Allison Transmissions

TRT 4820, 4821 Series Service Manual

IMPORTANT SAFETY NOTICE

IT IS YOUR RESPONSIBILITY to be completely familiar with the warnings and cautions described in this service manual. These warnings and cautions advise against the use of specific service methods that can result in personal injury, damage to the equipment, or cause the equipment to be unsafe. It is, however, important to understand that these warnings and cautions are not exhaustive. Detroit Diesel Allison could not possible know, evaulate and advise the service trade of all conceiveable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, Detroit Diesel Allison has not undertaken any such broad evaluation. Accordingly, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY DETROIT DIESEL ALLISON MUST first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service methods selected.

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

WARNINGS, CAUTIONS, AND NOTES

Three types of headings are used in this manual to attract your attention.

WARNING is used when an operating procedure, practice, etc., which, if not correctly followed could result in personal injury or loss of life.

CAUTION is used when an operating procedure, practice etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE is used when an operating procedure, practice, etc., is essential to highlight.

LIST OF WARNINGS

Do not burn discarded Teflon seals. Toxic gases are produced by burning.

Never dry bearings by spinning them with compressed air. A spinning bearing can disintegrate, allowing balls or rollers to become lethal flying projectiles. Also, spinning a bearing while it is not lubricated can damage the bearing.

SA 1363B

Service Manual

Allison Transmissions

POWERSHIFT MODELS

TRT 4820-1, 4821-1

1 NOVEMBER 1981

Detroit Diesel Allison
Division of General Motors Corporation
Indianapolis, Indiana 46206

Printed in U.S.A.

NOTE:

This publication is revised periodically to include improvements, new models, special tools, and procedures. Revision is indicated by letter suffix to publication number. Check with your Detroit Diesel Allison service outlet for currently applicable publication. Additional copies of this publication may be purchased from authorized Detroit Diesel Allison service outlets. See your yellow pages under Engines—Diesel or Transmissions—Truck, Tractor, etc.

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Section 1. GENERAL INFORMATION

1-1. SCOPE OF MANUAL

a. Coverage. This Service Manual describes the operation, maintenance and overhaul procedures for the TRT 4820, 4821 transmissions (fig. 1-1, 1-2, and 1-3). The function and operation of the hydraulic systems, torque paths, wear limits, inspection procedures and torque specifications are included.

b. Illustrations. Transmission features and overhaul procedures are illustrated mainly by photographs. Line drawings are used to supplement detailed assembly procedures; cross sections show torque paths and the relationship of assembled parts. Cross sections, color-coded hydraulic schematics, and parts exploded views are on foldouts at the back of this manual. The foldouts may be opened for reference while studying the text.

c. Maintenance Information. Each task outlined in this Service Manual has been successfully accomplished by service organizations and individuals. It is not expected that every service organization or individual will possess the required special tooling, training, or experience to perform all the tasks outlined. However, any task outlined herein may be performed if the following conditions are met:

(1) The organization or individual has the required knowledge of the task through:

- Formal instruction in a DDA or Distributor training facility.
- "On-the-job" instruction by a DDA or Distributor representative.
- Experience in performing the task.

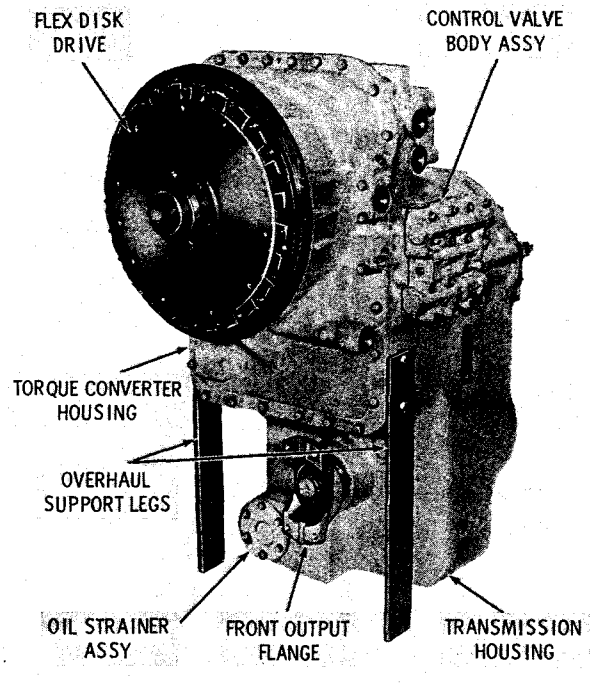


Fig. 1-1. TRT 4800 series transmission, direct mount--left-front view

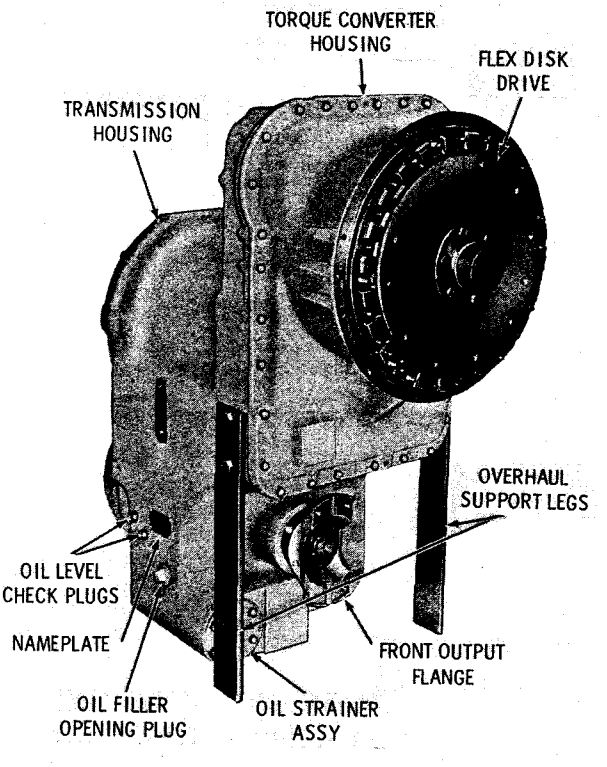


Fig. 1-2. TRT 4800 series transmission, direct mount--right-front view

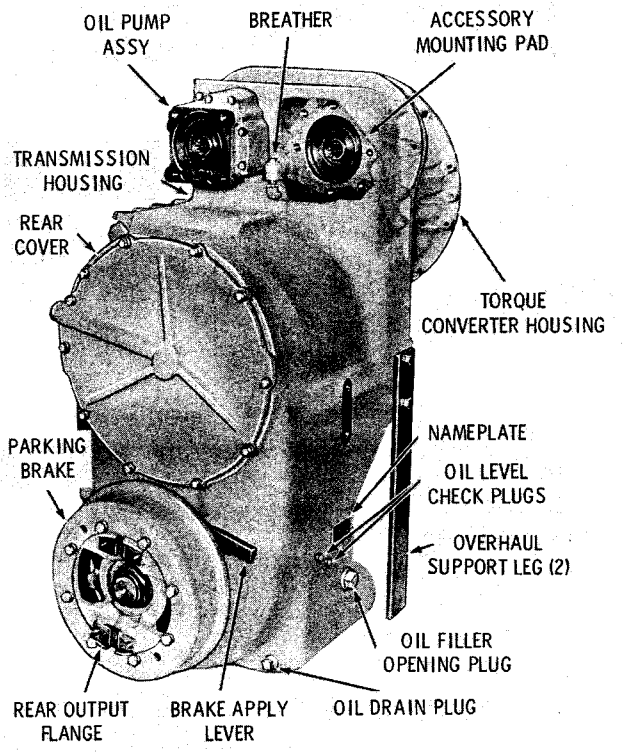


Fig. 1-3. TRT 4800 series transmission--right-rear view

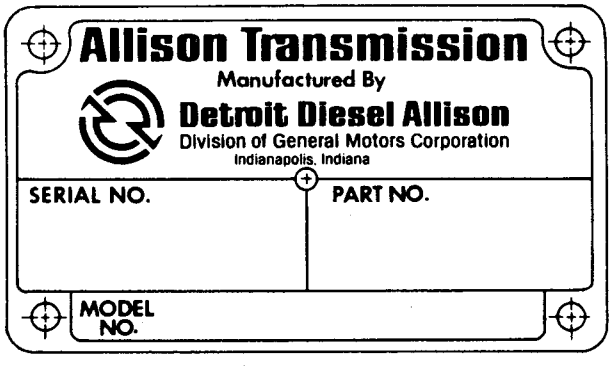


Fig. 1-4. Transmission nameplate

(2) The work environment is suitable to prevent contamination or damage to transmission parts or assemblies.

(3) Required tools and fixtures are available as outlined in the Service Manual.

(4) Reasonable and prudent maintenance practices are utilized.

NOTE

Service organizations and individuals are encouraged to contact their local DDA Distributor for information and guidance on any of the tasks outlined herein.

1-2. SUPPLEMENTARY INFORMATION

Supplementary information will be issued, as required, to cover any improvements which occur after publication of this manual. Check with your dealer for the latest information.

1-3. ORDERING PARTS

a. Transmission Nameplate. The nameplate (fig. 1-4), located on the lower right side of the transmission housing, has the serial number, part number (assembly number), and model number, all of which must be supplied when ordering replacement parts or requesting service information.

b. Parts Catalog. All replacement parts and service kits should be ordered from your dealer. These parts are listed in the current Parts Catalog SA 1158. Do not order parts by illustration item numbers used in this Service Manual.

1-4. DESIGN FEATURES

a. Mounting and Input Drive (foldout 1)

(1) The transmission may be direct-mount or remote-mount. A direct-mount transmission is coupled to the engine through an SAE 2 mounting face on torque converter housing 3, which is bolted to the engine flywheel housing. Flex disk drive assembly 2 is bolted to the engine flywheel.

(2) A remote-mount transmission is equipped with front cover 6. Input shaft 5 extends through the front cover and receives the customer selected flange. Input flange 4 is driven by the engine through a drive shaft and universal joints.

b. Twin-Turbine Torque Converter (foldout 1)

(1) A four-element twin-turbine torque converter transmits power from the engine to the transmission gearing through two sets of turbine gears.

(2) When torque demand is high, the freewheel clutch is engaged and the first turbine, assisted by the second turbine, drives the range gears. When the speed of the vehicle increases and torque demand decreases sufficiently, the second turbine assumes the entire load and the freewheel clutch disengages. The transition from both turbines to second turbine only (high torque to high speed) is automatic, and occurs when the load demand has reduced to a level that can be supplied by the second turbine.

c. Range Gearing, Clutches (foldout 1). The transmission has three planetary gear sets and four clutches. A range clutch always works in conjunction with either the forward or reverse clutch to produce the operator-selected gear ratio and direction of travel. All four multiplate clutches are hydraulically applied and spring released. All gearing is in constant mesh.

d. Transfer Gears (foldout 1). Two transfer spur gears are in constant mesh and provide a 24-inch (610 mm) vertical drop from the input shaft to the output shaft. The transfer gears drive the output shaft.

e. Output Shafts (foldout 1). The transmission has either a one-piece output shaft for front and rear drive or a two-piece output shaft which provides optional single-axle drive for roading the vehicle.

f. Oil Pump (foldout 1). A positive displacement, three-gear oil pump 15 furnishes the oil flow and pressure for hydraulic operation, lubrication, and cooling of the transmission components. Either an SAE C, four-bolt or two-bolt mounting pad is provided at the rear of the pump to accommodate an implement pump. Rotation at this pad is clockwise (as viewed from the rear), and the speed is the same as that of the engine. Lubrication is supplied to the splined drive and a customer-supplied gasket is required at the mounting surface.

g. Accessory Drive Pad

(1) An SAE C, four bolt or two bolt mounting pad is located at the rear, upper-right corner of the transmission housing to accommodate a steer pump or other accessory (in addition to the pad at the oil pump). Rotation at this pad is clockwise (as viewed from the rear), and the speed is the same as that of the engine. Lubrication is supplied to the splined drive and a customer-supplied gasket is required at the mounting surface.

(2) If no requirement exists for a drive at this location, the drive gear and related parts are omitted, and the openings in the housing are plugged.

h. Control Valve Body Assembly

(1) The control valve body assembly is located on the left side of the transmission housing (fig. 1-1). Movement of the valves within the valve body controls the functions of the transmission. The control valve body assembly contains, in addition to the pressure regulator, range selector, and related components, either a clutch cutoff valve or an inching valve.

(2) The range selector valve permits the operator to control the transmission with a single shift lever. Movement of the selector valve produces either forward or reverse operation in the selected gear ratio.

(3) The clutch cutoff valve permits the operator to divert engine power to the PTO driven equipment, without shifting to neutral. The clutch cutoff valve is actuated by either hydraulic or pneumatic brake pressure when the vehicle service brakes are applied.

(4) The inching valve permits the operator to maneuver the vehicle in confined areas, without loss of power to the

PTO driven equipment. The inching valve is manually actuated through linkage from the operator's controls.

i. Parking Brake. The transmission may be equipped with a 12 x 3 in. (305 x 76 mm) expanding shoe parking brake. The brake is mechanical and is manually operated.

j. Oil Filter, Cooler. Provision is made for connecting a remote-mount, full flow oil filter and an oil cooler to the transmission (both customer furnished). Refer to figure 3-1.

1-5. OPERATING INSTRUCTIONS

NOTE
Refer to Operators Manual SA 1336.

a. Related to Vehicle. For information on controls and linkage provided by the vehicle manufacturer, refer to the vehicle service manual.

b. Range Selection

(1) Position the range shift lever in neutral before starting the engine. A neutral start switch (if used) will prevent the engine from starting in any other position.

(2) When a shift is made from neutral to any driving range, the engine should be at idle. An upshift to a higher speed range in the same direction can be made at full throttle and load. A downshift to a lower speed range can be made at full throttle and load, providing the vehicle is not exceeding the maximum speed attainable in the lower range.

c. Changing Direction of Travel. Directional shifts can be made under full power or full speed conditions in the working ranges (F1 to R1 and R1 to F1). Shifts from reverse should be made to F1 drive range--not F2. Direct shifts from R2 to F1 or F2, and F2 to R1 or R2 should not be made; shifts of this nature will adversely affect clutch service life.

d. Clutch Cutoff Control. When the transmission is equipped with a clutch cutoff control, application of the vehicle brakes releases the high range and/or forward clutch(es). Thus, without shifting to neutral, full engine power is available for PTO driven equipment in all ranges except low-range reverse (R1). In earlier models, the clutch cutoff is functional in all operating ranges, but the response time for reengagement of the clutch(es) is longer.

e. Inching Control. Applying the inching control releases the driving clutch. The inching control may be used during operation in any range except that its use in high range (F2 and R2) is not recommended above creeping speeds. Full application will completely release the driving clutch; lesser application will slip the clutch while it is driving. Very slight and slow movements of the vehicle can be made with this control while maintaining full throttle and hydraulic efficiency. Additional cooling and lubricating oil is supplied to the driving clutch during inching operation.

f. Output Disconnect (foldout 1). The transmission front output may be disconnected by actuating disconnect shifter shaft 41 which moves disconnect coupling 38 forward. Rearward movement of the shifter shaft connects front and rear output shafts 40 and 35 through the splines of the coupling. Two spring-loaded ball detents retain the coupling in either position. The control should never be shifted while the vehicle is moving.

g. Temperatures, Pressures

(1) When a transmission is equipped with a temperature gage, the bulb or sending unit is mounted in the converter-out oil line (fig. 3-1). The temperature indicator should never be permitted to exceed 275°F (135°C) or be in the red band on the gage. If extended, severe operating conditions cause the temperature to reach this maximum, shift the transmission to neutral and run the engine at 1000-1500 rpm for several minutes until a normal temperature of 180-220°F (82 to 104°C) is restored. If the temperature

reaches 275°F (135°C) or red band during normal operation of the transmission, stop the engine and locate the trouble. Refer to the Troubleshooting Chart (para 3-11).

(2) When a transmission is equipped with a clutch (main) pressure gage, it is connected to the front of the control valve body assembly (fig. 3-1). The pressure shown is that which is effective in the operating range clutch. Shifting or use of the clutch cutoff or inching control will cause fluctuations in the indicated pressure. If abnormal pressures are evident, refer to the Troubleshooting Chart (para 3-11).

1-6. SPECIFICATIONS, DATA

The following specifications and data are applicable to all models within the scope of this Service Manual.

SPECIFICATION AND DATA CHART

Transmission type	torque converter and planetary gear	
Input rating (max):		
speed	2800 rpm	
torque	630 lb ft (854 N·m)	
power	355 hp (264.7 kW)	
Speeds -- forward	2	
-- reverse	2	
Weight, dry	1640 lb (743.9 kg)	
with remote mounting, add	40 lb (18.1 kg)	
with parking brake, add	35 lb (15.9 kg)	
with TT 600 converter, add	15 lb (6.8 kg)	
Rotation, viewed from input end:		
input	clockwise	
outputs, forward operation	clockwise	
Gear ranges, selector positions	high range forward (F2) low range forward (F1) neutral low range reverse (R1) high range reverse (R2)	
Gear ratios	0.846:1 T2 Ratio	1.48:1 T2 Ratio
high range forward (F2)	0.69:1	1.21:1
low range forward (F1)	2.58:1	4.52:1
low range reverse (R1)	2.35:1	4.11:1
high range reverse (R2)	0.63:1	1.10:1
(for overall ratios at stall, multiply by applicable converter ratio)		
Gearing	constant mesh, straight spur, planetary type; in-line transfer gearing	

SPECIFICATION AND DATA CHART (continued)

Mounting, drive:
- side . . . . . four 5/8-11 tapped holes in side pads, each side
- front, direct mounted. . . . . SAE 2 flange on converter housing, bolts to engine flywheel housing, flex plate drive
- front, remote mounted. . . . . front unmounted, converter enclosed, input flange for shaft and universal joint coupling

Torque converter . . . . . 2-stage, 2-phase, 4-element, twin turbine

torque multiplication ratio. . . .	0.846:1 T2 Ratio		1.48:1 T2 Ratio	
	TT425	5.18:1	TT 626	2.76:1
	TT430	6.61:1	TT 646	2.86:1
	TT445	4.92:1		
	TT450	6.34:1		
	TT465	4.67:1		
	TT470	6.01:1		
	TT615	5.25:1		
	TT625	5.21:1		
	TT645	4.91:1		

Clutch - type. . . . . multiplate, hydraulic actuated, spring released, oil cooled
- material. . . . . reaction plates - polished steel
  friction plates - resin graphite

Parking brake - type . . . . . Drum, 12 x 3 in. (305 x 76 mm) internal expanding shoes, mechanically applied
- static burnished rating* . . . 90,000 lb in. (10 170 N·m) at 567 lb (2560 N) apply lever force, lever length 7.38 in. (187 mm)

Flanges:
- input. . . . . Torqmatic coupling (Mechanics 7C); Mechanics 7C
- output . . . . . Mechanics 7C, 8C, 9C; Rockwell 7N; Spicer 1700, 1800

Oil system:
- oil pump . . . . . input driven, positive displacement dual section, gear type
- sump . . . . . integral
- oil type C-3
- fluid viscosity and grade — Ambient temperatures below which preheat of the transmission is required

30.	32°F (0°C)
15W-40.	15°F (-9.4°C)
10W, 10-10W	-10°F (-23.3°C)
5W-20	-30°F (-34.4°C)

*Brake is supplied unburnished. Unburnished static rating may be 66 percent less.

SPECIFICATION AND DATA CHART (continued)

oil capacity	40 U.S. quarts (38 litres) (excluding external circuit)
converter outlet oil pressure, at full throttle stall	40-65 psi (276-448 kPa)
lubrication pressure, at full throttle stall	15-30 psi (103-207 kPa)
main pressure	165-190 psi (1138-1310 kPa)
converter-out oil temperature	275°F (135°C) max
oil filter	remote mounted (supplied by customer)
oil cooler	remote mounted (supplied by customer)
pump output pressure (with clean filter)	230 psi (1586 kPa) max
Control valve body:	
range selector	manual actuated
clutch cutoff	hydraulic or pneumatic brake pressure actuated
inching control	manual actuated
Power takeoff ratings:	
duty cycle	
continuous - either pad	120 hp (89 kW) 315 lb ft (427 N·m)
intermittent - either pad	160 hp (119 kW) 420 lb ft (570 N·m)
combined rating - both pads	240 hp (179 kW)

Section 2. DESCRIPTION AND OPERATION

2-1. SCOPE OF SECTION 2

This section describes the hydraulic system and torque paths and the transmission components and their fuctions.

2-2. TWIN-TURBINE TORQUE CONVERTER

a. Description (foldout 1). The torque converter consists of torque converter pump 54, stator 56, first turbine 9 and second turbine 8. The pump is the driving member and rotates at engine output speed. The first turbine and second turbine are driven members and are connected to the transmission range gearing by transfer gears 16, 17, 51 and 52. The stator is the reaction member.

b. Operation (foldout 1). During operation, the first and second turbines function jointly or separately, depending upon the load demand and the speed of the vehicle. The first turbine gear train consists of gears 16 and 51. The second turbine gear train consists of gears 17 and 52. Freewheel clutch 53 permits the two turbines to operate jointly or separately. When load demand is high, and vehicle speed is low, the freewheel clutch is engaged. This causes both turbines to drive the range gearing, and provides maximum torque. As vehicle speed increases, and torque demand decreases, the second turbine speed approaches that of the first turbine. Then, the first turbine freewheels and the second turbine transmits all the torque to the range gearing. An increase in torque demand and the resulting decrease in vehicle speed will again cause the freewheel clutch to engage, and both turbines will drive the range gearing.

2-3. FORWARD, REVERSE GEARING AND CLUTCHES (foldout 1)

a. There are two planetary gear sets for the forward and reverse gearing. The reverse planetary has four pinion gears 50 and is connected to the forward planetary by reverse ring gear 47. The forward planetary has six pinion gears 49 and is connected to high range planetary carrier 24. The forward and reverse planetary gear sets are driven by forward and reverse sun gear 21.

b. Reverse and forward clutches 19 and 20 consist of two types of clutch plates: friction-faced internal-splined steel plates and external-tanged steel plates. In each clutch, these plates are stacked alternately. The clutches are hydraulic-applied, oil-cooled and spring-released. When the reverse clutch is applied, reverse carrier 18 is held stationary. When the forward clutch is applied, forward ring gear 46 is held stationary.

2-4. HIGH- AND LOW-RANGE GEARING AND CLUTCHES (foldout 1)

a. High-range and low-range operation is obtained through the high-range planetary gear set and clutches. The high-range planetary has four pinions 30 and is driven by forward planetary carrier 22.

b. High-range and low-range clutches 23 and 25 consist of two types of clutch plates: internal-splined friction-faced plates and external-tanged steel plates. In each clutch, these plates are stacked alternately. The clutches are hydraulic-applied, oil-cooled and spring-released. When the high-range clutch is applied, high-range ring gear 31 is held stationary. When the low-range clutch is applied, transfer drive gear 32 is locked to the high-range planetary gear set.

2-5. TRANSFER GEARS, OUTPUT SHAFTS (foldout 1)

a. Transfer Gears. The transfer gears consist of two spur gears which are in constant mesh. Drive gear 32 is bolted to the low-range clutch backplate. Driven gear 37 is located directly below the drive gear and is splined to output shaft 35 or 57.

b. Two-Piece Shaft. The two-piece shaft allows front output shaft 40 to be disconnected from the driveline. The front disconnect consists mainly of disconnect coupling 38 which is manually shifted by disconnect shifter shaft 41. In the engaged position (shown), torque from the rear output shaft is transmitted through the coupling splines to the front output shaft. In the disconnect position, the coupling is moved forward and rides entirely on the front output shaft. Thus, the torque to the front shaft is interrupted.

c. One-Piece Shaft. Output shaft 57 provides identical operation at the front and rear outputs.

2-6. PARKING BRAKE (foldout 1)

An internal, expanding shoe brake 33 may be mounted at the rear output location. The backplate of the brake assembly is bolted to the bosses at the rear of the transmission housing, and the drum is bolted to the output flange. The brake is manually applied.

2-7. OIL PUMP (foldout 1)

a. Oil pump assembly 15 consists mainly of three spur gears, the body assembly and the cover. The pump is driven by accessory and oil pump driven gear 12 which rotates any time the engine is running.

b. When the engine is running, rotation of the pump gears draws transmission oil through oil strainer 46 (B, foldout 4) and suction tube 5 and pumps the oil into two pressure cavities within the pump. One cavity directs the oil through lubrication pressure tube assembly 9 to the forward and reverse clutches for cooling and lubrication. The other cavity directs the oil through passages in the housing to the control valve body assembly where the oil is directed to other areas for clutch application, cooling and lubrication.

