upshifts. The splitter high valve then supplies apply pressure directly from the main pressure line (below trimmer valve) to the splitter high clutch. Note: Foldout 2 shows the low-speed control valve hydraulic circuit when applicable. Various hydraulic pressures shift the valve or assist or inhibit the shifting of it. Front governor (G1) pressure upshifts the valve from first to second gear. Rear governor (G2) pressure upshifts the valve from third and fifth gears to fourth and sixth respectively.

b. In neutral, reverse, first, third and fifth gears the valve is downward (in low-splitter position). In second, fourth and sixth gears, the valve is upward (in high-splitter position). The valve is upshifted by lockup pressure when a shift from third to second gear is made while operating in lockup. At all other times, G1 or G2 pressure is required to upshift it. In reverse gear and neutral, G2 does not exist and G1 is bled off through the reverse lockup inhibitor valve through line No. 6 (refer to foldout 2, back of manual). As a result, upshift to high-splitter position (and engagement of the lockup clutch) cannot occur in neutral and reverse gear.

c. In the 3-5 position of the range selector valve (refer to fig. III-3) line 8 is not charged. As a result, high-range clutch pressure (when in fifth gear) holds the splitter shift plug downward and prevents the splitter shift valve upshifting to sixth gear. This is splitter overcontrol. Refer also to 37 and 38, below, for details of the splitter overcontrol valve and accumulator valve which are closely related to the splitter shift valve action.

37. ACCUMULATOR VALVE AND G2 SPLITTER PLUG (fig. III-6)

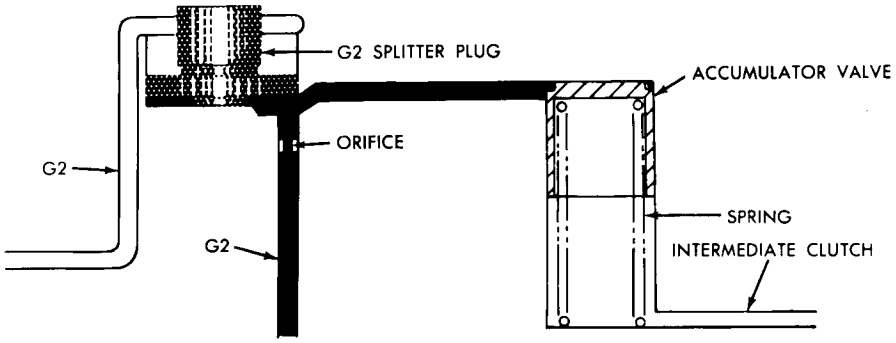
a. The G2 splitter plug acts as a hydraulic piston to lift the splitter shift valve upward for shifts from third to fourth and from fifth to sixth gears (shift to high-splitter position). The accumulator valve, when pushed downward against its spring, provides a space to store a quantity of fluid which can be subjected to a momentarily higher pressure when required to insure rapid movement of the G2 splitter plug.

b. The accumulator valve performs its function when a downshift from fifth to fourth gear is required. This shift requires a transition from high range to intermediate range simultaneous with a shift from low splitter to high splitter. To insure that the splitter upshift does not lag behind the range downshift and result in a 5-3-4 sequence, intermediate-range clutch pressure is directed to the bottom of the accumulator valve. Thus, the instant intermediate clutch pressure reaches the intermediate clutch it also is directed to the lower side of the accumulator valve (which is downward). This thrusts the accumulator valve upward and momentarily creates a pressure higher than G2 at the lower end of the G2 splitter plug. The G2 splitter plug moves upward rapidly, moving the splitter shift valve to high-splitter position.

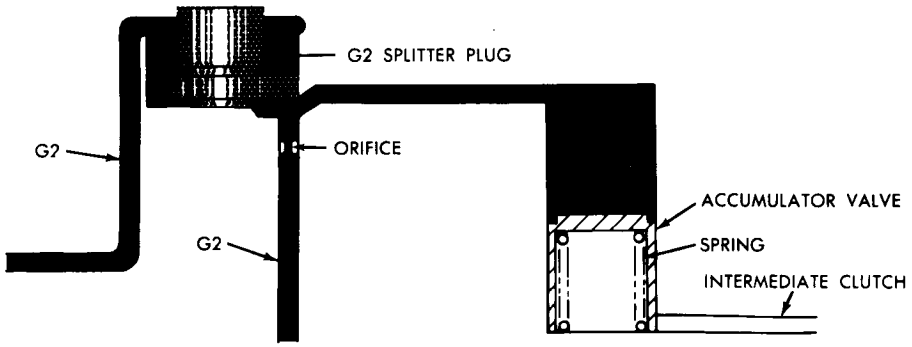
38. SPLITTER OVERCONTROL VALVE (fig. III-7)

a. The splitter overcontrol valve allows the splitter to upshift from third to fourth gear while preventing an upshift from fifth to sixth gear. In fifth gear (in 3-5 range only), line 8 is not charged. When line 8 is not charged, the splitter overcontrol valve remains at the upper end of its bore. In this position, high-range clutch pressure can enter the inner cavity of the valve and exert pressure downward on the splitter shift plug which, in turn, holds the splitter shift valve downward (in low-splitter position).

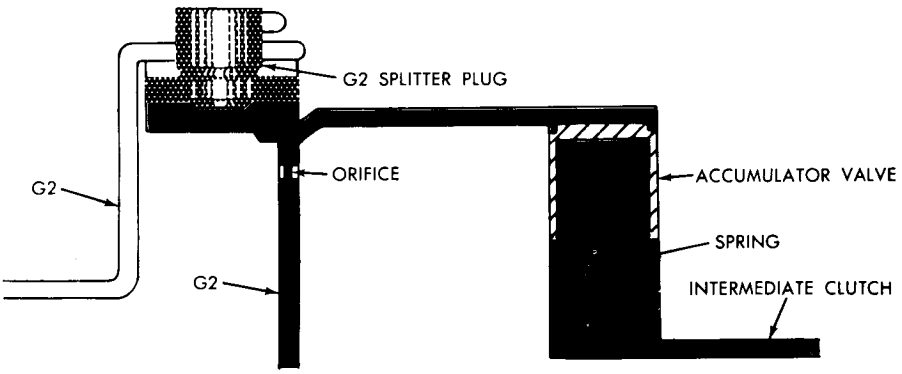
b. In the 3-6 range position, line 8 is charged and the splitter overcontrol valve is pushed downward. This closes the high-range clutch pressure port and opens a port to the sump. This allows the splitter shift plug and splitter shift valve to move upward when a shift to sixth gear is required. The presence or absence of pressure in line 8 in all other



A—NEUTRAL AND FIRST, SECOND AND THIRD GEARS



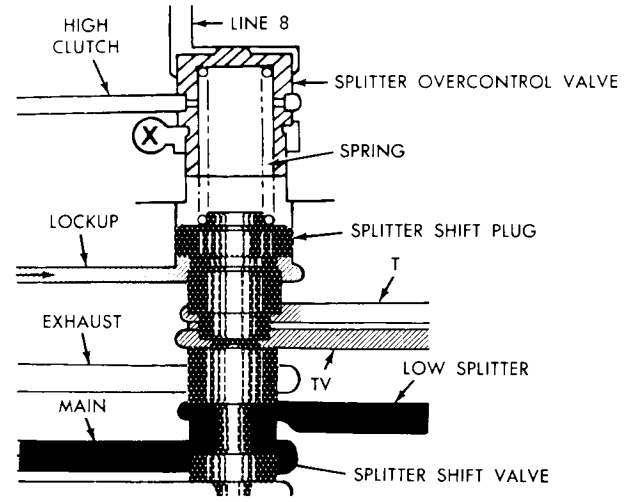
B—FIFTH GEAR



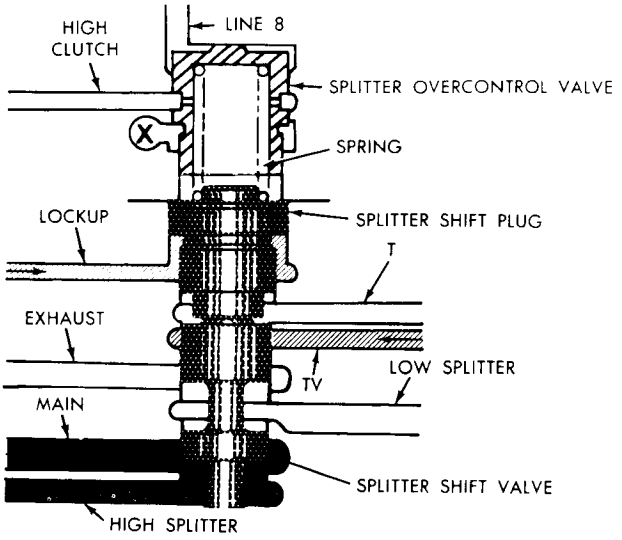
C—DOWNSHIFT FROM FIFTH TO FOURTH GEARS

■ G2 (REAR GOVERNOR) ■ INTERMEDIATE-RANGE CLUTCH ■ G2 INCREASED BY ACCUMULATOR ACTION

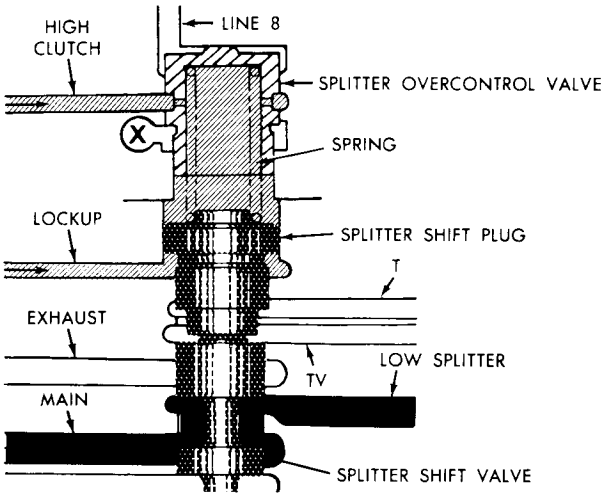
Fig. III-6 Action of accumulator valve



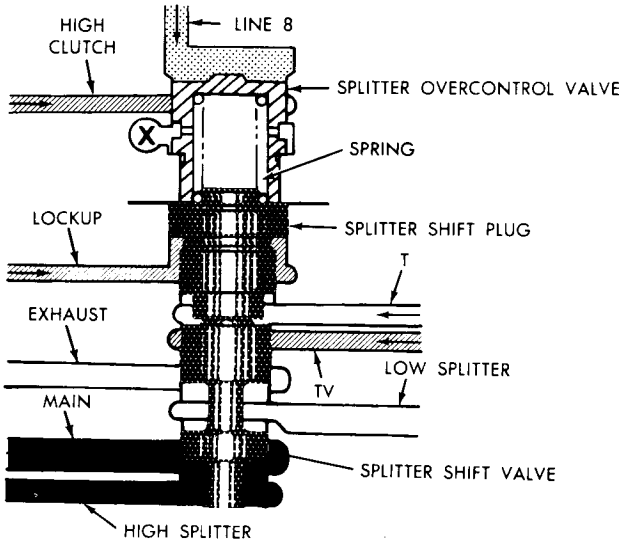
A—FIRST AND THIRD GEARS (PART THROTTLE)



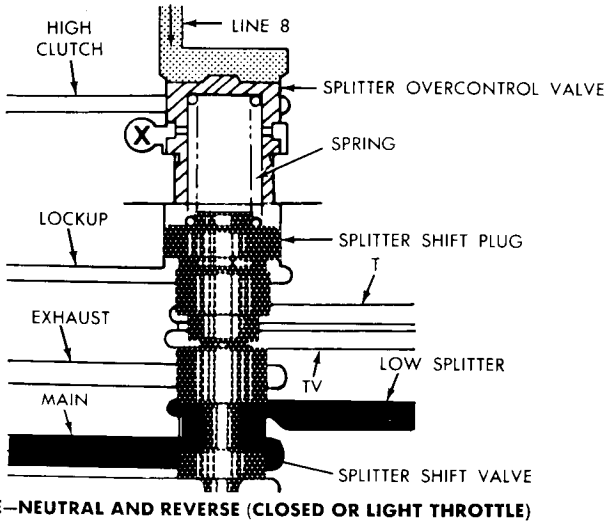
B—SECOND AND FOURTH GEARS (PART THROTTLE)



C—FIFTH GEAR (3-5 RANGE ONLY—CLOSED THROTTLE)



D—SIXTH GEAR (PART THROTTLE)



E—NEUTRAL AND REVERSE (CLOSED OR LIGHT THROTTLE)

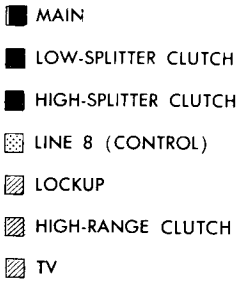


Fig. III-7 Action of splitter overcontrol valve

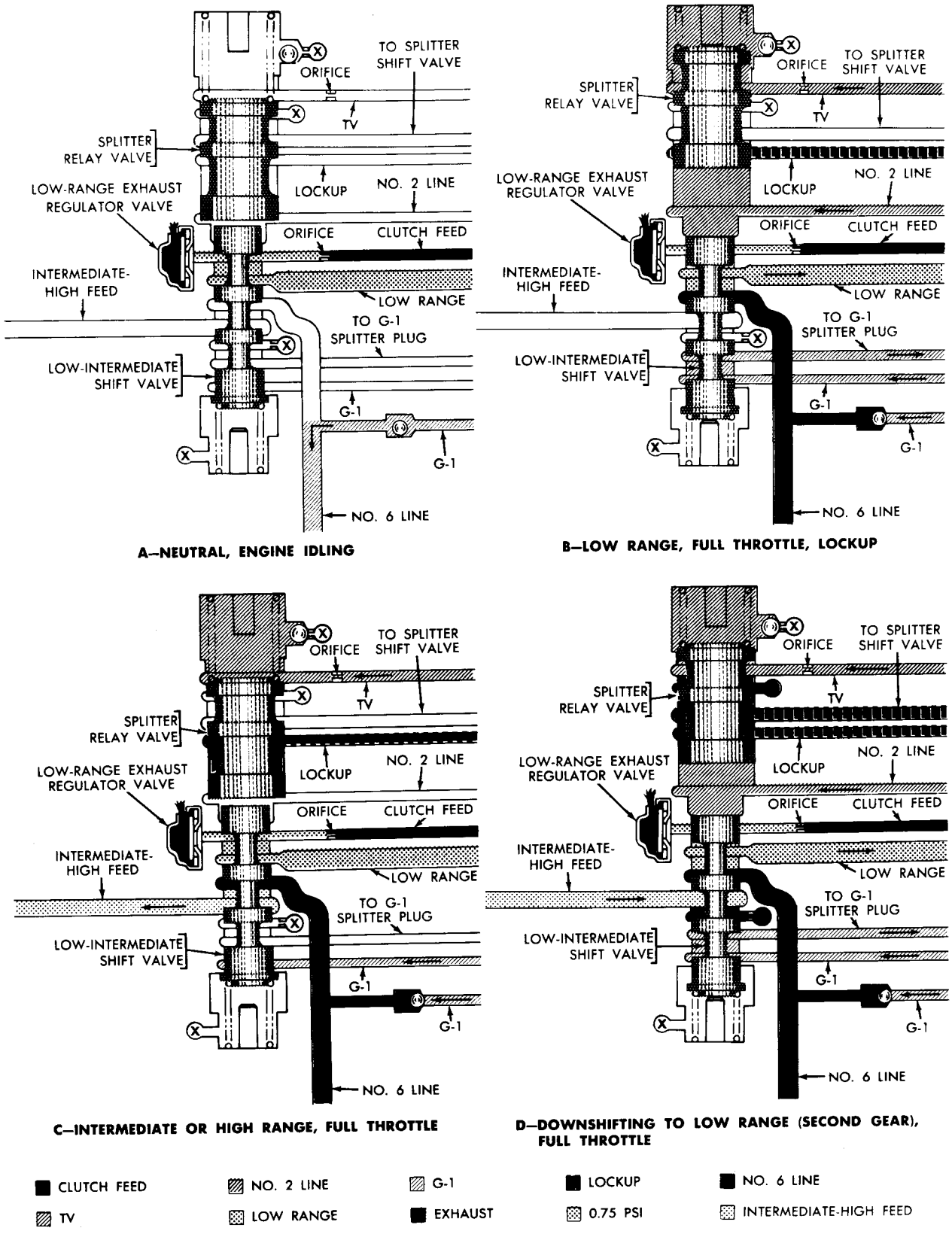


Fig. III-8 Action of splitter relay and low-intermediate shift valves

range positions and the resulting position of the splitter overcontrol valve does not affect movement of the splitter shift valve because high-range clutch pressure is not present to block the splitter shift plug from rising.

39. SPLITTER RELAY AND LOW-INTERMEDIATE SHIFT VALVES (fig. III-8)

a. The splitter relay valve, in a downshift from intermediate range to low range (1-2) during lockup operation, insures a splitter upshift. If the splitter shift valve is downward when such a shift is made, lockup pressure will be directed to it momentarily to assist G1 pressure in upshifting it.

b. The low-intermediate shift valve directs pressure to the low-range clutch when a shift is made to low range from any higher range. When a shift from low range to any higher range is made, pressure is directed to the intermediate-high shift valve. In addition, the low-intermediate shift valve directs G1 pressure to the G1 splitter plug to cause the automatic 1-2 upshift in low range. Fig. III-8 illustrates the valves' various functions.

40. INTERMEDIATE-TO-HIGH SHIFT VALVE (fig. III-9)

a. The intermediate-to-high shift valve selects either intermediate or high range, depending upon vehicle speed, throttle opening and range selector position. The valve works in conjunction with the intermediate-to-high blocker plug, intermediate-to-high shift plug and the intermediate-to-high accelerator plug—all of which are in a common bore.

b. When the valve is downward (in 3-4, 3-5, or 3-6 range), pressure is directed to the intermediate-range clutch. When the valve is upward (in 3-5 or 3-6 range), pressure is directed to the high-range clutch. Figure III-9 illustrates the functions of the valve under various conditions.

41. TRIMMER AND LOCKUP CUTOFF VALVES (fig. III-10)

a. The trimmer components regulate the application of all clutches except the lockup clutch. When shifts occur, particularly upshifts at full throttle, it is necessary that the clutches engage smoothly but with minimum slippage. The trimmer components, working in conjunction with the lockup cutoff valve regulate the clutch apply pressure to the required value at any degree of throttle opening.

b. The fluid supply for all range and splitter clutches must flow past the lockup cutoff valve. As a result, the valve moves upward and releases the lockup clutch momentarily during any shift. The trimmer regulates clutch apply pressure during engagement of the clutch by automatically bleeding off pressure through a port uncovered by the movement of the trimmer valve. Calibrated springs and orifices control the movements of the trimmer valve and restore full main pressure to the engaged clutch.

42. DOWNSHIFT TIMING VALVE (fig. III-11)

a. The downshift timing valve delays the exhausting (release) of the intermediate-range clutch during downshift from third (intermediate range) gear to second (low range) gear while providing quick exhausting of the clutch during the later phase of the shift when operating at heavy throttle. A secondary function is the quick charging of the intermediate-range clutch during a shift from second gear to third gear while operating at heavy throttle.

b. A combination of full low-range clutch pressure and full TV pressure is required at the right end of the valve to fully open the downshift timing valve. Thus, when the low-range clutch is engaged and heavy throttle is being applied, the valve opens fully. Lesser of either pressure will cause the valve to close.

43. EXHAUST REGULATOR VALVES

a. The exhaust regulator valve system controls the filling (engagement) of certain clutches in a timed relation with the exhausting (release) of others to prevent clutch slippage and engine overspeeding as well as overlapping engagement of two clutches. The

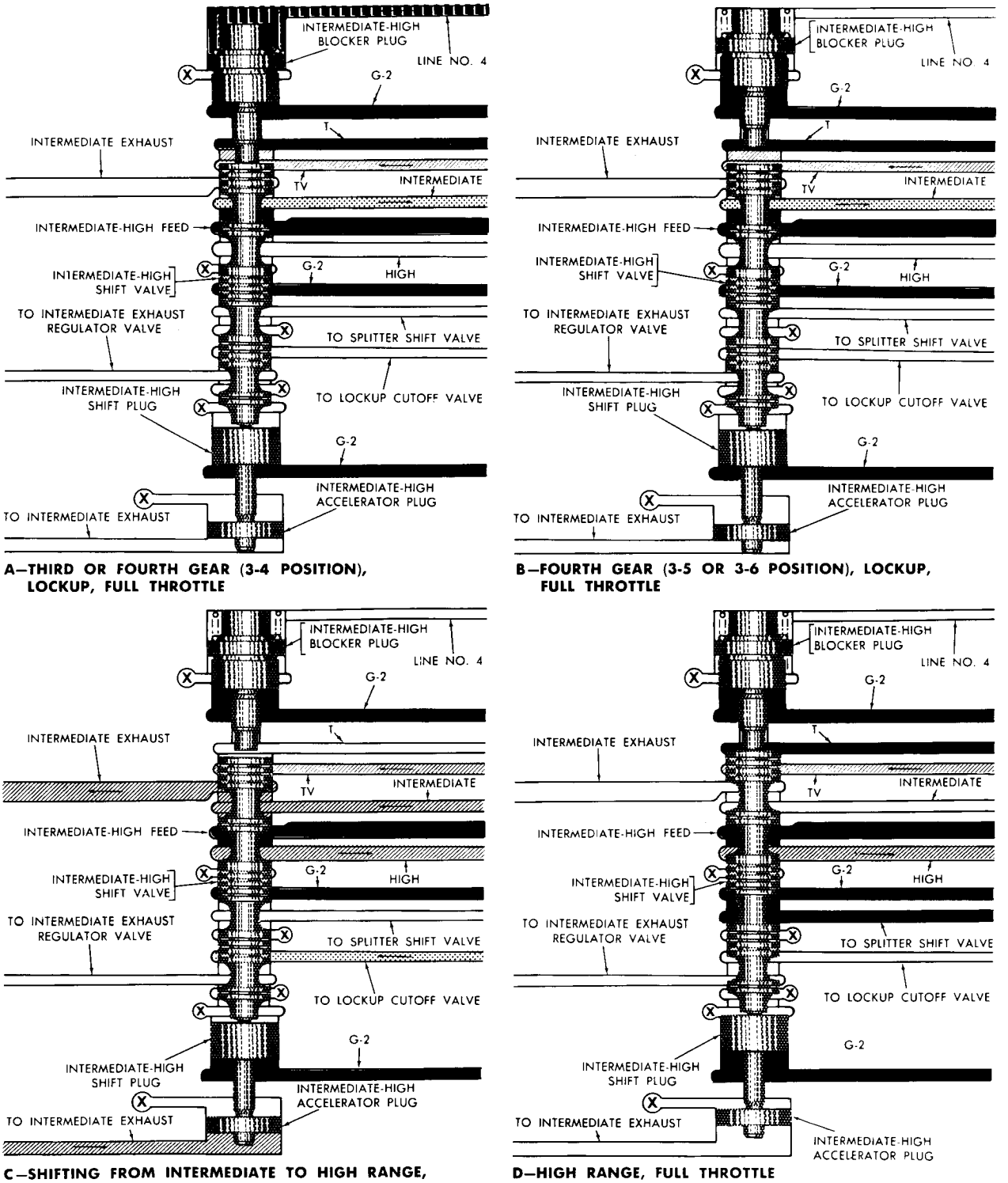


Fig. III-9 Action of intermediate-to-high shift valve

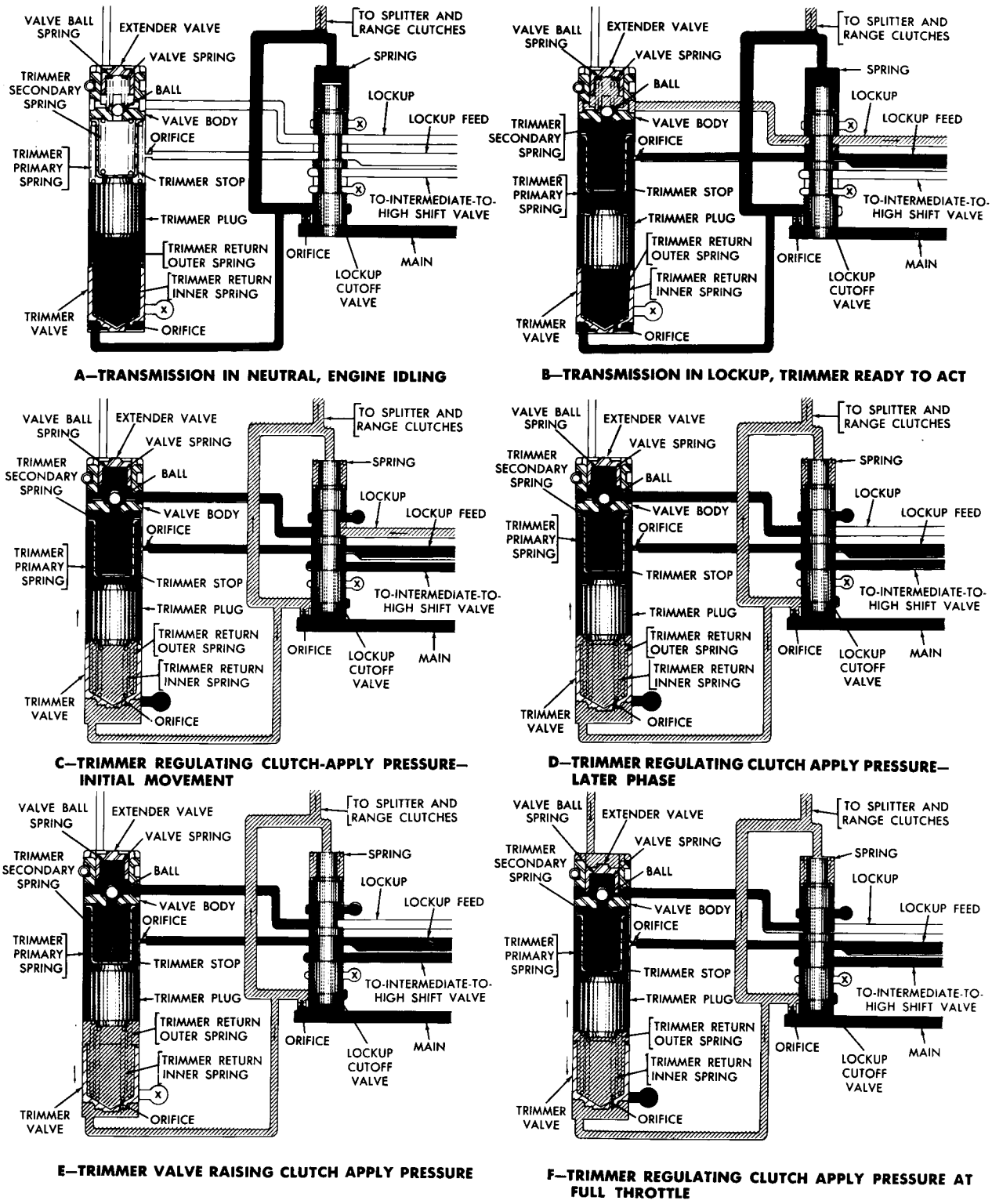
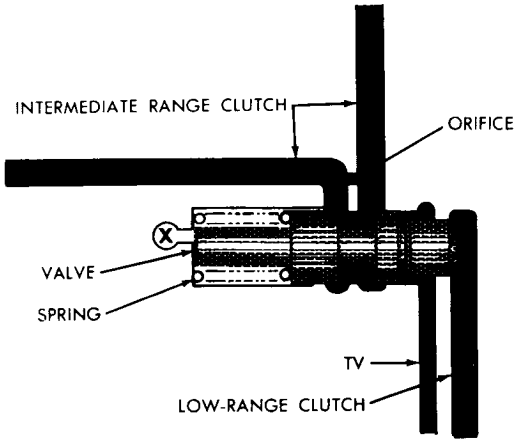
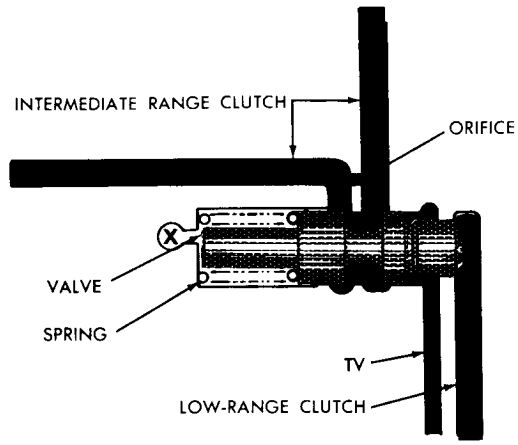


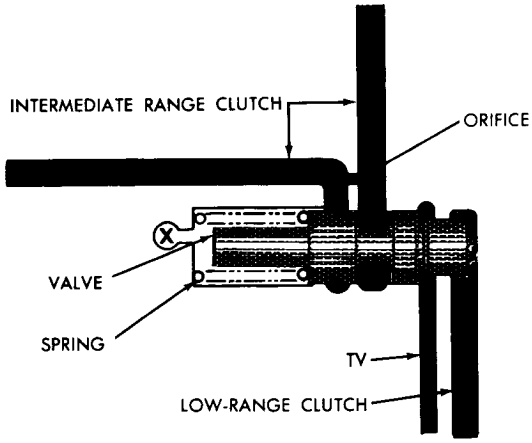
Fig. III-10 Action of trimmer circuit



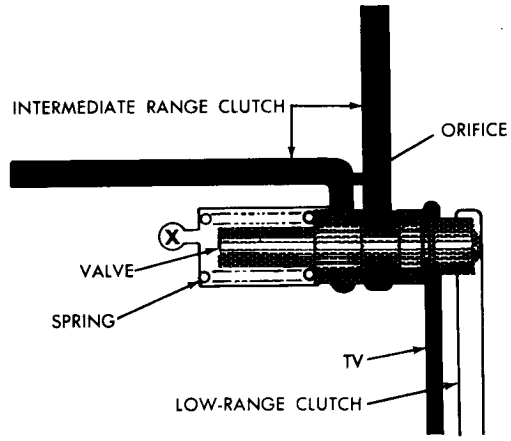
A—2-3 SHIFT, FULL THROTTLE (INITIAL PHASE)



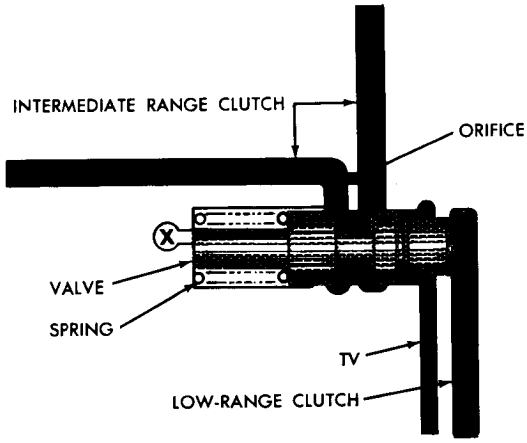
B—2-3 SHIFT, FULL THROTTLE (LATER PHASE)



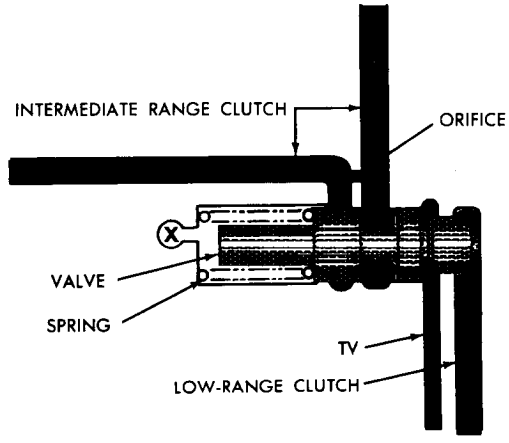
C—2-3 SHIFT, PART THROTTLE



D—3-2 SHIFT, FULL THROTTLE (INITIAL PHASE)



E—3-2 SHIFT, FULL THROTTLE (LATER PHASE)



F—3-2 SHIFT AT PART THROTTLE

■ INTERMEDIATE-RANGE CLUTCH ■ LOW-RANGE CLUTCH ■ TV

Fig. III-11 Action of downshift timing valve

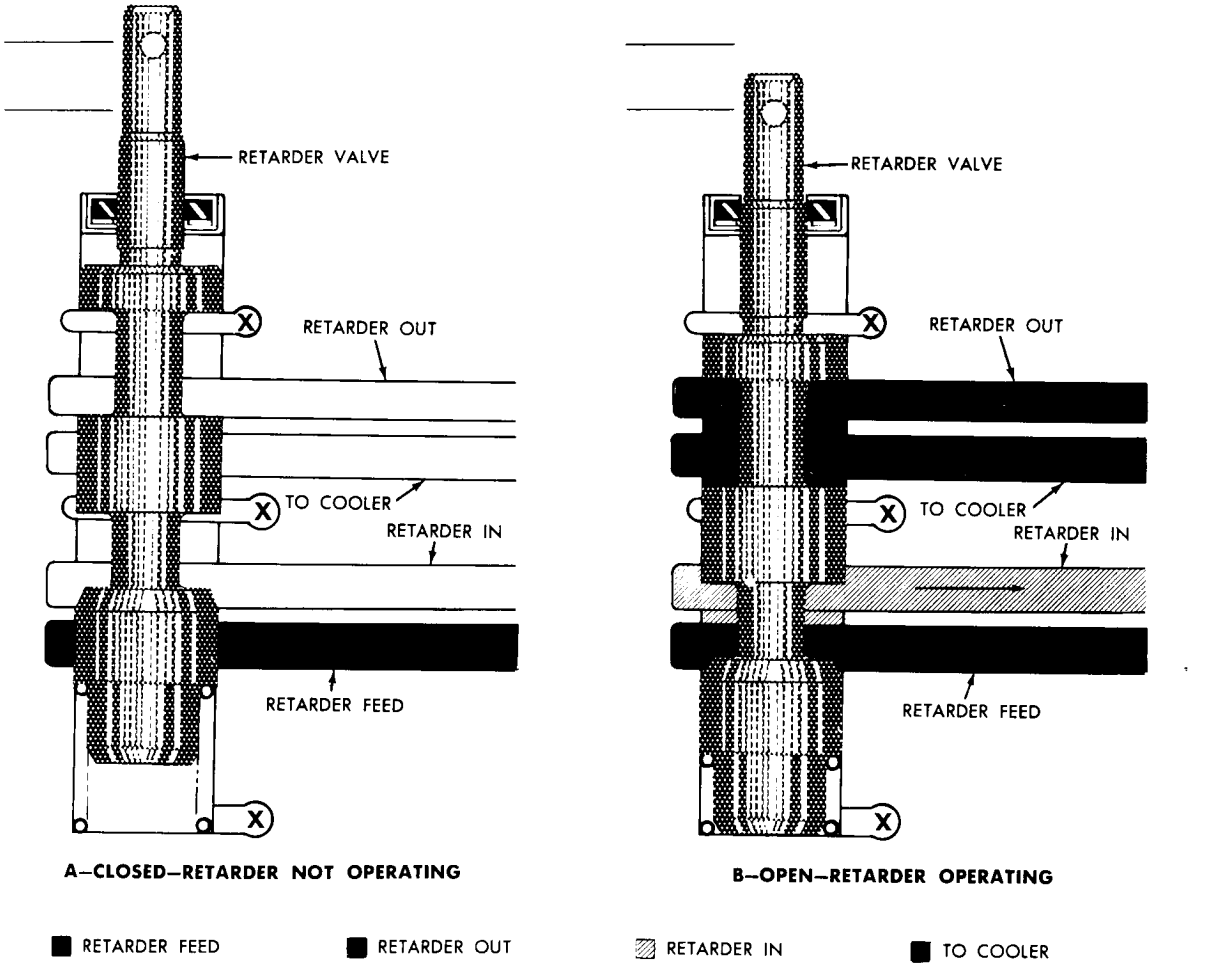


Fig. III-12 Action of hydraulic retarder control valve

intermediate-range exhaust regulator valve controls the exhaust (release) of the intermediate-range clutch in proper relation to the filling (engagement) of the high-range clutch.

b. The low-splitter exhaust regulator valve controls the exhaust (release) of the low-splitter clutch during any shift to high splitter. Full exhaust of the low-splitter clutch is delayed until the high-splitter clutch is sufficiently engaged.

c. Two AC spring-loaded valves control the exhaust of the reverse-range clutch and low-range clutch. The reverse-range clutch exhaust regulator valve maintains 0.75 psi hydraulic pressure in the clutch when released. It is not necessary to regulate the rate at which this clutch fills or exhausts. The low-range clutch exhaust regulator valve maintains 0.75 psi hydraulic pressure in the clutch when released. The exhaust rate is controlled by an orifice adjacent to the spring-loaded valve. The fill rate does not require regulation.

d. Refer to foldout 2 (back of manual) for the location and arrangement of the valves discussed in a through c, above.

44. HYDRAULIC RETARDER CONTROL VALVE (fig. III-12)

The hydraulic retarder control valve controls the application (filling) and release (exhausting) of the hydraulic retarder. The hydraulic circuit is arranged to direct oil to the retarder rotor cavity, and from the cavity to the external oil cooler when open (down). When closed (up) both the retarder "in" line and "out" line are opened to exhaust in the transmission sump. The pumping action of the hydraulic retarder causes it to empty itself when not in use.

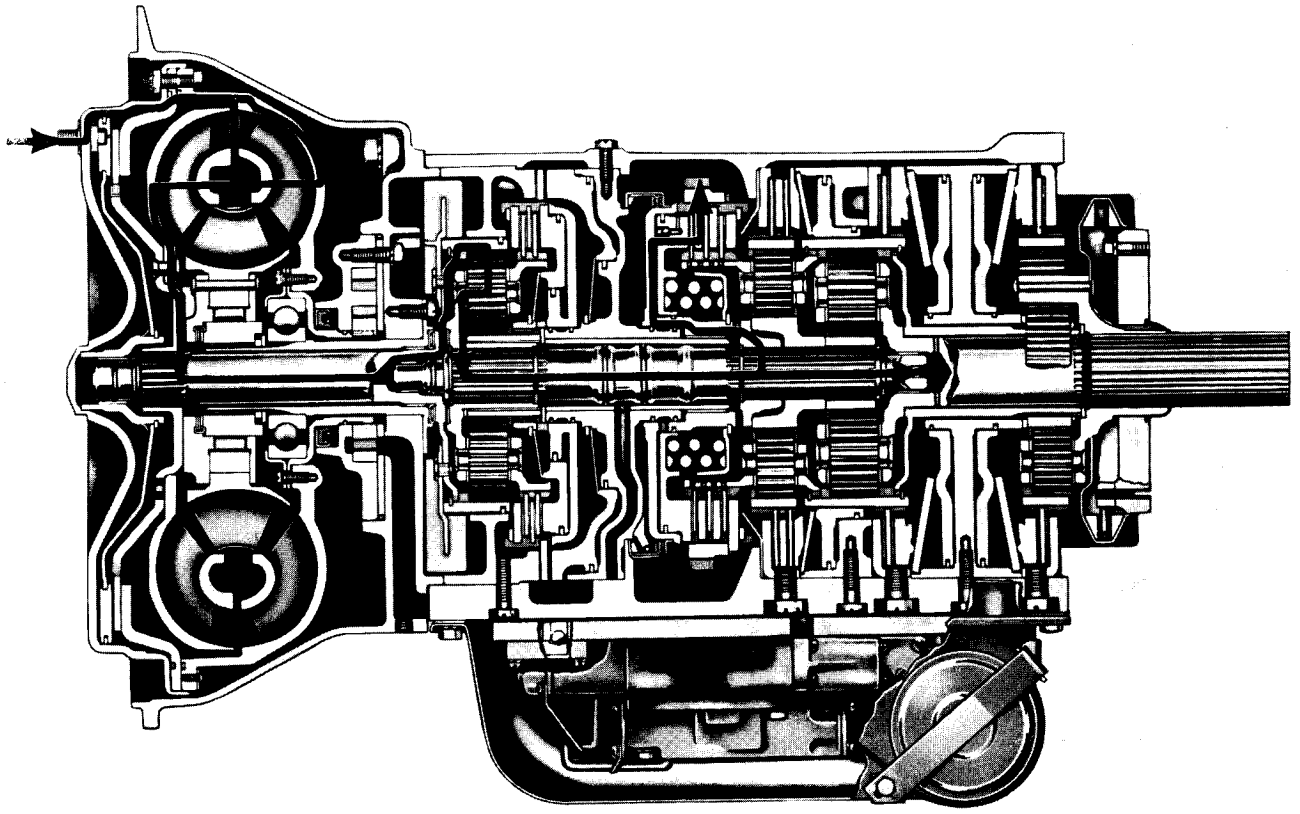


Fig. III-13 Neutral power flow, converter

POWER FLOW

45. GENERAL

The smooth flow of power from the engine through the transmission is continuous. The transmission automatically adjusts the ratio and torque to meet changing road and load conditions. Figures III-13 through III-21 illustrate the power flow, or torque path, through the transmission for neutral, each of the six speeds forward, reverse, and retarder operation. Refer to foldout 1 in the back of the manual for identification of components.

Note. Directions of rotation are determined by viewing the transmission from the input end (front).

46. NEUTRAL POWER FLOW (fig. III-13)

The splitter system is in low ratio (1.39:1) in neutral. However, none of the range clutches is applied, so no power is transmitted to the transmission output shaft. Power is transmitted only as far as the splitter output shaft. Thus power is available to the power takeoff drive gear in neutral. The splitter cannot upshift while the transmission is in neutral.

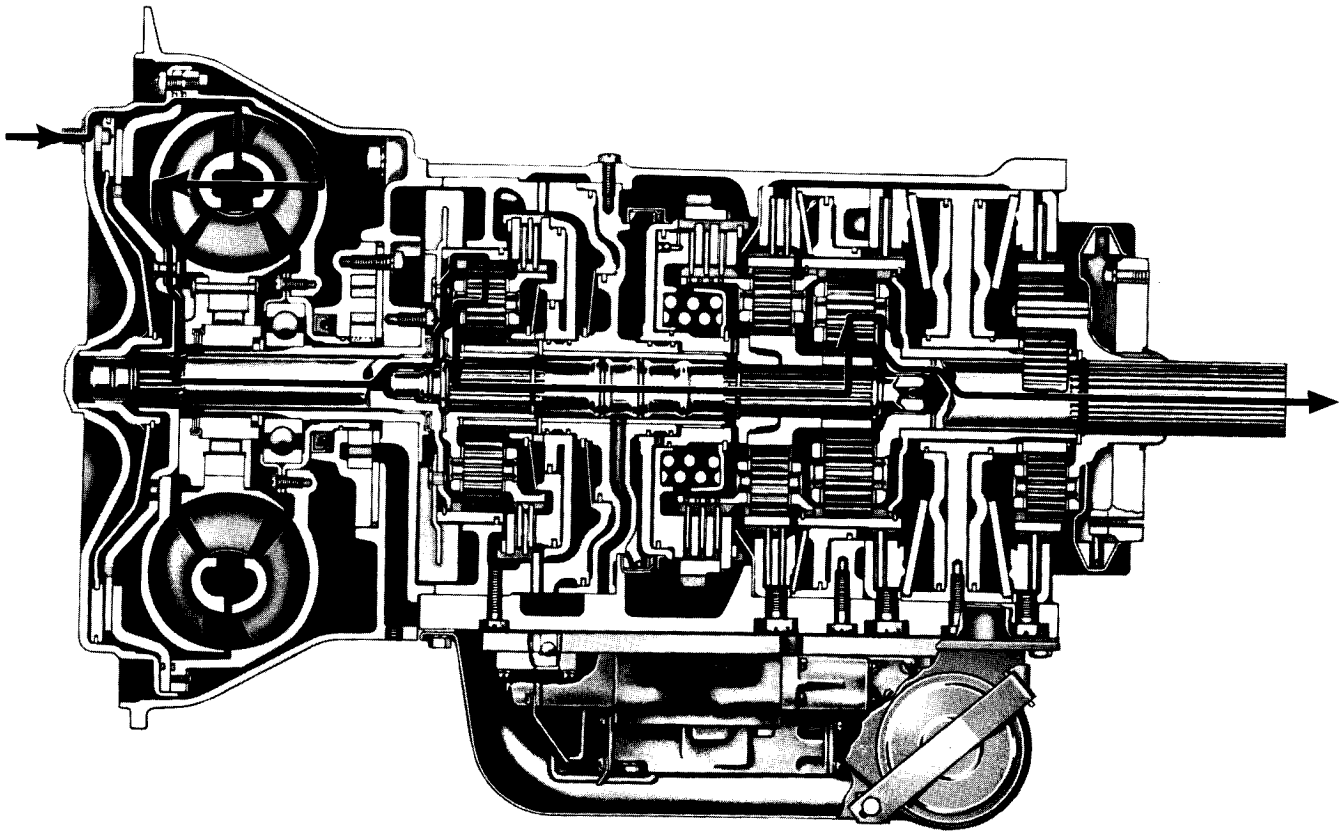


Fig. III-14 First-gear power flow, converter

47. LOW-RANGE POWER FLOWS

a. First Gear (fig. III-14). In first gear, the splitter system is in low ratio (1.39:1), driving the low-range sun gear clockwise. The low-range clutch is engaged, holding the low-range ring gear stationary. The low-range planetary pinions, meshing with both the sun gear and ring gear, are forced to roll clockwise (while rotating counterclockwise) around the inside of the ring gear. The low-range planetary carrier, integral with the transmission output shaft, is driven clockwise. First gear ratio is 5.296:1 (1.39 x 3.81):1 (converter in lockup).

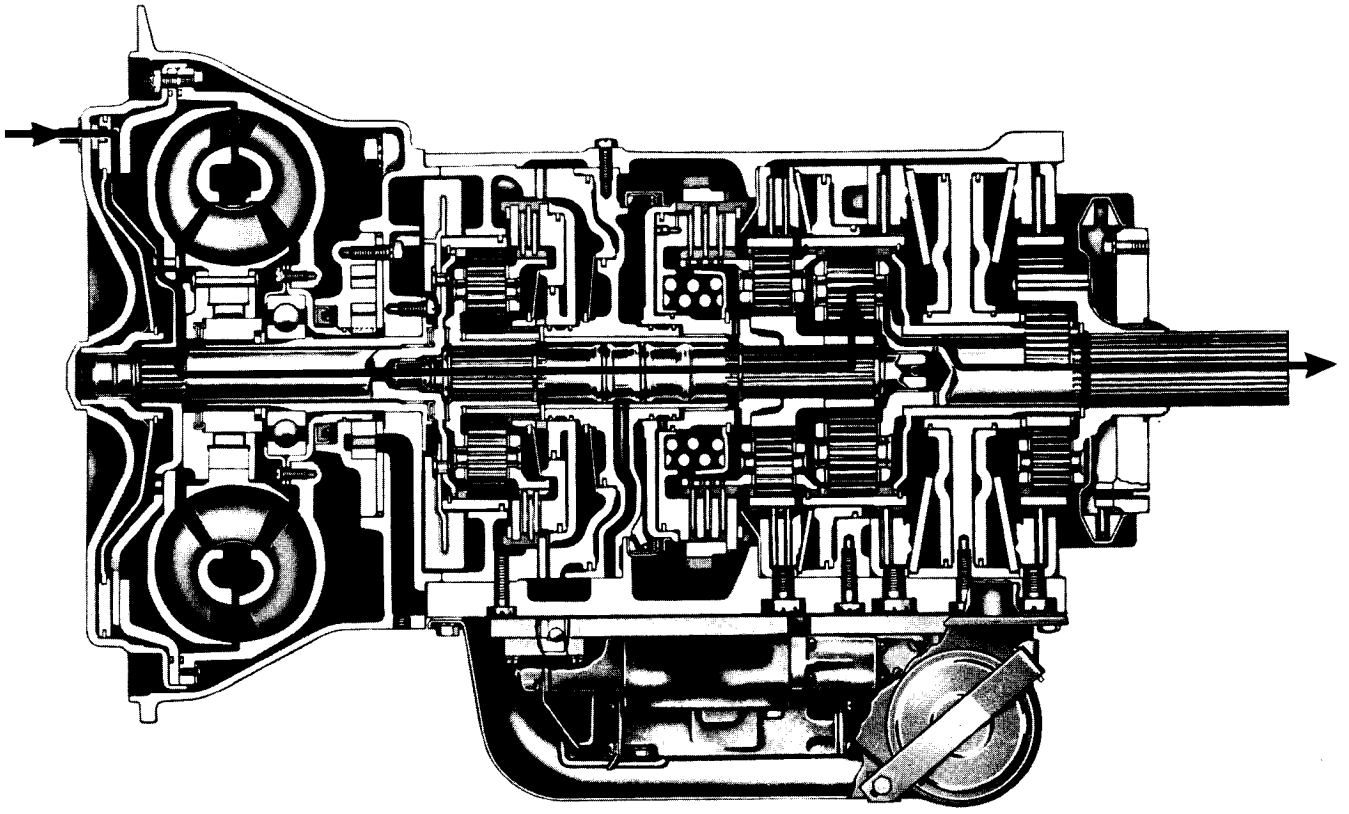


Fig. III-15 Second-gear power flow, lockup

b. Second Gear (fig. III-15). In second gear, the splitter is in high ratio (1:1) while the low-range planetary system functions as described in a, above. Second gear ratio is 3.81:1 (converter in lockup).

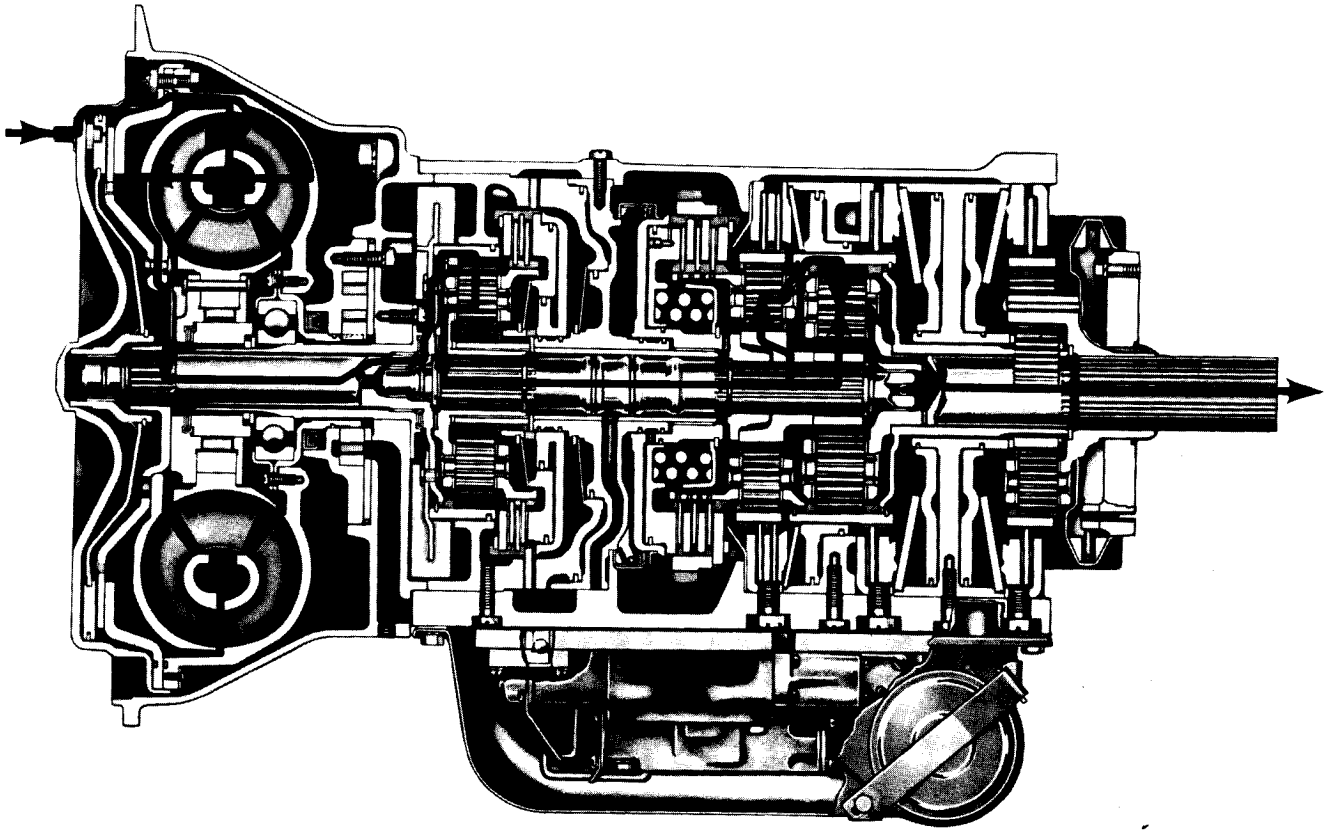


Fig. III-16 Third-gear power flow, converter

48. DRIVE-RANGE POWER FLOWS

Note. There are three selector positions within the drive range. One restricts automatic shifting to intermediate range (third and fourth gears). Another restricts automatic shifting to third, fourth and fifth gears. The other embraces intermediate and high ranges (third, fourth, fifth and sixth gears).

a. Third Gear (fig. III-16). In third gear, the splitter system is in low ratio (1.39:1). The splitter output shaft transmits clockwise rotation to the intermediate-range sun gear. The intermediate-range clutch is applied, holding the intermediate-range ring gear stationary. The intermediate-range pinions, in mesh with both the sun gear and ring gear, are forced to roll clockwise (while rotating counterclockwise) around the inside of the ring gear. This imparts clockwise rotation to the low-range ring gear, which is splined to the intermediate-range carrier. The low-range sun gear is rotating at the same speed as that of the intermediate-range sun gear. Thus, rotation is imparted to the low-range carrier (and transmission output shaft) by the low-range ring and sun gears which are rotating at different speeds. The final ratio is 2.691:1 (1.39 x 1.936):1 when the converter is in lock-up. The coupling of two planetary systems (low and intermediate) in this manner is called "compounding."

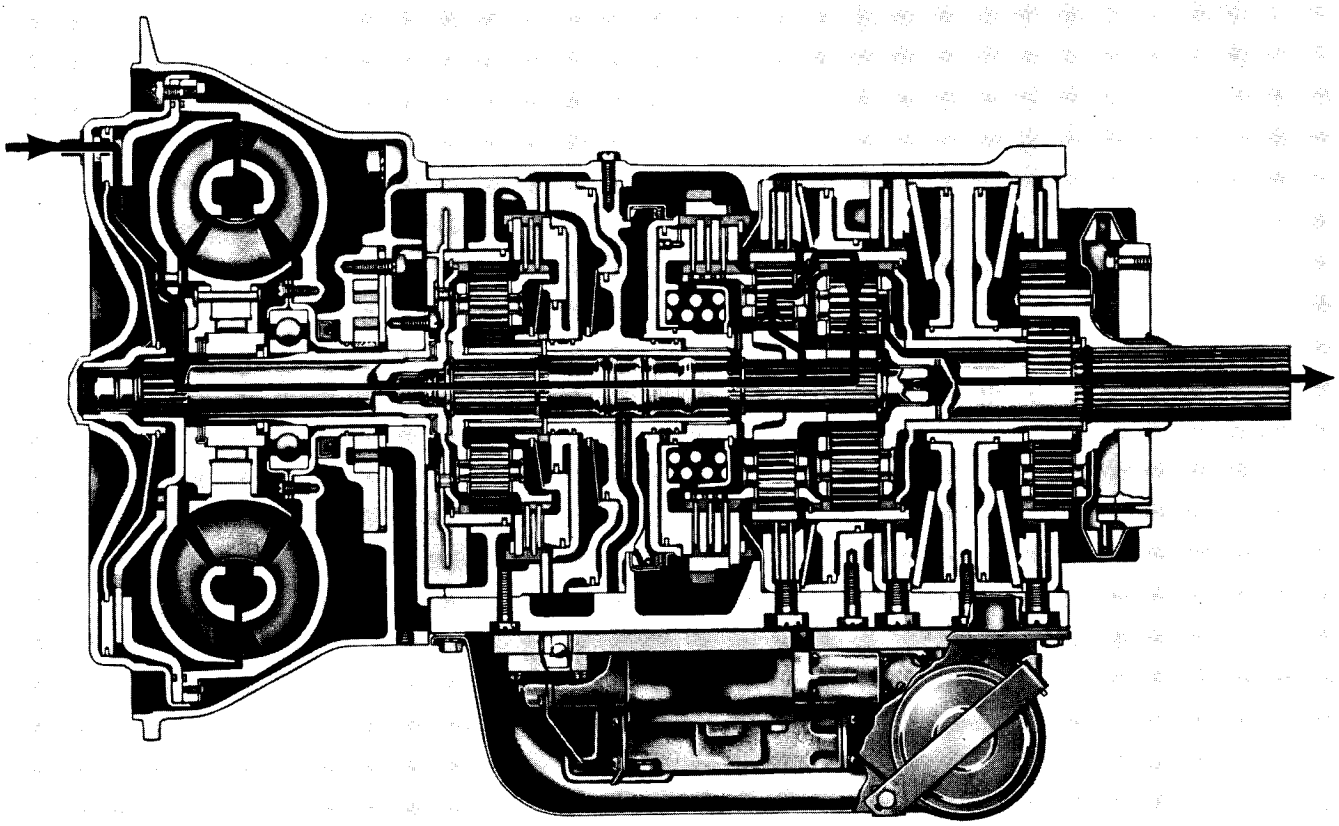


Fig. III-17 Fourth-gear power flow, lockup

b. Fourth Gear (fig. III-17). Fourth gear operation is the same as described in a, above, except that the splitter system is in high ratio (1:1) and the final ratio is 1.936:1 (converter in lockup).

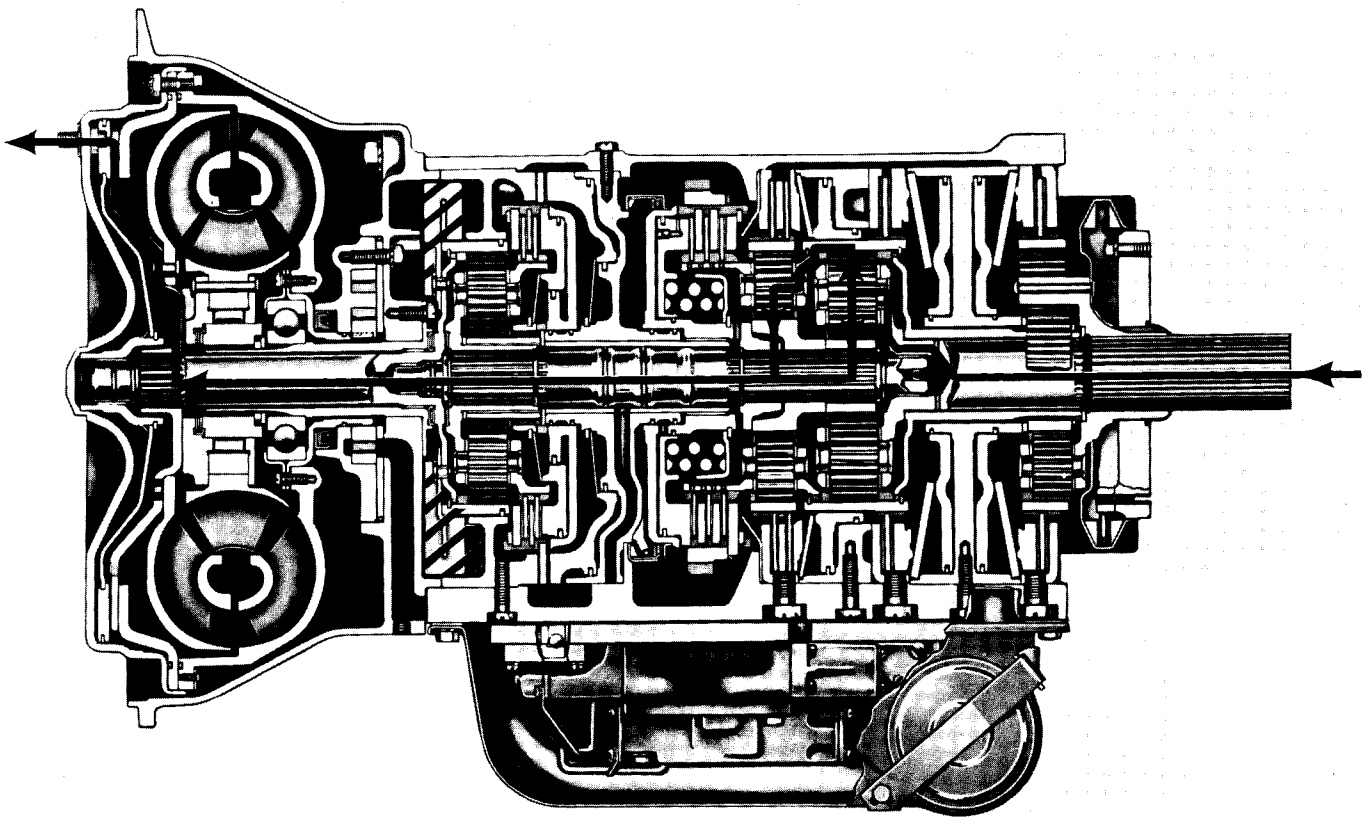


Fig. III-18 Fourth-gear power flow, lockup (hydraulic retarder in operation)

c. Fourth Gear, Lockup, Hydraulic Retarder in Operation (fig. III-18)

Note. The lower the selector range, the more speed reduction effect is obtained. However, the transmission should never be downshifted to a point that will cause the engine to exceed governed speed.

In retarder operation the flow of power passes through the same components but in a different direction. The power is generated by the vehicle's speed and is absorbed by both the retarder and the engine (which is throttled back).

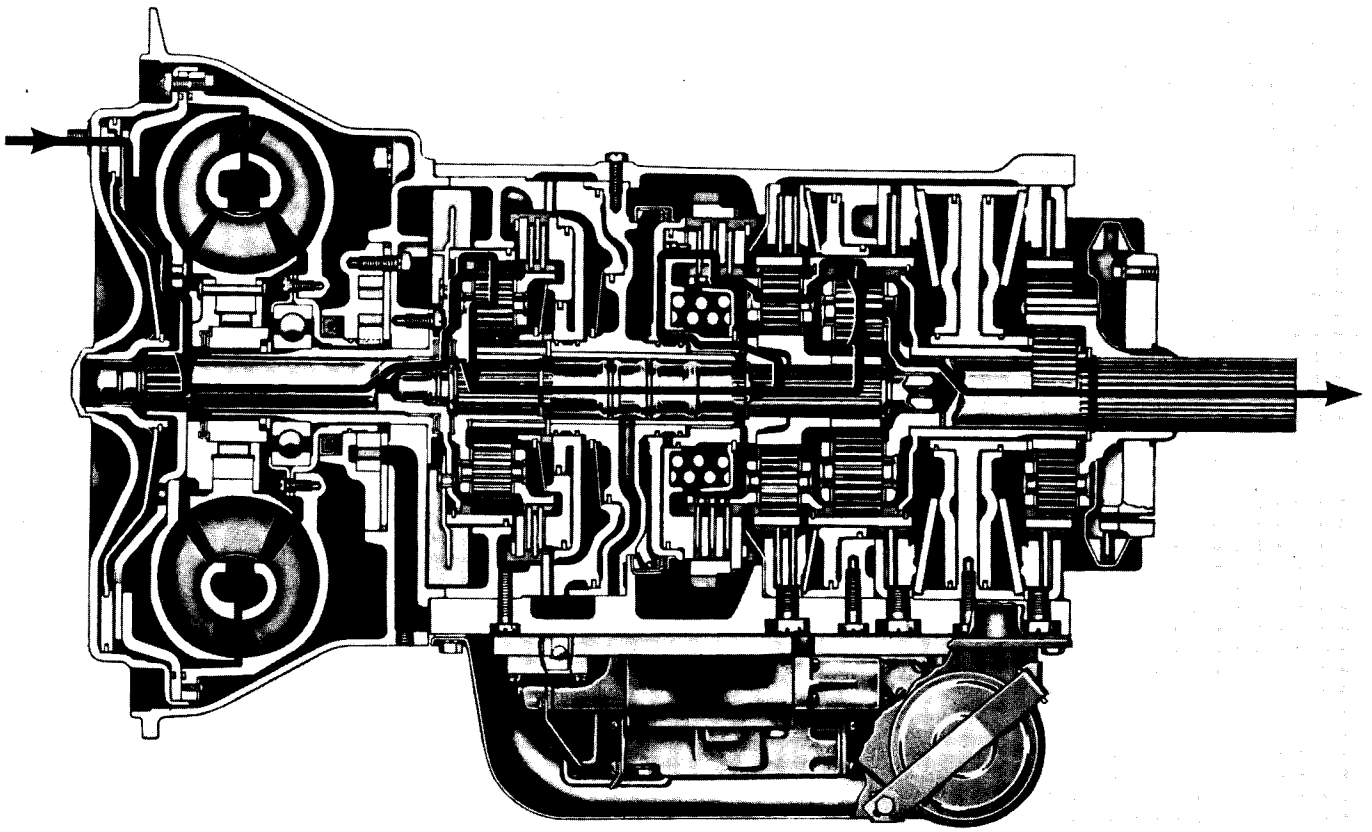


Fig. III-19 Fifth-gear power flow, lockup

d. Fifth Gear (fig. III-19). In fifth gear, the splitter system is in low ratio (1.39:1). The splitter output shaft is rotating the high-range clutch housing clockwise. The high-range clutch is applied and drives the intermediate-range carrier. The intermediate-range carrier drives the low-range ring gear. The low-range ring gear, in combination with the low-range sun gear which is rotating at the same speed, drives the transmission output shaft. The only speed reduction is in the splitter system, thus the final reduction ratio is 1.39:1 (converter in lockup).

