

# Allison Transmissions

# TT 3000 Series Service Manual



## **IMPORTANT SAFETY NOTICE**

Proper service and repair is important to the safe, reliable operation of all motor vehicles. 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.

It is important to note that some warnings against the use of specific service methods that can damage the vehicle or render it unsafe are stated in this service manual. It is also important to understand these warnings are not exhaustive. Detroit Diesel Allison could not possibly know, evaluate and advise the service trade of all conceivable 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 satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects.

# Service Manual

## Allison Transmissions

### POWERSHIFT MODEL

TT 3420-1

1 MAY 1977



**Detroit Diesel Allison**

Division of General Motors Corporation  
Indianapolis, Indiana 46206

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**NOTE:**

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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1	TT 3420-1 Transmission	A,5 Power takeoff
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B,2	Input components, remote mount	A,6 Reverse-range clutch and planetary
A,3	Input components, direct mount	B,6 Low-range clutch and planetary
B,3	Torque converter	A,7 High-range clutch and piston housing
A,4	Torque converter housing and turbine drive gears	B,7 Transmission rear cover
B,4	Turbine driven gears and freewheel clutch	A,8 Output shafts and disconnect assembly
		B,8 Oil pump assembly
		A,9 Parking brake
		B,9 Control valve assembly

## Section 1. GENERAL INFORMATION

### 1-1. SCOPE OF MANUAL

**a. Coverage.** This Service Manual describes the operation, maintenance, and overhaul procedures for the TT 3000 Series Powershift transmission. Figures 1-1 and 1-2 are representative of the models covered in this manual. The disassembly and assembly procedures are presented, and the function and operation of the hydraulic systems and torque paths are explained. Wear limits information, parts inspection procedures, and torque specifications also are included.

**b. Illustrations.** The text is illustrated with photographs, line drawings, schematic views, and cross-section and exploded views. Transmission features and overhaul procedures are illustrated mainly by photographs. Line drawings are used to illustrate the hydraulic system. Cross-section views illustrate the torque paths and the relationship of assembled parts. The cross-section and exploded views appear on foldouts at the back of the manual. The foldouts may be opened for reference while studying the text.

### 1-2. SUPPLEMENTARY INFORMATION

Supplementary information will be issued when significant design changes occur. The supplements will pertain only to specific changes, and therefore, must be used in conjunction with this Service Manual.

### 1-3. ORDERING PARTS

#### a. Transmission Nameplate

The nameplate (fig. 1-3), located on the lower left side of the transmission housing, has the serial number, part number (assembly number) and model number assigned to define a specific configuration. Because of the differences in models, options, and component arrangement, be sure to include all three numbers (and metal-stamped letters, if present) when ordering 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 TT 3000 Series Allison Powershift Transmission Parts Catalog (SA 1519). Do not order parts by illustration item numbers used in this Service Manual.

### 1-4. DESIGN FEATURES

#### a. Mounting, Input Drive (foldout 1)

(1) The transmission may be direct mounted or remote mounted. In the direct-mount arrangement, the transmission is coupled to the engine through a modified SAE 3 mounting face on torque converter housing 8, bolted to the engine flywheel housing. Flexible disks 3 and 4 (A, foldout 3) bolt to the engine flywheel.

(2) For the remote-mount arrangement, the transmission is equipped with front cover 2 (foldout 1). An input shaft 42, connected to converter drive cover 3, extends through front cover 2 and receives the flange. Input flange 1 is driven by the engine through a drive shaft and universal joints.

#### b. Twin-turbine Torque Converter (foldout 1)

(1) Each turbine is connected to its own output gear set. First turbine 6 provides high torque at low speed; second turbine 5 provides higher speed with less torque. There are four elements in the twin-turbine torque converter—pump 8, first turbine 6, second turbine 5, and stator 7.

(2) First-turbine drive gear 14, driven gear 36, and freewheel clutch 38 connect the first turbine to the range gears and clutches. Second-turbine drive gear 39 and driven gear 37 connect second turbine 5 to the range gears and clutches. The first-turbine gear set provides a reduction in speed with an increase in torque delivered to the range gearing. The second-turbine gear set provides an increase in speed with a reduction in torque delivered to the range gearing.

(3) 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, torque demand decreases. When this occurs, the second turbine assumes the load and the freewheel clutch disengages. The transition from first turbine to second turbine (high torque to high speed) is automatic, being determined by speed and load conditions.

## TT 3000 SERIES POWERSHIFT TRANSMISSIONS

### Para 1-4

#### c. Range Gearing, Clutches (foldout 1)

(1) The transmission has two planetary gear sets and three clutches. The reverse-range planetary gear set consists of ring gear 33, carrier assembly 35, and sun gear 26 (integral with low-range sun gear). The reverse-range gear set is controlled by reverse-range clutch 16.

(2) The low-range planetary gear set consists of ring gear 31, carrier assembly 27 and sun gear 26 (integral with reverse-range sun gear). The low-range gear set is controlled by low-range clutch 18.

(3) Torque is supplied to the reverse- and low-range planetary gear sets by the shaft of second-turbine drive gear 37, which drives the reverse-and-low-range sun gear. High-range clutch 23, when engaged, gives direct drive from the turbine driven gear 37 to transfer drive gear 21. The low-range clutch, when engaged, provides drive from the turbine driven gear 37 to transfer drive gear 21 with a reduction in speed. The reverse-range clutch, when engaged, provides drive from gear 37 to gear 21, with a reversal of direction and reduction in speed. Two forward gears (F1 and F2) and reverse (R) are derived from the range gearing and clutches. All three clutches are multiplate, hydraulically applied, spring released.

**d. Transfer Gears** (foldout 1). The transmission output consists of transfer gears 21 and 30 which drive one of two output configurations—front and rear output or front disconnect and rear output (A, foldout 8). Constant-mesh, spur-type transfer gears are used in-line to provide a 19-inch vertical drop from the input shaft to the output shaft.

#### e. Output Shafts (foldout 1)

(1) The transmission may be equipped with one of two output shaft configurations—one-piece shaft 28, or two-piece shaft 4 and 14 (A, foldout 8).

(2) The one-piece shaft provides identical operation at the front and rear outputs. The two-piece shaft and disconnect coupling 7 allow front output shaft 4 to be disconnected from the driveline while drive at rear output shaft 14 is maintained.

#### f. Accessory Drive Pad

(1) An SAE size B, 2-bolt mounting pad is located at the upper-right rear of the transmission housing to accommodate a steer pump or other accessory (in addition to that mounted at the rear of the oil pump).

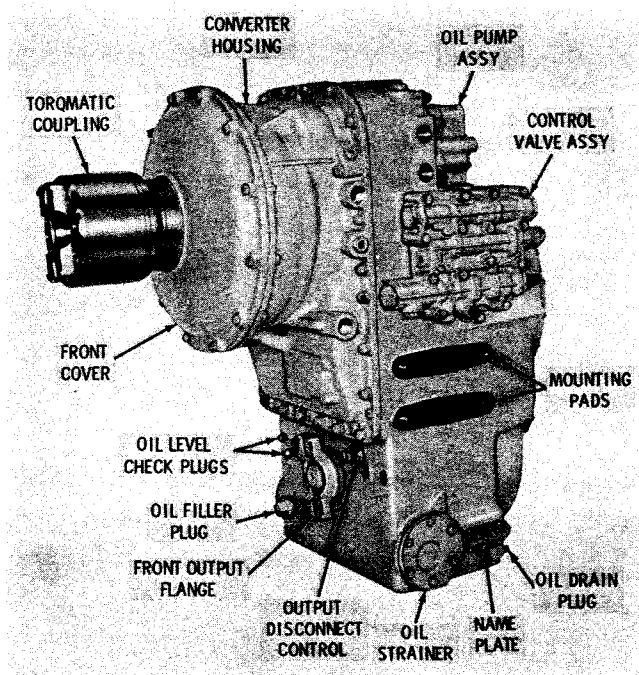
(2) If no requirement exists for an accessory drive at this location, the drive gear, shaft assembly, and related parts are omitted, and the openings in the housing are closed with plugs.

**g. Oil Pump** (foldout 1). A positive displacement, dual section, 3-gear oil pump 13 furnishes the oil flow and pressure necessary for hydraulic operation, lubrication, and cooling of the transmission components. A pad is provided at the rear of the pump to accommodate an implement pump. Rotation of the pump is in a clockwise direction (viewed from the rear) at engine speed.

#### h. Control Valve Body Assembly (B, foldout 9)

(1) Control valve body assembly 5 is mounted on the left side of the transmission housing (fig. 1-1). The significant components contained within the valve body are main-pressure regulator valve 8 (B, foldout 9), trimmer plug 16, range selector valve 25, and a clutch cutoff valve 20.

(2) The clutch cutoff valve is hydraulically actuated (by hydraulic brake pressure). When the vehicle brakes are applied, the valve releases the transmission drive clutch. Thus, when the vehicle is brought to a stop by the brakes, the power-driven pumps may be controlled by opening the throttle without having to shift to neutral.



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Fig. 1-1. Model TT 3420-1 transmission equipped for remote mounting—left-front view

(3) Linkage connects the range selector valve to the operator's manual controls. A brake pressure line connects the clutch cutoff valve to the vehicle brake system.

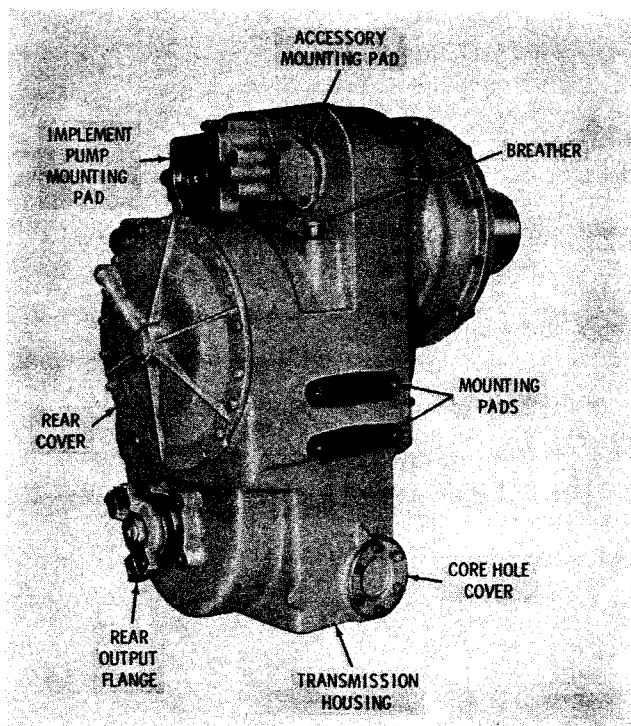
i. **Parking Brake** (A, foldout 9). A 10 x 3-inch (254 x 76.2 mm), expanding shoe-type parking brake 1 is available. The brake is mechanical, and manually operated.

j. **Housings** (fig. 1-1 and 1-2). The torque converter housing is cast aluminum, and the transmission housing is cast iron. The front cover is cast iron. The rear cover is cast iron. The lower part of the transmission housing serves as an oil sump. Openings in the transmission housing provide for installation of external piping, oil check plugs, breather, drain plug, oil filler tube and oil strainer.

k. **Oil Filter, Cooler.** Provision is made for connecting a remote-mount, full-flow filter and an oil cooler to the transmission (both customer-furnished). Refer to figure 3-1 for the points at which these items are attached.

## 1-5. OPERATING INSTRUCTIONS

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



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Fig. 1-2. Model TT 3420-1 transmission, equipped for remote mounting—right-rear view

## b. Range Selection

(1) Position the range selector control to neutral position while starting the engine. A neutral start switch will prevent the engine from starting if the shift lever is in any other position.

(2) When a shift is made from neutral to any driving range, the engine should be at idle speed. Any shift to a higher speed range, in the same direction, can be made at full throttle, under load. Downshift to the next lower speed range may be made at full throttle, under 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 and/or full-speed conditions in the working ranges (F1 to R and R to F1). Shifts from reverse should be made to F1 drive range—not F2. Direct shifts from R to F2 will adversely affect clutch service life.

d. **Clutch Cutoff Control.** When the transmission is equipped with the clutch cutoff control, the driving clutch is completely released whenever the vehicle brakes are applied. Hydraulic pressure which applies the brakes also actuates the clutch cutoff. Thus, with the clutch released, full engine power is available for PTO-driven equipment without shifting the range selector control to neutral.

e. **Output Disconnect.** The transmission front output may be disconnected by actuating the control (fig. 1-1) which moves the disconnect coupling (at the front of the transmission drop box) forward. Rearward movement connects the front and rear output shafts 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.



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Fig. 1-3. Transmission nameplate

## TT 3000 SERIES POWERSHIFT TRANSMISSIONS

### Para 1-5/1-6

#### f. Temperatures, Pressures

(1) When a transmission is equipped with a temperature gage, the bulb or sending unit is mounted in the converter-out oil stream (fig. 3-1). Temperature should never be permitted to exceed 250°F (121°C). Extended, severe operating conditions may cause the temperature to reach this maximum. If so, the transmission should be shifted to neutral and the engine should be operated at approximately 1000 to 1500 rpm for several minutes until normal temperature (180 to 220°F (82 to 104°C) is restored. If the temperature reaches maximum (250°F (121°C)) during normal operation of the transmission, stop the engine and locate the trouble. Refer to 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 will cause fluctuations in the pressure indicated. If abnormal pressures are evident, refer to the Troubleshooting Chart (para 3-11).

### 1-6. SPECIFICATIONS, DATA

The following table of specifications and data are applicable to all models in this Service Manual.

## SERIES TT 3000 POWERSHIFT TRANSMISSIONS SPECIFICATIONS AND DATA

Item	Description
Transmission type .....	Torque converter and planetary gear
Rating:	
input speed .....	2800 rpm (max.)
input torque .....	400 lb ft (542 Nm)
input horsepower .....	150-250 HP (112-186 kW)
	Depending upon application
Rotation, viewed from front:	
input .....	clockwise
output (forward operation) .....	clockwise
(reverse operation) .....	counterclockwise
Mounting, drive:	
side .....	four 5/8-11 tapped holes in side pads, each side
front, direct mounted .....	modified SAE-3 flange on converter housing
	bolts to engine flywheel housing, flex plate
	attaches to engine flywheel
front, remote mounted .....	front unmounted, converter enclosed, input
	flange for shaft and universal joint coupling
Gear ranges, selector positions .....	reverse, neutral, low range (F1), high-range (F2)
Weight, dry (approx.):	
direct mount .....	1000 lb (454 Kg)
remote mount (add) .....	40 lb (18 Kg)
parking brake (add) .....	20 lb (9 Kg)
Torque converter .....	2-stage, 4-element, twin-turbine
*torque multiplication ratios: .....	TT-445 — 4.92:1
	TT-465 — 4.67:1

## SPECIFICATIONS AND DATA — Continued

Item	Description
Gear data:	
range gearing .....	constant mesh planetary
transfer gearing .....	constant mesh in-line
gear type .....	spur
*Gear ratios:	overall ratio with .846 dropbox
low range — F1 .....	2.52:1
high range — F2 .....	.70:1
reverse — R .....	2.33:1
Clutch data:	
type .....	multidisk, hydraulic-actuated, spring released, oil-cooled; automatically compensates for wear
material .....	external-tanged reaction plates — cross-ground steel internal-splined friction plates — resin-graphite on steel
Parking brake:	
size and type .....	10 x 3 DCM (254 x 76.2 mm), expanding shoe, mechanical-applied
static rating .....	60,000 lb in. (6779 Nm) at 1500 lb (6672 N) apply force
(run-in and burnished) .....	meets SAE J237 with respect to parking brake systems
Flanges:	
input .....	Mechanics 6C
output .....	Mechanics 7C
Torqmatic® coupling .....	Mechanics 7C, non-separating limited stroke design
Oil system:	
oil pump .....	input driven, positive displacement
sump .....	single, integral
oil type .....	hydraulic transmission fluid Type C-2
oil capacity (less external circuits) .....	initial fill — 8-1/2 US gal. (32.18 liters)
oil filter (customer furnished) .....	remote mounted
converter-out oil temperature .....	250° (121°C) max continuous
main pressure .....	160-195 psi (1103-1344 kPa)
converter-out pressure at full throttle stall .....	40 psi (276 kPa) min
converter-out pressure at full throttle, no-load .....	65 psi (448 kPa) max
Control valve body assembly:	
clutch cutoff .....	hydraulic-actuated

## TT 3000 SERIES POWERSHIFT TRANSMISSIONS

Para 1-6

### SPECIFICATIONS AND DATA — Continued

Item	Description
Power takeoff data:	
implement pump drive (pad at rear of oil pump):	
ratio .....	1.00 x engine speed
maximum rating horsepower, at 2000 to 2800 rpm:	
intermittent .....	160 HP (119 kW)
continuous .....	120 HP (90 kW)
**mounting pad .....	SAE size C, 4-bolt
spline coupling adapter .....	SAE size C-to-B reducer
Accessory drive pad:	
ratio .....	1.00 x engine speed
rating, maximum intermittent horsepower, at 2000 to 2800 rpm .....	70 HP (52 kW)
**mounting pad .....	SAE size B, 2-bolt

\*To obtain overall transmission torque ratios, multiply the applicable torque converter ratio times the overall gear ratio.