2-8. IMPLEMENT PUMP, ACCESSORY DRIVE PADS (foldout 1)

a. Implement Pump Drive Pad. The implement pump drive pad is located at the rear face of oil pump assembly 15. The pad may be either an SAE C four-bolt or SAE C two-bolt configuration. Drive at this location is furnished by accessory and oil pump driven gear 12. The driven gear rotates at engine speed any time the engine is running. Rotation is clockwise (as viewed from the rear) regardless of the range selector position. Implement drive coupling 19 (A, foldout 8) may be used to accommodate a B-size spline to the C-size splines in the driven gear.

b. Accessory Drive Pad. The accessory drive pad is located at the upper-right rear face of the transmission housing. The pad will accommodate either a two-bolt or a four-bolt SAE C mounting flange. Drive at this location is furnished by accessory driven gear 2 (B, foldout 4). The driven gear rotates at engine speed anytime the engine is running. Rotation is clockwise (as viewed from the rear). For vehicles that do not require a power takeoff at this location, the accessory driven gear (and related parts) are omitted and the opening in the housing and lubrication orifice are closed with plugs 37 and 35.

2-9. CONTROL VALVE BODY ASSEMBLY

a. Control Valve Body (B, foldout 7). The control valve body contains three significant valves: manual selector valve 27, main pressure regulator valve 8, and either clutch cutoff valve 20 or inching control valve 43. The remaining components assist the control functions. The main pressure regulator valve components and trimmer plug components are located in the upper bore. The clutch cutoff valve (or inching control valve) components are in the middle bore. The selector valve components are in the lower bore.

b. Main Pressure Regulator, Selector Valves (B, foldout 7)

(1) Main pressure regulator valve 8, with trimmer plug 16, regulates the pressures for all hydraulic functions.

(2) The selector valve is a spool valve which is manually moved lengthwise in the bore. Movement of the selector valve

charges and exhausts the appropriate circuits to produce the desired operating range. Spring-loaded detent balls 28 position the valve in each range.

c. Clutch Cutoff Valve (B, foldout 7)

(1) The clutch cutoff valve is a spool valve which is moved rearward by spring 19 and forward by plug 21 when brake hydraulic pressure acts against the plug. In applications that have the cutoff valve actuated by brake air pressure, a miniature air cylinder is mounted at the rear of the valve body. A stem in the air cylinder moves plug 48 forward within retainer plug 49.

(2) During normal operation, clutch cutoff valve 20 is rearward. This allows main pressure to flow through the right end of the selector valve bore and into the trimmer circuit. When vehicle brakes (hydraulic or air) are applied, valve 20 moves against spring 19. This interrupts the flow of main pressure to the right end of the selector valve and releases the high and/or forward clutches.

d. Inching Control Valve (B, foldout 7)

CAUTION

Do not use the inching control during high range operation. No provision is made for cooling the high range clutch during inching operation.

(1) Inching control valve 43 is a spool valve that is manually controlled by the vehicle operator through mechanical linkage. Valve return spring 44 and main oil pressure hold the valve in the "clutch-on" (noninching) position and full main oil pressure is directed to the range selector valve.

(2) When the inching control is moved (manually), main pressure applying the driving clutch is bled-off through an oil passage to the driving clutch plate area. This reduces main pressure available to apply the clutch, allowing it to slip. At the same time, the oil being bled off cools and lubricates the slipping clutch. This bled off oil supplements the direct flow from the oil pump. The degree of inching valve movement determines the degree of slippage, from full apply to full release. Inching regulator valve 40 and spring 42 maintain a uniform clutch apply pressure at any given position.

2-10. HOUSINGS, COVERS

a. Torque Converter Housing. Torque converter housing 8 (B, foldout 3) is cast iron. It covers the large front opening of the transmission housing. It supports and encloses the torque converter components. It is the front supporting member for the accessory drive gears and the converter gears. In direct-mount transmissions, the front of the converter housing bolts to the engine flywheel housing. In remote-mount transmissions, it supports front cover 7 (A, foldout 2).

b. Transmission Housing

(1) Transmission housing 14 (B, foldout 4) is cast iron and is the main structural member of the transmission assembly. It supports and encloses the rear end of the accessory driven gears and converter driven gears. It supports and encloses the range gearing and clutches, output transfer gears, output shafts and front disconnect components. It provides an external mounting surface for the transmission oil pump and accessory pump. It includes passages for oil circuits. It also provides a mounting pad on the left side for the control valve body assembly.

(2) The lower section of the housing provides a sump for the oil necessary for operation, lubrication, cooling and control functions. Two flat mounting surfaces, with two 5/8-11 tapped holes in each, are provided at each side of the housing.

c. Front Cover. Transmission front cover 7 (A, foldout 2), used on remote-mount assemblies, is cast iron. It is bolted to the front flange of the torque converter housing. It supports the input shaft. It forms an oil-tight enclosure for the torque converter and accessory gear area.

d. Rear Cover. Transmission rear cover 23 or 29 (B, foldout 6) is cast iron, and closes the large circular opening at the rear of the transmission housing. It supports the rear end of the high-range clutch and the output transfer drive gear. The rear cover includes an oil passage which connects the control valve body and high-range clutch.

2-11. HYDRAULIC SYSTEM

a. System Functions. The hydraulic system generates, directs and controls the pressure and flow of the hydraulic fluid within the transmission. The hydraulic fluid transmits power through the torque converter, lubricates and cools the transmission components, applies the clutches and drives the converter turbines.

b. System Schematics (fig. 2-1 and 2-2). Color-coded schematics are presented which illustrate the two hydraulic systems — clutch cutoff (fig. 2-1) and inching control (fig. 2-2).

c. Oil Pump, Filter Circuit. Oil is drawn from the transmission sump, through a wire mesh strainer, into the oil pump. With the exception of the direct flow for cooling and lubricating the reverse and forward clutches, the pump delivers its entire output to a full-flow oil filter which is customer supplied. The oil filter is mounted external to the transmission. From the filter, the oil is returned to the transmission and control valve body assembly.

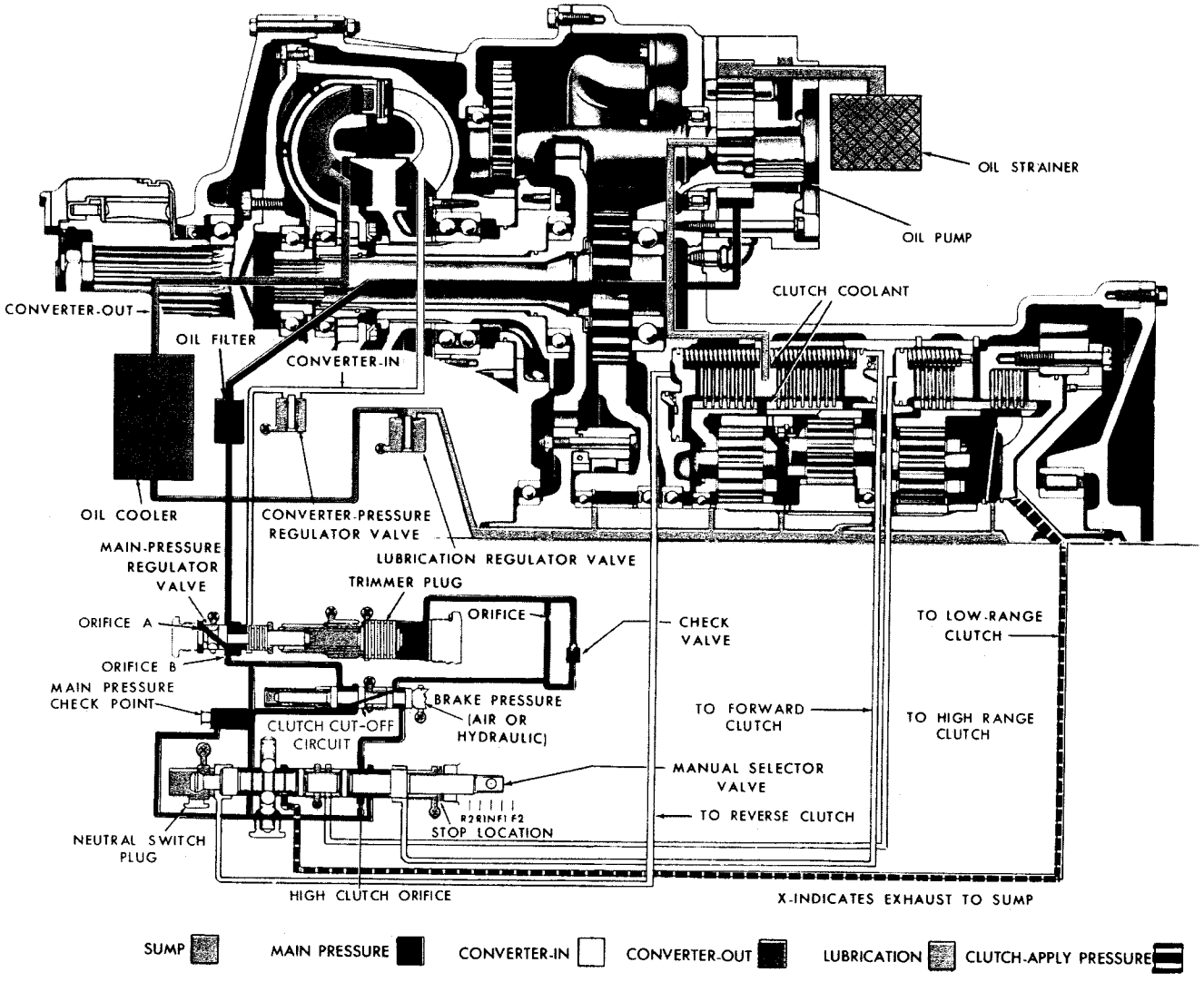


Fig. 2-1. Hydraulic system with clutch cutoff valve--schematic

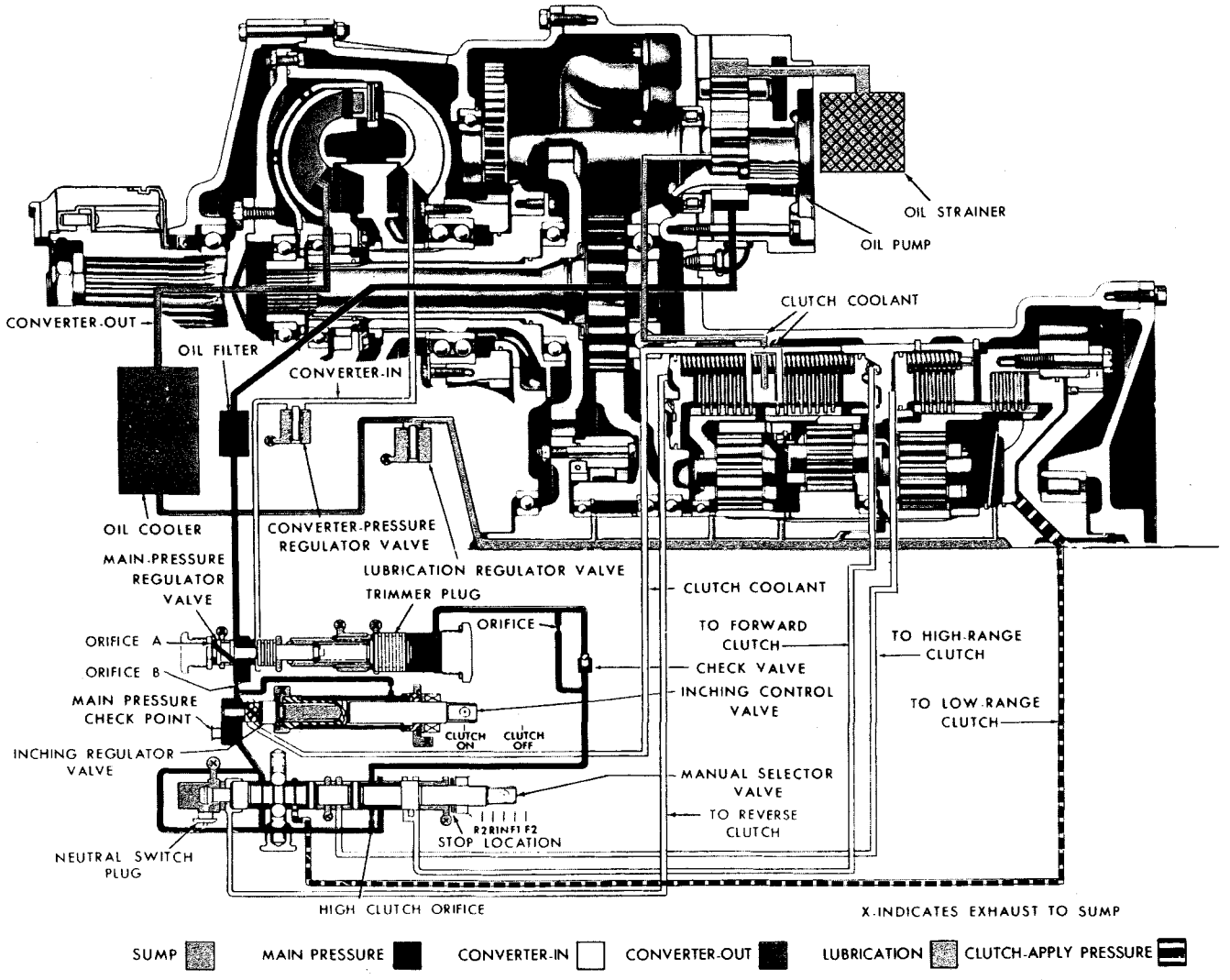


Fig. 2-2. Hydraulic system with inching control valve--schematic

d. Main Pressure Regulator Valve, Converter-in Circuit (fig. 2-1 and 2-2).

(1) At the control valve body assembly, oil from the oil filter (red) enters the valve body and flows around the main pressure regulator valve. The oil also flows through a diagonal passage (orifice A) to the left end of the valve which pushes the valve rightward against a spring until the oil pressure is balanced by spring force.

(2) The rightward movement of the valve against the spring exposes the port to the converter-in circuit (yellow). Oil in excess of that required to maintain main pressure escapes into the converter-in circuit. Under certain conditions, the converter-in circuit is charged with more oil than can be exhausted by the converter pressure regulator valve. The main pressure regulator valve moves farther to the right and allows oil to exhaust (blue) at the left end of the valve. This flow occurs between the two short lands at the left end of the regulator valve.

(3) Oil flowing into the converter-in (yellow) circuit is directed to the torque converter. A pressure regulator valve in the circuit limits converter-in pressure to 80 psi.

e. Torque Converter. The torque converter is continuously filled with oil during transmission operation. Rotation of the converter pump imparts energy to the oil which, in turn, drives the turbines. The oil then flows between the stator vanes which redirect the oil to the pump.

f. Converter-out, Cooler, Lubrication Circuit (fig. 2-1 and 2-2)

(1) Oil flowing out of the torque converter (orange) is directed into the oil cooler. The oil cooler (and oil filter) is customer supplied and vehicle mounted. The oil cooler is a heat exchanger in which the oil flows through water- or air-cooled passages.

(2) From the cooler, oil flows to the lubrication circuit (green) for distribution to the transmission components. All oil in excess of that required to maintain lubrication pressure is exhausted to sump (blue) through the lubrication regulator valve.

(3) Another lubrication and cooling circuit is provided by the lubrication pressure tube. This tube delivers oil directly from the oil pump to the reverse and forward clutches.

g. Clutch Cutoff Valve Circuit (fig. 2-1)

(1) Main pressure oil (red), supplied from the main pressure regulator valve, flows through orifice B to the clutch cutoff valve bore. The clutch cutoff valve directs the flow to the selector valve. The selector valve redirects the flow back through the clutch cutoff valve and into the trimmer circuit.

(2) The clutch cutoff valve is normally in the position shown and functions only when the vehicle brakes are applied. A spring holds the valve rightward, allowing main oil pressure to flow through the valve bore to the manual selector valve and trimmer.

(3) When the vehicle has hydraulic clutch cutoff, hydraulic brake pressure acts directly against a plug which moves the clutch cutoff valve leftward during brake application. When the vehicle has air clutch cutoff, air brake pressure actuates a miniature air cylinder. The air cylinder piston rod pushes the clutch cutoff valve leftward.

(4) When leftward against its spring, the clutch cutoff valve interrupts the flow of main pressure oil to the manual selector valve. In this position, the oil in the trimmer circuit is retained, and the high and/or forward clutch(es) exhaust to sump (blue) through the port shown at the top-center of the valve. Thus, when the vehicle brake is applied, the high and/or forward clutch(es) is released.

(5) When the brake is released, the clutch cutoff valve returns to its normal position (as shown). This allows the oil retained at the trimmer to enter the exhausted clutch circuit. This additional volume from the trimmer assists in the quick application of the clutches.

(6) In later models, in reverse-1 there is no cutoff function. The main pressure oil supply that applies both the reverse and low range clutches, during operation in reverse-1, bypasses the clutch cutoff valve.

h. Inching Control Valve Circuit (fig. 2-2)

(1) Main pressure (red) from the main pressure regulator connects to the inching control valve at two points. One point is at orifice B, directly below the regulator valve. The other point is near the right end of the inching control valve. Pressure at the left passes to the manual selector valve. Pressure at the right helps retract the valve against rightward movement caused by main pressure at the inching regulator valve. A spring keeps the valve retracted when the engine is stopped.

(2) Main pressure at the left pushes the inching regulator valve rightward against a spring which seats in the left end of the inching control valve. When the inching control valve is released, main pressure and spring force at the right end are sufficient to

hold the valve leftward. This exerts sufficient pressure on the regulator spring to hold the inching regulator valve leftward far enough to prevent oil escaping to the clutch lubrication passage. Thus, main pressure is retained at the left end of the inching regulator valve.

(3) When the inching control is actuated, the valve is pulled rightward. This reduces the force of the spring acting against the inching regulator valve, permitting the valve to move rightward. This uncovers a port which directs additional cooling oil to the clutch which slips during inching. The amount of oil which goes to the slipping clutch depends upon the degree of movement of the inching control valve. The escape of oil into the clutch lubrication line reduces main pressure, which causes the driving clutch to slip. Orifice B, directly below the main pressure regulator valve, restricts the flow of oil and causes a lower pressure downstream from the orifice.

(4) Full rightward movement of the inching control valve will completely release the driving clutch. Any degree of clutch engagement is possible by allowing the control to retract.

i. Manual Selector Valve Circuit

(1) Main pressure oil from orifice B flows into the manual selector valve bore and surrounds the valve in the area of the detent notches for the low-range and reverse circuits. Main pressure oil is also supplied to another surrounding area toward the right end of the valve. Here it is available for high range and forward, and for operation of the trimmer.

(2) Four clutch-apply (or exhaust) lines leave the bottom of the selector valve bore. From left to right these are reverse, low range, high range, and forward. In neutral, clutch-apply pressure (red and white) is directed to the low-range clutch, and the remaining three are exhausted. Moving the selector valve one notch rightward will leave the low-range clutch applied and will charge the forward clutch. This is forward-1 (F1).

(3) Moving the selector valve a second notch rightward will close off oil to the low-range clutch and allow it to exhaust. The forward clutch will remain applied and clutch-apply pressure will also be directed to the high-range clutch. This is forward-2 (F2). The high-range clutch orifice restricts the volume of oil which can flow to the clutch in a given time. As a result, the high-range clutch fills at a slower rate and thus provides smoother engagement.

(4) Moving the selector valve one notch leftward of neutral will allow clutch-apply pressure to charge the reverse clutch while allowing the low-range clutch to remain charged. This is reverse-1 (R1).

(5) Moving the valve a second notch leftward will close off oil to the low-range clutch and allow it to exhaust. The reverse clutch will remain applied and the high-range clutch will be charged. This is reverse-2 (R2).

j. Trimmer Circuit

(1) The trimmer circuit works in conjunction with orifice B and the high-range orifice. The trimmer regulates clutch-apply pressure during initial stages of clutch engagement, and the orifices provide a specific flow at a given pressure. The combination of the trimmer and orifices provides the final pressure and flow pattern to engage the clutches.

(2) Normally, full main pressure (red) holds the trimmer plug leftward against its spring and a shoulder in the valve body bore. This compresses the main pressure regulator valve spring which causes main pressure to be regulated at maximum value.

(3) When any shift is made, oil is required to charge the oncoming clutch. This oil must flow through orifice B, directly below the main pressure regulator valve. The restriction of the oil flow through the orifice causes pressure below the orifice to be reduced. This reduction in pressure allows the trimmer plug to move rightward. Force against the main pressure regulator valve spring is reduced and main pressure is thus reduced.

(4) When the clutch being charged is full, flow through the orifice stops, and pressure below the orifice rises until it equals main pressure. This increased pressure acts against the right end of the trimmer plug, pushing the trimmer plug leftward. This compresses the main pressure regulator valve spring and raises main pressure. As main pressure rises, the trimmer plug moves farther leftward until main pressure is restored to maximum.

(5) The check valve and orifice in parallel branches of the line connecting the selector valve bore (fig. 2-2) or clutch cutoff valve bore (fig. 2-1) to the trimmer plug bore ensures rapid movement of the trimmer plug toward the right (check valve opens) and slower return of the trimmer plug leftward (check valve closes, orifice restricts flow). Main pressure is rapidly reduced but slowly restored.

2-12. TRANSMISSION TORQUE PATHS

a. Component Functions. The torque converter, driven by the engine, directs torque through the first and/or second turbine to the second turbine driven gear shaft. The shaft, splined to the forward-and-reverse sun gear, drives the forward and reverse planetaries. Hydraulic-actuated clutches, when applied, cause reactions within planetary components. The interaction within the planetaries and application of the range clutch determine the gear ratio and direction of torque imparted to the transfer gears. The torque path changes for each operating condition. Therefore, a knowledge of how these components direct the torque flow through the transmission is necessary for proper diagnosis of transmission trouble. An understanding of the accessory gearing is also helpful when the vehicle includes equipment driven by the transmission PTO components.

b. Cross Sections

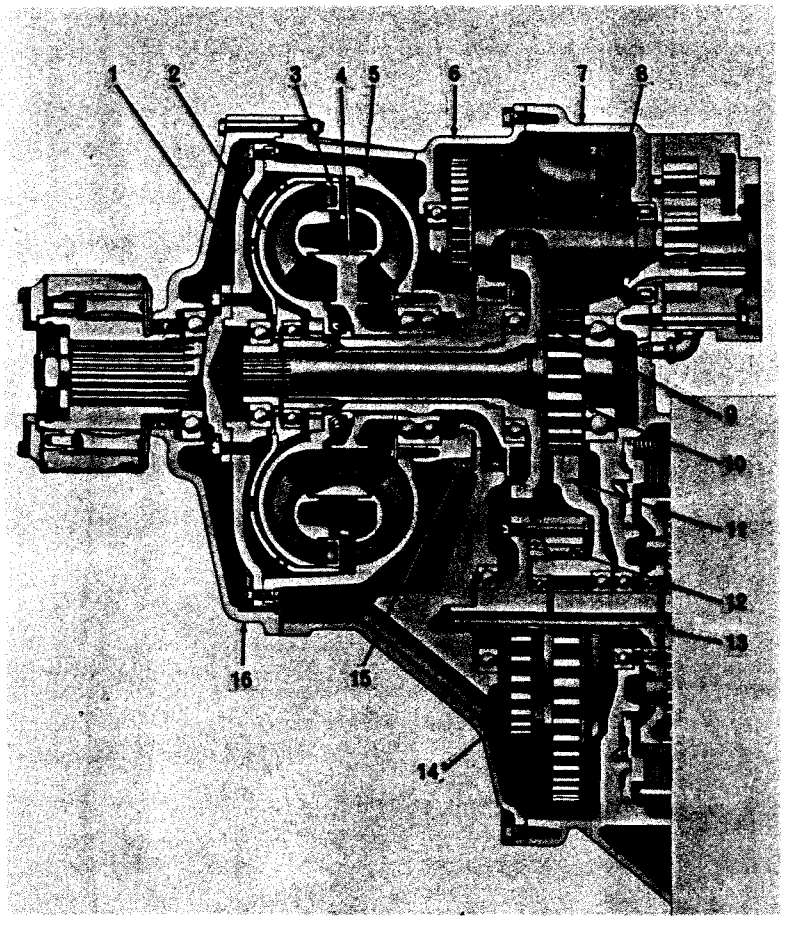
(1) Figure 2-3 is a cross section of the twin-turbine torque converter. Figures 2-4 through 2-8 illustrate the paths through which the torque flows from the engine to the transmission outputs.