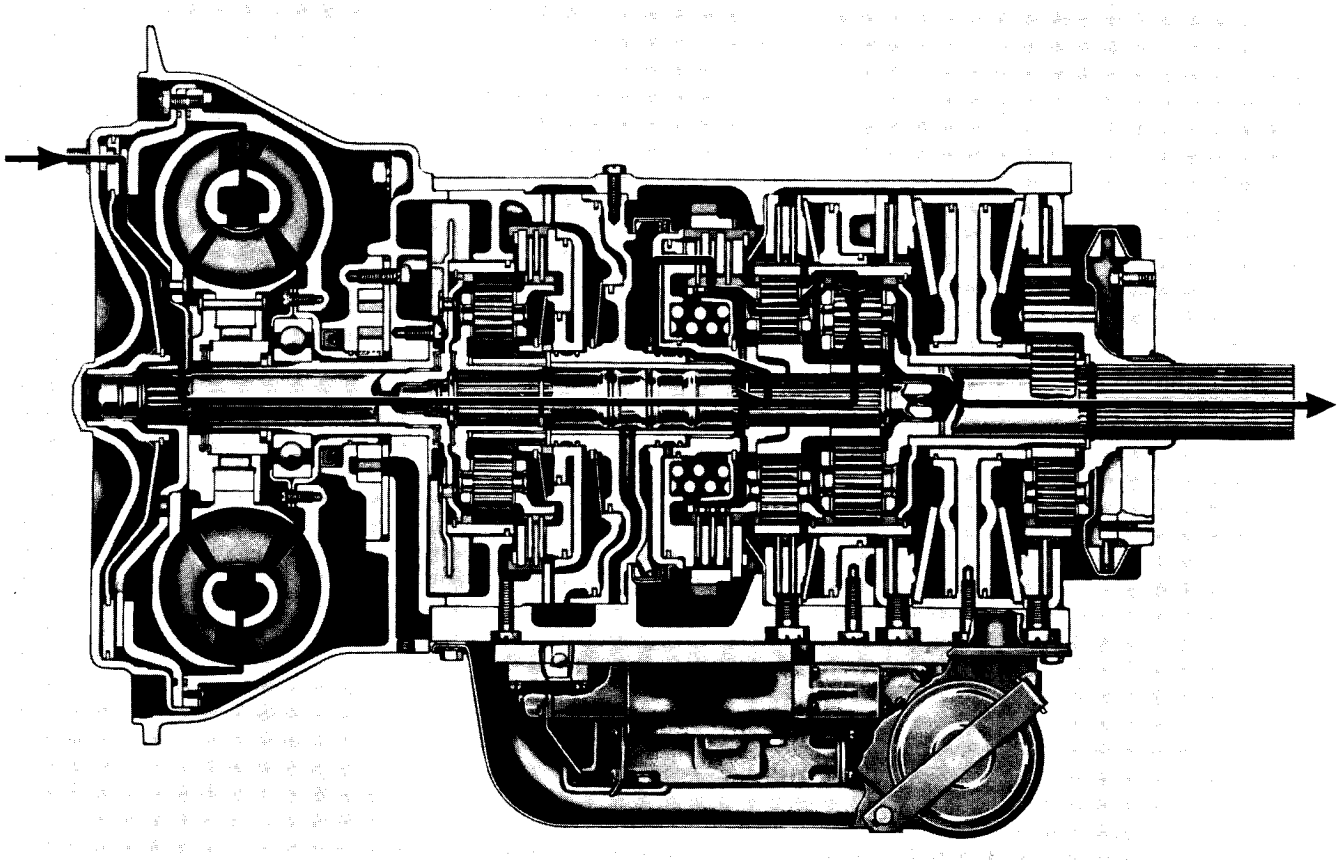


Fig. III-20 Sixth-gear power flow, lockup

e. Sixth Gear (fig. III-20). In sixth gear, the splitter system is in high ratio (1:1) while the high-range system functions as described in d, above. Thus, the final output ratio is 1:1 (engine speed) (converter in lockup).

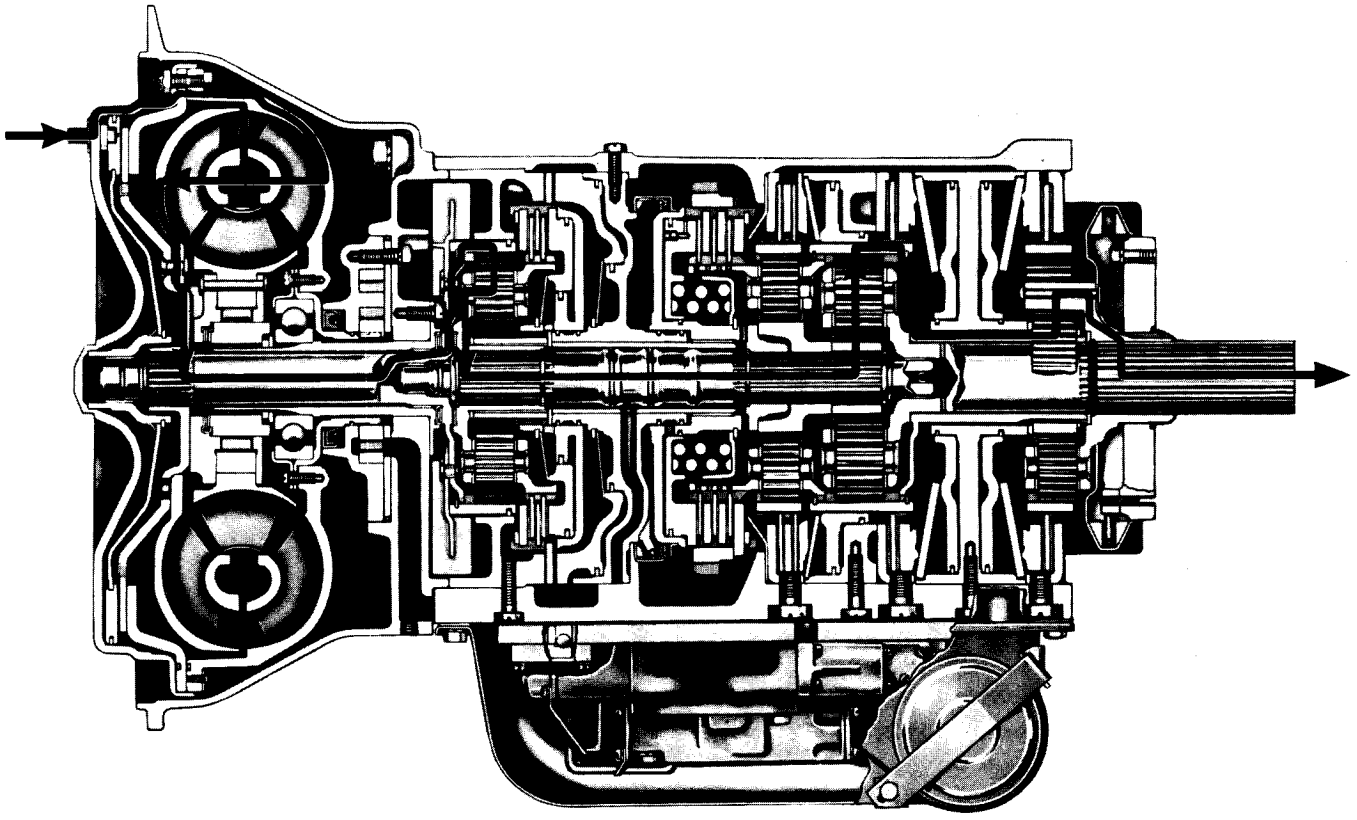


Fig. III-21 Reverse-gear power flow, converter

f. Reverse Range (fig. III-21). In reverse range, the splitter system is in low ratio (1.39:1). The reverse-range clutch is applied, holding the reverse-range ring gear stationary. The reverse-range sun gear is driven by the low-range ring gear which is driven by the low-range sun gear acting through the low-range pinions. The low-range carrier, although rotating, is the reaction member in the low-range planetary gear set. It is in the low-range planetary that reversing of rotation actually occurs. Some speed reduction as well as reversing occurs in the low-range planetary. Further speed reduction occurs in the reverse-range planetary. This is another example (refer to a, above) of "compounding." Lockup cannot occur in reverse range. Thus the final reduction ratio is the mechanical ratio (6.042:1) times the torque converter ratio.

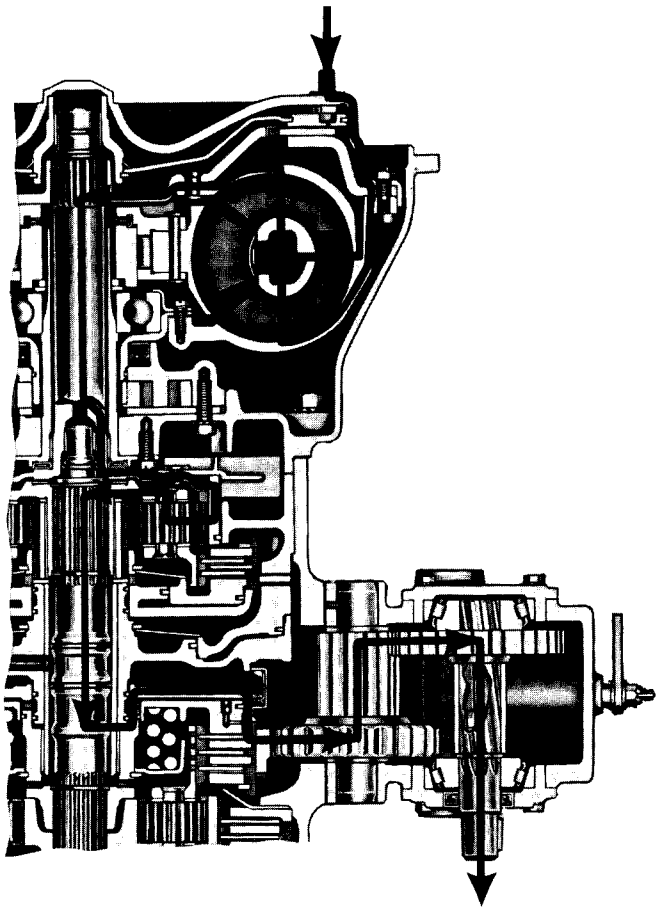


Fig. III-22 Power takeoff flow, converter

POWER TAKEOFF

49. DESCRIPTION (fig. III-22)

a. On each side of the transmission, at approximately the center of the transmission housing, is a six-bolt power takeoff mounting pad. These accommodate SAE regular duty power takeoff units. The power takeoff drive gear is a 57-tooth, 6-8 pitch gear concentric with the high-range clutch. It has a pitch diameter of 9 1/2 inches.

b. The power takeoff drive gear rotates with the high-range clutch housing which is splined to the splitter output shaft. Thus, it always rotates at splitter output shaft speed. When the vehicle is not moving, the selector lever is at neutral position, and the engine is running at idle speed, the drive gear may have a tendency to rotate. However, no power is available until the engine is accelerated.

50. OPERATION

a. Converter Driven. Torque is transmitted from the vehicle engine to the splitter ring gear either hydraulically through the torque converter or mechanically through the lockup clutch. The splitter ring gear transmits torque to the splitter pinions. When the splitter is in low ratio, the sun gear is stationary and the pinions must rotate around it. When the splitter is in high (direct) ratio, the carrier and sun gear are locked together and the splitter rotates as a unit. The splitter output shaft is splined to the carrier and transmits torque to the high-range clutch housing.

b. Throttle Control. When the engine is accelerated, the torque converter transmits torque and power becomes available. In neutral, the splitter is in low ratio (1.39:1) and cannot upshift. Neither can lockup of the torque converter occur. For these reasons, the power takeoff drive gear has the advantage of converter drive and its speed and torque are precisely controlled entirely by throttle operation.

c. Operates In Any Range. The power takeoff can be driven during the operation of the transmission in any range. The speed of the drive gear (in relation to engine rpm) then will be subject to splitter shifts and lockup of the torque converter. Also the speed of the power takeoff will be in various relations to transmission output speed – each gear establishing a definite relation.

d. Lockup In Forward Only. Lockup of the torque converter and shifting of the splitter ratios occur in every forward range. Neither can occur in reverse range. When the lockup clutch is released, there is no definite relation between power takeoff drive gear speed and engine speed. Usually, engine speed will be greater. However, in some instances, the engine may be throttled down while the vehicle is coasting so that power takeoff drive gear speed is greater.

e. Lockup Ratio. When the lockup clutch is engaged, power takeoff drive gear speed will be 0.72 times engine speed when low

splitter is engaged (first, third, fifth and reverse gears). When high splitter is engaged (second, fourth and sixth gears), the power takeoff drive gear speed will equal engine speed.

f. Low-range Ratio. The relation of power takeoff drive gear speed to transmission output speed is definite in each gear. In first and second gears (low range – creeper), the drive gear rotates at 3.81 times the speed of the transmission output shaft. In the next higher range (lowest of three drive ranges), the transmission operates in either third or fourth gear. In either gear, the power takeoff drive gear rotates at 1.936 times the speed of the transmission output shaft.

g. Intermediate-range Ratio. In the next higher range (middle in the three drive ranges), the transmission shifts automatically between third, fourth and fifth gears. Thus, the power takeoff drive gear will turn 1.936 times transmission output speed (in third or fourth gear) or at a speed equal to output speed (in fifth gear).

h. High-range Ratio. In the highest of the drive ranges, automatic shifts occur between third, fourth, fifth and sixth gears. The power takeoff drive gear turns at 1.936 times output shaft speed (in third and fourth gears) or at a speed equal to output shaft speed (in fifth and sixth gears).

i. Reverse Gear Ratio. In reverse gear, the power takeoff drive gear rotates at 4.35 times the speed of the transmission output shaft. Rotation is clockwise regardless of the position of the range selector.

j. Lubrication. The power takeoff is lubricated by either the transmission oil splash-fed into its housing, or by forced-feed from the cooler-return line or lubrication pressure supply. The method of lubrication is determined by the specific requirements of the power takeoff used.

Section IV. MAINTENANCE AND OPERATING INSTRUCTIONS

1. INSPECTION AND CARE

The transmission should be kept clean to make inspection easy. Check for loose bolts, loose or leaking oil lines, condition of control linkages, and oil leakage. Check the transmission oil level at the intervals specified in sect. II (refer to 2, below).

2. CHECKING OIL LEVEL

a. Maintaining the proper oil level is very important. If the oil level is low, the clutches and converter will not receive a sufficient supply. If too high (more than 5/16 inch above Full mark) the oil will be churned about in the transmission and become aerated. This will cause overheating. Drain excess oil to restore the proper level.

b. With the vehicle on a level surface, start the engine and run it at a fast idle until normal operating temperature (160 degrees Fahrenheit minimum) is attained.

c. Apply the hand brake fully.

Note: Do not operate the hydraulic retarder to warm the oil. This will aerate the oil and result in false level readings.

d. Move the selector control through each selector position to fill all clutches.

e. Clean the exposed part of the dipstick and the area immediately around it before removing the dipstick.

f. Place the selector control in neutral position and run the engine at approximately 800 rpm. Remove the dipstick, wipe it clean and reinsert it to its full depth. Again remove it and note the oil level.

g. If necessary, add oil to bring the level to the Full mark.

3. ALTERNATE METHOD OF CHECKING OIL LEVEL

If difficulty is encountered in obtaining a stabilized oil level, use the following alternate method:

a. Oil temperature at 160° F min.

b. Set vehicle brakes securely.

c. Place the selector lever in the highest drive range (3-6 gear).

d. Run the engine at 1000-1200 rpm for at least 30 seconds before and during the oil check.

e. Check the oil and add, if required.

4. OIL SPECIFICATIONS

Refer to sect. II for recommendations of oil to be used.

5. OIL AND OIL FILTER CHANGE INTERVALS

a. The oil and oil filter should be changed at the intervals specified in sect. II.

b. After overhaul of the transmission, oil and filter should be changed as prescribed in sect. II.

6. AUXILIARY OIL FILTER CHANGE INTERVALS

If the transmission oil system has been fitted with an auxiliary oil filter (refer to sect. II), this filter should be changed at the same time intervals prescribed for the regular filter in the transmission (refer to para 5, above).

7. OIL AND OIL FILTER CHANGE PROCEDURES

a. The transmission should be at oper-

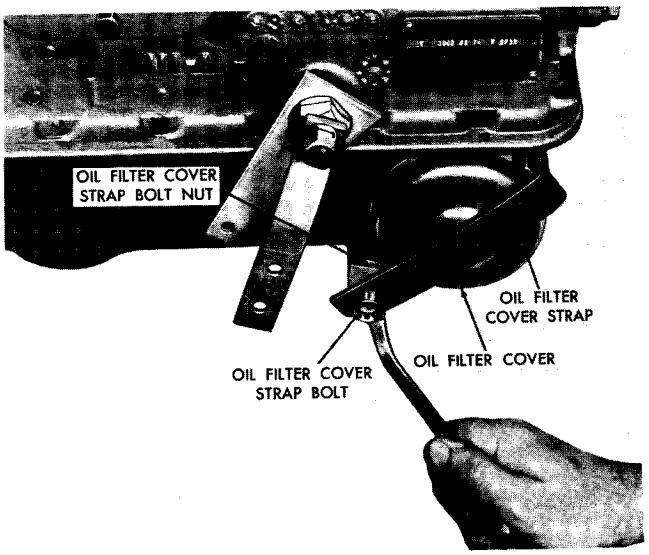


Fig. IV-1 Removing oil filter cover strap bolt

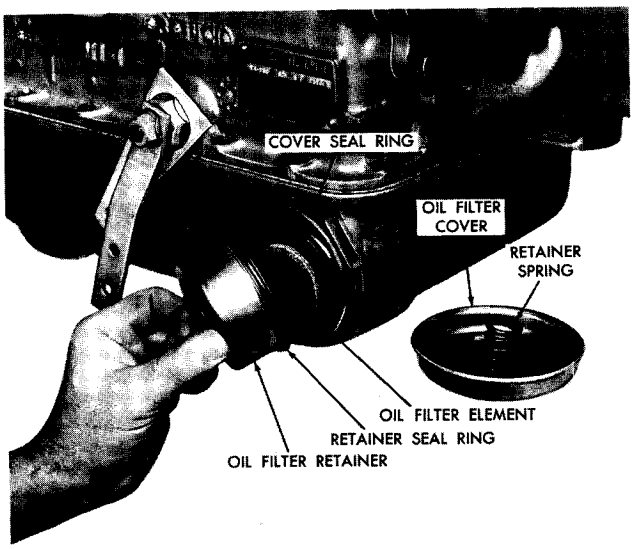


Fig. IV-2 Removing oil filter retainer

ating temperature (160° F min) when oil is drained. This will insure quicker and better drainage.

b. Remove the nut and bolt which retain the oil filter cover strap while holding the oil filter cover to prevent its falling off (fig. IV-1). Remove the cover strap.

c. Carefully remove the oil filter cover to prevent oil "gushing" out. A coil-type retainer spring should remain on a clip in the cover. Discard the cover seal ring (refer to fig. IV-2).

d. Grasp the bail on the filter retainer and remove the retainer by pulling straight out (fig. IV-2). Discard the retainer seal ring.

e. Remove the filter element assembly and discard it. Allow the oil to drain thoroughly.

Note: All of the oil in the transmission and external system cannot drain when only the filter cover is removed. Approximately 9 quarts are required to refill the transmission.

f. After the oil has drained thoroughly, install a new oil filter element assembly. Install a new retainer seal ring on the lip of the retainer. Install the retainer, pushing it firmly into the filter cavity.

g. Install a new cover seal ring on the oil pan filter opening lip. Install the cover, cover strap and the bolt and nut which retain the strap.

h. If an auxiliary filter is used (refer to sect. II), remove it by unscrewing the center bolt and removing the filter shell. Discard the element assembly and the filter shell seal ring. Clean the filter shell thoroughly. Install a new filter shell seal ring and a new element assembly. Tighten the center bolt to 35 to 45 pound feet torque.

i. Pour approximately 9 quarts of the specified oil (refer to sect. II) into the oil filler tube. Check the oil level as prescribed in para 2 or 3, above.

8. BREATHER

A transmission breather connection is located above the power takeoff on the left side of the transmission housing. The breather should be inspected and cleaned at intervals depending upon the severity of operating conditions which involve dust and dirt. Refer to sect. II for further information on the breather.

9. TEMPERATURES

a. The approximate temperature of the transmission oil is indicated by the temper-

ature indicator for the vehicle cooling system. When the vehicle has been operated for some time the temperatures of the engine and the transmission will tend to equalize. Any condition which raises the engine coolant temperature will raise the transmission temperature since the transmission oil is cooled by the engine coolant. Overheating of the transmission will raise engine coolant temperature when the cooling capacity of the radiator is exceeded.

b. In some installations, positive indication of transmission overheating is provided by a warning light in the vehicle cab which comes on if the temperature of the oil leaving the converter exceeds the temperature for which the sensing unit is set. Refer to sect. II for information on the warning light.

10. LINKAGE

Proper adjustment and functioning of the shift selector, throttle valve and hydraulic retarder linkage is of utmost importance to efficient performance of the transmission. Periodic inspections should be made for worn or bent parts, loose threaded connections, loose bolts and accumulation of grease and dirt. All moving joints must be kept clean and well lubricated. Refer to sect. II for adjustment procedures.

11. EXTERNAL LINES AND OIL COOLER

Periodic inspection should be made for loose or leaking connections, worn or damaged hoses and tubing and loose fastenings. Examine the radiator coolant occasionally for possible leakage of transmission oil to the engine coolant. This condition indicates a faulty heat exchanger. Refer to sect. II for additional information.

12. DRIVING INSTRUCTIONS

Refer to sect. II for driving instructions.

Service Information Notes

Section V. TROUBLESHOOTING

1. OPERATING CHARACTERISTICS

a. Effective Troubleshooting. To perform effective troubleshooting, the mechanic must have a thorough knowledge of the construction features and operating characteristics of the transmission. Particular attention should be accorded to the subjects below.

b. Learn Components. Refer to sect. III for description of transmission components and an explanation of transmission operations.

c. Operating Instructions. Refer to sect. II for instructions on operating the transmission while driving the vehicle in which it is installed and to sect. IV for oil supply information.

d. Adjustments, Linkages. Refer to sect. II for information on proper adjustment of control and throttle linkage. Refer to sect. XVI for tests and adjustments of other components.

2. TROUBLESHOOTING – BEFORE REMOVAL OR OPERATION

Do not operate the vehicle prior to completing the procedures described in this paragraph. Inspect for oil leakage. Visually inspect all split lines, connections, valve bodies, and plugs for oil leaks. Oil leakage at split lines may be caused by loose mounting bolts or defective gaskets. Tighten all bolts and plugs where leakage is found. If mounting bolts are tight and oil continues to leak, install a new gasket.

3. TROUBLESHOOTING – BEFORE REMOVAL AND DURING OPERATION

If the inspection in para 2, above, does not reveal the cause of the failure, and the vehicle is operable, further troubleshooting is necessary. Do not remove the transmission from the vehicle until the causes of trouble listed in the TROUBLESHOOTING CHART, para 6, below, are checked. In order to make a thorough test of the transmission while it is mounted in the vehicle, be sure that the engine is properly tuned, and the oil level in the transmission is correct. Refer to sect. IV, para 2.

4. TROUBLESHOOTING TESTS

All of the tests prescribed after rebuild may be applied to a transmission in which a malfunction is suspected. Refer to sect. XVI TESTS AND ADJUSTMENTS for such test procedures.

5. TROUBLESHOOTING – TRANSMISSION REMOVED FROM VEHICLE

When the malfunction of a transmission is not ascertained by tests before removal from the vehicle, the transmission should be mounted in a test stand and checked. Refer to sect. XVI. Particular attention should be given to proper oil level and to correct linkage adjustment in every transmission test.

6. TROUBLESHOOTING TABLE

The troubleshooting information, below, will assist in diagnosing and correcting transmission malfunctions before removal of the transmission from the vehicle. Use the TROUBLESHOOTING CHART, in conjunction with sect. XVI TESTS AND ADJUSTMENTS. In the chart below, the letters shown opposite the malfunction indicate the probable causes of trouble in the order in which they should be checked. The instructions given in the last column are to be followed in correcting the malfunction.

Note: The various oil pressure check points are shown in fig. XVI-1. The various oil pressures are listed in sect. I, under para 3, General Specifications and Data.

TROUBLESHOOTING CHART

	Malfunction		Probable Causes		Corrective Action
1.	Automatic shifts at too high speed on first to second shift and all lockup shifts	a.	Governor G1 pressure insufficient	a.	Refer to item 11, below
		b.	Lube pressure, low	b.	Refer to item 13, below
2.	Lockup shift points high and transmission will not shift to second gear	a.	G1 pressure, insufficient	a.	Refer to item 11, below
		b.	Lube pressure, low	b.	Refer to item 13, below
3.	Low-main pressure in all ranges	a.	Oil level, low	a.	Add oil to proper level (para 2, sect. IV)
		b.	Oil filter element, clogged	b.	Replace element (para 5, sect. IV)
		c.	Air leak at oil transfer tubes or seals in oil filter can	c.	Replace seals and/or oil filter can (step 66, sect. XV)
		d.	Main-pressure regulator valve spring weak, or improper spring	d.	Replace or rebuild range selector valve body (step 64, sect. XV or para 4, sect. VIII)
		e.	TV pressure, low at full throttle; normal at closed throttle	e.	Adjust throttle linkage (sect. II)
		f.	TV pressure spring, broken or weak	f.	Replace or rebuild control valve body (step 64, sect. XV or para 4, sect. VIII)
		g.	Range selector valve body, leakage	g.	Replace or rebuild control valve body (step 64, sect. XV or para 4, sect. VIII)
		h.	Valves sticking	h.	Replace or rebuild control valve body (step 64, sect. XV or para 4, sect. VIII)
		i.	Charging pump, worn or damaged	i.	Replace or rebuild pump (para 1d, 2d, sect. IX)
4.	Low-main pressure in low range	a.	Low-range circuit of range selector valve body, leakage	a.	Replace or rebuild control valve body (step 64, sect. XV or para 4, sect. VIII)
		b.	Leakage between low-range piston housing and transmission housing	b.	Tighten anchor bolts or replace housing (step 26, sect. XV)
		c.	Excessive leakage at low-range piston seals	c.	Overhaul transmission, replace seals (sect. VI through XV)

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Malfunction	Probable Causes	Corrective Action
5. Misses second gear in downshift to low range	a. Driver shifts manually at too low vehicle speed	a. Downshift to low range at higher vehicle speed
	b. G1 pressure, insufficient	b. Refer to item 11, below
	c. Splitter relay valve ball or ball seat, defective	c. Replace or rebuild control valve body (step 64, sect. XV or para 4, sect. VIII)
6. Transmission will not shift to fourth gear in intermediate range or in drive range	a. G2 pressure, insufficient	a. Refer to item 10, below
	b. Rear-pitot (G2) splitter plug, sticking	b. Replace or rebuild control valve body (step 64, sect. XV or para 4, sect. VIII)
7. All automatic shifts at too low speed at full throttle	a. TV pressure, low at full throttle	a. Adjust throttle valve control linkage (sect. II)
	b. TV linkage not adjusted correctly	b. See a, above
	c. Throttle valve spring weak or broken	c. Replace TV spring in control valve body (para 4, sect. VIII)
	d. Main pressure leaking into governor circuit	d. Replace oil transfer plate gasket and/or tighten all transfer plate and valve body bolts (steps 61, 62, 63, sect. XV)
8. All shift points too high except lockup and first to second shift	a. G2 pressure, insufficient	a. Refer to item 10, below
	b. Rear-pitot tube, loose	b. Tighten rear-pitot tube mounting bolts (step 32, sect. XV)
	c. Rear-fluid velocity governor, damaged	c. Replace governor (para 1a(3), 1b(3) sect. XII)
	d. Rear-pitot tube, damaged	d. Replace pitot tube (step 25, para XV)
9. Buzzing noise occurring intermittently	a. Low-oil level	a. Add oil to proper level (para 2, sect. IV)
	b. Oil filter element, clogged	b. Replace elements (para 7, sect. IV)
	c. Air leak at oil transfer tubes or seals in oil filter can	c. Replace seals and/or oil filter can (step 66, sect. XV)
10. Insufficient governor G2 pressure	a. Rear-pitot tube, loose	a. Tighten pitot tube mounting bolts (step 32, sect XV)
	b. Rear-fluid velocity governor, damaged	b. Replace governor (para 1a(3), 1b(3), sect. XII)
	c. Rear-pitot tube, damaged or improperly installed	c. Replace or properly install pitot tube (step 25, para XV)

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Malfunction	Probable Causes	Corrective Action
11. Insufficient G1 pressure	a. Lube pressure, low	a. Refer to item 13, below
	b. G1 circuits leak or obstructed	b. Replace or rebuild control valve body (step 64, sect. XV or para 4, sect. VIII)
	c. Anchor bolts holding high-range clutch diaphragm in housing, loose	c. Refer to sect. XV, steps 46 and 47
	d. Front-fluid velocity governor, damaged	d. Replace high-range clutch housing (para 2, sect. X)
	e. Front-pitot tube, damaged or loose	e. Replace pitot tube or tighten tube mounting screws (steps 25, 32, sect. XV)
12. Excessive creep in any range except neutral	a. Engine idle speed too high	a. Adjust to correct idle speed (sect. II)
13. Low lube pressure	a. Oil level, low	a. Add oil to proper level (para 2, sect. IV)
	b. Excessive internal air leakage	b. Check piston housing anchor bolts. Check valve body mounting bolts. Check oil pump mounting bolts. Check oil filter can suction tube seal rings (steps 29, 46, 47, 65, 66, sect. XV and para 2d, sect. IX)
	c. Oil lines restricted	c. Clean or replace lines
	d. Cooler lines or fittings, leakage	d. Tighten fittings or replace lines
	e. Lube regulator valve ball or spring in hydraulic retarder control valve body, faulty	e. Replace lube regulator valve (para 5, sect. VIII)
	f. Oil filter element, clogged	f. Replace element (para 7, sect. IV)
	g. Pump overage regulator, failure	g. Replace overage valve in main valve body (para 4, sect. VIII)
	h. Charging oil pump, failure	h. Replace assembly (para 1d, 2d, sect. IX)
	i. Converter pressure regulator valve ball, failure	i. Replace converter pressure regulator valve assembly on oil transfer plate (para 2, sect. VIII)

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Malfunction	Probable Causes	Corrective Action
14. Oil leaking into converter housing	a. Engine crankshaft rear oil seal, leakage	a. Refer to vehicle service manual
	b. Torque converter seals, leakage	b. Overhaul transmission, replacing all converter seals
	c. Charging oil pump, lip-type seal, faulty; or seal drain, restricted	c. Overhaul charging oil pump (para 1d, 2d, sect. IX)
	d. Hook-type seal ring on converter pump hub, broken	d. Replace seal ring (para 1c, 2c, sect. IX)
	e. Drive studs in converter pump cover, loose	e. Replace cover (para 1d, 2d, sect. IX)
	f. O-type seal ring at charging oil pump, leaking	f. Replace seal ring (para 1d, 2d, sect. IX)
15. Transmission heating up in all ranges	a. Oil level, low	a. Add oil to proper level (para 2, sect. IV)
	*b. Oil level, high	b. Drain oil to proper level (para 2, sect. IV)
	c. Engine cooling system, restricted	c. Refer to vehicle service manual
	*d. Oil cooler lines, restricted	d. Clean or replace lines (refer to vehicle manual)
	*e. Hydraulic retarder, partially applied	e. Adjust hydraulic retarder valve linkage (sect. II)
	*f. Bushing in converter ground sleeve, worn	f. Overhaul transmission and replace bushing
	*g. Stator on freewheel	g. Overhaul transmission
16. Lockup clutch will not engage	a. Governor G1 pressure, insufficient	a. Refer to item 11, above
	b. Lockup shift valve or lockup cutoff valve, sticking	b. Replace or rebuild range selector valve body (step 64, sect. XV or para 4, sect. VIII)
	c. Hook-type seal rings on splitter shaft or turbine shaft, broken	c. Replace seal rings (para 2, sect. X or step 55, sect. XV)
	d. Lockup clutch piston seal ring, leaking	d. Replace seal (para 1d, 2d, sect. IX)
	e. Excessive internal leakage	e. Overhaul transmission

(Continued on next page)

*Can also result in excessive fuel consumption

TROUBLESHOOTING CHART - Continued

Malfunction	Probable Causes	Corrective Action
17. No response to movement of shift lever	a. Range selector linkage, defective	a. Repair or replace linkage (refer to vehicle manual)
	b. Main pressure, low	b. Refer to item 3, above
	c. Low-splitter clutch, failure	c. Overhaul transmission
	d. Low-splitter clutch piston seals, leakage	d. Overhaul transmission
18. High stall speed	a. Oil level, low	a. Add oil to proper level (para 2, sect. IV)
	**b. Clutch pressure, low	b. Refer to item 4, above
	c. Converter pressure, low	c. Replace converter pressure regulator valve assembly on oil transfer plate (para 2, sect. VIII)
	**d. Range clutches, failure	d. Check stall speed in each range; overhaul transmission to correct clutch failure (para 4c, sect. XVI)
	**e. Low-splitter clutch, failure	e. Overhaul transmission
19. Low stall speed	a. Engine not performing efficiently (may be attributable to altitude)	a. Refer to engine manufacturer's manual (or vehicle service manual)
	b. Converter stator, improper functioning due to improper installation or failure of components	b. Assemble thrust bearing, springs and rollers properly or replace components (para 1b, 2b, sect. IX)
20. Early failure of low-splitter clutch after transmission overhaul	a. Low-splitter clutch plate, improperly assembled (except on clutches with doweled piston)	a. Rebuild transmission, replacing failed components
21. Rough shifting	a. Manual selector linkage out of adjustment	a. Adjust linkage properly (sect. II)
	b. Throttle valve linkage out of adjustment	b. Adjust linkage properly (sect. II)
	c. Valves, sticking	c. Replace or rebuild control valve body (para 4, sect. VIII)

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**Clutch slippage may be recognized by alternate racing and loading of the engine which is, at times, accompanied by a violent chatter

TROUBLESHOOTING CHART - Continued

Malfunction	Probable Causes	Corrective Action
22. Engine overspeeds on full-throttle shift out of low range (refer also to item 27, below)	a. Downshift timing valve, sticking	a. Replace or rebuild downshift timing valve (para 3, sect. VIII)
	b. Seals on intermediate-range clutch piston, excessively worn	b. Overhaul transmission
23. Loss of hydraulic retarder braking effect	a. Oil level, low	a. Add oil to proper level (para 2, sect. IV)
	b. Hydraulic retarder valve linkage, out of adjustment	b. Adjust linkage properly (sect. II)
	c. Oil filter element, clogged	c. Replace element (para 7, sect. IV)
	d. Air leaks at oil transfer tubes or seals in oil filter can	d. Replace oil filter can and/or seals (step 66, sect. XV)
	e. Lube regulator valve in hydraulic retarder valve body, failed	e. Replace regulator valve (para 5, sect. VIII)
	f. Hook-type seal ring on outside diameter of splitter ring gear, faulty	f. Overhaul transmission; replace seal ring (para 1, sect. X)
24. Excessive slippage and clutch chatter in first and second lockup only	a. Low-range clutch failure	a. Check stall speed in low range; if stall speed is higher than specified, overhaul transmission to correct clutch failure (see item 18, above)
	b. Excessive leakage of low-range clutch piston seals	b. Overhaul transmission
25. Excessive slippage and clutch chatter in first, third and fifth gear lockup	a. Low-splitter clutch failure	a. Make a stall test in drive range (item 18, above)
	b. Anchor bolts holding high-range clutch diaphragm in housing, loose	b. Refer to sect. XV, steps 46 and 47
	c. Excessive leaking of low-splitter clutch piston seals	c. Check main pressure drop in first, third and fifth gear lockup; overhaul transmission (sect. XVI)

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Malfunction	Probable Causes	Corrective Action
26. Excessive slippage and clutch chatter in second, fourth and sixth gear lockup only	a. High-splitter clutch, slipping	a. Check main pressure at lockup pressure point (para 3, sect. XVI)
	b. Anchor bolts holding high-range clutch diaphragm in housing, loose	b. Refer to sect. XV, steps 46 and 47
	c. Excessive leaking of high-splitter piston seals	c. Check main pressure drop in second, fourth and sixth gear lockup; overhaul transmission (para 3, sect. XVI)
27. Excessive slippage in third and fourth gear lockup only	a. Intermediate-range clutch failure	a. Make a stall test in drive range; overhaul transmission to correct clutch failure (item 18, above)
	b. Intermediate-range clutch piston seals, excessive leakage	b. Check main pressure drop in third and fourth gear lockup; overhaul transmission and replace seals (para 3, sect. XVI)
28. Dirty oil	a. Failure to change at specified interval	a. Change oil, install new oil filter element (para 7, sect. IV)
	b. Oil filter element, improperly installed or damaged	b. Change oil; replace element (para 7, sect. IV)
	c. Heat, excessive	c. Clean or replace cooler lines; refer to item 15, above
	d. Clutch failure	d. Overhaul transmission
29. Oil leak at output shaft	a. Faulty or missing seal at output flange, or flange retaining bolt	a. Install new lip-type seal in rear-bearing retainer, or O-type seal at bolt (para 2, 3, sect. XI) Caution: Rear-pitot tube mounting bolts must be loosened at least 1/16 inch before loosening output flange, and must remain loose until flange bolt is tight again; do not rotate output shaft with pitot tube loose

(Continued on next page)

TROUBLESHOOTING CHART - Continued

Malfunction	Probable Causes	Corrective Action
30. Slippage in fifth and sixth gear lockup only	a. High-range clutch slipping	a. Check main pressure drop in fifth and sixth gear lockup; overhaul transmission (para 3, sect. XVI)
	b. High-range clutch piston seals, excessive leakage	b. Overhaul transmission; replace seals
31. Slippage in all forward gears	a. Oil level, low	a. Add oil to proper level (para 2, sect. IV)
	b. Clutch pressure, low	b. Refer to item 3, above
	c. Lockup clutch, slipping	c. Check lockup pressure inspect lockup clutch (para 3, sect. XVI)
32. Slippage in reverse range; proper function in all forward gears	a. Reverse-range clutch failed	a. Make reverse-range stall test; overhaul transmission to correct clutch failure (item 18, above)
	b. Reverse-range clutch piston seals, excessive leakage	b. Check main pressure drop in reverse range; overhaul to replace seals (para 3, sect. XVI)
33. Vehicle moves forward in neutral range	a. Range selector linkage out of adjustment	a. Adjust linkage properly (sect. II)
	b. Range clutch, failed and dragging	b. Overhaul transmission
	c. Insufficient range clutch clearances	c. Check clutch clearances; refer to sect. VII, step 28 (or sect. XIV, fig. 1)
34. Vehicle moves backward in neutral range	a. Range selector linkage out of adjustment	a. Adjust linkage properly (sect. II)
	b. Reverse-range clutch, failed and dragging	b. Overhaul transmission
35. Throws oil out of transmission filler tube	a. Dipstick, loose	a. Replace, if necessary
	b. Breather line, clogged, disconnected, or pinched	b. Connect, clean or replace line (sect. II)
	c. Oil level, too high	c. Drain oil to proper level (para 2, sect. IV)
36. Oil leak at rear bearing retainer	a. Bearing retainer bolts, loose	a. Tighten bolts (step 27, sect. XV)
	b. Gasket, blown, or of improper thickness	b. Replace with proper gasket (step 25, sect. XV)

7. CLUTCHES AIR PRESSURE CHECKS

a. Compressed air may be used to check the operation of the various clutches in the transmission, and to find leaks that may be caused by broken, damaged, or missing seals.

b. To make the air pressure checks, remove the oil pan, oil filter can, valve body, and oil transfer plate from the transmission, then apply 85 to 100 psi (do not exceed 150 psi) air pressure at the appropriate holes in the mounting pad at the bottom of the transmission housing. These holes are shown and identified in fig. V-1.

c. When compressed air is applied as directed, listen for the noise that occurs when the clutch is applied. If no clutch application noise is heard, a leak may exist in the hydraulic system. Check the transmission for leakage of air while conducting this test. The AIR PRESSURE CHECK CHART, below, is a guide for this test.

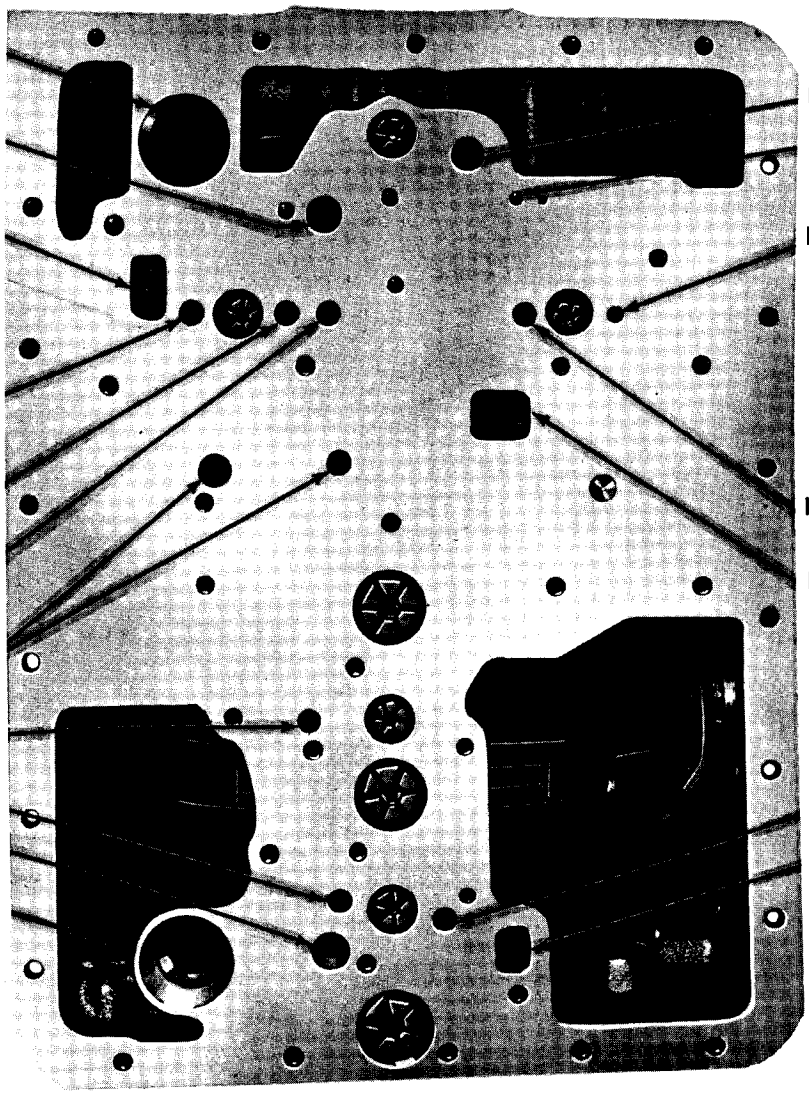


Fig. V-1 Air pressure check points

CLUTCHES AIR PRESSURE CHECK CHART

Check Passage	Leak Location	Cause of Leak
Low-splitter clutch	Between diaphragm and case	Bottom two anchor bolts loose, or not drawing diaphragm to case
	At piston id	Hook-type oil seal for id broken, or omitted
	At piston od	Seal for od broken, nicked or omitted
High-splitter clutch	Between diaphragm and case	Bottom two anchor bolts loose, or not drawing diaphragm to case
	At piston id	Hook-type oil seal for id broken, or omitted
	At piston od	Seal for od broken, nicked or omitted
	Lube hole in retarder valve body pad	Diaphragm front hub hook-type seal ring broken or omitted
	Retarder feed	Diaphragm rear hub hook-type seal ring broken or omitted
High-range clutch	Between diaphragm and case	Bottom two anchor bolts loose, or not drawing diaphragm to case
	At front-pitot hole or at lube in retarder valve body pad	Inner hook-type seal ring on rear hub broken or omitted
	At lube hole in retarder valve body pad	Rear hook-type seal ring on rear hub broken or omitted
	Around clutch piston spring	Hook-type seal ring for clutch piston id broken or omitted
	Around high-range clutch hub	Seal at piston od broken, nicked, or omitted

(Continued on next page)

CLUTCHES AIR PRESSURE CHECK CHART - Continued

Check Passage	Leak Location	Cause of Leak
Intermediate-range clutch	Between case and intermediate clutch piston housing	Anchor bolts loose, intermediate clutch housing not tight against hole in case
	At piston id	Hook-type ring broken or omitted
	Around low-range clutch plate	Same as above
	At piston return spring and piston od	Seal at piston od broken, nicked, or omitted
Low-range clutch	Between case and low-reverse piston housing	Anchor bolt loose; low-reverse clutch housing not tight against case
	At piston id	Hook-type seal broken or omitted
	Around clutch id	Same as above
	At piston od	Seal broken, nicked, or omitted
Reverse clutch	Between case and low-reverse piston housing	Anchor bolt loose; low-reverse clutch housing not tight against case
	At piston id	Hook-type seal broken or omitted
	Around clutch id	Same as above
	At piston od	Seal broken, nicked, or omitted
Lockup clutch	At piston od	Seal broken, nicked, or omitted
	At od of converter cover	Seal between reaction plate and cover, or between plate and converter pump flange, damaged or omitted
	At turbine shaft	Broken or omitted hook-type rings at front end of turbine shaft, front end of splitter shaft, or center of splitter shaft

Section VI. GENERAL OVERHAUL INFORMATION

1. GENERAL

a. Proper Equipment. Proper equipment must be available before disassembly is started. This equipment includes a suitable hoist of at least 1/2-ton capacity, proper hand tools and special tools, receptacles for small parts, wiping cloths, and a press. Refer to sect. II for list of special tools.

b. Supply New Gaskets, etc. Gaskets, lock wires, lock strips, and cotter pins should be discarded at transmission disassembly. New parts should always be supplied in such cases.

c. Avoid Component Damage. Care must be used to avoid damage to transmission components during disassembly, cleaning, inspection, repair, and reassembly. Nicks, dents and scratches caused by careless handling may cause oil leakage or improper functioning and could result in transmission failure. All defective parts must be replaced.

d. Torque Requirements. All standard torquing requirements for bolts, screws, and nuts are tabulated in sect. XVII. Where special torque requirements apply, they will be found in the applicable text.

2. CLEANING RECOMMENDATIONS

a. General. Cleanliness is of paramount importance in servicing the transmission. All components must be thoroughly cleaned and kept clean throughout the rebuild process. The presence of dirt can cause malfunction, and possible failure of the transmission.

b. Cleaning Parts

(1) Every component should be thoroughly cleaned after the transmission is disassembled. Cleaning is necessary to insure effective inspection for wear, damage, and serviceability of components.

(2) The utmost care should be used in handling of parts during cleaning and rebuild operations. Nicks, scratches, dents, or burs can prevent proper assembly or cause malfunction after assembly. This is especially true of valves and valve body parts.

(3) Abrasives, files, scrapers, wire brushes and sharp tools should never be used on surfaces where finish is important to the operation or sealing of ports, except where specifically recommended.

(4) Gum or varnish may be removed by soaking in dry cleaning solvent or mineral spirits paint thinner and by the use of a soft bristle brush. Crocus cloth may be used to remove minor surface irregularities. Lapping compound may be used, if required, in valve body bores to free sticking valves. Clean thoroughly to remove compound after use.

(5) A soft wire (brass or copper) may be used to clean oil passages. Always flush such passages thoroughly after cleaning.

(6) If steam cleaning is used, dry the cleaned parts immediately with compressed air and apply a film of oil to prevent rusting. Never use lye or caustics which will corrode or etch metal surfaces.

(7) Do not clean the lubricant from new bearings. Keep new bearings wrapped until they are to be installed. Soak bearings which have been in service, in dry cleaning solvent or mineral spirits paint thinner to loosen deposits of dirt. Do not spin the bearings during cleaning or drying. After cleaning, turn the bearings by hand and note any evidence of grit. Reclean them if grit is present.

3. INSPECTION AND REPAIR RECOMMENDATIONS

a. Castings, Forgings, Machined Surfaces

(1) Inspect all castings and forgings for breaks, cracks, and wear or scoring that would impair serviceability. Remove nicks and small surface irregularities with crocus cloth or a soft stone.

(2) Inspect all oil passages for obstructions and dirt. Reclean passages if necessary.

(3) Inspect mounting faces for nicks, scratches and scores. Remove minor defects with crocus cloth or a soft honing stone. Replace any parts in which defects, which cannot be corrected, will impair the operation of the transmission.

(4) Inspect threaded openings for damaged threads. Chase damaged threads with the correct size used tap.

Note: A new tap will cut oversize. If threads are stripped, discard the part unless it can be satisfactorily repaired by installing an insert.

(5) Replace housings or other cast parts that are cracked or broken.

b. Roller or Ball Bearings. Refer to 2b(7), above, for cleaning. Inspect the bearings for free and smooth rotation and tightness of fit. If defects are found, replace the bearing.

c. Needle-type Roller Bearings. Inspect the bearings for free and smooth rotation, broken or missing rollers, and tightness of fit in the bore. If defects are found, replace the bearing, using the proper replacer.

d. Bushings, Bushing-type Bearings, and Thrust Washers

(1) Inspect bushings and bushing-type bearings for size, scoring and out-of-roundness, burs, sharp edges and evidence of seizing. Minor scores, sharp edges and scratches may be removed with crocus cloth. Out-of-round, deeply scored or worn parts should be discarded.

Note: Do not remove bushings and bushing-type bearings unless replacement is necessary, as removal usually damages these parts.

(2) Remove bushings and bushing-type bearings by using a puller or press when possible. Bushings in blind holes may require removal by sawing or the use of a narrow cape chisel.

Caution: If necessary to cut out a bushing, do not damage the bore into which it fits.

(3) Inspect thrust washers for wear, distortion, scores and burs. Correct minor defects but replace parts that are worn, scored or deformed.

e. Oil Seals and Gaskets

(1) Inspect hook-type seal rings for wear, distortion, cracks and broken hooks. Replace defective seal rings.

(2) Inspect composition type seal rings or packings for wear, brittleness, cracks, cuts, deformation, and deterioration. Replace defective seals.

(3) Inspect lip-type seals for cracks, wear, cuts and brittleness. Inspect springs and seal shells. Replace any seals found defective.

Note: Removal of a seal will usually damage it. Inspect it rigidly before reusing it.

(4) Replace all flat-type gaskets without inspection.

f. Gears

(1) Inspect gears for burs, wear, broken teeth and pitting at tooth contact areas.

(2) Inspect planetary carrier assemblies for smooth bearing rotation, bearing looseness or gear end play.

(3) Remove burs, using a soft honing stone. Replace gears that are excessively worn or pitted.

g. Splined Parts

(1) Inspect splined parts for twisted or broken splines, burs, and excessive wear.

(2) Remove burs, using a soft honing

stone. Replace parts which have twisted or broken splines and excessive wear.

h. Clutch Plates

(1) Inspect nonmetallic plates for excessive wear, cracks, breaks, and deep scoring. Replace plates if such defects are found.

(2) Inspect faced steel plates for burs, imbedded metal particles, severely pitted faces, excessive wear, cracks, distortion and damaged spline teeth. Remove burs, using a soft honing stone. Replace plates which have other defects.

(3) Inspect steel plates for burs, scoring, excessive wear, distortion, imbedded metal, galling, cracks, breaks, and damaged spline teeth. Remove burs and minor surface irregularities, using a soft honing stone. Replace plates which have other defects.

i. Threaded Parts

(1) Inspect all threaded parts for stripped or damaged threads and burs.

(2) Replace all parts which have stripped threads or damage which cannot be repaired by chasing the threads with a tap or die of the proper size.

Note: If possible, chase the threads with a used tap or die. A new tap may cut oversize, while a new die may cut undersize.

j. Snap Rings. Inspect snap rings for nicks, burs, distortion, cracks and wear. Discard snap rings which are defective.

k. Springs. Inspect springs for wear, distortion, cracks, breaks, evidence of overheating, and loss of tension or compression. Discard defective springs.

l. Shafts and Spindles

(1) Inspect shafts and spindles for excessive wear, bending, scores, cracks, burs, and obstructed oil passages.

(2) Remove burs and minor surface irregularities with crocus cloth or a soft honing stone. Remove obstructions by probing with soft wire or with compressed air. Discard parts with other defects.

m. Ball-type Valves

(1) Inspect balls for rust, pitting, or grooving. Discard balls which will not seat properly.

(2) Inspect ball seats for wear and pitting. Reseat by lapping with the proper size ball. Discard parts in which the seat cannot be restored.

(3) Discard plastic balls which are rough, chipped, cracked, broken or worn.

n. Spool-type Valves

(1) Inspect valves for wear, burs, scoring, and evidence of sticking. Try valves in their bores. All valves should move in their bores by their weight alone. Do not force valves.

(2) Inspect the edges of all valve lands. All edges should be square and sharp. Do not destroy these sharp edges in cleaning or repair operations. These sharp edges help prevent the accumulation of substances which might cause the valve to stick in its bore.

(3) Remove burs with a soft honing stone. Reclean valves if necessary to remove gum or dirt. Discard all valves which have other defects.

o. Sheet Metal Parts

(1) Inspect sheet metal parts for bends, cracks, distortion, interference with adjacent parts, and loose welded points.

(2) Straighten bent parts. Weld cracks or loose welds.

(3) Discard governor oil collector rings if any damage is evident.

Service Information Notes

Section VII. DISASSEMBLY OF TRANSMISSION INTO SUBASSEMBLIES

1. GENERAL

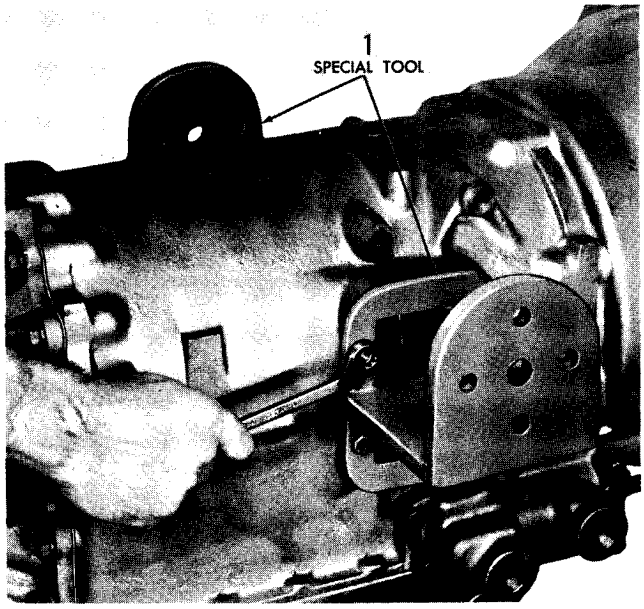
a. Pictorial Steps. This section is arranged in consecutive pictorial steps illustrating the disassembly of the transmission. Directly beneath each picture are simple disassembly instructions keyed to pictures by letter callouts.

b. Cross Section, Exploded View Foldouts. Refer to transmission cross section (foldout 1) and to component exploded views (foldouts 3 through 9) for functional relation of parts, and parts identification.

c. Special Tools. Refer to sect. II for special tools.

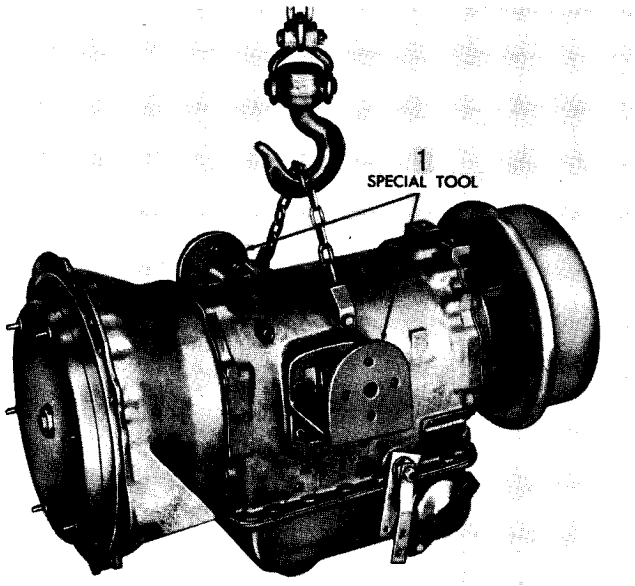
2. DISASSEMBLY STEPS

Drain the oil from the transmission, if it was not drained before the transmission was removed from the vehicle. Refer to sect. IV, para 7.



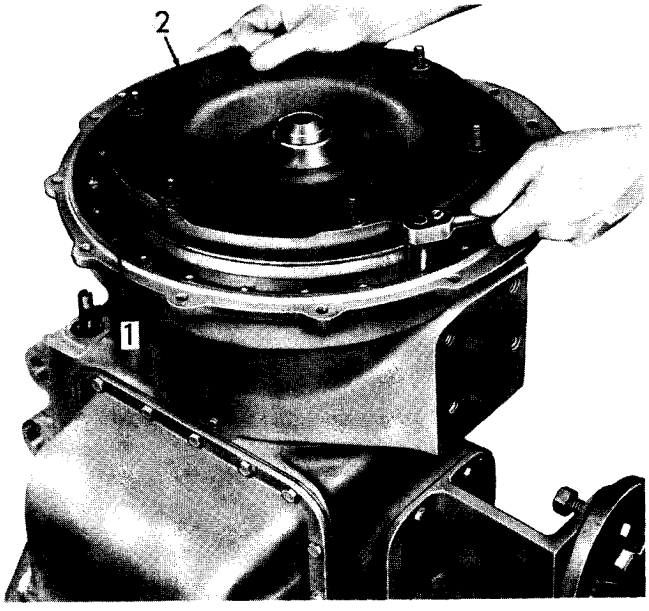
STEP 1

Remove power takeoff covers (one on each side of transmission) and install a repair stand adapter bracket 1 on each opening.



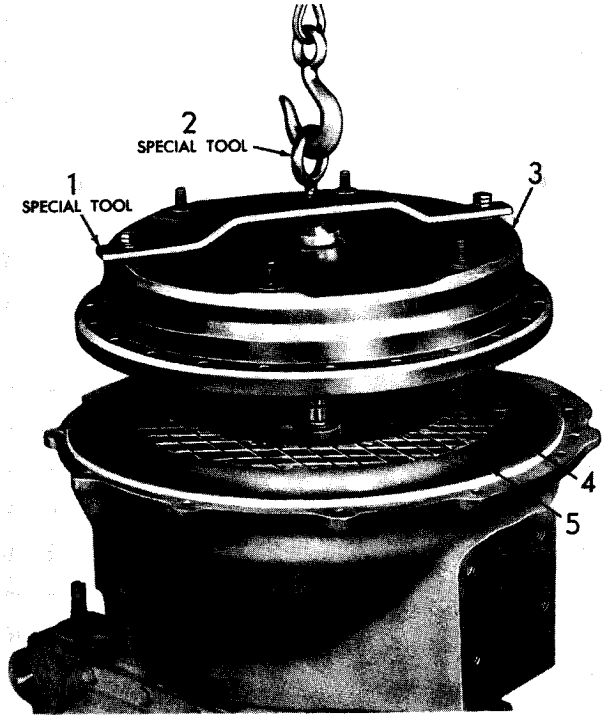
STEP 2

Hoist the transmission, with adapter brackets 1 installed, and position it in the overhaul stand.



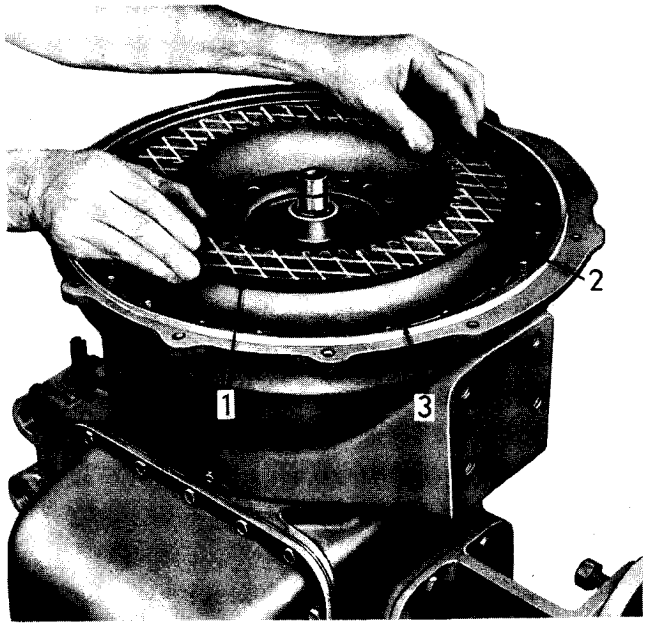
STEP 3

Position the transmission, converter upward, and remove 24 self-locking nuts 1 which retain the converter pump cover assembly 2.



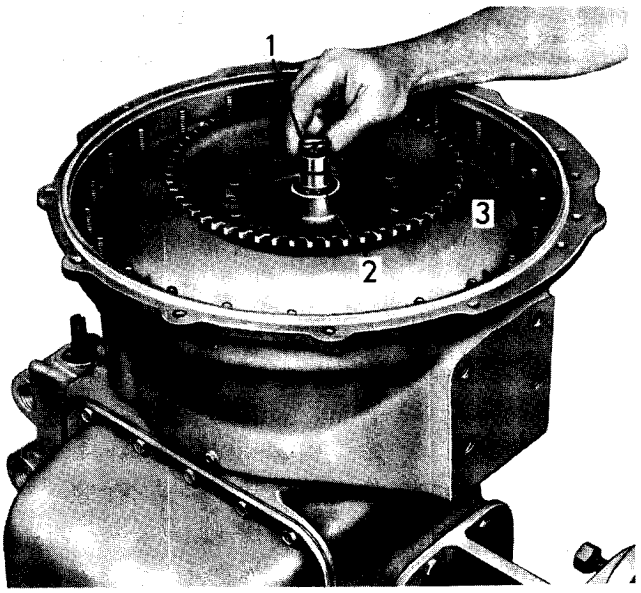
STEP 4

Using strap 1 and lifting eye 2, remove cover assembly 3. Note: Clutch plate 4 and back plate 5 may come off with cover assembly 3. If so, support them until they can be removed.



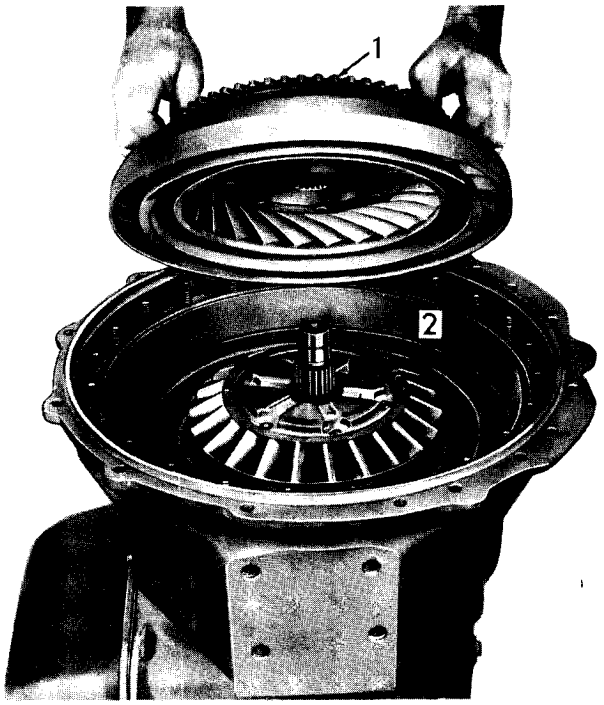
STEP 5

Remove lockup clutch plate 1, seal ring 2, and lockup clutch back plate 3.



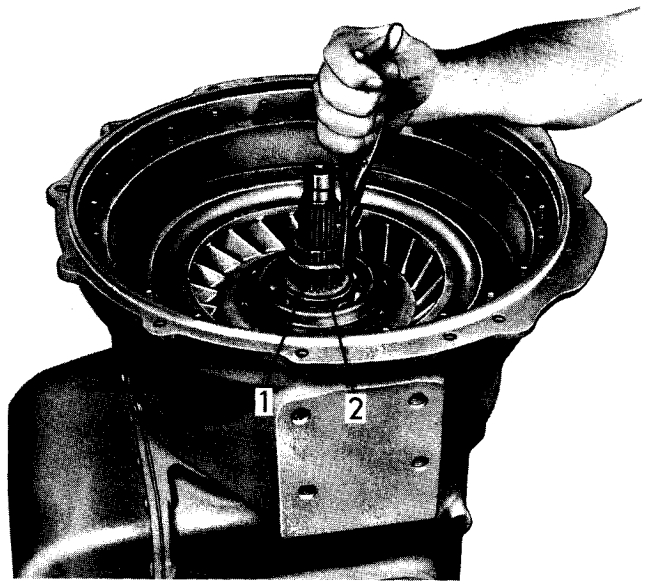
STEP 6

Remove hook-type seal ring 1, snap ring 2, and seal ring 3.



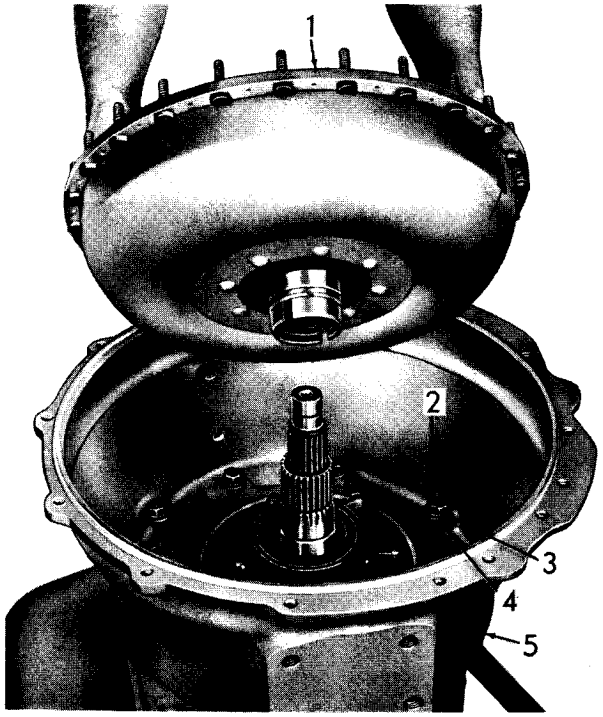
STEP 7

Remove converter turbine assembly 1. Twist converter stator 2 counterclockwise to lock it to the freewheel roller race and lift up while sliding fingers under the race end before it comes all the way off the shaft. Invert the stator assembly before releasing fingers.