\*\*Customer supplied gasket required to seal lubrication at spline drive.

## Section 2. DESCRIPTION AND OPERATION

### 2-1. SCOPE OF SECTION 2

This section describes the functions of the transmission components. The hydraulic system is explained and schematically illustrated. The transmission torque paths are also explained for each gear range.

### 2-2. TWIN-TURBINE TORQUE CONVERTER

**a. Converter Construction** (foldout 1). The torque converter consists of pump 8, first turbine 6, second turbine 5, and stator 7. Pump 8 is the driving member and is driven at engine output speed. First turbine 6 and second turbine 5 are driven members, connected by transfer gears 14, 36, 39, and 37 to the transmission range gearing. Stator 7 is the reaction member.

**b. Converter Operation** (foldout 1). During operation, the first and second turbines function jointly or separately, depending upon the load demand and speed of the vehicle. The first-turbine gear train consists of gears 14 and 36. The second-turbine gear train consists of gears 39 and 37. The turbines are able to function jointly or separately by means of a freewheel clutch 38. At high load demand and low speed, the freewheel clutch is engaged, permitting both turbines to drive, and providing maximum input torque to the range gearing. As the vehicle speed increases and load demand decreases, the second-turbine speed, as it approaches the first-turbine speed, provides all of the torque. The first turbine then freewheels. Upon an increase in load demand and the resulting decrease in vehicle speed, the freewheel clutch automatically reengages, permitting both the first turbine and second turbine to again provide the necessary torque multiplication.

### 2-3. LOW-, REVERSE-RANGE GEARING AND CLUTCHES

**a.** Two planetary gear sets are used in the transmission gear train. One transmits low-speed forward and the other transmits reverse drive. The planetary gear sets are interconnected through integral sun gear 26, (foldout 1) and reverse-range ring gear 33, which is splined to the low-range planetary carrier assembly 27.

**b.** The reverse-range planetary carrier assembly 35 (foldout 1) and the low-range planetary carrier assembly 27 (foldout 1) each have four pinions. Reverse-and-low-range sun gear 26 is the driving member for both planetary gear sets. In the reverse-range planetary, carrier assembly 35 is the reaction member and ring gear 33 is the driven member. In the low-range planetary, ring gear 31 is the reaction member and carrier assembly 27 is the driven member.

**c.** Reverse-range clutch 16 (foldout 1) has five external-tanged reaction plates and five internal-splined friction plates. The reaction plates engage the anchor pins in reverse-and-low-range clutch anchor 32. The friction plates engage the splined hub of reverse-range planetary carrier 35. Low-range clutch 18 has five internal-splined friction plates and five external-tanged reaction plates. The friction plates engage the spines of low-range ring gear 31 and the reaction plates engage the anchor pins in reverse-and-low-range clutch anchor 32. Engagement of the reverse-range clutch holds the reverse-range carrier stationary, and engagement of the low-range clutch holds the low-range ring gear stationary.

### 2-4. HIGH-RANGE CLUTCH

**a.** High-range drive is obtained through the high-range clutch—no planetary gearing is involved. High-range clutch 23 (foldout 1) consists of three friction plates and two external-tanged reaction plates. The friction plates attach to high-range clutch hub 24, which is driven by reverse-and-low-range sun gear 26. The external tanges on the reaction plates engage the drive pins in transfer drive gear 21.

**b.** Thus, when the high-range clutch is applied, transfer drive gear 21 is locked to reverse-and-low-range sun gear 26. This causes transfer drive gear 21 to rotate at a 1 to 1 ratio.

### 2-5. TRANSFER GEARS, OUTPUT SHAFTS

**a. Transfer Gears.** The transfer gears consist of two spur gears which are in constant mesh. Transfer drive gear 21 (foldout 1) is splined to the

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### Para 2-5/2-8

hub of low-range planetary carrier assembly 27. Transfer-driven gear 30 is located directly below the drive gear and is splined to output shaft 28.

**b. One-Piece Shaft.** Output shaft 28 provides identical operation at the front and rear outputs. The output disconnect shaft hole is closed by a shifter shaft plug when the one-piece shaft is used.

**c. Two-Piece Shaft, Front Disconnect.** (A, foldout 8). The two-piece shaft configuration allows front output shaft 4 to be disconnected from the driveline. The front disconnect consists mainly of disconnect coupling 7 which is manually shifted by disconnect shifter fork 10 and shaft 9. In the engaged position (rearward) torque from rear output shaft 16 is transmitted through the coupling splines to the front output shaft. In the disengaged position (forward), the coupling rides on the rear splines of the front output shaft and torque to the front output is interrupted.

### 2-6. IMPLEMENT PUMP, ACCESSORY DRIVE PADS

#### NOTE

Refer to specifications and Data (para 1-6) for duty ratings.

**a. Implement Pump Drive Pad.** The implement pump drive pad, located on the rear face of oil pump 6 (B, foldout 8), is a 4-bolt, SAE size C. Accessory-driven gear 4 (A, foldout 4) is engine-driven through accessory drive gear 18 (B, foldout 3) at 1 to 1 ratio. Regardless of the range selector position, the shaft rotation is clockwise as viewed from the rear. An adapter drive coupling may be used to accommodate a B-size spline to the C-size splines in gear 4 (A, foldout 4).

**b. Accessory Drive Pad.** A 2-bolt, SAE size C pad is located at the upper right rear face of the transmission housing. The drive at the pad is provided by accessory drive gear 1 (A, foldout 5) and gear shaft 4, which rotates at engine speed. Regardless of the range selector position, the shaft rotation is clockwise as viewed from the rear. If no requirement exists for a PTO at this location, the drive gear, shaft, and related parts are omitted, the opening closed by cup plug 7 (A, foldout 5) and the oil passage closed by cup plug 6.

### 2-7. OIL PUMP

Oil pump assembly 6 (B, foldout 8) consists mainly of three spur gears 10, 12 and 14, body assembly 16, and cover 7. The oil pump assembly

furnishes the entire oil flow and pressure for all transmission operations. The pump is driven by accessory drive gear 4 (A, foldout 4) and rotates any time the engine output shaft rotates. The transmission oil is drawn, through oil strainer 20 (B, foldout 5), into the lower end of suction tube 4 which directs it to the pump assembly. The oil is then directed, under pressure, through passages in the transmission housing to the control valve assembly and other locations for lubrication and cooling.

### 2-8. CONTROL VALVE BODY ASSEMBLY

**a. Control Valve Body** (B, foldout 9). The control valve body contains a manual-operated range selector valve 25 for reverse, neutral, low- or high-range operation, plus main-pressure regulator valve 8, and clutch cutoff valve 20.

**b. Main-pressure Regulator, Selector Valve** (B, foldout 9)

(1) Main-pressure regulator valve components and trimmer valve components are contained in the upper bore of the body; clutch cutoff valve components in the middle bore; and the selector valve components in the lower bore. The main-pressure regulator valve group includes items 6, 7, 8, 13, and 14. The selector valve group contains items 25, 26, 27, 28, 29, 30, 34, and 35.

(2) Main-pressure regulator valve 8 is spring loaded and regulates the pressure for all hydraulic functions. The selector valve is a spool-type valve which is manually moved lengthwise to the various range positions. Spring-loaded detent balls 27 position the valve in each range.

**c. Clutch Cutoff Valve** (B, foldout 9)

(1) Clutch cutoff valve 20 is located between the main-pressure regulator valve and selector valve 25. It is a spool-type valve which is moved rearward by spring 19 pressure and forward by plug 21 when brake hydraulic pressure acts on the plug.

(2) During normal operation, valve 20 is rearward. This allows main pressure to flow to the selector valve and trimmer plug 16. When vehicle brakes are applied, valve 20 moves against spring 19. This interrupts the flow of main pressure to the selector valve and exhausts clutch apply pressure, releasing the applied clutch.

## 2-9. PARKING BRAKE

An expanding shoe-type brake may be mounted at the lower-rear output location on the transmission housing. The brake assembly 1 (A, foldout 9) is bolted to the transmission housing. The brake is manually operated.

## 2-10. HOUSINGS, COVERS

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

**b. Transmission Front Cover.** Transmission front cover 3 (B, foldout 2) is used only on remote-mount transmissions. It is cast iron, and is bolted to the front flange of the torque converter housing. It supports input shaft 8 in ball bearing 5. Oil seal 1 prevents loss of oil or entry of dirt.

### c. Transmission Housing

(1) Transmission housing 9 (B, foldout 5) is cast iron and is the main structural member of the transmission assembly. It supports and encloses the rear ends of the accessory driven gears and converter driven gears, the range gearing, and clutches. It also supports and encloses the output transfer gears and output shaft. It provides an external mounting surface for the transmission oil pump and accessory pump. It includes various oil passages within the casting for oil circuits.

(2) The lower section of the housing provides a sump for the oil necessary for operation, lubrication, cooling, and control functions. Flat mounting surfaces with four tapped holes in each are provided at each side of the housing.

**d. Rear Cover.** Transmission rear cover 4 (B, foldout 7) 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 is the power-transmitting medium in the torque converter. Its flow lubricates and cools the transmission components, its pressure applies the clutches, and its velocity drives the converter turbines.

**b. System Schematics** (fig. 2-1). Color-coded schematics are presented which illustrate the hydraulic system with clutch cutoff.

**c. Oil Pump, Filter Circuit.** Oil is drawn from the transmission sump, through a wire-mesh strainer, into the oil pump. 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 entire oil supply is returned to the transmission and control valve assembly.

### d. Main-pressure Regulator Valve, Converter-in Circuit (fig. 2-1)

(1) At the control valve 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. The resultant pressure at the left end of the valve pushes the valve rightward against a spring until the oil pressure is balanced by spring force.

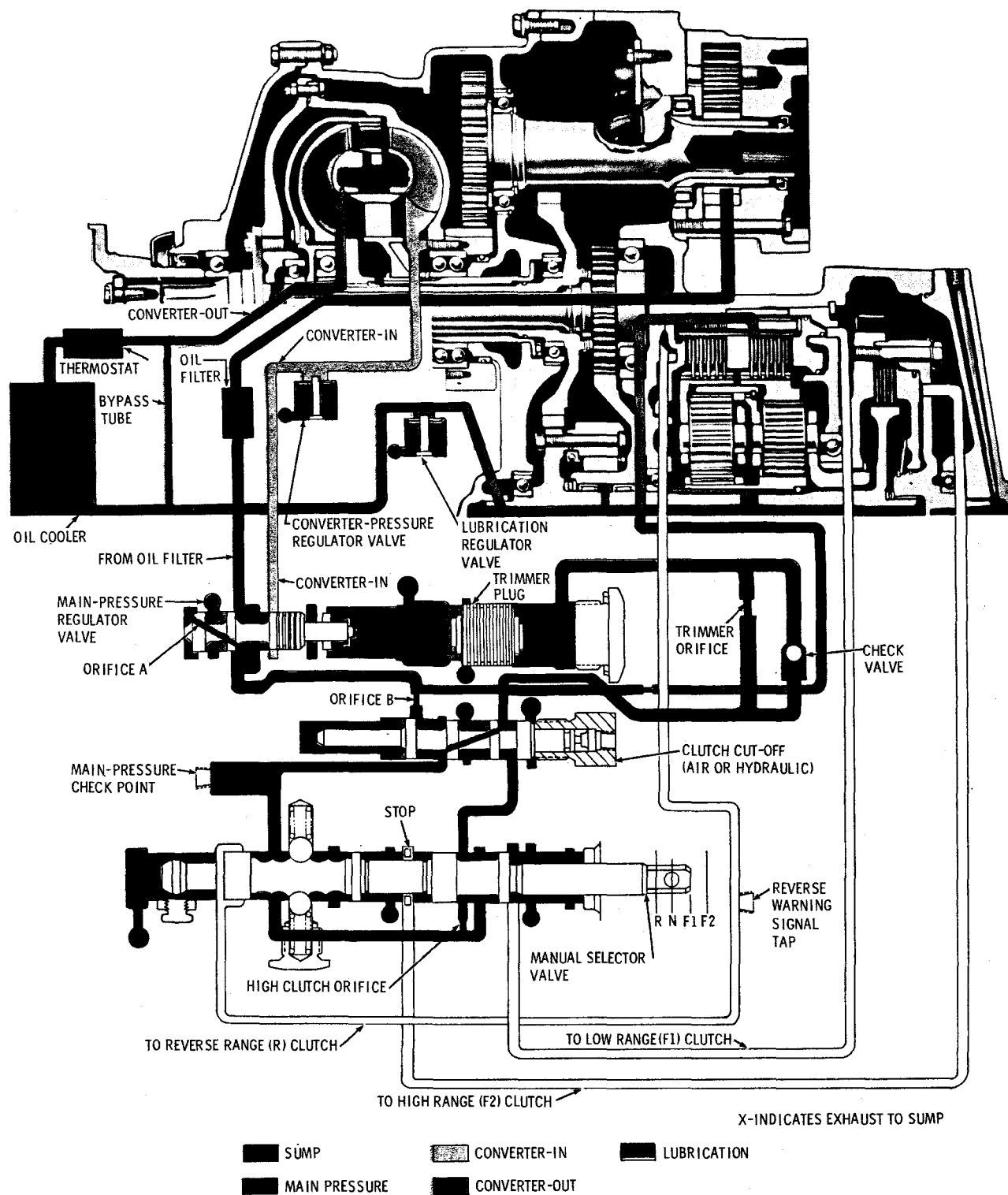
(2) The rightward movement of the valve against the spring exposes the port to the converter-in circuit (yellow). Oil in excess of that required to maintain main pressure is allowed to escape into the converter-in circuit. Under certain conditions, the converter-in circuit can be charged with more oil than can be exhausted by the converter pressure regulator valve. When this is the case, the main-pressure regulator valve moves farther to the right and allows oil to flow directly into the exhaust port (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 it to the pump.

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Fig. 2-1. TT 3420-1 hydraulic system with clutch cutoff control—schematic view

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

(1) Oil flowing out of the torque converter (orange) is directed into the oil cooler. The oil cooler, like the 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.

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

(1) Main pressure oil (red), supplied from the left end of the main-pressure regulator valve, flows through orifice B to the clutch cutoff valve bore and then to the manual selector valve. From the selector valve the flow is directed back through the clutch cutoff valve bore to the trimmer. The orifice functions in conjunction with the trimmer (refer to i, below).

(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 brakes, hydraulic brake pressure acts directly against a plug which moves the clutch cutoff valve leftward during brake application. 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 charged clutch is allowed to exhaust to sump (blue) through the port shown at the top-center of the valve. Thus, when the vehicle brake is applied, the driving clutch is released.

(4) 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 the quick application of the clutch.

**h. Manual Selector Valve Circuit**

(1) Main-pressure oil from the clutch cutoff valve flows into the manual selector valve bore and surrounds the valve in the area of the detent notches. Main oil then flows, regardless of valve position, to another surrounding area

toward the right end of the valve. Here it is available for low range, high range or for operation of the trimmer.

(2) Three clutch apply lines leave the bottom of the selector valve bore. From left to right, these are reverse range (R), high range (F2), and low range (F1). In neutral, all three clutch lines are exhausted, the neutral start switch is actuated. Moving the selector valve one notch rightward will charge the low-range line and thus apply the clutch. This condition provides low-range operation.

(3) Moving the selector valve to a second notch rightward will close off oil to the low-range line and allow it to exhaust. At the same time, oil will charge the high-range line and thus apply the clutch. This condition provides high-range operation. When the selector valve is in the high-range position, oil to fill the high-range clutch must pass through both orifice B and the high-range clutch orifice. The high-range clutch orifice being smaller than orifice B restricts the volume of oil which can flow through 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 charge the reverse line and thus apply the clutch. This condition provides reverse operation.

**i. 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 in the desired manner.

(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 psi.

(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 reduced.

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(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, finally, main pressure is restored to maximum.