(2) Because the driving turbine is automatically determined by the load and speed requirement imposed by the vehicle, the torque path through the converter is not necessarily confined to a specific operating range. Thus, both paths are shown--a dotted red line indicates the first turbine torque path and a broken red line indicates the second turbine torque path. Engagement of the range clutches is indicated by horizontal red bars across the clutch plates.

c. Torque Converter, Freewheel Clutch (fig. 2-3)

(1) Torque is transmitted from the engine to torque converter pump assembly 5 by either a flex disk drive or an input flange. From the pump, torque must be transmitted hydraulically to either first turbine assembly 3 or second turbine assembly 2, or to both under certain conditions.

(2) Speed and load determine whether the torque flows through the first and second turbine assemblies or only through the second turbine assembly. At high load demand and low speed, freewheel clutch 12 is engaged and the first turbine assembly acts as the primary driving member (second turbine assists). As speed increases and load demand decreases, the freewheel clutch disengages and the second turbine assembly becomes the primary driving member. Thus, first turbine operation is related to higher torque, and second turbine operation to higher speed. The transition from the torque phase to the speed phase is automatic, governed by the load and speed of the vehicle.



Legend for fig. 2-3

1. Converter drive cover
2. Second turbine assembly
3. First turbine assembly
4. Stator
5. Torque converter pump assembly
6. Torque converter housing
7. Transmission housing
8. Power takeoff drive
9. Second turbine drive gear
10. First turbine drive gear
11. First turbine driven gear
12. Freewheel clutch
13. Range gear input shaft
14. Second turbine driven gear
15. Accessory drive gear
16. Transmission front cover

Fig. 2-3. Typical twin-turbine torque converter and converter gearing--cross section

2-13. CONVERTER TO RANGE GEARING TORQUE PATH

a. First Turbine (fig. 2-3). Torque from converter pump 5 is transmitted hydraulically to first turbine 3. The first turbine is splined to first turbine drive gear 10 which meshes with first turbine driven gear 11. The first turbine driven gear is connected by freewheel clutch 12 to second turbine driven gear 14. The second turbine driven gear is integral with range gear input shaft 13. The forward-and-reverse sun gear is splined onto the shaft end. The hydraulic action in the converter and the interconnection of the turbine driven gears (first and second) permit the second turbine to assist the first turbine until the freewheel clutch disengages.

b. Second Turbine (fig. 2-3). When the output speed of the torque converter increases, the load is assumed by second turbine 2, and, when it attains sufficient speed, freewheel clutch 12 disengages. This allows first turbine 3 to rotate freely and no drive is contributed by the first turbine. Second turbine 2 is splined to the hollow shaft of second turbine drive gear 9. The drive gear meshes with second turbine driven gear 14 (integral with range gear input shaft 13) which is splined with the forward-and-reverse sun gear.

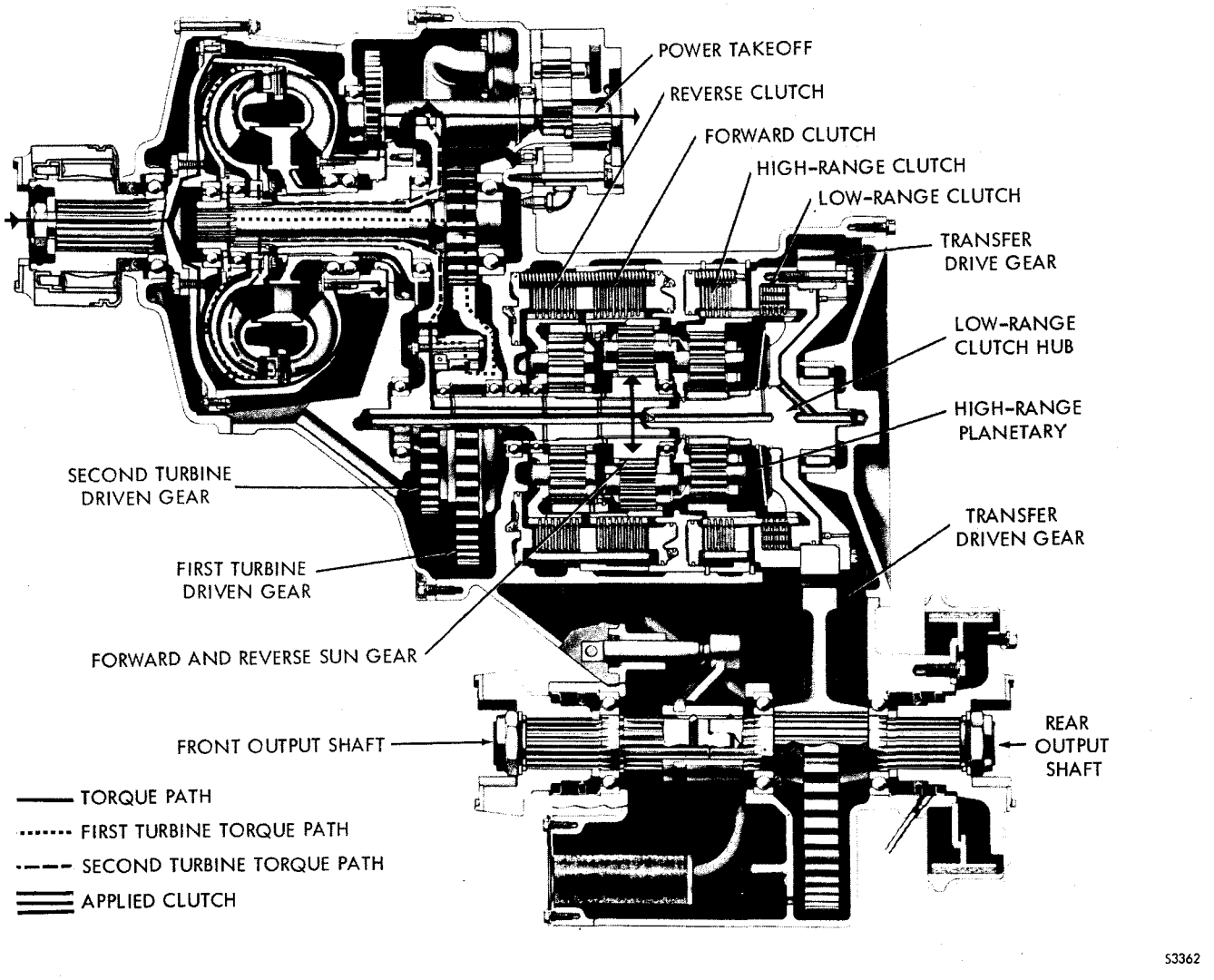


Fig. 2-4. Neutral and power takeoff torque path

2-14. NEUTRAL AND POWER TAKEOFF TORQUE PATH

a. Figure 2-4 illustrates the neutral torque path through the transmission and power takeoff gears. In neutral, torque is transmitted only to the forward-and-reverse sun gear. The low-range clutch is applied but the forward or reverse clutch is not applied. Thus, the reverse carrier and forward ring gear rotate freely.

b. Torque for the power takeoff is produced any time the engine is running. Torque from the engine flows through the converter pump and accessory drive gear to the internal splines of the oil pump driven gear. On transmissions equipped with an accessory power takeoff, a second gear shaft is located directly behind (relative to illustration) the oil pump driven gear. The torque flow to the accessory drive splines is identical to that described for the oil pump drive gear.

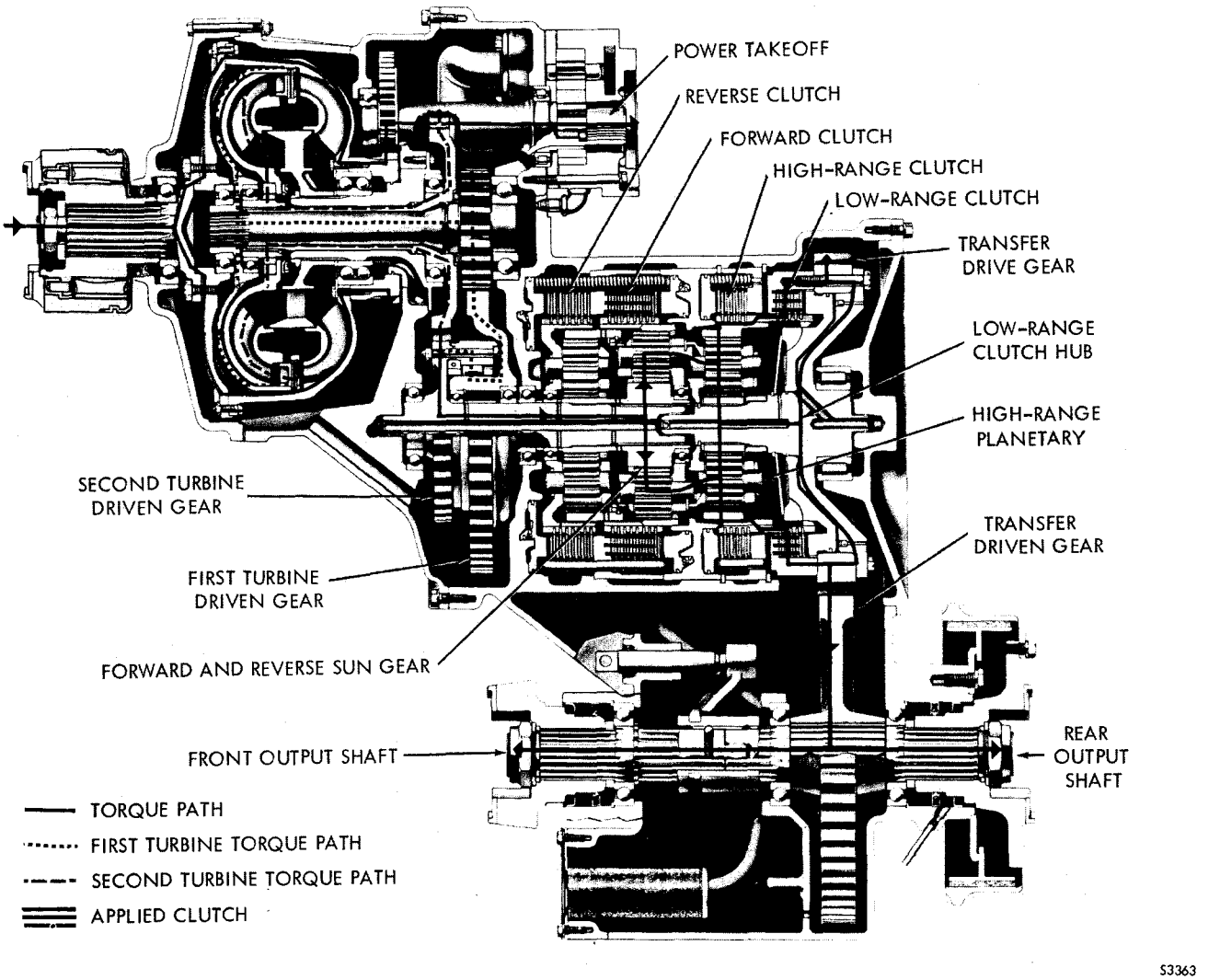


Fig. 2-5. Forward-1 torque path

2-15. FORWARD-1 TORQUE PATH

a. In forward-1 operation (fig. 2-5), torque is transmitted through the torque converter to the forward-and-reverse sun gear as described in paragraph 2-13. When the range selector is moved from neutral to forward-1, the low range clutch remains applied. The forward clutch is also applied, which holds the forward planetary ring gear stationary.

b. The rotating forward-and-reverse sun gear drives the forward planetary pinions within the stationary ring gear. This causes the forward planetary carrier to rotate at a reduced speed. The forward carrier drives the high-range carrier through the interconnecting bolts.

c. The high-range sun gear and high-range ring gear are locked together through the applied low-range clutch and low-range clutch hub. With the sun gear and ring gear locked together, the high range planetary must rotate as a unit. Thus, rotation of the forward planetary drives the high-range carrier which drives the transfer drive gear through the interconnecting bolts and dowel pins.

d. The transfer drive gear meshes with the driven gear which is splined to the output shaft. The manually operated disconnect coupling, when moved forward, will interrupt the drive to the front output.

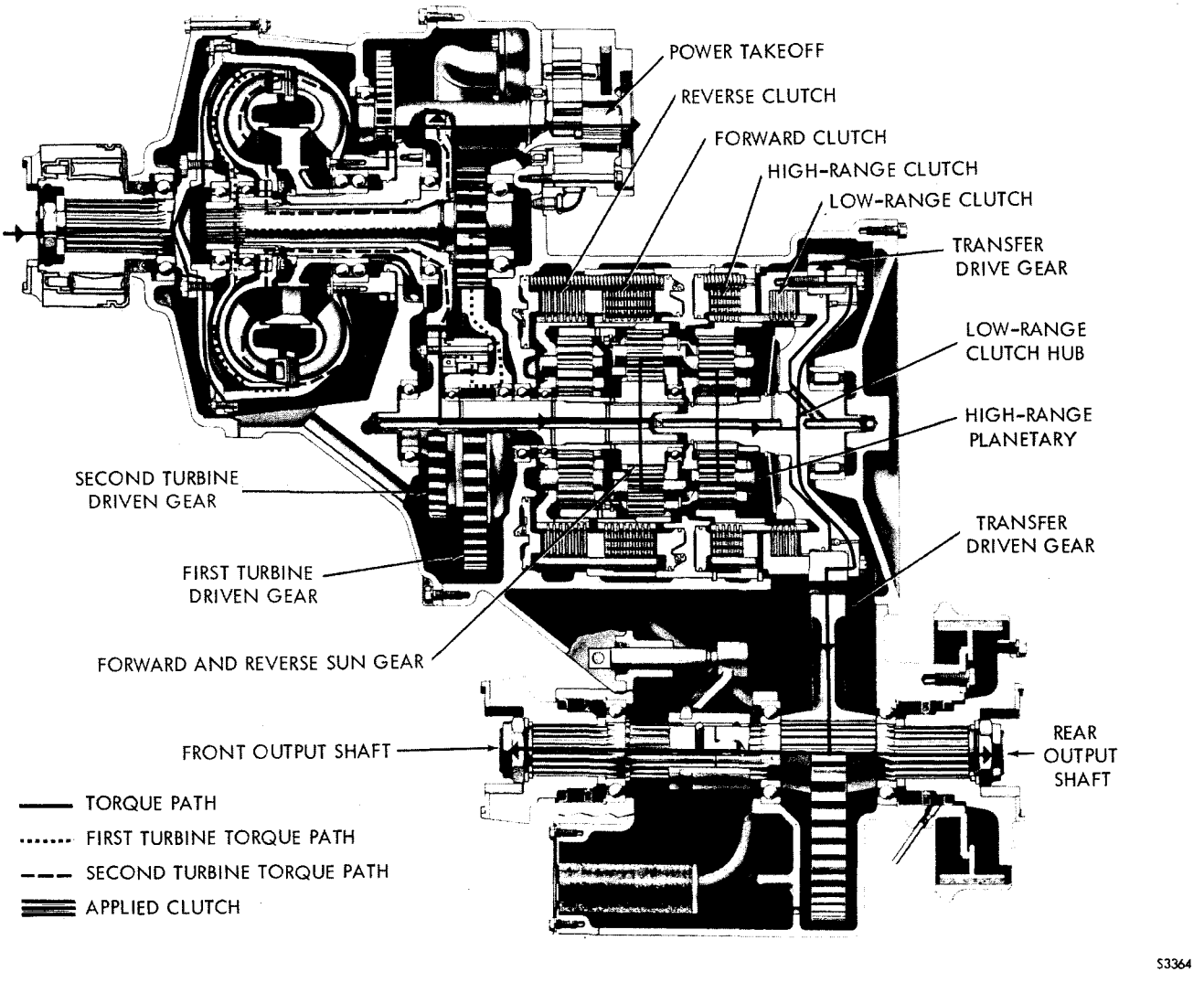


Fig. 2-6. Forward-2 torque path

2-16. FORWARD-2 TORQUE PATH

a. In forward-2 operation (fig. 2-6), torque is transmitted through the torque converter to the forward-and-reverse sun gear as described in paragraph 2-13. When the range selector is moved from forward-1 to forward-2, the low-range clutch releases and the high-range clutch is applied. The forward clutch remains applied, holding the forward ring gear stationary.

b. The torque through the forward planetary to the high range planetary is the same as that described in forward-1 operation (para 2-15b).

c. The applied high-range clutch holds the high-range ring gear stationary. The rotating carrier drives the pinions within the stationary ring gear. This causes the high-range sun gear to rotate at an increased speed. The sun gear is splined to the low-range clutch hub which, in turn, is bolted to the transfer drive gear. Thus, the transfer drive gear is driven by the high-range sun gear.

d. The torque path from the transfer drive gear to the output shaft is the same as described in forward-1 operation (para 2-15d).

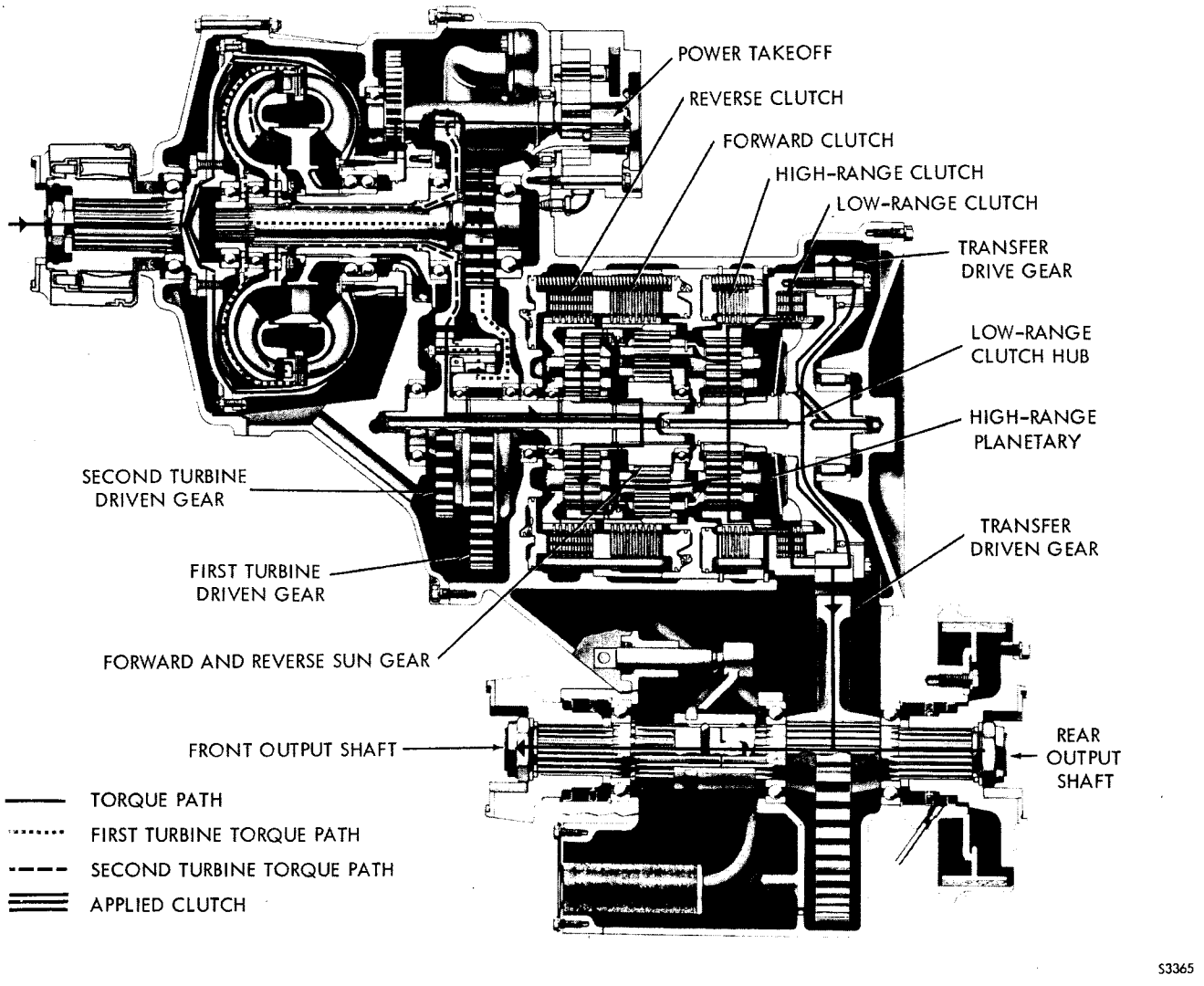


Fig. 2-7. Reverse-1 torque path

2-17. REVERSE-1 TORQUE PATH

a. In reverse-1 operation (fig. 2-7), torque is transmitted through the torque converter to the forward-and-reverse sun gear as described in paragraph 2-13. When the range selector is moved from neutral to reverse-1, the low-range clutch remains applied. The reverse clutch is also applied, which holds the reverse planetary carrier stationary.

b. The rotating forward-and-reverse sun gear drives the planetary pinions which in turn drive the reverse ring gear. This causes the ring gear to rotate at a reduced speed in reverse. The forward carrier, being splined to the reverse ring gear, transmits the reverse torque to the high-range planetary carrier through interconnecting bolts.

c. The torque path through the high-range planetary carrier to the output shaft is the same as that described in forward-1 operation (para 2-15c and d) except that all rotations are reversed.

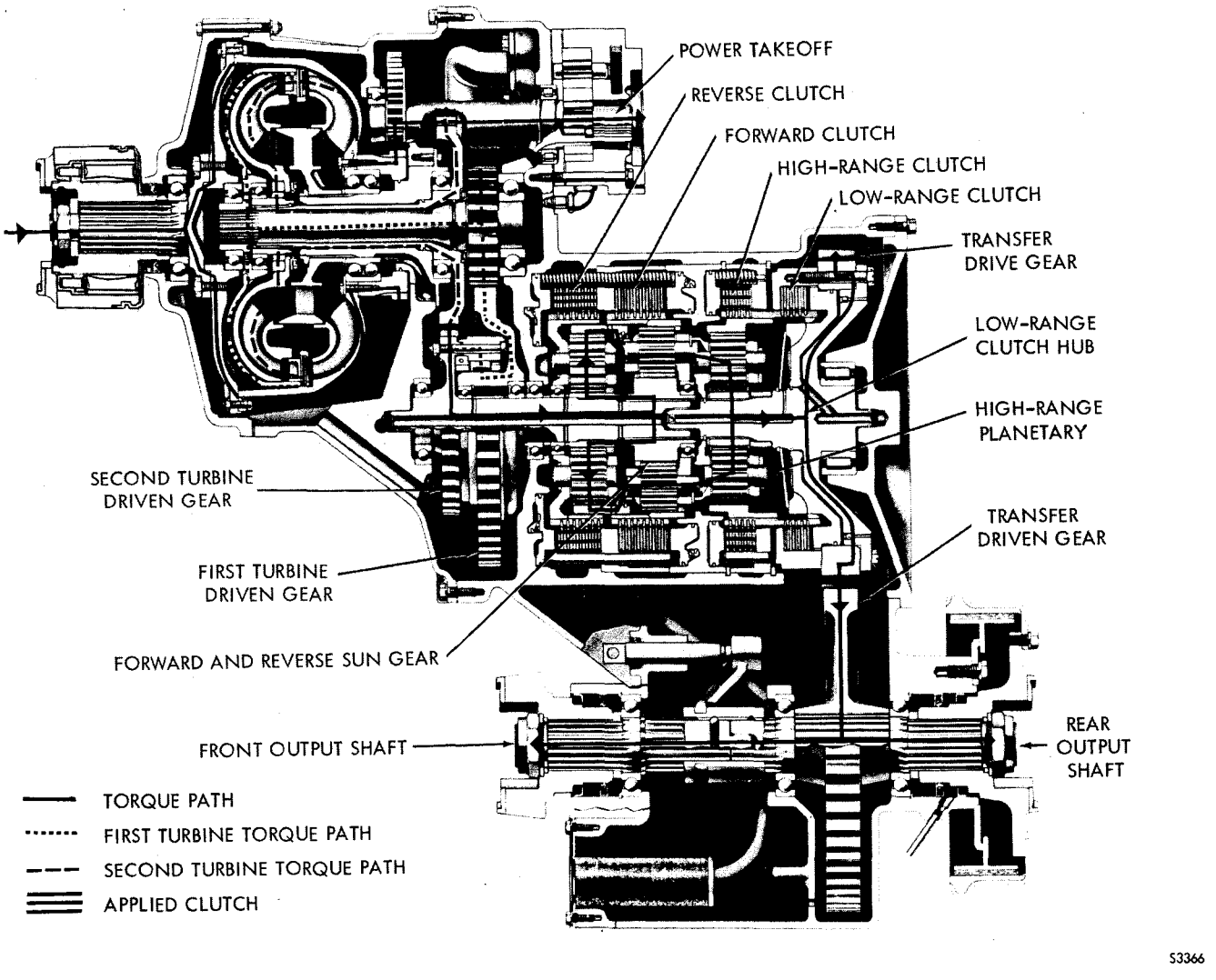


Fig. 2-8. Reverse-2 torque path

2-18. REVERSE-2 TORQUE PATH

a. In reverse-2 operation (fig. 2-8), torque is transmitted through the torque converter to the forward-and-reverse sun gear as described in paragaraph 2-13. When the range selector is moved from reverse-1 to reverse-2, the low-range clutch releases and the high-range clutch is applied. The reverse clutch remains applied, holding the reverse planetary carrier stationary.

b. Torque through the reverse and forward planetaries to the high-range carrier is the same as described in paragraph 2-17b.

c. Torque through the high-range planetary and transfer gears to the output shaft is the same as in forward-2 (para 2-16c and d), except that all rotations are in reverse.