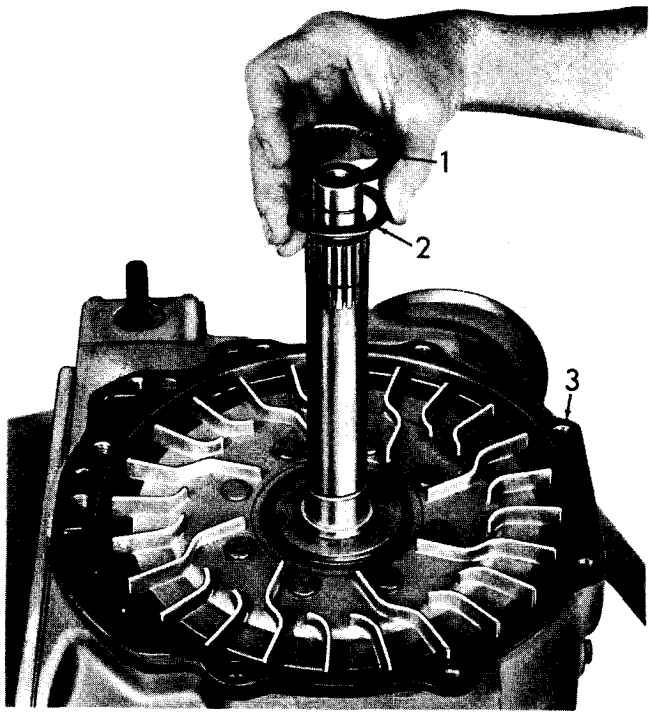
STEP 8

Remove snap ring 1 and converter pump spacer 2.



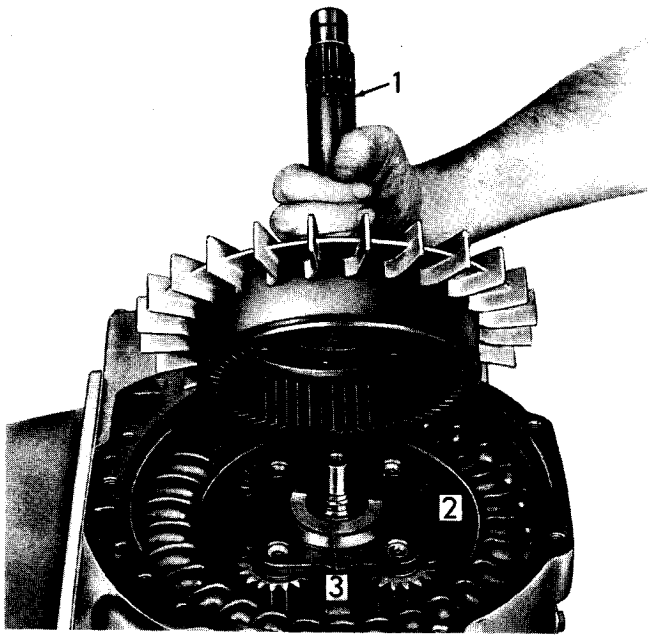
STEP 9

Remove converter pump assembly 1. Remove ten bolts 2, ten lock washers 3, (and ten flat washers 4 on aluminum housing models). Lift off converter housing assembly 5.



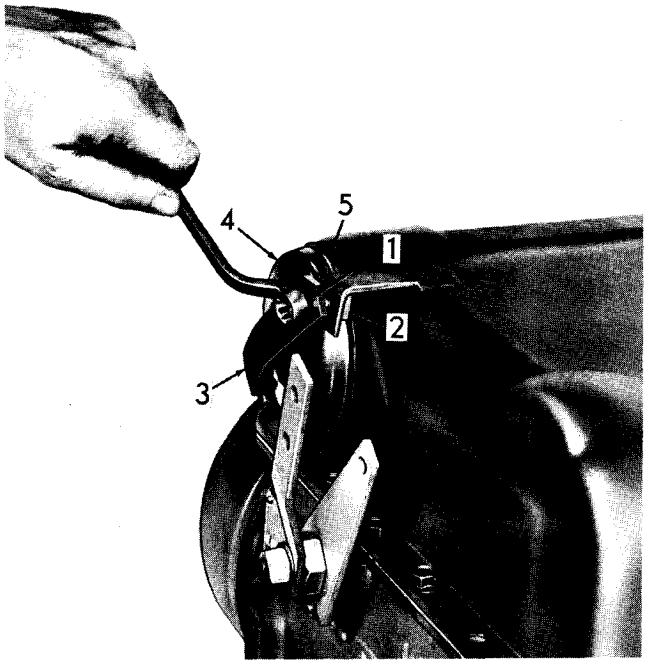
STEP 10

Remove needle bearing assembly 1 and needle roller bearing race 2. Remove converter housing gasket 3.



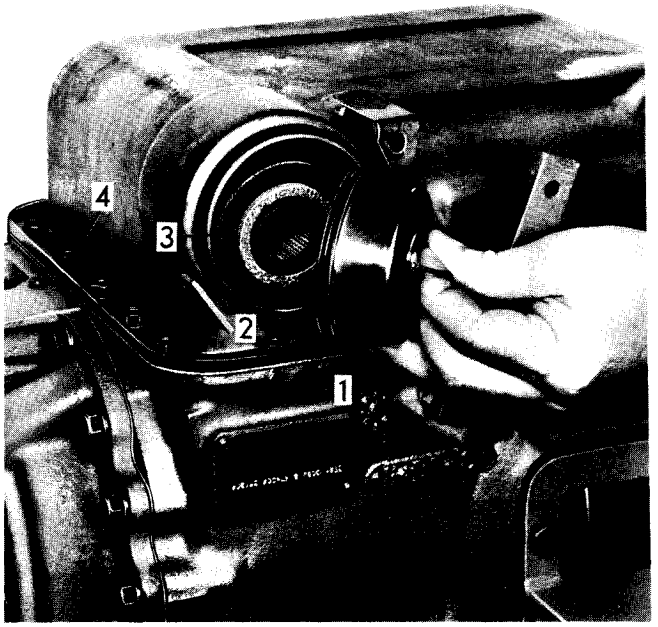
STEP 11

Remove hydraulic retarder shaft and rotor assembly 1. Remove the hook-type seal ring 2 and thrust washer 3.



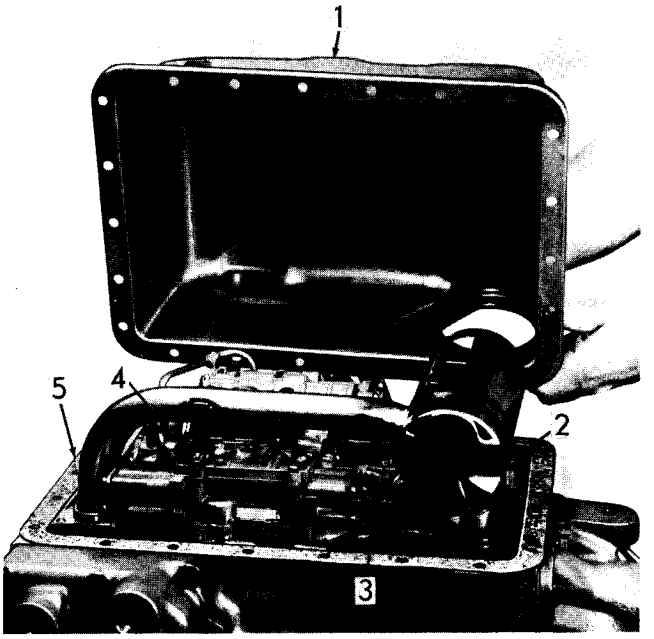
STEP 12

Position the transmission, bottom upward. Remove bolt 1, nut 2 and strap 3. Remove cover 4 and seal ring 5.



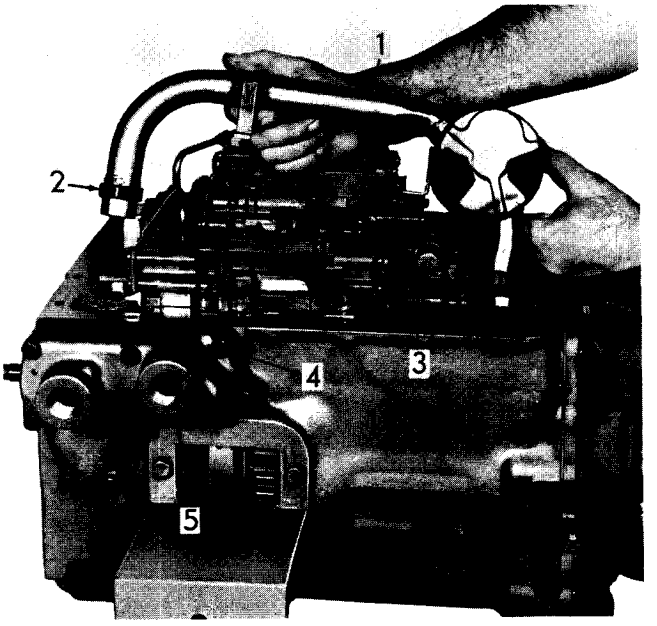
STEP 13

Remove retainer 1, seal ring 2, and filter element assembly 3. Remove oil pan retaining bolts 4.



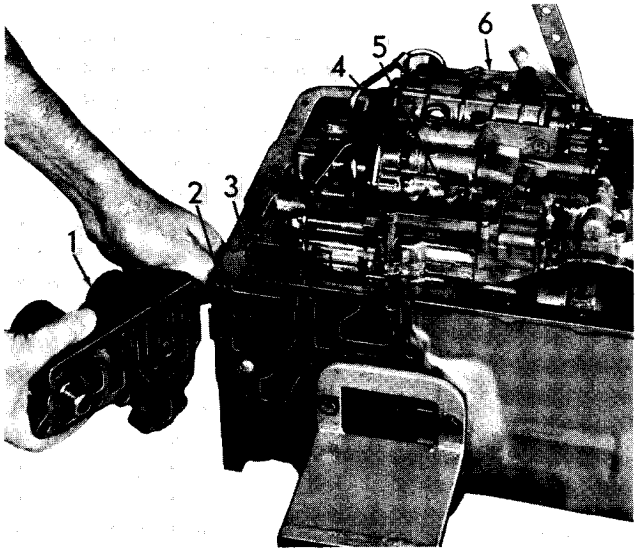
STEP 14

Remove oil pan 1. Remove 3 bolts and lock washers 2, 3 and 4. Remove gasket 5.



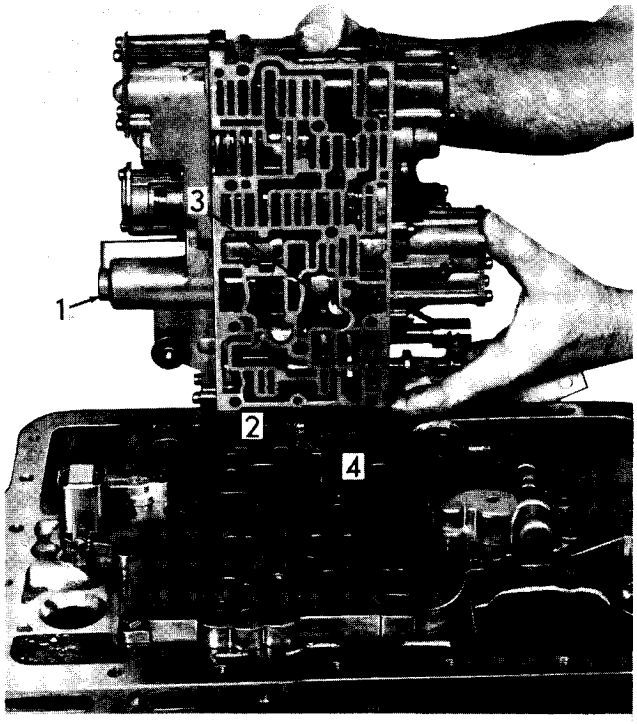
STEP 15

Remove oil filter can assembly 1. Remove seal ring 2 (and a second seal ring at 3, on models having a rear-oil pump). Remove eight bolts and lock washers 4 retaining valve body 5.



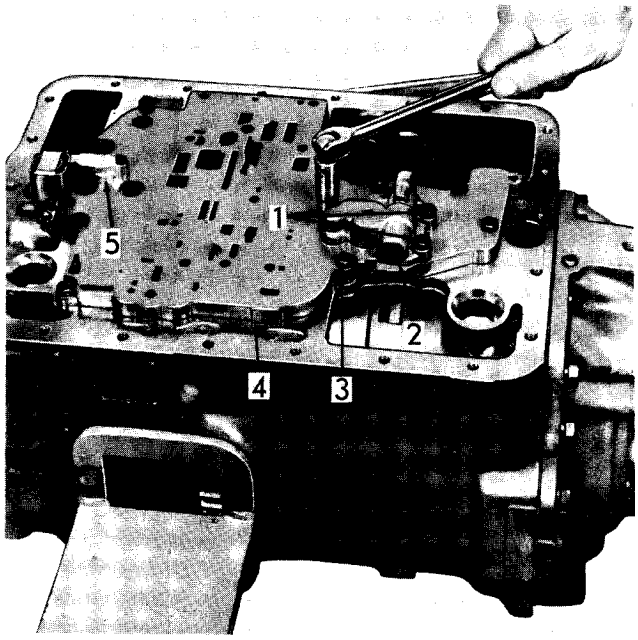
STEP 16

Remove valve body assembly 1, ball 2, and gasket 3. Remove eight bolts and lock washers 4, and three sleeves 5 retaining valve body assembly 6.



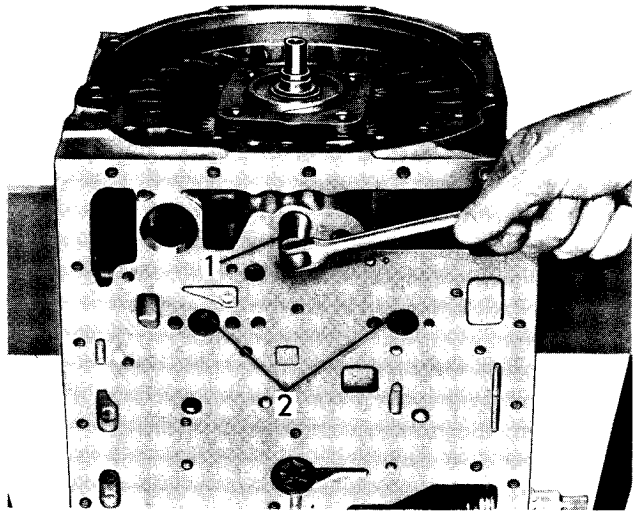
STEP 17

Remove valve body assembly 1, being very careful that ball 2 and ball 3 do not drop into the transmission. Remove balls 2 and 3, and spring 4.



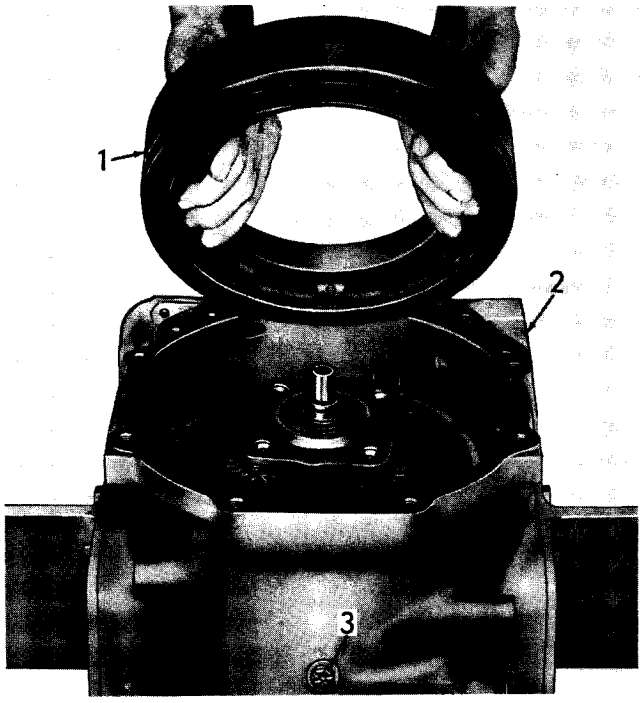
STEP 18

Remove three bolts and lock washers 1 retaining valve body assembly 2. Remove ten bolts and lock washers 3. Remove oil transfer plate assembly 4, being careful that the ball under cover 5 does not fall into the transmission. Remove the ball when plate 4 is lifted.



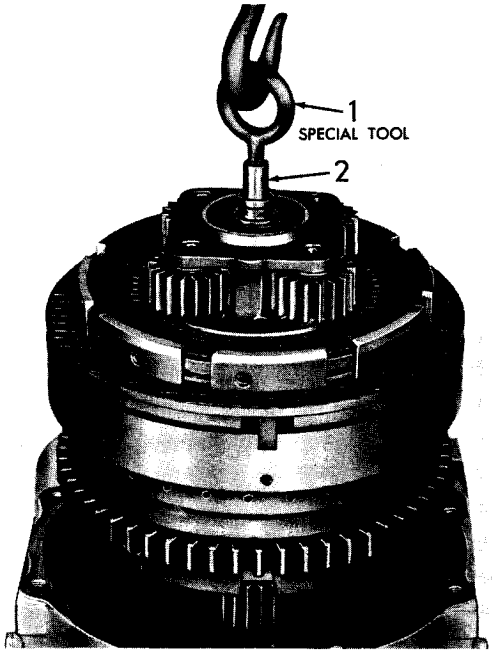
STEP 19

Position transmission, converter end upward. Remove low-splitter clutch reaction plate anchor bolt 1 and the two high-range clutch diaphragm anchor bolts 2.



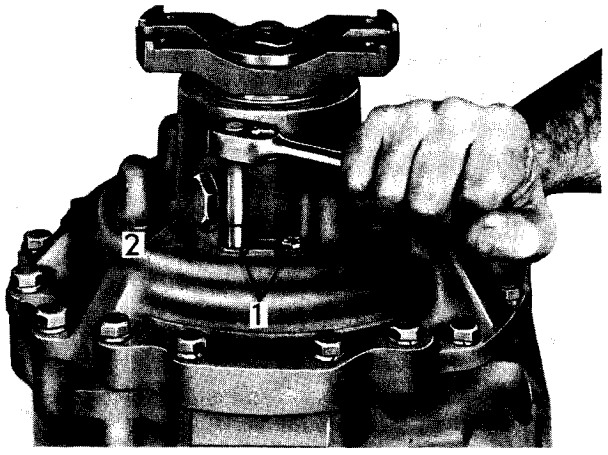
STEP 20

Remove low-splitter clutch reaction plate 1 from transmission housing 2. Remove high-range clutch diaphragm anchor bolt 3.



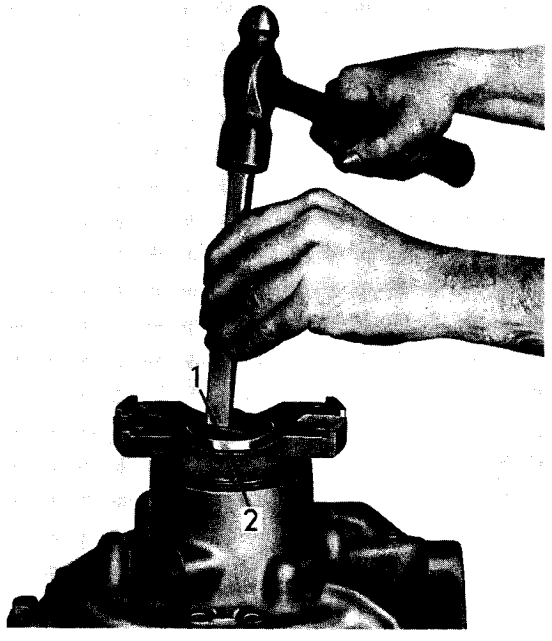
STEP 21

Install lifting eye 1 into threaded hole of splitter output shaft 2. Hoist the entire splitter and high-range clutch section carefully from the transmission.



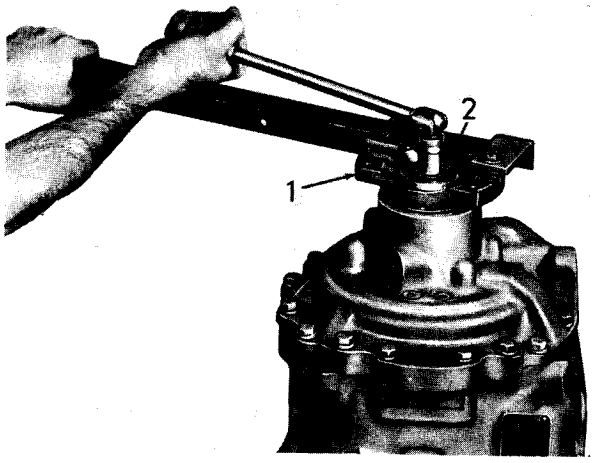
STEP 22

Position the transmission, rear bearing retainer upward. Caution: On transmissions equipped with parking brakes, as well as those not so equipped, the pitot tube bolts must be removed before the output flange retaining bolt is loosened. Remove the two rear-governor pitot tube bolts 1 (and flat washers on aluminum housings). Remove speedometer drive or plug 2, if not previously removed.



STEP 23

Flatten tab lock washer 1 against flange retainer washer 2. Note: Follow procedures shown in steps 24 through 27, as applicable, depending upon whether or not brake is used and what type brake is used.

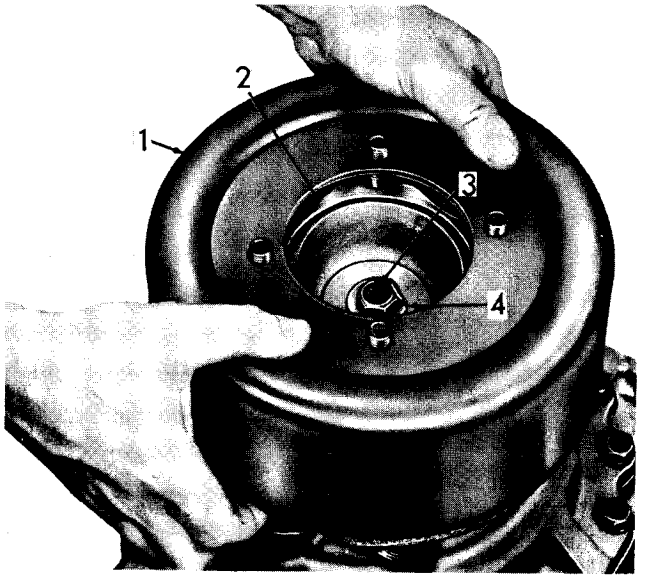


STEP 24

WHEN NO BRAKE IS USED. Lock output flange 1 to prevent rotation. Remove the flange bolt and tab washer 2. Remove the seal ring under the tab washer. Remove output flange 1.

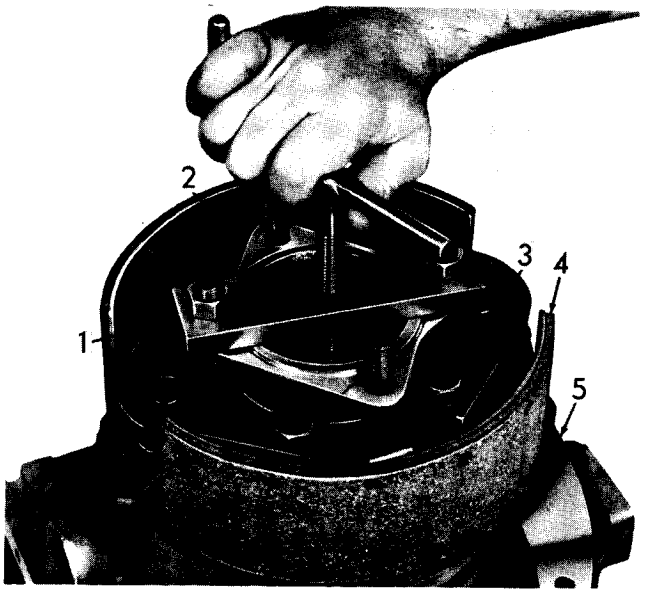
STEP 25

WHEN CONTRACTING BAND-TYPE BRAKE IS USED. Lock the drum against rotation and remove bolt 1, tab lock washer 2 and the seal ring under the washer. Remove lock wire 3, screw 4, two bolts 5 and band assembly 6. Remove drum and output flange. Note: When band assembly is removed, a spring at 7 is freed. Do not lose it.



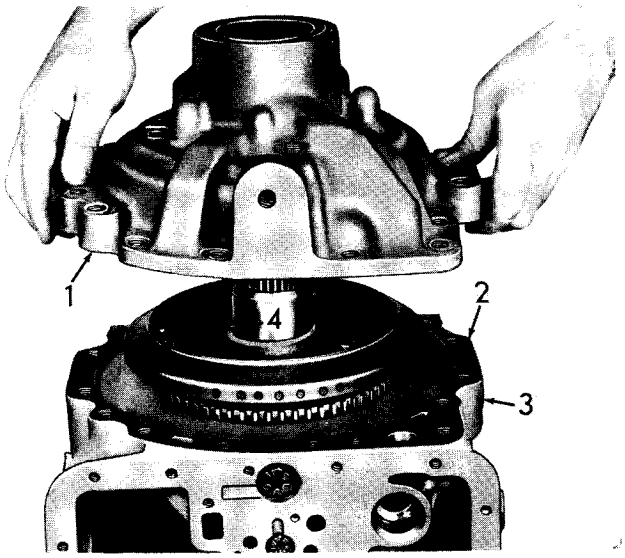
STEP 26

WHEN EXPANDING SHOE-TYPE BRAKE IS USED. Remove brake drum 1. Hold flange 2 to prevent rotation and remove bolt 3, tab lock washer 4 and seal ring under washer 4.



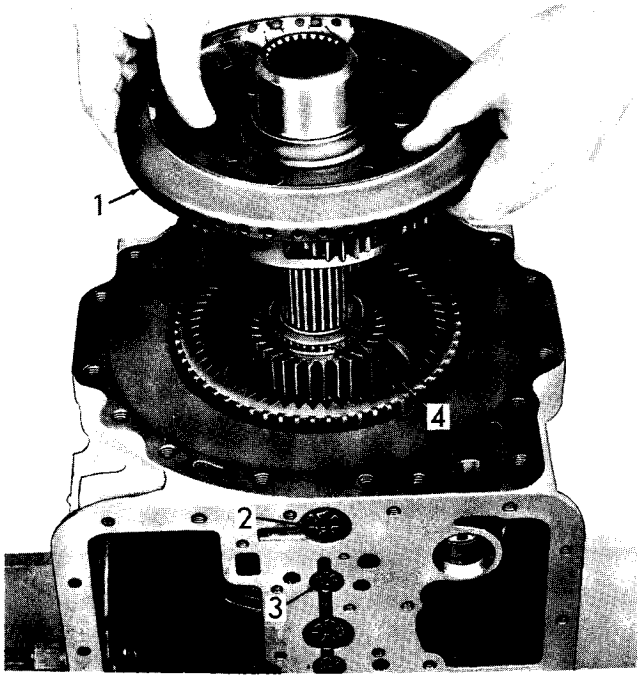
STEP 27

WHEN EXPANDING SHOE-TYPE BRAKE IS USED. Using puller 1, remove flange 2. Remove four bolts and lock washers 3. Lift off brake assembly 4 and apply lever 5. Note: On larger brakes of the expanding shoe type, the shoes must be removed from the assembly before the mounting bolts are removed. In addition, a shield is included, which must be removed last.



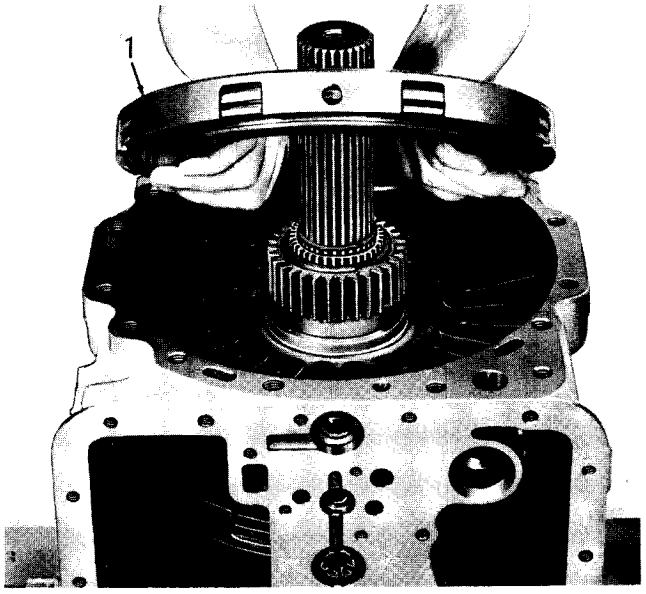
STEP 28

Remove rear bearing retainer 1 and gasket 2 from transmission housing 3. Lift out loose pitot tube 4.



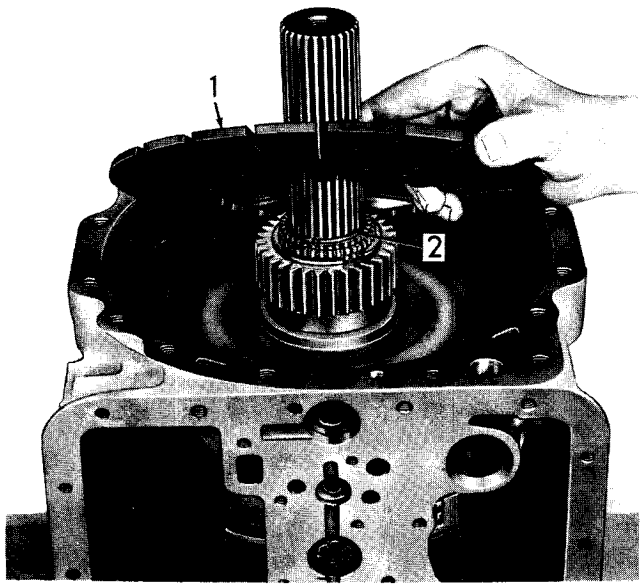
STEP 29

Remove reverse-range planetary carrier assembly 1, reverse-range clutch reaction housing anchor bolt 2 and low- and reverse-range piston housing anchor bolt 3. Remove thrust washer 4 from position shown (or from bore of carrier 1).



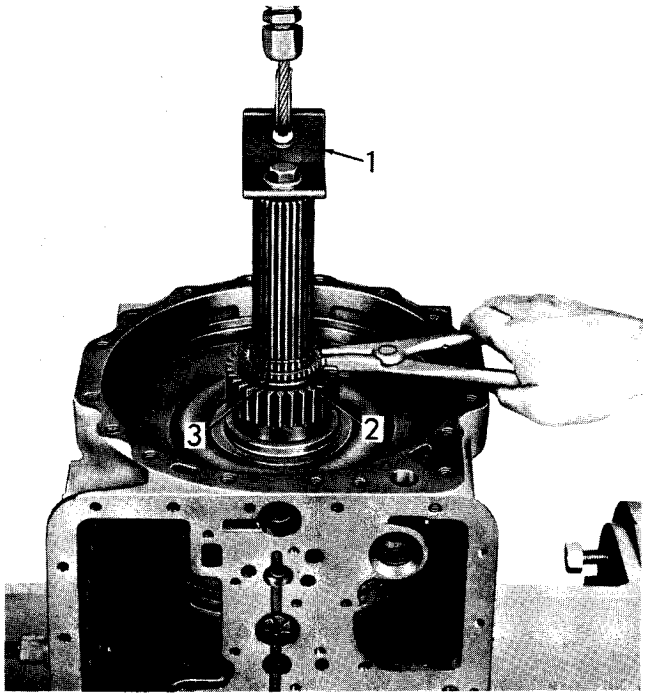
STEP 30

Lift out reverse-range clutch reaction housing 1 with clutch plates and ring gear and place it on the bench, plates up. Lift the plates out of the housing (some models have single plate; others three plates). Note: These parts have red markings and should not be intermixed with the other clutches. Refer to note in sect. XIV, para 1.



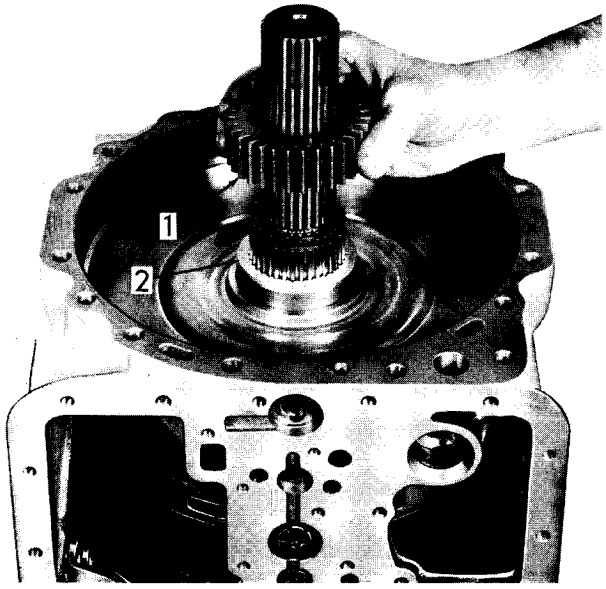
STEP 31

Lift out reverse-range clutch spring 1. Remove round wire snap ring 2.



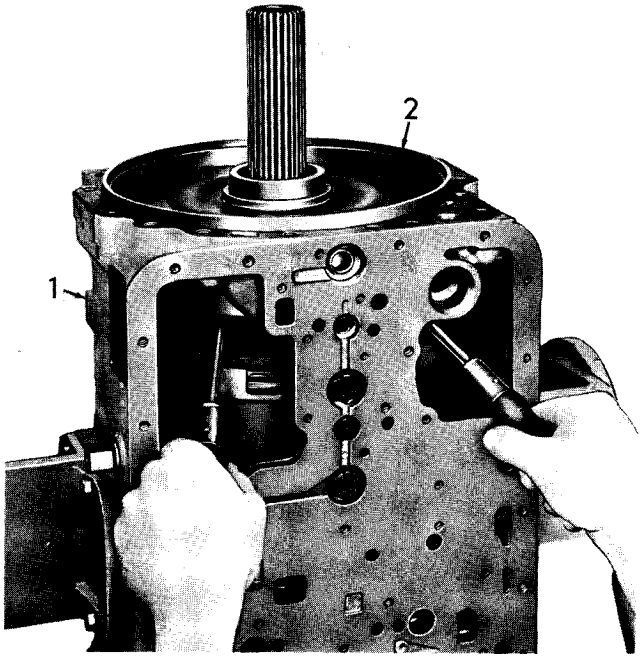
STEP 32

Using hoist and sling 1 to release pressure from snap ring, remove snap ring 2 from reverse-range sun gear shaft 3. Disconnect the sling.



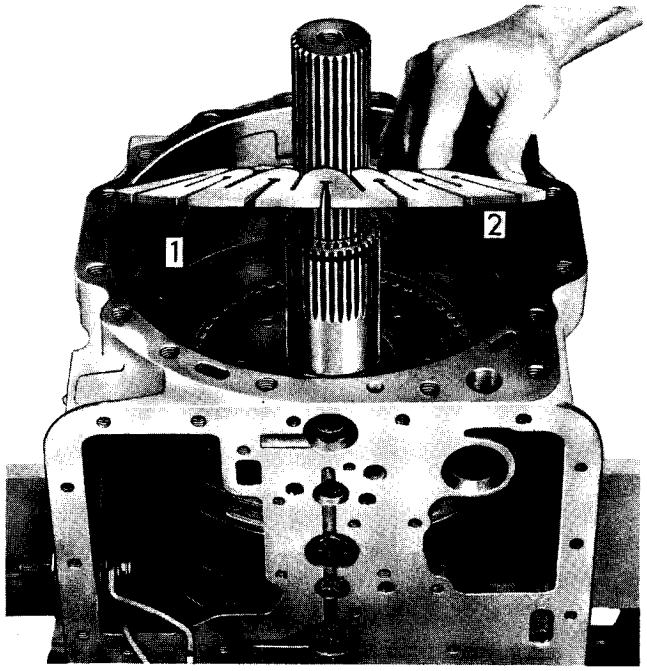
STEP 33

Remove reverse-range sun gear 1 and internal-splined reverse-range sun gear thrust washer 2.



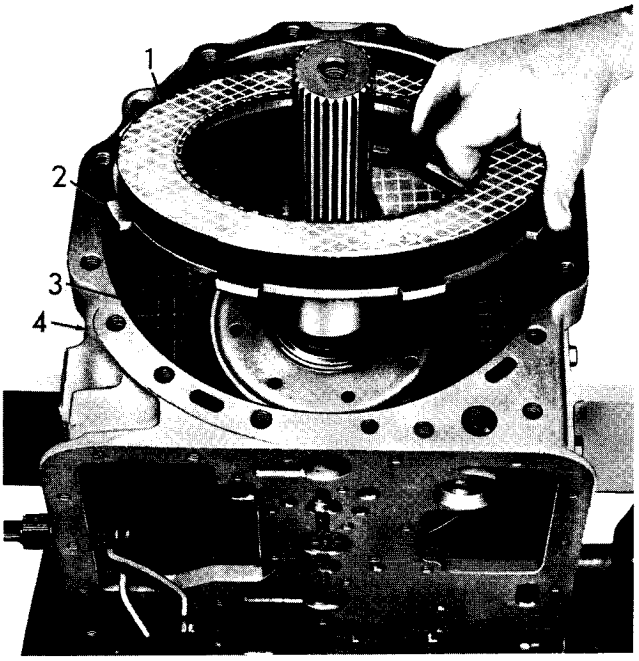
STEP 34

Working through openings in transmission housing 1, remove low- and reverse-range piston housing assembly 2.



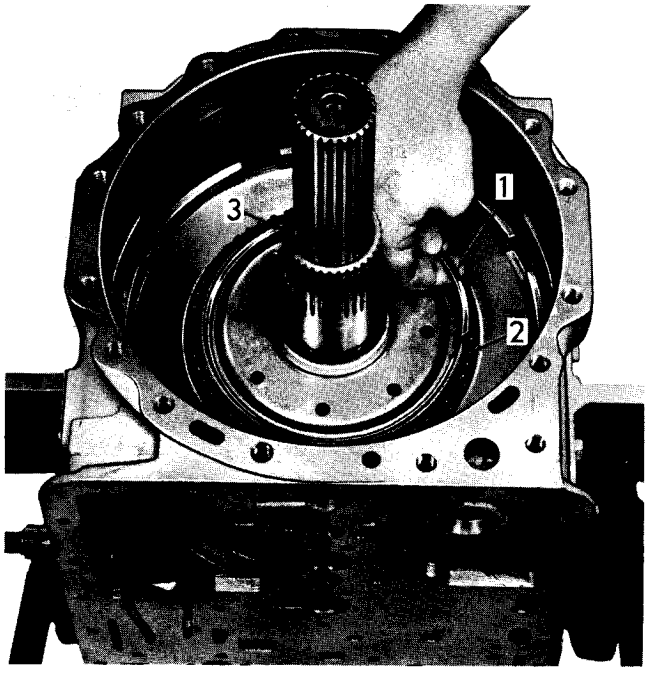
STEP 35

Lift out low-range clutch spring 1 and low-range clutch apply plate 2. Note: Low-range clutch parts have green markings.



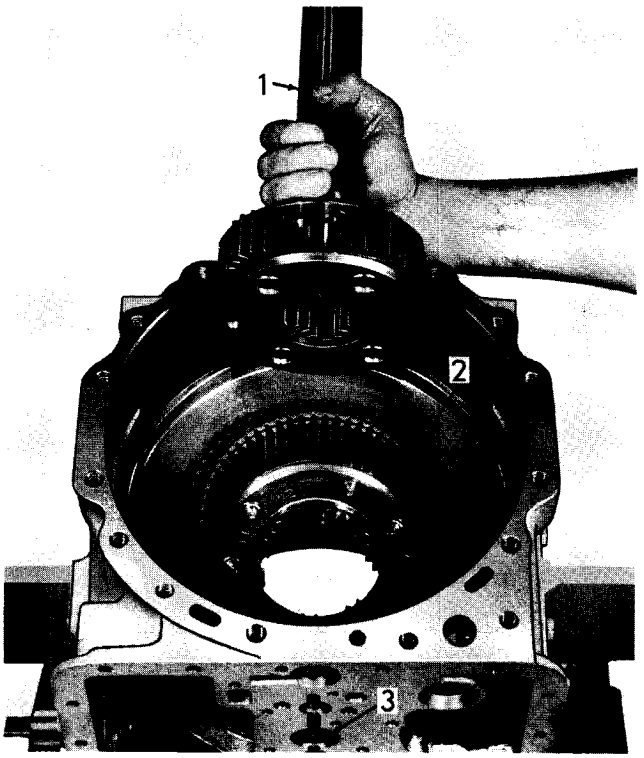
STEP 36

Remove low-range clutch plates 1, 2 and 3 from transmission housing 4. (Some models have a single plate; others three plates).



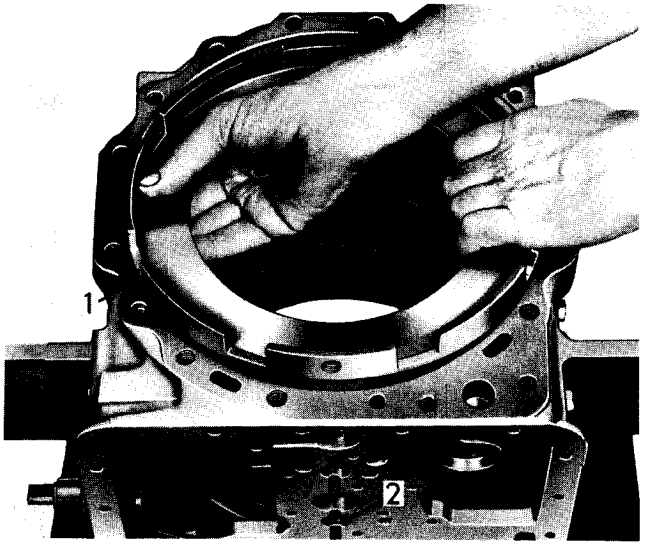
STEP 37

Remove internal-snap ring 1 from low-range ring gear 2 and lift out reverse-range sun gear shaft 3.



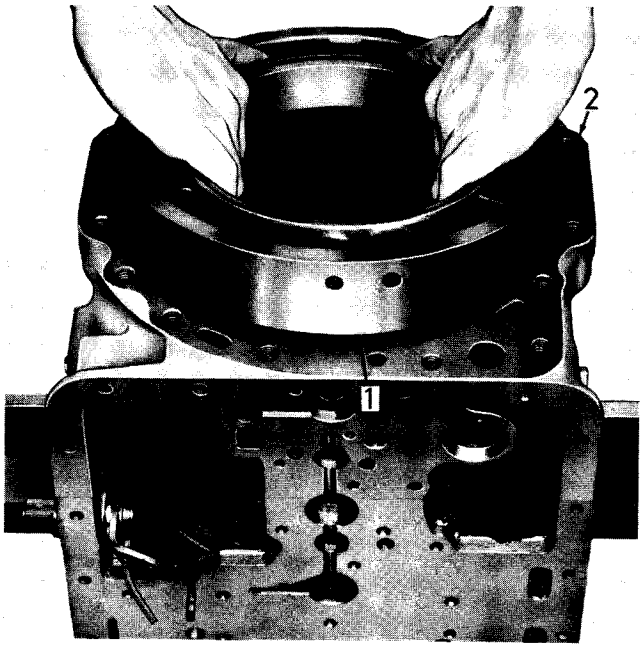
STEP 38

Lift out transmission output-shaft assembly 1 and low-range ring gear and intermediate-range planetary assembly 2. Remove low-range clutch reaction housing anchor bolt 3.



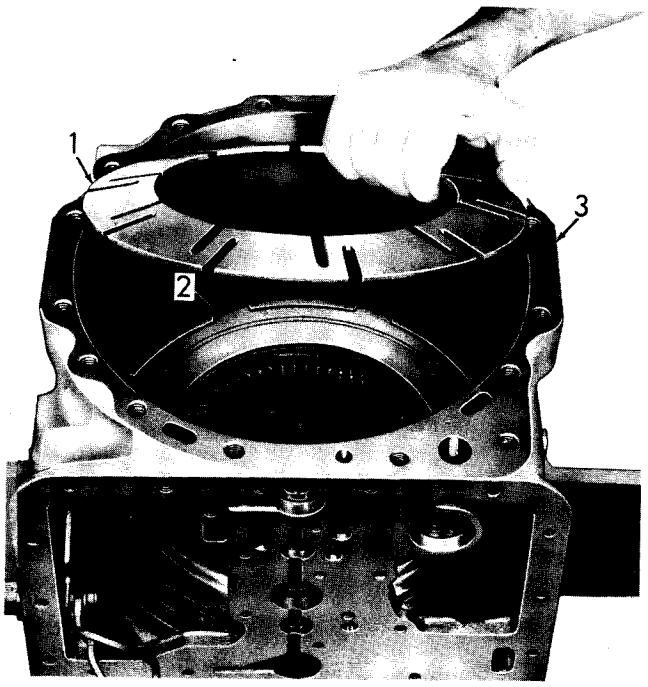
STEP 39

Remove low-range clutch reaction housing 1. Remove intermediate-range piston housing assembly anchor bolt 2.



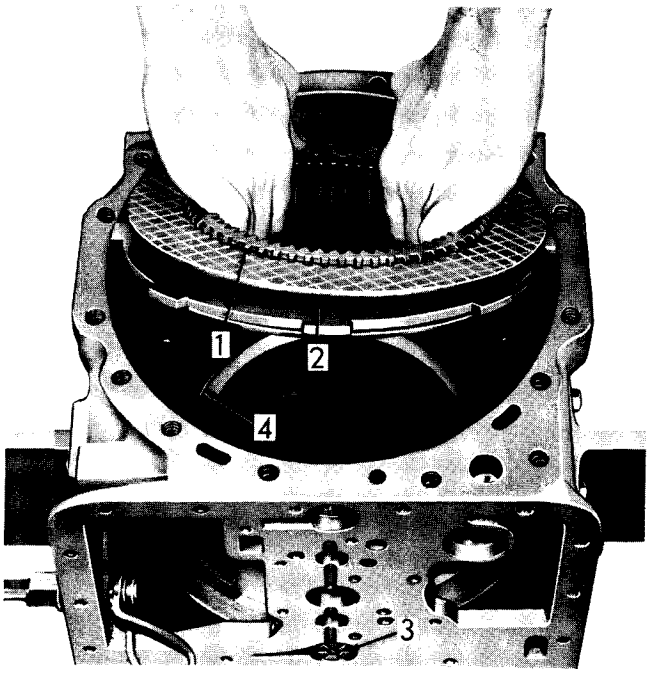
STEP 40

Remove intermediate-range piston housing assembly 1 from transmission housing 2.



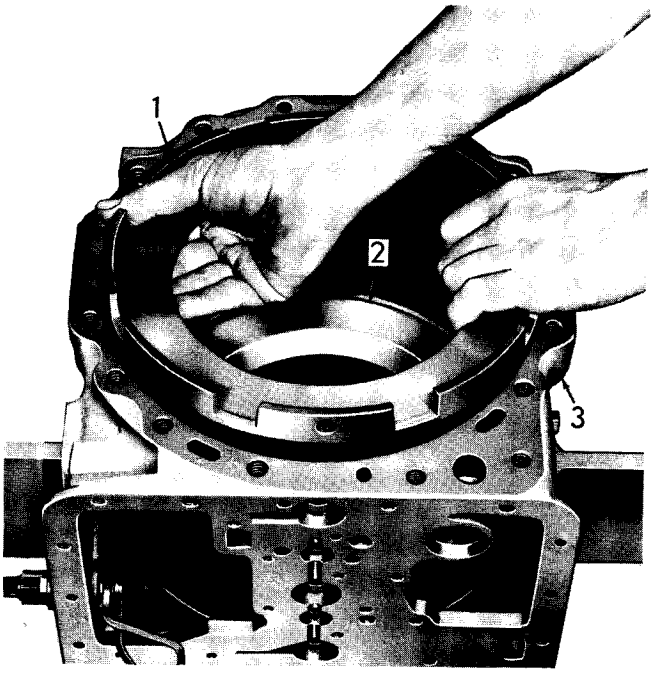
STEP 41

Remove intermediate-range clutch spring 1 and intermediate-range clutch apply plate 2 from transmission housing 3. Note: Intermediate-range clutch parts have yellow markings.



STEP 42

Remove intermediate-range ring gear 1, clutch plates 2 and the anchor bolt 3 from intermediate-range clutch reaction housing 4.



STEP 43

Remove intermediate-range clutch reaction housing 1 and oil collector 2 from transmission housing 3.

Service Information Notes

Section VIII OIL TRANSFER PLATE ASSEMBLY, DOWNSHIFT TIMING VALVE BODY ASSEMBLY, CONTROL VALVE BODY ASSEMBLY AND RETARDER VALVE ASSEMBLY – REBUILD

1. SCOPE

The complete disassembly procedure is outlined in the following paragraphs. Disassembly is keyed to exploded views, foldouts 5, 8 and 9. Assembly of the control valve body assembly is keyed to photographic-type exploded views accompanying the text. Assembly of the smaller assemblies is keyed to the exploded views.

Note: Cleanliness and careful handling are of utmost importance in servicing the control valve body assembly. Springs, balls and similar components should be placed in individual containers upon removal from the assembly, and the containers should be plainly marked with the parts' location in the valve body. Refer to sect. VI for cleaning and inspection recommendations.

2. OIL TRANSFER PLATE ASSEMBLY
(Key numbers in text refer to foldout 9)

a. Disassembly

(1) Remove two screws 9, and washers 7 retaining the converter lubrication supply cover 10 to oil transfer plate 4. Remove the cover. Remove valve seat 11 from the cover only if it needs replacement.

(2) Remove two screws 6 and washers 7 which retain the converter pressure regulator valve assembly to the oil transfer plate. Remove the retainer 5, spring 8, washer 12, and steel ball 13.

(3) Low-range exhaust regulator valve assembly 2 is pressed into the oil transfer plate 4 (and retains orifice cup 3). Do not remove this valve unless inspection shows it to be necessary.

Note: The 3/8-inch nylon lubrication supply check valve ball 14 was removed from the other side of the plate when the plate was removed from the transmission.

(4) Check exhaust regulator valve assembly 2. It should retain cleaning solvent on the side of the valve opposite the spring for at least 15 seconds. If there is doubt as to the functioning of the valve, it should be replaced, as described below.

(5) Place transfer plate 4, with valve 2 down, on wood blocks. Using a hammer and brass drift, drive the valve out. Wood blocks should be placed as close to the valve as possible to avoid damage to the transfer plate.

(6) Support the transfer plate with the valve bore up and install orifice cup 3, raised side up. Install a new valve 2 into the counterbore of the plate until it bottoms. Do not use excessive pressure as damage could result to the valve or transfer plate.

Note: A piece of pipe 2 inches long with 11/16-inch inside diameter and 7/8-inch outside diameter can be used as an installer tool to install the valve.

b. Assembly

(1) If removed for replacement, position new lubrication supply valve seat 11, chamfered side out, in supply cover 10; then install the cover and two screws 9 with lock washers 7. Tighten screws to 24 to 36 inch pounds torque.

Note: It is possible to install the cover incorrectly. Install the cover with the end containing the valve seat toward the center of the transfer plate.

(2) Assemble the steel converter pressure regulator ball 13, washer 12, spring 8, and retainer 5 to the oil transfer plate. Install two screws 6 and lock washers 7. Tighten the screws to 24 to 36 inch pounds torque.

3. DOWNSHIFT TIMING VALVE BODY ASSEMBLY
(Key numbers in text refer to foldout 9)

a. Disassembly

(1) Remove three screws with lock washers 20 retaining downshift timing valve cover 19 to valve body 16. Remove the cover.

(2) Remove downshift timing valve 17 and spring 18.

b. Assembly

(1) Install downshift timing valve 17 in valve body 16. The valve should first be installed dry and must move in the valve body by its own weight. If the valve sticks, proceed as follows.

(2) Remove the valve and recheck for nicks or burs and remove them with a fine stone.

(3) If the valve is satisfactory, it may be necessary to use a lapping compound to provide sufficient clearance between the valve and its bore. A fine finishing compound is recommended such as carborundum finishing compound. When the valve fits freely, lubricate it at final installation.

Note: If a lapping compound is used, it will be necessary to thoroughly clean all parts with cleaning solvent and dry with air.

(4) Install downshift timing valve spring 18 and cover 19.

(5) Install three attaching screws and lock washers 20. Tighten screws to 24 to 26 inch pounds torque.

4. CONTROL VALVE BODY ASSEMBLY
(Key numbers in text refer to foldout 8)

a. Disassembly

(1) Position control valve assembly on the bench, flat side down.

(2) Remove screws which retain drive and high transfer tube clips (10 and 13).

(3) Remove the tubes 11 and 12 with the clips attached. Do not remove the clips from the tubes.

(4) Remove two screws 77 which retain exhaust regulator valve body 63 to the control valve body 102. Remove the exhaust regulator valve body.

(5) Remove selector valve detent spring 100 and lift valve body separator plate 97 off the control valve body 102. Remove 3/8-inch steel detent ball 101 from the valve body.

(6) Remove three screws 52 which retain accelerator plug cover 48. (Some models use a bracket 51, spring 50 and ball 49, retained by two screws 52. Remove them.) Remove the accelerator plug cover and accelerator plug cover and accelerator plug 47.

(7) Remove four screws 58 from regulator cover 57 and remove the cover, lockup knockdown plug 55, accumulator valve spring 56 and accumulator valve 54.

(8) Remove two screws 59 and 62 and throttle valve retainer 61 from the valve body. Do not remove screw 60 from retainer.

Note: Screw 62 is 3/8-inch long and should not be mixed with 7/16-inch screws. Keep screw 62 (and shorter screw 88A, when used – refer to 27A, below) separated from the longer screws to insure that they are installed in the proper locations when valve body is reassembled.

(9) Remove the remaining three screws 53 which retain valve body rear cover 46 to the valve body, and remove the rear cover.

Caution: Valve body rear cover is spring loaded and must be held while the screws are being removed.

(10) Remove intermediate shift valve spring 44, which is exposed when the rear cover is removed.

(11) Remove regulator plug 41 from the rear cover.

(12) Remove throttle valve 98 and spring 99 from control valve body 102.

(13) Remove manual selector valve 43 from the rear of the control valve body.

(14) From the same side of the control valve body, remove hydraulic retarder regulator plug 42, lockup plug 40, rear pitot (G2) plug 39 and front pitot (G1) splitter plug 36, low-to-intermediate shift valve 38 and intermediate-to-high shift plug 37.

(15) Position control valve body 102 on its rear surface and remove two screws 23 which retain splitter overcontrol valve body 19 to valve body front cover 32. Remove the splitter overcontrol valve body.

(16) Remove screw 22 which retains overcontrol valve cover 21 to the overcontrol valve body. Remove the cover and splitter overcontrol valve 20 from the body.

(17) Remove splitter shift plug spring 28 and splitter shift plug 29, which are exposed upon removal of the overcontrol valve body 19 from front cover 32.

(18) Remove the three screws 24 and 25 which retain intermediate-to-high shift valve cover 26 to valve body front cover 32. Remove cover 26, intermediate-to-high shift valve spring 27 and intermediate-to-high blocker plug 30.

(19) Remove the three screws 15 while holding the valve body front cover against spring pressure. Remove front cover 32.

(20) Remove 1/4-inch ball 34 which is freed when the front cover is removed. Remove also the main-pressure regulator spring 35 (and secondary spring 35A, used in some models), splitter relay valve spring 111 and lockup shift valve spring 108, which are exposed upon removal of the front cover.

(21) Remove throttle valve plug 33 from valve body front cover 32.

(22) Remove retainer spring 17 and withdraw pump overage valve assembly 18 from the front cover.

(23) Remove the two overage valve spring retainers 16 and spring 14 from the front cover.

(24) Remove throttle regulator valve 106, main-pressure regulator valve 107, lockup shift valve 109, splitter shift valve 110, splitter relay valve 113 and intermediate-to-high shift valve 112 from the front of control valve body 102.

(25) Do not remove reverse-range clutch exhaust pressure regulator valve 105 unless replacement is necessary. Check the operation of the valve while cleaning the valve body. The valve should retain solvent on the side opposite the spring for 15 seconds. If the solvent leaks through sooner, the valve is defective.

(26) Do not remove reverse lockup inhibitor check valve retainer 103 and 7/32-inch ball 104. If the retainer, the ball or valve body 102 is defective, all three items must be replaced by new ones.

(27) On models which include bracket 89, remove two screws 88, bracket 89, spring 90, and ball 91. Remove remaining six screws 88 which retain exhaust regulator valve body cover 80 to exhaust regulator valve body 63. Remove the cover.

> Caution: The cover is spring loaded and must be held while the screws are being removed.

(27A) On models which do not include bracket assembly 89, remove seven screws 88 and screw 88A. Remove cover 80 (see Caution, above).

> Note: Screw 88A is 3/8-inch long and should not be mixed with 7/16-inch screws. When removed, separate it (and screw 62) from the longer screws to insure installation of the short screws in the proper locations.

(28) Removal of the cover will expose intermediate exhaust regulator valve spring 94, low-splitter valve spring 93 and lockup cutoff valve spring 81. Remove these springs from exhaust regulator valve body.

(29) Remove intermediate exhaust regulator valve 96, lockup cutoff valve 82, and low-splitter exhaust regulator valve 95.

(30) Remove extender valve 87, extender valve spring 86, extender valve ball spring 85, and extender valve ball 84. Do not remove extender valve body 83 and roll pin 92 unless replacement is necessary. Check the operation of the valve while cleaning the extender valve. If replacement is necessary, remove the roll pin and tap out the extender valve body toward the nearest opening (front) of exhaust regulator valve body 63.

(31) Remove four screws 72 from trimmer cover 73 and remove the cover from the rear of exhaust regulator valve body 63.

Caution: The cover is spring loaded and must be held while the screws are being removed.

(32) Remove trimmer valve 74, trimmer valve inner 75 and outer 78 springs, trimmer plug 79, trimmer primary spring 71, trimmer stop 70 and trimmer secondary spring 69 from exhaust regulator valve body 63.

(33) Remove screw 68 and retainer 67 and remove low-splitter exhaust regulator stop plug 65 and low-splitter exhaust regulator plug 64. Note: Models using setscrew 45A (at bottom of valve body 63) do not use regulator plug 64. Remove intermediate exhaust regulator stop plug 66 from the rear of exhaust regulator valve body 63.

(34) Do not remove pipe plug 76 from the valve body except for inspection or cleaning.

b. Cleaning, Inspection

(1) All the valve body parts should be thoroughly cleaned in cleaning solvent and dried with compressed air. All passages must be completely free of dirt and obstructions. Use a soft-bristle brush. Do not use abrasives or scraping tools. Cleanliness is of paramount importance. After cleaning, place the parts on clean paper and cover with paper to keep the dust out.

(2) Inspect all the parts closely for wear, breaks, cracks, burs, and dirt. Burs may be removed with a soft abrasive stone. Do not destroy the sharp edges of the valves. The valves are designed with sharp edges to prevent their sticking in their bores.

(3) Inspect all the springs and check them for free length and load. Correct performance of the transmission depends upon the good condition of the springs. Refer to the spring chart applicable to the specific valve body being inspected. These charts may be found following wear limits, sect. XVII.

(4) Before assembly, try all the valves in their bores. When the parts are clean and dry, the valves should move in their bores by their weight only. Do not force them into the bores. Refer to sect. VI, para 3n.

(5) Reclean the parts, if necessary, after inspection. Lubricate the parts with specified fluid. Do not use waste or linty cloths for cleaning.

c. Assembly (Key numbers in text refer to foldout 8)

(1) General. The control valve body assembly is assembled as illustrated in fig. VIII-1 through VIII-16. In the procedures, below, all parts are identified by callout numbers used in foldout 8 in the back of the manual. All parts for all model variations are shown in fig. VIII-1 through VIII-16 and explained in the text.

(2) Exhaust regulator valve body, rear end (fig. VIII-1)

(a) Install plug 66, small diameter first, into exhaust regulator valve body 63.

(b) Install plug 64.

Note: Some models do not use a plug in this location. Such models are identified by the presence of a socket-head set screw 45A in the location shown.

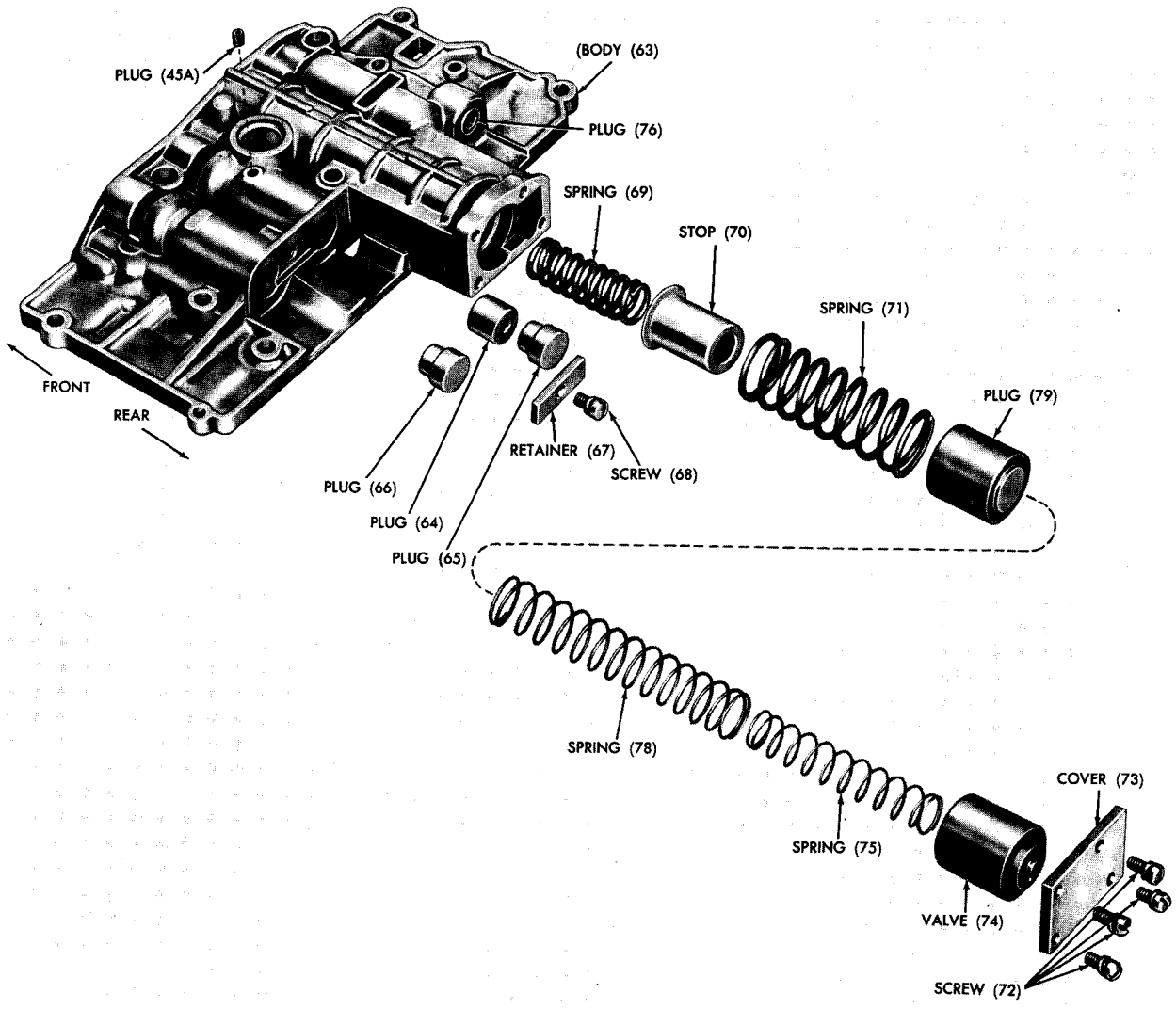


Fig. VIII-1 Exhaust regulator valve body, rear end — exploded view

(c) Install plug 65, small diameter first.

(d) Install retainer 67 and screw 68. Tighten the screw to 24 to 36 inch pounds torque.

(e) Install spring 69, stop 70, spring 71 and plug 79.

(f) Install springs 75 and 78, and valve 74.

(g) Install cover 73 and four screws 72. Tighten the screws to 24 to 36 inch pounds torque.

(h) If plug 76 was removed, install it.

(3) Exhaust regulator valve body, front end (fig. VIII-2)

(a) If extender valve body 83 was removed, install it and retain it with pin 92. Press pin 92 into valve body 63 until it is slightly below the flat surface of the body.

(b) Install valves 95 and 96.

(c) Install springs 93 and 94.

(d) Install ball 84, springs 85 and 86 and valve 87, recessed end first.