(5) The check valve and orifice in parallel branches of the line connecting the selector valve bore to the trimmer plug bore insure 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

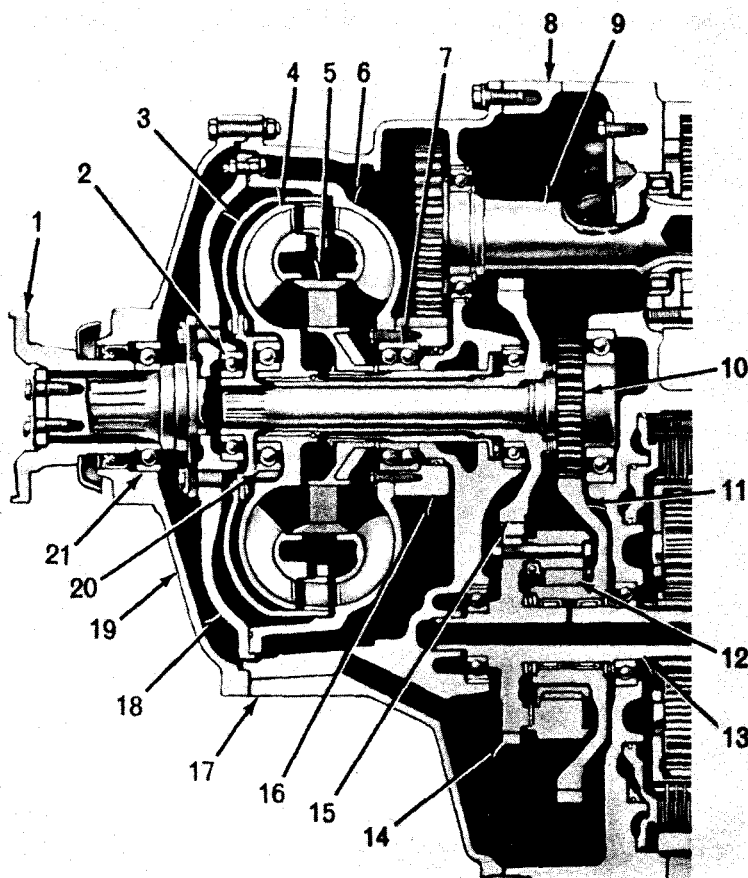
**a. Component Functions.** The torque converter, driven by the engine, directs torque

through the first and/or second turbine to the second-turbine driven gear shaft. The shaft, splined to the reverse-and-low-range sun gear, drives the range planetaries and the high-range clutch hub. Hydraulic-actuated clutches, when applied, cause reactions within the involved range components. The interaction within the planetaries or application of the high-range clutch determines the gear ratio and direction of torque imparted to transfer gears. Thus, the torque path changes for each operating condition. Therefore, a knowledge 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-Section Illustrations.

(1) Figure 2-2 is a cross-section view of the twin-turbine torque converter. Figures 2-3 through 2-6 illustrate the paths through which the power flows from the engine to the transmission outputs.

- 1 - Input flange
- 2 - First-turbine support bearing
- 3 - First-turbine assembly
- 4 - Second-turbine assembly
- 5 - Stator
- 6 - Converter pump assembly
- 7 - Converter pump bearing
- 8 - Transmission housing
- 9 - Oil pump and engine-driven PTO
- 10 - First-turbine drive gear
- 11 - First-turbine driven gear
- 12 - Over-running (freewheel) clutch
- 13 - Range gear input shaft
- 14 - Second-turbine driven gear
- 15 - Second-turbine drive gear
- 16 - Input accessory drive gear
- 17 - Torque converter housing
- 18 - Converter drive cover
- 19 - Transmission front cover
- 20 - Second-turbine support bearing
- 21 - Converter front support bearing



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Fig. 2-2. Torque converter and converter gearing—cross-section view

(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. 2-2)

(1) Power is transmitted from the engine to torque converter pump assembly 6 by either a flex disk drive or an input flange. From the pump, power must be transmitted hydraulically to either first-turbine assembly 3 or second-turbine assembly 4, or to both under certain operating conditions.

(2) Speed and load determine whether the torque flows through the first- and second-turbine assemblies 3 and 4, or only through the second-turbine assembly 4. At high-load demand and low speed, freewheel clutch 12 is engaged and first-turbine assembly 3 acts as the driving member. As speed increases and load demand decreases, freewheel clutch 12 disengages and second-turbine assembly 4 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 phases to the speed phase is entirely automatic, governed by the load and speed of the vehicle.

**2-13. CONVERTER GEARING TO  
REVERSE-AND-LOW-RANGE  
SUN GEAR — TORQUE PATH**

**a. First Turbine** (fig. 2-2). Torque from converter pump assembly 6 is transmitted hydraulically to first-turbine assembly 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 reverse-and-low-range sun gear is splined onto the shaft end. Thus, all these components rotate when the vehicle is operating in a high-load, low-speed condition. 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 until the freewheel clutch disengages.

**b. Second Turbine** (fig. 2-2). When the output speed of the converter increases, the load is assumed by second-turbine assembly 4, and when it attains sufficient speed, freewheel clutch 12 will disengage. This allows first-turbine assembly 3 to rotate freely, and no drive is contributed to the first turbine. Second-turbine assembly 4 is splined to the hollow shaft of the second-turbine drive gear 15. The drive gear meshes with second-turbine driven gear 14 (integral with range gear input shaft 13) which is splined to the reverse-and-low-range sun gear. Thus, all these components rotate when the vehicle is operating in a low-load, high-speed condition.

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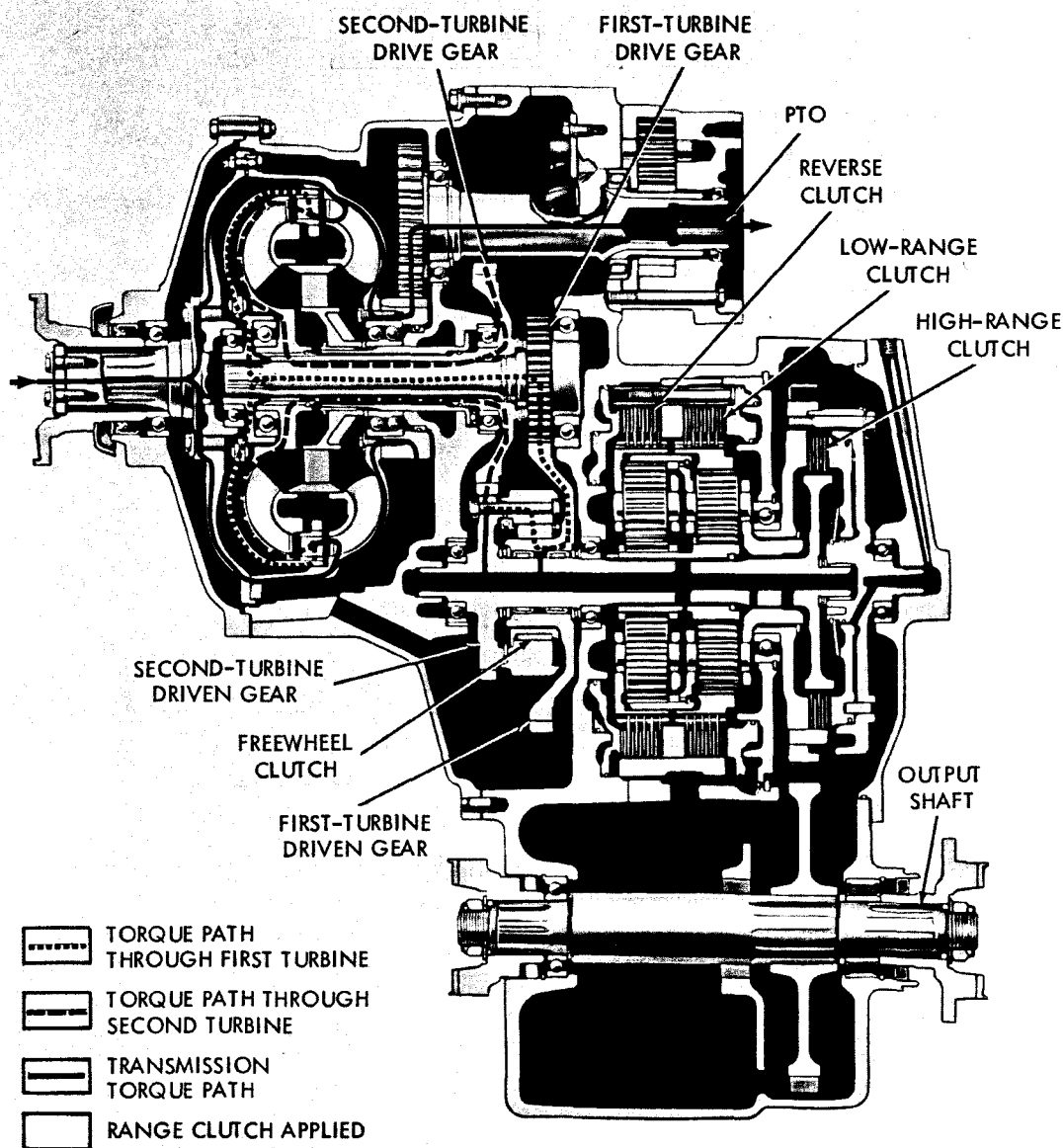


Fig. 2-3. Neutral and PTO torque path

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### 2-14. NEUTRAL AND POWER TAKEOFF — TORQUE PATH (fig. 2-3)

a. When the range selector is in neutral position, power is transmitted through the torque converter to the reverse-and-low-range sun gear as described in paragraph 2-13. No range clutches are engaged. Thus, rotation of the sun gear causes the planetary pinions to rotate freely, and no power flow occurs in the range gearing.

b. Torque from the engine flows through the torque converter pump to the input accessory drive gear. Rotation of the input accessory drive gear drives the engine-driven PTO through the accessory driven gear. If the transmission is equipped with an accessory drive, rotation of the input accessory drive gear also drives the accessory drive gear and shaft assembly. The gearing for the accessory drive is located directly behind (relative to illustration) the engine-driven PTO gearing.

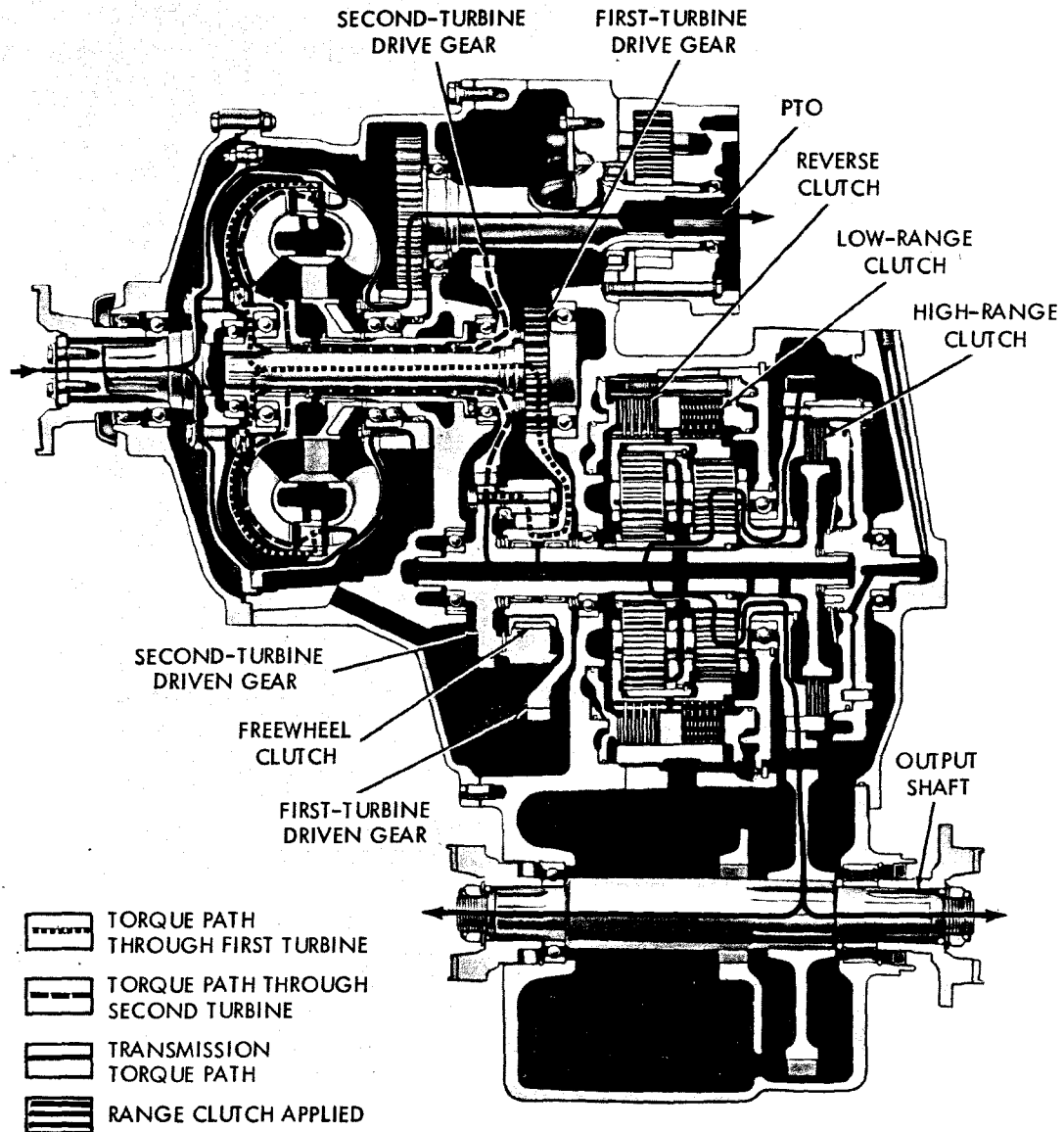


Fig. 2-4. Low-range torque path

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## 2-15. LOW RANGE — TORQUE PATH (fig. 2-4)

a. In low-range operation, torque is transmitted through the torque converter to the reverse-and-low-range sun gear in the same manner as described in paragraph 2-13. When the range selector is moved from neutral to low range (F1), the low-range clutch engages and holds the low-range ring gear stationary.

b. The rotating reverse-and-low-range sun gear drives the low-range planetary pinions within the stationary ring gear. This causes the low-range planetary carrier to rotate. The hub of the carrier is splined to the transfer drive gear. The drive gear meshes with the driven gear which is splined to the output shaft. The manual-operated disconnect coupling, when moved forward, will interrupt the drive to the front output.

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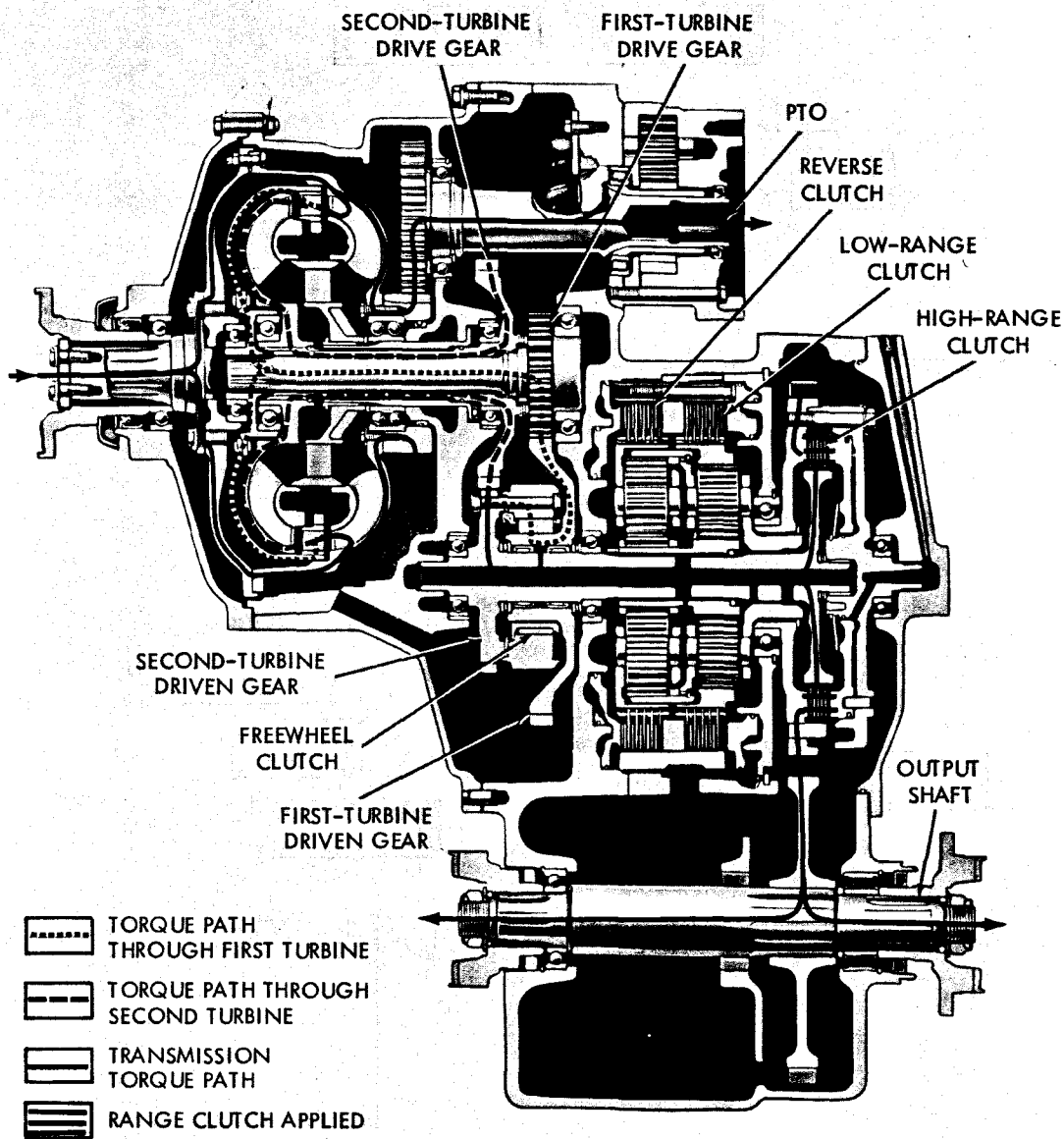


Fig. 2-5. High-range torque path

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## 2-16. HIGH RANGE — TORQUE PATH (fig. 2-5)

a. In high-range operation, torque is transmitted through the torque converter to the reverse-and-low-range sun gear in the same manner as described in paragraph 2-13. When the range selector is moved from low range (F1) to high range (F2), the low-range clutch releases and the high-range clutch engages.

b. The rotating reverse-and-low-range sun gear drives the high-range clutch hub which is splined to the high-range clutch friction plates. Engagement of the high-range clutch locks the transfer drive gear to the rotating high-range clutch hub. The transfer drive gear meshes with the driven gear which is splined to the output shaft. The manual-operated disconnect coupling, when moved forward, will interrupt the drive to the front output.