Section 3. PREVENTIVE MAINTENANCE

3-1. SCOPE OF SECTION 3

This section describes routine procedures to maintain the transmission in good operating condition. Included are instructions for care of the oil system, minor adjustments of the transmission and control linkages, tests to determine condition, instructions for extended storage and a troubleshooting chart.

3-2. PERIODIC INSPECTIONS, CLEANING

a. Inspecting Exterior. The exterior of the transmission should be cleaned and inspected at regular intervals. The severity of service and operating environment will determine the frequency of such procedures. The transmission should be inspected for loose bolts, oil leaks, linkage troubles, and bent or damaged oil lines. Oil leaks require immediate attention. Linkage must be kept clean, adjusted and well lubricated.

b. Cleaning Breather. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Clean the area around the breather stem before removing the breather. Wash the breather thoroughly by agitating it in mineral spirits or cleaning solvent. Dry it thoroughly with compressed air after cleaning. Always use a proper size wrench to remove or replace the breather. Pliers or a pipe wrench will damage it and produce metal chips which could enter the transmission.

3-3. OIL CONTAMINATION

a. Examine at Oil Change. At each oil change examine the oil which is drained for evidence of dirt or water. A normal amount of condensation will emulsify in the oil during operation of the transmission. However, if there is evidence of water, check the cooler (heat exchanger) for leakage between the water and oil areas. Oil in the water side of the cooler (or vehicle radiator) is another sign of leakage. This, however, may indicate leakage from the engine oil system. Any accumulation of sludge or soft dirt in the sump should be removed with flushing oil.

b. Coolant Leakage. If engine coolant leaks into the transmission oil system, immediate action must be taken to prevent malfunction and possible serious damage. Glycol will attack friction-faced clutch plates. The transmission must be completely disassembled, inspected and cleaned. If glycol is present, all friction-faced clutch plates must be replaced. All traces of the coolant and varnish deposits resulting from coolant contamination must be removed. The cooler should be repaired or replaced prior to installation of the new or rebuilt transmission.

NOTE

A Gly-Tek test kit to detect glycol in transmission oil can be obtained from Nelco Company, 1047 McKnight Road South, Saint Paul, Minnesota 55119. (Some C3 fluids may produce a positive reading due to "additives" that are not actually glycol. When test results are questionable, a test of an unused sample of the oil type or brand should be made to confirm test results.)

c. Metal Particles. Metal particles in the oil (except for the minute particles normally trapped in the oil filter) indicate damage has occurred in the transmission. When these particles are found in the sump or on the magnetic drain plug, the transmission must be disassembled and closely inspected to find the source. Metal contamination will require complete disassembly of the transmission and cleaning of all internal and external circuits, cooler, filter, and all other areas where the particles could lodge.

d. Auxiliary Filter

(1) After a transmission failure that introduces debris into the oil system, a complete clean-up of the oil cooler and lines is necessary.

(2) Repeated cleaning and flushing may not remove all debris. To prevent a repeated failure, caused by eventual movement of trapped debris, installation of an auxiliary filter in the cooler-out line (between cooler and transmission) is recommended. This recommendation applies whether the failed transmission is overhauled, or replaced by a new or rebuilt unit.

(3) If any doubt exists about the clean-up of the oil cooler, replace the cooler.

(4) When an auxiliary filter is placed in the cooler-out line, converter regulator valve spring P/N 6773551 must be replaced with spring P/N 6880795 on S/N's before 9659.

(5) Refer to paragraph 6-9 for instructions for removal and replacement of the converter regulator valve, spring and pin, and for required rework of converter housings before S/N 9659.

(6) The auxiliary filter should be an AC PM 13-5 P/N 5575224 or equivalent 40 micron filter. Pressure drop across the new filter cannot exceed 5 psi (34 kPa), and the cooler circuit pressure differential cannot exceed 40 psi (275.8 kPa) at operating temperature and at full throttle stall.

(7) Auxiliary filter elements should be monitored for contamination after 500-1000 hours operation (depending on application), and changed at regular filter change intervals thereafter. Maximum allowable pressure drop across a dirty filter is 15 psi (103 kPa).

3-4. CHECKING OIL LEVEL

a. Cold Check

(1) Two oil level check plugs are located at the lower-right side of the transmission housing (fig. 1-2 and 1-3). Before starting the engine, remove the upper (Full) plug. If oil flows from the plug opening, it is safe to start the engine. If no oil flow is present, add sufficient oil to cause a flow from the opening, and replace the plug.

(2) Start the engine and operate at 1000 to 1500 rpm with the transmission in neutral. Operate for approximately one minute to charge the hydraulic system. Then idle the engine and shift through all range positions slowly.

(3) While the engine is running, add oil as required to establish the oil level at the lower (Add) plug. Then, proceed with the hot check (b, below).

NOTE

Oil checks made at lower than prescribed engine speeds may result in low oil level at operating speeds. Thermal expansion will raise the oil level when the transmission attains operating temperature.

b. Hot Check.

Start the engine and operate the vehicle until the transmission reaches an operating temperature of 180-220°F (82-104°C). Then idle the engine and shift through all range positions slowly. This will ensure that all parts of the system are filled with oil. Shift to neutral and run the engine at approximately 1200-1500 rpm. Remove the upper (Full) oil level check plug. Oil should be at the level of the plug opening. Add or drain oil to bring it to this level. Tighten Add and Full plugs to 14-16 lb ft (19-21 N·m).

NOTE

Observe the type of flow from the plug opening. Foaming or spurting may indicate a false oil level.

c. Dipstick Cold Check

(1) If the transmission is equipped with a transmission oil dipstick, check the oil level before starting the engine. It is safe to start the engine if the oil is near or above the Hot mark. If the oil level is not within this range, add oil.

(2) Start the engine and let it idle (500-750 rpm) with the transmission in neutral. Idle the engine for approximately two minutes to charge the hydraulic system. Then, shift through all range positions slowly. Add oil as required to establish the oil level at the Cold mark.

d. Dipstick Hot Check

(1) Start the engine and operate the vehicle until the transmission reaches normal operating temperature. Idle the engine and shift through all range positions slowly. With the engine at idle speed and transmission in neutral range, the oil level should be within the Operating Range and not exceed the Hot mark.

(2) If oil level is below the Cold mark, add oil to bring the level to within the Operating Range.

3-5. MAINTENANCE INTERVALS

a. Frequency. The severity of service and the environment in which the transmission operates will determine the frequency of some maintenance operations. Under very dusty or dirty operating conditions the transmission oil should be changed more often. Oil should be changed immediately if it has been subjected to severe overheating. The breather will require more frequent cleaning when dirt and dust conditions are severe.

b. Oil and Filter Change. Generally the oil and filter(s) should be changed after each 1200 hours of operation. For severe service, refer to a, above. Refer also to paragraph 3-3 before changing oil. Do not operate a transmission which is filled with preservative oil except for minimum necessary time or distance.

3-6. CHANGING OIL, FILTER

a. Draining Oil. Transmission should be at operating temperature of 180-220°F (82°-104°C) when the oil is changed. Remove the drain plug at the lower-right rear of the transmission housing (fig. 1-3). Remove the oil filter element(s) from the remote-mount filter(s). Remove and clean the oil strainer assembly (fig. 1-1). Let the oil drain for 30 minutes if time permits. Replace the oil strainer, gasket and oil drain plug. Tighten the oil strainer bolts to 26-32 lb ft (35-43 N·m). Tighten the drain plug to 33-37 lb ft (45-50 N·m). Install a new oil filter element and gasket.

b. Refilling Oil System. Refer to Table 3-1. Add 32 U.S. quarts (30 litres) of transmission oil after an oil change. Then conduct the hot check as described in paragraph 3-4b or 3-4d, adding oil as necessary to establish the correct oil level for operation.

Table 3-1. CHOICE OF PROPER C3 OIL

Fluid viscosity and grade	Ambient temperature below which PREHEAT IS REQUIRED
30	32°F (0°C)
15W-40	15°F (-9°C)
10W, 10-10W	-10°F (-23°C)
5W-20	-30°F (-34°C)

c. Oil System Capacity. Add 40 U.S. quarts (38 litres) for an initial fill or after a complete overhaul. This amount does not include the oil necessary to fill the external filter and cooler circuits. The refill amount is less than the initial fill because some oil remains in the external circuits and transmission cavities.

3-7. PRESSURES, TEMPERATURES

Figure 3-1 illustrates the points where the transmission temperature and pressure may be measured. The vehicle may be equipped with a temperature gage and a pressure gage. If so, the temperature gage registers the converter-out (to cooler) temperature, and the pressure gage registers main (clutch) pressure. Clutch pressure during normal operation in any gear or in neutral is approximately equal to main pressure and may be regarded as main pressure. However, while either the clutch cutoff control or inching control is being used, clutch pressure may drop to practically zero -- this does not indicate that main pressure has decreased. Therefore, when checking main pressure, do not actuate either of these controls.

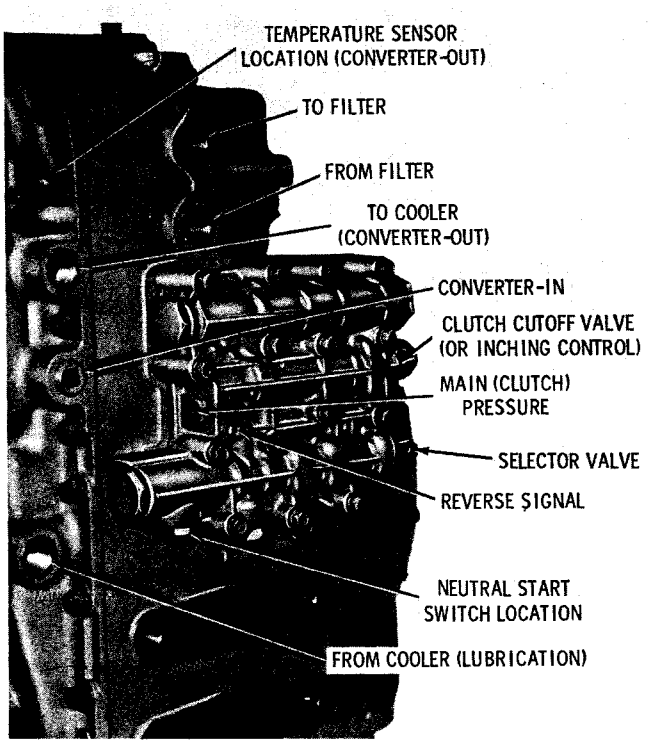


Fig. 3-1. Pressure and temperature check points

3-8. LINKAGE CHECKS, ADJUSTMENTS

a. Vehicle Manual Instructions. The specific design of control linkage for range selection, inching control, output disconnect, and parking brake depends upon the installation. Control linkage is provided by the vehicle manufacturer, and only general instructions for linkage adjustments are provided in this manual.

b. Selector, Inching Linkage. The selector linkage must be adjusted so that the operator's control and the selector valve are both in the desired range at the same time. Make initial adjustments in neutral. Then shift through all range positions to ensure the selector valve is in full detent position in each range. Adjust the inching valve control linkage so that the valve has full travel from retracted to extended positions. Linkage must be kept clean, adjusted, and well lubricated. Damaged linkage must be repaired or replaced.

c. Front Output Disconnect

(1) There are two points of adjustment for the front output disconnect. The shifter shaft must be adjusted first; then the linkage must be adjusted. Push the shifter shaft inward (toward the rear) to its engaged position. A spring-loaded detent will indicate engagement. Adjust the shifter shaft by rotating it until the center of the clevis pin hole is approximately 15/16 inch (24 mm) ahead of the linkage support bracket mounting pad faces.

(2) When the shifter shaft is pulled outward (forward) to its disengaged position, the detent ball should seat when the center of the clevis pin hole is approximately 2-5/8 inches (67 mm) ahead of the bracket mounting pad faces. Adjust the linkage so that the engaged and disengaged positions of the operator's control correspond exactly with the detent positions of the shifter shaft.

d. Parking Brake

(1) Adjust the brake shoes for proper drum clearance by inserting a screwdriver or adjusting tool into one of the openings at the rear of the brake drum and turning the starwheel. The brake linkage should be disconnected during this adjustment. The starwheel should be rotated until 0.010 inch (0.254 mm) thickness gages are held snugly between the adjustment end of the shoes and the drum (use two gages simultaneously -- one at each shoe).

(2) Adjust the vehicle linkage by releasing the hand lever fully and adjusting the connecting rod so that it can be connected to the brake assembly actuating lever. During adjustment, the brake assembly actuating lever must be held so that all slack is removed (without applying the brakes).

3-9. TRANSMISSION STALL TEST

NOTE

The engine stall speeds for all Detroit Diesel Allison approved engine/transmission applications may be obtained from the SCAAN Computerized Vehicle Performance program. Access to this program is available at Detroit Diesel Allison distributors and any Detroit Diesel Allison Regional Office.

a. Purpose

(1) A stall test should be conducted when the power package (engine and transmission) is not performing satisfactorily. The purpose of the test is to determine if the transmission is the malfunctioning component.

(2) A stall test is conducted with the transmission in F2 range, the engine running at full throttle, and the transmission outputs stalled. The data obtained from the test must be used in conjunction with engine-converter matched performance curves. These performance curves can be obtained from your Detroit Diesel Allison dealer or distributor.

b. Procedure

(1) Connect a tachometer of known accuracy to the engine, and bring the transmission to a normal operating temperature of 180-220°F (82-104°C).

CAUTION

The stall condition should never be maintained for more than 30 seconds at any one time because of the rapid rise in oil temperature.

(2) Apply the parking brake, block the vehicle securely, and shift the selector control to high range. (The test may also be conducted in low or reverse range, if necessary. However, such tests must be made with extreme caution because of the high torque delivered at the transmission output shaft.)

CAUTION

Do not apply the service brakes if the transmission is equipped with a clutch cutoff.

(3) Accelerate the engine to full throttle. After reaching a converter-out temperature of 225°F (107°C) minimum, record the engine speed while the engine is at open throttle. Do not let the converter-out temperature exceed 275°F (135°C).

NOTE

Allow approximately two minutes of neutral operation between stall tests to prevent overheating. During the two minute period, engine speed should be maintained (except for the momentary throttle release when shifting to neutral).

c. Results. Under stall test conditions, a comparison of actual engine speed with the established normal speed for such conditions will indicate if the engine or the transmission is malfunctioning. To determine the proper engine speed at stall, refer to the matched performance curve for the particular installation.

NOTE

Environmental conditions, such as ambient temperature, altitude, engine accessory loss variations, etc., affect the power input to the converter. These conditions may cause the stall speed to vary ± 150 rpm from the established normal value. When deviation can be attributed to such causes, the actual speed can be accepted as normal.

3-10. PRESERVATION, STORAGE

a. Storage, New Transmissions. New transmissions are tested with preservative oil and drained prior to shipment. The residual oil remaining in the transmission provides adequate protection to safely store the transmission for six weeks without further treatment.

b. Preservation Methods. When the transmission is to be stored or remain inactive for an extended period (up to one year), specific preservation methods are recommended to prevent damage due to rust, corrosion, and growth of biologicals. Preservation methods are presented for storage with and without oil.

c. Storage, One Year -- Without Oil

(1) Drain the oil and replace the oil filter element(s) (para 3-6).

(2) Seal all openings with moisture-proof tape.

(3) Coat all exposed, unpainted surfaces with preservative grease, such as petrolatum (MIL-C-11796), Class 2.

(4) If the breather can be easily removed, spray one ounce (30 milliliters) of Motorstor ® * (or equivalent) into the transmission through the breather hole. Also, spray one ounce (30 milliliters) through the fill tube hole. If the breather cannot be removed, spray two ounces (60 milliliters) of Motorstor (or equivalent) into the transmission through the fill tube hole.

(5) If additional storage time is required, repeat (3) and (4) at yearly intervals.

d. Storage, One Year -- With Oil

(1) Drain the oil and replace the filter element(s) (para 3-4).

(2) Fill the transmission to operating level with a mixture of 30 parts Type C3 oil to one part Motorstor rust preventative (or equivalent). Add 1/4 tsp of Biobor JF® ** (or equivalent) for each 3 gallons (11 liters) of oil in the system.

NOTE

When calculating the amount of Biobor JF required, use the total volume of the system including external lines, filters, and cooler; not just the quantity required to fill the transmission.

(3) Shift through all selector positions to thoroughly distribute the oil. Operate the vehicle for approximately five minutes. Then stop the vehicle and stall the transmission output until an oil temperature of 225°F (107°C) is obtained.

CAUTION

Do not allow the temperature to exceed 225°F (107°C). If the vehicle does not have a temperature gage, do not stall the transmission for more than 10 seconds.

(4) Stop the engine. As soon as the unit is cool enough to touch, seal all openings and breather with moisture-proof tape.

(5) Coat all exposed, unpainted surfaces with preservative grease, such as petrolatum (MIL-C-11796), Class 2.

(6) If additional storage time is required, just add the prescribed mixture (para d(3), above) of Motorstor and Biobor JF, or equivalents, and repeat (3) through (5) above, at yearly intervals. It is not necessary to drain the transmission each year.

e. Restoring Units to Service

(1) Remove the tape from openings and breather.

(2) Wash off all the external grease with mineral spirits.

(3) If the transmission is new, drain the residual preservative oil. Refill the transmission to the proper level (para 3-6) with type C3 oil.

(4) If the transmission was prepared for storage without oil, refill the transmission to the proper level (para 3-6) with type C3 oil.

* Motorstor ® is the registered trademark for a vapor phase rust preventative manufactured by the Daubert Chemical Company, Chicago, Illinois. Motorstor is covered by Military Specifications MIL-L-46002 (ORD) and MIL-I-23310 (WEP) under the designation of "Nucle Oil".

** Biobor JF® is the registered trademark for a biological inhibitor manufactured by U.S. Borax and Chemical Corporation.

(5) If the transmission was prepared for storage with oil, check for proper oil level (para 3-6). Add or drain transmission oil as required to obtain the proper level.

NOTE

It is not necessary to drain and refill the transmission with new oil.

3-11. TROUBLESHOOTING

a. Importance. Troubleshooting is the systematic search for and location of malfunctions in the engine or transmission that affect transmission performance. A thorough study of the description and operation of components and the hydraulic system (Section 2) will be helpful in troubleshooting. The engine and transmission must be regarded as a single package during troubleshooting.

b. Troubleshooting Chart. The following chart outlines the possible causes of and remedies for transmission troubles. Capital letters indicate the symptom; numerals following the symptom indicate several possible causes; numerals in the center column indicate remedies for the correspondingly numbered causes in the left column numerals in the right column indicate where service information can be found.

TROUBLESHOOTING CHART

	Cause		Remedy	Reference
A	LOW MAIN PRESSURE			
1.	Low oil level	1.	Add oil to correct level	para 3-4
2.	Clogged oil strainer	2.	Clean oil strainer	para 3-6a
3.	Clogged oil filter	3.	Replace filter element	para 3-6a
4.	Weak or broken main pressure regulator valve spring	4.	Replace spring	para 6-4
5.	Inching control adjustment not fully retracted	5.	Check, adjust linkage	para 3-8
6.	Oil pump worn	6.	Rebuild oil pump	para 6-8
7.	Air leak at intake side of oil pump	7.	Check pump mounting bolts Check oil pickup tube bolts	para 7-6b para 6-19
8.	Internal oil leakage	8.	Disassemble transmission; rebuild subassemblies as required	
9.	External oil leakage	9.	Tighten bolts or replace gaskets	
10.	Brake hydraulic (or air) pressure applying clutch cutoff valve	10.	Check brakes for full release; check brake pressure (brakes released)	
11.	Trimmer plug sticking	11.	Check valve body bolt torques; check trimmer valve bore for dirt or metal chips	

TROUBLESHOOTING CHART (continued)

	Cause		Remedy	Reference
B	OVERHEATING			
1.	High oil level	1.	Restore proper oil level	para 3-4
2.	Clutch failed	2.	Rebuild transmission	
3.	Vehicle overloaded	3.	Reduce load	
4.	Low main pressure	4.	Refer to A, above	
5.	Engine water overheated	5.	Correct engine overheating	
6.	Oil cooler or water lines kinked or clogged	6.	Clean or replace line	
C	LOW CLUTCH APPLY PRESSURE			
1.	Low main pressure	1.	Refer to A, above	
2.	Clutch piston sealrings failed	2.	Overhaul transmission	
3.	Clutch cutoff control valve sticking	3.	Rebuild control valve assembly	para 6-4
4.	Inching control valve sticking	4.	Rebuild control valve assembly	para 6-4
5.	Internal oil leakage	5.	Overhaul transmission	
D	AERATED (foaming) OIL			
1.	Incorrect type oil used	1.	Change oil; use proper type	para 3-6
2.	High oil level	2.	Restore proper oil level	para 3-4
3.	Low oil level	3.	Restore proper oil level	para 3-4
4.	Air entering suction side of oil pump	4.	Check oil pump bolts and gasket; check oil pickup tube bolts	para 7-6b para 6-19
5.	Air entering at clutch cutoff valve (air actuated)	5.	Check plug seal and sealring of valve	para 6-4

TROUBLESHOOTING CHART (continued)

Cause	Remedy	Reference
E VEHICLE WILL NOT TRAVEL		
1. Low main pressure	1. Refer to A, above	
2. Low clutch apply pressure	2. Refer to C, above	
3. Selector linkage broken or disconnected	3. Repair or connect linkage	para 3-8
4. Internal mechanical failure	4. Overhaul transmission	
F VEHICLE TRAVELS IN NEUTRAL WHEN ENGINE IS ACCELERATED		
1. Selector linkage out of adjustment	1. Adjust linkage	para 3-8
2. Clutch failed (won't release)	2. Overhaul transmission	
G VEHICLE LACKS POWER AND ACCELERATION		
1. Low main pressure	1. Refer to A, above	
2. Low clutch apply pressure	2. Refer to C, above	
3. Turbine freewheel clutch failed	3. Overhaul transmission	
4. Engine malfunction	4. Check engine; refer to engine service manual	
5. Aerated oil	5. Refer to D, above	
H STALL SPEED TOO HIGH (see para 3-9)		
1. Clutch slipping	1. Overhaul transmission	
2. Low main pressure	2. Refer to A and C, above	
I STALL SPEED TOO LOW (see para 3-9)		
1. Engine not producing full power	1. Tune or repair engine; refer to engine service manual	
2. Torque converter failed	2. Rebuild converter	
3. Loss of engine power through accessories attached to engine	3. Disconnect accessories which are absorbing power	

Section 4. GENERAL OVERHAUL INFORMATION

4-1. SCOPE OF SECTION 4

This section contains general information for overhaul, cleaning and inspection of the transmission. Good shop practices together with the recommended procedures will aid in restoring high quality performance.

4-2. TOOLS, EQUIPMENT

a. Table 4-1 lists tools to aid the mechanic during overhaul.

b. The following tools and supplies, in addition to common tools should be available:

- Snapring pliers
- Hoist, 1/2-ton (453 kg) capacity, min
- 3-leg lifting sling -- 1/2-ton (453 kg) capacity -- 90-degree-angle attaching plates
- Micrometer
- Press (for removal and installation of press-fit parts)
- Supply of wood blocks
- Clean lint-free shop cloths (do not use waste)
- Parts receptacles

CAUTION

Use only mineral spirits such as PD 680-2 (or equivalent) for cleaning. Solvents such as trichloroethylene, Benzol, Acetone and all aromatics are harmful to oil seals using polyacrylate rubber.