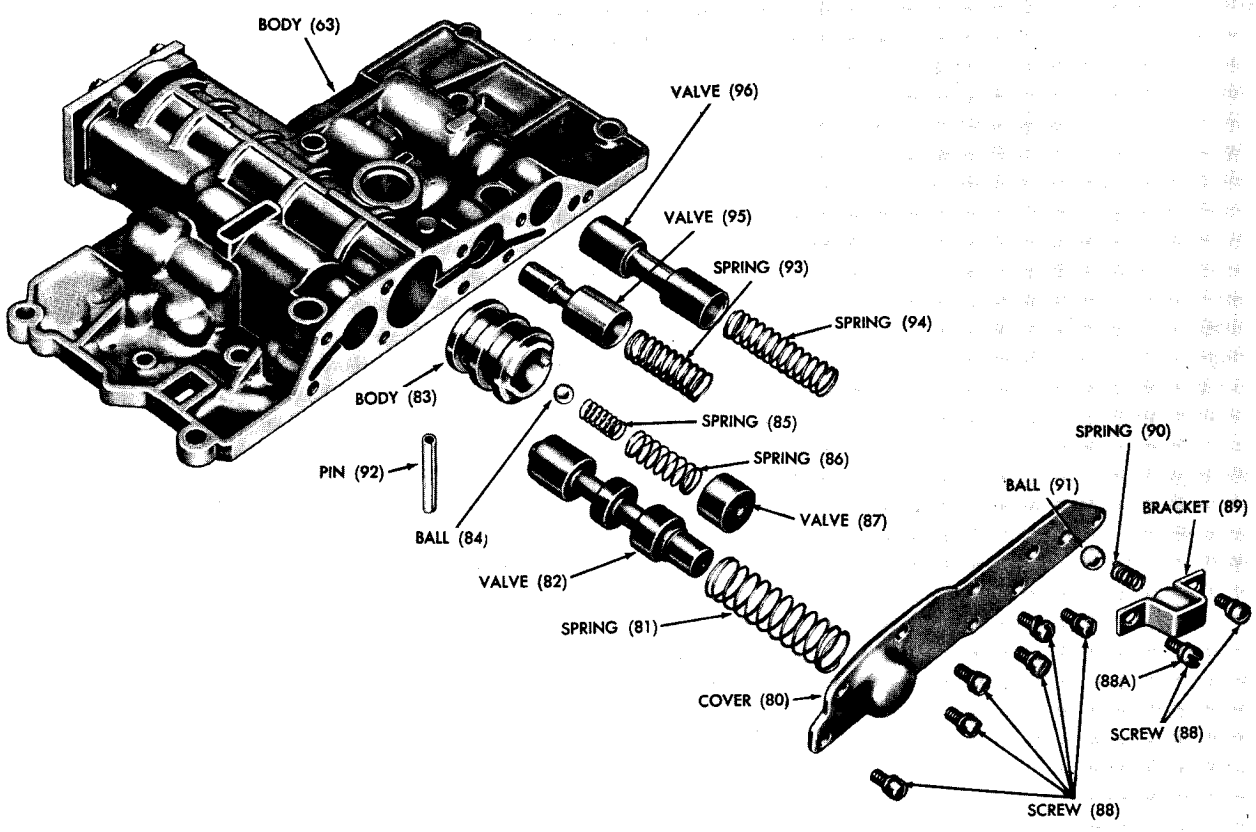


Fig. VIII-2 Exhaust regulator valve body, front end — exploded view

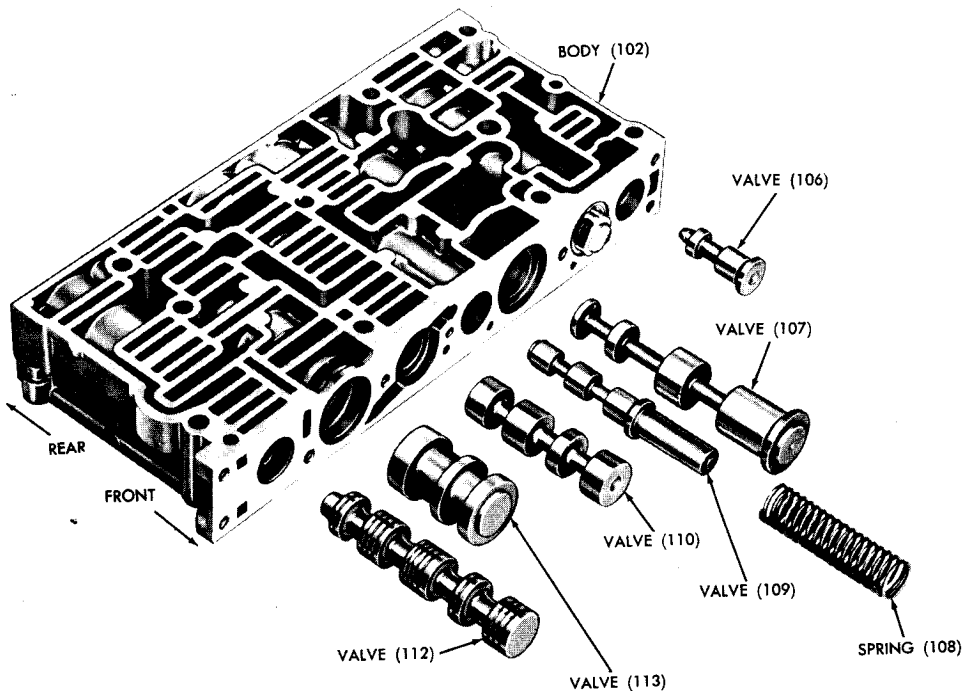


Fig. VIII-3 Control valve body, front end — exploded view

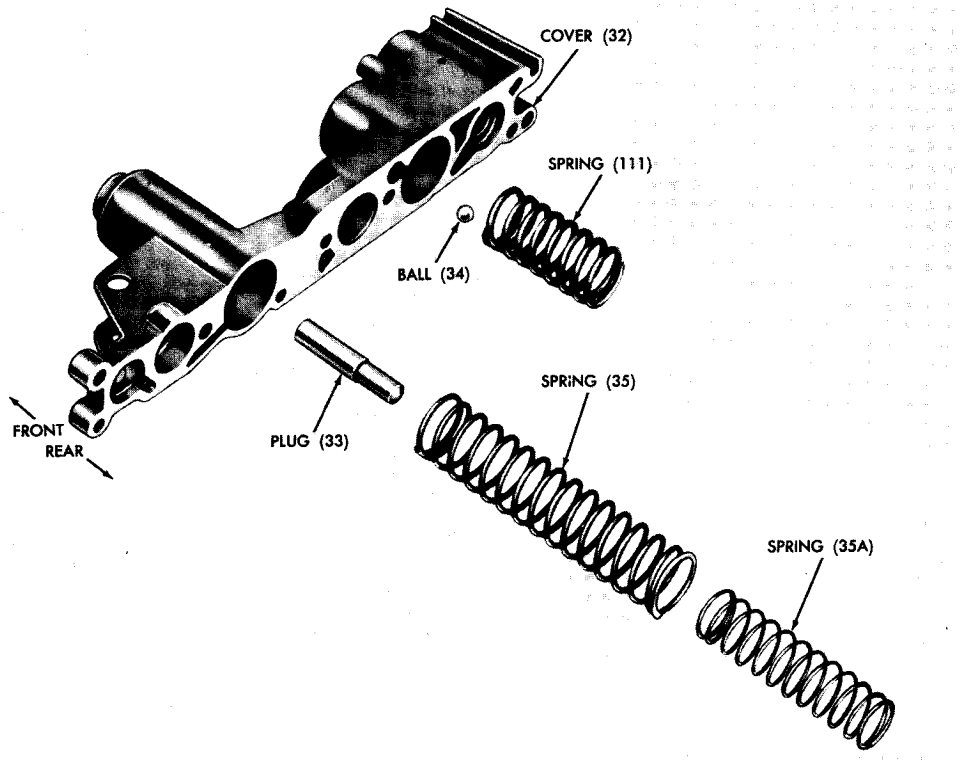


Fig. VIII-4 Control valve body front cover, rear end — exploded view

(e) Install valve 82 and spring 81.

(f) Install cover 80 and six screws 88.

(g) On models which use bracket 89, spring 90 and ball 91, install these parts and retain them with two screws 88.

(h) On models which do not use bracket 89, spring 90 and ball 91, install one screw 88 in the hold at the right end of cover 80 and one screw 88A in the remaining screw hole.

Note: A short (3/8 inch) screw 88A must be installed in the second screw hole from the right end of cover when bracket 89 is not used.

(i) Tighten the cover screws to 24 to 36 inch pound torque.

Note: Screw which retains drive transfer tube clip (at A) is not installed at this time.

(4) Control valve body, front end (fig. VIII-3)

(a) Install valves 106, 107, 109, 110, 112 and 113 into their respective bores and in the positions illustrated in valve body 102.

(b) Install spring 108 onto the stem of valve 109.

(5) Valve body front cover, rear end (fig. VIII-4)

(a) Install ball 34 into the small bore at upper left of the bore which receives spring 111. Retain it with oil-soluble grease.

(b) Install plug 33, large diameter first, into the small bore at the bottom of the recess which receives spring 35.

(c) Install springs 35, 35A when used, and 111.

Note: Some models do not include secondary spring 35A.

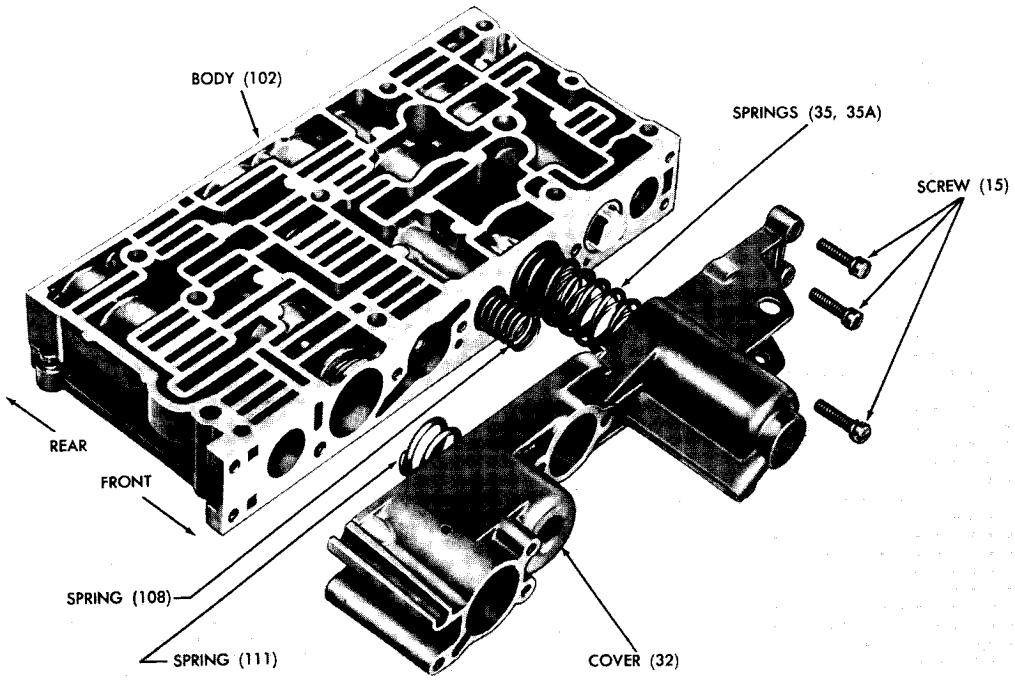


Fig. VIII-5 Control valve body and front cover — exploded view

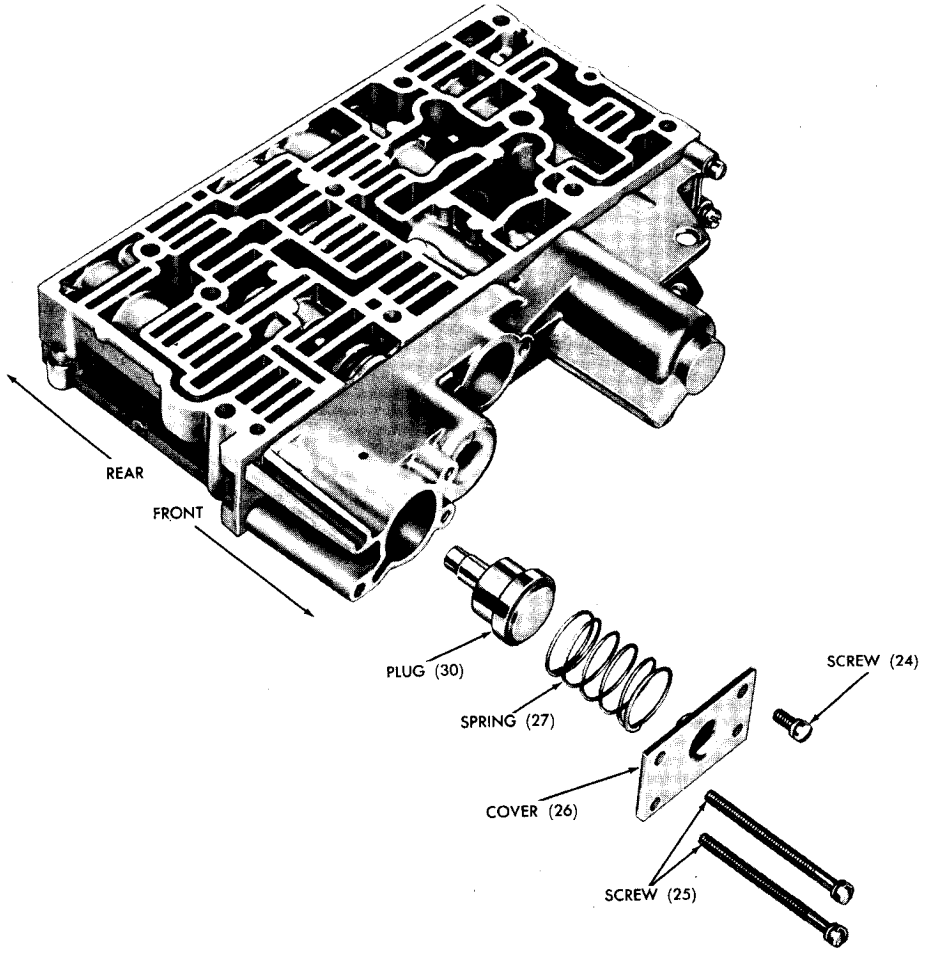


Fig. VIII-6 Intermediate-to-high shift valve components — exploded view

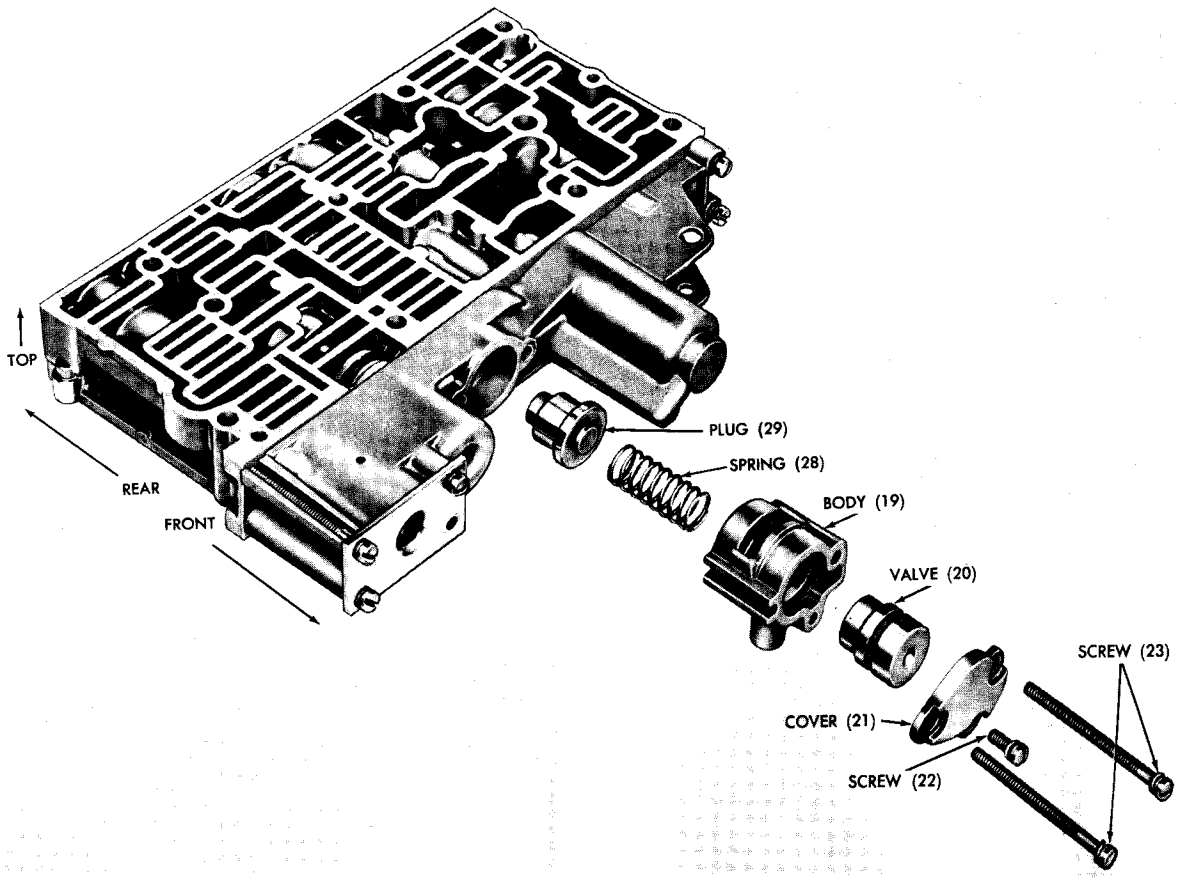


Fig. VIII-7 Splitter overcontrol valve components — exploded view

(6) Control valve body and front cover (fig. VIII-5)

(a) Install the valve body front cover 32 and its related components (as assembled in (5), above) onto the control valve body 102 and its related components (as assembled in (4), above).

(b) Compress the springs and install three screws 15 in the locations shown. Do not tighten the screws at this time.

(7) Intermediate-to-high shift valve components (fig. VIII-6)

(a) Install plug 30 and spring 27.

(b) Install cover 26, two screws 25, and one screw 24 in the location shown. Do not tighten the screws at this time.

(8) Splitter overcontrol valve components (fig. VIII-7)

(a) Install plug 29 into valve body front cover.

(b) Install valve 20 into body 19.

(c) Install cover 21 onto body 19 and retain it with one screw 22.

(d) Install spring 28 into recessed end of valve 20, previously installed in body 19.

(e) Install assembled spring 28, body 19, valve 20, cover 21 and screw 22 onto valve body front cover. Install two screws 23 but do not tighten them at this time.

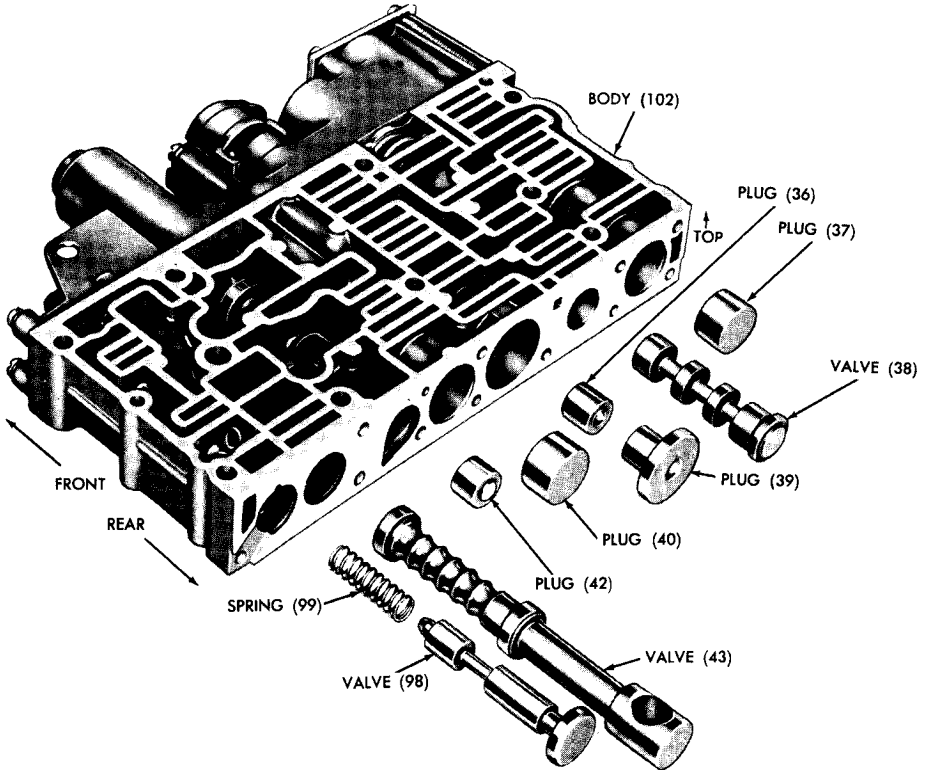


Fig. VIII-8 Control valve body, rear end — exploded view

(9) Control valve body, rear end (fig. VIII-8)

(a) Install plug 37, valve 38, plug 36, plug 39, plug 40 and plug 42.

(b) Install valve 43, spring 99 and valve 98.

(10) Control valve body rear cover, front end (fig. VIII-9). Install plug 41 and spring 44 into cover 46.

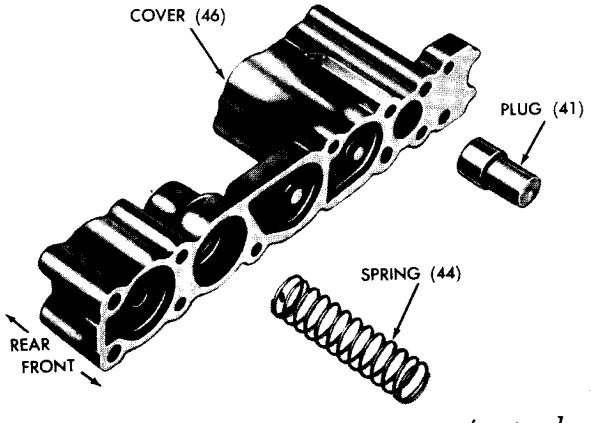


Fig. VIII-9 Control valve body rear cover, front end — exploded view

(11) Control valve body and rear cover, rear end (fig. VIII-10)

(a) Install cover 46 and its assembled components onto the assembled valve body.

(b) Install three screws 53 to retain cover 46. Do not install screw 59 which retains retainer 61. Do not tighten screws at this time.

(c) Install retainer 61 and retain it with one screw 62 and one screw 59. Do not tighten the screws at this time.

(d) If screw 60 has been removed from retainer 61, install but do not lock it in retainer 61. Refer to sect. XVI, para 5b(1) for adjusting instructions concerning this screw.

(12) Lockup knockdown plug and accumulator valve (fig. VIII-11)

(a) Install plug 55, smaller end first.

(b) Install valve 54, closed end first.

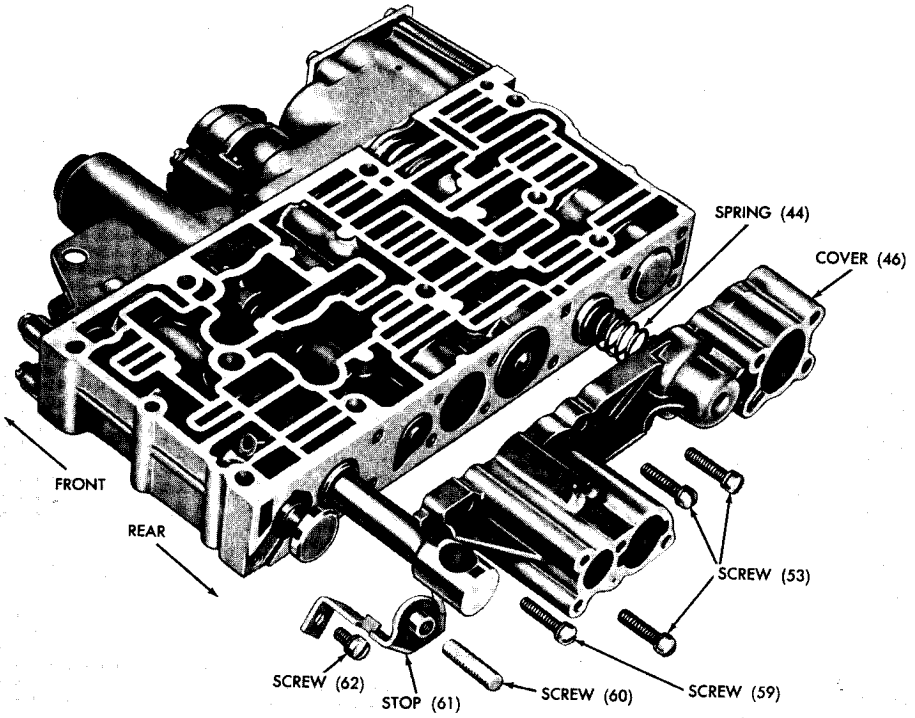


Fig. VIII-10 Control valve body and rear cover, rear end — exploded view

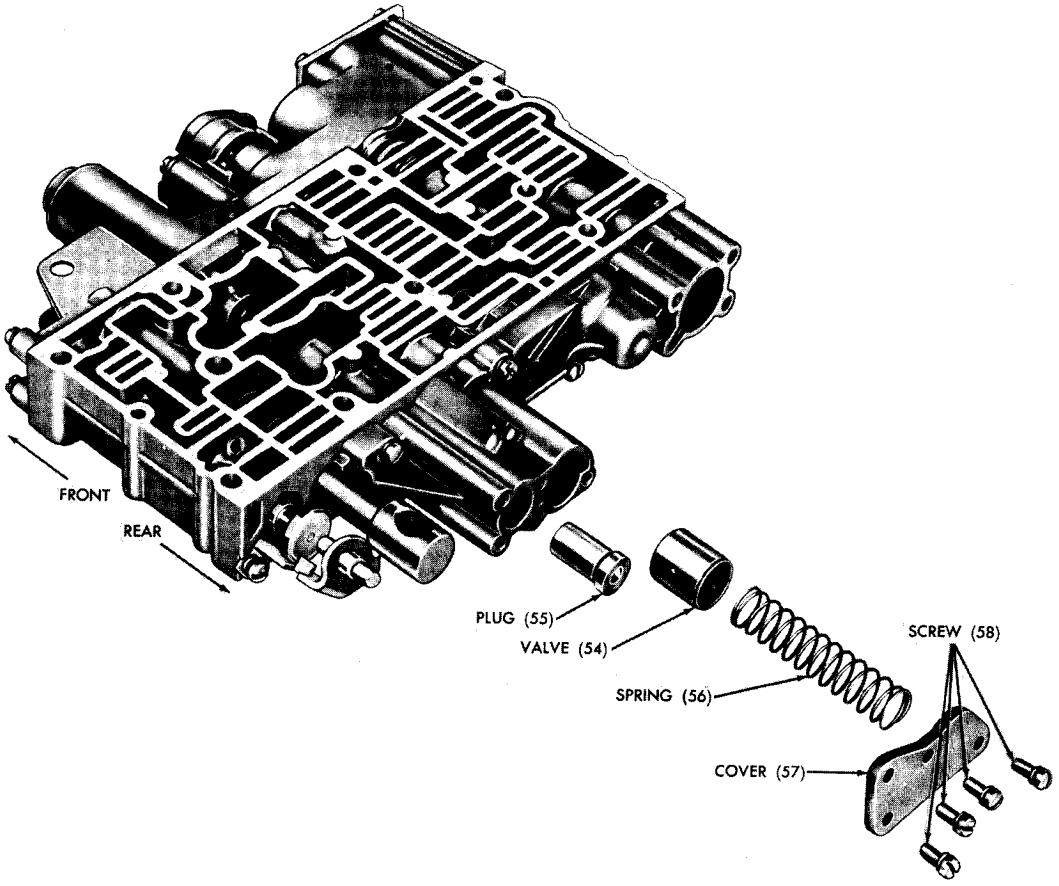


Fig. VIII-11 Lockup knockdown plug and accumulator valve — exploded view

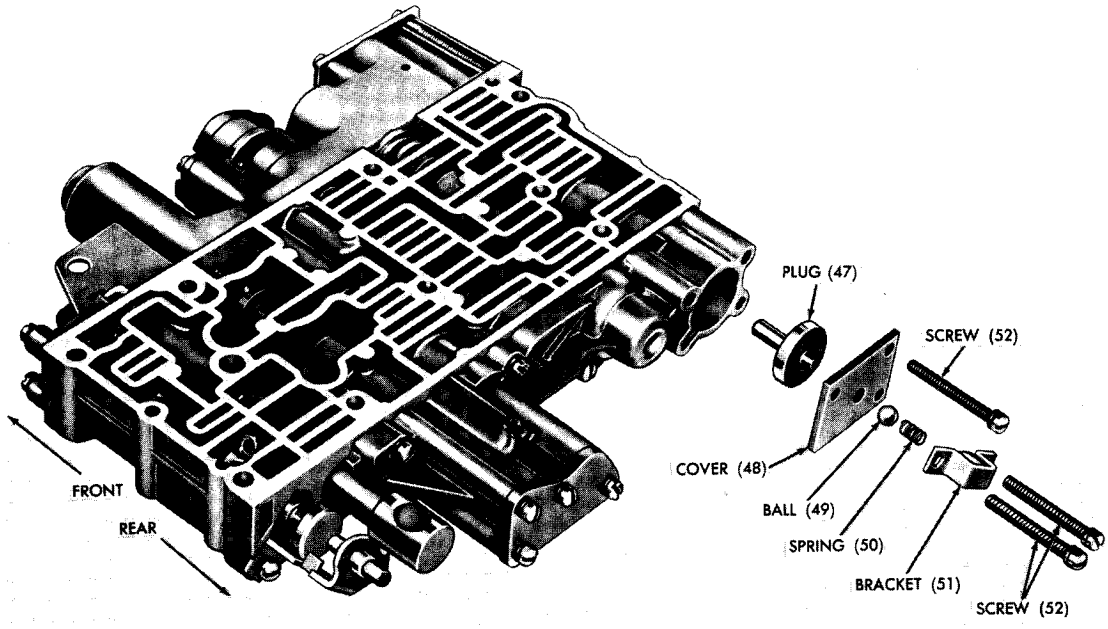


Fig. VIII-12 Accelerator plug and cover — exploded view

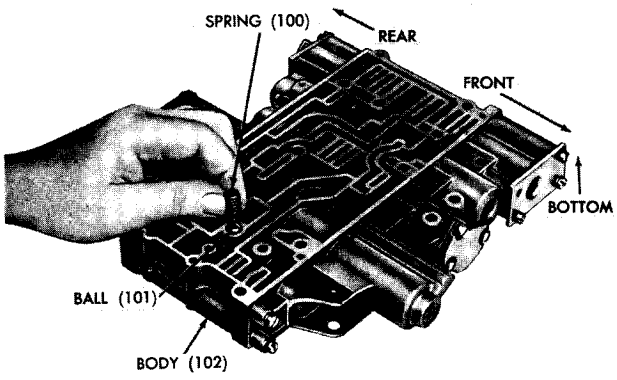


Fig. VIII-13 Installing selector valve detent ball and spring

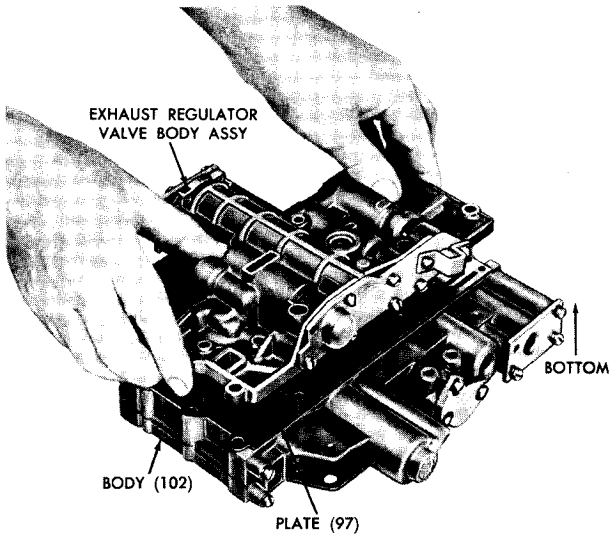


Fig. VIII-14 Installing exhaust regulator valve body assembly

(c) Install spring 56 and cover 57.

(d) Retain cover 57 with four screws 58. Tighten screws 58 to 24 to 36 inch pounds torque.

(13) Accelerator plug and cover (fig. VIII-12)

(a) Install plug 47 and cover 48.

(b) On models which include ball 49, spring 50 and bracket 51, install these parts and retain with two screws 52. Install a third screw 52 to retain cover 48. Do not tighten the screws at this time.

(c) On models which do not include ball, spring and bracket, install three screws 52 to retain cover 48. Do not tighten the screws at this time.

(14) Installing selector valve detent ball and spring (fig. VIII-13). Install ball 101 and spring 100 into the hole which registers with the manual selector valve indentations.

(15) Installing valve body separator plate and exhaust regulator valve body (fig. VIII-14)

(a) Install plate 97 onto the valve body assembly.

(b) Install the assembled regulator valve body and retain it with two screws 77 (foldout 8). Tighten the screws to 24 to 36 inch pounds torque.

(c) Place the control valve body assembly, flat (top) side downward on a flat surface. Check to determine if the end covers project below the valve body. Tap the valve body downward to correct any such projection. Tighten all screws at the front and rear of the valve body to 24 to 36 inch pounds torque.

Note: This check is important. The valve body must seat tightly against the oil transfer plate, to which it mounts, to prevent oil leakage.

(16) Pump overage valve (fig. VIII-15). Assemble a spring retainer 16 to each end of pump overage valve spring 14. Compress the spring and install it between the ribs on the valve body front cover 32. Install pump overage valve assembly 18 and fasten it with retainer spring 17.

Note: Seat face of valve assembly 18 must protrude at least 0.005 inch beyond the valve body mounting plane to assure seating of the valve against the oil transfer plate.

(17) Oil transfer tubes (fig. VIII-16)

(a) Install high-transfer tube 12 with clip 13. Fasten the clip with a screw 22.

(b) Install drive-transfer tube 11 with clip 10. Fasten the clip with a screw 22.

(c) Tighten screws 22 to 24 to 36 inch pounds torque.

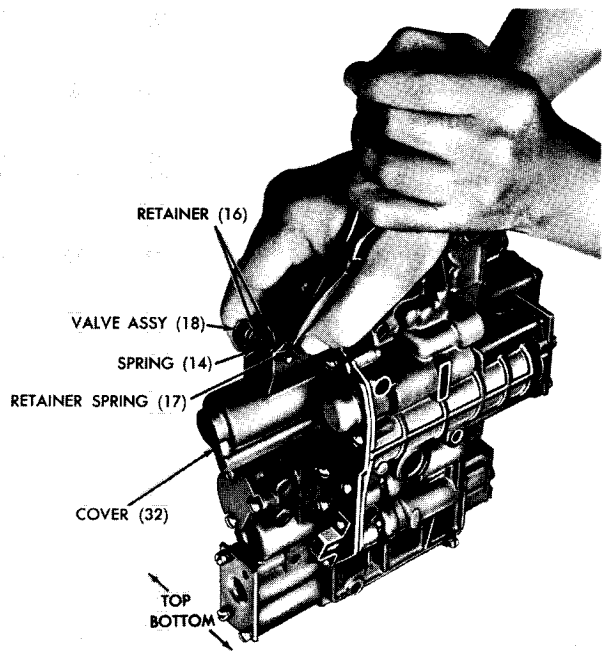


Fig. VIII-15 Installing overage valve retainer spring

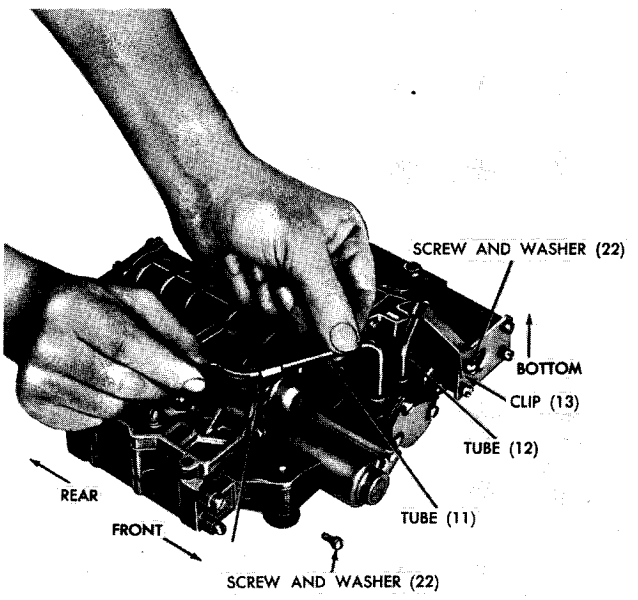


Fig. VIII-16 Installing drive transfer tube and clip

5. HYDRAULIC RETARDER CONTROL VALVE ASSEMBLY (Key numbers in text refer to foldout 5)

a. Disassembly

(1) Using vise-grip pliers, twist lubrication regulator valve retainer 10 out of retarder control valve body 7.

(2) Remove lubrication regulator valve spring 9 and regulator valve (steel) ball 8.

(3) Drive out retarder valve retaining pin 11.

(4) Strike the retarder valve stem several sharp blows with a mallet. The rebound of the valve, after being driven against its spring, will force out the oil seal (fig. VIII-17).

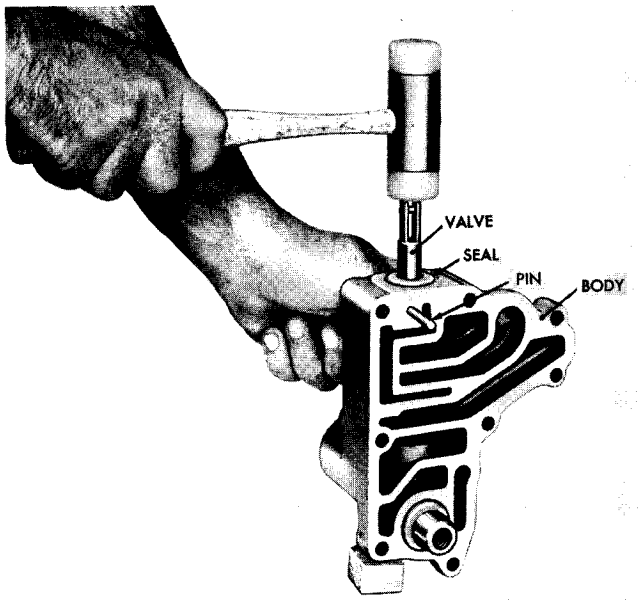


Fig. VIII-17 Removing hydraulic retarder valve seal

(5) Remove retarder valve assembly 5, oil seal 2 and return spring 6.

(6) Spring pin 4 and clevis pin 3 need not be removed unless replacement is necessary.

b. Assembly

(1) If clevis pin 3 and spring pin 4 were removed, replace them.

(2) Install retarder valve return spring 6 and retarder valve assembly 5 into retarder control valve body 7.

(3) By inserting a thin fiber strip into one of the valve body ports while valve 5 is compressed against spring 6, hold the valve in its inward position. From the ported side of the valve body, drive pin 11 into valve body 7. Drive the pin slightly below the valve body surface. Remove the fiber strip.

(4) Press oil seal 2, lip side first, into the valve body. The seal must be positioned flush with the front of the valve body.

(5) Install lubrication regulator valve (steel) ball 8, spring 9 and retainer 10. Press the retainer flush with, or to 0.030 inch below, valve body surface.

Note: The hydraulic retarder control valve body assembly contains the lubrication regulator valve and the oil cooler connections. Therefore, the assembly is necessary to the functioning of the transmission whether the retarder is used or not. Where the retarder is not used, no retarder control linkage is provided on the vehicle.

Section IX TORQUE CONVERTER AND INPUT DRIVE—REBUILD

1. DISASSEMBLY

Note: The key numbers shown below refer to foldout 3.

a. Input Drive Cover and Lockup Clutch Piston

Refer to sect. II for special tools.

(1) Using remover and replacer sleeve, compress the center of the lockup clutch piston and remove snap ring (fig. IX-1).

Caution: Do not press more than necessary to relieve pressure against the snap ring.

(2) Turn converter pump cover assembly 1, foldout 3, over with lockup clutch piston down and bump the cover sharply on wood blocks to remove piston 5.

(3) Lift out lockup clutch piston 5 and remove seal ring 6 from groove in piston outer diameter.

(4) Remove oil seal 4 and seal retainer 3, if loose, from the hub of converter pump cover 1.

(5) If converter pump cover bushing 2 in the cover hub needs replacement, remove it. Refer to sect. VI, para 3d.

b. Converter Stator and Cam Assembly

(1) Position stator assembly 13 on the bench so that freewheel roller race 15 is upward.

(2) Remove the freewheel roller race by rotating it clockwise while lifting it out of converter stator and cam assembly (fig. IX-2).

(3) Remove the 10 rollers and 10 springs from the stator and cam assembly (fig. IX-2).

(4) Check needle bearing assembly 14. Wash and flush the needle bearing assembly thoroughly with dry cleaning solvent or mineral spirits paint thinner. Dry it and lubricate it with transmission oil. Replace the freewheel race only and rotate the bearing while pressing upon the freewheel race. If there is no roughness or binding, the needle bearing as-

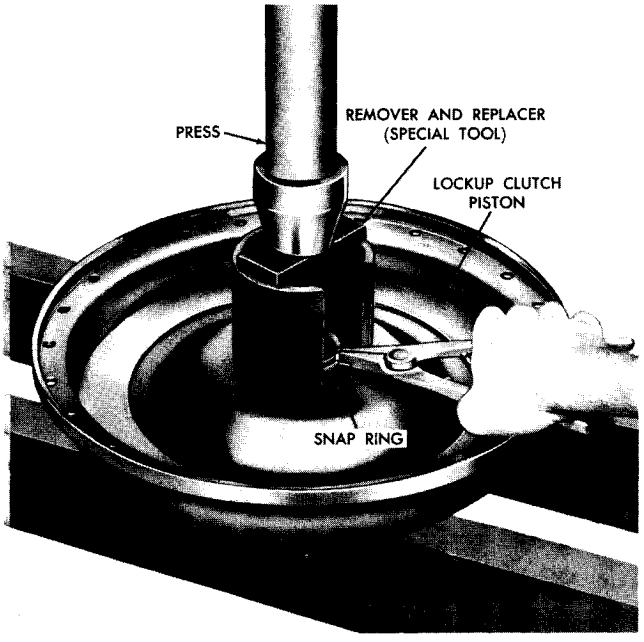


Fig. IX-1 Removing snap ring from hub of converter pump assembly

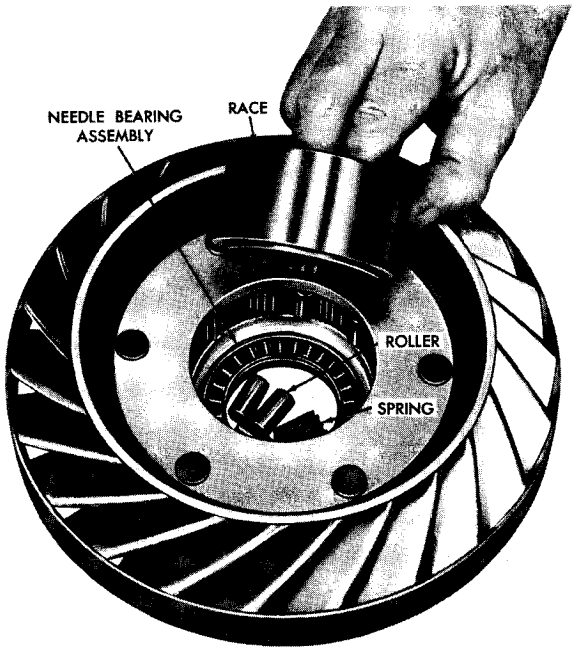


Fig. IX-2 Removing freewheel roller race

sembly may be left in the stator and cam assembly and reused. Do not mistake dirt or grit for a damaged needle bearing. Reclean and re-oil the needle bearing if dirt is suspected. Check the needle bearing end of freewheel race for smooth finish. Replace the freewheel race if the bearing end is scratched or contains chatter marks.

(5) If needle bearing assembly 14 needs replacement, replace entire stator and cam assembly 13.

Caution: Do not scratch or nick any stator bores.

(6) Do not attempt to disassemble the stator and cam assembly. If damaged or worn beyond reuse limits, replace it with a new assembly.

c. Converter Pump Assembly

(1) Remove hook-type seal ring 50 from pump hub 24.

(2) Remove any loose or damaged bolts from converter pump 48 flange.

Note: If balance weights are loose or are removed, the same weights must be replaced in the same locations.

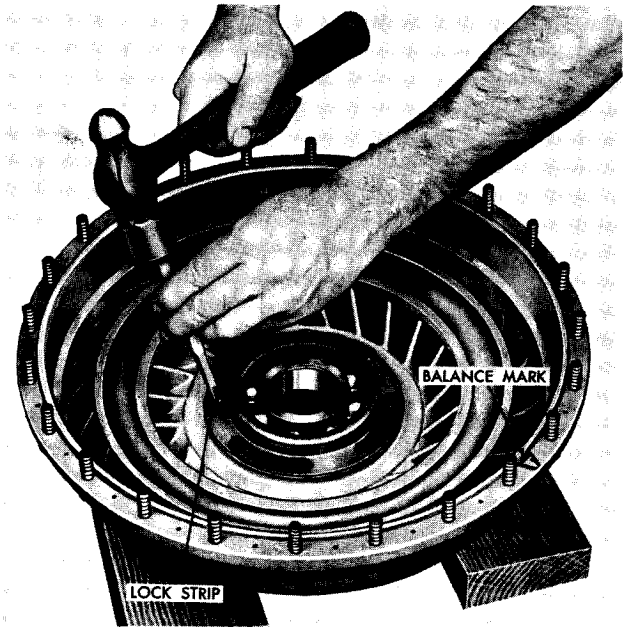


Fig. IX-3 Flattening lock strip tab

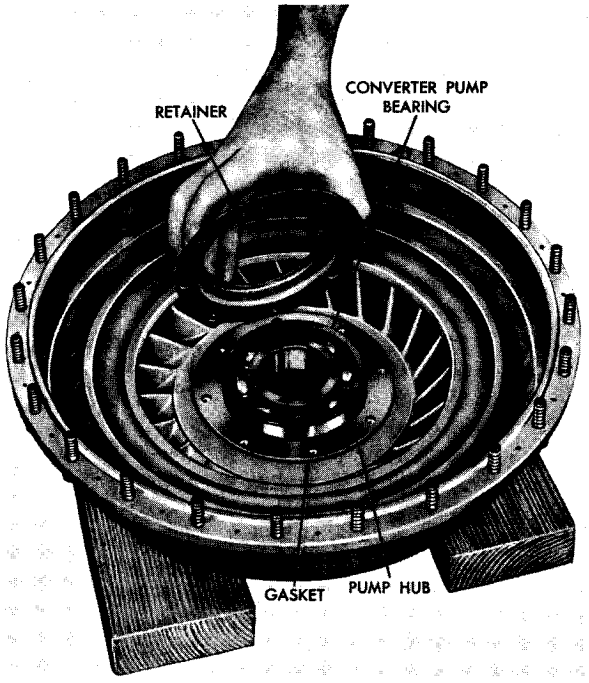


Fig. IX-4 Removing bearing retainer

(3) Flatten lock strip tabs and remove the four strips and eight bolts (fig. IX-3).

(4) Remove the converter pump bearing retainer (fig. IX-4), converter pump hub and converter pump hub gasket (under hub).

(5) Separate ball bearing assembly 23, and converter pump hub 24.

d. Converter Housing Assembly

(1) Remove six bolts 33, lock washers 34 (and plain washers 35 on the aluminum housings only).

(2) Remove front oil pump assembly 42, and seal ring 41.

(3) Remove front oil pump cover 43, drive gear 44 and driven gear 45 from pump body 46.

(4) If replacement is necessary, remove oil seal 47, from oil pump body 46.

(5) If converter ground sleeve 29 replacement is necessary, remove four self-locking bolts 32 from the rear end of the converter ground sleeve.

Fig. IX-5 Installing pump cover bushing

(6) Using a wood block on the small end, drive out the converter ground sleeve 29.

(7) If converter ground sleeve bushing 30 needs replacement, remove it without damaging the bore.

2. ASSEMBLY

Note: The key numbers shown below refer to foldout 3.

a. Input Drive Cover and Lockup Clutch Piston

(1) If converter pump cover bushing in converter pump cover hub was removed, use input drive cover bushing replacer to install new bushing (fig. IX-5).

(2) If removed, install seal ring retainer 3, on converter pump cover 1 hub with larger diameter toward open end (rear) of cover. Install oil seal ring 4 into the retainer.

(3) Install piston seal ring 6 into outer groove of lockup clutch piston 5.

(4) Insert lockup clutch piston (fig. IX-6) into the converter pump cover, with the stamped balance marks (if any) alined so that piston guide pins will enter the nearest holes in the piston.

Note: To make installation of the lockup clutch piston assembly easier, put a pencil mark in line with the pin nearest the orifice in the piston (when balance marks are alined as in fig. IX-6). Then when the piston assembly is being installed, use the pencil mark as a guide to the location of the pin beneath the orifice. One recessed hole in the piston is concentric with the orifice. Rotate the piston slightly, if necessary, during installation to insure that the piston engages the pins. To make certain that the piston is properly seated, measure the distance from the pump cover mounting surface to the piston. This distance should be approximately 1 1/2 inches (fig. IX-7).

Caution: The lockup clutch will not release if the piston is not engaged with the pins.

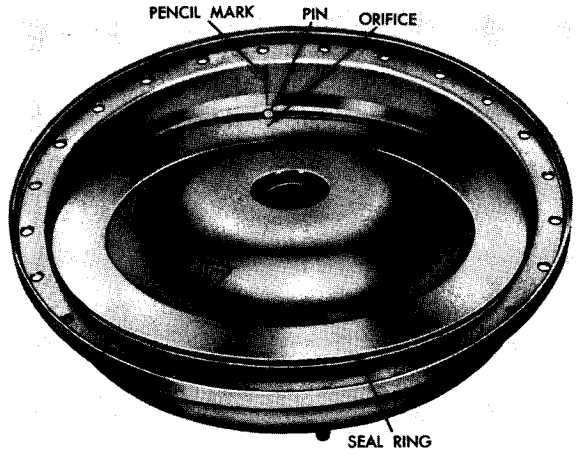


Fig. IX-6 Positioning lockup clutch piston assembly

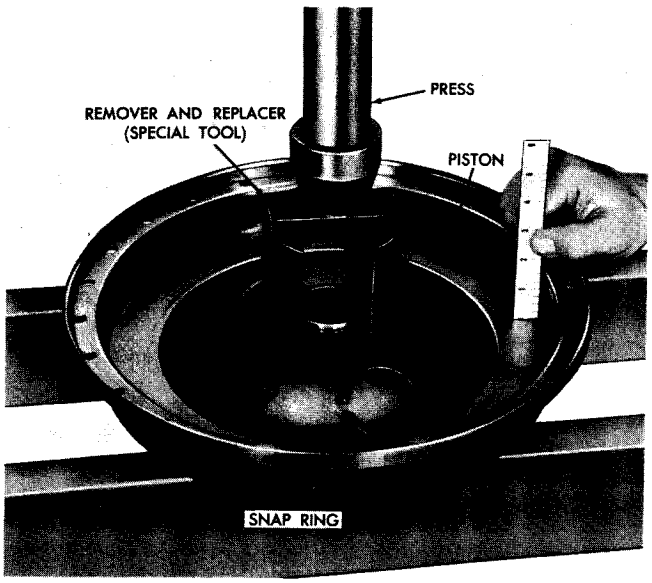


Fig. IX-7 Installing lockup clutch piston assembly

(5) Place the converter pump cover (fig. IX-7) on wood blocks to prevent damage to the threads on studs by the press table. Using remover and replacer sleeve, compress the center of the piston only enough to install the snap ring.

b. Converter Stator and Cam Assembly

(1) Cover the bottoms of the stator cam pockets with oil soluble grease and install the 10 freewheel rollers and 10 springs (fig. IX-8). The ends of the springs must be toward the center of the stator and cam assembly. The rollers are installed in the shallow end of the cam pockets.

Caution: Only oil soluble grease may be used. Non-oil soluble vegetable cooking compounds must not be used any place in the transmission.

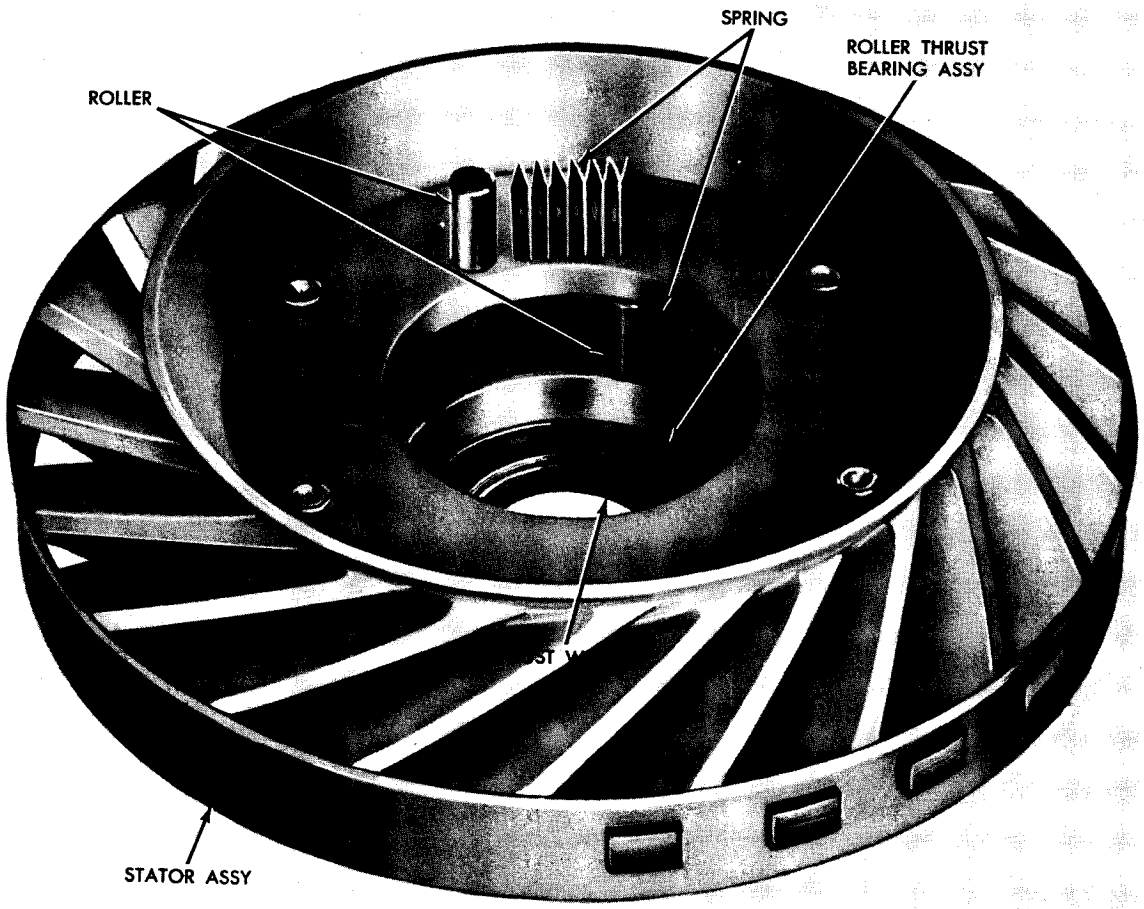


Fig. IX-8 Torque converter stator components

(2) When all of the springs and rollers have been installed, press them, with the fingers, into the stator cam pockets to make room for the freewheel roller race.

(3) Install the freewheel roller race, counterbored side facing away from the stator, (fig. IX-9) into the stator and cam assembly. Rotate the freewheel roller race in a clockwise direction while installing it. When it is fully seated, twist it firmly in the opposite direction to lock it into the stator and cam assembly. Place the stator and cam assembly so that the freewheel roller race is upward until installation.

c. Converter Pump Assembly

(1) Position a new converter pump hub gasket 25 on converter pump 48 bore.

(2) Install ball bearing 23 in converter pump hub 24.

(3) Install pump hub 24 in converter pump 48 bore and aline the holes.

(4) Place converter pump bearing retainer 22 over the ball bearing and aline the holes.

(5) Install eight bolts 20 through four new lock strips 21 and into pump 48. Tighten the bolts.

(6) Bend pointed corners of lock strips 21 up to lock bolts.

(7) Replace any converter pump flange bolts 49 necessary and make sure weights (if any) are in their original positions if pump bolts have been removed.

(8) Install hook-type seal ring 50 on pump hub 24.

d. Converter Housing Assembly

(1) If the converter ground sleeve bushing was removed from the converter ground sleeve, use a press and ground sleeve bushing replacer and install the new bushing in the converter ground sleeve (fig. IX-10).

(2) If converter ground sleeve 29 was removed, use two 5/16-18 guide bolts and install the converter ground sleeve, properly alined, into converter housing 40.

(3) Install four self-locking bolts 32.

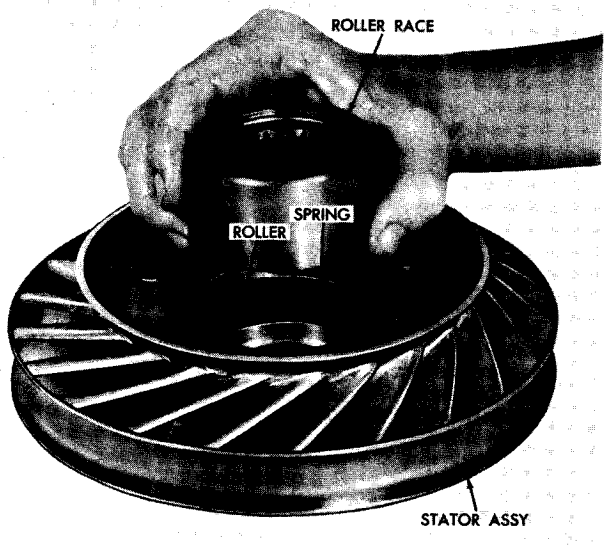


Fig. IX-9 Installing freewheel roller race

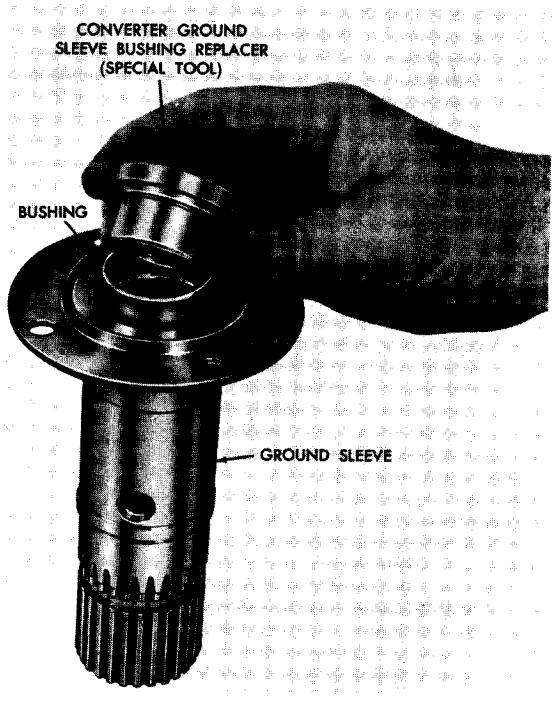


Fig. IX-10 Installing converter ground sleeve bushing

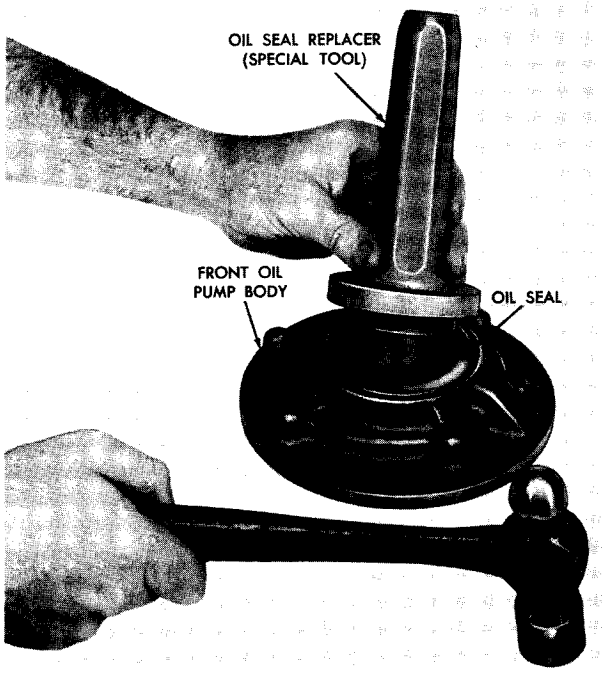


Fig. IX-11 Installing front oil pump seal

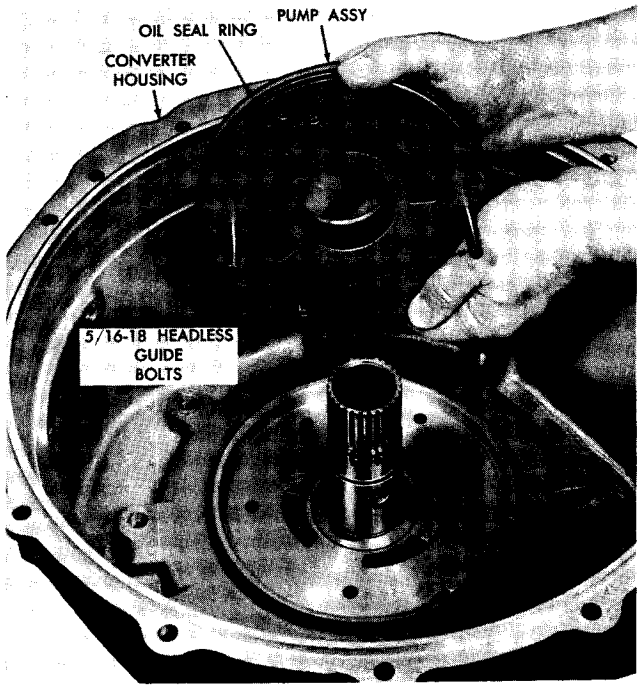


Fig. IX-12 Installing front oil pump assembly

(4) If the front oil pump seal was removed from the front oil pump body, coat the outside diameter of the new seal with white lead and, using the front-pump oil seal replacer, install the oil seal in the bore of the front oil pump body (fig. IX-11), seal lip end first.

(5) Install oil pump driven gear 45 and drive gear 44 into oil pump body 46.

(6) Install two 5/16-18 guide bolts in the pump body (fig. IX-12).

(7) Install the front oil pump cover over the guide bolts (fig. IX-12).

(8) Install the oil seal ring around the front oil pump cover outside diameter (fig. IX-12).

(9) Using the guide bolts, guide the front oil pump assembly into the converter housing (fig. IX-12).

(10) Install four bolts 33, four lock washers 34 (and, on aluminum converter housings, four plain washers 35).

(11) Remove the two guide bolts and install the two remaining bolts 33 and washers 34 (and 35, if aluminum housing is used), as in (10), above.

Section X SPLITTER AND HIGH-RANGE CLUTCH PACKAGE ASSEMBLY — REBUILD

1. SHAFT AND ROTOR ASSEMBLY

Note: The key numbers shown below refer to foldout 4. Refer to sect. II for special tools.

a. Disassembly

(1) Remove hook-type seal ring 4 from the groove in the gear outside diameter of hydraulic retarder shaft and rotor assembly 2.

(2) If bushing 3 needs replacement, remove it from the large end of shaft. Refer to sect. VI, para 3d.

b. Assembly

(1) If the bushing was removed from the shaft and rotor assembly, install a new bushing. Use press and rotor bushing replacer (fig. X-1). Press until the bushing replacer bottoms.

(2) Install hook-type seal ring 4 into the groove of the gear outside diameter of shaft and rotor assembly 2.

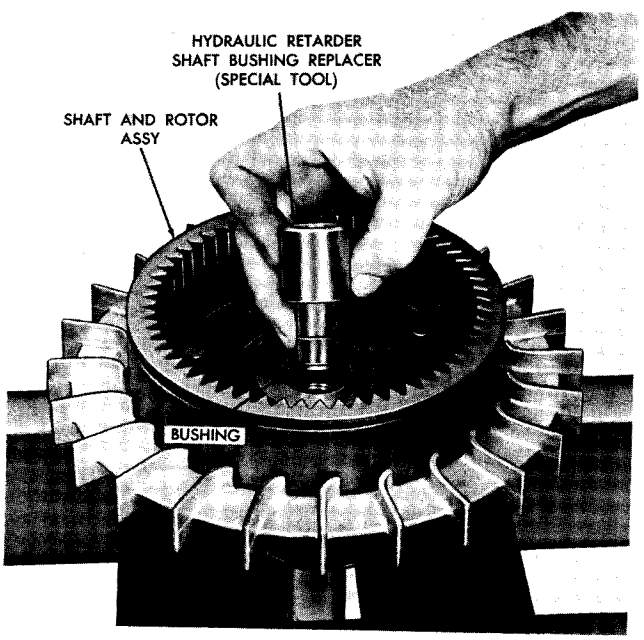


Fig. X-1 Installing rotor shaft bushing

2. CLUTCH PACKAGE ASSEMBLY

Note: The key numbers shown below refer to foldout 4. Refer to sect. II for special tools.

a. Disassembly

(1) Splitter planetary carrier assembly

(a) Remove the snap ring from the end of splitter output shaft assembly (fig. X-2).

(b) Remove splitter planetary carrier assembly 8. Bronze splitter thrust washer 14 may come out with the planetary carrier or stay on top of the sun gear. Remove the washer.

(c) Do not disassemble the carrier assembly. If there is evidence of undue wear or damage, replace the carrier assembly as a unit.

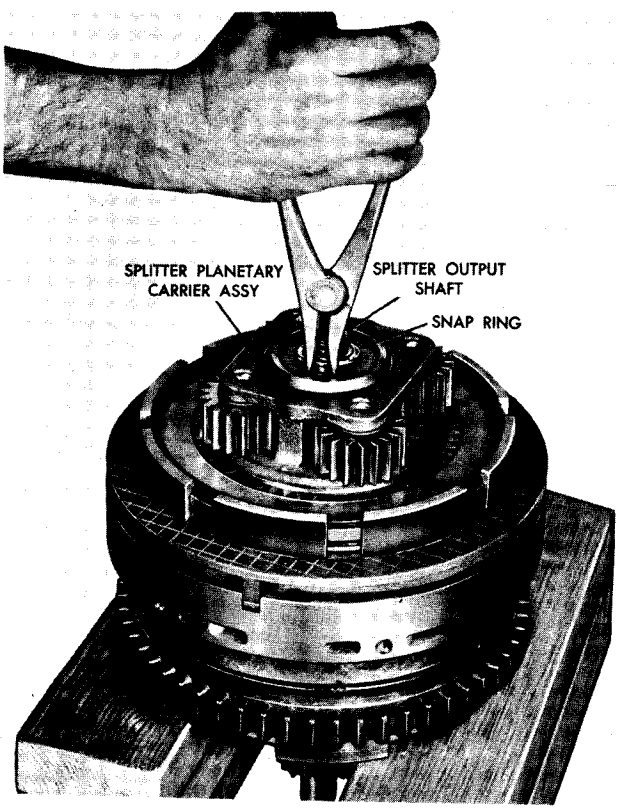


Fig. X-2 Removing splitter output shaft snap ring

(2) Splitter clutches

(a) Lift off the splitter clutch assembly and position it on the assembly table with the flat side down. Lift off bronze thrust washer 28. (On models having an 8-tanged, low-splitter clutch plate, remove the plate at this time.)