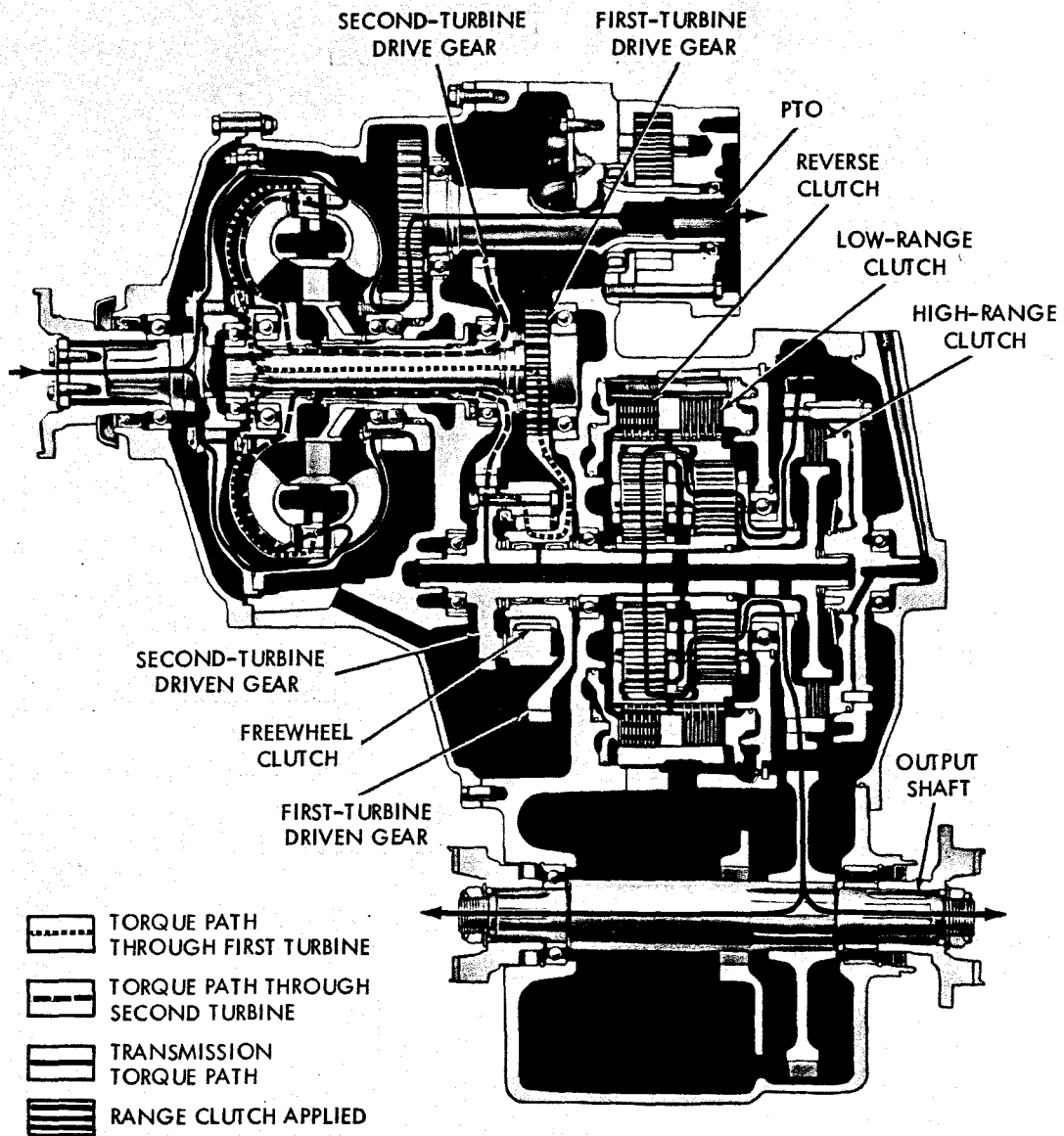


Fig. 2-6. Reverse torque path

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## 2-17. REVERSE RANGE — TORQUE PATH (fig. 2-6)

a. In reverse-range operation, torque is transmitted through the torque converter to the reverse-and-low-range sun gear in the same manner as described in paragraph 2-13. When the range selector is moved to reverse-range position, the forward-range clutches (F1 and F2) are exhausted and the reverse-range clutch engages and holds the reverse-range planetary hub (and carrier) stationary.

b. The rotating reverse-and-low-range sun gear drives the pinions which also are in mesh

with the reverse-range ring gear. This causes the ring gear to rotate in a direction opposite to that of the sun gear. The ring gear is attached to the low-range planetary carrier. Thus, the reverse torque is transmitted from the reverse-range ring gear through the low-range planetary carrier to the transfer drive gear. The transfer drive gear meshes with the driven gear which, in turn, drives the transfer driven gear and output shaft in reverse. The manual-operated disconnect coupling, when moved forward, will interrupt the drive to the front output.

## Section 3. PREVENTIVE MAINTENANCE

### 3-1. SCOPE OF SECTION 3

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

### 3-2. PERIODIC INSPECTION, 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 that cannot be stopped by tightening the parts require immediate attention. Linkages 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 wrench of the proper size to remove or replace the breather. Pliers or a pipe wrench will crush or damage the breather and produce metal chips which could enter the transmission.

#### c. Oil Contamination

(1) 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 operating 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.

(2) 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.

(3) If engine coolant containing ethylene glycol leaks into the transmission oil system, immediate action must be taken to prevent malfunction and possible serious damage. The transmission must be completely disassembled, inspected and cleaned. All traces of the coolant, and varnish deposits resulting from coolant contamination, must be removed.

### 3-3. CHECKING OIL LEVEL

#### a. Cold Check.

(1) Two oil level check plugs are located at the lower-right front of the transmission housing (fig. 1-1). Before starting the engine, remove the upper (Full) plug. If oil flows from the plug opening, the hydraulic system has sufficient oil to permit starting 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 range. Operate for approximately 1 minute to charge the hydraulic system.

(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

An oil check made at a lower engine rpm may result in low oil level at operating speeds. Thermal expansion will raise the oil level when the transmission attains operating temperature.

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**b. Hot Check.** Start the engine and run it at 1000 to 1500 rpm until the transmission reaches operating temperature (180 to 220°F (82 to 104°C)). Then idle the engine and shift through all range positions slowly. This will insure that all parts of the system are filled with oil. Shift to neutral and set the engine speed at approximately 1200 to 1500 rpm. Remove the upper (Full) oil level checkplug. Oil should be at the level of the plug opening. Add or drain oil to bring it to this level.

#### NOTE

Foaming or spurting may indicate a false oil level. A true level is indicated by a steady trickle of oil flowing from the checkplug hole. The transmission may be operated safely as long as the oil is above the level of the lower (Add) oil checkplug.

#### c. Dipstick Cold Check

(1) If the transmission is equipped with an 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. One quart (or liter) equals approximately 1/2-inch (12.7 mm) change in oil level.

(2) Start the engine and let engine idle (500-750 rpm) with the transmission in neutral. Idle engine for approximately 2 minutes to fully charge all oil lines and circuits.

(3) Add oil as required to establish the oil level at the COLD mark. One quart (or litre) equals approximately 1/2-inch (12.7 mm) change in oil level.

#### d. Dipstick Hot Check

(1) Start the engine. 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. One quart equals approximately 1/2-inch (12.7 mm) change in oil level.

### 3-4. 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 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 should be changed after each 1000 hours of operation. For severe service, refer to **a**, above. Refer also to paragraph 3-2 before changing oil. Do not operate a transmission which is filled with preservative oil except for minimum necessary time and distance.

### 3-5. CHANGING OIL, FILTER

**a. Draining Oil.** Transmission should be at operating temperature (180 to 220°F (82 to 104°C)) when the oil is changed. Remove the drain plug at the lower-left rear of the transmission housing (fig. 5-2). Remove the oil filter element from the remote-mount filter. 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. Install a new oil filter element.

**b. Refilling Oil System.** Add 7-1/2 US gallons (28 liters) of specified transmission fluid (para 1-6). Then conduct the hot check as described in paragraph 3-3b, adding oil as necessary to establish the correct oil level for operation.

**c. Oil System Capacity.** Add 8-1/2 US gallons (32.18 liters) for an initial fill or after a complete overhaul. This amount does not include the oil necessary to fill the external filter and cooling circuits. Thus, the refill amount is less than the initial fill because some oil remains in the external circuits and transmission cavities.

### 3-6. PRESSURES, TEMPERATURES

Figure 3-1 illustrates the points where the transmission temperature and pressures may be measured. 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 the clutch cutoff control is being used, clutch pressure may fall to practically zero—this does not indicate that main pressure has decreased. Therefore, when checking main pressure, do not actuate this control.

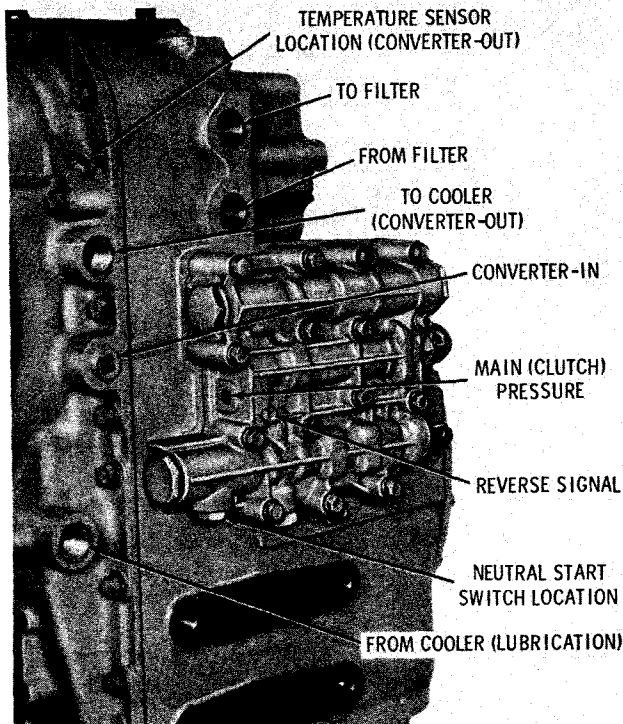


Fig. 3-1. Pressure and temperature check points

### 3-7. LINKAGE CHECKS, ADJUSTMENTS

**a. See Vehicle Manual Instructions.** The specific design of control linkage for range selection, output disconnect, and parking brake depends upon the installation. Therefore, only general instructions for linkage adjustments can be provided in this manual.

#### **b. Front Output Disconnect**

(1) There are two points of adjustment for the front output disconnect. The shifter shaft must be adjusted first, and then the linkage adjusted. Push the shifter shaft inward (toward the rear) to its engaged position. A spring-loaded detent will indicate positive engagement. Adjust the shifter shaft by rotating it until the center of the clevis pin hole is 0.17 to 0.21 inch (4.32 to 5.33 mm) behind the front face of the transmission housing (at rear of converter housing gasket).

(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 1.7 inch (43.18 mm) ahead of the engaged position. 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.

### 3-8. TRANSMISSION STALL TEST

#### **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 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 equipment dealer or distributor.

#### **b. Procedure**

(1) Connect a tachometer of known accuracy to the engine, and bring the transmission to normal operating temperature (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 transmission output shaft.)

#### **CAUTION**

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

(3) Accelerate the engine to wide-open throttle. After reaching a stabilized 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 250°F (121°C).

#### **NOTE**

Allow approximately 2 minutes of neutral operation between stall tests to prevent overheating. During the 2-minute period, engine speed should be maintained (except for the momentary throttle release when shifting to neutral).

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**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. The established normal stall speed for a specific engine-transmission combination may be obtained from your equipment dealer or distributor.

### 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  $\pm 150$  rpm from the established normal value. When deviation can be attributed to such causes, the actual speed can be accepted as normal.

### 3-9. PRESERVATION, STORAGE

**a. Preservative Selection.** When the transmissions are to be stored or remain inactive for extended periods of time, specific preservative methods are recommended to prevent rust and corrosion damage. The length of storage will usually determine the preservative method to be used. Various methods are described below.

**b. Storage, New Units.** New units contain preservative oil when shipped from Allison and can be safely stored (inside) for 6 weeks without further treatment.

#### **c. Storage, Month to 6 Weeks**

(1) The following procedures will prepare the transmission for a month to 6 weeks storage, depending on the environment.

(2) Drain the oil as described in paragraph 3-5a, above. Remove the transmission oil filter element(s).

(3) Install the drain plugs and new filter element(s).

(4) Fill the unit to operating level with any commercial preservative oil which meets US Military specifications MIL-L-21260, Grade 1, to latest specifications.

(5) Operate the unit for at least 5 minutes at a minimum of 1000 rpm. Shift the transmission slowly through all selector positions to thoroughly distribute the oil, then stall the converter to raise the oil temperature to 225°F (107°C).

### CAUTION

Do not allow temperature to exceed 250°F (121°C). If the unit does not have a temperature gage, do not stall for more than 30 seconds.

(6) As soon as the unit is cool enough to touch, seal all openings and breathers with moisture-proof tape.

(7) Coat all exposed, unpainted surfaces with a good grade of preservative grease, such as Petrolatum (MIL-C-11796) Class 2.

(8) Repeat the above procedures ( (5) through (7) ) at monthly intervals for indefinite storage.

#### **d. Storage, 1 Year — Without Oil**

(1) Drain oil as described in paragraph 3-5a, above.

(2) Seal all openings and breathers, except oil drain hole, with moisture-proof tape.

(3) Coat all exposed, unpainted surfaces with a good grade of preservative grease.

(4) Atomize or spray 2 ounces (59 ml) of Motorstor\*, or equivalent, into the transmission through the oil drain hole. Install the drain plug.

(5) If additional storage time is required, (3) and (4), above, should be repeated at yearly intervals.

#### **e. Storage, 1 Year — With Oil**

(1) Drain the oil as described in paragraph 3-5a, above. Remove the transmission oil filter element(s).

(2) Install the drain plugs and new filter element(s).

(3) Fill the transmission to operating level with a mixture of 30 parts hydraulic transmission fluid, type C2, and 1 part Motorstor preservative, or equivalent.

(4) Operate the unit for approximately 5 minutes at a minimum of 1000 rpm. Shift the transmission slowly through all selector positions to thoroughly distribute the oil, then stall the converter to raise the oil temperature to 225°F (107°C).

### CAUTION

Do not allow temperature to exceed 250°F (121°C). If the unit does not have a temperature gage, do not stall for more than 30 seconds.

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

(6) Coat all exposed, unpainted surfaces with a good grade of preservative grease.

(7) If additional storage time is required, (3) through (6), above, should be repeated at yearly intervals, except it is not necessary to drain the transmission each year—just add the Motorstor, or equivalent.

#### f. Restoring Units to Service

(1) If Motorstor, or equivalent, was used in preparing the transmission for storage, use the following procedures to restore the unit to service.

(2) Remove the tape from the openings and breather.

(3) Wash off all the external grease with solvent.

(4) Add hydraulic transmission fluid, type C2, to proper level.

#### NOTE

It is not necessary to drain C2 oil and Motorstor mixture from the transmission.

(5) If Motorstor, or equivalent, was not used in preparing the transmission for storage, use the following procedures to restore the unit to service.

(6) Remove the tape from openings and breather.

(7) Wash off all external grease with solvent.

(8) Drain oil as described in paragraph 3-5a, above.

(9) Install a new oil filter element(s).

(10) Refill the transmission with hydraulic transmission fluid, type C2, to proper level.

\*Motorstor is a preservative additive manufactured by Daubert Chemical Company, Chicago, Illinois. Motorstor (under the designation of "Nucle Oil") is covered by US Military Specifications MIL-L-46002 (ORD) and MIL-I-23310 (WEP).