- Container of mineral spirits (for cleaning parts)
- 100 inch-pound (11 N·m) torque wrench
- 100 foot-pound (136 N·m) torque wrench
- 1000 foot-pound (1356 N·m) torque wrench
- Oil-soluble grease, MIL-VV-P-236 or Amojell petrolatum (Amoco Oil Co.), or equivalent
- Nonhardening sealer, Permatex* No. 2, or equivalent (for plugs, seals that are not precoated)
- Loctite** Pipe Sealant with Teflon, or equivalent (for plugs that are not precoated)
- Loctite Sleeve Retainer 601, or equivalent (for sleeve-type bearings)
- High temperature grease, MIL-G-81322, Mobil Grease No. 28 (Mobil Oil Co.), or Aeroshell Grease No. 22 (Shell Oil Co.), or equivalent (for lip-type oil seals -- DO NOT USE inside transmission)
- Lubriplate*** 630-AA (anti-seize compound for mating parts of parking brake non-friction surfaces.)
- Molybdenum disulfide grease (anti-seize compound for input and output shaft threads -- DO NOT USE inside transmission)
- Dry ice (for cooling interference-fit parts)
- Heating equipment or hot plate to provide oil at 300-350°F (149-176°C)

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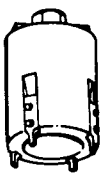
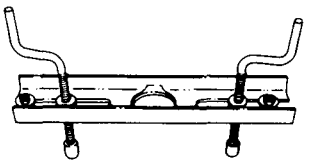
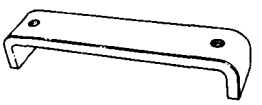
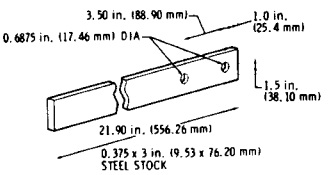
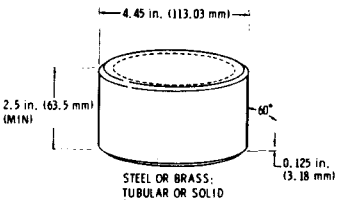
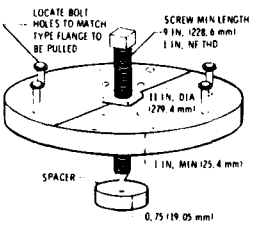
* Permatex® is a registered trademark of Permatex Co. Inc., West Palm Beach FL

** Loctite® is a registered trademark of Loctite Corporation, 705 N. Mountain Rd., Newington CT 06111.

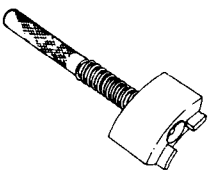
*** Lubriplate® is a registered trademark of the Fiske Bros. Refining Co., Newark, NJ, and Toledo, OH.

Table 4-1. TOOLS

Kent-Moore Tool No.	Name of Tool	Use Illustrated	Tool
*J6534-02	Torque Converter Spanner Wrench		 SPANNER WRENCH
*J7470-A (used with J-24839)	Clutch Spring Compressor	5-25, 5-27, 7-14, 7-18	 COMPRESSOR
*J24839 (used with J7470-A)	Forward Clutch Piston Housing Compressor	5-25, 5-27, 7-14, 7-18	 COMPRESSOR TOOL
**Fabricated	Overhaul Support Legs	1-1, 1-2, 1-3, 5-1,	 SUPPORT LEG
**Fabricated	Freewheel Roller Dummy Race	6-17, 6-18	 DUMMY RACE
**Fabricated	Typical Flange Puller		 FLANGE PULLER
**Fabricated	Work Table	Refer to figure 4-1.	

* Available from Kent-Moore Tool Division, 29784 Little Mack, Roseville, MI 48066
** Not available from Kent-Moore

Table 4-1. TOOLS

Kent-Moore Tool No.	Name of Tool	Use Illustrated	Tool
*J-23559	Staking Tool		 STAKING TOOL

* Available from Kent-Moore Tool Division, 29784 Little Mack, Roseville, MI 48066

4-3. REPLACEMENT PARTS

a. Ordering Information. Refer to paragraph 1-3 for information on ordering parts and service kits.

b. Parts Normally Replaced. The following parts are normally replaced during overhaul:

- Gaskets
- Lockstrips
- Washers or snaprings damaged by removal
- Oil seals, sealrings

WARNING

Do not burn discarded Teflon seals. Toxic gases are produced by burning.

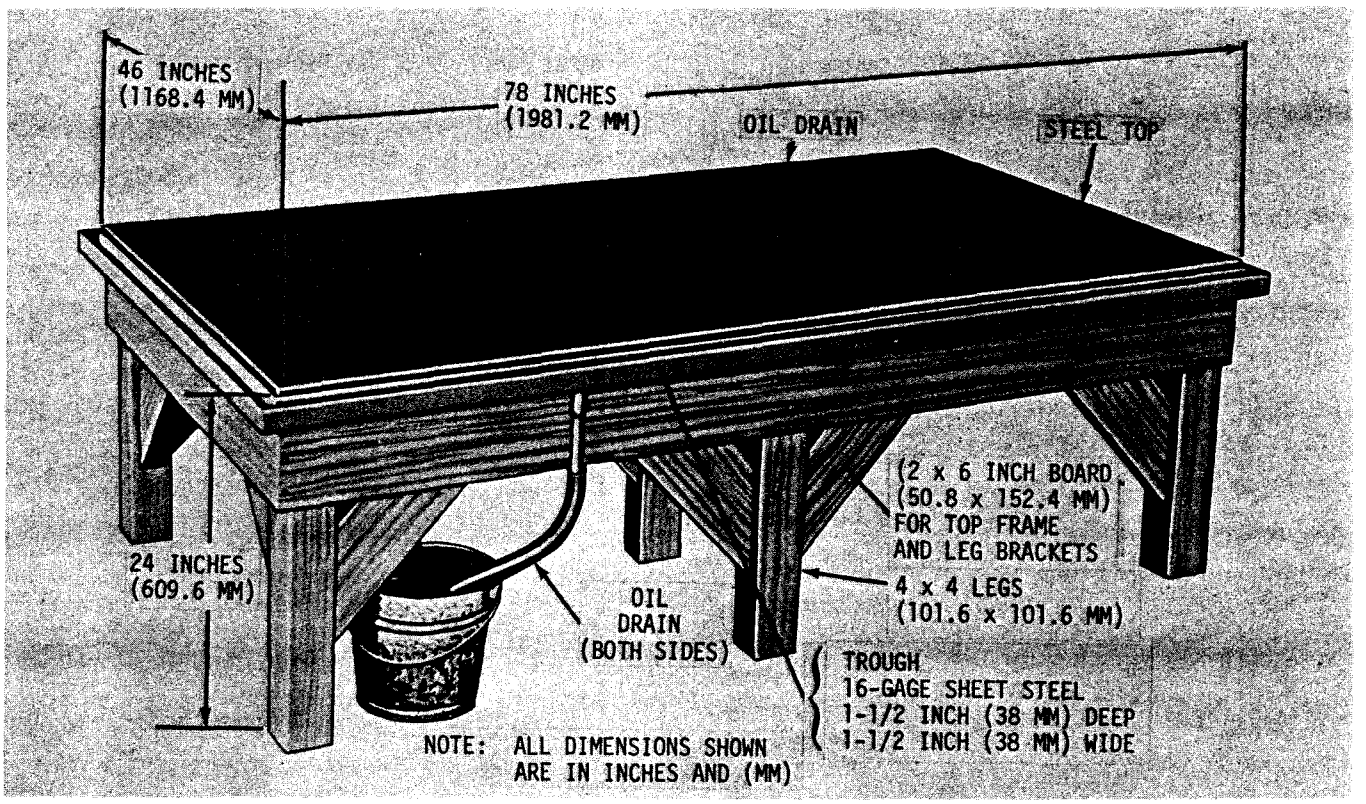


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Fig. 4-1. Work table

4-4. CAREFUL HANDLING

Parts which have close operating tolerances must be handled carefully to prevent nicking, scratching or denting. The slightest damage to these parts can result in erratic operation and possible malfunction of the transmission. These parts should be carefully handled and protected during removal, cleaning, inspection and installation.

4-5. CLEANING, INSPECTION

a. Dirt-free Assembly. All parts must be clean to permit effective inspection. During assembly, it is very important that no dirt or foreign matter enters the transmission. Even minute particles can cause the malfunction of close-fitting parts.

b. Cleaning Parts

CAUTION

Use only mineral spirits such as PD 680-2 (or equivalent) for cleaning. Solvents such as trichloroethylene, Benzol, Acetone, and all aromatics are harmful to oil seals using polyacrylate rubber.

(1) Use only mineral spirits on friction-faced clutch plates and bearings. All other metallic parts of the transmission should be cleaned thoroughly with mineral spirits, or by steam cleaning. Do not use a caustic soda solution for steam cleaning.

(2) Parts should be dried with compressed air. Steam cleaned parts must be oiled immediately after drying.

(3) Clean oil passages by working a piece of soft wire back and forth through the passages and flushing with mineral spirits. Dry the passages with compressed air.

(4) After cleaning, examine the parts and especially the oil passages to make certain they are entirely clean. Reclean them, if necessary.

(5) Removal of minor defects with such items as crocus cloth, soft honing stones, and scrapers produces debris and residue. Cover adjacent parts, ports, and cavities before removing defects. Thoroughly reclean the affected areas after rework.

c. Cleaning Bearings

WARNING

Never dry bearings by spinning them with compressed air. A spinning bearing can disintegrate, allowing balls or rollers to become lethal flying projectiles. Also, spinning a bearing while it is not lubricated can damage the bearing.

(1) Bearings that have been in service should be thoroughly washed in mineral spirits.

(2) If the bearings are particularly dirty or filled with hardened grease, soak them in mineral spirits before trying to clean them.

(3) Before inspection, oil the bearings with type C3 transmission oil.

d. Inspecting Bearings

(1) Inspect bearings for roughness of rotation. Replace a bearing if its rotation is still rough after cleaning and oiling.

(2) Inspect bearings for scored, pitted, scratched, cracked, or chipped races, and for indication of excessive wear of rollers or balls. If one of these defects is found, replace the bearing.

(3) Inspect the bearing housing and shaft for grooved, burred, or galled conditions that indicate the bearing has been turning in its housing or on the shaft. If the damage cannot be repaired with crocus cloth, replace the defective part.

CAUTION

Any bearing that has been subjected to metal contamination (para 3-3c) must be closely inspected for metal particles. Metal particles will cause failure of the bearing.

e. Keeping Bearings Clean. Since the presence of dirt or grit in ball bearings is usually responsible for bearing failures, it is important to keep bearings clean during installation and removal. Observance of the following rules will do much to ensure maximum bearing life.

(1) Do not remove the wrapper from new bearings until ready to install them.

(2) Do not remove the grease in which new bearings are packed.

(3) Do not lay bearings on a dirty bench; place them on clean paper.

(4) If assembly is not to be completed at once, wrap or cover the exposed bearings with clean paper or lint-free cloth to keep out dust.

f. Inspecting Cast Parts, Machined Surfaces

(1) Inspect bores for scratches, wear, grooves and dirt. Remove scratches and burrs with crocus cloth. Remove foreign matter. Replace parts that are deeply grooved or scratched.

(2) Inspect all oil passages for obstructions. If an obstruction is found, remove it with compressed air or by working a soft wire back and forth through the passage and flushing it with mineral spirits.

(3) Inspect mounting faces for nicks, burrs, scratches and foreign matter. Remove such defects with crocus cloth or a honing stone. If scratches are deep, replace the defective part.

(4) Inspect threaded openings for damaged threads. Chase damaged threads with the correct size used tap (a new tap can cut oversize).

(5) Replace housings or other cast parts that are cracked. Magnaflux and rinse planetary carriers using approximately 8000 ampere-turns (8 amperes in 1000 turn coil) to determine if fractured.

(6) Inspect all machined surfaces for damage that could cause oil leakage or other malfunction of the part. Rework or replace defective parts.

(7) Inspect piston bores in clutch housings for nicks, burrs, and displaced metal that could interfere with mating parts or damage piston sealrings. Remove these defects with crocus cloth or soft honing stone.

(8) Inspect sealring grooves in clutch pistons for nicks, burrs, dents, or displaced metal that could damage sealrings. Remove these defects with crocus cloth or soft honing stone.

g. Inspecting Bushings, Thrust Washers

(1) Inspect bushings for scores, burrs, roundness, sharp edges and evidence of overheating. Remove scores with crocus cloth. Remove burrs and sharp edges with a scraper or knife blade. If the bushing is out-of-round, deeply scored or excessively worn, replace it, using the proper size replacer tool. Whenever it is necessary to cut out a defective bushing, do not damage the bore into which the bushing fits.

(2) Inspect thrust washers for distortion, scores, burrs and wear. Replace if defective or worn.

h. Inspecting Oil Seals, Gaskets

(1) Inspect piston sealrings for nicks, cuts, tears, splits, and pattern damage. This type damage on old sealrings can indicate defects in the piston grooves or in the piston housing bores. Locate and remove the defects. Refer to paragraphs 4-5f,(7) and (8).

(2) Inspect metal-encased seals for cuts and hardness. Replace the seal if defects are found or if defects are found or if the seal is damaged by removal. Replace all sealrings (except hook type), and composition gaskets.

(3) Inspect the hook-type sealrings for wear, broken hooks, and distortion.

(4) Install a new hook-type sealring if the ring shows any wear on the outside circumference, or if there is excessive side wear. The sides of the sealring should be smooth, and have a maximum side wear of 0.005 inch (0.127 mm). The sides of the shaft groove (or the bore) in which the sealring fits should be smooth 50 microinches (1.27 μ m) and square with the axis of rotation within 0.002 inch (0.051 mm). If the sides of ring grooves have to be reworked (0.020 inch (0.51 mm) maximum side wear), install a new sealring.

i. Inspecting Gears

(1) Inspect gears for scuffed, nicked, burred or broken teeth. If the defect cannot be removed with a soft honing stone, replace the gear.

(2) Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace the gear.

(3) Inspect the thrust faces of gears for scores, scratches and burrs. If the defect cannot be removed with a soft honing stone, replace the gear.

j. Inspecting Splined Parts. Inspect for stripped, twisted, chipped or burred splines. Remove burrs with a soft honing stone. Replace the part if other defects are found. Spline wear is not considered detrimental except when it affects tightness or fit of the splined parts.

k. Inspecting Clutch Plates

(1) Inspect friction-faced steel plates (internal-splined plates) for burrs, embedded metal particles, severely pitted faces, excessive wear, cone, cracks, distortion and damaged spline teeth. Remove burrs, using a soft honing stone. Replace plates which have other defects.

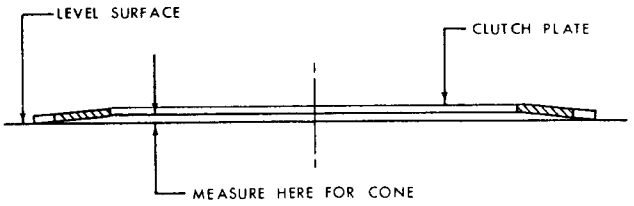


Fig. 4-2. Method for determining cone of clutch plate

(2) Inspect steel plates (external-tanged plates) for burrs, scoring, excessive wear, cone, distortion, embedded metal, galling, cracks, breaks and damaged tangs. Remove burrs and minor surface irregularities, using a soft honing stone. Replace plates which have other defects.

(3) The amount of cone is determined by measuring the distance between the inside diameter of the plate and a level surface (fig. 4-2). Discard plates having excessive cone (refer to wear limits, Section 8).

l. Inspecting Threaded Parts. Inspect parts for burred or damaged threads. Remove burrs with a soft honing stone or fine file. Replace damaged parts.

m. Inspecting Snaprings. Inspect all snaprings for nicks, distortion and excessive wear. Replace the snapring if any of these defects is found. The snapring must snap tight into the snapring groove for proper functioning.

n. Inspecting Springs. Inspect all springs for signs of overheating, permanent set or wear due to rubbing adjacent parts. Replace the spring if any of these defects is found. Refer to spring chart at the end of Section 8.

o. Inspecting Seal Contact Surfaces. Inspect the surfaces that contact the sealing area or lip of any seal. Roughness, scoring, pitting or wear that will permit oil leakage

or cause damage to the seal must be corrected. The affected part must be replaced if defects cannot be corrected.

p. Inspecting Swaged, Interference-fit Parts. If there is evidence of looseness due to relative motion, the assembly should be replaced.

q. Inspecting Balls in Clutch Pistons. Inspect all balls in clutch pistons for free movement. Any restriction could prevent the ball from seating during clutch application.

r. Inspecting Pump Gears. Inspect pump gears for evidence of wear such as scoring or shiney area due to rubbing of adjacent parts. Replace gears with any signs of wear.

4-6. ASSEMBLY PROCEDURES

a. Clutches, Pistons

(1) Soak each friction-face clutch plate (two-minute minimum) in transmission fluid prior to final assembly.

(2) Apply a generous amount of transmission fluid to the piston cavity prior to final assembly.

(3) Assemble clutch plates so that the cone of each plate faces the same direction as the cone of the adjacent plates (fig. 4-2).

b. Parts Lubrication. During final assembly, lubricate all moving parts with transmission fluid. The lubricant will help protect the friction surfaces and ferrous metals until the unit is in service.

c. External Pipe Plugs, Hydraulic Fittings.

(1) New Precoated Plugs. New plugs that are precoated with Teflon need no preparation for assembly.

(2) Reused or Uncoated Plugs, Hydraulic Fittings. Prepare the threads with a small amount of nonhardening sealant, such as Loctite Pipe Sealant with Teflon, or equivalent. Do not use Teflon tape.

CAUTION

Inaccurate torque can cause leakage and cracked housings. Tighten all pipe plugs to the torque specified in the assembly step and on the exploded views.

d. Oil-soluble Grease. Use only oil-soluble grease with a low melting point, such as MIL-W-P236 or Amojell petrolatum (Amoco Oil Co.) or equivalent -- to temporarily retain parts, step-joint sealrings, scarf-cut sealrings, and hook-type sealrings during assembly with mating parts.

CAUTION

Do not use petrolatum to retain cork gaskets.

e. Sealing Compounds, Nonsoluble Greases. Do not use gasket-type sealing compounds, fibrous greases, or nonsoluble, vegetable-base cooking compounds any place inside the transmission. Do not use them any place where they could be flushed into the transmission hydraulic system.

f. Lip-type Oil Seals

(1) When replacing metal-encased lip-type oil seals, make sure the spring-loaded lip side is toward the oil to be sealed in (toward the inside of the unit). Coat the inside of the seal with high temperature grease, such as MIL-G-81322, Mobil Grease No. 28 (Mobil Oil Co.), Aeroshell Grease No. 22 (Shell Oil Co.) or equivalent, to protect the seal during shaft installation and to provide lubrication during initial operation. Do not use high temperature grease on other transmission internal parts.

(2) Precoated Seals. The circumference of some seals is precoated with a dry sealant. The sealant is usually colored for

easy identification. The precoated seals do not require any additional sealant before installation.

(3) Uncoated Seals. Prepare the circumference of uncoated seals with a nonhardening sealant such as Permatex No. 2, or equivalent before installation.

g. Interference-fit Parts. Assembly of interference-fit parts may be accomplished by heating and chilling the respective parts. The female part can be heated in an oven or oil bath to 300°F (149°C), and the male part can be chilled in dry ice. Either one or both parts may require a thermal process. However, if the chill process is used for a ferrous alloy part, coat the components with transmission fluid to inhibit rust due to frost and moisture.

h. Sleeve-type Bearings. Loctite Sleeve Retainer 601 or equivalent should be used to retain bushings and sleeve-type bearings that have press-fit tolerances.

i. Bearings (Ball or Roller)

(1) When installing a bearing on a shaft, heat the bearing to 200°F (93°C) on an electric hot plate or in an oil bath. Use the proper size installation sleeve and a press to seat the bearing.

NOTE

Bearings must be heated long enough for sufficient expansion. Heating time is determined by the size of the bearing. Forty-five minutes is sufficient for the largest bearing in these transmissions.

(2) If a bearing must be removed or installed without a sleeve, be careful to drive or press only on the race which is adjacent to the mounting surface. If a press is not available, seat the bearing with a drift and a hammer, driving against the supported race.

4-7. REMOVING, INSTALLING TRANSMISSION

a. Drain Oil. Before removing the transmission from the vehicle, drain the oil. For better drainage, the transmission should be warm and allowed to drain overnight. Replace the drain plug. Consult the vehicle service manual for specific instructions for transmission removal and installation.

b. Check Linkage, Lines. Make sure that all linkage, controls, cooler and filter lines, pressure and temperature lines, driveline couplings and mounting bolts are disconnected before transmission removal. Carefully place oil lines clear of the removal path and cover all openings to keep out dirt.

c. Remove, Clean Transmission. Consult the vehicle service manual for specific instructions for removal and installation, as applications will differ. Clean the exterior of the transmission. If steam cleaning is used, the transmission should be disassembled and dried immediately as condensation of the steam will rust the ferrous parts in the transmission.

d. Lifting. Two 3/4-10 tapped openings are provided at the top of the transmission housing. Bolts or eyebolts may be installed into the openings for lifting the transmission assembly.

e. Reconnect at Installation.

(1) At installation, reconnect all linkage and lines which were previously removed. Refer to the vehicle service manual and to paragraph 3-7 for proper adjustments of control linkage.

(2) Use Loctite Pipe Sealant with Teflon, or equivalent, (rather than Teflon tape) for thread sealing on hydraulic, air, and other threaded fittings. Loose slivers of tape can plug orifices, cause valves to stick or interfere with check ball operation.

4-8. TIGHT-FIT FLANGES

a. Removal of Flanges

(1) Flanges are retained by a self-locking nut. Before removing the nut, check to see how many notches have been cut into the wrenching flats. If there are five notches, remove the nut and throw it away.

(2) If there are less than five notches, or none at all, remove all dirt and any burrs from the exposed shaft threads. Then, only loosen the nut until there is approximately 1/16-inch (1.59 mm) gap between the nut and flange.

(3) Check the running torque while removing the nut. The nut can be reused only if it meets the following requirements.

- The first time (no notches) the nut is removed the running torque must be at least 400 lb in. (45 N·m).
- Each additional time (one to four notches) the nut is removed the running torque must be at least 300 lb in. (34 N·m).

(4) Each time the nut is reused, deeply scribe one of the wrenching flats. This method of marking the nut will indicate how many times the nut has been reused. The nut must not be reused more than five times.

CAUTION

A puller placed on the outside diameter of the flange may deform the pilot diameter and mounting face.

(5) Install a suitable heavy-duty puller to the face of the flange. A typical puller is illustrated in table 4-1. A Torqmatic coupling requires a puller that will engage the internal groove machined in the coupling hub.

(6) In order to protect the tapped holes in the end of the shaft, install a soft metal spacer between the puller jackscrew point and the end of the shaft.

(7) Provide a means for preventing flange rotation.

CAUTION

Do not use a pry bar or hammer to force the flange at disassembly.

(8) Remove the flange by tightening the puller screw against the spacer and shaft.

b. Installation of Flanges

(1) Coat the shaft splines and the lip of the oil seal with a thin layer of bearing grease.

(2) Heat the flange to approximately 300°F (149°C) prior to assembly. Either heat in a controlled temperature furnace for at least 45 minutes or submerge the flange in a container of oil and heat the oil. (If acetylene torch is used, heat the container of oil for 15 minutes.)

CAUTION

Do not let the flange cool prior to installation. If the flange cools and seizes to the shaft prior to its final assembly, it will be necessary to remove the flange and repeat the assembly procedure. Do not attempt to force the flange with a hammer.

(3) Immediately after heating, install the flange on the shaft, making sure that the flange is tight against its locating shoulder. The flange should slide freely to its assembled position.

(4) Coat the threads of the nut with molybdenum disulfide grease and install the flange retaining washer and nut. (Do not reuse nut with five notches; refer to paragraph 4-8a.) Tighten the input nut to 450-700 lb ft (611-949 N·m). Tighten the output nut to 500-750 lb ft (678-1016 N·m).

(5) After the assembly has cooled, it is good practice to check the nut for tightness and, if necessary, retighten it.

4-9. WEAR LIMITS, SPRING CHART

a. Wear Limits Inspection. Refer to Section 8 for information covering parts specifications, clearances and wear limits.

b. Spring Inspection. Refer to the Spring Chart in Section 8 for spring identification and specifications.

4-10. TORQUE SPECIFICATIONS

Torque specifications are given with each assembly procedure. Also the exploded view foldouts state torque specifications for all threaded fasteners.