(b) Remove internal-snap ring 15 that retains high-splitter clutch, reaction plate 16.

(c) Remove high-splitter clutch reaction plate 16.

(d) In 3-plate clutch assemblies, remove one high-splitter clutch, internal-splined plate 17, one external-splined clutch plate 18 and the other internal-splined plate 17. In 5-plate clutch assemblies, remove one more external-splined clutch plate 18 and one more internal-splined plate 17.

(e) Remove internal-tanged, low-splitter clutch plate 20 (on models having 6-tanged plate.)

(f) Place the splitter clutch housing assembly (fig. X-3) in a press and, using a remover and replacer sleeve, depress the high-splitter clutch piston return spring to remove pressure against the snap ring. Remove the snap ring and the piston return spring.

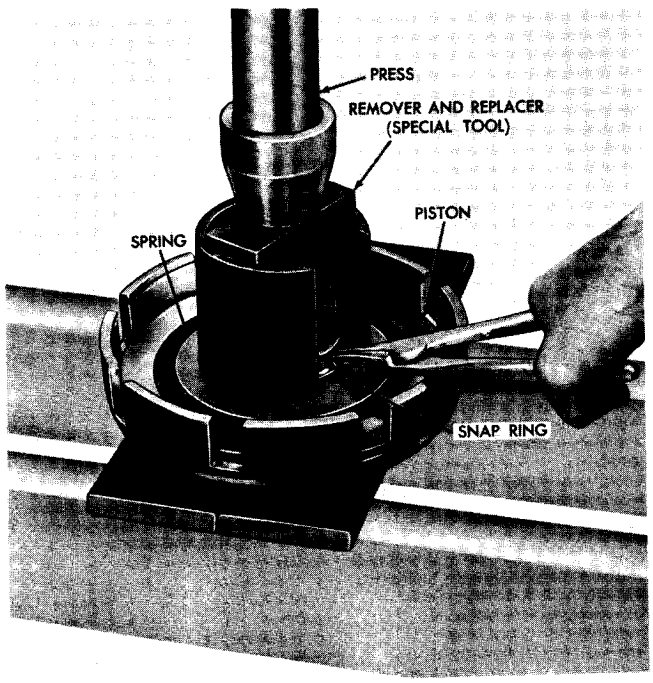


Fig. X-3 Removing high-splitter clutch spring snap ring

(g) Remove high-splitter clutch piston 22 and remove seal ring 23 from the piston outside diameter.

(h) Remove hook-type seal ring 24 from high-splitter clutch housing 26.

(i) If splitter sun gear bushing 25 in housing 26 needs replacement, remove it. Refer to sect. VI, para 3d.

(3) High-range clutch diaphragm assembly

(a) Remove the two hook-type seal rings 27, from the hub of high-range clutch diaphragm assembly 35.

(b) Turn the diaphragm and high-range clutch assembly over so that the rear end of splitter output shaft 59 is up.

Caution: When turning assembly end-for-end, grip all components together to prevent damage to the pitot tube.

(c) Remove snap ring 63 from the rear end of the splitter output shaft assembly.

(d) Lift off the low- and intermediate-range sun gears 62 and 61.

(e) Turn the assembly diaphragm and high-range clutch over, placing low-splitter clutch piston 31 up.

Caution: When turning assembly end-for-end, grip all components together to prevent damage to pitot tube.

(f) Remove splitter output-shaft assembly 58, the two hook-type seal rings 57 and the two wire-type snap rings 56.

Note: Do not remove orifice plug 60 in the end of the shaft.

(g) Place the assembly in a press and, using a remover and replacer sleeve (fig. X-4), depress the low-splitter piston return spring to relieve pressure on the snap ring and remove the snap ring.

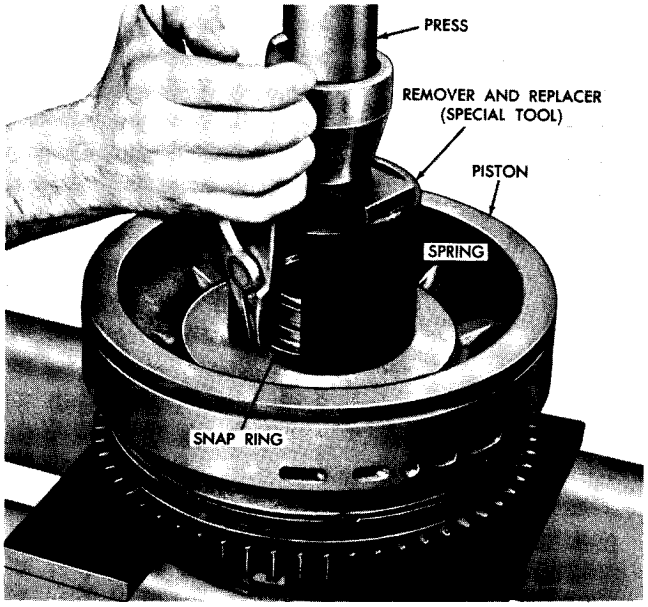


Fig. X-4 Removing low-splitter clutch spring snap ring

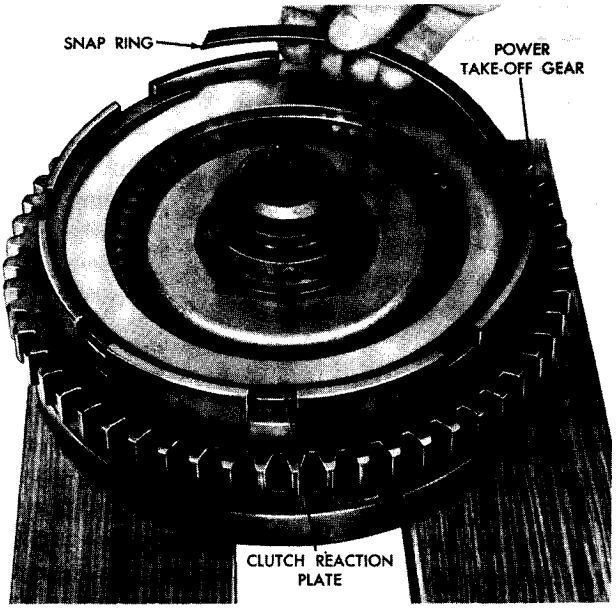


Fig. X-5 Removing snap ring retaining high-range clutch plates

(h) Remove low-splitter clutch piston 31 and seal ring 32 from the piston outside diameter.

(i) Remove hook-type seal ring 33 from the hub of diaphragm assembly 35.

(j) Remove the two front pitot tube screws and washers 34.

(k) Lift off high-range clutch diaphragm 35 and remove the two hook-type seal rings 38 from its hub.

(l) Remove the pitot tube 37.

(4) High-range clutch and piston assembly

(a) Turn the high-range clutch over and remove the internal-snap ring from the high-range clutch housing assembly (fig. X-5).

(b) Remove high-range clutch reaction plate 53.

(c) In 5-plate clutch assemblies, remove three internal-splined 50, and two external-splined 51, high-range clutch plates. In 7-plate clutch assemblies, remove one more internal-splined 50, and one more external-splined 51, clutch plates. Remove power takeoff gear 52 (on models which use a separate gear).

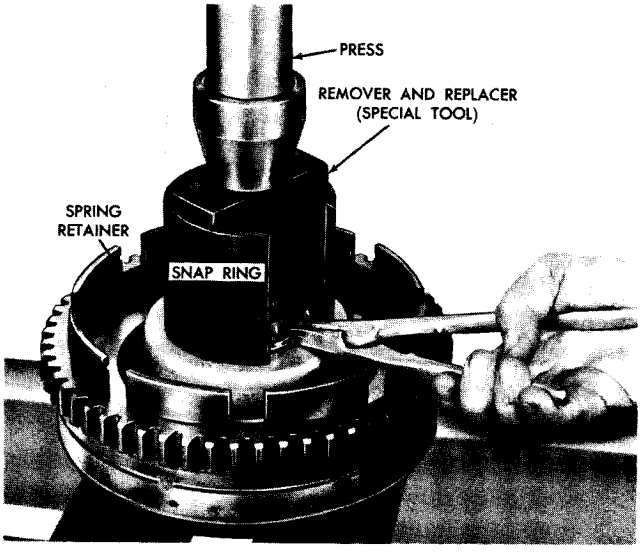


Fig. X-6 Removing high-range clutch spring retainer snap ring

(d) Block up the assembly so that no weight will be on the governor oil collector ring and use a press and a remover and replacer sleeve to compress the high-range clutch piston return springs (fig. X-6). Remove the snap ring.

Caution: Do not attempt to remove the snap ring without a press.

(e) Remove the high-range clutch piston return spring retainer 48 and the two springs 46 and 47.

(f) Tap the rear of high-range clutch housing assembly 40 on wood blocks to loosen piston 43. Remove high-range clutch piston 43, seal ring 42 from the piston outside diameter, and hook-type seal ring 41 from the hub of high-range clutch housing 40.

(g) If high-range clutch housing bushing 39 needs replacement, remove it. Refer to sect. VI, para 3d.

b. Assembly

(1) Splitter clutches

(a) If splitter sun gear bushing was removed from a high-splitter clutch housing, use a press and a bushing replacer (fig. X-7) to replace bushing. Press until the bushing replacer bottoms.

(b) Install hook-type seal ring 24, on the hub of high-splitter clutch housing assembly 26.

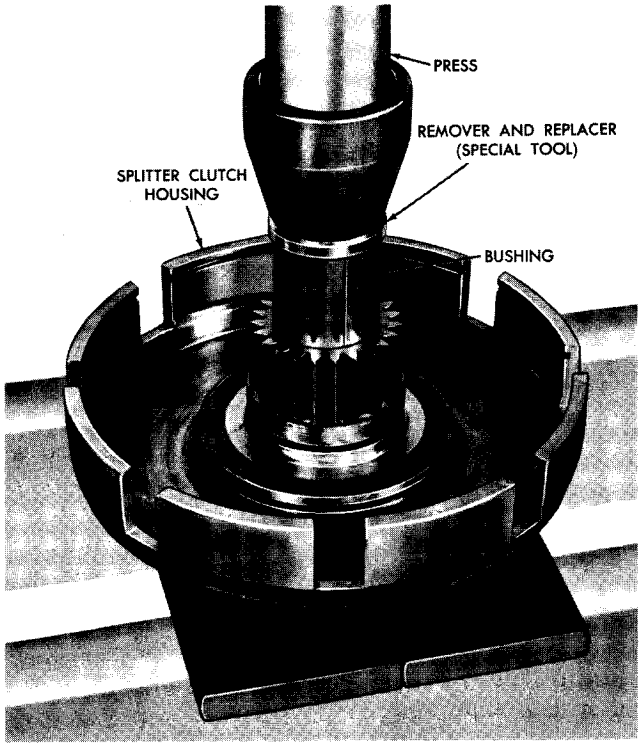


Fig. X-7 Installing splitter sun gear bushing

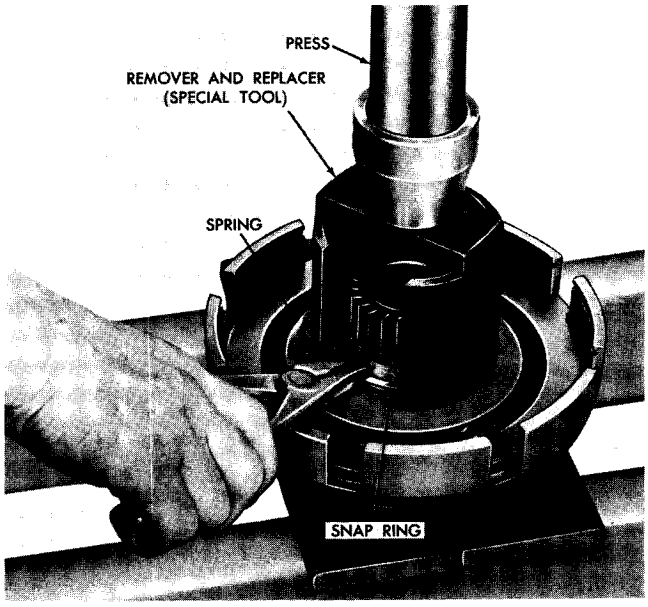


Fig. X-8 Installing high-splitter clutch piston return spring snap ring

(c) Install seal ring 23 in the groove in high-splitter piston 22 outside diameter and install the piston in high-splitter clutch housing 26. Note: On models which have external tangs on piston 22, aline the tangs with any opposite pair of slots in housing 26. On models which have dowels in housing 26, be sure the recesses in piston 22 engage them.

(d) Using a press and a remover and replacer sleeve (fig. X-8), install the high-splitter piston return spring, concave side down, and the snap ring.

Caution: Do not depress spring more than necessary to install ring.

(e) On models using a 6-tanged plate, install the low-splitter, internal-tanged clutch plate, making sure that tangs are not in the same slots as piston tangs (fig. X-9).

Caution: Low-splitter clutch failure will result if piston tangs and clutch plate tangs are in the same slot.

(f) In three plate clutch assemblies, install an internal-splined plate 17, the external-splined plate 18 and the other internal-splined plate 17. In the five clutch plate assemblies, install another external-splined 18 and another internal-splined plate 17.

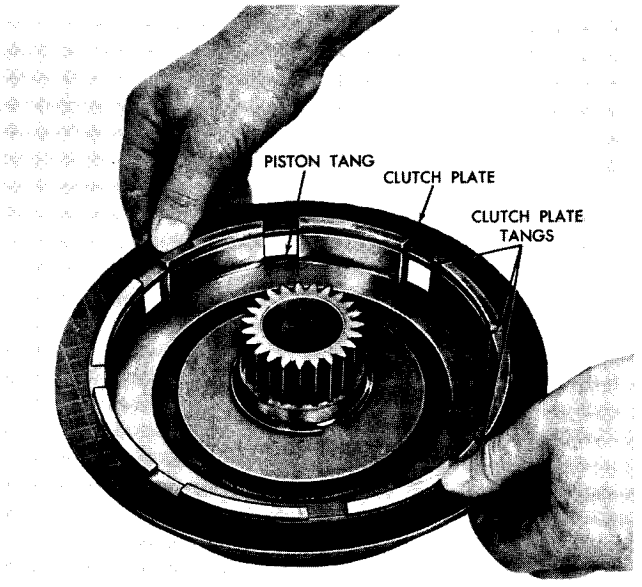


Fig. X-9 Installing low-splitter clutch plate

(g) Install high-splitter clutch reaction plate 16 with smooth side facing clutch plates.

(h) Install internal-snap ring 15.

(2) High-range clutch and piston assembly

(a) If the high-range clutch housing bushing was removed from the high-range clutch housing, use a bushing replacer and a press to install new bushing (fig. X-10). Press until the bushing replacer bottoms.

(b) Install hook-type seal ring 41, on hub of high-range clutch housing 40.

(c) Install seal ring 42 in groove in outside diameter of high-range clutch piston 43 and install high-range clutch piston in housing 40, smooth side first. Note: On models using pistons having external tangs, tangs must be engaged in slots of housing. On models using dowels in housing, recesses in piston must engage dowels.

(d) Position the two high-range clutch piston return springs 46 and 47 on the high-range piston and place the cup of retainer 48 over them.

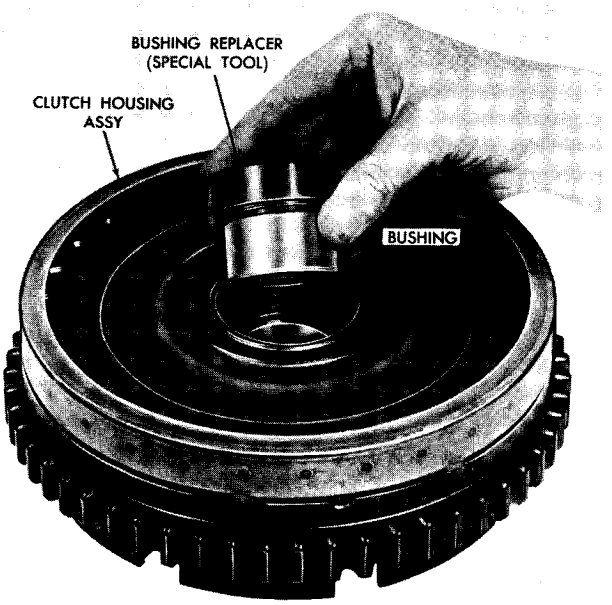


Fig. X-10 Installing high-range clutch housing bushing

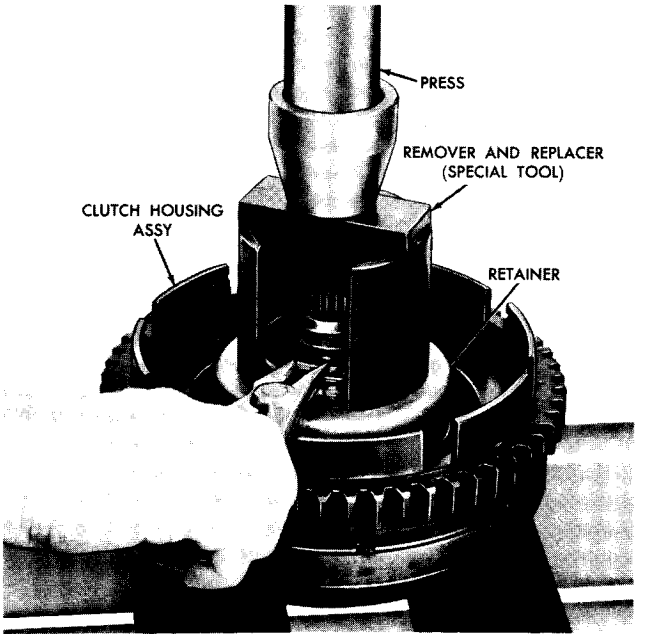


Fig. X-11 Installing high-range clutch spring retainer snap ring

(e) Place the assembly in a press with center blocked up to keep the governor oil collector ring off the table. Use a remover and replacer sleeve to compress springs and install snap ring (fig. X-11).

(f) In the 5-clutch plate model, install an internal-splined, high-range clutch plate

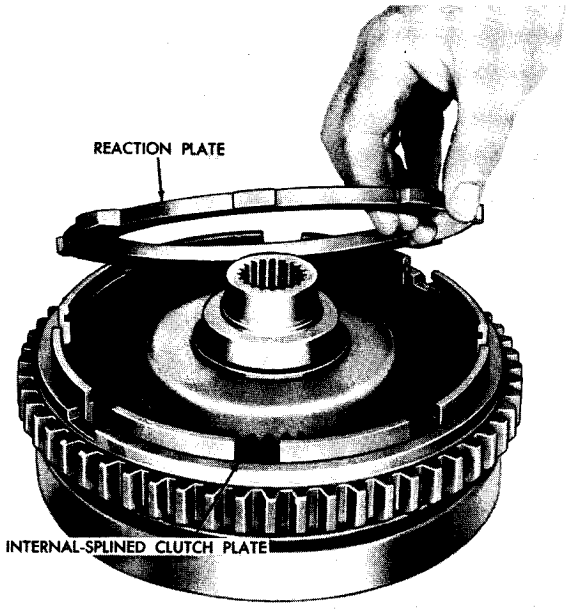


Fig. X-12 Installing high-range clutch reaction plate

50 first, then an external-splined plate 51, another internal-splined plate 50, another external-splined plate 51 and a third internal-splined plate 50. In the 7-clutch plate model, install a third external-splined plate 51, and a fourth internal-splined plate 50.

(g) Install power takeoff gear 52 with end slots up (on models using a separate gear).

(h) Install high-range clutch reaction plate so that the two longer tangs engage slots in power takeoff gear (fig. X-12).

(i) Install internal-snap ring 54.

(3) High-range clutch diaphragm assembly

(a) Install two hook-type seal rings on long hub end of the high-range clutch diaphragm assembly (fig. X-13). Install two 10-32 guide bolts in front pitot tube, center hole toward the bolts. Position the guide bolts through the high-range clutch diaphragm with the pitot tube tip toward the outside diameter and install the diaphragm in the high-range clutch housing.

(b) Remove one guide bolt (fig. X-14) and install a screw and washer. Remove the

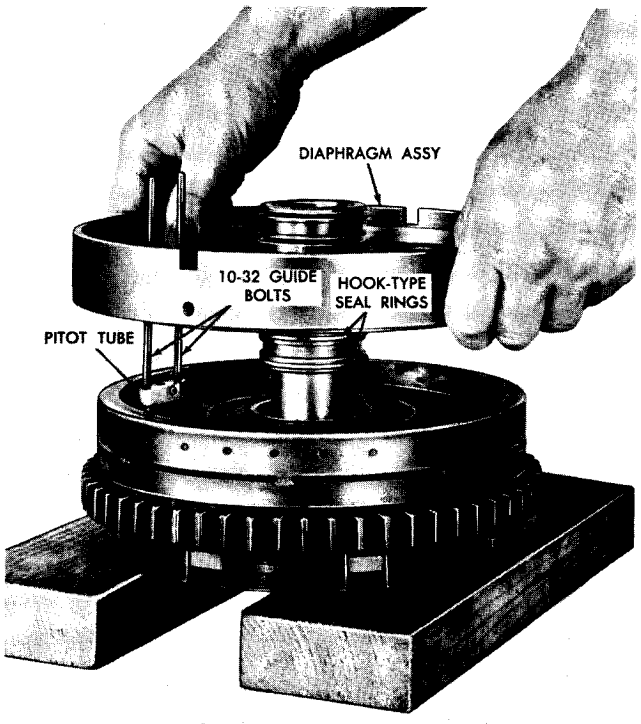


Fig. X-13 Installing high-range clutch diaphragm assembly

Fig. X-14 Installing front-pitot tube screw and washer

other guide bolt and install the second screw and washer.

> Caution: While handling, do not let the high-range clutch diaphragm and high-range clutch package separate at any time or the pitot tube and governor might be damaged.

(c) Install hook-type seal ring 33 on the hub of high-range clutch diaphragm hub 35. Install seal ring 32 in the groove in the outside diameter of low-splitter clutch piston 31. Install the low-splitter clutch piston in diaphragm assembly 35.

(d) Using a press and remover and replacer sleeve (fig. X-15) compress the low-splitter piston return spring and install the snap ring.

(e) Install two round wire-type snap rings 56 in grooves on splitter output shaft assembly 58. Install two hook-type seal rings 57 on splitter output shaft and install splitter output shaft assembly through diaphragm 35 bore. Note: Larger diameter shaft end is downward (fig. X-16).

(f) Install two hook-type seal rings 27 on the hub of high-range clutch diaphragm assembly 35. Install bronze thrust washer 28 using coating of oil-soluble grease to retain the washer in the bore of high-splitter clutch housing assembly 26.

(g) On models which use an 8-tanged, low-splitter clutch plate, install the plate on the assembled high-splitter clutch, engaging it with the rear tangs on housing. Install the assembled splitter clutch on high-range clutch diaphragm hub (fig. X-16).

(h) Using a coating of oil-soluble grease to retain it, install the bronze thrust washer 14 in the hub of splitter planetary carrier assembly 8.

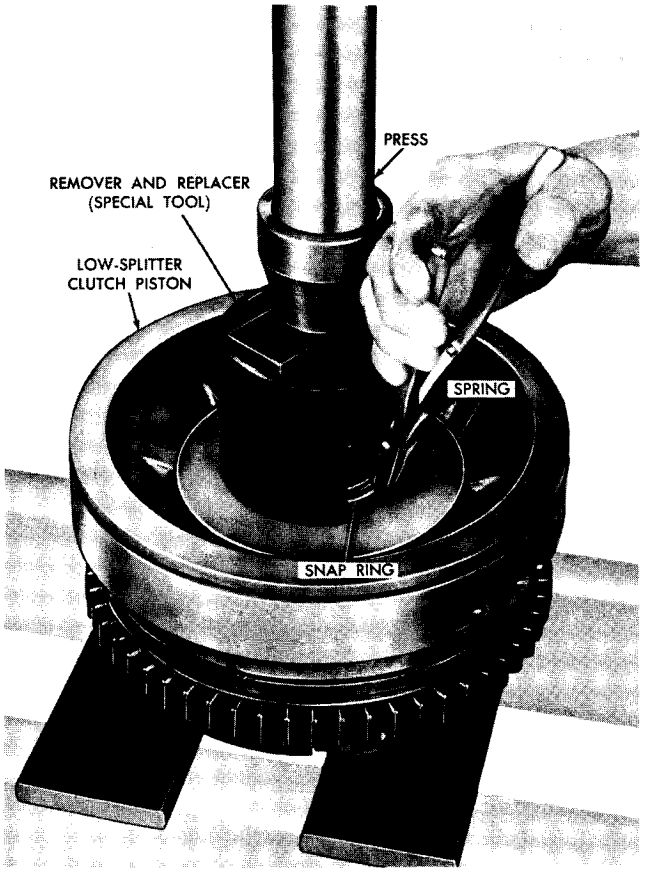


Fig. X-15 Installing low-splitter piston return spring snap ring

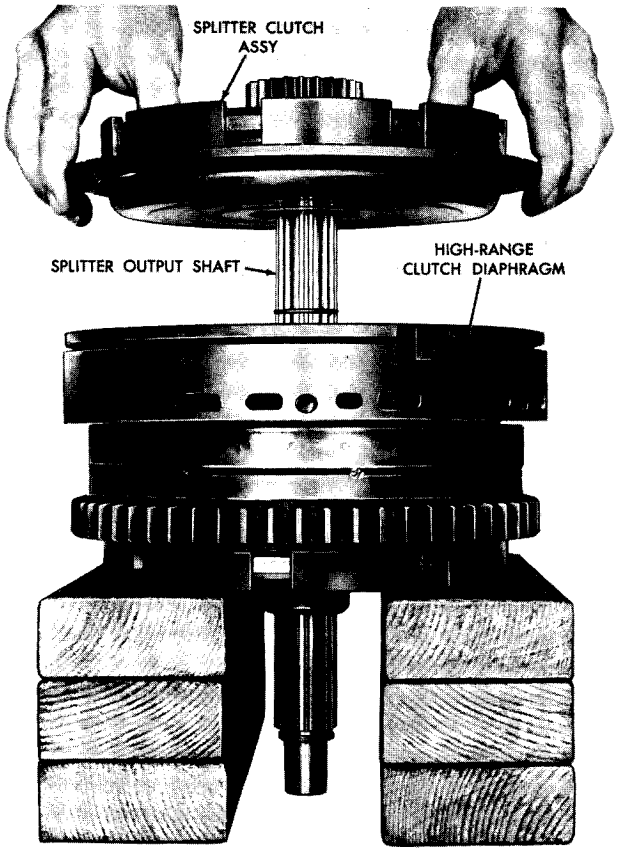


Fig. X-16 Installing splitter clutch assembly on diaphragm hub

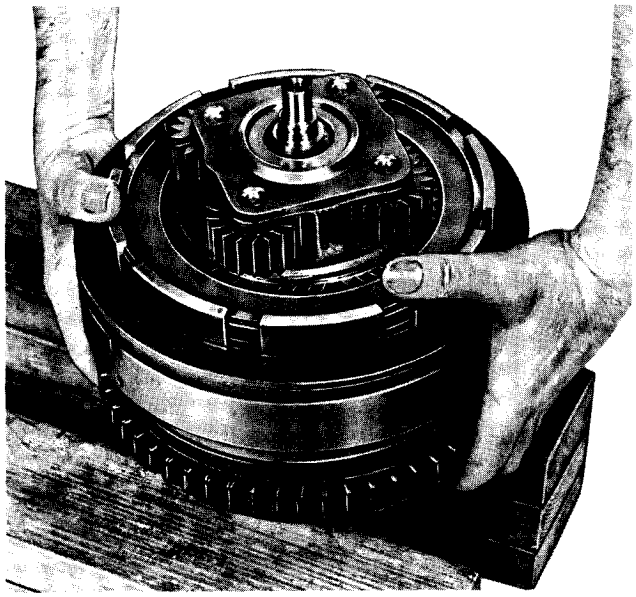


Fig. X-17 Lifting splitter and high-range clutch assembly

(i) Install the splitter planetary carrier assembly into splitter clutch housing 26. Lift splitter output shaft assembly 58 to fully expose snap ring groove and install snap ring 6.

(j) Lift splitter assembly (fig. X-17) by hand and position it on its side. Note: On models using an 8-tanged, low-splitter clutch plate, place thumbs on splitter clutch housing.

Caution: Grasp the components firmly while moving the assembly to prevent their separation and possible damage to the pitot tube.

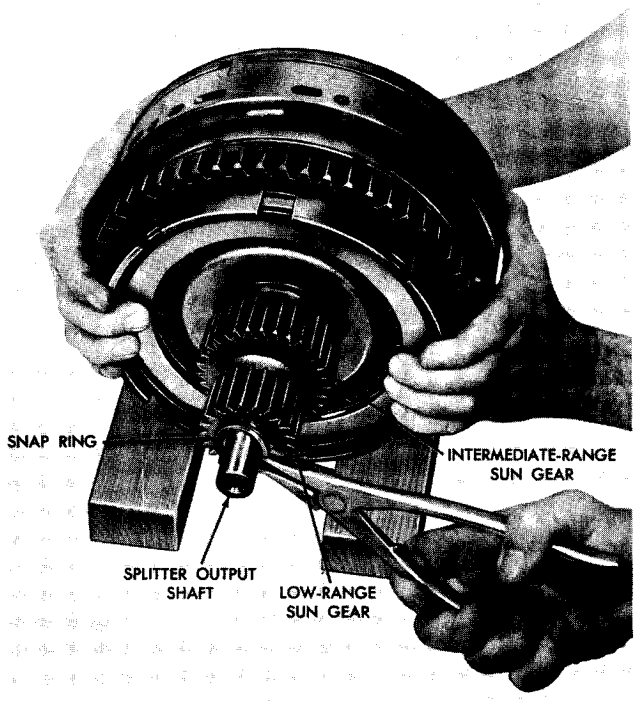


Fig. X-18 Installing splitter output shaft rear-snap ring

(k) With the assembly on its side (fig. X-18), install the intermediate- and low-range sun gears and snap ring which retains them.

Section XI OUTPUT DRIVE AND BRAKE ASSEMBLY — REBUILD

1. GENERAL

Because several options of brakes, output flanges and rear bearing retainers are offered, rebuild procedures vary among transmission models. The headings for the following paragraphs identify procedures applicable to each configuration.

Note: The key numbers, below, refer to foldout 7 in the back of the manual.

2. DISASSEMBLY

a. Rear-bearing Retainer Assembly (models having rear-oil pump)

(1) Remove five bolts 11 and lock washers 12.

(2) Remove rear oil pump assembly 59. Remove cover 63, drive gear 62 and driven gear 61 from body 60. Mark the sides of gears 61 and 62 before removal to assure identical reassembly.

(3) Remove oil seal 26.

(4) Remove snap ring 25 and bearing 23.

(5) Remove washer 22A (if used) and speedometer gear 22.

Note: Models which use a small gear 22, use washer 22A. Models which use a larger gear do not require the washer.

(6) Some models use speedometer driven gear bushing 20. Remove it only if replacement is necessary.

(7) Some models use oil drain tube 21. Remove it only if replacement is necessary.

(8) Remove pressure check plug 19.

b. Rear-bearing Retainer Assembly (models having no rear oil pump)

(1) Remove five bolts 11 and lock washers 12.

(2) Remove pitot adapter 13.

(3) Follow (3) through (8) in a, above.

c. Output Flange and Brake Drum

(1) Press serrated-shank bolts 36 out of drum 37 and flange 27.

Note: Some models have the drum installed at the rear of the output flange. Such drums may be lifted off prior to removal of bolts 36.

(2) Do not remove retainer washer 28 from flange 27 unless replacement is necessary.

Note: The mating surfaces of washer 28 and flange 27 are finished by grinding to insure oil-tight assembly.

d. Brake and Brake Band Assemblies (all models). Refer to foldout 7 for the applicable configuration and disassemble, if necessary, according to the details illustrated.

3. ASSEMBLY

a. Brake and Brake Band Assemblies (all models). If disassembled, refer to foldout 7 for the applicable configuration and assemble according to the details illustrated.

b. Output Flange and Brake Drum

(1) If retainer washer 28 has been removed from flange 27, inspect the mating surfaces of both for burs, nicks or dirt which would prevent oil-tight assembly. Press washer 28, flat side first, into the rear of flange 27.

(2) On models in which the web of the brake drum 37 is forward of the flange 27, position the rear of flange 27 downward and install drum 37. Press the serrated shank bolts 36 through the holes in the drum and flange (while supporting the flange).

(3) On models which have no brake drum or in which the brake drum is located behind flange 27, position the flange, rear side downward, and press the serrated shank bolts through the holes in the flange, seating the bolt heads against the front side of the flange.

c. Rear-bearing Retainer Assembly (models having rear-oil pump)

(1) Install pressure check plug 19 into bottom of rear-bearing retainer 15.

(2) If oil drain tube 21 is used, and was removed, install it by pressing it into retainer 15. It is installed, small end first, through the large bore at the rear of retainer 15. Press it below the surface adjacent to the hole in which it fits.

(3) If speedometer driven gear bushing 20 is used, and was removed, install a new bushing. Press it flush with, to 0.010 inch below the surface adjacent to the hole in which it fits.

(4) Position retainer 15 front side down and install speedometer drive gear 22.

Note: When small gear 22 is used, position of gear when installed is not important. When larger gear 22 is used, the counterbore in the gear must face the rear (upward).

(5) On models using smaller gear 22, install washer 22A. When larger gear 22 is used, no washer is required.

(6) Install rear bearing 23, pressing it against the shoulder in the bore of retainer 15. Install snap ring 25.

(7) Install a new oil seal 26, spring-loaded lip inward. Press the seal until it bottoms lightly.

(8) Assemble rear oil pump by installing driven gear 61, drive gear 62 and cover 63 into body 60.

Note: Gears should be reinstalled in the same position as removed. Bolt holes in cover must aline with those in body.

(9) Install pump assembly and retain it with five bolts 11 and washers 12.

d. Rear-bearing Retainer Assembly (models having no rear-oil pump)

(1) Follow (1) through (7), in c, above.

(2) Install pitot adapter 13, retaining it with five bolts 11 and washers 12.

Section XII REAR GEAR AND CLUTCH SUBASSEMBLIES — REBUILD

1. INTERMEDIATE-, LOW-, AND REVERSE-RANGE PLANETARIES

Note: The key numbers shown below refer to foldout 6, except as noted. Refer to sect. II for special tools.

a. Disassembly

(1) Intermediate-range planetary carrier assembly

(a) Remove internal-snap ring 22 from low-range ring gear 23.

(b) Lift out intermediate-range planetary carrier assembly 16.

(c) Do not disassemble the intermediate-range planetary carrier assembly. If there is evidence of undue wear or damage, replace the carrier assembly as a unit.

(2) Low-range planetary carrier assembly

(a) Do not disassemble transmission output shaft assembly 24. If there is evidence of undue wear or damage (other than bushing 29), replace the assembly as a unit.

(b) If transmission output shaft bushing 29 needs replacement, remove the bushing (refer to sect. VI, para 3d).

(3) Reverse-range planetary carrier assembly

(a) If the rear-pitot collector ring needs replacement, drill out the heads of the rivets holding it to the carrier. Drive out the rivets.

Caution: Do not drill into the carrier.

(b) Do not disassemble reverse-range planetary carrier 1, foldout 7. If there is evidence of undue wear or damage, replace the assembly as a unit (refer to sect. VI, para 3a, c, d, f and l.

b. Assembly

(1) Intermediate-range planetary carrier assembly

(a) Install intermediate-range planetary carrier assembly 16 into low-range ring gear 23.

(b) Retain carrier assembly 16 with internal-snap ring 22.

(2) Low-range planetary carrier assembly. If transmission output shaft bushing 29 was removed, use press and output shaft bushing replacer (fig. XII-1) and install bushing 29. Press until bushing replacer bottoms.

(3) Reverse-range planetary carrier assembly

(a) If rear-pitot oil collector ring 7, foldout 7 was removed, install a new ring.

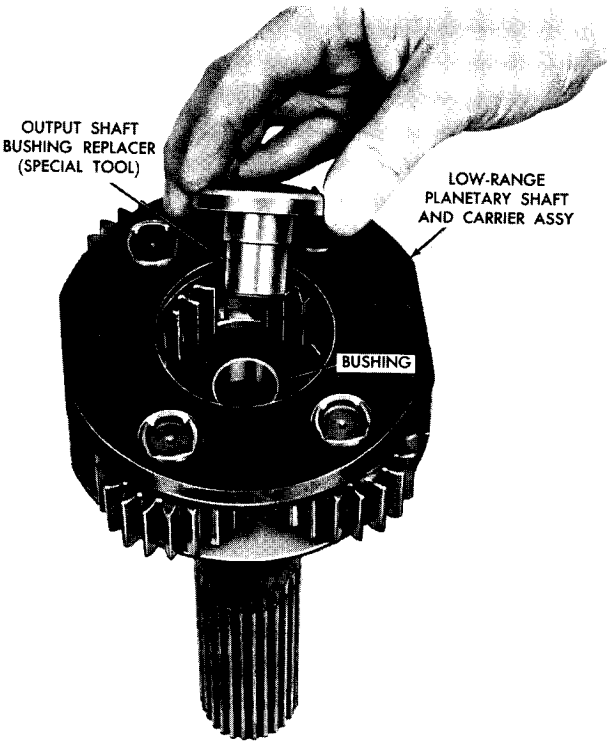


Fig. XII-1 Installing transmission output shaft bushing

(b) Install new rivets 9, foldout 7, through external-tang lock washers 8, collector ring 7 and carrier 2. Peen the ends protruding through flat end of carrier while supporting the rivet heads on a flat-headed backup tool.

Note: Three rivets are used in the 6-pinion carrier; four rivets are used in the 4-pinion carrier.

2. INTERMEDIATE-, LOW-, AND REVERSE-RANGE CLUTCH PISTONS AND HOUSINGS

Note: The key numbers shown below refer to foldout 6.

a. Disassembly

(1) Intermediate-range piston housing

(a) Using compressed air at oil inlet hole in intermediate-range piston housing 11, remove intermediate-range piston 9.

(b) Remove seal ring 8 from intermediate-range piston 9 outside diameter.

(c) Remove hook-type seal ring 10 from intermediate-range piston 9 hub.

(2) Low- and reverse-range piston housing

(a) Using compressed air in the oil supply holes in low- and reverse-range piston housing 37, remove low- 35 and reverse- 39 range pistons.

(b) Remove seal ring 34 from outside diameter of low-range piston 35.

(c) Remove seal ring 40 from outside diameter of reverse-range piston 39.

(d) Remove hook-type seal rings 36 and 38 from the two hubs of housing 37.

b. Assembly

(1) Intermediate-range piston housing

(a) Install hook-type seal ring 10 on hub of intermediate-range piston 9.

(b) Install seal ring 8 in piston 9 outside diameter groove. Lubricate seals 8 and 10.

(c) Install intermediate-range piston 9, hub first, into piston housing 11.

(2) Low- and reverse-range piston housing

(a) Install hook-type seal rings 36 and 38 on hubs of low- and reverse-range piston housing 37.

(b) Install seal ring 34 in groove in outside diameter of low-range piston 35. Lubricate seals 34 and 36.

(c) Install low-range piston 35 in housing 37.

(d) Install seal ring 40 in the groove in the outside diameter of reverse-range piston 39. Lubricate seals 38 and 40.

(e) Install reverse-range piston 39 in housing 37.

3. REVERSE-RANGE CLUTCH PLATE AND RING GEAR ASSEMBLY (foldout 6)

Note: Used only with single-plate reverse-range clutch.

a. Disassembly

(1) Using a remover and installer, straighten the clutch plate retainer ring at either side of the plate (fig. XII-2). Remove the ring.

(2) Lift the plate off the gear. Straighten and remove the other retaining ring. Discard the rings.

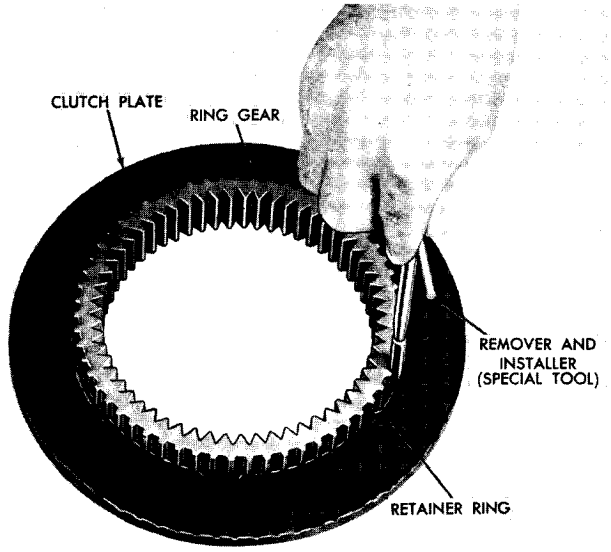


Fig. XII-2 Removing clutch plate retaining ring

b. Assembly

(1) Engage the internal splines of the clutch plate with the external splines of the ring gear and position the plate between the two grooves cut around the outside diameter of the ring gear.

(2) Place a new clutch plate retainer ring in one of the two grooves; then, using the remover and installer, crimp the ring at five evenly spaced intervals around the gear (fig. XII-2).

Caution: Do not crimp the retainer ring at points where cutouts are made in the friction facings.

(3) Turn the assembly over and install a second new retainer ring in the same manner that the first ring was installed.

Service Information Notes

Section XIII TRANSMISSION HOUSING ASSEMBLY—REBUILD

1. DISASSEMBLY

Note: The key numbers shown below refer to foldout 5.

a. Manual Selector Shaft and Throttle Valve Shaft Assemblies

(1) Flatten bent tab on throttle valve lever washer 45 away from nut 44.

(2) Remove throttle valve lever nut 44, washer 45 and throttle valve outside-lever 46 from throttle valve shaft assembly 23.

(3) Flatten bent tab on shift valve lever washer 48 away from nut 47.

(4) Remove shift valve lever nut 47, washer 48 and shift valve outside-lever 49 from manual selector shaft assembly 24.

(5) Remove the two shaft assemblies as a unit.

(6) Remove seal ring 25 from manual selector shaft assembly 24.

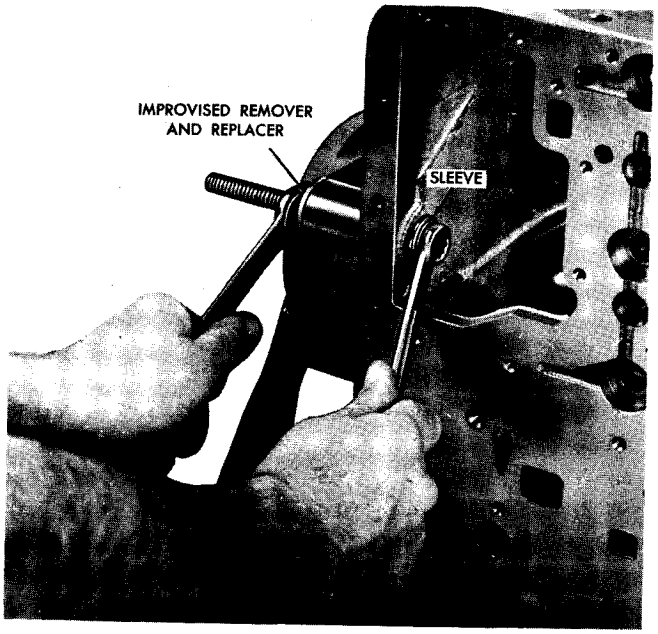


Fig. XIII-1 Removing shift lever sleeve from transmission housing

(7) Remove throttle valve shaft assembly 23 from selector valve shaft assembly 24.

(8) Remove seal ring 22 from the throttle valve shaft assembly 23.

b. Transmission Shift Lever Sleeve

(1) Shift lever sleeve 51 is to be removed only if it needs replacement.

(2) Using an improvised remover and replacer (fig. XIII-1), tighten the nut to pull the shift lever sleeve from the transmission housing into the hollow tube.

2. ASSEMBLY

Note: The key numbers shown below refer to foldout 5.

a. Transmission Shift Lever Sleeve

(1) If the transmission shift lever sleeve 51 was removed, install a new one as outlined below.

(2) Using an improvised sleeve remover and replacer, install the shift lever sleeve into the transmission housing (fig. XIII-2).

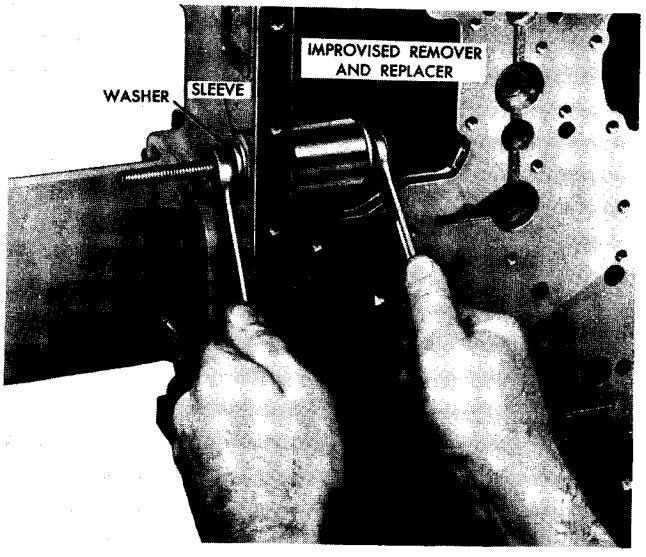


Fig. XIII-2 Installing shift lever sleeve

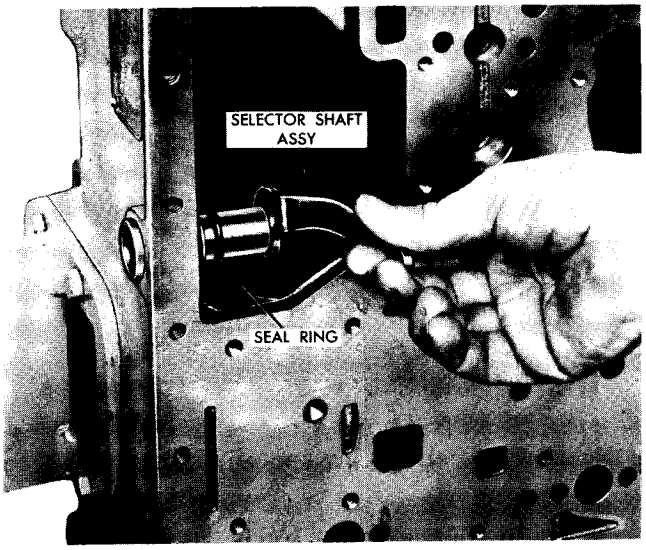


Fig. XIII-3 Installing manual selector shaft assembly

b. Manual Selector Shaft and Throttle Valve Shaft Assemblies

(1) Install seal ring 25 on manual selector shaft 24.

(2) Install manual selector shaft assembly 24 into shift lever sleeve 51 in transmission housing (fig. XIII-3).

(3) Install seal ring 22 on throttle valve shaft assembly 23.

(4) Install throttle valve shaft assembly 23 inside manual selector shaft assembly 24 in the transmission housing (fig. XIII-4).

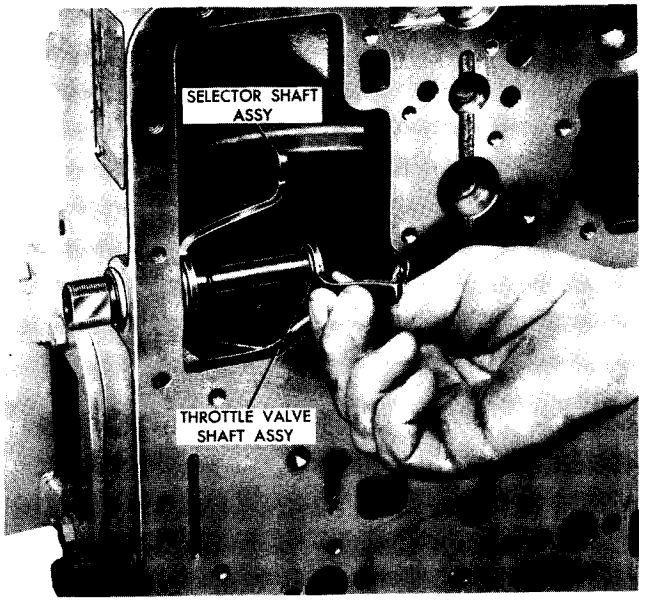


Fig. XIII-4 Installing throttle valve shaft assembly

(5) Install shift valve lever 49, shift valve lever washer 48 and shift valve lever nut 47. Tighten nut to 14 to 17 pound feet torque.

(6) Install throttle valve outside-lever 46, throttle valve lever washer 45 and throttle valve lever nut 44. Tighten nut to 14 to 17 pound feet torque.

(7) Lock the shift valve lever nut 47 and throttle valve outside-lever nut 44 by bending shift valve lever washer 48 and throttle valve lever washer 45 against a flat on each nut.

Section XIV CHECKING RANGE CLUTCH CLEARANCES PRIOR TO TRANSMISSION ASSEMBLY

1. INSTALLING RANGE CLUTCH COMPONENTS IN FIXTURE

Note: Refer to sect. II for special tools.

a. When the transmission is overhauled, the running clearances of the low-, intermediate-, and reverse-range clutches should be checked prior to reassembly. These checks can be made before assembling the components into the transmission housing by using the clutch checking fixture (fig. XIV-1).

Note: Various clutch parts are color coded when assembled during manufacture. These parts should be reassembled in the same locations to insure proper fitting. Parts marked yellow are for the intermediate-range clutch; those marked green are for the low-range clutch; and those marked red are for the reverse-range clutch. Color coding is used to maintain the original assembled tolerances. If a part is replaced, the original tolerance is disrupted. Compensate by using selective thickness clutch apply plates.

b. Position the clutch checking fixture on a bench and remove the nut, flat washer, thrust bearing, and top plate. Carefully stack the clutch parts into the fixture, centering each part. The parts must be stacked in the exact sequence outlined in c through p, below.

c. Install the reverse-range clutch reaction housing, slotted side upward (fig. XIV-1).

d. On models having a 3-plate reverse clutch, install an internal-splined plate, an external-splined plate, a second internal-splined plate, and the reverse-range clutch apply plate, contoured side upward.

e. On models having a single-plate reverse clutch, install the reverse-range clutch plate and gear assembly into the reaction housing with long end of gear downward. Install the reverse-range clutch apply plate, contoured side upward.

f. Install the reverse-range clutch piston return spring, convex side upward. Center it carefully.

g. Install the assembled low- and reverse-range clutch piston housing and pistons, long hub extension downward.

Note: Be sure clutch pistons are pushed all the way into the housing.

h. Install the low-range clutch piston return spring, concave side upward and center it in the piston housing.

i. On the spring just installed, install the low-range clutch apply plate, contoured side downward.

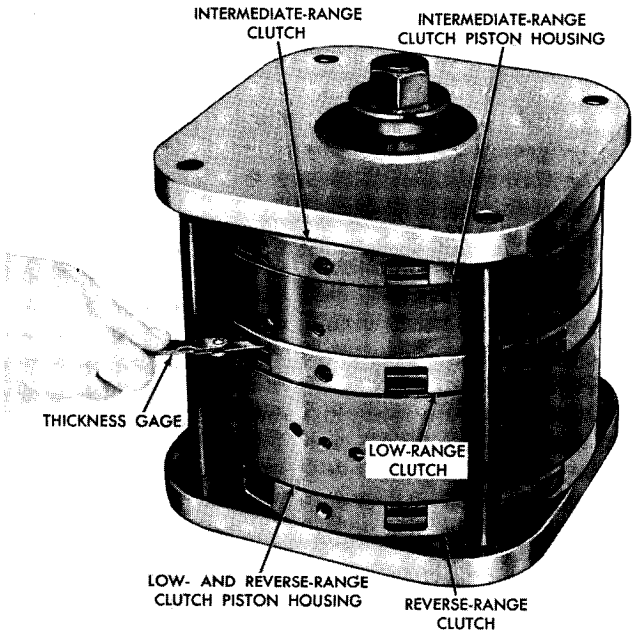


Fig. XIV-1 Checking range clutch clearances

j. On models having a 3-plate, low-range clutch, install an internal-splined plate, an external-splined plate, a second internal-splined plate, and the low-range reaction housing with slots downward. Rotate it to engage the splines of the external-splined plates.

k. On models having a single-plate, low-range clutch, install the low-range, internal-splined plate and the reaction housing with slots downward. Rotate the housing to engage the external splines of the apply plate.

l. Install the assembled intermediate-range clutch piston housing and piston, large bore (piston side) upward.

m. Install the intermediate-range clutch piston return spring, concave side upward and center it in the piston housing.

n. On the spring just installed, install the intermediate-range clutch apply plate, contoured side downward.

o. Install an internal-splined plate, an external-splined plate, a second internal-splined plate, and the intermediate-range reaction housing with slots downward. Rotate the housing to engage the external splines of the external-splined plates.

p. Install the fixture top plate, thrust bearing, flat washer, and nut. Tighten the nut to 80 pound feet torque.

Note: All clutch parts must be perfectly centered and torque must be exactly 80 pound feet to insure accurate measurement of clutch clearances.

2. CHECKING CLUTCH CLEARANCES

a. Using a small screwdriver, separate the top plate in each set from the plate below it and insert a thickness gage between the plates. Measure the clearance in each clutch at four of the slots (90 degrees apart) and record the average measurement for each clutch (fig. XIV-1).

Note: Do not force the thickness gage between the plates.

b. Clutch clearance specifications are as follows:

Low range
(3-plate) – 0.020 to 0.030
(single-plate) – 0.010 to 0.015

Intermediate range – 0.030 to 0.040

Reverse range
(3-plate) – 0.020 to 0.030
(single plate) – 0.010 to 0.015

(Refer also to wear limits information in sect. XVII).

c. Compare the clearances recorded in a, above, with the clearances specified in b, above. If the clearances are not within the specified limits, measure the apply plate for the applicable clutch and select a new one which is thicker or thinner - whichever is necessary.

Note: Measure the apply plate, from the stack, at its maximum thickness (from contour to flat side). Select new plates which are thicker or thinner, as required. Refer to transmission parts listings for choice of plates.

d. Reassemble the clutch parts in the checking fixture after replacing the apply plates and recheck the clearances.

Note: In cases where the transmission has been in service for a considerable time, wear of clutch reaction housings and clutch plates may make replacement of these parts necessary to establish proper clutch clearances.

e. When the proper clearances are established, remove the nut, flat washer, thrust bearing, and top plate from the fixture. Leave the clutch parts in the fixture, from which they may be installed, in the order removed from the checking fixture, into transmission.

Note: All clutch plates must be soaked in specified transmission oil for 2 minutes before being installed into transmission.

Section XV. ASSEMBLY OF TRANSMISSION FROM SUBASSEMBLIES

1. GENERAL

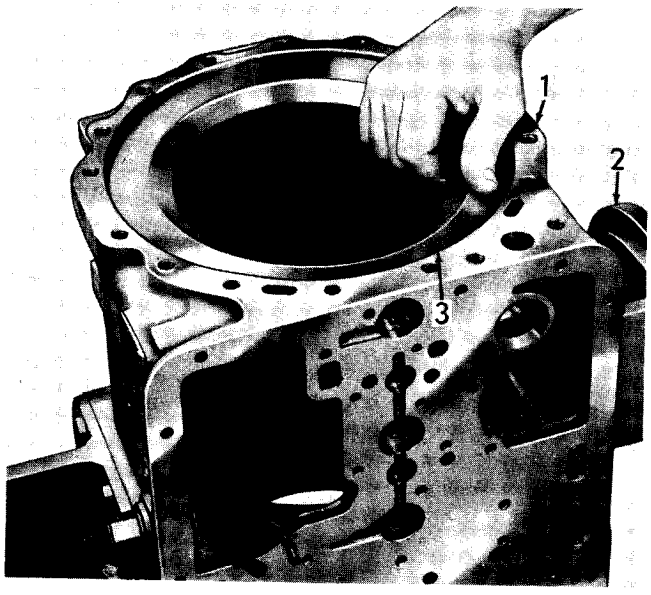
a. Pictorial Steps. This section is arranged in consecutive pictorial steps illustrating the assembly of the transmission. Directly beneath each picture are simple assembly instructions keyed to pictures by number callouts.

b. Cross Section, Exploded View Foldouts. Refer to transmission cross section (foldout 1) and to component exploded views (foldouts 3 through 9) for assembly sequence and parts identification.

c. Oiling Parts. All clutch plates must be soaked in specified transmission oil for 2 minutes before being installed. All thrust surfaces, gears, bushings and bearings must be oiled as they are installed.

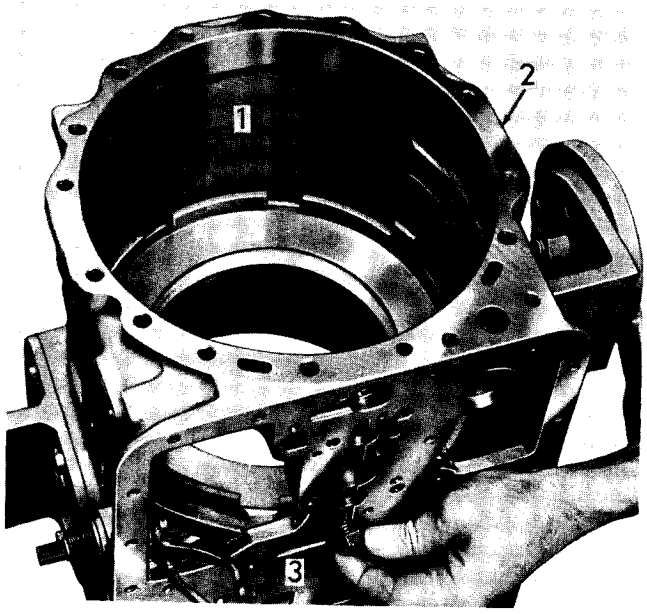
d. Special Tools. Refer to sect. II for special tools.

2. ASSEMBLY STEPS



STEP 1

Refer to disassembly steps 1 and 2, sect. VII, and mount transmission housing 1 in overhaul stand 2. Install oil collector 3.

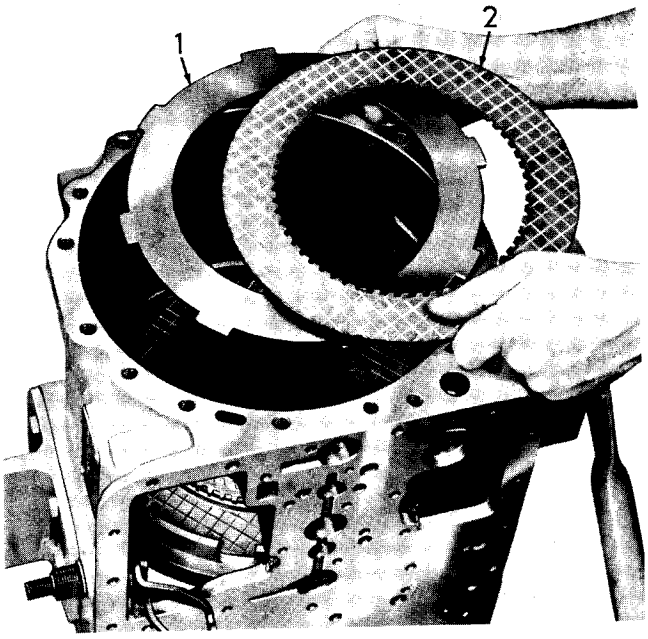


STEP 2

Install intermediate-range clutch reaction housing 1, alining its threaded anchor bolt hole with the anchor bolt hole in housing 2. Install anchor bolt 3 finger tight. Note: Intermediate-range parts are marked yellow; low-range parts are green; and reverse-range parts are red. Like-colored parts for each of these ranges must be assembled accordingly. Do not mix the colors.

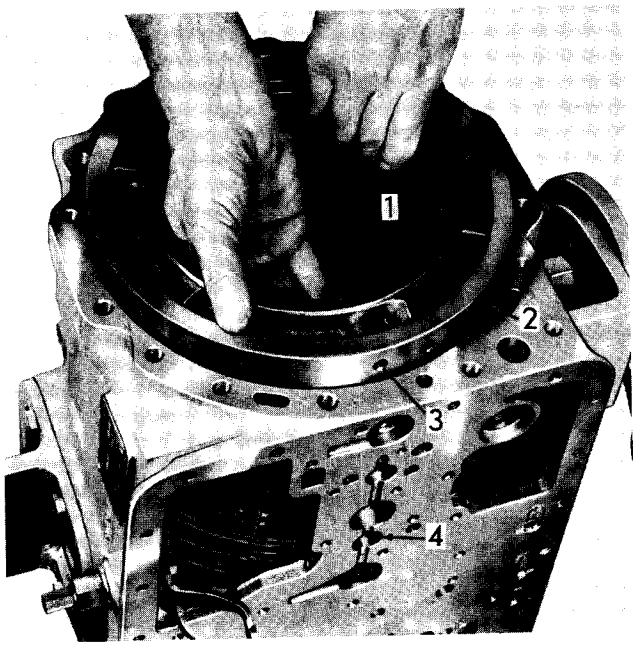
STEP 3

Install intermediate-range ring gear 1, long spline end first, into intermediate-range clutch internal-splined plate 2 and install in reaction housing 3. Note: Clutch plate 2 must be on splines below the ring on gear 1.



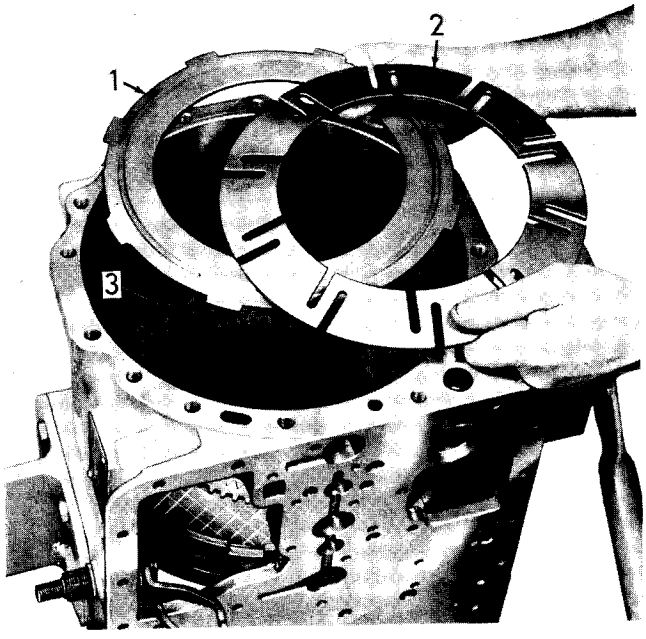
STEP 4

Install intermediate-range clutch external-splined plate 1 and remaining internal-splined plate 2.



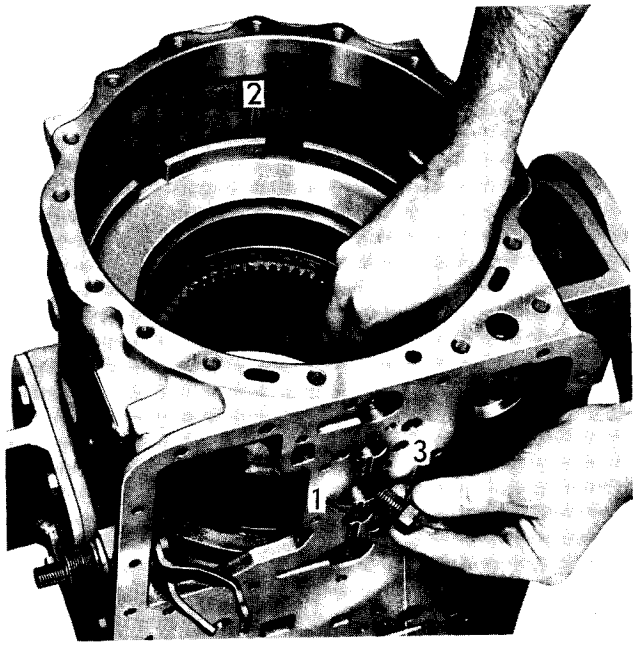
STEP 6

After centering spring 1, install the assembled intermediate-range clutch piston and housing 2. Aline anchor bolt hole 3 with hole 4.



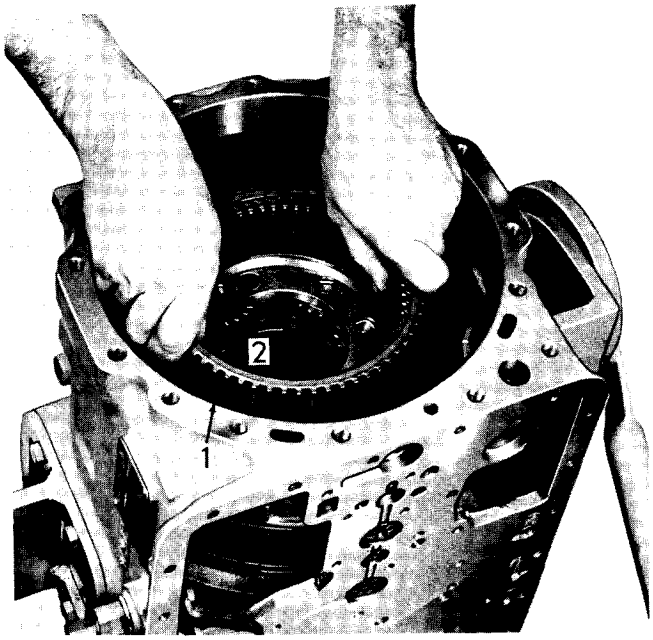
STEP 5

Install intermediate-range clutch apply plate 1 and intermediate-range clutch spring 2 on plate 3. Note: Contoured side of plate 1 and convex side of spring 2 are upward.