### 3-10. FLANGE RETAINER SHIMS

a. If the transmission is equipped with input and/or output flanges which require shims, use the following procedure to determine the shim pack thickness.

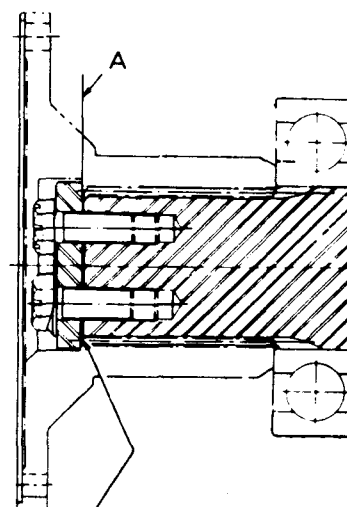
b. Install the flange onto the splined shaft. Install the flange washer and the two self-locking bolts. Tighten the bolts sufficiently to draw the flange into its final position on the shaft.

c. Remove the two bolts and flange washer. Measure and record the dimension from the flange washer seat in the flange (face A) to the end of the shaft (fig. 3-2).

d. For input shafts, subtract 0.007 inch (0.17 mm) from the recorded dimension; for output shafts, subtract 0.010 inch (0.25 mm). The remainder is the thickness of the shim pack required for the specific location. Select shims which equal this thickness (within  $\pm 0.002$  inch/0.05 mm/).

#### NOTE

Shims are available in 0.005 inch (0.12 mm) and 0.025 inch (0.63 mm) thicknesses. Combine these as required to obtain the proper pack.



SHIM AS REQUIRED TO  
0.005-0.009 IN.  
(0.12-0.22 mm)  
BELOW FACE "A" OF FLANGE

Fig. 3-2. Flange retainer shims

e. Install shim pack, flange washer, lockstrip, and two flange bolts. Tighten the 1/2-20 bolts to 96 to 115 pound feet (130 to 156 Nm) torque. Tighten the 3/8-24 bolts to 41 to 49 pound feet (56 to 66 Nm) torque. Bend the lockstrip corners against the flats on the bolt heads.

### 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 right column indicate remedies for the correspondingly numbered causes in the left column.

## TROUBLESHOOTING CHART

Cause	Remedy
<b>(A) LOW MAIN PRESSURE</b>	
1. Low oil level	1. Add oil to correct level (para 3-3)
2. Clogged oil strainer	2. Clean strainer (para 3-5a)
3. Clogged oil filter	3. Replace filter element (para 3-5a)
4. Weak or broken main-pressure regulator valve spring	4. Replace spring (para 6-3)
5. Oil pump worn	5. Rebuild oil pump (para 6-17)
6. Air leak at intake side of oil pump	6. Check pump mounting bolts (para 7-9a); check oil pickup tube (para 7-6c (3))
7. Internal oil leakage	7. Disassembly transmission; rebuild sub-assemblies as required
8. External oil leakage	8. Tighten bolts or replace gaskets
9. Brake hydraulic pressure applying clutch cutoff valve	9. Check brake residual pressure (brakes released); check brakes for full release
<b>(B) OVERHEATING</b>	
1. High oil level	1. Restore oil level (para 3-3)
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. Cooler oil or water line kinked or clogged	6. Clean or replace line
<b>(C) LOW CLUTCH APPLY PRESSURE</b>	
1. Low main pressure	1. Refer to A, above
2. Clutch piston sealrings failed	2. Overhaul transmission
3. Clutch cutoff control valve stuck	3. Rebuild control valve assembly (para 6-3)
4. Internal oil leakage	4. Overhaul transmission

TROUBLESHOOTING CHART — Continued

Cause	Remedy
<b>(D) AERATED (foaming) OIL</b>	
1. Incorrect type oil used	1. Change oil; use proper type (para 1-6)
2. High oil level	2. Restore proper oil level (para 3-3)
3. Low oil level	3. Restore proper oil level (para 3-3)
4. Air entering suction side of oil pump	4. Check oil pump bolts and gasket (para 7-9a); check oil pickup tube and flange (para 7-6c (3))
<b>(E) VEHICLE WILL NOT TRAVEL</b>	
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 3-7)
4. Internal mechanical failure	4. Overhaul transmission
<b>(F) VEHICLE TRAVELS IN NEUTRAL WHEN ENGINE IS ACCELERATED</b>	
1. Selector linkage out of adjustment	1. Adjust linkage (3-7)
2. Clutch failed (won't release)	2. Overhaul transmission
<b>(G) VEHICLE LACKS POWER AND ACCELERATION AT LOW SPEED</b>	
1. Low main pressure	1. Refer to A, above
2. Low clutch apply pressure	2. Refer to C, above
3. 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
<b>(H) STALL SPEED TOO HIGH (see para 3-9)</b>	
1. Clutch slipping	1. Overhaul transmission
2. Low main pressure	2. Refer to A and C, above
<b>(I) STALL SPEED TOO LOW (see para 3-9)</b>	
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 preliminary information required for the overhaul of the transmission. Cleaning instruction, inspection criteria, and recommended rework practices are discussed. Good shop practices, coupled with recommended procedures described herein, will aid in restoring high-quality performance.

### 4-2. MODEL CHANGES

The release of new assemblies may require new or different overhaul procedures. Major changes in the transmission will be described in subsequent issues of this manual. Contact your dealer or distributor for the latest information. When requesting service information, be sure to give the model, assembly part number, and serial number as stamped on the transmission nameplate (refer to para 1-3).

### 4-3. TOOLS, EQUIPMENT

In addition to ordinary hand tools, the following items should also be available.

- Chain hoist (1/2-ton [453.6 kg]) capacity, min)
- Suitable disassembly and assembly table
- Press (for removal and installation of press-fit parts)
- Supply of wood blocks
- Clean wiping cloths (do not use linty waste)
- Parts receptacles
- Cleaning equipment (brushes, solvents, etc.)
- Torque wrenches
- Oil-soluble grease
- Dry ice (for cooling interference-fit parts)
- Heating equipment or hot plate to provide oil at 300°F (150°C) (for heating interference-fit parts)
- Nonhardening sealer
- High-temperature grease

### 4-4. REPLACEMENT PARTS

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

**b. Service Kits.** Make use of the repair and overhaul kits which contain the gaskets, seals, lockstrips, etc. required for a complete overhaul (refer to para 1-3).

**c. Parts Normally Replaced.** The following parts are normally replaced during overhaul: gaskets, cotter pins, lockstrips, lip-type oil seals (when removed), damaged snaprings, and washers.

### WARNING

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

### 4-5. 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.

### 4-6. 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**

(1) All metallic parts of the transmission (except bearings) should be cleaned thoroughly with volatile mineral spirits, or by steam-cleaning method. Do not use a caustic soda solution for steam cleaning. Gum and varnish deposits should be removed by allowing the parts to soak in varnish remover.

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(2) Parts should be dried with compressed air. Steam-cleaned parts should 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 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.

#### c. Cleaning Bearings

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

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

(3) Before inspection, oil the bearings with the same type of oil that will be used in the transmission.

#### NOTE

Never dry bearings with compressed air. Do not rotate bearings while they are not lubricated.

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

(4) 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. Coat the mating surfaces with white lead and 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 the transmission.

(5) 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.

**e. Keeping Bearings Clean.** 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 insure maximum bearing life.

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

(2) Do not remove 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 cloth to keep out dust.

#### f. Inspecting Cast Parts, Machined Surfaces

(1) Inspect bores for scratches, wear, grooves, and dirt. Remove scratches and burs 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 out with cleaning solvent.

(3) Inspect mounting faces for nicks, burs, 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 tap.

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

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

**g. Inspecting Bushings, Thrust Washers**

(1) Inspect bushings for scores, roundness, burs, sharp edges, and evidence of overheating. Remove scores with crocus cloth. Remove burs 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.

**NOTE**

Sometimes it is necessary to cut out a defective bushing. Be careful not to damage the bore into which the bushing fits.

(2) Inspect thrust washers for distortion, scores, burs, and wear. Replace the thrust washer if it is defective or worn.

**h. Inspecting Oil Seals, Gaskets**

(1) Inspect lip-type sealrings for cuts and hardness. Replace the sealrings if these defects are found.

(2) When replacing lip-type sealrings, make sure the spring-loaded side is toward the oil to be sealed in (toward the inside of the unit). Use a nonhardening sealing compound on the outside diameter of the seal to help prevent oil leaks. Coat the inside diameter of the seal with high temperature grease (MIL-G-3545A or equivalent) to protect the seal during the shaft installation and to provide lubrication during initial operation.

(3) Replace all composition gaskets.

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

(5) Install a new hook-type sealring if it is worn so much that there is no gap between the hooks of the sealring when it is installed.

(6) The sides of the sealring should be smooth (0.005 inch (0.12 mm) maximum side wear). The side of the shaft groove (or the bore) in which the sealring fits should be smooth (50 micro-inches (1.25  $\mu$ m)) and square with the axis of rotation within .002 inch (0.05 mm). If the sides of the 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 burs. Remove such defects with a soft honing stone.

**j. Inspecting Splined Parts.** Inspect parts for stripped, twisted or chipped splines. Replace the part if these defects are found. Remove any burs with a soft stone. Spline wear is not considered detrimental except where it affects tightness or fit of the splined parts.

**k. Inspecting Clutch Plates**

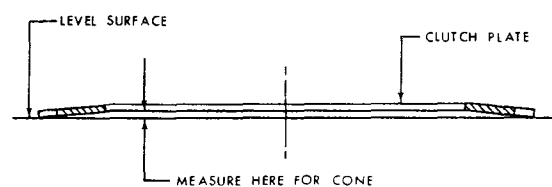
(1) Inspect the friction-faced plates for burs, imbedded metal particles, severely pitted faces, excessive wear, cone, cracks, distortion, and damaged spline teeth. Remove burs, using a soft honing stone. Replace plates which have other defects.

(2) Inspect steel plates for burs, scoring, excessive wear, cone, distortions, galling, cracks, breaks, and damaged tangs. Remove burs 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. 4-1). When assembling a clutch pack, soak clutch plates in type C2 oil for a least 2 minutes and make sure that each plate is installed so that the cone is in the same direction as the adjacent plates. (Refer to wear limits chart in Section 8 for maximum allowable cone.)

**l. Inspecting Threaded Parts.** Inspect parts for burred or damaged threads. Remove burs 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 part if any one of these defects is found. The snapring must snap tight in its groove for proper functioning.



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Fig. 4-1. Method for determining cone of clutch plate

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**n. Inspecting Springs.** Inspect all the springs for signs of overheating, permanent set, or wear due to rubbing adjacent parts. Replace the spring if any one of these defects is found. Replace springs which do not meet the load-height specifications in the spring chart in Section 8.

### 4-7. REMOVING, INSTALLING TRANSMISSION

**a. Drain Oil.** Drain the oil from the transmission. 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 removal and installation, as applications will differ. Clean the exterior of the transmission. If the steam cleaning method is used, the transmission should be disassembled immediately — condensation of the steam will rust the ferrous parts in the transmission.

**b. Check Linkages, Lines.** Make sure that all linkages, controls, cooler and filter lines, pressure and temperature lines, driveline couplings, and mounting bolts are disconnected before transmission removal. Oil lines should be carefully placed clear of the removal path and all openings covered to keep them clean.

#### **c. Reconnect at Installation**

(1) At installation, reconnect all linkages and lines which were previously removed. Two 3/4-10 tapped openings are provided at the top of the transmission housing. Bolts or eyebolts may be installed in the openings for lifting the transmission assembly.

### 4-8. REMOVING, INSTALLING INTERFERENCE-FIT FLANGES

**a. Removal.** When the interference-fit flanges are used, they should be removed prior to complete disassembly. A heavy duty puller kit is required. A heavy steel plate may be bolted to the ears of the flange to provide a grip surface for the puller jaws and to prevent distortion. A steel bar may be used to prevent rotation of the flange during the pulling process. Removal of the Torqmatic coupling requires a puller which will engage the internal groove within the coupling hub. Always place a spacer between the transmission shaft and puller draw bolt to protect the end of the shaft.

**b. Installation.** Inspect the shaft and splines for dirt, paint, rust, burs, and rough spots. Remove any of these. Make sure that spacers or other parts are in place on the shaft. Coat the splines with light bearing grease and grease the lip of the oil seal. Lubricate the shaft threads with molybdenum disulfide grease (such as Molykote Type G, or equivalent). Heat the flange to approximately 300°F (150°C) for 45 minutes. While the flange is still hot, quickly install it on the shaft. Seat it immediately and install the retaining washer, sealring, and self-locking nut which retain it. Tighten the nut to the specified torque.

### CAUTION

If the flange seizes to the shaft before it is properly seated, it will be necessary to remove the flange and repeat the assembly procedure. Do not attempt to force the flange with a hammer. Recheck the nut or bolt torque after the flange cools.

### 4-9. WEAR LIMITS, SPRING CHART

**a. Wear Limits Inspection.** When parts are being inspected, those listed in Section 8 should be measured for wear. Those parts which have reached or exceeded the specified wear limit should be discarded and replaced. All wear limits data are tabulated in Section 8. The item numbers are keyed to the parts shown in the exploded views at the back of the book.

**b. Spring Inspection.** The data presented in Spring Chart in Section 8 will aid in identification and inspection of the springs within the transmission.

### 4-10. TORQUE SPECIFICATIONS



The assembly procedures in Sections 6 and 7 specify the torque requirements for all bolts and nuts. For general reference, a torque specification chart is presented below. The torque specifications in the chart apply to all assembly procedures unless otherwise specified in the text or cross-section illustration at the end of Section 6. The illustration may be used as a convenient reference for the torque required to tighten the hardware in the cross-section view.

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## STANDARD TORQUE SPECIFICATIONS

(all torque values, given in pound feet and Newton metres)

Size	Threads per inch	Standard heat- treated bolts and screws		Special heat-treated bolts, screws, Allen-head screws and self-locking capscrews		Nuts	
							
		lb ft	(N·m)	lb ft	(N·m)	lb ft	(N·m)
1/4	20	9-11	(12-15)	9-11	(12-15)		
	28	10-12	(14-16)	10-12	(14-16)		
5/16	18	13-16	(18-21)	17-20	(23-27)		
	24	14-18	(19-24)	19-23	(26-32)	14-18	(19-24)
3/8	16	26-32	(35-43)	36-43	(49-58)		
	24	33-40	(45-54)	41-49	(56-66)	33-40	(45-54)
7/16	14	42-50	(57-67)	54-65	(73-88)		
	20	50-60	(68-81)	64-77	(87-104)		
1/2	13	67-80	(91-108)	81-97	(110-131)		
	20	83-100	(113-135)	96-115	(130-155)		
5/8	11	117-140	(159-189)	164-192	(222-260)		
	18	134-160	(182-217)	193-225	(262-305)	134-160	(182-217)

## Section 5. DISASSEMBLY OF TRANSMISSION INTO SUBASSEMBLIES

### 5-1. SCOPE OF SECTION 5

**a. Models Covered.** This section describes the disassembly of the transmission into sub-assemblies. The procedures are applicable to the TT 3000 models and related optional features.

**b. Disassembly Sequence.** The instructions depict, in a logical sequence, the removal of exterior components and front components, through the torque converter assembly to the splitline at the transmission housing. The transmission is then repositioned and the remaining components are removed from the rear of the main housing.

#### c. Illustrations

(1) Disassembly is referenced primarily to photographs in this section. When considered helpful, reference is also made to photographs in Section 7.

(2) Disassembly of some components is referenced to foldouts in the back of the manual, especially when several small components are involved. A cross-sectional view is presented on foldout 1 to aid in defining relationship of assembled parts.

### 5-2. REMOVAL OF EXTERIOR COMPONENTS

**a. Lifting Points.** All transmissions have two 3/4-10 tapped holes in the top of the transmission housing. Bolts or eyebolts may be installed into the holes to provide a means of supporting or repositioning the transmission during disassembly (fig. 5-1).

**b. Oil Pump Drive Coupling.** If the transmission is equipped with adapter drive coupling for an implement pump (fig. 1-2), remove the coupling.

**c. Oil Strainer Assembly.** Remove six bolts and lockwashers that retain the oil strainer assembly (fig. 5-2). Remove the strainer assembly and gasket. Remove the oil drain plug.

#### d. Parking Brake and Output Flanges

(1) Remove six self-locking bolts that retain the brake drum. Remove the brake drum.