Section 5. DISASSEMBLY OF TRANSMISSION

5-1. SCOPE OF SECTION 5

a. Models Covered. This section describes the disassembly of the transmission into subassemblies. The procedures are applicable to the TRT 4820 and 4821 models.

b. Disassembly Sequence. Components are removed from the converter housing first and then, after the transmission is repositioned, the remaining components are removed from the rear of the main housing.

c. Illustrations. Disassembly is referenced primarily to photographs in this section. Disassembly of some components is referenced to foldouts in the back of the manual. A cross section is presented on foldout 1 to show the relationship of assembled parts.

d. General Information. Refer to Section 4 for general information on overhaul, cleaning, and inspection of the transmission.

5-2. SERVICING OF VEHICLE MOUNTED TRANSMISSIONS

CAUTION

Refer to paragraph 5-9b prior to removal of the disconnect shifter shaft.

a. Servicing Without Removal. The TRT transmissions are designed so that major service operations can be accomplished without removing the transmission from the vehicle. The disassembly procedures in this manual, however, relate to operations with the transmission removed.

b. Accessibility. Accessibility in the vehicle, the nature of service required and other factors will determine the advisability of performing major operations without removing the transmission. Procedures for disassembly are essentially the same, but the position of the transmission may cause some inconvenience at times. In general, if the construction of the vehicle provides room, all external subassemblies and all components to be removed from the rear of the transmission may be serviced.

5-3. REMOVAL OF EXTERIOR COMPONENTS

a. Lifting Points. All twin-turbine transmissions have two 3/4-10 tapped holes in the top of the transmission housing. Bolts or eyebolts may be installed into these holes for lifting and handling the transmission while positioning it for disassembly (fig. 5-1). The overhaul support legs (Table 4-1) will support the transmission when the lifting sling is removed.

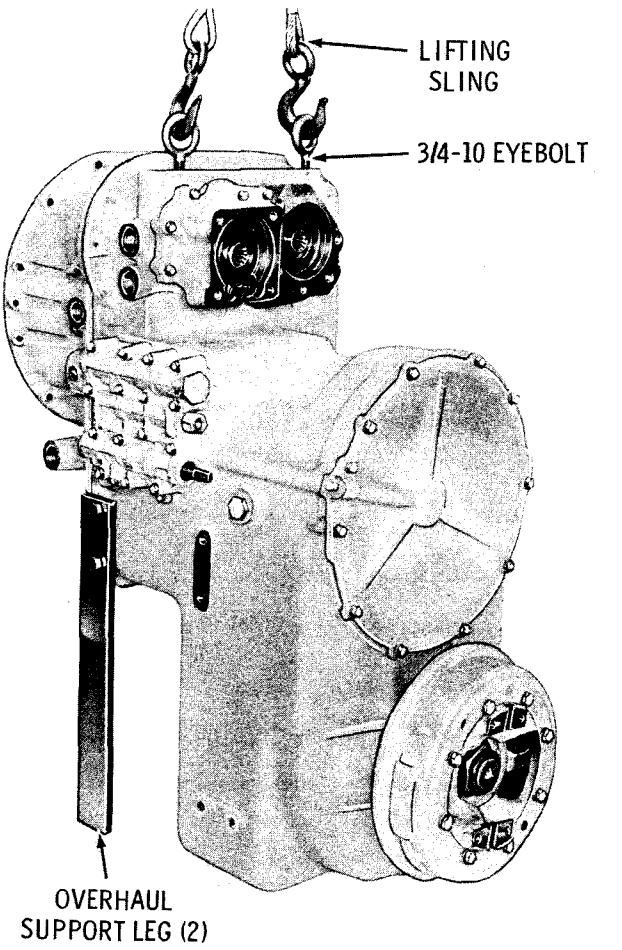


Fig. 5-1. Lifting transmission

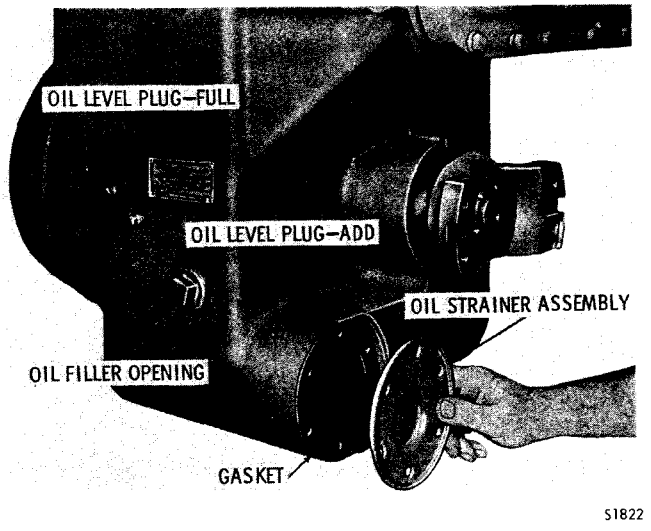


Fig. 5-2. Removing oil strainer and gasket

b. Adapter Drive Coupling. If the oil pump is equipped with implement drive coupling 19 (A, foldout 8), remove the coupling.

NOTE
Coupling 19 is used only with pumps which drive an accessory having SAE B splines.

c. Oil Strainer Assembly. Remove the six bolts and lockwashers that retain the oil strainer assembly (fig. 5-2). Remove the strainer assembly and gasket. Remove the oil level plugs and (if present) the oil filler plug or fittings.

d. Output Flanges, Parking Brake

(1) Remove eight bolts and lockwashers that retain the parking brake drum (fig. 5-3). Remove the parking brake drum.

(2) Refer to paragraph 4-7. Remove the rear output flange nut (fig. 5-4). Remove flange retaining washer 31 (A, foldout 7) and sealring 30. Remove the rear output flange (fig. 5-5).

(3) The parking brake can be serviced in this position (see para 6-3) or the parking brake can be removed as an assembly. Remove bolts 21 (B, foldout 8), and washers 20. Remove brake assembly 2. Refer to paragraph 6-3 for parking brake assembly rebuild.

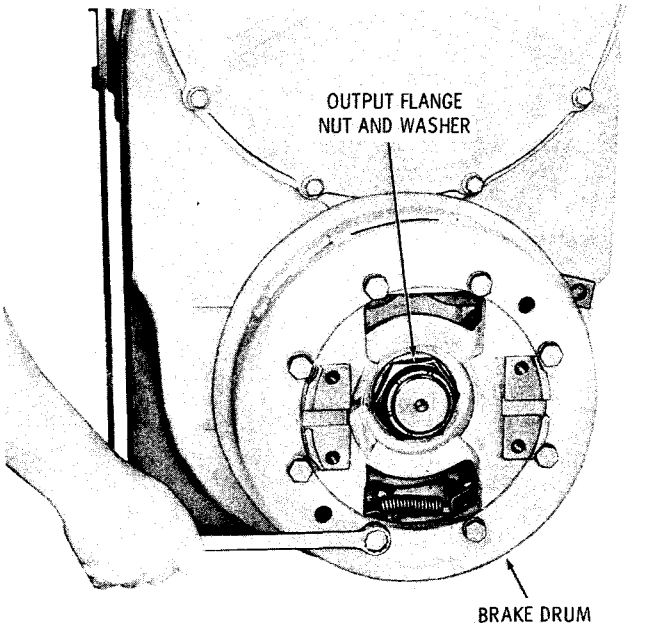


Fig. 5-3. Removing parking brake drum

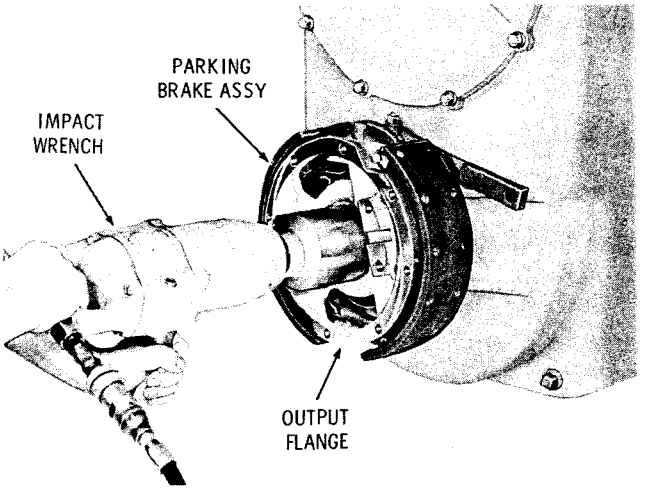
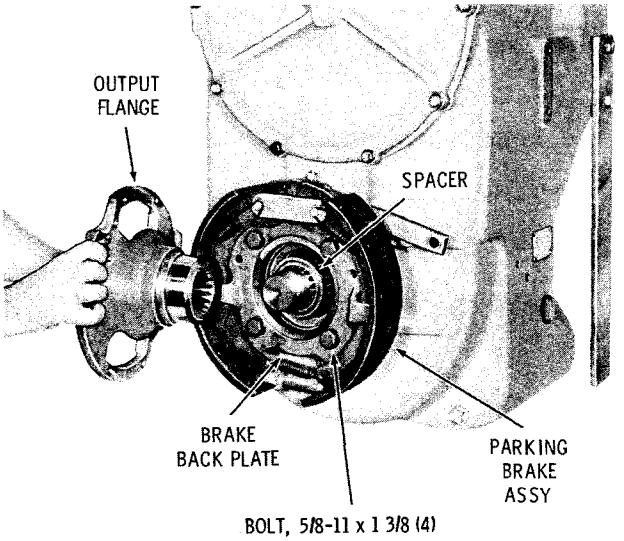


Fig. 5-4. Removing rear output flange nut

(4) Refer to paragraph 4-7. Remove front output flange retaining nut 1 (A, foldout 7), retaining washer 2 and sealring 3. Remove front output flange 4, 5, or 33 and spacer 8 from output shaft 11 or 12.

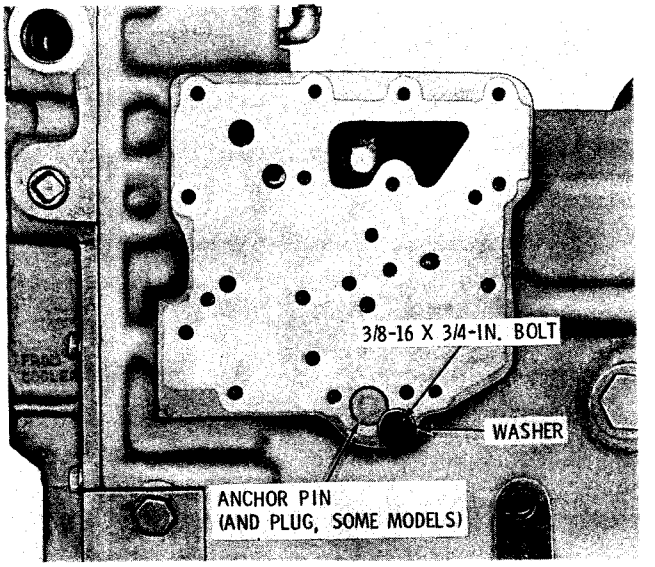
e. Control Valve Assembly

(1) Remove 16 bolts and lockwashers that retain the control valve body assembly. Remove the control valve body assembly and gasket (fig. 5-6). Refer to paragraph 6-4 for control valve body assembly rebuild.



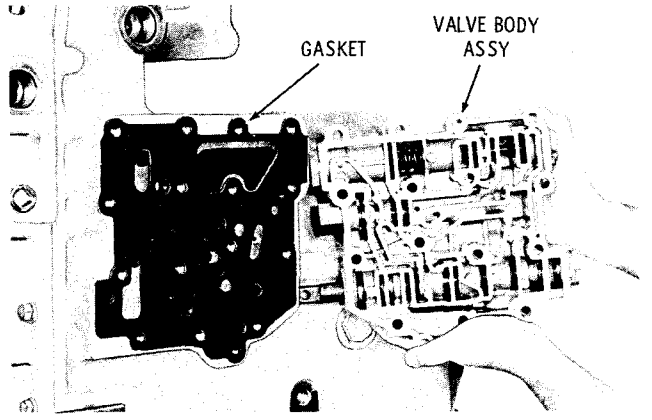
S3326

Fig. 5-5. Removing rear output flange



S3328

Fig. 5-7. Clutch anchor pin and plug temporarily retained



S3327

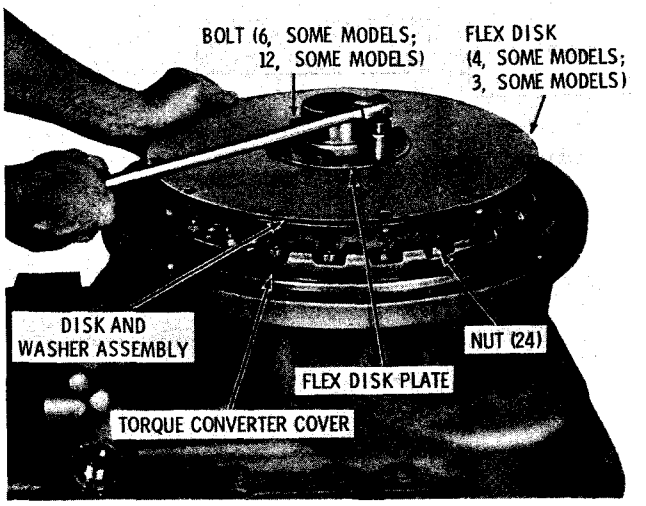
Fig. 5-6. Removing control valve body

(2) Temporarily install a flat washer and a 3/8-16 x 3/4-inch bolt to retain the clutch anchor pin (and plug, if present) (fig. 5-7).

5-4. REMOVAL OF INPUT COMPONENTS

NOTE

Direct-mount models, proceed to paragraph 5-4a. Remote-mount models, proceed to paragraph 5-4b.



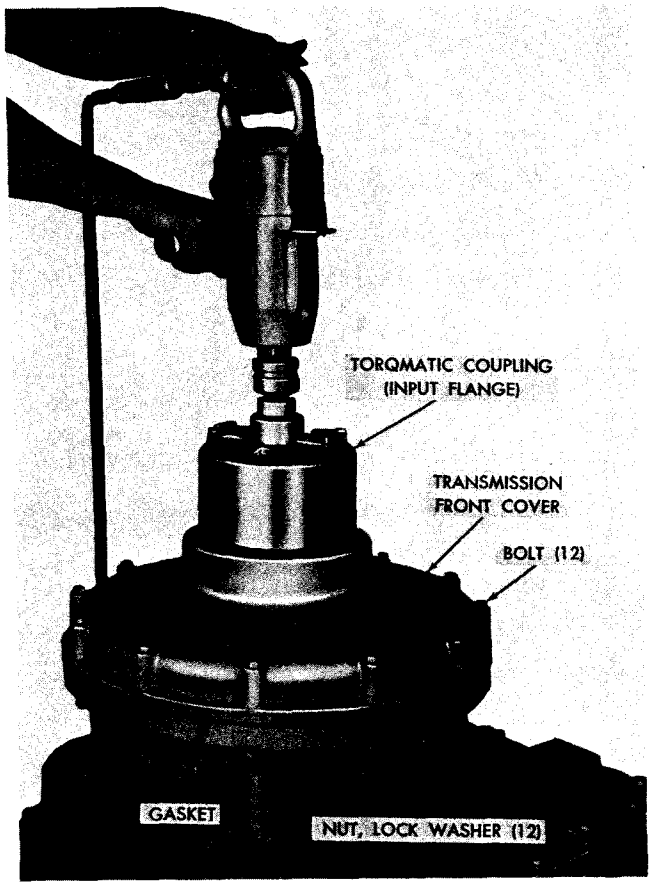
S1828

Fig. 5-8. Removing flex disk assembly

a. Direct Mount

(1) On models equipped with 16-inch flex plate drives, remove twelve self-locking bolts (six used for 14 inch-plates) and the flex disk plate that retain the flex disk assembly (fig. 5-8). Then remove the four flex disks (three used for some 14-inch plates) and the disk and washer assembly.

(2) Remove 24 self-locking nuts that retain the torque converter cover (fig. 5-8). Remove the cover.



S1829

Fig. 5-9. Removing input flange (coupling) nut

(3) If present, remove and discard gasket 7 (B, foldout 2).

(4) Proceed to paragraph 5-5.

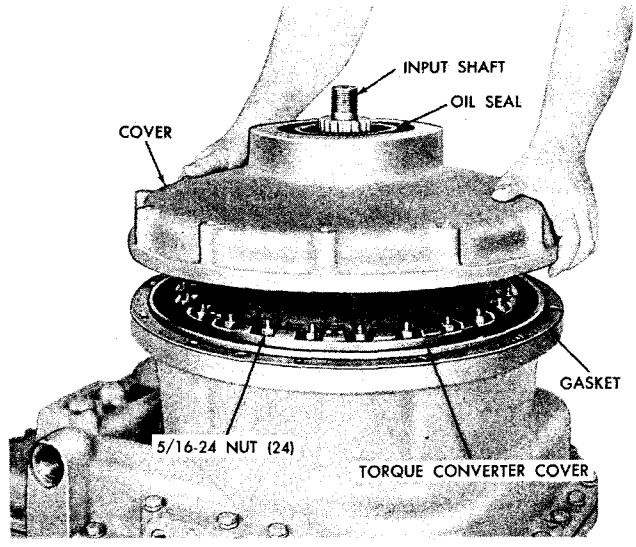
b. Remote Mount

(1) Refer to paragraph 4-7. Remove the nut and retaining washer that retain the Torqmatic coupling or input flange and remove the flange (fig. 5-9).

(2) Remove the twelve bolts, nuts and lockwashers that retain the transmission front cover (fig. 5-9).

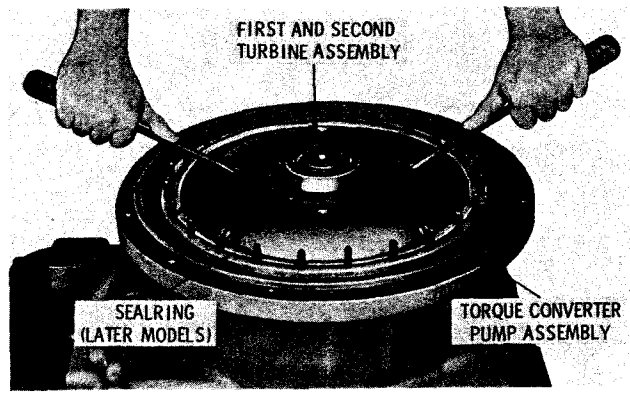
(3) Remove the transmission front cover and gasket (fig. 5-10). Remove the oil seal from the transmission front cover.

(4) Remove 24 self-locking nuts that retain the torque converter cover (fig. 5-10). Remove the torque converter cover, input shaft and ball bearing as a unit. Refer to paragraph 6-5 for converter cover rebuild.



S1831

Fig. 5-10. Removing transmission front cover (remote mount)



S1832

Fig. 5-11. Removing first-and-second turbine assembly

5-5. REMOVAL OF CONVERTER, OIL PUMP, CONVERTER HOUSING

a. Converter Components

(1) Using two screwdrivers, lift upward and remove the first-and-second turbine assembly as a unit (fig. 5-11). Refer to paragraph 6-6 for rebuild of the turbine assembly.

(2) For TRT 4820 models, proceed to step (4). On TRT 4821 models, remove snapring 23 (A, foldout 3) from the groove in the splines of the second turbine drive gear shaft 28 (B, foldout 3).

(3) Using a chisel, straighten the staking in locknut 24 (A, foldout 3) on the end of the ground sleeve. Using spanner wrench J-6534-02, remove the locknut. Proceed to step (5).

(4) On TRT 4820 models, remove the stator snapring from the end of the ground sleeve (fig. 5-12).

(5) For all models, lift the stator off the ground sleeve (fig. 5-12). Remove the splined spacer (under stator) that engages the ground sleeve.

(6) Loosen the torque converter pump assembly from the ground sleeve by prying evenly at opposite points on the rim of the pump (fig. 5-13).

NOTE

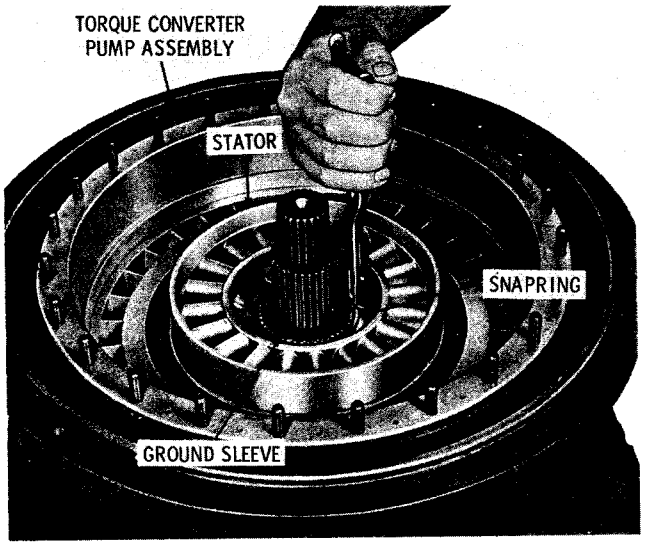
If the pump assembly will not loosen readily, remove two self-locking bolts and attach a puller. Tighten the puller against a sleeve placed against the ground sleeve. The puller sleeve must extend above the turbine drive gear shafts (fig. 5-13). Do not apply puller pressure to the gear shafts.

(7) When loose, remove the torque converter pump assembly. Refer to paragraph 6-7 for torque converter pump rebuild.

b. Oil Pump Assembly

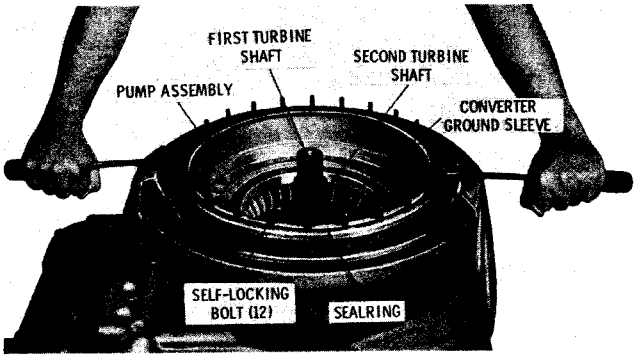
(1) Remove nine bolts and lockwashers that retain the oil pump assembly (fig. 5-14).

(2) Remove the oil pump assembly and gasket (fig. 5-14). Do not separate the oil pump components. Refer to paragraph 6-8 for oil pump assembly rebuild.