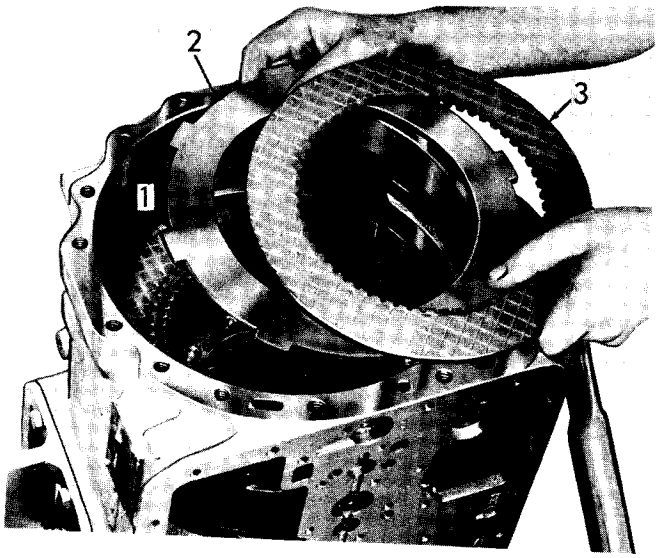
STEP 7

Install intermediate-range clutch piston housing anchor bolt 1 finger tight. Install low-range clutch reaction housing 2 and its anchor bolt 3, finger tight.



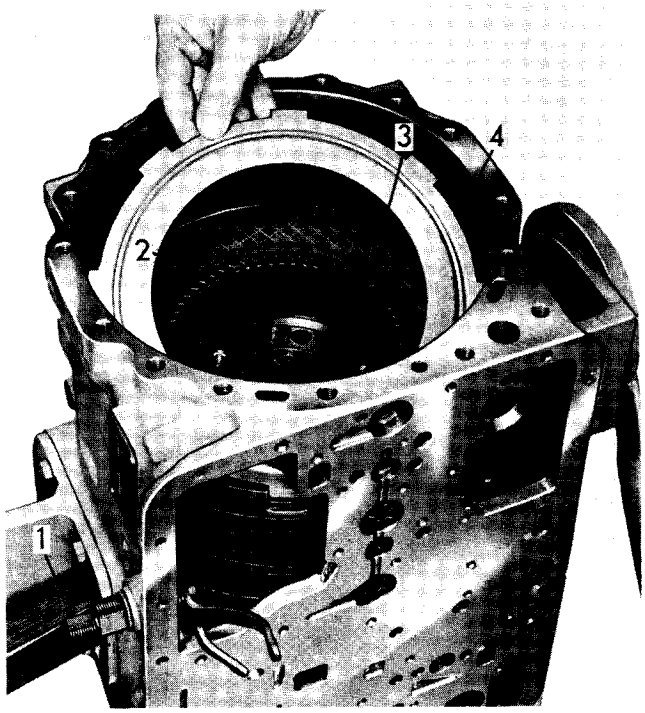
STEP 8

Install the assembled low-range ring gear and intermediate-range planetary carrier assembly 1, meshing pinions 2 with the intermediate-range ring gear previously installed.



STEP 9

On models having single-plate, low-range clutch, install only low-range clutch internal-splined plate 1. On models having three low-range clutch plates, install an internal-splined clutch plate 1, external-splined plate 2 and the remaining internal-splined plate 3.

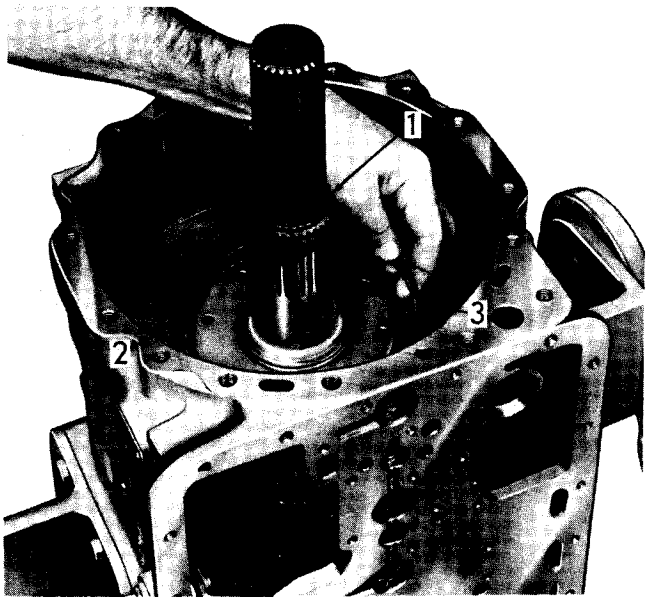


STEP 10

On models having three-plate, low-range clutch, install wood block 1 to raise ring gear 2 into good engagement with plate 3. On all models, install low-range clutch apply plate 4, contoured side up.

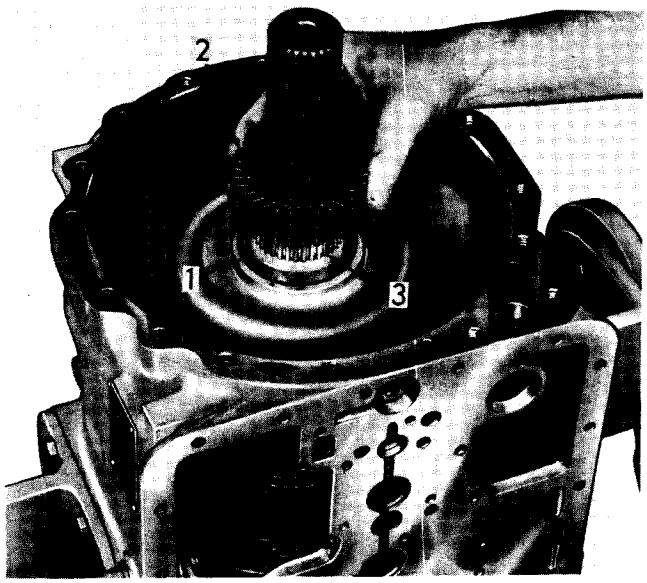
STEP 11

Install transmission output shaft assembly 1 into low-range ring gear 2. Rotate assembly 1 to engage the pinions 3 with gear 2.



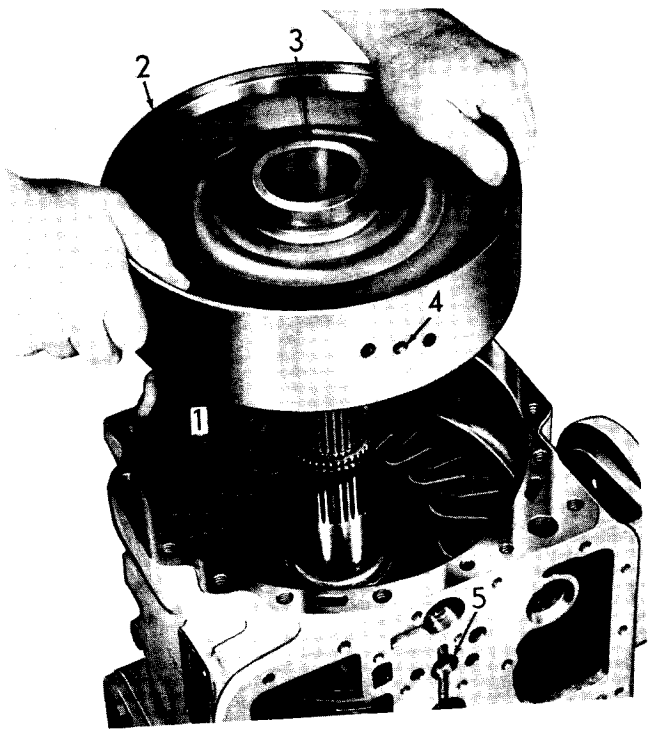
STEP 12

Install reverse-range sun gear shaft 1 and secure it in ring gear 2 with internal-snap ring 3.



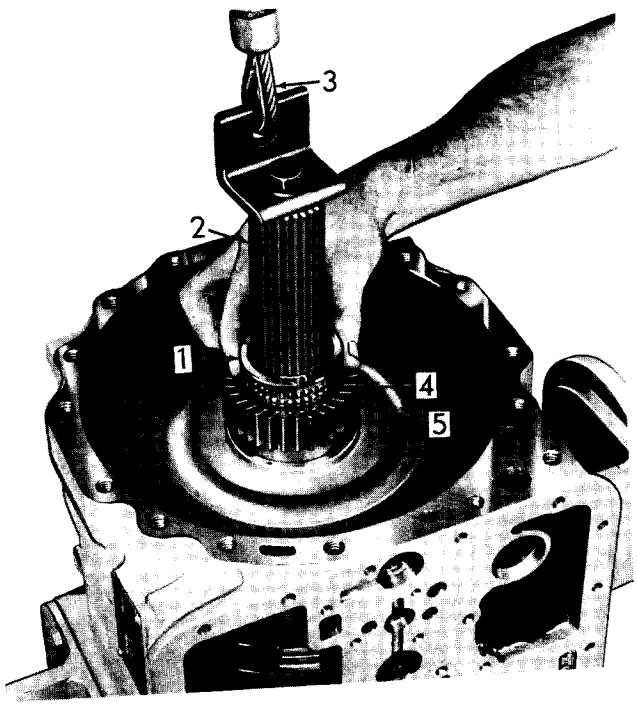
STEP 14

Install reverse-range sun gear splined thrust washer 1 and reverse-range sun gear 2 onto reverse-range sun gear shaft 3.



STEP 13

Install low-range clutch spring 1, convex side upward. Install assembled low- and reverse-piston housing 2 with long hub end 3 up. Aline anchor bolt hole 4 with hole 5.

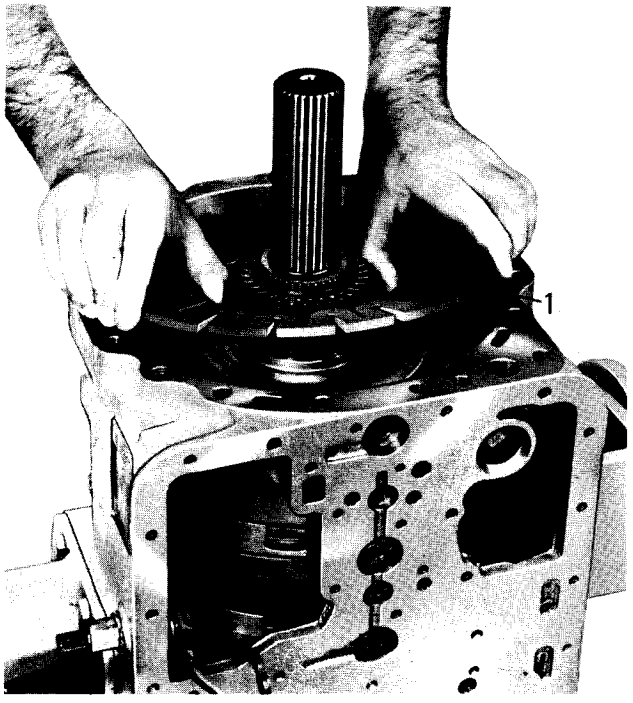


STEP 15

Place snap ring 1 over shaft 2. Then, using hoist 3, raise shafts 2 and 4 until snap ring groove in shaft 4 clears sun gear 5. Install snap ring 1. Remove hoist.

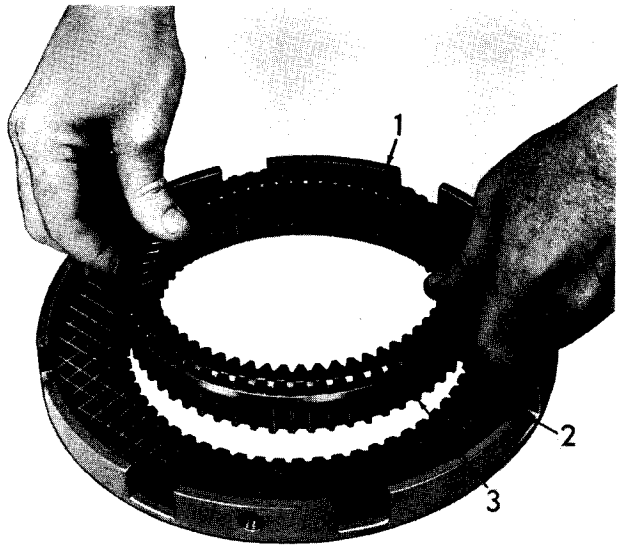
STEP 16

While holding upward on transmission output shaft 1, install snap ring 2.



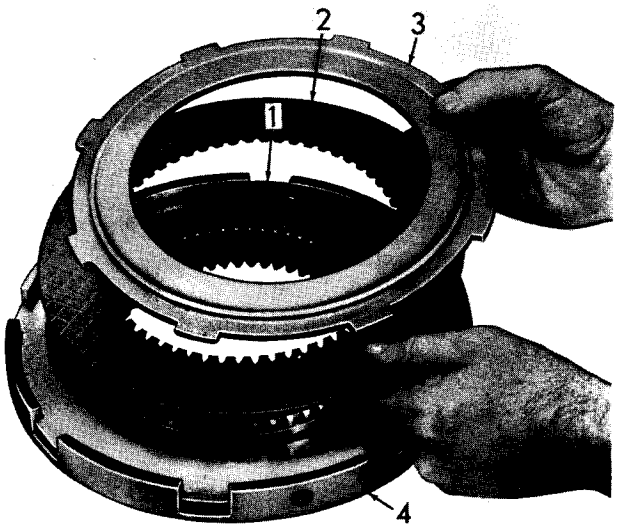
STEP 17

Install reverse-range clutch spring 1 with concave side up. Center it carefully.



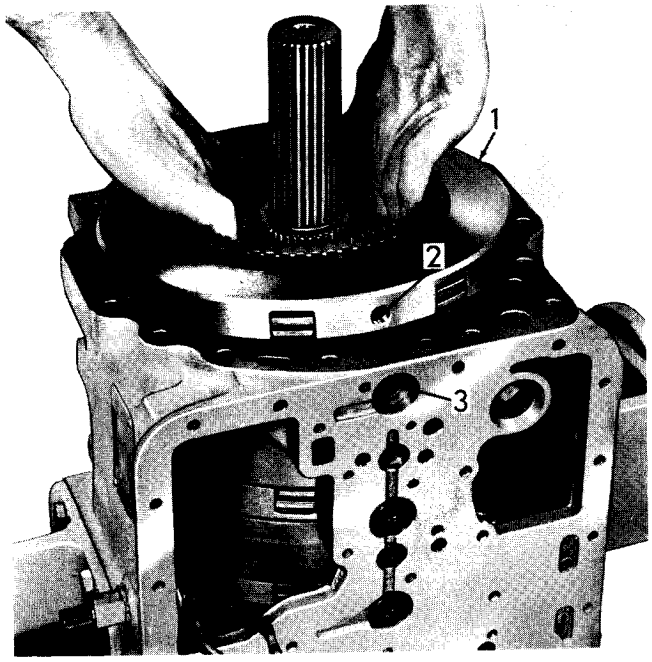
STEP 18

On models having single-plate, reverse-range clutch, install reverse-range plate and ring gear assembly (not shown), long splines downward, into reverse-range clutch reaction housing 1. On models having three-plate clutch assemblies, install a reverse-range, internal-splined clutch plate 2 and reverse-range ring gear 3, long splines downward, into reverse-range clutch reaction housing 1.



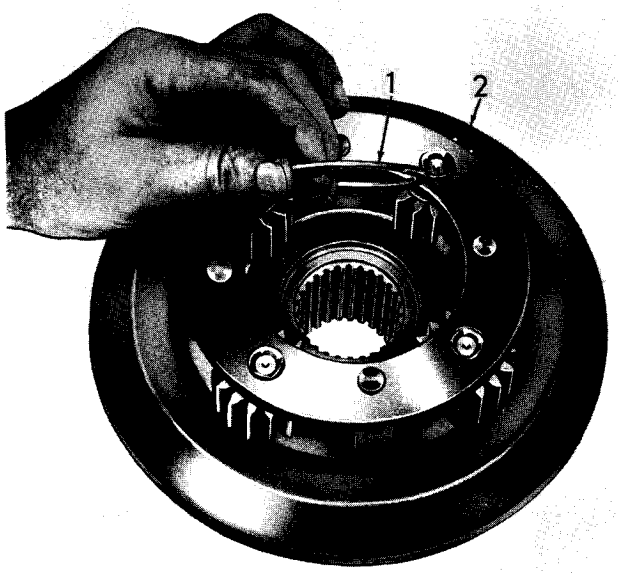
STEP 19

On three-plate clutch assemblies, install reverse-range clutch external-splined plate 1, internal-splined plate 2, and, on all models, apply plate 3 (contoured side up) into housing 4.



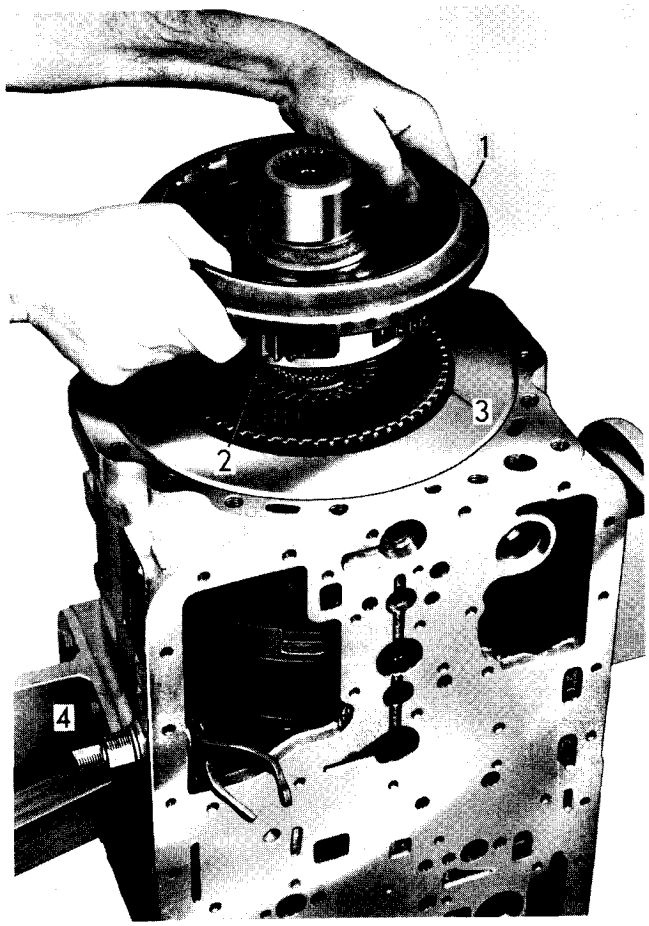
STEP 20

Grasp parts 1 (assembled in steps 18 and 19) and turn them over. Install them, alining anchor bolt hole 2 with hole 3.



STEP 21

Install thrust washer 1 into reverse-range carrier 2, retaining it with oil-soluble grease.



STEP 22

Install reverse-range planetary carrier assembly 1, meshing pinions 2 with ring gear 3. If used, (with models having three-plate, low-range clutch) remove wood block 4.

KEEP

ALL

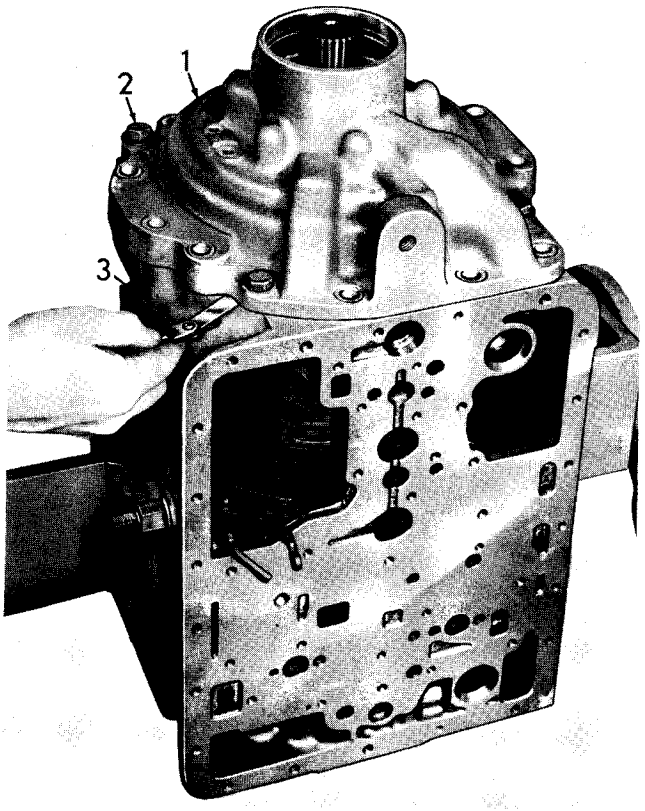
PARTS

CLEAN

WHEN

ASSEMBLING

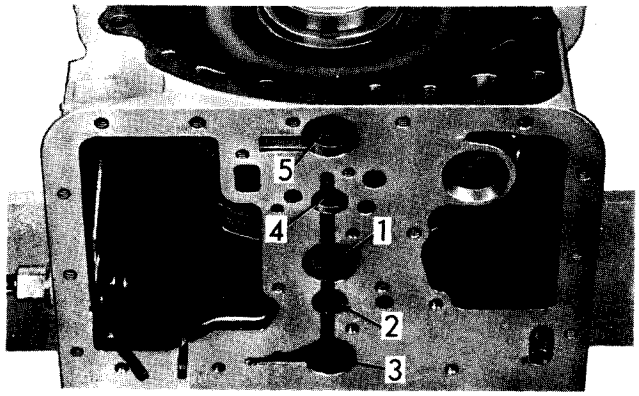
TRANSMISSION



STEP 23

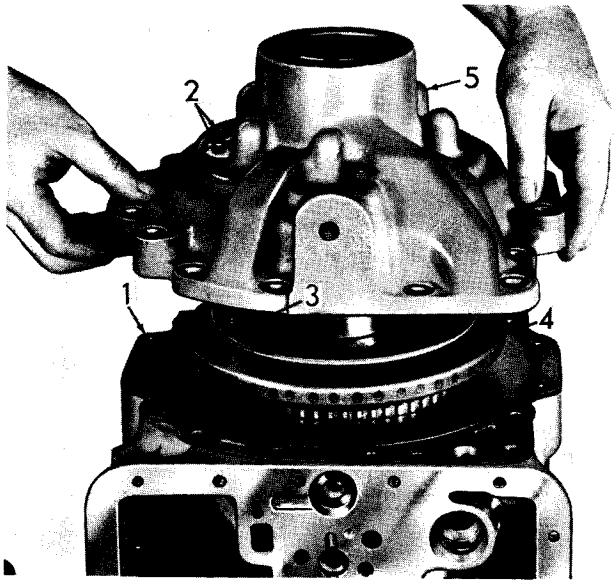
Install rear-bearing retainer 1 without a gasket. Install four bolts 2, equally spaced, and four flat steel washers. Draw them down evenly to seven pound feet torque. Use a thickness gage 3 and measure the clearance near each of the four bolts. Determine the average of these measurements. Remove bolts 2 and retainer 1. Note: The procedure in this step is necessary to select the proper rear-bearing retainer gasket. The gasket thickness controls the compression load on the clutch stack. A thin gasket increases the load; a thick gasket decreases it. Gaskets are available in 0.012, 0.016 and 0.021-inch thicknesses. If gaskets are not plainly marked, measure their thickness with a micrometer. Select gaskets as outlined below:

Clearance	Thickness
0.005-0.015 in.	0.012 in.
0.016-0.021 in.	0.016 in.
0.022-0.027 in.	0.021 in.
0.028-0.029 in.	0.012 in. and 0.016 in.



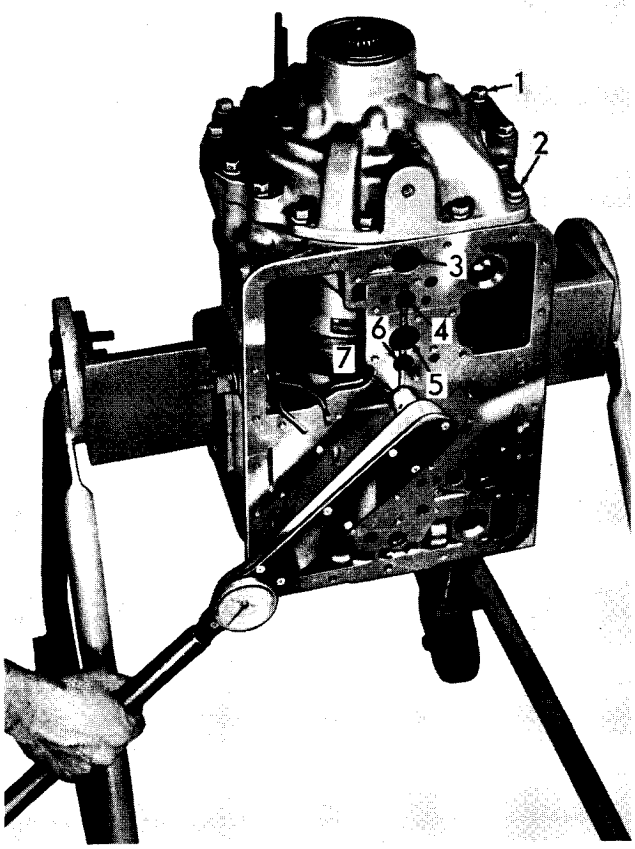
STEP 24

Tighten three anchor bolts 1, 2 and 3 to 10 pound feet torque. Check alinement of remaining two-threaded anchor bolt holes with holes 4 and 5 in the transmission housing.



STEP 25

Install proper gasket 1 as indicated in the note for step 23. Install 1/4-inch guide bolts 2 into pitot tube 3, which must be positioned with its pickup tube against governor ring 4 and pointing toward the top of the transmission. Install the assembled rear-bearing retainer 5, guiding the bolts 2 through the pitot tube bolt holes. Note: On models having rear-oil pump, guide the rear-oil pump drive lugs into engagement with the reverse-range planetary carrier. On all models, guide the speedometer drive gear into mesh with the transmission output shaft.



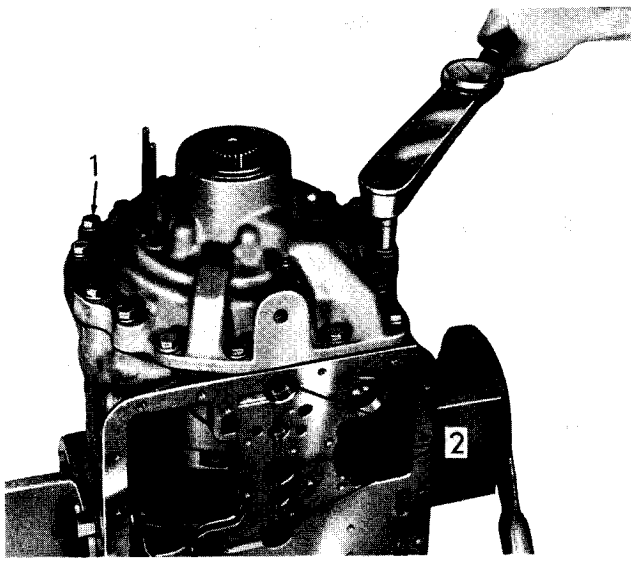
STEP 26

Install sixteen bearing retainer bolts 1 and 2 with lock washers, (except on models equipped with a contracting band brake; on such models, do not install the two bolts 1 which retain the brake bracket). While evenly tightening the above bolts, install anchor bolts 3 and 4 as soon as they will enter their threaded holes. Before the rear-bearing retainer bolts are fully drawn down, tighten all five anchor bolts 3, 4, 5, 6 and 7 to 10-pound feet torque. Note: Tightening the anchor bolts at this time is necessary to pull the reaction housings and piston housings against the transmission housing, which will firmly seal the oil passages against internal leakage.

KEEP ALL PARTS

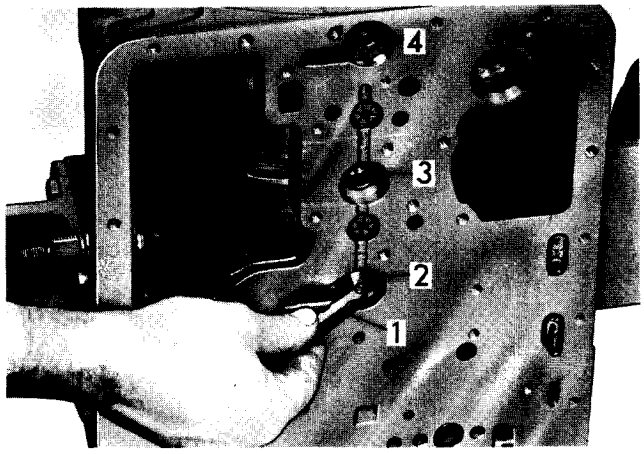
CLEAN WHEN

ASSEMBLING TRANSMISSION



STEP 27

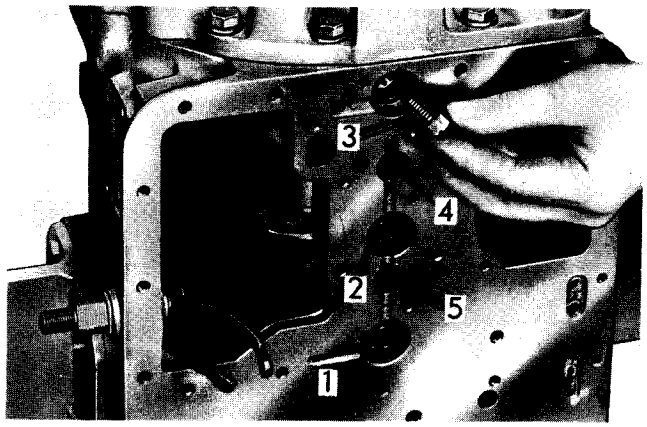
Tighten bearing retainer bolts 1 to 42 to 50 pound feet torque. When bolts 1 are tight, remove three anchor bolts from holes 2.



STEP 28

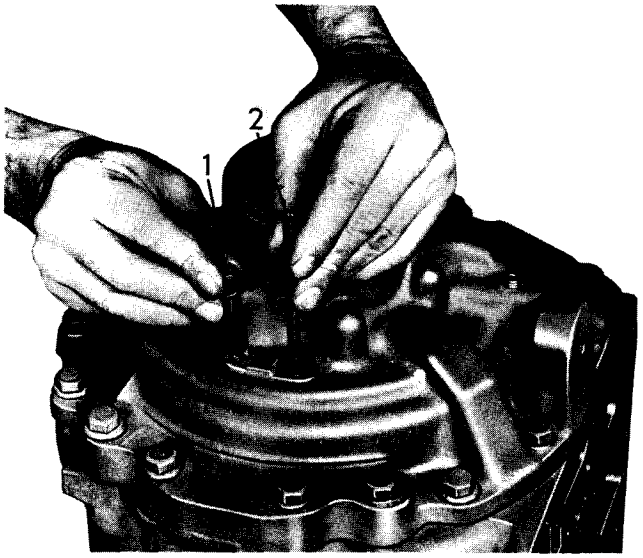
Check running clearances of the three clutches by inserting a thickness gage 1 through anchor bolt holes 2, 3 and 4. Note: Clearances should be within the following limits:

Intermediate-range clutch (hole 2)
– 0.030 to 0.040 in.
Low-range clutch (single plate) (hole 3)
– 0.010 to 0.015 in.
(three plate)
– 0.020 to 0.030 in.
Reverse-range clutch (single plate) (hole 4)
– 0.010 to 0.015 in.
(three plate)
– 0.020 to 0.030 in.



STEP 29

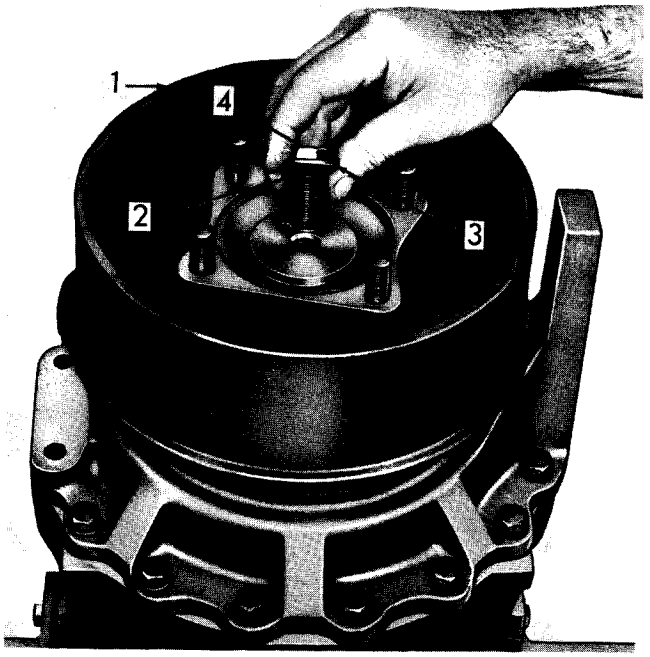
If clutch clearances are not satisfactory, refer to sect. XIV for corrective action. If clearances are satisfactory, install anchor bolts 1, 2 and 3. Tighten bolts 1, 2 and 3 to 35 to 40 pound feet torque. Tighten anchor bolts 4 and 5 to 17 to 20 pound feet torque.



STEP 30

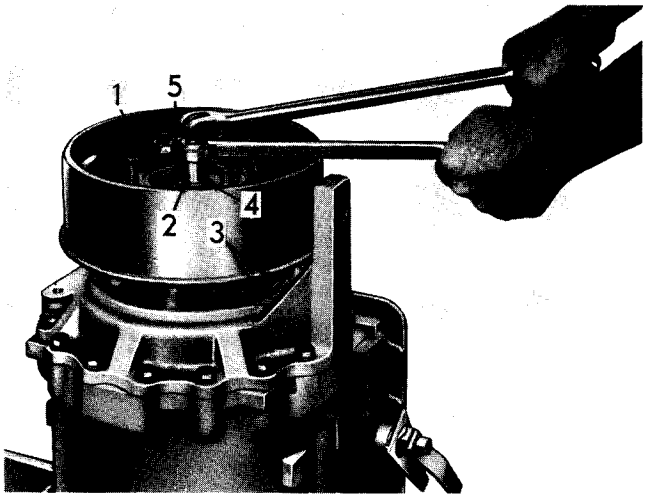
Remove one guide bolt and install a pitot tube bolt 1 (and washer when aluminum housing is used) while holding the remaining guide bolt 2 firmly upward. Then remove guide bolt 2 and install the remaining pitot tube bolt (and washer, if used). Leave both bolts loose (approximately two turns).

Note: On models using the contracting band-type brake, follow steps 31 through 34, below.



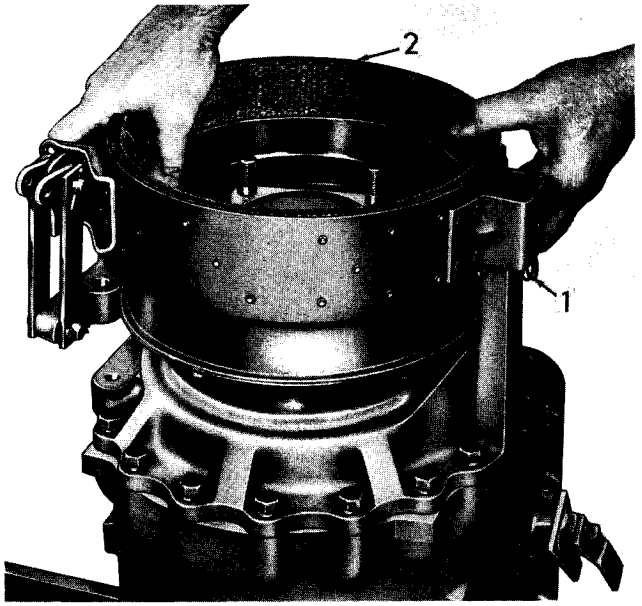
STEP 31

Install output flange and drum assembly 1. Install seal ring 2, tab washer 3 and bolt 4.



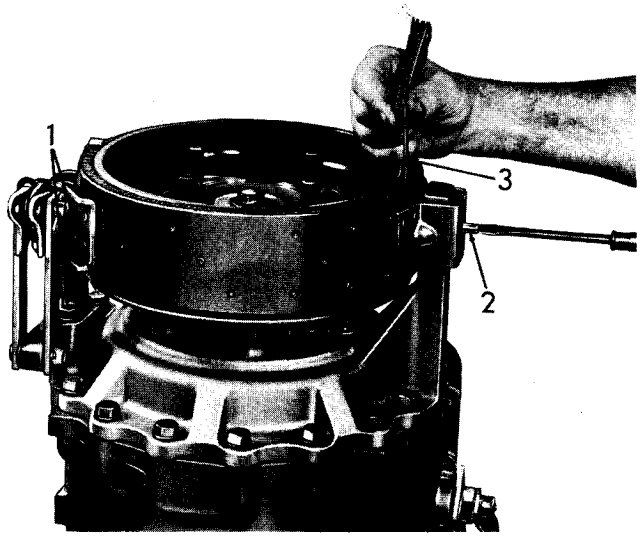
STEP 32

Lock output flange 1 and tighten bolt 2 to 83 to 100 pound feet torque. Tighten pitot tube bolts 3 to 8 to 10 pound feet torque. Indent tab washer 4 into hole in flange washer 5. Bend the tab washer against head of bolt 2. Caution: Do not allow transmission output to rotate until flange bolt 2 and pitot tube bolts 3 are tight. Damage to the rear governor may result from rotation.



STEP 33

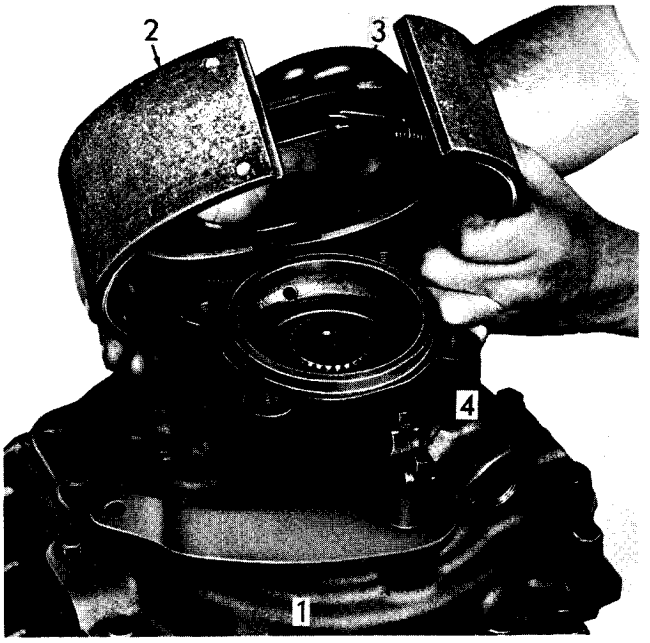
Install spring 1 and brake band assembly 2.



STEP 34

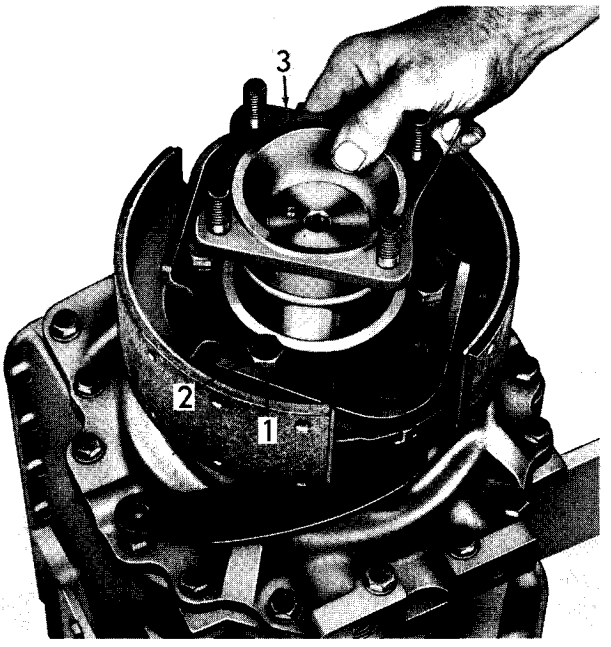
Install two bolts and lock washers 1. Tighten bolts to 42 to 50 pound feet torque. Install screw 2. Insert a 0.015-inch thickness gage 3 between the brake band and drum. Adjust screw 2 until gage 3 binds slightly. Install a lock wire to retain screw 2. Refer to sect. II for further brake adjustment instructions.

Note: On models using the 9 x 3-inch expanding shoe-type brake, follow steps 35 through 37, below.



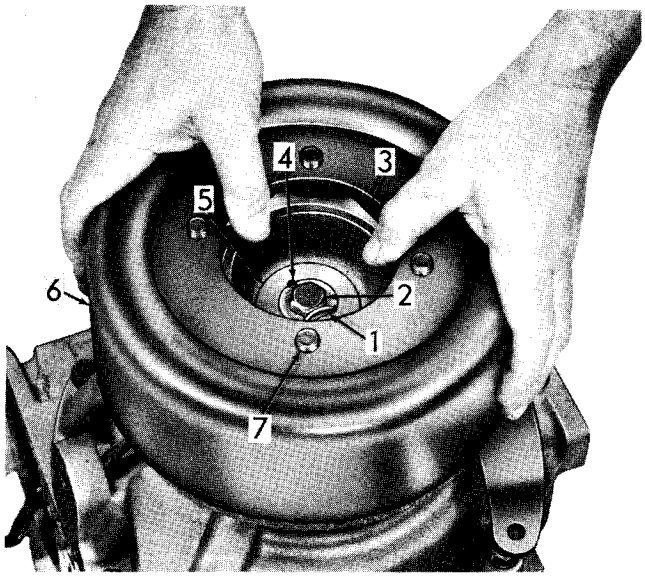
STEP 35

Install brake apply lever 1 and brake assembly 2. Be sure that slot 3 engages tangs 4 on apply lever 1.



STEP 36

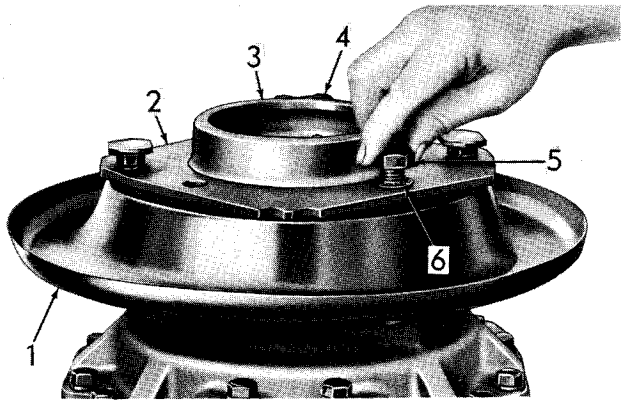
Install four 1/2-13 x 1 1/8 bolts 1 and lock washers 2. Tighten them to 67 to 80 pound feet torque. Install flange assembly 3, tapping it down until it seats in the transmission rear bearing.



STEP 37

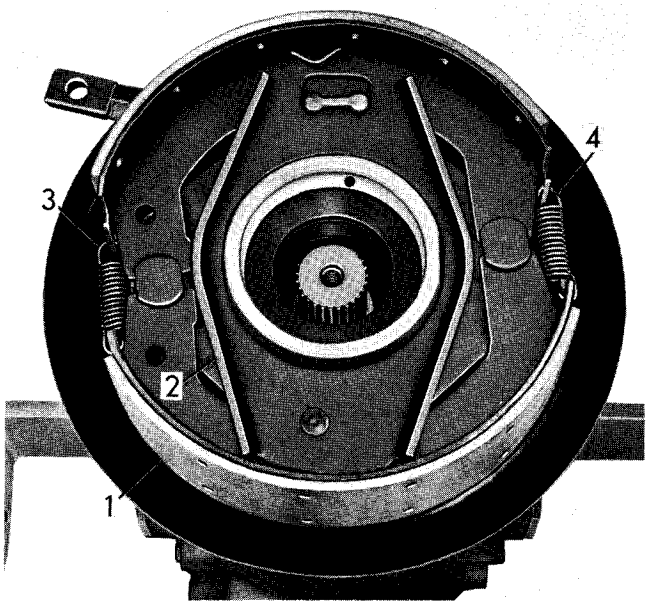
Install a seal ring (item 29, foldout 7), tab lock washer 1 and bolt 2. Hold flange 3 against rotation and tighten bolt 2 to 83 to 100 pound feet torque. Tighten pitot tube bolts (refer to step 32, above). Bend washer 1 against head of bolt 2. Indent washer 1 into hole 4 in retainer 5. Install brake drum 6. Install a 1/2-20 nut onto bolt 7 to temporarily retain the brake drum.

Note: On models using the 12 x 4-inch expanding shoe-type brake, follow steps 38 through 42, below.



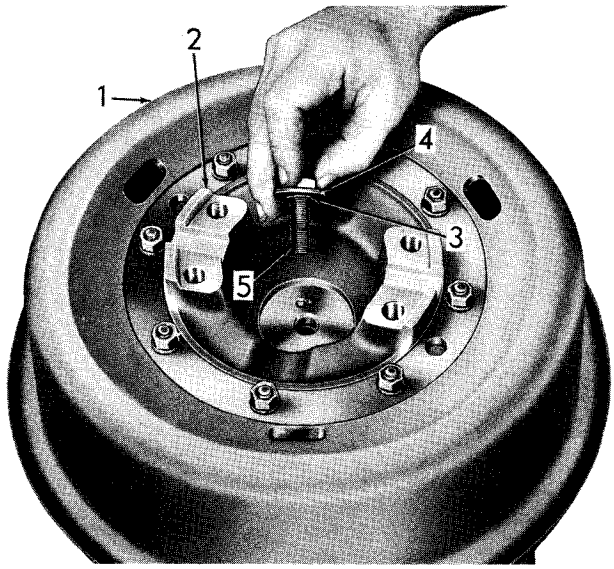
STEP 38

Install shield 1 onto brake back plate 2. Install shield and back plate onto rear bearing retainer 3. Note: Brake apply lever 4 is toward the bottom of the transmission. Install four 5/8-11 x 1 3/8-inch bolts 5 and lock washers 6. Tighten the bolts to 117 to 140 pound feet torque.



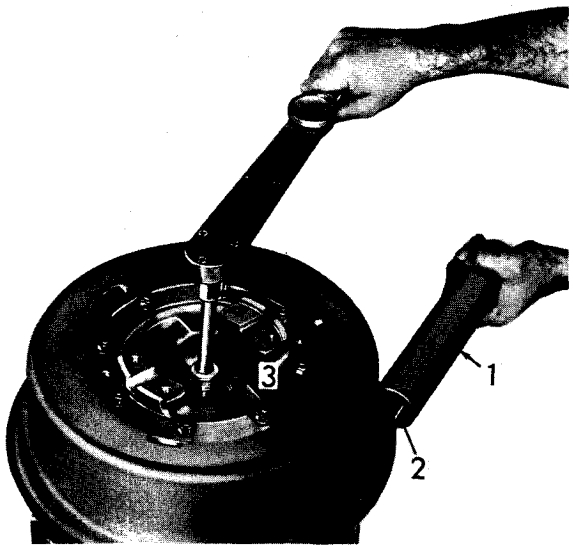
STEP 39

Install brake shoes 1, plate 2, spring 3 and spring 4. Note that one spring 3 is below the web of shoes 1 while the other, 4, is above the shoe web.



STEP 40

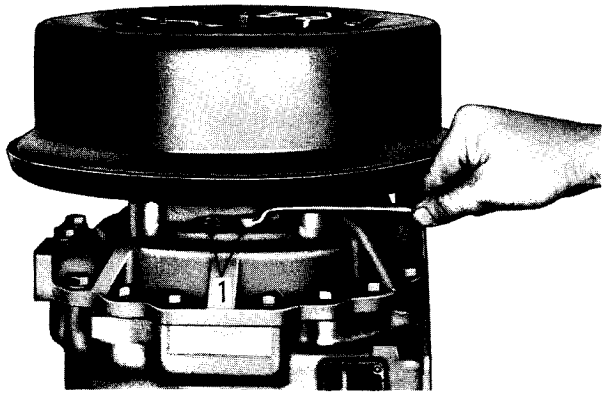
Assemble brake drum 1 to output flange 2. Note: Some models have the brake drum ahead of the output flange and the flange and drum are assembled by pressing the output flange bolts into the drum and flange, from the inner side of the drum. Install the drum and flange. Install seal ring 3, tab lock washer 4 and bolt 5.



STEP 41

Apply the brake firmly by using a pipe 1 over lever 2. Tighten bolt 3 to 83 to 100 pound feet torque. Bend the tab lock washer against the head of bolt 3 and indent the edge of the washer into the hole in the flange retainer.

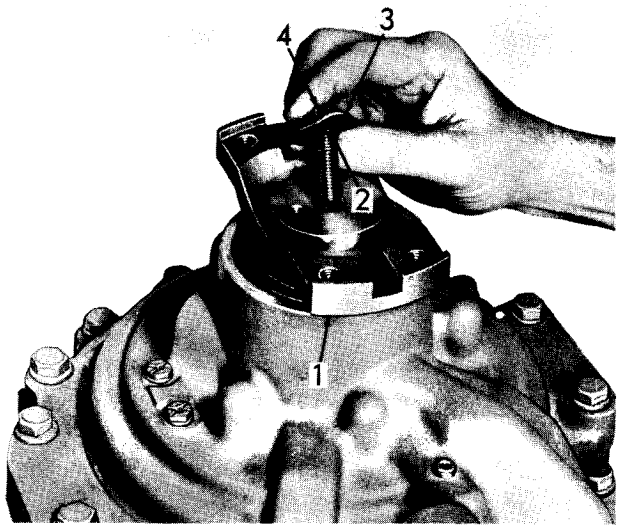
Caution: Do not allow the output flange to rotate until the pitot tube bolts are tight (see STEP 42, below).



STEP 42

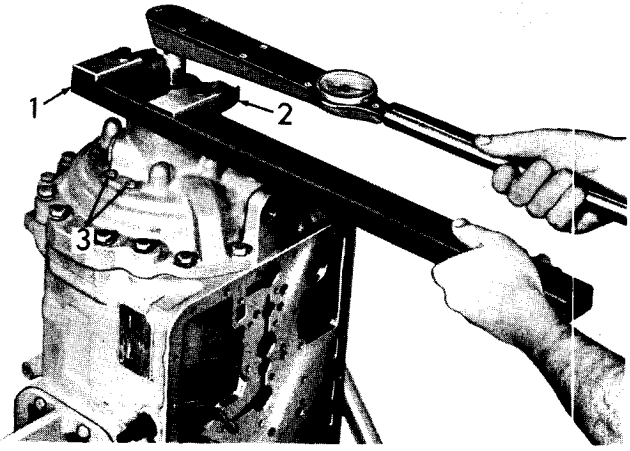
Tighten pitot tube bolts 1 to 8 to 10-pound feet torque.

Note: On models which do not use a parking brake, or which use a brake drum only as a spacer, follow steps 43 and 44, below.



STEP 43

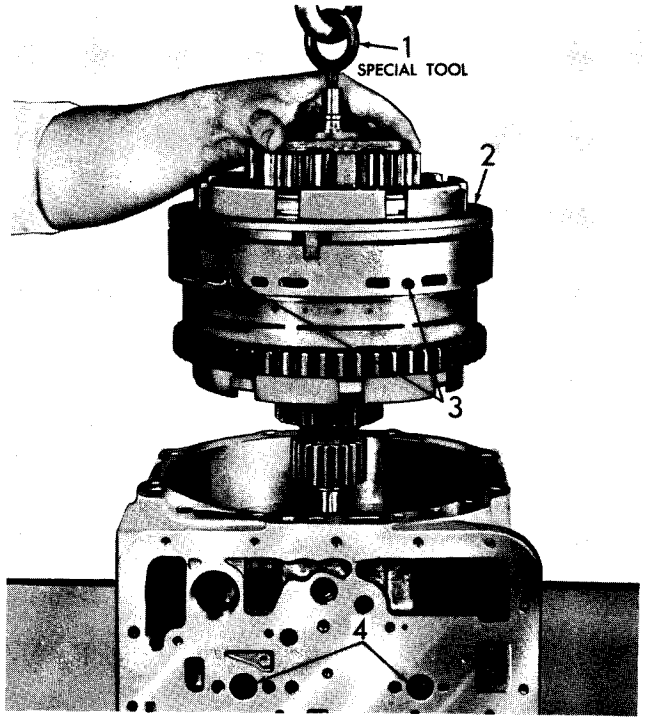
Install flange 1 (and drum, if used), tapping it down until it seats in the transmission rear bearing. Install seal ring 2, tab lock washer 3 and bolt 4.



STEP 44

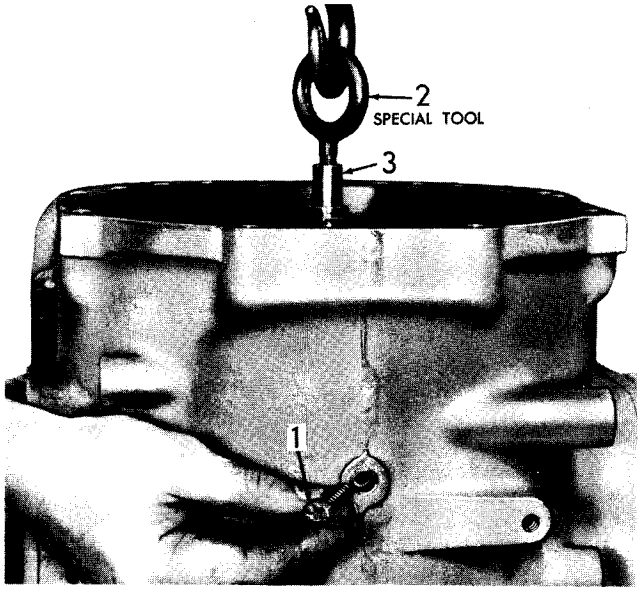
Using tool 1 to prevent rotation of flange 2, tighten the flange bolt to 83 to 100 pound feet. Tighten pitot tube bolts 3 to 8 to 10 pound feet. Indent the tab lock washer into the hole in the flange retainer. Bend the tab lock washer against the head of the flange-retaining bolt.

Caution: Do not allow the output flange to rotate until the flange bolt and pitot tube bolts 3 are tight. Damage to the rear governor may result from rotation.



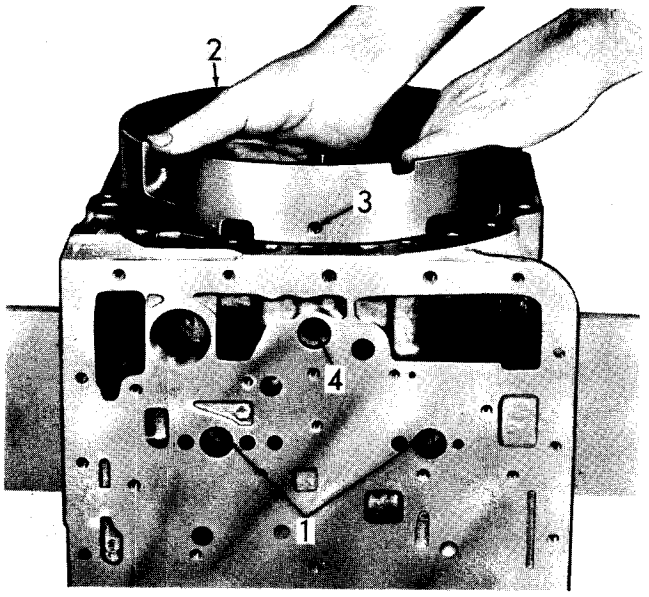
STEP 45

Rotate transmission converter end up. Using lifting eye 1 and hoist, lower the assembled splitter and high-range clutch assembly 2 carefully into the transmission housing. Work slowly and carefully until holes 3 aline with holes 4.



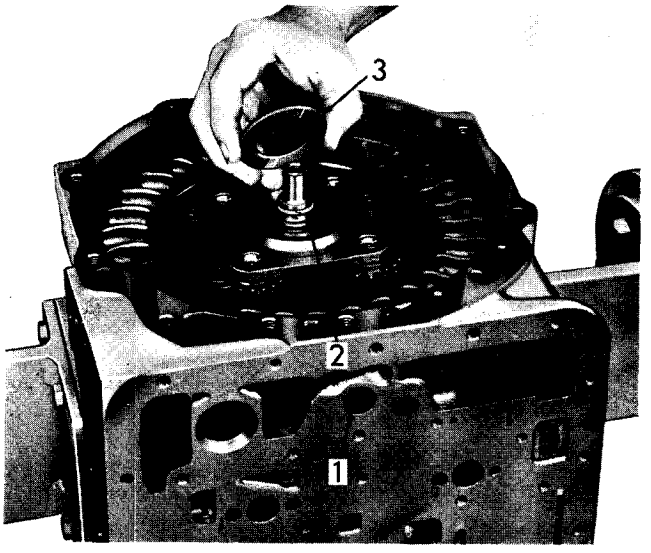
STEP 46

Install high-range clutch diaphragm bolt 1 loosely. Remove hoist and lifting eye 2 from splitter output shaft 3.



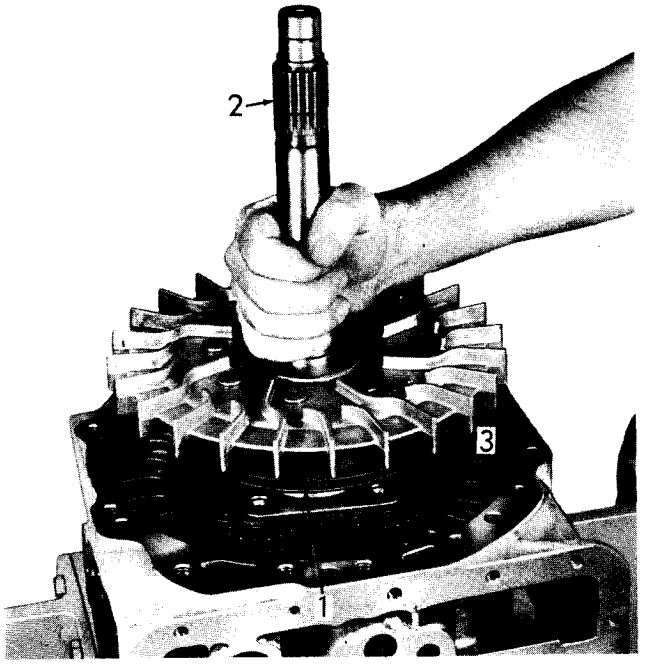
STEP 47

Install two high-range clutch diaphragm anchor bolts 1. Tighten them to 17 to 20 pound feet torque. Install low splitter clutch reaction plate 2, alining hole 3 with hole 4.



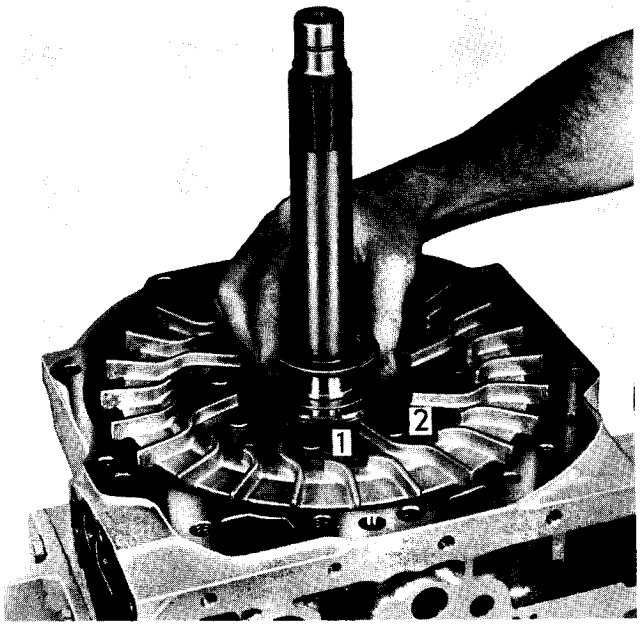
STEP 48

Install low splitter clutch reaction plate anchor bolt 1 and tighten it to 17 to 20 pound feet torque. Tighten the remaining diaphragm anchor bolt (other side of housing) to 17 to 20 pound feet torque. Install hook-type seal ring 2 and thrust washer 3. Caution: Failure to tighten anchor bolts in the order prescribed can result in internal oil leakage and malfunction of the transmission.



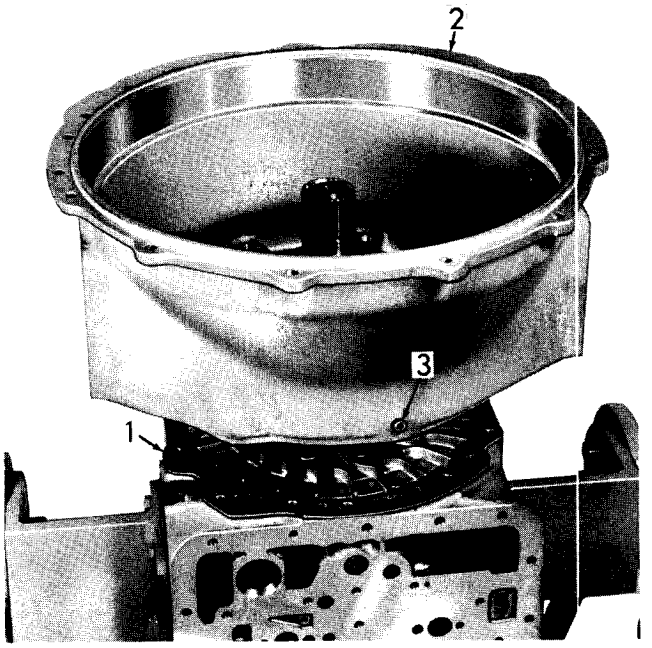
STEP 49

Check to be sure that hook-type seal ring 1 is installed (during rebuild) and install shaft and rotor assembly 2. Rotate it to mesh its internal teeth with pinions 3.



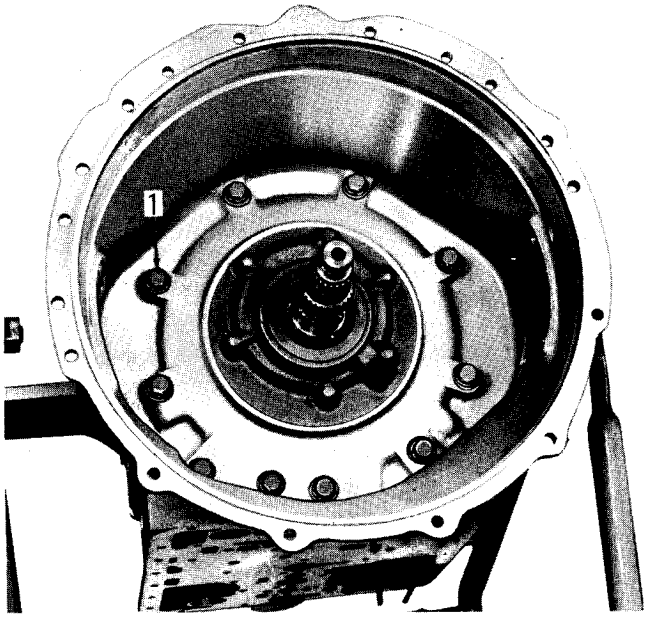
STEP 50

Install needle roller bearing race 1 and needle bearing assembly 2. Be sure rollers in assembly 2 are downward.



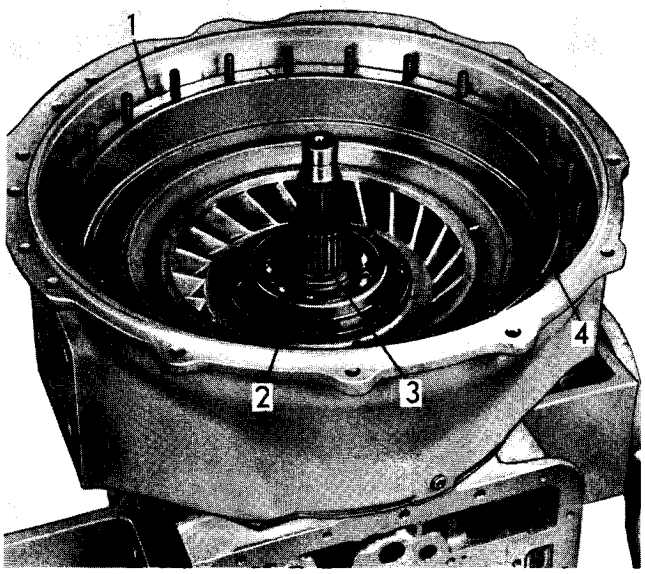
STEP 51

Install converter housing gasket 1 and converter housing 2. Note that plug 3 is at the bottom position of the transmission.



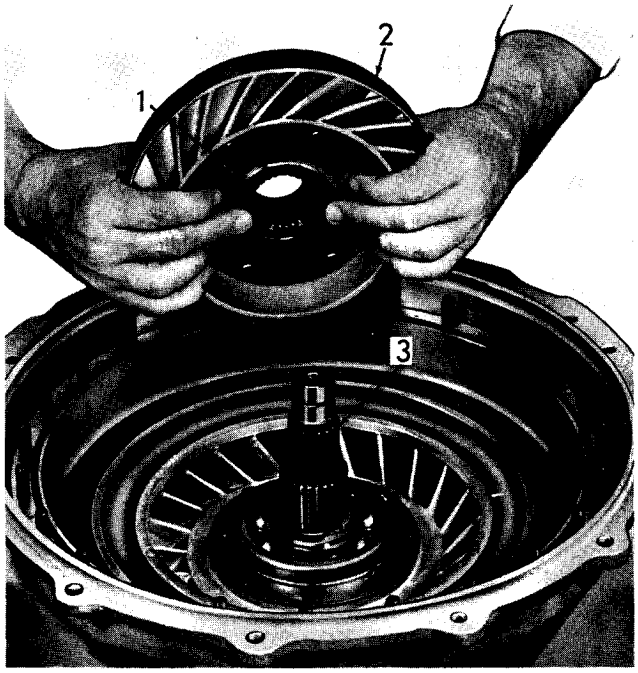
STEP 52

Install a lock washer (and on aluminum converter housing models a flat washer also) on each of bolts 1. Install the bolts and tighten them to 42 to 50 pound feet torque.