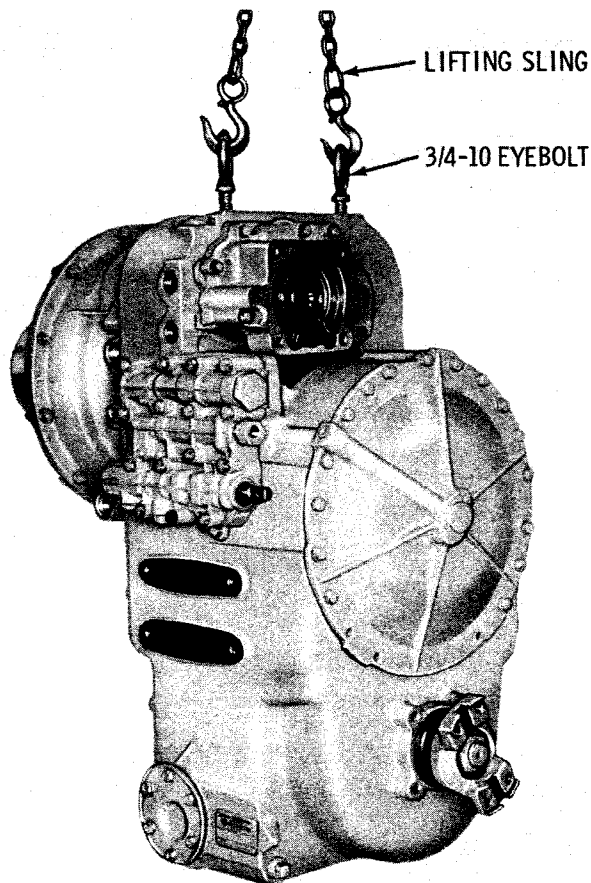


Fig. 5-1. Lifting transmission assembly

S4075

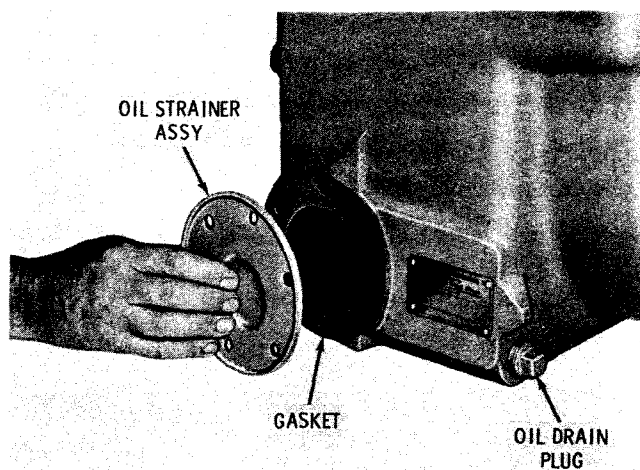
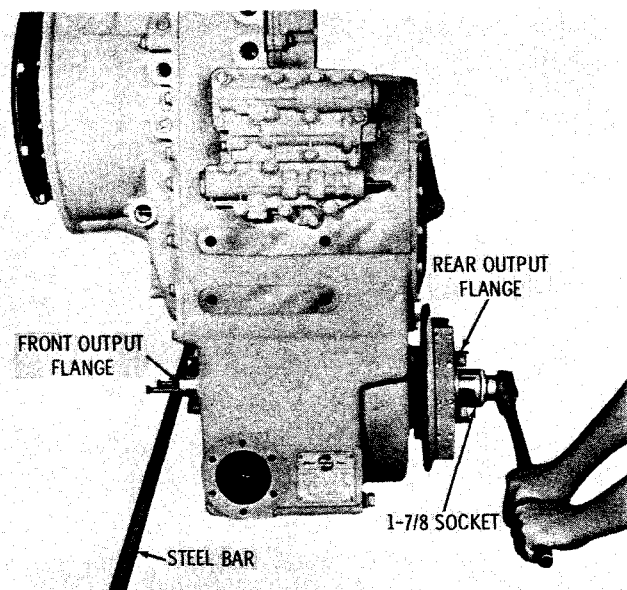


Fig. 5-2. Removing oil strainer assembly

S4076

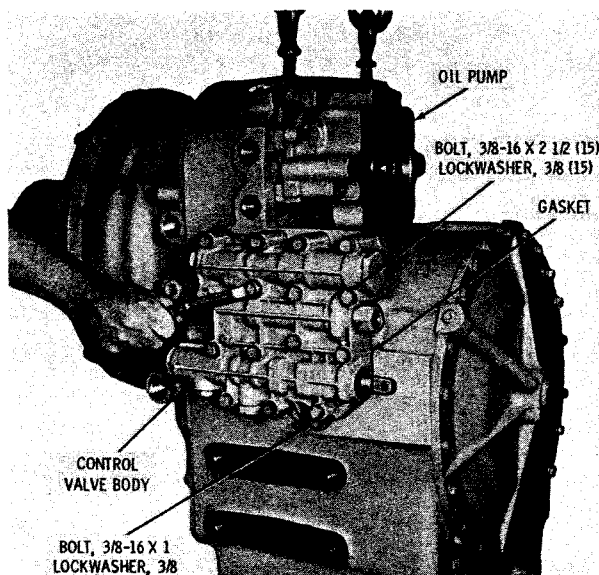
## TT 3000 SERIES POWERSHIFT TRANSMISSIONS

Para 5-2/5-3



S2536

Fig. 5-3. Removing rear-output flange nut



S4077

Fig. 5-4. Removing control valve body bolts

(2) Remove the 1-1/4-12 flange retaining nut and washer from the rear output shaft (fig. 5-3). To prevent rotation of the flange, install two bolts into the front output flange. Then, place one end of the bar stock between the bolts and allow the other end to press against the assembly table. Remove the front output flange retaining nut and washer, using the same procedure. Remove the front and rear output flanges. Remove the sealing from the bore of each flange. If necessary, use a flange puller as described in paragraph 4-8a.

(3) Remove four bolts 2 (A, foldout 9). Remove brake assembly 1.

### e. Control Valve Body Assembly

(1) Remove the sixteen bolts and lockwashers that attach the control valve body assembly to the transmission housing (fig. 5-4).

(2) Remove the control valve body assembly and gasket. Refer to paragraph 6-3 for the control valve body assembly rebuild instructions.

## 5-3. REMOVAL OF INPUT COMPONENTS

### NOTE

Position the transmission to rest on its rear surface. Do not allow the transmission to rest on the output shaft.

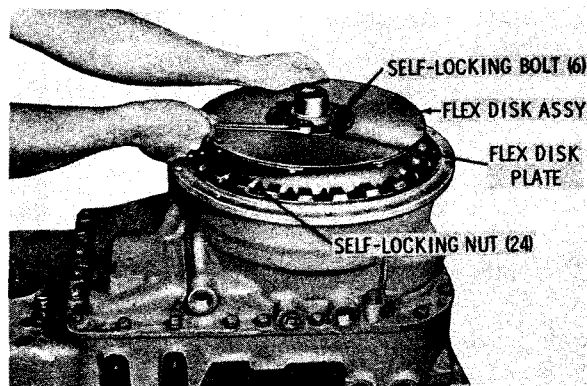
### a. Direct Mount (flex disk)

(1) Remove the six self-locking bolts and plate that retain the flex disk assembly (fig. 5-5).

(2) Remove the flex disk plate and flex disk assembly consisting of three flex disks and a disk and washer assembly (fig. 5-5).

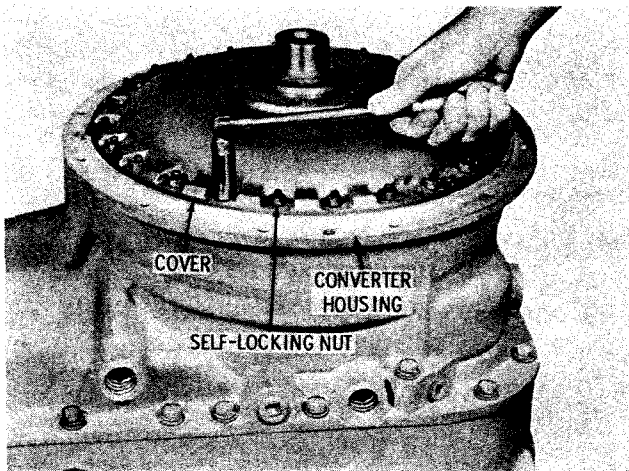
(3) Remove the twenty-four self-locking nuts that retain the torque converter drive cover (fig. 5-6).

(4) Attach a sling and remove the torque converter drive cover (fig. 5-7). Ball bearing 1 (B, foldout 3) may remain in the torque converter drive cover; if so, remove the bearing.



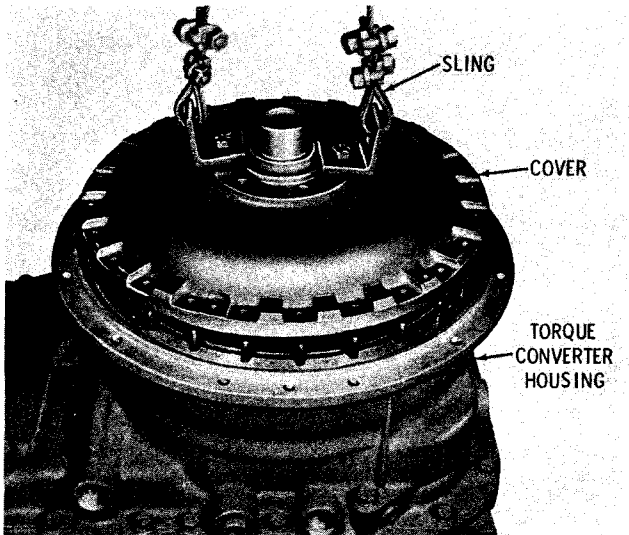
S2539

Fig. 5-5. Removing flex disk bolts



S2540

Fig. 5-6. Removing torque converter drive cover nuts



S2451

Fig. 5-7. Removing torque converter drive cover

#### b. Remote Mount

(1) The input flange is retained with two self-locking bolts 1 (A, foldout 2), lockstrip 2, and retaining washer 3.

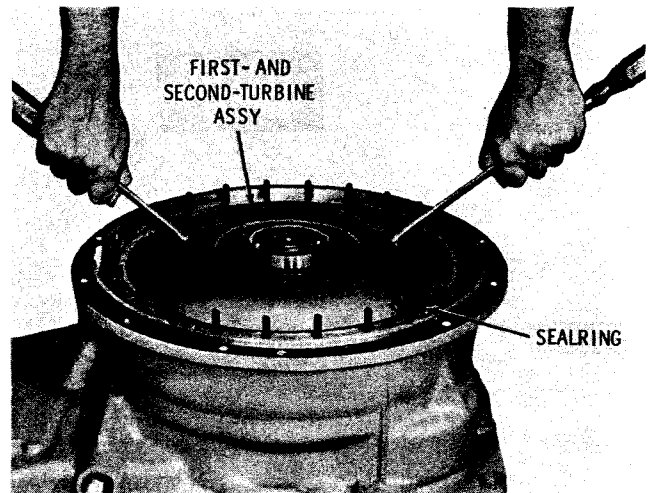
(2) To remove the flange, straighten the ears of the lockstrip and remove the bolts. Remove the lockstrip, retaining washer, and shim(s) 4 and/or 5. Remove the flange or Torqmatic coupling assembly.

(3) If the Torqmatic coupling assembly 6 (A, foldout 2) has seized to the shaft splines, use a bearing puller for removal of the coupling assembly. Install the puller so that the puller feet

nest in the groove within the inside diameter of the coupling and the puller bolt works against a spacer placed against the end of the input shaft. If a flange other than Torqmatic coupling has seized to the shaft splines, use a suitable puller for removal. Refer to paragraph 4-8 if the flange is a tight fit.

(4) Remove twelve 3/8-24 x 2-inch bolts, nuts and lockwashers that retain the transmission front cover (fig. 7-35). Remove the gasket. Refer to paragraph 6-4 for rebuild of the front cover.

(5) Remove the twenty-four self-locking nuts 9 (B, foldout 2) that retain torque converter drive cover 10. Remove torque converter drive cover 10 and attached input shaft 8 and bearing 5 as an assembly. Refer to paragraph 6-5 for the torque converter drive cover rebuild instructions. Remove the sealing (if used) from the torque converter pump (fig. 5-8).



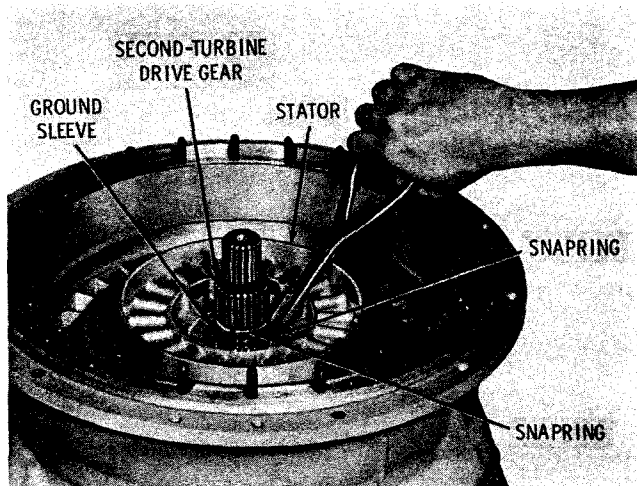
S4078

Fig. 5-8. Removing first- and second-turbine assembly

### 5-4. REMOVAL OF CONVERTER COMPONENTS AND HOUSING

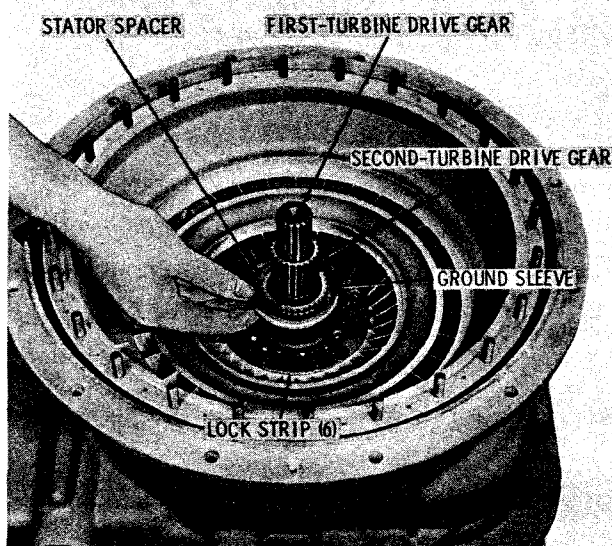
#### a. Converter Components

(1) Using two screwdrivers, and lifting straight upward, remove the first- and second-turbine assembly (fig. 5-8). Do not disassemble this unit unless inspection or parts replacement is necessary. If necessary, refer to paragraph 6-6 for turbine assembly rebuild instructions.



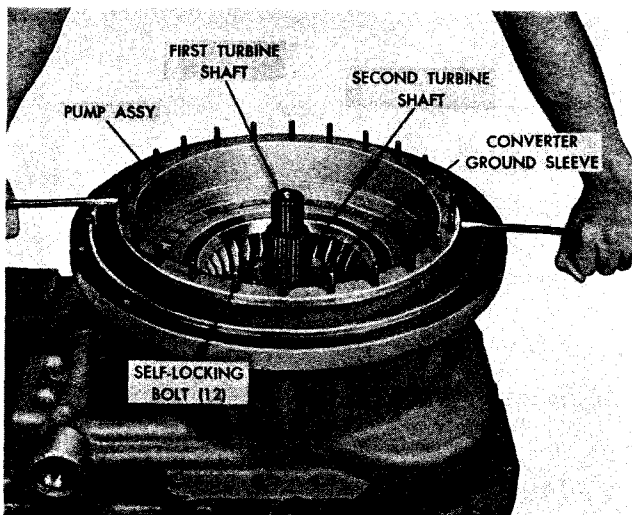
S4079

Fig. 5-9. Removing stator snapping



S1403

Fig. 5-10. Removing stator spacer



S1835

Fig. 5-11. Removing torque converter pump assembly

(2) Remove the snapping that retains the converter stator, and remove snapping from the second-turbine drive gear. Remove the stator from the converter ground sleeve (fig. 5-9).

(3) Remove the stator spacer from the converter ground sleeve (fig. 5-10).

(4) Loosen the torque converter pump assembly from the ground sleeve by prying evenly at opposite points on the rim of the pump (fig. 5-11).

## NOTE

If the pump assembly will not loosen readily, attach a puller after two self-locking bolts are removed. Tighten the puller against a sleeve placed against the ground sleeve. The puller sleeve must extend above the turbine drive gear shafts (fig. 5-11). Do not apply puller pressure to the gear shafts.

(5) When the converter pump bearing has been drawn from its seat on the ground sleeve, remove the puller.

(6) Remove the torque converter pump and reinstall the two bolts removed in (4), above. If further disassembly is planned, refer to paragraph 6-7 for converter pump rebuild instructions. If disassembly is not necessary, tighten the two 1/4-28 x 1-1/4-inch bolts to 10 to 12 pound feet (14 to 16 Nm) torque, and bend the lockstrip tabs against the replaced bolts.

## b. Converter Housing

(1) Remove the twenty-four bolts, lockwashers, and plain washers that attach the converter housing to the transmission main housing (fig. 7-30).

(2) Attach a sling to the converter housing flange (fig. 5-12). Apply slight tension on the sling and, using a soft hammer, bump the converter housing away from the transmission main housing.