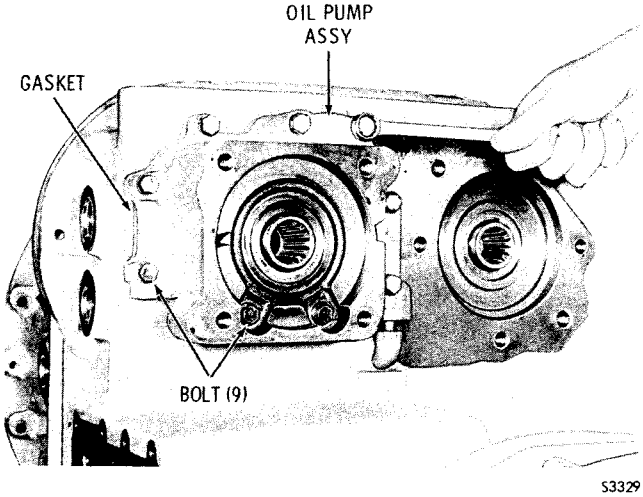
S1833

Fig. 5-12. Removing stator snapring (TRT 4820 models)



S1835

Fig. 5-13. Removing torque converter pump assembly



S3329

Fig. 5-14. Removing oil pump assembly

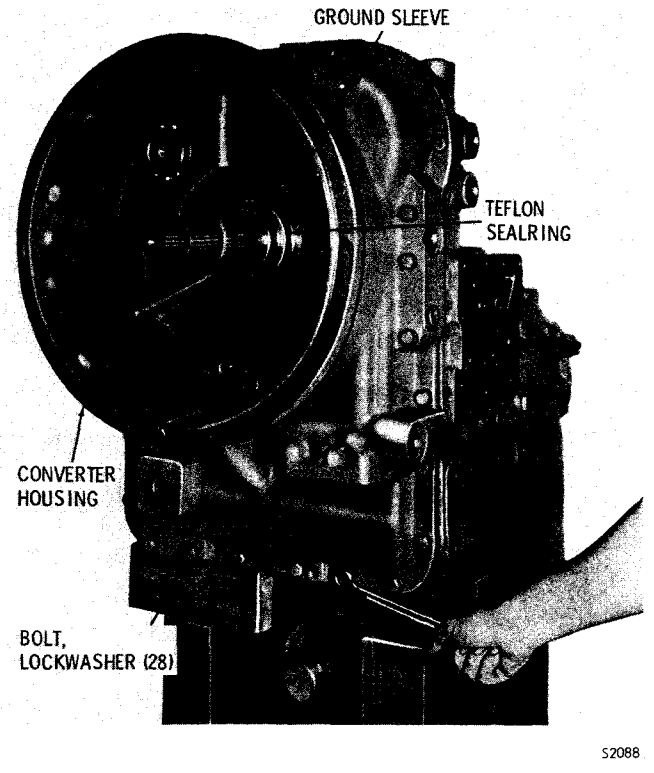


Fig. 5-15. Removing torque converter housing bolts

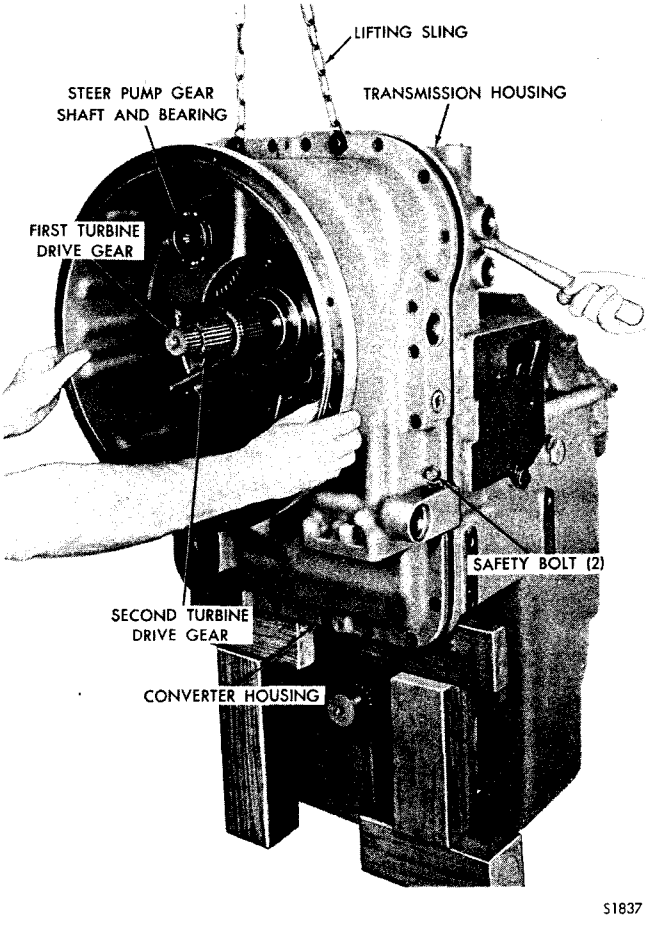


Fig. 5-16. Removing torque converter housing and related components

c. Torque Converter Housing

(1) Remove the step-joint Teflon sealring from the ground sleeve (fig. 5-15).

CAUTION

Install a safety bolt at each side of the housing before separating the converter housing from the transmission housing (fig. 5-16). These bolts should permit only about 3/4-inch (19 mm) movement of the converter housing.

(2) Remove 28 bolts and lockwashers that retain the torque converter housing (fig. 5-15).

(3) Move the torque converter housing away from the transmission housing far enough to attach a lifting sling (fig. 5-16).

(4) Support the lifting sling with a hoist (fig. 5-16). Remove the safety bolts and tap the accessory and oil pump driven gear 17 (B, foldout 3) and accessory driven gear 2 (B, foldout 4) forward to keep them seated in the converter housing. Work the converter housing forward, tapping occasionally on the first turbine drive gear to keep it seated in the transmission housing.

(5) Remove the torque converter housing, with its related parts, as shown in figure 5-17. A thrust bearing and race may cling to the second turbine drive gear. Remove the converter housing gasket, and remove the oil pump bearing race from the transmission housing.

(6) Position the converter housing on blocks, and remove the race and thrust bearing (if they cling to the part) and the second turbine drive gear (fig. 5-18). Remove the step-joint Teflon sealring. Remove the ball bearing from the gear only if replacement is necessary.

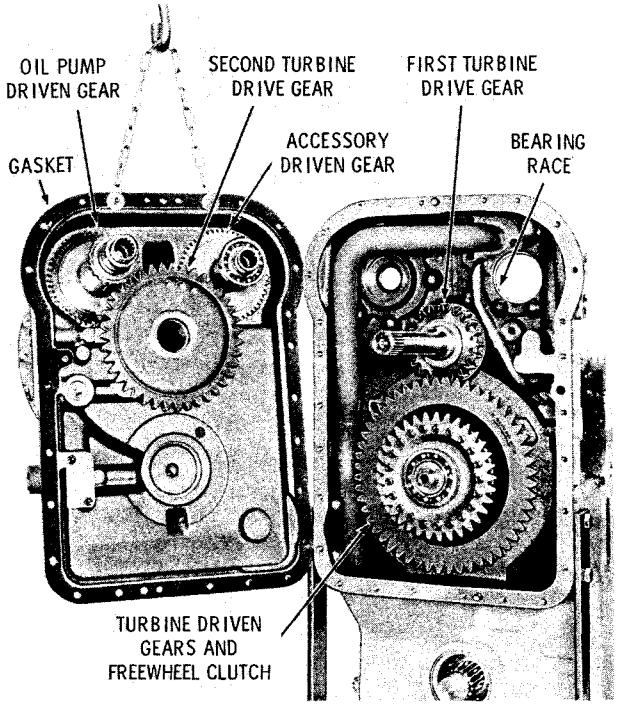


Fig. 5-17. Torque converter housing removed from transmission housing

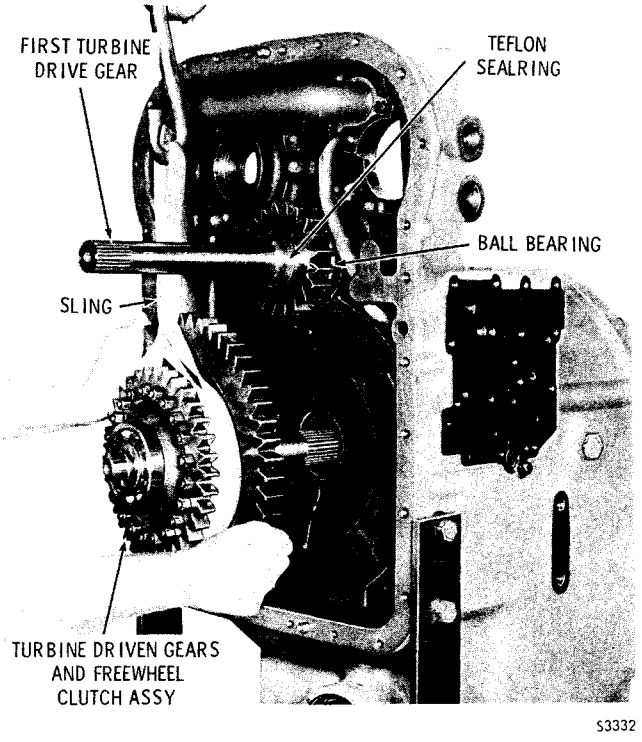


Fig. 5-19. Removing freewheel clutch assembly

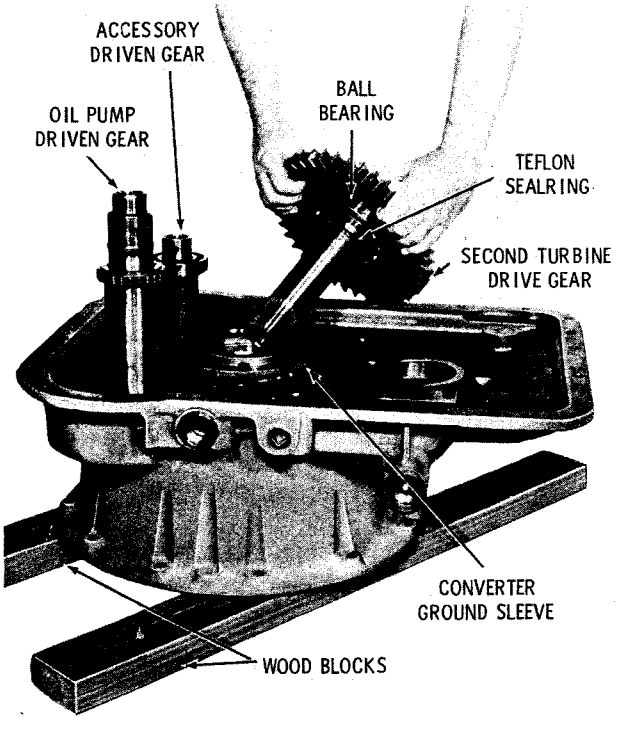


Fig. 5-18. Removing second turbine drive gear

(7) Remove the oil pump driven gear (fig. 5-18). Remove the accessory driven gear (if used). Remove the bearings from these gears only if parts replacement is necessary. Refer to paragraph 6-9 for converter housing rebuild.

5-6. REMOVAL OF FREEWHEEL CLUTCH, CONVERTER GEARING

a. Freewheel Clutch Assembly

(1) Attach a sling or rope to the freewheel clutch assembly (fig. 5-19).

(2) Support the freewheel clutch assembly on a hoist, and remove the assembly by pulling it away from the housing (fig. 5-19). Refer to paragraph 6-10 for freewheel clutch assembly rebuild.

b. First Turbine Drive Gear

(1) Remove the step-joint Teflon sealring from the first turbine drive gear (fig. 5-19).

(2) If parts did not cling to the converter housing assembly, remove the needle bearing assembly (30, 31, and 32; B, foldout 3) from the first turbine drive gear (fig. 5-19).

(3) Remove the first turbine drive gear and attached ball bearing. Remove the ball bearing only if replacement is necessary.

NOTE

If the gear cannot be removed easily, remove breather nipple 34 (B, foldout 4). Insert a soft drift through the threaded hole, and tap the gear from the housing. During removal, support the gear shaft to keep it parallel with the housing bore.

(4) If present, remove thrust washer 49 (B, foldout 4).

5-7. REMOVAL OF REAR COVER, RANGE GEARING, AND CLUTCHES

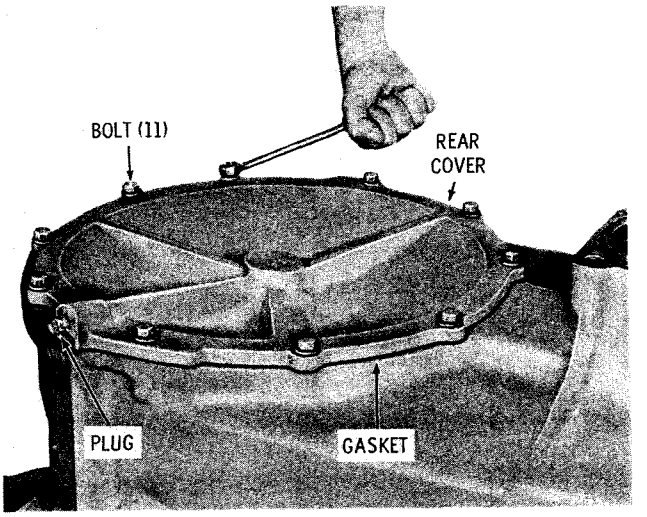
a. Rear Cover

(1) Position the transmission housing to rest on wood blocks, front downward. Remove the eleven bolts and lockwashers that attach the rear cover to the transmission housing (fig. 5-20). Remove the rear cover and gasket. If the outer race of the rear bearing remains with the rear cover, remove the race. Remove the plug from the cover only if replacement is necessary.

(2) If the transmission is equipped with a speedometer drive assembly, remove two bolts 38 (B, foldout 6) and lockwashers 37 from speedometer drive sleeve 36. Remove speedometer drive sleeve assembly 33, gasket 32, adapter 31, and gasket 30 from rear cover 29. Remove lip-type oil seal 34 and washer 35 from drive sleeve 36 only if replacement is necessary.

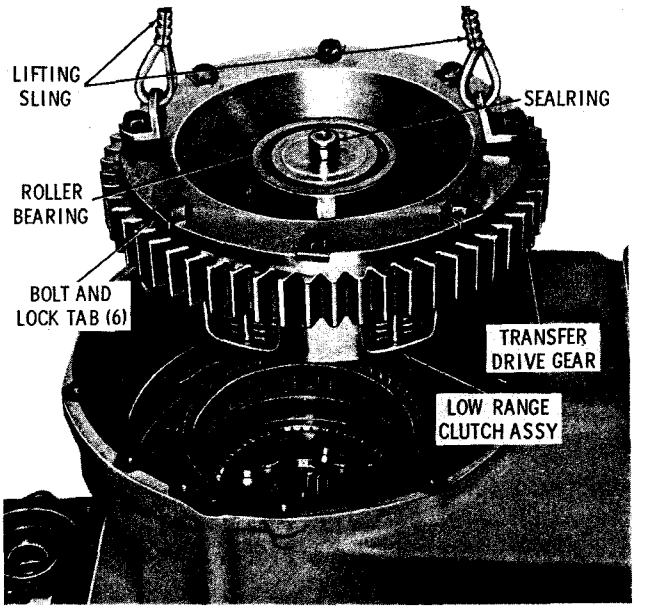
b. Low-Range Clutch and Transfer Gear

(1) Remove two bolts and lock tabs from the low-range clutch hub and attach a lifting sling (fig. 5-21). Loosen the remaining six bolts. Remove the transfer drive gear and attached low-range clutch components. Remove the hook-type sealring from the clutch hub, and position the assembly on blocks. Remove the sling, and remove the remaining six bolts and lock tabs. Remove the bearing outer race. Remove the bearing inner race only if replacement is necessary.



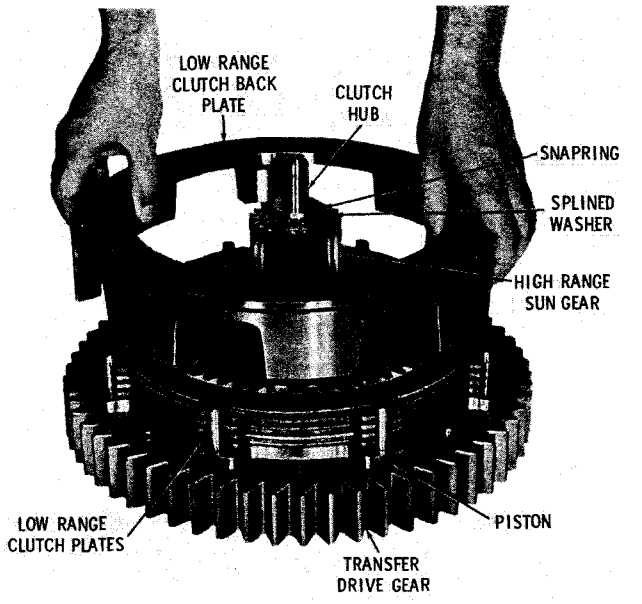
S3333

Fig. 5-20. Removing rear cover



S3367

Fig. 5-21. Removing transfer drive gear and low-range components



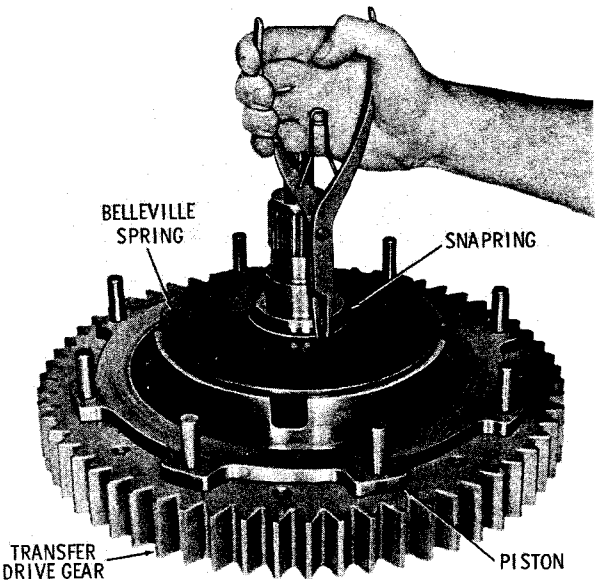
S3368

Fig. 5-22. Removing low-range clutch backplate

(2) Turn the assembly over, and remove the low-range clutch backplate (fig. 5-22). Remove the low-range clutch plates (four external-tanged plates and five internal-splined plates). Remove the snapring that retains the splined washer and sun gear. Remove the splined washer and sun gear. On later models, a spacer is located behind the high-range sun gear. Remove the spacer.

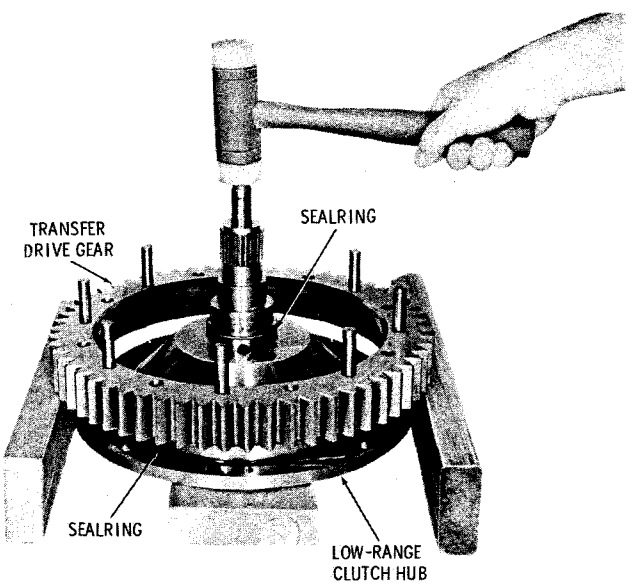
(3) Remove the snapring that retains the Belleville spring against the low-range piston (fig. 5-23). Remove the Belleville spring, and remove the piston. Refer to paragraph 6-11 for piston sealring replacement instructions.

(4) Support the transfer drive gear on wood blocks and position a wood block below the low-range clutch hub (fig. 5-24). Using a soft mallet, tap the clutch hub from the transfer drive gear. Remove one large and one small sealring from the clutch hub. Refer to paragraph 6-12 for transfer drive gear rebuild, and paragraph 6-13 for clutch hub rebuild.



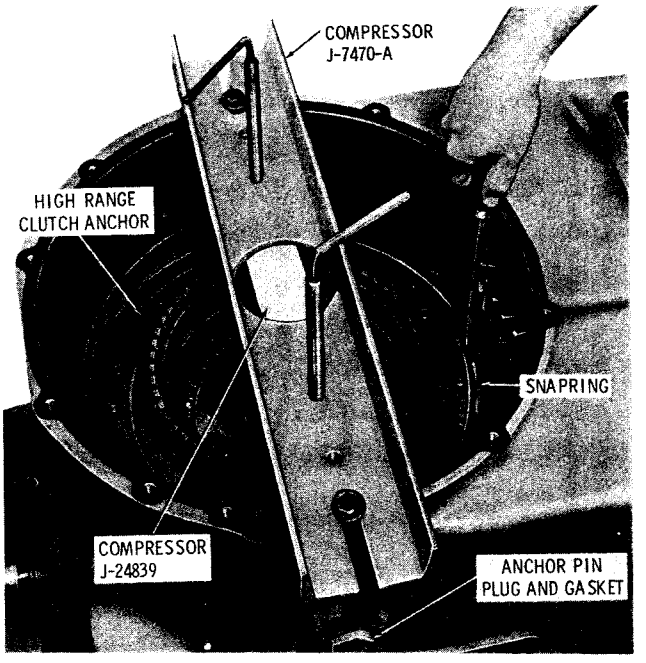
S3369

Fig. 5-23. Removing Belleville spring snapring



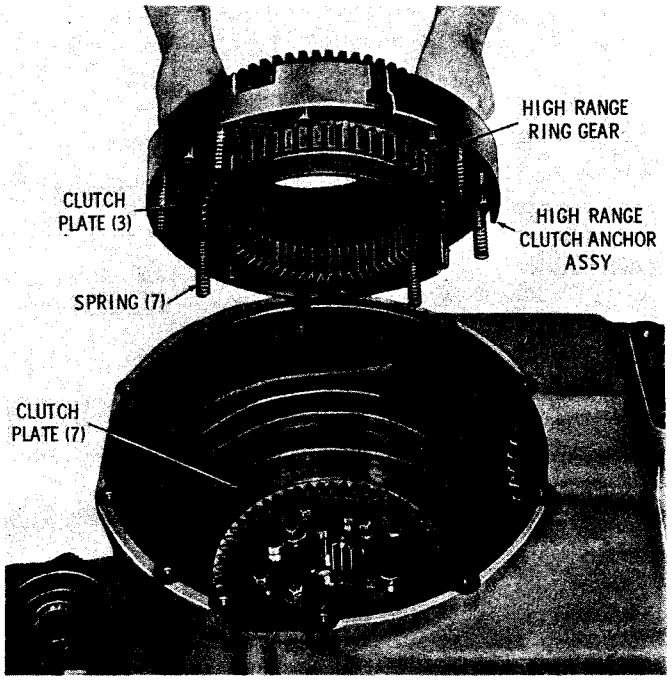
S3370

Fig. 5-24. Removing low-range clutch hub from transfer drive gear



S3371

Fig. 5-25. Removing high-range clutch anchor snapring



S3372

Fig. 5-26. Removing high-range clutch anchor and high-range ring gear

c. High-Range Clutch

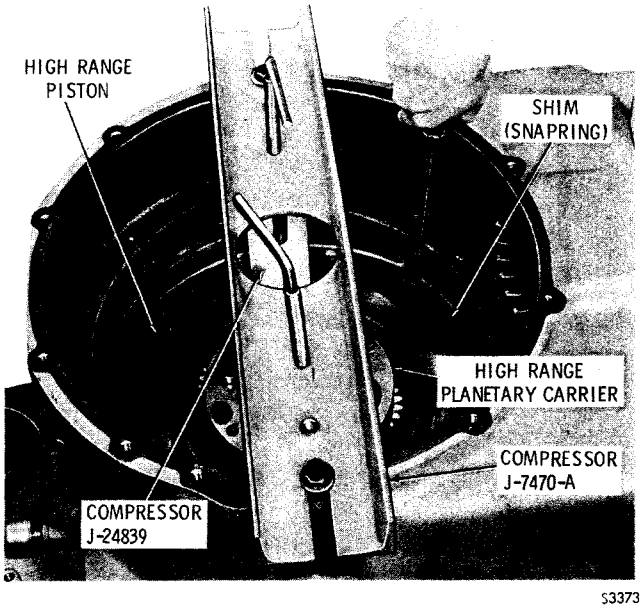
(1) Using compressor J-7470-A and compressor J-24893, depress the high-range clutch anchor to allow removal of the snapring (fig. 5-25). Remove the snapring from the groove in the housing wall. Remove compressors. Remove anchor pin plug 40 (B, foldout 4), gasket 39 and anchor pin 38.

(2) Grasp the high-range ring gear, and remove the following parts as a unit: high-range ring gear, high-range clutch anchor and three clutch plates (fig. 5-26). Separate these parts. Remove seven clutch return springs. Remove the remaining seven clutch plates from the housing. Refer to paragraph 6-14 for high-range clutch anchor rebuild.

5-8. REMOVAL OF HIGH-RANGE PLANETARY, FORWARD-, AND REVERSE-RANGE COMPONENTS

a. Forward- and High-Range Planetaries

(1) Install compressor J-7470-A and compressor J-24839 so that they act against the lower step of the high-range piston (fig. 5-27). (Do not press against the apply surface of the piston.) Depress the piston (and housing) slightly, and remove the special snapring-type shim that retains the piston housing. Remove the compressors.