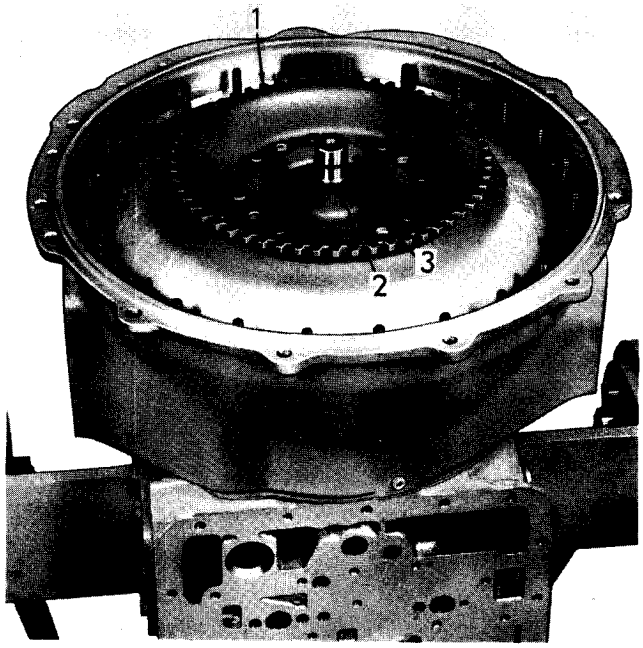
STEP 53

Install the assembled converter pump 1, spacer 2 and snap ring 3. Install large seal ring 4 in groove of pump 1.



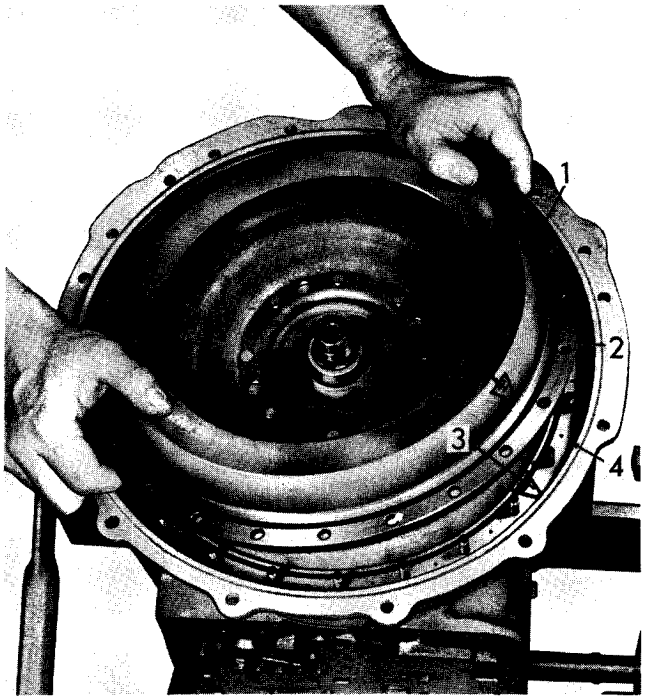
STEP 54

To prevent dropping it, hold freewheel roller race 1 while installing stator assembly 2. Install the assembled parts onto converter ground sleeve 3. Check to insure that stator 2 freewheels in clockwise rotation and locks in counterclockwise rotation.



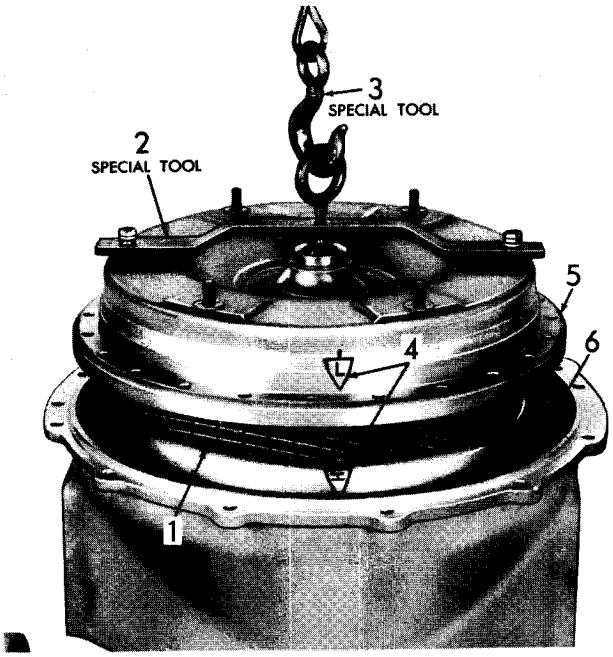
STEP 55

Install converter turbine assembly 1, snap ring 2 and hook-type seal ring 3.



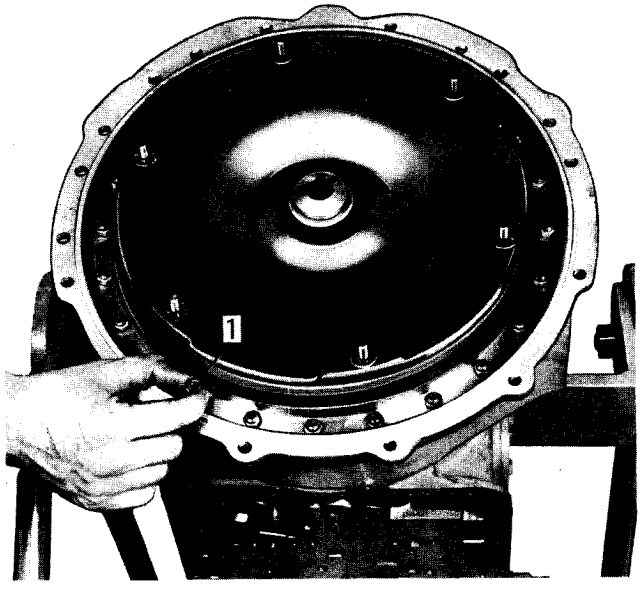
STEP 56

Install seal ring 1 into groove in lockup clutch back plate 2. Aline balance marks 3 and install back plate 2 onto converter pump 4.



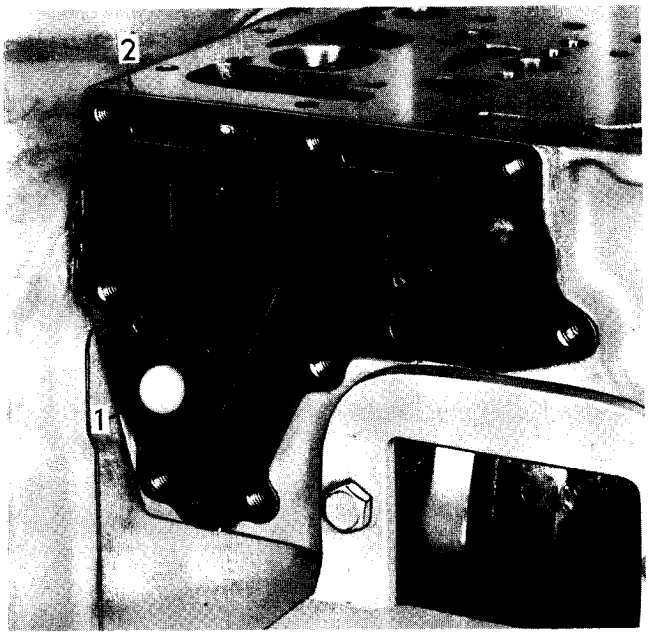
STEP 57

Install lockup clutch plate 1. Using lifting strap 2 and lifting eye 3, aline balance marks 4 and install converter pump cover assembly 5 onto pump 6.



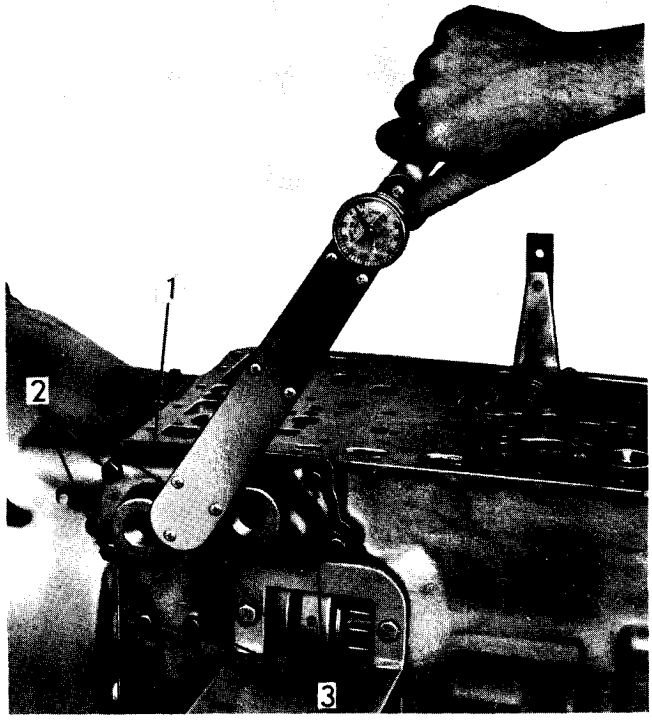
STEP 58

Install 24 lock nuts 1. Tighten four nuts, installed at 90 degree intervals, alternately and evenly to 10 pound feet torque to seat the cover evenly on its seal ring. Then tighten all nuts to 19 to 23 pound feet torque.



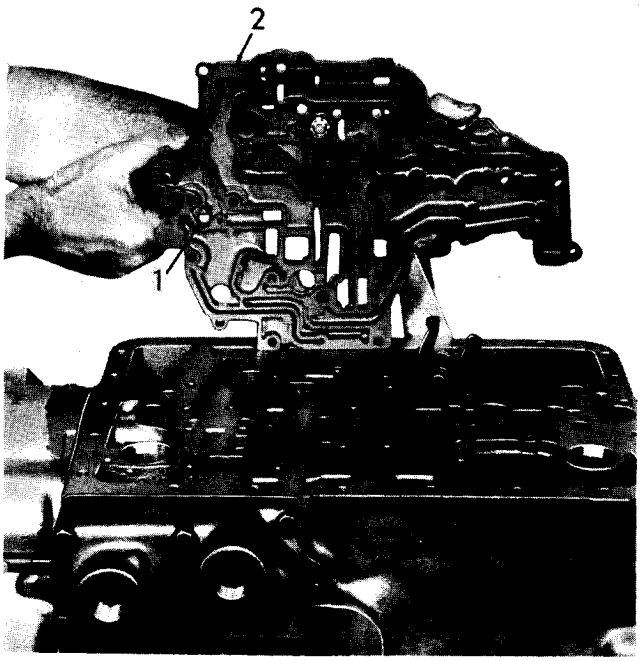
STEP 59

Rotate transmission bottom up. Install 5/8-inch ball 1 and hydraulic retarder valve body gasket 2. Retain both with oil-soluble grease.



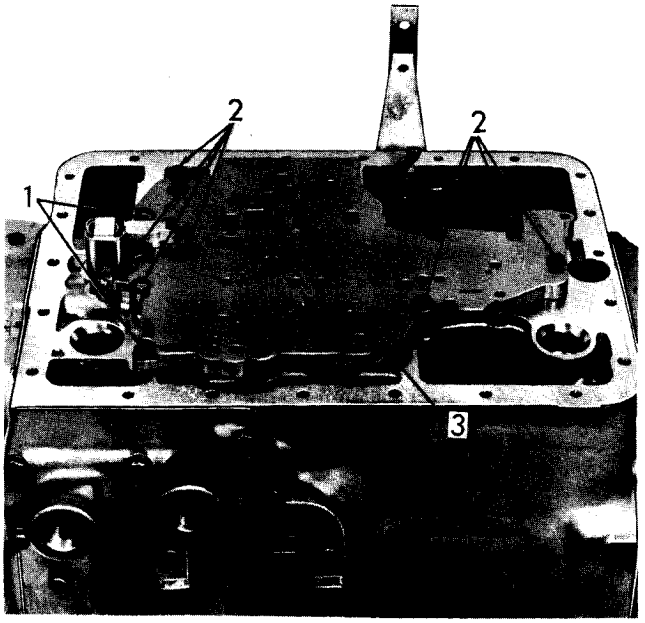
STEP 60

Install valve body 1. Install three long 2 and five short bolts 3.



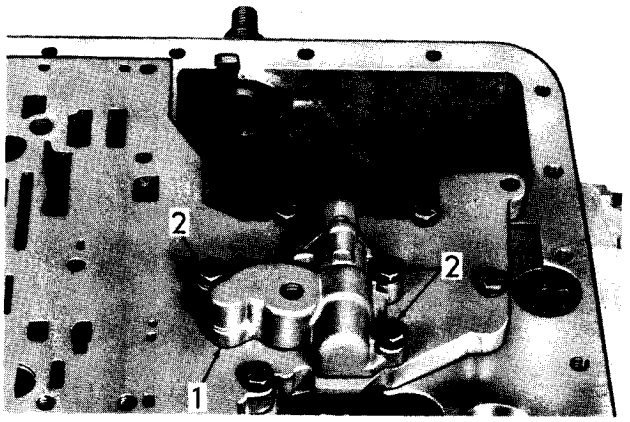
STEP 61

Install 3/8-inch nylon ball 1 in oil transfer plate 2, using oil-soluble grease to retain ball. Install plate 2.



STEP 62

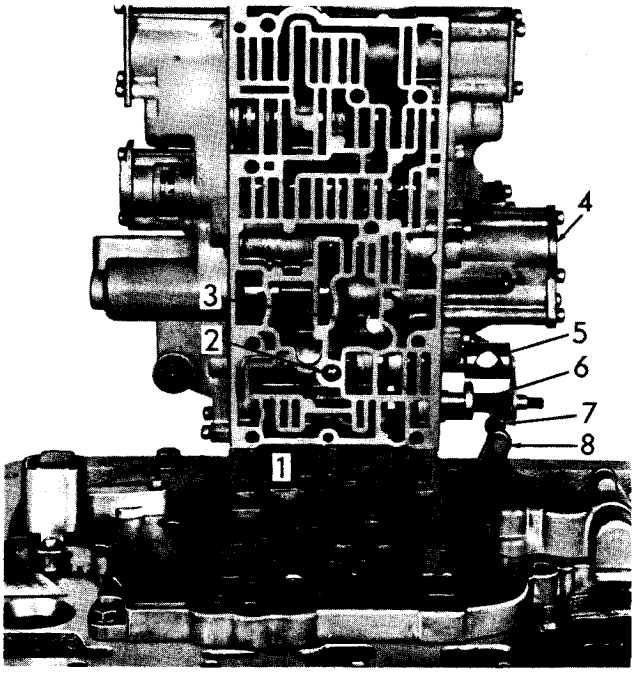
Install two 3/4-inch long bolts 1 and eight 7/8-inch bolts 2 with ten lock washers to retain oil transfer plate 3. Tighten bolts to 8 to 10 pound feet torque.



STEP 63

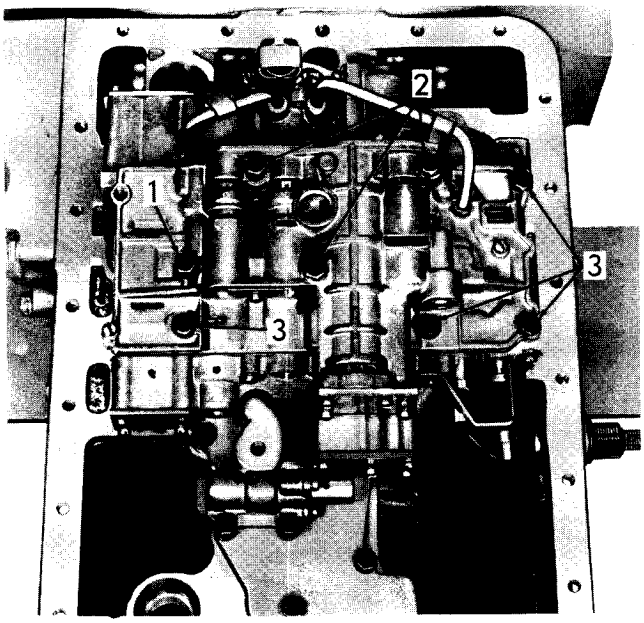
Install downshift timing valve body assembly 1. Install three short bolts 2 with lock washers. Tighten bolts to 8 to 10 pound feet torque.

Caution: Particular care should be taken to keep the valve body, oil filter components and other components of the hydraulic system clean during assembly. Check for evidence of dirt or foreign matter during assembly.



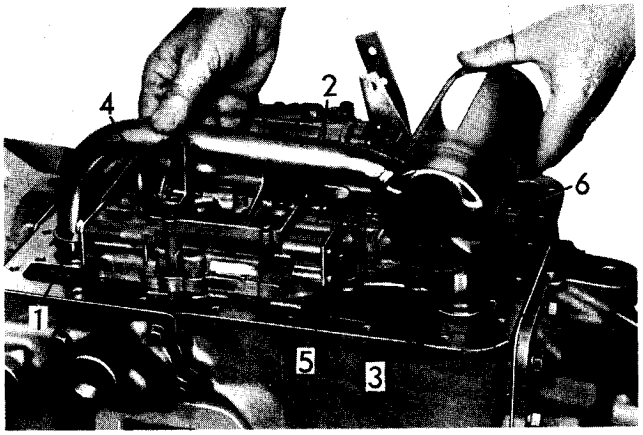
STEP 64

Install detent spring 1, 3/8-inch steel ball 2 and 1/2-inch nylon ball 3. Use oil-soluble grease to retain balls. Install control valve body assembly 4. Note that throttle lever 7 must be located at 6, and selector lever 8 must index with valve 5, when valve body 4 is installed.



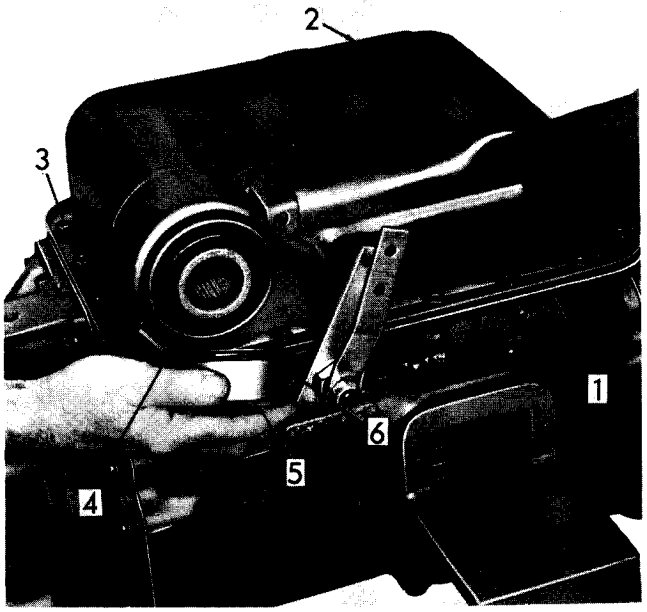
STEP 65

Install one 3-1/4-inch bolt 1, three 3-3/4-inch bolts 2 and four 2-3/4-inch bolts 3. Bolts 2 must have lock washers and spacer sleeves installed before bolts are installed; bolts 1 and 3 have only lock washers. Tighten bolts to 4 to 6 pound feet torque.



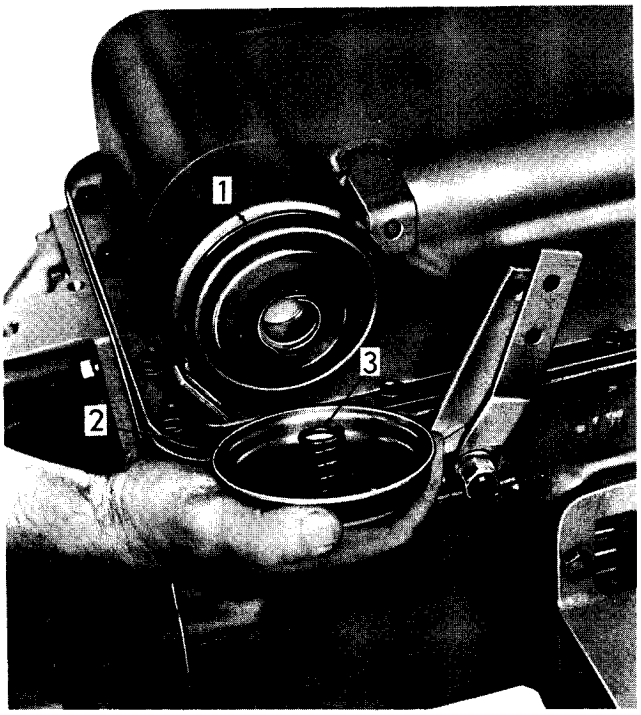
STEP 66

Install seal ring 1 onto long tube end of oil filter can 2 on models without rear-oil pump. On models with rear pump, install a second seal ring 1 on short tube 3 of oil filter can 2. Install oil filter can 2 over the control valve body. Install a 1/4-20 x 3 bolt at 4, a 1/4-20 x 2 bolt at 5, and a 1/4-20 x 1-1/8 bolt at 6. Tighten bolt 4 to 4 to 6 pound feet torque; tighten bolts 5 and 6 to 8 to 10 pound feet torque.



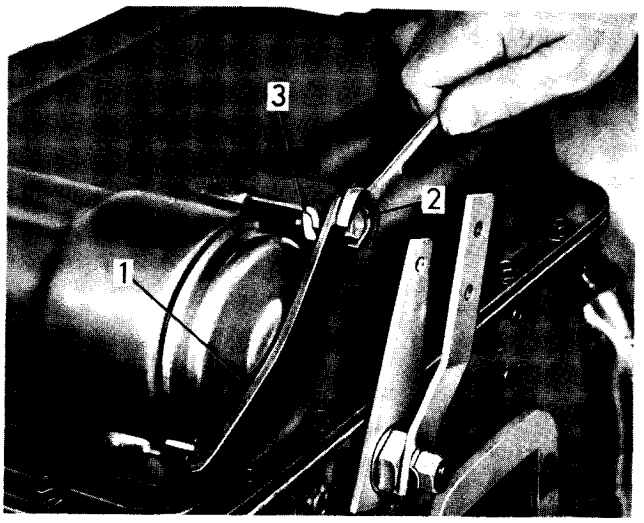
STEP 67

Install oil pan gasket 1 and oil pan 2. Install bolts 3 and tighten them to 8 to 10 pound feet torque. Install oil filter 4, retainer 5 and seal ring 6.



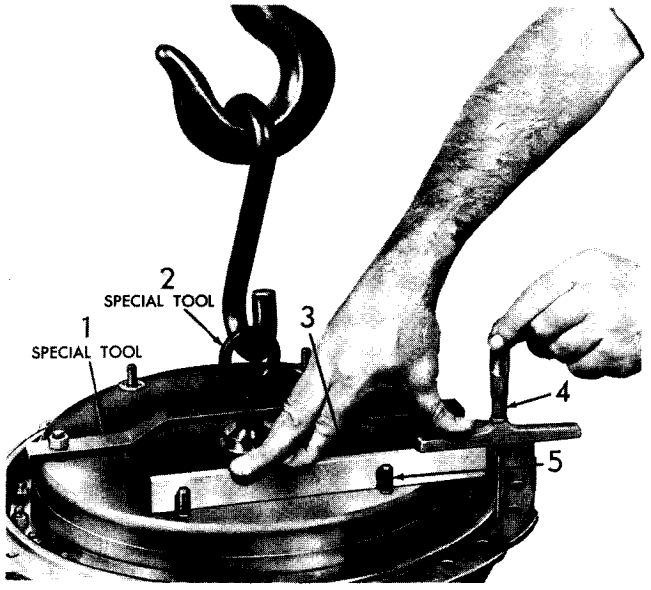
STEP 68

Install seal ring 1, cover 2 and spring 3.



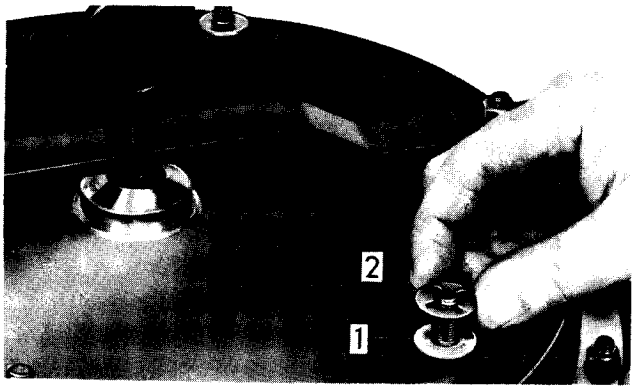
STEP 69

Install strap 1, bolt 2 and nut 3. Tighten bolt 2 to 17 to 20 pound feet torque.



STEP 70

Rotate transmission, converter up, in overhaul stand. Using strap 1 and lifting eye 2, attach a hoist and lift the converter section upward. Only enough lifting force should be used to remove end play. Using a straight edge 3 and depth micrometer 4, measure to the transmission-to-engine mounting face. Record this dimension. Measure the height of straight edge 3 and subtract this dimension from the larger dimension recorded. Subtract the resulting figure from 1.566 inches. The remainder is the thickness of the shim pack required at stud 5.

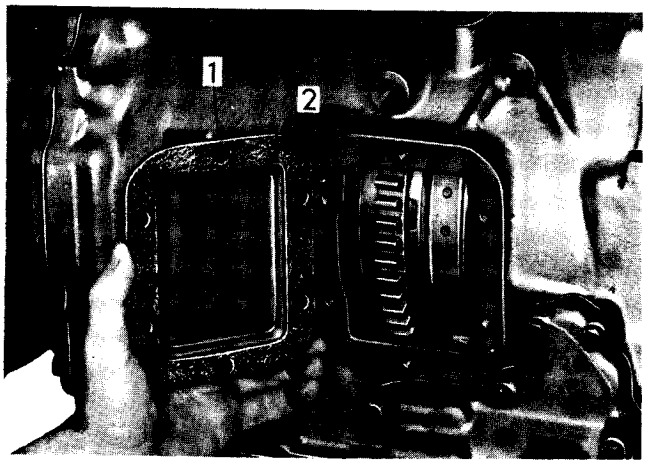


STEP 71

Select the proper combination of stack control spacers to most nearly equal the thickness of shim pack required. Install stack control washers 1 and retainer 2. Repeat the procedures in Step 70 and this step for the remaining five input drive studs.

Note: Stack control spacers are available in the following thicknesses and color codes.

0.027-0.029 – Gold
0.045-0.047 – Silver
0.063-0.065 – Copper
0.081-0.083 – Black
0.099-0.101 – Plain



STEP 72

Remove the transmission from the overhaul stand. Install gasket 1 and power takeoff cover 2 at each side of the transmission housing. Retain them with twelve 3/8-16 x 3/4-inch bolts (six for each cover) tightened to 26 to 32 pound feet torque.

Service Information Notes

Section XVI TESTS AND ADJUSTMENTS

1. GENERAL

Tests described in this section will determine if the functional operation of a transmission is satisfactory. The operation of the clutches, oil pump, torque converter, hydraulic system and gearing is tested. The tests may be performed in the vehicle (or on a properly equipped test stand). Adjustments of transmission components must be correct when tests are made, or corrected during tests.

2. TEST EQUIPMENT

a. A tachometer to determine transmission input rpm is required.

b. A tachometer indicating forward and reverse rpm of the transmission output shaft is required.

c. A bulb-type temperature indicator which will read to 400° F is required, with the fittings needed to install the bulb in the oil line carrying oil to the oil cooler.

d. A spring is required to hold the carburetor throttle valve in the closed position while the accelerator linkage is disconnected from the carburetor.

e. Two pressure gages reading to 100 psi are required for checking front-governor G1 pressure and rear governor G2 pressure. These gages must include flexible lines which can be connected into 1/8-27 NPT openings.

f. Two pressure gages reading to 300 psi are required for checking main pump pressures and lockup pressure. These gages require flexible lines and must connect into 1/8-27 NPT openings.

g. Two pressure gages reading to 50 psi are required for checking lubrication and cooler-in pressures.

3. OIL PRESSURE READINGS

Use oil pressures listed in Sect. I, as normal values in testing the transmission.

> Note: Certain pressures have a wide range because several factors influence them. These factors are speed, gear engaged, lockup or converter operation, and position of transmission throttle lever. All pressures are based on normal (160°-180°F) transmission operating temperature.

4. TESTS

a. Warm-up

(1) With the manual selector lever in neutral (N), start the engine and run it until the transmission reaches normal (160°-180°F) temperature. Shift through all gears to charge the system.

(2) It may be necessary, at times, to shift to 3-6 range and run the engine at 1200 to 1500 rpm while applying the vehicle brakes, to warm the transmission.

> Caution: Do not allow the converter-out temperature to exceed 300° F.

(3) Check the transmission and external lines for leakage.

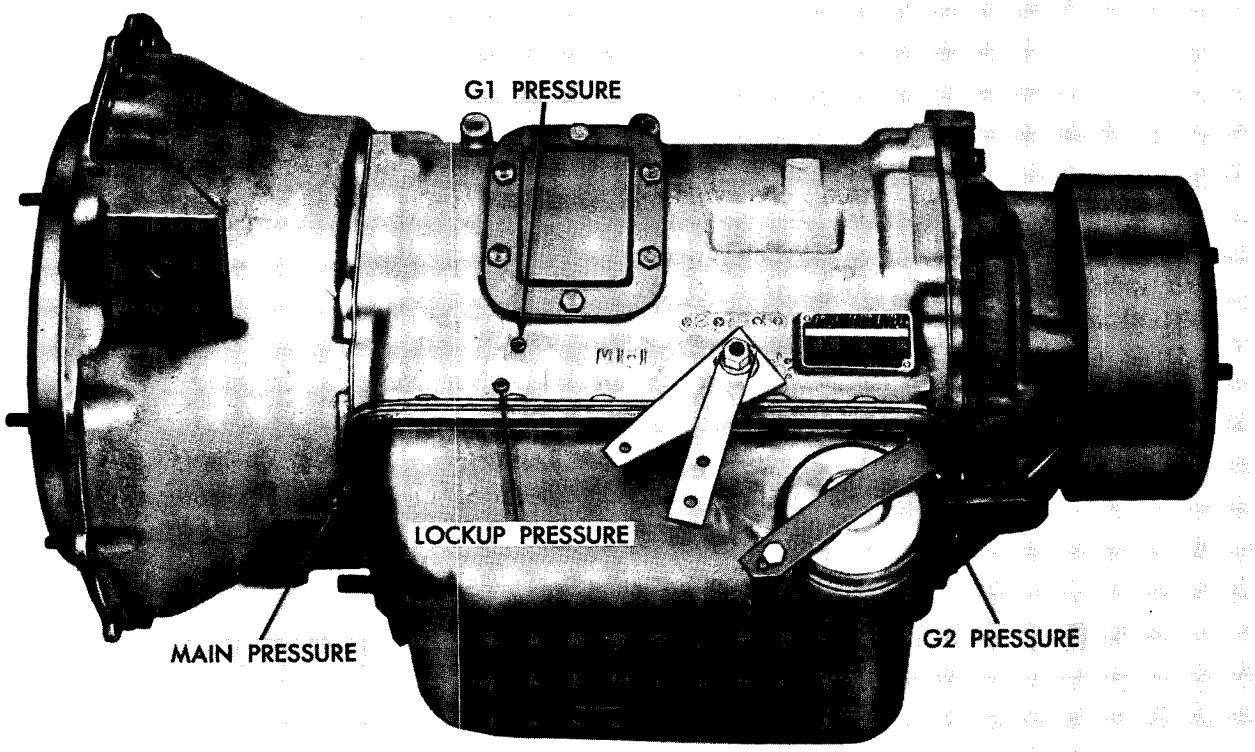


Fig. XVI-1 Oil pressure check points

b. Oil Pressure

Note: Do not attempt to connect or disconnect gages while engine is running.

(1) There are four pressure check points on the transmission left side (fig. XVI-1). Remove the 1/8-inch pipe plugs and attach gages as follows:

Main pressure check point –
0 to 300 psi gage
Lockup check point –
0 to 300 psi gage
Front-governor (G1) pressure
check point – 0 to 100 psi gage
Rear-governor (G2) pressure
check point – 0 to 100 psi gage

(2) For lube pressure, use pipe T connection and connect 0-50 psi pressure gage into rear opening of retarder control valve on right side of transmission. For both cooler-in pressure and temperature, use pipe T connections and connect 0-50 psi pressure gage and 0-400° F temperature gage to front opening of retarder control valve.

(3) Start the engine and check the idle speed. Idle speed must be correct (refer to sect. II).

(4) Check main pressure at engine idle speed.

Note: Refer to sect. I for hydraulic pressure schedule.

(5) With the manual selector lever in neutral, accelerate the engine to 1500 rpm transmission input speed and note the lubrication pressure.

c. Torque Converter Stall

Caution: When conducting a converter stall test, the vehicle must be positively prevented from moving. Both the parking and service brakes must be applied and, if necessary, the vehicle should be blocked to prevent movement forward or in reverse. Do not maintain the stalled condition longer than 30 seconds due to rapid heating of the transmission oil. With the transmission in neutral, run the engine at 1200 to 1500 rpm for two minutes to cool the oil between tests. Do not allow the converter-out temperature to exceed 380° F. Keep close check to prevent the engine cooling system from overheating.

(1) A torque converter stall test is performed by locking the transmission output, putting the transmission in gear, accelerating the engine to full throttle, and noting the maximum rpm the engine will attain. The speed attained is then compared to the speed specified by the vehicle manufacturer as normal for those conditions. An engine speed above or below the specified range may indicate a malfunction in the engine or transmission.

Note: Engine power will decrease with an increase in elevation (altitude), becoming more pronounced at greater elevation. This will result in a lower engine speed under converter-stall conditions.

(2) After making allowances for elevation, a low engine speed may indicate the engine is not delivering full power. Refer to engine service manual for engine repair information.

(3) If low engine speed persists after engine is tuned, refer to the troubleshooting procedures and chart in section V.

(4) If high engine speed is noted, refer to TROUBLESHOOTING CHART in section V.

(5) Converter stall tests may be made in 3-4, 3-5, or 3-6 range. The low-splitter and intermediate-range clutches will be the only clutches tested regardless of which of the three ranges, above, are used.

d. Forward and Reverse Ranges

(1) Check the rotation of the transmission output flange (drive shaft disconnected) by setting the input speed at 1200 rpm and shifting through all forward ranges and reverse range. Idle the engine when shifting from forward to reverse or reverse to forward ranges.

(2) Disconnect the throttle linkage at the carburetor or governor and temporarily install a spring to close the engine throttle. Stall the output flange by connecting the drive shaft and applying vehicle brakes.

(3) Test main pressure in converter operation by setting the transmission input speed at 1500 rpm and leaving the accelerator pedal fully released. Check main pressure in each selector lever position. Idle the engine while changing from each range to another. Refer to sect. I for main pressure schedule.

(4) Test main pressure in lockup operation by allowing transmission output flange to rotate freely. Shift to 3-6 position. Fully depress the accelerator pedal (throttle linkage to carburetor or governor disconnected) and gradually open the throttle. Refer to sect. I for main pressure schedule.

5. ADJUSTMENTS

a. Manual Selector Linkage. The linkage connecting the manual selector lever in the operator's compartment and the transmission manual selector lever must be adjusted so that the range positions of both levers coordinate. Check the adjustment as follows:

(1) Disconnect the linkage at the transmission selector lever (short, heavy lever nearer to transmission).

(2) Pull the lever forward (toward the input end of the transmission). Next, push the lever toward the rear one detent notch. This is neutral.

(3) Place the operator's manual selector lever in neutral (N) position.

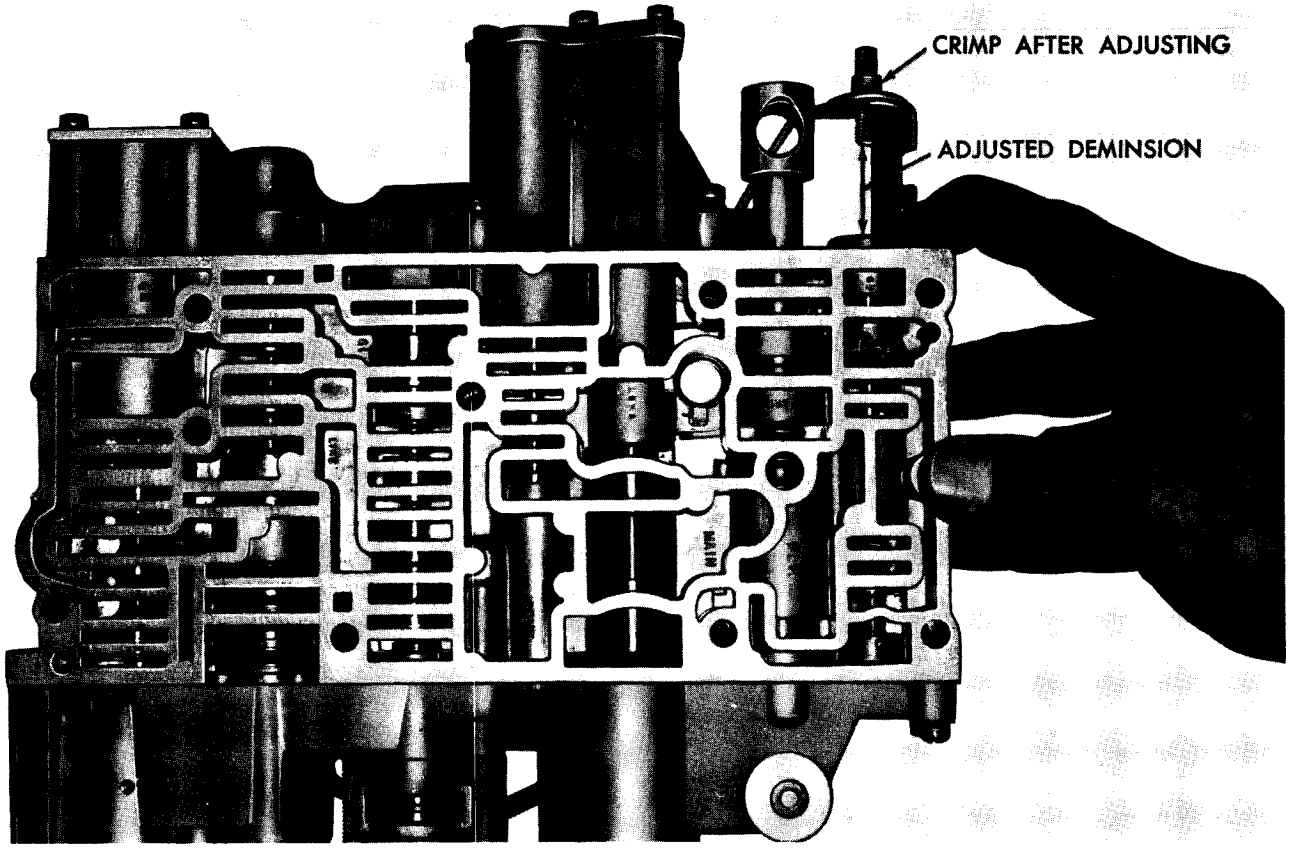


Fig. XVI-2 Throttle valve adjustment

(4) The linkage should now be alined and connect freely at the transmission lever. If it will not aline, adjust the length until it will connect freely.

(5) Connect the linkage and shift the operator's selector lever through all ranges, noting whether it alines with each range position.

b. Throttle Linkage. There are two adjustments which must be made for throttle linkage. One is internal and must be performed before the oil pan is installed. The other is external and is made after installing the transmission in the vehicle. The internal adjustment concerns the adjustment and locking of the headless screw in the throttle valve retainer at the rear of the control valve body assembly.

Note: This adjustment is necessary only when a replacement valve body assembly (Foldout 8) is installed in the transmission.

The adjustment, if required, is made as follows:

(1) Measure the distance on the original valve body assembly between the rear of the throttle valve (depressed until it bottoms) and the front of the throttle valve adjusting screw (fig. XVI-2). Record this dimension.

(2) Adjust the screw on the new valve body assembly until the distance between the front of the screw and the rear of the depressed throttle valve corresponds exactly with the measurement made in (1), above.

(3) Lock the adjusting screw by crimping the threaded portion of the retainer against the flat side of the adjusting screw.

(4) The external adjustment concerns the linkage connecting the accelerator pedal, engine throttle, and the transmission throttle lever. This adjustment is extremely important because it matches the transmission func-

tion to the power input from the engine. The position of the transmission throttle lever controls throttle "T" and throttle valve "TV" pressures. These pressures, in turn, influence upshifts, downshifts, lockup, main pressure, and coordination of clutch application and release.

Note: The procedures outlined below are general and are to be used as a guide in determining the necessary points of adjustment. There may be some differences in linkage configurations for various installations.

(5) Disconnect the throttle valve control rod at the throttle valve lever on the transmission.

(6) Push the accelerator treadle down to "detent" (not through detent) and adjust the accelerator-to-carburetor linkage so that the carburetor throttle valve (butterfly) (or fuel rack on diesel applications) is in its fully open position.

(7) With the carburetor valve (or fuel rack) held in fully open position and the treadle at detent, pull the throttle valve lever on the transmission forward as far as it will move and adjust the transmission end of the linkage so that it will freely enter the hole in the transmission throttle valve lever. Do not connect the rod at this time.

(8) Lengthen the transmission throttle control rod by turning the clevis counterclockwise seven turns. Release the accelerator treadle and connect the linkage to the transmission throttle valve lever. Adjust the accelerator treadle stop bolt to provide 1/16-inch clearance when the treadle is fully depressed (through detent).

c. Hydraulic Retarder Control Linkage

(1) The hydraulic retarder valve must have 1/2-inch of travel from its closed position (toward input end of transmission).

(2) The control linkage must be adjusted so that the valve is fully open (retarder applied when the retarder pedal is depressed within 1/16 to 1/8-inch of the stop provided beneath the pedal toe end.

(3) The control valve must be fully closed (retarder released) when the pedal is released. The pedal must return positively and immediately to released position when foot pressure is released.

Service Information Notes

Section XVII TORQUE SPECIFICATIONS AND WEAR LIMITS

1. STANDARD AND SPECIAL SPECIFICATIONS

Standard torque specifications are listed in the table below. Special torque specifications are given in assembly and rebuild instructions wherever special torques are required.

2. GENERAL WEAR LIMITS INFORMATION (for MT-30, MT-31, MT-40, MT-41, and MT-42)

a. Bearings, Bearing Journals, and Bores. The application of bearings to any product is based on the recommendation of the bearing manufacturer. Therefore, no diametral dimensional deviation should be permitted on the bearing or mating pieces. Bearings should be carefully checked for signs of distress before reinstalling in the products.

b. Gears. Gears should be inspected for load pattern and signs of distress. Any distress indicates a possible future failure and the reusing of such gears should be the decision of the individual customer, based on previous experience.

c. Splines. Unless severe, spline wear is not considered detrimental, except where it affects tightness of an assembly such as drive line flanges.

d. Oil Seals. Seals should be replaced if there are signs of excessive hardening, scoring, or other indications of deterioration.

e. Springs. Springs should be replaced if they show signs of overheating, permanent set, or do not fall within the limits specified.

STANDARD TORQUE SPECIFICATIONS – BOLTS AND SCREWS
(All torque values are given in pound feet)

Size	Threads per inch	Standard heat-treated bolts and screws	Special heat-treated bolts, screws, Allen-head screws, and self-locking cap screws
			  
1/4	20	6-8	9-11
	28	8-10	10-12
5/16	18	15-18	17-20
	24	17-20	19-23
3/8	16	26-32	36-43
	24	33-40	41-49
7/16	14	42-50	54-65
	20	50-60	64-77
1/2	13	67-80	81-97
	20	93-100	96-115

f. Piston Type Seal Rings

(1) The sides of the seal ring should be smooth; maximum side wear 0.005. Seals must be free in grooves. No lip is permissible.

(2) The sides of the shaft groove in which the seal ring runs should be smooth (50 micro inch equivalent), and square with the axis of rotation within 0.002.

(3) A new seal ring should be installed if shaft grooves are reworked, or seal ring outside diameter wear causes elimination of gap between seal ring hooks when ring is installed.

3. FRICTION WEAR LIMITS DATA

The following table presents the wear limits data for component friction wear for models as specified in the second column.

WEAR LIMITS TABLE
(All dimensions in inches)

Foldout - Item	Part No.	Models	Part Name	New Dimension	Wear Limit
3-7	6770678	All	Lockup clutch friction plate	0.190 0.180	0.175
3-5	6770845	All	Lockup clutch piston assy		No score permissible
3-11	6756778	All	Lockup clutch back plate		No score permissible
4-20	6770309 or 6772854	All	Splitter low clutch plate	0.244 0.250	0.239
4-50, 17	6770289 or 6773303	All	High and splitter high friction plates	0.154 0.150	0.145
4-18	6770917	All	Splitter high reaction plate	0.095 0.091	0.005 Cone
4-51	6770917	MT-40, 41, 42	High reaction plate	0.095 0.091	0.005 Cone
4-51	6770916	MT-30, 31	High reaction plate	0.1965 0.1945	0.003 Cone
4-16	6769892	MT-30, 40	Splitter high back plate	0.300 0.290	0.003 Cone
4-16	6771753	MT-31, 40, 41, 42	Splitter high back plate	0.240 0.236	0.003 Cone
4-53	6770765	All	High back plate	0.296 0.298	0.003 Cone
4-53	6770766	All	High back plate	0.304 0.306	0.003 Cone
4-53	6770767	All	High back plate	0.312 0.314	0.003 Cone
4-53	6770768	MT-40, 41, 42	High back plate	0.320 0.322	0.003 Cone
6-3	6770290 or 6773305	All	Intermediate clutch friction plate	0.156 0.150	0.145

(Continued on next page)

WEAR LIMITS TABLE - Continued

Foldout - Item	Part No.	Models	Part Name	New Dimension	Wear Limit
6-13, 48	6770290 or 6773305	MT-40, 41, 42	Low and reverse clutch friction plate	0.156 / 0.150	0.145
6-13, 48	6770344	MT-30, 31	Low and reverse clutch friction plate	0.300 / 0.296	0.286
6-6	6770265	All	Intermediate clutch apply plate	0.316 / 0.312	0.010 Cone
6-6	6770266	All	Intermediate clutch apply plate	0.302 / 0.298	0.010 Cone
6-6	6770267	All	Intermediate clutch apply plate	0.288 / 0.284	0.010 Cone
6-6	6771436	All	Intermediate clutch apply plate	0.295 / 0.291	0.010 Cone
6-6	6770268	All	Intermediate clutch apply plate	0.274 / 0.270	0.010 Cone
6-15, 47	6770265	MT-40, 41, 42	Low and reverse clutch apply plates	0.316* / 0.312	0.010 Cone
6-15, 47	6770266	MT-40, 41, 42	Low and reverse clutch apply plates	0.302* / 0.298	0.010 Cone
6-15, 47	6770267	MT-40, 41, 42	Low and reverse clutch apply plates	0.288* / 0.284	0.010 Cone
6-15, 47	6770268	MT-40, 41, 42	Low and reverse clutch apply plates	0.274* / 0.270	0.010 Cone
6-15, 47	6771436	MT-40, 41, 42	Low and reverse clutch apply plates	0.295* / 0.291	0.010 Cone
6-15, 47	6770341	MT-30, 31	Low and reverse clutch apply plates	0.462* / 0.458	0.010 Cone
6-15, 47	6770342	MT-30, 31	Low and reverse clutch apply plates	0.469* / 0.465	0.010 Cone
6-15, 47	6770343	MT-30, 31	Low and reverse clutch apply plates	0.476* / 0.472	0.010 Cone
6-4	6770264	All	Intermediate clutch reaction plate	0.204 / 0.196	0.003 Cone
6-14, 49	6770264	MT-40, 41, 42	Low and reverse reaction plate	0.204 / 0.196	0.003 Cone
3-13	---	All	Inside diameter of side plates in stator assy	2.853 / 2.849	2.857
3-13	---	All	Stator thrust washer in stator assy (Measure across thrust washer face and Torrington needle bearing with bearing in installed position)	0.4561 / 0.4439	0.435

(Continued on next page)

*Dimension from Belleville fulcrum to opposite face.

WEAR LIMITS TABLE - Continued

Foldout - Item	Part No.	Models	Part Name	New Dimension	Wear Limit
3-15	6770088	All	Outside diameter of race	2.8435 2.8430	2.841
4-14	6755581	All	Splitter sun gear to carrier thrust washer	0.095 0.091	0.085
4-5, 28	6769128	All	Thrust washer	0.095 0.091	0.085
6-41	6769016	All	Thrust washer	0.095 0.091	0.085
6-44, 46	6772853	All	Thrust	0.095 0.091	0.085
3-44, 46	6772575 6772574	All	Front oil pump assy - drive gear side clearance	0.0005 0.0015	0.003
3-45, 46	6772576 6772574	All	- driven gear side clearance	0.001 0.002	0.003
3-45, 46	6772576 6772574	All	Diametral clearance between front pump body and outside diameter of driven gear	0.005 0.008	0.010
7-62, 60	6776795 6756801	All**	Rear oil pump assy - drive gear side clearance	0.001 0.002	0.003
			- driven gear side clearance	0.001 0.002	0.003
7-61, 60	6756794 6756801	All**	Diametral clearance between rear pump body and outside diameter of driven gear	0.005 0.008	0.010
3-2	6756782	All	Converter cover (bushing running clearance)	0.0005 0.0035	0.006
3-30	6756861	All	Ground sleeve (bushing running clearance)	0.0005 0.0035	0.005
4-3	6756822	All	Converter output shaft (bushing running clearance)	0.0015 0.0045	0.007
4-25	6759975	All	Splitter high housing (sun gear bushing running clearance)	0.004 0.011	0.015
4-8	6756587		Splitter planetary carrier assy (journal)	(No score permissible)	
4-39	6756863	All	High clutch housing (bushing running clearance)	0.0020 0.0045	0.008
6-29	6756835	All	Output shaft (bushing running clearance)	0.0015 0.0045	0.007

*Dimension from Belleville fulcrum to opposite face.
**Most MT models after 1961 do not have rear pumps.

4. BELLEVILLE SPRINGS WEAR LIMITS DATA

The following table presents the Wear Limits Data for Belleville Springs.

BELLEVILLE SPRING WEAR LIMITS

Foldout - Item	Part No.	Part Name	Free Height
4-30	6757043	Splitter low piston return	.25/.30
4-21	6756134	Splitter high piston return	.25/.30
6-7	6755782	Intermediate piston return	.50/.53
6-33, 46	6772717	Low and reverse piston return	.705/.745
4-21	6771527	Splitter high piston return	.19/.21
6-33, 46	6756734	Low and reverse piston return	.705/.745

5. COIL SPRINGS WEAR LIMITS DATA

The following table presents the Wear Limits Data for high clutch piston coil springs.

HIGH CLUTCH PISTON RETURN COIL SPRING WEAR LIMITS

Foldout - Item	Part No.	Part Name	Approx Free Ht.	Load (lb)	at	Height (in)
4-47	6770669	High clutch piston return, outer	2.88	470.0	± 30.0 lb	1.53
4-46	6770670	High clutch piston return, inner	3.016	348.0	± 25.0 lb	1.53

Note: Control valve body spring charts, which include wear limits data for coil springs, follow this section.

Service Information Notes

CONTROL VALVE BODY SPRING CHART

30H

Valve body assembly 6772805 Transmission assembly 6772677

Spring	Part No.	No. coils	Diameter of wire	Outside diameter	Free length	Length--under--load lb.	
Selector valve detent	6768570	9	.053 -.055	.345	.77	.64	8.4 -10.2
Pump overage regulator	6758872	9 1/2	.062 -.064	.060	1.40	.82	9.5 -11.5
Intermediate-to-high shift valve	6768593	6	.061 -.063	.97	1.41	.55	5.8 -7.1
Splitter shift plug	6768544	14	.053 -.055	.56	1.99	.84	8.1 -9.9
Main pressure regulator valve (primary)	6757145	16	.0905-.0935	1.00	4.46	1.98	22.5 -24.5
Main pressure regulator valve (secondary)	6757146	13 1/2	.053 -.055	.78	3.67	1.22	6.2 -6.8
Intermediate-to-low shift valve	6756921	13 1/2	.046 -.048	.62	2.34	.80	4.5 -5.5
Accumulator valve	6759954	14	.052 -.056	.654	2.85	1.78	4.5 -5.5
Trimmer (primary)	6772620	9 1/2	.1035-.1075	.855	2.66	1.54	28.5 -31.5
Trimmer (secondary)	6772621	10	.1035-.1075	.70	1.88	1.59	28.5 -31.5
Trimmer return (inner)	6769825	12	.0465-.0485	.667	3.26	2.22	2.76-3.36
Trimmer return (outer)	6759964	15	.0615-.0635	.85	4.50	1.03	11.16-13.64
Extender valve ball (also Trimmer valve ball)	6770664	8	.027 -.029	.312	.63	.38	1.425-1.575
Extender valve return	6771254	7	.043 -.045	.43	.867	.70	2.86-3.06
Low-splitter exhaust regulator valve	6770253	11	.053 -.055	.48	1.24	.78	7.84-8.16
Intermediate exhaust regulator valve	6770763	14	.040 -.042	.48	2.03	.78	3.8 -4.2
TV (Throttle valve)	6770641	13	.0465-.0485	.392	1.28	.78	7.95-8.25
Lockup shift valve	6757058	18 1/2	.062 -.064	.61	2.22	1.24	7.7 -8.7
Splitter relay valve	6770353	8 1/2	.118 -.122	.95	2.00	1.25	50.4 -61.6
Converter pressure regulator	6772871	13	.0662-.0682	.873	3.093	1.13	9.0 -11.0
Downshift timing valve	6770676	20	.053 -.055	.487	2.415	1.40	7.65-0.35

CONTROL VALVE BODY SPRING CHART

Valve body assembly 6772809 Transmission assembly 40H 6772678 40H2 6773087

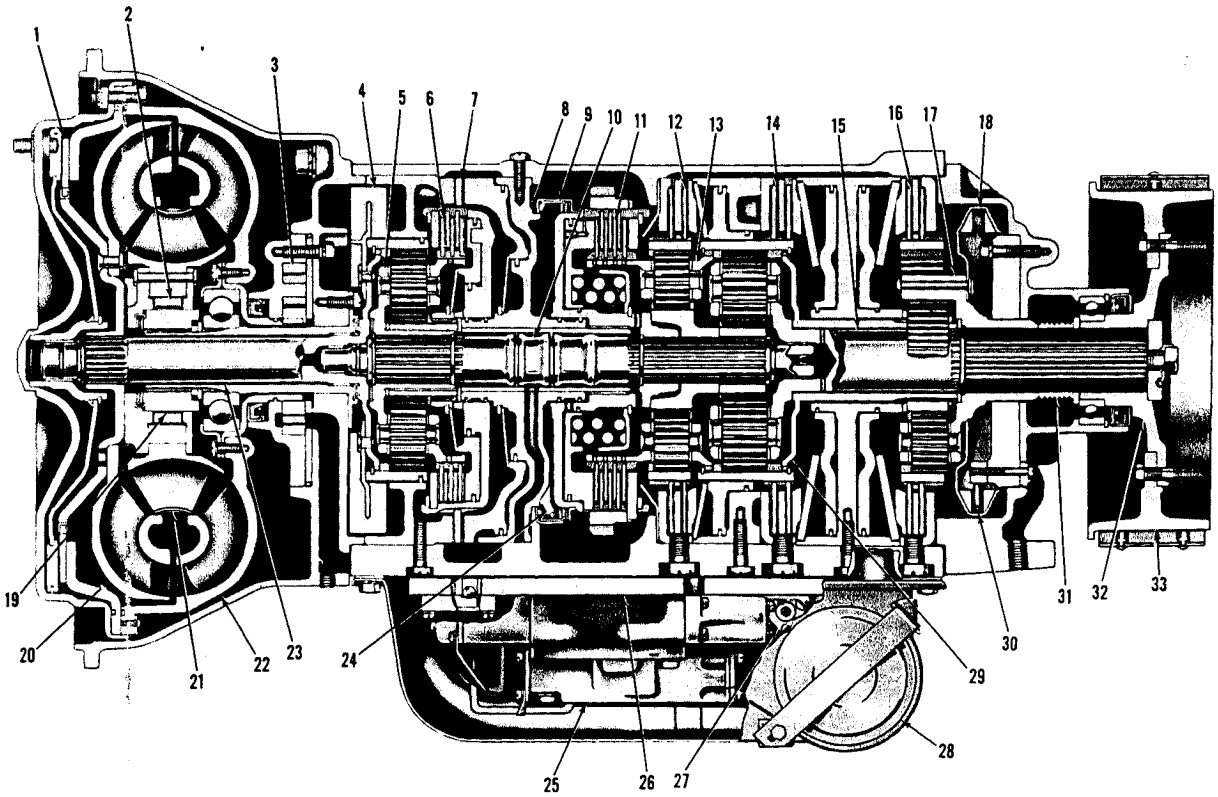
Spring	Part No.	No. coils	Diameter of wire	Outside diameter	Free length	Length--under--load lb.	
Selector valve detent	6768570	9	.053 -.055	.345	.77	.64	8.4 -10.2
Pump overage regulator	6758872	9 1/2	.062 -.064	.060	1.40	.82	9.5 -11.5
Intermediate-to-high shift valve	6768593	6	.061 -.063	.97	1.41	.55	5.8 -7.1
Splitter shift plug	6768544	14	.053 -.055	.56	1.99	.84	8.1 -9.9
Main pressure regulator valve	6770118	14	.104 -.107	1.02	3.94	1.98	37.0 -39.0
Intermediate-to-low shift valve	6756921	13 1/2	.046 -.048	.62	2.34	.80	4.5 -5.5
Accumulator valve	6759955	13	.046 -.048	.65	3.02	1.78	3.2 -4.0
Trimmer (primary)	6772620	9 1/2	.1035-.1075	.855	2.66	1.54	28.5 -31.5
Trimmer (secondary)	6772621	10	.1035-.1075	.70	1.88	1.59	28.5 -31.5
Trimmer return (inner)	6769825	12	.0465-.0485	.667	3.26	2.22	2.76-3.36
Trimmer return (outer)	6759964	15	.0615-.0635	.85	4.50	1.03	11.16-13.64
Extender valve ball (also Trimmer valve ball)	6770664	8	.027 -.029	.312	.63	.38	1.425-1.575
Extender valve return	6770642	7	.031 -.033	.426	1.059	.45	2.85-3.15
Low-splitter exhaust regulator valve	6770253	11	.053 -.055	.48	1.24	.78	7.84-8.16
Intermediate exhaust regulator valve	6770665	14	.040 -.042	.48	2.03	.78	4.8 -5.2
TV (Throttle valve)	6770668	11 1/2	.043 -.045	.384	1.27	.78	6.94-7.18
Lockup shift valve	6757058	18 1/2	.062 -.064	.61	2.22	1.24	7.7 -8.7
Splitter relay valve	6770353	8 1/2	.118 -.122	.95	2.00	1.25	50.4 -61.6
Converter pressure regulator	6772871	13	.0662-.0682	.873	3.093	1.13	9.0 -11.0
Downshift timing valve	6769489	17	.046 -.048	.467	2.40	1.40	6.0 -6.6

CONTROL VALVE BODY SPRING CHART

41H

Valve body assembly 6773264 Transmission assembly 6773018

Spring	Part No.	No. coils	Diameter of wire	Outside diameter	Free length	Length--under--load lb.	
Selector valve detent	6768570	9	.053 -.055	.345	.77	.64	8.4 -10.2
Pump overage regulator	6758872	9 1/2	.062 -.064	.060	1.40	.82	9.5 -11.5
Intermediate-to-high shift valve	6768593	6	.061 -.063	.97	1.41	.55	5.8 -7.1
Splitter shift plug	6768544	14	.053 -.055	.56	1.99	.84	8.1 -9.9
Main pressure regulator valve	6770118	14	.104 -.107	1.02	3.94	1.98	37.0 -39.0
Intermediate-to-low shift valve	6756921	13 1/2	.046 -.048	.62	2.34	.80	4.5 -5.5
Accumulator valve	6770816	12 1/2	.040 -.042	.657	3.10	.78	3.63-4.01
Trimmer (primary)	6772620	9 1/2	.1035-.1075	.855	2.66	1.54	28.5 -31.5
Trimmer (secondary)	6772621	10	.1035-.1075	.70	1.88	1.59	28.5 -31.5
Trimmer return (inner)	6769825	12	.0465-.0485	.667	3.26	2.22	2.76-3.36
Trimmer return (outer)	6759964	15	.0615-.0635	.85	4.50	1.02	11.16-13.64
Extender valve ball (also Trimmer valve ball)	6770664	8	.027 -.029	.312	.63	.38	1.425-1.575
Extender valve return	6770642	7	.031 -.033	.426	1.059	.45	2.85-3.15
Low-splitter exhaust regulator valve	6772517	16	.046 -.048	.44	1.84	.92	7.2 -8.8
Intermediate exhaust regulator valve	6770665	14	.040 -.042	.48	2.03	.78	4.8 -5.2
TV (Throttle valve)	6772958	12	.040 -.042	.384	1.28	.78	5.11-5.29
Lockup shift valve	6772518	18 1/2	.0615-.0635	.61	2.08	1.24	6.3 -7.7
Splitter relay valve	6770353	8 1/2	.118 -.122	.95	2.00	1.25	50.4 -61.6
Converter pressure regulator	6772871	13	.0662-.0682	.873	3.093	1.13	9.0 -11.0
Downshift timing valve	6758316	20	.046 -.048	.467	2.05	1.25	4.3 -4.7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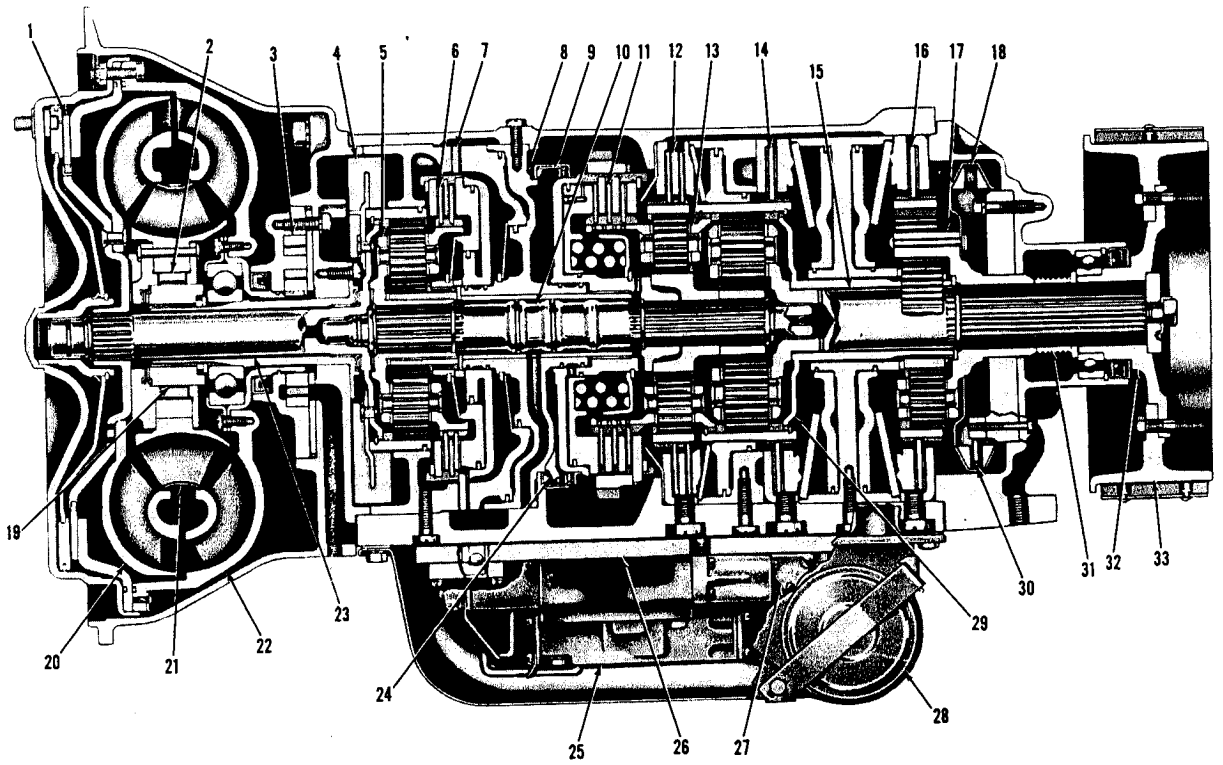
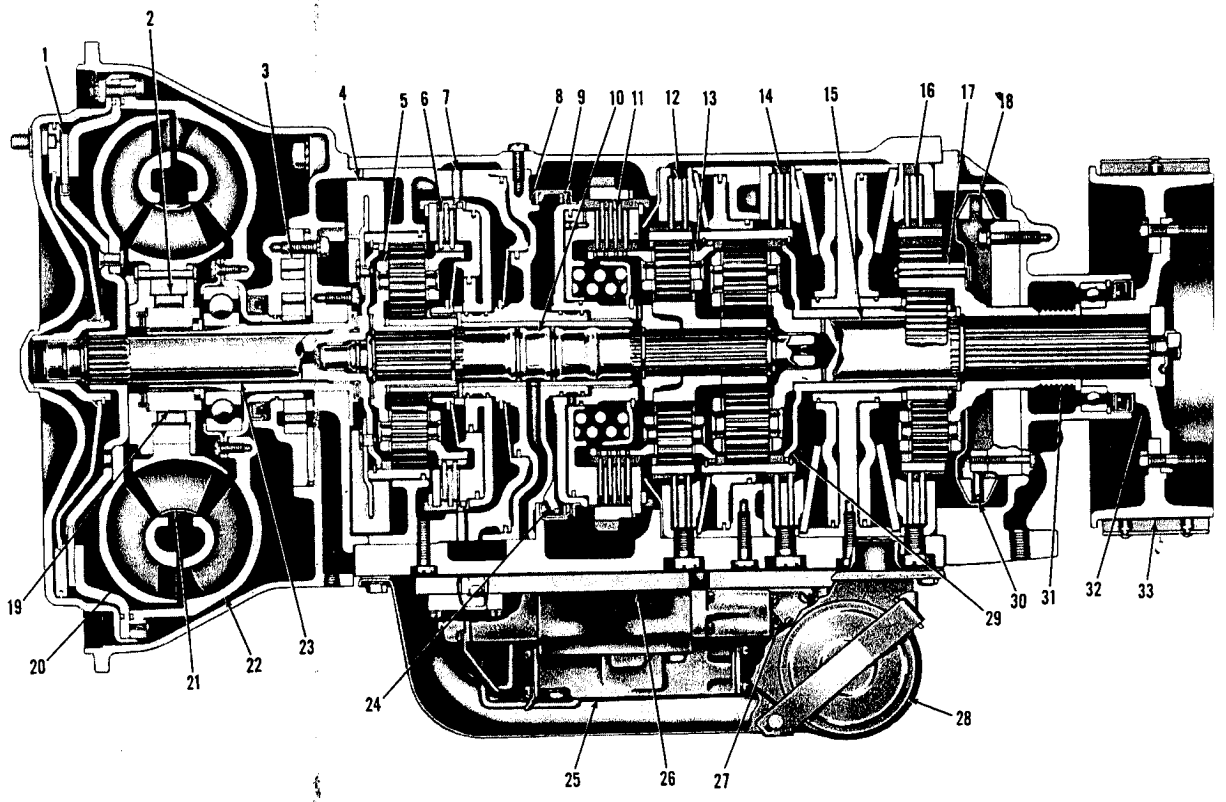
Model MT-41H