## CAUTION

When the converter housing has cleared the transmission housing (approximately 1-1/2-inches (38 mm)), check to insure that the freewheel unit remains with the transmission main housing. If necessary, use two long screwdrivers to pry the freewheel front bearing from the converter housing. If the freewheel unit is raised with the converter housing, the oil suction tube will be damaged.

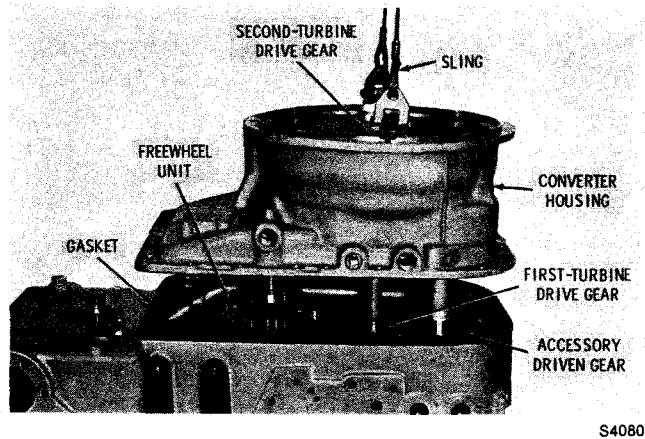


Fig. 5-12. Removing torque converter housing

(3) Remove the converter housing and attached parts (fig. 5-12). Remove the gasket. Remove bearing race 22 (B, foldout 3) from the hub of second-turbine drive gear 20. Remove the second-turbine drive gear (fig. 5-12). Remove sealring 18 (A, foldout 4) and ball bearing 19 from drive gear 20. Refer to paragraph 6-8 for converter housing rebuild instructions.

## 5-5. REMOVAL OF OIL SUCTION TUBE AND TURBINE GEARING

### a. Oil Suction Tube

(1) Remove self-locking bolts 2 and 3 (B, foldout 4) and self-locking bolt 1, and remove oil suction tube 4 (fig. 5-13).

(2) Remove sealring 5 from top end of suction tube.

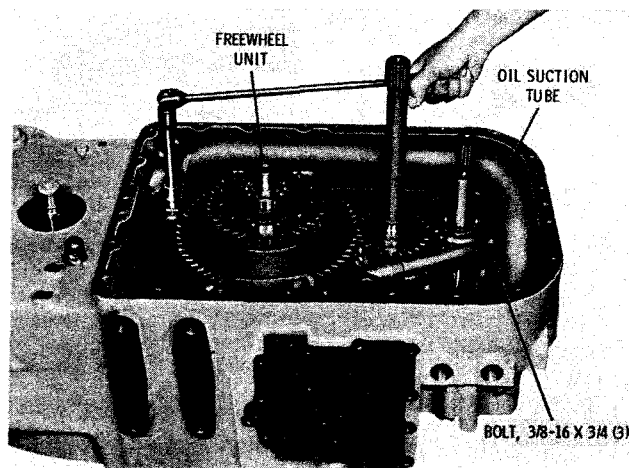


Fig. 5-13. Removing oil suction tube bolt

### b. Turbine Gearing

(1) Remove the first- and second-turbine driven gear and freewheel unit as an assembly (fig. 5-13). Refer to paragraph 6-9 for freewheel unit rebuild instructions.

(2) Remove sun gear spacer 23 (A, foldout 4) from the shaft of the second-turbine driven gear (or the bore in the transmission housing).

(3) Remove the self-locking bolt that retains the lubrication tube (fig. 5-14), and lift the tube from the housing.

(4) Remove the needle thrust bearing and race from the first-turbine drive gear. Remove the sealring. Remove the first-turbine drive gear and ball bearing (fig. 5-14). Remove the bearing only if replacement is necessary. Refer to paragraph 6-10 for rebuild of first-turbine drive gear.

### c. Accessory Drive Shaft

Remove the accessory drive shaft (fig. 5-14). Remove the bearing from the accessory drive shaft only if replacement is necessary. On models that are not equipped with an accessory drive shaft, the housing bore and lubrication orifice are sealed with plugs 6 and 7 (A, foldout 5). Remove these plugs only if replacement is necessary.

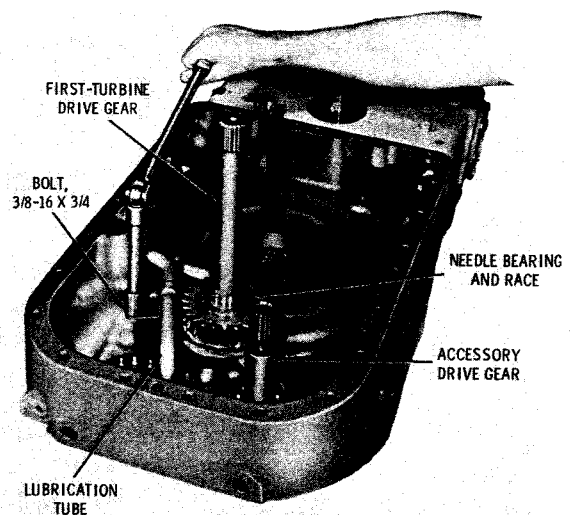
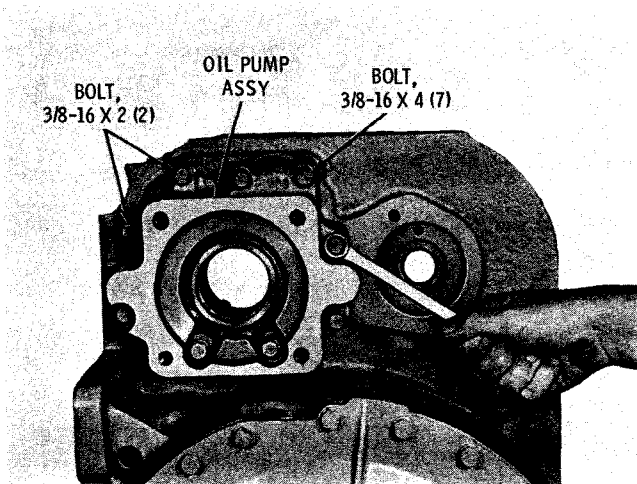


Fig. 5-14. Removing lubrication tube bolt

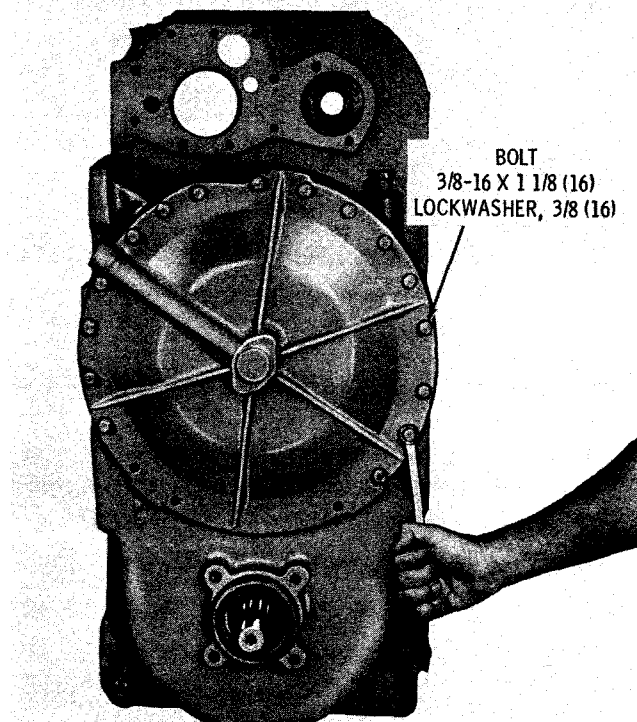
## TT 3000 SERIES POWERSHIFT TRANSMISSIONS

### Para 5-6



S4083

Fig. 5-15. Removing oil pump bolts



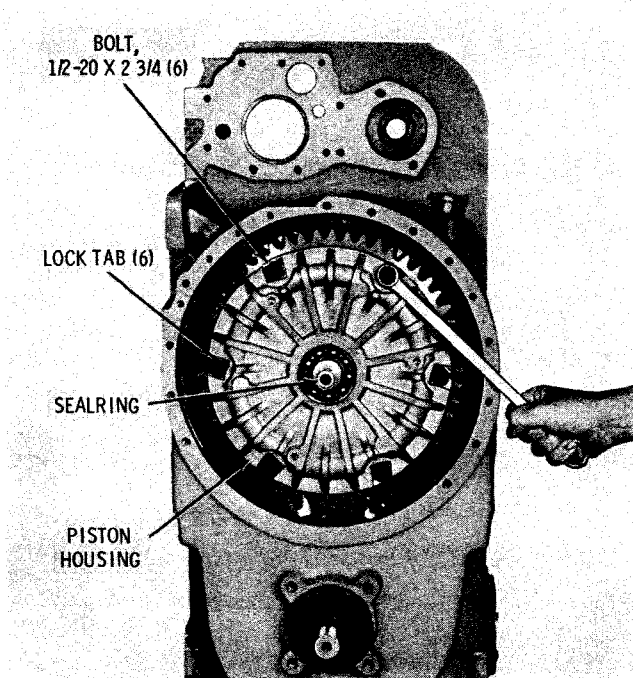
S4084

Fig. 5-16. Removing rear cover bolts

### 5-6. REMOVAL OF OIL PUMP AND HIGH-RANGE CLUTCH PISTON HOUSING

#### a. Oil Pump, Rear Cover

(1) Remove the nine bolts and lockwashers that attach the oil pump to the transmission housing (fig. 5-15). Remove the oil pump assembly and gasket. Do not separate the



S4085

Fig. 5-17. Removing high-range clutch piston housing bolts

pump components unless inspection or parts replacement is necessary. Refer to paragraph 6-17 for the oil pump rebuild instructions.

(2) Remove the sixteen bolts and lockwashers that attach the rear cover to the transmission housing (fig. 5-16). Remove the cover and gasket. Remove sealring 2 (B, foldout 7) from the cover. Remove 1/8-inch plug 3 only if necessary for cleaning or parts replacement.

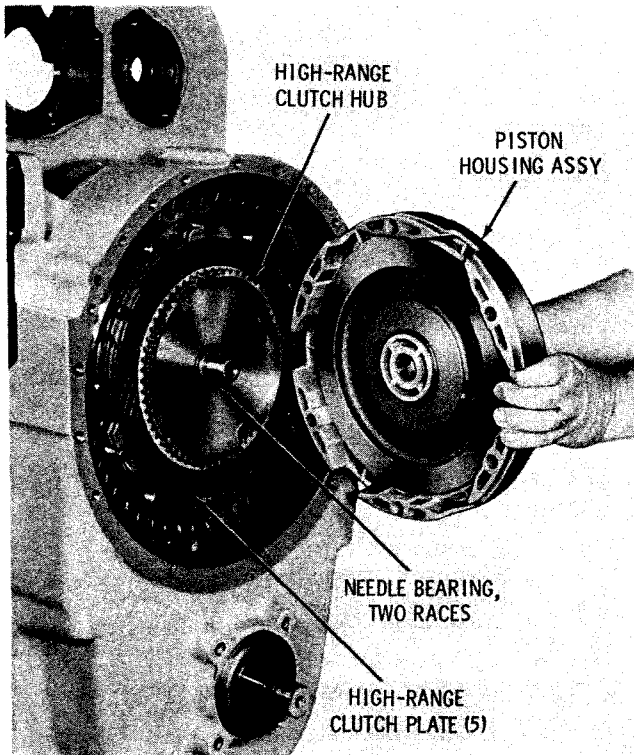
(3) Remove the hook-type sealring from the hub of the piston housing (fig. 5-17).

#### b. High-Range Clutch Piston Housing

(1) Straighten the lock tabs. Remove the six bolts and lock tabs that attach the piston housing to the transfer drive gear (fig. 5-17).

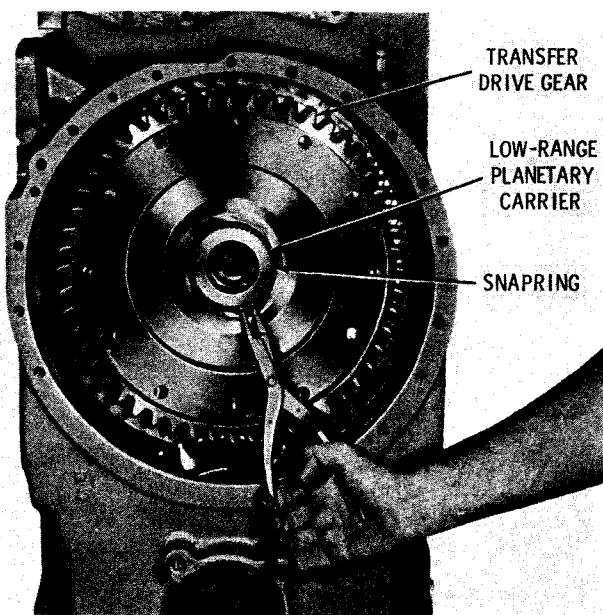
(2) Remove the high-range piston housing and attached parts from the transfer drive gear (fig. 5-18). It may be necessary to pry the housing from the bore in the drive gear. Refer to paragraph 6-11 for the high-range clutch piston housing rebuild instructions.

(3) Remove the bearing and two races from the high-range clutch hub. Remove the five high-range clutch plates, and remove the clutch hub. Remove snapping 6 (A, foldout 7) from the clutch hub.



S4086

Fig. 5-18. Removing high-range clutch piston housing assembly



S4087

Fig. 5-19. Removing transfer drive gear snapping

## 5-7. REMOVAL OF TRANSFER GEARS, OUTPUT COMPONENTS

### a. Transfer Drive Gear

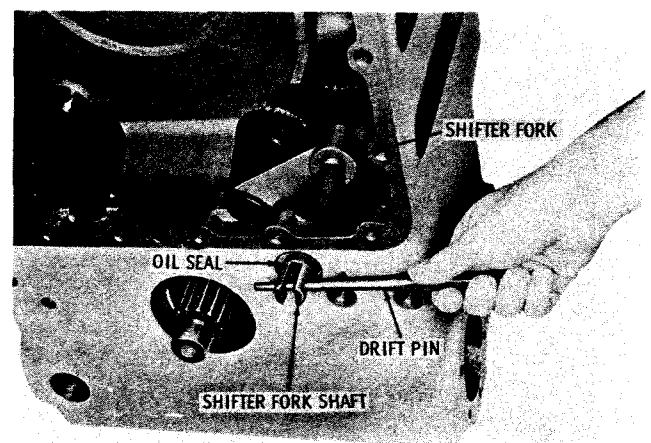
Remove the snapping that retains the transfer drive gear to the low-range carrier (fig. 5-19). Remove the transfer drive gear. Refer to paragraph 6-12 for the transfer drive gear rebuild instructions.

### b. Two-piece Output Shaft (front disconnect)

#### CAUTION

If only the shifter shaft oil seal requires replacement, do not remove shifter shaft. Removal of the 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 counter-clockwise to remove it from the front of the transmission housing (fig. 5-20). Removal of the shifter fork shaft will allow the shifter fork to fall into the sump area. Remove the shifter fork. Remove the shifter shaft oil seal only if replacement is necessary.

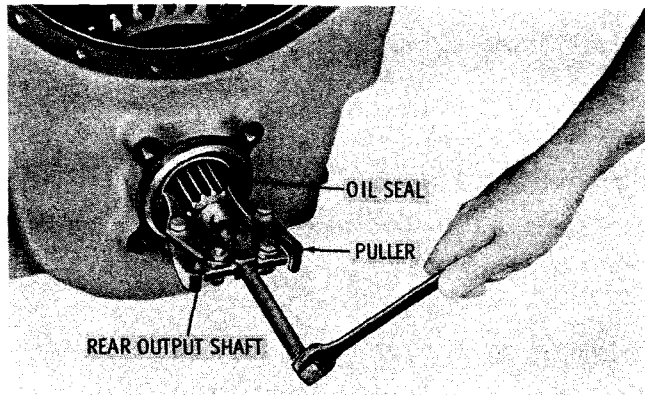


S1456

Fig. 5-20. Removing disconnect shifter shaft

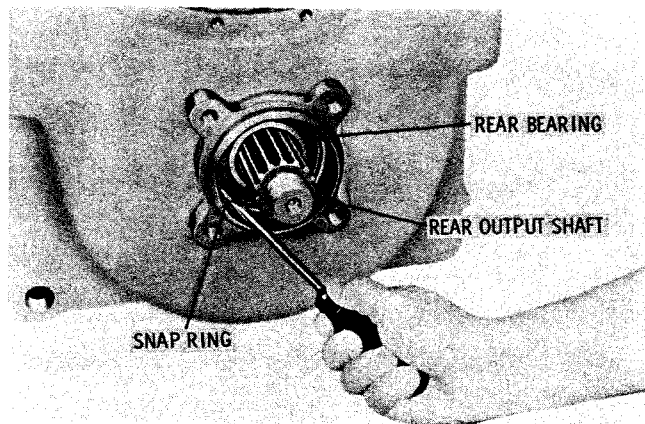
## TT 3000 SERIES POWERSHIFT TRANSMISSIONS

### Para 5-7



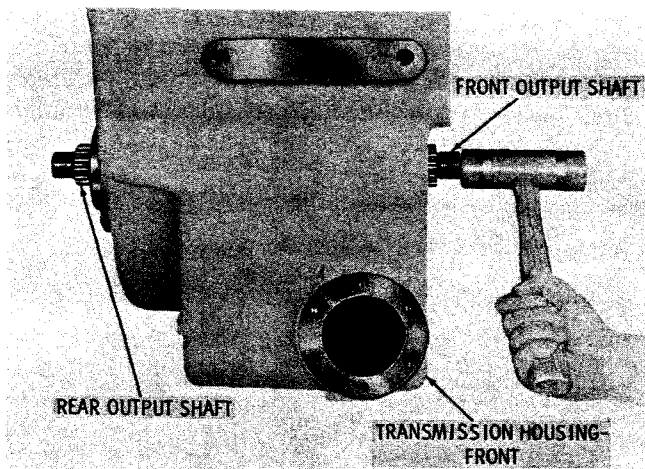
S2561

Fig. 5-21. Removing rear-output shaft oil seal



S2562

Fig. 5-22. Removing rear-output shaft bearing snapping



S1457

Fig. 5-23. Driving two-piece output shaft rearward

(2) Using a puller, remove the oil seal from the rear of the transmission housing (fig. 5-21). Remove the snapping (fig. 5-22).