S3373

Fig. 5-27. Removing forward-and-high-range clutch piston housing snapring

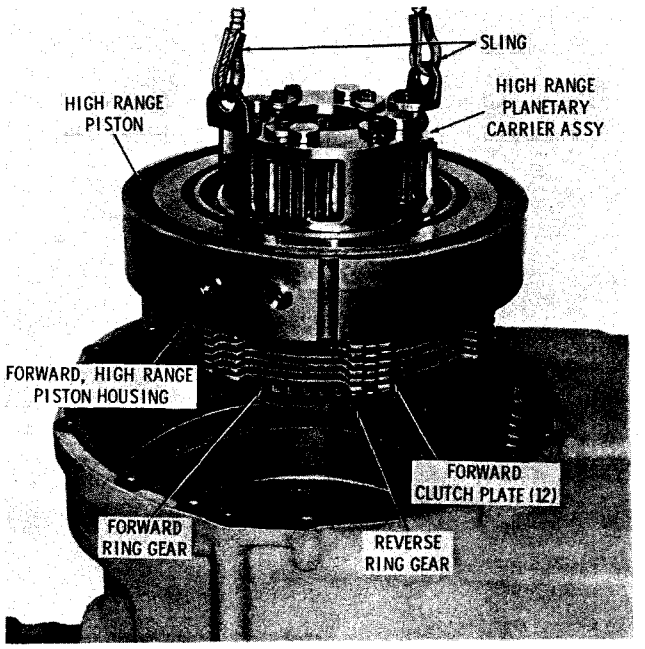


Fig. 5-28. Removing forward- and high-range planetaries, clutch piston housing and associated parts

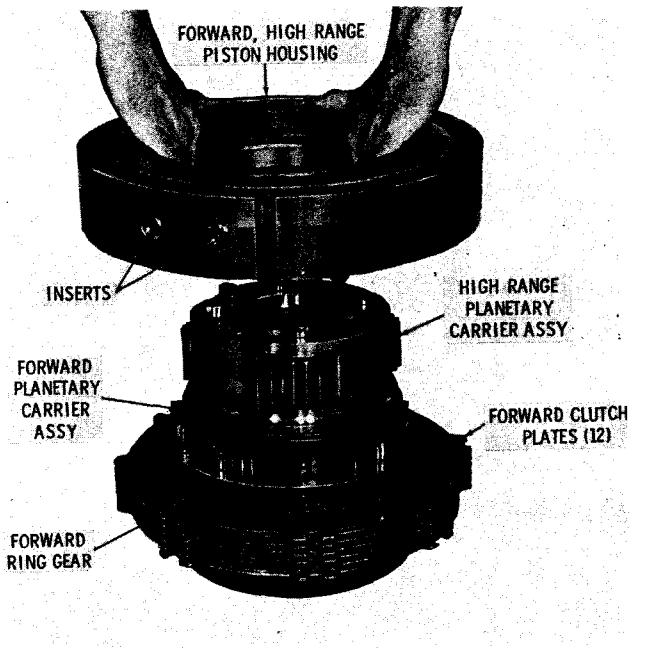


Fig. 5-29. Removing forward-and-high-range clutch piston housing (pistons in place)

(2) Remove two self-locking bolts, 180 degrees apart, from the outer bolt circle on the high-range planetary carrier, and attach a sling to the carrier (fig. 5-28). Remove the following parts as a unit; forward-and-high-range clutch piston housing, twelve forward clutch plates, forward and reverse ring gears, forward- and high-range planetary assemblies, and forward-and-reverse sun gear.

(3) Position this unit on a clean working surface for further disassembly and remove the sling.

b. Forward-and-High-Range Piston Housing and Pistons. Remove the forward-and-high-range piston housing (fig. 5-29). Remove both inserts and sealrings (beneath inserts) from the piston housing. Remove the high range and forward pistons from the piston housing. Refer to paragraph 6-11 for clutch piston rebuild.

c. Forward Clutch Plates, Ring Gear, and High-Range Planetary. Remove the twelve forward clutch plates from the forward ring gear (fig. 5-29). Remove the forward ring gear. Remove the remaining two self-locking bolts (outer bolt circle) that attach the high-range planetary carrier assembly to the forward planetary assembly. Remove the high-range carrier assembly. Refer to paragraph 6-15 for the high-range carrier assembly rebuild.

d. Forward Planetary, Reverse Ring Gear, Sun Gear

(1) Remove the snapring that retains the reverse ring gear to the forward planetary carrier, and remove the reverse ring gear (fig. 5-30).

(2) Release the spindle locking plate by rotating it clockwise, and remove the plate (fig. 5-31). Remove the snapring that retains the bearing and sun gear. Remove the sun gear and bearing. Remove the bearing only if replacement is necessary. Refer to pararaph 6-16 for the forward carrier assembly rebuild.

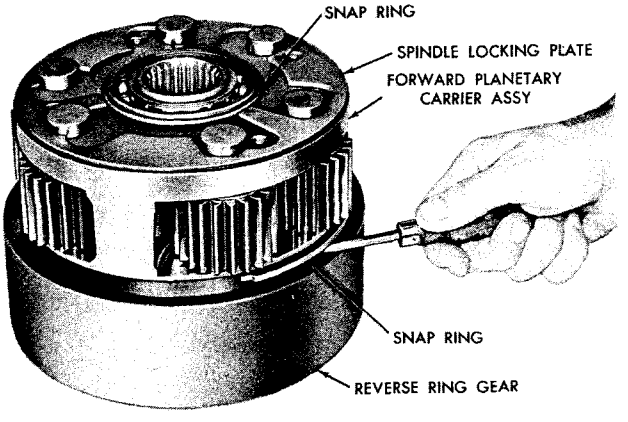


Fig. 5-30. Removing reverse ring gear snapring

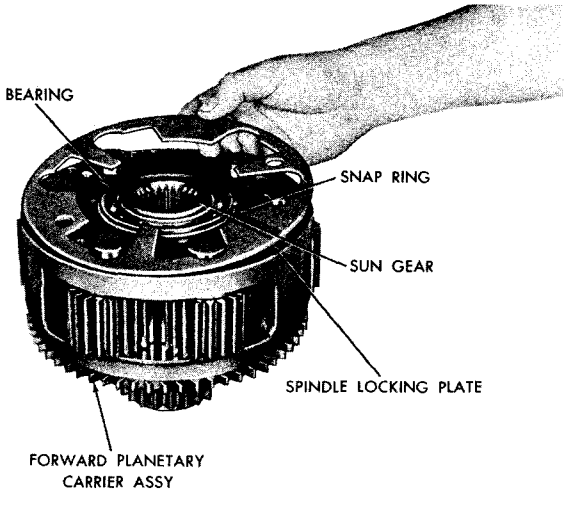


Fig. 5-31. Removing spindle lock plate

e. Forward and Reverse Clutch Plates, Clutch Anchor, Reverse Planetary

(1) Remove the reverse and forward piston return springs and guide pins (fig. 5-32). Remove the piston housing anchor key and the remaining four forward clutch plates from the clutch anchor. Remove the clutch anchor assembly from the transmission housing. Refer to paragraph 6-17 for the clutch anchor assembly rebuild instructions.

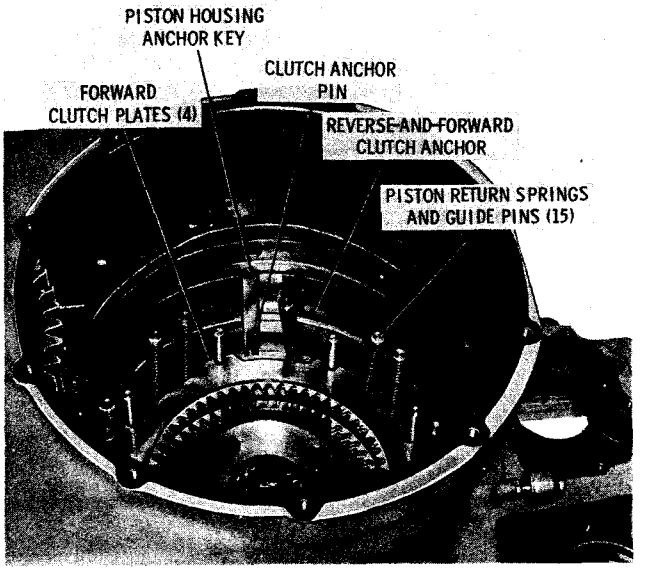


Fig. 5-32. Reverse-and-forward clutch anchor, piston return components, and forward clutch plates

(2) Remove the reverse planetary carrier assembly and seven of the reverse clutch plates which are held by the spacer ring on the carrier (fig. 5-32). Separate the plates from the carrier. Refer to paragraph 6-18 for the reverse planetary carrier assembly rebuild instructions. Remove the remaining seven clutch plates from the transmission housing.

(3) Remove the bolt and lockwasher which were temporarily installed in the control valve mounting pad to retain the clutch anchor pin and plug (fig. 5-7). Remove the anchor pin and plug, and remove the reverse piston (fig. 5-33). Refer to paragraph 6-11 for piston rebuild.

5-9. REMOVAL OF OUTPUT COMPONENTS AND TRANSFER DRIVEN GEAR

a. One-Piece Shaft

(1) Using a bearing puller, remove the dust shield and oil seal from the front of the transmission (fig. 5-34). On later models, no dust shield is present.

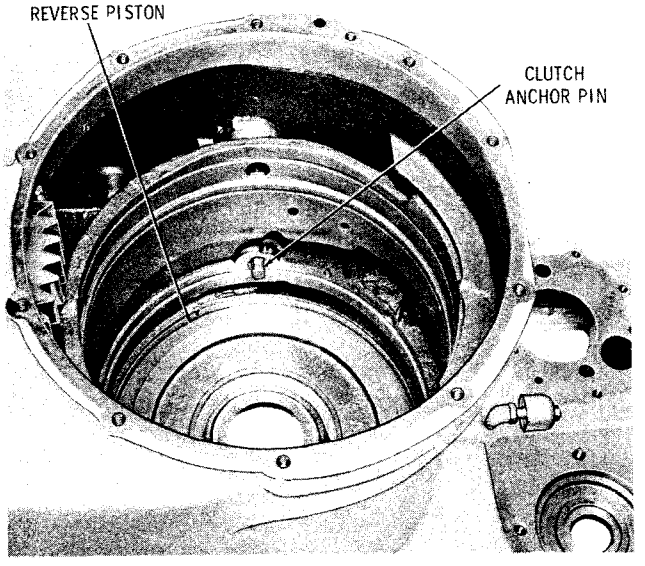


Fig. 5-33. Reverse clutch piston and clutch anchor pin

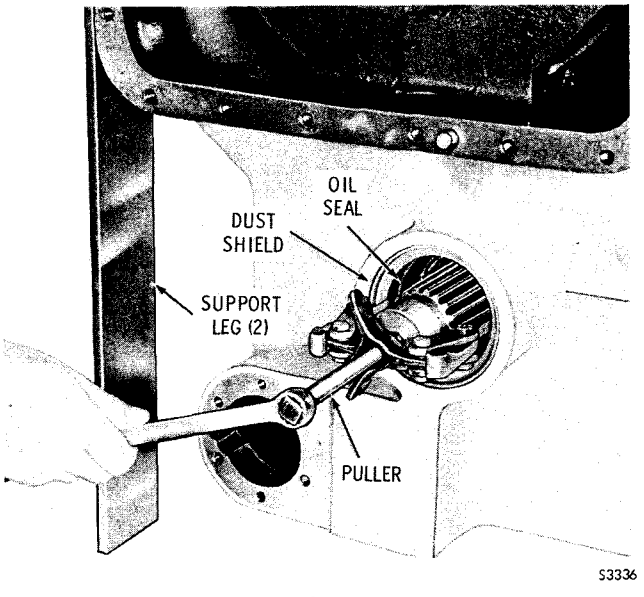


Fig. 5-34. Removing front output dust shield

(2) Remove the snapring that retains the ball bearing at the forward end of the output shaft (fig. 5-35).

(3) Using a soft hammer, drive the output shaft forward until the front bearing is free of the housing (fig. 5-36). Remove the output shaft and bearing as an assembly. Press the bearing from the shaft only if replacement is necessary.

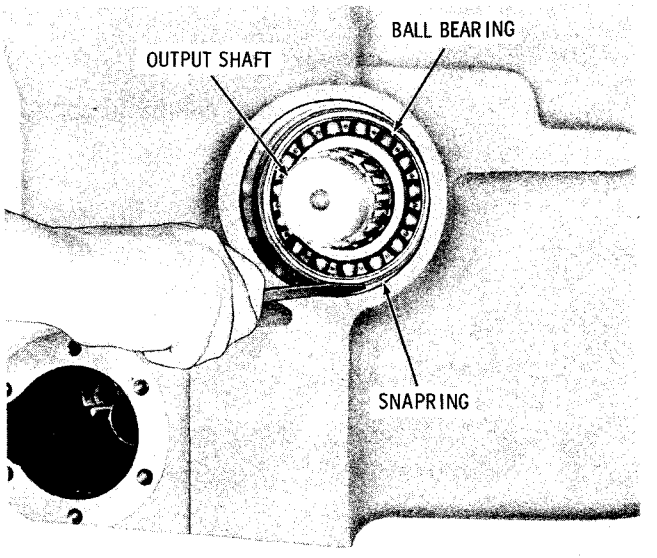


Fig. 5-35. Removing front output shaft bearing snapring

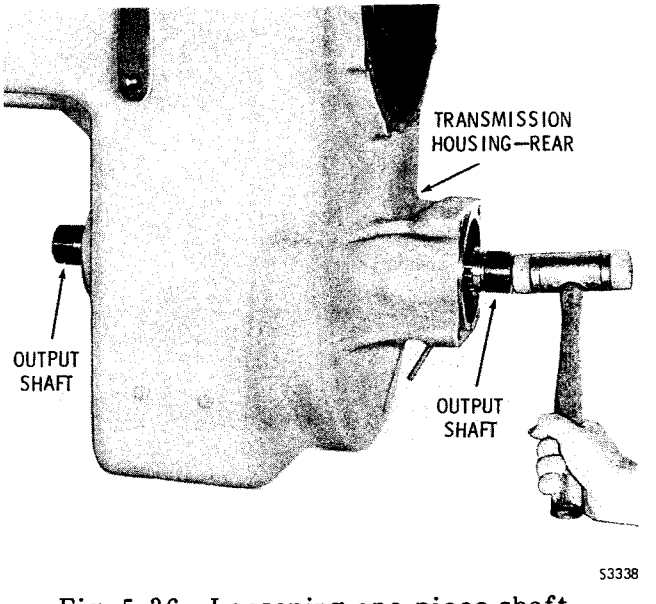


Fig. 5-36. Loosening one-piece shaft

(4) Remove the transfer driven gear (fig. 5-37). Remove ball bearing 24 (A, foldout 7), oil seal 27 and dust shield 28 from the rear of the housing.

(5) Remove cap 34 from the bore in the front of the housing only if necessary.

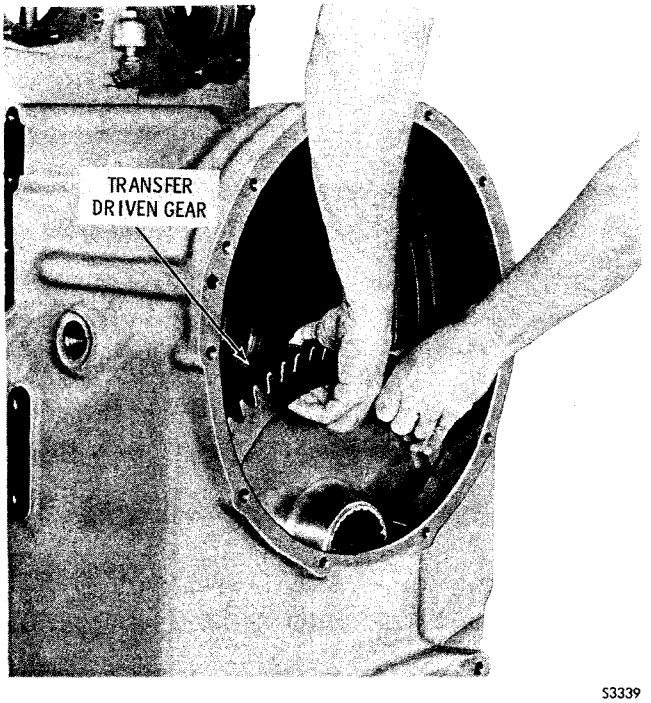


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Fig. 5-37. Removing transfer driven gear

b. Two-Piece Shaft, Disconnect Coupling (A, foldout 7)

CAUTION

Do not remove shifter shaft if only the shaft seal requires replacement. Removal of the shifter shaft will allow the shifter fork to drop into the sump area, and partial disassembly of the transmission is required to reinstall the shifter components. (Destroy and remove the failed seal. Install the new seal and press it lightly against the shoulder in the bore.)

(1) Rotate shifter fork shaft 17 (A, foldout 7) counterclockwise to remove it from the transmission housing. Removal of the shaft will allow shifter fork 16 to fall into the sump area. Remove the shifter fork. Remove oil seal 18 from the bore in the front of the housing.

(2) Using a bearing puller, remove dust shield 28 and oil seal 27 from the rear of the housing. Remove snapring 25 that retains bearing 24 in the housing bore.

(3) Using a soft hammer, drive front output shaft 12 rearward until bearing 24 (on rear output shaft assembly 21) is free of the housing bore. Remove rear output shaft 21 and bearing 24 as an assembly. Press the bearing from the shaft only if replacement is necessary. Remove sleeve bearing 22 from rear output shaft 23 only if replacement is necessary.

(4) Remove transfer driven gear 20. Remove bearing 19 from the support web within the housing. If necessary, use front output shaft 12 and disconnect coupling 15 to bump the bearing from its bore. Remove the front output shaft and disconnect coupling as an assembly through the rear of the housing.

NOTE

A spring and two detent balls will be released when the disconnect coupling is removed from the front output shaft. Drape a shop towel over the assembly to prevent possible loss of the balls.

(5) Remove the disconnect coupling from the front output shaft. Place detent balls 13 and spring 14 in a container.

(6) Remove dust shield 6 (if present), oil seal 7, and snapring 9 from the front housing bore. Remove bearing 10. If necessary, tap evenly around the outer race with a drift to drive the bearing forward from its bore. Refer to paragraph 6-19 for transmission housing rebuild.

Section 6. REBUILD OF SUBASSEMBLIES

6-1. SCOPE OF SECTION 6

This section contains the rebuild procedures for the subassemblies which were removed in Section 5.

6-2. GENERAL INFORMATION FOR SUBASSEMBLY REBUILD

a. General Information. Refer to Section 4 for general information for overhaul, cleaning, and inspection of the transmission.

b. Torque Specifications. The torque value for each threaded fastener is specified in the assembly step. Torque values are also presented on the exploded-view foldouts at the back of this manual.

6-3. PARKING BRAKE ASSEMBLY

a. Disassembly (B, foldout 8)

(1) Remove the two shoe return springs (fig. 6-1). Remove the anchor pin brace.

(2) Remove the adjusting screw spring and adjusting screw assembly (fig. 6-2). Do not disassemble the adjusting screw assembly unless parts replacement is necessary.

(3) Remove the two shoe and lining assemblies.

(4) If present, remove spring 5 (B, foldout 8).

NOTE

If brake apply lever 3 is to be removed, first, deeply scribe or center punch the end of the camshaft and the lever at the 12 o'clock position to show the relationship of the two parts. This will assist correct re-assembly.

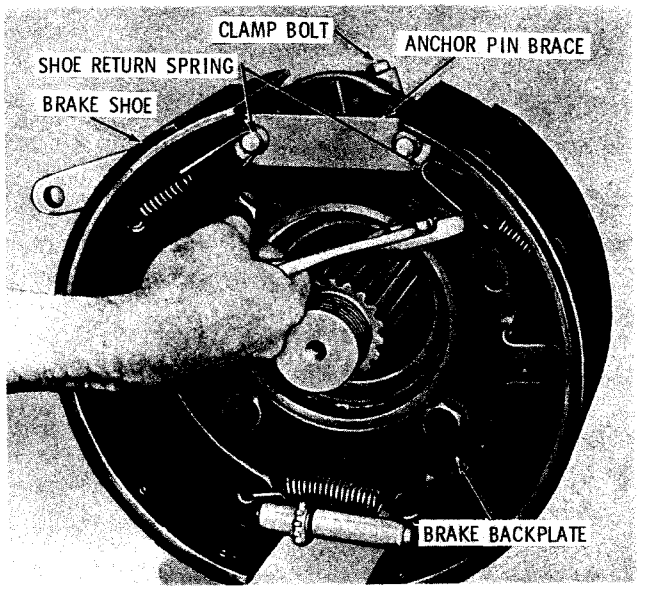

Fig. 6-1. Removing parking brake shoe return spring

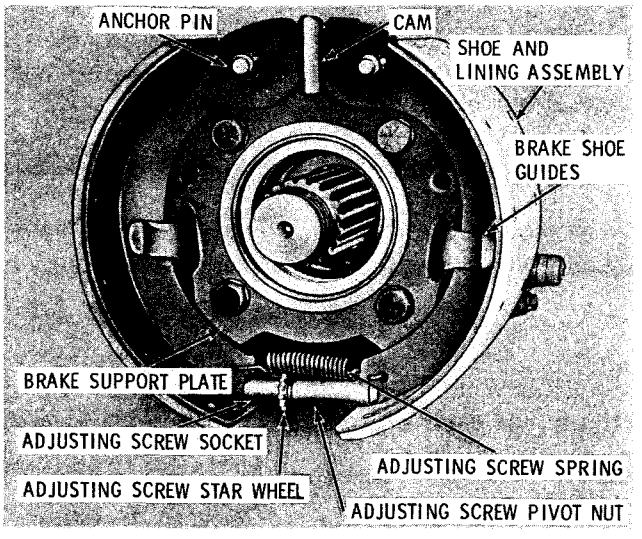

Fig. 6-2. Parking brake shoe assembly

(5) Only if necessary, loosen the clamp bolt and remove apply lever 3, spring washer 6, nuts 7, lockwashers 8, camshaft support 9, anchor pins 17 and camshaft 16.

NOTE

Refer to paragraph 6-2.

b. Assembly (B, foldout 8)

CAUTION

Brake linings must be kept free from oil, grease or other contamination.

(1) Coat the threads of anchor pins 17 with an anti-seize compound (such as Lubriplate* 630-AA) and install the anchor pins and camshaft support 9 and retain them with lockwashers 8 and nuts 7. Tighten nuts 7 to 1500-2000 lb in. (170-225 N·m).

NOTE

If a new lever is being installed, scribe marks onto the new parts in the same location as the scribe on the old parts.

(2) Coat the shaft of camshaft 16 with an anti-seize compound and install the camshaft, spring washer 6 and apply lever 3, using care to line up the marks that were scribed into the lever and shaft prior to disassembly. Seat the lever firmly against the spring washer to prevent play in the camshaft and lever assembly. Tighten the clamp bolt (fig. 6-1) to 26-32 lb ft (36-43 N·m). Install spring 5 (B, foldout 8).

(3) Coat the support plate surfaces, where the shoe webs rest, with an anti-seize compound.

(4) If the adjusting screw assembly was disassembled, coat the cleaned parts with an anti-seize compound and reassemble the parts.

(5) Set the brake shoes in place, over the anchor pins, and install the adjusting screw assembly and spring (fig. 6-2).

(6) Install the anchor pin brace over the anchor pins (fig. 6-1).

(7) Install the shoe return springs (fig. 6-1).

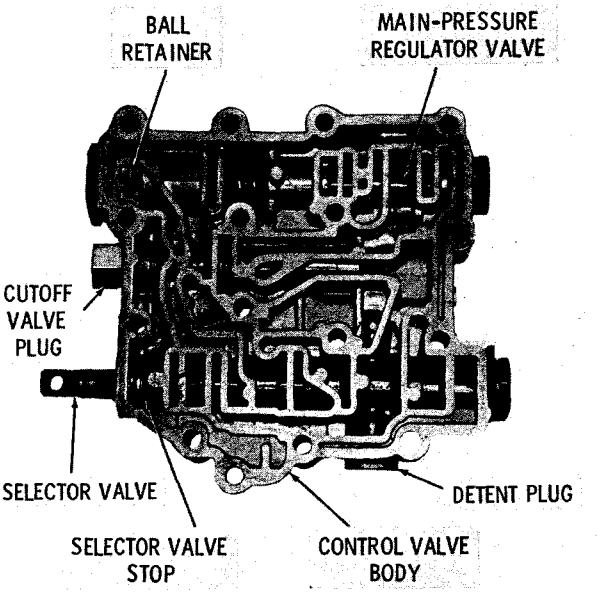

Fig. 6-3. Control valve body assembly--mounting side

6-4. CONTROL VALVE BODY ASSEMBLY

a. Disassembly (clutch cutoff models) (B, foldout 7)

(1) Remove the selector valve stop from the selector valve (fig. 6-3). Remove plug 32 (or customer-supplied neutral start switch and spacer) and washer seal 33 (B, foldout 7). Remove detent plug 29 and gasket 30, and remove one detent spring 31 and one detent ball 28 from control valve body 9.

(2) Remove plug 36 and gasket 35 from the control valve body. Remove manual selector valve 27 by tapping on the front (plug end) of the valve, driving oil seal 26 from the valve body with the valve. Remove the remaining detent ball 28 and detent spring 31.

(3) On models equipped with hydraulic-actuated clutch cutoff, remove retainer plug 25 and gasket 23. Remove clutch