1 - Lockup clutch
2 - Freewheel roller
3 - Front oil pump
4 - Hydraulic retarder
5 - Splitter planetary
6 - High splitter clutch
7 - Low splitter clutch
8 - High clutch diaphragm
9 - G1 oil collector ring
10 - Splitter output shaft
11 - High-range clutch
12 - Intermediate-range clutch
13 - Intermediate-range planetary
14 - Low-range clutch
15 - Low-range planetary and output shaft
16 - Reverse-range clutch
17 - Reverse-range planetary
18 - G2 oil collector ring
19 - Freewheel roller race
20 - Converter turbine
21 - Stator assy
22 - Converter pump
23 - Turbine output shaft
24 - G1 pitot tube
25 - Range selector valve body assy
26 - Oil transfer plate
27 - Downshift timing valve assy
28 - Oil filter cover assy
29 - Reverse-range sun gear shaft
30 - G2 pitot tube
31 - Speedo drive gear
32 - Output flange
33 - Parking brake drum

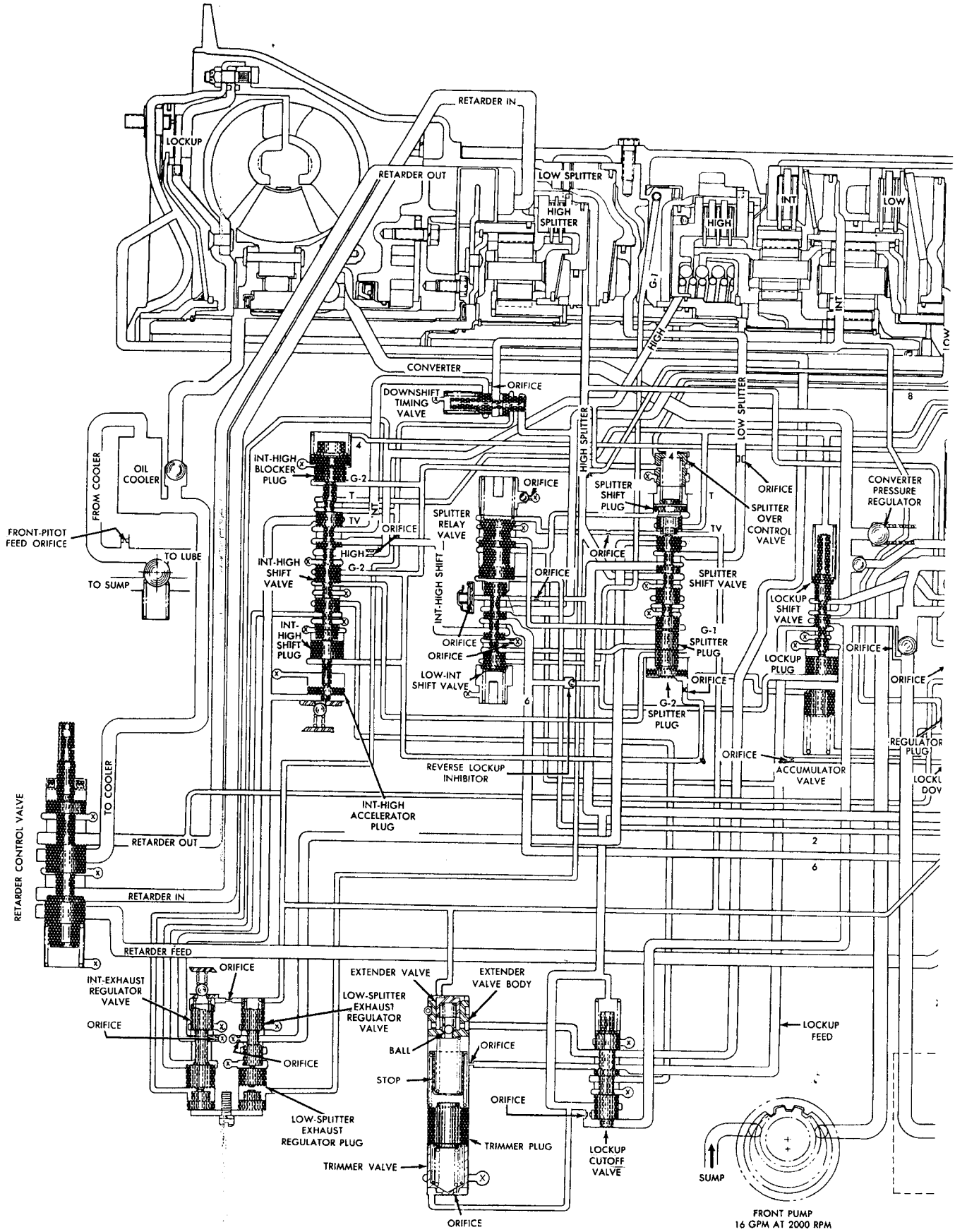
Foldout 1. MT transmission cross section



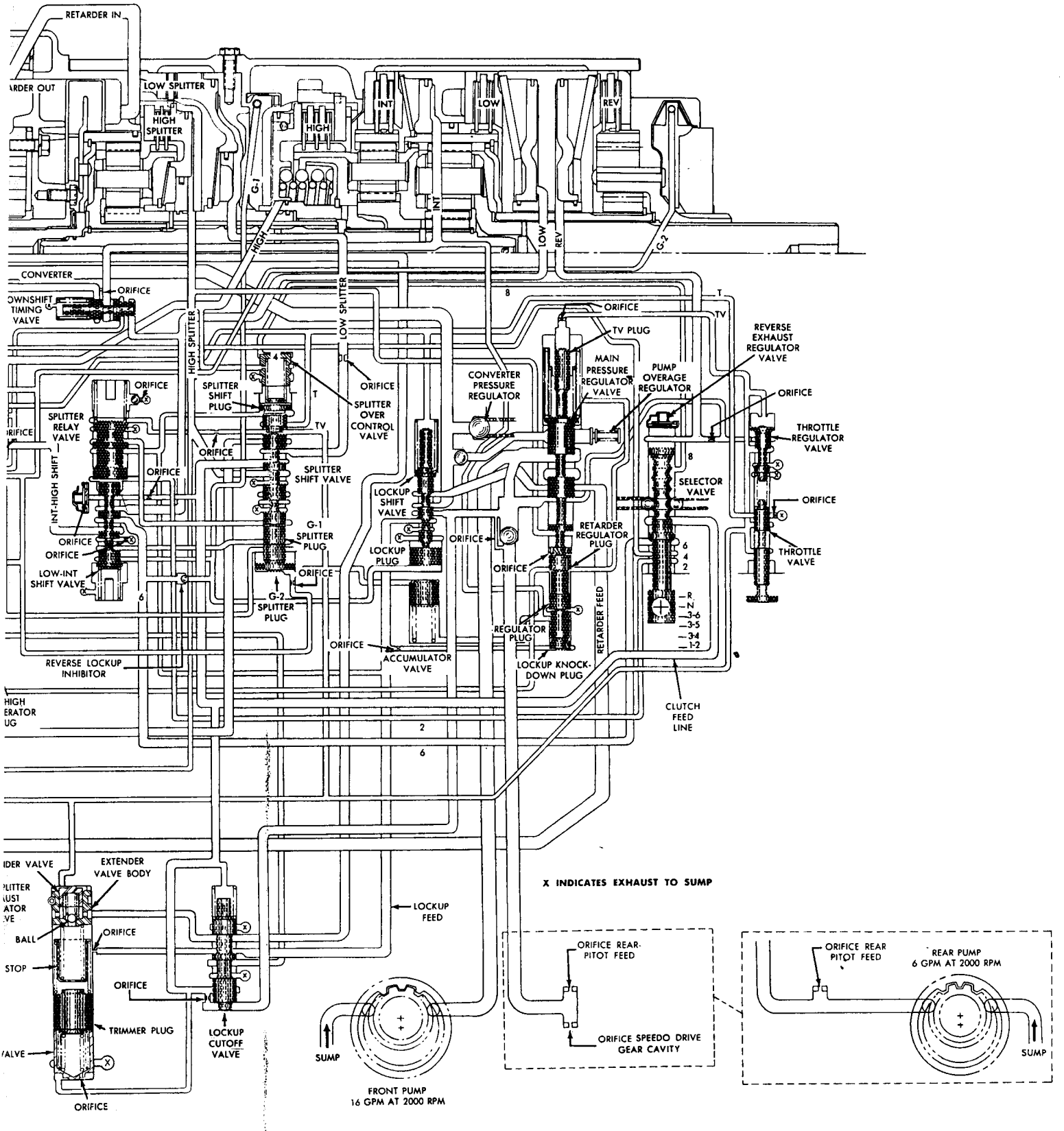
Model MT-30H



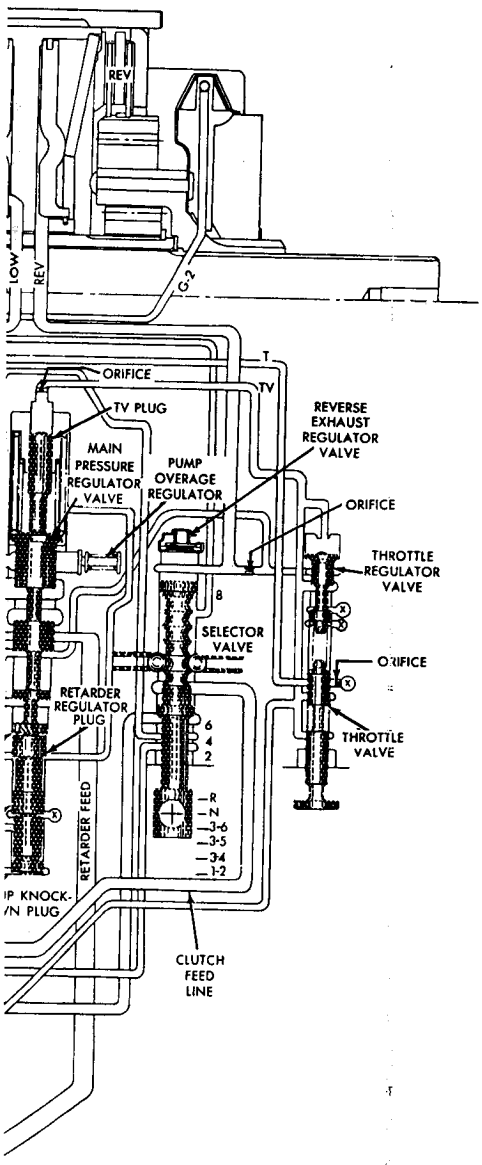
Model MT-40H

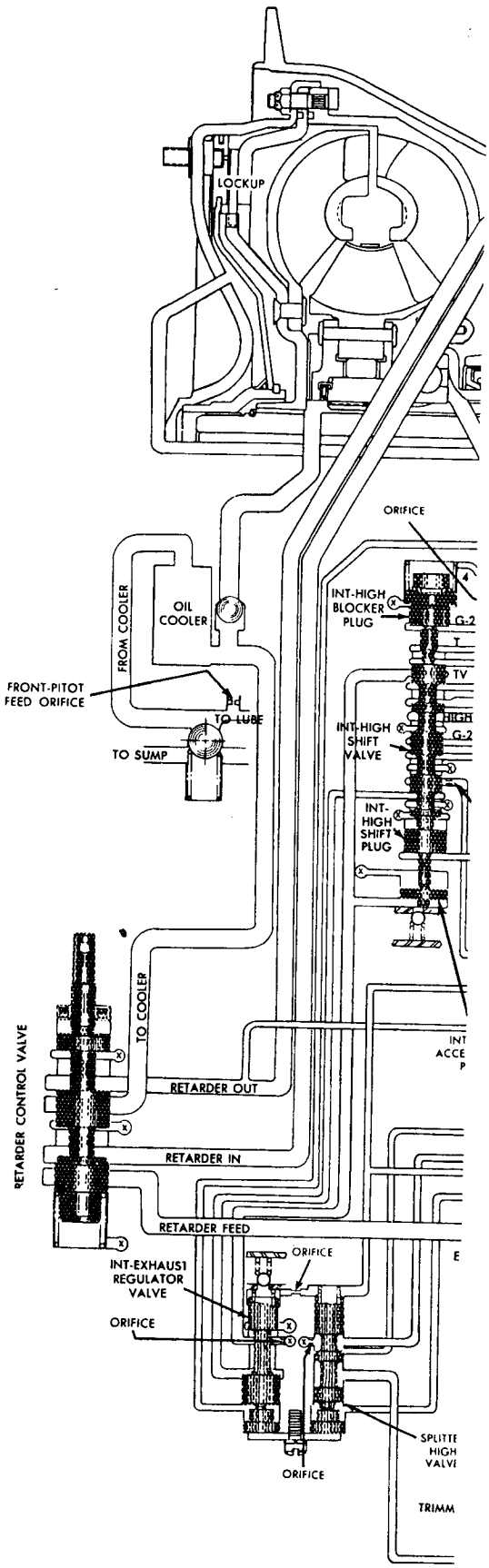


Transmission hydraulic system (MT-30, -40 and -42 mod

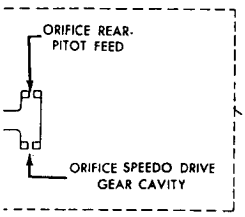


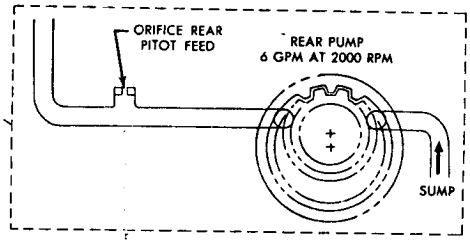
Transmission hydraulic system (MT-30, -40 and -42 models) – schematic



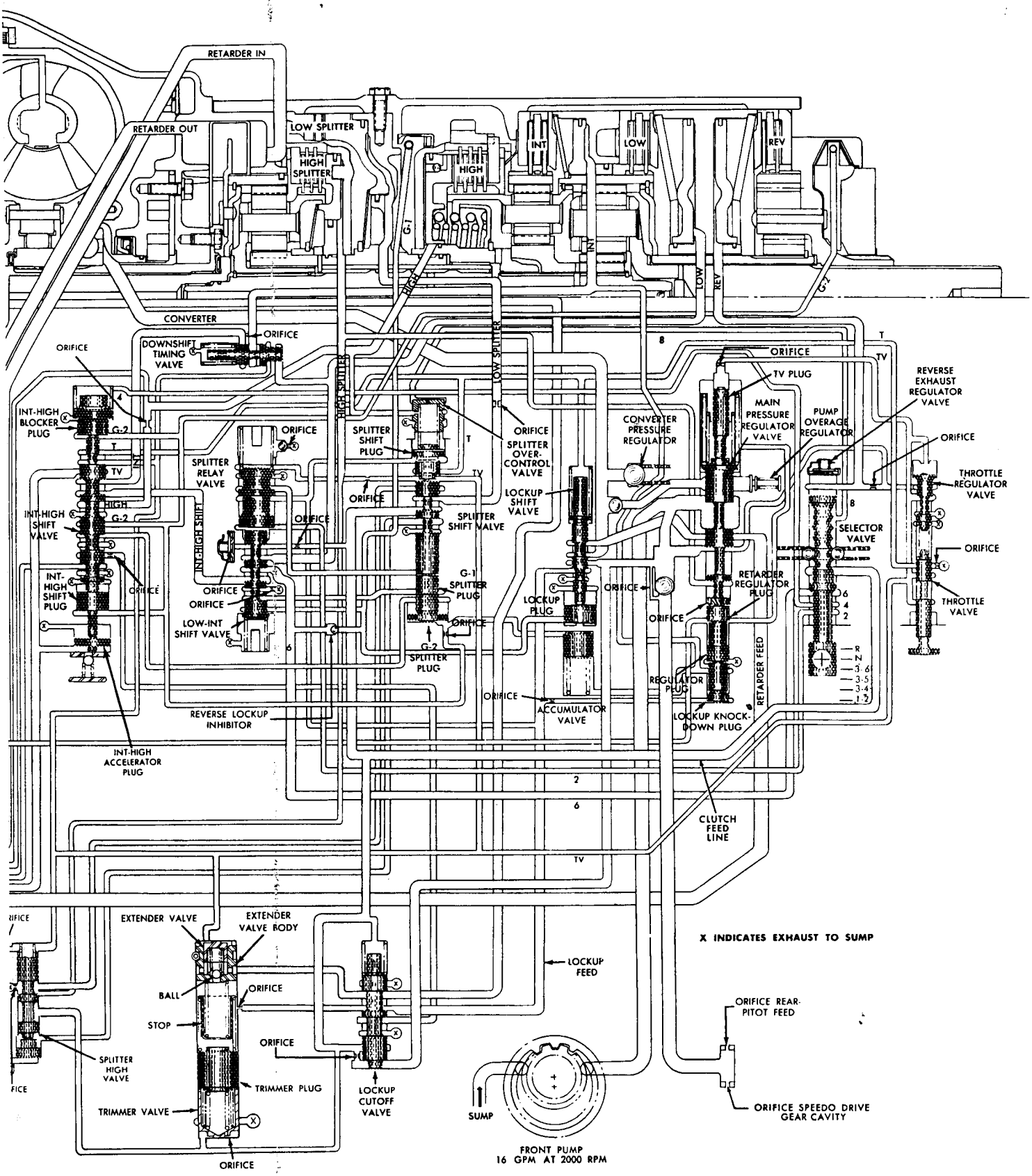


INDICATES EXHAUST TO SUMP





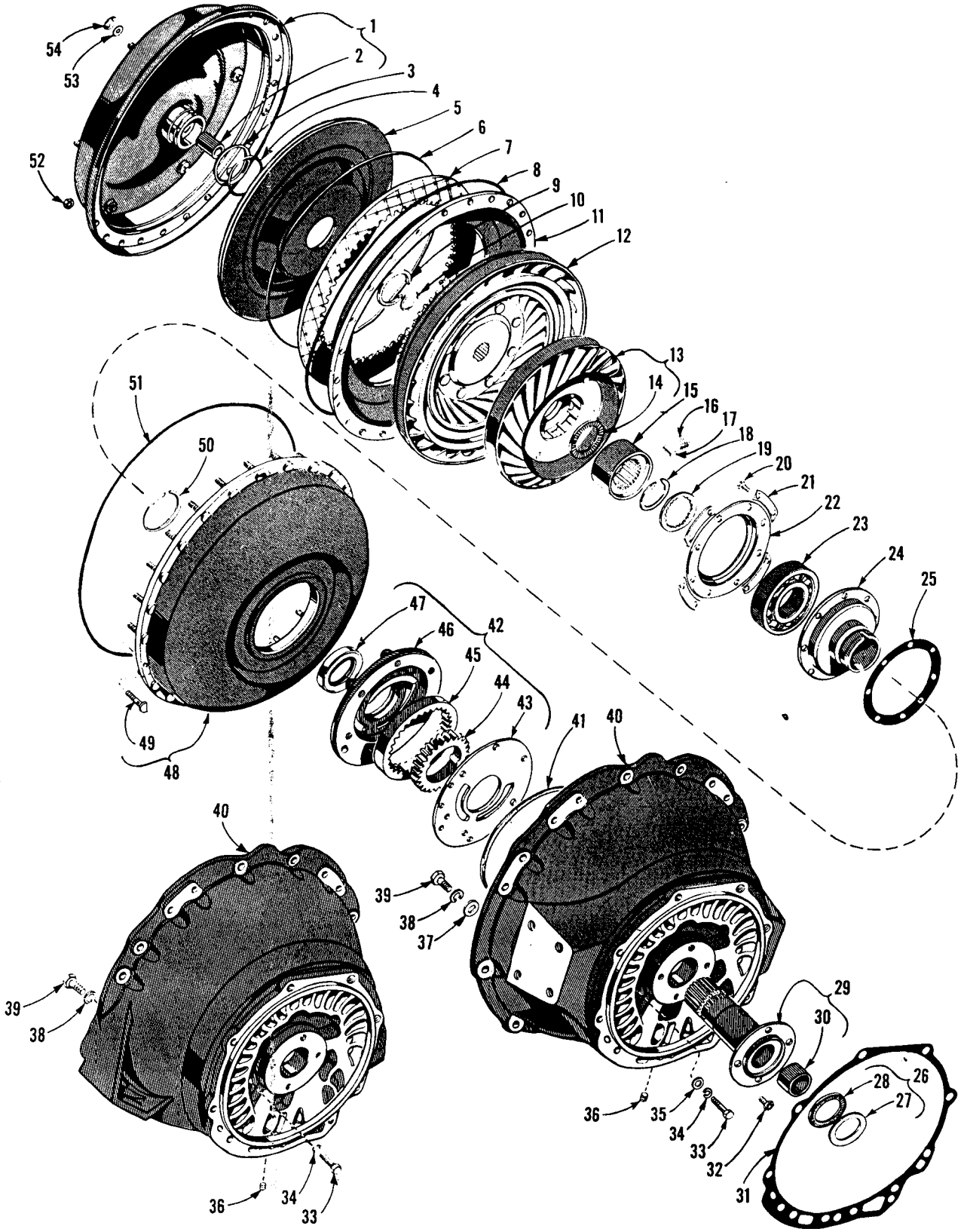
ls) – schematic



Transmission hydraulic system (MT-31 and -41 models) – schematic

1 - Converter pump cover assy
2 - Bushing
3 - Oil seal retainer
4 - Oil seal
5 - Lockup clutch piston assy
6 - Seal ring
7 - Lockup clutch plate
8 - Seal ring
9 - Snap ring
10 - Snap ring
11 - Lockup clutch back plate
12 - Turbine assy
13 - Stator and cam assy
14 - Thrust bearing assy
15 - Freewheel roller race
16 - Freewheel roller spring
17 - Freewheel roller
18 - Snap ring
19 - Spacer
20 - Bolt, 1/4-20 x 5/8
21 - Lock strip
22 - Bearing retainer
23 - Ball bearing
24 - Converter pump hub
25 - Converter pump hub gasket
26 - Thrust bearing assy
27 - Needle thrust bearing race
28 - Needle thrust bearing assy
29 - Converter ground sleeve assy
30 - Bushing
31 - Gasket
32 - Self-locking bolt, 5/16-18 x 3/4
33 - Bolt, 5/16-18 x 1
34 - Lock washer, 5/16
35 - Plain washer, 5/16
36 - Pipe plug, 1/8-27
37 - Plain washer, 7/16
38 - Lock washer, 7/16
39 - Bolt, 7/16-14 x 2
40 - Converter housing
41 - Seal ring
42 - Front oil pump assy
43 - Oil pump cover
44 - Oil pump drive gear
45 - Oil pump driven gear
46 - Oil pump body
47 - Seal
48 - Converter pump assy
49 - Bolt, 5/16-24 x 1.30
50 - Hook-type seal ring
51 - Seal ring
52 - Lock nut, 5/16-24
53 - Spacer (AR) - 0.027 thk (gold)
- 0.045 thk (silver)
- 0.063 thk (copper)
- 0.081 thk (black)
- 0.099 thk (plain)
54 - Retainer - 0.015 thk

Foldout 3. Torque converter and input drive – exploded view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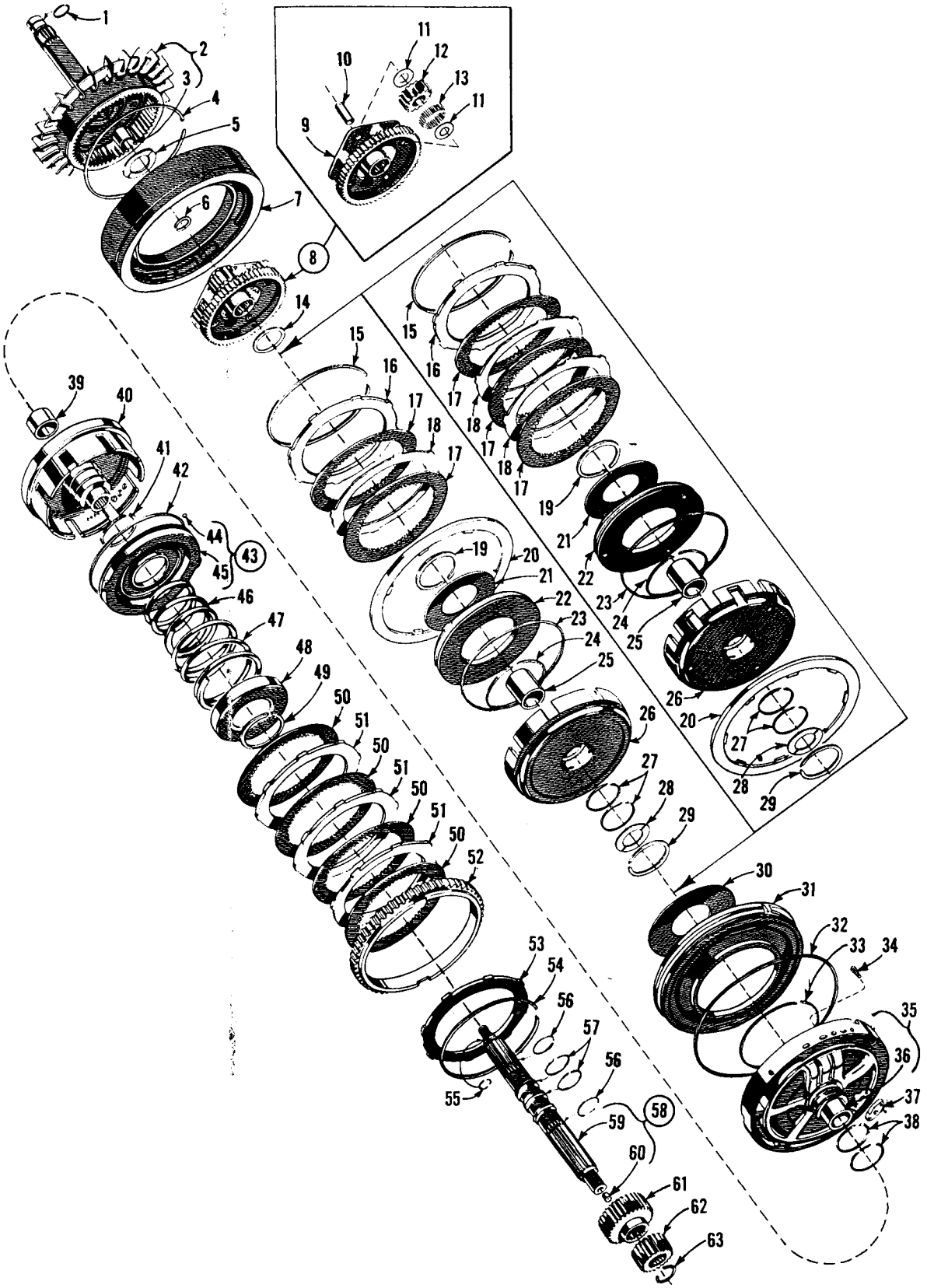
1 - Hook-type seal ring
2 - Turbine shaft and hydraulic retarder rotor assy
3 - Bushing
4 - Hook-type seal ring
5 - Thrust washer
6 - Snap ring
7 - Low-splitter clutch reaction plate
8 - Splitter planetary carrier assy
9 - Splitter planetary carrier
10 - Splitter planetary pin
11 - Thrust washer
12 - Splitter planetary pinion
13 - Roller
14 - Thrust washer
15 - Internal-snap ring
16 - High-splitter clutch reaction plate
17 - Internal-splined clutch plate
18 - External-splined clutch plate
19 - Snap ring
20 - Low-splitter clutch plate
21 - Piston return spring
22 - High-splitter piston
23 - Seal ring
24 - Hook-type seal ring
25 - Bushing
26 - High-splitter housing and gear assy
27 - Hook-type seal ring
28 - Thrust washer
29 - Snap ring
30 - Piston return spring
31 - Low-splitter clutch piston
32 - Seal ring
33 - Hook-type seal ring
34 - Screw and washer, 10-32 x 5/8
35 - Diaphragm assy
36 - Sleeve
37 - Front pitot tube
38 - Hook-type seal ring
39 - Bushing
40 - High-range clutch housing assy
41 - Hook-type seal ring
42 - Seal ring
43 - High-range clutch piston assy
44 - Ball, 1/4 dia
45 - High-clutch piston
46 - Inner spring
47 - Outer spring
48 - High-range clutch spring retainer
49 - Snap ring
50 - Internal-splined clutch plate
51 - External-splined clutch plate
52 - Power takeoff gear
53 - High-range clutch reaction plate
54 - Snap ring
55 - Hook-type seal ring
56 - Wire-type snap ring
57 - Hook-type seal ring
58 - Splitter output shaft assy
59 - Splitter output shaft
60 - Lube orifice plug
61 - Intermediate-range sun gear
62 - Low-range sun gear
63 - Snap ring

Foldout 4. Hydraulic retarder, splitter mechanism, and high-range clutch – exploded view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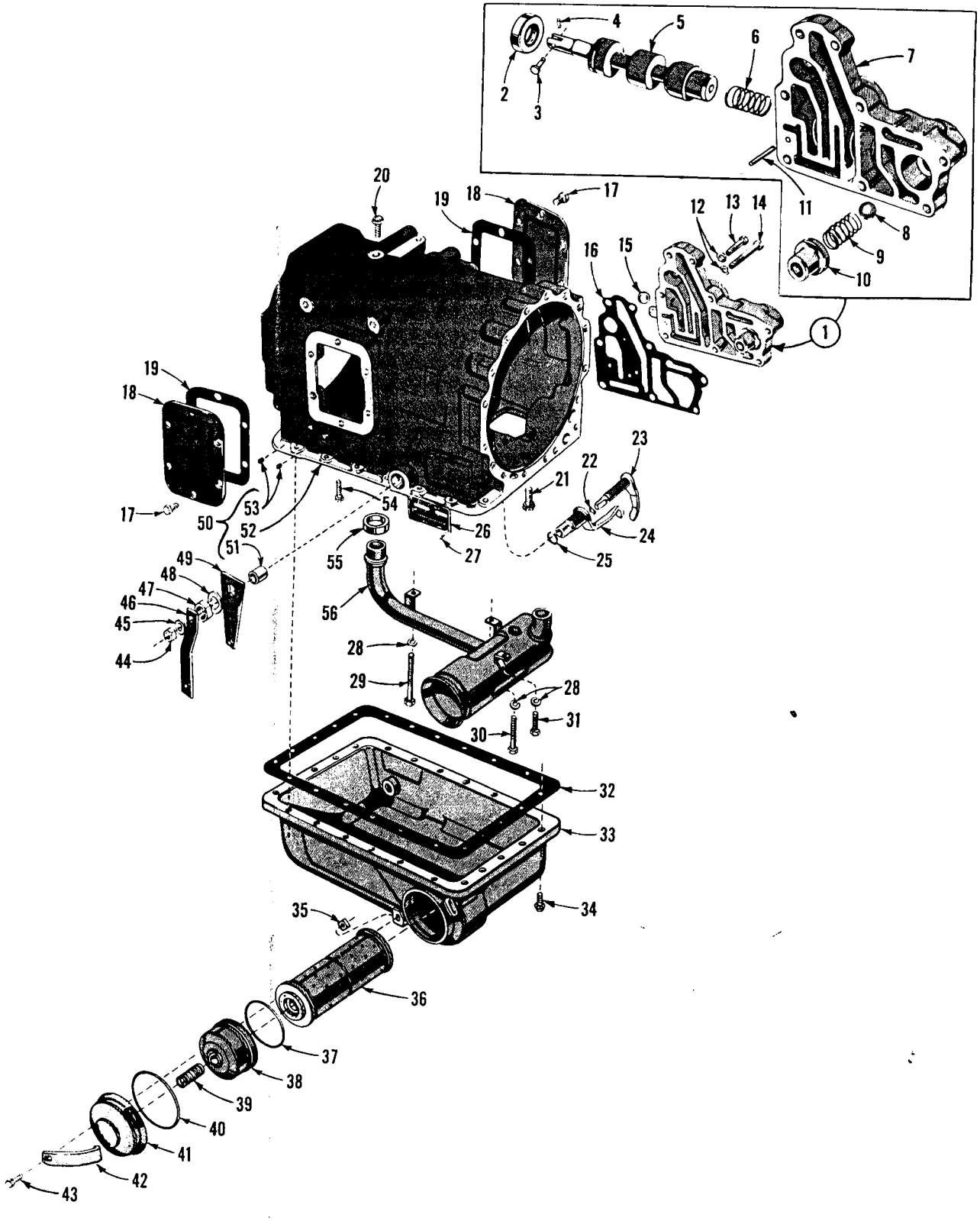
1 - Hydraulic retarder control valve assy
2 - Oil seal
3 - Clevis pin
4 - Slotted spring pin
5 - Retarder valve
6 - Retarder valve return spring
7 - Retarder control valve body
8 - Lubrication regulator valve ball
9 - Lubrication regulator valve spring
10 - Lubrication regulator valve retainer
11 - Retarder valve retainer pin
12 - Lock washer, 5/16
13 - Bolt, 5/16-18 x 1-1/4
14 - Bolt, 5/16-18 x 2-1/4
15 - Teflon ball, 5/8
16 - Retarder valve body gasket
17 - Bolt, 3/8-16 x 3/4
18 - Power takeoff cover
19 - Power takeoff cover gasket
20 - Bolt, 5/16-18 x 1
21 - Bolt, 1/2-20 x 3/4 special
22 - Seal ring
23 - Throttle valve shaft assy
24 - Manual selector shaft assy
25 - Seal ring
26 - Name plate
27 - Drive screw
28 - Lock washer
29 - Bolt, 1/4-20 x 3
30 - Bolt, 1/4-20 x 2
31 - Bolt, 1/4-20 x 1-1/8
32 - Oil pan gasket
33 - Oil pan
34 - Bolt, 5/16-18 x 1/2
35 - Nut, 5/16-24
36 - Oil filter element
37 - Seal ring
38 - Oil filter element retainer
39 - Spring
40 - Seal ring
41 - Filter cover assy
42 - Cover strap
43 - Bolt, 5/16-24 x 1
44 - Throttle valve lever nut
45 - Throttle valve lever washer
46 - Throttle valve outside lever
47 - Shift valve lever nut
48 - Shift valve lever washer
49 - Shift valve lever
50 - Transmission housing assy
51 - Shift lever sleeve
52 - Transmission housing
53 - Pipe plug, 1/8-27
54 - Bolt, 5/16-18 x 1-1/4
55 - Oil suction tube seal ring
56 - Oil filter can assembly

Foldout 5. Hydraulic retarder control valve, transmission housing, oil pan, and oil filter – exploded view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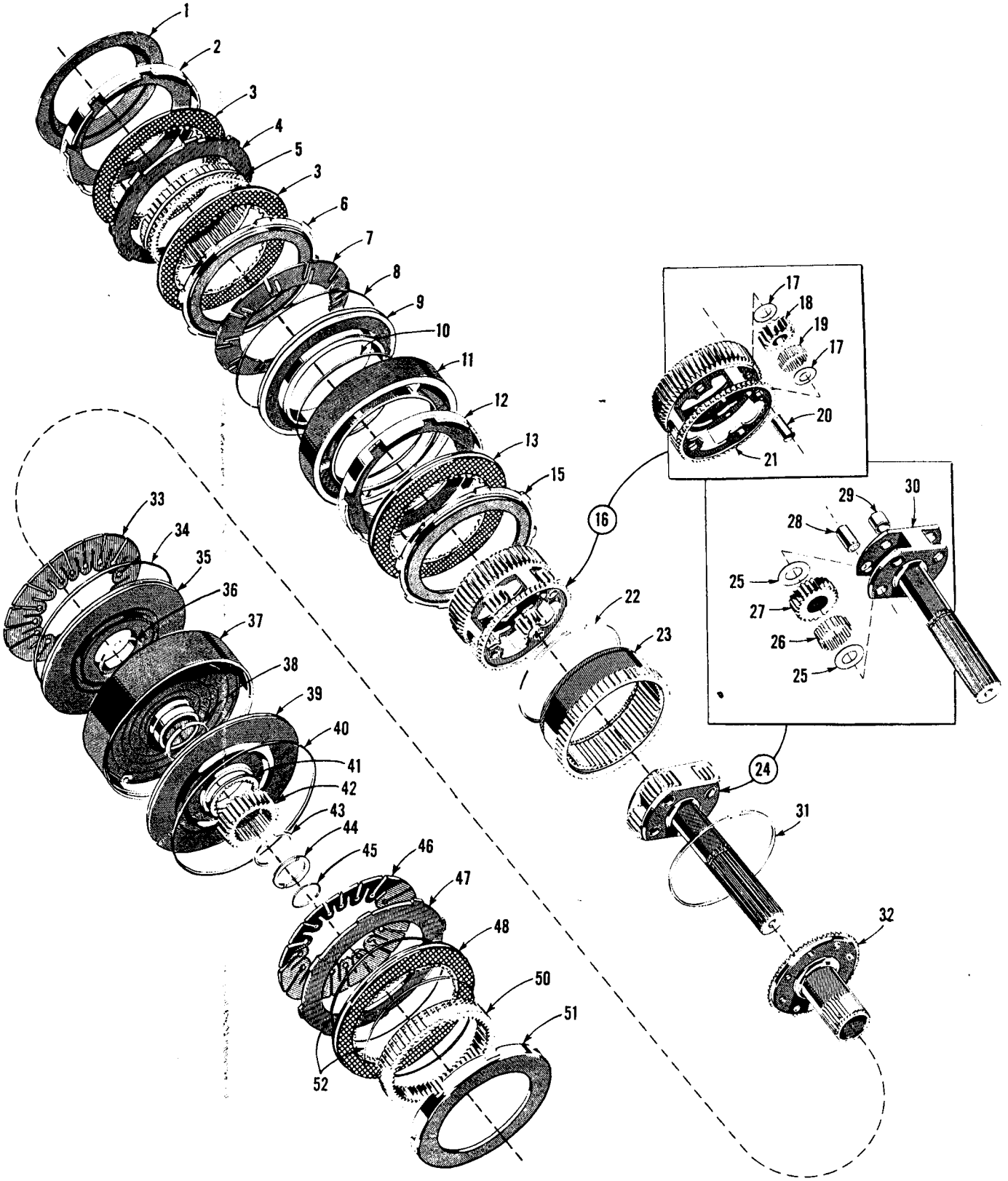
1 - Oil collector
2 - Intermediate-range clutch reaction housing
3 - Internal-splined clutch plate
4 - External-splined clutch plate
5 - Intermediate-range ring gear assy
6 - Intermediate-range clutch apply plate
7 - Intermediate-range clutch spring
8 - Seal ring
9 - Intermediate-range clutch piston
10 - Hook-type seal ring
11 - Intermediate-range piston housing
12 - Low-range clutch reaction housing
13 - Internal-splined clutch plate
14 - External-splined clutch plate
15 - Low-range clutch apply plate
16 - Intermediate-range planetary carrier assy
17 - Thrust washer
18 - Intermediate-range planetary pinion
19 - Roller
20 - Intermediate-range planetary pinion pin
21 - Intermediate-range planetary carrier
22 - Internal-snap ring
23 - Low-range ring gear
24 - Low-range planetary carrier and transmission output shaft assy
25 - Thrust washer
26 - Roller
27 - Planetary pinion
28 - Planetary pinion pin
29 - Bushing
30 - Low-range planetary carrier and transmission output shaft
31 - Internal-snap ring
32 - Reverse-range sun gear shaft
33 - Clutch spring
34 - Seal ring
35 - Low-range piston
36 - Hook-type seal ring
37 - Low- and reverse-range piston housing
38 - Hook-type seal ring
39 - Reverse-range piston
40 - Seal ring
41 - Thrust washer
42 - Reverse-range sun gear
43 - Snap ring
44 - Thrust washer
45 - Snap ring
46 - Clutch spring
47 - Reverse-range clutch apply plate
48 - Internal-splined clutch plate
49 - External-splined clutch plate
50 - Reverse-range ring gear assy
51 - Reverse-range clutch reaction housing
52 - Clutch plate retaining ring

Foldout 6. Intermediate-, low- and reverse-range clutches and intermediate-range planetary carrier and output shaft assemblies – exploded view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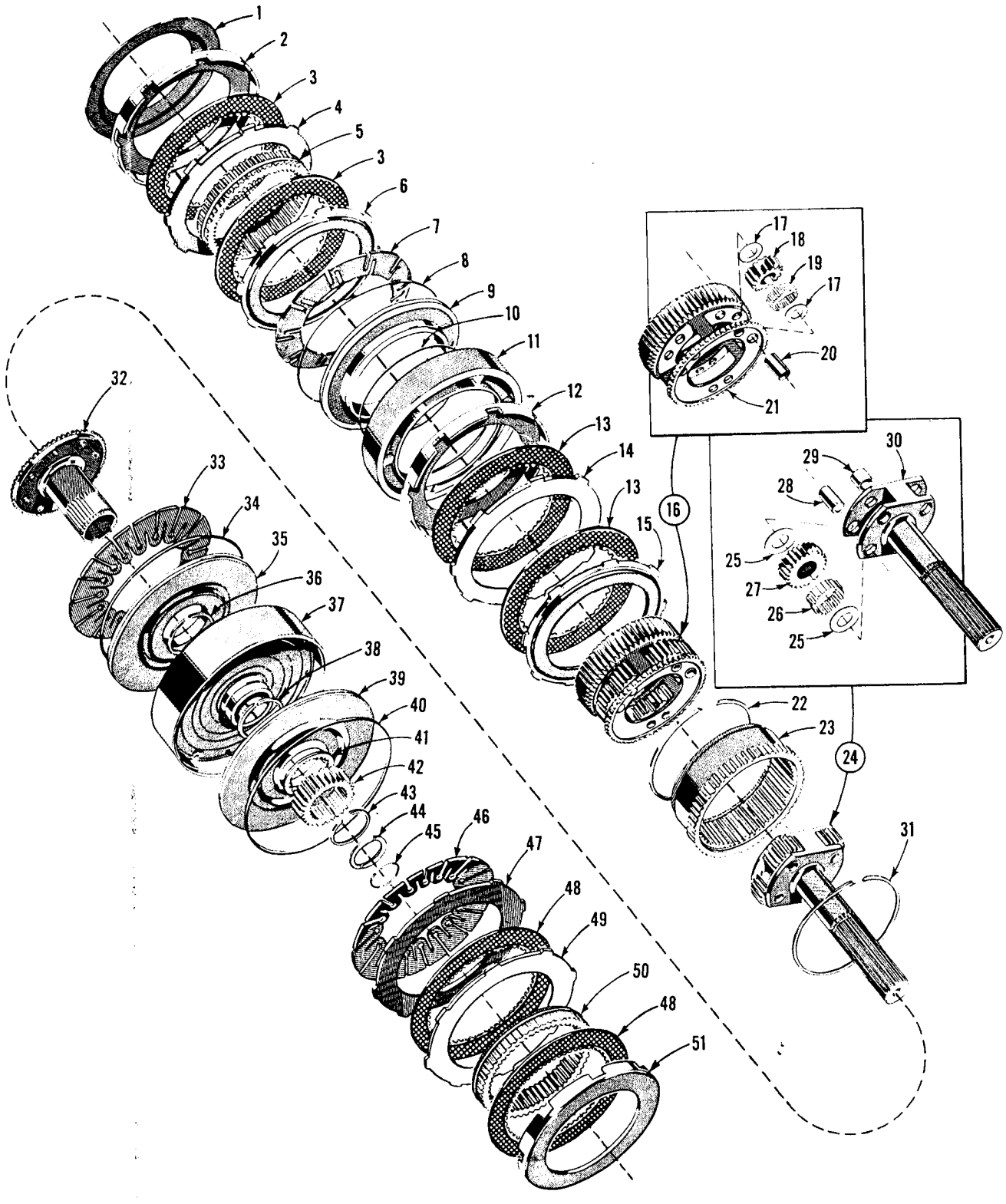
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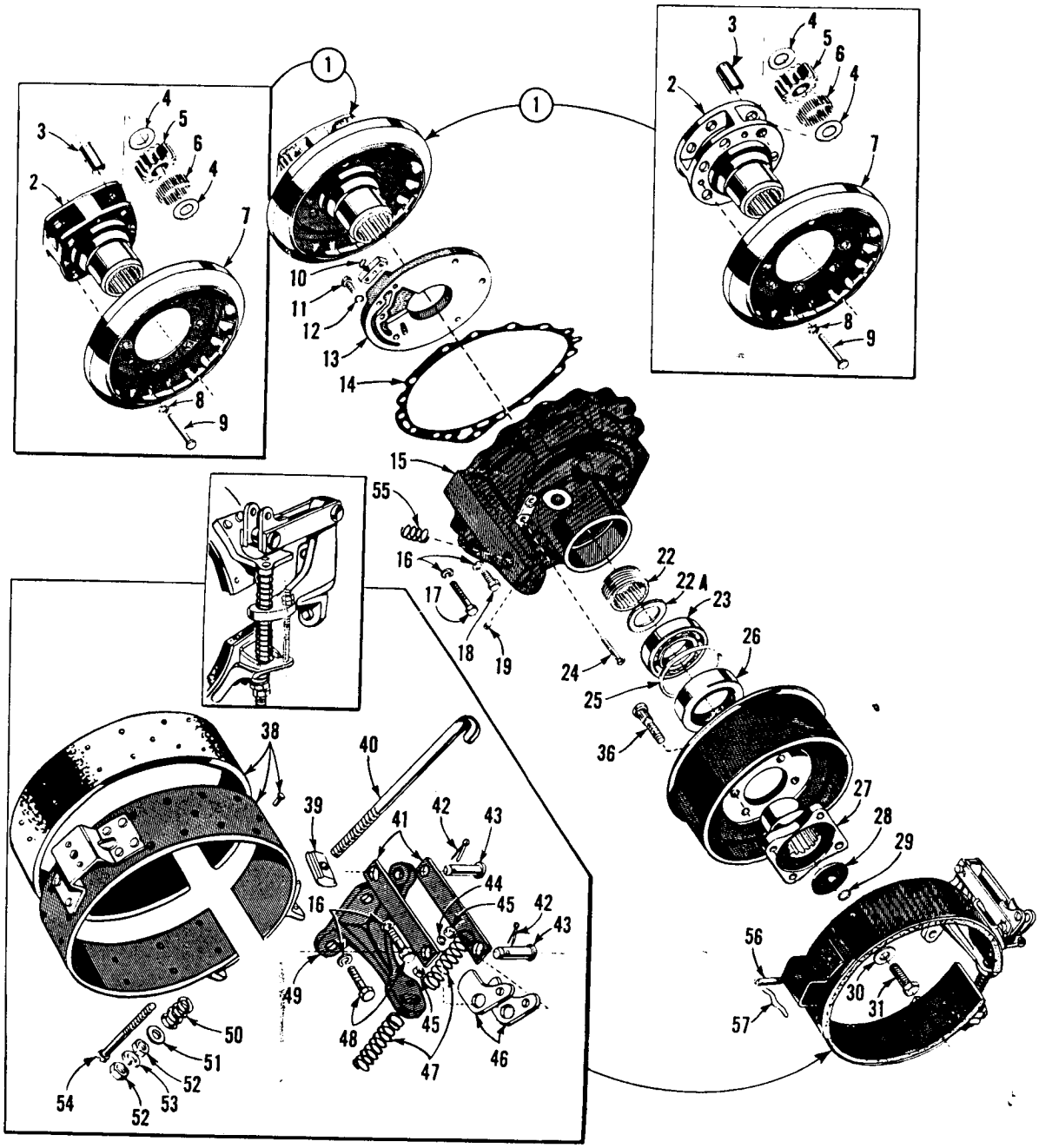
1 - Reverse planetary carrier assy
2 - Reverse planetary carrier
3 - Planetary carrier pinion pin
4 - Thrust washer
5 - Planetary carrier pinion
6 - Roller
7 - Rear pitot collector ring
8 - External lock washer
9 - Rivet, 1/4 x 2-1/2
10 - Rear pitot tube
11 - Bolt, 5/16-18 x 1-3/8
12 - Washer, 5/16 lock
13 - Rear pitot adapter
14 - Bearing retainer gasket (AR) - 0.012 thk
- 0.016 thk
- 0.021 thk
15 - Rear bearing retainer
16 - Washer, 7/16 lock
17 - Bolt, 7/16-14 x 2-1/2
18 - Bolt, 7/16-14 x 1-3/8
19 - Pipe plug, 1/8-27
20 - Speedo bushing
21 - Oil drain tube
22 - Speedo drive gear
22A - Washer
23 - Ball bearing assy
24 - Rear pitot bolt
25 - Internal snap ring
26 - Output flange seal
27 - Output flange
28 - Flange retainer washer
29 - Seal ring
30 - Tab lock washer
31 - Bolt, 1/2-20 x 1-1/2
32 - Shield
33 - Brake assy
34 - Lock washer, 5/8
35 - Bolt, 5/8-11 x 1-3/8
36 - Serrated shank bolt
37 - Brake drum
38 - Brake band assembly
39 - Brake cam shoe
40 - Brake adjusting bolt
41 - Brake cam link
42 - Cotter pin, 1/8 x 7/8
43 - Clevis pin, 1/2 x 1-27/64
44 - Lock washer, 1/4
45 - Hexagon nut, 1/4-20
46 - Brake cam
47 - Brake release spring
48 - Bolt
49 - Brake bracket
50 - Brake adjusting bolt spring
51 - Plain washer, 1-1/8 od x 1/2 id
52 - Hexagon nut
53 - Lock washer
54 - Slotted fillister-head screw 1/4-20 x 3-1/4
55 - Brake band anchor bolt spring
56 - Clip screw
57 - Lock wire

Foldout 7. Reverse-range planetary, rear-bearing retainer, and parking brake — exploded view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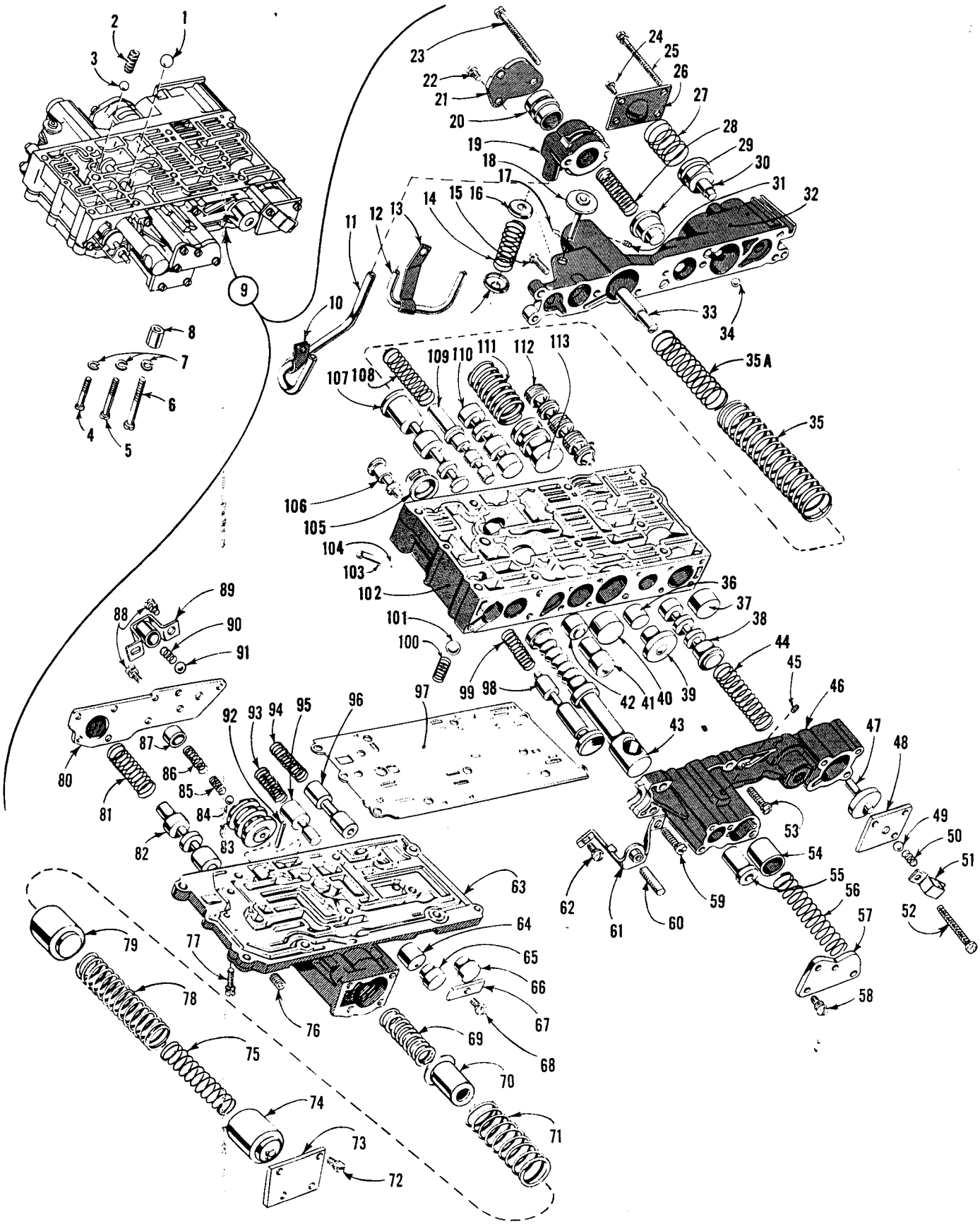
1 - Nylon ball, 1/2
2 - Shift valve detent spring
3 - Shift valve detent ball
4 - Bolt, 1/4-20 x 2-3/4
5 - Bolt, 1/4-20 x 3-1/4
6 - Bolt, 1/4-20 x 3-3/4
7 - Lock washer, 1/4
8 - Valve body bolt sleeve
9 - Control valve body assy
10 - Drive transfer tube clip
11 - Drive transfer tube
12 - High transfer tube
13 - High transfer tube clip
14 - Pump overage regulator spring
15 - Screw and washer, 10-24 x 3/4
16 - Regulator spring retainer
17 - Retainer spring
18 - Pump overage regulator valve assy
19 - Overcontrol valve body
20 - Overcontrol valve
21 - Overcontrol valve cover
22 - Screw and washer, 10-24 x 7/16
23 - Screw and washer, 10-24 x 2-3/8
24 - Screw and washer, 10-24 x 7/16
25 - Screw and washer, 10-24 x 2-3/8
26 - Intermediate-to-high shift valve cover
27 - Intermediate-to-high shift valve spring
28 - Splitter shift plug spring
29 - Splitter shift plug
30 - Intermediate-to-high blocker plug
31 - Oval point setscrew, 10-24
32 - Valve body front cover
33 - Throttle valve plug
34 - Nylon ball, 1/4
35 - Main-pressure regulator valve spring (primary)
35A - Main-pressure regulator valve spring (secondary)
36 - Front splitter shift (G1) plug
37 - Intermediate-to-high shift plug
38 - Low-to-intermediate shift valve
39 - Rear-splitter shift (G2) plug
40 - Lockup plug
41 - Regulator plug
42 - Hydraulic retarder regulator plug
43 - Manual selector valve
44 - Intermediate-to-low shift valve spring
45 - Oval point setscrew, 10-24
45A - Oval point setscrew, 10-24
46 - Valve body rear cover
47 - Accelerator plug
48 - Accelerator plug cover
49 - Ball
50 - Trimmer ball regulator spring
51 - Valve guide bracket assy
52 - Screw and washer, 10-24 x 1-5/8
53 - Screw and washer, 10-24 x 3/4
54 - Accumulator valve
55 - Lockup knockdown plug
56 - Accumulator valve spring
57 - Regulator cover
58 - Screw and washer, 10-24 x 7/16
59 - Screw and washer, 10-24 x 3/4
60 - Throttle valve adjusting screw
61 - Throttle valve retainer
62 - Screw and washer, 10-24 x 3/8
63 - Exhaust regulator valve body
64 - Low-splitter exhaust regulator plug
65 - Low-splitter exhaust regulator stop plug
66 - Intermediate-exhaust regulator stop plug
67 - Plug retainer
68 - Screw and washer, 10-24 x 7/16
69 - Trimmer secondary spring
70 - Trimmer stop
71 - Trimmer primary spring
72 - Screw and washer, 10-24 x 7/16
73 - Trimmer cover
74 - Trimmer valve
75 - Trimmer return inner spring
76 - Pipe plug, 1/4
77 - Screw and washer, 10-24 x 3/4
78 - Trimmer return outer spring
79 - Trimmer plug
80 - Exhaust regulator valve cover
81 - Lockup cutoff valve spring
82 - Lockup cutoff valve
83 - Extender valve body
84 - Extender valve ball
85 - Extender valve ball spring
86 - Extender valve return spring
87 - Extender valve
88 - Screw and washer, 10-24 x 7/16
89 - Valve guide bracket assy
90 - Trimmer ball regulator spring
91 - Ball
92 - Extender valve body roll pin
93 - Low-splitter exhaust regulator valve spring
94 - Intermediate exhaust regulator valve spring
95 - Low-splitter exhaust regulator valve
96 - Intermediate exhaust regulator valve
97 - Valve body separator plate
98 - Throttle valve
99 - Throttle valve (TV) spring
100 - Selector valve detent spring
101 - Selector valve detent ball
102 - Control valve body
103 - Reverse lockup inhibitor check valve retainer
104 - Nylon ball, 7/32
105 - Reverse-range clutch exhaust regulator valve assy
106 - Throttle regulator valve
107 - Main-pressure regulator valve
108 - Lockup shift valve spring
109 - Lockup shift valve
110 - Splitter shift valve
111 - Splitter relay valve spring
112 - Intermediate-to-high shift valve
113 - Splitter relay valve

Foldout 8. Control valve body – exploded view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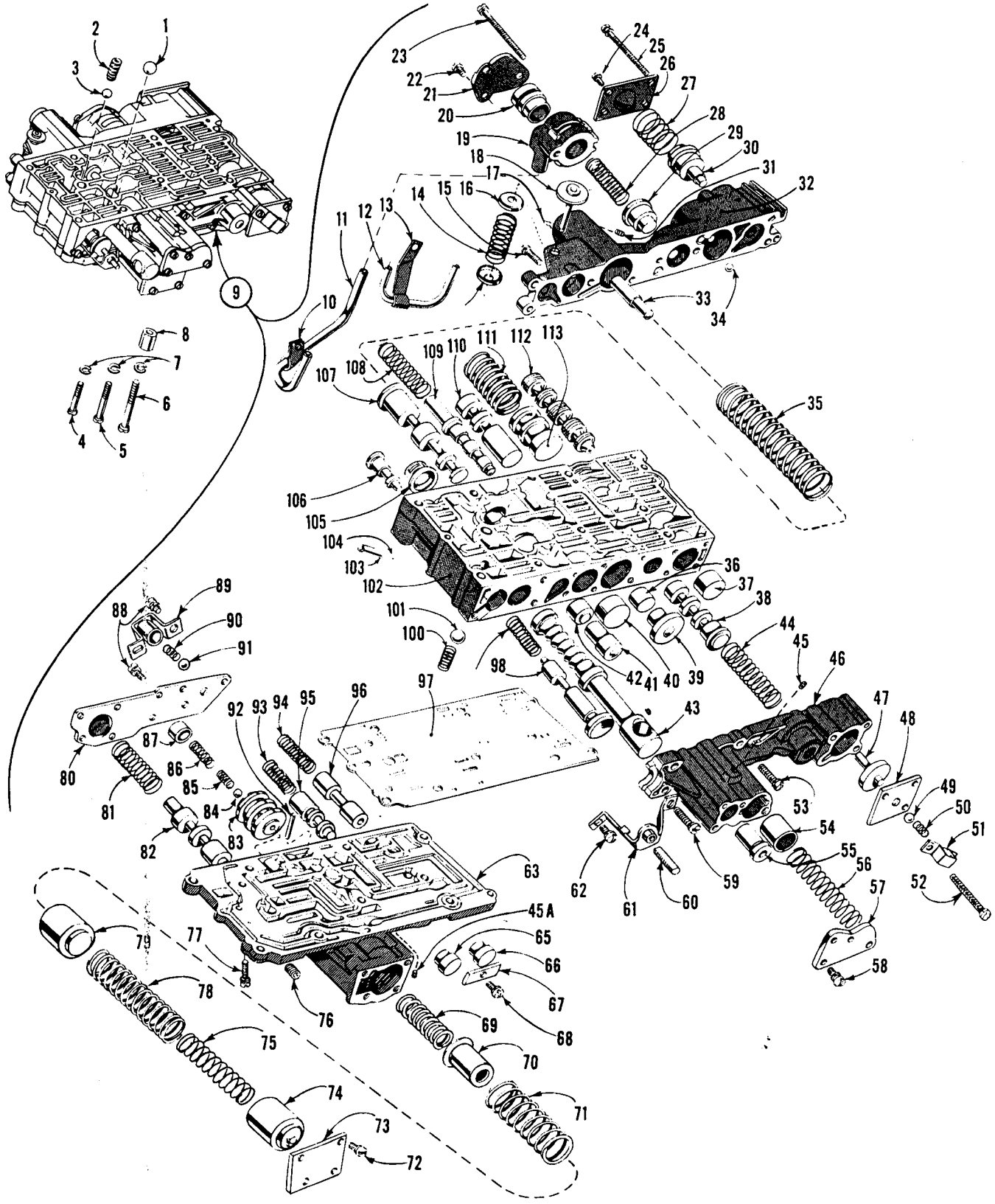
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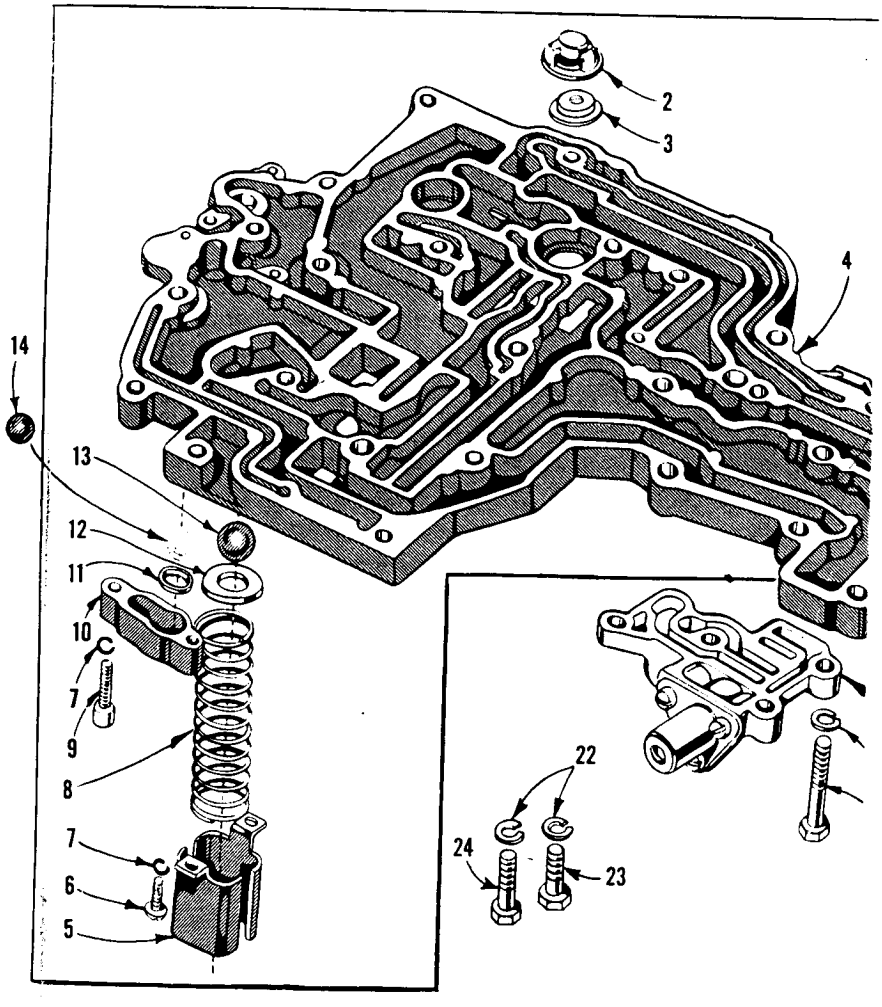
1 - Oil transfer plate assy
2 - Valve assy
3 - Orifice cup
4 - Oil transfer plate
5 - Converter pressure regulator valve retainer
6 - Screw, 10-24 x 1/2
7 - Lock washer, No. 10
8 - Converter pressure regulator spring
9 - Screw, 10-24 x 1
10 - Converter lubrication supply cover
11 - Converter lubrication valve seat
12 - Washer
13 - Converter pressure regulator valve ball
14 - Nylon ball, 3/8 dia
15 - Downshift timing valve body assy
16 - Downshift timing valve body
17 - Downshift timing valve
18 - Downshift timing valve spring
19 - Downshift timing valve cover
20 - Screw and washer, 10-24 x 3/8
21 - Bolt, 1/4-20 x 1-3/8
22 - Lock washer, 1/4
23 - Bolt, 1/4-20 x 3/4
24 - Bolt, 1/4-20 x 7/8

Foldout 9. Oil transfer plate and downshift timing valve – exploded view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FOLDOUT No. 9