(3) Using a soft hammer, drive the front output shaft rearward until the bearing on the rear output shaft is free from the housing bore (fig. 5-23). Remove the rear output shaft and the

attached bearing and spacer as an assembly (fig. 5-24). Remove the bearing only if replacement of the bearing or spacer is necessary. Do not remove bushing 15 (A, foldout 8) from rear output shaft 16 unless replacement is necessary.

(4) Removal of the rear output shaft from the transmission housing will free transfer driven gear 13 (A, foldout 8) and allow spacer 12 to fall into the sump area. Remove the transfer driven gear (fig. 5-25), and remove the fallen spacer from the sump. If difficulty is encountered in removing the transfer driven gear, remove the fallen spacer before removing the gear.

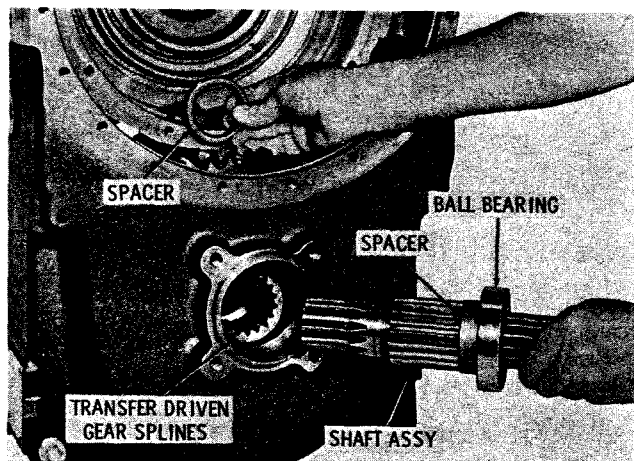
(5) Remove center bearing 11 (A, foldout 8) from its bore in the housing web.

(6) Remove the output shaft front oil seal (fig. 5-26). Remove the front bearing snapping (fig. 5-27). Using a soft metal drift, drive the front output shaft forward. When the front bearing is free from the housing, remove the shaft. Remove the ball bearing from the shaft only if parts replacement is necessary.

### NOTE

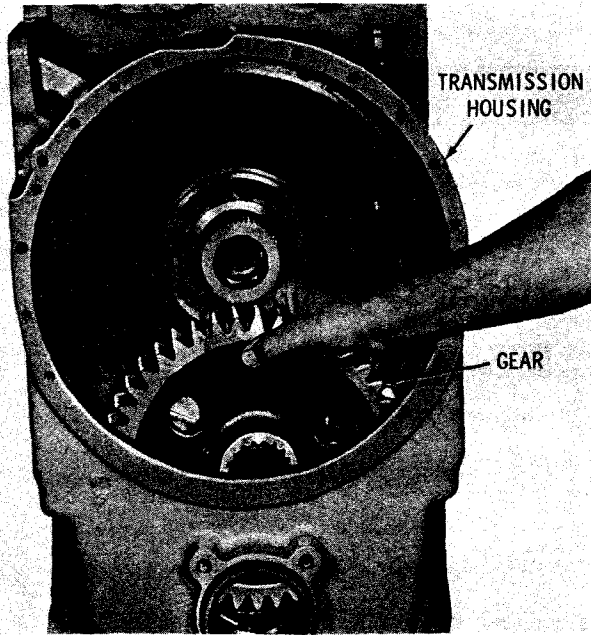
A spring and two detent balls will be released when the disconnect coupling is removed from the front output shaft. Drape a shop towel over the assembly to prevent possible loss of balls.

(7) Remove the disconnect coupling from the front output shaft, and place the two detent balls and spring in a parts receptacle.



S2599

Fig. 5-24. Removing rear-output shaft assembly



S4088

Fig. 5-25. Removing transfer driven gear

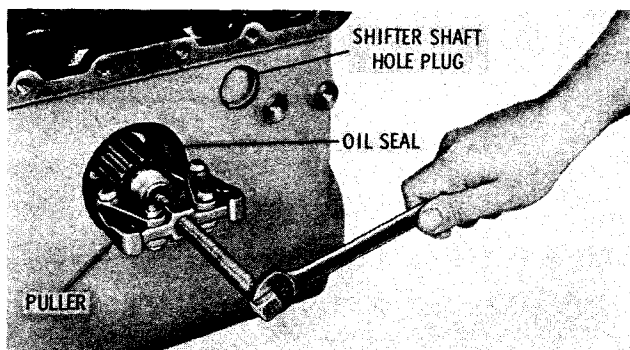
**c. One-piece Output Shaft (without disconnect)**

(1) Using a puller, remove the oil seal from the front of the transmission housing (fig. 5-26).

(2) Remove the snapping that retains the output shaft bearing in the housing bore (fig. 5-27). Do not remove the shifter shaft hole plug unless replacement is necessary.

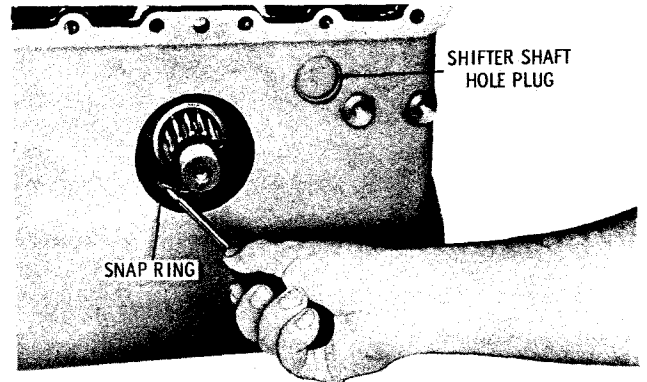
(3) Using a soft hammer, drive the output shaft forward until the front bearing is free from the housing bore (fig. 5-28).

(4) Remove the output shaft and front bearing as an assembly (fig. 5-29). Remove the front bearing from the output shaft.



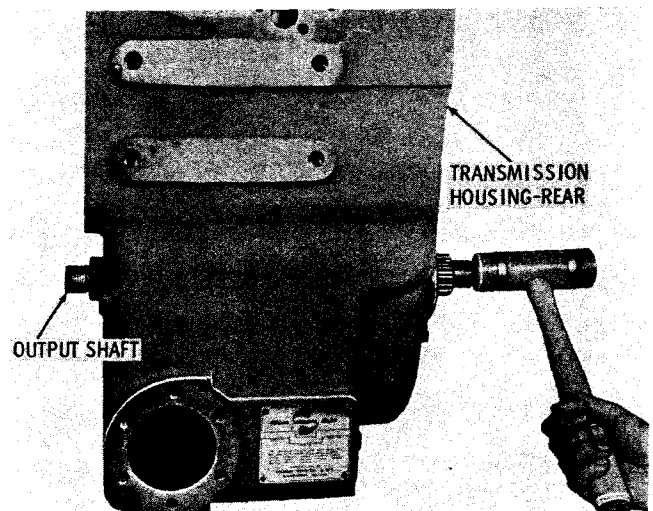
S1452

Fig. 5-26. Removing output shaft front oil seal



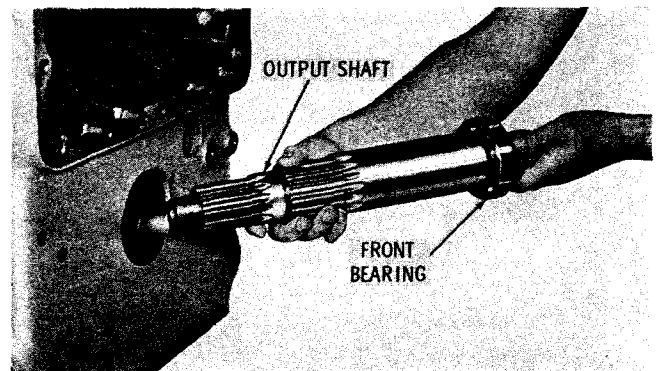
S1453

Fig. 5-27. Removing output shaft front bearing snapping



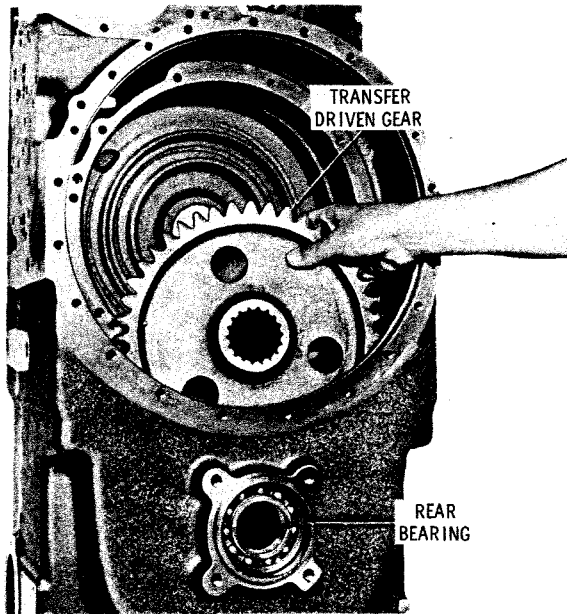
S1454

Fig. 5-28. Loosening one-piece output shaft front bearing



S2559

Fig. 5-29. Removing one-piece output shaft



S2560

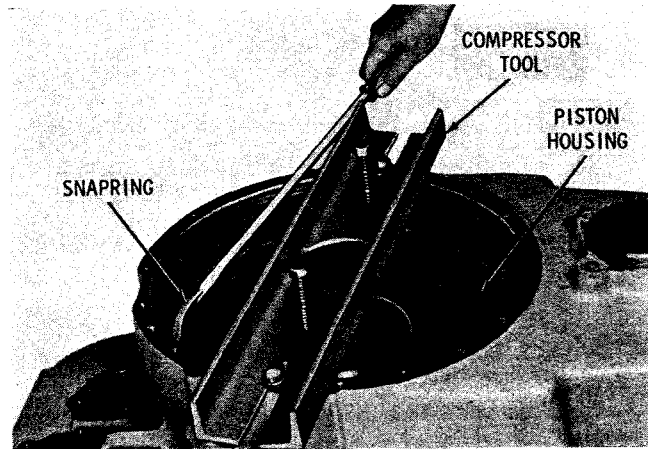
Fig. 5-30. Removing transfer driven gear (one-piece shaft)

(5) Removal of the output shaft will free the transfer driven gear 13 and spacer 12 (A, foldout 8). Remove the transfer driven gear (fig. 5-30) and remove the spacer from the sump area. Remove lip-type seal 20 (A, foldout 8) from the rear of the housing. Remove the output shaft rear bearing from its bore (fig. 5-30).

## 5-8. REMOVAL OF RANGE GEARING, CLUTCHES

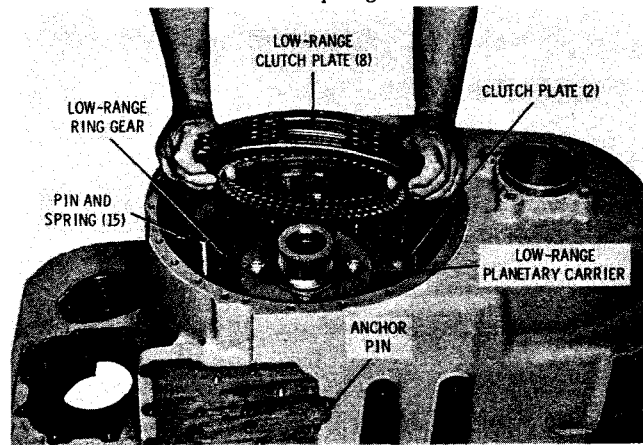
### a. Low-range Clutch and Planetary

(1) Using a suitable compressor, compress the low-range clutch piston housing sufficiently to allow removal of the snapping (fig. 5-31). Remove the snapping, and remove the compressor.



S4089

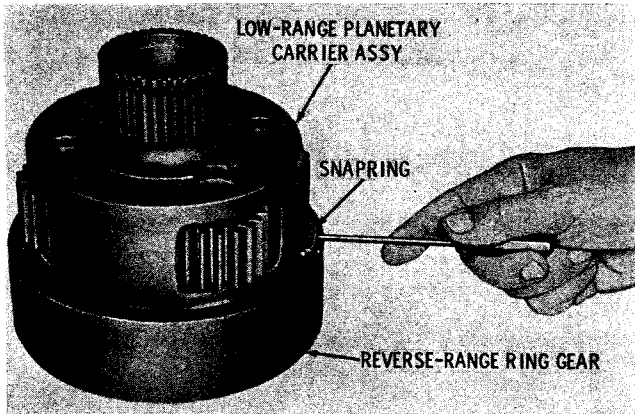
Fig. 5-31. Removing low-range clutch piston housing snapping



S4090

Fig. 5-32. Removing low-range clutch plates

(2) Remove the low-range clutch piston housing 18 (B, foldout 6) and piston 12 as an assembly. Remove insert 17 from the recess in piston housing 18. Remove low-range piston 12 from the housing. Remove sealrings 13, 14, and 15 from the piston only if parts replacement is necessary. Refer to paragraph 6-13 for clutch piston rebuild instructions.



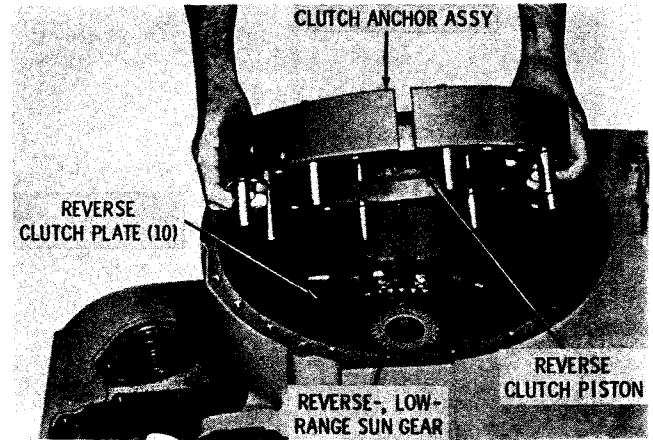
S2557

Fig. 5-33. Removing snapping from reverse ring gear

(3) Remove eight of ten low-range clutch plates from the low-range ring gear (fig. 5-32). Remove the ring gear and the remaining two clutch plates. Separate the plates from the gear. Remove the low-range planetary carrier assembly and reverse ring gear as a unit. Remove the snapping and separate the ring gear from the planetary carrier assembly (fig. 5-33). Remove the fifteen piston return springs and guide pins. Remove the anchor pin from the valve body pad. Refer to paragraph 6-14 for the low-range planetary rebuild instructions.

#### b. Reverse Clutch and Planetary

(1) Remove the reverse- and low-range clutch anchor assembly (fig. 5-34). Refer to paragraph 6-15 for the clutch anchor rebuild instructions.



S4091

Fig. 5-34. Removing reverse- and low-range clutch anchor assembly

(2) Remove the reverse- and low-range sun gear. Remove the reverse planetary carrier and clutch plates as an assembly. Separate the ten clutch plates from the carrier. Refer to paragraph 6-16 for the reverse planetary carrier assembly rebuild instructions.

(3) Remove the reverse piston from the transmission housing. Remove sealrings 1, 2, and 3 (A, foldout 6) from the piston only if parts replacement is necessary. Refer to paragraph 6-13 for clutch piston rebuild instructions.

(4) Remove the remaining parts from the transmission housing only if parts replacement or additional servicing is required. Refer to paragraphs 6-18 for the transmission housing rebuild instructions.